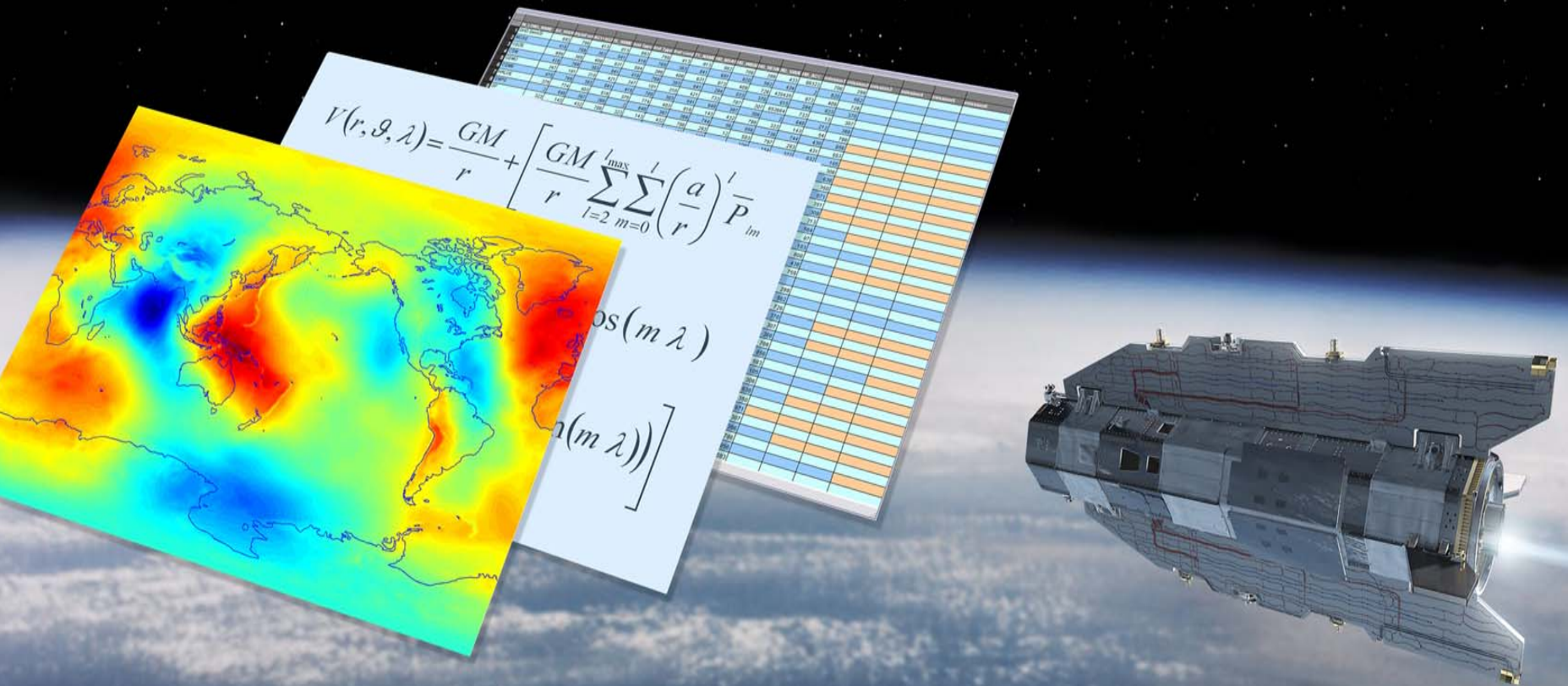


Mission Status & Performance of GOCE Gravity Field Models

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1. GOCE Mission Status

- **General Status**
- **System Performance**
- **Level 1B Processor**

2. Level2 Products

- **Status & Plans**
- **GOCE Gravity Fields Performance**

3. Summary & Outlook

GOCE Mission Status

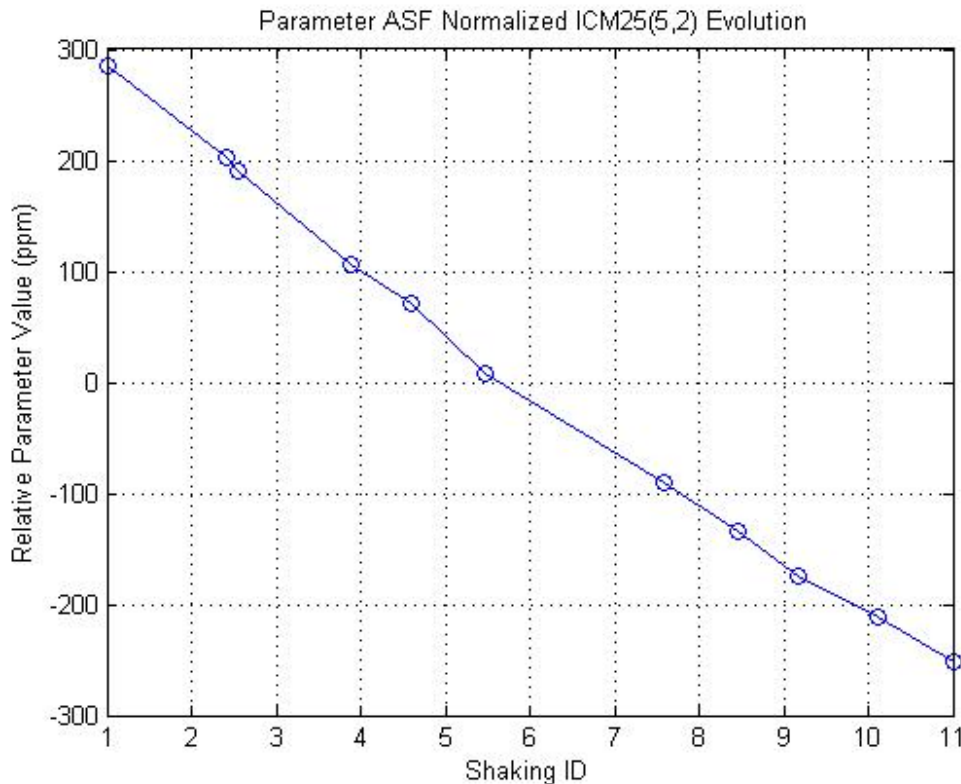
General Status

- Nominal **lifetime completed 15 April 2011**
- Extended **mission operations funded through 2012**, further extension planned as part of ESA's Earth Observation Envelope Programme 2013-2017.
- Actual **lifetime depends on solar activity**, which dictates the net air drag and therefore the Xenon gas consumption. **End of 2013 seems feasible.**
- It is foreseen to **operate GOCE essentially at the same altitude** until the end of the mission. Concept of hibernations at higher altitude needs not to be applied.
- GOCE is **performing extremely well**. The satellite has recently passed its third in-flight test review. No show-stoppers or problem areas have been identified which would prevent mission operation until exhaustion of Xe gas. No major problem on any sub-system since last year's emergency on the main (A-side) on-board computer.
- Ground segment and **science data systems are operating nominally**. Validated data are released with a latency (w.r.t. sampling) of less than 6 months

GOCE Mission Status

System Performance

- The excellent overall **system performance is stable since the beginning of the mission.**
- **Scale factor parameters show essentially a near-linear (aging) drift.** The gradiometer structure is mechanically extremely stable (no measureable change since launch).

