Analysis of Accelerometer Data from Aerobraking

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Personnel

- PI Michael Mendillo (Boston University)
  - Institutional PI
- Co-I and Science PI Paul Withers (Boston University)
  - Data processing, documentation, science
- Co-I Jim Murphy (New Mexico State University) and an NMSU graduate student
  - Data validation, PDS interface, science

Where do I fit?

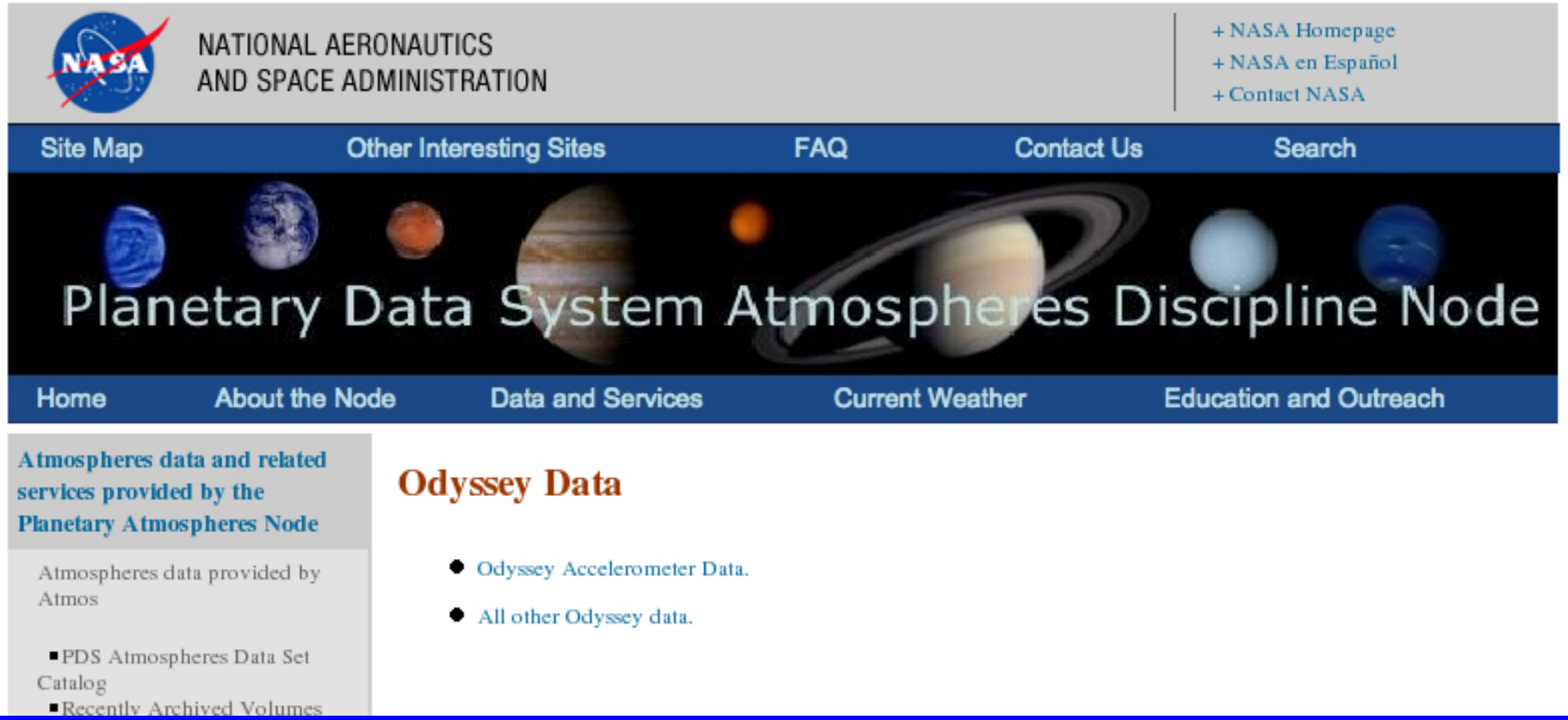
- GRS (Boynton, Feldman, Mitrofanov)
- THEMIS (Christensen)
- MARIE (Zeitlin)
- and me

- Is interface between me and Odyssey project different from that for other Participating Scientists?
  - Possibility of isolation is a potential concern

Aerobraking = Ancient History?

