Inversion analysis of postseismic deformations in poroelastic medium.

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Following a large earthquake, postseismic deformations in the source regions have been observed by several geodetic measurements: Global Positioning System (GPS), Interferometric synthetic Aperture Radar (InSAR), leveling measurements and the other geodetic measurements. These observations show the temporally decaying movements of postseismic deformations. In order to explain the above phenomena, many studies propose the time-dependent processes include afterslip, viscoelastic relaxation and poroelastic rebound. The cases of afterslip and viscoelastic relaxation are major study; however, poroelastic rebound is largely unexplored.

The coseismic stress change generates pore pressure gradients in the shallow crust. The pore fluids are trapped for a short time as well as the seismic processes. Such conditions are called the undrained conditions. In undrained condition, poroelastic media have the undrained Poisson's ratio. As time passes after the earthquake, the pore fluids infiltration allow the pore pressure gradients to dissipate and reaches drained condition with the drained Poisson's ratio. Peltzer et al. [1998] modeled the poroelastic rebound after the Landers earthquake by simply calculating the difference between two coseismic dislocation models using undrained and drained Poisson's ratio. But this model didn't include the effects of poroelastic rebounds by the afterslip processes. It is important to understand the time series of poroelastic rebound.

Because of this, we developed the inversion method that accounts for both afterslip and poroelastic rebound using FEM to estimate the difference of slip distributions on the fault quantitatively. The inversion analysis takes following steps. First, we calculate the coseismic and postseismic response functions on each fault segment induced by the unit slip. Where postseismic response function indicate the poroelastic rebound. Next, we make the observation equations at each time step using the response functions and estimate the spatiotemporal distribution of slip on the fault. In solving this inverse problem, we assume the slip distributions on the fault are smooth in space and time except for rapid change (coseismic change). Because the hyper-parameters that control the smoothness of spatial and temporal distributions of slip are needed, we determine the best hyperparameters using ABIC. In this presentation, we introduce the example of analysis results using this method.