Case Study
Danube River Basin

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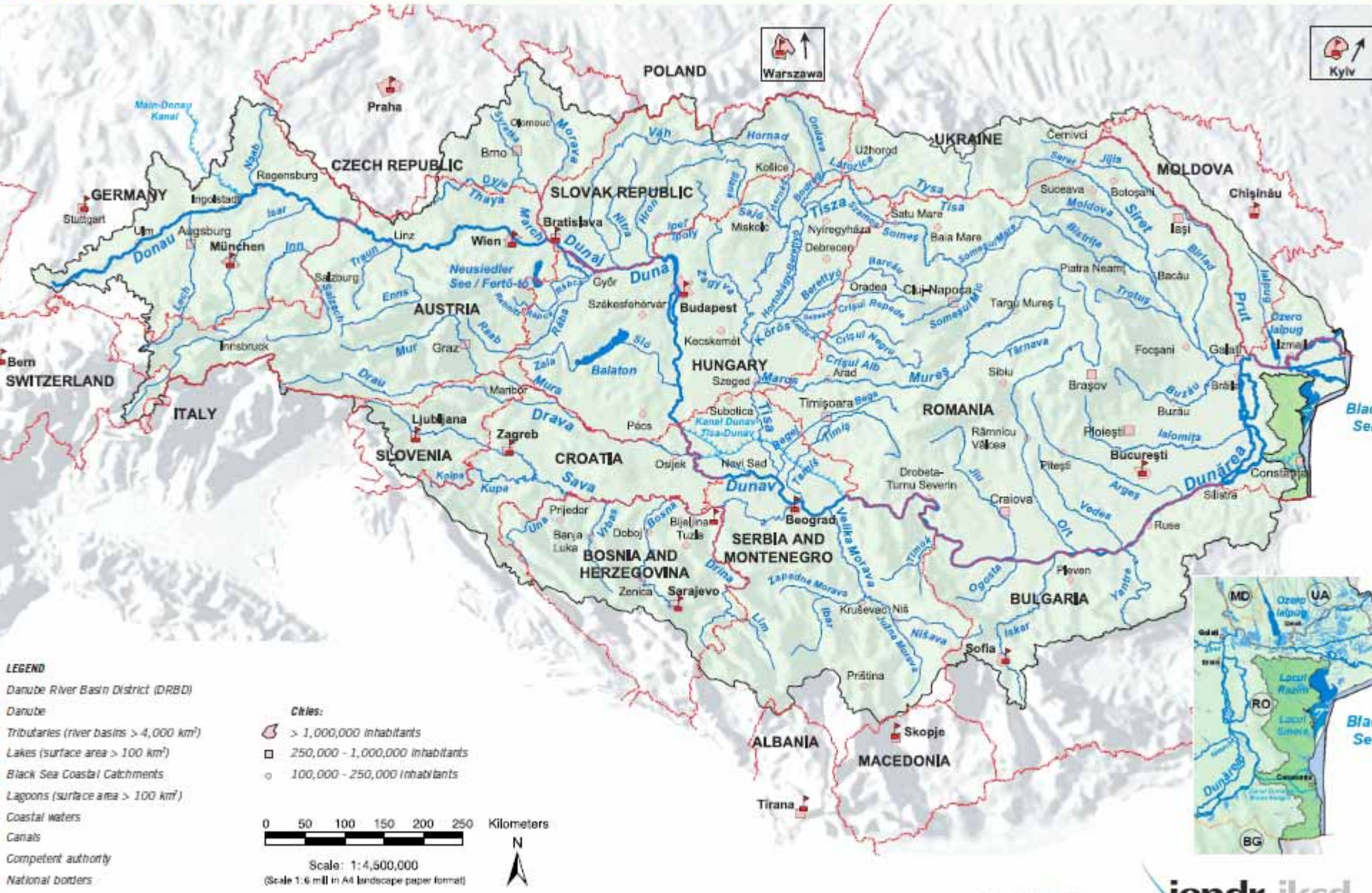
IWHW-BOKU

nube River Basin District: Overview



LEGEND

- Danube River Basin District (DRBD)
- Danube
- Tributaries (river basins > 4,000 km²)
- Lakes (surface area > 100 km²)
- Black Sea Coastal Catchments
- Lagoons (surface area > 100 km²)
- Coastal waters
- Canals
- Competent authority
- National borders

Cities:

- > 1,000,000 inhabitants
- 250,000 - 1,000,000 inhabitants
- 100,000 - 250,000 inhabitants

0 50 100 150 200 250 Kilometers

N

Scale: 1:4,500,000

(Scale 1:6 mill in A4 landscape paper format)

Product of ICPDR, Vienna

ed by FLUVIUS, Vienna, June 2005

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Some Figures About The Basin

- Countries:
  - Moldova, Ukraine, Romania, Bulgaria, Republic of Yugoslavia, Montenegro, Bosnia-Hercegowina, Croatia, Slovenia, Hungary, Slovakia, Czech Republic, Austria, Germany
  - Switzerland, Italy, Poland, Macedonia, Albania
- Figures:
  - Length: 2857 km
  - Area: 817.000 km2
  - Population: 80-82 Mio.

Theme 1

- What are the magnitudes of anthropogenic and environmental changes in the global water system and what are the key mechanisms by which they are induced?

Global Changes ?

