Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/hess-2022-2-RC1, 2022

Referee comment on hess-2022-2

Anonymous Referee #1

Referee 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-RC1, 2022

This is an inspiring paper. I was in the audience of the Dalton Medal lecture and I am delighted that Prof. Blöschl has accepted the invitation to put that talk on this excellent paper. Hereafter are some comments/questions/curiosities for which I would be grateful of knowing Prof. Blöschl opinions (and that may or may not result in minor additional discussion in the paper, even if they were not discussed in the medal lecture).

- The concept of the "digital twin" of the earth system is gaining more and more relevance in science, and not only, given the progress of technology (e.g., Machine-Learning) and of data availability. Does Prof. Blöschl think that a digital twin of the earth system (including hydrology) is possible? Hydrologists are starting to think of implementing a digital twin of the hydrologic system (see e.g., Rigon et al., 2022, https://hess.copernicus.org/preprints/hess-2021-644/). Rigon et al. (2022) suggest that the digital twin metaphor can be something more than the hyperresolution modeling paradigm mentioned by Prof. Blöschl, i.e., an infrastructure to connect different data/models/hypotheses. Can such a digital twin be the tool to bridge the gap between scales and to help hydrologists to learn about flood processes from patterns at all scales? Is this the tool to approach, as a community, the questions raised by Luca Brocca commenting on the present paper? Or, does Prof. Blöschl think that a digital twin of the earth system (including hydrology) is possible?

- I will give this paper to my students for opening their minds on what is hydrology as a science. Even though it is touched here and there, the paper is less revealing of how "applied hydrology" could benefit from looking at flood processes at different scales. How has this journey through scales helped Prof. Blöschl to improve flood design, flood forecasting, flood risk assessment, etc.? How should common engineering practice evolve given the lesson learned (or to be discovered) by observing flood processes at different scales?

- On page 3 the debate about inherent and cognitive uncertainty is mentioned, and Prof.

Blöschl suggests that "scaling work" can be an opportunity to resolve it (this is what I understand by the unification of concepts) and an opportunity to better estimate uncertainty (this is what I understand by the unification of tools and measurement techniques). Is this the meaning of the last paragraph on page 3? If so, it is to me unclear how the scale research is contributing to these issues. Would it be possible to give an example or two?

- The concept of "trading space for time", not explicitly mentioned here, is very much used in hydrology. I know this paper is about space and not time (not explicitly) but I am curious to know in what cases, based on his journey across spatial scales, Prof. Blöschl thinks that trading space for time is justified (e.g., flood frequency analysis, flood design under climate change, ...). For example, if flood generation processes result from the coevolution of climate and landscape, are we allowed to assume that the humid catchment A will behave like the dry catchment B 50 years from now?

- I am looking forward to the follow-up of this paper: an opinion on process patterns across temporal scales, from the instantaneous peak discharge to the long-term climatic flood behavior (e.g., Blöschl et al., 2020, https://www.nature.com/articles/s41586-020-2478-3). What could we learn from the temporal scales of floods? How would Prof. Blöschl streamline such a paper (just a curiosity of mine)?