

Climate ≈ water

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



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Climate change and water. Identification of the research needs in Europe

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The project

- ClimateWater (Bridging the gap between adaptation strategies of climate change impacts and European Water policies) is an EU-FP7 funded project
- Project type: Supporting action (FP7);
- Home page: <http://www.climatewater.org>
- The project was carried out thanks to the contribution of 11 partners from 9 European countries

Partners:

VITUKI, Hungary

UNIDEB, University of Debrecen, Faculty of Engineering, Hungary;

CNR-IRSA, Water Research Institute of the National Research Council, Italy;

USF, Institute of Environmental Systems Research, University of Osnabrück, Germany;

GeoEcoMar, National Institute of Marine Geology and Geo-ecology, Romania;

Geonardo, Geonardo Environmental Technologies, Hungary;

UNILEI, University of Leicester, UK;

UNIVIEN, University of Vienna, Austria;

SHMU, Slovak Hydrometeorological Institute, Slovakia;

SOGREAH, SOGREAH Consultants, France;

MRA, Malta Resources Authority, Malta

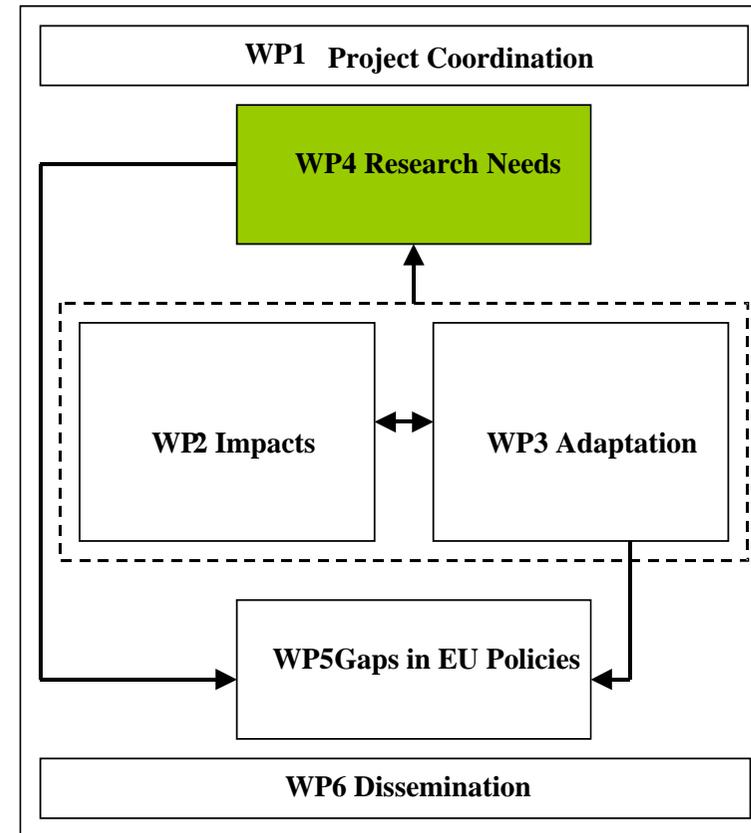


Project aim

- The study of **adaptation measures** and strategies to tackle the consequences of climate change on water resources, how these are taken into account by European water policies and to what extent these measures are capable of responding to the identified needs.

Project aim

- The project reached this aim through the achievement of four intermediate objectives, corresponding to the below mentioned four work packages:
 - analysis and synthesis of water related impacts (WP2);
 - analysis and synthesis of methodologies of adaptation measures (WP3);
 - identification of research needs (WP4)
 - identifying and bridging gaps in water related European policies (WP5).



WP4 - identification of research needs

WP4 represents one of the main outputs and synthesizing efforts of the whole project. The WP highlights **the research gaps still existing with reference to:**

- the effects of climate change on water resources,
- the understanding of the indirect effects on productive sectors that use great amounts of water
- the adaptation and mitigation strategies that can be employed to minimize these effects
- fields, such as alternative sewage treatment, that may represent powerful tools to mitigate or to adapt to climate change impacts.



