Hydrology and Earth System Sciences Discussions

Interactive comment on "Assimilating scatterometer soil moisture data into conceptual hydrologic models at the regional scale" *by* J. Parajka et al.

J. Parajka et al.

Received and published: 21 February 2006

Author response to review 1

We would like to thank the reviewer, Dr. Moradkhani, for his very helpful comments on the manuscript. We have addressed his comments as follows:

Specific comments:

1) We agree with the reviewer that the description of the calibration methodology is similar to that published in an earlier paper. However, for clarity of presentation of the calibration and assimilation methodology and particularly for strengthening the discussion of the determination of the weights (see comment 2) we have chosen to retain the description as it is.

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2) The sensitivity of weights in the compound objective functions was assessed in test simulations not shown in the paper as, in our opinion, these analyses go beyond the scope of the paper. These test simulations consisted of sensitivity analyses that showed that the model results were only moderately sensitive to the choice of weights. The selection of weights is always subjective and depends on the relative importance attached to each component by the modeller. In order to demonstrate the relative importance of the different criteria we have added the following to the text (p. 2749): "...Eq. 2 ...where the weights were set to $w_1 = 0.6$, $w_2 = 0.1$ and $w_3 = 0.3$ on the basis of test simulations. The test simulations consisted of sensitivity analyses that showed that a change in w_1 from 1.0 to 0.6 resulted in a variation of runoff model performance by only 4%. At the same time, changing w_2 and w_3 resulted in more than a 10% increase in the snow model performance and in a significant improvement of the robustness of model parameters. These results indicate that the model results were only moderately sensitive to the choice of weights. The selection of weights is always subjective and depends on the relative importance attached to each component by the modeller. In this paper, we assigned the weights in way so that, on average, the runoff (Z_Q), snow (Z_S) and a priori (Z_P) penalties contributed 65%, 5% and 30%, respectively, to the final compound objective function Z_C."

3) The discussion on the quality and sensitivity of scatterometer data is mostly based on results obtained within this study and presented in the results section of this paper. We thus prefer to retain the structure of the paper.

4) In response to this comment and suggestions for future work we have added references to other data assimilation techniques which we plan to test in future studies (p. 2765): "...For the soil moisture assimilation we are planning to test more powerful data assimilation techniques which can explicitly account for different sources of errors. These include the particle filtering approach (Moradkhani, 2005) and the ensemble Kalman filter assimilation methodology (e.g. Reichle et al, 2002)."

Moradkhani, H., Hsu, K., Gupta, H.V., and Sooroshian, S.: Uncertainty assessment

of hydrologic model states and parameters: sequential data assimilation using particle filter. Water Res. R., 41, W05012, doi:10.1029/2004WR003604, 2005.

Reichle, R. H., McLaughlin, D.B., and Entekhabi, D.: Hydrologic data assimilation with ensemble Kalman filter. Mon. Weather Rev., 130, 103-114, 2002.

Technical corrections:

We have made the following technical corrections as suggested by the reviewer: 1) We have changed "model structure" to "model estimation" (p. 2743, l.20-21).

2) We have corrected "know" to "known" (p.2746, l.23).

3) We have corrected "introduced" to "introduce" (p. 2750, l.14).

4) We have changed "date" to "data" (p.2752, l.23).

5) The meaning of "However significant regional differences exist" is meant to contrast the previous sentence as there are also catchments with good soil moisture corre-lations even though the median of correlation efficiency over 320 catchments is low. Therefore we have chosen to leave the sentence as it is. (p. 2753, l.28).

6) We have corrected the assimilation efficiency r in the text to -0.06 (p. 2756, l.14).

7) We have corrected "represent" to "represented" (p. 2761, l.14).

8) We think it is clearer not to change the representation of the ERS values (bar graph in Figure 4) to continuous lines (solid or dashed) because they represent discrete soil moisture estimates (approx. every 10 days).

9) In our opinion, the statistical evaluation of the results presented in Tables 2 and 3 does not fully represent the similarities/differences in the model efficiencies, as it does not display the possible differences in spatial variability over the 320 catchments. We have therefore chosen to retain Figure 6.

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