AOB Seminar

講演者名: Asaf Inbal 博士

所　　属: Tel Aviv University

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場　　所: 理学研究科　合同 C 棟地物第一講義室

講演題目&要旨:

Enhancing Slip Inversions via Joint Seismo-Geodetic Approaches : Examples from Anza and Parkfield, California

Due to the large number of unknowns, slip inversions are generally underdetermined and non-unique. This issue is usually addressed by imposing smoothness and/or dumping constraints. Indeed, regularizing the set of equations can turn the problem overdetermined and more stable, but it does not render the solution more trustable. Additionally, slip distributions on segments located farther away from the geodetic network are (much) less well-resolved than those on segments closer to the network. Here we present two new approaches, aimed at enhancing the resolving power of the inversion procedure in places where the geodetic-only inversion cannot resolve the final slip. The effectiveness of these schemes is demonstrated for the slow-slip events on the Anza segment of the San Jacinto Fault (SJF) and for the final slip of the M6.0 2004 Parkfield mainshock.

The first technique is used to study a three-month long transient slip event that followed the remote Mw7.2, 2010 El Mayor-Cucapah (EMC) earthquake, and was recorded by several strainmeters of the Plate Boundary Observatory. Our approach is based on Dieterich's (1994) model relating the evolution of seismicity rate to applied stresses, within the framework of rate-and-state friction. By inferring stress changes from variations in seismicity rates we are able to resolve slip on deep segments located below the seismogenic zone. We find that the EMC sequence in Anza initiated with ten days of rapid (~100 times the long-term slip rate), deep (12-17 km) slip, which migrated along the SJF strike. During the following 80 days, slip remained stationary, thus significantly stressing the area of the SJF that eventually hosted the Mw5.4 Collins Valley (CV) earthquake. Remarkably, the cumulative moment due to creep induced by the CV event is about 10 times larger than the total seismic moment of the mainshock and its aftershocks. Similar to sequences of large earthquakes rupturing fault gaps, creep induced by the two mainshocks is spatially complementary. The spatial pattern may be due to stresses imparted on the fault early in the EMC sequence, which determined the spatial extent of the late slip episode, or due to strong heterogeneity of frictional properties within the transition zone.

The second technique is used to study the static slip distribution of the M6.0 2004 Parkfield earthquake, which ruptured a ~35 km long densely monitored segment of the San Andreas Fault. Since near-fault 1 Hz GPS data are only available from 11 sites located to the northwest of the epicenter, the static slip distribution to the southeast of the epicenter is poorly resolved. To address this issue, we have developed an approach for extracting permanent offsets from body-wave spectra of strong motion seismograms recorded at the near-field, where the velocity spectra at frequencies well below the corner frequencies approaches the permanent offset. We validated this approach at sites of collocated (or nearly collocated) strong motion sensors and 1 Hz GPS receivers in Japan. By incorporating permanent offsets inferred from strong-motion records satisfying the near-field criteria, we increased the number of permanent offsets in Parkfield by factor of 4, and dramatically enhanced the resolution of the slip inversion. Preliminary results reveal notably more co-seismic slip than previously inferred southeast of the hypocenter.