Hungarian Academy of Sciences, Roosevelt Tér 9

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# Futures of European Waters

## Insight of ClimateWater project activity : adaptation of navigation and hydropower to climate change

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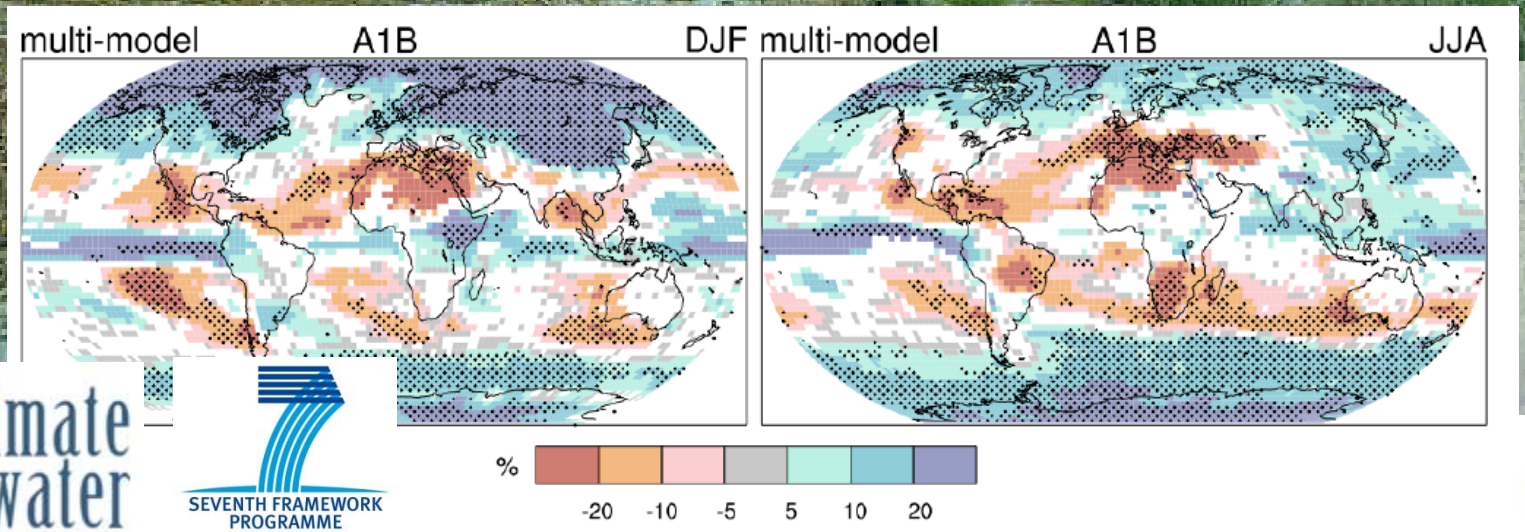
# WATER INDUSTRIES, NAVIGATION, ENERGY

## Major climate change impacts

- Modifications of water regime expected : increase of annual precipitations in the North, decrease in the South
- Increase of extreme hydrological events expected (floods, droughts, heat)
- Decrease in water availability during summer season
- Sea level rise
- Many industries can and should adapt by saving water in their processes
- Navigation and hydropower may face difficulties, adaptation is needed
- Adaptation is needed to manage conflicts in multi-use of water resource




