

Hierarchically Fourier-aggregated signals and generalized coherence of the noise in the GPS time series

Alexey Lyubushin

Institute of Physics of the Earth, Moscow, Russian Federation (lyubushin@yandex.ru)

A new method for joint analysis of big number of time series is presented. The method is based on using of Fourier-aggregated signals and it has a purpose to detect time intervals and frequency bands when there is a coherence between noise components of all time series. An aggregated signal (AS) is constructed in two stages. At the 1st stage, initial multidimensional time series is substituted by time series of the same dimensionality but composed of so-called canonical components. The canonical components accumulate signals that are common for all initial components and are free of local variations that are specific for individual scalar time series only. At the 2nd stage, the common signals are amplified by constructing a single scalar time series, their first principal component. Thus, an AS is the first principal component of canonical components.

In the case when there is a monitoring system with big number of recording stations all stations are split into a number of clusters with moderate number (10-20) of stations within each clusters. For all clusters AS are calculated which could be called AS of the 1st order. The technique of the 1st order AS computing provides estimating in moving time window and gives a possibility to take into account gaps in registration. If the number of the 1st order aggregation clusters is still big they could be split into 2nd order aggregation clusters and the 1st order AS could be aggregated more into 2nd order AS. At any stage of aggregation a multiple spectral coherence measures could be calculated which present time-frequency diagrams for evolution of coherence between noise components of time series.

The elaborated method was applied to daily 3-components GPS time series from the networks in the USA (4512 stations) and in Europe (2122 stations). The multiple coherence measure estimated for different combinations of AS of the 1st and 2nd orders inside regions of USA and Europe and between them extracted essential peaks of coherence values for periods 4-18 days within time intervals 2012-2016 which could be indicator of general synchronization of global ambient Earth's noise which is observed after Sumatra mega-earthquake at the end of 2004.