Hydrol. Earth Syst. Sci. Discuss., 7, C4451–C4453, 2010
www.hydrol-earth-syst-sci-discuss.net/7/C4451/2010/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrologic similarity among catchments under variable flow conditions" *by* S. Patil and M. Stieglitz

Anonymous Referee #3

Received and published: 24 December 2010

This paper presents an analysis of hydrologic similarity between nearby (and nested) sub-watersheds in 4 basins in the north-east US. In particular, the authors examine how the similarity between catchments changes across the range of flows. The variability in the flow duration curves inter-annually in a sub-watershed, and between water sheds within a basin are examined. The manuscript is well written and of appropriate length, and its subject matter is suitable for publication in HESS once a few considerations are addressed.

The introduction could be strengthened by a motivating discussion of what similarity is (i.e. how it arises), and why we might expect it to vary across the range of flows. Simply saying that it is "not clear yet whether hydrologic similarity among two or more catch-

ments is preserved across flow conditions" seems to underplay the point somewhat. It seems to me that similarity might arise in some cases where both A) the climatic forcing dominates the hydrograph and B) the climatic forcing is similar between catchments. Furthermore, where catchment storage and release of water are a significant control (e.g. where soil moisture storage capacity, groundwater contributions or snowpack are large) similarities will only arise where the additional structural and climatic controls on the partitioning and release of water from storage are similar (e.g. geology and vegetation water uptake). However, since the degree of climatic control on the runoff generation varies with runoff itself (being higher at larger flows, and when the storages in a catchment are full), we might expect that the similarity between catchments varies between high and low flows.

This paper seems to be testing this hypothesis. However a few things are lacking. Firstly, it should be established that the climatic controls on each catchment in the basins are similar - a figure showing the precipitation equivalent of the flow duration curves would serve for this.

Secondly, it would strengthen the case if the differences at low flow could be related to differences in the geology of the catchments. Do sub-watersheds with similar geologies behave similarly at low flow?

Thirdly, I think there is the potential for some spuriousness in the use of nested watersheds as though they are independent samples. A study of this sort conducted explicitly in a set of nested watersheds to examine the role of scale would certainly be of interest, as would one using independent watersheds in a similar area. Mixing nested and separate watershed seems to confuse the issue. Given the small number of watersheds it is probably not feasible to simply exclude some. I would recommend at least identifying nested watersheds in Figure 4. Also, it is not clear if the watersheds chosen for comparison in figure 5 are nested. If so, these should be replaced with truly independent watersheds.

Last but not least, there is also a methodological issue that needs to be addressed. The CV is the std divided by the mean. You would therefore naturally expect it to be large when the mean is small (and vice-versa). Given that the flows are likely close to log-normally distributed, this effect will be magnified by the variability over orders of magnitude. It could be argued that your conclusions are therefore simply an artifact of the method you use to analyze the variability. To rule this out, you could compare the results to some null model of log-normal values. This could also provide a measure of the statistical significance of the result. Error analysis is sorely lacking here given the relatively small sample size.

Minor point: I was very confused for a while when I compared Figure 2 and Figure 3, thinking that the numbers didn't make sense. Then I realized it was because the axes are reversed! (Figure 2 is % exceedance and Figure 3 is flow percentile). Please be consistent.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 8607, 2010.