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The vertical distribution of atmospheric dust during the Viking lander 1 dust storms

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Abstract

Dust storms on Mars can rapidly obscure the surface making remote observations of the surface region complicated or even impossible. Measurements from the surface by landers offer a way to track a dust storms development from below and complement remote observations to help understand the development of dust storms on Mars.

Viking lander 1, which operated on the surface of Mars from 1977 to 1982, experienced several global storms and a number of local storms. We assess and investigate the possibility of using Viking lander 1 boom and footpad temperature measurements to investigate the development of dust storms over this site.

1. Introduction

Martian dust has a direct and observable influence on the Martian atmosphere and landscape and has been a major focus for spacecraft investigations. Progress has been made in understanding the mechanisms involved in the lifting and transport of dust. One important result of these mechanisms are global dust storms. The initiation and inter-annual variability of which are still poorly understood.

2. Method

In this work we fit a 1D column model, with a comprehensive and realistic dust radiation scheme [1], to the Viking lander 1 temperature data [2] to track the evolution of dust storms and hopefully shed some light on their development and subsequent impact on the Martian climate. The model is configured to model the vertical dust distribution as layers and so properly account for the relative influence of reflection and absorption of the radiation that eventually will reach the Martian surface. We use a hill climbing algorithm [3] to adjust the tau values of the dust layers in the model to obtain a fit.

3. Results

So far we have applied our 1D column model to the two major dust storms experienced by the Viking lander 1 (VL-1) during its first Martian year (1977). We also plan to apply the model to a major dust storm in 1982, just before the end of the mission.

So far we have fitted our model to the boom temperature measurements several sols after the initiation of the during the first and second VL-1 dust storms. The tau values are in line with the lander opacity measurements measured on these sols. There is a clear structure to the distribution of dust in the model. In addition we have fitted the model to the sequence of sols during the start of the first dust storm which show an interesting evolution of the dust with time.

The figure below shows a fit of the model to sol 330 temperatures during VL-1's first year and during the second dust storm.

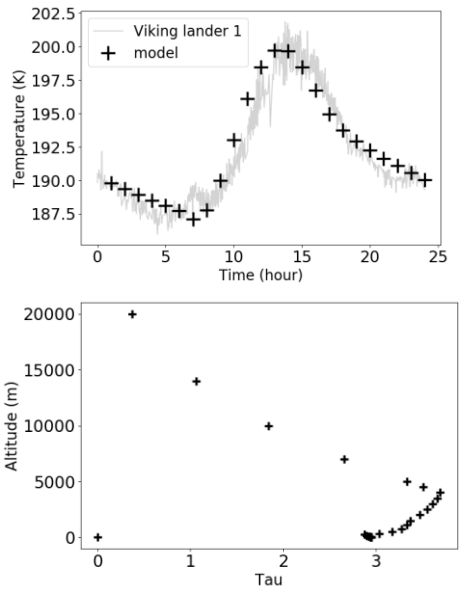

Figure 1 : Initial results for VL-1 sol 330 (Ls=285°).

References

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