The research areas considered

- 1. Ecohydrological strategies for water and ecosystem management;
- 2. Research into climate change induced causes of pollution;
- 3. Research into alternative wastewater and sewage water treatment and reuse technologies;
- 4. Research into water stress and drought;
- 5. Research into drinking water supply;
- 6. Research into groundwater;
- 7. Research into sustainable agricultural and silvicultural production in drought ridden regions;
- 8. Research into palaeoflood hydrology;
- 9. Research into navigation;
- 10. Research into water dependent energy sector;
- 11. Research into flood forecast and defence;



Ecohydrological strategies for water and ecosystem management

- Ecohydrology (EH) is a scientific concept that links hydrology and habitat hydraulics with the aquatic and terrestrial ecosystems at all possible scales. It represents an effective tool to mitigate climate change impacts on aquatic environments.
- Defining research needs in EH requires the identification of knowledge gaps in more than just a scientific field. On the other hand, an attempt to mitigate all possible impacts of climate change in a particular environment may be unnecessarily expensive and time consuming. This makes **the identification of the fundamental impacts of climate change the most important topic of EH research associated to climate change.**



Ecohydrological strategies for water and ecosystem management (2)

Two other pretty general research needs concern

- The modalities to bridge the gaps in scales that are inherent to the concerned disciplines.
- Climate change impacts may spread from directly impacted areas to other areas and sectors, through complex linkages. Therefore, total impacts are poorly estimated considering only direct impacts and research is needed concerning **how to better identify and take into account these indirect effects.**



Research into climate change induced causes of pollution

From the studies performed within the ClimateWater project it came out that especially diffuse pollution sources that transport pollutants intermittently, for example in concomitance with particularly intense weather events, are influenced by climate change.

With this reference knowledge gaps remain concerning:

- the development of technical methods to minimize nutrient loss. These methods already exist at field or small catchment level. What is needed are **large scale experiments**, such as field-edge sediment and nutrient traps, to test and quantify nutrient reduction;
- understanding of the **efficiency of the pollutant removal capacity** of adaptation strategies applied to contrast diffuse pollution.



Research into alternative wastewater and sewage water treatment and reuse technologies

Due to problems of drought and water scarcity **wastewater has not to be consider anymore a waste**, but a valuable source of substances and energy besides that, of course, of water. To transform this paradigm shift from theory into practice, **waste water treatment should be considered as a manufacturing process** to obtain, to recover or to reuse a number of products (e.g. bio-plastic, methane, nitrogen and phosphorus and wastewater).



Research into alternative wastewater and sewage water treatment and reuse technologies

With this in mind important research fields concern:

- a) Implementation of [enhanced process control](#);
- b) Evaluation and application of [membranes](#) for wastewater treatment;
- c) Increased use of [anaerobic steps](#) in wastewater treatment;
- d) Expanded use of [wetlands](#) for wastewater treatment;
- e) Study of the [microbial ecology of biological treatment systems](#);
- f) Development of [technologies for separation and treatment](#) of black water and grey water;
- g) Development of a [local reuse demonstration project](#) for grey water reclamation;
- h) Development and commercialization of [molecular sensors](#);
- i) Development of the [ability to disinfect waterborne pathogens](#);
- j) Development of [methods for tracking chemicals and microorganisms](#) within the wastewater stream to determine how they affect water quality;
- k) Identification and quantification of [new risks for wastewater treatment industry](#);



Research into water stress and drought

Drought and water scarcity is the most severe climate change related issue in Southern Europe, but also in Northern countries water shortages are already met, especially during summer (EEA, 2010). Frequency and rate of water scarcity and drought is projected to increase.

With this reference the research areas synthetically described below were identified.

- **Drought related data collection, indices and modelling**
 - identification of indicators to detect drought situations;
 - development of tools to assess drought vulnerability;
 - development of models that take into account also social and economic scenarios.
- **Water demand management**
leakage reduction and increase water use efficiency.
- **Alternative sources of water supply**
to be considered only when the potential for water saving has been exhausted.



Research into drinking water supply

- It is very likely that **climate change**, through more frequent and severe drought, flooding and weather events, **will impact all areas of water services**: the quality and availability of water sources, infrastructures and the type of treatment needed to meet quality standards.
- The research needs in this field are the same highlighted with reference to alternative wastewater and sewage water treatment and reuse technologies



Research into groundwater

Groundwater conditions are the reflection not only of precipitation and temperature changes, but also of human actions, such as agricultural drainage that can, in turn, indirectly be conditioned by climate change.

