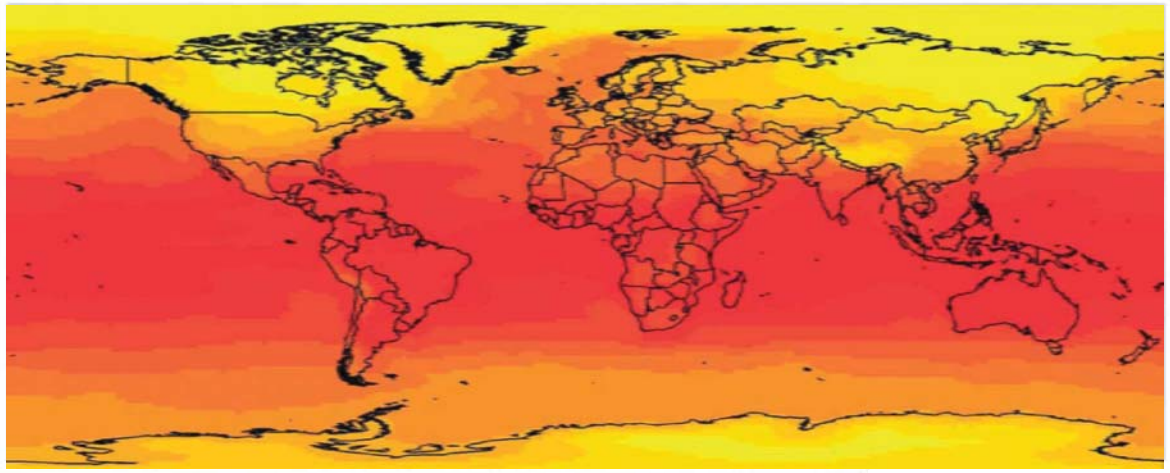


Introduction to the Rhine River Basin

1st Rhine-Mekong Symposium
"Climate change and its influence on water and related sectors"
8-9 May 2014, Koblenz, Germany

Manfred Spreafico
University of Berne

Content

1. Brief overview
2. Information to the main uses/users water supply, navigation, water power production and fishery
3. Environmentally sound management of the Rhine River
4. Flood protection strategy
5. Impact of global change on the Rhine River discharge

