Aspects of Large Station Networks for GPS Orbits and Clocks

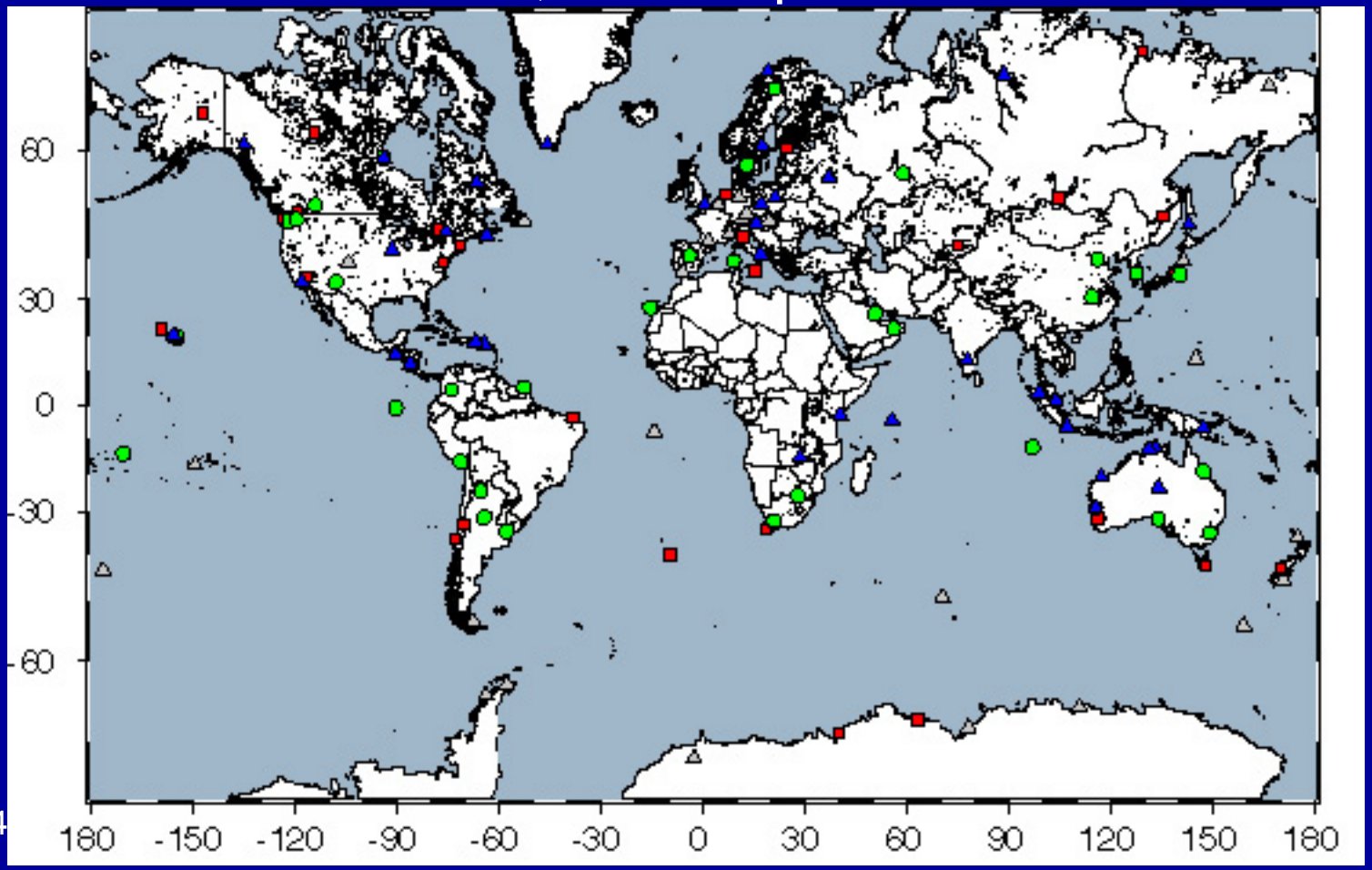
Thomas Herring, MIT
tah@mit.edu
http://geoweb.mit.edu/~tah

