Hydrol. Earth Syst. Sci. Discuss., 11, C3258–C3260, 2014
www.hydrol-earth-syst-sci-discuss.net/11/C3258/2014/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Assimilation of near-surface cosmic-ray neutrons improves summertime soil moisture profile estimates at three distinct biomes in the USA" *by* R. Rosolem et al.

Anonymous Referee #2

Received and published: 21 August 2014

The study of "Assimilation of near-surface cosmic-ray neutrons improves summertime soil moisture profile estimates at three distinct biomes in the USA" by R. Rosolem et al., (2014) presents the new promising cosmic ray soil moisture sensing assimilation using the land surface model NOAH to improve the root zone soil moisture estimation. The OSSE is implemented for evaluating the results. Although there is some limitation of OSSE because it will overestimate the performance of the assimilation. But it is still very useful for validating the new assimilation methodology. I think this work is interesting and useful for the COSMOS community to extend this valuable technique.

But some points are still not well handled with the current stage, especially for the data assimilation parts:

1. Section 3.1, Was the initial condition perturbed at each assimilation step or only the at the beginning of the time period? The model parameter are usually perturbed in the land data assimilation, otherwise the spread of model ensemble members could not be kept enough (e.g. the soil moisture ensembles during the dry period). What is the variance for the initial condition perturbation? It has large impacts on the assimilation results. One major issue is that the soil moisture ensemble spread in case of DA-2-day will decrease rapidly during the forward run compared with the DA 1-hour, than it decreases the performance of DA 2-day assimilation due to the small model uncertainty. 2. Section 3.2, the perturbed forcing and model parameters were used to generate the synthetic observations, but there is only one ensemble in this parallel run. How were these perturbations applied for this single run? 3. How was the state vector defined in EAKF? Because the sensor depth of the COSMOS will change between 10 cm and 70 cm. In y-H(x), how was the observation y related to the model x? Was the first layer of NOAH used always? 4. Were the instantaneous observations assimilation both in the hourly and daily assimilation? In the daily assimilation, how accurate can be for this one instantaneous observation because of the large variations of neutron counts in hourly step? And the soil moisture could not change so rapidly. Is it reasonable to use instantaneous observation for soil moisture assimilation? 5. Is it worth assimilating the soil moisture in hourly step? Why should we assimilate the soil moisture so frequently? 6. In this OSSE, the openloop run is quite close to the truth. Generally the model simulation will not obtain such good openloop run due to the uncertainty of forcing, parameters and model physics. It is better to show a case with large model error. If the model behaves like this, what is the value of data assimilation? Is it still necessary? 7. And where the model bias came from? Because the same perturbations were used for all layers, but the deep layers were more biased. 8. The validations of assimilation results are not enough. The soil moisture can be easily improved with the assimilation of soil moisture information. I suggest to add some discussion of the surface fluxes.

Moreover, the surface fluxes could be influenced under the dry condition.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 5515, 2014.