Rhine River Basin

Area: 185`000 km2

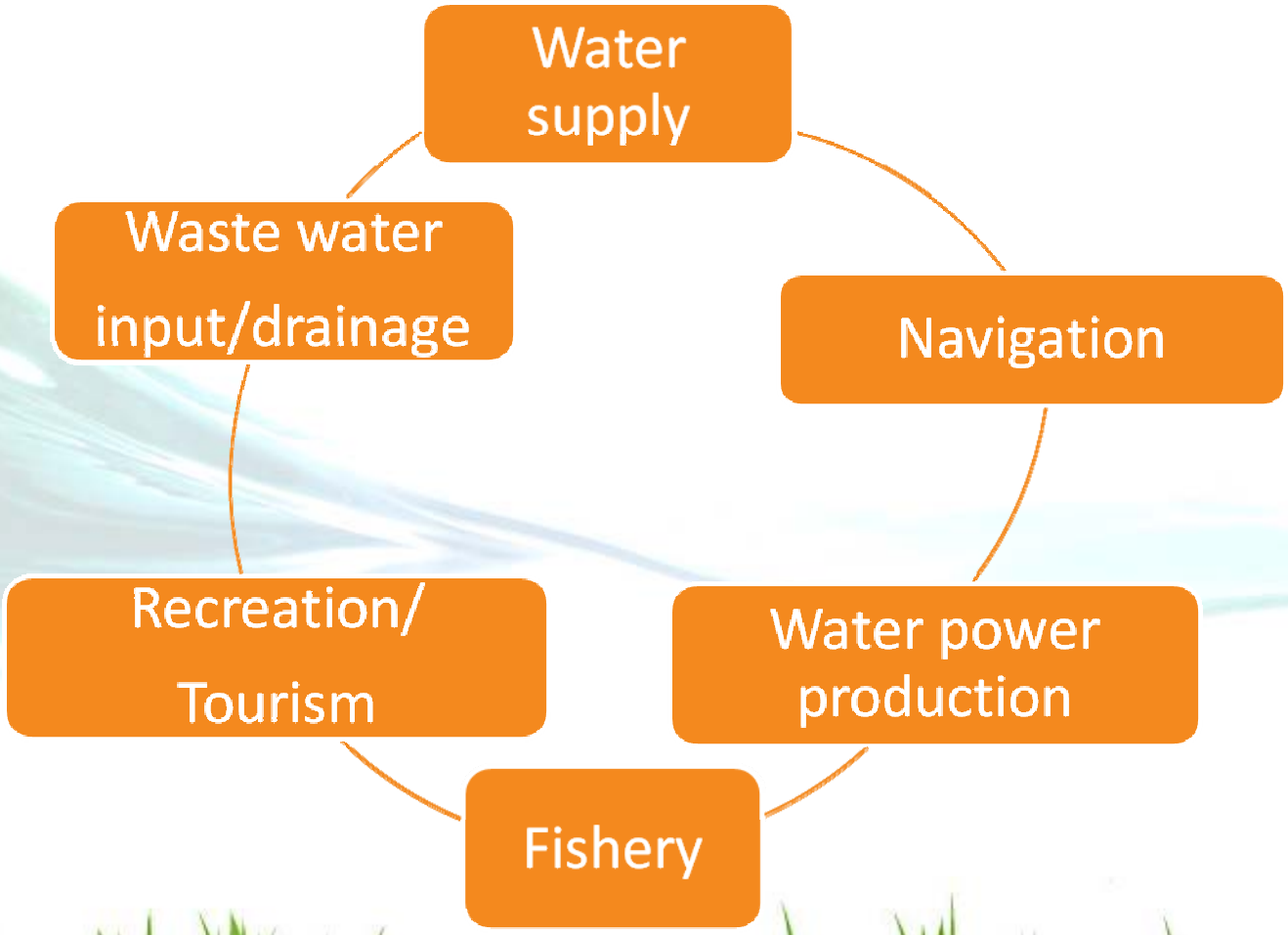
Mean discharge: 2`200 m3/s

Length: 1`239 km

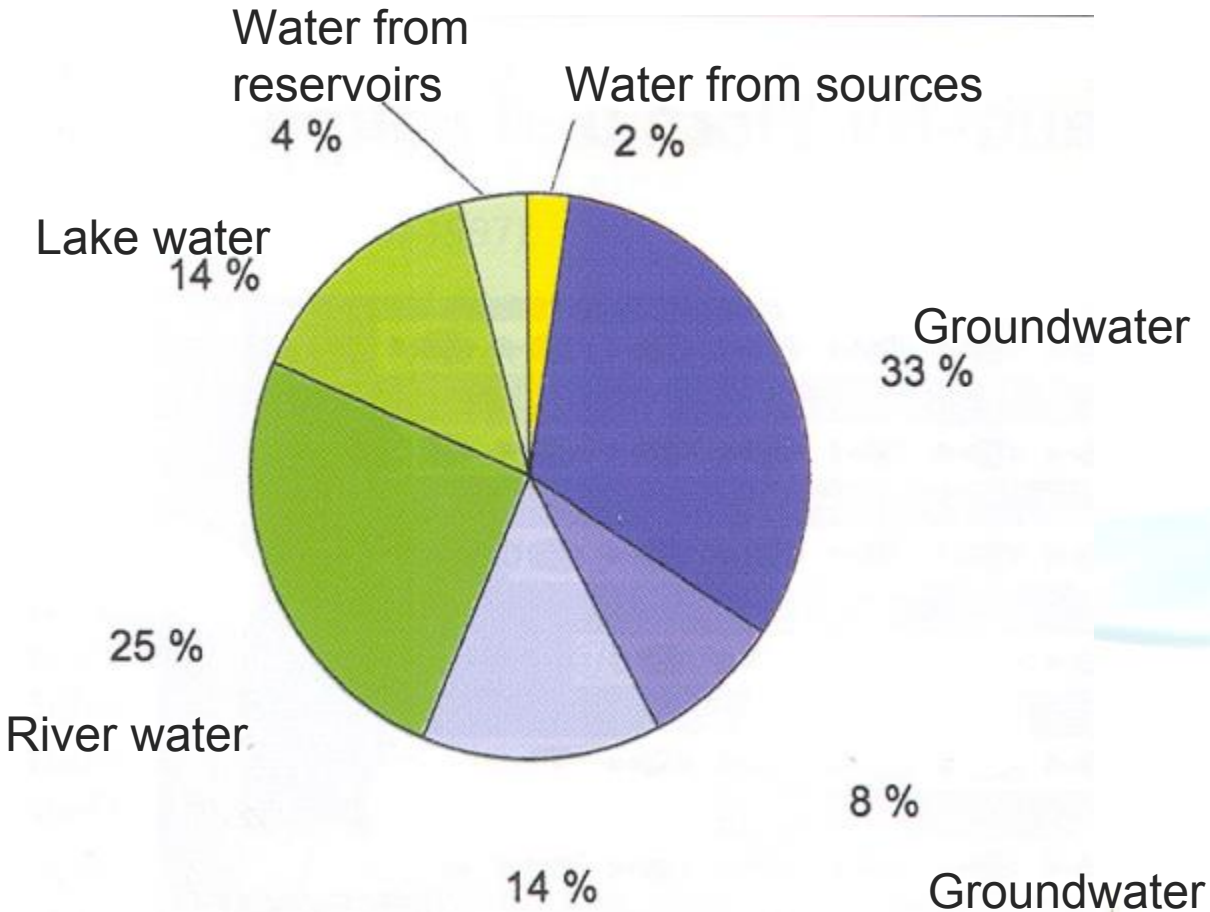
Population: 50 Mio

Basin sharing countries: 9

Main Uses/Users of the River Rhine



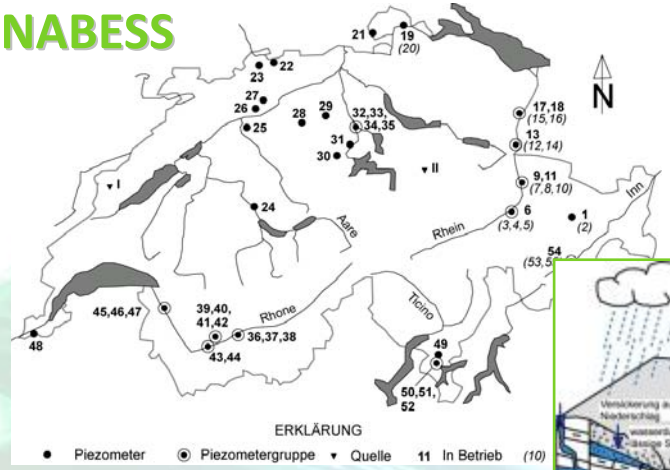
Water Supply

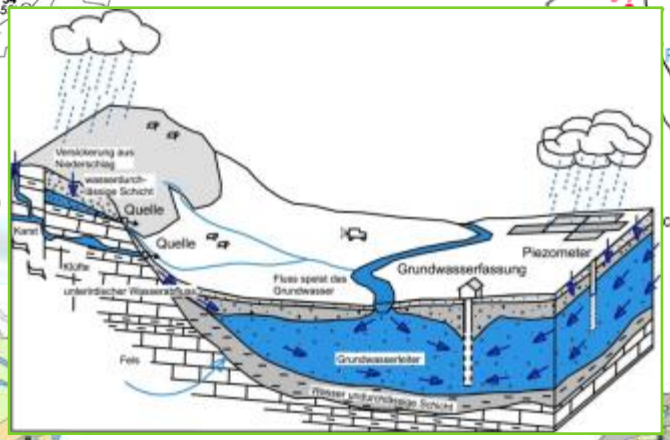


Groundwater

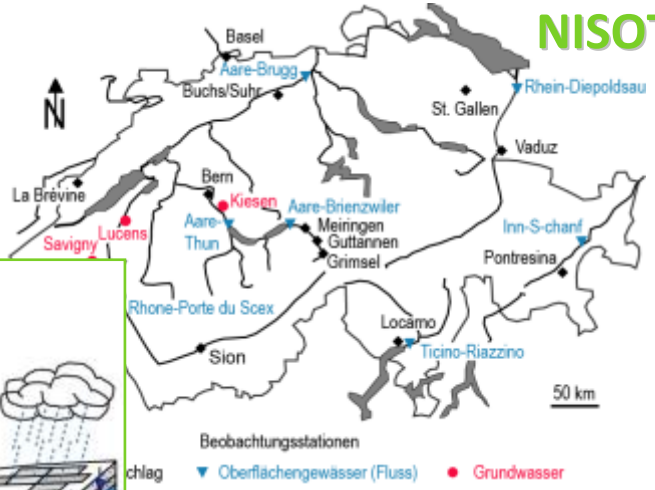
Networks

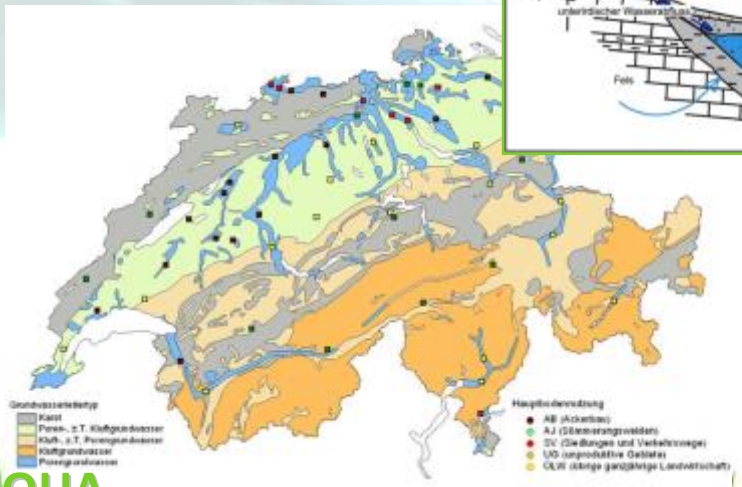
NABESS



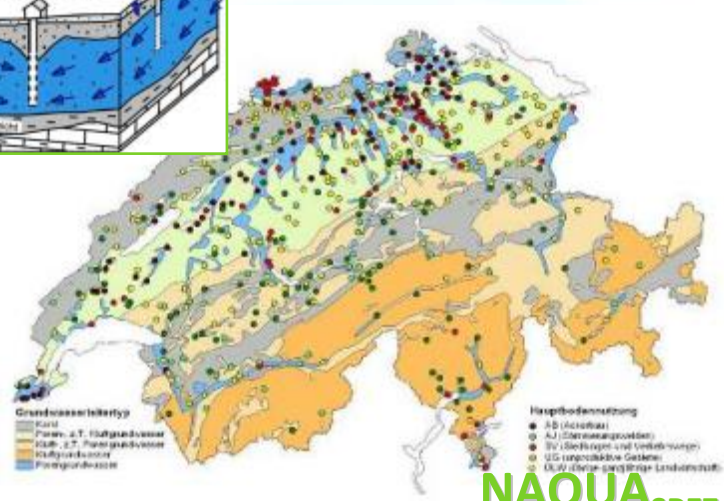


NISOT



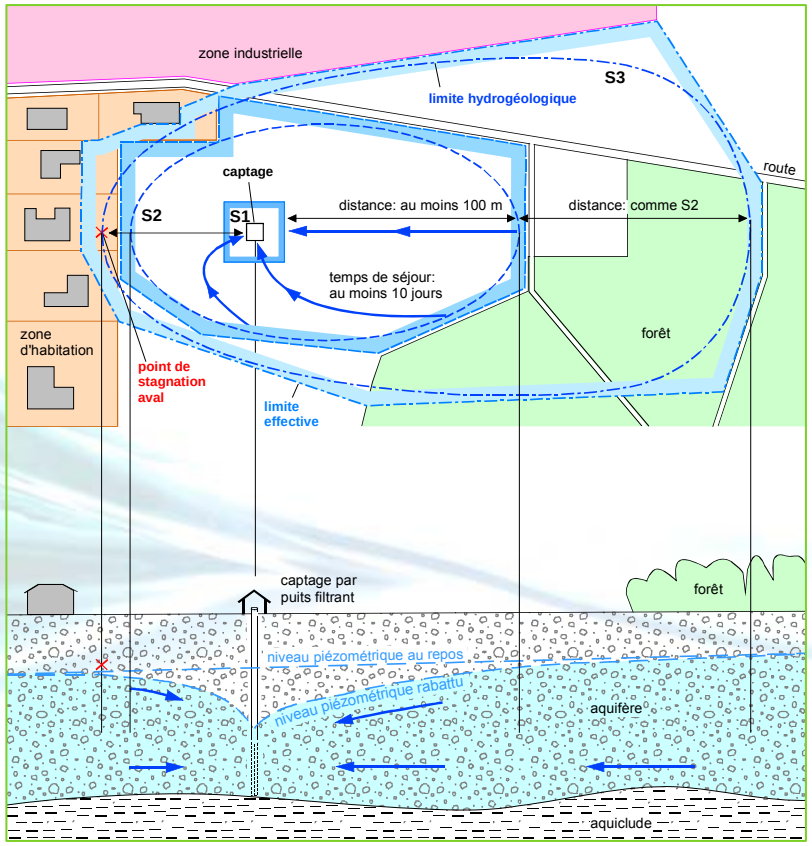


NAQUA$_{TREND}$



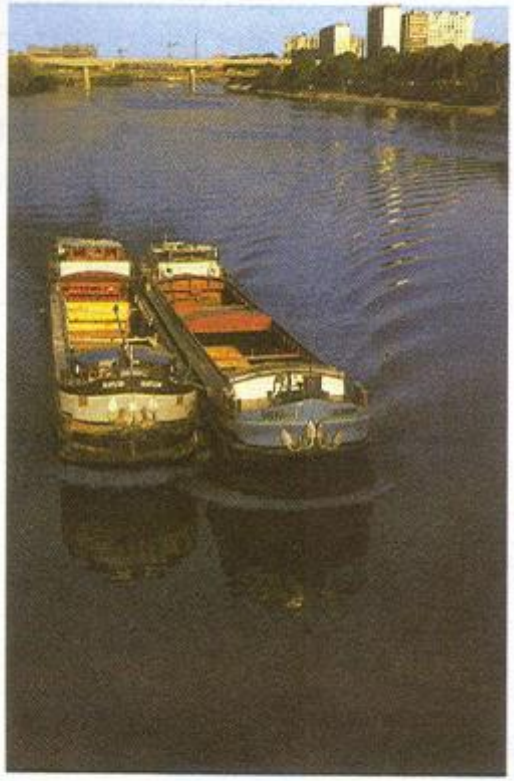
NAQUA$_{SPEZ}$

Guidelines for Groundwater Protection Zones



Waterway Rhine

Navigation an Important User



Predicted transport volume in mio t for 2015

Güterverkehrsmengen für das Jahr 2015

(in Mio t)

		zu Berg	zu Tal
1	Oberrhein bei Iffezheim	20	18
2	Mittelrhein bei Bingen	66	29
3	Niederrhein Grenze NL/D	140	59
	zum Vergleich im Jahr 2000	111	52

