



GOCE's Impact on World Height System Unification



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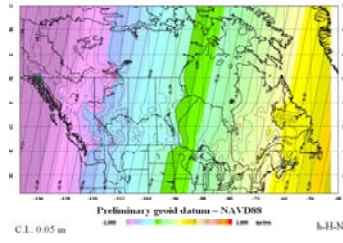
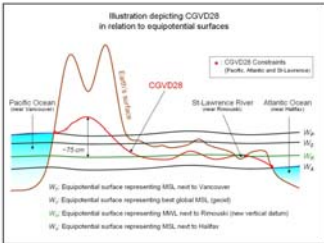
Introduction: GOCE will allow the determination of geoid heights with an accuracy of 1-2cm and spatial resolution of about 100 km. An important application that will benefit from this is the global unification of the (over 100) existing height systems. GOCE will provide three important components of height unification: highly accurate potential differences (geopotential numbers), a global geoid- or quasi-geoid-based reference surface for elevations that will be independent of inaccuracies and inconsistencies of local and regional data, and a consistent way to refer to the same datum all the relevant gravimetric, topographic and oceanographic data. The poster summarizes the project as proposed by the authors and funded since spring this year by European Space Agency. Main goal of the study is to identify the impact of GOCE gravity field models on world height system unification. The work is structured as following: (1) requirements consolidation, (2) review of existing methods for height system unification and further development, (3) assessment of impact of GOCE gravity field models, and finally, (4) preparation of a scientific roadmap towards applications.

Major Project Goals

- Collect information and review the state-of-the-art.
- Quantify the currently known differences (without precise GOCE geoid) between height systems in Europe and other areas.

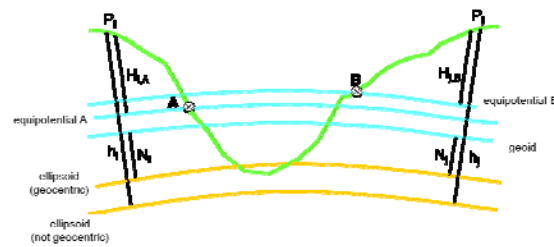


- Review, evaluate and improve methodology and/or existing algorithms for height determination and height system unification.
- Attempt global height unification and tide gauge unification for those parts of the world where the data sets are available.



- Demonstrate the benefit of using GOCE data for this purpose.
- Provide a roadmap for future work required to define a world height system and vertical datum exploiting GOCE data.

GBVP Approach – Basic Principle



$$N_{ij}^{AB} = N_{A0} - N_{B0} + N_{ij}^{GOCE} + N_{ij}^{res} + N_{ij}^{res-do}$$

N_{ij}^{AB} Geoid difference between points P_i and P_j related to vertical datums A and B, respectively.

N_{A0} Geoid height offset of vertical datum A wrt. geoid.

N_{B0} Geoid height offset of vertical datum B wrt. geoid.

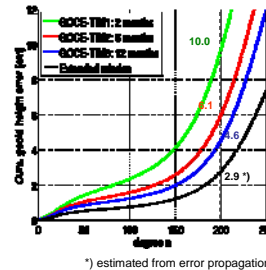
N_{ij}^{GOCE} Geoid difference between points P_i and P_j computed from GOCE model.

N_{ij}^{res} Residual geoid difference (omission error) between points P_i and P_j computed from gravity anomalies (Stokes integral).

N_{ij}^{res-do} Impact of datum offsets in gravity anomalies on residual geoid difference between points P_i and P_j computed from gravity anomalies (Stokes integral).

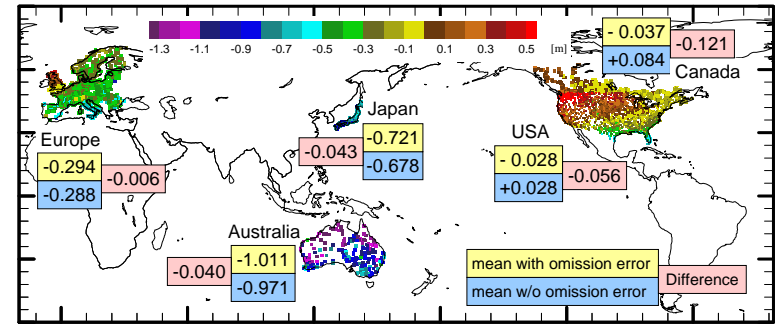
Outlook

- With GOCE gravity models a significant improvement of the global geoid can be reached.
- Models based on 1 year of data reach a global geoid error of 4.6 cm at 100 km resolution.
- With a successful extended mission of GOCE this can be further improved to better than 2.9 cm after 2012.



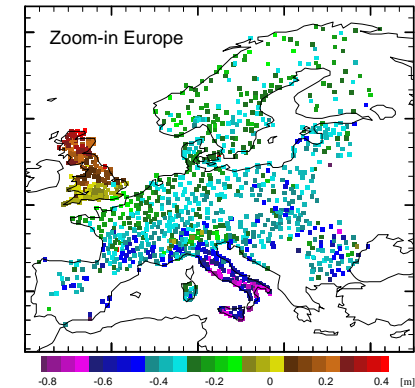
GOCE Models vs. GPS Nivellement Data for Height System Offsets

- Mean differences between worldwide GPS-Nivellement geoid heights and GOCE gravity field model (TIM 3rd release, d/o=200) indicate height system offsets between regions.
- Impact of omission error on mean differences (height system offsets) is investigated by comparing mean values taking into account the omission error and not.



Mean differences between datum corrected European (EUVN-DA) GPS-Nivellement geoid heights per country and GOCE gravity field model (TIM 3rd release, d/o=200) in [m]. Colour code of 1st col. defines height systems used in different countries (see top right figure in project goals section). Colour codes of 2nd and 3rd col. defines if omission error has been estimated (see above).

Austria	-0.36	-0.41
Belgium	-0.28	-0.31
Denmark	-0.27	-0.27
Finland	-0.34	-0.23
France	-0.34	-0.33
Germany	-0.33	-0.35
Great Britain	+0.11	+0.12
Italy	-0.49	-0.53
Netherlands	-0.28	-0.29
Norway	-0.25	-0.18
Poland	-0.39	-0.35
Spain	-0.42	-0.42
Sweden	-0.28	-0.26
Switzerland	-0.33	-0.31



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