Mars Global Surveyor Accelerometer Experiment data: Longitudinal wave features during phase-2 aerobraking

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Introduction

Mars Global Surveyor's Accelerometer Experiment has observed stationary longitudinal structure in upper atmospheric densities at 130 km. Variations in density by a factor of 3 were routine. Such variations were not predicted prior to their discovery.

The fact that this **longitudinal** structure was seen in data collected at an essentially constant latitude and Local Solar Time requires the cause of the structure to be fixed with respect to longitude. Any cause satisfying this requirement is most likely surficial (topography is a prime candidate.) An origin in the lower atmosphere, followed by propagation up through the middle atmosphere to 130 km, means that the longitudinal structure contains information on the properties of the lower and middle atmosphere.

As the longitudinal structure was not predicted prior to discovery, our understanding of the martian upper atmosphere is incomplete. As it originates in the lower atmosphere, our understanding of the lower and middle atmosphere is incomplete as well. When its implications are fully understood, they may extend to surface processes with an atmospheric interaction, such as aeolian erosion and the CO_2 sublimation and deposition cycle

Starting Points For Discussion

How will MCO's aerobraking extend this dataset?
Are densities at 130 km all you can measure?
Occasionally the spacecraft samples the same longitude, latitude, and Local Solar Time on a daily basis. How extreme is this day-to-day variability?
Is there a similar video for inbound densities as they cross the South Pole and Local Solar Time changes to 2am?

About The Video

The video shows changes in the longitudinal structure in outbound density at 130 km over the duration of Phase-2 aerobraking (September 1998 - February 1999). Seasonal progression is very slow during northern spring (aphelion) and the Local Solar Time at which the measurements were made decreased from 5pm to 3pm. Conversely, the latitude at which the measurements were made changed significantly, beginning at 60'N and moving southward to the South Pole by the end of Phase-2.

Frames in the video show an 11 parameter wave-5 fit to all measurements within a 10' latitude range. The step-size between frames is 5'. Each frame shows the latitude, local solar time, date, and periapsis number range of the data. At around 10'S spacecraft problems prevent the instrument team from obtaining the density data. The paucity of data in this region causes the fitting procedure to fail and you see a few crazy frames. They're not real.

Crosses are MGS accelerometer data, solid line is wave-5 fit, dotted lines are one sigma uncertainties in the fit.

What To Look For In The Video

Decrease in mean density as we move into the winter hemisphere.
Wave-3 pattern in the north, peaks at 90'E, 250'E, 330'E.
Wave-2 pattern in the tropics, peaks at 90'E, 250'E.
Weak wave-1 pattern in the south, peak at 180'E.
Decay of 90'E peak and rise of 250'E peak.
Comparison with topography