

HF and VLF electromagnetic signatures recorded by DEMETER at the time of powerful lightning discharges

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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 (~700 km), the phenomena observed on the E-field spectrograms recorded during night time by the satellite are mainly dominated by sferics and whistlers. The ISUAL (Imager of Sprites and Upper Atmospheric Lightning) experiment on FORMOSAT 2 (the former ROCSAT 2) determines spatial, temporal and spectral properties of lightning induced upper atmospheric TLEs (Transient Luminous Events): sprites, elves, blue jets, etc. FORMOSAT 2 has been launched in May 2004 onto a Sun-synchronous orbit located at 890 kilometers. The two satellites cover the same time period but they are not synchronized and simultaneous observations are only possible from time to time. On one hand this paper will show the characteristics of some events simultaneously observed by the two satellites (VLF electromagnetic emissions and TLEs). On the other 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 ~2 MHz have been observed at the time of intense sferics. 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.