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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Optimality and inference in hydrology from entropy production considerations: synthetic hillslope numerical experiments" *by* S. J. Kollet

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The MEP principle is applied to a synthetic hillslope based on a spatially-distributed andd physics-based model. The entropy production is computed. The research question is important and interesting. The methodology is reasonable. I have a few major comments related to the design of the simulation experiments. I hope my comments are useful for the authors to revise the manuscript.

Lines 25-27 on Page 5127: Rainfall and other climatic variables (such as temperature and humidity) may be correlated. If rainfall is reduced b by about 30% but other variables are not changed, this may be not realistic. Why not obtain the climatic data from a semi-arid watershed?

Related to the comment above: "Runoff out of the domain occurred only for Ksat = 0.0005 (m h−1) and S2 and was only 2.2 % of the annual precipitation." (lines 7-8 on page 5129). Even though for the case of runoff (Q)=2.2% of the annual precipitation (R) → the ratio of annual evaporation (E) to precipitation, E/PCP=0.98 → according to Budyko curve, Ep/PCP>3 → potential evaporation Ep>1900 mm since R=637 mm (line 1 on page 5128). I am not sure whether the setting of climatic variables can reach this potential evaporation (temperature is 291 K, line 27 on page 5127). It may be better to constrain the system to the observed pattern or reality when the MEP principle is used for understanding the system.

A further comment based on the above comments, how is evaporation determined? PCP=E for most of the cases. In these cases, the competition between evaporation and runoff is removed. ". . ..entropy production inside equals the net entropy exchange with the outside." (Lines 3-5 on page 2125). How is the power by the evaporation process related to the power computed in this paper? Maximum entropy production (or power) principle is used for a particular flux, and the conductance coefficient is treated as the decision variable. From the system perspective, the entropy production by all the fluxes such as discharge and evaporation may need to be summed (Wang et al., 2015, DOI: 10.1002/2014WR016857). There are two types of competition or tradeoff in the system: 1) flux and gradient for a particularly flux; 2) among different types of fluxes (e.g., evaporation versus runoff). In this paper, some of competitions (e.g., runoff and evaporation) is pre-defined. Some discussions and clarifications will potentially be valuable for the readers.

Lines 11-13 on Page 5128: No flux cross the vertical boundary at x=0? Why not set free discharge at the boundary of x=0 and assuming negligible water depth in the channel?

Line 17 on Page 5128: "In order to identify"

Equation (4) on page 5129 and other places: the superscript of net exfiltration/infiltration is changed to (-ex, inf)?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 5123, 2015.