- Political changes
- Severe economic changes
- Climate change

The last 20 years

- Collapse of Yugoslavia in a civil war
  ten thousands were killed, hundred thousands were expatriated
- New states have been established
  Czech Republic, Slovakia, Slovenia, Croatia, Bosnia-Hercegowina, Makedonia, Montenegro
- Politically unsettled problems (Kosovo, Transnistria)
- Political transition: CZ,SLW,HU,SLV,BLG,ROM are EU members
- CRO, MA, SE are accession states

Economic Status and Development

Table 36 General socio-economic indicators (data source: Competent authorities in the DRB unless marked otherwise)

	GDP (in bill national currency)	GDP (in million EUR)	Total population (million)	GDP per capita (in EUR per capita)	GDP per capita (in PPP EUR per capita)
Albania[1]	na	14	<0.01	1,390	na
Austria	2,732	198,611	7.7	25,795	25,521
Bosnia i Herzegovina[1]	na	3,493	2.9	1,204	na
Bulgaria	14	7,266	3.5	2,076	8,010
Croatia	99	12,942	3.1	4,175	7,460
Czech Republic[4]	520	15,247	2.8	5,461	13,226
Germany	557	285,075	9.4	30,321	29,215
Hungary	13,172	50,663	10.1	5,016	11,243
Italy[2]	780	403	0.02	20,225	22,457
Macedonia[3]	1	19	<0.01	1,921	6,020
Moldova[1]	na	394	1.1	358	na
Poland[2]	1	187	0.04	4,672	9,230
Romania	776,445	38,908	21.7	1,795	5,264
Serbia and Montenegro[5]	983	8,628	9.0	959	na
Slovak Republic	898	21,077	5.2	4,059	11,157
Slovenia	3,523	17,182	1.7	9,892	14,696
Switzerland[2]	1	739	0.02	37,258	na
Ukraine[3]	9	1,840	2.7	686	3,706

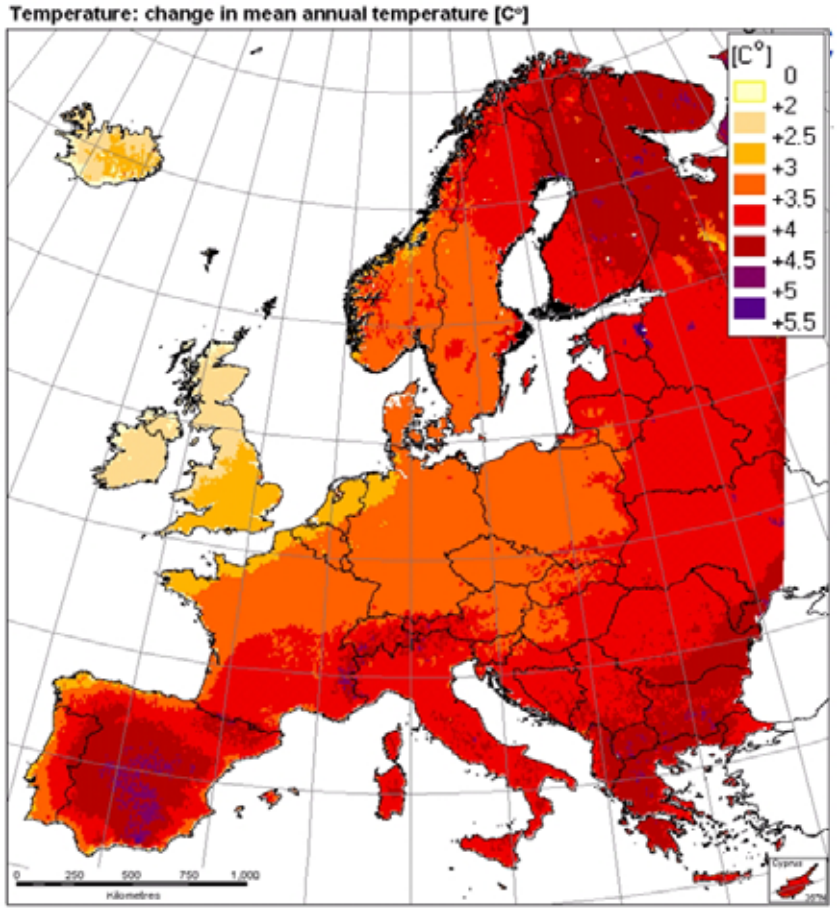
[1] 2002; WORLD BANK (2003b).
[2] EUROSTAT (2004b).
[3] 2000; VIENNA INSTITUTE FOR INTERNATIONAL ECONOMIC STUDIES (2003).

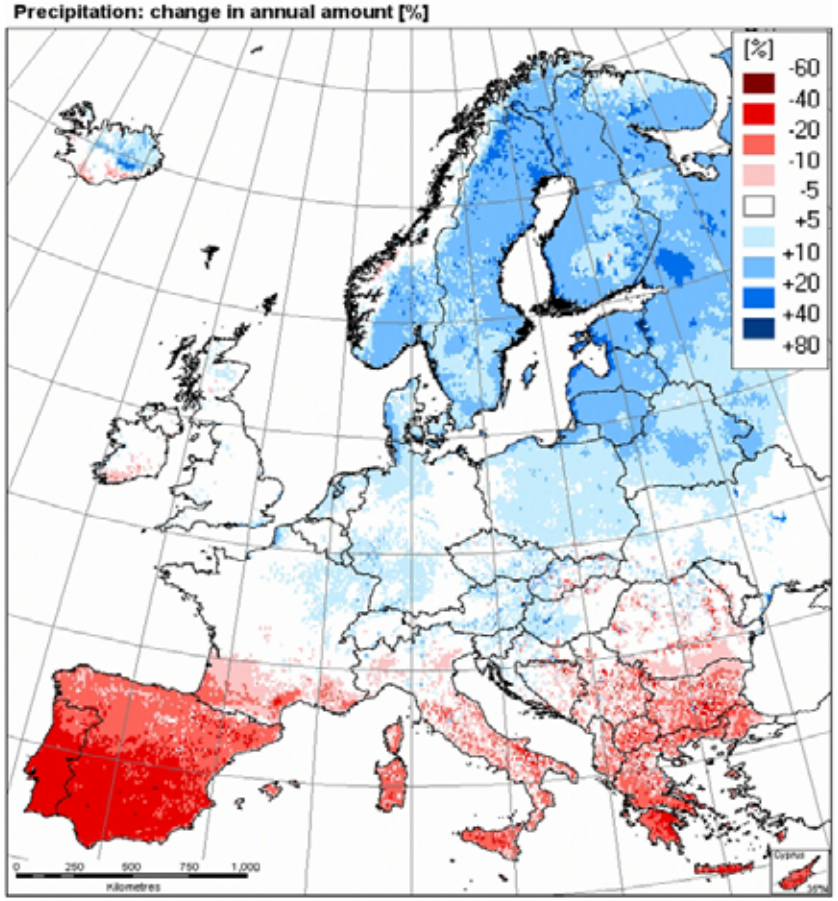
Economic Status and Development

- Large gradient in GDP/capita from upstream to downstream
- Economic growth rate in some downtream countries is larger than upstream (UK, RO, BLG,..)
- The economy is very volatile

