WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES

COST ACTION ES1206 *GNSS4SWEC* – GNSS and GNSS-met activities in POLAND

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GNSS4SWEC MC & WG, Golden Sands, Bulgaria, 11 – 12 September 2014

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WUELS – current status of WG1 tasks

GNSS&METEO team from WUELS (Wroclaw, Poland) is working on improvement of existing service for ZTD estimation (WUEL data on EGVAP website). In parallel the new service working on Bernese 5.2 and the most recent models is in preparation, to be operational in DD and PPP modes. The PPP mode is developed as multi-GNSS, with the use of Ultra-Rapid and RTS orbit/clock information.

Main features to be included or tested within Bernese 5.2 for better IWV retrieval over the area Poland and close neighbourhood:

- Integration of GPS, GLONASS and Galileo signals in PPP estimation,
- Combination of Ultra-Rapid and RTS orbits/clocks to improve PPP in BSW 5.2,
- Impact of different physical and troposphere models on ZTD / IWV reliability,

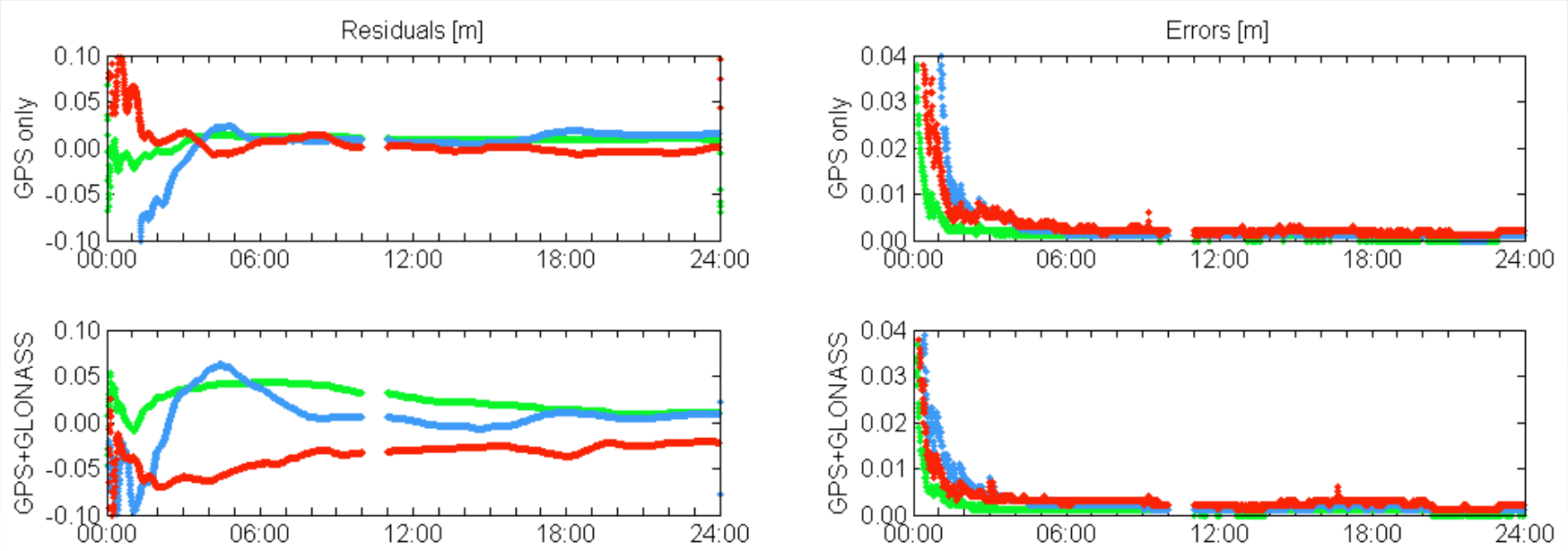
Planned completion of the work – Winter 2014/Spring 2015.

Except of the above, the STD estimation is being investigated, to be implemented next year.

