Titan's Detached Haze as a Test of Circulation and Microphysical Models

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Abstract

In 1981 Voyager ISS images showed a thin, high haze layer above Titan's main haze. Rages and Pollack (*Icarus* **55,** 50-62, 1983) measured the altitude of this so-called detached haze to be at 357 km at the equator and about 27 km lower in the high southern latitudes. In the Voyager images and later in the Cassini ISS images starting in 2004 the detached haze was observed to be present and continuous over all latitudes south of the northern polar vortex boundary, but in the Cassini images beginning in 2004 the altitude of the haze was significantly higher (just over 500 km) and more circular. West et al. (*Geophys. Res. Lett*., **38**, L06204, doi:10.1029/2011GL046843, 2011) tracked the altitude of the haze from 2004 to August of 2010, and found that the altitude dropped dramatically and most rapidly near equinox in 2009. More recent images taken in 2011 show the altitude to be the same, within a few km, as the altitude measured by Rages and Pollack almost 30 earth years and one Titan year earlier. Two very different models to explain the existence and properties of the detached were put forward prior to the observation of the altitude shift. One by Rannou et al. (*Nature* **418**, 853-856, 2002) produces the detached haze via a global meridional cell and includes seasonal variations. Another by Lavvas et al. (*Icarus*, **201**, 626–633, doi:10.1016/j.icarus.2009.01.004, 2009), produces the haze by a purely steady-state microphysical mechanism and must be coupled with a dynamical process to produce the evolution. The collapse of Titan's detached haze is most likely a feature of the breakdown of a global meridional cell in the high stratosphere at equinox as solar heating becomes symmetric, although the haze does not disappear with the change in altitude as predicted by the model of Rannou et al.. The detached haze, a scientific curiosity for almost 30 years, has become an incisive test for Titan circulation and haze microphysical models.

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