Geophysical Research Abstracts, Vol. 9, 09682, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09682

The 2001 planet-encircling dust storm on Mars: a study by means of data assimilation

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Planet-encircling dust storms are a major atmospheric phenomenon on Mars. The last global dust storm occurred in 2001 and has been observed by NASA's Mars Global Surveyor (MGS) spacecraft with several instruments on board, among which was the Thermal Emission Spectrometer (TES). The emergence, evolution and decay of a planet-encircling dust storm is still a poorly understood part of the study of the Martian atmosphere.

This paper is a study of some mechanisms which might trigger the onset of such a storm. In particular, we investigate the role played by the thermal tides and the stationary waves during the 2001 global dust storm.

Our study uses the results from a data assimilation analysis applied to the Martian atmosphere. The application of this technique to Mars has been made possible by the substantial dataset of MGS/TES thermal and dust opacity observations with good spatial and temporal coverage. The advantage of such an approach, which combines modelling with a state-of-the-art Martian global circulation model and observations, is to provide global, four-dimensional information about the atmospheric state, including analyis of those variables which are not directly observed, such as near-surface winds and surface pressure. The study of waves is therefore facilitated by the availability of the global re-analysis, reconstructed from the observations of a single, sun-synchronous satellite.