WG1 **Benchmark**

Status summary, future planning

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GNSS4SWEC WG1 Meeting, Varna, September 11-12, 2014

Questionnaire - summary

- January 2014
- 16 responses
- We want to compare:

  ZTD + SLANT DELAYS (gradients and post-fit residuals)

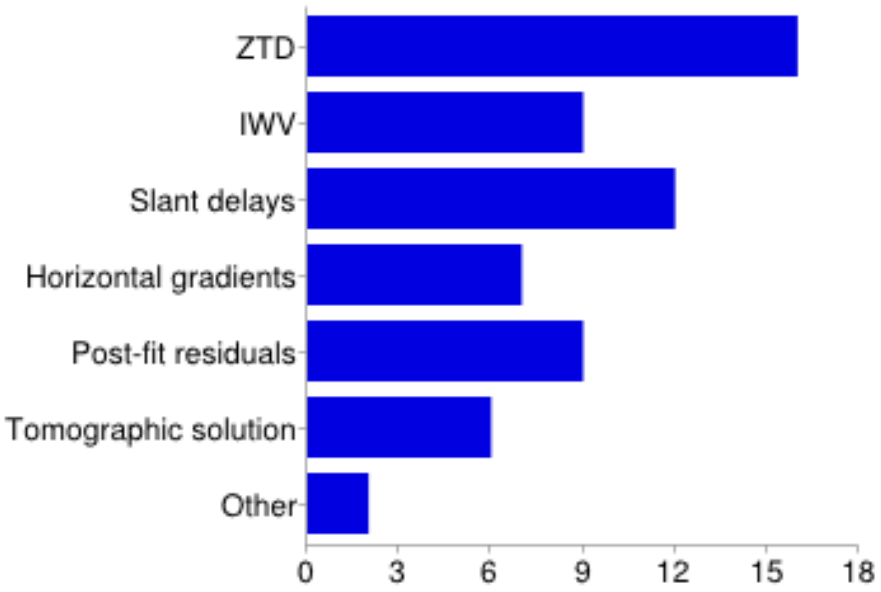
  IWV + Tomographic solutions

- We want to use:

  All types of processing (DD x PPP, RT x NRT x PP)

- We are willing to work on benchmark assessment

What would You like to compare/evaluate within the benchmark?

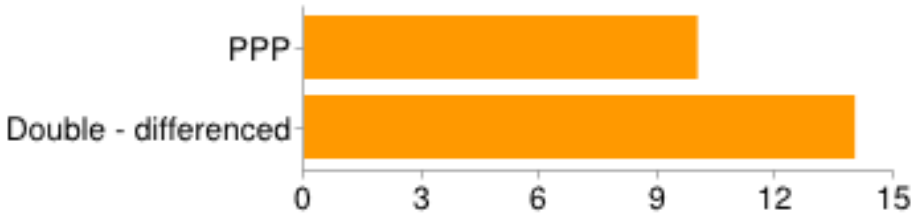


ZTD	**16**	26%
IWV	**9**	15%
Slant delays	**12**	20%
Horizontal gradients	**7**	11%
Post-fit residuals	**9**	15%
Tomographic solution	**6**	10%
Other	**2**	3%

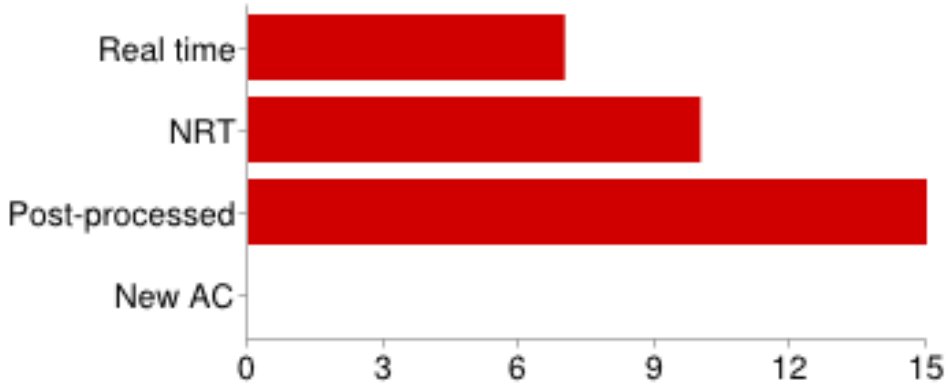
Other: GOP Pecny (Dousa), IGN LAREG (Nahmani, Bock, Bosser)

Real Slant Delays => slant delays + gradients + residuals

What type of processing do You use and would like to evaluate within the benchmark?

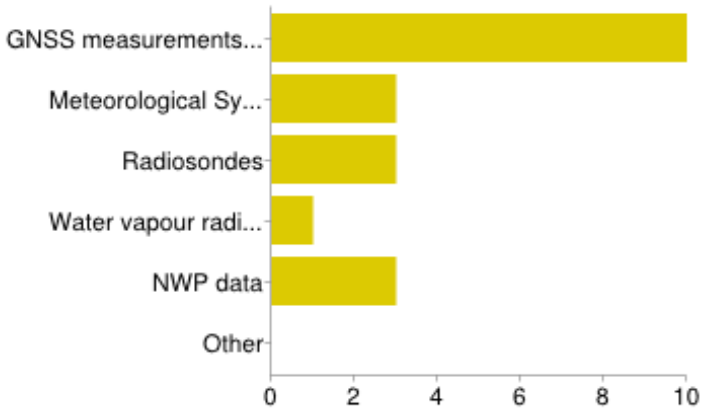


PPP	**10**	42%
Double - differenced	**14**	58%



Real time	**7**	22%
NRT	**10**	31%
Post-processed	**15**	47%
New AC	**0**	0%

Are You able to contribute with any data into benchmark?



GNSS measurements from local sites (dense network of receivers)	**10**	50%
Meteorological Synoptic measurements	**3**	15%
Radiosondes	**3**	15%
Water vapour radiometer	**1**	5%
NWP data	**3**	15%
Other	**0**	0%

GOP (Dousa) + GFZ Potsdam have a WVR

Inquiry on requirements, Munich WS

	Period	#sites	Scale	Conditions	Area	Software	Data
ASYM	1-2 weeks	dense 40-50	Local/ Region	Severe & Quiet	Flat & Mountains		WVR, NWM-HR
MODEL	1-2 weeks		local region	Severe & Quiet	Flat & Mountain	GFZ NWM, WUELS, G-Nut/Shu, TUW1	NWM-HR & Global
NEW							
PPP Multi-GNSS					Flat & Mountains	GNUT/Geb, GINPOS, GNSS- WARP, GeMon, BNC	NWP-HR
REPRO	EUREF						
RT/UR	2 weeks after 2013	40-50 sites dense	Local region	Quit & severe condition	-	BNC, GEmon, EPOS- RT, Tefnut, GNSS- WARP, GINPOS, GIPSY	IWV conversion
TOMO	2-3 months	Dense !!! (20 km) < 50 sites		both	Mountains, (anywhere)		Raobs WVR, lidar, IASI
WG2: requirement	Different seasons			both			
WG3 / EVAL							NWP, in situ synoptic, …

Summary of requirements

Compatible requests:

- > 2-3 weeks, limited to recent years (2013-2014)
- Main needs for a dense network

Incompatible requests = increasing redundancy → Priority!

- different seasons: which - priority or focus on specific event?
- different weather conditions: quiet / severe (!)
- different topography: flat / mountainous → trade-off?

