

# HF Pulses and VLF V-Shaped Emissions Recorded by DEMETER above Powerful Thunderstorms

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DEMETER is an ionospheric micro-satellite launched on a polar orbit in June 2004. Its main scientific objectives are to study the ionospheric perturbations in relation with seismic and anthropogenic activities. Therefore, its scientific payload allows to measure electromagnetic waves and plasma parameters all around the Earth except in the auroral zones. At its altitude ( $\sim 700$  km), the phenomena observed on the E-field spectrograms recorded during night time by the satellite are mainly dominated by whistlers. On one hand, the paper is related to HF emissions observed at the time of powerful lightning by DEMETER. During thirty months, 130 events with HF emissions at frequency  $\sim 2$  MHz have been observed at the time of intense whistlers. A map of these events indicates that they do not occur above regions of intense thunderstorm activity as the upper part of South America or the middle Africa. It is shown that this lack of occurrence above these two regions is due to the high value of the critical frequency of the F layer which prevents the propagation of the lightning pulses up to the altitude of the satellite. The characteristics of the lightning discharges related to some HF events have been determined above the North American region with the National Lightning Detection Network (NLDN). It gives time, location, intensity and sense of the lightning discharges. It is shown that the HF events correspond to intense lightning discharges occurring in close vicinity below the satellite. On the other hand, the paper is also related to V-shaped emissions observed at the time of powerful lightning by the low altitude satellite DEMETER. During three years, 87 events with V-shaped emissions associated with intense and numerous whistlers in VLF range have been observed. The NLDN indicates that these V-shaped emissions occur above intense isolated thunderstorms. A model is proposed to explain the funnel shape of the emissions.