

Trends in Titan's Thermosphere and their possible origins

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Abstract

Analysis of Cassini Ion Neutral Mass Spectrometer (INMS) N₂ and CH₄ density measurements in Titan's upper atmosphere have revealed a general trend of decreasing densities at a fixed altitude level. The decreasing densities are accompanied by an increase in CH₄ mole fractions. Together, these trends are consistent with a collapse of thermospheric isobar heights by ~0.7 scale heights. An average temperature decrease in the 600-900 km ("agnostosphere") region by up to ~30 K could cause such an observed collapse. There is observational evidence from the Cassini Imaging Science Subsystem (ISS) and Ultraviolet Imaging Spectrograph (UVIS) observations for the disappearance of the detached haze layer as Titan approached equinox. Recent calculations and UVIS observations have indicated that the disappearance of the detached haze layer could reduce temperatures near 700 km by up to 50 K. This suggests the possibility that the observed thermosphere density trend may be linked to the disappearance of detached haze layer, which itself may be seasonally driven. We discuss the observational evidence and calculations in support of this correlation, which – if correct – would provide a perfect example of vertical coupling in Titan's atmosphere.