

# ASI Near-Real Time products and related processing experiences

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- NRT Zenith Total Delay for E-GVAP



- NRT Zenith Total Delay Combination for E-GVAP

- NRT Site Coordinates for EUREF



- NRT quality monitoring on GPS data available at EUREF Local Data Center





# ASI NRT solution for E-GVAP - ZTD



ASI/CGS has been processing GPS data for meteo applications since 1999.



ASI E-GVAP sub network

- ~ 70 NRT sites with GIPSY
- 12 E-GVAP Super Sites
- 30 sites in Italy





- Standard technique of network adjustment with GIPSY 4.04
- data 24h sliding windows shifted by 1 hour, 5 min sampling rate, 10 deg cut-off
- IGU orbits fixed update 4-times daily
- ZTD products extracted from the last hour
- ocean loading FES2004
- absolute satellite & station (if available, individual ant. calibrations) PCV from May07
- post-fit phase residual analysis for detection of noisy station/satellite
- site coordinates fixed to values provided by combining 1 month of daily PP solutions & updated every month



For meteo applications a PPP approach is preferable over a network approach because:

- computing time increases linearly with the number of stations,
- parallel processing is available,
- a 'noisy' station doesn't disturb the others.

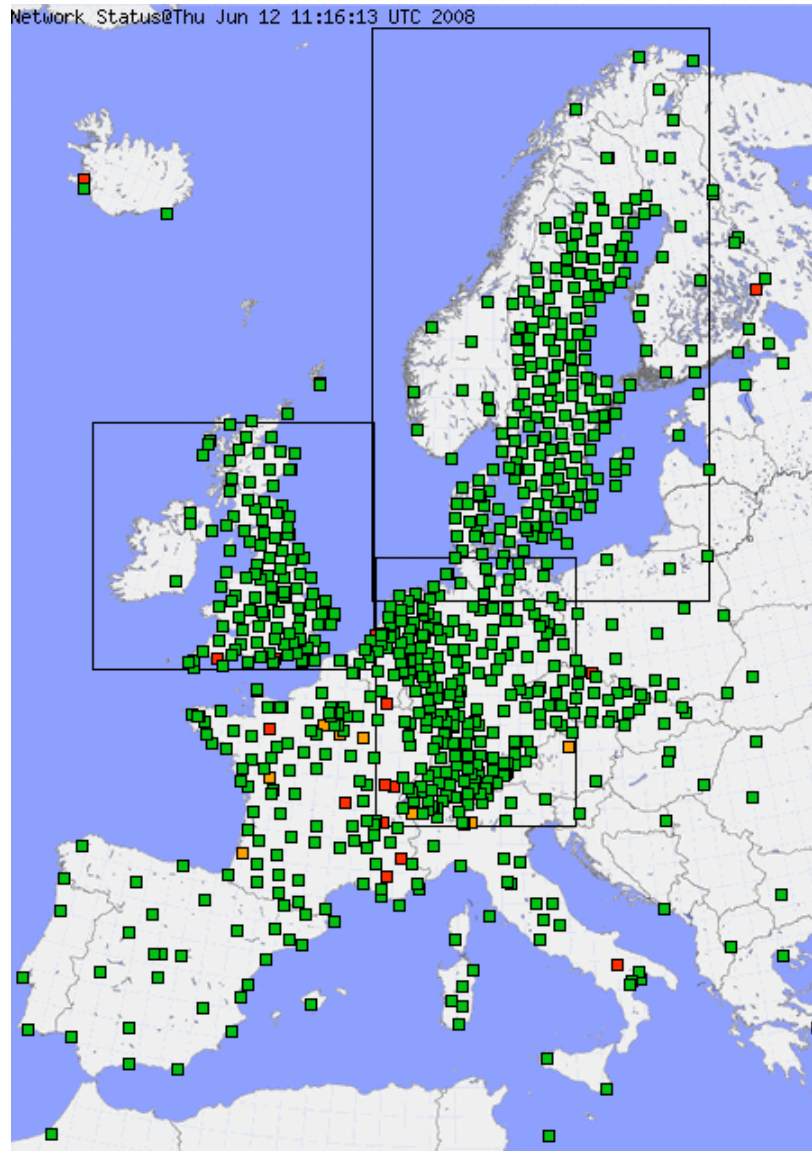
But for PPP satellite clocks should be available in NRT. IGS is encouraging its ACs to participate in the IGS UR clock products (see *IGS AC Workshop 2008 Recommendations*).

In E-GVAP each AC is processing a different network, with different SW and processing settings. The ZTD\_sigma is not a reliable ZTD quality indicator (*Pacione and Vespe, JTREC 2008*).

Combining solutions can reveal problems in the processing and can provide a reliable quality indicator for each solution.



