Geosci. Model Dev. Discuss., 2, C300–C302, 2009
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Geoscientific
Model Development
Discussions

Interactive comment on "Streamflow data assimilation for soil moisture analysis" *by* K. Warrach-Sagi and V. Wulfmeyer

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Received and published: 30 September 2009

Thank you very much for the review of our manuscript.

1. The EnKF:

Yes, during the updating time the same climate data is used, only the initial soil moisture is spatially disturbed (see fig.4). Of course one could change many more variables, namely the quantity and location of precipitation is still a major challenge in the numerical weather prediction, but also the vegetation and soil parameters such as e.g. LAI, root depth, porosity and hydraulic conductivity pose an uncertainty on the soil moisture. Pauwels and DeLannoy (2006) e.g. used a much larger number of ensemble members based on changed parameters and precipitation for their streamflow assim-

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ilation study. We limited our OSSE to the perturbation of the initial soil moisture field since our goal was to focus on the uncertainty of initial soil moisture fields for numerical meteorological models and to allow for a clearer interpretation of the results of the OSSE. Even only changing the initial soil moisture results in an ensemble spread in simulated streamflow at the gauging station of up to -60% to +120% after 74 hours in Pforzheim. A figure of streamflow and mean soil moisture timeseries resulting from different initial conditions only will be added to the revised manuscript as suggested.

2. Set up of the OSSE:

We will add the following to the final manuscript: Warrach-Sagi et al. (2008) showed for the study area that the streamflow simulated with TERRA-ML underestimates the observation. This is due to model errors, land surface heterogeneity, spatial variability of meteorological conditions and errors in meteorological forcing data set, and soil and vegetation parameter uncertainty. Model errors may be to a large extent estimated applying TERRA_ML at meteorological stations where also soil moisture, soil temperature and eddy correlation measurements are available. This is e.g. done during EVAGRIPS and published by Ament and Simmer (2006) and Johnsen et al. (2005, http://www.hydrol-earth-syst-sci.net/9/586/2005/hess-9-586-2005.pdf). But the heteorogeneity of the land surface and weather poses a large source of uncertainty. The usually underestimated streamflow will increase the soil moisture also when measured data is applied. Since the OSSE shows that the concept works it is expected that also assimilating observed streamflow will cause a more realistic soil moisture pattern, namely during underestimated streamflow this will lead to larger soil moisture in the catchment. The catchment was chosen with care though, it is not dominated by deep groundwater flows, otherwise streamflow data assimilation should not be expected to be a suitable tool for soil moisture analysis in a land surface model like TERRA-ML.

3. Figures 5-11:

No, this is not correct. The initial condition of the soil moisture is at time t=0, for the

GMDD

2, C300–C302, 2009

atmospheric model we want to improve the initial condition, so the control and analysis panel also show the soil moisture at t=0. It is obtained assimilating streamflow from t=0 to t=48h. If I am interested in the soil moisture at t=5 h, I would need to assimilate streamflow from t=5h to t=53h. We will clarify this in the revised manuscript.

Interactive comment on Geosci. Model Dev. Discuss., 2, 551, 2009.