Demeter mission: a microsatellite for the detection of seismic/tsunami ionospheric signals

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A few observations performed by satellites, such as the Aureol-3 satellite, have shown anomalous low frequency (<1 kHz) electromagnetic noise above epicenter of quakes, a few hours to a few days before the events. The French satellite Topex-Poseidon has also recorded perturbations in the total electronic content (TEC) of the ionosphere a few hours before quakes, and in the vicinity of the epicenter. Such electromagnetic signals are not related to instrumental errors. Their association to quakes was proposed, but is still unexplained despite several mechanism proposed. The lack of detection in many other cases furthermore demonstrates that these signals cannot be specific to all seismic events. See Parrot et al., 1993 for a review.

The French satellite Demeter (Detection of Electro-Magnetic Emissions Transmitted from Earthquake Regions) was proposed in order to perform the first survey of the ionosphere and to complete these first intriguing observations : potential signals related to quakes, volcanoes and anthropogenic activity will then be monitored during two years, and a complete set of statistics will then be achieved. Such statistics will be able to precise the occurrence of pre-seismic signals in the Earth ionosphere. The post-seismic perturbations of the ionosphere will also be recorded. These perturbations are related to the propagation up to the ionosphere of the acoustic and gravity signals related to quakes. A special emphasis will be put on the recording of possible ionospheric signals related to tsunamis. The tsunami normal modes, due group velocities close from the group velocities of atmospheric normal modes, may indeed affect strongly the ionosphere.

The Demeter mission is the first micro satellite from the French Space Agency (CNES, and was proposed by the LPCE (Orléans, France), with the contribution of several Institutes : CETP (Saint Maur des Fossés, France), CESR (Toulouse, France), ESTEC (Nordwik, Pays-Bas), and IPGP (Paris and Saint Maur, France). The satellite has a mass of about 110 kg and will be launched in mid-2002. It carries sensors for the measurement of electric fields (from DC to 3.25 MHz), magnetic field (from 10 Hz to 18 kHz), for the determination of the main plasma parameters (density, composition, temperature and ions velocities, as well as density and temperature of electrons) and for the measurement of energetic particles.

Reference: Parror M, J. Achache, J.J. Berthelier, E. Blanc, A. Deschamps, F. Lefeuvre, M. Menvielle, J.L. Plantet, P. Tarits,J.P. Vilain, 1993. High Frequency seismo-electromagnetic effects, Phys. Earth. Planet. Inter., 77, 65-83.