The South Residual CO_2 Cap on Mars: Investigations with a Mars Global Climate Model

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The CO_2 cycle is one of the three controlling climate cycles on Mars. One aspect of the CO_2 cycle that is not yet fully understood is the existence of a residual CO_2 ice cap that is offset from the south pole. Previous investigations suggest that the atmosphere could control the placement of the south residual cap (e.g., Colaprete et al., 2005). These investigations show that topographically forced stationary eddies in the south during southern hemisphere winter produce colder atmospheric temperatures and increased CO_2 snowfall over the hemisphere where the residual cap resides. Since precipitated CO_2 ice produces higher surface albedos than directly deposited CO_2 ice, it is plausible that CO_2 snowfall resulting from the zonally asymmetric atmospheric circulation produces surface ice albedos high enough to maintain a residual cap only in one hemisphere. Our current work builds on these initial investigations with a version of the NASA Ames Mars Global Climate Model (GCM) that includes a sophisticated CO_2 cloud microphysical scheme. Processes of cloud nucleation, growth, sedimentation, and radiative effects are accounted for. Simulated results thus far agree well with the Colaprete et al. study—the zonally asymmetric nature of the atmospheric circulation produces enhanced snowfall over the residual cap hemisphere throughout much of the winter season. However, the predicted snowfall patterns vary significantly with season throughout the cap growth and recession phases. We will present a detailed analysis of the seasonal evolution of the predicted atmospheric circulation and snowfall patterns to more fully evaluate the hypothesis that the atmosphere controls the placement of the south residual cap.