******************Editor******************

Dear Authors,

I am glad to inform you that your paper can be accepted subject to the minor corrections proposed by the reviewer. Please correct the manuscript accordingly. Thank you for considering NHESS for the publication of your research.

Sincerely

V. Kotroni

Editor

Thank you very much for your message. We have corrected our manuscript according to the corrections proposed by both reviewers. We hope that this new version of our manuscript can be accepted for publication in NHESS.

******************Referee 1******************

1. Page 3, line 71. Table 1 title. Suggest: "Date, newspaper name, title, …" -> "Date, newspaper name, title [translated title], …"

Thank you. We have accepted this suggestion.

2. Page 3, Table 1, typo: Tittle

Thank you. We have corrected this typo in Table 1.

3. Page 3, Table 1, 2nd column, third row (item), typo: cadaver (accent missing on the second 'a')

Thank you. We have corrected this typo in Table 1.

4. Page 4, line 124, typo: norther

Thank you. We have corrected this typo (page 6, line 124).

5. Page 5, lines 101-102: This sentence has no verb; what about combining it with the previous one: "… data assimilation method, thus providing a direct estimation of the most likely state of the global atmosphere (for each three-hour period)."?

Thank you very much. We have corrected this sentence without verb combining it with the previous one, as suggested by the referee.

6. Page 5, line 102: there also is an -> there is also an

Thank you. We have corrected the order of these words.

7. Page 5, last paragraph. Authors should make clear that the upper-level information (250 hPa) from the reanalysis used for the period examined was derived essentially using statistical methods and is not the result of a standard reanalysis. This means it has a level of uncertainty much higher than sea-level pressure fields or upper-level information for periods where radiosonde information is available. This remark is important as several statements are made

using 250 hPa level data which should be taken with caution – the current text seems they correspond to a standard reanalysis.

Thank you for this comment. We have added to this paragraph the following sentences: "The upper level (250 hPa) information from the 20CR reanalysis will also be used in this work. It should be noted that it was derived primarily by statistical methods for the period examined and is not the result of a standard reanalysis. This means that it has a much higher level of uncertainty than the sea level pressure fields or the upper level information for periods where radiosonde information is available."

8. Page 6, 1st paragraph. Some locations mentioned in the text are not shown in Figure 3 such as river Tajo or the "Sierra de Gata and Sierra de San Pedro" – please make sure that all cited locations are shown so that readers can follow the text.

We have included in the new version of the manuscript a new Figure 3 incorporating the suggestions made by the referee.

9. Page 8, Figure 3. The names of the rivers can hardly be read; please modify the font used to make them clearer.

We have included in the new version of the manuscript a new Figure 3 incorporating the suggestions made by the referee.

10. Page 8, Figure 3 caption, line 183. Typo: means -> mean

Thank you. We have corrected this typo (page 8, line 183).

11. Page 9, Figure 4. Could you please indicate in the map (Figure 3) the locations of the 7 rain gauge stations shown in Figure 4?

Please, note that the locations of the 7 rain gauge stations shown in Figure 4 are indicated in Figure 2.

12. Page 10, Equation 2 (and line 205). There's still some problem with the symbol used to indicate the average value – please correct.

We are sorry. It has already been corrected.

13. Page 10, line 208, typo: times series should be time series.

Thank you. We have corrected this typo (page 10, line 208).

14. Page 10, Figure 5 (and Figure 6). Please add the degree units to the axis titles.

We have included new versions of Figures 5 and 6 adding the degree units to the axis titles.

15. Page 17, Figure 9. Please remove the vertical and horizontal lines near the borders.

Thank you. This problem was solved.

******************Referee 2******************

The authors have addressed the majority of my comments, especially the inline comments. The methodology is now much clearer than the original version. The synoptic analysis (section 5) is still limited and could be expanded by looking at daily data and including more variables, but this could also be a focus of future work. Unfortunately, there is still little comparison to previous literature. I recommend further revisions before publishing.

Section 5

• The authors decide to not include any further meteorological variables and stick with sea level pressure, precipitable water content and CAPE. The limitation to this is that thunderstorms and deep moist convection require three ingredients: moisture, instability and lift (Doswell et al. 1996). Vertical wind shear is also required to allow storm organisation (e.g. Markowski and Richardson, 2010). In the current manuscript, the authors only look at the first two ingredients: precipitable water content (moisture) and CAPE (instability). Sufficient instability and moisture are not enough to allow thunderstorm initiation, lifting (a triggering mechanism) is also required. Whilst there are numerous sources of lift including very local sources, I think that at a minimum the vertical velocity anomaly in the reanalysis should be included. Indeed, there is a negative anomaly in Omega at 500 hPa during June 1925 in western Iberia (NOAA Physical Sciences Laboratory, 2024). While the sea level pressure anomaly is negative across much of Europe (Figure 9), western Iberia stands out as a region with stronger large-scale lifting than average when looking at the Omega field. This indicates that large-scale lifting could have been a relevant factor for the development of the thunderstorms in June 1925.