Changes during the Centuries

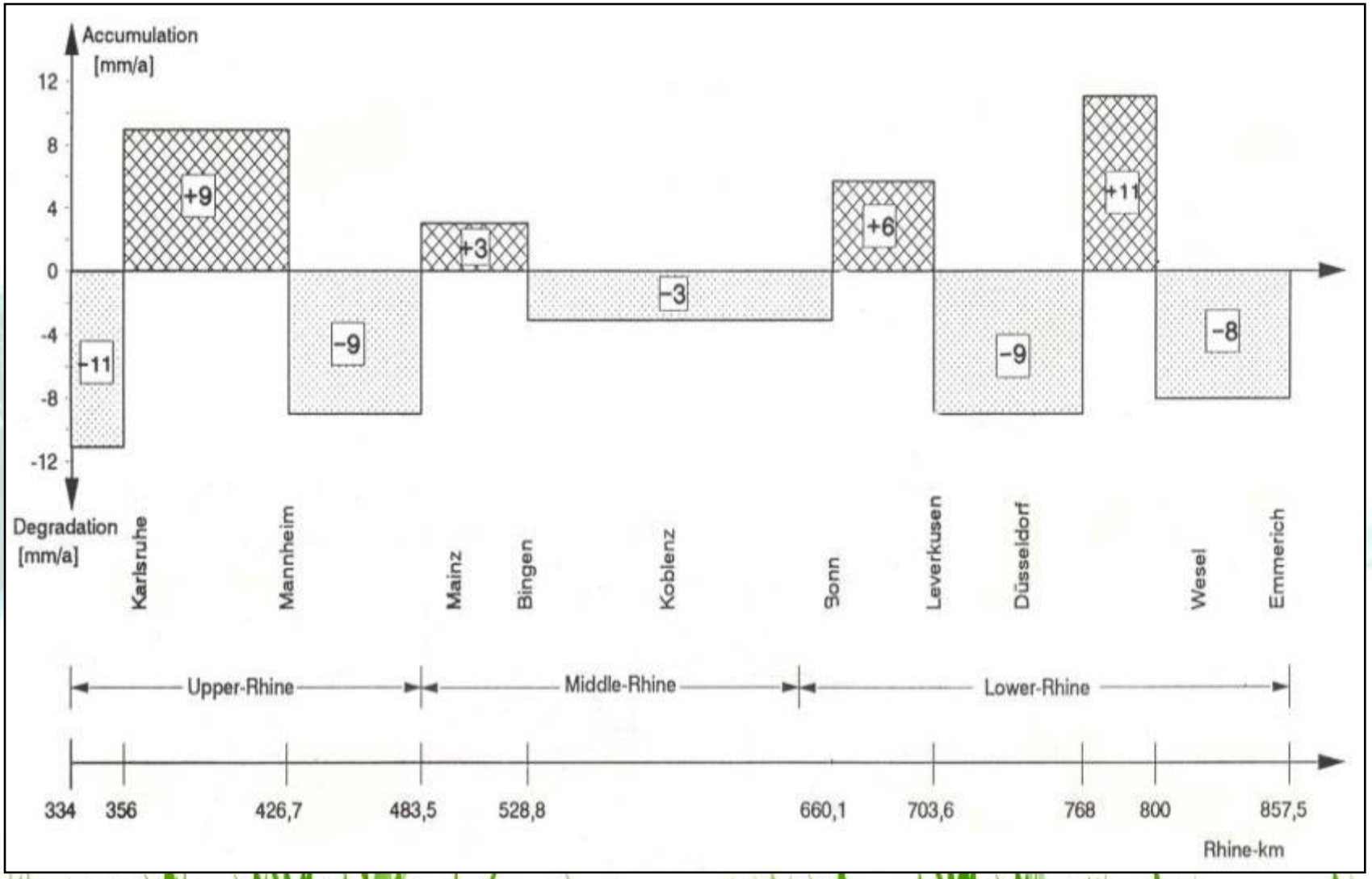
1838

1872

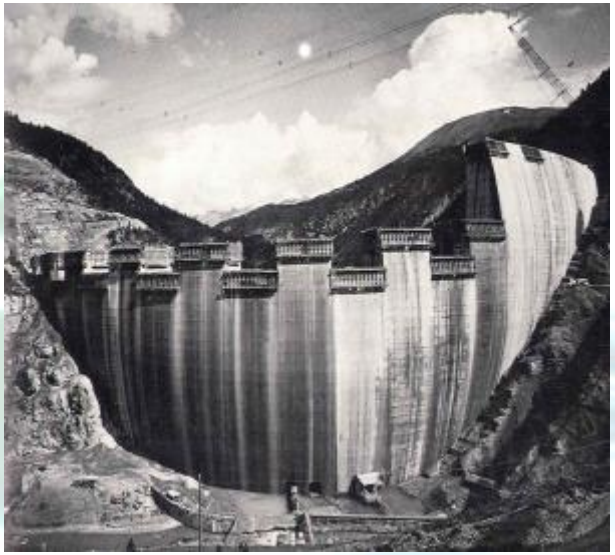
1980

Over the years: 85 % loss of alluvial flood areas

Erosion and Sedimentation (1981-1990)



