An Evaluation of Last Years Activities within the EUREF Permanent GPS Network

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1. Introduction

At the EUREF symposium in Sofia in June 1997, it was recognized that the voluntary contributions from institutes all over Europe made the EUREF permanent network to the success it is today. At the same time. some items came up which still had to be improved [Bru98]:
Two-way communication between the analysis centers and the station managers ;
Better subnetwork distribution ;
Tuning of the analysis strategies used in the EUREF analysis centers.
Now, one year later, some of these items have clearly been dealt with. Others are presently looked into.

2. Extensions of the EUREF Permanent Network

2.1 Tracking Network

Since May '97, six new stations have been integrated into the EUREF permanent network. They are given in Table 1. It is interesting to see that most of these new stations are located in regions with a low density of permanent GPS stations.

Stations	4 char ID	Country	Lat (N)	Lon (E)	Agency
Golosiiv	GLSV	Ukraine	50.3642	30.4967	UNAS
Höfn	HOFN	Iceland	64.2673	-15.1979	BKG/ICS
Nicosia	NICO	Cyprus	35.1409	33.3964	BKG/DLS
Sofia	SOFI	Bulgaria	42.5561	23.3947	BKG/MTS
Toulouse	TOUL	France	43.5608	1.4807	CNES
Westerbork	WSRT	The Netherlands	52.9146	6.6045	DUT
Zelenchukskaya	ZECK	Russia	43.7884	41.5651	BKG/IAA

Table 1: New EUREF stations (since May '97)

BKG :	Bundesamt für Kartographie und Geodäsie, Germany
CNES :	Centre National d'Etudes Spatiales, France
DLS :	Department of Lands and Surveys, Cyprus
DUT :	Delft University of Technology, Netherlands
IGS :	Iceland Geodetic Survey, Iceland
IAA :	Institut of Applied Astronomy, Russia
UNAS :	Ukrainian National Academy of Sciences, Ukraine
MTS :	Military Topographic Service, Bulgaria

The stations presently belonging to the EUREF permanent network are shown in Figure 1.

