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Multichannel singular spectrum analysis in application to GRACE and Jason-1 satellites data

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Multichannel singular spectrum analysis (MSSA) was applied to the Stokes coefficients of the temporal gravity filed solutions obtained from the GRACE twin-satellite gravity mapping mission, and to the 10-days gridded maps of Sea Surface Height (SSH) time series from Jason-1 altimetry satellite. With use of this method Principal components (PCs), representing different physical phenomena were separated, and the noise has been filtered out from these data sets.

MSSA is a generalization of Principal Components Analysis (PCA) for the multidimensional time series. It allows one to recognize correlated spatially-temporal patterns and separate them into the PCs. MSSA is more flexible then PCA in terms of oscillations, trends and noise separation, because it searches for correlations in the time series over an embedding space of large dimensionality, or globally. Instead of using covariance matrix analysis for each component, full trajectory matrix for all the components is analyzed at once. Natural extension of MSSA is the prediction of components.

MSSA of GRACE monthly gravity anomalies allowed to decompose the signal into an average, PC of annual period, secular component, and higher order components containing geographically-correlated high-frequency noise (stripes) and transient mass redistributions. MSSA-processing of ocean altimetry SSH-maps from Jason-1 satellite demonstrated the strength of the method by providing the PCs of different periods separated from the noise. Results are available at http://lnfm1.sai.msu.ru/∼tempus/science/MSSA/

We conclude that the suggested processing method of multidimensional, time-variable observations simplifies studies of quantifying geophysical phenomena, related with global environmental changes, post-glacial rebound, annual cycles, El Nino.

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