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The Geodesist's Handbook

Le Manuel du Géodésien

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International Association of Geodesy

International Union
of Geodesy and Geophysics

Union Géodésique
et Géophysique Internationale

Bureau Central
de l'Association Internationale
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GEODESIST'S HANDBOOK
1996
MANUEL DU GEODESIEN

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FOREWORD
AVANT-PROPOS

Pascal Willis

Every four years, after every General Assembly, the International Association of Geodesy publishes the Geodesist's Handbook as a special issue of the Journal of Geodesy (previously the Bulletin Géodésique). The first edition of the Geodesist's Handbook was done in 1980 after the Canberra General Assembly in 1979. This is the 5th edition of this document describing the International Association of Geodesy.

The first part describes the IAG itself (history, statutes and by-laws). The second part is a report of the XXIth General Assembly, held in Boulder (USA). The third part describes in detail the structure and organization of the International Association of Geodesy itself for the 1995-1999 period. The fourth part presents scientific information related to geodesy. The last part contains the IAG Directory listing the names and addresses of people related to the International Association of Geodesy.

Let me first thank all the individuals who gave information to be included in this Geodesist's Handbook 1996 and took the time to send corrections or proof-read documents from this volume. More specifically I would like to thank the new IAG Central Bureau in Denmark (C.C. Tscherning, O.B. Andersen and H. Hansen) for helping me compile all the necessary information.

Most of the information contained in this volume is also available on the IAG Central Bureau Web server in Denmark and will be regularly updated. In this issue, new information is also given on some Web sites already existing and related to Geodesy.

Corrections and updates to the Geodesist's Handbook will be published regularly in the IAG Newsletter, as part of the Journal of Geodesy.

Tous les quatre ans, après chaque Assemblée Générale, l'Association Internationale de Géodésie publie le Manuel du Géodésien, numéro spécial du "Journal of Geodesy" (anciennement Bulletin Géodésique). La première édition du Manuel du Géodésien a été réalisée en 1980, après l'Assemblée Générale de Canberra. Ceci est la 5ème edition de ce document décrivant l'Association Internationale de Géodésie.

La première partie décrit l'AIG (historique, statuts et réglement). La seconde partie est un compte-rendu de la XXIème Assemblée Générale, tenue à Boulder (USA). La troisième partie décrit en détail la composition et l'organisation de l'Association Internationale de Géodésie pour la période 1995-1999. La quatrième partie présente des informations scientifiques liées à la Géodésie. La dernière partie contient l'annuaire de l'AIG comportant les noms et adresses des personnes liées à l'Association Internationale de Géodésie.

Permettez-moi tout d'abord de remercier ici toutes les personnes qui ont fourni les informations publiées dans le Manuel du Géodésien 1996 et qui ont pris le temps d'envoyer des corrections et de relire les documents de cet ouvrage. Je voudrais tout particulièrement remercier la nouvelle équipe du Bureau Central de l'AIG au Danemark (C.C. Tscherning, O.B. Andersen, H. Hansen) pour m'avoir aider à compiler la totalité des informations utiles.

La majorité des informations publiées dans cet ouvrage sont aussi disponibles sur le serveur Web du Bureau Central de l'AIG au Danemark et remises à jour régulièrement. Dans ce volume, de nouvelles informations concernant les serveurs Web relatifs à la Géodésie ont été rajoutées.

Les corrections et remises à jour du Manuel du Géodésien seront publiées régulièrement dans la Newsletter de l'AIG, au sein du "Journal of Geodesy".

The International Association of Geodesy (IAG) - More than 130 Years of International Cooperation -

Wolfgang Torge, Hannover
IAG-President

1. *Introduction*

Geodesy is the science of determining the size and figure of the earth, and its external gravity field (see *Torge* 1991). This definition includes the orientation of the earth in space, and temporal variations of the earth's orientation, its surface and its gravity field. Obviously, geodesy therefore is part of the geosciences, providing significant boundary conditions for modelling the earth's body and its dynamics, including the oceans and the atmosphere. On the other hand, geodesy has strong relations to surveying and cartography, to navigation and engineering. Consequently, geodesy can trace back its roots several thousands of years. We mention the highly developped cadastral and engineering surveys in Mesopotamia and Egypt, and astronomical positioning at mapping the territories of the large antique empires. The proper geodetic problem was attacked by arc measurements which aimed at determining the diameter of the earth, after the sphere was adopted as a reasonable model of the earth. Well documented is the meridian arc measurement of Eratosthenes (276 - 195 B.C.). With the distance between Aswan and Cairo known from Egyptian cadastral surveys, and the corresponding central angle of the earth determined by observations to the sun, he found the earth's diameter with an error of only 2 %. Several other arc measurements followed in the classical Greek, Chinese, Arabian and European civilizations but a more pronounced international collaboration started only in the 18th century.

In the sequel, we mainly follow *Torge* (1993, using partly the English translation given by *Reilly* 1994). We first summarize the development of international cooperation in geodesy, from the 18th century until the present, concentrating on the different stages which the International Association of Geodesy passed through since its beginnings in 1862. Three examples then demonstrate which strategies and programs have been developped by the international organisations in order to attack and solve in an iterative manner the problem areas of "Geodetic Reference Systems", "Gravity Reference Systems", and "Geoid Determination".

2. *International collaboration in geodesy: the precursors*

In the seventeenth century the ellipsoidal form of the Earth had been postulated on the basis of the physically-defined models of Newton and Huygens; astronomical observations and pendulum measurements in various latitudes supported this assumption (for an historical introduction see *Torge* 1991). What was lacking was a geometric proof that the curvature of the Earth's surface was latitude-dependent, and here again the method of measuring an arc of meridian offered itself. Measurement of the meridian arc at different latitudes demanded international agreements and coordinated programmes to carry out the local observations, which was a field of collaboration for the various scientific academies that were at that time coming into being. As an outstanding example, we can point to the Academy of Sciences of Paris (founded in 1666) which sponsored the arc-measurement in Peru (1735-1744; Bouguer, La Condamine, Godin) and in Lapland (1736-37; Maupertuis, Clairaut et al.), which yielded both the geometric flattening of the poles, and the major semidiameter of the Earth-ellipsoid. Agreements between France and Spain, in the one case, and Sweden and Russia, in the other, were a necessary preliminary. Pendulum measurements, which following Clairaut's Theorem could equally yield the geometric flattening, were undertaken along with the arc measurements, and also on extensive maritime expeditions by English, French and Russian navigators in the first decades of the nineteenth century.

A further example of an important international operation was the Hanoverian arc-measurement of Carl Friedrich Gauss (1821-1825). This continued the Danish arc-measurement southward, joining up with the Dutch and the Hessian triangulation networks, and thereby with

the French arc measurement, leading Gauss to hope that "...perhaps it is not an unrealisable prospect, that one day all the astronomical observatories of Europe could be connected together by trigonometric means ...".

3. *The international scientific organisations*

In April 1861, the Prussian General Johann Jacob Baeyer, a collaborator of Bessel in the East Prussian arc measurement (1831-1836), submitted to the Prussian War Ministry a document "On the size and figure of the Earth: a memorandum on the establishment of a Central European arc measurement, along with a sketch map", which he dedicated to the memory of Alexander von Humboldt. The aim of the proposal was to connect the numerous astronomical observatories to be found in Central Europe by the existing and planned triangulation networks, thereby to determine the regional and local curvature anomalies (i.e. the deflections of the vertical, and thus the relative structure of the geoid). This scientific project entailed international collaboration in surveying and in the collection and evaluation of the data, as well as for the analysis of the results. In the same year, the Prussian King ordered Baeyer's plan to put into effect. In 1862 an inaugural conference took place in Berlin, and by the end of 1862 fifteen European states had affirmed their participation in this organisation. This was the start of an organized international collaboration in geodesy and the International Association of Geodesy counts the foundation of this "Mitteleuropäische Gradmessung" (Central European Arc Measurement) as its origin (see *Levallois* 1980, *Mueller* 1990, and *Torge* 1994, with an extensive reference list). In 1864 the first General Conference of the "Mitteleuropäische Gradmessung" took place, and fixed both the organisational structure (Central Bureau, Permanent Commission, General Conferences at three-yearly intervals) and the research programme (e.g. "Systematic investigation of local deflections at all principal triangulation points", "Determination of the intensity of gravity", "Standardisation of units of measurement"). It is notable that this was a scientific organisation built around a gathering of governmental delegates; the resolutions of the General Conference had an advisory character, and were usually enthusiastically adopted. The Central Bureau began its work in 1866 with Baeyer as President; in 1867 followed its expansion as the "Europäische Gradmessung", and in 1870 the Prussian Geodetic Institute was established and entrusted with the operation of Central Bureau.

After Baeyer's death in 1885, Friedrich Robert Helmert became in 1886 Director of the Geodetic Institute and of the Central Bureau. Particularly notable is the 8th General Conference, where the scope was extended to the "Internationale Erdmessung" (Association Internationale de Géodésie), the organisation overhauled, and the scientific programme essentially broadened. Arc measurements remained the fundamental means of earth-measurement, but other objectives were added. Along with the prosecution of programmes, there was increasing emphasis on the discussion of fundamental scientific problems and the development of methods. We cite from the report of the Central Bureau 1899 the following areas of scientific work :

"1. Continuation of the calculations for the European system of deflections of the vertical;

2. Derivation of the movement of the Earth's axis within the Earth's body, from the results of the voluntary cooperation of the astronomical observatories;

3. Preparations for the International Polar Motion Service;

4. Absolute pendulum measurements;

5. Connection of the national gravity fundamental stations by relative pendulum measurements; collection of relative pendulum results."

In 1916 the last intergovernmental agreement for the "Internationale Erdmessung" lapsed and was not renewed. With this, and with Helmert's death in 1917, ended a fruitful period of international cooperation, although several neutral states continued some of the programmes, and the Prussian Geodetic Institute continued to function as the Central Bureau.

From 1919, international science organized itself in many areas, but now in a "non-governmental" form. An International Research Council (from 1931 the International Council of Scientific Unions - ICSU) united under its aegis a number of scientific unions, amongst them being the International Union for Geodesy and Geophysics (IUGG). Geodesy set up here its own section, known since 1932 as the International Association of Geodesy (IAG), as the successor to the "Internationale Erdmessung". The objectives of the IAG were further widened to embrace the whole field of geodesy. The statutes give these in a quite general form (see "The Geodesist's Handbook", Bulletin Géodesique 66(2), 1992):

"2. The Objectives of the Association are

a) to promote the study of all scientific problems of geodesy and encourage geodetic research;

b) to promote and coordinate international cooperation in this field, and promote geodetic activities in developing countries;

c) to provide, on an international basis, for discussion and publication of the results of the studies, researches and works indicated in paragraphs a) and b) above."

The work of the IAG is pursued through the existing structure of the Association, and at the quadrennial General Assemblies. The Association is subdivided into five Sections:

Section I:	*Positioning*
Section II:	*Advanced Spac Technology*
Section III :	*Determination of the Gravity Field*
Section IV :	*General Theory and Methodology*
Section V :	*Geodynamics*

Within the framework of the Sections are included Commissions, Special Commissions, Special Study Groups, and International Services for specialised functions; examples are given below.

4. *Geodetic Reference Systems*

In geodesy, two distinct reference systems are to be noted:

1. a space-fixed (quasi) inertial system (Conventional Inertial System CIS);

2. an Earth-fixed terrestrial system (Conventional Terrestrial System CTS).

Both systems share the Earth's centre of gravity (Geocentre) as an origin, and the Earth's rotational axis as a coordinate axis. The reciprocal connection is through precession and nutation, as well as Earth-rotation (polar motion and time). The IAG has from the beginning collaborated closely with Astronomy on the questions of reference systems and the determination of the Earth's rotation.

The classical solution used the fixed stars for the realisation of the CIS. This space-fixed system was achieved using the coordinates and proper motions determined by astronomy, as well as precession and nutation. The terrestrial system was then fixed by the vertical deflections (astronomical latitude and longitude) of fundamental points, and oriented by astronomical azimuth. In practice, the many national survey systems established in this century, differ between themselves, and from the Geocentre, by 100 to 1000 m, while the parallelism of the rotation axis, and the reference meridian, is determinable to the accuracy of geodetic astronomy (0.01_, or 1 ms). The question of the reciprocal relationships between these individual systems, and the creation of a global system, cannot be solved in the absence of global measurements methods.

The "Internationale Erdmessung" placed great value on the definition and establishment of the Earth-rotation parameters, and therewith the coordinate axes of the terrestrial reference system. In 1898 the 12th General Conference decided to set up the International Polar Motion Service (IPMS). The Bureau International de l'Heure (BIH) was established in 1913, and with the Greenwich meridian a common worldwide reference x-axis in the equatorial plane was fixed. The z-axis was defined by the mean polar axis 1900.0 to 1906.0 (Conventional International Origin). IPMS and BIH worked without significant interruption until 1987, when IUGG decided, in cooperation with the International Astronomical Union, to incorporate them into the International Earth Rotation Service (IERS). This service exclusively employs modern space methods (Very Long Baseline Interferometry, Satellite Laser Ranging, Lunar Laser Ranging), which allow to monitor polar motion and rotation time with an accuracy of ± 0.001 _ and ± 0.1 ms and a resolution of one day, or better. The CIS is now realized by extragalactic radio sources, in connection with a limited number of fixed stars. By including the satellites' orbits into the models, geocentric station coordinates can be determined now with cm-accuracy, thus realizing the CIS.

At the 20th General Assembly in Vienna in 1991, the IUGG defined anew the Conventional Terrestrial Reference System (CTRS), with consideration of relativistic effects and of earth deformation, and in accordance with the corresponding IAU resolution adopted at Buenos Aires in 1991:

"1. CTRS to be defined from a geocentric non-rotating system by a spatial rotation leading to a quasi-Cartesian system,

2. the geocentric non-rotating system to be identical to the Geocentric Reference System (GRS) as defined in the IAU resolutions,

3. the coordinate time of the CTRS as well as the GRS to be the Geocentric Coordinate Time (TCE),

4. the origin of the system to be the geocentre of the Earth's masses including oceans and atmosphere, and

5. the system to have no global residual rotation with respect to horizontal motions at the Earth's surface."

The IERS now provides yearly values for these newly-defined reference systems: the Terrestrial Reference Frame (ITRF) and the Celestial Reference Frame (ICRF). They include the coordinates of the radio sources used and of the terrestrial stations (more than 100) participating at the Service, as well as the parameters of Earth rotation. For geodynamic investigations the IAG has set up an "International GPS Geodynamic Service (IGS)" based on

the Global Positioning System (GPS), and operational from 01.01.1994. This service already now significantly contributes to the IERS, densifying this net and extending it over the whole globe. Regional reference systems are now under construction by GPS measurements and tied to a certain epoch of the ITRS. For Europe a corresponding "European Terrestrial Reference System" has been established in 1989, in close cooperation between IAG and the national survey agencies, and a similar enterprise has been initiated for South America, with a continental GPS campaign scheduled for 1995.

The question of the reference system is closely bound up with that of a standard Earth model. Such an Earth model should approximate both the Earth's surface (geometric parameters) and its gravity field (physical parameters) by the simplest possible mathematical formulations. Consistent Earth-models were established by the IAG General Assemblies of 1924/1930 and 1967; the currently recommended "Geodetic Reference System" (GRS80) was adopted at the 17th General Assembly in Canberra in 1979:

"The International Union of Geodesy and Geophysics, recognizing that the Geodetic Reference System 1967 adopted at the XIV General Assembly of IUGG, Lucerne, 1967, no longer represents the size, shape and gravity field of the Earth to the accuracy adequate for many geodetic, geophysical, astronomical and hydrographic applications and considering that more appropriate values are now available, recommends

"a) that the Geodetic Reference System 1967 be replaced by a new Geodetic Reference System 1980, also based on the theory of the geocentric equipotential ellipsoid, defined by the following conventional constants:

1. equatorial radius of the earth:
$a = 6\,378\,137$ m,

2. geocentric gravitational constant of the Earth (including the atmosphere):
$GM = 3\,986\,005 \cdot 10^8\ m^3\ s^{-2}$,

3. dynamical form factor of the Earth, excluding the permanent tidal deformation:
$J_2 = 108\,263 \cdot 10^{-8}$,

4. angular velocity of the Earth
$\omega = 7\,292\,115 \cdot 10^{-11}$ rad s^{-1},

b) that the same computational formulas, adopted at the XV General Assembly of IUGG in Moscow 1971 and published by the IAG, be used as for Geodetic Reference System 1967, and

c) that the minor axis of the reference ellipsoid, defined above, be parallel to the direction defined by the Conventional International Origin, and that the primary meridian be parallel to the zero meridian of the BIH adopted longitudes".

The GRS80 has been widely introduced in science and practice. In view of the increasing use of GPS positioning, it should be noted that the ellipsoidal parameters of GPS-system WGS84 are identical with the corresponding values of GRS80 (except for one unit in the ninth place in the value for the flattening).

5. *Gravity reference systems*

The performance of gravity measurements with simple physical pendulums, with wire pendulums, and (after 1817) with reversible pendulums, was restricted to several arc-measuring campaigns and other expeditions, and the results showed the dependence of gravity on latitude, height, and mass anomalies. The "Mitteleuropäische Gradmessung" from the beginning put gravity intensity measurements on its programme, and later, the "Internationale Erdmessung" undertook the organisation of measuring campaigns and the establishment of national fundamental gravity stations; regular reports were issued on the collected gravity values (approximately 2500 values by 1912).

The problem of the combination of very onerous but inaccurate absolute gravity values with the more accurate gravity differences led to the adoption of a strategy of establishing a global gravity standard by connection with relative measurements to the most accurate possible absolute station. In 1900 the "Vienna Gravity System" was adopted by IAG, but already in 1894, on Helmert's suggestion, preparations for a new determination of absolute gravity at the Geodetic Institute in Potsdam started. The basic investigations and numerous series of measurements were brought to a conclusion in 1906 with the publication by Kühnen and Furtwängler of the adjusted gravity value at the pendulum pillar (standard error of $\pm$ 30 μms^{-2}).

The "Potsdam Gravity System" thus established by IAG was a great success. It served well into the 1960's as a reference for national gravity networks, for regional gravimetric surveys, and for the numerous gravimetric measurements in applied geophysics. Later evaluations of the Potsdam Gravity System, and new absolute gravity measurements in the 1930's, showed that the adopted Potsdam gravity value was too large by about 100 to 200 μms^{-2}. The national networks connected by relative measurements to Potsdam, themselves exhibited additional errors of a similar magnitude. In the second half of the twentieth century, metrology and geodesy could no longer tolerate such errors in the gravity standard. New absolute gravity measurements, and the experience of Woollard, Morelli and others that relative gravity measurements could yield useful results even over great distances, opened up the possibility that a better gravity standard could be established. The IAG tackled this problem through its

International Gravity Commission (IGC) set up in 1951. A new world-wide gravity net, and extensive gravity calibration lines, were planned and measured, and in 1968 the free-fall apparatus of Faller became available as a transportable absolute gravity measuring device. The adjustment of a global network of absolute and relative gravity measurements (pendulum and spring-gravimeter) finally yielded the International Gravity Standardization Net 1971 (IGSN71) that was adopted at the 15th General Assembly of IUGG in Moscow as the new gravity standard. The mean accuracy of $\pm$ 1μms^{-2} (and better) of IGSN71 suffices for most users in physics, geodesy, geophysics, and navigation. The IGSN71 has also quickly ensured that gravimetric surveys can be correspondingly transformed, and new networks either connected, or based upon new absolute measurements, with an improvement of from a half to one order of magnitude (and can thus be declared to be compatible with IGSN71).

Transportable absolute gravimeters, which now permit an accuracy in the range of $\pm$0.03 to 0.1 μms^{-2}, make possible the use of gravimetry to study global geodynamic processes. The IAG has taken up this issue with the proposal for the establishment and regular measurement of the global International Absolute Gravity Basestation Network (IAGBN). Of 36 stations, chosen mainly from geodynamic considerations, more than two-thirds have now been set up and measured at least once.

6. *Geoid determination*

The geoid is defined as that equipotential surface of the Earth's gravity field that most closely coincides with mean sea level. Already introduced in 1828 by C.F. Gauss as the "geometric surface of the Earth", it was involved during the nineteenth century in investigations of the nature and computation of this surface. However, because of the lack of global data there was no question of applying spherical harmonic expansions for modelling the geoid. For regional modelling, the integral formula of Stokes (1849) was available, which even so presupposed gravity anomalies over the whole Earth. It was therefore of great significance that Helmert in 1880/1884 showed, with "astronomical levelling", how local and continental geoid sections could be computed by path-integration of the deflections of the vertical. From a synthetic evaluation of the influences of continental land-masses, Helmert concluded that the values of geoidal undulations were likely to lie within a range of 400 m; but by taking into account plausible isostatic compensation, the actual geoidal variation was likely to be within $\pm$ 27 m. From a later consideration of gravity anomalies he derived a range of $\pm$ 50 m.

Both the "Mitteleuropäische Gradmessung" and the "International Erdmessung" gave special importance to the determination of the geoid, particularly in relation to the investigation of the curvature anomalies (the field of deflections of the vertical) and of the best-fitting ellipsoid; and the geological-geophysical information in the form of the geoid was early recognized. Later, an IAG "Geoid Section" concerned itself from 1948 with the compution of a European Geoid. As a result we had from 1954 onwards the famous Bomford Geoid in progressively updated versions (the last in 1978 revised by Levallois and Monge). The collection and evaluation of deflections of the vertical in Europe continued into the 1980s under an IAG Special Study Group led by Biradi.

The gravimetric geoid computations by Stokes' method needed better gravity surveys of the Earth, and a central bank of data and their reduction to a common system. This was begun by the "Internationale Erdmessung", with regular publications of results. From the 1920s the number of gravity observations grew rapidly, at first by the submarine pendulum measurements of Vening Meinesz, and from the 1930s with the introduction of elastic-spring gravimeters in geophysics. An "International Gravity Survey Project" was proposed to IAG by de Graaf Hunter in 1936, with the object of the gravimetric determination of the geoid, and in the same year the IAG founded the International Isostatic Institute in Helsinki. Here Heiskanen began a global collection and reduction of gravity values, continued later in Columbus, Ohio, and leading to the publication of the gravimetric "Columbus Geoid" in 1957. Along with the establishment in 1951 of the new International Gravity Commission (IGC) there was also set up the Bureau Gravimétrique International (now domiciled in Toulouse), whose principal task is the systematic collection, preparation and dissemination of global gravity data.

With the availability of global gravity field parameters, derived from the analysis of satellite orbits, and the computation of high-order geopotential models, geodesy, geophysics and oceanography can benefit from improved determination and interpretation of the geoid. The regional accuracy requirements of operational GPS positioning are in the 1 to 10 cm range over distances from a few km out to 1000 km and more. The geoid can then serve for the reduction of GPS heights to orthometric heights, and thus render GPS useful for heigt determination. The IAG has responded to these needs by setting up the International Geoid Commission (1987) and the International Geoid Service (1991). Again Europe serves as a test area for these high-precision geoid calculations. An IAG Subcommission for the European geoid was set up in 1990, and the Institute für Erdmessung (IfE), University of Hannover, Germany, was asked to serve as the corresponding computing center. The gravimetric geoid solution uses high-resolution global models, local point gravity data, and digital terrain models for the high frequency geoid part. A final result will be available 1995 at the IUGG General Assembly in Boulder, Colorado.

7. *Conclusion*

We have shown how geodesy after several 1000 years of development, over the last 130 years pursued solutions to geodetic problems through targeted programmes organized within the framework of international scientific collaboration. The initial phase of this organized cooperation (1862-1885) was dominated by the President of IAG, Johann Jacob Baeyer. The following phase of the "Internationale Erdmessung" (1886-1916) was essentially determined by Friedrich Robert Helmert in his role as Director of both the Prussian Geodetic Institute and of the IAG Central Bureau. The examples of the definition and realisation of geodetic reference systems, of the introduction of a gravity reference system, and of the determination of the geoid, show how progress dependent on the development of theory, methods and techniques has continued to the present day, particularly through the sponsorship and coordination of the International Association of Geodesy. Solutions emanating from scientific geodesy have been and are of practical importance for a multiplicity of users. Amongst these are numbered, outside the obvious astronomy and land surveys, also engineering surveys, hydrography and navigation, geophysics including oceanography, and finally - because of the accuracy attainable on global, regional and local scales - all the disciplines concerned with recent geodynamic processes. The IAG has taken account of these interdisciplinary aspects in revising its organisational structures at its most recent General Assembly in Vienna in 1991. Among others new Special Commissions have been established for "Applications of Geodesy to Engineering", "Marine Positioning", "Mathematical and Physical Foundation of Geodesy", and "Fundamental Constants". New Special Study Groups deal with "Kinematic Global Positioning System", "Combined use of gravimetry and stress-strain measurement techniques", "Global geodynamic variations", and "Geodetic research toward the reduction of natural hazards". Future directions of IAG activities are already clearly visible, they will in many cases require a stronger collaboration with other geosciences, but also with the engineering and geoinformatics disciplines, represented in the International Union of Surveys and Mapping. Developping countries have much more to be involved in IAG activities, and a number of measurements has been taken already in that direction. From the scientific point of view the most important statement is that geodesy can now contribute fundamentally to the understanding of the kinematics and dynamics of the Earth, at global, regional and local scale.

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STATUTS ET REGLEMENT INTERIEUR

I- STATUTS

I- Définition et mission de l'Association Internationale de Géodésie

1. *L'Association Internationale de Géodésie*, ci-après désignée *l'Association*, est l'une des associations constituant *l'Union Géodésique et Géophysique Internationale*, ci-après désignée *l'Union*.

2. L'Association a pour *mission* :

a) de promouvoir l'étude de tous les problèmes scientifiques de la géodésie et d'encourager la recherche géodésique;

b) de prendre toute initiative pour faciliter et coordonner la coopération internationale dans ce domaine et de promouvoir les activités géodésiques dans les pays en développement;

c) d'assurer, sur le plan international, la discussion et la publication des résultats des études, recherches et travaux mentionnés aux paragraphes a) et b) ci-dessus.

3. Pour atteindre ces objectifs, l'Association comprend un petit nombre de Sections, chacune d'entre elles traitant une partie distincte de la géodésie. Des Commissions, des Commissions Spéciales, des Groupes Spéciaux d'Etudes peuvent être créés selon des formes précisées dans le Règlement Intérieur.

4. Chaque pays adhérant à l'Union *(Pays Membre)* est admis à se faire représenter à l'Association par des Délégués.

4A. Des scientifiques peuvent devenir *Affiliés* de l'Association, soit en tant que *Compagnons*, soit en tant qu'*Associés*, selon des règles précisées dans le Règlement Intérieur.

II- Administration

5. L'***Assemblée Générale*** de l'Association est constituée par les Délégués des Pays Membres, dûment accédités par l'Organisme Adhérent de chaque pays, tel que défini par les Statuts de l'Union.

6. Le ***Conseil*** de l'Association est constitué par les Délégués, appelés Délégués au Conseil, désignés et dûment accrédités par les Organismes Adhérents des Pays Membres pour les représenter à chacune des réunions du Conseil, à raison d'un Délégué par Pays Membre. Chaque membre du Conseil est soit un Compagnon, soit un Associé de l'Association.

Aucun membre du Bureau de l'Association ne peut être choisi comme Délégué au Conseil d'un Pays Membre. Le Président de l'Association préside les réunions du Conseil, sans participer aux votes, sauf dans le cas d'égalité de voix comme précisé à l'Art. 16 ci-après.

7. La *responsabilité* de la direction des affaires de l'Association est dévolue au Conseil de l'Association. Les décisions prises par le Conseil sont présentées à l'Assemblée Générale. Si une majorité à l'Assemblée Générale est en désaccord avec les décisions du Conseil, celui-ci doit reconsidérer sa position et prendre une décision qui devient définitive.

8. Dans l'intervalle des réunions du Conseil, la gestion des affaires de l'Association est dévolue au *Bureau* et au *Comité Exécutif* dont la composition et les attributions respectives sont définies ci-après.

9. Le ***Bureau*** de l'Association est constitué par le *Président*, le *Premier Vice-Président* et le *Secrétaire Général*, tous trois élus par le Conseil. Le rôle du Bureau est d'administrer l'Association conformément aux présents Statuts et Règlement Intérieur et aux décisions du Conseil et du Comité Exécutif.

10. Le ***Comité Exécutif*** de l'Association est constitué par le Bureau, le Président sortant et le second Vice-Président de l'Association, ainsi que par les Présidents des Sections.

Les Présidents Honoraires et les Secrétaires Généraux Honoraires de l'Association, les Présidents des Commissions, les Secrétaires des Sections, les Secrétaires adjoints de l'Association et le Rédacteur en Chef du Bulletin Géodésique peuvent assister, à titre consultatif, à toute réunion du Comité Exécutif de l'Association.

Le rôle du Comité Exécutif est de guider les Sections et autres organismes scientifiques de l'Association vers la réalisation de leurs aspirations scientifiques, en assurant entre eux une coordination efficace et en formulant les règles générales nécessaires au bon déroulement des travaux scientifiques de l'Association.

Les membres du Comité Exécutif participent, à titre consultatif, à toutes les délibérations du Conseil.

III- Droit de vote

11. Un Délégué au Conseil ne peut être le Délégué que d'un seul Pays Membre.

Un Pays Membre non représenté à une réunion du Conseil peut voter par correspondance sur toute question bien précisée à l'ordre du jour définitif distribué à l'avance aux Pays Membres, pourvu que les débats n'aient pas introduit d'importants aspects nouveaux de cette question, ni modifié sa substance, et pourvu que le bulletin de vote considéré soit parvenu au Président avant l'ouverture du vote.

12. Pour que les délibérations du Conseil soient valables, la présence effective au Conseil de la moitié au moins des Délégués des Pays Membres représentés à l'Assemblée Générale de l'Union est nécessaire.

13. Pour toutes les questions n'ayant aucune incidence financière, le vote au Conseil se fait par Pays Membre, chaque Pays Membre ayant une voix, à condition qu'il ait payé ses cotisations à l'Union jusqu'à la fin de l'année civile qui précède le vote.

14. Pour toutes les questions financières, le vote au Conseil se fait par Pays Membre, à condition également que le pays considéré ait payé ses cotisations à l'Union jusqu'à la fin de l'année civile qui précède le vote. Le nombre de voix attribuées à chaque Pays Membre est alors égal au numéro de la catégorie dans laquelle le Pays adhère à l'Union.

15. Avant un vote en Conseil, il revient au Président de décider si la question prise en considération est d'ordre financier ou non, et si la procédure du vote par correspondance s'applique.

16. Les décisions au Conseil sont prises à la majorité simple, sauf dans les cas spécialement mentionnés dans les présents Statuts. Si, au cours d'un vote au Conseil, il y a égalité de voix, la décision appartient au Président. La majorité simple ou la majorité des deux-tiers sont déterminées par la proportion des votes affirmatifs à la somme de tous les votes (affirmatifs, négatifs, abstentions). Les bulletins blancs, les bulletins non valables et les votes non exprimés par les délégués présents sont décomptés comme abstentions.

IV- Généralités

17. Les propositions formulées en vue de la modification d'un article des Statuts de l'Association doivent parvenir au Secrétaire Général au moins six mois avant la date fixée pour la réunion du Conseil au cours de laquelle elles seront examinées. Le Secrétaire Général devra faire connaître à tous les Pays Membres, au moins quatre mois avant la date fixée pour la réunion du Conseil, toutes les propositions reçues à ce sujet.

18. Les Statuts de l'Association ne peuvent être modifiés que par un vote du Conseil à la majorité des deux tiers.

Les présents Statuts, ou toute modification ultérieure, prennent effet à la clôture de la réunion du Conseil à laquelle ils ont été approuvés.

19. Dans le cadre des Statuts de l'Association, le Conseil a pouvoir d'adopter un Règlement Intérieur.

Ce Règlement Intérieur ne peut être modifié que par un vote du Conseil à la majorité simple.

Ce Règlement Intérieur, ou toute modification ultérieure, prend effet à la clôture de la réunion du Conseil à laquelle il (ou elle) a été approuvé(e).

20. En cas de dissolution de l'Association, ses avoirs sont cédés à l'Union.

21. Sauf au cas où les Statuts, ou le Règlement Intérieur, en décideraient autrement, les réunions de travail seront conduites selon les règles: "Robert's Rules of Order".

22. Les présents Statuts et le Règlement Intérieur sont établis en Français et en Anglais.

Leur validité ne peut être mise en cause par toute erreur de caractère formel ou accidentel.

II- REGLEMENT INTERIEUR

I- *Structure de l'Association*

1. Les travaux scientifiques de l'Association Internationale de Géodésie sont répartis dans les *Sections* dont les attributions respectives sont décidées par le Conseil sur recommandation du Comité Exécutif. La structure de ces Sections est revue tous les huit ans (soit deux périodes) par un Comité, appelé Comité Cassinis, qui présente ses propositions au Comité Exécutif. En raison des relations complexes entre les différentes activités de l'Association, des interactions entre les Sections sont nécessaires.

L'Association comprend actuellement les ***cinq Sections*** ci-après:

- **Section I :** *Détermination de position.*
  . réseaux horizontaux et verticaux de précision;
  . méthodes spatiales de positionnement;
  . méthodes inertielles de positionnement;
  . méthodes cinématiques de positionnement;
  . astronomie géodésique;
  . positionnement en mer;
  . réfraction.

- **Section II** : *Technologie spatiale avancée.*
  . développement des techniques spatiales en géodésie, telles que: techniques radioélectriques de poursuite de satellite, techniques radio-interférométriques, mesures de distance laser terre-satellite et terre-lune, altimétrie par satellite, poursuite de satellite par satellite, gradiométrie par satellite, mesures géodésiques depuis l'espace;
  . calculs d'orbites;
  . résultats géodésiques directement issus de ces techniques;
  . techniques géodésiques pour la lune et les planètes.

- **Section III** : *Détermination du champ de pesanteur.*
  . mesures terrestres absolues et relatives de pesanteur;
  . variations de pesanteur non liées aux marées;
  . détermination du champ extérieur de pesanteur et du géoïde à l'aide de la gravimétrie, de la gradiométrie, de l'astronomie géodésique, des techniques spatiales et inertielles;
  . réduction et estimation des paramètres du champ de pesanteur.

- **Section IV** : *Théorie Générale et Méthodologie.*
  . modèles mathématiques généraux en géodésie;
  . analyse statistique et numérique;
  . traitement et gestion des données;
  . méthodes d'optimisation;
  . méthodes des moindres carrés;
  . théories différentielle et intégrale du champ de pesanteur;
  . théorie de l'estimation, l'approximation et la représentation du champ de pesanteur.

- **Section V** : *Géodynamique.*
  . systèmes de référence;
  . observation et étude des phénomènes variant avec le temps: mouvement du pôle, rotation terrestre, marées terrestres, mouvements récents de l'écorce terrestre, variations de la pesanteur, topographie de la surface marine et niveau moyen des mers;
  . aspects géodésiques des projets géodynamiques internationaux;
  . dynamique des planètes et de la lune;
  . interprétation géophysique de la pesanteur et des données s'y rapportant.

1A- Chaque Section crée en son sein un ***Comité Directeur*** constitué par le Président et les Secrétaires de la Section, les Présidents des Commissions et des Commissions Spéciales appartenant à la Section et par toute personne qui, ayant travaillé dans la Section, est cooptée par le Président de Section.

2. Des ***Commissions*** peuvent être créées pour certaines activités qui nécessitent une coopération ou une organisation internationale importante, en particulier pour les problèmes de longue durée ou les activités intéressant de vastes territoires.

Chaque Pays Membre de l'Union a le droit de nommer un représentant dans chaque Commission, excepté dans celles traitant de zones géographiques particulières; dans ce dernier cas, seuls les pays membres situés dans la zone géographique considérée peuvent nommer un représentant dans la Commission.

Normalement, une Commission fait partie d'une Section. Chaque Commission peut s'organiser selon les exigences qui lui sont propres tout en respectant les Statuts et Règlement Intérieur de l'Association et en se soumettant à l'approbation du Comité Exécutif; elle peut, par exemple, créer des Sous-Commissions régionales.

2A- Des ***Commissions Spéciales*** peuvent être créées pour étudier des problèmes scientifiques à long terme requérant une coopération étroite entre spécialistes de différents pays.

Normalement, une Commission Spéciale fait partie d'une Section.

Chaque Commission Spéciale peut s'organiser selon des exigences qui lui sont propres tout en se conformant aux Statuts et Règlement Intérieur de l'Association et en se soumettant à l'approbation du Comité Exécutif, elle peut, par exemple, créer des Sous-Commissions pour étudier des problèmes spécifiques dans son domaine.

3. Des ***Groupes Spéciaux d'Etudes*** peuvent être créés pour étudier des problèmes scientifiques particuliers d'étendue limitée mais qui requièrent une coopération étroite entre les spécialistes de différents pays.

Normalement, un Groupe Spécial d'Etudes fait partie d'une Section.

4. La création et la dissolution des Commissions, des Commissions Spéciales et des Groupes Spéciaux d'Etudes sont décidées par le Comité Exécutif qui précise également si la Commission, la Commission Spéciale ou le Groupe Spécial d'Etudes doit être placé sous l'autorité directe de l'Association ou de l'une de ses Sections.

La liste des Commissions, des Commissions Spéciales et des Groupes Spéciaux d'Etudes est publiée dans le Manuel du Géodésien à l'issue de chaque Assemblée Générale.

5. L'Association peut aussi prendre part aux activités d'organismes scientifiques communs avec d'autres Associations de l'Union Géodésique et Géophysique Internationale ou, représentant l'Union, avec d'autres Unions. Ces Organismes sont administrés suivant des règles spécifiques découlant des relations avec les autres groupes, mais ils présentent un rapport sur leurs activités scientifiques aux Assemblées Générales de l'Association.

Le Comité Exécutif de l'Association décide si la participation à un tel organisme commun doit être placée sous la responsabilité de l'Association ou de l'une des Sections. Cette responsabilité inclut la désignation des représentants à ces organismes ainsi que la participation à la planification de leurs activités futures.

II- *Elections*

6. Les élections sont faites par le Conseil au cours de chaque Assemblée Générale Ordinaire de l'Association.

Le Président en exercice, après avoir pris l'avis des membres du Comité Exécutif, désigne un Comité de Nomination composé d'un président et de trois autres membres. Le Comité de Nomination, après avoir pris l'avis des Organismes Adhérents des Pays Membres et des Officiels de l'Association, propose un candidat pour chacun des postes soumis à élection au Conseil. Les candidats doivent signifier leur acceptation et fournir un résumé de leur carrière, en 150 mots maximum, mettant en évidence leur fonction actuelle, leurs intérêts de recherche et leurs activités en rapport avec l'Association. Les délégués sont tenus informés, très tôt au cours de l'Assemblée Générale, de ces candidatures ainsi que des résumés les accompagnant, en outre, des annonces sont faites pour permettre, pendant une période d'au moins 48 heures, à d'autres candidatures de se manifester. Celles-ci doivent êtres présentées par écrit, avoir l'appui d'au moins deux membres du Conseil, et être adressées, accompagnées des résumés tels que décrits ci-dessus, au Secrétaire Général. Les délégués ont connaissance de ces dernières candidatures, des résumés, ainsi que des noms des personnes apportant leur soutien.

Les élections ont lieu au scrutin secret.

Une même personne ne peut occuper en même temps plus d'un des postes suivants : Président de l'Association, Vice-Président, Président de Section et Président de Commission ou de Commission Spéciale.

7. L'intervalle de temps séparant les clôtures de deux Assemblées Générales Ordinaires successives de l'Association est appelé "*période*".

8. Le ***Président*** de l'Association est élu pour une période. Il n'est pas immédiatement rééligible à ce poste, mais le Conseil peut le nommer Président honoraire.

9. Le ***Premier*** et le ***Second Vice-Présidents*** sont élus pour une période et ne sont pas immédiatement rééligibles aux mêmes postes.

10. (*Article supprimé*).

11. Le ***Secrétaire Général*** est élu initialement pour une période. Il peut être ré-élu pour deux autres périodes, par périodes successives.

12. Ces mêmes règles (Art. 11) s'appliquent aux ***Secrétaires adjoints*** de l'Association, à l'exception du Secrétaire adjoint élu selon la procédure prévue à l'Art. 37A.

13. Les membres du Bureau et du Comité des Finances de l'Union ne peuvent occuper les postes de Président, Premier Vice-Président ou Secrétaire Général de l'Association.

14. Si le poste de Président devient vacant dans l'intervalle entre deux Assemblées Générales Ordinaires, les fonctions en sont assurées jusqu'à la fin de l'Assemblée Générale Ordinaire suivante par le Premier Vice-Président. De la même façon, les fonctions du Premier Vice-Président reviennent alors au Second Vice-Président.

Si le poste de Secrétaire Général devient vacant, le Président charge immédiatement le Comité Exécutif d'élire par correspondance un remplaçant de façon à assurer la continuité de fonctionnement du Bureau Central. Cette élection n'a d'effet que jusqu'à la fin de l'Assemblée Générale Ordinaire suivante.

15. Les ***Présidents des Sections*** sont élus pour une période et ne sont pas immédiatement rééligibles aux mêmes postes.

16. Les ***Secrétaires des Sections*** sont élus pour une période et sont rééligibles pour une autre période.

Le Président de chaque Commission appartenant à une Section devient Secrétaire de cette Section. Le nombre maximum de Secrétaires dans une Section est deux, sauf si le nombre de Commissions dans cette Section dépasse un, dans ce cas le nombre de Secrétaires est égal au nombre de Commissions plus un.

17. Si un poste de Président de Section devient vacant entre deux Assemblées Générales Ordinaires, le Comité Exécutif désigne un Président intérimaire qui tient le poste jusqu'à la fin de la prochaine Assemblée Générale.

Dans le cas d'autres vacances, le Comité Exécutif peut désigner des intérimaires.

18. Les ***Présidents des Commissions*** et des ***Commissions Spéciales*** sont élus par le Conseil de l'Association pour une période et peuvent être immédiatement ré-élus pour une autre période.

19. Le ***Président d'un Groupe Spécial d'Etudes*** est nommé par le Comité Exécutif pour une période seulement.

20. Une même personne ne peut être à la fois président de plus d'un des organismes visés aux Art. 18 et 19.

III- *Assemblées Générales*

21. L'Association tient ses propres Assemblées Générales Ordinaires en liaison avec celles de l'Union, à la même date et dans le même pays.

22. Avant chaque Assemblée Générale, le Bureau de l'Association prépare un ordre du jour détaillé. Pour ce qui concerne les travaux scientifiques, l'ordre du jour est établi par le Comité Exécutif. Cet ordre du jour est envoyé aux pays membres et à tous les Officiels de l'Association de façon à leur parvenir au moins deux mois avant la date de l'Assemblée. En principe, seules les questions qui figurent à l'ordre du jour sont prises en considération pendant les sessions; il peut en être autrement par un vote acquis à la majorité des deux tiers soit en Conseil, soit au Comité Exécutif.

23. A chaque Assemblée Générale, le Président de l'Association présente un rapport détaillé sur les activités scientifiques de l'Association pendant la période de sa présidence. Le Secrétaire Général présente, pour la même période, un rapport détaillé concernant les activités administratives et les finances de l'Association. Ils soumettent chacun des propositions sur les activités à entreprendre au cours de la période à venir dans la mesure où les ressources envisagées le permettent.

Ces rapports sont remis aux Délégués présents à l'Assemblée Générale avant l'ouverture de cette Assemblée.

24. Les réunions scientifiques ont généralement lieu par Section, mais l'étude de certaines questions peut nécessiter des réunions communes à plusieurs Sections ou des symposiums placés sous la responsabilité de présidents désignés par le Comité Exécutif.

Des symposiums communs couvrant des sujets intéressant au moins deux Associations de l'Union peuvent être organisés.

25. A chaque Assemblée Générale, les travaux de chaque Section font l'objet d'un rapport présenté par son Président assisté de ses Secrétaires. De même, les travaux de chaque Commission, Commission Spéciale ou Groupe Spécial d'Etudes sont présentés par les présidents respectifs.

26. L'inscription de communications scientifiques à l'ordre du jour des séances de l'Assemblée Générale est décidée par un Comité constitué par un membre du Bureau et les Présidents des Sections.

27. Les communications scientifiques individuelles sont reproduites par leur auteurs. Elles sont distribuées aux Délégués par le Bureau Central avant la séance à laquelle elles doivent être présentées. Elles peuvent être publiées dans le Bulletin Géodésique sous réserve d'en satisfaire la politique d'édition.

IV- *Publication*

28. Le journal officiel de l'Association est le **Bulletin Géodésique**, ci-après désigné "le Journal". Le Journal est publié à intervalles réguliers, par une société d'édition liée par accord à l'Association, ou par tout autre moyen approuvé par le Comité Exécutif. Les termes sont négociés par le Président et sont ratifiés par le Comité Exécutif.

Un (ou plusieurs) Rédacteur(s) en Chef, désigné(s) ci-après "le Rédacteur", est (sont) en charge du Journal.

Le Rédacteur est conseillé et assisté par un Comité des Rédacteurs, ci-après désigné "le Comité".

Le Rédacteur est responsable du contenu scientifique du Journal. Tous les articles scientifiques sont soumis à la procédure de revue et le Rédacteur prend la décision finale d'accepter ou non l'article pour le publier. Le Rédacteur informe l'Association des activités et de l'état des opérations concernant le Journal.

28A. A chaque Assemblée Générale, le Rédacteur, après consultation et accord du Président de l'Association, recommande des candidats pour devenir membres du nouveau Comité appelé à opérer pendant la période suivant l'Assemblée Générale.

Pendant cette Assemblée, le Comité en exercice élit les membres du nouveau Comité parmi les candidats recommandés. Après son entrée en fonction, le nouveau Comité élit un (ou plusieurs) Rédacteur(s) pour la période à venir. La désignation du Rédacteur doit être approuvée par le Comité Exécutif.

Le Rédacteur, ainsi que les membres du Comité, sont élus pour une période, mais sont susceptibles d'être ré-élus pour une période supplémentaire.

28B. Après chaque Assemblée Générale, il est publié un numéro spécial du Bulletin Géodésique appelé le "***Manuel du Géodésien***". Cette publication a pour but de fournir des informations détaillées sur l'Association, sa structure, ses activités scientifiques et bien d'autres informations à caractère technique ou administratif.

29. A l'issue de chaque Assemblée Générale, l'ensemble des rapports présentés par les Sections, Commissions et Groupes Spéciaux d'Etudes est publié sous le nom de "***Travaux de l'Association Internationale de Géodésie***". Cette publication est adressée gratuitement aux Officiels de l'Association et aux Organismes Adhérents des Pays Membres.

30. L'Association assure également des ***publications spéciales*** qui présentent les références recommandées en géodésie.

31. A chaque Assemblée Générale les Pays Membres de l'Union sont invités à fournir un certain nombre d'exemplaires de leur ***Rapport National*** sur les travaux géodésiques effectués depuis la précédente Assemblée Générale. Ces Rapports Nationaux, dans la mesure où ils sont disponibles, sont distribués comme les "*Travaux de l'Association*" par le Bureau Central de l'Association.

V- *Administration*

32. Le ***Conseil*** de l'Association :

a) examine les questions de politique scientifique générale ou d'administration dans les affaires de l'Association et désigne, à cet effet, les Comités qui, le cas échéant, peuvent être jugés nécessaires;

b) élit les membres du Bureau et du Comité Exécutif, les Secrétaires adjoints de l'Association, les Secrétaires des Sections, les Présidents des Commissions et des Commissions Spéciales;

c) reçoit les rapports du Secrétaire Général et examine, pour approbation, les décisions ou mesures prises par le Bureau et le Comité Exécutif depuis la dernière réunion du Conseil;

d) désigne les trois membres du comité ad hoc créé pour l'examen des finances de l'Association, étudie ses recommandations et adopte le budget définitif;

e) examine les propositions de modification des Statuts et du Règlement Intérieur.

Le Conseil se réunit sur convocation du Président de l'Association. Il se réunit normalement pendant les Assemblées Générales Ordinaires.

33. Le ***Comité Exécutif*** de l'Association :

a) prend les mesures et établit les règles nécessaires à l'accomplissement des missions scientifiques de l'Association;

b) comble toute vacance de poste qui pourrait survenir, entre deux Assemblées Générales, selon les règles des Statuts et du Règlement Intérieur;

c) crée et dissout les Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes;

d) nomme les Présidents des Groupes Spéciaux d'Etudes et approuve l'élection du(des) Rédacteur(s) en Chef du Bulletin Géodésique;

e) nomme les membres du Comité Cassinis;

f) présente des recommandations au Conseil sur les questions de politique générale de l'Association;

g) sur recommandation du Bureau, désigne les Compagnons et les Associés de l'Association. Les anciens Officiels de l'Association, y compris ceux des Commissions et des sous-Commissions, ont vocation à être nommés Compagnons de l'Association et sont invités à le devenir. Les personnes élues Officiels de l'Association ou désignées comme membres des Commissions, Commissions Spéciales ou Groupes Spéciaux d'Etudes deviennent automatiquement Associés de l'Association. Les personnes de Pays Membres qui en font la demande, en mentionnant leurs activités passées au sein de l'Association, ou présentant une recommandation de leur Organisme Adhérent national ou celle d'un Officiel ou d'un Compagnon de l'Association, peuvent être admises à devenir Associés et sont recommandées par le Bureau.

Le Comité Exécutif se réunit sur convocation du Président de l'Association. Il se réunit au cours des Assemblées Générales et ses membres participent, à titre consultatif, aux réunions du Conseil. Il se réunit également au moins une fois entre deux Assemblées

Générales, un an avant l'Assemblée Générale pour préparer le programme des activités scientifiques et le projet d'emploi du temps de cette Assemblée Générale.

Lors d'une réunion du Comité Exécutif, aucun membre ne peut se faire représenter par quiconque, sauf un Président de Section qui peut être représenté par un Secrétaire de sa Section. Les délibérations du Comité Exécutif sont déclarées valides si au moins la moitié des membres sont présents au représentés.

L'ordre du jour de chaque réunion du Comité Exécutif est préparé par le Bureau et adressé aux membres au moins trois mois avant la réunion.

34. Le ***Bureau*** de l'Association :

a) établit l'ordre du jour des réunions du Conseil et du Comité Exécutif;

b) assure l'administration de l'Association.

Il se réunit normalement avant chaque réunion du Comité Exécutif.

35. Le ***Président*** de l'Association :

a) représente l'Association dans ses relations avec les Organismes ou Institutions nationales ou internationales;

b) convoque et préside les Assemblées Générales et toutes les réunions du Conseil, du Comité Exécutif et du Bureau;

c) présente à l'Assemblée Générale le rapport sur les activités scientifiques de l'Association pendant la période de sa présidence.

Il est membre du Comité Exécutif de l'Union. En cas d'indisponibilité du Président, le *Premier Vice-Président* le remplace.

36. Le ***Secrétaire Général*** de l'Association :

a) assume les fonctions de secrétaire de l'Assemblée Générale, du Conseil, du Comité Exécutif et du Bureau; il organise leurs réunions, prépare et diffuse promptement l'ordre du jour et les procès-verbaux de toutes ces réunions;

b) remplit les fonctions de Directeur du Bureau Central;

c) gère les affaires de l'Association, se charge de la correspondance et assure la conservation des archives;

d) distribue toutes les informations concernant l'Association;

e) prépare les rapports d'activité de l'Association, en particulier il présente à l'Assemblée Générale le rapport sur l'administration et les finances de l'Association pour la période en cours;

f) accomplit toutes autres tâches qui lui sont confiées par le Bureau.

37. Pour aider le Secrétaire Général dans l'accomplissement de ses tâches envers l'Association, celle-ci établit une structure permanente, le *Bureau Central*, comportant un nombre variable d'employés payés sur des fonds de l'Association.

Le Secrétaire Général est également assisté d'un petit nombre de *Secrétaires adjoints*, dont l'un deux réside dans la même localité que le Secrétaire Général. Ces fonctions sont gratuites et ne peuvent donner lieu qu'au remboursement des frais occasionnées par ces charges.

37A. Un Secrétaire Adjoint supplémentaire, désigné "*Le Secrétaire de l'Assemblée*", peut également être nommé par le Conseil sur recommandation du pays où se tiendra la prochaine Assemblée Générale. Si cette procédure de nomination n'est pas réalisable, le Conseil délègue cette nomination au Bureau de l'Association.

En collaboration avec le Bureau Central, ce Secrétaire Adjoint est responsable des relations avec les organisateurs s'occupant de la préparation de l'Assemblée Générale. Ce Secrétaire Adjoint n'est nommé que pour une seule période.

VI- *Activités des Sections, Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes*

38. Le ***Président d'une Section*** a la responsabilité du développement des activités scientifiques de sa Section et il représente sa Section au Comité Exécutif de l'Association. En liaison étroite avec son Comité Directeur, il encourage, guide et coordonne les travaux des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes de sa Section, et, en particulier, rend compte annuellement des activités de sa Section aux officiels de la Section ainsi qu'aux membres du Bureau de l'Association.

Le Président d'une Section, ou, à défaut, l'un de ses Secrétaires, doit assister à chaque symposium concernant la Section.

Avant chaque Assemblée Générale, le Président d'une Section reçoit les rapports d'activité des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes rattachés à sa Section et, assisté du Comité Directeur, il prépare alors le compte rendu des activités de la Section à présenter à l'Assemblée Générale. Il reçoit les suggestions pour créer de nouveaux Groupes Spéciaux d'Etudes et pour continuer

l'activité de Groupes déjà existants, selon la procédure exposée à l'Art. 43. Après consultation du Comité Directeur de la Section, il coordonne ces demandes et transmet ses recommandations au Comité Exécutif.

Chaque ***Comité Directeur de Section*** se réunit au moins une fois durant chaque Assemblée Générale Ordinaire et au moins à une autre occasion au cours de la période entre deux Assemblées Générales. Lors de la réunion à l'Assemblée Générale, ou au cours de toute autre occasion appropriée, le Comité Directeur passe en revue les activités des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes pendant la période écoulée, et examine les programmes de celles et ceux dont la poursuite de l'activité est proposée pour la période suivante.

Les ***Secrétaires de Section*** assistent le Président de Section dans ses fonctions.

39. Le ***Président d'une Commission*** a la responsabilité d'en promouvoir et d'en diriger les travaux et d'en recruter les membres, à l'exception des représentants des Pays Membres, désignés comme indiqué à l'Art. 2.

Le Président de chaque Commission établit une brève description du travail à accomplir et une liste des membres, pour publication dans le Manuel du Géodésien après chaque Assemblée Générale.

Afin d'assurer la communication et la coopération au sein de chaque Commission, les membres sont tenus informés, annuellement, des résultats obtenus et des problèmes en cours.

39A. Le ***Président d'une Commission Spéciale*** a la responsabilité d'en promouvoir et d'en diriger les travaux et d'en recruter les membres.

