

STUDY OF SEISMO-ELECTROMAGNETIC EVENTS RECORDED BY THE MICRO-SATELLITE DEMETER

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Abstract:

DEMETER is a micro-satellite (130 kg) with a low-altitude (710 km) and a nearly polar orbit. The launch by CNES (French National Space Agency) was in June 2004, and the duration of the mission is 2 years. The main scientific objectives of the DEMETER experiment are to study the ionospheric disturbances due to seismic and anthropogenic activities. The seismo electromagnetic effects are the electric and magnetic perturbations caused by natural geophysical activity such as earthquakes and volcanic eruptions. It includes: electromagnetic emissions in a large frequency range, perturbations of ionospheric layers, anomalies on the records of VLF transmitter signals, particle precipitation, and night airglow observations. Such phenomena are of great interest, because they start a few hours before the shock and can be considered as short term precursors. Electromagnetic emissions in the ULF/ELF/VLF range that are related to seismic or volcanic activity are known since a long time but their generation mechanisms are not well understood. The emissions can propagate up to the ionosphere, and observations made with low altitude satellites have shown increases of ULF/ELF/VLF waves above seismic regions.

The payload of the DEMETER micro satellite allows to measure these waves and also some important plasma parameters (ion composition, electron density and temperature, energetic particles). The scientific payload is composed of several sensors: - Three Electric and three magnetic sensors (6 components of the electromagnetic field to investigate from DC up to 3.5 MHz), - A Langmuir probe, - An ion spectrometer, and, - An energetic particle analyzer. They are associated to two special equipments: a large onboard memory (8Gbits) in order to record data all around the Earth, and a high bit rate telemetry in X band (18 Mb/s).

There are two modes of operation: (i) a survey mode to record low bit rate data, and (ii) a burst mode to record high bit rate data above seismic regions. In the survey mode the telemetry is of the order of 950 Mb/day, and in burst mode, it is larger than 1 Gb/orbit.

The telemetry is received in Toulouse. The data processing center is located in LPCE, Orléans. We perform correlation with seismic activity using data from the GEOSCOPE network. Quick-Looks of the data are available on a WEB site dedicated to the experiment (<http://demeter.cnrs-orleans.fr>). The data processing center is also in relation with ground-based experiments. It is expected to have close collaboration with ground-

based experiments performing measurements of DC fields, electromagnetic noise in various frequency bands, ionospheric parameters, optical parameters,....Mutual comparison of all parameters (ground-based and satellite recorded) will allow to understand the generation mechanism of the EM perturbations registered during seismic activity. At the end of the mission it is expected to perform a statistical analysis to search for the effects in the ionosphere induced by the seismic activity. At this time this paper will present some ionospheric perturbations in relation with earthquakes occurring close to the satellite orbit tracks. This study of individual cases is important to determine which ionospheric parameters are more sensitive to the seismic activity.