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

Summary: This article analyzes lightning data collected between 2001 and 2021 in Central Western Europe using a solid statistical method. The analysis was conducted on both gridded data and convective clustered events. The effect of NAO on lightning frequency and convective clustered events was also investigated.

The article is suitable for NHESS. It is well written, and the structure is well crafted. The methodology is robust and clearly explained, with an appropriate level of detail. The figures are informative and comprehensive. The results are noteworthy and original, making the work deserving of publication. However, I have some minor comments that I recommend addressing before publication.

Minor comments:

1. Line 88: suggest using “CCEs” instead of “convective clustered events” for consistency.

2. Eq. 3: I assume “AR” refers to autoregression. It would be helpful to clarify this in bullet point 3. Additionally, I am not very familiar with the TFPW method—could you expand on how AR(1) is defined and how it was computed in this specific application? Thank you.

3. Eq. 5: p is not defined, probably is the sample point. Please clarify

4. Line 166: do border points fail to meet the density criteria because they do not exceed the minPts value? I suggest clarifying this.

5. Line 245: How did you determine the values [20, 80] and [15, 25]? Earlier, you mentioned 30 km and 20 minutes as initial guesses for parameter selection. Are you selecting parameter ranges at the edges of the strongest gradient region? I assume this is because a strong gradient implies the exclusion of strokes that truly belong to convective clusters. I suggest adding a sentence to further explain the rationale behind choosing these parameter ranges.

6. Line 264: How is the concavity parameter defined?

7. Line 270: By “all,” do you refer to all clusters detected in the selected example, or in the entire dataset?

8. Line 272 It appears that the increase in the mean area ratio ends around 2.4. Why do you indicate it ends at 2.2?

9. Line 295: The higher values might also be due to more intense thunderstorms with high electrical activity, though these are rare. Storm initiation in the Adriatic Sea is difficult, but when a storm forms on the surrounding orography and crosses the sea, it often intensifies due to high moisture availability. I have observed this pattern several times in late summer. Stationary storms are not very common over the sea; they typically form near the orography.

10. Line 309: Florence is more inland than the observed local minimum. It looks like is more centered in the "Piana di Pisa", which is the second largest alluvial plain in Italy after the Po Valley.

11. Figure 6: Manzato et al. (2022) found that the maximum lightning density in NE Italy is much higher than in other parts of the Alps. They also used EUCLID data, although for a slightly different period (2005–2019). Your figure shows higher lightning density in Central Italy and Bosnia. Do you have any idea why this discrepancy occurs? Even accounting for the difference in spatial resolution, the variation is difficult to explain. I recommend addressing this point in the manuscript.

12. Line 346-352: Manzato et al (2025) found a similar results. While in NE Italy instability and moisture is raising according to the radiosoundings data, there is not a significant trend of rainfalls, hailstorms and lightning in the same region. I suggest adding this reference.

    Manzato, A., G. Fasano, A. Cicogna, F. Sioni, and A. Pucillo, 2025: Relationships between Environmental Parameters and Storm Observations in Po Valley: Are They Climate Change Invariant?. *J. Appl. Meteor. Climatol.*, **64**, 267–298, https://doi.org/10.1175/JAMC-D-24-0034.1.

13. Line 401: I suggest avoiding the term "obvious." While a trend exists, it is not particularly strong.

14. Figure 10: It may be helpful to include the black box over France from Fig. 1 in panel (a) of this figure as well.

15. Line 452: I suggest adding a geographic reference for the Shetland Islands. Since they are not shown in Fig. 1a, consider adding "northeast of Scotland."

16. Lines 471-473: computing the correlation between Fig 10a and 7a over France (i.e., between lightning trend and odds ratio) maybe can strengthen your result. I suggest performing this analysis.

17. Line 496: those studies are based on proxies from reanalysis data or soundings. Your study is based on observations of lightnings. I recommend emphasizing this important distinction, which enhances the significance of your findings.

18. Line 525: space missing after the parenthesis

19. Lines 511-514: I recommend explicitly stating that, based on your findings, there appears to be no clear effect of climate change on lightning frequency during the studied period, whereas internal climate variability (specifically NAO fluctuations) has a strong impact. This is an important conclusion. Since the introduction discusses previous studies on thunderstorms and climate change (lines 45–54), a concluding remark on this key result is highly appropriate.