

## ***Interactive comment on “Regional co-variability of spatial and temporal soil moisture - precipitation coupling in North Africa: an observational perspective” by Irina Y. Petrova et al.***

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### **General comments**

This paper describes a detailed analysis of soil moisture-precipitation coupling over North Africa. Building upon the work from Taylor et al. (2012) and Guillod et al. (2015), the authors conduct an analysis at a higher resolution which allow them to identify the driving mechanisms in more details than these previous global studies. Among others, they highlight the role of wetlands and irrigated areas, and also study mesoscale convective systems (MCS) (both their impact on the statistical analyses and the impact of soil moisture on these systems).

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The manuscript presents a useful study that deserves publication in HESS. It is overall well written, clear and concise, with a few exceptions that deserve improvements listed below. Most of my comments below are minor but there is a number of them, hence I recommend major revisions although they should not be difficult to account for.

I have also listed below a number of typos or edits (e.g. removal of commas). Being myself not a native english speaker, the authors can feel free not to implement these if they are confident that their version is more correct.

I am also happy to forgo anonymity.

Benoit Guillod

**Specific comments** (given as PX,LY for page X, line Y):

- P3,L5-7,L16,L25-26: The mention of the 5 degrees resolution of T12 and G15 analyses (and 1 degree in this study) is somewhat misleading. All three studies analyse events at 0.25 degree, and subsequently aggregated their statistics to 5 degrees boxes (or 1 degree in your case). Please make this clearer at these lines to avoid confusion for readers who are not very familiar with those previous studies.

- P6, L7-9: The event identification and spatial metric (point i) is from T12 but the temporal metric (point ii) is from G15.

- P6,L29-30: "a negative rainfall gradient between Lmax and its adjacent four pixels must be present". I do not understand what the authors mean: if Lmax is the pixel where is rained most, isn't a negative gradient with the neighbouring pixels already ensured? Or perhaps I misunderstand what is meant here, in which case some clarification would be useful.

- P8,L20-22. "As in G15, the weakest negative coupling signal in the Sahelian domain is obtained with the PERSIANN (Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks) data set (Hsu et al., 1997)." I do not fully understand this sentence since the authors did not use PERSIANN. Do you mean per-

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haps not "As in G15" but rather "The PERSIANN estimates from G15 exhibit weakest negative spatial coupling from all..." or something along these lines?

- P8, L24-25: It could be stated that the first part relates to the grey lines on Fig. 5 while the second and last part of the sentences is not shown.

- P10, L2: The chosen range ( $Q25-1.5 \times IQR$ ,  $Q75+1.5 \times IQR$ ) is somewhat complicated to understand. Why wasn't an easier range such as a percentile (e.g. Q01-Q99) or a fixed distance to the mean (e.g.,  $\pm 2$  std deviation) chosen? I understand that the choice restricts the selection to values that are very far from the mean and this might not happen at every pixel, but it is not straightforward to understand.

- P10, L5-10: This result might indicate that the use of the median Delta rather than the mean might be more appropriate, i.e. less affected by those extreme values?

- P12, L7-9: This is encouraging and supports the methodology of T12/G15 which was primarily aimed at detecting newly created systems rather than existing, advected MCS. This might be worth noting.

- P13, L9-19: The description of LCL results confused me initially, because Fig. 10b shows the height in hPa but the authors implicitly refer to the height as a distance above ground, both of which are of opposite sign. Hence I was first confused when reading "A slight increase of the LCL in the South" while Fig. 10b shows negative anomalies. I support the implicit use of height above ground in the text, but I suggest the addition of a short sentence that highlights that increase of the LCL height is shown as a decrease, in red, of LCL in hPa - or something along these lines.

