Geophysical Research Abstracts
Vol. 18, EGU2016-12176, 2016
EGU General Assembly 2016

Lightning Climatology with a Generalized Additive Model

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This study present a lightning climatology on a 1km x 1km grid estimated via generalized additive models (GAM). GAMs provide a framework to account for non-linear effects in time and space and for non-linear spatial-temporal interaction terms simultaneously. The degrees of smoothness of the non-linear effects is selected automatically in our approach. Furthermore, the influence of topography is captured in the model by including a non-linear term.

To illustrate our approach we use lightning data from the ALDIS networks and selected a region in South-eastern Austria, where complex terrain extends from 200 an 3800 m asl and summertime lightning activity is high compared to other parts of the Eastern Alps. The temporal effect in the GAM shows a rapid increase in lightning activity in early July and a slow decay in activity afterwards. The estimated spatial effect is not very smooth and requires approximately 225 effective degrees of freedom. It reveals that lightning is more likely in the Eastern and Southern part of the region of interest. This spatial effect only accounts for variability not already explained by the topography. The topography effect shows lightning to be more likely at higher altitudes. The effect describing the spatio-temporal interactions takes approximately 200 degrees of freedom, and reveals local deviations of the climatology.