Response to all three reviewers in respect of application of conceptual framework to real catchments

A common refrain of all three reviewers is that the paper does not present a demonstration of the proof of concept (of the conceptual framework we propose) in actual catchments. In our response to Reviewers #1 and #2 (already submitted) we argued that this was beyond the scope of this paper for three reasons:

(1) Application of the current REW model to actual catchments is not a straightforward exercise. It will require inclusion of landscape heterogeneity and process complexity that is present in actual catchments, and will require calibration as well. Such analyses are already reported in another paper in HESS(D) by Carrillo et al. (2011) where a much more sophisticated and complete model is applied to 12 of the MOPEX catchments.

(2) There is a separate study currently underway where the conceptual framework presented here is used to separate the components of the FDCs, explore regional patterns, and explore the underlying process controls. The results of this study will be submitted to HESS(D) in the next few months.

(3) We felt that exploring the physical controls of the FDCs in a generic sense using a simple physically based model, and extracting the conceptual framework would be sufficient for this paper.

However, due to the fact that this is raised by all three reviewers, we have decided to include examples of the separation of the FDCs into the components from three selected MOPEX catchments, but without the inclusion of more advanced modeling results. This is certainly feasible, and will hopefully allay the concerns of the reviewers. These example results from the future work will show the relationship between the PDC and the SFDC and the regime curve and the SSFDC. We believe this will be sufficient for the purposes of this paper. Results of further modeling studies and the classification that results from that work will be presented in subsequent papers.

Here below we present the results from 3 of the 200 MOPEX catchments. Here we present the FDCs for precipitation, surface runoff, subsurface runoff, as well total runoff and FDC estimated from the “regime curve” (mean monthly variation of total runoff). The surface and subsurface runoff components are estimated using a baseflow separation algorithm (Lyne and Hollick, 1979), which is also summarized in Sivapalan et al. (2011). These results confirm the conclusions of the theoretical model in actual catchments. The catchments selected are located in diverse climatic regions: Idaho and North Carolina. These results will be incorporated in the revised manuscript to be submitted later.

Lyne, V. and M. Hollick (1979). Stochastic time-variable rainfall-runof. *Proc. Hydrology and Water Resources Symposium*, Perth, 89-92, Inst. of Engrs. Australia.

Sivapalan, M., M. A. Yaeger, C. J. Harman, X. Xu, and P. A. Troch (2011), Functional model of water balance variability at the catchment scale: 1. Evidence of hydrologic similarity and space-time symmetry, Water Resour. Res., 47, W02522, doi:10.1029/2010WR009568.

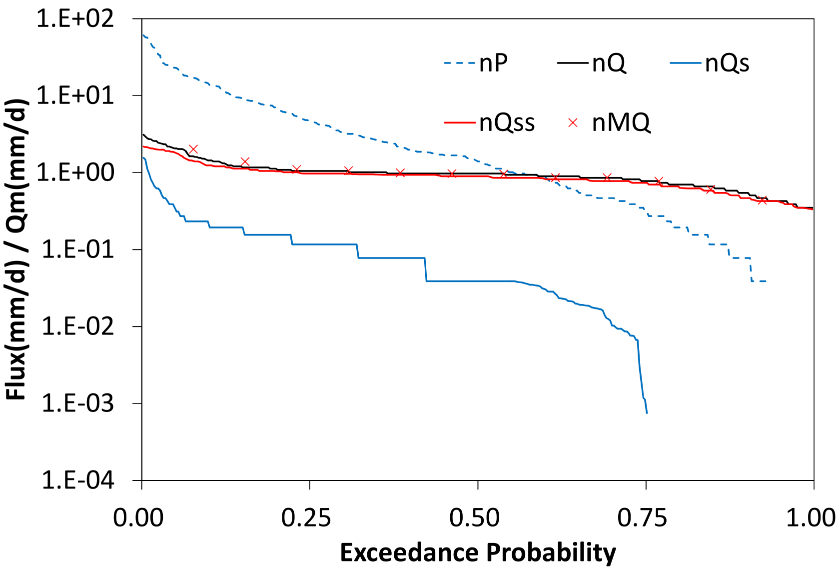

Fig. 1. Relationships among duration curves of precipitation (P), total runoff (Q), surface runoff (Qs), subsurface runoff (Qss) all at daily time scales and normalized by annual mean daily flow (Qm) along with mean monthly runoff at daily time scale normalized by annual mean daily flow (Qm). Data is from a MOPEX watershed #86, Salmon River at Salmon, ID, USA, 2001.

