

E-GVAP

The EUMETNET GPS Water Vapour Programme

6th plenary meeting

DMHZ, Dubrovnik

Agenda, E-GVAP 6'th plenary meeting

Start of meeting 9:00

- Practicalities.
- Approval of agenda.
- Approval of minutes from 5'th plenary meeting.
- Information about E-GVAP work and progress from the E-GVAP team.
- Information about the GPS meteorological status in each member country, by each member representative.
- Discussion of status and plans for next period.
 - Specific item: User Workshop November 6'th in Copenhagen.
- Discussion of E-GVAP-II proposal.
- Discussion of update of User Requirements
- Planning of next, final plenary meeting
- Other matters

Finish of meeting no later than 17:00.

Highlights

- New processing center started in Spain, more Spanish sites becoming available.
- Also data from more sites in Scandinavia.
- E-GVAP observations currently used operationally at 2 European met centres, giving a positive impact on NWP forecast scores.
- First joint expert team meeting held in May.
- E-GVAP extension plans of previous plenary meeting became obsolete.
- Formulation of E-GVAP-II proposal in response.

Timeline and members

E-GVAP started 2005-04-01, to run for 4 years, from April 2005 to March 2009.

About 6 months left.

Initially 11 members, now 13 members, no change during this last period.

Members:

Belgium, Croatia, Denmark, Iceland, Ireland, Finland, France, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom

E-GVAP economy

Yearly budget, same through all 4 years.

•Project manager 0.5 year per year	43.0 k€	DMI
•Contract to support hub/central processing	25.5 k€	UK Metoffice
•Contract to quality control facility	25.5 k€	KNMI
•Project Travel	10.0 k€	
•Liaison group meetings	15.0 k€	
•Expert Team meetings	10.0 k€	
•Total	129.0 k€	

For the current period we are missing payments from Belgium, Croatia and Spain.

Travelmoney not all spent. About 27 k-euro has been paid out, about 7 k-euro are being processed, and an estimated 25 k-euro can be claimed for travels already made, but which have not been invoiced to E-GVAP, leaving about 45 k-euro. Workshop (lessons be E-GVAP user experts) and joint expert team meeting in November will add significantly to expenses.

OLD Question: Consider to use some of the money for the workshop participants (requires a yes from above, PB-OBS) and/or to assist "poor" processing centres working on best effort basis, by buying equipment (pc's) for them?

E-GVAP primary contact and information points

- Email address: egvap@dmi.dk
- Web address: <http://egvap.dmi.dk>
- Uid and pw at website: egvap, gps2user. Site links to validation site and dataserwer.
- Access to database is institute specific, password protected.
 - Contact Jonathan Jones for access.

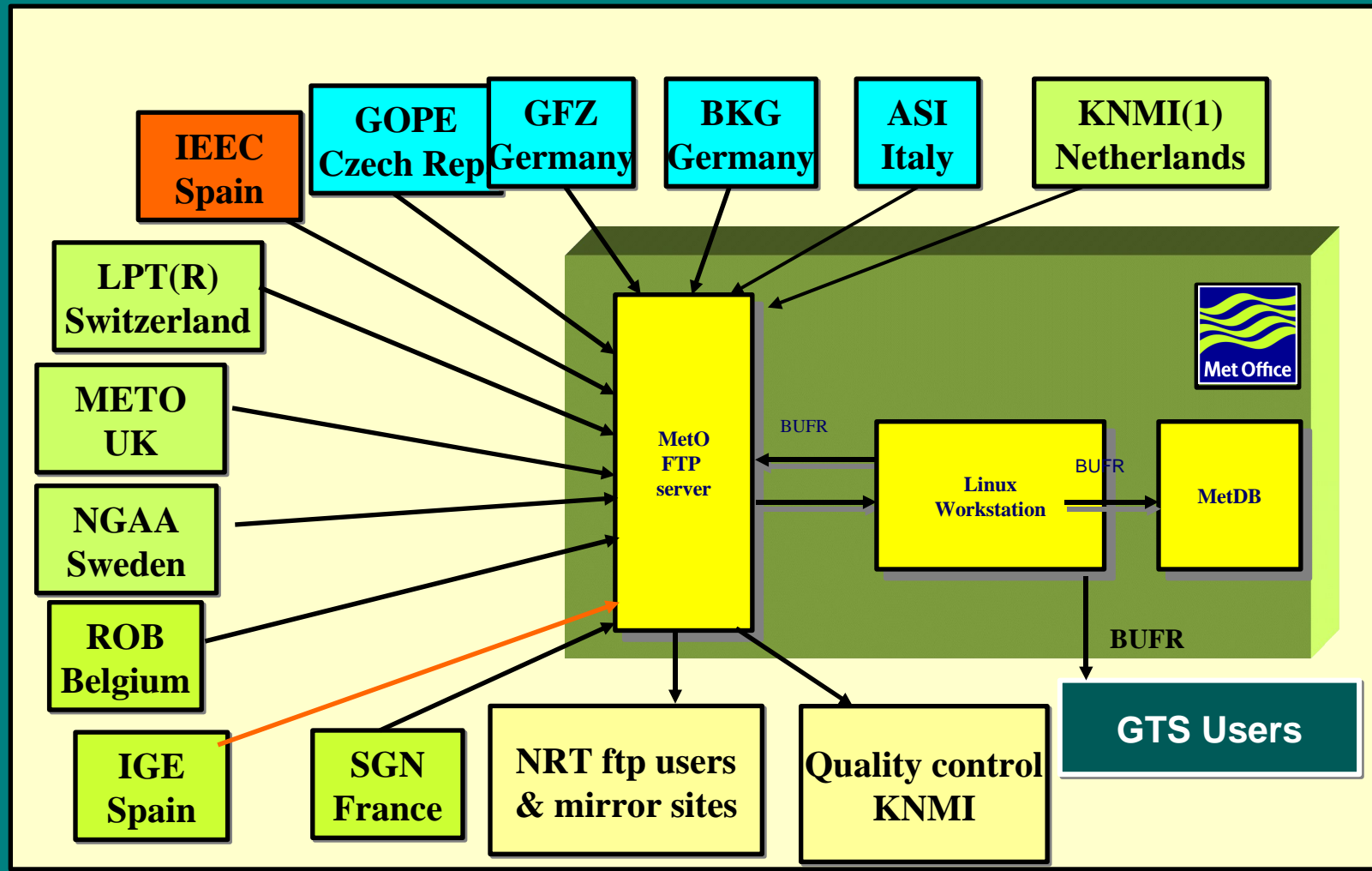
E-GVAP work in past period

- Establishing and maintaining contacts with relevant people on both meteorological and geodetic side.
- Updates of validation software and validation site.
- Updates of homepage.
- Preparation and partaking in meetings.
- Update, expansion and running processing of GPS data at UK MetO.
- Plenary meetings, PB-OBS meetings, Council meetings
- Collaboration with EUCOS team.
- Expert groups on data processing and expert group on data usage.
- MoU related work between EUREF and E-GVAP/EUMETNET.
- Assisting NMSeS to make agreements with national GNSS data providers.
- Assisting new processing centres starting to process GNSS data for ZTD production.
- Preparation of E-GVAP-II programme
- Planning of E-GVAP workshop.
- Preparation of new user requirements document.

Meetings in past year and near future

- E-GVAP 5'th plenary, Jan. 2008, Météo France, Toulouse
 - EUMETNET programme managers meeting, primo March 2008, Brussels
 - EUMETNET central datahub proposal meeting, ultimo March 2008, Offenbach
 - Expert teams on both data processing and data usage, May 6-7, 2008, Potsdam, Germany
 - EUREF symposium, primo June, 2008
 - EUMETNET PB-OBS, ultimo June, 2008, Graz
 - IGS meeting, summer 2008, USA.
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- 6'th plenary meeting, September 16, Dubrovnik
 - Council meeting (E-GVAP-II), October 16, 2008
 - **E-GVAP workshop on data usage, November 6, DMI, Copenhagen.**
 - E-GVAP joint expert team meeting, November 7, DMI, Copenhagen.
 - E-GVAP 7'th and final plenary meeting, primo 2008.

NRT GPS Processed Data Flow. Now



Green = nation member of E-GVAP. Blue = nation not member of E-GVAP.

Orange = no updates to processing.

E-GVAP

6'th plenary meeting, DMHZ, Dubrovnik, 2008-09-16

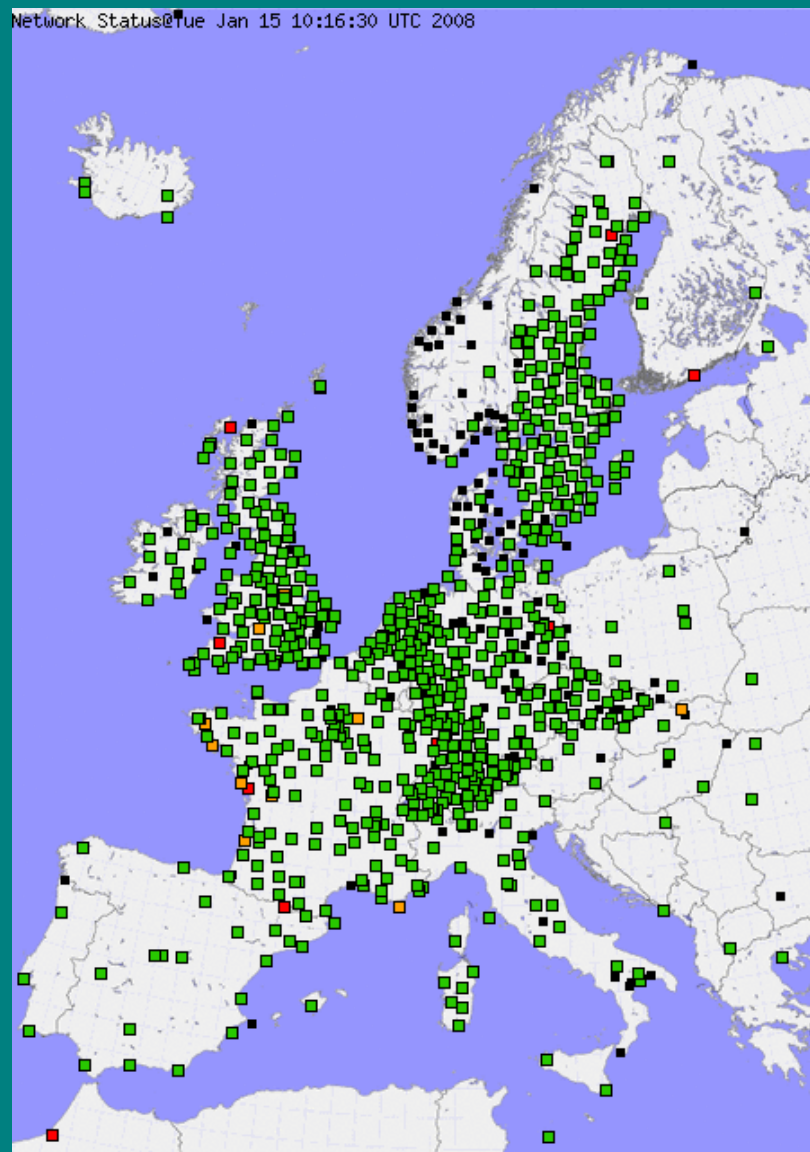
DATA COVERAGE

Status map from 20080115 from the E-GVAP validation site.

Data available at ftp-server at MetO: [ftp.meto.gov.uk](ftp://ftp.meto.gov.uk)

Validation statistics and graphs are created automatically and shown via click at each square representing a GPS

Made and run by Siebren de Haan.



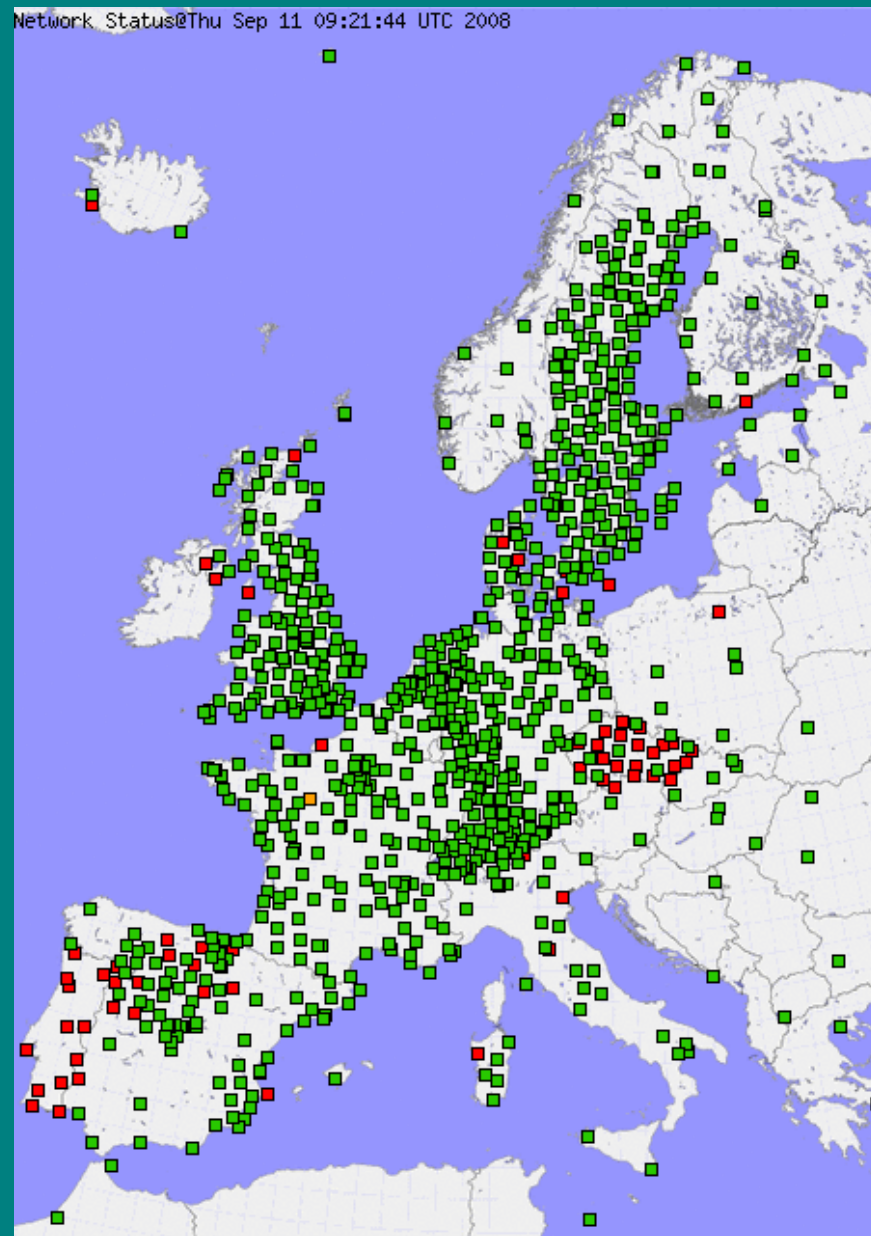
DATA COVERAGE

Status map from 20080911 from the E-GVAP validation site.

