Hydrol. Earth Syst. Sci. Discuss., 8, C5866–C5868, 2012
www.hydrol-earth-syst-sci-discuss.net/8/C5866/2012/

Interactive comment on "Applying a simple water-energy balance framework to predict the climate sensitivity of streamflow over the continental United States" *by* M. Renner and C. Bernhofer

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Received and published: 25 January 2012

Author reply to the first reviewer

We thank the reviewer for his constructive comments on our manuscript.

The manuscript is linked with the more theoretical manuscript Renner et al. (2011) which is also published in HESSD. Based on the critiques stated in the interactive discussion http://www.hydrol-earth-syst-sci-discuss.net/8/8793/2011/hessd-8-8793-2011-discussion.html we revised that manuscript and it is currently under review.

The referee criticised that we suggested that the CCUW hypothesis is of different conceptual basis than the Budyko type of approaches.This was actually not intended, but we wanted to highlight the apparent differences between both approaches.

We understand, that both frameworks are based on long term average data, which are components of the water and energy balance equations. Also both sensitivity approaches describe how actual evapotranspiration E_T is changing with a change in precipitation, i.e. the partial differential term $\frac{\partial E_T}{\partial P}$. To determine this term one needs a functional description of how a basin moves through different climatic conditions, which is e.g. available through the Budyko type of functions. As the referee correctly states, also the CCUW hypothesis can be expressed as a Budyko function, see Renner et al. (2011, Section 2.3, Eq. (28)). In that respect both approaches are indeed similar.

The difference is in the derivation of these Budyko type functions. For example, Yang et al. (2008) show how the Mezentsev function can be derived by the coupled consideration of the water and energy balance equation and including the water and the energy limits as boundary conditions. In contrast, the CCUW hypothesis, makes an assumption on how the relative partitioning of water fluxes is linked to the relative partitioning of energy fluxes under a change in either P, E_p or both. Using this, we illustrate in Renner et al. (2011) how to derive the analytical solutions for the sensitivity of E_T and streamflow Q under a change in climate.

Therefore, we withdrew the claim of a better theoretical basis in the revision of the first manuscript and as well in the revision of this manuscript. Additionally, we tried to state our arguments more precisely.

Further remarks

The referee also suggested to improve the manuscript by calculating the change in the catchment parameter n between both periods. We incorporated this idea in the revised manuscript.

We also agree to focus our analysis on the scheme of Roderick and Farquhar (2011) using a parametric Budyko function approach. Thus, the non-parametric Budyko functions will be removed.

In point 5 of his review the referee asks which value of the catchment parameter n of the parametric Budyko function of Mezentsev has been used to compute the right panel of Figure 4, P33. The graph shows the sensitivity of streamflow to precipitation $\varepsilon_{Q,P}$ for a multitude of catchments. Thereby, we computed the catchment parameter for each catchment based on long-term averages of P, E_p, and $E_T = P - Q$.

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