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Titan's emergence from winter

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We summarize the changes in Titan's thermal structure derived from Cassini CIRS and radio-occultation data during the transition from winter to early spring. Titan's surface, and middle atmosphere show noticeable seasonal change, whereas that in most of the troposphere is muted. This can be understood in terms of the relatively small radiative relaxation time in the middle atmosphere and much larger time scale in the troposphere. The surface exhibits seasonal change because the heat capacity in an annual skin depth is much smaller than that in the lowest scale height of the troposphere. Surface temperatures rise $\sim$1 K at mid and high latitudes in the winter northern hemisphere and cool in the southern hemisphere. Changes in in the middle atmosphere are more complicated. Temperatures in the middle stratosphere ($\sim$1 mbar) increase by a few kelvin at mid northern latitudes, but those at high latitudes first increase as that region moves out of winter shadow, and then decrease. This probably results from the combined effect of increased solar heating as the sun moves higher in the sky and the decreased adiabatic warming as the sinking motions associated with the cross-equatorial meridional cell weaken. Consistent with this interpretation, the warm temperatures observed higher up at the winter polar stratopause cool significantly.