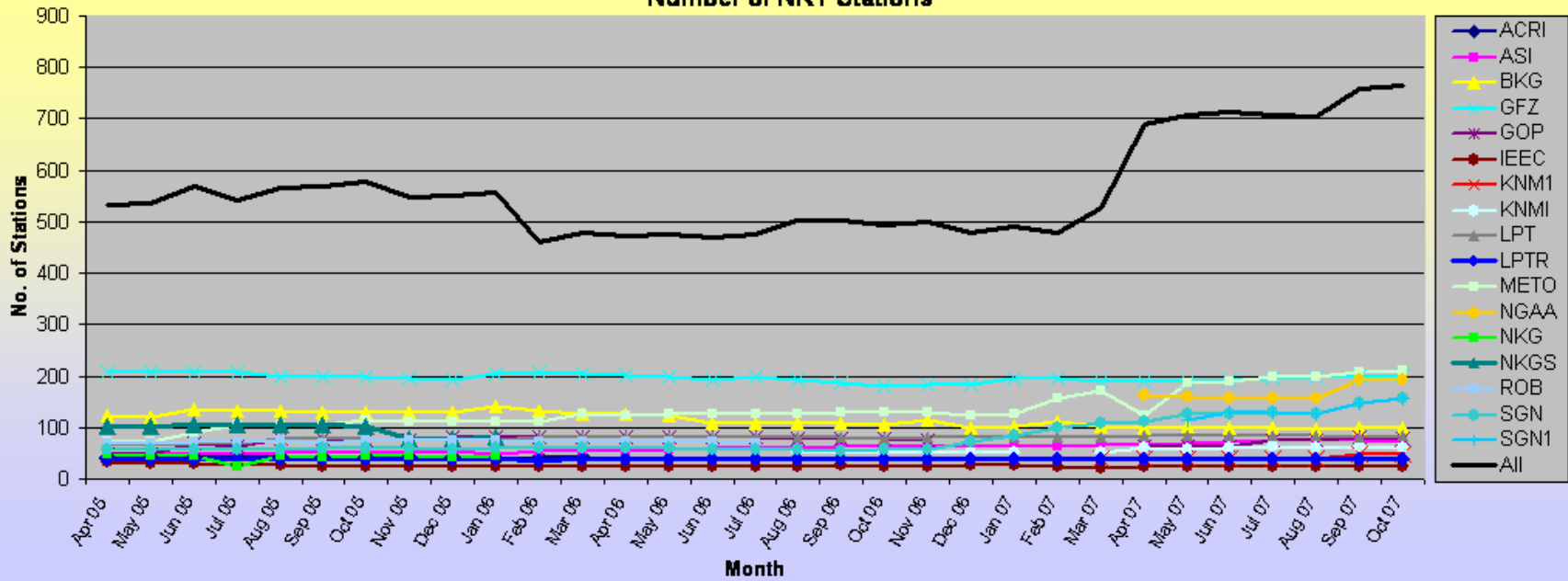
Data available at ftp-server at MetO: [ftp.meto.gov.uk](ftp://ftp.meto.gov.uk)

Validation statistics and graphs are created automatically and shown via click at each square representing a GPS

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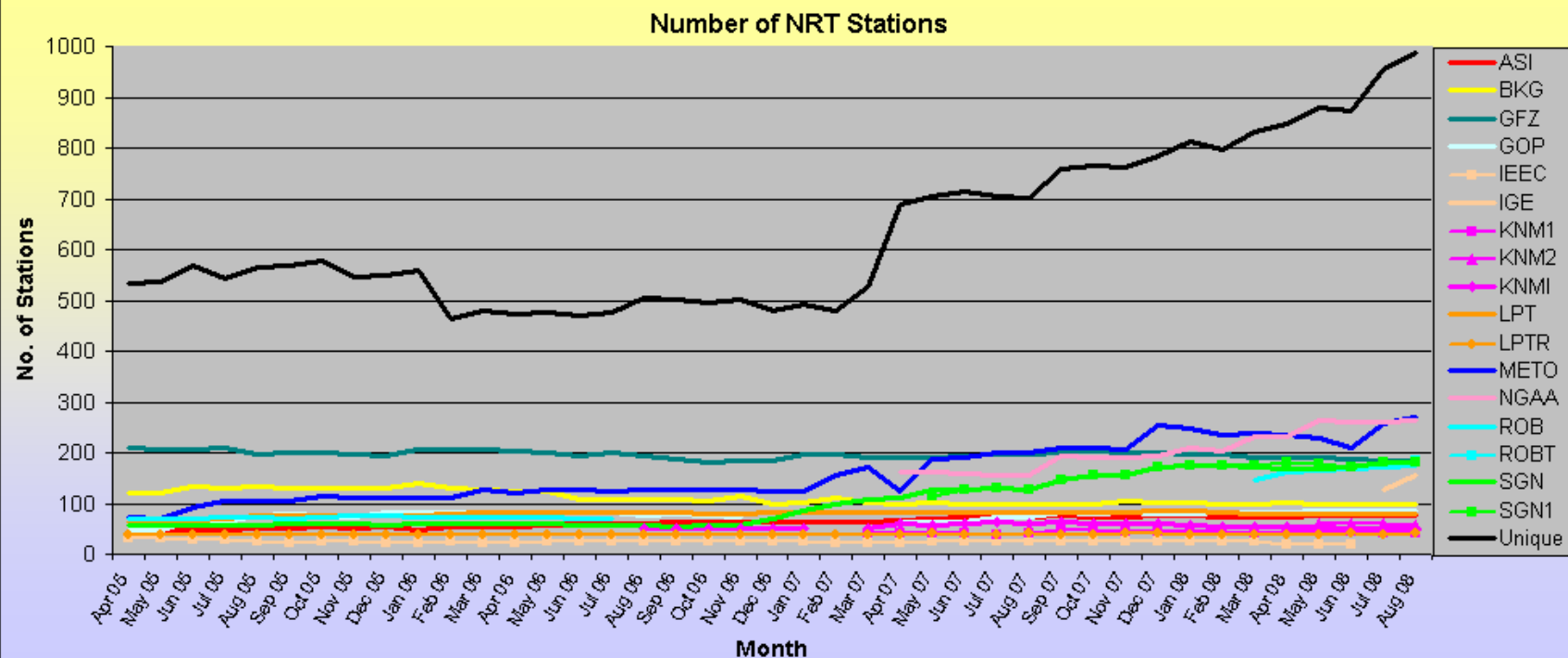
Number of NRT Stations



By Dave Offiler. Available via validation link on E-GVAP website

Mark more clearly which are **operational** and which are **experimental**?

17/12 2007 – 13/1 2008 data from 801 stations in 3275583 samples.

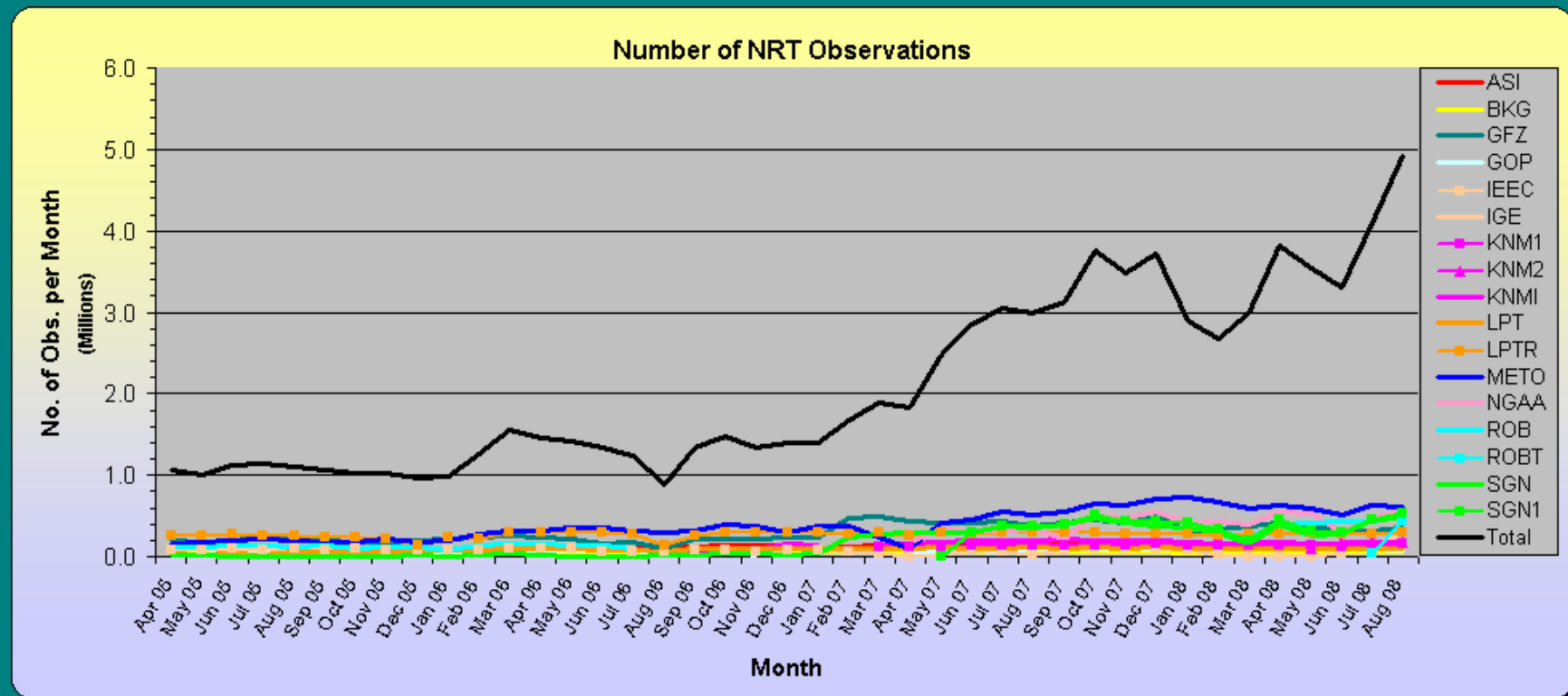


By Dave Offiler. Available via validation link on E-GVAP website.

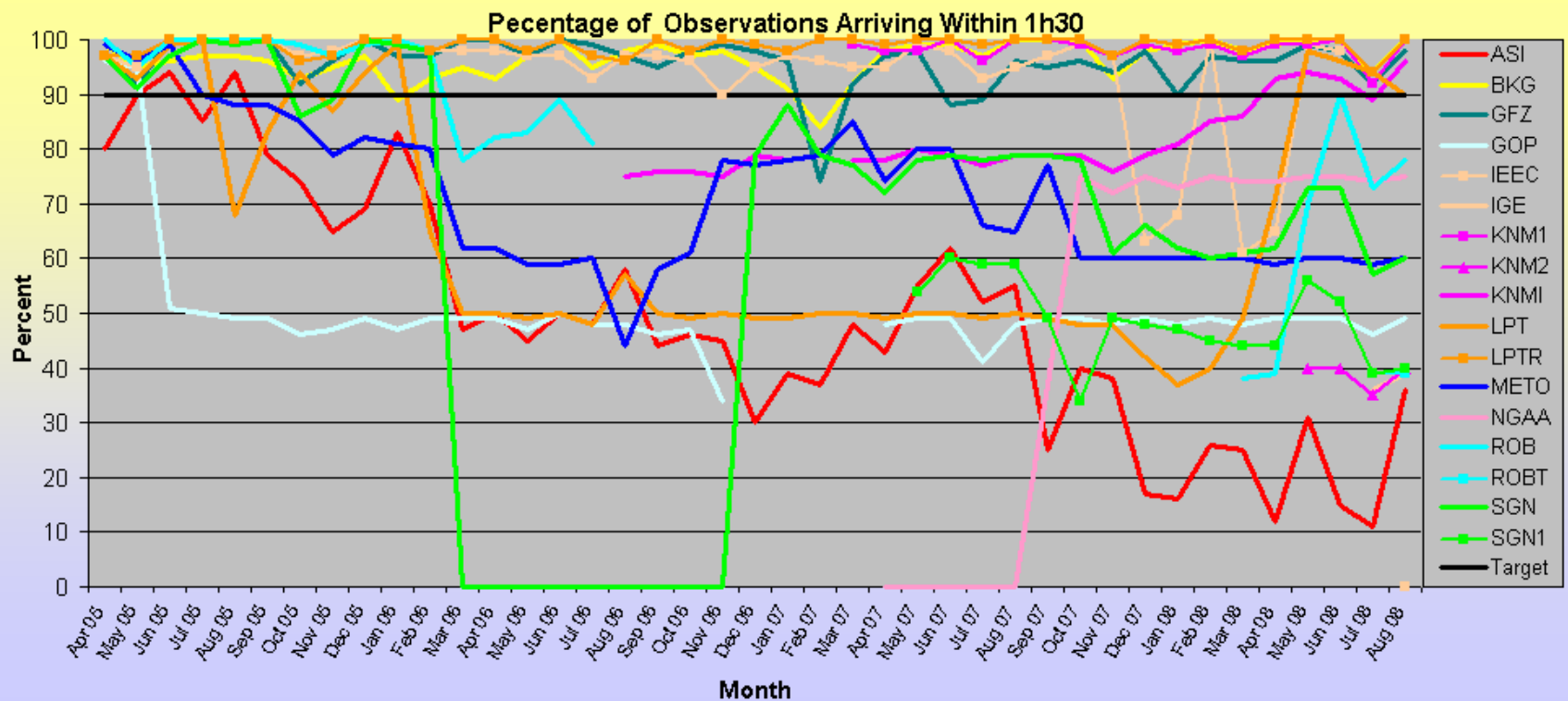
Mark more clearly which are **operational** and which are **experimental**?

Mark more clearly which products are 'real-time' instead of 'near real-time'?

Data from nearly 1000 stations.

