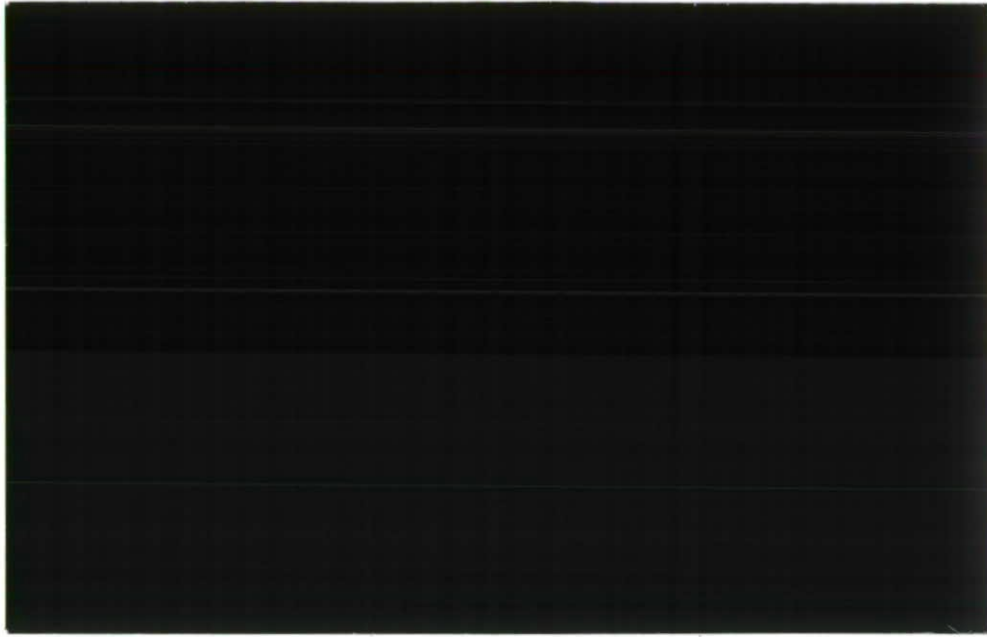




**Institute of
Hydrology**



1995/001

PROVISION OF RIVER FLOW DATA TO THE NORTH AND IRISH SEAS (FRIEND)

Progress Report March 1995

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Executive summary

The Flow Regimes from International Experimental and Network Data (FRIEND) research programme is an important study into regional scale hydrology. Its aims are to improve the understanding of the spatial and temporal variability of the hydrological regime and so enable the development of better design methods to combat the causes and effects of droughts and floods.

The Institute of Hydrology (IH) was instrumental in launching the project in 1985 and continues to play a leading role both administratively and scientifically. The regional analysis of the FRIEND project has largely been facilitated by the establishment of a major hydrological database at the Institute of Hydrology. Comprising river flow data from over 4000 gauging stations throughout Europe, the European Water Archive, as it is now called, provides FRIEND research with the most comprehensive hydrological dataset in Europe.

This progress report describes how the Department of the Environment, through the consultancy contract 'Provision of river flow data to the North and Irish seas' (FRIEND), has helped the continued development of the archive and maintained the Institute of Hydrology's role in the project during 1994/95.

1 Introduction

This document is the first progress report to the Department of the Environment under the consultancy contract 'Provision of river flow data to the North and Irish seas (FRIEND)' and describes activities carried out in the financial year 1994/95.

The Flow Regimes from International Experimental and Network Data (FRIEND) research programme began in 1985 as an international collaborative study into regional hydrology in northern Europe. It is essentially a coordinated collection of individual projects undertaken by five scientific project groups:

- | | |
|------------|--|
| Project 1: | European Water Archive |
| Project 2: | Low flows |
| Project 3: | Variations in river flow characteristics |
| Project 4: | Extreme rainfall & runoff estimation |
| Project 5: | Processes of streamflow generation in small basins |

With recent expansion into eastern Europe and States of the former Soviet Union, the project now encompasses research groups from 22 northern European countries.

The FRIEND project is a major contribution to UNESCO's International Hydrological Programme (IHP) and was recently designated Project 1-1 for IHP V. The Institute of Hydrology has been the leading organisation in the UK associated with the FRIEND project since the project's inception and coordinates the activities of three key research groups (the European Water Archive, Low flow studies and Variations in river flow characteristics), as well as providing the secretariat service.

