MAVEN Accelerometer Team PDS Deliverables User Advisories

The PDS includes deliverables of accelerometer-based density profiles for all orbits that have derived density data available. The quality of these density profiles varies widely throughout the mission due to a variety of data quality issues and spacecraft motion. Data quality issues largely arise from a high noise factor in the accelerometer data, persistent negative densities, or unexplained signatures. Spacecraft motions that most commonly affect the calculation of density profiles are those caused by NGIMS wind scans. To inform the user of the data quality a Bias Noise Sigma (BNS) parameter is included in the table file. The BNS is a derived parameter that is intended to provide a “quicklook” value of the overall quality of the density data. It is calculated as the standard deviation of the density data in the time intervals used to calculate the accelerometer biases. Additional data are included to provide time-dependent estimates of density uncertainties:

- Compute Δρ $\Delta\rho = \rho_{99} - \rho_1$ Eq. 1
- Smooth Δρ (11-pt running mean)
- Compute standard deviation of Δρ over 11 pts
- Inflate standard deviation $\sigma_1^2 = \sigma_{\Delta\rho}^2 + \sigma_{\min}^2$ Eq. 2
- Compute 99-second data uncertainty $\sigma_{99}^2 = \left(\frac{\sigma_1}{\sqrt{99}}\right)^2 + \sigma_{\min}^2$ Eq. 3

Figure 1 shows the BNS for the data delivered to the PDS, including all 9 Deep Dip (DD) campaigns and aerobraking.

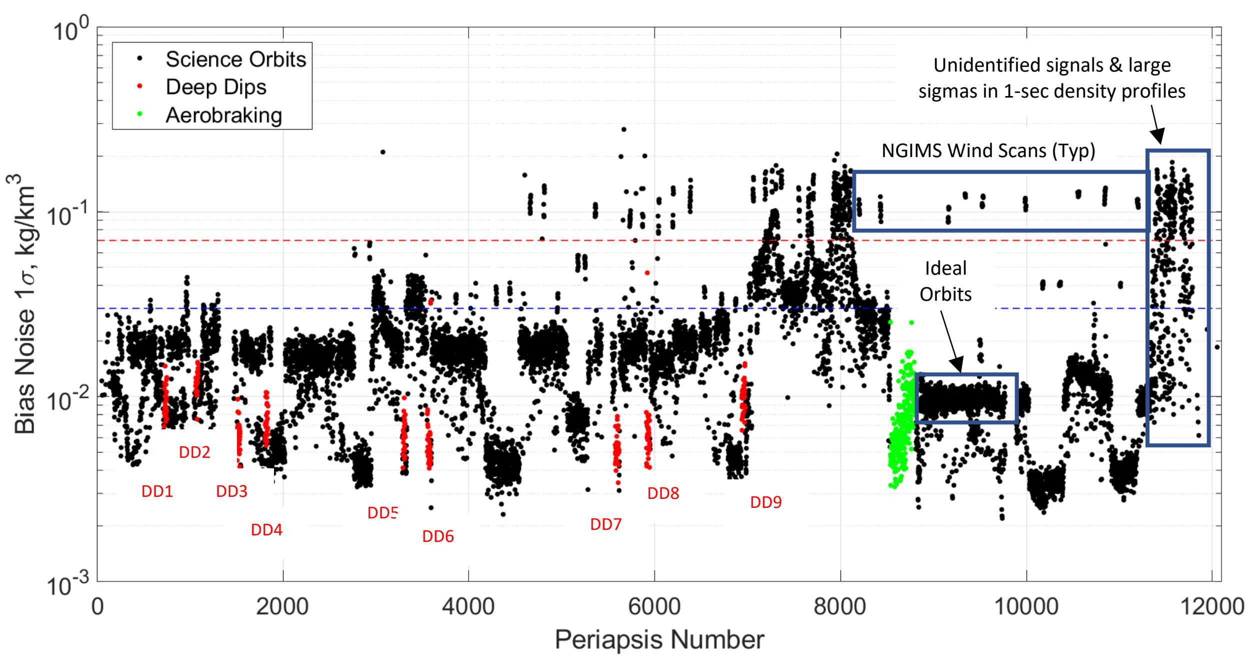

Fig 1: Bias Noise Sigma Over All Orbits with Accelerometer-Derived Density Profiles

In general, orbits with a BNS above 0.03 are suspect (blue dashed line in Fig. 1), and orbits with a BNS above 0.07 (red dashed line) are likely not usable. These are general guidelines; individual orbits may be better or worse for analysis purposes. If the 99-second density data appear reasonable while the 1-

second density data do not, the data quality may be poor. Final assessment of usability is left to the judgment of the end user.

