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IGE Analysis Centre Report in E-GVAP

Instituto Geográfico Nacional

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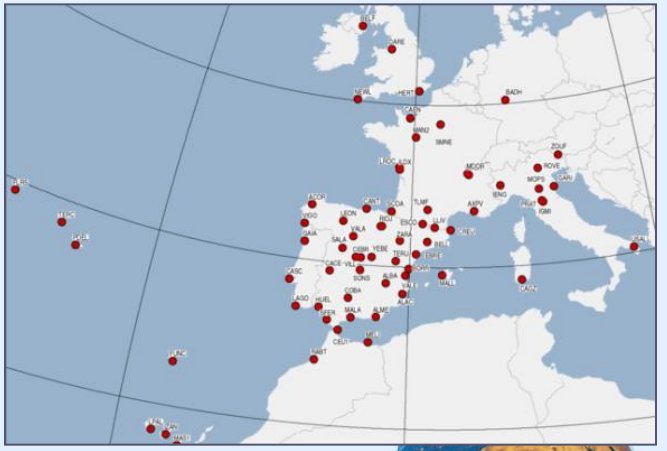
IGN-E background

- IGN managing GNSS national network.
  - About 80 stations.
  - 26 of them integrated in IGS / EUREF.
  - Main purposes: geodesy and real time positioning services.

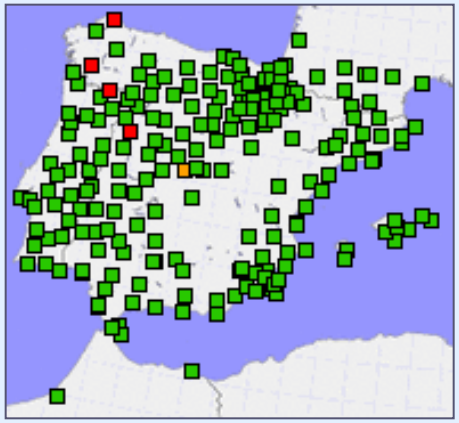
- EUREF Local Analysis Center since 2001
  - Proccessing subnetwork 64 EPN stations.
  - Final and rapid solutions.
  - BSW 5.2, GPS+GLONASS.
  - EUREF Repro1 & Repro2 AC.



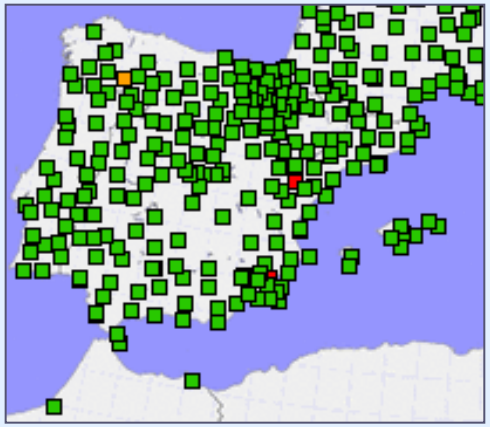
- IGE, E-GVAP Analysis Centre since 2008.
  - Providing ZTD from ~ 340 stations for Spain & Portugal in nrt.

EGVAP analysis

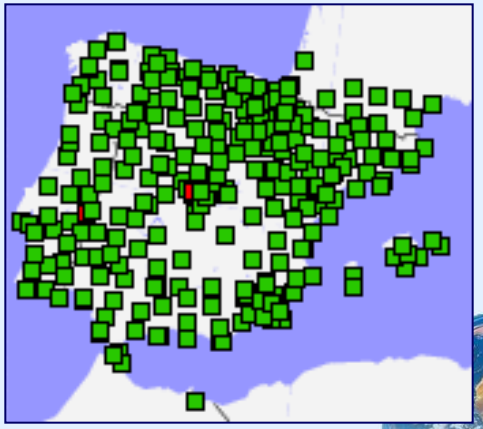
- No relevant changes since the last meeting in IGE solution:
  - Number of stations has grown up slightly (from 320 to ~ **340 stations**).
  - Former solution IGE_ (based on BSW5.0) stopped last year.
  - IGE2: **BSW5.2, COST 2.2** format, from April 2014.
  - Hardware migrated to a 16 core machine, hourly process takes **4-5 min**.
  - No new GNSS networks have been installed in the area in the last years. Only few stations for densification.



