

EIG EUMETNET GNSS Water Vapour Programme E-GVAP

E-GVAP Status and outlook

Henrik Vedel, hev@dmi.dk, DMI and E-GVAP team

Siebre de Haan, siebre.de.haan@knmi.nl KNMI and E-GVAP team

Jonathan Jones, jonathan.jones@metoffice.gov.uk,

Dave Offiler, Dave.offiler@metoffice.gov.uk, and

Gemma Bennitt, gemma.bennitt@metoffice.gov.uk, UK Metoffice and E-GVAP team

What is E-GVAP?

- EIG EUMETNET GNSS Water Vapour Programme.
- EUMETNET = organisation of European national meteorological offices. Not all are members, EUMETNET is gradually enlarging.
- E-GVAP is a separate observing programme under EUMETNET.
- Not all EUMETNET members are members of E-GVAP (currently 16).

Purpose of E-GVAP

- To provide 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.

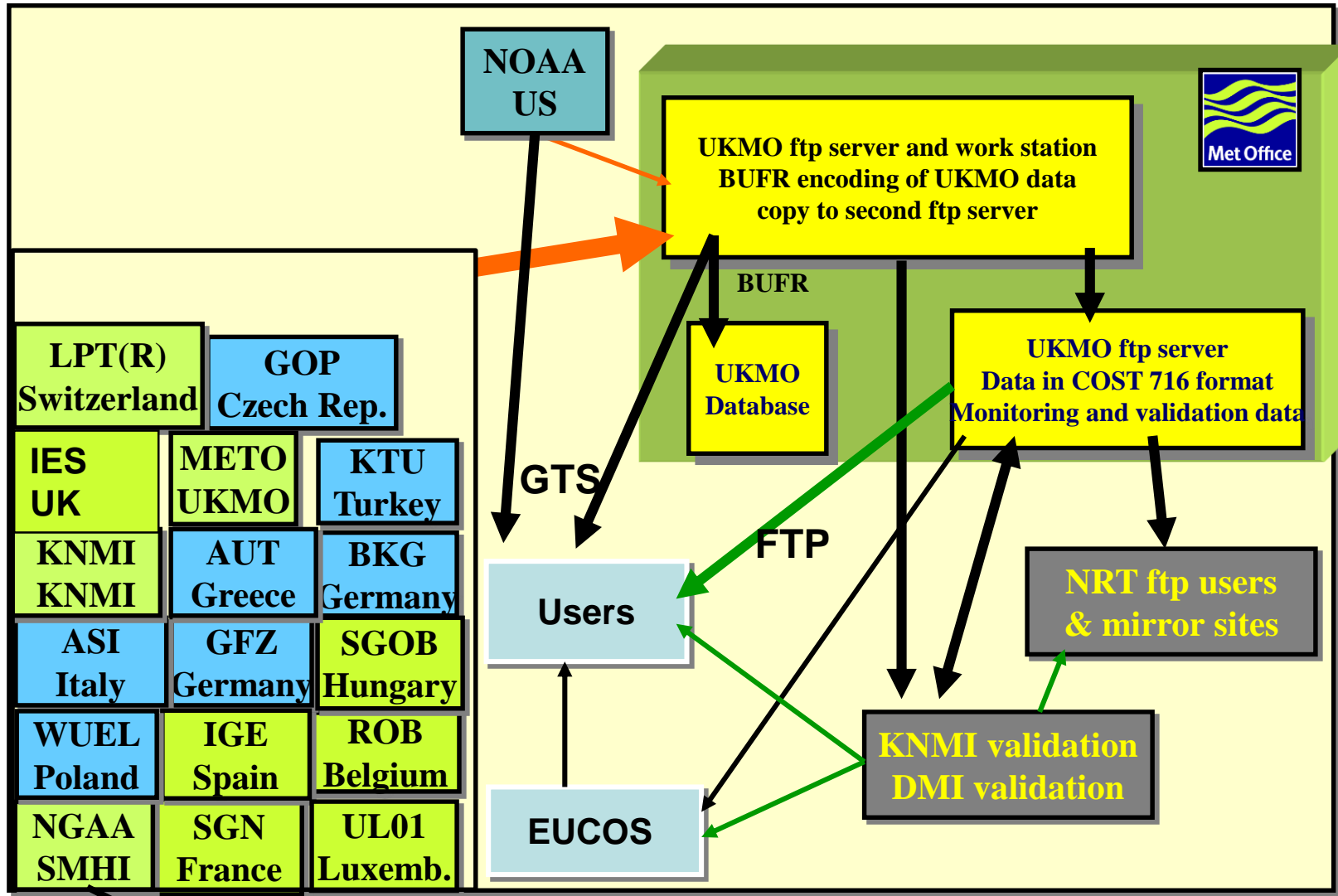
It is "geodesy" at large, that owns the GNSS receivers and has the expertise to process the GNSS data.

MoUs, stating the dedication to collaborate, are in place between EUMETNET and both EUREF and EUPOS.

The majority of the E-GVAP analysis centers (ACs), making ZTD estimates for E-GVAP, are geodetic institutions. A few ACs are located at metoffices, set up with help from geodetic experts.

