

New IAG Structure: Status March 2003

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IAG Committee for the Realization of the New IAG Structure

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1 Introduction and Overview

The new IAG structure was developed after the IUGG General Assembly in Birmingham in summer 1999. Between summer 1999 and summer 2001 a thorough review of the IAG work and structure was performed by the so-called IAG Review Committee, the work of which is documented in (Beutler et al., 2001), a report which was presented at the IAG Scientific Assembly in Budapest in September 2001 in Budapest. At the same meeting, the proposed new structure was accepted by the IAG Executive Committee and later on by the IAG Council, which held an extraordinary meeting on September 8, 2001 in Budapest.

At the same meeting (Rummel et al., 2001) proposed to create the IGGOS, the Integrated Global Geodetic Observing System as IAG's first project.

It is worthwhile to cite a few lines from the new IAG Statutes and IAG By-Laws, which were accepted by the IAG Council at the September 8, 2001 meeting. According to these Statutes the Mission of the Association is defined as:

*The **MISSION** of the Association is the advancement of geodesy, an earth science that includes the study of the planets and their satellites. The IAG implements its mission by advancing geodetic theory through research and teaching, by collecting, analyzing, and modeling observational data, by stimulating technological development and by providing a consistent representation of the figure, rotation, and gravity field of the earth and planets and their temporal variations.*

The Association's objectives are subsequently stated in the IAG Statutes. The future scientific work of the Association is further specified in the new IAG By-Laws:

*The scientific work of the Association is performed within a component-structure consisting of Commissions, Services, the Communication and Outreach Branch, and IAG Projects, hereafter called the Association-components or **components**.*

The new ByLaws allow it furthermore to establish Inter-Commission Committees, where the following rules shall be observed according to the IAG ByLaws:

***Inter-commission Committees** shall handle important and permanent tasks involving all commissions. Each Inter-commission Committee shall have a steering committee consisting of the following membership:*

- a. President appointed by the IAG Executive Committee.*
- b. Vice-president appointed by the IAG Executive Committee.*
- c. One representative from each Commission*

The terms of reference for each Inter-commission Committee shall be developed by a planning group appointed by the IAG Executive Committee. The Inter-commission Committees report to the IAG Executive Committee. The Inter-Commission Committee will be reviewed every eight years.

The following specific tasks were identified in Budapest to be achieved between the IAG Scientific Assembly 1999 and the IUGG General Assembly 2003 in Sapporo:

- The existing IAG Structure should be mapped into the new one.
- An Inter-Commission Committee on Theory should be created by a dedicated planning group
- IGGOS should be set up as the first IAG project by a dedicated planning group.
- A call for proposals should be issued for the the new Communication and Outreach Branch

The work of mapping the old structure into the new one, of creating the planning group for the ICC on Theory, and of issuing the call for the outreach branch was given to the IAG Committee for the realization of the new IAG structure. It was decided furthermore that the creation of a planning group for the IAG Project called IGGOS (Integrated Global Geodetic Observing System) should be left to the initiative of Reiner Rummel and Gerhard Beutler (see section 10 of this report).

The planning group for the Inter-commission Committee on Theory was set up early in 2002. The group members are:

- Bernhard Heck (Chair)
- Veronique Dehant
- Christopher Jekeli
- Chris Rizos
- Nico Sneeuw
- Peiliang Xu

The discussions within this group and of the group with a broader community were rather intense, but very interesting. A convergence was reached and summarized in an e-mail sent out by the Chairman on July 2, 2002. The outcome of the work is presented in section 7 of this report. It is in essence based on a summary by Bernhard Heck and the first report of the Planning Group compiled by Peiliang Xu.

The IAG Committee for the realization of the new IAG structure held three meetings (on September 6, 2001 in Budapest, on December 11, 2001 in San Francisco, and on April 26, 2002 in Nice).

The five Section presidents agreed to serve as task leaders for the creation of the four new commissions and the Inter-Commission Committee on Theory. The outcome of their work will be summarized in sections 3-7. Christian Tscherning, IAG Secretary General, is the task leader for the establishment of the Communication and Outreach Branch.

At its meeting in Nice the Committee decided to support a proposal made by Prof. Erwin Groten (who was invited to attend the Nice meeting) and Erik Grafarend to create an *Inter-commission Committee on Geodetic Standards*. It was furthermore decided that Section V should take the leadership in the planning group for this committee, and that the IAG services, in particular the IERS, IGS, IVS, ILRS, and the gravity-related services should be represented in the planning group. (The IAG EC actually asked Clark Wilson, president of Section V to chair this planning group and to create it with prominent representation from the services, in particular from the IERS, the IGS, IVS, ILRS, and the gravity-related services.)

