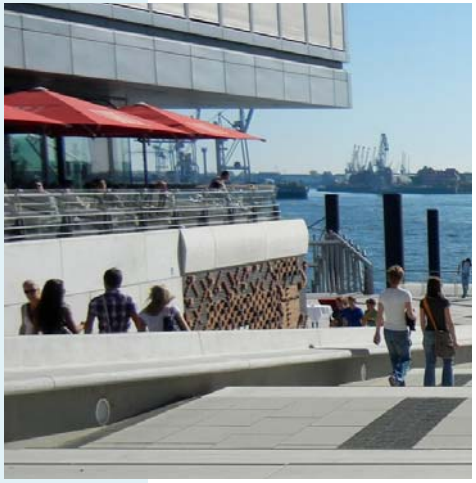
BaltCICA

CLIMATE CHANGE:

Impacts, Costs and Adaptation in the Baltic Sea Region



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CLIMATE CHANGE ADAPTATION PUT INTO PRACTICE

The BaltCICA project has:

- identified adaptation measures and implemented them in the Baltic Sea Region
- produced new knowledge relating to climate change impacts, costs and benefits and governance of adaptation
- reduced uncertainty in decision-making in relation to adaptation by strengthening the science-practice link
- increased participation of stakeholders and citizens in adaptation related decision-making

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INTRODUCTION

The BaltCICA project has identified and implemented climate change adaptation measures in various case studies in the Baltic Sea Region. The case studies were also used to explore the still relatively unknown costs and benefits of adaptation. New scientific methodologies to increase the participation of stakeholders in adaptation planning were developed and employed.

The 13 BaltCICA case studies focused on specific thematic areas, such as metropolitan planning and adaptation strategies (Hamburg, Tampere, Helsinki and its Metropolitan Region), groundwater and climate change (Hanko, Klaipėda and Falster), the Environment (North Vizdeme, Karklė) as well as scenario development and citizen participation (Kalundborg, Riga, Klaipėda, Tampere, Hamburg).

PAN-BALTIC COOPERATION

Transnational learning a vital part of BaltCICA

Impacts of climate change occur and are perceived differently throughout the Baltic Sea Region. Depending on local circumstances, climate change adaptation processes are in various stages and address different challenges.

The Foresight approach endorsed exchange of perspectives and approaches between the project's case studies. Workshop sessions and study visits facilitated transnational learning among the BaltCICA case studies. Transnational communication comprised awareness raising, methods for stakeholder involvement, technical solutions and cost-benefit-analysis of adaptation processes. Case studies with longer experience exchanged knowledge with less experienced partners.

Stakeholders were engaged in decision making processes through scenario workshops. This methodology was adapted to local circumstances by several project partners.

Information and experience on technical protection measures were also exchanged, including beach nourishment or sustainable use of ground water from coastal aquifers. The use of cost–benefit analysis and multi criteria decision analysis (MCDA) were explored by several workshops that used examples derived from BaltCICA case studies.

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ISLAND OF FALSTER

Groundwater resources in Danish coastal areas are threatened by climate change

The Marielyst waterworks represents a typical Danish water supply situation in coastal areas. The groundwater resources potential in the area is constrained by seawater intrusion, which is enhanced by drainage pumping from canals in low-lying reclaimed land areas below sea level.

Several waterworks on the island of Falster already face problems with high chloride content in groundwater. The projected sea level rise will increase this problem.

Most climate change models predict sea level rise, an increase in winter precipitation, and a decrease in summer precipitation. This especially challenges the drinking water supply, irrigation and drainage management in the area, and potential conflicts of interest may arise.

During the BaltCICA project, a 3D variable density groundwater model was constructed to test the following hypotheses and provide recommendations: 1) The projected sea level rise will increase saltwater intrusion and thereby decrease the available drinking water resources; 2) The projected increased winter precipitation will to some extent compensate for the negative effects of sea level rise, and 3) A necessary increase in drainage pumping to keep reclaimed lands dry will counteract this benefit.

The project investigations were planned in collaboration with the local waterworks, the land reclamation association, the municipality and the Danish Nature Agency. These stakeholders including local farmers and land/summer house owners are informed about the main results of the climate impact simulations, and recommendations for future adaptation measures are provided.

