Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-53-AC3, 2016

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Subgrid spatial variability of soil hydraulic functions for hydrological modelling" *by* P. Kreye and G. Meon

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Received and published: 12 April 2016

We thank Dr. Hans Thodsen for his comments. This will help us to improve the manuscript.

Specific comments

> *The text can in some sections be hard to follow for a non soil-scientist as my self (hydrological modeler) because of the large number of symbols and abbreviations.*

We could add a short appendix with a list of abbreviations, if the editor agrees.

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Generally the figure captions needs to explain the symbols used in the figures, to comply with the "being able to stand alone" criteria.

We totally agree and are going to improve the figure captions.

How is the Ks and other values included in the hydrological model? And how does the model handle the parameter-variation within each soil class (if I understand you right)? Please give an example of the difference the use of different parameter settings makes to the model outcome. Please state what the hydrological model is evaluated against.

In the following, we partly use similar explanations as in our answer to reviewer 3, which we uploaded just shortly before you made your comment.
We use all derived sets of van Genuchten parameters (VGP) and Ks to parameterize the soil hydraulic functions of the soil model, which is incorporated in the hydrological model (PANTA RHEI). Hence, the soil model is parameterized many times with different VGP sets for the same location; the structure and equations were not changed. These “different” models (domains) operate simultaneously and are connected to each other. Summary: We have one model with multiple parameterizations (please take a look at the attached figure in our answer to reviewer 3).
We compared breakthrough curves (1D) with different numbers of VGP sets and with different standard deviations of the Ks distribution functions. Soil moisture patterns could also be compared in dependence of the number of applied VGP sets. The model is evaluated against three types of observations/data: discharge, spatial distributed soil moisture (satellite data, ERS1/2-ESCAT, MetOp-ASCAT, ENVISAT-ASAR) and

groundwater level. The satellite soil moisture data accounts for the upper few cm of the soil surface. The groundwater level data accounts for the lower boundary of the soil model. Individual objective functions were used and connected to a stepwise Downhill-Simplex to calibrate the model parameters. To achieve this, a lexicographical strategy was developed, where different objectives can be defined as an order of preference (Gelleszun et al., 2015). At the moment, we are working on a pursuing manuscript focusing on the hydrological model and its calibration.

9/6 How can the multivariate method give a worse fit than the linear?

The average R^2 are nearly the same (rounded numbers). We think that both methods achieve the same performance and the small difference in R^2 can be explained by the optimization algorithm (we used Levenberg-Marquardt, which is a local algorithm).

References

Gelleszun, M., Kreye, P., and Meon, G.: Lexikografische Kalibrierungsstrategie für eine effiziente Parameterschätzung in hochaufgelösten Niederschlag-Abfluss-Modellen, Hydrologie und Wasserbewirtschaftung, 59, 84–95, 2015

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