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Biogeosciences Discussions

Interactive comment on "Analyzing precipitationsheds to understand the vulnerability of rainfall dependent regions" *by* P. W. Keys et al.

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This paper presents an interesting idea: relating the sources of moisture in the atmosphere (area of evaporation) to their sinks (area of precipitation). Seven sink regions which are dependent on rainfed agriculture are selected. For these regions, the precipitationsheds are determined and the land-use of the precipitationsheds are analysed.

I think the paper is well written and presents an new concept. However some changes need to be made, to the reflection on the methods used, and also to the interpretation of the land use in the precipitationsheds.

Specific comments:

- As the precipitationshed is the novel idea in this paper, the authors should consider to

explain the concept in a section of its own. Possibly part of the "Background" section can be merged with the introduction section and a section presenting the precipitationsheds can follow the introduction section.

- In the Data and Methods section, the shortcomings and assumptions of the methods used should be more highlighted. As the water accounting model (WAM) calculates vertically integrated fluxes, it will do a good job in areas where the variability of horizontal moisture transport with height is small. However, in areas where this variability is high, it will perform less.

- Related to the previous point and the WAM, the 1.5 degree resolution of the input data might be a bit coarse. At this data resolution, the moisture convergence/divergence that is implicitly calculated by the WAM might suffer from numerical errors. I do not know how these errors propagate in the current analysis (maybe the overall effect on the shape of the precipitationsheds is quite small for some precipitationsheds), but they should be discussed.

- How large is the interannual variability in the (shape of the) precipitationsheds? And how does this relate to variability in evapotion, wind and precipitation patterns? The variability on this spatial scale is probably not very large, but it would be good to give the reader an impression of the robustness of the precipitationsheds. For a similar study done for the Indian subcontinent (http://www.agu.org/pubs/crossref/pip/2011JD016221.shtml), we found that the variability in moisture recycling (related to the precipitationsheds presented here) was mainly due to the variability in wind and precipitation patterns, and much less due to variability in evaporation.

- Related to the interannual variability of the precipitationsheds, I think that the vulnerability of the seven regions in this study should probably be based on the precipitationsheds of the years with the lowest precipitation. Those are the years in which upwind evaporation can make the difference for water resources.

- The anthromes composition in table 3 are displayed in pie-charts. Pie charts are hard to interpret, because people generally have difficulty to compare the differences in areas between the parts. I suggest to put the eight number on which the pie charts are based in the table, in that way they can be intercompared better.

- How are the anthromes compositions of the precipitationsheds determined? From the fractions ocean and land in table 3, the compositions seem to be determined by the areal fraction in the 70% relative precipitationshed. I suggest to weigh the anthromes composition by the contribution to precipitation in the sink region. In that way, the land uses that contribute a lot to the precipitation in the sink region are represented more in the anthromes composition than those that contribute less. Another advantage of weighing over the contribution to precipitation is that it can be done over the entire globe and the 70% cutoff value (which seems arbitrary) is not needed. (Because areas far away that contribute little to the precipitation in the sink region have only a small representation in the anthromes composition.)

- figure S1: What is the message of this figure? The absolute and relative scales under each figure are very useful, showing that the absolute precipitation in the sink region is coupled to the evaporation in the source region, the concept of the precipitationshed. The comparison of figures S1(a) and S1(b) tells me only that colorscales should be chosen wisely, which is probably not necessary for the readers of this paper. My suggestion is to put figure like S1(a) in the main paper and elaborate on the difference between the absolute and relative scale to define the concept of precipitationsheds.

Minor issues:

- It would be helpful if the amount of precipitation in the growing season (in mm and mm/day) would be included in the caption of the precipitationshed figures, in that way the reader does not have to switch between the figures and table 1.

- p10496: "A large amount of evaporation originates within the Western Sahel sink region" –> A large amount of precipitation originates from evaporation within the Western

Sahel... ?

- p10497 L11: "are spatially contiguous" –> is this the case in practise? Because theoretically this is not necessary.

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