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CREEP AND STRONG MOTIONS OF TECTONIC PLATES DEFINEDBY THE FAULT GEOMETRY

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We consider a two-dimensional slider block model subject to the rate and state dependent friction law. The block interacts with a slowly moving surface through a static and dynamic friction coefficients defined separately for the stick and slip phases of motion. The elastic forces tending to move the block to its initial position are described by a strain tensor, which in the simplest case can be reduced to two stiffness coefficients acting in mutually orthogonal directions. The model is capable of reproducing complicated oscillatory patterns of stick-slip motion, starting from simple periodic oscillations to quasiperiodic, chaotic, and intermittent behavior.

It has been found out that the oscillatory patterns shown by the model can be roughly attributed to two big classes of creep and strong motions, and the system can demonstrate sudden transitions between the oscillations of different classes, either periodically or in an irregular intermittent manner. This behavior looks similar to the temporal distribution of seismic events in some areas, where long time intervals of creep motion are interrupted by large events. On the other hand, the model can be used for the study of those regions where only creep behavior or only strong motions are observed.

In this presentation, we focus on the dependence of the model behavior on the geometry of fault structure it can simulate. The transitions between the two classes of behavior (creep and strong) are analyzed in detail, depending on the direction of motion of the surface underneath the block. This setting corresponds to the analysis of dynamics of a fault segment with respect to the angle between the fault surface and velocity vector of the tectonic plates constituting the fault. We show that even small changes in the direction of motion of tectonic plates can switch the dynamics of the fault segment from creep to stick-slip motions of high amplitude. The results can be used for interpreting the observations where geographically close fault segments demonstrate qualitatively different dynamics, i.e. some part of the fault produces only creep motion while the adjacent part generates big events.