Predicted evolution of precipitations in 2090-2099 v/s situation in 1980-1999

IPCC 2007

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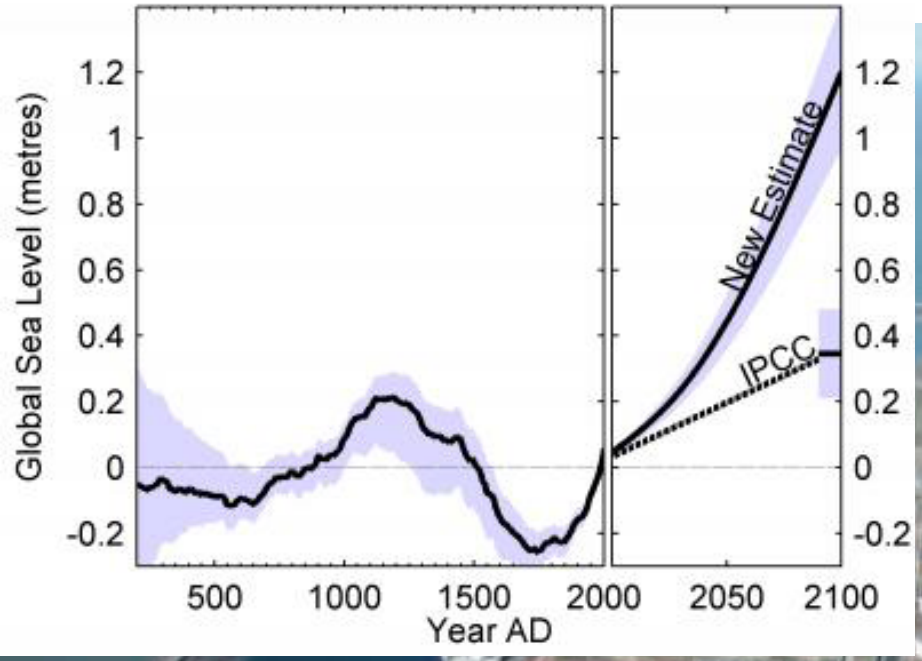
# NAVIGATION

## Major climate change impacts on marine navigation




### Sea level rise impact

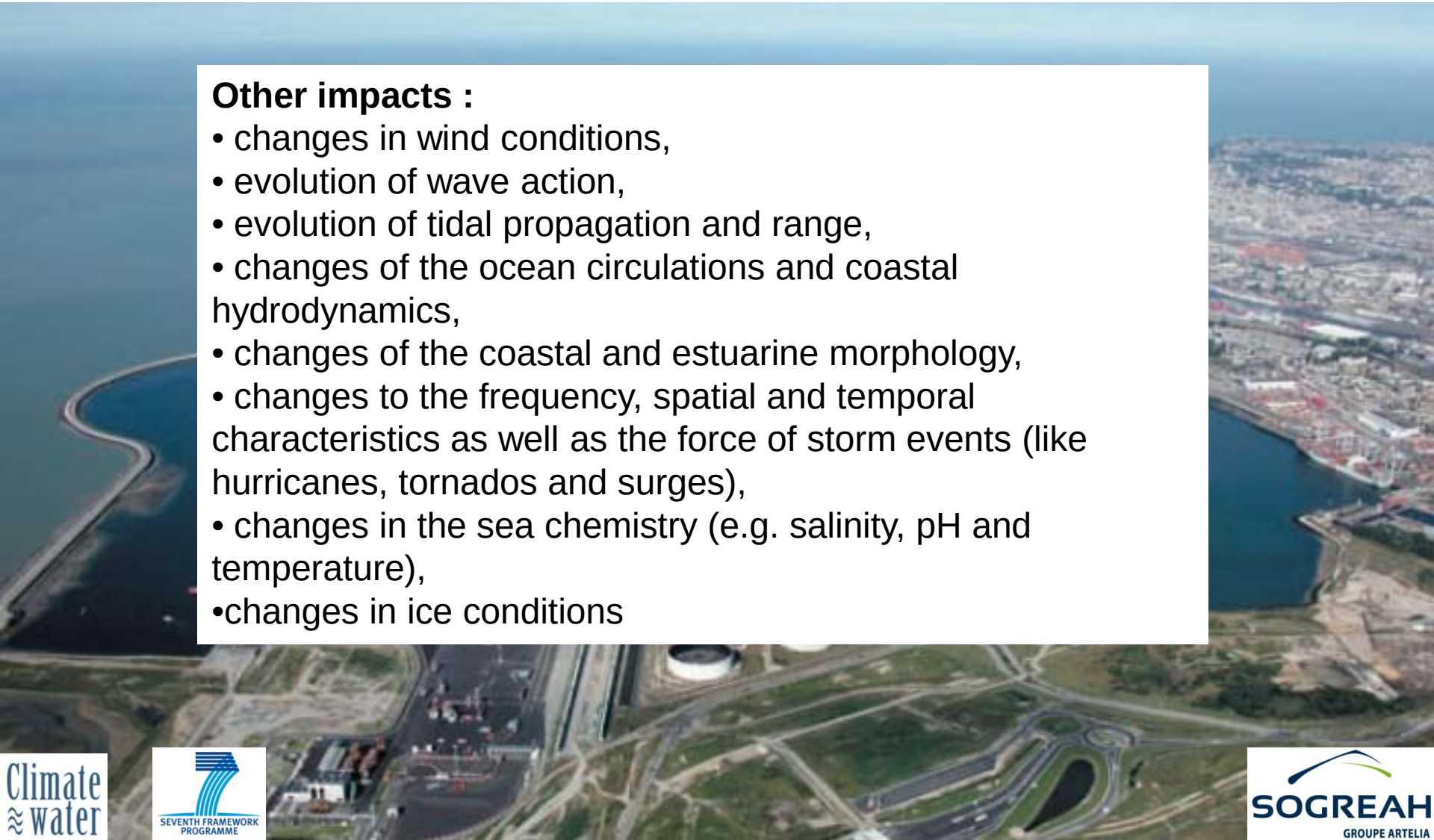
**Caption:** The curve shows the sea level from the year 2000 to the year 2100. The future rise in sea level of 1 m is calculated from global warming of 3 degrees in this century. The dotted line indicates the UN Intergovernmental Panel on Climate Change's prediction. The blue shade indicates the calculations' degree of uncertainty.
**Credit:** Aslak Grinsted, Niels Bohr Institutet

