Geophysical Research Abstracts
Vol. 19, EGU2017-11149, 2017
EGU General Assembly 2017

Accounting for rainfall spatial variability in the prediction of flash floods

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Flash floods are a particularly damaging natural hazard worldwide in terms of both fatalities and property damage. In the United States, the lack of a comprehensive database that catalogues information related to flash flood timing, location, causative rainfall, and basin geomorphology has hindered broad characterization studies. First a representative and long archive of more than 15,000 flooding events during 2002-2011 is used to analyze the spatial and temporal variability of flash floods. We also derive large number of spatially distributed geomorphological and climatological parameters such as basin area, mean annual precipitation, basin slope etc. to identify static basin characteristics that influence flood response. For the same period, the National Severe Storms Laboratory (NSSL) has produced a decadal archive of Multi-Radar/Multi-Sensor (MRMS) radar-only precipitation rates at 1-km spatial resolution with 5-min temporal resolution. This provides an unprecedented opportunity to analyze the impact of event-level precipitation variability on flooding using a big data approach. To analyze the impact of sub-basin scale rainfall spatial variability on flooding, certain indices such as the first and second scaled moment of rainfall, horizontal gap, vertical gap etc. are computed from the MRMS dataset. Finally, flooding characteristics such as rise time, lag time, and peak discharge are linked to derived geomorphologic, climatologic, and rainfall indices to identify basin characteristics that drive flash floods. The database has been subjected to rigorous quality control by accounting for radar beam height and percentage snow in basins. So far studies involving rainfall variability indices have only been performed on a case study basis, and a large scale approach is expected to provide a deeper insight into how sub-basin scale precipitation variability affects flooding. Finally, these findings are validated using the National Weather Service storm reports and a historical flood fatalities database. This analysis framework will serve as a baseline for evaluating distributed hydrologic model simulations such as the Flooded Locations And Simulated Hydrographs Project (FLASH) (http://flash.ou.edu).