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Global dynamics on Titan from the stratosphere to the thermosphere

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Abstract

To-date, winds on Titan have been observed in the stratosphere and troposphere, with no observational constraints available for regions above around 500 km. Calculations with the Titan Thermosphere General Circulation Model (TGCM) have shown the importance that horizontal and vertical thermospheric winds potentially play in distributing neutral gases in Titan's upper atmosphere, leading to horizontal variations in composition [1]. The TGCM studies also highlighted the importance of vertical coupling in Titan's atmosphere, making thermospheric winds above 1000 km sensitive to dynamics below [2]. Recently, studies of ionospheric density structures on Titan have indicated the potential importance of thermospheric neutral wind velocities for distributing ionized species [3]. To-date no self consistent calculations of dynamics from the stratosphere to thermosphere have been published. This paper presents first results of such calculations and investigates topics including (1) how can we constrain densities and temperatures across the "agnostosphere" region on Titan (500–1000 km) where few measurements are available? (2) how valid is the gradient wind equation in the stratosphere? (3) what role is gravity wave drag likely to play? (4) how do calculated variations in CH_4 mixing ratios in the thermosphere compare with Cassini INMS measurements? and (5) what are the typical neutral wind speeds in the thermosphere/ionosphere region on Titan? Our study uses a variant of our Titan TGCM with background atmospheric conditions (densities, temperatures) constrained in the stratosphere by Cassini-CIRS observations and in the thermosphere by Cassini INMS in situ measurements.

References

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