

Bureau of Products and Standards Implementation Plan 2017-2018

1.0 IMPLEMENTATION OVERVIEW

1.1 Introduction

The Bureau of Products and Standards (BPS) is a redefinition of the former Bureau for Standards and Conventions (BSC), which was established as a GGOS component in 2009. This redefinition is a consequence of a restructure of the GGOS organization in 2014. The work of the BPS is primarily focused on the IAG Services and the products they derive on an operational basis for Earth monitoring making use of various space geodetic observation techniques such as VLBI, SLR/LLR, GNSS, DORIS, altimetry, gravity satellite missions, gravimetry, etc. The Bureau is built upon existing observing and processing systems of IAG. It supports the IAG in its goal to obtain products of highest possible accuracy, consistency, and temporal and spatial resolution, which should refer to a consistent reference frame, stable over decades in time. To achieve this important goal, it is a fundamental requirement that common standards and conventions are used by all IAG components for the analysis of the different geometric and gravimetric observations. The BPS also concentrates on the integration of geometric and gravimetric parameters and the development of new products, required to address important geophysical questions and societal needs.

Charter of the Bureau of Products and Standards (BPS):

The main purpose of the BPS is to keep track of adopted geodetic standards and conventions across all IAG components as a fundamental basis for the generation of consistent geometric and gravimetric products. The work is primarily built on the IAG Service activities in the field of data analysis and combinations. The BPS shall act as contact and coordinating point regarding homogenization of standards and IAG products. The organization structure can be considered as a system of systems, where the IAG Services shall keep their full responsibility.

More specifically the charter of the BPS may be divided into two major topics/activities:

- (1) **Standards:** This includes the compilation of an inventory regarding standards, constants, resolutions and conventions adopted by IAG and its components and a regular update of such a document. Steps shall be initiated to close gaps and deficiencies in standards and conventions. Based on the recommendations given in this inventory priorities should be defined together with dedicated experts in the field. An action plan shall be compiled, including the definition of tasks, responsibilities and a time schedule. Finally, the BPS shall propose the adoption of new standards where necessary and propagate standards and conventions to the wider scientific community and promote their use.
- (2) **Products:** The BPS shall take over a coordinating role regarding the homogenization of standards and products. The present status regarding IAG Service products shall be

evaluated, including analysis and combination procedures, accuracy assessment with respect to GGOS requirements, documentation and metadata information for IAG products. The Bureau shall initiate steps to identify user needs and requirements for geodetic products and shall contribute to develop new and integrated products. It shall also contribute to the general GGOS goal that all relevant geodetic products for Earth sciences and applications shall be made accessible through the GGOS Portal including metadata and web services to increase visibility and enable searches in a most efficient way.

1.2 Goals and Objectives

The role of the Bureau is to provide a forum for the IAG Services and other entities involved in standards and products. In this context the BPS shall act as contact and coordinating point to share and discuss plans, progress and to develop and monitor multi-entity efforts to address GGOS requirements.

A primary goal of the BPS is to serve the goal 3 of GGOS as specified in the Terms of Reference **“Services, Standardization, and Support (internal and external coordination): Optimal coordination, support and utilization of IAG services, as well as leveraging existing IAG resources, are critical to the progress of all goals and objectives GGOS”**.

Primary objectives:

- (1) The BPS shall ensure that common standards and conventions are implemented and adopted by all IAG components as a fundamental basis for the generation of consistent IAG products.
- (2) The BPS shall act as contact and coordinating point for the IAG Services regarding homogenization of standards and products, whereas the IAG Services shall keep their full responsibility and visibility to manage their supporting data, products and information systems.
- (3) The BPS shall take over a coordinating role and shall define procedures to ensure an overall efficient use of resources. The primary focus of the BPS shall be on existing geodetic products and on the development of new products to meet the needs of both scientific users and society in general.

The BPS also contributes to various objectives of the GGOS goals 1 and 2 of the strategic plan (see Table 1.2.1). These objectives are under the major responsibility of other GGOS entities. Thus they are considered as secondary objectives of the BPS and they are addressed in the implementation plans of the respective GGOS entities.

Table 1.2-1: Bureau of Products and Standards (BPS): Goals and Objectives Mapping. The table identifies the primary (✓✓) and secondary (✓) Goals and Objectives that the BPS will be supporting to meet the outcomes stated in the GGOS strategic plan. Primary goals and objectives are those that are aligned with the charter of the GGOS Entity in question and are not likely to be realized without its involvement. Secondary goals and objectives are those that the given GGOS Entity can support as part of its charter.

