

Focus Area “Unified Height System” and JWG 0.1.2 “Strategy for the Realization of the International Height Reference System (IHRF)”

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Activities

The objectives and planned activities of the GGOS-FA “Unified Height System” 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 (IHRF) defined by the IAG 2015 Resolution No. 1 (ibid. page 981). The progress is summarized as follows:

- In December 2015, the joint working group (JWG) *Strategy for the Realization of the IHRF* was installed with the objective of developing an appropriate scheme for the realization of the IHRF; i.e., the establishment of the International Height Reference Frame (IHRF). This JWG is supported by the International Gravity Field Service (IGFS), the IAG Commissions 1 and 2 (Reference Frames and Gravity field), the Inter-commission 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).
- A brainstorming and definition of action items took place at a JWG meeting carried out during the International Symposium on Gravity, Geoid and Height Systems 2016 (GGHS2016) in Thessaloniki (Greece) in September 2016. This JWG meeting was attended by 70 colleagues and allowed us to identify the activities to be faced immediately. A main output of this meeting are the criteria for the selection of IHRF reference stations:
 - collocation with fundamental geodetic observatories to ensure a consistent connection between geometric coordinates, potential and gravity values, and reference clocks (to support the implementation of the GGRF);
 - continuously operating reference stations to detect deformations of the reference frame;
 - preference of stations belonging to the ITRF and the regional reference frames (like SIRGAS, EPN, APREF, etc.);
 - collocation of GNSS stations with reference tide gauges and connection to the national levelling networks to facilitate the vertical datum unification;
 - availability of terrestrial gravity data around the IHRF reference stations as main requirement for high-resolution gravity field modelling (i.e., precise estimation of potential values).

- 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 the conclusions of the meetings in Thessaloniki and Boston, 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).
- With this preliminary 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.
- 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 IHRF realization and the implementation of a roadmap based on the available geodetic data.
- 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.ggosdays.com/en/focus-areas/unified-height-system/>.

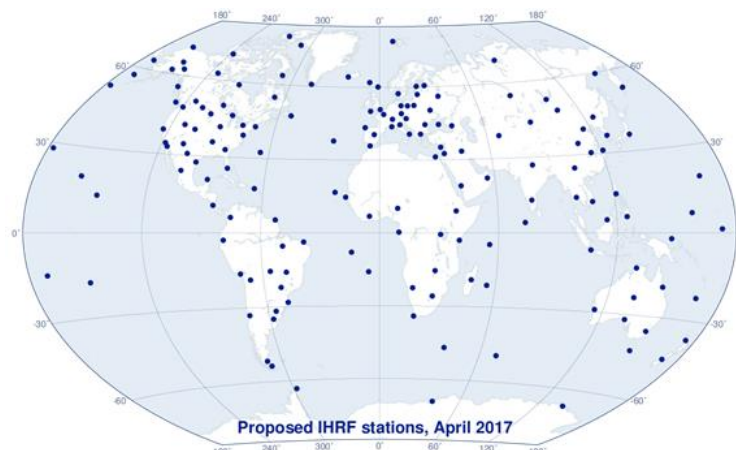


Fig. 1. Proposed IHRF stations as of April 2017.

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