Comparison of atmospheric temperatures obtained through Mars Global Surveyor Radio Science and the Global Mars Multiscale Model.

Adam Rosso, Youssef Moudden, and John C. McConnell, *Centre for Earth and Space Science, York University, Toronto, Canada.*

Introduction:

The current work presents a comparison of temperature profiles from the Mars Global Surveyor (MGS) Radio Occultation (RO) data and GM3 (the Global Mars Multiscale) [Moudden and McConnell, 2005]. The purpose of this work is to evaluate the ability of GM3 to produce realistic atmospheric temperatures for a variety of locations and conditions. The comparisons will determine how well the model can predict temperature profiles with varying latitudinal and longitudinal positions. Specific locations will also be compared over different time periods to see how well the GCM predicts seasonal variations.

The current data set provided from the MGS Radio Science instrument includes eight years of data. The database includes such fields as temperature, pressure, latitude, longitude, occultation time, date and geopotential. Quality assurance testing has been completed on the dataset to ensure that the data stored within our local database is accurate and complete.

The current work focuses on comparing RO temperature profiles with GM3.

This study will provide an assessment of the model's potential in simulating temperatures and suggest possible improvements. Such comparison is also helpful in evaluating our ability to understand and properly represent in a conceptual model the thermal and dynamical processes.

Summary of Work:

The current work is on-going and has recently begun An analysis of available data determined that there is sufficient data to complete an annual comparison between the MGS data and synthetic model data.

Specific sampling periods where Northern and Southern Radio Occultations occurred during the same orbit provide opportunities to study the temperature profiles of different hemispheres of Mars within a small time scale difference. By studying these sampling periods, an analysis should determine characteristics of seasonal atmospheric temperature profiles.

For the initial study we have split the dataset into seasonal groups, Spring, Summer, Autumn, and Winter as determined by the Ls value calculated from orbital information. Seasons are a reference to the season in the Northern Hemisphere. Since occultation of both the Northern Hemisphere and Southern Hemisphere on the same orbit does not occur every month, the data set was narrowed to a maximum of two months of data per season. In each month long dataset, a maximum of the days of data was used. Frequently, the Northern Hemisphere (~60°-70° North) was sampled more often.

To compare regional longitudinal areas, Mars was split into six 60° sections running north to south. Some months MGS did occultation measurements over a variety of latitudinal locations. These sampling periods reveal a good distribution of temperature profiles which help determine atmospheric temperature conditions in the tropics, sub tropic and Polar Regions within a month time scale.

Height above the surface was calculated from the geopotential value in the original dataset. Gravitation acceleration for these calculations was taken to 3.6 m^2/s.

Conclusions and Further Work:

Seasonal patterns are clearly evident in the temperature profiles. During the summer and winter seasons, surface polar temperatures vary from ~145°K to 220°K in southern and northern polar regions respectively as shown in Figure 1.

Temperature profiles for RO data are shown in Figures 2 and 3 for north and south Polar Regions respectively. For Figure 1, the data are averaged over LS = 140° to 153°. It is clear that in spite of solar heating that the cold temperature of the (water) polar cap at this time is strongly constraining temperatures in the PBL. Figure 3, for the south pole indicates clearly the effects of strong radiative cooling in the southern winter.

When observing occultation measurements in the mid-latitudes there appears to be a larger variation of temperature where as in the equatorial regions there seems to be more stable profiles.

At the wok shop we will present a detailed comparison with GM3 temperature profiles and evaluation presented.

Acknowledgement

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Figure (1)