MIT IGS Analysis Center

- Analysis primary focus on global clocks
- 4 networks each of 40 stations per day: Base of each network Time service clocks, H2, Cs and Rb clocks. Networks dynamically filled each day.
- Each daily solution run on single CPU (about 10 hours for iterated 4 networks)
- Ambiguity resolution using Melbourne-Wubena Wide lane (MW WL) for L2-L1 and estimate for L1 cycles.
- Weekly combination with daily satellite position and velocity IC, radiation parameters process noise set by daily variation. Many satellites have single estimate of 9-day combination.
- Weekly solution for clock estimates run on 4-nodes of 45-node cluster with MIT final orbits fixed (12 hours for 7 days of data)

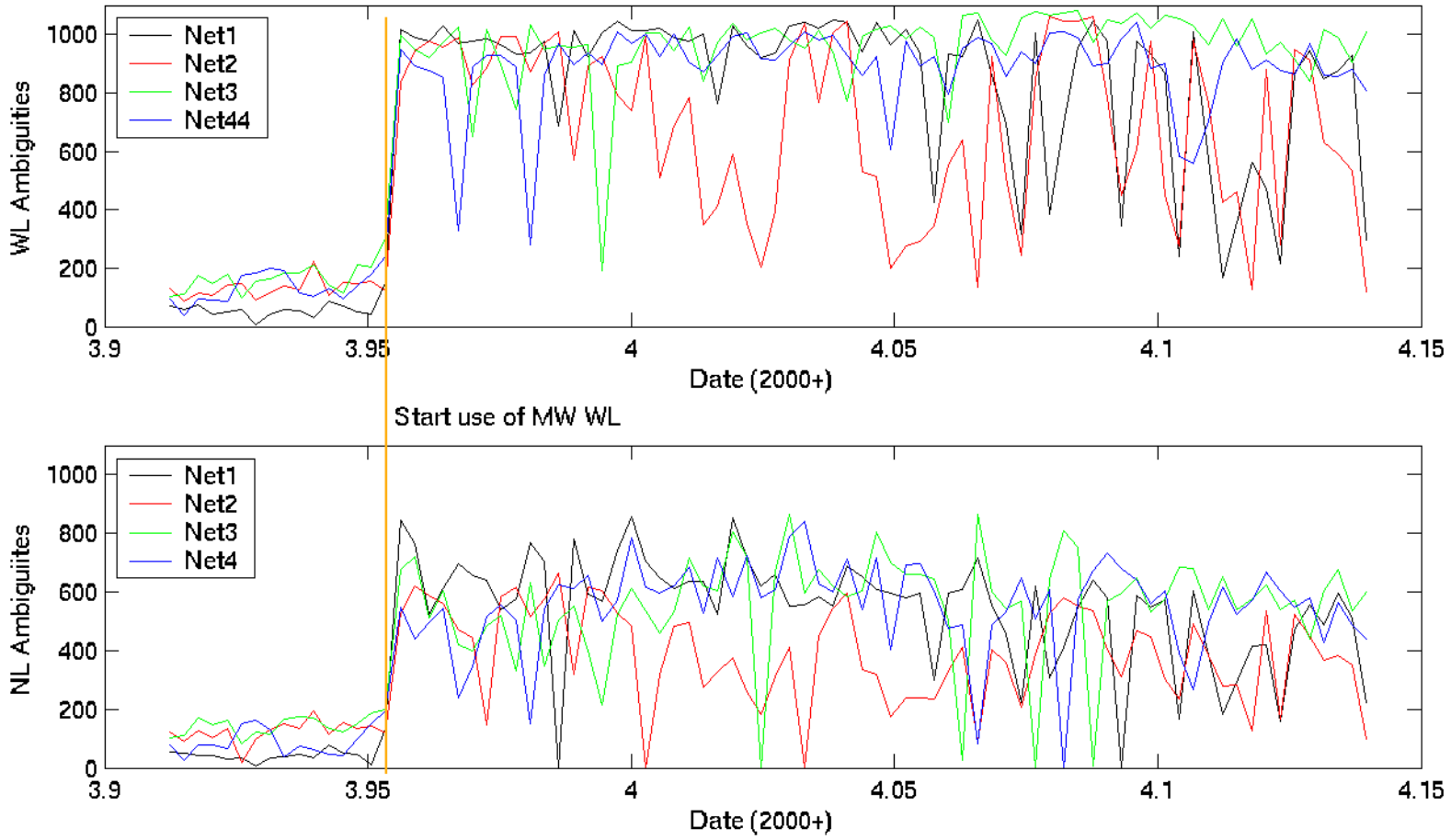
Typical MIT daily network

Grey Triangles: Time Service; Red squares H2 Masers;
Green circles Cs clocks; Blue triangles Rb clocks
4 Networks of 40 sites, 4 overlap sites: Total 148 sites



