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Volume, Mass and Density of Mars' Season Polar Caps

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A re-analysis of altimetry and tracking data acquired by the Mars Global Surveyor (MGS) spacecraft has provide estimates of the volumes and masses of the season deposition at Mars' north and south poles. The new analysis of the MOLA altimeter data spanning slightly more than 1 Mars year has provided estimates of the volume at each pole as a function of solar longitude (Ls). These results suggest a major difference in the volume of material at the two poles with the north pole being larger than the south. Although the total depth of precipitation as a function of latitude appears comparable at both poles the total volume of the precipitation as a function of Ls is much larger in the north than the south. The mass derived from the perturbations of the orbit, and observed in the tracking data, shows a larger mass in the south than the north as predicted by General Circulation Models (GCMs) and observed by other instruments, such as the Gamma ray and Neutron instruments on the Odyssey spacecraft. A comparison of the masses and volumes indicates that the density of the seasonal CO2 in the south is larger than the north by a factor of at least 2. Further, the results suggest that the density in the south increases with time and reaches a maximum around Ls 180, the beginning of southern Spring. This would suggest than the form of precipitation compacts to something close to solid CO2, at least on parts of the cap. Our results suggest that during early spring the volume rapidly decreases concurrent with a steady drop in density. If the density drop is correct we believe this must be results of a complex melting or sublimation process that is non-uniform spatially and probably includes melting from below.