Harvard University Solid Earth Physics Seminar
1:15 p.m. Thursday 6 February 2014
Dept. EPS Faculty Lounge, 4th Floor,
Hoffman Laboratory, 20 Oxford St.

Crustal seismic velocity changes associated with earthquakes and slow slip events: Indications for a widespread non-elastic short-term response of the crust?

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We use ambient noise based monitoring of the seismic velocity to detect slight temporal changes in the elastic behavior of the crust. We present observations of temporal velocity changes associated with earthquakes and slow slip events. We focus the discussion on earthquakes on the cases of the 2011 Mw9 Tohoku-oki earthquake (Brenguier et al., 2014) and 2008 M7.9 Wenchuan earthquake (Froment et al., 2013, Obermann, 2013). In Japan, we observe a strong coseismic drop of seismic velocities (up to 0.2%) in volcanic regions throughout Japan, including Mt Fuji Volcano about 400 km away from the epicentral area of the Tohoku-oki earthquake. This is the prominent feature of the response during the first days after the earthquake. The velocity drop increased in the following days in the region of maximum deformation produced by the earthquake, eventually followed by a phase of slow recovery. We compare the temporal response of the crust in Japan after Tohoku-oki earthquake with the one observed in Sichuan basin and Tibet after the 2008 M7.9 Wenchuan earthquake. In both cases, the results indicate that, beyond a relaxation of the co-seismic non-linear effect on the seismic speed, post seismic processes affect the seismic velocity at depth. We investigated the cases of slow slip events, for which there is no dynamic shaking, and found a velocity drop at depth associated with the SSEs (Rivet et al., 2011, 2013). We found a correlation between the temporal evolution of speed and the occurrence rate of non-volcanic tremors that cannot be associated with measurement bias. These examples suggest that seismic measurements could allow for the detection of slow deformation at depth.