Hydrology and Earth System Sciences Discussions

Interactive comment on "Bayesian inverse modelling of in situ soil water dynamics: using prior information about the soil hydraulic properties" *by* B. Scharnagl et al.

Anonymous Referee #4

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The paper applied methods developed in previous papers to synthetic and real data in order to show how prior information on soil characteristics, namely percentage of sand, silt and clay, can improve the results of inverse modeling. As such the paper does not provide innovative methods, but provides interesting numerical and practical tests.

I think that the tests conducted for this paper show the importance of imposing "a priori" information on the correlation among different model parameters. This can be done by the application of the ROSETTA software to simple data, i.e. the relative abundance of sand, silt and clay in the soil.

General comments

(1) The title is quite generic; also, the abstract does not add proper information to understand the key results of the paper. It is necessary to explicit, at least in the abstract, which soil data are used. Moreover, the central result is not the generic use of prior information, but the importance of assessing the correlation between different parameters. Mentioning the bayesian approach in the title is almost useless, as it is well known since decades that this is the most natural approach to include prior information in stochastic inversion.

(2) Section 2.1. Some references, figures or tables with details on the field site could be useful. For instance I have the following questions: how are spatially distributed the monitoring points (61 points evenly spaced over a square grid?)? How many soil samples have been collected? Where are they collected? Which is the variability of the grain size distribution among the samples? Where and how was measured the pressure head? The Authors mention the presence of a discontinuity at a depth of about 30 cm, but they neglect this in the numerical model and do not discuss how the variation of the sand, silt and clay percentages affects the VGM parameters. Can the results of inerse modeling be considered as representative of the shallow horizon?

(3) The covariance matrix of prior soil parameters is computed with an arbitrary covariance matrix of the sand, silt and clay percentages. Why have the measurements on soil samples not been used for the evaluation of this covariance matrix?

(4) The presentation and discussions of the results is very long and could be shortened: the key sentence is at page 2039, lines 24 & 25. This concept should be better emphasized, because it remains partly hidden within a lot of other remarks and technical details.

(5) I do not agree with the conclusion at page 2044, lines 1 & 2. In fact the comments to figure 7 (see page 2041, lines 24 to 27) show that there are some outliers, which are apparent on the tails of the distribution in figure 9c. It is well known from inverse

problem theory (see, e.g., the textbooks by Menke, 1989, and Tarantola, 1987) that this condition could be described more appropriately by an exponential pdf than by a gaussian pdf. I think this topic deserves some further comments.

Specific comments

(1) Page 2023, line 6, add (2011) after Steenpass et al.

(2) Page 2028, line 17. Is "expertise" the proper word, or should it be replaced with "experience"?

(3) I would erase lines 2 to 5 of page 2045, because it is absolutely obvious that one cannot estimate in a confident way the residual and saturation water content if dry and wet conditions are not monitored!

(4) Page 2059, Erase the sentence "The grey lines...the data."

(5) Page 2061, figure 7b. Is it possible to draw an estimated error bar for the measured water content? This should include the uncertainties related to the Topp's formula and to the spatial variability.

(6) Page 2062, figure 8a. Some observations fall outside the 95% prior distribution bounds. Could you comment on this?

(7) Page 2063, figure 9a. What is "partial" autocorrelation? Which are the measurement units of lag? I assume that the data on volumetric water content have been labelled according to the measurement date and the lag refers to this code. Am I right? Is it reliable an autocorrelation function computed from as few as 30 data?

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