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

Yong Chang[1], Ling Liu[2], Guanghui Jiang[3,4], Andreas Hartmann[5,6], Jichun Wu[7]

[1] School of Earth Science and Engineering, Hohai University, Nanjing 210098, China.

[2] Geological Survey of Jiangsu Province, Nanjing 210018, China.

[3] Karst Dynamics Laboratory, Institute of Karst Geology, Guilin 541004, China.

[4] International Karst Research Center auspices of UNESCO, Guilin 541004, China.

[5] Chair of Hydrological Modeling and Water Resources, Freiburg University, Freiburg, 79098, Germany.

[6] Department of Civil Engineering, University of Bristol, Bristol, BS8 1TR, United Kingdom.

[7] Department of Hydrosciences, School of Earth Sciences and Engineering, Nanjing University, Nanjing 210093, China.

Albert-Ludwigs-Universität Freiburg

河海大學
HOHAI UNIVERSITY

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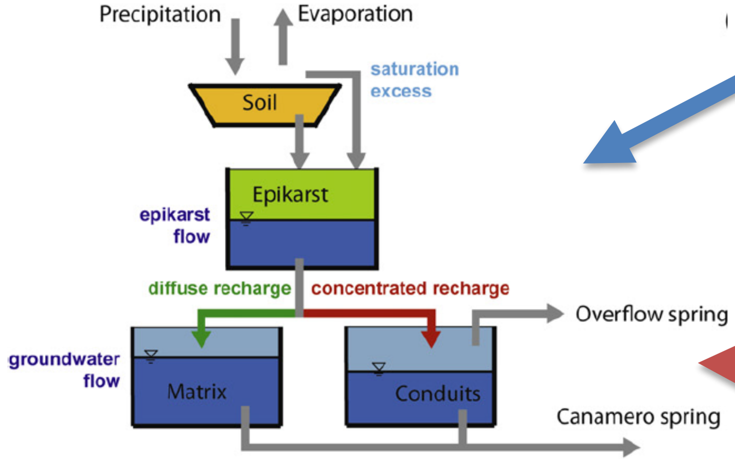
Motivation



Hartmann et al. (2013) Advances in water resources

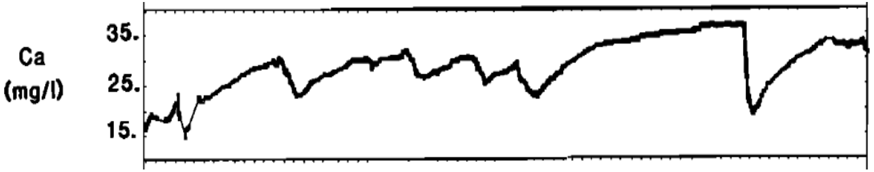
Discharge

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

Additional hydro-chemical data

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

Ca^{2+} is a useful environment tracer to indicate the internal behavior of karst aquifers.