La répartition géographique de ces derniers doit refléter une bonne coopération internationale sur le sujet d'étude et leur nombre ne doit pas excéder 30.

Le Président de chaque Commission Spéciale établit une brève description du travail à accomplir et une liste des membres, pour publication dans le Manuel du Géodésien après chaque Assemblée Générale.

Afin d'assurer la communication et la coopération au sein de chaque Commission Spéciale, les membres sont tenus informés, annuellement, des résultats obtenus et des problèmes en cours.

40. Le ***Président d'un Groupe Spécial d'Etudes*** a la responsabilité d'en promouvoir et d'en diriger les travaux et d'en recruter les membres.

La répartition géographique de ces derniers doit refléter une bonne coopération internationale sur le sujet d'étude et leur nombre ne doit pas excéder 20.

Le Président de chaque Groupe Spécial d'Etudes établit une brève description du travail à accomplir et une liste des membres, pour publication dans le Manuel du Géodésien après chaque Assemblée Générale.

Afin d'assurer la communication et la coopération au sein de chaque Groupe Spécial d'Etudes, les membres sont tenus informés, annuellement, des résultats obtenus et des problèmes en cours.

41. Le Président de l'Association, le Bureau Central et le Président de la Section concernée reçoivent copie des correspondances officielles et des notes aux membres des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes.

42. Les rapports d'activité de chaque Commissions, Commission Spéciale et Groupe Spécial d'Etude doivent être transmis au Président de la Section concernée au moins trois mois avant chaque Assemblée Générale. Ces rapports ainsi que les rapports des Sections sont publiés dans les "*Travaux de l'Association Internationale de Géodésie*".

43. La période d'activité de chaque Groupe Spécial d'Etudes prend normalement fin à l'Assemblée Générale ordinaire. Dans le cas exceptionnel où une poursuite d'activité est jugée nécessaire, le Président du Groupe Spécial d'Etudes soumet à son Président de Section trois mois avant l'Assemblée Générale une proposition écrite bien argumentée, y compris une suggestion pour la désignation de son successeur. Le Président de Section présente alors une recommandation au Comité Exécutif.

44. Les Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes non rattachés à une Section particulière sont placés sous la responsabilité du Président de l'Association.

45. Les Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes sont libres d'organiser des réunions de travail de leurs membres. S'ils désirent organiser des Symposiums scientifiques, ils doivent suivre la procédure d'approbation des symposiums prévue par l'Association. Les symposiums ne peuvent être organisés que si leur sujet déborde du cadre d'activité d'une Commission, Commission Spéciale ou d'un Groupe Spécial d'Etudes.

VII- *Symposiums*

46. L'Association peut organiser des symposiums scientifiques pour étudier des problèmes particuliers d'intérêt général.

Le Comité Exécutif a la responsabilité de veiller au choix judicieux des symposiums, de façon à garantir une équitable représentation par sujet et une bonne

répartition géographique et aussi à éviter des doubles emplois, des recouvrements et une fréquence injustifiée.

Les symposiums parrainés par l'Association sont ouverts à tous les scientifiques, selon les règles du Conseil International des Unions Scientifiques.

47. Les propositions de symposiums pour la période entre deux Assemblées Générales Ordinaires sont normalement soumises par les Organisateurs au Secrétaire Général, avant l'Assemblée Générale précédant cette période. Au cours de cette Assemblée Générale d'autres propositions peuvent être soumises au Secrétaire Général, au plus tard deux jours avant la dernière réunion du Conseil.

Le Conseil, sur recommandation du Comité Exécutif, décide si l'Association doit parrainer tel ou tel symposium.

Dans des cas très exceptionnels, le Comité Exécutif peut donner son accord à des demandes faites hors des délais normaux. De telles demandes ne peuvent être faites moins de 18 mois avant la date proposée pour le symposium.

48. L'Organisateur d'un symposium doit envoyer une annonce officielle au Bulletin Géodésique au moins un an à l'avance, ou immédiatement après l'approbation par l'Association; la date annoncée ne doit plus changer ensuite.

49. Moins de trois mois après le symposium, l'Organisateur est tenu de fournir un rapport pour le Bulletin Géodésique. Ce rapport doit indiquer si les Actes du symposium seront publiés, et où, et quand ils le seront. Les Actes du symposium, ou au moins une copie de chaque communication présentée, doivent être adressées au Bureau Central de l'Association.

50. Le parrainage d'un symposium par l'Association signifie une reconnaissance officielle mais n'implique pas un soutien financier.

VIII- *Coopération scientifique internationale*

51. L'Association peut coopérer à des travaux scientifiques de caractère international ou interdisciplinaire, elle peut également les entreprendre directement ou en surveiller la réalisation. En principe, l'Association est représentée aux Congrès, réunions internationales, Assemblées Générales, etc... des organismes scientifiques internationaux dont l'activité est en rapport avec la sienne propre. Le Président de l'Association ou son délégué représente l'Association à ces réunions.

Les frais de voyage et de séjour du représentant de l'Association peuvent être mis en totalité ou partiellement à la charge de l'Association. Un compte rendu de ces réunions incluant les discussions en rapport avec la géodésie, est préparé par ce représentant, en vue d'une publication, totale ou partielle, dans le Bulletin Géodésique.

L'Association peut aussi représenter l'Union au sein de Commissions inter-Unions ou de Comités spéciaux communs traitant de sujets en rapport avec ses propres études.

La désignation des représentants de l'Association ou de l'Union à ces organismes permanents est faite par le Comité Exécutif. Ces représentants sont élus pour une période et peuvent être ré-élus pour une période supplémentaire.

IX- *Finances*

52. Les *ressources* de l'Association proviennent:

a) des cotisations des pays membres de l'Union dont une partie, déterminée par le Conseil de l'Union sur recommandation de son Comité des Finances, est versée à l'Association par le Trésorier de l'Union;

b) de la vente des publications;

c) de toute autre origine (subventions, dons, intérêts, fonds disponibles après un symposium, etc...).

53. Le Secrétaire Général reçoit du Bureau et du Conseil de l'Association, la responsabilité de gérer ces ressources conformément aux Statuts et Règlement Intérieur, ainsi qu'aux décisions du Conseil et aux recommandations du Comité des Finances de l'Union.

Le Secrétaire Général est seul responsable de la maîtrise des opérations financières de l'Association, cependant un Secrétaire Adjoint reçoit délégation de signature pour chaque compte bancaire ouvert au nom de l'Association.

54.A chaque Assemblée Générale Ordinaire de l'Association, le Secrétaire Général présente la proposition de budget pour la période à venir et la soumet au Conseil pour approbation.

Le budget, tel qu'approuvé par le Conseil, est exécuté par le Secrétaire Général.

A l'Assemblée Générale ordinaire suivante, le Conseil examine si les dépenses ont été engagées conformément aux propositions précédemment approuvées. Le Conseil désigne un Comité ad hoc pour effectuer cet examen dans le détail.

De plus, cette comptabilité est vérifiée par un comptable agréé et est ensuite présentée au Trésorier de l'Union, selon les prescriptions de l'Art. 20 du Règlement Intérieur de l'Union.

STATUTES AND BY-LAWS

I- *Definition and objectives of the International Association of Geodesy*

1. The *International Association of Geodesy*, hereafter called the Association, is one of the constituent associations of the *International Union of Geodesy and Geophysics*, hereafter called the *Union*.

2. The *objectives* of the Association are :

a) to promote the study of all scientific problems of geodesy and encourage geodetic research;

b) to promote and coordinate international cooperation in this field, and promote geodetic activities in developing countries;

c) to provide, on an international basis, for discussion and publication of the results of the studies, researches and works indicated in paragraphs a) and b) above.

3. To achieve these objectives, the Association shall comprise a small number of Sections, each of which deals with a distinct part of geodesy.

Commissions, Special Commissions and Special Study Groups may be formed as provided in the By-Laws.

4. Every country adhering to the Union *(Member Country)* may be represented by Delegates to the Association.

a) Scientists may become *Affiliates* of the Association, either as *Fellows* or *Associates*, as provided in the By-Laws.

II- *Administration*

5. The *General Assembly* of the Association shall consist of the Delegates of the Member Countries duly accredited by the corresponding Adhering Bodies, as defined in the Statutes of the Union.

6. The ***Council*** of the Association shall consist of the *Delegates*, known as Council Delegates, designated for meetings of the Council and formally accredited by the Adhering Body of Member Countries on the basis of one Delegate for each Member Country. Each Council member shall be an Associate or a Fellow of the Association.

No member of the Bureau of the Association shall serve as a Council Delegate of a country. The President of the Association shall preside over the Council meetings, without vote, except in the case of a tie as provided in article 16 hereafter.

7. Responsibility for the direction of the Association affairs shall be vested in the Council of the Association. Decisions of the Council shall be reported to the General Assembly. In the case that the majority of those present at a General Assembly meeting disagrees with the decisions of the Council, the Council shall reconsider the question, and make a decision, which shall be final.

8. Between meetings of the Council, the direction of the affairs of the Association shall be vested in the *Bureau* and the *Executive Committee*, the respective composition and responsabilities of which are defined hereafter.

9. The ***Bureau*** of the Association shall consist of the *President*, the *First Vice-President* and the *Secretary General*, all of whom shall be elected by the Council. The duties of the Bureau shall be to administer the affairs of the Association in accordance with these

Statutes and By-Laws and with the decisions of the Council and the Executive Committee.

10. The ***Executive Committee*** shall consist of the *Bureau*, the *immediate past President* and the *Second Vice-President* of the Association, and the *Presidents of the Sections*.

The Honorary Presidents and the Honorary General Secretaries of the Association, the Presidents of Commissions, the Secretaries of the Sections, the Assistant Secretaries of the Association and the Chief Editor of the Bulletin Geodesique may attend any meeting of the Executive Committee of the Association, with voice but without vote.

The duties of the Executive Committee shall be to further the scientific objectives of the Sections and other scientific bodies of the Association through effective coordination and through the formulation of general policies to guide the scientific work of the Association.

The members of the Executive Committee shall attend meetings of the Council, with voice but without vote.

III- Voting

11. A Council Delegate may represent only one Member Country.

A Member Country which is not represented at a Council meeting may vote by correspondence on any specific question, provided that matter has been clearly defined on the final agenda distributed in advance to the Member Countries and that the discussion thereon has not produced any significant new considerations or changed its substance, and provided that the said vote has been received by the President prior to the voting.

12. In order that the deliberations of the Council shall be valid, the number of the Council Delegates present must be at least half of the Member Countries represented at the General Assembly of the Union.

13. On questions not involving matters of finance, the voting in Council shall be by Member Countries, each Member Country having one vote, provided that its Union subscriptions shall have been paid up to the end of the calendar year preceding the voting.

14. On questions involving finance, the voting in Council shall be by Member Countries, with the same provision that a voting country shall paid its Union subscriptions up to the end of the calendar year preceding the voting in Council. The number of votes allotted to each Member Country shall then be equal to the number of its category of membership as defined by the Union.

15. Before a vote in a Council meeting, the President shall decide whether or not the matter under consideration is financial in character and whether the procedure of voting by correspondence applies.

16. Decisions of the Council shall be taken by a simple majority, except as otherwise specified in these Statutes. If a tie should occur in a Council vote, the President shall cast the decisive vote. Simple and two-thirds majorities are determined by the proportion of affirmative votes to the sum of all votes (affirmative, negative and abstention). Bank and invalid ballots and votes not cast by delegates present are counted as abstentions.

IV- General

17. Proposals for a change of any article of the Statutes of the Association must reach the Secretary General at least six months before the announced date of the Council meeting at which it is to be considered. The Secretary General shall notify all Member Countries of any proposed change at least four months before the announced date of the Council meeting.

18. The Statutes of the Association may not be modified except by the approval of a two-thirds majority of votes cast at a Council meeting.

These Statutes or any further modification of them shall come into force at the close of the Council meeting at which they are approved.

19. The Council shall have the power to adopt By-Laws within the framework of the Statutes of the Association.

These By-Laws may not be modified except by a simple majority of votes cast at a Council meeting.

These By-Laws or any further modification of them shall come into force at the close of the Council meeting at which they are approved.

20. In the event of the dissolution of the Association, its assets shall be ceded to the Union.

21. Conduct of meetings : Except as otherwise provided in the Statutes or By-Laws, business meetings shall be conducted according to Robert's Rules of Order.

22. These Statutes and By-Laws of the Association are set out in French and in English.

The validity of these rules shall not be vitiated by any error of a formal or accidental nature.

II- BY-LAWS

I- Structure

1. The scientific work of the International Association of Geodesy is allocated to *Sections*, the respective responsabilities of which are decided by the Council on recommendation of the Executive Committee. The structure of these Sections shall be reviewed every eight years (two periods) by a committee, called the Cassinis Committee, which shall make proposals to the Executive Committee. Because of the complex interrelations among various activities of the Association, interactions between the individual sections are implied.

There are at present ***five sections*** which are the following :

- **Section I** : *Positioning.*
  . high precision horizontal and vertical networks;
  . satellite and spatial positioning;
  . inertial positioning;
  . kinematic positioning;
  . geodetic astronomy;
  . marine positioning;
  . refraction.

- **Section II** : *Advanced Space Technology.*
  . development of space techniques for geodesy, such as: satellite radio-tracking techniques, radio-interferometric techniques, satellite and lunar laser ranging, satellite altimetry, satellite-to-satellite tracking, satellite gradiometry, geodetic measurements from space;
  . orbital computations;
  . direct results of such techniques;
  . planetary and lunar geodetic techniques.

- **Section III** : *Determination of the gravity field.*
  . absolute and relative terrestrial gravity measurements;
  . non tidal gravity variations;
  . determination of the external gravity field and the geoid from gravimetry, gradiometry, geodetic astronomy, space and inertial techniques;
  . reduction and estimation of gravity field quantities.

- **Section IV** : *General Theory and Methodology.*
  . General mathematical models for geodesy;
  . statistical and numerical analysis;
  . data processing and management;
  . optimization methods;
  . least squares methods;
  . differential and integral theories of the gravity field;
  . theory of estimation, approximation and representation of the gravity field.

- **Section V** : *Geodynamics.*
  . reference systems;
  . monitoring and study of time-dependent phenomena: polar motion, Earth rotation, Earth tides, recent crustal motions, variations of gravity, sea surface topography and mean sea level;
  . geodetic aspects of international geodynamic projects;
  . planetary and lunar dynamics;
  . geophysical interpretation of gravity and related data.

1A- Each Section shall set up a ***Steering Committee*** consisting of the Section President, the Secretaries, the Presidents of Commissions and Special Commissions within the Section, and such other persons, who have participated in the work of the Section, as are coopted to the Committee, on the recommendation of the Section President.

2. ***Commissions*** may be formed for activities for which close international cooperation or organization is necessary, in particular for long term problems or activities relating to large regions.

Every Member Country of the Union is entitled to nominate one representative to each Commission, except those dealing with specific geographical areas; to the latter Commissions, only Member Countries of the Union in the geographical area in question are entitled to nominate one representative each.

A Commission is normally assigned to one Section.

Each Commission may be organized according to its own requirements in compliance with the Statutes and By-Laws of the Association and subject to approval by the Executive Committee, for instance through the formation of regional Sub-Commissions.

2A- ***Special Commissions*** may be formed to study scientific problems of a long term character which require close cooperation between specialists from different countries.

A Special Commission is normally assigned to a particular Section. Each Special Commission may be organized to its own requirements in compliance with the Statutes and By-Laws of the Association and subject to the approval by the Executive Committee, for instance through the formation of special Sub-Commissions to study defined aspects in its fields.

3. ***Special Study Groups*** may be formed to study specific scientific problems of limited scope which require close cooperation between specialists from different countries.

A Special Study Group is normally assigned to a particular Section.

4. The setting-up and dissolution of the Commissions, the Special Commissions and the Special Study Groups are decided by the Executive Committee which also specifies whether the Commission, the Special Commission or the Special Study Group is to be placed under the direct authority of the Association or of one of its Sections.

The list of Commissions, Special Commissions and Special Study Groups shall be published in the Geodesist's Handbook after each General Assembly.

5. The Association may also participate in joint scientific bodies with other Associations of the International Union of Geodesy and Geophysics, or, representing this Union with other Unions. These bodies shall be administered according to specific rules proceeding from their relations with other agencies, but they shall report on their scientific work at each General Assembly of the Association.

The Executive Committee of the Association shall decide whether the relationship with any such common body is to be placed under the responsibility of the Association or of one specific Section. This responsibility includes the appointment of representatives to these common bodies as well as participating in the planning of their future activities.

II- Elections.

6. Elections shall take place in the Council during each Ordinary General Assembly of the Association.

The President in office, after taking advice from members of the Executive Committee, shall appoint a *Nominating Committee* consisting of a Chairman and three other members. The Nominating Committee, after taking advice from the Adhering Bodies of the Member Countries and officers of the Association, shall propose a candidate for each position to be filled by election in the Council. Candidates shall be asked to signify their acceptance of nomination and to prepare a resume, maximum 150 words, outlining their position, research interests and activities relating to the Association. The delegates shall be informed of these nominations and the resumes, early in the General Assembly, and a notice posted allowing for submission, over a period of at least 48 hours, of further nominations. Such nominations shall be in writing, shall be supported by at least two members of the Council, and shall be submitted with resumes as described above to the Secretary General. Delegates shall be informed of these further nominations and resumes and of their supporters.

Elections shall be by secret ballot.

No person may hold more than one of the following offices at the same time : President of the Association, Vice-President, President of a Section and President of a Commission and a Special Commission.

7. The time interval between the closures of two successive Ordinary General Assemblies of the Association is called here *a period.*

8. The ***President*** of the Association is elected for one period. He may not be re-elected to this office, but the Council may appoint him as *Honorary President.*

9. The ***First*** and ***Second Vice-Presidents*** are elected for one period and may not be immediately re-elected to the same office.

10. deleted.

11. The ***Secretary General*** is elected for one period initially. He may be re-elected for two additional single periods.

12. The same rules as in Art. 11 apply to ***Assistant Secretaries***, other than the Assistant Secretary appointed under Art. 37A.

13. A member of the Bureau or of the Finance Committee of the Union may not occupy the post of *President*, of First *Vice-President* or of *Secretary General* of the Association.

14. Should the position of President become vacant in the interval between two Ordinary General Assemblies, his duties devolve to the First Vice-President until the closure of the next Ordinary General Assembly. In the same way the duties of the First Vice-President then devolve on the Second Vice-President.

Should the post of Secretary General become vacant, the President shall arrange without delay for the Executive Committee to elect a replacement by correspondence so as to ensure the continuity of the work of the Central Bureau. This election has effect until the closure of the next Ordinary General Assembly.

15. The ***Presidents of Sections*** are elected for one period and may not be immediately re-elected to the same office.

16. The ***Secretaries of Sections*** are elected for one period but may be re-elected for one further period.

The President of each Commission which is in a Section shall be a Secretary of that Section. The maximum number of Secretaries in a Section shall be two, except where the number of Commissions in a Section is greater than one, the number of Secretaries shall then equal the number of Commissions plus one.

17. Should the position of President of Section become vacant between two Ordinary General Assemblies, the Executive Committee shall appoint an interim member to take office until the closure of the next General Assembly.

Should other vacancies occur, the Executive Committee may make interim appointments.

18. The ***Presidents of Commissions*** and ***Special Commissions*** are elected by the Council of the Association for one period and may be immediately re-elected for one further period.

19. The ***Chairman of a Special Study Group*** is appointed by the Executive Committee for one period only.

20. A person may be President or Chairman at the same time of no more than one of the bodies referred to in Arts. 18 and 19.

III- General Assemblies.

21. The Association shall hold its own Ordinary General Assemblies in conjunction with the Ordinary General Assemblies of the Union, at the same time and in the same country.

22. Before any General Assembly, a detailed agenda is prepared by the Bureau of the Association. As far as the scientific work is concerned, the agenda is drawn up by the Executive Committee. This agenda is sent to the member countries and to all the officers of the Association so as to reach them at least two months prior to the Assembly. In principle, only matters on the agenda may be considered during the sessions, unless a decision to do otherwise is passed by a two-thirds majority in the Council or in the Executive Committee.

23. At each General Assembly, the President of the Association shall present a detailed report on the scientific work of the Association during his tenure. The Secretary General shall present a detailed report on the administrative work and on the finances of the Association for the same period. They both should submit proposals regarding work to be undertaken during the coming period, within the limits of expected resources.

These reports are handed to the delegates attending the General Assembly before the opening of the Assembly.

24. The scientific meetings generally take place Section by Section, but the study of some questions may require joint meetings of several Sections or Symposia under chairmen appointed by the Executive Committee.

Joint Symposia covering topics interesting two or more Associations within the Union may be arranged.

25. At each General Assembly, the work of each Section shall be reported by its President assisted by his Secretaries. Similarly, the work of each Commission, Special Commission or Special Study Group shall be reported by its President or Chairman.

26. The inclusion on the agenda of scientific papers for presentation at sessions of the General Assembly is decided by a committee consisting of one member of the Bureau and the Presidents of Sections.

27. Individual authors are responsible for the reproduction of their scientific papers. These papers are distributed to the delegates by the Central Bureau prior to the meeting where they are presented. They may be published in the Bulletin Géodésique subject to its editorial policy.

IV- Publications.

28. The Association's journal is the **Bulletin Géodésique**, hereinafter referred to as the journal. The journal is published at regular intervals, through an agreement between the Association and a publishing company, or by other arrangement approved by the Executive Committee. The terms of any agreement for publication of the journal shall be negotiated by the President and ratified by the Executive Committee.

There shall be one or more *Editors-in-Chief* for the journal, hereinafter referred to as the *Editor*. The Editor shall be advised and assisted by a *Board of Editors*, hereinafter referred to as the *Board*.

The Editor shall be responsible for the scientific content of the journal. All scientific manuscripts shall be subject to a refereeing process and the Editor shall make the final decision on whether a manuscript is accepted for publication. The Editor shall keep the Association informed of the activities and status of operations of the journal.

28A. At the time of each General Assembly, the Editor shall, in consultation and agreement with the President of the Association, recommend candidates for membership of the new Board, which is to hold office for the next period. During the Assembly, the current Board shall elect the members of the new Board from those recommended. After taking office, the new Board shall elect one, or more, Editors(s) for the next period. The nomination of the Editor(s) shall be approved by the Executive Committee.

The Editor and the members of the Board, shall each hold office for one period, but shall be eligible to be elected for one further period.

28B. After each General Assembly, a special issue of the Bulletin Géodésique shall be published under the name of *"Geodesist's Handbook"*. This issue aims at providing detailed information on the Association, its structure and scientific activities, and other relevant technical and administrative information.

29. After each General Assembly, a collection of the reports presented by the Sections, Commissions and Special Study Groups shall be published in the *"Travaux de l'Association Internationale de Géodésie"*. This publication is supplied free of charge to the Officiers of the Association and to the Adhering Body of each Member Country.

30. The Association also issues ***special publications*** which contain information on recommended standards in geodesy.

31. At every General Assembly each Member Country of the Union is invited to supply an adequate number of copies of its National Report on geodetic work done since the previous General Assembly. These **National Reports**, as far as available, are distributed by the Central Bureau of the Association in the same manner as the "Travaux de l'Association Internationale de Géodésie".

V- Administration.

32. The ***Council*** of the Association shall :

a) examine questions of general scientific policy or administration in the business of the Association and appoint such Committees as may, from time to time, be deemed necessary for this purpose;

b) elect the members of the Bureau and of the Executive Committee, the Assistant Secretaries of the Association, the Secretaries of Sections, the Presidents of Commissions and of Special Commissions;

c) receive reports from the Secretary General and consider for approval the decisions or actions taken by the Bureau and the Executive Committee since the last Council meeting;

d) appoint the three members of the ad hoc committee created for examining the finances of the Association, consider its recommendations and adopt the final budget;

e) consider proposals for changes in the Statutes and By-Law;

The Council is convened by the President of the Association. It shall normally meet during the Ordinary General Assemblies.

33. The ***Executive Committee*** of the Association shall :

a) initiate actions and issue guidelines, as required, to guide the Association towards the achievement of its scientific objectives;

b) fill vacancies occuring between General Assemblies, in accordance with the present Statutes and By-Laws;

c) set up and dissolve Commissions, Special Commissions and Special Study Groups;

d) appoint Chairmen of Special Study Groups, and approve the election of the Editor(s) in Chief of the Bulletin Géodésique;

e) appoint members of the Cassinis Committee;

f) make recommendations to the Council on matters of General policy of the Association and on the implementation of its objectives;

g) on the recommendation of the Bureau, appoint Fellows and Associates of the Association. Past officers of the Association, including those of the Commissions and sub-Commissions, shall be eligible for appointment as Fellows and shall be invited to become Fellows of the Association. Persons elected as officers of the Association or nominated as members of Commissions, Special Commissions of Special Study Group, shall automatically become Associates of the Association. Persons from Member Countries who apply, indicating previous participation in Association activities, or providing a recommendation from their national Adhering Body or a recommendation from an officier or a Fellow of the Association, shall be eligible to become Associates, and shall be recommended by the Bureau.

The Executive Committee is convened by the President of the Association, it shall meet at General Assemblies and its members shall attend the meetings of the Council, with voice but without vote. It shall also meet normally at least once betwen General Assemblies, one year ahead of the General Assembly, in order to prepare the scientific agenda and the time-table during the next General Assembly.

At a meeting of the Executive Committee, no member may be represented by any other person, except a President of a Section who may be represented by a Secretary of his Section. In order that the deliberations of the Executive Committee shall be valid, half at least of its members must be present or represented.

The agenda for each meeting of the Executive Committee shall be prepared by the Bureau and sent to the members at least three months prior to the meeting.

34. The ***Bureau*** of the Association shall :

a) draw up the agenda of the meetings of the Council and Executive Committee;

b) ensure the adequate administration of the Association. It shall normally meet before each meeting of the Executive Committee.

35. The ***President*** of the Association shall :

a) be the representative of the Association in its dealing with National or International Organizations or Institutions;

b) convene and preside over the General Assembly and over all meetings of the Council, Executive Committee and Bureau;

c) submit a report to the General Assembly on the scientific work of the Association during his tenure;

He is a member of the Executive Committee of the Union. In case of his absence, the *First Vice-President* shall act.

36. The ***Secretary General*** shall :

a) serve as secretary of the General Assembly, the Council, the Executive Committee and the Bureau: arrange for meetings of these bodies, prepare and distribute promptly the agenda and the minutes of all their meetings;

b) be the Director of the Central Bureau;

c) manage the affairs of the Association, attend to correspondence, preserve the records;

d) circulate all appropriate information related to the Association;

e) prepare the reports on the Association's activities, especially report to the General Assembly on the administration and the finance of the Association during the current period;

f) perform such other duties as may be assigned to him by the Bureau.

37. To assist the Secretary General in the performance of his duties to the Association, the Association establishes a permanent agency, the Central Bureau, including a variable number of employees paid out of Association funds.

The Secretary General is also assisted by a small number of *Assistant-Secretaries*, one of whom is located in the same office as the Secretary General. All these functions are unpaid and only expenses incurred in connection with them are repayable.

37A. An additional *Assistant Secretary* to be known as the *Assembly Secretary* may also be appointed by the Council on the recommendation of the Adhering Body of the country in which the next General Assembly takes place. If this procedure is not feasible then the Council may delegate the appointment to the Bureau.

In cooperation with the Central Bureau, this Assistant Secretary has responsibilities for liaison with the organizers working on the preparation of the General Assembly. This Assistant Secretary shall be appointed for one period only.

IV- Activities of Sections, Commissions, Special Commissions and Special Study Groups.

38. The ***President of a Section*** is responsible for the scientific development within the area of his Section and is the representative of his Section on the Executive Committee of the Association. Working closely with the Steering Committee he shall encourage, guide and coordinate the work of the Commissions, Special Commissions and Special Study Groups within his Section, and in particular keep the officers of his Section as well as the Bureau of the Association informed of the Section's activities, on an annual basis.

It is desirable the the President of a Section, or else one of the Secretaries of the Section, should attend each of the Symposia related to the section.

Before each General Assembly the President of a Section shall receive the reports of the Commissions, Special Commissions and Special Study Groups within his Section and, assisted by the Steering Committee, prepare a report on the activities of the Section to be presented at the General Assembly.

He shall receive suggestions for new Special Study Groups, and suggestions for continuation of existing Special Study Groups under Art. 43, and, after consulting his Section Steering Committee, shall coordinate them and transmit his recommendations to the Executive Committee.

Each ***Section Steering Committee*** shall meet at least once during each Ordinary General Assembly and on at least one other occasion during the period. At the General Assembly meeting, or on some other appropriate occasion, the Steering Committee shall review the activities of Commissions, Special Commissions and Special Study Groups over the past period, and for those which will be recommended for continuation, review their programmes for the forthcoming period.

The ***Section Secretaries*** assist the Section President in his duties.

39.The ***President of a Commission*** is responsible for initiating and directing its work and selecting its members, apart from those representatives of Member Countries appointed under Art. 2.

The President of each Commission shall issue a brief description of the work to be performed and a list of members, to be published in the Geodesist's Handbook after each General Assembly.

To assist communication and cooperation within each Commission, members should be informed, on an annual basis, of results achieved and of outstanding problems.

39A. The ***President of a Special Commission*** is responsible for initiating and directing its work and selecting its members. Special Commission membership should be balanced so as to reflect international cooperation in the subject and shall be limited to a member not exceeding 30.

The President of each Special Commission shall issue a brief description of the work to be performed and a list of members, to be published in the Geodesist's Handbook after each General Assembly.

To assist communication and cooperation within each Special Commission, members should be kept informed, on an annual basis, of results achieved and of outstanding problems.

40. The ***Chairman of a Special Study Group*** is responsible for initiating and directing its work and appointing its members. Special Study Group membership should be balanced so as to reflect international cooperation in its subject and shall be limited to a number exceeding 20.

The Chairman of each Special Study Group shall issue a brief description of the work to be performed and a list of members, to be published in the Geodesist's Handbook after each General Assembly.

To assist communication and cooperation within each Special Study Group, members should be kept informed, on an annual basis, of results achieved and of outstanding problems

41. The President of the Association, the Central Bureau and the President of the relevant Section should receive copies of all official correspondence and of notices to members of Commissions, Special Commissions and Special Study Groups.

42. The reports of each Commission, Special Commission and Special Study Group should reach the President of each relevant Section at least three months before each General Assembly. These reports and the reports of the Sections are published in the "Travaux de l'Association Internationale de Géodésie".

43. The period of work of each Special Study Group normally ends at an Ordinary General Assembly. In the exceptional case that a continuation of the work is deemed necessary, the Special Study Group Chairman shall submit in writing a well-grounded proposal, including a suggestion for his successor, to his Section President, at least three months before the General Assembly. The Section President shall then make a recommendation to the Executive Committee.

44. Commissions, Special Commissions and Special Study Groups not assigned to one Section shall be under the responsibility of the President of the Association.

45. Commissions, Special Commissions and Special Study Groups are free to hold workings of their members. If they wish to arrange scientific Symposia, these are subject to the usual approval procedure for Symposia of the Association. Symposia should be arranged only if the topic transcends the frame of one Commisson, one Special Commission or one Special Study Group.

VII- Symposia.

46. The Association may organize scientific Symposia to study particular questions of wide interest.

The Executive Committee is responsible for a balanced selection of Symposia, to ensure a representative coverage of subjects and a good geographical distribution and to avoid duplication, overlap and undue frequency.

Symposia sponsored by the Association shall be freely open to all scientists, in accordance with ICSU regulations.

47. Normally applications for Symposia to be held in the period between two Ordinary General Assemblies should be submitted by the Host Organization to the Secretary General before the General Assembly preceding that period. During this General Assembly other applications may be submitted to the Secretary General at least two days before the last meeting of the Council.

The Council, on recommendation of the Executive Committee, shall decide whether the Symposium in question will be sponsored by the Association.

In exceptional cases, the Executive Committee may approve late applications. Such applications must be submitted at least 18 months before the proposed date for the Symposium.

48. The Symposium Organizer must send an official announcement of the Symposium to the Bulletin Géodésique at least one year in advance or immediately after the approval by the Association; the announed date of the Symposium must not be changed later.

49. Within three months after, the Symposium Organizer shall provide a report to be published in the Bulletin Géodésique. This report should indicate whether, where, and when the Proceedings will be published. A Copy of the Symposium Proceedings, or else one copy of each paper presented at the Symposium, shall be sent to the Central Bureau of the Association.

50. Sponsorship by the Association means only official recognition and does not imply financial support.

VIII- International Sientific Cooperation.

51. The Association may undertake directly, supervise or cooperate in scientific work of an international or interdisciplinary character. As a matter of principle, the Association should be represented at Congresses, International Meetings, General Assemblies, etc... of scientific organizations whose activities are connected with its own. The President of the Association or its designate will be the representative of the Association at these meetings.

Travelling and accommodation expenses of the Delegate of the Association may be charged, in whole or in part, to the Association. The Delegate shall prepare a report of the meeting, including the discussions relating to geodesy, which may be published, in whole or in part, in the Bulletin Géodésique.

The Association may also represent the Union in inter-Union Commissions or special joint Committees dealing with topics that are related to its own studies.

Elections of Association or Union geodetic representatives to those permanent bodies shall be made by the Executive Committee. These representatives shall be elected for one period and may be re-elected for one further period.

IX- Finance.

52. The *funds* of the Association derive from :

a) the contributions of the member countries of the Union of which a proportion, determined by the Council of the Union on recommendation of its Finance Committee, is paid to the Association by the Treasurer of the Union;

b) the sale of publications;

c) any other source (including grants, donations, interest, funds remaining after a symposium, etc...).

53. The Secretary General is responsible to the Bureau of the Association and to the Council for managing the funds in accordance with the Statutes and By-Laws, with the decisions of the Council and with the recommendations of the Finance Committee of the Union.

The Secretary General alone shall responsible for control of the financial operations of the Association; however for each bank account of the Association, there shall be one Assistant Secretary who shall also have access to the account.

54. At each Ordinary General Assembly of the Association the budget proposal for the ensuing period shall be presented by the Secretary General and submitted for approval to the Council.

The budget as approved by the Council shall be implemented by the Secretary General.

During the next Ordinary General Assembly, the Council shall examine all expenditures to ensure that they were in accordance with the proposals previously approved. The Council shall appoint an *ad hoc* committee for carrying out this examination in detail.

In addition, these accounts shall be audited by a qualified accountant and shall then be reported to the Treasurer of the Union, as prescribed in Art. 20 of By-Laws of the Union.

GUY BOMFORD PRIZE, LEVALLOIS MEDAL

Rules For The Award Of The Guy Bomford Prize

Purpose: the Guy Bomford Prize is awarded by the International Association of Geodesy for outstanding contribution to Geodesy. It was established by the British National Committee for Geodesy and Geophysics to mark the contributions to geodesy of Brigadier G. Bomford, formerly of the University of Oxford and a Past President of the International Association of Geodesy. It has been inaugurated by the I.A.G. in 1975. The Prize is normally awarded at intervals of fours years on the occasion of the General Assembly of the I.A.G. held concurrently with the General Assembly of the International Union for Geodesy and Geophysics. The following rules for the award of the Guy Bomford Prize may be altered by the I.A.G. Executive if a majority of its voting members sees a necessity to do so.

Eligibility: The Guy Bomford Prize is awarded to a young scientist or to a team young scientists for outstanding theoretical or applied contributions to geodetic studies, particularly in the four year period preceding the General Assembly at which the award is made. Scientists who are under 40 years of age on December, 31, of the year preceding the Assembly at which the award is made, are eligible for the award.

Nominations: Nominations will be invited by the I.A.G. Bureau from all National Committees of I.U.G.G. member countries at least one year ahead of the General Assembly. Each committee can make one nomination which has not necessarily to be from its own country. The deadline for nominations will normally be six months before the next General Assembly and will be explicitly started in the letter of invitation.

Nominations must be accompanied by:

- The full name, address, age, academic and/or professional qualifications and position of the candidates and the name of the National Committee making the nomination.

- An outline of the reasons for the nomination including a general summary of the career and scientific achievement of the candidate.

- A review of the recent achievements of the candidates which would merit the award, including references to key papers, published, alone or jointly, during the preceding four-year period.

- A curriculum vitae, publication list, and copies of up to two key papers which are considered to justify candidature.

- The name and address of two referees who could be consulted.

Selection procedure: A screening committee will be appointed consisting of the presidents of the I.A.G. Sections and two other members to be appointed by the I.A.G. Bureau. Based on the material submitted by the National Committees, each member of the screening committee will rank the nominations and send a short list of three to the I.A.G. Bureau. The decision among the three top ranking candidates will be communicated to all National Committees, and the successfull candidate(s). The Prize may be withheld if, in the opinion of the I.A.G. Bureau, there is no sufficiently qualified candidate.

Presentation of award: The Prize shall be presented to the successfull candidate at the opening at the opening Plenary Session of the I.A.G. Assembly. He or she shall be invited to deliver a lecture during the course of the I.A.G. Assembly.

Levallois Medal

The **Levallois Medal** was established by the International Association of Geodesy in 1979 to honour **Jean-Jacques Levallois**, and to recognize his outstanding contribution to the I.A.G., particularly his long service as Secretary General, 1960-1975.

The award of the Medal will be made in recognition of distinguished service to the Association, and/or to the science of geodesy in general.

The Medal is normally awarded at four year intervals, on the occassion of the General Assemblies of the International Association of Geodesy and International Union of Geodesy and Geophysics; but the award may be omitted if it is considered that there is no candidature of sufficient merit, and an additional award may be made at any time if justified by exceptional circumstances.

A nomination for the award shall be made by an ad hoc committee consisting of the Honorary Presidents and must be confirmed by the I.A.G. Executive Committee. The ad hoc committee shall prepare a citation, suitable for publication, setting out the grounds for the proposed award before the General Assembly.

RULES FOR IAG SCIENTIFIC MEETINGS

These new Rules were prepared during the Executive Committee meeting held in Paris, 3-10 March 1988. After some amendments they were adopted by the Bureau and then the Executive Committee.

They now become effective and especially applicable to scientific meetings organized by the association itself. They do not conflict with those rules contained in the By Laws which more generally concern Symposia and workshops approved or sponsored by the IAG. These new rules must be considered as a necessary and more detailed complement to Chapter VII of the By Laws, should they be approved by the Council.

1. Scientific Meetings relevant to IAG may take place

1. during Ordinary General Assemblies of IAG, held at the same time and in the same country with the Ordinary General Assemblies of the IUGG,

2. during Scientific General Assemblies and/or General Meetings of IAG, held in the period between successive Ordinary General Assemblies,

3. at times and places outside of the General Assemblies and General Meetings of the IAG.

2. During the (Ordinary and Scientific) General Assemblies the scientific meetings generally take place Section by Section (including the respectively assigned Commissions and Special Study Groups) under the Chairmanship of the Section Presidents (called Section Meetings). The study of some questions may require joint meetings of several Sections under a chairman, appointed by the Executive Committee. The inclusion on the agenda of scientific papers for presentation at sessions of a General Assembly is decided by a Committee consisting of the Presidents of Sections. Besides the scientific sessions the Sections, Commissions, and Special Study Groups are free to hold working meetings of their members under the responsibility of the respective Presidents.

3. If one or more Sections, Commissions, or Special Study Groups wish to arrange a scientific symposium during the General Assembly this is subject to the usual approval procedure for IAG-Symposia (ref. 7). Symposia should be arranged only if the topic covers at least the frame of one Section, one Commission, or two Special Study Groups.

4. General Meetings of IAG may be considered as a group of IAG-Symposia and Section Meetings held at the same time and place.

5. At each General Assembly joint Symposia covering topics interesting two or more Associations within the Union and/or other international scientific organizations may be arranged.

Though the IAG may be asked to act as convenor or co-convenor these Symposia follow the rules issued by the IUGG in these particular cases.

6. The IAG may participate also in Joint Symposia at any other time outside of the General Assemblies obeying the same procedures.

7. The IAG may sponsor scientific Symposia covering broad parts of Geodesy and having large attendance at any suitable time outside of the General Assemblies and/or General Meetings, and may call them IAG-Symposia if the following conditions are fulfilled :

. the Symposium has to be sponsored by one or more Sections or Commissions or at least by two Special Study Groups of IAG ;

. the host organization of the symposium must accept a Scientific Committee appointed by the Executive

Committee of IAG with the advice of the proposer of that symposium ;

. the symposium must be open to all bona-fide scientists in accordance with the ICSU Rules ;

. the proceedings of the Symposium shall be published within 6-8 months after the end of the Symposium.

IAG expects that immediately after the end of the symposium the Chairman of the Scientific Committee supplies a short summary to be published in the Bulletin Géodésique.

8. Applications for approval as IAG-Symposium by the Executive Committee of IAG should be submitted to the Secretary General of IAG at least tow years before the proposed date of the Symposium. The following information is essential to the proposal :

1. Title
2. Date and duration
3. Location
4. Sponsoring and co-sponsoring Sections, Commissions, SSG's of IAG, other co-sponsoring scientific organization : letters enclosed.
5. Suggested composition of the Scientific Committee
6. Suggested Local Organization Committee, host organization
7. Name and address for maintenance of contact
8. Estimated number of participants
9. Financial support expected from sources other than the IAG
10. Names of the proposed Editors of Proceedings
11. The outlined Scientific Programme
12. A detailed account of why the proposed Symposium is useful and necessary at the time proposed and its relationship with other meetings.

9. Guide-lines for the agenda of the symposium
activities of the Scientific Committee (SOC)
activities of the Local Organizing Committee (LOC)
financial considerations
publication of the Proceedings.

9a) IAG-Symposia have to be performed at a high standard of scientific value and organized in a very effective way. The agenda may consist of any or all of the following :

a) Invited Review Papers,
b) Invited Papers,
c) Contributed Papers,
d) Contributed Poster Papers,
e) Video Film,
f) Discussion, including Panel Discussions.

Discussion following papers is regarded as an essential form of communication. It should be necessary to devote at least 1/3 of total meeting time to discussion. The Scientific Committee should pay particular regard to adequate provision for poster sessions.

9b) The Scientific Committee if responsible for a high standard of scientific value of the Symposium. The Chairman of the Scientific Committee

a) invites participants after the Symposium is approved by the Executive Committee,
b) accepts or rejects requested invitations,
c) invites contributions and sets a dead line for submissions of abstracts,
d) informs the Secretary General of all important things about the Symposium immediately after.

9c) The Local Organizing Committee takes care of the smooth running of the Symposium. It does not receive financial help from the IAG, the necessary expenses being met by the local funds or by contributions from the participants.

The requirements of local organizations are generally as follows :

1.

a) Meeting Rooms suitable for the expected number of participants and for the presentation of scientific papers should be reserved.

b) Adequate space for poster sessions should be reserved. It is important that the LOC make provision for a supply of pins, sticky tape, etc... for mounting poster material and for notification of participants of the time and venue of poster displays.

c) Arrangements should be made for the display of visual materials : overheads, slides, films and videos. Participants should be advised of the film and video standard(s) available at the meeting venue.

2. Arrangements should be made for the reproduction of participant's documents.

3. Sufficient secretarial and technical assistance should be secured, with careful attention to the requirement for projection equipment microphones, tape recorders, etc...

4. In conjunction with the requirements of the SOC, arrangements should be made to record verbal discussion. Reliance on tape recordings if often unsatisfactory and providing each contributor with a sheet of paper on which to record or summarize his remarks is advisable.

5. Information on accommodation (hostels, hotels, etc...) should be agreed with the Chairman of SOC and sent

a) to the Executive Committee for acceptance and
b) to prospective participants in good time Block reservations are often advisable.

6. All participants should be asked to send their wishes as regards accommodation, excursions and social events to the LOC.

7. Receptions and excursions can be organized during a free period within the meeting, or just before or after the meeting. A Guest Programme is usually welcome.

8. Participants should be informed of the reservations made for them and how to reach their hotel or the meeting rooms on arrival.

9. The LOC should provide a Preliminary and a Final Programme, including g useful auxiliary information, to be distributed to each participant at the appropriate time; A list of Participants, produced on about the second day of the meeting is also extremely valuable if it corresponds closely with those actually present.

10. The IAG intends to arrange all the IAG-Symposia, that means the Symposia held during the General Assemblies and the General Meetings of IAG, and the Symposia approved in accordance with point 7 -in a series and so give each of them a number starting with the first IAG-Symposium which will be performed after the 19th General Assembly of IAG, held in August1987 in Vancouver, Canada.

11. The IAG Executive Committee shall recognize also the scientific meetings organized by the Commissions, their Subcommissions, and working groups, and the Special Study Groups of IAG alone or jointly with other international and national groups and bodies at any time outside of the General Assemblies, if they have been approved by the Executive Committee at the advice of the respective Section President in due time before the first announcement. If so the Meeting may be announced as "International Meeting, organized by the ..... of IAG".

Is is not permitted to use the term IAG-Symposium.

12. The IAG is willing to recognize also scientific meetings, organized by national bodies as important scientific event with benefit for the international geodetic community and to sponsor them if the respective meeting shall be open to all bona-fide scientists according to the ICSU Regulations and will be sponsored by one or more Sections, Commissions, or Special Study Groups of IAG and if the organizer shall obey the organisational standard for IAG-Symposia.

These Meetings may be announced as "International Meeting, organized by ....., sponsored by IAG". It is not permitted to use the term IAG-Symposium. Sponsorship by the IAG means only official recognition and does not imply financial support by the IAG. IAG may appoint an official representative to that meeting. IAG expects that the Proceedings of the meeting will be prepared by the local organizers and published within 6-8 months after the end of the meeting.

Applications for sponsorship should be submitted to the Secretary General not later than 18 months before the intended date of the meeting.

13. In its decision about approval and/or sponsorship the Executive Committee takes into account a balanced selection of meetings, a representative coverage of subjects and a good geographical distribution. The IAG intends to avoid duplication, overlapping and undue frequency.

The Secretary General shall publish annually a calendar of future IAG-Symposia and other scientific meetings organized by IAG-bodies or sponsored by IAG in the Bulletin Géodésique.

14. The Executive Committee shall appoint an official representative of the Association for each of the scientific meetings to be governed by these rules. The representative is obliged to watch the way in which the organizer of the meeting obey the IAG Rules for Scientific Meetings and to report about it to the Executive Committee in due time.

IAG Fund

IAG Fund

The IAG Fund aims at supporting specific IAG activities. Its primary goals are:

- to provide travel support for young scientists to attend IAG Symposia and workshops,
- to assist in the organisation of IAG workshops in developing countries, and
- to provid an annual IAG Best Publication Award for young scientists.

The fund was established by the IAG Executive Committee at its meeting in Columbus, Ohio, 1992, see Bulletin Geodesique, Vol. 68, pp. 41-42, 1994.

Contributions were requested from all IAG Fellows with much success, so that already by January 1996 more then $ US 18500 had been received and $ US 2800 have been spend (two best paper Awards and one International Travel Award).

Contributors are divided in 3 groups:

- Presidents Club (cummulative contributions of $ 1000 or more)
- Special contributors (annual contributors of $ 100 or more)
- Contributors (annual contributions of less than $ 100)

At its meeting in Copenhagen, 1995, Mr. R. Forsberg, president Section III, was appointed to lead the fund-raising activities.

The rules for the IAG Best Publication award and for the IAG Travel award for yound scientists are given below.

I wish to contribute to the IAG fund.

Annual basis ☐ One-and-for-all ☐

Amount ☐☐☐

Payment :

Please charge my : Eurocard, MasterCard, VISA, JCB
Card number :

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Expires : ☐☐☐☐

Cheque enclosed ☐

Title : _____

Name : _____

Institution/Department : _____

_____

Address : _____

Country : _____

Phone : _____

Fax : _____

E-Mail : _____

Date : _____

Signature : _____

Rules for the IAG Best Publication Award

Purpose:

To draw attention to important contributions by young scientists in the Journal of Geodesy (previously Bulletin Géodésique and Manuscripta Geodetica) and to foster excellence in scientific writing.

Eligibility:

The applicant must be 35 years of age or younger when submitting the paper for the competition. The paper must present his or her own research, and must have been published in the Journal of Geodesy (previously Bulletin Géodésique and Manuscripta Geodetica) during the previous calendar year. Although multiple authors papers will be considered, single author paper will be given more weight in the selection process.

Award:

The award will consist of a certificate and a cheque of US $ 1000. It will be given annually.

Selection procedure and criteria:

The selection will be made by the voting members of the Executive Committee. It will be based on the importance of the scientific contribution, which may be either theoretical or practical, and on the quality of the presentation. The name of the award winner will be published in the issue of the Journal of Geodesy (previsously Bulletin Géodésique) following the decision.

Rules for the IAG Travel Award

Purpose:

To assist young scientists from member countries to present results of their research at IAG meetings (general meetings, workshops, etc...)

Eligibility:

The applicant must present results of his or her research at the meeting and must be 35 years of age or less at the date of the application. The application must be supported by at least one IAG Fellow or two Associates.

Type of awards:

There are two awards, one for meetings in the applicant's own country, the other for meetings outside the applicant's country. The first group is called **IAG National Travel Award** and has a maximum financial value of US $ 400. It is available for meetings in developping countries. The second award is called the **IAG International Travel Award** and has a maximum financial value of US $ 800. The amounts can occasionally be adjusted by the IAG Executive Committee. Normally, the total number of awards are limited to 10 in any given year.

Application procedure:

Applicants are asked to send their application at least three months before the meeting to the IAG Central Bureau, General Secretary, University of Copenhaguen, Department of Geophysics, Juliane Maries Vej 30, DK-2100 Copenhaguen 0, Denmark. As a minimum, the application should contain: title, authors, and abstract of the paper to be presented, acceptance by the organizing committee (if available), travel budget and sources of additionnal funding. The letter(s) of support (one IAG Fellow or two Associates) should be sent separately and should be in a sealed envelope.

Selection procedure and criteria:

Selection of applicants will be done by the IAG Bureau. It will be based on the letter(s) of support and the applicant's ability to actually attend the meeting. Priority will be given to candidates from developping countries.

Additional benefits:

The IAG will encourage organizers of meetings to waive registration fees for all IAG Travel award winners.

PRESIDENTIAL ADDRESS

International Association of Geodesy
XXI IUGG General Assembly
Boulder, Colorado, July 1995

by Wolfgang Torge

Distinguished Guests,
Dear Colleagues,
Ladies and Gentlemen,

I have the honour to welcome you at the opening of the IAG General Assembly, which our Association traditionally holds within the frame of the IUGG General Assembly. I should like to especially welcome the President of the International Union of Geodesy and Geophysics, our colleague Professor Helmut Moritz, and the President of the International Union of Surveys and Mapping, Mr. Earl James, who is also the President of the International Federation of Surveyors. My greetings also go to the representatives of our sister organizations, united in the IUSM.

I should like to also inform you that our Honorary President Professor Bomford will reach the age of 96 years this week and I propose to send a message of congratulation to him. I now come to the Presidential Address, which will report on some major accomplishments of IAG, achieved during the last four years. In addition, I shall try to indicate some future tendencies and actions.

But at first it is my duty to remember our friends who left us since the last General Assembly. We lost

Richard Anderle, USA
Arpad Czobor, Hungary
Czeslaw Kamela, Poland
Georges Laclavère, France, Secretary General of IUGG from 1951 -1963
Mikhail Sergevich Molodensky, Russia
Gabriel Obenson, Cameroon
Leonard Pavlovich Pellinen, Russia
Avraam Perelmuter, Israel
Donald A. Richardson, USA
Karl Rinner, Austria
Ove Simonsen, Denmark
Charles Whitten, USA, IAG-President from 1963 to 1967
Helmut Wolf, Germany, and
Tadeusz Wyrzykowski, Poland.

May I ask you to stand up for a minute of silence to honour the memory of our colleagues. Thank you.

Let me now make a few notes on the historical relation between the IAG and our host country. As you know, IAG has its roots in the "Mitteleuropäische Gradmessung", established in 1862 in Central Europe. The extension to the International Association of Geodesy occurred in 1886, and a significant break-through towards a global international organization happened, when the United States of America joined IAG in 1889. An Act of Congress (21.2.1889) authorized the President of the United States to appoint a delegate to the Association, and at the General Conference in Paris, in October 1889, the U.S. Delegate George Davidson, Assistant U.S. Coast and Geodetic Survey, brought kind greetings and expressed the "conviction that (the Association's) views will grow with the breadth of the new world before it." A detailed report about the geodetic activities in the United States followed, including the manifold work along the 39th parallel. Since that time, the United States have been a very active member of IAG, as demonstrated by the

Presidents William Bowie (1920 - 1933),
Walter D. Lambert (1946 - 1951),
Charles Whitten (1960 - 1963), and
Ivan Mueller (1987 - 1991),

and IUGG/IAG General Assemblies held in Washington (1939) and in Berkeley (1963). Taking the

outstanding contributions of the United States to Geophysics and Geodesy into account, it was certainly high time to meet again in this country.

I now come to the scientific achievements over the last period. These achievements are of course due to the work of the individual scientists, who engage themselves in IAG bodies as Sections, Commissions, Special Study Groups, Services and projects, and the next two weeks will demonstrate in detail their activities and results. Having with the five sections a very strict scientific structure, it is only justified if the Section Presidents later at this opening session shortly inform about highlights of their work. Nevertheless I should like to make a few more general statements about the present state of geodesy, and in this connection also refer to some new or successfully continued IAG activities.

If we classify the fundamental geodetic tasks into reference systems, positioning, and gravity field modelling, we first have to recognize that the observation techniques now approach or have reached the 10^{-9} accuracy on global and regional scale, and that modern data acquisition systems allow a very high time sequence of the observations. In addition, kinematic survey methods system more and more govern geodesy employing artificial satellites as well as airborne and land vehicle systems. This progress in technology has raised many problems and posed partly unexpected challenges. IAG by coordinated efforts tried to promote the study of those problems, especially through international cooperation. Important research areas can be read off from the present IAG structure, and include a much more refined functional modelling of geodetic observations into geodetic parameters, taking the increased accuracy and time variations into account, and extending those models to kinematic methods, a deeper understanding and modelling of the observational errors at high data rates, taking non-random effects and frequency dependence into account, new studies of the geodetic boundary value problem, under the aspect of available space data, as well as improved models of the upper layers of the Earth, design problems of geodetic fundamental and geodynamic networks, combining different observation techniques, interpretation of global regional and local geodetic data within the frame of geophysical models and jointly with geophysical data sets, from the static and the dynamic point of view.

Let me mention - without any completeness - some of the overall IAG activities, generally with interdisciplinary character, and including collaboration with other scientific bodies:

The International Earth Rotation Service (IERS) continued to work with great success as a joint enterprise of IUGG and IAU since 1988. Providing the basic reference frames by employing advanced space methods, the evaluation and interpretation of the results has brought an enormous progress at our understanding of the kinematic and dynamic behaviour of the Earth, and linked together practically all fields of IUGG, with astronomy and space research, at continental dimensions, reference frames are under construction, fitting into the IERS frame and employing GPS-techniques. These activities more strongly connect geodesy to cartography and surveying, and - in general - to all kind of geoinformation systems. Examples of this type of work are the European Reference Frame now extended to Eastern Europe, and the SIRGAS project in South America, both running in close cooperation with the national Geodetic Surveys, the International GPS Service for Geodynamics started routine work on January 1, 1994, and proved to be extremely successful. In close cooperation with the IERS, well - accepted products are provided to users in high - precision and in practical geodesy. Especially, the IGS represents an efficient tool, to monitor the local and regional strain-field of the Earth, as an important boundary-condition in geodynamics research.

