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How to deal with uncertainties in remotely linked models?

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Models have been increasingly used to describe and predict hydrological and environmental problems. Due to the awareness of the interactions of several domains (eg. climatology on hydrology; hydrology on ecology), more and more models are integrated or linked to each other. Where we moved from a single model to a composite model in the 90-ies, we are now moving from a single PC based modeling to a remotely linked modeling configuration. Not only for computer power reasons, but more often to keep the individual models being used, maintained and updated by the relevant expert teams. When models are used for decision making, it is however crucial that the uncertainties of the outcomes are properly described. In a complex, remotely linked modeling system this is however a real challenge. The state-of-the-art solution is the representation the model uncertainties by a set of ensembles. Disadvantage of these methods is the large amount of data that needs to be transferred.
New emerging technologies can help to tackle these problems:
(1) the use of generic descriptors that allow for a synthesized description of the model uncertainties. Such an approach is the best embedded in system using standards to transfer the uncertainty related to data and/or model results (eg. Standardized meta-data structures) in order to allow to generate new sets of ensembles without additional model runs. An illustration is given for the assessment of cascade uncertainty between climate and hydrological models in the Nzoia catchment in Kenya.
(2) the use of meta-models that can replicate the interactions and the associated uncertainties between several variables on the basis of individual models (eg. Bayesian belief networks). Such an approach is used within the REACH-ER decision support tool that allows for the integration of groundwater pollution towards the surface water quality that on its turn, affects the riverine ecology, considering both spatial relationships (upstream-downstream) as relationships between variables (water chemistry-water biology).