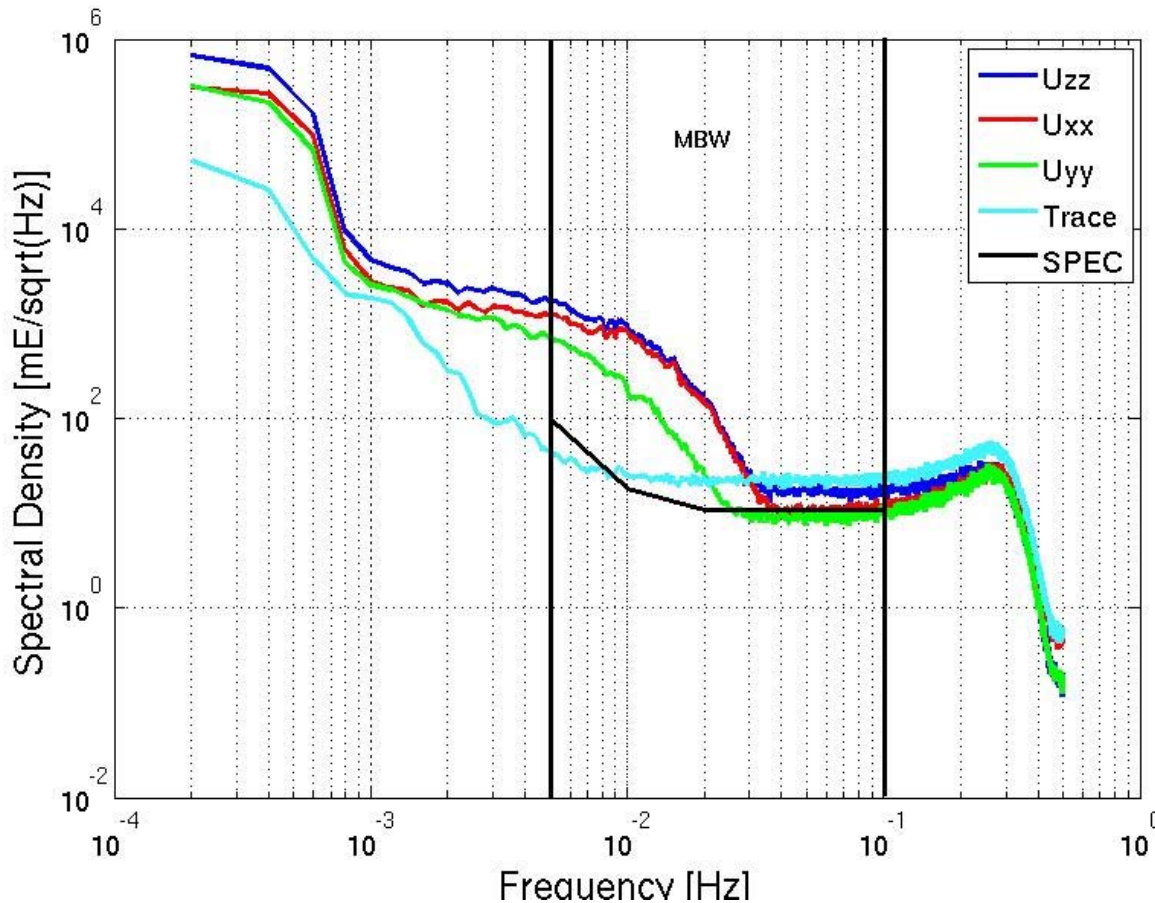


OAG25y differential scale as function of time

GOCE Mission Status

System Performance

➤ Typical performance figures



V_{xx} and V_{yy} are approx in spec. Noise level of V_{zz} about 2x above expectation. Error source not entirely understood.

Trace rootPSD shows the noise level due to instrument, satellite/instrument coupling and the data processing.

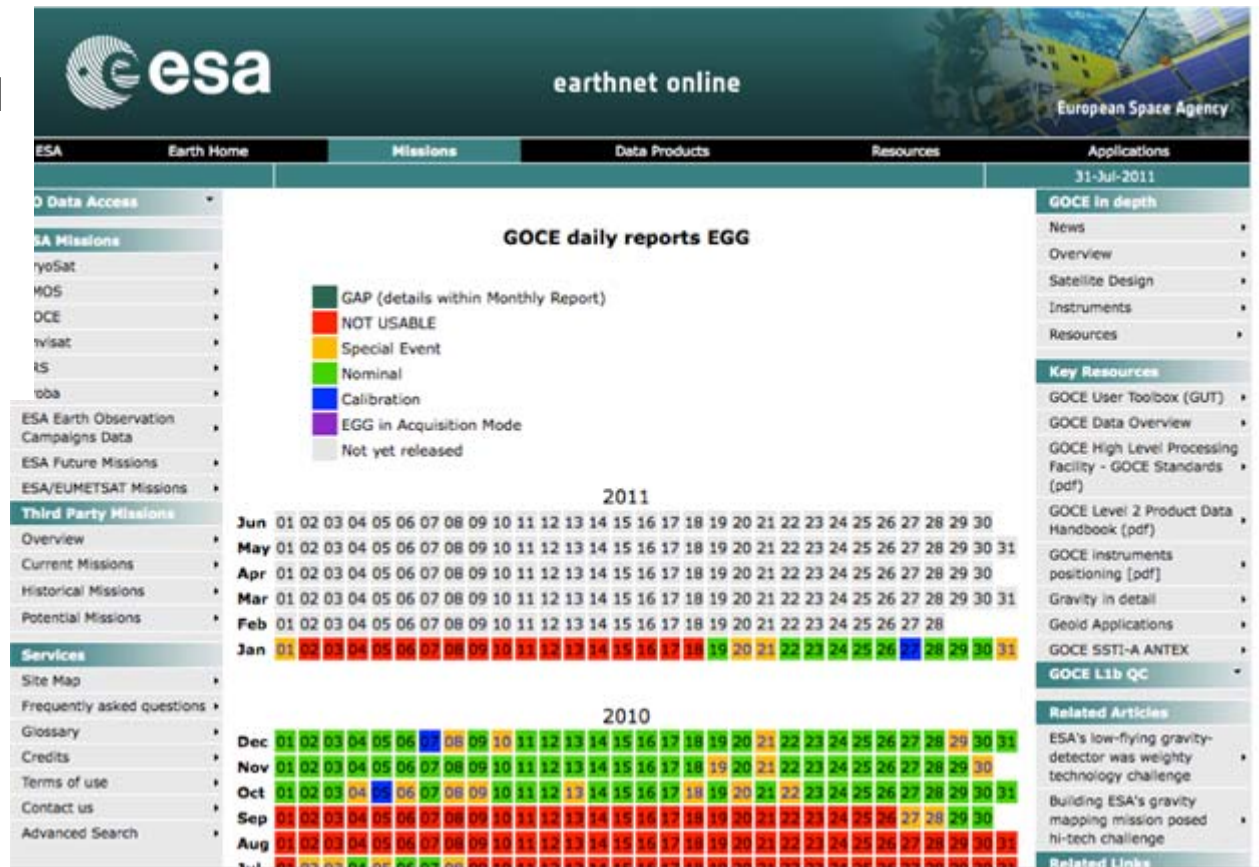
(should be zero in vacuum and for error-free measurements)