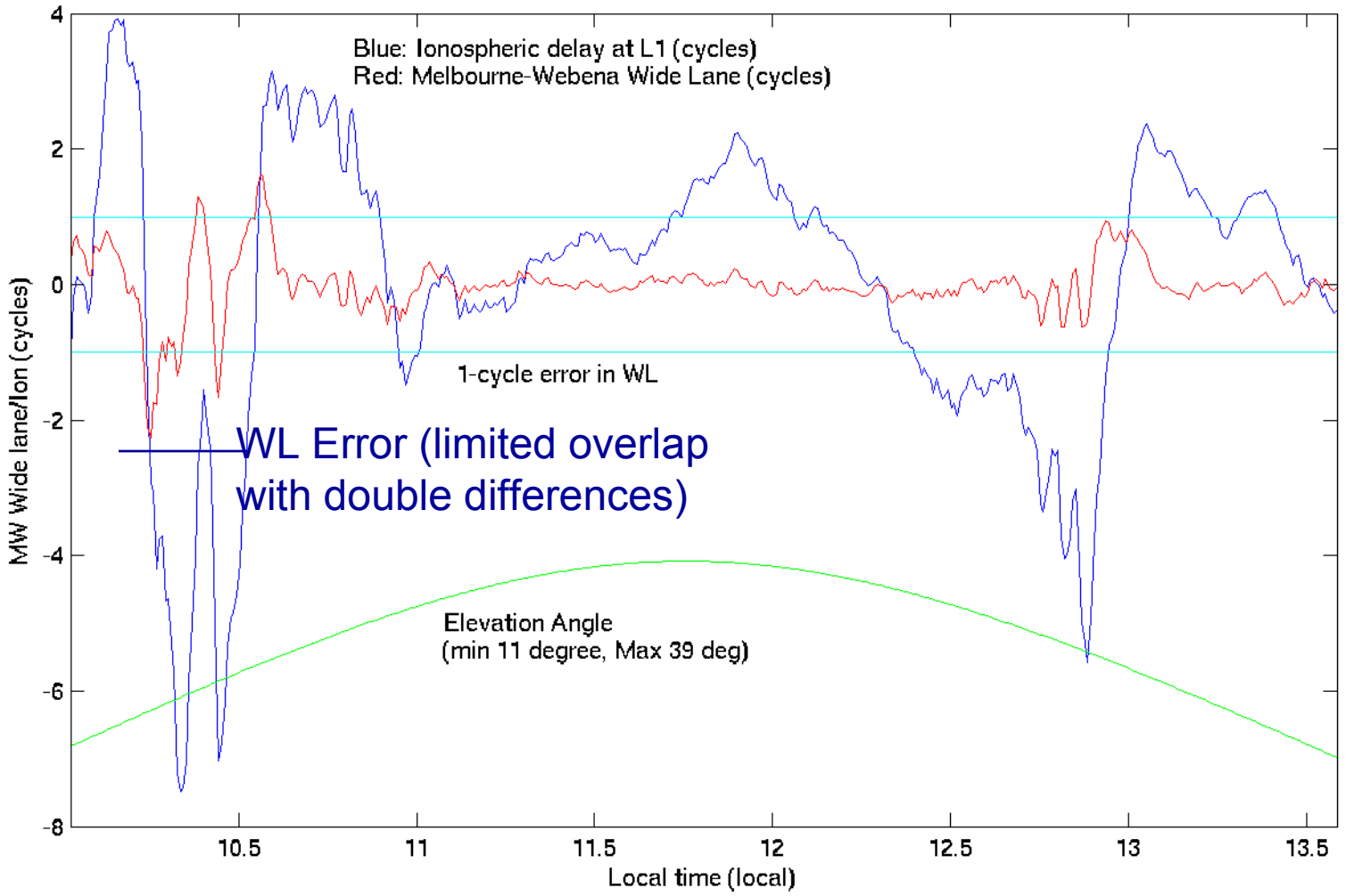
Wide Lane bias fixing performance

Typical Day has 1000-1100 ambiguities. Red line is H2 maser network.