Conversely, the Deep Dip campaigns, the aerobraking period and a stretch of approximately 800 orbits following aerobraking were often ideal for deriving density profiles from accelerometer data, despite the range of maximum density, as the BNS was quite low. Figure 2 shows such an example. For comparison, Figures 3 and 4 show derived densities from good Deep Dip and Aerobraking orbits, respectively. Figures 2-8 all show derived density (kg/km^3) as a function of time from periapsis (in seconds).

Figures 5-8 show examples of orbits with high Bias Noise Sigmas that would likely not be usable for analysis, including negative persistent densities, strange signals, and NGIMS wind scans (the last due to deliberate spacecraft motions).

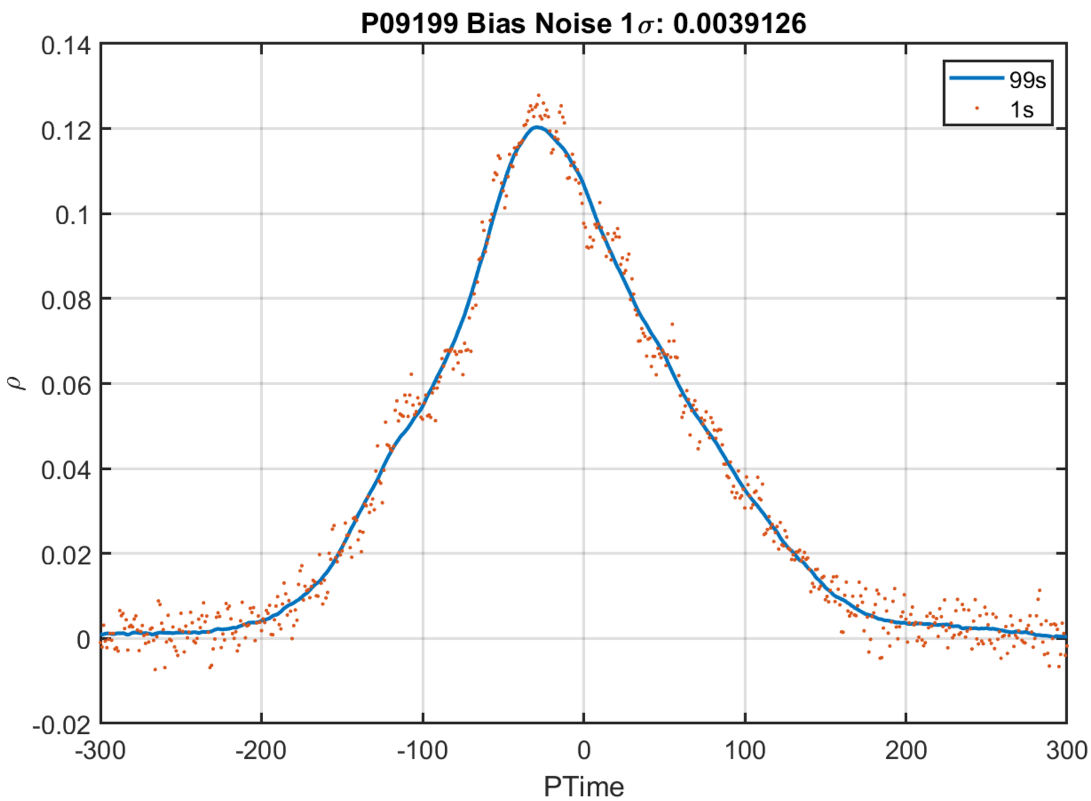

Fig 2: Example Density Profile Over an Ideal Post-Aerobraking Orbit

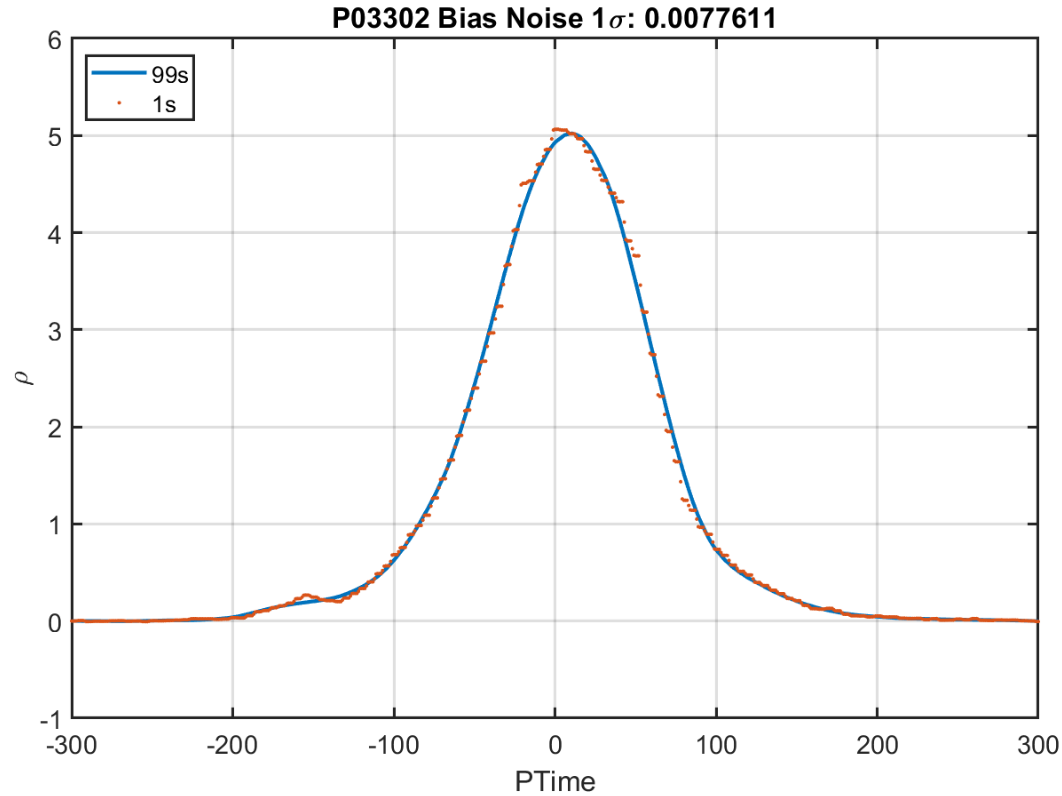

Fig 3: Example of Density Profile Over a Typical Deep Dip Orbit

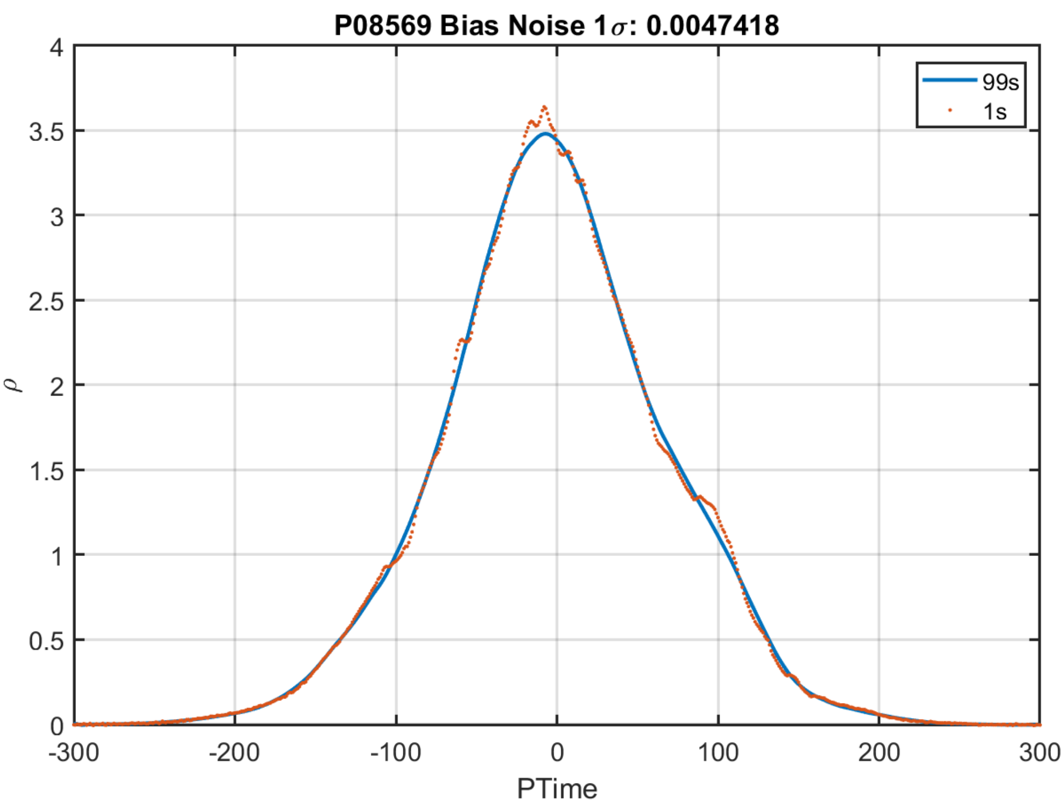