Trace spec is indicated by the solid black line.

GOCE Mission Status

L1B Processing

- Data available:
Nov. 2009 to Mar. 2011
- Commissioning data also available:
SST_NOM_1b
SST_RIN_1b



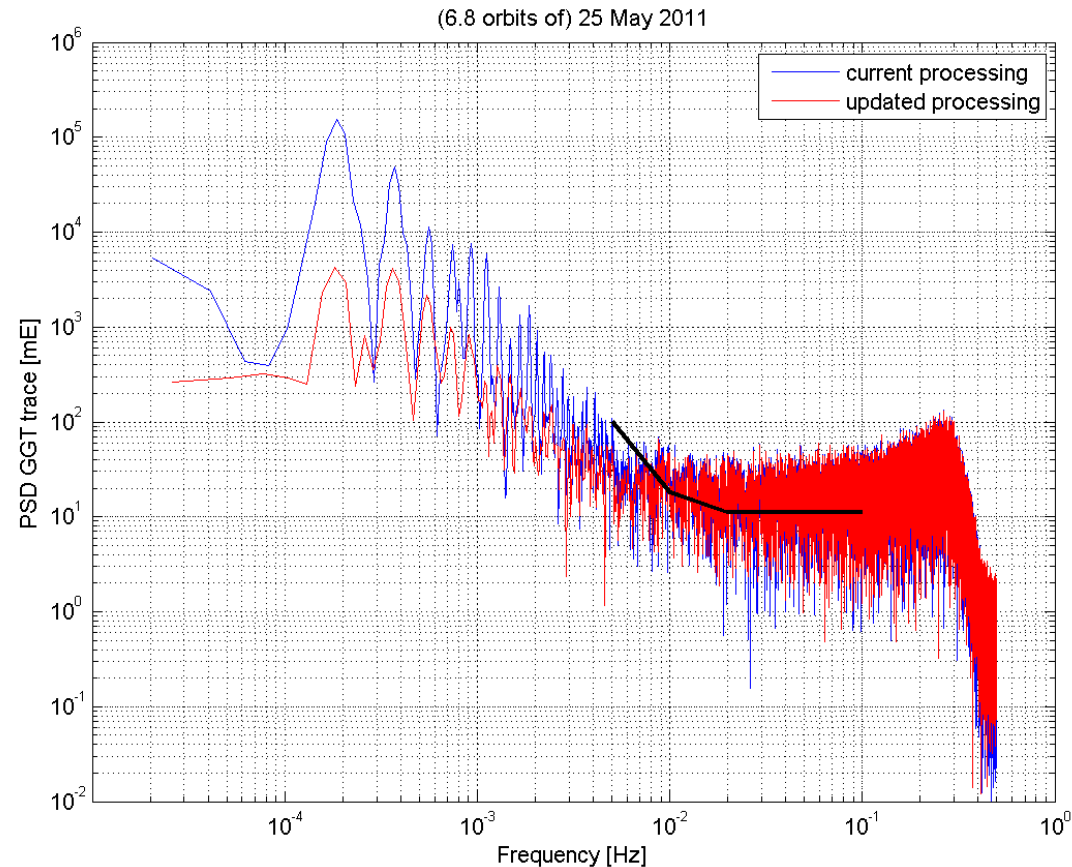
<http://earth.esa.int/GOCE>

GOCE Mission Status

L1B Processor Update

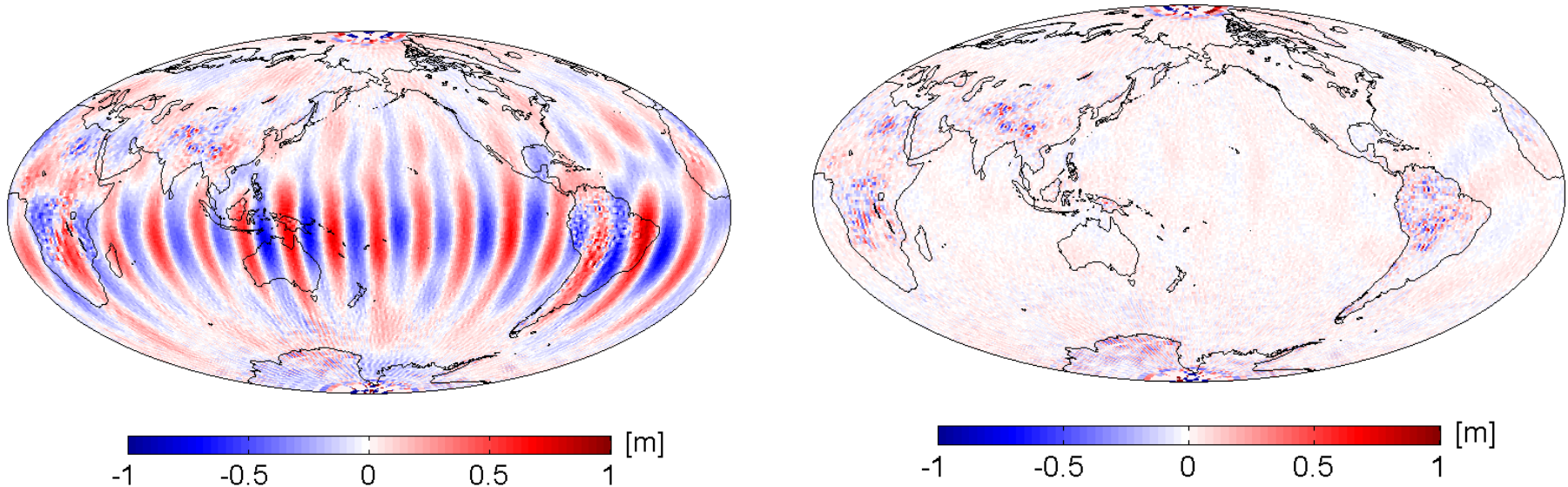
L1b Processor update:

- Combination of STR data.
- Combination of EGG and STR data by Wiener filter.
- Linear interpolation of calibration parameters.
- Installation on operational platform by end August 2011.
- Significant quality improvement in lower MBW and below.
- ESA will re-process all data according to the new scheme.



