Extremely Low Frequency laboratory investigation of moving sand and dust – a case of the Martian environment

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We present first results of laboratory experiments on extremely low frequency (ELF) electromagnetic (EM) field generation by moving sand and dust. This work is a part of our ongoing project to design and manufacture an autonomous ELF Mars Station that will enable studying electric properties of the Martian ionosphere as well as the subsurface of Mars.

ELF waves are very weakly attenuated in the planetary environments and propagate in a cavity made of two high-conductivity spherical boundaries: a planetary ionosphere and a planetary ground. On Mars, as there is no liquid water at the planetary surface, the high-conductivity layer of the ground is expected to be located at greater depths than on Earth, and therefore, ELF investigation on Mars can be used as a tool for studying the subsurface layers. It can be especially useful for groundwater detection. However, the main aim in ELF studies on Mars is related to investigating ELF sources.

ELF sources on Mars can be generated by frequently occurring phenomena: dust storms and dust devils. However, up till now, electromagnetic activity of these dust events on Mars has not been investigated in situ, and remote sensing measurements have been inconclusive. On Earth, many works indicate that dust storms and dust devils generate electromagnetic field, and some ELF fields in dust devils were detected. Also, some aeolian tunnel experiments showed that electric fields can be produced by moving sand.

Our laboratory experiments were performed in an aeolian environmental tunnel located at the Jagiellonian University in Krakow, designed to study aeolian transport. The measurements were carried out by dedicated ELF detectors and using a developed technique of signal processing and analysis. Several aeolian materials, different in mineralogical and granulometric composition, were tested.

This work has been supported by the National Science Center under grant 2015/19/B/ST9/01710.