| | Goal 1 – Geodetic Information and Expertise | | | Goal 2 – Global Geodetic Infrastructure | | Goal 3 - Services, Standardization, and Support | | Goal 4 - Communication, Education, and Outreach | |
|----------------------------|--|---|--|--|--|---|---|--|--|
| | <i>Objective 1-1 – Understand societal and scientific needs and deficiencies</i> | <i>Objective 1-2 – Position GGOS as the primary source for geodetic information and expertise</i> | <i>Objective 1-3 – Connect with the larger scientific community and integrate with other Earth observing</i> | <i>Objective 2-1 – Support and advocacy for infrastructure and associated elements</i> | <i>Objective 2-2 – Lead efforts for the integration of various ground observation networks within the GGOS network</i> | <i>Objective 3-1 – Standardization</i> | <i>Objective 3-2 – Coordination and Development of IAG Services</i> | <i>Objective 4-1 – Establish a Strong Internet/Online Presence</i> | <i>Objective 4-2 – Outreach to the Technical Community and General Society</i> |
| Coordinating Board | ✓✓ | ✓✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Consortium | ✓ | ✓ | ✓✓ | ✓ | ✓ | ✓ | ✓✓ | | ✓ |
| Coordinating Office | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓ | ✓✓ |
| Bureau of N&O | | | ✓ | ✓✓ | ✓✓ | ✓ | ✓ | | |
| Bureau of P&S | ✓ | ✓ | ✓ | ✓ | | ✓✓ | ✓✓ | | |
| Science Panel | ✓✓ | ✓ | ✓✓ | | | | ✓ | | ✓ |

1.3 BPS Authority, Governance Structure, Management Structure, and Implementation Approach

1.3.1 BPS Authority

The BPS shall take over the responsibility to define the policies and procedures for the management and coordination activities as well as for the other tasks specified in its charter. Beside the BPS staff, the Bureau also includes the chairs of the associated GGOS entities (see Section 1.3.3 and appendix D) as well as the nominated representatives of the IAG Services and other entities (see Tab. 1.3.1) to formulate the tasks and to design the necessary procedures in the field of standards and geodetic products.

The Bureau is authorized to conduct their management and coordination tasks as given in this implementation plan. This includes the specification of tasks and a time schedule for the activities of the BPS itself as well as for the associated GGOS entities. The BPS is also responsible to setup procedures to measure the progress of the work with respect to the implementation plan and to undertake actions to resolve potential deficiencies. The overall procedures for the operation of the Bureau activities including the interactions with the contributing components shall be managed in an efficient way to avoid an overload of bureaucracy.

Concerning other GGOS entities and the interactions between different components, the authorities and responsibilities should be defined in the overall GGOS framework and coordinated by the GGOS Coordinating Office. The GGOS Coordinating Board acts as central oversight and decision-making body. If actions and decisions have to be taken that involve outside GGOS entities such as the IAG Services, their respective governing bodies and for general issues also the IAG Executive Committee should be consulted prior to execution.

1.3.2 Governance Structure

Not Applicable

1.3.3 Management Structure

ALLOCATION AND DISTRIBUTION OF RESOURCES

The basic configuration of resources (man-power) for the BPS will be composed by the staff members of Deutsches Geodätisches Forschungsinstitut (DGFI-TUM), the Lehrstuhl für Astronomische und Physikalische Geodäsie (APG) and the Forschungseinrichtung Satellitengeodäsie (FESG) of the Technische Universität München, within the Forschungsgruppe Satellitengeodäsie (FGS). This consortium includes in addition the Bundesamt für Kartographie und Geodäsie (BKG), Frankfurt am Main, and the Institut für Geodäsie und Geoinformation (IGG) of the University Bonn.

Staff members of the BPS:

- Director: Detlef Angermann
- Co-Director: Thomas Gruber

Geodetic fields covered by the BPS team:

- Geometry, TRF, orbits: Detlef Angermann, Urs Hugentobler, Peter Steigenberger (as associated member)
- Earth orientation, CRF: Michael Gerstl, Robert Heinkelmann (as representative of IAU)
- Gravity, height systems: Thomas Gruber, Laura Sánchez

In its current structure the following GGOS entities are associated to the BPS:

- Committee “Earth System Modelling” (Chair: Maik Thomas),
- Working Group “ITRS Standards for ISO TC 211” (Chair: Claude Boucher)
- Joint Working Group “Establishment of the GGRF” (Chair: Urs Marti)

As defined in its charter, the BPS serves as contact and coordinating point for the IAG Analysis and Combination Services. The IAG Services and the other entities have chosen their representatives (e.g., Analysis Coordinator) as associated members of the BPS to support the Bureau business and to ensure the interaction between the different components.

The Bureau comprises the BPS staff members, the chairs of the associated GGOS entities and the representatives of the IAG Services and other entities involved in standards (see Tab. 1.3.1). The GGOS Committee on Earth System Modelling and the Working Groups on “ITRS Standards for ISO TC 211” and “Establishment of the Global Geodetic Reference Frame (GGRF) have formulated a charter and work plan which are included in this implementation plan (see appendix D).

OVERSEEING AND COORDINATING THE DAY-TO-DAY OPERATIONS

Together with the associated GGOS entities the BPS will develop a task plan and define/setup procedures to oversee and coordinate day-to-day operations. The staff members of the BPS will arrange face-to-face meetings on a very flexible basis due to short distances. Other communication tools are telecons, e-mails and phone calls to coordinate the day-to-day operations, the monitoring of the schedule as well as a redefinition of tasks and responsibilities in case of need.

