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New General Circulation Model for the Venusian mesosphere and thermosphere.

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Retrograde zonal wind (RZW) as fast as 100 m/s exists in the Venusian mesosphere (70-110 km) and thermosphere (above 110 km), while super-rotation wind exists in the Venus cloud deck region (50-70km). The strength of the RZW is variable. For example, RZW was observed to be 132 m/s at about 100 km altitude in 1988 [Shah et al., 1991], while 25 m/s at about 105 km in 1986 [Goldstein et al., 1991]. The mechanisms of driving the RZW and its variability are unknown.

We have developed a General Circulation Model (GCM) for the Venusian mesosphere and thermosphere in order to investigate the above unknown problems. Our model is based on a Martian thermospheric GCM previously developed by our group. We have included the EUV heating, 15 um CO_2 cooling, and 1-5 um NIR heating processes in the GCM. The new heating and cooling codes are checked with the temperature and number density of an empirical model of the Venusian mesosphere and thermosphere (VTS3). The EUV heating rate, which is calculated with an EUV spectrum of the EUVAC model, shows a peak of about 4200 K/day at about 150 km altitude while the heating rate becomes about 0 K/day below about 130 km. The EUV heating rates at the solar zenith angles between 0 degrees and 80 degrees also show almost the same tendency. We use the parameterization by Gordiets et al. [1982] for the calculation of the 15 um cooling rate. The largest cooling rate is calculated to be 4300 K/day at 12:00 LT at about 145 km. The largest value at 09:00 LT is about 600 K/day at about 100km. These local time variations of the cooling rate depend on the temperature and number density of CO_2 and O. As for 1-5 um NIR heating rate, we use the simplified calculation method to avoid complex treatment of the non-local thermodynamic equilibrium (Non-LTE) effect. We multiply the heating efficiency, which is derived from the previous study considering the Non-LTE effect [Bougher et al., 1986], to our simple calculation with the same way as the EUV heating rate. The maximum value of 1200 K/day is obtained at about 130 km. The 15 um cooling and 1-5 um heating rates will balance at around 130km, while the 15 um cooling and EUV heating will balance at around 150 km. Above 150km, only the EUV heating is effective among those heating and cooling processes. Molecular heat conduction will balance with the EUV heating above 150 km.

In this study, we show some calculation results of the heating and cooling rates, and initial results of our GCM simulation.