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Characterization of the vertical profile of C_2N_2 profile in Titan's atmosphere

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Abstract

Titan's atmosphere hosts a large variety of trace species. Some of them, such as hydrocarbons and nitriles ($C_xH_yN_z$) are produced by a complex photochemistry, initiated by the dissociation of N_2 and CH_4 by solar UV and EUV photons, high energy electrons from Saturn's magnetosphere, and cosmic rays (Wilson & Atreya 2004; Vuitton et al. 2012). The meridional and vertical distributions of each photochemical product are shaped in a specific way by atmospheric dynamics and chemistry, depending on its production and loss chemical reactions, and on its photochemical lifetime. Thus, these species can be used as tracers of the chemical and dynamical processes in Titan's atmosphere.

In this study, we present the first measurements of the vertical profile of C_2N_2 (cyanogen). We analyse Cassini/CIRS (Flasar et al. 2004) limb spectra in the far-infrared to probe the volume mixing ratio of C_2N_2, using its ν_5 band at 234 cm^{-1}. These observations allow us to measure C_2N_2 in the the stratosphere, between 5 and 0.5 mbar. C_2N_2 profiles are obtained using the constrained non-linear inversion code NEMESIS (Irwin et al. 2008).

In this work, we focus on two regions undergoing very different atmospheric conditions. First, we retrieve C_2N_2 profiles in the equatorial latitudes (25°N - 25°S) between 2006 and 2014, where insolation and stratospheric temperature vary weakly during a Titan's year (Vinatier et al. 2015; Bampasidis et al. 2012). Then, we measure C_2N_2 profiles at high southern latitudes during autumn (after 2009), where strong dynamical effects have been inferred from previous Cassini/CIRS measurements (Coustenis et al. 2016; Vinatier et al. 2015; Teanby et al. 2012), and where the chemistry is different compared to other latitudes, due to the lack of insolation. These results are compared to photochemical models such as Dobrijevic et al. (2016); Krasnopolsky (2014) in order to bring constraints on the chemistry of C_2N_2. Vertical profiles of many other photochemical species have been measured at these latitudes and at similar pressure levels during the Cassini mission (e.g Vinatier et al. (2015)). We compare the C_2N_2 profiles to the profiles of other nitriles such as HCN, and photochemical species with longer and shorter chemical lifetime like H_3CN (2.5×10^7 s for H_3CN and 8.0×10^6 s for C_2N_2 at 300 km according to Wilson & Atreya (2004)) and C_4H_2 (1.4×10^6 s, Wilson & Atreya (2004)), in order to better understand chemical and dynamical processes at play in Titan's stratosphere.

References

Bampasidis, G., Coustenis, A., Achterberg, R. K., et al. 2012, ApJ, 760, 144

Coustenis, A., Jennings, D. E., Achterberg, R. K., et al. 2016, Icarus, 270, 409

Dobrijevic, M., Loison, J. C., Hickson, K. M., & Gronoff, G. 2016, Icarus, 268, 313

Flasar, F. M., Kunde, V. G., Abbas, M. M., et al. 2004, Space Sci. Rev., 115, 169

Irwin, P. G. J., Teanby, N. A., de Kok, R., et al. 2008, J. Quant. Spec. Radiat. Transf., 109, 1136

Krasnopolsky, V. A. 2014, Icarus, 236, 83

Teanby, N. A., Irwin, P. G. J., Nixon, C. A., et al. 2012, Nature, 491, 732

Vinatier, S., Bézard, B., Lebonnois, S., et al. 2015, Icarus, 250, 95

Vuitton, V., Dutuit, O., Smith, M. A., & Balucani, N. 2012, in Titan: Interior, Surface, Atmosphere, and Space Environment, ed. I. Müller-Wodarg, C. A.

Griffith, E. Lellouch, & T. E. Cravens (Cambridge: Cambridge University Press), 224–284

Wilson, E. H. & Atreya, S. K. 2004, Journal of Geophysical Research (Planets), 109, E06002