Geophysical Research Abstracts, Vol. 7, 00821, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00821

Global estimation of gravity potential value of geoid, Sea Surface Topography, and the geoid based on 11 years of Topex-Poseidon satellite altimetry data

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Using 11 years of Topex-Poseidon satellite altimetry data a model for the estimation of Mean Sea Level (MSL) based on orthogonal base functions at the sea areas has been derived. This model is used to produce MSL in terms of Gauss ellipsoidal heights at a $1^\circ \times 1^\circ$ mesh of 33,486 point over the global sea bodies. The Gauss ellipsoidal coordinates $\{l, b, h\}$ of the points on the MSL is converted into the Jacobi ellipsoidal longitude λ, Jacobi ellipsoidal latitude ϕ, and Jacobi ellipsoidal height u via Cartesian coordinate, according to the transformation sequence $\{l, b, h\} \rightarrow \{x, y, z\} \rightarrow \{\lambda, \phi, u\}$. Ellipsoidal harmonic expansion to degree and order 360 is used to compute the gravity potential values at the points on MSL. The average of the computed gravity values is derived as the new estimation of geoid's potential value according to the Gauss-Listing definition of geoid as an equipotential surface which fits to global MSL in the least squares sense. Having derived $W_0 = 62,636,855.78 \pm 0.0131\,(m^2/s^2)$ as a new estimate of geoid potential value the difference between the computed gravity potential at the 33,486 points on the MSL and the geoid potential value is computed. Those potential differences are transformed into geometry space by using a new version of Bruns formula, in order to derive Sea Surface Topography (SST) as a by-product of the computations. Removal of SST heights from MSL heights provided us with a new global estimate for the geoid at the sea areas, as the second by-product of our computations.