

# Adaptation to climate change in the River Basin Management Plan for the Danube River Basin

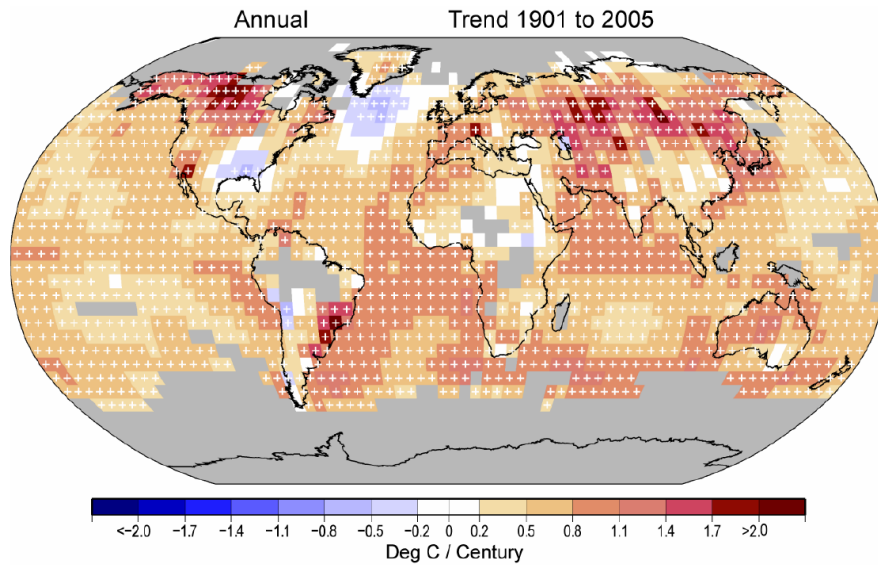
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Director  
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ECRAN Multi-beneficiary Workshop, Istanbul, 11-13 April 2016

## Climate Change a global issue

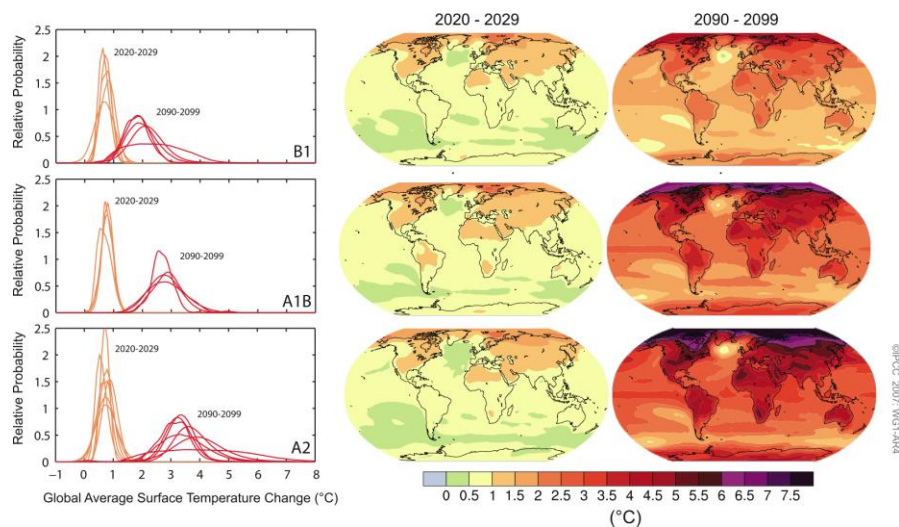
- Global surface temperatures have risen by about 0.6°C since 1900
- It is likely that this warming is larger than for any century since 200AD, and that the 1990s were the warmest decade in the last millennium.
- The warming differs in different parts of the world, but over the last 25 years, almost everywhere has warmed, and very few places have cooled.
- Other changes have occurred, e.g.:
  - Sea level has risen by about 20 cm,
  - Ocean heat content has increased,
  - Almost all mountain glaciers have retreated
- Coincident with this global warming, levels of CO<sub>2</sub> (and other 'greenhouse' gases) have dramatically increased, to levels higher than those experienced for maybe millions of years.
- Next: are temperatures and atmospheric composition linked?