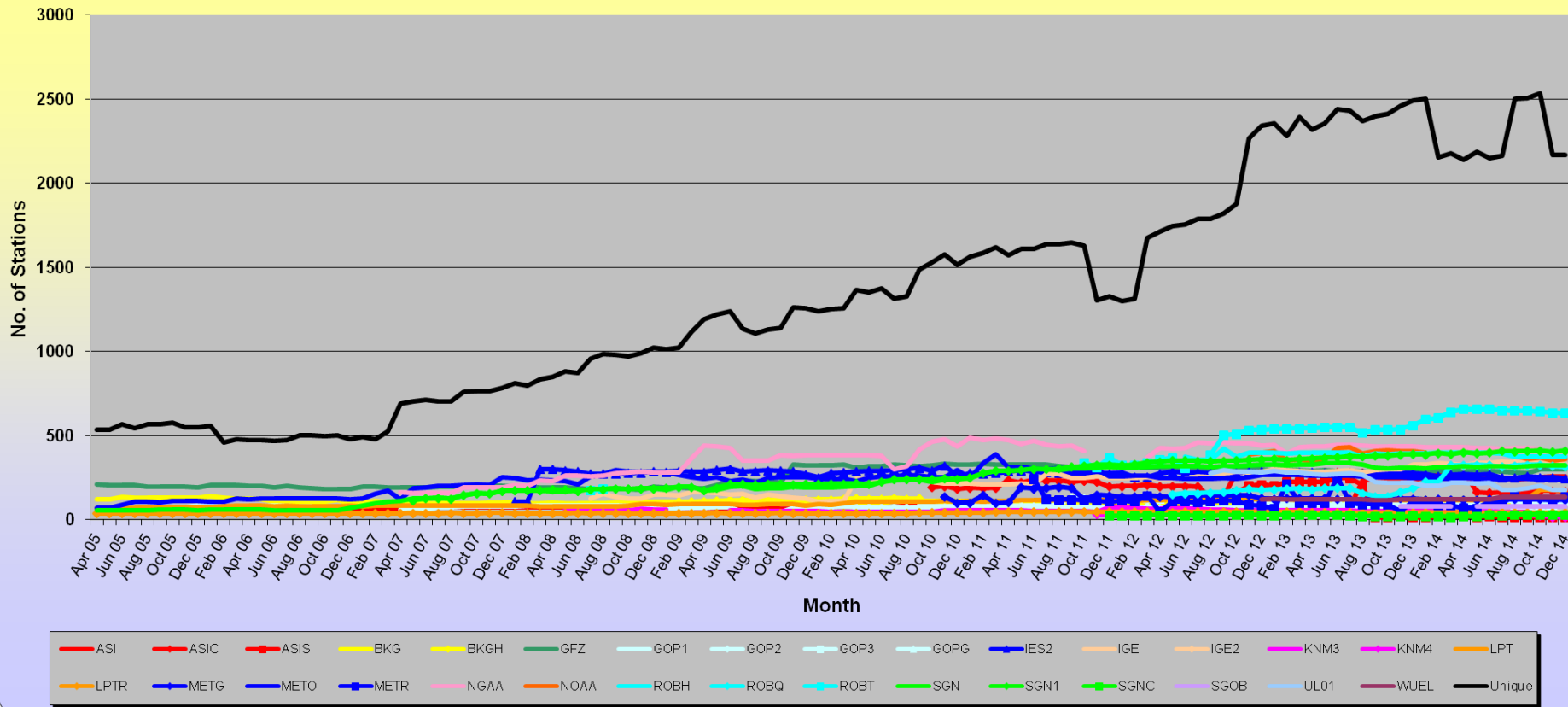
AC	Institution
ASI	e-geos/Telespazio, Italy
AUT	Aristotle University of Thessaloniki, Greece NEW
BKG	Federal Agency for Cartography and geodesy, Germany
GFZ	Helmholz Centre Potsdam, GFZ German Res. Cen. f Geosciences
GOPE	Geodectic Observatory Pecny, Czech Republic
IES	Inst. of Eng., Surv. And Space Geodesy, Univ of Nottingham, UK
IGE	Instituto Geografica National, Spain
KNMI	Royal Meteorological Institute of the Netherlands
KTU	Karadeniz Technical University, Turkey NEW
LPT	SwissTopo, Switzerland
METO	UK Metoffice
NGAA	Norrköping GNSS Analysis Agency, SMHI, Sweden
NOAA	NOAA/NCEP, USA
ROB	Royal Observatory of Belgium
SGN	Institut Geographique National, France
SGOB	Satellite Geod. Obs, IGCERS + Technical Univ. Budapest, Hungary
UL01	University of Luxembourg, Fac. Of Science and Communication
WUEL	Wroclaw University + Inst. Of Geodesy and Geoinformatics, Poland

NRT GNSS ZTD data flow



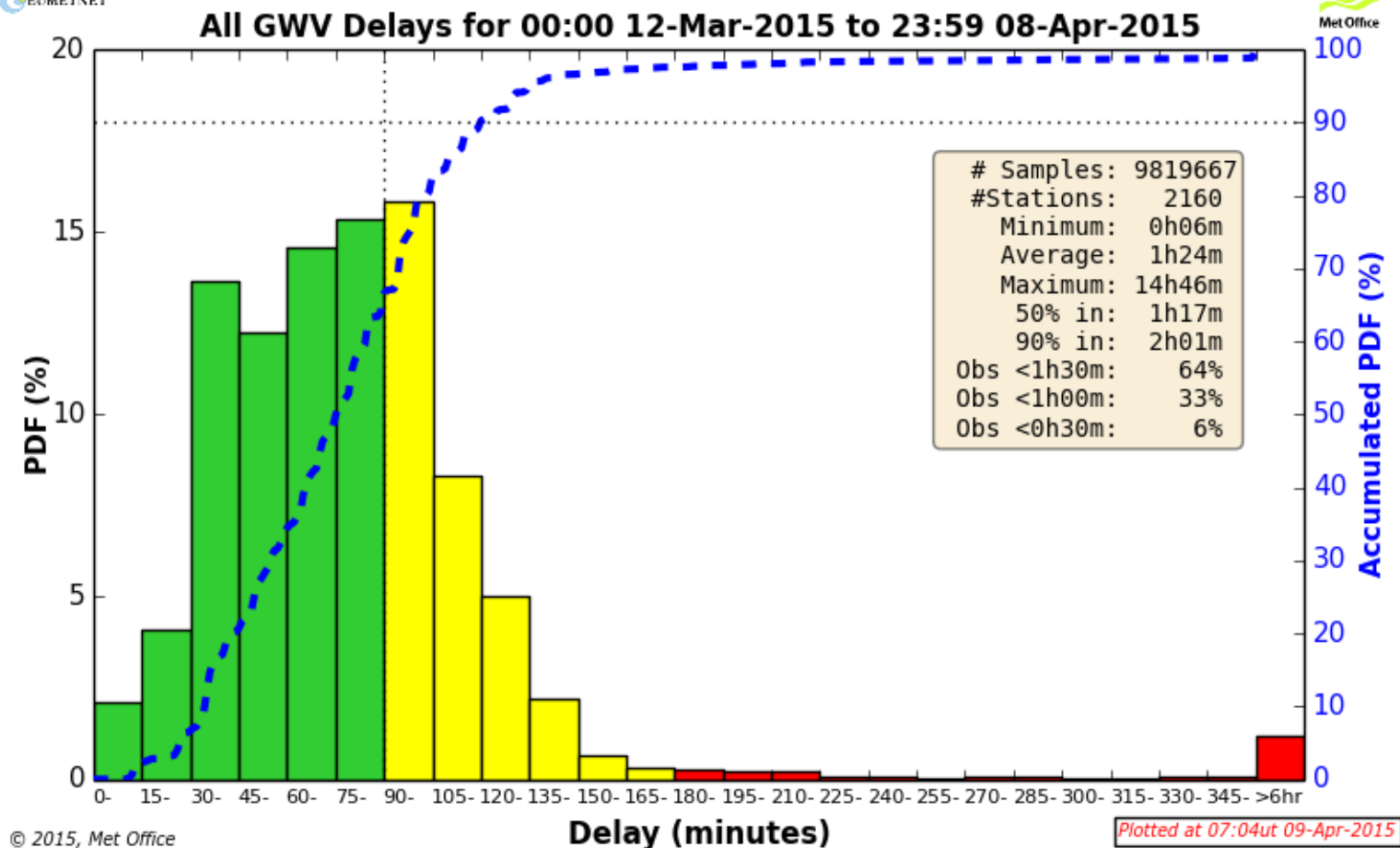
Analysis centres (ACs), each processing raw GNSS data from many sites. Each AC send data to UKMO.