WUELS – WG1: PPP software development

GNSS-WARP (Wroclaw Algorithms for Real-time Positioning):

- **in-house developed software with original algorithms;**
- **a state-of-the-art PPP software;**
- **developed from scratch in Matlab environment;**
- **capable of processing data in real-time and postprocessing mode;**
- **highly configurable, easy to modify for specified user application;**
- **up to 10 Hz sampling in real-time.**

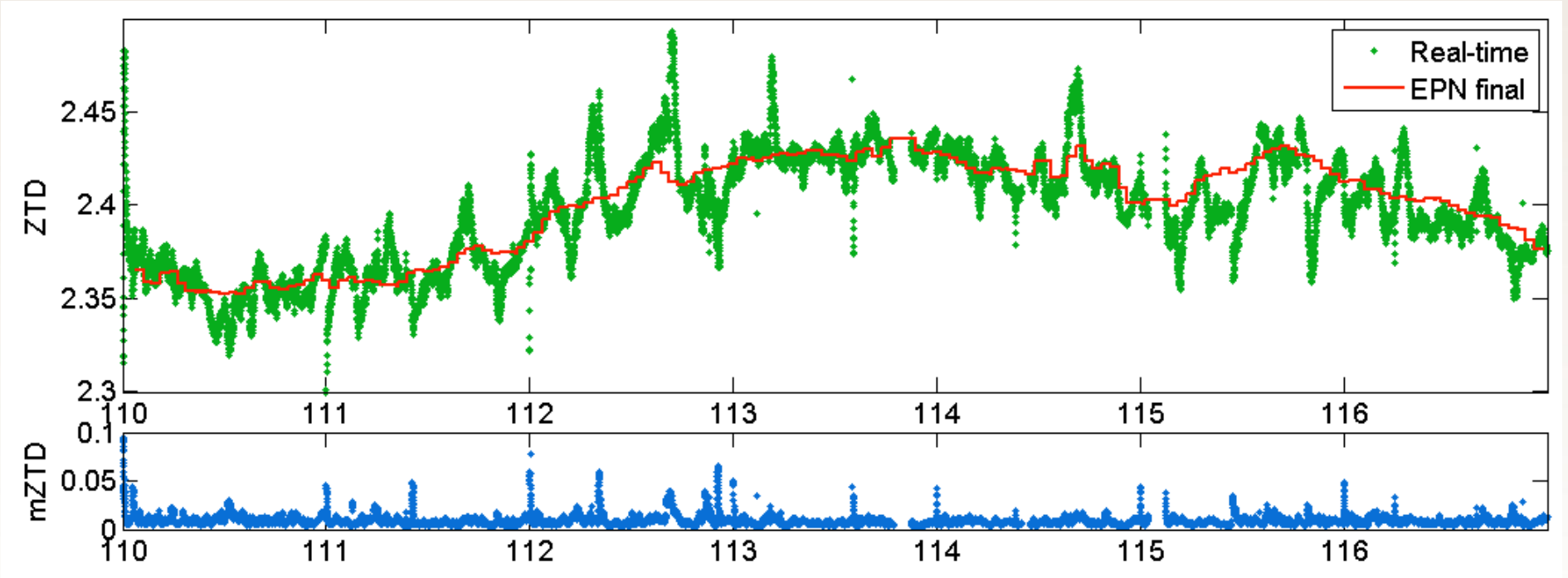


Results of GPS and GPS+GLONASS with RTS stream in real-time positioning (static mode) for station WROC, DOY 114, 2014

WUELS – WG1: real-time ZTD

GNSS-WARP for real-time ZTD estimation:

- **preliminary test for GPS only**
- **real-time static mode with 10s interval**
- **residuals: -2.5mm shift with 11.2mm of standard deviations**
- **9.0 mm of mean estimated error**

