

## STATUS REPORT 15-09-2019

### GGOS Focus Area Unified Height System (FA-UHS), and JWG 0.1.2: Strategy for the Realization of the International Height Reference System (IHRF)

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## Present Status and Progress

The objectives and planned activities of the FA-UHS 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); especially, the establishment of the International Height Reference Frame (IHRF). The corresponding activities were coordinated for the term 2015-2019 by the joint working group (JWG) *Strategy for the Realization of the IHRF*. It was 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). The progress is summarized as follows:

- Sep. 2016 (first meeting of the WG at GGHS2016, Thessaloniki): Brainstorming and definition of action items; criteria for the selection of IHRF stations.
- Oct. 2016 (GGOS Days 2016, Cambridge, MA): Preliminary station selection for the IHRF.
- Nov. 2016 – Mar. 2017: Interaction with regional/national experts about the preliminary station selection and proposal for further geodetic sites.
- Apr. 2017 (EGU2017, Vienna): First proposal for the IHRF reference network.
- Since May 2017: Numerical experiments for the computation of potential values at the IHRF stations.
- Aug 2017 (IAG General Assembly, Kobe) The *Colorado experiment* is initiated. Main objective is the computation of geoid undulation, height anomalies and potential values using exactly the same input data, a set of basic standards, and the own methodologies (software) of colleagues involved in the gravity field modelling, to ascertain the magnitude of the disagreement between different processing approaches. This experiment is supported by
  - GGOS JWG: Strategy for the realisation of the IHRF (chair: L Sánchez)
  - IAG JWG 2.2.2: The 1 cm geoid experiment (chair: YM Wang)
  - IAG SC 2.2: Methodology for geoid and physical height systems (chair: J Ågren)
  - ICCT JSG 0.15: Regional geoid/quasi-geoid modelling - Theoretical framework for the sub-centimetre accuracy (chair: J Huang).
- Dec 2017 - Jan 2018: Preparation of a set of basic (minimum) standards for the data processing (L Sánchez, J Ågren, J Huang, YM Wang, R Forsberg).
- Feb 2018: Distribution of the Colorado data (YM Wang, NGS-NOAA).
- Feb - Aug 2018: First computations with 10 contributing groups.
- Sep 2018 (GGHS2019 Symposium, Copenhagen): Comparison of preliminary results.
- Nov - Dec 2018: Refinement of the basic standards for the data processing (L Sánchez, J. Ågren, J. Huang, YM Wang, R. Forsberg).
- Jan - June 2019: Refined computations for the Colorado experiment with 14 contributing groups.
- July 2019 (IUGG General Assembly, Montreal): Comparison of results to identify sources of discrepancy between the delivered solutions.

## Planned Actions and Milestones

The results of the Colorado experiment will be published in a Special Issue of the Journal of Geodesy. It will contain the state-of-the-art in the modelling of the Earth's gravity field for the precise determination of physical heights and associated reference surfaces. A new joint working group chaired by the GGOS-FA-UHS will be established for the term 2019-2023 to continue the activities required for a first solution for the IHRF. Aim of this first solution is to evaluate the achievable accuracy under the present conditions (data availability, computation methods, etc.) and to identify key actions to improve the determination of the IHRF/IHRF coordinates. In addition, this working group should investigate the best way to establish an IHRF/IHRF element within the IGFS to ensure the maintenance and availability of the IHRF. This implies regular updates of the IHRF to take account for new stations, coordinate changes with time, improvements in the estimation of coordinates (more observations, better standards, better models, better computation algorithms, etc.), geodetic products associated to the IHRF (description and metadata), and the organizational and operational infrastructure to ensure the IHRF sustainability.