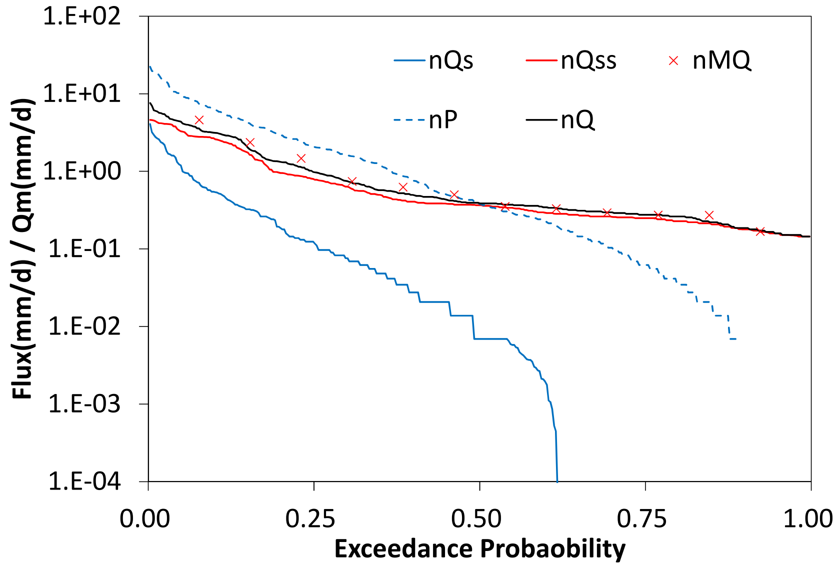

Fig. 2. Relationships among duration curves of precipitation (P), total runoff (Q), surface runoff (Qs), subsurface runoff (Qss) all at daily time scales and normalized by annual mean daily flow (Qm) along with mean monthly runoff at daily time scale normalized by annual mean daily flow (Qm). Data is from a MOPEX watershed #323, Lochsa River near Lowell, ID, USA, 2001.

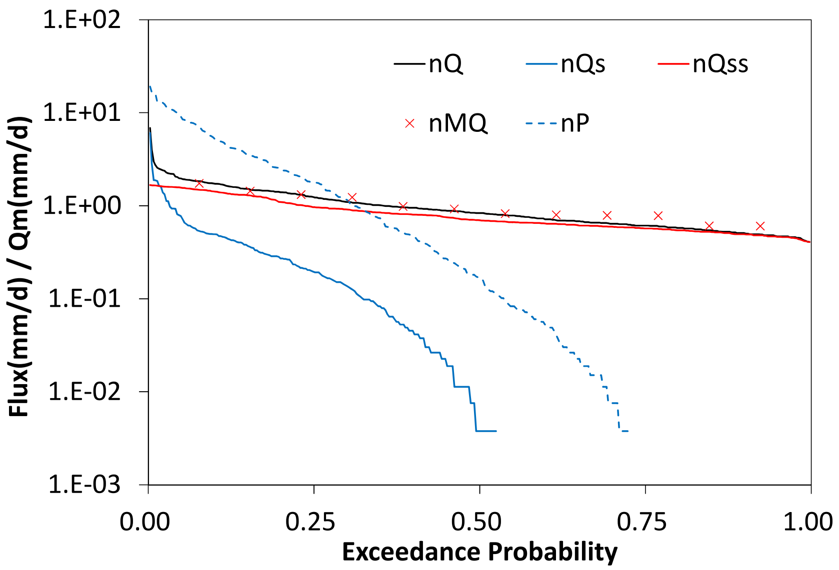

Fig. 3. Relationships among duration curves of precipitation (P), total runoff (Q), surface runoff (Qs), subsurface runoff (Qss) all at daily time scales and normalized by annual mean daily flow (Qm) along with mean monthly runoff at daily time scale normalized by annual mean daily flow (Qm). Data is from a MOPEX watershed #237, Nantahala River near Rainbow Springs, NC, USA, 2001.