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P41A-05: Harmonic Analysis of Zonal Density Structures in Martian Upper Atmosphere

The MGS accelerometer has measured upper atmospheric densities at many latitudes, longitudes, altitudes, LSTs, and seasons.

Measurements of the intrinsic variability of upper atmospheric density from day to day at fixed latitudes, longitudes, altitudes, LSTs, and seasons show how that variability changes with latitude, altitude, and LST.

It has revealed a stable longitudinal structure to upper atmospheric density at fixed latitude,

altitude, LST, and season and shown how that pattern changes with latitude, altitude, and LST.

Day-to-Day Variability

When the martian day is close to an integer multiple of the spacecraft orbital period, MGS periapsis passes occur at essentially the same latitude, longitude, altitude, LST, and season on successive days. As MGS's orbital period decreases due to aerobraking forces, this resonance passes and only a few orbits are clustered together. We measure the day to day variations in atmospheric density within this cluster, at a location that is essentially fixed.

Inbound and outbound crossings of the 130 km level are about 20' apart, so we measure the atmospheric variability at the same longitude, altitude, LST, and season at different latitudes. Temporal control can be seen to be more important than latitudinal control. Variability decreases with altitude, though variabilities at a given latitude, longitude, LST, and season are related.

Towards the end of Phase 2, the 11:1 resonance occurred when the inbound leg at 130 km was near 70S at 0100 LST and the outbound leg was near 70S at 1500 LST. There is no strong evidence for LST-control of this variability.

Longitudinal Structure

Density measurements at fixed latitude, altitude, LST, and season reveal longitudinal structure which is relatively stable on weekly timescales. Here I show the structure at 130 km on the inbound and outbound legs of aerobraking between 10S and 20S during Phase 2. Each panel contains about a week of data, with a week's gap between the two data sets.

The change in this structure with altitude can be seen. Its strength decays as altitude increases but the phases of individual harmonics stay constant

Phases are very constant with latitude, consistent with John Wilson's MGCM predictions. There is no obvious control by the phase of the underlying topography. The amplitudes of individual harmonics vary, with waves 2 and 3 being most important.

Diurnal variations in the longitudinal structure are present, though interpretation is difficult.

Conclusions

Day-to-Day Variability

* Day-to-day variability can be studied in unprecedented detail with this dataset.
* Temporal control is more important than latitudinal control.
* No obvious time-of-day control is observed.
* Variability decreases as z increases.

Longitudinal Structure

* Longitudinal structure, stable on weekly timescales, is ubiquitous.
* Its strength decreases as altitude increases.
* Individual harmonic phases are constant with altitude and latitude.
* Diurnal variations are present.