The Radiative Stability of Titan's Atmosphere.

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Last year clouds were first imaged on Titan. They are exotic in that they reside solely at high southern latitudes, where summer prevails. Their recent discovery is unexpected because measurements of Titan's equatorial thermal profile at equinox (in the summer) by Voyager indicated no evidence for clouds.

The presence of clouds in Titan's atmosphere is not well understood because the moon's lower atmosphere is dimly lit (poorly powered) and slow to respond to daily and seasonal variations in sunlight. Titan thus lacks characteristics that facilitate cloud formation on Earth. Here I discuss an investigation of the stability of Titan's thermal profile to changes in atmospheric and surface composition, and seasonal forcing, aimed at understanding how clouds form in Titan's atmosphere. This study indicates that Titan's long radiative time constant (or slow response to radiative forcing) enables the formation of convective clouds to form in the summer poles, although not in the summer tropics, and not through noon heating, as occurs in Tucson. In addition, we find that the seasonal variations in insolation at Titan's surface, while insufficient at the tropics, are sufficient to instigate summer convection at high latitudes, as observed on Titan. Titan is thus similar to Earth in that the polar regions receive the lowest annual sunlight and the highest daily summer sunlight. Titan however differs from Earth in that the troposphere remains cool in the summer, while the surface heats up.

This summer surface heating of the cool polar atmosphere appears to be the cause of the clouds that have been witnessed, in the past year, to flower daily over Titan's summer south pole.