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Interactive comment on "Towards understanding the mean annual water-energy balance equation based on an Ohms-type approach" *by* Xu Shan et al.

Anonymous Referee #2

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The author try to present a study on explaining the Budyko-framework based on Ohms-law analogy. They use an interesting moisture recycling approach, that made me really enthousiastic in the beginning of the paper. However, the paper is so oddly written that I quickly was not able to understand it anymore. I am completely lost in equations that are not properly explained and the weird structure. Nowhere in the paper I see a justification that Ohms-law can be applied on catchment evaporation. Nowhere I see any validation of the study. Figures 3-5 might be the validation, but I have no clue what I see here. What is 'x'? Nor is clear what this paper adds: what do the authors try to solve (i.e. knowledge gap is missing)? Where are the results? Are that the graphs in Section 4?!?. This section is also totally unclear. It seems partly an introduction, partly

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results... at least for sure no 'discussion'.

So to conclude: I am not able to grasp the paper at all. Maybe the method is OK, but based on the weird manuscript structure, it is impossible to follow and to judge it. Please improve the structure and link more to the physical processes in hydrology (HESS is a hydrological journal). Additionally, the language can also be improved.

Specific comments:

-P1 L10: "however, few hydrological processes were involved in the derivation". Is it? And are they included in your approach?

-P1 L13-17: ?? which new constraint? What is a generalized flux?

-P1 L19: What is a homogeneity constraint?

-P2 L10-11: The 'd' of derivative should not be italic. it's not a parameter.

-P3 L6: Be consistent in capital and non-capital parameters (phi)

-P3 L21: "accordingly". I don't get how your objective links to the existing work. Please describe the knowledge gap and the relevance of your work.

-P4 L1: ".. phase transitionS..... namely evaporation AND condensation.."

-P4 L10: It's more that once you consider a time scale of more than 1 year, you can neglect the storage change term.

-P4 L13-33: This part has to be rewritten. I am completely lost here. What is the difference between i and j? Why are the assumptions valid? How do the authors justify that evaporation is driven by a 'potential' difference dU? I do see this analogy with e.g. Darcy's Law where flow is driven by a pressure difference. However, in the case of evaporation it's a trade-off between evaporative power (Epot) and water availability. This is the main idea behind Budyko. So I don't see why Ohms law analogy can be used in the Budyko framework.

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-Figure 1-2: how are these figures linked to each other? I think they both try to explain the method, but I don't see how figure 2 follows from figure 1.

- Figure 1: So the authors use a recycling approach, where evaporation from 1 catchment can re-precipitated in the same or another downwind catchment. This is true, but what I am missing is that catchment 2 receives, beside rainfall from evaporated moisture from catchment 1, als rainfall from other catchments. How is this incorporated? Please also read and refer to: van der Ent, R. J., Savenije, H. H. G., Schaefli, B., Steele-Dunne, S. C. (2010). Origin and fate of atmospheric moisture over continents. Water Resources Research, 46(9), W09525. doi.org/10.1029/2010WR009127

- P5 L18: What is the physical meaning of U2-U1?

- Section 2.2: I would start with this section before explaining the mathematical equations. Additionally, section 2.2 should more link to the physics (as the title suggests). Why is it valid to apply this approach??

-P5 L15-22: This list is not introduced

-P5 L23-31: This list is not introduced.

-P6: completely lost here from here onwards.

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