This country profile was compiled by the OECD Secretariat and reflects information available as of June 2013. Further information and analysis can be found in the publication: OECD (2013) *Water and Climate Change Adaptation: Policies to Navigate Uncharted Waters,* OECD Studies on Water, OECD Publishing. http://dx.doi.org/10.1787/9789264200449-en. Country profiles for all OECD member countries are available for download at: www.oecd.org/env/resources/waterandclimatechange.htm. These profiles will be regularly updated and it is planned to expand coverage over time to include key partner countries.

European Commission

Climate change impacts on water systems

Observed changes and trends

- Global mean temperature has increased by 0.8 °C compared with pre-industrial times. Europe has experienced greater warming than the global average.
- Precipitation changes show spatially variable trends across Europe. Increase in annual precipitation in northern Europe by 10% to 40% and decrease up to 20% in some parts of southern Europe during the 20th century.
- Increasing trend in annual river flows showed in northern parts of Europe over the 20th century, with increases mainly in winter, and a slightly decreasing trend in southern parts of Europe.
- Significant acceleration of the melting of European glaciers since 1980.
- More flooding and heavy rain events have occurred in recent years.
- Several major droughts have occurred in recent decades, such as the catastrophic drought in the summer of 2003 in central parts of the continent and the 2005 drought in the Iberian Peninsula.

Projected impacts

- Increase in temperature of 1 °C to 5.5 °C by the end of the century, higher than the projected global warming of 1.8 °C to 4 °C.
- Increase in mean annual precipitation in the North and decrease in the South.
- Decrease in annual river flow in southern and south-eastern Europe and increase in northern Europe. However, precise changes remain uncertain.
- Significant changes in the seasonality of river flows across Europe. Decrease in summer flows in most of Europe, including in regions where annual flows will increase.
- Increase the frequency and severity of droughts due to river flow in southern and south-eastern Europe, the United Kingdom, France, Benelux, and western parts of Germany over the coming decades. In snow-dominated regions, where droughts typically occur in winter, river flow droughts are projected to become less severe because a lower fraction of precipitation will fall as snow in warmer winters.
- Substantial decrease in glacier coverage across Europe's mountains over the coming decades. Alpine glaciers could all but disappear this century. If glaciers continue to retreat at current or even faster rates, many areas will be put at much greater risk of floods, water shortages and sea level rises.
- Decreasing quantity of fresh groundwater resources, especially in coastal areas and in southern Europe, while brackish and salt groundwater bodies will expand. In addition, fresh groundwater bodies will become more vulnerable to pollution due to reduced turnover times and accelerated groundwater flow.
- Higher water temperatures and extreme weather events such as flooding and droughts will also impact on water quality and exacerbate existing pollution problems.
- Increase in the frequency and intensity of floods in large parts of Europe. In particular, flash and urban floods, triggered by local intense precipitation events are likely to be more frequent throughout Europe. Flood hazard will also probably increase during wetter and warmer winters, with more frequent rain and less frequent snow. Even in regions where mean river flows will drop significantly, as in the Iberian Peninsula, the projected increase in precipitation intensity and variability may cause more floods.
- Increase in the frequency and intensity of droughts in many regions of Europe as a result of higher temperatures, decreased summer precipitation, and more frequent and longer dry spells.
- The regions most prone to an increase in drought hazard are southern and south-eastern Europe, but minimum river flows will also decrease significantly in many other parts of the continent, especially in summer.

Primary concerns

Water quantity	Water quality	Water supply and sanitation	Extreme weather events	Ecosystems
✓			✓	

Key vulnerabilities

- Western Europe is vulnerable to water scarcity, droughts, and floods. The energy sector is the most vulnerable. A shift in cooling systems, together with reduced thermal electricity production, can help to overcome water shortages and protect ecosystems from thermal pollution. Some minor irrigated agricultural areas may not suffer from water shortages due to increasing efficiencies. However, due to temperature increases, maize yields are expected to decline, meaning that either cropping calendars or cropping patterns need to be adapted. Due to climate change impacts and increasing future water abstractions, minimum water requirements for ecosystem maintenance and the hydropower sector are at risk. Navigation will suffer from climate change during either drought periods or flooding. The largest unknown is with regard to future water quality, which is expected to decrease resulting from diffuse source loadings released with floods and heavy rainfall or reduced dilution capacity of the rivers. Transboundary river basins are of particular interest, as they have to deal with many kinds of vulnerabilities.

