

The IAG Project “Integrated Global Geodetic Observing System (IGGOS)” – Setup of the Initial Phase

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Abstract

The Integrated Global Geodetic Observing System (IGGOS) was established in 2003 as the first and only Project of the International Association of Geodesy (IAG). The project structure shall be installed during an initial phase in the years 2003 to 2005. The vision, mission, objectives and the first ideas of the overall structure are described in the paper.

1. Introduction

The Project “Integrated Global Geodetic Observing System” (IGGOS) of the International Association of Geodesy (IAG) was installed within the new structure of IAG during the XXIII General Assembly of the International Union of Geodesy and Geophysics (IUGG) in Sapporo, Japan, July 2003. According to its bylaws, projects of the IAG are of a broad scope and of highest interest and importance for the entire field of geodesy. They serve as the “flagship” of the Association for a long time period. At the same event in Sapporo, IGGOS was endorsed by the IUGG through the Resolution No. 3.

2. Vision

IGGOS integrates different techniques, different models and different approaches in order to achieve a better consistency, long-term reliability and understanding of geodetic, geodynamic and global change processes. It is geodesy’s contribution to Earth sciences and the bridge to the other disciplines; it asserts the position of geodesy in geosciences, integrates the work of IAG and emphasizes the broad spectrum of geodetic research and application fields. IGGOS provides the scientific and infrastructure basis for all global change research in Earth sciences. In the frame of IGGOS, the Earth system is viewed as a whole including the solid Earth as well as the fluid components, the static as well as time-varying parameters.

3. Mission

IGGOS is to collect, archive and ensure the accessibility of geodetic observations, results and models covering the three fundamental fields of geodesy:

- geometry and kinematics of the Earth’s surface,
- Earth orientation and rotation, and

- the Earth's gravity field and its variability.

IGGOS shall identify a complete set of geodetic products in these fields and establish the requirements concerning the products' accuracy, time resolution, and consistency. It will identify eventual gaps in the products provided by the IAG services and develop strategies to close them. Intensive cooperation between existing and new IAG services shall be stimulated and the visibility of scientific research in geodesy shall be promoted and improved. By these means a maximum benefit for science shall be achieved. IGGOS is geodesy's central interface to the scientific community and to society in general.

4. Objectives

In the first phase IGGOS aims at maintaining the stability of and providing the ready access to the existing time series of geometric and gravimetric reference frames. It focuses on all aspects relevant to ensure the consistency of geometric and gravimetric products. This includes space-borne and terrestrial techniques. The targeted overall accuracy and consistency of the products is of the order of 10^{-9} or better. IGGOS ensures the consistency between the different geodetic standards used in the geosciences community in agreement with the international unions and aims at improving the geodetic models at the level required by the observations.

IGGOS shall actively participate in the IGOS, the United Nation's Integrated Global Observing Strategy. IGOS brings together the major satellite and surface-based systems for global environmental observations in a strategic planning process. It shall support the environmental information needs of scientists, operational environmental programmes, as well as national and international decision makers.

5. Scientific Rationale

IGGOS shall have a central theme and a master product. The central theme "Global deformation and mass exchange processes in the System Earth" must include all the activities IGGOS might envisage in future. It comprises the Earth's geometry, rotation and gravity field. In addition, it may easily be translated and broken down into tangible individual sub-themes and sub-products. From the general theme one general product may be derived, encompassing the following scientific questions/areas:

- Deformation (loading as well as expansion) of the Earth due to the mass transfer between atmosphere, hydrosphere (including ice) and solid Earth, separating the effects of mass changes from motion and from thermal expansion;
- The global pattern of tectonic processes including inter-plate and intra-plate deformation;
- The global pattern of height changes in one datum and on all time scales, of geodynamic as well as of anthropogenic origin, on land, of ice covers, and of sea level, separating the effects from solid Earth and from the oceans ("absolute" sea level);
- Quantification of the mass exchange between all the components of the System Earth.

The above list is not meant to be final and will be further developed.

