IGS Reprocessing Activity at GFZ

Z. Deng, G. Gendt, T. Schöne, and M. Fritsche

Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences
Telegrafenberg, 14473 Potsdam, Germany

Introduction

After the successful first full reprocessing by the International GNSS Service (IGS) in 2010 the Analysis Centers (ACs) of the IGS began the second reprocessing. The full history of GPS data collected by the IGS global network since 1994 have been reanalysed in a fully consistent way using the latest models and methodology: reference frame IGb08 based on ITRF2008, antenna calibration igs08.atx, Albedo model, geopotential model (IERS2010), higher-order ionosphere effects, apriori meteorological model (GPT2) and VMF mapping function etc.

Two ACs of the German Research Centre for Geosciences contributed to the 1st and 2nd IGS Reprocessing Campaign. They are the routinely operating IGS AC (GFZ) and the IGS Tide Gauge Benchmark Monitoring Project (TIGA). For the GFZ / TIGA reprocessing the GPS data of the globally distributed IGS & TIGA tracking network with 307 / 794 stations for the time span from 1994 to end of 2012 were reprocessed (Fig. 1). Our repro2 solutions, GF2 & GT2, could contribute to the ITRF2013 by providing long and consistent time series of station coordinates, GPS satellite orbits and earth rotation parameters. Additionally, the GF2 solution provides 5 min. satellite and stations clock products.

Since the repro2 combined solutions are not available yet, the quality of reprocessed GPS satellite orbits will be assessed through comparison with the IG1 reprocessing and IGS routine orbits. Several ACs have already finished their 2nd reprocessing and provided solutions to IGS. Based on their solutions an inter-agency comparison is presented here.

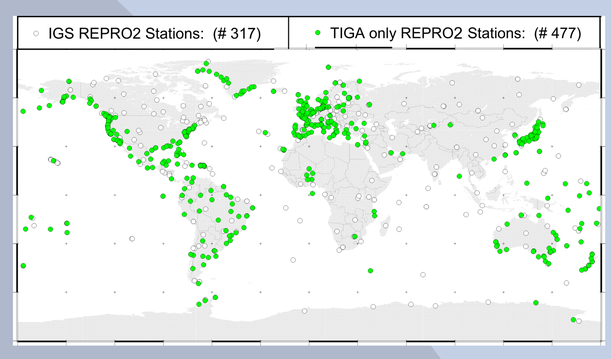

Fig. 1: *Global distribution of the TIGA reprocessed GPS stations for IGS REPRO2 (white dots) and TIGA reprocessing (green+white dots).*

Data Processing

In GFZ the reprocessing is done in two steps (Fig. 3), firstly precise satellite clocks, orbits, 1-day normal equations are generated from the GF2 solution based on up to ~200 IGS stations (Fig.2).

In the second step the TIGA stations without the stations used in GF2, named TIGA only stations, are processed in PPP mode using the GF2 products to clean the observation data and estimate the station coordinates. Since the processed number of TIGA daily stations can reach up to ~560 stations (Fig.2) and the EPOS.P8 can process up to 250 stations for one single job, the large number of stations must be processed in up to 3 sub-networks. To connect the two or three sub-networks, 30 global distributed stations from GF2 are selected and processed together with the TIGA sub-networks. The 30 connection stations are different for each sub-network and are selected automatically for each day according to its distribution and post fit in GF2. The GF2 stations is one of TIGA sub-network from 2000 to the end of 2012.

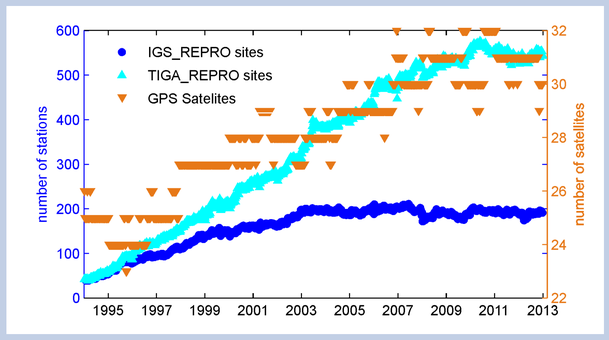

Fig. 2: *Weekly number of stations and satellites included in the GF2 and GT2. GT2 is based on the same set of GF2 stations, so that the difference to GT2 shows the number of processed TIGA only stations.*

