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Properties of the lightning flashes in North-western Mediterranean Sea as documented during the EXAEDRE project

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The EXAEDRE (EXploiting new Atmospheric Electricity Data for Research and the Environment) project aims at better understanding North-western Mediterranean Sea thunderstorms through coupled observational- and modelling-based studies with a dedicated focus on the lightning activity and its properties at flash, storm and regional scale.

In this work, the lightning activity is measured by the VHF Lightning Mapping Array (LMA) network SAETTA and the operational French lightning detection network Meteorage. SAETTA VHF sources are merged in flashes based on a DBSCAN algorithm (L2 SAETTA dataset). Meteorage strokes and pulses are then combined to SAETTA flashes based on temporal and pulse/stroke-dependent spatial criteria (L2b SAETTA-Meteorage dataset). Four categories of flashes can then be investigated: 1) CG L2b flashes with at least one CG stroke, 2) pure IC L2b flashes as detected by Meteorage with only IC pulses, 3) No-MTRG flashes which are only detected by SAETTA flashes with no concurrent Meteorage records, and 4) No-SAETTA flashes which were only reported by Meteorage with no concurrent SAETTA records.

Several lightning parameters have been investigated for the first three L2b flash categories listed above. It includes among others the flash duration, the vertical flash extension, the 2D horizontal flash extension, the 10/50/90 percent quantile of flash altitude, the flash trigger altitude, the stroke/pulse number per flash, and the flash vertical extension. Based on the L2b database built from the SAETTA and Meteorage records of the entire year 2018, No-MTRG flashes have tendency to be rather small in terms of 2D flash extension or short in duration. They also statically exhibit a similar distribution of their 10/50/90 percent quantile of flash altitude. CG L2b flashes exhibit mainly altitudes below 8 km while the majority of pure IC flashes show distinct distribution of 10/50/90 percent quantile flash altitude. Three trigger altitude ranges, i.e. 4-5 km, 7-9 km, 11-12 km are found in the three studied categories. Finally, for the studied year, less +CG flashes occurred compared to the -CG flashes while CG flashes with more ground connections have the tendency to last longer and to be larger.

First we will introduce the instruments and the data. We will then present the different methodologies applied here to generate the L2b dataset with some typical lightning observations. We will then discuss on the characteristics of the different parameters listed above.