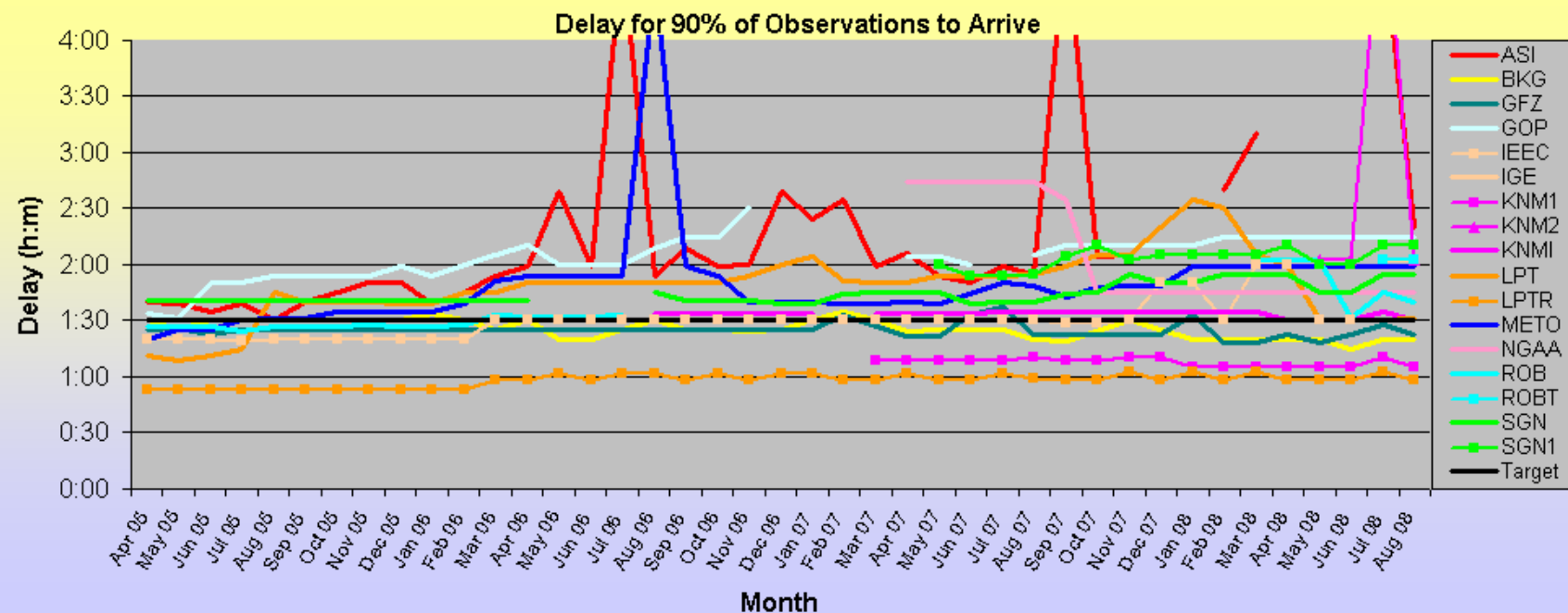


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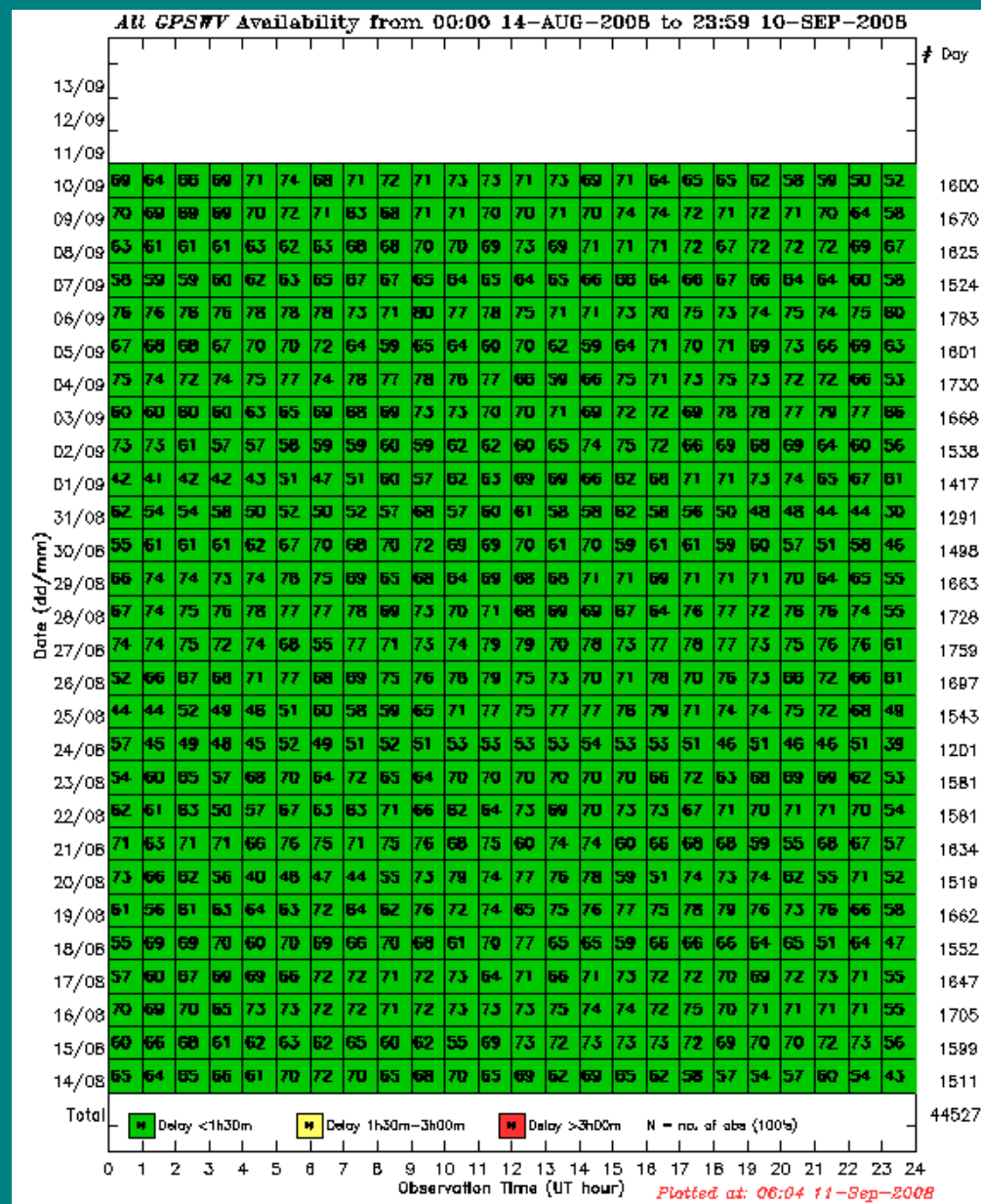
By Dave Offiler. Available via validation link on E-GVAP website.

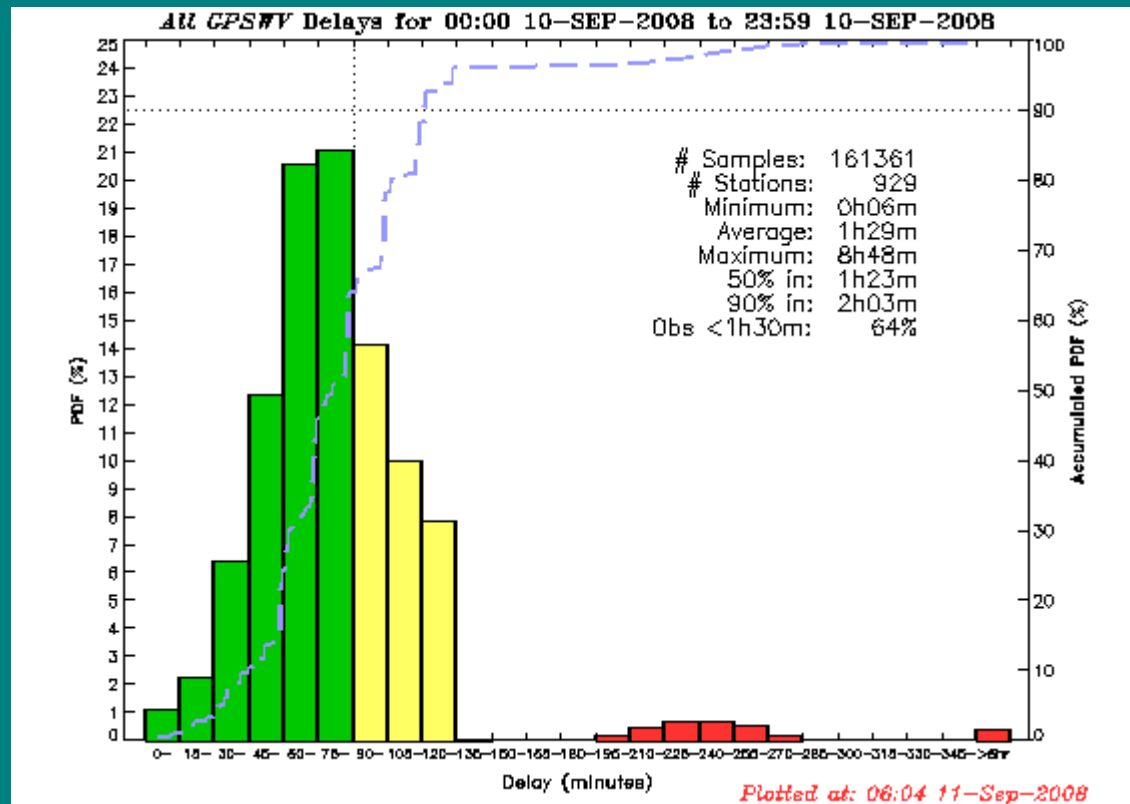
URD question: Timeliness criteria to change?



Set up by Dave Offiler. Available via validation link on E-GVAP website.

By Dave Offiler, UK MetO.



