Use of GOCE TRF vertical gravity gradients and ground gravity for spherical harmonic coefficient estimation.

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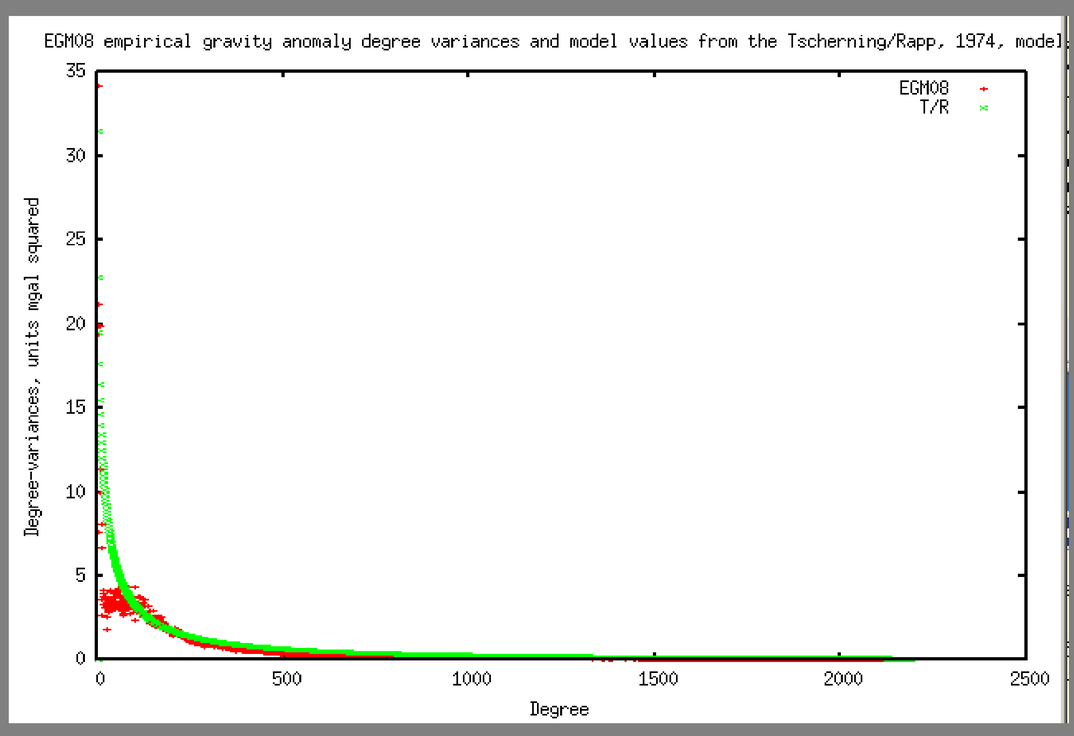
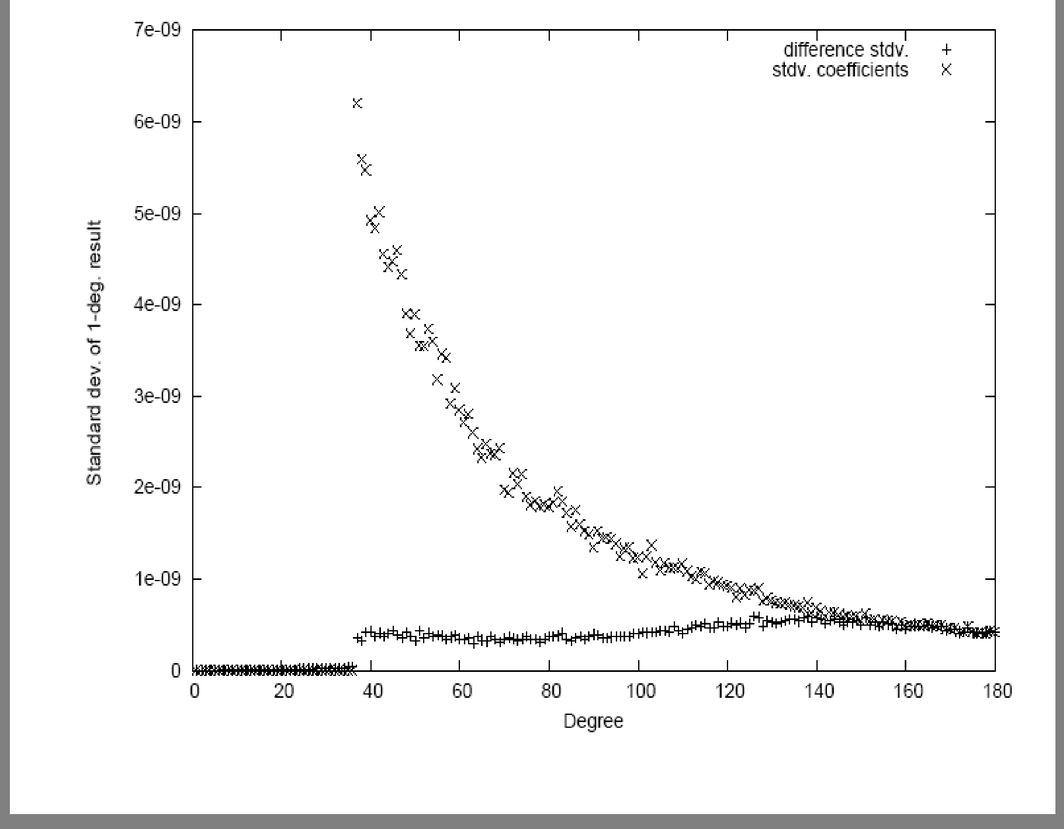
GOCE TRF Gradient data and error-estimates in North-Oriented Frame used from 2009 – 2011. 27965737 non-flagged rec. Anomalous Tzz values computed using EGM96/36 without using spherical approximation. Mean: 0.000 E, St.dev. 0.115 E.