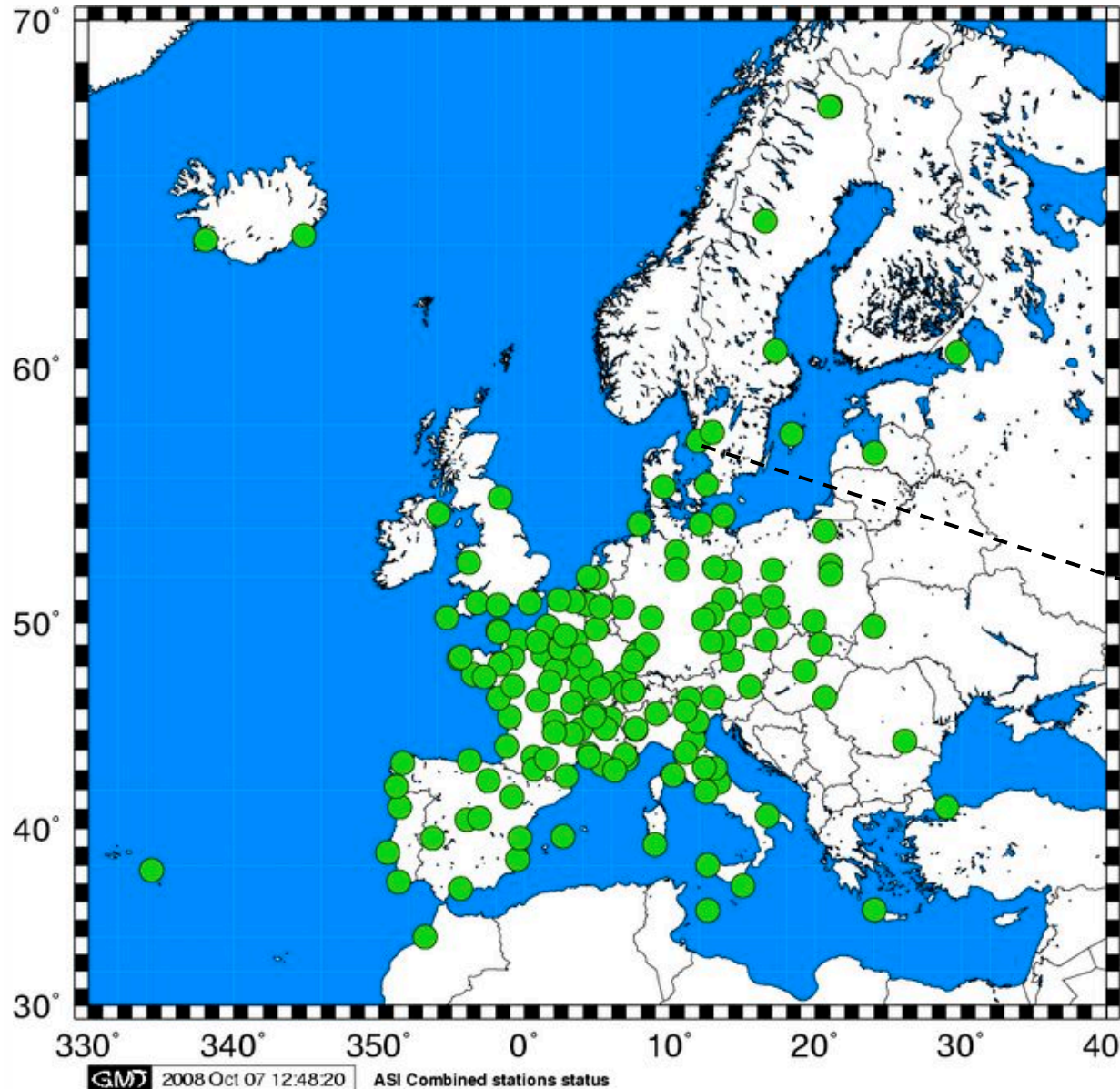
# Operational E-GVAP Network



- 13 Institutions
- 10 ACs
- > 800 GPS sites
- ~ 250 analyzed at least by 2 ACs
- ~ 150 analyzed at least by 3 ACs

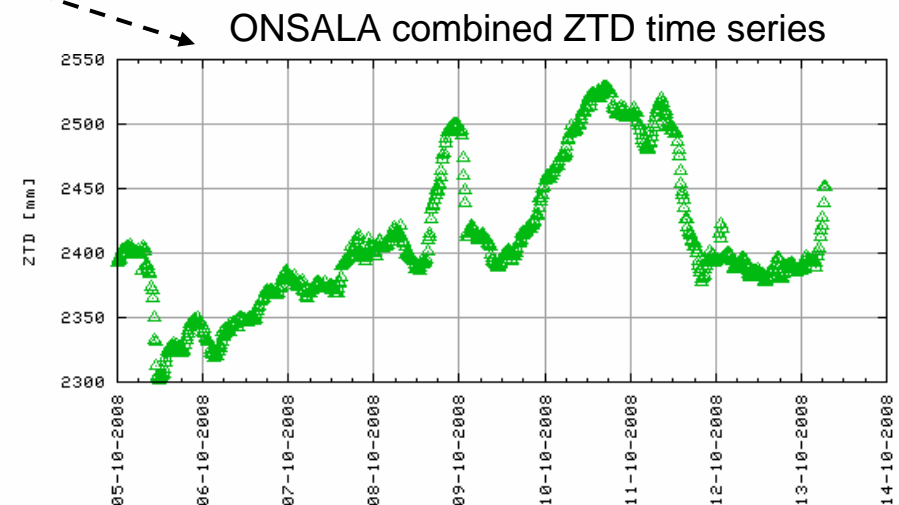


# ASI Combined E-GVAP Network



Every hour, with a delay of 3 hours w.r.t the last COST file available, the contributing solutions are fetched from UKMeto and the ZTD combination performed.

The combination of ~150 sites takes a couple of min.





## Input for NRT ZTD Combination



We consider the time series of GPS ZTD estimates obtained by different ACs for the same GPS site. Ideally the time series within each batch should have the same length and sampling interval but in practice .....

AC	# samples	@
ASI	4	00-15-30-45
BKG	1	30
GFZ	4	07,30-22,30-37,30-52,30
GOP	2	00-59
KNMI	5	00-14-29-44-59
KNM1	5	00-14-29-44-60
LPT	2	00-59
LPTR	11	02-07-12-17-22-27-32-37-42-47-52
METO	5	00-15-30-45-59
NGAA	4	05-20-35-50/10-20-35-50/00-15-30-45
SGN	5	00-15-30-45-59
SGN1	5	00-15-30-45-59

..... there is the need to specify a set of equidistant time moments at which to perform time series combination.



The first step in the combination process is reading and checking the cost files.

At this stage, gross errors are detected and removed.

Data or processing problems are suddenly detected and e-mails send to the ACs.



Data Problem: LPTR/site FHBB: 4 different ZTD estimates at the same epoch.

It was a bug caused by the Trimble Software (E. Brockmann private communication).



Processing Problem: format error in many cost files from different ACs.



For a single site ZTD is modeled as:

$$y_n^k = Y_n + b^k + e_n^k$$

$n = 1, \dots, N$  time epochs  
 $k = 1, \dots, K$  analysis centers

where  $Y_n$  is the 'true' ZTD at epoch  $t_n$ ,  $b^k$  is the analysis center bias and  $e_n^k$  is the residual between  $Y_n$  and  $y_n^k$ .

The linear function model which can be solved in the generalized least square sense by adding the following constrain equation:

