An evaluation of uncertainty in extreme landslide-triggering precipitation

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There are many sources of uncertainty that present challenges to skillful landslide predictions such as road cuts, vegetation changes, and subsurface soil structure. However, perhaps the largest source of uncertainty in landslide probability estimates is hydrologic uncertainty or uncertainty in the volume and spatial distribution of both antecedent soil moisture and precipitation during and immediately preceding the event. The key challenge is the wide range of values represented in different available precipitation datasets. Here we investigate the contribution of precipitation uncertainty, and subsequently the uncertainty in modeled soil saturation, to the uncertainty of predicted landslide probability. First, we compare precipitation at 257 landslide locations across the continental US and Canada. Precipitation data are taken from four products that cover disparate measurement methods: satellite, radar, gauge, and numerical weather prediction. The products also cover a range of spatial and temporal resolutions. We compare the average intensity, peak intensity at the smallest interval available, duration of the landslide-triggering storms, and return period as measured by each product. Next, we identify the enclosing watershed for each landslide and use the streamflow in combination with the precipitation measurements to compare the runoff ratio during the triggering event. Finally, we evaluate the soil moisture at each site leading up to the landslide by using each precipitation dataset to drive the Hydrus hydrologic model. The implications of uncertainty in precipitation for the precision of landslide predictions in different climates and types of landslides are explored.