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THE ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

INTEGRATED FLOOD MANAGEMENT

CASE STUDY

GERMANY: *FLOOD MANAGEMENT IN THE RHINE AND ELBE RIVER BASINS*

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Dr. Klaus Wilke[1]

1. Case Study on the River Rhine

1.1 Characteristic of the catchment area

The catchment area of the river Rhine covers an area of some 185,000 km^2. In morphological terms, the 1,320 km of the Rhine can be divided in six parts: the Alpine Rhine, the High Rhine, the Upper Rhine, the Middle Rhine, the Lower Rhine, and the Rhine Delta, which differ strongly in their hydrological behaviour. The Alpine Rhine originates on the Gotthard Massif in Switzerland, where small streams come down from a height of more than 3,400 m a.s.l. The main tributary of the High Rhine is river Aare. Downstream the river Rhine flows through lowlands with a markedly flatter gradient. The main tributaries are Neckar, Main and Moselle.

- The mean annual runoff at gauge Emmerich is 2,270 m^3/s.
- The range of discharge fluctuations, expressed by the ratio low-waterflow to high-waterflow (LQ/HQ) derived from time series 1931/1983 is upstream of Lake Constance about 1:50; at Rheinfelden it is reduced to about 1:12 caused by the influence of the lakes, and further downstream it varies between 1:10 and 1:18.

The annual pattern of runoff is caused by alpine snowmelt during summer and high amounts of precipitation in the lowland catchment area during winter. The catchment basin is extraordinary heterogeneous, also with view to the meteorological constellation. This is illustrated by the fact that in a long series of hydrological records no single flood event can be found that occurred simultaneously and in comparable dimension in all sub-catchments of the Rhine.

1.2 Rhine floods 1993 and 1995

The meteorological cause for the flood in December 1993 was wide-areal precipitation in the basins of rivers Neckar, Main, Nahe and Moselle in two periods. First from 7 to 18 of December and second from 19 to 20 December, each entailing between 100 and 200 % of mean December precipitation. The flood became an outstanding event only downstream river Nahe (BfG, 1994).
For Cologne, on the basis of the data series 1901/1990, a recurrence period of 80 years was calculated (Engel and Oppermann, 1999).

The cause for the flood in January 1995 was also wide-spread precipitation. Within 9 days (21 to 29 January 1995) 100 mm precipitation fell in the catchments of rivers Main, Nahe, Mosel, Sieg, Ruhr, and Lippe.

Contrary to 1993, flood conditions also appeared south of the river Neckar mouth. But this was only for a short time, the condition for the retention measures was not fulfilled. Due to the extreme floods at rivers Main and Nahe downstream, the Nahe mouth the maximum discharge came up to 6400 m^3/s. This produced at gauge Kaub a higher crest than the 1993 flood. In contrast the crest at Koblenz was 31 cm lower than at the 1993 flood, because of the lower discharge of river Moselle. Downstream of river Sieg mouth the discharge increased up to some 12,000 m^3/s at gauge Emmerich (BfG, 1996).

