Geophysical Research Abstracts
Vol. 21, EGU2019-11042, 2019
EGU General Assembly 2019

Ground-based climatology of lightning and transient luminous events above Europe

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Over the past years, ground-based optical observations of transient luminous events (TLEs) have been taken by the Eurosprite network and partners, covering large areas over Europe and parts of the Mediterranean Sea. In particular, a coordinated effort in 2009 through 2013 led to producing the first climatology of more than 8000 TLEs observed above about 1000 thunderstorm systems, and study for the first time their distribution and seasonal variations in these areas. Consistently, lightning were recorded from the World Wide Lightning Location Network (WWLLN) allowing a direct comparison to TLEs. The climatology shows that TLE activity in Europe is intense during summer over continental areas, and in late autumn over coastal areas and sea. The two seasons peak respectively in August and November, whereas almost no TLEs are recorded in March and April. The observed TLE activity, which is composed mostly by sprites, is shown to be consistent with the seasonal distribution of lightning activity. The consistency among individual years makes the observed seasonal cycle a robust general feature of TLE activity above Europe. Because of the inhomogeneous spatial distribution of the adopted ground-based observing systems, observations were treated in terms of anomalies about the yearly mean. Key areas where the observations have a homogeneous coverage and were continued in the following years are identified and discussed. These areas may be used to normalize the overall distribution and for intercomparing with space-based observations from the Atmosphere-Space Interactions Monitor (ASIM) flying on the International Space Station, and to future lightning observations from the Meteosat Third Generation Lightning Imager.