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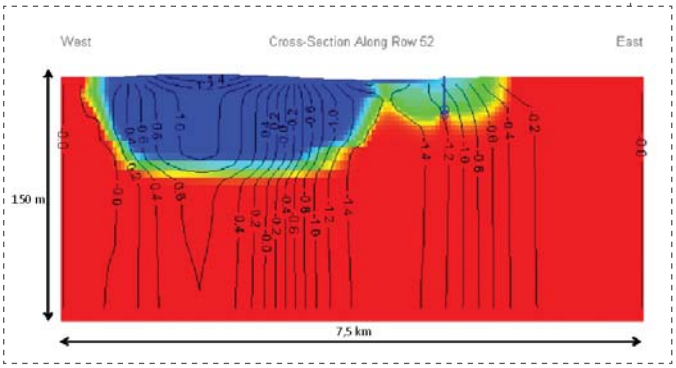

Left:
Air-borne measurements of saltwater intrusion into coastal groundwater resources.

Above:
Example of computed saltwater intrusion into coastal aquifer. Colour scale: Blue - fresh water, red - salt water.

THE HELSINKI METROPOLITAN AREA

The Helsinki Metropolitan Area is preparing for the consequences of climate change

The Helsinki Metropolitan Area consists of the cities of Helsinki, Espoo, Vantaa and Kauniainen. The area covers 745 square kilometres and contains a total population of approximately one million, which is about one quarter of Finland's population.

The Helsinki Metropolitan Area is situated on the coast of the Baltic Sea. Some of the effects of climate change can already be felt in the area as warmer summers, wetter and warmer winters and sea level rise. These and future potential challenges, such as increasing extreme weather events, require early adaptation actions.

The four cities of the Metropolitan area together with the Helsinki Region Environmental Services Authority (HSY) are responding to these challenges. As part of the work carried out for the adaptation strategy, experts and stakeholders developed adaptation options for the consequences of climate change in the four cities.

The key question is how to transfer the policies and measures into action. An essential requirement for implementation is that the adaptation measures are useful and relevant and deal with concrete impacts and risks for the area. City planners and experts are involved in this task and decision makers' support is constantly sought.

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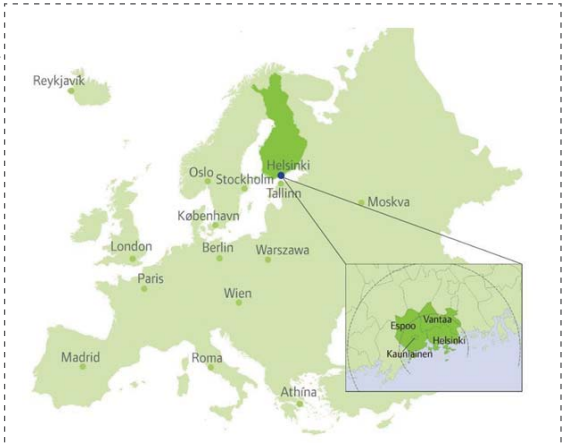

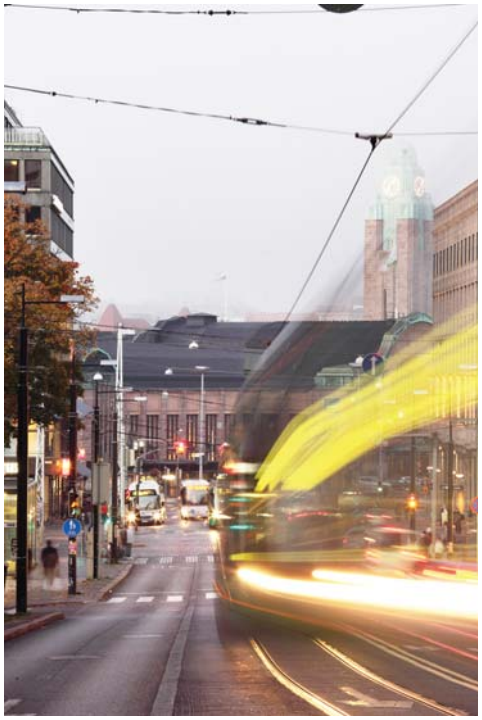

CITY OF HELSINKI

City of Helsinki faces the challenge of climate change

Some of the effects of climate change can already be felt in the City of Helsinki. The challenges of climate change that Helsinki will face include storm water management, moisture damage to buildings, securing energy distribution and the maintenance of telecommunication networks, worsening air quality and increasingly slippery road conditions.

The City of Helsinki already applies procedures that prepare for variable and extreme weather conditions while rectifying any damage arising from extreme weather phenomena, such as the Storm Water Strategy and the Flood Strategy. Helsinki has built flood dykes and set temporary flood barriers for extreme flooding. The Storm Water Strategy aims for a holistic approach in storm water management.

