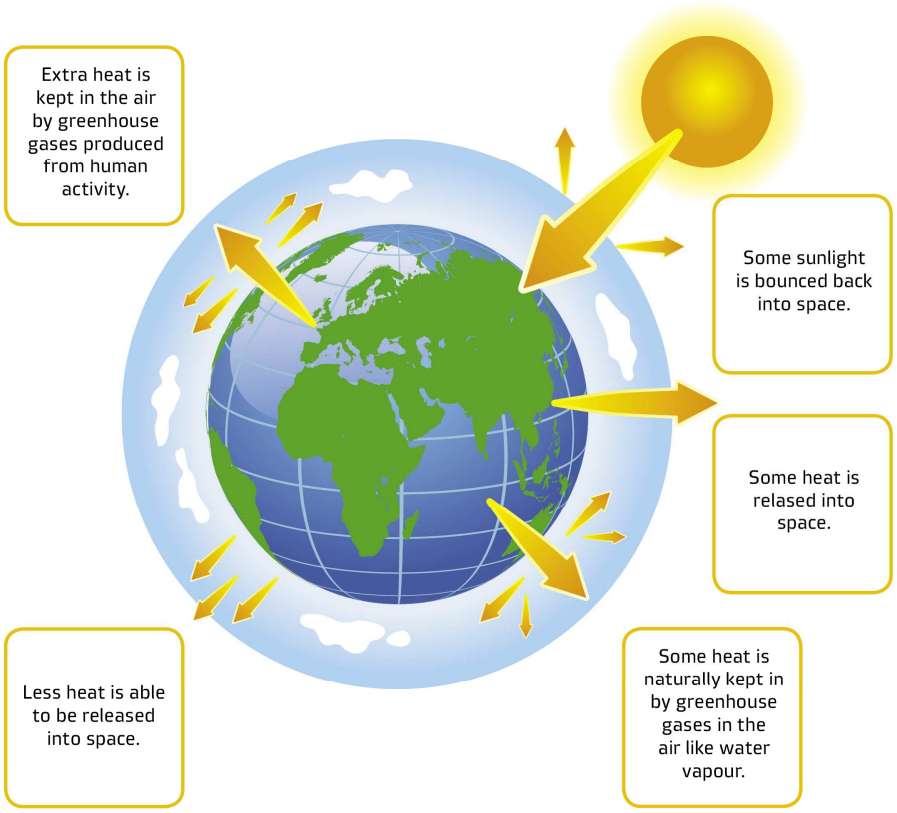
EU2009.CZ
České předsednictví v Radě EU
Czech Presidency of the Council of the EU
Présidence tchèque du Conseil de l'UE
2009

Draft Presidency Paper

The European Union is adapting to climate change

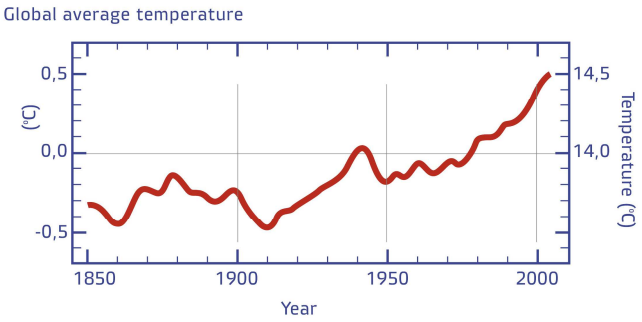
1. Climate change and its impacts

Climate change presents one of the most serious global environmental threats. According to various sources, e.g. results of the 4th Assessment Report of the Intergovernmental Panel on Climate Change (4AR IPCC, 2007) and the 2008 EEA-JRC-WHO report Impacts of Europe's Changing Climate, this problem is real and all human activities associated with the exploitation of fossil fuels contribute significantly to climate change. In many parts of the world, particularly in least developed countries, climate change is already occurring and is negatively affecting different aspects of human life.

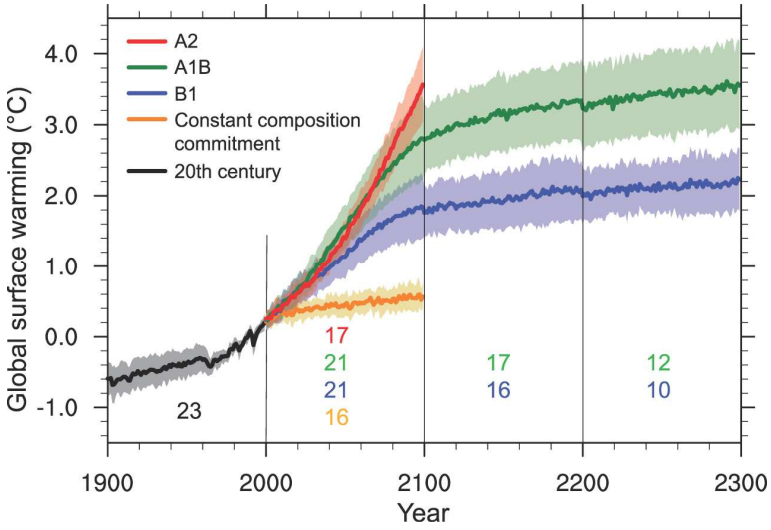


The greenhouse effect, a basic and natural atmospheric process that ensures that our planet is warm enough to provide conditions suitable for life, has been intensified due to excessive emissions of anthropogenic greenhouse gases into

the atmosphere (figure no.1)[1]. According to scientists from the IPCC, warming greater than 2°C above pre-industrial levels would cause irreversible changes to the planet's climatic system (figure no.2)[2]. Even worse impacts are expected with reference to greater increases of observed greenhouse gas emissions (figure no.3)[3].



A global approach and the reduction of at least 50 % of anthropogenic greenhouse gases by 2050 in comparison to 1990 levels will be necessary to limit an increase in average global temperature to pre-industrial levels.



With the adoption of the Climate action and renewable energy package in December 2008, the European Union committed to undertake measures to reduce greenhouse gas emissions and to contribute to keeping the increase of average global temperatures below the 2°C limit. But only to mitigate emissions is not enough. The impacts and effects of climate change are already visible and in view of the fact that the life cycle of greenhouse gases in the atmosphere lasts for several tens and hundreds of years, there will be certain inevitable changes in our climate.

