Hydrology and Earth System Sciences Discussions

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Reply to CC1

Günter Blöschl

Author comment on "Flood generation: process patterns from the raindrop to the ocean" by Günter Blöschl, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-2-AC1, 2022

I could not agree more with Luca Brocca's observations, both regarding the open questions on scaling and the need for a more in-depth discussion of them.

How to exploit these similarities across scales, e.g. regarding preferential flow, in modelling? Truly a challenging topic which, I am afraid, I will not be able to do full justice in this paper. There exists a plethora of upscaling and downscaling methods (see, e.g., Blöschl, 2005), some of which account for connectivity, such as connectivity functions at the local and catchment scales (Western et al., 2001) and top-kriging at the catchment and regional scales (Skøien and Blöschl, 2007). The more general point in this paper is that the use of observed process patterns seems to me a key element in coming up with the structure and the parameters of such scaling methods. This means, rather than conjecturing the scaling relationships (which we do when, e.g., assuming that Richards equation applies to the catchment scale), the idea is to learn from observed patterns. From the patterns it is also possible to establish cause-effect relationships directly at the scale of interest, without resorting to scaling methods, when viewing hydrology through the prism of scale. In this case no upscaling methods are needed.

Reviewer RC1 has asked how applied hydrology could benefit from looking at flood generation patterns at different scales, and in the response I have provided a number of examples from my own work in the response, which could also help shed light on the scaling question posed here. I believe that flood design has benefitted from process patterns such as those in Fig. 6 (runoff generation) and Fig. 7 (flood types) through the flood frequency hydrology approach (Merz and Blöschl, 2008). Flood forecasting has benefitted from using observed snow and soil moisture patterns as well as preferential flow representations in the soil (Blöschl, 2008). And risk assessment of spring contamination has benefited from observed patterns of evidence on surface runoff (Reszler et al., 2018).

I will add these practical examples to the conclusions sections, but feel that an in-depth discussion of the topic – notwithstanding its importance – goes beyond what this paper tries to achieve. It would be worthwhile thinking about a follow up discussion or paper focusing more specifically on upscaling that builds on patterns.

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