Exploitation of the new IGS Real-Time Products for GNSS Meteorology

R. Pacione

e-GEOS S.p.A. ASI/CGS - Matera, Italy

W. Soehne

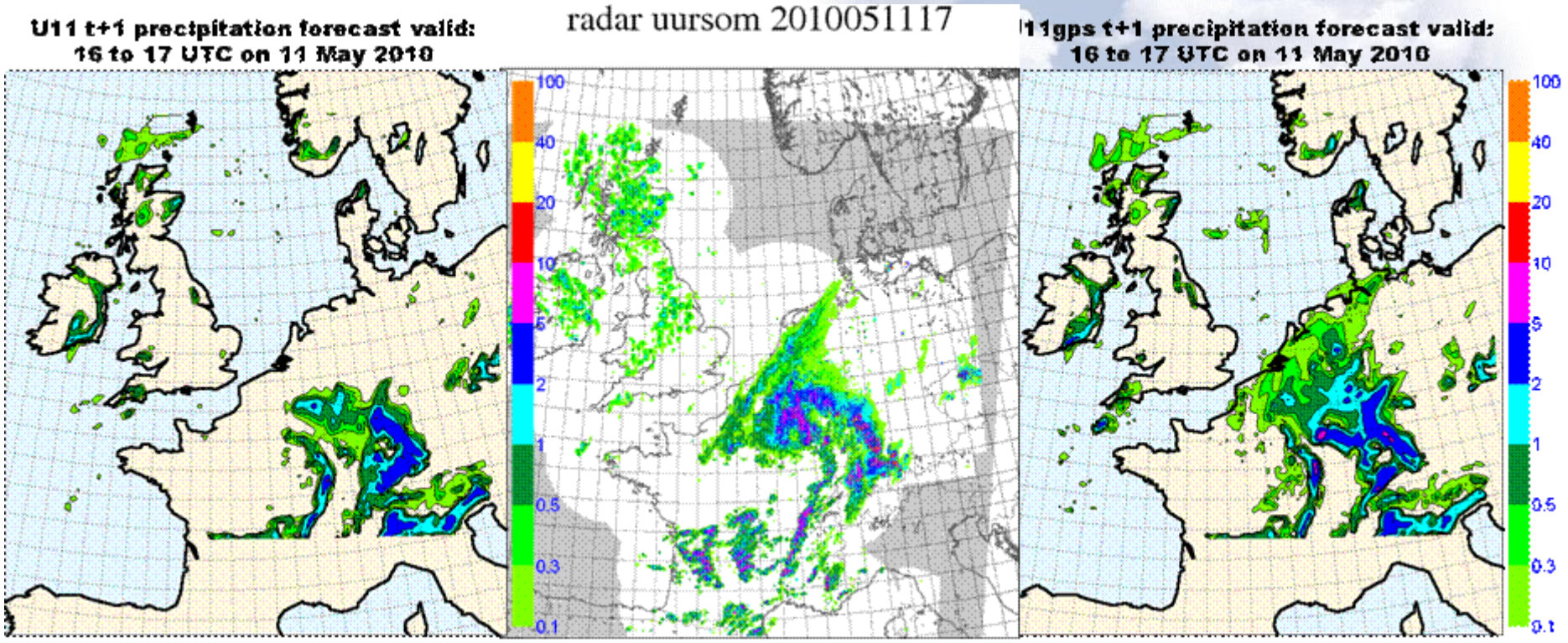
Federal Agency for Cartography and Geodesy (BKG) - Frankfurt, Germany

Outline of the talk

- Motivation
- GNSS-Met Product Requirements
- Sub-hourly and real-time processing schemes
- Test processing and reference data set
- Conclusions

Motivation

Rapid Update Cycle in NWP (KNMI, Siebren De Haan)



GNSS-Met Product Requirements

GNSS-Met Observational requirements for Regional NWP

	IWV		
	Threshold	**Breakthrough**	**Goal**
Horizontal Domain	Regional (e.g. Europe, N. America)		
Horizontal Sampling	250 km	25 km	3 km
Observation Cycle	12 h	6 h	1 h
Accuracy	5 kg m^{-2}	2 kg m^{-2}	1 kg m^{-2}
Timeliness	6 h	30 min	5 min

GNSS-Met Observational requirements for Nowcasting

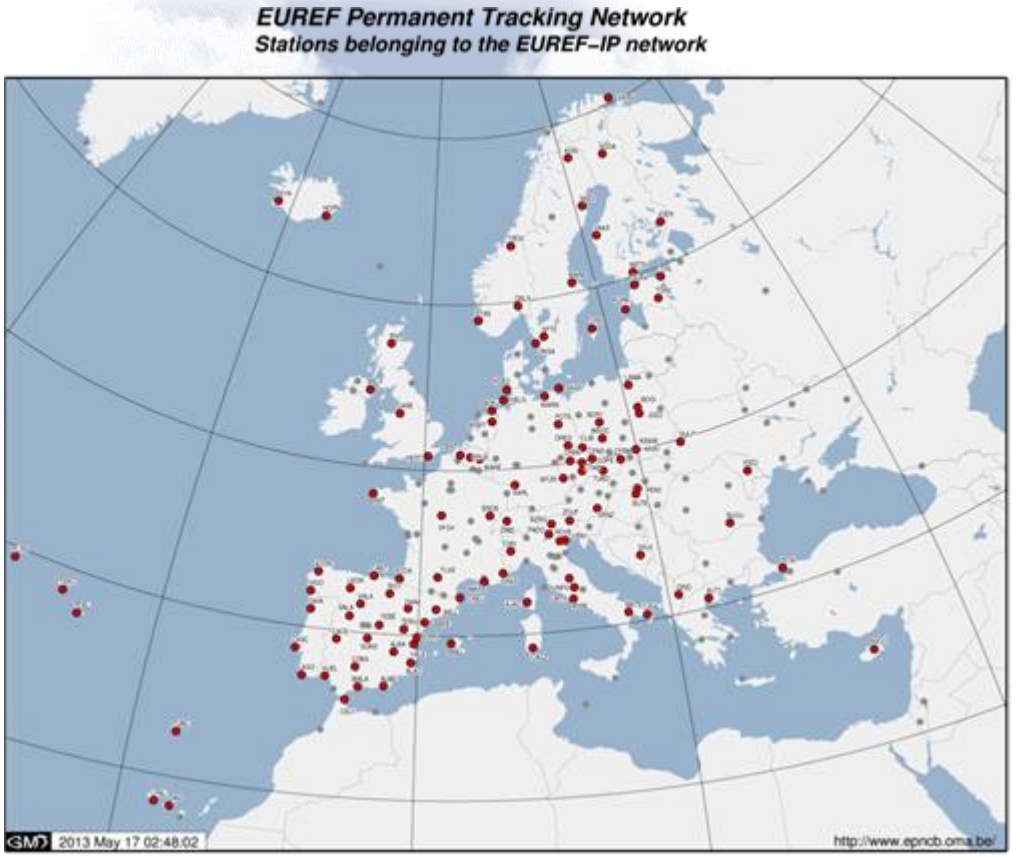
	IWV		
	Threshold	**Breakthrough**	**Goal**
Horizontal Domain	Sub-regional (a few 100km)		
Horizontal Sampling	50 km	10 km	5 km
Observation Cycle	30 mins	10 mins	5 mins
Accuracy	5 kg m^{-2}	2 kg m^{-2}	1 kg m^{-2}
Timeliness	30 mins	10 mins	5 mins

