**Insurance loss model vs meteorological loss index – How comparable are their loss estimates for European windstorms?**

By Moemken et al.

The paper compares loss estimates for European windstorms from a simple meteorological Loss Index (LI) with losses from a catastrophe model from model provider Aon Impact Forecasting. The paper aims to shed light on a) the sensitivity of the loss index to different underlying re-analysis data sets and b) the differences between the loss index and the more complex cat model results. The authors conclude that there are substantial differences between the ERA5 and ERA-interim loss index values and that the loss index values have difficulties in distinguishing between extreme and moderate windstorms in terms of loss numbers compared to the insurance loss model.

**General comments**

Given the high importance of natural catastrophes for society, especially in the light of climate change, this topic is clearly within the scope of NHESS. The paper is well-structured and is clearly written. The research questions are clearly posed in the final part of the introduction. The paper has the potential to shed light on the performance of a simple loss index which can be applied to both re-analysis data sets and climate model outputs and the dependency on e.g., spatial resolution. Furthermore, how well such a simple approach can be used to benchmark more refined commercial cat models. This can ultimately help to increase resilience by better understanding of past and future risk of European windstorms.

Overall, the analysis performed appear to be a bit simplistic, though, with mainly correlation and scatter plot analysis between the two meteorological loss indices and the losses from the AON cat model. Most of the analysis do not shed light on the cause of the differences and especially on the quality of the approaches. To answer the research question how comparable and how sensitive the approaches are, more in-depth and refined approaches are recommended.

The comparison between the transparent meteorological based indices and the AON insurance loss models is severely hampered by the fact that the AON model is basically a black box in this analysis. The differences between the approaches likely strongly depend on the vulnerability assumption/ damage functions applied. Here only generic information is given for the AON model in the paper. Therefore, no statements about quality of the approaches can be derived.

In my view the manuscript requires major work to expand the depth of analysis and make the conclusions more stringent.

**Specific comments**

- Abstract: There are a number of qualitative statements such as “comparable storm ranks”, “yet it is an effective index”, etc, which should be underpinned with quantitative numbers/measures

- Introduction

    1. Given the high interest of climate change, a short statement/references to recent trends of European windstorms should be added

    2. The paper is mainly focusing on the wind-damage/loss relationships which is also one major conclusion from the comparison of the LI and the AON model output. However, loss datasets are not used in the current paper. Therefore I suggest to either expand the scope of the paper and compare the loss estimates to loss datasets or to shorten the introduction in this respect and more focus on wind-damage relationships in the literature

- Section 2.1.

    1. The LI equation (1) is summing up grid squares. One major reason for the differences between ERA5 and ERA-interim results are the different horizonal resolutions as stated by the authors later in the paper - which is kind of superficial. Suggest to exclude this effect in the analysis by appropriate measures.

    2. Ln100: No rationale is given for the threshold chosen. Why 5 storms per season on average? How much % of historic losses of European windstorms are covered by this selection?

    3. Ln109: see above, since the formula (1) is summing up every grid point, differences are to be expected for different horizonal resolutions. This effect should be normalized.

    4. Ln 119: What would be the difference /effect if a 24-hour period is used, similar to the AON approach?

- Section 2.2.

    1. The AON model is only described rather high level. Especially the wind-damage relationship function is key in comparing the results with the LI index and derive meaningful conclusions. Without further details the conclusions will be rather qualitative and vague.

    2. Ln142: Commonly used damage functions assume either a power law or an exponential form. Please discuss why the $v^3$ approach was chosen and discuss the strength and weaknesses of the approach compared to the “commonly used” ones.

    3. Ln148: The hazard component consists of 26 historical events. What is the meteorological data used to define these events? In the table only date and name

are given. How do the wind gust footprints compare between AON and ERA5?

4. Ln150: Was any downscaling performed to derive wind gust at higher horizonal resolution than native resolution of the ECHAM 5 global climate model?

5. Ln164: See above, can more details be given about e.g. one damage curve used in the analysis?

- Section 3.1.

    1. The 98$^{th}$ percentile acts quasi as a representation of building codes/standards for the LI approach. Does the AON model also have building code regions (where a similar wind speed would cause a different loss) implemented and if yes, how does the 98$^{th}$ "building code region" pattern compare to these?

- Section 3.2

    1. Table1: Correlation numbers for the loss seem to be mis-aligned with Figure 3, e.g. France 0.9059 vs 0.62

    2. Ln205: "unlike ERA-interim, ERA5 shows a broader area of high wind guest, especially over the UK and Western continental Europe". Despite, the outlier shows very low LI ERA5 values?

    3. Ln215: The obvious reason is the higher spatial resolution of ERA 5: as stated above: to make the analysis more revealing, it is suggested to aim to remove the grid square # dependency by normalization/scaling in the LI formula (1) and look at the remaining differences. Then also absolute values can be used in the analysis of Figure 3.

    4. Ln219: ranking of storms: Does this rank analysis really add significant value? At least some rationale for the differences should be given. Consider to instead translate the LI index values in monetary amounts by using one recent storm as reference loss/by normalizing it with e.g. PERILS loss estimate. This would be more tangible and can be also used to compare to AONs estimates (if available) in section 4.

- Section 4

    1. Table2: Suggest to add the number of storms for the ERA5 data set to allow for a comparison to the AON model

- Section 4.1.

    1. The core analysis of the paper (as also stated in the title) is to reveal the differences between the LI and AON model loss estimates which is mainly addressed in a scatter plot analysis. It is obvious that there are substantial differences between the two approaches. More emphasis should be put on revealing the reasons for the differences seen. Most likely this is due to the different vulnerability curve shape of the $v^3$ approach and the AON model. Since the $v^3$ approach was used in literature quite often in the past, it would be very beneficial to work out the limitations and suggest improvements based on the learnings of the comparison. However, this

would likely mean to have more insights in the AON approach and to cross-check with real world loss numbers.

2. Figure 6 shows clearly the very different behavior of both approaches. Maybe a more in depth analysis for some few selected storms can help to shed more light on the differences, e.g. by looking into the loss contribution to the overall loss by wind speed.

- Section 5

1. "For all of Europe, LI values are higher for ERA5 than for ERA-interim". This is mostly an effect of different horizontal resolution. Suggest to remove and discuss the residual differences as stated above.

2. "Compared to AON's IF model, LI ERA5 shows overall lower loss values". This statement is only true for normalized values but not for (more relevant) monetary values. For this (highly valuable) analysis, LI loss index values need to be translated in monetary loss values and compared to AON's output.

3. Ln296: "the AON model seems to better distinguish between high and moderate impact events": Without benchmark with real world loss numbers this statement appears quite subjective.

4. Ln 299: …, the catastrophe model shows a clear regional dependency of loss values. This regional dependence in less pronounced in LI ERA5. Suggest to discuss the reason for this behavior. Are AON footprints downscaled or have higher resolution?

5. Ln316: As stated above, what is the impact of using a 24h definition also for the LI approach?

6. Ln333: "the LI index is missing a detailed damage component, thus struggles to capture the non-linear response of the buildings at the tail of the gust spectrum for high impact events". The LI $v^3$ approach is obviously non-linear, so the question is what stronger non-linearity would be more suitable. But foremost, from the analysis it is only clear how the wind-loss relationship compares to the unknown AON approach and it is difficult to draw conclusion on the quality of the approaches without comparison to reality.

7. Ln343: "…it is suitable for estimating the impact…" Without more quantitative measure and real world comparisons (and given the large differences to the supposedly more sophisticated AON approach) it is hard to follow this conclusion.