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Hydrology and Earth System Sciences Discussions

Interactive comment on "Catchment classification: hydrological analysis of catchment behavior through process-based modeling along a climate gradient" *by* G. Carrillo et al.

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The paper reports the application of a scale-aggregated, process-based model to a variety of catchments with different hydro-climatic conditions. It is an interesting, well written paper that applies a very good step-wise model parameterization approach.

The model is too a large extent a combination of existing (previously published) modules/routines that were nicely put together in a coherent framework. Alternative model structures would be equally plausible (page 4601, line 10) and the model structure was not really based on detailed field investigations. However, the same model structure

was applied to all catchments, assuming that all used modules/routines are suitable for all catchments (with a catchment specific parameterization, of cause). Yes, this as been done many other inter-site comparison studies, this is a classical assumption. However, I found this in particular tricky for the subsurface flow components, where the model structure defines 2 aquifer systems: a perched and a deep system. Whereby the model was parameterized such that both contribute to the MRC and the perched aquifer (representing an interflow component) is contributing to the early part and the deep system mainly to the baseflow. But, why can the authors assume that 2 systems exist in all catchments? Is the geomorphology in all catchments (with quite different topography, geology and soils!) suggesting such a model structure and related hydrological response? I understand that no detailed process investigations were done in these catchments. One alternative model structure (many others could be suggested) would be to have only one groundwater systems with a non-linear, stronger response if the water table is higher ('transmissivity feedback'). This behavior has been described for instance in many till soil covered catchments in Scandinavia and North America (cf. papers by Kevin Bishop, Jan Seibert, Allan Rodhe etc.). Or, how about the importance of a riparian groundwater system (as found very important in many catchment in the US, see papers of McDonnell, Peters, Hooper etc.) that sustains the base flows?

I think the title of the paper promises too much, as this paper mainly summarizes the analysis of catchment behavior through model application in a range of catchments. However, I found the emphasis on catchment classification too strong, as this comes only out in the discussion.

Specific comments: 1. The abstract is quite long and has many introduction parts. I found the last sentence too speculative based on the presented results.

2. Section 2: All variables should be defined with units.

3. I found it clearer if the units of the water balance parameters (page 4607, line 10-13) are give as fluxes (what they are!) and not as storage volumes; i.e. mm/a instead of

HESSD

8, C1883–C1885, 2011

mm. Use d as a unit instead of day.

4. Model parameterization: - Why are the snow temperature threshold vales so high (1-3 C)? Did you not correct the temperature input for the mean elevation of the catchment? - I have never seen so high melt rates (degree day factor: 10-15 mm/d/C), and it not think that this is physical possible. I am aware of values in the range of 2-4 mm/d/C in forested and mountainous catchments, and know that values can go up to 8 mm/d/C in flat and open catchments, but the suggested parameters in the paper seem unrealistic.

5. Figure 2 and related discussion: I found the term Deep Aquifer Fraction confusing as it is not a fraction but a flux. I can not believe that the R2 is 0.99 looking at the figure, considering that there is also a log-scale. How was that calculated?

6. All model results are only shown in a very aggregated way (monthly, annual values, RC matches etc.), but to really assess the model goodness 2D-plots Qobs vs. Qsim on daily scale would be more helpful. Generally, model efficiencies of about 0.5 after extensive calibration is not really impressive assuming that the input data sets are good.

7. Figure 8-11: Why is the number of catchments varying? What were the criteria to include/exclude a catchment? Giving a R2-value with 4 digits is really too much considering that the number of data sets (n) is often only 6. Stefan Uhlenbrook, Delft, The Netherlands

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