

## Anonymous Referee #3

This paper aims to (i) link insurance claims to individual ETCs, (ii) apply the method to clusters of ETCs and (iii) assess the impact of storm clusters on insured losses. Overall, the paper achieves the aims. In places the language used in the paper is overly emphatic for a piece of scientific writing and rewriting is needed to ensure that all statements are supported by evidence (see comments below for specific examples).

We thank the reviewer for the feedback. We appreciate the insightful and helpful comments which contribute to improve our manuscript. The responses to each of the comments appear in blue.

### General comments

1. In many places the authors describe their work as fundamental, significant, valuable and a step forward. It should be left to the reader to evaluate the importance and novelty of the results presented. Please remove all emphatic adjectives.

We will remove these redundant emphatic adjectives.

2. There are several statements in the paper referring to small storms, however I could not find any description of how storm size was measured. The authors need to include this, or be more precise about what is meant by small storms, perhaps it refers to the intensity or duration of the storms rather than their physical dimensions?

We agree that “small storms” are frequently mentioned in the manuscript without being specifically defined. This initially refers to their intensity but also affect their physical extension. We will provide a characterization of these in the section 2.1.

3. The evidence to demonstrate the validity method is described in sections 4.2 and 4.3. This is after results using the method to link storm occurrence to losses (figure 6b, section 4.1). It would make more sense if the paper were reordered to demonstrate the method before it is used. Also, it would be helpful to provide quantitative information regarding the partitioning of losses between the storms in the cluster as well as partitioning the number of claims.

We take the recommendation and we will consider reorganizing the section 4. We will move the present section 4.1 to 4.3 and the case studies of sections 4.2 and 4.3 will be moved to sections 4.1 and 4.2. For these 2 case studies, we will add quantitative information about the partitioning of losses and number of claims, similar to information in figure 6.

### Specific comments

4. Title: Is the word ‘Unravelling’ necessary in the title? This verbose language is common when using AI to suggest a title so should be avoided.

No AI chatbot was used in any part of this paper. The verb “Unravelling” corresponds exactly to what we want to highlight in the paper. Additionally, research on google scholar reveals that this verb has been used for climate science papers.

5. Line 5: The authors describe their own work as a cornerstone for insurance and reinsurance processes. This is a very bold statement and should be left to the reader to determine how fundamental the methodology presented is.

We will rephrase the sentence.

6. Line 19: Here and elsewhere the storms are described as being displaced, I think path or track might be a more familiar word to use.

Exactly: displacement refers to the track of the ETC. We will make this clearer.

7. Line 24: The SSI should be explained in more detail. What does it measure?

We will add a brief description of the SSI index.

8. Line 32: A Poisson distribution describes events that happen randomly and independently. I think that there is no reason why a Poisson distribution with a large mean cannot also have a large variance.

We will rephrase this sentence.

9. Line 44: The dispersion metric can be used globally I believe. Although I agree that it might not be suitable for impact assessments.

This is the point we want to raise. We will rephrase the sentence accordingly and remove the mention of “globally”.

10. Line 55: How does the representation of hazards in insurance loss models lead to damage prevention?

We agree with the reviewer that the connection is not straightforward. A better representation of the hazard leads to a better comprehension of the risk. The insurer might then be more aware for the regions at risk and target the prevention accordingly in these specific areas. We will clarify this in the revised version of the manuscript.

11. Line 77: This sentence does not have an end. What advantages are unlocked? Perhaps ‘unlocking several advantages’ is not needed in this sentence?

The “several advantages” are listed in the following sentences for the different perspectives (vulnerability, meteorology). We will consider removing it or integrating it better with the rest of the paragraph.

12. Line 79: Where in the paper are the environmental factors leading to damage investigated?

We underlined, thanks to the association method, that clusters of storms are associated with exacerbated impact compared to individual storms. In particular, we state in line 280 “This means that storms can be concentrated over several days or weeks of a season and with given locations can experience both close successions or absences of storms.” This represents an environmental factor exacerbating damage.

We acknowledge that the manuscript does not present any result on the structural factor contributing to damage. We will remove this part.

13. Line 79: Here the authors describe their work as ‘significantly enhancing our understanding of storm clustering events’. This is a bold claim and perhaps best left to the reader to decide on the usefulness of the paper.

We will moderate this claim.

14. Line 83: The assessment of reliability is difficult since there is no truth with which to evaluate the method. Perhaps remove the word reliably?

Indeed, the manuscript aims to underline that there is no ground truth about which storm resulted in damage. We will remove the word “reliably”.

15. Line 98: By displacement of trajectories, are the authors referring to the minimum storm track length?

We refer to the total length of the trajectory, both in terms of number of points and distance. We will modify the sentence to make this clearer.

