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Titan, Saturn's biggest moon, is an ocean world, covered by organic materials and therefore one of the most promising astrobiological target in the Solar System, likely holding clues on the origin of life on Earth. That is why NASA has selected the Dragonfly mission to send in 2027 a rotorcraft lander to Titan and investigate its prebiotic chemistry and habitability.

Making multiple flights (up to 24 in 2.5 years, starting in 2034), Dragonfly will explore a variety of locations, from the Shangri-La dune field to the rim of the young impact crater Selk (Lorenz et al., 2018), and therefore sample materials and determine surface properties in different geologic settings. The two permittivity probes - called DIEL- on board the Geophysical and Meteorological package (DraGMet) will be especially useful to characterize Dragonfly landing site environment.

DIEL consist of 2 electrodes acting as self-impedance permittivity probes. They will be mounted on each skid of the Dragonfly rotorcraft and operate independently for sake of redundancy and safety. Their objective is to measure the complex ground permittivity at several low frequencies (<10 kHz) which will provide clues on the composition, moisture and porosity of the near-subsurface of Titan as well as on the spatial and temporal variations of such properties. As a reminder, the first permittivity probe on Titan (actually the first ever planetary permittivity probe) successfully determined the complex permittivity of the Huygens landing site in 2005 (Grard et al, 2006; Hamelin et al. 2016).

During this presentation, we will describe the tests that have been performed on prototypes of the DIEL electrode plates in order to estimate their sounding depth and sensitivity to composition variations. Tests were performed e.g., with the electrode lying on reference plastic slabs and natural materials (air, sand, soil, liquid water, etc.) of well-known complex permittivity, at ambient and Titan temperatures. The effect of porosity and of a bad ground-electrode contact was also

investigated leading to suggestions to optimize DIEL electrode design, accommodation and performance.

Indeed, the design of the DIEL experiments (size, shape, accommodation of the electrodes, modes of operation ect.) is not frozen yet and we are also conducting modelling simulations with COMSOL Multiphysics © to explore possible better designs and confirm the results obtained in laboratory.

Lastly, in order to relate DIEL measurements to the ground composition, it is crucial to know the electrical properties of materials relevant to Titan's surface. This is the purpose of the PAP (Permittivité d'Analogues Planétaires) measurement bench that have been developed at LATMOS. This bench includes a cryostat to perform measurements at Titan's temperature (90 K). It was successfully used to investigate the complex permittivity of analogs of Titan's organic aerosols called "tholins" (Lethuillier et al., 2018). Future measurements will focus on "eroded" tholins, that is tholins that have been modified during their descent to the surface by processes analogous to those at play in Titan's atmosphere: UV radiations (Carrasco et al., 2018), interaction with ionosphere's charged particles (Chatain et al., 2020), deposition of ice in the low stratosphere (Fleury et al., 2019; Dubois et al., 2020), wetting by droplets of liquid methane in the troposphere etc.

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