

May 17, 2005

Preliminary Analysis of DART-to-GPS Ionosphere Delays

We used the orbits of the LEO and GPS satellites to simulate the links between the LEO and each GPS satellite. After removing links with elevation angles less than -20 degrees, we estimated the slant ionospheric delay along the ray path by integrating through a 4D global ionospheric density grid for 2005/04/16. The electron density grid was generated by a data assimilation run of the Global Assimilative Ionosphere Model (GAIM) using ground GPS data from ~200 worldwide sites. The slant ionospheric delay values are expressed in total electron content (TEC) units of 10^{16} electrons/meter² (where 1 TECU is 16 cm of delay at L1).

Figure 1 shows a plot of the slant TEC values for links to all GPS satellites, with the elevation cutoff of -20 degrees. The maximum slant ionosphere delay is ~350 TECU or 56 meters at L1. The larger delays occur at lower elevations since the ionospheric density peaks at 300-450 km altitude.

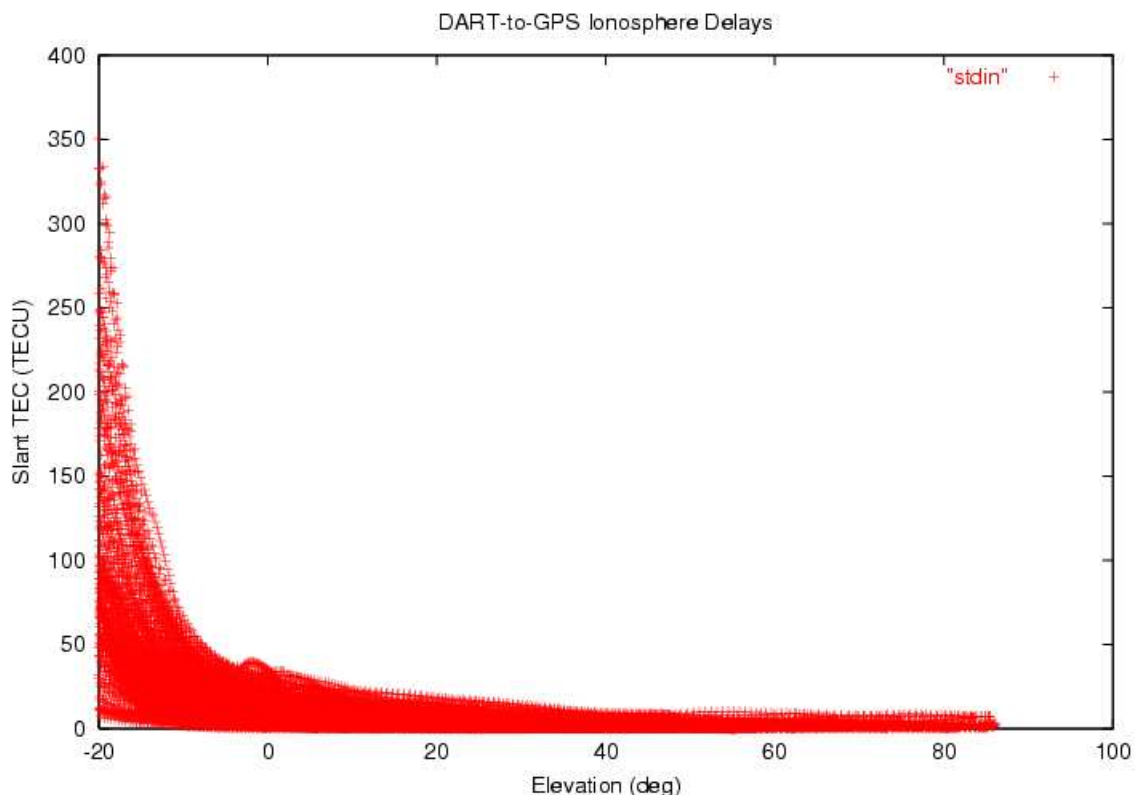


Figure 1. Slant ionospheric delays for DART-to-GPS links plotted versus elevation.