I should like to thank here all the individuals and agencies involved in IGS, and as representatives I mention Gerhard Beutler, the Chairman of the IGS Governing Board, and Ivan Mueller, who initiated the Service, the ad-hoc planning group on Global Change, established after Vienna and chaired by Jean Dickey, identified IAG related problem areas, and succeeded to link geodesy to the International Geosphere-Biosphere-Program, within the Core-Project "Land-Ocean Interactions in the Coastal Zone", the International Geoid Service, located at Milano, is operational since 1992, and provides effective support to individuals and agencies, involved in geoid determination, while Regional Subcommissions as for Europe and South America push forward calculations on a continental scale, the links to our sister organisations have been strengthened through our involvement in the International Union of Surveys and Mapping (IUSM). IAG could contribute to the IUSM Working Groups on GPS, on Engineering, on Education, and on Geographical Information Systems, and joint meetings on the first three topics will be held here in Boulder, finally, I mention one outcome of our active GALOS group, chaired by Petr Vanicek, which is the establishment of an IHO (International Hydrographie Organization) / IAG Advisory Board on Hydrographic and Geodetic Aspects of the UN Convention on the Law of the Sea.

Research work done and results obtained, again have been discussed and documented in scientific meetings sponsored by IAG, and in the IAG related publications. Following our tradition, IAG sponsored

more than 30 symposia, workshops, summer schools and seminars, during the past four years. We were happy to again have a General Meeting between the General Assemblies, in 1993 in Beijing, with six dedicated topics, and a strong emphasis on the contribution of geodesy to global change problems. Let me thank again our second Vicepresident Dr. Chen, who was responsible for the organisation of the successful meeting. We tried to also offer an interesting palette of topics at this General Assembly, with strong emphasis on interdisciplinary aspects. As you have recognized from the program, IAG is involved in 6 Union Symposia and 13 Inter-Association Symposia, convening 2 respectively 3 of them. In addition, we shall have 3 IAG-Symposia, 4 Intersection-Symposia, and the 5 section meetings. We already have proposals for a number of symposia to be held in the next period, and we especially have received invitations from Brasil and from Australia, to hold the next "General Meeting", which we shall call now "Scientific Assembly" in those countries in the year 1997.

For internal communication and discussion, but also for showing up geodetic research results and geodetic products to the outside world, IAG has different possibilities and we also had some progress in this field. First of all, I can announce here, that the two journals "Bulletin of Geodesique" and "manuscripta geodaetica" will unite on January, 1. 1996, and a "Journal of Geodesy" as the official journal of IAG will be published then at Springer publisher, with one issue per month. Let me thank here the two chief-editors of BG and mg, Christian Tscherning and Petr Vanicek, as well as the Editorial Board of Bg/mg for their engagement. A report will be given here by Christian Tscherning. Another effort to document the IAG work are the IAG Symposia Proceedings started in 1989. Up to now 13 volumes have been published, one is in press and two more are planned as an outcome of this General Assembly. We continue of course with the "travaux" or "proceedings" of the General Assemblies, and with the IAG-Newsletters, in our new Journal. The Central Bureau has established an IAG Information Service on Internet, with a large variety of interesting details about IAG. I should like to thank the IAG Assistant Secretary Pascal Willis, for his hard work in order to establish and improve the Newsletters, the Information Service and the Travaux, as well as for his other manifold activities. I should also mention, that a number of IAG bodies regularily publish their information bulletins, thus very efficiently contributing to the exchange of ideas and the progress in the corresponding research field. Thanks to all the responsible editors for their strong engagement

I now come to an item, where IAG, and this is the total of scientists affiliated to IAG, can be especially proud of. As you know, we have introduced in Vienna 1991 the categories of IAG Fellows and Associates, in order to create a more personal relation of individuals to our Association. About 200 Fellows and more than 1000 Associates have by now declared their affiliation to IAG. In 1993, the IAG President started an initiative to establish an IAG Fund, by voluntary contributions from the Fellows, and later also from the Associates. This action was extremely successful, and I very warmly thank all the contributors for their immediate positive reaction. The Fund is managed completely independent from the IAG budget and the Fund's reserves are only used for three dedicated purposes, which are an annual best paper award for young scientists, and the award winner for 1993 and 1994 will be announced later, a travel award for young scientists and among the about 15 scientists supported for attending this General Assembly, four have received support from the Fund, the support of IAG workshops in developing countries, and planning is underway, to organize and support such a workshop within the next years.

My thanks go to the 1. Vicepresident Klaus-Peter Schwarz and to Ivan Mueller, who took over the efforts of the Fund raising. IAG feels a special responsibility to promote geodetic activities in developing countries as explicitely stated in the IAG Statutes. Although progress is slow, some positive records can be given here. A number of symposia either took place in third world countries, or concentrated on geodetic problems in that areas. As examples I mention the Symposium on Geodesy in Latin America in Vienna 1991, and the forthcoming Symposium on South East Asia, to be held here in Boulder, as well as Symposia or Workshops in Maracaibo, Bali, Lagos and Nairobi held between 1992 and 1994. A successful enterprise was the establishment of a Committee for Developing Countries in 1992, chaired by our Honorary Secretary General Michel Louis. With the Courier for Development, this group has remarkably improved the information lines and triggered new activities. Coming to projects, I should like to mention the extremely well running SIRGAS project, jointly sponsored by IAG, PAIGH, and DMA, with the intention to establish a zero order reference system in South America, and to tie the national control nets to that system. I should like to thank here especially the SIRGAS president Ing. Fortes from Brazil. Another example is the Geoid Subcommission for South America, which started in 1994, and gives another example how regional activites within the frame work of our commissions can promote geodetic activities from the scientific as well as from the application point of view.

Looking forward, I try to identify a few areas of future activities, at developping internal IAG-

structures, as well as relations to geosciences, engineering and the field of geoinformation systems:

The IAG structures will be again revised and adapted to the new requirements, by the Cassinis-Committee set up here in Boulder. The Committee certainly has to evaluate if the present structure has to be modified, but also how IAG could react more flexible to challenges from the outside, and trigger initiatives in geosciences. I remind you that a "Cassinis Forum" will take place on Monday, 9. July, in the evening 19.00, and I invite you to discuss then the problems existing and to collect ideas about the future of IAG, IAG certainly should try to even more involve young people. There is again one chance here at the Assembly: The "old boys" should identify qualified young people, and include them into the IAG work, especially into the Special Study Groups. The youngsters on the other hand, should actively bring in their ideas and enter into the IAG bodies, they can and must stimulate our Association, IAG should continue and strengthen its activities with respect to developping countries. I think, that the establishment of regional subcommissions for dedicated tasks as geoid determination is one adequate tool in that direction. Another one is the joint realization of projects, and of course symposia and workshops related to problems in those regions should be supported even more.

Obviously, the promotion of young scientists and the support of activities in developping countries strongly depends on the financial basis. Under that point of view, IAG should improve and extend its services, and in that way directly or indirectly involve young scientists, and scientists from developping countries in IAG work, and continue the building-up of an individual feeling of an "IAG-membership", through the Fellows and Associates. The IAG Fund has opened a chance to remarkably strengthen our support, and more than 1000 affiliates even by a small annual contribution could significantly contribute.

I now come to the announcement and lending of some IAG awards. As I mentioned earlier, one outcome of the IAG Fund is the IAG Best Paper Award for Young Scientists with the purpose to draw attention to important contributions in the Bulletin Geodesique or manuscripta geodaetica, and to foster excellence in scientific writing. For the year 1993, the award is given to Dr. Hussein Abd-Elmotaal. Born in Cairo in 1960, he studied at Ain Shans University and at Graz University of Technology, and he is now Assistant Professor at Minia University, Egypt. He receives the award for his paper "Vening Meinesz Moho depths: traditional, exact and approximated", published in manuscripta geodaetica vol. 18, no. 4, 1993. For 1994, the award winner is Dr. Jean-Pierre Barriot. Born in 1959, he studied at Montpellier University, and held postdoctoral research positions at the French Space Agency and at Jet Propulsion Laboratory. He is now research engineer at CNES in France. The award is given for his paper "Line of sight operators in planetary geodesy", published in manuscripta geodaetica, vol. 19, no. 5, 1994.

I am now going to announce the award of the Levallois medal. This medal was established by IAG in 1979, to honour our former Secretary General and his outstanding contributions to IAG. The award is made in recognition of distinguished service to the Association, and/or to the science of geodesy in general. I have the great honour to inform you that the Nomination Committee proposed, and the Executive Committee confirmed, that the Levallois medal shall be awarded to Professor Willem Baarda. Prof. Baarda worked for several decades at the Technical University at Delft, Netherlands, and the results of his research strongly influenced geodesy. He was the first to develop a systematic framework of statistical quality control, including the famous "data snooping". He also firstly introduced criterion matrices for testing a network precision, and invented the reliability concept, now at widespread use. Finally, I mention the invention of the S-transformations, nowadays employed at "free network" adjustments. Some of Prof. Baarda's publications from the 1960's and 1970's belong to the fundamental literature in geodesy. Just a few days ago, I even received a new basic publication from Prof. Baarda, related to the coupling and interaction between geometric and physical geodesy. Prof. Baarda received many honours, and he is a member of several scientific academies. For IAG he served as a member of the Cassinis Committee, as the Chairman of Special Study Groups on Networks and Statistics, and as a member of the Commission on Education.

Through the Levallois medal, IAG recognizes the outstanding scientific contributions of Prof. Baarda to geodesy, and especially expresses its gratitude for his service to IAG. Unfortunately Prof. Baarda could not attend the General Assembly, but the Netherlands Geodetic Commission and Delft University will organize an appropriate event within the next few months, and I then shall hand over the medal to him.

And now, last not least, I come to the Bomford Prize. This prize was inaugurated by IAG in 1975, and it is given at four years intervals, to a young scientist for outstanding theoretical or applied contributions to geodetic studies. Five very qualified young scientists have been nominated by the National Committees, and after a careful review process, the Prize Committee decided to award the Guy Bomford Prize 1995 to Professor Thomas A. Herring. Dr. Herring was born in 1955 in Cooroy/Queensland, Australia. He was

educated at the University of Queensland, with a Bachelor and Master Degree in Surveying, and at the MIT, with the Ph. D. Degree. His scientific carreer includes positions at the University of Queensland and at Harvard University, and he is now Associate Professor of Geophysics at the Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology. From his many professonal activities I mention his engagement in IAG research groups on atmospheric refraction, and on the application of space-based interferometry, in the IAU Working Group on Astronomical Standards, and in Committees or panels of the National Academy of Sciences, NASA, and AGU.

Tom Herrings career has been marked by leadership in the use of space-geodetic measurements to study the properties of the Earth. His first paper established the ability of VLBI to measure continental baselines with cm precision. Five years later, he and his colleagues published the first conclusive evidence from VLBI of plate motions. The improved analysis of VLBI data also led to an empirical nutation model which is currently used at the IERS. In the past four years, Tom Herring continued his VLBI studies, but now also made important contributions to GPS measurements of global and regional geodynamics, and demonstrated that earth rotation variations can be derived from GPS. An outstanding example for combination techniques developed for time series of heterogeneous data sets is the determination of the velocity field for Southern California from VLBI and GPS observations spanning eight years. By combining a critical understanding of the inherent deficiencies in space-geodetic measurements with a vision of their potential accuracy, Tom Herring has consistently pushed the analyses to higher levels, based on his fundamental knowledge of geodetic observations, Earth models, and Astronomy.

IAG is proud to award the famous Bomford Prize to you, Dr. Herring.

Let me conclude the Opening Ceremony by reminding you that our old and still young Association depends on all of you, on your engagement, on your positive criticism, and on your proposals for the future direction. Looking back on four years of office, I am optimistic that IAG is able to renew itself continuously, and this optimism is based upon the support and the input I had during the last four years from so many colleagues. I have mentioned some of them already, but I especially want to thank the Bureau members and the members of the Executive Committee, as well as all the IAG officers: I enjoyed the work with you. Sincere thanks have to be expressed to the Institut Géographique National of France, which hosted the IAG Central Bureau over more than 70 years, and to all the Secretary Generals and Assistant Secretaries, who served IAG over this time span. Let me especially thank Jean Dickey, our representative at the Organizing Committee: you did an excellent job at the organization of this very complex event. I wish you all an interesting meeting, with fruitful discussions, getting new ideas for the future work, finding new friends, and strengthening the relations within our Association, the IAG, and to our sister organisations.

I now declare the IAG General Assembly to be opened.

Laudatio for Prof. Baarda

on the occasion of presenting the Levallois Medal
Delft, 17. November 1995
by Wolfgang Torge, IAG Honorary President

Levallois Medal 1995 for Professor Willem Baarda

At the XXIst IUGG General Assembly held in Boulder, Colorado, July 1995, the IAG Levallois Medal has been awarded to Professor Willem Baarda in recognition of distinguished service to the Association and to the science of geodesy in general. This was announced by the IAG President at the opening ceremony of the IAG General Assembly on July 3rd, 1995. The Netherlands Geodetic Commission organized an afternoon event on November 17th 1995 at Delft University of Technology, where the Levallois Medal was presented to Professor Baarda by the past IAG President Wolfgang Torge, in conjunction with an invited lecture entitled "The development of the geoid concept and its realization in Europe -200 years of international collaboration". The laudatio for Professor Baarda is printed below.

Mr. President of the Netherlands Geodetic Commission,
Dear Professor Baarda,
Dear Colleagues of the Dutch Geodetic Community,
Ladies and Gentlemen,

in 1979, the International Association of Geodesy established the award of the Levallois Medal, in order to honour our former Secretary General and his out-standing contributions to geodesy. The award is made in recognition of distinguished service to the Association, and/or to the science of geodesy in general. The medal shall be normally awarded at four year intervals, on the occasion of the General Assemblies of the International Association of Geodesy and the International Union of Geodesy and Geophysics. Between 1979 and 1991, the award was given to Charles Whitten/USA, Rudolf Sigl/Germany, Arne Bjerhammar/Sweden, and Paul Melchior/Belgium.

In 1994, the IAG again set up a Nomation Committtee consisting of the IAG Honorary Presidents. The committee proposed, and the IAG Executive Committee confirmed that the Levallois Medal 1995 shall be awarded to Professor Willem Baarda. This was announced by the IAG President at the opening ceremony of the IAG General Assembly in Boulder, Colorado, on July 3rd, 1995. As Professor Baarda could not attend the General Assembly, I am glad and grateful that the Netherlands Geodetic Commission organized this afternoon's event, thus giving me as the IAG past President the opportunity to personally present the medal to you, Professor Baarda.

It is in no way possible within our limited time frame to review here in full detail all your scientific work over nearly 50 years and your contributions to geodesy and surveying engineering. This was done comprehensively at the celebration of your 65th anniversary, and I shall limit myself here to only recall some highlights of your major scientific achievements, and your engagement in IAG.

You were the first to develop a systematic framework of statistical quality control for geodesy, and the famous "data snooping" among others, since many years is part of testing procedures applied in geodesy and surveying. You firstly introduced criterion matrices for testing a network precision, and you invented the reliability concept, now at widespread use. I also mention the invention of the S-transformations nowadays employed at "free-network" adjustments. At the end of the 1970's, you even extended your broad field of interest, looking from a very profound point of view closer on the links between geometric and physical geodesy. The coupling and interaction between those two sides of the same coin, which for many decades were considered rather separately, again is the topic of your most recent publication. Looking through the geodetic literature, we easily recognize that your work is part of the fundamentals of our science,

and that in addition many of your concepts entered into all fields of the practice of our profession, providing a more solid basis and offering new possibilities for our engineering tasks. This is also in line with the more recent IAG policy to intensify our relations to the sister organisations in the field of engineering and cartography, in addition to our scientific and organisational links to the Earth sciences.

This brings me to Prof. Baarda's services for IAG. It was a fortune for the Association that already in the 1950's you not only engaged yourself in FIG, but also in IAG. Thereby you followed the great tradition of Dutch geodesists, who until today contribute significantly to the Association's work, since the Netherlands from the very beginning participated in the discussions on the "Mitteleurop!ische Gradmessung", and in 1865 officialy joined this organisation. With the names of van de Sande Bakhuyzen, Secretary General between 1900 and 1916, and Vening Meinesz, President between 1933 and 1946, two outstanding representatives of the Netherlands must be mentioned here, who especially succeeded to not only maintain the idea of international cooperation during wartime but also to manage the continuation of important services.

Prof. Baarda, first of all, engaged himself in several IAG Special Study Groups. These Groups represent the forefront of the Association's scientific work, and your membership in the SSG's on "Numerical Computations of Large Triangulation Networks", "Computer Techniques in Geodesy" and "Mathematical Structure of the Gravity Field", as well as your long (1963 - 1979) chairmanship of the SSG on "Statistical Methods as applied to the Specification of Networks" clearly reflect your main research areas, but also the intention to implement scientific achievements into practical work. As a member of the IAG "Continental Networks" Subcommission you contributed to the long standing IAG attempts to unify the geodetic systems in Europe, thus also demonstrating to other regions of the world how to transfer scientific and technological progress into operational systems, by exploiting international cooperation and organisation.

As a highly engaged University Professor, IAG also benefitted from your engagement in the Commission on Education, where you brought in your enthusiasm and skill in teaching. Last but not least I mention your membership in two Cassinis Committees. Every 8 years, this Committee shall review the structures of IAG and propose eventual changes to the Executive Committee and to the Council, thus securing a continous revision and renewal of our Association. You worked in the first (1960 - 1963) and in the second Cassinis Committee, when important decisions about the IAG reorganisation were made, and thus contributed in keeping our Association vivid.

Through the Levallois Medal, IAG honours your outstanding scientific contribution to geodesy and expresses its gratitude for your strong engagement in our Association.

I have the great pleasure and honour, to hand over now the Levallois Medal and the related certificate to you, Professor Baarda. The certificate reads:

The International Association of Geodesy awards
the Levallois Medal

to

Professor dr. ir. Willem Baarda
in recognition of distinguished service to the
Association and the science of geodesy in general

XXIst IUGG/IAG General Assembly,
Boulder, USA, July 1995

Wolfgang Torge, IAG-President.

I congratulate you personally and on behalf of the IAG Bureau and the Executive Committee, to this award, and I connect this congratulation with the best wishes for your future.

Bomford Prize Acceptance

by T.A Herring

IUGG President Moritz, IUSM President James, IAG President Torge, IAG Secretary Boucher, colleagues, it is a great honor to receive the 1995 Guy Bomford Prize. Tradition has it that I speak of my research, and although at times I feel my whole career can be summarized in ten minutes, I would like to review the spectacular progress geodesy has made in the past decade and to comment on its future directions. My research has been focused on the geophysical applications of geodesy and much of this research has been made possible by the advent of space-based geodetic systems.

There has been a dramatic evolution in geodetic measurements in the past three decades with approximately an order of magnitude improvement in precision and accuracy per decade since the early 1970s when meter level baseline results were first obtained. By the early 1980s, ten-centimeter precision baseline determinations over intercontinental distances were being reported, and by the early 1990s, measurements of these lengths with 1 cm precision were common. We are currently well on our way to 1 mm precision determination of intercontinental positions even now in mid-decade. Two examples of the accuracies that can be achieved are illustrated in the Figures 1 and 2.

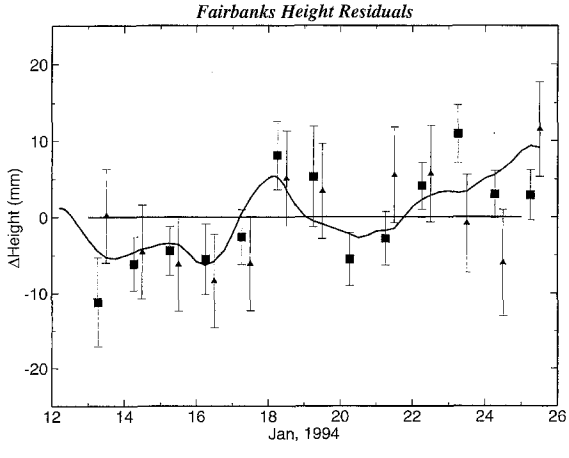

Figure 1: Estimates of the height at Fairbanks, Alaska, determined with VLBI (squares) and GPS (triangles). Both results are shown with one standard deviation error bars. The solid line is the expected height variations from atmospheric pressure loading computed from local pressure and assuming an admittance of 0.5 mm/mbar (coefficient from vanDam and Herring, Detection of atmospheric pressure loading using very long baseline interferometry measurements, *J. Geophys. Res., 99,* 4505-4518, 1994).

In Figure 1, estimates of the height at Fairbanks Alaska are shown determined by very long baseline interferometry (VLBI) and the global positioning system (GPS). The correlation between these estimates is evident but even more remarkable is that these variations are also correlated with the variations expected from the elastic deformation of the Earth due to atmosphere pressure changes. Modern geodesy has already reached the stage where temporal variations of stations positions (other than those due to tides and plate tectonics) have to be considered to fully exploit the accuracy of modern systems. Of even more importance are the methods used to judge the accuracy of geodetic systems. In the case of Figure 1, the height variations, if measured with only one measurement system could be considered to be noise, and the error budget of the system set so that variations of this type would be considered to be an unknown, temporally correlated noise source. If this process is followed, with no consideration of these variations being actual signal, then signals of this type will always be below noise level of the measurement system. But it is also clear that there are unmodeled noise sources and therefore all variations are not necessarily signals. Thus with modern geodetic systems, it would seem critical that the noise in the measurements be assessed independently of our perceived notions of the nature of the geodetic results. The only way to do this is ensure that the noise contributions from each part of the geodetic system are understood and quantified. The "art" of the modern geodetic analysis is to separate the noise from signals

without artificially turning signals into noise and visa versa.

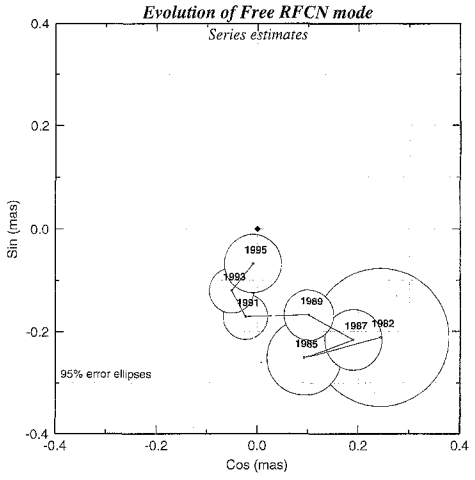

Figure 2: Time evolution of the free excitation of the retrograde free-core nutation (RFCN). The estimates are made in two year intervals except for the interval 1979-1983 which was estimated as one interval (due to the lower accuracy data collected during that interval. The reason for the decay of the free excitation is not clear at the moment especially since the primary excitation mode is thought to be global average diurnal pressure changes [Sasao and Wahr, An excitation mechanism for the "free core nutation", *Geophys. J. R. Astron. Soc., 64*, 729-746, 1981.]

The second case shown, Figure 2, is another example of temporal dependence of geodetic results. In this case, we have no other independent means of assessing the accuracy of these results. Here we must rely on knowing the individual contributions to the error budget. Analysis of the data under different scenarios can also be used to judge the significance of the results. (For example, estimates of time dependence of signals close in frequency to the RFCN mode do show variations of the magnitude seen in Figure 2.)

Fifty years ago, geodesy was determining the size and shape of the Earth. We are now able to monitor its secular changes and soon we will be reliably detecting and hopefully interpreting non-secular motions. In some senses it is amazing how stable the Earth is given that we know the planet can sustain tens of centimeter deformations daily due to Earth tides (strain rates of 10^{-12} per second) and the geological record shows strains of up to 50% occurring over intervals of millions of years (10^{-15} per second). Modern geodetic systems are approaching the point where strain rates of 10^{-14} per second can be measured with one day of data. Given the Earth can accommodate strain rates two order magnitude larger than this, it is curious that the observed non-secular variations are so small.

I would be remiss not to mention colleagues who have helped so many times of the years. Modern geodesy is (and I think has to be) a collaborative effort. I would like to thank my early mentors Mete Nakiboglu and Irwin Shapiro; my colleagues at MIT and the Harvard-Smithsonian Center for Astrophysics that provide a unique combination of geodesists and geophysicists, Bob King, Brad Hager, Rob Reilinger, Peter Molnar, Clark Burchfiel and Jim Davis. I would also like the acknowledge the assistance of colleagues at Scripps Institution of Oceanography, Yehuda Bock and Fang Peng; Goddard Space Flight Center, Tom Clark, Chopo Ma, and Jim Ryan; the Jet Propulsion Laboratory, Mike Watkins and Mike Heflin; the University of Berne, Gehard Beutler and Marcus Rothacher; and the University of Texas, Bob Schutz.

Guy Bomford must be impressed with modern geodesy but in many respects there is still much we need to learn. Geodetic systems have produced some spectacular results but we have still not exploited their full potential either in measurements or their interpretation. However, I am confident that we will continue to see breakthroughs in both these areas.

XXIth IAG General Assembly
Report of the Secretary General

Claude Boucher

The Secretary General of the International Association of Geodesy is pleased to submit to the XXIth General Assembly his report on the activities of the Association for the period between the XXth and the XXIth General Assemblies.

In accordance with the Statutes and By-Laws, the Secretary General reports on the administrative and financial affairs, the President reporting on the scientific work of the Association.

I- *Administrative activities of the Association*

During the past period the main features of the administrative activities were: (i) meetings of the Bureau and Executive Committee where decisions were taken on future actions of the Association and (ii) publication of scientific and administrative information.

I.1. Meeting of the Executive Committee

During this period the Executive Committee met twice:

- in Columbus,Ohio in March 1992,
- in Paris, in March 1994

and the Committee, reduced to the Bureau and the Presidents of Section, also met in Paris in March 1995. All those meetings were prepared by meetings of the Bureau. Some other meetings were held meantime, in particular during the Beijing General Meeting in August 1993.

The detailed reports of these meetings were published in the IAG Newsletter which appears at the end of each issue of the Bulletin Géodésique. . Large parts of those meetings were devoted to the preparation of the General Meeting, Beijing, August 1993, and of the present General Assembly.

A new important point was to establish the concept of IAG affiliates in accordance with our new regulations. This procedure was rather succesfull :presently we can count 190 Fellows and 1173 Associates.

Also the establishment of a IAG Fund was decided to provide travel support to young scientists, to give each year a best paper award for young scientists and to help to organize workshops in developing countries.

I.2 Publications

I.2.1. **Bulletin Géodésique** - This is the official journal of the IAG which is published since 1991 January 1st by the German publishing company, Springer Verlag, following an agreement between them and us. This company also publishes manuscripta geodaetica.

IAG, Springer Verlag and the editors of Manuscripta Geodaetica spend efforts towards a complete merging of both journals. This has been reached through a new formal agreement:from January 1996, a unique journal will be published under the name of Journal of Geodesy. This journal will be in particular the continuation of the Bulletin Géodésique.

The Bulletin Géodésique also included the IAG Newsletter in each of its four annual issues. This Newsletter was edited by Dr Pascal Willis, IAG Assistant Secretary and contained a number of useful informations about IAG activities,symposia announcements and reviews, book reviews,bibliography..;

I.2.2. **Geodesist's Handbook** - The next Geodesist's Handbook will be published by Springer

Verlag in 1996 in place of one regular issue of the new Journal of Geodesy (formerly Bulletin Géodésique). This publication is now well appreciated by geodesists and non-geodesists, but it must be available early after the General Assembly to keep its interest. Dr Pascal Willis has agreed to act as the editor of this forthcoming issue .

I.2.3 Travaux de l'Association Internationale de Géodésie

Volumes of the Travaux will continue to be published by the Central Bureau of IAG. They contain the quadrennial reports concerning the activities of Sections, Commissions, Special Study Groups, Bureaus, and other Permanent Services, with the relevant bibliography. Dr Pascal Willis will be also the editor of this forthcoming issue and has already sent specifications to collect in due time individual reports from authors in word processor format.The target is to publish this volume in fall 1995.

I.2.4. Publication of Symposia Proceedings

According to the new editing policy the Proceedings of IAG Symposia are now published by Springer Verlag. This new procedure was already used for the publication of several Symposia (101 to 108).The following ones has been published since Vienna:

109 Permanent Satellite Tracking Networks for Geodesy and Geodynamics, Vienna,1991

110 From Mars to Greenland: charting gravity with Space and Airborne Instruments, Vienna,1991

111 Recent Geodetic and Gravimetric Research in Latin America, Vienna,1991

112 Geodesy and Physics of the Earth, Potsdam,1992

113 Gravity and Geoid, Graz,1994

114 Geodetic Theory Today, L'Acquila, 1994

For the other Symposia and Workshops which are only sponsored by the IAG or which are organized by IAG bodies (such as meetings of commissions or SSG) the organizers are free to choose their own publishing agency. They are however requested to have the proceedings published early after the Symposium and to inform the Central Bureau.

I.3. IAG Information System

An IAG Information System (IAGIS) has been established and maintained by the Central Bureau since 1992. This system includes informations on various topics of potential interest which were partly existing in the Geodesist's Handbook:

-directory of addresses which was permanently updated and includes more than 1800 items
- geodetic data centers
-educational institutions
-symposia related to Geodesy
-bibliography
-IAG and IUGG structures

Other topics are under consideration (standards,campaigns and projects,datums and coordinate systems)

This IAGIS is available on Internet since end 1993.This service also includes a forum for IAG sections and IAG Newsletters. Finally a series of IAG Mails was also initiated by the Assistant Secretary who was also manager of this system.

I.4. Scientific meetings

I.4.1. **Symposia and Workshop** - The list of these meetings sponsored by the IAG is given in Appendix A. One can note the large variety of topics treated and the effort towards a good geographical distribution. I must insist again on the necessity to receive from the organizers information in due time on announcement, report and publication of proceedings.These informations are redistributed as soon as possible by the Central Bureau through the IAG Newletter or IAGIS.

I.4.2. **General Meeting** - Such a meeting was held in Beijing, August 1993, it was the third General Meeting of IAG after the first one in Tokyo, May 1982 and the second in Edinburgh, August 1989. As the previous ones, this meeting was a real success with a very active participation of geodesists from all continents.

II-Finance

The financial report for the period 1991-1994 is presented in Appendix B. The following comments may be added :

II.1. Receipts

The receipts were stable from subvention point of view. The incomes from sales of publications considerably decreased even when excluding BG.

II.2. Expenditures

The expenditures were close to what was predicted with some significant differences:

The administrative expenses decreased globally with regards to the previous period but changed in nature:

- decrease of personnel item thanks to IGN support
-postage and communication (including Internet subscription) paid by IGN
-significant increase of travel supports for Executive or Bureau meetings; it is clear that it is more difficult for IAG officers to get funds from their own country so that IAG has to increase its support.

There was also a decrease of support to meetings, but partially due to accont reports for 1995. Also the role of IAG Funds has to be considered.

II.3. IAG Funds

An other initiative was to establish the IAG Fund by collecting voluntary contributions from IAG affiliates. Since 1993, more than 100 individuals have contributed to a global amount of 17 000 US $.

II.4. Bomford Prize

Dr.Thomas Herring was declared the winner of the Bomford Prize 1995 by the IAG Bureau, on the recommendation of a review committee consisting of the Presidents of Section. A cheque of 2000 US $ will be presented to him during this session. The significant increase of the amount was decided in order to maintain the Bomford prize as the major recognition from IAG, especially with regard to the Best paper Award.

The accounts concerning the Bomford Prize are included in Appendix B.

Now it is time to conclude. This is the first and last report that I am pleased to present you as Secretary General of the Association. Various considerations has pushed me as well as my colleague Pascal Willis not to prepare a new proposal for General Secretary and Central Bureau. I wish good luck to our successors . In spite of the termination of this tradition to have the Secretariat in France, I want to ensure you that we shall do our best to continue to serve IAG.

Appendix A

1st International Symposium on applications of Geodesy to Engineering, (IAG) Stuttgart (Germany) May 13-17 1991

6th International Symposium on Satellite Positioning, Columbus (USA) March 17-20 1992

1st Continental Workshop on the Geoid in Europe Prague (Czechoslovaquia) May 11-24 1992

Symposium on Refraction of transatmospheric signals in Geodesy, The Hague (Netherlands) May 19-22 1992

International Summer School of Theoretical Geodesy "Satellite altimetry in Geodesy and Oceanography" Trieste (Italy) May 25-June 6 1992

International Workshop on GPS in the Geosciences, honouring Prof. George Veis Chania (Greece) June 8-10 1992

1st International Conference on Geodetic aspects of the Law of the Sea Bali (Indonesia) June 8-11 1992

COSPAR/IAG Meetings during the COSPAR Meeting Washington (USA) August 31-September 5 1992

IAG Regional Symposium on Recent Crustal Movements in Europe Szekesfehervar (Hungary) August 31-September 4 1992

IAU/IAG Symposium on Development of Astrometry and its impact on Astrophysics and Geodynamics, Shanghai (China) September 14-19 1992

3rd Orlov Conference "The studt of the Earth as Planet by methods of astrometry, geophysics and geodesy" Odessa (USSR) September 21-26 1992

7th International Symposium on Geodesy and Figure of the Earth (IAG 112) Potsdam (Germany) October 5-10 1992

IAG/PAIGH International Conference Cartography Geodesy Maracaibo (Venezuela) Movember 24-December 4 1992

IGS Workshop Bern (Switzerland) March 24-27 1993

IERS Workshop Paris (France) May 2-6 1993

EUREF Symposium Budapest (Hungary) May 17-19 1993

12th International scientific Symposium on Earth Tides Beijing (China) August 3-8 1993

IAG General Meeting;Beijing (China) August 8-15 1993

1st International Symposium on Mathematical and Physical Foundations of Geodesy Stuttgart (Germany) September 7-9 1993

International Workshop on Geodetic techniques in Crustal Movement and Deformation studies Lagos (Nigeria) October 18-22 1993

8th International Symposium on Recent Crustal Movements Kobe (Japan) December 6-11 1993

3rd Hotine-Marussi Symposium on Mathematical Geodesy , (IAG 114) L'Aquila (Italy) May 29-June 2 1994

EUREF Symposium Warsaw (Poland) June 8-11 1994

6th WEGENER Meeting St Petersburg (Russia) June 20-24 1994

International Symposium on Kinematic Systems in Geodesy, Geomatics and Navigation KIS 94 Banff (Canada) August 30-September 2 1994

1st Turkish International Symposium on Deformations Istambul (Turkey) September 5-9 1994

Joint Meeting of the IGC and IGeC (IAG 113) Graz (Austria) September 12-16 1994

International Symposium on Marine Positioning INSMAP 94 Hannover ((Germany) September 19-23 1994

International School for the Determination and Use of the Geoid Milan (Italy) October 10-15 1994

9th International Workshop on Laser Ranging Instrumentation Canberra (Australia) November 7-11 1994

4th International Symposium on Recent Crustal Movements in Africa Nairobi (Kenya) November 28-December 2 1994

Summer School on GPS for Geodesy Delft (Netherlands) March 26-April 1 1995

EUREF Symposium Helsinki (Finland) May 3-5 1995

IERS Workshop Paris (France) May 10-12 1995

IGS Workshop Potsdam (Germany) May 15-17 1995

INTERNATIONAL ASSOCIATION OF GEODESY

Financial Report for the period 1991-1994

Amounts in US$, Exchange rate 1US$ = 5.5483 FF

	RECEIPTS	IUGG	GRANTS & CONTRACTS
15	IUGG ALLOCATION	102800.00	
2	UNESCO GRANTS		
3	OTHER GRANTS	8134.99	5000.00
4	CONTRACTS WITH UNESCO,etc.	464.83	
5	SALES OF PUBLICATIONS	5735.96	
6	MISCELLANEOUS		
	(Gains on change)	533.25	249.71*
	(Interest)	1839.19	544.01*
	(Others)	5819.23	151.59*
7	TOTAL RECEIPT	125327.45	5945.31
8	CASH ON HANDS AND IN BANKS (Jan 1, 1991)	15219.12	
9	INVESTMENTS & RESERVES (Jan 1, 1991)	653.35	1835.69*
10	TOTAL	141199.92	7781.00

	EXPENDITURES	IUGG	GRANTS & CONTRACTS
11	ADMINISTRATION		
11.1	Personnel	8194.73	
11.2	Quarters (rents and services)		
11.3	Supplies and Equipment	7209.50	
11.4	Communication	596.11	
11.5	Travel	25669.88	
11.6	Miscellaneous	13890.74	
12	PUBLICATIONS		
12.1	Proceedings of Assemblies	8890.24	
12.2	Proceedings of Symposia		
12.3	Periodicals	10260.02	
12.4	Others		
13	ASSEMBLIES		
13.1	Organization	6207.92	
13.2	Travel	21140.57	
14	SYMPOSIA & SCIENTIFIC MEETINGS		
14.1	Organization	7514.74	
14.2	Travel	1591.49	
16	GRANTS (Permanent Services, etc.)	4115.59	5223.91
17	CONTRACTS WITH UNESCO	1233.18	
18	MISCELLANEOUS	3035.09	614.08*
19	TOTAL EXPENDITURES	119549.80	5837.99
20	CASH ON HAND AND IN BANKS (Dec. 31, 1994)	9020.56	
21	INVESTMENTS & RESERVES (Dec 31, 1994)	12629.56	1943.01*
22	TOTAL	141199.92	7781.00

* = Bomford Prize

INTERNATIONAL ASSOCIATION OF GEODESY

Estimate and Expenses for the period 1995-1999
Amounts in US$, Exchange rate 1US$ = 5.6 FF

	RECEIPTS	IUGG	GRANTS & CONTRACTS		EXPENDITURES	IUGG	GRANTS & CONTRACTS
15	IUGG ALLOCATION	100000.00		11	ADMINISTRATION	53000.00	
2	UNESCO GRANTS			12	PUBLICATIONS	19000.00	
3	OTHER GRANTS			13	ASSEMBLIES	26000.00	
4	CONTRACTS WITH UNESCO,etc.			14	SYMPOSIA & SCIENTIFIC MEETINGS	8000.00	
5	SALES OF PUBLICATIONS	6000.00		16	GRANTS (Permanent Services, etc.)	4000.00	
6	MISCELLANEOUS			17	CONTRACTS WITH UNESCO		
				18	MISCELLANEOUS		
7	TOTAL RECEIPT	106000.00		19	TOTAL EXPENDITURES	110000.00	
8	CASH ON HANDS AND IN BANKS (Jan 1, 1991)	9000.00		20	CASH ON HAND AND IN BANKS (Dec. 31, 1994)	7000.00	
9	INVESTMENTS & RESERVES (Jan 1, 1991)	12600.00		21	INVESTMENTS & RESERVES (Dec 31, 1994)	10600.00	
10	TOTAL	127600.00		22	TOTAL	127600.00	7781.00

* = Bomford Prize

XXIth General Assembly of the International Association of Geodesy

(Boulder, Colorado, USA, July 3-14, 1995)

REPORT on the MEETINGS
of the - Executive Committee
- Council
- General Assembly

During this General Assembly,

. The Executive Committee met on July 3 (morning and evening), July 11
. The Council met on July 3, July 5 and July 12

The participants to the Executive Committee Meetings were the President (W. Torge), the First Vice-President (K.-P. Schwarz), the Second Vice-President (J.-Y. Chen), the immediate past President (I.I. Mueller), the Secretary General (C. Boucher) and Assistant Secretary (P. Willis) of the Association, the Presidents of the Sections (M. Prilepin, Ch. Reigber, H.-G. Wenzel, F. Sansò, J. Dickey) and the Secretaries of the Sections (F.K. Brunner, K. Poder, R. Rummel, B. Schutz, R. Forsberg, I. Marson, H. Sünkel, P. Holota, P.J.G. Teunissen, M. Feissel, H. Hsu, T. Tanaka), the Editors-in-Chief of the Bulletin Géodésique (C.C. Tscherning, P. Vanicek) and H. Moritz as Honorary President.

At the Executive Meeting, held on July 11, the newly elected members of the future Executive Committee were invited (with voice but without vote).

At the meetings of the Council, 36 member countries were represented :

- **Algeria** (S. Kahlouche)
- **Australia** (R. Coleman)
- **Austria** (E. Erker)
- **Belgium** (U. Van Twembeke/P. Pâquet)
- **Brazil** (D. Blitzkow)
- **Canada** (R.B. Langley)
- **China** (Jianguo Hu)
- **Czech Republic** (P. Holota)
- **Denmark** (F. Madsen)
- **Egypt** (A. Tealeb)
- **Finland** (H. Kakkuri)
- **France** (M. Feissel)
- **Germany** (F.W. Grafarend)
- **Hungary** (J. Adam)
- **India** (V.K. Gaur)
- **Indonesia** (R. Matindas)
- **Isarael** (G. Steinberg)
- **Italy** (C. Morelli)
- **Japan** (J. Segawa)
- **Korea** (C.G. Baag)
- **Luxembourg** (G. Breger)
- **Netherlands** (P.J.G. Teunissen)
- **New Zealand** (D. Grant)
- **Norway** (B.G. Harsson)
- **Nigeria** (O. Cocker)
- **Poland** (L.W. Baran)
- **Portugal** (J.A. Torres)
- **Russia** (M.T. Prilepin)
- **South Africa** (R.T. Wonnacott)
- **Sweden** (L. Sjöberg)
- **Switzerland** (E. Gubler)
- **Taiwan** (Cun-Sung Chen)
- **Thailand** (A. Phansanong)
- **United-Kingdom** (V. Ashkenazi/G. Blewitt)
- **United States of America** (B.E Schutz/ J. Dickey)
- **Zimbabwe** (C. Masterton)

During these meetings, topics concerning the activities and administrative affairs of the International Association of Geodesy were treated. Decisions or conclusions were drawn as follows.

1 - *Finances - Approval of the financial report of the Secretary General*

The financial report for the period 1991-1994 was presented by the Secretary General during the opening session of the General Assembly. An Audit Committee was nominated by the Council for carrying out detailed examination of the accounts, and the

following report was unanimously adopted by the Council:

"Report of the Audit Committee of the Council of the IAG."

At the first session on Monday, July 3, 1995, the Council elected the following Committee to audit the accounts of the Association from 1991 to 1994:

C.E. Calvert (Chairman)
J. Adams
U. Van Twembeke

The Audit committee met four times.

1.1. ***The Audit Committee performed the following:***

1.1.1 Examined all receipts and bank statements for the period of account.
1.1.2 Examined all entries in daily ledgers, monthly and annual totals.
1.1.3 Checked balances appearing in the annual and quadrennial reports of the IAG.
1.1.4 Made enquiries which were clarified by Dr. Pascal Willis.

1.2. ***The Audit Committee makes the following comments on the IAG account:***

1.2.1 The accounts are well presented and expenditure supported by receipts.
1.2.2 Multi currency transfers have been clearly documented.
1.2.3 During the period 1991-1994 the value of investments and reserves has risen by 5.777,65 US $ to 21.650,12 US $. This has been largely due to wise investment and careful spending.
1.2.4 The IUGG allocation for the next four years should remain the same as previously.
1.2.5 At the end of the period 1991-1994 the disposable balance of IAG is 21.650,12 US $.
1.2.6 The IAG should gratefully acknowledge the assistance by Institute Géographique National of France by providing accommodation and personnel for the IAG Bureau.

1.3. ***Audit Committee makes the following comments on the IAG Fund.***

1.3.1 The ledgers and investment books of the fund were examined and checked.
1.3.2 The IAG Fund accounts were split from the IUGG (IAG) accounts during 1993. The creation of separate ledgers and accounts have enabled better financial regulation.
1.3.3 There should be a duplicate receipt to acknowledge receipt of funds into the account and dispersal from the account.
1.3.4 The value of the IAG Fund is currently 16.043,35 US$.

1.4. ***Recommendation***

The Audit Committee recommends the Council of the IAG to accept the financial report for the period 1991-1994 as presented in the appendix B of the report of the Secretary General.

2 - ***Elections***

The elections were prepared by the Nominating Committee (I.I. Mueller - Chairman, J.Y. Chen, P.J.G. Teunissen, H.G. Wenzel) which presented its list of candidates at the first meeting of the Council on Monday July 3. The elections took place in the Council on Wednesday July 5 ; they gave the following results :

President : **K.-P. Schwarz** (Canada)
First Vice President : **F. Sansò** (Italy)
Secretary General : **C.C. Tscherning** (Denmark)
Second Vice President : **J.O. Dickey** (USA)
(attending any meeting of the Bureau on invitation of the President)

Section I : ***Positioning***
President : **F. Brunner** (Austria)
Secretaries : **Y. Bock** (USA)
(Commission X) : **C. Boucher** (France)

Section II : ***Advanced Space Technology***
President : **R. Rummel** (Germany)
Secretaries : **P. Willis** (France)
(Commission VIII) : **G. Beutler** (Switzerland)

Section III : ***Determination of the Gravity Field***
President : **R. Forsberg** (Denmark)
Secretaries : **M. Sideris** (Canada)
(Commission III) : **I. Marson** (Italy)
(Commission XII) : **H. Sünkel** (Austria)

Section IV : ***General Theory and Methodology***
President : **P. Holota** (Czech Rep.)
Secretaries : **B. Heck** (Germany)
C. Jekeli (USA)

Section V : ***Geodynamics***
President : **M. Feissel** (France)
Secretaries : **C. Wilson** (USA)

(Commission V) : **H.-G. Wenzel** (Germany)
(Commission VII) : **T. Tanaka** (Japan)

Journal of Geodesy
Editor-in-Chief **P.J.G. Teunissen** (The Netherlands)

Assistant Secretary of the Association :
O.B. Andersen (Denmark)

Honorary President :
G. Bomford (U.K.)
Y. Boulanger (Russia)
T.J. Kukkamäki (Finland)
H. Moritz (Austria)
P.V. Angus-Leppan (Australia)
I.I. Mueller (USA)
W. Torge (Germany)

Honorary Secretaries General :
J.J. Levallois (France)
M. Louis (France)

3 - *Review of Commissions, Special Commissions and Special Study Groups*

3.1 Commissions

No new commission were created, but two out-of-section commissions were dissolved: Commission IX (Education) and Commission XI (Geodesy in Africa):

Commission IX (Education): The topic of this Commission was found as very important. The work performed, under the direction of R. Langley and in collaboration with sister associations, within the frame of IUSM (International Union of Surveying and Mapping), was acknowledged with thanks. As a certain goal has been reached by the work of the Commission, it was decided to dissolve it, and to follow up questions on education by a Coordinator for Educationnal Initiatives, R. Langley was elected as Coordinator, directly reporting to the IAG Bureau.

Commission XI (Geodesy in Africa): The activity of this commission was not as strong as it should have been, taking into account the importance of the subject. This was especially due to their too broad definition of the Commission, which should cover the whole field of Geodesy in a continent (being the only structure of that typoe within IAG). As dedicated Sub-Commission (e.g. for networks, geoid,...) successfully work with the common structure for other regions of the world, the Commission was dissolved, and it was strongly recommended that the Commissions take care, within their regional Sub-Commissions, on geodetic problems in Africa.

The other Commissions were continued, i.e.

Commission III (International Gravity Commission): **I. Marson** (Italy)

Commission V (Earth Tides): **H.-G. Wenzel** (Germany)

Commission VII (Recent Crustal Movement): **T. Tanaka** (Japan)

Commission VIII (International Coordination of Space Techniques for Geodesy and Geodynamics -CSTG): **G. Beutler** (Switzerland)

Commission X (Global and Regional Geodetic Networks): **C. Boucher** (France)

Commission XII (International Geoid Commission): **H. Sünkel** (Austria)

3.2 Special Commissions

According to the IAG by-laws, Special Commissions may be formed to study scientific problems of a long term character which require close cooperation between specialists from different countries.

Two Special Commissions were dissolved: SC 2 (History of Geodesy) and SC 5 (Marine Positioning):

SC 2 (History of Geodesy): The work accomplished by this Special Commission, chaired by J. Weightman, was acknowledged with thanks by the Executive Committee and the need to continue this activity in the future was stressed. The Sub-Commission structure was found to be inappropriate and the structure of a Committee directly reporting to the Central Bureau was proposed and accepted by the Council.

SC 5 (Marine Positioning): This Special Commission had to cover an extremely large area of research and application, which is of fundamental importance for Geodesy. The work of the Special Commission, chaired by M. Kumar, was acknowledged with thanks. In order to be evenmore effective, and to avoid overlaps with the relevant work done within the Sections structure, it was decided to dissolved the Special Commission and to follow-up the issues of marine geodesy within the Sections structures, mainly trhough Special Study Groups.

The four remaining Special Commissions were maintained, i.e.:

SC 1 (Mathematical and Physical Foundations of Geodesy): **E.W. Grafarend** (Germany)

SC 3 (Fundamental Constants): **E. Groten** (Germany)

SC 4 (Applications of Geodesy to Engineering): **H. Kahmen** (Austria)

SC 6 (Wegener Project): **S. Zerbini** (Italy)

Two new Special Commissions were created:

SC 7 (Gravity Field Determination by Satellite Gravity Gradiometry): **K.-H. Ilk.** (Germany) (in Section II)

SC 8 (Sea Level and Ice Sheet Variations): **W.E. Carter** (USA) (in Section V)

3.3 Special Study Groups

As Special Study Groups are created to study specific scientific problems of limited scope, most of them are terminated after a four year period at the General Assembly. After proposal from the Sections and discussion within the Executive Committee, the following decisions were made and agreed upon by the Council:

Section I:

a)termination of:

SSG 1.105 : Kinematic Global Positioning System

SSG 1.125 : Positioning with Inertial Systems

SSG 1.126 : Permanent GPS Arrays

SSG 1.127 : Error Propagation in GPS Networks

SSG 1.128 : Wet Propagation Delay

b)continuation of:

(none)

c)creation of:

SSG 1.153 : Precise Marine Positioning (Surface and Seafloor)
D. Egge (Germany)

SSG 1.154 : Quality Issues in Real Time GPS Positioning
C. Rizos (Australia)

SSG 1.155 : Active GPS Networks
H. Tsuji (Japan)

SSG 1.156 : Advanced GPS Analysis for Precise Positioning
G. Blewitt (U.K.)

SSG 1.157 : Ambiguity Resolution and Validation
P.J. de Jonge (The Netherlands)

SSG 1.158 : Antenna and Site Effects
J. Johansson (Sweden)

SSG 1.159 : Use of GPS Positioning for Atmospheric Monitoring
M. Bevis (USA)

Section II:

a)termination of:

SSG 2.107 : Gravity-Field Determination by Satellite Gravity-Gradiometry

SSG 2.109 : Applications of Space VLBI in the Field of Astrometry and Geodynamics

SSG 2.130 : Non-Gravitational Force Modelling Effects on Satellite Orbits

SSG 2.131 : Spaceborne GPS/GLONASS

SSG 2.132 : Time-Varying Gravitational Effects on Satellite Orbits

SSG 2.151 : Altimetry: Optimal Processing for Geodesy, Geophysics and Oceanography

b)continuation of:

(none)

c)creation of:

SSG 2.160 : Spaceborne Interferometric SAR Technology
R. Klees (The Netherlands)

SSG 2.161: Spaceborne Atmospheric Sounding
C. Rocken (USA)

SSG 2.162 : Precise Orbits using Multiple Space Techniques
A. Marshall (USA)

Section III:

a)termination of:

SSG 3.133 : Techniques of Precise Gravimetry

SSG 3.134 : Airborne Gravimetry

SSG 3.135 : Optimization of Spectral Gravity Field Modelling Methods

SSG 3.136 : High Resolution Geoid Modelling and Evaluation

SSG 3.137 : Combined Use of Gravimetry and Stress-Strain Measurements Techniques

b)continuation of:

(none)

c)creation of:

SSG 3.163 : Assesment and Refinement of Global Digital Terrain Models
D. Arabelos (Greece)

SSG 3.164 : Airborne Gravimetry Instrumentation and Methos
M. Wei (Canada)

SSG 3.165 : Global Gravity Field Determination and Evaluation
N. Pavlis (USA)

SSG 3.166 : Local Gravity Field Modelling and Interpretation
T. Basic (Croatia)

SSG 3.167 : Regional Land and Marine Geoid Modelling
H. van Gysen (South Africa)

Section IV:

a)termination of:

SSG 4.138 : Modelling and Quality Control for Precise Integrated Navigation

SSG 4.139 : The role of Terrain in Gravity Field Modelling

SSG 4.140 : Tomography of the Atmosphere by Geodetic Measurements

SSG 4.141 : Integrated Inverse Gravity Modelling

SSG 4.142 : Applications of the Boundary Value Problem Techniques to Space and Airborne Graviy Field

b)continuation of:

(none)

c)creation of:

SSG 4.168 : Inversion of Satellite Altimetric Data
P. Knudsen (Denmark)

SSG 4.169 : Wavelets in Geodesy
B. Benciolini (Italy)

SSG 4.170 : Integrated Inverse Gravity Modelling
L. Ballani (Germany)

SSG 4.171 : Dynamic Isostasy
L.E. Sjöberg (Sweden)

Section V:

a)termination of:

SSG 5.143 : Rapid Earth Orientation Variations

SSG 5.144 : Dynamic Effects in Earth Rotation Theory

SSG 5.145 : Long-Term Variations in Earth Rotation

SSG 5.146 : Processing of Optical Polar Motion Data in View of Plumb Line Variations

SSG 5.147 : Studies of the Baltic Sea

SSG 5.148 : Global Geodynamic Variations

SSG 5.149 : Studies on Vertical Datums

SSG 5.150 : Density Distribution within the Lithosphere

SSG 5.152 : Geodetic Research Toward the Reduction of Natural Hazards

b)continuation of:

(none)

c)creation of:

SSG 5.172 : Understanding Natural Hazards: The Geodetic Contribution
S. Okubo (Japan)

SSG 5.173 : Interaction of the Atmosphere and Oceans with the Earth's Rotational Dynamics
C. Wilson (USA)

SSG 5.174 : Geophysical Interpretation of Temporal Variations of the Geopential
A. Cazenave (France)

SSG 5.175 : Interannual Variations of Vertical and Their Interpretation
Z.X. Li (China)

3.4 International Bureaus, Services and Centers

The following bodies will continue their work, and are affiliated to FAGS :

. Bureau Gravimétrique International (B.G.I)
Director : **G. Balmino** (France)

. Bureau International des Poids et Mesures (B.I.P.M)
Time Section: Director : **C. Thomas** (France)

. International Centre of Earth Tides (I.C.E.T.)
Director : **B. Ducarme** (Belgium)

. International Earth Rotation Service (I.E.R.S.)
Chairman of the Directing Board :
C. Reigber (Germany)
Director of the Central Bureau :
M. Feissel (France)

. Permanent Service for Mean Sea Level (P.S.M.S.L.)
Director : **P.L. Woodworth** (U.K.)