Nov. 2012

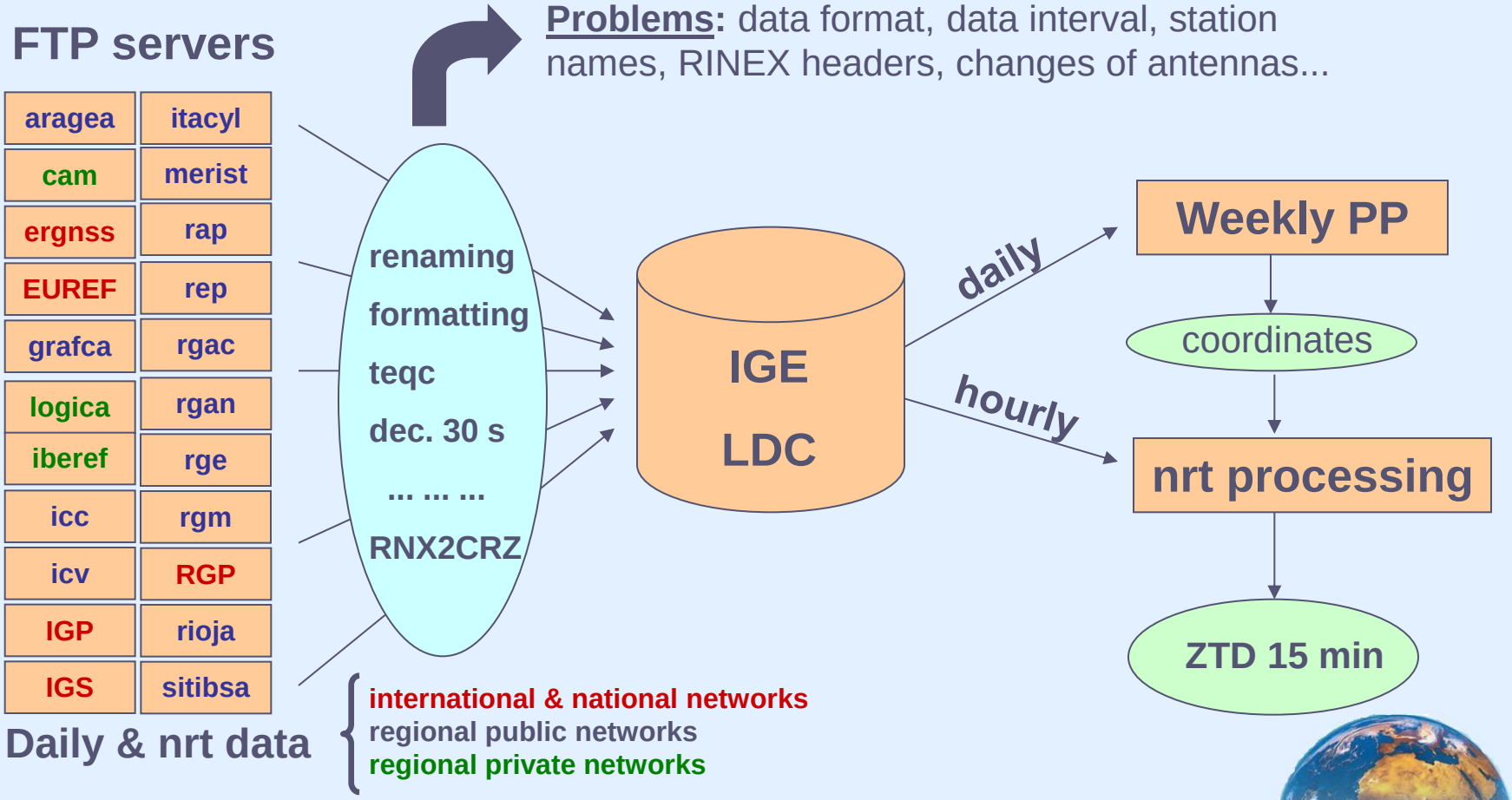


Nov. 2013



Oct. 2014 ≈ Dec 2016

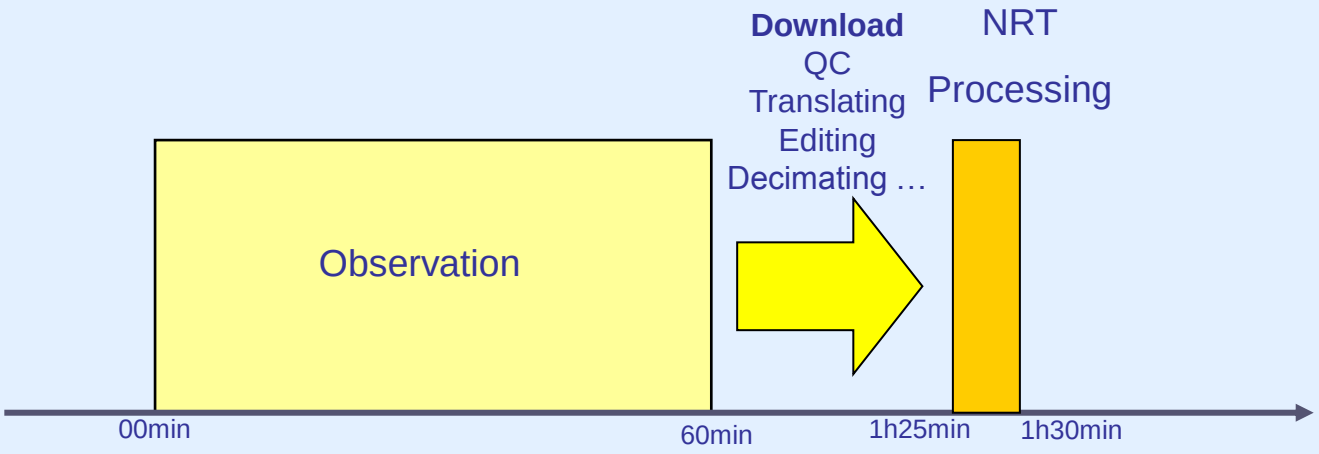
Data flow



(~ **22 different networks**, main purpose: **RTK**)

Schedule

- NRT starts each hh:25.
- NRT finishes 4-5 minutes later, hh:30.
- Last hour + 5 NEQ stacking for the troposphere final solution.
- Coordinates from the weekly process from previous 2 weeks.
- ZTD submitting time limited by availability of data from regional networks (sometimes ~ 20 min).
- Processing can be advanced in time on demand of Met agencies, but in this case not all posible stations can be processed.



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Analysis of the Influence of some variables in ZTD results

- In order to find the optimal configuration in BSW5.2 a study was made and the influence of some parameters were analysed.
- Comparisons made with the final EUREF ZTD combined solution used as reference (in EPN stations).
- High ZTD variation epoch used.
- Example of variables analysed and compared:
  - CODE orbits & ERPs vs. IGS.
  - Only GPS vs. GPS+GLONASS.
  - Changes in the stations constrained coordinates (height component).
  - Changes in the network design.
  - Atmospheric tidal loading corrections vs. not use them.
  - A priori tropospheric models: Global Mapping Function (GMF) vs. Vienna Mapping Function (VMF).