There is a need for mutual understanding regarding adaptation within the City of Helsinki's different departments. The BaltCICA project assessed what is already covered in existing programmes and what additional adaptation measures are needed. Findings are integrated into regular work in different departments.

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RIGA

Adaptation to flood risks

Adaptation to flood risk in Riga is challenging in several aspects: geographical characteristics, policy design and governance. The capital city has a large diversity of land use types, and fragmented patterns of residential and economical activities.

Nearly 60% of Riga's 15 kilometre long coastline is vulnerable to sea level rise and storm surges. Man-made coastal flood protection started in the 13th century. Traditionally flood-prone areas have not been developed and dunes serve as natural flood protection. In recent decades flash floods occur due to intensive precipitation and the outdated infrastructure of the urban water system. The urban flood prone area is estimated to increase by 27% by the year 2100 (based on IPCC A1B scenario projections).

Close cooperation between researchers and practitioners helped to integrate specific climate change knowledge into operational activities of the municipality in the field of spatial planning, risk assessment and civil protection. New and innovative climate change adaptation, including governance approaches, adaptation policy design and multi-criteria decision-making analysis are currently being explored for their applicability in Riga.

Riga has benefitted from and contributed to cooperation and knowledge transfer for flood prevention and climate change adaptation in the Baltic Sea Region. The implementation of integrated adaptation measures are political and planning priorities for Riga.

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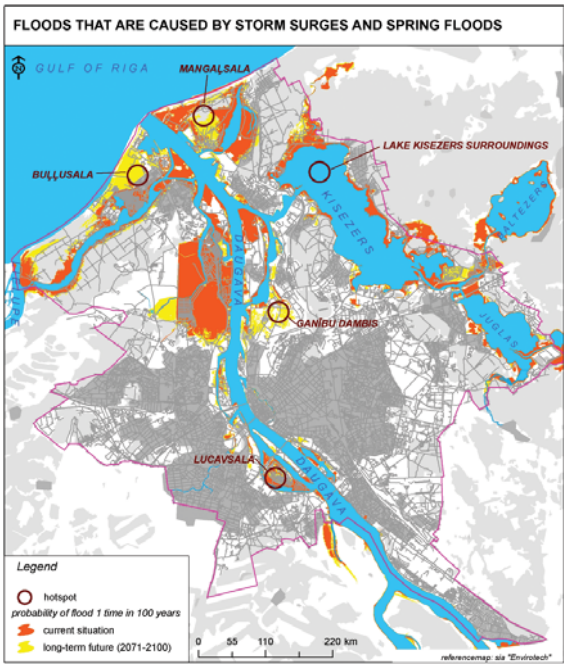
Above:
Flash floods in Riga on July 16, 2009.



Right:
Hot spots for climate change adaptation measures in Riga.

METROPOLITAN REGION OF HAMBURG

Climate change and future flood defense: “Living with water” instead of levees?

The Metropolitan Region of Hamburg (MRH) has to deal with storm surges, sea level rise and urban heat islands. Flood defence has a long tradition along the river Elbe. To reduce vulnerability, the marshland is protected by a continuous levee-line on both sides of the river, which is up to 14.5m high. According to current climate change scenarios, these levees will protect the land behind them during the next decades. After all, the MRH has to face serious impacts in the second half of the century since ongoing levee enhancement is seen as critical.

“Living with water” becomes the guiding principle among stakeholders, including measures such as “opening the levee-line”, “enabling water- and heat-adapted housing areas” or “innovative rainwater management”. Having introduced the scenario method as a tool of climate adaptation governance, stakeholders are eager to include this as well as the innovative results of the Scenario Workshops into the ongoing adaptation process. In addition, a Feasibility Study contributed recommendations on how to include resilient settlement structures into future regional planning in the county of Pinneberg across administrative boarders.

It has become obvious that there has to be a paradigm shift in the way how water is treated in urban and regional development. Instead of hiding water behind levees, climate change adaptation in MRH will treat water as a resource offering cities and regions new chances for quality of life and sustainability.

