

A development of a broadband radiative transfer model "Mstrn-Venus" for Venus atmosphere

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Venus has a dense atmosphere entirely covered by a thick cloud layer (ranging over 50 –70 km altitude). Due to the high opacity of the atmosphere, there is almost no remote-observational access to the lower atmosphere below the cloud. Past (only a few, though) in-situ measurements suggest that a convective layer appears 18 to 32 km, but the nature of such a thermal structure is still not understood clearly.

To better knowledge on the thermal structure (radiative transfer of the thermal flux), we developed a newly developed 1-D radiative transfer model “MSTRN-Venus”. The absorption coefficients of the molecular gases in the Venus atmosphere (CO_2 , H_2O , CO , SO_2 , HF , HCl , and OCS) are calculated in each 0.005cm^{-1} wavenumber, and correlated k-distribution are calculated and applied. The settings of radiative parameters for gas absorption and scattering processes are mainly based on Haus et al. [2015] for shortwave and Lee et al. [2016] for longwave region. The spectroscopic parameters such as the transition position and line strength are taken from the recent compilations of HITRAN 2012, HITEMP, and UCL08 catalogs. In addition, the collision-induced absorption of CO_2 is also included. We prepared the absorption coefficients under several pressure and temperature conditions within the ranges of 0.01 - 100 bar and 100 - 800 K, respectively. The results are kept in a look-up table of (p, T) domain so that we can interpolate the absorption coefficient for any pressure and temperature condition without repeating computational burdens. The sulfuric acid clouds, Rayleigh scattering, and UV unknown absorber are also considered. The upward and downward flux density is calculated for a given atmospheric profile using the MSTRN code. This code has been successfully applied in several studies of our terrestrial atmosphere, and also adopted as the radiation calculation module of several global circulation models.

The presentation will discuss the sensitivity of the radiative-convective temperature profile concerning the abundance of minor species, incoming solar heating, and cloud opacities.

Keywords: Venus, radiative transfer model