DOWNWARD CONTINUATION OF THE MARTIAN MAGNETIC FIELD. J. R. Espley[1], J. E. P. Connerney[1], D. M. Jurdy[2], and M. H. Acuña[1], [1]Solar System Exploration Division, Code 695.0, Goddard Space Flight Center, Greenbelt, MD 20771 (Jared.Espley@gsfc.nasa.gov), [2]Department of Earth and Planetary Sciences, Northwestern University, Evanston, IL 60208, donna@earth.northwestern.edu.

Introduction: Mars Global Surveyor's (MGS) magnetometer/electron reflectometer (MAG/ER) instrument observed regions of strongly magnetized crust on Mars [1]. The strongest crustal fields were observed in a series of linear bands in the ancient southern highlands [2] but physically significant fields were observed over many regions of the planet.

The most accurate map of these crustal fields comes from data acquired during the approximately 400 km altitude MGS mapping orbit. This is because the large number number of observations (over 6 years worth) yielded excellent statistics and allowed Connerney et al. [3] to create a map using only nightside data in which the influence of the solar wind induced magnetic fields is small. However, data acquired during the premapping mission phases are also of great interest since it was acquired from much lower altitudes (between 80 and 200 km) and hence has much better spatial resolution of the source fields. Unfortunately this data is much sparser and was usually acquired during daytime illumination and hence contains large, time-varying induced fields due to the solar wind. Hence, for many purposes it would be useful to have data with the accuracy of the mapping orbit data and spatial resolution as good as the premapping orbit data. By downward continuing the mapping orbit data we can achieve such a goal.

Downward Continuation: Continuing field measurements (gravity, magnetic, etc.) made at one distance from the sources to another distance either closer or farther has been used in numerous applications [4]. Essentially one finds the distribution in Fourier space of the sources as observed at one's observing altitude, and multiplies this distribution by an continuation function to either upward or downward continue the distribution. Upward continuation is a smoothing function and maps, at higher altitudes, the contribution of the most extended sources. Downward continuation is subject to any noise in the original data since it strongly amplifies the smallest variations in the signal. Thus, downward continued signals must filter the size of the distribution of sources allowed to contribute to the continued field. In using the MGS MAG data we have found that for downward continuations from the mapping orbit to approximately the altitude of the premapping orbit we need to exclude source distributions with spatial extents of less than several hundred km to prevent the noise from overwhelming the signal.

Since we have the premapping data for the altitude to which we are continuing the mapping data, we are able to make comparisons between these datasets. This provides a sort of "ground-truthing" of the downward continuation although one must remember the weaknesses of the premapping data (its sparseness and its contamination with the solar wind induced fields).

Case examples: We have downward continued the mapping orbit data over a number of interesting regions of Mars. We note two of these regions.

North pole. Figure 1 shows an example of our results. Panel (a) shows the original mapping orbit data from 400 km whereas (b) shows this data downward continued to 200 km. Notice that the color bars are different for these panels. Panel (c) shows the original premapping data from 200 km with the same color bar as in (b). Panel (d) shows visual topography for comparison.

A number of features are visible only in panels (b) and (c) indicating the value of lower altitude data. However, there are significant differences between these datasets as well. We interpret this differences as due primarily to the solar wind induced fields in the premapping data.

Southern crustal fields. Another interesting region is the area of strong crustal fields in the southern highlands. Jurdy and Stefanick [5] carried out downward continuation of mapping orbit data in this region using a Cartesian approximation and found that it closely matched premapping data from around 100 km. We have also downward continued this data and find similar results. We also find that the downward continued data accentuate the east-west linear trending of the crustal fields. This result reinforces [2].

References: [1] Acuña M.H. et al. (1999), *Science* , *284*, 790-793. [2] Connerney, J.E.P, et al. (1999), *Science*, *284*, 794-798. [3] Connerney, J. E. P. et al. (2005), *PNAS*, *102*, doi / 10.1073 / pnas.0507469102. [4] Blakely, R. J. (1995), *Potential Theory in Gravity & Magnetic Applications*, Cambridge University Press. [5] Jurdy, D. M., and M. Stefanick (2004), *JGR*, *109*, doi:10.1029/ 2004JE002277.

