Takahashi, Y. O., Y.-Y. Hayashi, G. L. Hashimoto, K. Kuramoto, M. Ishiwatari, and H. Kashimura, 2024: Dependence of the radiative-convective equilibrium structure of the lower atmosphere of Venus on the thermodynamic model, *J. Meteor. Soc. Japan*, **102**, https://doi.org/10.2151/jmsj.2024-001.

Plain Language Summary: The effect of gas non-ideality has been one of the concerns in considering the structures under the high temperature and pressure condition of the lower atmosphere of Venus. The present study reveals that the one-dimensional radiative-convective equilibrium profile by the use of the ideal gas thermodynamic function actually produces significant differences from that of the real gas, about 7 K increase in the surface temperature even when temperature-dependence of specific heat is implemented.

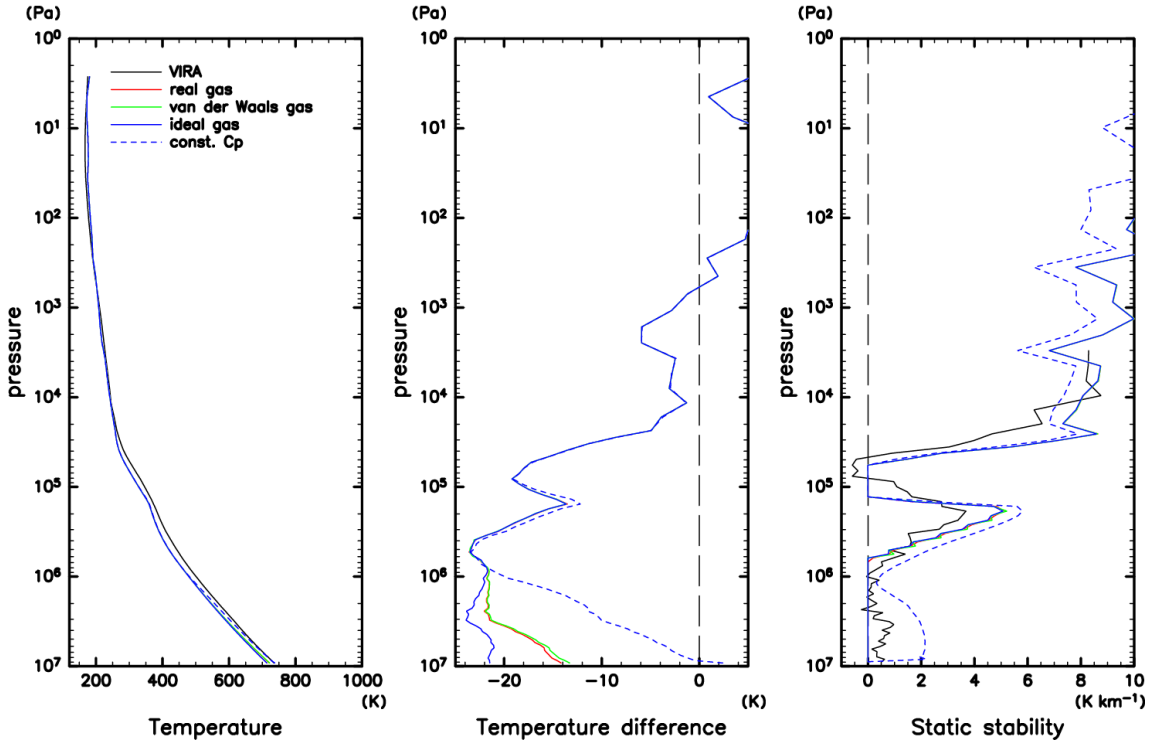

Figure 1. Radiative-convective equilibrium profiles of (a) temperature, (b) temperature difference from the Venus International Reference Atmosphere (VIRA) model, and (c) static stability calculated with thermodynamic models of real gas (red), van der Waals gas (green), and ideal gas (blue), respectively. The dashed blue lines are those calculated with a constant specific heat at constant pressure of 850 J K^{-1} kg^{-1}. The black lines are those for the VIRA model.

Highlights:

- The radiative-convective equilibrium profiles for the Venus lower atmosphere calculated with different thermodynamic models differ due to the difference in adiabatic lapse rate of the thermodynamic models.
- It is the difference in the thermal expansion coefficient between the real gas and the ideal gas that mainly causes the difference in the adiabatic lapse rate.
- It is confirmed that, in order to obtain better calculations of atmospheric circulations including the lower atmosphere of Venus, the ideal gas with a constant specific heat should be abandoned.
- A method to obtain better calculations of atmospheric circulation with the assumption of ideal gas is suggested.