The European Water Archive (EWA) is an international hydrological database containing time series data (gauged river flows) and spatial data such as catchment boundaries, land-use information and soil types. Up to the present time the EWA has mainly comprised data from smaller catchments in northern Europe (area < 500 km²) for the purpose of relating river flows to catchment characteristics.

The objective of this contract with DOE is to provide support to IH to maintain and expand the EWA, particularly to update river flow data to the end of 1992 and to bring an added dimension to the database by including outflows from the larger rivers of Europe, especially those which drain into the North and Irish seas.

During the year 1994/95 the FRIEND database project has made contact with organisations supplying data to the EWA, requesting river flow data up to the end of 1992 where possible. New initiatives have been set up to expand the archive to eastern Europe, including the European states of the former Soviet Union.

The updating of river flow data will continue to be a priority in 1995/96, together with the acquisition of river flow data from the major rivers draining into the North and Irish seas. This will enable monthly flow duration curves, hydrographs and monthly mean flows to be derived for these major rivers. The issue of data quality will be addressed to ensure accurate estimates of river flows.

The remainder of this document describes the European Water Archive, the way it is administered, progress achieved in 1994/95 and plans for its future development.

2 The FRIEND European Water Archive

Within the UNESCO FRIEND Project H-5-5: *'Application of methods of hydrological analysis using regional data sets'*, the Institute of Hydrology manages Project 1, the 'European Water Archive'. This gives IH responsibility for:

- * coordinating data acquisition
- * maintaining the master version of the EWA
- * applying quality control procedures to the data
- * supplying data to groups actively involved in FRIEND research
- * coordinating work of the regional data centres and liaising with the Alpine and Mediterranean Hydrology (AMHY) group
- * informing the wider hydrological community of the EWA
- * keeping abreast of new technology and database management techniques.

The archive is a major hydrological database, the largest in Europe, and is set up for the purpose of conducting regional analysis. Data is obtained from both national hydrometric networks and experimental catchments. The basic criteria for acceptance of data is that it should be from basins of area < 500km², having at least five years of record, and with a natural regime (i.e. uninfluenced by man).

Time series data stored on the EWA include:

- * gauged daily flow data for over 4000 stations (average record length of 25 years)
- * annual maxima flow series for approximately 2000 stations

During the European Flood Study, undertaken at IH between 1982-84, and subsequently the first phase of the FRIEND project, digitised catchment boundaries were produced for approximately 2000 catchments in Ireland, France, Belgium, Luxembourg, the Netherlands, Germany and Denmark. These have been incorporated in the EWA and are stored as series of x,y coordinate data. Digitised catchment boundaries from the Nordic countries are expected to be received for the archive in the near future but none are available for countries recently joining the project. Other spatial data stored on the EWA include:

- * 1:1,000,00 scale European Soil Map, produced by the EC 'Coordination of Information on the Environment' (CORINE) project
- * 1.25km x 1.25km grid of forest, urban and lake cover
- * 2.5km x 2.5km grid of average annual rainfall
- * derived drainage classes

In addition to IH acting as the coordination centre for the EWA, a network of regional data centres has been established with responsibility for data from the countries as listed below and shown in Fig 2.1.

IH Wallingford	-	UK, Republic of Ireland, Poland, Hungary
Centre National du Machinisme Agricole du Genie Rural des Eaux et des Forêts (CEMAGREF), Lyon	-	France and AMHY member states

Federal Institute of Hydrology, Koblenz	-	Austria, Germany, Czech Republic, Slovakia, Switzerland
Agricultural University, Wageningen	-	The Netherlands, Belgium, Luxembourg
Norwegian Water Resources and Energy Administration (NVE), Oslo	-	Norway, Sweden, Finland, Denmark, Iceland, The Faroe Islands, Estonia
The State Hydrological Institute (SHI), St Petersburg	-	Russia, Bellarus, Ukraine

Each regional data centre is responsible for:

- * data acquisition for the countries listed
- * applying quality control measures
- * transferring data to the master version of the EWA at Wallingford.

The database group, comprising regional coordinators and project participants, meet annually to discuss progress and agree future strategy.

