EIG EUMETNET GNSS Water Vapour Programme

E-GVAP

Status of E-GVAP

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What is E-GVAP?

- EIG EUMETNET GNSS Water Vapour Programme.
- EUMETNET = organisation of European national meteorological offices (West European + number of East European, enlarging).
- E-GVAP is a separate observing programme under EUMETNET. Not all EUMETNET members are members of E-GVAP (currently 15).

Purpose of E-GVAP

- To provide quality checked, ground based GNSS delay and integrated water vapour data (ZTDs and IWVs) in near real-time (NRT) for use in operational numerical weather prediction (NWP) models and in now-casting to the participating EUMETNET members.
- To improve on the NRT GNSS ZTD data quality and enlarge data coverage
- To assist users in utilising the data for weather forecasting.

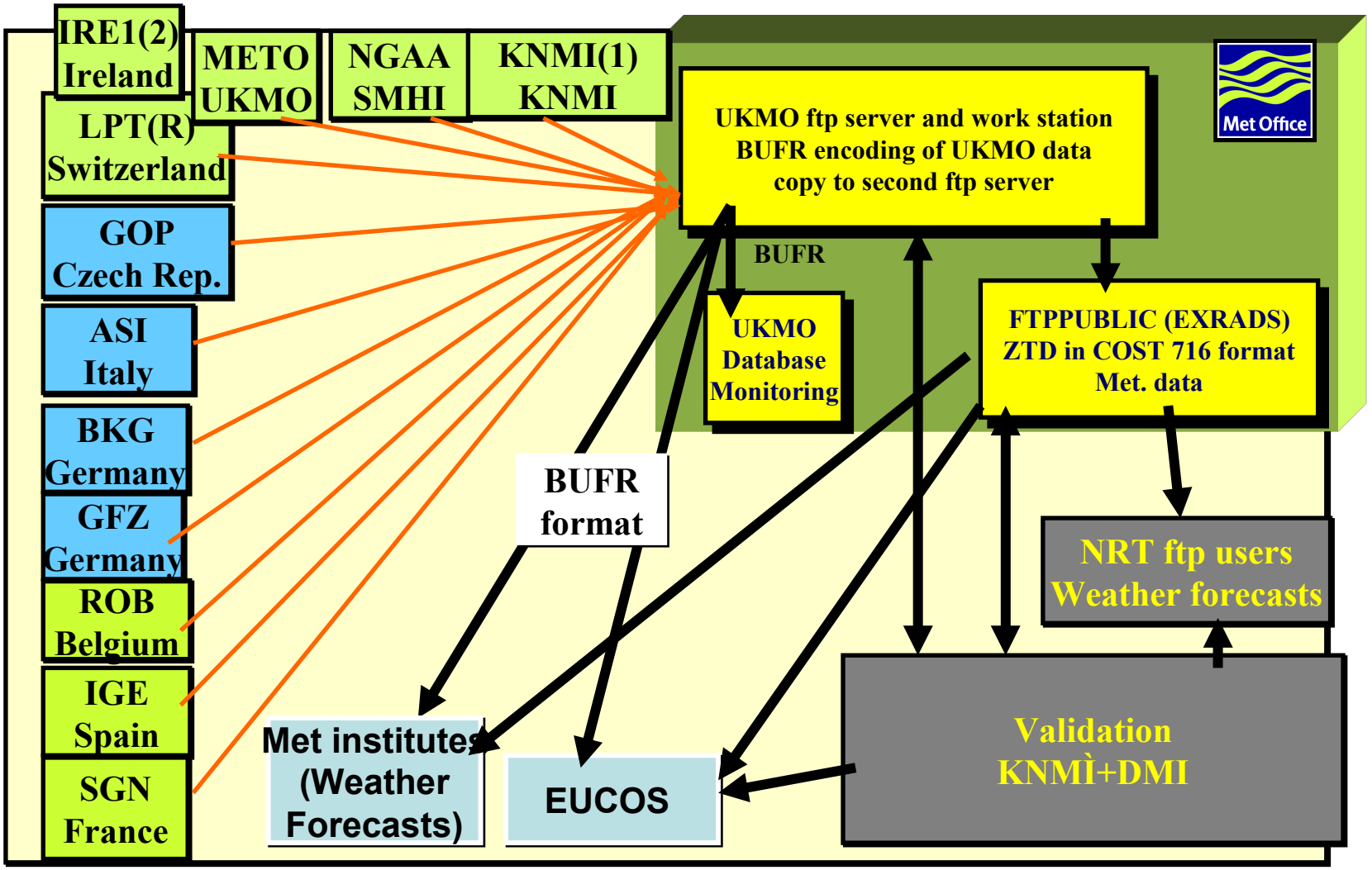
Method

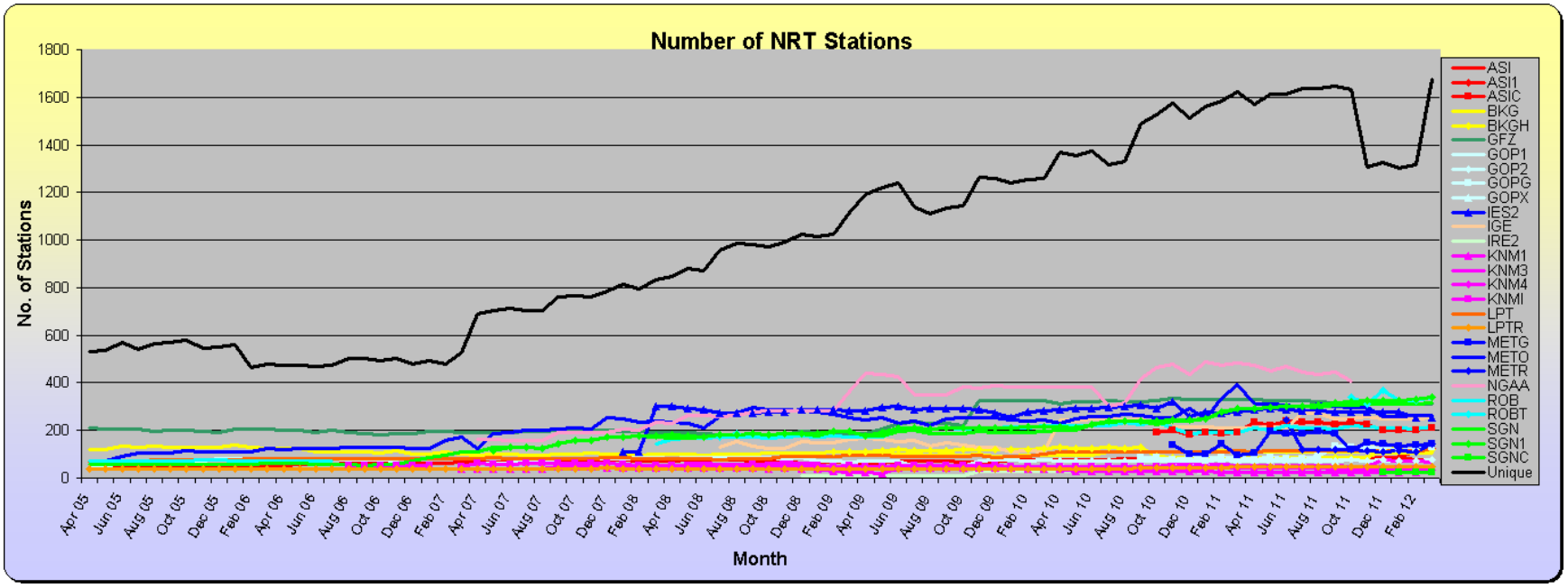
Collaboration with geodesy.

