Modeling Survey of Ices in Titan's Stratosphere

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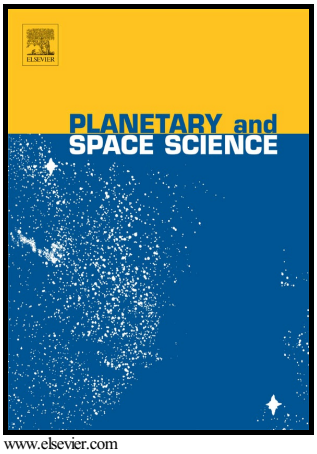

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Abstract

Processes in Titan's upper atmosphere, such as photochemical destruction of methane along with the destruction of nitrogen molecules from energetic electrons, result in the production of a number of hydrocarbon and nitrile compounds which are capable of condensing in the colder temperatures of Titan's mid to lower stratosphere. Stratospheric ices can contribute to the opacity of Titan's atmosphere as well as affect the chemistry of the more optically thick clouds seen in the troposphere, should they serve as condensation nuclei. We model the microphysics of a dozen trace species in Titan's atmosphere and show the resulting cloud properties. Clouds form and settle into layers between 50 and 80 km. Condensation timescales can be slow, with half the species only growing to a radius $\lesssim 1\mu$m. Ethane cloud particles grow the largest with radii up to 20μm. Factors such as the vapor pressure equation, nucleation rate, gas abundance, and temperature profile can have a significant effect on the appearance of the cloud particles. Though the data on optical constants is sparse for many of these ices, estimates show opacities of $10^{-5} - 10^{-3}$ for visible wavelengths.

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