

## Theme 1: Unified Height System

Chair: Michael G. Sideris (Canada)

### Present Status and Progress

- **Joint Working Group 0.1.1: Vertical Datum Standardisation**
  - Global  $W_o$  computations by four different groups delivered very close results (around  $62\,636\,854\text{ m}^2\text{s}^{-2}$ ), but there are still differences of about  $0.5\text{ m}^2\text{s}^{-2}$  ( $\sim 5\text{ cm}$ ). It is necessary to start defining the standards and conventions for a formal recommendation on  $W_o$
  - Web site: <http://whs.dgfi.badw.de>
- **ESA project STSE – GOCE+: Height System Unification with GOCE**
  - Unification of North American, European and North Atlantic Datum
  - Studies of regional  $W_o$  determination, datum offsets estimation, GOCE and other EGM contributions, effects of: local data/omission errors, data biases and noise, ocean models, EGM truncation, benchmark/tide gauge spacing and distribution
  - Results published online in Special Issue on Regional and Global Geoid-based Vertical Datums of the *Journal of Geodetic Science*, Issue 4 (Dec. 2012), pp. 246 - 376, <http://www.degruyter.com/view/j/jogs.2012.2.issue-4/issue-files/jogs.2012.2.issue-4.xml>
  - Web site: [www.goceplushsu.eu](http://www.goceplushsu.eu)
- **Canada (GSD), Mexico (INEGI), USA (NGS) - NA vertical datum unification plans**
  - Selected the  $W_o$  in the ERS Conventions (based on tide gauge fit in NA)
  - Implementation:
    - Canada: will adopt geoid-based datum this November
    - USA: will adopt geoid-based datum in 2022
  - Web sites: [www.ngs.noaa.gov/heightmod/](http://www.ngs.noaa.gov/heightmod/) & [www.nrcan.gc.ca/earth-sciences/geography-boundary/spatial-referencing/height-reference-system/modernization/5664](http://www.nrcan.gc.ca/earth-sciences/geography-boundary/spatial-referencing/height-reference-system/modernization/5664)

### Planned Actions and Milestones

- **Joint Working Group 0.1.1: Vertical Datum Standardisation**
  - Formal recommendation of adoption of a new global  $W_o$  value by the IAG based on additional studies of
    - Combination of a “geodetic” sea surface model and an “oceanographic” DOT model to reproduce a sea surface closer to an equipotential surface (geoid)
    - Integration of polar regions on the Earth’s surface representation
    - Differences between  $W_o$  values obtained from a long-term mean sea surface model and yearly mean sea surface models
  - A formal procedure for proper error propagation
- **ESA project STSE – GOCE+: Height System Unification with GOCE**
  - Completion of the assessment of GOCE’s contributions to HSU
  - Recommendation of HSU procedures
    - for well surveyed (large and small) regions
    - for poorly surveyed areas
    - across the ocean
  - Production of a roadmap for regional and global height datum unification

## **Open problems**

- **Data, procedures, standards, policies**

- Lack of standards and conventions for physical heights
- Inconsistencies between physical and geometric heights (e.g., tide systems) – Insufficient collaboration between “geometric” and “gravimetric” Services
- Uncertainties with respect to data biases, accuracies, gross errors, reference epochs, reference surfaces, temporal changes
- Acceptable global realization of the surface of potential  $W_0$
- Governments unready to accept new height datums (and thus new elevation values), especially where social issues may arise (e.g., in coastal regions, flood-prone regions)

- **Difficulty in attracting broad international participation in the work of Theme 1**

- Groups work in this area only if (a) they have either their own individual research funding or (b) are jointly funded by government or other sources (such as ESA)
- Though very difficult, GGOS should maybe consider the possibility of supporting its Themes in attracting funding for their work, through its connections with GIAC, National Geodetic Surveys, Space agencies