Geophysical Research Abstracts
Vol. 13, EGU2011-1477-1, 2011
EGU General Assembly 2011

Microscale simulations of convective adjustment and mixing: Application to the Venus atmosphere

Masaru Yamamoto
Kyushu University, RIAM, Kasuga, Japan (yamakatu@riam.kyushu-u.ac.jp)

Heat, momentum and material transport processes caused by convective adjustment and mixing are important in modeling of Venus' atmosphere. Recently Yamamoto (2011, Icarus, in press) conducted microscale atmospheric simulations near the Venusian surface using the Weather Research and Forecasting model (WRF), in order to elucidate the thermal and material transport processes of convective adjustment and mixing. When convective adjustment occurs, the heat and passive tracer are rapidly mixed into the upper stable layer with convective penetration. The convective adjustment and mixing produce high eddy diffusion coefficients of heat and passive tracer, which may explain the large eddy diffusion coefficients estimated in previous radiative-convective equilibrium models. In the case that values of surface heat flux Qs is larger than a threshold, the convectively mixed layer with high eddy diffusion coefficients grows with time. In contrast, the mixed layer decays with time in the case of Qs smaller than the threshold. The thermal structure near the surface is controlled not only by radiative processes with extremely long time scales ($\sim$10,000 Earth days), but also by microscale dynamics with time scales of a few hours. A mixed layer with high eddy diffusion coefficients may be maintained or grow with time in the regions where the surface heat flux is high (e.g., the volcanic hotspot and adjacent areas).

In the present study, I applied the abovementioned microscale atmospheric model (Yamamoto 2011) to the dynamical processes in the unstable/neutral layer of the Venusian cloud (50-55 km), and investigated the eddy mixing and its effective eddy diffusivity. Maximum values of eddy fluxes of momentum, heat and passive tracer become larger with increasing the vertical negative gradient of the initial potential temperature (Γ) and the heat flux at the bottom of the lower cloud (Qb). In the unstable/neutral layer, the eddy diffusion coefficients of 10^3 m^2 s^{-1} are estimated for momentum, heat and passive tracer. In the cases that the vertical shear of the initial zonal wind is changed, although the flux magnitudes somewhat differ with those in the cases of the zero initial shear, the sensitivities to Γ and Qb are qualitatively similar to those in the cases of the zero initial shear. Such microscale modeling contributes to the numerical analyses of the balloon and radio science experiments and the improvements of the eddy diffusions in the aerosol and chemical models.