The solution is adaptation, which is defined as any adjustment in natural or human systems in response to actual or expected adverse effects of climate change (IPCC 2007). Some systems may react actively and adapt autonomously (e.g. behavioural and migration responses – natural systems; relocation of activity, reconstructions – human systems). Due to increased vulnerabilities and varying perceptions of climate risks and levels of information about anticipated climate change impacts, anticipatory adaptation measures will need to be undertaken, as well (e.g. crop diversification, insurance purchase, etc.).

Climate change impacts will negatively affect mainly the most vulnerable least developed countries and small islands states. Nevertheless, the European continent will not be spared, and some effects have already been registered: the increased occurrence of extreme meteorological events and the consequent health implications, heat waves and prolonged droughts, the retreat of—in

[1] Greenhouse effect
[2] Global temperature increase; source: 4AR IPCC
[3] Climate projections in relation to different emission scenarios; source: 4AR IPCC

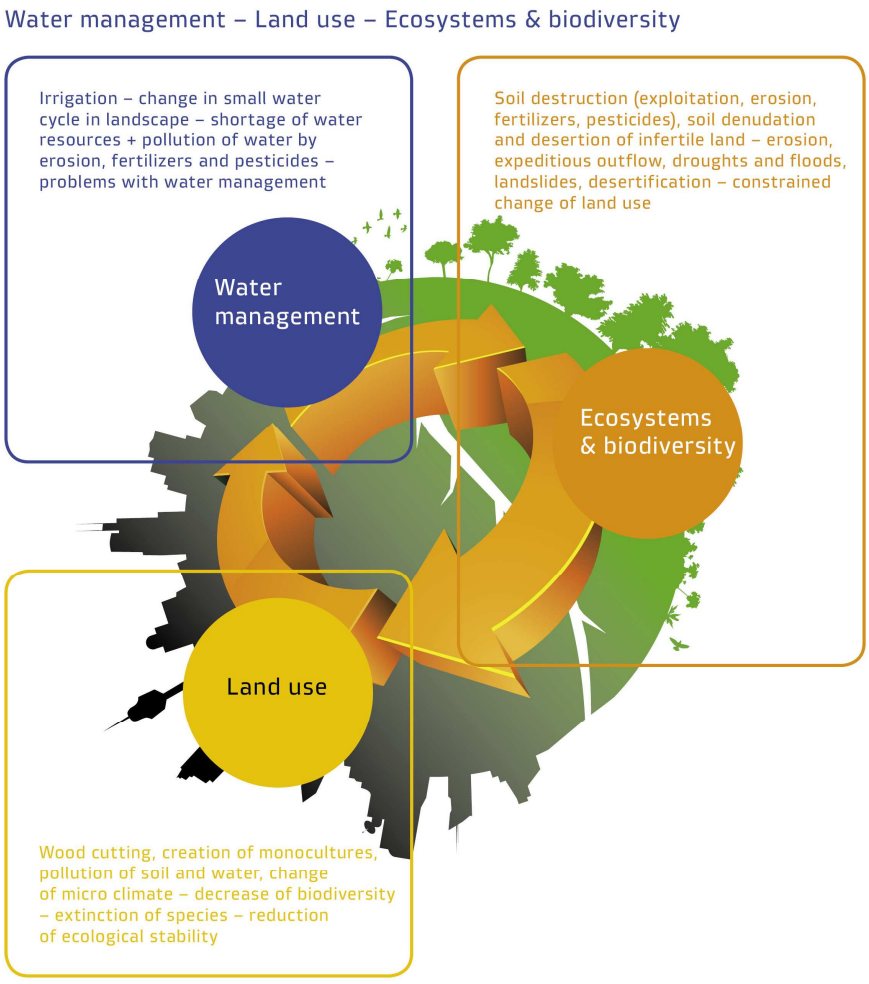
particular—Alpine glaciers, a prolonged vegetation period, changes in the extent of natural species occurrence, etc.

Inevitable climate change will affect the individual European regions in various ways, depending on the variability and distribution of precipitation. Most vulnerable are the Mediterranean and mountainous areas, the outermost islands, densely populated urban areas and the Arctic. With regard to various sectors, climate change will affect both natural and consequently economic sectors and the social sphere. Particularly vulnerable is water management, which will adversely affect the development of several other areas, such as agriculture, electricity production, human health, ecosystems and biodiversity, etc.

According to the results of consultations of variety of stakeholders in 2007[4], it is clear that—with regard to environmental impacts—**water management, land use, biodiversity and ecosystems** are the priority areas and other social and economic impacts can be linked to these, with a special attention to water.

There are several relations, including positive and negative feedbacks among water, land use and ecosystems and biodiversity. Some of these are demonstrated by the following example of growing fruit on a plantation (figure no.4)[5].

