The International GNSS Service (IGS) Tide Gauge Benchmark Monitoring – Working Group (TIGA-WG) is responsible for analyzing GNSS data from stations at or near tide gauges (TG) on a continuously basis and to provide information specifically for the vertical rates. The position and vertical velocity results of the stations are applied in several geodetic and geophysical studies, e.g., regional and global sea-level change studies, calibration of satellite altimeters and the unification of height systems.

As one of the TIGA Analysis Centers the German Research Centre for Geosciences (GFZ) is contributing to the IGS TIGA Reprocessing Campaign. After the first reprocessing the standard model of 2nd IGS reprocessing were implemented into the latest GFZ software version EPSO.P8: reference frame IGS08 based on ITRF2008, antenna calibration IGS08.atx, geopotential model (IERS2010), higher-order ionosphere effects, a priori meteorological model (GPT2) and VMF mapping function etc.

The GPS data was collected through the SONEL data centre (www.sanel.org) of the Global Sea Level Observing System (GLOSS). The data of about 800 sites for the time span from 1994 until end of 2012 is reprocessed. In this presentation the GFZ process scheme and some results of the IGS GNSS data reprocessing are given.

Processing Scheme

For the TIGA Reprocessing the software package EPSO.P8 developed at the GFZ is used. The data processing is performed on a Linux cluster with a maximum number of 30 computers/servers. Using EPSO.P8 a high degree of automatization of the individual processing jobs can be achieved on the computers/servers cluster.

The TIGA data reprocessing is done in two steps, firstly precise satellite clocks, orbits, 1-day normal equations are generated from the GFZ REP20 stations using the IGS stations. In the second step the TIGA stations without the GFZ REP20 stations, named TIGA only stations, are processed in PPP mode using the GFZ REP20 satellite clock and orbit products to clean the observation data. Since the processed number of TIGA only stations can reach up to 560 stations (Fig.3) and the EPSO.P8 can process up to 250 stations for one single job, the TIGA stations must be processed in up to 3 sub-networks. To connect the two or three sub-networks 30 global distributed GFZ REP20 stations are selected and processed together with the TIGA sub-networks. The 30 connection stations are different for each sub-network and be selected automatically from GFZ REP20 stations for each day according to its distribution and post fit. The GFZ REP20 solutions would be one of TIGA sub-network solutions, if the number of TIGA REP20 stations larger than 250 stations.

Since the initial coordinates of most TIGA only stations have insufficient accuracy (> 2 cm) for the IGS data analysis, in the PPP data clean step the estimated station coordinates are used to generated new initial coordinates and velocities. For example, the PPP coordinates of the station AUFT are given in Fig.4, from the coordinate time series the initial coordinates and velocities can be retrieved. The IGS like data analysis for the clusters will be finish in the next months. For the GFZ IGS data analysis the used models and algorithms are listed below.

Observation data:
- Ionosphere-free linear combination, undifferenced carrier phase and pseudo-range observables
- Sampling rate: 5 minutes
- Elevation cut-off angle: 7°
- Elevation dependent weighting: 1/2sin(e) for e<30°

Measurement models:
- Updated satellite & ground antenna phase center offsets (PCOs) and phase center variations (PCVs) in IGS08_1730.ATX file.
- Ocean tide loading: FES2004 (CoM corr. applied)
- Loading due to S1 & S2 atmosphere pressure tides. Tidal effects: IERS Conventions 2010
- ARP eccentricities from site-logs/igs.snx
- Toposphere: a priori zenith delay from Saastamoinen, Global Pressure & Temperature model (GPT2) and Vienna Mapping Function (VMF)
- Ionosphere: include 2nd order ionosphere correction

Reference frames:
- Terrestrial: IGS realization of ITRF2008 (IGb08)
- IAU 2000A Precision-Nutation model
- Bulletin A EOPs as a priori values
- Orbit models:
  - Gravity field: EGM2008 (12x12) with temporal variations
  - Geopotential ocean tide model: FES2004
  - Third-Body: JPL Planetary ephemeris DE405
  - Solar radiation pressure: a priori none
  - Albedo Acceleration: model from C.J. Rodriguez-Solano
  - Earth shadow model: penumbra
  - Attitude model: Bar-Sever, based on nominal yaw- rates
  - Relative effects: Schwarzschild and Lense-Thirring dynamical correction and gravitational time delay

Estimated parameters (Least Square Adj.):
- Coordinates of stations
- Clocks of satellites and receivers per epoch
- Orbits (position, velocity, SRP, stochastic impulses, yaw-rate) per day
- Troposphere: 2D per hour, gradients per 24 h
- Ambiguities: fixed
- EPRs: pole coordinates and rates, LOD per day

Since the IGS REP20 combination solutions are not available, the quality of the reprocessed GPS and IGS Final orbits by 7-parameter similarity transformations. The mean RMS of the transformed reprocessed orbits w.r.t. IGS08/IGb08 are shown in Fig. 5. The RMS decreases rapidly from about 15 cm in 1994 to about 2 cm in the mid of 1995.

GFZ is contributing to the IGS TIGA Reprocessing Campaign. The GPS data of the globally distributed tracking network of 794 stations for the time span from 1994 until end of 2012 has been reprocessed with up-to-date models and processing strategies. The GFZ TIGA products are now available at GFZ TIGA FTP and CDDIS FTP. The GFZ FTP stores the daily & weekly SNX, orbit SP3 and ERP files. Beside the coordinate and orbit products we have troposphere parameters as by products, which can be used for climate studies.

Acknowledgment: The IGS and TIGA reprocessing is generously found and supported by GFZ. We thank the IGS and the SONEL data center (www.sanel.org) for providing GNSS observation data.

**Summary**

GFZ is contributing to the IGS TIGA Reprocessing Campaign. The GPS data of the globally distributed tracking network of 794 stations for the time span from 1994 until end of 2012 has been reprocessed with up-to-date models and processing strategies. The GFZ TIGA products are now available at GFZ TIGA FTP and CDDIS FTP. The GFZ FTP stores the daily & weekly SNX, orbit SP3 and ERP files. Beside the coordinate and orbit products we have troposphere parameters as by products, which can be used for climate studies.

Acknowledgment: The IGS and TIGA reprocessing is generously found and supported by GFZ. We thank the IGS and the SONEL data center (www.sanel.org) for providing GNSS observation data.