Number of NRT Stations



Number of GNSS sites in E-GVAP data distribution versus time.

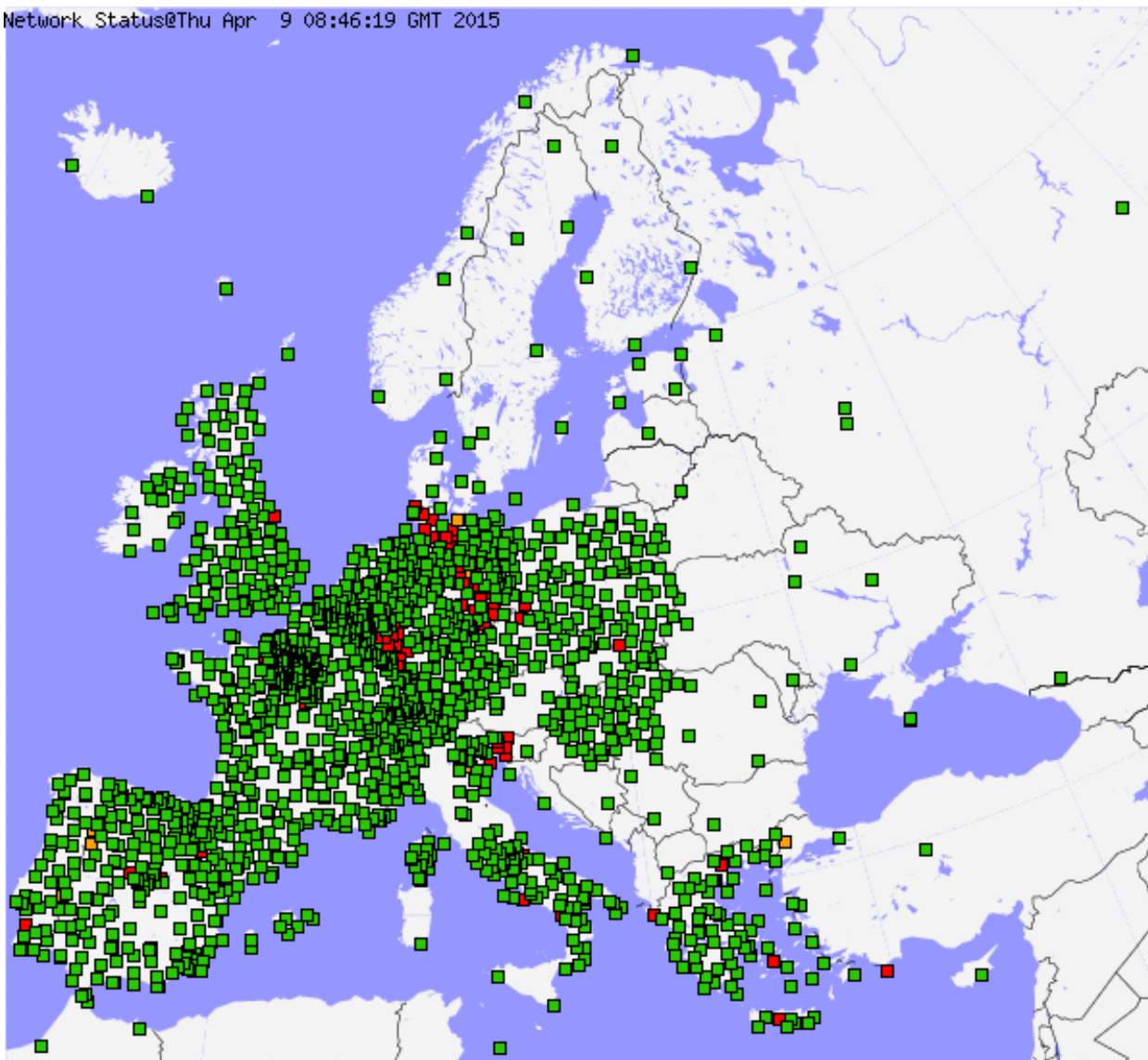
The drop mid 2014 was due to lack of NOAA (North American) data. The drop starting end of 2014 is due to lack of NGAA (Nordic) data. NGAA processing is being restructured to improve ZTD quality.



Timeliness: Age of observations when arriving in UKMO database, counted in 15 min bins.



