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EVOLUTION WITH SEASONS OF THE ORGANIC CONTENT ON TITAN : FROM ITS ATMOSPHERE TO THE SURFACE

Abstract

Titan is one of the most promising moons from the astrobiological perspective in particular because of its large organic content in the atmosphere and on the surface. These chemical species evolve with time. We have monitored Titan's stratosphere from the equator to the poles since the beginning of the Cassini mission. We will describe especially the seasonal evolution near Titan's poles and equator from 2012 until the last flyby of Titan in 2017. In our research (Coustenis et al. 2016; 2018 and references therein) we have reported on the observed strong temperature decrease and onset of a strong enhancement of several trace species such as HC3N and C6H6 at Titan's south pole, while previously observed only at high northern latitudes. This is due to the transition of Titan's seasons from northern winter in 2002 to summer in 2017 and, at the same time, the advent of winter in the south pole. An opposite effect was expected in the north, but observed with certainty only after 2015. We find that while the North pole continues to decrease in abundances, the South pole is finally also reduced in abundance in 2017. We will discuss the results and interpretations in terms of GCM and photochemistry.

We also investigate Titan's low-latitude and midlatitude surface using spectro-imaging near-infrared data from Cassini/Visual and Infrared Mapping Spectrometer (Solomonidou et al., 2016, 2018). We use a radiative transfer code to first evaluate atmospheric contributions and then extract the haze and the surface albedo values of major geomorphological units identified in Cassini Synthetic Aperture Radar data. We find significant differences in the composition among the various areas. We compare with linear mixtures of three components (water ice, tholin-like, and a dark material) at different grain sizes. Our results show a latitudinal dependence of Titan's surface composition, with water ice being the major constituent at latitudes beyond 30N and 30S, while Titan's equatorial region appears to be dominated partly by a tholin-like or by a very dark unknown material. The albedo differences and similarities among the various geomorphological units give insights on the geological processes affecting Titan's surface and, by implication, its interior. We discuss our results in terms of origin and evolution theories.

References: Coustenis et al., 2016, Icarus 270, 409-420; Coustenis et al., 2018, Astroph. J., Lett., 854, no2; Solomonidou et al.: Icarus, 270, 85-99, 2016 ; Solomonidou et al.: JGR, 123, 489-507, 2018.