Through EUREF (MoU between EUREF and EUMETNET) and EUPOS (MoU being finished between EUPOS and EUMETNET) and on national level. Examples:

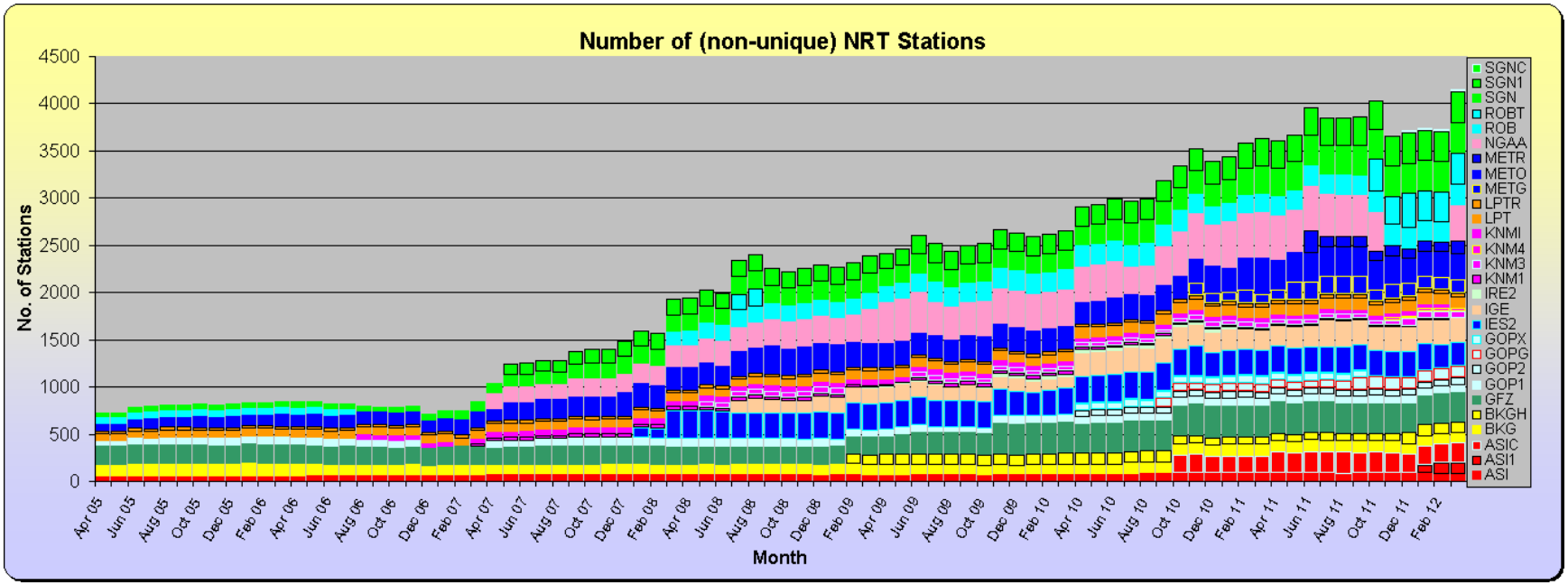
- **Exchange of data.**
- **Exchange of knowhow**
- **Collaboration in national and international cross dicipline projects. From practical level, joint article level, to common EU research projects.**
- **Sharing of facilities.**

NRT GNSS ZTD data flow





Number of GNSS sites versus time.
More than 1600 unique GNSS sites by March 2012.



Number of AC-GNSS site combos versus time.

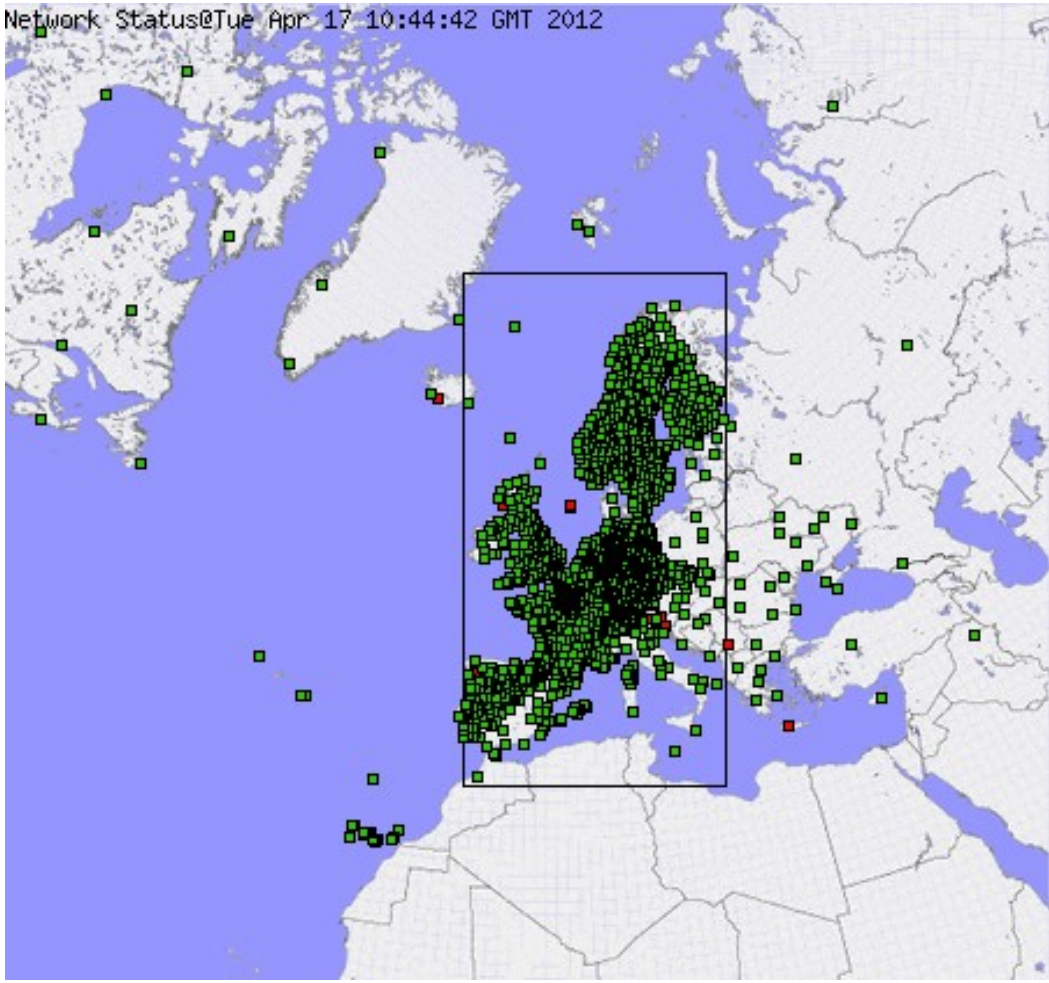
The significant overlap in site processing is in part for each AC to get a network of sufficient spatial extent. It enables inter-comparison of ZTDs from many more sites than just supersites, which is good for quality control.