GOCE Mission Status

L1B Processor Update – Impact on Gravity Field



- Geoid height differences to GRACE-based EGM2008 (d/o 10-200) for GOCE SGG-only gravity field models before and after L1B processor upgrade. Improvement in long wavelengths clearly visible.

See also: Stummer, C.; Fecher, T.; Pail, R.: Alternative method for angular rate determination within the GOCE gradiometer processing; Journal of Geodesy, Springer, ISSN 0949-7714, DOI: 10.1007/s00190-011-0461-3, 2011

Level 2 Products

Status and Plans – Gravity Gradients

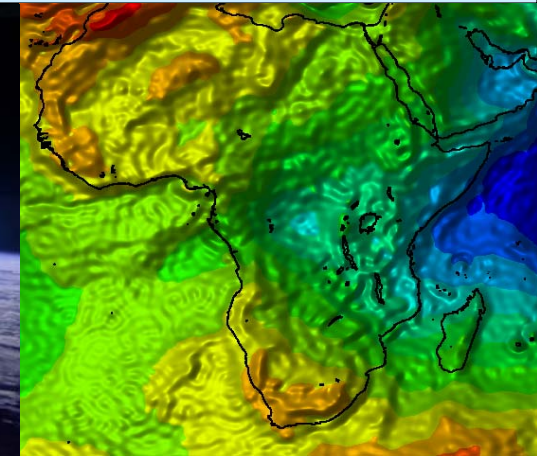
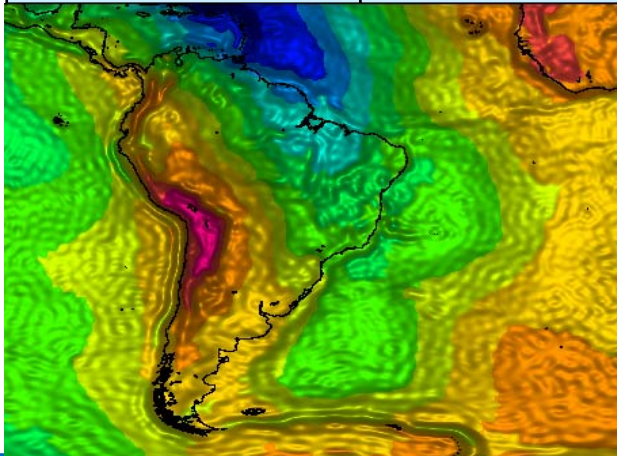
Identifier	Description
EGG_NOM_2	Gravity Gradients in Instrument System: <ul style="list-style-type: none">• Gravity gradients in instrument frame• Corrections to gravity gradients for temporal gravity variations• Flags for outliers and data gaps• Inertial attitude quaternions
EGG_TRF_2	Gravity Gradients in Earth-fixed System: <ul style="list-style-type: none">• Gravity gradients in Earth fixed reference frame• Error estimates for transformed gradients

- All GOCE products available with about 6 month delay from:
 - EOLI: <http://earth.esa.int/EOLi/EOLi.html>
 - GOCE virtual archive: <http://eo-virtual-archive1.esa.int>
- Products from November 2009 to February/March 2011 are on-line.

Level 2 Products

Status and Plans – Gravity Fields

Identifier	Description
EGM_GOC_2	<p>Gravity Field Model:</p> <ul style="list-style-type: none">• GOCE Earth gravity field model as spherical harmonic series including error estimates.• Grids of geoid heights, gravity anomalies and deflections of the vertical computed from final GOCE Earth gravity field model.• Grid of propagated geoid height error estimates (variances)
EGM_GVC_2	<p>Gravity Field Error Structure:</p> <ul style="list-style-type: none">• Complete variance-covariance matrix of final GOCE Earth gravity field model