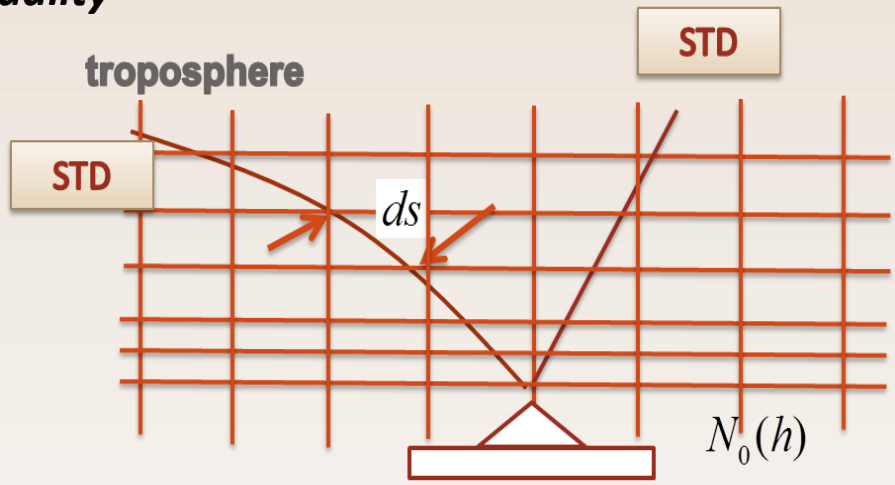


Real-time ZTD (green) and its error (blue) compared with EPN final ZTD (red) at station WROC over DOY 110-117, 2014

WUELS – current status of WG2 tasks

Program SONATA: Project „GNSS observations as a numerical weather prediction data source, a way forward to enhanced forecast quality"

WP1 - Review of the available processing strategies in the context of troposphere monitoring using DD and PPP approach (WP1 - Trop. est. review);
WP2 - Development of forward operator for STD in NWP model (WP2 – NWP for. op.);
WP3 - Development of effective Slant Troposphere Delay estimation methodology (WP3 – STD estimation);
WP4 - Assimilation of ground-based GNSS observations into the NWP models (WP4 – STD assimilation);
WP5 - Comprehensive evaluation and impact assessment for weather forecasting (WP5 – Assimilation impact);



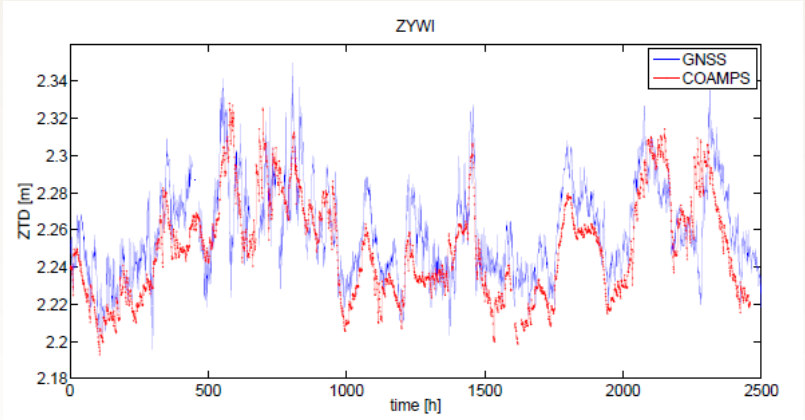
2.5 mln STDs per day in PL
(5 minutes resolution)