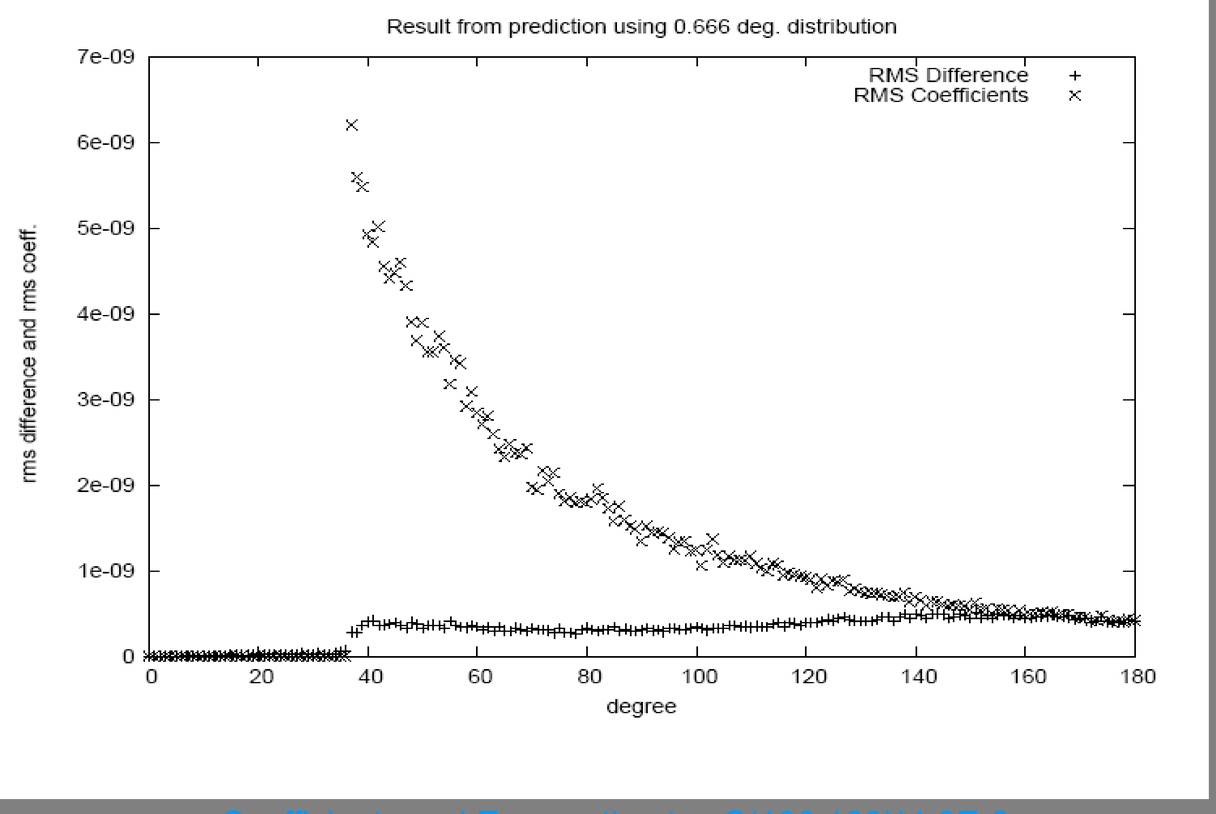


Ground gravity from Arctic and Ant-Arctic. LSC (Least Squares Collocation) used to predict values of 15 km altitude in order to avoid Bjerhammer-sphere problem. Error standard deviation typically 3 mgal. All data preprocessed by subtracting EGM96 to degree 36.

Prediction of Spherical harmonic coefficients and error-estimates using LSC without spherical approximation Global Analytic T/R model used (simplified).

Data selected close to equal area grid points in order to obtail uniform error-estimates and avoid singularities close to poles. Assigned error standard deviation of 0.03 E to represent along track means





The calculation of error-estimates and correlations is time consuming, but multiprocessing helps when calculating all error-estimates simultaneously

$$e^2 = C_0 - C_p^T \bar{C}^{-1} C_p$$

Uniform (per degree) error-estimates obtained which agreed well with the calculated standard deviation of the differences (observed-EGM96) coefficients.

Possible improvements:
Use of denser ”grid”
Use of more gradients
Use new data from Antarctica
Use ground gravity where GOCE data has gaps
Represent data as along-track filtered values.
Use of sophisticated data-selection procedure
Reduce computational time by GRID computing
Use of EGG_NOM_2 gradients (and quarternions)
Use of error-covariances
Use remore-restore of topography/bathymetry

Coefficients and Error-estimates C(100,100)*1.0E-8

Model	Value	Error
EGM96	0.111	0.036
EGM08	0.100	0.012
GCF TIM2	0.105	0.015
LSC 1 deg. 41219 obs	0.120	0.054
LSC 0.5 deg 164212 obs	?	?

Conclusion:

The use of multiprocessing has enabled the use of LSC for coefficient calculation using large data-sets

LSC with GOCE gradient data enables the direct computation of an EGM and its error-covariances.

The GOCE TRF product has as high quality as shown by comparing coefficients computed using the data with existing models.

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