

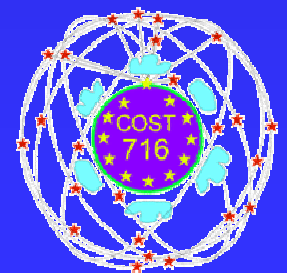
EUREF TWG Meeting, Budapest, Hungary, March 22-23, 2004

COST-716, EUMETNET and possible role of EUREF

Hans VAN DER MAREL, Elmar BROCKMANN

Delft University of Technology,
Aerospace Engineering (DEOS/MGP)
Netherlands

swisstopo
Wabern, Switzerland



COST-716 Action

Exploitation of Ground-Based GPS for Climate and Numerical Weather Prediction Applications for Europe

- Action in force September 1998 (duration 5 years)
- Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Spain, Sweden, Switzerland and UK.
- 4 working groups:
 1. State of the art....
 2. Demonstration project...
 3. Applications...
 4. Towards operational...
- Workshops:
 - ◆ 1st Workshop 10-12 July, 2000, Oslo, Norway
 - ◆ 2nd Workshop 28-29 January, 2002, Potsdam, Germany
 - ◆ 3rd Workshop 1-3 December, 2003, De Bilt, Netherlands
- Action finished April 2004



NRT demonstra- tion

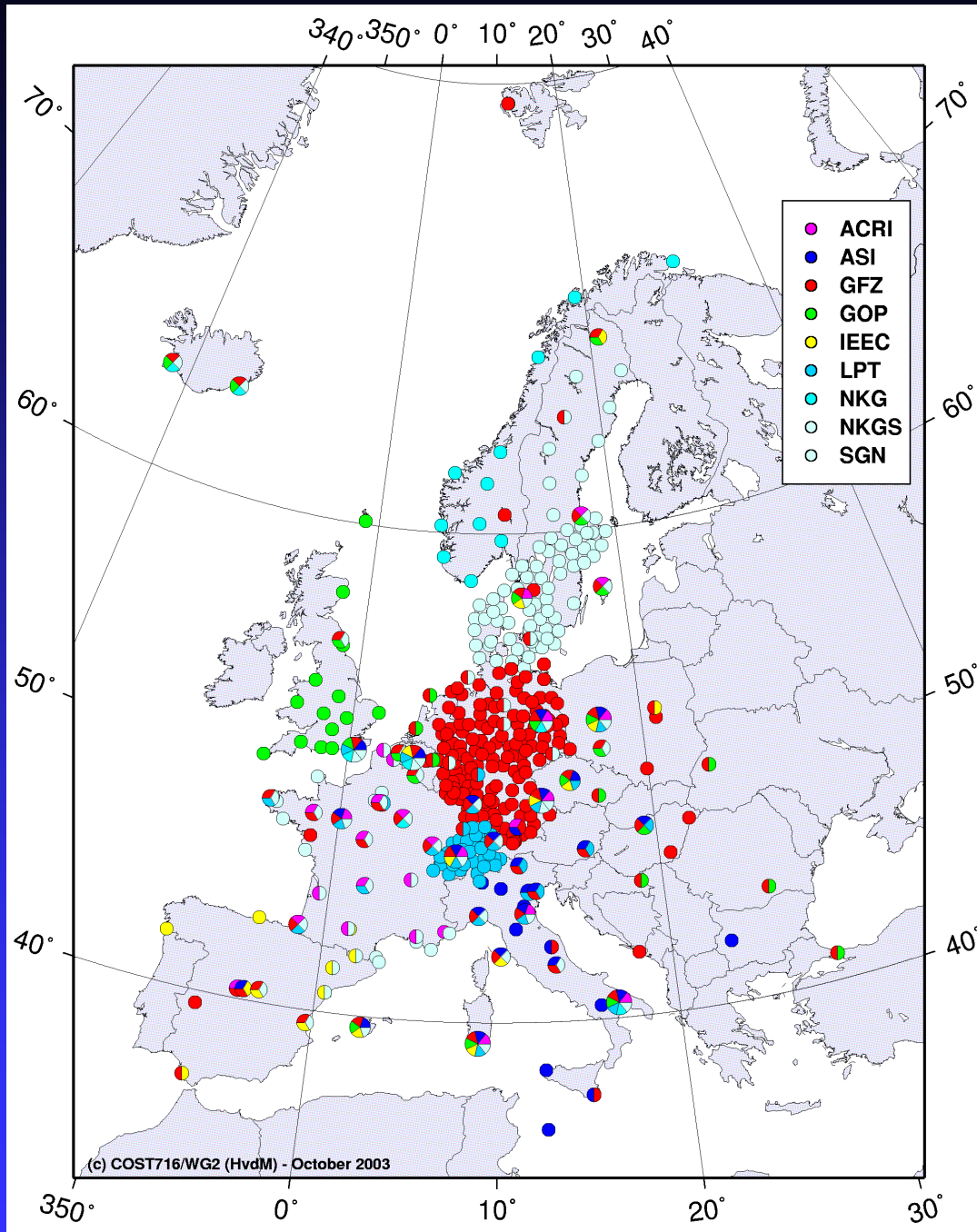
Started March 2001

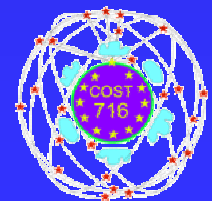
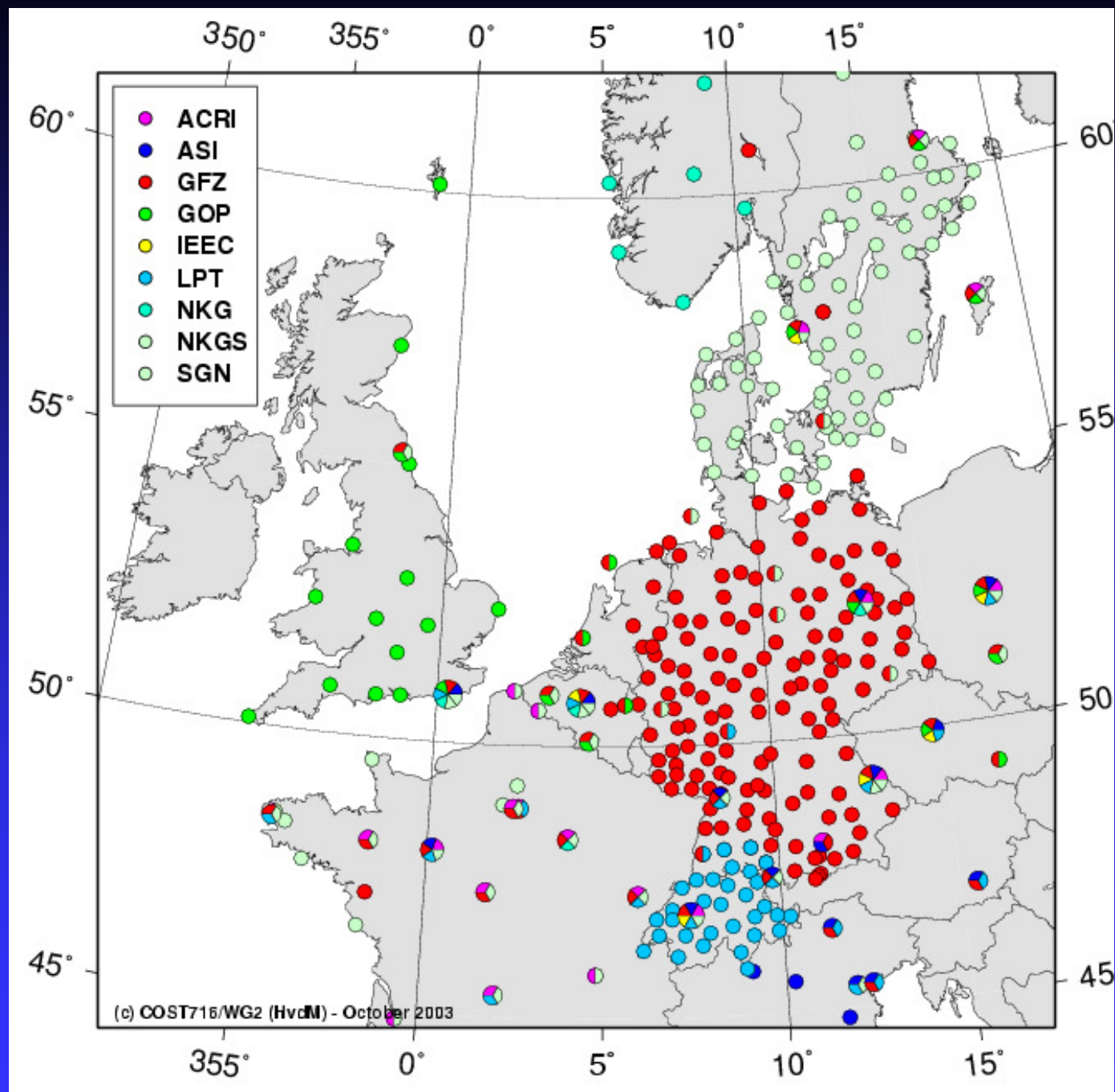
Status March 2004:

