MARS' POLAR VORTICES AND THE 2018 GLOBAL DUST STORM. P. M. Streeter1, S. R. Lewis1, M. R. Patel1,2, J. A. Holmes1, 1School of Physical Sciences, The Open University, Walton Hall, Milton Keynes MK7 6AA, U.K. (paul.streeter@open.ac.uk), 2Space Science and Technology Department, Science and Technology Facilities Council, Rutherford Appleton Laboratory, Harwell Campus, Didcot, Oxfordshire OX11 0QX, U.K.

Abstract:

Suspended atmospheric dust aerosol is a crucial active component of Mars' atmosphere, with significant radiative-dynamical effects through its scattering and absorption of radiation [1]. The exact nature of these effects depends on a variety of factors: aerosol optical depth is important, as are the specific radiative properties of the aerosol particles [2,3], and the vertical distribution of the dust itself [4]. Mars Global Dust Storms (GDS) are spectacular, planet-spanning events which dramatically increase atmospheric dust loading. The 2018 GDS was observed through its lifecycle by the Mars Climate Sounder (MCS) instrument aboard the Mars Reconnaissance Orbiter [5]; using data assimilation [6] to integrate MCS retrievals [7] with the LMD-UK Mars Global Circulation Model (MGCM) [8] therefore offers an opportunity to examine the effects of the GDS on the polar vortices, and the interplay between the factors described above. The reanalysis contains the MGCM's best possible representation of the GDS geographical, temporal, and in particular vertical structure. Mars' winter atmosphere is characterized by a polar vortex of low temperatures around the winter pole, circumscribed by a strong westerly jet [e.g. 9]. These vortices are a key part of the atmospheric circulation and impact heavily on dust and volatile transport. In particular, they have a complex and asymmetrical (north/south) relationship with atmospheric dust loading [9]. Regional and global dust events have been shown to cause rapid vortex displacement [10,11] in the northern vortex, while the southern vortex appears more robust, preventing intra-vortex transport of dust [12]. Previous reanalysis studies of the polar vortices have used TES data [9,11]; MCS contains temperature profiles for higher in the atmosphere as well as dust vertical profiles, allowing for investigation of higher-altitude phenomena as well as the impact of the dust vertical distribution on polar dynamics. Crucially, MCS observations are not latitudinally restricted and fully cover the polar regions. In addition, the 2018 GDS dataset allows the opportunity for investigation of the effects of that specific event, the first fully observed by MCS. We present results from our reanalysis, and compare to free-running MGCMs, reanalyses of previous GDS events, and orbital datasets including MCS and the ExoMars Trace Gas Orbiter's NOMAD spectrometer [13]. In particular, we focus on the dynamics of the vortices themselves and cross-vortex dust transport.

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