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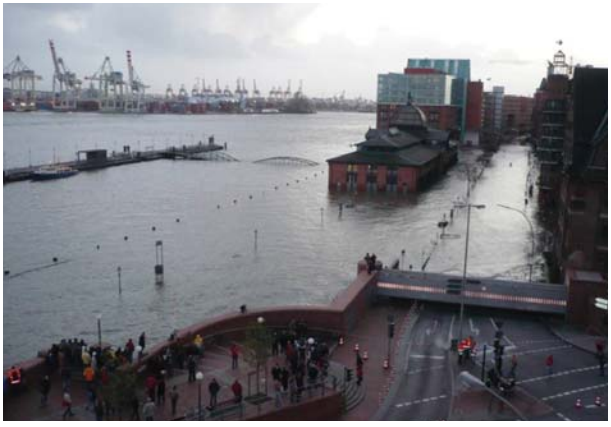

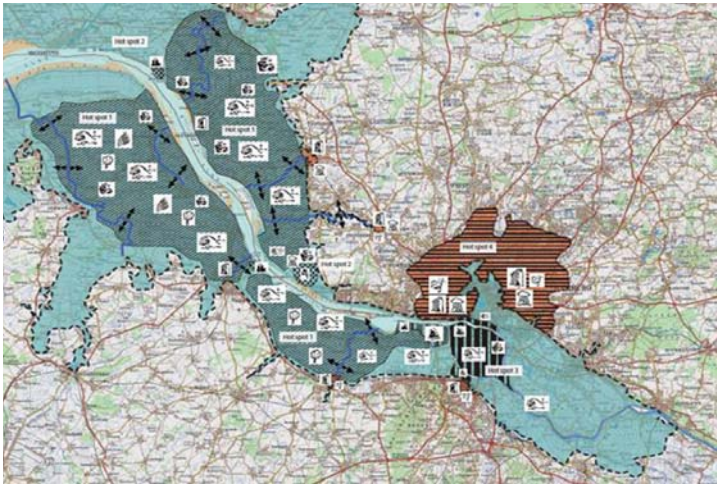

Left:
Flood protection gate at Hamburg harbour.

Above:
Vulnerability hotspots along the river Elbe.

KLAIPĖDA DISTRICT

Evaluation of climate change impact on groundwater resource

The Klaipėda district is located on the Baltic Sea coast, covering about 1300 km2 and stretching some 40 km inland. About 50,000 inhabitants live in the district (65% rural, 35% urban). Groundwater is the only source used for individual and public water supply. Nearly 60% of the population is connected to public water supply, while the remaining part still uses individual shallow dug or drilled wells.

Reconstruction and development of the former drinking water supply and wastewater management infrastructure is currently ongoing. Therefore, the main tasks for hydro-geologists are to evaluate present fresh groundwater resources in the region and to predict how climate change could affect those during the 21st century. Models were applied to calculate groundwater resources of different aquifers and used to simulate future scenarios.

The simulation results show that groundwater resources will increase in the next 100 years. Predicted groundwater resources are up to one-and-a-half times higher than the estimated present resources. In the wet years, average annual shallow groundwater level could rise by 0.2–0.5 m to 2.5–2.8 m. During dry years, average annual groundwater level in shallow groundwater could fall to 10–15 cm.

Increasing levels of shallow groundwater will increase the vulnerability of groundwater pollution and the risk of inundation. Thus, shallow groundwater is the most vulnerable to climate change and pollution, and the future water supply system should be based on confined aquifers, which could supply enough drinking water in the future.

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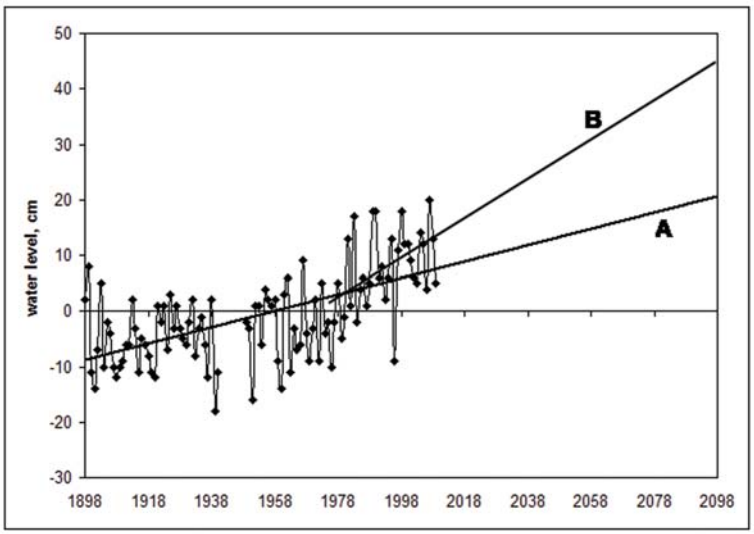

Above:
Potential flooded territory in southern part of Klaipėda city caused by sea water level rise 102 cm.

KLAIPĖDA CITY

Adaptation to flood risk

The southern part of Klaipėda territory periodically experiences flooding from the Smeltale River, which is mainly caused by two reasons:

- heavy precipitation (and sudden snow melt) in the Smeltale river basin;
- high sea water levels in the Baltic sea and the Klaipėda channel.

