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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.

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Author response to review 2

We would like to thank the anonymous reviewer for his/her insightful comments on the manuscript. We have addressed the comments as follows:

Specific comments:

1) We agree with the reviewer that it is difficult to fully interpret different objectives in aggregated (compound) objective measures. We interpreted the objectives through sensitivity analyses (not shown in the paper) and have added the following text on p. 2749 for clarification: "...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."

2) We agree with the reviewer that in multiple objective calibration the user has always to define an acceptable trade-off between different solutions. One way of doing this is to evaluate the shape of the Pareto solutions and subjectively select one of them. An alternative, applied in our study, is to define an aggregated (compound) objective function that reflects subjective priorities with regards to multiple objectives - in our study the runoff, soil moisture and snow cover observations and the robustness of model parameters. With respect to this comment we retained the structure of the discussion section but, in addition to the response to comment 1, we extended the Scatterometer soil moisture assimilation section by the following explanation (p. 2755): "The form of the compound objective function has been chosen subjectively in order to reflect the trade-off between the multiple objectives. As the objective function is minimised, large correlation ..."

3) We have added a justification for using correlation coefficients to measure the performance of different soil moisture estimates. In future studies we are planning to assess the performance of more powerful data assimilation techniques (e.g., ensemble Kalman filter) which, however, require additional analyses of model and observation errors. In response to this comment we have added the following to the Scatterometer soil moisture assimilation section (p. 2755): "... the compound objective function defined by Eq. 2. We selected the correlation coefficient r as a measure of similarity

HESSD

2, S1448–S1450, 2005

between the two soil moisture estimates because it allows a comparison of the temporal dynamics of the two variables irrespective of their absolute magnitudes and possible intercepts in their relationship."

4) We have added the snow model efficiencies for the ungauged case in Table 4 and Table 5 as requested by the reviewer.

Technical corrections:

1) We have corrected the typo in Eq. 12 to read:

$$Z_U = w_5 \cdot (1 - r) + w_6 \cdot Z_S + w_7 \cdot Z_P$$

2) We have checked the cited work of Scipal et. al. (2005) and R^2 is indeed the correct notation.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 2739, 2005.