

HYDROLOGICAL AND CLIMATE DATA IN EUROPE

[Working Note 8]

K. Croker & A. Young

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Institute of Hydrology
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

Tel: 01491 838800
Fax: 01491 692424
Telex: 849365 Hydrol G

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1 Introduction

At the fourth GREAT-ER Enlarged Task Force meeting in Milan, June 1997, the Institute of Hydrology were actioned to review the pan-European availability of requisite data for constructing catchment characteristic-based statistical hydrological models. This report presents a summary of the hydrological, climatological and relevant georeferenced data across the European Union.

A number of questionnaire-based surveys have been undertaken to identify the extent and quality of the hydrometric and meteorological data available across the European Union member states by the Institute of Hydrology. Other organisations, such as the Global Runoff Data Centre (GRDC) and the European Statistical Office (Eurostat) have also published details of reports and databases that contain hydrological and climatic data and which are widely available. This report summarising the available documents should not be regarded as an exhaustive survey of national data availability. The scale of undertaking detailed national surveys should not be underestimated.

From these surveys and publications, it can be concluded that the quantity and quality of flow data is variable depending on the country and the national organisations involved. Where data is provided to a single organisation for incorporation into a central database (eg the Flow Regimes from International and Network Data – FRIEND database) then some quality control of the data is undertaken by the collating organisation.

The publications referenced within the document are listed in Table 1.1. Organisations that hold relevant information, identified through participation in these surveys or directly referenced in publications, are summarised in Table 1.2.

Table 1.1 Sources of information referenced within this document

Title of publication	Project, funding organisation & aim of project/publication
Inventory of the Catchments for research in Europe. Barbet & Givone. 1992	Funded by CEMAGREF, the aim of the project was to extend the French inventory of representative and experimental research basins to cover other European and Mediterranean countries.
Flow Regimes from International experimental and Network Data (FRIEND) Ed Gustard. 1993	The FRIEND project is a component of Unesco's Fourth International Hydrological Programme. The research programme is a collection of related projects which consider different aspects of the hydrological regime across Europe.
Compilation of a European Atlas of Small Hydrometric Resources. Gustard & Young. 1993	European Atlas of Small Hydrometric Resources, funded by EU Altener program on behalf of ESHA, this report is a survey to determine the availability of data and models for use in the development of a pan European model for estimating hydropower potential
Report on a study into the state of river and catchment boundary mapping in the EC and the feasibility of producing an EC-wide river and catchment boundary database. Morris & Kronvang. 1994.	Funded by the European Environment Agency to identify the extent of river and catchment boundary mapping in the EC and investigate the feasibility of producing an EC-wide river and catchment boundary database.
Survey of hydrometric data provision in the European Union. Rees & Dixon 1994.	Funded by the National Rivers Authority to identify organisations responsible for providing hydrometric services in Europe and identify

Title of publication	Project, funding organisation & aim of project/publication the range and potential effectiveness of different services in Europe
European Atlas of Small Scale Hydropower Resources. Part 2. Spain and Italy. Irving et al, 1995.	European Atlas of Small Hydrometric Resources, funded by EU Altener program on behalf of ESHA, Phase II. The report describes the development of the Atlas in Italy and Spain
Eurostat Catalogue. Publications and electronic services. 1995. GISCO database manual	Statistical information service to the European Union funded by the European Commission for the European Communities for the dissemination of a wide range of social, economic, industrial and environmental data
Inventory of meteorological data in the European Union. Álvares and Rodriques. 1997	Statistical Office of the European Communities (Eurostat), Lot 20, funded by the European Environment Agency (EEA) to make an inventory of the existing monitoring networks for meteorological data in the EU.
Surface water quantity monitoring. Rees, Cole & Gustard. 1996	Funded by the European Environment Agency the aim of the report was to document the availability of data relating to water quantity monitoring procedures within the EU
Advances in Regional hydrology through East European co-operation. Eds Gustard & Cole. 1997	Funded by the European Commission the aim of the project was to advance co-operation in science and technology in Central and Eastern European countries
Report No. 16. The GRDC Database – Conception & Implementation. Pauler & Decouet. 1997	GRDC is a component of the World Meteorological Office. It is a central data centre for information relating to river flows across the world.
Estimation of renewable water resources in the European Union. Eds Rees & Cole, 1997	Collaborative project, co-ordinated by the Institute of Hydrology on behalf of the Commission of the European Communities. The aim of the report was to develop consistent methods for estimating renewable resources in the European Union.

Note: Full references are listed in Chapter 7 of the document

Table 1.2 Organisations that hold hydrological or meteorological data

Country	Organisation	National	Regional	Pan European	Hydrometric	Met. Org	National dataset & general info
Austria	HZB	x			x		
Austria	9 regional offices		x		x		
Denmark	NERI	x			x		
Denmark	14 counties		x		x		
Finland	FEA	x			x		
Finland	13 Regional centres		x		x		
France	MOE	x			x		
France	IOW	x			x		
France	CEMAGREF						ICARE Inventory of the catchments for research in Europe
France	CEMAGREF			x			IAMHY database of the Alpine and Mediterranean regions as part of the FRIEND programme
France	> 100 organisations	x	x		x		
France	BRGM				x		PROPHETE Computerised, dynamic database of river flow and catchment characteristics
Germany	GRDC			x			GRDC
Ireland	EPA	x			x		
Ireland	OPW, ESB	x			x		
Italy	NHS	x			x		
Italy	12 peripheral offices		x		x		
Netherlands	RIZA	x			x		
Netherlands	RIKZ	x			x		
Luxembourg	Eurostat			x	x	x	GISCO
Portugal	INAG	x			x		
Portugal	DRARNS, EDP		x		x		
Spain	DGOH	x			x		
Spain	JAC, CPT		x		x		
Spain	CEDEX	x			x		
Spain	INTECSA				x		steamflow from 330 station for 50 years, hydrological models for flow and rainfall, national inventory of catchment characteristics
Sweden	SMHI	x			x		
UK	Bartholomew						Digital databases for the world, GB and Ireland
UK	Met Off					x	
UK	IH	x			x	x	National River Flow Archive (NRFA)
UK	IH	x		x	x	x	FRIEND
UK	EA, SEPA, DOENI, DANI		x		x		

Note: Organisation names have been abbreviated. Full names are listed in Annex 1.

