Towards constraining hydrologic models using satellite retrieved soil moisture

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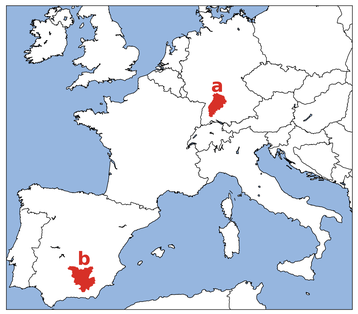
1. Motivation

Hydrological models are usually calibrated against observed discharge at the catchment outlet and thus are conditioned by an integral catchment information. This procedure does not take into account any spatio-temporal variability of fluxes or state variables and can lead to uncertainties in model internal states as e.g. soil moisture (SM). Satellite data may help to better constrain model parameters.

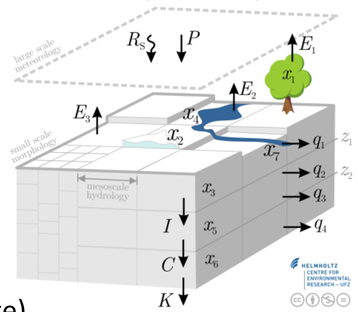
The first objective of this study is to calibrate a hydrological model with synthetic soil moisture data to investigate the skill of different objective functions (OF) for recovering model parameters. The different approaches aim either for spatial, for temporal or for spatio-temporal matching of the two patterns. A second objective is to calibrate the hydrologic model with ESA-CCI satellite soil moisture using the superior OF.

2. Study domain and mesoscale Hydrologic Model (mHM)



mHM [1] is a distributed model which treats grid cells as hydrologic units. mHM's key feature is the Multiscale Parameter Regionalization technique (MPR).

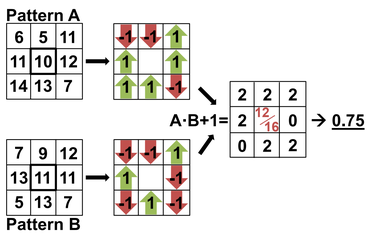
Two distinct European basins
a – Neckar (humid climate)
b – Guadalquivir (semi-arid climate)



3. Calibration objectives

OF1 – KGE of catchment average SM (spatio-temporal pattern)

OF2 – pattern similarity (spatial pattern)

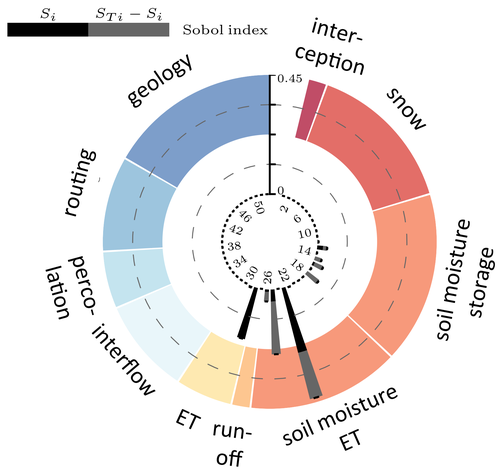


OF3 – sum squared errors of SM anomaly (temporal pattern)