- 420 stations
- 10 operational ACs:

GFZ, GOPE, IEEC,
ASI, LPT, NKG, NKGS,
ACRI, SGN, BKG

[http://www.knmi.nl/samenw/
cost716.html](http://www.knmi.nl/samenw/cost716.html)



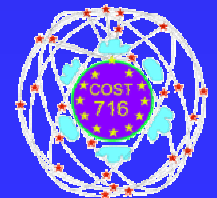


NRT analysis centers

GPS analysis centers which contribute to the NRT demonstration are:

ACRI	ACRI Sciences de Terre, Valbonne, France
ASI_	Agenzia Spaziale Italiana, Matera, Italy
BKG_	Bundesamt für Kartographie und Geodäsie, Frankfurt, Germany
GOPE	Geodetic Observatory, Pecny, Czech Republic
GFZ_	GeoForschungsZentrum, Potsdam, Germany
IEEC	IEEC, Barcelona, Spain
LPT_	Federal Office of Topography, Wabern, Switzerland
NKG_	Nordic Geodetic Commission - Statens Kartverk, Norway
NKGS	Nordic Geodetic Commission - Onsala Space Obs. Sweden
SGN_	Institut Geographique National, Paris, France

Different processing strategies and software are used



NRT GPS data providers

GPS data providers which contribute to the NRT demonstration are:

- International GPS Service (IGS)
- EUREF Permanent GPS Network (EPN)
- National Mapping Agencies (OS,BKG,SAPOS,SWEPOS,NMA,LPT,...)
- National Meteorological Services (Met.Office, DWD, ...)
- Universities and research networks
- Private companies

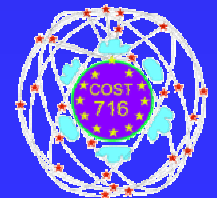
GPS data collection is handled by the analysis centers:

- ◆ uses IGS and EPN data centers, completed with several local data centers, resulting in a dense network
- ◆ analysis centers often have access to unique sources of data which are otherwise not available to the public
- ◆ analysis independent from EPN and IGS

