Earth System
Dynamics
Discussions

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Interactive comment on "**Atmospheric rivers moisture transport from a Lagrangian perspective**" *by* **A. M. Ramos et al.**

Anonymous Referee #2

Received and published: 27 January 2016

1. Overall evaluation

The manuscript presents an analysis of the evaporation-minus-precipitation (E-P) signature along atmospheric river (AR) trajectories of hydrological relevance to various sectors of west Europe. The detection of AR is based on an existing method introduced in Lavers et al. (2012) with refinements to facilitate applications to different geographical sectors. Analysis of AR trajectories is based on a Lagrangian dataset produced by a global simulation of the FLEXPART model widely used in the community. The ERA-Interim reanalysis is used for the detection of ARs, and for forcing the FLEXPART model. The methods used are reasonable, and the results represent a useful contribution to the ongoing understanding (sometimes debate) of the moisture sources and transport associated with ARs.

I would like to recommend publication of the article in Earth Syst. Dynam. subject to major revisions suggested below.

2. Major comments

2.1 AR detection

The detection of ARs is based on refinements to the method introduced in Lavers et al. (2012). Specifically, multiple (i.e., three) reference meridians are used instead of a fixed one for the entire west Europe. Landfall time and locations based on the three reference meridians are then pooled and regrouped into five sub-domains based on geographical relevance.

Part of the overarching difficulties involved in AR detection over large domains is the challenge to establish a universal threshold for the AR intensity, and the above is a potentially useful effort toward improved AR detection over large domains based on the Lavers et al. method, and may represent one of the novel aspects of the study.

However, it is not clear whether the refinements actually improved AR detection. For example, do ARs in the final five sub-domains better correlate with heavy precipitation in each sub-domain than does the original set of ARs based on a single reference meridian at 10W? I wish the authors would take the opportunity to show that the refined method indeed works better.

2.2 Trajectory analysis

To my knowledge the current study is one of the two studies that analyzed the E-P (or dq/dt) signature along AR trajectories, the other study being the case study in Stohl et al. (2008). In this regard, the current study is the first to present the E-P signature from a climatological perspective, a novel aspect not articulated in the paper currently.

What would make the paper more interesting and insightful would be to additionally analyze the E and/or P components of E-P to show the relative importance of E vs. P over different moisture source regions. The analysis, if done, would have important

implications to observing and simulating ARs as precipitation is among the least well represented processes in GCMs which may limit our capability to realistically simulate the AR moisture balance along its trajectory.

What would usefully complement the E-P analysis would be the distribution of track densities, i.e., the count of parcels that contributed to the E-P calculations at each location, for example, see Figs. 3d-f of Rutz et al. (2015). With this information on track density the inference of AR moisture source regions would be more complete and compelling.

While I do not expect the authors to conduct all of the new analysis suggested in my major comments, I encourage the authors to take the opportunity to make the paper a more insightful and potentially more influential contribution to the science of ARs.

3. Minor comments and corrections

P2618L12: it would make more sense to give the parcel size; the total number of parcels is less relevant.

P2618L19: remove "is" before "found".

P2618L22-23: change "further the analysed longitude along the North Atlantic is located eastward" to "at locations closer to AR landfalls".

P2619L2: "~500 km" is not accurate, "on average ~500 km" will be better.

P2619L7: Neiman et al. (2008) could be cited.

P2619L18: remove "the use of".

P2619L20: it feels the paragraph is not naturally ended, i.e., you mentioned there are two approaches, and so what does that entail?

P2619L23: Ralph et al. (2004) could be cited.

P2620L4: what exactly does "analyses" mean here?

P2620L7: change "proposes" to "proposed".

P2620L11: change "has" to "have".

P2620L13: fix the grammar in "It is discussed the possibility that".

P2620L18: could a reconciling remark be made here regarding the two different views?

P2620L20: change "scares" to "scarce".

P2620L20: one or more of the following latest studies could be cited and briefly discussed: Garaboa-Paz et al. (2015), Rutz et al. (2015), Ryoo et al. (2015).

P2620L23: change "on the Norwegian" to "in Norway".

P2621L6: change "specific moisture" to "specific humidity".

P2622L6: change "humidity" to "specific humidity".

P2622L16-17: do you mean a meridian (a line) or an area (a box)? If a line why "centered"?

P2623L1: ". . . since . . .": this is not really an explanation which I suggest be removed.

P2623L13: "local IVT threshold": does "local" mean the threshold is dependent on both longitude and latitude?

P2623L16: change "20.25" to "22.5".

P2623L17: as far as I know one degree of longitude at 55N is ∼64 km.

P2623L20: to define persistent ARs do you limit how far the AR can move along the north-south direction over the 18 h period? In principal two independent ARs separated by certain distance can each make landfall at the same reference meridian at two adjacent time steps – how is this scenario handled?

P2624L6: see comment above to P2618L12.

P2624L10: remove "mentioned".

P2625L1: K is the total number of parcels in the column above area A, and therefore must be a function of A, not a constant like 2 million. Please fix the explanation.

P2625L19: change "9.75" to "9.75°W".

P2625L25: the re-organization needs more detailed explanation: how does it go from a line-based landfall to a box-based landfall?

P2627L21: "(a)" does not a corresponding "(b)".

P2628L29 and P2640 2nd from bottom line: as far as I understand the Tropic of Cancer is currently located at 23°26'N or 23.43°N, NOT 23.26°N.

P2630L9: the word "confirms" sounds weird as in the previous sentence you just described something inconsistent with your result.

P2630L25: add "divided" before "into".

P2631L7: change "4.5" to "4.5°W", and change "45-55" to "45-55°N".

P2632L6: change "longitudes are located westward" to "for longitudes away from the landfall locations".

Figure 1: I think the readability of the figure can be considerably improved if the two panels are combined into one single plot over one single domain. That way the reader can visually understand how the five boxes are defined relative to the three reference medians.

Figure 3: either increase the font size for the axis labels, or remove them entirely. Currently they are way too small to be read.

4. References

http://dx.doi.org/10.1063/1.4919768

Interactive comment on Earth Syst. Dynam. Discuss., 6, 2617, 2015.

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