Further details of the information available are presented in the following Chapters; Chapter 2 presents details of gauged river flow data available, Chapter 3 presents the climate data; Chapter 4 river network data; Chapter 5 the catchment characteristics and Chapter 6 gridded data of relevance to hydrological studies. Details of national organisations including addresses, telephone and fax numbers are presented in the Annexes to the report.

2 Gauged river flow data

2.1 HYDROMETRIC SURVEYS

In January 1992, questionnaires were sent to hydrological organisations in member states in order to determine the availability of data and methods for estimating hydropower design in Europe (Gustard and Young, 1993). This survey found that in all countries, with the exception of Denmark and Portugal, several different authorities, based on region or field of interest, measured river flows. Time series of flow data for Greece and Ireland were held by individual national agencies, while in other countries, the time series flow data were archived in central locations. In Portugal and Spain, however, the computerisation of the data was not complete. By comparison, Germany possessed only a partial central data set and the Netherlands had no central data set.

A more recent survey, undertaken by the European Topic Centre on Inland Water (ETC/IW) and co-ordinated by the Institute of Hydrology on freshwater monitoring procedures in Europe (Rees et al, 1996), obtained information from national agencies in each of the 18 countries of the European Environment Agency (EEA) area. With the exceptions of Belgium, Luxembourg and Iceland, all countries provided information on their national surface water quantity monitoring programmes. Twelve of the countries provided an inventory of their gauging station network in computer readable form, which has been collated into a single database at the Institute of Hydrology.

Table 2.1 summaries, for each country, the type of hydrometric information which is archived and Table 2.2 indicates the availability of the data.

Table 2.1 Summary of variables archived for gauging stations (Source: Rees et al, 1996)

Country	Water Level	Disch.	Temp.	Turbid.	Susp. Sedimen t	Bed Material	Other	Frequency
Austria	x	x	x					daily, 2 hr, 1 hr, 30 min, 15 min
Belgium								
Denmark	x	x						15 min - 3 hrs
Finland	x	x	x				ice thickness	continuous, 1 hr, 15 min
France	x							daily
Germany								
Greece								
Iceland								
Ireland	x							continuous
Italy	x	x						continuous, hourly, daily
Luxembourg								
Netherlands	x	x						10 minutes
Norway								
Portugal	x	x	x		x			hourly
Spain	x	x						
Sweden	x	x	x				ice	hourly to daily
UK	x	x	x	x	x	x		15 minutes

Table 2.2 *Availability of data to other organisations (Source: Rees et al, 1996)*

Country	Disk/ Tape	Paper sheets	Reports	Fee payable	Restricted	Available to public	Availability of data & reports
Austria	Y	Y	Y	Y	N	Y	From Hydrological Central Office in Austria
Belgium							No information
Denmark	Y	Y	Y	Y/N	Y	Y	Special reports are available at libraries, educational institutes. Data reports of counties are available
Finland	Y	Y		N	Y	Y	Data from Finnish Environment Agency
France	Y	Y	Y	Y	Y/N	Y	From Reseaux d'hydrometrie generale
Germany							No information
Greece							No information
Iceland							No information
Ireland	Y	Y	Y	N	N	Y	From Environment Protection Agency
Italy	Y	Y	Y	N	Y	Y	From National Hydrographical Survey
Luxembourg							No information
Netherlands	Y		Y	Y/N	Y	Y	
Norway							No information
Portugal	Y	Y	Y	Y	N	Y	Data from Instituto da Agua
Spain	Y	Y	Y	N	N	Y	Available from CEDEX
Sweden	Y	Y	Y	N	Y	N	
UK	Y	Y	Y	Y	Y	Y	Available from NRFA office, IH

From the results of this survey, it was concluded that, although monitoring programmes had evolved independently, there was much uniformity in the monitoring procedures across Europe. Most of the countries in the EU have a monitoring programme that is co-ordinated at a national level by a single body, which is also responsible for any database management and publications. In many countries, networks operated by private organisations for specific purposes, such as hydropower, water supply or flood forecasting, contribute to the national programme.

Table 2.3 indicates that the networks are well established in all countries (for which information was received), within which a significant proportion of gauging stations possess long records, in excess of 20 years. Most countries operate continuously recording gauging stations that measure river level (stage) which is converted to discharge using stage-discharge relationships. In the UK, weirs and flumes are extensively used for flow measurement compared to velocity-area stations which are dominant in France, Spain, Austria, Denmark, Sweden and the Netherlands. Discharge may be recorded directly at some of the gauging stations.

The ETC/IW survey revealed that in the majority of countries, paper charts are still the most common on-site recording method, although digital loggers are widely used in the UK and Denmark. This survey revealed that all countries now archive their data in digital format on computer. The data may be available to outside organisations, in digital format or as published material, although the charging policy and restrictions will vary between countries.

Table 2.3 *Temporal extent of flow data from the ETC/IW Survey (Source: Rees et al, 1996)*

Country	No. stations	Earliest Record (Year)	Average Record Length (Years)
Austria	759	1893	25
Belgium	-	-	-
Denmark	417	1917	14
Finland	626	1847	55
France	3500	1850	-
Germany	-	-	-
Greece	-	-	-
Iceland	-	-	-
Ireland	1243	1893	40
Italy	969	1919	-
Luxembourg	-	-	-
Netherlands	66	1987	8
Norway	-	-	-
Portugal	214	1900	27
Spain	1214	1912	28
Sweden	420	1807	-
UK	1339	1841	25

The Institute of Hydrology has also undertaken a survey of the hydrometric data provision in Europe on behalf of the UK Environment Agency (Rees & Dixon, 1994). The purpose of the document was to identify the range and effectiveness of services provided by different agencies in Europe. Questionnaires were issued to principal organisations in 11 member countries of the European Union, plus Austria, Switzerland, Finland, Norway and Sweden. The survey identified those organisations responsible for rainfall monitoring, obtaining current meter readings, river gauging and groundwater monitoring. This report, whilst copyright of the UK Environment Agency, can be purchased from the Agency

2.2 THE FRIEND DATABASE

The FRIEND (Flow Regimes from International Experimental and Network Data) research programme was set up in 1985 as part of the Fourth International Hydrological Programme, funded by Unesco (Gustard, 1993). The programme, which is still ongoing, consists of a number of research projects, undertaken by research groups in participating countries. These projects focus on different elements of the hydrological cycle such as low flows, large-scale variations in river flow characteristics, techniques for extreme rainfall and runoff estimation and physical processes of streamflow generation in small catchments.