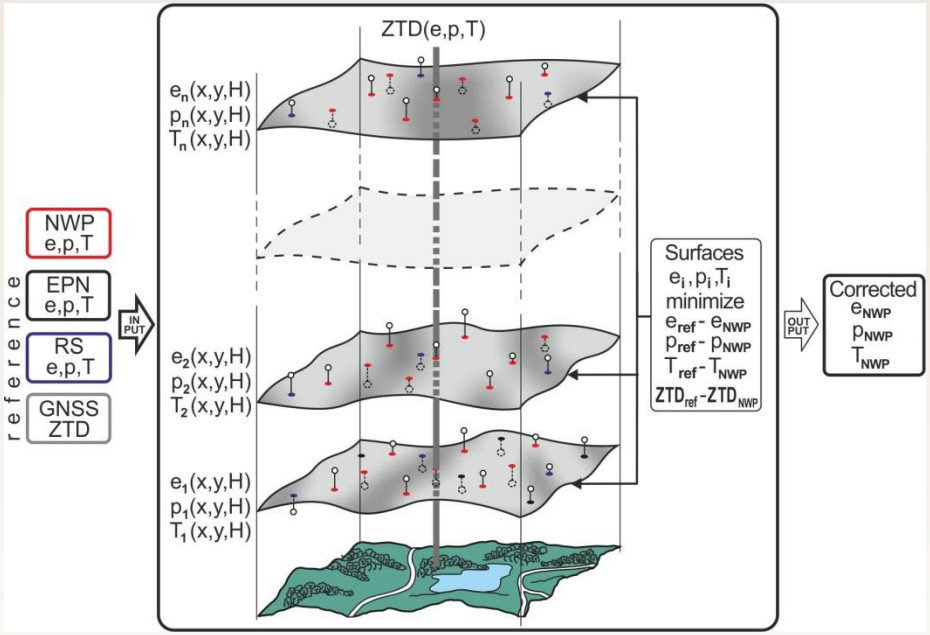
Consortium

WUELS – current status of WG3 tasks

Program PRELUDIUM: Project „Prognostic troposphere model based on meteorological data, GNSS products and Numerical Weather Prediction models”

WP1 - Analysis of existing solutions in troposphere modeling, establishment of datasets and assessment of data accuracy;
WP2 - Methodology and algorithms development for troposphere parameters interpolation and prediction;
WP3 - Testing of developed methods and establishing integrated model of troposphere;





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MUT – currently status of WG1 tasks

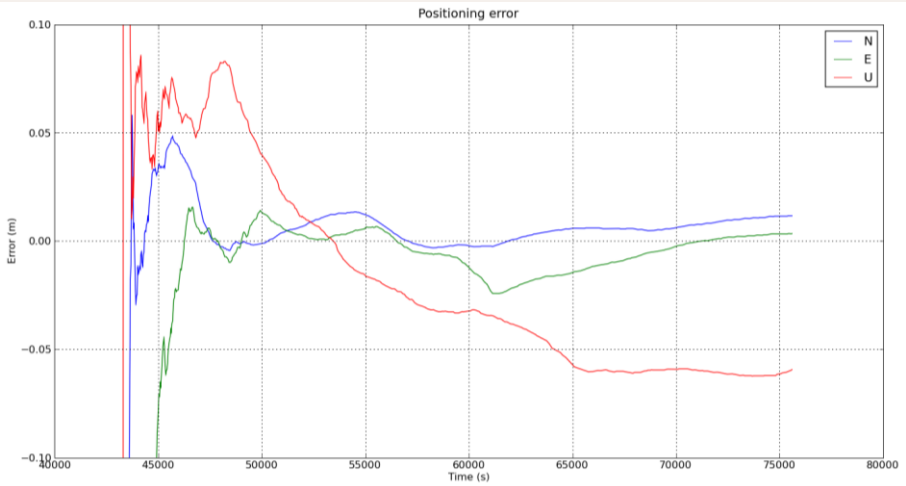
Scientific team from MUT working on software for precise point positioning and tropospheric parameters estimation based on GPS and Galileo signals.

Main features:

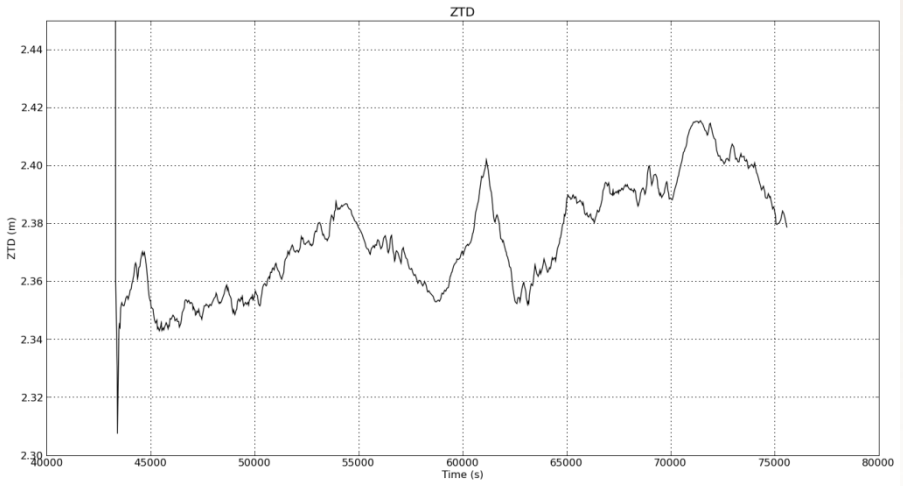
- Integration of GPS and Galileo signals.
- Epoch by epoch estimation for static and kinematic mode.
- Advanced tropospheric models and mapping functions.
- Models are based on new conventions (e.g. IERS 2010).

