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Discussions
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Interactive comment on "On the origin of moisture related to synoptic-scale rainfall events for the North American Monsoon System" *by* Paulina Ordoñez et al.

A. M. Durán-Quesada (Referee)

ana.duranquesada@ucr.ac.cr

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General comments:

The study aims to provide a long term analysis of the sources of atmospheric water vapor for the NAM system and their relationship with synoptic scale rainfall events using a backward Lagrangian trajectories method based upon the FLEXPART mode. Considering moisture supply to the NAM has been mostly analyzed from an Eulerian perspective, the proposed approach provides a new insight to the problem analysis. Moreover, including a more detail analysis in terms of the synoptic rainfall events is regarded as a new and valuable contribution.

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Discussion paper

Specific comments:

Introduction

1- The introduction condenses a vast amount of previous studies on the NAM, still something can be added to briefly explain why regardless of not fulfilling the wind reversal criteria, the system is considered as a monsoon.

Method

Section 2.1:

Page 3:

2- It is not clear which FLEXPART version was used to generate the trajectories dataset or whether the data was generated for this work at all. Version 9.0 is referred as Stohl et al., 1998 and Stohl and Thomson, 1999 but those correspond to much older versions of the model, version 9.0 was released in 2012. More detail on the dataset generation is needed or mention the correspondent reference of the work for which the data was originally computed that must have the full detail.

Page 4:

3- How does “the difference between simulated precipitation and CHIRPS data” represent a lifetime? Does this refer to a validation of the skills of the trajectories to capture rainy days compared to (I suppose daily) CHIRPS based on a threshold for daily accumulated precipitation and dq/qt?

4- I would suppose CHIRPS is a reasonably good dataset for the analysis domain as a larger amount of observations are included, I would like to recommend some briefing on the accuracy of FLEXPART to capture rainy days compared to CHIRPS to ensure reliability.

Section 2.2:

4- Page 4:

5- Though this section provides an explanation to previous question, the method for selecting events must be better explained.

6- The interpretation of synoptic events is confusing, it is certainly based on a spatial scale considerations which is a bit different to what is expected after reading the title and introduction. Following the title one may expect a full synoptic classification (such as Hochman et al. 2018) that identifies the large scale conditions associated with rainfall for which the (E-P)-n field is analyzed. Instead, the synoptic classification is used to provide a sort of measurement of the precipitation influence area identified following a dry/wet days criteria. A change in the title is suggested to avoid confusion in what to expect from the method and results.

7- Caption of figure 3 is required to be self-explanatory. The cut in the figure looks weird, you can use a larger domain to show a more complete map and contour only the region of interest.

Results

Section 3.1:

Page 5

8- There seems to be a misunderstanding on the interpretation of (E-P)-n (when using trajectories analysis) for it is known that the presence of a moisture source is valid interpretation for (E-P)-n > 0 over ocean, the accuracy of a similar interpretation for (E-P)-n > 0 over land is rather questionable (the bias of E estimation is high with this method so that interpretation of recycling ratios is restricted to an upper level, see full detail in Stohl and James, 2004). Further aspects are to be considered for recycling, namely a few: a) meaning of the “E” term and how does it reflect or not recycling processes such as transpiration, b) the scale dependency of moisture recycling rations need to be taken into consideration (see e.g Van der Ent and Savenije, 2011) , c) what

does “recycling” actually mean in terms of the modeled scales?

9- The identification of the “five moisture sources” is then limited to the interpretation of the (E-P)-n estimates. Hence, strictly speaking, the results for sources identified as NAM, EAST and NORTH need a through review for the full manuscript. Same for every result related to inferred “recycling”.

10- The GoC has been previously highlighted as a relevant source of moisture for the NAM development, however the results show that it is not the GoC but the region off the Pacific coast which acts as a moisture supplier. Does this present a contrasting result compared to previous work? How do you interpret the result in comparison with previous works?

11- figures 5 and 6 should be modified according to the considerations of the “precipitation recycling” interpretation.

Page 6

Previous comments on interpretation of precipitation recycling apply for this section as well the full document.

12- [Considering the oceanic sources only] results for the difference among weak, moderate and extreme rainfall events (figure 9) show very little variations from one case to the other. How do you interpret this result in terms of moisture availability, transport and observed precipitation for the events? The use of other variables such as precipitable water vapor and a measure of atmospheric stability could provide support for analysis.

13- Vectors in figure 10 are not easy to ready, you can try plotting them every 5 or 10 grid points to improve the figure. The discussion regarding the interpretation of the Geopotential height and moisture transport anomalies in the analysis in page 7needs improvement. Consider for example discussing the dynamics underlying the large scale patterns and the bin of event (weak, moderate, extreme).

Summary and concluding remarks

14- Considering the authors have defined the recycling of precipitation in terms of local evaporation over the NAM domain, the analysis and this section need a revision. It is key to note that the time scale of the simulations does not necessarily fit the scale of processes that occur at local scales.

References

- Hochman A, Harpaz T, Saaroni H, Alpert P. Synoptic classification in 21st century CMIP5 predictions over the Eastern Mediterranean with focus on cyclones. International Journal of Climatology. 2018 Mar 1;38(3):1476-83.

- Van der Ent, R.J. and Savenije, H.H.G., 2011. Length and time scales of atmospheric moisture recycling. Atmospheric Chemistry and Physics, 11(5), pp.1853-1863.

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