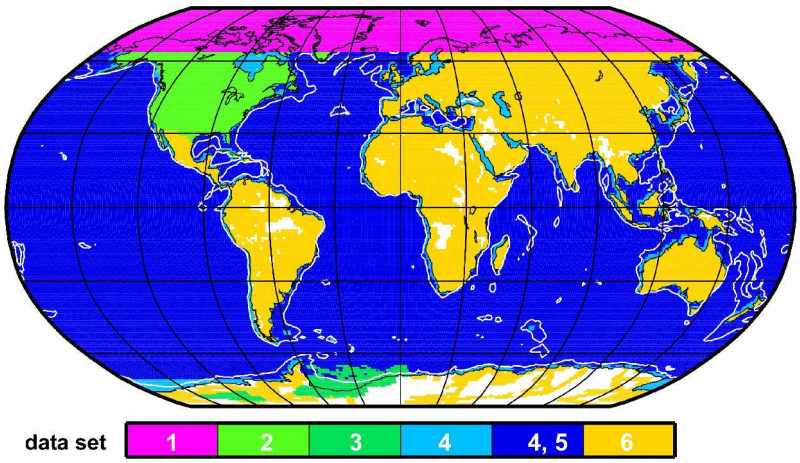
EIGEN-CG01C: A high resolution global gravity field model combining CHAMP and GRACE satellite mission and surface data

EIGEN-CG01C is a combination of GRACE mission (200 days out of April/May/Aug/Nov 2002 and April/May/Aug./Oct./Nov. 2003) and CHAMP mission (860 days out of Oct. 2000 to June 2003) data plus altimetry and gravimetry surface data. The model is complete to degree/order 360 in terms of spherical harmonic coefficients and resolves wavelengths of 110 km in the geoid and gravity anomaly fields. A special band-limited combination method has been applied in order to preserve the high accuracy from the satellite data in the lower frequency band of the geopotential and to form a smooth transition to the high-frequency information coming from the surface data. Compared to pre-CHAMP/GRACE global high-resolution gravity field models, the accuracy could be improved by one order of magnitude to 4 cm and 0.5 mgal in terms of geoid heights and gravity anomalies, respectively, at a spatial resolution of 400 km wavelength. The overall accuracy of the full model is estimated to be 20 cm and 5 mgal, respectively, and benefits also from recently issued new gravity anomaly compilations over polar regions. In general, the accuracy over the oceans is better than over the continents reflecting the quality of the available surface data.

The following surface data were used for the combination with the CHAMP and GRACE satellites' normal equations (s. Figure for coverage):

(1) Arctic Gravity Project (ArcGP) gravity anomalies (Forsberg, Kenyon 2004), for regions with $\varphi > 64°$,
(2) NRCan gravity anomalies (Véronneau 2003, pers. comm..), covering North America,
(3) AWI (Studinger 1988) and LDO (Bell et al., 1999) gravity anomalies, over two small areas of Antarctica and, in the case of AWI, adjacent sea ice,
(4) NIMA altimetric gravity anomalies over the ocean, including standard deviations,
(5) Geoid undulations over the oceans by using CLS01 altimetric Sea Surface Heights (Hernandez et al., 2001) and the Sea Surface Topography from the ECCO simulation (Stammer et al., 2002),
(6) NIMA terrestrial gravity anomalies (if not covered by data sets 1 to 3) including standard deviations, almost worldwide continental coverage, except for Antarctica and some smaller data gaps, and
(7) NIMA ship-borne gravity anomalies over water depths less than 2000 m.



Coverage of surface data sets 1 through 6; white line mark used ship gravimetry data (data set 7) over water depths less than 2000 m; white areas are not covered with surface data.

Note:

The estimated coefficients C(2,1),S(2,1) in the EIGEN-CG01C model represent mean values (i.e. mean pole position in IERS system)over the data evaluation period. As GRACE data have the highest impact in the long-wavelength part of the model, the evaluation period extends from April 2002 to Nov 2003. No C(2,1)-,S(2,1)-dot values are estimated nor applied.

The degree 1 terms are estimated in order not to introduce a constraint via the GPS-SV orbits. Compared to the calibrated errors, these coefficients are within the three sigma significance level.