- Aerobraking from October 2001 – January 2002
- Instrument Lead was Keating (LaRC)
- Science input from Aerobraking Advisory Group (Zurek, Bougher, Murphy, others)
- Atmospheric densities derived from accelerometer measurements
- Operational support only

- No published papers, no archived data



Odyssey Accelerometer Archives

About Accelerometer Data Products

A reduced Accelerometer data set is being archived with PDS. At the present time, it is mostly undocumented and has not undergone a peer review. **Users should exercise due caution when using these data.** It is very likely that this will be the only Odyssey Accelerometer data set that is archived with PDS.

Objectives

- Convert a(t) into ρ(lat,lon,z)
  - This needs lots of information
  - I'm going to describe what I need
  - If you have it, talk to me

- Archive data products with PDS
- Do science with data products

Theory: $ma = \rho C A v^2 / 2$

- Measure a
- Know m, A, v
- Know C as function of ρ using database

- C x ρ is nice, monotonic function of ρ
- Find ρ
- Repeat for every timestep and orbit

$ma = \rho C A v^2 / 2$

- m: 461 kg at start of aerobraking
  - I want m for each periapsis pass
  - I want uncertainty for each value of m

$ma = \rho C A v^2 / 2$

- a: aerodynamic acceleration along spacecraft y axis, nominally parallel to flow
  - Raw accelerations also include effects of thruster firings and angular accelerations
  - Low rate (1 sample every second)
  - High rate (Average of 200 samples every second, better quality)
  - Both delivered to PDS by Keating's group without documentation
  - Have effects of thrusters been removed?
  - If not, how do I remove them?
  - Have angular accelerations been removed?
  - If not, I have enough information to remove them

$ma = \rho C A v^2 / 2$

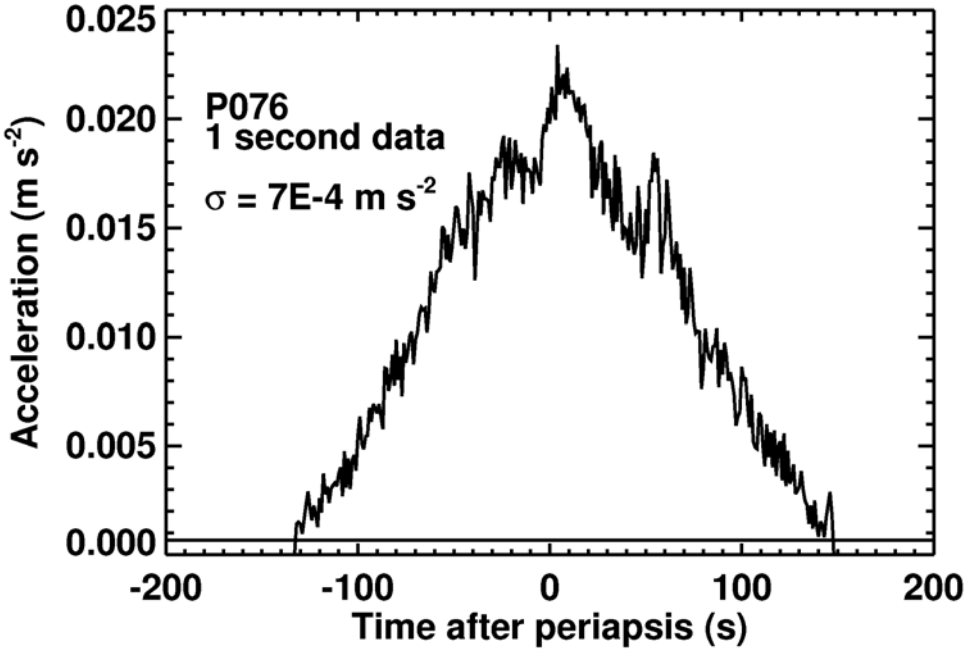
- C: aerodynamic coefficient (~2), function of attitude of Odyssey with respect to flow and of density
  - Database calculated by numerical modelling
  - I have database, I'm translating its definition of attitude into one I can use