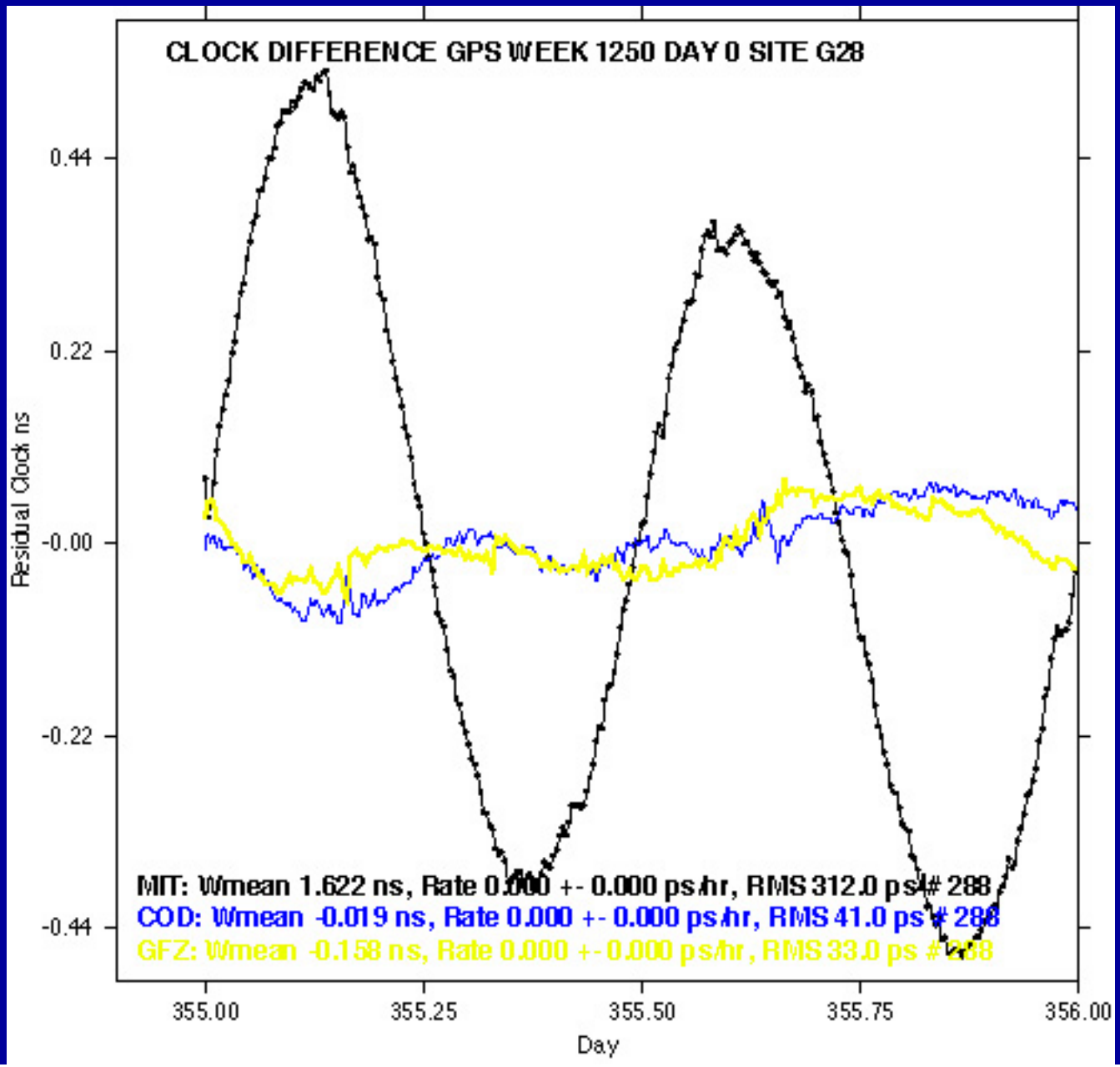
Example of problem with MW Wide lanes

ALRT (Ashtech μZ) MW-WL correlated ionospheric delay during rapid variations in ionosphere (pseudo range smoothing?)



MIT clock comparisons

- In following plots: Clock estimates from MIT, COD, GFZ and JPL shown as differences from IGS clock estimates with a common reference site selected.
- PRN 28 (Block IIR shown, MIT has problem modeling this satellite on occasions; problem persists for a few weeks, slowly degrades and improves)
- PRN 03 on same day, PRN 28 on another date (not always a problem).

