Hydrol. Earth Syst. Sci. Discuss., 11, C1942–C1944, 2014
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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Analyzing runoff processes through conceptual hydrological modelling in the Upper Blue Nile basin, Ethiopia" *by* M. Dessie et al.

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Received and published: 20 June 2014

This manuscript is very interesting for me. The writing is clear and concise. The authors applied a new modelling framework (Savenije, 2010) to do runoff production area classification by topography information. Slope was used as criteria to do the classification. The model structure is simple but reasonable. The number of free parameters is also limited to 7, which dramatically reduces the equaifinality. Although the model did not apply the normally used curve in soil reservoir to represent the distribution of water storage capacity (Zhao, 1992), the results are also excellent, which is intriguing for me.

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The authors cooperated topographic information and soil texture information into the model. The average slope gradient and slope length are parameterized into the conceptual model by semi-empirical relations. The porosity and field capacity of soil are used to determine the storage capacity. All the functions are clear and reasonable for me. But there are still several things needs to be clarified.

1. Following the comments from Prof. Merz and Anonymous Referee #1, I also think a benchmark model is necessary in this paper to illustrate the better performance or transferability of this modelling approach than traditional lumped models which neglect the heterogeneity of catchments. Not only hydrograph, but also the flow duration curve shall be shown to illustrate the model performance on flow frequency simulation.

2. The model structure is not very clear for me, although it is mentioned in the text and shown in Figure 2 and Figure 3. I suggest the authors show the inter-link between different runoff production areas in one figure, which could be clearer and easier to follow.

3. Please show the slope map, classification map obtained by topography criteria, and the soil map, from which we can easily see the heterogeneity among different catchments.

4. In Section 6.3, for the transferability test, I think the authors should do more discussion to clarify why this modelling approach can get good transferability. The authors could refer our newly published paper (Gao et al., 2014) about the application of the FLEX-Topo modelling approach in the Heihe river basin in China, in which paper the model performance comparison and transferability with several benchmark models are test.

Minor comments:

1. Perhaps I have missed something, do the different hydrological components have isolated groundwater or they share the same groundwater reservoir?

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2. Equation 12. Why the saturated hydraulic conductivity of deep soil layer (Ks,e) is not a free parameter in Table 2? How did the authors determine the Ks,e?

3. Equation 23 and 24. Where is i in these equations?

4. Table 1. Is 'flat' more suitable than 'level'?

5. Table 1. Are field capacity and porosity parameters or input data? If they are input data, how did you get these information in catchment scales? Please clarify this point.

6. Table 2. Why lambda is a parameter? To my point view, you can determine the proportion of impermeable surface by soil map. Is it possible?

Reference

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