Hydrol. Earth Syst. Sci. Discuss., 2, S1236–S1240, 2005
www.copernicus.org/EGU/hess/hessd/2/S1236/
European Geosciences Union

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.

H. Moradkhani (Referee)

moradkha@uci.edu

Received and published: 6 January 2006

General Comments:

The paper presents the application of remotely sensed scatterometer data from ERS satellite in the conceptual hydrologic model while investigating the potential of this massive data in improving the hydrologic simulation for both gauged and ungauged basins. The methodology represented in the paper, builds upon the previous paper by Parajka et. al. (2005), who introduced a method for regionalization of catchment model parameters, and they extended the work by assimilating the scatterometer data in the calibration phase to make closer relation between soil moisture dynamics derived from

satellite data and what has been estimated through hydrologic model.

Although assimilating scatterometer data, as reported, does not enhance the model performance in terms of runoff simulation, this comprehensive study gives some insights on the sources of disagreement in model and in particular satellite soil moisture estimation.

Honest conclusion on the minimal applicability of the procedure in gauged and especially ungauged catchments is provided which opens the doors for further studies on more advanced calibration-assimilation techniques conditioning the reliance on the scatterometer data for hydrologic simulation.

Overall, this is a relevant contribution to the topic of assimilating satellite data into hydrologic models. The manuscript is well written with good sentence structure. However, some comments regarding the organization of the paper, and its shortening are provided in below. Also some minor typos are seen which are mentioned in the technical correction section.

Specific Comments:

Ţ Section 3.3, “Multiobjective calibration of the hydrologic model”, pages 2748-2751: looks quite similar to the previous paper of authors (Parajka et al. 2005). The calibration methodology (objective functions, etc.) presented here has thoroughly been discussed in that paper and seems redundant in the current paper. I believe that providing reference to that paper would be informative enough while avoiding reporting some material repetitively and keeping the paper from being lengthy.

Ţ One of the important parts of the calibration-assimilation presented in the paper is the weights (degree of importance of different objective functions) in the weighted objective functions reported at various sections of the paper. It seems they play key roles in the calibration process and model performance. Neither from this paper nor the paper by Parajka et al (2005) it is clear that how the weights are determined or

HESSD

2, S1236–S1240, 2005

calibrated. As seen in page 2749, and also page 2757, the weight values have been taken from previous study of Parajka et el. (2005) determined in test studies (not shown in the paper though). A brief explanation in this regard could clarify the choice of these weights and applicability of the procedure in some other regions.

Ţ In section 7, “discussion and conclusion”, some detailed analyses and discussion on the quality and sensitivity of ERS scatterometer data to soil moisture are provided. This is very good and informative on the usefulness of these data for hydrologic simulation; however, I think if this part be moved to the early part of the paper, it gives the reader some background on the quality and reliability on such data for different elevation zones, land uses, etc. for regions of interest.

Ţ As pointed out by the authors, the existence of correlation between soil moisture derived from ERS satellite and estimated by hydrologic model does not necessarily guarantee improvement of runoff simulation. This statement was justified by this study; nevertheless, one can argue that the accuracy of runoff estimation by data assimilation (DA) is dependent on the assimilation technique employed for this purpose. For example, in order to examine the efficacy of the calibration/assimilation scheme used in this study, a synthetic experiment is warranted. In such a way one can explore the capability of the assimilation scheme (through eq. 11) on simulating the synthetic runoff accurately. The DA scheme used in this study seems simplistic that do not explicitly account for different sources of errors, mainly forcing data error, observation error and model error i.e., parameter uncertainty and model structural error. The variational DA are powerful techniques to account for uncertainty sources but suffers from the complication they possess in deriving the adjoints and incapability in taking advantage of new information when they become available. The sequential DA on the other hand specifically ensemble DA can cope with these limitations. Ensemble Kalman filter (EnKF) as reported in the literature review by the authors is a powerful assimilation technique which has garnered the attention of hydrologists recently and seen different applications in land surface and rainfall-runoff modeling (Reichle et al. 2002, Margulis et al.

HESSD

2, S1236–S1240, 2005

2002, Moradkhani et al. 2005a). Another ensemble DA methodology built upon the full sequential Bayesian updating i.e., Particle Filtering (PF), does not even have the limitations of EnKF and can take the better advantage of information content in the observation so that better conformity of the model output (soil moisture, runoff) with the observation can be attained (Moradkhani et al., 2005b). The above-mentioned assimilation techniques would be well suited to apply for the purpose of this or future studies. Perhaps the additional references provided above could be included in the literature review or in the discussion and conclusion giving other options on assimilation from technical standpoint.

References:

Margulis S., McLaughlin D., Entekhabi D., and Dunne S., Land data assimilation and estimation of soil moisture using measurements from the Southern Great Plains 1997 Field Experiment, Water Resources Research, VOL. 38, NO. 12, 1299, doi:10.1029/2001WR001114, 2002

Moradkhani, H., Sorooshian S., Gupta, H.V., Houser, P. Dual State-Parameter Estimation of Hydrological Models using Ensemble Kalman Filter, J. of Advances in Water Resources, 28, 2,135-147, 2005a.

Moradkhani, H., Hsu, K., Gupta, H. V., and Sorooshian, S., Uncertainty Assessment of Hydrologic Model States and Parameters: Sequential Data Assimilation Using Particle Filter, Water Resources Research, 41, W05012, doi:10.1029/2004WR003604, 2005b.

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

Technical Corrections:

Ţ Page 2743, lines 20-21: in “Ěreconciling the penetration depth of the satellite data with the model structure”, the ”model structure” needs to be changed to “model estimation” for the meaningful statement.

HESSD

2, S1236–S1240, 2005

Ţ Page 2746, line23: “know” should read “known”.

Ţ Page 2750, line 14: “introduced” should read “introduce”.

Ţ Page 2752, line 23: “date” should read “data”.

Ţ Page 2753, line28: “However” does not seem a proper adverb as the meaning of “significant regional differences exist” is in agreement with finding in the previous sentence, therefore instead of “however” the word “therefore” or something similar is suggested.

Ţ Page 2756, line 14: “-0.04” does not match with “-0.06” in figure 8, therefore the correction is required.

Ţ Page 2761, line 14: “represent” should read “ represented”

Ţ Figure 4: for consistency in plotting, it would be better off plotting Scatterometer (ERS) as solid line or dashed line (preferably with different color)

Ţ Figure 6: it seems redundant, as it looks quite similar to Figure 2 without assimilation. Instead, the spatial patterns of the “r” after assimilation could better demonstrate the potential improvements in terms of “r”. meanwhile, table 3 properly displays the performance measures and would be sufficient.

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