Regional (Nested) GCMs

- Several nested models were developed in the past with

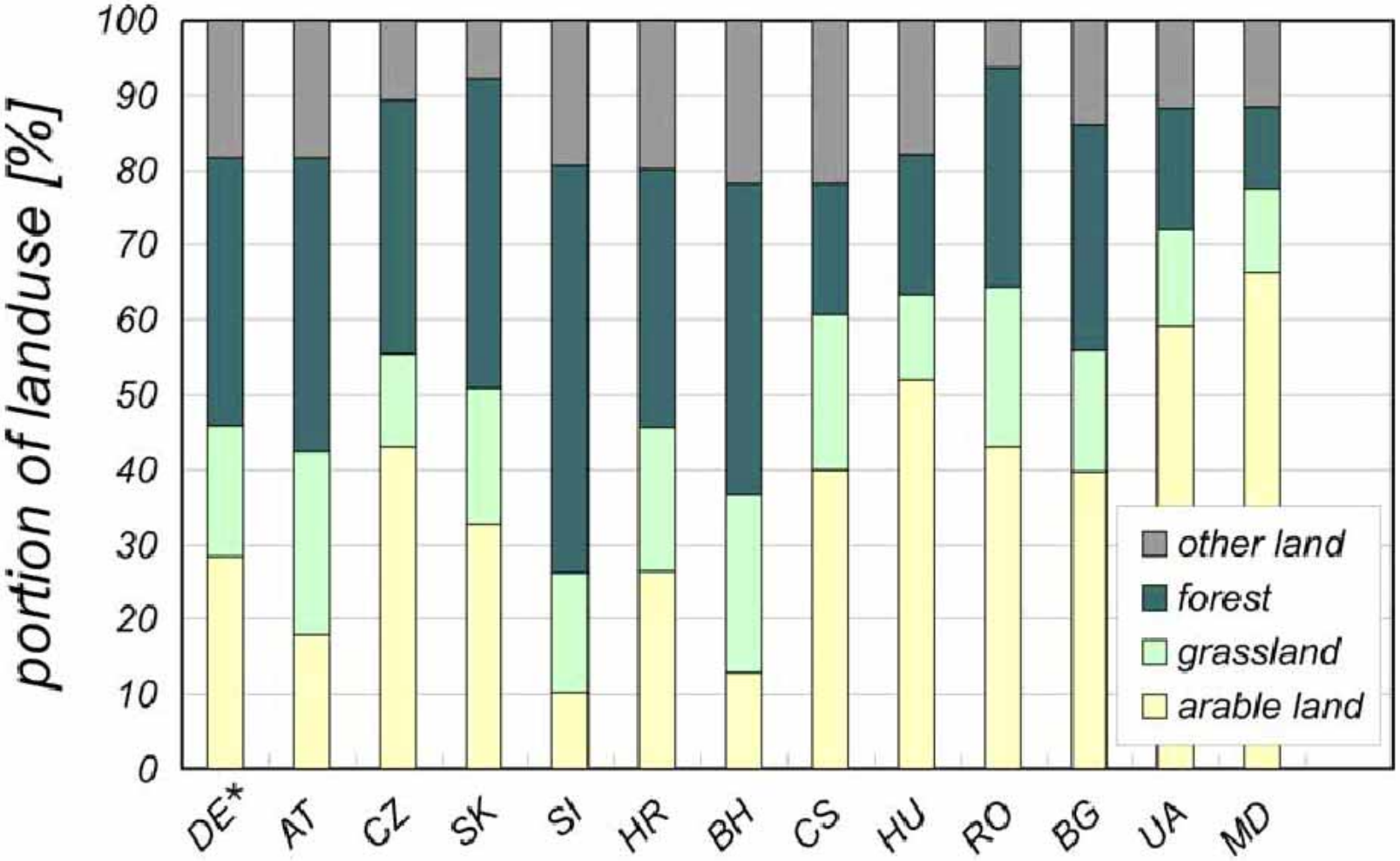




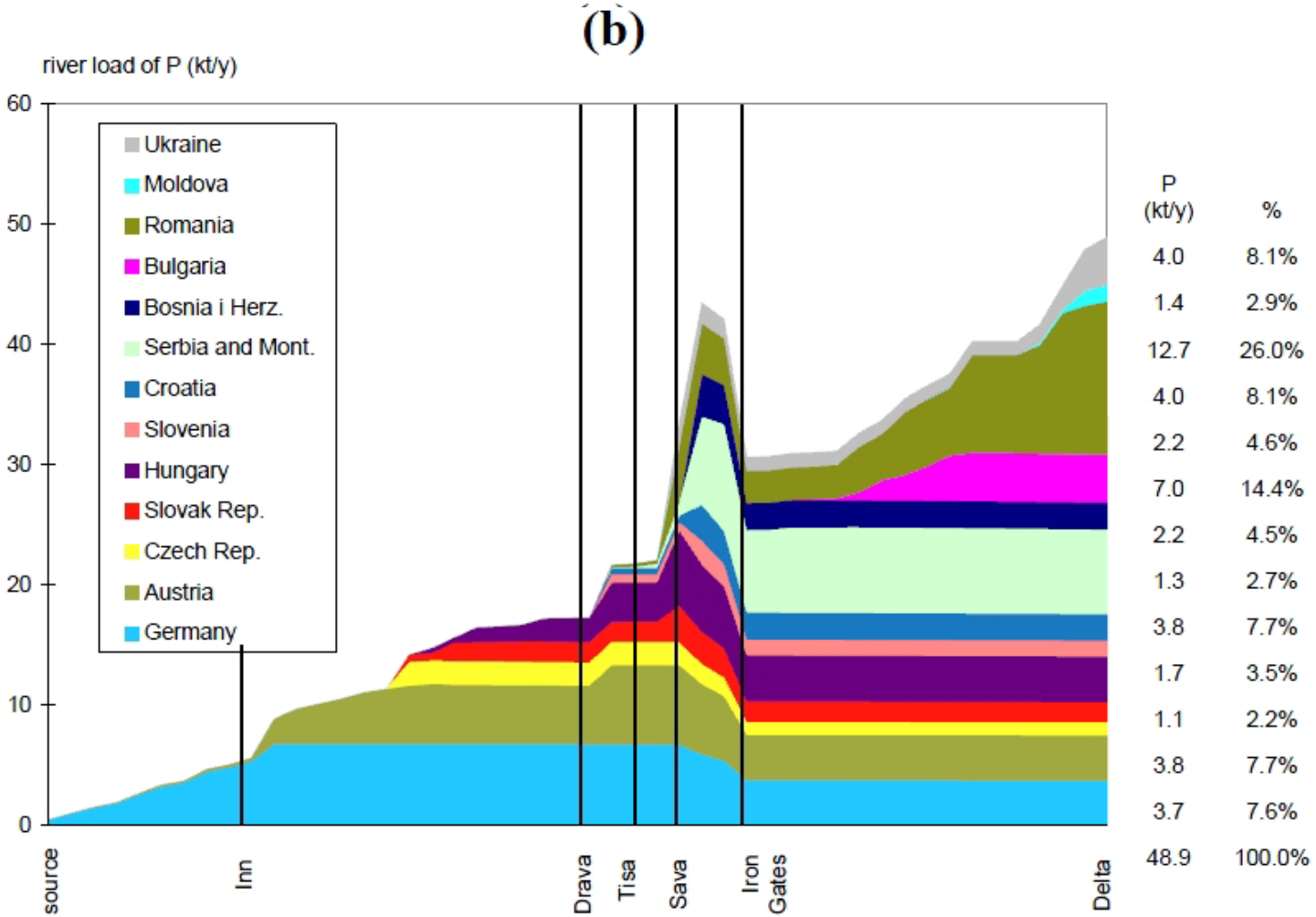
Role of Human Intervention

- Numerous reservoirs