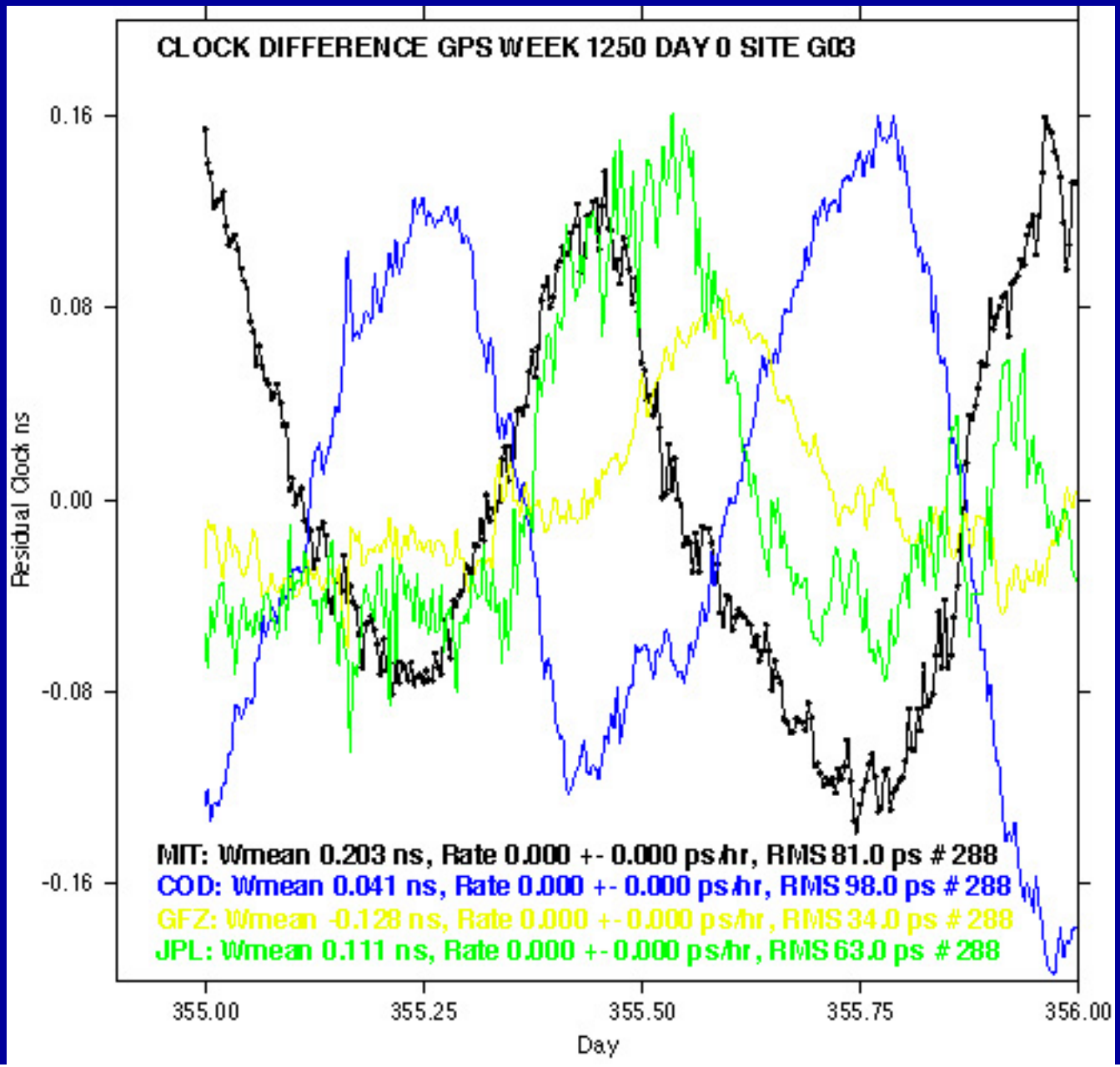


PRN 28 clock

Reason for large deviation not clear.

