# ADIABATIC LAPSE RATE AND STATIC STABILITY IN THE VENUS ATMOSPHERE

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The knowledge of adiabatic lapse rate is needed in investigating weather and climate on planets. For an ideal gas, this lapse rate ($g/C_p$) is generally assumed constant. On Venus, the range of temperatures and pressures and the thickness of this atmosphere make this assumption invalid. Staley [1] pointed out the need to use real gas equation of state to calculate the adiabatic lapse rate and calculated the adiabatic lapse rate across a range of pressures and temperatures that can be found in the atmosphere of Venus by assuming that the atmosphere is composed of pure carbon dioxide. Seiff et al. [2] assumed an ideal gas mixture of carbon dioxide and nitrogen in the ratio of 96.5:3.5 by mole number to calculate the adiabatic lapse rate under Venus conditions to interpret the Pioneer Venus entry probe profiles of temperature with altitude.

Static stability in the atmosphere influences small-scale turbulence caused by convection or wind shear, mesoscale motions and large-scale circulations. In order to calculate static stability accurately, we need to be able to calculate the adiabatic lapse rate in the atmosphere very accurately.

In this work, we calculate the adiabatic lapse rate more rigorously than previous calculations by considering the real gas effects of the binary mixture of carbon dioxide and nitrogen that largely make up the Venus atmosphere. By considering a thermodynamic model explicit in Helmholtz energy formulated in [3], we are able to predict the real gas mixture properties by using equations of state for pure carbon dioxide [4] and pure nitrogen [5]. This mixture model only depends on density, temperature, and composition of the mixture.

We consider the composition of the Venus atmosphere to be a binary mixture of carbon dioxide and nitrogen in the ratio of 96.5:3.5 by mole number. Data available in [6] and [7] contain pressure and temperature measurements for altitudes of 0-60 km and 55-100 km respectively. Our calculations show that there is an unstable layer below 10 km altitude and a slightly unstable to neutral layer between 50 and 55 km.

It should be possible to verify our calculations in the laboratory.

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