2. The New Structure in Overview

The services associated so far with the IAG were invited to become official IAG Services under the new structure. The following services made the decision to follow this invitation in the sense defined by the new IAG Statutes and By-Laws:

- The IERS (International Earth Rotation Service)
- The IGS (International GPS Service)
- The ILRS (International Laser Ranging Service)
- The IVS (International VLBI Service for Geodesy and Geodynamics)
- The BGI (International Gravimetric Bureau)
- The IGES (International Geoid Service)
- The ICET (International Centre for Earth Tides)
- The PSMSL (Permanent Service for Mean Sea Level)

The IAG services work and act in a relatively independent way. Their decision to join the IAG as services in the sense of the new statutes and by-laws could not be „enforced“ by the IAG. The Committee on the Realization of the New Structure is very much pleased by this positive response. According to the IAG By-Laws the following four commissions shall be set up:

Commission 1 *Reference Frames*

Objectives:

- a. Establishment, maintenance, improvement of the geodetic reference frames.
- b. Advanced terrestrial and space observation technique development for the above purposes.
- c. International collaboration for the definition and deployment of networks of terrestrially-based space geodetic observatories.
- d. Theory and coordination of astrometric observation for reference frame purposes.
- e. Collaboration with space geodesy/reference frame related international services, agencies and organizations.

Commission 2 *Gravity Field*

Objectives:

- a. Terrestrial, marine, and airborne gravimetry.
- b. Satellite gravity field observations.
- c. Gravity field modeling.
- d. Time-variable gravity field.
- e. Geoid determination.
- f. Satellite orbit modeling and determination.

Commission 3 *Earth Rotation and Geodynamics*

Objectives:

- a. Earth Orientation (Earth rotation, polar motion, nutation and precession).
- b. Earth tides.
- c. Tectonics and Crustal Deformation.
- d. Sea surface topography and sea level changes.
- e. Planetary and lunar dynamics.
- f. Effects of the Earth' s fluid layers (e.g., post glacial rebound, loading).

Commission 4 *Positioning and Applications*

Objectives:

- a. Terrestrial and satellite-based positioning systems development, including sensor and information fusion.
- b. Navigation and guidance of platforms.
- c. Interferometric laser and radar applications (e.g., Synthetic Aperture Radar).
- d. Applications of geodetic positioning using three dimensional geodetic networks (passive and active networks), including monitoring of deformations.
- e. Applications of geodesy to engineering.
- f. Atmospheric investigations using space geodetic techniques.

Each Commission shall have a Steering Committee, with a maximum of twelve voting members, which shall define the appropriate sub-structure of the Commission, which may consist of the following components:

- a. Sub-commissions,
- b. Study Groups.
- c. Commission Projects

A planning group for the IGGOS was set up, a first meeting was held in May 2002 in Washington, a second in October 2003 in Munich. The proposal of this group is contained in the separate document (Beutler, Drewes, Rummel, 2003). The status of the realization of the prominent elements of the new IAG structure is summarized in the following sections.

3. Commission 1 (*Task Leader: C.K. Shum*)

This proposal emerged from discussions in Nice before, at the, and after the third meeting of the IAG Committee for the Realization of the New IAG Structure on April 26, 2002. It is proposed to set up the following Sub-commissions (SC):

SC1.1: Coordination of Space Techniques

Take over the coordinating role of its predecessor CSTG in a changed environment. The SC shall establish and further the contact of the space geodetic services based on space techniques, in particular IERS, IGS, ILRS, IVS and commission projects like DORIS.

SC1.2: Global Reference Frame

Address research-related and practical aspects of establishing the global reference frame. Address fundamental issues of the multi-technique global geodetic observatories. This SC must play a strong role in the new IAG project IGGOS. Its activities shall be coordinated with the IERS. SC1.3 shall in particular establish and maintain the contact with COSPAR.

SC1.3: Regional Reference Frames

SC1.3 shall offer a home for service-like regional reference frame activities AND address common aspects of these units. In order to avoid the creation of sub-sub-commissions , it is proposed to formally establish

- SC1.3a: EUREF,
- SC1.3b: SIRGAS,
- SC1.3c: NAREF,

- SC1.3c: AFREF,
- SC1.3e: APSG, and
- SC1.3f: SCAR (Antarctic)

with the understanding that these subcommissions also form the steering committee of SC1.3. Aspects of common interest shall be addressed, combined workshops, sessions at workshops, etc. shall be organized.