Current precipitation and flood patterns might be altered by climate change over the 21st century.

During the 20th century the sea level rose by 14.9 cm in Klaipėda, which might increase between 25 cm and 86 cm (according to IPCC's B1 and A1F scenarios, respectively) during the 21st century. During storm surges the average flood height is 50 cm, a record height reached at 186 cm. Taking sea level rise into account, in 2100 flood heights could reach between 102 cm and 238 cm.

Flooding causes damage to the city infrastructure as well as to private and public property. In the frame of the BaltCICA project two scenario workshops were organised for the local community, city administration and other interested stakeholders to combine their efforts to solve the problem. During scenario workshops possible solutions to mitigate flood risk were elaborated and later on evaluated by a feasibility study. The solution to install flood protection embankments along the river was finally chosen as the best solution. Klaipėda city administration accepted the solution and started preparatory work towards the installation of the flood protection measures.

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KARKLĖ BEACH

Adapted to coastal change

As part of elaborating a detailed spatial plan for the Karklė beach (Klaipėda district municipality), an analysis of geological and geomorphological conditions and dynamical processes was carried out.

The coastal dynamics indicate that the Karklė beach is developing in a cyclic manner – erosion periods are followed by accretion. However, sand accumulation has prevailed in the beginning of the 21st century compared with that of the begining of the 20th century and therefore the state of the beach is currently more stable.

Besides the determination of that historical trend, the development of Karklė morphology was modelled according to predicted sea level changes in the 21st century. Baltic Sea water level rose up to 14.9 cm besides Klaipėda in the 20th century. Increasing sea level changes are expected for the 21st century. It was calculated that the coastline at Karklė during the 21st century will retreat 1.6–2.1 m or 3.9–4.9 m.

Geoscientific recommendations were implemented in the spatial plan in order to establish relevant infrastructure for the Karklė beach and exploit its interesting features.

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Graphic on previous page:
Forecast of the Baltic sea level rise in Lithuania in 21st century: A – if trend of 20 century continues, B – if trend of last 35 years continues.

WEST ESTONIAN COASTAL ZONE

First climate change adaptation measures for low lying coastlines

The west Estonian coastal zone extends 300 kilometres in the north–south direction. Predicted temperature rise will be 3–5°C by 2100, and the sea level might rise by 1 metre.

Almost 146 square kilometres of the west Estonian lowland is nowadays 0–1 metres above mean sea level. The flood prone areas below 2 metres cover 253 square kilometres, and those below 3 metres 449 square kilometres .

Local administration and stakeholders were introduced to the current and future flood hazards during workshops and meetings. The topics covered natural and man-made causes of climate change, as well as potential environmental, economical and human vulnerabilities.

The principal results were compiled in presentations that were forwarded to local governments and environmental officials to adjust local development plans. Project results have been disseminated through all available media channels and have led to substantial interest among stakeholders.

As a first result, decision makers decided to ban future construction of permanent housing below 3 metres in the Audru Region and 2.5 metres above sea level in the Haapsalu Region.

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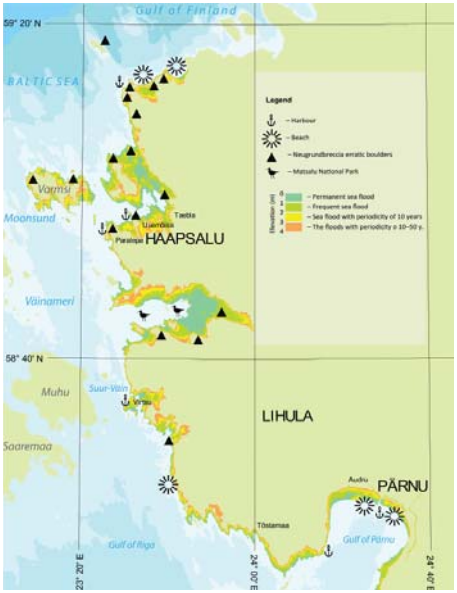
Above:
Cambrian impact breccia boulders that originate from the ring wall of the Neugrund meteorite crater.



Above:
Flooding scenarios at the west Estonian coast for the end of the 21st century taking into account neotectonic movements.

BERGEN

Economic and legal responsibility for climate change damages

Economic and legal responsibility for climate change damage has been an important aspect of the Bergen case study. The Bergen region is characterised by fjords, mountains and islands. Annual precipitation is expected to increase by 25–30 percent over the next 50 years. The sea level is expected to rise by approximately 75 centimetres and the storm surge level may increase up to 221–276 centimetres by 2100. Such changes will have devastating impacts on the city's infrastructure, transport system and tunnels, buildings and sewage system. They also highlight questions of economic and legal responsibility.

