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Bridging the gap between adaptation strategies of climate change impacts and European water policies

Funded by the Seventh Framework Programme

Water Research Institute of the Italian National Research Council (CNR-IRSA) P3

Analysis and synthesis of water related climate change impacts

October 13 – 14, 2011

Aim

- Aim of WP2 was to provide an overview of the main impacts, already observed, or that are likely to occur in the next years, caused by climate change (CC) on the European waters.

- WP2 consisted in performing an extreme synthesis of a considerable number of the processed papers with reference to practically all the impacts occurring on the water sector as a consequence of climate change.

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- The impacts were organized according to the categories established at the beginning of the project.

- This synthesis was performed based on the two sub-work package reports, one on the impacts on the society and economy (P8 - UNILEI) and the other on the impacts on nature (P7 – UNIVIEN.FE) which are, in turn, based on the task leader reports and on the thematic focus reports.

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The past

The Earth's average surface temperature has risen by 0.76 °C since 1850. Most of the warming over the past 50 years is very likely to have been caused by emissions of carbon dioxide (CO_2) and other 'greenhouse gases' from human activities.

The future

There are numerous indications that the climate change (mainly precipitation and temperature change) will assume different charcteristics in different parts of Europe.

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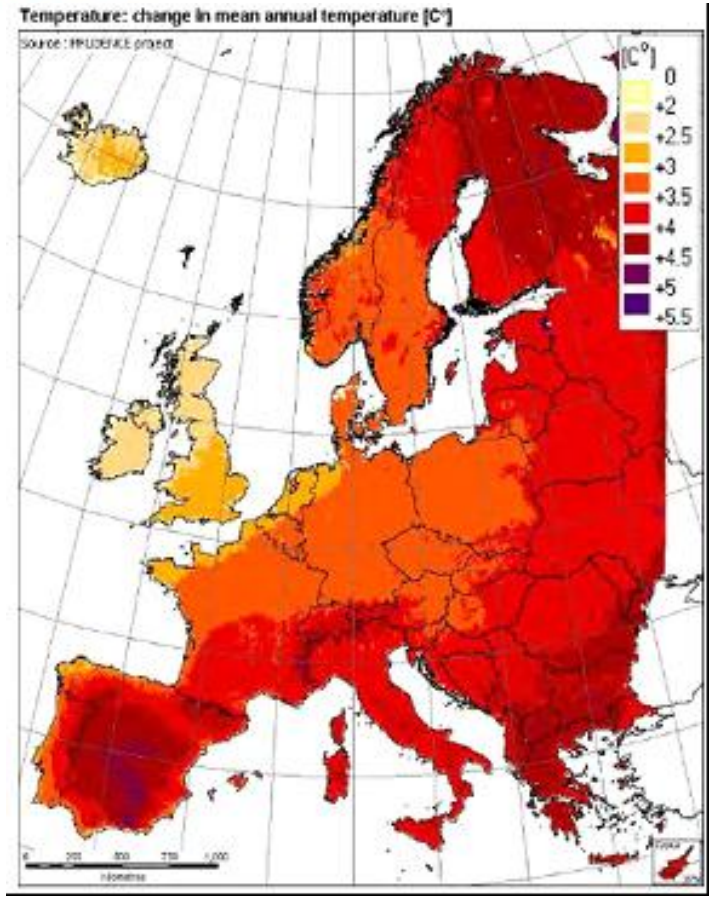

