European Parliament meeting for Water and Climate Change, 21st of April, Strasbourg

Intermediate results of the Project ClimateWater

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and

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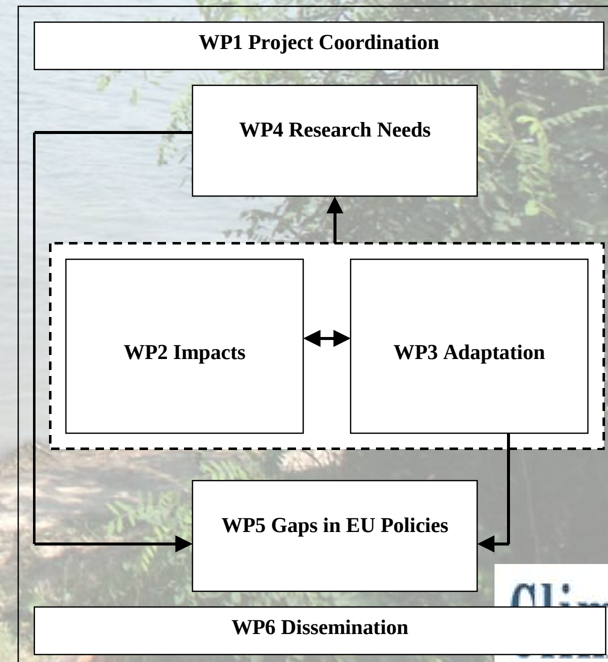
ClimateWater : BRIDGING THE GAP BETWEEN ADAPTATION STRATEGIES OF CLIMATE CHANGE IMPACTS AND EUROPEAN WATER POLICIES

Project duration:3 years 2008 November-2011 November
Project type: Supporting action (FP7);
Home page: http://www.climatewater.org

Coordinator: VITUKI, Hungary, Budapest/Jolánkai

Partners:
UNIDEB, Hungary;
CNR-IRSA, Italy;
USF, Germany;
GeoEcoMar, Romania;
Geonardo, Hungary;
UNILEI, UK;
UNIVIEN,Austria;
SHMU,Slovakia;
SOGREAH, France;
MRA, Malta



We have so far processed literally hundreds of documents, mostly those of larger projects. Thus only fragments of the results on climate change induced impacts on water related issues of Europe (e.g. Impacts on human life and nature) can be given in a presentation.

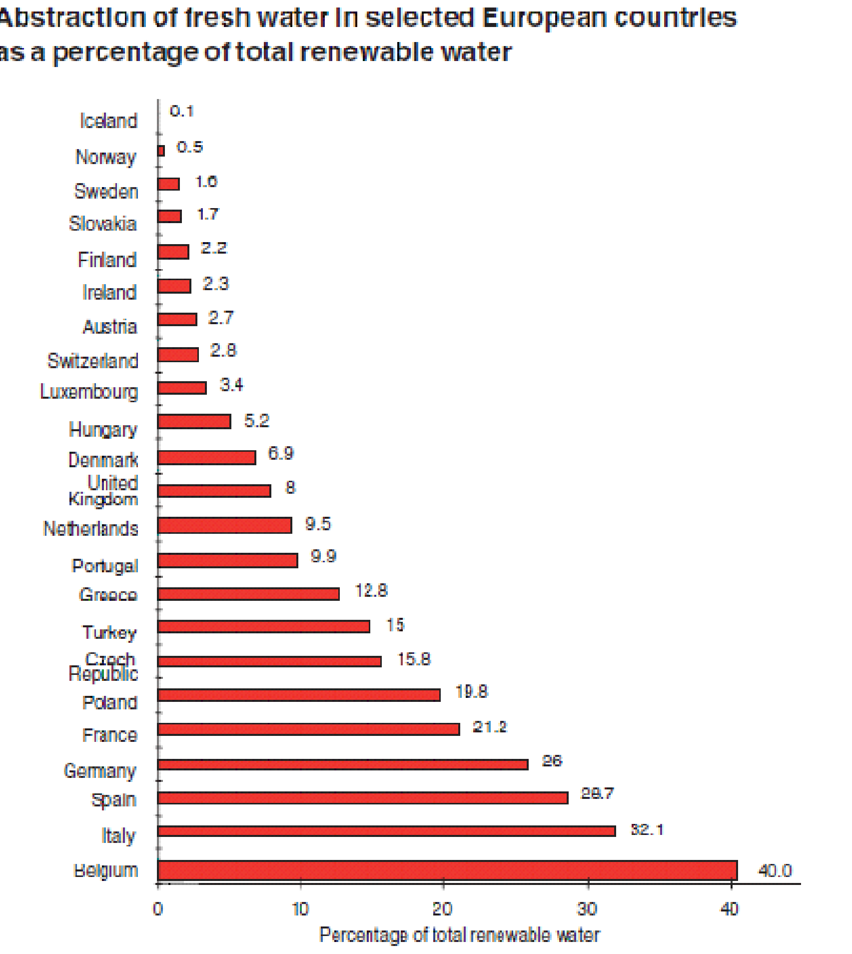
47 sub-topics, grouped for

1/ Floods and excess waters;
2/ Drought and water scarcity;
3/ Water quality and water pollution;
4/ Water supply and water management;
5/ Nature, aquatic ecosystems;
6/ Water industries, navigation, hydropower

WATER SUPPLY AND WATER MANAGEMENT

Major climate change impacts on water supply

- **Decrease in water availability during summer season**
- **Deterioration of water quality.**



Results:

- Overuse of groundwater resources (with decreasing recharge rates and drying wetlands)
- Increasing background pollution of bank-well filtered drinking water resources
- Empty drinking water reservoirs,
- Saltwater intrusion into coastal aquifers

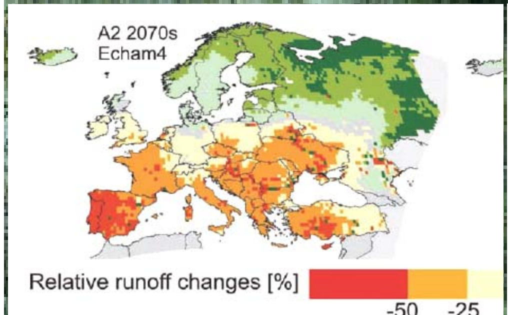
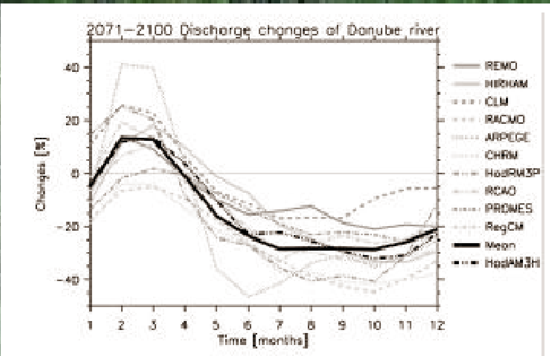
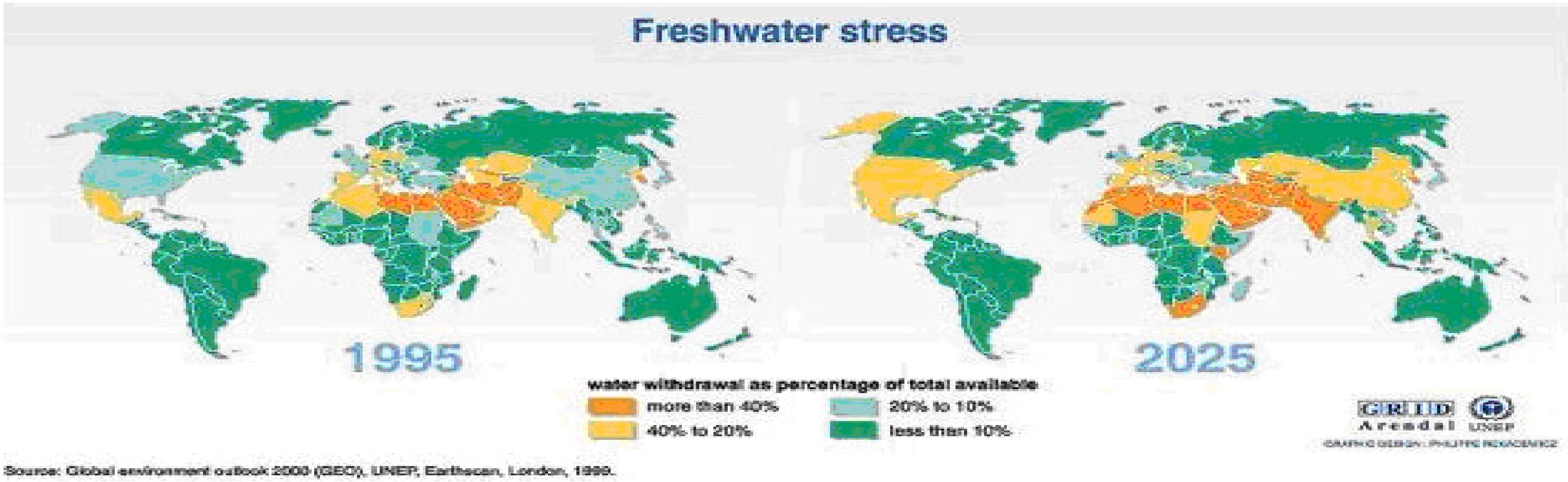


