How accurate are the recent geoid models based on GOCE and GRACE data for oceanographic applications?

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ABSTRACT

In the framework of the ESA HPF (High Processing Facility), a number of gravity models have been computed from the GOCE data since the beginning of the mission in 2009. In addition to the classical method (the so-called direct approach) that combines orbit and gravity modeling using the orbit perturbation theory, two alternative methods have been developed dedicated to the GOCE mission, i.e. the time-wise and the space-wise approaches. After, preliminary models were delivered in June 2010 based on 71 days of GOCE data, and then in March 2011 based on more than 6 months of GOCE data, new models have been made available recently, based on more than twelve months of data. In addition to the HPF products, geoid models have been computed recently that combine both GRACE and GOCE data (EGM12G, EGM02S2).

In this work, the accuracy of the different models for oceanographic application has been assessed. Both the impact of the different methodologies used to compute the gravity field as well as the contribution of the four months of supplementary data have been checked.

For that purpose, the different GOCE geoids were used to determine the ocean MDT (Mean Dynamic Topography) which was subsequently compared with other MDT estimations using other geoidal models, ocean circulation model outputs, or in-situ oceanographic data. The MDT comparisons were carried out by analysing MDT residuals as well as their associated geostrophic surface currents at different maximum harmonic degrees or intervals. Finally, both global and regional assessments have been performed.

METHOD

**COMPUTATION OF THE OCEAN MEAN DYNAMIC TOPOGRAPHY (MDT)**

- Geoidal model
- Data
- 100 km (DO 200)
- 125 km (DO 160)
- 150 km (DO 130)
- 200 km (DO 100)
- 250 km (DO 80)
- 350 km (DO 60)

**FILTERING OF THE MDT WITH A GAUSSIAN FILTER**

**COMPUTATION OF THE GEOSTROPHIC CURRENTS**

\[(u'a, v'a) = (u, v) - (u', v')\]

\[\text{Standard deviation of the difference (cm/s)}\]

**CONCLUSIONS**

The computation of Mean Dynamic Topographies from different geoidal models and the comparisons with independent data from in-situ oceanographic measurements and altimetry permit to carry out an independent validation of the preliminary GOCE Level-2 products at different resolution scales.

- The use of only 2 months of GOCE data improves a lot the GOCE only geoidal model.
- Further improvement is therefore expected with the third release by HPF of GOCE geoidal models, due in the coming weeks.