

COMPUTATIONAL RESEARCH in BOSTON and BEYOND SEMINAR

Geodetically constrained models of viscoelastic stress transfer and earthquake triggering along the North Anatolian Fault

PHOEBE ROBINSON DeVRIES
Harvard University

ABSTRACT:

Over the past 75 years, 8 $M_w > 6.7$ strike-slip earthquakes have ruptured the North Anatolian fault (NAF) from east to west. The series began with the 1939 Erzincan earthquake in eastern Turkey, and the most recent 1999 $M_w = 7.4$ Izmit earthquake extended the pattern of ruptures into the Sea of Marmara in western Turkey. The mean time between seismic events in this westward progression is 8.5 years, with a standard deviation of 11 years, much greater than the timescale of seismic wave propagation (seconds). The delayed triggering of these earthquakes may be explained by the propagation of earthquake-generated diffusive viscoelastic fronts within the upper mantle that slowly increase the Coulomb failure stress (CFS) at adjacent hypocenters. Here, we develop a three-dimensional viscoelastic block model of the greater NAF region to simultaneously explain geodetic observations from both before and after the Izmit earthquake. With a two-layer structure (crust and mantle) and a Burgers rheology (with Maxwell viscosity $\eta_M \approx 10^{18.6} - 10^{19.0}$ and Kelvin viscosity $\eta_K \approx 10^{18.0} - 10^{19.0}$), a block model that incorporates tectonic plate motions, interseismic elastic strain accumulation, transient viscoelastic perturbations, and internal strain can explain these pre- and post- earthquake observations with a single unified model. We combine this geodetically constrained rheological model with the observed sequence of large earthquakes since 1939 to calculate the time-evolution of CFS changes along the North Anatolian Fault due to viscoelastic stress transfer. Based on the median and mean of these critical stress values, we infer that the NAF strand in the northern Marmara Sea near Istanbul, which previously ruptured in 1509, may reach a critical stress level between 2015 and 2032.

FRIDAY, OCTOBER 2, 2015
12:00 PM – 1:00 PM
Building 34, Room 401A
(EECS)

Pizza and beverages will be provided.

<http://math.mit.edu/crib/>