Hydrol. Earth Syst. Sci. Discuss., 4, S1569–S1571, 2007
www.hydrol-earth-syst-sci-discuss.net/4/S1569/2007/


Hydrology and Earth System Sciences Discussions



# *Interactive comment on* "Generation of soil moisture patterns at the catchment scale by EOF interpolation" *by* M. A. Perry and J. D. Niemann

**M. A. Perry and J. D. Niemann**

Received and published: 30 November 2007

We would like to begin by thanking the reviewer for their suggestions. We found the review to be very constructive, and we believe we have implemented all of the suggestions. In this response, we specifically identify the changes made in response to each of the comments.

Reviewer 1

1. Suggestion to also cite theoretical work on soil moisture.

This is an excellent idea, and we have included citations of work in that field in the introduction of the revised manuscript.

2. Clearer explanation of the difference between this paper and the JH paper

The JH paper did not consider interpolation of soil moisture at all. Instead, the EOF methodology was used to estimate soil moisture patterns based on the current average soil moisture and past detailed patterns of soil moisture. Thus, the approach in that paper was applicable to downscaling applications or certain forecasting scenarios. In the present paper, the EOF methodology is used for the interpolation problem. Thus, the approach is applicable to situations where sparse soil moisture observations are available on multiple dates and estimates are required at a finer spatial resolution on the same dates. In response to this comment, we have added more explanation of the differences between the methods in the introduction of the revised manuscript.

3. Clarification of definition of ECs and how they are estimated.

Both reviewers commented on this part of the methodology explanation. We have included a little more detail in the sections where the ECs are introduced in the revised manuscript. The ECs for the fine-scale patterns are determined directly from the sparse soil moisture data. This approach is evaluated in Figure 2.

4. Verification of the application of the two EOF significance procedures and why they are so different

The tests for the significance of EOFs are based on different underlying assumptions about the dataset and use different approaches for testing significance, so it is expected that they will produce different results. We revisited the original published works on these tests to verify that our application is correct. We also applied the tests to synthetic datasets that were generated by orthogonally combining known numbers of independent spatial patterns along with random noise. Based on these analyses, we believe that the following limitations may apply to the tests:

(a) Both tests evaluate the null hypothesis that adjacent eigenvalues are of equal magnitude. If the null hypothesis cannot be rejected, the associated EOFs are not considered to be significant. However, it is quite possible for adjacent eigenvalues to be nearly equal even if the EOFs are significant. In particular, two independent patterns



HESSD
4, S1569–S1571, 2007





EGU

might account for approximately the same amount of variation in the dataset. For small sample sizes, the Johnson and Wichern test appears to be especially susceptible to misidentifying the number of significant patterns if multiple independent patterns explain approximately equal variation.

(b) At small sample sizes, the results of the Bartlett test usually converge with those of the Johnson & Wichern test. However, at larger sample sizes, the Bartlett test may not be discriminating enough to eliminate some insignificant EOFs. In particular, for small samples, we observed that the Bartlett statistic does conform to the proposed chi-squared distribution. However, at larger sample sizes it can diverge from this distribution.

Based on our limited analysis, it seems that the Bartlett test may not be accurate with larger sample sizes and that the Johnson and Wichern test may be overly conservative (too few rejections of the null hypothesis) in certain situations, like small sample size with eigenvalues of similar magnitude. We have added a note in the revised manuscript to this extent.

5. Suggestion that the confidence intervals in Figure 6 might be wider.

The reviewer is correct that the initial samples of soil moisture used in developing that figure are not independent. Thus, the ranges of NSCE observed in that experiment may not be representative of the range that would be observed if a large number of independent samples were available. However, we believe that those ranges still have value because they show the reader the range that is actually observed using the data that is available. We have added a cautionary statement to this effect in that section of the revised manuscript.

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 2837, 2007.