A Numerical Simulation of Mars Atmosphere General Circulation

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The Mars Global Surveyor (MGS) performed in situ observations of the Mars upper atmosphere during its aerobraking phase. These observational results show that the upper atmosphere of Mars is greatly affected by the lower atmosphere, as demonstrated by many other past spacecraft observations.

We have been developing a Mars atmosphere general circulation model to investigate the coupling processes between the lower atmosphere and the upper atmosphere. The model covers a wide altitude range from the surface to the thermosphere. We have developed a three dimensional atmosphere model in the altitude range of 0-80 km.

We will discuss about the temperature and wind fields, and the effects of the lower atmosphere to the upper atmosphere calculated by a three dimensional model.

The Mars Global Surveyor (MGS) performed in situ observations of the Mars upper atmosphere during its aerobraking phase to achieve circular orbit. These observational results show that the upper atmosphere of Mars is greatly affected by the lower atmosphere, as demonstrated by many other past spacecraft observations. The MGS observed some type of density variations. The density, temperature and wind velocity of the upper atmosphere are varied in two ways: (1) the expansion and contraction of the lower atmosphere due to heating and cooling, respectively, (2) various atmospheric waves such as tides, gravity waves, planetary waves, which are generated in the lower atmosphere, propagating upward and penetrating into the upper atmosphere. The several variations are intensified by the heating accompanied by dust storms which often occur in the lower atmosphere. The MGS observed a temporal response of the upper atmosphere to the regional dust storm.

We have been developing a Mars atmosphere general circulation model to investigate the coupling processes between the lower atmosphere and the upper atmosphere. The model covers a wide altitude range from the surface to the thermosphere. First, we developed a two dimensional lower atmosphere model in the altitude range of 0-40 km, and discussed about seasonal variations and energy balances of meridional circulation in the lower atmosphere. Next, we extended the model to a three dimensional model covering from the surface up to about 80 km. The three dimensional model can treat zonal variations and be used to examine the region around the lower boundary of the Mars upper atmosphere.

We will discuss about the temperature and wind fields, and the effects of the lower atmosphere to the upper atmosphere calculated by a three dimensional model.