Summer temperature vs. height profile in polar regions. LS= 140º to 153º

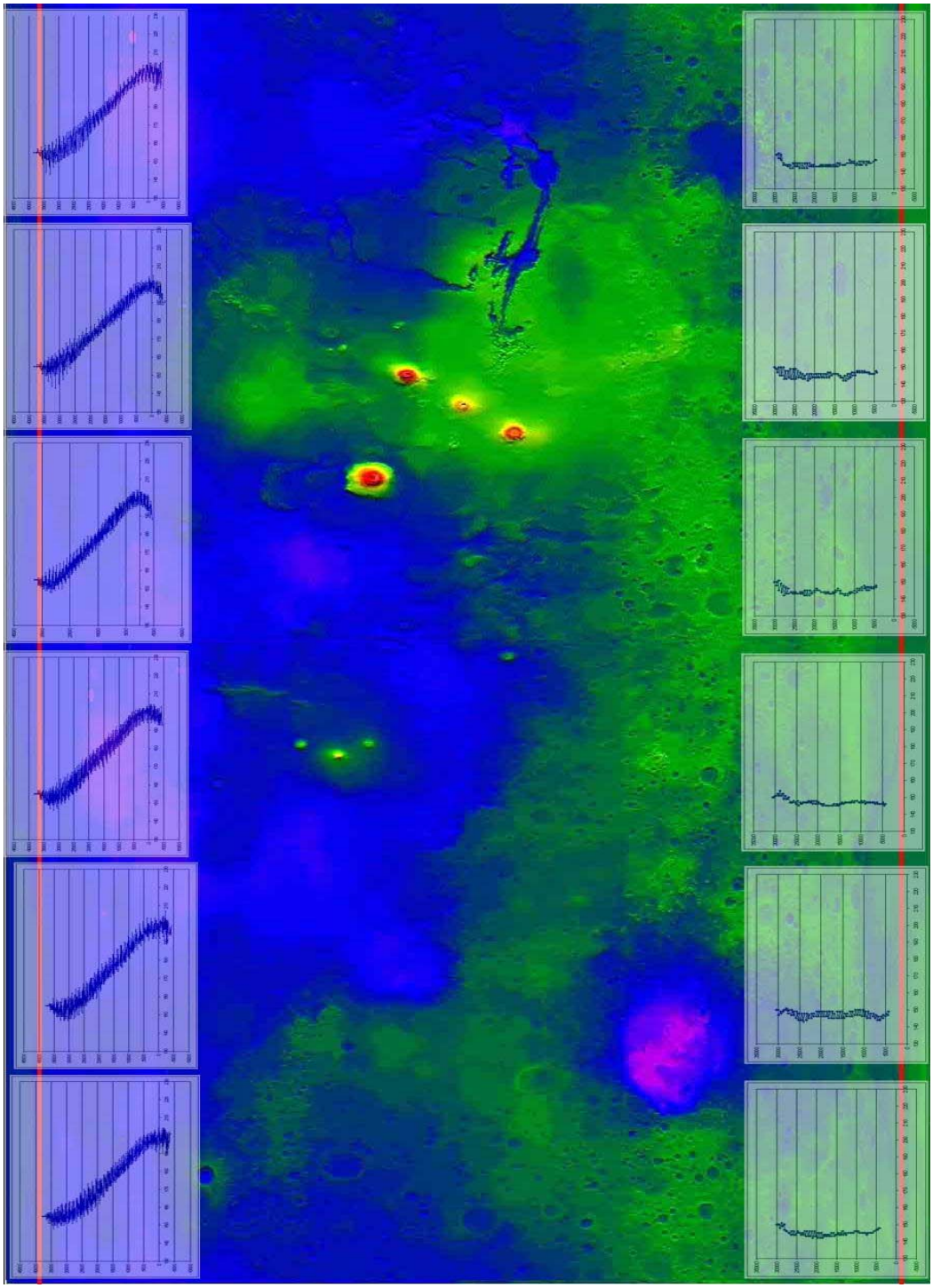


Figure (2)

