Titan Meteorology

Titan's methane clouds have received much attention since they were first discovered spectroscopically (Griffith et al. 1998). Titan's seasons evolve slowly, and there is growing evidence of a seasonal response in the regions of methane cloud formation (e.g. Rodriguez et al. 2009). A complete, three-dimensional view of Titan's clouds is possible through the determination of cloud-top heights from Cassini images (e.g., Ádámkovics et al. 2010). Even though Titan's surface is warmed by very little sunlight, we now know Titan's methane clouds are convective, evolving through tens of kilometers of altitude on timescales of hours to days with dynamics similar to clouds that appear on Earth (Porco et al. 2005). Cassini ISS has also shown evidence of rain storms on Titan that produce surface accumulation of methane (Turtle et al. 2009). Most recently, Cassini has revealed a 1000-km-scale, arrow-shaped cloud at the equator followed by changes that appear to be evidence of surface precipitation (Turtle et al. 2011b). Individual convective towers simulated with high fidelity indicate that surface convergence of methane humidity and dynamic lifting are required to trigger deep, precipitating convection (e.g. Barth & Rafkin 2010). The global expanses of these cloud outbursts, the evidence for surface precipitation, and the requirement of dynamic convergence and lifting at the surface to trigger deep convection motivate an analysis of storm formation in the context of Titan's global circulation.

I will review our current understanding of Titan's methane meteorology using Cassini and ground-based observations and, in particular, global circulation model simulations of Titan's methane cycle. When compared with cloud observations, our simulations indicate an essential role for planetary-scale atmospheric waves in organizing convective storms on large scales (Mitchell et al. 2011). I will end with predictions of Titan's weather during the upcoming northern hemisphere summer.