The following body will continue its work, but is not affiliated to FAGS:

The International Geoid Service -IGeS-
Chairman of the Directing Board
F. Sansò (Italy)

After a long discussion and a vote, it was decided that the International Center for Recent Crustal Movement (ICRCM) would continue as an IAG body for only one year after Boulder (August 1995-July 1996). After this period, ICRCM will not be considered anymore as an IAG body. The activities of ICRCM were acknowledged with thanks, and it was decided to include them in a larger research structure of IAG which has still to be defined. An Ad Hoc Planning Group, chaired by M. Bevis, was created to explore the establishment of a Crustal Deformation Bureau and the Modernization of the Commission on Recent Crustal Movement.

A new Service, affiliated to FAGS, was created in Section II:

International GPS Service -IGS-
Chairman of the Directing Board:
G. Beutler (Switzerland)
Director of the Central Bureau :
R. Neilan (USA)

3.5 Committees reporting to the IAG Bureau

Several Committees, directly reporting to the Central Bureau, were established:

Cassinis Committee
Chairman : **W. Torge** (Germany)

Committee on Geodetic Aspects of the Law of the Sea -GALOS-
Chairman : **P. Vanicek** (Canada)

Committee for Developping Countries
Chairman : (to be defined by the Bureau)

Committee on the History of Geodesy
Chairman : **J. Weightman** (U.K.)

Coordinator for Educational Initiatives :
R. Langley (Canada)

Ad Hoc Planning Group on Crustal Deformation
M. Bevis (USA)

4 - IAG Representatives to other organizations

IAG REPRESENTATIVES TO EXTERNAL BODIES

BGI Directing Board
I Marson (Italy)
(President IGC)

COSPAR/IAU/IAG Workimg Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites
M. Bursa (Czech Republic)

IAPSO Commission on Mean Sea Level and Tides
C. Boucher (France)

IAU Working Group on Astronomical Standards (WGAS)
E. Groten (Germany)

IAU/IUGG Working Group on Non Rigid Earth Rotation
T. Herring (USA)

ICET Directing Board
H.-G. Wenzel (Germany)
(President Earth Tide Commission)

ICL
P. Wilson (Germany)

ICSU Panel on World Data Centers
(to be appointed following proposal by G. Balmino)

IERS Directing Board
C. Reigber (Germany)

IGS Governing Board
I.I Mueller (USA)
G. Beutler (USA)
(appointed by section II)

ISO TC 211
C. Boucher (France)

IUGG Inter-Association Committee for Mathematical Geophysics
M. Vermeer (Finland)

IUSM Executive Board:
I.I. Mueller (USA)
K.-P. Schwarz (Canada)

PAIGH (Panamerican Institute for Geography and History):
W. Torge (Germany)

SIRGAS
H. Drewes (Germany)

WMO/IUGG Working Group on data exchange for forecast of natural disasters
Y. Bock (USA)

5 - Awards

5.1 **The Bomford Prize 1995** was awarded to **Thomas Herring**, Professor at the Massachussets Institute of Technology, USA, for his outstanding contribution to geodesy and particularly to his long-term contribution in space geodesy. The Prize was handed over to him by W. Torge, President of the IAG, during the IAG General Assembly opening ceremony, and Prof. T. Herring gave a short lecture summarizing his research work during the opening ceremony (published in the Geodesist's Handbook.

5.2 **The Levallois Medal** was awarded to Prof. W. Baarda, Delft University of Technology (the Netherlands) in recognition of distinguished service to the Association and to the science of geodesy in general. The Levallois Medal will be given to Prof. W. Baarda by the IAG President W. Torge during a ceremony in Delft on November 17, 1995.

5.3 **The 1995 IAG Best Paper** was awarded to **J.P. Barriot** (France) for his paper entitled "Line of Sight Operators in Planetary Geodesy" published in Manuscripta Geodaetica, vol 19, 5, pp. 269-283.

6 - Resolutions

6.1 - Resolutions presented by the International Association of Geodesy and endorsed by the International Union of Geodesy and Geophysics

Three resolutions proposed by I.A.G. were accepted by I.U.G.G. :

- Resolution IUGG n°1 to recommend national agencies and institutions to contribute to the operations of IERS by providing observations and products.

- Resolution IUGG n°2 to strongly recommend the implementation of a dedicated satellite gravity mission.

- Resolution IUGG n°3 to request the IAU to reconsider its recent resolution (1994, C4) regarding the use of Julian Days Scale.

6.2 - I.A.G. Resolutions

- Resolution IAG n°1 to recommend the fixing of tide gauges in a geodetic reference frame at the sub-centimeter accuracy in vertical.

- Resolution IAG n°2 to continue detailled comparaison of mean sea level slopes with those obtained from adjusted heights in vertical geodetic networks.

- Resolution IAG n°3 for the establishment of a group identified as a six-year observation period for the global gravity monitoring network.

- Resolution IAG n°4 for the establishement of an Asian-Pacific space geodynamic project.

- Resolution IAG n°5 to encourage geodynamics project in Africa supported by local institutions and international cooperating agencies.

- Resolution IAG n°6 to thank the french colleagues of the IAG Central Bureau from 1919 to 1995.

- Resolution IAG n°7 to thank the organizing Committee for the preparation of the General Assembly.

7 - *Publications*

7.1 BG/mg

An agreement between Springer-Verlag and the IAG has been signed, with the content that the two journals Bulletin Géodésique and manuscripta geodaetica will be merged in one journal, called "Journal of Geodesy", starting in Jan 1, 1996. The new Editor-in-Chief and the board of editors were appointed by the IAG Executive Committee: P.J.G. Teunissen (Editor-in-Chief), F.H. Schroder (Assistant-Editor-in-Chief), C.C. Tscherning (IAG information Editor), D. Arabelos, F. Barlier, R. Barzaghi, Y. Bock, E. Cannon, M. Feissel, H. van Gysen, P. Holota, H.T. Hsu, C. Jekeli, D.G. Milbert, S. Okubo, B. Schaffrin, G. Seeber, A. Stolz, M. Vermeer, H.-G. Wenzel, P. Willis

7.2 Travaux

Most of the reports were distributed in Boulder. It should be possible to print and distribute the Travaux within a short timetable (fall 1995).

7.3 The Geodesist's Handbook

The Geodesist's Handbook will be published in 1996, as a specific issue of the new Journal of Geodesy. P. Willis has been appointed as Editor of the Handbook.

8 - *Cassinis Committee*

Following the IAG By-Laws, a Cassinis Committe was formed, chaired by W. Torge, to propose new ideas and changes for the IAG structure. An open forum was initiated during the Boulder General Assembly to raise new proposal from the members of the IAG scientific community. The Cassinis Committee is formed by the following people: W. Torge (Chairman), J.Y. Chen, I.I. Mueller, F. Sansò, J. Dickey, C.C. Tcsherning, H. Sünkel.

9 - *IAG Fund*

The IAG Fund initiative proved to be a great success during the last period. More than a hundred people already made a contribution to this fund. This fund has been used:

- to help young scientists to assist to large international symoposium (4 grants were given for Boulder),
- to forster publication from young scientists in the IAG journals (3 IAG Best Paper Awards were given),
- to support organization of IAG Workshop in developping countries.

10 - *IAG New Fellows*

The IAG Executive Committee appointed the following Fellows of the International Association of Geodesy:

Jozsef Adàm
Riccardo Barzaghi
Matthias Becker
Gehrard Beutler
Wolfgang Bosch
Benjamin Fong Chao
Heiner Denker
John Dow
Gunnar K. Elgered
Bjorn Engen
Alain Geiger
Teruyuki Kato
Jan Kouba
Alfred Kleusberg
Herbert Landau
Richard B. Langley
Klaus Linkwitz
Serguei Molodensky
Ruth E. Neilan
Carey Noll
Shuhei Okubo
Paul Pâquet
John C. Ries
Jean M. Rüeger
Ernst J.O. Schrama
Che-Kwan Shum
T.A.Th. Spoelstra
Seyuzo Takemoto
Claudine Thomas
Jack A. Weightman
Pascal Willis
Thomas Yunck

N.B.: It must be noted that additionnal new IAG Fellows can also be appointed at the next IAG Executivce Committee meeting.

11 - *Support of workshops in developing countries*

It is important that workshops, summer schools could be organized regularly in developping countries. For this purpose, possible financial support is already available from the IAG Fund initiative. During the past period, several workshops proved to be effective and were efficiently organized on a local basis.

12 - *IAG Service Policy*

IAG is now providing more and more products and services to the IAG community and also to outside users. A discussion was initiated to define general principles that IAG bodies should apply, as general policy, for their data distribution. In particular, the question of revenues for IAG products and services was raised. This topic will be rediscussed and finalized during the next IAG Executive Committee meeting.

13 - *Future Scientific Meetings*

13.1 IAG Scientific Assembly 1997

The IAG Scientific Assembly will be organized in Rio de Janeiro (Brazil) in September 1997.

13.2 IAG Sponsored meetings

The following meetings were accepted for IAG sponsorship by the IAG Executive Committee:

ISPRS Workshop on Integration sensor orientation:
theory, algorithms, and systems,
Barcelona, Spain, September 4-8, 1995

3rd Conference on
Optical 3-D Measurement Techniques
Vienna, Austria, October 2-4, 1995

FISOLS 95 - 5th International Symposium
on land Subsidence
The Hague, The Netherlands, October 16-22, 1995

International Summer School of Theoretical Geodesy
Como, Italy, May 26-June 7, 1996

Second International Conference GALOS
Denpasar, Bali, Indonesia, July 1-4, 1996

XII International Course in Engineering Geodesy
Graz, Austria, Sept. 7-16, 1996

5th International Winter Seminar on Geodynamics
Gravity in Space and Time
Sopron, Hyngary, 1996

Regional Symposium on Deformations and Crustal movements investigations using Geodetic techniques
Szekesfehervar, Hungary, Autumn 1996

Joint Symposium of IGC and IGeC
Tokyo, Japan, Nov., 1996

Tropical School of Geodesy - ITB
Bandung, Indonesia, Oct-Nov. 1996

International Symposium on Kinematic Systems in Geodesy, Geomatics and Navigation KIS 97
Banff, Canada, June 3-6, 1997

IAG Participation in the
Joint Assemblies of IAMAS and IAPSO
Melbourne, Australia, June, 1997

13th International Symposium on Earth Tides
Brussels, Belgium, Aug. 1997
(ICET)

4th International Seminar on GPS in Central Europe
Penc, Hungary, 1997
(postponed)

6th International Winter Seminar on Geodynamics on Long periodic variations in Earth rotation
Sopron, Hungary, 1998

9th International Symposium on Recent Crustal Movements
Cairo, Egypt, Dec. 1998

5th International Seminar on GPS in Central Europe
Penc, Hungary, 1999
(postponed)

13.3 Next IUGG General Assembly

The next IUGG General Assembly will be held in Birmingham (U.K.) in summer 1999.

13.4 Next Meeting of the IAG Executive Committee

The next meeting of the IAG Executive Committe will be held in Copenhagen in fall 1995.

IUGG Resolutions adopted at the XXIth General Assembly in Boulder and related to Geodesy

RESOLUTION N°1

The International Union of Geodesy and Geophysics,

recognizing that:

a)since its establishment in 1988, the International Earth Rotation Service (IERS) has successfully developed a comprehensive observation and analysis system to realize the International Terrestrial Reference System (ITRS) and the International Celestial Reference System (ICRS), and to permanently link them by monitoring the Earth's orientation; and

b)IERS achievements are entirely due to the contributions of national agencies in terms of technical development, network operation, and data analysis;

noting that:

a)the IERS-published reference systems are of high quality and are used in a wide range of research and applications in geodesy and geophysics to provide quantities that the user would otherwise have to determine for himself and at his own expense;

b)the IERS Directing Board has published a strategy statement describing the optimal combination of the astronomical and space techniques to fulfill the IERS missions,

recommends that national agencies and institutions contribute to the operation of IERS by providing observations and products in compliance with the IERS Strategy.

RESOLUTION N°2

The International Union of Geodesy and Geophysics,

referencing IUGG Resolution 4 of the XXth General Assembly in Vienna (1991) on the urgent need for an improved determination of the global gravity field of the Earth,

noting that several space agencies, such as ESA and NASA, have plans to realize a mission for the improvement of the Earth's gravity field and that such a mission will have important consequences for geodesy, solid earth physics and oceanography;

strongly recommends the implementation of a dedicated satellite gravity mission.

RESOLUTION N°3

The International Union of Geodesy and Geophysics,

noting that Resolution C3 of the International Astronomical Union (IAU) at its XXIInd General Assembly in the Hague (1994) recommended rescinding Resolution 4 of its XVth General Assembly (1976) which established the Modified Julian Day (MJD) system, and using Julian Days as the only time scale for archiving and exchanging time-based astronomical phenomena,

recognizing that:

a)the Julian Day is not defined in terms of an internationally recognized time scale,

b)modified Julian Days are widely used in geodesy and geophysics, particularly for the slow changing parameters of the Earth Sciences, and that any change would cause confusion and risk of error,

c)Earth Sciences require the exchange of astronomical as well as geodetic and geophysical data,

requests the International Astronomical Union:

a)to reconsider its 1994 Resolution C3 regarding the use of Julian Days and to maintain the modified Julian Days scale wherever it is commonly used in geodesy and geophysics,

b)to prepare a joint IUGG/IAU recommendation for a precisely defined time scale including a continuous day-count convention suitable for archiving and exchanging time-based data used in the analysis of astronomical as well as geodetic and geophysical phenomena.

Résolutions de l'UGGI adoptées à la XXI^{ème} Assemblée Générale, et concernant la Géodésie

RÉSOLUTION 1

L'Union Géodésique et Géophysique Internationale

reconnaissant

1. que depuis sa création en 1988, le Service International de la Rotation Terres est un système global d'observation et d'analyse pour réaliser le Système International de Référence Terrestre et le Système International de Référence Céleste et les relier entre eux d'une manière permanente par la mesure de l'orientation de la Terre; et

2. que les réalisations de l'IERS sont entièrement dues aux contributions des agences nationales aux développements technologiques à l'opération de réseaux et à l'analyse de données ;

notant

1. que les systèmes de référence publiés par l'IERS sont d'une grande qualité et qu'ils sont utilisés dans de nombreux domaines de recherche et d'applications en géodésie et en géophysique afin de fournir les paramètres que, dans le cas contraire, l'utilisateur devrait déterminer lui-même, à ses propres frais ;

2. que le Comité Directeur de l'IERS a publié les lignes de conduite pour combiner de manière optimale les résultats des techniques astronomiques et spatiales pour remplir les missions de l'IERS;

recommande :

que les Institutions et Agences nationales contribuent au fonctionnement de l'IERS en fournissant des observations et des produits en accord avec la stratégie de l'IERS

RÉSOLUTION 2

L'Union Géodésique et Géophysique Internationale

se référant

à la Résolution n° 4, adoptée lors de l'Assemblée Générale tenue à Vienne (1991), au sujet de la nécessité urgente de l'amélioration de notre connaissance du champ de gravité global de la Terre,

notant

que plusieurs agences spatiales, telles que l'ASE et la NASA, ont des projets de réaliser une mission pour l'amélioration des modèles du champ de gravité de la Terre et qu'une telle mission aura des conséquences importantes pour la géodésie, la géophysique et l'océanographie

recommande vivement

la mise en place d'un satellite consacré à la cartographie du champ de gravité.

RÉSOLUTION 3

L'Union Géodésique et Géophysique Internationale

notant

que la Résolution C3 adoptée par l'Union Astronomique Internationale au cours de la XXIIème Assemblée Générale tenue à La Haye (1994), recommande de retirer la Résolution No. 4 de sa XVème Assemblée Générale (1976) qui établissait le système du Jour julien Modifié (MJD) et d'utiliser les Jours juliens comme unique échelle de temps pour

l'archivage et l'échange de données relatives à des phénomènes astronomiques dépendant du temps,

reconnaissant

1. que le Jour julien n'est pas défini en tant qu'échelle de temps reconnue internationalement ;

2. que le Jour julien Modifié est largement utilisé en géodésie et en géophysique, particulièrement pour les paramètres lentement variables en Sciences de la Terre, et que tout changement provoquera de la confusion et des risques d'erreur ;

3. que les Sciences de la Terre requièrent l'échange de données géodésiques et géophysiques aussi bien que de données astronomiques

demande à l'Union Astronomique Internationale :

1. de reconsidérer sa résolution C3 de 1994 relative à l'utilisation des Jours juliens et de maintenir l'échelle des Jours juliens Modifiés, dans les domaines de la géodésie et de la géophysique où son usage est habituel.

2. de préparer une recommandation, commune à l'UAI et l'UGGI, pour la définition précise d'une échelle de temps incluant une convention pour le comptage continu des jours, et adaptée pour l'archivage et l'échange de données temporelles utilisés pour les analyses tant des phénomènes astronomiques que des phénomènes géodésiques et géophysiques.

IAG Resolutions adopted at the XXIth General Assembly in Boulder

RESOLUTION N°1

The International Association of Geodesy,

Recognizing that tide gauge records are essentially relative measurements,

Endorses the proposal to fix them in a geodetic reference frame so as to decouple land from ocean effects, especially those of low frequency (e.g. signales related to climate change).

Recommends that vertical positionning be of sub-centimetre accuracy within this framework, and

Requests relevant agencies aim to ensure that this specification is met directly on site through continuous GPS measurements, or through compatible coastal connections of equivalent accuracy.

Sponsored by E. Groten as chairperson of SSG 5.149

RESOLUTION N°2

The International Association of Geodesy,

Endorses progress made in adjusting international vertical control networks,

Recognizes the significant advance in mathematical models of ocean circulation since geodetic and oceanic leveling were last compared,

Recommends continued detailed comparison of mean sea level slopes - calculated from high resolution ocean circulation models - with those obtained from adjusted heights in a vertical geodetic network and

Requests responsible agencies to provide necessary support for these comparisons to be thoroughly investigated and reported

Sponsored by E. Groten as chairperson of SSG 5.149

RESOLUTION N°3

The International Association of Geodesy,

Recognizing the effort in organizing gravity measurements over a network of existing and future superconduction gravimeters supplemented periodically by absolute gravimeters,

Supports the establishment group identified of a six-year observation period for the global gravity monitoring network.

Sponsored by Marson on behalf of the International Gravity Commission (Graz 1994)

RESOLUTION N°4

The International Association of Geodesy,

Recognizing *that :*

(a) the vast areas of East Asia and the Pacific Basin have not yet been subjected to such close geophysical investigation as that carried out in other areas of the world;

(b) large parts of this region are heavily populated and are experiencing rapid economic growth ;

(c) the tectonic character of the region is complex and inadequately understood;

(d) the region is at extreme risk from tectonic, volcanic, seismic and other natural hazards ; and

noting that :

(a) precise geodetic measurements using space and terrestrial techniques give an effective means of monitoring tectonic, volcanic, seismic, and environmental conditions over great spatial and temporal ranges;

(b) the IAG/COSPAR Commission on International Coordination of Space Techniques for Geodesy and Geodynamics (CSTG) has been established to facilitate and coordinate global and regional work in the field of space geodesy and geodynamics;

(c) cooperation between governements, insitutions and individuals is essential for large-scale scientific investigations which an lead to the mitigation of the effects of natural disasters,

(d) in this conneciton the September 1994 UNESCO expert symposium held in Beijing on Space Technology and Applications for Sustainable Development, resolved that;

> *"An Asian-Pacific space geodynamic project is recommended to be established to promote and corrdinate related activities in the region as well as encourage international cooperation in order to provide more basic information for earthquake predictin, volcanic eruptions and sea-level rise."*

(e) the Asian Pacific Space Geodynamic Initiative is a proposal which conforms to this resulotion :

Recommends that :

(a) this project be supported by local institutions and international coopetating agencies ;

(b) the relevant space geodetic (such as Satellite Laser Ranging, Very Long Baseline Interferometry, Global Positioning SDystem and Dynthetic Apertune Radar) and terrestrial techniques (such as gravimetry, tide gauge measurmenet, meteorological observation) be employed in support on fhis project;

(c) steps be taken to improve regional communication in support of these activities;

(d) the data acquired by the project be made available for general scientific purposes.

Sponsored by Shu-Hua Ye

RESOLUTION N°5

The International Association of Geodesy,

Recognizing that :

(a) the geodynamics of the continent of Africa are of high scientific interest;

(b) the region is in the early stages of economic growth, and

noting that;

(a) bilateral agreements, such as in the ADOS campaign which IAG coordinated, have proved a successful vehicle for cooperation in the past ;

(b) Kenya has embarked on a project to monitor the current crustal movements in the Kenyan segment of the East African Rift-Valley;

(c) Tunisia and France are cooperating on a geodynamic study to evaluate seismic risk in the Gafsa region in Souhern Tunisia;

recommends that ;

(a) bilateral agreements on geodynamic projects should be encouraged and supported by the Africal community of nations as leading to scientific progress for the continent as a whole;

(b) these projects be supported by local institutions and by interntional cooperating agencies;

(c) the relevant space geodetic and terrestrial techniques be employed in support of these projects;

(d) steps be taken to improve regional communication in support of these activities;

(e) the data ecquired by the project be made available for general scientific purposes.

RESOLUTION N°6

The International Association of Geodesy,

Noting :

that France and the Institut Geographique National have provided indispensable support and efficient administration of the Association by operating the Central Bureau over the whole period from 1919 to 1995 under the responsibility of the following Secretaries General and Assistant Secretaries General :

G. Perrier
P. Tardi
G. Laclavère
J.J. Levallois
M. Louis
C. Boucher
P. Willis

Extends:

to these friends and coleagues the grateful thanks of the Association for all that they have done to keep the organization alive, healthy and changing with the times.

RESOLUTION N°7

The International Association of Geodesy,

Noting:

that the preparations by the Americal Geophysical Union and by the University of Colorado at Boulder have combined to make the XXIst General Assembly of the IAG in Boulder, from 2 to 14 July 1995, a remarkable and unforgettable occasion.

Extends :

To Jean Dickey, the Organizing Committee and supporting staff its grateful thanks for all that they ave done to make this possible, in particular the willing and friendly assistance of the staff in the IAG office at Baker Hall has been outstanding.

Voeux de l'AIG adoptés à la XXI^{ème} Assemblée Générale à Boulder

VŒU N°1

L' Association Internationale de Géodésie,

Constatant que les enregistrements marégraphiques sont essentiellement des mesures relatives,

Approuve la proposition de les déterminer dans un système de référence géodésique afin de découpler les effets terrestres des effets océaniques, en particulier pour ceux de basse fréquence (par ex. signaux liés aux changements climatiques)

Recommande que la composante verticale de la position dans ce système soit de qualité sub-centimétrique et

Demande aux organismes concernés de rechercher à atteindre cette specification directement à la station grâce à des mesures GPS continues, ou par des rattachements côtiers d' exactitude comparable.

Proposé par E. Groten, président du SSG 5.149

VŒU N°2

L' Association Internationale de Géodésie,

Approuve les progrès realisés pour la compensation des réseaux internationaux de nivellement,

Reconnait l' avancée significative faite en modélisation de la circulation océanique depuis les dernières comparaisons entre les nivellements géométriques et steriques

Recommande une comparaison détaillée et permanente entre les pentes du niveau moyen des mers calculées à partir de modèles à haute résolution de circulation océanique et celles déduite des altitudes compensées dans un réseau de nivellement, et

Demande aux organismes responsables de fournir le soutien nécessaire pour que ces comparaisons puissent être étudiées en détail et publiées.

Proposé par E. Groten, président du SSG 5.149

VŒU N°3

L' Association Internationale de Géodésie,

Reconnaissant l' effort fait pour réaliser des mesures de pesanteur sur un réseau de gravimètres supraconducteurs existants ou en projet, complété périodiquement par des gravimètres absolus,

Soutient l' établissement d' une période de six ans d' observations sur le réseau global de surveillance de la pesanteur (parfois connu sous le nom de Projet Géodynamique Global GGP).

Proposé par I.Marson au nom de la Commission Gravimétrique Internationale (Graz 1994)

VŒU N°4

L' Association Internationale de Géodésie,

Reconnaissant que

(a) les vastes étendues de l' Asie de l' Est et du Bassin Pacifique n' ont pas encore donné lieu à des recherches aussi intenses que dans d' autres régions du monde;

(b) de larges parts de cette région sont très peuplées et font l' objet d' un développement économique rapide;

(c) la strucure tectonique de cette région est complexe et insuffisamment comprise;

(d)cette région est sujette à des risques importants de nature tectonique, volcanique, sismique ou autres, et

notant que:

(a) les mesures géodésiques précises utilisant les techniques spatiales et terrestres donnent un moyen effectif pour surveiller les conditions tectoniques, volcaniques, sismiques et environnementales dans une large bande du spectre spatio-temporel;

(b) que la Commission pour la Coordination Internationale des Techniques Spatiales pour la Géodésie et la Géodynamique de AIG/COSPAR (CSTG) a été établie pour faciliter et coordonner les activités globales et régionales dans le domaine de la géodésie et géodynamique spatiale;

(c) la coopération entre les gouvernements, institutions et individus est essentielle pour les recherches scientifiques à grande échelle qui pourraient conduire à l' atténuation des effets des désastres naturels;

(d) à ce sujet le Symposium des experts organisé en septembre 1994 par l' UNESCO à Beijing sur le thème Technologie Spatiale et applications aux développements soutenables prenait comme résolution que:

"Il est recommandé d' établir un projet de géodynamique spatiale pour l' Asie et le Pacifique afin de promouvoir et coordonner les activités concernées se déroulant dans cette région et également d' encourager la coopération internationale en vue de fournir davantage d' informations fondamentales pour la prévision des séismes, des éruptions volcaniques et de l' élévation du niveau de la mer."

(e) l' Initiative pour la Géodynamique Spatiale en Asie et Pacifique est une proposition qui va dans le sens de cette résolution;

Recommande que:

(a) ce projet soit soutenu par les institutions locales et les organismes intéressée au titre de la coopération internationale;

(b) les techniques spatiales (telles que Télémétrie Laser sur Satellite, Interférométrie à Très Longue Base, Système de Positionnement Global et Radar à Synthèse d' Ouverture) et terrestres (telles que gravimétrie, marégraphie et mesures météorologiques) soient utilisées dans le cadre de ce projet;

(c) des actions soient entreprises pour établir un réseau régionnal de communications qui offrirait un soutien adéquat à ces activités;

(d) les données acquises par ce projet soient mises à la disposition générale de la communauté scientifique.

Sponsored by Shu-Hua Ye

VŒU N°5

L' Association Internationale de Géodésie,

Reconnaissant que:

(a)la géodynamique du continent africain offre un grand intérêt scientifique;

(b)la région est dans un stade peu avancé de développement économique; et

notant que:

(a) la mise en oeuvre d' accords bilatéraux, tels qu' il s' en est passé lors de la campagne ADOS coordonnée par l' AIG, s'est avérée un véhicule fructueux de coopération dans le passé;

(b) le Kenya a pris part à un projet de surveiller les mouvements actuels du segment kenyan du rift Est-africain;

(c) la Tunisie et la France coopèrent pour une étude géodynamique afin d' évaluer le risque sismique dans la région de Gafsa dans le Sud tunisien;

recommande que:

(a) des accords bilatéraux sur des projets géodynamiques soient encouragés et soutenus par la communauté des pays africains comme source de progrès scientifique pour le continent tout entier;

(b) ces projets soient soutenus par les institutions locales et par les organismes intervenant au titre de la coopération internationale;

(c)les techniques géodésiques spatiales et terrestres adaptées à ces projets soient mises en oeuvre;

(d) des actions soient entreprises pour établir un réseau régionnal de communications qui offrirait un soutien adéquat à ces activités;

(e) les données acquises par ce projet soient mises à la disposition générale de la communauté scientifique.

VŒU N°6

L' Association Internationale de Géodésie,

Notant que la France et l' Institut Géographique National ont fourni un soutien indispensable et une administration efficace à l' Association en opérant le Bureau Central sur l' ensemble de la période 1919-1995 sous la responsabilité des Secrétaires Généraux et Secrétaires Adjoints suivants:

G. Perrier
P. Tardi
G. Laclavère
J.J. Levallois
M. Louis
C. Boucher
P. Willis

Exprime à ces amis et collègues les remerciements reconnaissants de l' Association pour tout ce qu' ils ont fait afin de maintenir ce bureau vivant, efficace et à jour.

VŒU N°7

L' Association Internationale de Géodésie,

Notant que la combinaison des préparatifs effectués par l'American Geophysical Union et l'Université du Colorado à Boulder a rendu remarquable et inoubliable l' occasion offerte par la XXI^{ème} Assemblée Générale de l' AIG à Boulder du 2 au 14 juillet 1995

Etend à Jean Dickey, au Comité d'Organisation et son équipe ses profonds remerciements pour tout ce qu'ils ont fait pour rendre possible cet évènement; en particulier, l' aide active et amicale du personnel du bureau de l' AIG de Baker Hall a été exceptionnelle.

STRUCTURE of the INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS for the period 1995-1999

1. BUREAU

President	:	**Prof. P.J. Wyllie** (USA)
Vice-President	:	**Dr. U. Shamir** (Israel)
Secretary General	:	**Dr. G. Balmino** (France)
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Assist. Treasurer		**Dr. P. Knudsen** (Denmark)

2. EXECUTIVE COMMITTEE

- The Bureau

- The Past President of the Union :
Prof. H. Moritz (Austria)

- The Presidents of the Associations :

International Association Of Geodesy (IAG)
President : **Prof. K.P. Schwarz** (Canada)
Secretary General : **Dr.C.C. Tscherning** (Denmark)

International Association Of Geomagnetism And Aeronomy (IAGA)
President : **Prof. M. Kono** (Japan)
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International Association Of Hydrological Sciences (IAHS)
President : **Dr. J.C. Rodda** (UK)
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INternational Association Of Meteorology And Atmospheric Sciences (IAMAS)
President : **Prof. R.A. Duce** (USA)
Secretary General : **Dr. R. List** (Canada)

International Association Of Seismology And Physics Of The Earth's Interior (IASPEI)
President : **Prof. C. Froidevaux** (France)
Secretary General : **Dr. E.R. Engdhal** (USA)

International Association Of Physical Sciences Of The Ocean (IAPSO)
President : **Dr. R. Muench** (USA)
Secretary General : **Dr. F.E. Camfield** (USA)

International Association Of Volcanology And Chemistry Of The Earth's Interior (IAVCEI)
President : **Dr. G. Heiken** (USA)
Secretary General : **Prf. R.W. Johnson** (Australia)

(The Secertary Generals of the Associations may attend any meeting of the Executive Committee of the Union in an advisory capacity)

- The Editor of the Chronicle
Prof. P. Melchior (Belgium)

3. FINANCE COMMITTEE

Chairman	:	**Prof. A.A. Ashour** (Egypt)
Secretary	:	**Dr. A.F. Sprilhaus** (USA)
Members	:	**Dr. V.K. Gaur** (India)
		Prof. E. Groten (Germany)
		Prof. M.J. Hamlin (UK)

STRUCTURE of the INTERNATIONAL ASSOCIATION OF GEODESY for the period 1995-1999

1. BUREAU

President: **K.-P. Schwarz** (Canada)

First Vice President: **F. Sansò** (Italy)

Secretary General: **C.C. Tscherning** (Denmark)

Second Vice-President: **J.O. Dickey** (USA)

(Attends any meeting of the Bureau on invitation of the President).

2. EXECUTIVE COMMITTEE

- The Bureau and the Second Vice President
- The Past President: **W. Torge** (Germany)
- The Section Presidents:

Section I : *Positioning*
President: **F.K. Brunner** (Austria)
Secretaries: **Y. Bock** (USA)
(Comm X) **C. Boucher** (France)

Section II : *Advanced Space Technology*
President: **R. Rummel** (Germany)
Secretaries: **P. Willis** (France)
(Comm VIII) **G. Beutler** (Switzerland)

Section III : *Determination of the Gravity Field*
President: **R. Forsberg** (Denmark)
Secretaries: **M.G. Sideris** (Canada)
(Comm III) **I. Marson** (Italy)
(Comm XII) **H. Sünkel** (Austria)

Section IV : *General Theory and Methodology*
President: **P. Holota** (Czech Rep.)
Secretaries: **B. Heck** (Germany)
C. Jekeli (USA)

Section V : *Geodynamics*
President: **M. Feissel** (France)
Secretaries: **C. Wilson** (USA)
(Comm V) **H.-G. Wenzel** (Germany)
(Comm VII) **T. Tanaka** (Japan)

3. OTHER OFFICERS

Editor in Chief of the Journal of Geodesy :
P.J.G. Teunissen (the Netherlands)

Assistant Secretary of the Association :
O.B. Andersen (Denmark)

Honorary Presidents :
Y. Boulanger (Russia)
T.J. KukkamSki (Finland)
H. Moritz (Austria)
P.V. Angus-Leppan (Australia)
I.I. Mueller (USA)
W. Torge (Germany)

Honorary Secretaries General :
J.-J. Levallois (France)
M. Louis (France)

(The Secretaries of the Sections and the other officers may attend any meeting of the Executive Committee of the Association in an advisory capacity).

International Association of Geodesy

Sections, Commissions, Special Commissions, Special Study Groups

Section I : *Positioning*
President: **F.K. Brunner** (Austria)
Secretaries: **Y. Bock** (USA)
(Comm X) **C. Boucher** (France)

Commission of Section I:
Comm. X : Global and Regional Geodetic Networks
President: **C. Boucher** (France)

Special Commission of Section I:
SC4: Applications of Geodesy to Engineering
President: **H. Kahmen** (Austria)

Special Study Groups of Section I
SSG 1.153 Precise Marine Positioning: Surface and Seafloor
Chairman: **D. Egge** (Germany)

SSG 1.154 Quality Issues in Real time GPS Positioning
Chairman: **C. Rizos** (Australia)

SSG 1.155 Active GPS Networks
Chairman: **H. Tsuji** (Japan)

SSG1.156 Advanced GPS Analysis for Precise Positioning
Chairman: **G. Blewitt** (UK)

SSG 1.157 GPS Ambiguity Resolution and Validation
Chairman: **P.J. de Jonge** (The Netherlands)

SSG 1.158 GPS Antenna and Site Effects
Chairman: **J. Johansson** (Sweden)

SSG 1.159 Use of GPS Positioning for Atmospheric Monitoring
Chairman: **M. Bevis** (USA)

Section II : *Advanced Space Technology*
President: **R. Rummel** (Germany)
Secretaries: **P. Willis** (France)
(Comm VIII) **G. Beutler** (Switzerland)

Commission of Section II:
Commission VIII: International Coordination of Space Techniques for Geodesy and Geodynamics (CSTG)
President: **G. Beutler** (Switzerland)
Secretary: **H. Drewes** (Germany)

Special Commissions of Section II
SC6: "Wegener Project"
President: **S. Zerbini** (Italy)

SC7 Gravity Field Determination by Satellite Gravity Gradiometry
President: **K.-H. Ilk** (Germany)

Special Study Groups of Section II
SSG 2.160 SAR Interferometry Technology
Chairman: **R. Klees** (The Netherlands)

SSG 2.161 Spaceborne Atmospheric Sounding
Chairman: **C. Rocken** (USA)

SSG2.162 Precise Orbits using Multiple Space Techniques
Chairman: **A.Marshall** (USA)
(Change at IAG EC meeting Nov. 9, 1995).

International Service in Section II:
International GPS Service for Geodynamics -IGS- (affiliated to FAGS)
Chairman of the Directing Board:
G. Beutler (Switzerland)
Director of the Central Bureau:
R. Neilan (USA)

Section III: *Determination of the Gravity Field*
President: **R. Forsberg** (Denmark)
Secretaries: **M.G. Sideris** (Canada)
(Comm III) **I. Marson** (Italy)
(Comm XII) **H. Sünkel** (Austria)

Commissions of Section III
Comm III: International Gravity Commission
President: **I. Marson** (Italy)

Comm XII: International Geoid Commission
President: **H. Suenkel** (Austria)

Special Study Groups of Section III
SSG3.163 Assessment and Refinement of Global Digital Terrain Models
Chairman: **D. Arabelos** (Greece)

SSG 3.164 Airborne Gravimetry Instrumentation and Methods
Chairman: **M. Wei** (Canada)

SSG 3.165 Global Gravity Field Determination and Evaluation
Chairman: **N. Pavlis** (USA)

SSG3.166 Local Gravity Field Modelling and Interpretation
Chairman: **T. Basic** (Croatia)

SSG 3.167 Regional Land and Marine Geoid Modelling
Chairman: **H. van Gysen** (South Africa)

International Services in Section III:
International Gravimetric Bureau -BGI- (affiliated to FAGS)
Director: **G. Balmino** (France)

International Geoid Service (IGeS)
Director: **F. Sansò** (Italy)

Section IV: *General Theory and Methodology*
President: **P. Holota** (Czech Republic)
Secretaries: **B. Heck** (Germany)
C. Jekeli (USA)

Special Commission of Section IV
SC1Mathematical and Physical Foundations of Geodesy -
President: **E.W. Grafarend** (Germany)

Special Study Groups of Section IV

SSG 4.168 Inversion of Altimetric Data
Chairman: **P. Knudsen** (Denmark)

SSG 4.169 Wavelets in Geodesy
Chairman: **B. Benciolini** (Italy)

SSG 4.170 Integrated Inverse Gravity Modelling
Chairman: **L. Ballani** (Germany)

SSG 4.171 Dynamic Isostasy
Chairman: **L.E. Sjoeberg** (Sweden)

SSG4.176: Temporal variations of the gravity field.
Chairman: **D.Wolf** (Germany)
(New SSG created by the Executive Committee in Nov. 1995.)

Section V: *Geodynamics*
President: **M. Feissel** (France)
Secretaries: **C. Wilson** (USA)
(Comm V) **H.-G. Wenzel** (Germany)
(Comm VII) **T. Tanaka** (Japan)

Commissions of Section V
Comm V: Earth tides
President: **H.-G. Wenzel** (Germany)

Comm VII: Recent Crustal Movements
President: **T. Tanaka** (Japan)

Special Commissions of Section V
SC3: Fundamental Constants
President: **E. Groten** (Germany)

SC8: Sea Level and Ice Sheet Variations
President: **W.E. Carter** (USA)

Special Study Groups of Section V
SSG 5.172 SSG5.172 Understanding Natural Hazards-The Geodetic Contribution
Chairman: **S. Okubo** (Japan)

SSG 5.173 Interaction of the Atmosphere and Oceans with the Earth's Rotational Dynamics
Chairman: **C. Wilson** (USA)

SSG5.174 Geophysical Interpretation of Temporal Variations of the Geopotential
Chairman: **A. Cazenave** (France)

SSG5.175 Interannual Variations of the Vertical and Their Interpretation
Chairman: **Z.X. Li** (China)

International Services in Section V
International Center of Earth Tides -ICET-
(affiliated to FAGS)
Director: **B. Ducarme** (Belgium)

International Earth Rotation Service -IERS-
(affiliated to FAGS)
Chairman of the Directing Board:
C. Reigber (Germany))
Director of the Central Bureau:
M. Feissel (France)

Permanent Service for Mean Sea Level -PSMSL-
(affiliated to FAGS)
Director: **P. L. Woodworth** (UK)

Bureau International des Poids et Mesures -BIPM-
Time Section:
Director: **C. Thomas** (France)

Committees reporting to the Bureau
Cassini Committee
Chairman: **W. Torge** (Germany)

Committee Geodetic Aspects of the Law of the Sea -GALOS-
Chairman: **P. Vanicek** (Canada)

Committee for Developing Countries:
Chairman: **F.Sansò** (Italy)
(appointed 1995-11-09)

Committee on the History of Geodesy
Chairman: **J. Weightman** (UK)

Educational Initiatives:
Coordinator: **R. Langley** (Canada)

Ad Hoc Planning Group
Establishment of a Crustal Deformation Bureau
Chairman: **W. Prescott** (United States)

SECTION I

POSITIONING
DETERMINATION DE POSITION

President: F.K. Brunner (Austria)
Secretaries: Y. Bock (USA)
C. Boucher (France)

I. Terms of reference

Section I is concerned with the scientific aspects of the measurement and analysis of regional and global geodetic networks as well as satellite, inertial, kinematic and marine positioning. The practical results of this research work should be made available through recommendations to National Survey Organisations. Applications of geodesy in engineering is a recent new task of Section I.

Tremendous advances of GPS surveying have occured especially in precision and applicability. However, there are some remaining issues of accuracy and reliability of GPS surveying (hardware and software) which need to be addresses carefully. Recently, GPS measurements have shown the potential to be used as remote sensing tool of atmospheric parameters.

II. Structure

Commissions :

Commission X : Global and Regional Geodetic Networks
President : C. Boucher (France)

Special Commissions :

SC4 : Applications of Geodesy to Engineering
President :H. Kahmen (Austria)

Special Study Groups :

SSG 1.153 : Precise Marine Positioning : Surface and Seafloor
Chairman : D. Egge (Germany)

SSG 1.154 : Quality Issues in Real Time GPS Positioning
Chairman : C. Rizos (Australia)

SSG 1.155 : Active GPS Networks
H. Tsuji (Japan)

SSG 1.156 : Advanced GPS Analysis for Precise Positioning
Chairman : G. Blewitt (UK)

SSG 1.157 : GPS Ambiguity Resolution and Validation
Chairman : P.J. de Jonge (Netherlands)

SSG 1.158 : GPS Antenna and Site Effects
Chairman : J. Johansson (Sweden)

SSG 1.159 : Use of GPS Positioning for Atmospheric Monitoring
Chairman : M. Bevis (USA)

Commission X

Global And Regional Geodetic Networks
Réseaux Géodésiques Globaux et Régionaux

President : **C. Boucher** (France)
Secretary : **H. Fagard** (France)

I) Purpose

The purpose is to focus on the variety of existing control networks (horizontal and vertical, national and continental, global from space techniques) as well as their connections and evolutions.

II) Charter

The Commission X has two types of subdivisions : Sub-Commissions and working groups.

(1) Sub-Commissions for large geographical areas :

Europe
North America
South America
Africa
South East Asia and Pacific
.....

Such Sub-Commissions will deal with all types of networks (horizontal, vertical and three-dimensional) and all related projects which belong to the geographical area. Such a Sub-Commission will be established only if sufficient active countries in the area want to participate.

(2) Working Groups for specific technical topics which are be relevant to the activities of the Commission X.

Such working groups should not substitute a SSG of IAG but rather look at technical and practical problems, in particular by establishing specifications for the countries and also possibly training seminars.

In addition Commission X will have a Steering Committee (SC) consisting of :

- president of the Commission
- presidents of the Sub-Commissions
- chairmen of the Working Groups

Each country member of IAG is allowed to appoint one representative to Commission X. If the country belongs to an area where a Sub-Commission has been already established, the representative will be a de facto member of the Sub-Commission. A Sub-Commission is free to have specific rules in addition to those of the whole commission. In particular they may ask for more than one representative for specific reasons.

Each country not yet being a full member of IAG is welcome to appoint an observer to the Commission. Members of Working Groups will be selected by the chairmen and approved by the SC after consultation of relevant people and representatives of countries.

Sub-Commission for Europe
(former EUREF and UELN/REUN)
President : E. Gubler (Switzerland)
Secretary : H. Hornik (Germany)

Sub-Commission for North America
President : TBD
Secretary : TBD

Sub-Commission for South America
President : TBD
Secretary : TBD

Sub-Commission for Africa
TBD

Sub-Commission for
South East Asia and Pacific
TBD

Working Group 1
Datums and Coordinate Systems
Chairman : J.P. Dufour (France)

The purpose of this group is to :

- establish standards and terminology about datums and coordinate systems (a preliminary work has been done in Europe and circulated in the EUREF Sub-Commission)

- participate to the worjk of the ISO TC 211 group on geographical information

- establish a catalogue of datum and coordinate systems existing over the World

Working Group 2
Use of GPS and IGS for ITRF densification
Chairman : W. Gürtner (Switzerland)

This group should establish specifications to process properly GPS campaigns using IGS products and to be if wished included rigorously into the densification of the ITRF/IGS network as a so called IGS regional network.

Working Group 3
Worldwide Unification of Vertical Datums
Chairman : W. Kearsley (Australia)

This group should investigate the possible actions to be undertaken to realize a global vertical datum and to determine its connection to the various existing vertical datums.

Steering Committee :

C. Boucher (France)	President
J.P. Dufour (France)	WG1
E. Gubler (Switzerland)	Subcomm. for Europe
W. Gurtner (Switzerland)	WG 2
W. Kearsley (Australia)	WG3

Contact or liaisons with related activities :

IAG bodies
Commission XII : H. Sünkel (Austria)
IERS : C. Boucher (France)
IGS : G. Beutler (Switzerland)

Other organizations
Defense Mapping Agency: R. Smith (USA)
SCAR: J. Manning (Australia)

Projects
AFREF : TBD

SIRGAS : H. Drewes (Germany)

III) National Representatives

C. Bruyninx	(Belgium)
M.R. Craymer	(Canada)
Y. Zhang	(China)
J. Kostelecky	(Czech Rep.)
F. Madsen	(Denmark)
A. Shaker	(Egypt)
M. Le Pape	(France)
E. Reinhart	(Germany)
J. Adàm	(Hungary)
H. Tsuji	(Japan)
D. Grant	(New Zealand)
O.M. Ostach	(Russia)
R.T. Wonnacott	(South Africa)
J.L. Caturla	(Spain)
W. Gürtner	(Switzerland)
W. Strange	(USA)

Special Commission SC 4

Application of Geodesy to Engineering

President : **H. Kahmen** (Austria)

Rapid developments in engineering, microelectronics and the computer sciences have greatly changed both instrumentation and methodology in engineering geodesy. The objectives of the Special Commission are on the one hand to document the body of knowledge in this field and on the other hand to encourage new developments and present them in a consistent frame work.

To accomplish the first objective, a group of internationally well-known scientists have been asked to contribute (by communicating and cooperating) in this task. In addition, a series of symposia will be planned to document the current state of development in engineering applications of geodesy. This will be an ongoing task of the Special Commission and therefore requires long-term planning by a group of leading specialists.

The second objective will be accomplished by four working groups which will be established in areas of current research interest and which will have specific goals which can be accomplished in a four year period.

Members :

M. O. Altan	(Turkey)
V. Ashkenazi	(United Kingdom)
J. M. Becker	(Sweden)
F. Brunner	(Austria)
W. Caspary	(Germany)
A. Chrzanowski	(Canada)
A. Detreköi	(Hungary)
H. Erwes	(Brazil)
H. Haggren	(Finland)
H. Henneberg	(Venezuela)
H. Ingensand	(Switzerland)
H. Kahmen	(Austria) - President
K. Linkwitz	(Germany)
G. Miler	(Bulgaria)
H. Nakamura	(Japan)
T. Oshima	(Japan)
O. Remmer	(Denmark)
M. Roic	(Croatia)
J. M. Rüeger	(Australia)
K. P. Schwarz	(Canada)
H. Schlemmer	(Germany)
B. Witte	(Germany)
B. N. Yambaer	(Russia)
P. Zazuliak	(Ukraine)

The following four working groups are considered as challenging:

1) SC 4 WG 1: "Mobile Multi-Sensor Systems"
Chairman: Naser El-Sheimy (Canada)

Comments and context:

To fullfil the need for up-to-date inventory and geometric data along transportation routes (roads, railways, rivers, pipelines) mobile inventory systems are being operated. In general motion of a vehicle in three-dimensional space can be described by six parameters: they are normally chosen as three position and three orientation parameters.

Frequently GPS integrated with other sensors is proposed to fullfil these trajectory requirements. In addition inventory and geometric data can be collected with sensors, such as: CCD cameras, extensometers, tiltmeters, laser scanners, etc. Normally the multi-sensor systems need highly efficient software tools to adjust and store data.

Members:

W. Benning (Germany)
J. B. Bullock (USA)
W. Caspary (Germany)
I. Colomina (Spain)
D. Cosandier (Canada)
H. Döller (Austria)
Naser El-Sheimy (Canada) - Chairman
A. Hasan (Canada)
W. Niemeier (Germany)
G. Presle (Austria)
G. Retscher (Austria)

2) *SC 4 WG 2: "Building Structures as Kinematic Systems"*
Chairman: G. Mentes (Hungary)

Comments and context:

Many tasks in engineering geodesy require monitoring the motion of objects, such as bridges and towers affected by wind, buildings and industrial establishments affected by recent crustal movements, land slides, etc. Instruments used to observe the motion are often fixed to the moving object or are moved with respect to the object. Consequently, the system parameters change. The aim of the working group is to develop mathematical and physical models as well as experimental methods for the determination of such parameter changes.

Members:

M. O. Altan (Turkey)
A. Bilajbegovic (Croatia)
F. Brunner (Austria)
B. Crippa (Italy)
E.-N. Dietz (Germany)
X. Ding (Australia)
T. Egeltoft (Sweden)
H. Heister (Germany)
O. Heunecke (Germany)
J. Kalmar (Hungary)
A. Kopacik (Slowakia)
G. Lachapelle (Canada)
G. Mentes (Hungary) - Chairman
H.-J. Mönicke (Germany)
H. Papo (Israel)
A. Pfeufer (Germany)
J. Piechocinski (Sweden)
W. Proszynski (Poland)
J. M. Rüeger (Australia)

3) *SC 4 WG 3: "High Precision Alignment Systems"*
Chairman: R. Ruland (USA)

Comments and context:

The development and application of high precision alignment systems has become increasingly important for the fields of civil engineering and manufacturing. Typical examples of applications are: high speed trains, dams, particle accelerators, aero-space industry, etc. The working group will summarize the state-of-the-art for these applications in algorithm development, instrumentation and special equipment, by analysing recent examples of challenging projects.

Members:

M. Mayoud (Switzerland)
Orén (USA)
R. Ruland (USA) - Chairman
Schauerte (Germany)
Schwarz (Germany)
A. Sprent (Australia)

(Additional members will be nominated by the chairman.)

4) *SC 4 WG 4: "Geometrical Investigation of Spatial Geodetic Problems"*
Chairman: Th. A. Wunderlich (Austria)

Comments and context:

The task of the proposed working group is to study, to describe and to develop the pure geometrical foundations and properties pertinent to new sophisticated geodetic techniques and to demanding architectural design. Modern geodetic measurement techniques, sometimes based on novel measurement quantities (like e.g. pseudoranges in GPS), have their own specific geometrical properties. Research is needed to gain insight into the geometrical behaviour and to isolate optimum and critical configurations.

The investigations have to be accompanied by the development of instructive software to visualize the findings for training purposes. Modern architectural designs, often in connection with precise prefab-manufacturing of plastic construction parts, demand geodetic conversion of the artistic idea into consistent geometric parameters and coordinates. Investigations are needed as an essential part of TQM on the major steps leading to the realization of the design, such as the geometrical elements and on-site assembly.

Members :

T. Ayan (Turkey)
A. Geiger (Switzerland)
R. Finsterwalder (Germany)
R. Heer (Germany)
M. Husty (Austria)
W. Rath (Austria)
R. Santerre (Canada)
P. Savvaidis (Greece)
Th. A. Wunderlich (Austria) - Chairman

Special Study Group 1.153

Precise Marine Positioning, Surface and Seafloor

Chairman : **D. Egge** (Germany)

Terms of Reference :

Precise marine positioning is an important subset of marine geodesy. As such, it is in close vicinity to the sciences of navigation and hydrography. Coordinates of stationary points on the continents have to be transported to points on the sea surface and on the seafloor, thereby extending geodetic control to these points. This is accomplished by measurements that involve moving interfaces such as satellites and surface vessels. In general, marine positioning is a multisensor effort in a dynamic environment with partly specialized instrumentation. This, in turn, leads to related modelling, estimation, and optimization problems. The rapid

evolution of computer and networking technology adds another dimension of complexity to the subject.

The purpose of this Special Study Group is to promote comprehensive research for precise geodetic positioning in the marine environment. The overall objectives are

- to help to improve our understanding of current capabilities and applications,
- to analyze remaining limitations,
- and to explore the possibilities of achieving future improvements.

Program of Activities :

1. This IAG Special Study Group (SSG) will attempt to focus on the relevant marine positioning aspects of the IAG Special Commission on Marine Positioning (ISCOMAP, 1991 - 1995).

2. The members of this SSG are invited to contribute their ideas and findings (copies of publications) to a central information pool maintained by the SSG Chairman.

Preferred study areas are:

a. Seafloor positioning.
b. Seafloor spreading.
c. Height systems and bathymetry.
d. Surface positioning.
e. Instrumentation / measurement techniques.
f. Modeling of observations and errors.
g. Geoid and mean sea level.
h. Estimation techniques.
i. Applications.

3. Participation in related symposia and meetings is encouraged.

4. It is planned to continue the very successful quadrennial symposia series known as "International Symposium on Marine Positioning" (INSMAP).

Special Study Group 1.154

Quality Issues in Real time GPS Positioning

Chairman : **C. Rizos** (Australia)

Main objectives :

Concerns about GPS positioning quality are shared by all users, from those engaged in the most precise geodetic applications through to the casual navigator. The quality of GPS positioning, however, is dependent on a number of factors. Experience with precise geodetic applications of GPS has shown that sophisticated mathematical modelling, careful field procedures and top-of-the-line GPS hardware are all necessary prerequisites. However great care still has to be applied to ensure that data quality is uniformly high. The procedure of data screening, position computations, result evaluation and quality assurance has generally been an off-line (as well as iterative) process. With the development of precise "on-the-fly" GPS positioning techniques it is no longer possible to process (and re-process) GPS data in post-mission mode until positioning quality is assured. The challenge therefore is to develop quality control and quality assurance procedures that can be applied in "real-time" (or "near-real-time") GPS positioning.

The work of the SSG on "Quality Issues in Real-Time GPS Positioning" will focus on identifying practical procedures, as well as mathematical techniques, that can be applied to assure the quality of positioning results obtained from this distinct class of GPS applications. The objectives of the SSG are to :

(a) IDENTIFY the main issues impacting on the "quality" of real-time GPS positioning - including those due to instrumental effects, environmental sources, site-dependent effects, communcations-dependent, etc.

(b) COMPILE a set of procedures, algorithms and guidelines that can be implemented within real-time GPS positioning software - this is the practical outcome.

(c) DEFINE areas for further research and development - as derived from practical experience on the one hand, and a study of the literature and research trends in the development of mathematical and/or empirical tools for "quality control".

Program of activities :

1. Compile and document the QC procedures and algorithms as implemented in scientific GPS geodesy software.

2. Investigate which of these procedures are adaptable for "real-time" operation - for example, for the detection of faulty navigation messages, data spikes, etc.

3. Compile a bibliography of QC literature specifically applicable to precise kinematic GPS positioning.

4. Research fault detection algorithms for real-time GPS applications.

5. Encourage discussion and critical evaluation of such algorithms.

6. Monitor the activity taking place in the development of quality control (QC) and quality assurance (QA) for standard pseudo-range based DGPS.

