EFFECT OF ATMOSPHERIC DUST ON INTERANNUAL VARIABILITY IN THE MARTIAN SOUTH POLAR CAP. P.B. James[1] and B.P. Bonev[2], [1]Space Science Institute, 4750 Walnut St,. Boulder, CO 80301, pjames@cableone.net; [2]Dept. Physics, Catholic U. of America, Washington, DC 20064

Mars Observer Camera (MOC) observations from Mars Global surveyor (MGS) revealed that the Residual South Polar Cap (RSPC) consists of several units that show evidence of deposition and erosion with characteristic times on the order of ~ 100 years [1]. These authors suggested that significant changes observed in the RSPC between MY 9, when Mariner 9 observed the cap,, and MY 12, observed by Viking, represent deposition of a new CO2 layer following erosion of a previous layer(s) by unidentified processes (Figure 1).

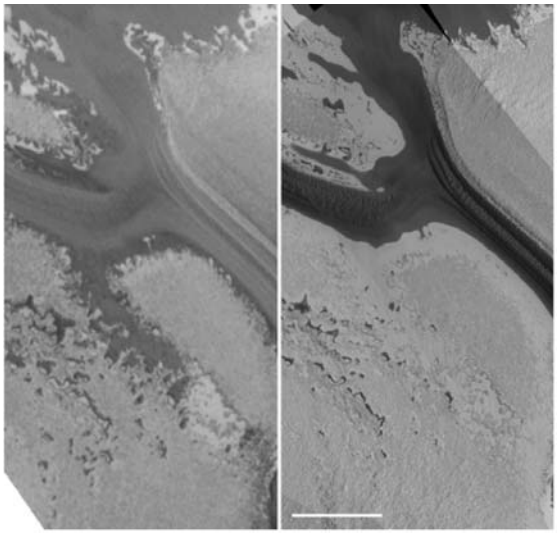

Figure 1: MY9 (M9 B frame) and MY28 (CTX) views of the "fork" region in the RSPC. Most of new deposits were in place byViking.

One possibility is that a layer eroded gradually due to growth of pits in the RSPC surface observed by MGS [2,3]. However, the changes in the small-scale structures over the four MGS years were not accompanied by changes of either the albedo [4] or surface area [5] of the residual cap. Thus the current expansion of the pits does not unambiguously result in any net sublimation of the cap as would be required to remove a layer.

Another mechanism that could possibly remove a layer is a change in absorbed insolation caused by redistribution of incident flux in wavelength due to interannual variability in the dust content of the atmosphere in late spring. This mechanism accounted for small observed interannual variations in features in the seasonal south polar cap [6]. This prompted the conjecture that a major perihelic dust storm, such as the events observed in MY1, MY9, and MY 12, could accelerate cap sublimation to the extent that an entire CO2 layer in the RSPC [7] could be removed.

Mars Reconnaissance Orbiter (MRO) observed a large perihelic dust event in MY28 that partially obscured the south polar cap and subsequently observed the RSPC for the entire summer of MY28. Comparison of the MY 28 observations to those in MY26 show significant changes in an outlier that is the last seasonal feature to disappear (Figure 2).

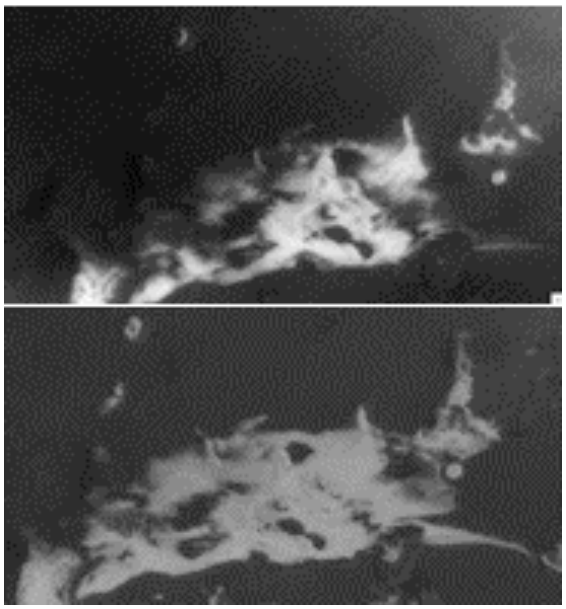

Figure 2: RSPC outlier in MY 28 (MARCI) and MY 26 (MOC).

This outlier feature is classified as seasonal since the frost entirely shrank to a narrow remnant in almost every year that it was observed so that it must be redeposited during the succeeding winter. However, Mariner 9 observations of this outlier in MY 9 showed that it was already in its remnant form in early summer and completely gone at the end of summer. Since the feature is seasonal ice, either the CO2 deposition in the winter of MY 9 is reduced significantly by some unconstrained mechanism or summer sublimation is significantly enhanced in late spring / early summer. The much smaller acceleration of sublimation of the outlier seen in the MY 28/ MY 26 comparison suggests that, if the different outlier behaviors are attributed to dusty

atmospheres, the MY 28 storm is less intense than that in MY 9.

We investigated the effects of perihelic dust storms on the RSPC in [7]. We adopted conservative storm parameters: an initial optical depth of 2.0 and a decay time of 22° in Ls units. The modeled storm increases CO2 sublimation by between 40 and 110 kg/m^2, depending on the surface frost model (amount of dust and water contamination) adopted. Although this is more than ample to produce the changes seen in the outlier in MY 28, for a CO2 density of 700 kg/m3 this would be only 6 – 16 cm of frost, which is much less than the thickness of a layer in the RSPC. Indeed, the MY 28 storm did not result in any significant changes to the late summer RSPC, consistent with this conclusion.

Comparison of outlier changes between Mariner 9 and Viking on the one hand and between MY 26 and 28 on the other, requires the MY 9 storm to be much more intense than that in MY 28 if the dust scenario is to explain the eroded M9 cap. We have therefore extended the range of dust storm models used to address the question of the upper limit to the amount of CO2 that can be removed by a dust storm in order to see it this mechanism is able to account for the Mariner 9 observations of the outlier and residual ice in the RSPC.

This work was funded by MDAP Grant No. NNG05GQ40G.

References: [1] Thomas, P.C. et al.. (2005) *Icarus* **174**, 535-559. [2] Thomas, P.C. et al.(2000) *Nature* **404**, 161-164). [3] Malin, M. C. et al., (2001) *Science* **294**, 2146-2148. [4] James, P.B. et al. (2007) *Icarus* **192**, 318-326. [5] Piqueux, S. and Christensen, P.R. (2008) JGRE 113, E02006. [6] Bonev, B.P. et al. (2002) GRL 29, doi:10.1029/2002GL015458. [7] Bonev, B.P. et al. (2008). P&SS 56,181-193.

.