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Can the electrical conductivity of karst spring discharge improve the identification of model structures and reduce simulation uncertainty?

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Lumped karst hydrological models often suffer from the over-simplified structures. In recent days, hydrochemical has been used as an auxiliary information to define realistic karst model structures. For karst aquifers, the hydrochemical dynamics of karst springs contain important information about the internal behavior of the karst aquifer that can be conducive to model identification and calibration. In this presentation, electrical conductivity (EC), as a substitution for Ca^{2+} concentration of the spring discharge, is evaluated for its potential for model structure identification and reduction of simulation uncertainty. A new framework to integrate EC in karst modeling is developed at a small, well-instrumented karst catchment near Guilin City, China. A set of different hydrologic models were enabled to consider the linear dissolution process of Ca^{2+} and its transport to investigate the models' abilities to reproduce the behavior of spring discharge and EC. We found that most hydrologic models obtain similar performances concerning spring discharge, however, their performances in simulating spring EC show obvious differences. The combination of observed spring discharge and EC could identify a more realistic model structure that was in accordance with the observed perception of this karst aquifer's functioning. Using the identified "most realistic" model, we use sensitivity analysis to show that spring EC only improves the identifiability of one hydrologic parameter mostly due to too complex EC dynamics during recharge events and therefore has limited potential to reduce discharge simulation uncertainty. Consequently, our new framework to include EC in karst models opens new doors for more realistic simulation but an explicit treatment of uncertainties remains necessary due to EC's limited potential to reduce simulation uncertainty. The next step of our work is to integrate appropriate nonlinear dissolution process of carbonate rock in the model to further improve the simulation of spring EC (Ca^{2+}).