Geophysical Research Abstracts
Vol. 21, EGU2019-16373, 2019
EGU General Assembly 2019

Insights on Titan's equatorial dune fields morphodynamics

Antoine Lucas (1), Sébastien Rodriguez (1,2), Jeremy Brossier (3), Radebaugh Jany (4), Le Gall Alice (5), Charnay Benjamin (6), Cornet Thomas (7), and Narteau Clément (1)

(1) IPGP, CNRS, Paris, France (lucas@ipgp.fr), (2) Université Paris Diderot, Paris, France, (3) Institute of Planetary Research, German Aerospace Center, Berlin, Germany, (4) Department of Geological Sciences, Brigham Young University, Provo, UT, USA, (5) LATMOS/IPSL, UVSQ Université Paris-Saclay, Sorbonne Université, CNRS, Guyancourt, France, (6) Laboratoire d'études spatiales et d'instrumentation en astrophysique, Observatoire de Paris, Meudon, France, (7) European Space Agency, European Space Astronomy Center, Madrid, Spain

During thirteen years (2004 – 2017), the Cassini-Huygens mission revealed that Titan is is a frozen version of Earth, where methane behaves as water, organic matter as sediment, and where water ice may be as hard as rock. Consequently, Titan experiences a large variety of surface processes that involve exchange between its surface and its atmosphere. Here we focus on an overview of our understanding of the equatorial regions dominated by sand dunes. Hyperspectral and micro-wave probing of the surface allowed us to characterize not only the geomorphology of bedforms but also their interactions with the regional and local topography, their composition and when comparing with climate predictions, their morphodynamics. Our compositional analysis and geomorphological observations give us valuable insights on the formation and evolution of Titan's dune equatorial landscapes. The atmospheric organic "dust" deposits tend to dominate Titan's surface, covering mountains and plains. This organic sediment is transported downward by mass wasting and fluvial processes after rainfalls, and can be then blown by the winds to form the dunes in the lowlands, exactly as on terrestrial transition areas from mountainous terrains to stony deserts (regs) and sandy deserts (ergs). Inversion of the backscatter signal from the RADAR experiment onboard the Cassini spacecraft shows that Titan's dunes and interdunes present significant differences in texture, likely to be due to grainsize differences (by at least one order of magnitude). This provides new insights on the aeolian transport ongoing on Titan. Where the sediment bed is a thick layer of particles that can be entrained by the wind, dune growth can be described as a bed instability selecting the alignment for which the normal-to-crest component of transport is maximum. It gives rise to the emergence of a regular dune pattern where topographic highs (crests) and lows (troughs) keep the same composition and texture. In contrast to this transport-limited conditions, recent works works have shown that dunes may also elongate on a non-erodible surface in the direction of the resultant sediment flux at the crest. These finger-like structures occur under multi-directional wind regimes in zones of low sand availability or where coarse grains form an armor layer as a result of size-segregation effects. In all these cases, dunes composed of mobile particles can be easily distinguished from the interdune areas (bedrock, desert pavement). The sediment compartment has therefore a critical control on the dune growth mechanism and on the subsequent dune and surface properties. Hence, our results on the shallow surface of Titan's sand seas show that Titan's low latitudes undergo geological processes very similar to those occurring in arid regions on Earth, in agreement with the predictions of climate models.