

# **Real-Time/Ultra-Rapid Activity**

## **WG<sub>1</sub> COST Action ES1206**

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# RT/UR Goals

(compiled by Jan Dousa/Galina Dick)

- Develop and assess ultra-fast troposphere products suitable for nowcasting
  - Development and assessment of real-time or sub-hourly tropospheric solutions (Milestone 1)
  - Optimization of the strategy according to the required timelines and accuracy (Milestone 2)
  - Co-operation with WG2 (requirements, feedback, benchmark, ...)
  - Benchmark – assessment of various strategies, software, etc

# Background

- In Valencia WG1 defined a number of activities
- 14 groups declared their interest in the RT/UR activity
- A questionnaire was sent out to probe these groups on their current work within this topic
- 6 Groups responded

# Summary (Processing Parameters)

Software packages Used within RT/UR Activity	Mode	Used UR processing interval [min]	GNSS	Strategy	Ambiguity Fixed?	Orbit Product	Clock Product	Adjustment
BNC2.7	RT		GPS	PPP	n	IGS02	IGS02	Kalman
BSW5.0/5.2	UR	15/60	GPS	DD	y/n	IGU		LSQ
EPOS-RT	RT		GPS	PPP	y	GFU	GFZC6	LSQ
GAPS (proposed)	UR	Can be defined	GPS	PPP	n	IGS/IGU	IGS/IGU	LSQ
PPP-Wizard	RT		GPS	PPP	y	CNES CLK9B	CNES CLK9B	Kalman
G-Nut/Tefnut	RT UR	Flexible	GPS	PPP	n	IGS01 IGS02 CLK91	IGS01 IGS02 CLK91	Kalman, backward smoothing

# Summary (Processing Output)

Software packages Used within RT/UR Activity	Mode	Update cycle	Latency of tropo product	ZTD2IWV	Filtering/QC
BNC2.7	RT	5s	10 min	n	n
BSW5.0/5.2	UR	15min/30 min		Yes (UK MetOffice)	QC yes
EPOS-RT	RT	5s	<1min	n	n
GAPS (proposed)	UR	15 min	15min	n	n
PPP-Wizard	RT	1s	10 min	n	Y
G-Nut/Tefnut	RT UR	10s 5-15min	<1.5min <1.5min	n	Y

# How will you contribute to the activity?

- Provide RT/UR products for validation studies
- Comparison of methods and ZTD/IWV results
- Optimize current processing system to give better and more consistent results
- Establish new UR processing system using multiple GNSS (GPS and GLONASS)
- Develop new RT processing system using own software
- Development of a ZTD nowcasting service

# Ultra-rapid Processing Systems (status/achievements)

- Work continued on ultra-rapid (sub-hourly at 15 min intervals) processing systems at ROB and UL
  - BSW5.2 using a double-difference strategy
  - GPS-only, ZTD-only

# RT PPP Processing Systems (status/achievements)

- Work continued on real-time (seconds to minutes) processing systems at GFZ, ROB, GOP, UL, and Wroclaw University
  - BNC, EPOS-RT, G-Nut/Tefnut and PPP-Wizard using a PPP strategy
  - GPS-only and multi-GNSS (GOP, GFZ, ROB)
  - ZTD estimates only and ZTD with gradients
  - Standard BNC and PPP-Wizard need bias model updates to give best results
  - STSM of Pavel Vaclavovic (GOP) at ROB
- RT IWV accuracy of 1-2 mm achieved for 1 day (Li et al, 2014)
- RT IWV accuracy <3 mm achieved for 1 month (Yuan et al, 2014)
- RT ZTD precision 6-9 mm over 9 months (Dousa, Vaclavovic. 2014)
- In these, different data sets have been used. Ahmed et al (2014) use one data set for their comparison of software packages.
- A benchmark data set is needed for simulated RT comparisons.



# Relevant peer-reviewed publications

- Li et al (2014) Real-time GPS sensing of atmospheric water vapor: Precise point positioning with orbit, clock, and phase delay corrections, *GRL* 41, 2013GL058721
- Dousa and Vaclavovic (2014) Real-time zenith tropospheric delays in support of numerical weather prediction applications. *Adv in Space Res.* (2014), Vol 53, No 9, pp 1347-1358, doi:10.1016/j.asr.2014.02.021
- Yuan et al (2014) Real-time retrieval of precipitable water vapor from GPS precise point positioning, *JGR Atmos.*, 119, 2014JD021486.
- Ahmed (2014) A Comparative Analysis of Real-Time Precise Point Positioning Zenith Total Delay Estimates, *GPS Sol.*, in review.