Central to the FRIEND project is the hydrological database, referred to as the European Water Archive, which was established at the Institute of Hydrology in 1985 and continues to be updated. There are two distinct components: the ARC/INFO geographical information system and the ORACLE relational database. Station details for 4000 gauging stations across western and northern Europe, catchment characteristics, time series of flows, annual maximum flows and derived statistics are held on ORACLE as separate, yet related database tables. The ARC/INFO database contains spatial coverage of catchment boundaries, national, hydrometric-

region and area boundaries, river networks, climate data and soil and land-use types. Further details of the information held on the ARC/INFO database are presented in later sections.

The development and maintenance of the EWA is the overall responsibility of the FRIEND Database Project Group, co-ordinated by the Institute of Hydrology. Five Regional Data Centres have been established across Europe to assist in the acquisition of data (Gustard & Cole, 1997). The Centres in Lyon, Koblenz, Oslo, Wallingford and St Petersburg play a key role in updating the archive, each having responsibility for contacting and obtaining data from supplying agencies within a given region.

The success of the FRIEND project in northern European countries has led to other FRIEND initiatives world-wide. In Europe, an Alpine and Mediterranean Hydrology (AMHY) group was created in 1991 specifically to study the hydrology of rivers in these regions (Lang & Oberlin, 1995).

There are 25 countries that make up the FRIEND study area. These countries have been subdivided into major hydrometric regions in which the boundaries follow topographic boundaries, which coincide with catchment boundaries rather than national boundaries. These hydrometric regions are further divided into hydrometric areas. All gauging stations held on the EWA have been assigned a unique seven-digit number which identifies the hydrometric region, the hydrometric area and a sequential number of the gauging station within the hydrometric area.

The gauging stations archived on the FRIEND databases have been selected to provide a suitable basis for regional analysis of the natural European flow regimes. As a result, they satisfy certain selection criteria rather than provide a comprehensive list of all the information that is available. The archive comprises river flow data from catchments that have minimal artificial influences and gauged time series for at least 5 years of record. The selected catchments are nominally less than 500 km². Table 2.4 summarises the extent of flow data held on the European Water Archive

On the AMHY database, there are 244 daily discharge stations and 92 rainfall stations, 39 of which are coupled with gauging stations for direct hydrological model applications. The data has been used for studies in Romania, Spain, Italy and France. The gauging station numbering system is consistent with the European FRIEND database, and the selection criteria are broadly consistent with the FRIEND database. (Oberlain (Ed), 1997)

2.3 GLOBAL RUNOFF DATA CENTRE

Close links exist between the FRIEND Project Group and the Global Runoff Data Centre (GRDC) based at the Federal Institute of Hydrology in Koblenz. The GRDC was established in 1988 in response to the need for the global collection and dissemination of river discharge data. The GRDC operates under the auspices of the World Meteorological Organisation (WMO), a specialised agency in the United Nations (UN) system.

The aim of the GRDC is to facilitate and optimise the information exchange in surface water hydrology world-wide. Data is provided for the Operational Hydrology Programme (OHP) and the World Climate Research Programme (WCRP) and close collaboration is maintained within the framework of water-related programmes of other UN organisations.

In 1996, daily discharge data were archived for 2500 gauging stations from 140 countries across the world. Information about the GRDC and requests for data obtained via the World Wide Web. The home page can be found under: <http://www.wmo.ch/web/homs/grdchome.html>

2.4 OTHER SOURCES OF INFORMATION

Details of selected hydrometric and climate stations are archived within the Inventory of the Catchments for Research in Europe (ICARE) (Barbet & Givone, 1992) on behalf of CEMAGREF. The ICARE is a relational database which provides descriptive data for European Research Basins (ERBs), primarily summary statistical information relating to the mean annual discharge, the ratio of base flow to total flow, the ratio of sediment discharge to total discharge. Other descriptive information includes the name, location and altitude of the station and the objectives of the research programme within the basin.

Table 2.4 Temporal extent of flow data on the European Water Archive (Source: Gustard & Cole, 1997)

Country	No stations		Earliest Record	Latest Record	Record Length (Years)	
	Oct '93	Dec '96			Mean	Max
Austria	79	82	1951	1990	31	40
Belgium	76	76	1929	1994	11	54
Bulgaria	-	3	1978	1986	9	9
Czech Republic	17	28	1887	1993	53	104
Denmark	19	35	1971	1994	57	78
Finland	38	69	1847	1991	50	144
France	1316	1335	1863	1992	22	128
Germany	505	520	1908	1994	31	83
Greece	-	2	1978	1980	3	3
Iceland	-	8	1932	1994	48	61
Ireland	36	67	1940	1996	23	56
Italy	-	252	1925	1990	16	66
Netherlands	18	25	1901	1994	23	93
Norway	180	196	1871	1995	35	114
Poland	-	30	1955	1992	25	36
Romania	-	33	1838	1990	35	153
Russia	-	12	1932	1988	42	57
Slovakia	22	23	1930	1992	63	63
Slovenia	-	12	1945	1990	25	45
Spain	-	240	1912	1989	14	74
Sweden	49	66	1907	1992	39	85
Switzerland	57	76	1904	1992	37	82
Turkey	-	7	1975	1987	11	12
UK	1049	1031	1879	1995	26	117
Yugoslavia	-	5	1978	1990	13	13
Total	3461	4233				

3 Measured data from climate stations

3.1 EUROSTAT

A network of climate stations exists across Europe which provide data for the GISCO database based at the Statistical Office of the European Communities (Eurostat). The database contains the location of 5308 climate stations within the 12 member states the European Union. Data have been obtained from three major publications (Landsberg, CLINO and Klimadaten) and from national meteorological services, supplemented by information from databases and publications from other agencies (Source EUROSTAT-GISCO Database Manual).

Within the database, details of a variety of different climatic variables are archived. The database includes information relating to the following:

- (i) Location of the station (x,y co-ordinates in Lambert Azimuth projection),
- (ii) Precipitation (including rainfall and snowfall statistics),
- (iii) Temperature,
- (iv) Relative humidity,
- (v) Vapour pressure,
- (vi) Atmospheric pressure,
- (vii) Sunshine hours,
- (viii) Evapotranspiration,
- (ix) Wind speed,
- (x) Cloud cover.

