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Can we test model hypotheses of flow and transport in assessing the hydrological impacts of change?

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There is more and more demand for predictions of the hydrological (and related) impacts of future change driven by scenarios of future inputs, a demand driven by the need to inform long term sustainability of water resources. More and more predictions are being made to satisfy this demand, but how much faith should we have in those model outputs? The predictions depend on models that have not been adequately tested as hypotheses about hydrological function and models of future boundary conditions that generally do not reproduce the hydrological forcing without desperate resort to bias corrections in the past and change factors in the future. It is clear that we will not do better until we are more rigorous about testing models as hypotheses for both flow and transport processes. This paper will address the issues involved in doing so, from methods of model evaluation to defining the functional requirements for new types of observations designed specifically for hypothesis testing.