The Coupled Mars Dust and Water Cycles: Understanding How Clouds Affect the Vertical Distribution and Meridional Transport of Dust and Water.

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The dust and water cycles are crucial to the current Martian climate, and they are coupled through cloud formation. Dust strongly impacts the thermal structure of the atmosphere and thus greatly affects atmospheric circulation, while clouds provide radiative forcing and control the hemispheric exchange of water through the modification of the vertical distributions of water and dust. Recent improvements in the quality and sophistication of both observations and climate models allow for a more comprehensive understanding of how the interaction between the dust and water cycles (through cloud formation) affects the dust and water cycles individually. We focus here on the effects of clouds on the vertical distribution of dust and water, and how those vertical distributions control the net meridional transport of water. For this study, we utilize observations of temperature, dust and water ice from the Mars Climate Sounder (MCS) on the Mars Reconnaissance Orbiter (MRO) combined with the NASA ARC Mars Global Climate Model (MGCM). We demonstrate that the magnitude and nature of the net meridional transport of water between the northern and southern hemispheres during NH summer is sensitive to the vertical structure of the simulated aphelion cloud belt. We further examine how clouds influence the atmospheric thermal structure and thus the vertical structure of the cloud belt. Our goal is to identify and understand the importance of radiative/dynamic feedbacks due to the physical processes involved with cloud formation and evolution on the current climate of Mars.