Hydrol. Earth Syst. Sci. Discuss., 10, C215–C217, 2013
www.hydrol-earth-syst-sci-discuss.net/10/C215/2013/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Improving soil moisture profile prediction from ground-penetrating radar data: a maximum likelihood ensemble filter approach" *by* A. P. Tran et al.

S. Manfreda (Referee)

salvatore.manfreda@unibas.it

Received and published: 5 March 2013

The present work explores the potentials of a new sequential assimilation procedure to assess the accuracy of the soil moisture profile prediction using time-lapse GPR data. The authors develop a closed-loop data assimilation procedure based on the maximum likelihood ensemble filter algorithm (MLEF), developed by Zupanski (2005), to update the vertical soil moisture profile from time-lapse ground-penetrating radar (GPR) data. The validation of the procedure was carried out using a numerical simulation generated by the Hydrus-1D model. The experiment was carried out on a synthetic soil column with a depth of 80 cm and analyzed the effects of the soil type on the data assimilation

considering 3 different soil types: loamy sand, silt and clay.

The results show that the soil moisture profile obtained by assimilating the GPR data with a closed-loop is much better than that obtained with an open-loop. Results also reveal that the effectiveness of the GPR data assimilation depends on the hydraulic properties of the soil type.

Personally, I think the approach is interesting and can be useful for improving real-time prediction of the soil moisture profiles from time-lapse GPR measurements. The paper deserves to be published on HESS after revisions.

My major concern regards the fact that the methodology makes use only of synthetic data both for the soil moisture profile and also for the GPR data. These two are linked and representative of a virtual case that one will never be able to replicate in the real world, where soil will never be homogeneous and GPR data will be affected by noise due to the antenna or by the presence of stones or other elements. I understand that the scope of the paper is essentially to compare different algorithms, but as a reader I would like to see the real potential of the proposed approach using eventually measured data.

Another aspect that deserves attention is the presentation of the methodology that needs a clear description not only of the mathematics, but also of the steps and interactions between different modules that construct the procedures (hydrodynamic model, the observation operator (electromagnetic model) and the MLEF data assimilation algorithm). Each sub model is presented somewhat as independent from the others and it is not clear to me the full picture of the procedure proposed. For this specific point, I suggest to provide a preliminary overview of the procedure at the beginning of section 2, where the flow chart of figure 1 is introduced without an exhaustive description.

Minor points:

- Pag. 14, line 25, should be: “Comparing Fig. 3a, c, e and 3c, d, f”.

HESSD

10, C215–C217, 2013

-Pag. 16, line 5; in fig. 5 where a comparison between the open loop and data assimilation procedure with the synthetic soil moisture is reported, it is difficult to recognize in the same figure the different functions. Moreover it would be useful to increase the font size of the legend.

- Pag. 16, line 15, the meaning of “updated soil moisture profile” should be clarified.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 1581, 2013.