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CH4 non-LTE and applications to Titan and early Earth

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Recent data from the Cassini mission provide new information on the upper mesosphere and lower thermosphere on Titan and provide much tighter constraints on the thermal structure than previously available. These observations will be interpreted with non-LTE calculations of the thermal structure. I will also discuss non-LTE effects on the retrieval of atmospheric temperature from remote sensing measurements. Recent studies of the production and escape of hydrogen on the early Earth have raised the possibility that, because of inefficient escape, the hydrogen mole fraction on early Earth may have been quite large. The efficiency of hydrogen escape depends quite sensitively on the thermal structure of the upper atmosphere. In particular, the thermospheric temperature depends on the radiative cooling rate in the lower thermosphere and the pressure of the mesopause. Both of these characteristics depend on non-LTE processes in the upper mesosphere and lower thermosphere. I will present non-LTE models for a variety of assumptions about the composition of the atmosphere of the early Earth and discuss how the thermal structure affects the escape rate and hydrogen abundance.