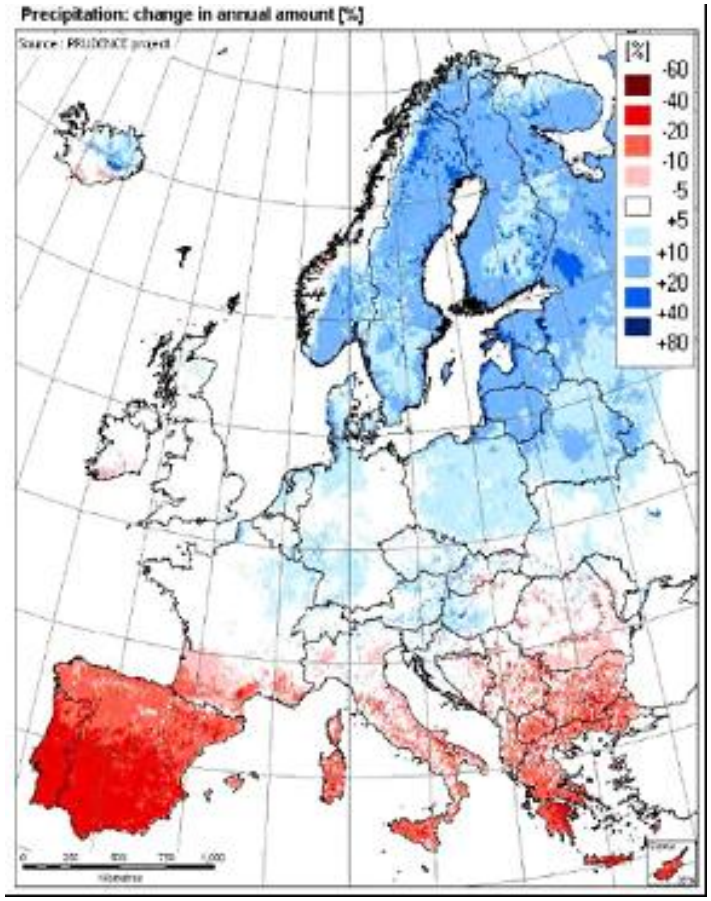

Modelling of Regional IPCCA2 Changes: Possible Temperature (left) and precipitation (right).
Source: Prudence Project

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Water use

- On average, 42% of total water abstraction in Europe is used for agriculture, 23% for industry, 18% for urban use and 18% for energy production.

- Nevertheless it has to be taken into account that sectoral water use changes considerably across Europe.

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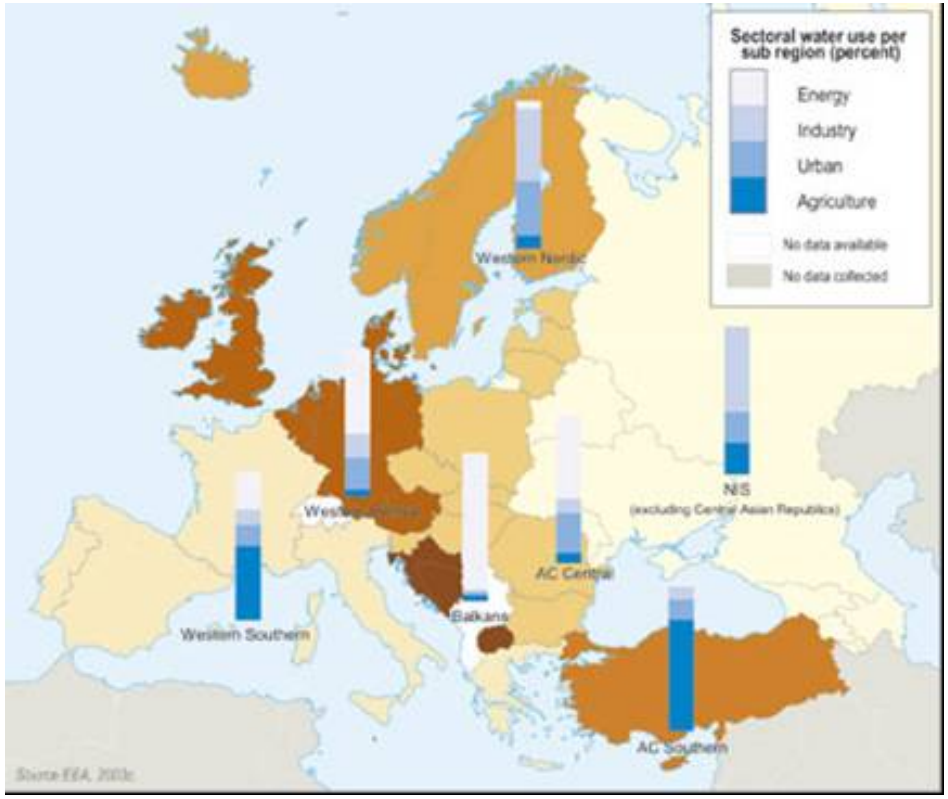
Water use



Sectoral water uses in different parts of Europe. After: EEA, 2003.

