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Computing the Earth's mean gravitational field from the GRACE satellite data using the acceleration approach

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The data acquired by the Gravity Recovery And Climate Experiment (GRACE) has been a valuable source of information for determination of the Earth's mean and time-varying gravitational field. Various approaches have been proposed in order to process the GRACE gravimetric data. The approach developed at the Delft University of Technology is based on the inter-satellite ranges acquired by the K-Band Ranging (KBR) system. Three successively measured ranges are combined in order to form an entry of the data vector, which is used as the input for the gravitational field modeling. In essence, those entries can be interpreted as inter-satellite accelerations averaged with a weight within the differentiation time interval. The developed approach was already successfully applied to produce the DEOS Mass Transport (DMT-1) model, which represents the monthly differences of the gravitational field in terms of spherical harmonic coefficients with respect to a mean field. The major objective of the presented study is to analyze whether or not a similar data processing methodology can also be applied to compute a model of the mean gravitational field. Both a stand-alone processing of the KBR data and a combined processing of those data with satellite positioning data derived from the GPS tracking observations have been considered. In order to produce totally independent GRACE-based solutions, we have employed the EGM96 field as the initial model in the computations. The KBR-based input data were subject to a newly defined geometrical correction in order to compensate for large errors in the orbits based on the EGM96 model. A proper data weighting in the frequency domain has been applied in order to deal with colored noise in the data. No regularization has been imposed. A high quality of the computed models has been proved by a comparison of them with those produced at other GRACE data processing centers. Moreover, the importance of the frequency-dependent data weighting and the added value of the GPS-based positioning data are demonstrated.