•**Positive impacts :** It allows greater underkeel clearance for vessels. With ice melting, new maritime roads are opening.

•**Negative impacts :** Coastal erosion ; degradation of port structures ; incidents of overtopping and lowlands flooding ; increased corrosion of decks, wharfs and jetties ; increased salinity of estuaries ; reduction of top clearance between ships and bridges.

# NAVIGATION

## Major climate change impacts on marine navigation (Cont'd)

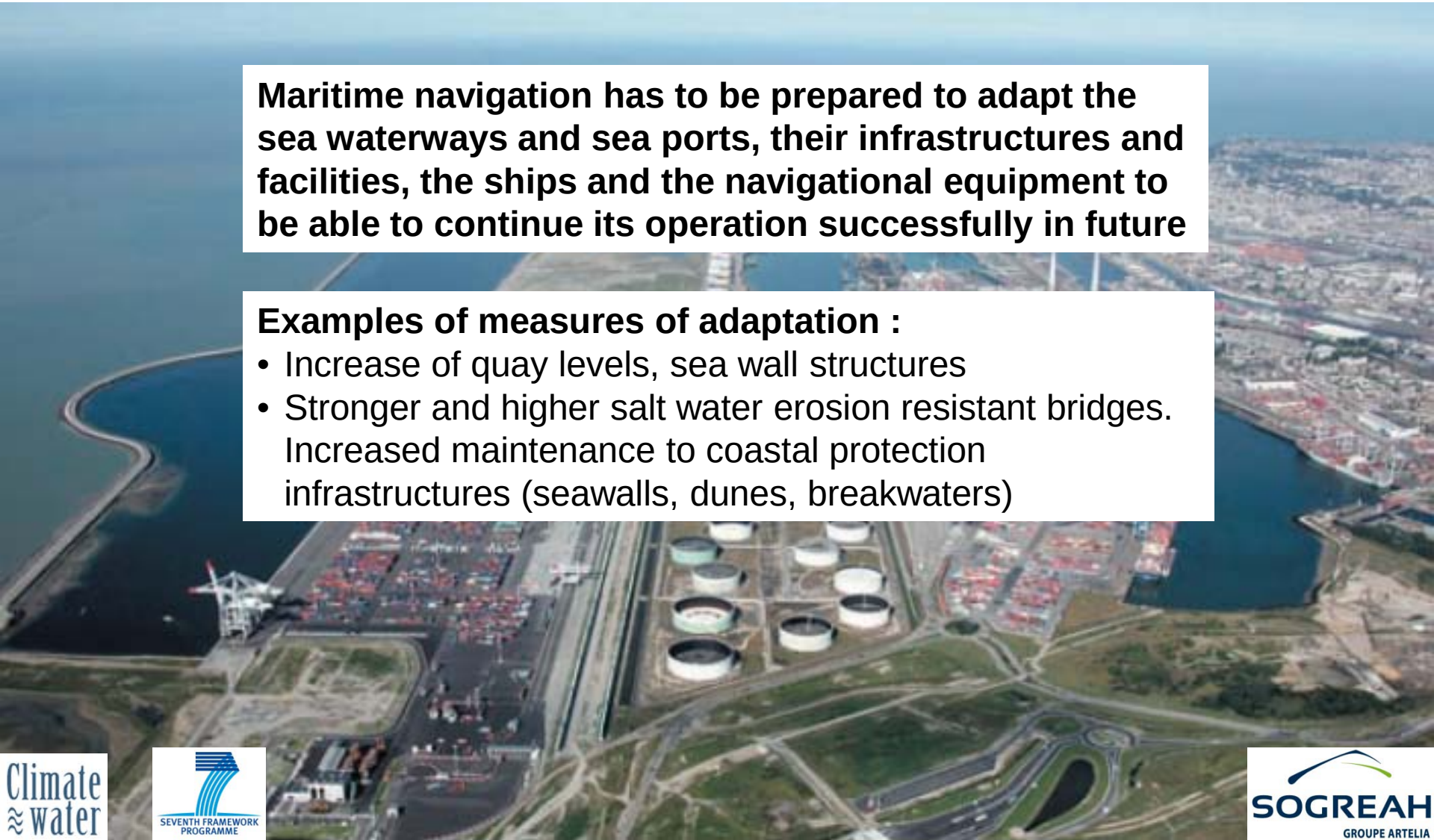


**Other impacts :**

- changes in wind conditions,
- evolution of wave action,
- evolution of tidal propagation and range,
- changes of the ocean circulations and coastal hydrodynamics,
- changes of the coastal and estuarine morphology,
