CONVECTIVE VORTICES ON MARS: A REANALYSIS OF VIKING LANDER 2 METEOROLOGICAL DATA, SOLS 1-50. T. J. Ringrose, M. C. Towner, and J. C. Zarnecki, Planetary and Space Science Research Institute, The Open University, Walton Hall, Milton Keynes, MK7 6AA, UK., t.j.ringrose@open.ac.uk

Introduction: On 7th August 1976 the Viking 2 lander touched down at Utopia Planitia, Mars. Both Viking lander's primary aim was to look for the presence of organic life on the surface of Mars. The lander also had a comprehensive meteorological package to monitor the martian conditions. The meteorological package included pressure, temperature, and wind sensors, enabling the landers to perform the first detailed in-situ investigation of martian weather.

Dust devil tracks were first detected from orbit by Mariner 9, but it wasn't until Viking that orbital photographs of columnar clouds/dust devils were taken. Possible dust devils/convective vortices were also detected by the Landers meteorological instruments.

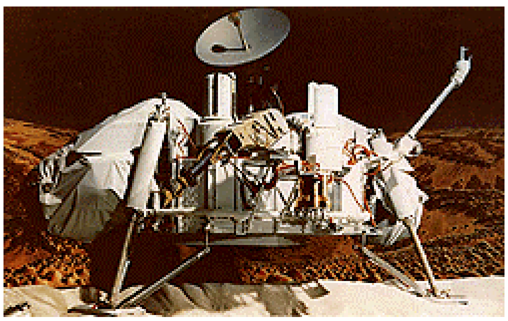

Figure 1 shows a Viking lander, [1].

The detection of dust devils from the surface of Mars was first reported in summary by Ryan and Lucich, [2], who gave an indication of annual occurrence statistics. We have reanalysed Viking lander 2 meteorological data using the triggering routine that will be used in the software of the Beagle 2 Environmental Sensor Suite (ESS), [3], to detect possible convective vortices. It is the object of this research to give not only annual but diurnal statistics of convective vortex formation for the Viking 2 landing site.

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.

The Beagle 2 software routine incorporates the technique by which the short term mean, STA, and the long term mean, LTA, [4] are compare to a specified threshold value:

$$shortmean - longmean > threshold$$

where 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. This method has been used successfully to analyze a terrestrial dust devil during a recent field investigation, as part of the MATADOR program, [5]. The Viking lander 2 data has been reanalysed using the same approach as MATADOR, although the latter case was easier to verify with visual confirmation.

Initial attempts to detect vortices in the Viking lander 2 data proved unsuccessful, however this was found to be due to the fact that threshold values used were too high; during the martian Summer of 1976 the wind speeds were in general below 10ms^{-1}, this wind speed is insufficient to loft dust on Mars, but convective vortices can still form. Threshold values of wind speed and direction were decreased to 6ms^{-1} and 40 degrees, which produced 12 vortices in the first 10 sols alone.

SOL	LOCAL TIME
3	14:15
4	13:27
4	15:00
6	11:47
7	14:41
7	16:20
7	16:26
7	16:36
8	16:09
9	13:17
10	11:45
10	11:49

Table 1

Figure 2 is a graph of a convective vortex from Sol 4, which shows the distinctive vortex signature. There is an abrupt change in wind direction, an increase in wind speed, and temperature, this all occurs in a time scale of ~90 seconds. This is a good example, showing the vortex core, and must have passed almost directly over the lander. Other examples which only pass by the lander are much harder to discriminate, there may only be a small rise in wind speed, coupled with a change in wind direction. Work is ongoing in this area to better characterise the likely signature from a near miss. Ryan and Lucich, [2], analysed 52 Sols in the Winter and 23 Sols in the Spring, of which 8% and 70% of the Sols respectively contained vortices.

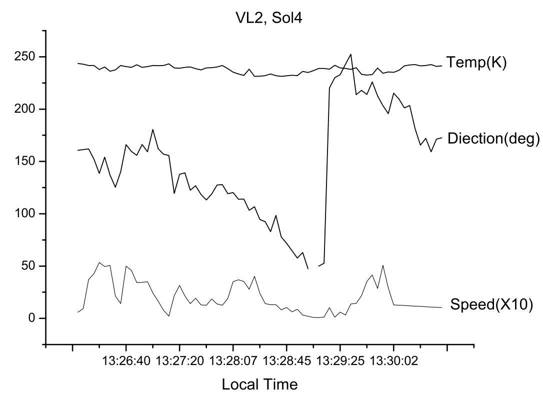

Figure 2

Only the first 50 sols have been analyzed to date, as yet no dust devils have been detected, since for a dust devil to form a threshold wind speed of 35ms^{-1} or greater is required.

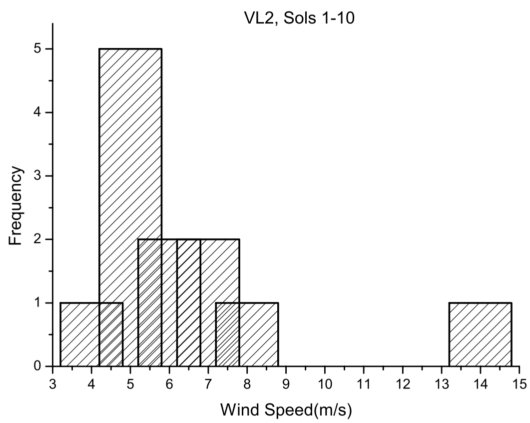

Figure 3

Figure 3 shows the frequency and internal wind speed of convective vortices in the first ten sols of the mission.

Conclusions: Dust devils can be identified from their distinctive meteorological signature. This meteorological signature is highlighted by the Beagle 2 detection routine, which has been successfully used to identify MATADOR dust devils. It is therefore now possible to provide diurnal occurrence statistics for convective vortices at or near the Viking 2 landing site, work is ongoing to produce this data, and will also lead to improved values for thresholds in the Beagle 2 ESS, hopefully enhancing the science return.

References: [1] http://nssdc.gsfc.nasa.gov [2] Ryan and Lucich, (1983), Possible Dust Devils, Vortices on Mars, JGR, Vol. 88, pp 11005-11011 [3] Towner M. C. et al., 2000, The Beagle 2 Environmental Sensor: Instrument Measurements and Capabilities, 31st LPSC Abstract no. 1028. [4] http://mahi.ucsd.edu/research projects/Autopicker/autopicker/node3.html [5] Hecht M et al, 2001, MATADOR Dust Devil Campaign, personal communication.

Acknowledgements: Jim Murphy (New Mexico State University) is thanked for providing the Viking lander 2 meteorological data.