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DIPARTIMENTO DI GEOSCIENZE

Seminario

Anatomy of the Main Himalayan Thrust: Implications for elastic energy storage and lateral segmentation

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Aula Arduino

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Abstract:

There is increasing evidence that the Himalayan seismicity can be bimodal: partial ruptures (M7+) tend to cluster in the downdip part of the seismogenic zone, whereas infrequent large earthquakes (M8+) propagate up to the surface. To explore the conditions that could explain this bimodal seismicity, we developed a 2D, seismo-thermo-mechanical (STM) model of the Nepal Himalaya. The model reproduces a realistic earthquake sequence of irregular moment magnitude main shocks — including events similar to the 2015 Mw 7.8 Gorkha earthquake — and provides an excellent match to the interseismic observations. More importantly, they establish the dependence of earthquake rupture pattern on fault frictional properties and non-planar geometry of the Main Himalayan Thrust (MHT) due to variations in strength excess. An increase in fault friction leads to a transition from ordinary cycles of similar sized complete ruptures to irregular cycles. These irregular cycles are even more emphasized when the model accounts for a realistic ramp-flat-ramp geometry of the MHT, since a steep frontal ramp increases the depth-dependent strength. We then use a recent compilation of geodetic data to derive the first probabilistic estimates of fault coupling along the MHT. Using a fully Bayesian approach, we evaluate the population of plausible coupling models given geodetic data and forward problem uncertainties. The spatial variability in coupling and complexity in earthquake history suggest lateral variations in the collisional structure, which are probably related to inherited tectonic structures from the India-Eurasia collision. The Himalayan megathrust appears to be paved with low- and high-coupling patches and the resulting pattern seems to have a profound influence on its long-term seismic behaviour, as well as on individual earthquakes.

Proponente: Manuele Faccenda