Software is still under development and testing.

Planned completion of the work - the beginning of 2015.



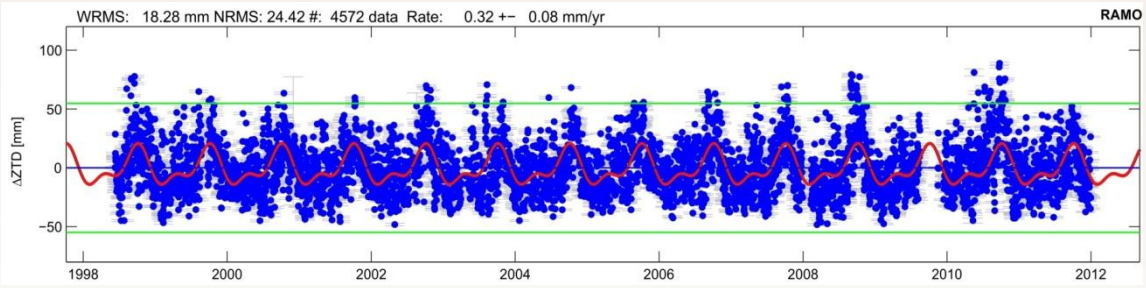
Example of PPP solution with float ambiguites.



Example of ZTD estimation.

MUT – currently status of WG2 tasks

- Analysis of availability and quality of meteorological data derived from GPS stations (EPN permanent network).
- Analysis of character, availability and quality of ZTD long time series derived from GPS reprocessed data (EPN permanent network).
- Conversion from ZTD to IWV and analysis of long time IWV time series.
- Determination the annual and semi-annual oscillation and phase shift of time series.
- Study of impact mapping functions on troposphere parameters and estimated coordinates, and their potential application to the climate-related investigations.

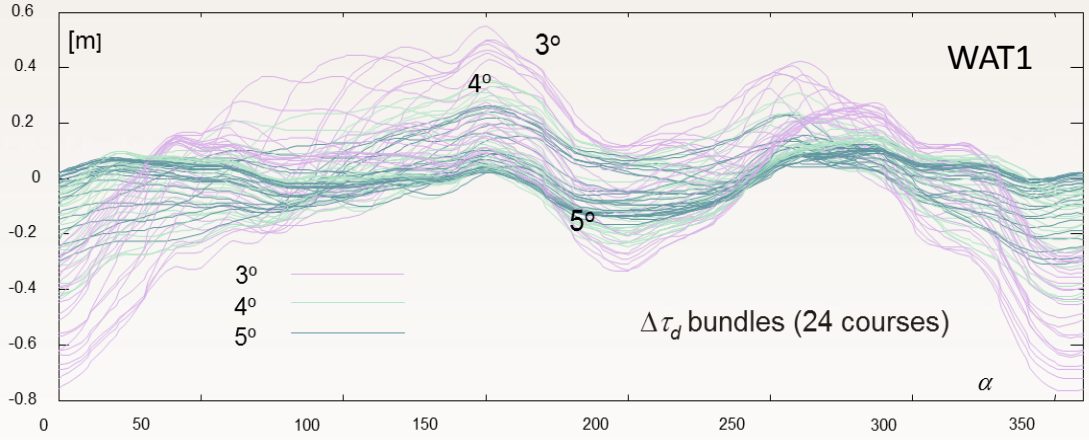


RAMO station ZTD oscillations (annual, semi-annual and 1/3 year)