$$\sum_k b^k = 0$$

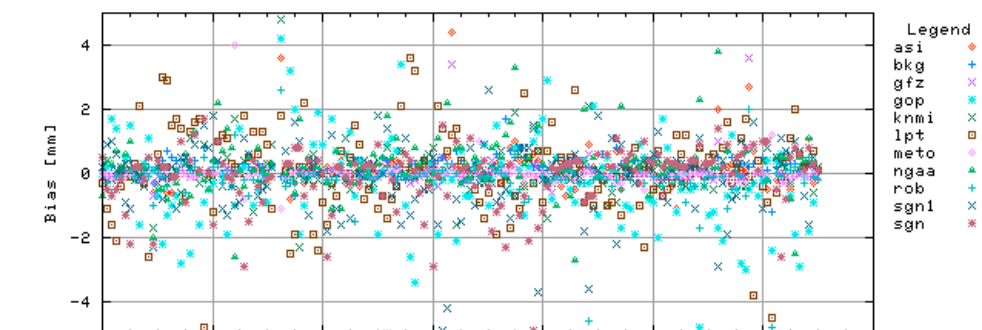


# NRT ZTD Combination @ CAGL

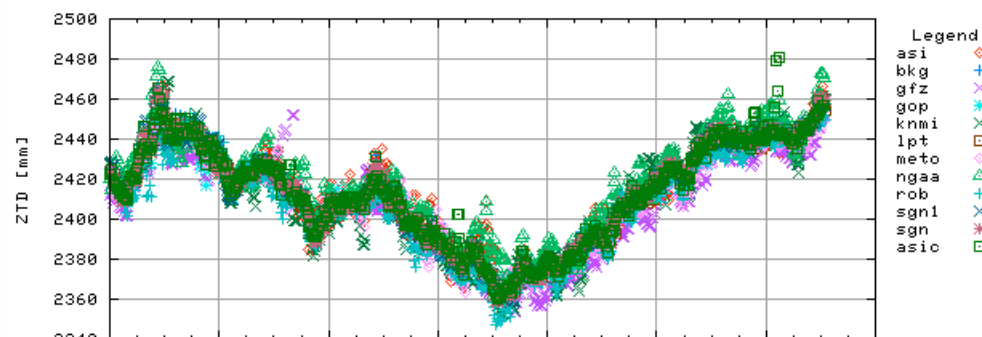


## ASI combination

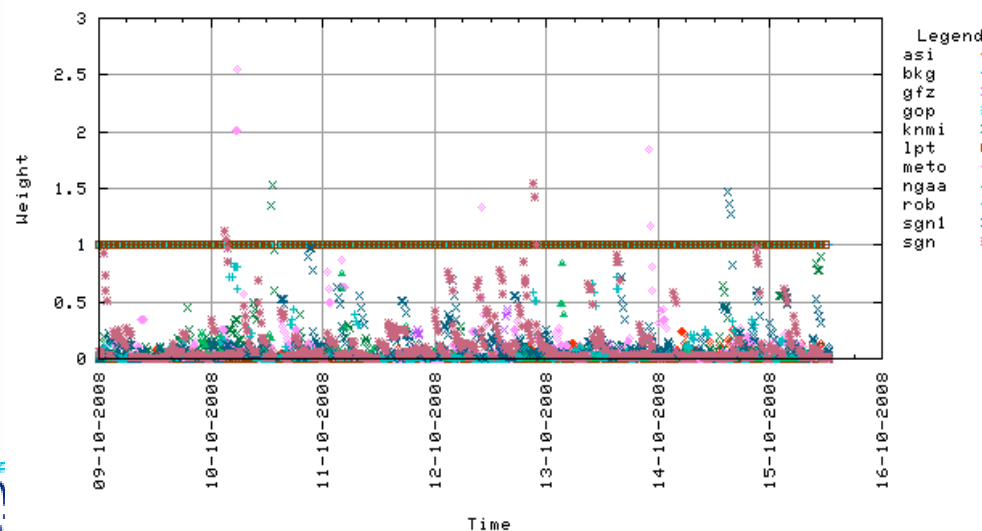
ZTD Bias w.r.t. ASIC



GPS ZTD time series

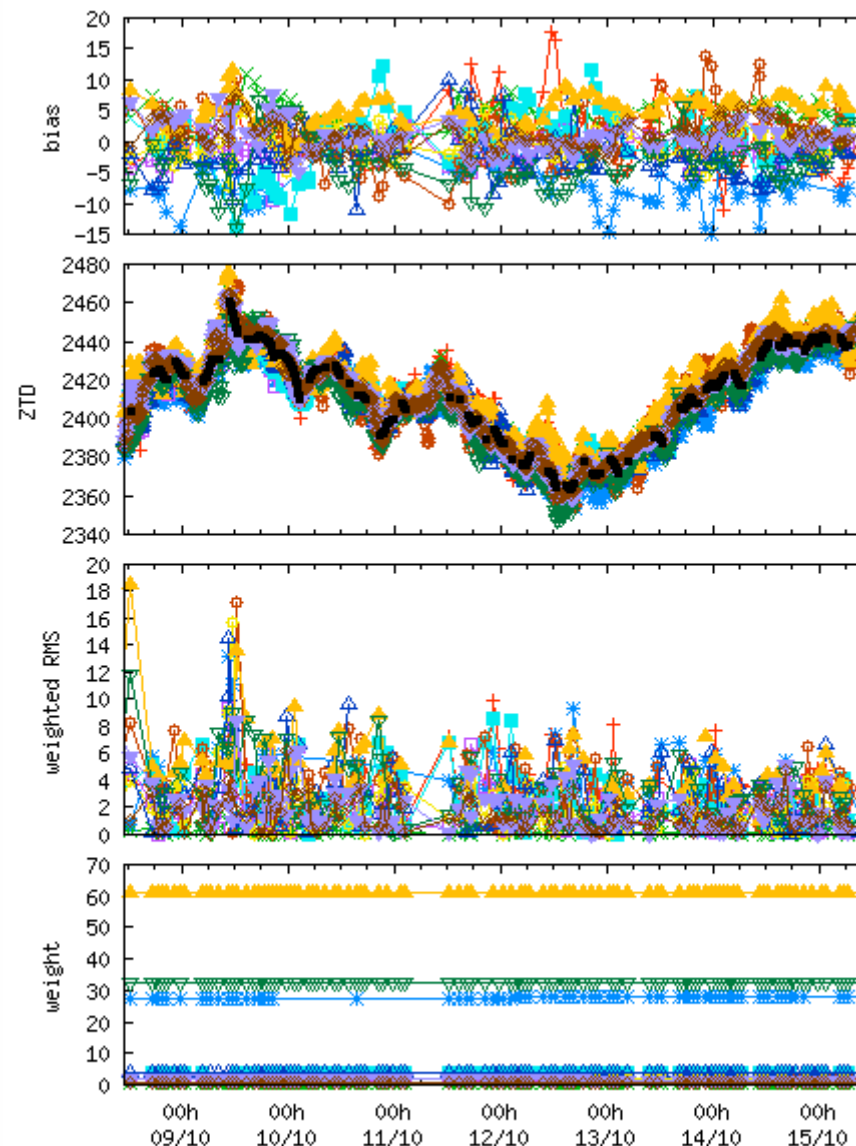


ZTD Weight w.r.t. ASIC



## KNMI combination

CAGL created: 15 Oct 14:58 UTC



ASI\_ + GFZ\_ \* IGE\_ + LPT\_ + NGAA\_ + SGN1\_ +  
BKG\_ \* GOP\_ + KNMI\_ + METO\_ + ROB\_ + SGN\_ +

