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The structure of Titan's troposphere and atmospheric boundary layer from Cassini radio occultations

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Radio occultations offer the only means of retrieving temperatures globally over most of Titan's troposphere. A comparison of tropospheric temperatures at low, mid, and high latitudes during northern winter shows a very small variation with latitude. The warmest temperatures occur at the lowest latitudes sounded (near 30° S), and temperatures at higher latitudes in both hemispheres are cooler. The sounding in the north-polar region (74° N) has the coldest temperatures, but at 40-50 km (the tropopause region) they are only 5 K cooler than those at low latitudes. Near the surface, temperatures are less than 3 K colder. At 30° S, the profiles near the surface lie close to the dry adiabat. This extends to a height of ∼2 km, much higher than reported from the Huygens HASI experiment, and more comparable to that reported from the Voyager occultation soundings. Just above the surface, however, a stable inversion with vertical extent ∼200 m is seen in the low-latitude profiles obtained near the morning terminator. Radiative cooling is much too weak to account for this, but a turbulent viscosity ∼1000 cm^2/s could. At higher latitudes in the north and south, the temperature profiles are noticeably more stable than dry adiabatic in the lowest few kilometers. At high northern latitudes, the profiles are isothermal or even form a stable inversion over this altitude range.