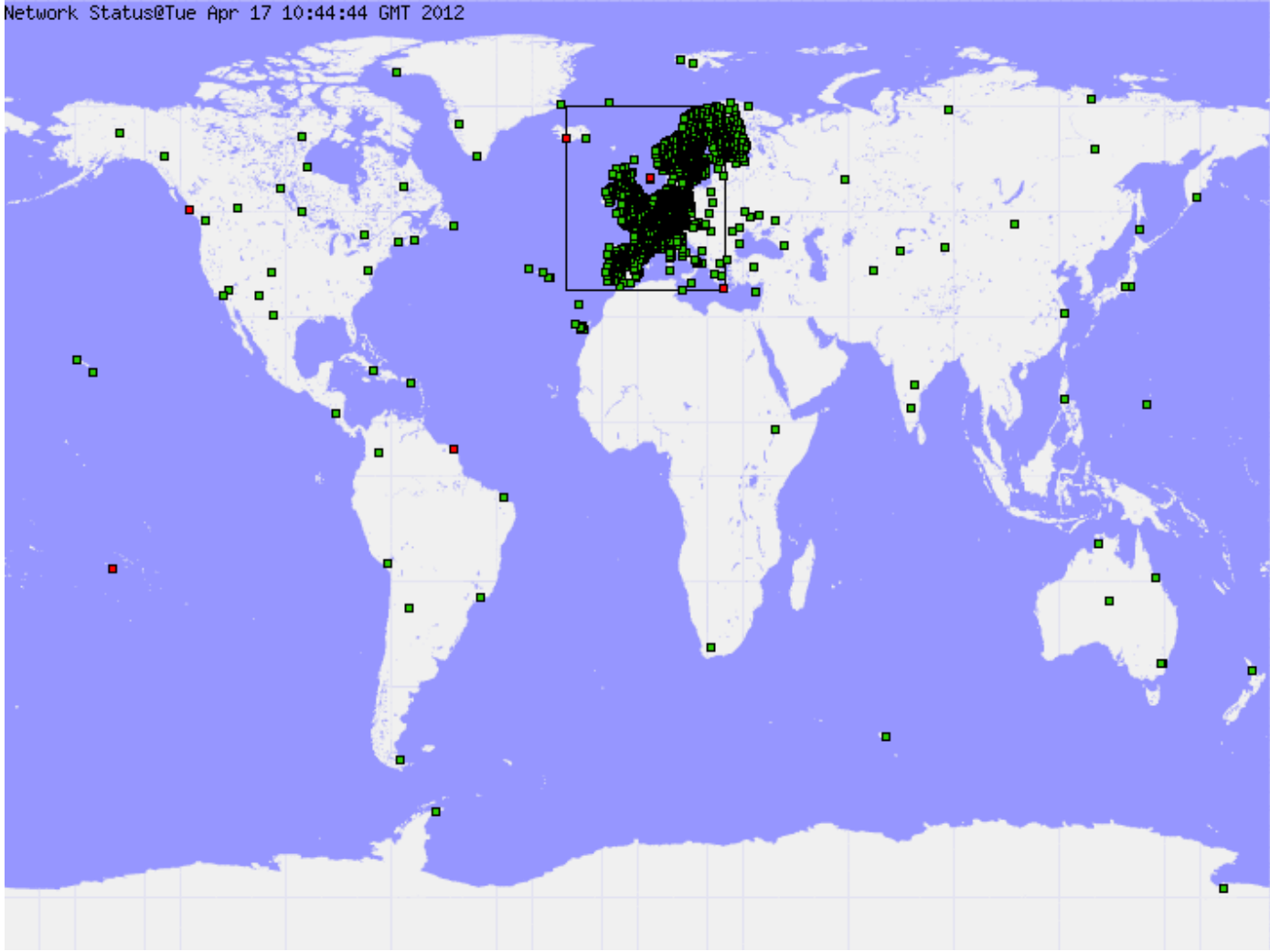
Data coverage

Extensions expected this year in Eastern Europe and Scandinavia.

In particular an MoU is being made between EUPOS and EUMETNET, opening for collaboration between individual EUPOS countries and institutes and E-GVAP.

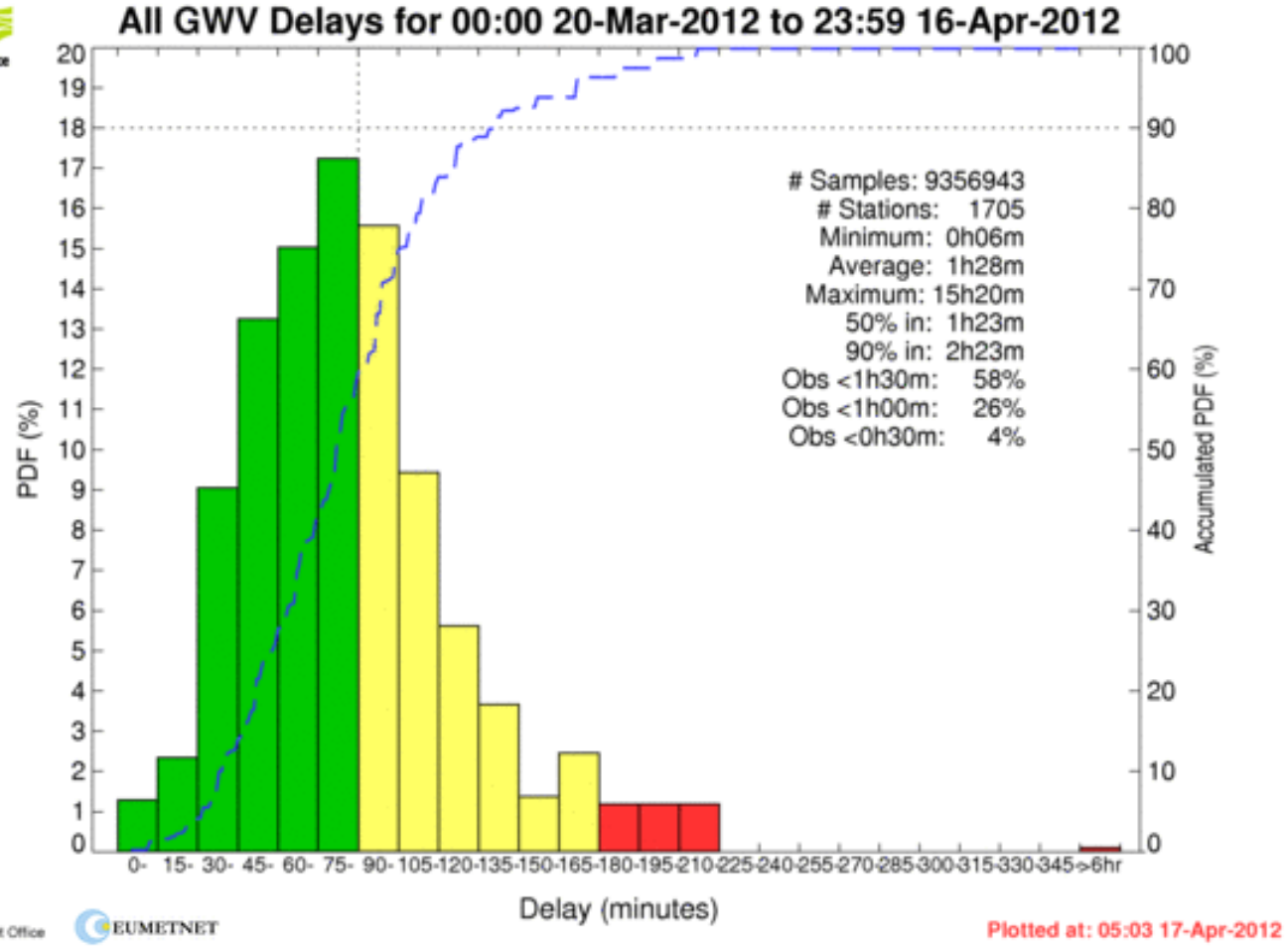
It is important to E-GVAP to expand coverage toward East and South East.