E-GVAP II Product Requirements Document

Why a PPP processing?

- Due to steadily increasing number of operational GNSS sites, PPP strategy is very promising for future efficient GNSS meteorology, that is NRT processing of large networks (>100 sites) within short computation time.
- Sub-hourly processing for now-casting applications
- Availability of necessary input for PPP (orbit and clock products) within time frame and with acceptable accuracy

IGS Real-Time Service



IGS RT Network

~130 globally distributed stations

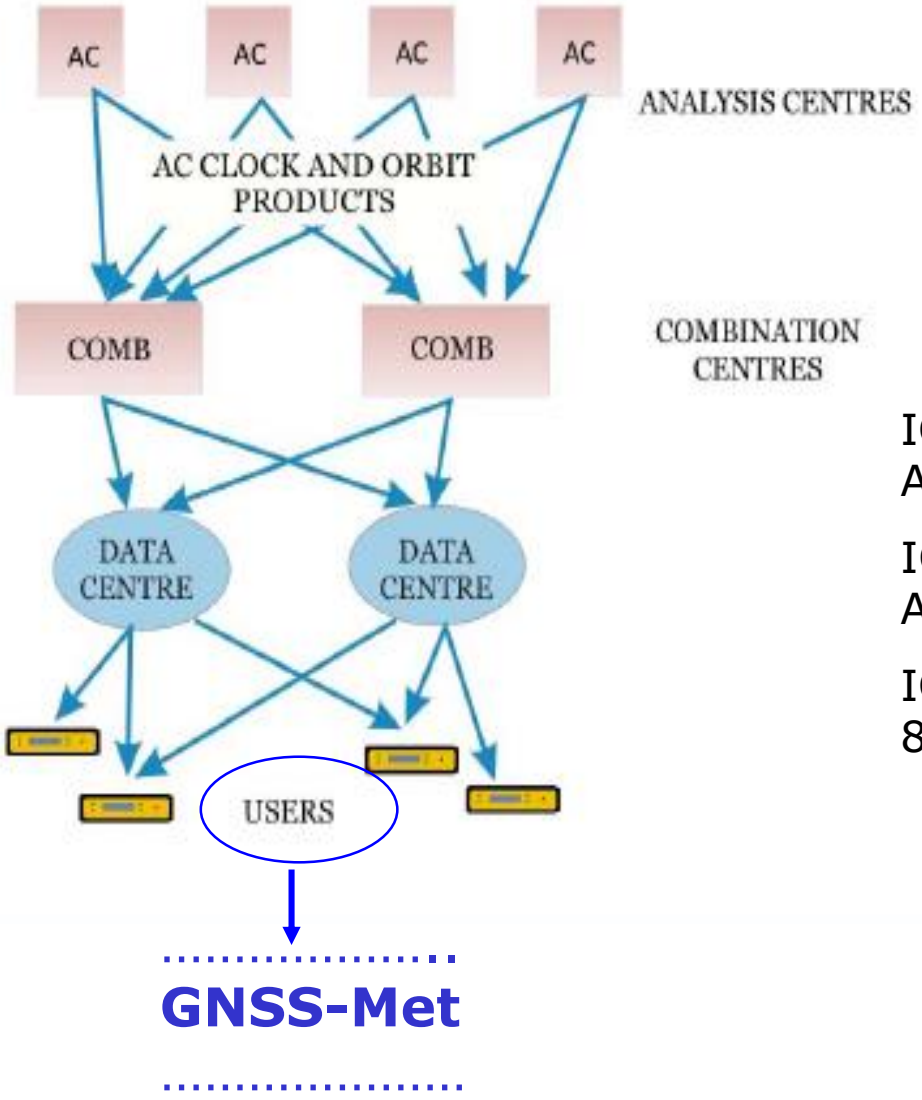
1 Hz data in RTCM 3 format, 1–3 sec latencies

