Reconciling independent observations: lessons from slow slip mechanics and earthquake triggering

Tectonic and volcanic processes are frequently observed and investigated through several streams of data, such as seismic, geodetic, and laboratory observations. However, there have been limited efforts to jointly model separate and independent observations through a single unified model. Moreover, sometimes prevailing theories and models are not consistent with all lines of evidence.

In this talk, I explore two examples of reconciling independent observations from my research. First, I investigate a poroelastic mechanism that gives rise to spontaneous nucleation of stable slow slip pulses on mildly rate-strengthening faults. Thus possibly reconciling laboratory observations that suggest slow slip occurs at rate-strengthening friction with current theories, which generally assume a rate-weakening frictional behavior. The simulated slip pulses share many important characteristics of slow slip in nature, such as having low stress drops, but a large minimum slip patch dimension. Secondly, I construct a model that predicts both deformation and microseismicity for a propagating dike while maintaining total consistency in joint fields that affect both geodetic and seismic observables. We apply the model to the 2014 Bárðarbunga dike in Iceland, which is the best observed large dike intrusion (> 0.5 km$^3$) to date. The model captures many of the complex spatial, and temporal characteristics of the dike induced earthquakes and gives insight into the spatial frictional structure of the crust.