Proposal for the GGOS Bureau for Standards and Conventions

Proposing institution

Forschungsgruppe Satellitengeodäsie (FGS)

represented for the proposal by

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Proposed leadership of the GGOS Bureau for Standards and Conventions

- **Designated Head**

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- **Designated Secretary**

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Abstract

The implementation of common standards and conventions for the generation of geodetic/ geophysical products is of crucial importance for GGOS. This is necessary to ensure that the data of the different space geodetic techniques (e.g., GPS, SLR/LLR, VLBI, DORIS, altimetry, CHAMP, GRACE, and upcoming GOCE) can be processed to consistent time series for monitoring global change and geophysical processes. The proposing institutions will provide the expertise, capabilities and financial support for the operation of the GGOS Bureau for Standards and Conventions (BSC). The BSC will establish a permanent contact and routine exchange of information and results within the IAG Services and Commissions and with other entities in charge with standards and conventions (e.g., BIPM, ISO, CODATA) and neighbouring disciplines, in particular from other IUGG Associations and the International Astronomical Union (IAU), in order to guarantee the interdisciplinary consistency of geodetic standards and conventions.

Goals

A major goal of the GGOS Bureau for Standards and Conventions (BSC) is to keep track of the strict observance of geodetic standards, standardized units, fundamental physical constants, resolutions and conventions in all official products provided by the geodetic community. This includes the regular control of data released by the geodetic services and a comparison of the consistency of heterogeneous products generated by different services. The BSC will review, examine and evaluate all standards, constants, resolutions and conventions adopted by IAG or its components, and recommend their use or propose the necessary updates. This includes the identification of any gaps and deficiencies in standards and conventions and the initiation of steps to close them. Another objective is to propose necessary resolutions by IUGG and IAU, and to establish a strong interface with institutions in charge with standards and conventions (e.g., BIPM, ISO, CODATA) in order to propagate the use of unique geodetic standards and conventions to the scientific community and to society in general.

Expertise

The proposal is submitted by the Forschungsgruppe Satellitengeodäsie (FGS), a research group including Forschungseinrichtung Satellitengeodäsie (FESG) and Institut für Astronomische und Physikalische Geodäsie (IAPG) of Technische Universität München, Deutsches Geodätisches Forschungsinstitut (DGFI), München, Bundesamt für Kartographie und Geodäsie (BKG), Frankfurt a. M., and Institut für Geodäsie und Geoinformation (IGG), Universität Bonn. The FGS focuses on research in satellite geodesy and geodynamics as well as on operation and development of the Observatory Wettzell, Germany. The three FGS institutions proposing to operate the BSC have a profound expertise in geodetic data analysis, modelling and scientific interpretation of results.

FESG is a research establishment of TUM installed to operate the geodetic observatory in Wettzell in close cooperation with the BKG. FESG is mainly involved in the operation of the 20m VLBI telescope and the large "G" ring-laser. FESG has expertise in global and regional GNSS data analysis for geodetic applications.

DGFI is a research institution associated with the German Geodetic Commission and in charge of various functions in IAG. H. Drewes, director of DGFI, is the IAG Secretary General and chair of the GGOS Working Group on Conventions, Analysis and Modelling. W. Bosch is the chairman of the Steering Committee of the International Altimetry Service (IAS). Within the IERS, DGFI holds an ITRS Combination Centre and IERS Combination Research Centre. In the ILRS, DGFI runs one of the two global data centres, an ILRS Analysis Centre and the backup ILRS Combination Centre. Within the IVS, DGFI is an Analysis Centre and, together with the BKG, a Combination Centre. In IGS, DGFI is the Regional Network Associate Analysis Centre for Latin America. The expertise of DGFI includes geodetic data analysis (GNSS, SLR, VLBI, altimetry, gravity field), combination of different space-geodetic techniques, modelling, and interpretation.

IAPG is involved in the upcoming GOCE gravity field mission of ESA and has profound expertise in gravity field recovery using CHAMP and GRACE data. R. Rummel, director of IAPG, is PI of the data analysis consortium for GOCE.

U. Hugentobler, the designated head of the BSC, is professor for satellite geodesy at the IAPG, coordinator of the FGS, and head of FESG. He is a member of the IGS Governing Board and IGS Executive Committee, of the IERS Conventions Advisory Committee, and of IAU. His expertise includes GNSS data analysis for precise global applications and orbit modelling. He was responsible for the maintenance and development of the Bernese GPS Software before taking over his current position in Munich.