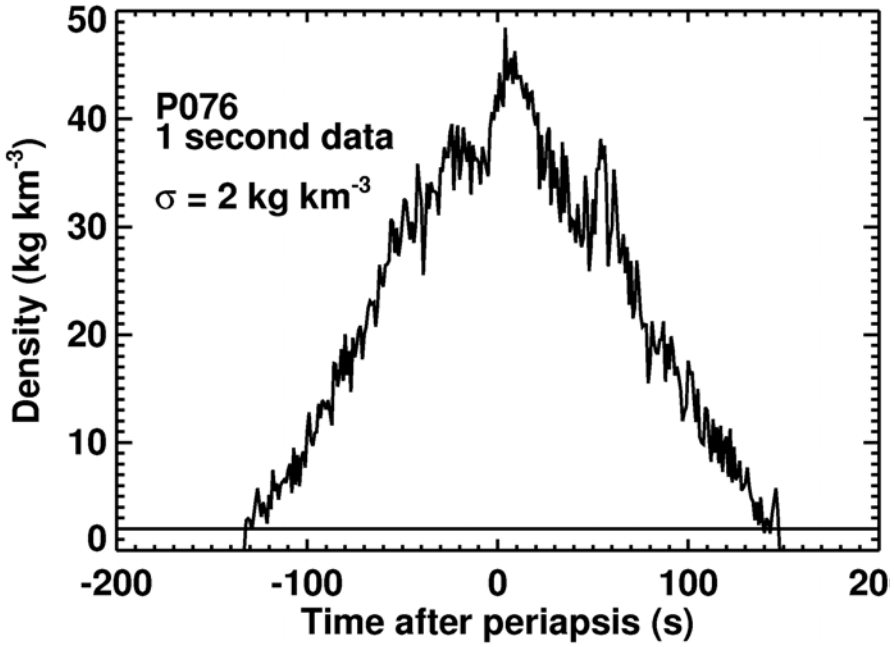
$ma = \rho C A v^2 / 2$

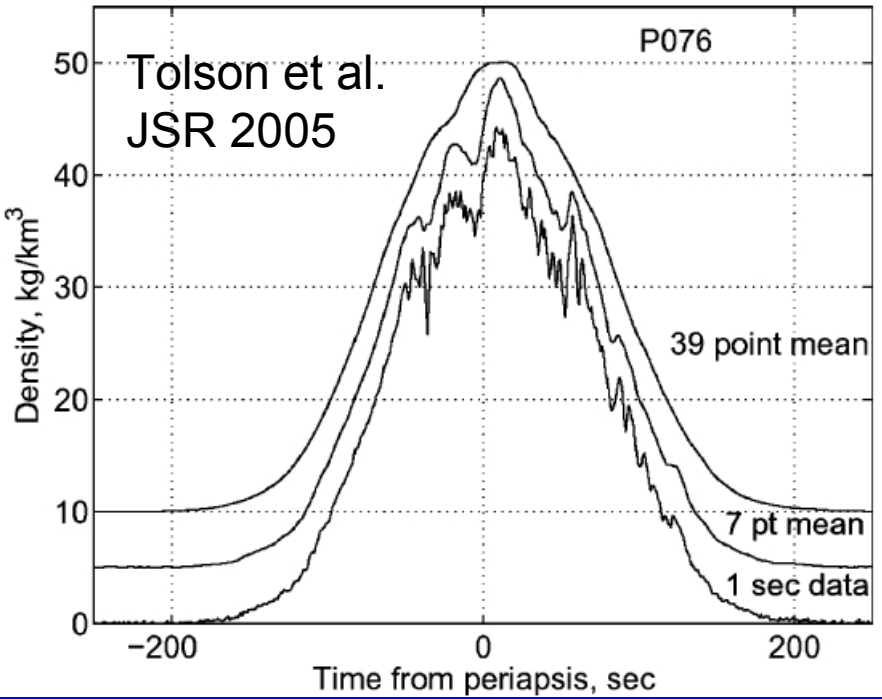
- A: 11.03 m^2

- Position in inertial space: SPICE
  - What is official areoid for r-> z?
- Velocity in inertial space: SPICE
  - What is speed with respect to atmosphere?
- Orientation in inertial space: SPICE
  - What is orientation with respect to flow?

