ANALYZING SEASONAL FORCING MECHANISMS OF THE MARTIAN POLAR WARMING WITH THE NASA AMES MARS GLOBAL CLIMATE MODEL. A. S. Brecht[1], M. A. Kahre[1], A. Kling[2], R. J. Wilson[1], and J. L. Hollingsworth[1], [1]NASA Ames Research Center, Mail Code: 245-3, Moffett Field, CA 94035, USA (amanda.s.brecht@nasa.gov), [2]Bay Area Environmental Research Institute/NASA Ames Research Center, Mail Code: 245-3, Moffett Field, CA 94035, USA.

Introduction: The meridional transport of heat, momentum, water, dust, trace species and gases is critical for the control of Mars' climate. Though the nature and structure of the mean meridional circulation has been previously studied, questions remain regarding the seasonal forcing mechanisms, and the implications on the combined thermal and dynamical response for Mars' climate. A useful diagnostic of the mean meridional circulation and transport in the middle atmosphere is polar warming.

Polar warming is a dynamically induced phenomenon that results from the compressional heating of air in the descending branch of the Hadley cell. It is characterized by a reversed (poleward) meridional temperature gradient in the mid-to-high latitudes during winter, spring, and fall. Polar warming was first observed within temperature profiles derived from Mariner 9 IRIS spectra [1],[2]. Since Mariner 9, there have been many thermal observations which exhibit polar warming such as; Mars Global Surveyor (MGS) /TES [3]; Mars Odyssey aerobraking [4], [5], [6]; Mars Reconnaissance Orbiter (MRO) /MCS [7], [8], [9], [10], [11]; and Mars Express (Mex) /SPICAM [12]. The study by [11] utilized the MRO/MCS-derived atmospheric temperatures to characterize the magnitude, structure, and seasonality of the Martian polar warming. From this study, trends in the polar warming behavior were identified to suggest the need to further understand the complex mean meridional circulation.

Discussion: Observations along with numerical studies can help isolate and quantify the relative contribution and importance of various forcings. Previous numerical work has been done focusing on the contributions of water and dust and their radiative forcings, along with gravity waves, planetary (Rossby) waves, global thermal tides, and other large-scale eddies (e.g. [13], [14], [15], [16], [17], [18], [19], [20], [21], [22]). However, these studies were all focused on a single season. The type of systematic analysis of polar warming that was done by [11] with observations has not been done with a numerical model to understand the seasonal forcing mechanisms.

The presented work sets out to identify and quantify the seasonal forcing mechanisms of polar warming by utilizing the NASA Ames Mars Global Climate Model (MGCM), which is supported by the Agency's Mars Climate Modeling Center. The MGCM now employs the NOAA/GFDL cubed-sphere finite-volume dynamical core with the Legacy MGCM physics implemented as described in [23]. A "baseline" simulating will be compared to the [11] vertical cross-sections of MCS derived polar warming as shown in Figure 1. Then a series of numerical simulations will be conducted to analyze the contribution from clouds, gravity waves, and radiative effects. Understanding the seasonal forcing mechanism(s) of polar warming will help discern trends of other polar phenomenon (e.g. nightglow emissions) and further, controlling processes of the net mean meridional circulation.

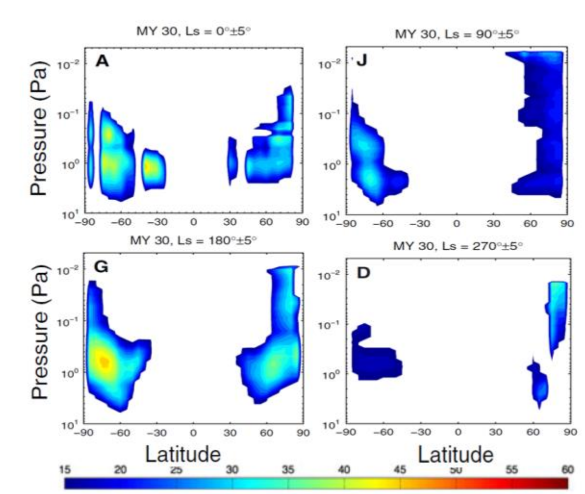

Figure 1: Vertical cross-sections of MCS derived polar warming at 10° -Ls intervals for MY 30 adopted from [11]. The color bar is in K with contours drawn every 2 K.

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