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Hydrology and Earth System Sciences Discussions

Interactive comment on "*HESS Opinions* "Topography driven conceptual modelling (FLEX-Topo)"" *by* H. H. G. Savenije

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I would like to thank the editor, Erwin Zehe, for his valuable suggestions. He raises four issues: the link between topography and soils, scale, connectivity and realism.

1. On the link between topography and soils

Soils influence hydrological behaviour significantly. What is important is the texture of the soil: the porosity, the permeability, the layering, the existence of preferential flow channels, the water repellence, etc. An interesting phenomenon is that soil properties are related to the topography. The riparian zones have relatively heavy soils, which may crack in the dry season, but swiftly become poorly permeable when they get wet.

The hillslopes are very heterogeneous with a dual porosity consisting of immobile pockets intersected by preferential infiltration channels. Soils are generally not very deep with a decreasing permeability over the depth leading to sub-surface drainage on the interfaces or through a network of preferential drainage structures (e.g. Brooks et al., 2010; Uchida et al., 2005). On the plateau the soils are generally deeper, with a larger storage capacity, particularly if there is deep rooting vegetation. So we see, that also the soil characteristics are correlated with the topography.

2. On the issue of scale

Indeed a realistic model structure depends on the scale. In my approach I donot want to go below the catchment scale. So I don't go as deep as an individual hillslope, landscape element or pixel. I make use of the fact that a catchment (a drainage basin that discharges through a common outfall) is organised as a result of a long enough period of co-evolution of geo-morphology, ecosystem and micro-climate for a drainage structure to evolve. Sometimes these catchments are small (several square kilometers) and sometimes they are huge. Preliminary tests with the HAND algorithm that I have seen indicate that the algorithm is capable of distinguishing between hydrological landscapes at all catchment scales. In practice we apply the algorithm at a pixel scale within a DEM, but the resulting distribution of landscape types is subsequently used in a lumped fashion. Very attractive is to confront the distributed landscape map with land use and rainfall and to account for the moisture in a distributed sense, but the model structure itself remains essentially lumped.

3. On realism

True, realism is the key. I also think that one can only conceptualise a catchment correctly if we have visited the catchment and identified the dominant mechanisms in the field. This is not easy and it requires experience, but it is a crucial aspect of hydrological modelling, where we observe the real world and subsequently try to fit this reality in a conceptual world. Only if the level of realism is high will the model provide good results for the right reasons, will the parameters be identifiable, and will the predictive uncertainty reduce. Linked to this issue is the question of residence times. Observations of residence times in a catchment are often 'orthogonal' sources of information that constrain the correct model structure. Sometimes this information is implicit in the geology, but often it is not. A good example of such a case is the study by Fabrizio Fenicia on the Maimai catchment (Fenicia et al., 2008).

Again, I would like to thank the editor for the stimulating discussion and the excellent reviews received during the discussion stage. I shall use elements of the discussion to improve and expand the paper where appropriate.

Reference:

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