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Reply on RC3

Samuel Schroers et al.

Author comment on "Morphological controls on surface runoff: an interpretation of steady-state energy patterns, maximum power states and dissipation regimes within a thermodynamic framework" by Samuel Schroers et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-479-AC6, 2021

We thank K. Beven for all of his comments as well as his elaboration on doubts regarding circularities.

While we agree that there is potential of circularity and that it is highly challenging to describe the spatial pattern of a dissipation term in nature, we think that thermodynamic approaches might hold untapped potential for limiting runoff-erosion processes. In the special case of our study, we made assumptions regarding boundary conditions of a hydrological system, which might only be achievable in laboratory environments. However, describing the thermodynamic principles of a restricted hydrological system in a laboratory would be a first step towards constraining more complex systems in nature. On a brief note, we would like to mention that although the transfer of free energy to bound energy happens on a molecular scale, patterns seem to manifest even at much larger scales. E.g., Hooshyar et al. (2020) show that mean elevation profiles of simulated landscapes resemble the distribution of mean velocity in the viscous boundary layer of turbulent flow. Again, we agree with K. Beven that these findings are partly restricted to a digital idealized environment, but it seems to us that these highly interesting similarities merit further research on a theoretical basis as well as in laboratory setups and finally complex natural systems. For the present study we are grateful for the comments by K. Beven and will highlight these uncertainties and assumptions in a revised version of the manuscript.

References:

Hooshyar, M., Bonetti, S., Singh, A., Foufoula-Georgiou, E., and Porporato, A.: From turbulence to landscapes: Logarithmic mean profiles in bounded complex systems, Physical Review E, 102, 033 107, 2020.