EEA Indicator Fact Sheet: Sectoral water use. http://themes.eea.eu.int/Specific_media/water/indicators/WQ02,2003.1003

WP2 - Water impacts

2.1 Impacts on society and economy

2.1.1 Direct Impacts

- Water supply
- Floods and excess water
- Water quality
- Drought and water scarcity

2.1.2. Indirect Impacts

- Water management
- Agriculture
- Navigation
- Hydropower and nuclear power generation
- Industrial production
- Tourism
- Land use planning

2.2 Impacts on nature

2.2.1 Aquatic ecosystems

2.2.2 Terrestrial ecosystems

2.2.3 Terrestrial-aquatic ecotones

IMPACTS - Water Supply
Fresh water (1)

- More annual runoff caused by increased precipitation is likely in the high latitudes.

  - In case precipitation increase consists of more intense and less frequent rainfall, increased contamination of surface water runoff, especially by eroded soil, microorganisms, pesticides and fertilizers can occur.

  - Always in case of occurrence of more intense and less frequent rainfall, if there is inadequate storage capacity to contain runoff, water supplies could decline, even with increased precipitation.

- In contrast, some lower latitude basins may experience large reductions in runoff and increased water shortages as a result of a combination of increased evaporation and decreased precipitation.

IMPACTS - Water Supply
Fresh water (2)

- All the above mentioned consequences of the climate change may impair water supply services that will have to cope with the challenge to satisfy consumer demand during periods of intensified water shortages.
- Such limitations in the availability of clean and fresh water could result in difficulties in achieving the goal of improved safe access to drinking water, in conflicts among different users.
- The increased frequency of extreme precipitation events may put under pressure sewage networks.
- Another problem anticipated by some of the referenced documents is that the poorer water quality consequence of the climate change, will require more robust water treatment measures.

IMPACTS - Water Supply
Groundwater (1)

Groundwater is a major source of drinking water all over Europe, and thus the state of groundwater in terms of quality and quantity is of vital importance.

Nevertheless, the effects of climate change on groundwater (for example changes in the rates of groundwater recharge) are almost undetected.

Climate changes, will lead to land and soil degradation, more frequent floods, rising sea levels, increasing aridity. All these modifications have a direct effect on both groundwater quality and quantity.

IMPACTS - Water Supply
Groundwater (2)

Decreasing groundwater recharge from surface water supplies may be directly caused by climate change. Nevertheless, also increased groundwater withdrawals due to higher temperatures and lower precipitation may be responsible for lower groundwater levels.

Exploitation of groundwater sources beyond a sustainable level can affect the environment (loss of wetlands and effects on river ecosystems) and reduce the future availability of the resource.

IMPACTS - Water Supply
Groundwater (3)

Many aquifers, exert a strong influence on river flows. For example, in summer, many rivers are dependent on the groundwater base flow contribution to provide a minimum flow.

Lower groundwater levels may, therefore, endanger river-dependent functions (including water supply from surface water abstractions).

IMPACTS - Water Supply
Seawater - Coastal regions (1)

Melting ice and thermal expansion of oceans are the key factors driving sea level rise. In addition to exposing coastlines, where the majority of the human population live, to greater erosion and flooding pressures, rising sea levels will also lead to salt water contamination of groundwater supplies, threatening the quality and quantity of freshwater to large percentages of the population.

Nevertheless, the main cause of saline intrusion is commonly regarded not to be the climate change, but an excessive groundwater abstraction from coastal aquifers.

IMPACTS - Water Supply
Seawater - Coastal regions (2)

Because of its high salt content, about 2% of seawater mixed with freshwater makes the water unusable in terms of drinking water standards, also because conventional treatment methods do not remove the salt.

A small amount of intrusion, therefore, can jeopardize the use of an aquifer for water supply. Due to the long residence time of groundwater, once contaminated with seawater, an aquifer can remain contaminated for decades.

In these conditions, costly water supply projects, such as desalination plants, pipelines, and dams will become more economically attractive.