SC1.4: Satellite Dynamics

This SC shall address problems of satellite dynamics, which are outside the scope of the services. One might, e.g., think of the *materialization of the celestial reference frame in satellite geodesy* as a central theme, where aspects like the transfer of the Quasar-derived frame into the optical domain, but also the value of modern high-accuracy astrometric places (based on modern telescopes, CCD-equipment) could be addressed.

The following three *Commission Projects* are proposed:

CP1.1: Altimetry: The project shall promote the free access to all satellite altimetry data and its use for geodetic reference frames, in particular height systems. It shall set up the basis for a unified multi-mission long-term record of altimeter data and investigate new techniques and application areas of satellite altimetry (e.g., off-nadir altimetry, altimetry over land, laser altimetry etc.). The necessary steps towards the establishment of an altimetry service shall be studied.

CP1.2: GNSS: The main objective of this project is the coordination of geodetic activities with respect to the new global navigation satellite systems. The links to the international bodies involved in the establishment of new missions and systems shall be maintained and intensified. The adequate use of GNSS for geodetic applications shall be studied in cooperation with the subcommissions of Commission 1.

CP1.3: DORIS: The project shall coordinate the establishment of a DORIS service. In this task, it is cooperating closely with the other components of Commission 1 and the existing IAG services in this field (IERS, IGS, ILRS, IVS). The project will be discontinued as soon as a DORIS Service is installed.

4. Commission 2: Gravity Field (*Task leader: Michael G. Sideris*)

The new Commission is derived mainly from the existing Section III (Determination of the Gravity Field), with elements of Sections II, IV and V. When mapping the old into the new structure, one may argue that the new Commission 2 should consist of the existing Section III, of Special Commission 7 (Satellite Gravity Field Missions) from Section II, of Special Commission 1 (Physical Foundations of Geodesy) with Sub-commission 3 (Boundary Value Problems) from Section IV, and even of part of Commission 5 (Earth Tides) from Section V. Of course the latter can fit as well under the new Commission 3 (Earth Rotation and Geodynamics).

Although the theoretical aspects of SC1 and its sub-commission 3 could be covered under the proposed Inter-Commission Committee on Theory, it is felt that their natural place is under the new Commission 2, with full cooperation and coordination with the activities of the Inter-Commission Committee.

The five major thematic areas of the new Commission 2 will be:

- Gravimetry and Gravity Networks
- Precise Geoid Determination
- Gravity Field Determination from Satellite Altimetry
- Dedicated Gravity Satellite Missions
- Temporal variations of the Gravity Field

Based on the above themes, there are currently only three major elements planned, that will define the structure of Commission 2. In terms of Sub-commissions, these are:

- SC2.1 on Gravimetry and Gravity Networks
- SC2.2 on Spatial and Temporal Modelling of the Gravity Field
- SC2.3 on Dedicated Gravity Satellite Missions

The proposed SC2.3 might be part of SC2.1 or SC2.2, but, given the very high importance of the new satellite missions, it is felt that, at least initially, there should be a separate sub-commission to deal with the special issues and the variety of applications of these missions. Several study groups similar to the ones that exist currently would again be established to (i) investigate more specific topics and (ii) coordinate regional efforts of gravity mapping, geoid determination, vertical datums, etc.

Commission 2 has very strong links to the newly established International Gravity Field Service (IGFS). consisting of:

- Bureau Gravimetric International (BGI)
- International Centre of Earth Tides (ICET)
- International Geoid Service (IGeS) I, in Milano
- International Geoid Service (IGeS) II, at NIMA
- International Centre of Global Earth Models (ICGEM), at GFZ

IGFS's terms of reference are available under a separate document. It is clear that the givenning bodies of Commission 2 and IGFS should have a few common members on their Boards to ensure constant communication and proper coordination of their activities.

5. Commission 3 *Earth Rotation and Geodynamics (Task Leader: Clark Wilson)*

As discussed at the IAG reorganization planning meeting on April 26, the new Commission 3 Earth Rotation and Geodynamics, replaces Section V Geodynamics in the current structure. Activities *not* proposed to be included in the two subcommissions below are proposed to be assigned as follows:

- The present International Earth Tide Commission is proposed to be assigned to new Commission 2;
- Activities of the present Fundamental Parameters special commission will be assigned to a new Inter-Commission Committee which will report its results via the IERS Conventions;
- The services (IERS, PMSL, ICET, BIPM time division) will acquire representation on a level with Commissions in the IAG executive committee.

