FIELD TEST CAMPAIGN IN THE MOROCCO DESERT AS ANALOG FOR THE DREAMS EXPERIMENT ON BOARD EXOMARS 2016 MISSION. F. Esposito[1], C. Popa[1], G. Di Achille[1], C. Molfese[1], F. Cozzolino[1], L. Marty[1], K. Taj Eddine[2], G. G. Ori[2,3], [1]INAF-Osservatorio Astronomico di Capodimonte, Napoli, Italy, [2]Ibn Battuta Centre - University Cadi Ayyad, Marrakech, Morocco, [3] IRSPS Università G. D'Annunzio, Pescara, Italy

Introduction: DREAMS (Dust Characterization, Risk Assessment and Environment Analyzer on the Martian Surface) is a meteorological station with the additional capability to perform measurements of the electric field close to the surface of Mars that will land on Meridiani Planum onboard the European Space Agency ExoMars 2016 Entry Descent and Landing Demonstrator Module (EDM). DREAMS is an autonomous system that includes its own power supply and control system. It consists of the following subsystems: MarsTEM (thermometer), DREAMS-P (pressure sensors), DREAMS-H (humidity sensor), MetWind (2-D wind sensor), MicroARES (electric field sensor), SIS (Solar Ir-radiance Sensor), a CEU (Central Electronic Unit) and a battery. The ExoMars 2016 EDM mission is foreseen to land on Mars during the time when dust storms are more likely to happen on the planet. Therefore, DREAMS might have the unique chance to make scientific measurements to characterize the Martian environment in a dusty scenario also performing the first ever measurements of atmospheric electric field on Mars. Here, we present preliminary results of a field test campaign that we performed in the Moroccan desert to collect atmospheric and environmental measurements comparable to those that will be acquired on Mars by DREAMS. Focus is given to the effect of dust lifting in the electric properties of the atmosphere.

Figure 1 – Field instrumentation deployed at the Moroccan desert.

Equipments and site selection: The field instrumentation was deployed at - 4.113499 W and 31.161265 N (elevation 797.77 m a.s.l) in the middle of July 2013 and worked up to the beginning of September. It included: three 2D sonic anemometers (for wind speed and direction measurements) and 2 thermometers installed at different heights from the ground, sensors for the measurement of pressure, relative humidity, atmospheric electric field, soil temperature and humidity, solar irradiation, two impact sensors (Sensit), three sand catchers capable of collecting windblown sand grains, a dust monitoring station (atmospheric dust abundance and size distribution in the range 0.265- 34 μm vs time) (Fig. 1). The station was set to operate 24h/day and to collect measurements at 1Hz. This is the most complete set of instruments deployed for the study of aeolian processes and the relative role of atmospheric electrification.The site of deployment is a flat surface constituted by Quaternary lake sediment beds (Fig.1). The site provided the topography similar to the expected ExoMars 2016 landing site as well as the presence of loose material (sand and silt) to be lifted during the intense wind events. The period chosen for the campaign is the dry season (June-September), when the site experiences the peack in dust activity, as confirmed by MODIS-Terra data.

Dust lifting process and role of the atmospheric electric field: This study is a systematic work including an extensive field campaign with a large set of sensors devoted to the study of dust lifting mechanisms and their effect on atmospheric electric field. The main objective is to quantify the effect of fresh lifted dust on the atmospheric electric field and its feedback on the lifting process. An enhancement of the atmospheric electric field is expected during dust events such as sand saltation process (sand particles hop along the surface under wind stress), dust devils, dust storms (e.g [1], [2], [3], [4], [5]). This is due to charge transfer among particles during sand-dust-soil collisions. This mechanism is poorly understood but from some laboratory and field experiments ([2], [3]) we expect that saltating sand particles charge negatively while the soil surface charges positively, so that the resulting electric field is expected to be reversed in sign with respect to fair weather.

Moreover, some studies show also evidences of the role of electric field in reducing the wind stress needed to start sand saltation process ([1], [3], [6], [7]).

