A Study on Trend Component Estimation Method of Strain Time Series Data Using State Space Model

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When detecting some crustal deformation by strain observation data, it is important to eliminate the influence of barometric pressure, tide and precipitation contained in the observation data and to detect the change of the crustal deformation itself. Usually, by investigating the response due to the effect of barometric pressure or the like in advance and separating from the observation value, the true crustal deformation amount is calculated. Another method is to express the time series data of the crustal deformation observation as a state space model and estimate the distribution of the state vector under the condition given the observation data.

In this study, I express time series of strain data observed by Japan Meteorological Agency as state space model, estimate state vector and some parameters by maximum likelihood estimation with Kalman filter algorithm, and separate trend component. In formulating state space expression, observation values at each time point are divided into trend component, barometric pressure response, tidal response, precipitation response, jump effect like co-seismic step or instrument maintenance, and observation errors. Furthermore, in order to attempt formulation by the state space model of the Ishii type strain meter, the term of the response component to the geomagnetism is introduced and also the jump component is not a simple step function but a posteriori effect (including post-seismic deformation or the relaxation of instruments for sudden strain changes) is expressed.

Compared with the conventional method, by using a state space model approach, it is possible to detect change of trend component more stochastically. As a result, it becomes possible to more objectively judge the start and end of crustal deformation, and it is considered that there is an advantage in inversion of deformation sources based on Bayesian method. If parameters of the state space model can be appropriately estimated based on the accumulated observation data, interpolation of missing values, detection of crustal deformation and estimation of sources can be performed in real time.

Keywords: Strain observation, State space model, Objective detection method of crustal change