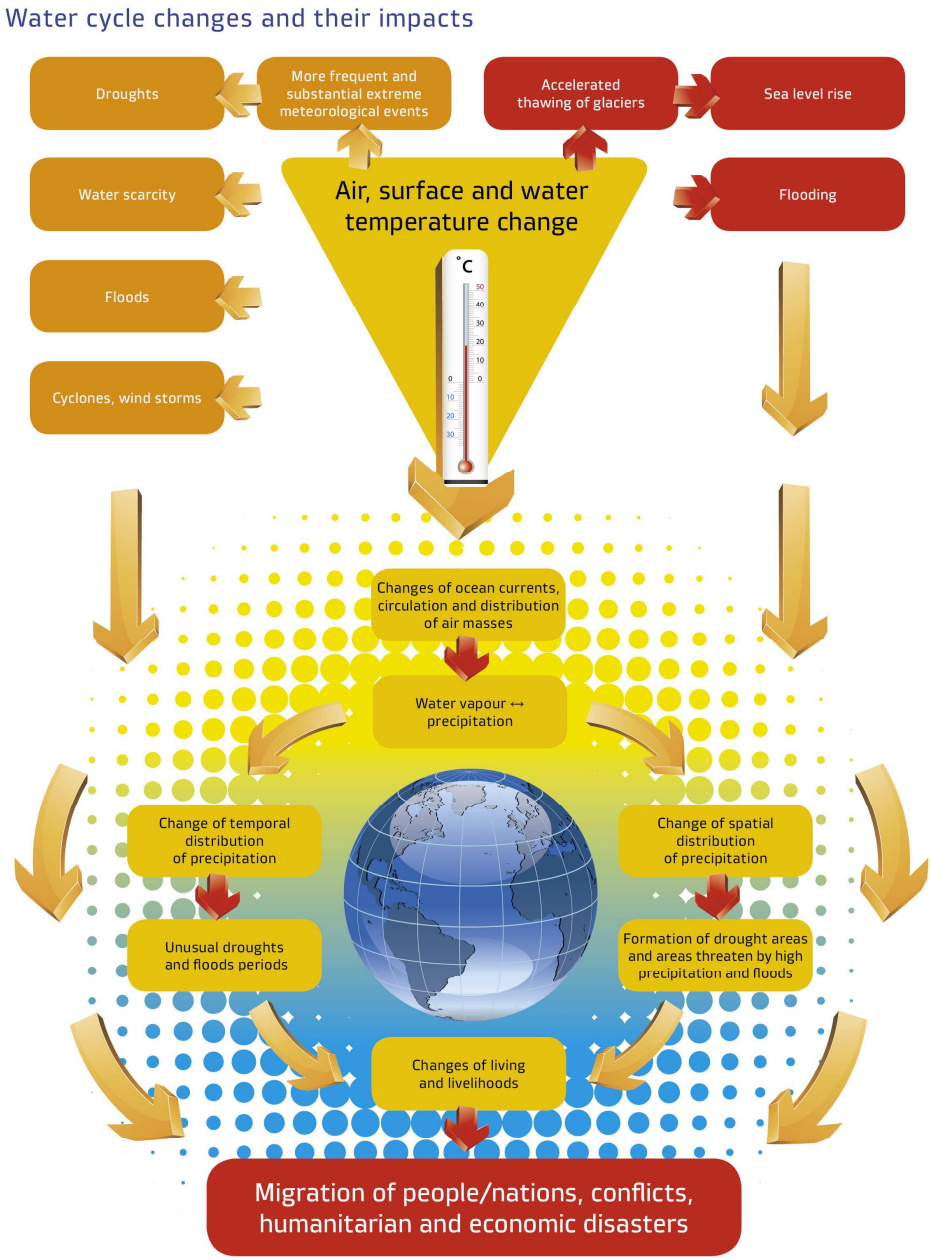
Although this is only an illustrative example, the processes described relate to Europe in that they are in an advanced stage and have undergone historical development (e.g. deforestation of Mediterranean areas in ancient history – droughts and soil erosion in the present; agriculture and forests monocultures and inappropriate management – disrupted water regime and soil). In order to ensure the sustainability of these three areas, it is necessary to increase the ecological stability



[4] These wide-range consultations followed the release of the Green Paper on Adaptation to Climate Change by the European Commission in 2007; more information in chapter 2
[5] Interaction and linkages between water, land use and ecosystems and biodiversity

of ecosystems, water retention and water and soil protection against pollution.

The outcomes from the 5th World Water Forum, held in Istanbul in March 2009, also indicated the crucial importance of water as such and point out that it should be given specific treatment. Water is one of the main and basic conditions for life. All human activities related to water already are and will be influenced even more significantly by climate change in the future in many different ways (floods, droughts, extreme events, water quality, etc.). Water is also a limited factor in other various natural and human areas (figure no.5)[6] (more information in the Annex).



[6] Water cycle changes and their impacts with relation to climate chnage

2. Adaptation to Climate Change

2.1 Adaptation measures and their objectives

Adaptation to climate change refers to undertaking measures that facilitate the adjustment to inevitable changes, or measures that at least mitigate or even prevent the negative impacts of those changes. As was already mentioned in the preceeding paragraphs, there are different types of adaptation. Autonomous adaptation measures are reactive and will be driven mainly by sectoral and short-term perspectives, while anticipatory adaptation measures must be planned and driven by a multi-sectoral approach to improve the adaptive capacity of natural, economic and social system in medium and long-term perspective.

The following are examples of the objectives of adaptation measures related to three environmental crosscutting issues:

Water management

- Efficient management to increase the supply of water
- Water pricing, incentives for using less water – actions to reduce consumption
- Increase in efficient water practices – reduce losses of water due to leakages and failing infrastructure
- Retrofitting of water appliances and regulating the new ones
- Wastewater recycling
- More examples and other information are found in the Annex

Land use

- Complex and systematic soil protection and prevention
- Sharing losses – to support rural economies affected by desertification and threatened regions; to limit land abandonment by keeping agricultural production and soil management viable
- Mitigating the threat – to reduce the loss of organic soil matter by agricultural management and cultivation practices (e.g. low tillage, green manure, crop rotation) and supporting the use of soil quality improvement agents and organic fertilizers; and to control erosion, organic matter decline and salinisation.
- Change in land use – land needs to be increasingly managed as a scarce resource. Land use policy should target the recycling of land (brownfields cleanup and redevelopment) and multifunctionality (flood plain/recreation). In the future, land use policy should address nature conservation and soil protection in the broadest sense of sustainable soil and land use, integrating the entire spectrum of physical, chemical and biological soil functions and properties.

Ecosystems and biodiversity

- Restoration of water habitats and creation of new ones,
- Revitalisation of watercourses that have been narrowed or have lost their natural capacity to support biodiversity due to human activities (modification and pavement of riversides, elimination of trees and shrubs on river banks, artificial drying or silting of cut-off meanders)

- Restoration or creation of migration routes for migratory animals
- Restoration and creation of landscape elements that support biodiversity and have positive effects on slowing the water outflow off the landscape (alleys and groups of trees, hedgerows, small water bodies, other erosion control measures).

An indicative list of actions is included in the Annex.