Fig 4: Example of Density Profile Over a Typical Aerobraking Orbit

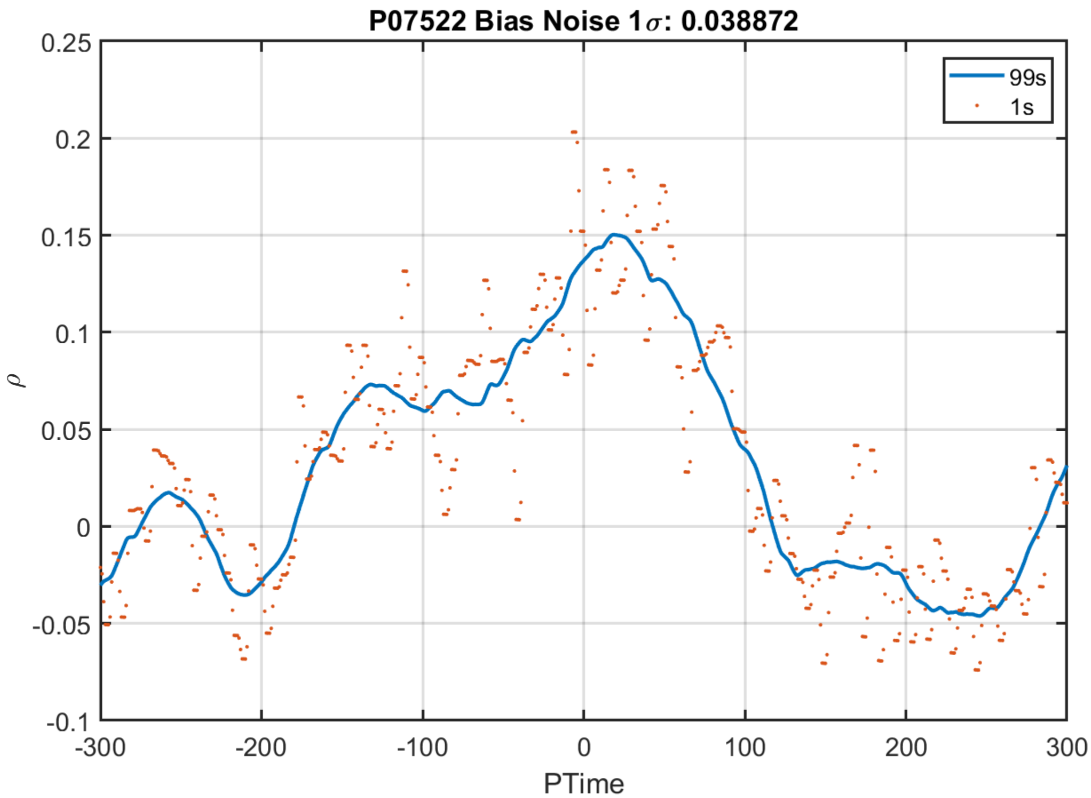

Fig 5: Example of Orbit With Persistent Negative Densities

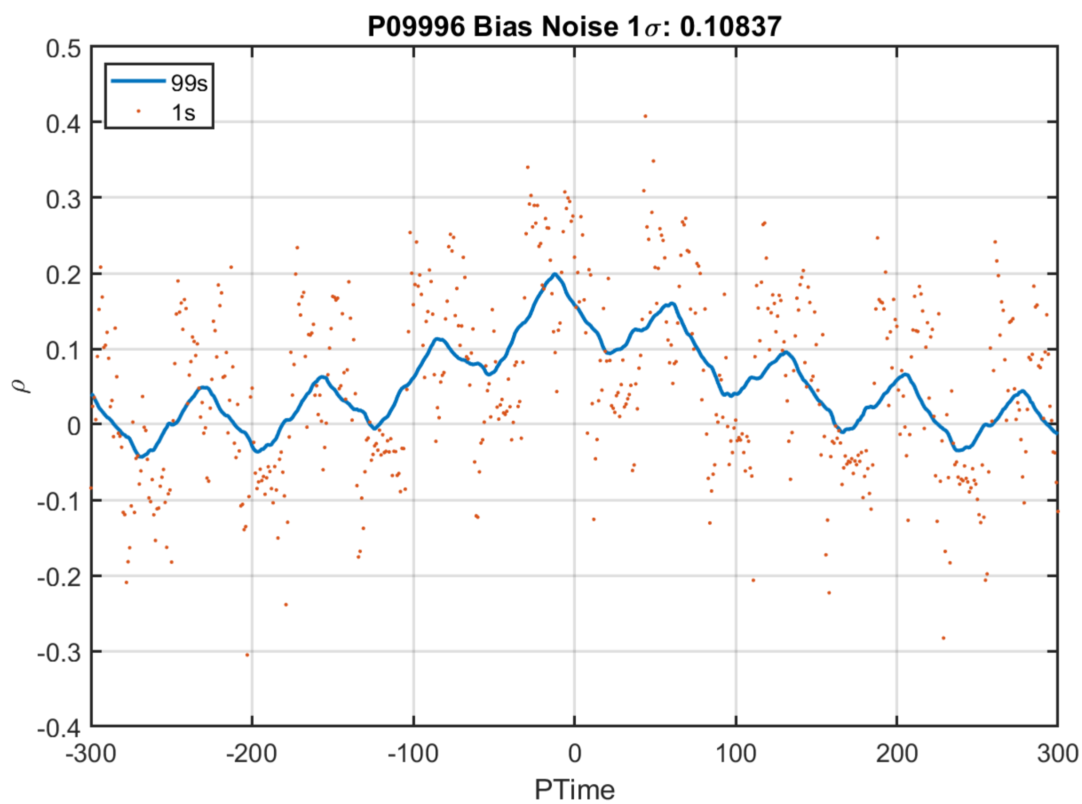

Fig 6: Density Profile During NGIMS Winds Scans. Periodic Variation is Caused by Wind Scans.