EPN RT Network

~120 of 250 EPN stations

1 Hz data in RTCM 3 format, 1–3 sec latencies

IGS Real-Time Service



IGS RTS Products

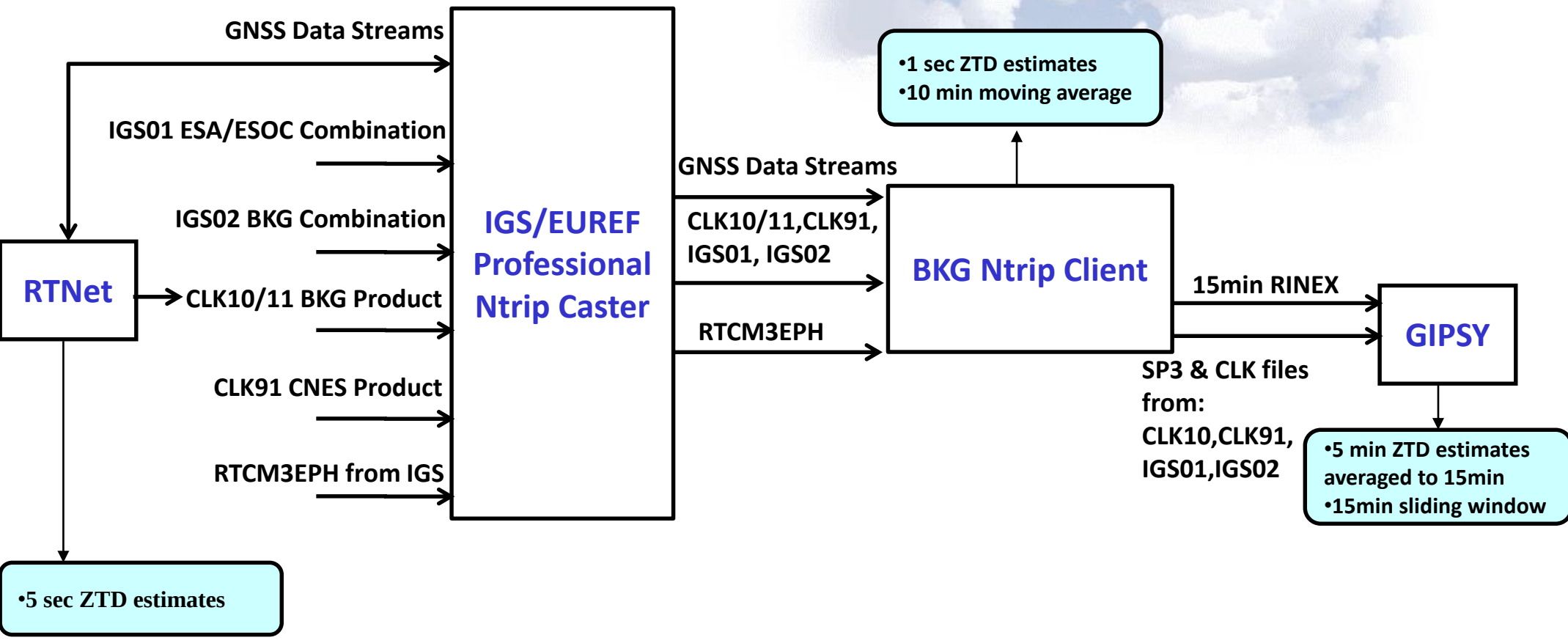
IGS01: GPS-only single-epoch combination of 8 ACs; sampling rate 5 seconds

IGS02: GPS-only Kalman filter combination of 8 ACs; sampling rate 5 seconds

IGS03: GPS+GLO Kalman filter combination of 8 ACs; sampling rate 5 seconds (not used here)