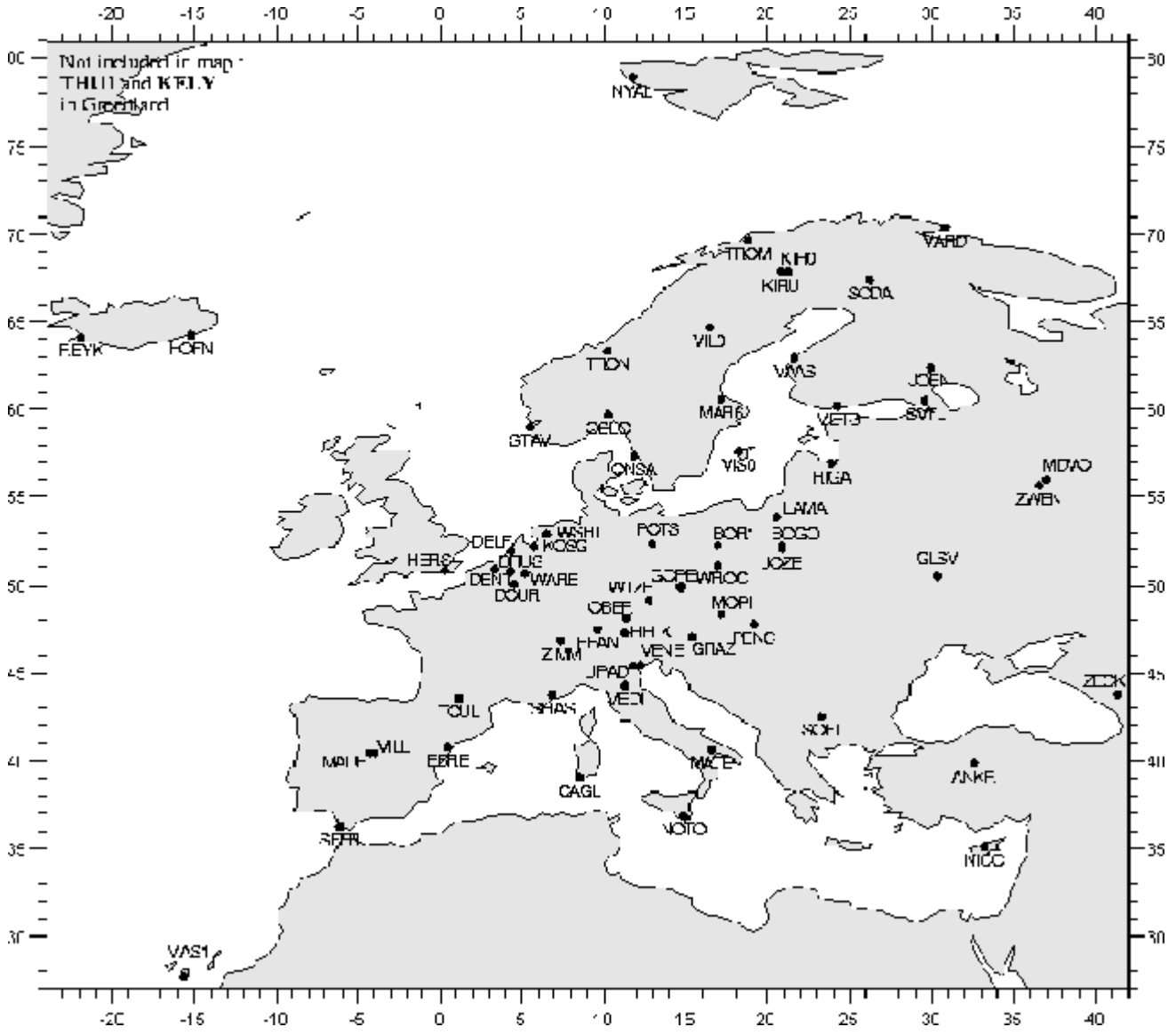

Figure 1: Stations included in the permanent EUREF GPS network (May '98)

Within the last year, the number of problems with tracking sites were limited. The most important problems/changes were : EUREF stopped processing data from some older, less performant receivers :

- Madrid : the older ROGUE SNR-8 receiver (MADR data) became unreliable and in April '98 EUREF switched to the ROGUE SNR-12 RM receiver (MAD2 data) which is connected to the same antenna as the old receiver.

- Ny-Ålesund and Tromsö : In the beginning of 1998, the data from two new ROGUE SNR-12 RM

receivers installed respectively at the Ny-Ålesund (NYA1 data) and Tromsö (TRO1 data) became available at BKG. These two receivers are not connected to the same antennas as the ones used for the IGS at these sites : new monuments were constructed and new antennas were used. TRO1 and NYA1 are located at THE markers used for future observations. Because of the newer equipment and the higher stability of the monumentation, EUREF stopped processing the data from the older ROGUE SNR-8 receivers (the TROM and NYAL data) and switched to NYA1 and TRO1 in May '98.

- Herstmonceux : In November of 1997, the IGS site at Herstmonceux stopped submitting data to the Regional Data Center at BKG because the quality of the data from the ROGUE SNR-8C receiver became too unreliable to guarantee high quality positioning.
  In the mean time a new receiver and antenna (Ashtech) have been installed at Herstmonceux. Herstmonceux will be integrated into the EUREF processing as soon as the quality of the data from the new receiver is checked.

Changes at the antennas and/or its direct environment :

- Oslo, Vardö, Stavanger and Trondheim : In October 1997, the L1/L2 PERMANENT antennas (Part No 23903-00) at Oslo, Vardö, Stavanger and Trondheim were replaced by the well known DORNE MARGOLIN TRIM antennas. After this antenna change, the coordinates of these four Norwegian sites shifted between 0.5 and 1.5 cm in the North and East components, going up to several cm in the Up component. The shift is probably due to the limited knowledge of the phase eccentricity values of the old L1/L2 PERMANENT antennas.

- Modra-Piesok : The 4000ST L1/L2 GEOD antenna is equipped with a spherical radome. In March 1998, the radome was taken off for a one day experiment and afterwards put on the antenna again, but it was not fixed at exactly the same height as before because the radome has a freedom in height shifting. The change in the height of the radome resulted in a coordinate jump of -3.5 cm in the up-component.

- Snow accumulation on the dome of the antenna in some of the Scandinavian stations.

2.2 Data Availability

The data from all the Scandinavian EUREF stations are freely available since in August 97 thanks to the opening of the Data Center of the Nordic Geodetic Commission. From that moment on, the RINEX data from ALL the EUREF tracking stations have been freely available at one of the EUREF local data centers or at the Regional Data Center.

2.3 Data Analysis

Last year, the EUREF analysis centers agreed to optimize some aspects of the data analysis :

- the tuning of the analysis strategies, following the recommendations of the EUREF Analysis workshop

- the redistribution of the subnetworks, in order to have all stations analyzed by at least 2 and not more than 3 analysis centers.

In the summer of 1997, a proposal for redistribution of the subnetworks was approved by the EUREF analysis centers and it has been effective since September 1997. Presently 18% of the stations have their data routinely analyzed by 2 EUREF analysis centers, 79 % by 3 centers and 3% by 4 analysis centers.
Interested station managers can have a look at the permanent network Web pages where the information is displayed about which analysis center is analyzing their station data.
Last year, the EUREF analysis centers were using different elevation cut-off angles going from 10° to 20°. Since the summer of 1997, all analysis centers are using an elevation cut-off angle of 15°. Any future changes in the cut-off angle can only be done after a common agreement between all the analysis centers in order to

preserve the homogeneity of the solution. Switching, for example, to a 5° degrees solution with elevation dependent weighting can not be done by one analysis center individually.

