Manuscript Review – HESS

Ref #: HESS-2011-391

Title: Applying a simple water-energy balance framework to predict the climate sensitivity of streamflow over the continental US

Authors: Renner & Bernhofer

This manuscript describes and evaluates an approach for separating the impacts of land cover change from climate change on catchment runoff. The paper is on an important topic of direct relevance to HESS.

This is very interesting and important work. I recently reviewed a paper on the same topic by the same group in HESSd. In that review I pointed out how their CCUW framework fits within the overall Budyko-type approaches and is actually an extension of that framework. However, for some reason the authors are arguing that it is from a different conceptual basis. I did not understand that in the previous manuscript and do not understand it here. Accordingly, the overall setting of the work requires some slight adjustments as explained below.

I have cut and paste from the previous review here:

"At first reading one is led to think that this is somehow very different from previous work. For example, p. 8801 (lines 18-19) claims a better theoretical basis. However, that is not the case and the main contribution here has not actually been emphasised directly. Consider for example a comparison with the Roderick & Farquhar 2011 (hereafter RF11) scheme. RF11 separates the effect of changes in climate (dP, dEp) from changes in catchment properties (dn) to estimate changes in evapotranspiration (dE) and runoff (dQ). In contrast, the current manuscript starts with (more or less) the same estimates (P, Ep, n) but makes assumption/s about how the changes occur. These are called the CCUW and BCUW hypothesis. The way this is done, is mathematically equivalent to actually prescribing how the catchment moves through the Budyko space. This is shown very clearly in Fig. 3 where a given CE value does not perfectly follow a given value of n. Hence by keeping CE constant, then as changes occur, n must in fact also change. That is why the scheme is equivalent to prescribing the changes. In that respect the work is not an alternative to RF11, but actually builds on it by making an additional hypothesis to prescribe the changes. This paper then opens up the possibility of further investigations on the validity of the CCUW and BCUW (and any other) hypotheses. In that respect this contribution is important."

The same comments apply equally to this manuscript.

For example, when comparing CCUW with the RF11 scheme (called Mezenstev in the figures) the authors actually set the change in catchment properties parameter, dn = 0. In fact, as the authors show, many catchments actually do show changes in the catchment properties parameter. I think it would be useful to actually point this out. Even better, why not use the

formulation of RF11 to actually calculate the changes in catchment properties (dn) for the basins.

Further, and as I pointed out in the earlier review, the contribution is diluted by adding the different Budyko curves (Oldekop, Mezentsev). Recently, Donohue et al (2011, Assessing the differences in sensitivities of runoff to changes in climatic conditions across a large Basin, Journal of Hydrology, 406, 234-244) have noted that the original Budyko curve can be more or less reproduced using the Mezenstev equation by setting n=1.9. Hence, why not just use the so-called Mezentsev curves and use different values of n to emphasise your main ideas.

Recommend: Accept after major revision.

Other Comments

1. P. 3, line 2. Typo – missing word/s near "twice as"

2. P. 4, line 2-5. The different conceptual approach idea is discussed in the main comments above. It is not a different concept. Rather, the CCUW introduces a hypothesis about how a basin "moves" in the Budyko space. This needs to be clearly stated.

3. P. 6, line 10. One of the long standing problems in hydrology is that Rn is not routinely measured. The issue is that it depends on albedo and surface temperature as you explain later (P. 21, lines 9-15).

4. P. 21, Section 4.5.2. Nice points in this section.

5. P. 33, Fig. 4. What value of n was used to produce the Mezenstev curve in the right panel?

6. P. 34, Fig. 5. The units of P are mm per time. The units of integrated P are mm. The units in the panel are mm – they are for the integral. So you need to say; Annual changes are given in [mm]. Same in Fig. 6 and 8.