## Observed surface temperature trend



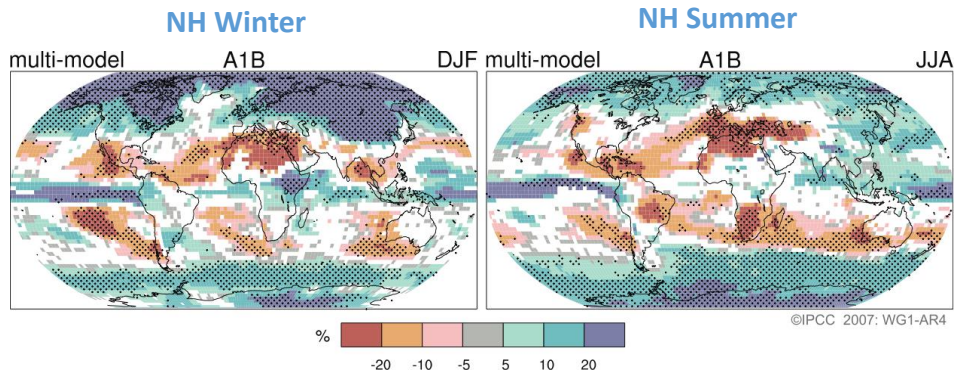
Trends significant at the 5% level indicated with a '+'. Grey: insufficient data

*Projected surface temperature changes for the early and late 21st century relative to the period 1980–1999*



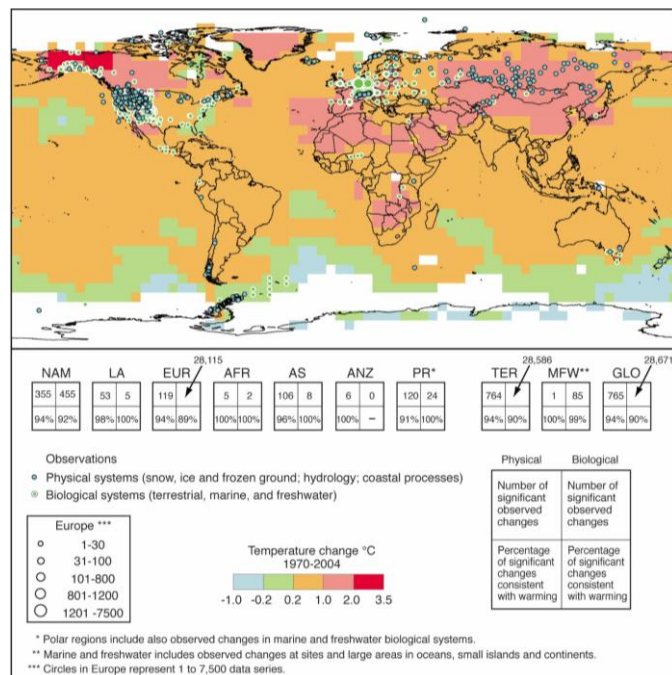
**Continents Warm 50% more than oceans**

*Projected percent changes in precipitation  
for the period 2090–2099  
(relative to 1980–1999)*



**Warmer climate → More Water Vapor in the atmosphere  
but an expanded belt of subtropical aridity**

Changes in the  
physical and  
biological  
systems and  
surface  
temperature  
1970-2004



(IPCC WG2, 2007)

