

Can GOCE help to improve temporal gravity field models ?

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Improvement of GRACE temporal gravity estimates

Input data:

GRACE: 2-months solution for November/December 2009 applying the Celestial Mechanics Approach (Bern); attention: 7-days resonance during this period !

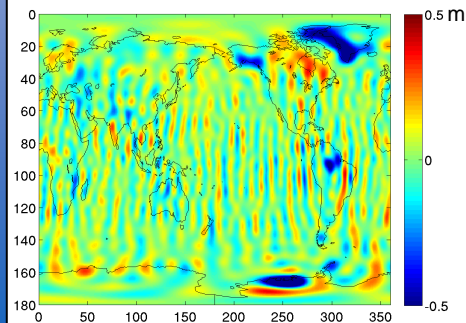
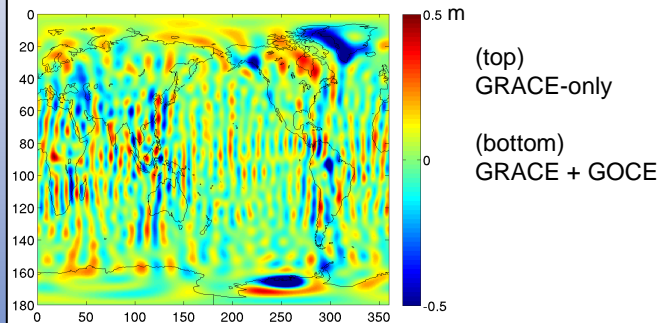
GOCE: - Gradiometry: 2-months solution for Nov./Dec. 2009 applying time-wise method (realistic stochastic modelling)
- GOCE SST: Celestial Mechanics Approach

Resolution of combined model: D/O 224.

Remark: This case study based on 2-monthly estimates can be reduced to 1 month without major changes in the results/conclusions.

Results:

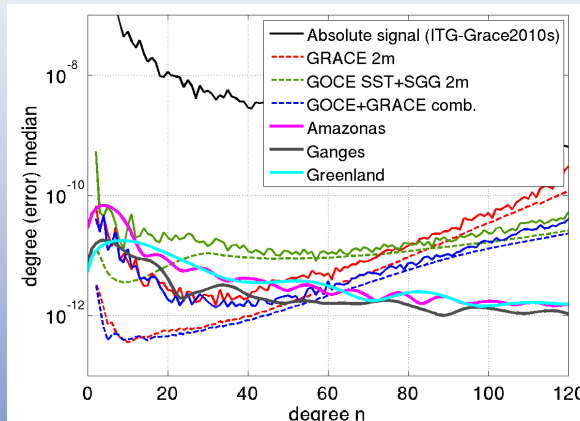
Differences in equivalent water height [m] to ITG-Grace2010s shows significant reduction of stripes at D/O 40 in the combined model.



Introduction

The main objective of the GOCE mission is to determine the static part of the Earth's gravity field with unprecedented accuracy and spatial resolution. Opposed to the original schedule, it turned out that it is technically feasible to probe the Earth's gravity field continuously also during the long eclipse (hibernation) phases, and due to the mission extension until December 2012 even for a much longer time period.

In this feasibility study a first analysis shall be done to what extent GOCE can support and improve time-variable GRACE gravity field estimates.



Formal errors (dashed), differences to ITG-Grace2010s (solid), and selected temporal variation signals.

Conclusions

- GOCE normal equations help to stabilize the combined solution and to reduce stripes.
- Gain is less dramatic for „good“ months (without 7 days resonance), but still significant.
- Same effect might be achieved by reduction of high-frequency (static) gravity field signals and smaller max. resolution of GRACE-only models. However, inclusion of monthly/bi-monthly GOCE solution is more consistent!
- It might possible to see temporal gravity effects in GOCE SST.
- Current major problem: long-wavelength errors in GOCE SST are larger than shown by stochastic models → systematic errors.
- GOCE orbits will not perform much better than CHAMP, because the lower altitude is only a small beneficial aspect for very low degrees!

Temporal gravity from GOCE-only ?

If at all, direct temporal variation signals will become visible from GOCE-SST.

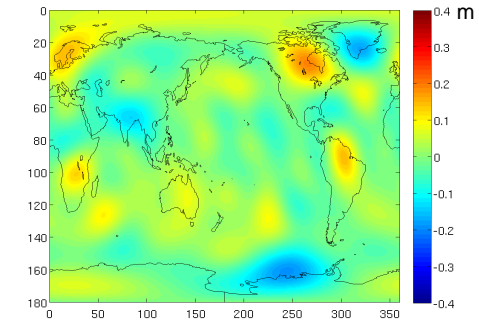
Case study environment.

- Monthly GOCE SST-only solutions (Cel. Mech. Approach, Bern), complete to D/O 120
- Comparison with monthly GFZ RL04 solutions (coefficients only), GAC and GAD products have been added back
- Monthly fields for time period November 2009 – June 2010
- Max. degree/order: 10

Results:

Differences in equivalent water height [m] to ITG-Grace2010s up to D/O 10. Some correlations might be visible among the GRACE solution and the GOCE-SST model, shown here for June 2010.

(top)
GRACE GFZ RL04 –
ITG-Grace2010s,
June 2010



(bottom)
GOCE SST –
ITG-Grace2010s,
June 2010

