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Separation of Structural and Measurement Uncertainties in Watershed Hydrological Models

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A hydrological model incurs three types of uncertainties: measurement, structural and parametric uncertainty. Measurement uncertainty exists due to errors in the measurements of rainfall and streamflow data. Structural uncertainty exists due to errors in the mathematical representation of hydrological processes. Parametric uncertainty is a consequence of limited data available to calibrate the model, and measurement and structural uncertainties.

Recently, separation of structural and measurement uncertainties was identified as one of the twenty-three unsolved problems in hydrology. The information about measurement and structural uncertainties is typically available in the form of residual time-series, that is, the difference between observed and simulated streamflow time-series. The residual time-series, however, provides only an aggregate measure of measurement and structural uncertainties. Thus, the measurement and structural uncertainties are inseparable without additional information. In this study, we used random forest (RF) algorithm to gather additional information about measurement uncertainties using hydrological data across several watersheds. Subsequently, the uncertainty bounds obtained by RF were compared against the uncertainty bounds obtained by two other methods: rating-curve analysis and recently proposed runoff-coefficient method. Rating curve analysis yields uncertainty in streamflow measurements only and the runoff-coefficient yields uncertainty in both rainfall and streamflow measurements. The results of the study are promising in terms of using data across different watersheds for the construction of measurement uncertainty bounds. The preliminary results of this study will be presented in the meeting.