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Titan's Atmospheric Composition from Space Investigations

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Titan's extraordinary atmosphere has attracted much attention since its discovery a century ago. Investigations of Titan's atmospheric composition in the past decade include remote sensing measurements by the Infrared Space Observatory. ISO has provided the detection of the water vapor in Titan's atmosphere (Coustenis et al., 1998) and given a precise measure of the chemical composition as a disk-average (Coustenis et al., 2003). More recently, data recorded by the Composite Infrared Spectrometer (CIRS) aboard the Cassini spacecraft became available during the later Titan flybys (Flasar et al., 2005; Teanby et al., 2006). The spectra characterize various regions on Titan from 75°S to 75°N with a variety of emission angles and pertain mainly to Titan's stratosphere. We study the emission observed in the mid-infrared CIRS detector arrays (covering roughly the 600-1500 cm-1 spectral range with apodized resolutions of 2.54 or 0.53 cm-1). The composite spectrum shows several molecular signatures: hydrocarbons, nitriles and CO2. A firm detection of benzene (C6H6) is also provided by CIRS at 674 cm-1. We have inferred the abundances of the trace constituents and some of their isotopes in Titan's stratosphere (Coustenis et al., 2006). No longitudinal variations were found for the gases. Information is retrieved on the meridional variations of the trace constituents and tied to predictions by dynamical-photochemical models. Molecules showing a significant enhancement at high northern latitudes are the nitriles (HC3N, HCN) and the complex hydrocarbons (C4H2, C3H4). Some species (C3H8, CO2) show hints of an abundance decrease towards both poles. The D/H ratio on Titan was also determined from the CH3D band at 8.6 micron and found to be 1.25 ±0.2 10-4. Constraints are also set on the vertical distribution of C2H2. References: Coustenis et al., 1998, Astron. Astrophys., 336, L85; Coustenis et al., 2003, Icarus 161, 383; Coustenis et al., 2006, Icarus, submitted; Flasar et al., 2005, Science 308, 975; Teanby et al., 2006, Icarus, in press.