Understanding the impact of waves on Venus' Upper Atmosphere through General Circulation Model Simulations

A. S. Brecht[1*], S. W. Bougher[2], E. Yiğit[3], and H.-L. Liu[4]

[1] NASA Ames Research Center, M/S 245-3, Moffett Field, CA, 94035, USA
[2]CLaSP, University of Michigan, 2418C Space Research Building, Ann Arbor, MI, 48109, USA
[3]George Mason University, Department of Physics and Astronomy, 4400 University Drive, Planetary Hall, Fairfax, VA, 22030, USA
[4]High Altitude Observatory, NCAR, Boulder, CO, 80301, USA

The upper atmosphere of Venus has been observed for many decades by multiple means of observations (e.g., ground-based, orbiters, probes, fly-by missions). The European Space Agency Venus Express (VEX) orbiter and more recently the Japanese mission, Akatsuki, have been providing illuminating observations of the Venusian atmosphere. From past and present observations there is evidence of wave activity contributing to Venus' atmospheric dynamics and variability. Systematic studies with theoretical models can help better understand the underlying physical processes.

The Venus Thermospheric General Circulation Model ((VTGCM), e.g. Brecht et al., 2011) has improved upon the already existing constraints by including more chemistry (OH nightglow, SOx, $[SO]_2$), modern energy budget calculations (near-IR and aerosol heating, NLTE 15-μm cooling), and wave specification and parameterizations (planetary-scale waves and small scale gravity waves).

The presented work will focus on VTGCM simulations and their comparisons with published observations in regards to wave-induced variability within the circulation and nightglow emissions. Small-scale gravity waves, incorporated into the VTGCM by a whole atmosphere gravity wave parameterization (Yiğit et al., 2008), along with specified internal waves (Kelvin and Rossby waves) impact the background atmosphere. The effects of these subgrid-scale waves and large-scale internal waves on atmospheric circulation will be discussed. The O_2 IR nightglow emission and the NO UV nightglow emission are great features to observe and help constrain circulation. The location (spatial and temporal), intensity, and variability of these emissions provide information (model constraints) on temperature, winds, and density. These emissions have been observed and their averaged behavior has been documented (Soret et al., 2012; Steipen et al., 2013). However, the emission variability (and the wave processes responsible) has not been studied in detail. The impacts the wave specification and parameterizations have on these emissions and their variability will also be presented.