EIGEN-6S4: A time-variable satellite-only gravity field model to d/o 300 based on LAGEOS, GRACE and GOCE data from the collaboration of GFZ Potsdam and GRGS Toulouse

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GFZ Potsdam and GRGS Toulouse have a long-time close cooperation in the field of global gravity field determination. This presentation deals with GFZ's and GRGS' latest satellite-only model EIGEN-6S4 (EIGEN = European Improved Gravity model of the Earth by New techniques). This new model is of maximum spherical degree/order 300 and is basically a time variable version of release 5 of the GOCE gravity field model by means of the direct approach (GOCE-DIR5).

EIGEN-6S4 has been computed including the reprocessed Satellite Gravity Gradiometer data from the entire GOCE mission (November 2009 through October 2013). The three-axes GOCE gradiometer provided gravity gradients that are measured with a high accuracy only within its measurement bandwidth of approximately 0.005 to 0.1 Hz. Due to this instrumental behavior, the gravity gradient observation equations must be filtered. Within the direct numerical approach this has been done using a band pass filter of 8 - 120 seconds. That means the GOCE gravity signal is filtered out below degree 50.

The low-to-medium degree spherical harmonic coefficients of EIGEN-6S4 are determined using 10 years (2003 – 2013) of GRACE GPS-SST and KBR data as well as 25 years (1985 – 2010) of LAGEOS SLR data from the CNES/GRGS release 3 processing.

All data are combined at normal equation level, which are solved using Cholesky decomposition. We apply the spherical cap regularization to stabilize the low-order spherical harmonic coefficients for the polar gaps in the GOCE data. Furthermore, Kaula regularization is used at the high degrees.

EIGEN-6S4 contains time variable components for all spherical harmonic coefficients up to d/o 80. This comprises annual and semi-annual oscillations as well as yearly trends. These time variable components were adjusted from GRGS' release 03 LAGEOS/GRACE monthly gravity fields.

Our evaluations of EIGEN-6S4 show the improved performance of this model w.r.t. previous time variable as well as static global gravity field models like EIGEN-6S2, GOCO03S, DGM-1S and others. In this context we present orbit adjustment fits for various satellites, GPS-leveling comparisons and independent oceanographic evaluations. EIGEN-6S4 is available for download at the ICGEM data base at GFZ Potsdam: icgem.gfz-potsdam.de.