ExoMars entry, descent and landing science

Conference or Workshop Item

How to cite:

For guidance on citations see FAQs.

© 2011 The Authors

Version: Version of Record

Link(s) to article on publisher’s website:

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online’s data policy on reuse of materials please consult the policies page.
ExoMars Entry, Descent and Landing Science


(1) CISAS “G. Colombo”, University of Padova, Via Venezia 15, 35131 Padova, Italy (francesca.ferri@unipd.it), (2) The Open University, Milton Keynes, UK, (3) Boston University, MA, USA, (4) Jet Propulsion Laboratory, California Institute of Technology, CA, USA, (5) FMI – Finnish Meteorological Institute, Helsinki, Finland, (6) International Research School of Planetary Sciences, Università d'Annunzio, Pescara, Italy, (7) Imperial College London, UK, (8) Institut für Geophysik und Meteorologie, Universität zu Köln, Albertus-Magnus-Platz, 50923 Köln, Germany

Abstract

The entry, descent and landing of ExoMars offer a rare (once-per-mission) opportunity to perform in situ investigation of the martian environment over a wide altitude range. Entry, Descent and Landing System (EDLS) measurements can provide essential data for atmospheric scientific investigations. We intend to perform atmospheric science measurements by exploiting data from EDLS engineering sensors and exploiting their readings beyond the expected engineering information.

1. Introduction

EDL phases are critical with reference to mission achievement and require development and validation of technologies linked to the environmental and aerodynamical conditions the vehicle will face. An accurate knowledge of the dynamics of the probe during entry and descent (i.e. trajectory and attitude determination) allows the retrieval of the atmospheric vertical profile of values such as density, temperature and pressure at a vertical resolution far higher than previously explored and/or reachable by remote sensing.

ExoMars 2016 will provide the opportunity for new direct in situ measurements during the martian statistical dust storm season. These data will contribute to exploring an altitude range not covered by an orbiter, providing surface and atmosphere a “ground truth” for remote sensing observations and important constrains for updates and validations of the Mars atmosphere General Circulation models [1].

2. Background

Mars’ atmosphere is highly variable in time and space, due to due to phenomena including inertio-gravity waves, thermal tide effects, dust, solar wind conditions, and diurnal, seasonal and topographic effects. Atmospheric profile measurements, drawing on scientific analysis heritage from the Huygens Atmospheric Structure Instrument (HASI), which encountered Titan’s atmosphere in 2005 [2], and various previous Mars missions such as the Mars Exploration Rovers (MER) and Mars Phoenix (PHX) will allow us to address questions of the martian atmosphere's structure, dynamics and variability.

By careful consideration of EDLS measurements to yield science as well as a successful landing, we will obtain continuous atmospheric density, temperature and pressure profiles over the widest ever explored altitude range, with the highest sensitivity and spatial resolution.

The first in situ measurements of Mars planetary atmospheric structure have been obtained by the USSR spacecraft Mars 6 in 1974 during its entry into the martian atmosphere. These data confirmed the remote sensing observations of 5.45 mbar surface pressure and estimated the lapse rate in the lower and middle atmosphere [3]. To date, only six vertical profiles of density, pressure and temperature of the martian atmosphere have been obtained from in situ measurements. Three high vertical resolution and high accuracy atmospheric vertical profiles have been retrieved from measurements performed by Viking 1 and 2 during the day [4] and by Mars Pathfinder (MPF) during the night [5, 6]. Two more vertical profiles have been retrieved from the deceleration curves and aeroshell drag properties of the two Mars Exploration Rovers (MER) during atmospheric entry [7], but with a much lower accuracy. Recently the Mars Phoenix EDL data have been used to obtain the first profile of atmospheric density, pressure and temperature at the martian polar regions [8].
3. Summary and Conclusions

The main objective of the ExoMars EDL Science team is to exploit the Entry Descent and Landing System (EDLS) engineering measurements for scientific investigations of Mars’ atmosphere and surface.

From the measurements recorded during entry and descent, using similar methods and analysis employed on previous in situ missions (e.g. ESA Huygens, NASA MPF, MER and Phoenix) we will retrieve an atmospheric vertical profile along the entry and descent trajectory. The experience and lessons learned in the framework of the Huygens project will be put in perspective for the ExoMars Entry, Descent and Landing (EDL) science experiment.

Our selected team members are all experts in the relevant fields required for this investigation and provide an excellent balance of the skills and expertise.

Acknowledgements

We do acknowledge our national space agencies, namely Italian Space Agency (ASI), UK Space Agency, FMI, that are supporting and will endorse this work and our participation to ESA ExoMars mission.

References