EPSC Abstracts,
Vol. 2, EPSC2007-A-00172, 2007
European Planetary Science Congress 2007

Titan's neutral atmospheric composition

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Our understanding of Titan's atmospheric chemical composition has recently been enhanced by the data returned by the Cassini instruments. Spectra recorded by the Composite Infrared Spectrometer (CIRS) aboard the Cassini spacecraft have been processed from the Titan flybys spanning three years now since SOI (Flasar et al., 2005; Teanby et al., 2006, Vinatier et al., 2006; Nixon et al., 2006; Coustenis et al., 2007). The spectra characterize various regions on Titan from 85˚S to 80˚N with a variety of emission angles. We have studied the emission observed in the CIRS detector arrays (covering the 10-1500 cm^{-1} spectral range with apodized resolutions of 2.54 or 0.53 cm^{-1}). We have used temperature profiles retrieved from the inversion of the emission observed in the methane ν_4 band at 1304 cm^{-1} and a line-by-line radiative transfer code to infer the abundances of the trace constituents and some of their isotopes in Titan's stratosphere (Coustenis et al., 2007a). The composite spectra show several signatures of previously identified molecules: hydrocarbons, nitriles, H_2O and CO_2. Besides these well-known trace species, a firm detection of benzene (C_6H_6) is provided by CIRS at 674 cm^{-1} and allows for the study of its latitudinal variations. No longitudinal variations were found for any of the gases. Information is retrieved on the meridional variations of the trace constituents and tied to predictions by dynamical-photochemical models (Hourdin et al., 2004; Lavvas et al., 2007). Molecules showing a significant enhancement at northern latitudes are the nitriles (HC_3N, HCN) and the complex hydrocarbons (C_4H_2, C_3H_4). The D/H ratio on Titan was also determined from the CH_3D band at 8.6 micron and found to be about 1.3 $\pm$0.2 10^{-4}. We have also identified the presence of C_2HD at 678 cm^{-1} for the first time (Coustenis et al., 2007b, in preparation). Constraints are also set on the vertical distribution of C_2H_2.

References : Coustenis et al., 2007a, Icarus, in press; Flasar et al., 2005, Science 308, 975 ; Hourdin et al., 2004, J. Geophys. Res. 109, E1205; Nixon et al., 2006, BAAS 38; Lavvas et al., 2007, Plan. Space Sci., in press; Teanby et al., 2006, Icarus 181, 243; Vinatier et al., 2006, Icarus, 188, 120.