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High resolution global simulations of the Martian atmosphere

S. R. Lewis (1), L. Montabone (1) and P. L. Read (2)

(1) Department of Physics and Astronomy, The Open University, UK, (2) Atmospheric, Oceanic and Planetary Physics, University of Oxford, Oxford, UK. (S.R.Lewis@open.ac.uk)

We present results from general circulation model (GCM) simulations of the Martian atmosphere run using a semi-spectral version of the European Mars GCM at horizontal resolutions of up to 512x256 points in longitude and latitude (a triangular spectral truncation at total wavenumber 170), equivalent to 0.7° or roughly 40 km horizontal resolution. These are designed to complement long-term climate simulations, typically run on 96x48 or 64x32 point horizontal grids (truncated at total wavenumber 31 or 21 respectively), and used to form the European Mars Climate Database (MCD), for example. The current version of this GCM employs the hydrostatic approximation, and its resolution is not as high as that possible with a limited-area mesoscale model, but the present simulations form a bridge between climate experiments and detailed, local simulations. The model is run both freely, with prescribed dust distributions, and with a dust distribution and an initial atmospheric state based on an assimilation of Thermal Emission Spectrometer/Mars Global Surveyor observations.

One motivation for the higher resolution experiments is to investigate the sensitivity to resolution of atmospheric fields such as winds, which might be expected to vary strongly, especially near the surface in regions of high slopes. We simulate times of year on Mars relevant to ExoMars entry, descent and landing and compare the high resolution GCM and MCD predictions. High and low resolution representations of transient waves and other intrinsic variability within the Mars GCM are compared for several times of year and under different dust conditions in order to assess an optimal resolution for different types of GCM experiments.