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Seasonal composition and temperature variations monitored in Titan's stratosphere

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Ten years after Cassini's Saturn orbit insertion, we look at the evolution of the thermal and chemical composition of Titan's atmosphere by analyzing Cassini CIRS spectra. In particular, we use CIRS data from 2004-2013 to derive the temperature structure [1,2,7] and the neutral chemistry at latitudes between 50°S and 50°N [2]. The peak in abundance in the North was observed around the northern spring equinox (NSE), with a rapid decrease after mid-2009, indicating that the vortex has shrunk. The fulfillment of one Titanian year of space and ground-based observations in 2010 provided us for the first time with the opportunity to evaluate the relative role of different physical processes in the long term evolution of this complex environment [2-7], as also reported by other studies [10, 11]. The haze and gaseous content in Titan's atmosphere has shown some significant and rapid evolution in the past couple of years as Titan has moved from Northern winter through Northern Spring Equinox (NSE, in mid-2009) to summer. The reverse is true for the Southern hemisphere. The gaseous and haze content of the atmosphere has exhibited new features marking these seasonal passes [8,9]. After inferring the haze component by adjusting the aerosol description for each latitudinal bin, we have been monitoring the molecules appearing in CIRS/FP3 looking for recent seasonal variations as the south polar region is now moving into winter. We find significant changes for all the molecules included in the 600-720 cm-1 range (C4H2, C3H4, HC3N, CO_2, C6H6, and HCN), as well as R-wing lines of the HCN and C2H2 bands. Within a 2-3 yr period in the South strong factors of increase for C4H2 and C3H4 are observed, whereas 30-40% decreases are found for HCN and for CO_2. A rather stable situation with its "summer" abundance is seen for C2H2 and C2H6. Most importantly, we witness the dramatic advent of HC3N and C6H6, among the most short-lived and least abundant species after late 2011 and early 2012. The HC3N disappearance in the North has happened some time between 2009 and 2010. Its appearance in the South is more recent, sometime in 2012, just as for the 220 cm-1 haze feature. All in all the HC3N distribution between North and South seems to have changed by 2 orders of magnitude in 2 years time.

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