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Mapping Dust Devils Activity in the South Hemisphere of Mars: Preliminary Results

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Abstract

In the abstract we show the partial result of the mapping of the dust devil activity in the South Hemisphere of Mars. We used dust devil tracks, identified in MOC and HiRISE images, to infer dust devil activity.

1. Introduction

Dust devils are thermally generated cyclostrophic vortices that are driven by insolation. Rising warm air from solar-heated surfaces is replaced by colder, dense air surrounding the vortex. Particles are lifted by turbulence produced by wind shear and by a suction effect produced by the vertical instability inside the low-pressure convection core [3]. In Mars they are more frequent in the South hemisphere where solar radiation is higher due to the planet eccentric orbit. As dust devils remove bright air fall dust from the surface, the tracks left behind may reveal a darker substrate. In some rare cases tracks are brighter than the surrounding areas. [4] argue that this type of tracks occur when dust devils disintegrate superficial dust aggregates, which are coarser and have lower albedo, into fine grained material with higher albedo. Martian dust devil tracks display linear, curved, and irregular morphologies that generally range from 10 m to greater than 200 m in width and can be up to a few kilometers in length [1, 2]. Therefore, dust devil tracks are albedo patterns on the surface that are considered to result from the removal of particles by the presence of a dust devil to expose an underlying surface with a different albedo. Although [5] estimate that only 14% of dust devils leave tracks, this kind of feature can be used to infer dust devils activity. We have analyzed MOC NA and HiRISE images depicting regions in the South hemisphere of Mars in order to identify tracks and used the center coordinates of the scenes to map dust devil occurrence.

2. Image Datasets

We have searched MOC narrow angle (Malin Space Science Systems database) and HiRISE (The University of Arizona) images containing dust devil tracks in the south hemisphere of Mars, in regions Memnonia (Mars Chart 16), Phoenicis Lacus (Mars Chart 17), Aeolis (Mars Chart 23), Phaethontis (Mars Chart 24), Thaumasia (Mars Chart 25), Argyre (Mars Chart 26) Noachis (Mars Chart 27), Hellas (Mars Chart 28) and Eridania (Mars Chart 29). As discussed previously, dust devil tracks can be either dark or bright, the last ones being rarer. Yet, their morphology usually is linear and/or curvilinear, but in some cases they present a cycloidal aspect. Fig. 1 shows examples of dark linear/curvilinear tracks (a) crossing a crater in Hellas region, cycloidal tracks (b) in Eridania region and bright tracks (c) in Phoenicis Lacus. Table 1 gives information about the amount of images searched and the amount of images showing tracks. The search in regions Aeolis, Eridania, Hellas, Argyre and Noachis is still in course and has not been entirely completed yet.

3. Mapping dust devils activity

We grouped the images in four different classes, which were: Bright, Linear/Curvilinear, Cycloidal and Linear and Cycloidal. Then the center coordinates of the scenes in the planetocentric system were plotted on a base map, which is part of the Mars Digital Dune Database. The base map has as background layer MOLA images in simple cylindrical projection. Fig. 2 shows the dust devils activity map. Triangles stand for MOC images and circles for HiRISE images. Red symbols stand for images showing bright dust devil tracks, blue symbols stand for linear/curvilinear tracks, yellow for

cycloidal tracks and green for cycloidal and linear tracks.

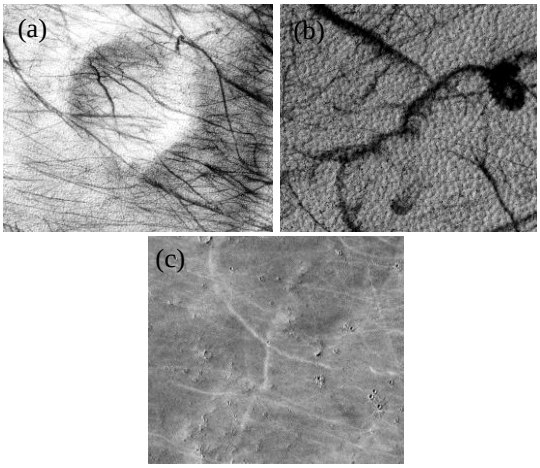

Figure 1: Examples of dust devil tracks: (a) linear/curvilinear; (b) cycloidal; (c) bright.

Table 1: Searched regions.

Region	Searched	With tracks	%
Phaethontis	3.450	275	7.97
Phoenicis Lacus	2.351	18	0.77
Memnonia	1.827	28	1.53
Thaumasia	2.906	130	4.47
Aeolis	239	5	2.10
Eridania	427	45	10.54
Argyre	425	71	16.70
Hellas	438	40	9.13
Noachis	514	39	7.58

4. Partial conclusions

The mapping is still an ongoing process. As far as it is we can see that the dust devils activity is higher in latitudes far from equator. As our search gets complete we hope to confirm that trend. Also, we will be able to compare the activity with other information layers, as for example thermal inertia layers and albedo layers in order to figure out some relationship if any.

References

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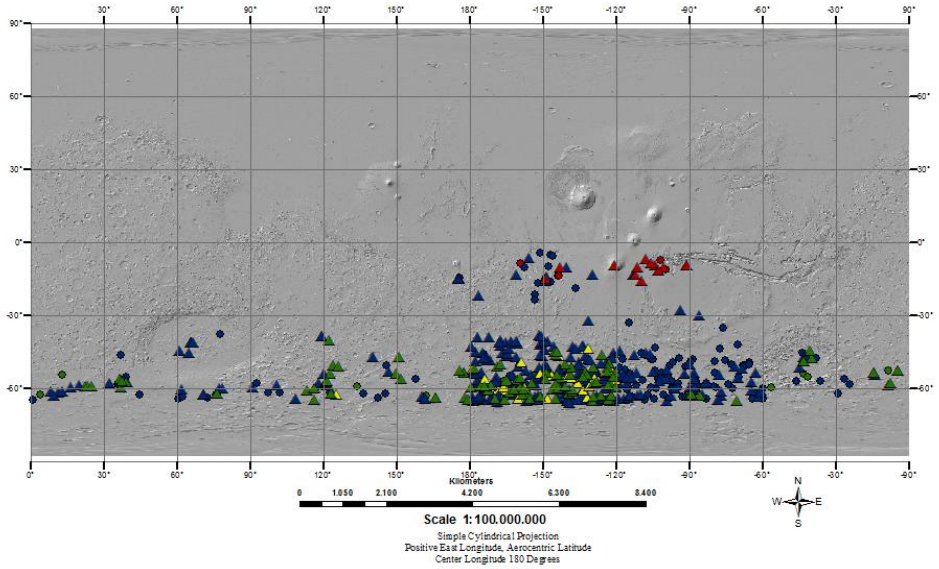

Figure 2: Dust devils activity in South Hemisphere of Mars.