Validation of 2nd Release of GOCE Gravity Field Models

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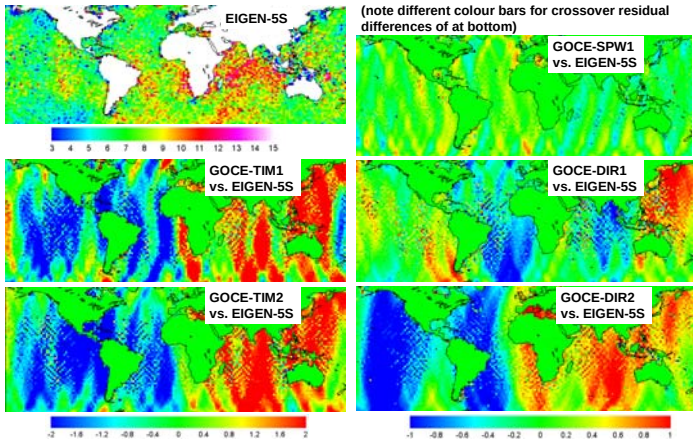
Introduction: New GOCE gravity field models based on 8 months of measurement phase data (November 2009 until June 2010 have been computed by ESA's High-level Processing Facility and were released to the user community. As part of the product validation activities these GOCE gravity field models are extensively tested by different methods. For external quality control in general two methods are applied: (1) Comparison of the global models against independent GPS-levelling derived geoid heights and (2) analysis of orbit residuals computed for a number of satellites. The presentation addresses the validation procedure and includes results of the validation activities, specifically focusing on the performance of the 2nd release GOCE models (named as GOCE-DIR2 and GOCE-TIM2) compared to the first release solutions (named as GOCE-DIR1, GOCE-SPW1, GOCE-TIM1).

Orbit Fit Results

RMS-of-fit of tracking observations for ERS-2.

Model	SLR (cm)	PRARE RNG (cm)	PRARE RR (mm/s)	SXO (cm)	DXO (cm)
EIGEN-5S	4.3	4.1	0.25	6.7	6.9
GOCE-DIR1	4.3	4.2	0.25	6.8	6.9
GOCE-DIR2	4.8	4.3	0.26	6.8	7.1
GOCE-TIM1	5.0	4.6	0.28	7.3	7.4
GOCE-TIM2	4.5	4.3	0.26	7.1	7.3
GOCE-SPW1	4.4	4.2	0.25	6.8	6.9

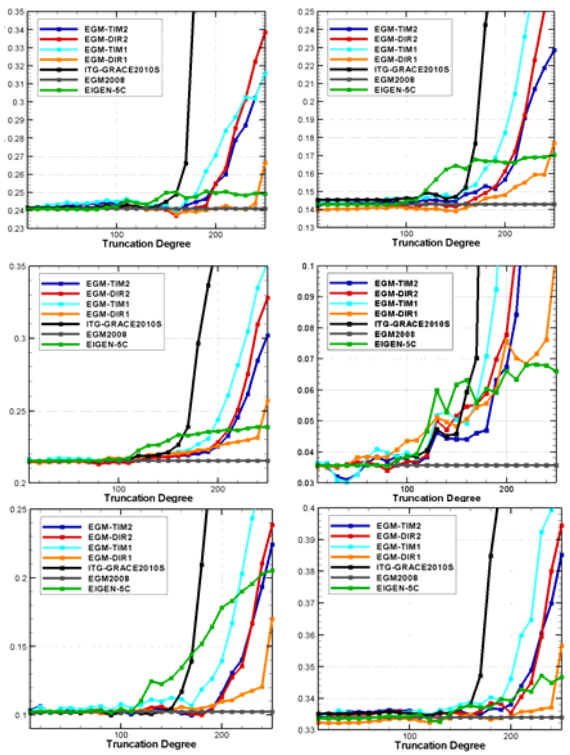
Mean and differences of ERS-2/TOPEX dual-satellite altimeter crossover residuals averaged in 2°x2° bins for gravity fields [cm].



RMS-about-mean (cm) of geographically averaged ERS-2 single- (SXO) and ERS-2/TOPEX dual-satellite altimeter crossover (DXO) residuals.

	EIGEN-5S	GOCE-DIR1	GOCE-DIR2	GOCE-TIM1	GOCE-TIM2	GOCE-SPW1
SXO 2°x2°	2.1	2.5	2.3	3.3	3.1	2.2
DXO 2°x2°	1.9	1.9	2.3	2.9	2.9	1.9

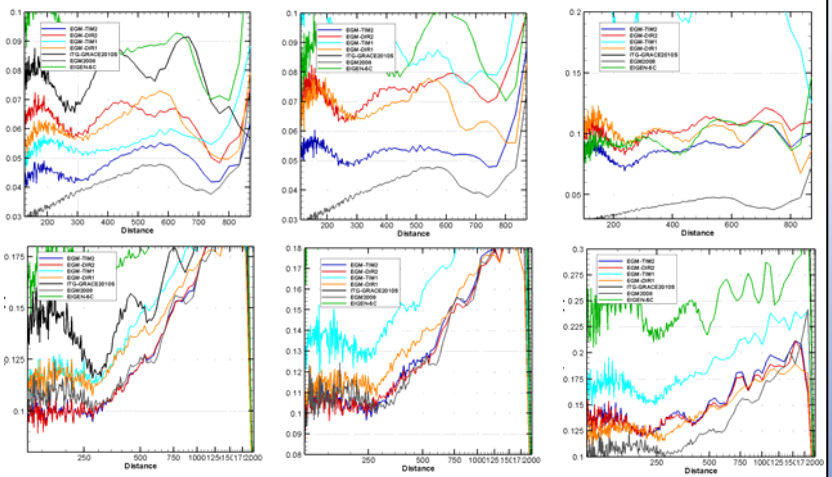
Geoid Comparison Results



RMS of geoid height differences (height anomaly differences in case of European and German data set) after subtraction of mean value in [m] per degree of truncation for GOCE and other global gravity field models. Top row: Australia (left), Canada (right). Middle row: Europe (left), Germany (right). Bottom row: Japan (left), USA (right).

Geoid Comparison Results

RMS of geoid slope differences [m] per distance class for Germany (top row) and Japan (bottom row) for various degrees of truncation. 1st col.: Degree 160, 2nd col.: Degree 180. 3rd col.: Degree 200. For degree 180 and 200 the GRACE model is not shown.



Conclusions

(1) Compared to pre-launch models, all five released GOCE gravity field models show a degraded performance in precise orbit determination for the selected satellites. There are indications that higher degree and order gravity field terms need to be estimated to properly take into GOCE orbital resonances.

(2) GOCE data provide significant new information for the medium to higher spatial resolution of the Earth's gravity field. When analyzing the results obtained with the high quality GPS-levelling data in Germany we can conclude that the geoid accuracy is at the level of 6-7 cm at degree and order 200 (corresponding 100 km in the spatial domain). Taking into account the error level of the GPS-levelling data the GOCE geoid performance probably is even slightly better. With more GOCE observations, according to the error propagation law, one can assume further improvements towards the mission goal.

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