16. Line 101: What is the impact distant from? The storm centre or metropolitan France?

The distance is always computed from the storm center. We will rephrase the sentences to make this more explicit.

17. Line 105: Closest point to what? Does this refer to the location along the storm track that occurs closest to a longitude of 7.5W?

Yes: the point of closest approach is measured by the distance between the storm track points and the longitudinal line of 7.5W. We will clarify that sentence.

18. Line 110: It is not clear what the numbers in the curly brackets refer to.

The curly brackets refer to temporal window in number of hours around each track points. This means that for each track point, we will retain the maximal wind gust observed within the spatial mask of 1300km and temporal windows ranging from 12h before the date of the track point to 12h after.

19. Line 113: Earlier it is stated that a cyclone duration of 24hours is used, but here the authors state that the conditions on cyclone duration and intensity are ‘relaxed’. What does this mean?

This means that fewer constraints are applied over the duration and intensity of the tracks, compared to the studies we are referring to in the paper. (Lockwood et al., 2022; Priestley et al., 2024) used the same TRACK algorithm but with a minimal cyclone duration of 48h (which is only 24h for us), a minimal displacement of the track of 1000km (which we did not constrain) and a minimal threshold of maximum vorticity of  $1 * 10^{-5} s^{-1}$  (variable that we did not constrain either).

20. Lines 114 and 252: How do ‘relaxed’ constraints on cyclone duration and intensity refer to the speed and size of the storms considered? Additionally, on line 252 the authors refer to small storms, how is storm size determined?

Fast moving cyclones can cross the country and result in some damage in less than 48h, if they are detected in their late development. If conditions regarding the minimal duration are applied, such storms are likely to be discarded.

Regarding the usage of “small storms”, we agree that this term is too vague for the objects we are trying to characterize. We will remove this in the revised version.

21. Line 118: I don’t think the authors have included any evidence to support their statement that including storms ‘of all scales’ reduces the bias. What bias are they referring to and how have they determined the scale of the storms?

The bias is not used for it is statistical meaning. Here we refer to the fact that if the input set of tracks is too restrictive, the association method will try to align with it. In particular, over the 344 storms associated with some damage for Generali presented in the manuscript, 107 of the them would have been omitted with constrains identical to the ones selected by (Lockwood et al., 2022; Priestley et al., 2024). Pre-constraining the set of storm tracks is equivalent to say that only some type of storms can result in some claims for the insurance, which is not the case. The bias is the extent to which the impacting are conditioned by the set of storms tracks.

22. Line 124: Earlier the radius of the storms considered for impact was set to 1300km but here it is reduced to 700km. Which is used in the study and why are 2 radii for impact mentioned?

Several radii of influence can be found in the study of ETC. Paper working with frontal structure, for example associating precipitations to ETC, usually chose large radius of  $12^\circ$  (Hawcroft et al., 2012; Sinclair & Catto, 2023). On the other hand, some studies have used radius of  $6^\circ$  to characterize the area of strongest wind related to the ETC (Gramscianinov et al., 2020; Zappa et al., 2013).

The radius of 1300km used for the construction of the footprint was deliberately chosen to be large in order to capture the potential wind impact which, because of frontal structures, can be distant from the center of the ETC. Conversely, cluster of storms should be events for which common area could have been impact be successive storms. For this reason, after trial and error, we decided to the smaller radius of 700km. This also ensure that not all the storms are parts of clusters. We will clarify theses points in the revised version of the manuscript.

23. Line 177: How are the robustness and reliability of the results quantified?

Robustness and reliability are estimated using the 3 performances metrics presented in section 3.2. The robustness of the association is also evaluated with respect to theses metrics. Figure A1 shows that the optimal values of the tuning parameters ( $X_a, X_b, n_{claims}$ ) is constant for a varying weight varying between 0.3 and 0.6.

24. Line 187: What does the closest local maximum refer to?

The closest local maximum corresponds the local maximum for which the date is the closest to the date of the storm. We will clarify this in the manuscript.

25. Line 188: What does the number of local maxima refer to?

This corresponds to the number of local maxima which are defined in line 181 as “The local maxima are identified by peaks over the time series of claim count gathering at least 10 claims.”

26. Line 201: Here the authors state that lighter colours indicate better results. What is meant by better and is this the case for all 3 tuneable parameters?

Lighter color indicates better results for each of the 3 tunable parameters. “Better” has a different meaning for each parameter; this is described in section 3.2, in the sections between lines 202 and 221.

27. Line 237: How are the authors quantifying the accuracy/preciseness of their method? What are they comparing the method to?