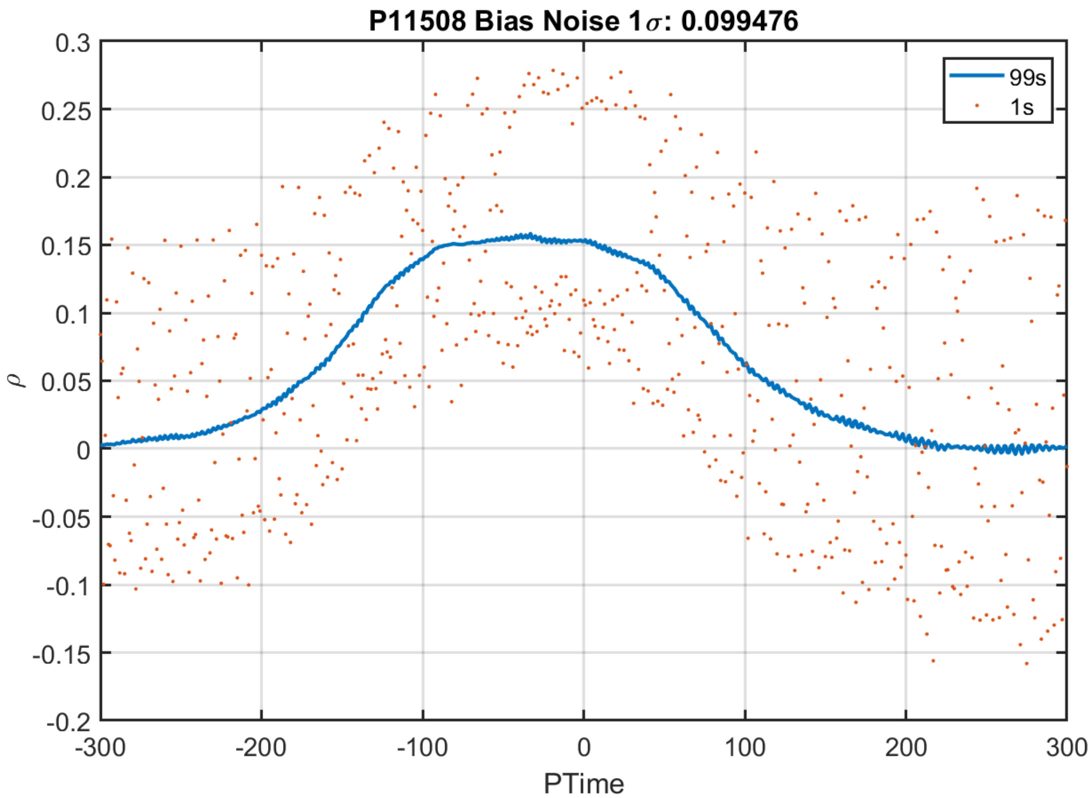

Fig 7: Example 1 of Unidentified Signals in Density Profiles

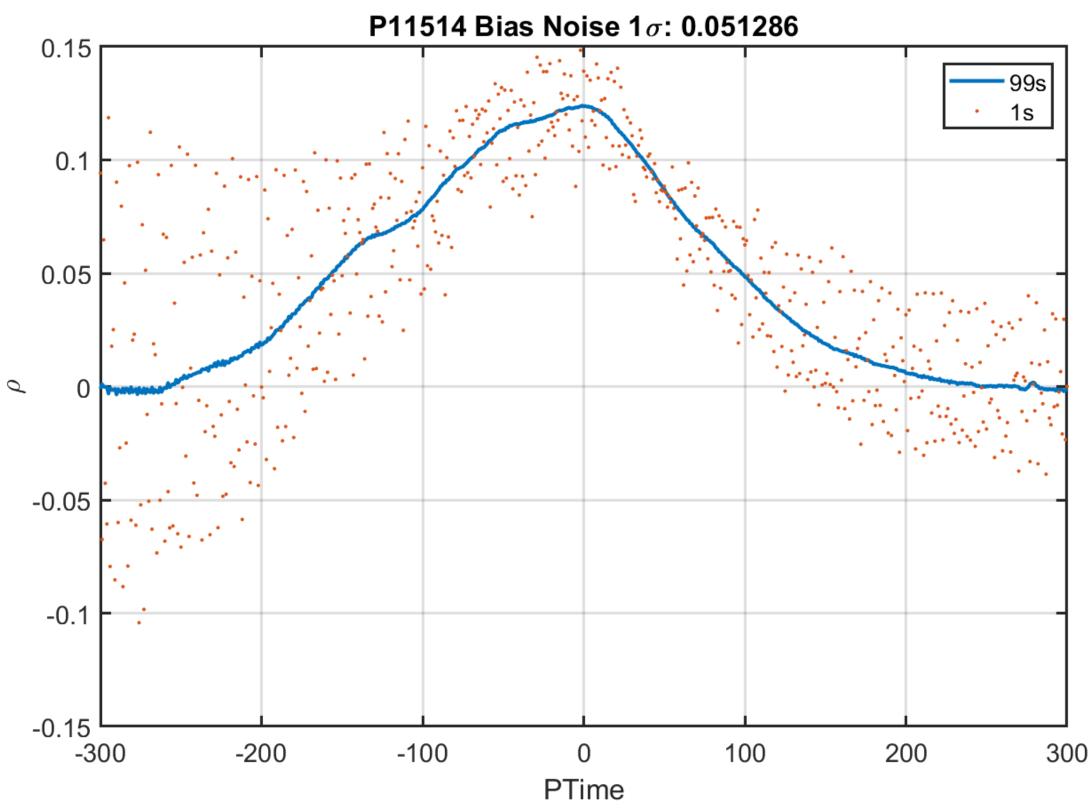

Fig 8: Example 2 of Unidentified Signals in Density Profile