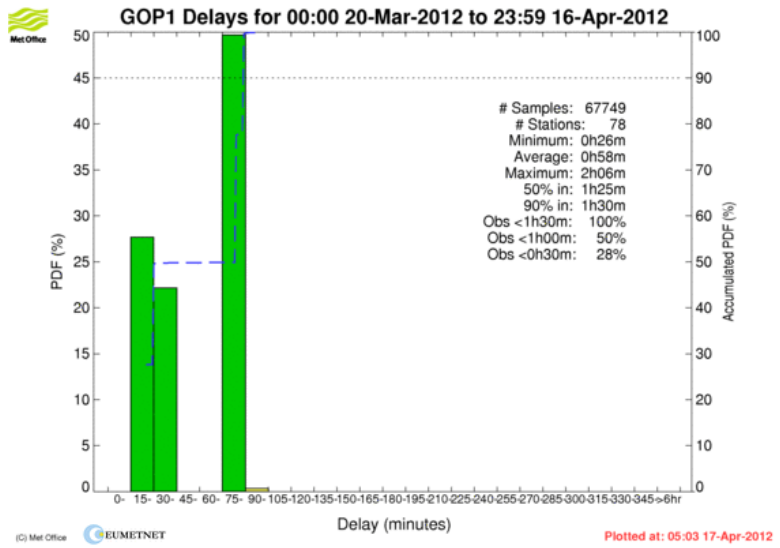
DATA COVERAGE

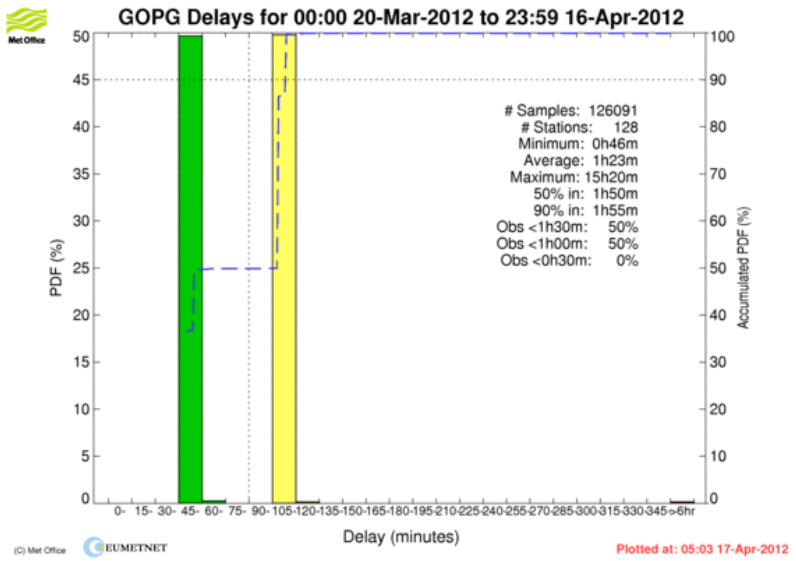
Now processing of global data at both GOP and METO (GOPG and METG) For members running global NWP.

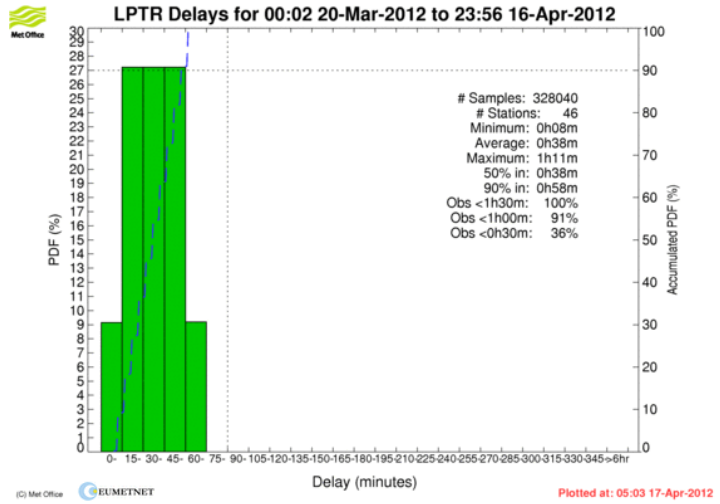


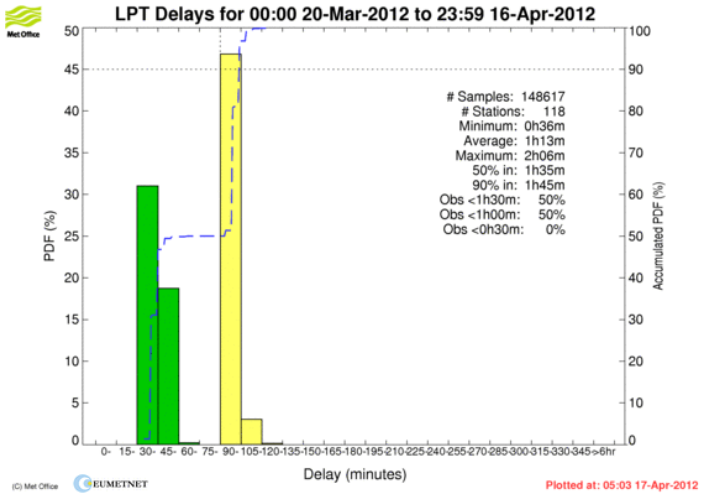
Timeliness: Age of observations when arriving in UKMO database, counted in 15 min bins.
Currently data oploads are hourly, which automatically leads to ”aging” of some of the observations.

(GOP global [non european])









(LPTR is calculated with only 5 min delay, but currently uploaded hourly.)

Timeliness and NWP developments

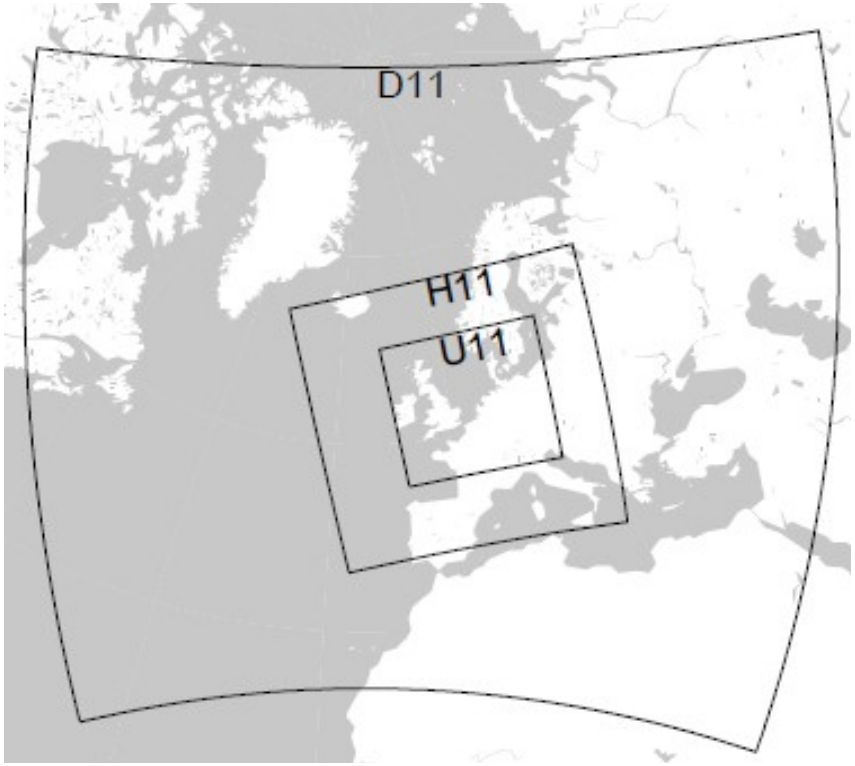
- **Movement toward NWP models with higher resolution and hourly cycling. Of particular importance to improve forecasting of extreme precipitation.**
- **To provide stating conditions for these models, observations with a high resolution in space and short delivery times, and relatated to humidity/rain/convergence are of particular interest.**
- **Ground-based GNSS delays are among the most promissing observations in this regard.**
- **It will result in a wish for faster access to data = sub hourly data processing (real-time not necessary, but fine, as long as ZTD quality is reasonable).**
- **Shortly, a *new scheme for naming of the COST-format* files uploaded to E-GVAP will be released, enabling sub-hourly data uploads.**
- **Current routine hourly processing and uploads need not change due to this.**
- **New setups, also of hourly processing and delivery, should be using the new format.**