However, not all variables are recorded at each station. As a general rule, a value of precipitation and temperature should be available for all stations. The data for the climate stations (where available) are provided for annual and monthly periods, over a common period of 1931 to 1960, although some countries have data that include more recent periods, such as 1941 – 70 or 1951 – 80.

A recent survey was undertaken (Alvares and Rodrigues, 1997) in order to determine whether additional meteorological data was available to improve the spatial distribution of climate data. In common with the previous surveys, discussed in earlier sections, questionnaires were distributed to 15 countries of the European Union, plus Switzerland, although replies were obtained from only ten.

With the exception of Italy, the revised inventory incorporated an increased number of stations in each country. In particular, data are now available for Sweden, which was not previously included in the GISCO database. The number of climate stations is generally small, compared with rain gauge only stations, with the exception of Sweden, where general climate stations represent 30% of the total number of stations.

Table 3.1 provides information relating to the extent of climate stations as a result of the recent survey. Table 3.2 lists the meteorological variables archived in each country.

Table 3.1 *Spatial and temporal extent of European meteorological gauging stations (Source: Alvares and Rodrigues, 1997)*

Country	Area (km ²)	No. Gauging stations			Earliest Record (year)	Mean record length (No. years)
		Total	Meteorological	Precipitation		
Austria	83851					
Belgium	30507					
Denmark	43936					
France	550985					
Germany	248000	4390	640	3750	1879	40
Greece	13300	113	113	-		
Ireland **	70000	692	103	589	1866	25
Italy	372000	124	124	-		
Luxembourg	2600	1	1	-		
Netherlands	34000	356	36	320	1851	45
Norway	324000					
Portugal *	925000	1272	270	1002	1836	50
Spain	505345	5330	112	5218	1805	40
Sweden	449165	795	295	500	1722	50
Switzerland	41295					
UK	244000	4900	800	4100	1853	

Notes * Madeira and Azores only
 ** From the 103 meteorological stations, 88 are climatological and 15 synoptic, but only 55 are good quality. Of the 589 raingauge sites, 450 are reliable.

Table 3.2 *Meteorological variable recorded (Source: Alvares and Rodrigues, 1997)*

Country	Meteorological variables observed										
	Prec	Evap	Air temp	ET	Humid	Atmos Press	Solar Rad	Insolat	Wind	Soil moist	Others
Austria											
Belgium											
Denmark											
France											
Germany	x	x	x		x	x	x		x	20 stns	
Greece	x	x	x	x	x	x	x	x	x	x	
Ireland **	x	2 stns	x	1 stn	x	x	7 stns	x	x	x	
Italy	x		x		x	x	x	x	x		Visib, cloud
Luxembourg	x		x		x	x		sunsh.	x		Visib, cloud, soil temp.
Netherlands	x	x	x	x	x	x			x		
Norway											
Portugal	x	x	x		x	x		sunsh.	x		soil temp.
Spain	x	x	x		x	x		x	x		Visib, cloud
Sweden	x		x		x	x	10 stns	10 stns	x		Visib, cloud
Switzerland											
UK	x		x		x	x	x	x	x		Visib, cloud, snow depth, soil temp.

3.2 OTHER SOURCES OF INFORMATION

As noted in the previous Chapter, details of selected climate stations are archived within the ICARE. For each station, summary statistics relating to the mean annual temperature, the mean annual rainfall and the daily maximum rainfall with a 10 year return period are archived. This is in addition to the descriptive locational information for the station, as described in the previous Chapter.

4 River networks

4.1 PAN EUROPEAN RIVER NETWORKS

A survey of the availability of digital river network and catchment boundary mapping across Europe (Morris & Kronvang, 1994) was undertaken in 1993. The survey formed the basis of a feasibility study to establish a digital database of European rivers and catchment boundaries. The survey covered an area of approximately 3.85 million square kilometres, extending eastwards to include parts of Bulgaria, the Czech and Slovak republics, Poland and the former Yugoslavia where catchments drain into northern Europe. The survey concluded that the digital river networks and catchment boundaries were readily available in only a limited number of countries. Base maps at a scale of 1:250 000 (or better) were found to be available in all countries in Europe, from which it would be possible to digitise the river networks and catchment boundaries. Table 4.1 summarises the details of the availability of digitised networks derived from 1:250 000 (or nearest scale) scale maps, while the availability of the base maps are presented in Table 4.2.

Table 4.1 Availability of 1:250 000 (or nearest scale) digital rivers (Source: Morris & Kronvang, 1994)

Country	Source Scale	Map series	Co-ordinate system	Proportion of country covered	Accuracy	Resolution
Austria	1: 50 000	Official maps	Gauss-Kruger	100%	< 0.1 mm	-
Denmark	1:100 000	Different	UTM	100	< 0.5 mm	1m
Germany ¹	1:200 000	TUK 200	-	Planned 100%	< 0.1 mm	2m
Germany ²	1:300 000	Gewasserkarte	Gauss-Kruger	100%	< 0.1 mm	-
Great Britain	1:250 000	Routemaster	National Grid	100%	< 0.25 mm	1m
Northern Ireland	1:250 000	Holiday Map	Transv. Mercator	100%	< 0.1 mm	1m
Netherlands	1:50 000	Waterstaatskaart	National Grid	100%	< 0.25 mm	-
Norway	1:50 000	M711	UTM (ED 50)	100%	< 0.5 mm	1m
Poland	1:200 000	Podzial Hydrograf.	Lat/long	20%	< 0.1 mm	10 m
Portugal	1:500 000	Official maps	Gauss	100%	< 0.25 mm	< 0.1 m
Spain	1:200 000	Provincial maps	UTM	100%	-	-
Sweden	1:250 000	Roda Karten	National Grid	100%	< 0.1 mm	10 m
Switzerland	1:200 000	Official maps	National Grid	100%	< 1 mm	< 0.1 m

Notes: ¹ Planned for all Germany (1995)
² Nordrhein - Westfalen

Following the feasibility study, a project is currently in progress, funded by the European Environment Agency and co-ordinated by the Institute of Hydrology, which will develop a digital river network for Europe at a 1:1 000 000 scale. The database will be available in February 1998 as an ARC/INFO coverage and will include the local and English name. It is anticipated that the attribute table will also include river length and catchment area. The project will also generate digital catchment boundaries for the 1000 largest catchments in Europe, based on the United States Geological Survey (USGS) Digital Terrain Model, available as a 1km grid, and corrected for anomalous sinks.

