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Comparing distinct ground-based lightning location networks covering the Netherlands

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Lightning can be detected using a ground-based sensor network. The Royal Netherlands Meteorological Institute (KNMI) monitors lightning activity in the Netherlands with the so-called FLITS-system; a network combining SAFIR-type sensors. This makes use of Very High Frequency (VHF) as well as Low Frequency (LF) sensors. KNMI has recently decided to replace FLITS by data from a sub-continental network operated by Météorage which makes use of LF sensors only (KNMI Lightning Detection Network, or KLDN).

KLDN is compared to the FLITS system, as well as Met Office's long-range Arrival Time Difference (ATDnet), which measures Very Low Frequency (VLF). Special focus lies on the ability to detect Cloud to Ground (CG) and Cloud to Cloud (CC) lightning in the Netherlands. Relative detection efficiency of individual flashes and lightning activity in a more general sense are calculated over a period of almost 5 years. Additionally, the detection efficiency of each system is compared to a ground-truth that is constructed from flashes that are detected by both of the other datasets. Finally, infrasound data is used as a fourth lightning data source for several case studies.

Relative performance is found to vary strongly with location and time. As expected, it is found that FLITS detects significantly more CC lightning (because of the strong aptitude of VHF antennas to detect CC), though KLDN and ATDnet detect more CG lightning. We analyze statistics computed over the entire 5-year period, where we look at CG as well as total lightning (CC and CG combined). Statistics that are considered are the Probability of Detection (POD) and the so-called Lightning Activity Detection (LAD). POD is defined as the percentage of reference flashes the system detects compared to the total detections in the reference. LAD is defined as the fraction of system recordings of one or more flashes in predefined area boxes over a certain time period given the fact that the reference detects at least one flash, compared to the total recordings in the reference dataset. The reference for these statistics is taken to be either another dataset, or a dataset consisting of flashes detected by two datasets.

Extreme thunderstorm case evaluation shows that the weather alert criterion for severe thunderstorm is reached by FLITS when this is not the case in KLDN and ATD, suggesting the need for KNMI to modify that weather alert criterion when using KLDN.