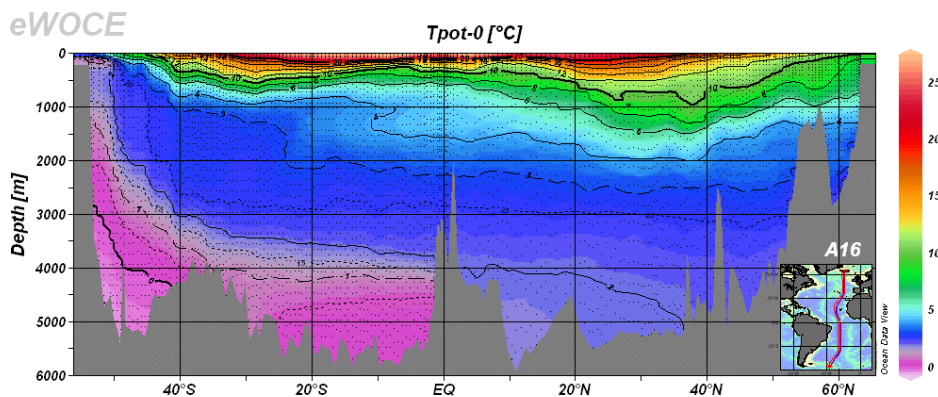
## Other evidence of Climate Change

- Glacier retreat

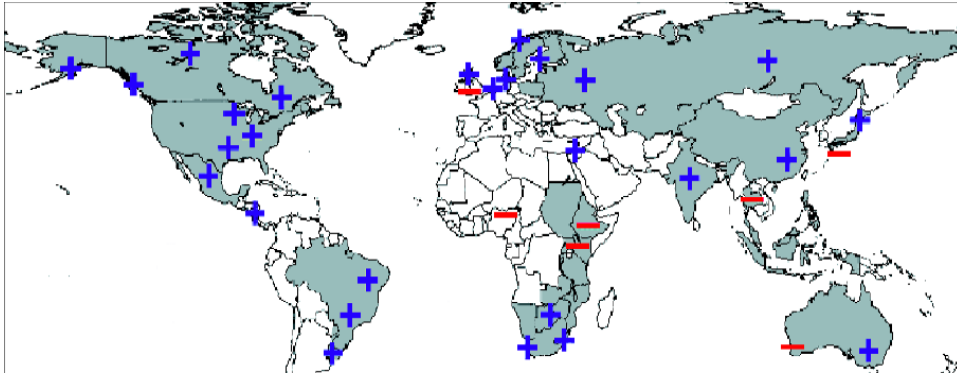


## Other evidence of Climate Change

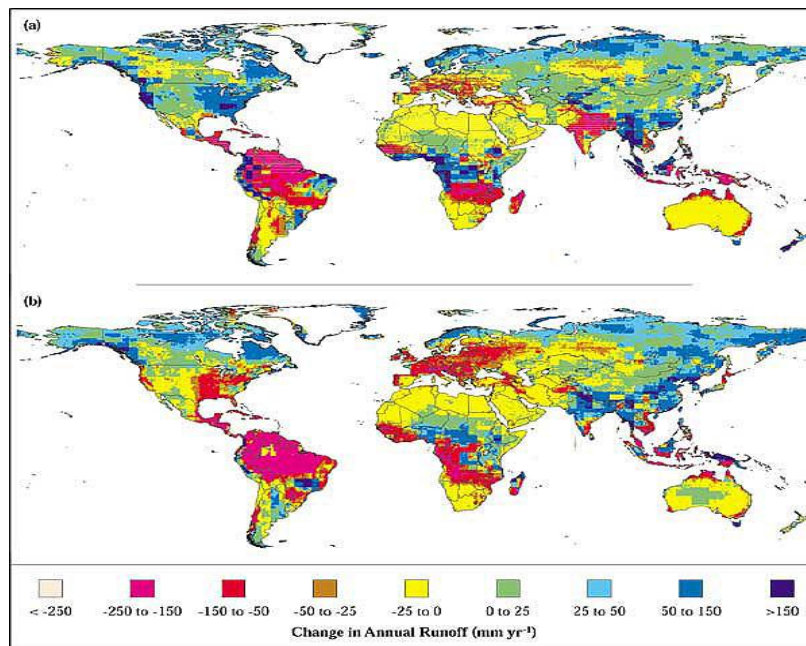
- Ocean heat content has increased
- Temperatures in the Atlantic:



*Proportion of extreme precipitation events  
increasing in most areas*



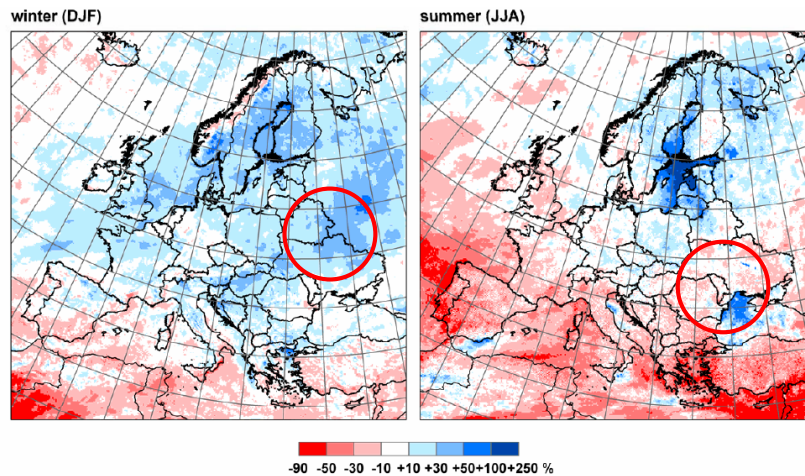
The frequency of heavy precipitation events has increased over most land areas - consistent with warming and increases of atmospheric water vapor while more intense and longer droughts have been observed since the 1970s, particularly in the tropics and subtropics.





# Impacts of climate change

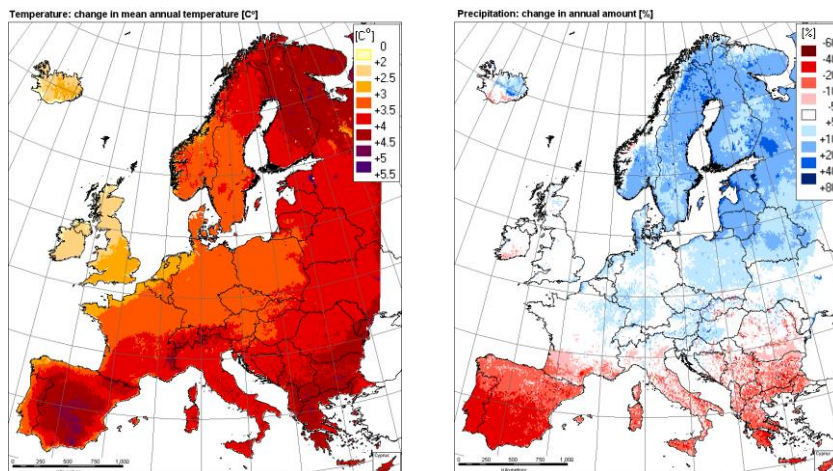
## Change in seasonal maximum 5-day precipitation



source: Danish Meteorological Institute; worst case scenario IPCC A2;  
maps show difference between control run (1960 – 1990) and scenario run (2070 – 2100) after M. Grasserbauer; EC 2006

# Impacts of climate change

## IPCC SRES scenario A2- temperature; rainfall



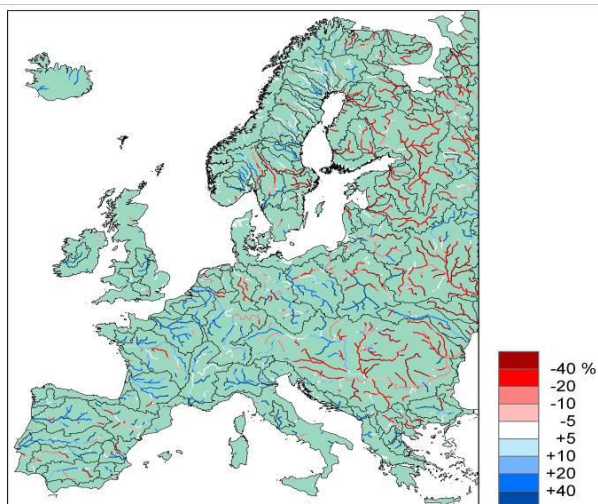
impacts are estimated for 2071-2100 relative to 1961-1990