Water Power Production

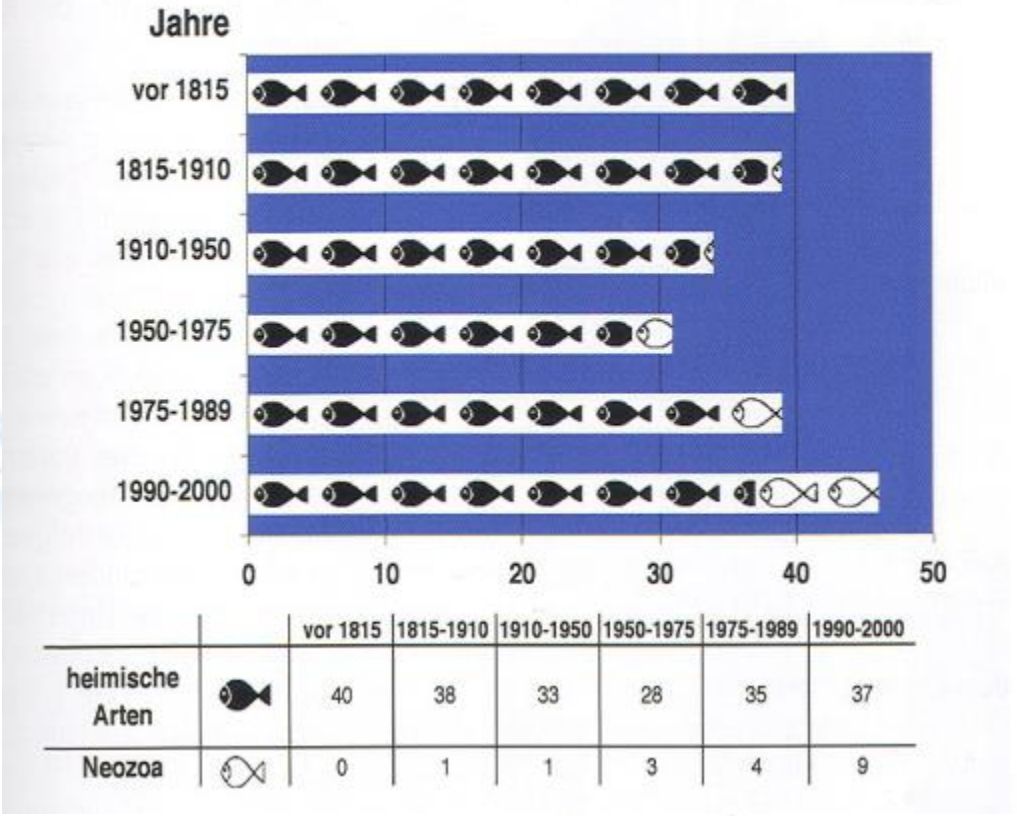


Electric Power Generation

Energy	Switzerland %	Germany %
Hydro	56	3
Nuclear	24	18
Thermal	-	58
Others	5	21

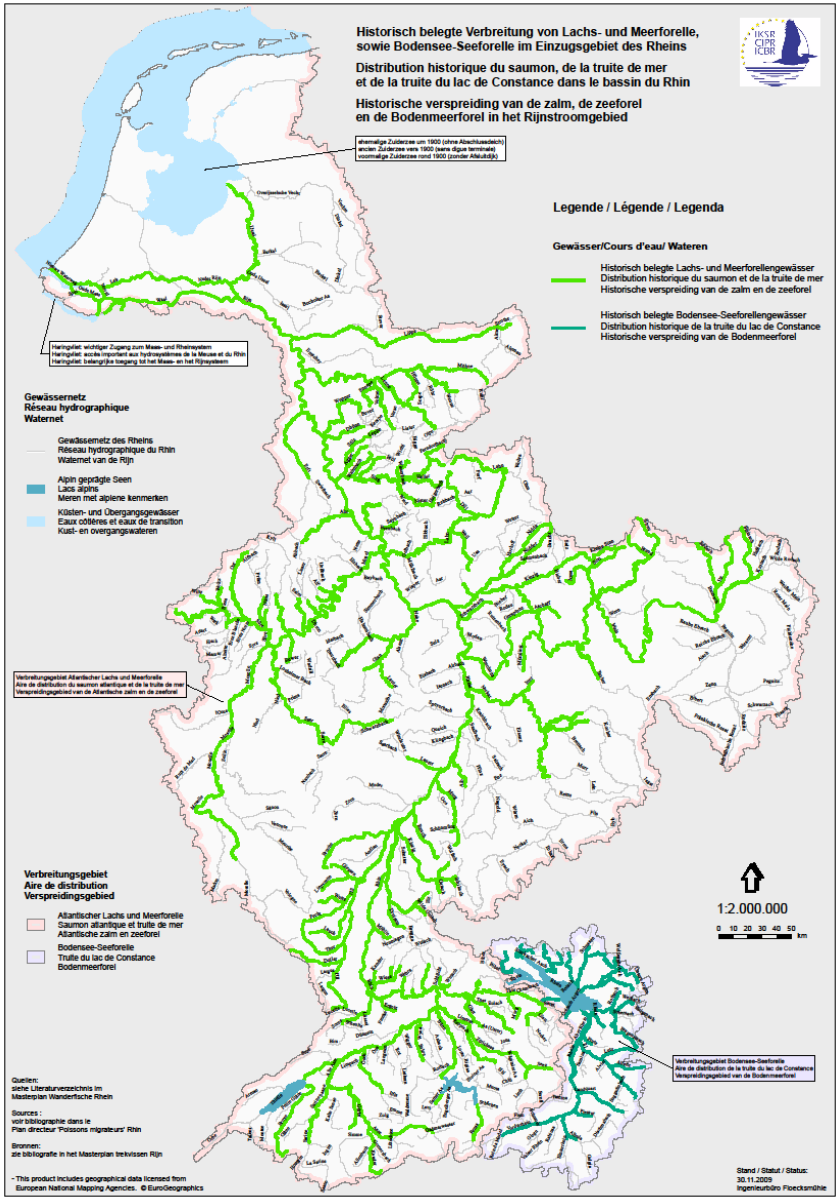
Fishery

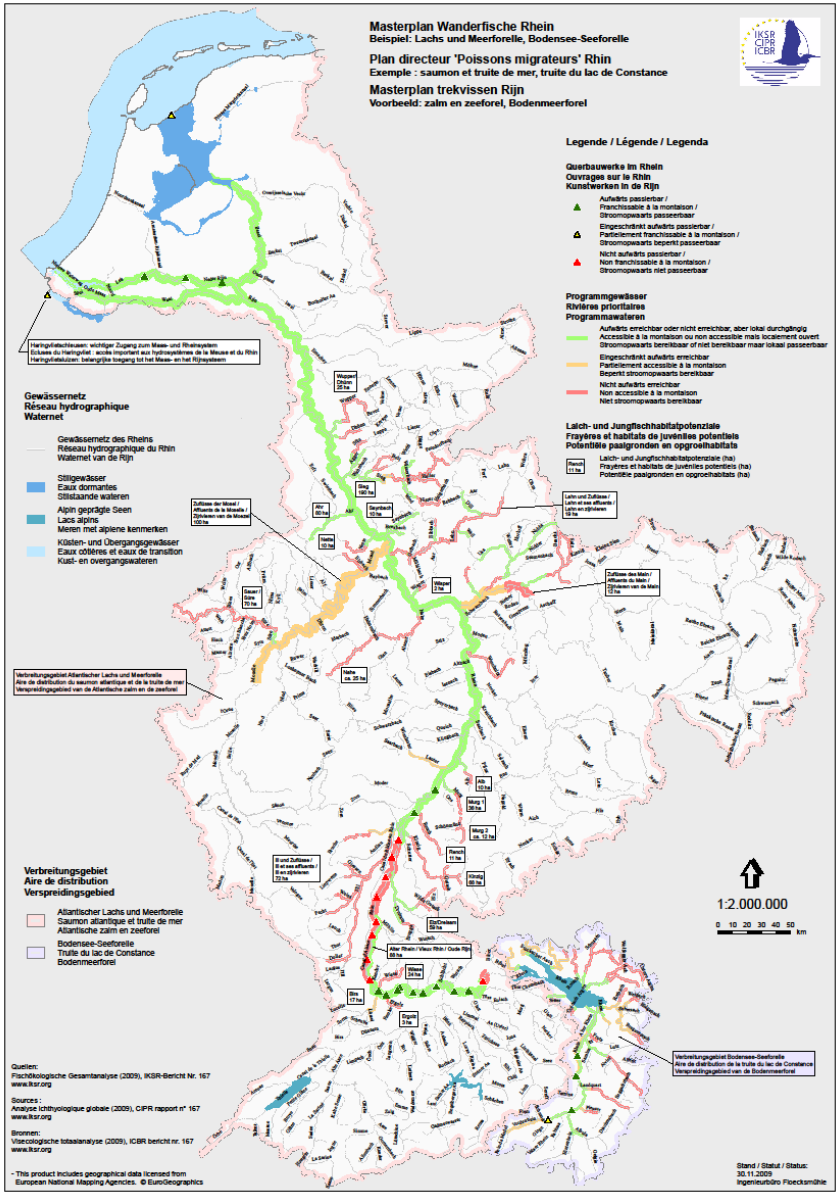
Development and number of fish species in the lower Rhine



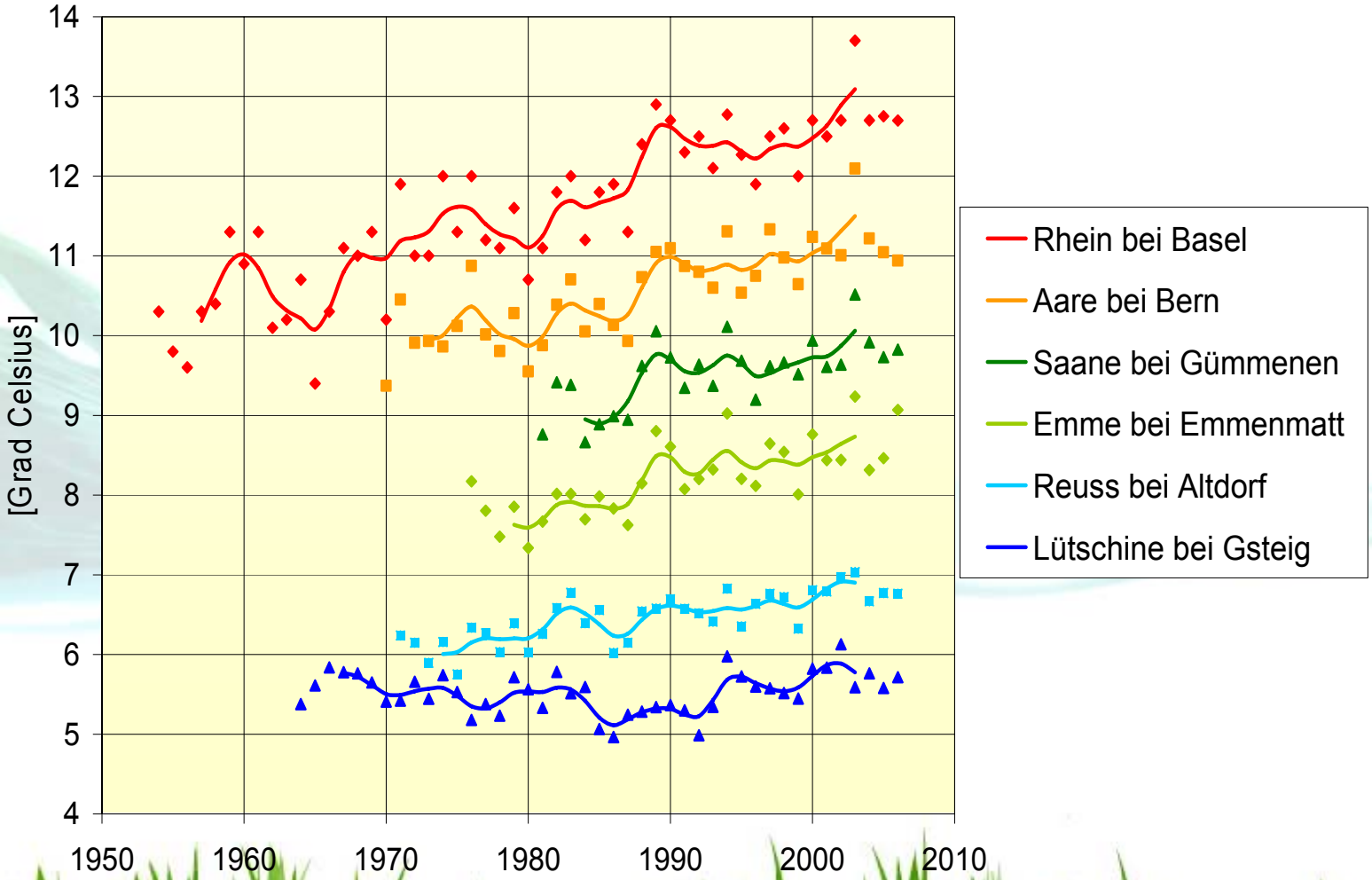
		vor 1815	1815-1910	1910-1950	1950-1975	1975-1989	1990-2000
heimische Arten		40	38	33	28	35	37
Neozoa		0	1	1	3	4	9

