# Numerical experiments on estimation method of frictional parameters on the SSE fault -Through Ensemble Kalman Filter-

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Slow slip events (SSEs) occur repeatedly on the plate interface beneath the source regions of the interplate large earthquakes. The activity of SSE possibly changes before the occurrence of large interplate earthquakes (Peng and Gomberg, 2010). Hence, it is essential to know the frictional properties for producing SSEs to predict the occurrence of large earthquakes. Our final goal is to optimize slip evolution and frictional parameters on the SSE fault related to SSE with GPS data through Ensemble Kalman filter (EnKF), one of data assimilation methods which combines the observational data and the forecast values derived from a simulation model, and then to give some insight on the occurrence of large interplate earthquakes. In this paper, we construct the synthetic data from simulated slip velocities with the observation errors. Then, we perform numerical experiments on estimation of frictional parameters through EnKF, verifying the estimated values and its errors.

We set a dipping fault embedded in a homogeneous elastic half space. The friction on the fault is assumed to obey a rate-and state-dependent friction law, and the slowness law of state evolution. We set an asperity at depths of 20-40 km on a stable sliding plate interface, whose frictional properties are characterized by frictional parameters A, B and L. The asperity has the velocity weakening frictional property of A-B<0 and its radius is nearly equal to or less than the nucleation radius determined by frictional parameters. Then, we successfully reproduce the SSEs with the recurrence interval of about 6 months.

We perform numerical experiments on estimation of frictional parameters on the fault through EnKF with the constructed model. EnKF is the method for estimating optimum values by sequentially updating the observations, simulated results and their variance-covariance matrix in a statistical way. The variance-covariance matrix is calculated by computing a lot of ensemble members which are generated by adding random numbers to initial values.

The experimental results in the cases using the synthetic data on the fault show that retrieving frictional parameters requires the appropriate arrangement of observation points which can resolve the spatiotemporal evolution of the SSE slip. We perform the experiment using the synthetic data on the ground surface to discuss possibility of application to the actual SSE faults. It seems to be possible to apply the Bungo channel SSE and the Tokai SSE regions, though this should be confirmed by performing numerical experiments assuming the models and the arrangements of observation points appropriate for these regions.

Keywords: Ensemble Kalman Filter, slow slip event

 