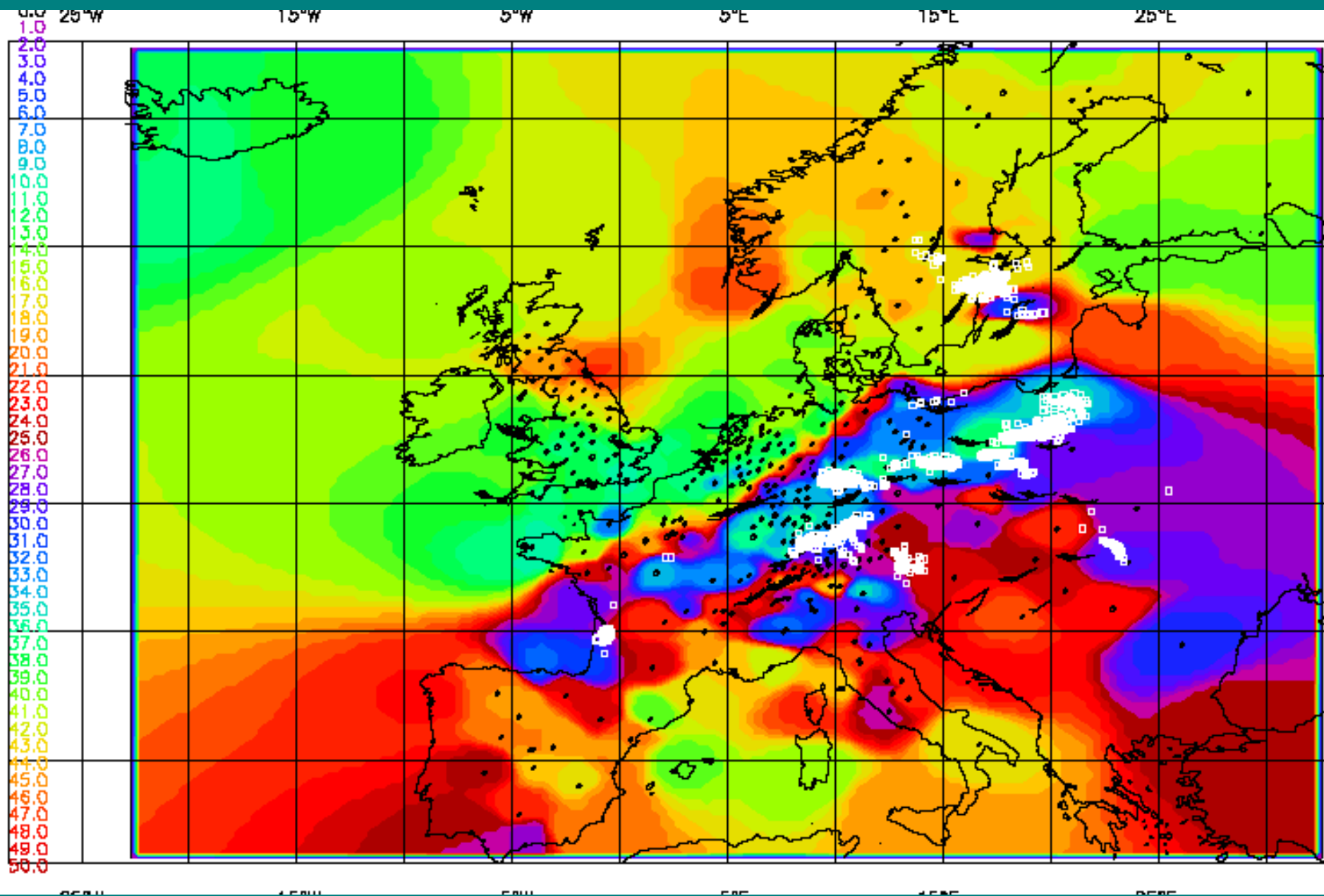


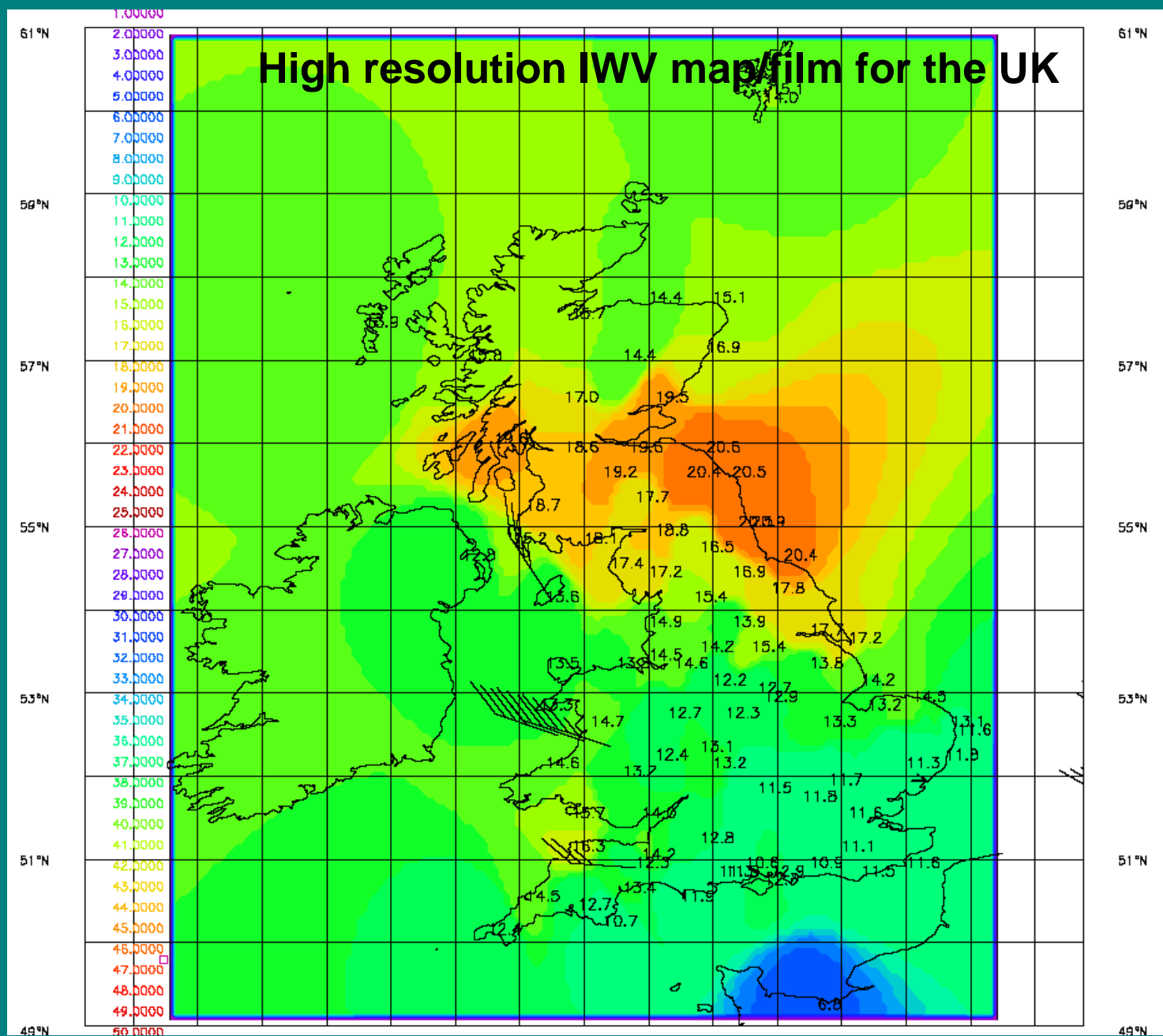
Time arrival statistics, September 10, 2008. Also available for each processing centre separately.
 Set up by Dave Offiler, UK MetO.

IWV maps/films

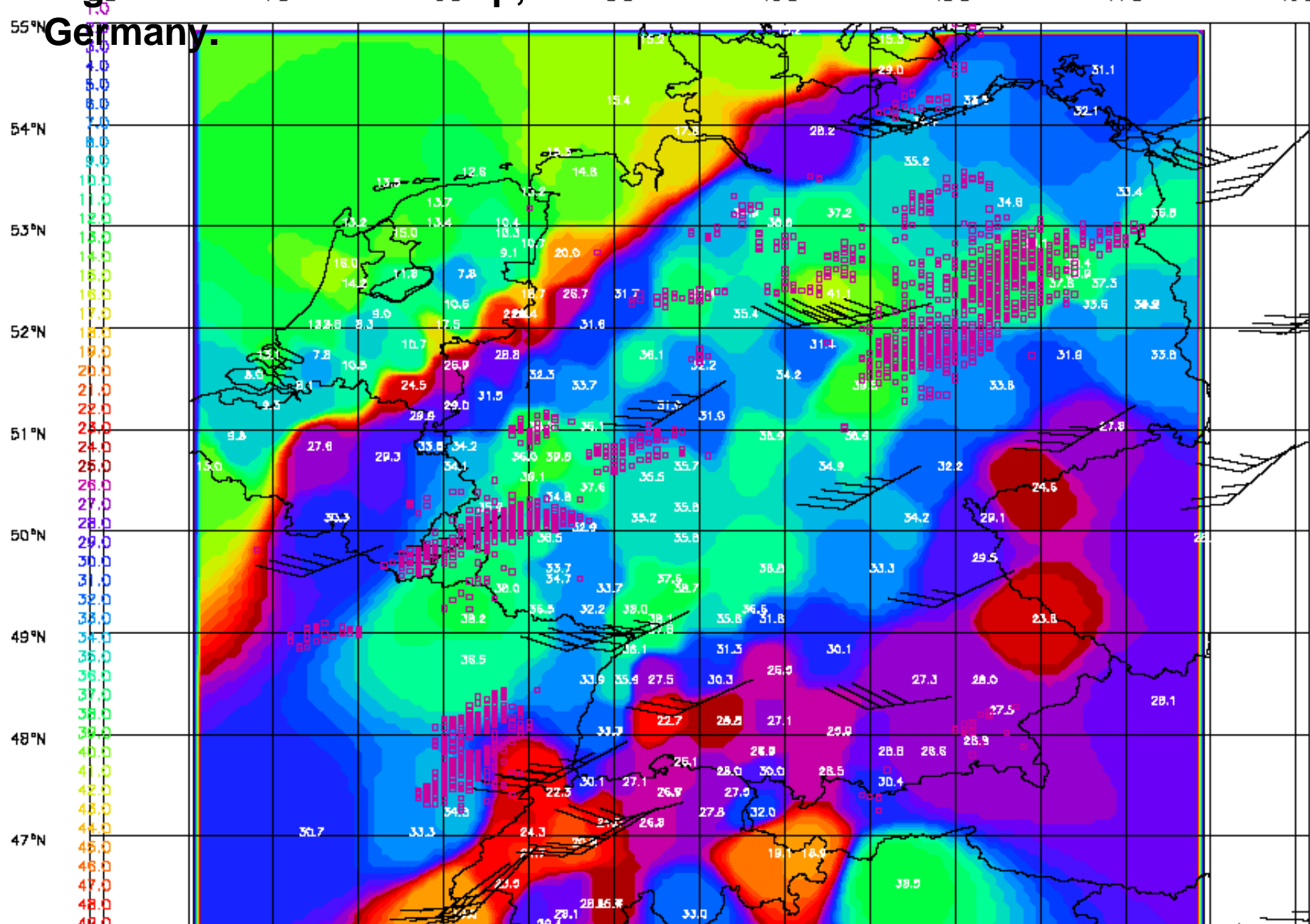
- Based on nearest SYNOP pressures and temperatures the ZTD observations are converted to IWV. The IWV point “measurements” are combined into 3 different maps: Europe, Netherlands + neighbors, and UK.

IWV, low resolution, Europe





High resolution IWV map, Netherlands + Germany.



IWV maps/films

- Better property available than 2mT for wet delay to IWV conversion?
- The maps includes also wind directions (currently from a limited number of wind profilers) and locations with lightning.
- Done every hour. The maps are combined into a film, covering the past 24 hours, which can be viewed via the egvap homepage.
- We expect such maps to be useful in now-casting. But this requires experience, which has first to be gained.
- We **still** encourage forecasters to check these maps regularly and report to us suggestions for improvement and comments about usefulness.

Data distribution policy for E-GVAP ZTD/IWV data

Former plenary meeting decisions:

Continue with 'free access'= access for all interested meteorological institutes, for institutes receiving GTS data, and for individuals declaring their use of the data is for scientific purposes.

Reconsider if mis-used.

Propose to keep unchanged as regards national meteorological institutes.

Increasing 'pressure' on access to ZTD/IWV from non meteorological users.

"Conditions of use" document made for agreements about data usage between E-GVAP and third parties.

Expert team on data processing

Has become the primary contact point between the meteorological and geodetic side.

Team involves both the real processing experts, and people from institutes starting to process GNSS data for delivery to E-GVAP.

Rosa Pacione/Francesco Vespe, ASI, Italy

Jan Dousa, GOP, Czeck Republic.

(Etienne Orliac, Univ. Nottingham, UK, recently stopped)

Elmar Brockmann, Swisstopo, Switzerland

Galina Dick, GFZ, Germany

Jan Johansson, Chalmers Tech. Univ., Sweden

Marcelino Valdes/Miquel Angel Cano, IGE, Spain

Jacques Beilin/Therry Duquesnoy, SGN/IGN, France.

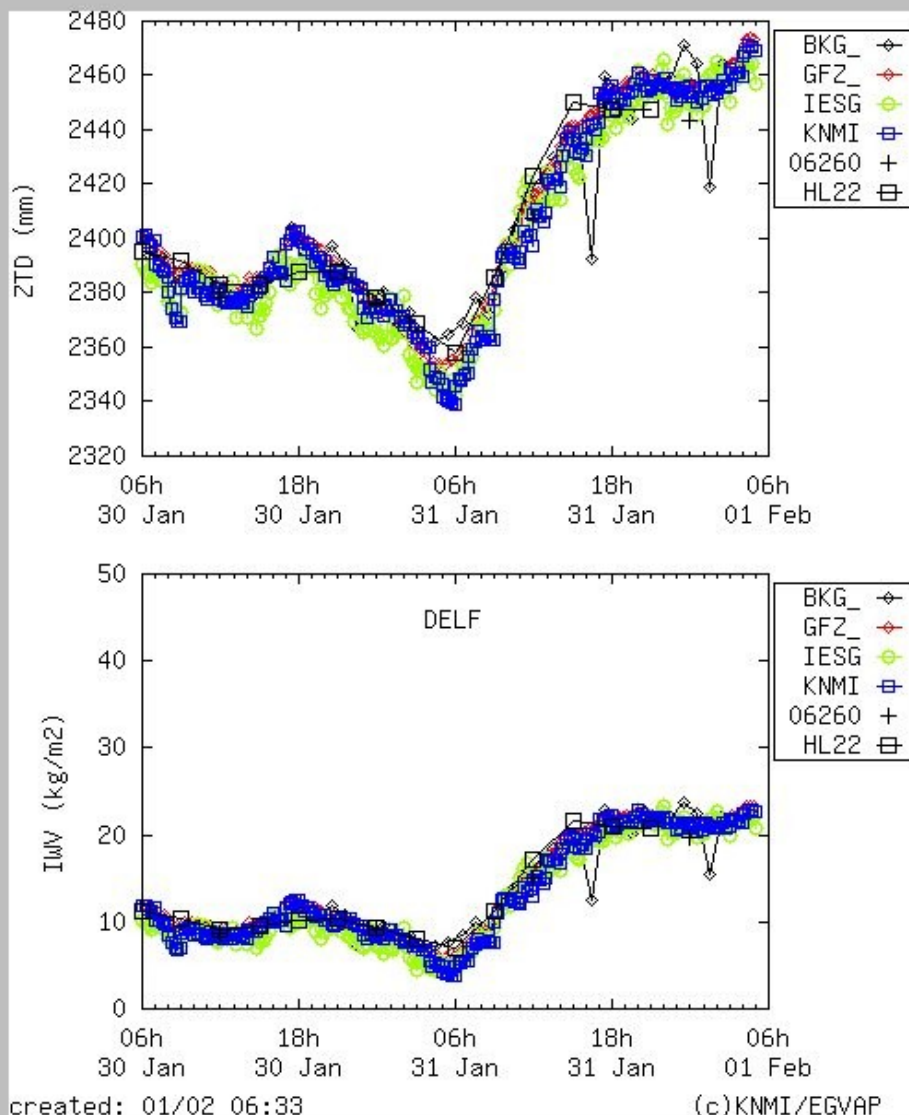
Eric Pottiaux/Carine Bruyninx, ROB, Belgium

Jonathan Jones, Siebren de Haan, Henrik Vedel.

Responsible person: Jonathan Jones.

Expert processing team meetings

- September 2006 in Payerne (Thanks to Dominique Ruffieux, MeteoSwiss)
- September 2007 (Thanks to Rosa Pacione (Telespazio) and Francesco Vespe (ASI), Italy)
- May 2008, joint meeting with user expert team (Thanks to Galina Dick and Jens Wickert, GFZ, Germany).
- Introduction of **Super-sites** = sites at which GPS receivers co-exist with radiosonde site and/or WVR site.
- All processing centres to include super-sites in their processing.
- Super-sites serve several purposes:
 - Continuous inter-comparison of PCs, for fast detection of certain types of single PC processing problems
 - Long term inter-comparison between PCs, against post processed data and against meteorological data (RS, WVR, and NWP) for identification of superior processing techniques.
- Recommendation to use same "clocks and orbits", where applicable.
- Contact to IGS to update orbit determinations/predictions more frequently – currently main product is from GFZ.



HIRLAM(KNMI) AN - GPS ZTD

7day stat. 2007/01/25 - 2007/01/31

AC	num	bias	RMS	stddev
BKG	53	-0.1	8.0	8.0
GFZ	55	-3.7	7.7	6.7
IESG	53	2.4	9.4	9.0
KNMI	56	-0.8	7.5	7.5

Notes

- Statistics are updated daily
- GPS ZTD are interpolated to NWP analysis time

HIRLAM(KNMI) FC - GPS ZTD

Latest Obs. vs NWP-forecast

AC	Obs.time	FC.time (sec)	HIRLAM-GPS
IESG	07:00	3600	5.6
KNMI	07:00	3600	1.7
GFZ	07:07	4020	-1.7
KNMI	07:14	4440	0.8
IESG	07:15	4500	10.4
GFZ	07:22	4920	-0.6
KNMI	07:29	5340	0.5
IESG	07:30	5400	8.6
BKG	07:30	5400	-4.7
GFZ	07:37	5820	-1.4
KNMI	07:44	6240	2.1
IESG	07:45	6300	6.9

By Siebren de Haan. Available via
E-GVAP homepage under "validation"

Liaison

Inter European scale (EUREF)

- Joao Agria Torres, Chairman of EUREF.
- Elmar Brockmann, Swisstopo
- Hans van der Marel, Tech. Univ. Delft.
- Carine Bruyninx, Roy. Obs. Belgium, EUREF coordinator
- Henrik Vedel E-GVAP, DMI
- Jonathan Jones E-GVAP, UK Metoffice
- Siebren de Haan E-GVAP, KNMI

Responsible person: Henrik Vedel.

Very fine collaboration with both above geodesists. Preparatory discussions and drafting mainly by Elmar and Henrik.

Jonathan has been representing E-GVAP at EUREF symposia where Henrik could not go.

ECOMET Discussions between Ton Donker, KNMI and Henrik+Siebren.

National scale.

- E-GVAP team.

Responsible person: Henrik Vedel.

- EUMETNET directors prefer national arrangements.
- Practical matters, e.g. national GPS data obtained by a national mapping agency also points to national arrangements.

Best arranged how to develop in "poor" countries?

- A changing liaison group, involving persons from currently active partners
- Database with examples of agreements/contracts between data owners and met. inst.

- EUMETNET Council: Agreements made between met. Offices and GPS providers
- Formally each E-GVAP member institute is responsible for making available GPS data from that country for E-GVAP, or trying to, depending on the current level of national GPS meteorological collaboration. Help in this process can be provided from the E-GVAP team, and from the liaison group one it has been formed. Currently the situation is very different from country to country, and it will be a gradual process and a central part of E-GVAP to achieve good coverage in all countries.

