On standardization of regional gravity potential determination for realization of IHRS

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Introduction

- According to the IAG resolution 1 from 2015, the vertical coordinates of the IHRS are geopotential numbers referring to the conventional W_0 value. The realization IHRS requires modelling of the gravity potential.
- For highest accuracy, especially in mountain areas, it is not sufficient to use a combined Global Geopotential Model (GGM) with ultra-high maximum degree (for instance EGM2008 or EIGEN-6C4 with maximum degree 2160/2190).
- High resolution regional gravity potential modelling is needed to realize IHRS, at least for the more accurate applications.
- Questions asked by Laura concerning regional gravity potential determination:
  - ✓ Is it possible to identify the basic requirements to compute regional models that represent one and the same global gravity potential?
  - ✓ Does it make sense to outline a roadmap for the gravity potential modelling that standardizes the procedure and minimizes sources of disparity between different regional computations?

Regional gravity potential modelling for realization of IHRS

- Direct pointwise computation of the potential number C_P at the stations in the IHRF network,

$$C_P = W_0 - W_P = W_0 - U_P\left(h_P\right) - T_P$$

- The regional quasigeoid/geoid (fulfilling certain "IHRS requirements") is modelled as grids. The quasigeoid/geoid grid is then used to compute the potential number,

$$C_P = W_0 - W_P = \left(h_P - \zeta\right)\cdot\bar{\gamma} \quad \text{(quasigeoid case)}$$

$$C_P = W_0 - W_P = \left(h_P - N\right)\cdot\bar{g} \quad \text{(geoid case)}$$

In the geoid case, *N* and mean gravity has to be consistent… all quantities in the above formulas have to be consistent)

- We are here talking about standardization and/or requirements for both these cases of gravity (disturbing) potential determination.

Is it possible to standardize regional gravity potential computation for realization of IHRS?

- Regional geoid modelling has been developed for a long time. A large number of methods have emerged, developed by different groups - or schools – according to different theories, philosophies and practices.
- The question is to what extent regional geoid computation can be standardized. We believe that it will be very difficult to single out a certain "IHRS method" at the present time. This would require that the active geoid modelers can agree on this.
- So, if we cannot agree on a full IHRS gravity potential determination method, what can we do? We can standardize as much as possible to get as similar and compatible results as possible with the different methods.
- Or, we formulate the basic requirements (or minimum requirements) that a regional gravity potential or geoid/quasigeoid computation has to fulfil to count as realization of IHRS. Besides this, we leave the choice of method open to the geoid modeler.
- On the other hand, we should work towards standardization of the "IHRS method" as a long term goal. Comparisons are very important, the JWG 2.2.2 ("The 1 cm geoid experiments") fits in very nicely, etc.

Draft suggestion of basic requirements on regional geoid determination (for realization of IHRS)

1. Normal gravity field and W_0 (zero degree correction)
2. First degree terms assumed to be zero ($N_1 = \zeta_1 = T_1 = 0$). By this assumption, the geocenter is aligned with the origin of the used ITRFXXXX.
3. Reference frame for the ellipsoidal heights (ITRFXXXX)
4. Gravity system and permanent tide system for the terrestrial gravity data and GGM
5. Reference frames for the heights and horizontal positions of the terrestrial gravity data
6. Atmospheric correction
7. Correction of zero and first degree effects introduced by the topographic and atmospheric corrections

(Other corrections: All significant corrections should be taken into account for the method and accuracy level in question, for instance: topographic, DWC, ellipsoidal …)

8. Possibly: Choice of Global Geopotential Model (GGM) and maximum degree
9. Possibly: Specification of the spectral transition from satellite-only to terrestrial gravity (kernel modification)
10. Reference epoch and corrections for geodynamical effects (like postglacial rebound in mainly Fennoscandia and northern Canada)

????? (Discussion)