

Martian Atmospheric General Circulation Simulated by GCM: A Comparison with the Observational Data

Yoshiyuki O. Takahashi[1]; Masatsugu Odaka[2]; Yoshi-Yuki Hayashi[2]

[1] Graduate School of Science, Hokkaido University ; [2] Earth and Planetary Sci., Hokkaido Univ.

Characteristics of the general circulations simulated by our Mars GCM are compared with the observational data. Three simulations are performed under the conditions of Viking year, Mars Pathfinder (MPF) year, and the Mars Global Surveyor (MGS) year, respectively.

The Mars GCM used in this study is the spectral model based on the primitive equation system. As for the radiative processes, the effects of carbon dioxide and dust suspended in the atmosphere are considered. The vertical mixing is now evaluated by the method of Mellor and Yamada [1982]. A 13-layer soil model is introduced to evaluate the surface temperature accurately. Mass exchange between the atmosphere and the polar caps is incorporated. The resolution of model utilized in the present study is T21L40, which is equivalent to about 300 km grid size.

The distribution of dust opacity is given as an external condition because it is difficult to predict a realistic dust distribution in the model self-consistently. The vertical distribution of dust is given by following Conrath [1975]. In the Viking and MPF year simulations, we assume a horizontally uniform dust distribution with seasonal variation. In the MGS year simulation, we assume a zonally uniform dust distribution with a seasonally varying latitudinal profile determined from the Thermal Emission Spectrometer (TES) observation onboard the MGS.

The simulated seasonal variation of the daily mean surface pressure at the site of Viking lander and the position of polar cap boundary are quite close to that of observation. The meridional temperature distribution simulated by our GCM agrees well with the MGS-TES observation especially below about 20 km altitude. Above about 20 km altitude, however, the simulated temperature tends to be lower than the observed one by about 5 to 15 K. The amount of temperature difference is within the range of ambiguity of the vertical extent of dust profile. The temperature profile observed by the MPF is roughly reproduced by our GCM below about 30 km except for the temperature inversion. The amount of temperature difference above 30 km is comparable to those between the other GCMs and observation.