MoU between EUREF and EUMETNET

- To strengthen the collaboration between EUREF and E-GVAP, to further collaboration also on the national level. the making of an MoU was initiated in connection with the EUREF Annual Symposium in Vienna June, 2005.
- The MoU has been approved by the TWG of EUREF (January 2007)
- The MoU has been approved by the EUMETNET Council (April 2007)
- The MoU has been signed on behalf of E-GVAP/EUMETNET, by the Chairman of EUMETNET Fritz Neuwirth. (May 2007)
- The MoU has signed by the Chairman of EUREF, Joao Agrio Torres (June 2007)

Content of the MoU (extract)

- EUREF will provide to E-GVAP/EUMETNET free access to the EPN raw data for the determination of ZTD, IWV and other meteorological applications. The data and conditions of use are more precisely specified in annex 1.
- E-GVAP/EUMETNET will provide to EUREF free access to meteorological data for GNSS data processing, analysis, and validation. The data and conditions of use are specified more precisely in annex 1.
- EUREF and E-GVAP/EUMETNET will create common guidelines for the exchange of data.

Content of the MoU (extract, cont.)

- EUREF will contact the European GNSS network operators inviting them to collaborate with European national meteorological institutes on co-located observations (GNSS and meteorological observations) and support GNSS data processing from dense national networks to contribute to meteorological applications.
- E-GVAP/EUMETNET will contact the European national meteorological institutes inviting them to collaborate with the responsible for national GNSS networks and/or EPN stations to provide the necessary meteorological data for GNSS data processing and analysis.
- Use of data exchanged under this MoU for publications must be acknowledged by citation to the relevant data providing party (EUREF or EUMETNET).

Conditions of use of exchanged data

A: EUREF use of meteorological data

- The meteorological data will be used for GNSS data processing, validation of GNSS processing and products, and for scientific studies.

The meteorological data will not be sold or used for any direct economical gain or profit, nor forwarded to third parties, unless a separate written agreement has been made to the contrary.

Conditions of use of exchanged data

B: Meteorological use of GNSS data

Raw GNSS data (RINEX format) will not be forwarded to third parties unless specifically agreed with EUREF in advance.

The data will be used solely with the purpose of estimation of atmospheric GNSS delays and further computation of atmospheric water vapour. Actual positions determined in connection with the delay estimation will not be distributed. The GNSS delays will be utilised in numerical weather prediction models and IWV used to assist forecasters to monitor the weather. The goal is to enhance the skill of the meteorological forecasts.

GNSS delay data and associated error estimates will be distributed free of charge within the meteorological community (including EUREF if required) for use in weather forecasting and climate monitoring. The distribution between E-GVAP and the meteorological community will take place via the Global Telecommunication System and password restricted ftp.

The GNSS delays derived from EUREF data or provided by EUREF will not be sold or used for any direct commercial gain or profit unless a separate written agreement has been made to the contrary.

Annex 1, extract

Responsibilities

EUREF will provide to E-GVAP/EUMETNET free access to the EPN raw data (hourly and daily satellite observation files in RINEX format) for the determination of ZTD, IWV and other meteorological applications.

E-GVAP/EUMETNET will provide to EUREF the following data:

Hourly

Observations of pressure, T2m, and RH2m from the **nearest SYNOP site** to the EUREF GNSS stations. From essential data + additional data from institutes on Annex 2 list.

Daily

Observations of pressure, T2m and RH2m from SYNOP sites, with a time resolution of 3 hours. From essential data + additional data from institutes on Annex 2 list.

Radiosonde observations of pressure, temperature and humidity from radiosondes within 50 km of a EUREF GNSS site. From essential data.

Water vapour radiometer data from sites located within 50 km of GNSS receiver. Pending agreement with data owner in each case.

Annex 1, extract

The **Annex 2** of the *MoU between EUREF and E-GVAP/EUMETNET* is a list of meteorological institutes that have agreed that for extraction of the data mentioned below their *additional data* may be used.

Met.no has stopped discriminating between essential and additional data from Norway and now declares all their data as essential. Therefore signing of annex 2 is not relevant for met.no

Annex 2, signing

From E-GVAP we have asked all members of EUMETNET to consider signing Annex 2.

Note: From E-GVAP we **do not** plan to ask for additional data from members not already providing additional data. However, the acceptance for members currently providing additional SYNOP data to DMI, KNMI and UK Metoffice to sign Annex 2 will significantly ease the work in E-GVAP, as the information about whether data are essential or additional is unfortunately not stored when observational data are transferred from the GTS to the meteorological databases for observational data.

MoU, recent developments

- Extraction of meteorological data for EUREF institutes has been set up.
- SYNOP data (surface pressures, 2m temperature, 2m humidity) are extracted by KNMI
- TEMP (radiosonde data) are extracted by DMI
- Data are moved to "E-GVAP" ftp-server at UKMO
- Access to data is institute and password specific.
- Prior to access each institute must agree to conditions of use, specified on a conditions of use document, separate from the MoU, providing also the name of a responsible person.
- The conditions of use of the meteorological data are tighter than the original conditions of use in the MoU! This is due to ECOMET and EC equal access right rules.
- Data must only to be used for scientific or educational purposes, ie. ruling out also indirect economic exploitation.

EUREF paper.
E-GVAP

Expert team on GPS observation usage

Purpose: To further the use of gb GPS data in NWP and now-casting through sharing of results and expertise, to provide guidance material for others, and to provide feedback to processing centres.

Gemma Bennit (previously Adrian Jupp) & Dave Officer, UKMO,
Daniel Leuenberger, MeteoSwiss.

Jana Sanchez Arriola, AEMET, Spain

Patrick xxx (previously Paul Poli), Meteo-France.

Maria Tomassini, DWD. Stopped at DWD summer 2008.

Henrik Vedel, DMI and E-GVAP

Jonathan Jones, UKMO and E-GVAP

Siebren de Haan, KNMI and E-GVAP.

Responsible person: Henrik Vedel.

Meetings financed by E-GVAP. Met February 2007 and November 2007.

Joint meeting May 5-6, 2008 in Potsdam with expert team on data processing and a number of other scientists working on GPS meteorology.

Next meeting November 7, joint meeting at DMI.

Operational status:

- Two 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).
- Both report a positive impact from the use of the E-GVAP data.
- Both institutes assimilate NRT ZTD using variational data assimilation systems (3 and 4DVar). Besides there are significant differences in their approach.
- MF uses a white list for selection of sites&processing centres to be included in the data assimilation. The list is determined based on the O-B statistics. Site&processing centre specific bias correction (from month long offset averages) and observation errors.
- UKMO uses available data from a subset of the E-GVAP processing centres. Bias correction based on month long offset averages.

Operational status (2):

- In both cases the screening is very heavy compared to screening of other types of observations.
 - Some cases sites are left out due to data thinning or due to large differences between model orography and real altitude of GPS site,
 - But mainly the screening is meant to remove sites-processing centre combinations that are not producing ZTD data of constant good quality based on O-B offset statistics.

Conclusion.

- Positive results obtained in operational NWP from use of E-GVAP data.
- However, important aspect to improve in order to make **all** data useful and to limit the risk of forecasts degrading due to abrupt changes in data processing.
 - Homogeneity of data quality a main issue. Significant differences between ACs.
 - Stability in processing a main issue, ie not change anything at AC without some type of notice (warning ahead when reason to consider important, notification in log file and via version number in COST file otherwise).

- Many HIRLAM countries are preparing assimilation (DMI, KNMI, INM/AEMET, SMHI?).
- At DMI we have done
 - "passive assimilation since July 07.
 - an impact experiment for July 2007 and January 2008, neutral impact.
 - want to start a "parallel" assimilation experiment to compare with our operational models. Have for a time been awaiting more stable quality for the NGAA NRT ZTDs which are important to us.
 - In DMI strategy to include gb GPS in operational models during 2008.
- At INM/AEMET
 - Passive Assimilation.
- At KNMI
 - Siebren.
- Presentations from expert team meetings are available at egvap homepage and/or egvap ftp-server.

- DWD re-starting, since ultimo 2007, work on use of gb GPS data in

From "Tomassini, Mariella" Maria.Tomassini@dwd.de , Thu, 12 Jun 2008 11:33:03 +0200

- You might like to know that assimilation experiments with GPS data (from GFZ) have been finally running here with the high resolution model (COSMO-DE 2.8 km) for the period June 2007 and results look very encouraging.
- Unfortunately I am leaving DWD end of this month and I do not know if will be able to put in writing these results.
- However, there will be a new person appointed to work also with GPS data for the project COPS, I will make sure she/he will get in touch with you in order to have a new contact person at DWD.

I take this opportunity to thank you, and also Siebren and Dave, for all the efforts you have made for the progresses of GPS usage in NWP, and wish you all the best and success for your future work,

Year 1 milestones

- *Successful setup of liaison group and the two expert groups and first years reports from those. Achieved.*
- *Successful setup of hub to receive GPS meteorological data, distribute them and archive them. Achieved.*
- *Start of quality measurements/report facility. Achieved*
- *An agreement with EUREF about use of GPS data. MoU made, transfer of met data being set up, final details on met side regarding annex 2. No problems with EUREF at any time.*
- *Recommendations for design of regional/national networks for water vapour determination. Final TOUGH report on this has been made, based on input from most of the experts in the E-GVAP expert team. UK Met Office document on installation of GPS sites.*

Year 2 milestones

- *Formal arrangements with national organisations assuring delivery of GPS data to hub for a multi-year period. Either via NMS or directly with E-GVAP. **Achived in most E-GVAP countries.***
- *Operation of quality measurement/report facility. Quality measured against NWP, radiosonde an dother available meteorological data. Reported quarterly. **Achived, reported on web.***
- *Workshop on the production and use of GPS data (possibly in connection with project meeting). **Workshop will be held November 6 at DMI.***

Year 3 milestones

- *Formal arrangements with facility which can process "raw" GPS data which might become available in Europe, but are not processed already by current GPS processing centres for whatever reason. Current processing centres have capacity of process additional data for the moment.*
- *Functioning automated quality control of GPS meteorological data against GPS meteorological data from nearby stations, other GPS networks with common stations, and against NWP data and other meteorological observations. Automated near real time feedback to owners of problematic stations and processing centres processing the station(s) in question. Periodic feedback to all involved parties. Automated quality control in place. Automated feedback not.*
- *Organised support for expansion of network in regions with poor coverage, and for GPS sites collocated with radiosonde sites, airport (AMDAR), and other meteorological sites. MoU between EUREF and EUMETNET supports site sharing as an important form of EUREF EUMETNET collaboration. Supersites.*

Year 4 milestones

- Ongoing processing of ground based GPS data from an increasing European GPS network. **Is taking place.**
- Review of processing, utilisation, and impact of ground based GPS data at European meteorological services. **To be made after workshop and expert team meetings, November 6 and 7.**
- A review/discussion of the future route for European ground based GPS observations for meteorology.
 - Proposal for E-GVAP-II is the essential response to this.
 - Report on status to be made following workshop and expert team meetings **primo November.**

- 1 Making of MoU between EUREF and "us" acceptable to PB-OBS and EUMETNET Council (and EUREF). *Signed, met data exchange now running.*
- 2 Development of GPS observing system in "poor" E-GVAP countries. There is a particular wish to help densify and solidify the Spanish GNSS observing network. *IGE starting to process Spanish data, as well as UKMO. IGE people partaking in processing expert team.*
- 3 E-GVAP and Meteo-France collaboration. *Done. Also DHMZ now a member*
- 4 Review of **User Requirements**, data formats, and data distribution with the goal of a future update. *Discussed at expert team on data usage meetings, but no strong wish for an update.*
- 5 Decide on long term archiving strategy (e.g. for climate research). *A UK institute has expressed its willingness to archive the E-GVAP data, but should NRT delay/IWV data be used for climate studies? Can we control whether it goes beyond meteorology/climate study users? Is it necessary?*

Considered central at at 5'th plenary meeting.

- Milestones for years 1 to 4.

Other action items:

- Spanish network. **Expanding**
- Croatian GPS data? **?**
- Setup of met data transfer facility to serve EUREF institutes. **Done**
- User requirements, data formats, data exchange (ftp/BUFR/?). Balance between decentralisation in data delivery and central quality control. Next expert meeting. **Being done.**
- Workshop, when and where. **DMI, November 6, 2008**
- EUCOS. When? Central server facility apparently not clear soon. **Becoming part of E-GVAP-II**

- Automated quality checking running. Automated feedback: Report what to whom? **Initially to report to E-GVAP team.**
- Clearer marking between operational and experimental data at E-GVAP server. **Partly done, missing in arrival monitoring.**
- Attempt to make MoU with GFZ and BKG? Yes, in connection with the expert meeting in Potsdam, May 2008. **Problem as to with whom on met side.**
- Attempt expanding network in non E-GVAP countries?

E-GVAP mail aliases

To facilitate easy communication of E-GVAP matters the following mail aliases have been set up:

- egvap_operational@dmu.dk To people/institutes using E-GVAP products operationally or preparing operational use.
- egvap_suppliers@dmu.dk To all processing centres supplying data to E-GVAP
- egvap_user_wg@dmu.dk To all member members of expert team on data usage.
- egvap_processing_wg@dmu.dk To all member members of expert team on data processing.
- egvap_users@dmu.dk To all people interested in E-GVAP and ground based GNSS meteorology
- egvap_members@dmu.dk To all member representatives of E-GVAP (you, if you are not here in place of somebody else).
- egvap_gts@dmu.dk and egvap_gts@dmu.dk For messages related specifically to GTS and ftp related matters.
- egvap_supersites@dmu.dk Regarding supersites specific issues.
- + a few.

To see who is on each list use the E-GVAP homepage. To get on/off a list, send a mail to hev@dmu.dk (Henrik).