M. Caissy et. al. IGS 2012 Workshop

Sub-Hourly and Real-Time System Architecture

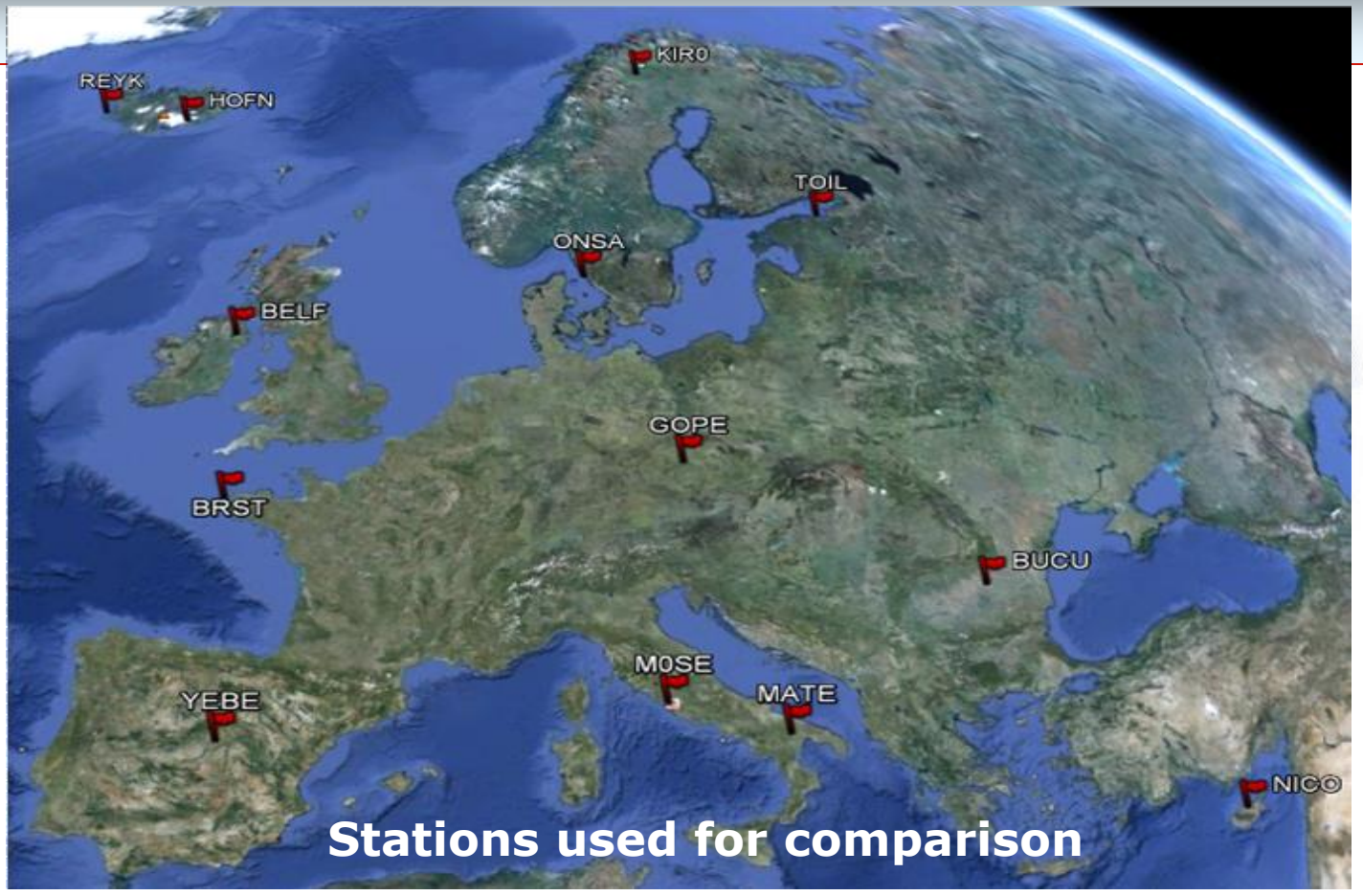


Sub-Hourly and Real-Time Solutions

Sub-Hourly and Real-time solutions generated with

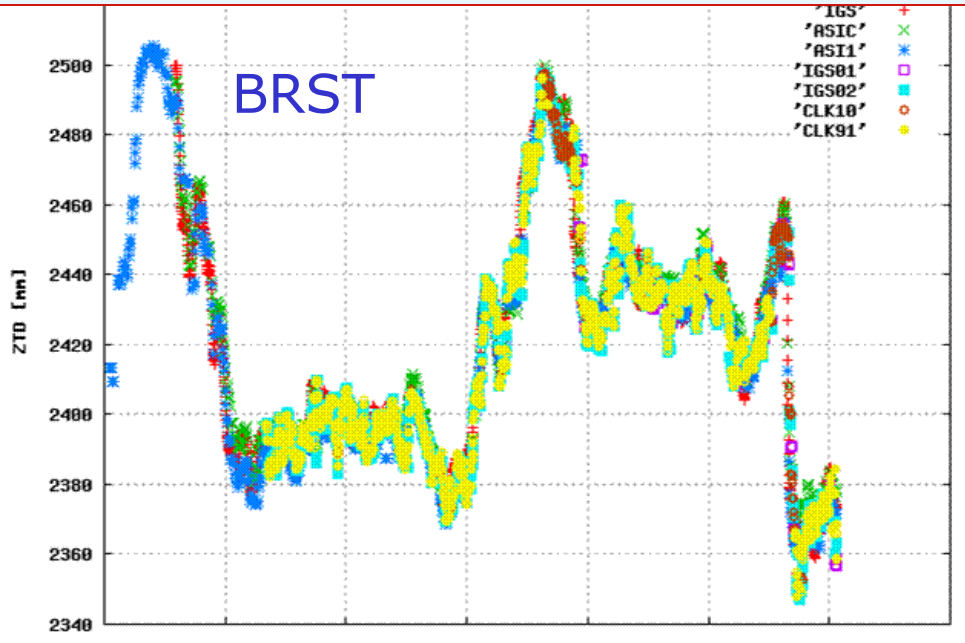
	GIPSY-OASIS 6.1.2	BNC	RTNet
Update Cycle	15 min	1 sec	5 sec
Output Interval	5 min	1 sec	5 sec
GNSS Used	GPS	GPS, GPS+GLO	GPS, GPS+GLO
GNSS data	RT converted into RNX via BNC	RTCM 3	RTCM 3
Clock Stream	RT converted into clock RNX via BNC	RTCM 3	RTCM 3
Ephemeris Stream	RT converted into sp3 via BNC	RTCM3EPH	RTCM3EPH
Site Coordinates	Fixed	Fixed	Fixed
Tropo model	GMF/GPT	Saastamoinen	GMF_WET
Ambiguity Resolution	Not Fixed	Not fixed	Not fixed

