Summary & Recommendations for "Processing Algorithms up to the Geoid and Gravity Field"

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Three main topics have been identified for detailed consideration in the discussion:
A) Scientific Pre-Processing,
B) Main L1 to L2 Processing, and
C) Validation.

A) Scientific Pre-Processing
Temporal gravity corrections
One central issue is the treatment of temporal gravity field variations.

Recommendations:

1. Even if many temporal effects (e.g. oceanic and atmospheric mass variations, hydrology) only play a minor role in satellite gradiometry (although in some regions (in the spatial domain) the effect may be larger than the noise level), one should apply available models (e.g. for tidal effects) the best way one can, in order to keep aliasing and systematic effects small (use the best available geophysical models or models from GRACE).
2. The effect of temporal gravity should still be investigated in further depth. It is recommended that further simulations with much more realistic input are repeated and that we validate the results through multiple independent comparisons of various approaches (of simulation).There should be a careful assessment of the external information used in the various analyses, as far as their quality and consistency are concerned.
3. Additionally, processing software should be prepared so that temporal parameters could be co-estimated with the static gravity field part in the global fit, if necessary or as validation.
   Some users could benefit from access to the correction parameters for temporal effects on the gravity gradients, which should then be provided as part of Level 2.
4. A possible impact of more regional phenomena (which may not be visible in error degree variance representations) or systematic effects from the two semi-annual measurement phases of GOCE should be investigated to some extent, as well as a possible direct use of GRACE data.

Reference frames
The change of the observational gradiometer frame (GRF, which is different from the LORF) seems not to pose bigger problems to the processing algorithms developed in the geodetic community.

Recommendations:

5. Transformation of the gravity gradient should be avoided as much as possible.
6. For a wider use of the GOCE gravity field, e.g. in Geophysics or Oceanography, L2 SGG products should be provided in appropriate reference frames (e.g. geographical, earth fixed reference frame (EFRF)) together with the transformation parameters from the GRF to such EFRF and realistic error estimates, including commission and possibly omission errors. However, the reduced (and to some extent unknown) accuracy of the transformed gradients in subsequent frames has to be taken into account carefully. The error model of the L2 SGG data products should be obtained by a strict (statistical) error propagation method.
7. If possible, correspondingly filtered or smoothed gravity field quantities or further derived products should be provided based upon the user's needs. Here the development of a dedicated toolbox (User Toolbox?) by ESA which considers special user's interests would be desirable. This recommendation is strongly supported by the oceanographic community.

B) Main L1 to L2 Processing
Data processing approaches
All approaches ("brute force" (or: direct), semi-analytical, regional base functions, ...) for processing GOCE observations are becoming quite mature and sophisticated. Special constraints concerning the computation speed or memory seem not to exist or are not regarded as a critical issue for the time when GOCE is in orbit.

Recommendations:

8. As up to now no one has ever processed real GOCE-like (especially SGG) data, all data processing approaches should be further developed and improved, and the different methods can benefit from each

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other. A reasonable distinction between the different methods can not be made at the time being, and all methods deserve proper attention.

9. A decision on which method is "the best" can only be made when the actual GOCE data has been processed. For comparison and validation purposes more methods have to be implemented and should be run on the same data and under similar conditions (benchmark run).
10. The treatment of certain features like data gaps, regularization, weighting scheme, etc. is more inter-linked with the respective processing methods than with the satellite data. Therefore, there should be no restrictions or requirements for uniform treatment of such characteristics of the data.
11. Also, concerning the noise models, filter approaches etc., every group should use his own method optimally developed for his approach. Eventually the used filters etc. should then be made available to the community.
12. The use of reference fields in some of the applied techniques is an issue to be investigated.

Noise models

There is a clear need for an a priori noise model of the SGG observations.

Recommendations:

13. ESA is asked to provide a "realistic" a priori noise model of the SGG observations as well as common input data sets to simplify comparisons between the various approaches. This model should include the latitude-dependence of the gradiometric measurements.
14. A realistic error assessment should take place on the basis of the actual observations.

C) Validation

Recommendations:

15. Validation over the full GOCE measurement bandwidth should be striven for, where global procedures should be applied for the long wavelength and regional methods for smaller scales.
16. A dedicated measurement campaign (e.g. airborne gravimetry) for validation should be further discussed.
17. Possible systematic errors caused by erroneous topographic models should be considered carefully.
18. Since GOCE is a European mission, a dedicated European validation test should be conducted, making use of the excellent ground data available in Europe.