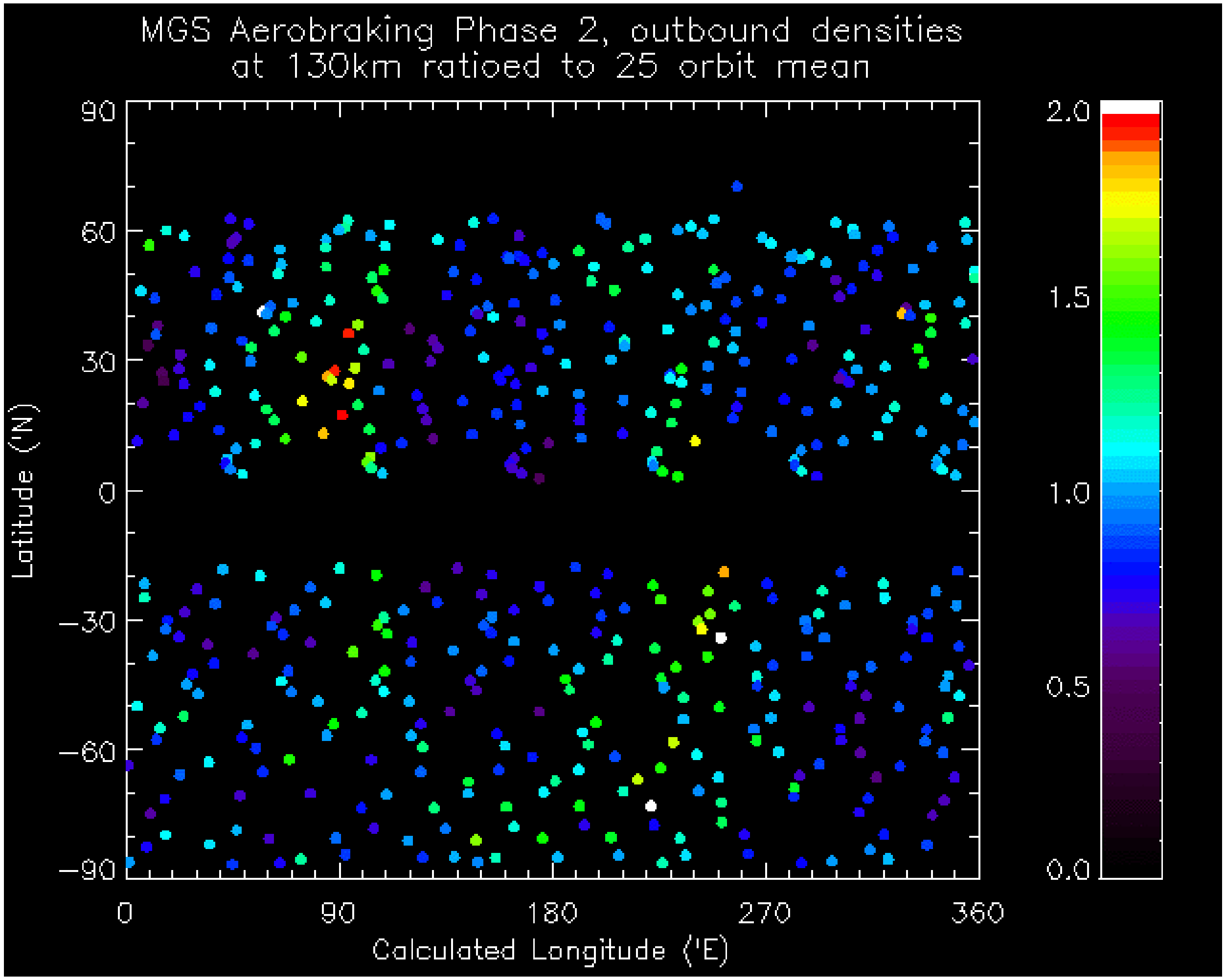
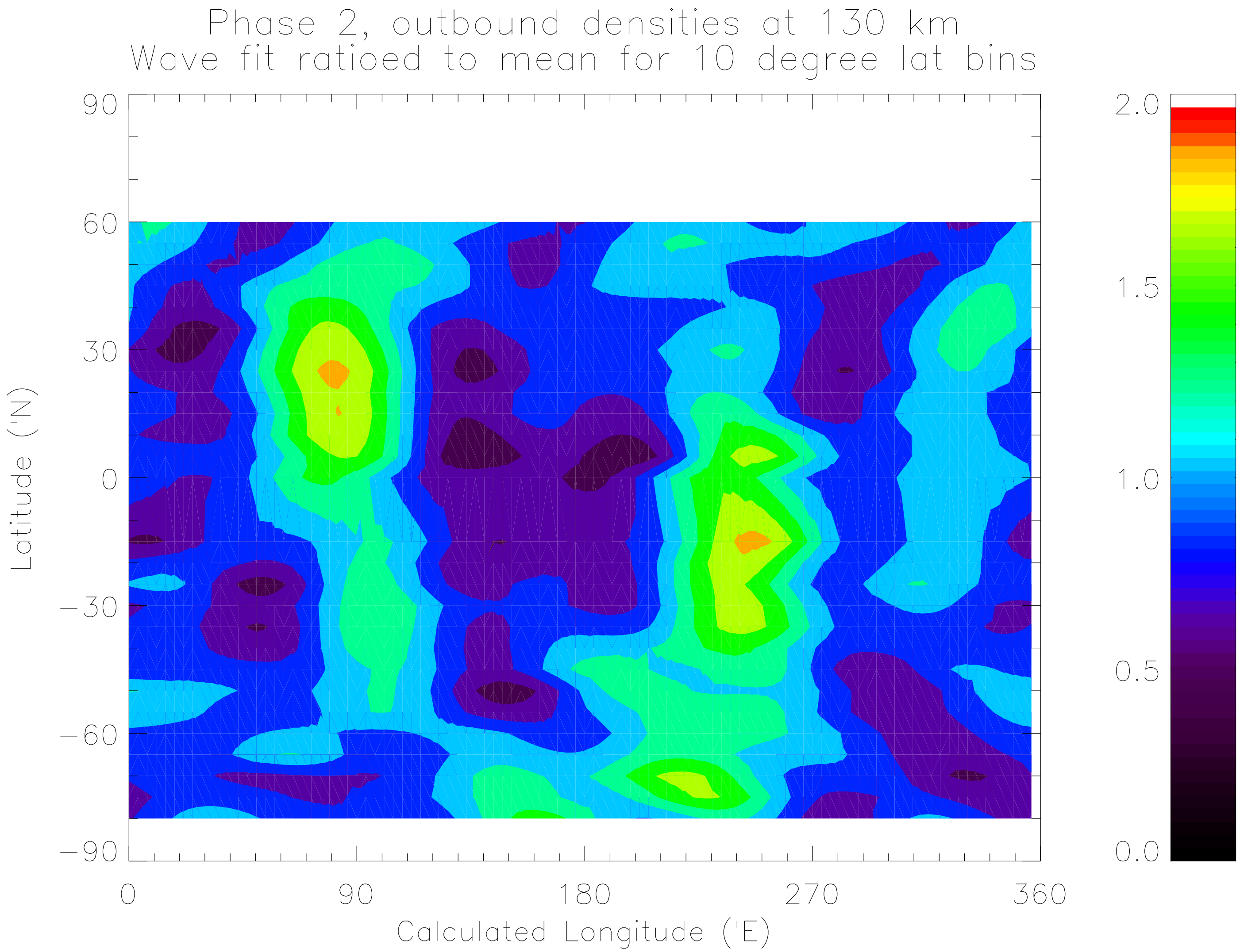
Introduction