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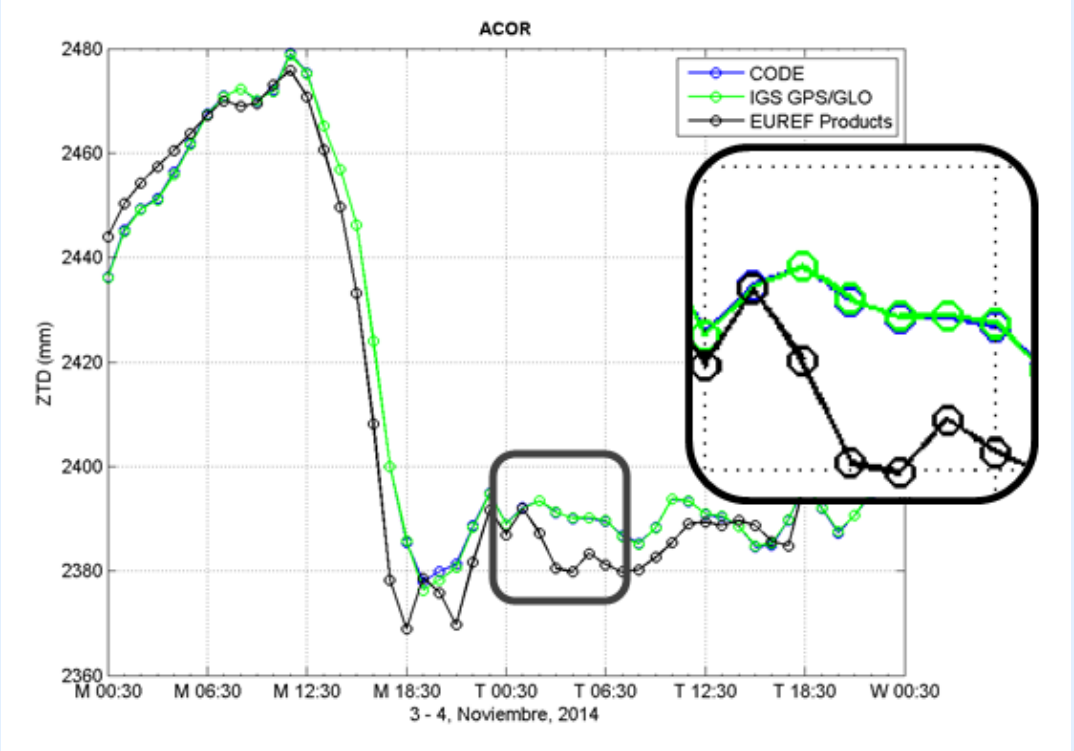
CODE vs IGS products

- ✓ Mean absolute ZTD difference between the solutions with IGS or CODE products (GPS+GLONASS observables): **0.2 mm.**
- ✓ Mean absolute ZTD differences between the solutions and the EUREF combined solution: **4.4 mm** in both cases.

