OU WATER DISTINGUISHED LECTURE SERIES

ADVANCING LONG-LEAD FLASH FLOOD FORECASTING

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Quantitative Flood Forecasting (QFF) at long-lead times to enable effective warning of communities and is challenging in headwater basins, where orographic precipitation enhancement is significant and flash floods are frequent. Recent work shows that state-of-the-art numerical weather prediction models and reanalysis severely underestimate extreme precipitation events, which therefore handicaps the predictability of flash floods in operational forecast. This work presents a hybrid AI-Physics operational framework for flash flood forecasting. First optimal high resolution precipitation estimates for floods of record were obtained by applying the Inverse Rainfall Correction method to StageIV rainfall. Next, an AI error prediction model was developed to correct High-Resolution Rapid-Refresh (HRRR) rainfall forecasts at different lead times. In the current implementation, the error prediction model works as a headwater-scale bias corrector algorithm using a Random Forest Classifier (RFC) trained against IRC-corrected ground-based radar precipitation products (i.e., StageIV) for 161 IRC-corrected extreme rainfall events in 28 headwater basins along the Appalachian Mountains from 2021 to 2024. Results show that the error correction improves HRRR QPF estimates significantly, especially at long lead times up to 44 hrs. The HRRR QPF is fractally downscaled to 250m resolution, and then used to drive operational flood simulations for more than 1000 km of stream network in the Great Smokies National Park. A pathfinder end-to-end operational system has been deployed in testing mode as an API since May 2025. We present results from a flood study for events during the passage of Hurricane Helene including discussion of practical challenges going forward.

VIRTUAL PRESENTATION
7–8 p.m.
Wednesday, November 5

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