A close encounter with a terrestrial dust devil

Conference or Workshop Item

A CLOSE ENCOUNTER WITH A TERRESTRIAL DUST DEVIL.

M. C. Towner[1], T. J. Ringrose[1], M. R. Patel[1], M. Balme[2], S. M. Metzger[3], R. Greeley[2] and J. C. Zarnecki[1], [1]PSSRI, Open University, Walton Hall, Milton Keynes, MK7 6AA, UK (m.c.towner@open.ac.uk), [2]Arizona State University, Arizona, USA, [3]Reno, Nevada, USA.

Introduction: During August 03 a dust devil field investigation campaign was conducted in the El Dorado Valley, Nevada. This field site has been well characterised previously [9], and has a well documented record of dust devil events. We report on one particular encounter from this field campaign, whereby a dust devil was sampled by a large number of sensors. These measurements consist of wind speed at 8 heights up to 4m, wind direction at 5 heights, air temperature at 6 heights, air pressure at 2 heights, upward looking UV flux (opacity) and 2 dust impact sensors. As such this data set represents one of the best characterisations of a dust devil lower structure to date. Dust flux estimates obtained can be compared to those expected on Mars.

Dust devils: Dust devils are a common occurrence both here on Earth and on Mars. They form when the correct conditions arise; these include convective plumes, and atmospheric vorticity. Convection occurs when the sun heats the ground, which in turn heats the air above. This heating will cause the air to become less dense and thus start to rise. These phenomenon have been observed on Mars by the Viking Orbiters and landers [1,2], Mars Pathfinder [3,4] and by Mars Global Surveyor[6]. A dust devil will have a rotating column of air, and a low-pressure area at the central core. Dust is lofted when wind speeds become sufficiently high [5]. The dust devil will then move across the landscape with the nominal ambient wind speed and may cause marks or scars on the surface. This is particularly noticeable on Mars where the surface matter is removed by the dust devil revealing a darker or lighter material underneath [6]. The dust lofting process within a dust devil has recently been studied in more detail [7].

Equipment: Figure 1 is an image of the equipment deployed, referred to as DASHER. The equipment and its operation is described in more detail in a companion abstract[8]. A typical dust devil encounter during fieldwork would involve a chase, and deployment of the instruments in the oncoming path of the devil, allowing the dust devil to pass over the sensors.

Figure 1

Results: On 18 July 03 at around 14:40, a strong dust devil was encountered by DASHER. Figure 2 below shows the wind speed, direction and pressure during this encounter. A clear dust devil signature was seen, with a double peak in wind speed and a shift in wind direction indicative of the sensor suite passing through the core. From this signature it will be possible to estimate the dust devil diameter, miss distance (minimum distance between the sensors and the geometric centre of the dust core), and maximum wind speed.

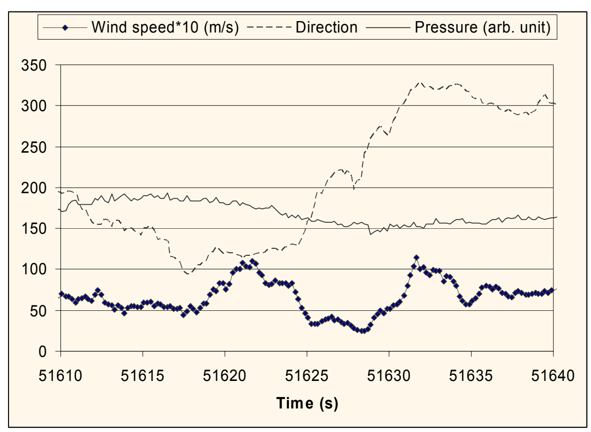

Figure 2

In addition to the data shown, a vertical wind profile was recorded, and a UV flux drop was seen – shown in figure 3. We see a clear correlation between UV flux and Dust impacts, as the dust obscures the view of the Sun. UV flux was recorded in three spectral bands, and in combination with the dust flux data we hope to recover a dynamic particle distribution within the core, to investigate the dust lofting (and deposition) process. Further investigation of the dust lofting (and dust vertical transport) process will be further complemented by vertical wind profile information – as can be seen from figure 1, DASHER deployed 8 wind sensors, up to a height of 4m, giving detailed characterization of the vertical wind profile. When analysis of this event is complete, it will provide an comprehensive data set giving the signature of a dust devil encounter.

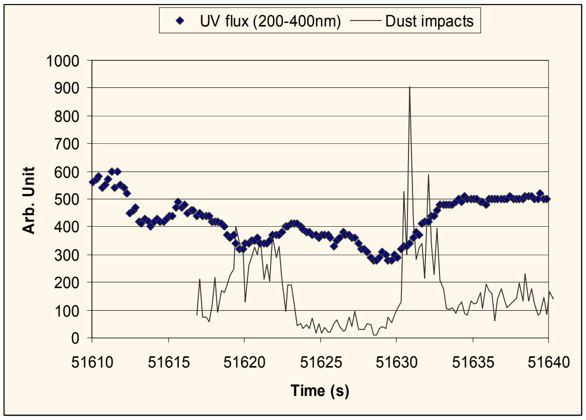

Figure 3

References:

[1] Ryan, J. A. and R. D. Lucich (1983), JGR 88, C15, 11005-11011. [2] Thomas, P. C. and P. J. Gierasch, (1985), Science 230, 175-177. [3] Schofield, J. T., *et al.*, (1997), Science 278, 1752-1758. [4] Metzger *et al.* (1999), GRL 26,18, p2781. [5] Greeley, R and J. D. Iversen (1985) Wind as a geological process, ISBN 0-521-35962-7. [6] Edgett, K. S. and M. Malin (2000). JGR 105(E1): 1623-1650. [7] Greeley, R. *et al.* (2002) JGR 108, E5, p7-1, DOI 10.1029/2002JE001987. [8] Metzger, S. M. *et al*, this volume. [9] Metzger, S. M., (2003), LPS XXXIV, Abstract#2048