[1] Federal Institute of Hydrology, Koblenz, Germany

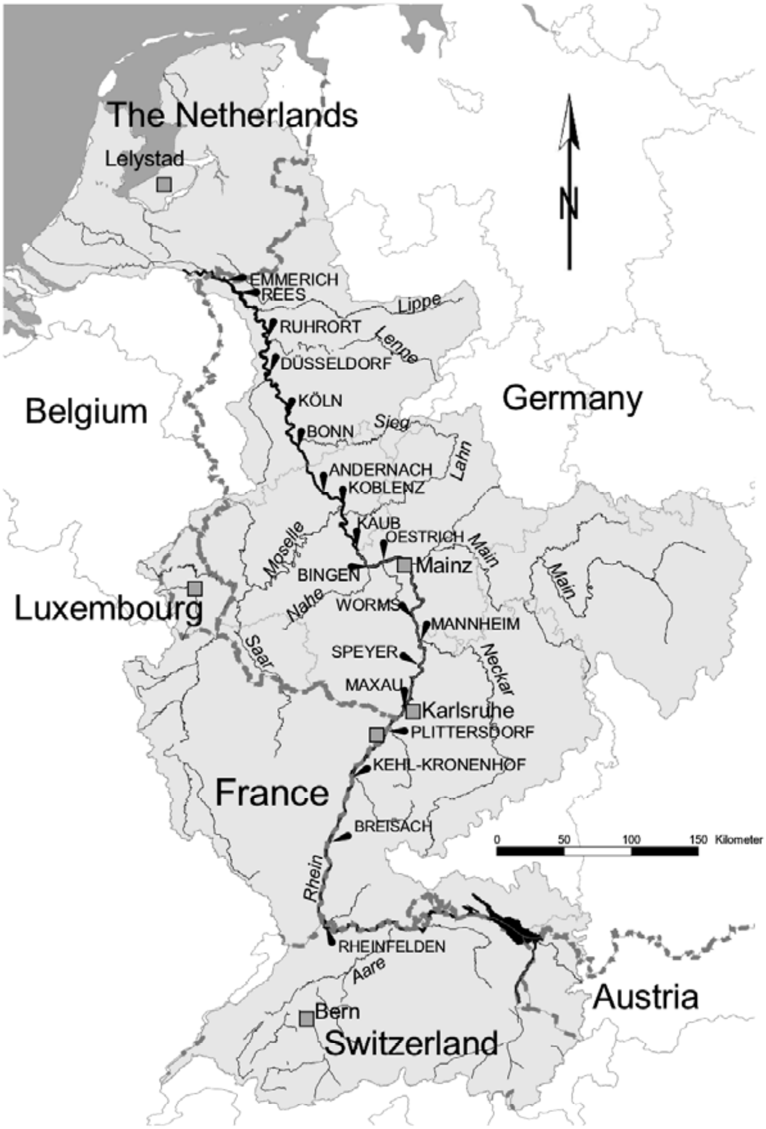

Figure 1. River Rhine basin

1.3 Flood management measures

The Rhine flood in December 1993 was the motive for the decision of the 11th Ministerial Conference of the riparian countries on the Rhine in December 1994 to include issues of flood protection into the list of tasks of the International Commission for the Protection of the Rhine (ICPR, 1995).
Immediately after the next major Rhine flood in January 1995, the ICPR was commissioned by the environmental ministers of the member countries to draft a flood action plan.
The ICPR initiated the compilation of an inventory of flood reporting systems and proposals for improved flood forecasting in the Rhine basin (ICPR, 1997). On the basis of this report, the ICPR Action Plan on Flood Defence was adopted by the 12th Conference of Rhine Ministers in Rotterdam on 22 January 1998 (ICPR, 1998).
The objective of the Action Plan is to improve the protection of man and material assets against floods and to enhance the ecological state of the Rhine and its alluvial areas (ICPR, 2001). The following targets are set out for action:

- Reduce damage risk (damage risk as a linking of damage probability and extent of damage done) – no increase of damage risks until the year 2000, reduction up to 10 % by 2005 and up to 25 % by 2020.

- Reduce flood levels – reduce extreme flood stages downstream of the impounded part of the river up to 30 cm until the year 2005 and up to 70 cm until the year 2020.
- Increase flood awareness – increase the awareness of flooding by drafting risk maps for 50 % of the floodplains and the areas at flood risk by the year 2000 and for 100 % of these areas by the year 2005.
- Improve the flood announcement system – short-term improvement of flood forecasting systems international cooperation. Prolong the forecasting period by 50% by the year 2000 and by 100 % by the year 2005.

1.3.1 Reduce damage risk

Policy

In Germany, each Land Government holds different legislation and guidelines for water management. Although the State Governments cooperate in the LAWA (Federal States Working Group on Water Issues) since 1956, the separate policies have not been harmonized. The last years, sustainable development and integrated water management have become a central issue in German water management (NCR, 2001). Preventive flood protection is fixed in the regional planning law. One of the regional planning principles is to keep flood risk areas open in order to store flood water and to evacuate flood water. Building laws demand that the flood risk in flood areas should not rise.

Basically new development is prohibited in areas with high flood risk outside existing settlements. Inside settlements the necessary measures of property protection must be taken for all new and renovated buildings.

Technical flood protection

The core of many dykes along the river Rhine is older than 100 years and do not conform to today's requirements. Since 1995 around 100 km of dyke is redeveloped withaltogether 400 km dyke in need of rehabilitation.

Regional flood protection measures are useful in areas where a continuous dyke is not possible. At the Middle Rhine flood defence constructions are built in the cities of Worms-Rheindürkheim, Bingen, Braubach, Spay and Koblenz-Ehrenbreitstein (ICPR, 2001). At the tributaries more than 157 regional flood defence constructions are carried out till the end of 2000.

Measures of risk preparedness

Insurances cover unpredictable damage due to rare events by spreading the damage to a risk community. The German “Gesamtverband der deutschen Versicherungswirtschaft (GdV)” is launching a risk orientated insurance covering damage due to flooding. This risk orientated insurance is based on a zoning system (ZÜRS 99) with three zones of different flood hazard ((ICPR, 2001).

Zone	*Flooding risk*
I	>50 years
II	10-50 years
III	< 10 years

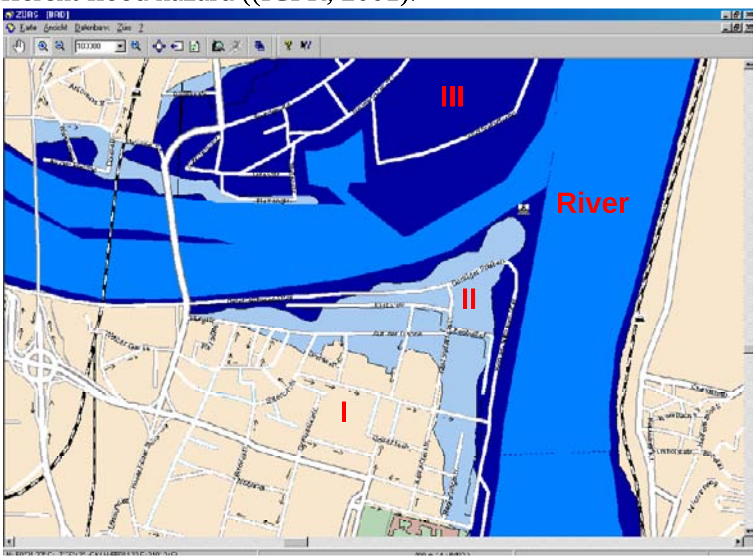

Figure 2. ZÜRS flood hazard (GDV, 2003)

Areas inside zone I and II are general insurable, but areas inside zone III with a flood frequency less than 10 years are insurable only under special conditions and requirements.
These zones are a uniform basis for the classification of hazard of the insurance companies.

