Mars North Polar Cap Recession and Summer Variation: Five Mars Years of MARCI Observations. W. M. Calvin\(^1\), B. C. Cantor\(^2\), and P. B. James\(^3\), \(^1\)Dept. Geological Sci., University of Nevada, MS 172, Reno, NV 89557 (wcalvin@unr.edu), \(^2\)Malin Space Systems, San Diego, CA, \(^3\)Planetary Science Institute, Prescott, AZ.

**Introduction:** The annual condensation and sublimation of roughly 25% of the atmosphere onto the pole that is in winter drives the Martian climate. This seasonal advance and retreat has been monitored from a variety of spacecraft and instruments, including Viking, MGS, Mars Express, and MRO [1-7]. The retreat of the north seasonal cap is generally symmetric about the geographic pole, with a very repeatable pattern of the latitude of the cap edge with Ls [3,6,7]. However, dust storms have some impact on the altitude of the cap edge with Ls [3,6,7].

**Major Features from Past Observations:** We have previously reported on the north cap retreat as observed by MARCI in MY 29-31 [6,7]. That work identified several common and repeatable albedo trends. First the albedo pattern of the residual ice and surrounding dark dune field are apparent through the seasonal frost cover, even at the earliest stages of retreat. The seasonal frost retreats with latitude and then with elevation, leaving the areas of Gemini Scopuli, the lower elevations of Gemina Lingula, Rupes Tenius, and Abalos Mensa dark, and reaching a minimum of bright deposits by Ls 95. Subsequently, these areas again brighten, reaching a maximum exposure of ice (under clear skies) near Ls 135, just prior to the onset of polar hood formation. Cantor et al. [6] suggested the brightening could be caused either by deposition of new frost or removal of a dust lag, and Calvin et al. [7] favored the dust lag removal mechanism due to the wide range of elevations and orientations where bright deposits reappear. Brown et al. [9] used CRISM data to argue for new frost deposition on the residual ice dome after ~Ls 140.

**New Observations:** We now have an additional two Mars Years of MARCI observations. Calculation of the optical edge of the retreating seasonal cap is underway and will be synthesized with previous measurements. Of note in MY33, a late stage ice deposit near lat 78N, long 40E retreats slowly until ~Ls 85, and leaves behind a bright dust deposit on the otherwise dark dune material in a region where extensive bright deposits are not observed in any other MY (Figure 1). This dust deposit is eventually eroded, by Ls 160, lending observational support in a nearby region to the hypothesis that large scale brightening on the residual ice dome after Ls 95 is caused by removal of a dust lag.

Figure 2 shows the residual ice deposits near ~Ls 130 in each MY from 28-33. Of note is that the albedo pattern on Olympia Planum is highly variable in each MY, and much of the region remains obscured by a dust lag in both MY 32 and 33, in contrast to prior years. This region does again brighten after Ls 155, however it is difficult to discern in MARCI imagery if this is due to deposition of new seasonal frost or late stage removal of dust lags. A large section of the Gemini Scopuli region remains dust covered in MY 32, unlike most other years.

Abalos Mensa was shown to reach a minimum extent of the bright deposits in MY 30, followed by large exposures in MY31 [7]. In both MY 32 and 33, this small mound at the margin of the polar dome continues to have large exposures of ice, most similar to MY 24 in extent. Nearby, the Rupes Tenius is also dark in MY 30 and 31, again brightening in MY 32 and 33.

Movies of daily images show that the Gemini Scopuli region continues to brighten in localized areas after Ls 117, and the patterns vary from year to year (Figure 2). Large interannual variability suggest the interplay between surface dust deposits and local weather and storms, and dust removal is often seen to link to dust clouds over small areas.

Late (up to Ls 85) seasonal frost covering the Olympia Undae area where gypsum has been identified was noted in MY29 [6]. Frost patterns over Olympia Undae near the summer solstice vary a great deal between Mars Years, but no year has the large extent seen in MY29.

**Future Work:** Long observation of the seasonal cap retreat by MARCI will allow us to construct an average or climate model for the optical boundary of the retreating seasonal cap. We plan to explore separation of water and carbon dioxide ices using properties in all of MARCI’s color filters.

Figure 1 (left): In MY 33 late frost leaves a bright dust lag on a dark area of the circumpolar dunes (arrows, Ls 78 and 116) that is eventually removed. MY 29 (lowest image) shows the typical appearance of this region in other MY. This observation supports the hypothesis that brightening of the residual ice dome after Ls 95 is related to dust removal rather than new frost deposition.

Figure 2 (above): Appearance of the north residual ice dome in each of the six years observed by MARCI. Ls ranges from 129 to 133 as noted on the image. This Ls was chosen as the most clear image showing the maximum extent of ice deposits prior to the onset of significant cloud (both dust and ice) activity. Also, MRO did not begin systematic mapping until November of 2006. Arrows call out the maximum ice exposures on Olympia Planum (MY30), and at the end of Gemini Lingula (MY33), and the minimum exposure on Gemini Scopuli (MY32).