Operational status regarding use in NWP

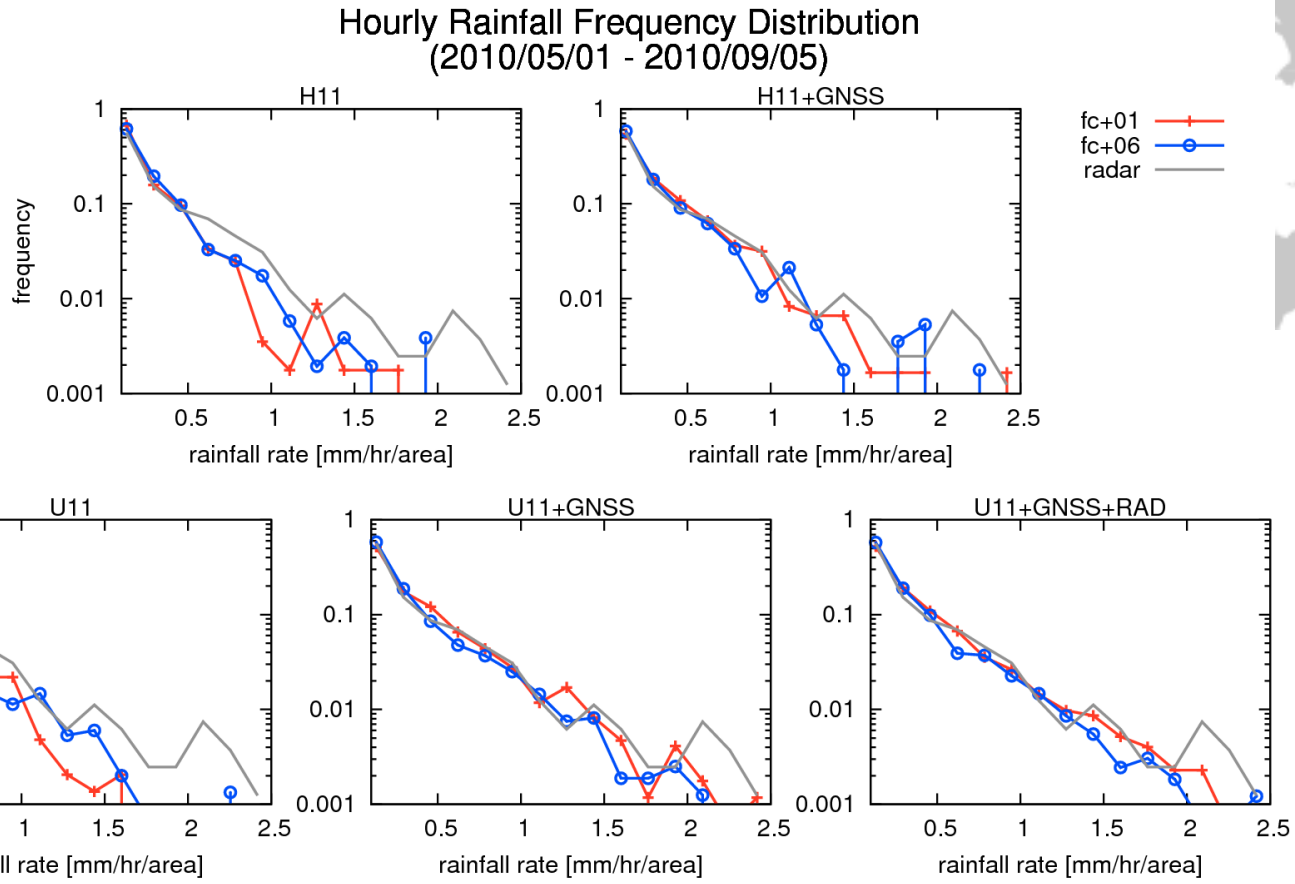
- **Four institutes, assimilate E-GVAP data in their operational models.**
  - **Météo France in Arpege (global), Aladin (regional) and Arome (meso scale, at 2.5 km).**
  - **UKMO in NAE (regional) and UK4 (meso scale), under trial in global model**
  - **KNMI**
  - **DMI**
  - **More to follow in 2012**
- **A positive impact from the use of the E-GVAP data is reported.**

Hourly asimilation (U11)

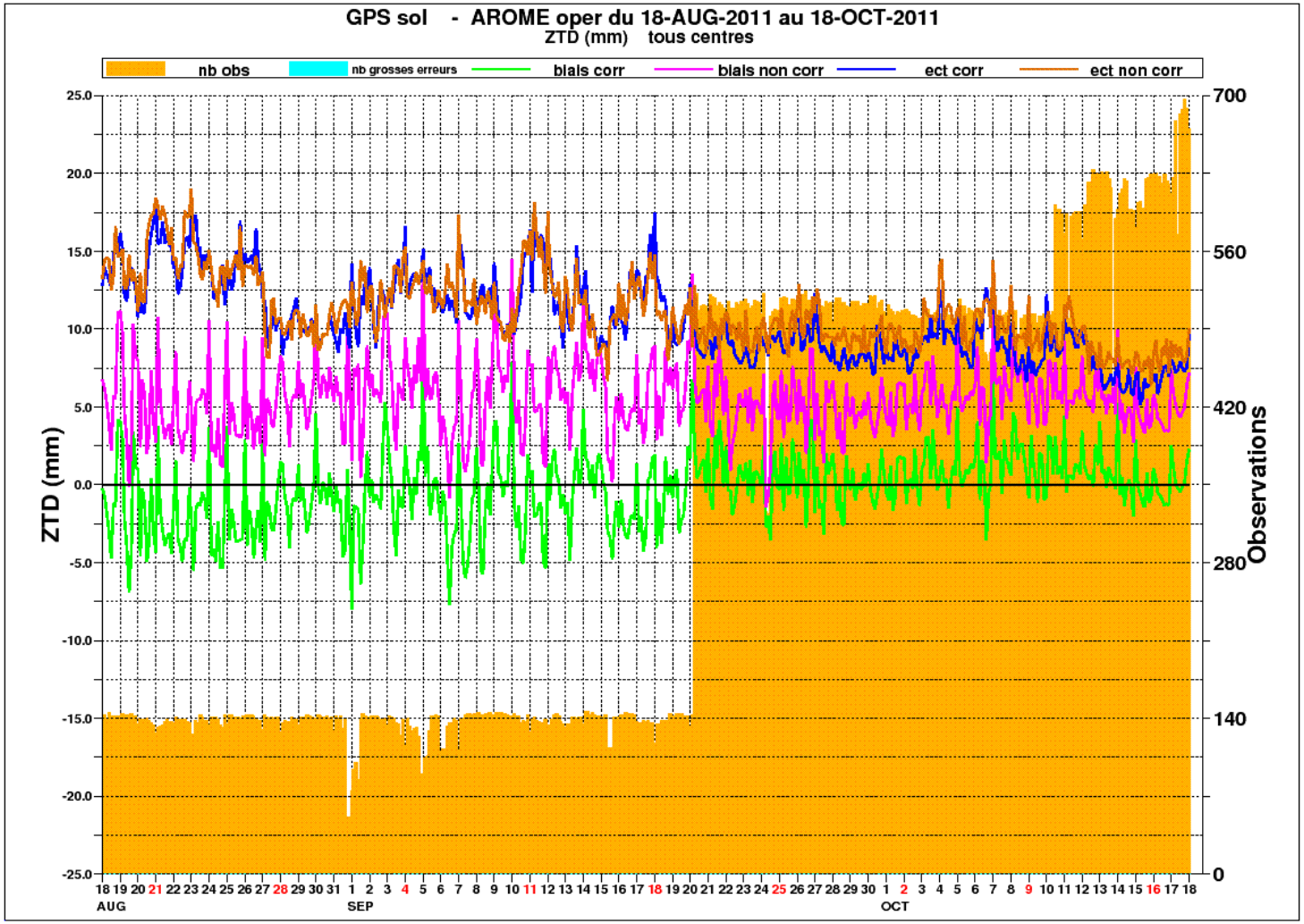
- Cycle dedicated for ATC
- Input
  - Aircraft (ModeS)
  - Surface pressure
  - Additional
    - GPS
    - radar radial winds
- Operational 2011/05
  - Windprofilers: 2010/08 passive
- FC+09: output every 10min
- 11km resolution