Network Status@Thu Apr 9 08:46:19 GMT 2015



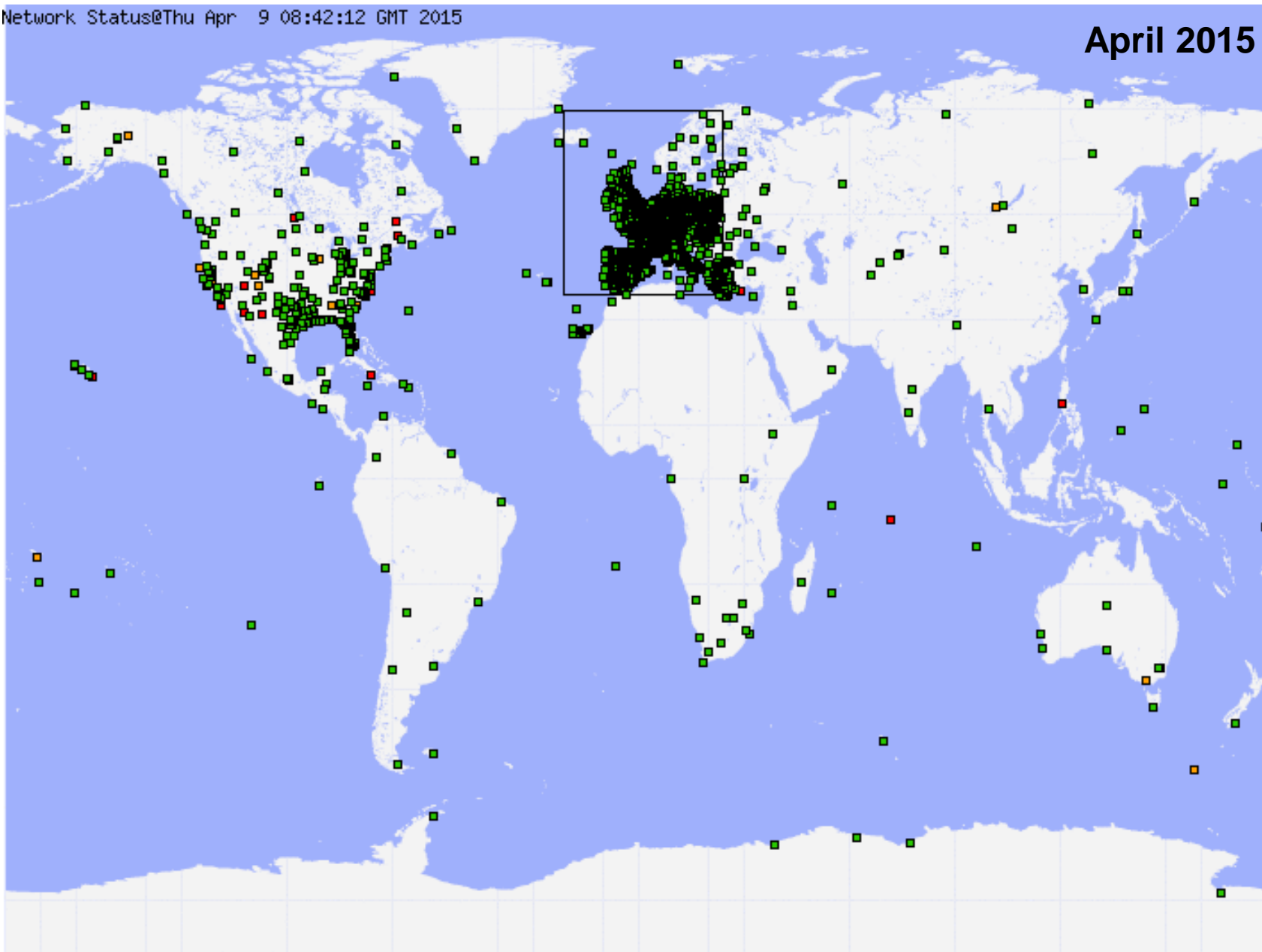
Coverage

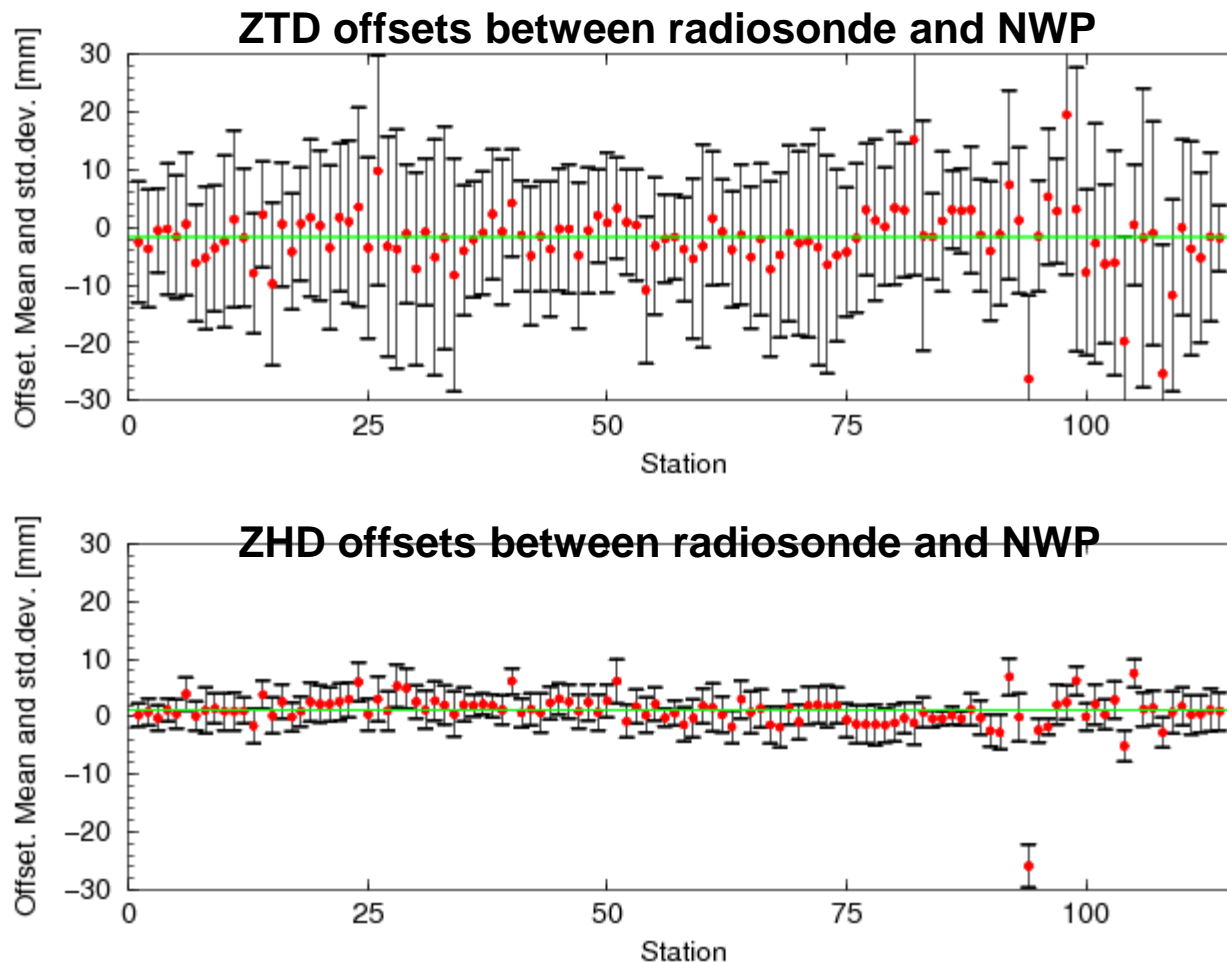
April 2015



Network Status@Thu Apr 9 08:42:12 GMT 2015

April 2015

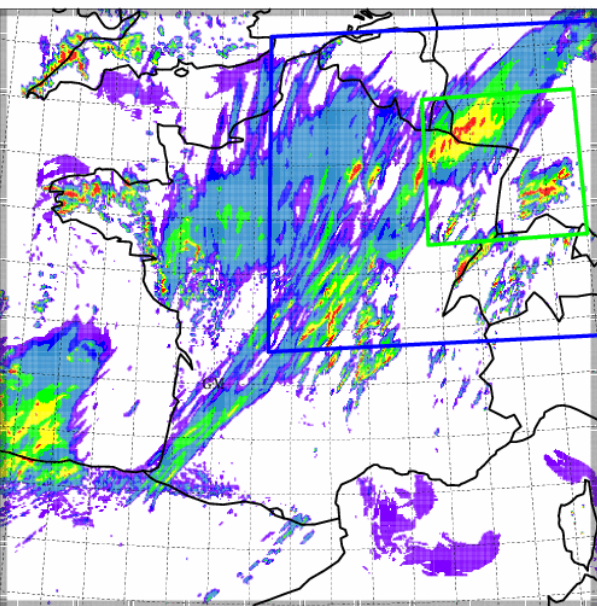




- Because NWP is better in estimating ZHD than ZTD, the ZTD provides in reality mainly information about water vapour, when assimilating ZTD into NWP.
- Use NWP surface pressure (proportional to ZHD) in GNSS data processing instead of climatology?