Related questions:

- Relevance of location with respect to NWP territory covered
- Max. number of stations

Overall schedule

- Initial inventory of interests and contributions
- Benchmark region/dataset proposal (06/2014)
  - 1 proposal available exploiting available inputs
  - do we need other proposal ?
- Preliminary period(s) identification (07/2014)
  - NWM ray-traced tropo gradients + visualization (DNS by Zus and Douša)
  - requested feedback and suggestions from WG2
- Revision of benchmark design and further planning (09/2014)
- Data and product collections (12/2014)
- Topic / sub-WG / inter-WG coordination (09/2014-03/2015)
- Contributions (12/2015)
- Evaluations/interpretations (12/2016)

Space domain: GNSS data sources

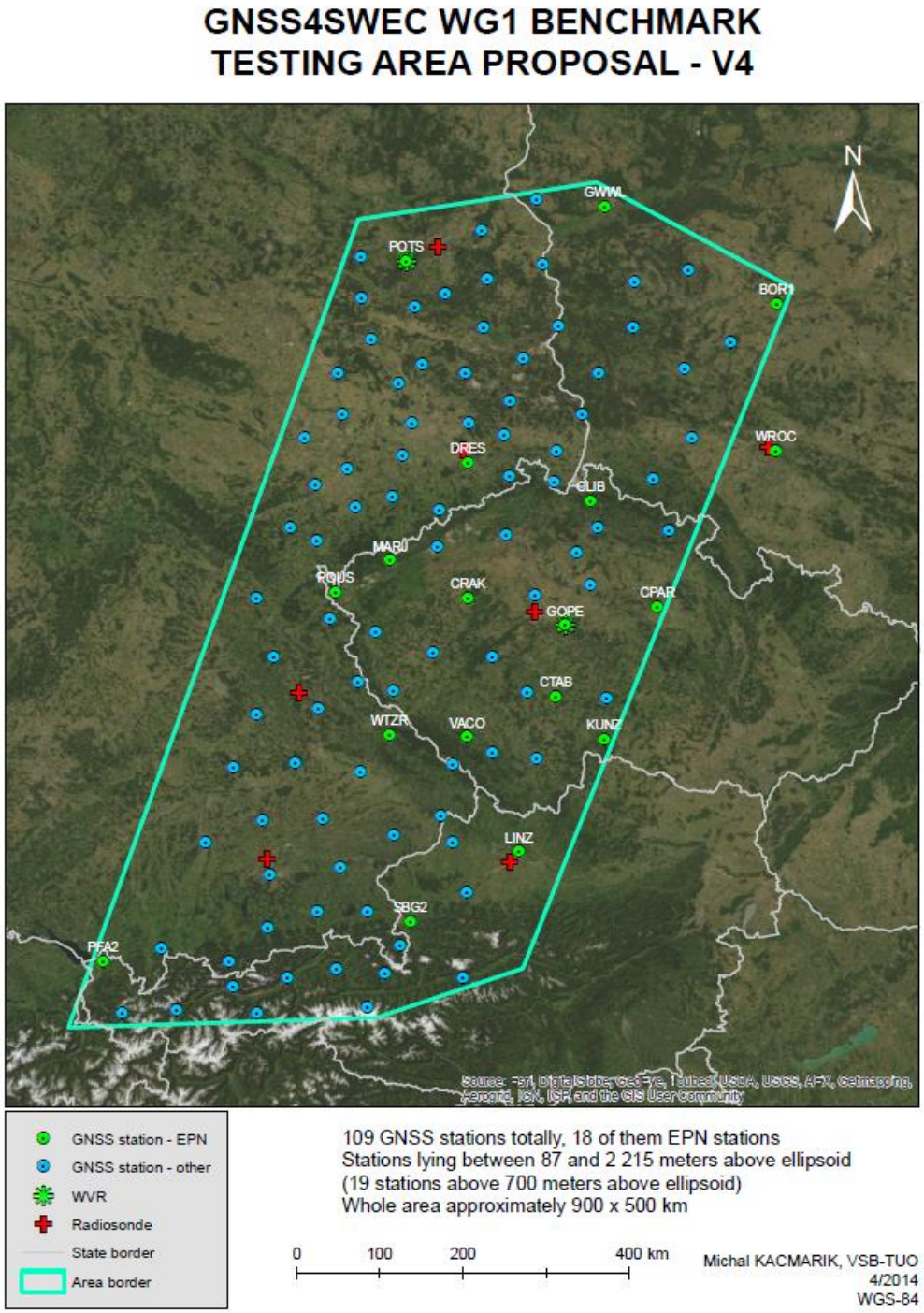
- Available sources:
  - EUREF/IGS Permanent Network
    - open access
  - **Austria**: network EPOSA
    - TU Vienna - G. Möller
  - **Czech Republic**, network CZEPOS (optionally GEONAS, TopNET)
    - GOP/VSB – J. Douša / M. Kačmařík
  - **Germany**, network SAPOS
    - GFZ Potsdam – G. Dick
  - **Poland**, network ASG
    - WUELS /MUT– J. Kaplon / K. Szafranek

Space domain: candidate

> **110 GNSS** reference stations

- **2 x WVR** (GOPE, POTS)
- **7 x RS**

- GNSS stations located between 87 and 2 215 m above MSL
- 19 stations > 700 m above MSL
- Area: roughly 900 x 500 km



Space domain: potential densification

- More than **250 GNSS** reference stations are available in total
- Could this solve the problem of a request for dense network required needed for **tomography** reconstruction ?