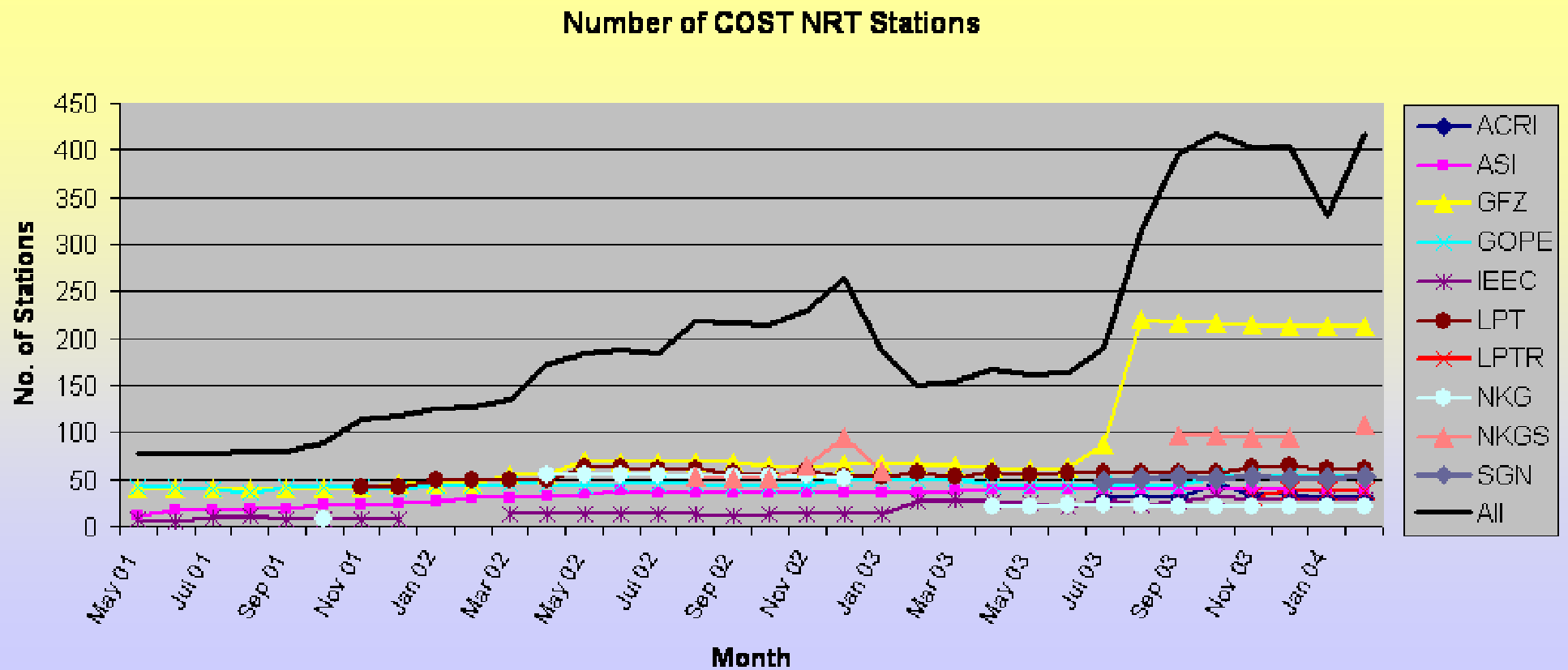


COST716 Data Flow

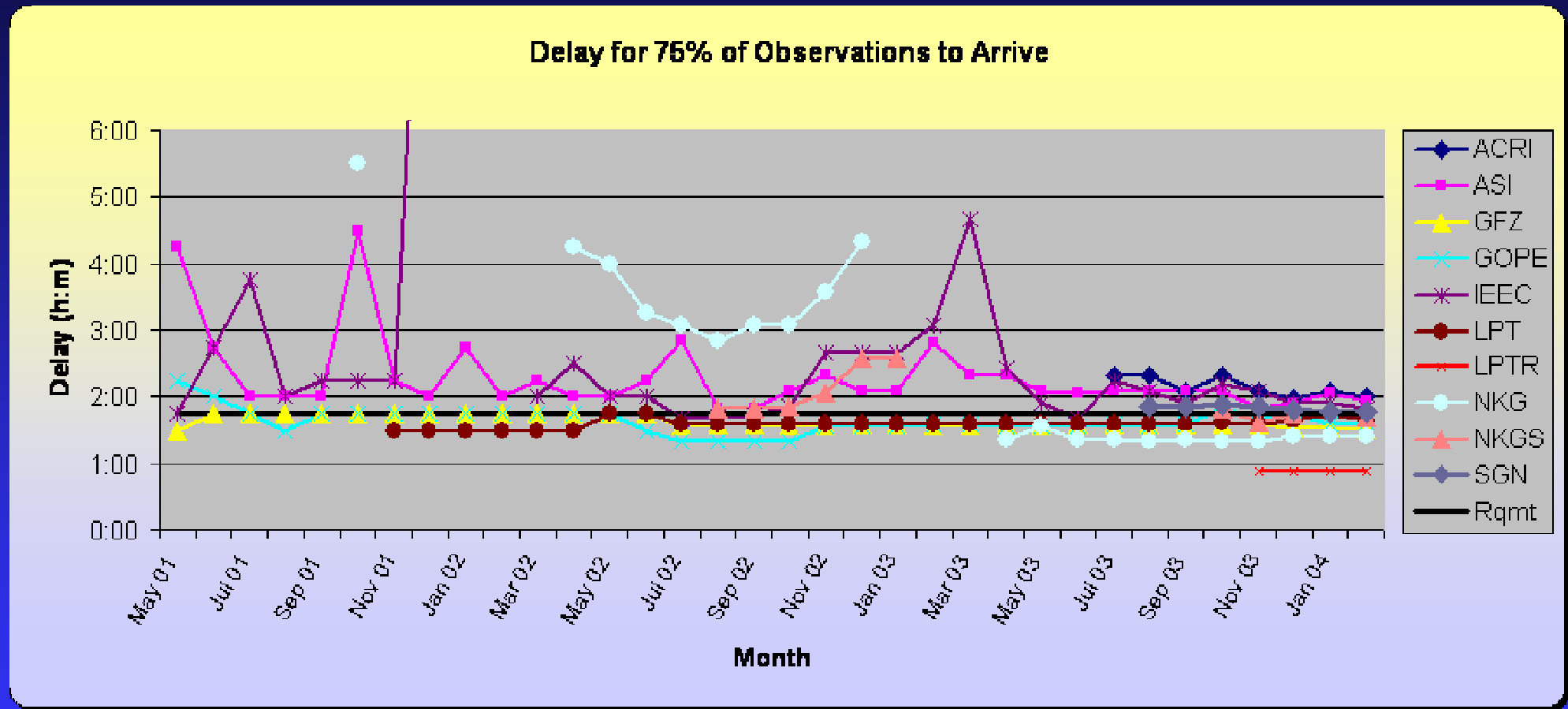
- AC's compute ZTD (Zenith Total Delays) in hourly batches
 - ◆ Download GPS data from various data providers (15 –20 min)
 - ◆ Processing, each AC use different strategies/software (20-25 min)
- ZTD within 1h45m to UK Met Office in the COST format (ftp)
 - ◆ Acts as a gateway to participating meteorological institutes
 - ◆ Converted into BUFR format (used on the GTS)
 - ☞ Operational since beginning of March 2004!
 - ☞ ZTD data is filtered (only IGS, EPN and those stations w/ permission)
- Ftp-mirror at TUD/Delft (holds the full archive)
- The ZTD is converted to IWV at KNMI using
 - ◆ Measured pressure and temperature at GPS site
 - ◆ Pressure and temperature interpolated from nearby synoptic sitesDisplayed on the WWW; IWV data available by ftp
<http://www.knmi.nl/samenw/cost716.html>
- The ZTD are used for NWP assimilation trials by WG/3



Number of COST 716 stations



Delay for 75% of Observations to Arrive



COST 716 conclusions

- Demonstration experiment exceeded expectations!!
- Shown to meet operational requirement in terms of timeliness and accuracy
- ZTD's are used directly for NWP (no combination), must be available in 1h 45m ($> 70\%$ of the data)
- Timely available GPS data is essential for success
 - ◆ on a continental or global scale (NRT reference network)
 - ◆ on a local scale for the necessary density

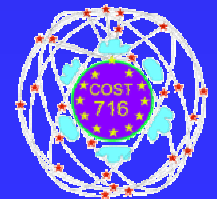
But improvement still needed (gaps in network, reliability and latency)
- Slight positive impact in case of heavy precipitation
- Extremely valuable data for validation and monitoring
- New nowcasting applications



The way ahead...

