MARS: DUST DEVIL TRACKS IN HELLAS BASIN AND ARGYRE PLANITIA. P.L. Whelley[1], M.R. Balme[1], R. Greeley[1], [1]Arizona State University, Dept. Geological Sciences, Box 871404, Tempe, AZ, 85287-1404, Tel. 480-965-7029, pwhelley@asu.edu.

Introduction: Dust devils on Mars could be an important mechanism for delivery of dust into the Martian atmosphere. Suspended dust in the Martian atmosphere is observed to be ~1-2µm in diameter [1,2,3] and calculations of fall-out rate [4,5] imply an ongoing supply of this fine dust to the atmosphere. Laboratory wind tunnel experiments [6,7], however, suggest that entrainment of fine dust into the atmosphere requires surface wind speeds exceeding those measured on Mars. Recent experiments using a laboratory scale vortex generator at low-pressure [8,9] suggest that vortex action (i.e. a dust devil) is more efficient at lifting fine dust than boundary layer winds. Coupled with the many observations of dust devils on Mars [10], these experiments suggest that dust devils are an important contributor to the global dust budget and hence to the global climate.

Characterizing the temporal and spatial distribution of dust devil activity on Mars is therefore essential for generating accurate climate models. However, the transient nature of dust devils, the limited spatial coverage of the high resolution images required to actually resolve them, and restricted viewing times of the Mars Orbiter Camera (MOC) makes their detection serendipitous. Several studies have attempted to measure the frequency of active dust devils using both Wide Angle [11] and Narrow Angle (NA) [12] MOC images but, for the reasons given above, they can only sample a small fraction of dust devil activity. However, the passage of dust devils over the surface can leave a surface track that remains visible on the surface for orders of magnitude longer than the dust devil that produced them (fig. 1). Here we investigate the distribution of these dust devil tracks in two study areas: Argyre Planitia (20° to 50°W; –50° to -30°S) and Hellas Basin (250° to 320°W; –50° to -15°S).

Approach: The study areas were chosen because they a) display a variety of geomorphic units, b) cover a range of elevations, c) are at similar latitudes for seasonal comparisons, and d) contain a reasonable percentage of images with visible tracks.

We searched all MOC NA images with resolution 5m/pixel or better from the CAL to E12 phases (March 1999 to February 2002) of the Mars Global Surveyor mission for dust devil tracks. The number of tracks in each image was estimated and then normalized by the surface area of the NA strip to estimate the density of tracks per square km. In total, we searched 637 images in Argyre and 2037 in Hellas.

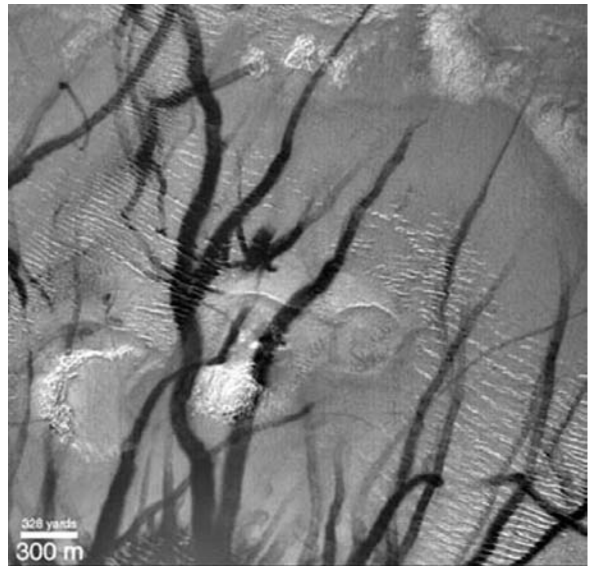

Figure 1. Martian dust devil tracks. (NASA image PIA 02376, Malin Space Science Systems).

Results and conclusions: Fig. 2 shows mean areal dust devil track density plotted against Martian season (L_s) for both study areas. Fig 3 shows mean areal track density plotted against elevation of the center-point of the images.

Laboratory experiments [9] suggest that small changes in surface pressure (as would occur between regions of different elevation) might influence the efficiency of dust devil particle entrainment. Hellas does indeed show greater track abundance at lower altitudes, except for the very lowest regions. In Argyre most tracks are found around the datum and no clear conclusion on the influence of elevation on track formation can be drawn.

In contrast, the occurrence of dust devil tracks clearly depends on Martian season and is greatest in spring/summer when insolation is at its peak. Fig 2. also reveals differences between the two study areas: 1) "summer" dust devil activity starts earlier and continues longer in Argyre; 2) Almost all dust devil activity ceases in mid fall in Argyre whereas in Hellas, dust devil tracks are still visible until the onset of winter. This behavior suggests that dust devil tracks form preferentially in Argyre but are covered/erased more quickly than in Hellas. This change could reflect differences in availability of fine materials for dust devils to pick up (and later to cover their tracks) or differences in seasonal weather patterns between the two study areas.

