# GeoFEM earthquake generation cycle simulation

# Kazuro Hirahara[1]

[1] Environmental Studies, Nagoya Univ.

We have developed program codes for simulating earthquake cycle mainly based on FEM. Together with RIST, we have developed GeoFEM earthquake cycle simulation modules. We review the recent progresses on earthquake cycle simulation in our research group.

In GeoFEM, dislocation is implemented for representing fault slips and the kinematic plate subduction. Using this kinematic frame of plate subduction, we construct 3-D viscoelastic FEM models to simulate kinematic earthquake cycle in northeast and southwest Japan, respectively. In northeast Japan, we simulate 100-year crustal deformation caused by plate subduction and interplate earthquakes which occurred actually (Suito et al., 2002). Comparison with the observations suggests a possibility that at least a great slow slip event (Mw=8.4) occurred.

In southwest Japan, we simulate 300-year crustal deformation due to Philippine Sea plate subduction and 3 great interplate earthquakes along the Nankai trough. The temporal change of Coulomb Failure function on several inland active faults due to subducting plate and interplate earthquakes well predicts the occurrence of the inland earthquakes on faults with the strikes perpendicular to the direction of the plate subduction (Hyodo and Hirahara, 2002a). On the other hand, this is not the case for other faults. For long-range transferring of effect of the plate subduction and the origin of NKTZ, we present a quantitative model, which has laterally heterogeneous elastic crust and the viscoelastic upper mantle (Hyodo and Hirahara, 2002b).

GeoFEM has a function of contact analysis. We regards the earthquake slip evolution as the contact problem on the plate boundary or faults. At present, a simple friction law is only implemented, and a efficient method for solving rate and state friction law is under development.

In Earth Simulator, we have installed GeoFEM and run simple test models. In parallel with GeoFEM development, we have developed 3-D code (Hirose and Hirahara,2002) extended from 2-D earthquake cycle simulation with a rate and state friction law (Kato and Hirasawa, 1997). This code will be also installed in Earth Simulator to execute a large scale earthquake cycle simulation in northeast and southwest Japan. Together with the calculation of stress due to unit slip in a 3-D viscoelastic medium using GeoFEM, we simulate earthquake cycle in 3-D heterogeneous viscoelastic medium.