Invited personnel：Roland Bürgmann (UC Berkeley)
Host researcher：Toru Matsuzawa (Graduate School of Science, Tohoku University)
Period：14-23 July 2016
Purpose：To give a seminar at Tohoku University, to discuss the current and future joint researches, and to attend the ”International Symposium on Crustal Dynamics”
Seminar information：

Date and time: 15 July 2016, 02:00-03:30 PM
Place: 2nd Lecture Room at Research Center for Prediction of Earthquakes and Volcanic Eruptions Graduate School of Science, Tohoku University
Abstract:

Title: Transient deformation and stress from postseismic deformation of the 2011 great megathrust earthquake

Abstract: Great megathrust earthquakes produce far-reaching and enduring postseismic deformation transients that affect crustal stress, seismicity and earthquake hazard for many decades. Here we draw on insights gained from modelling postseismic deformation of several recent global subduction zone earthquakes to consider the effects of three dimensional (3D) rheology structure and contributions from multiple relaxation mechanisms on the predicted evolution of deformation and stress in the aftermath of the 2011 M9.0 Tohoku earthquake in Japan.

We have developed a three-dimensional, spherical viscoelastic finite element model to study the postseismic deformation of the Tohoku earthquake that has been recorded at unprecedented resolution in space and time (Hu et al., 2014; Hu et al., 2016). We integrate geodetic observations and constraints on afterslip from small repeating earthquakes on the megathrust to better distinguish contributions from the different postseismic processes. We model stress-driven afterslip in a 2-km-thick weak shear zone away from historic rupture zones on the megathrust. We model both the viscoelastic relaxation of the upper mantle and shear-zone deformation with a transient Burgers body rheology. The optimal steady-state viscosities of the deep weak shear zone, continental mantle wedge and oceanic upper mantle are determined to be 5×10^{17} Pa s, 3×10^{19} Pa s, and 5×10^{19} Pa s, respectively (Hu et al., 2016). The stress-driven afterslip in the shear zone is up to ~3.5 meters in the first two years after the earthquake, equivalent to a Mw8.4. Our model reproduces the first-order pattern of the land-based and seafloor GPS observations both in horizontal and in vertical directions.

We compute Coulomb stress changes on faults in Japan from both coseismic and transient postseismic deformation. Stress on continental thrust faults in NE Japan were generally relaxed by the Tohoku earthquake, whereas substantial stress increases are predicted on the adjacent sections of the Japan subduction zone, normal faults of the outer rise, and a number of strike-slip faults in continental Japan. Seismicity rates across Japan have substantially changed since the Tohoku earthquake including enduring accelerations in the Kanto region. The enduring nature of these rate changes suggests that in addition to the initial static and dynamic stress changes due to the Tohoku

rupture, postseismic deformation rate changes are affecting the seismicity across the region.