- changes to the frequency, spatial and temporal characteristics as well as the force of storm events (like hurricanes, tornados and surges),
- changes in the sea chemistry (e.g. salinity, pH and temperature),
- changes in ice conditions

# NAVIGATION

## Adaptation measures needed for marine navigation



**Maritime navigation has to be prepared to adapt the sea waterways and sea ports, their infrastructures and facilities, the ships and the navigational equipment to be able to continue its operation successfully in future**

**Examples of measures of adaptation :**

- Increase of quay levels, sea wall structures
- Stronger and higher salt water erosion resistant bridges. Increased maintenance to coastal protection infrastructures (seawalls, dunes, breakwaters)

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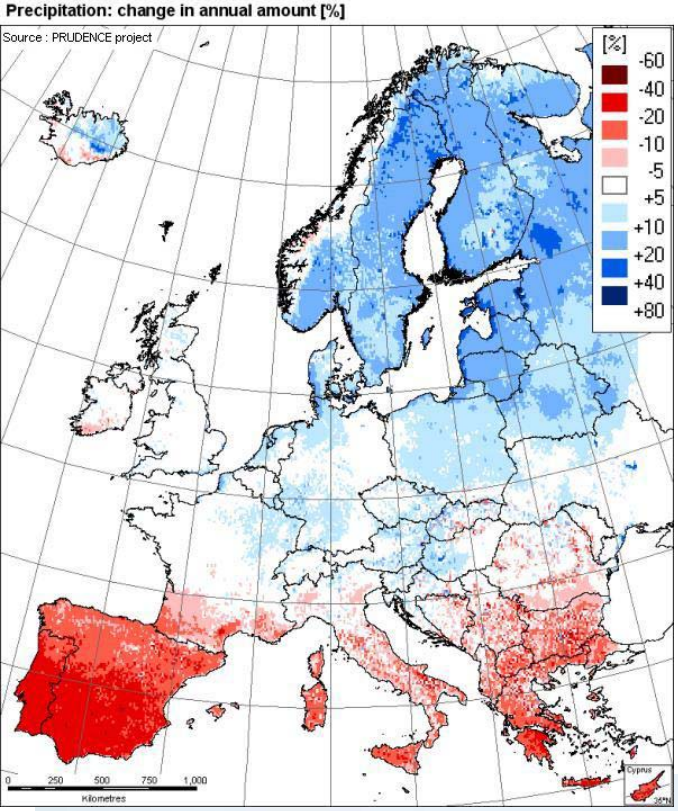