3. Permanent Network Web site

The Web site where all relevant information about the permanent network can be found is :
http://www.oma.be//KSB-ORB/EUREF/eurefhome.html
A lot of effort has been put into making from this Web-site a well documented database about the EUREF permanent network.
One of the goals of the Web-site is to give a good feed back to the station managers operating EUREF stations. The coordinate time series which are made available for each station individually is a first step in this direction.

4. Outlook

4.1 Planned Extensions of the Network

Table 2 gives a temptative list of permanent stations which will apply to be part of the EUREF network. Some of these stations are already installed but are presently in the stage of setting up a smooth data flow to one of the EUREF data centers.
IGN France has announced that it would start analyzing a EUREF subnetwork including the new permanent stations planned in France.

Stations	Country	Lat(N)	Lon(E)	Agency
Brest	France	48.24	-4.30	LAREG
Bucharest	Romania	44.27	26.07	UB
Cascais	Portugal	38.69	-9.42	IPCC
Davos	Switzerland	46.83	9.92	FOT
Dubrovnic	Croatia	42.55	17.9	CSA
Zürich	Switzerland	47.41	8.51	FOT
Euskirchen	Germany	50.67	6.76	BKG
Muttenz	Switzerland	47.53	7.64	FOT
Genova	Italy	44.43	8.92	ASI
Istanbul	Turkey	41.02	28.57	TUI
Jungfraujoch	Switzerland	46.55	7.98	FOT
Karlsruhe	Germany	49.01	8.41	BKG
Lampedusa	Italy	35.52	12.57	ASI
Le Mans	France	48.01	0.09	ENSG/LAREG
Locarno	Switzerland	46.17	8.83	FOT
Marne la Vallée	France	48.50	2.35	ENSG/LAREG
Marseille	France	43.16	5.21	ENSG/LAREG
Morpeth	U-K	55.10	-1.41	UN
Nantes	France	47.20	-1.35	ENSG/LAREG
Ohrid	Macedonia			MSA

Ochrid	Macedonia	-	-	MSA
St-Jean des Vignes	France	42.52	4.40	CNES
Tirana	Albania	-	-	ASI
Trabzon	Turkey	41.00	39.60	UT
Ventspils	Latvia	57.50	21.90	-
Villnius	Lithuania	54.65	25.30	VUT

BKG	Bundesamt für Kartographie und Geodäsie
CNES	Centre National d'Etudes Spatiales, France
CSA	Croatian Survey Agency, Croatia
FOT	Federal Office of Topography, Switzerland
IPCC	Instituto Portugues de Cartographia e Cadastro, Portugal
LAREG	Laboratoire de Recherche en Geodesie, France
MSA	Macedonian Survey Agency, Macedonia
TUI	Technical University of Istanbul, Turkey
UB	University of Bucarest, Romania
UN	University of Newcastle, UK
UT	University of Trabzon, Turkey
VUT	Vilnius Technical University, Lithuania

4.2 Going from a Pilot Project to an Operational Service

Within the IGS Pilot Project for Densification, the RNAACs (such as EUREF and the three GNAACs are ready to switch over to a routine operation. The GNAACs have already answered positivily to the question to commit themselves for the operational phase of the densification.
Before actually switching to routine operations, the following steps have to be performed by the IGS :

- the RNAACs have to be asked to continue delivering their contributions in the operational phase (commitment for the operational phase),
- the exact procedure to come up with the weekly official IGS solution has to be defined,
- the coordinate discrepancies published each week by Jan Kouba (IGS Report) have to be removed.

Especially this last item is presently restraining the IGS to switch to an Operational Service.

4.3 Inclusion of "Associated EUREF stations" in the EUREF analysis

In order to assess the velocity of the European plate with respect to neighbouring tectonic plates, EUREF has expressed its interest to include permanent stations from outside Europe (North-Africa, Middle-East) into its routine network processing. These stations will be considered at "Associated EUREF stations".

4.4 Hourly Data Upload

At the EUREF Technical Working Group Meeting in Delft, in December 1997, the possible future needs for faster availability of the tracking data of the permanent receivers has been discussed. Two applications can benifit from a faster turnaround time of the data: near real-time orbit improvement and prediction and near real-time atmospheric water vapour determination, e.g. for weather prediction. An upload of hourly RINEX files would be appropriate for these purposes. Therefore EUREF will look into the possibility to start up a Pilot Project in order to test the feasibility of such an accelerated data generation and distribution.

4.5 Submission of new EUREF solution to the IERS

Following the resolution of last years symposium, the CODE analysis center has agreed to produce a new EUREF solution which will be submitted before the end of June 98 to the IERS Terrestrial Frame Section in response to its call for input solutions for the ITRF97.

5. References

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