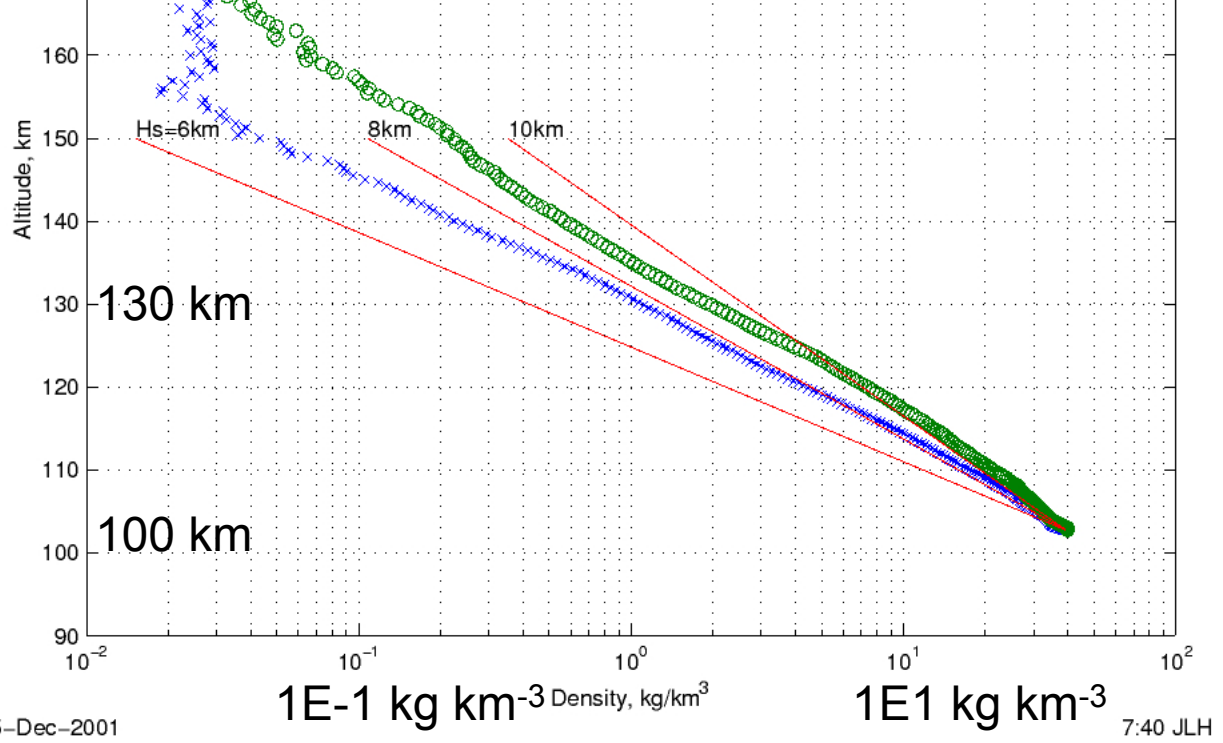
Results so far

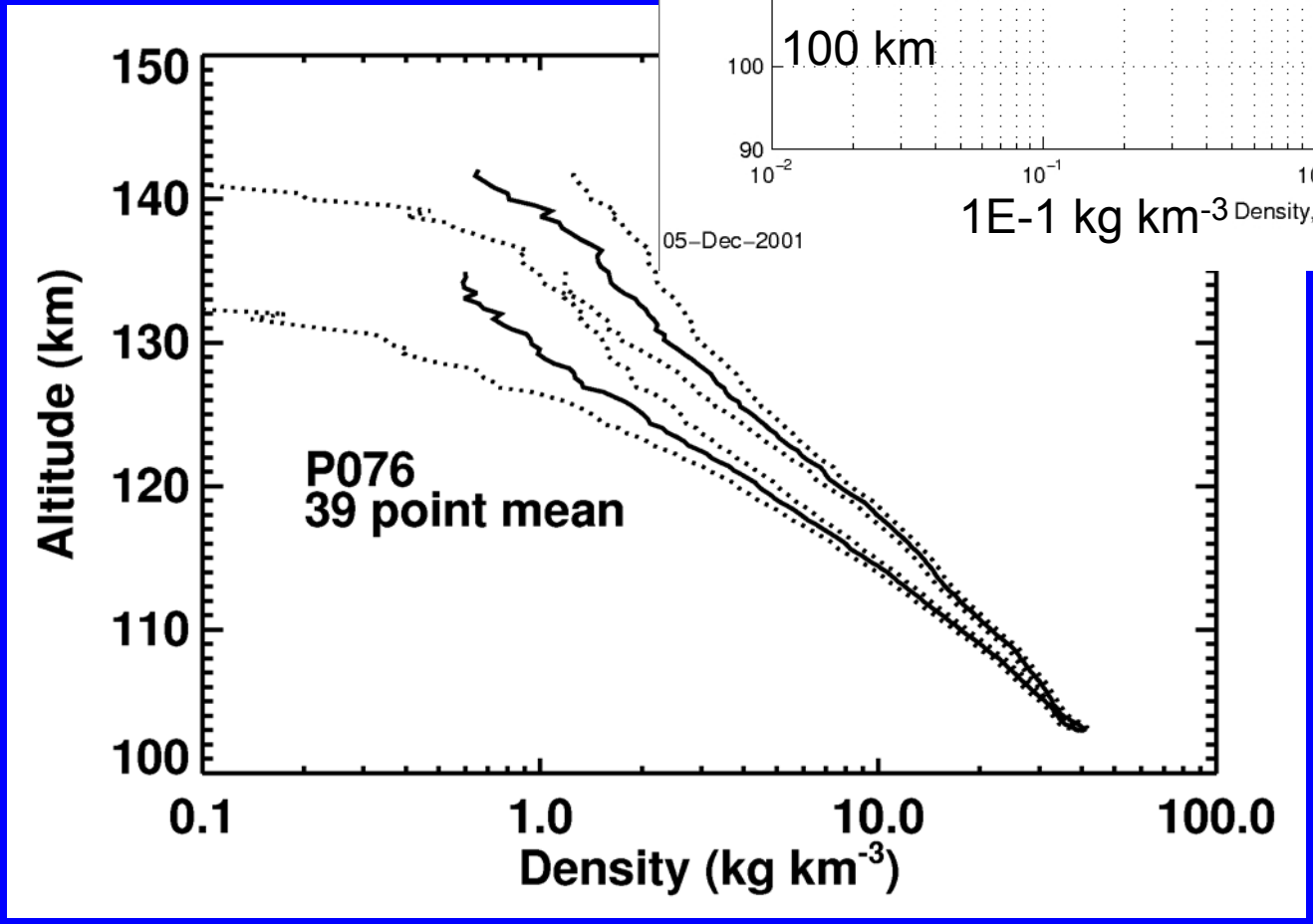


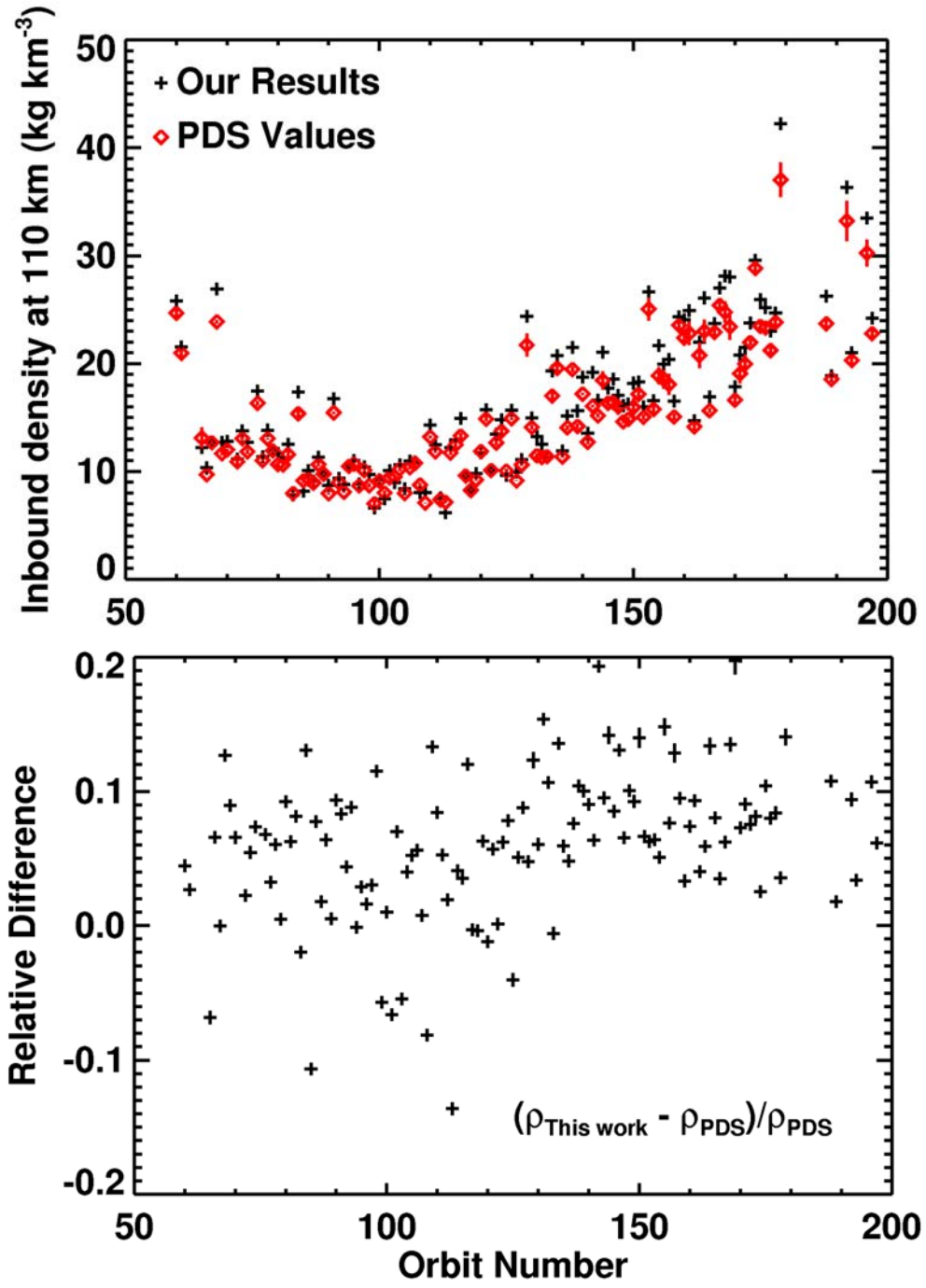




Quick Look Report for orbit P076 --->







Results agree well with those that have been archived at the PDS

PDS has got density and density scale height at 110 and 120 km

Inbound density at 110 km shown here

10% differences are fine at this stage

Expect improvements when I start to use high-rate accelerations and real values of C.

Plans for Next Year

- Improve density data products
- Work on PDS formatting and documentation

What I Want

- Mass
- Have effects of thrusters been removed?
- Have angular accelerations been removed?
- Any other issues with accelerations?

- What documentation exists about the instrument?