

EUREF E-GVAP Memorandum of Understanding and Status of E-GVAP

What is E-GVAP?

- EUMETNET GPS Water Vapour Programme
- EUMETNET = organisation of European national meteorological offices (West European + number of East European, enlarging)
- E-GVAP is a separate programme under EUMETNET, not all EUMETNET members are members of E-GVAP.

Purpose of E-GVAP

1. The main purpose of E-GVAP is 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.
2. To improve on the data quality and enlarge data coverage
3. To assist in utilising the data for weather forecasting.

Approach

- Build on results and collaboration established in COST716, TOUGH, and other fora.
- Arrangements on the European level mainly to be made between EUREF and E-GVAP
- Arrangements on national level mainly to be made between national met office and national GNSS site/data owners (to avoid problems related to transfer of national data over borders). E-GVAP can help on making those arrangements.
- For same reason no single central processing centre. Processing to take place where it is most practical in a given situation.
- Build mainly on exchange of data (GNSS data versus meteorological data) and on sharing of resources (e.g. GPS stations being placed on meteorological sites).
- Funding for services are arranged on national level. Mainly for extra expenses in setting up data transfer, for transfer of processing expertise, in some cases for processed data.

Making the MoU

- To strengthen the collaboration between EUREF and E-GVAP, and to further collaboration also on the national level. the making of an MoU was initiated in connection with the EUREF Annual Symposium in Vienna 2005.
- The MoU has been made by people in the **liaison group between EUREF and E-GVAP**, consisting of Elmar Brockmann, Joao Agrio Torres, Hans van der Marel, and Carine Bruyninx from EUREF and Henrik Vedel, Jonathan, and Jones, and Siebren de Haan from E-GVAP.
- Finalising the MoU has taken some time, mainly due to issues related to data ownership and furthering on the meteorological side.

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.

Approval of MoU

- The MoU has been approved by the TWG of EUREF
- The MoU has been approved by the EUMETNET Council (the highest deciding body of EUMETNET)
- The MoU has been signed on behalf of E-GVAP/EUMETNET, by the Chairman of EUMETNET Fritz Neuwirth in two copies.
- I bring with me for this meeting those two copies for signing by the Chairman of EUREF, Joao Agrio Torres.
- Copies of the signed MoU will be made available to those interested. Further the MoU will be made visible at the E-GVAP homepage <http://egvap.dmi.dk>

Next important step

- GNSS processing centres working for E-GVAP already have access to EPN data.
- Access for EUREF to meteorological data will be set up within a few months.
- It is foreseen that access will be provided via password restricted, institute specific ftp.
- How and where will be discussed at the next E-GVAP plenary meeting, which is to take place June 20

Another issue for EUREF E-GVAP discussions:

- Naming (of GNSS sites) policy (for meteorological databases the name must be unique).

Status of E-GVAP

- Runs April 2005 to March 2009.
- Belongs to a group of new EUMETNET observing systems currently considered "experimental" and in "setup phase".
- Planned to transfer into EUCOS (coordinating programme for "permanent" meteorological observing systems) at the end of E-GVAP.
 - This requires trusts in the long term existence of the observing system. One reason for the high interest of an EUREF E-GVAP MoU at the meteorological offices.

Members of E-GVAP

Current: Belgium, Denmark, Finland, Iceland, Netherlands, Norway, Rep. Ireland, Spain, Sweden, Switzerland, United Kingdom (11 members)

To join in 2007: Croatia and France (13 members)

EGVAP project team

- **Management.**

Danish Meteorological Institute (DMI), Henrik Vedel. Email: egvap@dmı.dk

- **Data processing and database.**

UK Met Office (MetO), Jonathan Jones, John Nash, and Dave Offiler.
Email: jonathan.jones@metoffice.gov.uk

- **Validation.**

Royal Netherlands Meteorological Institute (KNMI), Siebren de Haan.
Email: siebren.de.haan@knmi.nl

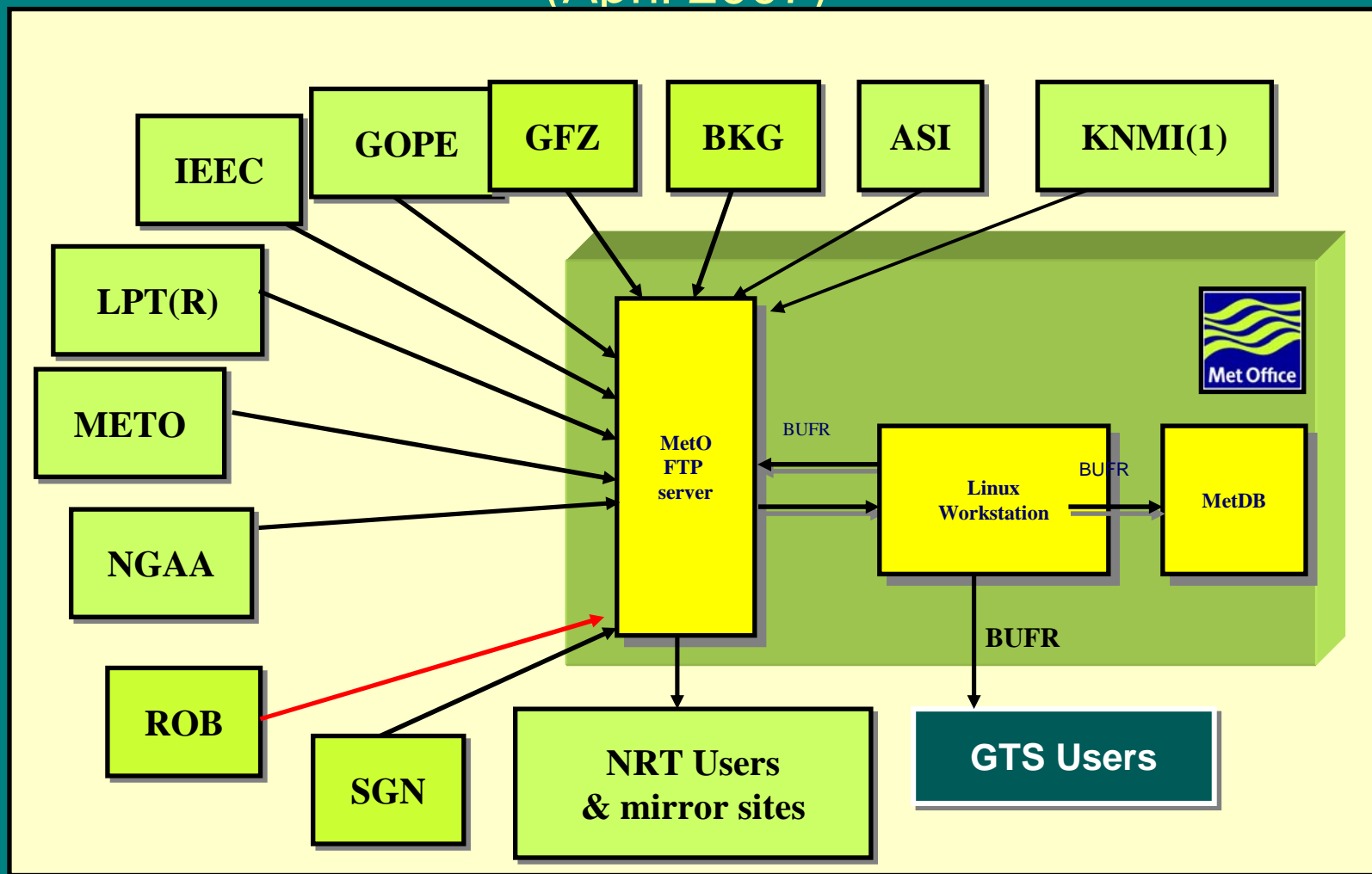
E-GVAP primary contact and information points

Email address: egvap@dmı.dk

Web address: <http://egvap.dmi.dk> (Has links to validation site and datasever)

NRT GPS Processed Data Flow

(April 2007)

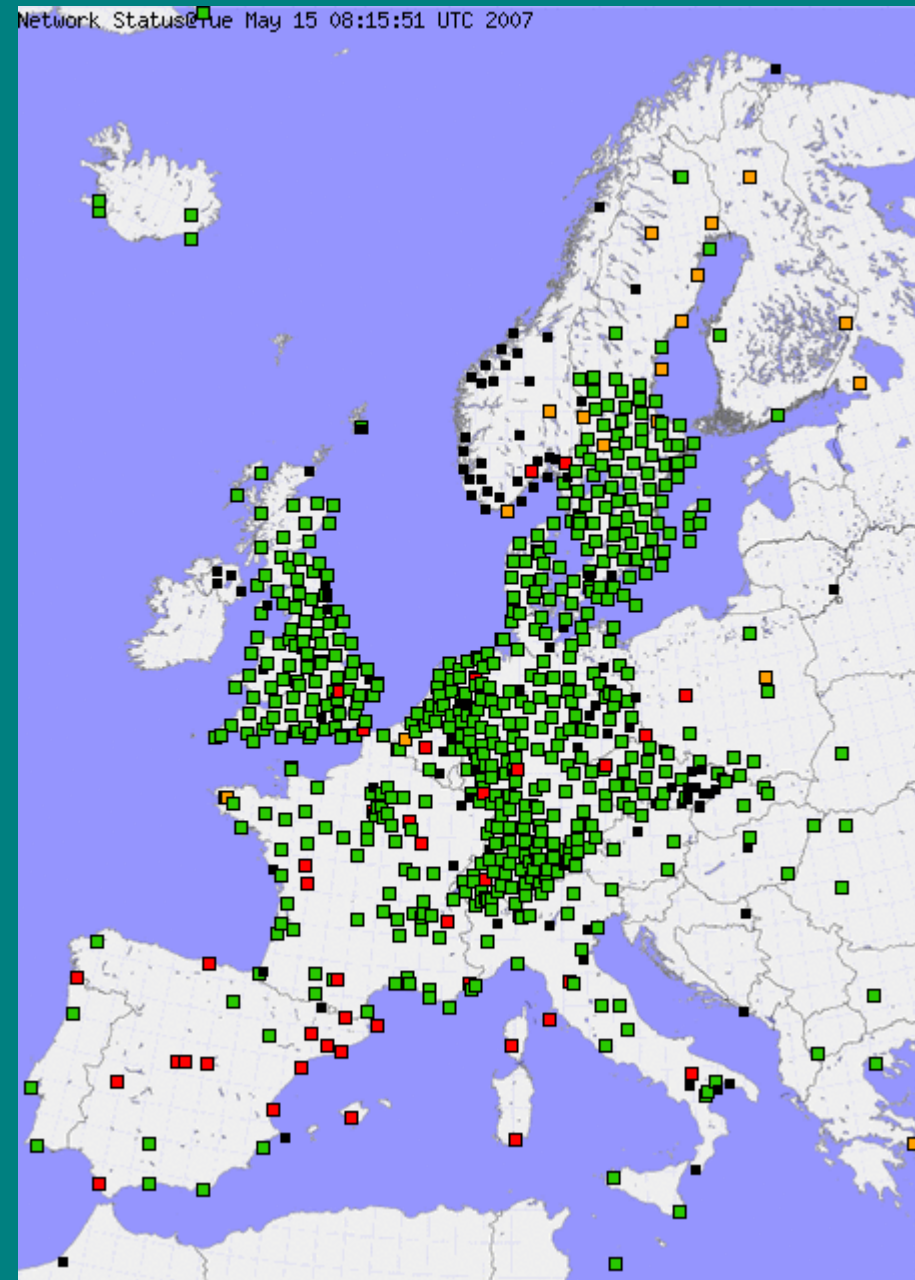


DATA COVERAGE

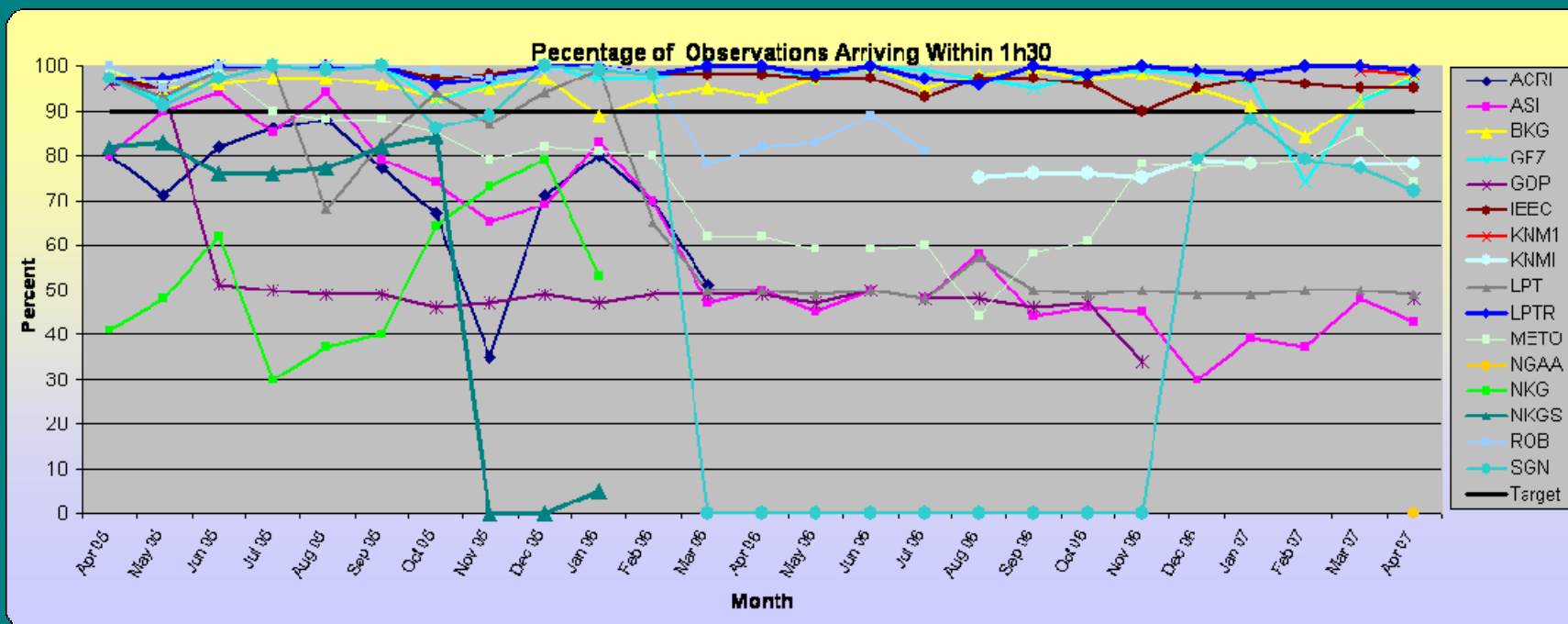
Status map from 20070515 from the E-GVAP validation site. (See egvap.dmi.dk under validation for current situation).

Each square represents a site providing data. Colour indicates age of most recent data from site.

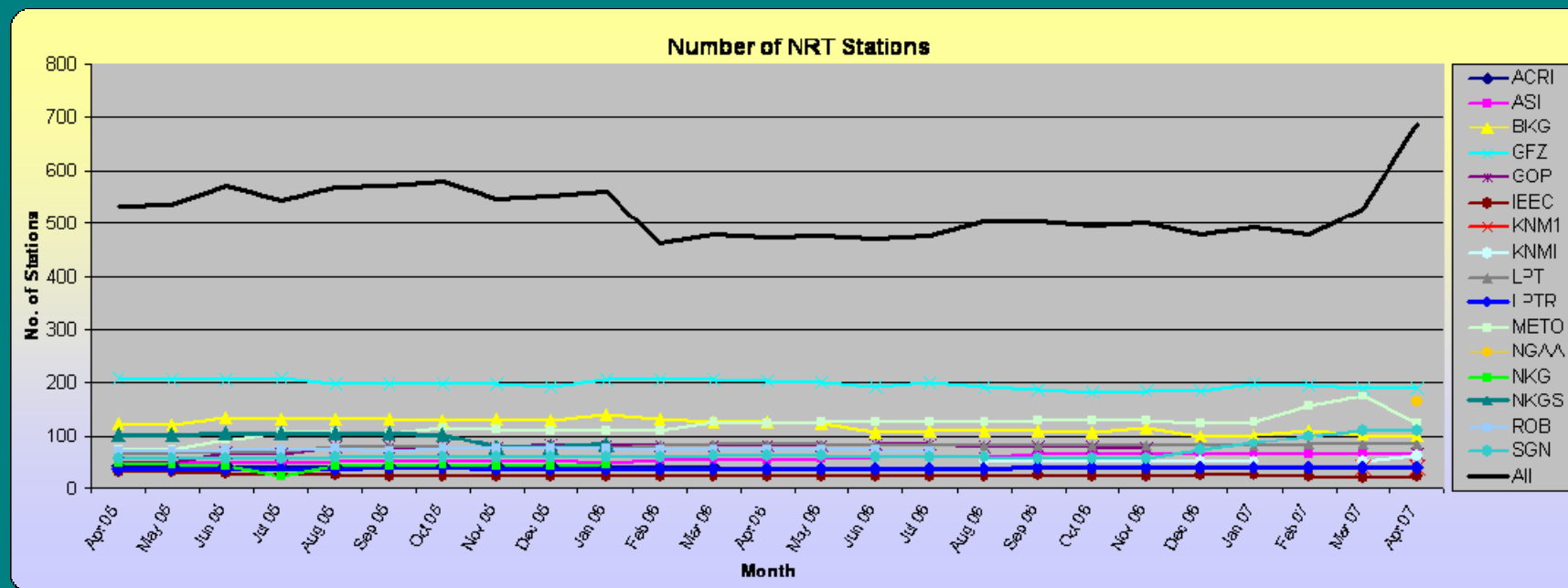
Data available at password protected ftp-server at MetO:
[thorn.meto.gov.uk](ftp://thorn.meto.gov.uk)
and via the GTS network
(between national meteorological offices)



Timeliness monitoring



Number of sites



Quality monitoring

- Continuous quality monitoring is performed and shown at the validation site. Monitoring is against NWP HIRLAM data and against radiosonde data.
- Will be updated with automatic flagging of deviating data.
- Will be updated with automatic feedback to processing centres/site owners in case of detected problems.
- Statistics is now compiled for the NWP-GPS offsets and presented at the KNMI validation site.
- Periodic reports on performance of all stations/centres against NWP and other data will be made. These can be used to assess the quality of various processing methods.

Improving quality monitoring

- Based on a recommendation from the E-GVAP expert team on data processing of expert geodesists as well as E-GVAP people it has been decided to introduce a set of **super-sites** that all data processing centres must include in their processing in the future.
- This will enable quicker identification of many types of problems with the processing that can arise.
- The super-sites are sites with co-located meteorological equipment (radiosonde launch and/or water vapour radiometer).
- Comparisons will be made both between processing centre solutions for ZTD and validation performed against meteorological observations as well as against numerical weather prediction model data.

Expert team on data processing

Rosa Pacione, ASI.

Jan Dousa, GOP.

Etienne Orliac, Univ. Nottingham

Elmar Brockmann, Swisstopo

Galina Dick, GFZ

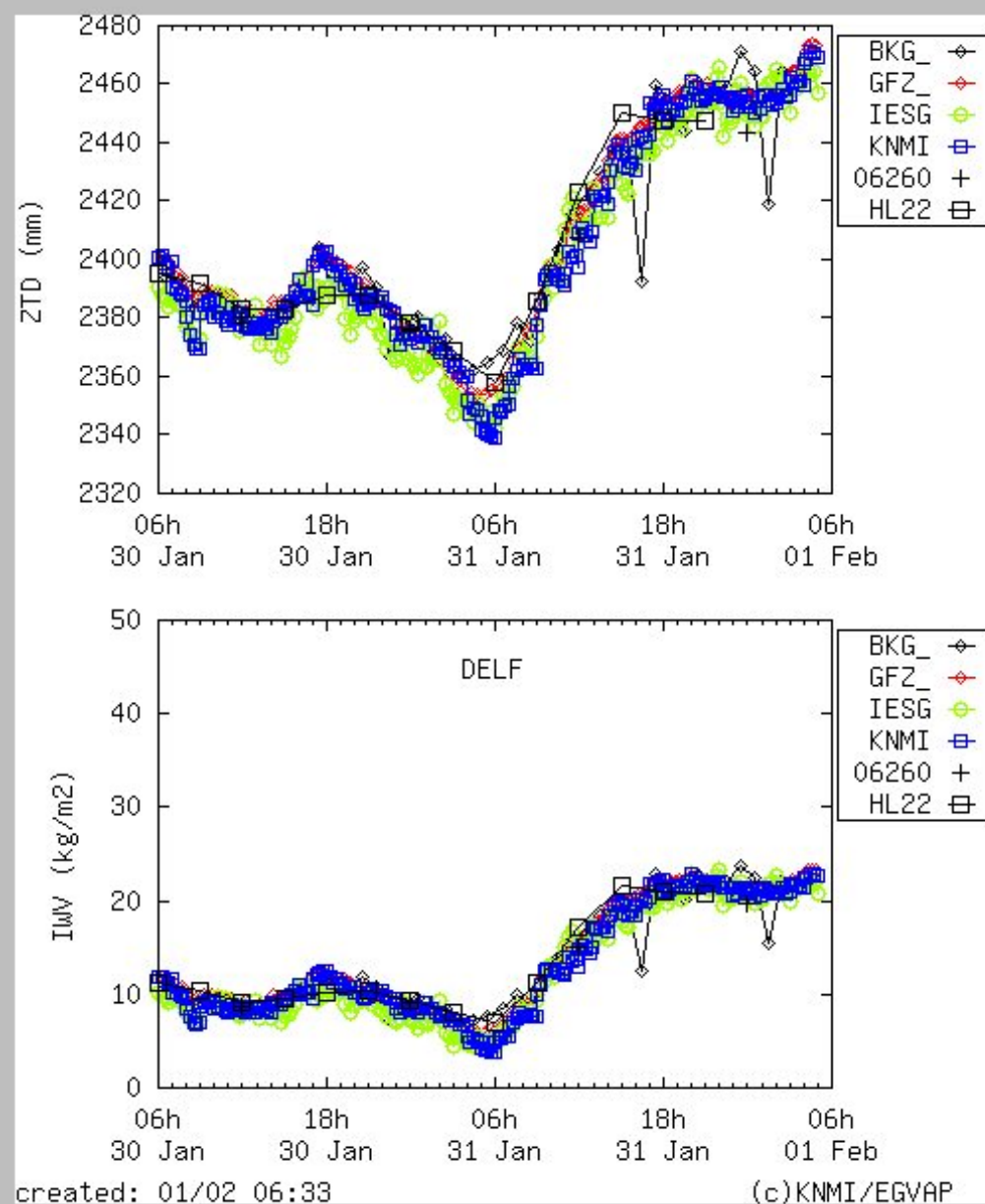
Jan Johansson, Chalmers Tech. Univ.

E-GVAP: Jonathan Jones, Siebren de Haan, Henrik Vedel

Responsible person: Jonathan Jones.

E-GVAP is funding the meetings of the team.

First meeting September 2006. Next meeting September 2007



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

NRT IWV maps (films)

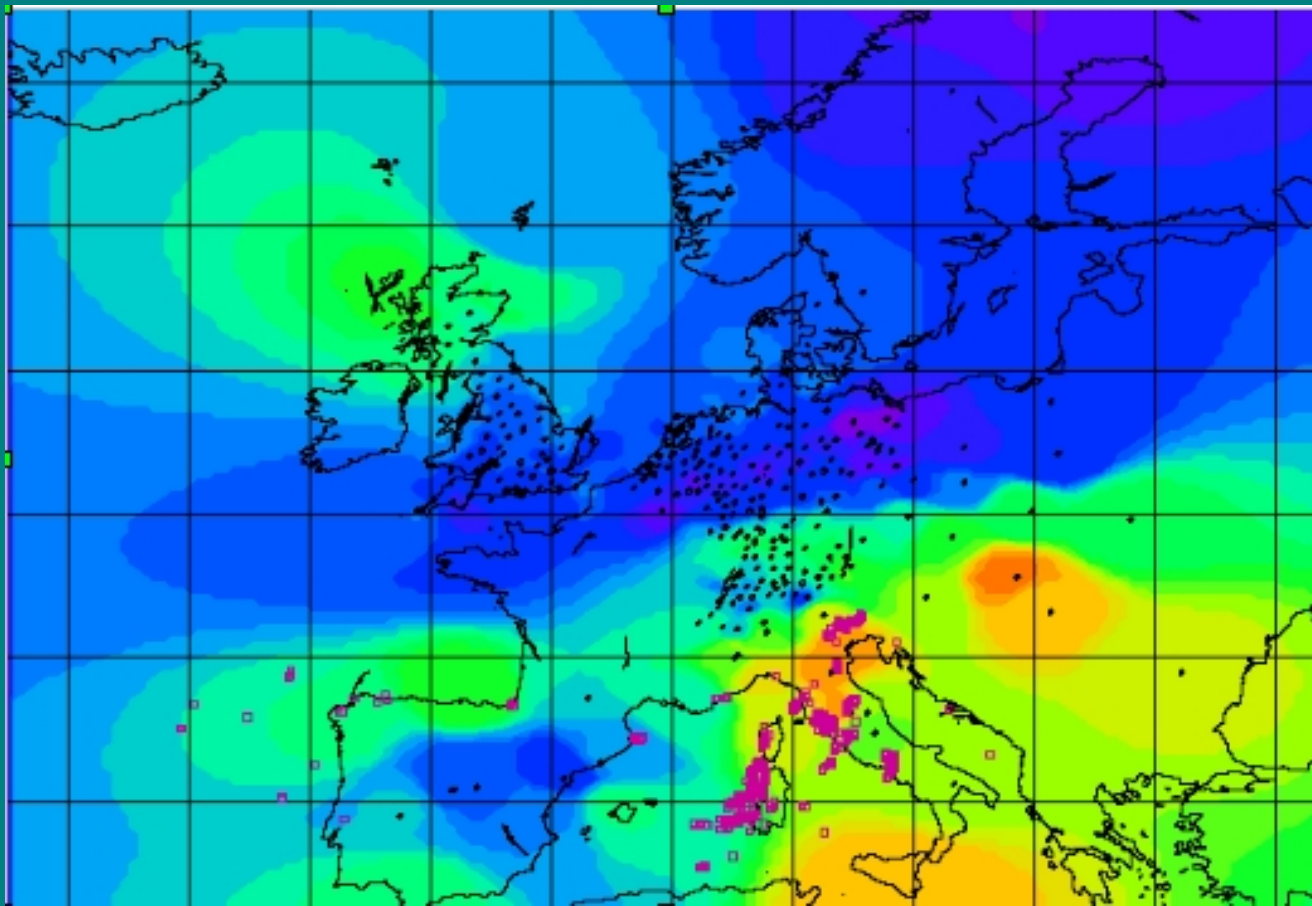
Based on SYNOP pressures and temperatures the ZTD observations are converted to IWV. The IWV point “measurements” are combined into European IWV maps, one per hour, which can be viewed as a film covering the last 24 hours.

Made to assist forecasters in “now-casting” (combining NWP weather forecasts with recent observations to produce a more precise short term forecast.

An area of GPS meteorology which is currently minute, but has a great potential.

IWV map

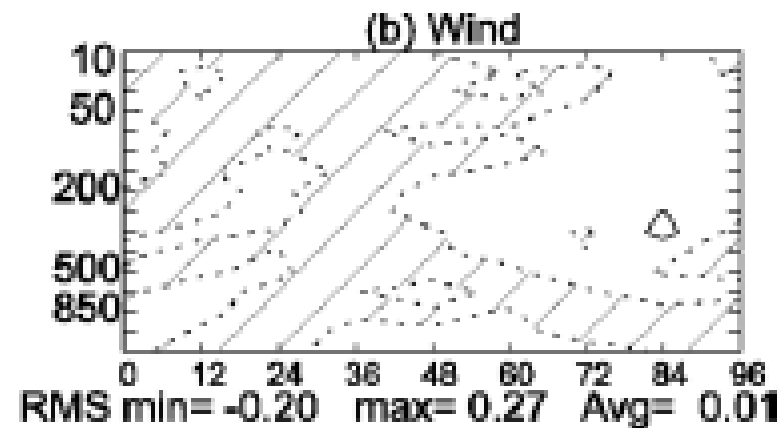
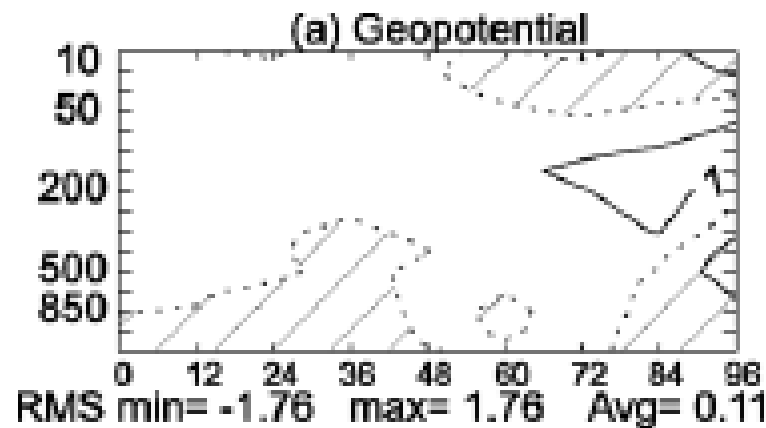
Weather is visible in high density regions, example of few station artefacts seen in some of the data sparse areas.



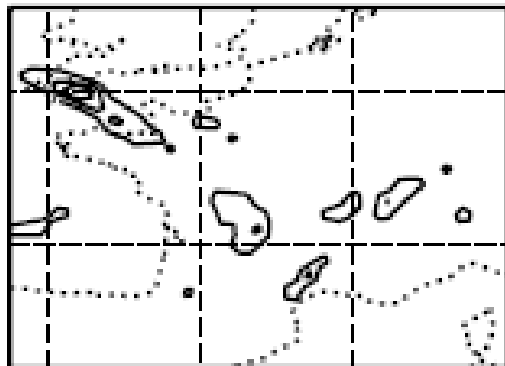
Use of gb GNSS data in European meteorology

- Impact experiments in general indicate an improvement of rain forecasts is found. At some centres only at mid and high levels.
- Some other fields (e.g., humidity/geopotential height/2mT..) are improved, but which varies from centre to centre.
- Importance of bias correction unclear – might be NWP model dependent.
- Data quality is an issue. Sometimes a degradation of the forecasts is seen. Sometimes due to poor GPS ZTDs, also problems in the data assimilation and NWP systems play a role.
- Today UK Met Office and Meteo-France uses NRT ZTDs in their operational forecasts.
- During 2007 Spain, Denmark, possibly also Netherlands and Sweden expect to start using NRT ZTDs in the operations. Currently data are being "monitored".

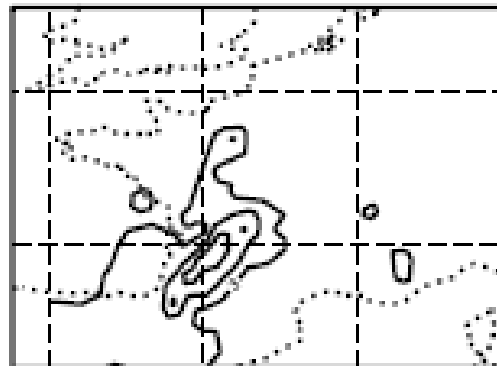
Example of impact



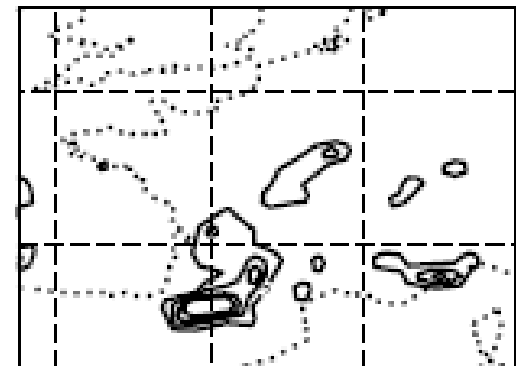
(d) CTL2
2005/04/24 00H-06H Precip



(e) RAIN GAUGES (FRANCE ONLY)
2005/04/24 00H-06H Precip

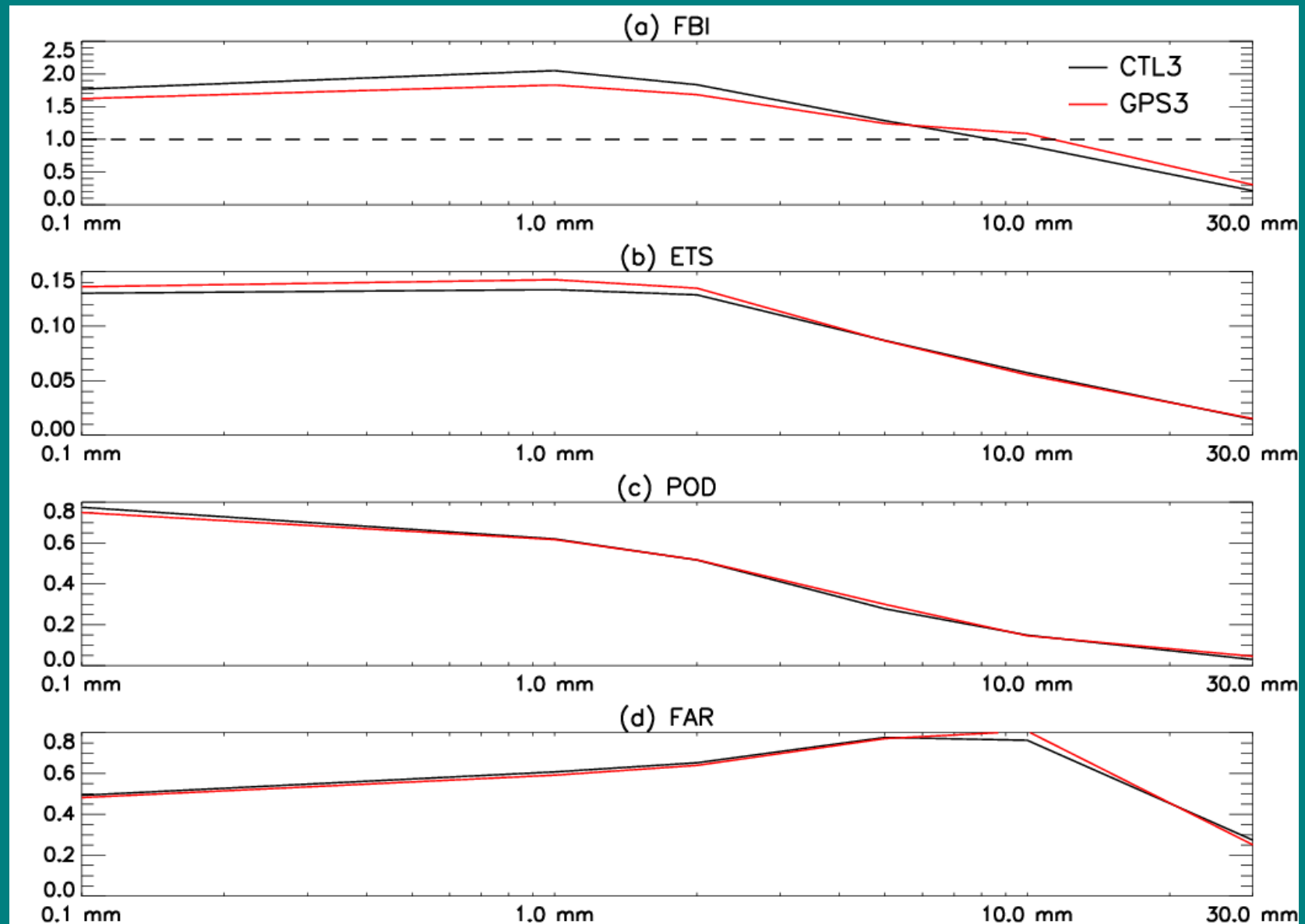


(f) GPS2
2005/04/24 00H-06H Precip



From Poli et al, 2006.

Example of impact (Poli, Meteo-France)



- A significant increase in GPS ZTD data density is sought in a number of countries, including Spain and Italy
- Whether data are processed at a geodetic institute or a met centre depend on convenience, not a plan. The important thing is the quality, the possibility to act in case of detected problems the future stability, and the economy.

European scale liaison group

Inter European scale (EUREF).

- Elmar Brockmann, Swisstopo
- Hans van der Marel, Tech. Univ. Delft.
- Carine Bruyninx, Roy. Obs. Belgium.
- E-GVAP: Henrik Vedel, Jonathan Jones, Siebren de Haan.

Responsible person: Henrik Vedel.

- E-GVAP wants to help in establishing **local liaison**.
- Some funding for meetings/travels is available.
- The purpose of the liaison groups is to further in practice the geodetic – meteorological collaboration.

Future

- We are confident that ground based GNSS data are beneficial to meteorology.
- We expect that some of the resources available at European met centres are beneficial to geodesists (e.g. met data, sharing of sites and other facilities), probably even more in the future.
- We look forward to a tightening of the collaboration between geodesy and meteorology.

The End / Questions