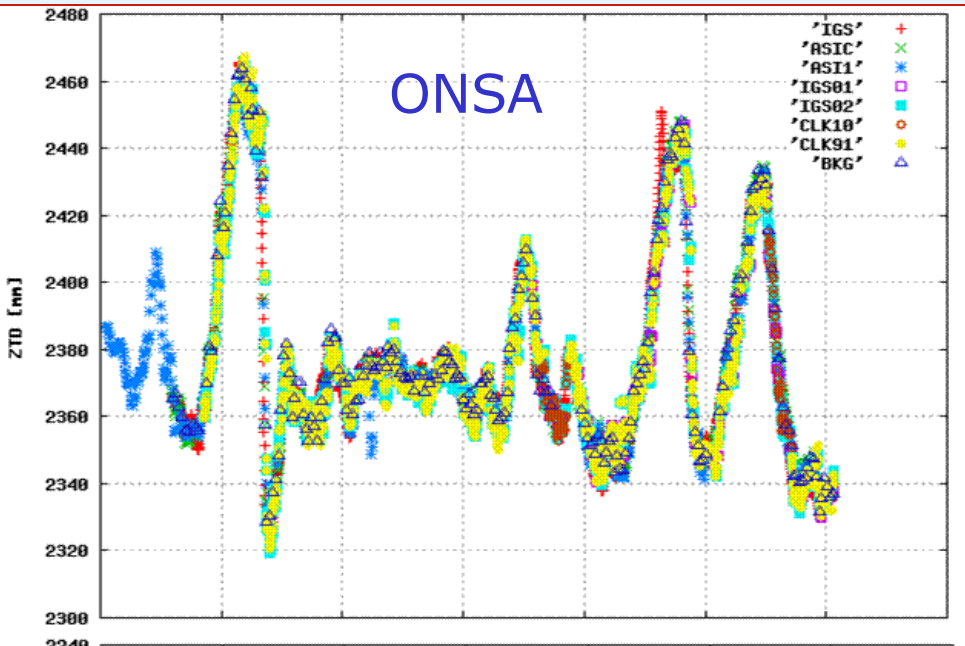
Test Dataset

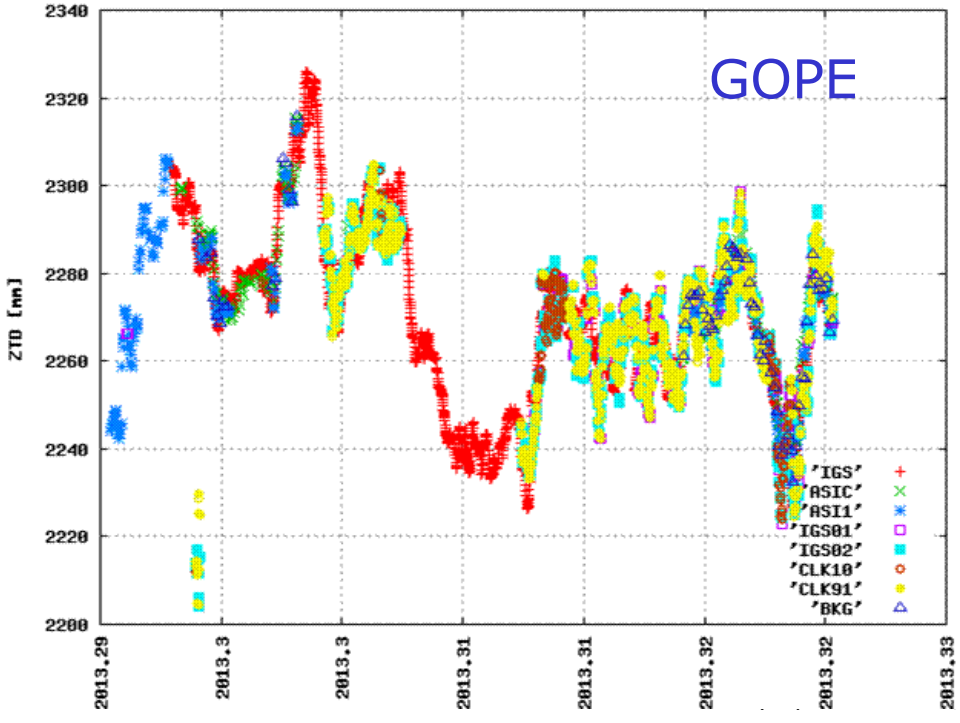


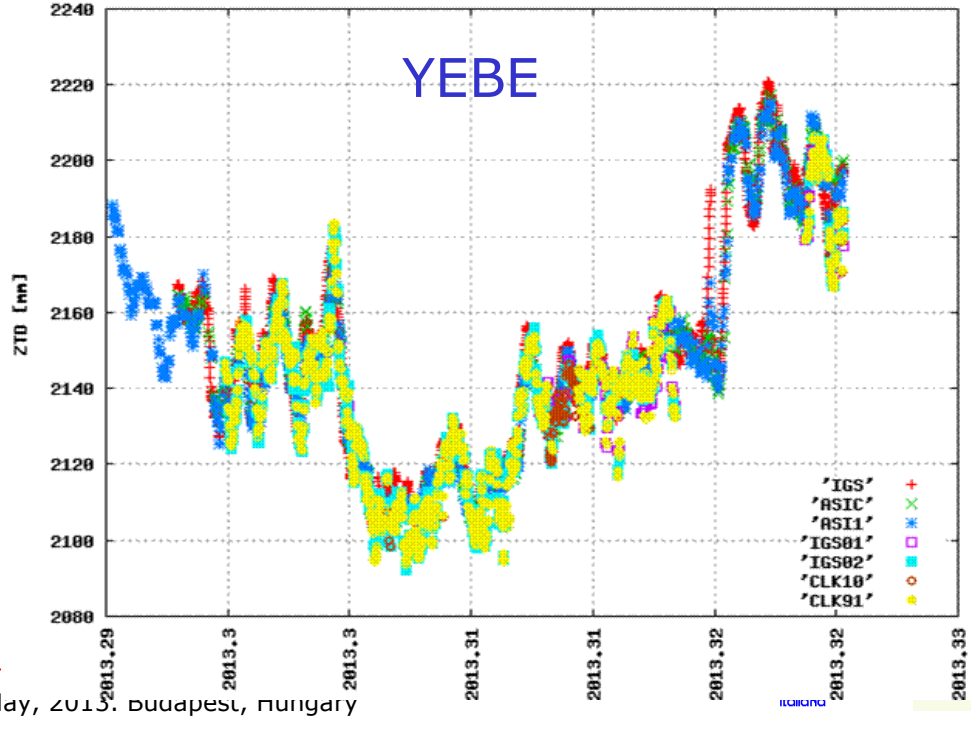
- Time period: 2013-04-16 to 2013-04-26 (DoY 106-116, MJD 56398-408)
  2013-04-29 to 2013-05-07 (DoY 119-127, MJD 56411-419)
- Stations selected for comparison: BELF, BRST, BUCU, GOPE, HOFN, KIR0, M0SE, MATE, NICO, ONSA, REYK, TOIL,YEBE
- Combined clock corrections: IGS01, IGS02 (individual solutions CLK10/11 and CLK91 for comparison)
- Reference tropo solution: IGS; NRT (E-GVAP processing)

