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Spatio-temporal pattern of Saturn's equatorial oscillation

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Abstract

Recent ground-based and Cassini CIRS thermal-infrared data have characterized the spatial and temporal characteristics of an equatorial oscillation in the middle atmosphere of Saturn above the 100-mbar level. The CIRS data [1] indicated a pattern of warm and cold anomalies near the equator, stacked vertically in alternating fashion. The ground-based observations [2], although not having the altitude range or vertical resolution of the CIRS observations, covered several years and indicated an oscillation cycle of ~ 15 years, roughly half of Saturn's year. In Earth's middle atmosphere, both the quasi-biennial (~ 26 months) and semi-annual equatorial oscillations have been extensively observed and studied (see *e.g.*, [3]). These exhibit a pattern of alternating warmer and cooler zonal-mean temperatures with altitude, relative to those at subtropical latitudes. Consistent with the thermal wind equation, this is also associated with an alternating pattern of westerly and easterly zonal winds. Moreover, the pattern of winds and temperatures descends with time. Momentum deposition by damped vertically propagating waves is thought to play a key role in forcing both types of oscillation, and it can plausibly account for the descent. Here we report the direct observation of this descent in Saturn's equatorial atmosphere from Cassini radio occultation soundings in 2005 and 2009. The retrieved temperatures are consistent with a descent of $0.7 \times$ the pressure scale height. The descent rate is related to the magnitude of the wave forcing, radiative damping, and induced meridional circulations. We discuss possible implications.

References

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