# Change in $Q_{100}$ river discharge

DMI-HIRHAM A2 scenario (12km) with 5km LISFLOOD

Increased flooding:  
almost everywhere

Decreased extreme floods:  
Southern Sweden, Finland,  
Russia, Lower Danube  
(decreased snowmelt?)



Phenomenon <sup>a</sup> and direction of trend	Likelihood of future trends based on projections for 21 <sup>st</sup> century using SRES scenarios	Examples of major projected impacts by sector			
		Agriculture, forestry and ecosystems {WGII 4.4, 5.4}	Water resources {WGII 3.4}	Human health {WGII 8.2, 8.4}	Industry, settlement and society {WGII 7.4}
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	Virtually certain <sup>b</sup>	Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks	Effects on water resources relying on snowmelt; effects on some water supplies	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism
Warm spells/heat waves. Frequency increased over most land areas	Very likely	Reduced yields in warmer regions due to heat stress; increased danger of wildfire	Increased water demand; water quality problems, e.g. algal blooms	Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially isolated	Reduction in quality of life for people in warm areas without appropriate housing; impacts on the elderly, very young and poor
Heavy precipitation events. Frequency increases over most areas	Very likely	Damage to crops; soil erosion, inability to cultivate land due to waterlogging of soils	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries and infectious, respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property
Area affected by drought increases	Likely	Land degradation; lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases	Water shortage for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	Likely	Damage to crops; windthrow (uprooting) of trees; damage to coral reefs	Power outages causing disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases; post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers; potential for population migrations, loss of property
Increased incidence of extreme high sea level (excludes tsunamis) <sup>c</sup>	Likely <sup>d</sup>	Salinisation of irrigation water, estuaries and freshwater systems	Decreased freshwater availability due to saltwater intrusion	Increased risk of deaths and injuries by drowning in floods; migration-related health effects	Costs of coastal protection versus costs of land-use relocation; potential for movement of populations and infrastructure; also see

## Climate Change & RBM Plans

### Approach on the EU Scale

- **EC Green Paper** “Adapting to Climate Change in Europe – Options for EU Action” (June 2007)
  - acknowledged that the EU Water Framework Directive provides a consistent framework for integrated water resource management but does not directly address climate change
  - recognised the need to incorporate consideration of climate change issues in the first RBM planning cycle by 2009
- **EC White Paper** proposes guidance to be developed to make RBM Plan ‘climate proof’ in 2015 and to ensure climate changes to be taken into account related to the EU Floods Directive

## Climate Change

- **...is of declared importance in the DRB**
- Humans and environment are expected to be affected in many ways
- The water management sector must deal with climate change issues inter alia to
  - estimate climate change impacts on the aquatic environment and respective consequences
  - find appropriate *climate proof* solutions
- Actions regarding climate change adaptation are already taking place
- Different scenarios currently exist (following slides)



## Danube River Basin District: Overview

MAP 1



## Climate Change & the Danube River Basin

- Workshop ***Adaptation of Water Management to Effects of Climate Change in the Danube River Basin***
  - Jointly organised by AT Ministry of Environment and Water Management, AT Ministry for European and International Affairs and the ICPDR
  - 3 December 2007
- Helped to achieve a common understanding on the issue and an agreed approach that is also part of the DRBM Plan