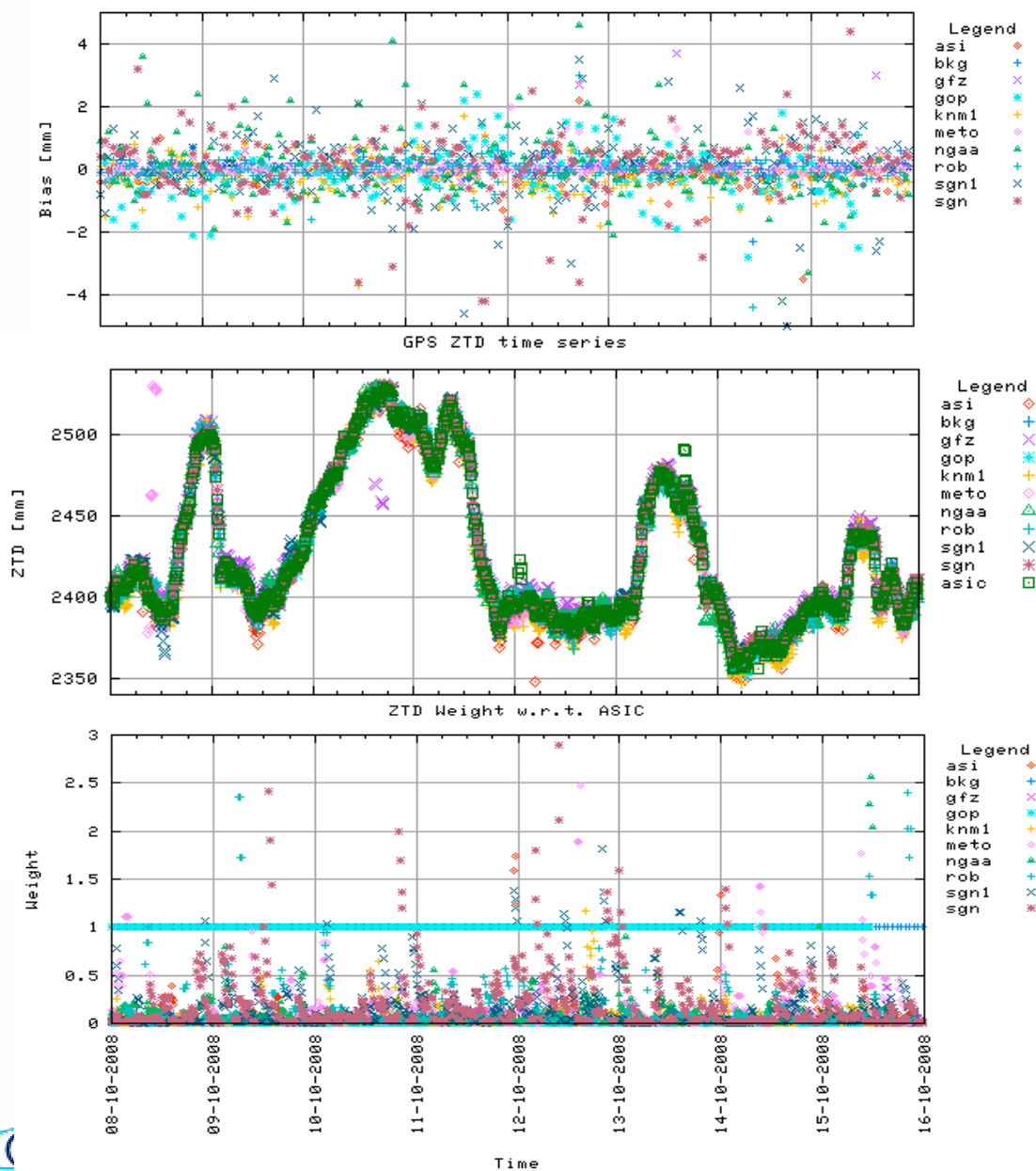


# NRT ZTD Combination @ ONSA



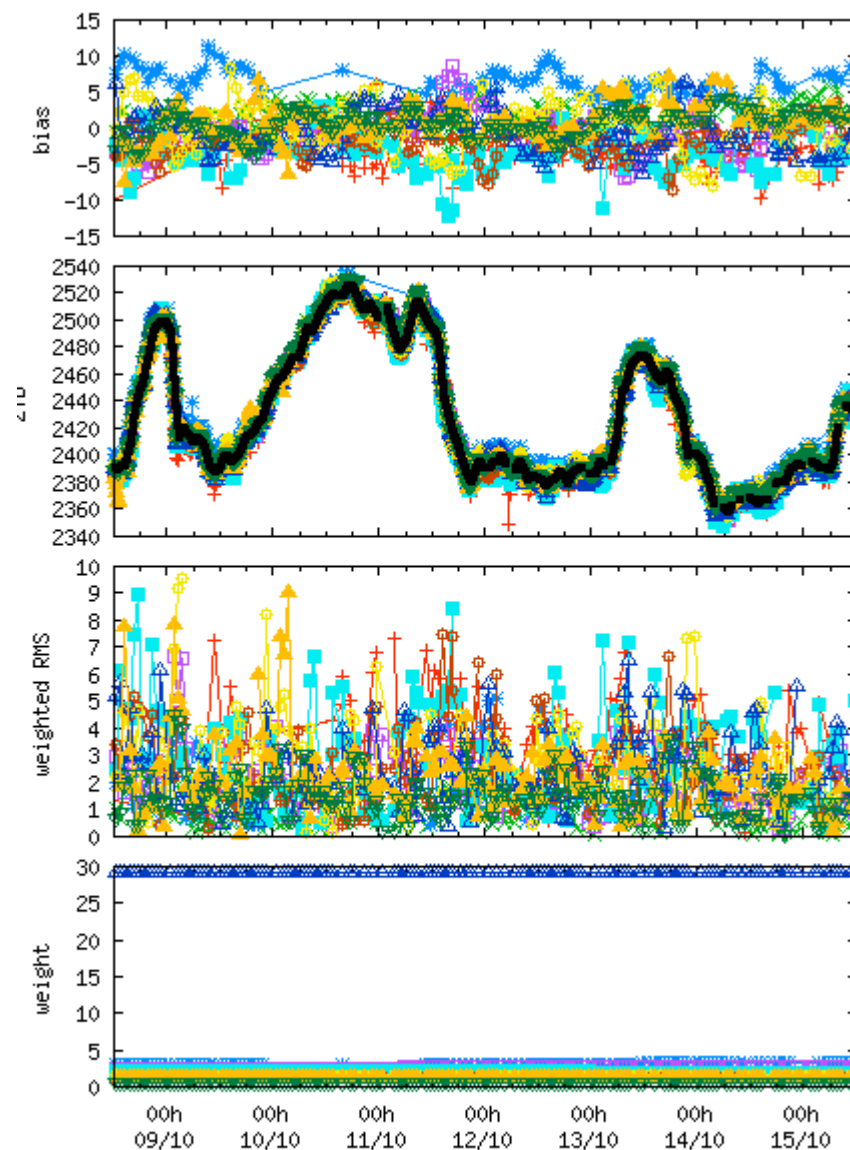
## ASI combination

ZTD Bias w.r.t. ASIC



## KNMI combination

ONSA created: 15 Oct 14:59 UTC

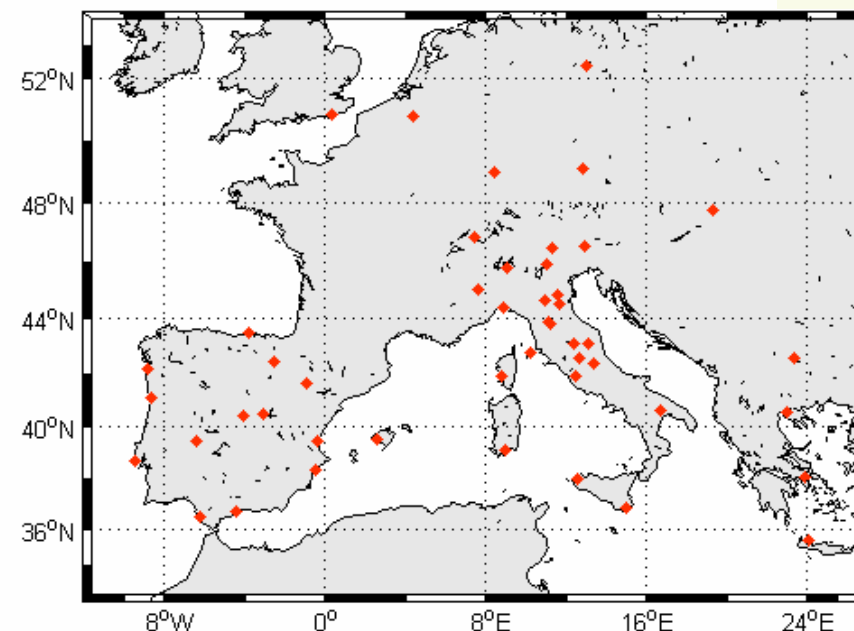


ASI\_ + GFZ\_ \* KNM1 \* NGAA \* SGN1 \*  
BKG\_ \* GOP\_ \* METO \* ROB\_ \* SGN\_ \*

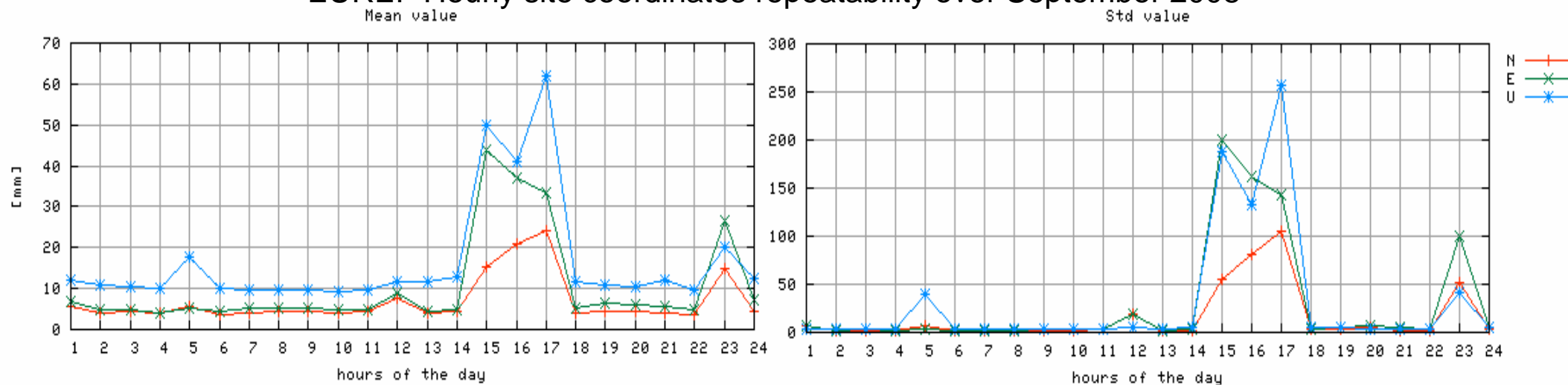
Frankfurt/Main, Germany, 22-23 October, 2000