REPORTING OF TECHNICAL AND/OR SCIENTIFIC PROGRESS AND CONFIGURATION MANAGEMENT

The reporting of technical and/or scientific progress against schedule, as well as alignment of this progress is part of the communication plan (see Table 1.3-2). The coordination and management among all GGOS entities is given in the implementation plan of the GGOS Coordinating Office.

Table 1.3-1: Resources of the BPS

| Position | Resource | Entity Contributing |
|---|--|--------------------------------|
| BPS Director, Co-Director | Detlef Angermann, Thomas Gruber | DGFI, APG (both TUM) |
| BPS Team Geometry, TRF, satellite orbits Earth rotation, CRF Gravity, height systems | D. Angermann, U. Hugentobler, P. Steigenberger (associated member) M. Gerstl, R. Heinkelmann (IAU Repr.) T. Gruber, L. Sánchez | TUM + GFZ, GSOC/DLR |
| Committee „Earth System Modeling“ | Chair: Maik Thomas | GFZ (Germany) |
| WG „ITRS Standards for ISO TC 211“ | Chair: Claude Boucher | France |
| JWG “Establishment of the GGRF” | Chair: Urs Marti | Swisstopo (Switzerland) |
| IERS Conventions Centre | Director: Gerard Pétit (retired, needs to be replaced) | BIPM (France) |
| IERS Analysis Coordinator | Tom Herring | MIT (USA) |
| IGS Representative | Urs Hugentobler (BPS staff member) | FESG/TUM (Germany) |
| ILRS Analysis Coordinator | Erricos Pavlis | UMBC/NASA (USA) |
| IVS Analysis Coordinator | John Gipson | GSFC/NASA (USA) |
| IDS Representatives | Frank Lemoine, John Ries, Jean-Michel Lemoine, Hugues Capdeville | GSFC, CSR (USA), CNES (France) |
| IGFS Chair | Riccardo Barzaghi | Politecnico, Milano (Italy) |
| BGI Chair | Sylvain Bonvalot | IRD (France) |
| ICCGEM Chair | Franz Barthelmes | GFZ (Germany) |
| Gravity community | Jürgen Kusche (Representative) | Univ. Bonn (Germany) |
| IAG Representative to ISO | Johannes Ihde (retired, needs to be replaced) | BKG (Germany) |
| IAG Communication and Outreach | Chair: Josef Ádám | University Budapest (Hungary) |
| IAU Representative | Robert Heinkelmann (BPS staff) | GFZ (Germany) |
| Chair of Control Body for ISO Geodetic Registry | Chair: Mike Craymer Vice-Chair: Larry Hothem | NRCan (Canada) USA |

Table 1.3-2: BPS Communications Plan. The table identifies the communications requirements of the BPS

| Communication Type | Purpose | Medium | Frequency | Audience | Owner | Deliverables |
|--|--|--------------------------|--------------------------------------|--|--------------|---|
| GGOS Consortium meeting | Interactions GGOS/IAG | Face-to-face | Annually | Consortium members | CB Chair | Presentations, report of GGOS entities, minutes |
| GGOS CB meeting | Review status, strategic issues | Face-to-face | Twice per year (EGU, GGOS Days) | Coordinating Board members and invitees | CB Chair | Reports of GGOS entities, minutes |
| GGOS EC telecons | Discussion of day-to-day business | Telecons | Monthly | GGOS EC members | CB Chair | Minutes, action items |
| Directors of Coordination Office, Bureaus, Science Panel | Manage day-to-day execution of Bureaus and Science Panel | Telecons | Quarterly, to be established | Directors of CO, Bureaus and Science Panel | CO Director | Progress reports, minutes, action items |
| BPS staff member meetings | Management of BPS day-to-day business | Face-to-Face in Munich | Every two months | BPS staff members | BPS Director | Minutes, action items |
| Reports of BPS and associated entities | Monitoring progress | n/a | To be defined (e.g., twice per year) | Bureau Board members and invitees | BPS Director | Progress reports, minutes, action items |
| BPS meetings | Manage BPS business | Face-to-face or telecons | Varying | Entity members and invitees | BPS Director | Reports, minutes, action items |

1.3.4 Implementation Approach

The Bureau comprises the BPS staff members, the chairs of the associated GGOS entities and the representatives of the IAG Services as well as other entities involved in standards. This configuration of the BPS ensures a close interaction among GGOS entities and IAG Services. A communication plan (see Tab. 1.3.2) has been defined and setup for a regular exchange of information, in particular regarding the homogenization of standards and IAG products. The implementation approach should consider interactions between existing components, such as the BPS and the IERS Conventions Centre regarding standards and conventions and with the IAG Services regarding IAG products. The interdependencies between these entities and the responsibilities should be clearly specified to ensure efficiency and straight forward approaches. The implementation approach of the BPS should also consider user needs and requirements for geodetic products as well as the development of new products, which will require novel combination approaches. For these activities the BPS should bring together the existing resources of IAG Services, and should also involve other GGOS entities (e.g., the Focus Areas and the Science Panel). Concerning the requirements regarding infrastructure (e.g., space geodetic networks) there will be a close cooperation with the GGOS Bureau of Networks and Observations (BNO).

At present, we do not see any dependency on outside resources or approvals and also make-or-buy decisions and trade studies are not relevant for the BPS.

1.4 Stakeholder Definition

The stakeholder definition and advocacy strategies are overall tasks of GGOS (see implementation plans of the GGOS Coordinating Board and the GGOS Coordinating Office).

Table 1.4-1: BPS Stakeholders and Advocacy Strategies

| STAKEHOLDERS | ADVOCACY STRATEGIES |
|--|--|
| INTERNAL STAKEHOLDERS | |
| GGOS Coordinating Board GGOS Coordinating Office GGOS Science Panel IAG Services | The advocacy strategies are specified in the implementation plans of the GGOS Coordinating Board and Coordinating Office (see also the communication plan given in Table 1.3-2). |
| EXTERNAL STAKEHOLDERS | |
| CEOS GEO Space Agencies United Nations Universities National Mapping and Geodetic Agencies IAU | The advocacy strategies are specified in the implementation plan of the GGOS Coordinating Board. |

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| ISO CODATA | |
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2.0 GGOS Bureau of Products and Standards BASELINES

PROJECT BASELINES CONSIST OF A SET OF REQUIREMENTS:

The work of the BPS fundamentally depends on a long-term stable and adequate geodetic infrastructure, comprising, e.g., global terrestrial networks of observatories, Earth observing satellites, data infrastructure, analysis and combination centers of the IAG Services, as well as the GGOS Portal as central access point to IAG products. Regarding the infra-structural issues there is a close interaction with the GGOS Bureau of Networks and Observations.

TECHNICAL OR SCIENTIFIC CONTENT THAT FORMS THE BPS:

The major contribution of the BPS is to support IAG in its goals to provide highly accurate and consistent geodetic products based on unified standards and conventions. The Bureau should address the user needs and requirements for geodetic products and should contribute to develop new products from an integration of geometric and gravimetric observations.

EXECUTION AND REPORTING:

The BPS will regularly measure the progress of the work with respect to the activities and the schedule defined in the implementation plan and will report to the other GGOS entities and to IAG as specified in the GGOS communications plan.

2.1 Requirements Baseline

The requirements addressed in this baseline are those requirements of a technical nature that will require a technical verification and validation. They represent “*the high level activities that GGOS together with the IAG must ensure*” (GGOS 2020, p. 224). Other activities pursued in support of meeting objectives and their overarching goals are presented as part of Section 2.2 (Schedule Baseline). Table 2.1-1 shows only those requirements that whose oversight has been allocated to the BPS—the totality of functional and operational requirements can be found in the Coordinating Board implementation plan. It also shows the allocation of those requirements to an IAG service or other entity. (These requirements may be rewritten at a later stage to ensure they meet requirement definition standards.)

There are the following general requirements:

- The BPS activities strongly depend on a stable geodetic infrastructure, including global terrestrial networks of observatories (Bureau of Networks and Observations), data infrastructure, analyses and combination centers providing IAG Service products.
- The interactions among GGOS entities and IAG Services and the responsibility of the different components need to be clearly specified.

- The Science Panel should support the BPS to assess the user requirements regarding existing products and the need for new products.
- The GGOS Portal should be the access point for GGOS products.

Table 2.1-1: BPS Requirement Allocation

The Requirements concerning gravity field related products need to be updated. This will be done in cooperation with the GGOS Committee on Satellite Missions (Chair: Jürgen Müller)

| REQUIREMENT REFERENCE | REQUIREMENT AND INTERPRETATION | GGOS ALLOCATION | IAG SERVICE (OR OTHER ENTITY) ALLOCATION |
|---|---|-----------------|--|
| Functional Specifications for GGOS | | | |
| Determination, maintenance, and access to the global terrestrial reference frame | | | |
| ITRF-001-DER | Provision of the reference frame through a dynamic Earth reference model — The terrestrial reference frame will be provided by an operational dynamical Earth reference model which will assimilate observations of variations in the Earth's geometry (in particular, for a reference polyhedron), the shape of the ice and ocean surfaces, the gravity field, and Earth rotation. Moreover, the reference model will also assimilate auxiliary observations, in particular meteorological observations. This dynamic Earth reference model will allow the prediction of reference trajectories for any point on Earth with temporal resolution of 1 hour and a sub-kilometer spatial resolution. The stability of the model in terms of geokinematic will be that of the reference polyhedron, i.e., sub-millimeter per year. | Bureau of P&S | IERS |
| ITRF-002-ORI | Tie between RFO and CM — The deviation between the reference frame origin of the terrestrial reference frame and the center of mass of the Earth system will be smaller than 1 mm at any time. | Bureau of P&S | IERS |
| ITRF-003-PRE | Precision of reference coordinates — The precision of coordinates of the points of the reference polyhedron of the ITRF will be better than 1 mm in the horizontal and 3 mm in the | Bureau of P&S | IERS |

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|--|---|---------------|------------|
| | vertical component at any time. | | |
| ITRF-004-SCA | Scale of the reference frame — The scale of the reference frame will be accurate to 0.1 ppb and stable to 0.01 ppb/yr. | Bureau of P&S | IERS |
| Earth rotation | | | |
| ERP-001-EOP | Earth Orientation Parameter — Earth Orientation Parameters will be determined with an accuracy of 1 mm, a temporal resolution of 1 hour, and a latency of 1 week; near real-time determinations of the Earth Orientation Parameters will be determined with an accuracy of 3 mm. | Bureau of P&S | IERS |
| Earth's gravity field | | | |
| GRAV-001-GEOID | Accuracy of the static geoid — The static geoid will be provided with an accuracy of 1 mm, a long-term stability of 0.1 mm/yr and a spatial resolution of 10 km. | Bureau of P&S | IAG: IGeS |
| GRAV-002-VAR | Accuracy of the time variable gravity field — The time variable geoid will be provided with an accuracy of 1 mm, a long-term stability of 0.1 mm/yr, a spatial resolution of 50 km, a temporal resolution of 10 days, and a latency of 0.5 months. | Bureau of P&S | IAG: IGFS |
| Earth system monitoring: mass transport and mass redistribution | | | |
| ESM-001-SSH | Sea surface height variations — The sea surface height variations will be determined globally with an instantaneous local accuracy of 10 mm, a temporal resolution of 10 days, a spatial resolution of 10 km, a latency of 5 days, and a local secular accuracy of 0.5 mm/yr. | Bureau of P&S | IAG: PSMSL |
| ESM-001-GSL | Global sea surface changes — The globally average sea surface height changes will be determined with an instantaneous accuracy of 1 mm, a temporal resolution of 10 days, a latency of 10 days, and a secular accuracy of 0.1 mm/yr. 224 Gross et al. | Bureau of P&S | IAG: PSMSL |
| ESM-002-CRY | Cryosphere mass balance — The variations in the surface elevation for the large ice sheets will be determined with an instantaneous local accuracy of 20 mm, a temporal resolution of 10 days, a spatial resolution of 10 km, a latency of 20 days, and a local secular accuracy of 0.2 mm/yr. | Bureau of P&S | IAG: PSMSL |
| ESM-003-WCY | Mass transport in the global water cycle — The mass transport in atmosphere, ocean, cryosphere, and terrestrial hydrosphere will be determined to an accuracy of an equivalent of 10 mm water cover with a temporal resolution of 10 days, a spatial resolution of 400 km, and a latency of 0.5 months. | Bureau of P&S | IAG: PSMSL |
| Determination, maintenance, and access to the celestial reference frame | | | |
| ICRF-001- | Determination of the Celestial Reference Frame — The ICRF will be defined by the coordinates of | Bureau of P&S | IERS |

| | | | |
|--|--|---------------|---|
| DET | a number of extragalactic radio sources distributed throughout the sky. The coordinates of the ICRF sources will be accurate to 25 microarcseconds and stable to 3 microarcseconds/yr. | | |
| Operational Specifications for GGOS | | | |
| GGOS-Ops-5 | Operate a dynamic Earth reference model assimilating comprehensive observations of variations in Earth's geometry, gravity field and rotation. | Bureau of P&S | TBD |
| GGOS-Ops-6 | Document the procedures, standards, and conventions used to generate the products. | Bureau of P&S | None |
| GGOS-Ops-8 | Ensure continuity, accuracy, and consistency of observations and products as the networks and data reduction procedures evolve. | Bureau of P&S | Individual GGOS sub- networks IAG Services |

2.2 Schedule Baseline

The charter and the general objectives of the BPS are provided in Sect. 1.1 and 1.2. The scheduled activities of the GGOS Bureau of Products and Standards are given in Tab. 2.2-1. They include the communication among GGOS entities, the coordination of the Bureau business and the reporting as well as the monitoring of progress.

Table 2.2-1: Schedule of BPS activities

| | 2017 | | | | | | | | | | | | 2018 | | | | | | | | | | | | | | |
|---|------|---|---|---|---|---|---|---|---|---|---|---|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <i>GGOS communications with BPS participation</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Coordinating Board meetings | | | | X | | | | | | | | X | | | | | | | X | | | | | | | | X |
| Consortium meetings | | | | | | | | | | | | X | | | | | | | | | | | | | | X | |
| EC telecons (monthly) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| CO/BNO/BPS/SP (quarterly) | X | | | X | | | | X | | | | | X | | | | X | | | | X | | | | X | | |
| Reporting (1-page reports) | | | | X | | | | | | X | | | | | | X | | | | | | | | X | | | |
| <i>Operational BPS bureau business</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Internal BPS meetings | X | | X | | X | | X | | X | | X | | X | | X | | X | | X | | X | | X | | X | | |
| BPS Board meetings | | | | X | | | | | | X | | | | | X | | | | | | X | | | | X | | |
| Reporting of BPS entities | | | | X | | | | | | X | | | | | X | | | | | | X | | | | X | | |
| Monitoring progress | | | | X | | | | | | X | | | | | X | | | | | | X | | | | X | | |

Specific tasks of the BPS:

- The Bureau should continue the work regarding standards and conventions of the former BSC (long-term activity).
- The document “Inventory on standards and conventions used for the generation of IAG products” has been published in the IAG Geodesist`s Handbook 2016 (done).
- This document is also available on the GGOS website and should be updated regularly (ongoing).
- The BPS should propose procedures how to proceed with the recommendations given in this inventory. In this context the BPS proposes to generate a summary (1-2 pages) for each topic/product and to contact responsible scientists/services how to deal with the recommendations (June 2017).
- Based on the outcome, an action plan should be compiled (together with the representatives of the IAG Services), including a task description, specification of responsibilities and a time schedule (December 2017).

- The present status regarding IAG Service products and related metadata information should be evaluated, gaps and deficiencies should be identified and recommendations should be provided. The work requires a close interaction between the BPS and the IAG Services as well as with the GGOS Portal. It is essential that well-defined procedures are defined to ensure effectiveness (ongoing).
- As specified in Section 2.1, the GGOS requirements concerning geodetic products (see Table 2.1-1) are allocated to the BPS. In cooperation with the responsible IAG Services the accuracy requirements given in the GGOS 2020 document should be evaluated and should be updated in case of need. This activity will be supported by the GGOS Committee on "Satellite Missions".
- If the current accuracy does not satisfy the user requirements, appropriate procedures and methods should be set up to improve the accuracy of the products. This task requires an optimal coordination, support and utilization of IAG Services, as well as leveraging existing IAG resources.
- The BPS should initiate steps to identify the user needs and requirements for products that are currently not provided by the IAG Services, required to address important geophysical questions and user needs. This task should be supported by the Science Panel and the Focus Areas.
- The BPS should work towards the development of new products derived from a combination of geometric and gravimetric observations. If such integrated products should be routinely provided, the establishment of new analysis and/or combination centers may become necessary.
- The BPS proposes to strengthen its role w.r.t. ISO/TC 211. The BPS acted as a proposer for the "New Work Item Proposal" ISO/TC 211: Revision of ISO 19111 "Geospatial Information – Spatial references by coordinates".
- The BPS will continue the cooperation with the IAU concerning standards and conventions. A link has been established with the IAU Commission A3 "Fundamental Standards" and IAU's Standards and Fundamental Astronomy (SOFA) service.
- The director of the BPS has been nominated by the IAG Executive Committee as the IAG Representative to the United Nations Global Geospatial Information Management (UN-GGIM) Working Group for a Global Geodetic Reference Frame (GGRF), Key Area: "Data Sharing and Development of Geodetic Standards". Thus, the BPS will be involved in the definition and establishment of the GGRF.

2.3 Resources

The work force requirement for the activities of the BPS is estimated to be in the order of about one full-time position per calendar year, composed by the seven BPS staff members of DGFI-TUM, APG, FESG, GFZ and GSOC/DLR (see sect. 1.3.3) and by other representatives of the BPS (e.g., Committee and WG chairs, associated members).

Infrastructure requirements, including computer servers and other supporting technologies (e.g., for tele- or videoconferences) will be provided by the host institutions.

3.0 CHANGE LOG

Table 3-1: GGOS Bureau of Products and Standards Implementation Plan Change Log

| VERSION | RELEASE DATE | SYNOPSIS OF RELEASE |
|---------|--------------|---|
| X.Y | [YYMMDD] | [Synopsis goes here] |
| 1.0 | 140801 | First draft version |
| 2.0 | 150326 | Second draft version for review of GGOS CB in Vienna (April 2015) |
| 3.0 | 150528 | Revised version (May 2015) |
| 4.0 | 161019 | Implementation Plan 2017-2018, first draft version, discussed during GGOS days 2016 |
| 5.0 | 170224 | Implementation Plan 2017-2018, second draft |
| 6.0 | 170315 | Revised version |

4.0 APPENDICES

Appendix A Abbreviation

| | |
|----------|---|
| APG | Lehrstuhl für Astronomische und Physikalische Geodäsie, TU München |
| BKG | Bundesamt für Kartographie und Geodäsie, Frankfurt/Main |
| BNO | Bureau of Networks and Observations |
| BPS | Bureau of Products and Standards |
| BSC | Bureau for Standards and Conventions |
| CB | Coordinating Board |
| CEOS | Committee on Earth Observations Satellites |
| CO | Coordinating Office |
| CODATA | Committee on Data for Science and Technology |
| CNES | Center National d'Etudes Spatiales |
| CRF | Celestial Reference Frame |
| DGFI-TUM | Deutsches Geodätisches Forschungsinstitut der Technischen Universität München |
| DLR | Deutsches Zentrum für Luft- und Raumfahrt |
| DORIS | Doppler Orbitography and Radiopositioning Integrated by Satellite |
| EC | Executive Committee |
| EOP | Earth Orientation Parameter |
| FESG | Forschungseinrichtung Satellitengeodäsie, Technische Universität München |
| FGS | Forschungsgruppe Satellitengeodäsie |
| GEO | Group on Earth Observation |
| GEOSS | Global Earth Observation System of Systems |
| GFZ | Deutsches GeoForschungsZentrum Potsdam |
| GIAC | GGOS Interagency Committee |
| GGIM | Global Spatial Information Management |
| GGOS | Global Geodetic Observing System |
| GGRF | Global Geodetic Reference Frame |
| GNSS | Global Navigation Satellite System |
| IAG | International Association of Geodesy |
| IAU | International Astronomical Union |
| ICRF | International Celestial Reference Frame |
| IDS | International DORIS Service |
| IERS | International Earth Rotation and Reference Systems Service |
| IGFS | International Gravity Field Service |
| IGG | Institut für Geodäsie und Geoinformation, Universität Bonn |
| IGS | International GNSS Service |
| ILRS | International Laser Ranging Service |
| ISO | International Organization for Standardization |

| | |
|------|---|
| ITRF | International Terrestrial Reference Frame |
| IVS | International VLBI Service for Geodesy and Astrometry |
| LLR | Lunar Laser Ranging |
| SLR | Satellite Laser Ranging |
| TRF | Terrestrial Reference Frame |
| UN | United Nations |
| VLBI | Very Long Baseline Interferometry |
| WG | Working Group |

Appendix B Glossary

Table B-1: Terms and Definitions

| TERM | DEFINITION |
|------------------|------------------------|
| [Term goes here] | [Definition goes here] |

Appendix C References

ANGERMANN D., GRUBER T., GERSTL M., HEINKELMANN R., HUGENTOBLE, U., SÁNCHEZ L., STEIGENBERGER P.: GGOS BUREAU OF PRODUCTS AND STANDARDS: INVENTORY OF STANDARDS AND CONVENTIONS USED FOR THE GENERATION OF IAG PRODUCTS. THE IAG GEODESIST'S HANDBOOK 2016, J GEOD 90(10): 1095-1156, DOI:10.1007/s00190-016-0948-z, 2016.

PLAG, H.P AND M. PEARLMAN (EDITORS): GLOBAL GEODETIC OBSERVING SYSTEM – MEETING REQUIREMENTS OF A GLOBAL GEODETIC SOCIETY ON A CHANGING PLANET IN 2020, SPRINGER 2009, DOI: 10.1007/s10291-007-0067-7.

Appendix D GGOS Entities associated to the BPS

D.1. GGOS Committee "Contributions to Earth System Modelling"

(Maik Thomas)

Purpose

The GGOS Committee "Contributions to Earth System Modelling" aims to promote the development of a consistently coupled Earth system model that can be applied for the analysis and forward simulation of all geodetic parameter types (Earth rotation, gravity and surface geometry) and observation techniques in order to contribute to:

- the interpretation of geodetic monitoring data by revealing underlying physical processes;
- the establishment of a link between the global time series of geodetic parameters delivered by GGOS and relevant process models;
- the consistent integration of observed geodetic parameters derived from various observation techniques and sensors;
- the preparation of geodetic products for the interdisciplinary utilization of geodetic observations.

Objectives

The overall goal is the development of a comprehensive numerical Earth system model for the homogeneous processing, interpretation and prediction of geodetic parameters with interfaces allowing the introduction of constraints provided by geodetic time series of global surface processes, rotation parameters and gravity variations. This ultimate goal implicates the following mid- and long-term objectives:

- development of a physically consistent modular dynamic Earth system model accounting for the relationship between surface deformation, Earth rotation and gravity field variations as well as the interactions and physical fluxes between all relevant sub-systems;
- promotion of homogeneous processing strategies (e.g., de-aliasing, reduction) in order to allow consistent and thereby improved analyses of geodetic observations;
- contributions to the interpretation of geodetic parameters derived from different observation techniques by developing model based strategies to separate underlying physical processes;
- application of forward modelling and inversion methods in order to predict geodetic quantities and to invert geodetic observations for the underlying causative processes;
- development and implementation of coupling algorithms to ensure consistent interactions and physical fluxes among sub-systems;
- contributions to the integration of geodetic observations based on different techniques by introducing data assimilation techniques into process models in order to provide a tool for validation and consistency tests of various geodetic products.

Current action items

- Development of a strategy for the consistent consideration of processes related to mass loading and self-attraction;
- implementation of various data assimilation algorithms into (stand-alone) process models and corresponding sensitivity analyses;
- feasibility studies for the provision of uncertainties and error estimates of model predictions of geodetic quantities by means of ensemble simulations;
- preparation of level 2 and 3 products for the interdisciplinary scientific community.

Appendix D GGOS Entities associated to the BPS

D.2. GGOS Working Group "ITRS Standards for ISO TC 211"

(Claude Boucher)

Background

This group was initially established to investigate the strategy to obtain the adoption by the International Standardization Organization (ISO) of a standardization document related to ITRS.

Following the initial work done by the group, a proposal was submitted to ISO by France. This proposal was a New Work Item Proposal (NWIP) related to ITRS submitted to the ISO TC 211 on Geographical information/Geomatics, to which IAG is a liaison. A new NWIP on ITRS has been officially re-submitted by France to ISO TC211 which is presently under the formal approval channel.

ISO finally decided that a preliminary study demonstrating the importance of geodetic references at large was necessary before going further in the direction of the initial proposal. A project (19161) was therefore established within ISO TC211 WG4 and chaired by Claude Boucher. The project report was finalized in January 2015, reviewed and finally submitted to WG4 for approval and decision of further actions.

The report ends with some recommendations:

- To develop a standard related to ITRS
- To make further studies about the interest and feasibility of a standard on vertical references
- To make similar action for universal identification of geodetic stations
- To work to improve geodetic terminology, including update of existing standards

As an implementation of those recommendations, a proposal to develop a standard related to ITRS was proposed by France in mid 2015, formally circulated in January 2016 for approval by TC211, under the reference 19161_1.

Mission

The mission of the WG is to coordinate the IAG community in the support of the development of the ISO standard on ITRS.

Objectives

In order to ensure this support, some specific objectives have been identified (this list may be updated if needed):

1. To establish the list of IAG contributors to the work of the WG
2. To collect comments and proposals on any draft documents provided by the ISO TC211/19161
3. To establish a glossary of geodetic terms in relation with the scope of the WG

The work will be ensured mostly by mail.

Appendix D GGOS Entities associated to the BPS

D.3. Joint Working Group "Establishment of the Global Geodetic Reference Frame (GGRF)"

(Urs Marti)

Purpose

The United Nations General Assembly adopted the resolution on a Global Geodetic Reference Frame for Sustainable Development (A/RES/69/266) on February 26, 2015. UN-GGIM (Global Geospatial Information Management) established a working group on the Global Geodetic Reference Frame (GGRF). One of its main objectives is to develop a roadmap for a collaborative global geodetic observation network and the associated infrastructure, with sustainable funding and investment, as well as strategic partnerships between mapping, space and other interested agencies (see http://ggim.un.org/UN_GGIM_wg1.html)

Besides the UN resolution, there exist the following two IAG resolutions adopted at the IUGG General Assembly 2015 in Prague:

- Resolution 1 for the definition and realization of an International Height Reference System (IHRS)
- Resolution 2 for the establishment of a Global Absolute Gravity Reference System

IAG, as the responsible scientific organization for the establishment and maintenance of global reference systems and reference frames initiated a joint working group (JWG) for the realization of this UN resolution under the umbrella of the Bureau of Products and Standards (BPS) of the Global Geodetic Observing System (GGOS). This JWG works together with representatives of IAG Commissions 1 and 2, the Inter-Commission-Committee on Theory (ICCT) the International Earth Rotation and Reference Systems Service (IERS) and the International Gravity Field Service (IGFS). It should act as an extension of the UN-GGIM WG and focus more on the technical details and the integration of geometrical and physical (height, gravity) observation networks.

A preparatory paper "Description of the Global Geodetic Reference Frame" has been prepared and accepted by the IAG EC which explains the details of the components of a GGRF (http://iag.dgfi.tum.de/fileadmin/IAG-docs/GGRF_description_by_the_IAG_V2.pdf).

This JWG will work on the establishment and coordination of the geometric reference frame, the global height system, the global gravity network and their temporal changes. The application of Earth orientation parameters and tidal models and the underlying standard and reference models has to be brought into consistency.

Objectives and activities

Main objectives and activities of the Working Group are:

- Assist the UN-GGIM WG in establishing the GGRF
- Assist GGOS in defining the fundamental network and observing systems for the realization of the global geometric reference frame
- Assist the working group for establishing the International Height Reference System (IHRS) in the realization
- Integrating and combining the new global gravity network with other techniques
- Advance the realization of a conventional global reference gravity field model

- Study the influence of earth orientation parameters, tidal models and loading effects on the realization of a consistent global reference frame in geometry, height and gravity
- Form the basis of a new “best estimate” global reference system and study the necessity to replace / update GRS80 in collaboration with IERS, IUGG and IAU.
- Foster the free exchange of geodetic data and products
- Organize and assist sessions and symposia on the global reference frame at conferences
- Development of a roadmap for the definition and realization of a Global Geodetic Reference System