

# DIURNAL DUST DEVIL BEHAVIOUR FOR THE VIKING 1 LANDING SITE: SOLS 1 TO 30.

T. J. Ringrose, M. C. Towner and J. C. Zarnecki, Planetary and Space Sciences Research Institute, The Open University, Walton Hall, Milton Keynes, Buckinghamshire, MK7 6AA, UK, [t.j.ringrose@open.ac.uk](mailto:t.j.ringrose@open.ac.uk).

**Introduction:** On 20<sup>th</sup> July 1976 Viking Lander 1 touched down on Chryse Planitia, Mars. The Viking Landers provided the first detailed *in situ* analysis of the martian meteorological conditions. The meteorological package included pressure, temperature, and wind sensors, enabling the landers to perform the first detailed *in situ* investigation of martian weather. Around the same time it was becoming apparent that dust devils existed on Mars and were responsible for lofting considerable amounts of surface material.

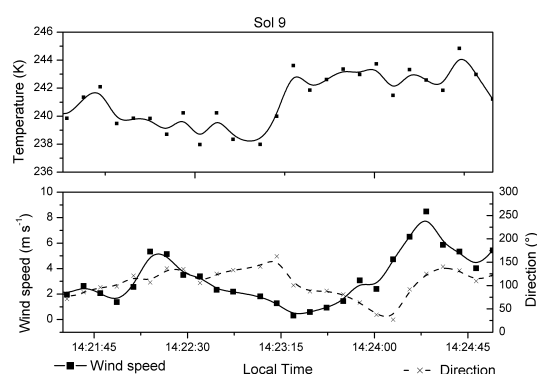
The detection of dust devils from surface meteorological data was first reported in summary by Ryan and Lucich, [1], who gave an indication of annual occurrence statistics. Subsequent diurnal analysis of the Viking Lander 2 meteorological data has been reported by Ringrose *et al* [2] and this work follows on from these findings.

**Vortex Detection:** Convective vortices are characterized by their meteorological parameters, or 'signature'. This signature can include a change in wind speed, direction, a rise in temperature, and a drop in pressure. The last two parameters will only be truly characteristic if the sensor suite passes through the vortex core.

These vortex events are detected using a software routine originally developed for the Beagle 2 Mars lander meteorological data. The software routines compares the short term and long term means to specific threshold values. The short mean uses the most recent 3 samples and the long mean uses the most recent 50 samples. Possible convective vortex events are then highlighted and examined manually. This method has been used successfully to analyze terrestrial dust devils and the Viking Lander 2 meteorological data [2].

**Results:** A number of threshold values for change in, temperature, wind speed and wind direction were tested. It was found that the optimum results were obtained with thresholds of 2 K, 4 m s<sup>-1</sup> and 40°. When the threshold values are lowered a number of events could be left undetected, conversely if the threshold values are too high then too many 'false' events are detected. In order to decide on the correct threshold values a number of software runs have to be carried out and the detections visually scrutinized.

The detections are then manually characterized using a dust devil characterization scheme devised by Ringrose *et al* [2]. It is impossible to say whether an event is a dust devil without visual confirmation, although it can be inferred from the internal wind speeds of a specific event. If the internal wind speeds reach 35 m s<sup>-1</sup> it can be concluded that the event is a dust devil.



**Figure 1** An encounter from sol 9, Viking Lander 1.

Figure 1 shows an encounter from sol 9 where there is a clear indication of a convective vortex. This is illustrated by the twin peak rise in wind speed and the sudden changes in wind direction and temperature, all characteristics of a convective vortex or dust devil. However this event is not considered to be a dust devil as the internal wind speeds are below the threshold of particle motion for a martian dust devil.

**Conclusions:** This proven technique for convective vortex detection provides diurnal vortex occurrence statistics. It is now possible to present comparisons of dust devil behavior between different areas of the martian surface.

**References:** [1] Ryan, J. and R. Lucich (1983). Possible dust devils, vortices on Mars. *J. Geophys. Res.* **88**: 11005-11011. [2] Ringrose, T. J., M. C. Towner and J. C. Zarnecki (2003). Convective vortices on Mars: A reanalysis of Viking lander 2 meteorological data, sols 1-60. *Icarus* **163**(1): 78-87.

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