The thermal structure of Jupiter’s troposphere revealed by the Juno microwave radiometer

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The thermal structure of Jupiter’s troposphere has been elusive because Jupiter’s atmosphere is optically thick below 5 bars. During the last two years, the Juno microwave radiometer found that the thermal emission from Jupiter’s troposphere is warmer than what was expected from an idealized adiabat, a consequence previously attributed to the nonuniform distribution of ammonia gas. Here we examine a new explanation that the excessive brightness temperature is due to the superadiabatic temperature gradient near the water condensation level. As demonstrated by a two-dimensional cloud-resolving simulation of Jupiter’s atmosphere, the seemingly unstable temperature gradient is balanced by a negative gradient of the concentration of water vapor such that the density profile is still stably stratified. In addition, the mean profile of ammonia gas shows a depletion in the subcloud layer down to nearly 10 bars. These results are consistent with the Juno MWR observations.