Summer temperature profile for 83º North. LS = 140º to 153º

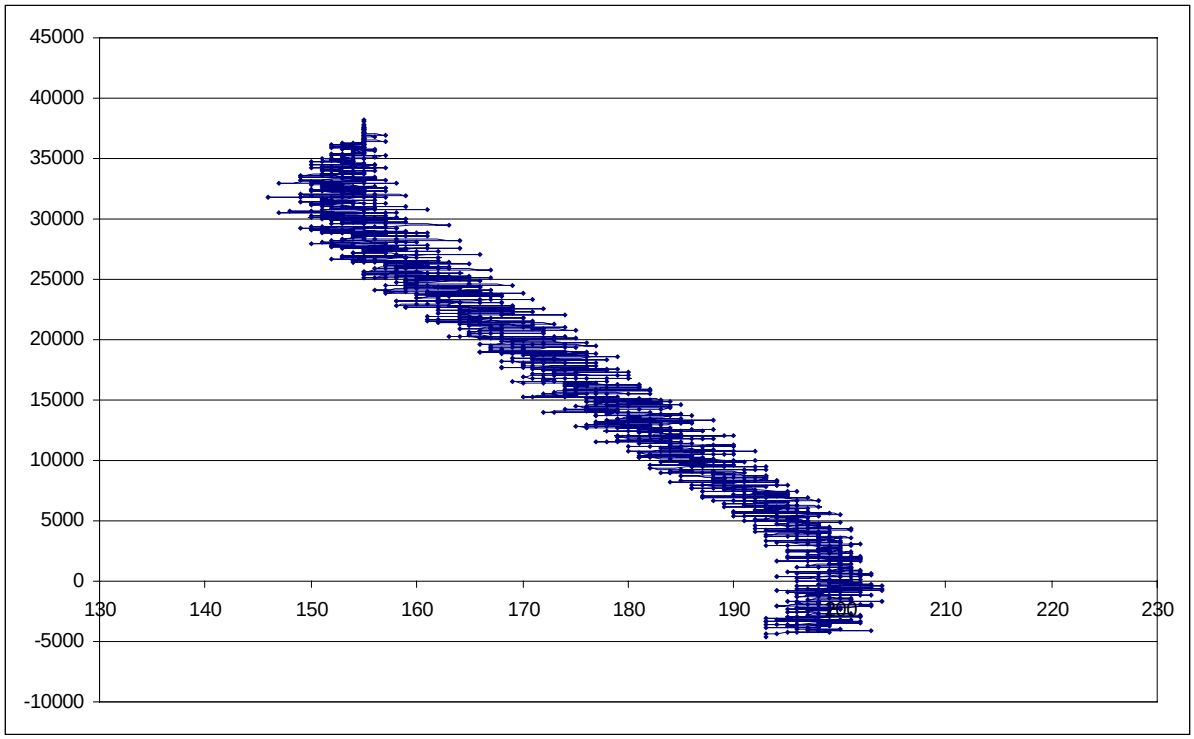
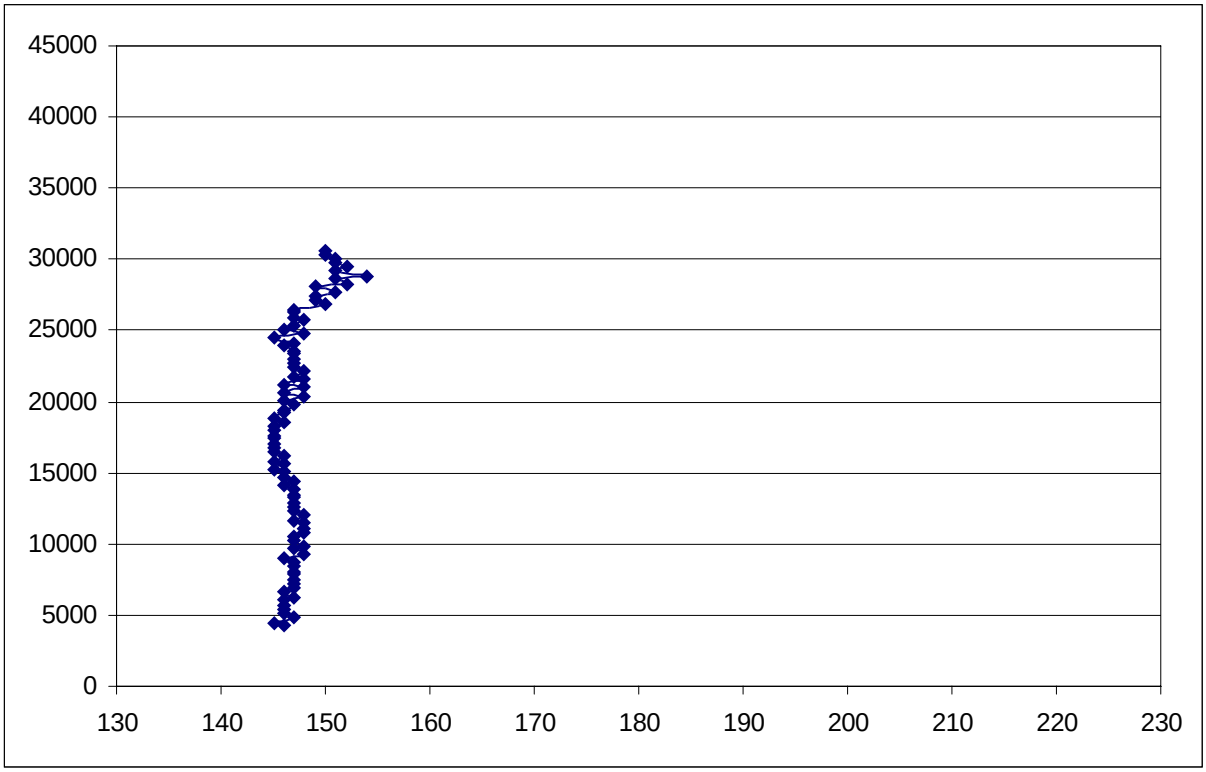


Figure (3)

Winter temperature profile for 89º South. LS = 140º to 153º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