Geophysical Research Abstracts, Vol. 7, 04597, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04597

Modelling the Atmospheric and Haze Vertical Structure of Titan using a Radiative/Convective - Photochemical - Microphysical Model

P. Lavvas (1), I.M. Vardavas (1,2), A. Coustenis (3) and I. Papamastorakis (1,2)

(1) Department of Physics, University of Crete, Greece, (2) Foundation of Research and Technology, Crete, Greece, (3) Paris Observatory, Meudon, France (lavvas@physics.uoc.gr)

Titan's vertical atmospheric temperature profile, atmospheric chemical composition and haze structure are controlled by many processes. In this work we present a self-consistent 1D simulation of radiation transfer, photochemistry and haze microphysics that determine Titan's atmosphere and haze. Our atmospheric model is and will be validated against observed data (geometric albedo, chemical composition, thermal structure, etc.) in order to understand better the physical processes that control: Titan's methane abundance; the production, structure and radiative properties of the haze; and the radiative properties of Titan's surface.

The Radiative/Convective - Photochemical Model presented during the 1st General Assembly (Lavvas et al., EGU04-A-02340; PS4.2-1TH3P-0641; p.280) simulates the coupling between the radiation transfer and the photochemistry in Titan's atmosphere, from the surface up to the lower thermosphere. It calculates the radiation field and the vertical thermal structure and uses them for the generation of the hydrocarbon and nitrile species following a detailed photochemical scheme. The production of haze monomers is directly coupled with the photochemically derived species through specific pathways. The procedure is iterative and time evolving so that it also describes the temporal evolution of the atmosphere.

The model now includes haze microphysics in which the haze monomers grow, following a Brownian coagulation scheme, to attain a spherical shape. The significant difference from previous microphysical models is that now both the monomer production rate and the distribution in the atmospheric layers are not arbitrarily set but determined by the photochemistry. There are in total, 35 size bins ranging from 13A (monomer size) up to $\sim$2.6 microns while larger sizes are prohibited due to the electrostatic repulsion between the haze particles, which is taken into consideration in our model. The microphysical model generates the vertical number density for each particle size. The optical properties for each monomer size are calculated using Mie theory and laboratory measurements of the refractive index. These are then used to calculate the atmospheric radiation field and temperature structure. In addition, the haze particles are used as seed nuclei for the condensation of hydrocarbons in the stratosphere of Titan, and this is used to explain the haze cut-off between the lower stratosphere and the upper troposhere, which is necessary to obtain an adequate match between model and observed geometric albedo for Titan.