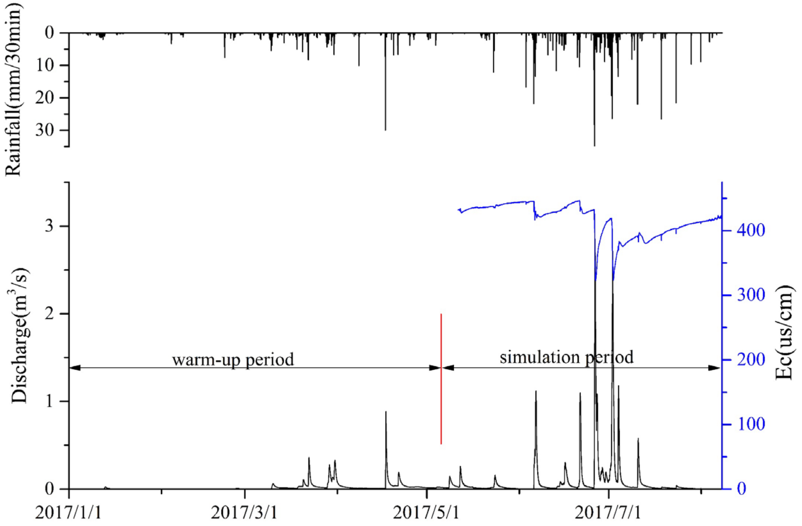


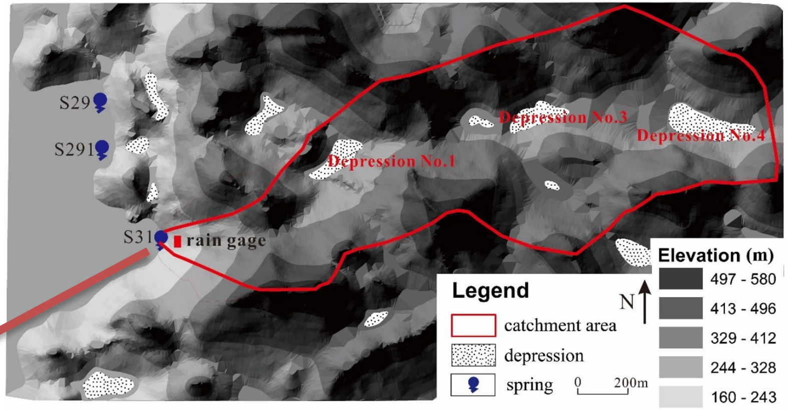
Dreiss (1989) Water Resources Research

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.
Dreiss, S. J. (1989), Regional scale transport in a Karst Aquifer: 1. Component separation of spring flow hydrographs, Water Resour. Res., 25(1), 117-125.