•Some nice discussion has been added in section 5, especially about the links between the cut-off low and how this would have affected the moisture advection. However, comparison to previous literature is still lacking. The only citations in section 5 are pointing to the classification scheme that they used.

Thank you very much for this comment and suggestion. We agree. lifting (a triggering mechanism) is also required. Therefore, we have re-written a large part of Section 5 and we have included a new Figure 10. The new material is copied below.

Lastly, we have generated synoptic charts of the main meteorological fields, as well as different composites of the monthly mean values and anomalies regarding the climatological period covered by the 20CR reanalysis. Following Doswell et al. (1996), thunderstorms and deep moist convection require three ingredients: moisture, instability and lift. Vertical wind shear is also required to allow storm organization (e.g. Markowski and Richardson, 2010). In the current manuscript, precipitable water content (moisture), CAPE (instability) and Omega (dp/dt, lifting) are analyzed.

A summary of our results is presented in Figure 9 and Figure 10. Figure 9 is made up of six panels. The top two panels show SLP while the middle two panels depict Convective Available Potential Energy (CAPE) and the bottom two panels display total precipitable water. The panels on the right present the composite means of the variables indicated for June 1925 while the panels on the left exhibit the composite anomaly.

The top panels of Figure 9 show a typical negative North Atlantic Oscillation (NAO) situation with low pressures west of the British Isles and negative SLP anomalies in

southwestern Iberia. The middle panels of Figure 9 reveal that western Iberia had high CAPE values in the context of the Atlantic and Mediterranean region, with positive mean anomalies in western Iberia during June 1925 (the values shown correspond to the composite mean of the entire month). Finally, the bottom panels present high values of precipitable water in the entire atmosphere in southwestern Iberia with the highest values of the anomaly over the region of Extremadura. Note that these monthly anomalies are calculated from the composite mean value (climatology time period selected for the calculation is 1981-2010). Therefore, the exceptional month of June 1925 in Extremadura was characterized by a combination of negative NAO situation, high CAPE values, and total water vapor available in this area. In any case, note that Figure 9 shows the largest CAPE in Spain for June 1925 was not located exactly in the south-western Spain but in north-western Spain and northern Portugal. It seems the 20CR reanalysis for such early times gives us significant patterns although perhaps the exact location of the details is a little displaced.

Panels in Figure 9 are complemented by panels in Figure 10, that show Omega field at several pressure levels during June 1925 (left panels) as well as Omega field at the same pressure levels during all of June months for the period 1851-2014 except 1925 (right panels). Results on left panels show a negative anomaly in Omega at all pressure levels during June 1925 in western Iberia until a very high level far from surface (~150 hPa) where the lift seems to have disappeared. Moreover, while the sea level pressure anomaly is negative across much of Europe (Figure 9), western Iberia stands out as a region with stronger large-scale lifting than average when looking at the Omega field. This indicates that large-scale lifting could have been a relevant factor for the development of the thunderstorms in June 1925. Results on right panels show this negative anomaly is non-existent for June months for the full period of reanalysis 1851-2014 except 1925. It indicates the exceptionality of the month June 1925 treated on this work and not included in the ESWD (Dotzek et al., 2009) which only includes four severe weather phenomena for the year 1925 in eastern Spain.

Added references:

Doswell, C. A., Brooks, H. E., and Maddox, R. A.: Flash Flood Forecasting: An Ingredients-Based Methodology, Weather Forecast., 11, 560–581, https://doi.org/10.1175/1520-0434(1996)011<0560:FFFAIB>2.0.CO;2, 1996

Dotzek, N., P. Groenemeijer, B. Feuerstein, and A. Holzer, 2009: Overview of ESSL's severe convective storms research using the European Severe Weather Database ESWD. Atmos. Res., 93, 575–586, https://doi.org/10.1016/j.atmosres.2008.10.020.

Markowski, P. and Richardson, Y.: Mesoscale Meteorology in Midlatitudes, in: vol. 2 of Advancing weather and climate science, 1st Edn., Wiley, Somerset, ISBN 0470742135, 2010.