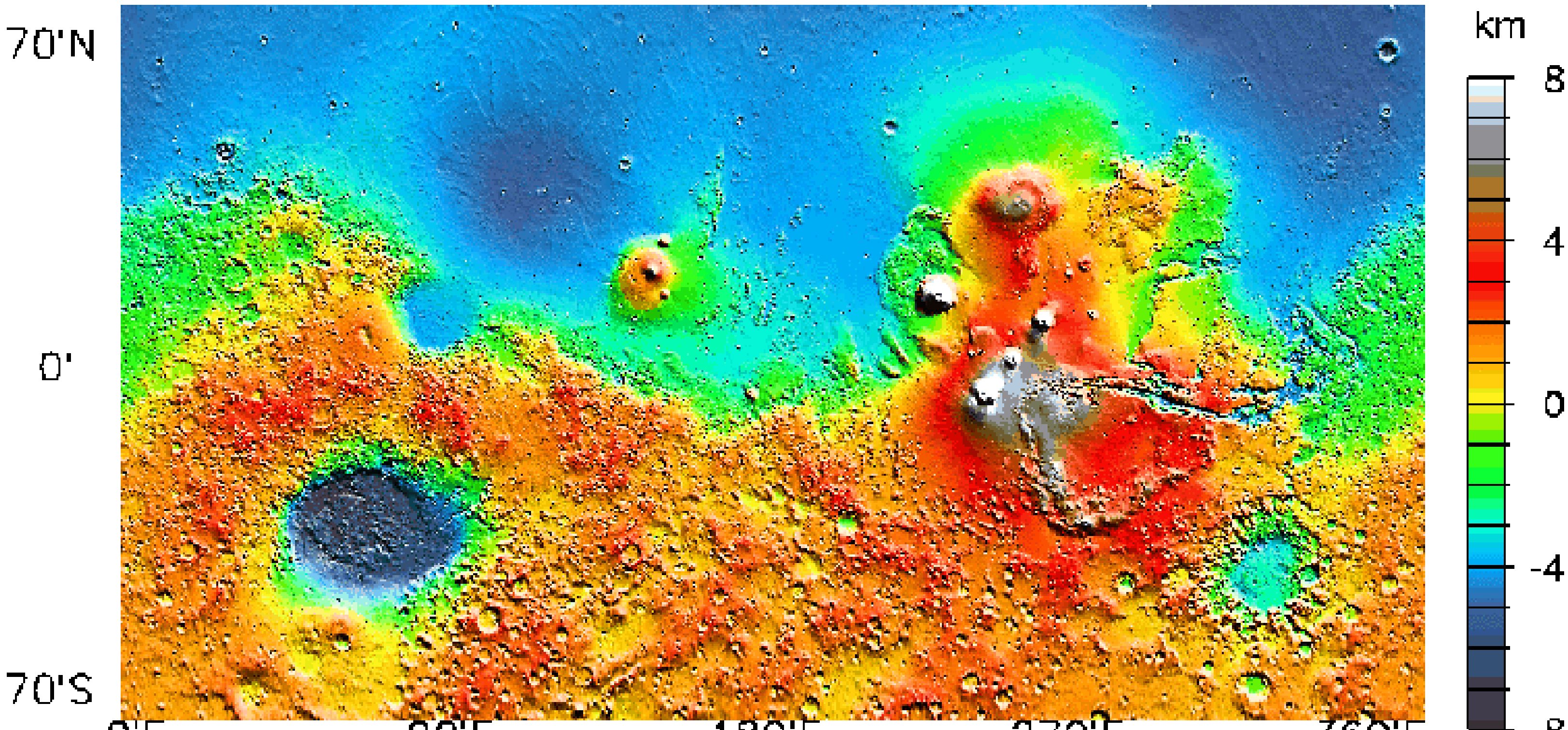
- The MGS accelerometer has revealed the behaviour of the martian upper atmosphere on daily, weekly, and seasonal timescales.
- Longitudinal variations in density measurements made at fixed latitude and local solar time require a forcing from the surface or interior of Mars.
- The longitudinal structure changes with local solar time.