At the same time, we shall avoid so-called *mal-adaptation,* which happens when adaptation actions lead to a shift in the impacts or exacerbate the problem in another area, country, sector or social group. These measures, in the end, might be counterproductive to our efforts to positively influence ecosystems and their services. Examples include building huge water reservoirs, capturing groundwater or using other techniques to ensure water availability in certain areas, which may not be effective long-term solutions on a larger scale.

With regards to the preparation of adaptation measures, policies and strategies, it is necessary to evaluate those already undertaken in order to determine systematically and objectively their relevance, efficiency, effectiveness and impact in light of their objectives. Evaluation and assessment of adaptation measures is also necessary for the consideration of any additional measures and this approach requires a comprehensive analysis at the appropriate level.

Effective adaptation to climate change requires the following:

- Well prepared and well timed **public awareness raising**
- Review all possible **information sources**
- Implement not only restrictive adaptation but also that, which has an **incentive character** – present adaptation as a good deal
- **Revise possible financial sources** in order to avoid contradictory effect
- Ensure proper **monitoring, assessment and feedback**
- **Update adaptation measures and strategies** according to possible new projections

2.2 Adaptation at national level

Member States have various approaches and measures to adapt to climate change. So far, eight Member States have adopted their National Adaptation Strategies[7].

- Denmark - Strategy for Adaptation to Climate Changes in Denmark (2008)
- Finland – Finland's National Strategy for Adaptation to Climate Change (2005)
- Hungary – National Climate Strategy 2008-2025 (2008)
- France – National Adaptation Strategy to Climate Change (2007)
- Netherlands – National Programme on Climate Adaptation and Spatial Planning (2008)
- Spain – National Plan for Adaptation to Climate Change (2006)
- United Kingdom – Adapting to Climate Change in England – a Framework for Action (2008)

[7] Source: Impact Assessment of the proposal for White paper on Adaptation to Climate Change

- Germany – National Climate Change Adaptation Strategy (2008)

In several Member States, the preparation of a national adaptation policy is ongoing.

For the majority of EU Member States, mitigation measures and policies have so far been prioritised. Reacting to the increase of climate change impacts in many European regions and the more pessimistic than optimistic scenarios, many Member States have already started to identify their adaptation needs and to undertake adaptation actions at the national, regional and local levels. However, **there remain large differences in progress among countries**. In comparison with mitigation actions, the level of adaptations plans and strategies is generally low and a clear formulation of policy measures is still needed.

Climate change impacts will vary in different regions and countries of the EU. Current National Adaptation Strategies are focused on particular sectors, which were indicated and considered highly vulnerable. Common priorities in the majority of strategies are water management, land use and agriculture and biodiversity. The EU Member States also identified awareness raising, information sharing and research, as well as coordinated action at different levels, as key elements of adaptation to climate change.

Specific examples of national adaptation strategies and measures will be illustrated at the informal meeting of environment ministers.

2.3 Adaptation at the EU level

The following table identifies different existing EC legislation and other relevant documents, in which adaptation measures are addressed already or there exists an opportunity to do so with reference to the three environmental crosscutting issues.

Existing EC legislation and related documents relevant to three crosscutting issues and opportunities to address adaptation to climate change	Water	Ecosystems & Biodiversity	Land use
Natura 2000 ecological network set up under the Habitats and Birds Directives	x	x	x
Biodiversity Strategy and Action plan	x	x	x
Water Framework Directive	x	x	x
Flood Directive	x		x
Communication on Water Scarcity and Drought	x	x	x
Nitrates Directive	x	x	x
Marine Strategy Framework Directive	x	x	
EIA/SEA Directives	x	x	x
Soil Thematic Strategy			x
Common Agriculture Policy	x	x	x
Forest Action Plan		x	x
Integrated Maritime Policy	x	x	
Integrated Coastal Zone Management	x	x	x

In 2007, the European Commission released the **Green Paper on Adaptation to Climate Change** and the results of consultations with stakeholders (e.g.

civilians, representatives of the EU Member State governments and nongovernmental organizations). It identified 7 elementary areas or sectors, which will be threatened by climate change and 3 crosscutting sectors, the changes in which will negatively affect all others. These are water management, land use and land cover, ecosystems and biodiversity. These areas will require our interest and protection and the identification and implementation of adaptation measures, since their changes will negatively influence areas such as agriculture, urban life and human health.

Additionally, extreme weather events and other natural disasters influenced by climate change have a very low possibility for prediction and impacts are massive and dangerous. Therefore, in February 2009 the European Commission released A Community approach on the prevention of man-made and natural disasters, which also includes those disasters generated by climate change. Its objective is to understand and to minimise impacts through the identification of appropriate measures.

On the basis of the results of the Green Paper, the European Commission is now presenting the **White Paper[8], Adapting to climate change: Towards a European framework for action**, which provides a phased approach to the development of a comprehensive adaptation framework. This will ensure improvements in the resilience of vulnerable sectors and areas in compliance of the subsidiarity principle and the support of sustainable development objectives.

The first phase (2009-2012) will focus on the preparation of the overall European adaptation framework, including collecting information and identifying climate change impacts in the EU, integrating adaptation measures into key EU policies and strengthening international cooperation in the field of adaptation. The second phase, which will follow after 2012, will focus on the implementation of this EU strategy. This approach will require close collaboration among stakeholders within the EU and at the national, regional and local levels.

Even if EU Member States have already developed and implemented their own National Adaptation Strategies, there are various reasons for action at the EU level. The White Paper and especially its Impact Assessment further elaborate on these. For example, climate change will result in transboundary impacts and thus it will be necessary to cooperate between different Member States as well as regions in order to avoid maladaptation and to be efficient and cost-effective. Many sectors that will be strongly affected by climate change are largely integrated at the EU level through the single market and common policies (e.g. transport, agriculture, water, etc.) so this should also be taken into account when considering any coordinated actions.

The principle is to integrate adaptation measures into existing European policies mentioned above. These should take possible climate change impacts into account, define relevant and effective adaptation measures and ensure their implementation.