7. Determine the appropriate "mix" of QC/QA procedures that can be recommended for real-time precise GPS

positioning - as it is likely that a "cocktail" of procedures will be necessary to give greatest assurance on quality.

8. Prepare a comprehensive report on the SSG's activities and recommendations.

Members :

C. Rizos	(Australia) Chairman
E. Cannon	(Canada)
R. Galas	(Germany)
Y. Hatanaka	(Japan)
X. Jin	(The Netherlands)
H. Kutterer	(Germany)
S. Mertikas	(Greece)
P. Morgan	(Australia)
S. Oszczak	(Poland)
W. Roberts	(United Kingdom)
G. Seeber	(Germany)
M. Stewart	(Australia)

Special Study Group 1.155

Active GPS Networks

Chairman : **H. Tsuji** (Japan)

Terms of Reference

"Active GPS networks" originally referred to permanent GPS arrays which automatically collect continuous data from GPS satellites for the primary purpose of monitoring crustal deformations. However, it is clear that such GPS network data are useful for surveying and navigation. Currently, many national GPS networks allow a public access to their data (RINEX or RTCM) to support static/kinematic/RTK/DGPS applications of GPS. Compared to conventional geodetic networks, such GPS arrays are "active" because they transmit products through electronic media on a continuous basis.

The goal of our SSG is to exchange and maintain descriptive information on these active GPS networks of the world and provide a forum to discuss common issues in making full use of such networks in close relationship with IGS.

Objectives

To achieve the goal, the SSG will maintain a WWW home page on the internet, and provide information on active GPS networks of the world. It is planned that members will provide linked pages giving details of their own regional networks. The SSG will also investigate and discuss the common issues in making full use of active GPS networks such as:

- technical innovations in network operations (e.g. communications, high-density storage devices, receiver automated status reports);

- technical requirements for better user interface (e.g. efficient compression of observation data, addition of ancillary data, integrated user interface for baseline analysis);

- new application of active GPS networks (e.g. possibility of ionospheric monitoring, GPS meteorology, and GPS seismology).

Members

Members

H. Tsuji	(Japan) - Chairman
B.C. Ambrosius	(Netherlands)
H. Dragert	(Canada)
P. Fang	(USA)
L.P.S. Fortes	(Brazil)
R. Galas	(Germany)
J. K ahar	(Indonesia)
J-T.Lee	(Taiwan)
J. Manning	(Australia)
M.A. Marsella	(Italy)
M. Murray	(USA)
B.R. Pettersen	(Norway)
W.E. Strange	(USA)
S. Tatevian	(Russia)
A. Tealeb	(Egypt)
F. Webb	(USA)
U. Wild	(Switzerland)
R. Wonnacott	(South Africa)
W. Zhu	(China)

Corresponding members

C. Boucher	(France)
J.M. Johansson	(Sweden)
C. Rizos	(Australia)

Special Study Group 1.156

Advanced GPS Analysis for Precise Positioning

Chairman : **G. Blewitt** (United Kingdom)

I- Terms of Reference

The goal of SSG 1.156 is to improve high precision GPS static positioning over regional to global scales. This will be achieved by providing a forum for experts in today's high precision GPS software and analysis techniques, with the aim of improving the software's models, algorithms, recommended processing procedure, and recommended estimation strategies. This will be achieved by conducting a comparative study of the state-of-the-art in models and methodology.

II- Objectives

The specific objectives of SSG 1.156 are to :

(i) investigate how best to compare models and solutions from high precision GPS positioning software, and determine methods and measures for the assessment of solution quality;

(ii) comparatively assess current models and algorithms that are embodied in high precision GPS positioning software;

(iii) comparatively assess current processing procedures and estimation strategies employed by experienced analysts who demand the highest positioning accuracy over regional to global scales;

(iii) assess new models, algorithms, and strategies which are proposed by the SSG members.

The outcome of these activities will be a final report which contains :

(i) a comparative description and assessment of current high precision analysis software and methodology;

(ii) recommendations (wherever possible) for GPS analysis methods which are most appropriate for specific types of situations (ranging from epoch regional campaigns, to global network analysis);

(iii) proposed modifications to the IERS standards for GPS analysis.

III-Members

G. Blewitt	(United Kingdom) Chairman
Y. Bar-Sever	(USA)
G. Dick	(Germany)
P. Fang	(USA)
J. Johansson	(Sweden)
J. Kouba	(Canada)
K. Larson	(USA)
T. Martin-Mur	(Germany)
M. Rothacher	(Switzerland)
M. Schenewerk	(USA)
T. Springer	(Switzerland)
H. Tsuji	(Japan)
T. vanDam	(USA)
J. Zumberge	(USA)

Special Study Group 1.157

GPS Ambiguity Resolution and Validation

Chairman : **P.J. de Jonge** (The Netherlands)

Terms of reference

Ambiguity resolution has been a `hot' topic for the last five years or so. Starting from relative simple rounding schemes, sophisticated and sometimes time consuming algorithms have been devised. Despite the large effort spent by many groups from all over the world in devising various schemes, knowledge about their theoretical foundation, and how the schemes are related to each other, is still lacking. Different terminology is used and comparisons between methods are rare.

Due to a lack of knowledge about the various methods, the implementations used in the comparisons are not always complete, thereby making the test results unreliable. Moreover, results reported of one particular method, are often difficult to relate to the results of another method, due to lacking knowledge of the characteristics of the data and the type of computer that was used.

It is important to note that ambiguity resolution is applied in different fields (navigation, rapid static surveying, ambiguity resolution in regional networks), and that every application has its own special needs. The validation of the results is another important topic that needs more attention (especially for the navigation and rapid-static applications).

Objectives

The outcome of this Special Study Group should be

1. A further understanding of the problem of ambiguity resolution.

2. Understanding how the various algorithms work, and how they are related to each other.

3. Advantages and disadvantages of each class of methods.

These goals can be met by

1. A formulation of a consistent terminology, or at least a translation between the terms that are used.

2. A classification and description of the various methods, using a standard terminology to clearly see the differences and similarities of the methods. This will lead to a better understanding of the concepts of the existing methods, and possibly to improvements.

3. Collection of test sets, consisting of data, a detailed description of it, and a ground truth for the integer ambiguities. The test sets should be exemplary for what is encountered in practice.

4. Comparisons of the various algorithms with the help of the test sets of (3).

Members :

P. de Jonge	(The Netherlands) - Chairman
H. Abidin	(Indonesia)

B. Betti	(Italy)
S. Corbett	(United Kingdom)
M. Crespi	(Italy)
H.-J. Euler	(Switzerland)
S. Han	(Australia)
H. Kutterer	(Germany)
H. Landau	(Germany)
B. Marana	(Italy)
M. Martin-Neira	(the Netherlands)
D. Marujoao	(Portugal)
J. Galera Monico	(Brasil)
S. Schaer	(Switzerland)
B. Remondi	(USA)
W. Werner	(Germany)
P. Willis	(France)
G. Wuebbena	(Germany)
M. Yang	(Taiwan)
Z. Li	(Canada)

Special Study Group 1.158

GPS Antenna and Site Effects

Chairman : **J. Johansson** (Sweden)

I- Terms of Reference

The improvement in precision obtained from GPS observations over recent years has revealed problems related to the local conditions at the GPS sites. In order to further improve high precision GPS positioning, orbit determination, and the estimates of atmospheric parameters, investigations of site dependent effects are required. The establishment of large numbers of permanent GPS stations on global, regional, and local scales has also raised concerns regarding the monuments used and the long- and short-term mechanical and electromagnetic stability of the sites.

The goal of SSG 1.158 is to provide information and recommendations regarding the reduction of site dependent effects such as those related to GPS antennas, radomes, electromagnetic scattering, monuments and local stability, radio interference, and local atmospheric conditions.

This goal will be achieved by providing a forum for discussions and for the exchange of ideas and literature. Interaction with the IGS community, regional and national GPS networks, and other study groups in Section I are essential to achieving the goals of the SSG.

II- Objectives

The objectives of SSG 1.158 are to :

(I) investigate the characteristics of different GPS antennas (mainly those used in high-precision applications) based on measurements in anechoic chambers, field experiments, and numerical evaluation; study the effects of "antenna mixing;" design and evaluate new space GPS antennas;

(II) study the influence of electromagnetic scattering (including multipath) and provide information on how to minimize these effects;

(III) investigate and formulate recommendations regarding establishment of new GPS sites, including the design and construction of pillars (monuments) and the monitoring of their long-term stability; evaluate radomes used to protect permanently installed antennas;

(IV) study and minimize the influence of snow, rain, and local atmospheric conditions on the final estimates;

(V) provide information and recommendations on how to eliminate (or minimize) the effects of radio interference.

The outcome of these activities will be summarized in a final report which contains information regarding site dependent effects and how to minimize them, recommendations (wherever possible) of appropriate solutions for the establishment of new GPS sites, and proposed modifications to GPS processing standards.

III- List of Members

Members

J. Johansson	(Sweden) - Chairman
J. Campbell	(Germany)
T. Clark	(USA)
J. Davis	(USA)
C. Dunn	(USA)
A. Geiger	(Switzerland)
K. Jaldehag	(Sweden)
H. Koivula	(Finland)
R. Langley	(Canada)
K. Larson	(USA)
G. Mader	(USA)
C. Meertens	(USA)
P. Morgan	(Australia)
A. Rius	(Spain)
M. Rothacher	(Switzerland)
B. Schupler	(USA)
J. Tranquilla	(Canada)
D. Van Loon	(The Netherlands)
L. Vittuari	(Italy)
R. Warnant	(Belgium)

Corresponding Members

G. Blewitt	(UK)
B. Burki	(Switzerland)
U. Lindqwister	(USA)
S.Musyoka	(Germany/Kenya)
C. Rizos	(Australia)
W. Schlueter	(Germany)
H. Tsuji	(Japan)

Special Study Group 1.159

Use of GPS Positioning for Atmospheric Monitoring

Chairman : **M. Bevis** (USA)

I. Main Objectives

In recent years is has become clear that continuous GPS networks can support a variety of meteorological applications. These applications include the study of climate and climate change, operational weather analysis and prediction, and basic research into tropospheric phenomena.

The main objectives of this SSG are :

(i) to identify the range of measurements that may be useful to the meteorological community,

(ii) to explore the many technical issues associated with optimizing such measurements in real-time and non-real-time settings,

(iii) to provide an interface between the geodetic and the meteorological communities, and

(iv) to advise the IGS on how the global tracking network can optimize its support of GPS meteorology,

(v) to investigate possible synergies between GPS meteorology and similar measurements made with VLBI or other geodetic techniques.

This SSG will not focus on characterization of the ionosphere, nor on space-based GPS meteorology, except to the extent that these areas intersect ground-based GPS characterization of the neutral atmosphere.

II. Program of Activities

1. Promote Discussions between Meteorologists and Geodesists about Goals and Priorities

Identify the various classes of measurements that can be made by GPS networks and specific meteorological applications in which each class of measurement might be useful. For example, numerical weather models could assimilate geodetic estimates of total column estimates such as precipitable water (PW), but also estimates of lateral gradients in these quantities at each GPS station, and even pointed measurements in which quantities are gauged along a specific station-satellite raypath. It may be that the computational burden associated with assimilating pointed measurements (and ray tracing) so greatly exceeds that associated with assimilation of total column variables such as PW, that operational meteorologists may assign these GPS measurements very different priorities on purely practical grounds. Geodesists need to understand these nuances as they explore new estimation strategies.

2. Discuss New or Improved Approaches to Measurement of Delay and Water Vapor Structure

Topics include

(i) optimizing mapping functions, including anisotropic mapping functions,

(ii) prior versus posterior decomposition of the total neutral delay into its hydrostatic and wet components,

(iii) antenna-related noise sources,

(iv) the role of ephemerides, including predicted ephemerides for nearly-real-time estimation,

(v) software architectures for real-time analysis, etc.

3. Promote and Discuss External Comparisons

There is considerable interest in comparing GPS-derived estimates of delay and PW, and of lateral gradients in these quantities with those derived from other classes of geodetic system (such as VLBI and DORIS) and from instruments more routinely employed by atmospheric scientists (such as water vapor radiometers, radiosondes, LIDAR, etc.).

4. Identification and Distribution of Standard Datasets

A few 'standard' regional and global datasets would greatly facilitate the intercomparison of GPS-derived quantities such as PW, by groups using different hardware, algorithms, software packages, and orbital solutions. The various GPS-derived time series might also be useful for meteorologists examining the impact of these data products on numerical weather prediction, climate models, etc. Of course, datasets that include some basis for external comparison are likely to prove the most useful.

III. Membership

Members

J. Beavan	(New Zealand)
M. Bevis	(USA) - Chairman
B. Bürki	(Switzerland)
S. Businger	(USA)
J. Davis	(USA)
A. Dodson	(UK)
G. Elgered	(Sweden)
G. Gendt	(Germany)
R. Ichikawa	(Japan)
S. Keihm	(USA)
G. Kirchengast	(Austria)
R. Langley	(Canada)
V. Mendes	(Portugal)
I. Naito	(Japan)
A. Rius	(Spain)
B. Sierk	(Switzerland)
P. Willis	(France)

Correspondin,g Members

H. Tsuji	(Japan)

SECTION II

ADVANCED SPACE TECHNOLOGY
TECHNOLOGIE SPATIALE AVANCEE

President: R. Rummel (Germany)
Secretaries: P. Willis (France)
G. Beutler (Switzerlands)

I- Objectives

Section II, Advanced Space Technology, is engaged in new space techniques for geodesy and geodynamics. Its objectives are to anticipate and promote their implementation into geodetic/geodynamic work and, in general, support and coordinate the optimal use of modern space technology for the benefit of geodesy.

For the coming term the activities of the section include:

1. Promotion of the realization of space experiments for the improvement of our knowledge of the Earth's gravity field in the medium spatial wavelengths.

2. Improvement of the coordination and combined use of the full range of geodetic space techniques, such us SLR, VLBI, GPS, DORIS, PRARE.

3. Continuation of the successful work of WEGENER with a broadened, new scope.

4. Stimulation of the geodetic use of interferometric SAR and of spaceborne sounding with global satellite navigation systems.

5. Development of concepts on how to come to an optimal worldwide distribution of geodetic/geophysical fundamental stations.

6. Continuation and further improvement of the work of I.G.S.

II-Structure

Commissions :

Commission VIII : International Coordination of Space Techniques for Geodesy and Geodynamics (CSTG)
President: G. Beutler (Switzerland)
Secretary: H. Drewes (Germany)

Special Commissions :

SC 6 : Wegener Project
President : S. Zerbini (Italy)

SC 7 : Gravity Field Determination by Satellite Gravity Gradiometry
President : K.-H. Ilk (Germany)

Special Study Groups :

SSG 2.160 : SAR Interferometry Technology
Chairman : R. Klees (The Netherlands)

SSG 2.161 : Spaceborne Atmospheric GNS Soundings
Chairman : C. Rocken (USA)

SSG 2.162 : Precise Orbits using Multiple Space Techniques
Chairman : A. Marshall (USA)

International Service

International GPS Service for Geodynamics (IGS)
Chairman of the Governing Board:
G. Beutler (Switzerland)
Director of the Central Bureau :
R.E. Neilan (USA)

Commission VIII

INTERNATIONAL COORDINATION OF SPACE TECHNIQUES FOR GEODESY AND GEODYNAMICS
(C S T G)

President : **G. Beutler** (Switzerland)
Secretary : **H. Drewes** (Germany)

I- General Objectives

The Commission on International Coordination of Space Techniques for Geodesy and Geodynamics (CSTG) was established during the XVII-th General Assembly of the IUGG in Canberra in 1979. It is Commission VIII in Section II of the International Association of Geodesy (IAG) and Subcommission B.2 in COSPAR. The charter of the commission is the following :

"Develop links between various groups engaged in the field of space geodesy and geodynamics by various techniques, coordinate work of these groups, elaborate and propose projects implying international cooperation, follow their progress, and report on their advancement and results."

The role of the CSTG is to facilitate the activities of national and international groups through the collection and dissemination of information within the groups and the member countries mainly through correspondence and also through international or regional meetings and to help in setting up coordinated multi-national observing projects and scientific investigation programs.

CSTG operates through an Executive Committee through the National Representatives in carrying out the Commission objectives stated in the charter. In addition a number of Projects and Subcommissions have been created to coordinate activities in the field of space geodesy and geodynamics which could benefit from the coordinating role of the Commission. Each Project and Subcommission has its own organizational structure and must issue its own informational bulletins or newsletters. Projects generally consist of highly focused activities over a limited period of time, Subcommissions cover long-term programs, often with programmatic implications.

It is the Commission plan to promote space geodesy in areas of the world in which there have been few space geodetic measurements and to encourage the continued conduct of comparisons between space geodetic techniques. The commission will also encourage the development of new techniques and application areas.

The CSTG will encourage dissemination of information between the various groups engaged in space geodesy and geodynamics through the publication of the CSTG Bulletin.

II- Objectives 1995-1999

In geodesy we have seen the evolution of VLBI, Satellite- and Lunar Laser- Ranging, and GPS as very powerful space techniques. We have also seen the evolution of two services, namely the IERS (International Earth Rotation Service) and the IGS (International GPS Service for Geodynamics), providing information to the scientific community. New techniques (Glonass, Doris, Prare) are coming up now, spaceborne applications of the GPS are becoming more and more routine. In this environment we envisage the following main objectives for the next four years :

1. So far, each technique was producing its own results without taking into account (at least not to the extent possible) the achievements of the other techniques. Results (coordinates and earth rotation parameters) are compared by the IERS, a combination is done on a very high level by simple averaging processes. It is clear, however, that more rigorous analysis techniques (ideally common processing of different techniques or equivalent procedures) must lead to better results. Also, it is possible today to observe the same satellites with different techniques (e.g. using SLR, GPS, DORIS, PRARE). The coordination of activities and efforts in these domains is the main objective of the newly established CSTG project "Coordination and Combination of the Analysis in Space Geodesy" and the subcommission "Precise Satellite Microwave Systems".

2. It is clear from the scientific point of view that VLBI, Laser Ranging, and satellite microwave techniques are indispensable as contributors to space geodesy. It is also clear, on the other hand, that operational costs play an essential role. Making optimum use of the existing tracking networks, developing low cost equipment, optimizing observation schedules and processing strategies will be the key issues within the techniques subcommissions.

3. Network optimization will have to be considered by all subcommissions. The problem of collocating the networks and/or of co-locating different techniques in one and the same observatory will be studied.

4. Dissemination of information is considered an essential tool in CSTG. We plan to issue at least one CSTG Bulletin per year.

III-Structure

Executive Committee :

G. Beutler	(Switzerland)	President
H. Drewes	(Germany)	Secretary
B.E. Schutz	(USA)	Past President
T. Clark	(USA)	Chairman, VLBI Subcommission
J. Degnan	(USA)	Chairman, SLR and LLR Subcommission

P. Willis	(France)	Chair, Subcommission on Precise Satellite Microwave Systems
J. Bosworth	(USA)	Chairman, Earth Science Sites (ESS) Sub-commission
T. Herring	(USA)	Chairman, Project on Coordination and Combination of Space Geodetic Analysis

Subcommissions :

Subcommission
VLBI (Very Long Baseline Interferometry)
Chairman : T.A. Clark (USA)

Established as subcommission on "International Radio Interferometric Surveying (IRIS)" in 1983. Renamed as VLBI Subcommission in 1995 at XXI-th IUGG General Assembly in Boulder.

Subcommissiopn
Satellite Laser Ranging (SLR) and Lunar Laser Ranging (LLR)
Chairman : J. Degnan (USA)

Established in 1986 as SLR subcommission. Scope broadened to include LLR in 1995 at XXI-th IUGG General Assembly.

Subcommission
Precise Satellite Microwave Systems
Chairman : P. Willis (France)

This subcommission was established in 1995 at the XXI-th IUGG General Assembly in Boulder. It replaces the former Subcommission on GPS. This seems to be justified because the IGS (International GPS Service for Geodynamics), formerly a CSTG project, now (in 1995) established as an International Service under Section II, is taking care of the International coordination and promotion of the GPS technique. Coordination between the established GPS techniques and the upcoming GLONASS, DORIS, PRARE systems is the main objective of this subcommission.

Subcommission
Geodetic and Geophysical Sites
Chairman : J. Bosworth (USA)

Established in 1989 as the Site Issues Sub-commission to identify, discuss and disseminate information on the types of monuments, monument stability and local site surveys necessary for various space geodetic measurement systems. Officially renamed the Geodetic and Geophysical Sites Subcommission at the twenty-first IUGG General Assembly in Boulder.

Project
Coordination and Combination of the Analysis in Space Geodesy
Chair : T. Herring (USA)

Established at the XXI-th IUGG General Assembly in Boulder. Coordinating the analysis of different space techniques, encouraging common processing strategies and common observations is the the key objective of this subcommission.

IV-National Representatives

The IAG member countries had the opportunity to nominate new National Representatives at the XXIst IUGG General Meeting in Boulder. The National Representatives also considered as the steering committee of the CSTG. Not all IAG country nominated representatives. Nominations are still possible and would undoubtedly facilitate the flow of information.

J. Manning	(Australia)
H. Sünkel	(Austria)
R. Warnant	(Belgium)
J. Kouba	(Canada)
Hu Jianguo	(China)
M. Bursa	(Czech Rep.)
B. Madsen	(Denmark)
A. Shaker	(Egypt)
J. Kakkuri	(Finland)
R. Biancale	(France)
R. Schluter	(Germany)
G. Veis	(Greece)
P. Denys	(New Zealand)
B. Ambrosius	(Netherlands)
B. Engen	(Norway)
I. Fejes	(Hungary)
B. Rajal	(India)
G. Bianco	(Italy)
T. Kato	(Japan)
B. Okumu	(Kenya)
Kim Cha Un	(Korea)
J.B. Zielinski	(Poland)
M. Prilepin	(Russia)
M.C. Perez-Urquiola	(Spain)
G. Nicholson	(South Africa)
J. Hefty	(Slovakia)
B. Ronnang	(Sweden)
W. Gurtner	(Switzerland)
R.M. Rezgui	(Tunisia)
S.M. Nakiboglou	(Turkey)
M. Watkins	(USA)
M. Yatskiv	(Ukraine)
A. Sinclair	(United Kingdom)

Special Commission SC 6

WEGENER PROJECT

Geodetic Investigations Related to the Kinematics and Dynamics of the African, Arabian and Eurasian Plates

President: **S. Zerbini** (Italy)

I. Main Objectives

Three main objectives have been defined. They are:

1. The investigation of deformations along the African-Arabian/Eurasian plate boundary which includes:

- determination of the relative plate motions in the framework of 3-D global plate motions,
- estimation of the extent of the deformation zones directly associated with the plate boundaries,
- assessment of the relative magnitudes of horizontal and vertical change and the variation of the deformations occurring across the boundary zones,
- interpretation and use of geodetic results as constraints on geodynamic models of the African-Arabian/Eurasian collision zone;

2. The investigation of post-glacial rebound in Fennoscandia, which includes:

- estimation of the extent of the rebound phenomena in the Fennoscandia region,
- determination of the rate of vertical deformation and the variation of rate as a function of distance from the centres of rebound,
- analysis of the geodetic results to constrain the viscosity of the mantle and the models describing deformation of the lithosphere in response to loading;

3. The investigation of height variation and changes of sea level, which includes:

- contributions to the establishment of a common global height datum,
- determination of improved geoidal information for the plate boundary and Fennoscandian regions,
- estimation of the relative magnitudes of the different factors contributing to height and sea-level variations and the relationship of changes in sea level to global change.

Each of these objectives will draw upon the data collection and analysis of GPS, SLR, VLBI, DORIS, PRARE, absolute and relative gravimetry, satellite altimetry and additional data sources.

II. Program of Activities

The currently scheduled activities comprise both field measurements and analysis. These include:

1. Research focused on the completion and maintenance of a reference frame adequate for the monitoring of horizontal and vertical crustal motion on the spatial and time scales addressed by the foregoing objectives.

2. Extensive space geodetic observations in the reference frame along the southern boundary of the Eurasian plate from the Azores to the eastern limit of its collision with the Arabian plate.

3. Space geodetic and terrestrial measurements to investigate the extent and magnitudes of Fennoscandian post glacial rebound and its associated effects, in this reference frame.

4. Space geodetic and terrestrial measurements to determine the origins and magnitudes of height variation and their relevance for understanding the interaction of crustal motion and sea level fluctuations.

5. Development and exploitation of models and analytical techniques to facilitate the estimation of time-dependant three-dimensional positional change, the separation of exogenic and endogenic effects, and the time-dependant components of the gravity field.

6. Inter-disciplinary interpretation of the results.

7. Evaluation and comparison of the observational techniques (in terms of reliability, continuity and accuracy) for meeting these goals.

III. WEGENER Structure

The WEGENER project structure has been organized in the following way:

Science Advisory Committee

H.G. Kahle (Switzerland)
I. Marson (Italy)
M. Pearlman (USA)
H.-P. Plag (Germany) - Chairman
R. Rummel (Germany)
D. Smith (USA)
W. Spakman (The Netherlands)
S. Tatevian (Russia)
P. Wilson (Germany)
S. Zerbini (Italy)

Executive Committe

G. Beutler (Switzerland)
J. Bosworth (USA)
C. Boucher (France)
B. Engen (Norway)
I. Kumkova (Russia)
J. LaBrecque (USA)
C. Reigber (Germany)
H. Seeger (Germany)

S. Zerbini (Italy) - Chairman

Technology Committee

B. Ambrosius (The Netherlands)
T. Baker (United Kingdom)
L. Bastos (Portugal)
G. Bianco (Italy)
G. Blewitt (United Kingdom)
T. Clark (USA)
J. Degnan (USA)
B. Richter (Germany) - Chairman
P. Tomasi (Italy)

Special Commission SC 7

Gravity Field Determination by Satellite Gravity Gradiometry

President: **K.-H. Ilk** (Germany)

I. Main Objectives

The necessity of a high-resolution spaceborne gravity field mission was defined already in 1969 in the so--called Williamstown Report by the leading geo--scientists at that time. The idea was to derive the gravity field and positions at the earth's surface and in space consistently at the same level of precision. For various technological as well as political reasons such a mission could not be realized within the last twenty five years despite the intensive work of many individual scientists and scientific groups and the International Association of Geodesy (IAG) as a whole.

The main objective of SC7 is therefore to create a forum that integrates all current international activities related to gravity field determination by satellite gravity gradiometry and to prepare the conditions for a future mission. In detail, the special commission shall

- represent IAG interests in such a mission on a political level,
- support a gravity gradiometry mission by scientific studies,
- investigate scientific and commercial applications of a very precise high resolution gravity field,
- assist in coordination and definition of national and international concepts related to gravity gradiometry,
- act as advisor to national and international bodies responsible for such a mission,
- inform the geodetic community about all these activities.

Steering and Advisory Committee

To make the work of the Special Commission as effective as possible and to integrate all interests to meet these objectives a 'Steering and Advisory Committee' within the Special Commission has been created. The commission consists currently of fifteen scientists actively involved in satellite gravity gradiometry:

G. Balmino	(France)
K.H. Ilk	(Germany)
W. Keller	(Germany)
R. Koop	(The Netherlands)
Ph. Moore	(UK)
H.J. Paik	(USA)
R. Rapp	(USA)
R. Rummel	(Germany)
F. Sansò	(Italy)
P. Schwintzer	(Germany)
C.K. Shum	(USA)
H. Sünkel	(Austria)
B. Tapley	(USA)
C.C. Tscherning	(Denmark)
M. Vermeer.	(Finland)

Task Groups

The following four task groups are bodies of the Special Commission:
Ad hoc Group 'Scientific objectives'
CIGAR-IV Study Group
STEP-Geodesy Working Group
Working Group 'Application of Boundary Value Techniques to Satellite Gradiometry'

Ad hoc Group "Scientific objectives"

As agreed at a joint meeting of NASA'S EOS-SEC and ESA'S Earth Observation and Advisory Committee at ESA headquarter on May, 11 to 12, 1995 a joint group has been formed that will review the science rational for a dedicated gravity field mission and formulate a concise and readable document for future discussion of the science community with space agencies, government organizations, etc.

CIGAR-IV Study Group

In the years since 1987 ESA supported a number of studies to investigate various questions related to the processing of gravity gradient measurements, eventually combined with precise satellite--to--satellite tracking data. Within these so--called CIGAR studies (I to III) all European scientists working in the field of future gravity field determination techniques found a forum for discussion and exchange of ideas. Present CIGAR-IV Scientific manager: H. Sünkel.

STEP-Geodesy Working Group

At this moment a main candidate for the realization of a gravity field mission is the geodesy experiment on STEP. It consists of a combination of spaceborne GPS and (very likely) single component gradiometry at reasonably low altitude and with an almost polar orbit. This mission has not been selected im spring 1993 as

medium mission 2 (M2) of the ESA science program but will compete again in spring 1996 for selection as M3.

Working Group 'Application of Boundary Value Techniques to Satellite Gradiometry'

This working group, under the chairmanship of W. Keller, is intended to continue the successful work of IAG Section IV Special Study Group 'Application of Boundary Value Techniques to Space-- and Airborne Gradiometry'.

The aim is to study satellite gravity gradiometry in the framework of the so--called spacewise approach. In this approach the gradiometer data are considered as sampled boundary values on a surface representing the satellite orbit. The relationship of those boundary data with the unknown gravitational potential is formulated as a boundary value problem and solved with related techniques.

The work of the group will concentrate on some unsolved problems related to existence and uniqueness of the solution, data reduction problems, development of numerical solution strategies, investigation of aliasing effects and to investigation of various geodynamic applications.

Members:

A. Albertella	(Italy)
V. Belikov	(Russia)
W. Freeden	(Germany)
M.v.Gelderen	(The Netherlands)
B. Heck	(Germany)
M. Hirsch	(Australia)
R. Klees	(Germany)
M. Schreiner	(Germany)
M. Thalhammer	(Germany)
M. Vermeer	(Finland)

Special Study Group 2.160

Spaceborne INSAR Technology

Chairman: **R. Klees** (The Netherlands)

I- Terms Of Reference

The special study group shall concentrate on the following topics :

1. Basic Principles and Theory of spaceborne INSAR
2. Modelling and software development for deriving DEMs
3. Modelling and software development for detecting deformations
4. Limitations to INSAR
5. Validation of INSAR results

II- Program Of Activities

The main focus point for present use of spaceborne INSAR (INterferometric Synthetic Aperture Radar) data is the generation of digital elevation models (DEMs) and the detection of deformations of the surface and of artifical objects. Although these kind of INSAR applications are rather new, this field develops very fast since the first results have become known in the mid-eighties.

In Geodesy, however, the technique is rather unknown although the generation of DEMs and especially the detection of surface and object deformations are treated in geodesy for a long time using other techniques.

Therefore, one term of reference of the SSG should be to promote INSAR within the geodetic community. This covers especially a review of synthetic aperture radar technique, its basic principles and theory, and the INSAR data processing. The activities should result in one of more overview articles on the state-of-the-art of the technique, its basic principles, the data processing, the applications, and the limitations.

One main application of INSAR is the generation of DEMs. Although airborne across-track interferometer might be best suited at the moment for that purpose, the SSG should focus on spaceborne single antenna SAR, e.g. ERS-1, ERS-2, RADARSAT. The SSG should contribute to the improvement of the mathematical models and of the processing algorithms to achieve optimal accuracies.

Main focus should be on the use of spaceborne INSAR for detecting deformations. The activities should include both modelling and processing aspects. With respect to modelling the SSG should concentrate on the the role of topography (DEMs) for detecting of deformations and on the problem of decorrelation. Especially the influence of the atmosphere on the results needs to be investigated. With respect to the data processing the SSG should contribute to the development and comparison of different algorithms for phase unwrapping and to the application of filter techniques.

The application of INSAR for detecting deformations have been shown in several field experiments. However, most of them have been run under rather "nice" conditions. Therefore, there is a need to investigate what can be obtained under less optimal conditions. Different conditions of surfaces, such as vegetation, slopes, urbanization, humidity should be assessed. The different error sources should be identified and quantified, e.g. by processing appropriate SAR images taken under different conditions. The mathematical models have to be improved correspondingly and have to be checked by comparison with independent ground truth. The next step then contains the integration of INSAR results with other observations, especially with GPS, levelling, and

atmospheric data. Therefore, the SSG should focus on the problem of validation of INSAR results and integration with information provided by other sensors.

Supporting activities which also aim at improving and strenghtening the output and the cooperation within the group should be: the distribution of relevant reports, papers etc. at time of submission among all members, the exchange of information on interesting INSAR-meetings, the choice of some basic INSAR scenes for modelling and error studies, the creation of an INSAR bibliography, and the exchange of information concerning interferometric software packages. Moreover, the SSG intents to initiate and organize a field experiment for investigating the application of INSAR for detecting surface deformations under real conditions.

III- Membership

R. Bamler (Germany)
S. Coulson(Italy)
Ph. Hartl (Germany)
R. Klees (The Netherlands) - Chairman
D. Massonnet (France)
M. Murakami (Japan)
C. Pearson (New Zealand)
M. Schmidt (Germany)
P. Vachon (Canada)
E. van Halsema (The Netherlands)

Special Study Group 2.161

Spaceborne Atmospheric GNS Soundings

Chairman : **C Rocken** (USA)

I-Introduction :

GPS and GLONASS are Global Navigational Systems (GNS) that were developed for precise positioning and timing on earth and vicinity. GNS signals that travel through the atmosphere to low earth orbiting satellites (LEOs) can also be used to obtain profiles of atmospheric and ionospheric properties.

This is done using radio occultation methods, originally developed at Stanford University and at the Jet Propulsion Laboratory (JPL) for planetary exploration. Since the successful launch of the first GPS receiver for atmospheric soundings in April, 1995, these techniques are now also applied to study the earth's atmosphere.

In light of promising early results from this proof-of-concept launch, we can expect a dramatic increase in activities to use GNS for active atmospheric sounding from space over the next years.

II-Objectives :

Future work and research in the field of active atmospheric GNS soundings will lead to progress in (a) the technology of occultation methods, and in (b) the impact that these data will have on society and on other fields of science. This study group shall function as a focal point in the discussions on progress in the following areas:

(1) The Technique of Using GPS for Active Atmospheric Limb Sounding

(a) Hardware and software developments for sounding the lower troposphere
(b) Use of Y-code and/or additional carrier frequencies
(c) Correcting for multipath effects
(d) Separating water vapor and temperature effects
(e) The ionosphere as noise and signal
(f) Profiling and tomographic techniques
(g) Comparison of GNS Limb Sounding with other techniques (Validation Studies)

(2) The Impact of the Sounding Data:

(a) Data assimilation into meteorological models - what data type shall be used?
(b) Combination of GNS Limb Sounding data with other atmospheric data
(c) Timeliness requirements for weather and climate studies
(d) Future experiments
(e) Operational LEO constellations - (How many satellites, Optimal Orbits, etc.)
(f) Use of the data: Meteorology, SAR, Communications, Airlines, etc. ...

III-Members :

M.Gurbonov	Russia
S. Sokolovskiy	Russia
P. Schwintzer	Germany
X. Zou	USA
T.P. Yunck	USA
T.K. Meehan	USA
B. Herman	USA
C. Rocken	USA
M. Exner	USA
G.A. Hajj	USA
P. Hoeg	Denmark
A. Jungstand	Germany
N. Jakowski	Germany
R. Govind	Australia
K.R. Hardy	USA
D. Anderson	USA
J. Eyre	UK
W. Smith	USA
J. Davies	USA
W. Spakman	The Netherlands

Special Study Group 2.162

Precise Orbits Using Multiple Space Techniques.

Chairman : **A. Marshall** (USA)

I. Terms Of Reference

TOPEX/POSEIDON (T/P) carries five independent tracking systems including Satellite Laser Ranging (SLR), Doppler Orbitography and Radio Positioning Integrated by Satellite (DORIS), Global Positioning System (GPS), the Tracking and Data Relay Satellite System (TDRSS), and its own radar altimeter. For the first time, the force model errors, especially gravity, have been reduced to a point where a comparison of the various satellite tracking systems at or near their noise level is possible. Results, as expected, show that each system has its own strengths and weaknesses.

Therefore, future precision orbit determination improvements for T/P, as well as other satellites such as GPS, ERS-2, and TDRS, will likely entail a combination of multiple tracking techniques. The focus of this study group will be to further evaluate and characterize the various tracking systems, develop and assess new tracking techniques, and apply the products to improve the state-of-the-art in precision orbit determination.

II. Program Activities

1. Characterize the strengths and weaknesses of all of the current and proposed precise tracking techniques including SLR, DORIS, GPS, TDRSS, GLONASS, Precise Range and Range-Rate Equipment (PRARE), and satellite altimetry.

2. Where possible, assess the impact of multiple tracking techniques on a single spacecraft (i.e. T/P, GPS-35, GPS-36, ERS-2, EUVE).

3. Attempt to resolve discrepancies between the various techniques (i.e. the unexplained "Z-bias" observed between the SLR/DORIS and GPS based T/P orbits).

4. Develop and evaluate alternative tracking techniques to further improve satellite positioning (i.e. use the SLR/DORIS orbits from T/P to refine the TDRS and TDRSS-user satellite ephemerides).

III- Membership

B. Ambrosius (The Netherlands)
P. Andersen (Norway)
W. Bertiger (USA)
R. Coleman (New Zealand)
J. Dow (Germany)
B. Haines (USA)
C. Huang (China)
S. Luthcke (USA)
A. Marshall (USA) - Chairman
F.H. Massmann (Germany)
F. Nouel (France)
E. Pavlis (USA)
J. Ries (USA)
E. Schrama (The Netherlands)
L. Senhal (Czech Republic)
C.K. Shum (USA)
P. Visser (The Netherlands)
M. Watkins (USA)
S. Zhu (Germany)

The International GPS Service for Geodynamics (IGS)

Chairman of the Governing Board :
G. Beutler (Switzerland)
Director of Central Bureau : **R.E. Neilan** (USA)

1. Development

The International GPS Service for Geodynamics (IGSwas established as an official IAG service on January 1, 1994. First discussions took place in 1989 at the IAG General Assembly in Edinburgh. The IAG Planning Committee
for the IGS was established by the IAG in April 1990 in Paris. This Committee, chaired by Prof. I.I. Mueller, issued the "Call for Participation" in April 1991. Based on the positive responses (about 100 agencies volunteered to take over responsibilities within the IGS) the Planning Committee was reorganized at the XX-th General Assembly in Vienna and renamed as IGS Campaign Oversight Committee. This new Committee conducted the 1992 IGS Test Campaign from 21 June - 23 September. The campaign was successful beyond any expectation. Therefore, the IGS Pilot Service was established on 1 November 1993 to bridge the gap between the 1992 IGS Test Campaign and the start of the official service. The IGS was approved by the IAG as an official service at the IAG General Assembly in Beijing in 1993.

2. The IGS Mission

According to the IGS terms of reference the primary objective of the IGS is to provide a service to support, through GPS data products, geodetic and geophysical research activities. The IGS collects, archives and distributes GPS observation data sets of sufficient accuracy to satisfy the objectives of a wide range of applications and experimentation. These data sets are used by the IGS to generate the following data products :

- high accuracy GPS satellite ephemerides
- earth rotation parameters

-coordinates and velocities of the IGS tracking stations
- GPS satellite and tracking station clock information
- atmospheric information.

3. The Structure

The IGS accomplishes its mission through :

- Networks of tracking stations
- Data centers
- Analysis Centers and Associate Analysis Centers
- Analysis Center Coordinator (at present J. Kouba)
- Central Bureau (Director R.E. Neilan)
- Governing Board (Chairman, 1995 G. Beutler)

The network was growing from about 30 stations in 1992 to about 100 stations in 1995. All stations are equipped with high-precision P-code receivers and with powerful data links allowing near-real-time data transmission.

At present 7 Analysis Centers, namely

- CODE (a cooperation of Astronomical Institute, Bern, Federal Office of Topography, Wabern, Institute for Applied Geodesy (Frankfurt)
- Institut Geographique National (France)
- EMR (Natural Resources, Canada)
- ESA (European Space Agency, Germany)
- GFZ (Geoforschungszentrum, Germany)
- JPL (Jet Propulsion Laboratory, USA)
- NGS (NOAA, National Oceanic and Atmospheric Administration)
- SIO (Scripps Institution of Oceanography)

are producing on a daily basis satellite ephemerides for all available satellites, earth rotation parameters (x- and y- components of the pole position in the earth fixed reference frame, length of day estimates).

Moreover the Analysis Centers are producing so-called free network solutions for the station coordinates and their velocities. These solutions are used by the ITRF section of the IERS for the production and maintenance of the International Terrestrial Reference Frame (ITRF) together with the results from the other space techniques.

The principal role of the Analysis Center Coordinator (Jan Kouba, Natural Resources, Canada) is to coordinate the activities of the IGS Analysis Centers and to produce the combined, official IGS products (see below).

The IGS Central Bureau is responsible for the general management of the IGS. The Central Bureau also acts as the GPS Coordinating Center for the IERS.

A key instrument of the Central Bureau is the Central Bureau Information System (CBIS). This CBIS provides public access to the state of the network and the other IGS components, and to the official products of the IGS. It also provides a means of electronic messaging among IGS participants through the IGS Message- and the IGS Report- series. The CBIS is a client of the Internet's World Wide Web.

The IGS Governing Board consist of 15 members. It should be well balanced from the institutional and the geographical point of view.

The current membership in the Governing Board :

G. Beutler	(Switzerland), Chairman
Y. Bock	(USA)
G. Blewitt	(Great Britain)
J. Dow	(Germany)
B. Engen	(Norway)
C. Boucher	(France)
J. Manning	(Australia)
J. Kouba	(Canada)
G. Mader	(USA)
B. Melbourne	(USA)
I.I. Mueller	(USA)
R. Neilan	(USA), Director Central Bureau
C. Noll	(USA)
C. Reigber	(Germany)
B. Schutz	(USA)

Persons representing organizations which participate in any of the IGS components are considered as IGS Associate Members. IGS Associate Members together with the GB vote for the incoming members of the Governing Board. A list of the IGS Associate is available upon request from the IGS Central Bureau. The list is also available in the IGS Directory (last edition: summer 1996).

4. The Products

The daily products of the individual Analysis Centers (satellite ephemerides and earth rotation parameters) are made available to the scientific community (at least) on a weekly basis through the three Global Data Centers

- CDDIS (Crustal Dynamics Data Information System) at NASA Goddard Space Fligth Center, USA),
- IGN (Institut Geographique National, France),
- SIO (Scripps Institution of Oceanography).

They are also available through many regional and National agencies.

The individual products are analysed on a weekly basis by the IGS Analysis Center Coordinator. The latter is responsible to generate the so-called official IGS Orbit through a weighted linear combination of the individual contributions. Since 1995 a combined IGS pole estimate based on the same principles as the combined orbit is available, too. The quality of the products is of the order of 5-10 cm per satellite coordinate and 0.1 - 0.2 mas for

the pole coordinates, which is of the same order of magnitude as that of the best individual series. The official IGS orbits and the earth rotation files associated with them are also made available through the Global Data Centers and through the Central Bureau Information System.

5. Publications

- IGS Messages and IGS Reports, available through the Central Bureau
- Information System (CBIS)
- IGS Colleague Directory, updated regularly, available through the Central Bureau
- IGS Resource Information (short information about the IGS, available through the IGS Central Bureau)
- IGS Annual Report (since start of the official service, report for 1994 available through the IGS Central Bureau)

6. Addresses

For more information please contact :

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M/S 238-540
4800 Oak Grove Drive
Pasadena, CA 91109 USA

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Fax : ++1 818 393 6686
Internet : igscb@igscb.jpl.nasa.gov
or : ren@logos.jpl.nasa.gov

SECTION III

DETERMINATION OF THE GRAVITY FIELD
DETERMINATION DU CHAMP DE PESANTEUR

President: R. Forsberg (Denmark)
Secretaries: M.G. Sideris (Canada)
(Commission III): I. Marson (Italy)
(Commission XII): H. Sünkel (Austria)

I-Terms of Reference

Section III, determination of the gravity field, is engaged in the determination and modelling of the earths gravity field variations. Knowledge of the gravity field variations is of prime importance for geodesy, geophysics and navigation, and efficient and accurate modelling of such variations is a key geodetic research activity. Within the modelling especially the precise determination of the geoid is of great contemporary significance due to requirements from satellite geodesy and oceanography.

The gravity field may be determined by a multitude of measurements: satellite tracking, absolute and relative gravimetry, gravity gradiometry, GPS-levelling, satellite altimetry, astronomical deflections of the vertical, etc. Currently the global determination of the gravity field is significantly improved due to advances in satellite techniques, the release of terrestrial gravity data from formerly classified sources, and the development of efficient airborne gravity survey techniques. Compared to just a few years ago, the global data coverage is improved to such a degree that the only major regions in the world void of data now are some tropical jungle regions and Antarctica.

The development of new global reference models, incorporating the advance in terrestrial data coverage and new satellite data, will be a major benefit to all geodesists in utilization of all these global gravity field data.

In the field of gravimetry, building up national and international networks of absolute and relative gravimetry continues to be a key element within the framework of Section III. With the increasing accuracy of these nets, now approcaching 10^{-9} g, the study of non-tidal gravity changes becomes increasingly important for geodynamic studies.

The developments in the the gravity field determination expressed in the formal IAG By-Laws, in which Section III is responsible for:

- absolute and relative terrestrial gravity measurements,
- gravity networks and control stations,
- non-tidal gravity variations,
- determination of the external gravity field and geoid the different gravity field data types, and
- reduction and estimation of gravity field quantities.

II-Structure

Commissions :

Commission III : International Gravity Commission
President : I. Marson (Italy)

Commission XII: International Geoid Commission
President : H. Sünkel (Austria)

Special Study Groups :

SSG 3.163 : Assesment and Refinement of Global Digital Terrain Models
Chairman : D. Arabelos (Greece)

SSG 3.164 : Airborne Gravimetry Instrumentation and Methods
Chairman : M. Wei (Canada)

SSG 3.165 : Global Gravity Field Determination and Evaluation
Chairman : N. Pavlis (USA)

SSG 3.166 : Local Gravity Field Modelling and Interpretation
Chairman : T. Basic (Croatia)

SSG 3.167 : Regional Land and Marine Geoid Modelling
Chairman : H. van Gysen (South Africa)

International Services

International Gravimetric Bureau (BGI)
Director : G. Balmino (France)

International Geoid Service (IGeS)
Director : F. Sansò (Italy)

Commission III

International Gravity Commission
Commission Gravimétrique Internationale

President: **I. Marson** (Italy)
Vice-Presidents: **G. Boedecker** (Germany)
J. Makinen (Finland)
Secretaries **N. Courtier** (Canada)
E. Klingele (Switzerland)

I. Program Of Activities

1.1 The International Gravity Commission (IGC) promotes scientific investigations of the gravity field of the Earth, its relationship to the form and processes of the Earth's interior and exterior and its variations with time. It does so through the concerted actions of its members to acquire homogeneous gravity anomaly coverage of the Earth. It regulates the operation of the Bureau Gravimetrique International (BGI), established to promote the free exchange of gravity data among the member countries for the benefit of not only geodesists but also geophysicists and geologists.

1.2 The Commission shall seek to collaborate with all international and national organizations concerned with the work of the IGC, particularly for the benefit of the developing countries.

1.3 The Commission will encourage and promote special campaigns to develop and compare instrumentations, techniques and procedure for the adjustment of the results of surveys.

1.4 The Commission will review its functions from time to time to ensure its activities are commensurate with the needs of the geodetic community.

1.5 The Commission will organize at least one meeting of a global nature in four-year period between the IUGG/IAG Assemblies. In addition, it would encourage regional meetings or workshops dedicated to specific problem where appropriate.

II. Functions

The functions of the IGC shall be :

a) To find solutions to problems requiring international cooperation in gravity research and review the results of such investigations ;

b) To recommend and coordinate international programmes for scientific investigation in gravity and related matters which call for concerted action by its members and interested organizations ;

c) To make recommendations to international organizations in matters which relate to the Commissions programme ;

d) To promote and make recommendations for the exchange of gravity data and the publication and dissemination of results of scientific investigations ;

e) to make recommendations to strengthen education and training programmes in gravity and its technology ;

f) to assist developing countries in gravity-related research and technology development ;

g) to promote scientific investigation of gravity on behalf of the international community, taking into account special interests and rights of countries concerning scientific research in the zones under their jurisdiction.

In carrying all its functions, the IGC shall bear in mind the special needs and interests of developing countries.

III. Cooperation

The IGC shall give due attention to supporting the objectives of the international organizations with which it collaborates and which may request IGC to act, as appropriate, as the medium for discharging certain of their responsibilities in matters relating to gravity investigations. The IGC may also request these organizations to take its requirements into account in planning and executing their own programmes.

IV. Organization

4.1 The Assembly of the IGC shall be its principal organ and, without prejudice to the previsions of paragraph of this Article, shall make all decisions necessary to fulfil the functions of the IGC.

4.2 In accordance with the By-Laws of the IAG, the President of the Commission is appointed by the Council of the IAG. Every four years, the Assembly shall elect two Vice-Presidents and a Secretary at its ordinary session. They, along with the President, shall constitute the Executive Board. The President may appoint a second Secretary to assist with the operation of the Commission.

4.3 The Executive Board shall exercise the responsibilities delegated to it by the Assembly and act on its behalf in the implementation of decisions of the Assembly.

4.4. The Executive Board shall review the effectiveness of the operating structure of the Commission and make recommendations to the Assembly on structural or other changes necessary.

V. Working Procedures

5.1 The Assembly shall be convened in ordinary session every four years. Extraordinary sessions may be convened at the discretion of the Executive Board or at request of at least five National Committees.

5.2 Each Country belonging to the IAG and represented at the Assembly shall have one vote, but may accompany its representative to sessions of the Assembly with alternates and advisers as it deems necessary.

5.3 The IGC either through its Assembly or by Executive action subject to the approval of the Assembly may create, for the examination and execution of specific projects, working groups or other subsidiary bodies composed of experts interested in such projects.

VI. Financial Support

6.1 The programmes endorsed and coordinated by the IGC and recommended to its Members Countries for their concerted action shall be carried out with the aid of the resources of participating member Countries, in accordance with the obligations that each Country is willing to assume.

6.2 The expenditure of the IGC shall be financed from funds appropriated for this purpose by IAG or other organizations of the IUGG.

6.3 Contributions to the Commission from outside the structure of the IUGG may be accepted and established as trust in accordance with the financial regulations of the IAG. Such funds will be allocated to programmes of the Commission in accordance with any special wishes of the donor or decisions of the Assembly or the Executive Board.

6.4 Funds so allocated shall be expended by a Secretary of the Commission who will be accountable in this matter to the Central Bureau of the IAG.

VII. Sub-Commissions

7.1 The International Gravity Commission can activate regional Sub-Commission to assist the Commission on specific topics.

7.2 The terms of reference for the Sub-Commissions are:

a) to act as a regional centre for maintaining a catalogue of information of the International Gravity Standardization Network (IGSN71), the International Absolute Gravity Base Station Network (IAGBN) and other gravity base stations in the area, including marine gravity bases, and to facilitate the supply of this information to BGI.

b) To coordinate the maintenance, revision and extension of the network of international gravity base stations in the region,

c) To collaborate with, and where necessary to coordinate assistance to, countries in the area wishing to set up and maintain national gravity reference networks.

d) To assist the BGI in obtaining a good regional coverage of surface gravity data in the area.

e) To undertake, in consultation with the President of the IGC, other activities as required in the pursuit of the objectives of the Commission.

f) To act as regional agency of IGC.

7.3 The coordinators are requested to organize the Bureau of each Sub-Commission as appropriate, based on regional support by parent agencies.

7.4 Membership of each Sub-Commission is envisaged to comprise:

a) Representatives of member Countries of the IUGG in the area concerned, as provided in the IAG Rules for Commissions.

b) Representatives of countries in the area who are not members of the IUGG, to be appointed in consultation with representatives of Member Countries.

7.5 Communication and Reporting

a) The Sub-Commission shall communicate to its members by circular letters, with information copies to the President of the IGC, the Director of BGI, the President of IAG, the President of Section III, and Presidents of eventual other Commissions of the IAG interested.

b) The Sub-Commission shall report to the President of IGC as required.

VIII. Work To Be Performed

8.1 Bureau Gravimetrique International

The Commission supports the continuing operation of the BGI with the emphasis on expanding its gravity data base to include national areas for which no data have been released and to improve coverage on land and on the oceans.

8.2 Absolute Gravity Measurements.

a) Intercomparisons of transportable absolute gravity meters at locations to be determined and in conjunction with the observations of the IAGBN, in order to investigate systematic errors.

b) Further development of the IAGBN

c) Collection of new absolute gravity measurements, regional and local network connections and adjustments.

8.3 International Gravity Standardization Net

Improvements and extensions of the existing net where necessary, new regional adjustment where necessary, combined adjustment of absolute and relative gravity data on fundamental networks.

8.4 Marine Gravity Data

Connection of harbour sites to existing gravity base stations networks, comparisons with satellite altimetry.

8.5 Gravity Variation with Time

Coordination of absolute gravity measurements at superconducting gravimeter sites in order to study instrumental effects and non-tidal gravity variations with time

IX. Working Groups

The Commission has established four Working Groups in order to perform a specific task and to assist the BGI:

WG2 - World Gravity Standards
Chairman: G. Boedecker (Germany)

WG6: Intercomparison of Absolute Gravimeters
Chairman: L. Robertsson (France)

WG7: Global Gravity Monitoring Network
Chairman: B. Richter (Germany)

WG8 : Relative Gravity Network for 1997 Absolute Gravimeter Intercomparison
Chairman: M. Becker (Germany)

X. National Representatives :

P. Steinhauser	(Austria)
O. Francis	(Belgium)
R. A. Gibb	(Canada)
L. Kubackova	(Czech Rep.)
R. Forsberg	(Denmark)
S. Riad	(Egypt)
J.J. Walch	(France)
E. Groten	(Germany)
E. Lagios	(Greece)
R. Hipkin	(Great Britain)
G Csapo	(Hungary)
B.C. Roy	(India)
C. Morelli	(Italy)
H.N. Nyapola	(Kenya)
Rin Ryong Un	(Korea)
S. Takemoto	(Japan)
J. Ning	(People's Rep. of China)
M. Rodrigues Lisboa	(Portugal)
P. Medvedev	(Russia)
D. Miskovic	(Slovenia)
R. Vieria Diaz	(Spain)
R.J. Kleywegt	(South Africa)
A. Haller	(Sweden)
E. Klingele	(Switzerland)
J. Zid	(Tunisia)
H. Demirel	(Turkey)
J. Faller	(USA)

Commission XII

International Geoid Commission

President: **H. Sünkel** (Austria)
Secretaries: **D.G. Milbert** (U.S.A.)
W. Kearsley (Australia)

1. Main Objectives

The International Geoid Commission (IGeC) is considered the primary activity center of the IAG for information related to the determination of the geoid for geodetic, geophysical and oceanographic purposes. The International Geoid Service (IGeS), as the working arm of IGeC, established at the Politecnico di Milano, is operational since January 1, 1993.

