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High Spectral Resolution Infrared Studies of Titan: Winds, Temperature and Composition

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Results from the most recent analyses of resolved ethane line emission profiles from the stratosphere of Titan, measured before (2003) [1, 2], near the time of (2005) [3, 4], and after (2008) Huygens descent, will be presented. Wind velocity, temperature and ethane abundance are retrieved from 11.7 μm measurements at spectral resolving powers ≥1000000 using the NASA Goddard Space Flight Center Heterodyne Instrument for Planetary Wind And Composition (HIPWAC) interfaced with the 8.2 meter Subaru telescope of the National Astronomical Observatory of Japan. Retrieved wind velocities (~190 m/s at 230 km) from Doppler shifts of measured emission lines are compared to previous infrared heterodyne studies and compared to results from other direct wind measurements – Huygens Doppler Wind Experiment [5], Doppler shifts of reflected visible radiation [6], and mm-wave investigations[6]. Comparison to indirect wind retrievals from stellar occultation [8] observations and Cassini CIRS thermal maps [9] is also made. An empirical altitude-dependent wind model will be presented.

The narrow ethane emission lines are analyzed to retrieve the ethane mole fraction and an attempt is made to evaluate the altitude distribution of ethane in the stratosphere for thermal profiles derived from measurements from Cassini and Huygens. Resultant ethane altitude distributions will be discussed and comparison to results from earlier HIPWAC and other remote sensing measurements and from contemporaneous Cassini/Huygens investigations [10, 11] will be made. Preliminary comparison suggests temporal or spatial variability in the line emission and retrieved ethane abundance in Titan's stratosphere. Possible detection of minor hydrocarbon constituents and evidence of possible probing of Titan's mesosphere and of mesospheric wind shear will be discussed.

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