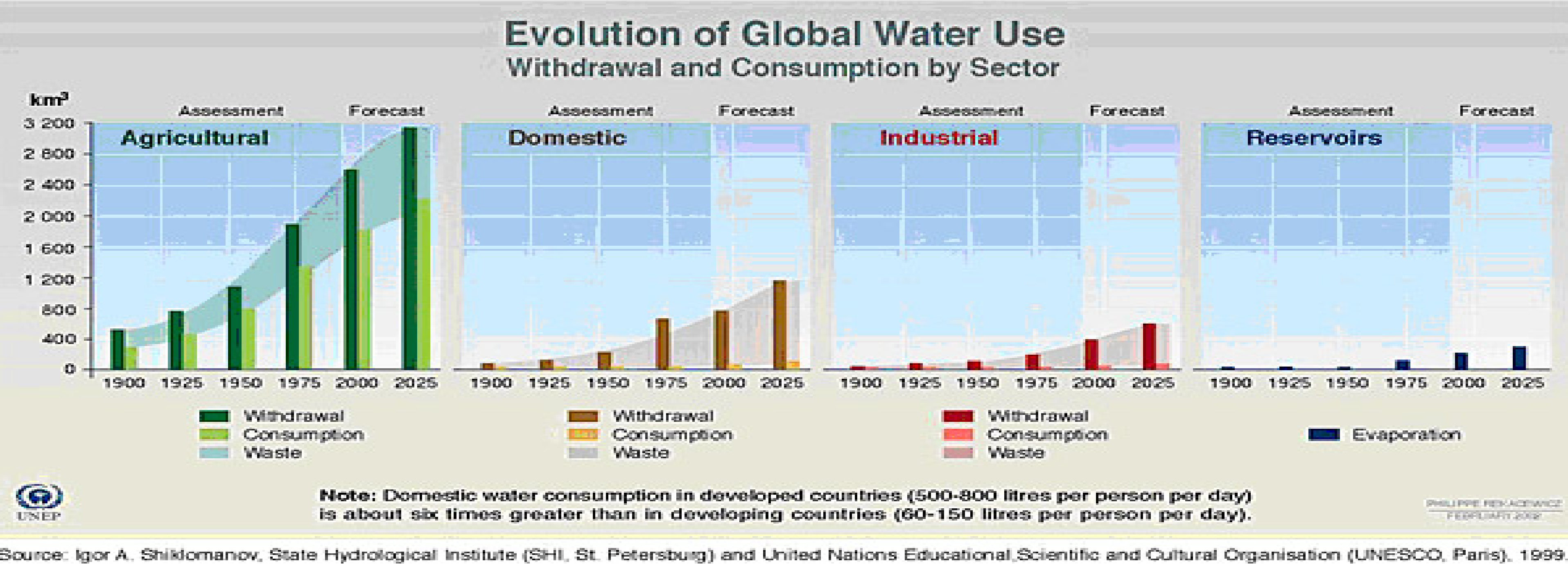
Figure 12.1. *Change in annual river runoff between the 1961-1990 baseline period ar*
(Alcamo et al., 2007)



WATER SUPPLY AND WATER MANAGEMENT

Major climate change impacts on water supply





WATER SUPPLY AND WATER MANAGEMENT

Major climate change impacts on water supply

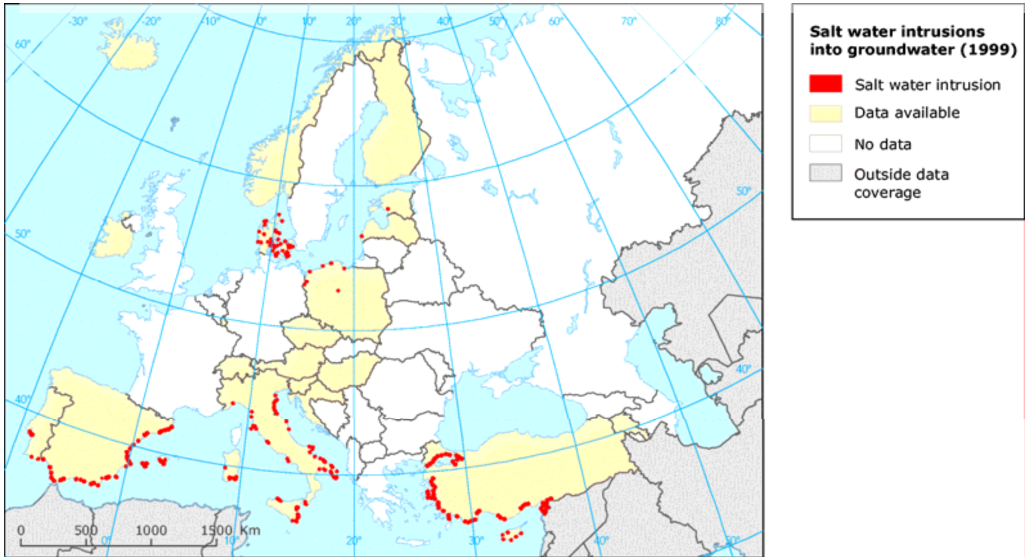


Fig. 3.2. Sectoral use of water in the countries of the European Union

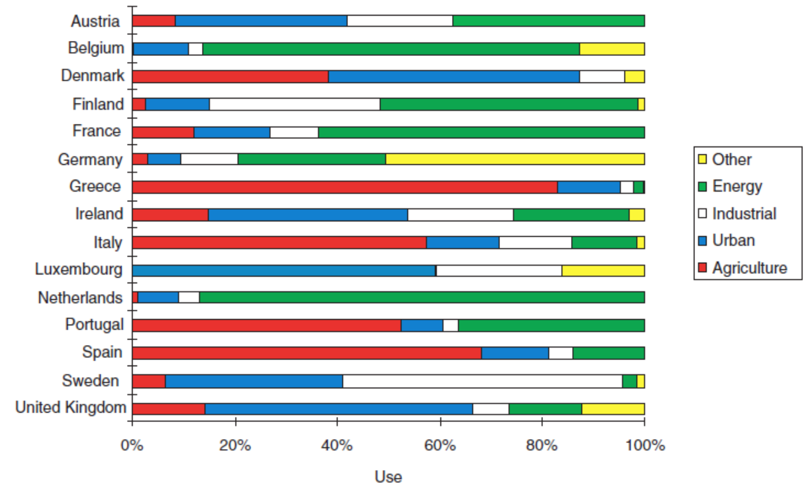
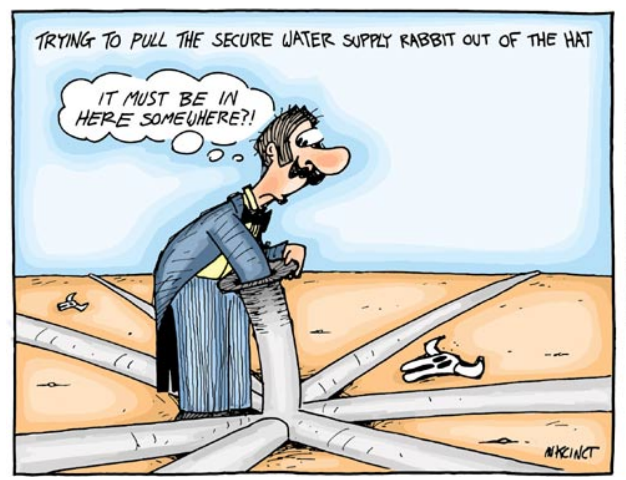