# NAVIGATION

## Major climate change impacts on inland navigation

**Inland navigation** is primarily influenced by the specific changes of the hydrological characteristics in each river basin like:

- decrease or increase of the water supply in the navigable river sections/waterways
- increase of more extreme hydrological conditions with more intense and long lasting high waters (floods) and low waters (droughts),
- changes of river morphology,
- changes in the efficiency of existing waterway infrastructure,
- increase of water temperature.

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# NAVIGATION

## Adaptation measures needed for inland navigation

**Measures :** Creation of water storage, adaptation of sediment management (dredging or artificial sediment supply), reduction of vessels weight, deepening of channels.

**Successful adaptation strategies** have to follow a common and **integrated approach** that covers measures in all water-related sectors. Navigation management and planning need to **become climate-proof**: the focus should be on making the right choices regarding the infrastructure, **compatibility with environmental legislation** including climate change, and the development of an **innovative navigation fleet** that can cope with future climatic conditions.

It is nowadays impossible to progress in a project without launching **constructive discussions** with all involved parties, including political leaders, environment associations, general public, etc. Experience shows that 30 years are needed to lead a major structural project from its early concept, through the various levels and types of studies, until its complete achievement

These **constructive discussions should begin as soon as possible** and should be supported by high quality, **independent, research work and consulting studies** that everybody can trust. The driving forces behind the project must be clearly explained. All constructive remarks arising in the constructive discussions shall be considered, and if relevant, taken into account.

# HYDROPOWER

## Major climate change impacts on hydropower

Greatest vulnerability : **drought**. South will be particularly touched.

Variability of climate expected with **accentuation of extremes**. North as South concerned.

In some areas (Scandinavia and Northern Russia), **hydropower may benefit** from increased hydropower potential, while in others (Southern and Central Europe) this potential will decrease due to reduced river runoff.

In areas with increased precipitation and runoff, **dam safety** may become a problem due to more frequent and intensive flooding events.

**Increased sedimentation of reservoirs** expected, both in North (increased inflows) and in South (land cover degradation)

Furthermore, energy supply infrastructure, in particular transmission grids, might be endangered and damaged by flooding events and avalanches. In addition, transmission networks may be affected by **melting of permafrost soils**.

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# HYDROPOWER

## Adaptation measures needed

**An important concern is dam safety**. Given the devastating effects of a dam failure, there is some urgency to explore whether rules and evaluation patterns should be adapted to adequately ensure safety in the face of changing climatic conditions.

A key action in the portfolio of adaptation strategies is to **increase water storage** capacity. This supposes to enlarge the existing **reservoirs** and/or create new reservoirs. Reservoirs however are known to generate significant impacts on the water courses (morphological changes, barriers to fish migration, etc.).

The obligation of competition in the **renewal of hydroelectric concessions** shall consider the necessity to encompass in a unique lot a complete hydraulic scheme. Indeed all the components of the system are linked, aimed at optimizing hydropower and other services. Managing a multipurpose hydraulic scheme requests a unique operator.

**Decentralised approaches and changes in the whole electricity supply systems**, including the energy mix and transmission and distribution grids, as well as its organisation (including market opening) will have to support adaptation.

Hydropower can be further developed or optimised by **using pump-turbines** and storing potential energy from other sources in reservoirs.

# Inland Navigation and Hydropower

## General adaptation measures needed

Successful adaptation strategies have to follow a **common and integrated approach that covers measures in all water-related sectors**, in particular, in sectors that are strongly depending on the availability of clean and/or sufficient water, such as water supply, agriculture, electricity production, inland navigation and tourism.