1.3.2 Reduce flood stages

Water storage along the Rhine
The most substantial contribution for the reduction of the flood stages is water storage directly along the Rhine. Till 1995 water storage of 31 mio. m^3 was ready for action. Since 1995 the following measures have been prefaced.

Table 1. Measures in Germany (ICPR, 2001)

	Status	*Area [ha]*	*Volume [Mio. m^3]*
Kulturwehr Kehl	under construction	700	24
Polder Söllingen/Greffern	under construction	550	12
Daxlanderau	Ready	166	5.1
Flotzgrün	Ready	165	5
Orsoyer Rheinbogen	Ready	220	10
Bislicher Insel	under construction	1100	50
Monheimer Rheinbogen	under construction	200	8

Since 1995 more than 10 mio. m^3 technical flood storage was created at the Upper Rhine and another 36 mio. m^3 are under construction. These measures should reduce the flood level up to 20 cm.
Another activity is the reactivation of flood zones (20 km^2 till 2005, 160 km^2 till 2020) , which should reduce the flood level up to 5 cm (2005) and 15-25 cm (2020).

Water storage in the Rhine basin
There are several measures in the basin, which also have the effects of restoration of aquatic and terrestrial habitats and the recharge of water table:

- renaturation
- reactivation of flood zones
- extensification of agriculture
- nature development, reafforestation
- unsealing
- technical flood storage

1.3.3 Increase flood awareness

Hazard understanding
Flood hazards are hard to determine. Flood hazard maps spatially represent the hazard. They are meant to inform and are at the basis of measures of spatial planning (ICPR, 2002).

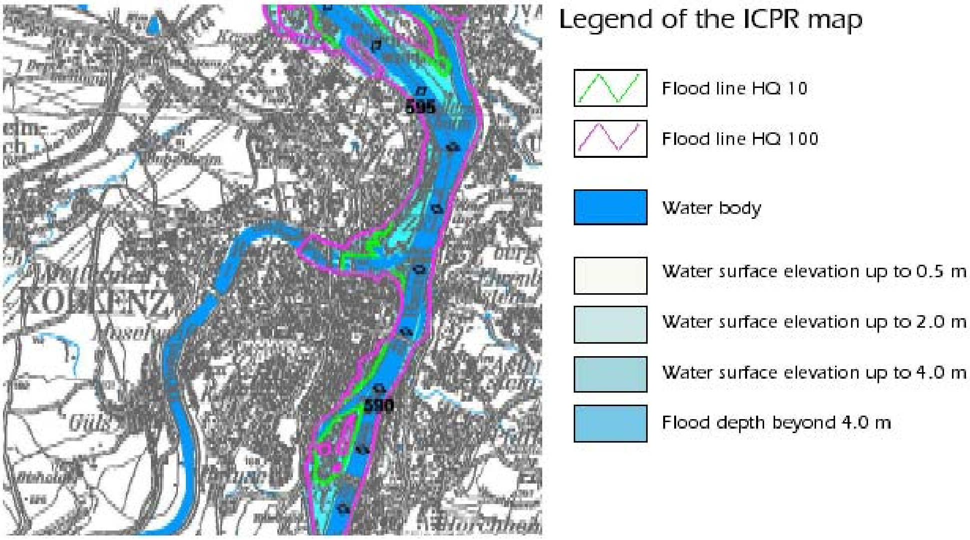

Figure 3. ICPR flood hazard map (ICPR, 2002)

Hazard awareness
People must recognize flooding as part of their environment. Inhabitants must be aware of being at risk. If they themselves have not yet experienced flooding, knowledge about the risk must be passed on with the help of the flood hazard maps (ICPR, 2002).

1.3.4 Improve the flood announcement system

Relatively reliable flood forecasts can today be given for about 24 hours on the High Rhine, 36 hours on the Upper-, Middle-, and Lower Rhine, and 72 hours on the Rhine Delta. On the tributaries, the lead times of forecasts range between 6 and 24 hours. Against the year 1997, this is a prolongation of forecasting periods by 50 %, what means that the first step demanded in the Flood Action Plan could be achieved. An essential prerequisite for this development were the design and improvement of forecasting models for the tributaries (Neckar, Moselle, Nahe). Moreover, the forecasting models for the Rhine itself were redesigned, e.g. by replacing statistical models by the hydrodynamic models WAVOS and FloRIJN. The availability and the exchange of data was also improved. The precipitation networks in France, Luxembourg, and Germany have become denser and automated over the past years and are thus able to provide the necessary data basis for rainfall-runoff modelling. The exchange of data between the forecasting centres is usually fast and easy via ftp and the Internet.

