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Remote measurement of infrared emission by ethane in Titan's stratosphere at the Huygens entry epoch

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The equatorial region of Titan was observed on 14 and 15 January 2005 UT, during and following the entry of the Huygens Probe, using the Goddard Space Flight Center Heterodyne Instrument for Planetary Winds and Composition (HIPWAC) mounted to the Nasmyth focus of the Subaru 8.2m telescope of the National Astronomical Observatory of Japan. The instrument beam width was constrained by the combination of the telescope diffraction limit and the infrared seeing at the time to a FWHM of approximately 0.6 arcsec, compared to Titan's 0.88 arcsec apparent diameter. Three radio-frequency (RF) spectral analysis systems were used to decompose the double sideband infrared spectrum at 11.74 μm wavelength to a resolving power of $\lambda/\Delta\lambda$ = 10^6, 5x10^6, and 25x10^6, respectively, providing confirmation of results obtained with any one RF system. The fully-resolved rovibrational transition lineshapes observed within $\pm$ 1.6 GHz ($\pm$ 0.053 cm^{-1}) of the isotopic carbon dioxide laser local oscillator at 11.7441 μm (851.4895 cm^{-1}) simultaneously constrain both the ethane abundance and temperature within the pressure regime sampled, approximately 30 millibar to 0.1 millibar. Spectra were acquired in alternating sequence at positions offset 0.26 arcsec toward the East limb, at disc center, and offset 0.26 arcsec toward the West limb. Ethane abundance and thermal information corresponding to each spectrum are retrieved in order to obtain best-fit global values as well as to search for spatial variations that have been proposed due to, for example, thermal tides (Zhu, X., Maintenance of Equatorial Superrotation in Titan's Atmosphere, AGU Fall Meeting, abstract #P42A-08, 2004).

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