## Climate changes and ICPDR

- The questions for us as an International River Basin Commission:
- **What will be the consequences of climate changes in the Danube hydrology?**
- **What will the possible climate changes mean for:**
  - a) **Pollution control**
  - b) **Flood protection**
  - c) **Water availability**
- **How can we develop a Program of Measures that are climate proof?**

## Agreed approach for Climate Change at DRB level

### Climate change

- is an issue of Danube basin wide significance
- will be addressed by a stepwise approach
- will be addressed respecting all SWMIs for the DRB
- will address the issues of flood protection, low water discharges, drought and land use

## Agreed approach for Climate Change at DRB level

- Climate change signals for the DRB are sufficient to act beyond existing scientific uncertainties
- Follow the ongoing DRB related scientific projects and their outcomes
- Existing DRB scientific activities are the basis for the further development of measures (see Annex 19 for a selected list of projects on climate change relevant for the DRB)
- Future infrastructure project have to be '*climate proof*'
  - Holistic and coherent in their approach (linking all relevant sectors)
  - Flexible management tools and no regret measures

## Climate Change & the DRBM Plan

- 4 Significant Water Management Issues identified:
  - Organic pollution
  - Nutrient pollution
  - Hazardous substances pollution
  - Hydromorphological alterations



Direct and indirect impacts on the aquatic ecosystem, water status, water quantity, and different water sectors/uses can be expected due to  
**Climate Change**

## Climate Change Effects & Water Sectors

- **Example water sector - Hydropower:**
- Decrease of runoff because of climate change?
  - = reduction factor for hydropower generation
- Increase of extreme drought periods
  - Critical situation for run of river HPP production
  - Importance of the storage capacity will rise (multipurpose use)
  - Restrictions for the operation of thermal power plants because of a lack of cooling water or the water temperature is too high
  - High electricity demand because of air conditioning



**How to adapt in order to prevent interest conflicts in water management and to achieve environmental objectives?**

## Climate Change Effects & Water Sectors

- Effects on water sectors **can be** effects on water environment
- **Example water sector - Navigation:**
- Navigation channel depth needs to be ensured
- Increased drought events due to climate changes are expected:
  - Effects on river hydrology – decrease of water levels
  - Decrease of navigation channel depth
- Possible conflict of interest:
  - Navigation needs to be ensured
  - Environmental objectives need to be ensured as well
- Further dredging of river bed to ensure channel depth – feasible to ensure environmental objectives?
- Adaptation of ships to river as option

