The ESPERIA satellite project for detecting seismic-associated effects in the topside ionosphere. First instrumental tests in space

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In recent times, ionospheric and magnetospheric perturbations constituted by radiation belt particle precipitations, variations of temperature and density of ionic and electronic components of ionospheric plasma, as well as electric and magnetic field fluctuations, were detected on board of *LEO* satellites. Observations aim at reconcile these phenomena not only with sun or atmospheric effects but also with Earth natural and anthropogenic activities. Ionospheric perturbations caused by EM emissions (EME) produced by human activities and radiated from the Earth's surface are constituted by power line harmonic radiation (PLHR), VLF transmitters, and HF broadcasting stations. EME-waves in a large frequency band are also detected on board of *LEO* satellites as a consequence of earthquake preparation and occurrence. The privileged zone for investigating these phenomena appears to be the ionosphere-magnetosphere transition zone (topside ionosphere). Several mechanisms have been invoked to justify the main sources of EM fields observed at the Earth's surface before earthquakes. On a macroscopic scale it has been shown that in the Earth's crust, rock microfracturing preceding a seismic fracture releases gas (radon, helium) and causes electrical conductivity changes, which depend upon the microcrack number and dimension and of pore fluids redistribution. Local deformation fields, rock microfracturing, gas emission, fluid diffusion, also have been associated with microscopic phenomena like rock dislocations, charged particle generation and motion, electrokinetic, piezomagnetic and piezoelectric effects. It has also been proposed that charge carriers could be activated in dry rocks mainly by the increasing external stress. In this case dry rocks can become a source of highly mobile electronic charge carriers, which increase the electric conductivity and may propagate through the rock as a charge cloud. One of the most fascinating applications related to these mechanisms is the so-called seismo-electromagnetic emissions. It consists of broad band (from DC to a few tens of MHz) EM fields generated by seismic sources in the seismogenic layer of the upper lithosphere and transmitted into the near Earth's space, before, during, and after an earthquake. Within this framework, earthquake-related ground strain deformation events (like fault creep strains) and consequent EM fields can be seen as coupling elements which contribute to the Earth-near-Earth Space interaction mechanisms. What is lacking is the demonstration of a causal relationship with explained physical processes and looking for a correlation between data gathered simultaneously and continuously by space observations and ground-based measurements. These coordinated space and ground-based observations must imply available test sites on the Earth surface to correlate strain and EM data, collected by appropriate networks of instruments in seismic areas, with EM, plasma, and particle data detected on board of *LEO* satellites. To study these phenomena, a specific space mission (the ESPERIA project) has been designed for the Italian Space Agency (ASI) and up to now two instruments of its payload have been built and tested in space. They are the ARINA and LAZIO particle detectors, and the EGLE search-coil magnetometer. LAZIO/EGLE has been launched on April 15, 2005 on the occasion of the ENEIDE European Soyuz mission to the ISS. The launch of ARINA occurred last June 15, 2006 on board the RESURS DK-1 Russian *LEO* satellite, within the PAMELA mission. The talk will include the justification, science background, and characteristics of the ESPERIA mission project as well as the description and testing of ESPERIA Instruments (ARINA and LAZIO-SIRAD) in Space.