Venus Atmospheric Circulation: Challenges in Observations and Understanding

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Since the discovery of the superrotation of the Venus atmosphere from ultraviolet photographs in early 1960s, Venera, Mariner, Pioneer, VeGa, Galileo Venus Express have provided additional details of the global circulation. Now Venus Climate Orbiter is poised to provide a unique view of the circulation from an equatorial perspective. With improvements in the computing power in the recent decades, numerical modeling of the Venus atmosphere to simulate its circulation has also shown advances.

There are still many aspects of the circulation that have not been adequately measured and those observed are not well understood. Two key processes expected to play a role in the maintenance of the super rotation are at and below the observed cloud top level are: (i) meridional transport of angular momentum by eddies and (ii) vertical transport of angular momentum by solar thermal tides. Yet the key measurements required to determine these quantitatively are not yet feasible. The winds can be inferred globally primariliy through cloud tracking but the tracking is possible on the day and night sides at different levels thus inhibiting a good estimate of the eddy components of the zonal and meridional winds. Similarly, the dynamical thermal tide has not been fully determined in terms of its diurnal and semidiurnal components even at the cloud top level.

Cyclostrophic balance is expected to be prominent in the Venus atmosphere, but the available thermal structure profiles of the deep atmosphere suggest some departures that are not well understood.

We will aim to discuss these issues and their implications for the required numerical studies to advance our understanding of the circulation of the Venus atmosphere.