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The 2001 Planet-encircling Dust Storm on Mars: A Meteorological view

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In July 2001 (Martian year 25), Mars was enshrouded by a thick veil of dust which lasted for several months and obscured the observation of its surface to spacecraft cameras and ground-based telescopes. The emergence and rapid evolution (within a few days) of multiple, isolated, regional dust storms which eventually attained planetary scale extent were observed by NASA's Mars Global Surveyor (MGS) spacecraft using high resolution camera images and the thermal profiles and dust opacity measurements provided by the Thermal Emission Spectrometer (TES).

We have applied a technique used in Terrestrial meteorology (sequential data assimilation) to obtain a complete, four-dimensional evolution of all the atmospheric variables during the period of this planet-encircling dust storm, even those which were not directly observed by the MGS satellite, such as surface pressure and winds. We assimilated TES nadir-pointing thermal profiles and total dust opacities in a global circulation model of the Martian atmosphere, developed jointly by the University of Oxford and the Open University in the United Kingdom, with the collaboration of the Laboratoire de Météorologie Dynamique in Paris (UK-MGCM).

In conjunction with the use of data assimilation, we have also carried out mesoscale simulations with the new Mars mesoscale model developed at the Laboratoire de Météorologie Dynamique. The boundary conditions have been in this case provided by the UK-GCM with data assimilation included.

The purpose of this study is to describe in detail the meteorology on Mars at the time of the onset and evolution of the 2001 planet-encircling dust storm, which can be separated in different key phases. One of these phases involves an episode of teleconnection (in the sense of radiative-dynamical connection at distance) which coupled two regions on the planet almost 180 degrees longitude apart: the Hesperia Planum (north of the Hellas Basin) and the Syria-Syrtis Planum (in the Tharsis region).