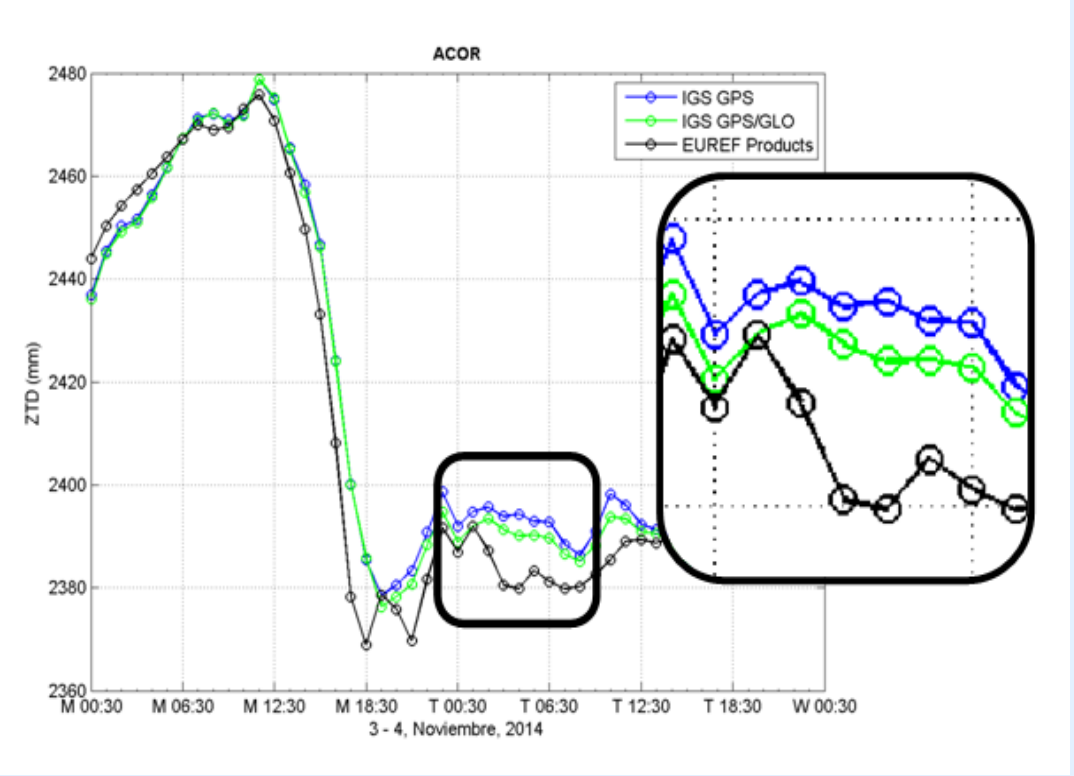


ZTD for ACOR station. Black: EUREF ZTD solution; Blue: ZTD solution with CODE orbits and ERP; Green: ZTD solution with IGS (GPS+GLONASS) orbits and ERPs.

GPS vs GPS+GLONASS observables

In both estimations IGS products have been used.

- ✓ Mean absolute ZTD difference between both solutions: **2.2 mm**
- ✓ Mean absolute ZTD differences between these solutions and the EUREF combined product: **5.5 mm** with only GPS observables and **4.4 mm** with GPS + GLONASS observables.



ZTD for ACOR station. Black: EUREF solution; Blue: ZTD solution with only GPS; Green: ZTD solution with GPS+GLONASS .

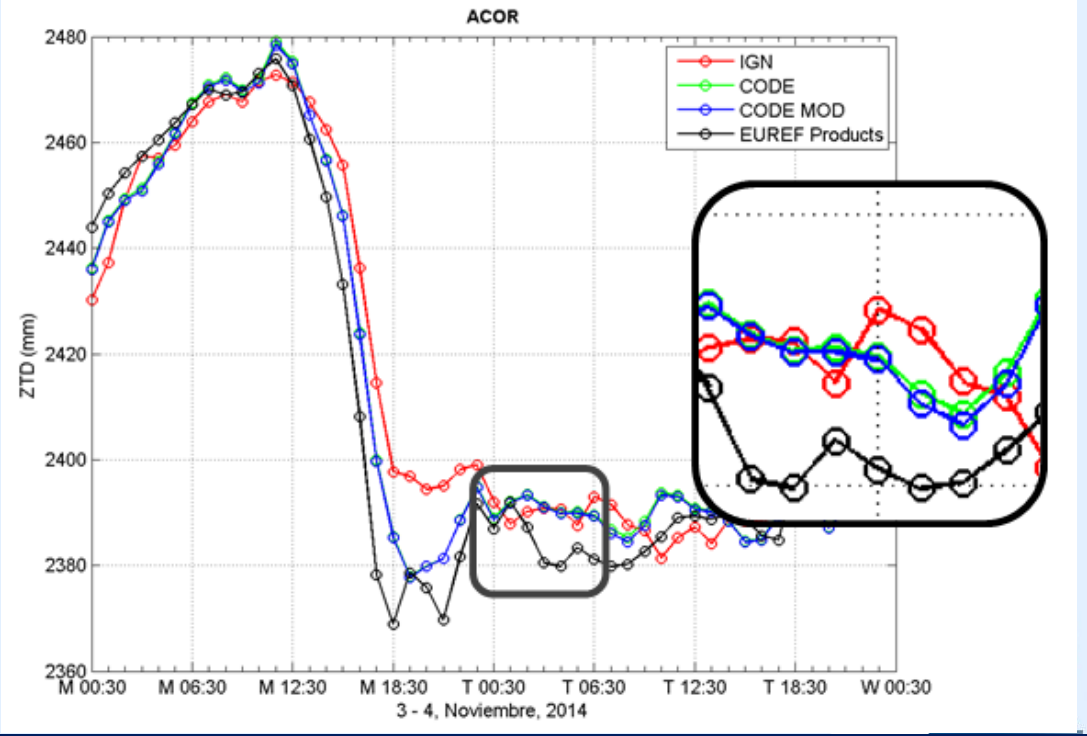
Constrained stations coordinates

A big offset of 5 cm was added in the up component of **all** the stations.

