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データ同化窓の設定と感度解析
Adequate Emplacement of the Data Assimilation Window and Sensitivity Analysis

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Comprehension of fault behavior in earthquake sequence inevitably requires to elucidate frictional properties on slip interfaces. One of the good candidates to grasp the properties is data assimilation.

Recently Kano et al. (2013) developed a methodology for applying an adjoint-based data assimilation method to constrain some of the frictional properties on a simplified fault model with synthetic afterslip observation data. They found that all the frictional parameters were optimized when both acceleration and deceleration phases of the observed slip-rate data were assimilated. Importance of their finding is that an adequate emplacement of the assimilation time window plays one of the key roles to optimize the frictional parameters.

In this research, we attempt to find where the assimilation time window should be placed on to constrain all the frictional parameters. It could be acceptable that the assimilation time window should cover portions of the slip rate time series having the highest sensitivity to perturbations of the frictional properties. To ensure the above notion, we make theoretical and numerical approaches.

First, we set a simplified fault model with a rate- and state-dependent law and an aging law, sketching characteristics of the long-term slow slip events (SSEs) recurring on the plate interface beneath the Bungo Channel in southwest Japan.

For searching the portions of the highest sensitivity, we take a first variation of the governing equations of the SSE model. This algebraic manipulation shows that the highest sensitivity appears in the acceleration phase of the slip rate time series.

We then make a series of synthetic data assimilation experiments to examine whether or not the highest sensitivity portion offer an adequate assimilation window. The experiments employ an adjoint data assimilation method to constrain frictional parameters of the Bungo SSE model with synthetic slip rate observation data.

In our presentation, we will demonstrate the results of the experiments that the acceleration part of the slip rate is expected to be necessary to retrieve all the frictional parameters on the slip interfaces.

Combining the results of the mathematical formulation and the synthetic data assimilation experiments, we may confirm that an adequate assimilation time window spans the portions having the highest sensitivity to perturbations of the frictional parameters. Also, the distribution of the sensitivities in the slip rate time series could be obtained as a priori knowledge through the algebraic manipulation of the governing equations.

キーワード: データ同化, 感度解析, アジョイント法
Keywords: data assimilation, sensitivity analysis, adjoint method