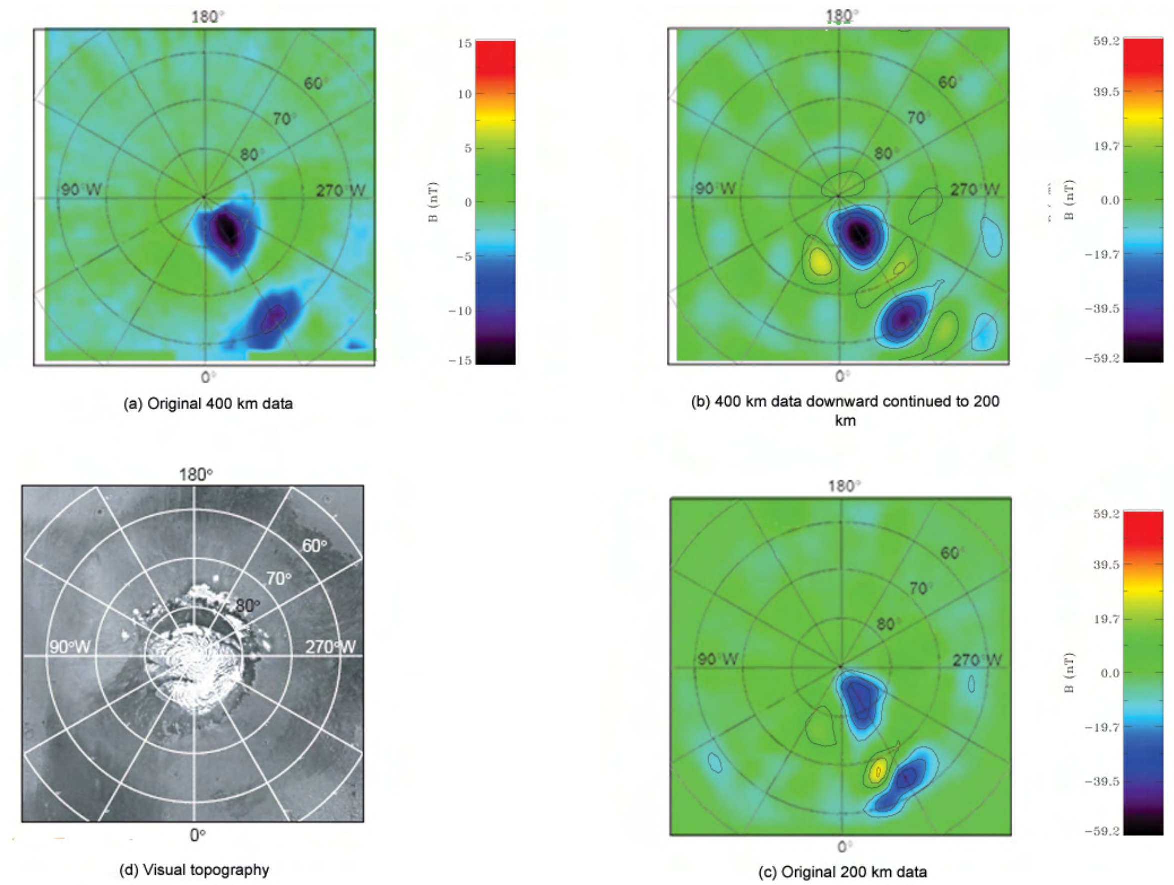

Figure 1 Panel (a) shows the original mapping orbit data from 400 km whereas (b) shows this data downward continued to 200 km. Notice that the color bars are different for these panels. Panel (c) shows the original premapping data from 200 km with the same color bar as in (b). Panel (d) shows visual topography for comparison.