

***Interactive comment on* “Local and remote moisture sources for extreme precipitation: a study of the two famous 1982 Western Mediterranean episodes” by Damián Insua-Costa et al.**

Reale (Referee)

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This is an excellent piece of research that brings a substantial advance to the complex issue of moisture sources related to flood-producing precipitation events over the Mediterranean region. While the writing could be improved, the results are very convincing. I find the methodology particularly praiseworthy. As such, I recommend the article to be accepted after some minor revision.

General comment: expand the focus.

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I agree with the other reviewer that the Authors should consider changing the title. Aside from defining as ‘famous’ events that may not be known outside the hydrology, engineering, and meteorology communities in Spain, I would rather use the term ‘infamous’ to describe catastrophic events that have caused death and destruction. Even better, I would avoid ‘fame’ entirely and perhaps refer to the events as ‘catastrophic’. The term ‘famous’ also appears in page 17, second par.

Most important, I suggest to modify the introduction, in order to provide a broader motivation that can make the article relevant to a much larger community. The description of general mechanisms as it is cannot provide objective, generic, absolute ‘causes’. Furthermore, the Authors themselves acknowledge that the 2 events are very different one from the other. Therefore, I suggest to broaden the focus of this article, by connecting this work with other research.

Conditions for the development of these events surely are strong instability, presence of some circulation that organizes the flow, exploiting orographic contribution. However, the puzzling aspect is that most of these conditions, for example Mediterranean baroclinic cyclones, are often present but are rarely associated with extreme precipitation. It is only a very small subset of Mediterranean cyclones that cause catastrophic events. Furthermore, in some instance the Mediterranean cyclone could be less relevant than the large-scale southerly flow associated with larger cyclonic circulations outside the Mediterranean. So, the Authors may consider starting with the statement that the presence (or absence) of intense moisture transport anomalies on a very large scale could be the critical, discriminating factor between many situations apparently similar but in which only one produces an extreme precipitation event.

Another suggestion is to think in a more ‘global’ scale. The Authors’ experiments, unlike previous work, are both at very high resolution and encompass a very large domain. As such, they have the possibility of linking Mediterranean floods with the global scale. If this is done, the article will attract a much larger set of readers interested in the subject of tropical-extratropical connections.

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As a starting work, consider the final part of Wu et al. (2013). In that work, we linked 2 cases of flood-producing precipitation over Europe with the so-called 6-9 day African Easterly Waves (for the part of the article relevant to your work, please see Section 3d, from page 6765 onwards). The 6-9 waves are different from the well-known 3-6 day waves, because they form to the north of the African Easterly Jet, at the jet level (about 600 hPa) and they travel northward. They can be conceived as a 'relaxation' in the subtropical high pressure that bridges mid latitude low pressure systems with the Inter Tropical Convergence Zone (ITCZ).

From this article's perspective, 6-9 day waves are relevant because they represent a way of connecting tropical moisture generated within the ITCZ with midlatitude systems. If one of such waves acts in phase with a deep midlatitude cyclone, a stream of moisture can leave the ITCZ, travel in a relatively stable area associated with the relaxed subtropical high (and thus without losing moisture) and 'connect' with the warm advection ahead of a frontal system in the midlatitudes. Then, any mechanism able to concentrate and release this enormous amount of moisture over a small area, can cause a flood-producing precipitation event. Figures 14, 15, and 16 from Wu et al. (2013) illustrate this aspect for extreme precipitation events occurred in 2000 and 2002, respectively. It seems that the plume of moisture associated with Fig.3b, Fig. 5d, in this work, bears remarkable similarities.

Most relevant for this work are also the papers by Knippertz (2003), Knippertz et al. (2003) which connect episodes of extreme precipitation over northwest Africa with anomalous advection from the tropics, and place these into the context of a tropical-extratropical interaction.

Schepanski and Knippertz (2011) further expand in this direction and finds in the Soudano-Saharan depression a key element connecting tropics with midlatitudes. We think that all these results are very consistent with each other, and simply focus on different aspects of the moisture transport.

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It is important to notice that anomalous moisture advection from the tropical Atlantic has been noted also outside the Mediterranean region: the study of Stohl et al. (2008) identifies a very similar moisture path for precipitation events in Norway, connecting these with the tropical Atlantic.

Minor comments:

The WVT could become a formidable tool, particularly because is coupled with the WRF, which is very well known and used worldwide. The Authors should consider distributing it, either through their own portal, or in collaboration with an WRF development team. It would gather widespread attention if it became an easily accessible methodology. I find particularly important, compared to earlier studies, the ability of investigating sources on a 3D scale.

Figures. The clarity of the figures illustrating the synoptic situation could be improved. Even coastlines and geographic features are barely detectable. In Figure 3a, I suggest blanking out the temperatures around 0C (such as -2 2) so as to have a white strip between cold and warmer air, and use less intense colors. If done in GrADS, the Authors could consider the use of transparencies which is now an option and allows more readable plots. Otherwise, just use lighter colors.

In figure 3b, I suggest to blank out completely the values of tpw less than 10mm. These are not relevant to this work, indicate simply drier air, and by eliminating them the emphasis would be given to the huge moisture plume stretching from the subtropical Atlantic towards the Iberian peninsula.

Similar suggestions for Figure 8.

In the text, there are some sentences whose clarity could be improved. See for example page 4, lines 7-8, d

Page 18, line 14.. a semantic issue.. Instead of 'verify the hypothesis' .. . Consider something like 'corroborate the idea that remote sources of moisture from the tropics

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contribute to an important fraction of extreme precipitation events in the midlatitudes..'

In summary, aside from these relatively minor suggestions, I believe that the article is a great contribution to precipitation research, and I recommend acceptance after minor revision. However, I believe that the article would benefit by placing the results into the broader context of tropical-extratropical interactions and large scale advection of tropical moisture.

Oreste Reale

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