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

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I would like to thank the author for the clarifications and additional analysis laid out in his response. I look forward to seeing the new results.

Here I would like to re-emphasise the lack of and need for consistency in units. Entropy production can indeed be expressed in units of $ML^2T^{-3}K^{-1}$, as done in Westhoff et al. (2014). However, in the present manuscript, on P5125L17, the units are given as $MT^{-2}K^{-1}$, i.e. L^2T^{-1} are missing. Since Eq. 1 in the manuscript is identical to Eq. 1 in Westhoff et al. (2014), and the units of the variables mentioned in Lines 18–19 are also

identical, the units for σ in Line 17 are probably just a typographical error. However, the units given for P in Line 25 are also inconsistent with "power per unit area", which should be MT^{-3}, i.e. energy (ML^2T^{-2}) per time per area. This is probably because Eq. 2 is missing a ρg (see Eq. 6 in Westhoff et al., 2014). Fixing this will probably not change the interpretation of the results (the missing variables are constants), but it will lead to less confusion and help the reader better understand what is being calculated, and how the results relate quantitatively to other results.

For the additional equations presented in response to my comments, I would also like to encourage clear statements about the units of each variable. This will help understand the derivations and calculations. For example, if s and J_s are expressed per unit surface area, how are the entropy fluxes at the boundaries (Γ_s) related to area? Are they computed per area of the receiving grid cells or the whole projected hillslope area?

I would also like to encourage explicit analysis of the entropy transport due to the boundary fluxes, as these largely determine the entropy balance of the system. An inflow of free water (infiltration) could be seen as an outflow of entropy independent of soil moisture (chemical potential of free water), while evaporation could be seen as an inflow of entropy that depends on soil moisture (chemical potential of bound water). There are probably alternative ways of defining consistent entropy balance components, but such explicit consideration of the entropy balance allows for detailed consistency checks of definitions and of the thermodynamic fluxes in the model as I have found while conducting the analysis published in Schymanski et al. (2010).

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