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Titan's trace gaseous stratospheric composition from Cassini/CIRS observations up to end of 2009

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Abstract

Titan, Saturn's largest moon, is probably the most intriguing object in our Solar system. It hosts a dense nitrogen atmosphere, rich in organic constituents as methane, other trace hydrocarbon gases, nitriles and some oxygen compounds [4,5]. Due to such a plentiful organic environment, Titan resembles the perfect planetary-size laboratory for interdisciplinary research.

Since July 2004, the findings of the Cassini/Huygens mission have significantly improved our knowledge of the Titan's environment by returning to Earth a wealth of data. The study of Titan's organic molecule envelope by the Cassini-Huygens instrumentation equips scientists with the proper tools to understand the dynamics of its atmosphere, its evolution and origin and, moreover, to examine its astrobiological potential [13].

In this work, we analyze the data retrieved from the CIRS instrument aboard the Cassini spacecraft at both medium (2.5 cm^{-1}) and high (0.5 cm^{-1}) resolutions [5]. In particular, we average the spectra obtained from the beginning of the Cassini's tour until late 2009, when the T62 flyby occurred. Then, we compare CIRS stratospheric observations to the spectra derived from our radiative transfer iterate model. Working with both nadir and limb CIRS data, our purpose is to improve on the values for the temperature profiles [1] and the mixing ratios of the trace constituents' inventory of satellite's stratosphere in respect to previous studies [e.g. 4,5,7,8,9]. Moreover, we will try to connect CIRS results with the INMS [16] ones by producing vertical distributions through a radiative photochemical model [10,11] for numerous trace molecules, beginning with benzene [2,3]. The significance of benzene turns up after its detection in the Titan throughout the stratosphere [4,5,6,7], by in situ measurements of the Huygens probe [12] and in the upper atmosphere [15]. Furthermore, the aromatic structure of benzene could produce polycyclic aromatic hydrocarbons (PAHs) one of the most interesting product of the photochemical chain. Finally, we also compare these results with other inferences from Cassini-Huygens data and previous space missions.

References

[1] Achterberg, R.K., et al., Titan's middle-atmospheric temperatures and dynamics observed by the Cassini Composite Infrared Spectrometer, Icarus, 194, p. 263-277, 2008.

[2] Bampasidis, G, et al., Benzene in Titan's atmosphere from Cassini CIRS data, EGU-908, 2010.

[3] Bampasidis, G, et al., Benzene in Titan's atmospheric envelope from Cassini/CIRS data until the T62 flyby, Faraday discussions 147: Chemistry of the Planets, Saint Jacut de la Mer, France, 2010.

[4] Coustenis, A., et al., Titan trace gaseous composition from CIRS at the end of the Cassini-Huygens prime mission, Icarus, 207, pp. 461-476, 2010.

[5] Coustenis, A., et al., The composition of Titan's stratosphere from Cassini/CIRS mid-infrared spectra, Icarus, 189, pp. 35-62, 2007.

[6] Coustenis, A., et al., Titan's atmosphere from ISO mid-infrared spectroscopy, Icarus, 161, pp. 383-403, 2003.

[7] Flasar, F. M., et al., Titan's atmospheric temperatures, winds, and composition, Science, 308, pp. 975-978, 2005.

[8] Flasar, F. M., et al., Exploring the Saturn system in the thermal infrared: The Composite Infrared Spectrometer, SSR, 115, pp. 169-297, 2004.

[9] Jennings, D., et al., Isotopic Ratios in Titan's Atmosphere from Cassini CIRS Limb Sounding: HC_3N in the North, Astrophys. J. Let., 681, pp. L109-L111, 2008.

[10] Lavvas, P., et al., Coupling photochemistry with haze formation in Titan's atmosphere, Part I: Model description, PSS, 56, pp. 27-66, 2008a.

[11] Lavvas, P., et al., Coupling photochemistry with haze formation in Titan's atmosphere, Part II: Results and validation with Cassini/Huygens data, PSS, 56, pp. 67-99, 2008b.

[12] Niemann, H.B., et al., The abundancies of constituents of titan's atmosphere from the GCMS instrument on the Huygens probe, Nature, 438, pp. 779-784, 2005.

[13] Raulin, F., Astrpbiology and habitability of Titan, SSR, 135, pp. 37-48, 2008.

[14] Teanby, N., et al., Dynamical implications of seasonal and spatial variations in Titan's stratospheric composition, PhTrRS, 367, pp. 697-711, 2009.

[15] Waite, J.H., et al., The process of tholin formation in Titan's upper atmosphere, Science, 316, pp. 870-875, 2007.

[16] Waite, H., et al., The Cassini ion and neutral mass spectrometer (INMS) investigation, SSR, 114, pp. 113-231, 2004.