Historical distribution of the Salmon





Increase in Water Temperature in Switzerland since 1953



Functions and Uses

… nature protection

… agriculture

… drainage

… shipping

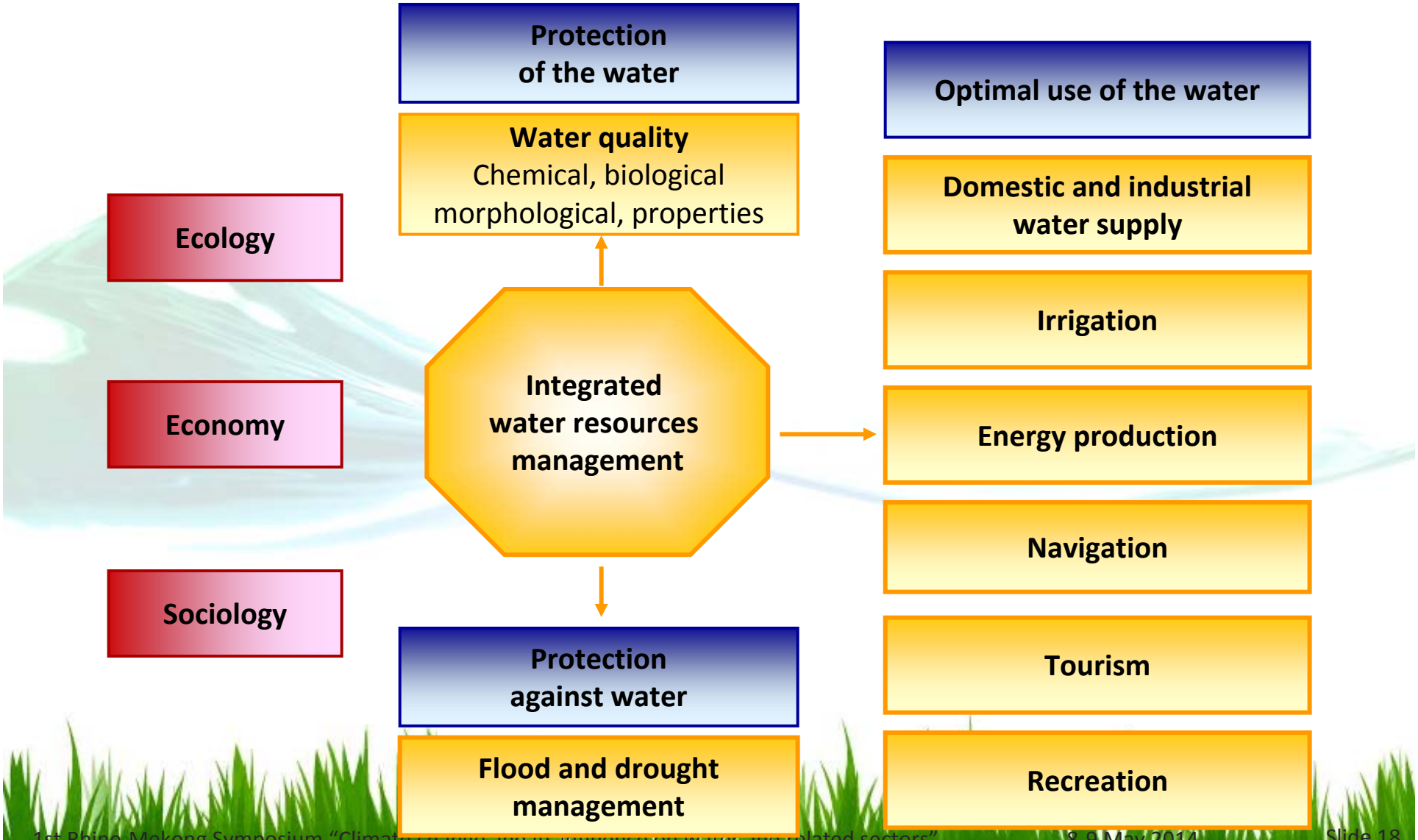
… tourism

… economic activities

… power production

… drinking water production

Integrated Water Resources Management



Environmentally Sound Management of the Rhine River

The Rhine Action Programme

Salmon story a successful approach

History

1971

Occurrence of considerable pollution of the Rhine by oxygen depleting substances

No fish life in downstream areas

Construction for shipping, hydroelectric power plants and flood protection measures have considerably modified the habitat

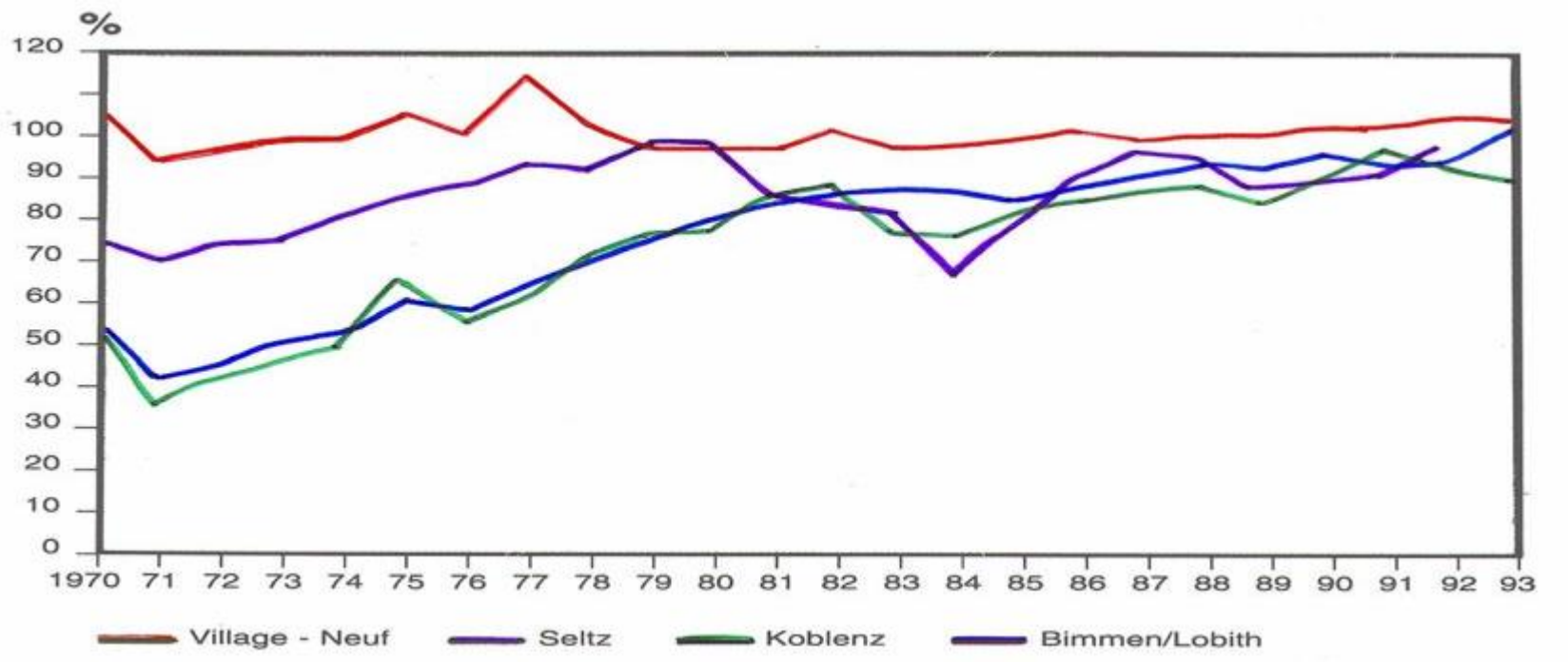
Loss of important structural elements (gravel banks)

