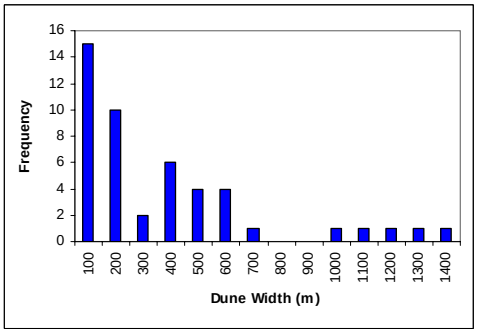
STUDIES OF DUNE CHANGE ON MARS COMBINING MOC AND HIRISE IMAGES. M. C. Bourke[1], A. Philippoff[1] and N. Bridges[2]. [1]Planetary Science Institute, 1700 E Ft. Lowell, #106, Tucson, Arizona 85719, USA, mbourke@psi.edu [2]Jet Propulsion Laboratory, MS 183-501, 4800 Oak Grove Dr., Pasadena, CA 91109.

Introduction: Recent observations from a series of Mars Orbiter Camera (MOC) images targeted at a location in the circumpolar sand seas (76.2°N, 95.3°E) found that two 20 m wide dome dunes disappeared and a third reduced its volume by 15% over 3.04 Mars years [1]. Here we report on the findings of an extended dune monitoring campaign at this location. The study was undertaken in order to 1) use higher resolution High Resolution Imaging Science Experiment (HiRISE) images to confirm the disappearance of the two dome dunes and 2) to extend the study area to include other dunes of similar scale, larger dunes and dunes of different form.

Methods: We used eight MOC and three HiRISE images in our dune monitoring study. These provide repeat cover over our target area. We monitored 43 additional dunes in a 450 km^2 area between March 10th 1999 and August 24th 2008, a period of 5.1 Mars years. Dune width and length were measured at each time step for dunes that fell within the image swath. Observations of dune morphology and surface characteristics were made in the highest resolution images.

The dune types examined included dome (16%), elongated dome (7%), modified dome (two slip faces, 2%), proto-barchan (23%), barchan (40%) and megabarchan (12%). The mean width of newly sampled dunes was 333 m with a range between 29 m and 1,362m (Fig.1). The majority of the dunes (66%) are slim or normal in planform (*sensu* [2]), similar to data for other locations in the North Polar region [3].

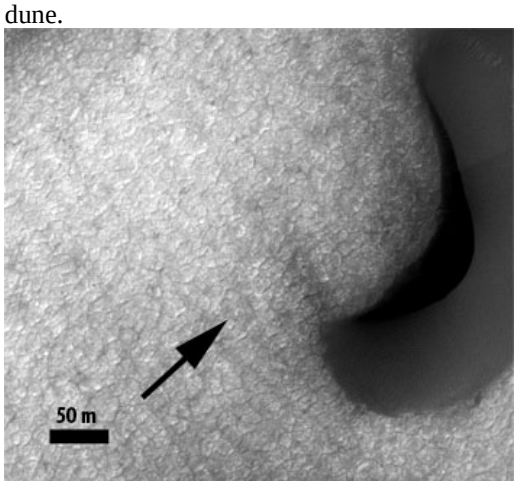
Figure 1: Dimensions of dunes included in the survey of dune change.



Findings: 1) HiRISE images confirm that the two dome dunes reported to have disappeared in MOC images [1] have been completely eroded (Fig 2). No remnant of the dunes remains at either location.

2) We have detected a third example of a dome dune in the North Polar region of Mars that reduced in size and then disappeared (Fig. 3). This dune was first detected in a MOC image taken March 10th, 1999 and again captured at a reduced size in a MOC image taken December 10th 2002. It was not apparent in the next MOC image of that location, Feb 17th 2006. When first noted, the dune had a slightly larger dimension (29 m wide) than the two other dunes that have been documented to disappear [1].

Figure 2: Confirmation of the complete erosion of dune i, detected using MOC images [1]. HiRISE PSP_009743_2565. Arrow indicates former location of 20 m wide dome dune.



3) The dimension of a third dune that was reported to have been reduced by 15% has not changed during the extended survey period (2 Mars years).

4) No other dunes display significant change within the confidence limits of our data.

Discussion: Estimated rates of sand transport at this North Polar location fall between 0.12 and 0.21 m^3/sol Table 1. These are similar to rates reported for dome dunes on Earth [1] although more data on dome dunes is required for Earth and Mars.

Observations of change in sand deposits at Meridiani and Gusev Crater [e.g. 4, 5] along with those presented here suggest that sand is mobile at a variety of locations across Mars. However the frequency of these observations so far, is low and the

magnitude of change also appears low. It is likely that dune change is limited to specific high energy wind events (dust and sand storms). This suggests that the potential for detection of bedform change in satellite images is best conducted at locations where there is a higher frequency of significant atmospheric events.

Whereas it is not expected that the larger dunes would show significant change in their volume, surface features indicate recent, small scale sediment transport. These features include i) fresh grain flows on avalanche faces that overlie ripples and ii) sand streamers that extend from both barchan arms and the main dune body.

Features that indicate dune quiescence include i) surface cracks (suggesting crusting) and ii) ripples that show no change between observations.

Similar to previous reports of dune erosion at this location, dune #22 has a domal form. Sand streaks extend in two directions downwind from dune #22 (Fig. 3a and b) suggesting multi-directional, sand-transporting winds. Dome dunes are known to be susceptible to erosion by multi-directional high velocity winds.

A significant volatile content (ice) within aeolian dunes may also play a role in rates of dune erosion on Mars. Further studies will continue monitoring for dune change and cataloging surface features that suggest niveo-aeolian deposits.

Conclusions: A new example of a dune that decreased in size and then disappeared is shown. Small-scale dome dunes on Mars (i.e. < 30 m wide) appear to be the most likely to display significant change in their dimensions over short time periods on Mars.

Larger dunes show no significant change in dimension over our study period. Some have surface features that suggest active sand transport, while others in the same dune field have features indicative of crust formation.

Dune change on Mars occurs infrequently and is likely linked to high energy atmospheric events.

Dune	Volume (m^3)	Bulk Volume (tones)	Sand transport rate (m^3/sol)
1	210	462	0.18
2	284	528	0.12
22	509	1119	0.21

Table 1 : Volumes and rates of sand movement on Mars. Rates for dune 1 and 2 from Bourke et al [1]. Dune height is estimated, not measured.

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Figure 3: New observations of dune change on Mars. a) Dune #22 first noted in MOC image FHA-00515 (3/10/1999). b) Apparent again, but smaller, in MOC E23-00490 (12/10/2002). Not evident in MOC S15-01703 (02/17/2006). c) Confirmed disappearance in high resolution image HiRISE PSP_009743_2565 (08/24/2008).