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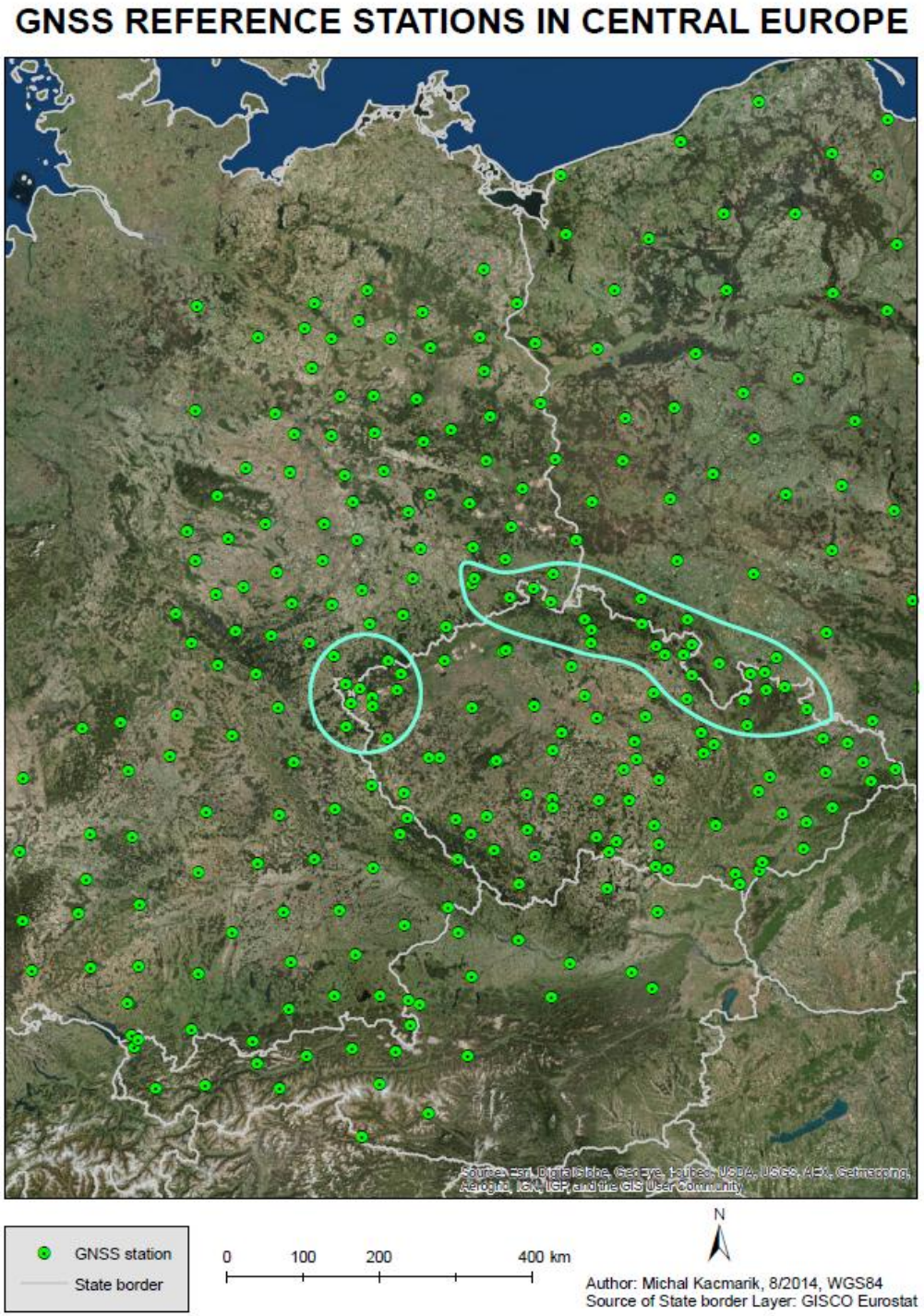
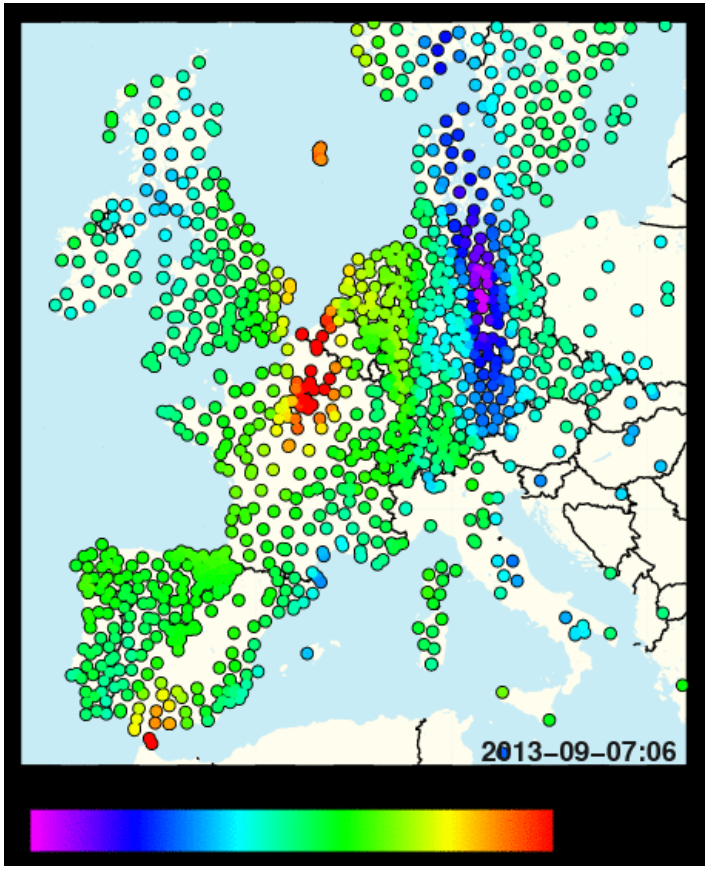


Time domain: periods of interest

- Jan Douša (GOP) and Florian Zus (GFZ Potsdam) prepared EW/NS gradient monthly animations from ECMWF's ERA-Interim reanalyzes (2012-2013)

- 6 weeks in different seasons were pre-selected looking to strong asymmetry pattern (gradients) and suggested for benchmark periods