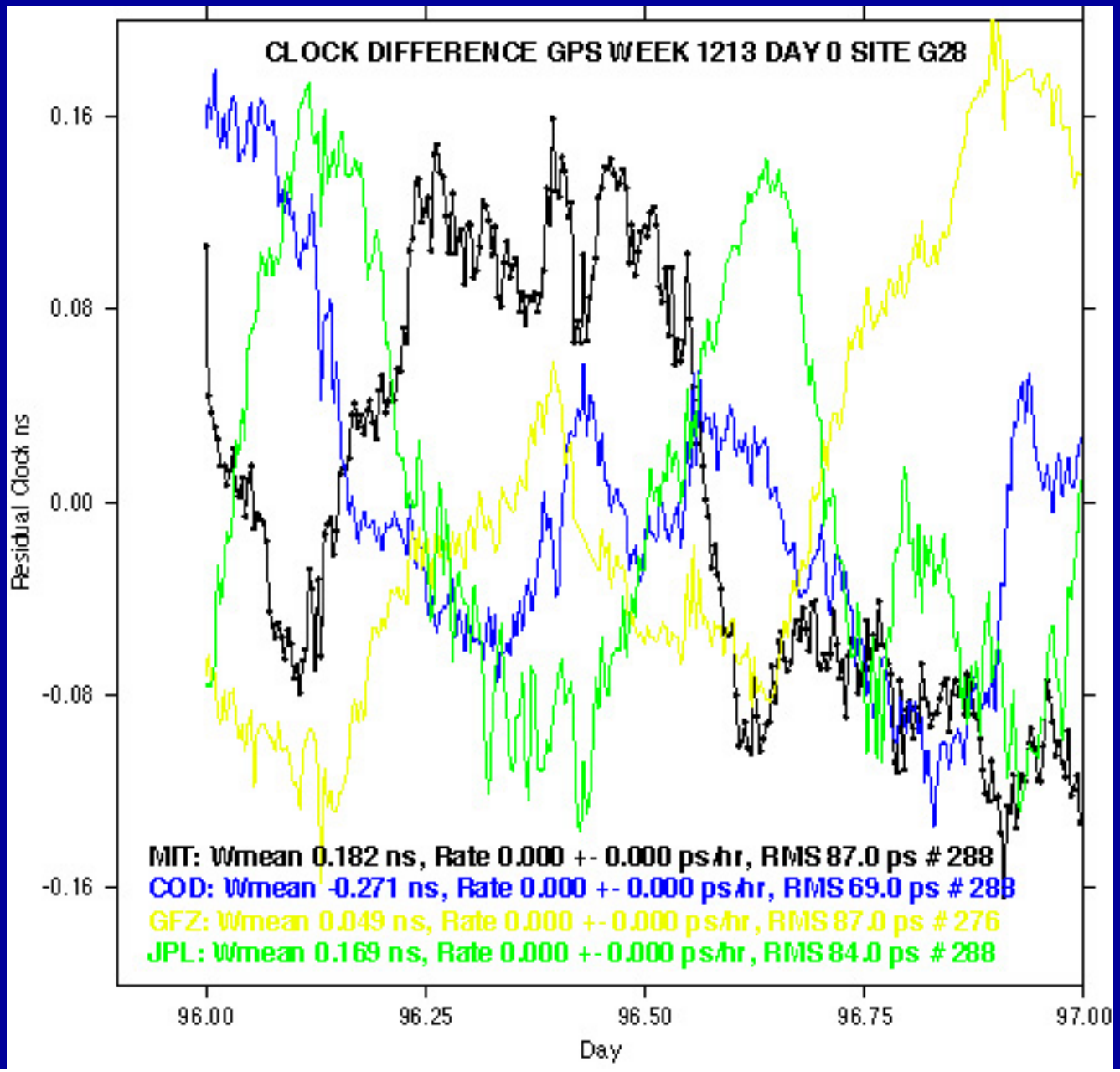
MIT orbit estimate has large radiation parameters

No JPL solution



PRN 03 (same day)

MIT not included in clock estimates at this time



PRN 28 (early 2003)

PRN 28 is not always a problem

Problems build and decay over a few week period

Conclusions

- Increase in network size not a major problem with parallel processing of networks. Merger of networks not a limiting step.
- Increase in satellite constellation would impact analysis time (unless constellations “networked”)
- Global ambiguity resolution makes global analysis more robust but pseudo range quality critical. H2 maser sites (also overlap with VLBI network) are some of the oldest receivers.
- Some modeling errors still present. Center of mass positions estimates from MIT daily solutions biased relative to weekly solutions (with longer term radiation parameter estimates).
- Ambiguity resolution also brings CoM closer to IGS estimates
- Results indicate modeling error effect enhanced with higher correlations but still present.