The European Commission proposes the establishment of the *Impacts and Adaptation Steering Group (IASG)*, composed of experts and representatives from the EU Member States, who are involved in the process of preparing national adaptation programmes and measures. Several technical groups, specifically focused on developments in key sectors and areas, would support

[8] http://ec.europa.eu/environment/climat/adaptation/index_en.htm

this working group. Experts would cooperate with the European Commission on the development and implementation of the EU strategy on adaptation to climate change. This work would be supported by the proposed *Clearing House Mechanism,* a tool for exchanging information about impacts and vulnerabilities among the EU member states.

Financial constraints are the main barriers to adaptation actions and this was already identified in the Stern Review[9]. Current financial perspectives (2007-2013) already identify climate change as a priority area. Implemented adaptation measures need to be assessed and improved if necessary and financial support needs to be better targeted in order to ensure adequate use of available resources and instruments. The European Economic Recovery Plan (EERP), which was adopted just recently, also addresses climate change investments within addressing the current economic crisis, to which various Member States consider investments as a response; these should take into account sustainable adaptation measures, which are part of the shift towards a low-carbon economy.

Market Based Instruments (MBIs) would need to be considered if any adaptation framework is adopted. These include incentives schemes and projects that enhance resilience of ecosystems and economic sectors, as well as insurance and other financial services products.

Climate change is inevitable and all sectors—natural, economic and social—will be affected or at least somehow influenced by its impacts. From the previous paragraphs, we see a close connection and relation among climate, water, ecosystems and human behaviour. The adaptation approach will require strengthened cooperation among all sectors and areas. Water management is one of the key areas to protect and take care of. It is linked to each of the above-mentioned areas and has its history, experiences and information on which we can base our response.

[9] The Economics of Climate Change – The Stern Review, N. Stern, Cambridge University Press, 2007

3. Discussion on further actions

The Presidency introduces four main questions for the debate of ministers in order to identify a direction for further discussions on adaptation policy at the EU level. The outcomes from our debate will be reflected in the climate change discussion at the June meeting of the EU Council on Environment.

1.) *The EU Member States have already prepared or are in the process of preparing their own National Adaptation Strategies. As was already indicated in the previous text, some action at the EU level might be needed to take into account the trans-boundary nature of climate change impacts and of most adaptation measures, to share information, to ensure mainstreaming of adaptation into current EU policies and to ensure solidarity among the Member States and regions.*

   What should be the EU level approach and where is it appropriate? Should the EU identify and develop its Adaptation framework to climate change impacts with respect to the geographical differentiation of European regions and various distributions of effects across sectors and vulnerable populations?

   Should National Adaptation Strategies be consistent and comparable across the EU and how should this be achieved?

2.) *In its White Paper, the European Commission proposed to establish the Impacts and Adaptation Steering Group (IASG) to take forward the approach outlined in the White Paper and to enhance cooperation among EU Member States. The proposal is to have representatives from the EU Member States involved in defining and implementing National Adaptation Strategies in the IASG supported by number of relevant technical groups. This Steering group would further assist by e.g. information sharing, joint analysis, adaptation strategies assessment etc.*

   Do Member states support this approach and are they willing to devote the appropriate resources (financial, human, etc.) so that it can fulfil its purpose? What should be the aim and objective of IASG?

3.) *There are some EU policies and EC legislation that already address adaptation or possibly could address this issue in the future (Water Framework Directive, Common Agriculture Policy, NATURA 2000, etc.). With regard to the recently adopted European Economic Recovery Plan, the issue of financing and financing mechanisms will also need to be addressed.*

   Is the current spectrum of existing policies and mechanisms effective and comprehensive enough to address adaptation needs and support adaptation actions and strategies? Are there any other potential relevant instruments or measures you can think of and would be willing to support that should be implemented at the EU level?

4.) *Regarding the areas of the impacts of climate change and adaptation, the main focus of the background document and specifically the annex is water, together with land use and ecosystems and biodiversity as three crosscutting issues, which significantly affect all other sectors. The*

outcomes of the 5th World Water Forum, held in Istanbul in March of this year, also indicated the crucial importance of water as such and point out that it should be given specific treatment.

Do Member States feel that there is a specific sector that should be prioritized and protected in the context of climate change impacts and adaptation? If yes, is there a need for developing specific sectoral approaches of adaptation and what should be the link with common strategies?