D. Angermann, the designated secretary of the BSC, is a research scientist at DGFI with longstanding profound experience in the combination of space-geodetic techniques and in the realization of the terrestrial reference frame. He is the coordinator of the DGFI Research Field

"Observation of the System Earth", the chairman of the IERS Combination Research Centre at DGFI, and member of several Working Groups in the IERS.

Expertise at the proposing institutions includes all fields of geodesy. Mathematical and physical models for the different space-geodetic techniques were studied to assess and understand the effects related to standards and conventions. The software packages are continuously updated, and the state-of-the-art standards and conventions are implemented. At the proposing institutions, the various software packages are in use for processing the different observation techniques. The Bernese GPS software has been improved for a homogeneous re-processing of the global GPS data of IGS, which was done in cooperation with GFZ Potsdam and TU Dresden. Recent updates of the Bernese software allow also for the processing of SLR data including LEO's and for the processing of VLBI data. The DOGS-OC software for the processing of SLR data is continuously updated. Furthermore the OCCAM software for processing VLBI data is in use and various software packages for processing satellite altimetry data were developed. Software packages for analysis of satellite data for gravity field recovery and validation are available.

The proposing institutions gained also experiences from the participation in various projects, missions and international activities. Some examples are given below:

- GGOS-D is a project funded by the German Ministry for Research and Education in the Program "Geotechnologien". Major objectives are the generation of homogeneously processed time series for the different space-geodetic observation techniques and the generation of consistent, high-quality time series of parameters. Data were processed homogeneously by applying unified standards, which have been implemented in the different software packages (DOGS for SLR, OCCAM for VLBI and Bernese for GPS). The outcome of the project provides a valuable contribution to GGOS.
- Reprocessing of the historical GPS tracking data is currently underway within the IGS with significant involvement of FESG/IAPG. The effort requires the comparison and cross-checking of the implementation of conventions and standards in the software packages used at the different analysis centres. First reanalyses were conducted by FESG, GFZ and TU Dresden; further efforts are planned at FESG/IAPG, including GLONASS.
- IAPG is prime contractor to ESA for the generation of the official GOCE products that are a high-precision gravity field as well as precise satellite orbit information. A standards document was compiled under strict observance of IERS standards where available. The implementation of the standards into the software packages used by the partners in the data analysis consortium was extensively tested. E.g., correct implementation of standards concerning system transformations could be verified at the 10^{-12} level.
- Recently an IERS Working Group on the Combination at the Observation Level was setup, following the discussions at the Unified Analysis Workshop in Monterey in December 2007. DGFI and FESG/IAPG are involved in these activities and cooperate with GRGS to perform detailed comparisons of solutions, which include a crosscheck of the implementation of standards and conventions.

Work and schedule

In order to fulfil the overall demands of the GGOS Bureau for Standards and Conventions, the work will be divided into the following high-level tasks:

- The BSC will maintain regular contact with all internal and external institutions involved in the adoption of standards, resolutions and conventions. It will therefor take advantage of representations in IAG Services, IAG Commissions, IUGG and IAU, as well as in other bodies involved in standards and conventions (e.g., BIPM, ISO, CODATA). Already existing contacts to representatives of these organizations will facilitate these activities.
- The Bureau will be charged with the administrative tasks, communications, data base and

web support. For these tasks, a close cooperation with the GGOS Coordination Office and Portal will be established.

- The BSC will evaluate the geodetic standards and conventions currently in use by all the IAG Services for the generation of geodetic/geophysical products. It will review official products of IAG with respect to the correct use of standards and conventions.

  As a first task, the BSC will compile an inventory of standards and conventions that are in use at the different GGOS components, e.g., by comparing different software packages in use. It will identify inconsistencies and evaluate consequences for products. Results will eventually be converted into proposals for improvements. Dedicated working groups will be set up to perform specific tasks.

- The BSC will propagate all geodetic standards and conventions to geodetic and general scientific communities and urge their common use. This will be accomplished, e.g., by attendance at relevant conferences or by organizing dedicated workshops. If necessary, the BSC will propose the adoption of new standards and conventions, changes and revisions.

- The BSC will propagate most important standards to society in general and promote their use. These outreach activities may, e.g., include the participation at relevant conferences and meetings and submission of papers to journals in neighbouring fields. Care will be taken to be adequately represented in the web pages of the GGOS Portal.

