Geophysical Research Abstracts
Vol. 19, EGU2017-7725, 2017
EGU General Assembly 2017

High-resolution global forward modelling: a degree-5480 global ellipsoidal topographic potential model

Moritz Rexer, Christian Hirt, and Roland Pail

Technische Universität München, Lehrstuhl für Astronomische und Physikalische Geodäsie, IAPG, München, Germany (m.rexer@tum.de)

The development of parallel computing and arithmetically extended integration algorithms make forward modelling of the gravitational potential of Earth possible on a global scale with very high resolution. We make use of an efficient spectral integration method and a composite global source-mass model developed at Technische Universität München over the past two years. The integration method allows the rigorous definition of an arbitrary number of volumetric mass layers of laterally varying mass-density that are referenced to an oblate ellipsoid of revolution. Often used simplifications such as spherical approximations and the rock-equivalent-topography concept are avoided in our modelling technique. Starting from band-limited degree-5400 layer-boundaries we demonstrate the creation of a (non-compensated) degree-5480 ellipsoidal topographic potential model that resolves the gravity field of Earth down to scales of ~ 4 km. This involves multiple spherical harmonic analysis of the height-density functions and their first 25 integer powers to degree 5400. Stark oversampling is required in order to ban aliasing that otherwise would distort the short-scale gravitational signal. This results in large grids, dimensioned 64801 x 129601 (67 GB), initiating a parallelization of the analysis procedure. The ellipsoidal topographic potential model shows significant signal amplitudes in the spectral window ranging from degree 2161 to 5480 and we successfully demonstrate their importance in combined high-resolution gravity field modelling over various regions on Earth. As an aside the model reveals interesting insights into spherical harmonics at short scales: the signal degree variances actually are rising towards short scales since they refer to the spherical harmonic reference sphere, where short-scale signals are dramatically amplified due to the attenuation factors found in the spherical harmonic series expansion. The signal strengths at Earth's surface, in contrast, are of monotonously decreasing character towards short scales.