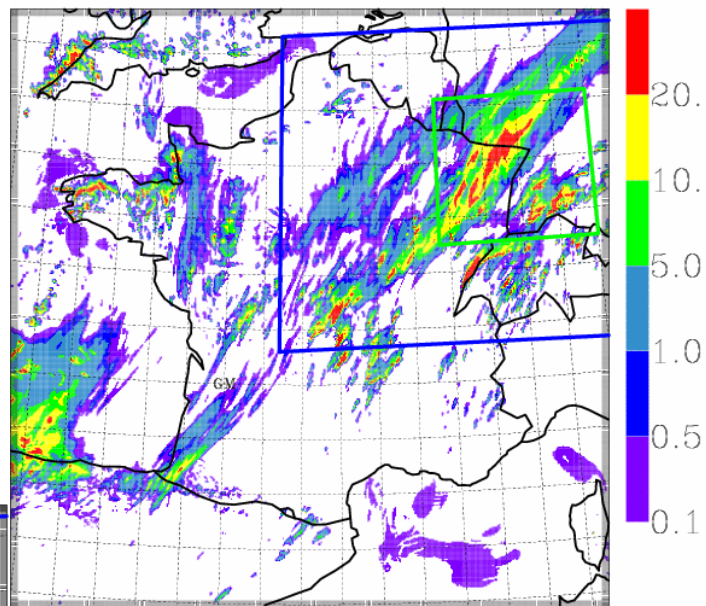
Impact on AROME forecast (OSE experiment)

