MODELING TITAN'S STRATOSPHERIC SUPERROTATION AND TROPOSPHERIC METHANE CYCLE. C. E. Newman,[1] M. I. Richardson, [1] Y. Lian,[1] C. Lee, [1]Ashima Research, 600 S. Lake Ave., Suite 104, Pasadena, CA 91106, USA, claire@ashimaresearch.com.

Introduction: Original TitanWRF general circulation model simulations were unable to reproduce the observed extent of stratospheric superrotation, however recent TitanWRF simulations performed without sub-grid-scale horizontal diffusion of momentum produce roughly the observed amount of superrotation in Titan's stratosphere. We have also used this version of the model to repeat earlier experiments into Titan's tropospheric methane cycle, using an improved transport scheme, and these results also show an improved match to observations of the surface methane distribution.

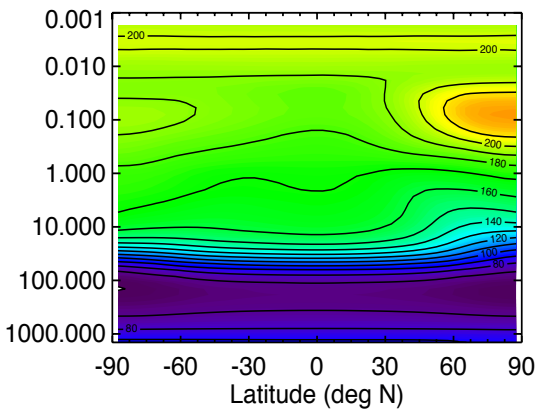

Figure 1 - Zonal-mean temperatures (K) for Ls ~293°-323° as a function of latitude (in deg N) and pressure (in mbar) as modeled by a spun-up year (Titan year 75) from the latest version of TitanWRF.

Stratospheric Results: We compare our stratospheric circulation results to Cassini-Huygens measurements of Titan's temperatures (Figure 1) and winds (Figure 2), and predict temperature and winds at future seasons. We also use angular momentum and transformed Eulerian mean diagnostics to show that equatorial superrotation is generated during episodic angular momentum 'transfer events' during model spin-up, and maintained by similar (yet shorter) events once the model has reached steady state. We suggest that these transfer events are produced by barotropic waves, generated at low latitudes then propagating poleward through a critical layer, thus accelerating low latitudes while decelerating the mid-to-high latitude jet in the late fall through early spring hemisphere. We also identify the dominant waves responsible for the transfers of angular momentum close to northern winter solstice during spin-up and at steady state.

Tropospheric methane cycle results: We also present simulations of the seasonal variation of methane clouds and precipitation, and show predictions of the evolving surface methane abundance using the TitanWRF model, which will be compared to the latitudinal distribution of lakes.

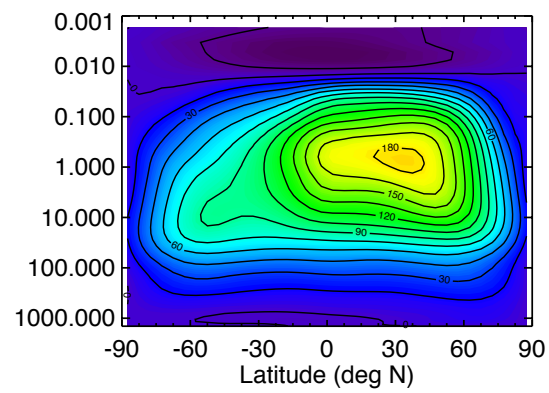

Figure 2 – As in Figure 1, but showing zonal-mean zonal winds (m/s).