Comparisons of Sub-Hourly ZTD Time Series

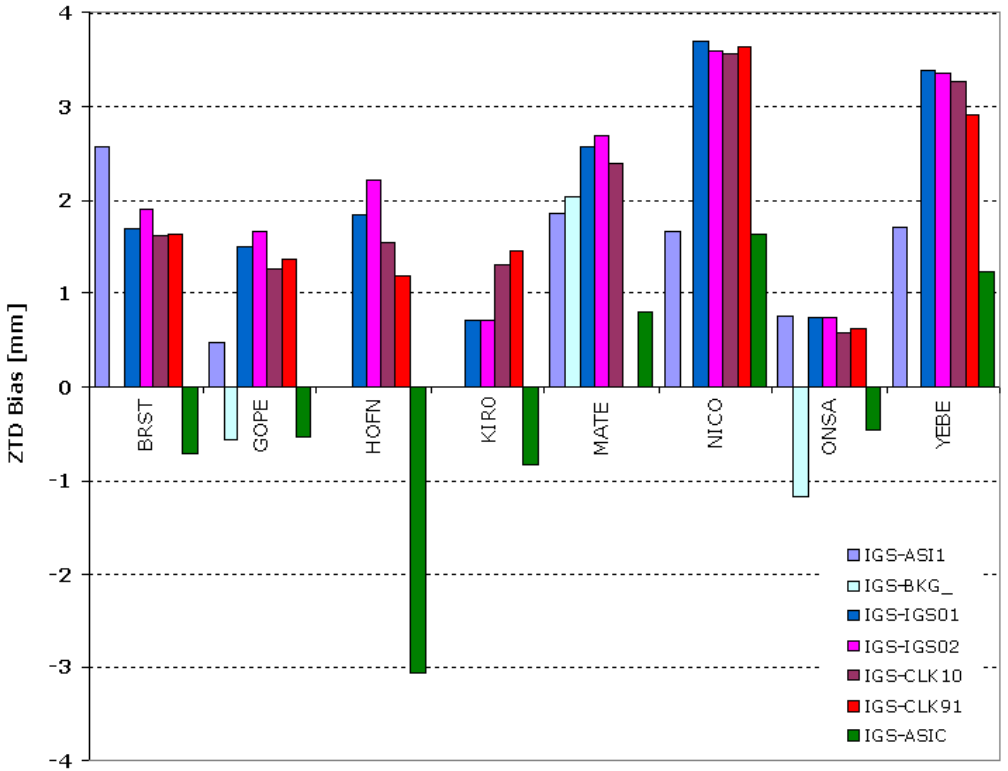


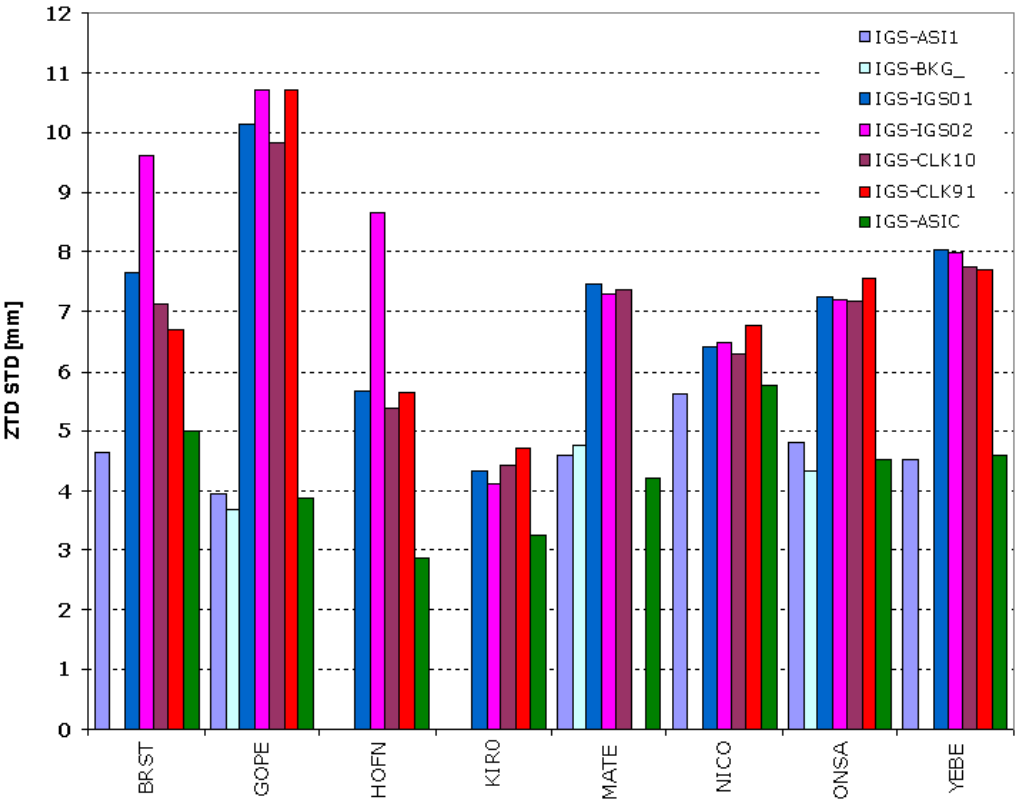






Sub-Hourly ZTD Time Series w.r.t. IGS

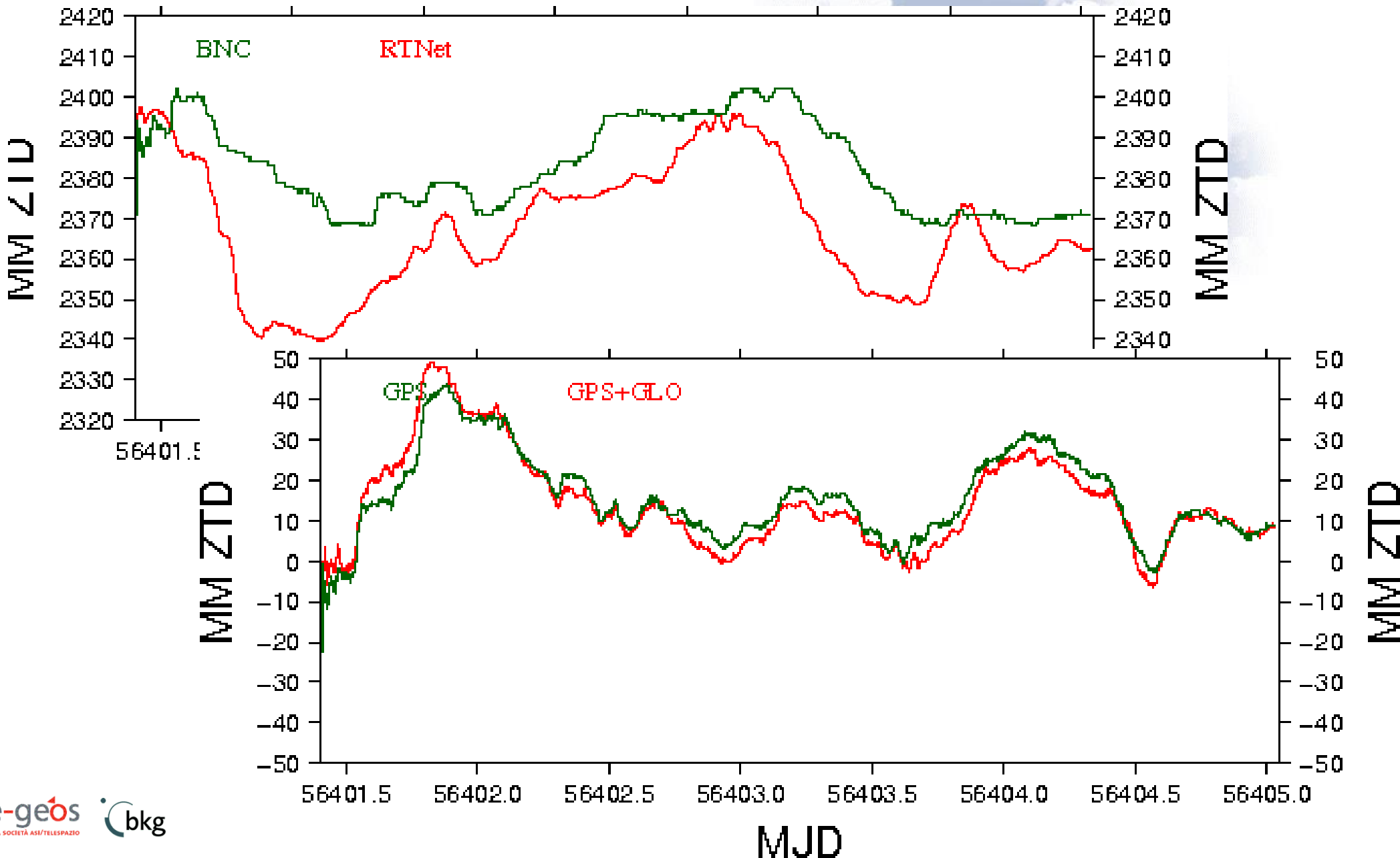




E-GVAP NRT and sub-hourly ZTD time series are compared w.r.t. IGS

RT Processing with BNC and RTNet

Only one station, NICO, available in both (BNC and RTNet) solutions



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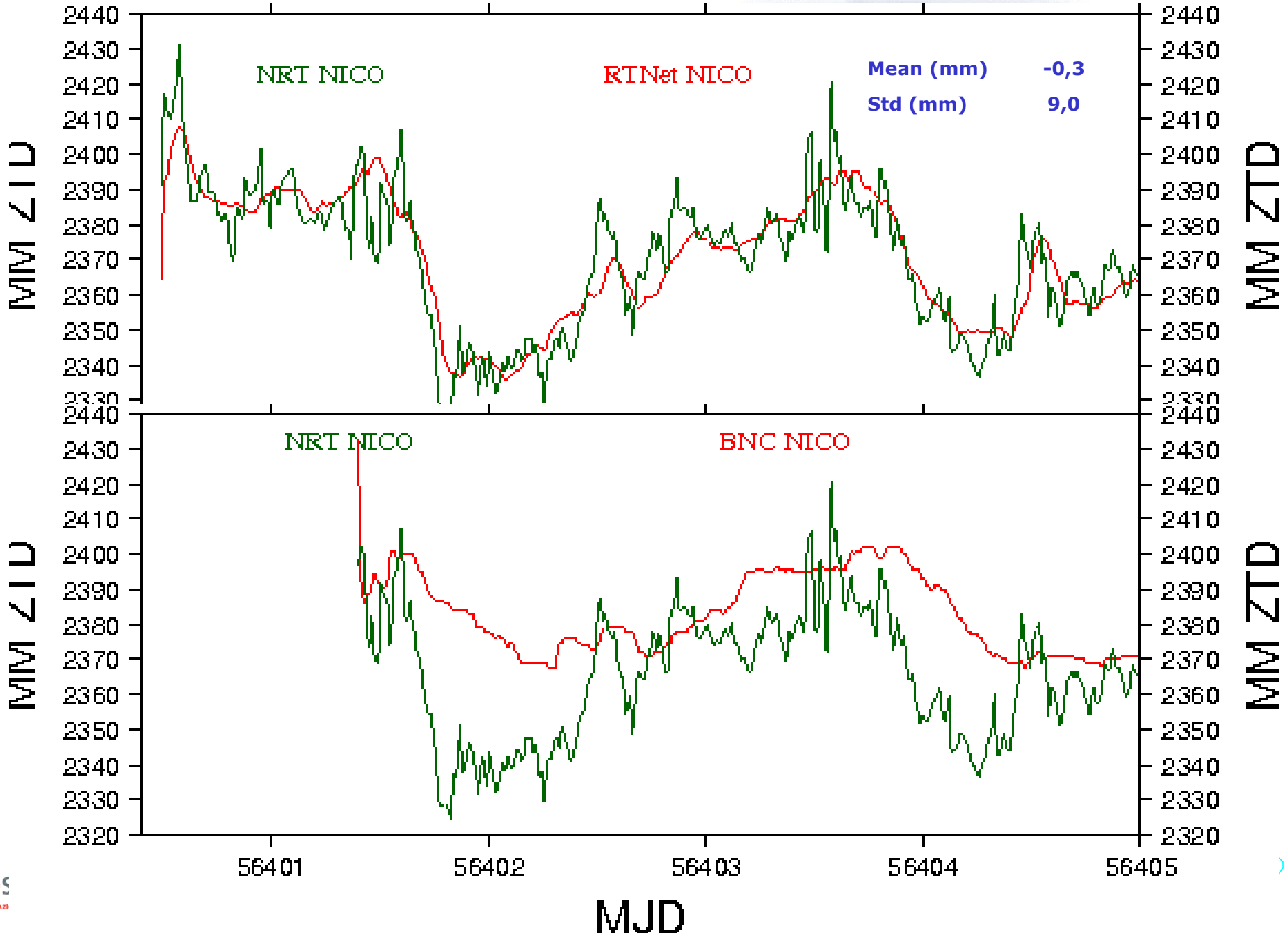
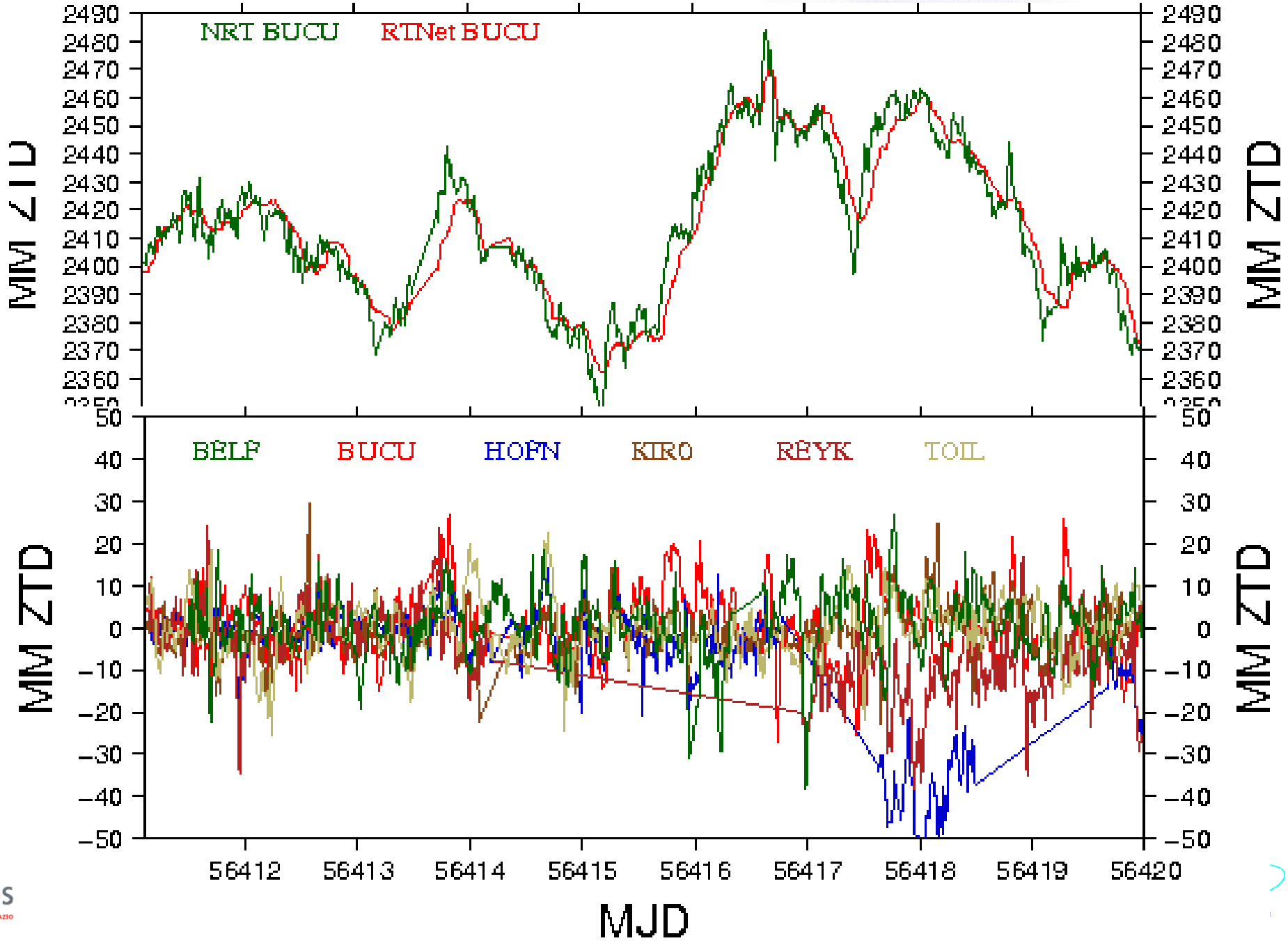