The **International Geoid Commission** accomplishes the following tasks:

- data collection
- coordination of computational efforts (merging of geoids)
- execution of geoid determinations through computer centers financed nationally or by international organizations
- execution of computational tasks of regional character
- evaluation and exchange of tested software
- organization of vertical positioning campaigns for geoid control
- organization of contacts to oceanographers in need of geoid data
- organization of expert meetings

The **International Geoid Service** accomplishes the following tasks:

- issuing a Bulletin to present IGS and its programs
- collecting geoids computed globally or locally
- implementation of such geoid solutions in a worldwide geoid data file
- organization of International Geoid Schools
- preparation of a standard software package for the computation of the gravity field, collecting already existing software packages; a special "call for software" will be issued where a sequence of well defined tasks will

be identified as well as format specifications for the input and output files provided

- the scientific program of IGeS will essentially consists in the participation in international projects such as

- studies for the realization of a dedicated gravity field mission

- studies for the use of altimeter data for geoid research

2. Program of Activities

- The Commission will identify centers having data needed for geoid determinations. Such centers include the Bureau Gravimétrique International (gravity data), Technical University Delft (altimeter data), Istituto Geografico Militare Italiano (vertical deflection data), The Ohio State University (Earth gravity field models). Other centers collecting related data such as topographic data, station positions, etc. will also be identified.

- The Commission will make available selected software for geoid computations.

- The Commission will help to coordinate geoid computations by active communication with countries and groups involved with such work.

- The Commission will prepare a newsletter at usually six-month intervals which will be sent to all active country representatives and interested parties.

- The Commission will organize at least one meeting of a global nature in the four-year period between the IUGG/IAG Assemblies.

In addition, it would encourage regional meetings where appropriate.

The Commission will provide information to groups and disciplines needing geoid data.

- The Commission will issue a national report about geoid related activities in its member countries for the past four-year period to be submitted at the IUGG/IAG Assemblies. The report for the period 1991 - 1995 is available as a postscript file and may be fetched using the following computer address:

anonymous ftp
host: ftp-geomatics.tu-graz.ac.at [129.27.91.2]
directory: /pub/IGeC
file: rep91-95.ps

3. Sub-Commissions

The Commission has established three Sub-Commissions, the Sub-Commission for the Geoid in Europe (chairman: Martin Vermeer, Finland), the Sub-Commission for the Geoid in South America (chairman: D. Blitzkow, Brazil), and the Sub-Commission for Geoid in South-East Asia (chairman: A.H.W. Kearsley, Australia). The objectives of the Sub-Commissions are in general agreement with the objectives of IGeC with special emphasis on the respective regions.

4. Executive Committee

The Commission has established an Executive Committee which is composed of the following members:

D. Blitzkow	(Brazil)
B. Heck	(Germany)
A.H.W. Kearsley	(Australia)
D.G. Milbert	(U.S.A.)
F. Sansò	(Italy)
M. Sideris	(Canada)
H. Sünkel	(Austria)
H.G. van Gysen	(South Africa)
M. Vermeer	(Finland)

5. National Representatives

	N. Lopez	(Argentine)
	W. Kearsley	(Australia)
*	E. Erker	(Austria)
*	P. Pâquet	(Belgium)
	J.A. Zelaya	(Bolivia)
*	D. Blitzkow	(Brazil)
*	M. Sideris	(Canada)
	H.T. Hsu	(China)
	K. Colic	(Croatia)
*	M. Pick	(Czech Republic)
*	P. Knudsen	(Denmark)
	S.R. Archiniegas-Ortega	(Ecuador)
*	D. Alnaggar	(Egypt)
*	M. Vermeer	(Finland)
*	H. Duquenne	(France)
*	B. Heck	(Germany)
*	D. Arabelos	(Greece)
*	G. Papp	(Hungary)
	B.S. Rajal	(India)
	J. Supomo	(Indonesia)
	E. Mogilowski	(Israel)
	B. Benciolini	(Italy)
*	Y. Fukuda	(Japan)
	N. Yahya-Sagarat	(Jordan)
	A.S. Lwangasi	(Kenya)
	Chan Peng Yue	(Malaysia)
	G.L. Strang van Hees	(Netherlands)
	W.I. Reilly	(New Zealand)
	C. Ezeigbo	(Nigeria)
	D. Solheim	(Norway)
	R.B. Feir	(Philippines)
	A. Lyszkowicz	(Poland)
	M.R. Lisboa	(Portugal)

*	P.P. Medvedev	(Russia)
*	M.J. Sevilla	(Spain)
*	H.G. van Gysen	(South Africa)
	L. Sjöberg	(Sweden)
*	B. Bürki	(Switzerland)
	J. Saburi	(Tanzania)
	C. Wichiencharoen	(Thailand)
	E. Ayhan	(Turkey)
	A.H. Dodson	(U.K.)
*	S. Nerem	(U.S.A.)

(* = confirmed)

Special Study Group 3.163

Assessment And Refinement Of Global Digital Terrain Models

Chairman : **D. Arabelos** (Greece)

I- Terms Of Reference

Precise gravity field modelling requires the combined manipulation of all available data especially in areas with a strong gravimetric signal. Among other data types, the information concerning the visual topography and its isostatic compensation is substantial in order to smooth the gravity field. Such information is strongly related to the effect of the topography on the various quantities related to the gravity field. For the computation of the various kinds of topographic reductions a digital terrain model that comprises the appropriate coverage and resolution is essential. In local scale applications precise and high resolution local DTMs are usually available in national geodetic data banks. On the other hand, for regional or global scale computations, global DTMs are available in different resolution. According to common experience, these models are affected by systematic and random errors. The aim of this study group will be the assessment and refinement of the global DTMs in different ways: (i) by detecting systematic and random errors (2), by predicting the bathymetry in sea areas with a good coverage of sea gravimetry or satellite altimetry, (3) by incorporating new data in the existing models.

II- Program Of Activities

- Comparisons between the global DTMs in various test areas.
- Assessment of the effects of the various systematic and random errors in different types of topography.
- Refinement of the global DTMs taking advantage of the local (national scale) high resolution DTMs.
- Detection of possible shift of coordinates and of gross errors of the global models, by comparing global DTMs with local models of the same resolution.
- Incorporation of new data to the existing models.
- Enhancement of the DTM over ice sheets using satellite and airborne altimetry, GPS, SAR interferometry, etc.
- Tests in order to assess the quality of the improved DTMs. These tests will include prediction experiments in the gravity field by taking into account the topography/ bathymetry in terms of the well known reductions (e.g., residual terrain modelling). The ground truth should be used to investigate the prediction results' quality in both cases i.e. using the original or the improved DTM.
- Prediction of bathymetry by inverting the gravity field in areas with a good coverage with gravity measurements. In case of areas that lack of satisfactory surface data, this data shall be recovered by an inversion of satellite altimetry data.
- Combination of other existing geophysical information is optional. The smoothing effect of the resulting model of bathymetry on other kinds of data, related to the gravity field, such as altimeter data, could be a measure to the quality of the model.

III- List Of Members

D. Arabelos	(Greece) - Chairman
R. Barzaghi	(Italy)
H. Denker	(Fed. Rep. of Germany)
S. Ekholm	(Denmark)
Y. Fukuda	(Japan)
C. Green	(United Kingdom)
R. Haagmans	(The Netherlands)
A. M. Hittelman	(USA)
W. Kearsley	(Australia)
P. Knudsen	(Denmark)
L. Li	(China)
R. Salman	(USA)
D. Sandwell	(USA)
G. Sarrailh	(France)
H.-G. Schenke	(Fed. Rep. of Germany)
H. Sünkel	(Austria)
C.C. Tscherning	(Denmark)
G.-C. Tsuei	(Republic of China)
I.N. Tziavos	(Greece)

Corresponding Members :

M.G. Sideris	(Canada)
M. Vermeer	(Finland)

Special Study Group 3.164

Airborne Gravimetry Instrumentation and Methods

Chairman : **M. Wei** (Canada)

Objective :

The research areas of the study group are: testing and further development of operational airborne gravity systems; development of new airborne gravity system concepts; software development and comparison; comparative analysis of flight test results.

Activities :

Hardware comparison - Investigation of different approaches to airborne gravity such as scalar gravimetry and vector gravimetry.

Establishment of a test range for comparative airborne tests. Software comparison on standard data sets made available by the SSG.

Error model improvement - Error models of acceleration measurements using scalar gravimeters or inertial systems, orientation errors using different attitude stabilization techniques, analysis of disturbing accelerations using GPS or other sensors.

Estimation and data processing - Investigation of different filtering methods including IIR and FIR digital filters, shaping filters, Kalman filters, wave filter technique and systems theory.

Analysis - Analyzing and evaluating test results from road or airborne tests made available by the SSG. Spectral analysis of airborne gravimetry with respect to spectral range of interest for gravity determination, the effect of system dynamics and flight conditions.

Members :

R.E. Bell	(USA)
G. Boedecker	(Germany)
J. Brozena	(USA)
I. Colomina	(Spain)
J. Czompo	(Canada)
X. Dong	(China)
B. Eissfeller	(Germany)
R. Forsberg	(Denmark)
W. Gumert	(USA)
K. Hehl	(Germany)
P. Jones	(UK)
B. Kearsley	(Australia)
E.E. Klingele	(Switzerland)
O.S. Salychev	(Russia)
J. Segawa	(Japan)
I.N. Tziavos	(Greece)
M. Van Gelderen	(Netherland)
M. Wei	(Canada) - Chairman

Corresponding members :

M.E. Halliday	(USA)
G.W. Hein	(Germany)
P. Holota	(Czech)
C. Jekeli	(USA)
W. Keller	(Germany)
Y.C. Li	(Canada)
K.P. Schwarz	(Canada)
L. Wu	(Canada)
J. Zhang	(Canada)

Special Study Group 3.165

Global Gravity Field Determination and Evaluation

Chairman : **N. K. Pavlis** (USA)

I- Terms Of Reference

Global models of the Earth's gravitational potential provide information required for a variety of geodetic, geophysical and oceanographic investigations and applications. High resolution gravitational models (extending to degree and order 360) are necessary to provide a reference surface for local or regional detailed geoid computations. Currently the accuracy of these models represents a limiting factor for oceanographic applications aiming to determine the absolute dynamic topography of the sea surface at increasingly finer resolution. The realization of a Global Vertical Datum depends strongly on the accuracy of global geopotential models.

The development of global high resolution gravitational models currently relies on the combination of information obtained from the analysis of satellite tracking data, terrestrial and airborne gravimetry and satellite altimeter data. It is therefore a task requiring expertise over a wide range of observational, modelling and analysis techniques. The theoretical aspects of the problem, despite the attention that they have received for many years, are still posing interesting questions. There is a persistent need for more rigorous and complete functional description of the data and for more efficient analytical and numerical methods for the set-up and solution of the very large least-squares adjustment problems involved. A dedicated geopotential mapping satellite mission, which may be launched in the near future, will undoubtedly introduce new challenges to the problem of global geopotential modelling.

There is a definite requirement that global geopotential models are accompanied by error estimates that accurately reflect the quality of the models.

Estimating the errors associated with these solutions is a difficult task given the large number of heterogeneous data based upon which these solutions are developed. A better representation of the stochastic properties of large data sets characterized by geographically varying accuracy and long wavelength systematic errors (such as gravity anomaly data bases), will make a significant contribution towards the improvement of the models.

The evaluation of global geopotential models is based on a variety of comparisons with information independent of the solutions. These comparisons help identify problem areas and therefore constitute a critical

part of the continuing effort for the improvement of the models.

The SSG aims to stimulate and coordinate research on these topics and facilitate the exchange of information among groups and individuals working in this area.

II- Program Of Activities

The proposed list of activities and research topics is as follows :

1. Modelling and estimation techniques. This includes :
   - functional representation of various data types
   - consideration of systematic effects
   - efficient techniques for high degree harmonic analysis/synthesis
   - alternative techniques for the development of high degree combination solutions
   - alternative forms of gravity field representation
2. Improvement on the consideration of the error properties of large data sets used in the development of global gravity models (e.g., consideration of correlated errors among the gravity anomalies in global 30'x30' data bases).
3. Design and set-up of a data base that may include :
   - published global gravitational models
   - independent data which may be used for evaluation of existing and future gravity models (e.g., GPS/ Levelling-derived geoid undulations)

The SSG, in close cooperation with other bodies of the IAG such as the International Geoid Service, should decide the content and format and consider the logistics involved in establishing and maintaining such a database.

III- List Of Members

Members

D. Blitzkow	(Brazil)
J.Y. Chen	(China)
T. Gruber	(Germany)
C. Jekeli	(USA)
A.H.W. Kearsley	(Australia)
J.-M. Lemoine	(France)
A.N. Marchenko	(Ukraine)
R.S. Nerem	(USA)
N.K. Pavlis	(USA) - Chairman
K. Seltz	(Germany)
M.G. Sideris	(Canada)
G. Sona	(Italy)
H. Suenkel	(Austria)
I.N. Tziavos	(Greece)
W. Wiejak	(Poland)

Corresponding Members

R. Biancale	(France)
W. Bosch	(Germany)
H. Denker	(Germany)
B. Heck	(Germany)
E.C. Pavlis	(USA)
R.H. Rapp	(USA)
P. Schwintzer	(Germany)

Special Study Group 3.166

Local Gravity Field Modelling and Interpretation

Chairman : **T. Basic** (Croatia)

Terms of Reference

The research areas of the study group are:

1. Use of more detailed and more accurate gravity field data on the local scale.
2. Use of terrain and geophysical (density and seismic) information.
3. Modelling problems with heterogenous gravity field data.
4. Application of different approximation methods (collocation, FHT, ..).
5. Interpretation of results, especially the influence of geological contribution.
6. Comparison to available regional and global solutions.

Membership

Members:

T. Basic	(Croatia) - Chairman
D. Behrend	(Germany)
W. E. Featherstone	(Australia)
A. Kenyeres	(Hungary)
N. Kuetreiber	(Austria)
D. G. Milbert	(USA)
J. Simek	(Czech Republic)
G. Strykowski	(Denmark)
I. N. Tziavos	(Greece)
W. Wiejak	(Poland)

Corresponding members:

M. Brkic	(Croatia)
H. Denker	(Germany)
D. A. Smith	(USA)

Special Study Group 3.167

Regional Land and Marine Geoid Modelling

Chairman : **H. van Gysen** (South Africa)

Objectives And Programme

Regional modelling of the geoid is a traditional part of the activities of Section III, and much has been achieved in this area, both as regards method (especially as regards approximation and numerical methods), and in results. That the interest in geoid modelling continues is due not only to its significance to practical geodetic surveying tasks and the needs of scientific investigations in other fields, but also because there remain unmet and new challenges within the topic itself, arising from new data sources, new theoretical methods, and new computational possibilities.

The objectives of SSG3.167 reflect this duality between past and future. It seeks in part to consolidate what has already been achieved, and to work towards addressing open and new questions. In consolidating the current state of knowledge in geoid modelling, it is appropriate to seek answers the following questions :

* To what extent is there agreement about the various elements of regional geoid modelling: data reductions and data preparation (including data gridding and block averaging) ; what theoretical model to use (which BVP, how to include terrain and non-linear effects); and what numerical techniques? To what extent is it possible to prescribe or recommend a standard procedure ?

* Are there any substantive differences between the modelling procedures for land and marine geoids, and are there real difficulties in working across the land/sea divide ?

* How is the quality of the geoid product assured? Is there agreement on validation procedures and measures of quality ?

* In what form should regional geoids be published - as maps, gridded heights, function coefficients, using data compression techniques ?

Looking to open issues, the following questions present themselves :

* What is the best way of working with heterogeneous data ?

* Are GPS-derived geoid heights forever to be relegated to a validation-only role? Are there new techniques for a common adjustment of GPS and geoid heights? What is the impact of GPS in studying the compatibility of neighbouring datums through geoid determination ?

* Are there new solutions of the GBVP that hold the promise of better theoretical geoid models ?

* Are there new approximation and numerical techniques that hold the promise of a closer representation or more efficient computation ?

* What can be done to improve regional marine geoids, so that they can better serve the needs of oceanographic studies ? In particular, what is the contribution of an accurate regional-scale marine geoid solution on sea surface topography studies ?

  Are there lessons that geodesists can learn from the oceanographers' technique of 'synthetic' geoid modelling ?

The cast of these questions is deliberately quite wide. It will be the task of the members of the study group, working together, to sharpen the focus, to identify the extent of common agreement, and to identify the key issues that remain to be tackled - doing all these things using the Internet. A World-Wide Web home page for the study group is being set up; it will serve not only as an information resource (containing news, a bibliography of recent publications, abstracts, short reports, geoid images, and links to sites where source data or results can be obtained), but will also serve as a forum for the members of the study group (and others). Members of the study group will be asked at intervals for their views on the questions above, and on issues identified by the group, and to contribute summaries of results and images of projects they are working on. These contributions will be published on the SSG's home page.

Members :

O. Andersen	(Denmark)
R. Barzaghi	(Italy)
D. Behrend	(Germany)
E. de Min	(The Netherlands)
W. Featherstone	(Australia)
R. Hipkin	(UK)
B. Kearsley	(Australia)
P. Knudsen	(Denmark)
J. Krynski	(South Africa)
M. Kuhn	(Germany)
J. Li	(Canada)
C. Merry	(South Africa)
D. Milbert	(USA)
G. Papp	(Hungary)
B. Shaofeng	(China)
I. Tziavos	(Greece) Co-chairman
H. van Gysen	(South Africa) Chairman
Tsuei Gwo-Chyang	(Taiwan)

M. Vermeer	(Finland)
J. Zhiheng	(France)

Associate Members :

W. Wiejak	(Poland)
H. Denker	(Germany)
M. Pearse	(Australia)
D. Blitzkow	(Brazil)

International Gravimetric Bureau
Bureau Gravimétrique International
(BGI)

Director : **G. Balmino** (France)

1.Objectives and Terms of Reference

The main task of BGI is to collect, on a world-wide basis, all gravity measurements and pertinent information about the gravity field of the Earth, to compile them and store them in a computerised data base in order to redistribute them on request to a large variety of users for scientific purposes. The data consists of: gravimeter observations (mainly location - three co-ordinates, gravity value, corrections, anomalies...), mean free air gravity values, gravity maps, reference station descriptions, publications dealing with the Earth's gravity field. Other data types are sometimes used for data validation and geophysical analysis, such as satellite altimetery derived geoid height and gravity anomalies, digital terrain models, spherical harmonic coefficients of current global geopotential models.

BGI has been developing various algorithms and software for data validation and analysis, as well as its own data management system. A large number of services are offered to the users (see below)..

All kinds of gravity data can be sent to BGI, with or without restrictions of redistribution to be specified by the contributors, sometimes in the form of a protocol of usage.

2. Structure and membership

- BGI is one of the offices of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS). It may also be considered as an executive office of the International Gravity Commission.

- It has a Directing Board composed of the following members :

Voting members :

I. Marson	(Italy)	IGC President
G. Boedecker	(Germany)	IGC Vice-President
J. Makinen	(Finland)	IGC Vice-President
G. Balmino	(France)	BGI Director
R. Forsberg	(Denmark)	Section III President
J.E. Faller	(USA)	elected
E. Groten	(Germany)	elected
P.P. Medvedev	(Russia)	elected
S. Takemoto	(Japan)	elected

Non voting members :

L. Robertsson	(France)	Chairman of WG6
B. Richter	(Germany)	Chairman of WG7
M. Becker	(Germany)	Chairman of WG8
N. Courtier	(Canada)	Secretary
E. Klingelé	(Switzerland)	Secretary

Ex officio members :

H. Sünkel	(Austria)	Presid.of Commission XII
F. Sansò	(Italy)	Director IGeS
P. Pâquet	(Belgium)	FAGS representative

The central office is located in Toulouse, France, in the premises of the Observatoire Midi-Pyrénées, of which it is one of the services. The other supporting organizations are : The Centre National d'Etudes Spatiales, the Bureau de Recherches Géologiques et Minières, the Institut Géographique National, the Centre de la Recherche Scientifique (via the Institut National des Sciences de l'Univers). There exists a covenant between these agencies to guarantee their support to the BGI.

The address of the office is :

Bureau Gravimétrique International
18, Avenue Edouard Belin
31401 Toulouse Cedex 4, France
Phone : 33-6133-2980
FAX: 33-6125-3098
Email: balmino@pontos.cst.cnes.fr

3. The BGI Bulletin d'Information

The office issues a Bulletin d'Information twice a year (generally in June and December).

It contains :

- general information in the fieled of the Bureau itself, about new available data sets,

- contributing papers in gravimetry,

- communications at meetings dealing with gravimetry (e.g. IGC meeting).

Every four years, an issue (which may be an additionnal one) contains the National Reports of Activities in Gravimetry.

The full catalogue of the holdings is issued every two years.

The Bulletin is sent free of charge to individuals and institutions which currently provide information and/or

data to the Bureau. In other cases, information and subscription prices can be obtained on request.

There exist 79 issues and about 350 subscribers as of mid-1996.

4. Providing data to BGI

Essential quantities and information for gravity data sumission are :

(a) position of the site :
- latitude, longitude (to the best possible accuracy)
- elevation or depth :
  for land datra : elevation of the site (on the physical surface of the Earth)
  for water stations : water depths

(b) measured (observed) gravity, corrected to eliminate the periodic gravitational effects of the Sun and the Moon, and the instrumentation driftt.

(c) Reference (base) station(s) used. For each reference station (a site occupied in the survey where a previously determined gravity value is available and used to help establish datum and scale for the survey), give name, reference station number (if known), brief description of location of site, and the reference gravity value used for that station. Give the datum of the reference value; example : IGSN71.

Give supplementary elevation data for measurements made on towers, on upper floor of buildings, inside of mines or tunnels, atop glacial ice. When applicable, specify whether gravity value applied to actual measurement site or it has been reduced to the Earth's physical surface (surface topography or water surface). Also give depth of actual measurement site below the water surface for underwater measurements.

For marine gravity stations, gravity value should be corrected to eliminate effects of ship motion, or this effect should be provided and clearly explained.

Additional informations are optional, but welcome.

5. Services

The most frequent service BGI can provide is data retrieval over a limited area. Data are sent on diskettes or printouts or transfered electronically. Data coverage plots may also be provided, usually over 20°*20° areas. Cases of massive data retrieval requests may be considered; they are studied and may be processed in a specific way. The simplest way for users is to acquire the open files of the BGI data base which are on two CDs.

Other services include :

- data screening,
- provision of gravity base station information,
- data evaluation and gridding,
- computation of mean values,
- contouring,
-supply of, or information on existing maps (catalogue available)

The costs of the services have been established in view of the categories of users-mostly contributors of measurements and scientists, and also considering the large amount of our host organizations. The charging policy is explained in detail in the Bulletin d'Information.

Some of the services may be provided free of charge upon request, to data contributors, individuals working in universities, such as students, and generally to any person who can contribute to the BGI activities on a data or documentation exchange basis.

6. Program of activities for the next four years

- continue publication of the Bulletin d'Information

- continue data collection, archiving and distribution : emphasis will be on those countries which have not, or seldom, contributed to the BGI data bank. First priority is then given to careful data evaluation; Land data and marine data are validated using different software. Satellite altimetry derived free-air anomalies are to be more and more frequently used to validate sea measurements.

- assist IGC in setting up the International Absolute Gravity Data Base Station (IAGBN), and assit in the intercomparisons of instrument

- establish simple procedures for the collection and archiving of absolute measurements.

- Link with the commission for the Geoid in data preparation in view of geoid computations and evaluations to be performed by the International Service for the Geoid.

-Assist in promoting satellites techniques to improve our global knowledge of the Earth's gravity field : satellite-to-satellite tracking, satellite gradiometry, etc...

International Geoid Service
Service International pour le Géoïde
(IGeS)

Director : **F. Sansò** (Italy)

Objectives

The main tasks of IGeS are:

- to collect data referring to the geoid on a worldwide scale,when possible to validate them and to disseminate

them upon request among the scientific community; other auxiliary data can also be collected by IGeS, when useful for the geoid determination, and might be made available with the sharp exclusion of gravity anomalies data,

- to collect, test and, when allowed, to distribute software for the geoid determination,

- to conduct researches on the best procedures for the geoid determination, possibly from different sources conveniently combined,

- to provide the international community with technical schools where consolidated techniques of geoid determination, be demonstrated and students trained in the use of the relevant software,

- to produce, at least once per year, an IGeS Bulletin on geoid related matters.

Data and software given to IGeS remain property of the source which can dictate the conditions of use and restrict their distribution. IGeS itself can indeed perform geoid computations within different projects, but not in economic competition with Firms or Public Organizations institutionally devoted to that.

Structure

The Service is for the moment provided by a Main Centre, at the Politecnico of Milano, and by individual scientists, called advisors, though in future more Centres could join the organization. IGeS is related to IAG, being the operative arm of the International Commission for the Geoid, operating within IAG - Section III. As such it has a Directing Board which receives a report and defines the long term program of the Service.

The Directing Board is composed by :

President of Section III
Secretaries of Section III
Director of BGI
Director of IGeS;

in this way a strong link is created between the two services of Section III, namely IGeS and BGI.

The Director of IGeS is nominated by the President of the International Geoid Commission, upon recommendation of the past Directing Board.

The IGeS-Main Centre is supported by Italian authorities which nominate its Director, upon recommendation of the International Geoid Commission. Its structure, tools and activities are illustrated in the IGeS reports to the International Geoid Commission. In the present period Director of IGeS as well as of its main centre is Fernando Sansï (Italy). The IGeS advisors are individual members of IGeS, which have had an outstanding activity in the field of geoid determination and also can represent IGeS in both research and teaching activities.

At present, beyond the members of the Directing Board, the following distinguished scientists are IGeS advisors:

C.C. Tscherning	(Denmark)
M. Sideris	(Canada)
W. Kearsley	(Australia)
J. Milbert	(USA)
H. Denker	(Germany)
M. Vermeer	(Finland)
D. Arabelos	(Greece)
M. Sevilla	(Spain)
B. Benciolini	(Italy)
R. Barzaghi	(Italy)

The list is open and nominations are welcome by IGeS Director.

Finally within the structure of IGeS, Working Groups can be established for specific purposes, limited in time. At present one W.G. is functioning on "Validation of Global Models" chaired by M. Sideris (Canada).

Programs till 1999

Beyond usual activities of IGeS, the following programs are worth of specific mention:

1) Geomed: improvement of the existing geoid and SST in the Mediterranean area,

2) Italgeo 2000: improved gravimetric geoid for Italy, with implementation of integrated procedures to combine gravimetric and GPS-leveling data,

3) Improved methodologies for the determination of global models,

4) Organization of 2 international geoid school, of which at least one in a developing country.

SECTION IV

GENERAL THEORY AND METHODOLOGY
THEORIE GENERALE ET METHODOLOGIE

President: P. Holota (Czech Republic)
Secretaries: B. Heck (Germany)
C. Jekeli (USA)

I-Terms of Reference

As stated in the by-laws, Section IV has primarily a methodological character. Its scope is not confined to one particular topic in Geodesy which would be peculiar to this Section only, but rather all topics are shared in one way or another with other IAG Sections, with the accent of the research pointing towards the systematic mathematical treatment of geodetic problems.

The Section keeps its basic structure as in the last period which originated from the preparatory work done by K.P. Schwarz and the decision of the Section IV Steering Committee to adopt a new organization, by establishing a novel structure in the core of the Section at that time, i.e. the Special Commission on Mathematical and Physical Foundations of Geodesy.

This Special Commission (even this name was born in Section IV) follows the original and standing concern to collect real specialists on the mathematical treatment of various geodetic problems, e.g. geodetic boundary-value problems, statistical problems in geodesy or problems in geometry, relativity, cartography, theory of orbits and dynamics of systems, and put them work on the assessment of difficult questions, open ever since many 4-years periods.

In this concept the new S.S.G.'s are on the contrary in duty to treat a much smaller range of problems, focussing on some very specific open questions to be solved as a rule in one 4-year period. Collective numerical experiments in the framework of S.S.G's are encouraged, when possible.

II-Structure

Special Commission :

SC1 : Mathematical and Physical Foundations of Geodesy

President : E.W. Grafarend (Germany)

Special Study Groups :

SSG 4.168 : Inversion of Altimetric Data
Chairman : P. Knudsen (Denmark)

SSG 4.169 : Wavelets in Geodesy
Chairman : B. Benciolini (Italy)

SSG 4.170 : Integrated Inverse Gravity Modelling
Chairman : L. Ballani (Germany)

SSG 4.171 : Dynamic Isostasy
Chairman : L.E. Sjöberg (Sweden)

SSG 4.176 : Temporal Variations of the Gravity Field
Chairman : D. Wolf (Germany)

Special Commission SC 1

Mathematical and Physical Foundations of Geodesy

President : **E. W. Grafarend** (Germany)

On the occasion the XXth General Assembly held in Vienna, 1991, Special Commission #1 has been founded within Section IV. The IAG-Council appointed Erik W. Grafarend as its first President. For the XXIst General Assembly in Boulder (USA), Special Commission #1 presented a special issue of manuscripta geodaetica (Springer-Verlag) as well as a series of review papers in Section IV Bulletin (IAG). Erik W. Grafarend had been re-elected to chair Special Commission #1 in the 1995-99 period. IAG's Executive Committee renewed the objectives and the operational manner of Special Commission #1 as following :

- to encourage and promote research on the foundations of geodesy in any way possible;

- to publish, at least once every four years, comprehensive reviews of specific areas of active research in a form suitable for use in teaching as well as research reference;

- to actively promote interaction with other sciences;

- to closely cooperate with the special study groups in Section IV.

Membership of Special Commission #1 is restricted to 30 members, one third of which will be replaced every four years. Chairmen of special study groups within Section IV are automatically members of Special Commission #1. The Section IV President as well as Section IV Secretaries are ex officio members. Other members are proposed by the Commission President and approved by the Section President.

Special Commission #1 will operate in the following manner :

Within half a year after the General Assembly, the Commission President will propose a research program and operational plan based on the input of members. The research program should identify the major research objectives for the four year period between general assemblies. Overlap with the work performed by special study groups in Section IV should be minimized. In case of conflict, the matter will be referred to the Section President for decision. The operational plan should identify the scientists or working groups responsible for specific tasks and give a rough time frame for the work to be performed.

The research program may be subdivided into specific tasks which can be assigned to working groups within Special Commission #1. Workshops of Special Commission #1 will be organized at least once between general assemblies and specialists from other disciplines will be invited to contribute to these workshops. The speedy transfer of research results to the teaching and working environment is part of the task of Special Commission #1 and the operational plan should be structured accordingly. A special series for publication of comprehensive research reviews should be considered. Representation on scientific bodies which can contribute to the work of Special Commission #1 or which should be aware of the research results will be sought on mutual basis.

On the occasion of the XXIst General Assembly held at Boulder the President of Section IV has accepted the following Subcomissions, the Working Group and Chair Persons :

Subcommission 1 "Statistics"
Chairman : A. Dermanis (Greece)

Subcommission 2 "Numerical and Approximation Methods"
Chairman : W. Freeden (Germany)

Working Group "Comparison of several techniques for solving geodetic boundary value problems by means of numerical experiments"
Chairman : R. Klees (The Netherlands)

Subcommission 3 "Boundary Value Problems"
Chairman : E. Grafarend (Germany)

Subcommission 4 Geometry, Relativity, Cartography
Chairman : J. Zund (USA)

Subcommission 5 Theory of Orbits and Dynamics of Systems
Chairman : R. J. You (Taiwan)

The following distinguished scientists have been invited to work in Special Commission #1 and its Subcommissions :

Ex officio

P. Holota	(Czech Republic) President of Section IV
B. Heck	(Germany) Secretary of Section IV
C. Jekeli	(USA) Secretary of Section IV
P. Kundsen	(Denmark) Chairman SSG 4.168 : Inversion of altimetric data
B. Benciolini	(Italy) Chairman SSG 4.169 : Wavelets in geodesy
L. Ballani	(Germany) Chairman SSG 4.170 : Inverse integrated gravity modeling
L. E. Sjöberg	(Sweden) Chairman SSG 4.171 : Dynamic isostasy
D. Wolf	(Germany) Chairman SSG 4.176: Temporal variations of the gravity field

Individuals

J. Adàm	(Hungary)
M. Belikov	(Russia)
J. A. R. Blais	(Canada)
R. Forsberg	(Denmark)
E. Groten	(Germany)
K. H. Ilk	(Germany)
W. Keller	(Germany)
K. R. Koch	(Germany)

L. Kubàcek	(Czech Republic)
L. Kubackova	(Czech Republic)
Z. Martinec	(Czech Republic)
R. Rummel	(Germany)
F. Sacerdote	(Italy)
F. Sansò	(Italy)
B. Schaffrin	(USA)
K.-P. Schwarz	(Canada)
M. Sideris	(Canada)
H. Sünkel	(Austria)
L. Svensson	(Sweden)
P. Teunissen	(The Netherlands)
C. Tscherning	(Denmark)
P. Vanicek	(Canada)
M. Vermeer	(Finland)
P. Xu	(Canada)

Subcommission 1
"Statistics"
Chairman : A. Dermanis

Research Program

- The theory of observables. Fundamental issues in the statistical analysis of geodetic observations.

- Linear models. Algebraic approximation versus stochastic estimation/prediction, linear observation equations subject to stochastic condition equations (dynamic system equations), fixed versus random effects, n-th incremental Kriging, stationarity on curved manifolds of non-spherical type, robust estimation, robustness by stochastic prior information.

- Nonlinear models. Polynomial approximation of nonlinear models, algebraic approximation versus stochastic estimation/prediction, nonlinear estimators-predictors, robust estimation, robustness by stochastic prior information.

- Linear and nonlinear models with integer unknowns. Discrete optimization, validation analysis (phase observations with integer ambiguities).

- Numerical least squares. Fast least squares.

- Boundary value problems for random fields. Stochastic boundary value problems with a stochastic boundary.

- Variance-covariance component estimation. Simultaneous estimation of first and second moments.

- Invariance of geodetic observation equations.
The invariance of geodetic observation equations with respect to symmetry transformations (the similarity group, the projective group) the invariace of geodetic observational functionals in geometry and gravity space, relation of invariance to estimability.

- Random tensor fields, random eigenspace, test statistics (the deformation tensor, the stress tensor, the metric tensor, the curvature tensor).

- Space-time processes and GIS (Voronoi meshes, Delauney triangulation on curved manifolds, stochastic geometry, quality evaluation).

- Bayesian statistics.

- Time series analysis. Signal analysis.

- Testing theory (confidence intervals for robust estimators, variance components)

- Optimal design. Reliability and integrity.

Additional Members

W. Caspary	(Germany)
S. Meier	(Germany)
M. Schmidt	(Germany)
Yu. A. Rozanov	(Russia)
Yuanxi Yang	(China)
Ziqiang Ou	(China)

Subcommission 2
"Numerical and Approximation Methods"
Chairman : W. Freeden

Research Program

- The use of spherical harmonic expansions of higher and higher degree for the determination of the gravitational field and the figure of the Earth has reached its bounds for several reasons (e.g. Nyquist rate, uncertainty principle). It is not appropriate to model local behavior by non-localizing functions. The polynomial nature of these functions causes severe numerical difficulties due to their oscillatory character. The evaluation of high order spherical harmonics tends to be unstable. Therefore one should concentrate on combined models, where expansions in terms of spherical harmonics are combined with local methods, e.g. radial basis function techniques as splines, wavelets, masspoints, etc. or finite elements. In addition, new trial functions like Abel-Poisson kernels, Gauss-Weierstrass kernels and locally supported kernels should be investigated in detail. Isotropy preserving methods should be compared with non-preserving techniques.

- For the use of these methods fast algorithms are still to be developed both for synthesis and analysis, e.g. in Gabor-, Toeplitz- and wavelet- expansions.

- The demanded high accuracy of future models has to take into account the mass distribution in the upper crust and the true surface of the Earth. Therefore, numerical methods usable for non-spherical boundaries should be an important goal for future developments. This includes finite difference methods, finite element methods, all

boundary element techniques as well as sphere-oriented methods (like harmonic splines or harmonic wavelets). For numerical efficiency, the use of multi-level or multi-resolution techniques is indispensable.

- The problem of combining data of different types and data coming from different heights is still a challenging one. In particular, the vectorial and tensorial nature of satellite data requires adequate approximation techniques. Future numerical methods should be able to handle such problems automatically.

Additionnal Members

J. Engels	(Germany)
H. van Gysen	(South Africa)
F.J. Narcowich	(Russia)
M. Schreiner	(Germany)
N. Sneeuw	(Germany)

The working group "Comparison of several techniques for solvin geodetic boundary value problems by means of numerical experiments headed by R. Klees should be continued.

Working Group "Comparison of several techniques for solving geodetic boundary value problems by means of numerical experiments"

Chairman : R. Klees

Research Program

Comparison of techniques for solving geodetic boundary value problems by means of numerical experiments.

Program of activities

- providing additional information about the data sets
- solving the BVP using different data sets with different resolutions
- detailed description of the underlying techniques and the procedures followed validation of the results
- comparison of the different techniques
- preparing the final report

Subcommission 3 "Boundary Value Problems"

Chairman : E. Grafarend

Research Program

- Pseudo-boundary value problems, reduction of observational functionals to simpler boundaries, in particular to the ellipsoid of revolution: the ellipsoidal Stokes bvp (the geoid) the ellipsoidal gradiometric bvp, datum problems in geodetic bvp, regional W_0-datum

- Stochastic boundary values, measurement errors, stochastic boundary, overdetermined bvps, regions of definition of the Poisson differential equation versus Laplace differential equation (domain of harmonicity), downward-upward continuation problems, internal bvp for the Poisson equation, the impact of extra-terrestrial masses (disconnected regions of mass distribution) time-dependent effects

- Representation of approximate solutions, deterministic versus stochastic collocation

Additional Members

M. Günther	(Germany)
J. M. Neyman	(Russia)
J. Otero	(Spain)
N. Weck	(Germany)
W. Wendland	(Germany)
K.J. Witsch	(Germany)
A. I. Yanushauskas	(Lituania)

Subcommission 4 "Geometry, Relativity, Cartography"

Chairman: J. Zund

Research Program

Geometry

- the generalized Marussi-Hotine approach to differential geodesy, including schemes for integrating the Hotine-Marussi equations

- conceptual foundations of Gaussian differential geodesy

- the geometry of plumblines, the Newtonian form of the differential equation of plumbline (orthogonal trajectories of a family of equipotential surfaces), plumblines as geodesics in a conformally flat 3-manifold, the deviation equation (Soldner-Fermi coordinates)

- the Lagrange portrait versus the Hamilton portrait of a geodesic, symplectic manifolds, Poincare diagrams

Relativity

- the general imbedding problem for relativistic space-times

- the differential equation od a geodesic in a relativistic space-time expressed in terms of "parallel coordinates" (Soldner-Fermi coordinates), geodesic deviation, higher order series representation, space-time Riemannian coordinates, stability analysis, bifurcation theory

- the coupled Einstein-Maxwell equations applied to compute the trajectories of an electromagnetic signal travelling in a curved space-time from a satellite to the

Earth's surface and back (the PRARE satellite system), geometric-optical approximation, the Gordon metric

- the analysis of relativistic gravity gradients in a local pseudo-orthogonal frame

- minimal atlas of group manifolds, e.g. SO(3), SO(1,3), application of the Lusternik-Schnirelmann category theorem

Cartography

- the Earth's topographic surface as a 2-manifold and its imbedding in an Euclidean 3-space, geodesics on the Earth's topographic surface and its Delaunay triangulation, Voronoi meshes and their curvature tensor, map projections of the Earth's topographic surface

- general analysis of Maupertuis manifolds, 3-manifolds of satellite orbit geometry, conformally flat manifolds of dimension 2, 3 and 4, the Weyl-Schouten theorem and its applications

- map projections of the geoid (Law of the Sea) in spheroidal-spherical harmonic series

- map projections of an ellipsoid of revolution: the Hotine oblique Mercator projection, pseudo-cylindrical/equiareal projections of an ellipsoid of revolution, the triple map projection: the Earth's topographic surface, ellipsoid of revolution, plane, map projections based on the second fundamental form of a surface

- map projections of a space-time manifold - in particular the Schwarzschild space-time, existence of hyperequiareal map projections

Additional Members

F. Bocchio	(Italy)
B. Mashhoon	(USA)
V. S. Schwarze	(Germany)
R. Syffus	(Germany)

Subcommission 5
"Theory of orbits and dynamics of systems"
Chairman : R. J. You

Research Program

Determination of the terrestrial gravity field by dynamic satellite geodesy

- Earth's gravity field and its time variations

- analysis of the Love number k_n

- inverse satellite gradiometry

Precise orbit computation

- study of spin-orbit coupling of an extended satellite body's orbit

- the impact of mass centre change of satellite

- the impact of a higher order tidal field

Relativistic orbit computation

- by means of KS elements

- study of the Zeeman effect

Modeling of nongravitational forces on satellite motions

Additional Members

O. L. Colombo	(USA)
C. Cui	(Germany)
S. Ehlers (till May 1996)	(England)
J. Feltens	(Germany)
P. Moore (from May 1996)	(England)
N. Sneeuw	(Germany)

Special Study Group 4.168

Inversion of Satellite Altimetry

Chairman : **P. Knudsen** (Denmark)

Objectives

This Special Study Group should study various geodetic and oceanographic inversion methods and data assimilation techniques. Through a deeper understanding of such techniques new ideas may be brought in order to enhance the use of satellite altimetry.

Activities

1) The estimation of the marine gravity field has been highly improved with data from the geodetic missions of Geosat and ERS-1. However, most processing schemes leave parts of the medium and long wavelength parts of the gravity field unsolved.

a) How does the recovery of the gravity field and the influence of ocean variability depend on the data type (sea surface heights, slopes, or curvature data) ?

b) How can TOPEX/POSEIDON altimetry be used as reference frame for GEOSAT and ERS-1 data ?

c) Is a Global Circulation Models adequate for elimination of the sea surface topography ?

d) How to process data in a global gravity field mapping?

2) The inversion of altimetry into marine geoid and sea surface topography has been improved along with the increased accuracies of the altimeter data and the geopotential models. However, in many regions the gravity models are not adequately accurate.

a) How does the a-priori spectrum for the topography look and is it homogeneous and isotropic ?

b) Which hydrodynamic flow mechanisms (geostrophy, friction, viscosity) are relevant to include and how can it be done ?

c) Which hydrodynamic constraints (mass, salt, and heat balance) are relevant to include and how can it be done ?

d) How important are other data sources (ship gravimetry, hydrography, AVHRR/ATSR surface temperature, ...) ?

3) The mapping of the ocean tides has been vastly improved in the deep ocean through the TOPEX/POSEIDON mission. However, in shelf regions major inconsistencies between the various models exist.

a) What causes the trade-off between hydrodynamics and altimetry and what is the role of errors in the bathymetry ?

b) Interpolation/extrapolation of ocean tides using empirical methods, assimilation techniques, or inversion techniques ?

c) How smooth is the ocean tides and which resolution should be used ?

d) Should other data sources (tide gauges, loadings, GPS, SAR) be included?

Members :

O.Ba. Andersen	(Denmark)
M. Brovelli	(Italy)
R. Coleman	(Australia)
G.D. Egbert	(USA)
G. Evensen	(Norway)
O. Francis	(Belgium)
Y. Fukuda	(Japan)
H. van Gysen	(South Africa)
R.H.N. Haagmans	(The Netherlands)
W. Keller	(Germany)
P. Knudsen	(Denmark) - Chairman
P.J. van Leeuwen	(The Netherlands)
F. Lyard	(England)
P.-Y. Le Traon	(France)
R.S. Nerem	(USA)
N. Pavlis	(USA)
R. Ray	(USA)
D. Stammer	(USA)
C.C. Tscherning	(Denmark)
P.L. Woodworth	(England)
Changyou Zhang	(USA)

Corresponding members :

R. Feron	(The Netherlands)
R.H. Rapp	(USA)
F. Sansò	(Italy)
V. Zlotnicki	(USA)
C. Wunsch	(USA)

Special Study Group 4.169

Wavelets in Geodesy

Chairman : **B. Benciolini** (Italy)

I- Terms of Reference

The theory of wavelets originated from the need of analysing a function with a tool able to balance localization in the space (or time) domain and localization in the frequency domain. First-generation-wavelets are families of functions derived by a single one, the mother function, by dilation and translation. Dilation and translation parameters can be considered to belong to continuous or discrete sets and correspondingly there are continuous and discrete wavelet transforms of a function.

A proper choice of the mother function and of the dilation and translation parameters allows the construction of families of wavelets that form a base (or sometime only a frame) of various functional spaces. Second-generation-wavelets are constructed with the so-called Lifting Scheme and offer more flexibility when facing with bounded domains, irregularly sampled functions, functions on curves and surfaces.

Several geodesists have already recognized the possibility of solving different geodetic problems with the help of wavelets. In particular, the ability of wavelets to represent integral operators in a very compact form allows the fast computation of such operators.

The SSG will stimulate and coordinate research activities in this field and it will also try to bring together geodesists and mathematicians for an interdisciplinary cooperation.

The theory of wavelets is now well established and mature, so that applied scientists can enter into the field and try to develop practical applications; on the other hand, it is also young enough to leave room for significant and original developments and to demand the interdisciplinary cooperation mentioned above.

Other topics strictly related to the theory of wavelets, such as multiresolution analysis and local Fourier transform, will also be of interest for the SSG.

II- Program of Activities

The following is a non-exhaustive list of research topics for the SSG; the list focuses on applications rather than on mathematical tools :

- analysis and reduction of geodetic and geophysical signals (e.g. gravimetric, seismic and earth rotation signals, photogrammetric and other images)

- data compression for efficient storage in geodetic data bank and GIS

- fast computation of linear operators in planar and in higher order approximation (e.g.: Stokes' integral)

- fast computation of the terrain effect

- harmonic continuation

- numerical solution of geodetic BVP's

- local and regional multiresolution gravity models

- global multiresolution gravity models (spherical wavelets)

- inverse modelling and regularization

- management of digital elevation models.

Some applications can be based on results already available in the theory of wavelets and require mainly an effort for the implementation of the software. Other applications will require more mathematical research.

III - Membership

Members :

L. Battha	(Hungary)
B. Benciolini	(Italy) - Chairman
G. Beylkin	(USA)
J.A.R. Blais	(Canada)
B.F. Chao	(USA)
F. Collin	(Belgium)
W. Freeden	(Germany)
E.W. Grafarend	(Germany)
V. Kunitsyn	(Russia)
R. Lehmann	(Germany)
Z. Li	(Canada)
E.C. Pavlis	(USA)
F. Sacerdote	(Italy)
B. Schaffrin	(USA)
M. Schmidt	(Germany)
P. Schroeder	(USA)
G. Strykowsky	(Denmark)
W. Sweldens	(USA)
J. Zavoti	(Hungary)
H. Sünkel	(Austria)

Correponding Members :

J. Adàm	(Hungary)
D. Arabelos	(Greece)
L. Ballani	(Germany)
R. Barzaghi	(Italy)
S. Bertoluzza	(Italy)
R. Coifman	(USA)
I. Colomina	(Spain)
H. Denker	(Germany)
J.O. Dickey	(USA)
A. Geiger	(Switzerland)
R. Hanssen	(The Netherlands)
G.W. Hein	(Germany)
B. Hofmann-Wellenhof	(Austria)
W. Keller	(Germany)
R. Klees	(The Netherlands)
A. Marchenko	(Ukraine)
W. Ming	(Canada)
L. Montefusco	(Italy)
C. Seegraef	(Germany)
D. Sguerso	(Italy)
L. Shumaker	(USA)
H. van Gysen	(South Africa)

Special Study Group 4.170

Integrated Inverse Gravity Modelling

Chairman : **L. Ballani** (Germany)

I - Terms of Reference

Considering the ill-posedness of the inverse gravimetric problem, the interpretation of gravity data becomes considerably more effective if it includes data from fields associated with other sources and phenomena. The possibility of joint inversions becomes more relevant with the availability of more input data of different fields and their improved resolution and accuracy. Another motivation to study the integrated inverse gravity modelling in detail comes from today's intensive investigation of geodynamic effects. In addition to the classical and important joint inversion of gravity and seismic data, new combinations appear: Gravity data are successfully inverted jointly with stress and strain data, with magnetic and heat flow data, and also coupled to kinematic and rheologic information. The modelled structures under investigation vary widely in dimension, shape and depth, and in scale. A broad spectrum of mathematical and physical models is employed connected with a diversity of solving algorithms for the inversion procedure. The methods are of deterministic and stochastic type or embedded in the frames of information theory and artificial intelligence.

II - Program of Activities

- Studies of the non-uniqueness (null space, inclusion of constraints, decomposition, approximation) and the instability (regularization procedures) in the inversion of potential fields, tests of different algorithms and their application to synthetic and measured data

- Study of the properties of different types of joint inversion (gravity data combined with other types of data) with respect to their implementation and the evaluation of the results

- Dependence of inversion procedures on the investigated structures (dimension, regional or global extension, layers, boundaries, depths, shape of the disturbing body, density model, etc.) and on the properties and the combination of the data

- Comparative calculations using different procedures and standard data sets

- Organization of special meetings, exchange of data and information and final publication integrating and reviewing the different aspects of the topic and the numerical results in special issue or monograph form

III - Membership

Members

U. Achauer	(France)
L. Ballani	(Germany) - Chairman
R. Barzaghi	(Italy)
O. Cadèk	(Czech Republic)
V.N. Glaznev	(Russia)
R. Lehmann	(Germany)
Z. Martinec	(Czech Republic)
V.O. Mikhailov	(Russia)
K. Mosegaard	(Denmark)
I. Nakanishi	(Japan)
M.K. Sen	(USA)
P. Smilde	(Germany)
D. Stromeyer	(Germany)
G. Strykowski	(Denmark)
G. Toth	(Hungary)
I. Tziavos	(Greece)
Q. Wang	(P.R. China)
T. Yegorova	(The Ukraine)
H. Zeyen	(Sweden)
S. Zhao	(P.R. China)

Associate Members

A. Buyanov	(Russia)
A. Geiger	(Switzerland)
E.E. Klingele	(Switzerland)
H. Hyvalovà	(Czech Republic)
O. Legostaeva	(The Ukraine)
H. Mikada	(Japan)
A. Raevsky	(Russia)
U. Schäfer	(Germany)
V.N. Starostenko	(Ukraine)
V.N. Strakhov	(Russia)
D.W. Vasco	(USA)

Special Study Group 4.171

Dynamic Isostasy

Chairman : **L.E. Sjöberg** (Sweden)

1. Objectives

It is well known that the classical isostatic models of Airy and Pratt do not generally fit the geoid over large portions of the Earth. Major parts of the long geoid waves are better explained by density variations in the Earth's mantle and by its core/mantle topography variations.

Isostasy may be understood in the terms of mass conservation, minimization of strain energy and mechanical equilibrium. Isostatic equilibrium may be the contribution of various mechanisms, such as crustal thickening/ thinning, thermal expansion of mantle density, postglacial rebound and plate flexure. Dynamic compensation, as opposed to static compensation, may be assigned to these latter effects.

2. Activities

It is the task of the group to study the dynamic effects of isostasy and to improve current isostatic models to better fit the geoid, e.g. as determined from high precision Earth gravity models.

3. Members

L.M. Asfaw	(Ethiopia)
A. Cazenave	(France)
K. Colic	(Croatia)
J. Engels	(Germany)
E.W. Grafarend	(Germany)
B. Hager	(USA)
B. Heck	(Germany)
K. Heki	(Japan)
X. Li	(P.R. China)
Z. Martinec	(Czeck Republic)
J. Mitrovica	(Canada)
R. Sabadini	(Italy)
L.E. Sjöberg	(Sweden) - Chairman
G. Spada	(Italy)
P. Vanicek	(Canada)
D. Wolf	(Germany)
S. Zhao	(P.R. China)

Corresponding Member :

F. Sansò	(Italy)

Special Study Group 4.176

Temporal Variations of the Gravity Field

Chairman : **D. Wolf** (Germany)

I- Terms of References

Recent advances in observational techniques have revealed temporal gravity variations of wide-ranging characteristic periods. Their time dependence has been related to different types of processes acting both near the Earth's surface and in its interior.

Quantitative predictions of the gravity variations require the development of dynamic Earth models.

II- Program Of Activities

- Classification of atmospheric, cryospheric, hydrospheric and solid-Earth processes responsible for gravity variations according to source type

- Study of conventional Love-number formalism for elementary sources (i.e. volume forces, normal and tangential surface forces)

- Development of generalized Love-number formalism for complex sources (i.e. dislocations)

- Development of generalized Love-number formalism for periodic sources (Fourier-transformed Love numbers) and aperiodic sources (Laplace-transformed Love numbers)

- Development of asymptotic approximations for large degrees and orders

- Development of viscoelastic Earth models for prediction of gravity variations

- Study of effects due to density stratification, compressibility, lateral heterogeneity, phase boundaries and rheology in mantle and core

- Prediction of gravity variations caused by atmospheric, cryospheric, hydrospheric and solid-Earth processes

III- List of Members

V. Dehant	(Belgium)
M. Ekman	(Sweden)
J. Engels	(Germany)
J. Fernandez	(Spain)
E.W. Grafarend	(Germany)
P. Johnston	(Australia)
X. Li	(China)
J.B. Merriam	(Canada)
J.X. Mitrovica	(Canada)
S. Okubo	(Japan)
L.E. Sjöberg	(Sweden)
G. Spada	(Italy)
L. Svensson	(Sweden)
B. Vermeersen	(Italy)
H.-G. Wenzel	(Germany)
D. Wolf	(Germany)-Chairman

Corresponding Member

W. Zürn	(Germany)

SECTION V

GEODYNAMICS
GEODYNAMIQUE

President: M. Feissel (France)
Secretaries: C. Wilson (USA)
(Commission V) H.-G. Wenzel (Germany)
(Commission VII) T. Tanaka (Japan)

I- Terms of Reference

According to the by-laws of the IAG, the Section V "Geodynamics" deals with the following topics :

- reference systems,
- monitoring and study of time-dependent phenomena, such as polar motion, Earth rotation, Earth tides, recent crustal movements, variations of gravity, sea surface topography including mean sea level,
- geodetic aspects of international geodynamic projects, such as the Lithosphere project,
- geophysical interpretation of gravity and related data.

The objectives of Section V are :

(a) to promote the study of all scientific problems mentionned above and encourage the research in these fields,

(b) to promote and coordinate international cooperation in this field,

(c) to provide, on an international basis, for discussion and exchange of the results of the studies, research and works indicated in paragraph (a) and (b) above,

(d) to involve as many active geodesists as possible in the program of the Section V and to make them enthousiastic supporters,

(e) to promote the cooperation with other international organizations workin in the field of geodynamics.

