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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A Budyko framework for estimating how spatial heterogeneity and lateral moisture redistribution affect average evapotranspiration rates as seen from the atmosphere" *by* Elham Rouholahnejad and James W. Kirchner

Anonymous Referee #1

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General comments

This manuscript evaluates the effect of averaging the non-linearity in Budyko curve in the context of subgrid heterogeneity in land surface models. Some theoretical results are developed based on the Turc-Mezentsev curve, which relate the overestimation of evapotranspiration as a function of climate variability and co-variability. The next section deals with redistribution of water fluxes into different land surface components. From the previous results, the flux transfer that optimises ET is derived, and this is

further explored using data from the Himalayas. The paper is very clearly written and contains some interesting results. My main criticism of this work is acknowledged by the authors in the discussion, namely that the results are "inherently hypothetical". I was curious as to how the optimal flux transfer is related to actual redistribution fluxes in different landscapes, and whether an "optimality" argument could be explored, i.e. do landscapes naturally organise themselves to generate an optimal flux or not? These questions are however both probably outside the scope of the paper.

Specific comments

I was surprised to not see a reference to Beven (1995), Hydrol. Processes, 9, 507–525, which seems to me to be quite relevant to the current manuscript.

p.5, 5: The use of the term "method of moments" is unfortunate here as this means something quite different (fitting a distribution by matching the first few moments to observed statistics). Really equation (6) is a 2nd order Taylor expansion of the function f about the mean values (as described accurately in the appendix).

P9, 13: I'm not sure what "harmonic difference" means in this context and this is not a term I have come across before. Consider removing this and just refer to "solving eq. 13"

The figures are of a high standard, but seem quite reliant on colour. This may be an issue for print versions of the article?

Technical corrections

p.1, 22 & 24: traditionally the aridity index refers to PET/P rather than P/PET ("humidity index"?). This use of P/PET is discussed in the article, but the use of aridity index for P/PET is potentially confusing, especially in the abstract.

p.2, 18: extra comma and space in the citation here.

There seem to be a few typos in the reference list, e.g. the first entry. Also, I couldn't

find reference to the first author of this first reference (i.e. shouldn't this be Ang and Tang?)

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