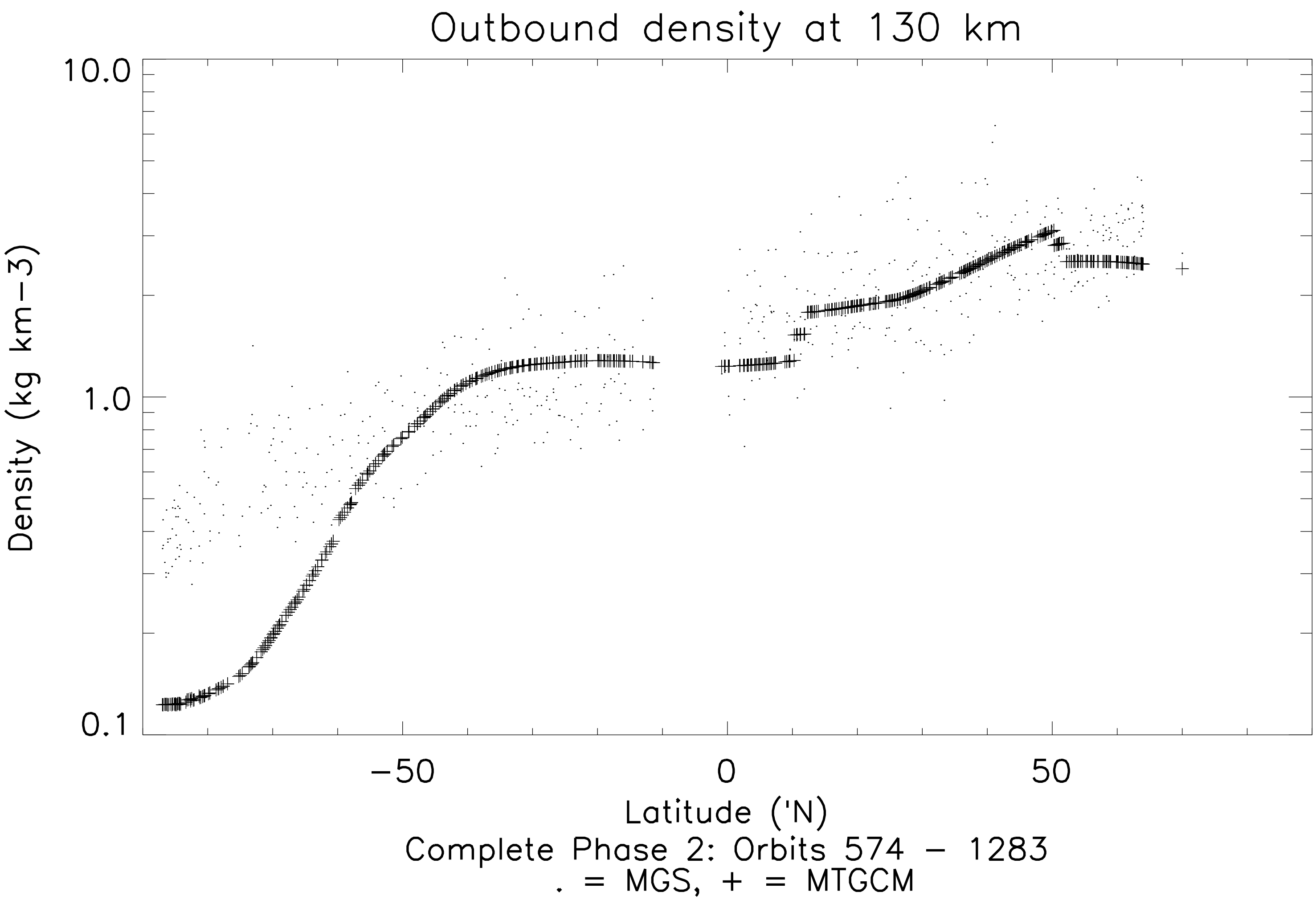
Longitudinal structure in the martian upper atmosphere



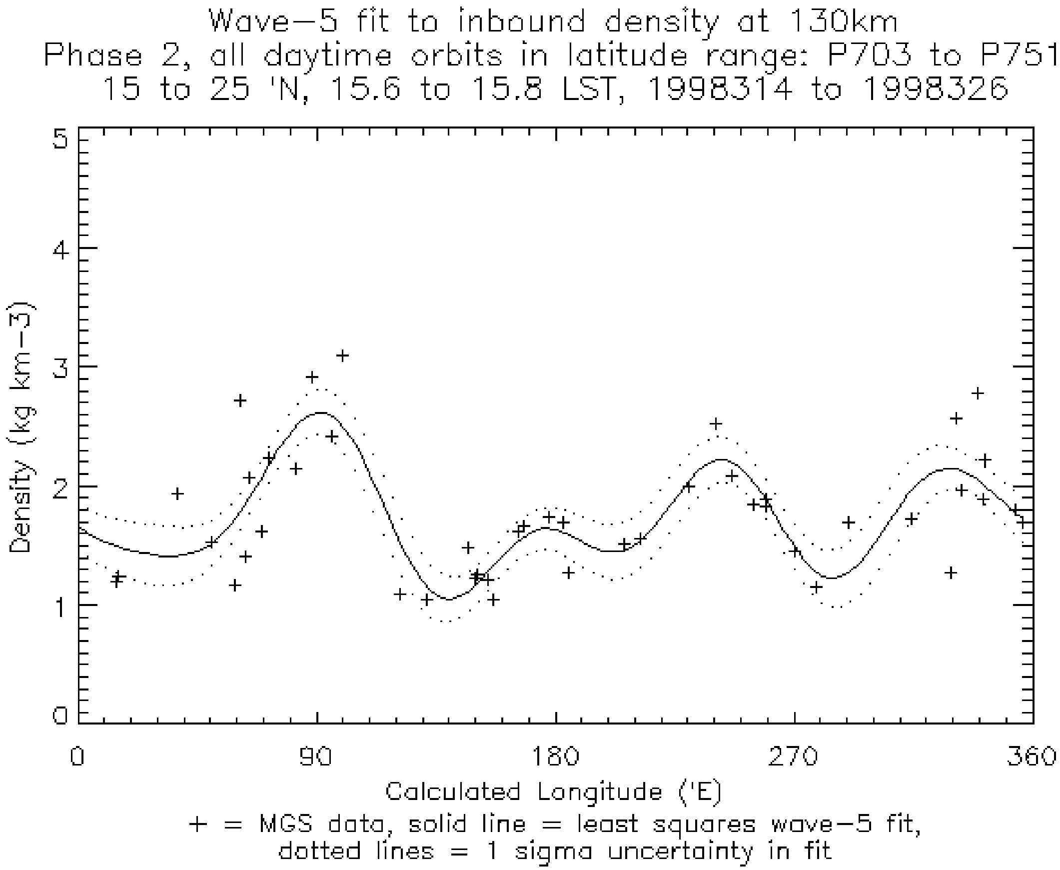
Fitted density at given latitude ratioed to mean density at that latitude