II- Structure

Commissions :

Commission V : Earth Tides
President: H.-G. Wenzel (Germany)

Commission VII : Recent Crustal Movements
President : T. Tanaka (Japan)

Special Commissions :

SC 3 : Fundamental Constants
President : E. Groten (Germany)

SC 8 : Sea Level and Ice Sheet Variations
President : W.E. Carter (USA)

Special Study Groups :

SSG 5.172 : Understanding Natural Hazards : The geodetic contribution
Chairman : S. Okubo (Japan)

SSG 5.173 : Interaction of the Atmosphere and Oceans with the Earth's Rotational Dynamics
Chairman : C. Wilson (USA)

SSG 5.174 : Geophysical Interpretation of Temporal Variations of the Geopotential
Chairman : A. Cazenave (France)

SSG 5.175 : and Interannual Variations of the Vertical their Interpretations
Chairman : Z.X. Li (China)

International Services

International Centre of Earth Tides (ICET)
Director : B. Ducarme (Belgium)

International Earth Rotation Service (IERS)
Chairman of the DB : C. Reigber (Germany)

Director of the CB : M. Feissel (France)

Permanent Service for Mean Sea Level (PSMSL)
Director : P.L. Woodworth (UK)

Bureau International des Poids et Mesures (BIPM)
Time Section
Director Time Section : C. Thomas (France)

Commission V

Earth Tides
Marées Terrestres

President :	H.-G. Wenzel	(Germany)
Vice-President :	S. Takemoto	(Japan)
Secretary :	O. Francis	(Belgium)

1. Program of Activities

The objective of the Commission is to promote international cooperation and coordination of investigations related to the observation, pre-processing, analysis and interpretation of earth tides.

By earth tides, we understand all phenomena related to the variation of the Earth's gravity field and to the deformation of the Earth's body induced by the tide generating forces, i.e. the forces acting on the Earth due to differential gravitation of celestial bodies as the Moon, the Sun and the planets.

The Commission will collaborate with all international and national organizations concerned with the observation, pre-processing, analysis and interpretation of earth tides.

The Commission will make standard software for the prediction of earth tide phenomena available to the scientific community by an electronic information service, established at November 1st 1995 under :

address :	gik.bau-verm.uni-karlsruhe.de
login :	ftp
password :	ftp
directory :	pub/etc

The Commission will encourage and promote campaigns to develop, compare and calibrate instrumentation for earth tide observations, techniques of operation, procedures for data pre-processing and data analysis.

The Commission will organize the 13th International Symposium on Earth Tides at Brussels/Belgium in 1997.

2. Working Groups

- ***Working Group 1 : Theoretical tidal model***
Chairwoman : V. Dehant (Belgium)

- ***Working Group 2 : High precision tidal data processing***
Chairman : G. Jentzsch (Germany)

- ***Working Group 3 : Tidal measurements and geodynamic research***
Chairman : R. Vieira (Spain)

- ***Working Group 4 : Calibration of gravimeters***
Chairman : NN

- ***Working Group 5: Global gravity monitoring network***
Chairman : B. Richter (Germany)

3. International Centre For Earth Tides (Icet)

The Commission supports the activities of the International Centre for Earth Tides (ICET) in collecting, analysing and distributing earth tide observations. The ICET is considered as the executive office of the Earth Tide Commission.

4. National Representatives

B. Ducarme	(Belgium)
S. Pagiatakis	(Canada)
H.T. Hsu	(China)
Z. Simon	(Czech Republic)
O.B. Andersen	(Denmark)
J. Hinderer	(France)
B. Richter	(Germany)
S. Moldenski	(Russia)
C.L. Merry	(South Africa)
R. Vieira Diaz	(Spain)
E. Klingele	(Switzerland)
S. Hekimoglu	(Turkey)
J. Wahr	(USA)

Commission VII

Recent Crustal Movement
Mouvements récents de l'écorce terrestre

President : **T.Tanaka** (Japan)
Secretary : **W.Augath** (Germany)

I- Objectives

- To promote the study of recent crustal movements.

- To promote and coordinate international cooperation in research of recent crustal movements.

- To support to exchange information and to publish the results of international studies.

II- Program of activities

1. Investigation of recent crustal movements by space techniques and conventional methods from the global viewpoint of geodynamics.

2. Improvement of methods for monitoring recent crustal movements of various scales as well as for data processing and analysis to develop modelling the dynamical process and to understand the mechanism of the movements.

3. Cooperation with CSTG and geophysical study groups in order to promote the above activities.

4. Cooperation with oceanic science research groups in order to understand the crustal movements under the ocean bottom.

The results from research activities in recent crustal movements will be presented and information will be exchanged at the Ninth International Symposium on Recent Crustal Movements in Cairo (1998), and IAG Regional Symposium on Deformations and Crustal Movement Investigations Using Geodetic Techniques in Szekesfehervar, Hungary (1996).

III- The internal organization

Bureau:

President	:	T.Tanaka (Japan)
Vice-President	:	P.Vanicek (Canada)
Vice-President	:	H.-G.Kahle (Switzerland)
Secretary	:	W.Augath (Germany)

Members of Bureau:

Yu.D.Boulanger	(Russia)
P.Vyskocil	(Czech)

Members of Executive Committee:

Chair of Sub-Commissions:

Europe	:	
Nordic	:	
North America	:	
Central and South America	:	
West Pacific	:	
South Asia	:	
Africa	:	A.Tealeb

IV- The list of members

National Representatives

B.Ducarme	(Belgium)
G.Carrera	(Canada)
K. Schmidt	(Denmark)
A.Tealeb	(Egypt)
K.Feigl	(France)
J.Mierlo	(Germany)
I.Joo	(Hungary)
K.Heki	(Japan)
J. Beavan	(New Zealand)
J.Krynski	(South Africa)
E.R.Pujol	(Spain)
H.-G. Kahle	(Switzerland)
J.B.Minster	(USA)

Special Commission SC3

Fundamental Constants (SCFC)

President : **E. Groten** (Germany)

The SC3 will basically continue the work of SC3 in the past. The updating of fundamental reference systems is the principal aim. Therefore, the following objectives etc. do not differ from those of the earlier periods.

I- Objectives

To assemble the system of the primary geodetic parameters defining the geodetic reference systems such as GRS.

To review the current information on the numerical values of physical quantities which are fundamentally important in the fields of astronomy, geodesy, and geodynamics.

To combine this information into a uniform, compatible set.

To recommend to the XXIInd General Assembly (1999) of I.A.G. the publication of a set of most up-to-date representative values.

To consider and contact the status of the GRS 1980 in view of any necessary changes in this reference system, and to make a recommendation to the XXIInd I.A.G. General Assembly.

II- Membership

C. Boucher	(France)
M. Bursa	(Czech Republic)
B.H. Chovitz	(USA)
A.H. Cook	(United Kingdom)
J.O. Dickey,	(USA)

R.J. Eanes	(USA)
T. Fukushima	(Japan)
A.M. Gontier	(France)
E.W. Grafarend	(Germany)
E. Groten	(Germany)
Hsu Hotse	(China)
D.D. McCarthy	(USA)
H. Moritz	(Austria)
E.C. Pavlis	(USA)
G. Petit	(France)
J.C. Ries	(USA)
J.M. Rüeger	(Australia)
A. Sidorov	(Russia)
Z. Sima	(Czech. Republic)
F.R. Stephenson,	(United Kingdom)
C.C. Tscherning,	(Denmark)
J.G. Williams	(USA)
Ye Shuhua	(China)

Additional members :

R. Vicente	(Portugal)
M.I. Yurkina	(Russia)
B. Guinot	(France)
V.A. Brumberg	(France)

Special Commission SC8

Sea Level and Ice Sheet Variations

President : **W.E. Carter** (USA)

1. Terms of Reference

- Promote, encourage, and assist international cooperation in studies and observing programs to apply advanced geodetic techniques to understanding the current rates and causes of changes in sea level and ice sheets.

- Foster interdisciplinary communication and cooperation among geodesists, geophysicists, glaciologists, oceanographers, and related earth scientists in the observation, study, interpretation, modelling and prediction of sea level and ice sheet temporal variations.

- Maintain close liaison with appropriate organizations such as Commissions and Special Study Groups of the International Association for Physical Sciences of the Ocean (IAPSO), the International Geosphere-Biosphere Program (IGBP) Land Ocean Interaction in the Coastal Zone (LOICZ) Projects, and national agencies with related responsibilities and programs, e.g., the US National Oceanic and Atmospheric Administration (NOAA).

Structure

- The President of SC8, the Presidents of Sub-Commissions formed by SC8, and the representatives of projects organized, coordinated, or endorsed by SC8 will serve as an ad hoc steering committee for SC8.

- Sub-Commissions and/or project teams will be organized by SC8 as deemed appropriate to carry out the work of Commission.

- Based on proposals submitted at General Assembly XXI, three Sub-Commissions will be established immediately upon approval of the SC8 plan by IAG :

. SSC8.1 Studies of the Baltic Sea, led by J. Kakkuri;

. SSC8.2 Vertical Crustal Deformation at the Edges of Continental Ice Masses, led by R. Dietrich.

. SSC8.3 Geodetic Methods for Ice-sheet Monitoring, led by Hans Werner Schenke.

3. Membership

G. Blewitt	(UK)
T.S. James	(Canada)
P. Morgan	(Australia)
B. Douglas	(USA)
S. Zerbini	(Italy)
T. Yoshino	(Japan)
A. Dodson	(UK)
J. Wahr	(USA)
E.R. Ivins	(USA)
R. Peltier	(Canada)
C. Bentley	(USA)
W. Wiejak	(Poland)
D.S. Robertson	(USA)
A. R. de Mesquita	(Brazil)
D. Pugh	(UK)
J. Manning	(Australia)
J. Kakkuri	(Finland)
C. Lingle	(USA)
H.W. Schenke	(Germany)
R. Dietrich	(Germany)
B. Engen	(Norway)
J. Hannah	(New Zealand)
B. Richter	(Germany)
G. Maul	(USA)
P. Woodworth	(UK)
J.O. Dickey	(USA)
K. Lambeck	(Australia)
M. Bevis	(USA)
Y. Takahashi	(Japan)
M. Odamaki	(Japan)
W.E. Carter	(USA) - President

Sub-Commission SC 8.1
Vertical Crustal Deformation at the Edges of Continental Ice Masses

1. OBJECTIVES

- Observe vertical crustal deformations with geodetic techniques in the marginal regions of continental ice masses (Greenland, Antarctica)

- Contribute with these observations to verify both ice load (historical and recent ice mass changes) and rebound models (viscoelastic response) in close interdisciplinary cooperation with modelling experts from glaciology and geophysics

2. Program of Activities

- Coordinate and initiate GPS observations of highest accuracy in ice free areas of Greenland and Antarctica (campaigns at remote sites in addition to permanent IGS stations)

- Promote use of other geodetic observations (gravimetry, tide gauge) for the purpose of SSC8.2

- Perform a consistent geodetic modelling of time variation of observed quantities (ellipsoidal heights, gravity, sea level) including periodical load changes due to ocean tides and seasonal ice mass variations

- Intercompare the observed geodetic effects with predictions of ice mass and rebound models, discuss the error budget of geodetic observations, ice mass balance models and viscoelastic modelling in interdisciplinary cooperation (glaciology, geophysics)

- Come out with conclusions on historical and recent ice mass changes in consistence of models and geodetic data. Compare these results with direct observations of recent ice mass changes (e.g. ice altimetry and INSAR, cooperation with SSC8.3)

Sub-Commission SC 8.2
"Vertical Crustal Deformation at the Edges of Continental Ice Masses"

Members :

R. Dietrich	(Germany)
C. Boucher	(France)
E. Dongchen	(China)
R. Forsberg	(Denmark)
G. Gendt	(Germany)
P. Huybrechts	(Germany)
F. Madsen	(Denmark)
J. Maekinen	(Finland)
D. McAdoo	(USA)
K. Shibuya	(Japan)

Sub-Commission SC 8.3
Geodetic Methods for Ice-sheet Monitoring

1. Rationale

Continental ice-sheets have great impact on the world climate, the global sea level and the weather patterns on all temporal and spatial scales. Therefore, precise geodetic methods and techniques must be evaluated and used for surveying and monitoring their size, extension and dynamic parameters.

2. Objectives

Observe horizontal and vertical movements and local strain rates, the surface topography, the structure and the margins of ice-sheets with geodetic methods.

Study the feasibility of advanced techniques (satellite radar altimetry, interferometric synthetic aperture radar, kinematic differential GPS, etc.) for surveying and monitoring ice-sheets and verify these observations with ground truth and geodetic fieldwork.

Monitor temporal variations of the ice-sheets extension and dynamics, in close interdisciplinary collaboration with glaciologists and geophysicists, in order to study the state (steady or unsteady) of the ice-sheets.

3. Work Program

- Study, by ground truthing in test areas, the accuracy of satellite radar altimetry for topographic mapping and for the observation of time dependent surface height changes.

- Investigate recent developments in interferometric synthetic aperture radar (INSAR) for monitoring height changes and structures of ice-sheets.

- Examine geodetic and geophysical methods of precisely measuring the vertical velocity of ice sheets with a maximum accuracy as this parameter is a direct indicator of ice mass balance.

- Organize interdisciplinary workshops and symposia together with glaciologists, geophysicists and others to foster interdisciplinary collaboration and communication and to harmonize the field activities.

- Observe and analyse the effect of ocean tides on ice-shelves in Antarctica.

Members :

G. Casassa	(Chile)
M. Lange	(Germany)
W. Niemeier	(Germany)
N. Reeh	(Denmark)
G. Seeber	(Germany)
J. Sievers	(Germany)
D. Vaughan	(UK)
I. Whillans	(USA)
D. Wingham	(UK)

Special Study Group 5.172

Understanding Natural Hazards - Geodetic Contribution

Chairman : **S. Okubo** (Japan),

I. Objectives

Applying theoretical, observational, and instrumental techniques to better understand natural hazards such as earthquake, volcanic eruption, and land slide.

II. Planned Activities

- Developing techniques to detect hidden seismic faults, premonitory signals of volcanic eruption/land slide from geodetic data.

Emphasis will be placed on air-borne precise gravimetry, SAR interferometry, Satellite altimetry, dense GPS monitoring network.

- Improving theory, which predicts changes of the geodetic observables : baseline change, elevation change, gravity change, strain and tilts changes and so on.

III. Membership

J. Brozena	(U.S.A.)
G. Hein	(Germany)
K. Hudnut	(U.S.A.)
J. Kahar	(Indonesia)
D. Massonnet	(France)
M. Murakami	(Japan)
T. Niebauer	(U.S.A.)
S. Okubo	(Japan) - Chairman
P. Pâquet	(Belgium)
W. M. Welsch	(Germany)
Zhao Shaorong	(China)

Special Study Group 5.173

Interactions of the Atmospheres and Oceans with the Earth's Rotational Dynamics

Chairman : **C.R. Wilson** (USA)

I. Terms of Reference

International Association of Geodesy Special Study Group 5.173, 'Interaction of the Atmospheres and Oceans with the Earth's Rotational Dynamics' is established to coordinate studies related to understanding the causes of observed rotational variations arising from oceanic and atmospheric variability over the range of time scales from hours to decades. Understanding these rotational variations requires a combined effort of theory, observation, and numerical modelling of geodetic, oceanographic, and atmospheric processes

II. Program of Activities

Attention will be given to the following scientific problems and activities:

Analysis of global numerical models of the oceans and atmosphere, including wind contributions, torques, and angular momentum regional and global scale fluxes and budgets.

Polar motion, nutation and interactions of oceans and atmospheres with the earth at periods near 1 day and less.

Understanding the loss of correlation between atmospheric and earth rotation time series at periods shorter than about 2 weeks.

Earth rotation variability at periods longer than a year, as measures of climate, sea level change, and internal processes.

The SSG will communicate through electronic mail, and a WWW site will be maintained to post items of interest to the membership. The test version of the WWW site is located at :

http://www.utexas.edu/cons/geo/wilson/

This should prove to be an effective tool in developing the interdisciplinary communication that is required to address these problems.

Meetings of the SSG will be organized to coincide with other geophysical and geodetic conferences. Discussions concerning any special meeting activities of this SSG will be held electronically, and at the Fall meeting of the American Geophysical Union in San Francisco, in

connection with a special Union Symposium on Earth Rotation.

III. Membership

Members

A. Brzezinski	Poland)
S. Dickman	(USA)
F. Bryan	(USA)
B. Chao	(USA)
S. Desai	(USA)
O. de Viron	(Belgium)
J.O. Dickey	(USA)
M. Eubanks	(USA)
M. Furuya	(Japan)
T. Herring	(USA)
D. Gambis	(France)
H. Itoh	(Japan)
K. Kuma	(Japan)
R. Ponte	(USA)
C. R. Wilson	(USA) - Chairman
S. Yoshida	(Japan)
D. Zheng	(China)

Corresponding members

M. Bell	(UK)
P. Brosche	(Germany)
V. Dehant	(Dehant)
R. Eanes	(USA)
M. Feissel	(France)
P. Gegout	(France)
R. Gross	(USA)
J. Hinderer	(France)
T. Johnson	(USA)
B. Kolaczek	(Poland)
W. Kosek	(Poland)
C. Ma	(USA)
R. Madden	(USA)
P. Mathews	(Canada)
J. Merriam	(Canada)
J.-F. Minster	(France)
I. Naito	(Japan)
J. Nastula	(Poland)
D. Peltier	(Canada)
J. Ray	(USA)
R. Ray	(USA)
R. Rosen	(USA)
D. Salstein	(USA)
J. Wahr	(USA)
K. Weickmann	(USA)

Special Study Group 5.174

Geophysical Interpretation of Temporal Variations of the Geopotential

Chairman : **A. Cazenave** (France)

I- Terms of Reference

1. Current status on the determination of the temporal variations of the Earth's gravity field and expected improvments

2. Relationships with geophysical phenomena

- Subdecadal fluctuations : decadal, seasonal and intraseasonal time scales;
  Constraints on surface mass redistributions within atmosphere and oceans,
  Continental water storage, melting or accumulation of glaciers, etc.

- Long term (larger than 10 years) and secular changes, with inference on :
  Long period tides
  sea level changes
  mass balance of Antarctica and Greenland
  Post glacial rebound and mantle viscosity structure

3. Complementary inputs from LOD and polar motion

Members

S. Bettadpur	(USA)
R. Biancale	(France)
A. Cazenave	(France) - Chairman
M. Cheng	(USA)
B.F. Chao	(USA)
R. Eanes	(USA)
P. Exertier	(France)
P. Gegout	(France)
T.S. James	(Canada)
S. Klosko	(USA)
J. Mitrovica	(Canada)
S. Nerem	(USA)
Y. Tamura	(Japan)
J. Wahr	(USA)

Special Study Group 5.175

Interannual Variations of the Vertical and Their Interpretation

Chairman : **Z.X. Li** (China)

I. Objectives :

Further investigating the possibility of deriving the variations in the deflection of the vertical,

including those in intraseasonal time scale if the Hipparcos Star Catalog is able to be used successfully in the near future from the optical astrometric observations; interpretations of these variations in examining the roles of atmosphere, ocean, and inner part of the terrestrial globe in causing these variations ; to search if abnormal deflection of the vertical could be used as a precursor to seismic events.

II. Program of activities :

- Selection of the continuous observational data of astrometric and gravimetric instruments performed in the past and still in operation, including stations distributed in seismic areas and low seismic areas ;

- Preparation of the atmospheric and oceanic data and other usable geophysical data; discussion in theory and data analysis ;

- Interpretation.

III. Members

M. Barlik	(Poland)
M. Becker	(Germany)
P. Gegout	(France)
H.Li	(China)
Z.-X. Li	(China) - Chairman
H.-P. Sun	(Belgium)
J. Vondrak	(Czech Rep.)

International Center for Earth Tides
Centre International des Marees Terrestres
(ICET)

(Federation of Astronomical and Geophysical Data Analysis Services, FAGS)
(World Data Center-C For Earth Tides)

Director : **B. Ducarme** (Belgium)
Vice-Director : **Olivier Francis** (Belgium)

Activities:

- Summary of Data Held: data from about 360 worldwide tidal gravity stations (hourly values, main tidal waves obtained by least squares analyses, residual vectors, oceanic attraction and loading vectors). The Data Bank contains also data from tiltmeters and extensometers.

- Data Products, Publications, Catalogues: a "Bulletin d'Informations Marees Terrestres" is published two or three times a year which contains a very great number of translations of Russian and some Chinese papers.

- A General Bibliography with 5027 references is also regurlaly kept up to date and published.

- User Services: the Center provides assistance for the setup of new stations, calibrations of the instruments, data processing as well as for tidal analysis. The assistance is accomplished either by a stay at the Centre or by providing FORTRAN programs.

- The ICET makes also available tidal predictions for any place and time, which are needed for field gravimetry, absolute gravity measurements and for tilt measurements. These predictions can be computed either on the basis of elastic Earth models and oceanic cotidal maps, or on basis of the results of direct measurements.

International Earth Rotation Service
Service International de la Rotation Terrestre
(IERS)

(Federation of Astronomical and Geophysical Data Analysis Services, FAGS)

Chairman of the Directing Board :
C. Reigber (Germany)
Director of the Central Bureau:
M. Feissel (France)

The International Earth Rotation Service (IERS) was established in 1987 by IAU and IUGG and it started operation on 1988 January 1st. It replaces the International Polar Motion Service (IPMS) and the earth-rotation section of the Bureau International de l'Heure (BIH) ; the activities of BIH on time are continued at Bureau International des Poids et Mesures (BIPM). IERS is a member of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS).

I- Functions

IERS is responsible for :

- defining and maintaining the international terrestrial reference system recommended by the IUGG, based on observing stations that use the high-precision techniques in space geodesy ;

- defining and maintaining the international celestial reference system recommended by the IAU that is based on extragalactic radio sources, and relating it to other celestial reference systems ;

- determining the earth orientation parameters connecting these systems, the terrestrial and celestial coordinates of the pole and universal time ;

- organising operational activities for observation and data analysis, collecting and archiving appropriate data and results, and disseminating the results to meet the needs of users.

In 1996 it relies on five observing techniques: Very Long Baseline Interferometry (VLBI), Lunar Laser Ranging (LLR), Global Positioning System (GPS), Satellite Laser Ranging (SLR), and Doppler Orbit Radio-positioning Integrated on Satellite (DORIS).

II- Organisation

The main centres in IERS are the Central Bureau, Sub-bureaus, and Coordinating Centres for each of the observing techniques. It is supported by many other organisations that contribute to the tasks of observation and data processing.

The Coordinating Centres are responsible for organizing observations, objects to be observed, schedules, preprocessing of observational results, etc. and for the selection of models and procedures to be used in the analysis of observations. These centres are the following in 1995.

VLBI Coordinating Centre
National Earth Orientation Service
MS 926.9
Goddard Space Flight Center
Geodynamics Branch
Greenbelt, MD 20771, USA
Internet: CMA@GEMINI.GSFC.NASA.GOV

LLR Coordinating Centre
OCA/CERGA
Avenue Nicolas Copernic
06130 Grasse - France
Internet: veillet @ocar01.obs-azur.fr

GPS Coordinating Centre
Jet Propulsion Laboratory
MS 238-540
4800 Oak Grove Drive
Pasadena, CA 91109 - USA
Internet:BILL_MELBOURNE.
JPL#u#330#u#QMail@JPL-335-
SERVER.JPL.NASA.GOV

SLR Coordinating Centre
Center for Space Research 60605
The University of Texas at Austin
Austin, TX 78712-1085 - U S A
Internet: schutz@utcsr.ae.utexas.edu

DORIS Coordinating Centre
Institut Geographique National
B P 68
2 avenue Pasteur
94160 Saint-Mande - France
Internet: willis@ign.fr

The observations are organized in networks for each of the observing techniques, under the responsibility of the IERS Technique Coordinating Centres. They are archived in data centres and distributed to Analysis Centres. Some of the centres contribute, in operational mode, earth-orientation data to the Sub-Bureau for Rapid Service and Predictions (weekly bulletins) and to the Central Bureau (monthly bulletins). Most Analysis Centres produce global solutions based on many years of observations, including the determination of station positions and velocities, earth rotation and, in the case of VLBI, directions of extragalactic compact radio sources. The Central Bureau combines the various types of results to obtain the final results, which are disseminated to the user community in Annual Reports and electronically accessed data bases. Assessment of the accuracy and precision of the contributed solutions is also provided. Technical Notes are distributed; some describe the IERS Standards, while others contain the reports of the Analysis Centres and details of the final IERS results. The mailing list includes 780 institutes in 62 countries : space-geodesy and astronomical observatories, geodetic institutes, universities, time services, etc. The observational results of VLBI, LLR, GPS, SLR and DORIS are archived at several centres, subject to the agreement of the relevant Coordinating Centres. The results on earth rotation and reference frames are archived at the network and analysis centres which obtained them, as well as at the Central Bureau.

The atmospheric data related to earth-orientation variations from four major meteorological centres are collected, validated and made available by the Sub-Bureau for Atmospheric Angular Momentum. Currently, there are four participating centers contributing to the Sub-Bureau. It serves as a focal point for the collection of atmospheric measurements. The data is made available within the IERS and to the users community. Research is performed in order to assess the accuracy and completeness of the series derived by the participating meteorological centers.

The Central Bureau decides and disseminates the announcements of leap seconds in UTC and values of DUT1 to be transmitted with time signals.

The principal IERS centres are :

CENTRAL BUREAU
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris - France
Internet: iers@obspm.fr

Terrestrial Frame Section
Institut Geographique National
B.P. 68
94160 St Mande - France
Internet: boucher@ign.fr

Earth Orientation Section
Observatoire de Paris
61, avenue de l'Observatoire
F-75014 Paris - France
Internet: gambis@obspm.fr

Celestial Frame Section
Observatoire de Paris
61, avenue de l'Observatoire
F-75014 Paris - France
Internet: felicitas@fcaglp.edu.ar

- SUB-BUREAU FOR RAPID SERVICE AND PREDICTIONS

National Earth Orientation Service
U.S. Naval Observatory
3450 Massachusetts Avenue, N.W.
Washington DC 20392-5420 - U S A
Internet: dmc@maia.usno.navy.mil

- SUB-BUREAU FOR ATMOSPHERIC ANGULAR MOMENTUM

Climate Analysis Center
NOAA/National Weather Service
5200 Auth Road-Room 805
Washington, DC 20233 - U S A
Internet: salstein@aer.com

The Directing Board exercises general control over the activities of the service, including modifications to the organisation and participation that would be appropriate to maintain efficiency and reliability, while taking full advantage of the advances in technology and in theory. It is advised by a group of Corresponding Members, who are kept informed of the activity of the Directing Board and are encouraged to submit comments and suggestions. The secretary of the Board is provided by the Central Bureau.

The Members of the Board are, in 1996 :

C. Reigber	International Union of Geodesy and Geophysics
B. Kolaczek	International Astronomical Union
O.B. Andersen	Federation of Astronomical and Geophysical Data Analysis Services
C. Ma	VLBI Coordinating Centre
C. Veillet	LLR Coordinating Centre
W.G. Melbourne	GPS Coordinating Centre
B.E. Schutz	SLR Coordinating Centre
P. Willis	DORIS Coordinating Centre
M. Feissel	Central Bureau

with the permanent participation of :

D.D. McCarthy	Sub-bureau for Rapid Service and Predictions
C. Boucher	Terrestrial Reference Frame Section of the Central Bureau
F. Arias	Celestial Reference Frame Section of the Central Bureau
D. Gambis	Earth orientation Section of the Central Bureau
D. Salstein	Sub-bureau for Atmospheric Momentum

III- Publications

. Weekly Bulletin A Earth orientation parameters (x,y,UT1,dy,de) : Rapid Service, prediction. First issue covering observation dates in the last week in 1987.

. Monthly Bulletin B Earth orientation parameters (x,y,UT1,dy,de) combined solution and individual series. Information on UTC time scale. First issue covering observation dates in January 1988.

. Annual Report Earth-orientation parameters, terrestrial and celestial frames of the IERS Reference System: combined solutions and analysis of individual results. First issue, Report for 1988, published in July 1989.

. Special Bulletin C Announcement of the leap seconds in UTC.

. Special Bulletin D Announcement of the value of DUT1 to be transmitted with time signals.

. Technical Notes Reports and complementary information of relevance to the work of IERS on Earth orientation and the reference systems. The IERS Conventions (called earlier IERS Standards are published every three years in this series).

The precision of the published results depends on the delay of their availability. For the operational solutions of earth rotation (weekly and monthly bulletins) it is of the order of one millisecond of arc. The prediction accuracy is in the range of 0.005-0.020" for x,y, 0.002-0.015s for UT and 0.002" for dy, de (prediction lags of 10 and 90 days). For the scientific solution of reference frames

and Earth orientation, the inaccuracy is lower than 0.0003" (1 cm).

The IERS publications are airmailed. Bulletin A is prepared and distributed by the sub-bureau for Rapid Service and Predictions;

The other publications are prepared and distributed by the Central Bureau. Bulletins A and Bulletin B are also distributed by e-mail and available on anonymous FTP (File Transfer Protocol) and World Wide Web.

The sub-bureau for Rapid Service and Predictions makes available various results on a Bulletin Board.

The Permanent Service For Mean Sea Level (PSMSL)

(Federation of Astronomical and Geophysical Data Analysis Services, FAGS)

Director : **P.L.Woodworth** (UK)

Introduction

Since 1933, the Permanent Service for Mean Sea Level (PSMSL) has been responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges. It is based at the Proudman Oceanographic Laboratory, Bidston Observatory, United Kingdom and is a member of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) established by the International Council of Scientific Unions (ICSU). It is supported by FAGS, by the Intergovernmental Oceanographic Commission (IOC) and by the U.K. Natural Environment Research Council. Information on FAGS and its various services, including the PSMSL, can be found in FAGS (1989).

Description of PSMSL 'RLR' and 'metric' datasets

The database of the Permanent Service for Mean Sea Level (PSMSL) contains monthly and annual mean values of sea level from approximately 1600 tide gauge stations around the world.

The PSMSL receives monthly and annual mean values of sea level from approximately 110 national authorities, distributed around the world, responsible for sea level monitoring in each country or region. Data from each station are entered directly as received from the authority into the PSMSL raw data file for that station (usually called the METRIC file in PSMSL publications). The monthly and annual means so entered for any one year are necessarily required to be measured to a common datum, although, at this stage, datum continuity between years is not essential. While the PSMSL makes every attempt to spot inconsistent or erroneous data, the responsibility for the monthly and annual means entered into the METRIC files in this way is entirely that of the supplying authority. A description of data checks routinely made by the PSMSL is given in Woodworth, Spencer and Alcock (1990) and IOC (1992a).

In order to construct time series of sea level measurements at each station, the monthly and annual means have to be reduced to a common datum. This reduction is performed by the PSMSL making use of the tide gauge datum history provided by the supplying authority. To date, approximately two thirds of the stations in the PSMSL database have had their data adjusted in this way, forming the 'REVISED LOCAL REFERENCE' (or 'RLR') dataset. For scientific purposes, the RLR dataset is normally superior to the 'METRIC', although the latter, which contains the total PSMSL data holdings, can also be analysed bearing in mind the above datum continuity considerations.

The RLR datum at each station is defined to be approximately 7000mm below mean sea level, with this arbitrary choice made many years ago in order to avoid negative numbers in the resulting RLR monthly and annual mean values. The detailed relationships at each site between RLR datum, benchmark heights, tide gauge zero etc. are not normally required by analysts of the dataset, although they can be made available on request.

The contents of the PSMSL dataset have been described in a report 'Data Holdings of the PSMSL November 1993' (Spencer and Woodworth, 1993). This replaces similar reports from 1987 and 1991 and it is intended that further regular updates will be produced. Copies can be obtained on request from the address shown below. Further information about the PSMSL, together with maps and plots of the spatial and temporal distribution of PSMSL data, can be found in reports by Woodworth (1990, 1991) and Woodworth, Spencer and Alcock (1990).

Copies of the PSMSL dataset can be obtained over the Internet by Anonymous FTP. Alternatively, data can be obtained on a CDROM.

In special circumstances, subsets of the dataset can be provided on floppy disk or as computer printout.

The PSMSL will be pleased to provide data, information and advice to all organisations and individuals interested in measuring and analysing sea level changes.

Geocentric coordinates of tide gauge benchmarks

In 1988 a meeting of tide gauge experts and geodesists was held at the Woods Hole Oceanographic Institution under the auspices of the IAPSO Commission on Mean Sea Level and Tides. The conclusions of the meeting were published as Carter et al. (1989). A key recommendation of the meeting was that geocentric coordinates of tide gauge benchmarks, derived primarily from differential Global Positioning System (GPS) measurements relative to International Earth Rotation Service (IERS) `fundamental points' (but not exclusively e.g. DORIS), should be stored at the PSMSL alongside the sea level data.

A follow-up meeting was held in December 1993 at the Institute of Oceanographic Sciences Deacon Laboratory, Wormley, Surrey to review progress, with the conclusions and recommendations published as Carter (1994). Since the Woods Hole meeting, considerable developments have taken place with the GPS technique in particular and with the organization of centres to analyse such data, in particular with the development of the International GPS Service for Geodynamics (IGS). The PSMSL will work closely with the IGS and other organisations in order to provide time series of vertical land movements alongside the sea level time series.

Linkage to the IOC GLOSS programme and to woce sea level centres

The IOC-coordinated Global Sea Level Observing System (GLOSS) programme has as its aim the establishment of a high quality global core network of approximately 300 tide gauges to serve the various oceanographic and climate change related sea level research purposes of the next decades (Pugh, 1987; IOC, 1990a; Woodworth, 1991). The PSMSL took a major lead in the planning of GLOSS which in the long term will result in a significant improvement in the quantity and quality of data delivered to the PSMSL. Further information on the development of GLOSS from a PSMSL perspective can be found in IOC (1990b, 1991, 1992b) and Woodworth (1990, 1991), while the PSMSL can provide details of current status at any time.

Over the past couple of years many GLOSS Contacts at national sea level authorities have contributed detailed information about their tide gauge installations to the PSMSL in order to enable the compilation of a 'GLOSS Handbook'. This publication is the main source reference of information about the GLOSS network. The Handbook, edited by Dr.Lesley Rickards on behalf of the PSMSL and IOC, was first published in early 1991, with Version 2 in March 1994, and contains full cross-reference to the PSMSL data holdings from GLOSS sites. It is available on floppy disk together with a software package to interrogate it.

Anyone wishing to obtain a copy of the 'Handbook' can mail the PSMSL at any of the above addresses or mail Dr.Rickards directly at bodcmail@pol.ac.uk.

GLOSS has played a particularly important role in the provision of training courses and training materials. The reports IOC (1985, 1988) contain information on the operation of tide gauges to GLOSS standards.

The next decade will see major efforts to collect higher frequency (typically hourly) sea level data in order to provide an 'in-situ' World Ocean Circulation Experiment (WOCE) dataset, primarily for comparison to and validation of sea level data obtained from satellite radar altimetry (WOCE, 1988a, 1988b). The designated 'WOCE tide gauges' are mostly GLOSS island sites and pairs of gauges across straits and total about 100 stations. There are two WOCE Sea Level Centres (WSLC's): one at the British Oceanographic Data Centre at Bidston Observatory alongside the PSMSL (the so-called 'slow centre'), and the other at the University of Hawaii alongside the Tropical Ocean Global Atmosphere (TOGA) Sea Level Center (the so-called 'fast centre'), with the two centres working closely together. Eventually, the centres will be producing their own data holdings reports etc.

Any requests to the PSMSL for WOCE higher frequency data will be automatically passed to the WSLC's for servicing. Alternatively, they may be contacted directly via at :

bodcmail@pol.ac.uk (Internet) (Attn. Lesley Rickards)

for the Bidston WSLC and :

mitchum@lolo.soest.hawaii.edu (Internet) (Attn. Gary Mitchum)

for the Hawaii WSLC.

Address :

Permanent Service for Mean Sea Level
Bidston Observatory
Birkenhead, Merseyside L43 7RA
United Kingdom

Telephone: (44) 151-653-8633
Fax: (44) 151-653-6269
Telex: 628591 OCEANB G
Email: psmsl@pol.ac.uk

WWW: http://www.nbi.ac.uk/psmsl/sea_level.html
FTP : bisag.nbi.ac.uk and cd pub/psmsl

Time Section
Bureau International des Poids et Mesures (BIPM)

Director (Time Section) : **C. Thomas** (France)

The Bureau International des Poids et Mesures (BIPM) has taken full responsability of the International Atomic Time (TAI), on 1988, January 1st. TAI was previsously established by the Bureau International de l'Heure (BIH).

Functions

The BIPM is in charge of :

- establishing TAI and also Coordinated Universal Time (UTC) (except for the UTC leap second occurence and announcement, in charge of IERS),

- providing the data making TAI and UTC available in the standard laboratories,

- participating to the worldwide coordination for time comparisons.

Activities and services

TAI is established on the basis of atomic clock data and atomic frequency standards data provided by 50 laboratories or national centers.

TAI and UTC are made available by the dissemination of corrections to be applied to the readings of the master clocks of the participating laboratories.

This activity requires accurate time comparisons between remote clocks, which are mostly based on the tracking of GPS satellites. The BIPM organizes these time comparisons by providing international GPS common-view tracking schedules and by checking differential calibration of GPS time receivers. The BIPM treats raw GPS data according to a unified procedure:

- Only strict GPS common views are used to minimize Selective Availability effects.

- The international network figures local stars on continental distances added to two long-distance links between the NIST (Boulder, Colorado, USA), the CRL (Tokyo, Japan) and the OP (Paris, France),

- Long-distance links are corrected for measured ionospheric delays on site and for precise satellite ephemerides.

The ultimate uncertainty is of a few nanoseconds for a tracking duration of 13 minutes.

In 1996, the stability of TAI is about 3×10^{-15} for averaging times of 2 months. The TAI scale unit differs from the SI second, on the rotating geoid, by an amount of $+2 \times 10^{-14}$ s. This shift, known with a relative uncertainty of 5×10^{-15}, is due to the uniform application (following a decision of the Comité Consultatif pour la Définition de la Seconde in March 1996) of corrections compensating for the black-body radiation shift, to the results of primary frequency standards.

In addition to TAI, whose definitive issue is available every 2 months, the BIPM establishes a scientific time scale TT(BIPM) for applications requiring ultimate long-term stability. A new version of this time scale, based on data reprocessing, is available every year and covers several past years.

Availability of BIPM time data

(a) Publications
- Circular T (monthly)
Corrections to the readings of laboratory clocks, to get TAI and UTC. Data on time comparisons. Informations.
- Annual Report of Time Section of BIPM. Methods of evaluation of TAI. Data on the clocks and time comparisons. Data from the primary frequency standards, BIPM results on time scales.
- Schedules for GPS satellites tracking (for participating laboratories), issued about twice a year.

(b) BIPM Data Service
INTERNET Anonymous ftp (node 145.238.2.2.)
See the READ.ME file for complete description.

Address

Bureau International des Poids et Mesures
Pavillon de Breteuil
92312 Sèvres Cedex
France

Phone: + 33 1 45 07 70 72
Fax: + 33 1 45 07 70 59
E-mail: tai@bipm.fr

OUT OF SECTION

Cassinis Committee.

Chairman: **W. Torge** (Germany)

I - Terms of Reference.

According to the By-Laws of the Association the structure must be reviewed every eight years by a committee called the Cassinis Committee. The committee reports to the Executive Committee, which also appoints its members.

A Cassinis Committee has been appointed in 1995 (see below), with the purpose of proposing structural changes to be implemented at the General Assembly in 1999.

II - Program of work.

As a preparation for the work a meeting (Cassinis Forum) were held during the General Assemmbly in Boulder, Colorado, 1995.

A first meeting of the committee has already been held following the first meeting of the Executive Committee in Copenhagen, Nov. 18, 1995.

The next meeting will be held in 1997, in connection with either the meeting of the Executive Committee or the Scientific Assembly.

III - Members.

W.Torge	(Germany) - Chairman
J.O. Dickey	(USA)
I.I.Mueller	(USA)
F.Sansò	(Italy)
H.Sünkel	(Austria)
C.C.Tscherning	(Denmark),
J.Y. Chen	(China)

Geodetic Aspect of the Law of the Sea (GALOS)

Chairman : **P. Vanicek** (Canada)

I- Program of work

The mandate of GALOS is to formulate recommendations concerning geodetic aspects of international maritime boundary delimitation within the framework of the Law of the Sea Convention 1982 for the IAG member countries. The geodetic tasks involved in the delimitation are :

1) accurate area determination;

2) definition of offshore limits, both geometrical and as continental shelf limits;

3) definition of equidistant boundaries;

4) definition of partial effect boundaries;

5) determination of base points.

II- Members

Members

G. Carrera	(Canada) - Secretary
D. Grant	(New Zealand)
E. Groten	(Germany)
B.G. Harsson	(Norway)
A.J. Kerr	(Monaco)
F. Madsen	(Denmark)
S. Mira	(Indonesia)
B. Murphy	(Australia)
S. Nichols	(Canada)
S. Oszczak	(Poland)
C. Rizos	(Australia)
G. Seeber	(Germany)
A.B.H. Salem	(Tunisia)
L.E. Sjöberg	(Sweden)
W.A. van Gein	(The Netherlands)
P. Vanicek	(Canada) - Chairman
J.A. Weightman	(UK)
J.D. Zund	(USA)

Observer:

T. Katsura (Japan)

Ex-Officio:

N.R. Guy (South Africa)

Ad Hoc Planning Group Establishment of a Crustal Deformation Bureau

Chairman : **W. Prescott** (United States)

I. Function

It has been suggested that the time is ripe for the formation of a Crustal Deformation Bureau, which would play a role in the coordination of international crustal deformation activities similar to the role of the International Earth Rotation Service for earth rotation activities. It is the aim of this study group to evaluate this idea and make a recommendation as to whether the Association should move forward with plans for such a Bureau. In order to make this decision it is necessary to clearly define the activities and structure envisioned for such a Bureau. If a decision is made that such a Bureau is worthwhile, the discussion of activities and structure will serve as a useful starting point for the design of the Bureau.

II. Objectives

1. To consider the necessity and usefulness of the formation of a Crustal Deformation Bureau,

2. To make recommendations about the scope of activities of such a Bureau.

3. To make recommendations for how such a Bureau would be structured.

III. Membership

[To be determined]

GEODETIC DATA CENTERS

This section covers international and national data centers.
A major reference is the "CODATA Directory in Geodesy" (CODATA Bull.n 52).

INTERNATIONAL DATA CENTERS

Bureau Gravimetrique International
c/o CNES-GRGS, 18 avenue Edouard Belin
31055 Toulouse Cedex, France
Phone : 61.27.44.27 - Tlx : 531081 CNEST F

Bureau Central du Service International de la Rotation Terrestre
61, avenue de l'Observatoire, 75014 Paris, France.
Phone : (1) 40.51.22.26 - Tlx : OBS 270776 F

Commission for Geodesy in Africa
Com. XI, c/o I.G.C.I.,
B.P. 3862, Abidjan 01, Cote d'Ivoire.
Phone : 44.22.04 - Tlx : 22108 MITRAV CI

Commission on International Coordination of Space Techniques for Geodesy and Geodynamics
Com. VIII, c/o G. Beutler, Director, Astronomical Institute of Bern,Director, Sidlerstrasse 5, CH-3012 Bern, Switzerland, Phone: (41)-31-631-8591, FAX: (41)-31-631-3869, Tlx: 912643PIBE CH,
Email: BEUTLER@AIUB.UNIBE.CH

Committee on Space Research (COSPAR)
51, boulevard de Montmorency, 75016 Paris, France.
Phone : (1) 45.25.06.79, Tlx : c/o ICSU 630 553 F

Federation of Astronomical and Geophysical Services (FAGS)
c/o D. Pugh, Institute of Oceanographic Sciences, Bidston Observatory, Brook Rd. Wormley, Godalming Surrey GU8 5UB, Great Britain,
Phone: (44)-428-68-4141, Fax: (44)-428-68-5637,
Email: D.PUGH@GATEWAY.OMNET.COM

ICSU Panel on World Data Centers
NOAA/EDIS, 325 Broadway, Boulder,
CO 80303, U.S.A.
Phone: 303.497.37.98 - Tlx: 592811

International Association of Geodesy
c/o C.C. Tscherning, Department of Geophysics, Juliane Maries Vej 30, DK-2100 Copenhagen Ø, Denmark.
Phone: +45 35320600 , Fax: +45 35365357
E-mail: iag@isis.gfy.ku.dki

International Data Centre for Earth Tides
c/o Observatoire Royal de Belgique,
3, avenue Circulaire, 1180 Brussels, Belgium.
Phone: 2.373.0211 - Tlx : 21565 OBSBEL B
Fx: 213749822

International Center on Recent Crustal Movements
250 66 Zdiby 98, Praha-Vychod, Czechoslovakia.
Phone: 2.896.391 - Tlx: 121330 SEIS C

International Geoid Service
Dipart. di Ingegnerica Idraulica, Ambientale e del Rilevamento, Politecnico di Milano, Piazza Leonardo, da Vinci, 32, I-20133 Italy
Phone : 2 2399 6504/6506 - Fax : 2 2399 6530

Inter-Union Commission on the Lithosphere (ICL)
State University Utrecht, Institute of
Earth Science - P.O. Box 80021
3508 TA Utrecht, Netherlands.
Phone : 30.535.110 - Tlx : 40704 VMLRU

NASA Geodynamics Program
Geodynamics branch, Code FRG-2, NASA
Headquarters, Washington, D.C. 20546, U.S.A.

North American Datum
National Geodetic Survey, NOAA/NOS, 6001 Executive Bld., Rockville, Maryland 20852, U.S.A.
Phone : 301.443.82.04

Permanent Service for Mean Sea Level
Institute of Oceanographic Sciences
Bidston Observatory, Birkenhead, L43 7RA Merseyside, United Kingdom.
Phone : 51.653.86.33

Sub-Commission for the Europe and Reference Frame (EUREF)
c/o Deutsches Geodätisches Forschungsinstitut,, Marstallplatz 8, Munich 22,, Federal Republic of Germany, Tlx : 521 3550 DGFI D

World Data Center A
Rotation of the Earth, U.S. Naval Observatory, Time Service Division, Washington, D.C. 20390, U.S.A.

World Data Center for Solid Earth
Geophysics, 325 Broadway, Boulder, Colorado 80803, U.S.A.

World Data Center B
Gravity Field, Soviet Geophysical Committee, Molodezhnaya 3, Moscow 117296, Russia.

NATIONAL DATA CENTERS

Algeria

Service de Traitement des Donnees Géodésiques
Institut National de Cartographie, 123, Rue de Tripoli, Hussein—Dey, Alger, Algeria.

Australia

Australian Geological Survey Organisation (AGSO)
GPO Box 378, Canberra, Australian Capital Territory 2601

Australian Surveying and Land Information Group (AUSLIG)
PO Box 2, Belconnen, Australian Capital Territory 2616

Austria

Bundesamt für Eich und Vermessungswesen
Schiffamtsgasse 1-3, Postfach 50, A-1025 Wien, Austria
Phone: (43) 1 21176 3201, Fax: (43) 1 2161062

Space Geodesy Division
Insitute of Space Research of the Austrian Academy of Sciences, Lustbühelstrasse 46, A-8010 Graz, Austria
Phone: (43) 316 472231, Fax: (43) 316 462678
Email: suenkel@mggi.tu-graz.ac.at

Institute of Theoretical Geodesy
Technical University Graz
Steyrergasse 30, A-8010 Graz, Austria
Phone: (43) 316 873 6346, Fax: (43) 316 813247
Email: suenkel@mggi.tu-graz.ac.at

Belgium

Département d'Astronomie Fondamentale et de Geodynamique
Observatoire Royal de Belgique,
Avenue Circulaire 3, B-1180, Brussels, Belgium.
Phone : 2 373 0211 - Fax : 2 374 9822

Département de Géodésie
Institut Geographique National, 13, Abbaye de la Cambre, B-1050 Brussels, Belgium.
Phone : 2 648 6480

Brazil

Departamento de Geodesia
IBGE, Ave Brasil, 15671, Parada de Lucas, 21241-051
Rio de Janeiro -JR- Brazil
Fax: (55) 21 391 7070

Burundi

Institut Geographique du Burundi
Département de Topographie et Cartographie
B.P. 34, Gitega, Burundi.

Canada

Canadian Geodetic Information System
Natural Resources Canada, Geodetic Survey Division, 615 Booth Street, Ottawa KlA OE9, Ontario, Canada.
Phone: (1) 613 995 4410, Fax: (1) 613 995 3215
Email: information@geod.nrcan.gc.can
www: http://www.geod.nrcan.gc.ca

National Gravity Data Base
Natural Resources Canada, Geomatics Canada, Geodetic Survey Division, 615 Booth Street, Ottawa KlA OE9, Ontario, Canada.
Phone: (1) 613 995 4410, Fax: (1) 613 995 3215
Email: information@geod.nrcan.gc.can
www: http://www.emr.ca/~jtod/geophys

China

China Cartographic Publishing House
Beijing, China.

Publishing House of S & M
Beijing, China.

Institute of Geodesy and Geophysics, CAS
54, Xu Dong Road, 430077 Wuhan, China.

National Bureau of Surveying and Mapping
Baiwanzhuang, Beijing, 100830 China.

National Information Center of Surveying and Mapping
Beijing, China.

Chinese Academy of Surveying and Mapping
16 Beitaping Road, Beijing, 100039 China.

Denmark

Kort-og Matrikelstyrelsen
(National Survey and Cadastre)
Geodetic Division
Rentemestervej 8
DK-2400 Copenhagen NV, Denmark

Finland

Finnish Geodetic Institute
Ilmalankatu lA, SF 00240, Helsinki, Finland.

France

Service de la Géodésie et du Nivellement
Institut Geographique National, 2, Avenue Pasteur, B.P. 68, F-94160 Saint-Mande, France.

Section Géodésie-Géophysque
Etablissement Principal du Service Hydrographique et Oceanographique de la Marine, 13, Rue du Chatellier, B.P. 426, F-29275 Brest Cedex, France.

Office de la Recherche Scientifique et Technique
Outre-Mer (ORSTOM), 70-74 Route d'Aulnay, F-93140 Bondy, France.

Groupe de Recherche de Géodésie Spatiale (GRGS)
GRGS/Institut Geographique National, 2, Avenue Pasteur, B.P. 68,, F-94160 Saint-Mande, France.

Département Banque des Donnees du Sous-Sol
Bureau de Recherches Geologiques et Minieres,
Dept. BSS, B.P. 6009, 45060 Orleans Cedex, France.

Germany

National Gravity Data Base
Deutsches Geodätisches Forschungsinstitut (DGFI)
Abt. I, Marstallplatz 8,, W-8000 München 22, Germany

Topography Data Base
Institut für Angewandte Geodäsie (IFAG), Richard-Strauss Allee 11, W-6000 Frankfurt a.M. 70, Germany

EUROLAS Data Center (EDC)
Deutsches Geodätisches Forschungsinstitut (DGFI)
Abt. I, Marstallplatz 8, W-8000 München 22, Germany

Remote Sensing Data
Deutsches Fernerkundungs Datenzentrum,
DLR, Munchnerstr. 20, W-8031 Wessling, Germany

Point of Contact for Geodetic Data
Arbeitsgemeinschaft der Vermessungsverwaltungen deutscher Lander (AdV) Niedersachsischer Minister des Inner, W-3000 Hannover 1, Germany

Greece

Hellenic Army Geographic Service
Pedion Areas, Athens, Greece.

Department of Geodesy and Surveying
University of Thessaloniki, POB 492, Thessaloniki, Greece.

Dionysos Satellite Observatory
Geodesy Department, National Technical University, Zographou 15773,Athens, Greece.

Hungary

Institute of Geodesy, Cartography and Remote Sensing
Department of Surveying and Central Data Supply
P.O. Box 546, H-1373 Budapest, Hungary
Phone: (36) 1 269 4560, Fax: (36) 1 269 4565
Telex: 22 4964

Tòth Agoston Mapping and Military Geographic Institute of the Hungarian Army
P.O. Box 37, H-1525 Budapest 114, Hungary
Phone: (36) 1 332 0161 - Fax: (36) 1 332 0161

Eötvös Loràn d Geophysical Institute of Hungary
P.O. Box 35, H-1440 Budapest, Hungary
Phone: (36) 1 252 4999, Fax: (36) 1 163 7256

Iceland

Icelandic National Energy Authority
Grensasvegur 9, 108 Reykjavik, Iceland.

Iceland Geodetic Survey
P.O. Box 5536, 105 Reykjavik, Iceland.

Indonesia

National Coordination Agency for Surveys and Mapping
Jalan Raya Bogor, Km. 46, Cibinong, Bogor, Indonesia.

Ireland

Ordnance Survey Office
Phoenix-Pk, Dublin, Ireland

School of Cosmic Physics
Dublin Institute for Advanced Studies
5 Merrion Square, 2, Dublin, Ireland.

Japan

Geographical Survey Institute
Kitasato-l, Tsukuba, Ibaraki 305, Japan
Phone: (81) 298 64 1111, Fax: (81) 298 64 1802

Hydrographic Department
Maritime Safety Agency
3-1 Tsukiji 5, Chuo-ku, Tokyo 104, Japan
Phone: (81) 3 3541 3685, Fax: (81) 3 3248 1250

Mizusawa Astro Geodynamics Observatory
National Astronomical Observatory
12, Hoshigaoka-cho 2, Mizusawan, Iwate 023, Japan
Phone: (81) 197 22 7111, Fax: (81) 197 22 7120

Earthquake Resarch Institute
1-1, Yayoi 1, Bunkyo-ku, Tokyo 113, Japan
Earthquake Prediction Research Center
Phone: (81) 3 5689 7264, Fax: (81) 3 5689 7234
Earthquake Observation Center
Phone: (81) 3 3813 7627, Fax: (81) 3 3813 8026

Research Center for Earthquake Prediction
Faculty of Science, Hokkaido University, Kita-10, Nishi-8, Kita-ku, Sapporo, Hokkaido 060, Japan
Phone: (81) 11 716 8377, Fax: (81) 11 746 7404

Observation Center for Prediction of Earthquakes and Volcanic Eruptions
Faculty of Science, Tohoku University, Aobayama, Aoba-ku, Sendai, Miyagi 980, Japan
Phone: (81) 22 223 7087, Fax: (81) 22 264 3292

Research Center for Earthquake Prediction
Disaster Prevention Research Institute, Kyoto University
Gokasho, Uji, Kyoto 611, Japan
Phone: (81) 774 32 3111, Fax: (81) 774 33 0726

Ocean Research Institute
University of Tokyo, 15-1, Minamidai 1, Nakano-ku, Tokyo 164, Japan
Phone: (81) 3 5351 6430, Fax: (81) 3 3377 3292

National Resarch Institute for Earth Science and Disaster Prevention
1, Tenodai 3, Tsukuba, Ibaraki 305, Japan
Phone: (81) 298 51 1611, Fax: (81) 298 451 1622

Kenya

Survey of Kenya
P.O. Box 30046, Nairobi, Kenya.