- The selections proposed for review within WG2



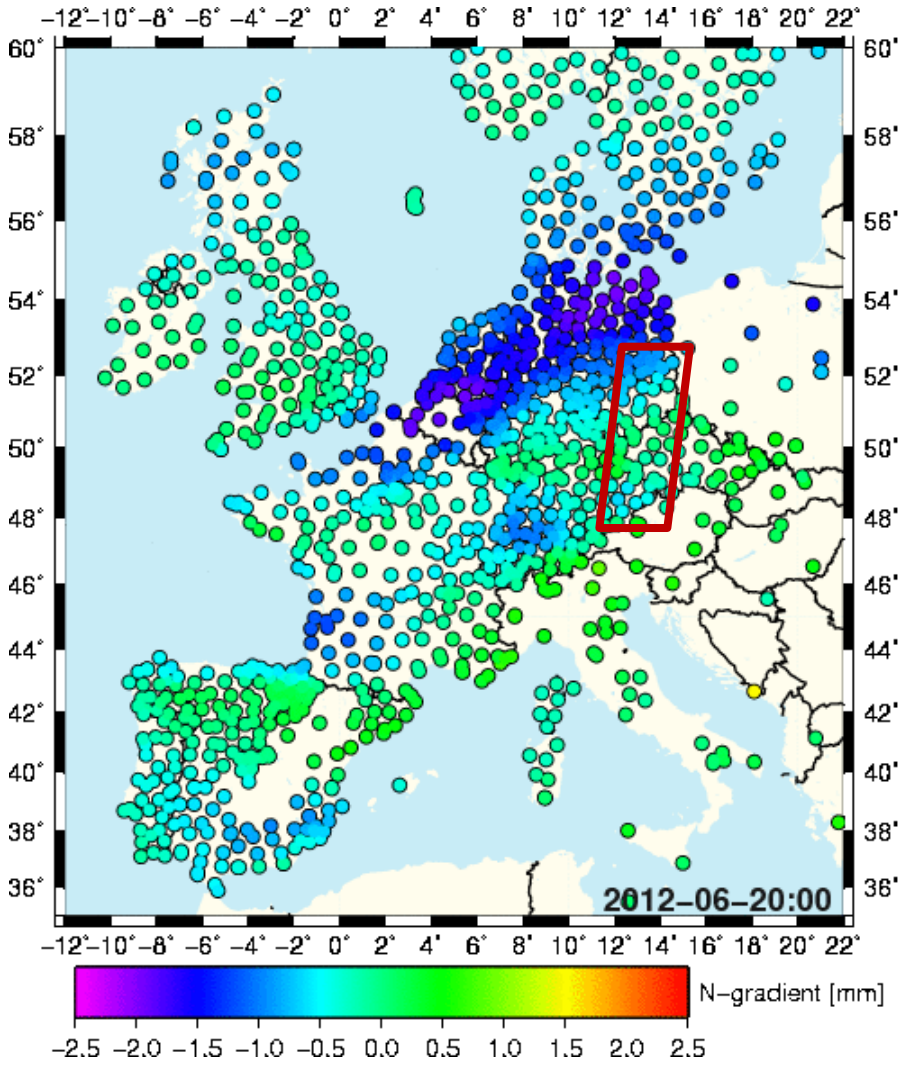
Time domain: candidate periods

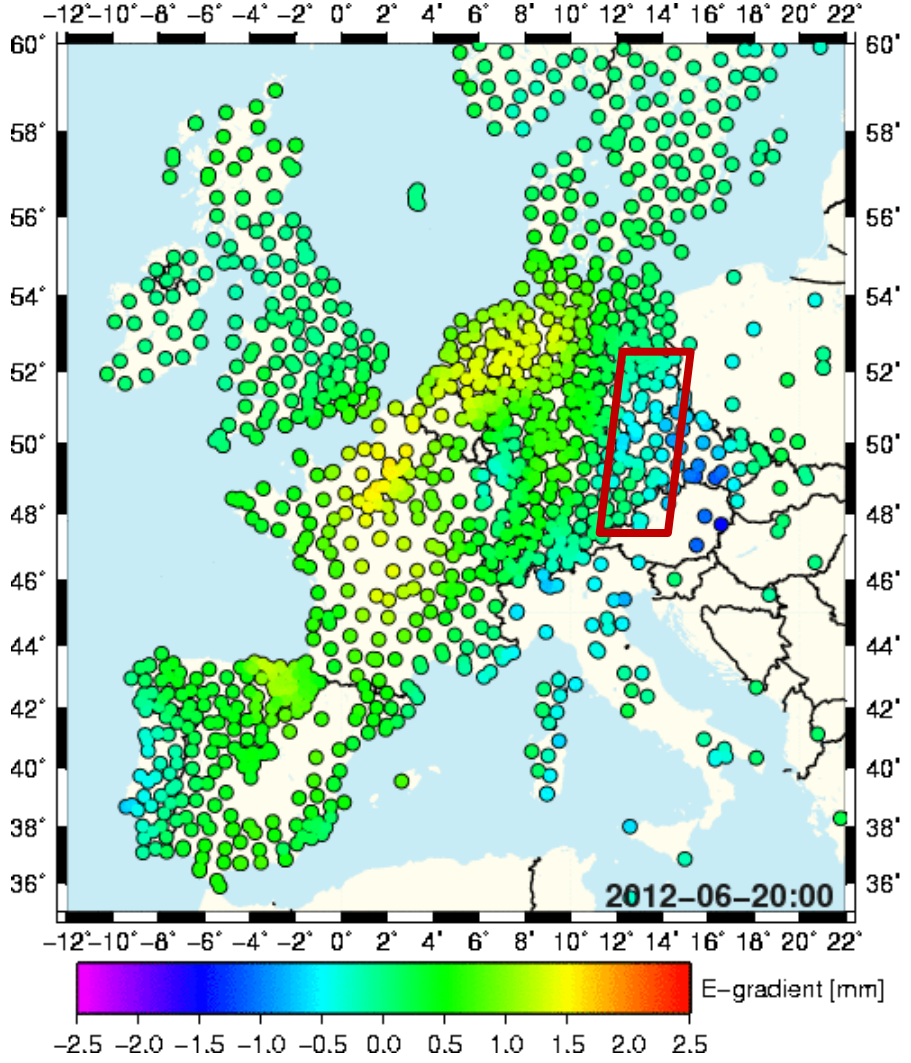
- December 21-28, 2012
- January 02-09, 2013

- June 22-30, 2012
- July 23-30, 2013

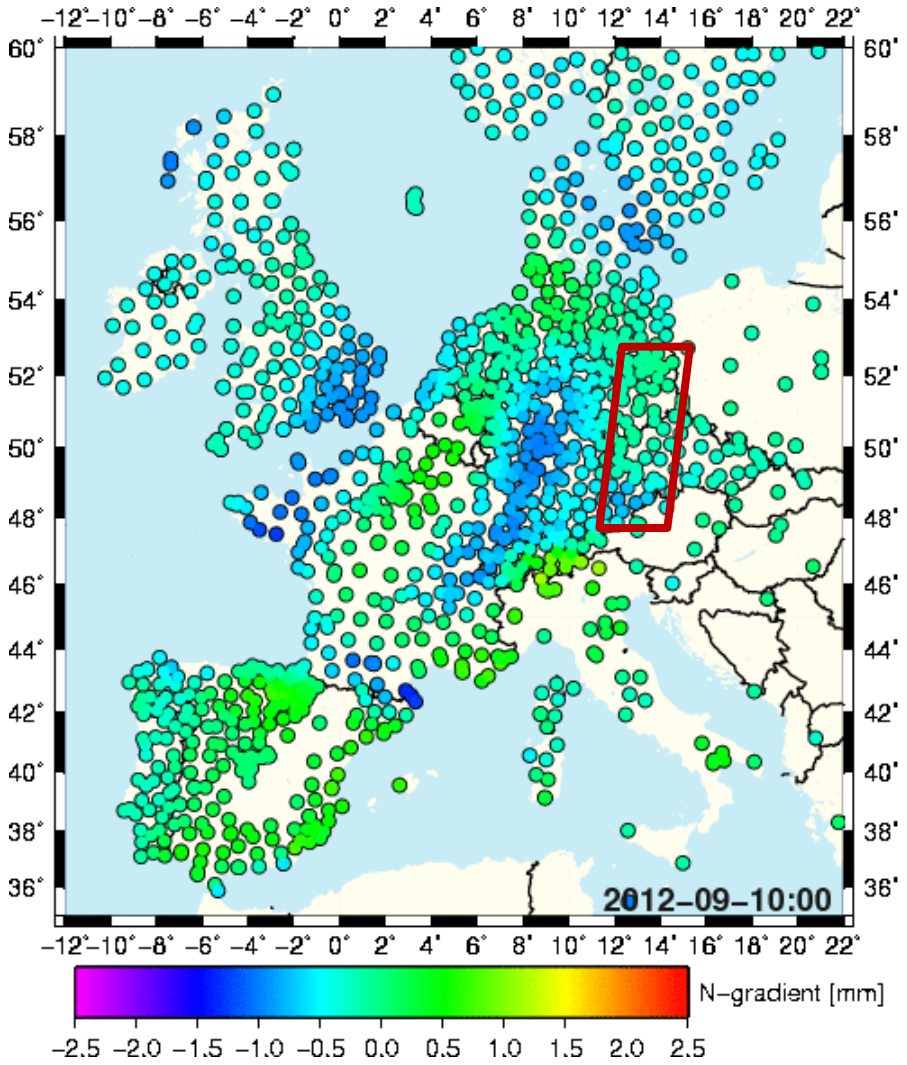
- September 18-25, 2012
- October 22-29, 2013