- Large irrigation schemes downstream
- Water abstraction
- Channelisation of rivers
- Environmental degradation

Land Use Pattern



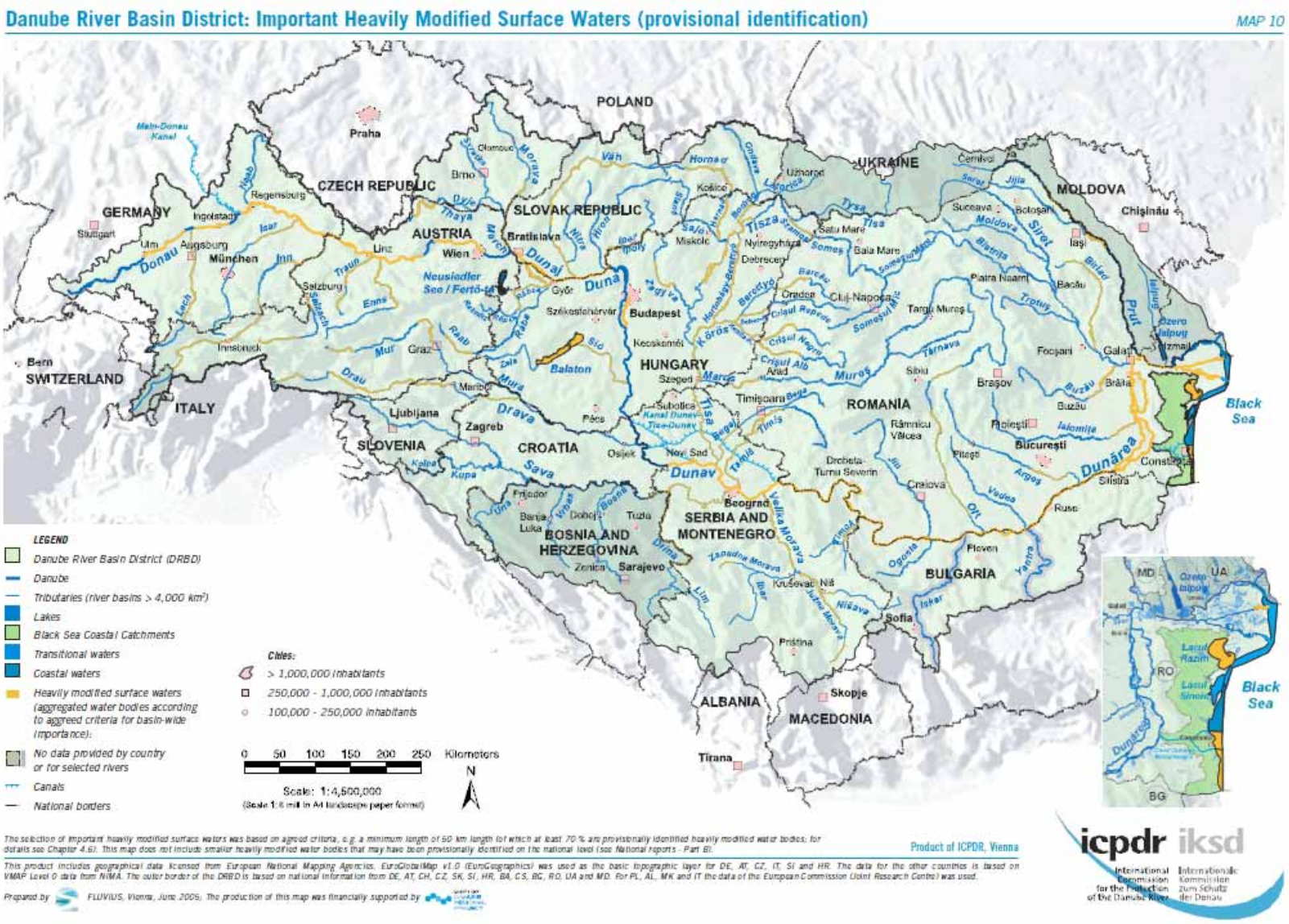
Flow Paths of Nutrients (N and P)