As a result of the complexity of these problems a detailed understanding of the relations between climate change pressures on groundwater and the consequent responses of the resource is still missing.

Some of the research areas emerged from ClimateWater are:

- assessment of implications of changes in precipitation and evaporation on groundwater recharge;
- assessment of hydrologic interactions between ground water and surface water systems;
- better understanding of the hydrodynamic conditions of catchments;
- improvement of the monitoring process and of primary data collection.



Research into sustainable agricultural and silvicultural production in drought ridden regions

Agriculture not only represents one of the most significant sources of diffuse pollution in many areas of the Globe but may, in turn, be impacted by other impact sources such as, for example, climate change (Garnier et al, 2010).

- To cope with these issues, the **uncertainty levels** of projected impacts must be reduced.
- More **research in the field of feasible, sustainable and profitable agricultural production systems**. This means to find the way to meet the growing demand for food, energy and fuels minimizing, at the same time, pressures on natural resources, taking into account accelerating climate change as well.



Research into palaeoflood hydrology

Paleoflood hydrology is the [study of the hydrology of past floods](#) and is believed it could greatly help in the understanding of the links between climate change and variations in river hydrology.

Palaeoflood hydrology is a rather new discipline and for this reason still presents some blanks that need further research.

Among these:

- the determination of the [confidence limits](#) of palaeo-information;
- the determination of the limits of the [spatial transferability of data](#) gained from palaeo-hydrological information;
- better quantitative evaluations of extreme hydrological responses to past environmental changes.



Research into navigation

Changes in sea levels and in wind and wave conditions, with implications for navigation and navigation infrastructures are also occurring because of climate change. Although navigation is a very old mean of transportation, technological innovations are still possible and desirable in this field.

Research is needed with this reference,

- to **reduce vessel fuel consumption**,
- to **reduce water consumption** in inland channels,
- to convert navigation into a very low GHG emission transportation mean;
- to find **ways** how to allow **the navigation community to work with the climate researchers**.



Research into water dependent energy sector

With particular reference to hydropower, some important research needs have been identified.

Among these:

- what should be the **minimum flow** to be left in rivers downstream of derivations;
- identification of solutions for the significant problem of **reservoir sedimentation**
- recognition of adequate approaches for the **restoration of river hydro-morphology**, after that the construction of dams has compartmented rivers;
- estimation of **methane emission** of reservoirs.



Research into flood forecast and defence

Flood defence is not an issue of ever increasing dam levees, but rather to decrease flood risk, therefore, research in this field should focus on **risk management** measures and improved **forecasts technologies**.

- Risk management
 - to study the best combinations of **structural and non-structural flood measures** to reduce river peak floods;
 - to quantify **the effects of** the maturity, density, arrangement and size of **flood plain forests** on flood levels.
- Flood forecasting
 - the **improvement of resolution and accuracy of models** and of radar measures, especially for mountainous areas where the complex orography makes it difficult to carry out accurate measures;
 - **use ensemble Regional Circulation models (RCMs)**, in larger numbers and for different periods to reduce the uncertainty of meteorological forecasts.



Conclusions (1)

There are other research needs that came out from the work performed within ClimateWater project that cross all the sectors dealt with during this presentation.

Among these the need:

- to **improve climate change scenarios** in order to obtain better predictions and better quantification of uncertainty;
- to **define reliable methods to assess risks** based on these uncertainties;
- of **more regular field studies and more detailed monitoring** of all water bodies;
- to prepare **adaptation measures of "no-regret" decision type**, because of the expected increased variability of the hydrological regime.



Conclusions (2)

Scientific knowledge available would in many cases already be enough to realize mitigation and adaptation measures related to problems caused by climate change, but often problems have not been solved yet. This is the reason why, apart from the research needs described up to this point, **another important kind of action is political.**

Environmental policies are needed to transform into legislation the identified measures and are as necessary as the filling itself of all the research gaps described.





Thanks for attention!

