Dear Referees,

thank you very much for your work and the useful and valuable comments on how to improve the scientific quality of our manuscript. Please find below our reply to the individual points, marked with an "AC" (author's comment).

Best regards,
David Piper and Michael Kunz

Response to the referee comments: Referee #1:

NOA correlation appears a bit short. For example, one wants more information about suppression of convection due to NOA+ effects.

AC: We will add two figures showing the anomaly patterns of upper-level wind field and θ_e, respectively, in order to clarify the reasons of convection suppression during NAO+.

4. The climatological question, to what extent 14 years lightning and 30 years NOA fit together may need some more comments.

AC: We used a subsample of the NAO time series that is defined by the time period lightning data were available. We will clarify this aspect in the text.

5. For a long time flash density maps are produced that take into account all flashes in certain grid cells. It may be interesting to learn to what extent the (total) densities correlate with the TD cells.

AC: Since the basic features of flash density and TD frequency maps are fairly similar to one another, we decided not to include an additional flash density figure in the manuscript. We will add an explanatory sentence about that.

6. Chapter 3.1 does not present much new insight and could be shortened; too many facts are detailed that are well known.

AC: We will check where it is possible to abridge this section and where the findings can be summarized. However, our objective is to give a comprehensive overview of thunderstorm activity in the large investigation area considered. Given the fact that previous studies focused both on much smaller domains and shorter time series we think that this section provides significant scientific added value.

Page 1; Line 16: it is mentioned that large natural hazards occur in southern Germany; the authors may recall that there have been very extensive hail disasters also in northern Germany (2013).

AC: This is correct. However, different hail climatologies have shown that the most prominent hail hot spots are located in the southern parts of Germany (e.g. Punge et al., 2014, Puskeiler et al., 2016); we will add a comment on this.

Page 8; Line 9: the k scale parameter is mentioned after Eq.1, but now quantities are given and the reader has no good idea what the numbers mean in a meteorological sense.

AC: We will explain this more in detail.

Page 15; Line 23: the authors suggest that cloud lightning could be detected only with VHF methods. This is incorrect. There are systems in the US (several) and in Japan (BOLT), as well as LINET in Europe and elsewhere, which can report sufficient cloud strokes in the VLF/LF range that relate to severe weather, especially hail.

AC: You are right. However, the EUCLID network exhibits a much lower detection rate for CC flashes compared to CG flashes (e.g. Pohjola and Mäkelä, 2013).

The paper could be published after the indicated suggestions have been duly considered.

Response to the referee comments: Referee #2:

This paper presents an interesting study based on the analysis of 14-year lighting data over a part of central/western Europe. The paper is well written and of interest for many readers. I would like to mention that the major part of the paper consists of a description of the temporal and spatial distribution of lightning (especially Section 3.1 is a rather long juxtaposition of locations with low/high lightning activity), while the discussion about NAO (although stated explicitly in the title of the paper) is not fully exploited. I recommend however publications of the paper, taking into account the following remarks.

AC: One objective of our study is to provide a deep and comprehensive analysis of lightning activity. Due to the large investigation area compared to previous studies, we are able to perform comparisons among various regions regarding several aspects of convection such as, e.g., the seasonality of diurnal cycles. Owing to the long time series of lightning data available, we are able to also investigate some aspects of multiannual variability yielding new insights regarding the spatio-temporal behavior of convective activity. However, we will check where to abridge especially section 3.1. We also agree in broadening the discussion about the link between convection and the NAO.

My main concern is the robustness of lighting data: the authors do not provide information about the location error and to the detection efficiency of the observing network. The latter information is very important to the reader in order to have a clearer idea on how the selection of 5 lighting flashes is justified in order to characterize a TD. Moreover, if the network experienced significant changes/modification through the elapsed 14 years (e.g. adding new sensors and/or applying modification to the location algorithms) these changes can jeopardize the robustness of results. Finally no information is given on the transformation of strokes to flashes (although I do not understand the necessity of such a transformation).

AC: We will add information about detection efficiency and location accuracy. There have been no significant changes during the investigation period. The grouping procedure transforming strokes into flashes is performed internally by EUCLID. We will add a sentence about that.

Reference to previous work on lighting climatology: I bring to authors' attention the recent publication of Kotroni and Lagouvardos (2016) (Lightning in the Mediterranean and its relation with sea-surface Temperature, Environmental Research Letters, 2016) which comprises a 10-year lightning climatology over a major part of Europe. Therefore the authors should modify accordingly their remarks in p2, lines 16-17. In this publication you can also find a discussion on the relationship of SST with lightning, an issue that is also mentioned in your paper.

AC: We will add this publication to the literature cited in the discussion. However, we would like to remark that the analyses performed by Kotroni and Lagouvardos (2016) are based on VLF lightning data exhibiting a fairly low location accuracy of ~6.8 km compared to ~100 m in the case of EUCLID (Schulz et al., 2016). Using EUCLID data, we are therefore able to provide new insights regarding local-scale features, and, owing to the large investigation area, to simultaneously perform comparisons among different regions.

The analysed area lacks a part of NE Italy and Slovenia, areas being identified by previous studies have as the hot-spots of lightning in Europe (Anderson and Klugmann, 2014; Kotroni and Lagouvardos 2016), is there any reason for that?

AC: Unfortunately, we were not able to get data of lightning in Italy and Slovenia. An exception is the northwesternmost parts of Italy, which are covered by the Swiss and French datasets.

In Section 3.1, p6, line 12: Which is the meaning of “local moisture anomalies”?

AC: Negative local moisture anomalies are present, when the local orographic features inhibit low-level moisture transport into some areas, which are given by several deep and contorted alpine valleys. These moisture anomalies imply the absence of strong moisture flux convergences necessary for thunderstorm development.

In the discussion in Section 3.3.2: how the authors believe that different vegetation types can influence the correlation between regions? Since many studies in the past have discussed this issue, I would suggest the authors having a look on this.

AC: We will add some information about this aspect.

As stated in the beginning, Section 3.3.3 devoted to the relation with NAO is not satisfactorily developed. Since this aspect of investigation is original, one would expect a more thorough discussion, maybe based on the analysis of other upper-level meteorological fields. In any case, I strongly believe that additional work on this issue would result in a more solid publication. In the light of the same remark, I would suggest further refining the last sentence of the abstract and a more comprehensive concluding part (in the conclusion section, only 3 lines are devoted to NAO relation to lightning).

AC: We will additionally discuss the anomaly patterns of the upper-level wind field and θ_e for both NAO phases, which clarify the relation between the NAO and convective activity. Accordingly, we will also modify the abstract and the conclusion section.