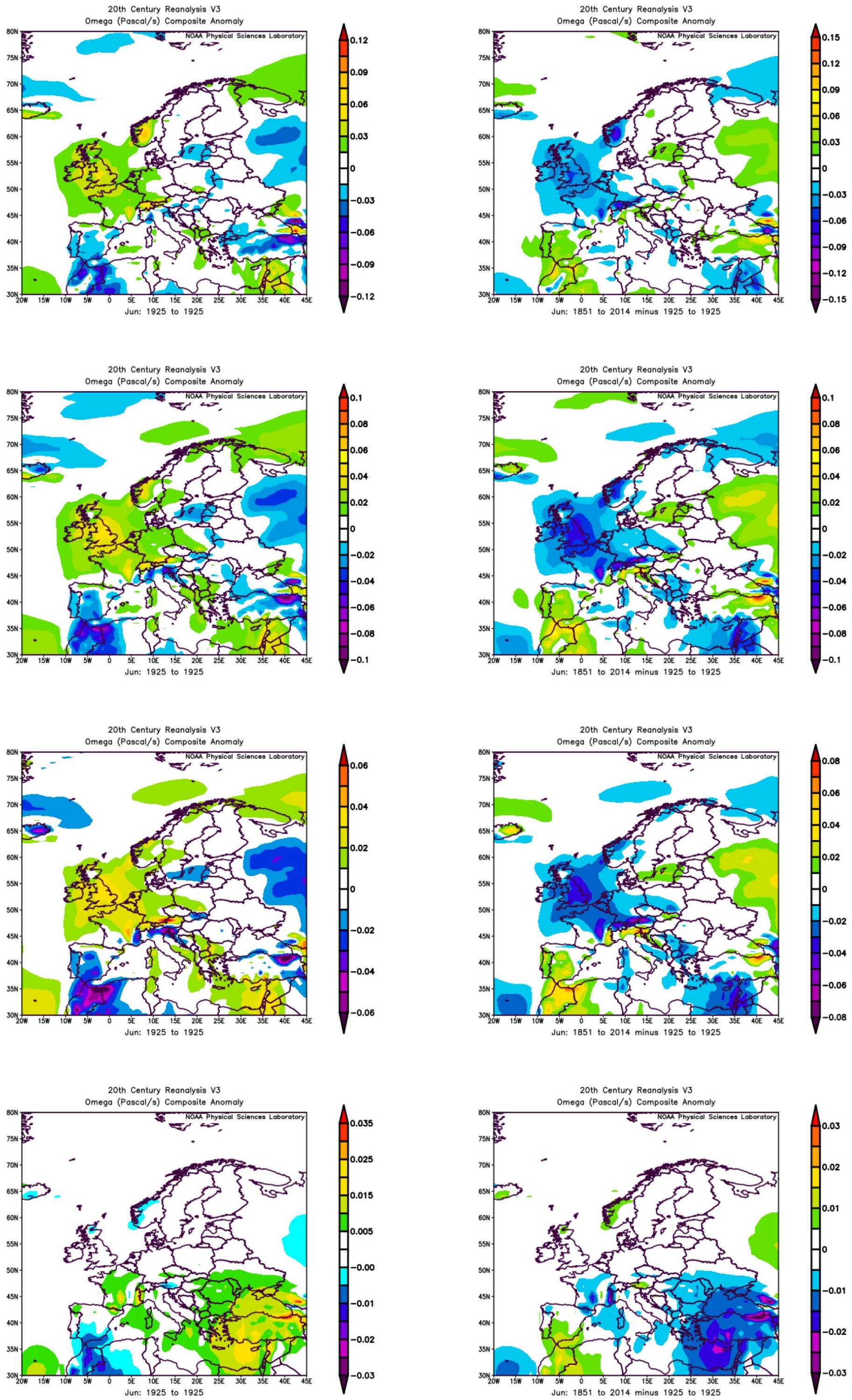


Figure 10: Composite anomaly for June 1925 (left panels) and composite anomaly for June months from 1851 to 2014 except 1925(right panels) of Omega (dp/dt) in the study area for pressure levels of 600, 500, 400 200 and 150 hPa(from top to bottom panels, respectively) from 20CR Reanalysis.

Inline comments:

L23: The authors now talk about "total water vapor availability". In Figure 9 precipitable water is analysed. Total column water vapour is a separate variable so this could be misleading. I'd recommend using consistent terminology.

We agree with this point. We have changed line 23 from "total water vapor availability" to "precipitable water".

L28–29: The authors should directly reference the European Severe Weather Database (ESWD; Dotzek et al. 2009), which is the main convective storm database used in Europe.