AROME, 15h forecast starting from the 00UTC analysis, 19 July 2008

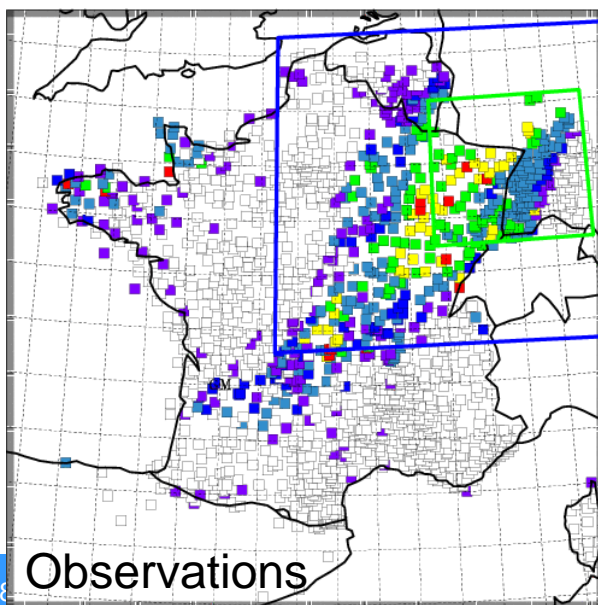


WITHOUT ZTD data
assimilation

Cumulated rainfall
between 03UTC and
15UTC, 19 July 2008



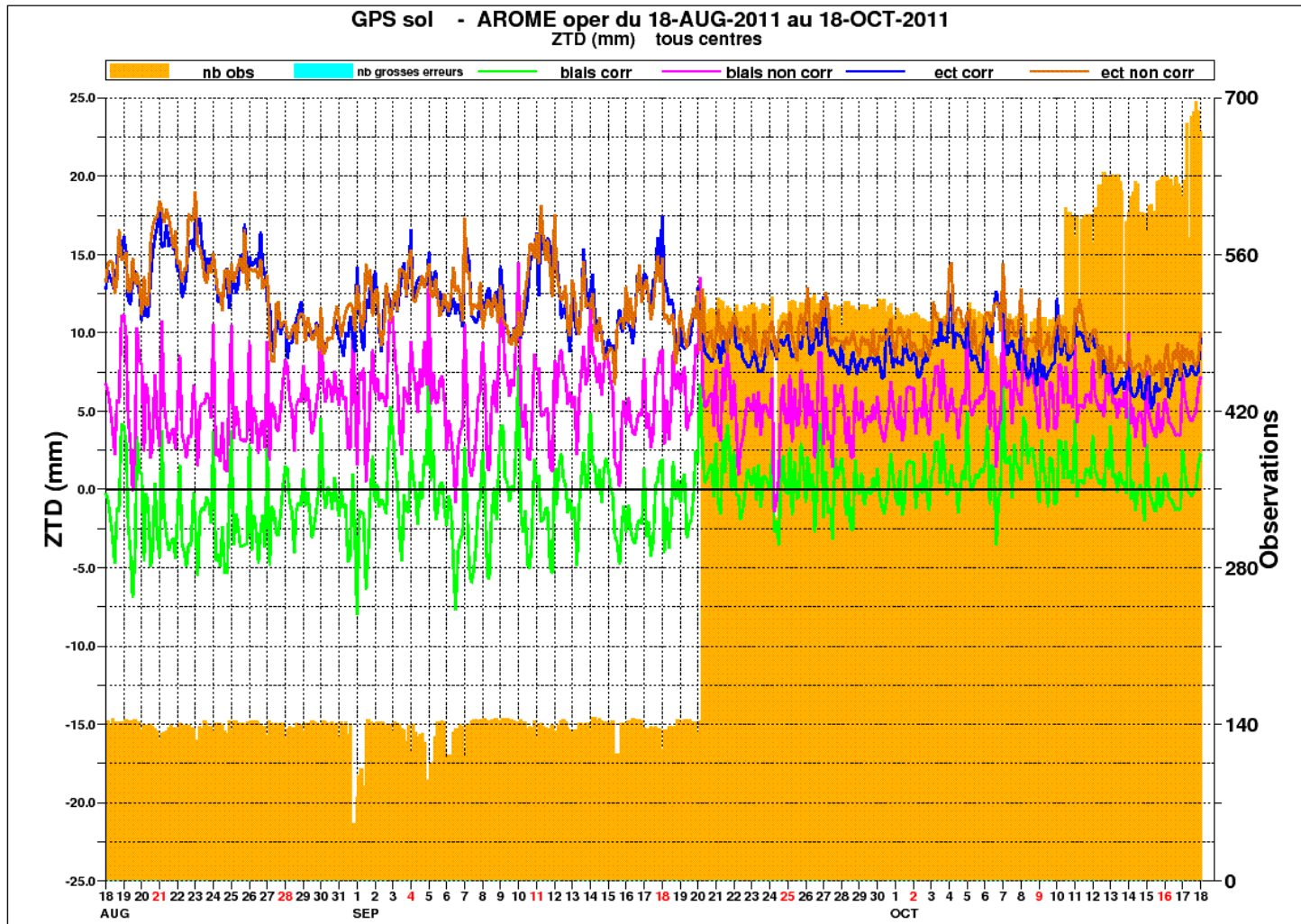
WITH ZTD data
assimilation



Observations

Slide from Patrick Moll
Meteo France

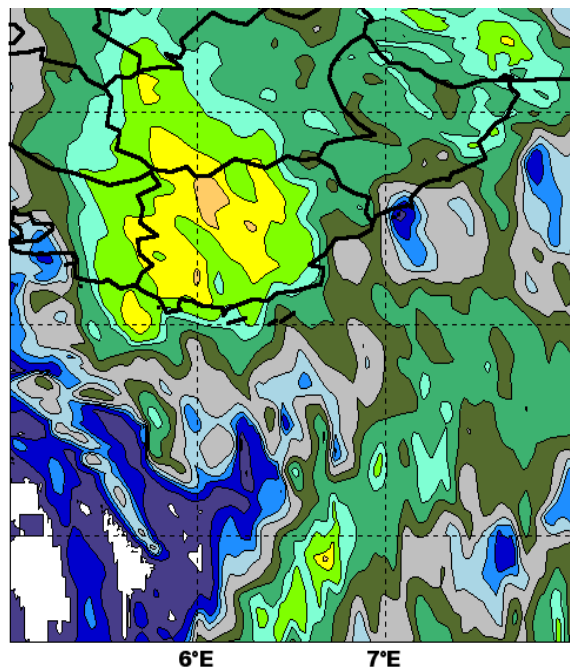
Monitoring example (time-series)



DPREVI/COMPAS

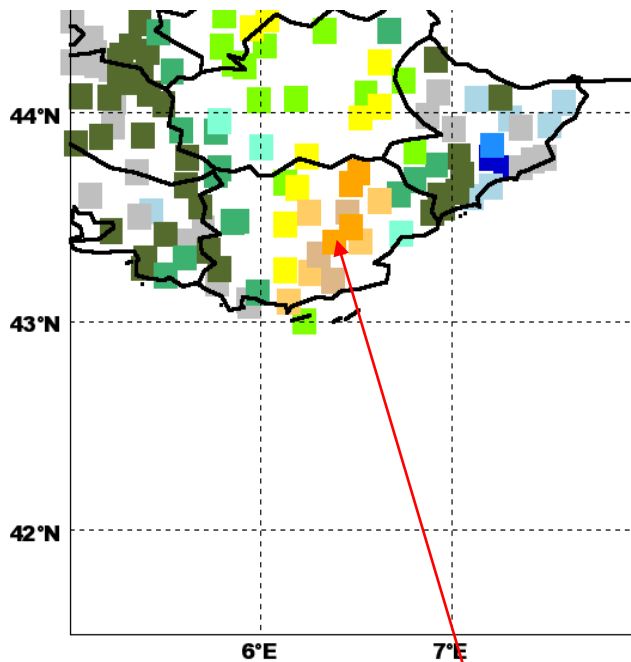
15/06/2010 – 09UTC

AROME_WMED (D031)



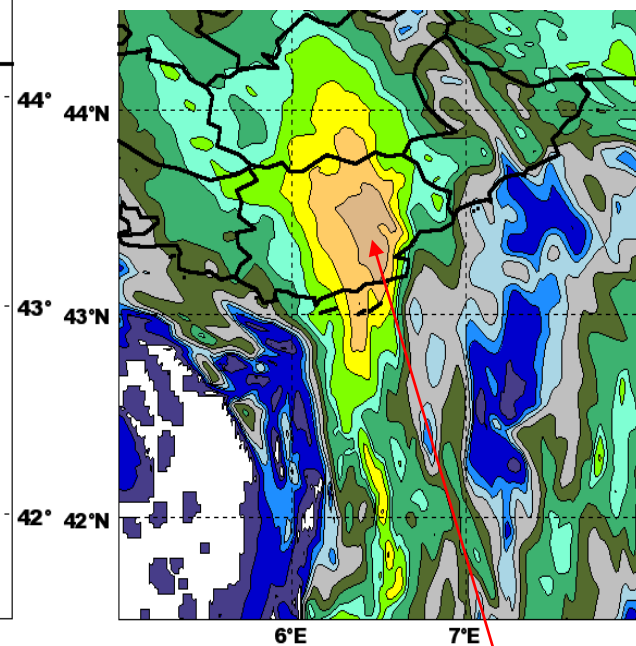
Old white list

OBS (6h Accumul.)



Rain gauges obs

AROME_WMED (D03Q)