ASI delivers, together with BKG and LPT, site coordinates of ~40 sites to **EUREF** on hourly basis with the aim to establish a near-real time processing for a quick monitoring of the EPN stations.

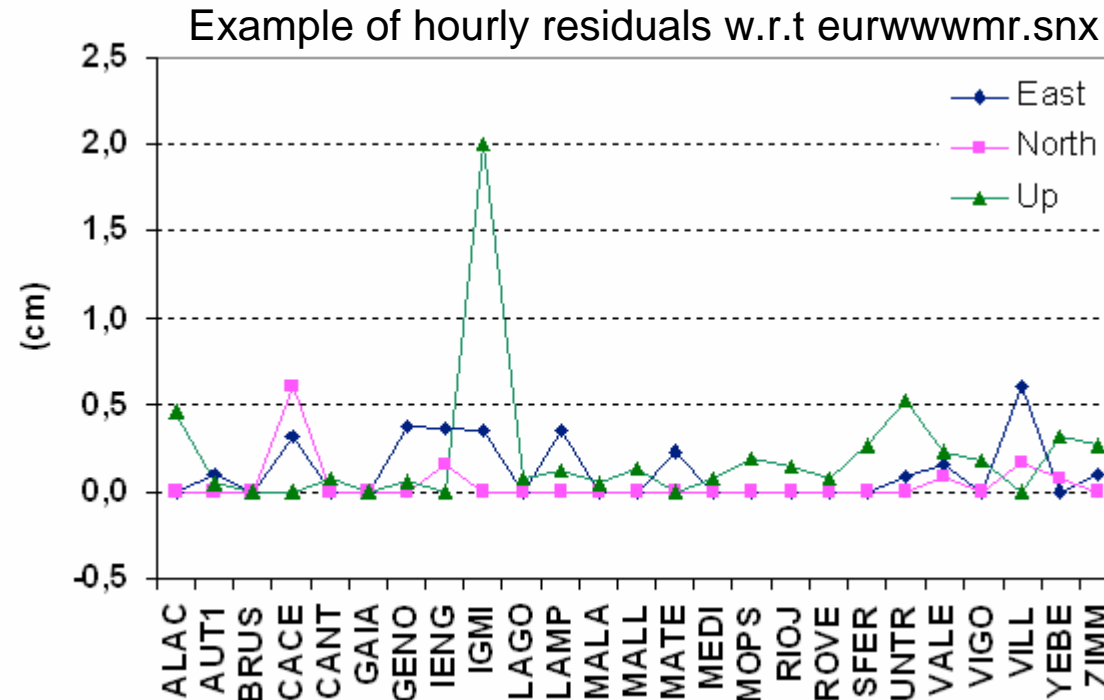


EUREF Hourly site coordinates repeatability over September 2008





Hourly IGS05 sinex files are compared w.r.t EUREF rapid weekly solutions (*eurwwwmr.snex*) and sites having *large* residuals ( $\pm 2.5\text{cm}$  e/n;  $\pm 3.5\text{cm}$  up) are detected and removed.

