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Atmosphere of Mars research proposal

I. Abstract

The descent entry profiles of the Mars Exploration Rovers provide new information about the atmosphere of Mars. Combined with atmospheric profiles derived using data collected by other missions, a diverse amount of information is available and useful for modeling thermodynamic behavior on Mars at various locations, times, and seasons. Atmospheric entry profiles derived from data taken by the Mars Exploration Rovers can be verified by comparison with data taken at the same times and coordinates by other spacecraft. The Mars Global Surveyor has collected data useful for this task. After the verification of the atmospheric profiles the thermodynamic information will be useful when attempting to solve for dust distribution parameters in Martian atmospheric thermodynamic models. The aim of this research is to help provide information that will be useful for Mars atmospheric thermodynamic modeling.

II. Introduction

For decades scientists have been publishing papers about the Mars atmosphere in science journals, and these papers have used data from a variety of Mars missions. Many of these missions have collected information at different times and locations, and few have collected information at the same time and location (such as the Mars

Exploration Rovers and the Mars Global Surveyor). When two or more missions collect data pertinent to the Martian atmosphere at the same time and location it is possible to check the result profiles for consistency. However, when this does not occur there is more unique data and we have more of an opportunity to explore how seasonal variations can affect the atmospheric conditions. Each situation provides its own distinct advantages, and it is through these advantages that we intend to gain information that will foster a better understanding of the atmospheric thermodynamics of Mars, and ultimately understand the factors thereof. Good models of the Mars atmosphere have already been developed, but there is still much room to improve modeling of the Martian atmosphere. We intend to focus on data from the Mars Exploration Rovers and the Mars Global Surveyor to provide more profile information useful for modeling. NASA's Planetary Data System is the host of much of the data collected from the Mars Exploration Rovers and Mars Global Surveyor.

Atmospheric profiles have been constructed with data from the Viking Lander missions, the Pathfinder mission, and the Rover missions. These kinds of atmospheric profiles, entry profiles, provide detailed information about the Mars atmosphere at small regions during small intervals of time. Atmospheric profiles that have been derived from Martian satellite missions are less detailed than entry profiles but usually cover larger planetary regions.

III. Research Question

What can the vertical profiles of atmospheric temperature derived from the entry deceleration measurements obtained from the Mars Exploration Rovers as they

descended through Mars atmosphere to its surface tell us about the content and vertical distribution of suspended dust present in the atmosphere at the landing locations and times? And is this information consistent with what other sources tell us about the same locations and times?

IV. Methodology

Dust is believed to be largely responsible for the thermodynamic structure of Mars' atmosphere; the atmospheric profiles should be able to give much insight into understanding the behavior and distribution of dust in the Mars atmosphere. With a good understanding of the dust on Mars, scientists will be able to make future predictions regarding the weather of Mars. We will use numerical (computer) models of the Mars atmosphere to attempt to infer the dust's content and vertical distribution at the locations and times of the Rover landings. A 1-dimensional (vertical) model in which radiatively active suspended dust can be included will be employed to understand the effect of varying dust amount and its vertical distribution and the resultant temperature variation with height, which will be compared with the derived Rover profiles. A 3-dimensional atmospheric (computer) model will also be employed to assess the importance of atmospheric waves upon the derived Rover temperature structures. With these analyses, we will use the derived Rover entry, descent, and landing temperature profiles to better constrain our knowledge of atmospheric dust content and distribution, and the sensitivity of the models to these dust variations.

V. Timeline

8/24/2007	Collect MER entry profiles from preselected sources (Paul Withers)
9/28/2007	Derive Mars Global Surveyor (MGS) Thermal Emission Spectrometer (TES) thermodynamic profile at the locations of the Rovers during Rover entry.
10/5/2007	Finish making DPS poster
10/7/2007	Present research at DPS meeting
12/1/2007	Run thermodynamic model simulations and extract appropriate information.
2/1/2008 through 4/1/2008	Compare MER profiles, TES profiles and results of model simulations with various parameters to attempt to build a case for the actual dust distribution at the specified times.
5/1/2008	Make first draft of final research paper
5/30/2008	Make final draft of research paper and have ready to present to the PDS management council
6/30/2008	Contribute new information to the PDS upon request along with new software

VI. References

Withers, P., Towner, M.C., Hathi, B., Zarnecki, J.C., 2003, Analysis of entry accelerometer data: A case study of Mars Pathfinder. Planet. Space Sci. 51, 541–561.

Withers, P., Smith, M.D., 2006, Atmospheric entry profiles from the Mars Exploration Rovers Spirit and Opportunity. Icarus 185, 133-142.