WIND REGIME, SEDIMENT FLUX AND BEDFORM RESPONSE ON TITAN.

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Introduction: Linear dunes observed within the equatorial sand seas on Titan are one of the most striking findings after Cassini-Huygens mission [1,2]. As we reach the Cassini mission's dusk, fundamental advanced in our knowledge of these large bedforms have been made from remote-sensing associated to predictions of global circulation models allowing sediment transport estimations and fine geomorphology analysis. The question of either these dunes are responding to past and/or current wind regimes is still under debate and requires a mulch-disciplinary view to be answered [3-5]. Here we integrate all the knowledge and constraints we have accumulate during the 13 years of Cassini mission from remote-sensing [6-9], theoretical consideration for dune growth mechanisms [4,10,11] and climate models [12-14] in order to provide new insights on wind regime, sediment flux and bedform response on the Saturn's largest moon.

Methods : We present state-of-the-art inversion technique based on radiative transfer in both IR and micro-wave domains in order to assess the physical properties of the sand seas, including both dune material and bedrock beneath [15, 16]. Then we present how dune morphodynamics depends on sediment fluxes (i.e., directionality and supply) [4,11,17,18]. Hence we show how the wind regime can be assessed from the geomorphic analysis of bedforms.

Results : We show that dunes and interdunes have significantly different physical properties both in terms of composition and surface roughness, suggesting different grain size. Consequently, our remote-sensing inversion argues in favor of sedimentary armoring in between the dunes and hence that inter-dune material does not contribute to the dune's morphodynamics and that Titan's dune grow primarily by elongation parallel to the direction of the resultant sediment flux.

Additionally potential secondary bedforms, also called defect have been investigated. Our findings show that the may reflect second sediment fluxes associated to a multi-directional wind regime.

By integrating our results, we show that sand seas evolve under current multi-directional wind regimes. Consequently sediment inventory and climatic conditions are being re-evaluated.

References:

[1] Lorenz et al., 2006; [2] Radebaugh et al., 2008 ; [3] Ewing et al., 2015; [4] Lucas et al., 2014a; [5] McDonald et al., 2016; [6] Le Gall et al., 2011; [7] Savage et al., 2014; [8] Radebaugh, 2013; [9] Rodriguez et al., 2014; [10] [Courrech du Pont et al., 2014; [11] [Gao et al., 2015; [12] Lebonnois et al., 2012; [13] Charnay et al., 2015; [14] Tokano, 2010; [15] Bonnefoy et al., 2016; [16] Lucas et al., 2017; [17] Ping et al., 2017; [18] Gao et al., 2016

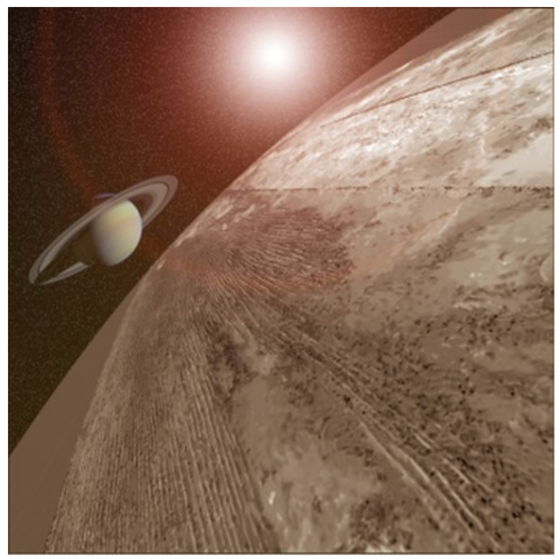

Figure 1 – Equatorial sand seas at Titan's surface after Cassini-Huygens mission.