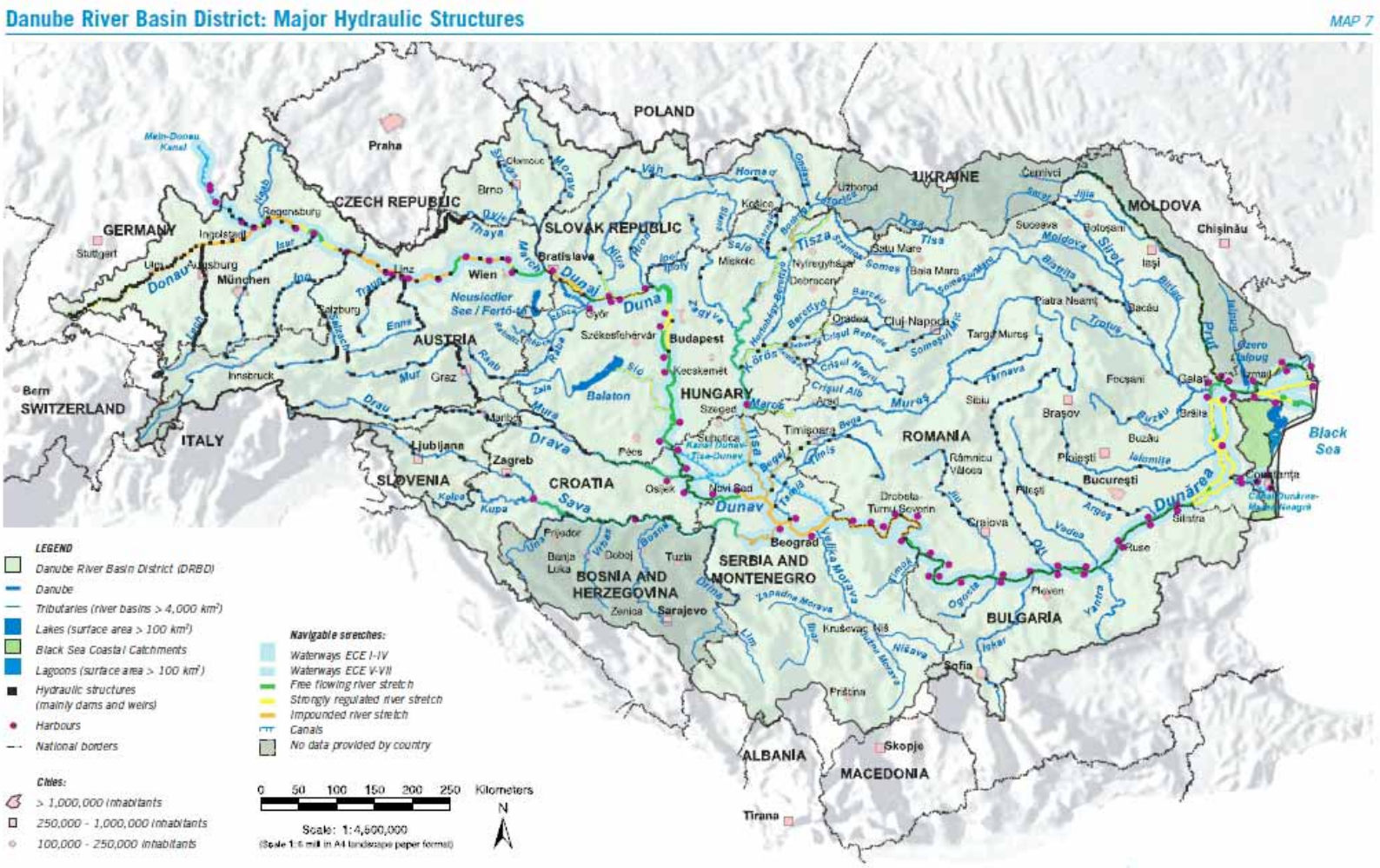
Environmental Problems and Pressures

- Water Pollution in Tributary Basins
  (also in drinking water)
- Nutrient Load and Euthrophication
- Sensitive Ecological Areas are Endangered
- The Black Sea is Endangered
  (it accumulates all the pollutants)
- Morphological Changes of the Rivers

Heavily Modified Water Bodies



Major Hydraulic Structures in the Basin



Data source for Hydraulic structures and Navigable stretches: Updated information based on UNDP/GEF Danube Pollution Reduction Programme, 1999, Map 12: Structural Analysis of Major Danube Basin Rivers (Major hydraulic structures). River stretches less than 20 km length are not depicted, e.g. the lower Danube has several 'strongly regulated' river stretches, but the general character is 'free flowing'.
Data source for harbours and waterways: via donau (2004).