A pilot study was undertaken to map the rivers at the 1:250 000 scale in the UK and south west Germany.

Table 4.2 *Availability of river maps at a scale of 1:250 000 (or nearby) (Source: Morris & Kronvang, 1994)*

Country	Source Scale	Map series	Supplier/producer	Co-ordinate system	Map projection
Austria	1:200 000	OK200	Bundesamt für Eich – und Vermessungswesen	Lat/long, UTM	Gauss-Kruger
Belgium	1:250 000	M534	Institut Géographique National	Lat/long, UTM	Lambert
Bulgaria	1:200 000	Old series	Austrian Survey Authority		Polyeder
Czech Republic	1:200 000	Tourist map	Geodetický a Kartografický Podnik v Praze	None	Gauss
Denmark	1:200 000	Road map	Geodætisk Institut	UTM	None
Finland	1:200 000	Road map GT	National Board Survey	Lat/long	Gauss-Kruger
France	1:250 000	T250	Institut Géographique National	None	Lambert
Germany (W)	1:200 000	TUK 200	Institut für Angewandte Geodäsie	Lat/long, UTM	Gauss-Kruger
Germany (E)	1:300 000	Road map	VEB Tourist Verlag	Lat/long, UTM	Gauss - Kruger
Great Britain	1:250 000	Routemaster	Ordnance Survey	National Grid	Mercator
Greece	1:200 000	Karta Nomos	Greek Statistical Office		
Greece	1:250 000	Hellas	Hellenic Military Geog. Service		
Northern Ireland	1:250 000	Holiday map	Ordnance Survey of Northern Ireland	National Grid	Lat/lon, Mercator
Rep. of Ireland	1:250 000	Holiday map	Ordnance Survey of Ireland	National Grid	Lat/long, Mercator
Italy	1:250 000	Regional map	Instituto Geografico Militare		Gauss Boaga
Italy	1:250 000	Touring map			
Italy	1:200 000	IGM	Instituto Geografico Militare		
Luxembourg	1:250 000	Grand-Duche	Admi. de Cadastra et de la Topo		
The Netherlands	1:500 000	1501	Topografische Dienst Nederland	Lat/long, UTM	Mercator
Norway	1:500 000	1501	Statens Kartverk	Lat/long, UTM	UTM
Poland	1:200 000	Hydro. Structures			
Portugal	1:500 000	M586	Servico Cartográfico do Exército	Lat/long, UTM	Mercator
Portugal	1:250 000	M585	Instituto Geográfico e cadastral	Lat/long, UTM	Mercator
Spain	1:200 000	2C	Servico Cartográfico del Ejecito	Lat/long, UTM	UTM
Sweden	1:250 000	Roda Karten	Lantmäteriverket	Lat/long, UTM	Gauss – Kruger
Switzerland	1:200 000	Landeskarten	Bundesamt für Landestopographie		

4.2 OTHER NETWORKS

Digital databases, which incorporate digital river networks, are commercially available through Bartholomew Digital Mapping for the whole of the world and for selected countries. The databases are based on ARC/INFO coverages and include administrative boundaries, contours, drainage networks, water areas, amenity/urban areas and road/rail networks. Published in 1990, the database which covers the world is available at a scale of 1:14 000 000. Databases for Great Britain (at a scale of 1:250 000) and Ireland (at a scale of 1:50 000) are also available. According to Bartholomew promotional material, it was anticipated that a database covering Europe at a scale of 1:1 000 000 would be available in the future.

The databases can be licensed from Bartholomew for an initial period of three years, with an annual maintenance payable for the second and third years. The cost of the data (based on 1990 figures) were:

Great Britain	complete dataset:		£20 000
	individual datasets:	drainage	£2 500
		administrative	£250
		coastline	£500
		water areas	£1 000
Ireland	complete dataset:		£2 500
World	complete dataset:		£3 000

The Statistical Office of the European Communities have co-ordinated the development of the GISCO digital database which consists of a variety of ARC/INFO coverages from topographic data over administrative regions and transport networks to data on the environment and natural resources. Within the database, a coverage representing the major rivers and Lakes within the European member states is available (Rees & Cole, 1997). The rivers are represented at a scale of 1:1 million.

The river network database can be integrated with the other GISCO coverages mentioned throughout this report. The complete GISCO dataset can be obtained for 2500 ECU (plus VAT), although the individual coverages can be purchased separately; the river pattern coverage (including lakes and coastlines) was quoted as 400 ECU (plus VAT).

With all the databases (Bartholomew and GISCO), there are additional charges depending on the media (e.g. tape or diskette; price per item).

5 Catchment and national boundaries

5.1 CATCHMENT BOUNDARIES

As part of the European Flood Study (Beran et al, 1984), over 1000 catchment boundaries were digitised from 1:250 000 scale 1404 series topographic maps. Co-ordinate pairs (x and y co-ordinates in Universal Transverse Mercator (UTM) projection) defining the vector boundaries for catchments in Eire, France, the (former) Federal Republic of Germany have been archived as ARC/INFO coverages within the FRIEND European Water Archive database. Details of the EWA were as discussed in previous Chapters. Additional catchment boundaries for gauging stations in the UK are also available.

Topographic catchment boundaries were digitised for 198 stations in Spain and 180 stations in Italy under Phase II of the European Atlas of Small Scale Hydropower Resources (Irving et al, 1995) funded through the European Union's Altener programme.

As noted in the previous Chapter, the GISCO database is available through the Statistical Office of the European Communities. In addition to the river patterns (i.e. drainage network), the watersheds (catchment boundaries) corresponding to the major rivers in Europe are available.

5.2 NUTS BOUNDARIES

The NUTS (Nomenclature des Unités Territoriales) boundaries represent the country, counties/provinces and local administrative boundaries for the European Union Countries. The boundaries have been made available through the EUROSTAT Lot 20 (Rees & Cole, 1997) project and have been archived on the European Water Archive database at the Institute of Hydrology.

