Improving streamflow and flood predictions through computational simulations, machine learning and uncertainty quantification

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Abstract

To mitigate the damaging impacts of floods, accurate prediction of runoff, streamflow and flood inundation is needed. Conventional approach of simulating hydrology and hydraulics using loosely coupled models cannot capture the complex dynamics of surface and sub-surface processes. Additionally, the scarcity of data in ungauged basins and quality of data in gauged basins add uncertainty to model predictions, which need to be quantified. In this presentation, first the role of integrated modeling on creating accurate flood simulations and inundation maps will be presented with specific focus on urban environments. Next, the use of machine learning in producing streamflow predictions will be presented with specific focus on incorporating covariate shift and the application of theory guided machine learning. Finally, a framework to quantify the uncertainty in flood models using Hierarchical Bayesian Modeling Averaging will be presented. Overall, this presentation will highlight that creating accurate information on flood magnitude and extent requires innovation and advancement in different aspects related to hydrologic predictions.