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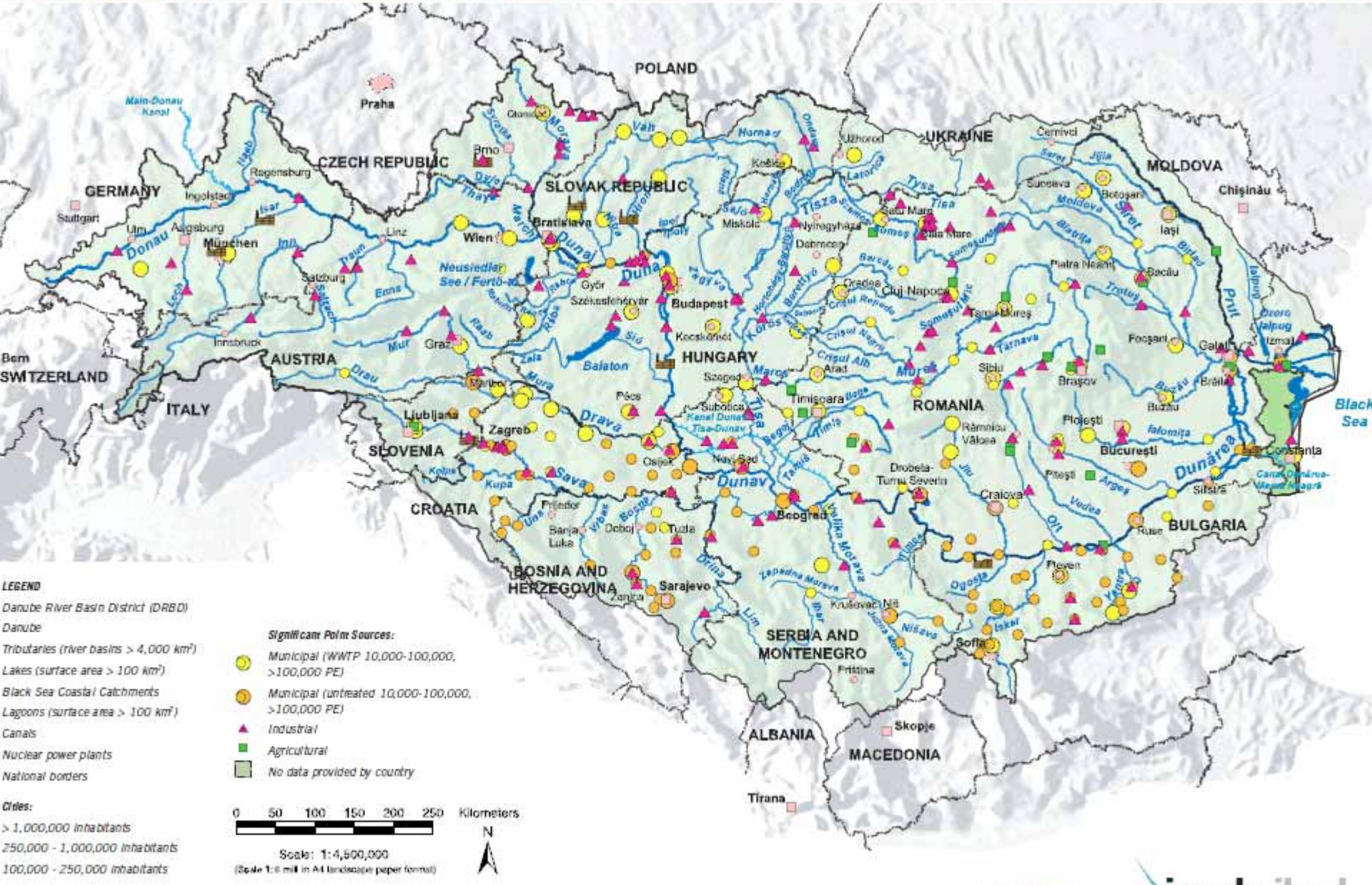
nube River Basin District: Significant Point Sources of Pollution

MAP



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- Canals
- Nuclear power plants
- National borders

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Significant Point Sources:

- Municipal (WWTP 10,000-100,000, >100,000 PE)
- Municipal (untreated 10,000-100,000, >100,000 PE)
- Industrial
- Agricultural
- No data provided by country

0 50 100 150 200 250 Kilometers

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Scale: 1:4,500,000

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clarification and harmonisation is necessary on some transboundary water bodies. Data for Croatia is preliminary.

