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アジョイント法による余効すべり時空間発展の予測手法の開発
Development of Forecasting Method of Spatio-Temporal Afterslip Evolution by Adjoint Method

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We develop a method to forecast spatio-temporal afterslip evolution based on adjoint method for the purpose of predicting the second event of compound earthquakes. One large earthquake sometimes triggers another earthquake nearby with the intervals of hours to years. An example includes megathrust earthquakes at the Kurile Trench. The 2004 November 29 Nemuro-oki earthquake followed the 2003 September 25 Tokachi-oki earthquake. A significant afterslip was observed between those two earthquake rupture regions. Furthermore the afterslip has propagated from the Tokachi-oki earthquake region to the Nemuro-oki region. Thus the Nemuro-oki earthquake is thought to be triggered by the afterslip. In such a case, forecast of afterslip propagation may help to predict the triggering of the second large event (the Nemuro-oki earthquake in this case).

This study is dedicated to develop a forecasting system of afterslip evolution. Evolution of slip velocity and frictional coefficient is governed by a rate- and state- dependent friction law. Three frictional parameters determine the friction that acts on the plate interface. Thus we need to know frictional parameters in addition to the initial conditions of differential equations. Kano et al. (2010, in Japanese) first employed an adjoint method and examined how this method works for our purpose by twin experiments. They used decaying phase of afterslip velocity on the plate surface to update frictional parameters. However, all frictional parameters are not constrained by those data. Thus we use data for the propagation of afterslip and investigate the possibility of estimating other parameters. The results are summarized as follows:

(1) Decaying part of afterslip data constrains the initial value of slip velocity and frictional parameter a-b, but does not either the initial value of state variable or the parameter L.

(2) Early phase of afterslip data prior to reaching to the steady state constrains the parameter L and initial value of state variable theta.

(3) Data for the propagation of afterslip constrains all of parameters a, a-b, and L.

The adjoint method, which is numerically efficient one, would be one of the future courses of developing a forecasting system of earthquake generation.