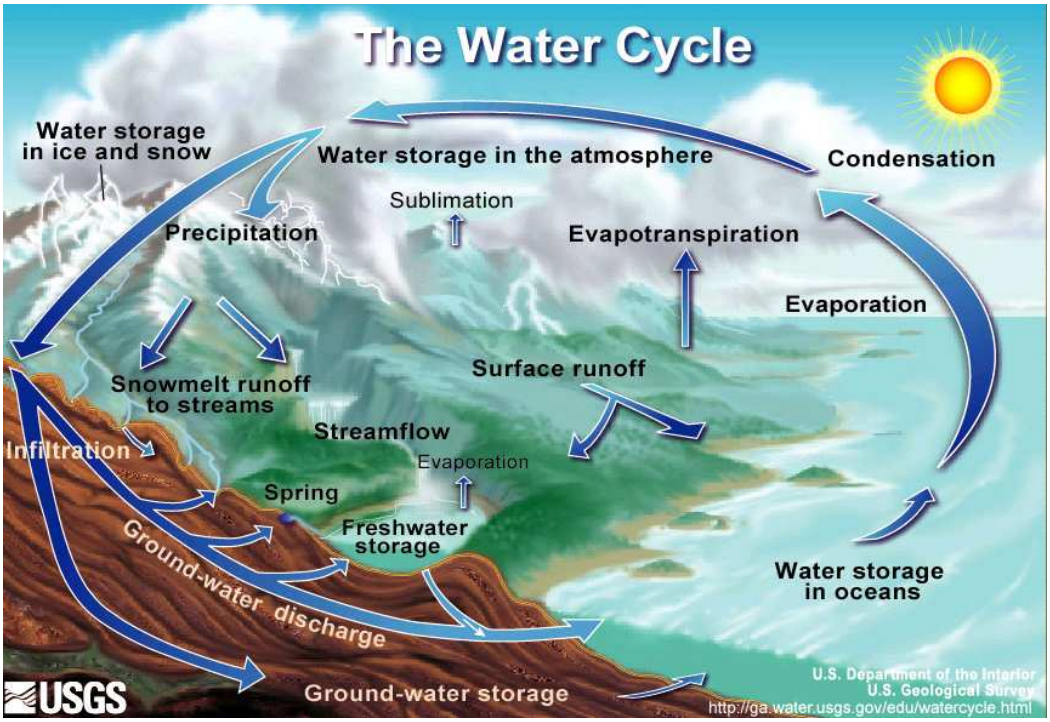
References

- **Proposal for White paper on Adaptation to Climate change; Adaptation to climate change: Towards a European framework for action**
- Impact assessment of the proposal for White paper on Adaptation to Climate change
- 4. Assessment Report of the Intergovernmental Panel on Climate Change (4AR IPCC),
- IPCC Technical Report on Climate Change and Water
- Impacts of Europe's changing climate – 2008 indicator-based assessment, EEA-JRC-WHO
- Draft Guidance on water and climate adaptation, prepared by the Convention's Task Force on Water and Climate and the Protocol's Task Force on Extreme Weather Events
- Draft Guidance of the Strategic steering group on climate change and water: Adaptation measures
- Draft Findings of the Ad Hoc Technical expert group on biodiversity and climate change
- USGS – U.S. Geological Survey
- http://www.waterfootprint.org
- http://ec.europa.eu
- http://dataservice.eea.europa.eu

Adaptation to climate change – water is an answer

Climate change is a significant environmental problem that affects all aspects of our present life and will affect it even more in the future. Although the atmospheric process is well known and observed, some relevant feedbacks have yet to be explored in detail.

For example, even a change in global temperatures on a magnitude of several tenths of one degree Celsius could significantly influence the water cycle, which determines climate and weather (figure no.1)[10].



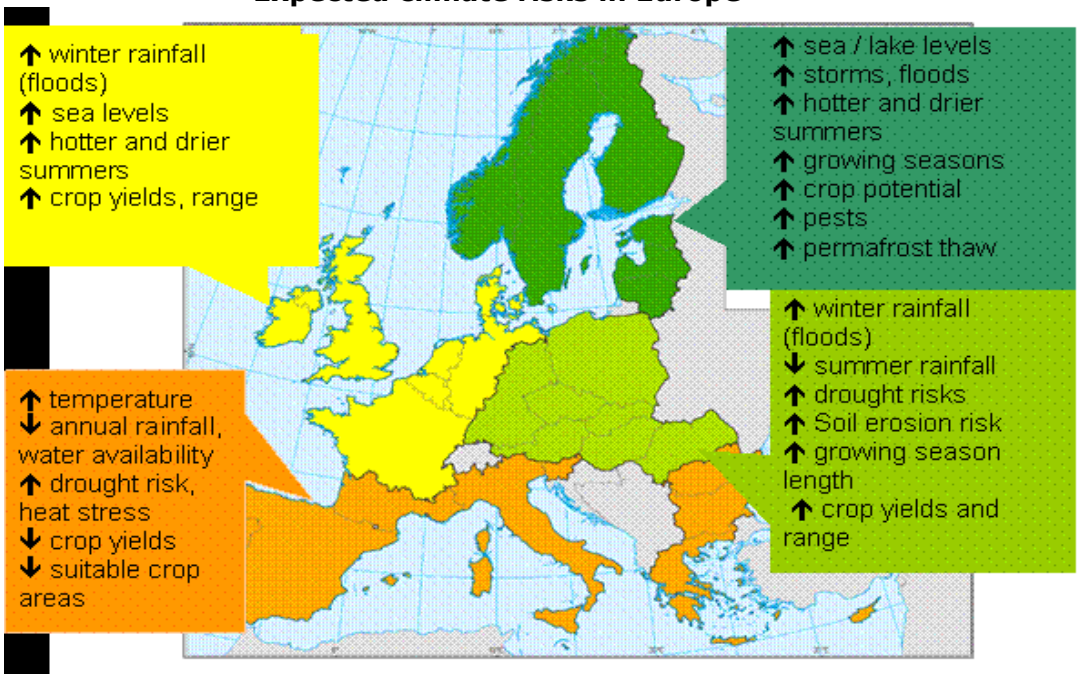
As was already indicated in the background document, climate change will affect the individual European regions in a variety of ways, mainly due to the variability and distribution of precipitation on the continent (figure no.2, page 2)[11].

The anticipated increase in temperature and drought in Southern Europe will reduce access to water and increase associated health risks. Heat waves and subsequent fires are already occurring and threaten these areas annually. The states of Western Europe will be affected mostly by the sea level rise and floods caused by frequent and abundant precipitation. Central and Eastern Europe will face lower precipitation levels in the summer season, with a high probability of flooding in the colder half of the year. Northern Europe at first will profit from

[10] Water cycle; source: USGS
[11] Expected climate risks in Europe; http://ec.europa.eu

some climate change impacts. The temperature increase will reduce demand for heating and prolong the vegetation period, which will consequently increase agricultural crop production. These positive affects will outweigh the negative ones, such as more frequent winter flooding, ecosystem degradation, soil erosion and instability.

Expected climate risks in Europe



Ecosystems/biodiversity, land use and especially water are the three key environmental areas, which require special attention. Climate change will further exacerbate problems we are already facing in each of these areas. The impacts of climate changes on the water cycle have already been presented in the background document. Regarding the other two issues, there are various projected impacts.

With respect to ecosystems, their degradation is significantly reducing their carbon storage and sequestration potential, leading to increases in emissions of greenhouse gases and biodiversity loss. Moreover, degraded ecosystems also have lower water retention capacity, which may lead to floods or droughts. Climate change, in particular the resultant milder winters, is responsible for the observed northward and uphill distribution shifts of many European plant species. Projections suggest that this will continue in 21st century. The rate of change will exceed the ability of many species to adapt, especially as landscape fragmentation may restrict movement. The timing of seasonal events in plants (phenology) is changing; for example, the average advance of spring and summer between 1971 and 2000 was 2.5 days per decade. The pollen season starts on average 10 days earlier and is longer than it was 50 years ago. Changes in seasonal events are projected to continue. The changing climate will contribute to the spread of invasive alien species, diseases and pathogens[12].