Table 2.2. Estimated water available (m³ per person per year) in selected European countries in 1990 and 2050 based on projection of present climate conditions (change resulting from population growth and other non-climate-related factors) and three transient climate change scenarios

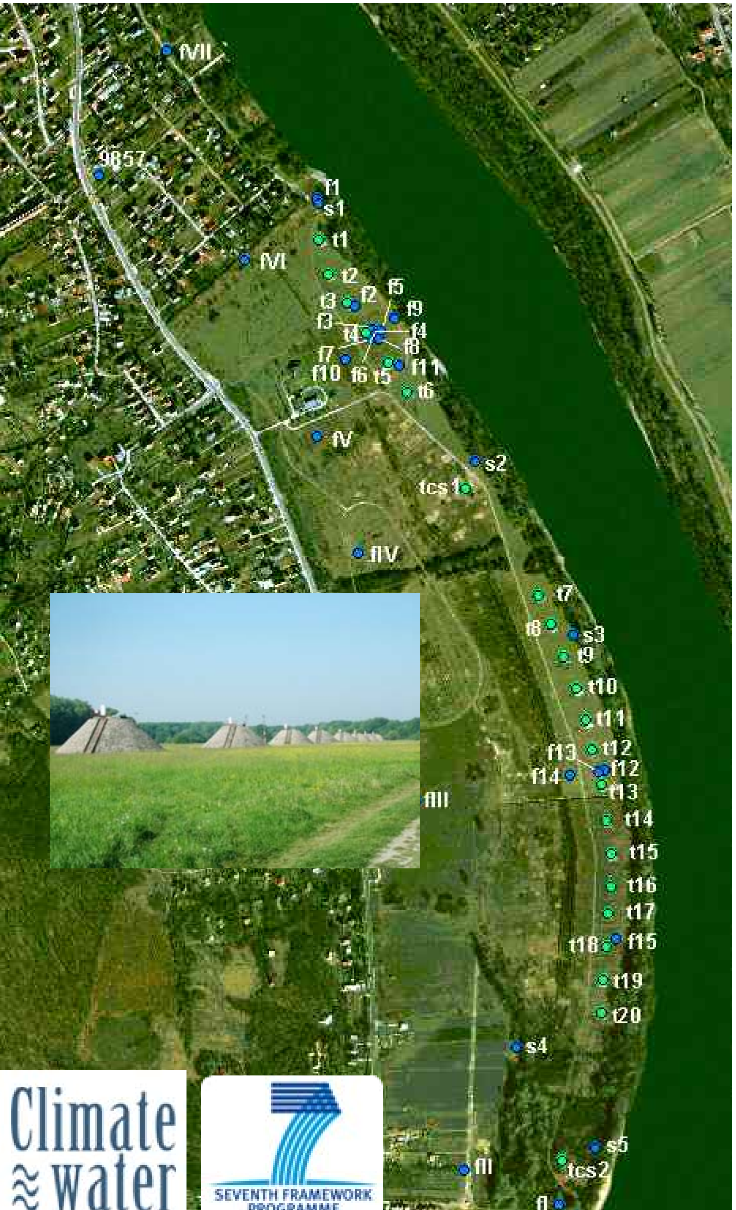
Country	Present climate, 1990	Present climate, 2050	Range of three climate scenarios, 2050
France	4110	3620	2510–2970
Poland	1470	1250	980–1860
Spain	3310	3090	1820–2200
Turkey	3070	1240	700–1910
Ukraine	4050	3480	2830–3990
United Kingdom	2650	2430	2190–2520

Source: McMichael et al. *(22)*.



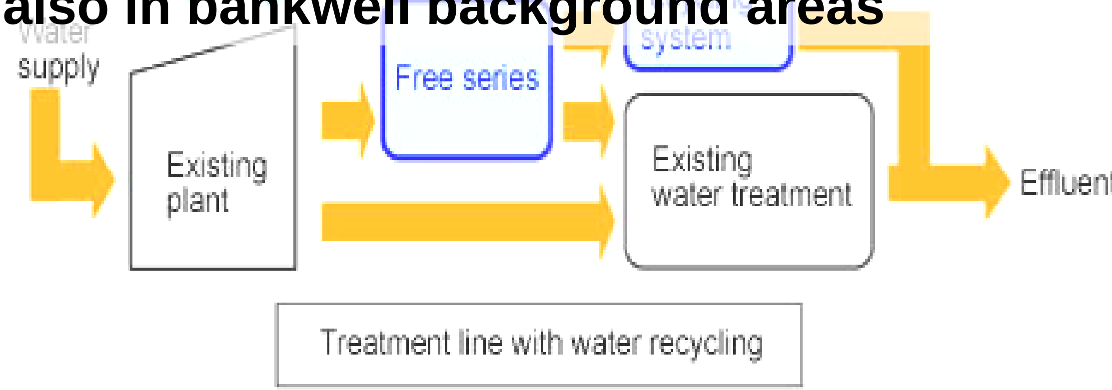
WATER SUPPLY AND WATER MANAGEMENT

Major climate change impacts on water supply



Adaptation strategies:

- **Water pricing, use-restrictions, basic changes in water-use behaviours of population and economy,**
- **More water storage, Rainwater-roof-water harvesting,**
- **Water saving and no-water technologies, full recycling, wastewater treatment to useable cleanliness;**
- **Groundwater recharge from flood flows, also in bankwell background areas**

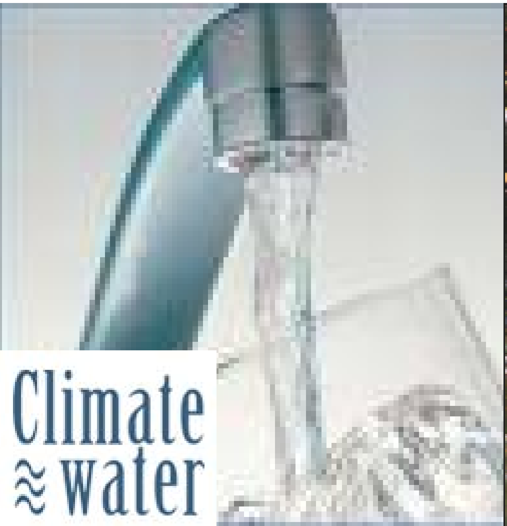


WATER SUPPLY AND WATER MANAGEMENT

Major climate change impacts on water supply

THE POLICIES CONCERNED

Drinking Water Directive (No /83/EC of 3 November 1998 on the quality of water intended for human consumption) and Directive 2006/118/EC of the European Parliament and of the council of 12 December 2006 on the protection of groundwater against pollution and deterioration' and other relevant regulations on other water uses and supplies

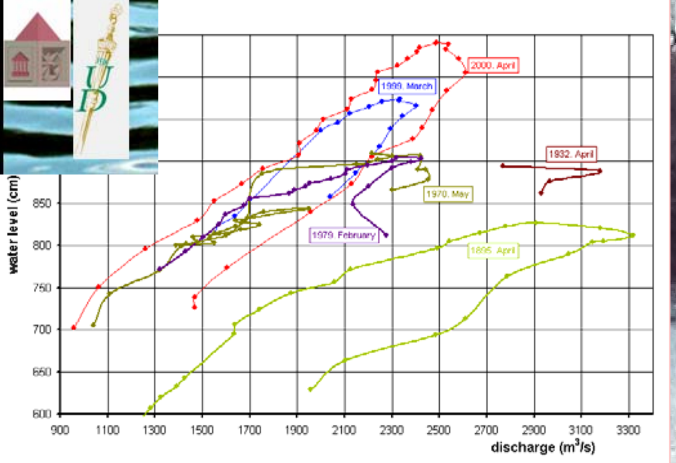


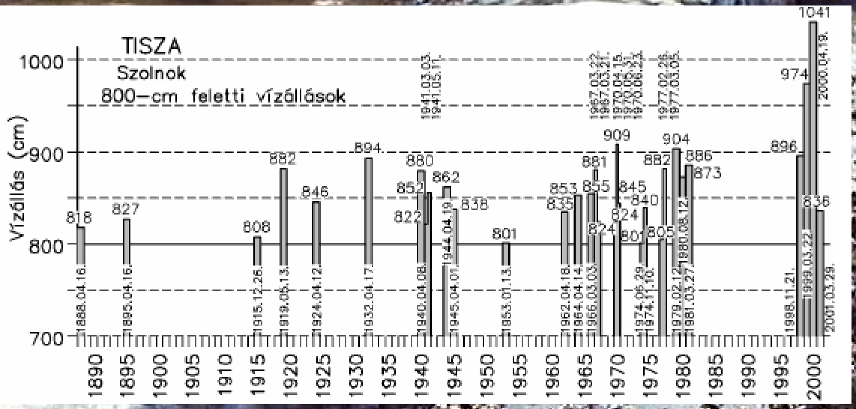
FLOODS

The drastic impact of climate changes on flooding is not a question anymore, especially not in Northern, Middle and Eastern Europe

