

Interactive comment on “Compound Hot-Dry and Cold-Wet Dynamical Extremes Over the Mediterranean” by Paolo De Luca et al.

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Dear de Luca et al.,

please find below the review of your manuscript.

Best regards, Melinda Galfi

GENERAL COMMENTS

The authors analyse hot-dry as well as cold-wet dynamical extremes over the Mediterranean region in ERA reanalysis data sets over the period 1979-2018. They use a novel method based on dynamical systems metrics and extreme value theory to select and analyse so-called “compound dynamical extremes.” The study is mainly based on

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two indicators, termed the co-recurrence ratio α and the co-persistence $\theta^{(-1)}$. They estimate these indicators for joint occurrences of daily maximum temperature and total precipitation, as well as of daily minimum temperature and total precipitation. They define the events with $\alpha > 90$ th quantile of the whole α distribution as compound dynamical extremes. The authors find a positive trend in the co-recurrence and co-persistence of hot-dry events during summer (JJA), whereas no trend can be found in case of the co-recurrence of cold-wet events in winter (DJF). Thus, they conclude that long-term warming strengthens the coupling between temperature and precipitation, leading to more intense hot-dry compound events. They also analyse spatial fields of sea level pressure, temperature and precipitation during compound dynamical extremes, as well as spatial maps of the co-recurrence ratio α .

The paper is well written, with a clear, fluent and concise language and a well-organised structure. I think that this new method based on dynamical systems metrics can provide new insights into understanding the mechanisms behind compound events. Hence, my assessment of the manuscript is overall positive. However, I have to point out some deficiencies, which need to be fixed before publication: 1. The computation of α and especially of $\theta^{(-1)}$ is not described clearly and precisely, and I think it should not be substituted by merely a reference to another publication. The manuscript should contain the basic equations for the two main indicators (at least in the supplement) since these represent the core of the whole analysis. To assure the reproducibility of the results a precise description of the computational steps for α and $\theta^{(-1)}$ is required. 2. Approaches based on dynamical systems and extreme value theory are developed under certain assumptions, which are usually not entirely fulfilled in case of applications to geophysical data. These assumptions, together with their possible consequences to the results of the analysis, are not mentioned in the manuscript. Furthermore, the manuscript lacks a critical discussion related to the advantages and disadvantages of the applied method. The authors should discuss these very important points in the paper. 3. In the conclusion, the authors write that their results are in correspondence with previous studies. However, they do not point out clearly enough

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the scientific gain based on this new work. What do we learn here we have not known before? This should be discussed thoroughly in the paper.

I would also welcome some comments about choosing $\alpha=90$ th quantile as threshold for defining compound dynamical extremes. How robust are the obtained results against changes of this threshold? It would be also interesting to know what the authors think about the effect of the horizontal grid resolution on α and $\theta^{(-1)}$. A more detailed discussion of the spatial patterns of α and their possible connection to the atmospheric circulation would increase the quality of the paper as well.

SPECIFIC COMMENTS

It is difficult to compare the results for the different reanalysis products, because of the different axis or colour scale limits. For example, Fig. 4 – S7 / S9, Fig. 5 – S11 / S12, Fig. 6 – S13 / S14.

Fig.1(c) and 2(b): There seems to be no trend in $\theta_{-(Tmax,P)}^{(-1)}$ and in $\theta_{-P}^{(-1)}$ after 1995.

TECHNICAL CORRECTIONS

P4-L103: . . . higher (lower) than those observed. . .

FIG1: It is hard to see the difference between the two red lines.

P2-L7 Suppl.Data: "Tmax, Tmin and P" instead of "Tmax, Tmin and TP".

FIGS2 caption: "Tmin and P" instead of "Tmin and TP".

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