Regarding land use and soil in general, the main consequences of climate change include organic matter decline, increased erosion risks, change in soil

[12] Draft Findings of the Ad Hoc Technical expert group on biodiversity and climate change, London, 17 -21 November 2008

biodiversity, salinisation and desertification. For example, the decline in organic matter will increase water runoff, which increases flooding risks in cases of extreme weather events; and increased erosion risks due to changing rainfall intensity and patterns as well as management practices will result in more severe flood vulnerability. Desertification is already affecting the Mediterranean regions of the EU due to the exacerbation of its environmental drivers (erosion, salinisation and soil organic matter decline). Soil sealing through urbanisation and urban sprawl has negative effects on soil functions. Sealing results in the creation of a horizontal barrier between the soil, air and water and thus has several severe consequences, such as the disruption of gas, water and energy fluxes, increased flood risks, reduced groundwater recharge, increased water pollution, and loss in soil and terrestrial biodiversity.

These impacts will need to be addressed by adaptation and the implementation of appropriate measures. Before setting out any strategy (conceptual approach) it would be necessary to assess the current situation, conditions and their trends. There already exist many different approaches in the field of water management. Some of them, which may help define priority areas and support decision-making, could be mentioned as examples of measuring water abstraction.

- Water exploitation index (WEI)
- Virtual water, Water footprint, Water neutral

Water exploitation index (WEI)

WEI = Annual total water abstraction per year as percentage of available long-term freshwater resources around 1990 and the latest year available (figure no.3, page 4)[13]. An index of over 10 % is normally taken to indicate water scarcity. The water exploitation index combines the results from two driving forces into status information; Water availability, described by meteorological information, and management[14].

Virtual Water – Water Foot Print

Virtual water

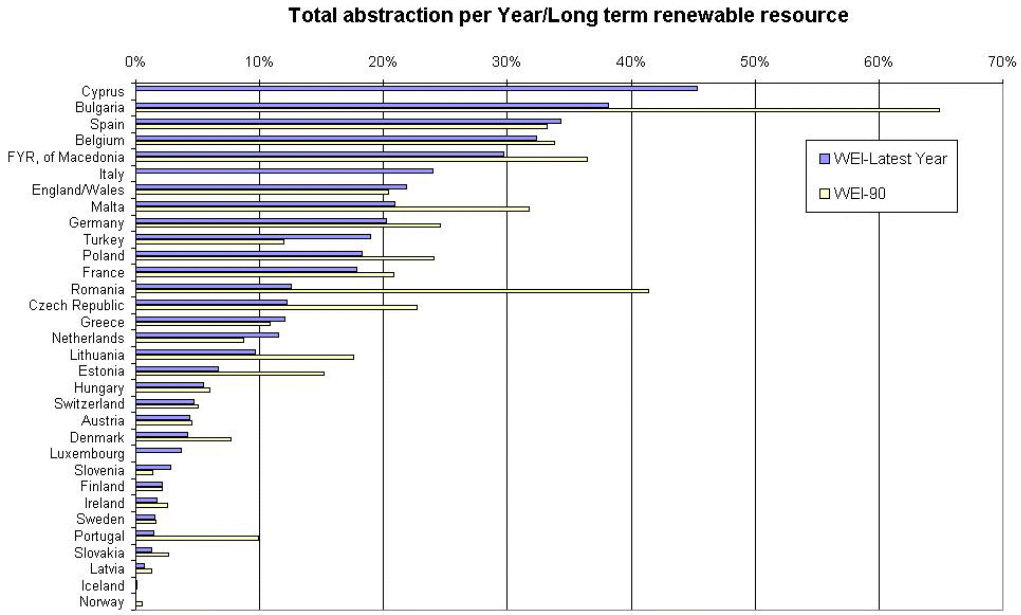
The term 'virtual water' was introduced by Professor Tony Allan[15] in the early 1990s. It is defined as the volume of water required to produce a commodity or service. When there is a transfer of products or services from one place to another, there is little direct physical transfer of water (apart from the water content of the product, which is quite insignificant in terms of volume). There is however a significant transfer of virtual water between developing and developed countries.

Water footprint

Traditional water use statistics show water supply per sector (domestic, agriculture, industrial water use). The approach has always been supply and producer oriented. The water footprint concept has been introduced to have a demand and consumer oriented indicator, as well. The 'water footprint' concept has been introduced by Professor Arjen Hoekstra[16] in 2002 in order to have an

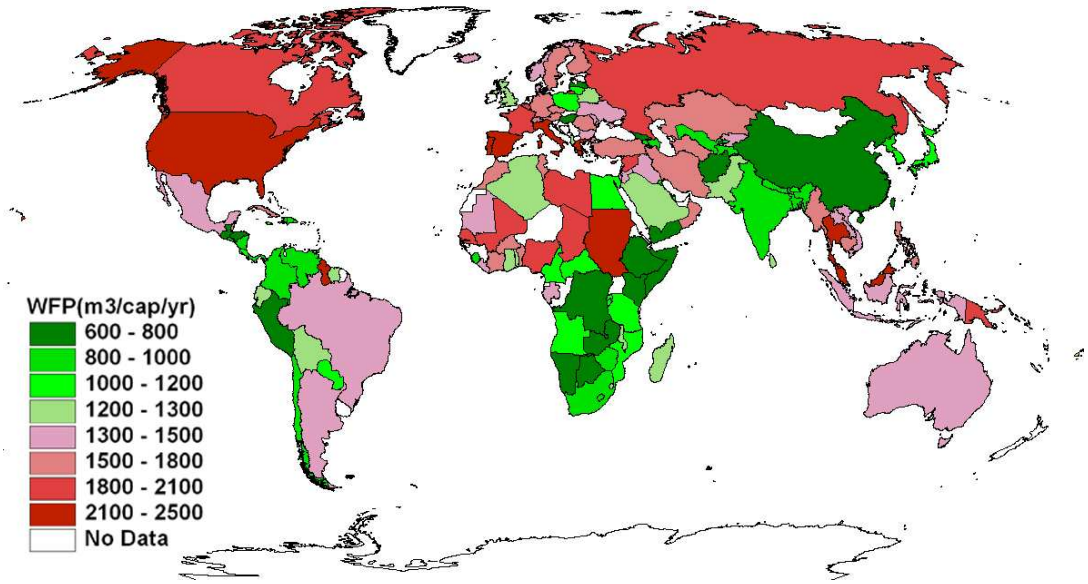
[13] EEA-ETC/WTR based on data from Eurostat data table: Annual water abstraction by source and by sector
[14] These facts were pointed out by Professor Jacqueline McGlade, Executive Director of the European Environment Agency at the European Water Partnership (EWP) conference, Zaragoza, 4th September 2008
[15] King's College London; named the 2008 Stockholm Water Prize Laureate in March 2008.
[16] University of Twente; Scientific Director of the Water Footprint Network