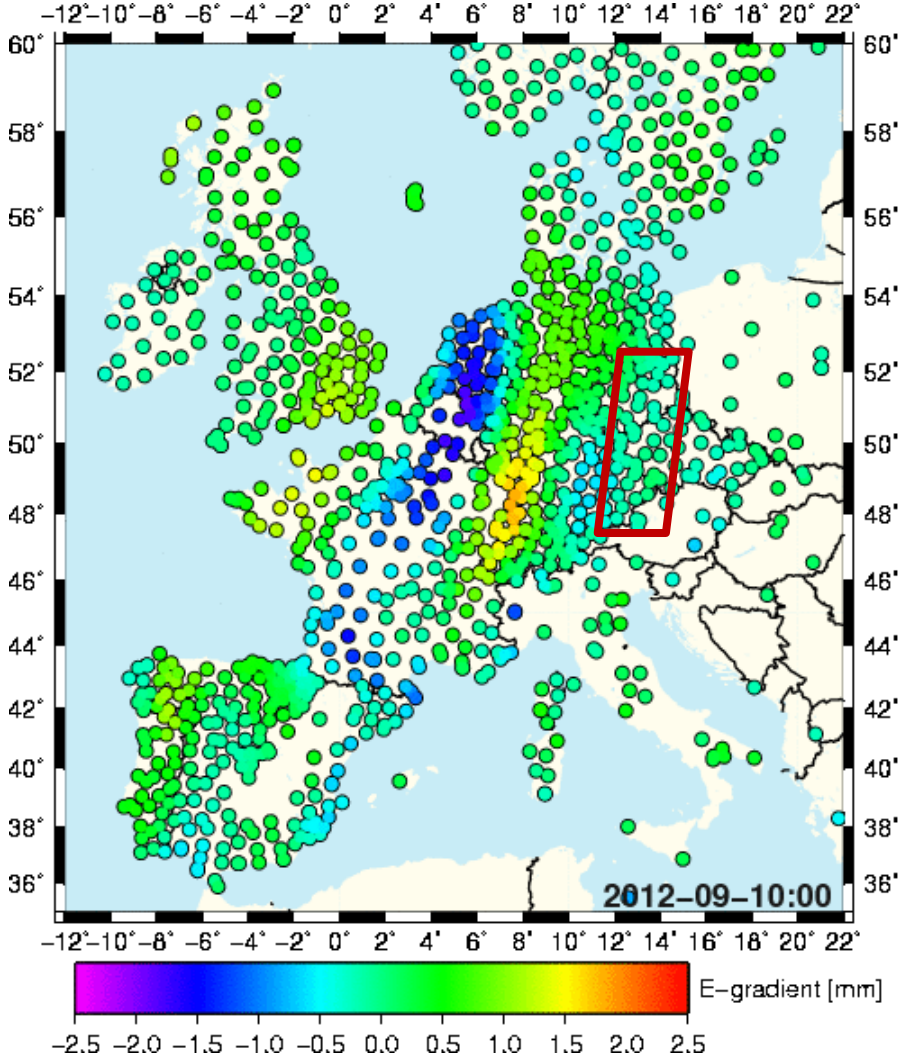
Period: Jun 22-30, 2012



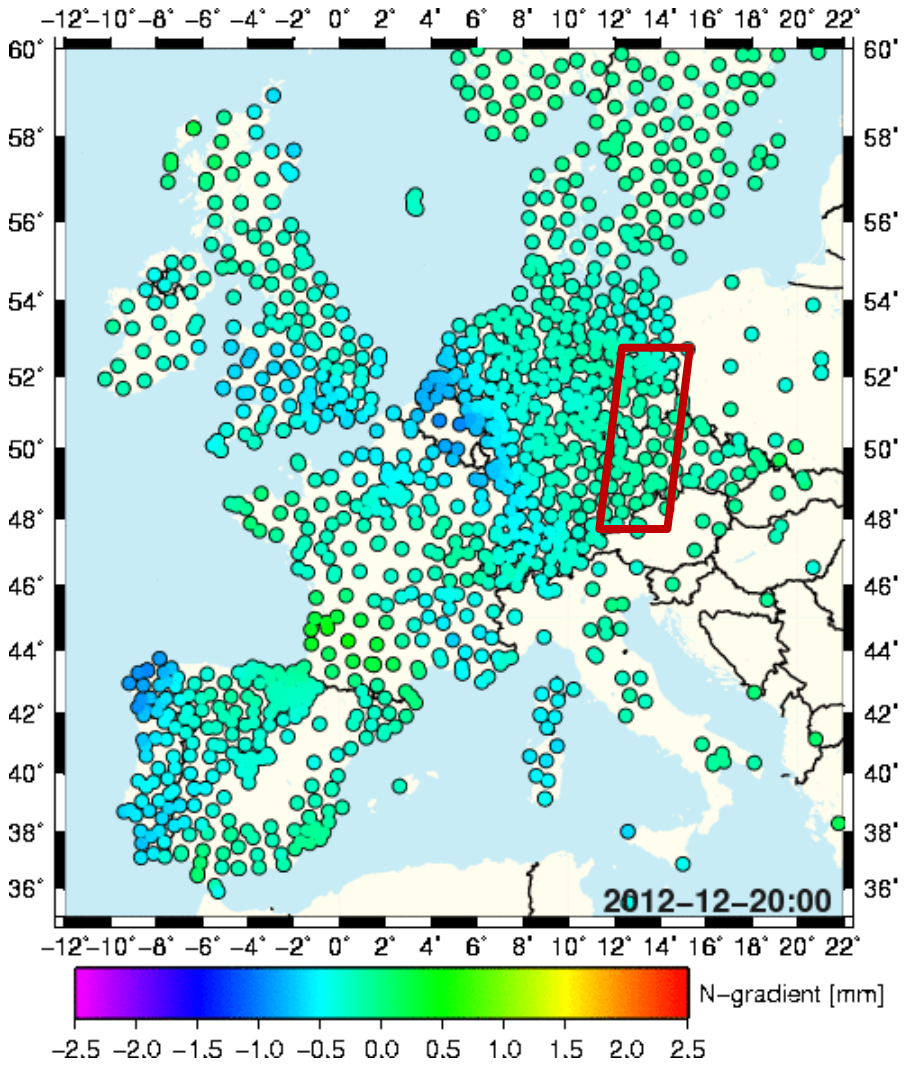


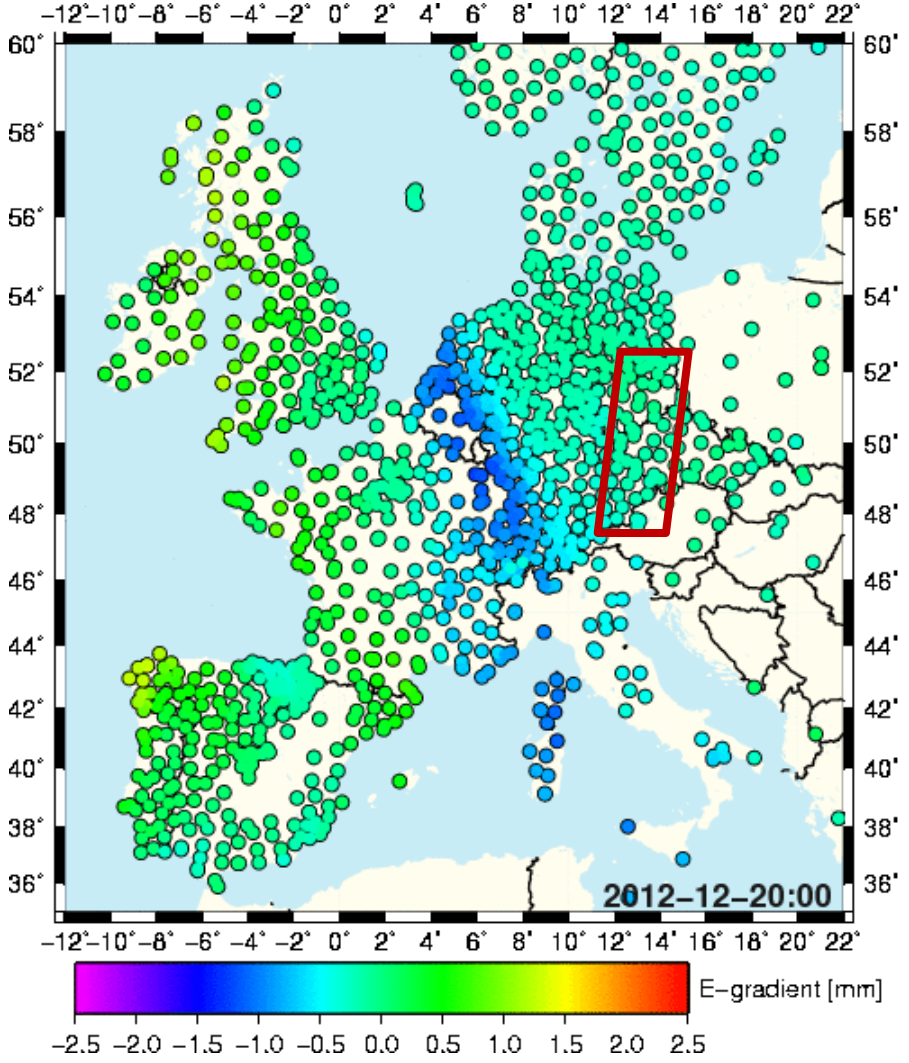
Period: Sep 18-25, 2012



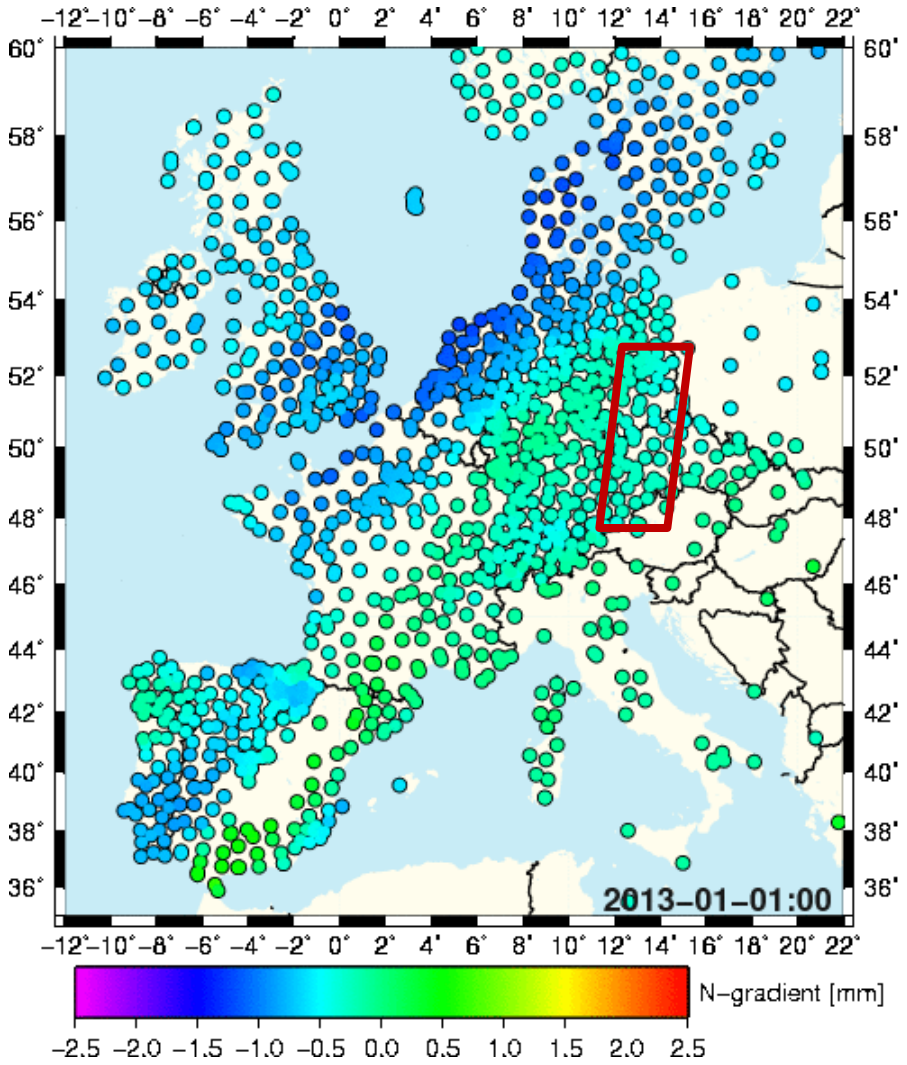


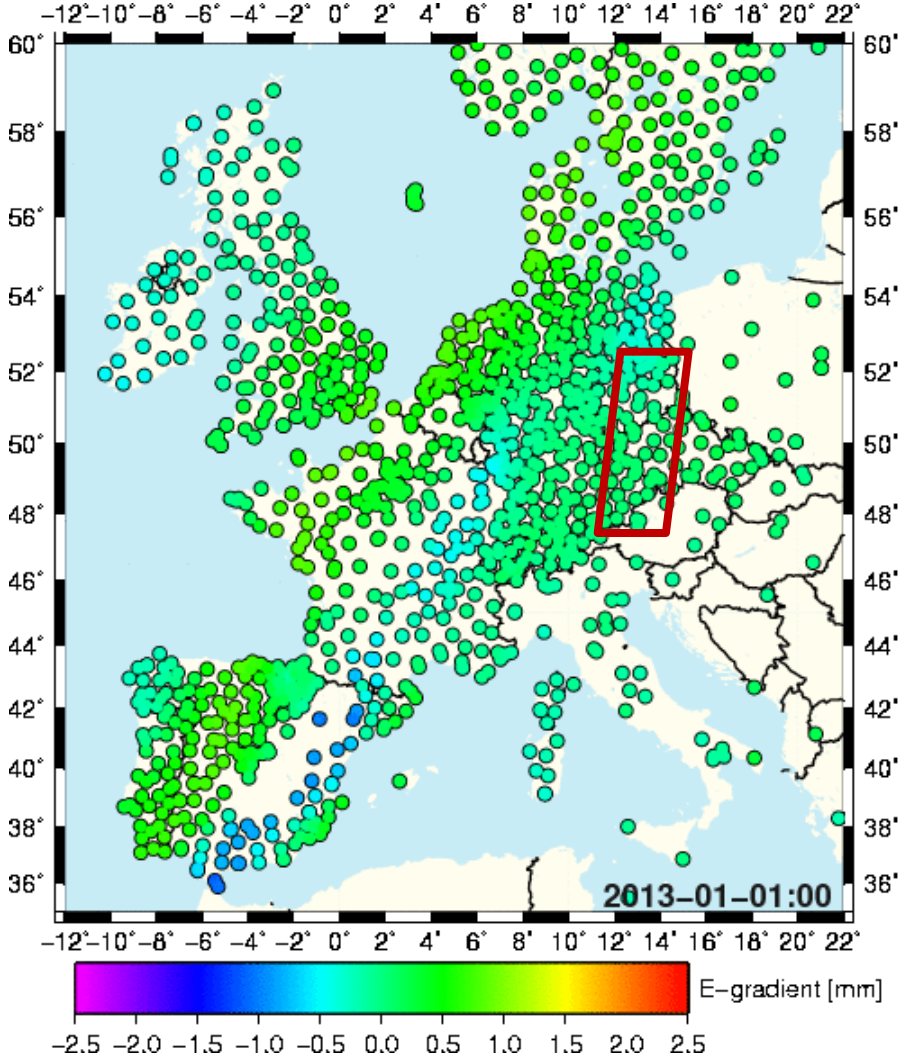
Period: Dec 21-28, 2012



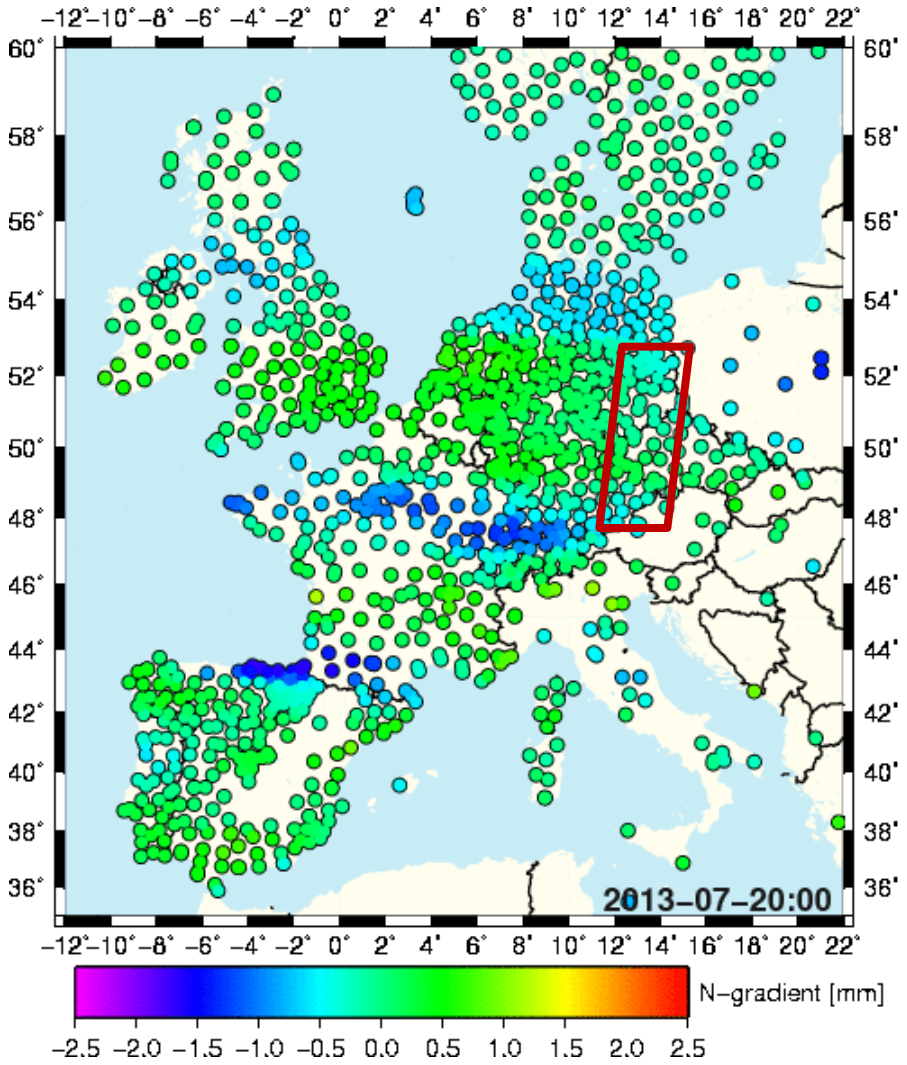


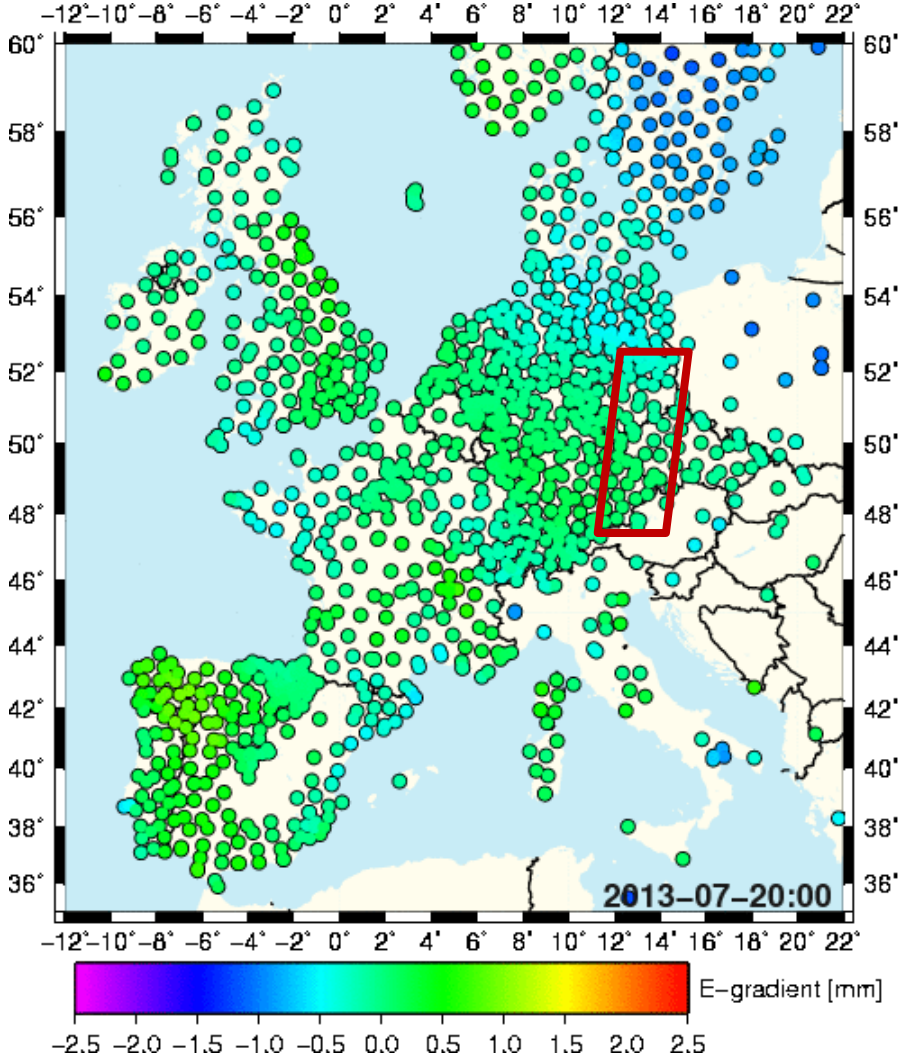
Period: Jan 02-09, 2013



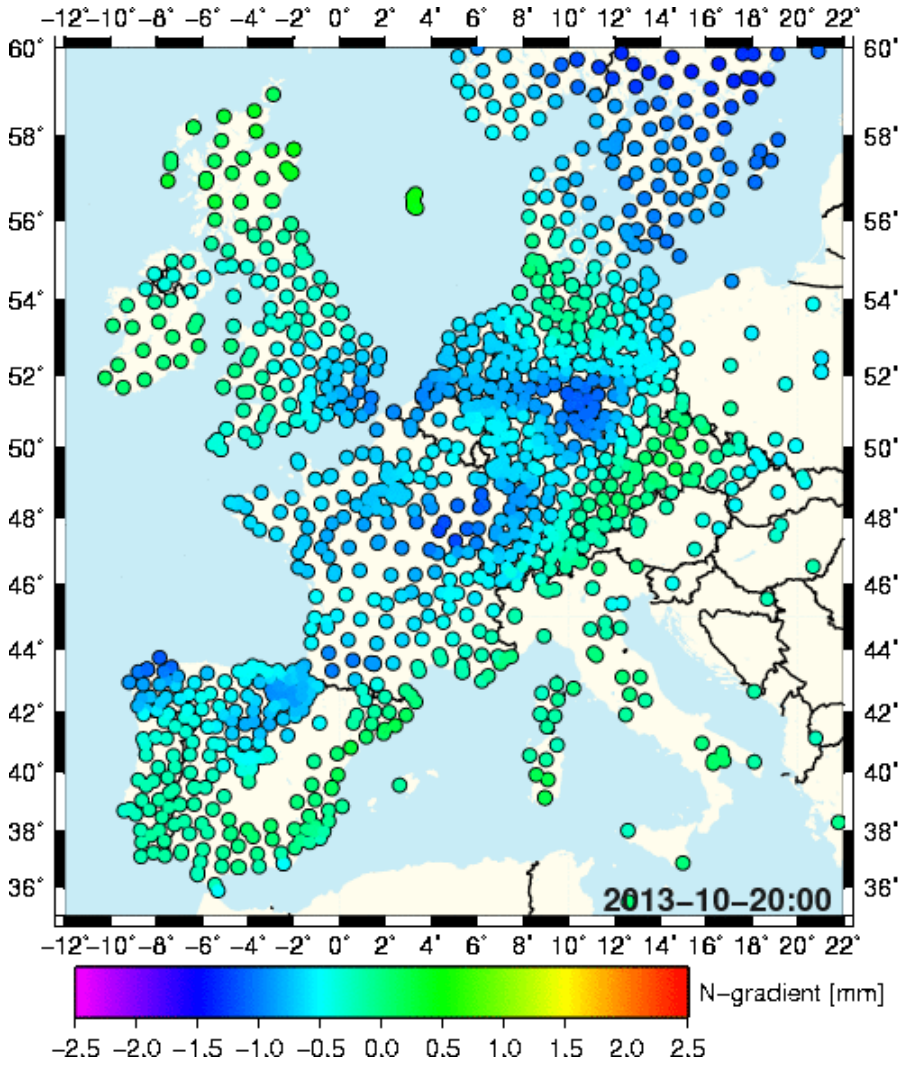


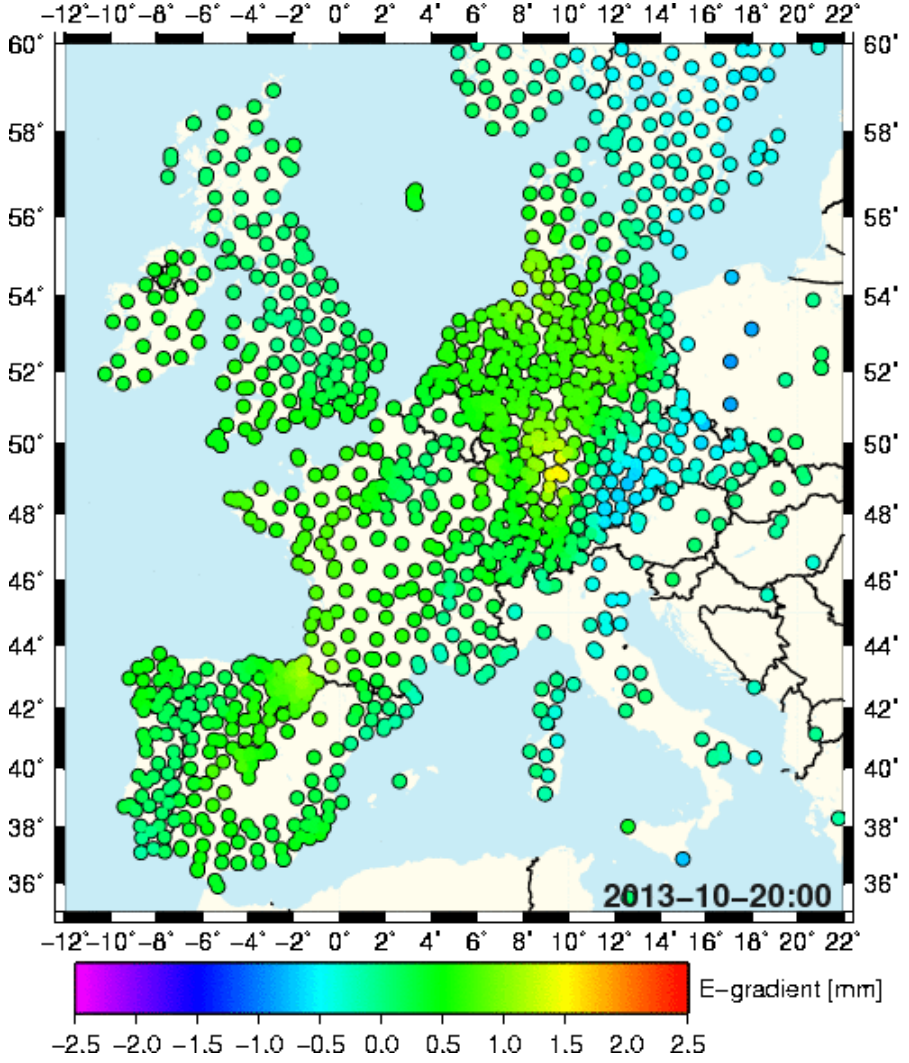
Period: Jul 23-30, 2013





Period: Oct 22-29, 2013





Data: GNSS (1)

Aimed at supporting GNSS processing (variety of strategies)

- GNSS observations and metadata
  - RINEX-O files: observations 30s/high-rate, daily/hourly, RINEX 2x/3x
  - RINEX-M files: in situ meteorological observations if available