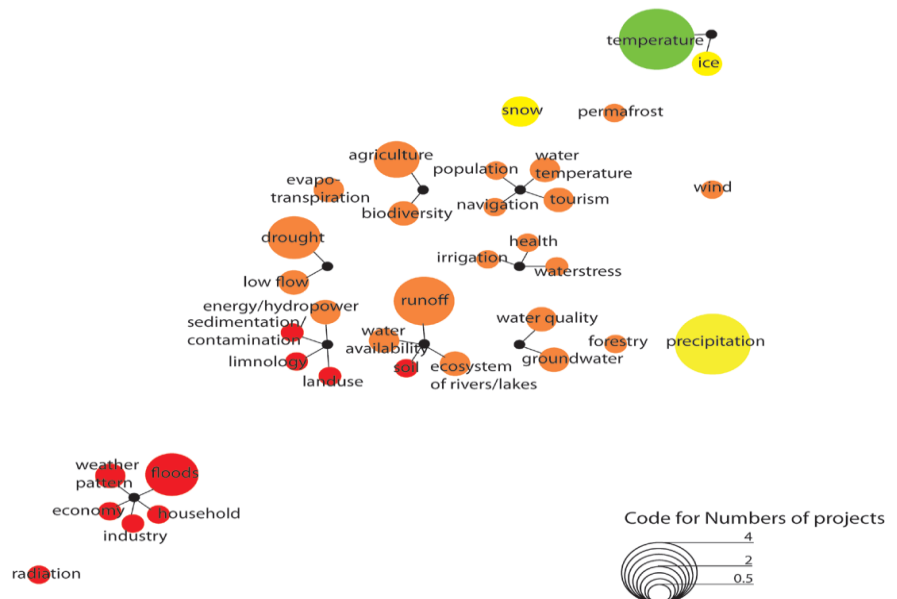


**How to adapt?**

# ICPDR Strategy on Adaptation to Climate Change

- Presentation of the Framework conditions
  - Relevant water-related EU Directives and Policies
  - National and international adaptation activities
  - ICPDR approach towards strategy development
- Introduction of the knowledge base
  - Climate change scenarios for the Danube river basin
  - Water-related impacts of climate change
  - Vulnerability
  - Overview of possible adaptation measures
- Presentation of the guiding principles, integration and next steps

Certainty for  
the impacts in  
the Danube  
River Basin due  
to the  
projected  
climate change

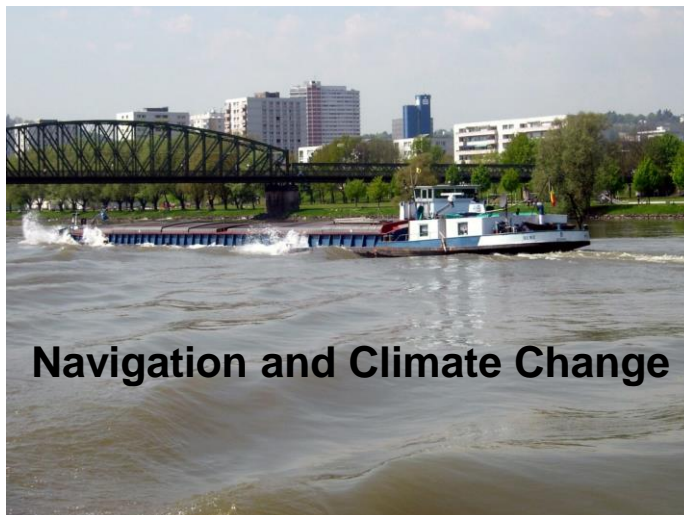




# Climate Change Effects

- **Eventual direct/indirect effects due to DRB climate changes**
- Increased flood events (i.e. 2005, 2006)
  - Raising the need for innovative flood protection including the creation of new flood retention areas besides traditional flood measures
- Increased drought events
  - Atomic Power Station had to be shut down because of lacking cooling water
- Assumption that the spreading of invasive species is increasing

