Non-hydrostatic general circulation model of the Venus atmosphere

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We present the first results of the non-hydrostatic general circulation model of the Venus atmosphere based on comprehensive treatment of gas dynamics. Due to spatially uniform triangular mesh and the absence of limitations implied by hydrostatic approximation, the model provides higher accuracy in two major aspects of Venus atmospheric dynamics: vertical motion and mesoscale dynamical processes in the polar regions. Radiation block of the model is based on comprehensive treatment of the Venus atmosphere spectroscopy, including line mixing effects in CO_2 far wing absorption. Momentum equations are integrated using the semi-Lagrangian explicit scheme that provides high accuracy of mass and energy conservation. The model reliably reproduces zonal superrotation, smoothly extending far below the cloud layer, tidal patterns at the cloud level and above, and non-rotating, sun-synchronous global convective cell in the upper atmosphere. One of the most interesting features of the model is the development of the polar vortices resembling those observed by Venus Express' VIRTIS instrument. Initial analysis of the simulation results confirms the hypothesis that it is thermal tides that provides main driver for the superrotation.