In October 2010, a stakeholder workshop discussed the following questions: How can legal rules contribute to resilience and a fair sharing of costs related to both preventing and compensating for negative impacts of climate change? Who is responsible for planning, mapping and implementing adaptation measures? Who should pay for what (ex ante), and what should be compensated, by whom, when climate related damage occurs (ex post)? What roles can insurance play in preventing and compensating for negative climate change impacts? Participants included local, regional and national administration, the business sector, environmental associations and the university sector.

The workshop created increased awareness on economic and legal responsibilities and on possible adaptation measures. Existing networks were strengthened. The business community was encouraged to play a more active role in climate change adaptation policies. Proposals that the City of Bergen can incorporate in their climate change adaptation strategy and in their work vis-à-vis stakeholders in urban development plans was produced.

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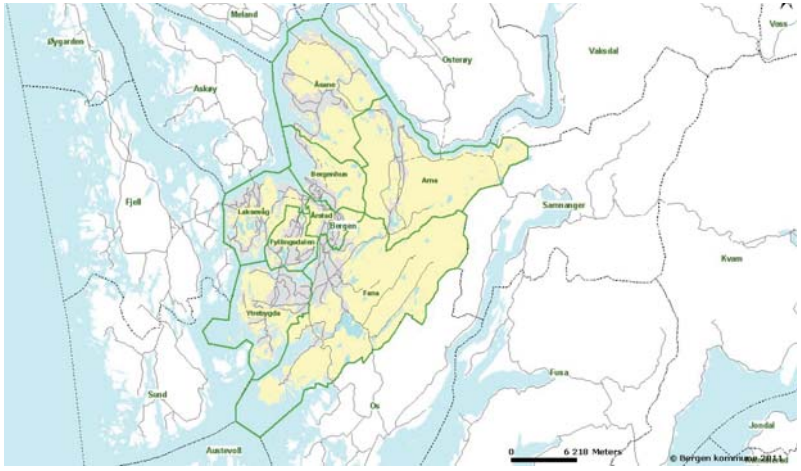

Left:
Bryggen at storm surge.

MECKLENBURG-VORPOMMERN

One spot – three processes

Tourism is the most important economic sector in the state of Mecklenburg-Vorpommern. About 21.9 million overnight stays have led to a gross income of €3.7 billion in 2010. For a region which is in large parts economically underdeveloped the future competitiveness of such a core sector is of major importance.

In this context climate change attracts attention: Coastal tourism is highly climate sensitive as climate is a main element in the decision-making process of tourists. But a changing climate not only has direct impacts on tourism by increasing or decreasing comfort elements such as temperature, humidity or windiness. In case of coastal tourism it might change also the quality of bathing waters (e.g. algae blooming) as well as the condition of beaches (e.g. erosion).

The Mecklenburg-Vorpommern case study tackled these three pillars (tourism, coastal water quality, coastal protection/beach management) in a holistic manner to achieve sustainable climate change adaptation. As a result, innovative internal management solutions (e.g. filtration measures within river estuaries) have been developed for the water quality sector in exchange with responsible authorities. And for coastal protection, additional third-party funds in the amount of €2.4 million have been raised for climate-adapted beach nourishment measures on Rügen Island.

These and other aspects have been discussed with an expanding regional tourism network where an exchange of best practice examples has led to increasing climate change competence. The BaltCICA process in this case study will be continued in the national climate change adaptation project "RADOST" and it contributes to "Baltadapt", another flagship project under the EU Strategy for the Baltic Sea Region.

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Right:
Coastal waters, beaches and anthropogenic uses (e.g. tourism) form a unit with a need for multi-level climate change adaptation.

HANKO

Safe drinking water now and in the future

Groundwater is the only source for drinking water in Hanko. The aquifer is shallow, small, and connected to the surrounding sea. The water works are close to the sea shore. This makes the supply of drinking water sensitive to changes in temperature, precipitation and sea level.

The BaltCICA Project developed a three-dimensional groundwater model for Hanko to estimate potential impacts of climate change on the groundwater and to assess alternatives for a safe water supply in the future.

The scenarios that were used assume up to 5°C warmer winters with more precipitation and up to 3°C warmer summers by the end of the 21st century. Change in sea level is expected between -0.59 and 1.48 metres. Storm surges could flood the area around the water works, flushing sea water into the aquifer

Currently, the spring snowmelt and autumn rain safeguard sufficient groundwater resources for water supply year-round. According to scenarios for the future, recharge of the groundwater would happen earlier in spring and later in autumn. In summer the drinking water resources could thus diminish.

