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

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Motivation

Hartmann, A., J. A. Barberá, J. Lange, B. Andreo, and M. Weiler (2013), Progress in the hydrologic simulation of time variant recharge areas of karst systems – Exemplified at a karst spring in Southern Spain, Adv. in Water Resour., 54(0), 149-160.


Hartmann et al. (2013) Advances in water resources

Discharge

More data, additional to discharge, is needed to identify more realistic model structures.

Additional hydro-chemical data

$\delta^{18}O, Cl^-, SO_4^{2-}, NO_3^-, DOC…$

$Ca^{2+}$ is a useful environment tracer to indicate the internal behavior of karst aquifers.
At the study site (Guilin, China), EC shows good linear relationship with Ca\(^{2+}\) concentration and is used to be a surrogate to investigate its contribution to model identification.
Different models

Simulation of EC:
- Linear dissolving process
- Assumption of complete mixing

Nash Sutcliffe efficiency to benchmark model performances both in terms of discharge and EC simulation.
Results

The complex model can get good simulation results of discharge and EC simultaneously.

EC is helpful to identify one hydrologic parameter $h_{\text{epi}}^{\text{max}}$

Frequency distribution curves (FDC) of each parameter in M4s2 before and after the screening by EC ($F_2$). An approach similar to that (Hartmann et al., 2017) was used. A large fraction of sensitive model parameters indicates that no over-parameterization occurs.
Ca$^{2+}$ or EC can be a potential useful environmental tracer to identify more realistic model structures.

EC shows a potential ability to identify the hydrologic parameters, however, it exhibits a limited contribution to uncertainty reduction of spring discharge in the study catchment.

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