## Conference on Adaptation of Water Management to Effects of Climate Change in the DRB



**Navigation and Climate Change**

## Hydropower in Europe and climate change

### Hydropower in Europe and Climate Change Consequences and Challenges

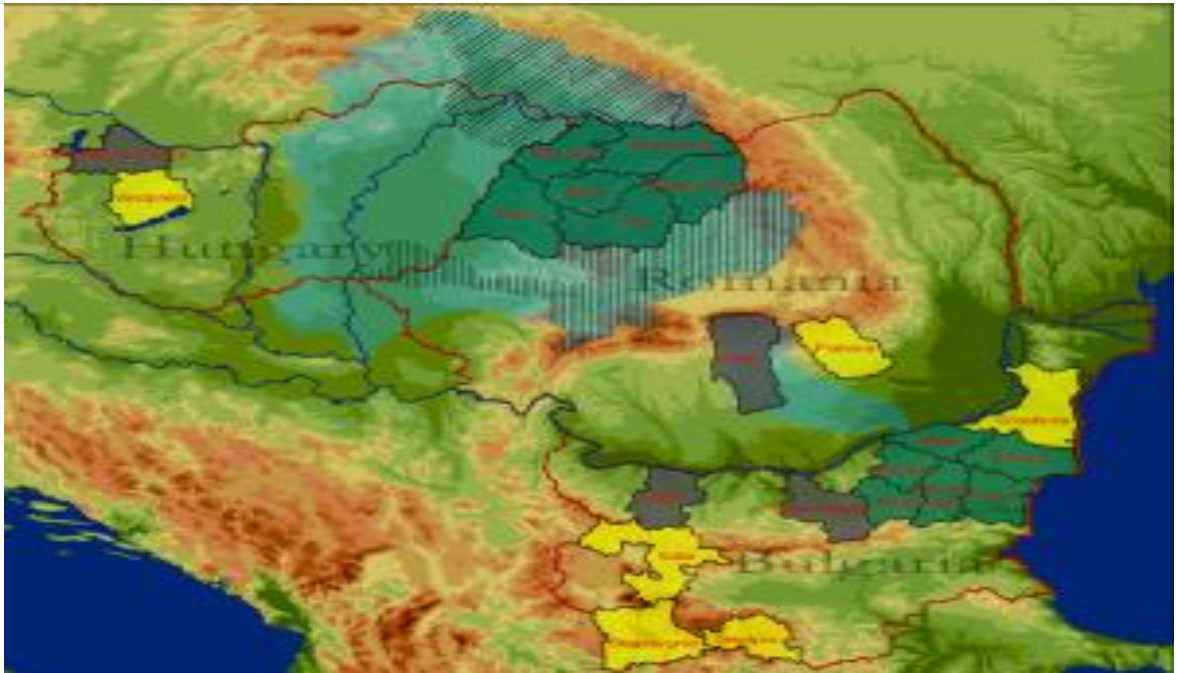
*O. Pirker / VGB Power Tech*



Climate change at  
Central & Eastern Europe:  
the CLAVIER project



- 1st September, 2006 – 30th August, 2009
- Bulgaria, Hungary, Romania
- [www.clavier-eu.org](http://www.clavier-eu.org)



## CLAVIER: Main objectives

- Investigation of ongoing and future climate changes and their associated uncertainties in CEEC.
- Analyses of possible impact of climate changes in CEEC on weather, air pollution, human health, natural ecosystems, forestry, agriculture, infrastructure and water resources.
- Evaluation of the economic impacts of climate changes in CEEC economies (agriculture, tourism, energy supply and public sector)

## Climate Change & the DRBM Plan

### **•What is planned to be done in the frame of the first DRBM Plan cycle by 2015?**

- Perform first investigations on eventual climate change impacts on water status
  - Identification of direct and indirect impacts
- Develop a respective road map regarding climate change adaptation
  - Ensure that the Joint Programme of Measures is *climate-proof*
- Involvement of relevant stakeholders into discussions (i.e. navigation, hydropower, etc.)
- Active use knowledge achieved in various ongoing research project (i.e. Clavier)

## Climate Change & the DRBM Plan

### **•Issues related to be tackled within following RBM cycles beyond 2015**

- Ensure that monitoring systems used in the DRB have the full ability to detect climate change impacts on *ecological and chemical water status*
- Investigation of the effects of climate changes on ecoregions, typologies and reference sites as well as proposals for solutions
- Improvement of models – climate and hydrological aspects at the DRB level
- Improvement of scenarios for the DRB
- Investigations of effects of climate change on the various sectors (i.e. navigation, hydropower) active in the DRB and the evaluation of indirect increases in impacts on water status

## Conditions for success

- Willingness to cooperate
- Political commitment at the national level
- Good coordination
- Good scientific support
- Common agreed targets
- River basin approach

## Common targets

- Joint Action Programme for Danube Basin
- Action Programme on Sustainable Flood Protection in the Danube River Basin
- Danube River Basin Management Plan



## Questions

- Which will be the extent of the climate change phenomena ?
- How rapid will be the changes?
- How to change the people behaviour on the short term ?
- How to change the economic development patterns ?
- How to avoid water conflicts ?

## Dilemmas

- Economic instruments versus command and control legislation
- Structural versus non-structural measures
- Governmental decision versus public participation
- Dams and dykes versus wetlands restoration
- Economic and social development versus environmental protection



Thank you very much for your attention !