Observations: We observed more than 10 local dust storms and wind speeds up to 20 m/s. Preliminary analysis shows that, during these events, the Sensit sensors registered up to 1000 sand particle impacts,

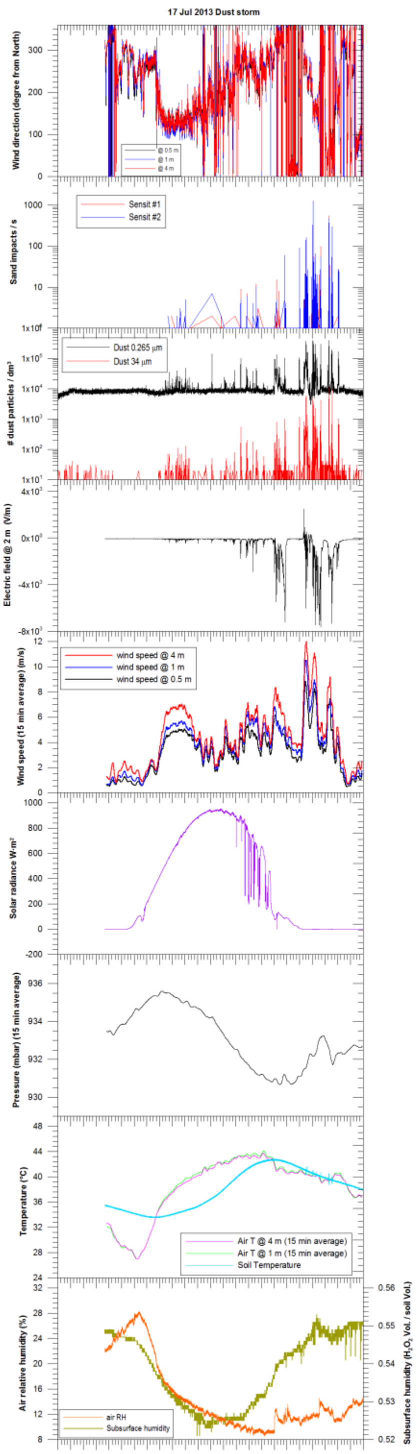

Figure 2: Data acquired during the local dust storm on 17th July 2013. It is evident the increase of electric field intensity with the increase of the amount of fresh lifted dust.

while the dust monitoring station observed an increment in the content of dust particles in the atmosphere up to three orders of magnitude (e.g. Fig. 2). We also observed an enhancement of the electric field @ 2 m up to -11 kV/m analysis. Note that the atmospheric electric field in fair conditions is around -50, -100 V/m. This enhancement has been observed to be strictly correlated to the injection of fresh lifted particles into the atmosphere. This strict correlation is evident also in fair weather, during short-event gusts, able to lift dust. This is evident, for example, in Fig. 3. Here, a short gust during a day with fair weather (3 Aug. 2013) was able to lift fresh dust into the atmosphere. As a consequence, the electric field intensity fastly increases.

From the preliminary analysis of our data we also observed that the generated electric field is mostly of the same sign than the terrestrial field in fair conditions. This is probably due to an excess of positive charges in the mixing region around the electric probe (placed at 2 m from the ground).

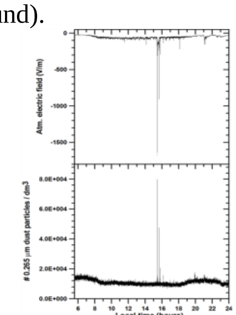

Figure 3: Fresh dust lifted during a gust and immediate effect on the atmospheric electric field.

Summary and conclusions: We acquired synchronized measurements of wind speed and direction, atmospheric pressure, solar radiation, air and soil humidity and temperature, wind erosion using impact sensors and sand catchers, dust lifting and electric field for about two months in the Moroccan desert. The latter measurements were complemented with laboratory analysis of the first 3 cm of ground collected nearby the station to characterize the soil from the sedimentary and mineralogical point of view, and of the samples of sand particles captured into the sand catchers during saltation process. Preliminary data analysis shows a strict correlation between the abundance of the fresh lifted dust and the enhancement of atmospheric electric field. This study provides new evidences in the relation of aeolian processes and electric properties of the atmosphere and will prepare the analysis of the data that will be acquired on Mars by the instrument DREAMS onboard the ExoMars 2016 space mission.

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