Climate change impacts on water systems *(cont.)*

- In Eastern Europe, water scarcity can be reduced due to integrated water management. There is no major water user that is particularly threatened. The region is also vulnerable to floods, with the highest costs related to damages in percent of GDP. Similar to Western Europe, transboundary rivers have to deal with high risk of flooding upstream, whereas downstream vulnerability is related to water shortages and droughts. Navigation and ecosystems are threatened by climate change impacts, which will be exacerbated by increasing abstractions.
- In Southern Europe, freshwater resources will suffer in the future from climate change impacts as well as socio-economic drivers. The region is highly vulnerable to water scarcity and drought and to flash floods. The agricultural sector is the most vulnerable. Reducing water abstractions can help to address the imbalance between water supply and demand. Technological changes and raising awareness will not be sufficient to reduce water stress and reduction in irrigated areas and changes in cropping calendars or cropping patterns should be taken into consideration. Of specific interest are transboundary river basins shared between Spain and Portugal. High water abstractions upstream not only cause water shortages downstream but could also lead to deterioration of groundwater aquifers due to saltwater intrusion and reduced river discharges.

Sources: European Commission (2009), *Fifth National Communication from the European Community under the UNFCCC*, *http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/4903.php* (accessed 22 June 2012); European Commission (2012), *Adaptation to Climate Change*, *http://ec.europa.eu/clima/sites/change* (accessed 20 April 2013); European Commission (2009), "Climate Change and Water, Coasts and Marine Issues", *Commission staff working document*, COM(2009)147 final, European Commission, Brussels; European Environment Agency (2007), "Climate Change and Water Adaptation Issues", *Technical Report*, No. 2/2007, European Environment Agency, Office for Official Publications of the European Communities, Luxembourg; European Environment Agency, Joint Research Centre, and World Health Organization (2008), "Impacts of Europe's Changing Climate – 2008 Indicator-Based Assessment", *EEA Report*, No. 4/2008, and *JRC Reference Report*, No. JRC47756, Office for Official Publications of the European Communities, Luxembourg; Flörke et al. (2011), *ClimWatAdapt Report*, Study for the European Commission, DG Environment, Brussels.

Key policy documents[1]

Document	Reference to Water?	Type of Instrument	Year	Responsible Institution
Water Framework Directive	Y	Legal Act	2000	DG Environment
Floods Directive	Y	Legal Act	2007	DG Environment
EU Adaptation White Paper	Y	Communication	2009	DG Environment
Guidance document on adaptation to climate change in water management	Y	Guidance document	2009	DG Environment
EU Adaptation Strategy		Adaptation Strategy	2013	DG Climate Action

1. For more information see *http://ec.europa.eu/environment/water/adaptation/index_en.htm*.

Policy instruments[1]

Areas \ Policy mix	Regulatory instruments	Economic instruments	Information and other instruments
Water quantity	• Water Framework Directive (WFD): Goundwater quantitative status and surface environmental flows needed to ensure good ecological status.	• Water pricing: The WFD requires that the price charged to water users adequately covers costs, including environment and resource costs, hence taking into account vulnerability to water scarcity and droughts.	• Public participation procedures in the preparation of the River Basin Management Plans required by the WFD and Flood Risk Management Plans required under the Floods Directive. All assessments, maps and plans prepared shall be made available to the public. • Droughts Management Plans. • Guidance on natural water retention measures to increase drought resilience and reduce flood risks to be prepared by 2013 as follow-up of the 2012 Blueprint to safeguard Europe's waters, to support the forthcoming River Basin Management Plans, and Flood Risk management Plans to be presented by Member States in 2015.
Water quality	• Water Framework Directive. • Urban Waste Water Directive. • Nitrates Directive.	• Water pricing under the WFD.	
Water supply and sanitation	• Urban Waste Water Directive. • Drinking water Directive.	• Water pricing under the WFD.	
Extreme weather events	• The Floods Directive requires that flood risk maps are drawn up by 013 for river basins and associated coastal areas at risk of flooding. By 015, flood risk management plans are to be established, *http://ec.europa.eu/environment/water/flood_risk/index.htm*.	• Potential implementation of payments for ecosystem services (PES) linked to natural water retention measures aiming at floods and droughts prevention.	

Policy instruments[1] *(cont.)*

Areas \ Policy mix	Regulatory instruments	Economic instruments	Information and other instruments
Ecosystems	• Framework Directive. • Integrated Coastal Zone Management (ICZM). • Natura 2000.	• Potential implementation of PES.	• European Climate Adaptation Platform (CLIMATE-ADAPT): On-line information platform to support Europe in adapting to climate change. An initiative of the European Commission, it helps users to access and share data and information on adaptation, *http://climate-adapt.eea.europa.eu/web/guest*. • The Water Information System for Europe (WISE): An on-line platform on water-related information for government, water professionals and scientists, as well as the general public, *http://water.europa.eu*. • WFD circa – Information Exchange Platform: An on-line platform established by the Commission. Circa ("Communication Information Resource Center Administrator") promotes information exchange about the implementation of the WFD between countries, European institutions, various stakeholders, and the interested public, *http://ec.europa.eu/environment/water/water-framework/iep/index_en.htm*.