The central theme and the main results (master products) derived from it will address the relevant science issues related to geodesy and geodynamics in the 21st century, but also issues

relevant to society in general (global risk management, natural resources, climate change, ocean forecasting and others). It is an ambitious project of a dimension that cannot be achieved by the geodetic community alone, and which requires a strong cooperation inside and outside this community.

In order to shape IGGOS through its master-theme and its master-products, a sound and comprehensive “IGGOS Science Plan” is required. The IGGOS Science Plan shall provide a logic framework for the work of IGGOS. The central theme and the corresponding master product(s) must be put into a broader science and application context. It should also include an analysis of the state-of-art in the science field under discussion, strength and deficiencies, recommendations of what should be done.

The IGGOS Science Plan should serve as the basis for the implementation of IGGOS in 2005. A work plan should be derivable from it. Furthermore it should become an attractive document for presentation to potential future partners and clients.

6. Initial Structure

The IAG Project Planning Group proposed and the IAG Executive Committee accepted to establish the following key elements of IGGOS:

1. The “IGGOS Project Board” as the central oversight entity.
2. “Working Groups” the tasks of which are to a high degree independent of the tasks of the IAG services.
3. A “Science Council” representing the geodetic and geophysical community.

The initial IGGOS structure (for the definition phase 2003-2005) is illustrated by Figure 6.3.

6.1. Project Board and Steering Committee

The IAG Bylaws ask for the establishment of a Steering Committee consisting of representatives appointed by the commissions, two members at large, and the chairs of the IAG project sub-groups. The Steering Committee is a subset of the IGGOS Project Board. In the initial phase of IGGOS it is composed of the following members which is to a large extent the same as the composition of the IGGOS Planning Group 2001-2003 (Steering Committee members are marked by an asterisk):

- Chair: *Chris Reigber**
- Members related to reference frames: *Claude Boucher, Hermann Drewes* (Representative of Commission 1), Markus Rothacher*
- Members related to gravity field and sea level: *Rene Forsberg* (Representative of Commission 2), Reiner Rummel, C.K. Shum*
- Members related to Earth rotation and geodynamics: *Veronique Dehant, Kosuke Heki, Susanna Zerbini* (Representative of Commission 3)*
- Members related to services for geometry: *Norman Beck, Chopo Ma, Mike Pearlman*
- Members related to services for gravity and sea level: *Fernando Sanso, Phil Woodworth, Mike Watkins*
- Members related to networks: *Wolfgang Schlüter, John Manning, Ruth Neilan*

6.2. Working Groups

Setting up the IGGOS working groups the following general principles are observed:

- IGGOS will be based on the existing IAG Services. It is in particular *not* taking over tasks of existing, and well working IAG services. IGGOS will provide a framework for existing or future services and ensure their long-term stability.
- New entities will be established only if there is a stringent requirement.
- IGGOS must be recognized by partners outside IAG, e.g., by UNESCO, ICSU, IGOS, GOOS, GTOS, governments, inter-government organizations, WCRP, IGBP, etc., as geodesy's most important contribution to Earth sciences. For this purpose contacts have to be established to these organizations.
- IGGOS must promote its master product and the related sub-products.
- IGGOS must promote interdisciplinary research in geodesy.
- IGGOS will provide standards and enforce quality management (validation, calibration, ensure the 1 ppb level) either by a new IGGOS entity or by delegating this task to one or several of the existing services.

6.3. Science Council

The primary task of the science council is to develop the IGGOS science plan based on the science rationale. The Inter-Commission Committee on Theory shall be represented in the Science Council.