- Flood risk in winter time will increase by 2020 in northern Europe
- The risk of flash floods will increase across all of Europe. (Historical trends in the Mediterranean don’t support this fully)
- Risk of snowmelt floods will shift from spring to winter
- The occurrence of the 100-year floods will be more frequent in most of northern, north-eastern, central and eastern Europe, while it will be less frequent in most of southern Europe
- The increasing volume of floods will make it more difficult for reservoirs to prevent floods
- Not only the magnitude but the frequency, timing, spatial extent and the temporal duration of the floods is also likely to change

And this is the actual and expectable result

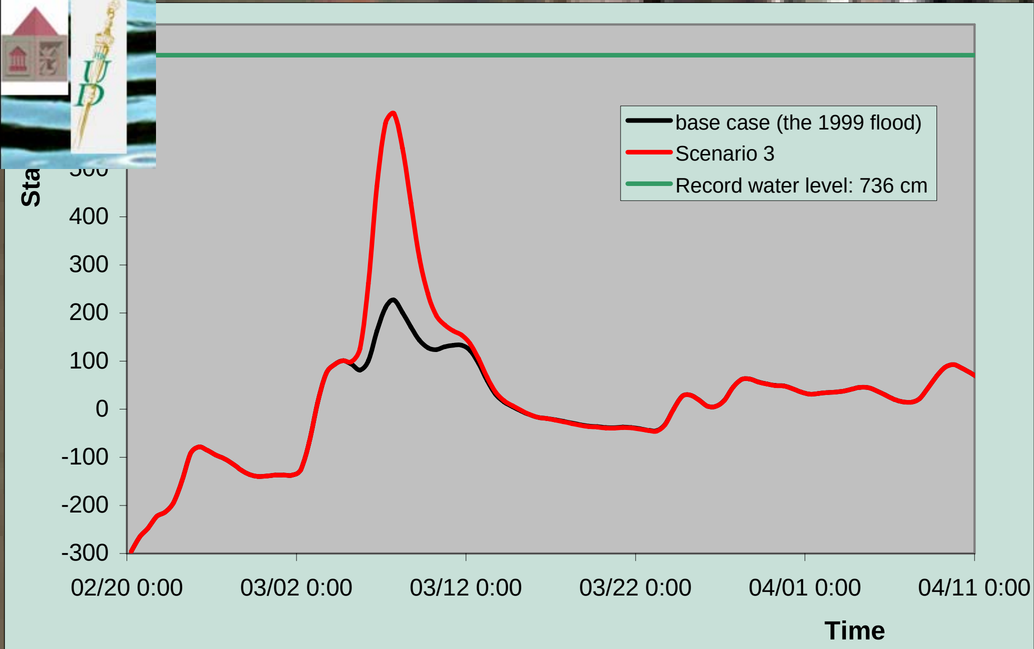


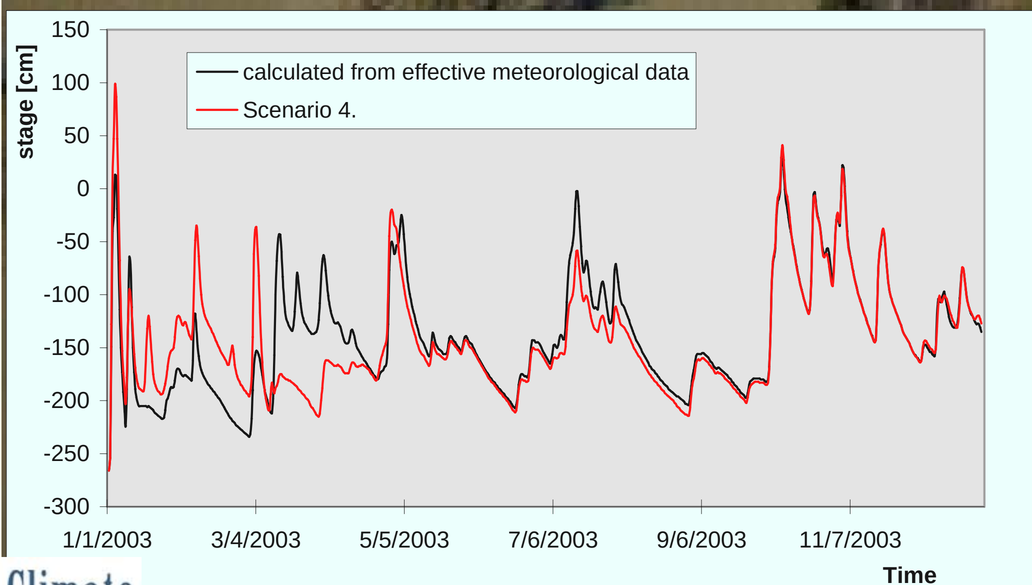


The Tarpa Levee Breach at RIver Tisza, 2006

Flood levels, frequencies and the steepness of flood waves are rising

Climate ≈ water





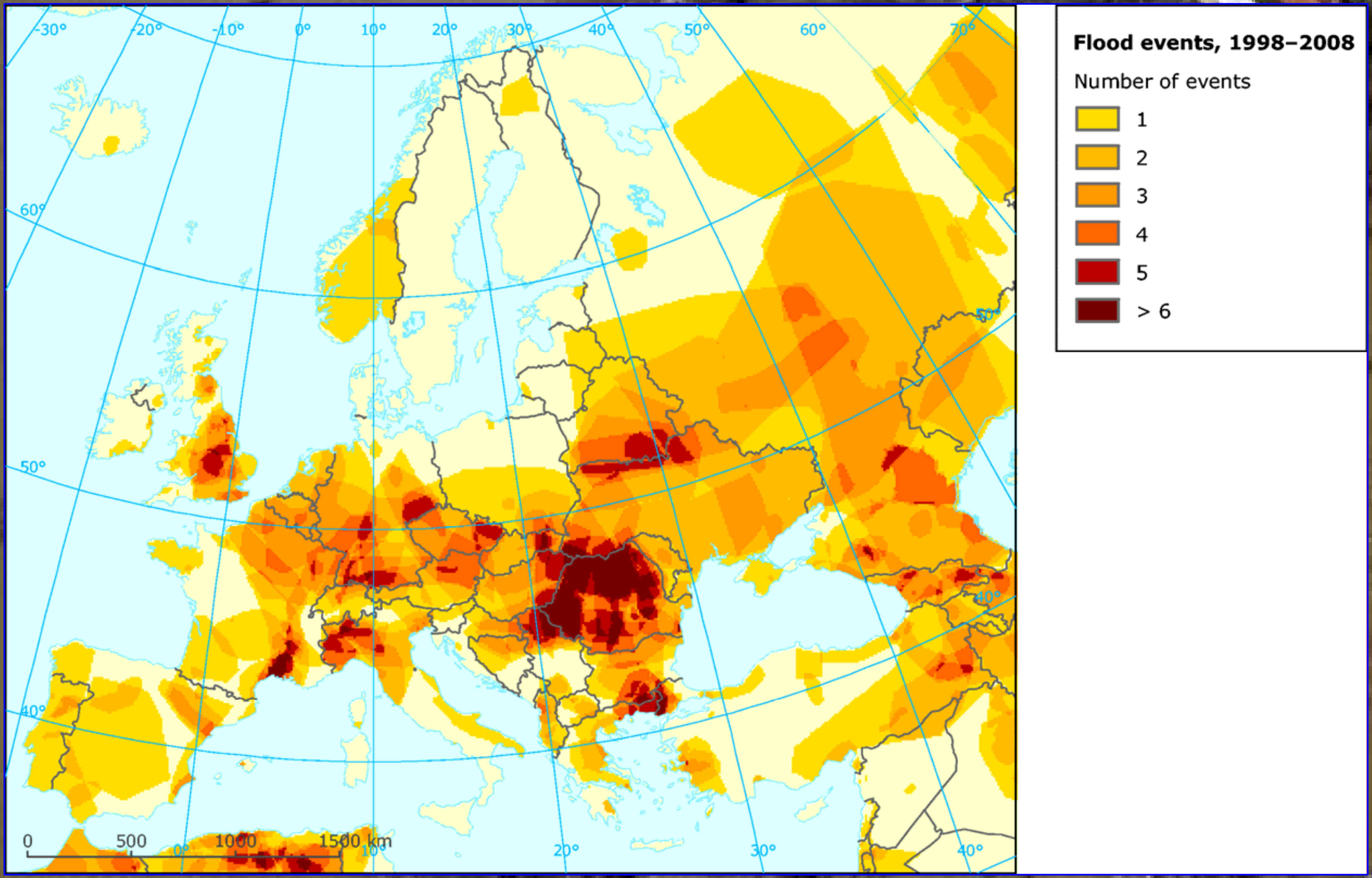
Model simulations of

Tisza River Project

showed that, higher floods are still to come, due to „natural” precipitation distribution events that have not yet happened but can happen in the futre and

