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Editorial

Editorial for the Special Issue "Advances in Atmospheric Electricity"

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The field of atmospheric electricity has been very active in the last decades. An important milestone was the declaration of lightning as a new essential climate variable by the World Meteorological Organization in 2018, as lightning is an essential element of the Earth's climate system. Lightning occurrence is closely related to meteorology and the climate. In turn, lightning can play an important role in the composition of the atmosphere by producing nitrogen oxides, which contributes to the tropospheric ozone budget. Finally, lightning represents a natural hazard, as it can ignite wildfires or produce damage in human communities.

The study of lightning requires a multidisciplinary approach that includes meteorology, plasma physics, electromagnetism, remote sensing, and engineering. In the last decades, important advances in lightning detection, lightning climatology, and the most fundamental physical and chemical mechanisms related to lightning have contributed to setting the role of lightning in the Earth's climate system. However, there are still significant open research questions related to atmospheric electricity, such as the role of meteorology in the occurrence of lightning, the role of lightning in the ignition of wildfires, and how to improve lightning detection systems to monitor lightning discharges better. The main scope of this Special Issue was contributing to shed light on these questions.

Schumann Resonances are excited at Extremely Low Frequency (ELF) bands by lightning discharges. Monitoring Schumann Resonances provides information on the variability of lightning occurrence. The first paper published in this Special Issue was written by Pizzuti et al. [1], who reported long-term observations of Schumann Resonances at Portishead (UK) for 5 years. The measurements reported by the BTD-300 sensor have provided new information about the diurnal, seasonal, and annual global variations of lightning. In particular, they have reported an increase in the occurrence of lightning during the 2015–2016 super El-Niño episode.

The second paper was authored by Mansouri et al. [2]. This study proposed the use of Benford's law to assess the quality of the data provided by lightning locating systems, such as the European lightning detection network (EUCLID). Mansouri et al. [2] used two decades of lightning data to demonstrate that the proposed approach can be used to test the success of software and hardware upgrades and to monitor the performance of lightning locating systems.

The third paper published in this Special Issue, written by Mohammad et al. [3], reported the characteristics of lightning and thunderstorms occurring in Antarctica. Due to the low convection in Antarctica, thunderstorms are rare and their characteristics are different from thunderstorms occurring in the rest of the world. They found that the peak current of lightning produced in Antarctica tends to be lower than in other regions of the world, suggesting that electrification is weaker and providing useful information to investigate the possible relationship between convection and lightning peak currents.

Pustovalov et al. [4], who have written the fourth paper of this Special Issue, have reported electric field measurements in the fair-weather electric environment in the South of Western Siberia for 14 years from the geophysical observatory of the Institute of Monitoring of Climatic and Ecological Systems. They have found significant diurnal and seasonal variations that can be related to meteorology. The found variability is related to solar irradiance, meteorological parameters, and the aerosol content of the atmosphere.

Lightning-ignited wildfires in the Tomsk region (Western Siberia) have been investigated by Kharyutkina et al. [5] in the fifth paper of this Special Issue. They have provided an analysis of the space-time variability of lightning and wildfires in Western Siberia between 2016 and 2021 by searching for lightning candidates of detected fires. Lightning is the precursor of about 37% of wildfires in the Tomsk region. Kharyutkina et al. [5] have found that the relationship between lightning and hotspots is positive, although the correlation coefficients are low. In addition, they reported that the fire activity caused by lightning in Western Siberia may vary from 5 to 43% during the warm seasons over the investigated period.

Medina et al. [6] have contributed to this Special Issue by reporting the microphysical and kinematic characteristics of inverted polarity thunderstorms in Cordoba (Argentina). Thunderstorms with normal charge structures produce more negative than positive cloud-to-ground lightning, while positive cloud-to-ground lightning is more frequent in inverted polarity thunderstorms. In particular, low-level anomalous charge structure storms, which are uncommon in other regions of the world, produce more positive than negative cloud-to-ground lightning and represent an interesting target for the investigation of the electrification mechanisms in thunderstorms. Medina et al. [6] found that the meteorological characteristics of the analyzed inverted polarity thunderstorms were different from those of thunderstorms without charge inversion. In addition, they reported that low-level anomalous charge structure storms had weaker updrafts than thunderstorms with other charge structures.

Finally, Yair et al. [7] have written the seventh paper of this Special Issue. Lightning activity is reduced during the weekend in some high-populated cities as a consequence of the lower concentration of aerosols. Yair et al. [7] analyzed thunderstorms taking place during nine winter seasons over the Tel-Aviv, Israel, Metropolitan Area. They have found that the occurrence of lightning is influenced not only by the lower concentration of aerosols during the weekend but also by the synergistic effects of desert dust and urban pollution particles.

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