- Section 5.2 (role of rainfall persistence): This section is useful and I like the concept behind Figure 11. However, the authors do not discuss explicitly whether rainfall persistence may partly reflects an effect of the land-surface or whether it only reflects atmospherically-driven persistence (the latter implying that the observed statistical relationship would be due to confounding factors). This is, of course, impossible to disen-

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tangle from observations alone and it is out of the scope of this paper to fully address this issue. Nonetheless, I feel that it deserves to be at least briefly discussed here. Numerous papers address this topic (e.g., Salvucci et al., 2002; Guillod et al., 2014; Teuling et al, 2005; Seneviratne et al., 2010).

- Figure 2: This is a very useful diagram.

- Figure 4: "The percentile values lying outside the significance range (10-90

- Figure 5: This figure is slightly confusing, although the content is useful. My understanding is that the upper dots are the fraction of negative SMPC and the lower dots are the fraction of positive SMPC, if that is correct this should be stated clearly. However I would suggest to use another way of displaying these, for example as a bar plot and one colour for positive SMPC, one colour for negative SMPC, both of them shown as values above 0 (technically it is the percentage of grid boxes so it cannot be negative). Also, the mean and ST.DEV are not clearly defined: is this the mean/stdev of all the dataset combinations of T12, G15 and your study? Why not show, for instance with light blue lines, the same for positive SMPC?

- Figure 6: "flood planes" -> "flood plains"? Also, why are there grey boxes? Is this where no extreme value is reached?

- Figure 7: "ERA-Interim temperature and specific humidity profile and surface pressure data" -> "ERA-Interim temperature, specific humidity profile and surface pressure data". Also, "their typical state" is unclear, perhaps replace with "their climatology"?

- Figure 8: This is a nice illustration, but it could be improved. Among others: (i) the X axis is not "[DAILY RAINFALL]" but "[TIME]". (ii) The Y-axis is not only soil moisture but also rainfall. (iii) Rainfall appears twice, once as "rain events" in grey bars and once as a solid black line (rainfall sums). Shouldn't it appear only once? Also, I am not sure why rainfall sums follows a sinusoidal shape here, I would favour the grey bars rather than the solid lines. (iv) More generally the caption should better explain the diagram.

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If some of these suggestions do not make sense, it probably points to something being unclear which led to a misunderstanding from myself...

### Technical corrections

- Page 1, line 2: "1 degree horizontal resolution". This is somewhat confusing as the analysis was done on 0.25 degree but the statistics were aggregated to 1 degree.
- Page 1, line 20: "1 to 3-D" -> "1-D to 3-D"?
- Commas (",") are a little over-used in the manuscript. I suggest the authors to check these, here is a non-exhaustive list of where I think should be removed: P2,L2: "Both, observational", P2,L34: "wet soil, can favour...", P7,L11: "To estimate, whether".
- P2,L12: TMPA is used as an acronym but is defined only later, perhaps refer to section 2.3.
- P3,L4: Add a comma before "respectively"?
- P3,L5: "no attempts were made" -> "no attempt was made"?
- P3,L15: "in North African region" -> "in North Africa"?
- P3,L18: "First we focus on identification" -> "First, we focus on the identification"?
- P3,L23: "inter-relate" -> "relate to each other" or "interact"?
- P4,L3: "inset rectangular" -> "dashed rectangle"?
- P4,L5: "2016) and one of the" -> "2016), and as one of the"?
- P6,L8-9 and P6,L26-P7,L3 and P9,L3 etc...: "-" often appear after (i),(ii) etc which could be removed.
- Title of subsection 4.1: replace "." with ":"?
- P12,L30: "anywhere" -> I think the authors meant "everywhere" (or perhaps "almost everywhere").

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- P13,L13: "typical value" is somewhat unclear, perhaps only mention "climatological mean"?
- P13,L13: "would imply presence of a stronger..., which can easier..." -> "would lead to stronger..., which can better..."?
- P13,L21: "is shown" -> "has been shown"?
- P16,L9: "Benoi Guillod" -> "Benoit Guillod"

### References

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- Seneviratne, S. I. et al. Investigating soil moisture-climate interactions in a changing climate: a review. *Earth-Sci. Rev.* 99, 125–161 (2010).
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