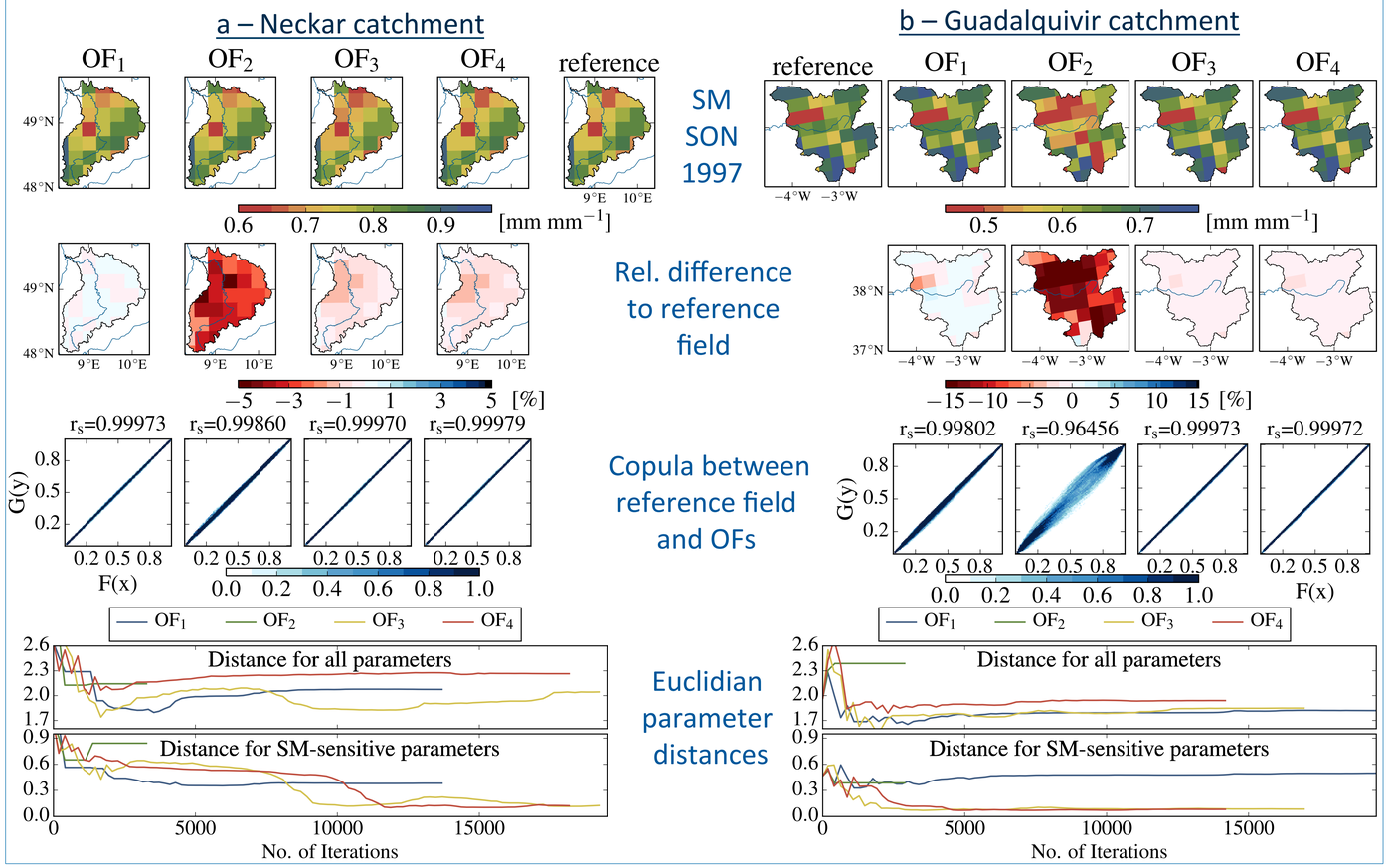
OF4 – spatial average of temporal correlation (temporal pattern)

4. SM-sensitive parameters

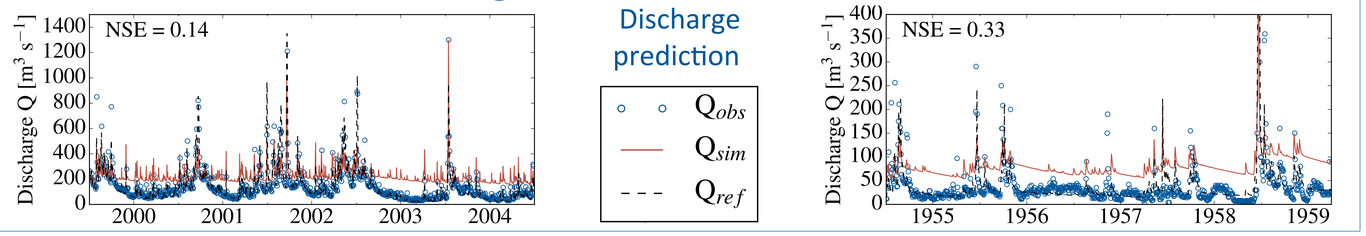
The model parameters which are sensitive to soil moisture are determined due to a sensitivity analysis.



5. Determining the appropriate objective function (synthetic dataset)



6. Calibration with OF3 using ESA-CCI soil moisture



7. Conclusions

- SM-sensitive parameters should be considered if deciding for an appropriate OF.
- Objective functions aiming on temporal patterns of SM almost recover SM-sensitive parameters.
- SM is not sufficient to constrain model parameters for discharge prediction.

References

[1] Samaniego, L., Kumar, R., & Attinger, S. (2010). Multiscale parameter regionalization of a grid-based hydrologic model at the mesoscale. *Water Resources Research*, *46*(5)

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