Hydrol. Earth Syst. Sci. Discuss., 8, C3866–C3869, 2011
www.hydrol-earth-syst-sci-discuss.net/8/C3866/2011/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Assimilation of ASCAT near-surface soil moisture into the French SIM hydrological model" *by* C. Draper et al.

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Received and published: 3 September 2011

We appreciate Dr Valadas for their interest in our paper. Dr Valadas's comments are reproduced below, with our response to each comment provided as a bullet point.

Overall well designed experiment. My comments are about the use of a citation and use of a statistics.

1) It seems the citation "Koster et al. 2009" may not be appropriate, as authors used: In this current study, the soil moisture mentioned right before the Koster et al., 2009

reference (p5437) refers to the climatologically corrected soil moisture, whereas the soil moisture differences between models presented in Koster et al., 2009 refers to the unchanged (not corrected) soil moisture values. In this current study, authors intended to say (I think) that differences between different soil moisture products exist even after performing a climatology correction based on the max/min values. However, in Koster et al. (2009) make a contrary statement: "once the climatological differences are accounted for, then the models tend to produce similar results". In this study, authors have already performed a correction for the soil moisture climatology with max/min matching algorithm. Therefore, the study by Koster et al., 2009 in fact gives a contrary example to what authors had in mind. I believe the argument, that there are significant climatological differences may exist, only holds before making any climatology correction; once it is done, if there is still a significant climatology difference, then it would only tell the poor performance of the climatology correction methodology chosen (which is not the case in this study; 1% climatology difference is not high when compared to 5% random error, so climatology correction with max/min method indeed works just fine without the CDF match).

- The Koster et al (2009) reference was intended to highlight the fact that modeled soil moisture quantities are defined by the specific choice of model physics, and hence are not expected to exhibit the same behaviour as observed soil moisture. So, even though the ASCAT data have been re-scaled in such a way that they match range of the ISBA model, there are still differences between the PDFs which was expected given the fundamental differences between the two variables. These sentences have been reduced, following the comment from Wade Crow.
- The soil moisture range between the wilting point and field capacity in the ISBA model is defined to be very narrow (close to $0.1 m^3 m^{-3}$), hence $0.01 m^3 m^{-3}$ represents a reasonable fraction of the model variability ($0.2 m^3 m^{-3}$ the annual range). Note that the (assumed) random error for the model w_1 is close to

$0.02 m^3 m^{-3}$, not $0.05 m^3 m^{-3}$ (again this small value was used, due to the narrow range of values - see Draper et al, 2010).

2) The bias difference that the authors found disappointing is less than 1% where the random errors of the system are around 5%. I believe this soil moisture difference (before the CDF match, after max/min match) is not disappointing; it is small when compared to the random errors, and it exists just because of the chosen climatology match algorithm (matching the max/min values). If instead an alternative method was chosen initially (like the CDF match authors per- formed later), then there wouldn't have been such bias difference at the very first step. Given both max/min and the CDF match methodologies are linear climatology match- ing methods, the final product authors used in the models (after CDF match) can be equivalently obtained without performing the max/min climatology correction initially. Accordingly, the max/min climatology match method is redundant.

- The ASCAT SDS has been first converted into a volumetric soil moisture based on the min and max soil moisture from SIM, by inverting equation 3. Following this, it has then been CDF-matched to reduce the remaining (small, but potentially important - see above) differences to the model climatology. At each point the CDF-matching coefficients were calculated based on the modeled and observed soil moisture in the surrounding 1 degree window. Hence, the CDF-matching was not used to convert from both from SDS to volumetric soil moisture and into the model climatology, since difference in the soil parameters within a given 1 degree window would result in inconsistencies in the conversion to $m^3 m^{-3}$ within that box. However, if the CDF-matching had been based only on the soil moisture at each individual grid point (without using the surrounding window), then the CDF-matching could have been directly performed on the SDS (since equation 3 in linear, although the CDF-matching is not).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 5427, 2011.