6 Geographic databases

In addition to the relational database held on the European Water Archive, an ARC/INFO Geographic Information System is used to archive the digital catchment boundaries and other spatial databases, including a soil map of the European Union, at a scale of 1:1 000 000 scale (CEC. 1985), land use, degree of urbanisation and digital elevation. These are described further in the following sections.

6.1 EUROPEAN SOIL COVERAGE

A soil map of the twelve countries in the European Union was published by the Commission of the European Communities in 1985 at a scale of 1:1 000 000. The map is based on the FAO soil classification and represents 312 soil associations. The map is also available in digital format, through the Co-ordination of Information on the Environment (CORINE) project as an ARC/INFO coverage. The digital coverage provides a basic inventory of soil units of the EU according to the FAO nomenclature and includes information relating to each soil association, including dominant soil characteristics, physical characteristics including texture and associated soil types.

An updated version (Version 2.0) of the soil database has been made available through the Eurostat (Rees & Cole, 1997) and provides new information relating to parent material and percentage of land use, for example. It should be noted that the CEC soil map was first published in 1985 at a scale of 1:1 000 000 and Version 1.0 of the digital soil database was produced in 1986. In the same year the territories of Austria and Switzerland were added to the map, however, the digitised extent of soils within the database does not include these countries. This would imply that although soil information is available, it has not been converted to digital information.

6.2 RAINFALL & EVAPORATION

In the UK, the Meteorological Office possesses digitised maps of standard period annual average rainfall (SAAR) with grid resolution of 1km x 1km grid squares. The standard periods of 1941 – 70 and 1961 – 90 are available. The Meteorological Office also hold digital databases of evaporation at the same resolution, based on 1:2 million scale maps of evaporation derived from the Penman equation with a surface albedo of 0.25.

For Europe, a grid of rainfall and evaporation have been generated based on data provided by the Climate Research Unit (CRU), UK. The dataset was developed under an EC funded project and provides a mean monthly climatology for the 1961 – 90 period covering the European Union and beyond. The resolution of the grid is 0.5 degrees of latitude by 0.5 degrees longitude.

The PE map was generated from the Penman equation. As part of a project undertaken on behalf of Eurostat, a 10km grid was generated from the same data. There are some known problems in the precipitation coverage where the rainfall is being under-estimated by an average of 10%.

Maps of mean annual and monthly rainfall at a scale of 1:3 000 000, average annual potential evaporation and other climate data (based on 1931-1960 data from 5000 measuring stations) are included in the Atlas Climatico de España which was supplied by INTECSA. The annual and monthly rainfall maps and the evaporation map were digitised as part of the second phase of the

ESHA project (Irving et al, 1995). Additional maps were also provided for the project by Centros de Estudios y Experimentación (CEDEX) of standard period (1961 – 90) average annual rainfall at a scale of 1:625 000. These maps were available as 1km grids, providing more up-to-date information than that included in the Atlas. In Italy, grids of rainfall and evaporation were made available, based on 20 x 20 km grids in central and southern Italy and 30 x 30 km grids in the north.

7 References

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- Rees, & Dixon, J.M., 1994. Survey of hydrometric data provision in the European Union. A draft report to the National Rivers Authority, UK. Institute of Hydrology, UK.

Annex 1 Organisation information

Country AUSTRIA
 Abbreviation HZB
 Organisation Name Hydrological Central Office (Hydrographisches Zentralburo)
 Address A-1030 Wien, Marxergasse 2
 Contact Name Dr.Krauseneker and Dip1.-Ing.Godina
 Phone No. +43-1-711-00-6936
 Fax No. +43-1-711-00-6951
 E-Mail Address

Country DENMARK
 Abbreviation NERI
 Organisation Name National Environmental Research Institute
 Address Vejlsovej 25, P.O. Box 314, DK-8600 Silkeborg
 Contact Name Niels Bering Ovesen
 Phone No. +45-89-20-14-00
 Fax No. +45-89-20-14-14
 E-Mail Address fvnbo@dmu.min.dk

Country FINLAND
 Abbreviation FEA
 Organisation Name Finnish Environment Agency
 Address BOX 140, FI-00251 Helsinki, Finland
 Contact Name Markku Puupponen
 Phone No. +358-0-403000
 Fax No. +358-0-40300190
 E-Mail Address markku.puupponen@vyh.fi

Country FRANCE
 Abbreviation MOE
 Organisation Name Ministre de l'Environnement, Direction de l'eau,
 Bureau des donnees sur l'eau
 Address 20, Avenue de segur, 75032 Paris 07 SP
 Contact Name Christian Scherer
 Phone No. +33-42-19-12-26
 Fax No. +33-42-19-13-33
 E-Mail Address

Country FRANCE
 Abbreviation IOW
 Organisation Name International Office for Water (Office International de l'Eau)
 Address 21 rue de Madrid, 75008 Paris
 Contact Name D Preux
 Phone No.
 Fax No.
 E-Mail Address

Country IRELAND
Abbreviation EPA
Organisation Name Environmental Protection Agency
Address St. Martin's House, Waterloo Road, Dublin 4
Contact Name P.J. Kenny
Phone No. +353-1-6602511
Fax No. +353-1-6680009
E-Mail Address

Country IRELAND
Abbreviation ESB
Organisation Name Electricity Supply Board
Address Ardna Crusha, Co. Limerick
Contact Name M Quinn
Phone No. +353 61 345588
Fax No. +353 61 344560
E-Mail Address

Country IRELAND
Abbreviation OPW
Organisation Name Office of Public Works
Address 51, St. Stephens Green, Dublin 2
Contact Name T Bolger
Phone No. +353 1 6613111
Fax No. +353 1 6761714
E-Mail Address

Country ITALY
Abbreviation NHS
Organisation Name National Hydrographical Survey
Address Via Curtatone, 3 - 00185 ROMA
Contact Name Ing. Giuseppe BATINI
Phone No. +39-6-44442410
Fax No. +39-6-4957947
E-Mail Address

Country NETHERLANDS
Abbreviation RIZA
Organisation Name RIZA Institute for Inland Water Management and Waste
Water Treatment
Address Maerlant 16, 8200 AA Lelystad
Contact Name W H Mulder
Phone No. +31 3200 70746
Fax No. +31 3200 49218
E-Mail Address

Country NETHERLANDS
Abbreviation RIKZ
Organisation Name RIKZ National Institute for Coastal and Marine Management
Address Kortenaerkade 1, 2518 AX Den Haag
Contact Name H W M Bots
Phone No. +31 70 3114566
Fax No. +31 70 3114321
E-Mail Address

