Influence of the North Atlantic Oscillation on annual spatio-temporal lightning clusters in western and central Europe

This manuscript uses lightning observations to identify convective trends in Europe and further investigates the role of the NAO and its anomalous activity on convection. The use of observed lightning data reveals trends that counter proxy-based estimates, raising questions about the compariability of proxies to observations of convection. The article focuses on large-scale outbreaks, that are identified using a spatio-temporal clustering algorithm.
Overall, the work is presented well and cohesively. Some additional discussion of current literature, additional interpretation/reasoning and clarifying aspects are necessary, however.
Below the line-by-line remarks detail the exact locations. More major comments are denoted in bold, where more technical remarks are in regular font.

1. Line 39: Recently, quite a lot of literature on regional climate modeling and convection has emerged, that should be referenced here (Cui et al., 2025, Thurnherr et al., 2025, Brennan et al., 2025, Feldmann et al., 2025, Kahraman et al., 2024)
2. Line 47: Twice “For example” in sentence
3. Line 216: I understand giving the clustering a separate sub-chapter, however, I think it would be beneficial to clarify, that this basically still belongs to the development of methods.
4. Line 305: Nice or Venice? The discussed regions do not match the city mention of Nice…
5. Line 306f: This would benefit from some references / literature support
6. **End of Section 4:** This requires some discussion regarding the length of time periods necessary to robustly identify trends. E.g. Nisi et al., 2018 show no measurable hail trend in Switzerland for 15 years, however, Wilhelm et al., 2024 show a significant positive trend, when evaluating 70 years by exploiting reconstruction techniques. The 20-year period here is still rather short and while significance testing accounts for interannual variability, decadal trends (such as driven by anomalous NAO activity) can still overlay a multi-decadal climate change trend.
7. Line 370: In-text quantifications like this are challenging to visualize as a reader. I would recommend either using a table, if the explicit number should be mentioned, or a visualization with e.g. a bar chart.
8. **Line 371:** The discussion on lifetime deserves a little bit more nuance. While isloated thunderstorms can have a >1h lifecycle, their lightning-active time tends to be shorter than the overall lifecycle. Events with at least 40 CG strikes certainly select towards more intense / larger storms, that tend to have longer lifecycles as well (e.g. Feldmann et al., 2023, Wapler et al., 2017).
9. Line 390: remove more
10. Fig. 9: Please include the information of the displayed percentile either directly in the plot, or in the caption.
11. Line 440: The French-Swiss border region is the Jura, not the Prealps.
12. **Line 455:** This argument on how the negative NAO affects thunderstorm environments should apply to the contradicting proxy studies as well. Some reflection here on where the differences might come from, would be greatly appreciated. Is it differing time periods? Do the proxies not adequately represent convective activity, despite being developed on observational data?
13. Line 478: remove “more” – is it really more storms that are smaller, or is it just a larger fraction of the total storm population, which could still be a smaller absolute number?
14. **End of section 6:** How does lightning activity depend on system size? Does flash rate per km change with system size (see e.g. Feldmann et al., 2023)? Ideally, this aspect would deserve another figure.

How do these results compare to Ghasemifard et al., 2024; where it is concluded that convective trends in Europe are not coupled to synoptic trends?

15. Line 485: double EUCLID
16. **Lines 496ff:** What decades do these studies consider? May this play a role in the comparison?

Recommended literature (partially preprints):

- Cui, R., Thurnherr, I., Velasquez, P., Brennan, K. P., Leclair, M., Mazzoleni, A., T. Schmid, H. Wernli, and C. Schär (2025). A European hail and lightning climatology from an 11-year kilometer-scale regional climate simulation. Journal of Geophysical Research: Atmospheres, 130, e2024JD042828. https://doi.org/10.1029/2024JD042828 (preprint at https://d197for5662m48.cloudfront.net/documents/publicationstatus/231295/preprint_pdf/cb4df177ce3efd8bacbea940c67782f5.pdf)
- Thurnherr et al., 2025: https://d197for5662m48.cloudfront.net/documents/publicationstatus/231295/preprint_pdf/cb4df177ce3efd8bacbea940c67782f5.pdf
- Brennan et al., 2025: https://egusphere.copernicus.org/preprints/2025/egusphere-2025-918/
- Wilhelm et al., 2024: https://nhess.copernicus.org/articles/24/3869/2024/
- Nisi et al., 2018: https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/qj.3286?casa_token=AhPPOv6_4j0AAAAA%3AGEcdWfIIi62f1GmW8-DLUYmrz3nZoNCn2k0NcZgFVrkUisad_y2aKU_DgZBgAYrxU8P1dbxuDOANx4zTrg
- Feldmann et al., 2023: https://www.nature.com/articles/s41612-023-00352-z
- Ghasemifard et al., 2024: https://iopscience.iop.org/article/10.1088/2752-5295/ad22ec/meta
- Kahraman et al., 2024: https://link.springer.com/article/10.1007/s00382-024-07227-w
- Feldmann et al., 2025: https://arxiv.org/abs/2503.07466
- Wapler et al., 2017: https://www.sciencedirect.com/science/article/pii/S0169809516306020?casa_token=vPb7aS5UahwAAAAA:uzj61dUfvGkZR7Nvsr7yAVGFbHaBSPBWjcJu_uJpL5moVuzrMIwDoTDxLu1gj4C0c5dmEqRgRg9L

- Probably too recent, but perhaps still interesting: https://egusphere.copernicus.org/preprints/2025/egusphere-2025-2296/