History

1971-92

Improvement in the water quality by new waste water treatment plants (60 billion of US $ spent for this purpose)

Oxygen content has not sunk below the mean value of 9.6 (fish require at least 4mg/l)



Reductions of point source input of substances

The reduction target set for 1995, namely 50 per cent less had been reached for almost all substances of the priority list

Reductions of point source inputs of substances in percent in the period 1985 or 1990 and 1992

No detectable point source inputs 1990 or 1992	**Reduction quotas**			
	80 – 100 %		**70 – 79 %**	**50 – 59 %**
atrazine azinphos-ethyle dichlorvos fenitrothion malathion parathion-methyle simazine trifluraline DDT dioxins	cadmium chromium 1,2-dichloro-ethane tetrachloro-ethene trichloro-methane trichloro-ethene tetrachloro-methane benzene hexachloro-benzene hexachloro-butadiene	chloroanilines chloronitro-benzenes PCB AOX pentachloro-phenol azinphos-methyle fenthion drins parathion-ethyle organic tin compunds	nickel bentazon **60 – 69 %** copper zinc lead 2-chloro-toluene	mercury 1,1,1-tri-chloroethane trichloro-benzenes total phosphorous **30 – 49 %** ammonium endosulfan 4-chloro-toluene

History

1986

Accidential spill of toxious substances

It is not enough to reduce the chronic pollution

It is not enough to eliminate or limit damage

It is important to go beyond, to elaborate a comprehensive restoration program

1987

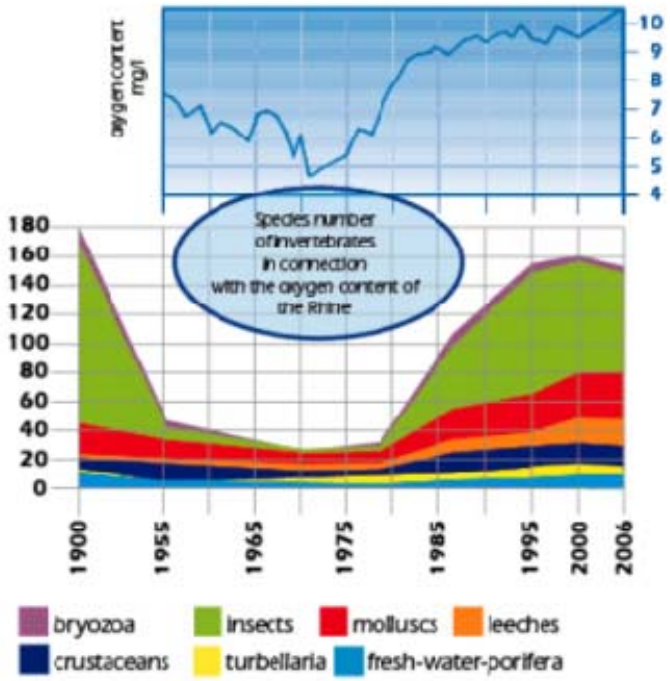
Adoption of the Rhine Action Programme

Environmentally Sound Management

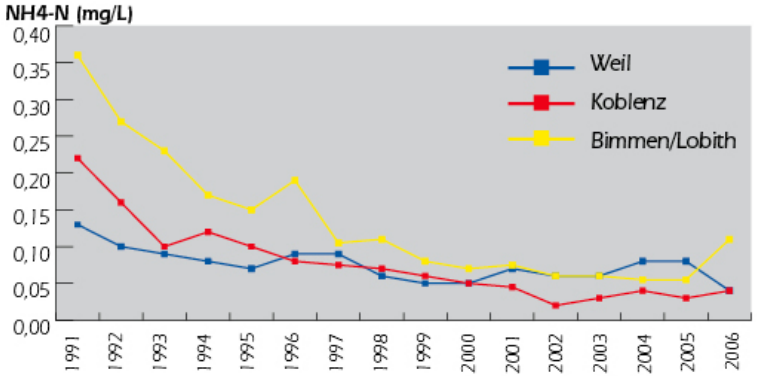
- Rhine Action Programme
- Where do we want to be ?
- Where are we now ?
- How can we get where we want to be ?
- Which way is best ?
- How resources will be allocated ?
- How do we ensure arrival at goals?

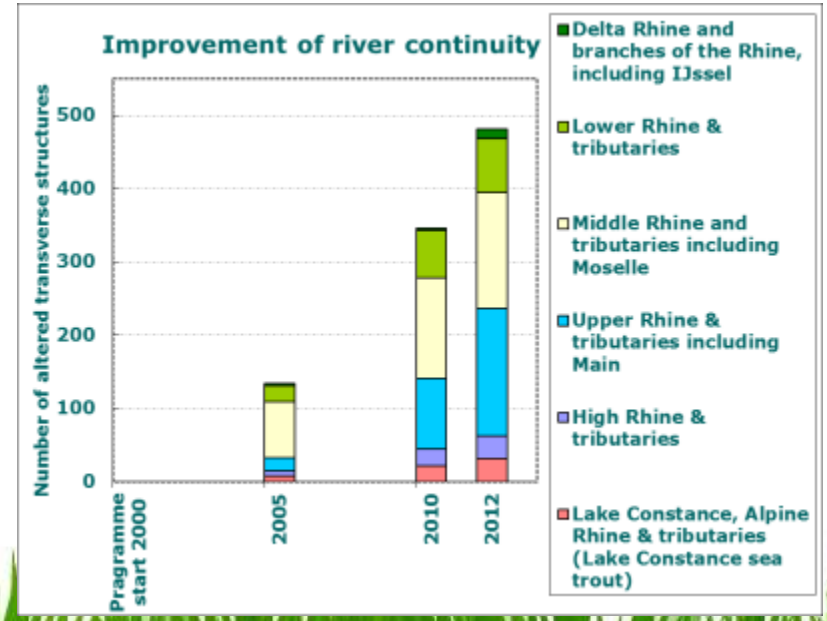
Results

Development of the communities of the Rhine and average oxygen content of the Rhine at Emmerich



Contents of ammonium (ammoniacal nitrogen) in Rhine water (1991-2006)

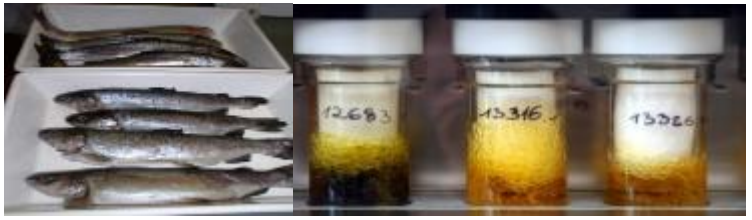




New Topics

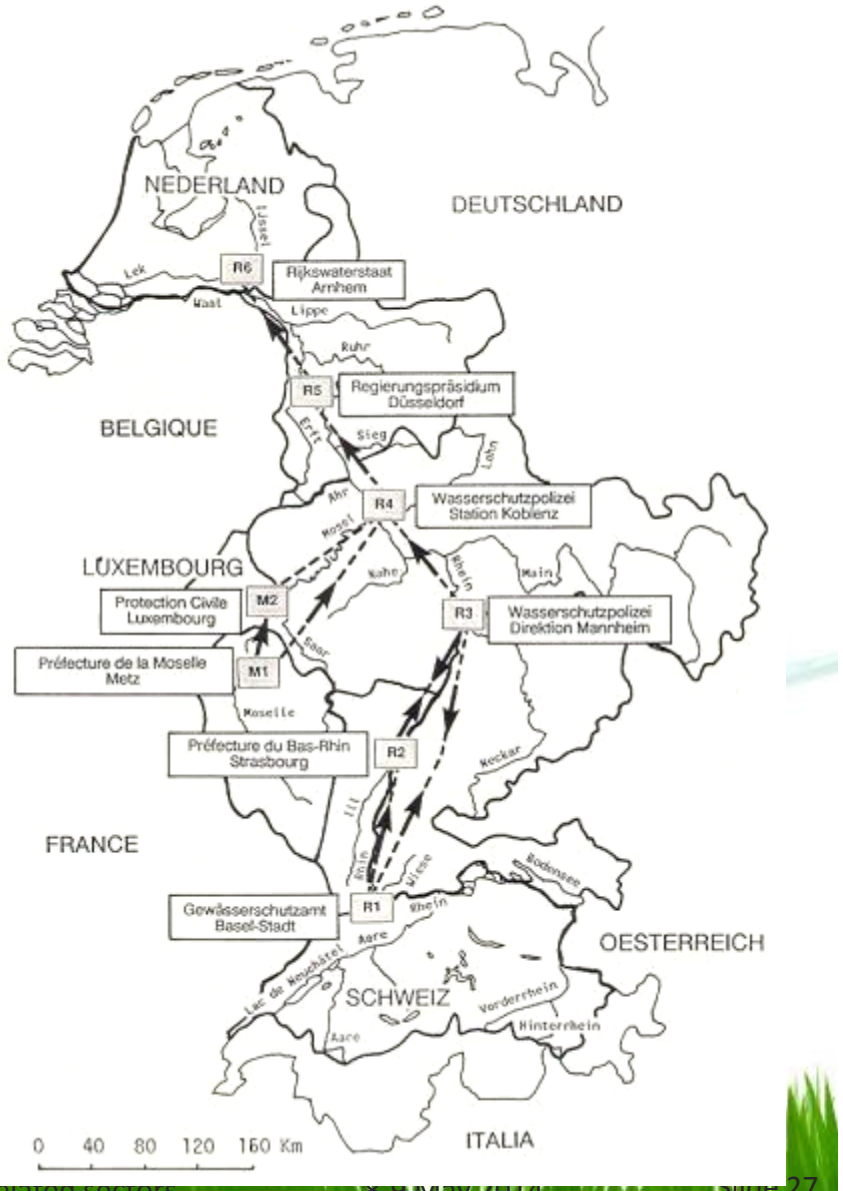
- **Micro-pollutants**

- **Contamination of fish**



- **Mitigating effects of climate change**

Rhine Alarm Model



A tool for the description and management of pollutant transport

Challenges

First Phase (50ties - 70ties twentieth-century)