In order to reach the aim of a 48-hour forecast on the Upper-, Middle-, and Lower-Rhine and a 96-hour forecast on the Rhine Delta by the end of the year 2005, new efforts are necessary. The forecasting models for the tributaries must be completed and operational (Lahn, Sieg, Ruhr, Lippe) to achieve prolonged forecasting periods. The forecasting periods on tributaries should be generally 24 hours. Because the results of rainfall-runoff models is strongly dependent on the precipitation forecasts of the German Meteorological Service, improved quality of these forecasts is also needed. Additionally, the forecasting systems must be extended and improved both in the field of hydrodynamic modelling and in the integration of rainfall-runoff models.

1.3.5 Summary of approaches and measures (ICPR, 2001)

Along the Rhine and in the lowlands of the Rhine

- Increase water retention along the Rhine by reactivating inundation (20 km^2 by 2005, 160 km^2 by 2020).
- Increase water retention along the Rhine due to technical retention facilities (68 mio. m^3 by 2005, 364 mio. m^3 by 2020).
- Maintain and strengthen dikes; adapt dikes to the level of protection (815 km by 2005, 1,115 km by 2020).
- Implement preventive measures in the field of spatial planning by introducing and promoting uses adapted to the risk of flooding.
- Implement preventive measures in the field of spatial planning by 2005 by drafting maps representing the risk of inundation and damage existing in all inundation areas and flood prone areas.
- Improve the flood warning systems and double flood forecasting periods by 2005 as a mean of damage reduction.

In the Rhine catchment

- Increase water retention in the Rhine catchment by renaturing streams (3,500 km by 2005, 11,000 km by 2020).
- Increase water retention in the catchment by reactivating inundation areas (300 km^2 by 2005, 1,000 km^2 by 2020).
- Increase water retention in the catchment by promoting extensive agriculure (1,900 km^2 by 2005, 4,900 km^2 by 2020).
- Increase water retention in the catchment by initiating measures aimed at a nature development and afforestation (1,200 km^2 by 2005, 3,500 km^2 by 2020).
- Increase water retention in the catchment by promoting rain water seepage (800 km^2 by 2005, 2,500 km^2 by 2020) and by limiting furure sealing measures.
- Increase water retention in the catchment by creating technical flood retention facilities (26 mio. m^3 by 2005, 73 mio. m^3 by 2020).

1.4 Institutions responsible for flood forecasting

Four countries, i.e. Switzerland, France, Germany, and the Netherlands, have larger shares in the Rhine basin, while five countries have small or very small shares, namely Luxembourg, Belgium, Italy, Austria, and Liechtenstein. This fact along with the political-administrative division of the Rhine basin led to the establishment of great number of flood-warning and flood-forecasting centres. At present 24 of such centres are in operation. Eleven of these centres are in Germany, six in France, four in the Netherlands, two in Luxembourg, and one in Switzerland. Of these 24 centres, 20 regional centres are responsible for warning and forecasting on the tributaries of the river Rhine or their tributaries, while the four supra-regional centres are responsible mainly for the Rhine itself.
Figure 1 shows in the grey-shaded Rhine basin the four supra-regional centres at Bern, Karlsruhe, Mainz, and Lelystad.

In the German Rhine basin, competence is shared between six Federal States: Baden-Württemberg, Bavaria, Rhineland-Palatinate, the Saarland, Hessen, and North-Rhine/Westphalia, as well as three Waterways and Shipping Directorates: South, South-West, and West.
The Flood-Forecasting centre (HVZ) Baden-Württemberg at Karlsruhe is responsible for the computation of forecasts on the Upper Rhine between Rheinfelden and Maxau with reference to the Swiss Forecasting Centre at Bern for the gauge Rheinfelden.

The Flood-Warning Centre (HMZ) Rhine at Mainz is a joint institution of the Federal State of Rhineland-Palatinate and the Federal Waterways and Shipping Administration (WSV). According to an administrative agreement between the neighbouring Federal states and the Federal Waterways and

Shipping Administration, the HMZ is responsible for the dissemination of flood warnings along the whole German reach of the Rhine.

Staff of the Land Agency for Water-resources Management of Rhineland-Palatinate (LfW) and of the Special Unit for Hydrology of the Waterways and Shipping Directorate (WSD) South-West work together in this flood-warning service. The HMZ computes water-level forecasts up to 36 hours ahead for the major Rhine gauges by means of a hydrodynamic model developed by the Fedral Institute of Hydrology (BfG). The forecasts issued by the HVZ for the gauges Maxau/Rhine and Rockenau/Neckar are integrated into this model. Table 2 shows the pathways of flood warning information of the HMZ Rhine, and Figure 4 presents the Internet homepages of the HMZ and the HVZ.