Smith, Zuber, et al topography, Science, 1999

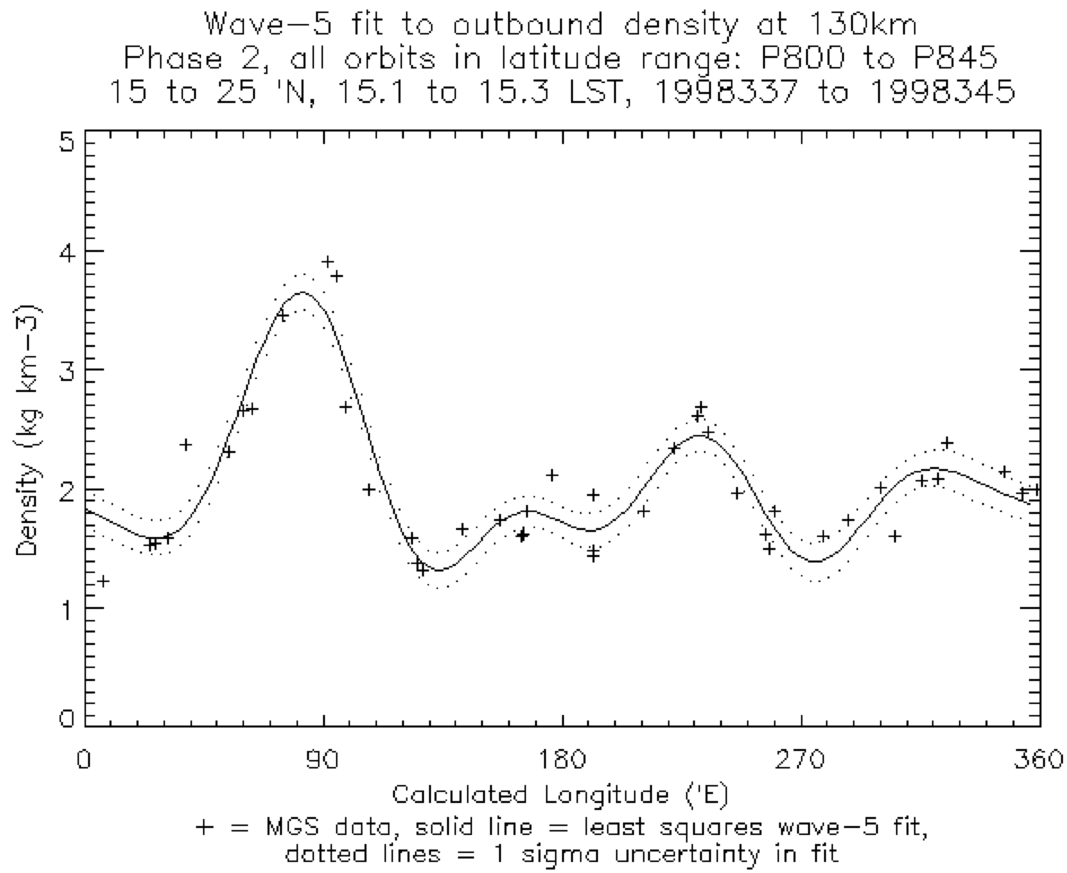


Poor predictions in polar regions



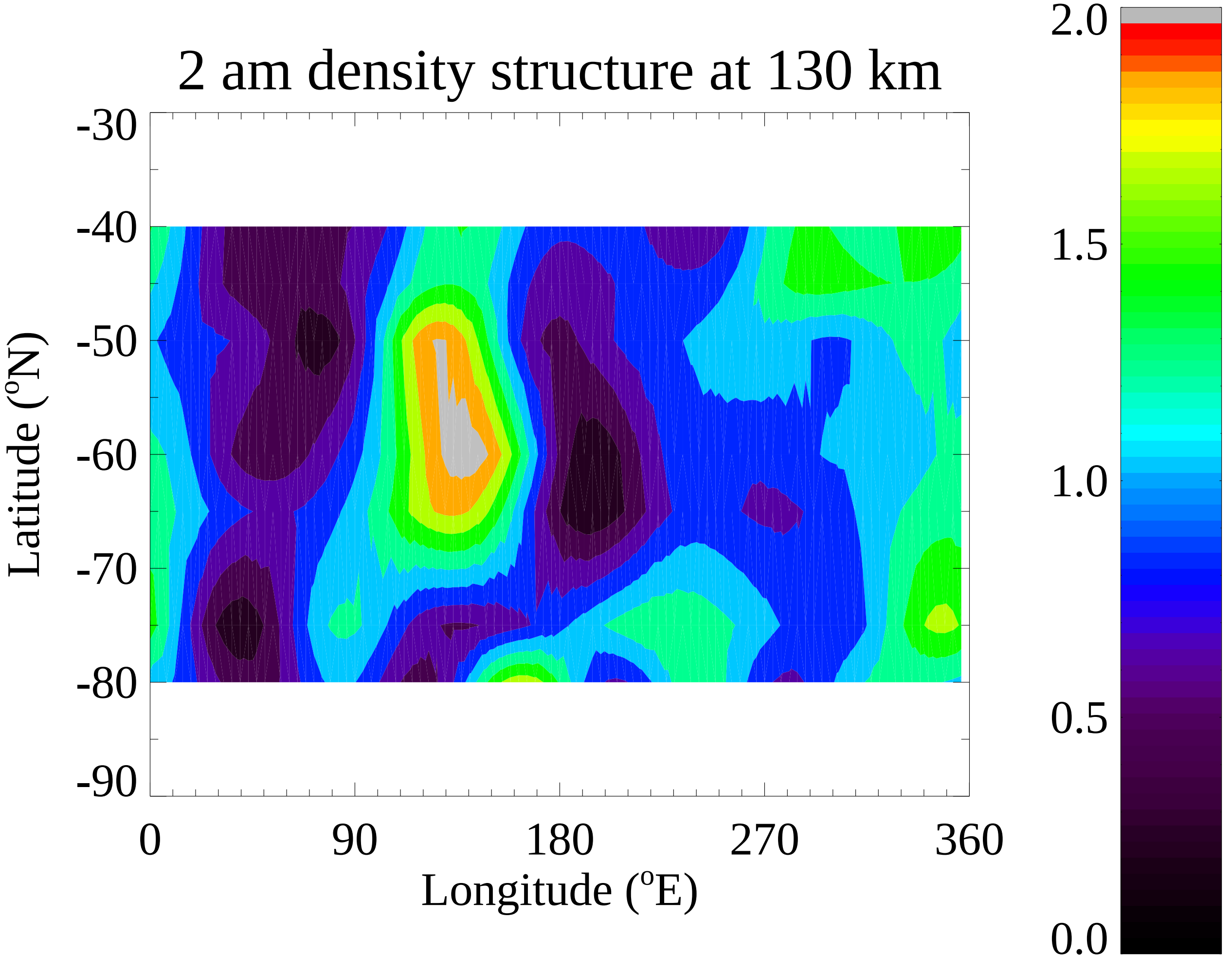
Densities around 20^{o} N in November 1998