- **Building trust and mutual understanding**
- **Convincing society of the danger of continuous increasing water pollution**

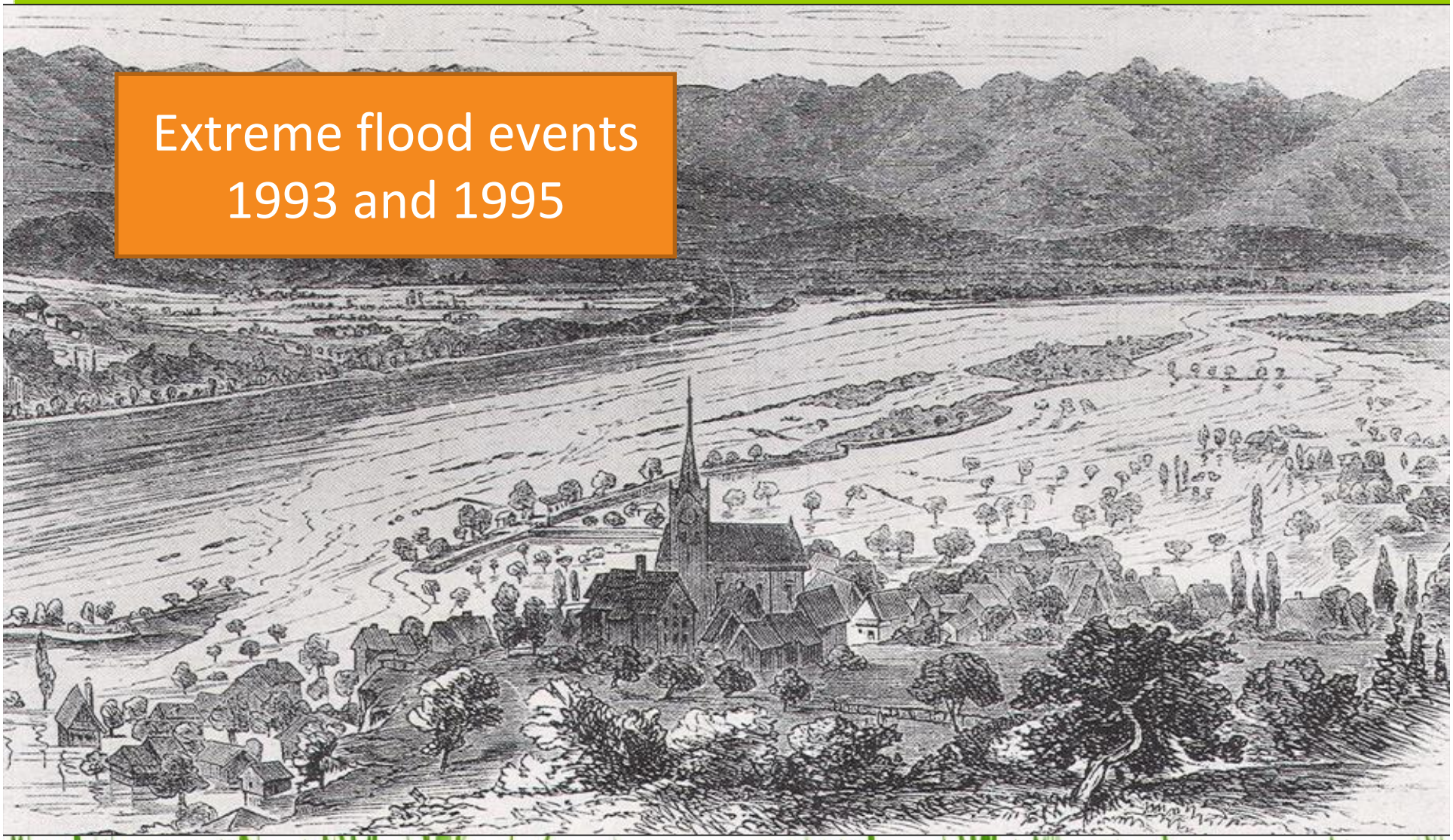
Turning Point: Sandoz Accident

- **From short term detailed technical discussion to long term ambitious goal setting**
- **Integration of all relevant policy fields**

For the future

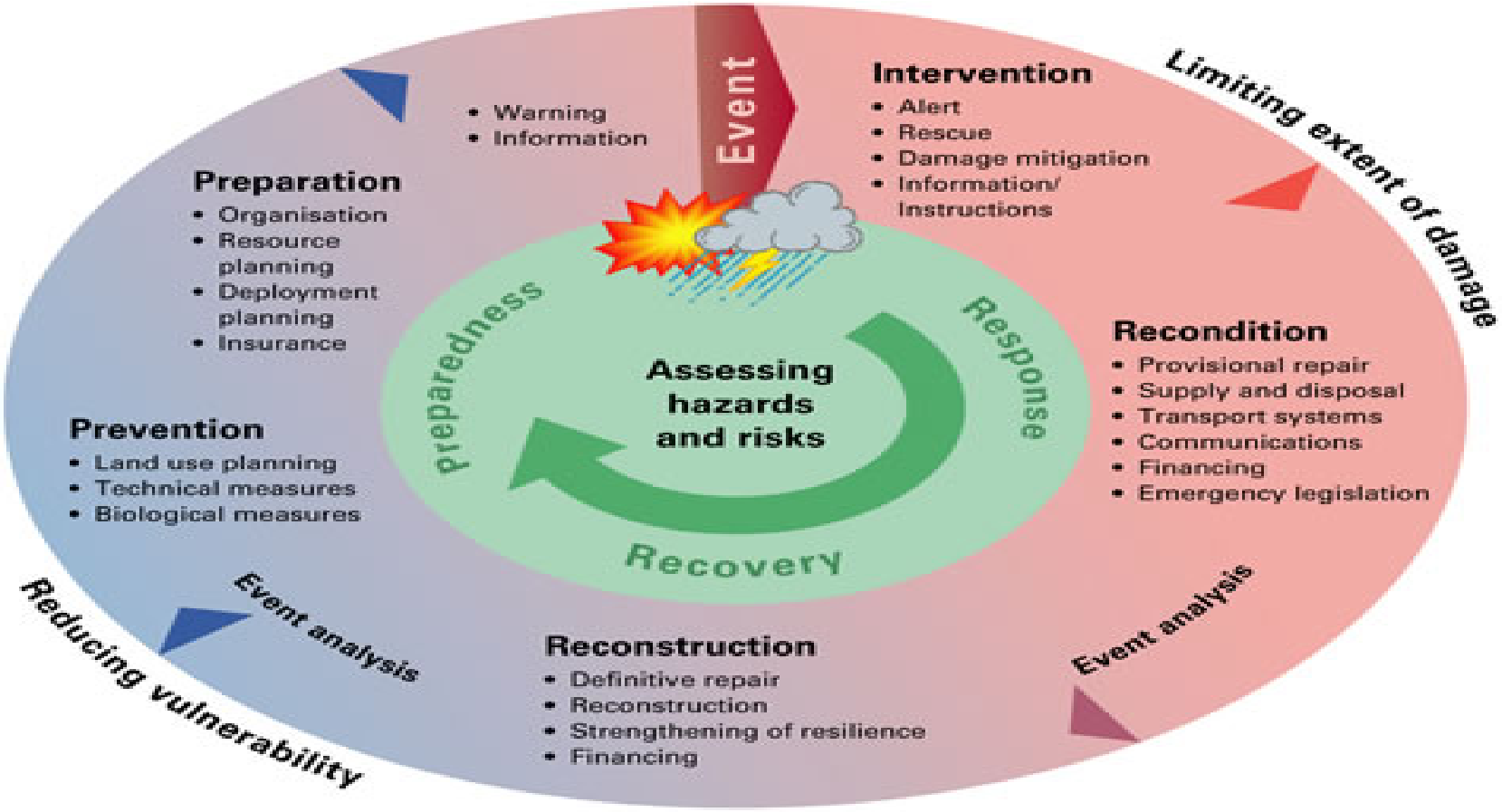
- **How correct the impact of missing environmental management of the past**
- **How to take account of uncertainties regarding the socioeconomic evolution and the impact of climate change**

