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Lightning super-bolts in Eastern Mediterranean winter thunderstorms

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Superbolts are defined as lightning flashes that are a thousand times stronger than normal ones, and their occurrence is estimated to be less than 0.001% of total number of lightning on earth. The global distribution of these extremely powerful lightning flashes is remarkably different than that of regular lightning, which are concentrated in the well-known convective "chimneys" in tropical Africa, South-America and the maritime continent in South-East Asia. The physical mechanisms producing these powerful flashes remain unknown, and the puzzle is exacerbated by the fact that they are discovered mostly over oceans, in maritime winter storms.

The Mediterranean Sea is one of the most prolific regions where super-bolts occur, especially in the months November-January (Holzworth et al., 2019). We analyzed 8 years of lightning data obtained from the Israeli Lightning Detection Network (ILDN), defining a 200kA peak current threshold for superbolts. We mapped the spatial and temporal distribution of superbolts and their monthly frequency in winter season thunderstorms (DJF) in the eastern Mediterranean, and identified the meteorological and microphysical circumstances in such storms.

Our working hypothesis is that large amounts of desert dust aerosols, coming from the Sahara Desert, are ingested into maritime winter storms over the eastern Mediterranean. The large dust contributes to convective invigoration, enhanced freezing and efficient charge separation, implying that superbolts are more likely to occur in the presence of large dust. We will present the results of simulation conducted using the WRF-ELEC numerical model, and WRF with spectral bin microphysics coupled with Lynn et al.'s (2012) Dynamic Lightning Scheme (DLS) and the Lightning Potential Index (Yair et al., 2010; LPI), for selected case studies when an enhanced fraction of superbolts was observed.

Holzworth, R. H., McCarthy, M. P., Brundell, J. B., Jacobson, A. R., and Rodger, C. J. (2019). Global distribution of superbolts. J. Geophys. Res. Atmos., 124., doi:10.1029/2019JD030975.

Lynn, B., Y. Yair, C. Price, G. Kelman and A. J. Clark (2012). Predicting cloud-to-ground and intracloud lightning in weather forecast models. Weather and Forecasting, 27, 1470-1488,

doi:10.1175/WAF-D-11-00144.1.

Yair, Y., B. Lynn, C. Price, V. Kotroni, K. Lagouvardos, E. Morin, A. Mugnai, and M. d. C. Llasat (2010). Predicting the potential for lightning activity in Mediterranean storms based on the Weather Research and Forecasting (WRF) model dynamic and microphysical fields, J. Geophys. Res., 115, D04205, doi:10.1029/2008JD010868