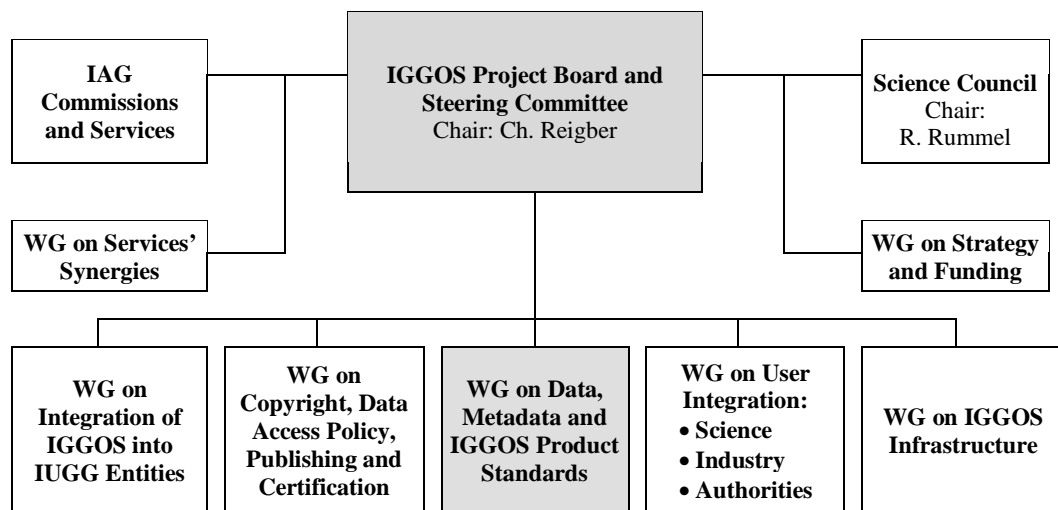


Figure 1. Initial IGGOS Structure.

7. Initial Program of Activities

WG on IAG Services' Synergies: The key issue within this WG is a thorough analysis of the existing IAG structure. Does it make sense to combine certain services into one? What new

services should be set up? Is it correct to distinguish within IAG between *level 1 services* (e.g., IGS, ILRS, IVS), dealing with raw observations and generating products which are more or less based on these observations only, and *level 2 services* (e.g., IERS) using the products of several level 1 services and generating new products, which are consistent with all the information from level 1? Shall additional level 2 services be established?

WG on Strategy and Funding: In the long run, funding has to be addressed by all permanent IAG entities requiring a complex infrastructure. As IGGOS per se (at least initially) will be based—exactly like all IAG services—on voluntary contributions of the relevant research organizations in the field, an IGGOS funding strategy must be developed in close coordination with these organizations. It seems therefore appropriate to establish a working group related to this topic. This aspect is clearly not dealt with at a sufficient rate within the existing IAG services structure.

WG on Integration of IGGOS in IUGG entities: This WG has the task to set up (so-to-speak) the foreign ministry of IGGOS. It must be the goal to have IGGOS acknowledged as a member in the important international programs dealing with global change, etc. The IGS is but one important example.

WG on Copyright, Data Access Policy, Publishing and Certification: This WG should deal with the consistent assignment of the *Digital Object Identifier* (DOI[®]) framework for IGGOS products and the usage of *Data Set Citation* rules in metadata documents for the definition and realization of copyright, data access, publishing and certification objectives.

WG on Data, Metadata, and IGGOS Product Standards: This WG has to deal with IGGOS products and standardization issues. The definition of IGGOS *Products* consisting of data and metadata, driven by user, application and service requirements using international *Standardization* specifications, constitutes the precondition for the creation of state-of-the-art value-added public and science IGGOS services.

WG on User Integration: This task is in part dealt with by the IAG services. A common policy on the IAG level is, however, missing. This WG must be set up in close cooperation with the services.

WG on IGGOS Infrastructure: The infrastructure of IGGOS has to be setup in accordance with the objectives. In the initial phase the following sub-groups shall be installed to study and to configure the corresponding tasks:

- SG on Fundamental Station Network
- SG on Data Centres
- SG on Mission Operations
- SG on Global Communication
- SG on TR/TTC Networks

8. Schedule for the Realization of IGGOS

The following plan to develop IGGOS is based on the decisions taken at the last IGGOS planning group meeting in Sapporo.

1. The IGGOS definition phase lasts from 2003-2005. The main tasks are:
 - Definition of the final IGGOS structure

- Development of the IGGOS Science Plan
2. The “final” IGGOS structure and the science plan will have to be approved by the IAG Executive Committee at the IAG Scientific Assembly in Cairns, Australia.
 3. The IGGOS, as IAG’s first project, should become operational in 2005.
 4. IGGOS, in particular the science plan developed between 2003 and 2005, will be a central issue of the IAG Scientific Assembly 2005.