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Meteorology of the 2001 Martian planet-encircling dust storm in global and mesoscale modelling with data assimilation.

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In July 2001, 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 evolution of the 2001 planet-encircling dust storm was observed by NASA's Mars Global Surveyor (MGS) spacecraft using, in particular, the Mars Orbiter Camera (MOC) and the thermal profiles and dust opacity measurements provided by the Thermal Emission Spectrometer (TES). In this paper, we study the meteorological phenomena associated with the onset and the subsequent evolution of the multiple dust storms (mainly originating in Hesperia Planum and the Tharsis-Claridas region) which added their effects together to create the 2001 planet-encircling storm. We use both the UK Mars global circulation model (UK-MGCM) with the assimilation of TES nadir thermal profiles and dust opacity measurements, and the new Paris-LMD Mars mesoscale model with boundary conditions provided by the UK-MGCM data assimilation. The combined use of the global and mesoscale models allows us to gain access to several meteorological phenomena having different scales and requiring different resolutions. We found that: 1) the initial dust storm located in Hesperia Planum (between the northern slopes of the Hellas basin and the Isidis Planitia) was favoured by strong slope winds which forced the convergence of air in Hesperia Planum and enhanced the associated vertical winds; 2) the thermal effect induced by the thick dust cloud in Hesperia Planum interacted strongly with

the thermal tides, strengthening the tides and causing a phase slip in particular between the sun-synchronous 1-sol period component (diurnal tide) and the 1-sol period, eastward-propagating component, which are usually resonant at fixed longitudes; and 3) this phase slip induced an eastward propagating perturbation in the surface pressure which might have affected the onset of the observed secondary lifting centres in the Tharsis and Claridas regions.