National reporting

Denmark

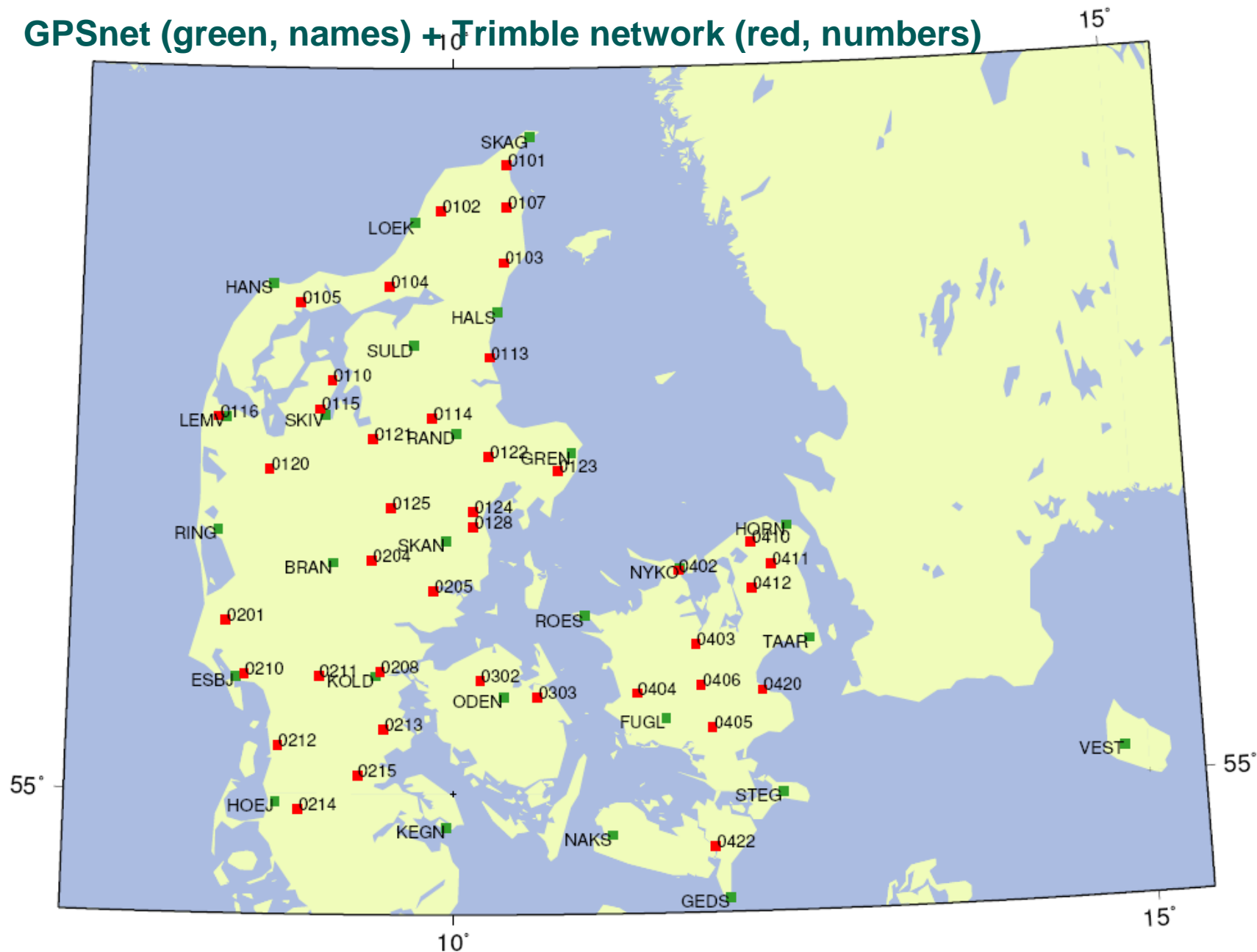
GB GPS data. Access and processing.

- DMI is collaborating with the NRT GPS processing centre NGAA at SMHI, such that Danish GPS data are processed at SMHI.
- The Danish GPS data come from 2 sources:
 1. The national Danish mapping agency.
 2. A private network called GPSnet.
- The access is based on an old non formal agreement between the data providers and Chalmers Space Observatory.
- Potential for more Danish data, as a second private network operator exists.
- Currently there is no direct interaction between DMI and the two private networks, but a formal agreement is obviously to be made.
- DMI plans of arranging for access to data from Greenland stations belonging to the national mapping agency.

GPSnet



GPSnet (green, names) + Trimble network (red, numbers)



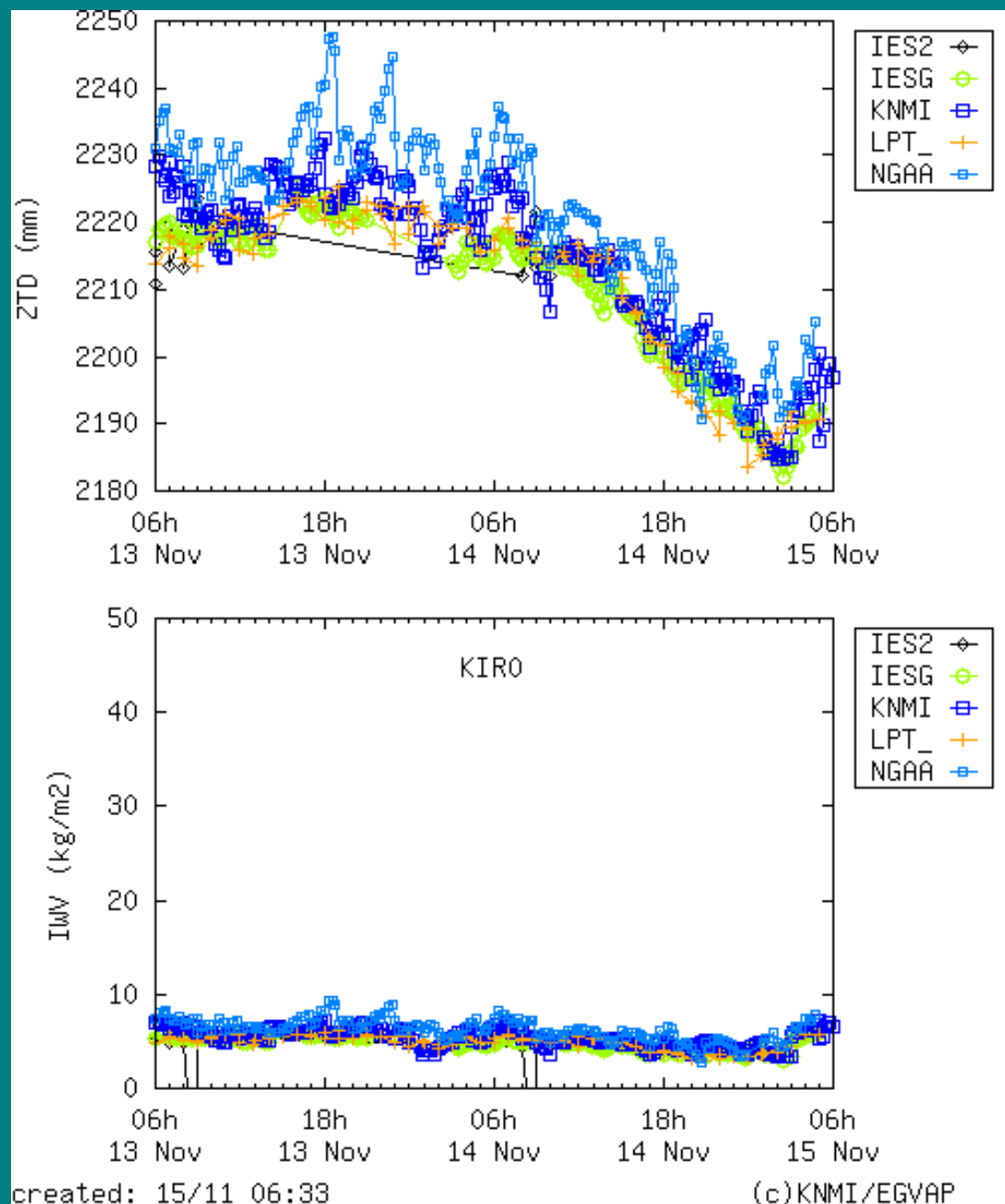
DMI gb GNSS work (cont.)

1. Extraction of O-B and O-A statistics from passive assimilation. Calculation of offset statistics. **Being done continuously since July 2007.**
 2. Use ZTD for continuous validation of HIRLAM **Being set up.**
 3. Based on that devise preprocessing/data selection algorithms enabling selection of "good and robust" ZTD data for assimilation.
 - Both processing centre and station dependent investigation.**First version finished.**
 4. Run impact experiments in parallel mode. **Started, but...**
 5. Run impact case studies. **Done July 2007 and January 2008.**
 6. Start operational assimilation of NRT ZTD **When impact studies have given satisfactory results (neutral to positive impact). Timescale: Operational usage in year 2008.**
- To provide DMI HIRLAM – GNSS ZTD offset statistics E-GVAP server.
 - Perform long term statistical analyses to monitor in detail short and long term variations of NRT ZTDs relative to other data (alternative NRT ZTD, post processed, NWP, radiosonde, WVR, solar spectograph).

Monitoring results. Site+AC selection algorithm.

- Collect O-B statistics from "passive" assimilation. Running since July 2007.
- Perform combined site dependend + AC dependend statistical analysis to estimate bias, standard deviation how well O-B represents a Gaussian distribution (The latter is a basic assumption upon which the data assimilation system is developed).
- Based on this, and on studies of the continuous monitoring at the E-GVAP site at KNMI, a white list is created.
- A site can only occur once on the whitelist (ie. apparently best AC from stat. analysis is chosen).
- Currently the site+AC "raw" bias and std. dev. are the values used in assimilation. It could be the std. dev. from the fitting of Gaussian distributions to O-B histograms.

Validation plot
from E-GVAP
monitoring page,
showing
importance of
proper data
selection
algorithms.



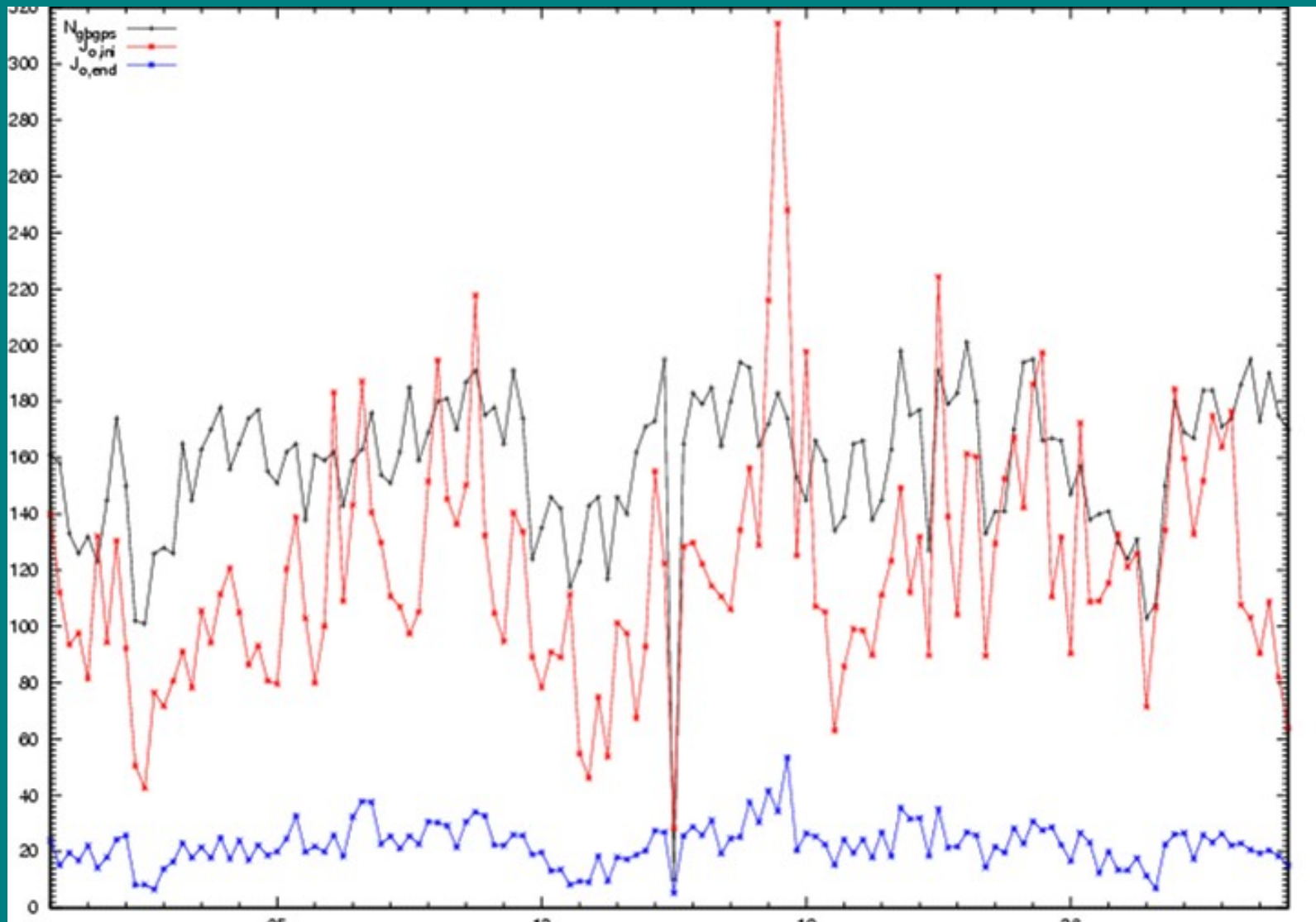
Conclusion and questions from DMI monitoring

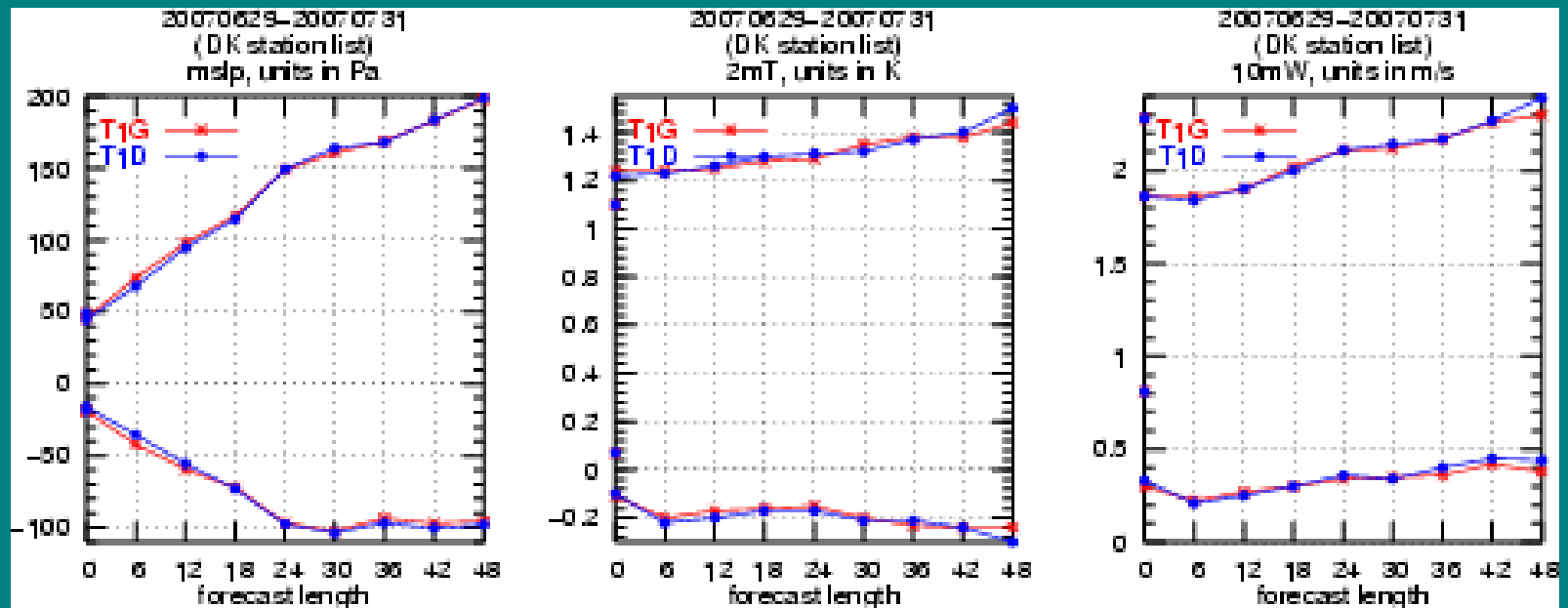
- Based on the O-B screening all ACs process sites that get rejected from the whitelist.
- This is not necessarily always a problem of the site or the processing. Also NWP models have problems.
- However, even for the same site the ACs sometimes differ significantly in their statistics. It would be nice to understand why.
- In the continuous monitoring (ie. not just every 6 hours, when we do data assimilation) we see a significant difference in the size of the variation of the ZTD on short timescales. It would be nice to understand why. Is it just differences in the constraints applied in the processing (in which case we can do some type of averaging for AC with weak constraints), or is there more to it?
- It will help us to prepare better assimilation of GNSS ZTDs if we understood better the nature of the differences between the ACs. Or if the differences got smaller...
- It is absolutely vital, that if changes are done to the AC processing a message is forwarded to the NWP users.