Table 2.Public information of the Flood-Warning Centre HMZ Rhine (Landesamt für Wasserwirtschaft Rheinland-Pfalz, 2003)

Pathway of information	Information			
	Hourly updated waterlevel	report of the situation	Forecast	miscellaneous
TV SWR-Videotext Board 800 Overview Board 801 Rhein Board 802 Mosel Board 803 Nahe, Glan Board 804 Lahn, Sieg	X	X	X	
Broadcast SWR1, SWR3, SWR4 RPR1, RPR2	X	X	X	
Internet www.hochwasser-rlp.de www.hochwasser.rlp.de	X	X	X	maxima waterlevel and hourly updatet waterlevel
cellular phone network wap.hochwasser-rlp.de	X		X	
Automatic telephone responder				updated waterlevel

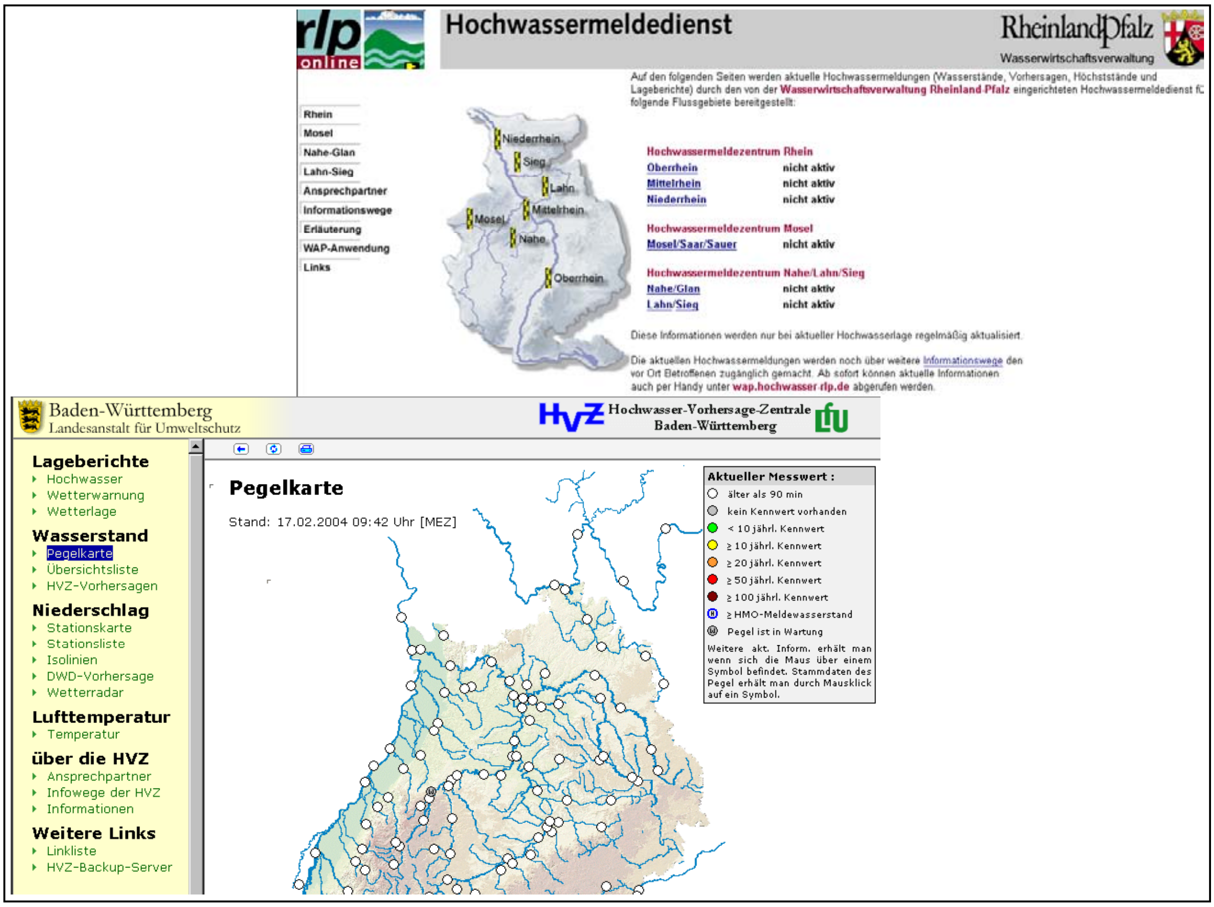

Figure 4.Internet homepages of the Flood-Forecasting Centre (Hochwasser-Vorhersage-Zentrale HVZ) Baden-Württemberg http://www.hvz.baden-wuerttemberg.de/ and the Flood-Warning Centre (Hochwassermeldezentrum HMZ) Rhine http://www.hochwasser-rlp.de/

The following centres are in charge of the forecasting service on the tributaries:

- The Flood-Forecasting Centre (HVZ) Baden-Württemberg at Karlsruhe computes forecasts by means of a rainfall-runoff model for the river Neckar up to 24 hours ahead and with a Kalman-filter model for the river Tauber with a lead time up to 10 hours.
- The Flood-Forcasting Centre Main (HVZ Main) is operated by the agency for water-resources management (WWA) Bamberg. Via rainfall-runoff models for the upper Main and the river Fränkische Saale and including the forecast from HVZ Baden-Württemberg for river Tauber, the hydrodynamic model WAVOS Main calculates forecasts for river Main.
- The Flood-Warning Centre Nahe-Lahn-Sieg of the regional administration for water-resources management, waste management and soil protection of Rhineland-Palatinate at Koblenz gives forecasts on the river Nahe for up to 9 hours and on the rivers Lahn and Sieg up to 6 hours ahead. A rainfall-runoff model is used for the river Nahe, while such a model is being prepared for application on the rivers Lahn and Sieg. The Flood-Warning Centre Saar at the Saarland State Agency for Environmental Protection at Saarbrücken forecasts developments on the river Saar up to 24 hours ahead with a multi-channel-filter model and a rainfall-runoff model.
- The Flood-Warning Centre Moselle of the regional administration for water-resources management, waste management and soil protection of Rhineland-Palatinate at Trier computes with a fuzzy-logic model and a rainfall-runoff model forecasts over 10 to 24 hours for the river Moselle and the lower reach of the river Sauer.
- The Centre of the Ruhr Association at Essen has operated a rainfall-runoff model for forecasts of 12 to 24 hours on the river Lenne and tributaries to the Bigge Reservoir since 1996; a forecasting model for the whole river Ruhr is under development.

