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# A high resolution mesoscale model for Mars: preliminary results

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## Abstract

Since the begin of the exploration of Mars it has been clear that its atmosphere could be modelled with the same algorithms used for the Earth and, hence, Global Circulation Models (GCMs) have been used to this aim (e.g. [1]).

However on Mars several phenomena require spatial resolutions not achievable by GCMs and, in addition, the assumption of a hydrostatic atmosphere used by GCMs gives severe limits to the further development of such models.

Very recently some terrestrial mesoscale models have been applied to Mars (e.g. [2]), opening a new way of research.

*Description of the model*

The model developed in this work is based on the PSU/NCAR MM5, developed for the Earth [3]. It is a mesoscale, non-hydrostatic model, and, in order to be used on Mars, several changes have been made (i.e. planetary mean radius, seasonal cycles, orbital eccentricity, solar constant and also specific heat and the constant R of gases).

The terrain properties (i.e. albedo, thermal inertia and altimetry) were derived by the available maps from NASA's Mars Global Surveyor Thermal Emission Spectrometer (TES) and Mars Orbiter Laser Altimeter (MOLA).

The model follows an approach never used for Mars, i.e. it is not initialized by a General Circulation Model (GCM), but by another (lower resolution) mesoscale model. For the sake of the clarity the Mars Climate Database (MCD) GCM [1] was used to initialize a 300 km (~ 5°) resolution MM5 and, subsequently, this model initialized the higher resolution (75 km, ~1° resolution) mesoscale model.

The advantage of using this approach is that the initial conditions for the high resolution MM5 were not derived by a hydrostatic GCM, but, on the contrary, from a non-hydrostatic mesoscale model.

The domain under study is equatorial, with a large variability in elevation (~7 km) and is shown in Figure 1.

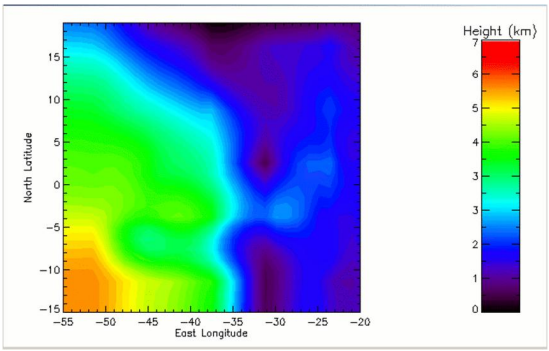


Figure 1: Topographic map of the area under study. The altitudes are relative to the minimum of the domain (and not to mean planetary radius).

The model has been run on 1st June 2004 and the results have been compared with both the low resolution model (the one used for the initialization) and observational data (TES).

*Results*

The comparison has been performed at 02:00 LT and 14:00 LT, when TES acquired vertical temperature profiles.

In Figure 2 the vertical profiles of TES, low resolution MM5 and high resolution MM5 are displayed for the two regions examined at different local times. It is evident that during the night the high resolution enhances the modeling of the Martian atmosphere, while, during the daytime, the two models are quite similar.

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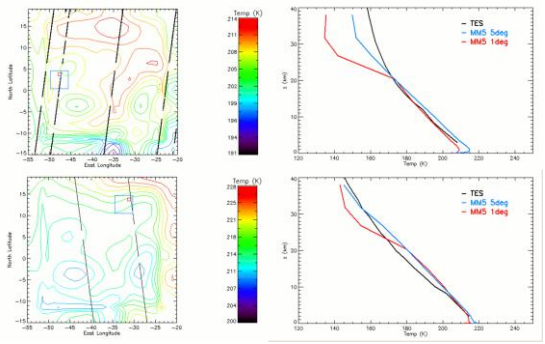


**Figure 2:** On the left: Surface temperatures of the domain at 02:00 LT (top) and 14:00 LT (bottom). The black strips are TES observations, the big blue square is the low resolution cell used for comparison and the red square is the high resolution cell. On the right: Temperature profiles for the two regions highlighted. The black line is the TES vertical profile, the blue line is the low resolution MM5 and the red line the high resolution MM5.

## References

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