EPSC Abstracts
Vol. 9, EPSC2014-134, 2014
European Planetary Science Congress 2014

Mars Science Laboratory (MSL) - Overview of the humidity and pressure observations of the first Martian year of operation

Maria Genzer (1), Osku Kemppinen(1), Henrik Kahanpää (1), Maria Komu (1), Walter Schmidt (1), Jouni Polkko (1), Ari-Matti Harri (1), Javier Gómez-Elvira (2) and the MSL Team
(1) Finnish Meteorological Institute, Helsinki, Finland (maria.genzer@fmi.fi), (2) Centro de Astrobiología (SCIS-INTA), Torrejón de Ardoz, Madrid, Spain

1. Introduction

The Mars Science Laboratory (MSL) made a successful landing at Gale crater early August 2012. MSL has an environmental instrument package called the Rover Environmental Monitoring Station (REMS) as a part of its scientific payload. REMS comprises instrumentation for the observation of atmospheric pressure, temperature of the air, ground temperature, wind speed and direction, relative humidity, and UV measurements. The REMS instrument suite is described at length in [1]. The REMS humidity and pressure instruments and initial observations are described in detail in [2] and [3]. Here we give an overview of the results of the first year of observations from the REMS humidity and pressure observations.

2. The REMS humidity device

The REMS humidity device is provided by the Finnish Meteorological Institute. It is based on polymeric capacitive humidity sensors developed by Vaisala Inc. The humidity device makes use of one transducer electronics section placed in the vicinity of the three (3) humidity sensor heads. The humidity device is mounted on the (MSL) boom providing ventilation with the ambient atmosphere through a filter protecting the device from airborne dust. The absolute accuracy of the humidity device is temperature dependent, and is of the order of 2%RH at the temperature range of -30 to -10 °C, and of the order of 10%RH at the temperature range of -80 to -60 °C. This enables the investigations of atmospheric humidity variations of both diurnal and seasonal scale.

The humidity device measurements will have a lag, when a step-wise change in humidity is taking place. This lag effect is increasing with decreasing temperature, and it is of the order of few hours at the temperature of -75 °C. We have developed a compensation algorithm to compensate for the lag effect.

3. The REMS pressure device

The REMS pressure device is provided by the Finnish Meteorological Institute. It is based on silicon micro-machined capacitive pressure sensors developed by Vaisala Inc. The pressure device makes use of two transducer electronics sections placed on a single multi-layer PCB inside the MSL payload bay with a filter-protected ventilation inlet to the ambient atmosphere. The absolute accuracy of the pressure device is < 3 Pa and zero-drift < 1 Pa/year enables the investigations of long term and seasonal cycles of the Martian atmosphere. The pressure device has special sensors for very high precision of less than 0.2 Pa that makes it a good tool to study short-term atmospheric phenomena, e.g., dust devils and other convective vortexes.

4. Results

The observed MSL pressure and humidity data enable us to understand both the long term and short term phenomena of the Martian atmosphere by adding to the knowledge gathered by earlier Mars missions and modeling experiments. Both pressure and humidity observations are revealing new information on the local atmosphere and climate at Gale crater, and will shed light on the mesoscale and micrometeorological phenomena.

The humidity observations were validated after tedious efforts. This was needed to compensate for the artifacts of the transducer electronics. The results appear to be convincing and are aligned with earlier observations of the total atmospheric precipitable water contents as well as with the modeling results [2]. Both the relative humidity and the derived volume mixing ratio show a clear seasonal behavior.

Pressure observations represent also planet-wide phenomena and are one key observation for enhancing our understanding of the global atmospheric flows and CO2 cycle of the Martian atmosphere [3]. The overview of the pressure observations of the first Martian year will be shown.

References

[1] Gómez-Elvira J. et al. (2012), Space Sci Rev., 170, 583-640

[2] Harri, A.-M. et al., JGR Planets, submitted

[3] Harri, A.-M. et al. (2014), JGR Planets, 119, 82-92