Also for climate Change scenarios as shown on the left with increased peaks in the winter and also a bit growing floods in the summer

Flood events in last decade (between 1998 and 2008)



Prof. Béla Nováky on IPCC report

EXCESS WATER INUNDATION

special water-impact problem of large flatland regions of Europe (to our knowledge mostly to Hungary and the Netherlands)

• The reason of no or much reduced infiltration is either the too high groundwater (in the Netherlands) or the impermeable (partly also compacted by agricultural machinery) near-surface soil layer (the Hungarian Great Planes).

•The problem seems to be growing with the increased wintertime precipitation and the rather rapid and frequent snow melts (resulting from never so-far experienced events as the nearly 40 centigrade temperature rise within 24 h in Hungary in December 2009)

Climate ≈ water

COASTAL FLOODING

Sea-level rise can have a wide variety of impacts on Europe's coastal areas; causing flooding, land loss, the salinisation of groundwater and the destruction of built property and infrastructures

- **North Atlantic Oscillation (NAO) has a well defined effect on the sea surface dynamics and according to SRES scenario projections the recent positive phase of the NAO will continue in the next century**
- **Flooding from wind driven storms will continue to be more significant, continuing the trend of recent times**
- **In the SRES emission scenarios the extreme events of storm surges with high tides will become less frequent but more significant**
- **Wave heights will increase as well and these two effects together will cause increased erosion and flooding in the estuaries, deltas and embayments**
- **Global mean sea level rise is projected to be around 0.09 to 0.88 m by 2100, and in Europe the regional elevation may be as much as 50% bigger then this value. (There is an uncertainty of 0.1-0.2 m caused by the NAO in winter sea levels)**

http://www.research.plymouth.ac.uk/cerg/images/flooding.jpg

COASTAL FLOODING

Sea-level rise can have a wide variety of impacts on Europe's coastal areas; causing flooding, land loss, the salinisation of groundwater and the destruction of built property and infrastructures

- **Coastal flooding could affect as much as 1.6 million people more each year in the Mediterranean, northern and western Europe by 2080 according to SRESA1IF scenario**
- **Approximately 20% of the coastal wetlands could disappear by 2080 under the same scenario**
- **In Europe the Mediterranean and the Baltic regions are ones of the most affected areas to coastal flooding global-wise in terms of expected flood loss - for a 1m sea-level rise scenario it is expected that the number of average annual people flooded could increase 14 fold**
- **Due to model uncertainties, low resolution and lack of historical flood damage data the results of flood damage estimates for Europe should be treated with caution**

http://www.ace-ej.org/files/images/2009_0618_coastal_flooding2-450.jpg

GENERAL REMARKS ON FLOOD ISSUES

the uncertainties of the climate projections are still significant
the effect of the land use change could be as significant as the change in precipitation itself

- **The spatial resolution of GCM's should be improved in future to reduce the uncertainties**
- **The frequency and intensity of convective storms leading to extreme weather events cannot be forecasted accurately with current simulations**
- **The normalized flood losses of recent decades do not show a trend**
- **The sensitivity of change in water runoff to the change in temperature is significant therefore the accuracy of models should be increased as much as possible, especially, if adaptation strategy and planning would be based on model projections**
- **The uncertainties coming from downscaling GCM results can be significant**

FLOODS

the major „research need messages” towards WFD

Research into all novel means of the overall river basin wide management of all waters is needed from sites where water falls to building reservoirs where it is possible (with ecological, and transboundary law issues). This is actually calls for the revising of RBMP the major tool of the WFD.

A special ecohydrological version of this approach is to reclaim off-levee (e.g sites on the protected side of the levee) flood channels and wetlands and use them as kind of emergency flood storage system coupled with other water uses (fishery, traditional pastures for grazing animals, ecotourism. etc) – And there is a further long list of flood management options that would need research to see more clearly. Research into model development for forecasting is also a task.

Climate ≈ water

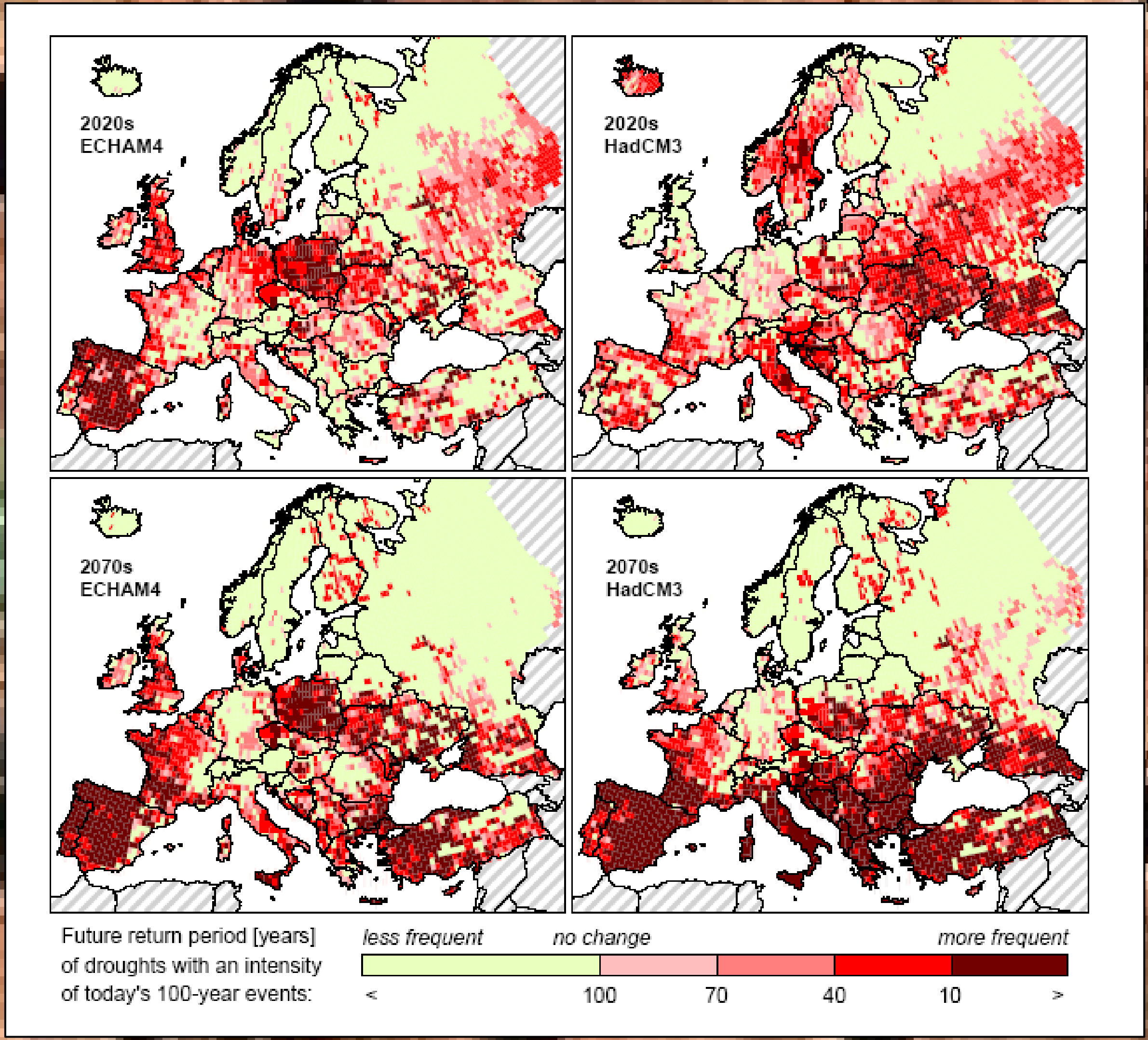
DROUGHT AND WATER SCARCITY

Has impacts on agriculture, food production, forestry, nature conservation, navigation etc, human life and nature in about half Europe