Country PORTUGAL
Abbreviation INAG
Organisation Name Instituto da Agua
Address Av. Almirante Gago Coutinho, 30 - 1000 LISBOA
Contact Name Manuel Lacerda
Phone No. +351-1-8470610
Fax No. +351-1-809218
E-Mail Address

Country PORTUGAL
Abbreviation EDP
Organisation Name Electricity Producer Company
Address N/A
Contact Name
Phone No.
Fax No.
E-Mail Address

Country PORTUGAL
Abbreviation DRARN
Organisation Name Direccoes Regionais do Ambiente e Recursos Naturais
Address N/A
Contact Name
Phone No.
Fax No.
E-Mail Address

Country SPAIN
Abbreviation DGOH
Organisation Name Direccion General de Obras Hidraulicas
Address Avda de Portugal, 81. MADRID
Contact Name Jose M. Santafe
Phone No. +34-1-5964990
Fax No. +34-1-5964910
E-Mail Address

Country SPAIN
Abbreviation JAC
Organisation Name Junta de Aguas de Cataluna
Address Via Layetana 10 bis., 08003 Barcelona
Contact Name Robert Verges
Phone No. +34 3 3105903
Fax No.
E-Mail Address

Country SPAIN
Abbreviation CPT
Organisation Name Conselleria de Politica Territorial,
Obras Publicas y Vivienidas
Address San Caetano s/n., 15071 Santiago Compostela, La Coruna
Contact Name A Hernandez
Phone No. +34 81 544551
Fax No. +34 81 544529
E-Mail Address

Country SPAIN
Abbreviation CEDEX
Organisation Name Centro de Estudios y Experimentacion de Obras Publicas
Address Paseo Bajo Virgen del Puerto 3, 28005 Madrid
Contact Name L Quintas
Phone No. +34 1 3357957
Fax No. +34 1 3357922
E-Mail Address Luis.Quintas@cedex.es

Country SWEDEN
Abbreviation SMHI
Organisation Name Swedish Meteorological and Hydrological Institute
Address 60176 Norrkoping
Contact Name Torbjorn Lindkvist
Phone No. +46 11 15 8340
Fax No. +46 11 17 02 07
E-Mail Address TLindkvist@SMHI.SE

Country UK
Abbreviation IH
Organisation Name Institute of Hydrology
Address Maclean Building, Crowmarsh Gifford,
Wallingford, Oxon, OX10 8BB
Contact Name M.L. Lees
Phone No. +01491-838800
Fax No. +01491-832256
E-Mail Address sgr@ua.nwl.ac.uk

Country UK
Abbreviation EA (formerly NRA)
Organisation Name Environment Agency (England and Wales)
Address Rivers House, Waterside Drive, Aztec West,
Almondsbury, Bristol, BS12 4UD
Contact Name Public Relations Department
Phone No. +44 11 79 624400
Fax No. +44 11 79 624409
E-Mail Address

Country UK
Abbreviation RPB
Organisation Name River Purification Boards (Scotland)
Address Scottish River Purification Boards Association,
1 South Street, Perth, PH2 8NJ
Contact Name
Phone No.
Fax No.
E-Mail Address

Country UK
Abbreviation DOENI
Organisation Name Department of the Environment Northern Ireland
Address DOENI, Environment Service,
Calvert House, 23 Castle Place, Belfast, BT1 2NS
Contact Name
Phone No.
Fax No.
E-Mail Address

Country UK
Abbreviation DANI
Organisation Name Department of Agriculture Northern Ireland
Address DANI, Hydebank, 4 Hospital Road, Belfast, BT8 8JL
Contact Name
Phone No.
Fax No.
E-Mail Address

Annex 2 Organisations providing hydrometric services

AUSTRIA

1. Hydrographisches Zentralbüro
Marxergasse 2
A-1030 Wien
Austria

Contact: Dr. Nobilis

BELGIUM

1. Ministère Wallon de l'Équipement et des Transports
D211 - Service d'Études Hydrologiques
Bld Simon Bolivar 30
WTC 3-11^e étage
1210 Bruxelles
Belgium
2. Institut Royal Météorologique
Avenue Circulaire, 3
B - 1180 Bruxelles
Belgium

Contact: Ir. Paul Dewil

Contact: Dr. H. Malcorps

3. Institute for Land and Water Management
Vital Decosterstraat 102
3000 Leuven
Belgium
4. Hydraulics Laboratory
University of Ghent
Seint Pietersnieuwstraat 41
B-9000
GHENT
Belgium

Contact: Prof. J. Feyen

Director: Prof. Dr. ir. R. Verhoeven

DENMARK

1. Hydrometrical Survey
Danish Land Development Service
Ringstedvej 20
PO Box 9
DK-4000 Roskilde
Denmark
2. Danish Meteorological Institute
Lyngbyvej 100
DK-2100 København O
Denmark

Contact: Ole Ekstrand

Contact: Mr. Ib Andersen

3. Rambøll, Hannemann & Hojlund
Bredevej 2
DK-2830 Virum
Denmark

Contact: Mr. Ole Michaelson

4. National Environmental Research
Institute
Ministry of the Environment
Vejlsovej 25
PO Box 314
8600 Silkeborg
Denmark

Contact: Neils Bering Ovesen

5. Geological Survey of Denmark
Thoravej 8
DK 2400-Kobenhavn NV
Denmark

Contact: Erik Nygaard

FINLAND

1. National Board of Waters & Environment
Hydrological Office
P O Box 436
SF-00101 Helsinki
Finland

Contact: Dr. P. Seuna

FRANCE

1. DIREN Poitou - Charentes
14 Bld Chasseigne
86000 Poitiers
France

Contact: F. Goussé

2. DIREN - Basse Normandie
CITIS - le Pentacle
14209 Herouville Cedex
France

Chef du SEMA: L. Chevalier
Contact: F. Letouzé

3. DIREN - Pays de la Loire
12 Rue Menou
44035 Nantes Cedex 1
France

Chef du SEMA: J.L. Denoyelle

4. DIREN Champagne - Ardennes
Complex Agricole du Mont Bernard
Route de Suippes
51037 Chalons-sur-Marne
Cedex
France

Contact: P. Marras

5. DIREN - Bretagne
15 Avenue de Cueillé
35047 Rennes Cedex
France

Contact: Y. Pellarin
6. DIREN - Centre
131 Rue du Faubourg Bannier
45042 Orleans Cedex 1
France

