# A generation mechanism of slow slip events in the simulation based on the rate- and state-dependent friction law

# Noa Mitsui[1], Kazuro Hirahara[2]

[1] Earth and Environmental Stu., Nagoya Univ., [2] Environmental Studies, Nagoya Univ.

In recent years, slow slips have been observed based on the GPS data analyses [e.g., Ozawa et al. 2002]. They do not have any seismic wave radiation, and its generation mechanism is unclear. Therefore numerical simulations are performed to understand it. Slow slips are reproduced in the simulations using a rate- and state-dependent friction law [e.g., Yoshida and Kato 2002; Hirose 2002]. Yoshida and Kato [2002] use a block-spring model with two blocks which have different frictional parameters, and they explain that the mechanism of the interseismic episodic slow slip at the aseismic region could be the decaying oscillation approaching a steady state and it is caused by the inhomogeneity of the frictional parameter and by the interaction between the asperities. Hirose [2002] uses a three-dimensional homogeneous elastic model and interprets that the stress inhomogeneity can produce slow slip even if the frictional parameter is homogeneous.

To find the physical mechanism common to these results, we simulate slow slip event using a block-spring model with two blocks based on the rate- and state-dependent law. For this purpose, we carefully examine the temporal change of the physical variables.

We investigate the block behavior in the case that two blocks have the different frictional parameters (a-b in case 1, L in case 2), and that the stress interactions between the blocks are different (case 3). Only one parameter in one block is changed in each case and the other parameters are kept to clarify what effects on the slip behavior. We find the common mechanism to produce slow slip based on the rate- and state-dependent law introducing the concept of 'interface strength' in the law proposed by Nakatani [2001]. As the result, friction increases until it reaches interface strength when earthquakes occur, while it decreases before it reaches interface strength when slow slips occur. Slip velocity of the block depends on the difference between friction and interface strength. Thus slow slips occur if friction and interface strength increase or decrease together. Consequently, when models have following conditions, (1) the system is that the constituent elements of a model are perturbed, (2) the system has spatial inhomogeneity in stress or frictional character, (3) the frictional state of one of the constituent elements can temporarily be located near the border between the stable and the unstable frictional state due to perturbation from the outside (or the other elements), slow slip events can occur.