Commission 3 is proposed to consist initially of *two subcommissions*:

SC3.1: *Crustal Deformation*

This proposed subcommission includes activities now under Commission XIV in the current IAG structure. The present Subcommission XIV contains sub-units related to particular geographical regions, including long-standing projects such as WEGENER, APSG, and the Central European Initiative, as well as Africa and Antarctica. The objectives of the current Commission XIV (described on its website <http://www.df.unibo.it/commXIV/>) are proposed to continue: *First*, to study 3-D motions, in active tectonic regions, post-glacial rebound and sea-level fluctuations and changes in relation to vertical tectonics along many parts of the coastlines and in relation to environmental fluctuations/changes affecting the geodetic observations; *Second*, to promote, develop and coordinate international programs related to observations, analysis and data interpretation for the three fields of investigation mentioned above; *Third* to promote the development of appropriate models.

SC3.2: *Earth Orientation and Global Geophysical Fluids*

This proposed subcommission includes activities within the IERS Global Geophysical Fluids Centers (GGFC). There are 7 special bureaus organized to examine the influence of the earth's mobile constituents (fluids) on the earth's orientation, defined broadly in terms of length of day, polar motion, nutations, geocenter and gravity. The 7 special bureaus are concerned with estimating influences of the core, mantle, oceans, terrestrial hydrology, atmosphere, and ocean tides. Activities under the present Special Commission 8 (Sea Level and Ice Sheets) are expected to be incorporated within the appropriate special bureaus. This proposed subcommission will follow the current goals

of the GGFC (taken from the GGFC website <http://bowie.gsfc.nasa.gov/ggfc/>): to compute time variations of angular momenta and related torques, gravitational coefficients, and geocenter shift for all geophysical fluids based on global observational data, and/or products from state-of-the-art models, and to conduct scientific sessions at international meetings and conferences.

6. Commission 4 Positioning and Applications (*Task leader Alan Dodson*)

The new Commission 4 will focus on multi-sensor applications, kinematic positioning, atmosphere propagation, monitoring of local geodynamic applications, etc.

The Commission shall have strong links to IAG-external organisations like FIG, ION, and (perhaps) to ISPRS. IAG-internally, the Commission must be linked to the IGS (implying an IGS representation on the Commission' s steering committee).

Proposed Sub-commissions:

- SC 4.1 on multi-sensor systems
- SC 4.2 on dynamic monitoring&analysis of structural and local geodynamic deformation
- SC 4.3 on GNSS measurement of the atmosphere
- SC 4.4 on Application of satellite & airborne imaging systems (e.g., INSAR, LIDAR)

Two commission projects are proposed:

- CP 4.1 on GPS Meteorology, Climate, and Space Weather
- CP 4.2 on Real-time monitoring systems

Open issues still are: the terrestrial systems, the height system.

7. Inter-Commission Committee on Theory

(*Task leaders: Bernhard Heck and Peiliang Xu*)

The proposed *Terms of Reference for the Inter-Commission Committee on Theory* are:

- Theory is contained within all IAG Commissions/Sections, the Inter-Commission Committee on Theory should primarily be a channel of cooperation amongst the different commissions, on the ground of methodology. The liaison with the Commissions is established through the ICCT's steering committee, the liaison to the broader field of mathematics and physics through the ICCT Advisory Committee. The Committee should be represented in the Steering Committees of IAG Project(s) either by a member of type c) or d) (IAG By-Laws, 1.4) in order to play its role.
- In recognition of the fact that geodesy has exposed new mathematical problems that have not been encountered or not been properly or thoroughly solved in mathematics, the Inter-Commission Committee on Theory encourages frontier research in the fields of mathematics as encountered in geodesy.
- The Inter-Commission Committee on Theory helps IAG in articulating the challenges of geodesy, in terms of mathematics and physics, with the aim to attract young talent to geodesy. It also interacts with scientists in other areas of science and engineering.
- In recognition of the fact that geodesy has an important role to play in understanding the physics of the Earth, the Inter-Commission Committee on Theory thus particularly encourages closer research ties with the relevant areas of the Earth Sciences.

Structure of the ICCT:

- The *ICCT's Steering Committee* is composed of its president and vice-president (both appointed by the IAG Executive Committee) and one representative from each of the four IAG Commissions.
- The *ICCT Advisory Committee* consists of the ICCT Steering Committee plus a number of colleagues from mathematics, physics, theoretical geophysics, etc. This advisory committee should provide an interface to external *sister communities* and should be understood as an *extended ICCT Steering Committee, where the additional members have voice but no vote*. The panel does establish the contact between *theoretical*

geodesists and practically oriented mathematicians who should have their home in the new IAG structure.