2. Case Study on the River Elbe

2.1 Characteristic of the catchment area

The river Elbe originates in the Czech part of the Riesengebirge at an elevation of 1,386 m above sea level and issues after a length of 1,094 km into the North Sea. With a catchment area of 148,268 km², the Elbe river basin is the fourth in size in Central Europe after the Danube, the Vistula, and the Rhine. Germany has a share of 97,175 km² (65.5 %) in this basin, the Czech Republic 49,933 km² (33.7 %), Austria 921 km² (0.6 %), and Poland 239 km² (0.2 %).
Major tributaries in the Czech Republic are the Vltava (Moldau) with a catchment of 28,090 km² and the Ohře (Eger) with 5,614 km². The main tributaries in Germany drain 24,096 km² in the case of the Havel, the Saale (24,079 km²), the Mulde (7,400 km²), and the Schwarze Elster (5,705 km²).
The Elbe passes in Germany the Federal States Saxony, Saxony-Anhalt, Brandenburg, Mecklenburg-Western Pomerania, Lower Saxony, and Schleswig-Holstein.

In hydrographic terms, the river Elbe may be divided into three sections:
- the middle-mountain regions from the Riesengebirge to the Harz mountains with elevations between 1,500 and 300 m above sea level;
- the Bohemian Basin with elevations from 300 to 150 m above sea level, and
- the Central- and North-German lowlands with elevations below 150 m above sea level.

The Elbe basin belongs to the temperate climatic zone, in the transition area from the humid oceanic climate of Western Europe towards the arid continental climate of Eastern Europe. In basin-shaped landscapes, the continental character is intensified.
The complex pluvio-nival runoff regime is marked by high streamflow in the hydrological winter half-years (November to April) and low flow in the hydrological summers (May to October). The spring snowmelt in the middle-mountain regions has a distinct influence on the flow regime (maximum of monthly mean flows in March/April).
The majority of significant flood events on the Elbe and its tributaries occur in winter and spring as a consequence of snowmelt combined with intensive areal precipitation. Floods fed exclusively by snowmelt are singular events and do not have significant dimensions. In summer, flood events may develop after several days of continuous abundant rainfall, e.g. floods in 1954 and 2002 (ICPE, 2001 and 2003).

2.2 Elbe flood 2002

Widespread heavy precipitation of more than 100 mm on 6 and 7 August 2002 in eastern Bavaria, the Bohemian Forest, and the Gratz Mountains triggered a first flood wave in the catchments of the Vltava (Modau) and the Ohře (Eger). The precipitation that fell from 11 to 13 August was caused by a Vb weather pattern, like the one that had produced in July 1997 the extreme flood in the basin of the Odra. The precipitation depth from 11 to 13 August was more than 150 mm over wide areas, and reached in the Erzgebirge up to 406 mm/72 h (station Zinnwald-Georgenfeld in the Erzgebirge).
The flood developed on the river Elbe and especially in many tributaries in the Czech Republic and in Saxony to the highest one ever recorded. At nearly all gauges on the Elbe, the highest water-level records were markedly exceeded.
The Elbe upstream of the inflow of the Vltava (Moldau), the Ohře (Eger), the Schwarze Elster, the Saale, and the Havel did not experience a flood event. Consequently, the extreme flood was preferentially produced by the flows of the Vltava (Moldau), the rivers from the Erzgebirge, and the Mulde.
At Dresden, the crest of the flood was measured on 17 August 2002 at a water level of 940 cm. In the further course, the water levels were influenced by 18 dyke failures between Meißen and Magdeburg. The region of Magdeburg was relieved by diverting part of the streamflow through the Elbe diversion channel. For the first time, the weir Neuwerben (completed in 1956) and the weir-group Quitzöbel were used to reduce the flood peak, and between 20 and 28 August 2002, 75 million m^3 of water from the Elbe were diverted into the Havel area and into five flood-retention polders on the river Havel. Thus, the flood

peak at the gauge Wittenberge was reduced by 40 cm. The flood peak of 645 cm arrived at the gauge Boizenburg on 23 August, i.e. six days after it had passed Dresden.

