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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Climate-vegetation-soil interactions and long-term hydrologic partitioning: signatures of catchment co-evolution" *by* P. A. Troch et al.

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Reviewer's comments are in between "", our response is printed in normal fonts.

"The study by Troch et al. touches upon an important topic in catchment hydrology, namely the possible co-evolution between the surface hydrologic cycle, vegetation and landscape. I think the paper of Troch et al. could become a major contribution in the emergent field of catchment ecohydrology. I nonetheless feel that the paper could be lengthened and could provide more discussion on the physical implications of the findings".

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Interactive Discussion
Discussion Paper

We thank Dr. Gentine for his nice comments and address his comments below.

"I find the paper relatively short and I would have enjoyed more insights on the physical processes at play. Since the authors have 12 models in 12 climates, that is 144 different climate-catchment pairs, substantial insights could be obtained, especially regarding the decomposed contribution of the soil surface and groundwater hydrology and vegetation dynamics. Could the analysis of shorter time scales lead to some insights regarding runoff generation and the surface water partitioning? What are the main climatic/vegetation/soil parameters dominating the annual and smaller scale responses? The current manuscript partly answered these questions but I feel that the study could go much more in depth and yield major insights on catchment ecohydrology".

First of all, we want to remind the reviewer that the goal of our study was to explore the role of climate-vegetation-soil interactions at the catchment scale on long-term hydrologic partitioning, i.e. the average annual water balance. Shorter time scale responses of the 12 selected catchments were presented and discussed in Carrillo et al., 2011, and we refer the reader of this paper on several occasions to that study. Second, since our model is a semi-distributed version of the hsB-SM model we cannot address small-scale processes. The reason the semi-distributed version was implemented was to keep the number of free parameters to a minimum to avoid over-parameterization. Our results indicate that certain catchment characteristics related to vegetation and soils show adaptation to the local climate and that when climates are interchanged between catchments, these characteristics result in systematic deviations from the expected hydrologic partitioning based on Budyko's hypothesis. It is unclear to us what exactly the reviewer has in mind when he asks for a more in-depth discussion, and we believe that by keeping the paper short and focused on testing a single hypothesis (available water and energy control the hydrologic partitioning at the catchment scale) we have a more concise presentation of the main results of our study. We certainly are considering further exploration of the simulations and focus on additional hypotheses related to catchment ecohydrology if funding permits.

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"Minor comments: - in the introduction the studies of Dietrich and Perron 2006, Perron et al. 2012 and Wang and Wu 2012 could be interesting from a geomorphological point of view".

Although the Perron papers are definitely interesting it would be a stretch to connect them to our work, so we decided to leave them out. We will add a reference to Wang and Wu (2013) and will discuss it in the Conclusions section of our revised manuscript.

"In section 2.1 it could be relevant to explain how you are dealing with infiltration excess"

The model details, including the ways different runoff generation mechanisms can be simulated, are presented in Carrillo et al., 2011, and we refer the reviewer to that paper for more details. In short, we allow infiltration excess to occur when the soil infiltration capacity, derived from the time compression approximation method, is exceeded by rain rate.

"In section 2.3 it would be worth having a sentence explaining why you chose daily rainfall data. In case of substantial infiltration excess this could be too coarse".

The reason we chose daily time steps for our model simulations is because this is the available data on the MOPEX website. Choosing hourly or shorter time steps was not possible due to the fact that many of the forcing variables needed by our model are not available at these time scales. We agree that shorter time scales are preferable to simulate infiltration excess runoff generation but we are not sure whether this would make a big difference at the scales of our selected catchments (drainage area > 1,000 km2).

"Section 3.1: the concept of (evolving) catchment filters is important. Could you elaborate a bit more?"

Again we are unclear what exactly the reviewer tries to ask from us. Indeed, the concept of co-evolution is important and some of the authors of this study have recently

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submitted a discussion paper to HESSD (Harman and Troch, 2013) that explores the role of co-evolution in catchment response in more detail. This paper should be on-line soon and presents a follow-up discussion to this paper.

"In table 1 could you have the annual precipitation, and aridity index of each basin"

Detailed information about the catchments, including annual precipitation and aridity index, are provided in Carrillo et al., 2011. Figure 1 of this paper also shows the annual evaporation index, E/P, versus the aridity index.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2927, 2013.