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ARES : an in situ sensor to characterize Mars atmospheric electricity

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The Atmospheric Relaxation and Electric Field sensor (ARES) is a compact (200g) instrument devoted to the investigation of atmospheric electricity at the surface of Mars. It can measure the ionization state of the atmosphere, the electric fields that result from various charging mechanisms and investigate the planet global electrical circuit. Atmospheric electrical phenomena are an important issue in many processes at the surface of Mars: dust transport, surface and atmospheric chemistry as well as habitability of the planet through their role in the production of oxydized constituents.

A global atmospheric electrical circuit is likely to exist on Mars, between the surface and the ionosphere, with similarities and differences with the Earth's circuit. Atmospheric ionization should be similar to that of the Earth's stratosphere but impact charging through collisions between dust particles moved by the wind and the surface, or between dust particles themselves, is expected to be the dominant charging mechanism on Mars. Intense electric fields, possibly capable of producing electrical breakdown, are expected at the time of dust storms and in the vicinity of dust devils.

Atmospheric electricity is also involved in several processes that have a noticeable impact on the surface and atmosphere. At times of dust storms, electrostatic forces on fine electrically charged dust grains may become larger than aerodynamic forces due to the wind. They are expected to play a significant role in the dynamics of suspended dust particles and their interaction with the surface, thus on the processes that contribute to the erosion and long term evolution of the surface. By energizing the free electrons, the atmospheric electric fields control their interaction with both the surface and the atmospheric gases. They have thus a definite role in the chain of physical and chemical processes that govern the chemical state of surface materials and the production of oxidized constituents in the atmosphere with far reaching consequences on the sustainability of proper conditions for life.

The ELF and VLF electric fields measured by ARES can help in investigating electrical breakdown phenomena in the atmosphere and detect wave emissions from the distant ionized environment of Mars as well as ionospheric cavity resonances. In addition characterizing the radio-electric background is a necessary step to plan experiments using radio-techniques that will be used in the future to conduct deep probing for liquid water which remains as a core goal of the Mars exploration