Level 2 Products

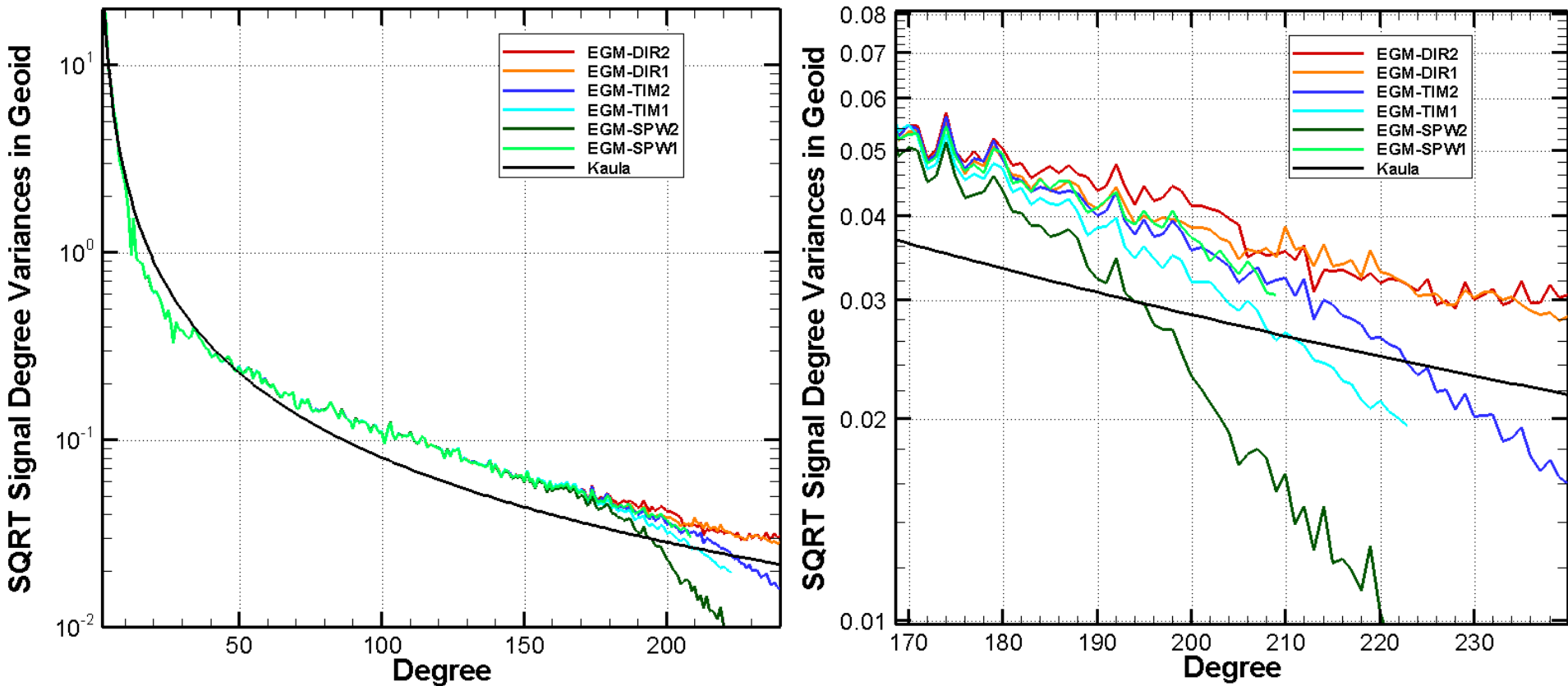
Status and Plans – Gravity Fields

	Direct	Time-wise	Space-wise
Rel. 1:			
Data	01.11.2009-11.01.2010	01.11.2009-10.01.2010	30.10.2009-11.01.2010
D/O	240	224	210
Product	EGM_GOC_2__ 20091101T000000_ 20100110T235959_0002	EGM_GOC_2__ 20091101T000000_ 20100111T000000_0002	EGM_GOC_2__ 20091030T005757_ 20100111T073815_0002
Descr.	Prior model (combined) plus GOCE orbits & gradiometry	Pure GOCE (kin. orbits & gradiometry)	GRACE low d/o plus GOCE gradiometry
Rel. 2:			
Data	01.11.2009-30.06.2010	01.11.2009-05.07.2010	31.10.2009-05.07.2010
D/O	240	250	240
Product	EGM_GOC_2__ 20091101T000000_ 20100630T235959_0002	EGM_GOC_2__ 20091101T000000_ 20100705T235500_0002	EGM_GOC_2__ 20091031T000000_ 20100705T235959_0001
Descr.	Prior model (GRACE-only) plus GOCE orbits & gradiometry	Pure GOCE (kin. Orbits & gradiometry)	Pure GOCE (kin. Orbits & gradiometry)

- **Release 3 gravity fields** are currently in preparation.
- Data coverage: Nov. 2009 to 13. April 2011 (complete nominal operational phase) corresponding to about **12 months of valid data**.
- Delivery in **early November 2011** – to be presented at AGU Fall Meeting.

Level 2 Products

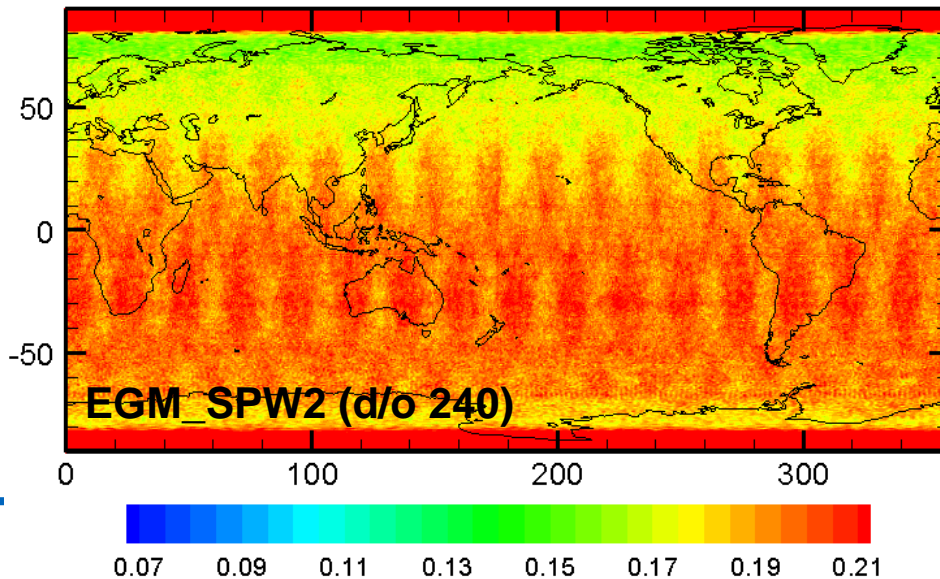
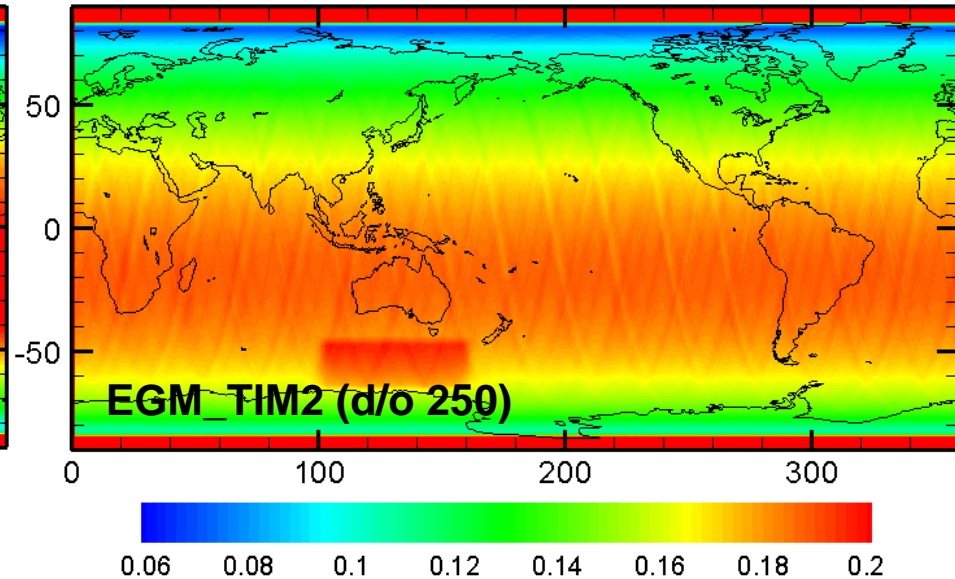
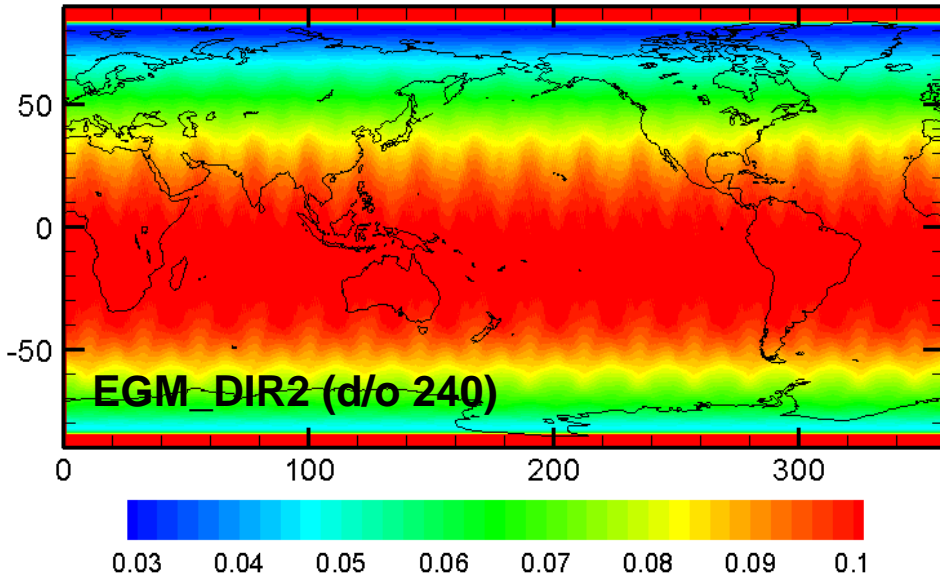
GOCE Gravity Field Performance



