Geophysical Research Abstracts
Vol. 20, EGU2018-12856, 2018
EGU General Assembly 2018

The main Himalayan thrust geometry and depth-dependent properties revealed by the 2015 Gorkha earthquake.

Zacharie Duputel (1), Han Yue (2), Gerard Wittlinger (1), György Hetényi (3), Jérôme Vergne (1), and Mark Simons (4)

(1) Institut de Physique du Globe de Strasbourg (CNRS and EOST/Université de Strasbourg), Strasbourg, France (zacharie.duputel@unistra.fr), (2) ITAG Institute of Theoretical and Applied Geophysics, Peking University, China, (3) Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland, (4) Seismological Laboratory, California Institute of Technology, Pasadena, USA.

On April 25th 2015, the $M_w = 7.8$ Gorkha earthquake ruptured a portion of the Main Himalayan Thrust (MHT) beneath central Nepal. This event offers an outstanding occasion to better constrain and resolve the geometry of the fault, which can have a profound influence on the seismogenic behavior of the MHT and the building of Himalayan topography. Using global seismological data, we perform reliable Centroid Moment Tensor inversions of the Gorkha earthquake sequence accounting for lateral structural heterogeneities. We also compute both S-to-P and P-to-S receiver functions in the main rupture area using a selection of $M_w > 6$ teleseismic events recorded by the Hi-CLIMB broadband network. In parallel, we use InSAR, GPS, high-rate GPS and teleseismic data to build kinematic slip models of the Gorkha earthquake. Results show that inverted centroid locations for the mainshock and largest aftershocks fall within a low-velocity zone revealed by receiver functions at 10-15 km depth in the flat portion of the MHT. Using both a regularized multi-time-window approach and an unsmoothed Bayesian formulation, our finite-fault inversions indicate a significant depth variation of slip properties during the mainshock. We observe higher slip roughness and rupture velocity in the deeper extents of the rupture area, while up-dip portions display a relatively continuous rupture. These observations are consistent with our long-period directivity analysis showing that long-period energy emanated up-dip of high-frequency radiation sources previously inferred by backprojection. A smooth up-dip rupture process is also in agreement with the depletion of high-frequency energy in the ground shaking of the Kathmandu valley, which was likely a combined effect of source properties and basin response. Such along-dip varying rupture properties might be explained by different factors such as fault geometry, the existence of small-scale asperities in the down-dip part of the MHT, and the presence of fluids suggested by the low-velocity zone in the flat part of the MHT.