DMI impact results from case studies

- Conducted experiments for July 2007 and January 2008. Not fully analysed yet.
- Assimilation is based on whitelists. Bias subtraction and std. dev. are based on monthlong statistics. Std. dev. is used as observation error.
- Control experiments include all obs. data used in operational DMI HIRLAM. GNSS experiments add GNSS ZTD to this.
- All experiments include "large scale blending" = a "re-analysis" in which ECMWF analyses are blended into the HIRLAM analysis. This to take advantage of the superior ECMWF treatment of satellite data (HIRLAM has a much lower top). This improves the analyses significantly, but reduces the ability of any single observing system to improve the analyses.
- The assimilation done is based on 3DVar, with an assimilation frequency of 6 hours.
- The runs cover the whole European area (+ a lot more), and are made at 0.15 degrees resolution.
- DMI (and HIRLAM) still use COST716 ascii format for input!

observations/cycle, Jo(Background), Jo(Analysis)





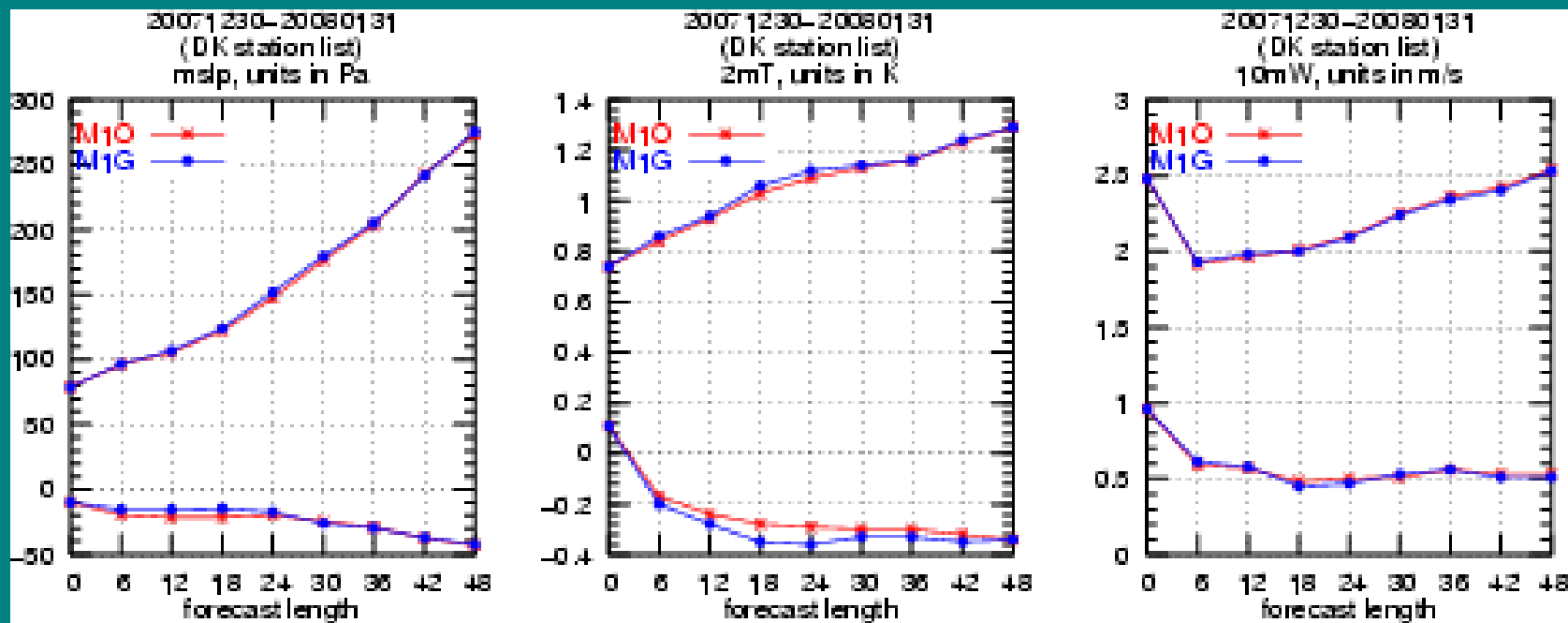


Table 1: Contingency table(s) for 0801 (6–18 h forecasts). Danish station list.

M1O 0801 (67.0%)							M1G 0801 (68.3%)						
$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum	$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum
F1	376	73	15	0	0	464	F1	398	70	17	0	0	485
F2	238	97	50	2	0	387	F2	217	105	45	2	0	369
F3	85	120	211	30	1	447	F3	84	116	220	27	2	449
F4	3	7	66	60	7	143	F4	3	6	60	63	8	140
F5	1	0	3	1	3	8	F5	1	0	3	1	1	6
sum	703	297	345	93	11	1449	sum	703	297	345	93	11	1449
%FO	53	33	61	65	27	52	%FO	57	35	64	68	9	54

M1O 0801 (67.0%)							M1P 0801 (65.5%)						
$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum	$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum
F1	376	73	15	0	0	464	F1	392	74	21	1	0	488
F2	238	97	50	2	0	387	F2	217	106	44	3	0	370
F3	85	120	211	30	1	447	F3	90	110	200	29	0	429
F4	3	7	66	60	7	143	F4	2	7	78	58	8	153
F5	1	0	3	1	3	8	F5	2	0	2	2	3	9
sum	703	297	345	93	11	1449	sum	703	297	345	93	11	1449
%FO	53	33	61	65	27	52	%FO	56	36	58	62	27	52

Table 2: Contingency table(s) for 0801 (18–30 h forecasts). Danish station list.

M1O 0801 (65.6%)							M1G 0801 (64.3%)						
$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum	$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum
F1	377	69	23	0	0	469	F1	379	73	20	1	0	473
F2	218	96	57	1	0	372	F2	216	93	67	0	0	376
F3	103	126	217	43	4	493	F3	103	124	205	50	4	486
F4	4	6	46	48	6	110	F4	5	7	51	40	5	108
F5	1	0	2	1	1	5	F5	0	0	2	2	2	6
sum	703	297	345	93	11	1449	sum	703	297	345	93	11	1449
%FO	54	32	63	52	9	51	%FO	54	31	59	43	18	50

M1O 0801 (65.6%)							M1P 0801 (64.9%)						
$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum	$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum
F1	377	69	23	0	0	469	F1	376	77	23	1	0	477
F2	218	96	57	1	0	372	F2	226	100	62	0	0	388
F3	103	126	217	43	4	493	F3	94	116	204	44	4	462
F4	4	6	46	48	6	110	F4	7	4	54	45	6	116
F5	1	0	2	1	1	5	F5	0	0	2	3	1	6
sum	703	297	345	93	11	1449	sum	703	297	345	93	11	1449
%FO	54	32	63	52	9	51	%FO	53	34	59	48	9	50

Table 4: Contingency table(s) for 0801 (6–18 h forecasts). EWGLAM station list.

M1O 0801							M1G 0801						
$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum	$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum
F1	8895	437	124	20	16	9492	F1	8983	442	130	20	16	9591
F2	2001	835	375	26	4	3241	F2	1951	849	379	24	3	3206
F3	821	810	1531	350	77	3589	F3	776	799	1529	373	82	3559
F4	47	62	345	372	177	1003	F4	55	57	331	360	173	976
F5	11	8	39	88	144	290	F5	10	5	45	79	144	283
sum	11775	2152	2414	856	418	17615	sum	11775	2152	2414	856	418	17615
%FO	76	39	63	43	34	67	%FO	76	39	63	42	34	67

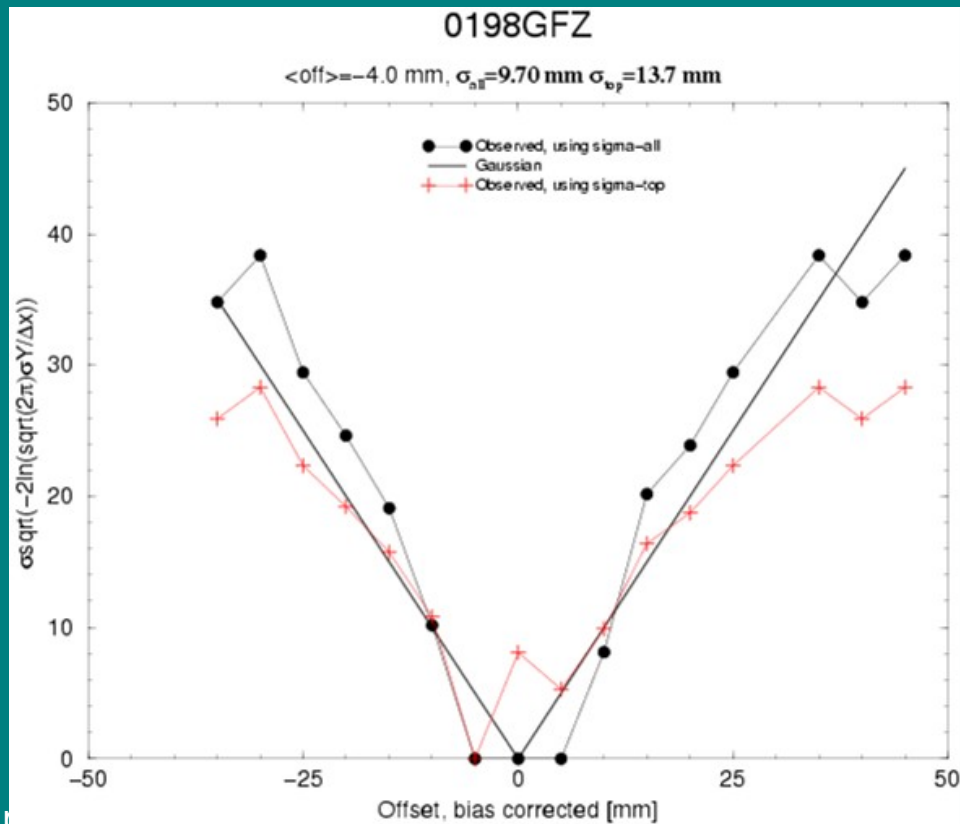
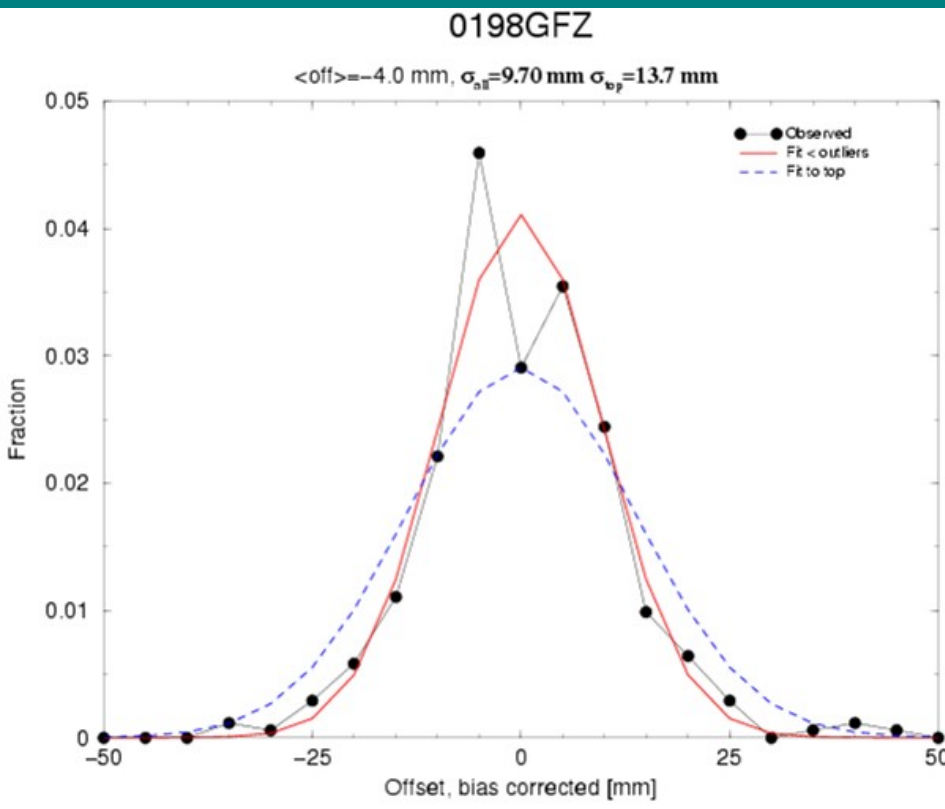
Table 5: Contingency table(s) for 0801 (18–30 h forecasts). EWGLAM station list.

M1O 0801							M1G 0801						
$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum	$\frac{obs \rightarrow}{\downarrow for}$	O1	O2	O3	O4	O5	sum
F1	8745	503	173	20	17	9458	F1	8820	509	166	24	17	9536
F2	2056	791	424	37	11	3319	F2	1970	802	425	39	15	3251
F3	907	779	1462	406	90	3644	F3	915	765	1468	403	89	3640
F4	58	70	317	301	166	912	F4	60	66	311	295	161	893
F5	9	9	38	92	134	282	F5	10	10	44	95	136	295
sum	11775	2152	2414	856	418	17615	sum	11775	2152	2414	856	418	17615
%FO	74	37	61	35	32	65	%FO	75	37	61	34	33	65
M1O 0801							M1G 0801						

Conclusion from DMI case studies.