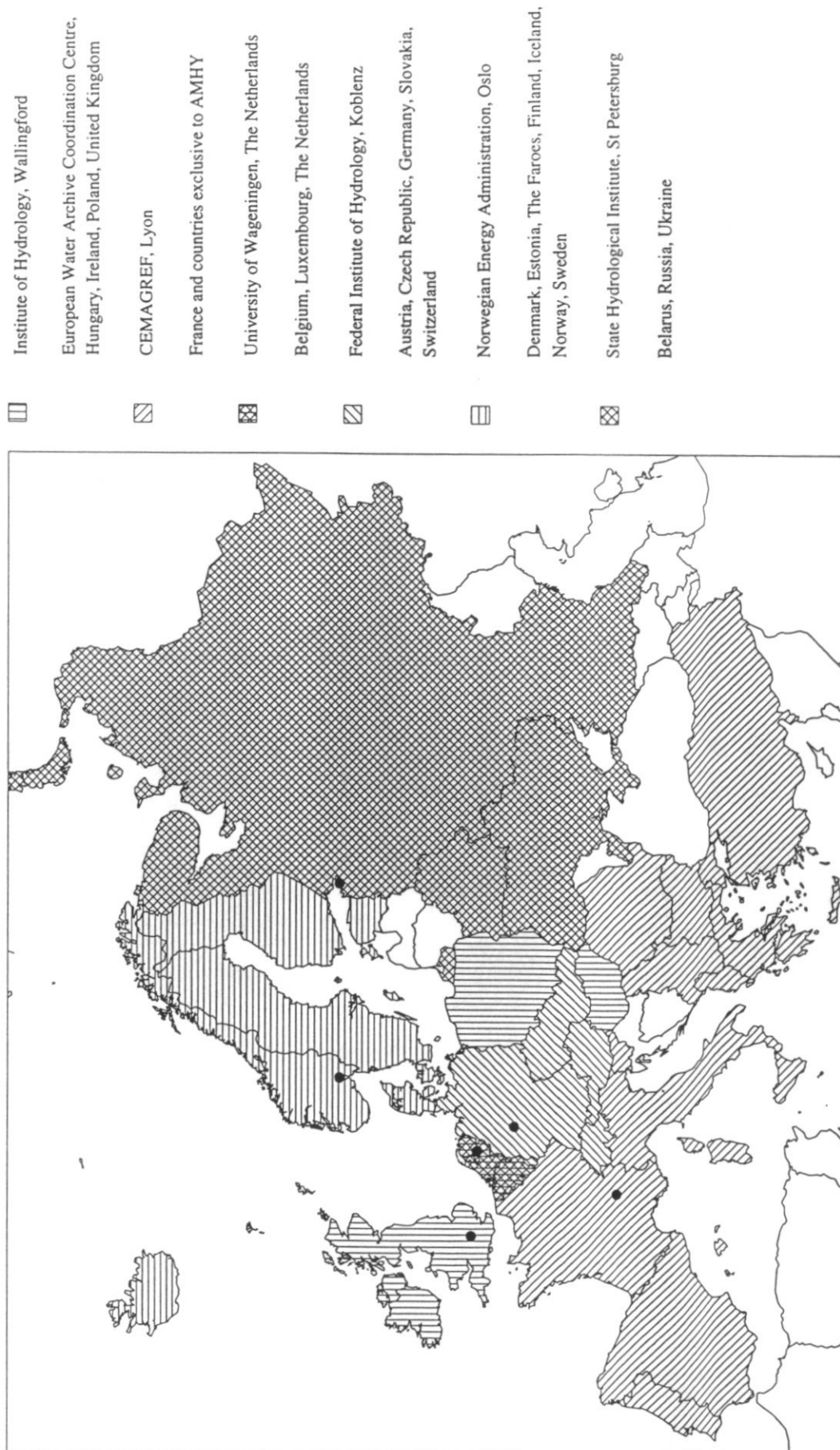


Figure 2.1 European Water Archive data centres

3 Database progress

3.1 DATABASE GROUP MEETING

Database group meetings are held annually to review progress, discuss problem areas, identify ways of improving the EWA and the dissemination of data. Advances in technology, and how they might be applied, also form a useful part of the agenda. The most recent meeting was held in Lyon in November 1994 with participants from the following organisations:

