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Radiative Modeling of the Atmosphere of Neptune

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Recent observations from Spitzer IRS spectra provide new constraints on the abundances of hydrocarbons in the atmosphere of Neptune (Meadows et al. 2007). A line-by-line radiative transfer model (Clough et al. 2005) is used to model the spectral radiance, heating and cooling rates in the middle atmosphere. We show that the radiative model is consistent with the molecular abundances of chemical species in the atmosphere, such as methane (CH4), ethane (C2H6), ethylene (C2H4), acetylene (C2H2) and diacetylene (C4H2) derived from an updated model based on that of Moses et al. (2005) and the Spitzer observations. A sensitivity study with respect to the changes of chemical species, energy sources and updated spectroscopic parameters (e.g., H2-H2 continuum modeling by Orton et al. 2007) will be presented. The quantitative modeling of the aforementioned well-known species is important for constraining the transport and chemistry of Neptune (e.g., transport time constant and abundance of CH4 at the tropopause). This will allow the exploration of the chemistry of less well-known species and aerosols. In particular, we will examine some of the outstanding problems in the atmosphere of Neptune, the sources and sinks of CO, HCN, C6H6 and aerosols (e.g., Lellouch et al. 2005).