

# ***Interactive comment on “Spatio-temporal smoothing of lightning climatologies” by Thorsten Simon et al.***

## **Anonymous Referee #2**

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### **1 General Comments**

In the study 'Spatio-temporal smoothing of lightning climatologies' Thorsten Simon and colleagues develop methods for estimating the climatological probability of occurrence and the intensity of lightning. For this purpose a GAM was used that is depending on altitude, geographical location and season (day of the year). The developed methods has been applied to the summertime observations between 2010 and 2015 of the lightning location system ALDIS in the Austrian state of Carinthia (Eastern Alps). In this regard, the results for the intensity and the occurrence model are quite similar: the altitude effect shows higher values for higher elevation, the spatial effect provides a minimum in the Northwest and a maximum in the Eastern part of Carinthia, the seasonal effect peaks in mid July. However, the main difference between intensity and

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occurrence model can be found in the spatial effect, since a higher spatial variability is provided for the intensity model. This aspect could be explained due to a higher influence of local constructions on the lightning intensity. Furthermore, quantitative applications for the proposed approach are presented.

This paper is basically comprehensible, well structured and written in good English. Moreover, the general idea of the paper is interesting and the given approach is straight forward and certainly viable.

Since I got the impression that a major asset is the modeling for a complex terrain, I would like to know what is the benefit of adding an altitude effect to the statistical model, whereas the lon/lat-part seems to be the most influential effect? Moreover, I am not sure whether spatial function and altitude function are really distinct. Isn't it just sufficient to take the location into account because it implicitly contains the altitude?

Finally, in terms of verification, it is not clear what kind of scores were calculated or used and what their results are.

## 2 Specific Comments

### 2.1 Title

I am afraid that the title 'Spatio-temporal smoothing of lightning climatologies' is misleading, because spatio-temporal smoothing implies some kind of grid-wise and time-wise moving average or filter, while the main idea of your study is to decompose the signal into a seasonal, spatial and also altitude effect by a statistical model. Reading the paper, I would have entitled it something like 'Statistical modeling of lightning climatologies for complex terrains' or 'Spatio-temporal smoothing of lightning climatologies for complex terrains'...

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## 2.2 Introduction

Reading your introduction, I got the impression that thunderstorms/lightning tends to occur at regions with moderate or lower altitude (page 2, lines 4-8). But your figures 3 and 4, top-left implying a positive and linear relationship between altitude and occurrence/intensity. Why doesn't the GAM fits a function with maxima for lower/moderate altitudes?

## 2.3 Data

Page 3, line 1: Reading this, with little experience on this scientific field, I would like to know the distinction between lightning, flash and stroke?

Maybe, it would be interesting to show a figure with the spatial climatologies of the number of flashes in Carinthia for the raw data.

## 2.4 Methods

page 4, line 6: As mentioned before, are altitude and horizontal space (lon/lat) really distinct. Thus, eq. (1) probably would have the form:  $g(\theta) = \beta_0 + f_1(doy) + f_2(lon, lat, logalt)$

## 2.5 Results

page 5, line 20: How does the 1000 day-wise block-bootstrapping work?

page 6, line 4: Is there any explanation for the maximum in the Gurktal Alps, although this region is quite low elevated?

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page 6, line 11: Is there any explanation for the flatter shape of the altitude effect function?

## 2.6 Discussion

In my opinion the part where the authors explain that cross-validation with day-wise blocks is much smoother and subsequently recommend to explore dependence structure of the data first would be more suitable for the method section.

## 2.7 Conclusion

Page 8, line 30-32: As far as I understand, in section 4.2 the higher spatial variability of the intensity model is explained due to local constructions, that trigger the number of flashes without affecting the occurrence. However, in the conclusion part one get the impression that higher spatial variability of the intensity model is distinct from local maxima in the vicinity of radio towers. Thus, I would suggest a sentence like: 'In particular the spatial effect of the intensity model varies more strongly than the corresponding effect of the occurrence model, because local intensity maxima are triggered in vicinity of radio towers. Moreover other new features were exhibited like...'

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