Figure 5. River Elbe basin

2.3 Flood management

The Action Plan on Flood Defence on the River Elbe was formulated on the basis of an inventory of existing flood-safety levels in the Elbe catchment of 31 January 2001 (ICPE, 2001) and in evaluation of the lessons learned from the flood event in August 2002. The following main items were adopted for the Elbe catchment downstream to the weir Geesthacht at the 16th session of the International Commission for the Protection of the Elbe (ICPE) on 21 and 22 October 2003 at Erfurt (ICPE, 2003):

Principles regarding

- increased water retention in the basin
- delineation, definition, and land use of inundation areas

Tasks and studies regarding

- estimation of flood risks and flood damage
- reactivation of former inundation areas at 15 potential sites by landward relocation of dykes (2.700 ha) and creation of additional water-retention capacity at 16 potential sites by polders for controlled flooding (178 mio. m^3)
- assessment of the effects of large reservoirs on the rivers Vltava (Moldau), Ohře (Eger), and Saale on the discharge of floods in the river Elbe

Reinforcement of technical weak-points in the dykes along the river Elbe and in the floodwater-retarding dykes of the Elbe tributaries in Germany. A total of 548 km of dykelines (45 % of existing dykes) should be rehabilitated by the year 2015 with an investment of Euro 560 million.

Building of technical flood defences according to streamflow studies in the most flood-prone towns and communities in the Czech Republic.

Improving the flood information system by

- establishment of a joint international flood-forecasting system
- modernising the technical equipment of the flood-reporting and flood-forecasting gauges and of the meteorological networks

Modern and advanced modelling systems will upgrade the joint Czech/German flood forecasting system, aiming to prolong the forecast lead-time and to improve the accuracy of forecasts.

Recommendations for action

- for improved flood defence and self-initiative of riparian dwellers
- for improved information of the public and increased awareness of flood risks

Regular reports account on the fulfillment of the Action Plan on Flood Defence on the River Elbe, the first one on 31 December 2005.

2.4 Institutions responsible for flood forecasting

The State Flood Centre in the Saxon State Agency for the Environment and Geology (*LfUG*) (Internet address: http://www.umwelt.sachsen.de/lfug) uses the program system *HW-Modell Obere Elbe* for forecasts concerning the gauges downstream from Schöna (24-hour forecasts) to Torgau (48-hour forecasts). The input streamflow data for this model from the gauges Louny (Ohře /Eger), Prague (Vltava/Moldau), Ústí n.L. (Labe/Elbe), and Brandýs (Labe/Elbe) are provided each day by the Czech Hydro-Meteorological Institute (ČHMÚ).
Flood forecasting for the tributaries of the Upper Elbe is provided by the *LfUG*. Competences for the Schwarze Elster, the Mulde, the Saale, and the Havel lie with the *LfUG* and the flood centres in the State Agencies for the Environment (*StUFA*), the Stage Agencies for Environmental Protection (*LUA*) of the Federal States Brandenburg, Thuringia, Saxony and Saxony-Anhalt, where rainfall-runoff models and flood-routing models are used for flood forecasting. The forecasts on the tributaries are used as forecasts on inflows into the Elbe.
The Flood-Centre Elbe (jointly operated by the State Enterprise for Flood Protection and Water-resources Management of Saxony-Anhalt and the Federal Waterways and Shipping Directorate East) in the Waterways and Shipping Office (*WSA*) Magdeburg has been using since 1995 the program system *ELBA*, that was developed by the Federal Institute of Hydrology (*BfG*), for forecasts concerning the gauge Wittenberg (48 hours forecasts) to the gauge Boizenburg (5-day forecasts) (Internet Address: http://www.wsa-magdeburg.de).
The forecasts are computed daily and are harmonized between the *WSA* Magdeburg, the *LfUG*, and the *ČHMÚ*.
In response to the flood of 2002, a first step is an update of the model *ELBA* and its integration into the user interface *WAVOS*. In a second step, the conceptual computation model is replaced by a hydrodynamic model as it is in use in the program system *WAVOS* for the rivers Rhine and Odra, and the forecasting range is extended to the weir Geesthacht.

Figure 5 shows the pathways of flood warning information at the Elbe basin.