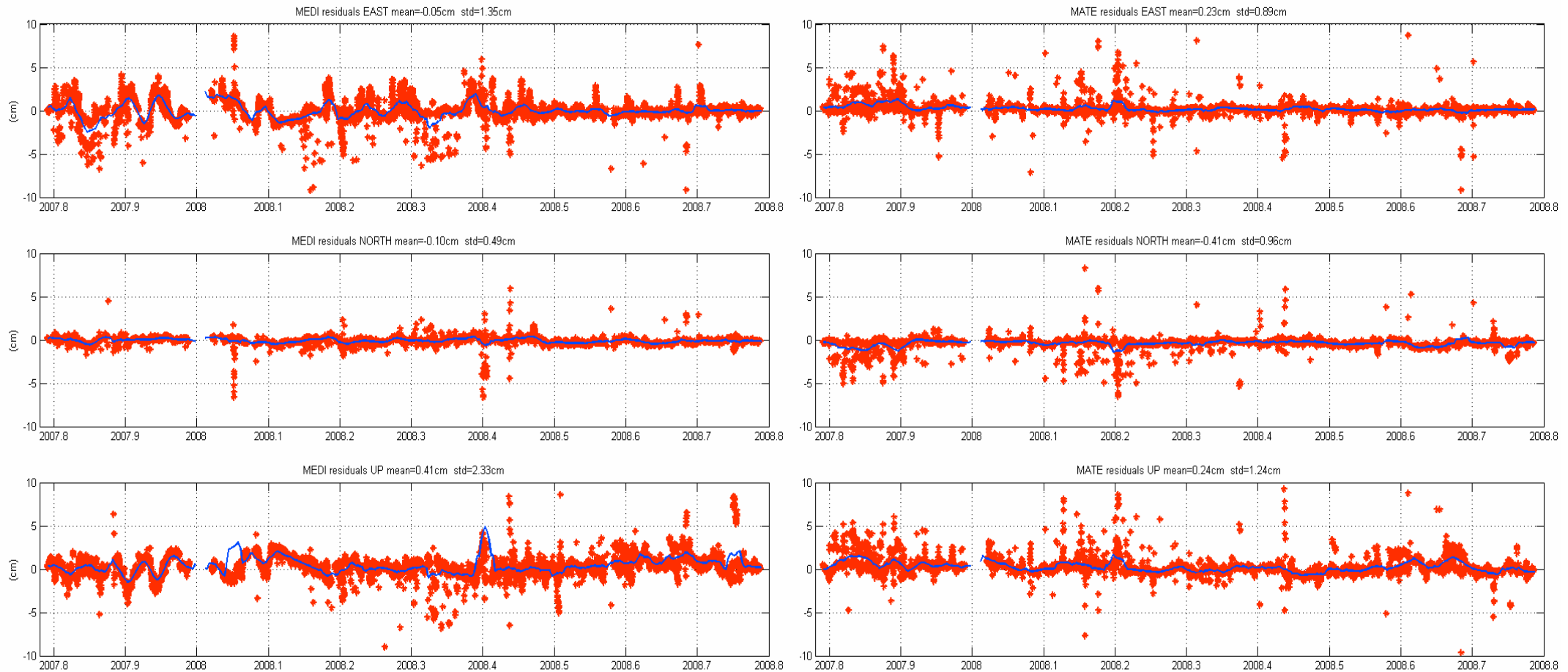


If the site belongs to the Italian GPS Fiducial Network an alert is sent to the station manager and we generally detect one of the TEQC parameters out of the expected range.

Site performance is monitored with a delay of less than 2 hours.