Rainfall forecast verifcation



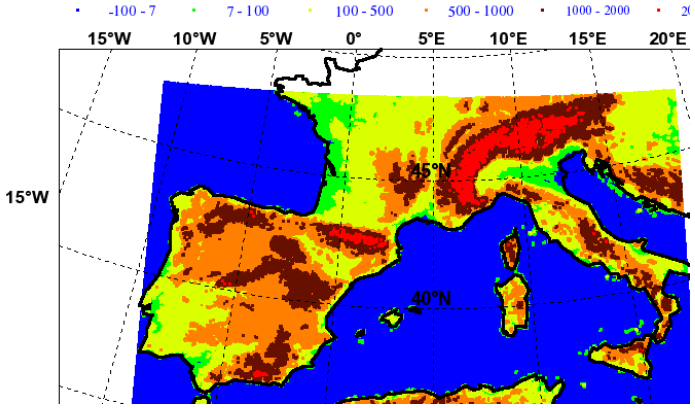
Monitoring example (time-series)



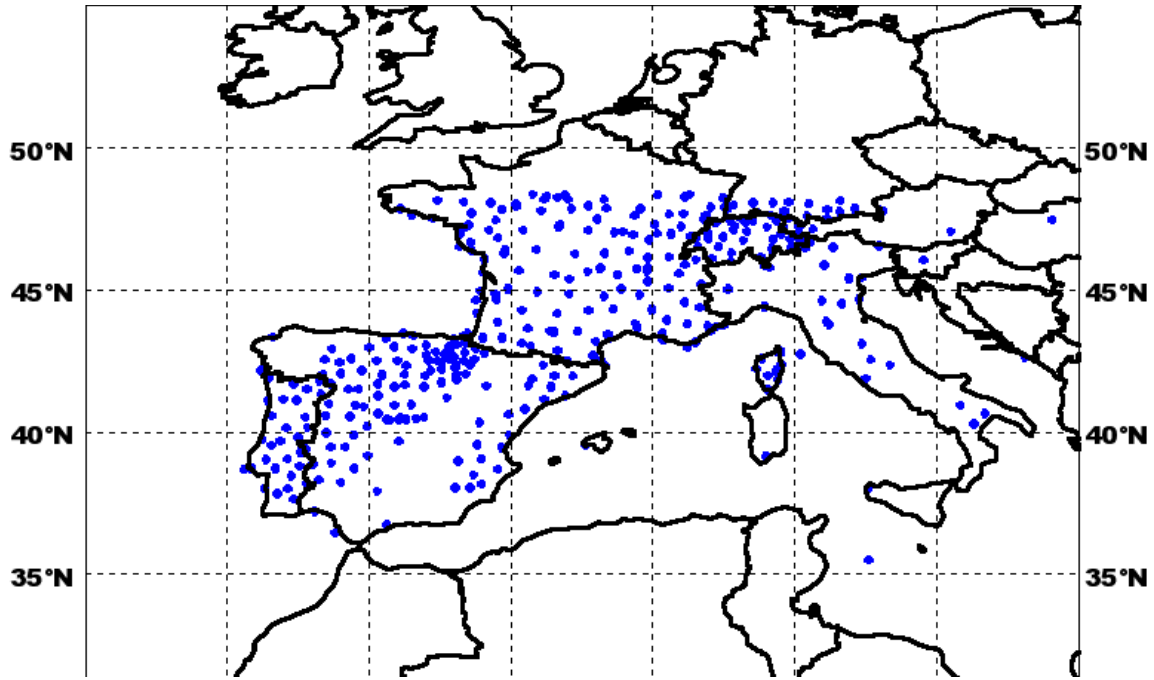
DPREVI/COMPAS

Validation of AROME-WMED

(Mathieu Nuret)



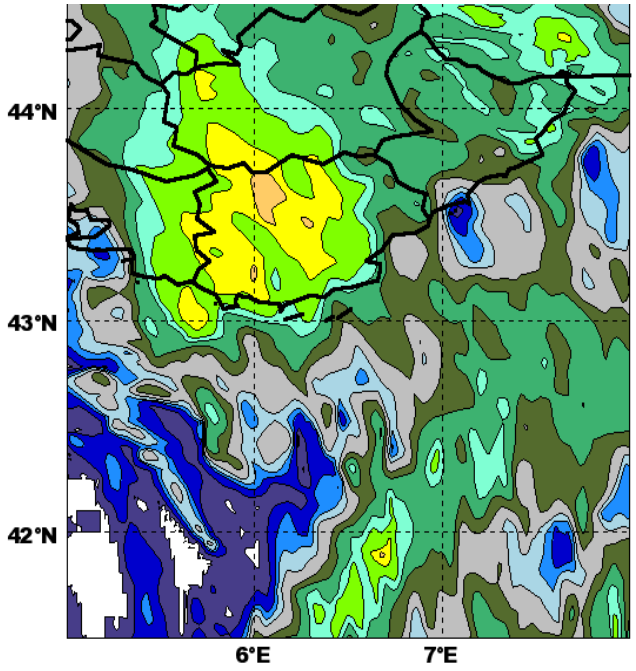
AROME WMED domain



GPS data used

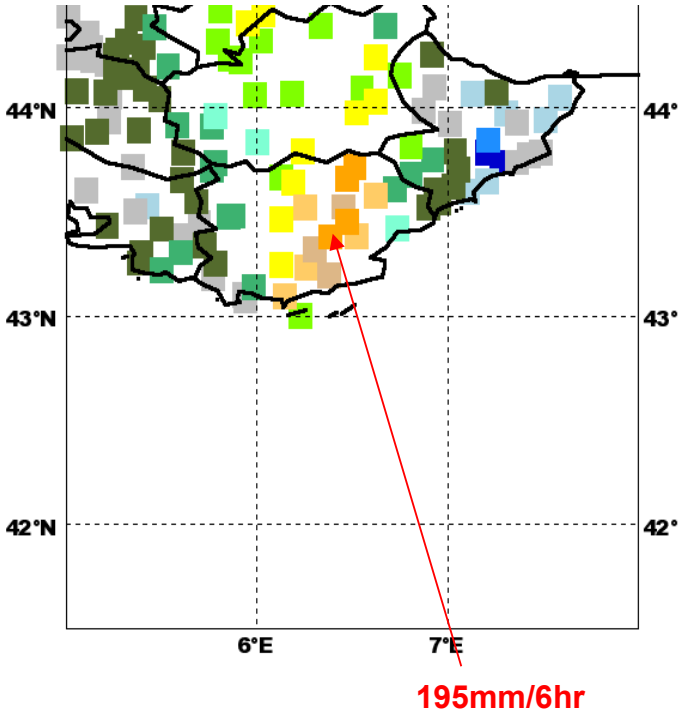
15/06/2010 – 09UTC

AROME_WMED (D031)



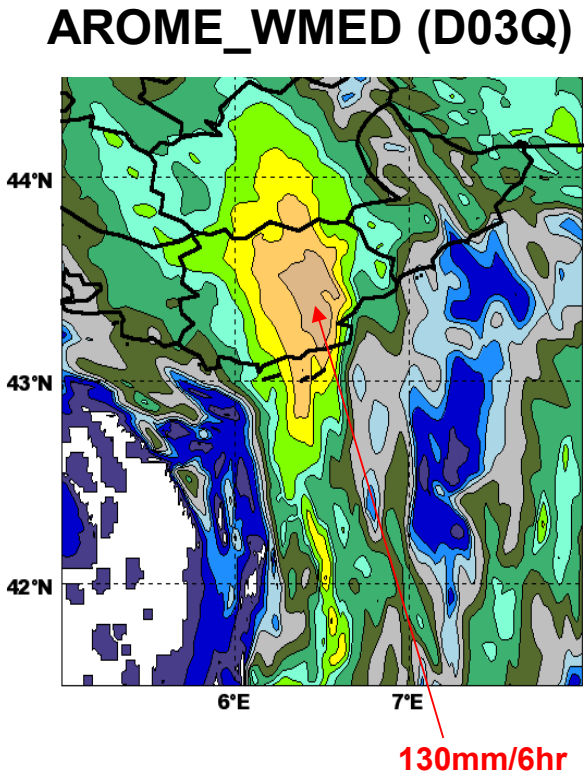
Old white list

OBS (6h Accumul.)