- ✓ Mean absolute ZTD difference between both solutions: **0.3 mm**.

In order to see local changes influence a new experiment is carried out modifying only one station (ALME). The up component is changed 5 cm and ZTD suffers an important change. The near stations are affected too (MALA, CEU1) and the influence is lower in far stations (ACOR, BADH).

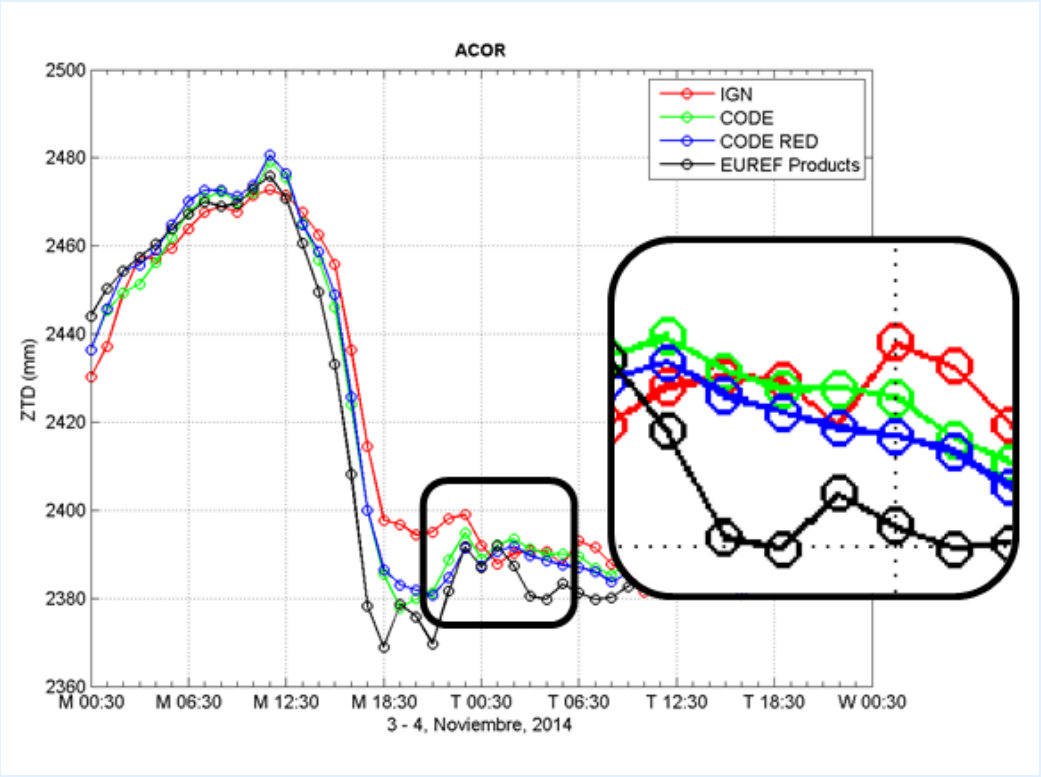
Station	ZTD *not modify coord.*	ZTD *modify coord.*	Absolute Difference
ACOR	2467.7 mm	2467.9 mm	0.2 mm
ALME	**2431.7 mm**	**2425.6 mm**	**6.1 mm**
MALA	2443.0 mm	2443.3 mm	0.3 mm
CEU1	2450.3 mm	2450.7 mm	0.4 mm
BADH	2368.6 mm	2368.7 mm	0.1 mm



Network design

Two networks have been processed. The first one with 82 stations and a reduced network with 67 stations.

- ✓ Mean absolute ZTD difference between these networks: 1.5 mm.
- ✓ Mean absolute ZTD differences between these solutions and the EUREF combined product: 4.1 mm in both cases.

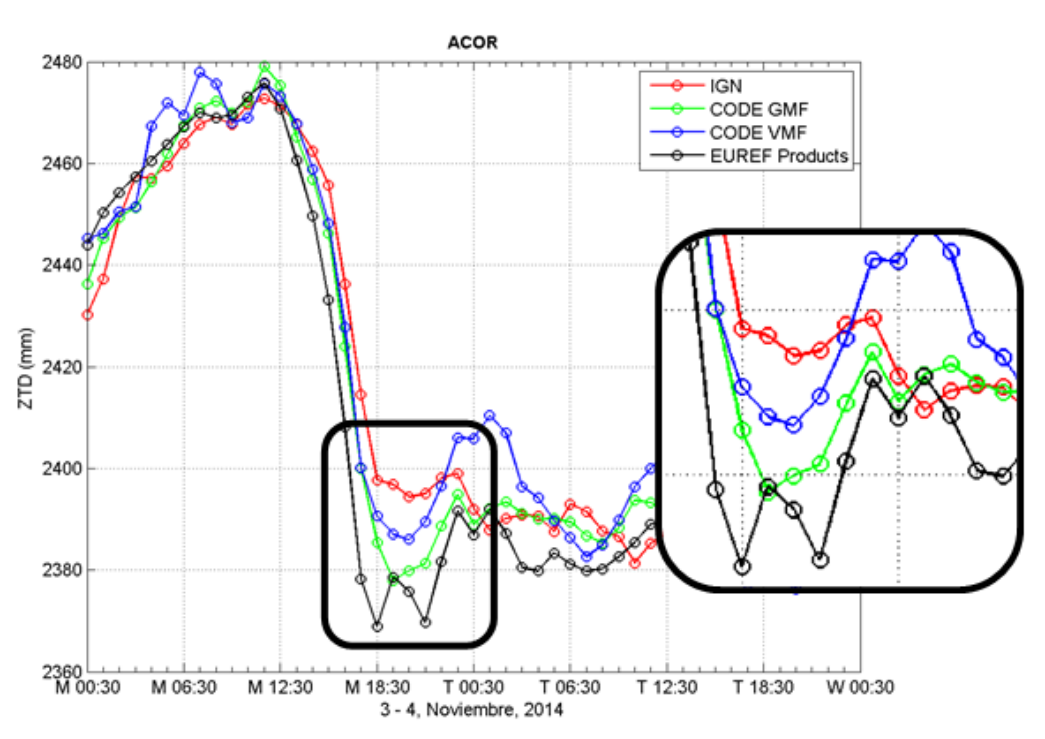


ZTD for ACOR station. Black: EUREF solution; Green: ZTD solution with 82 stations; Blue: ZTD solution with 67 station; Red: IGN solution (about 350 stations).

A priori troposphere model

ZTD estimations with two models have been compared: Global Mapping Function (GMF) and Vienna Mapping Function (VMF).

- ✓ Mean absolute ZTD difference between both solutions: 7.6 mm.
- ✓ Mean absolute ZTD differences between these solutions and the EUREF combined product: 4.4 mm with GMF and 8.6 mm with VMF.



ZTD for ACOR station. Black: EUREF solution; Green: ZTD solution with GMF; Blue: ZTD solution with VMF; Red: EUREF IGN solution.

Conclusions

- ✓ No relevant differences in ZTD estimation with ultra rapid CODE or IGS orbits and ERP.
- ✓ Significant differences between the determinated ZTD results with only GPS or GPS + GLONASS. The second, more similar to the EUREF troposphere solution.
- ✓ Relative variations in the constrained coordinates have strong influence in the ZTD estimation: updated coordinates are needed for the optimal ZTD determination.
- ✓ Network configuration is closely related to ZTD estimation in DD.
- ✓ Atmospheric and ocean tidal loading models are essential for achieving an accurate ZTD solution mainly in near coast stations.
- ✓ The a priori troposphere model has an important impact in the final ZTD. Better results have been obtained with GMF.

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Thank you for your atention

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