GGOS Focus Area 1: Unified Height System, and JWG 0.1.2: Strategy for the Realization of the International Height Reference System (IHRS)

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Present Status and Progress

The objectives and planned activities of the GGOS-FA1 are described in the Geodesist’s Handbook 2016 (Drewes, H., et al., 2016, J Geod 90(10): 1091, doi:10.1007/s00190-016-0948-z). The main goal at present is the implementation of the International Height Reference System (IHRS) defined by the IAG 2015 Resolution No. 1 (ibid. page 981); especially, the establishment of the International Height Reference Frame (IHRF). The corresponding activities are being conducted by the joint working group (JWG) Strategy for the Realization of the IHRS. It is supported by the International Gravity Field Service (IGFS), the IAG Commissions 1 and 2 (Reference Frames and Gravity field), the Intercommission Committee on Theory (ICCT), the regional sub-commissions for reference frames and geoid modelling, and both GGOS Bureaus (Networks and Observations and Products and Standards). The progress is summarized as follows:

• During the GGOS Days 2016 (Boston (MA), USA, October 2016), a preliminary station selection for the IHRF was performed. This selection is based on a global network with worldwide distribution, including a core network (to ensure sustainability and long-term stability of the reference frame) and regional/national densifications (to provide local accessibility to the global frame).

• Based on this preliminary station selection, regional and national experts were asked to evaluate whether the preliminary selected sites are suitable to be included in the IHRF (availability of gravity data or possibilities to survey them), and to propose additional geodetic sites to improve the density and distribution of the IHRF stations in their regions/countries.

• After the feedback from the regional/national experts, the first approximation to the IHRF is based on about 170 reference stations (Fig. 1).

• A web site summarizing the main characteristics of the GGOS-FA “Unified Height System” has been prepared and is now available at http://ihrs.dgfi.tum.de/. This information is also mirrored at http://www.ggos.org.

Fig. 1. Proposed IHRF stations as of April 2017.
Ongoing activities and planned actions for 2018

- With the preliminary IHRF station selection, next efforts concentrate on the computation of the station potential values and the assessment of their accuracy. Different approaches are being evaluated:
  - As national/regional experts provided the JWG with terrestrial gravity data around some IHRF sites, a direct computation of potential values (and their accuracy) is being performed. In this case, following experiments are being conducted:
    - simulations about the distribution and quantity of gravity points needed around the IHRF stations,
    - simulations about the variation of potential values with time,
    - comparison of different mathematical formulations (least-squares collocation, FFT, radial basis functions, etc.).
  - Computation of potential values (and their accuracy) by national/regional experts responsible for the geoid modelling using their own data and.
  - Computation of potential values (and their accuracy) based on global gravity models of high-degree (like XGM2016, EIGEN-6C, EGM2008, etc.).
  - Recovering potential values from existing local quasi-geoid models.
  - This activity is strongly supported by:
    - IAG SC 2.2: Methodology for geoid and physical height systems (chair: Jonas Ågren)
    - ICCT JSG 0.15: Regional geoid/quasi-geoid modelling - Theoretical framework for the sub-centimetre accuracy (chair: Jianliang Huang)
    - JWG 2.2.2: The 1 cm geoid experiment (chair: Yan Ming Wang)
    - Jaakko Mäkinen – tide system issues for the IHRF

- The comparison of the results obtained from these different approaches will provide a basis to outline further steps; especially, the identification of detailed standards and conventions for the IHRS realization and the implementation of a roadmap based on the available geodetic data.