

## Rivers in the Sky, flooding on the ground

### Reviewer 3 Report Round 1

This article analyzes the role played by atmospheric rivers in some of the most important flood events in the lower part of the Rhine River basin. Overall, the paper is well written, and the inclusion of the perspective of the hydrological extremes –floods– rather than the simple extreme precipitation is always an added value. The authors find most of the more important flood events over the region were preceded by an AR event, and this is an interesting result that could be valuable for the region. The quality of the figures is acceptable, but it could be improved. I suggest the authors improve some of them if that is not very problematic.

I believe that the title is a bit pretentious. It is a very catching title that would be probably the best choice for a review paper or a paper intended to get conclusions on a global scale. This manuscript is focused on a very particular region of Inland Europe, and I think that this should be reflected in the title somehow. I would perfectly understand if the authors would like to keep the "Rivers in the sky, flooding on the ground" –I would have done the same–, but I suggest that this title should be extended with a citation to the region of interest somehow.

I have already read the comments made by the other reviewers, and I mostly agree with them. Reviewer 2 suggests to extend the 10-events composites. I will not put that condition as necessary to give my full recommendation to publish, but I think that it could be a good improvement for the paper if the authors are willing to do it. Also, this colleague suggests the authors include a discussion about Helen Dacre's (and others) perspective of the importance of local convergence of moisture in ARs development. He/She is right, but I would like the authors to take into account –when they discuss this point– that there is also a huge bunch of articles of all kinds pointing out to the essential role played by the large scale advection of tropical and subtropical moisture. I do not think that the authors should take sides with any of those perspectives –actually, I believe that both mechanisms are necessary, and the relative importance between them changes among the events–, but both may be included in the discussion.

I will not suggest major changes, however, some of my comments (particularly those regarding the very likely explosive nature of some of the involved cyclones and also those regarding the role played by NAO) will take some time from the authors to be replied. I would like to read and discuss the answers in an eventual second round of the review process.

## Minor Comments

**L.43** I suggest the authors consistently arrange the citations by chronological order. It is not only fairer for our colleagues, but also the result is more elegant. For example, in this case, I would start from Lavers and finish by DeFlorio or Guan and Waliser.

**L.54** Please, leave a blank space between "50" and "km".

**L.57** The beneficial aspects of ARs are not restricted to arid/semiarid areas at all. Most ARs are beneficial even in mid-latitudes. This idea is well discussed in Ralph (2019), and I think that should be included somehow in the text.

Ralph, F. M., Rutz, J. J., Cordeira, J. M., Dettinger, M., Anderson, M., Reynolds, D., ... & Smallcomb, C. (2019). A scale to characterize the strength and impacts of atmospheric rivers. *Bulletin of the American Meteorological Society*, 100(2), 269-289.

**L.65** There are some other important analyses relating ARs and extreme precipitation and floods in Europe that the authors did not take into account. (e.g. Eiras-Barca et al.; 2016, 2017).

**L.87** I think that section 2 must be included in the methods section. However, this is just my opinion and I let this decision to the authors.

**L.116** If the authors had SLP, why did they start the vertical integration at the level of 1000 hPa instead of SLP, which would be the most correct option?

**L.130-134** I don't see the need to describe with words what the equations are already saying.

**L.135** The algorithm (and database) developed by Guan at UCLA is one of the most commonly used in our field, and I am not going to call it into question. However, did the author consider the possibility that the detection thresholds could have substantially changed in these almost 200 years that they are considering in the analysis?

**L.136** Please, replace the asterisks by ·

**L.152** How well is performing EOBS over Germany? Some analyses pointed out the fact that EOBS may not be the best option over continental Europe...

**L.164** Please, leave a blank space between 27 and mm. Take this into account throughout the rest of the article.

**L.320** The presence of both the high pressure over the Iberian and the low-pressure north of the British isles will be both almost mandatory requirements for a strong AR to landfall in the region of interest. However, I am not sure that the plots in Figure 11 are really catching the importance of the low-pressure system, which is essentially the one that is carrying the warm conveyor belt and the AR in its pre-frontal region. Particularly, I would be interested to know how many of those 10 systems were explosive cyclogenesis. There is a recent article (Eiras-Barca et al., 2018) analyzing the important correlation between explosive cyclogenesis and strong ARs over Europe, and it would be interesting to know how many of those 10 systems leading to the 10 highest flood peaks were explosive cyclones.

Additionally, I think that there is room here for a brief discussion about the role played by the NAO in all this. I suggest the authors include a brief discussion on the matter.

**Figure 1** Is not clear what “euro\_dem” is.

**Figures 3,4,6,7,9,10,11** Please include the units in the colorbars or the arrows.