Water vapor on Titan: the stratospheric vertical profile from Cassini/CIRS infrared spectra

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Water vapor in Titan's middle atmosphere has previously been detected only by disk-average observations from the Infrared Space Observatory (Coustenis et al., 1998). We report here the successful detection of stratospheric water vapor using the Cassini Composite Infrared Spectrometer (CIRS, Flasar et al., 2004) following an earlier null result (de Kok et al., 2007a). CIRS senses water emissions in the far-infrared spectral region near 50 microns, which we have modeled using two independent radiative transfer and inversion codes (NEMESIS, Irwin et al 2008 and ART, Coustenis et al., 2010). From the analysis of nadir spectra we have derived a mixing ratio of (0.14 ± 0.05) ppb at 100 km, corresponding to a column abundance of approximately (3.7 ± 1.3) × 10^{14} mol/cm^2. Using limb observations, we obtained mixing ratios of (0.13 ± 0.04) ppb at 125 km and (0.45 ± 0.15) ppb at 225 km of altitude, confirming that the water abundance has a positive vertical gradient as predicted by photochemical models. In the latitude range (80°S – 30°N) we see no evidence for latitudinal variations in these abundances within the error bars.