

# DERIVATION OF THE FORWARD VELOCITY OF MARTIAN DUST DEVILS AND THE COMPARISON WITH WIND PROFILES FROM A GENERAL CIRCULATION MODEL.

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## Introduction:

The High Resolution Stereo Camera (HRSC) on Mars Express provides stereo images of the Martian surface in excellent quality and high resolution. The stereo channels can also be used to investigate temporal and spatial variable surface features like dust devils which are dust-filled vortices with diameters up to hundreds of meters and up to 8 km high. They are identified by a bright spot which is the dust column reflecting the sunlight and their cast shadow.

## Observations:

The dust devils have been found in areas quite different in character from desert-like lowlands like Amazonis Planitia to highlands like Thaumasia Planum (Fig. 1). In contrast to common assumptions, dust devils have been detected by HRSC in local summer and local winter of the respective hemisphere, but in all cases at local afternoon as expected.

The forward velocity is derived for 20 dust devils from their change in position seen in the three stereo images of HRSC. Speeds of a few meters per second have been measured for dust devils with small diameters. This corresponds to expected velocities for dust devils assuming they are travelling with the ambient wind. The speeds of the bigger and higher dust devils, however, have been determined between 15 and 27 m/s not consistent with previous assumptions of the wind velocity at the Martian surface (ca. 5 m/s).

## Discussion:

Wind profiles from the Martian Climate Database (<http://www.lmd.jussieu.fr/mars.html>) have been taken to be compared with the derived

dust devil speeds and their heights. The altitude of the tracked bright spot is not directly known and probably the derived high speeds result from observations at higher altitudes and not from the surface.

Wind profiles have been derived for the given local time, season and region of each detected dust devil. Figure 2 compares a wind profile and the derived velocity of one dust devil approximately 3400 m high and moving at 19.6 m/s on average. The comparison suggests that the observed dust devil velocity (the change in position of the bright spot in HRSC images) have been measured at the “upper end” of the vortex rather than at the surface. This seems to apply for the large dust devils only.

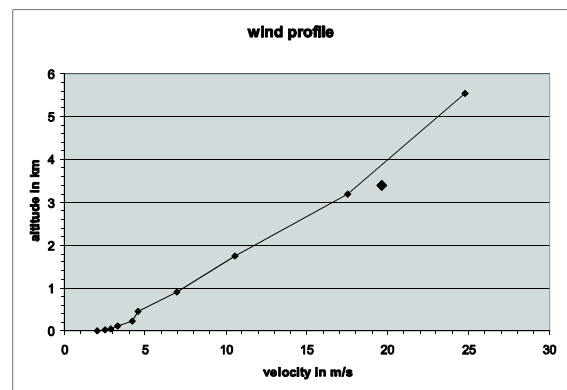
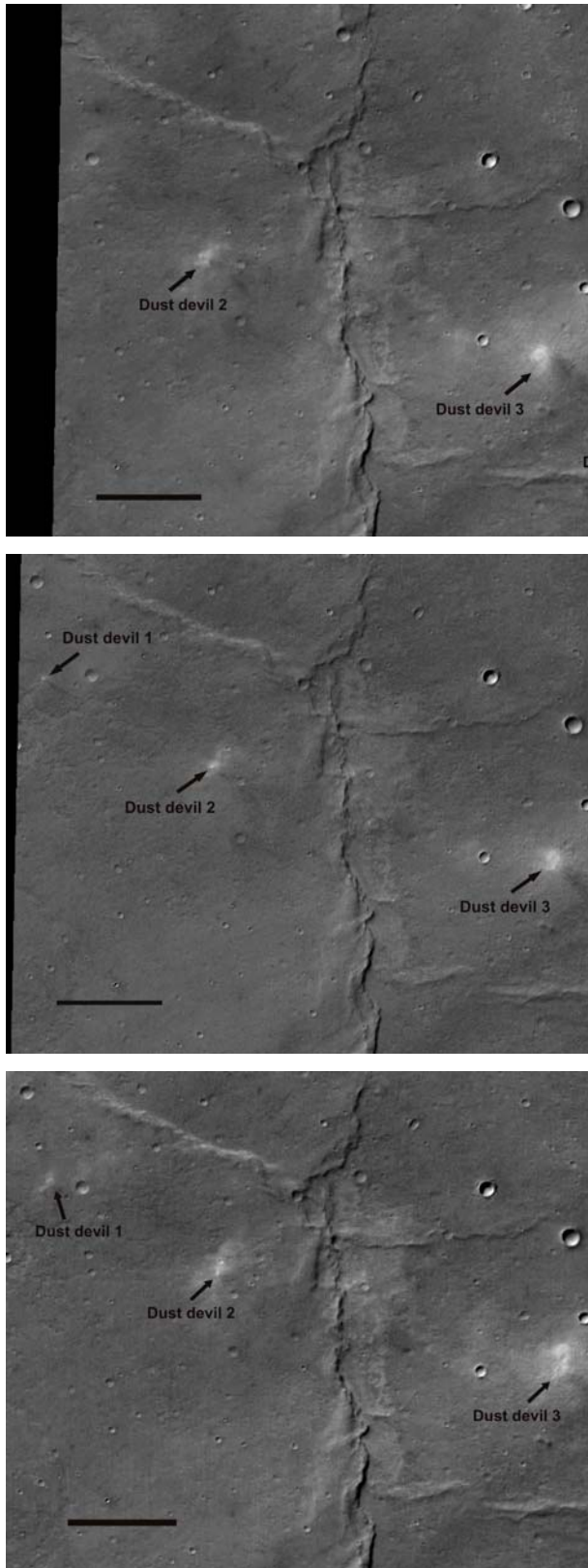


Figure 2: Wind velocity profile from the Martian Climate Database compared to a dust devil which travelled at 19.6 m/s on average with a height of 3.4 km (indicated by the big black diamond).



channel showing the change in position after 53 s after nadir image (97 s after Stereo 1).

Figure 1: HRSC Stereo images showing five dust devils in Thaumasia Planum. The scale bar represents 8 km. a) Stereo 1 forward looking channel. b) Nadir image showing the change in position of the dust devils after 44 s. c) Stereo 2 backward looking