Madagascar

National Institute of Geodesy and Cartography
Lalana Dama-tsoha Razafintsalama J.B.,
B.P. 323, 101 Antananarivo, Madagascar.

Mexico

Departamento de Geodesia
Direccion General de Geografia,
San Antonio Abad 124-PB, Col. Transito
Del. Cuavi, 06820 Mexico D.E.

New Zealand

Department of Lands and Survey
Head Office, Private Bag, Wellington, New Zealand.

Geophysics Division
Department of Scientific and Industrial Research,
P.O. Box 1320, Wellington, New Zealand.

Hydrographic Office
P.O. Box 33-341, Takapuna 9, Auckland, New Zealand.

Norway

Geographical Survey of Norway
Geodetic Section, Geodesy Division,
Monserudveien, 3500 Honefoss, Norway.

Geographical Survey of Norway
Surveying Section, Geodesy Division,
Monserudveien, 3500 Honefoss, Norway.

Portugal

Direccao dos Servicos de Geodesia
Instituto Geografico e Cadastral,
Praca da Estrela, 1200 Lisbon, Portugal

South Africa

Surveys and Mapping
Private Bag, 7705 Mowbray, Republic of
South Africa.

Spain

Centro Nacional de Informacion Geografica
Ibanez de Ibero 3, 28003 Madrid, Spain
Phone: (34) 1 5360636, Fax: (34) 1 5532913

Instituto de Astronomia y Geodesia
UCM-CSIC, Facultad de Matematicas, Universidade
Compltense, Ciudad Universitaria, 28040 Madrid, Spain
Phone: (34) 1 3944582, Fax: (34) 1 3944607

Instituto Geografico Nacional
Ibanez de Ibero 3, 28003 Madrid, Spain
Phone: (34) 1 5360636, Fax: (34) 1 5532913

Servei de Geodesia
Institut Cartografic de Catalunya, Parc de Montjuic,
08006 Barcelona, Spain.
Phone: (34) 3 4252900, Fax: (34) 3 4267442

Sweden

National Land Survey
Division of Geodetic Research, S-801 82 Gavle,
Sweden.

Switzerland

Astronomical Institute University of Berne
Sidlerstrasse 5, CH-3012 Berne, Switzerland.

Bundesamt für Landestopographie
Seftigenstrasse 264, CH-3084 Wabern, Switzerland.

Swiss Federal Institute of Technology
Zurich, (ETH Zurich), ETH-Honggerberg, CH-8093
Zurich, Switzerland.

Syria

General Establishment of Surveying
Department of Geodesy
P.O. Box 3094, Damascus, Syria.

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Bordas, Dunod, Gauthier-Villars, Paris, France.

Artificial Satellites
Polska Akademia Nauk,
Centrum Badan Kosmicznych 01-237,
Warsawa Ordona 21, Poland .

Australian Journal of Geodesy, Photogrammetry and Surveying
University of New South Wales,
School of Surveying, P.O. Box 1, Kensington,
New South Wales, 2033, Australia.

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Institution of Surveying of Australia,
65 York Street, Sidney, Australia.

Bolletin de Informacion
Servicio Geografico del Ejercito,
Dario Gazapo 8, 28024 Madrid, Spain.

Bollettino di Geodesia e Scienze Affini
Instituto Geografico Militare Italiano,
10 Via Cesare Battisti, 50100 Firenze, Italy.

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Osservatorio Geofisico Sperimentale,
34123 Trieste, Italy.

Bulletin-American Congress on Surveying and Mapping
American Congress on Surveying & Mapping,
210 Little Falls St., Falls Church,
VA 20046, USA

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50, Boulevard du Jardin Botanique, B.P. 38,
B-1010 Bruxelles, Belgique.

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Observatoire Royal de Belgique,
3, Avenue Circulaire, B-1180 Bruxelles, Belgique.

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B.G.I., 18 Avenue Edouard Belin, F-31055 Toulouse, France.

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140, rue de Grenelle, 75700 Paris, France.

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G.R.G.S., 77, Avenue Denfert-Rochereau, F-75014, Paris, France.

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Bureau Hydrographique International, 7, Avenue du President Kennedy, B.P. 345, Monaco .

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Earthquake Research Institute, University of Tokyo, Tokyo 113, Japan.

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Geographical Survey Institute, Kitasato 1 Yatabe-Machi Tsukuba-Gum, Ibaraki 300-21, Japan.

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Federal Office of Topography, Seftigenstrasse 264, CH-3084 Wabern, Switzerland.

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The Canadian Institute of Surveying, Box 5378, Station F, Ottawa, K2C 3J1 Canada.

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British Cartographic Society J.S. Keats, Department of Geography, University of Glasgow W2, Scotland.

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B.N.G.C., Beijing, China.

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D. Reidel Publ. Co., Dordrecht, The Netherlands.

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Universita di Cagliari, Istituto di Astronomia, 09100 Cagliari, Italy.

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Polish Academy of Sciences, Astronomical Latitude Observatory, Borowiec, 63-120 Kornik, Poland.

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Research Inst. of the Hungarian Academy of Sciences Museum U. 6-8, POB 5, H-9401, Sopron, Hungary.

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Committee on Space Research, 51 Boulevard de Montmorency, 75016 Paris, France.

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DMA, Hydrographic & Topographic Center, 6500 Brooks Lane, Washington D.C. 20315, USA

Deltion
Service Geographique de l'Armee Hellenique, S.G.A.H., Pedion Areas, Athens, Greece.

Department of National Development Division of National Mapping Technical Report
Division of National Mapping, P.O. Box 548, NSW 2620 Queanbeyan, Australia.

Deutsche Geodatische Kommission bei der Bayerischen Akademie der Wissenschaften
Reihe A : Hohere Geodäsie
Reihe B : Angewandte Geodäsie
Reihe C: Dissertationen
Reihe D: Tafelwerke
Reihe E : Geschichte und Entwicklung der Geodäsie
Marstallplatz 8, D-8000 München 22, Germany

Eidgenossische Technische Hochschule Zurich - Institut für Geodäsie und Photogrammetrie - Bericht (Report)
Institut für Geodäsie und Photogrammetrie, ETH-Honggerberg, CH-8093 Zurich, Switzerland .

Engineering Geodesy
The Kiev Institute of Engineering Construction

EOS-Transactions AGU
American Geophysical Union, 2000 Florida Av., Washington D.C. 20009, USA

ESA Bulletin
European Space Agency, 8-10, Rue Mario Nikis, 75738 Paris 15, France.

ESA-Journal
European Space Agency, 8-10, Rue Mario Nikis, 75738 Paris 15, France.

European Space Agency Special Publication
European Space Agency, 8-10, Rue Mario Nikis, 75738 Paris 15, France.

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Editorial Complutense
Cl. Moreto, 3, 28014, Madrid, Spain.

Geodatische Arbeiten Österreichs für die Internationale Erdmessung
Austrian Geodetic Commission, Bundemsamt für Eich unfd Vermessungswesen, Schiffamtsgasse 1-3, Postfach 50, A-1025 Vienna, Austria

Geodatisch-Geophysikalische Arbeiten in der Schweiz
Schweizerische Geodatische Kommission, ETH-Honggerberg, CH-8093 Zurich, Switzerland .

Geodatische und Geophysikalische Veroffentlichungen
Nationalkomitee für Geodäsie und Geophysik bei der DDR, 1500 Potsdam, Telegrafenberg A17, Germany

Geodesy and Cartography
The Chief Administration of Geodesy and Cartography under the Council of Ministers of the USSR.

Geodesy and Photogrammetry in Mining
Publisher: the Sverdlovsk Mining Institute.

Geodesy, Cartography and Air-Survey
Publisher: the Lvov Polytechnical Institute.

Geodeticky a Kartograficky Obzor
Spalena 51, 11302 Praha 1, Czechoslovakia.

Geodezia és Kartogràfia
Hungarian Society of Surveying, Mapping and Remote Sensing
Editorial Office: H-1860 Budapest, 55, PO Box 1, Hungary.

Geodezja i Kartografia
Politechnika Warszawska, Instytut Geodezji Wyzszej 1, Koszykowa 75, 00661 Warszawa, Poland.

Geomatica
Canadian Institute of Geomatics, PO VBox 5378, Merivale Depot, Ottawa, Ontario, K2C 3J1, Canada

Geomatics Canada - Geodetic Survey Division - Contract and Technical Reports
Natural Resources Canada, Geomatics Canada Geodetic Survey Division, 615 Booth Street, Ottawa, Ontario, K1A OE9, Canada

Géomètre
102, Rue de Charonne, 75011 Paris, France.

Geophysical Journal of the Royal Astronomical Society
The Royal Society, 6, Carlton House Terrace, London SWl Y 5AG, U.K.

Geophysical Research Letters
American Geophysical Union, 2000 Florida Avenue N.W.,Washington, D.C. 20009, USA

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D. Reidel, Publ. Co., Dordrecht, The Netherlands.

Geophysical Transactions
Eötvös Loràn̂d Geophysical Institute of Hungary, H-1440 Budapest, P.O. Box 35, Hungary.

Geophysics Division-Report
Department of Scientific and Industrial Research, Geophysical Division, New Zealand.

Geowissenschaftliche Mittelungen
Vienna University of Technology
Gusshaustrasse 27-29, A-1040 Vienna, Austria
Email: pwald@fbgeo1.tuwien.ac.at

Gerlands Beitrage zur Geophysik
Akademische Verlagsgesellschaft Geest & Portig K.G., Leipzig, Germany

Harita Dergisi
Harita Genel Komutanligi, 06100 Cebeci, Ankara, Turkey.

IEEE Transactions on Geoscience Electronics
IEEE, 445 Hoes Lane, Piscataway, New Jersey 08854, USA

IERS Technical Notes
Bureau Central de l'IERS
77, Avenue Denfert Rochereau, 75014 Paris, France.

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Publisher: the Chief Administration of Geodesy and Cartography under the Council of Ministers of the USSR.

Institut für Geodäsie und Photogrammetrie an der Eidgenossischen Technischen Hochschule Zurich-Mitteilungen
Institut für Geodäsie und Photogrammetrie, ETH-Honggerberg, CH-8093 Zurich, Switzerland .

Institut Geographique National-Géodésie-
I.G.N., 2, Avenue Pasteur, B.P. 68, 94160 Saint-Mandé, France.

Instituto de Astronomia y Geodesia - Publications
Facultad de Matematicas, Universidad Complutense Ciudad Universitaria, 28014, Madrdi Spain.

Instituto de Astronomia y Geodesia - Cursos y Seminarios
Facultad de Matematicas, Universidad Complutense

Ciudad Universitaria, 28014, Madrdi Spain.

Istituto di Geodesia e Geofisica dell' Universita di Trieste-Pubblicazione
Istituto di Geodesia, Via dell Università 7, 34123 Trieste, Italy.

Istituto di Miniere e Geofisica Applicata, Universita, Pubblicazioni
Piazzale Europa 1, 34127 Trieste, Italy.

ITC Journal
ITC, The Netherlands.

Jenaer Rundschau
VEB Carl Zeiss Jena, Carl Zeiss Str. 1, 6900 Jena, Germany

Jet Propulsion Laboratory, California Institute of Technology - Technical Publications
Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109, USA

Journal of Geodesy
Journal Production Department
Heildelberger Platz 3, W-1000 Berlin 33, Germany
Publisher: Springer-Verlag

Journal of Geophysical Research
American Geophysical Union (AGU), 2000 Florida Avenue N.W., Washington, D.C. 20009, USA

Journal of Physics of the Earth
Center for Academic Publications Japan
Yayoi 2-4-16, Bunkyo-ku, Tokyo 113, Japan.

Journal of Spacecraft and Rockets
AIAA Technical Information Service, 750 3rd Avenue, New York NY 10017, USA

Journal of Surveying Engineering
American Society of Civil Engineers, 345 East 47th Street, New York, NY 10017-2398, USA

Journal of the Geodetic Society of Japan
Geodetic Society of Japan, 1 Kitasato, Tsukuba, Ibaraki 305, Japan

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Wuhan, China.

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Kern & Co. Ltd., CH-5001 Aarau, Switzerland.

Kort-og Matrikelstyrelsen
(National Survey and Cadaster)
Skrifter 4 Raekke
(Publications 4 series)

Kort-og Matrikelstyrelsen
Geodetic Division, Technical Reports Rentemestervej 8, DK-2400 Copenhagen NV, Denmark

Lehrstuhl für Astronomische und Physikalische Geodäsie-Technische
Universität München
Arcisstrasse 21, D-8000 München 2, Germany

Magyar Geofizika
Association of Hungarian Geophysicists, H-1371 Budapest, P.O. Box 433, Hungary.

Marées Terrestres-Bulletin d'Information
ICET, Observatoire Royal de Belgique, 3, Avenue Circulaire, B-1180 Bruxelles, Belgique.

Marine Geodesy
Crane Russat & Co. Inc., 3 East 44th Street, N.Y., New York 10017, USA

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Publisher: the Moscow State University.

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Mitteilungen aus dem Institut für Theoretische Geodäsie der Universität Bonn
Nussallee 17, 5300 Bonn 1, Germany

Mitteilungen aus dem Institut für Astronomische und Physikalische Geodäsie Technische Universität München
Arcisstrasse 21, D-8000 München 2, Germany

Mitteilungen der Satelliten-Beobachtungsstation Zimmerwald
Astronomisches Institut, Sidlerstrasse 5, CH-3012 Berne, Switzerland.

Mitteilungen des Geodätischen Instituts der Technischen Universität Graz
Graz University of Technology, Geodetic Institute, Steyergrasse 30, A-8010 Graz, Austria.
Email: bt@ftphotsg01.tu-graz.ac.at

Mitteilungen des Instituts für Geodäsie und Photogrammetrie an der Eidgenossischen Technischen Hochschule Zürich

Honggerberg, CH-8093 Zurich, Switzerland.

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International Latitude Observatory, 2-12 Hoshigaoka Mizusawa-shi, Iwate-Ken 023, Japan .

Nachrichten aus dem Karten- und Vermessungswesen
Institut für Angewandte Geodäsie, Richard Strauss Allee 11, D-6000 Frankfurt a.M. 70, Germany

NASA Special Publication
NASA Headquarters, 600 Independance Avenue, S.W., Washington, D.C. 20576, USA

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NASA Headquarters, 600 Independance Avenue, S.W., Washington, D.C. 20576, USA

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NASA Headquarters, 600 Independance Avenue, S.W., Washington, D.C. 20576, USA

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National Geodetic Survey, NOAA, 6001 Executive Blvd, Rockville, MD 20852, USA

Naval Surface Weapons Center-Dahlgren Laboratory
Naval Surface Weapons Centre (NSWC), Dahlgren, VA 22448, USA

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Institut Francais de Navigation, 3, Avenue Octave Gréard, 75340 Paris Cedex 07, France.

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The Institute of Navigation, Suite 832, 815, 15th Street, N.W., Washington, D.C. 20005, USA

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Prace Instytut Geodezji i Kartografii
Polish Academy of Science, Space Research Centre, Department of Planetary Geodesy, Pkin P. 2313, 00901 Warszawa, Poland.

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Commission Géodésique Suisse, ETH-Honggerberg, CH-8093 Zurich, Switzerland.

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American Geophysical Union (AGU), 2000 Florida Avenue N.W., Washington, D.C. 20009, USA

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Societade Brasileira de Cartografia de Artes Graficas, Rua Riachuelo 128, Rio R5, Brazil.

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Instituto Panamericano de Geografia, Ex-Arzobispado n° 29, Mexico 18, D.F., Mexico.

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Bureau Hydrographique International (BHI-IHB), 7, Ave du Pdt Kennedy, BP 345, 98000 Monaco.

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Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex BN27 1 RP, U.K.

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Universität der Bundeswehr München D-85577 Neubiberg, Germany

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Academy of Sciences, Geophysical Institute, Czech. Acad. Sci., Bocni II Praha 4, Sporilov, Czech Rep.

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Geodeettinen Laitos Geodetic Institute, Ilmalankatu 1A, SF-00240 Helsinki, Finland.

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Geodeettinen Laitos Geodetic Institute,
Ilmalankatu 1A, SF-00240 Helsinki, Finlano.

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Directorate of Overseas Survey, Kingston Road,
Tolworth Surbiton, U.K.

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Little Falls Street, Falls Church, VA 20046, USA

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Colegio Oficial de Ingenieros Tecnicos en Topografia,
Paseo de la Castellana 210, 28046 Madrid, Spain.

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Elsevier Scientific Publishing Company,
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Tokyo Astronomical Observatory, Osawa Mitaka,
Tokyo 181, Japan.

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Colegio Oficial de Ingenieros Tecnicos en Topografia
Av. Reina Victoria, 66, 28014 Madrid, Spain.

Travaux de l'Association Internationale de Géodésie
IAG Central Bureau, c/o Department of Geophysics
Juliane Maries Vej 30, DK-2100 Copenhagen Ø,
Denmark.
Phone: +45 35320600 , Fax: +45 35365357
E-mail: iag@isis.gfy.ku.dki

Unisurv
University of New South Wales,
School of Surveying, Sydney, Australia.

University of Calgary - Publications of the Division of Geomatics Engineering
The University of Calgary, 2500 University Drive
N.W., Calgary T2N 1N4, Canada.

University of New Brunswick-Department of Surveying Engineering - Lecture Notes
University of New Brunswick,
P.O. Box 4400, Fredericton N.B. E3B 5A3, Canada.

University of New Brunswick - Department of Geodesy and Geomatics Engineering - Research Reports
University of New Brunswick,
P.O. Box 4400, Fredericton N.B., E3B 5A3, Canada.

University of New Brunswick - Department of Geodesy and Geomatics Engineering - Technical Reports
University of New Brunswick,
P.O. Box 4400, Fredericton N.B., E3B 5A3, Canada.

University of New South Wales-Monographs
University of New South Wales,
School of Surveying, Sydney, Australia.

Vermessung, Photogrammetrie, Kulturtechnik
Diagonal Verlags AG, Tafernstrasse 2,
CH-5405 Baden-Dattwil, Switzerland.

Vermessungsingenieur
Verband Deutscher Vermessungsingenieur (VDV)
e.V. D-4300 Essen, Moselstrasse 2, Germany

Vermessungswesen und Raumordnung
Danagkweg 80, D-5600 Wuppertal 1, Germany

Veroffentlichung des Geodatischen Instituts der Rheinisch Westfalischen Technischen
Hochschule Aachen

Veroffentlichungen der Bayerischen Kommission für die Internationale Erdmessung
Bayerische Kommission für die Internationale
Erdmessung, Marstallplatz 8, D-8000 München 22,
Germany

Wild Reporter
Wild Heerbrugg Ltd., CH-9435 Heerbrugg,
Switzerland

Wissenschaftliche Arbeiten der Fachrichtung Vermessungswesen der Universität Hannover
c/o Geodastisches Institut, Nienburger Strasse 7,
3000 Hannover 1, Germany

Wissenschaftliche Zeitschrift der Technischen Universität Dresden
Mommsenstrasse 13, 8027 Dresden, Germany

Wuhan Institute of Geodesy and Geophysics-Special Publication
Wuhan, China.

XYZ
Association Francaise de Topographie (AFT),
140, Rue de Grenelle, 75700 Paris, France.

Zbornik Instituta Za Geodeziji-University of Beograd

Zeitschrift für Vermessungswesen
Verlag Konrad Wittwer, Postfach 147,
D-7000 Stuttgart 1, Germany

PUBLICATIONS OF THE INTERNATIONAL ASSOCIATION OF GEODESY

I- Bulletin Géodesique (after Jan. 1, 1996: Journal of Geodesy).

Four issues per year :
annual subscription
sale by unit (Springer-Verlag)
sale of back issues from vol.64 (IAG Central Bureau) (available on paper or on microfiches).

II- Travaux de l'Association Internationale de Géodésie (IAG Central Bureau)

Volumes edited after every General assembly including General Reports and national Reports (separately from 1960).

Last volume (vol. 30 : Boulder 1995) february 1996.

III- Publications Speciales

N¡ 1 - Natural trogonometric functions (eight places, entry each centigrade).
N¡ 2 - (out of print).
N¡ 3 - Geodetic Reference System 1967.
N¡ 4 - International Gravity Standardization Net (IGSN 1971).

All these publications are available on request to :
IAG Central Bureau, c/o Department of Geophysics
Juliane Maries Vej 30,
DK-2100 Copenhagen Ø, Denmark.

IV- Proceedings of the IAG-Symposia at the IUGG General Assemblies

Vienna 1991 (published by Springer-Verlag).

Boulder 1995 (published by Springer-Verlag)

All these publications are available on request to :
Springer Verlag
Journal Production Department
Heildelberger Platz 3,
W-1000 Berlin 33, Germany.

V- Bibliographie geodesique internationale

- From 1928 to 1960 : 10 issues
- From 1961
  - Cards
  - Monthly Review : "Bibliographia Geodaetica" (in English),

available at :

Zentralstelle fur Internationale Dokumentation der Geodasie
Mommsenstrasse 13, Dresden 8027
(F.R.G.)

or IFAG (under negotation)
Richard Strauss Allee 11
D-6000 Frankfurt am Main 70
(F.R.G.)

VI- Catalogue of Reference Gravimetric Stations along the European Coasts from Norway to Italy

available at :

International Gravity Commission
Subcommission Western Europe
Bayer Akademie der Wissenschaften,
Marstallplatz 8, D-8000 Munchen 22, (F.R.G.).

List of World Wide Web servers for Geodesy and related sciences.

O. B. Andersen

The list is compiled from major international Web directories and is a snapshot of available servers. The list is by no mean complete and daily updates occurs.

Geoscience organisations.

AGU "http://www.agu.org"
CODATA
"http://www.cisti.nrc.ca/codata/welcome.html"
EGS "http://www.mpae.gwdg.de/EGS/EGS.html"
GOOS "http://www.unesco.org:80//loc"
IAG "http://www.gfy.ku.dk/~iag"
IAGA "http://www.sec.noaa.gov/IAGA/html"
IAHS "http://www.wlu.ca/~wwwiahs"
IAMAS
IAPSO
IASPEI
"http://www.neic.cr.usgs.gov/iaspei/"
IAU
"http://www.lsw.uni-heidelberg.de/iau.html"
IAVCEI
"http://www-geo.lanl.gov/Heiken/IAVCEI_home_page"
ICE "http://www.oma.be/KSB-ORG/ICET."
ICSU "http://www.lmcp.jussieu.fr/icsu/
IGBP "http://www.igbp.kva.se/igbpint.html/
ILP "http://www.gfz-potsdam.de/pb4/ilp/
IUGG "http://www.obs-mip.fr/uggi
PSMSL "http://www.nbi.ac.uk/psmsl/gb.html
SCOSTEP
"http://www.ngde.noaa.gov/stp/SCOSTEP/sostep.html
UNEP "http://www.unep.no
UNESCO
"http://www.unesco.org
URSI "http://intec.rug.ac.be:8080/www/u/ursi/
WDC "http://www.ngdc.noaa.gov/wdcmain.ntml
WMO "http://www.wmo.ch/web/wmo-home.html

Geosciences in general

European Commission's Centre for Earth Observation
"http://ceo-www.jrc.it/"
ESA Earth Observation Guide and Directory Service
"http://gds.esrin.esa.it/"
Gateway to Antarctica. The International Centre for Antarctic Info. and Res.
"http://icair.iac.org.nz/"
GeoForschungsZentrum Potsdam
"http://www.gfz-potsdam.de"
GIS/Remote Sensing/GPS/Geoscience
"http://www.zilker.net/~hal/geoscience/"
Global Change: International Geosphere Biosphere Prog. (IGBP)

Data and Information System of the IGBP
"http://xtreme.gsfc.nasa.gov/dis/"
Global Change Data Center at Goddard SFC
"http://ame.gsfc.nasa.gov/gcdc/gcdc.html"
Global Change Master Directory at Goddard SFC
"http://gcmd.gsfc.nasa.gov/"
"http://www.ngdc.noaa.gov/mgg/wdcamgg"
Global Land Information System
"http://sun1.cr.usgs.gov/glis/glis.html"
Internet GIS Information Sites (under construction)
"http://www.ifp.uni-stuttgart.de/subject/subject.html"
National Oceanic and Atmospheric Administration of the USA
"http://www.ncdc.noaa.gov/noaa/noaa.html"
National Geodetic Survey
"http://www.ngs.noaa.gov/"
National Space Science Data Center
"http://nearnet.gnn.com/wic/astro.05.html"
NASA, Goddard Space Flight Center
"http://www.gsfc.nasa.gov/GSFC_homepage.html"
Earth Sciences Directorate
"http://sdcd.gsfc.nasa.gov/ESD/"
Very Long Baseline Interferometry program for geodesy
"http://lupus.gsfc.nasa.gov/vlbi.html"
NASA, Earth Observing System (EOS)
"http://eos.nasa.gov/"
Science Office at EOSDIS Core System (ECS)
"http://observer.gsfc.nasa.gov/"
"http://ecsinfo.hitc.com/"

Mission to Planet Earth
"http://www.hq.nasa.gov/office/mtpe/"
NCSA Digital Library Overview
"http://www.ncsa.uiuc.edu/DigLib/prototype/overview.html"
NOAA Geosciences Laboratory(Geody, Sat and Ocean Dyn)
"http://www.grdl.noaa.gov/"
On-line Earth Science Journals Overseas users:
"http://gwrp.cciw.ca/internet/journals.html"
Planet Earth Home Page
"http://white.nosc.mil/info.html"
The World-Wide Web Virtual Library: Earth Sciences
"http://www.geo.ucalgary.ca/VL-EarthSciences.html"
The World-Wide Web Virtual Library: Earth Sciences Org
"http://www-vl-es.geo.ucalgary.ca/VL/html/es-orgs-by-location.html"
On-Line Resources for Earth Scientists by Bill Thoen
"http://www.englib.cornell.edu/geology_resources/ORES/earthscience.html"
Geosciences Services of Notice
"http://www.geod.emr.ca/html-public/geosciences.html"

Geodesy

Artificial satellites and Space Geodesy
"http://schubert.mi.astro.it/spacegeo.html"
Astronomische Berechnungen
"http://habicht.bauv.unibw-muenchen.de/ex-scherer/astro.html"
AUSLIG: Australian Surveying and Land Information Group
"http://www.auslig.gov.au/"
Bureau des Longitudes, Paris
"http://www.bdl.fr/"
Cagliari Astronomical Observatory, Italy (Int. Latitude Station)
"http://www.ca.astro.it/"
Satellite Laser Ranging Station
"http://www.ca.astro.it/slr.html"
Time and Frequency Laboratory
"http://www.ca.astro.it/timelab.html"
Satellite Geodetic Observatory, Penc, Hungary
"http://www.sgo.fomi.hu/"
Space VLBI Project
"http://www.sgo.fomi.hu/vlbi/vlbi.htm"
GPS Project
"http://www.sgo.fomi.hu/gps/gps.htm"
Canadian Space Geodesy Forum (CANSPACE)
"http://degaulle.hil.unb.ca/Geodesy/CANSPACE.html"
Canadian Superconducting Gravimeter Data
"ftp://erda.geophys.mcgill.ca/csgidata"
Coordinate Systems Overview by Peter H. Dana
"http://wwwhost.cc.utexas.edu/ftp/pub/grg/gcraft/notes/coordsys/coordsys.html"
Crustal Dynamics Data Information System (CDDIS)
"http://cddis.gsfc.nasa.gov/cddis.html"
Darmstadt Technical Univ.
"http://www.th-darmstadt.de/fb/vw/Welcome.de.html"
Delft Univ. of Tech., Section for Space Res. and Tech.
"http://dutlru8.lr.tudelft.nl/"
Altimetry Atlas
"http://dutlru8.lr.tudelft.nl/pages/atlas.html"
Satellite Laser Ranging for ERS-1
"http://dutlru8.lr.tudelft.nl/ers1/orbit.html"
Delft Univ. of Tech., Faculty of Geodetic Eng.
"http://www.geo.tudelft.nl/"
FMR: Physical, Geometrical, and Space Geodesy
"http://www.geo.tudelft.nl/~fmr/"
Dresden Kartographic Institute
"http://rex.rz.htw-dresden.de/%7Esbach1/"
Earth Orientation and Time Data available over the internet
"http://info.gb.nrao.edu/gbint/EOP.html"
Geodetic calculations
"http://habicht.bauv.unibw-muenchen.de/scherer/home/Geodaesie.html"
Geodetic Datum Overview by Peter H. Dana
"http://wwwhost.cc.utexas.edu/ftp/pub/grg/gcraft/notes/datum/datum.html"
Geodetic Information System (GeodIS) of the German Geodetic Res. Institute (DGFI/I)
"http://www.dgfi.badw-muenchen.de/"
EUROLAS Data Center (EDC)
"http://www.dgfi.badw-muenchen.de/edc/edc.html"
Literature of Space Geodesy
"http://www.dgfi.badw-muenchen.de/literature.html"
Geodetic Survey of Canada
"http://www.geod.emr.ca/"
GeoForschungsZentrum Potsdam
"http://www.gfz-potsdam.de/welcome_eng.html"
Recent Kinematics and Dynamics of the Earth (Department 1)
"http://www.gfz-potsdam.de/pb1/pb1_eng.html"
The Laser Satellite GFZ-1 (information in English)
"http://cddis.gsfc.nasa.gov/920_1/GFZ1.html"
German Geodetic Res. Inst Munich (DGFI, Abt.I)
"http://www.dgfi.badw-muenchen.de/DGFIHomePage.html"
GIS/Remote Sensing/GPS/Geoscience (Int.e Server)
"http://www.zilker.net/~hal/geoscience/"
Graz Univ. of Tech.: Faculty of Civil Eng.
"http://hyperg.tu-graz.ac.at/0x811b0205_0x0004be9a"
Harvard-Smithsonian Center for Astrophysics
"http://cfa-www.harvard.edu/"
Radio and Geoastronomy Division
"http://cfa-www.harvard.edu/cfa/rg.html"
Space Geodesy Group
"http://cfageod4.harvard.edu/"
IERS (International Earth Rotation Service)
"ftp://hpvlbi.obspm.fr/iers/ierscb.html"

Institut for Geodesy and Photogrammetri Berlin
"http://fpksu330.bv.tu-berlin.de/"
Institut for Geodesy and Photogrammetrie Braunschweig
"http://www.tu-bs.de/institute/geodae/"
Institut for Geodesy Munich
"http://habicht.bauv.unibw-muenchen.de/"
Institut for Geodesy and (IAG() Stuttgart
"http://www.uni-stuttgart.de/UNIuser/iagb/home/iagb.html"
Inst. f. Applied Geodesy and Photogrammetry
"http://hyperg.tu-graz.ac.at/TU-2710"
Sect. f. Applied Geodesy and Eng. Surveying
"http://hyperg.tu-graz.ac.at/TU-2711"
Sect. f. Surveying and Land Information
"http://hyperg.tu-graz.ac.at/TU-2712"
Inst. f. Theoretical Geodesy
"http://hyperg.tu-graz.ac.at/TU-2740"
Sect. f. Mathematical Geodesy and Geoinformatics
"http://hyperg.tu-graz.ac.at/TU-2741"
Sect. f. Physical Geodesy
"http://hyperg.tu-graz.ac.at/TU-2742"
Int. Association of Geodesy (IAG) WWW Server
"http://www.gfy.ku.dk/~iag/"
Institut Géographique National (LAREG)
"ftp://schubert.ign.fr/CIAG/index.CIAG.html"
Joint Institute for VLBI in Europe/European VLBI Network
"http://www.nfra.nl/home_jive.html"
Kashima Space Res. Center, Japan
"http://apollo.crl.go.jp/kashima.html"
Radio Astronomy Applications Section
"http://apollo.crl.go.jp/"
Space Geodesy
"http://apollo.crl.go.jp/crustal.html"
Kort- og Matrikelstyrelsen, National Survey - Denmark
"http://www.kms.min.dk/"
Altimetry Atlas
"http://www.kms.min.dk/pages/gravimetry.html/"
MIT Geodesy and Geodynamics Laboratory
"http://www-erl.mit.edu/geodesy/geodesy.html"
NASA Jet Propulsion Laboratory
"http://www.jpl.nasa.gov/"
Southern California Integrated GPS Network
"http://milhouse.jpl.nasa.gov/"
Space Very Long Baseline Interferometry Project
"http://sgra.jpl.nasa.gov/"
Topex/Poseidon Home Page
"http://topex-www.jpl.nasa.gov/"
NASA, Space Geodesy Branch. NASA/GSFC Laboratory for Terrestrial Physics
"http://ltpwww.gsfc.nasa.gov/"
Space Geodesy and Altimetry Projects Office (SGAPO)
"http://cddis.gsfc.nasa.gov/920_1/sgapo.html"
NASA SLR Sites
"http://cddis.gsfc.nasa.gov/920_1/nasaslr.html
SLR System Configuration Information
"http://cddis.gsfc.nasa.gov/slr_sys/slrsys_list.html"
SLR Satellite Constellation
"http://cddis.gsfc.nasa.gov/920_1/satlist.html"
Geodynamics Branch
"http://denali.gsfc.nasa.gov/"
Technical Report Server Online search in data base of publications.
"http://techreports.larc.nasa.gov/cgi-bin/NTRS"
National Geodetic Survey
"http://www.ngs.noaa.gov/"
Products
"http://www.ngs.noaa.gov/page2.html"
Geoid '93
"http://www.ngs.noaa.gov/GEOID/geoid.html
GPS Precise Orbits
"http://www.ngs.noaa.gov/GPS/GPS.html"
NOAA Geosciences Laboratory
"http://www.grdl.noaa.gov/"
Advanced Tech. Branch
"http://www.grdl.noaa.gov/ADV/ADV.html"
GPS Activities
"http://www.grdl.noaa.gov/GPS/GPS.html"
VLBI Data Analysis Center
"ftp://ray.grdl.noaa.gov/dist/vlbi/.HTML/VLBI.html"
Geodynamics Branch
"http://www.grdl.noaa.gov/GEO/GEO.html"
Gravimetric Res.
"http://www.grdl.noaa.gov/GRAV/GRAV.html"
Satellite and Ocean Dyn. Branch (analysis of sat alt. data) "http://www.grdl.noaa.gov/SAT/SAT.html"
NOAA & USNO, National Earth Orientation Service (NEOS), IERS Bulletins A and B, TAI-UTC, IERS Standards, etc
"http://maia.usno.navy.mil/"
Norwegian Inst of Tech, Dept of Surv and mapping,
"http://guran1.iko.unit.no/iko/ikoen.html"
NRAO Green Bank
"http://info.gb.nrao.edu/"
Geodetic 20 meter Telescope
"http://info.gb.nrao.edu/gbint/GB20m.html"
Ocean Tide models available on the Internet
"http://podaac-www.jpl.nasa.gov/tides.html"
Ohio State Univ. Center For Mapping
"http://www.cfm.ohio-state.edu/"
Onsala Space Observatory
"http://www.oso.chalmers.se/"
Geodetic VLBI Observations
"http://www.oso.chalmers.se/"
Plate Motion Calculator
"http://manbow.ori.u-tokyo.ac.jp/tamaki-html/plate_motion.html"
Satellite Laser Ranging leaflet by the Royal Greenwich Observatory
"http://www.ast.cam.ac.uk/RGO/leaflets/slr/slr.html"
Scripps Orbit and Permanent Array Center (SOPAC)
"http://jon.ucsd.edu/"
Southern California Earthquake Center, UCLA office
"http://scec.ess.ucla.edu/scecucla.html"

GPS Group
"http://scec.ess.ucla.edu/uclagps.html"
Sternberg Astronomical Institute
"http://www.sai.msu.su/"
Division of Gravitational Measurements
"http://mosca.sai.msu.su/"
Swiss Federal Inst Tech. (ETH), Zurich: Dept of Geod Sciences
"http://www.p.igp.ethz.ch/"
Tables of Contents in Geodesy
"http://www.geod.emr.ca/~craymer/tcg/"
Tide models available on the Internet
"http://podaac-www.jpl.nasa.gov/tides.html"
Univ. of New Brunswick, Dept of Geod. and Geom. Eng.
"http://degaulle.hil.unb.ca/Geodesy/"
Univ. of Ljubljana: Faculty of Architecture, Civil Eng. and Geodesy
"http://www.fagg.uni-lj.si/index.html"
Univ. of Texas, Center for Space Res. (CSR)
"http://www.csr.utexas.edu/home_page.html"
Topex/Poseidon Global Sea Level Analysis
"http://ftp.csr.utexas.edu/sst.html"
US Naval Observatory.
US Naval Observatory WWW server
"http://www.usno.navy.mil/"
Astrometry Department
"http://aries.usno.navy.mil/ad_home/ad.html"
Optical Interferometer
"http://aries.usno.navy.mil/ad_home/npoi.html"
FTP Server with GPS information etc.
"file://tycho.usno.navy.mil/"
WWW Servers for Space Geodesy
"http://igscb.jpl.nasa.gov/servers.html"

Mapping and photogrammetry

Canada Centre for Mapping
"http://ccm-10.ccm.emr.ca/"
Cartographic Data Archive
"ftp://spectrum.xerox.com/pub/map"
EPF Lausanne
"http://dgrwww.epfl.ch/PHOT/index.en.html"
Graz Univ. of Tech.: Faculty of Civil Eng.
"http://hyperg.tu-graz.ac.at/0x811b0205_0x0004be9a"
Inst. f. Applied Geodesy and Photogrammetry
"http://hyperg.tu-graz.ac.at/TU-2710"
Sect. f. Remote Sensing, Image Processing and Cartography
"http://hyperg.tu-graz.ac.at/TU-2713"
History of Cartography Project
"http://elvis.neep.wisc.edu/~cdean/index.html"
Institute of Photogrammetry, Bonn
"http://www.ipb.uni-bonn.de/"
Institute of Geodesy and Photogrammetry, Braunschweig
"http://www.tu-bs.de/institute/geodae/"
Institute of Geodesy and Photogrammetry, Karlsruhe
"http://ipfr.bau-verm.uni-karlsruhe.de/"
Institute of Geodinformation, Karlsruhe
"http://www.fh-karlsruhe.de/fbg/html/fbg.html"
Institute of Photogrammetry, Stuttgart
"http://www.ifp.uni-stuttgart.de/"
Institute of Karthography, Dresden
"http://www.tu-dresden.de/fghgik/anfang.htm"
Institute of Photogrammetry, Dresden
"http://rex.rz.htw-dresden.de/%7Esbach1/"
Institute of Photogrammetry, Trier
"http://kws01.uni-trier.de:8000/"
Institute of Photogrammetry, TU Wien
"http://www.ipf.tuwien.ac.at/welcome.html"
Map Projections by Peter H. Dana
"http://wwwhost.cc.utexas.edu/ftp/pub/grg/gcraft/notes/mapproj/mapproj.html"
Ohio State Univ. Center For Mapping
"http://www.cfm.ohio-state.edu/"
Ordnance Survey, the National Mapping Agency of Great Britain
"http://www.ordsvy.gov.uk/"
Photogram, Geography, Geology, Rem. Sens., Cartography, GIS
"http://www.ifp.uni-stuttgart.de/subject/index.html"
Swiss Federal Institute of Tech. (ETH), Zurich: Depat of Geod.c Sciences
"http://www.p.igp.ethz.ch/"
Institute of Cartography
"http://www.p.igp.ethz.ch/karto/start_karto.html"
Institute of Geodesy and Photogram, Chair of Photogrammetry
"http://www.p.igp.ethz.ch/p02/start_p02.html
The Perry-Castantildeda Lib Map Collection, Uni of Texas at Austin
"http://www.lib.utexas.edu/Libs/PCL/Map_collection/Map_collection.html"
TU Berlin Dept for Kartography ,
"http://gauss.geog.fu-berlin.de/Karto/KIV/Overview.html"
University of Nottingham
"http://www.ccc.nottingham.ac.uk/~iszwww"
WWWVL: Cartography Resources
"http://geog.gmu.edu/gess/jwc/cartogrefs.html
related WWW Servers from Chair of Photogra and Rem. Sens. Zurich
"http://www.geod.ethz.ch/p02/www_related.html"
Map-Related Web Sites
"http://www.lib.utexas.edu/Libs/PCL/Map_collection/map_sites.html"

Geophysics

American Geophysical Union
"http://earth.agu.org/kosmos/homepage.html"
European Geophysical Society (EGS)
"http://www.mpae.gwdg.de/EGS/EGS.html"

XXI Genl Assembly, The Hague, The Netherlands, 6 - 10 May 1996
"http://www.mpae.gwdg.de/EGS/egs96/egs96.htm"
JPL PO.DAAC - Physical Ocean Dist Active Archive Center
"http://podaac-www.jpl.nasa.gov/"
Universiteit Utrecht, Institute for Marine and Atmospheric Res.
"http://ruund3.fys.ruu.nl/"
Satellite Altimetry: Topex/. Ress (Ocean Circ. + Climate)
"http://ruund3.fys.ruu.nl/RT2.html"
WWW VL: Geophysics
"http://www-crewes.geo.ucalgary.ca/VL-Geophysics.html"

Geography

Geographic Resources
"http://wwwhost.cc.utexas.edu/ftp/pub/grg/gcraft/resource/contents.html"
Geography Departments Worldwide
"http://geo2.uibk.ac.at/links/geolinks.html"
GIS/Remote Sensing/GPS/Geoscience
"http://www.zilker.net/~hal/geoscience/"
World Factbook 1994 CIA
"http://www.odci.gov/cia/publications/94fact/fb94toc/fb94toc.html"

Meteorology

Deutsches Klimarechenzentrum Hamburg
"http://www.dkrz.de/"
Institut für Meteorologie der FU Berlin
"http://www.met.fu-berlin.de/"
Meteorological Publications
"http://www.met.fu-berlin.de/~stefan/"
The World-Wide Web Virtual Library: Meteorology
"http://www.met.fu-berlin.de/DataSources/MetIndex.html"

Global Positioning System (GPS)

Crustal Dynamics Data Information System (CDDIS)
"http://cddis.gsfc.nasa.gov/cddis.html"
Delft Univ. of Tech., Space Res,The GPS Page
"http://dutlru8.lr.tudelft.nl/gpsdir/gps.html"
GIBS: GPS Information Bulletin Board System</b
"http://gibs.leipzig.ifag.de"
Int. GPS Service for Geodynamics
"http://igscb.jpl.nasa.gov/"
KMS National Survey and Cadastre - Denmark: GPS page
"http://www.kms.min.dk/pages/gps.html"
National Geodetic Survey of the USA
"http://www.ngs.noaa.gov/"
GPS Precise Orbits
"http://www.ngs.noaa.gov/GPS/GPS.html"
Continuously Operating Reference Stations (CORS)
"http://www.ngs.noaa.gov/CORS/cors.html"
NOAA Geosciences Laboratory
"http://www.grdl.noaa.gov/"
Advanced Tech. Branch
"http://www.grdl.noaa.gov/ADV/ADV.html"
GPS Activities
"http://www.grdl.noaa.gov/GPS/GPS.html"
MIT Geophysics Geodesy and Geodynamics Laboratory
"http://www-erl.mit.edu/geodesy/geodesy.html"
GPS Res
"http://www-erl.mit.edu/gps/gpshome.html"
Satellite Geodetic Observatory, Penc, Hungary
"http://www.sgo.fomi.hu/"
GPS Project
"http://www.sgo.fomi.hu/gps/gps.html"
Southern California Earthquake Center, UCLA office
"http://scec.ess.ucla.edu/scecucla.html"
GPS Group
"http://scec.ess.ucla.edu/uclagps.html"
Southern California Integrated GPS Networks
"http://milhouse.jpl.nasa.gov/"
Scripps Orbit and Permanent Array Center (SOPAC)
"http://jon.ucsd.edu/"
The Global Navigation Satellite System (GLONASS)
"http://mx.iki.rssi.ru/SFCSIC/SFCSIC_main.html"
Univ. of Munich, Department of Geodesy and Geomatics Eng.
"http://habicht.bauv.unibw-muenchen.de/"
Univ. NAVSTAR Consortium (UNAVCO)
"http://www.unavco.ucar.edu/"
US Naval Observatory
"file://tycho.usno.navy.mil/"

Ocean Science

Ocean Data
AVHRR SST data (NOAA/NASA Pathfinder)
"http://sst-www.jpl.nasa.gov"
AVHRR SST data (Univ. of Rhode Island)
"http://rs.gso.uri.edu/avhrr-archive/archive.html"
Center for Coastal Studies, SIO, UCSD (& Data Zoo)
"http://www-ccs.ucsd.edu/"
Live Access to Climate Databases
"http://ferret.wrc.noaa.gov/ferret/main-menu.html"
TOGA-TAO Page with Realtime Data Access
"http://www.pmel.noaa.gov/toga-tao/el-nino/home.html"
Ames Res. Center, K-12)
"http://quest.arc.nasa.gov"
Connection to education bulletin board
"http://www.ciesin.org"
Earth System Science Community
"http://198.76.12.2/ESSCC.html"
Education catalog (a Web starting point)
"http://gnn.com/gnn/wic/ed.toc.html"
Educational Res. Info. Center (ERIC),Web start point
"http://ericir.sunsite.syr.edu"

Educational resources document
"http://podaac-www.jpl.nasa.gov/Edudoc.html"
El Nino Theme Page
"http://www.pmel.noaa.gov/toga-tao/el-nino/home.html"
Exploring Satellite oceanography on the WWW
"http://dcz.gso.uri.edu/amy/avhrr.html"
Oceanography course - Bill Prothero
"http://oceanography.geol.ucsb.edu"
Radar imagery with teaching unit
"http://southport.jpl.nasa.gov"
Sea Surface Temperature data and a lesson
"http://rs.gso.uri.edu/avhrr-archive/archive.html"
TOPEX/POSEIDON information and images
"http://podaac-www.jpl.nasa.gov/topex"
Weather and Climate Outreach
"http://www.ucar.edu:8080/ucargen/education/eduhome.html"

Ocean science in General (mostly US)
AGU "http://earth.agu.org/kosmos/homepage.html"
ASF Science
"http://sparc1k.images.alaska.edu"
Australian Oceanographic Data Centre (AODC)
"http://www.aodc.gov.au/AODC.html"
AVHRR NOAA-14
"http://satftp.soest.hawaii.edu"
AVHRR SST data (NOAA/NASA Pathfinder)
"http://sst-www.jpl.nasa.gov"
Canada Centre for Remote Sensing
"http://www.ccrs.nrcan.gc.ca/ccrs"
Center for Coastal Studies, SIO, UCSD
"http://www-ccs.ucsd.edu/"
Climatology for TOGA-COARE and Adjacent Regions
"http://thunder.atms.purdue.edu:80/toga_atlas"
Coastal Zone Project
"http://acri.cica.fr/Coastal.html"
Data Distribution Lab. with CD-ROM directory
"http://stargate.jpl.nasa.gov:80/ddl"
Datasets at NCAR
"http://www.ucar.edu/dss/datasets.html#avail"
Decoded Offshore Weather Data
"http://milkman.cac.psu.edu/~reh113/index.html"
Earth related satellite FAQs
"http://www.geog.nottingham.ac.uk/remote/satfaq.html"
ECS Electronic Data Handling System (EDHS)
"http://edhs1.gsfc.nasa.gov"
El Nino education
"http://www.pmel.noaa.gov/toga-tao/el-nino/home.html"
ENSO "http://noaacdc.colorado.edu/cdc/cdc_home.html"
ENSO "http://www.coaps.fsu.edu"
EOS and Mission to Planet Earth
"http://eos.nasa.gov"
EOSDIS Management Information System
"http://harp.gsfc.nasa.gov:1729/eosdis_documents/eosdis_home.html"
EOSDIS ASF DAAC
"http://goofy.gi.alaska.edu:12355"
EOSDIS Ciesin DAAC
"http://infoserver.ciesin.org:8080/ciesin-home.html"
EOSDIS EDC DAAC's
"http://sun1.cr.usgs.gov/landdaac/landdaac.html"
EOSDIS GSFC DAAC
"http://daac.gsfc.nasa.gov"
EOSDIS JPL DAAC
"http://podaac-www.jpl.nasa.gov"
EOSDIS LaRC DAAC
"http://eosdis.larc.nasa.gov"
EOSDIS MSFC DAAC
"http://wwwdaac.msfc.nasa.gov:"
EOSDIS NSIDC DAAC
"http://floeberg.colorado.edu:1733"
EOSDIS ORNL DAAC
"http://jupiter.esd.ornl.gov/programs/daac/daac.html"
Fluid dynamics, Oceanography & Meteorology
"http://solution.maths.unsw.edu.au/WWW.fluids/homepage/index.html"
Global Change Master Directory
"http://gcmd.gsfc.nasa.gov"
Global Sea Level Change
"http://biudc.nbi.ac.uk/gslc/gslc.html"
HDF information server
"http://hdf.ncsa.uiuc.edu:8001"
Int. Arctic Buoy Program (IABP)
"http://iabp.apl.washington.edu"
JPL PO.DAAC Homepage
"http://podaac-www.jpl.nasa.gov"
LDEA Climate Group Home Page
"http://rainbow.ldgo.columbia.edu"
Live Access to Climate Databases
"http://ferret.wrc.noaa.gov/ferret/main-menu.html"
MODIS Airborne Simulator
"http://ltpwww.gsfc.nasa.gov/MODIS/MAS/Home.html"
NASA Jet Propulsion Laboratory
"http://www.jpl.nasa.gov"
NASA/JPL Imaging Radar Homepage
"http://southport.jpl.nasa.gov"
NASDA
"http://hdsn.eoc.nasda.go.jp/guide/guide/intro/eois/eois_e.html"
National Center for Supercomputing Applications
"http://www.ncsa.uiuc.edu/General/NCSAHome.html"
National Geophysical Data Center:
"http://www.ngdc.noaa.gov"
National Oceanographic Data Center (NODC)
"http://www.nodc.noaa.gov"
NCAR Data Archive
"http://www.ucar.edu/dss/index.html"
NCAR Home Page
"http://www.ucar.edu/metapage.html"

NEMO - Oceanographic Data Server (SIO)
"http://nemo.ucsd.edu/nemo_front.html"
Net Information resources
"http://www.brandonu.ca/~ennsnr/Resources"
NOAA ESDIM Home Page
"http://www.esdim.noaa.gov"
NOAA Home Page
"http://www.noaa.gov"
NSSDC CD-ROM Catalog
"http://nssdc.gsfc.nasa.gov/cd-rom/cd-rom.html"
Ocean Info Center (OCEANIC) at U of Delaware
"http://www.cms.udel.edu"
Ocean Res. Institute, Univ. of Tokyo
"http://www.ori.u-tokyo.ac.jp"
Oceanography on the WWW
"http://www.ocgy.ubc.ca/oceanography.links.html"
Oceanographic directory
"http://orpheus.ucsd.edu/sio/ist/index.html"
Oceanographic education lesson plans
"http://dcz.gso.uri.edu/amy/avhrr.html"
Oceanography Society News
"http://www.tos.org"
Oceans SST Pathfinder (NOAA/NASA)
"http://sst-www.jpl.nasa.gov"
Pacific Marine Environmental Laboratory (PMEL)
"http://pmel.www.noaa.gov"
San Diego Supercomputing Center
"http://www.sdsc.edu/"
Satellite Altimetry
"http://www.satobsys.co.uk/home_page.html"
Scientific Data Format Information FAQ
"http://fits.cv.nrao.edu/traffic/scidataformats/faq.html"
Scripps Institution of Oceanography
"http://sio.ucsd.edu"
SeaWiFS
"http://seawifs.gsfc.nasa.gov"
SIR-C/XsSAR images
"http://www.jpl.nasa.gov/sircxsar.html"
Software Support Laboratory (NASA)
"http://sslab.colorado.edu:2222/ssl_homepage.html"
Tech. exposition
"http://www.techexpo.com"
The National Climatic Data Center (NCDC)
"http://www.ncdc.noaa.gov/ncdc.html"
The World-Wide Web Library: Oceanography
"http://www.mth.uea.ac.uk/ocean/oceanography.html"
TOGA COARE Information Services Web Site
"http://www.coare.ucar.edu/TCIPOhome.html
TOGA-TAO Page with Realtime Data Access
"http://www.pmel.noaa.gov/toga-tao/home.html"
TOGA/COARE Data Catalog
"http://www.cms.udel.edu/coare/"
TOPEX/POSEIDON (JPL)
"http://TOPEX-www.jpl.nasa.gov"
TOPEX/POSEIDON Images (JPL)
"http://podaac-www.jpl.nasa.gov/topex"
TOPEX/Poseidon data (AVISO)
"http://alti.cnes.fr"
U of Hawaii School of Ocean & amp
"http://www.soest.hawaii.edu"
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"http://satftp.soest.hawaii.edu"
US Joint Global Oceans Flux Study
"http://www1.whoi.edu/jgofs.html"
USGS Atlantic Marine Geology:
"http://bramble.er.usgs.gov"
USGS Global Change Res. Program
"http://geochange.er.usgs.gov/gch.html"
WOCE Data Information Unit
"http://diu.cms.udel.edu/woce/oceanic.html"
Woods Hole Oceanographic Institution
"http://www.whoi.edu"
World Wide Web Virtual Library -Earth Sci.
"http://www.geo.ucalgary.ca/VL-EarthSciences.html"

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The IAG Central Bureau have set up a home page on the World Wide Web as an open and up-to-date information medium. On this home page it is possible to access information for general use relevant to the IAG community. Among the major topics that can presently be accessed on the IAG home page are the following:

- Structure of IAG for the period 1995 - 1999.
- IAG address list of fellows and (a part of) the associates of IAG.
- IAG e-mail list.
- IAG Publication list.
- IAG Resolutions in English and French.

- IUGG structure 1991-1995.
- IUGG Officers 1995-1999.
- IUGG resolutions adopted at the XXI General Assembly (English and French).

- Information and addresses of Educational centers for Geodesy.
- Information about the IAG Special Study Groups.

- List of upcoming symposia and meeting for the next 2-3 years.
- Announcement of upcoming symposia.
- Geodesy program of selected upcoming symposia.

- The IAG newsletter.
- Links to Table of Content in Geodesy (by M&M Craymer)
- Links to other World Wide Web servers related to Geodesy via IFAG-Potsdam, Germany
- Much more.....

In order to access the IAG home page you need an INTERNET connection and a World Wide Web browser. The WWW browsers can purchased or downloaded free of charge on the INTERNET from numerous locations. Among the most popular browsers are products like Mosaic or Netscape. When you have installed a WWW browser, you can then access the IAG home page at the following INTERNET address:

URL: http://www.gfy.ku.dk/~iag/,
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- The I.A.G. registered participants in the XXI I.U.G.G. Assembly in Boulder, July 1995

This list seems to be a very useful tool for all our readers. The list can also be found at WWW, at the following address: http://www.gfy.ku.dk/~iag/
The list will be frequently updated.

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