➤ **Signal Degree Variances** (Square Root) in Terms of Geoid Height [m]

Level 2 Products

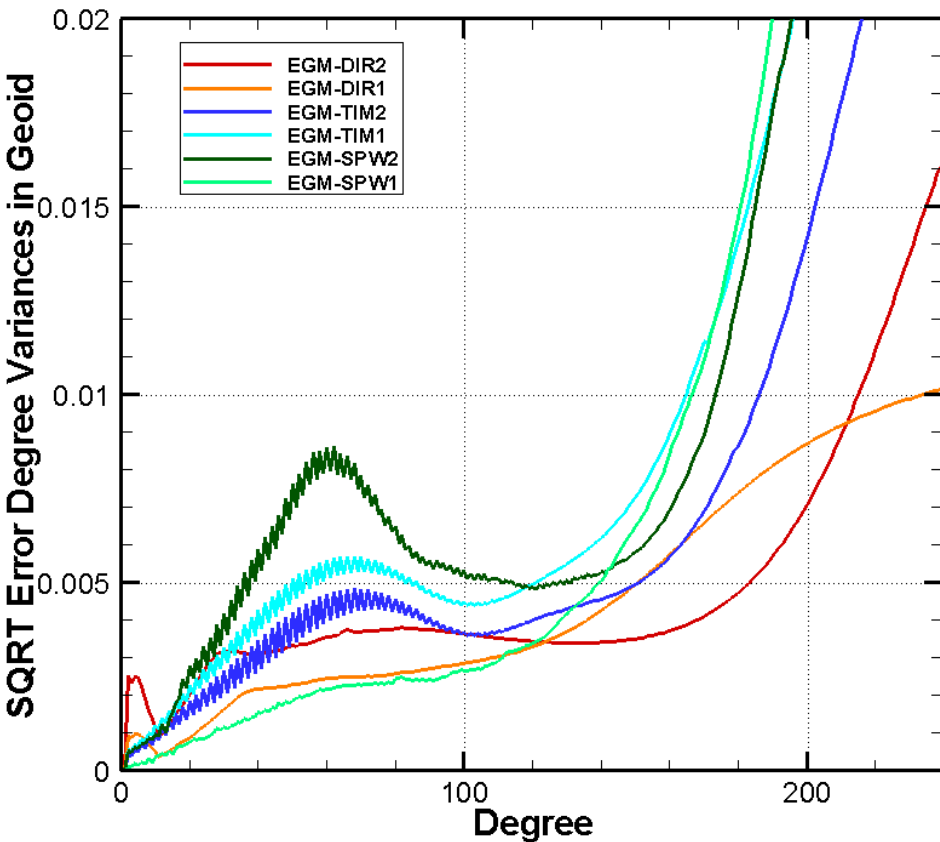
GOCE Gravity Field Performance



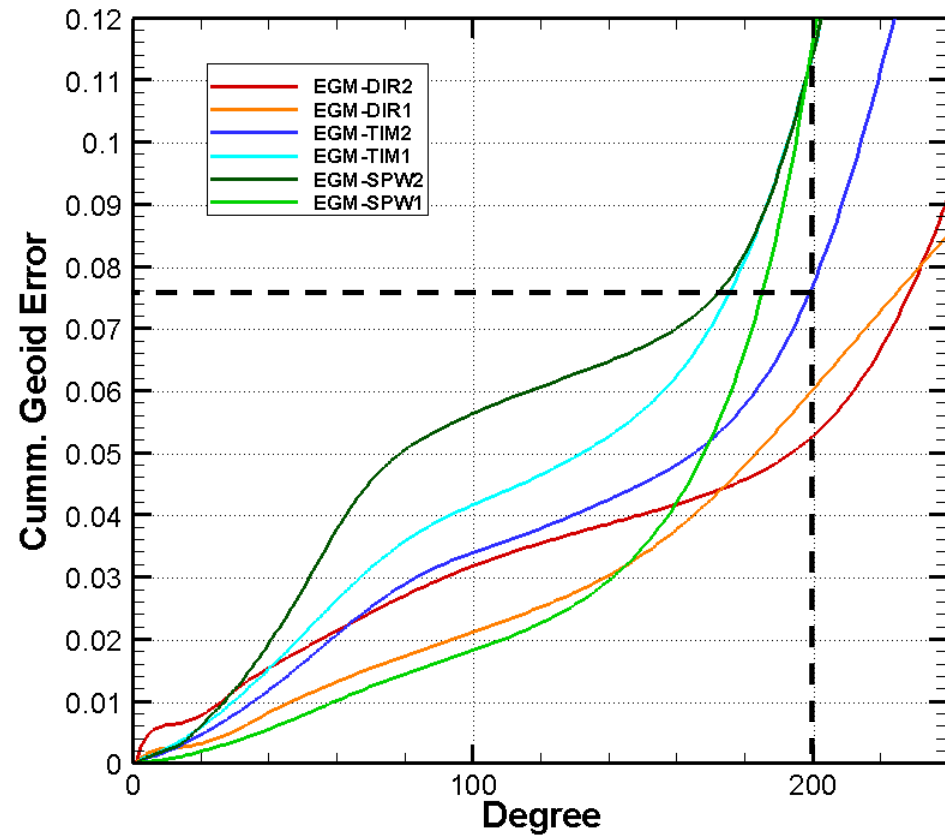
- Variance-Covariance Matrix Error Propagation to **Geoid Height Variances** (Square Root) [m].

