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Predicting flood responses from spatial rainfall variability and basin morphology through machine learning

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Predicting flash floods at short time scales as well as their impacts is of vital interest to forecasters, emergency managers and community members alike. Particularly, characteristics such as location, timing, and duration are crucial for decision-making processes for the protection of lives, property and infrastructure. Even though these characteristics are primarily driven by the causative rainfall and basin geomorphology, untangling the complex interactions between precipitation and hydrological processes becomes challenging due to the lack of observational datasets which capture diverse conditions.

This work follows upon previous efforts on incorporating spatial rainfall moments as viable predictors for flash flood event characteristics such as lag time and the exceedance of flood stage thresholds at gauged locations over the Conterminous United States (CONUS). These variables were modeled by applying various supervised machine learning techniques over a database of flood events. The data included morphological, climatological, streamflow and precipitation data from over 21,000 flood-producing rainfall events – that occurred over 900+ different basins throughout the CONUS between 2002-2011. This dataset included basin parameters and indices derived from radar-based precipitation, which represented sub-basin scale rainfall spatial variability for each storm event. Both classification and regression models were constructed, and variable importance analysis was performed in order to determine the relevant factors reflecting hydrometeorological processes. In this iteration, a closer look at model performance consistency and variable selection aims to further explore rainfall moments' explanatory power of flood characteristics.