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Estimation of GRACE observation error covariance in wavelet domain

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We present a wavelet-based error covariance estimator in the GRACE gravity parameter estimation procedure and study its impact on the recovered gravity field solutions based on the ITSG-Grace2016 scheme. So far, stationarity was the main assumption in modelling the noise in range rate observations and a stationary covariance function was used in the observation whitening (decorrelation) step performed before the least-squares adjustment. We have shown this assumption is violated as the noise has time-variable behaviour and should be modelled in the framework of non-stationary stochastic processes. The Discrete Wavelet Transform (DWT) is of particular interest for analysis of non-stationary and transient time series. This transform operates unconditional of the input process type and tends to achieve the desirable decorrelating property for a large class of stochastic processes, including stationary random processes and some non-stationary random processes such as fractional Brownian motions and fractionally differenced processes.
In order to perform the gravity parameter estimation in wavelet domain, both observation and design matrices are transformed by a discrete wavelet transform. In this case, the dense variance-covariance matrix of the noise is diagonalized by exploiting the decorrelation property of the transform. Implementation of gravity parameter estimation in wavelet domain, estimation of the empirical error covariance matrix using the residual coefficients, and comparison of the results with the ITSG-Grace2016 solution will be discussed.