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Assessment of GRACE L1B RL03 Data Products for Temporal Gravity Field Solutions through Improved Energy Balance Approach

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GRACE L1B data products are the main data set, along with the background force models, for temporal gravity field recovery. Recently, the new release of the attitude data (Star Camera – SCA1B RL03) has been provided by correcting the stellar aberration error in the onboard star tracker software and incorrect data weighting in the star tracker combination software which subsequently yielded corrections in the KBR (K/Ka Band Ranging) antenna phase center range correction, range rate correction and range acceleration terms in the KBR1B data products.

In this study, we used the improved energy balance approach (EBA) of Shang (2015) for monthly gravity field recovery by reprocessing the L1B RL03 data products of one year, namely 2010. The whole process includes the daily dynamic orbit reconstruction by fitting the reduced-dynamic (GNV1B) orbit to a complete reference model by co-estimating the accelerometer calibration parameters coupled with the alignment of intersatellite velocity pitch from KBR range rate observations, and estimation of the in situ geopotential difference (GPD) observations which are linearly connected with the spherical harmonic coefficients (SHCs) of the global gravity field model. Thus, using in situ GPD observations, the unknown SHCs of the monthly gravity field models are directly estimated through least squares adjustment without any need for linearization or assumption that the initial values of the parameters have to be known sufficiently close to the true parameters.

Our monthly gravity field solutions using RL03 data products show better agreement with official solutions from CSR (Bettadpur, 2018), JPL (Yuan, 2018) and GFZ (Dahle et al., 2018) than the solutions obtained using RL02 data. The correlation coefficient between the estimated GPD (using RL03 data) with those predicted from CSR, JPL and GFZ monthly solutions are all over 93% while the correlations drop down to 89% for solutions with RL02 data. Moreover, the north-south stripes of the geoid undulations computed from the recovered gravity field models reduce dramatically with the latest release of L1B data.