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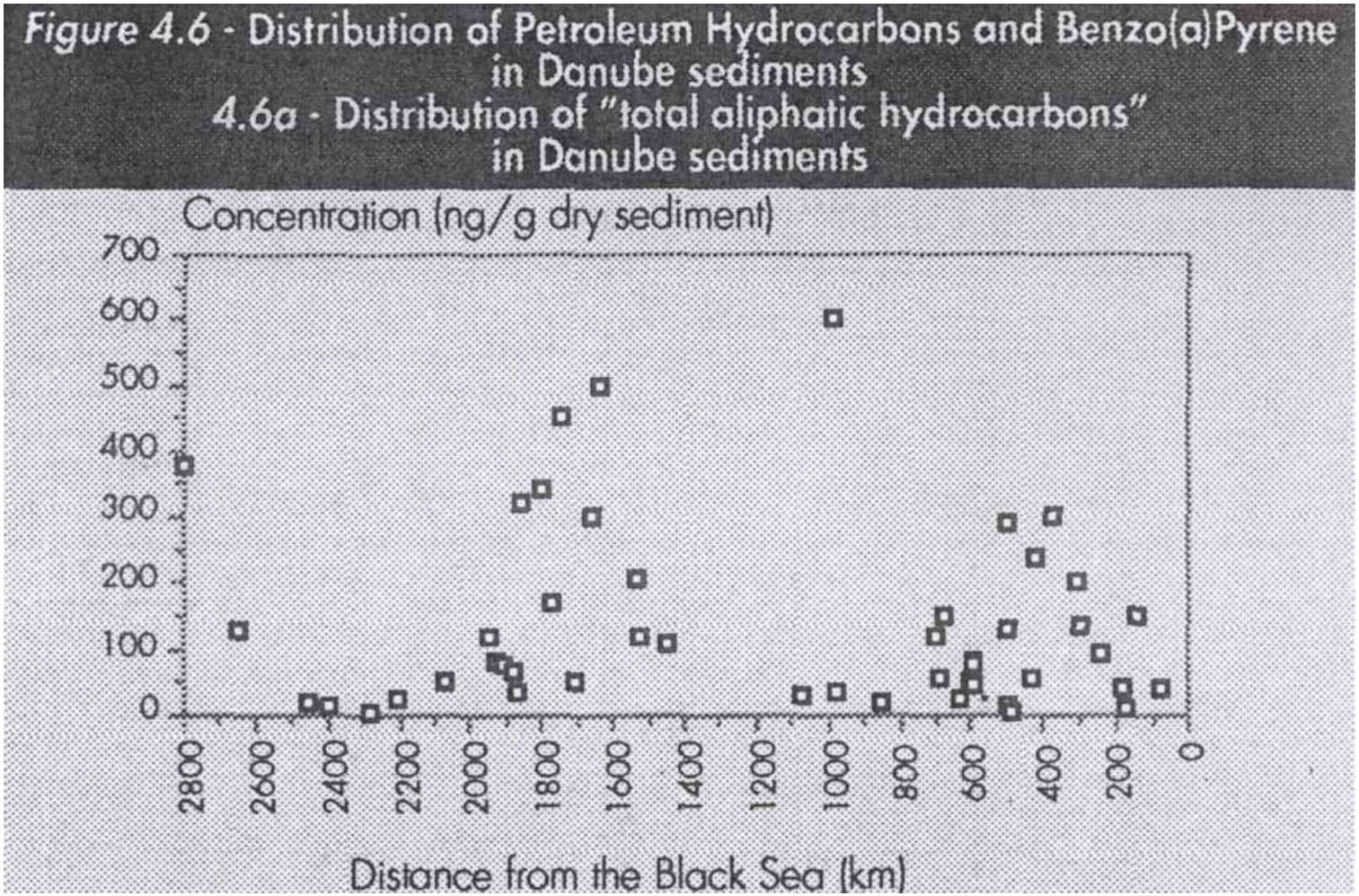
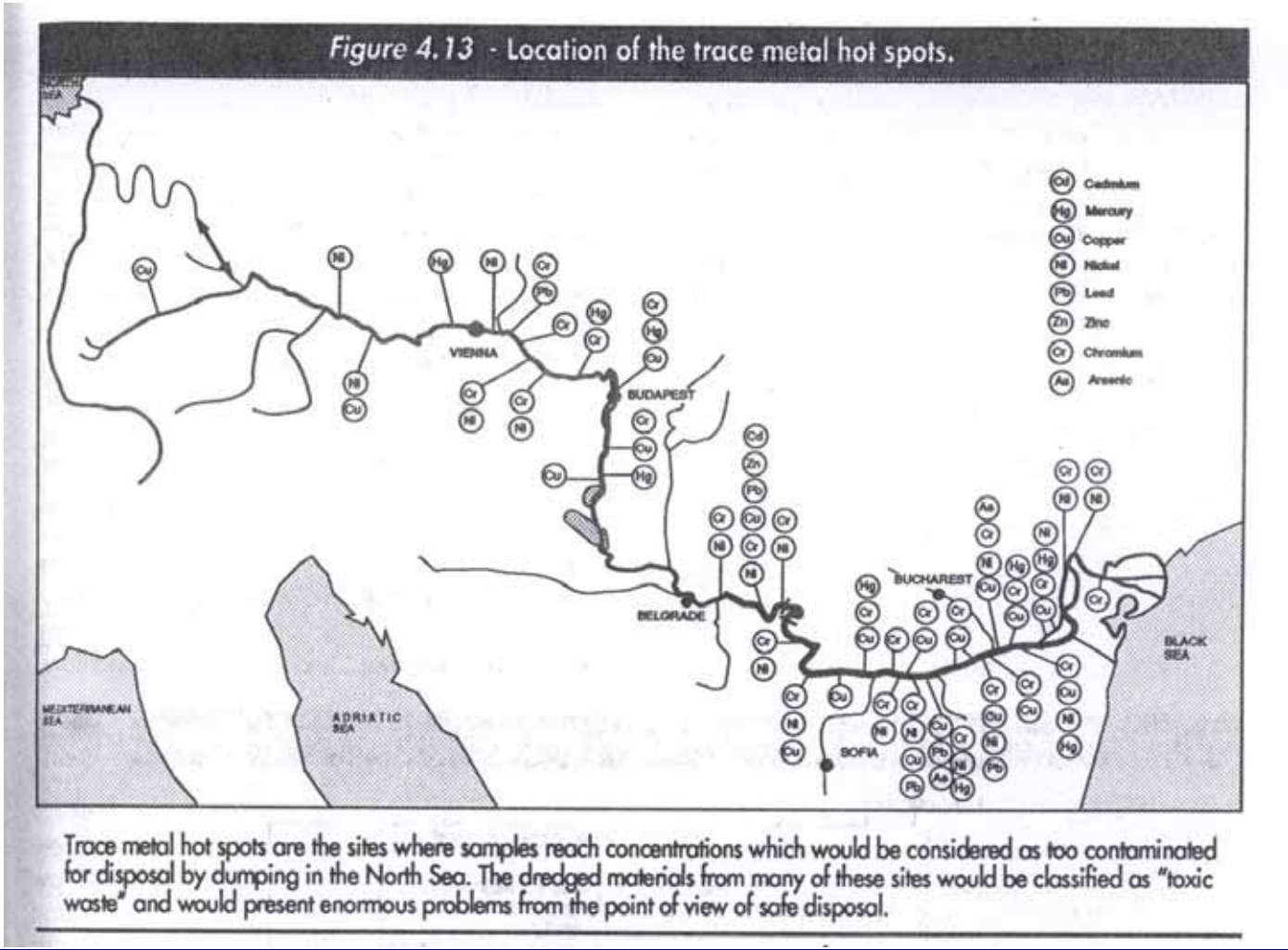
Aquatic Pollution:



Aquatic Pollution:



Trace metal hot spots are the sites where samples reach concentrations which would be considered as too contaminated for disposal by dumping in the North Sea. The dredged materials from many of these sites would be classified as "toxic waste" and would present enormous problems from the point of view of safe disposal.

What are the expected impacts of these changes on society and ecosystems?

- Migration pressures in the past originated in armed conflicts and in civil war, as in Croatia, Bosnia-Herzegovina, Serbia-Kosovo, and Moldova, and in the breakdown of the economy.
- Competition for available water is a serious problem in some regions of the Danube River basin, particularly in the left side tributary basins in Hungary and in Romania and Bulgaria.The main conflict is between agricultural water supply and other uses. In some countries, like Ukraine and Romania, the agricultural sector still requires more than 50 % of total water consumption. In Hungary and Moldova the share is above and around 30 % of total consumption.
- Pressure on the ecological system is increasing. Connected wetlands/floodplains play a significant role as they provide retention areas during flood events and they have also positive effects on the reduction of nutrients. Compared with the 19th century, less than 19% of the former floodplain area (7,845 km² out of a once 41,605 km²) remained.

Impacts of Political Changes on Agriculture

- During socialistic economy some of the countries like Romania and Bulgaria had exported especially agricultural products to Western countries.
- Downstream states changed the agricultural sector from large scale centrally managed agriculture to a decentralised small scale farming practice.
- Application of fertilisers and pesticides has been substantially reduced in the last twenty years.
- In Romania farmland in organic production has grown rapidly, more than tripling in the last five years.
- In Bulgaria agricultural production contributes 13,7 % of the GDP (2001) and remained until today an important economic sector. No information was found with respect to “virtual water exports”.
- The Danube links via the Rhine-Main-Danube channel the Black Sea with the North Sea and the river is thus vulnerable to invasive species. It is one of Europe’s four most important routes for invasive species.

