CO_2 FROST HALOS ON THE SOUTH POLAR RESIDUAL CAP OF MARS P. Becerra[1], S. Byrne[1], and A. J. Brown[2]. [1]Lunar and Planetary Laboratory, University of Arizona (becerra@lpl.arizona.edu) [2]SETI Institute.

Introduction: Imaging of the martian South Polar Residual Cap (SPRC) by HiRISE [1], and CTX [2] found that many of the scarps and pits within the CO_2 ice sometimes exhibit a bright "halo" around their edges (fig.1b,c). Investigating these halos will help constrain the mass balance of the SPRC, and contribute to an accurate description of the recent martian climate.

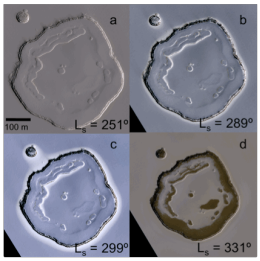

Figure 1. SPRC pit (~500m wide) at different seasons.

Observations: We examined ~200 CTX images, and ~600 HiRISE images of the SPRC, taken over three Mars years. We found halos only on images taken during Mars Year (MY) 28 in a specific season (Ls 280 – 330). This suggests that environmental interannual variability (e.g. the global dust storm of 2007) exists.

We measured the variation of brightness and width of the halos as a function of the orientation of the adjacent pit walls (fig. 2). The brightest parts of the halo appear adjacent to the sun-facing walls of the pit (270º, for the site shown), while the widest portions occur off of north-facing walls.

Our analysis of overlapping CRISM data revealed a uniform cover of CO_2 ice, ruling out spatial variations in dust, or water ice, as causes for the albedo difference seen by HiRISE.

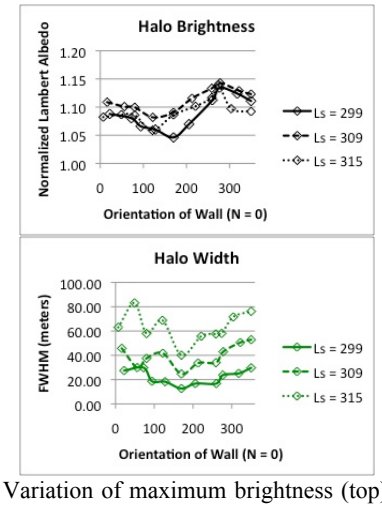

Figure 2. Variation of maximum brightness (top) and width (bottom) of halos with orientation of the pit walls

Model: Our hypothesis (fig.3) is that there is condensation, or slower sublimation of CO_2 ice occurring in areas close to the walls of the scarps. This is caused by a rise in the partial pressure of CO_2 gas in the local atmosphere, due to a faster sublimation rate from the sloped walls that receive sunlight at lower incidence angles. This effect is diminished far from the walls, by the diffusion and dilution of the excess CO_2 into the surrounding atmosphere.

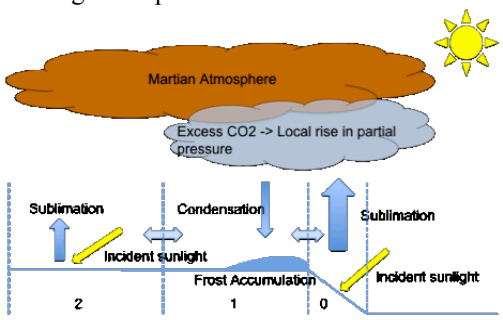

Figure 3. Schematic of the model. Model surfaces/cells labels: 0-slope, 1-adjacent, 2-distant.

If less ice is ablated from a surface adjacent to the walls than from a distant one, then the former would expose younger, smaller-grained, and brighter ice, creating a halo. Our model suggests that the surface 1 to surface 2 difference in ablation is at most several microns. It is unknown how thick the brighter material needs to be for it to be visible to HiRISE; however, some experimental work has hinted that perhaps only a very small difference in accumulated frost is needed to produce an observable brightness difference [3].

Preliminary Conclusions: (a) The halos are composed of fine-grained CO_2 and are not compositionally different than their surroundings. (b) Interannual variability exists in the mass balance of the SPRC (c) The seasonal occurrence of the halos is connected to the increased sublimation rate from adjacent slopes.

References: [1] McEwen et al. *JGR* 112, E05S02 (2007) [2] Malin et al., *JGR* 112, E05S204 (2007) [3] Murchie et al., *JGR* 112, E05S203 (2007) [3] Portyankina, G., 5th Mars Polar Science and Exploration Conf., Abs. # 6021 (2011)