New white list

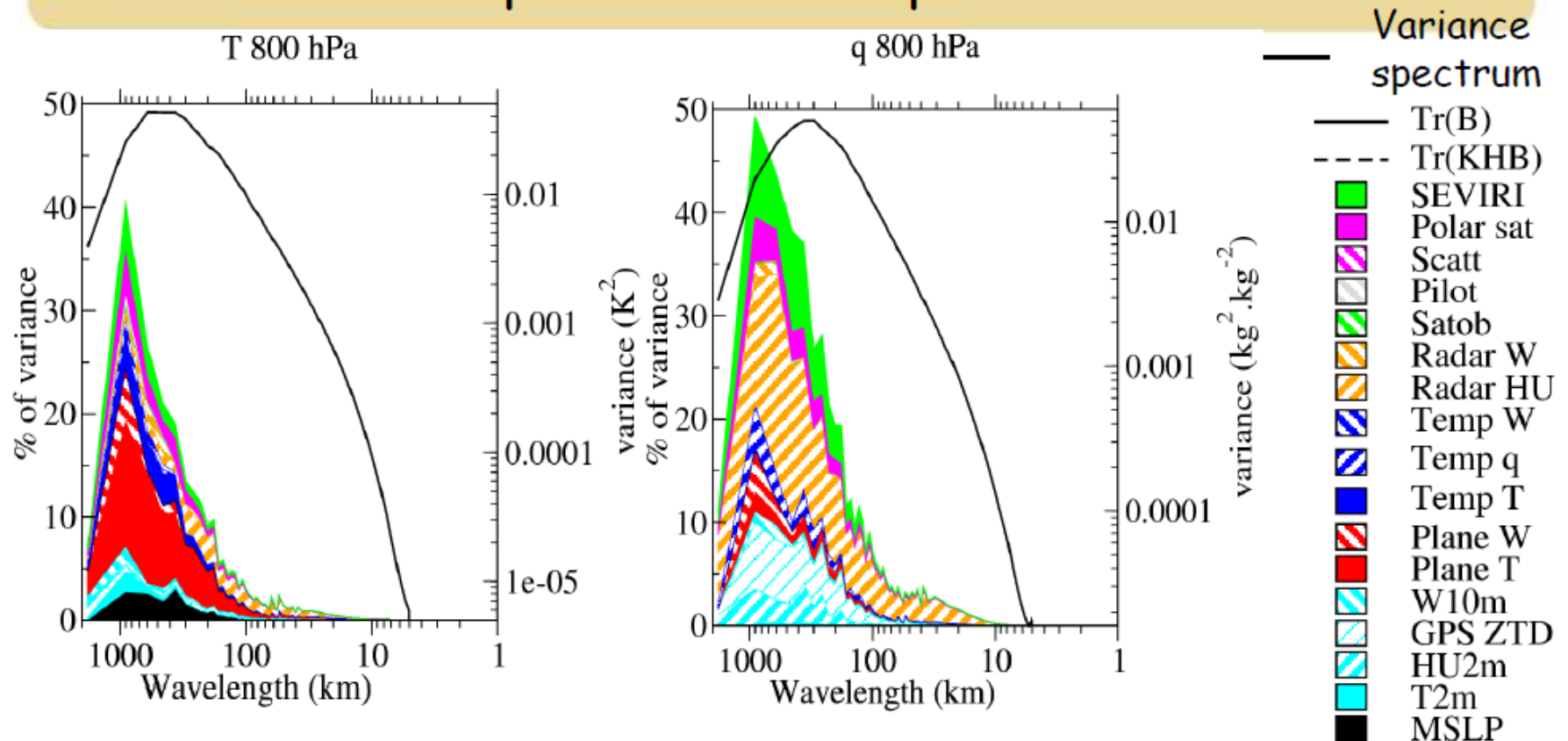
195mm/6hr

130mm/6hr

Conclusion:

More GNSS data (denser network) improves the Arome forecasts

Spectral decomposition

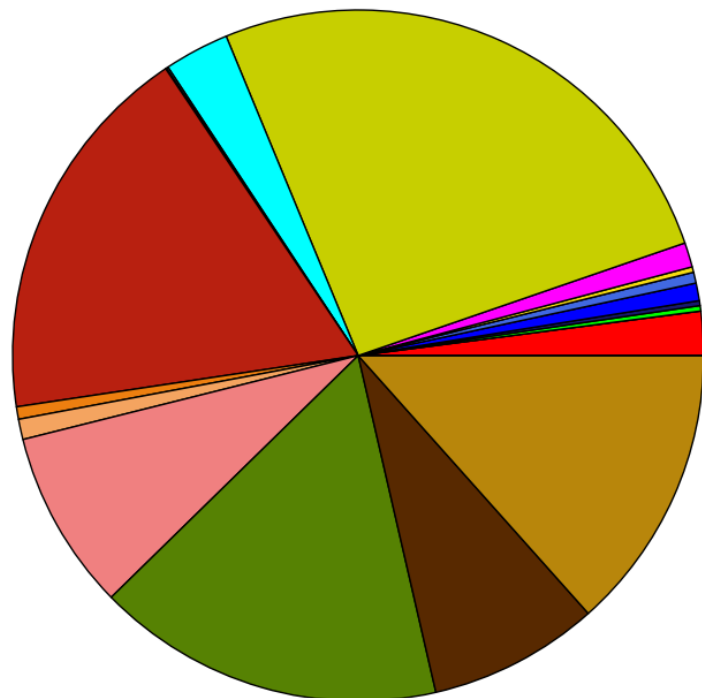


- Higher reduction of variance error for wavelengths corresponding to the higher values of variance spectra
- For wavelengths shorter than :
 - 200 km, only radar and plane measurements for temperature (GPS for specific humidity) contribute to the variance reduction
 - 100 km, the variance reduction reach only 5% of the error variance and it is only provided by radar observations

Slide from Pierre Brousseau, Météo France

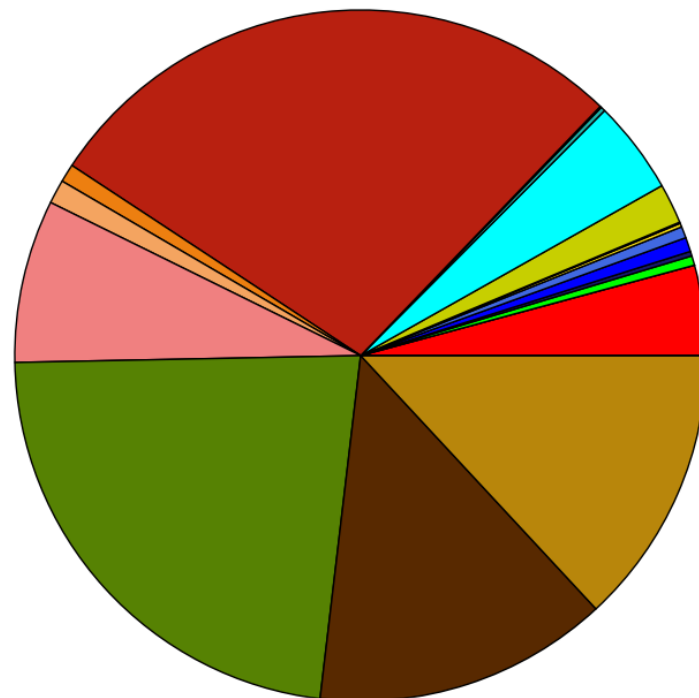
Arome DFS (rainy days)

Proportions des nombres d'observations utilisées par type d'obs
 analyses cut-off AROME - AROME France oper
 observations conventionnelles et satellites
 cumul du nombre d'observations utilisées sur la période 2012101100 - 2012101121 : 281



GPS ground	2.06%	AIRS	1.15%	PILOT/PRF	0.95%
GPS sat	0.00%	IASI	25.96%	TEMP	8.42%
SATOB	0.25%	SEVIRI	3.04%	AIRCRAFTS	16.28%
ATOVS HIRS	0.23%	SCATT	0.09%	RADAR Vr	7.99%
ATOVS AMSU-A	0.82%	BUOY	0.04%	RADAR Hur	13.40%
ATOVS AMSU-B	0.51%	SYNOP/SYNOR/RADOME	17.96%	BOGUS	0.00%
SSMIS	0.26%	SHIP	0.58%		

Part des DFS par type d'obs
 analyses cut-off AROME - AROME France oper
 observations conventionnelles et satellites
 cumul du DFS sur la période 2012101100 - 2012101121 : 100548