- The BSC will report regularly to the GGOS Steering Committee and to the IAG Executive Committee, and – if necessary or appropriate – to the IUGG Executive Committee.

The initial activity of the newly installed BSC will be the preparation of a detailed Charter for approval by the Steering Committee. In the following the BSC will establish the contacts to the different GGOS components and external bodies and present itself and its tasks. This includes the setup of the BSC web pages within the GGOS Portal. Regular activities according to the Charter will start in parallel with these activities.

Team and responsibilities for the GGOS Bureau for Standards and Conventions

- Univ. Prof. Dr. phil. nat. U. Hugentobler (FESG): Designated Head of the GGOS Bureau for Standards and Conventions.
- Dr.-Ing. D. Angermann (DGFI): Designated Secretary of the GGOS Bureau for Standards and Conventions.
- Dr.-ir. J. Bouman (DGFI): Team member of the GOCE-Science team and research scientist for modelling and processing data from the gravity field missions.
- Dr. rer nat. M. Gerstl (DGFI): Research scientist with many-year experience in the modelling of the different space geodetic observation techniques and the implementation of the state-of-the-art standards and conventions in the DOGS software.
- Dr.-Ing. T. Gruber (IAPG): Chief scientist for the HPF data analysis project for the GOCE satellite. He has a long-time experience in modelling and processing of data from gravity field missions.
- Dr.-Ing. B. Richter (DGFI): Research scientist with expertise in the fields of earth rotation, transformation between celestial and terrestrial reference systems.
- Dipl.-Ing. P. Steigenberger (IAPG): Research scientist involved in re-processing the global GPS data. Specialist in models, conventions and standards relevant for space geodetic data analysis.

The three institutions sharing the responsibilities are all located in Munich, FESG and IAPG even in the same building. Distributing responsibilities was successful and generated synergies already for a number of projects over many years. In the near future the cooperation between these institutions will further strengthen by a consortium planned to be institutionalized in 2009.

The responsibilities for the operation of the GGOS BSC are structured in the following way:

- The Bureau will be headed by a director (U. Hugentobler).
- The Bureau will include a secretariat (chair: D. Angermann) to perform high-level administrative tasks, communications, data base and web support.
- The Bureau will include the expertise that is necessary to conduct Bureau business and provide guidance and oversight to the supporting entities. The responsibilities for the operation of the Bureau are distributed according to the major geodetic fields:
    - Geometry: Michael Gerstl, Peter Steigenberger
    - Earth orientation and celestial reference frame: Burghard Richter
    - Gravity field: Thomas Gruber, Johannes Bouman
- Dedicated working groups will be set up for specific issues dealing with particular fields of geodesy (geometry, gravimetry, or combined products).

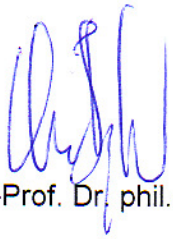
Interfaces with internal and external entities

- Since the BSC is essentially based on the IAG Services, it will include official representation from all relevant IAG Services. The BSC will establish a permanent contact with the IAG Services, the IAG Commissions, and the Inter-commissions Committee on Theory. This includes also a routine exchange of information and results, and regular meetings.
- In addition, a strong interface with the institutions in charge of standards and conventions will be set up, which comprise ISO, BIPM, and CODATA. Associate members will be included from these bodies and from neighbouring disciplines, in particular from other IUGG Associations and IAU.

Allocated resources

The proposing institutions will provide the funds required for the operation of the GGOS Bureau for Standards and Conventions. The proposers will have the expertise, capabilities and financial background to perform the proposed tasks. Personnel expenses for the team members will be provided by the proposing institutions. This holds also for the administrative and infrastructure support like consumables, telephone, and computer support as well as for computer resources. The tasks of the BSC will require the representation of the Bureau in various national and international meetings and conferences. Related travel costs will be provided by the proposing institutions. For specific issues dealing with particular fields it may be considered to request support and expertise from other entities.

Signatures



(Univ.-Prof. Dr. phil.nat. Urs Hugentobler, Head of FESG, Coordinator of FGS)

(Hon.-Prof. Dr-Ing. Hermann Drewes, Director of DGFI)

(Univ.-Prof. Dr.-Ing. Reinhard Rummel, Head of IAPG)