Level 2 Products

GOCE Gravity Field Performance



➤ **Error Degree Variances** (Square Root) in Geoid Height [m]

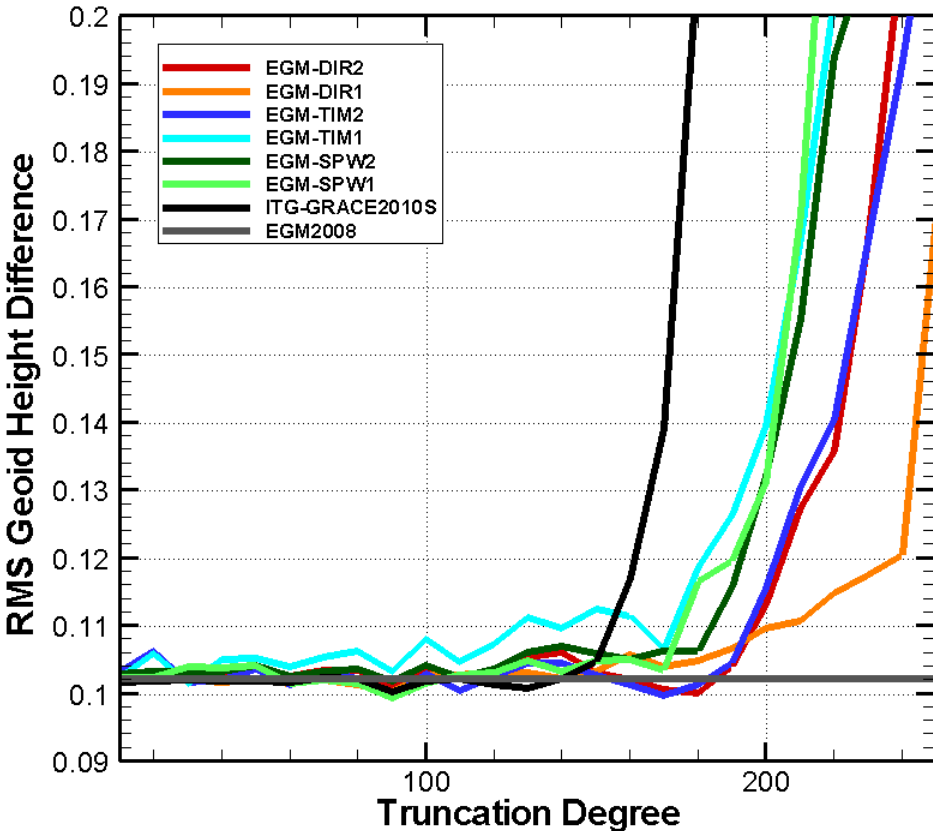


➤ **Cummulative Geoid Height Errors** [m]