- **probably this will get the highest IMAU (Index for Magitude of Impact and Urgency of adaptation) score in this Project**

DROUGHT AND WATER SCARCITY

Change in recurrence of 100-year droughts



Source: Lehner 2005, IPCC, 2007

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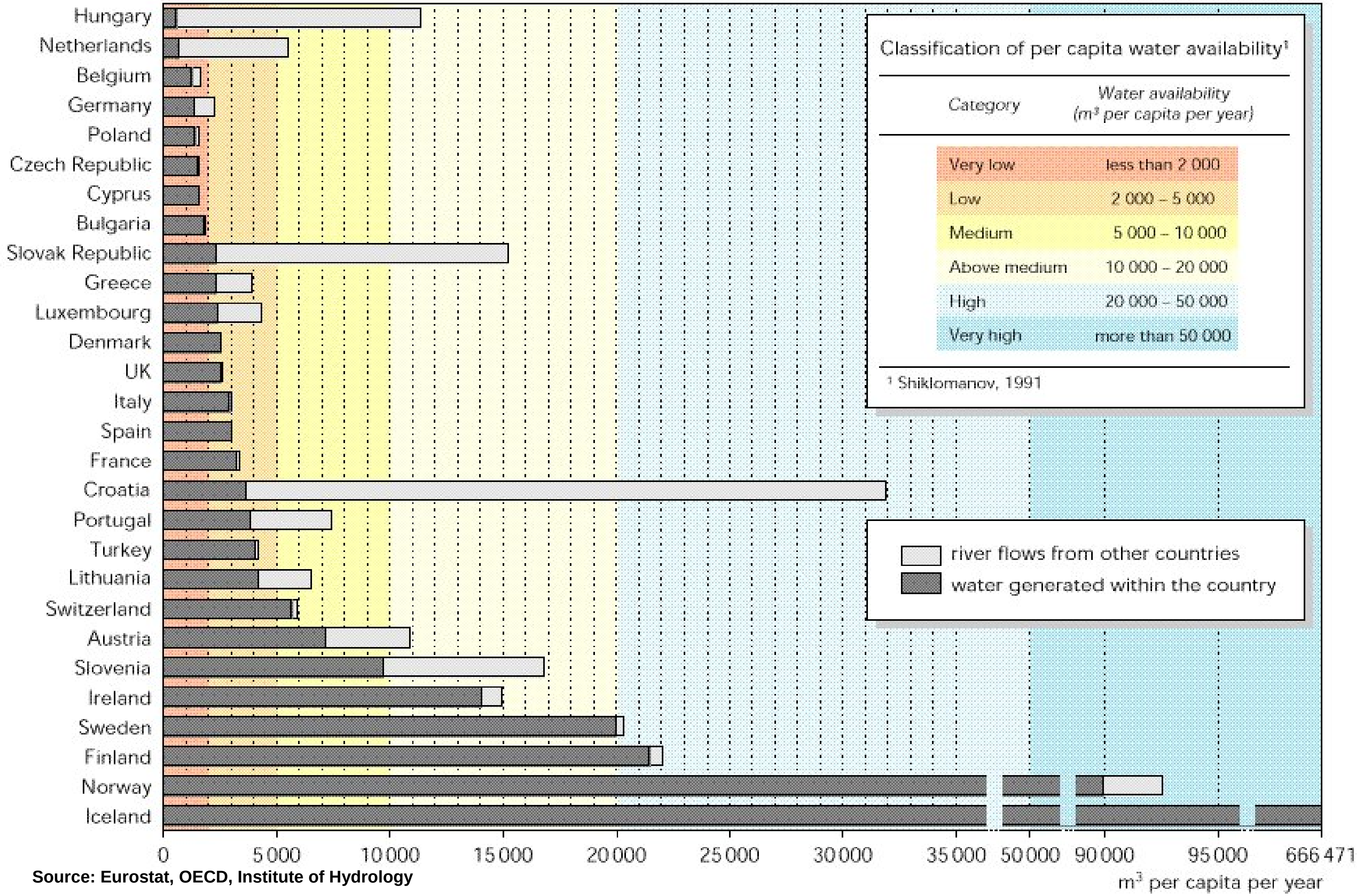
DROUGHT AND WATER SCARCITY

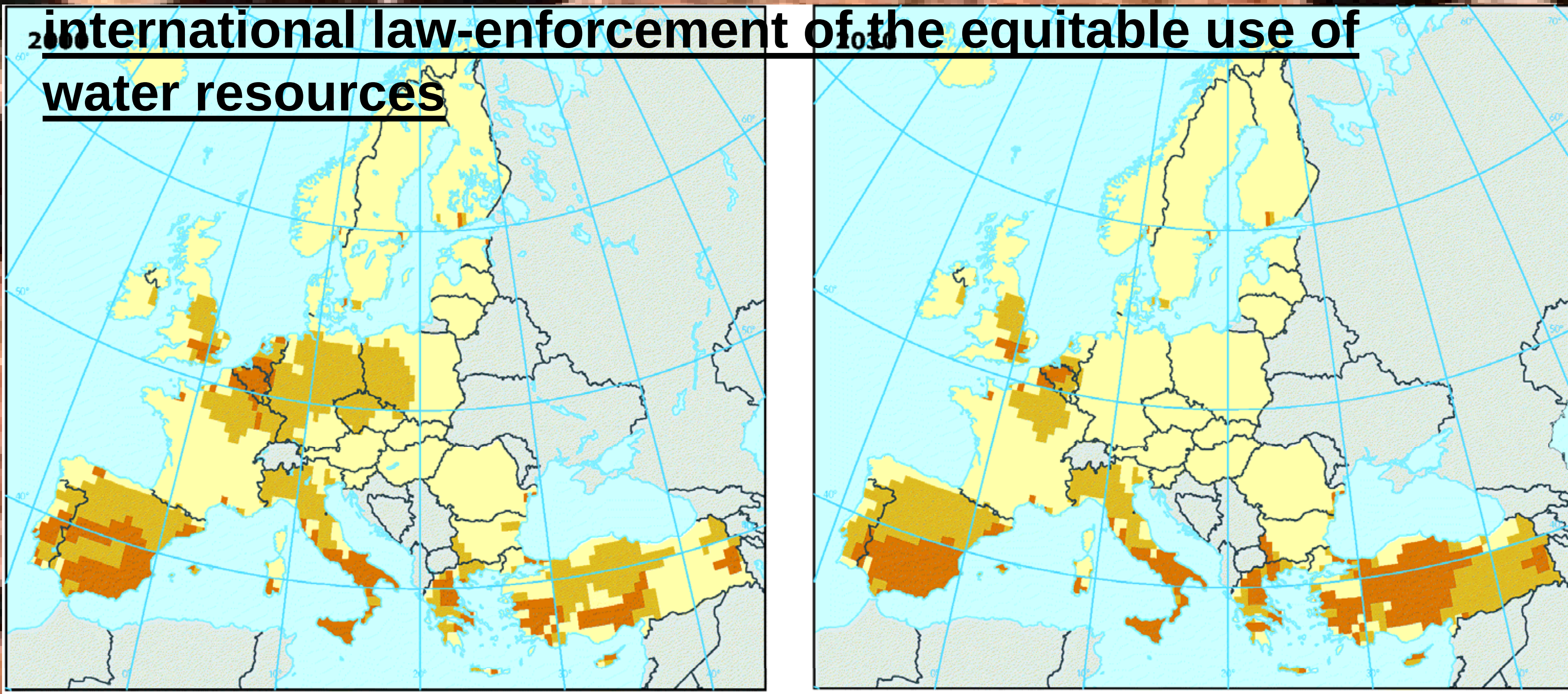


Source: Eurostat, OECD, Institute of Hydrology

A dramatic figure for Hungary and many other countries

DROUGHT AND WATER SCARCITY

Low water stress in Hungary and many other countries is due to transboundary flows (Danube and Tisza) and calls for the **international law-enforcement of the equitable use of water resources**



Water stress in European river basins in 2000 (left) and under the LREM-E scenario by 2030 (right)

