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# 3–Dimensional numerical simulations of the dynamics of the Venusian mesosphere and thermosphere

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## Abstract

We present the first results from a new 3–dimensional numerical simulation of the steady state dynamics of the Venusian mesosphere and thermosphere (60–300 km). We have adapted the dynamical core of the Titan thermosphere global circulation model (GCM) [1] to a steady state background atmosphere. Our background atmosphere is derived from a hydrostatic combination of the VTS3 [2] and Venus International Reference Atmosphere (VIRA) [3] empirical models, which are otherwise discontinuous at their 100 km interface. We use $4^{th}$ order polynomials to link the VTS3 and VIRA thermal profiles and employ hydrostatic balance to derive a consistent density profile. We also present comparisons of our background atmosphere to data from the ESA Venus Express Mission.

The thermal structure of the Venusian mesosphere is relatively well documented; however, direct measurements of wind speeds are limited. Venus' slow rotation results in a negligible Coriolis force. This suggests that the zonal circulation should arise from cyclostrophic balance; where the equatorward component of the centrifugal force balances poleward meridional pressure gradients [4]. The sparseness of direct and in-situ measurements has resulted in the application of cyclostrophic balance to measured thermal profiles to derive wind speeds [5] [6] [7] [8]. However, cyclostrophic balance is only strictly valid at mid latitudes ($\sim \pm$ 30–75°) and its applicability to the Venusian mesosphere has not been conclusively demonstrated. Our simulations, by solving the full Navier–Stokes momentum equation, will enable us assess the validity of cyclostrophic balance as a description of mesospheric dynamics.

This work is part of an ongoing project to develop the first GCM to encompass the atmosphere from the cloud tops into the thermosphere. When complete, this model will enable self-consistent calculations of the dynamics, energy and composition of the atmosphere. It will thus provide a framework to address many of the outstanding problems in Venus atmosphere science.

## References

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