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Northern Late Winter Planetary Waves: MRO/MARCI Observations and Mars Climate Model Simulations

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Abstract Text:

As does Earth, Mars presents pronounced global atmospheric circulation patterns. Solar differential heating drives mean meridional overturning (Hadley) circulations which are deep and intense, are hemispherically asymmetric, and where a cross-equatorial single cell dominates. Within middle and high latitudes, thermally indirect eddy-driven (Ferrel) circulation cells have been indicated. Differently, however, large-amplitude orography on planetary and continental scales on Mars can force very non-Earth-like hemispheric circulation patterns. Recent observations from the Mars Reconnaissance Orbiter, "Mars Color Imager" (MARCI) instrument are utilized that emphasize water ice clouds in ultra-violet (UV) wavelengths, and these measurements have been binned into "daily global maps" (DGMs) of water-ice cloud optical depth. The presence of large-scale, extratropical quasi-stationary atmospheric wave disturbances in middle and late winter of the northern hemisphere have been found to be present in such DGMs. In combination with such observations, a full-physics Mars global climate model (NASA ARC marsgcm 2.1) is applied to place the observations into context. During late northern winter, it is found that strong, forced Rossby modes (i.e., planetary waves) exist, and with direct correlation to column-integrated cloud opacity undulating spatial patterns. At this season, zonal wavenumber s = 2 dominates (in contrast to wavenumber s = 1), consistent with MGS/TES analyses at this particular season (Banfield et al., 2003). Large-scale, planetary waves dictate the "coherence" of the northern polar vortex. Fundamentally, such forced planetary waves influence the polar vortex's impermeability (wave-induced) to tracer transport (e.g., dust and water-ice aerosol) and temporal mean water vapor spatial variations. The large-scale dynamical features of such planetary waves will be highlighted and discussed.

Session Selection: Current Processes in the Atmosphere of Mars

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Scheduling Request: None, particularly; please schedule subject matter relatedly. Thanks!

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