**GRAVITY WAVES' INFLUENCE ON THE MIDDLE ATMOSPHERE: A COMPARISON BETWEEN MARS AND EARTH.** T. L. McDunn[1], S. W. Bougher[1], M. A. Mischna[2], and J. R. Murphy[3] [1]University of Michigan (2455 Hayward St., Ann Arbor, MI 48109, tmcdunn@umich.edu), [2]Jet Propulsion Laboratory, [3]New Mexico State University.

**Introduction:** When the impact of gravity wave momentum deposition on the middle atmosphere thermal structure was first considered for Mars [e.g., 1, 2], it's influence was overlooked due to a lack of sufficeint data to recognize it's impact. Using systematic observations from the Mars Climate Sounder (MCS) and numerical experiments with the Mars Weather Research and Forecasting (MarsWRF) general circulation model (GCM), we show that the forcing generated by gravity wave momentum deposition is not negligble for middle atmosphere dynamical warming at Mars as had been previously concluded. We compare previous findings for the influences of gravity waves on the middle atmosphere structure of Earth with these new results for Mars.

**MCS Dataset:**

MCS is a near-infrared radiometer that provides profiles of atmospheric temperature at Mars from the surface up to ~ 80 km altitude. Details of this dataset can be found in [3].

*Data Analysis Results*:

Polar warming (PW) is a dynamical feature of the Martian atmosphere that consists of a temperature enhancement over mid-to-high latitudes during winter, spring, and autumn. It produces a reversal of the meridional temperature gradient. This phenomenon is largely driven by the mean meridional overturning circulation [1, 2] and its intensification due to dust heating. Here we show a characterization of PW (e.g., Figure 1), based on 3 Martian years of MCS observations, that indicates that dust-heating intensification of the mean meridional circulation may not be the only driver of this phenomenon.

**MarsWRF Model:**

The Mars Weather Research and Forecasting (MarsWRF) model is a 3-D general circulation model that solves the fluid equations with a finite-differencing technique. It models the atmosphere from the surface to ~ 120 km altitude. Details of this model can be found in [4].

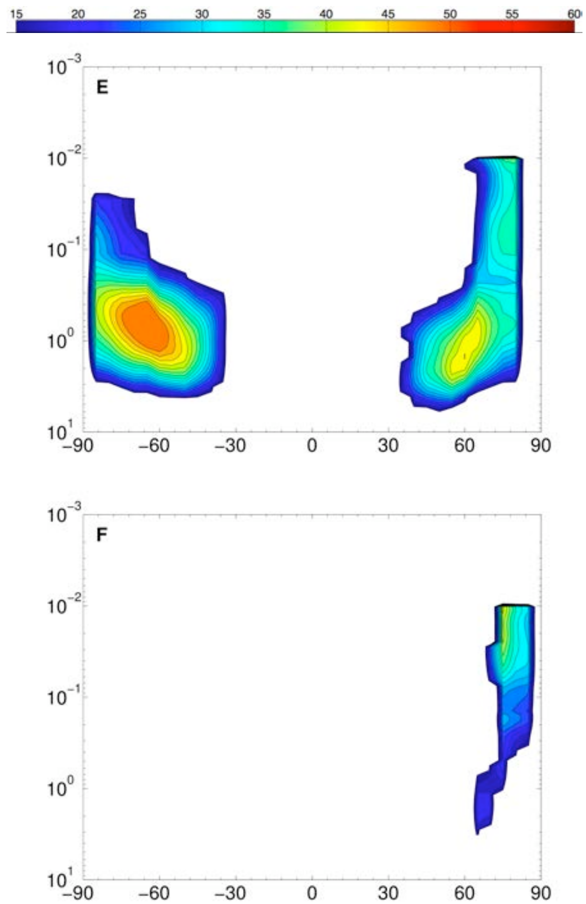


**Figure 1 Contours showing polar warming in the middle atmosphere of Mars as observed by MCS. The x-axis is latitude and the y-axis is pressure (in Pa). The top panel is for northern autumnal equinox and the bottom panel is for northern winter solstice. The colorbar applies to both panels and is in degrees K.**

*Modeling Results:*

Simulations from MarsWRF (e.g., Figure 2) indicate that the mean meridional circulation itself is not sufficient for generating the trends in dynamical polar warming observed by MCS. Simulations conducted with various dust prescriptions in the simulated lower atmosphere show that dust-heating intensification of the circulation is important for generating polar warming, but remains insufficient for generating the types of trends observed. We proceed to show modeling results that indicate that gravity wave momentum deposition influences the vertical structure and the magnitude of PW at Mars in ways not fully appreciated before these MCS observations were available.

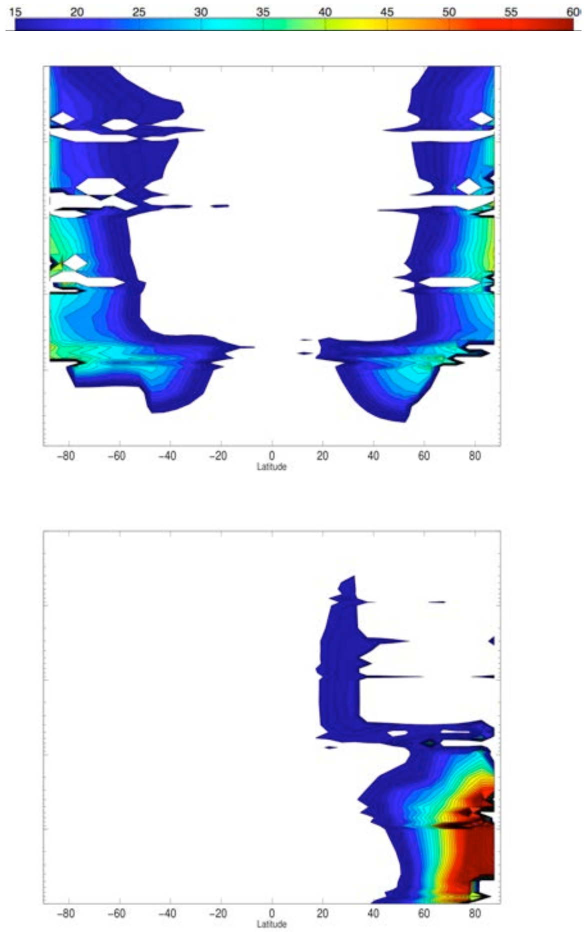


**Figure 2 As for Figure 1 except from simulations conducted with the MarsWRF GCM with dust heating effects included but without gravity wave momentum deposition.**

**Comparison between Earth and Mars:**

As discussed by [5], dynamical warming of the Earth's mesosphere has been linked to gravity wave momentum deposition. We explore similarities between gravity waves' influence on the thermal structure of the middle atmosphere of Earth with these new findings for Mars and consider what lessons we can learn from Earth atmospheric science and apply to Mars.

**References:** [1] Wilson, R. J. (1997) *GRL, 24,* 123–126. [2] Forget, F., et al. (1999) *JGR, 104,* 24,155-24,176. [3] Kleinböhl, A., et al. (2009) *JGR, 114,* E10006. [4] Richardson, M., et al (2007) *JGR, 112,* E09001. [5] Holton, J. R. (2004) *Elsevier Academic Press, 4th ed*.