- * Czech Hydrometeorological Institute, Prague
- * CEMAGREF, Lyon, France
- * Centre National du Recherche Scientifique (CNRS), France
- * IH, Wallingford
- * NVE, Oslo, Norway
- * Federal Institute of Hydrology, Koblenz, Germany
- * Water Resources Research Centre (VITUKI), Budapest, Hungary
- * Agricultural University of Wageningen, The Netherlands

Issues discussed at the meeting included the database update, applications of Geographic Information Systems (GIS), cooperation with other project groups, the proposal for a conference on data quality and management, and future work. Minutes of the meeting are available on request from IH. The next meeting is scheduled to be held in November 1995 in St Petersburg, to coincide with a symposium on runoff computations.

3.2 OVERSEAS VISITS

During 1994 a great deal of effort has been put into organising data acquisition to update the EWA. The main focus of the work has been to procure river flow data for the period up to the end of 1992 so that regional analysis of the 1991/92 drought can be undertaken. To this end, IH staff undertook visits to several agencies responsible for hydrological data provision.

Austria. G Rees visited the Hydrographisches Zentralburo in Vienna to discuss the provision of Austrian data. As a result data for 82 stations to 1990 have been loaded onto the EWA.

Belgium. In July 1994 G Rees visited organisations in Belgium to encourage the provision of data to the EWA. In the Flanders region of Belgium approval has been given for data from the entire network of 70 gauging stations to be made available. In the Walloon region, where there has previously been difficulty in obtaining data, a more positive air of cooperation has been generated.

Germany. Updated data (to 1992) has been received from 350 gauging stations in Germany. Revised gauging station location data has also been received and loaded onto the EWA.

Ireland. In September 1994 J Dixon visited the Office of Public Works (OPW) in Dublin to gain an appreciation of the hydrological services in Ireland. Although the OPW do not routinely process data from all their gauging stations they were encouraged to send us as much data as possible for the EWA in order that their country should be well represented in the dataset.

The Netherlands. G Rees visited the Netherlands in July 1994 and arranged for updated and new data to be transferred to the EWA. Data has subsequently been received from the Dommel, Roer en Overmas and Scilland Water Authorities. Long term data for the Rhine and the Meuse has also been received from the Institute for Inland Water Management and Waste Water Treatment (RIZA) and loaded onto the EWA.

3.3 STATUS OF THE ARCHIVE

The status of gauged daily flow data held on the EWA at 1 March 1995 is presented in Table 3.1, together with the summary of record length by country in Table 3.2. Numbers in brackets denote the state of the EWA in 1993/94. Figure 3.1 gives a histogram of distribution of record length of the data held.

Table 3.1 *Summary of gauged daily flow data held on the European Water Archive at 1 March 1995*

Country	Stations		Data to	Average length of record	Max length of record	Number of station/years
Austria	82	(79)	1990	21	30	1724
Belgium	76	(75)	1992	11	54	823
Bulgaria ⁺	3	-	1986	9	9	27
Czech Republic	30	(17)	1990	52	104	1566
Denmark	35		1991	53	75	1871
Finland	69		1991	50	144	3420
France	1357	(1315)	1992	22	128	30287
Germany	505	(500)	1992	27	79	13845
Greece ⁺	2	-	1980	3	3	6
Iceland [*]	8	-	1991	47	60	373
Ireland	62	(61)	1993	24	47	1469
Italy ⁺	72	-	1990	28	66	2041
Netherlands	25	(16)	1994	23	93	581
Norway	178	(174)	1993	37	114	6574
Poland [*]	18	-	1992	23	35	416
Romania ⁺	33	-	1990	35	153	1155
Slovakia	22		1990	61	61	1342
Slovenia ⁺	12	-	1990	25	45	300
Spain ⁺	251		1989	14	74	3412
Sweden	65		1991	40	85	2575
Switzerland	90	(58)	1992	38	82	3438
Turkey ⁺	7		1987	11	12	77
UK	1030	(1013)	1993	25	115	25417
Yugoslavia	5	-	1990	13	13	63
Total	4037	(3498)				102802(91069)

Figures in brackets denote status in 1994, where different.

^{*} FRIEND country, new entry to archive.

⁺ AMHY country, new entry to archive.

