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Comment

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 personal reply to Paul Dirmeyer's comment 6:

Comment 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

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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 coordinates 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."

I find it very interesting to hear that Paul Dirmeyer and Michael Bosilovich are pursuing a comparison of a posteriori vapour tracing methods with that of explicit GCM water vapour tracing. I do want to take the opportunity here to state that I am involved in a very similar project albeit with the output of an RCM applied on West Africa. Preliminary results of water tracing from Lake Volta show a different behaviour of explicit RCM water tracing, and the a posteriori water accounting models WAM and QIBT. As these results are preliminary I do not want to speculate too much on the causes and possibilities we see to ameliorate the problems.

In the case of the current paper, if Paul Dirmeyer is right and the contribution of the Mediterranean is overestimated, it might mean that the contribution of terrestrial sources (Table 1) is even higher than stated. Yet, I think that cross-desert moisture advection is very well possible, however, a detailed study with multiple water vapour tracing methods is certainly beyond the scope of this paper. In conclusion, I do look very much forward to the results of Paul Dirmeyer, Michael Bosilovich and collaborators, as well as the results from my own project group and anticipate that this will provide valuable insight in the applicability, but also limitations on a posteriori water vapour tracing methods such as QIBT or WAM.

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