Lomb-Scargle periodogram

MUT – currently status of WG3 tasks

- Forecasts using mesoscale nonhydrostatic meteorological models (WRF, COAMPS) in operational mode
- Investigations of temporal and spatial characteristics of mesoscale mapping functions for low elevation angles (raytracing – slant delays);
- Investigations concerning determination of prognostic discrete non-isotropic mapping function and slant delays on the basis of mesoscale forecasts;
- Investigation of ZTD data (GNSS products) impact on the analysis fields and short-term forecasts for various methods of physical processes parameterization and different choice of mesoscale models parameterization;
- Investigations concerning GNSS troposphere products assimilation to local (Poland area) NWP models based on local GNSS GBAS networks: ASG-EUPOS, TPI NETpro, VRSNET.pl, SmartNET;
- Establishment of the atmospheric NWP data repository for exploitation of NWP model data in near real-time GNSS processing.



Temporal and azimuthal variability of slant delay differences

UWM – current status of WG1 tasks

Program PRELUDIUM: Project: Analysis on the influence of advanced GNSS signal tropospheric delay modeling methods on estimated tropospheric parameters and realization of ETRS89 by ASG-EUPOS stations

WP1 - Assessment of the impact of the new tropospheric delay estimation methods of GNSS signals on the resulting troposphere parameters.

In the frame of this WP the applicant intents to analyze the influence of the GNSS observation, troposphere mapping functions, observation stochastic models on estimation of tropospheric delay of GNSS signals, its gradient and resulting integrated water vapor content. Accuracy, seasonal trends and periods of these parameters will be studied;

WP2 - Analysis of the influence of the troposphere modeling methods on the realization of the ETRS89 system by ASG-EUPOS stations in Poland.

This work package is related to analyses of the accuracy, reliability and stability of ASG-EUPOS stations coordinates and velocities with respect to the applied troposphere modeling methods for GNSS data processing;

WP3 - Development of the optimal method and GNSS data processing strategy for tropospheric delay modeling over ASG-EUPOS stations.

Based on the evaluation of the results of WP1 and WP2, the applicant will develop own, optimal data processing strategy for GNSS data processing of dense, regional networks with special emphasis on the tropospheric delay modeling;

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UWM – current status of WG1 tasks

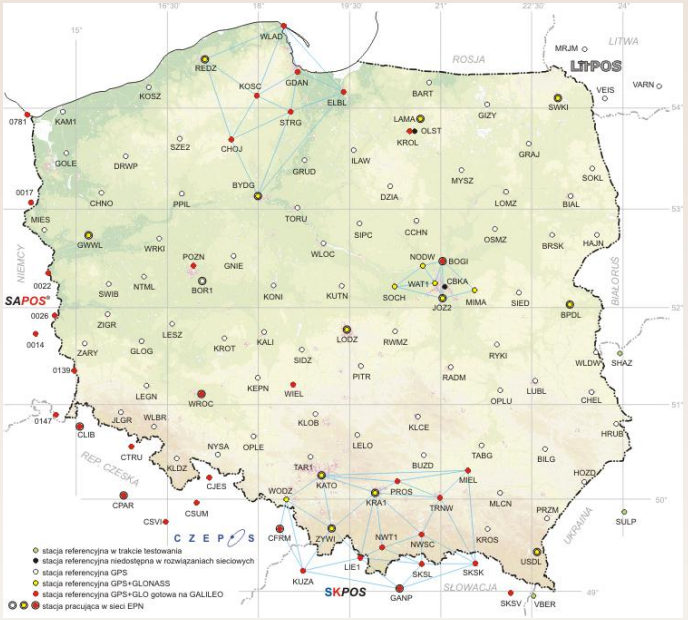
Gradient modeling in national CORS network: initial results for ASG-EUPOS network

Strategy # (Bernese)	Mapping function	Gradient	Spacing	A priori sigmas			
				Absolute		Relative	
				Zenith path delay	Horizontal gradients	Zenith path delay	Horizontal gradients
1	GMF	–	–	5 m	–	5 m	–
2	GMF	CHENHER	24 h	5 m	5 m	5 m	5 m
3	GMF	CHENHER	6 h	5 m	5 m	5 m	5 m
4	GMF	CHENHER	6 h	5 m	5 m	0.01 m	0.0001 m

UWM – current status of WG1 tasks

Repeatability of the ASG-EUPOS stations coordinates obtained with the evaluated processing strategies