Table 3.2 Summary of record length by country

Country	Stations	<=5	6-10	11-15	16-20	21-25	26-30	>30
Austria	82 (79)	4	9	21	9	6	33	
Belgium	76 (75)	25	14	23	12	1		1
Bulgaria ⁺	3 -		3					
Czech Republic	30 (17)	1	2	5				22
Denmark	35				1	4	2	28
Finland	69				2	3	10	54
France	1357 (1315)	52	120	208	290	399	133	155
Germany	505 (500)	102	16	31	74	26	52	204
Greece ⁺	2 -	2						
Iceland [*]	8 -							8
Ireland	62 (61)		7	7	16	9	11	12
Italy ⁺	72 -	7	6	12	3	6	6	32
Netherlands	25 (16)	2		13	7			3
Norway	178 (174)	3	7	23	33	33	16	63
Poland [*]	18 -		2	1	5	3	6	1
Romania ⁺	33 -	2	1		2	1	3	24
Slovakia	22							22
Slovenia ⁺	12 -			6		1	2	3
Spain ⁺	251	1	226		1		1	22
Sweden	65			4	17	9	6	29
Switzerland	90 (58)	3	1	3	9	17	16	41
Turkey ⁺	7		4	3				
UK	1030 (1013)	39	86	119	157	235	157	237
Yugoslavia	5 -		4	4				
Total	4037 (3498)	243(216)	505(254)	483(433)	638(615)	753(718)	454(423)	961(837)

Figures in brackets denote status in 1994, where different.

* FRIEND country, new entry to archive.

+ AMHY country, new entry to archive.

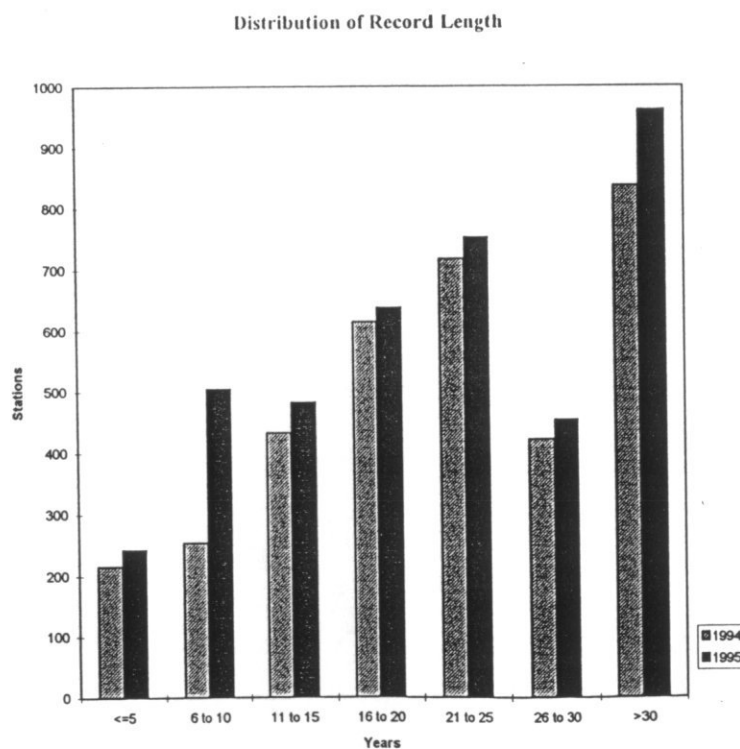


Figure 3.1 Distribution of record length

3.4 ESTABLISHMENT OF REGIONAL DATA CENTRE IN ST PETERSBURG

During the last year an initiative has been undertaken with INTAS, the International Association for the Promotion of Cooperation with Scientists from the Independent States of the Former Soviet Union, for the establishment of an additional regional data centre to be located in St Petersburg. In August 1994 agreement in principle was given for 70,000 ECU to be awarded for this purpose.

The data centre will be based at the State Hydrological Institute, St Petersburg. Other partners in this project will be the Administration for Hydrometeorology, Belarus, the State Committee of the Ukraine for Hydrometeorology and the Global Runoff Data Centre (GRDC), Koblenz. A three-year work plan has been agreed between the partners which will see data for stations from previously unrepresented areas of Eastern Europe added to the EWA.

