

## Reply for 3# Referee:

The manuscript presents an interesting and thorough analysis of the impacts of windstorms on Finland's electricity sector. Although in principle arbitrary, their classification shows relevant discrimination power into the impacts, especially if analysed jointly with other factors such as seasonality and environmental conditions. I consider the analysis to be quite thorough and the presentation of the results is very clear, in particular all the graphics have been developed quite carefully.

I think this manuscript provides a relevant contribution to impact studies driven from a good understanding of the meteorology of windstorms, and could promote further studies focused on other regions affected by ETCs and other types of impacts.

We thank the reviewer for their insightful comments and are pleased to hear that they found the paper's findings relevant and the presentation clear. We have copied all detailed comments below in blue and provided our responses to each specific comment in black.

Some minor comments I think the authors should address are:

General:

Would the authors consider that there could be a benefit in redefining the large domain to reduce the influence of the O category cyclones? There is no discussion in sections 4.1 or 5.

Reply: We agree that these kinds of box-type areas are of course arbitrary. In this study, however, we wanted also to see the “bigger picture” of windstorms occurring close to Finland. Also, in Section 4.2 there is some discussion when we say that “*In the characteristic comparison, we only considered classes F because a comparison with classes O would not be fair. This is due to the large size of the bounding box including numerous cyclone tracks in class O that do not affect the domain of Finland at all.*”

For figs 5 and 6, I would suggest a reconsideration for the colours, since these are not colour-blind friendly (most common type of colour blindness can't distinguish between red and green), but even for a standard sighted person I find it hard to distinguish the different tones in Fig 6, so maybe combine with different symbols?

Reply: We have now revised the colors in all figures as “colorblind safe” using <https://colorbrewer2.org/>. In addition, we revised Figure 6 so that it uses symbols to better separate the classes.

Minor comments on text

Line 8 (abstract): it currently read “northern part of a country”, but it should be of THE country, as this is not generic

Reply: Yes, you are correct. We have revised accordingly.

Lines 74-76, sentence starting with “Furthermore” though this might become clearer once the reader has covered the whole manuscript, this description is very confusing so early on in the text. I suggest the authors should review it and focus on the key aspects.

Reply: We have now reviewed the text beginning with the previous sentence and simplified the “Furthermore” sentence to clarify the points. The text now reads as follows (lines 73-79): *“We address these objectives by developing a novel classification for all extratropical cyclones and windstorms, based on their arrival location and direction as well as the climatological locations of the strongest wind gusts, and by identifying windstorms through their impact (power outages) rather than solely through meteorological features. Furthermore, we compare the meteorological characteristics of windstorms to extratropical cyclones, determine windstorm-related meteorological properties (e.g., min MSLP), and quantify how the impacts vary depending on the type of windstorm and its meteorological characteristics. We further investigate how the impacts vary by region and season.”*

Lines 107-108: On the issue of weather ERA5 overestimate or underestimates winds and gusts, the literature is a lot more nuanced. I suggest the authors take some time to look for example at the references below. There is specific literature that has focused on the performance for ETCs in particular:

<https://rmets.onlinelibrary.wiley.com/doi/10.1002/joc.8339> --> “ERA5 shows a good skill for wind speed with normalized mean bias (NMB) of -0.7% and normalized root-mean-square error (NRMSE) of 14.3%, despite a tendency to overestimate low winds and underestimate high winds”

<https://confluence.ecmwf.int/display/CKB/Windstorm+footprints%3A+Product+User+Guide> --> “It was found that wind gust from reanalysis (ERA-Interim and ERA5) underestimates measured wind gust on average”

And more generally there is a distinction between performance onshore/offshore and for low winds/high winds, and with topography and land use features

<https://link.springer.com/article/10.1007/s00382-020-05302-6>

<https://rmets.onlinelibrary.wiley.com/doi/pdf/10.1002/qj.3616>

<https://wes.copernicus.org/articles/9/1727/2024/>

<https://www.sciencedirect.com/science/article/pii/S2352484723015603>

<https://asr.copernicus.org/articles/17/63/2020/> --> “ERA5 is very skilled, despite its low resolution compared to the regional models, but it underestimates wind speeds, especially in mountainous areas”

<https://ges.rgo.ru/jour/article/view/3328/761> --> “The assessments revealed a

systematic error at most stations; in general, ERA5 tends to overestimate wind speed over forests and underestimate it over grasslands and deserts.”

I would suggest that the authors review their statement and add a bit more detail.

Reply: We appreciate the comment and the references and have added some additional details and references to the manuscript in lines 111-118: *“ERA5 demonstrates good performance in wind and gust analyses but has certain biases. It tends to overestimate low wind speeds while underestimating high winds, with wind gusts frequently being underestimated (Chen et al., 2024). The accuracy of ERA5 varies by region, performing better offshore than onshore and facing challenges in mountainous areas (Minola et al., 2020). Ongoing (unpublished) work at the Finnish Meteorological Institute has compared ERA5 10-m winds and wind gusts to observations and found that results in Finland are largely similar to those reported by Minola et al. (2020) for Sweden: weak winds are overestimated, while high winds and gusts are underestimated. Additionally, land cover influences wind speed estimates, with overestimations over forests and underestimations over grasslands and deserts (Shestakova et al., 2024).”*

Line 396: If the values are not normalised by number of storms, then the conclusion is not as direct as there are also more storms on autumn than winter. This should at least be mentioned.

Reply: The normalised, i.e., the averaged NDP per windstorms, are described on lines 430-432, where it is stated that: *“If we look at the average NDP numbers per windstorm, the most damage actually occurs during the summer (188 000 NDP per windstorm). In winter the number is 166 000/windstorm, autumn: 150 000/windstorm and spring: 94000/windstorm.”*