Rain gauges obs

AROME_WMED (D03Q)



New white list

Supersite processing, biases (one week)

Bias

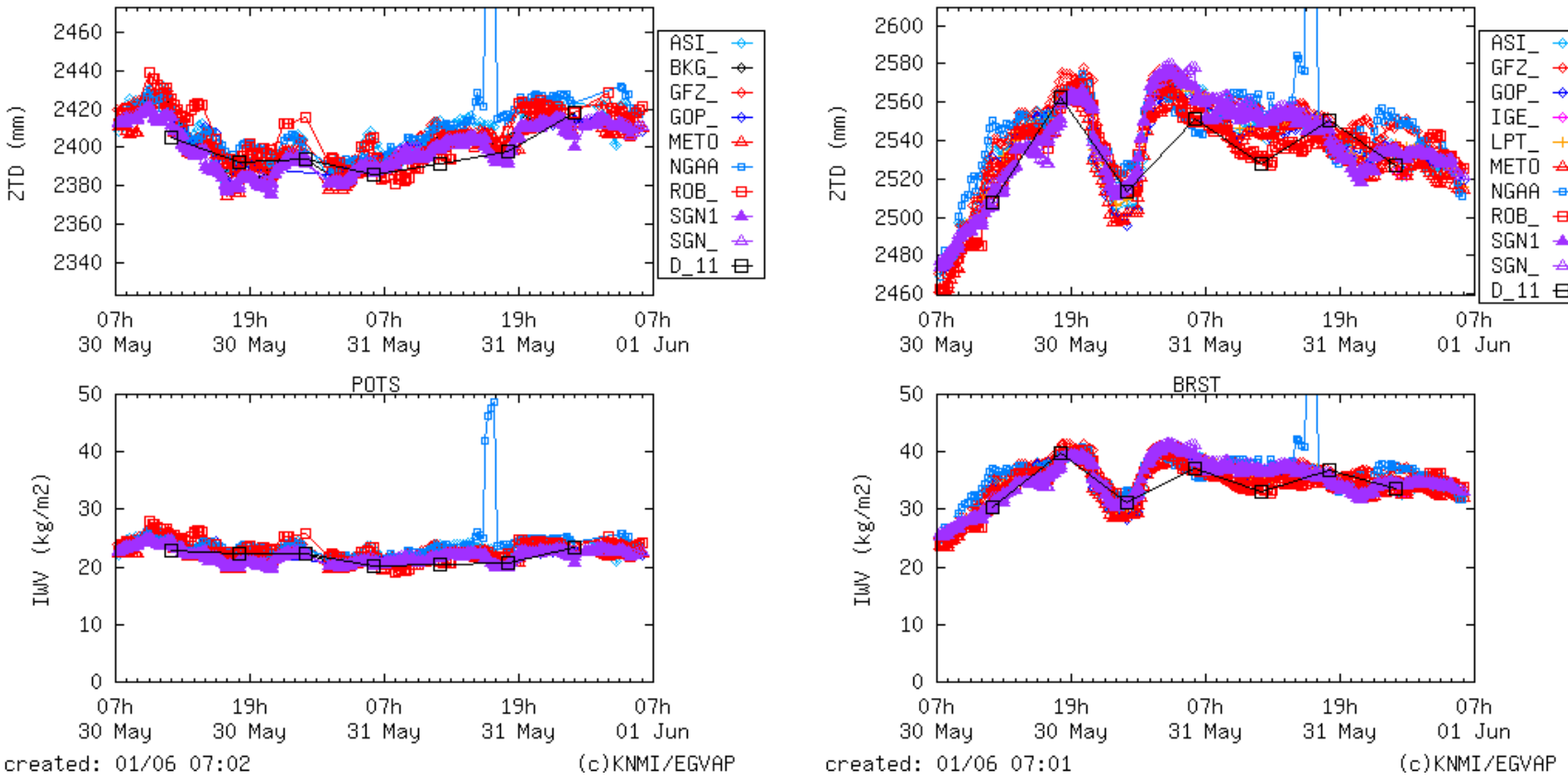
AC	BRST	CABW	CAGL	CAMO	GOPE	IZAN	LDB2	M0SE	MEDI	MILO	ONSA	PAYE	SMNE	YEBE	ZIMM
ASI_	-1.99		1.91		10.68		16.76	19.34	-7.93		30.71		0.52	3.45	4.27
ASIC	-1.80	2.09	0.98	-4.74	12.93		14.92	18.63	-8.49		28.69	3.44	0.23	2.45	4.86
BKG_			0.23		11.35		17.68		-10.24		27.20			0.15	3.19
GFZ_			-3.78		23.01		10.35		0.57		34.16			12.51	10.44
GOP1	1.42	4.05	1.61		8.58		16.54	19.52	-9.90		27.38		2.80	5.03	5.36
GOPG	3.20		2.71		9.73						27.23				
IGE_	1.09		1.43		14.50			21.05			28.80		3.81	3.09	6.43
KNM1	-15.25				14.66						27.40				
KNMI		-0.76	1.70					20.44	-8.42					2.54	4.20
LPT_	-0.95	4.03	1.03		12.88		16.72	18.57	-10.07		28.61	4.09	1.93	1.30	4.26
LPTR												4.72			
METO	-2.34		-0.67	-7.55	11.39		13.44	17.34	-10.30		26.06	1.38		0.72	
ROB_	2.76	2.83	2.30	-2.34	12.76		16.71	18.58	-9.98		29.61		1.70	2.18	5.43
SGN_	-0.01	2.59	1.11	-4.75	9.18		13.55	18.12	-10.25		26.71	3.55	-2.28	0.17	2.98
SGN1	0.11	3.17	1.00	-4.01	9.36		13.65	18.10	-10.14		26.84	3.77	-2.01	0.34	3.35

Supersite processing, standard deviations (one week)

Standard Deviation

AC	BRST	CABW	CAGL	CAMO	GOPE	IZAN	LDB2	M0SE	MEDI	MILO	ONSA	PAYE	SMNE	YEBE	ZIMM
ASI_	6.38		6.26		3.85		3.75	6.18	8.41		3.74		3.59	5.15	4.51
ASIC	6.00	6.04	6.02	4.62	3.63		2.95	5.99	7.52		3.96	4.29	4.33	3.17	3.77
BKG_			5.69		3.86		3.54		7.70		5.47			2.55	3.32
GFZ_			7.35		3.96		2.89		8.07		3.15			4.61	3.91
GOP1	5.45	7.89	5.73		4.32		2.81	6.37	6.80		7.38		5.49	4.55	3.62
GOPG	6.11		5.83		4.51						7.40				
IGE_	10.29		7.53		5.02			6.96			3.77		7.66	5.27	6.11
KNM1	8.22				5.03						6.59				
KNMI		6.80	8.26					7.19	9.21					6.41	3.63
LPT_	7.98	6.37	6.14		3.62		3.58	6.16	8.15		4.11	3.68	4.79	5.16	4.26
LPTR												6.58			
METO	5.93		7.06	5.32	5.51		3.93	5.92	7.76		4.80	4.86		4.08	
ROB_	6.87	5.88	7.18	5.11	4.16		5.17	5.80	8.30		3.54		4.73	3.88	5.89
SGN_	7.11	6.81	5.88	5.34	3.57		3.13	6.39	7.41		4.43	4.47	5.68	3.54	4.27
SGN1	7.44	7.17	5.76	5.91	3.55		3.07	6.35	7.35		4.37	4.26	5.87	3.43	4.35

