Plinius Conference Abstracts
Vol. 17, Plinius17-14, 2022
https://doi.org/10.5194/egusphere-plinius17-14
17th Plinius Conference on Mediterranean Risks
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

The frequency of lightning super-bolts in winter thunderstorms associated with Mediterranean cyclones

Yoav Yair[1], Colin Price[2], Barry Lynn[3], Menahem Kurzets[1], and Yannai Namia-Cohen[2]
[1]Reichman University (IDC Herzliya), Herzliya, Israel (yoav.yair@idc.ac.il)
[2]Tel-Aviv University, Tel-Aviv, Israel
[3]Hebrew University of Jerusalem, Jerusalem, Israel

The distribution of cloud-to-ground lightning energies is well established, and its most extreme values appear only in extremely rare flashes (< 0.0001%), defined as lightning "super-bolts". There are varying definitions of the specific energy values of super-bolts, depending on the detector or mode of observation. When using optical energy as viewed from a satellite, one usually refers to the brightest flashes (10^3 times brighter than average), while when relating to the electromagnetic radiation received by lightning detection networks, the definition revolves around the strongest signals in the VLF or ELF range, or the largest peak-current or charge-moment-change (CMC) inferred from the signal. These are all different metrics for evaluating the lightning's intensity, and they are inter-related and exhibit mutual dependence (e.g. extreme values of peak current positively correlate with extreme VLF amplitudes).

The global distribution of these extremely powerful lightning is remarkably different from that of normal lightning, which are concentrated in the 3 convective "chimneys" of tropical Africa, South America and the maritime continent in South-east Asia. Superbolts are found mostly over the oceans and near coastlines, such as Sea of Japan, the North Sea and in the Andes mountains (Holzworth et al., 2019). They are also discovered in maritime winter storms over the Mediterranean Sea, which is one of the most prolific regions, especially in the months November-January.

We present the climatology of east-Mediterranean super-bolts (peak current > 200 kA), and compare data obtained by various lightning detection networks (ENTLN, WWLLN and ILDN). Some storms exhibit a larger percentage of superbolts compared with the global average, up to 0.65% of total flashes. While the physical mechanisms producing these powerful flashes remains unknown, we suggest that such flashes are more common when large amounts of desert dust aerosols, coming from the Sahara Desert, are ingested into maritime winter cyclones and contribute to convective invigoration, enhanced freezing and efficient charge separation. Initial modelling results will be discussed.