Before the proposed association, no storm catalogue tailored to Generali’s damage and exposure existed. The only available resources were global dataset of storm tracks or set of storms resulting in important impact, such as the ones presented in the introduction (line 65-68). The results are

compared global dataset which gather impact at country level and are not able to differentiate between successive events. The proposed method is thus more accurate because we manage to link damage to specific storms events and more precise because such association has been done at claim resolution. We will clarify this in the revised version of the manuscript.

28. Line 248: Here and in 12 other locations the authors use the phrase ‘underlines’. This is quite repetitive use of language and alternative words could be used.

We understand that the referee finds this boring, but it is often recommended that scientific papers avoid the multiplication of synonyms (Day & Gastel, 2014).

29. Line 259: Figure 4 does not show the intensity of storms or the vulnerability, so it is not clear what the authors are using to support this statement.

Here, the intensity of the storm refers to the potential damage it has led to, which is visible in figure 4 with the total cost. We will rephrase this to make it clearer.

30. Line 263: Shift usually means a change. I believe the authors are simply referring to a difference here.

Yes, we will replace “shift” with “difference”.

31. Line 266: What does ‘cst’ mean? Is this euro cents?

It refers to “constant euro”, which is introduced in section 2.2, line 145. We will also introduce the “cst €” notation there for clarity.

32. Line 268: What is restricted about the winter 2018/2019 analysed by Mision Risques Naturels?

Here we meant that the analysis is restricted because it was only performed over one winter. We will rephrase this.

33. Line 276: How is the impact of the clusters measured? What criteria is used to class clusters as high-impact?

The impact is measured by the number of claims and/or the total losses associated with each storm of the cluster. A “high-impact” cluster is a cluster for which at least 2 of the storms have been associated with damage for Generali. This will be clarified in the revised text.

34. Line 277: Is an impacting storm one that resulted in loses for Generali only or one which has a track within 1300km of France?

An impacting storm is a storm which have been associated with claims for Generali. We will emphasize that point.

35. Line 302: What is meant by ‘far from the 100%’?

It means that total losses of the cluster cannot be assumed to be hold by only the costliest storm as this one represents only 72% (on average) of the total losses associated to the cluster. We will rephrase that more clearly.

36. Lines 312-324: These paragraphs repeat what is describes in earlier paragraphs so should be removed.

Indeed, this is a duplicate. We will remove it.

37. Lines 397-403: This paragraph is speculative. It does not describe the results from the paper so should be reworded or removed.

In fact, this was not directly addressed in the paper. We will move it to section 5.

38. Line 417: What is meant by a gathering around storms with at least 50 claims?

It corresponds to the last step of the method described in section 3.1, done with the  $n_{claims}$  parameter.

39. Line 419: What is meant by ‘highly transposable to other outlooks’? I am unsure what an outlook is.

We meant that this method can be used for other hazards (flood, convective storms...) but also using other types of damage (hail, water infiltration).

40. Line 443: By ‘came alone’ are the authors referring to non-clustered storm events?

Yes, we are referring to the storms which were not part of clusters. We will rewrite this.

41. Line 474: The authors evaluate their framework as valuable. This evaluation should be left to the reader.

We will remove this subjective statement.

42. Line 484: The authors describe their findings are a step forward in understanding. This evaluation should be left to the reader.

We will remove this subjective statement.

### **Typographical errors**

1. Line 23: The sentences describing windstorm metrics should form a separate paragraph since it introduces a new idea to the sentences preceding them.

We will write separate paragraphs.

2. Line 47: Do you need both event and impact here?

We will only keep “impact-perspective”

3. Line 65: Here ‘including’ should be ‘such as’.

We will modify this.

4. Line 89: I think ‘over’ should be ‘including’?

We will modify this.

5. Line 93: ERA stands for ECMWF ReAnalysis so it is not necessary to include the words ‘historical reanalysis’ afterwards.

We will rewrite theses occurrences.

6. Line 103: I think ‘landfall’ is more commonly used than ‘landing’.

Actually “landfall” mainly refers to tropical cyclones. We will change “landing date” to “impact date”.

7. Line 127: Should 70km be 700km to be consistent with line 124?

Yes, thanks you.

8. Line 149: The 'st' in italics should be roman text.

Indeed, we will fix this.

9. Line 203: What is the 'peal date'?

I should be "local maxima".

10. Line 354: Why is approx. in italics?

This will be rewritten to roman text.

11. Line 426: Why is the word 'soley' included in this sentence?

We will remove this word.

12. Line 449: Why is an 'double hyphen used here?

We will remove the double hyphen which is not needed.

Cornér, J. S., Bouvier, C. G. F., Doiteau, B., Pantillon, F., & Sinclair, V. A. (2024). *Classification of North Atlantic and European extratropical cyclones using multiple measures of intensity*. Atmospheric, Meteorological and Climatological Hazards. <https://doi.org/10.5194/egusphere-2024-1749>

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