CL03

SUDEM-CLI

Impact of climate change on river hydrology and ecology: A case study for interdisciplinary policy oriented research

Cluster of the research projects : ADAPT – CCI-HYDR

DURATION OF THE PROJECT
01/04/2008- 31/03/2010

BUDGET
94.932 €

KEYWORDS
Climate change impacts, ecology, Flood plains

CONTEXT

The impact of climate change on river hydrology and ecology is a subject that receives increasing attention and has strong implication for hydrological, ecological, economic and social policy. While integrating climatological, ecological and hydrological information, we are confronted with difficulties on the determination of appropriate scales, indicators and measures. Furthermore it is not only important to know the causes, magnitude and uncertainties of CC, but even so important to communicate this complexity and uncertainty to policy makers and water managers. How can uncertainties associated with projections of regional climate models, be communicated and how should they work through in decision making processes?

PROJECT DESCRIPTION

Objectives

The aim of this research is bringing together key experts from the climatological, hydrological and ecological research communities, as well as water managers and policy makers, in order to improve the decision making regarding the impact of climate change on aquatic and floodplain ecosystems. This will be achieved by organizing a series of workshops (four workshops) bringing together all sectors (climatologists, hydrologists / water engineers, biologists / ecologists and policy makers). Also hydrometeorologists, sociologists and economists collaborating in the ongoing ADAPT and CCI-HYDR projects will be invited to take part of these workshops and put their expertises in the general discussion around climate change and environmental friendly adaptation measures.

Methodology

The research will be implemented on the case study of the Grote Nete, which will allow focusing on relevant practical aspects. Direct implementation of the methodologies will draw interest from local and regional water management authorities and nature development organisations. The results of CC-projections will be made explicit in terms of changes in river hydrological regimes, water quality and ecological quality. This will allow to make better projections of future habitat quality and diversity. The integration of these results in sub-basin management plans can be of interest to water managers as they do not yet consider CC-impacts in these plans.

Interdisciplinary challenges

The primary objective is the determination of the ecological impact of changes in flooding characteristics. If the flooding characteristics (frequency, duration, season, depth and nutrient deposition) change under CC-scenarios, it will affect the vegetation of the floodplains. Therefore tables are drawn up for different vegetation types where the impact of certain flood conditions can be looked up. The cumulative impact of these different flood conditions within a relevant time-frame will determine the effect on the vegetation communities.
Communication is a very important aspect in this project. Four workshops are foreseen to communicate the progress of the project and to receive input from the participants, both on the level of the methodology as for the case-study.
Many climate studies do not agree on the effect of CC on winter flows, but they do agree on the effects on summer flows. More frequent and more extreme droughts and associated low flows episodes are expected, often interrupted by extreme summer storms. These conditions can curiously enough also trigger more summer floodings. Prolonged periods of drought arte ideal conditions for sewage sludge accumulation in sewers. Extreme summers storms can wash this sludge out into rivers through sewer overflows. To assess the impact of such mechanisms, it is necessary to run CC-scenarios in sewer system models. In addition it is also necessary to look into the water transfers that occur through sewage infrastructure across hydrographical regions.
Higher tempeatures and more sunlight have a direct effect on the growth of macrophytes. But there are also indirect CC effects through prolonged low flow episodes and increased nutrient availability. During periods of low flow, macrophytes can have maximal growth and function as a natural water retention mechanism. By their growth, they increase flow resistance and raise surface water levels, without increasing the flow volume. The river drainage is reduced and groundwater levels are maintained within the valleys, reducing the impact of the droughts on agriculture and nature values. The massive growth has also negative consequences since sudden increases in river flow by extreme precipitation might cause summer flooding.

SSD SCIENCE FOR A SUSTAINABLE DEVELOPMENT

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The hydrological model of the Grote Nete basin has already been developed in the framework of the CCI-HYDR-project (BELSPO), where CC-scenarios have been developed and simulated in that model. A module will be developed to extract the necessary floodtype maps that are needed for ecological impact assessment. Although these results are already adequate for ecological impact assessment, water quality remains a crucial factor for some vegetation types during the growing season. Therefore a water quality model will be developed.
Additional CC-scenarios and improved regional climate change models will be used to assess uncertainty aspects. Many emission scenarios have been developed so far and many regional models exist that do not always come to the same conclusions. Additional scenarios will be processed in most recent regional climate models, building on the ABC-Impacts project.
It is essential to include a long-term vision on nature development and water management in the catchment of the Grote Nete in the assessment of climate change scenarios. The determination of impacts on the current situation is of little use if the study area will be drastically altered by 2050. The catchment of the Grote Nete has large habitat and bird directive areas that will be converted into nature. Many initiatives are taken for river and floodplain restoration.

INTERACTION BETWEEN THE PARTNERS

It is clear that interdisciplinary is required to succeed the objectives of the project. Many feedbacks exist between the different disciplines. There are specific needs concerning the parameters for ecological impact assessment, which are rather uncommon to hydrologists. The output of the different scenarios and climate models are critically evaluated before they are used for the hydrological modelling. A water quality model is added to the hydrological models, where we also want to recognise secondary impacts of CC on nutrient input into the river system. Both the hydrological modal as the water quality model need to deal with the effects of macrophyte growth on river hydrology and water quality.

PARTNERS

ECOBE, Universiteit Antwerpen (Ecosystem Management Research Group)
ECOBE is involved in fundamental and applied research on ecological processes in watercourses, estuaries and wetlands. In addition ECOBE also focuses on the integrated management of water systems, ecosystems and landscapes as producers of ecosystem services.
Hydraulics Division, Katholieke Universiteit Leuven
The Hydraulics Division of K.U.Leuven has extensive expertise in the study of hydrological extremes along rivers and urban drainage systems, including the impact of climate change. In their studies combined use is being made of physically-based hydrodynamic modelling and statistical analysis techniques.
Institut d'Astronomie et de Géophysique Georges Lemaître, Université catholique de Louvain
The main research activities of the Institut d'Astronomie et de Géophysique deal with climate variability in polar regions, past climate changes, and regional climate and atmospheric processes. Its regional climate modelling activities are mainly developed inside the CLM international modelling community.

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Follow-up Committee
For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting
http://www.belspo.be/fedra or
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