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Cassini solstice mission seasonal effects on Titan's atmospheric chemistry and temperature

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We have monitored Titan's stratosphere from the equator to the poles since the beginning of the Cassini mission. We will report here on the monitoring of seasonal evolution near Titan's poles and equator from 2012 until the last flyby of Titan in 2017. In previous papers (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 complex hydrocarbons and nitriles (HC3N and C6H6 in particular) 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 present here a complementary analysis of nadir spectra acquired by Cassini/CIRS (Jennings et al., 2017) at high resolution in the past years and until the last Titan flyby in 2017 and describe the temperature and composition variations near Titan's poles. In the past years, the northern polar region has shown a temperature increase of 10 K, while the south has shown a more significant decrease (up to 25 K) in about 3-4 years. While the south polar region is continuously enhanced since about 2012 (Coustenis et al., 2018, and in preparation) we now see a change in the trend. The 2017 data we have acquired and processed are very important because we had no high-resolution polar data in the Southern pole since 2014. The new results indicate that while the North pole continues to decrease in abundances, the South pole is finally also finally reduced in abundance. Indeed, in the Titan south pole stratosphere most of the molecules, which had preserved their enhancement until end of 2016, sustain a sudden and large drop in abundance in 2017. We will discuss the results and interpretations in terms of GCM and photochemistry.

References: Coustenis et al., 2016, Icarus 270, 409-420; Coustenis et al., 2018, Astroph. J., Lett., 854, no2; Jennings et al., 2017, Applied Optics 56, no 18, 5274-5294.