

Flash-flood forecast uncertainty for distributed models using radar data

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Flash flooding in the southwest poses a significant danger to life and property. Implementation of a rainfall-runoff model during the forecast/warning process to mitigate this flood risk is subject to uncertainties stemming from the data and model used. This study investigated such an application using the mechanistic, distributed semi-arid rainfall-runoff model KINEROS2 driven by high resolution radar rainfall input estimates obtained from the NEXRAD WSR-88D DHR reflectivity measurements. Sources of operational uncertainty considered included those in the rainfall estimates, in the model parameters, and in the initial conditions. Using both real and synthetic data from several events, we found that the high predictive uncertainty in the modeled response is heavily dominated by the operational variability of biases in the radar rainfall depth estimates. Sensitivities to KINEROS2 parameters indicated the need for improved representation of semi-arid hillslope hydrology in small basins. Several influential KINEROS2 model parameters were poorly identified because of their wide uncertainty ranges. This was recognized for future directed field investigations in combination with detailed KINEROS2 studies. In the presence of high distributed model non-linearity and associated parameter interactions the ability to reduce such uncertainty ranges using the KINEROS2 alone will be difficult. All the above factors result in an inconsistency of behavioral/optimal model parameter sets for flash flood forecasting across events. Hence, a Monte-Carlo procedure that can incorporate such wide parameter uncertainty ranges with continuous incoming event information updating is required, like the example Generalized Likelihood Uncertainty Estimation (GLUE) procedure we implemented.

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