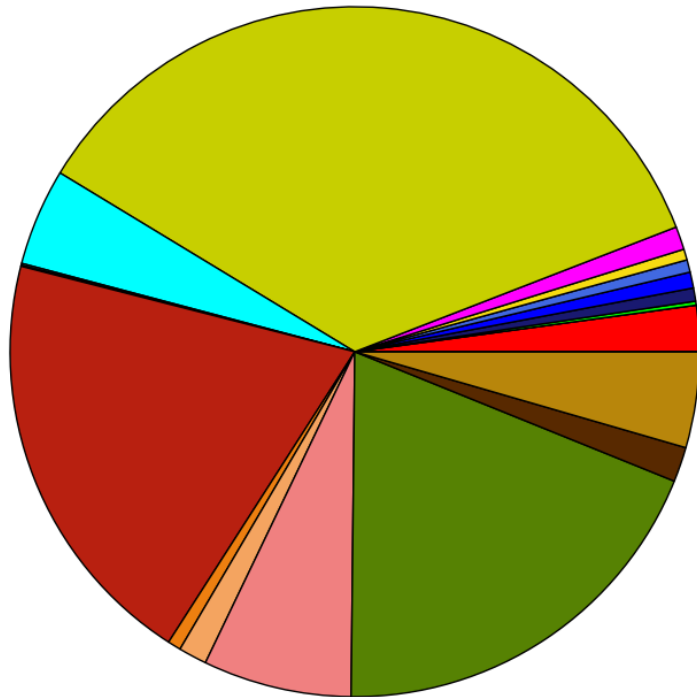
GPS ground	4.21%	AIRS	0.06%	PILOT/PRF	1.12%
GPS sat	0.00%	IASI	1.87%	TEMP	7.62%
SATOB	0.44%	SEVIRI	4.36%	AIRCRAFTS	22.81%
ATOVS HIRS	0.22%	SCATT	0.21%	RADAR Vr	13.78%
ATOVS AMSU-A	0.67%	BUOY	0.07%	RADAR Hur	13.09%
ATOVS AMSU-B	0.54%	SYNOP/SYNOR/RADOME	27.90%	BOGUS	0.00%
SSMIS	0.17%	SHIP	0.85%		

From Patrick Moll, Meteo France

Arome DFS (dry days)

Proportions des nombres d'observations utilisées par type d'obs
analyses cut-off AROME - AROME France oper
observations conventionnelles et satellites

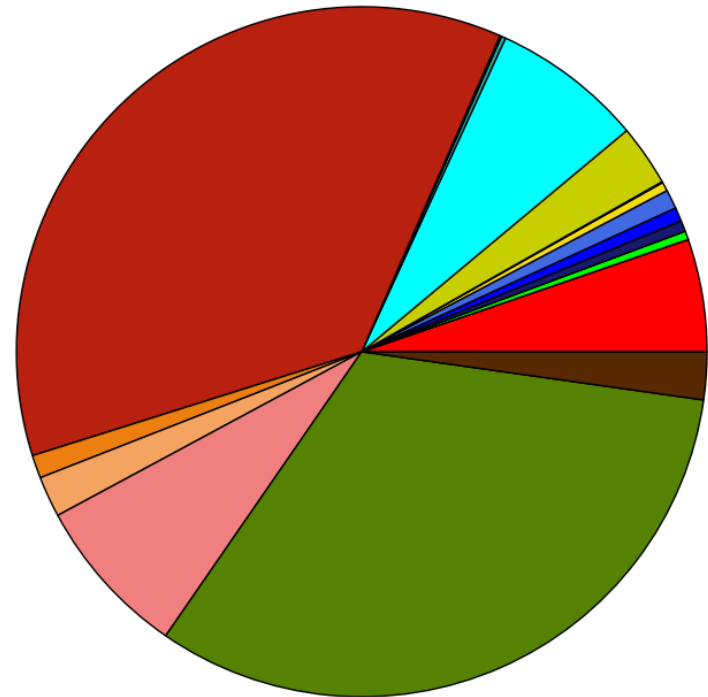
cumul du nombre d'observations utilisées sur la période 2012100500 - 2012100521 : 25



GPS ground	2.16%	AIRS	1.08%	PILOT/PRF	1.33%
GPS sat	0.00%	IASI	35.44%	TEMP	6.96%
SATOB	0.19%	SEVIRI	4.55%	AIRCRAFTS	19.05%
ATOVS HIRS	0.62%	SCATT	0.09%	RADAR Vr	1.63%
ATOVS AMSU-A	0.75%	BUOY	0.05%	RADAR Hur	4.49%
ATOVS AMSU-B	0.58%	SYNOP/SYNOR/RADOME	19.91%	BOGUS	0.00%
SSMIS	0.51%	SHIP	0.62%		

Part des DFS par type d'obs
analyses cut-off AROME - AROME France oper
observations conventionnelles et satellites

cumul du DFS sur la période 2012100500 - 2012100521 : 76214



GPS ground	5.28%	AIRS	0.05%	PILOT/PRF	1.92%
GPS sat	0.00%	IASI	2.87%	TEMP	7.53%
SATOB	0.40%	SEVIRI	7.09%	AIRCRAFTS	32.37%
ATOVS HIRS	0.52%	SCATT	0.20%	RADAR Vr	2.23%
ATOVS AMSU-A	0.65%	BUOY	0.08%	RADAR Hur	0.00%
ATOVS AMSU-B	0.90%	SYNOP/SYNOR/RADOME	36.42%	BOGUS	0.00%
SSMIS	0.42%	SHIP	1.08%		

From Patrick Moll, Meteo France

The GNSS ZTDs estimated and distributed under the MoUs between EUREF+EUPOS and EUMETNET are used in operational meteorology, and do improve weather forecasting.

To further improve the impact, the plan is to

- Continue to enlarge and densify the network (more sites)**
- Gradually move toward faster, subhourly processing where possible (of importance to forecasting of heavy local convective precipitation, which can occur rapidly and has short predictability).**
- Streamlining of E-GVAP monitoring and validation, to ease handling of many ACs and different products (hourly, sub-hourly, real-time).**
- Collaborate with EU Cost action GNSS4SWEC to stimulate production and usage of "next generation" GNSS data (ZTD gradients, slant total delays), as well as of meteorological data for usage in GNSS real-time position estimation.**
- An attempt has been made to cut this presentation to 10 min, and hand over the remaining 5 min to the next presentation on GNSS4SWEC**



Fin

E-GVAP team: egvap@dmi.dk
E-GVAP homepage: egvap.dmi.dk

E-GVAP Programme Manager

Henrik Vedel, PhD, Senior scientist
Danish Meteorological Institute, FM
Lyngbyvej 100
DK 2100 Copenhagen
Denmark

Tel: + 45 3915 7445
Email: hev@dmi.dk
Web: egvap.dmi.dk

GIE EUMETNET Secretariat

c/o L'Institut Royal Météorologique de Belgique
Avenue Circulaire 3
1180 Bruxelles, Belgique

Tel: +32 (0)2 373 05 18
Fax: +32 (0)2 890 98 58
Email: info@eumetnet.eu
Web: www.eumetnet.eu