Contact: M. Ghio
7. DIREN - Lorraine
19 Avenue Foch
BP 223
F - 57005 Metz Cedex 1
France

Contact: J. Abele
8. DIREN - Auvergne
RN89 - Marmilhat
63370 Lempdes
Cedex
France

Chef du SEMA: A. Rongere
9. DIREN - Nord - Pas de Calais
81 avenue de Soubise
BP 65
59831 Lambersart Cedex
France

Contact: P. Parent
10. DIREN - Aquitaine
29 rue de l'Ecole Normale
33073 Bordeaux Cedex
France

Contact: M. Aigrot
11. DIREN Midi-Pyrénées
2 Port St Etienne
31079 - Toulouse Cedex
France

Contact: M. Bouziges
12. DIREN - Alsace
24 Grande Rue
BP 55
68180 Horbourg - Wihr
France

Chef du SEMA: Y. Gobillon
13. Bureau de Recherches Geologiques et
Minières
BP 6009
45060 Orleans Cedex
France

Contact: J.C. Roux

GERMANY

- | | |
|---|---|
| 1. Landesumweltamt Brandenburg
Postfach 60 10 61
14410 Potsdam
Germany | 2. Ministerium für Natur, Umwelt
und Landesentwicklung des
Landes Schleswig-Holstein
Postfach 62 09
2300 Kiel 14
Germany |
| Contact: Dr. Haase | Contact: V. Petersen |
| 3. BfG: Bundesanstalt für Gewässerkunde
(Institut Fédéral d'hydrologie)
Kaiserin Augusta Anlagen, 15-17
56068 Koblenz
Germany | 4. Senatsverwaltung für Stadtentwicklung
und Umweltschutz
Lindenstrasse 20-25
D-10958 Berlin
Germany |
| Director: Prof. V. Wetzel | Contact: Hr. Dr. Jahn |
| 5. Niedersächsisches Umweltministerium
Archivstr. 2
30169 Hannover
Germany | 6. Umweltministerium
Mecklenburg-Vorpommern
Schlosstrasse 6-8
19053 Schwerin
Germany |
| Contact: S. Popp | Contact: Herr Wöhl |
| 7. Thüringer Ministerium für Umwelt und
Landesplanung
Postfach 722
99014 Erfurt
Germany | 8. Landesanstalt für Umweltschutz
Baden-Württemberg
Postfach 210752
76157 Karlsruhe
Germany |
| Contact: R.D. Teltscher | Contact: Dipl-Ing. Möhle |
| 9. Landesumweltamt Nordrhein-Westfalen
Postfach 10 23 63
45023 Essen
Germany | 10. Bundesanstalt für Wasserbau
Kussmaulstr. 17,
76187 Karlsruhe
Germany |
| Contact: Dr-Ing. Stein | Contact: Frau Gloger |

11. Albert - Ludwigs - Universität
Institute für Physische Geographie
Werderring 4
7800 Freiburg 1.BR
Germany

Contact: Dr. S. Demuth

12. Ministerium für Umwelt
Postfach 3160
55021 Mainz
Germany

Contact: Herr Humann

13. Landesamt für Wasserwirtschaft
Rheinland-Pfalz
Am Zollhafen 9
55118 Mainz
Germany

Director: Dipl-Ing. Lüthje

Contact: Dr. Meuser

14. Ministerium für Umwelt und
Naturschutz Sachsen-Anhalt
Pfälzerstr.
D39110 Magdeburg
Germany

Director: Dr. Püttmer

Contact: Frau Schulze

15. Amt für Umweltschutz
Umweltbehörde
Steindamm 22
20099 Hamburg
Germany

Contact: S. Jochem

GREECE

1. Ministry of Agriculture
Directorate of Geology - Hydrology
Halkokomdili Street 46
10432 Athens
Greece

Director: M. Kilakou - Salapata

2. Ministry of Industry, Energy
and Technology
Water Resources Directorate
80 Michalakopoulou Street
101 92 Athens
Greece

Director: Chr. Maniati - Siatou

ITALY

1. Servizio Idrografico e Mareografico Italiano
_Presidenza de Consiglio
via V. Veneto 56
00187 Roma
Italy

Director: Dott. Ing. G. Batini
2. Istituto di Ricerca Sulle Acque
via Reno 1
00198 Roma
Italy

Contact: G. Guiliano

NETHERLANDS

1. TNO Institute of Applied Geoscience
PO Box 6012
2600 JA Delft
The Netherlands

Contact: M.J. van Bracht
2. Rijkswaterstaat, Tidal Waters Division
P.O.Box 20907
2500 EX The Hague
The Netherlands

Contact: Ir. H.W.M. Bots
3. Directorate-General for Public Works and Water Management
Institute for Inland Water Management
PO Box 17
8200 AA Lelystad
The Netherlands

Contact: J.P. Bakker

NORWAY

1. NVE Norwegian Water Resources & Energy Administration
Hydrology Department
Box 5091 - Majorstua
N-301 Oslo
Norway

Contact: L.A. Roald

REPUBLIC OF IRELAND

1. Office of Public Works
17/19 Lower Hatch Street
Dublin 2
Ireland

Contact: T. Bolger

2. Geological Survey of Ireland
Beggars Bush
Haddington Road
Dublin 4
Ireland

Contact: R. Aldwell

SPAIN

1. Instituto Nacional de Meteorología
Paseo de las Moreras
s/n C. Universitaria
28040 Madrid
Spain

Contact: D. Antonio Labajo Salazar

2. Dirección General de Obras
Hidraulicas
MOPHTA
Avda. de Portugal 81
28011 Madrid
Spain

Director: Adrián Baltanás García

Contact: J.M. Santafe Martinez

3. Instituto Tecnológico Geominero de España
(ITGE)
Rios Rosas 23
28003 Madrid
Spain

Contact: J. A. López Geta

SWEDEN

1. Swedish Meteorological and
Hydrological Institute
S-60176 Norrköping
Sweden

Contact: Maja Brandt

2. Geological Survey of Sweden
PO Box 670
S-751 28 Uppsala
Sweden

Director: J.O. Carlsson