Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SCG62-P14 Room:Convention Hall Time:May 27 18:15-19:30

Estimation of frictional parameters on the SSE fault throuth Ensemble Kalman Filter

OKUDA, Ryosuke[1*] ; HIRAHARA, Kazuro[1] ; MIYAZAKI, Shinichi[1] ; KANO, Masayuki[2] ; OHTANI, Makiko[1]

[1]Graduate School of Science, Kyoto Univercity, [2]Earthquake Research Institute, University of Tokyo

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 frictional parameters on the fault related to SSE with GPS data through Ensemble Kalman filter (EnKF), a data assimilation method 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 velocity on the observation error. Then, we perform numerical experiments on estimation of frictional parameters through EnKF, verifying the estimated values and their errors.

In this paper, we focus on Yaeyama SSEs along the Ryukyu trench, southeast Japan. Around the Yaeyama islands, GPS observed southeast displacement related to SSEs recurrently. Heki and Kataoka (2008) reported the following features of Yaeyama SSEs; 1) there are few earthquake near affecting the SSE fault in the observation period ,2) SSEs recur on a plate interface at depths of 20-40km, 3) the average recurrence interval is 6.3 months, 4) its standard deviation is 1.2 months, 5) the slip rate released by SSEs is 11.0 cm/yr, in spite of the estimated convergence rate of 12.5 cm/yr.

We construct a simulation model which reproduces the above features of SSEs. 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 (Dietrich, 1979). 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 following Kato (2003). 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. We successfully reproduce the SSEs with the recurrence interval of about 6 months by setting a single asperity with the radius of about 30 km has frictional parameters of Vpl=12.5cm/yr, A=50 kPa, B=57.5kPa, and L=2.5 mm.

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 modifying the observations, simulated results and their variance-covariance matrix in a statistical way. The variance-covariance matrix are calculated by computing a lot of ensemble members which are generated by adding random numbers to initial values. As a first step, we generate the synthetic date as observed values by adding random noise to slip rate on the fault simulated on the above physical model and frictional parameters. Those parameters and calculated values are defined as true values on the experiments. We estimate slip rate, state variable and frictional parameters, A, A-B, and L thorough EnKF with the synthetic data and initial parameters with added offsets to true value, and verify the result by comparing the estimated values to true values.In this presentation, I show the verified result.

Keywords: slow slip events, Ensemble Kalman Filter