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Natural Uncertainty Measure for Forecasting Floods in Ungauged Basins

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Recent data analysis have shown that peak flows for individual Rainfall-Runoff (RF-RO) events exhibit power law scaling with respect to drainage area, but the scaling slopes and intercepts change from one event to the next. We test this feature in the 32,400 km^2 Iowa River basin, and give supporting evidence for our hypothesis that scaling slope and intercept incorporates all the pertinent physical processes that produce floods. These developments serve as the foundations for the key question that is addressed here: How to define uncertainty bounds for flood prediction for each event? We theoretically introduce the concept of Natural Uncertainty Measure for peak discharge (NUMPD) and test it using data from the Iowa River basin. We conjecture that NUMPD puts a limit to predictive uncertainty using measurements and modeling. In other words, the best any amount of data collection combined with any model can do is to come close to predicting NUMPD, but it cannot match or reduce it any further. For the applications of flood predictions, the concepts of Type-I and Type-II uncertainties in flood prediction are explained. We demonstrate Type-I uncertainty using the concept of NUMPD. Our results offer a context for Type-II uncertainty. Our results make a unique contribution to International Association of Hydrologic Sciences (IAHS) decade-long initiative on Predictions in Unaguged Basins (PUB) (2003-2012).