Strategy #	STD dN [mm]	STD dE [mm]	STD dU [mm]
1	1.76	1.72	4.32
2	1.29	1.38	4.00
3	1.30	1.34	4.01
4	1.28	1.36	3.81

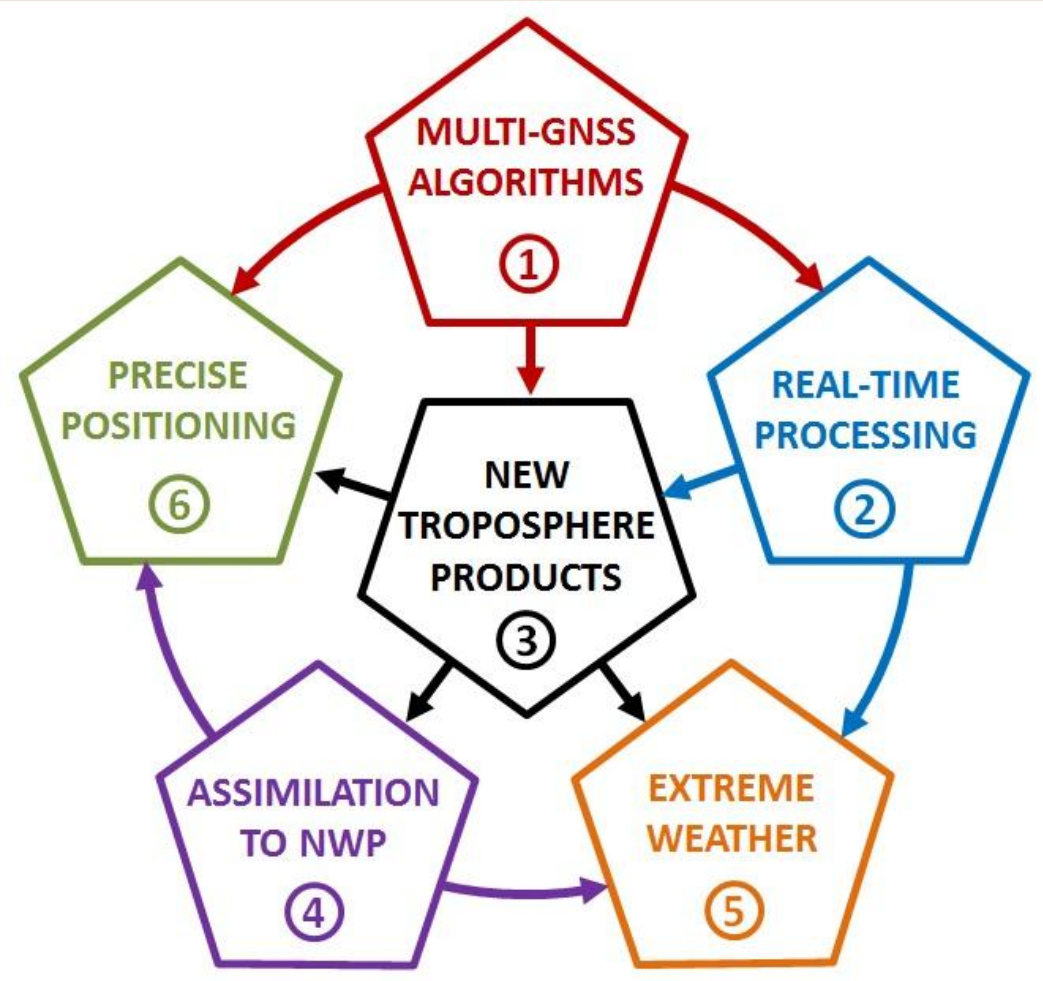


Number of daily station solutions with daily coordinates exceeding 10 mm for height and 5 mm for the horizontal components, respectively

Strategy #	N	E	U
1	115	73	249
2	28	37	178
3	24	31	187
4	30	32	164

* daily solutions, 12 weeks, 100 stations

Harmony Project *Advanced GNSS Tropospheric Products for monitoring Severe Weather Events and Climate (GNSS4SWEC)*



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