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Delft Mass Transport model DMT-2

Pavel Ditmar (1), Hassan Hashemi Farahani (1), Pedro Inacio (1), Roland Klees (1), Qile Zhao (2), Jing Guo (2), Xianglin Liu (3), Yu Sun (1), Ricardo Riva (1), and Jiangjun Ran (1)

(1) Department of Geosciences and Remote Sensing, Delft University of Technology, Delft, The Netherlands , (2) GNSS Research Centre, Wuhan University, Wuhan, China, (3) Fugro Intersite B.V., Leidschendam, The Netherlands

Gravity Recovery And Climate Experiment (GRACE) satellite mission has enormously extended our knowledge of the Earth's system by allowing natural mass transport of various origin to be quantified. This concerns, in particular, the depletion and replenishment of continental water stocks; shrinking of polar ice sheets; deformation of the Earth's crust triggered by large earthquakes, and isostatic adjustment processes. A number of research centers compute models of temporal gravity field variations and mass transport, using GRACE data as input. One of such models - Delft Mass Transport model - is being produced at the Delft University of Technology in collaboration with the GNSS Research Center of Wuhan University. A new release of this model, DMT-2, has been produced on the basis of a new (second) release of GRACE level-1b data. This model consists of a time-series of monthly solutions spanning a time interval of more than 8 years, starting from Feb. 2003. Each solution consists of spherical harmonic coefficients up to degree 120. Both unconstrained and optimally filtered solutions are obtained. The most essential improvements of the DMT-2 model, as compared to its predecessors (DMT-1 and DMT-1b), are as follows: (i) improved estimation and elimination of low-frequency noise in GRACE data, so that strong mass transport signals are not damped; (ii) computation of accurate stochastic models of data noise for each month individually with a subsequent application of frequency-dependent data weighting, which allows statistically optimal solutions to be compiled even if data noise is colored and gradually changes in time; (iii) optimized estimation of accelerometer calibration parameters; (iv) incorporation of degree 1 coefficients estimated with independent techniques; (v) usage of state-of-the-art background models to de-alias GRACE data from rapid mass transport signals (this includes the EOT11a model of ocean tides and the latest release of the AOD1B product describing the non-tidal mass re-distribution in the ocean and atmosphere); and (vi) utilization of a state-of-the-art model of the static part of the Earth's gravity field. To validate the DMT-2 model, we have used it to estimate mass variations in selected areas, where similar estimates are also obtainable with independent techniques. This includes the estimation of Greenland ice sheet mass variations and of water mass variations in the Lake Victoria (Africa). The conducted comparisons demonstrate a noticeably higher accuracy of DMT-2, as compared to its predecessors.