Geophysical Research Abstracts, Vol. 9, 09960, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09960

Coagulation and scavenging on tholin haze in the Titan atmosphere

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A self-consistent 1D microphysical model of Titan tholin haze, involving photochemical production, settling, eddy mixing, charging and Brownian coagulation, has been developed for the purpose of explaining data retrieved by various instruments during the descent of Huygens probe. The model simulates structural distribution size of tholin particles, i.e. the combined distribution in cluster size and monomer size, along with their charge distribution and electron and ion density of the surrounding medium. Electron density in the atmosphere is maintained at low level due to collisions with tholin particles and their subsequent charging. Simulations suggest that the break of density and particle sizes below 80 km observed by DISR spectral radiometer could be explained by the lack of mixing across a thin layer characterized by high static stability, where both vertical and horizontal air motion is suppressed. On the other hand, the observed flattening and shift of the linear polarization curve implies the increase of the effective monomer size, which may reflect the processes of capillary condensation within the nanopores of fractal aggregates. Besides nitrogen, a main component of the Titan atmosphere that passes critical temperature at the transition altitude, other minor constituents, including ethane and other hydrocarbons, may experience capillary condensation in tholin clusters as well, resulting in their low concentration in the troposphere.