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Understanding the behavior of complex models

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As we push our models to their computational limit, the expense of complex model configurations permit only a single deterministic simulation for a short time period. The preference for complex models creates challenges for model analysis, model improvement, and uncertainty characterization. Paradoxically, more complex models may achieve less physical realism than computationally frugal alternatives because computational limitations constrain capabilities to identify and resolve model weaknesses.

This presentation will summarize efforts to systematically evaluate information gains and losses using models of varying complexity. We will present results exploring the interplay between changes in process complexity and changes in spatial complexity for models configured over a large number of basins and for large geographical domains. We will also present applications of information theory to quantify how effectively models use the available information, i.e. to provide an estimate of system predictability. More generally, we will summarize progress in understanding why models differ, in characterizing model uncertainty, and identifying productive pathways to model improvement.