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The Mars Phoenix MET Pressure Sensor - Data Quality and Scientific Results

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1. Introduction

Meteorological conditions on the landing site of the Mars Phoenix lander were monitored with the MET experiment, provided by Canadian Space Agency (CSA). The MET experiment included a pressure sensor provided by Finnish Meteorological Institute (FMI)

The aim of this study is to find out the error sources of the Phoenix pressure sensor and to estimate their impact on the science data. Also the technical implementation of the sensor and the first scientific results are introduced.

2. Technical implementation of the sensor

The Phoenix pressure sensor was based on technology developed by Vaisala corporate. A Barocap® sensor head was used to measure scientific pressure readings with 2 s sampling intervals almost continuously during the 151 sol mission. Two other Barocap@ sensor heads where used to measure housekeeping pressure readings with 512 s sampling intervals.

3. Error sources

Error sources were studied using the data of sensor and spacecraft level tests, measurements during the interplanetary cruise and housekeeping measurements during the mission. Four error sources that affect the science data stored in the PDS archive were identified:

1) A +2.8 ± 2 Pa *constant offset* caused by calibration drift between the calibration tests and the start of the mission.

2) The so-called *thermal lag effect* [3] caused by temperature difference between the Barocap@ sensor heads and the housekeeping temperature sensors during fast temperature variations. This effect is corrected in the PDS data but there are residual errors with magnitude < 1 Pa and duration < 8 min.

3) The so-called *slow hysteresis* effect associated to temperature variations. The errors caused by this have magnitude < 0.5 Pa and duration circa 1 h

4) The *response time* of the sensor: 2.8 ± 0.2 s.

Except these there are no other error sources that could cause errors with magnitude > 0.3 Pa. After Phoenix landed it was detected that the difference between the reading of the main Barocap@ and the housekeeping Barocaps@ was temperature dependent [3]. Tests performed with a reference model reveled that this difference was caused entirely by the housekeeping sensors. Thus there is no temperature dependent error in the science data.

4. Scientific results

First scientific results are presented in [3] and [1]. The Phoenix pressure readings followed a model based on Viking lander observations [4], corrected for elevation differences, with a circa +10 Pa offset [3]. 2.8 ± 2 Pa of this offset is explained by the offset in the Phoenix data. The resulting circa 7 ± 2 Pa might result from the combined uncertainties of the modeling methodology and the Viking measurements but it might also be a sign of a secular climate change on Mars [2].

502 pressure drops indicating the passage of dust devils were detected by the Phoenix pressure sensor. A strong correlation between active weather events like low-pressure baroclinic systems and dust devil activity was found. [1]

5. Conclusions

The time scales of all errors are shorter than 1.5 h and magnitudes smaller than 1 Pa, except the constant offset. Therefore the PDS data can be used in studies of diurnal and longer time scale pressure variations without any further corrections. The +2.8 Pa constant offset has to be taken into account in multi-mission studies and the 2.8 s response time in studies of dust devils [1].

The Phoenix pressure sensor fulfilled its requirements and its data could be used to study phenomena from dust devils to annual pressure variations. The errors were mostly caused by fast variations in the temperature of the sensor. This should be taken into account in the thermal design of future landers where similar sensors are used.

References

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