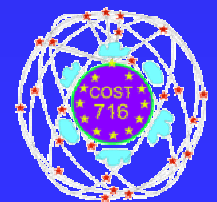
- Research continued within TOUGH project (2003-2006)
- EUMETNET project proposed at COST final workshop
 - ◆ Organisation of National Meteorological Services
 - ◆ Special project proposed to take actions to prepare the European GPS water vapour network to function operationally
 - ◆ Proposal written by John Nash (Met.Office)
 - ◆ 3 year project to be started in 2005
- Organise a geodetic interface to the EUMETNET project*)
 - ◆ Task given to Hans van der Marel, Elmar Brockmann, Hans-Peter Plag and Gerd Gendt by the COST 716 MC
 - ◆ Suggested to contact EUREF and IGS first
 - ◆ Letter of COST 716 chair to EUREF/TWG chair

**) the mandate is a little broader: the complete meteorological community*



TOUGH

- Targeting Optimal Use of GPS Humidity Measurements in Meteorology
- Shared-cost project co-funded by EU (5th framework programme)
- Objectives
 - ◆ Optimise assimilation of GPS ZTD into NWP
 - ◆ Methods for derivation and use of GPS slant delays
 - ◆ Run a research mode data collection (cont' of COST 716)
 - ◆ Investigate benefit of using GPS-data into NWP
- Partners:
 - ◆ Met.Services: DMI (DK), SMHI (SE), Met Office (UK), INM (ES), KNMI (NL), FMI (F)
 - ◆ Analysis Centers: ACRI-ST (F), Chalmers (SE), NMA (N), ASI (I), IEEC (ES), Swiss Topo (CH), GOP (CZ)
 - ◆ Universities: L'Aquila (I), Delft (NL) and Purdue (US)
- Started February 2003 and runs through January 2006



EUMETNET (E-GVAP) Objectives

- Take actions to prepare and coordinate future operational processing of GPS water vapour on both European and national scales
- Transfer from research funding to operational service as far as possible in liaison with the geodetic community
- Suitable standards for processing will be agreed with the geodetic GPS community (incl. naming)
- Establish a data hub for GPS ZTD and quality monitoring facility
- Activities will be designed to improve meteorological collaboration with operators of national GPS sensor networks,
 - ◆ by sharing facilities for reducing operational costs
 - ◆ by providing feedback of meteorological data
- Liaise with geodetic data processing centers to establish a long term policy for processing operational GPS water vapour measurements, and to co-ordinate national/regional processing efforts to ensure availability of data from the whole of Europe
- Promote methods of introducing the use of GPS water vapour measurements to operational meteorologists



EUMETNET (E-GVAP) Organisation

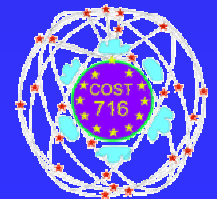
- Run by a responsible member providing a PM
- Operational liaison group to manage interaction with the wider GPS sensing community
- Expert team on data processing and standards
- Expert team on promoting the use of the observations
- Financial costs per year

PM	30k
Liason group meetings	15k
Expert team meetings	10k
Contract to support hub/central processing	30k
Project travel	10k



Potential benefits for GPS community

- Cost sharing
 - ◆ Common stations
 - ◆ Communications
- NRT quality monitoring hub
- Use of meteorological products
 - ◆ Pressure for atmospheric loading effects
 - ◆ Pressure to compute a-priori ZTD for GPS processing
 - ◆ Mapping functions from numerical weather models
 - ◆ Atmospheric delay corrections for Network RTK
- Use of meteorological services
 - ◆ Calibration of pressure sensors
 - ◆ Management of meteo equipment at GPS sites by NMS



What could be EUREF's role?

- Several areas of shared interest have been identified
- Possible benefits for EUREF and the contributing partners
- EUREF has been progressing as well
 - ◆ EUREF is already going towards (Near) Real-time
 - ◆ EUREF is already “densifying” (Certification initiative)
 - ◆ EUREF is becoming the reference for GPS in Europe at large, implicit and explicit standardization
- Should there be a role for EUREF?, how to do it?
 - ◆ EUREF TWG could play a coordinating role and liaise with the analysis centers (Special WG? Troposphere WG? role of AC workshops?)
 - ◆ At the symposium most of the major GPS providers (NMA, others) are represented
 - ◆ Open for discussion

