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Hydrology and Earth System Sciences Discussions

Interactive comment on "Recycling of moisture in Europe: contribution of evaporation to variability in very wet and dry years" *by* B. Bisselink and A. J. Dolman

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This manuscript proposes a study of the role of continental evaporation in generating precipitation in Central Europe. The paper is overall well-structured. While the topic of the paper is certainly suitable for publication in HESS, I have several important comments about the method and the selected study area.

To my view, the obtained results allow only a partial answer to the main research question ("role of evaporation in triggering precipitation"), because the study area seems arbitrarily chosen. The influence of scale on precipitation recycling ratios is mentioned

but the equally relevant question of the shape of the area (which is now an east-west oriented rectangle) is not discussed.

A priori, there are more possibilities for recycling within this study region if the atmospheric moisture flux is zonal, than when the atmospheric moisture flux is meridional. Imagine the case where the study area would be reduced to a long east-west oriented strip of only a few kilometers width. In this case even the slightest meridional moisture flux will lead to precipitation recycling ratios equal to zero. It is obvious that the results become meaningless in this case.

In the case of a mainly meridional oriented moisture flux, the precipitation recycling can still take place but perhaps from Italy, Spain or Norway towards Central Europe. The study region considered in this paper suffers from this problem. I would have liked to see the authors' comments on this issue.

The problem of the scale and shape dependency of the precipitation recycling definition used by the authors could be solved by using a scale-independent definition as proposed by Savenije (1995, 1996a) and Yoshimura (2004) (see below).

In general, I think the relevance of the results could be greatly enhanced if a larger part of Europe was taken into account in the modeling exercise; the focus of the results could then still be on Central Europe.

Detailed comments:

* Please provide a clearer explanation of the negative and positive feedback mechanisms for precipitation recycling (this could in fact be a strong point of the paper).

* I agree with the first reviewer that the triggering of precipitation should be better explained (try to support this with data). Recommended literature: Savenije (1996b), Eltahir (1998).

* I strongly suggest being consequent in using precipitation recycling, and not only recycling.

HESSD

6, C1152–C1156, 2009

* ρ and rr: Why not call this the local precipitation recycling ratioρ_l and the regional precipitation recycling ratio ρ_r, this is more elegant and more clear. More importantly, rr depends on the size and shape of the study region; ρ depends mostly on the shape and size of the mother region, which equals in this case the study region in figure 1 (see also next point).

* 3302-1-3: The authors state: “Precipitation recycling is defined as the contribution of local evaporation in a region to the precipitation in the same region” This sentence is not clear to me. I would replace this with: “We define (regional/local) precipitation recycling as ...” (Brubaker, et al. 1993)

As for the definition itself, because of its scale/shape dependency it is - to my view - not a workable definition if one wants to study the contribution of continental evaporation to rainfall. Savenije (1995, 1996a) proposed a local recycling ratio (λ) as the part of the rainfall that stems from terrestrial evaporation and Yoshimura (2004) proposed the continental cycling ratio as the ratio of precipitation that originates over land to total precipitation. The terminology is different, but in principle the definitions of Savenije (1995, 1996a) and Yoshimura (2004) are the same. This definition is not scale dependent and provides more insight into the importance of terrestrial evaporation to sustain rainfall.

* 3302-28-29: The authors state that the atmosphere is too dry to generate precipitation, this is true locally, but maybe it leads to precipitation outside the study region which is not investigated.

* 3307-14: I recommend names of the variables to be given in the text or at least in the table.

* 3307-17-3308-7: The validity of the well-mixed assumption is extensively discussed by Fitzmaurice (2007). Please give more details explaining why you think that “fast recycling” in Central Europe is unlikely to be as effective as in the Amazon.

HESSD

6, C1152–C1156, 2009

* 3308-8: The local recycling ratio is - to my view - a misleading name, because it implies to be a local characteristic but is actually rather artificial, depending on the mother region's shape and size. This should be mentioned.

* 3308-22: It appears to me that the authors claim a logarithmic relationship as if it was a law of nature. Is it not just curve fitting? Other authors, Eltahir and Bras (1996) and Dirmeyer, et al. (2007) have proposed an exponential relationship (which indeed also results from curve fitting).

* 3310-14-15: The authors mention a peak, which I have a hard time seeing; perhaps plotting P instead of Pr could help?

* 3317-13-14: To my view, the conclusion that precipitation largely originates from oceanic sources cannot be drawn from this research since only the land area within the study region is taken into account. Land area outside this bounding box may contribute to a large extent to the precipitation in Central Europe but this question is not investigated.

* 3317-22-26: In my opinion, this is not a conclusion, but an introduction.

* Figures 5-9: When the local precipitation recycling ratio is not defined (no precipitation), changing the color of the precipitation recycling ratio to completely white will definitely help the readers to interpret the results.

* Figure 7d: Lines are very unclear, what is the source (place of evaporation) and what is the destination (place of precipitation)? I suggest using arrows.

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HESSD

6, C1152–C1156, 2009

Interactive Comment

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HESSD

6, C1152–C1156, 2009