  - Multi-GNSS: a devoted subnet for GPS+GLO ?
  - Meta data: site-log files ?
- GNSS precise products and models
  - Final products
  - Real-time products
  - Consistency of models: effective exchange of settings, models,..
- Hierarchic / multi-level benchmark dataset organization
  - Spatial/temporal resolution, multi-constellation, …

Data: inter-comparisons (2)

Aimed at assessing GNSS results

- Radiosondes
  - Availability: sources, format, resolution
  - Processing: common
- Radiometers
  - Availability: sources, format
- Others
  - ?

Data: other supporting data(3)

Aimed at

1) supporting GNSS processing model developments,

2) converting results – strategy assessments, …

- NWP data
  - Utilization:
  - Sources: NWP models, resolutions, …
  - Formats: GRIB, NETCDF
  - Forecasts: analysis, predictions
- Synoptic data
  - Availability: source, formats, filtering
- Others ？

Data: data policy and repository

- Data policy
  - Common to all/individual datasets
  - Fully open access, COST members only or other
- Repository:
  - Common ftp server
  - Maintenance:
  - Dissemination and documentation
- Resulting publications, proper acknowledgments
  - How to handle

Asymmetry monitoring

- Potential utilization:
  - Gradient estimation
  - Slant delays estimations
  - Impact of post-fit residuals, multipath
  - …
- Evaluations:
  - gradients
  - slant delays
  - …
- Contributions:

Troposphere models

- Potential utilization:
  - External tropo models for GNSS positioning
  - coordinate repeatability
  - PPP convergence time
  - …
- Evaluations:
  - ZTD, gradients (from GNSS and NWM)
  - slant delays
  - coordinate repeatability
  - PPP convergence time
- Contributions: AUT, GFZ, GOP, TUW, WUELS

? Tomography ?

Different users …

- Potential utilization:
- Evaluations:
- Contributions:

PPP / Multi-GNSS

- Potential utilization:
  - Software troposphere products
  - Impact of precise products (real-time, near real-time, final)
  - Model effects and consistency (multi-GNSS)
  - Other aspects: ambiguity fixing
- Evaluations:
  - Tropospheric products
  - Gradients
  - Input precise products (orbit and clocks)
  - …
- Contributions:

Ultra-fast production / ZTD2IWV

- Potential utilization:
  - Study on temporal resolution
  - Optimizing troposphere constraints
  - Strategies for IWV map generations
  - …
- Evaluations:
  - ZTD, gradients
  - Auxiliary meteorological parameters
  - …
- Contributions: