E-GVAP

PB-OBS meeting
June 2008

Content

1. Status report for E-GVAP-I
2. Proposal for E-GVAP-II

Status of E-GVAP-I

Highlights

- A memorandum of understanding has been made between EUREF and E-GVAP/EUMETNET. The MoU governs the exchange of GNSS and meteorological data.
- Metéo-France and DHMZ have become new members in 2007.
- A significant increase in the number of included observing sites, in particular in the Nordic countries, France and Ireland.
- E-GVAP observations are now used operationally at 2 European met centres, giving a positive impact on NWP forecast scores. More institutes expected to follow in 2008.
- Introduction of ”supersites” and upgrade in monitoring.
- Upgrade in IWV films for now-casting.

Timeline

- Start, April 2005
- Finish, March 2009
- Current age 3 ¼ years out of planned 4 years.

Members

- In total 13 members: Belgium, Croatia, Denmark, Iceland, Ireland, Finland, France, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom

E-GVAP economy

The yearly budget (unchanged from year to year)

•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€	

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 invoinced to E-GVAP, leaving about 45 k-euro.

Update on data exchange between EUREF and EUMETNET

- MoU between EUREF and EUMETNET governing data exchange was signed June 2007, by EUMETNET and EUREF chairmen.
- MoU annex 2, governing exchange of ”additional” data, to be signed by individual met offices has since been approved by many members.
- Questions arisen from KNMI as to whether MoU and planed data exchange conflicts with ECOMET rules and EC legislation related to ”equal access rights” to restricted data (i.e. EUREF access to met data via data exchange versus private meteorological agencies access to met data via actual payment).

Solution

The data may be provided to EUREF free of charge, provided the data are used for research and development and are not used commercially.

- Access to meteorological data for EUREF member institutes will take place via password restricted, institute specific ftp.
- Prior to getting access each EUREF institute must return a document notifying detailing that they accept the data are solely for use in research and development, and providing name and address of a responsible person.
- Plans of commercial use must be reported to E-GVAP/EUMETNET, and an agreement found involving either payment or restricted data access (to free data).
- This approach has been approved by people from EUREF and E-GVAP and by a ECOMET representative.
- Met data exchange has just ben set up. GNSS data exchange has been ongoing for a long time.

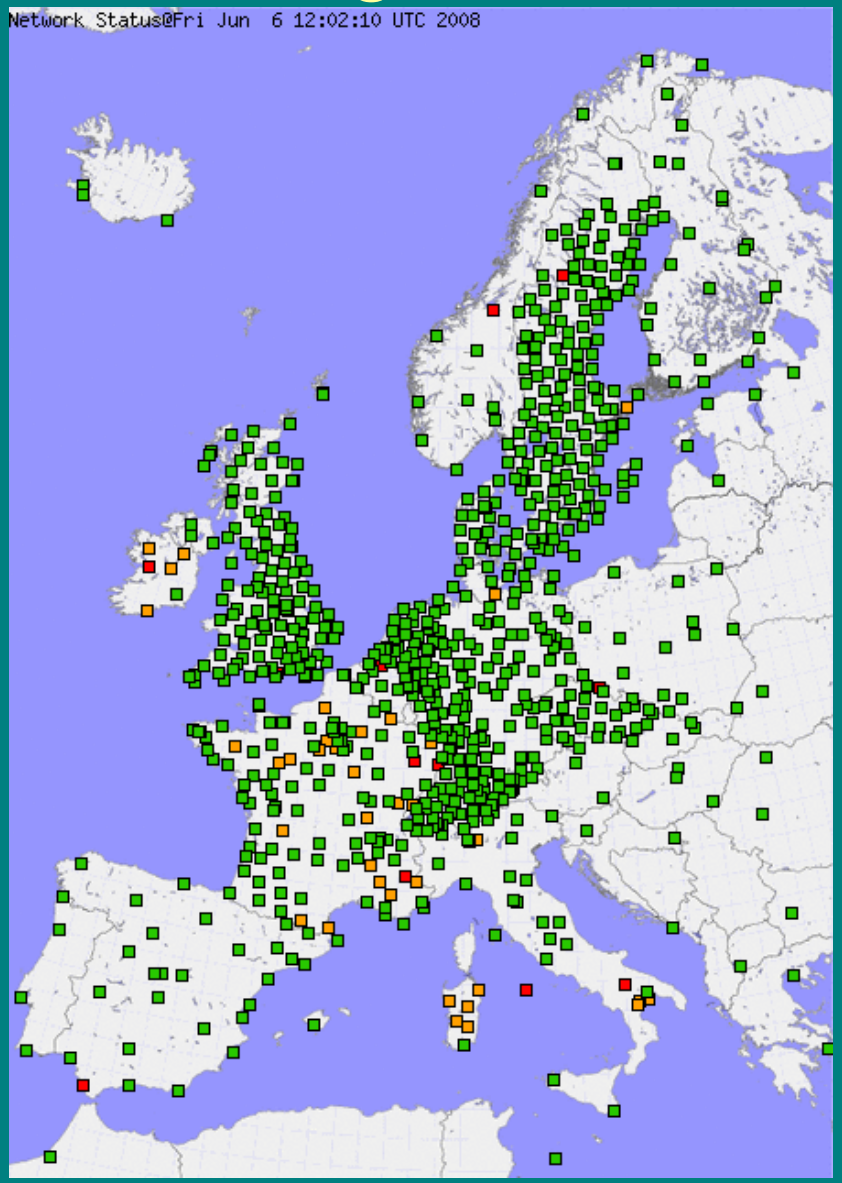
Geographical coverage

GNSS sites for which E-GVAP provides NRT ZTDs and IWVs

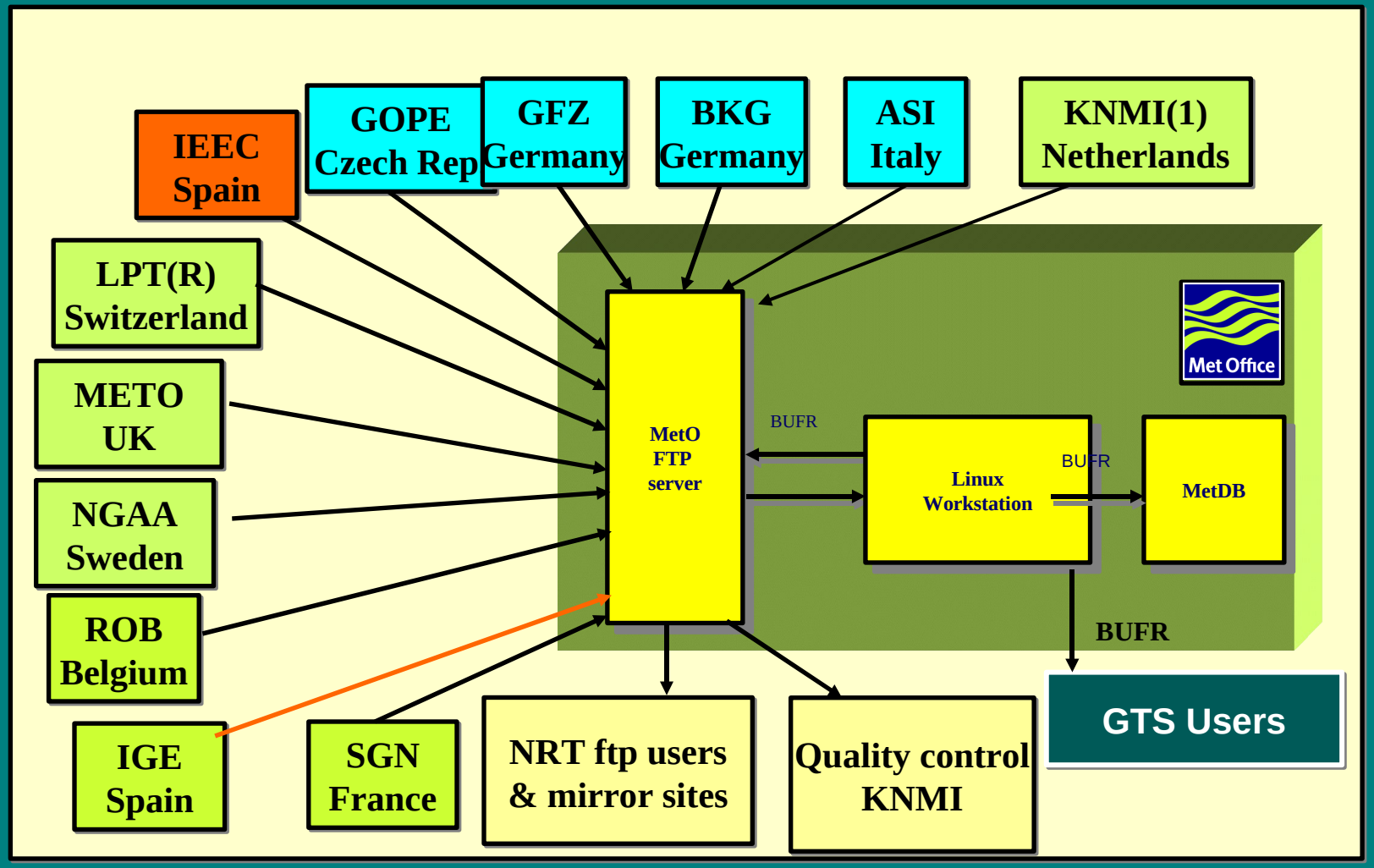
Recent changes: More Finnish sites and Norwegian sites.

Expected near future changes: Norwegiean sites from North Sea, more Spanish sites.

Available via homepage. By Siebren de Haan, KNMI.

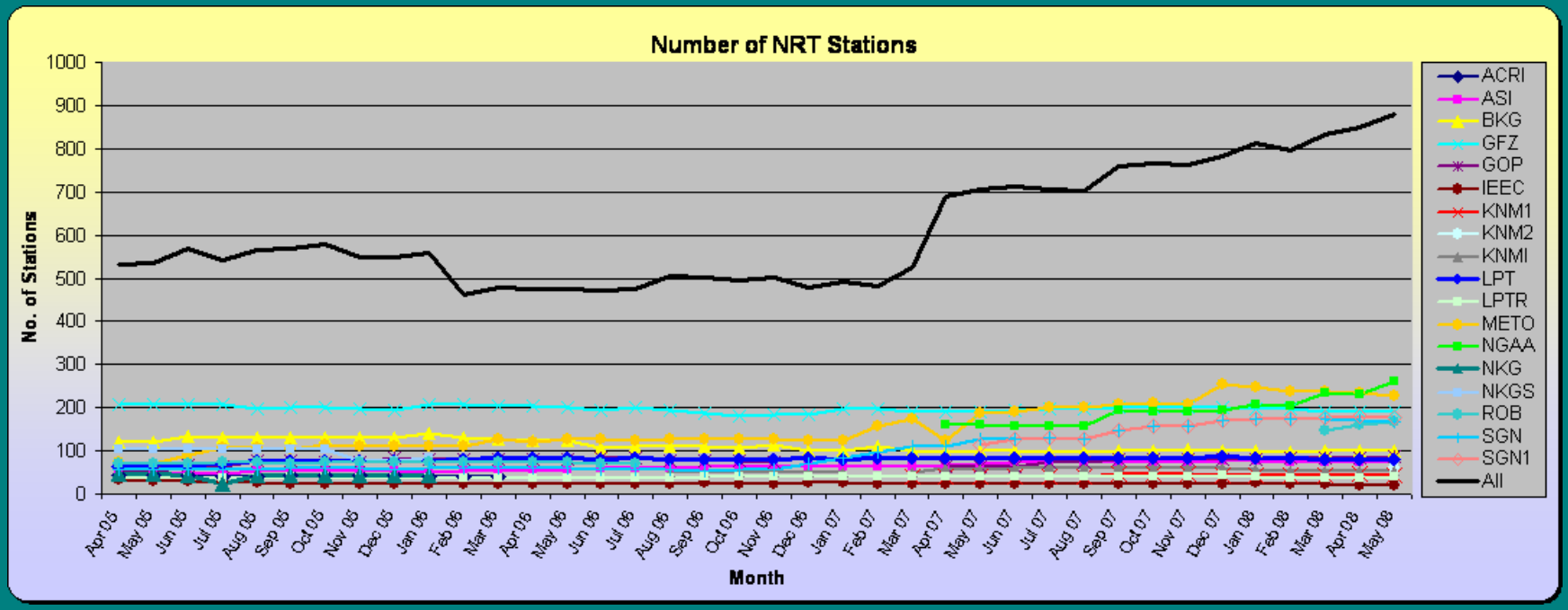


NRT GPS Processed Data Flow



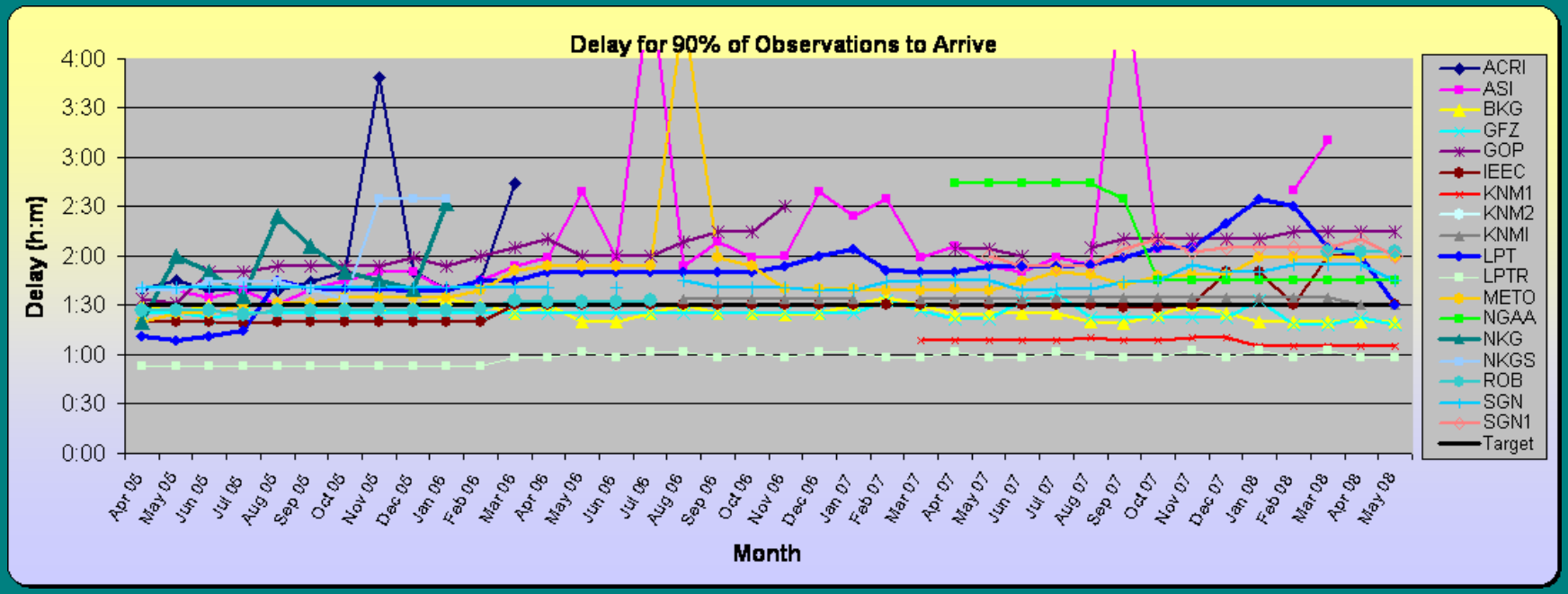
Green = nation member of E-GVAP. Blue = nation not member of E-GVAP. Orange = no updates to processing.

Time evolution of # GNSS sites with NRT ZTDs



Available via homepage. By Dave Offiler, UKMO.

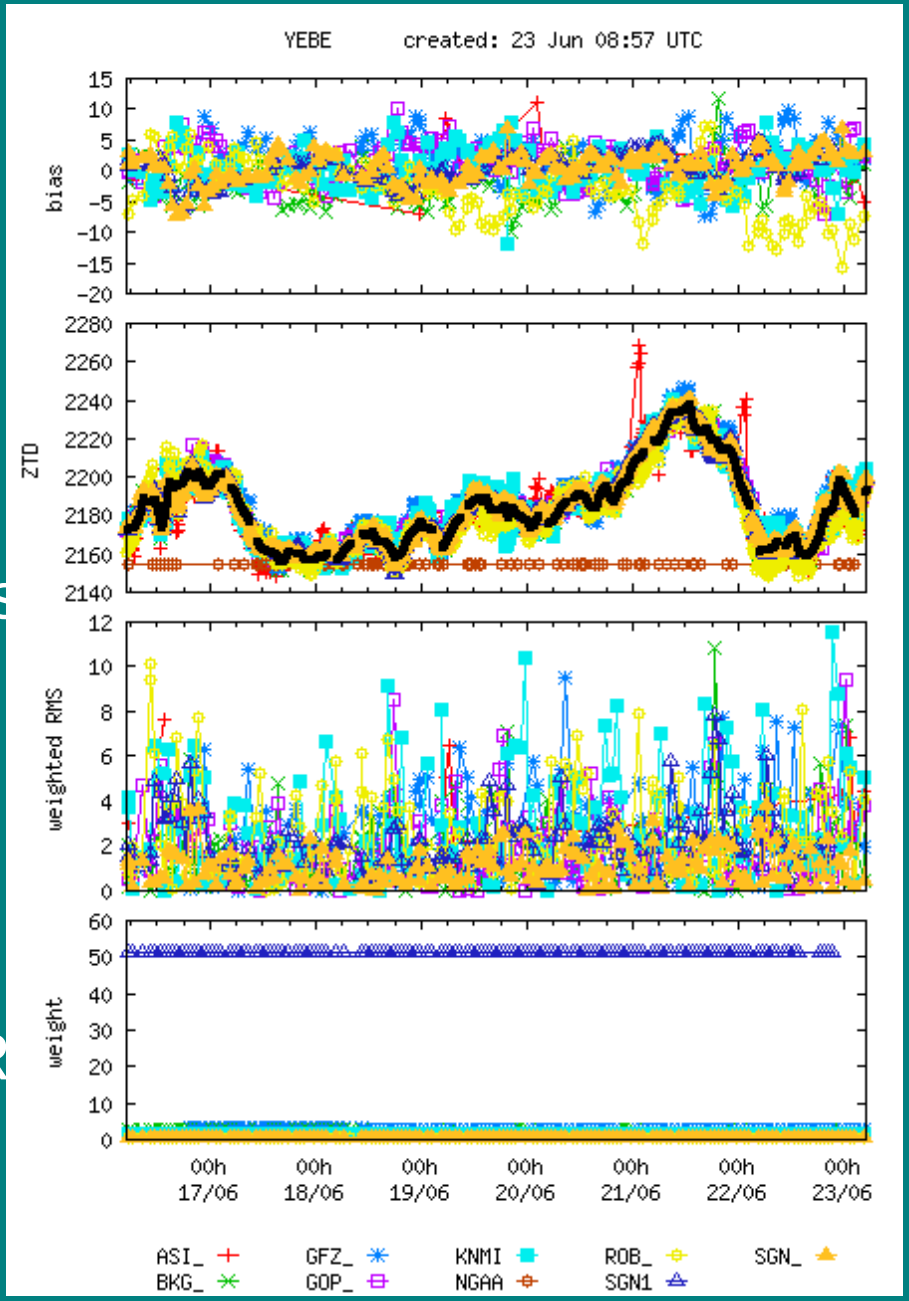
Time evolution of # GNSS sites with NRT ZTDs



Introduction of ”supersites”, decided by expert team on data processing.

Idea: All processing centres must process a common set of sites. Comparison of results provides insight to both general quality of processing and intermittent problems.

Existence of auxiliary observations (radiosonde and WVR) enable validation of GNSS results.



meetings

- Jan 2007 Plenary meeting, KNMI, de Bildt.
- Feb 2007 Expert team on data usage, DMI, Copenhagen.
- June 2007 Plenary meeting, INM, Barcelona.
- Sep. 2007 Expert team on data processing, ASI, Matera, Italy
- Nov. 2007 Expert team on data usage, KNMI, de Bildt.
- Jan 2007 Plenary meeting, Météo France, Toulouse
- May 2008. Joint meeting of expert team on data processing and expert team on data usage, GFZ, Potsdam.
- June 2008, IGS meeting, IGS, US.
- June 2008, EUREF annual symposium, EUREF, Brussels.

- June 16, 2008, Plenary meeting, Dubrovnik
- **November 11, 2008. Workshop, DMI, Copenhagen (note date may change within week)**
- November 12, 2008, Joint expert team meeting, Copenhagen.

Year 1 milestones

- *Succesful setup of liaison group and the two expert groups and first years reports from those.* Achived.
- *Succesful setup of hub to receive GPS meteorological data, distribute them and archive them*. Achived.
- *Start of quality measurements/report facility.* Achived
- *An agreement with EUREF about use of GPS data.* MoU made, transfer of met data just set up. 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 for some countries, starting in some, missing in some.
- *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* Workshop to be held November 2008 (11?! date might change to 10 or 13).

Year 3 milestones

- *Formal arrangements with facilty 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. No formal arrangement, clear that KNMI and METO can process additional data. Exploited EUCOS ”central data hub”, but that turned out to be sometime into the future.*
- *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 being set up with feedback to E-GVAP team.*
- *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. IGE starting in Spain, with help from E-GVAP team. Supersites has addtional data (radiosonde and/or WVR)*

Year 4 milestones

- Ongoing processing of ground based GPS data from an increasing European GPS network. OK
- Review of processing, utilisation, and impact of ground based GPS data at European meteorological services. To be made
- A review/discussion of the future route for European ground based GPS observations for meteorology.
  E-GVAP-II proposal.

Other central work in period as defined at plenary meeting a year ago.

1 Making of MoU between EUREF and ”us” acceptable to PB-OBS and EUMETNET Council (and EUREF). *OK.*

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, with help from E-GVAP team and participation in expert team meetings.

3 E-GVAP and Meteo-France collaboration. *Done. Also DHMZ now a member*

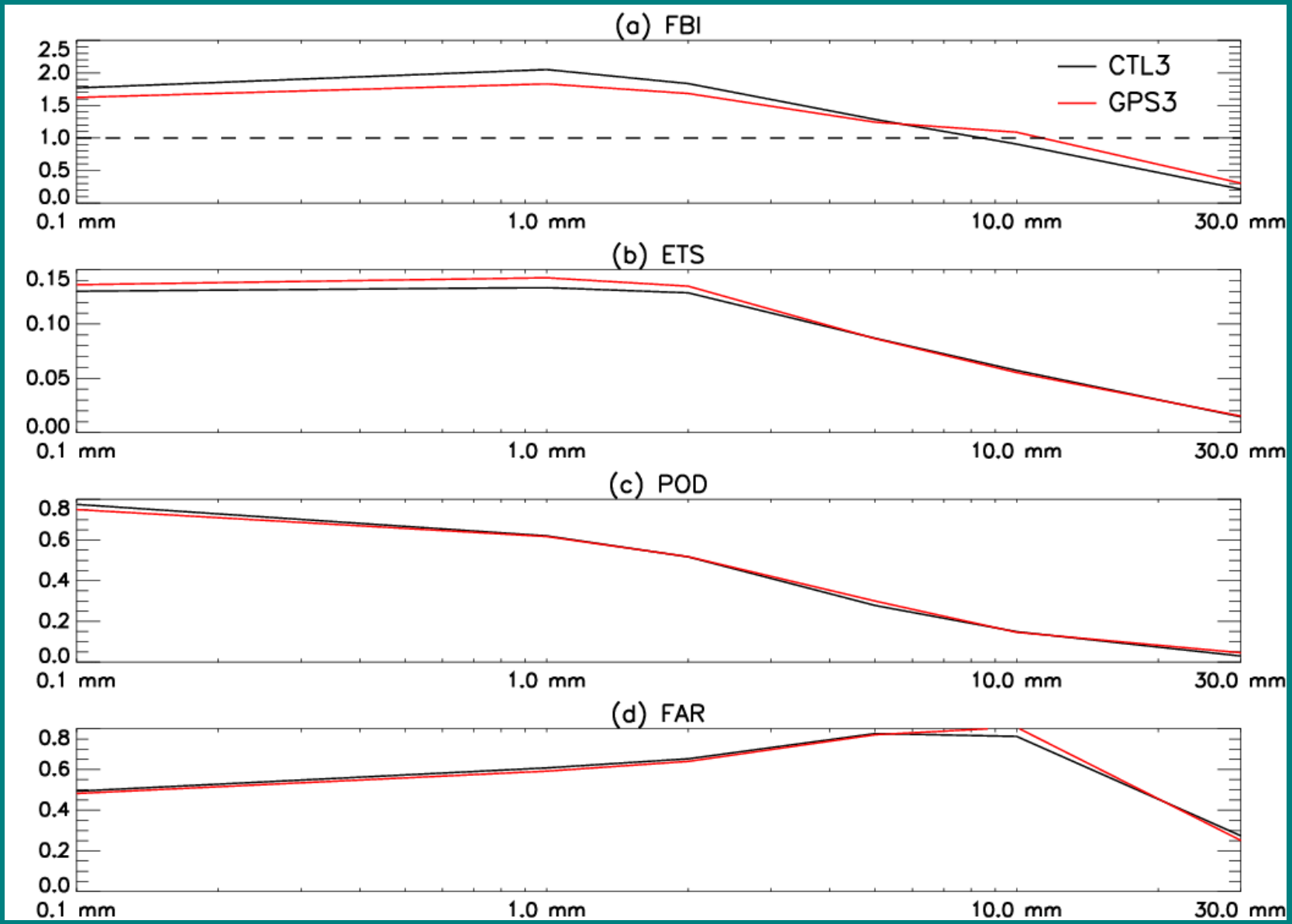
4 Review of User Requirements, data formats, and data distribution with the goal of a future update. User input scheduled to arrive end of June, compilations of requirements to take place during summer and finish at plenary meeting September 16 in Croatia.

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. Debated which type of data to deliver, decided to hand in the NRT GNSS ZTD data.

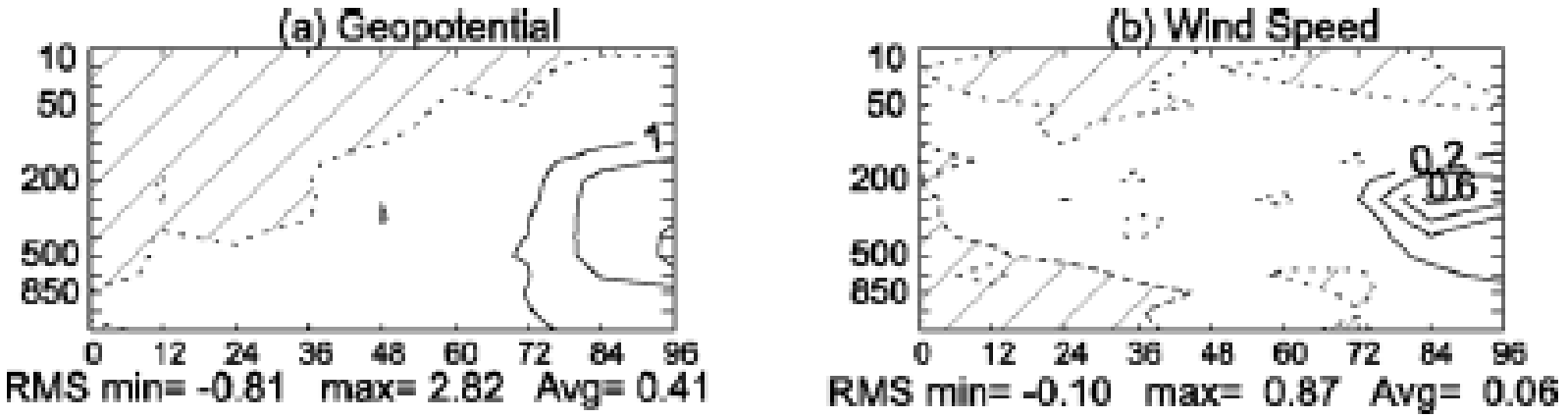
Current use of GNSS data in European weather forecasting

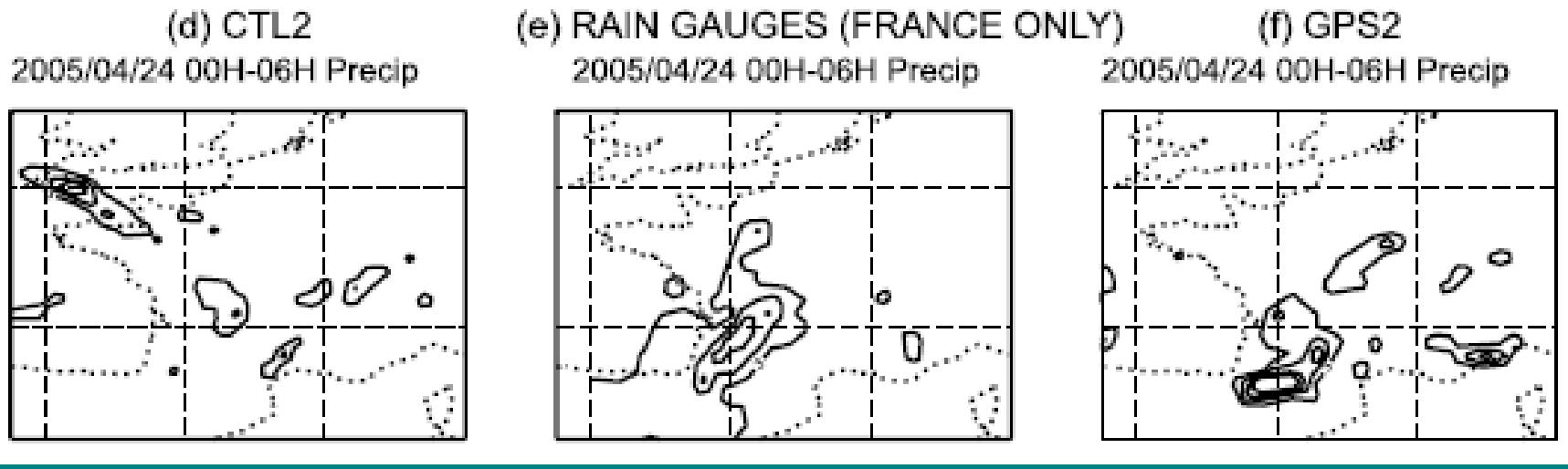
- Operational assimilation: Météo France, in global, regional and mesoscale models, uses whitelist of sites/PCs. UK Metoffice, in regional and mesoscale models, uses whitelist of PCs
- Testing assimilation, planning operational use: Several ”HIRLAM” countries (DMI, KNMI, AEMET(INM), FMI?, SMHI?). DWD starting to test use via nudging into regional model.
- MeteoSwiss working on tomography, to produce 3D fields of water vapour that can subsequently be assimilated.
- Now-casting: IWV maps and animations are available, but more work needs to be done getting experience from use and training users (forecasters) to utilize the data.

Example of use and impact (Poli et al, Meteo-France)



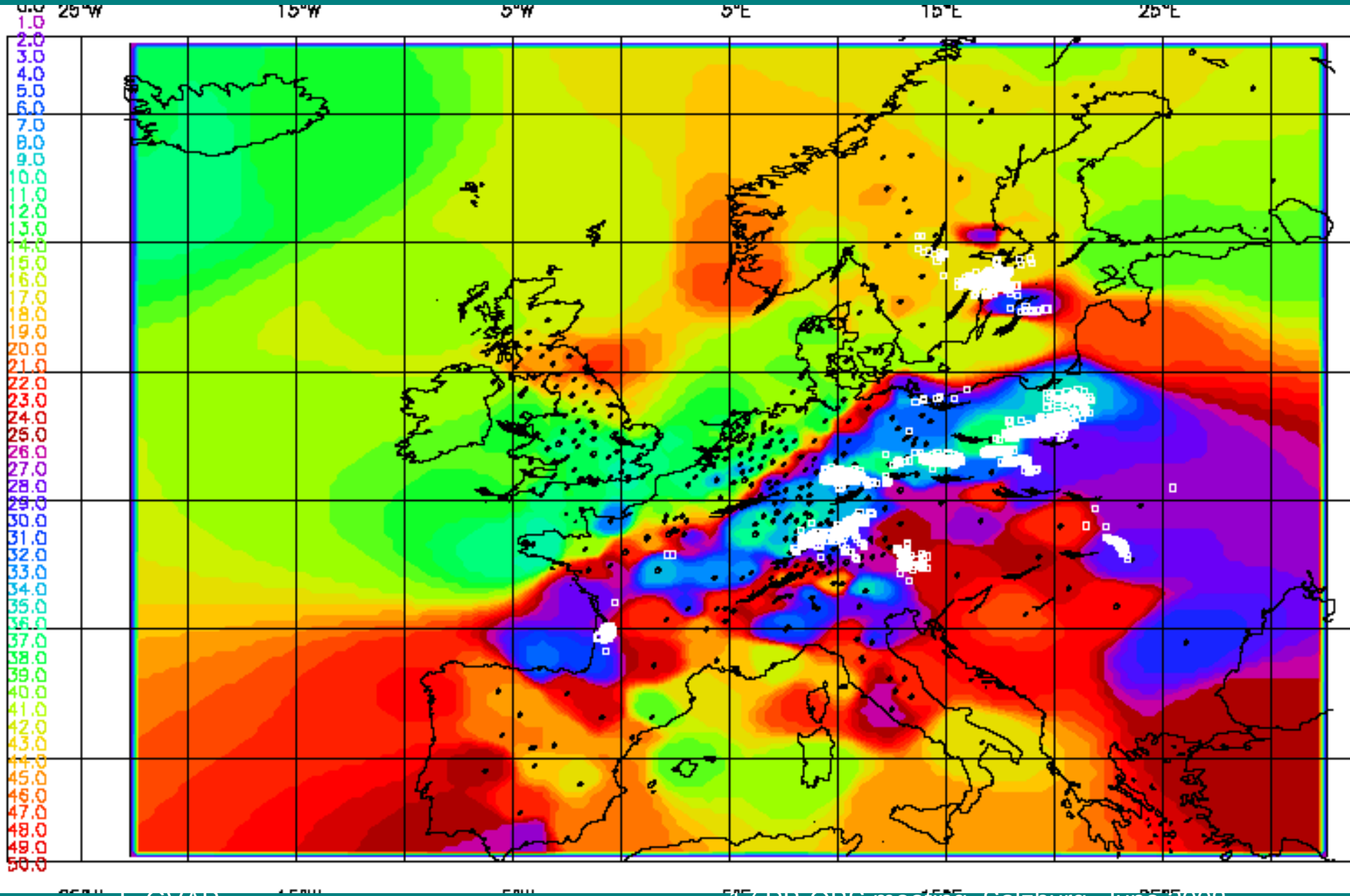
Example of impact



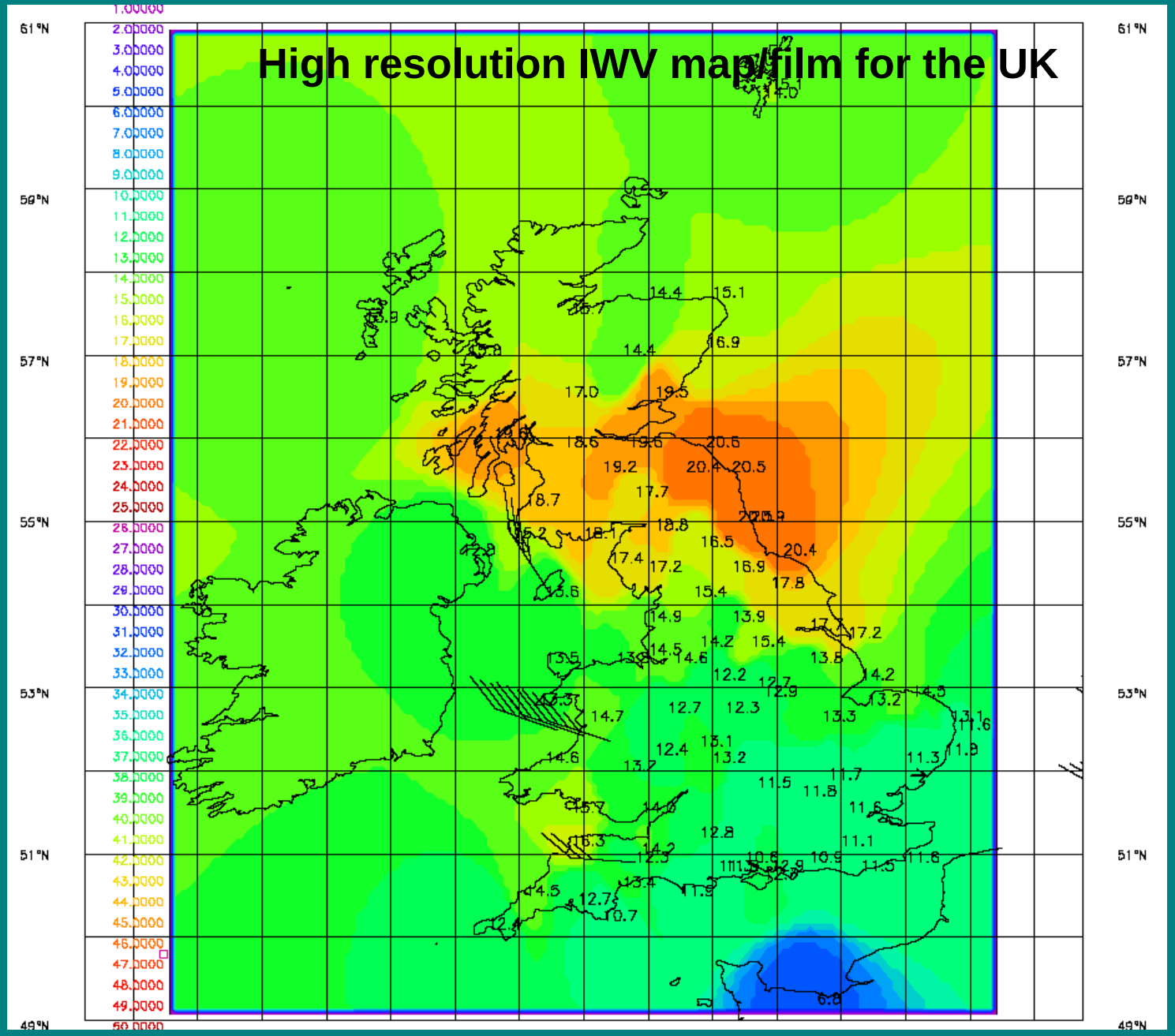


From Poli et al, 2006.

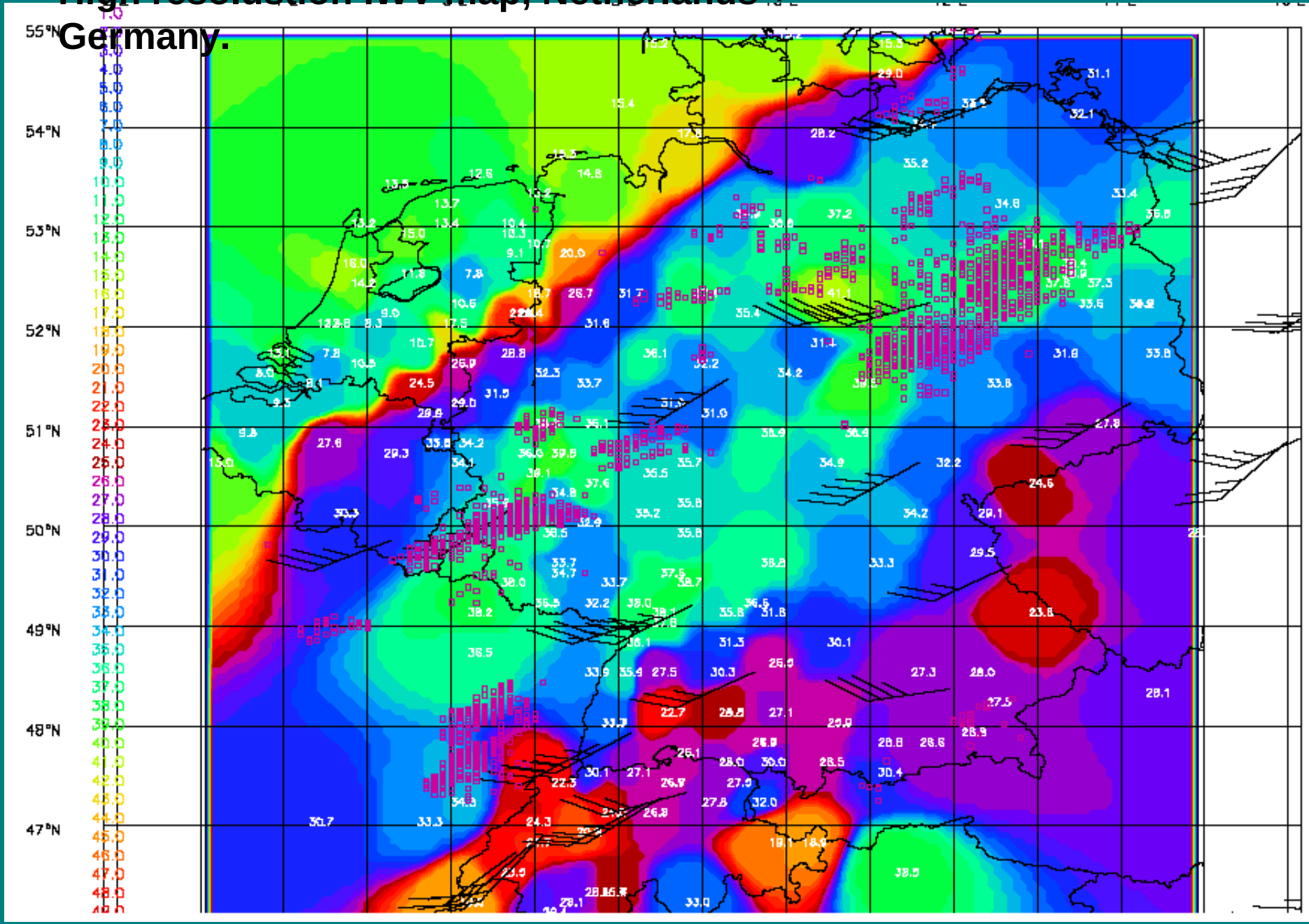
IWV, low resolution, Europe



High resolution IWV map/film for the UK



High resolustion IWV map, Netherlands + Germany.



Proposal for a follow up programme

E-GVAP-II

(EUMETNET GNSS Water Vapour Programme)

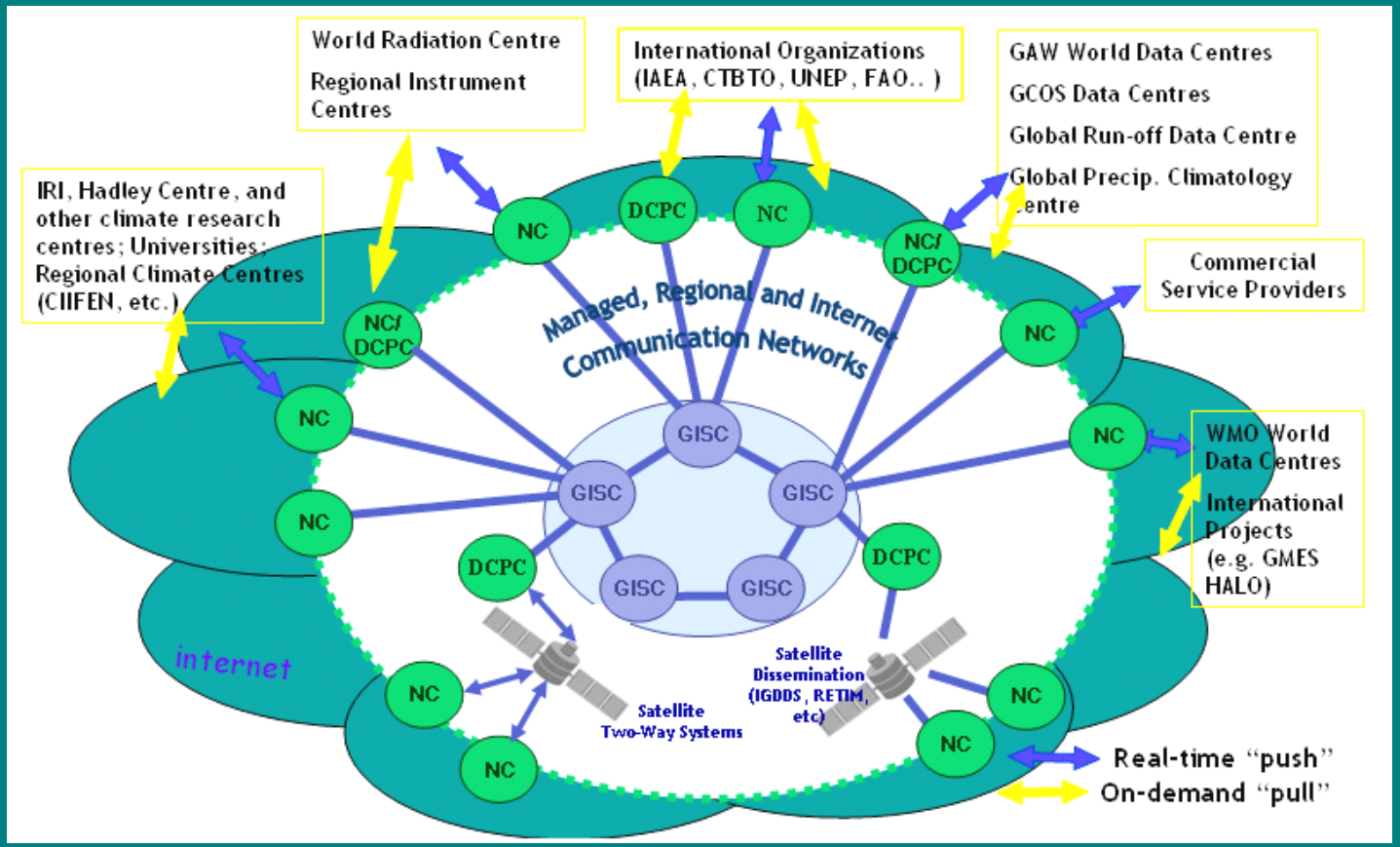
Why a second phase as independent programme?

- While E-GVAP was expected to transfer into EUCOS, there has never been a corresponding EUCOS action item to adopt E-GVAP.
- EUCOS central data hub not available soon enough to substitute E-GVAP servers. Computing capacity unclear.
- Difficulties (and high expenses) when combining in the short run different EUMETNET programmes software on common platform.
- Parallel development of the WIS under WMO, under which scheme the E-GVAP data-server + monitoring facility will become a DCPC for the VGISCs.
- Beneficial and possible to improve GNSS ZTD product significantly via central monitoring enabling ”corrective actions” (ie. withhold or flagging of poor data). Data should be kept ”close to the experts” during this phase.

Why a second phase as independent programme?

- The conclusion that a proposal for an independent E-GVAP programme second phase is the optimal approach in the current situation was made and agreed with the EUCOS team and other programme managerers at the drafting meeting for the EUOCS central data hub, in March 2008.
- Subsequently the plenary members of E-GVAP agreed to this approach.

WMO Information System (WIS)



Main objectives

- Make the European ground based near real time GNSS zenith total delay and water vapour network continue to function operationally.
- Expand network.
- Improve homogeneity and quality of GNSS ZTD product.
- Connect to EUCOS and WIS.

Time and cost

• Starting date	1 April 2009.
• Duration of programme	4 years and 9 months.
• Cost over four years	565,250 Euros.
• Cost of first year	119,000 Euros.
• Date of proposal	June 2008

Objectives

The main objectives of the E-GVAP-II programme are of two types.

The first type is ensuring continuation of the current data delivery.

The other will focus on improving the products and preparing implementation in the emerging common European distribution system for meteorological observations.

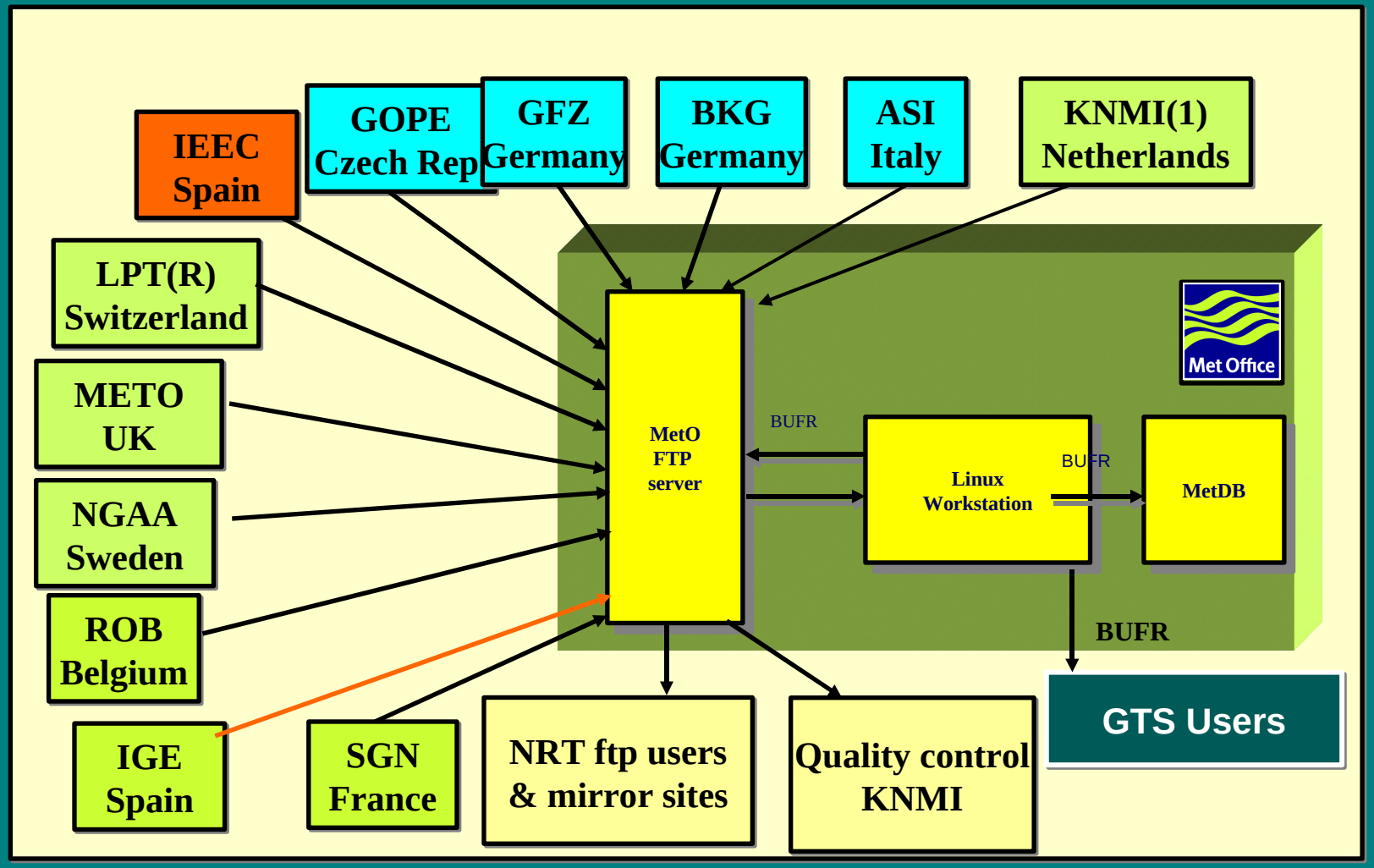
7. Ensure the system built up in E-GVAP-I is maintained and continue to run, to make available for assimilation and now-casting data from the sites currently available in E-GVAP-I beyond March 2009.

1. Continue the established, fruitful close collaboration with the geodetic community. Thereby increase the number of sites, in particular in regions with poor coverage and data, and increase the homogeneity and quality of the NRT ZTDs.
2. Further and improve the construction of IWV maps and animations for use in now-casting.
3. Ensure that data server and data monitoring facilities have backups in case of failure, minimising the risk of a complete lack of ZTD/IWV data.
4. In collaboration with the geodetic community, and possibly EUMETSAT, attempt to improve quality and security of access to so-called “satellite orbit and clock estimates”, which are used in the data processing by the processing centres.

1. Set up methods for monitoring that enable near real time detection and subsequent withhold or flagging of certain types of incorrect NRT ZTD data.
2. Formalise and improve the use of the “supersites” introduced in E-GVAP-I for monitoring of system stability and errors.
3. Collaborate closely with the EUCOS team, both regarding future implementation of E-GVAP into EUCOS, and regarding construction of the planned “EUCOS portal” for access to EUMETNET programme observational data.
4. Convince EUMETNET members using E-GVAP data to become members of E-GVAP.
5. Follow the development of the WIS and VGISC. Prepare for the E-GVAP data monitoring and distribution system to become a DCPC relative to the WIS.

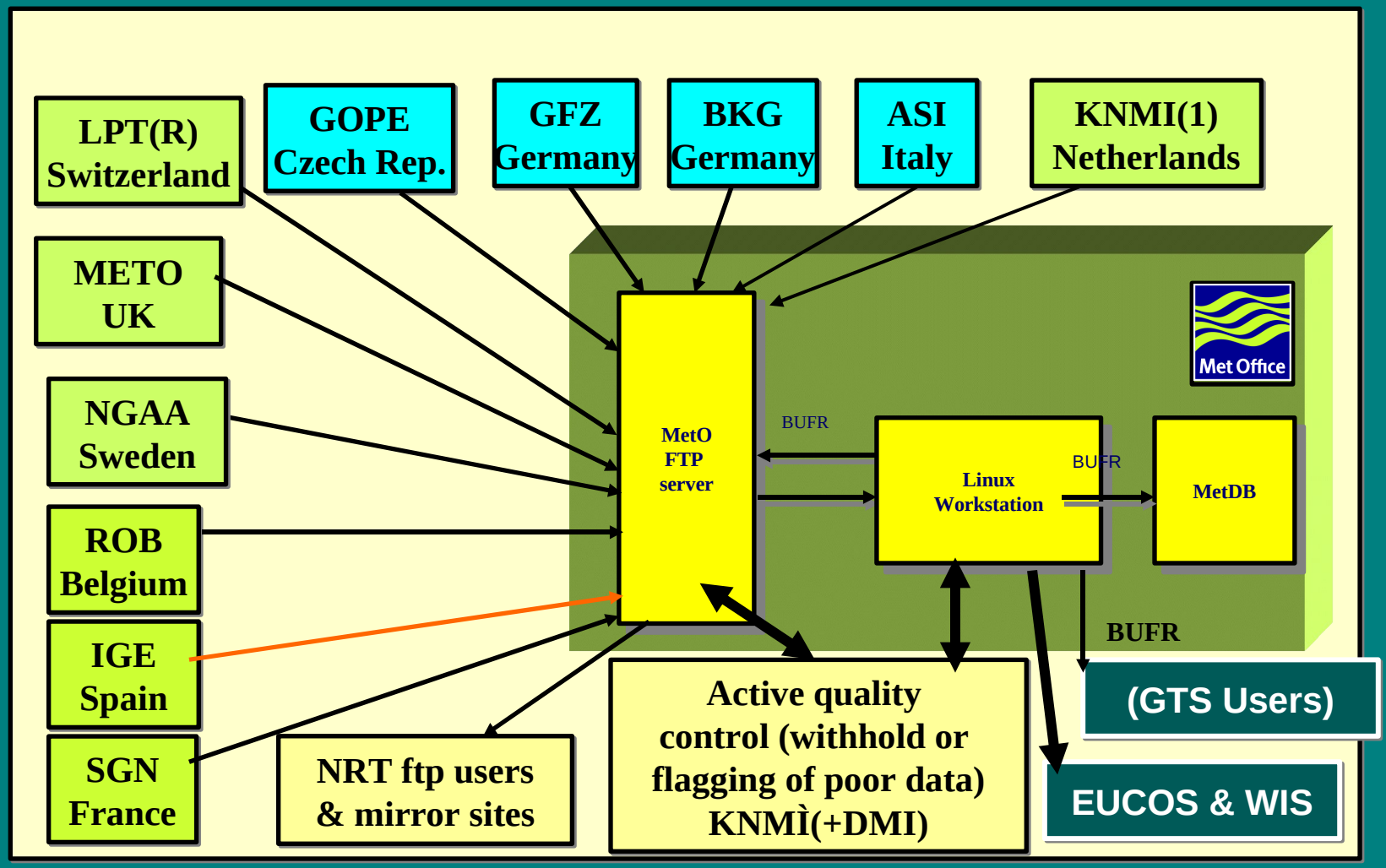
1. To co-ordinate the meteorological exploitation of national sources of GNSS data by cost-effective agreements and provide meteorological support for expansion of GNSS observing networks.
2. To report on the progress of water vapour /zenith total delay data assimilation research and promote the use of GNSS water vapour measurements in operational meteorology by the provision of suitable teaching material and documentation
3. Follow and report on the developments in the field of assimilation of slants and gradient. Enable and encourage production and distribution of gradients and slant delays via E-GVAP facilities.
4. To explore the possibilities for long-term central archiving of both raw (RINEX) and processed (ZTD) data for off-line research and potential future re-processing for climate applications.

NRT GPS Processed Data Flow. Now



Green = nation member of E-GVAP. Blue = nation not member of E-GVAP. Orange = no updates to processing.

NRT GPS Processed Data Flow Future



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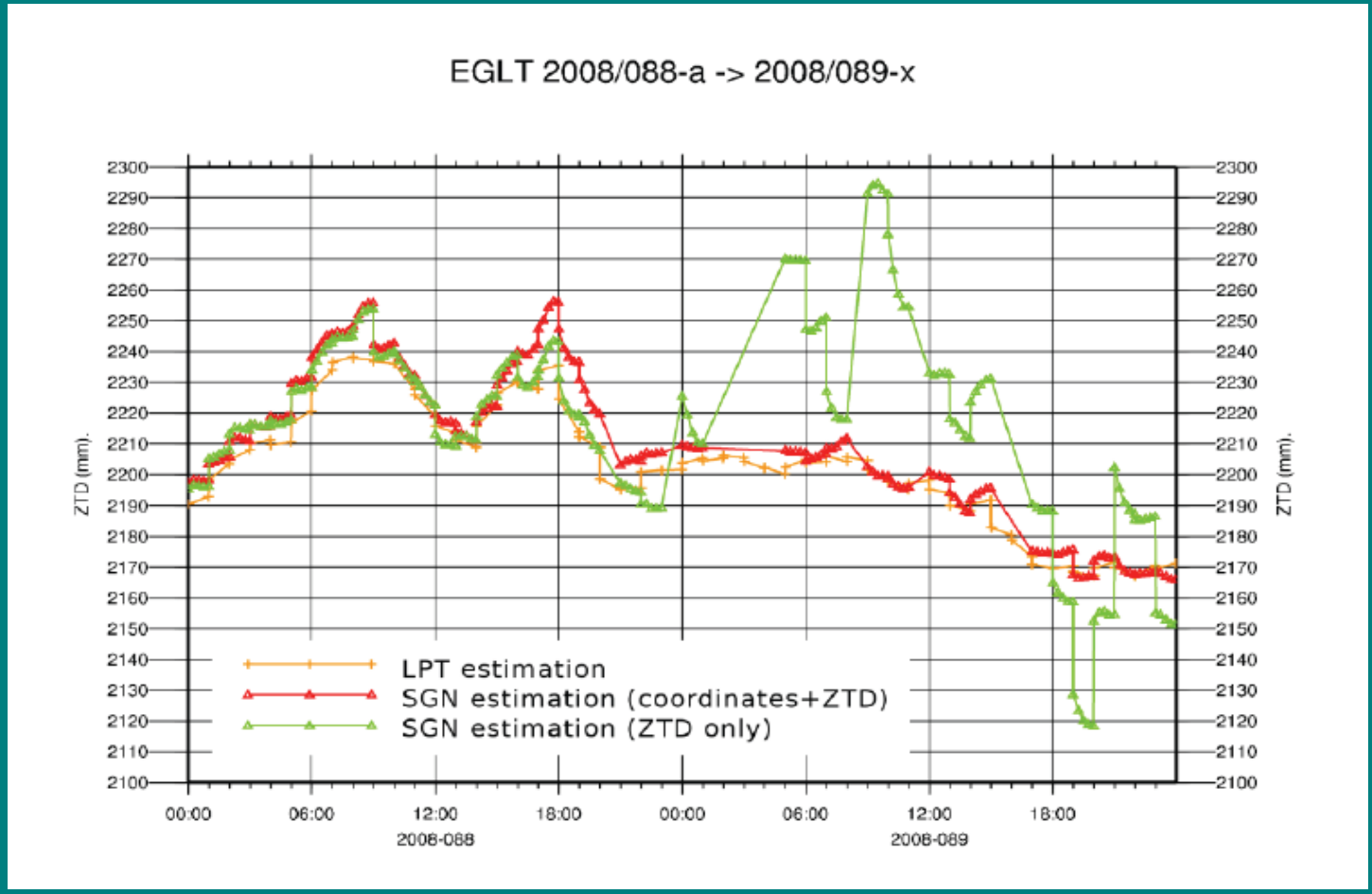
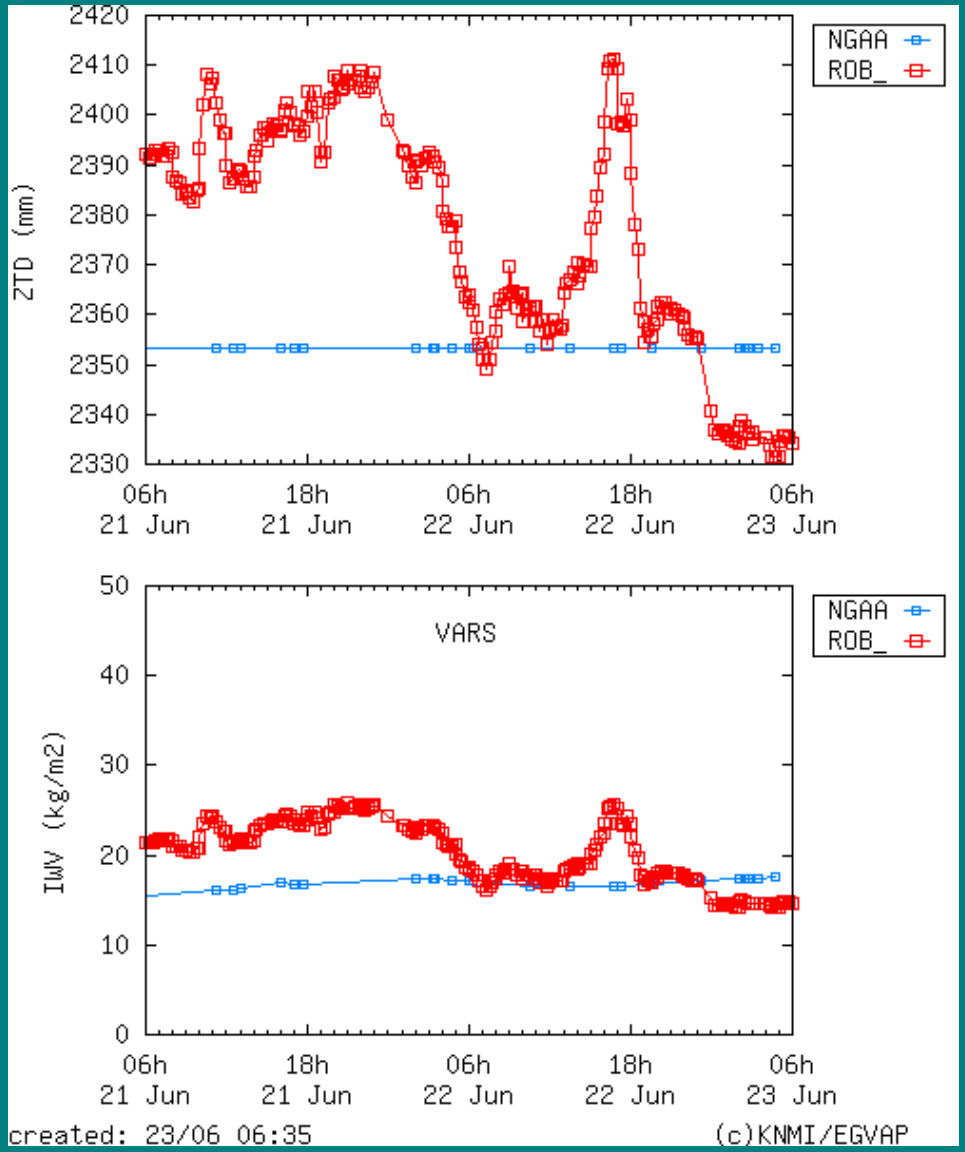
Examples cases for ”corrective actions”.
On day 88 of 2008, a Friday afternoon, a GNSS station was moved 40 m by a site owner. Processing centre was not informed. Because processing is based on a ”network” solution it effected ZTD estimates at ALL sites in the network.

Days 2008/088-091 problem

- Station moved : 40m
- Same acronym, same Domes number
- Switch on at new location on **Friday, 6 PM**

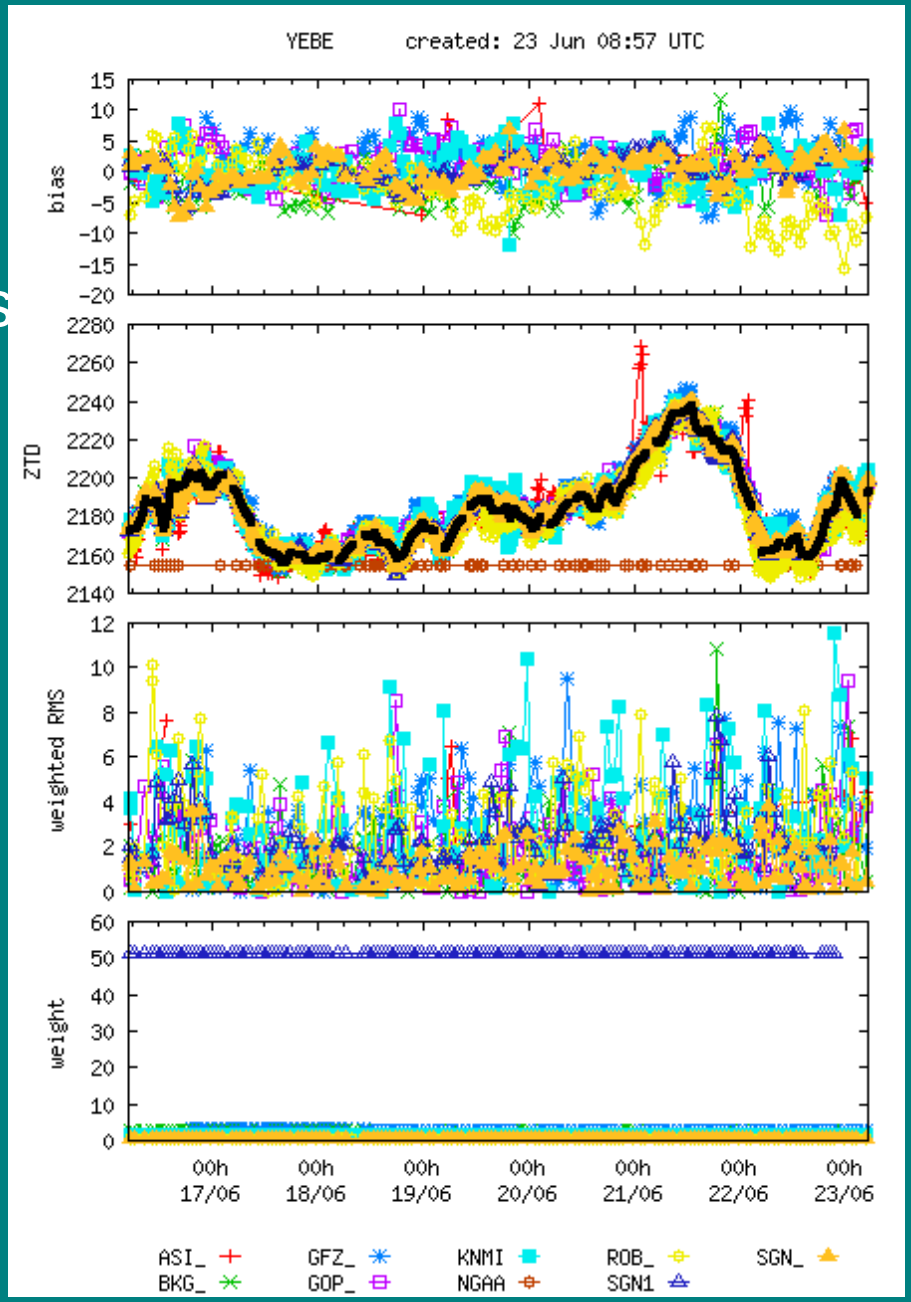


The purpose of ”active quality control”, that withhold or flag poor data, is to guard against such things. It is most easily set up and done at a central facility, passed by all GNSS data and comparison meteorological data.


ZTD (mm)
2420
2410
2400
2390
2380
2370
2360
2350
2340
2330
NGAA
ROB_
06h
21 Jun
18h
21 Jun
06h
22 Jun
18h
22 Jun
06h
23 Jun
IWV (kg/m2)
VARS
50
40
30
20
10
0
created: 23/06 06:35
(c)KNMI/EGVAP

Develop automatic intercomparison of supersites

Include comparison to NWP data.



Programme Time table

- The programme is planned to start on April 1’st, 2009 and to last for 4 years and 9 month.
- Plenary meetings at 6 month intervals.
- Expert teams on data processing and data usage to have joint meetings. Teams to meet once a year, more often if PM decides otherwise.
- Liaison meetings in connection with expert team meetings, EUREF yearly symposium, and on an ad hoc basis as necessary.

Programme Milestones

April 2009 to Dec 2009

- Setup of liaison group and the two expert groups
- Formalisation of contacts to EUCOS, including how to make in common a route map for implementation of E-GVAP into EUCOS.
- Establish contacts to people responsible for the development of the WIS and VGISC.
- Extension of networks in Spain and Portugal.
- First version of software capable of stopping automated distribution of delay data which the monitoring has found to be incorrect.
- Definition of common, minimum requirements to processing as regards problems with access to data from individual sites, and to satellite orbit and clock estimates.
- Establishment of an agreed set of User Requirements appropriate to a fully-operational environment, to be updated during E-GVAP-II as appropriate to changing external drivers and user needs.
- Reports from expert, liaison and E-GVAP teams.
- Establish contacts with non-European Suppliers and Users with the objective of mutual data exchange globally.

Programme Milestones

Year 2010

- Arrangement with facility(ies) which can process GNSS data which might become available in Europe, but are not processed already by current GNSS processing centres.
- Reports from expert, liaison and E-GVAP teams.

Year 2011

- Workshop on the production and use of gb GNSS delay data. In connection with expert team meeting or an international conference.
- Reports from expert, liaison and E-GVAP teams.

Programme Milestones

Year 2012

- A review/discussion of the future route for European ground based GNSS observations for meteorology
- Draft proposal for the future of E-GVAP.
- Reports from expert, liaison and E-GVAP teams.
- Nominal start of operations under EUCOS

Year 2013

- Review of processing, utilisation, and impact of ground based GNSS data at European meteorological services.
- Workshop on the production and use of gb GNSS delay data. In connection with expert team meeting or with international conference.
- Reports from expert, liaison and E-GVAP teams.
- Final report
- Formal hand-over of operations to EUCOS

Budget (per 12 months)

- Project manager 0.5 year per year 43.0 k€
- Contract to support hub/central processing + quality control facility 51.0 k€
- Expert team and liaison meetings 15.0 k€
- Project Travel 10.0 k€
- Total 119.0 k€

This is 10.0 k€ lower than the yearly budget of E-GVAP-I.

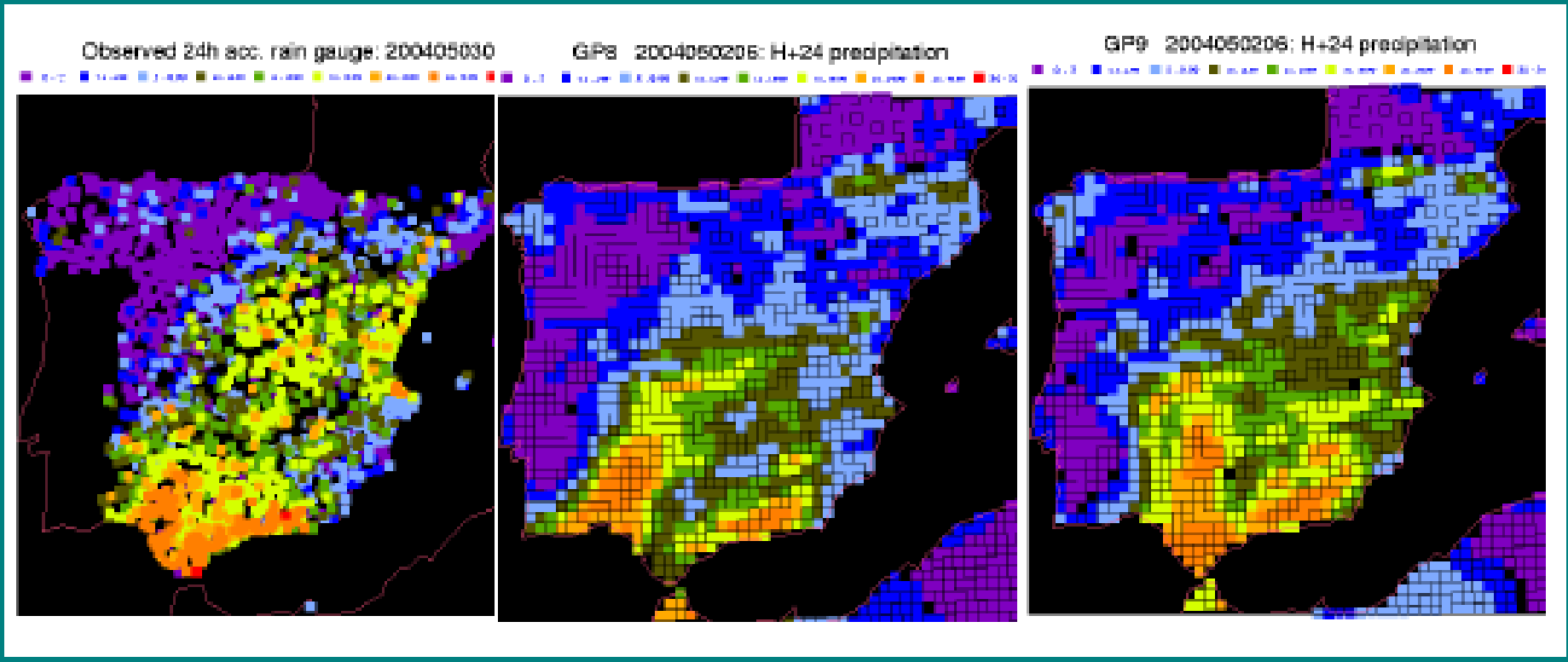
If continuing with the current team these will be spilt as:

- Project manager 0.5 year per year 43.0 k€ DMI
- Contract to support hub/central processing 25.5 k€ MetO
- Contract to quality control facility 25.5 k€ KNMI

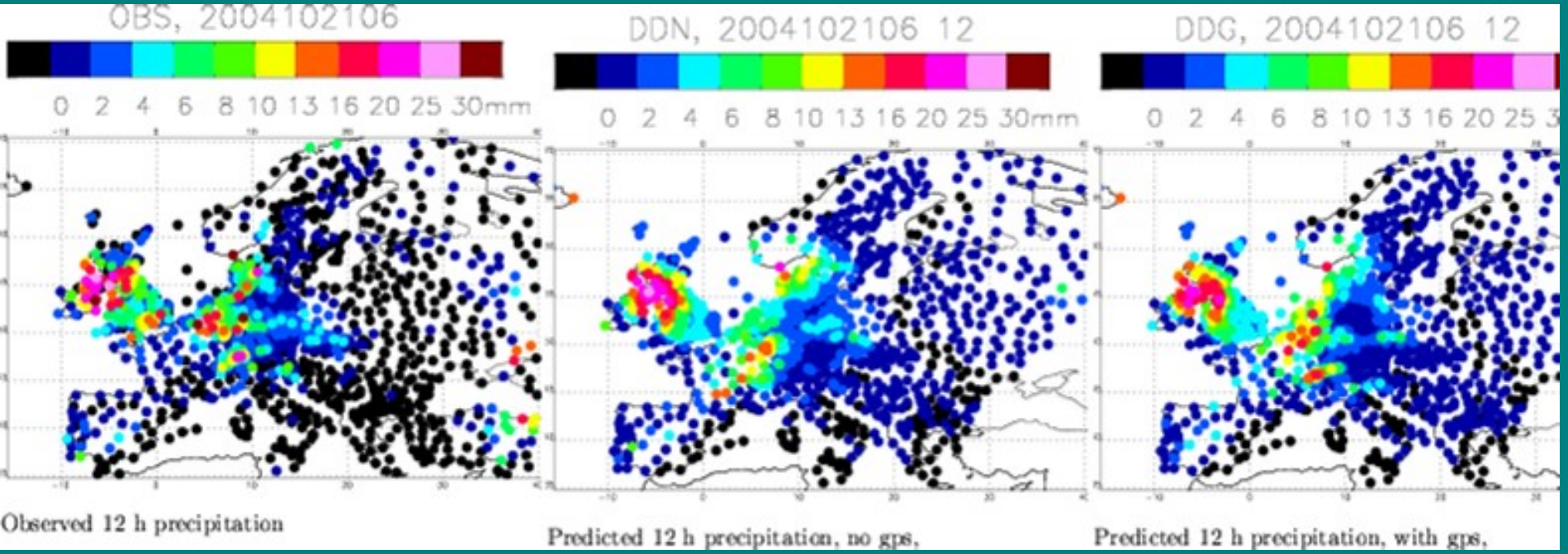
PB-OBS to consider

- Recommend E-GVAP-II to Council

- Eventually recommend selection procedure of responsible member to Council
- The current E-GVAP team, consisting of DMI (resp. member), Het Koninklijk Nederlands Meteorologisch Instituut (KNMI), and UK Metoffice (UKMO) are willing to continue.



Sanchez Arriola, Navascues, and Garcia-Moya, INM



12 hour precipitation, DDN=NWP with no GPS, DDG=NWP with GPS
Sattler and Vedel, DMI.