See December for small changes on two week timescale

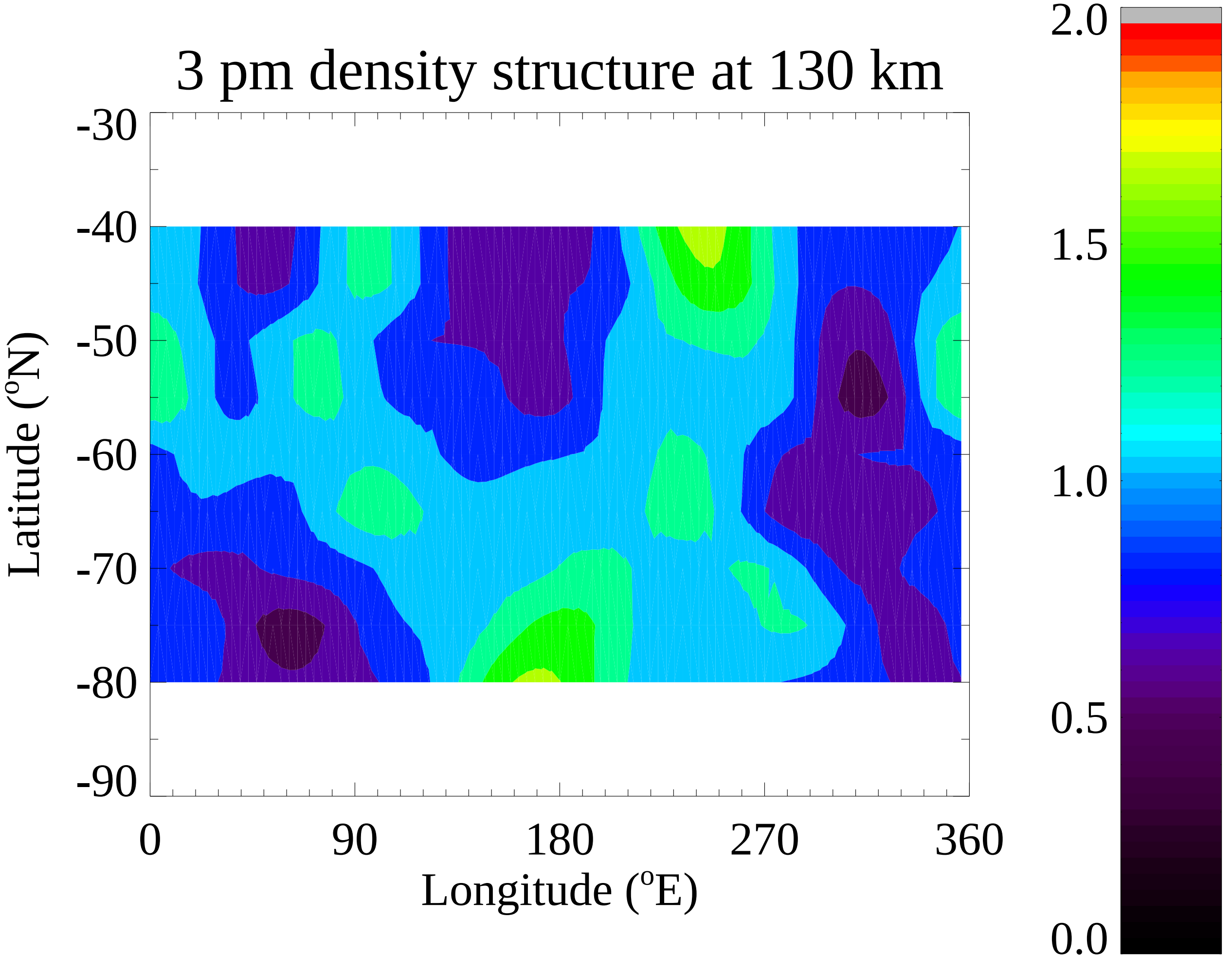


Densities around 20^{o} N in December 1998

See November for small changes on two week timescale

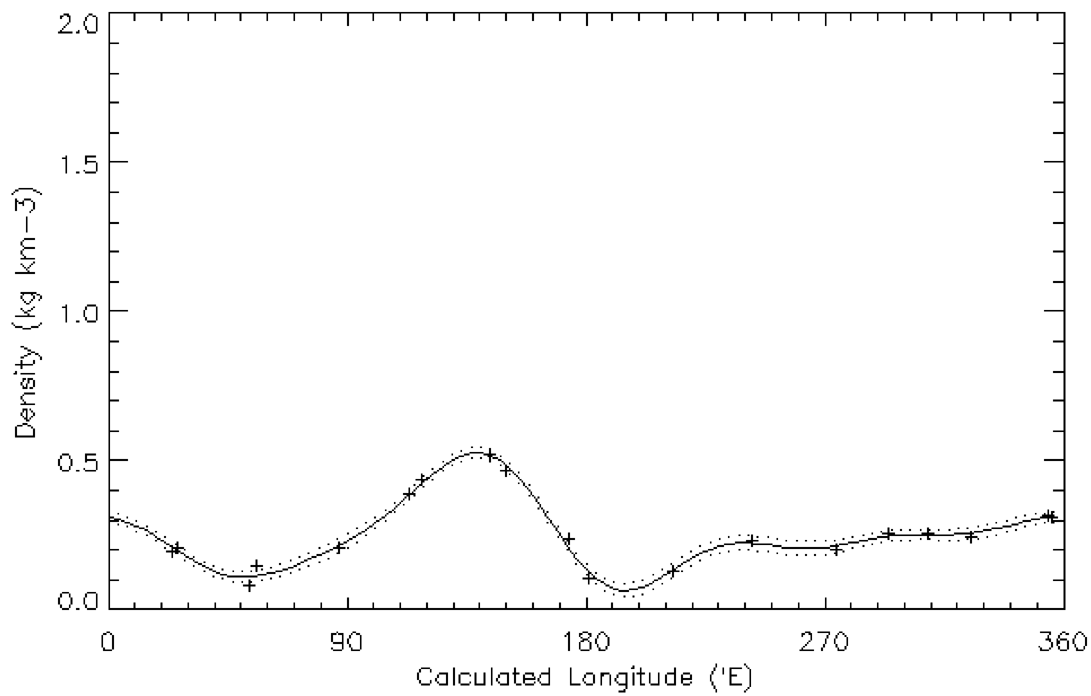


