Numerical simulation of global thermospheric flows using a high-resolution TGCM

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The thermosphere/ionosphere is the highest altitude region in the atmosphere and it is the boundary between the atmosphere and the space. The atmospheric density and pressure in this region are much lower than those of the lower atmosphere. The low density or pressure causes the long mean free paths of the air particles and this means that the molecular diffusion, heat conduction and viscosity are very important unlike the lower atmosphere. Furthermore, this region may be the upper limit for considering the fluid motion. It is thought that the characteristic of the dynamics in this region is quite different from other regions on the Earth.

Recent observations of thermosphere/ionosphere using radar and optical techniques enable us to estimate the spatial and temporal variations of the thermospheric flows. In addition to large scale flows, mesoscale phenomena, the relation between some phenomena, and the energy transfer from one region to another will be investigated in detail. In order to understand the complex system of the thermosphere/ionosphere, development of the methods for data analysis and numerical simulation are necessary.

We have developed and now are developing numerical codes for estimation of heating rates due to auroral particle precipitation, Joule heating, absorption of solar extreme ultra violet radiation, and one and three dimensional thermospheric models. In this study, we analyze the upper thermospheric flows using a three dimensional thermospheric model (thermospheric general circulation model: TGCM). The pressure coordinate system is used for investigation of both the large and meso scales of thermospheric circulation. The model has high resolutions of 2.5 degrees in horizontal and 0.5 scale height in vertical. In the previous calculation, we showed that the time scale to drive thermospheric winds with velocity of more than 100 m/s was about 30 minutes at 320 km altitude. The mechanisms for wind acceleration under several conditions will be investigated in this study. We will also mention about numerical schemes for calculation of the flows in the thermosphere/ionosphere.