

Response to Reviewer's Comments: Round 3

Reviewers' comments in black. Authors' response this round in green.

Response to Reviewer 2

Thank you for submitting the revised version of the manuscript. I appreciate the authors' efforts in addressing the comments raised by the reviewer. Although I still find it challenging to grasp the fundamental concept of categorizing a day as a hail day, regardless of the quantity of reports issued and their geographical distribution, I propose accepting the manuscript in its current form (but consider my comment in response to points 4 and 5).

We thank you for your comments and working with us to see this manuscript through to publication.

Regarding Major Points 4 and 5, it's noteworthy that most studies I am familiar with employ a similar definition but typically focus on single countries or specific regions. For instance, Pucik et al. (2019) determined hail days for a grid spanning 0.5° longitude and 0.5° latitude, not for all of Europe (Fig. 5 only displays diurnal cycles for Europe). The referenced review paper by Punge and Kunz (2016) discusses hail days for specific regions, not for the entire continent. Additionally, data from insurance companies, with which I have worked extensively, are usually spatially resolved. I recommend adjusting the statement in question to reflect these nuances, while also citing studies that specifically analyze thunderstorm/hail days for all of Europe without further subdivision.

Our response was to the reviewer's previous comment "Furthermore, it makes no sense to define a hail day for the whole of Europe, with its wide variety of local climates." We argue that *it does make sense* in some situations. The point in our response was to mention that there were studies that considered hail across all of Europe and the reasons why such studies may want to do that. That is all we are responding to.

Our response does not negate the fact that these studies may also have investigated variability on smaller spatial scales, and our response should not be taken to imply otherwise.

We believe that the statement we wrote adequately reflects the original statement.

Punge and Kunz (2016): "Insurance records do not distinguish among different hailstorms, but register only hail damage that occurred on a whole day within a region."

Hulton and Schultz (2024): "Punge and Kunz (2016) wrote that hail days are also aligned with information that the insurance industry uses, as their portfolios cover regions larger than countries and hailstorm outbreaks may cover more than one country."

Thus, we see no reason for further revision.

I want to express my gratitude for the inclusion of the new figures, which significantly enhance the manuscript's scientific value.

You are welcome.

Concerning Minor Point 3, I realize my previous comment may have been unclear. What I

intended to convey is that the review by Tuovinen et al. (2009) predominantly cites studies from an era predating data from remote sensing instruments or reports collected through crowd sourcing or community contributions (such as ESWD). Some sources of severe hail day information rely on damage to agricultural crops or property, both of which have undergone substantial changes in the past decades. For example, Schwind's study in 1957, based on crop insurance data, identified the highest hail frequency in the Rhine valley in Germany. However, more recent studies indicate that this region is not frequently affected by hail. This discrepancy can be attributed to the fact that, at that time, tobacco was a major crop in the area, and it is highly susceptible to sleet, graupel, and small hail.

Interesting. Thank you for providing this perspective.

I am satisfied with the newly added paragraph.

We are pleased.

Regarding Minor Point 5, I find it difficult to comprehend the authors' frustration with this issue and prefer not to delve further into it. My only request was for the objectives to be articulated more clearly in the introduction.

Similarly, we fail to understand your perspective about what is unclear about what we have written. Thus, we will have to agree to disagree on this point.

For Minor Points 8, 10, 11, and 13, I concur with the proposed changes.

Thank you.

Finally, in response to the last comment, I am perplexed as to where I should selectively edit the text to change the authors' intended meaning. The comment seems unusual, and the reaction appears disproportionate. However, I choose not to elaborate further on this matter.

Similarly, we fail to understand why you would have selectively edited our words to omit key concepts in our response. From our perspective, that is what appeared to happen.

Response to Reviewer 4

- Lines 124-128.

- o I believe the content here addresses the previously raised point but the wording could be improved. I believe it is acceptable to consider hail days across the whole of Europe and that introducing additional thresholds only shifts the debate to which threshold to use.

Thank you for your agreement that the concept of hail days across Europe makes sense.

- Generally relating to counting hail days

- o In recent years there are so many hail days that it ceases to become a useful measure of convective activity. I do not think it is an invalid metric to study but do wonder whether some additional criteria of severe hail days could be added.

We are unclear what the reviewer is asking for here with "some additional criteria".

Nevertheless, we have tried to address in our response below why hail days were a suitable choice.

We also consider the number of hail reports and highlight these by year (Figures 1 and 2) and by month (Figure 3) to highlight that there has been a change in how hail is reported and how this impacts the number of hail days recorded. Figure 2 in particular shows that it is only in the past 20 years or so that there seem to be a more stable relationship between hail reports and hail days, which could suggest a more stable time period within which most hail events are being recorded. This stable time period can also be seen in Figure 9 which shows little variation in the percentage distribution of each hail bin size from 2000 to 2020.

We also break down the number of hail reports by month by country (Figure 4), which shows that the warm season is more likely to be affected by these events, with little variation between countries across the continent.

Figure 14 also shows how the hail sizes are distributed by country, showing which areas are at most risk of seeing the largest hail. Hail days are not the only metric used in this study.

We hope this response helps convey that no additional criteria are needed.

- Additional Comments

- o I think the paper falls slightly short in its aim of evaluating the ESWD in any critical manner. The analysis of the observations is useful and may hopefully form a useful reference to anyone using the ESWD but the conclusions section could be embellished to truly evaluate the usefulness of the EWSD and its shortcomings.

Again, we are not entirely sure what else we could say to address the reviewer's concern that we have not "truly evaluated the usefulness of the EWSD". In some sense, that usefulness will be dependent upon the user's interest. Nevertheless, we hope our response to the comment below does help us go forward.

- o I would like to see some break down of the stable time period discussion by region to assess whether some areas are now reaching a saturation of reporting. It may also be worth considering at what point is the reporting sufficient that all major hail swathes are captured and additional reporting is only increasing the density or reports within swathes. This may be beyond the scope of this work but is essential for assessing the extent to which the ESWD can be used as a hail climatology. Section 3 does comment on this briefly.

We have added an annual large-hail day breakdown by country for the countries with 100+ reports for the period 2000–2020 (Fig. 14 a, b, c, and d). Here we demonstrate that the countries with the most annual-hail days have started to show a relatively consistent quantity of hail days over the past few years, which could suggest that all major hail swathes are being captured in the dataset. We also show that for those countries with fewer large-hail days, the quantity observed has increased over the past few years, which suggests and increasing in reporting in these regions, and hence expands the usefulness of the database by encompassing more events. However, we do also highlight that there remains much annual variability in hail-days per country, which could be due to meteorological and climatic factors, or may be more to do with reporting.

We have also added the following sentence to the conclusion: "When considering the annual number of large-hail days per country, there does appear to be an overall increase in the quantity observed for the countries which previously reported fewer hail-days, while those which observed greater numbers throughout this period seem to be stabilizing." (L525)

Yes, we agree that the point of sufficient hail reporting is beyond this particular work, but is an excellent future research project. Thank you again for your kind words and support.