Variation of water availability will **depend on the latitude**. **Adaptation measures thus have to be adjusted** to the specific circumstances of individual regions.

Adaptation to Climate Change should be integrated into current risk management strategies and planning processes, and **not be a stand-alone issue**, but part of a larger planning process.

Major hydraulic projects are being increasingly constrained, particularly in Europe, by environmental regulations and high investment costs. **Trade-offs and innovative solutions** will be needed to satisfy the adaptation needs, the economical constraints and the respect of the environment.

**In particular, reservoirs** are known to generate significant impacts on the water courses (morphological changes, barriers to fish migration, etc.). Solutions are needed to mitigate these impacts.

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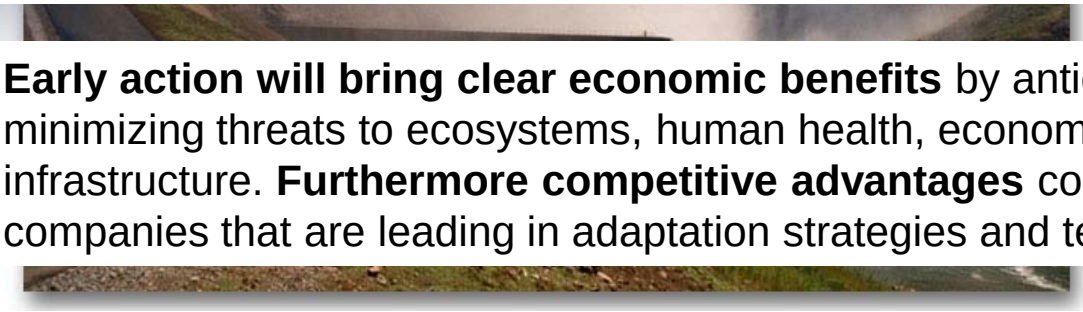
# NAVIGATION and HYDROPOWER

## General policy implications of adaptation needs

**In all European countries** navigation and hydropower will be impacted with sea level rise, reduction of low flows in summer and increase of extreme hydrological events.

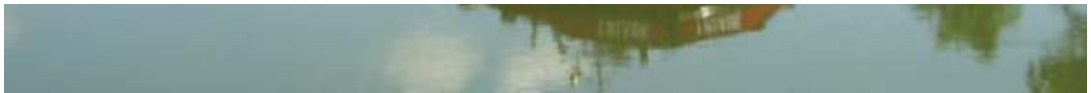
Thus **Climate Change impacts will touch all member states**; research, dedicated programmes and adaptation measures are thus needed. Codes and guidelines are also needed. **Impetus should be given at European scale trough policies.**



**Early action will bring clear economic benefits** by anticipating potential damages and minimizing threats to ecosystems, human health, economic development, property and infrastructure. **Furthermore competitive advantages** could be gained for European companies that are leading in adaptation strategies and technologies.

Navigation and energy management and planning **need to become climate-proof**: the focus should be on **making timely the right choices** regarding the infrastructure and the technologies which ensure compatibility with environmental legislation including climate change.

Complementary EU policies may be needed to **ensure that the market opening is not detrimental** to the development of optimised hydraulic schemes and to the necessary and difficult adaptation of these schemes to climate change.



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# Where are we with European policies ? Case of transport, including navigation

Several documents have been prepared by the EC on transport in general and on navigation in particular, including:

- White Paper – European transport policy by 2010: time to decide (2001)
- Europe on the move – at a crossroad – the need for sutainable transport (2003)
- NAIADES Action Programme : 1st progress report (2007)
- Green Paper. TEN-T: a policy review (2009)

Main objectives :

- Develop Trans European Networks and provide support to priority projects
- In the new context of sustainable development, Community cofinancing should be redirected to give priority to rail, sea and inland waterway transport

Concerning CC, in the early documents the point was to reduce GHG emissions (no mention of adaptation)

In the Green Paper (2009), need of adaptation is explicitely mentioned : **«** TEN-T policy should also take account of the need to adapt to the possible consequences of climate change»

Integrating adaptation to CC into the EU policies is still limited. Much remains to be done to give impetus to Member States.


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