Variation in density structure with Local Solar Time
Ratio of fitted density to mean fitted density at same latitude



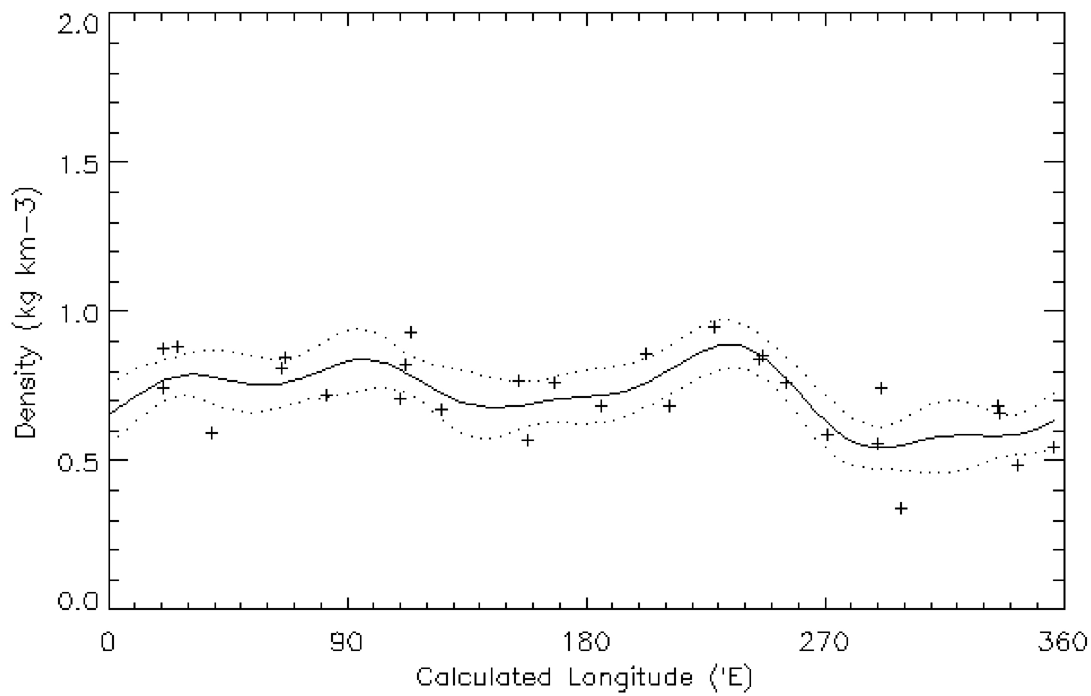
Variation in density structure with Local Solar Time
Ratio of fitted density to mean fitted density at same latitude