If one examines the tail of the histogram of the link delays (Figure 2 below), one sees that only a small number of the links exhibit slant TEC values of 200 TECU or above. However, if any of these low elevation (small positive or negative elevation) links are

used in the GPS position solution, and the ionospheric delay is uncalibrated, then the resulting position error could be substantial.

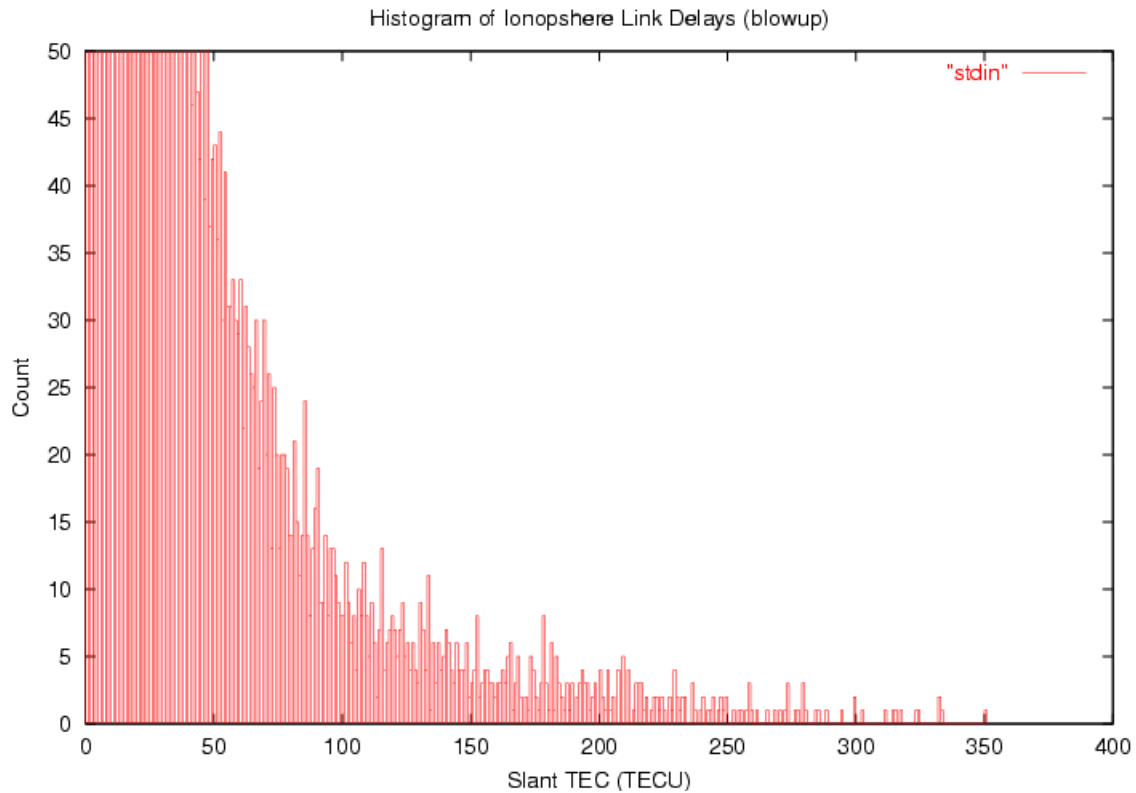


Figure 2. Tail of the histogram of slant TEC delays.

The estimated ionospheric delays for all DART-to-GPS links are available in the ASCII data file <ftp://sideshow.jpl.nasa.gov/pub/bdw/dart/observations.out>. This document (dart_iono_delays.pdf) is also available at the same ftp site. The data columns in the file are as follows:

1. Time (seconds past beginning of the day)
2. Slant TEC delay (in TECU)
3. Ignore
4. Transmitter ID (e.g., GPS24)
5. Receiver ID (a constant string)
6. Trn X position (m)
7. Trn Y position (m)
8. Trn Z position (m)
9. Rcv X position (m)
10. Rcv Y position (m)
11. Rcv Z position (m)
12. Ignore
13. Link Elevation (deg)

