

***Interactive comment on* “Exploring the physical controls of regional patterns of flow duration curves – Part 4: A synthesis of empirical analysis, process modeling and catchment classification” by M. Yaeger et al.**

Anonymous Referee #2

Received and published: 3 August 2012

Thank you for the opportunity to review the paper titled “Exploring the physical controls of regional patterns of flow duration curves – Part 4: A synthesis of empirical analysis, process modeling and catchment classification.” I found the paper to be well-written, the topic of the manuscript relevant to HESS and, although flow-duration curves (FDCs) have received much attention in the literature, the authors present a new application of flow-durations curves that yield interesting insights into the similarity of catchments.

I do have several comments about the technical aspects of the paper that could require

substantial revision before publication of the manuscript in its final form.

1) Please explain the regime curve in more detail in Section 2.2. Not all readers are familiar with this terminology and it may be difficult to fully understand the results and conclusions without a clear understanding of how the regime curve was determined.

2) In classifying streamgauges based on climate and catchment process, how do the authors rectify the findings of Wang and Hejazi (2011) that show many of the MOPEX locations are impacted by alteration in the catchment?

3) The paper fits a mixed gamma distribution to flow-duration curves; however, no probability plots or goodness of fit metrics demonstrating the appropriateness of this distribution is presented in the manuscript. At a minimum, the method of parameter estimation should be included in Section 2.2. What are the bounds of the mixed gamma? Are they such that the lower bound cannot generate streamflows below zero? I can understand that the mixed gamma distribution provides a reasonable fit to the FDC for much of the curve; however, I wonder how closely the three parameters are able to capture the tail behavior, where catchment response may differ more across the study region.

4) Following on comment 3, I wonder if the FDC slope is providing different information than the parameters of the mixed gamma? The conclusions appear to be similar for both analyses. I appreciate the authors' synthesis approach to this problem; however I wonder – given the length of the manuscript – whether both analyses are needed.

References: Wang, D. and M. Hejazi (2011), Quantifying the relative contribution of the climate and direct human impacts on mean annual streamflow in the contiguous United States, *Water Resour. Res.*, 47, W00J12, doi:10.1029/2010WR010283.

Interactive comment on *Hydrol. Earth Syst. Sci. Discuss.*, 9, 7131, 2012.

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