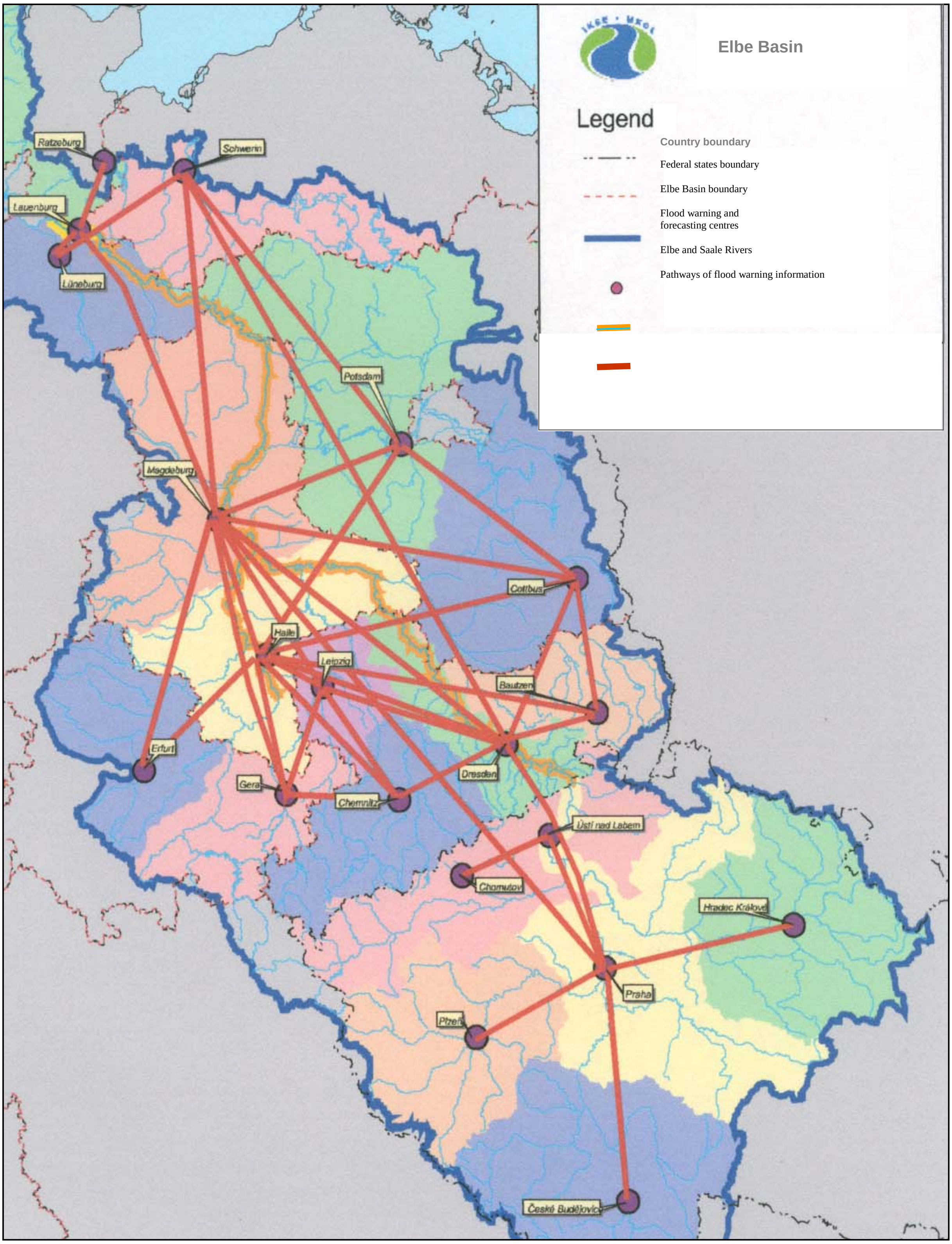

Figure 5. **Pathways of flood warning information at the river Elbe basin (ICPE, 2001)**

3. Lessons learned

Scientific evidence suggests that the accumulation of extreme weather conditions in the Rhine Basin is related to global warming. The floods remind us to reduce the contribution of humans to the climatic change drastically. Climatic protection is flood protection for the day after tomorrow. The consequence of the floods in the Rhine, Odra and Elbe Basins require comprehensive measures for flood precaution and for preventing danger warning. Flood protection is a task, which must be coordinated regionally, nationally and internationally.

3.1 Conclusions of the German Ministerial Conference

The German Ministerial Conference (Ministries of Environment) held in Berlin, Germany, 4th September 2002 arrived at following conclusions:

Immediate actions for the reconstruction and refurbishment of flood protection structures

- Reconstruction of damaged gauging equipment
- Reconstruction of dykes
- Additional protection of sensitive areas by mobile flood protection measures

Improvement of precautionary and emergency flood protection

- Reconstruction measures
- Increase natural flood retention areas
- Circular dykes
- No further construction in floodplains
- Increase flood retention in tributary rivers
- Reconstruction of natural floodplains wherever possible
- Federal assistance of the reconstruction of natural floodplains
- Reduce the rate of increase of sealed landscape
- Reassess flood protective measures with potentially dangerous installations
- Improve handling of oil tank installation
- Provide specialised direct information to the public and companies
- Harmonized environmental measurement programme of the individual states
- Assess possibility of flood insurance obligation

3.2 The 5-Points-Action Programme of the Federal Government of Germany

At the Flood Conference held in Berlin, Germany, 15th September 2002 the 5-Points-Action Programme of Federal Government of Germany "Working Steps Towards the Improvement of Precautionary Flood Protection" was worked out:

Common flood protection programme of federal state government and individual states

- Provide more space to the rivers
- Retain floods decentrally
- Control urban development - Reduce damage potential

Cross-border action plans - Specialised international conference
The elaboration of cross-border risk analyses and flood forecasts have to be considered within precautionary flood prevention actions.
Until End-2003: Intensification of co-operation and co-ordination between the different international commissions for river protection and navigation. Experiences from the rivers Odra, Rhine, Moselle, Saar and Meuse have to be collected and used. This concerns the actual results of practical flood protection measures and successful communication with the public.

Until End-2004: Specialised international conference hosted by Germany concerning the development of internationally co-ordinated integrated action lines for flood prevention and flood protection.

Fostering European co-operation

- Establishment of international cross-border land management planning
- Intensified usage of EU funds for rural development and of INTERREG III B for precautionary flood prevention

Reassess river training - Develop navigation in an environmentally friendly way

- Reassess the effects of structural measures on flood protection
- Submission of an updated Federal Transport Ways Plan

Immediate measures against floods

- Accelerated implementation of co-ordinating entity for danger situations covering large areas
- Extension of Academy for Crisis Management, Emergency Planning and Civil Protection
- Improvement of warning and information of the population
- Support of the neighbourhood self-assistance

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