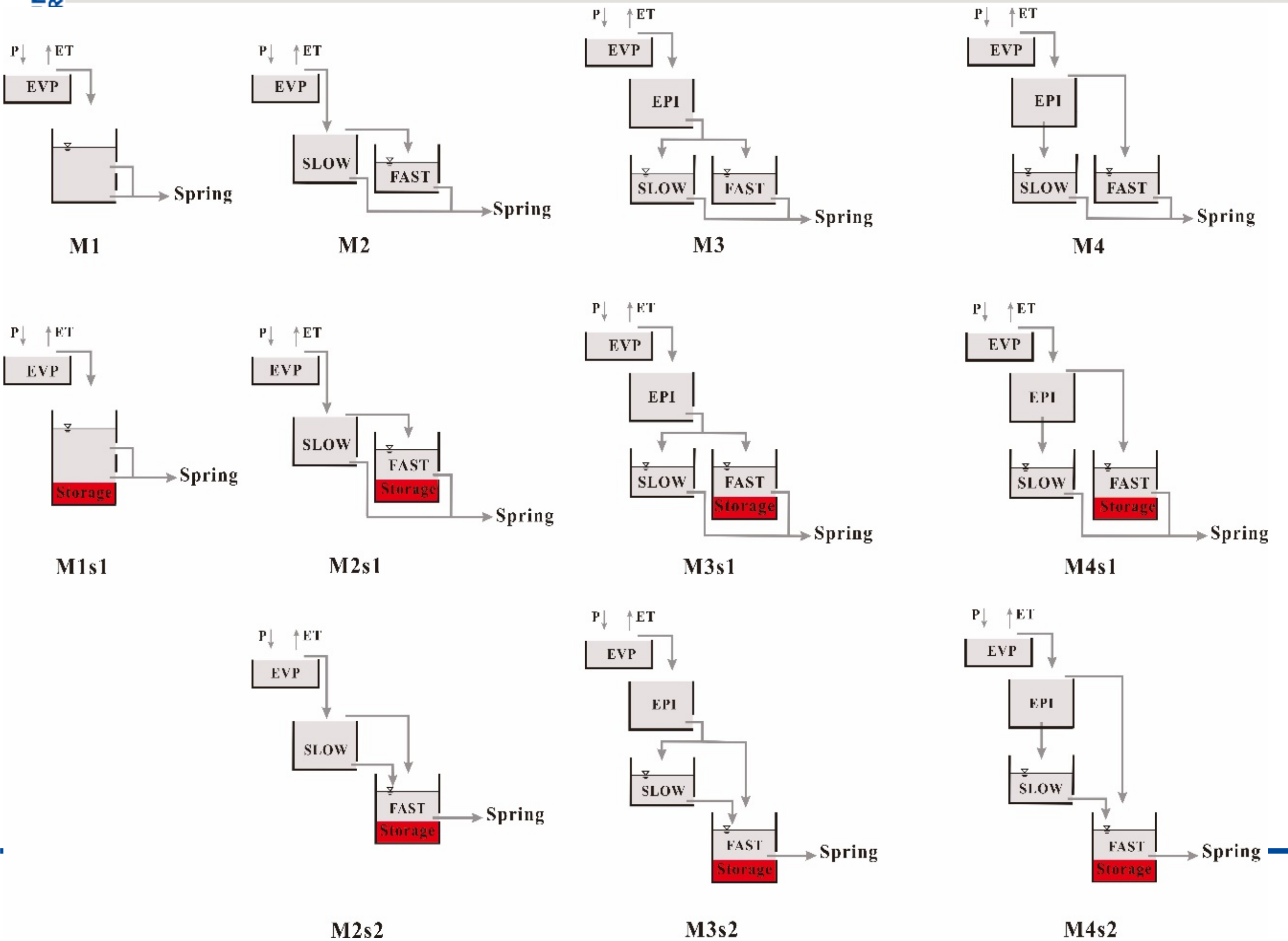
Study catchment

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

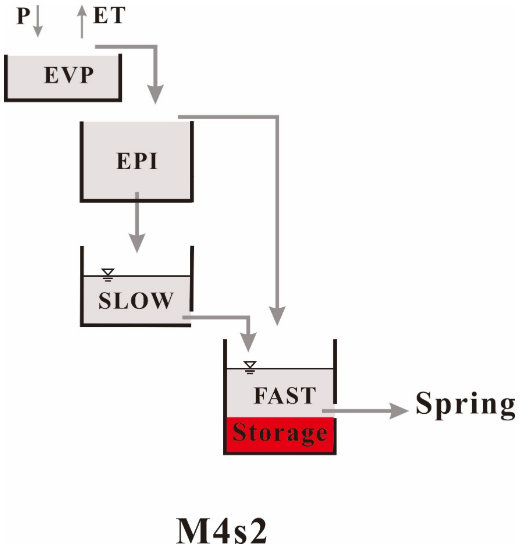


Simulation of EC:

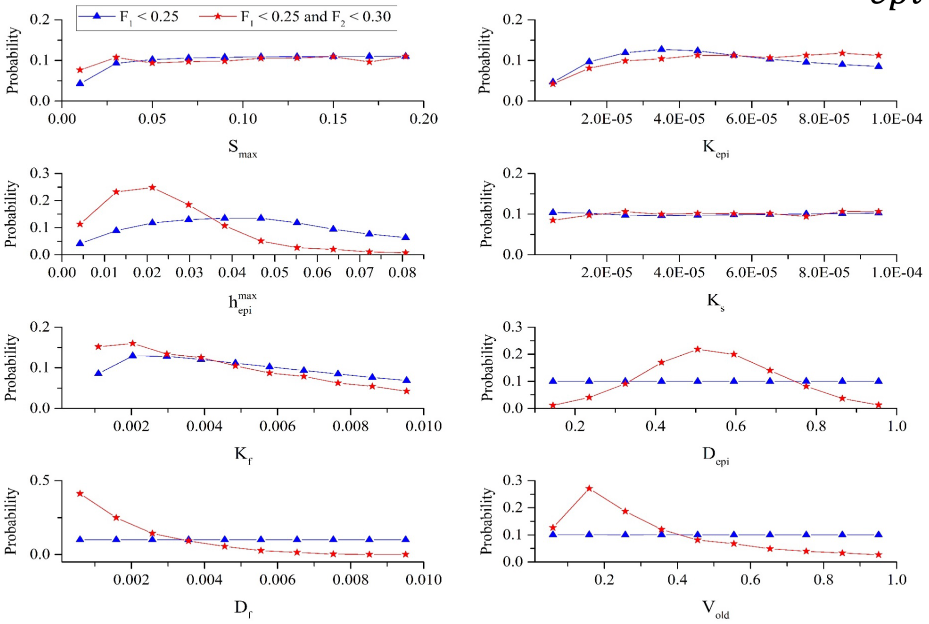
- Linear dissolving process
- Assumption of complete mixing

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

Results



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



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

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

Hartmann, A., J. A. Barberá, and B. Andreo (2017), On the value of water quality data and informative flow states in karst modelling, Hydrol. Earth Syst. Sci., 21(12), 5971-5985.

Conclusions

- 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.

Corresponding author: Yong Chang (wwwkr@163.com)

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Hartmann, A., J. A. Barberá, and B. Andreo (2017), On the value of water quality data and informative flow states in karst modelling, Hydrol. Earth Syst. Sci., 21(12), 5971-5985.