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The use of Bounded Intervals for Data Representation in the Evaluation of Uncertainties in Rainfall-Runoff Modeling

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The evaluation of parameter uncertainty and inadequacy in the model structure are innately linked in hydrological modeling when states are not accurately observed. As such, any attempt to separate the parameter uncertainty and model inadequacy are conditional, often in an unexplored way, to the observational and model structure error representations chosen. For example, consider modeling the Rainfall-Runoff process; this requires the consideration of at least two observational series, those of rainfall and river stage. As well as being incommensurate with most rainfall-runoff models the observations are often made on a different spatial and/or temporal scale. Given this any ‘measure of association’ between the observed data and data series used by the model is also a representation of the model inadequacy and parameter uncertainty of any mapping resolving scale or commensurability differences. The realization that the observational error representation also represents a component of the total model structural uncertainty can lead to an ill posed problem since the error representations may be inseparable from the model. One method of achieving this separation is to select a priori a set of acceptable bounds for the observational error. Then, by treating the parameters as evolving over time, the model inadequacy can be mapped into the parameter space. The patterns of parameter evolution can then be explored in a ‘top down’ method, with variation that cannot be accounted for by temporal changes in the system (for example vegetation cycles) being attributed to the inadequacy of the model structure. An application of the HyMod hydraulic model to the Leaf River Catchment (Nr. Collins, Mississippi, USA) is considered as a case study to illustrate the computational techniques and resulting inferences.