Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11497, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11497
EGU General Assembly 2008
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Microphysical Modeling of Titan's Convective Clouds

E.L. Barth and S.C.R. Rafkin
Southwest Research Institute, Boulder, CO

Microphysical processes influence the properties of clouds which can be viewed remotely, e.g. lifetime, cloud top altitude, and horizontal extent. Using the Titan Regional Atmospheric Modeling System (TRAMS), we are able to place constraints on parameters such as coalescence efficiency, critical saturation for nucleation, abundance of cloud condensation nuclei, and relative humidity of methane at the surface by comparing our cloud simulations with Cassini observations such as those reported by Griffith et al. 2005 (Science, 310, 474-477). We also find that these clouds can produce several centimeters of precipitation given an environment with more methane than was observed at the Huygens landing site. The cloud particles are composed predominantly of methane ice (with a possible ethane ice core) above 15 km and are both mixed phase (ice and liquid methane) and mixed composition (methane, nitrogen, and ethane) below. If methane ice particles fall through a subsaturated environment, the cooling effect of evaporation is sufficient to keep the particle frozen, such that about one third of the total precipitation reaching the surface remains ice. Ethane is much less volatile and so melts almost immediately upon reaching an environment warmer than the freezing point.