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Thermal Structure and Cloud Layer in the Venusian Atmosphere

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We draw a pseudo-adiabatic chart for the Venusian atmostphere, and calculate the cloud top for a given background temperature profile and a specified parcel temperature at the cloud bottom. The latter is uniquely determined by the sulfuric acid mixing ratio below the cloud bottom. The cloud top is quite sensitive to the background temperature profile assumed in each calculation. We consider that information on the top and bottom of the cloud layer can be used to estimate the temperature profile using this pseudo-adiabatic chart.

Venusian clouds are generated due to condensation of sulfuric-acid vapor in the carbon-dioxide atmosphere. They are distributed for a widealtitude range (45-75 km) almost all over the planet. The cloud generation process is governed by the thermal structrure, while the cloudsalso have a great influence on the thermal structure through albedo and greenhouse effect in the radiation processes. In this study we apply the cloud generation theories constructed for the earth's atmosphere to the Venusian clouds.

We draw a pseudo-adiabatic chart for the Venusian atmostphere, and plot a temperature profile of the background atmosphere and a point of LCL (lifting condensation level) on this chart. LCL corresponds to an air parcel at the cloud bottom, and has a temperature cooler than the background temperature. This parcel arrives at LCL from a lower level along a dry adiabat, and leaves from LCL upward along a moist adiabat. The intersection between the dry adiabat and the background temperature profile below LCL gives the initial level of the ascending parcel, and the two intersections between the moist adiabat and the profile are the level of free convection (LFC; lower one) and the cloud top.

If we specify the LCL pressure as a typical value at the cloud bottom altitude (45 km), the parcel temperature at LCL is determined uniquely by the mixing ratio of sulfuric acid below LCL. The initial level and the cloud top are also determined by intersections between the adiabats and background profile as mentioned above, and the results are quite sensitive to the background temperature profile assumed in each calculation. We consider that information on the top and bottom of the cloud layer can be used to estimate the temperature profile using this pseudo-adiabatic chart.