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Megathrust Earthquakes: How Large? How Destructive? How Often?

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Assessing seismic hazard remains a major challenge, especially when it comes to estimating the probability of occurrence, possible location, and magnitude of the most extreme events. Efforts to gain a better understanding of the physics governing fault and earthquake dynamics are therefore essential. In this talk, I will discuss progress made in that direction. I will focus in part on the Himalaya, which is a prime location to study the dynamics and seismicity at converging plate boundaries. I will review constraints on the kinematics of crustal deformation in the Himalaya and show that millenary Mw>8.5 earthquakes are likely required. I will also describe details of the 2015 Mw 7.8 Gorkha earthquake, Nepal. Our analysis shows that the earthquake unzipped the lower edge of the locked portion of the megathrust and formed a rather smooth slip pulse that propagated eastwards and ruptured the megathrust beneath Kathmandu basin. As a result, the earthquake produced mild shaking in Kathmandu at short periods (<1s) and limited destruction to vernacular few stories buildings. Taller buildings suffered comparatively more damage due to the resonance of the basin around 5s. This particular example of the Gorkha earthquake provides important insights on seismic hazards related to the Himalayan megathrust, and of the probable relevance to continental and subduction megathrust in general.

References:

Stevens, V. L., and J. P. Avouac (2016), Millenary M-w > 9.0 earthquakes required by geodetic strain in the Himalaya, Geophysical Research Letters, 43(3), 1118-1123.

Avouac, J.-P. (2015), From Geodetic Imaging of Seismic and Aseismic Fault Slip to Dynamic Modeling of the Seismic Cycle, Annual Review of Earth and Planetary Sciences, Vol 43, 43, 233-271.

Avouac, J.-P., L. Meng, S. Wei, T. Wang, and J.-P. Ampuero (2015), Lower edge of locked Main Himalayan Thrust unzipped by the 2015 Gorkha earthquake, Nature Geoscience, 8(9), 708.

Galetzka, J., et. al. (2015), Slip pulse and resonance of Kathmandu basin during the 2015 Mw 7.8 Gorkha earthquake, Nepal imaged with geodesy, Science.

Michel, S., J. P. Avouac, N. Lapusta, and J. L. Jiang (2017), Pulse-like partial ruptures and high-frequency radiation at creeping-locked transition during megathrust earthquakes, Geophysical Research Letters, 44(16), 8345-8351.