1. The instruments indicated in this table provide the framework within which the policies of the EU member states are developed.

Main research programmes

- Joint Research Centre (JRC):[1] Research in support of EC climate change policy focuses on five areas: mitigation; adaptation; scenario modeling; monitoring and verification; and civil society perspectives. In particular, JRC climate change research aims to determine costs and benefits (both in monetary and non monetary terms) of mitigation and adaptation policies.
  - European Drought Observatory (EDO): A tool for assessing, monitoring and forecasting droughts on a continental level in Europe, *http://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1000*.
  - Impact assessment for the Blueprint: Developed a baseline scenario bringing together climate, land-use and socio-economic scenarios and looking at the implication for water resources availability and use under different policy scenarios. A multi-criteria optimisation of scenarios for the protection of water resources in Europe is being developed to support the impact assessment of the Blueprint (forthcoming).
- The 7th Framework Programme (FP7) for Research and Technological Development: Climate change is included under the theme "environment" (one of ten themes), which has been granted EUR 1.89 billion for the period 2007-13. Research focuses on implementation of mitigation and adaptation options, in particular technological developments. Since 2003, expenditures on climate research in the EC Framework Programme are estimated at nearly EUR 570 million. Some of the most relevant projects include:
  - REFRESH: Adaptive strategies to mitigate the impacts of climate change on European Freshwater Ecosystems, *www.refresh.ucl.ac.uk*. Development of system enabling water managers to design cost-effective restoration programmes for freshwater ecosystems at local and catchment scales, accounting for future impacts of climate and land-use changes.
  - ACQWA: Assessing Climate Change Impacts on the Quantity and Quality of Water, *www.acqwa.ch*. Assessing vulnerability of water resources in mountain regions over the next 50 years, identifying possible conflicts among economic actors (users of water resources) and assessing governance/adaptation options.
  - CLIMATEWATER (*www.climatewater.org*): Study of European and international adaptation measures and strategies and how these are taken into account in water policies in order to formulate a coherent framework.
  - CLIMATECOSTS, CLIMSAVE, MEDIATION.
- ClimWatAdapt: "Climate Adaptation – Modelling Water Scenarios and Sectoral Impacts" sheds light on both vulnerability and adaptive capacity in different sectors and across Europe's river basins. It is using an integrated assessment framework consisting of scenarios on climate change and socio-economic developments, vulnerability indicators, an inventory of measures, instruments and methods to assess the performance of adaptation options, and decision support. It will cover the EU27 Member States. (*www.climwatadapt.eu*).

1. JRC is the research arm of the European Commission. It provides scientific and technical support to the development and implementation of EC policies, and it serves the interests of the Member States as a reference centre for science and technology issues.

Principal financing mechanisms and investment programmes

- EU Structural and Cohesion Funds: Provide some means to co-finance capital-intensive investment in water infrastructure and help EU Member States comply with water legislation. For management of water resources, EUR 8 billion in total funding is provided for reducing leakage rates, connecting to water supply, generating additional supply and improving infrastructure. For disaster prevention, EUR 7 billion is available. The Solidarity Fund (EUSF) provides funds for disaster relief in member states. Around EUR 1 billion are allocated each year, *http://ec.europa.eu/regional_policy/funds/cf/index_en.htm*.
- Life + Funds: Support environmental and nature conservation projects throughout the EU. For the period 2007-13, EUR 1.7 billion is available, *http://ec.europa.eu/environment/life/funding/lifeplus.htm*.
- Revenue from auctioning allowances under the Community greenhouse gas emission allowance trading system (EU ETS). The EU White Paper *Adapting to Climate Change: Towards a European Framework for Action* (2009) supports the possibility of using such revenue for adaptation purposes. The revised Directive governing the EU ETS provides that at least 50% of the revenue generated from auctioning allowances should be used, *inter alia*, for adaptation in Member States and developing countries.

Highlights and innovative initiatives

- **European Innovation Partnership for Water:** To support and facilitate the development of innovative solutions to deal with water-related challenges, as well as to support economic growth by bringing such solutions to the market. At the same time, innovations are considered to be an important tool to develop adequate and state of the art European water policy, *http://ec.europa.eu/environment/water/innovationpartnership/index_en.htm*.