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Discussions
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Interactive comment on "Derivation of the mean annual water-energy balance equation based on an Ohms-type approach" *by* X. Shan et al.

Anonymous Referee #1

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The paper aims for a physically based derivation of the mean water and energy balance equation. The authors use a description of water vapor transfer between catchments and describe the fluxes in a flux gradient approach. Imposing the Budyko hypothesis then yields the well known Mezentsev-Choudhury-Yang equation. I think that a general derivation of the Budyko or the MCY equation is of high interest for hydrological research and thus of interest for HESS. However, one of aims of this paper is a rigorous derivation which reflects hydrological understanding. To be honest, I find it difficult to understand the reasoning which form the basis for the derivation.

What I do not understand is the framework of water vapor transfer between catchments (illustrated in the figures). Figure 1 and 2 show a moisture transfer from one catchment to the next (downwind?) where the input of the next catchment is set by the evaporation

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of the first. This then leads to their statement that after n catchments there is no water left and E = 0. However, in reality there are also other sources of vapor which can contribute to precipitation in catchment 2 and these are being neglected. So this framework is not intuitive to me. The main derivation is illustrated with figure 3 where 4 different nodes are introduced. With corollary 2 it is stated that the resistance $n_{AB} \neq n_1$ arguing that there are other possible routes between the node Atmosphere A and the catchment node B, namely atmosphere A to atmosphere C to catchment D to catchment B. I did not understand this water transfer between the two catchments. I am also not sure if these assumptions and the ones in stated in section 2.1 are actually relevant for the derivation described in section 3. Therefore I recommend major revisions which should particularly improve the description to enable the reader to better understand how considering hydrological processes lead towards the MCY equation.

Further remarks:

abstract: “homogeneity assumption” should be described more specific to the paper

End of abstract, L15: There is no conclusion provided. Please explain what your results imply.

P5L2-5: it is unclear why this is mentioned here

P6L18: Garrison 2017 not in bibliography

P8L10: $\phi(E_0) =$; while $\phi = E/P$ on L27 ; unclear why the symbols is used for different meanings

P9L1: “. . . the MCY function is the best function among . . .” a) best in which respect and b) why is it the best?

P14: There are two Zhou et al., 2015 indicate in the text to which you are referencing to

Figure 3 and in text: I recommend to use a different symbol for water vapor than P which is precipitation. It may be also useful to consider physical units of the quantities within the derivation.

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