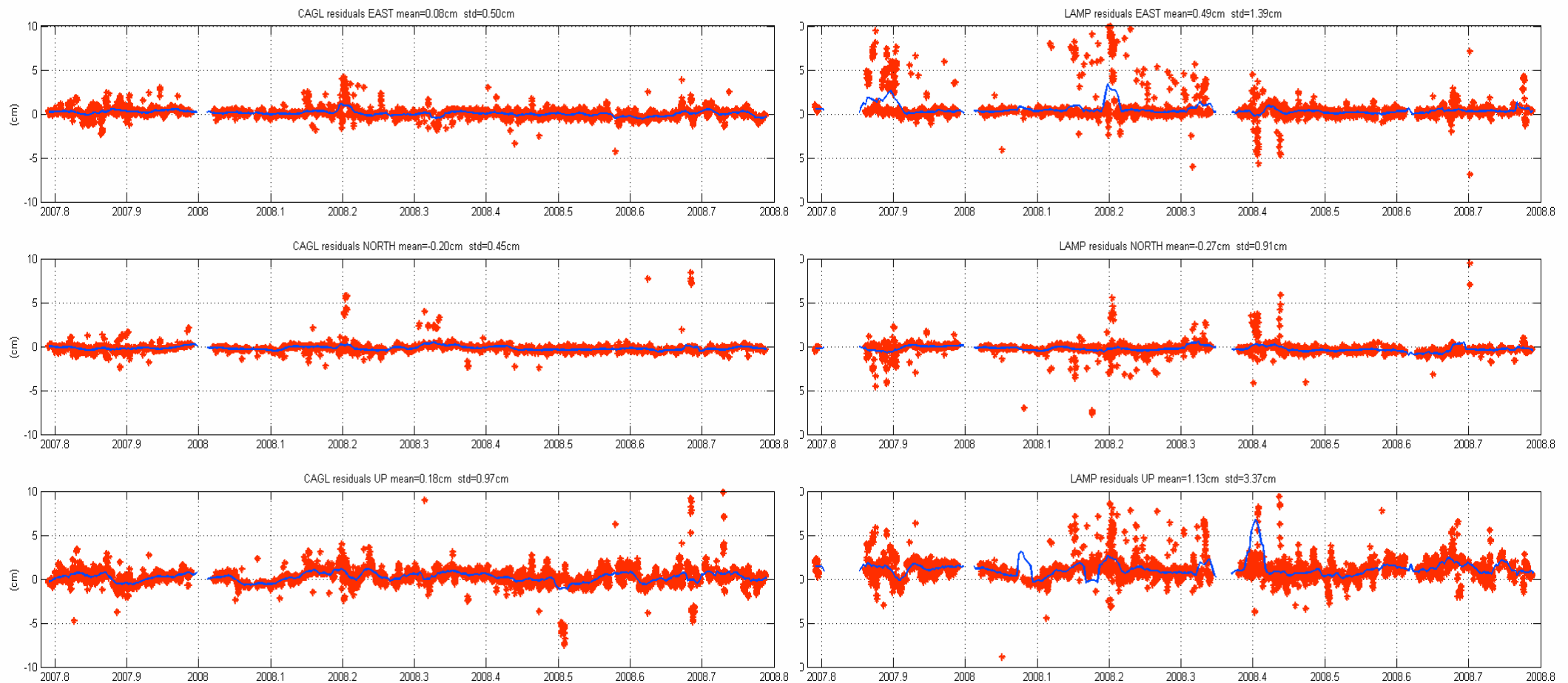


## Hourly SSC residuals w.r.t EUREF rapid weekly solutions from October 2007 to October 2008

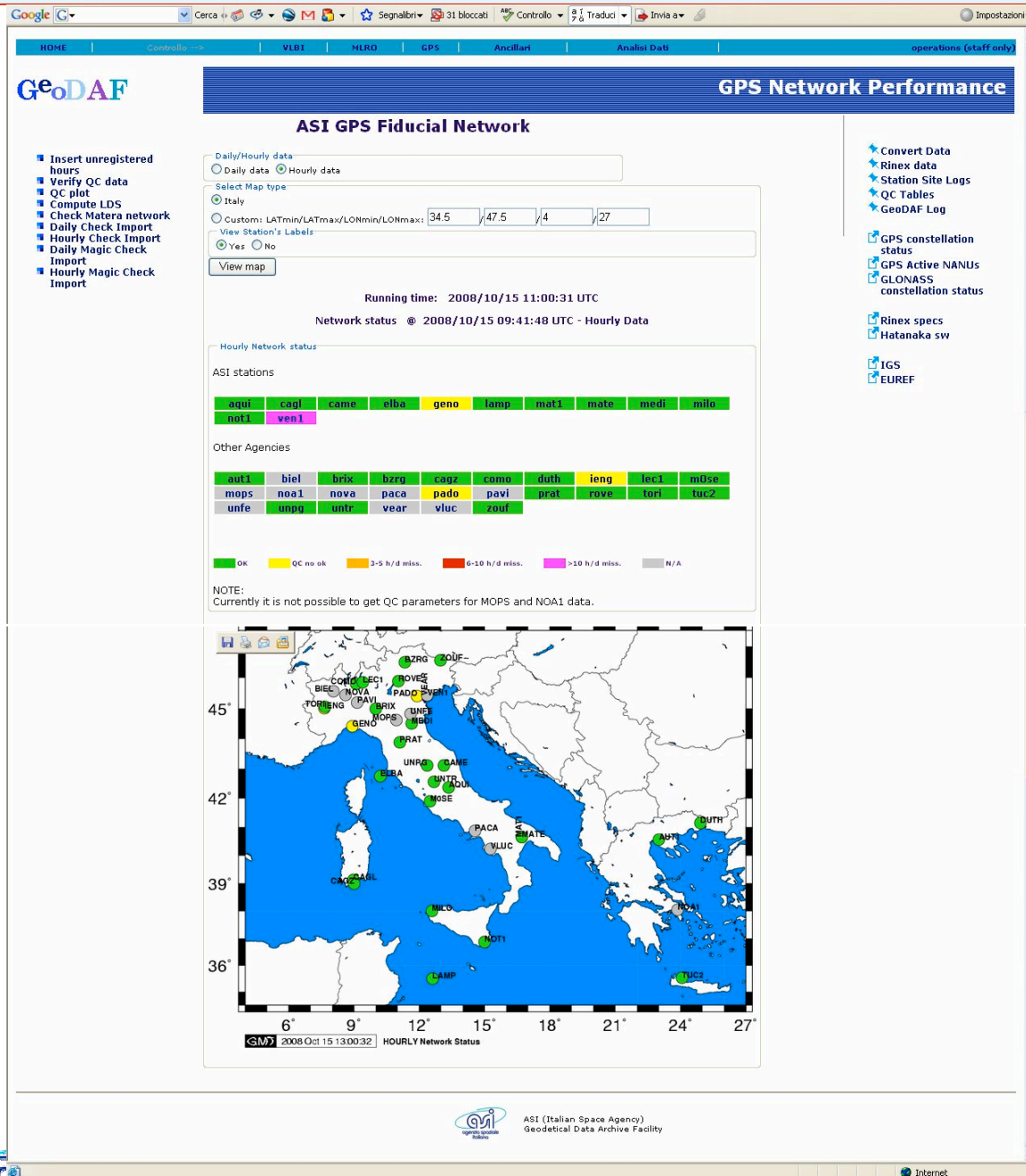




## Hourly SSC residuals w.r.t EUREF rapid weekly solutions from October 2007 to October 2008







An hourly/daily quality check on the GPS data (available at EUREF LDC GeoDAF) is performed in terms of data availability, integrity and quality.

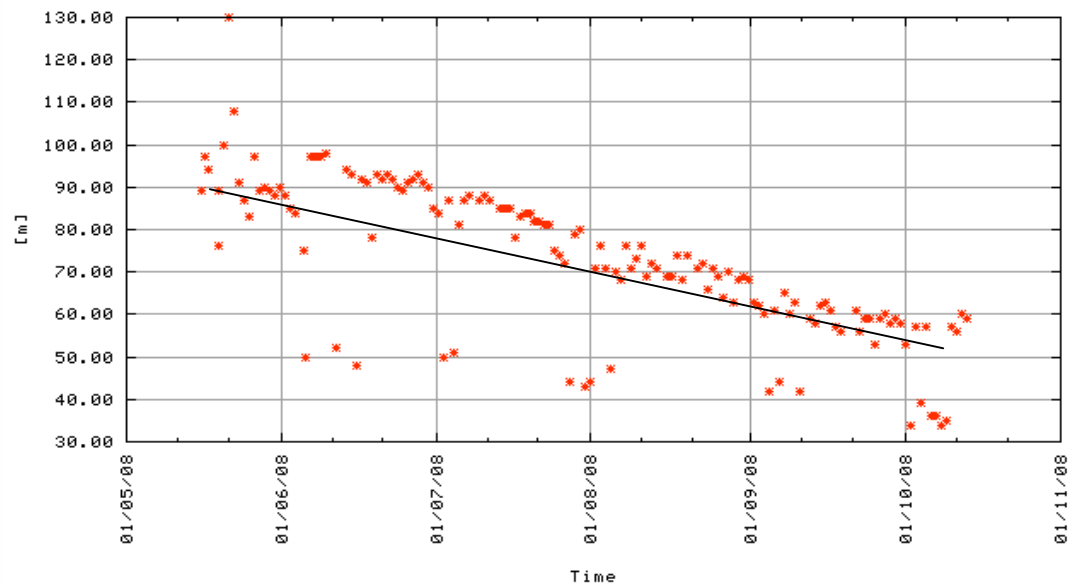
15days/1year TEQC parameter time series are routinely monitored and alert send if one of them is out of the expected range.



