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The derivation of the forward velocity of Martian dust devils and its comparison with wind profiles from a general circulation model

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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 detect and investigate temporal and spatial variable surface features like dust devils. Dust devils on Mars are dust-filled vortices with diameters up to hundreds of meters and up to 8 km high. They are identified by a bright spot from the sunlight reflecting dust column and their cast shadow.

Dust devils on Mars have been found by HRSC in areas quite different in character: from desert-like lowlands like Amazonis Planitia to highlands like Thaumasia Planum. In contrast to common assumptions, dust devils have been detected by HRSC in local summer and local winter of the respective hemisphere, in all cases, however, 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 that 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).

Wind profiles from the Martian Climate Database (http://www.lmd.jussieu.fr/mars.html) for the given local time, season and region of each detected dust devil are used to be compared with the derived dust

devil speeds and their heights. 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.