These results of the groundwater modeling help to manage the water resources now and in future. At a workshop for local authorities and stakeholders the groundwater model and local socio-economic development scenarios were used to think about the future of Hanko's drinking water.

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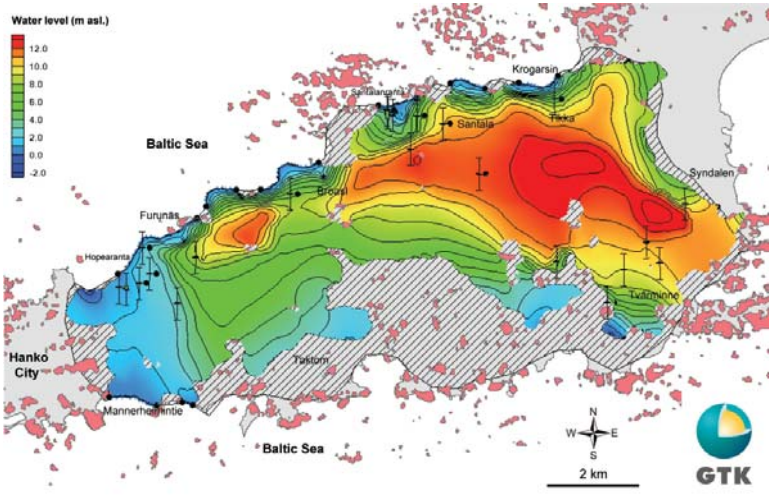
Above:
Coastline at the Hanko peninsula.



Left:
Modelled groundwater level for the Hanko Peninsula.

NORTH VIDZEME BIOSPHERE RESERVE

Development of innovative climate change adaptation methods

Several Salmon bearing rivers discharge into the Baltic Sea in the North Vidzeme Biosphere Reserve, which is located at the coast of the Gulf of Riga. Nutrient leakage from the catchment and increased sediment load, lead to oxygen depletion and decrease the rivers' biological quality.

Local people are mobilized to participate in local initiative groups, trained to assess and improve the biological quality of degraded river stretches. The initiative „Place a Stone in a Stream" involves local people in river management. The aim is to increase oxygen saturation and self purification capacities of streams to finally contribute to an improvement of biodiversity. The initiative is spreading beyond the BaltCICA project and is well accepted in Latvia as an innovative instrument giving instant results.

Cooperation of local citizens with scientists and students lead to the development of the „Climate Change Adaptation Strategy for the Salacgriva Municipality", which is the first climate change adaptation oriented document of a local municipality in Latvia.

An interactive exhibition describes climate change processes and possibilities for adaptation. Thus North Vidzeme becomes a real link for transferring climate change adaptation from sciences into society.

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Left:
Volunteers at work.

Above:
Aerial photo of Salacgriva.

TAMPERE

Adapting to changing surface runoff to support future spatial planning

Tampere is located between two lakes, Lake Näsijärvi and Lake Pyhäjärvi. The level of Lake Näsijärvi is 17 metres higher than Lake Pyhäjärvi. The lakes are separated by an 80 metre high ridge called Pyynikin-Epilänharju.

Knowledge of Pyynikin-Epiläharju's geolocigal structure and the level of groundwater is important in understanding the risks posed by climate change.

The findings of geotechincal surveys were transformed into maps of geological layers and groundwater level as well as a 3D model of the study area. Surface runoff and artesian groundwater were identified as factors that can negatively affect the ground stability of the ridge. With climate change leading potentially to more intense rainfall and more variable groundwater levels, these factors have to be taken into account for safe development of the area.

Urban planners, municipal and state environmental experts and local water works were involved in the identification of risks and development of adaptation options.

Stakeholder seminars and workshops were held in Tampere in April and October 2011. The results were presented in public urban planning sessions on ongoing detailed planning processes in the study area. These sessions marked the starting point for broad cooperation on adaption to climate change in the city of Tampere.

