EPSC Abstracts
Vol. 6, EPSC-DPS2011-874, 2011
EPSC-DPS Joint Meeting 2011

Viking Lander 1 wind data before and after the sensor failures

O. Kemppinen (1,2), W. Schmidt (1)
(1) Finnish Meteorological Institute, Helsinki, Finland (2) Aalto University School of Science, Finland
(osku.kemppinen@fmi.fi)

Abstract

The published Viking Lander 1 wind data is incomplete due to several hardware malfunctions during the mission, requiring modified algorithms. In this work the full mission data, processed with one of such algorithms, is presented. It is shown that this preliminary data follows the behavior of the data created with the original processing algorithm until the hardware malfunction, but with a systematic difference. After that, this set starts to deviate somewhat from another data set, found in Planetary Data System (PDS), that has been produced by an alternative modified algorithm. However, despite superficial difference, both sets agree on the most prominent features.

1. Introduction

Viking Lander 1 (VL1) is currently the longest meteorological mission on Mars, having operated 2245 sols. Unfortunately, it suffered from several hardware malfunctions early during its operation, reducing the amount of easily available data. Most notably, parts of the wind sensor were reportedly damaged early in the mission, as described below. In this work wind data, analyzed with an alternative wind vector calculation method is shown. The method is based on the elements of the sensor package that were undamaged.

1.1. Wind sensor

The wind measuring equipment consisted of three hot films and a quadrant sensor. The hot films were horizontal to the ground, two of them arranged at a 90° angle with respect to each other and were maintained at 100° C above the ambient temperature. The ambient temperature was measured by the third film, which was located between the two. In the following text “hot films” refers to the two films mentioned first, not the ambient temperature sensor.

Each hot film measures the power dissipated by the wind. With two films, the strengths, but not the directions, of two orthogonal wind components are acquired. The resulting four-fold ambiguity is solved by the quadrant sensor.

The quadrant sensor consisted of a heated center post and two pairs of thermocouple junctions. The thermocouple pairs were arranged so that the lines between pairs corresponded to the directions of the hot films. When the wind blew to the sensor, it increased in temperature due to the heated post. Therefore, the downwind thermocouple junction measured a temperature higher than the upwind side one, and therefore determined the direction of that wind component. With two pairs, the wind quadrant could be determined and the wind vector was completely known.[1]

1.2. Wind sensor malfunctions

On sol 45, the quadrant sensor center post heater failed the first time. However, the operating team concluded that during day the solar heating would increase the temperature of the post enough relative to the temperatures of the thermocouples so that the wind direction could still be determined. The same was true for night, when the infrared radiative cooling would result in the post being in a lower temperature than the thermocouples. Therefore, even without the heater, the quadrant should be determinable, at least during the slow wind periods when the post temperature can remain in a distinct temperature.[2, 3]

2. Results

The wind velocity of VL1 site based on three datasets is shown in the Figure 1. From the beginning of the mission to sol 40, where the dataset “tbin” ends, the three sets show similar trend, but with a systematic differences of 1–3 m/s, which should be solvable

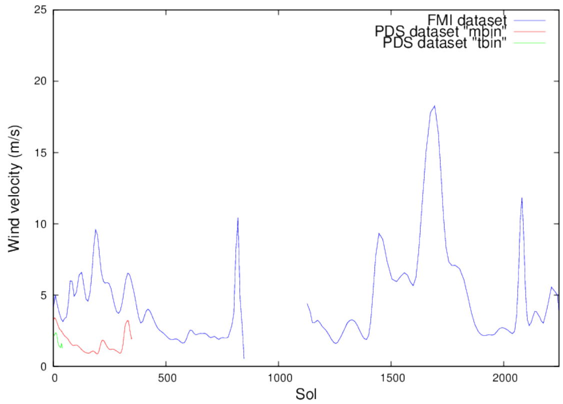

Figure 1: Sol averages of wind velocity data of VL1 mission.

with a simple calibration. After sol 40, when the first quadrant sensor heater malfunction occurred, the FMI and “mbin” datasets deviate. The two peaks shown in the “mbin” set can also seen in the FMI set, but with much higher magnitude. The two other peaks seen in the FMI set are not seen in the “mbin” set.

However, it looks as if the two peaks that are shared are the most significant ones. Therefore, even though other parts of the data differs, the key features of the algorithms agree. More work is required to find out which, if either, of the sets is correct, and if the difference is a matter of calibration or because of a qualitatively different algorithm.

3. Summary and Conclusions

The preliminary data presented here covers a significantly longer period than previously published data sets. The data has to be verified due to there being non-trivial differences to previously published extended data sets, but even in this state the key points are agreed on by the sets. In addition, there are systematic differences of 1–3 m/s between the different data sets, which require some calibration.

Acknowledgements

The authors are very grateful for the support of the University of Washington staff, especially by Prof. J. E. Tillman, the former leader of the Viking Computing Facility[4]. In addition, the authors want to thank Finnish students Rami Järvinen and Visa Hankala for their contribution to the early parts of the project.

References

[1] Chamberlain, T. E. et al.: Atmospheric Measurements on Mars: The Viking Meteorology Experiment, Bulletin Americal Meteorological Society, Vol. 57, pp. 1094–1104, 1976.

[2] Hess, S. L. et al.: Meteorological Results From the Surface of Mars: Viking 1 and 2, Journal of Geophysical Research, Vol. 82, pp. 4559–4574, 1977.

[3] Snyder, C. W.: The Extended Mission of Viking, Journal of Geophysical Research, Vol. 84, pp. 7917–7933, 1979.

[4] Viking Computing Facility, checked on 31.5.2011, `http://www.atmos.washington.edu/mars.html`.