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Influence of neglected covariances on the estimation of Earth rotation parameters, geophysical excitation functions and second degree gravity field coefficients

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The Earth rotation variability is redundantly described by the combination of Earth rotation parameters (polar motion and length of day), geophysical excitation functions and second degree gravity field coefficients. There exist some publications regarding the comparison of the Earth rotation parameters and excitation functions. However, most authors do not make use of the redundancy. In addition, existing covariances between the input parameters are not considered.

As shown in previous publications we use the redundancy for the independent mutual validation of the Earth rotation parameters, excitation functions and second degree gravity field coefficients based on an extended Gauss-Markov model and least-squares adjustment. The work regarding the mutual validation is performed within the project P9 “Combined analysis and validation of Earth rotation models and observations” of the research Unit FOR 584 (“Earth rotation and global dynamic processes”) which is funded by the German Research Unit (DFG); see also abstract “Combined Analysis and Validation of Earth Rotation Models and Observations”.

The adjustment model is determined at first by the joint functional relations between the parameters and second by the stochastic model of the input data. A variance-covariance component estimation is included in the adjustment model. The functional model is based on the linearized Euler-Liouville equation. The construction of an appropriate stochastic model is prevented in practice by insufficient knowledge on variances and covariances. However, some numerical results derived from arbitrarily chosen stochastic models indicate that the stochastic model may be crucial for a correct estimation. The missing information is approximated by analyzing the input data. Synthetic variance-covariance matrices are constructed by considering empirical auto- and cross-correlation functions. The influence of neglected covariances is quantified and discussed by comparing the results derived from meaningful synthetic variance-covariance matrices with results derived from uncorrelated input data.