Thank you very much. We have referenced this valuable work by Dotzek et al. (2009). We mentioned the European Severe Weather Database (ESWD; Dotzek et al. 2009) in sections 1 and 5.

L87: I think it would be useful to add a line on how Sánchez Lorenzo et al. (2012) defined an overcast day and cloudless day. If it is cloudy for 30 minutes of the day is this considered an overcast day? Must it be sunny for the entire day for it to be considered a cloudless day?

As is noted in our work, Sanchez-Lorenzo et al. (2012) recovered monthly series of cloudless and overcast days since 1865 from different volumes of the publications entitled "Resumen de las observaciones meteorológicas efectuadas en la Península", edited by Spanish Weather Service from 1865 to 1950. According to these authors, it was not possible to find the original human observations of daily cloud cover (most likely in oktas or tenths) made at the 39 meteorological stations analyzed in their work. Thus, it is not possible to response the questions reported by the reviewer because the information is not known. We have tried to partly clarify this issue, adding the following sentences to the revised version of the manuscript:

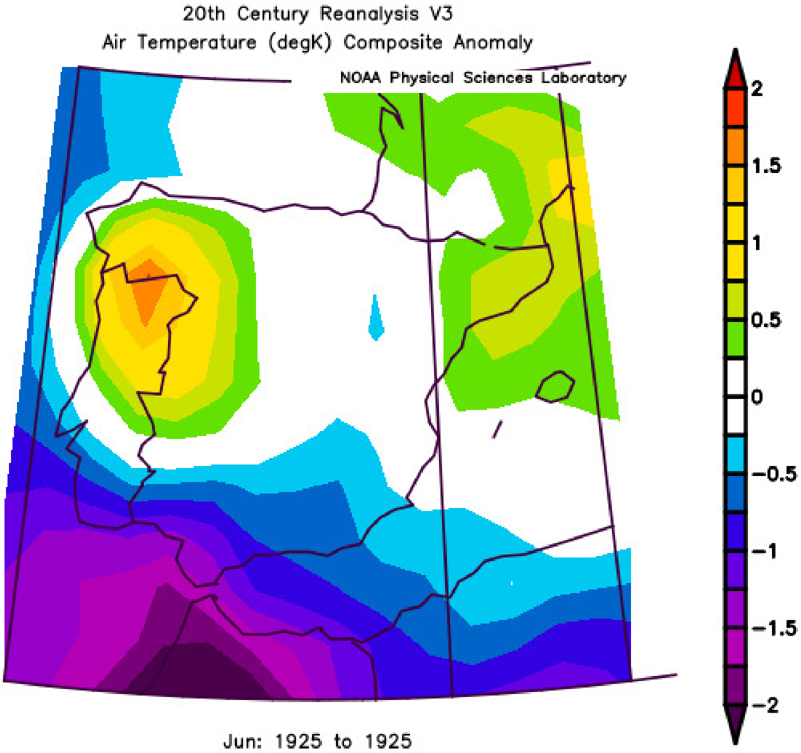
"Capel Molina (1981) established that a day is defined as cloudless if the mean cloud cover from several daily observations is lower than 20%, while is defined as overcast if this mean is higher than 80%. Thus, if the cloud cover is recorded in oktas the thresholds could be less than 1.5 for cloudless days and greater than 6.5 for overcast days."

Capel Molina, J.J.: Los climas de España. Ed. Oikos-tau, 1981.

L102–106: I appreciate that the authors have included further details on the 20th Century Reanalysis. If the observations shown in Figure 6 are independent, then the authors could show a comparison between observations and the 20th Century Reanalysis in the Appendix. This would support the authors' claim that "some comparison exercises carried out have been satisfactory".

We understand this point suggested by the referee. However, a direct comparison between observations and the 20th Century Reanalysis is not a simple task. Moreover, we are sure that a part of the observations shown in Figure 6 are not independent. In any case, we have made some simple approximations as a test. In them, we see that a reasonable likelihood between the observed data and the modeled data is verified. In particular, we can highlight that the general patterns of the meteorological fields are reproduced (although they may be slightly displaced in their location). As an example, we present a plot of the temperature anomaly in June 1925 obtained with the 20CR reanalysis. It can be clearly seen in this plot that the

general pattern is similar to that obtained with the observational data we present in our manuscript with negative anomalies in the SW of Spain.



L302: calculus calculations. Calculus involves differential equations.

Thank you. We have changed this word.

L303: “total water vapour available”. See comment above on L23.

Thank you very much. We have changed line 23 from “total water vapor availability” to “precipitable water”.