indicator of water use in relation to consumption (figure no. 4). The water footprint of an individual, business or nation is defined as the total amount of freshwater that is used to produce the goods and services consumed by the individual, business or nation.



Water footprint of nations.

Regional virtual water balances and net interregional virtual water flows related to the trade in agricultural products. Period: 1997-2001. Only the biggest net flows (>10 Gm3 per year) are shown.[17]



[17] http://www.waterfootprint.org

Example: Coffee

Water footprint: 140 litres for 1 cup of coffee.
It costs about 21000 litres of water to produce 1 kg of roasted coffee. For a standard cup of coffee we require 7 gram of roasted coffee, so that a cup of coffee costs 140 litres of water. Assuming that a standard cup of coffee is 125 ml, we thus need more than 1100 drops of water for producing one drop of coffee. Drinking tea instead of coffee would save a lot of water. For a standard cup of tea of 250 ml we require 30 litres of water.
The world population requires about 120 billion cubic metres of water per year in order to be able to drink coffee. This is equivalent to 1.5 times the annual Rhine runoff and constitutes 2 % of the global water use for crop production. International trade in coffee products is responsible for 80 billion cubic meters of virtual water exports, which is about 6% of the international virtual water flows in the world. Among all the crop and livestock products coffee stands at the top position in the list of global virtual water flows.

These approaches of measuring water abstraction could assist as the following:

- New instrument for defining the areas significantly threatened by climate change impacts
- Basis for prioritization of financing of adaptation and mitigation measures
- Support for government bodies, international institutions, non-governmental organizations, businesses and other organizations in implementing water footprint accounting and developing a sustainable and fair water policy

Once the priority areas and sectors are identified, adaptation strategies should define appropriate adaptation measures that consider the crosscutting character of climate change impacts. The main objectives for each area (water, ecosystems/biodiversity and land use) were listed in the background document. The following table provides further information on adaptation measures in water management with respect to other sectors.

Table : Overview of possible measures related to water management

	Flood prone situation	Drought prone situation	Impaired water quality	Health effects
PREVENTION **Measures** include…	• Restriction of urban development in flood risk zones • Measures aiming at maintaining dam safety, afforestation and other structural measures to avoid mudflows • Construction of dykes • Changes in operation of reservoirs and lakes • General land-use management *->Various legal/financial/economic instruments are available.*	• Reducing need for water • Water conservation measures/ effective water use (industrial and other sectors' practices and technologies) • Water saving (permit systems for water users) • Improved irrigation efficiency • Land-use management *->Various legal/financial/ economic instruments are available.*	• Prevention of and cleaning up of dump sites in flood risk zones • Improved waste water treatment • Regulation of wastewater discharge • Improved drinking water intake *->Various legal/financial/economic instruments are available.*	• Strengthen and use a capacity for long-term preparation and planning, especially to identify, address and remedy the underlying social and environmental determinants that increase vulnerability
IMPROVING RESILIENCE **Measures** include… **IMPROVING RESILIENCE (cont'd)**	• Operation of reservoirs/lakes (surplus of water can be handled without causing damage) • Implementation of retention areas • Improved drainage possibilities • Structural measures (temporary dams, building resilient housing, modifying transport infrastructure) • Migration of people away from high-risk areas	• Enlarging the availability of water (e.g. increase of reservoir capacity) • Improving the landscape water balance • Introduction or strengthening of a sustainable groundwater management strategy • Joint operation of water supply and water management networks or building of new networks • Identification and evaluation of alternative strategic water resources (surface and groundwater) • Identification and evaluation of alternative technological solutions (desalinization; reuse of wastewater) • Increase of storage capacity (for surface and ground waters) both natural and artificial	• Safety and effectiveness of waste water systems • Isolation of dump sites in flood risk zones • Temporary wastewater storage facilities	• Use existing systems and links to general and emergency response systems • Ensure effective communication services for use by health officials
PREPARATION **Measures** include…	• Flood warning (incl. early warning) • Emergency planning (incl. evacuation) • Flash-flood risks, (measures taken as prevention, as the	• prioritization of water use • restrictions for water abstraction for appointed uses • emergency planning • awareness-raising • risk communication to the public	• Restrictions to wastewater discharge and implementation of emergency water storage	• Strengthen the mechanism for early warning and action

	Flood prone situation	Drought prone situation	Impaired water quality	Health effects
	warning time is too short to react)	• training and exercise		
RESPONSE **Measures** include…	• Emergency medical care • Safe drinking water distribution • Safe sanitation provision • Prioritization and type of distribution (bottled water, plastic bags, etc.)			
RECOVERY **Measures** include…	• Clean-up activities • Rehabilitation options such as reconstruction of infrastructure • Governance aspects such as legislation on, inter alia, insurance, a clear policy for rehabilitation, proper institutional settings, rehabilitation plans and capacities, and information collection and dissemination.			

Soure: DRAFT GUIDANCE ON WATER AND CLIMATE ADAPTATION, prepared by the Convention's Task Force on Water and Climate and the Protocol's Task Force on Extreme Weather Events for the Workshop on Water and Climate Adaptation (Amsterdam, 1–2 July 2008).