3.5 APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS

During 1994 an application of GIS using the EWA was undertaken by a post graduate student, D Beveridge, entitled '*Drought in Europe: The presentation of hydrological data via Computer Graphics*'. This dissertation, submitted to Bournemouth University Department of Conservation Sciences for an MSc degree, uses EWA gauged flow data and digitised catchment boundaries to display catchment exceedence values of river flow rates in a series of monthly maps which show the progression of the drought in western France.

4 Cooperation with other project groups

4.1 INTRODUCTION

During 1994/95 the number of countries participating in the northern European FRIEND project rose to 22, recent newcomers to the project being Belarus, Iceland, Estonia, Hungary and the Ukraine. In 1994/95 IH provided advice and consultation to new and emerging FRIEND initiatives in south-east Asia, the Himalaya/Hindukush area, and Western Africa. Cooperation with the AMHY countries continues strongly.

4.2 SOUTH-EAST ASIA

Professor Takeuchi of Yamanashi University, Japan, coordinator of South-east Asia FRIEND, was provided with information regarding the design and contents of the EWA. The primary aim of the project in South-east Asia is to improve hydrological understanding regionally in order to support the production of rice.

4.3 HIMALAYA/HINDUKUSH AREA

Professor Chalise of the International Centre for Integrated Mountain Development (ICIMOD) represented the FRIEND Himalaya/Hindukush project at the FRIEND Steering Committee meeting at Stara Lesna in 1994. He expressed his interest in the EWA and further contact is expected.

4.4 WESTERN AFRICA

The project was re-launched in November and will be coordinated by the French Scientific Research Institute for Overseas Development (ORSTOM). E Servat of ORSTOM, the local coordinator of the project, visited IH in July 1994 and was given a demonstration of the EWA. The inaugural meeting of the project was held in Abidjan in November 1994 and was attended by Dr A Bullock of IH.

4.5 AMHY

The lead agency within the AMHY project is CEMAGREF, located in Lyon, France. There is continuing collaboration between FRIEND and AMHY groups to define hydrometric regions and areas to ensure consistency in numbering of gauging stations between projects.

In July 1994 Dr P Givonne and A Manea of CEMAGREF visited IH and exchanged a dataset containing time series data of 300 gauging stations in the Mediterranean region for a subset of the EWA.

5 Conclusions

The extension of the EWA data in both time and geographical extent is a major contribution to the understanding of hydrological variability across Europe. Considerable momentum has been generated in recent months towards the updating of gauged flow data held on the EWA. The provision of funds from the DOE via this contract has greatly assisted the development of the FRIEND European Water Archive to maintain its leading role as the major centre for river flow and thematic data in Europe.

During the 1994/95 phase of this contract the DOE's requirement for outflows of the larger rivers of Europe into the North and Irish seas has been addressed and links have been established within the European agencies for the supply of this data in 1995/96. Within the next year work will continue on monitoring and developing the European Water Archive. Priority will be given to the following:

Database update.

High priority will continue to be given to the updating of data to the EWA, particularly the inclusion of data from existing gauging stations on the archive to the end of 1992. The enlargement of the dataset to include eastern European stations will go ahead with the establishment of the data centre in St Petersburg.

Data for major rivers flowing into the North and Irish seas

This task is a new departure for the EWA, previously only data from smaller catchments (area < 500 km²) has been stored. Contact will be made with national hydrometric agencies and to the World Meteorological Organisation's Global Runoff Data Centre in Koblenz for this data.

Gauging station numbering

In order to allow the exchange of data with other organisations, (for example the AMHY group) the need for consistency in gauging station numbering is imperative, hence the definition and digitising of hydrometric areas for the Mediterranean region is being carried out with high priority.

Data Quality and Management

It has been proposed that the FRIEND database group should organise a conference on Data Quality and Management and a positive response has been received from UNESCO and WMO. This proposal is being actively pursued and a suitable date and venue investigated for further discussion.

All data will be subjected to routine quality assurance checks, including rainfall/runoff comparisons and time-series analysis (near neighbour comparisons, double-mass curve analysis).

European Water Archive brochure

A draft of the brochure has been prepared which will give potential users of EWA data information about the data held and how it can be applied. Future developments will be indicated, including the application of GIS.

Acknowledgements

The Institute of Hydrology acknowledges, with gratitude, the Department of the Environment's continued support since the inception of the FRIEND project during 1985.