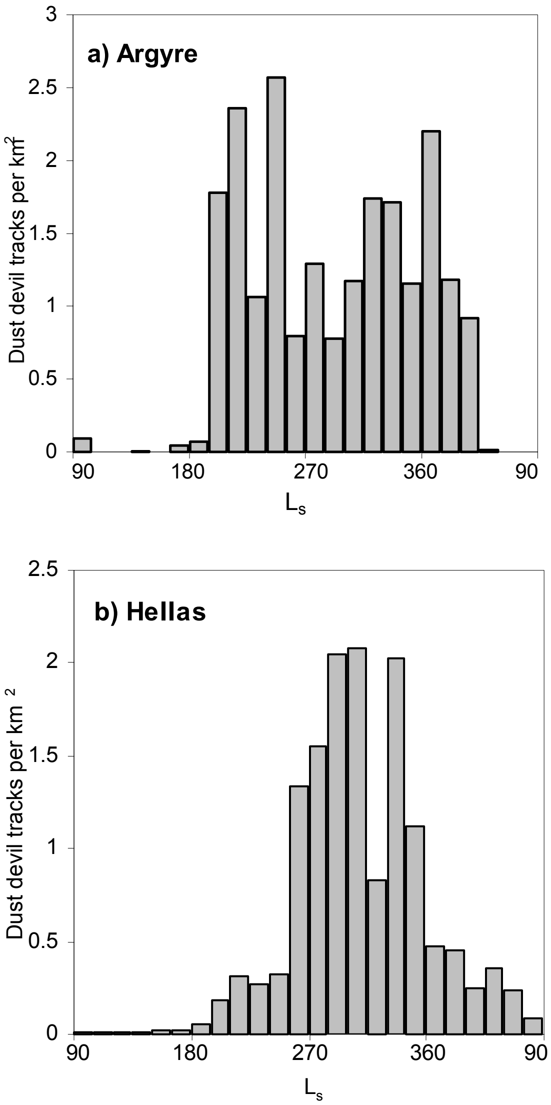

Figure 2. Occurrence of dust devil tracks as a function of Martian season. Track density is averaged over 15^o L_s bins. In Argyre (a), the occurrence of dust devil tracks rises sharply in early southern spring (~190^o L_s), is high throughout the summer and falls to almost nothing in mid fall (~50^o L_s) and throughout winter. In Hellas (b) the pattern is similar but the sharp rise in activity occurs much later at ~260^o L_s. Activity falls off immediately after summer (~ 360^o L_s) but there are still some dust devil tracks visible throughout fall until winter. In both areas the peak value of dust devil track abundance occurs in southern spring/summer and is about 2 - 2.5 tracks per km^2.

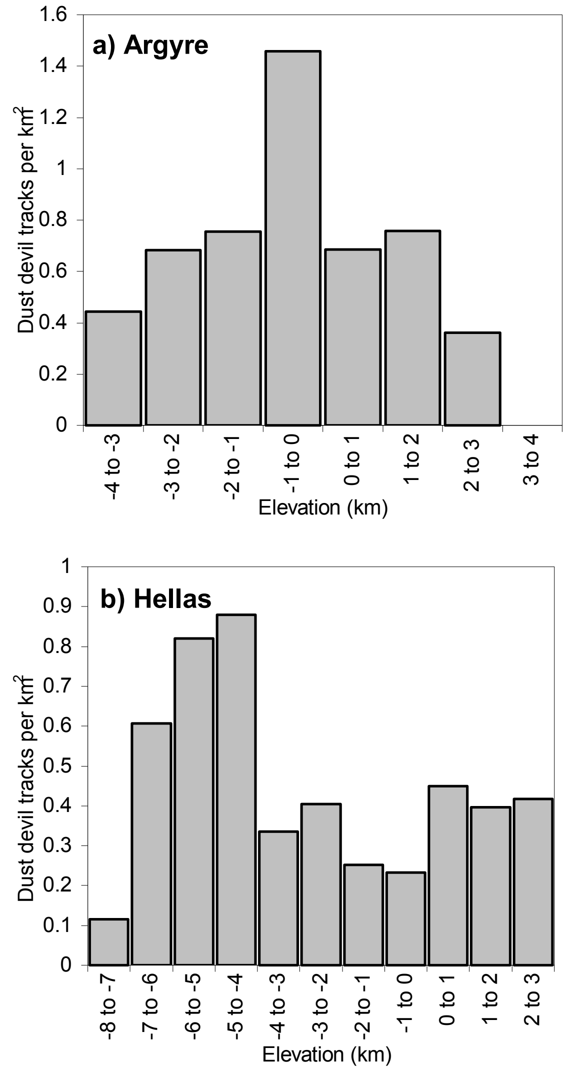

Figure 3. Occurrence of dust devil tracks in Argyre (a) and Hellas (b) as a function of elevation. Data are averaged for all Martian seasons over 1000m elevation bins.

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