Geophysical Research Abstracts
Vol. 20, EGU2018-7805, 2018
EGU General Assembly 2018

Initiation mechanisms and triggering thresholds associated with runoff-generated debris flows in the western U.S.

Luke McGuire (1), Hui Tang (1), Francis Rengers (2), Jason Kean (2), Dennis Staley (2), and Ann Youberg (3)
(1) University of Arizona, Department of Geosciences, Tucson, Arizona, United States (lmcguire@email.arizona.edu), (2) U.S. Geological Survey, Golden, Colorado, United States, (3) Arizona Geological Survey, Tucson, Arizona, United States

Runoff-generated debris flows initiate when water concentrates in steep channels, mobilizing large volumes of sediment and creating hazards that threaten human life and infrastructure. Debris flows generated by runoff, however, are poorly understood relative to those that are mobilized from shallow landslides. Multiple mechanisms have been suggested in the formation of runoff-generated debris flows, including progressive entrainment and the mass failure of channel bed sediment. However, the processes that create runoff-generated debris flows have remained elusive because there is a paucity of direct observations and the interpretation of debris flow deposits is complicated by modification from fluvial processes. In this study, we take advantage of recently compiled datasets that constrain the timing of post-wildfire debris flows triggered by rainstorms at four different study areas throughout the western U.S. Using a physically-based numerical model to simulate water runoff and sediment transport processes, we reconstructed the hydrologic conditions during debris-flow-producing rainstorms in order to quantify hydrologic thresholds associated with debris flow initiation and assess the likelihood of different initiation mechanisms. Numerical modeling indicates mass failure of channel bed sediment was crucial for debris flow initiation at multiple field sites. Furthermore, we found that debris flow initiation is inextricably linked to the available sediment in the channel systems and the runoff volume entering channels. More generally, however, our results suggest that debris flow initiation at a given site likely occurs through multiple mechanisms due to temporal variations in sediment supply and water discharge. This study provides general insight into the processes that transform runoff into debris flows and places additional constraints on the hydrologic conditions associated with runoff-generated debris flows.