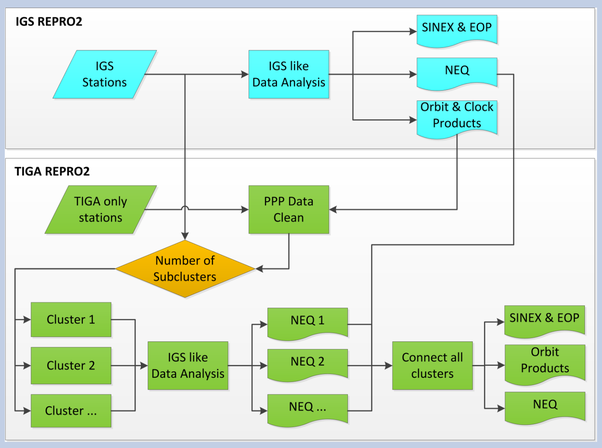

Fig. 3: *The solution GF2 has a processing scheme similar to GFZ routine analysis. The final GT2 solution is the result of a Normal Equation (NEQ) stacking (clusters + GF2).*

Orbit & Clock validation (2000~2008)

Since the combination of repro2 is not available, base on the submitted products from 5 ACs we made a GFZ orbit & clock combination solution (2000~2008) for validation, named GFZ_COMB2. The 5 ACs' solutions are CO2, EM2, ES2, GF2 and MI2 in Fig. 4

In Fig. 5 the weighted RMS of the orbit comparison is given. Most of the ACs have a RMS below 2 cm. The IG1 solution has even RMS below 1cm. The comparison indicates the good internal consistency among ACs, and also to the 1st reprocessing combination solution IG1.
Fig. 6 shows the translation and scale parameter of the ACs .vs. GFZ_COMB2 orbit. While the X and Y translations have a variation below 2 mm, the Z translation shows variation of 5 mm, which might be significant seasonal signals. The annual signal of GF2 and MI2 have a phase shift of about 180° to ES2. In the repro2 the Albedo model is applied, which cause a scale bias of about 0.5 ppb in IG1.

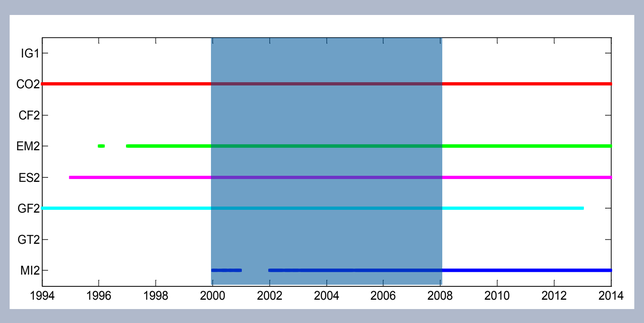

Fig. 4: *GFZ orbit & clock combination solution GFZ_COMB2 (2000~2008) is based on CO2, EM2, ES2, GF2 and MI2 solutions.*

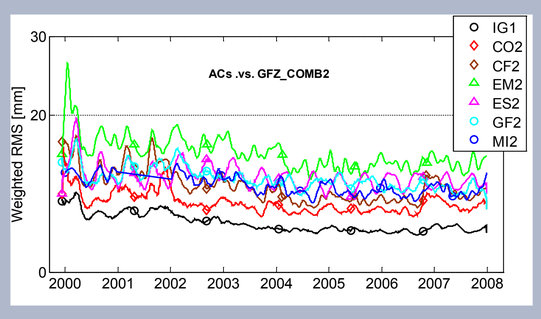

Fig. 5: *Orbit weighted RMS compared to GFZ_COMB2*

The clock validation is given in Fig. 7. In general the clock products from repro2 ACs are close to IG1. The GF1 shows the largest standard deviation of about 30 ps. The GF2's SDEV is slight larger than those of the other three repro2 ACs. More detail study will be carried out in the future.

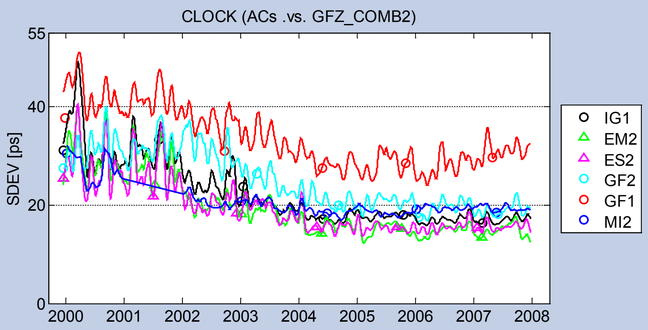

Fig. 7: *Clock combination and comparison (GFZ_COMB2)*

The GFZ orbit product GF1, GF2 and GT2 are validated by validation with GFZ_COMB2 solution. The GF2 solution is very close to the GT2. The two repro2 solutions are more homogeneous compared to GF1. It can be seen that GT2 and GF2 have good consistency w.r.t GFZ_COMB2.