Whilst the problem is most acute in Mediterranean coastal regions, saline intrusion also occurs in Northern Europe.

Conclusions

Huge number of papers have been published in the last decade on the likely consequences, the planet will be faced with, because of the ongoing and of the future changes of the climate.

A not so big, but still considerable, number of papers have been processed within WP2, and to draw meaningful conclusions from so many and assorted papers is not an easy task.

Besides, because it would be impossible, other than arbitrary, to make a choice among all the specific conclusions referred within all the processed papers, only some general conclusions are reported here.

Conclusions (2)

Among these there is the strong sensitivity of water resources to even comparatively small changes in climatic characteristics obtained for many regions of the world. This seems particularly true for the arid zones of the Planet that already have difficulties with water supply and experience conflicts between different water users.

It has also been reported that under all physiographic conditions, the values for water resources turn out to be more sensitive to changes in precipitation than in air temperature. This statement, in particular, allowed to assert that in the cases where the global warming is accompanied by a reduction in precipitation, water resources in the arid regions of the world will diminish drastically.

Conclusions (3)

There is overall consensus that climate change affects water system dynamics through temperature changes, changes in precipitation patterns (e.g. more rainstorms) increase of evaporation (extended droughts) and decrease of water storage in snow packs, glaciers and the polar ice caps.

Apart from these changes of the climate directly affecting one or more water resources, it has to be always taken into account that to further complicate matter, there is the hydrological connectivity among rivers, lakes wetlands and groundwater, that is responsible for the reverberation of many of the impacts on any one of these types of water body upon one or more of the others.

Conclusions (4)

Reading some of the papers dealing with the consequences of the CC it might seem that the main adverse effects caused by climate change on the water supply would occur in arid and semi-arid areas only.

Nevertheless it has to be mentioned that seasonal disruption might occur also in the water supplies of mountainous areas where, mainly because of increased temperature, the amount and duration of snow cover can be affected.

Conclusions (5)

Predictions about hydrology are difficult in Europe because anthropogenic factors, such as changes in land-use patterns, the drainage conditions of rivers and an increasing proportion of impermeable areas, strongly influence the European hydrological cycle, mixing up their effects with those of the CC.

Conclusions (6)

It is forecasted that, in the next decades, agriculture will remain the largest water user in the Mediterranean countries, with more irrigation and warmer and drier growing seasons resulting from climate change. Abstraction for the electricity sector is projected to decrease dramatically over the next 30 years as a result of continuing substitution of once-through cooling by less water-intensive cooling tower systems; industrial water use is likely to stabilise or even decrease; in Eastern Europe, urban water supply may grow significantly.

Conclusions (7)

The magnitude of all the impacts will depend on the baseline conditions of the water supply system impacted, including the socio-economic situation of the area, that strongly conditions the vulnerability and the capacity to adapt of a system.

There is, in fact, general agreement that development can, by its very nature, build adaptive capacity, helping poor countries to become less vulnerable to the impacts of climate change.

This is the reason why it is suggested that development policies, rather than explicit adaptation strategies would be the most effective way to reduce the vulnerability to CC impacts.

Conclusions (8)

There is also general agreement that, to cope with impacts of such a variety, magnitude and geographical extension, the measures have to be management, planning and political measures, before that structural interventions. Only water resource managers, in fact, can respond to the combined effect of the climate change, of the population growth (and consequently of changes in demand) and of changes in technology, in economic, social and legislative conditions.

With this reference, a need is acknowledged for reconsidering water management on a catchment basis, through openly agreed and fairly conducted procedures. These approaches have to take into consideration all classes of users, including the natural world. Besides, it has to be considered that, mainly where integrated water management systems exist, improved management may also protect water users from the effects of climate change at minimal costs.

Conclusions (9)

Considering the transboundary extension of many of the CC impacts, some of the processed papers also conclude suggesting that integrating CC into foreign policies could greatly enhance the ability an willingness of nations and of the international community to meet the challenge of minimising the impact of the CC.

Research is needed aimed at the reliable location of "hot spot" areas (special geographical areas containing either human populations or ecosystems highly vulnerable to impacts of climate change). The advantage is that the sparse resources of the society could be devoted, before all, to such limited areas.

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Thanks for attention!