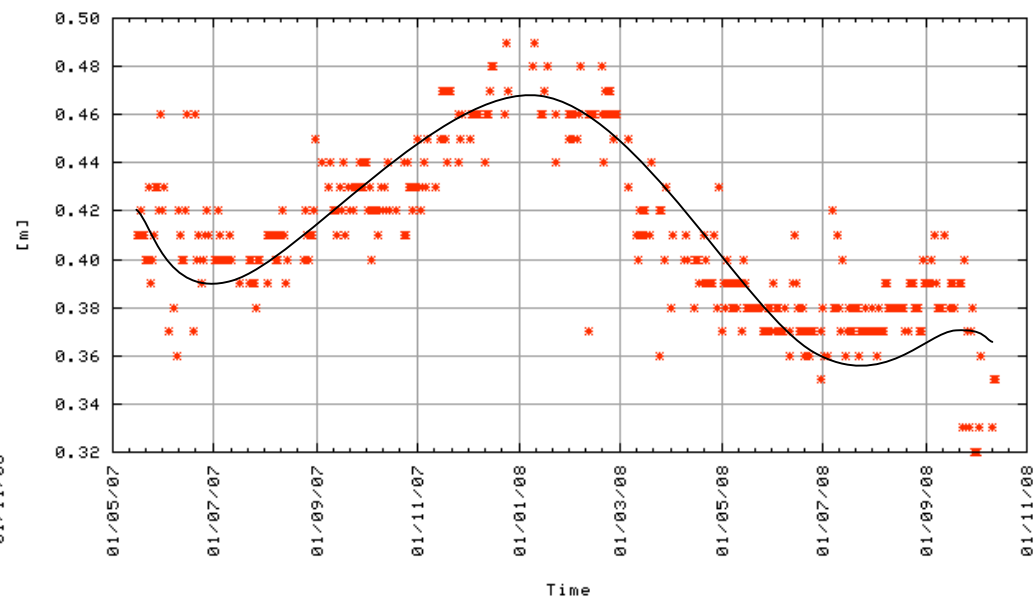
# TEQC parameter time series



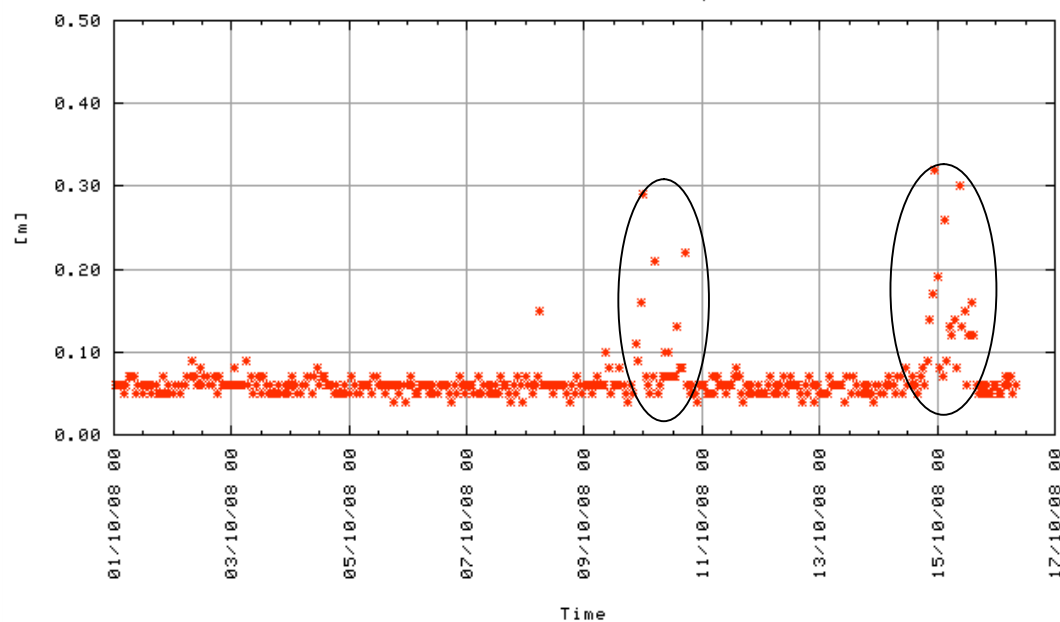
brix - pos.n - DAILY Data



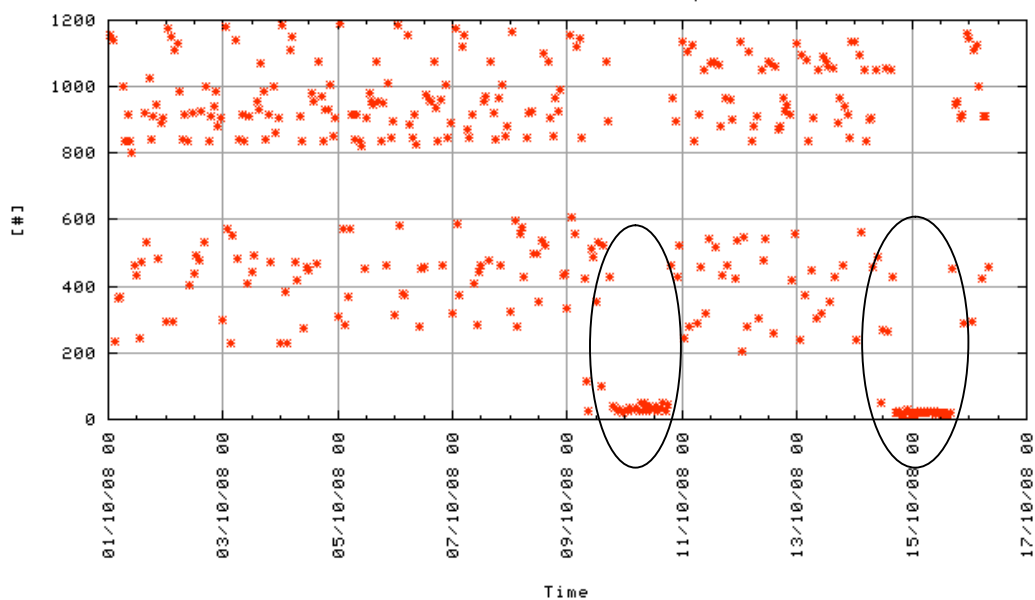
pado - DAILY Data - mp1



mate - HOURLY Data - mp1



mate - HOURLY Data - oslps





- An overview of ASI/CGS Near Real Time products has been presented.
- ASI/CGS plays the role of NRT AC both in E-GVAP and EUREF contexts, delivering regional GPS products (ZTD and SSC) and performing an hourly quality check on the GPS data available at GeoDAF.
- ASI/CGS is also acting as E-GVAP combination center.

