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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 is a very interesting paper, presenting a refinement of previous concepts in the literature on source regions of evaporative moisture for precipitation in specific regions to the notion of "precipitation-shed" (I feel compelled to hyphenate it as it seems too difficult to read otherwise), which gives it a more sociological bent on top of its analogy to conventional hydrology.

I list specific comments below, mostly minor, except for #6, which points to what is likely a failing of this methodology (as well as other related approaches) in certain circumstances - this should be discussed by the authors, perhaps after a little more diagnostic exploration with the data and WAM method.



Specific comments:

1. 10489, L17-19: Foley et al. (2011) would be another good citation to motivate this work: http://www.sciencemag.org/content/309/5734/570.abstract

2. 10493, L18-23: Full resolution ERA-Interim data are now publicly available: http://data-portal.ecmwf.int/data/d/interim_full_daily - do you feel there would be any sensitivity of the results to the resolution of the driving data?

3. Fig 2: It is very difficult to discern the blue lines. Maybe it would be better to use black lines, and change the color scale for recycling ratio so it does not contain black.

4. 10495, L11-12: Please indicate the proportion of each grain. I suspect a smaller fraction of global maize is represented in these specific areas than the other two.

5. Fig 3: Please zoom in the map so it just encompasses the the colored area, so readers can better see the detail, especially close to the sink region where the confidence should be highest.

6. Fig 3a and Sec 4.3: I highly suspect that the large source region around the Mediterranean is bogus. We encounter the same situation when identifying source regions (analogous to precipitation-sheds) with the quasi-isentropic back-trajectory (QIBT) technique (see: http://www.iges.org/wcr/ & cfr. http://www.iges.org/wcr/river/Niger.png). In areas where there is strong low-level convergence between humid and dry (maritime and continental) air masses, such as along the Sahel region, or the "Dryline" of the Southern Great Plains of the US, virtually all the moisture for precipitation is supplied from the humid side of the convergence line. However, a posteriori water accounting methods like WAM or QIBT cannot resolve at the GCM grid scale which side of the convergence/precipitating grid cell the moisture came from, even with data at sub-diurnal temporal resolution. They tend to estimate approximately equal sources from each side of the line of low-level convergence. We have tried to correct for this in QIBT by changing the random selection of X,Y coor-

dinates for starting parcels launched in areas of strong specific humidity gradients to skew heavily toward the humid side of the grid box - this did little to ameliorate the problem. We are currently involved in a funded project with M. Bosilovich and colleagues at NASA/GSFC where we will apply the QIBT technique to output from a version of the GEOS5 GCM that contains explicit tracing of water vapor. This will provide for the first time a cross-validation and, I suspect, expose this apparent cross-desert moisture advection as a spurious artifact of a posteriori water vapor tracking methods.

7. 10497, L8-10: The likelihood that trans-desert moisture advection is a much less important source than suggested by the analysis should be discussed here.

8. Table 3: An interesting and unique table - could you add a column for total population in the precipitation-shed?

9. Sec 5.3: This section provides a unique and instructive perspective that I have not seen before in water cycle studies like this. It is very interesting - more qualitative than quantitative, but that is OK as it is providing more of a social science perspective.

10. Sec 5.4: These assessments seem highly subjective. Please describe in more detail your criteria for each category (a decision tree or flow chart, perhaps), or couch this section more as "speculation" than "assessment".

11. 10502, L11-13: Not a new idea, but laudable, yet politically *very* difficult, as the authors certainly must be aware. Nevertheless, the more research published showing the interconnectedness of our planet's resources, the more hope there is for breaking through short-sighted nationalistic policies.

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Interactive comment on Biogeosciences Discuss., 8, 10487, 2011.