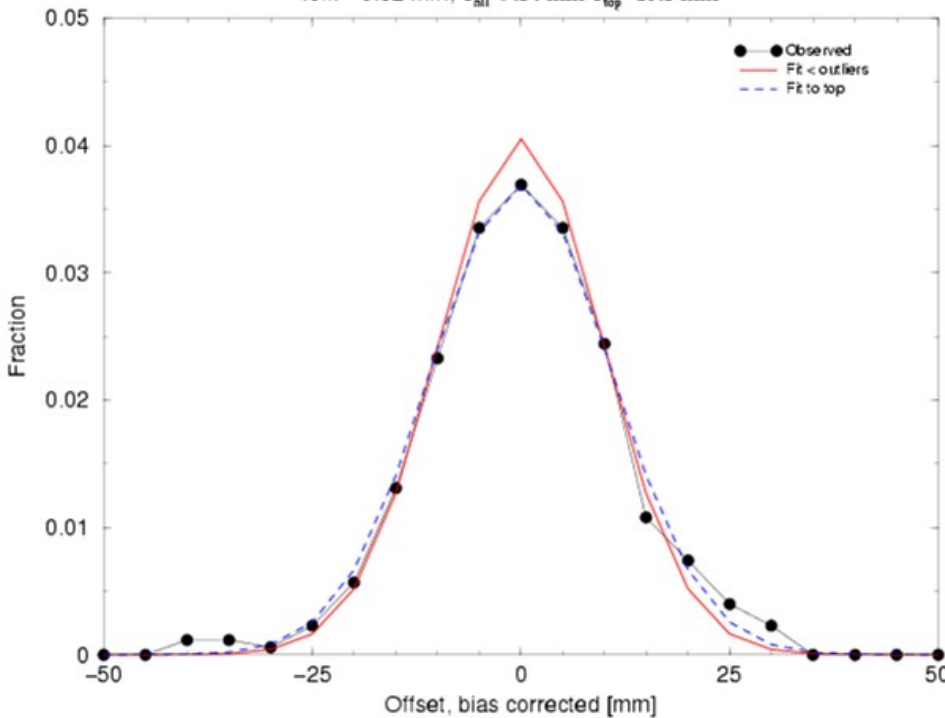
- Of the order 160 ZTDs were assimilated per cycle, based on the whitelist screening. Potentially the number is much larger. Some regions were without any ZTD data, e.g. no NGAA data in the January experiment.
- Objective statistical verification reveals a neutral impact in both the summer and the winter run.
- Subjective analysis of the results, in particular of precipitation fields, must be carried out before a final conclusion can be made.

The O-B distribution for site 0198 processed by GFZ



0897GFZ

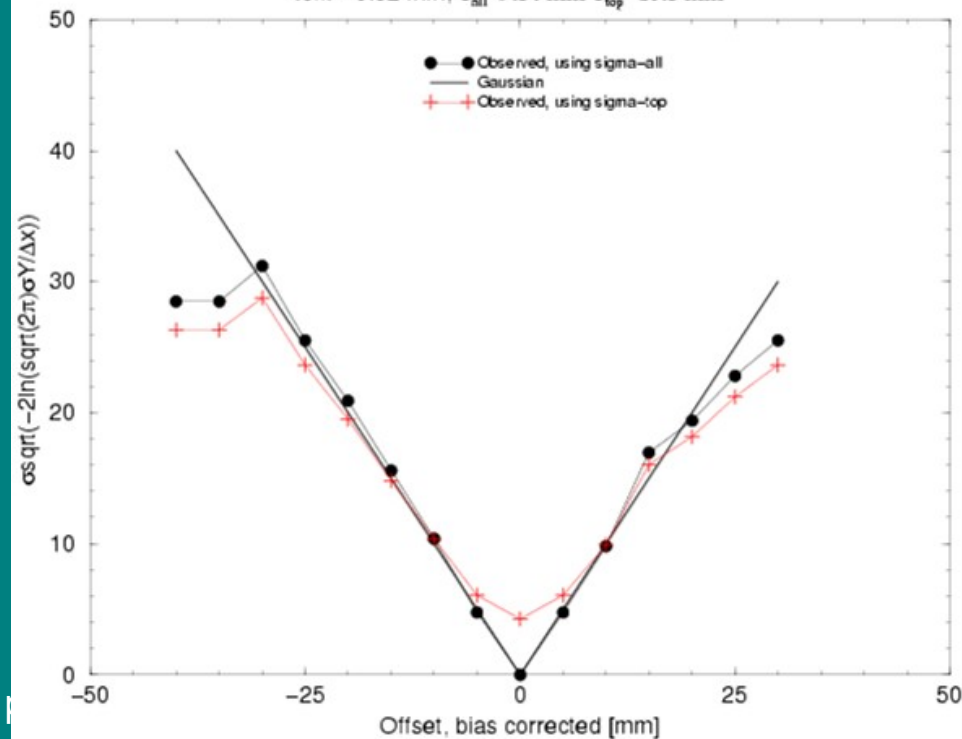
$\langle \text{off} \rangle = 0.62 \text{ mm}$, $\sigma_{\text{all}} = 9.84 \text{ mm}$ $\sigma_{\text{top}} = 10.8 \text{ mm}$



The O-B distribution for site 0897 processed by GFZ

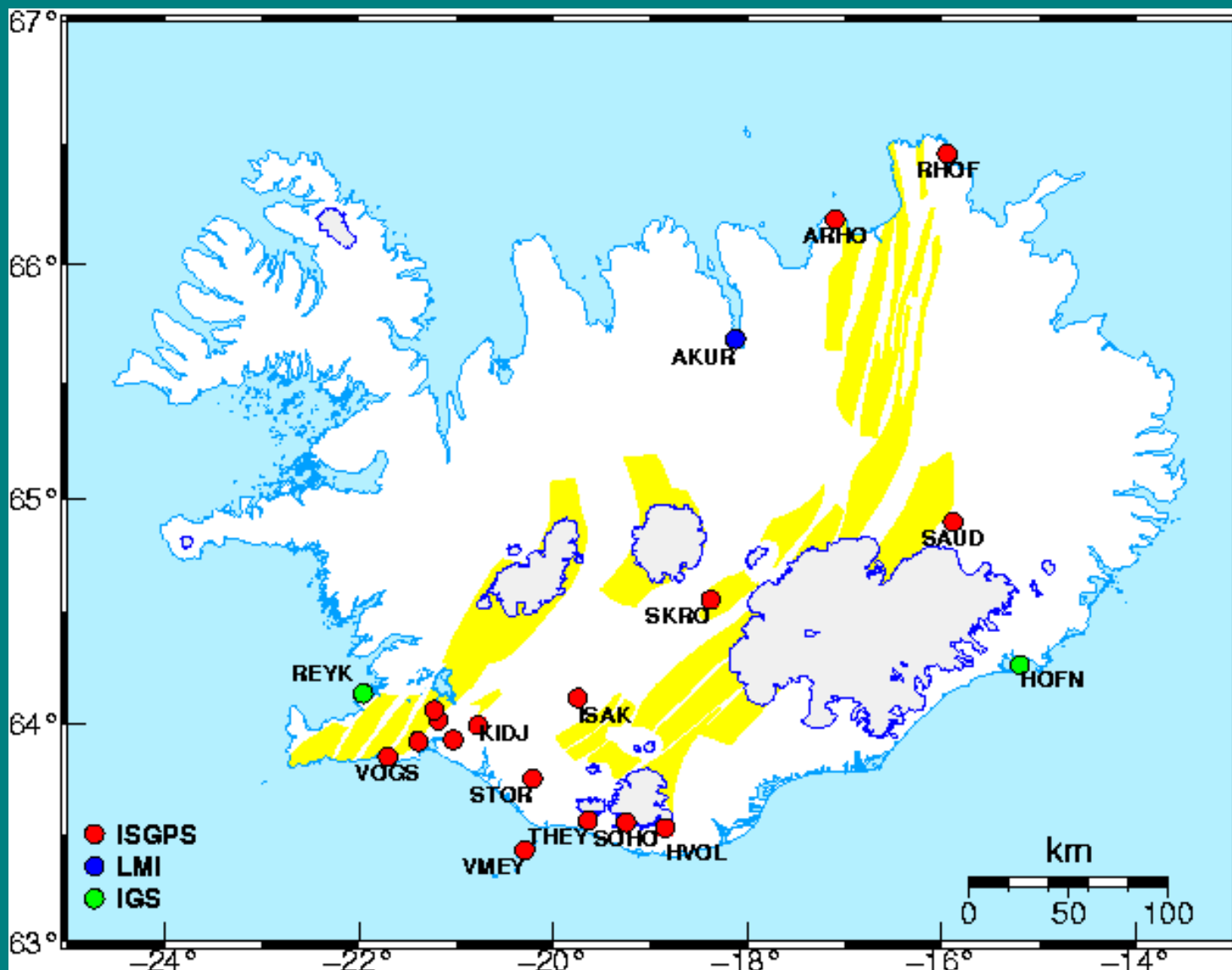
0897GFZ

$\langle \text{off} \rangle = 0.62 \text{ mm}$, $\sigma_{\text{all}} = 9.84 \text{ mm}$ $\sigma_{\text{top}} = 10.8 \text{ mm}$



E-GVAP

6'th



Belgium

- Different sensitivity tests for an optimal reconstruction of tropospheric parameters (ZTD and horizontal gradients of delays) have been performed at the Royal Meteorological Institute (RMI) using GAMIT geodetic software V.10.32 applied to the whole Belgian Dense Network (BDN) of GNSS stations. For the moment, near real time observations of ZTD and gradients are not available at RMI.
- The possible interest of ZTD and horizontal gradient measurements for the now-casting is presently studied in collaboration with forecasters and radar imaging researchers.
- In addition, ZTD's for all GNSS stations of the BDN are compared with ZTD's estimated from post-processing of ALADIN NWP. Different ALADIN models with different microphysics are compared with GNSS observations. ZTD measurements represent a useful tool to validate the different tests of ALADIN NWP.

Belgium (2)

- A collaboration with the Belgian Institute for Space Aeronomy and the “Université Libre de Bruxelles” is established to compare different techniques allowing to measure the IWV content (FTIR, CIMEL photometer, radiosonde).
- Four periods of two weeks in 2006 and 2007 have been studied. GNSS IWV contents represent a reference and a useful tool of validation for these other techniques due to the fact that GNSS IWV measurements are available continuously (24 hours on 24) under all weather conditions.
- GNSS IWV will be used to calibrate the CIMEL sun photometer. On the other hand, a comparison between Slant Integrated Water Vapour content (SIWV) from CIMEL photometer (in the direction of the sun) and GNSS SIWV (mapped in the direction of the sun using mapping function, ZTD, horizontal gradients, ground pressure and temperature measurements) will be used to estimate the resolution of GNSS slant delays measurements, in particular to detect the formation of small-scale tropospheric structures.

Updating the User Requirements Document (URD)

- Made user questionnaire late spring to get input for update of URD.
- Very limited response.

From Paul Poli at expert meetings:

- Notify about new stations and movement of stations.
- Changes in processing should be visible in data file delivered to E-GVAP data-server (i.e., change of version number), enabling **automatic detection of change by data assimilation software**.

From "Tomassini, Mariella", DWD

- Regarding the request about the way we would like to be informed about changes in the GPS processing at present an email notification would be fine for DWD, since the data are not used operationally.
- For the future I agree that the information like version number or phase antenna parameter changes should be preferably included in the data file.

From Reima Eresmaa, FMI

We have discussed at FMI about the update of the User Requirements Document.

At this stage, we propose no tuning of the tables specifying threshold values for horizontal sampling, repetition cycle, absolute accuracy, long term stability, integration time and timeliness.

We are interested in using slant delay data in NWP, and we are making preparations for possible operational use of these observations in future. Important for us, and also more widely, to make slant delay data sets available for research use. The currently available data sets are limited. Access to a couple of one-month data sets from a network as dense as possible in the European domain would accelerate research experiments and bring the operational use one step closer in future. Ideally, there would be at least one month of data for a summer period and a similar data set for a winter period.

The URD document currently focuses on specifying those threshold characteristics that need to be met by the processing centres and receiver networks in order to make benefit of the GPS data in meteorological applications. Could the aspect of slant delay data sets be brought up in the document?

?

Discussions at joint expert team meeting, and between Adrian and Henrik about how distant GNSS sites must be placed in order not to measure effectively the same volume of the atmosphere.

Provides absolute lower limit of intersite distance to be mentioned in URD.

If this value is low compared to current URD standard and real intersite distances a higher value could be used, in order to provide a realistic goal.

However, this could result in GNSS delay data not becoming available from (small) dense networks that happen to exist already – limiting the possibility to study the effect of very dense networks in meso scale models, in now-casting and in the development of GNSS slant delay meteorology.

Updated URD to be made by Henrik, Dave, +
Propose to have draft ready for joint expert team meeting in November, and based on discussions there.

Final period plans

- Workshop
- Finalising E-GVAP-II proposal and supporting it through EUMETNET Council.
- Automated feedback.
- URD
- Long term archiving

7'th plenary meeting

- January 2009

Other matters

Data exchange beyond meteorology?!

Data exchange beyond meteorology

Hullo, Is it possible for me to have access to the ftp server holding the NRT GPS ZTD repository?

Best Regards, David Mackay *Engineer*

*VERIPOS *, United Kingdom Web Site: <http://www.veripos.com/>

+++++

Thanks for responding.

VERIPOS (www.veripos.com) operates a global network of dGNSS reference stations including several in Europe.

Several of our stations are close to stations in the E-GVAP network. I was interested in comparing the NRT ZTD results from these stations with real-time ZTD estimates from VERIPOS stations.

Best Regards, David Mackay, Engineer, VERIPOS

Extension to a larger territory?!

Turkey

Re: Turkish State Meteorological Service

I am I.smail MERT from the Turkish State Meteorological Services(TSMS). I have been working on the WRF Model and 3DVAR data assimilation. We use synoptic, metar, temp and ship observations in the assimilation process. We want to add PW values obtained from GPS ground stations and radio occultation data from GPS satellites.

We (TSMS) and General Command of Mapping (GCM) have been in a joint working for assimilating IPWV data to WRF Model. We will be able to receive IPWV data from 150 GPS ground stations in Turkey in coming months. Our aim is to use these two sets of data in 3DVAR and 4DVAR assimilation processes.

And we would like to collaborate and work with you.

Fin

- Many thanks for your participation.
- In particular thanks to Kreso and Nikolina for help in organising the meeting.