- *Working Groups of Type 1*: These are joint working groups set up by the Committee and the Commissions. They should establish a close cooperation between theory and application within IAG. SC1.4 (although at present not set up in this way) might be an example. A concrete list of working groups should be established till spring 2003.
- *Working Groups of Type 2*: These *internal Working Groups* concentrate on basic theoretical problems (e.g., general statistical and numerical methods for geodetic data evaluation) or summarize geodetic theory and methodology in a concise way. A concrete list will be prepared by the ICCT Planning Committee for the 2003 Spring Meeting of the IAG Executive Committee.

The working groups also might be called study groups.

8. Inter-Commission Committee on Geodetic Standards

The planning group should be established as soon as possible.

9. Outreach Branch

The process of setting up the Outreach Branch is in the hands of the secretary general.

10. IAG Project IGGOS (Integrated Global Geodetic Observing System)

The IGGOS planning group is chaired by Gerhard Beutler till summer 2003, Hermann Drewes is the planning group's secretary. The group met twice, once in Washington and once in Munich.

The planning group held a first meeting in Washington on May 27, 2002 in Washington. The meeting was intense and at times controversial. The establishment of IGGOS seemed to be far from trivial. A vision and a mission statement as well as objectives for IGGOS were subsequently proposed by Gerhard Beutler, Jim Ray, John Manning, Hermann Drewes, and Reiner Rummel.

The second meeting of the planning group took place on November 22, 23 in Munich at DGFI, the German Geodetic Research Institute. This meeting was extremely constructive and successful. In a first phase the vision, mission and objectives for IGGOS were briefly reviewed and finalized (to the extent that such statements may ever reach a final form). The agreed upon version of the IGGOS vision, mission, and objectives are reproduced in this document. The primary (and ambitious) goals of the November 2002 IGGOS planning group meeting were to reach a consensus on the following four aspects:

- Strategy to develop an IGGOS Science Rationale,
- strategy to develop an IGGOS Science Plan,
- strategy to develop an IGGOS Structure, and
- outline of a realistic IGGOS Schedule.

The meeting resulted in the proposal to actually establish the IGGOS as IAG's first project. The full text is contained in the reference (Beutler, Drewes, Rummel, 2003).

11. Summary and Action Items

Summary: The present document gives an overview of the status of the IAG Restructuring process. The process is complex and needs to be finalized between the two IAG Executive Committee Meetings in Nice (April 2003) and in Sapporo (July, 2003). The work must be performed mainly by the IAG Bureau, the five section presidents, and the newly elected IAG officers.

Specific concerns were brought forward by Bernhard Heck. They are not yet resolved, which is why this task has to be addressed by the same group in the time frame mentioned above. The concerns are:

- The proposed structure of Commission 1 seems to be not fully consistent with the original objectives of the new Commissions, which should act as scientific entities instead of reflecting regional initiatives. The substructure of Commission 1 is felt to be

too close to the structure of the present Section I. Scientific aspects should be more pronounced. Regional initiatives should get another status and might be organized by advisory panels for the respective regions rather than in Sub-Commissions.

- The natural place for the present Earth Tide Commission is Commission 3; this topic is explicitly stated in Section 1.2.1 of the new IAG Bylaws.
- There is a strong interrelation visible between SC3.1 on Crustal deformation in Commission 3 and SC 4.2 (local geodynamic deformation). It might be preferable to create a joint sub-entity. The open issues addressed to in item 3.4 might be solved in the following way: - terrestrial systems belong to Commission 1,-height systems might be integrated in Commission 2.

Thanks to the work of Bernhard Heck, Peiliang Xu, Véronique Dehant, and the entire ICCT planning committee we now have a concrete proposal concerning the objectives and the structure of the new Inter-Commission Committee on Theory.

No progress was made up till now with the ICC on Geodetic Standards. We should have concrete proposals at the Nice Executive Committee meeting. Otherwise the ICC on Standards cannot be set up in Sapporo.

It should be possible to formally establish the definition phase for IGGOS in summer 2003. The proposal will be made at the Nice Executive Committee meeting.

Concrete Action Items:

- Review of the above document by the IAG Committee for the Realization of the New IAG Structure by the IAG Executive prior to April 1.
- Define and approve workplan between Nice and Sapporo IAG EC Meetings.

12. References

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