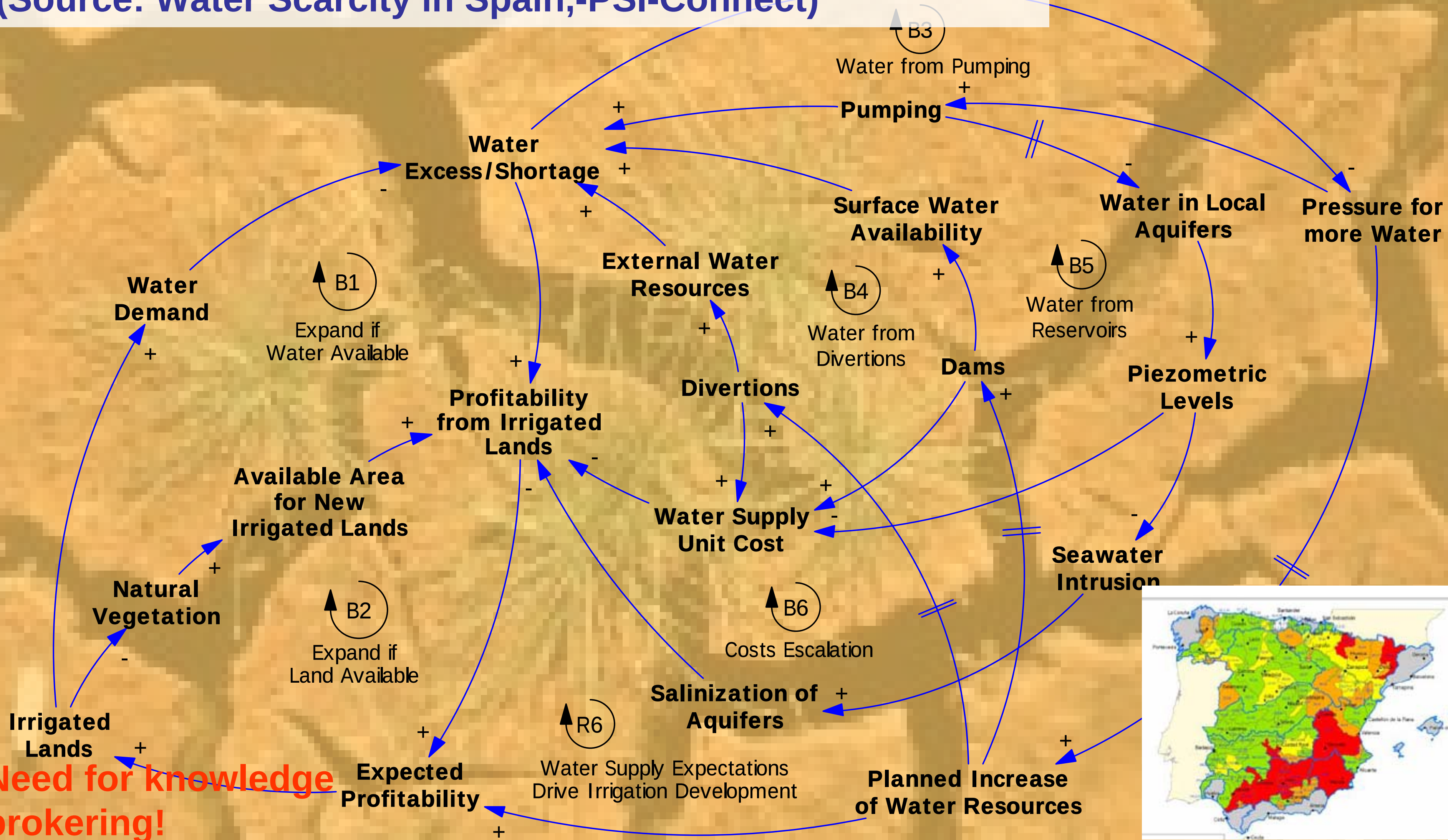
Water exploitation index (%):
- 0–20 (low water stress)
- 20–40 (medium water stress)
- > 40 (severe water stress)
- Outside data coverage

DROUGHT AND WATER SCARCITY

The complexity of drought impacts and strategies:

Unexpected effects of hydrotechnical investments

(Source: Water Scarcity in Spain,-PSI-Connect)



Need for knowledge brokering!

DROUGHT AND WATER SCARCITY
RESEARCH NEEDS

Research into multiple and sparing use of water resources and into the design of refined storage-distribution systems seems to be necessary.

Role of using more fertilisers as drought-adaptation techniques ??? must be also subjected to research and/or international debate.

Upon the hopefully recovering quality of our surface- and ground-waters (by 2015??! as of WFD!!) animal husbandry might reconsider the return to traditional grazing ,along with watering them and their grasses from natural surface and/or groundwater sources.

<u>Ecohydrological solutions</u> might be needed in conjunction with flood and excess water management
Research into drought tolerant crop species and appropriate cultivation/soil management techniques is needed.

Research into forest management techniques of the „pro Silva" type is needed along with that of into the shifting of forest-steppe ecotones.

DROUGHT AND WATER SCARCITY

Upon the results of research the relevant chapters of the corresponding policies (WFD, CAP and COM 414 etc.) should be reviewed, with special regard to supporting and financing multiobjective adaptation strategies.

WATER QUALITY AND WATER POLLUTION

affected by temperature rise and decreasing low flow, intensified precipitation and extreme „flashy" runoff, change in landuses and agricultural practice

- Temperature rise in the summer will affect the r**ates of all chemical and ecological processes**, resulting in multiple adverse effects;
- One of the major chemic/ecological impacts will be the **decreasing oxygen content** (resulting from high temperatures, lower flow velocities and higher organic and inorganic loads);
- Decreasing flows (in summer time even in rivers of Europe where total annual runoff will increase according to the projections) will represent **lower dilution and thus higher concentrations** of polluting components;
- **Higher nutrient loads** (due to more intensive precipitations and extreme "flashy" runoff hydrographs, and also to longer growing seasons and the changed agricultural activities and agro-chemical applications) result in **accelerated eutrophication**, which also worsens the oxygen conditions;
- Changing climate also may alter chemical processes in the soil, including chemical weathering, thus will change WQ of waters. Change of hardness.

WATER QUALITY AND WATER POLLUTION

- **Extreme weather events mobilize all contaminants** (via runoff from urban and partly surfaces) and these may cause serious deterioration in terms of priority pollutants (e.g. heavy metals) and also pathogens, which may result in **serious health risk** (bathing in natural water bodies)

- Extreme precipitation-runoff events are likely to put sewerage networks under additional pressure, with specially increased risk to **both sewage and drinking water treatment**

- Intensified precipitation-runoff events, including very rapid snowmelts, **will shift the total load of many (if not most) of the polluting substances towards diffuse or non-point sources**, thus changing the need for altered RBM strategies (still focus mostly on point source treatment)

- Altered precipitation and runoff conditions may result in **extra pollution loads to groundwater resources** (especially to the near-surface phreatic ones), resulting in the deterioration of groundwater quality

- In coastal regions under drought conditions **saltwater intrusions** into freshwater bodies or coastal aquifers might cause serious water quality deterioration and risk to water supply.

WATER QUALITY AND WATER POLLUTION
ADAPTATION STRATEGIES

- **Control of point and nonpoint sources pollution, treatment of wastewaters are the essential strategies.**
- **Drainage basin scale water quantity (runoff control, saving of rainwater where it falls) and water quality (land use management) that is IWRM or RBMP in the integrated quantitative, qualitative and ecological sense will provide the overall solution.**
- **Measures to reduce flood risk could result in improved urban water quality thanks to sustainable urban drainage systems.**

WATER QUALITY AND WATER POLLUTION
RESEARCH NEEDS

- research into the impact of climate change on the outcome of the changes of washoff pollution (e.g. diffuse) loads should be initiated as soon as possible (supported by ample field experiments), to clear the issue of “reduced diffuse loads”
- in drier climates against another hypothesis that longer pollutant accumulation periods associated with heavier than usual rainfall will result in increased diffuse event-based loads also in drier climate (with stronger impact on the aquatic environment even if the annual total load will be smaller)
- research into nutrient loads and eutrophication must be intensified
- research into „ecohydrology” is needed (in the multidisciplinary sense)

WATER QUALITY AND WATER POLLUTION

POLICY IMPLICATION INDENTIFIED

The River Basin Management Planning methodology (RBMP of WFD) should probably be restructured with due concern to Integrated Water Resources Management (IWRM),

in the sense that <u>water quality, quantity and ecological management concepts be integrated</u>

at the level of assuring complete control of all point and diffuse sources of pollution, all land use practices and all hydrological runoff control measures in such a way that a decision support planning tool (modelling??) helps this planning.