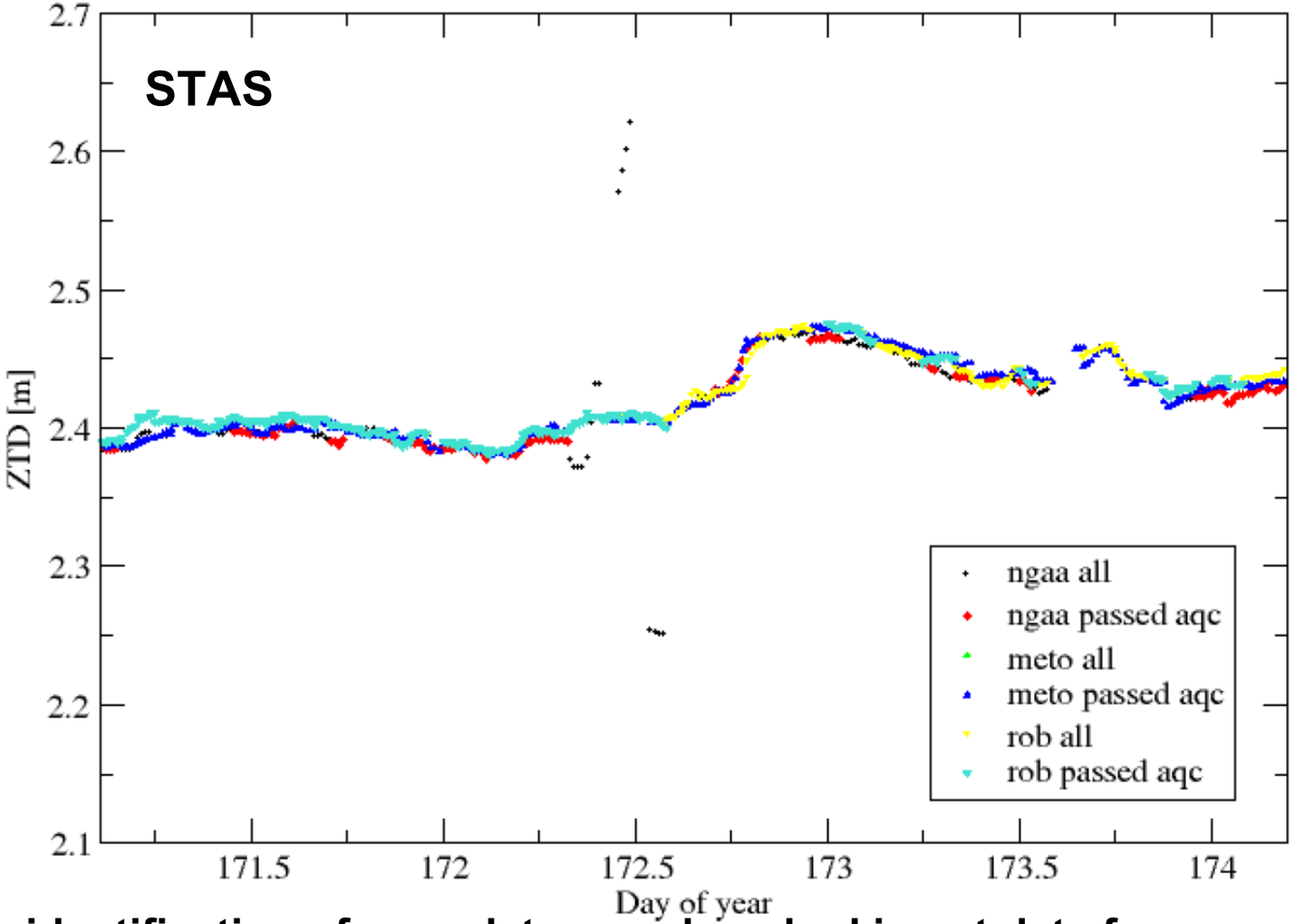
Active quality control, AQC



Example highligting

1) General agreement between 9 ACs (and NWP) at two sites = good quality.
2) But: When one AC is wrong at one site it is **also** wrong at the other. This is very particular to GNSS ZTD estimation, and dangerous to NWP.

Active quality control.
Method has been tested and demonstrated to work.



Notice, the identification of poor data was done looking at data from completely different sites! This site is processed by 3 ACs, and did not enter the AQC statistics. Yet the AQC conclusion appear perfect also for STAS.

The future of E-GVAP inside EUMETNET

- **EUMETNET has recently been restructured. In view of this and the financial crisis, EUMETNET has made a new ”roadmap for observations” and all observing programmes will be terminated in their current phase by end of 2012.**
- **The roadmap for ground-based GNSS observations corresponds nicely to what we and our geodetic colleagues in E-GVAP consider continuation of what works well, and natural next steps (coverage, timeliness); moving toward ZTD gradients, slants and tomography, to the degree progress in research projects demonstrates good impact.**
- **During summer 2012 EUMETNET members can bid to run observing programmes for the next 5 years, 2013-2017. The current E-GVAP team will bid for the continuation of E-GVAP. The deadline is ultimo June.**
- **The development of E-GVAP so far is reviewed very favourably! However, this does not ensure E-GVAP continuation, since the core programmes of EUMETNET uses the vast majority of the money.**
- **Autumn 2011 appeared un-certain. But gradually things have improved. Right now, we are confident that E-GVAP-III, 2013-2017, will start its existence next year.**

Conclusion

- From E-GVAP we are thankful for the good coorporation with European geodetical institutions. This includes both ACs (analysis centres), the owners of the GNSS sites providing the raw data for processing, and EUREF and EUPOS.
- NRT GNSS ZTDs are in practice used to improve European weather forecasts.
- ZTDs from additional sites and faster access will increase benefit.
- Through E-GVAP, meteorological data are made available for geodetic institutions. There is an increasing interest for this type of collaboration.
  - Currently an IAG working group establishing firm transformations between ”geodetic” and ”NWP” coordinate system.
  - An IAG working group on ”Integration of GNSS atmospheric models with NWP models”
- Results from E-GVAP AQC can be made available when it has become operational.
- The possibility of site sharing is now being used in practice.
- There is in EUMETNET an increasing interest for exploiting GNSS ZTD gradients, slants delays, and 3D water vapour fields from tomography.

A new EU Cost Action on ground-based GNSS meteorology?

1) transfer of knowledge West-East, extending the legacy of COST 716 to East (E) and Southeast (SE) Europe; aiming at filling the gap of the GNSS stations contributing to EGVAP
2) application of GNSS data for Numerical Weather Prediction (NWP) in E and SE Europe; aiming at model validation and assimilation
3) demonstration of GNSS potential in now-casting; aiming at case studies for extreme events like floods etc..
4) exploiting the potential of reprocessed GNSS (15+ years) in long term monitoring
5) responding to the strong interest in the community for application of GNSS for climate research; aiming at data consistency/errors in the reprocessed data
6) GNSS gradients; aiming at validating GNSS gradients with independent IWV/ZTD measurements
7) GNSS tomography; aiming at demonstration of concept of slant path delays application in operational NWP as well as dedicated tomography campaign

This has now passed the pre-preproposal stage, and final proposal has to be made. Deadline July 27.

Contact Jonathan Jones and/or Guergana Guerova.

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