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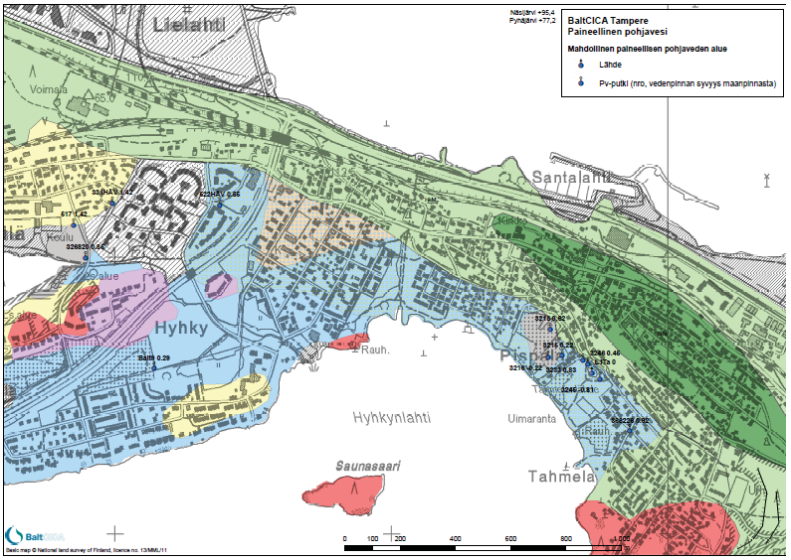
Above:
Pispala built heritage area on the ridge.



Right:
Soil and potential artesian aquifer in the study area.

KALUNDBORG

Citizens vote on climate adaptation options

In Kalundborg, a municipal climate adaptation strategy with clear political priorities is now in the making. This has emerged through a transparent decision-making process involving both stakeholders and citizens in the municipality.

First, local stakeholders were presented with possible climate and flooding scenarios for the Kalundborg case area. On this basis, they developed different solutions to the challenges at a scenario workshop. Local politicians were also consulted and alternative political choices and options identified. Environmental and socioeconomic consequences of these choices and options were estimated and presented at a citizen summit to 350 local citizens, which were selected to reflect the demographic diversity in the municipality. Prior to the summit, the citizens were provided with relevant information material and were then introduced to the pros and cons of different adaptation options. Finally, the citizens discussed and voted on those options.

Two-thirds voted to phase out the current land use (such as farmland and summer cottages) in the most threatened non-urban areas of the municipality and turn them into wetlands, rather than building dikes. 90% of the citizens wanted the municipality to act now and make long-term plans based on climate change scenarios. The participatory nature of the decision-making process allowed local politicians to make more extensive decisions than they might otherwise have felt comfortable making.

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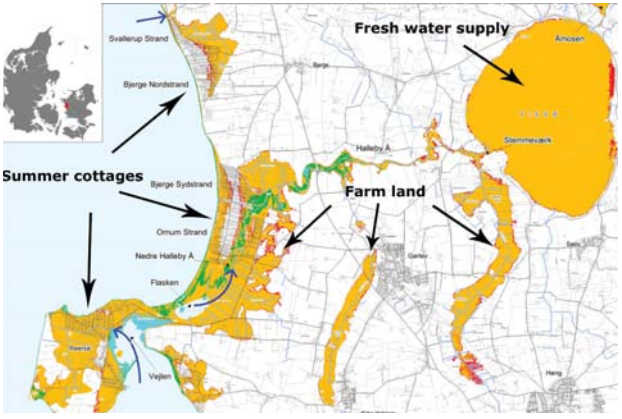
Above:
Citizen summit in Kalundborg.



Right:
Anticipated flooding in the southern part of Kalundborg Municipality in 2090.

PROJECT PARTNERS

FINLAND:

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- Hanko Water and Wastewater Works
- Union of the Baltic Cities – Commission on Environment (UBC)
- Helsinki Region Environmental services Authority (HSY)
- City of Helsinki
- City of Tampere

ESTONIA:

- Geological Survey of Estonia (EGK)

LATVIA:

- University of Latvia
- North Vidzeme Biosphere Reserve

NORWAY:

- Norwegian Institute for Urban and Region Research (NIBR)

SWEDEN:

- Nordregio

LITHUANIA:

- Municipality of Klaipeda
- Municipality of the Klaipeda district
- Environmental Centre for Administration and Technology (ECAT)
- Vilnius University
- Lithuanian Geological Survey under the Ministry of Environment

DENMARK:

- Kalundborg Municipality
- Danish Board of Technology (DBT)
- Geological Survey of Denmark and Greenland (GEUS)

GERMANY:

- Leibniz Institute for Baltic Sea Research Warnemünde (IOW)
- HafenCity University Hamburg/Reserach Unit Urban Planning and Regional Development (HCU)
- EUCC – The Coastal Union Germany
- Potsdam Institute for Climate Impact Research (PIK)

CASE STUDIES OF THE BALTCICA PROJECT

Baltic Sea Region Programme 2007-2013

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