Wave−5 fit to inbound density at 130km
Phase 2, all nighttime orbits in latitude range: P1196 to P1218
−65 to −55 'N, 1.6 to 1.8 LST, 1999028 to 1999029

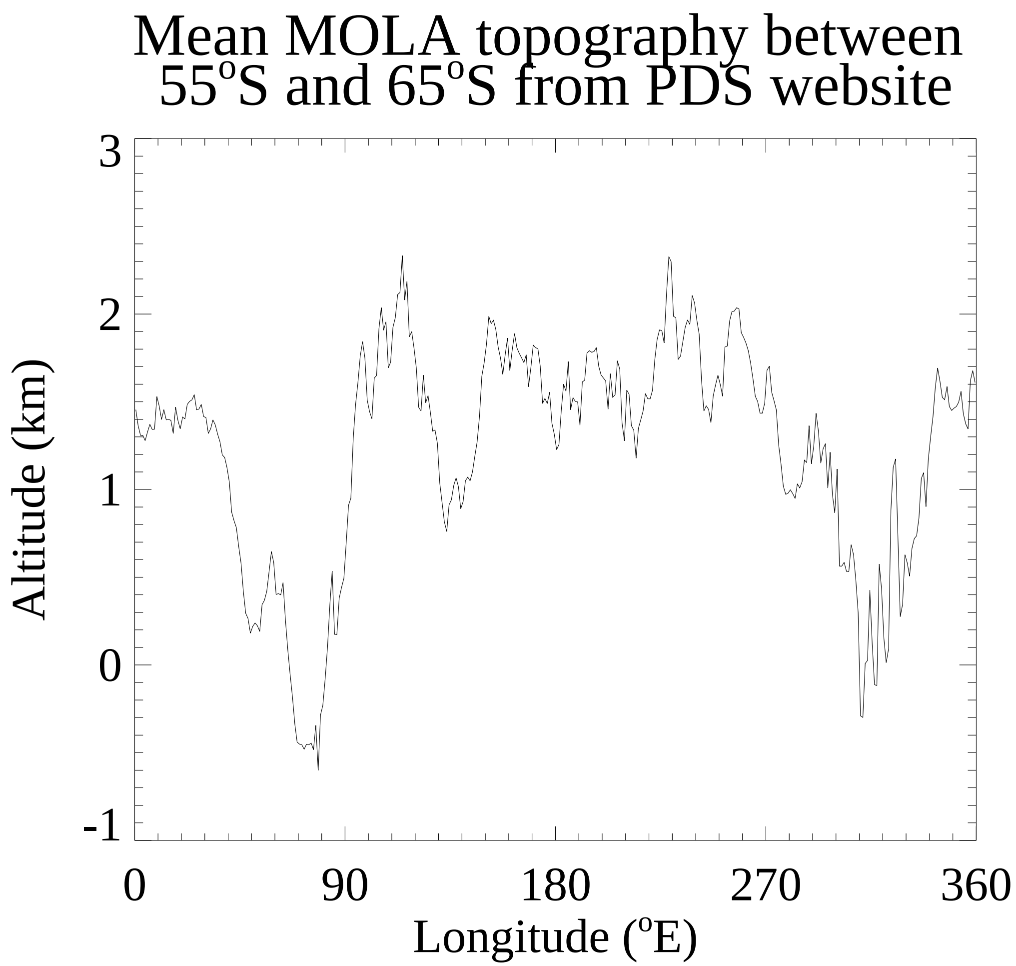


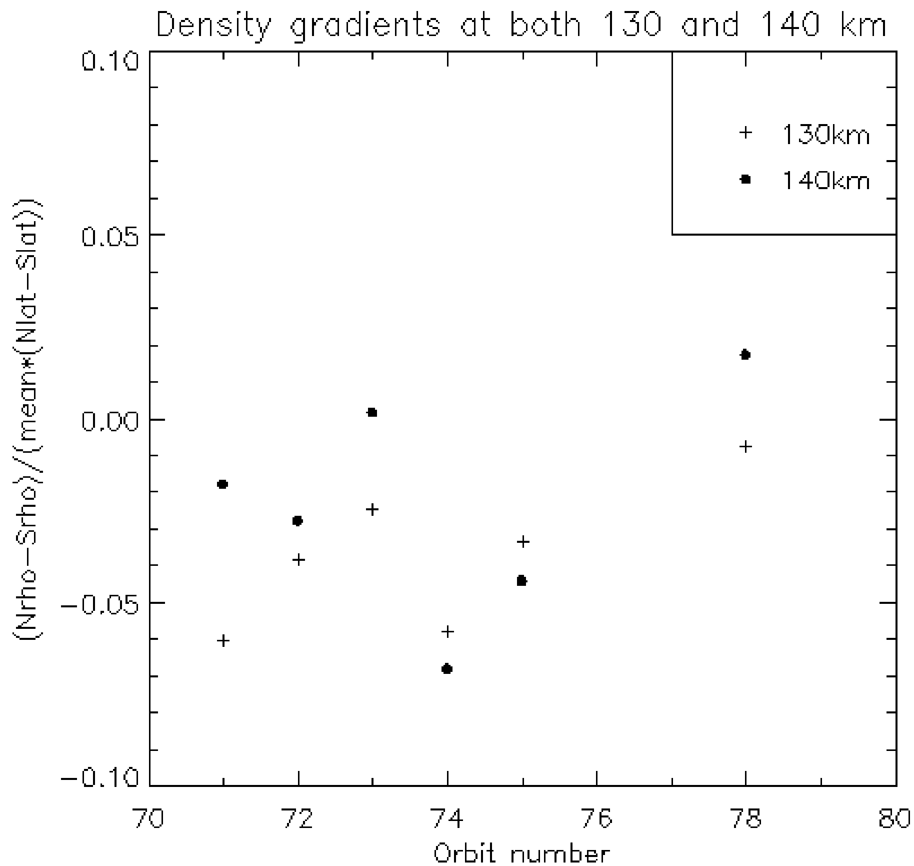
+ = MGS data, solid line = least squares wave−5 fit,
dotted lines = 1 sigma uncertainty in fit