Flood Protection

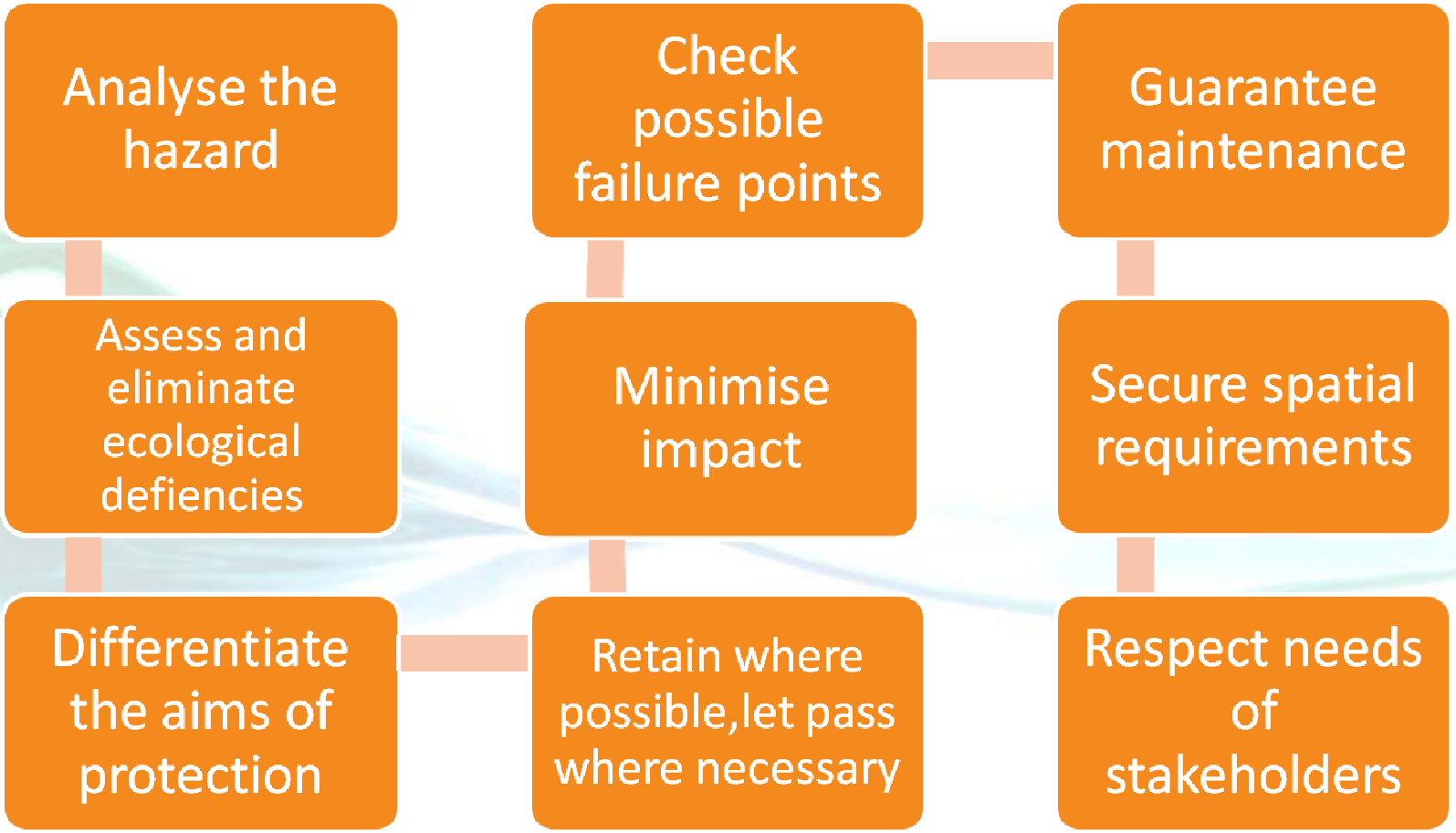


Extreme flood events
1993 and 1995

Integrated Flood Risk Management



Flood Protection Strategy

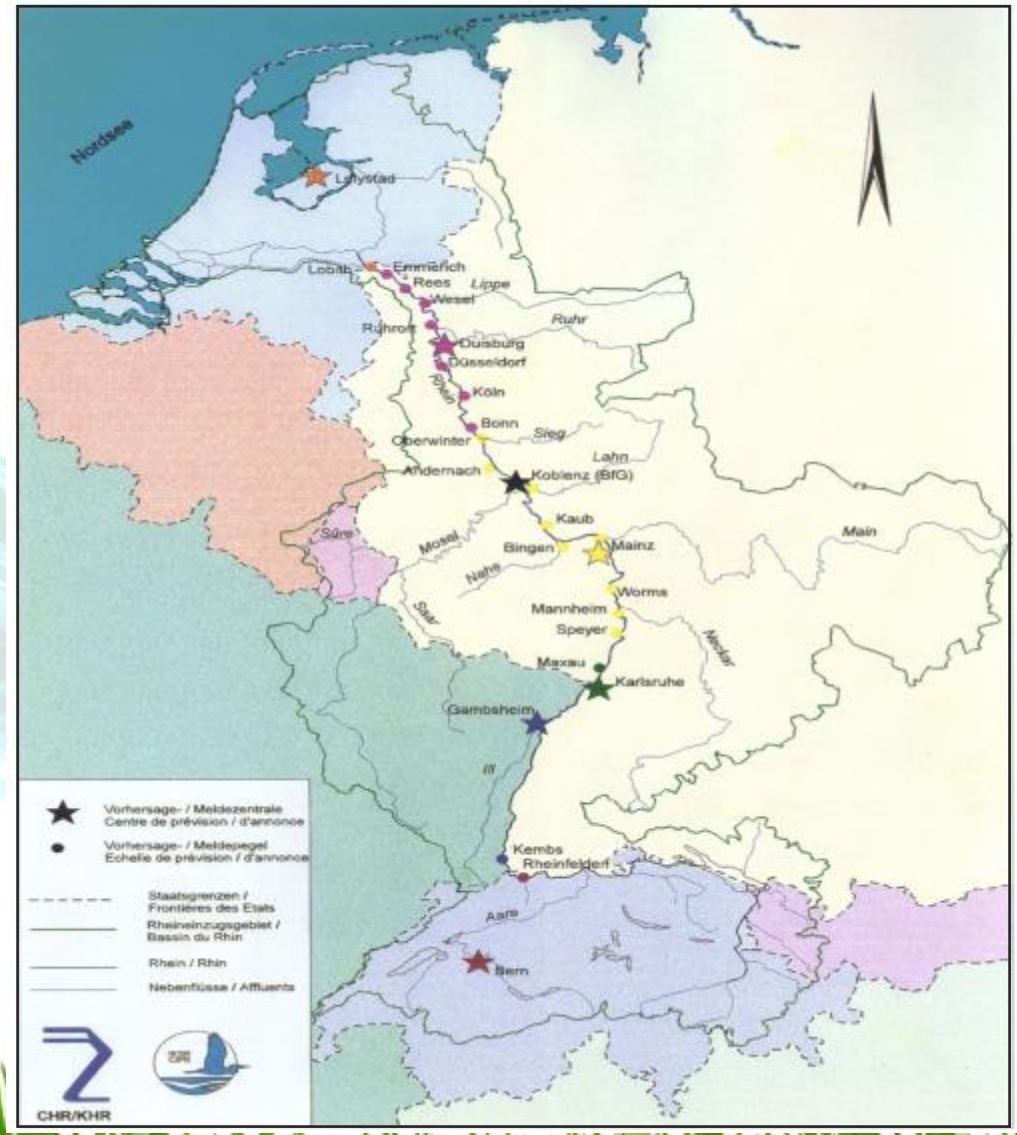


Rhine Action Plan Floods

The four action targets of the Rhine Action Plan Floods 1995-2005

- Reduce damage risks
- Reduce extreme flood stages
- Increase awareness of flooding
- Improve the flood forecasting system

Flood Forecast and Warning Systems



Determination of the Impacts on Water Resources Caused by Global Change

Monitoring	→	Long term time series
Analysis	→	Process understanding Long-term changes
Determination of anthropogenic impacts	→	System changes
Modelling	→	Scenarios Extrapolation/estimation of future developments

Climate Change Adaptation Strategies

Immediate Response Strategy

Wait and Verify Strategy

No Regret Strategy

Transboundary Cooperation

Cooperation requires patience, persistence and realism. It requires linking water reforms to broader political and economic reforms.
ICPR 1950 – 2014, Central Commission for Navigation 1815 - 2014

Lessons Learnt

Both the Sandoz fire in 1986 and the floods of 1993 and 1995 were triggers for fundamental changes in policy

•always try to find a positive approach, even when catastrophic events have occurred

•start with building common denominators, not with identifying disagreements

Agreements should be developed bottom-up and with involvement of all stakeholders. This does increase ownership and acceptance.