Fig. 6: *Orbit translation and scale parameters of individual solution to GFZ_COMB2*

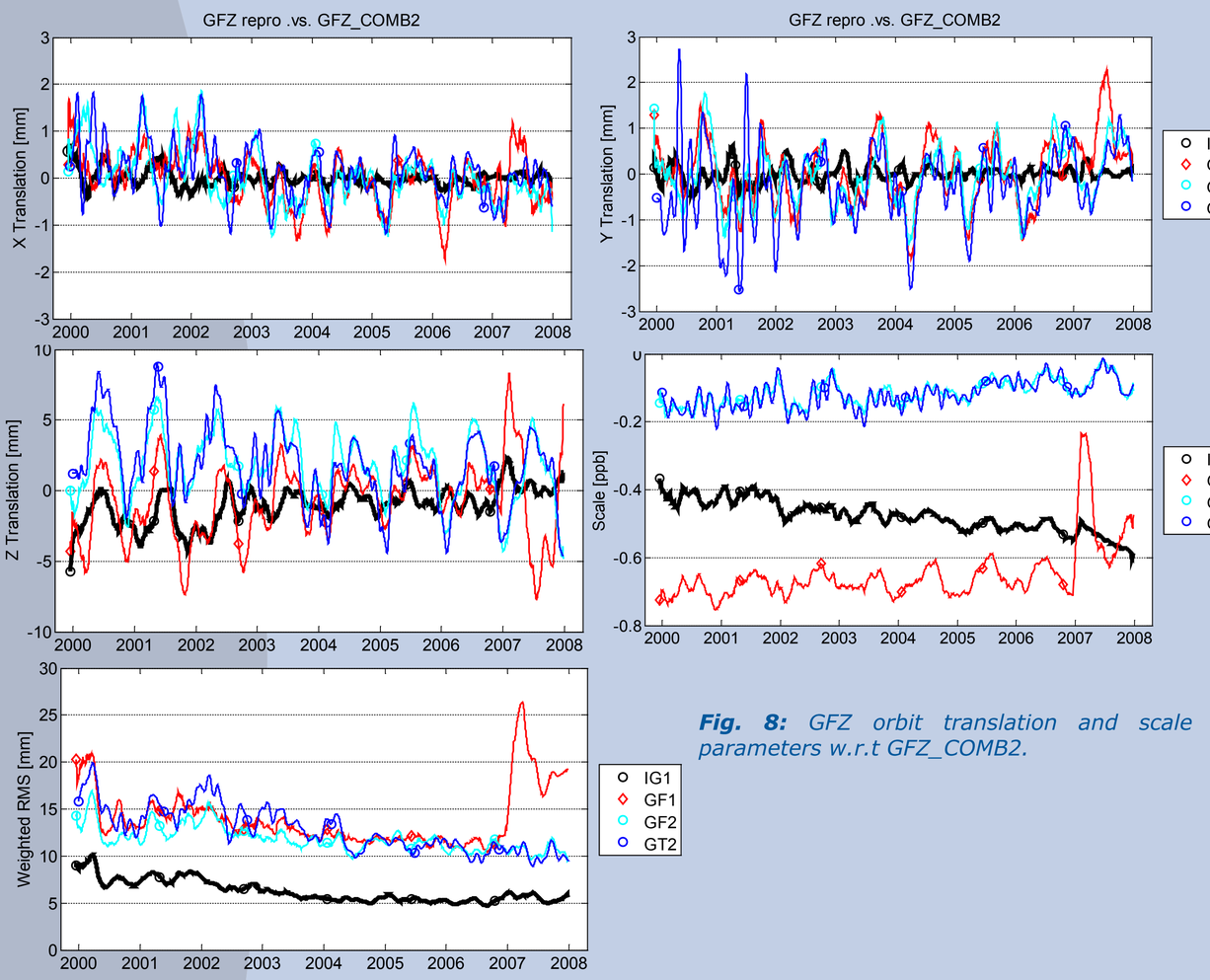

Fig. 8: *GFZ orbit translation and scale parameters w.r.t GFZ_COMB2.*

Summary

GFZ could contribute two solutions GF2 and GT2 to the IGS Reprocessing Campaign. The GPS data of the globally distributed tracking network of 307 / 794 stations for the time span from 1994 to the end of 2012 has been reprocessed with up-to-date models and processing strategies. To access the quality of our GF2 and GT2 product, a GFZ_COMB2 solutions is generated based on orbit and clock products from 5 ACs. The GFZ_COMB2 shows a good internal consistency among ACs, and also to the 1st reprocessing combination solution IG1. The comparison with GFZ_COMB2 shows a significant improvement in quality and homogeneity of our repro2 products w.r.t. our 1st reprocessing solution.

deng@gfz-potsdam.de