Monitoring Time Offset to GPS at European GNSS stations

A. Caporali, A. Dalla Torre, J. Zurutuza, R. Corso
 University of Padova
 May 2014

- •Galileo Nav message: HS/DVS set to zero since 2013-12-03
- •Systematic monitoring of Coordinates, TZD, Time Offsets : results for January 2014
- disalignment to GPS of Glonass, BeiDou is non random and receiver dependent
- •How the IGS DCB can be used

Time system biases and receiver dependent biases in 2013 data

- Glonass to GPS Time Offset
- Galileo to GPS Time
 Offset (I/nav, F/nav)
- Beidou to GPS Time Offset
- QZSS to GPS Time Offset
- All have been monitored for different receiver types and using broadcast and SP3 orbits



Dalla Torre and Caporali, GPS Solutions 2014 (DOI 10.1007/s10291-014-0388-2)

GPS+Glonass+Galileo positioning:

-GLGP and GPGA estimated (top plot)

-Time series of coordinates relative to nominal ETRF2000 values, and TZD (bottom plot)



Glonass to GPS Time Offset: varies from day to day, depends on receiver type

(error bars not shown; differences within each receiver group are negligible DCB's for satellites and MGEX stations and not applied: their size is <15-20 ns max)



BeiDou to GPS Time Offset: systematic drift, depends on receiver type



QZSS to GPS Time Offset: close to zero, only KIRU data



day of Jan.2014

Postfit and time series of coordinates Trimble (1/2)



Postfit and time series of coordinates Trimble (2/2)





TZD estimated epochwise from pseudoranges to multiple GNSS





Systematic monitoring of multiGNSS European sites

- Web page: map of multiGNSS permanent sites in Europe, with different receiver types; updated weekly
- For each site, link to downladable plots and data sheets (.csv) with the following information
 - Time offset to GPS
 - Coordinate residuals from multiGNSS processing
 - Post Fit residuals, with different symbols for different GNSS's
 - TZD estimates
- Software: own Matlab development

MultiGNSS european network.

Select a site clicking on the relative marker.

Legenda = Javad Leica Septentrio Trimble Daily estimates of clock offsets and drift relative to GPS. View file

About this Web Page

Background

To investigate the interoperability of the various GNSS constellations we compute epochwise the positions of European permanent GNSS receivers by analyzing data simultaneously from different GNSS constellations.

Method

Use RINEX 3.02 data freely available within the MGEX data base. Process pseudoranges in ionofree combination, and broadcast ephemeris. Use as apriori coordinates official ITRF2008/IGb08 values.

Solve for 3 coordinates, 1 clock offset for each GNSS constellation, 1 Tropospheric Zenith Delay (ZTD) at each computation epoch.

The computation is made daily for a sample of European GNSS sites, and different receiver types. This Web site is updated on a weekly basis, beginning Jan.1, 2014.

Goal

Our goal is to provide data, in tabular and plot format (see Keyword File Type), enabling one to assess (see Keyword Parameter):

-Parameter = Position: epochwise departures in North East Up from a priori position



Example: KIRU for October 18, 2014



Glonass clock steering



day of year 2014

Starting August 19, 2014 (doy 231) the Glonass time offset relative to GPS is being reduced progressively

Conclusions

- Interoperability of GNSS is demonstrated, **<u>but</u>** has an obstacle in:
 - Time Scales of GNSS are offset relative to GPS; offset may not be time independent
 - Offset depends on the receiver type
 - For Galileo we have data in 2014 with invalid HS and DVS, but maybe the data are acceptable anyway; GGTO is made more complicated by the presence of F/NAV and I/NAV clock models, and irregular upload of the message (especially F/NAV)
- Disadvantage for user: needs to solve for separate satellite time offsets (one for each GNSS)
- Possible improvements: phase smoothed pseudoranges; Sp3 instead of brdc (but which SP3? Several agencies publish theirs); adopt IGS DCB's (but first we must understand them in full detail)
- Proposal (offline and/or Real Time):
 - Monitor Time Offset for several GNSS sites and receivers
 - Estimate mean values which could serve as reference for future calibration
 - TZD epochwise with <0.5 m rms