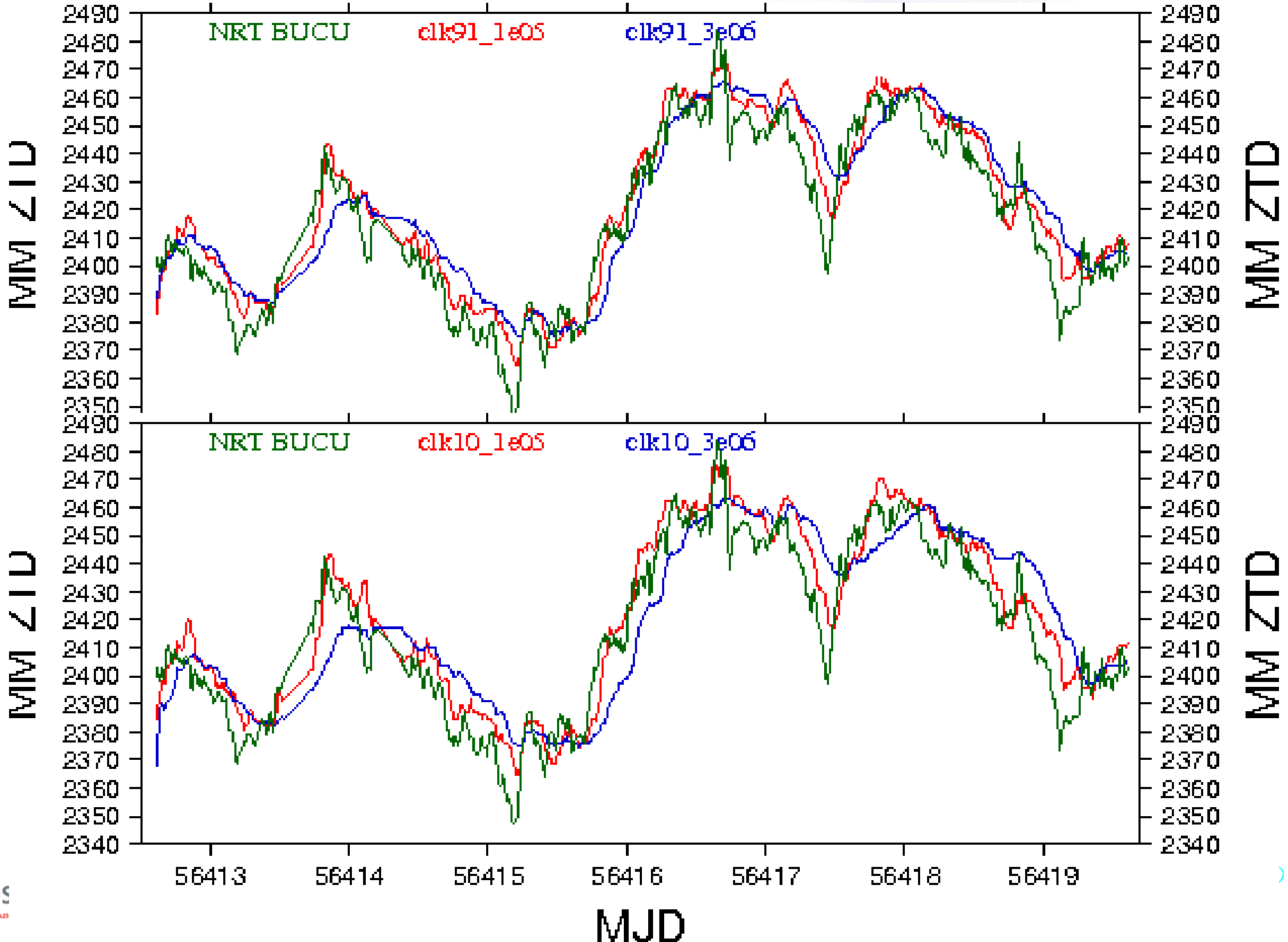
RT Processing with BNC and RTNet – w.r.t. NRT



RT Processing with RTNet – w.r.t. NRT



RT Processing with BNC – w.r.t. NRT



Summary and conclusions

- Thanks to the availability of the IGS RT Products we are no longer depending on IGS UR only since it is possible to store RT products in standard format (sp3, clk) within a short latency.
- Sub-hourly ZTD processing can be setup. The outcome of our test is that the accuracy is between the 'breakthrough' and 'goal' as reported in the product requirements for nowcasting.
- The results of the RT PPP with BNC shows (still) a delay w.r.t. NRT or post-processing results.
- RT network results show good agreement but number of stations is limited.
- The combined orbit & clock corrections and the individual solutions seem to fit on the same level – except for outliers.
- A robust real-time orbit & clock product without interruptions and outliers is mandatory for each PPP application (either coordinates or ZTD).