Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-307-AC1, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Picturing and modelling catchments by representative hillslopes" *by* Ralf Loritz et al.

Ralf Loritz et al.

ralf.loritz@kit.edu

Received and published: 4 July 2016

First of all, thank you, Dr. Ding, for contributing your thoughts and comments to the discussion of our manuscript. In this reply we take the chance to highlight the main avenues of our manuscript once more:

In order to obtain a catchment scale model, you propose to add a Muskingum type lumped storage element to our hillslope scale distributed "CATFLOW" model (Zehe et al. 2001). Though we acknowledge that this might be an interesting approach for some studies /areas, in this case we explicitly chose to focus on the representation of a headwater catchment by a single hillslope for various reasons. As we point out in the manuscript our research catchment is most likely hillslope-dominated and hence not dominated by the river network (Kirkby, 1976; Robinson et al., 1995). Furthermore,

topography is not a first order control in the area as shown by Fenicia et al. (2016) and Jackisch (2015). With this in mind and combined with the fact that the soil and geological maps which are available for this lower-mesoscale catchment are almost uniform, we feel it is difficult to justify a catchment scale distributed model.
We believe, it does not make much sense to calculate the same hillslope 241 times to then connect the results with a flow routing model, if river flow routing is not a dominant process at the scale of interest. In our opinion, a representative hillslope model is a better starting point for the headwater catchment we investigated, and makes the identification of dominant processes and structures more straightforward. Additionally, as we state in our discussion paper, we are not looking from a flood simulation perspective (as you state in your comment) on hydrological modeling. We think that physically-based models as diverse and parameter-rich as "CATFLOW" are not the right tool if the goal is the most accurate rainfall-runoff simulation.
We understand the wish for using a hydrological model in a distributed form where every model element is connected to a real-world object. But in some cases this might be a rather difficult task in the context of the availability and the information content of spatially distributed data. We agree with you that a possible next step could be a distributed modelling approach; however, we would follow this path not because we are convinced to achieve a perfect rainfall-runoff simulation, but to learn more about, for example, how distributed precipitation fields trigger different (or similar) responses in landscape elements, temporally and spatially.

You are right; Line 555 should be the left and not the right boundary.

"The catchment, in terms of the area, almost doubles the sum of its representative hillslopes, i.e., 241 times 4.26 ha" - The hillslopes have different sizes and are not all 4.26 ha. Our calculations are based on a single hillslope which was picked from the distribution of all hillslopes, according to its average distance and elevation to the creek.

We thank Dr. Ding again for his comments and recommendations on our discussion paper.

References:

Fenicia, F., Kavetski, D., Savenije, H.H.G., Pfister, L., 2016. From spatially variable streamflow to distributed hydrological models: Analysis of key modeling decisions. Water Resour. Res. 1–36. doi:10.1002/ 2015WR017398
Jackisch, C., 2015. Linking structure and functioning of hydrological systems. KIT - Karlsruher Institut of Technology. doi:10.5445/IR/1000051494
Kirkby, M., 1976. Tests of the random network model, and its application to basin hydrology. Earth Surf. Process. 1, 197–212. doi:10.1002/esp.3290010302
Robinson, J.S., Sivapalan, M., Snell, J.D., 1995. On the relative roles of hillslope processes, channel routing, and network geomorphology in the hydrologic response of natural catchments. Water Resour. Res. 31, 3089–3101. doi:10.1029/95WR01948
Zehe, E., Maurer, T., Ihringer, J., Plate, E., 2001. Modeling water flow and mass transport in a loess catchment. Phys. Chem. Earth, Part B Hydrol. Ocean. Atmos. 26, 487–507. doi:10.1016/S1464-1909(01)00041-7

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-307, 2016.