Countries	Share in total water use (Percentage)			Irrigated land (Thousand ha)				
	Agricultural	Industrial	Domestic					
	2000	2000	2000	1979–1981	1989–1991	1999–2001	2002	2003
Austria	0.9	64.0	35.1	4	4	4	4	4
Bulgaria	18.8	78.2	3.0	1 189	1 251	624	592	588
Hungary	32.1	58.6	9.3	190	201	223	230	230
Moldova	32.9	57.6	9.5			303	300	300
Romania	57.0	34.4	8.6	2 301	3 124	3 082	3 077	3 077
Serbia and Montenegro						23	32	32
former Socialist Federal Republic of Yugoslavia				150	161			
Ukraine	52.5	35.4	12.2			2 393	2 262	2 208

Water Allocation and Change in Irrigation

Changes in WS and WWT

- EU funds for improved water sanitation
- Critical situation in Bosnia-Hercegovina, Moldowa and some regions in Romania

General Trends

- Reduced nutrient input
- Slow reduction in pollution from point sources
- ICPDR has been established

Further Pressures

- From hydropower development
- Improvement of navigation conditions
- Economic development ? (benefits and disadvantages)

Wetlands and Endangered Areas:

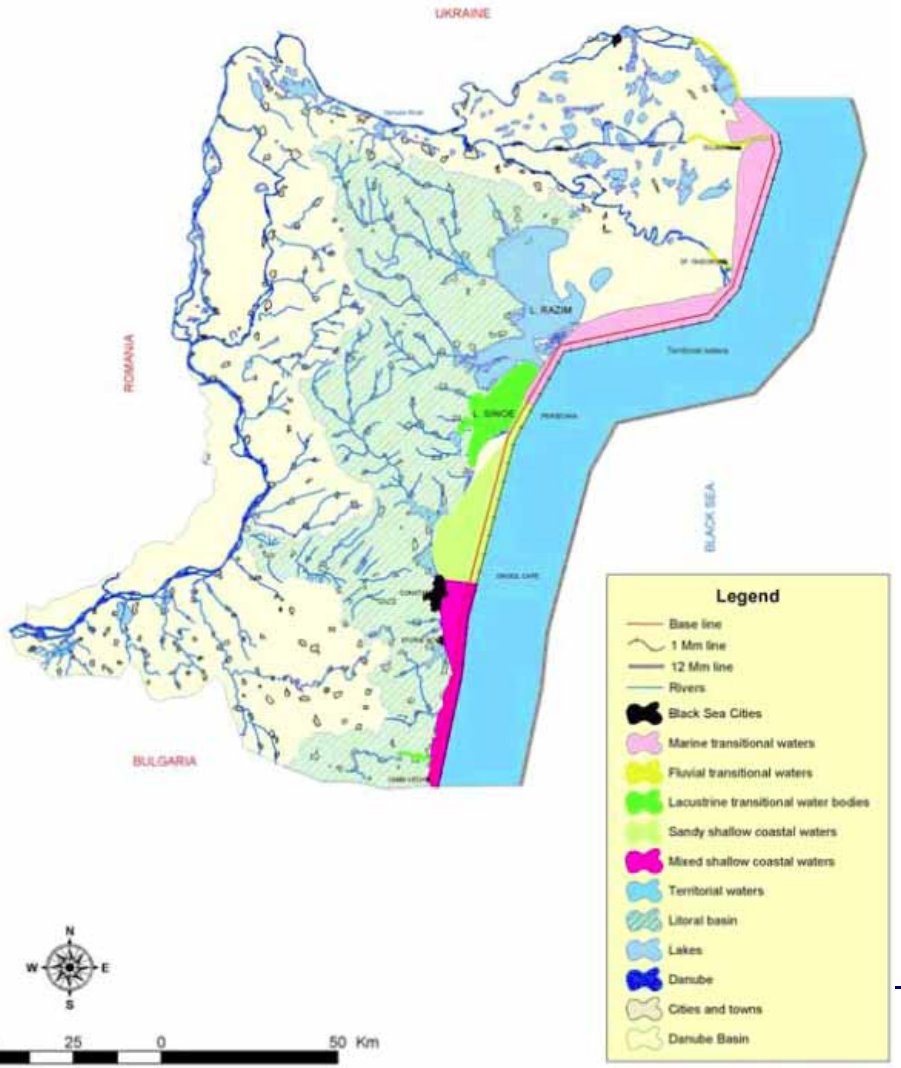
Institutional settings

- In the EU countries (Germany, Austria, Czech Republic, Slovakia, Slovenia, Hungary, Bulgaria, Romania) the implementation of the **EU-WFD directive** and now of the **Flood Risk Directive** has strong impacts on water management and raises the awareness to environmental issues.
- The ICPDR plays an important role in assisting in the implementation of coherent basin wide environmental standards and in transboundary water management. The development of an agreed data base about water resources, water quality and water uses provides the basis for a rational water management structure.

How do international power relations affect the use of water and other natural resources in catchments?

- European agriculture policy strongly affects international markets and hence water use within the Danube catchment. Several countries are already members of the EU and several of them (Croatia, Bosnia and Herzegovina, Serbia and Montenegro are accession states.

Interactions with coastal zone and oceans e.g. through reservoirs



How resilient and adaptable is the global water system to change, and what are sustainable water management strategies?

- The terminology would require further specification before it can be applied to operational tasks. Without clear definition everybody would apply different criteria.

Measures to reduce vulnerability

- Political integration
- Transboundary water management
- Institutional setup at different levels
- Re-establishment of large wetland areas (buffer zones, retention of floods, bio-diversity

International Agreements

- Convention for the sustainable use of water resources
- Strategic action plan
- Environmental Programme for the Danube River Basin
- EU-FWD
- Flood Risk Directive

Future Problems

- Heterogeneity in economic development
- Nutrient load
- Adaption to climate change
- River morphology