There is a need for changing WFD policy towards non-point sources and their control techniques (still in baby shoes in terms of knowledge on their efficiency!!).

Climate ≈ water

NATURE,
TERRESTRIAL ECOTONE, AQUATIC ECOSESTEMS

Water-related impacts

- Both too much and too little water and the deteriorating water quality have serious impacts on ecosystems
- Warming results in eutropication and DO deterioration, vanishing of cold water species, spread of alien species, etc.
- Decrease of ice cover might have positive impact in some regions.
- Increase of invertebrate predators in drought conditions
- Parasite mobility and reproduction rates increase with temperature
- Sea level rise will result in inundation and displacement of coastal wetlands and lowlands
- Loss of mangroves, salt marshes and/or intertidal habitat by 2080
- etc

Climate ≈ water

NATURE,
TERRESTRIAL ECOTONE, AQUATIC ECOSESTEMS

Water-related impacts
SOLUTION: ECOHYDROLOGY

The essence of ecohydrology is:

- **to save aquatic ecosystems by indentifying sources of degradation problems (sedimentation, excess nutrient loads, other pollutants, too little or too much flow)**
- **and find hydrological and pollution control solution (also by modelling),**
- **while enhanced ecosystems will provide means of controlling flows and water quality.**

Research needs can also be summarized as those into ecohydrology (strategies of ecology, hydrology, hydraulic construction and pollution control of point and nonpoint sources)

Climate ≈ water

NATURE, TERRESTRIAL ECOTONE, AQUATIC ECOSESTEMS

Water-related impacts
POLICY GAP

Several directives are involved in climate change and ecosystem-adaptation issues

The WFD;-where reconsideration of RBMP is needed with much more concern on joint planning of quality-quantity-ecology of water resources and all the human activities having an impact. Much more reliance on quantification of cause-and effect relationships –eq.- integrated catchment modelling– will be needed;

Similar critical review of the directives relating to nature conservation, EWI; drought management and the CAP and the „Green Paper” are due in order to ensure the proper approach to adapting human activities to provide the best possible adaptation to the impacts on ecosystems

Climate ≈ water

Summary, conclusions

- For many water-related climate change impacts one of the adaptation strategies is an all-basin wide management of flows, quality components and the state of the ecoosystems (natural and man made-managed)
- These strategies together are called the Ecohydrological management
- These actions should be planned and the River Basin Managment Planning is (must be) the suitable frame, in the form of an appropriate planning (modelling) tool
- This tool is missing (!!!) and therefore the urgent task is to develop and apply

ECOHYDROLOGICAL RBMP MODELLING TOOLS

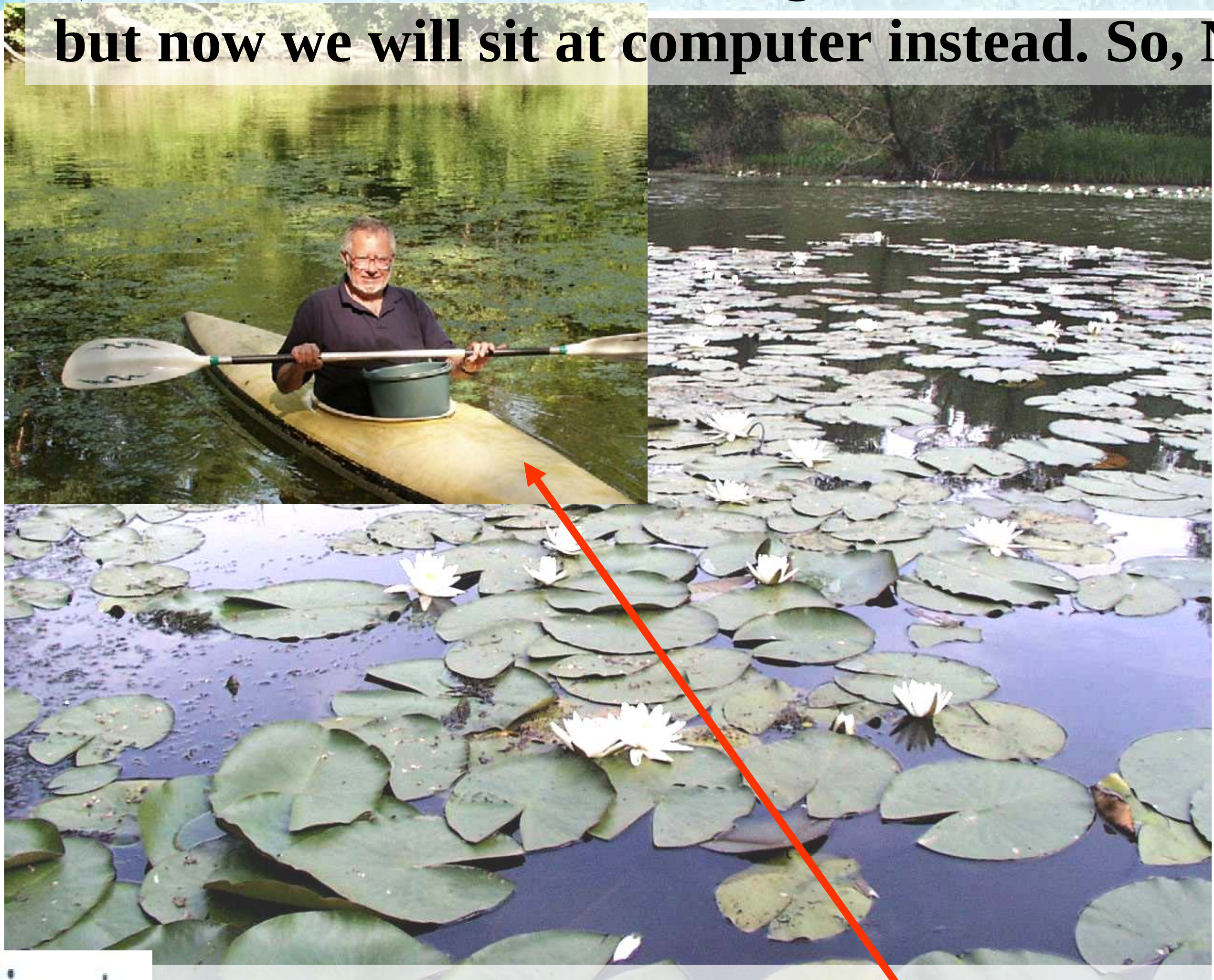
Climate water

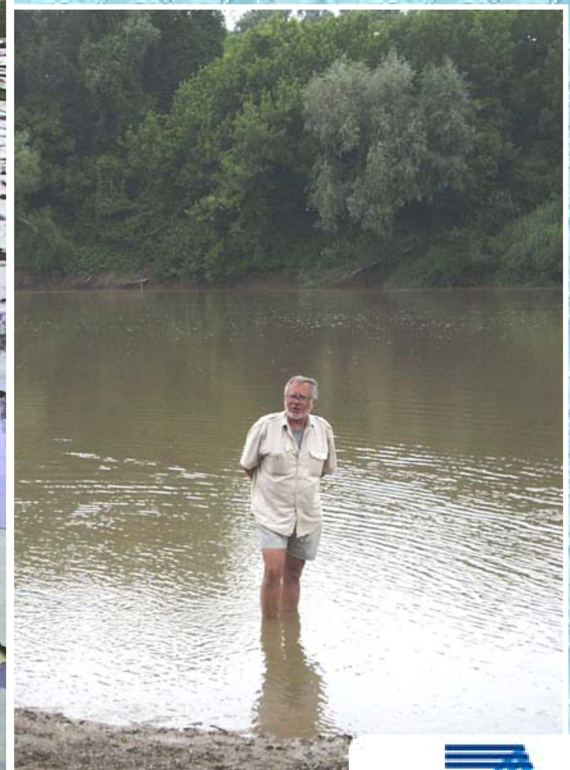
WFD LILLE 2010 WATER FRAMEWORK DIRECTIVE

VITUKI BUDAPEST

Thank you for your kind attention

(This is what I would call a good environmental research, but now we will sit at computer instead. So, NEXT TIME)





The environmentally friendly sampling vessel