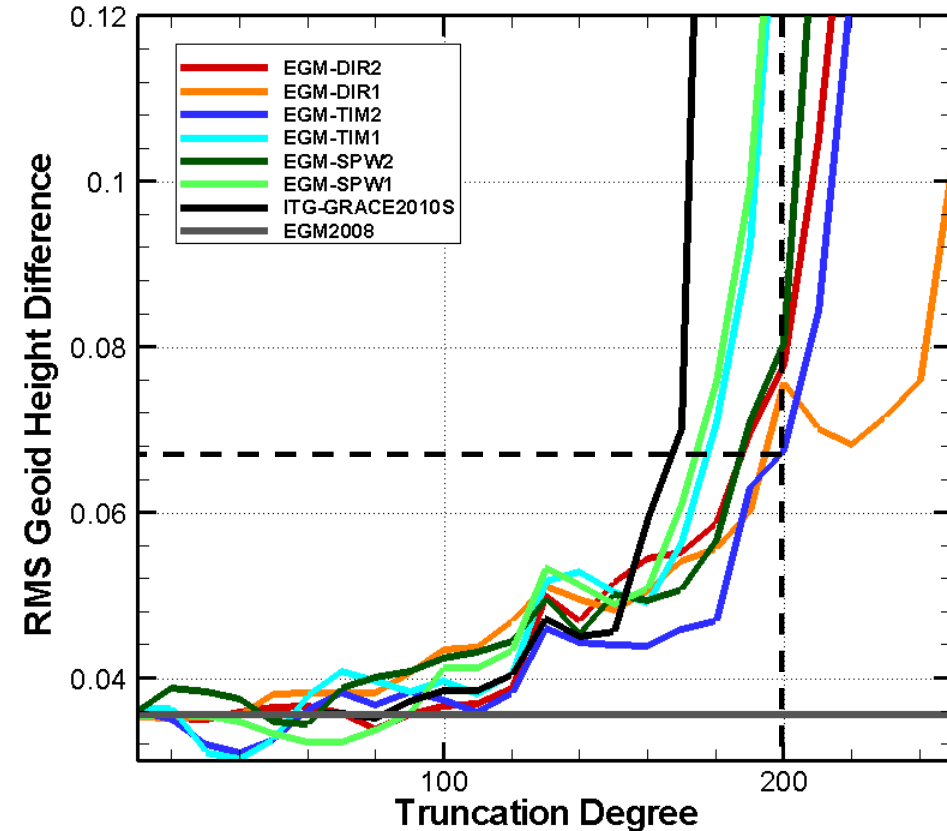
Level 2 Products

GOCE Gravity Field Performance

Japan



Germany

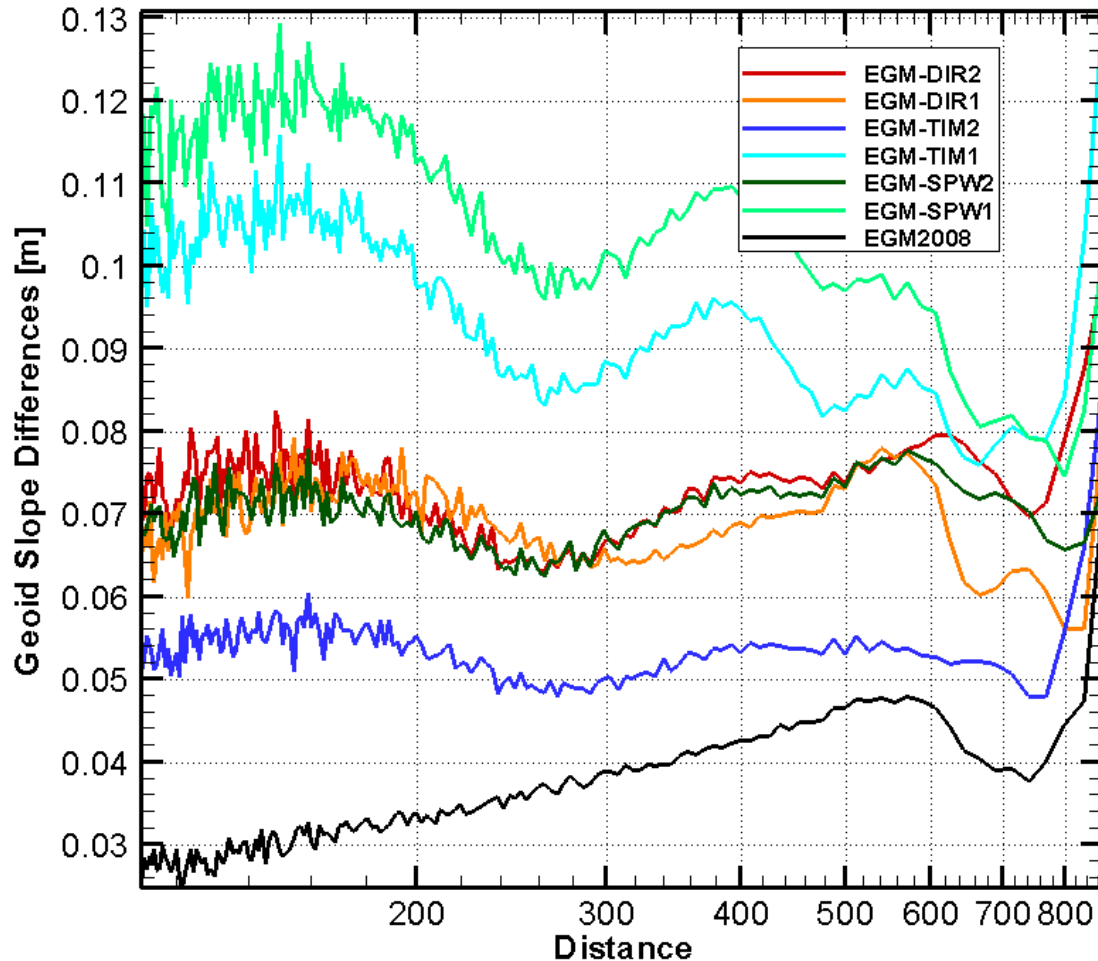


➤ **GPS-Levelling Geoid Comparison** – RMS per Truncation D/O [m]

See: Gruber, T.; Visser, P. N. A. M.; Ackermann, C.; Hosse, M.: *Validation of GOCE gravity field models by means of orbit residuals and geoid comparisons*; Journal of Geodesy, Springer, ISSN 0949-7714, DOI: 10.1007/s00190-011-0486-7, 2011

Level 2 Products

GOCE Gravity Field Performance



- GPS-Levelling Geoid Comparison:
- **RMS Geoid Slope Differences** per Distance Class [m]

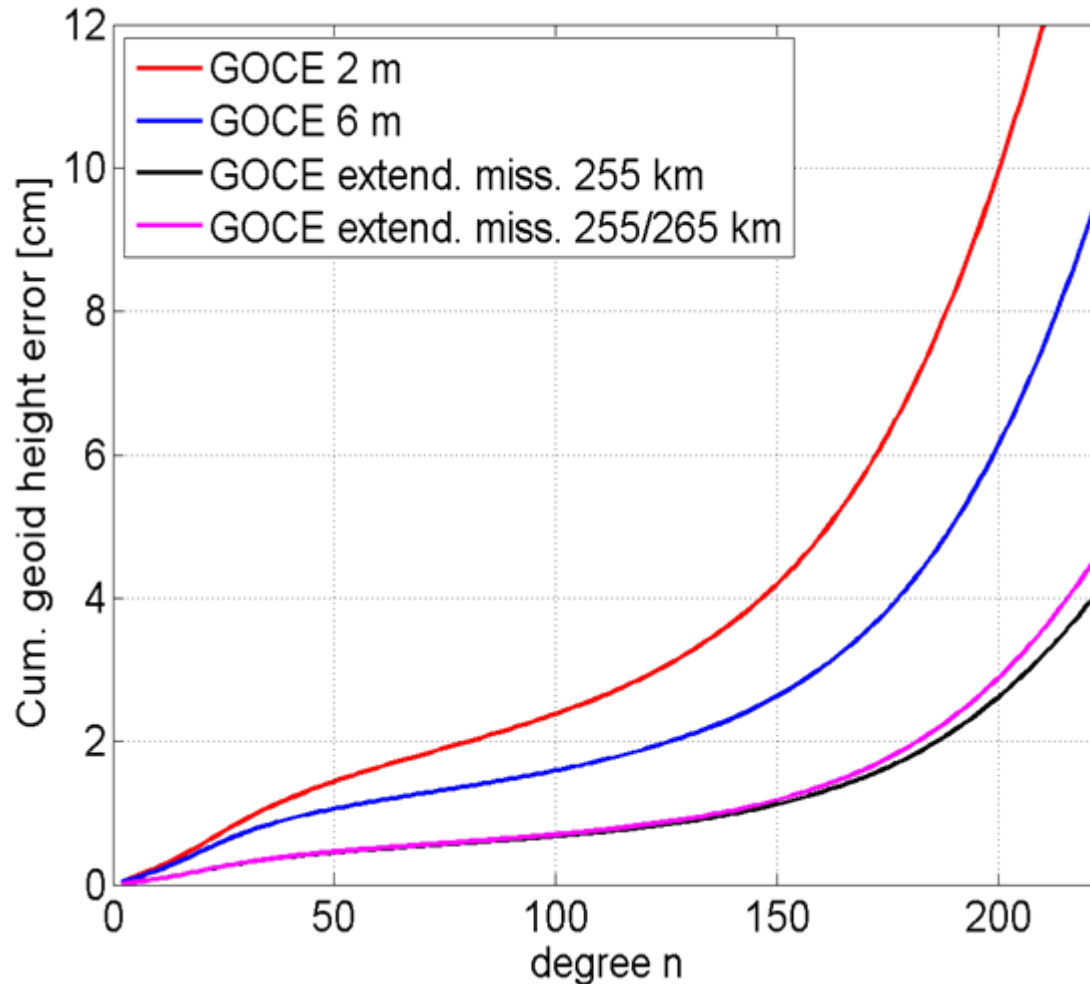
See: Gruber, T.; Visser, P. N. A. M.; Ackermann, C.; Hosse, M.: *Validation of GOCE gravity field models by means of orbit residuals and geoid comparisons*; Journal of Geodesy, Springer, ISSN 0949-7714, DOI: 10.1007/s00190-011-0486-7, 2011

Summary & Outlook

- GOCE **nominal mission lifetime completed**. Extended mission phase approved until end 2012. Lifetime prediction even longer.
- GOCE is **performing very well**. No show-stoppers or problem areas identified.
- Complete **reprocessing of L1B gravity gradients** starts end of August. Improvements mainly in lower part of measurement band expected.
- Next **(third) GOCE gravity field release Nov. 2011**.
- Further **gravity field updates planned for autumn 2012 and 2013** using reprocessed gradients and extended mission data.
- Gravity field **performance (rel. 2) at a level of 5-6 cm at 100 km resolution**. Further improvements expected with more data. Goal of 2 cm shall be realistic (see prediction by R. Pail).
- **Journal of Geodesy special issue** on GOCE processing ready for publication. Several papers available on-line.
- Several GRACE/GOCE combination models (based on normal equations) have been generated: Look for GOCO and EIGEN6 models.

Summary & Outlook

- Projected Geoid Accuracy after extended Mission Phase (Dec. 2012).



from: R. Pail, IAPG