Wave−5 fit to inbound density at 130km
Phase 2, all daytime orbits in latitude range: P1037 to P1068
−65 to −55 'N, 14.9 to 15.0 LST, 1999010 to 1999014

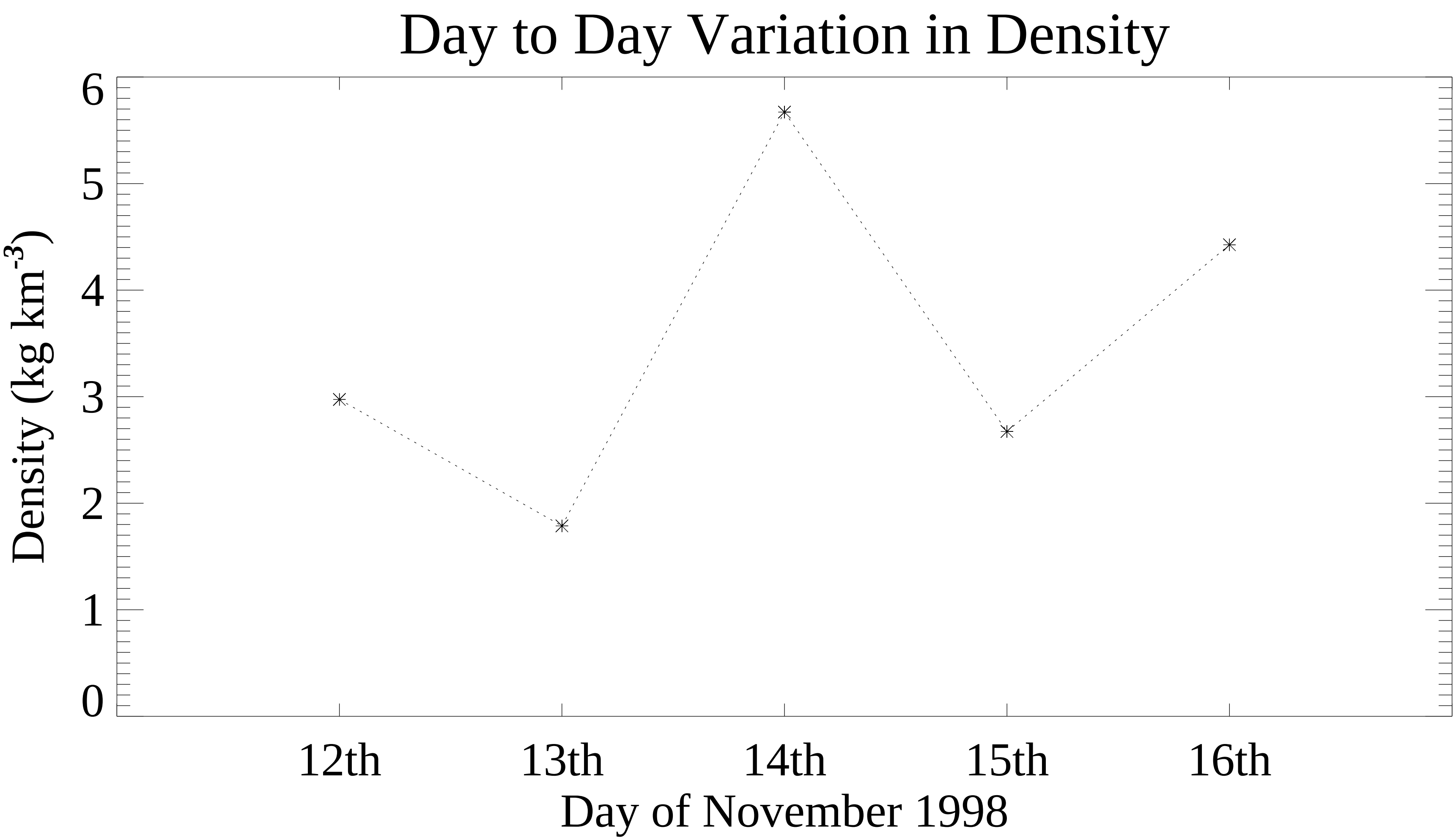


+ = MGS data, solid line = least squares wave−5 fit,
dotted lines = 1 sigma uncertainty in fit


Mean MOLA topography between
55°S and 65°S from PDS website
3
2
1
0
-1
Altitude (km)
0
90
180
270
360
Longitude (°E)



Persistent negative density gradient is consistent with positive westerly shear within the mean polar vortex (i.e., mean zonal jet) (Jeff Hollingsworth)



These five measurements were made at the same latitude, longitude, and local solar time. The large variations give some idea of the intrinsic variability of the martian upper atmosphere. This is an extreme case, variabilities of 35% are more typical.

Future Work

- Soon-to-be-released data will provide density and derived pressure and temperature measurements at all points along atmospheric path - a major improvement on the current three data points per periapsis.
- Modelling to understand longitudinal structure.
- Study variability on daily, weekly, and seasonal timescales.

Conclusions

- Ubiquity, stability, and large amplitude of longitudinal structure make it an important martian phenomenon.
- It contains as-yet-unextractable information on the martian lower atmosphere.
- The longitudinal structure is stable on weekly timescales, though daily variations in density can be as much as a factor of two.
- Changes with local solar time argue against a stationary wave origin for the longitudinal structure.