Final report

BALTCICA:

CLIMATE CHANGE IMPACTS, COSTS AND ADAPTATION IN THE BALTIC SEA REGION

VERSION 1.0

May 2012

Edited by:

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www.baltcica.org

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1 Preface

The BaltCICA Project formed part of the Baltic Sea Region Programme 2007-2013. It was part-financed by the European Union (European Regional Development Fund and European Neighbourhood and Partnership Instrument). The project duration was from February 2009 to January 2012. This report displays the main activities achieved by transnational cooperation and learning as well as applications in case studies.

The lead partner of the project was the Geological Survey of Finland (GTK) and the partnership comprises 24 partners including municipalities, regional authorities and research institutes:

Finland: Geological Survey of Finland (GTK, lead partner); Aalto University/ Centre for Urban and Regional Studies (Aalto/YTK); 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

Lithuania: Klaipeda City Municipality; Municipality of the Klaipeda District; Environmental Centre for Administration and Technology (ECAT) Lithuania; 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);

Sweden: Nordregio

Norway: Norwegian Institute for Urban and Region Research (NIBR)

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

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2 Summary of project achievements

The BaltCICA project has identified adaptation measures and implemented them in the Baltic Sea Region.

In order to achieve this the BaltCICA project has:

- 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;
- and increased participation of stakeholders and citizens in adaptation related decision-making

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, Klaipeda and Falster), the Environment (North Vizdeme, Karklé) as well as scenario development and citizen participation (Kalundborg, Riga, Klaipeda, Tampere, Hamburg).

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3 Transnational cooperation on climate change adaptation and policy implications

by

Stefanie Lange, Lisa Van Well and Asli Tepecik Dis, Nordregio

Climate change adaptation in policies

The impacts of climate change are expected to affect the countries bordering the Baltic Sea in some way. Although consequences differ between localities and regions, adaptation to a changing climate is set high on the political agenda of the Baltic Sea Region as a "macro-region" of multi-levels of governance. A number of concrete adaptation activities are currently being undertaken at the *local and regional level* while there is some variation of efforts at the national level among those countries that have already adopted a *National Adaptation Strategy (NAS)* and those who do not yet have a NAS in place (see Map 1.).

Adaptation to climate change has been promoted on EU level through the *EU Green Paper on Adaptation* that emphasises the need of sharing experiences from early adaptation action (COM 2007). The *EU White Paper "Adapting to Climate Change: Towards a European Framework for Action"* is the basis of the EU's strategic approach "to ensure that timely and effective adaptation measures are taken, ensuring coherency across different sectors and levels of governance" (COM 2009a). The White Paper identifies EU's vulnerability to the impact of global warming and emphasizes the need of an adaptation strategy at EU level and solidarity among EU Member States. The White Paper aims to improve Europe's resilience to climate change by emphasising the need to integrate climate adaptation into all key European policies and enhance cooperation at all levels of governance. Thus, the EU sees its role in facilitating the coordination and exchange of knowledge in this cross-cutting issue (COM 2009a).

As the EU´s first macro-region in 2009, the Baltic Sea Region (BSR) region strives for closer cooperation between the Member States. The *EU Strategy for the Baltic Sea Region (EUSBSR)* provides an Action Plan for the BSR addressing issues concerning the marine environment, prosperity, transport and energy and safety and security. As the strategy makes no provisions for new institutions, funding, instruments or regulations, its role is rather as an integrated framework by which to utilize existing structures, institutions and actions – many of these in the form of projects funded by the Baltic Sea Region Programme 2007-2013. The strategy stresses the need for coordinated joint actions in the BSR on a "macro-regional" level including discussions with external partners, especially Russia. Concerning climate change adaptation, the Action Plan calls for the BSR to "Establish a regional adaptation strategy at the level of the Baltic Sea Region

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which would provide a useful framework for strengthening co-operation and sharing information across the region" (COM 2009b, see Box below).

Strategic action.

"Establish a regional adaptation strategy at the level of the Baltic Sea Region" which would provide a useful framework for strengthening co-operation and sharing information across the region. The possibility of establishing such a regional adaptation strategy should be considered and the consistency of any such strategy with actions at EU level further to the White paper from the European Commission on adaptation needs to be ensured. This issue could be addressed in the Impacts and Adaptation Steering Group proposed in the White Paper. Ensuring complementarities with EU-wide initiatives, a regional strategy could focus on issues of cross border interest in the region such as: developing a more robust evidence base on the impacts and consequences of climate change, raising awareness of the need for action; ensuring and measuring progress (using indicators as benchmark for measuring progress) and recommending early action to ensure that adaptation is integrated in key policy areas – this means reviewing policies in the light of the risks of climate change and considering options for adaptive action" (COM 2009b).

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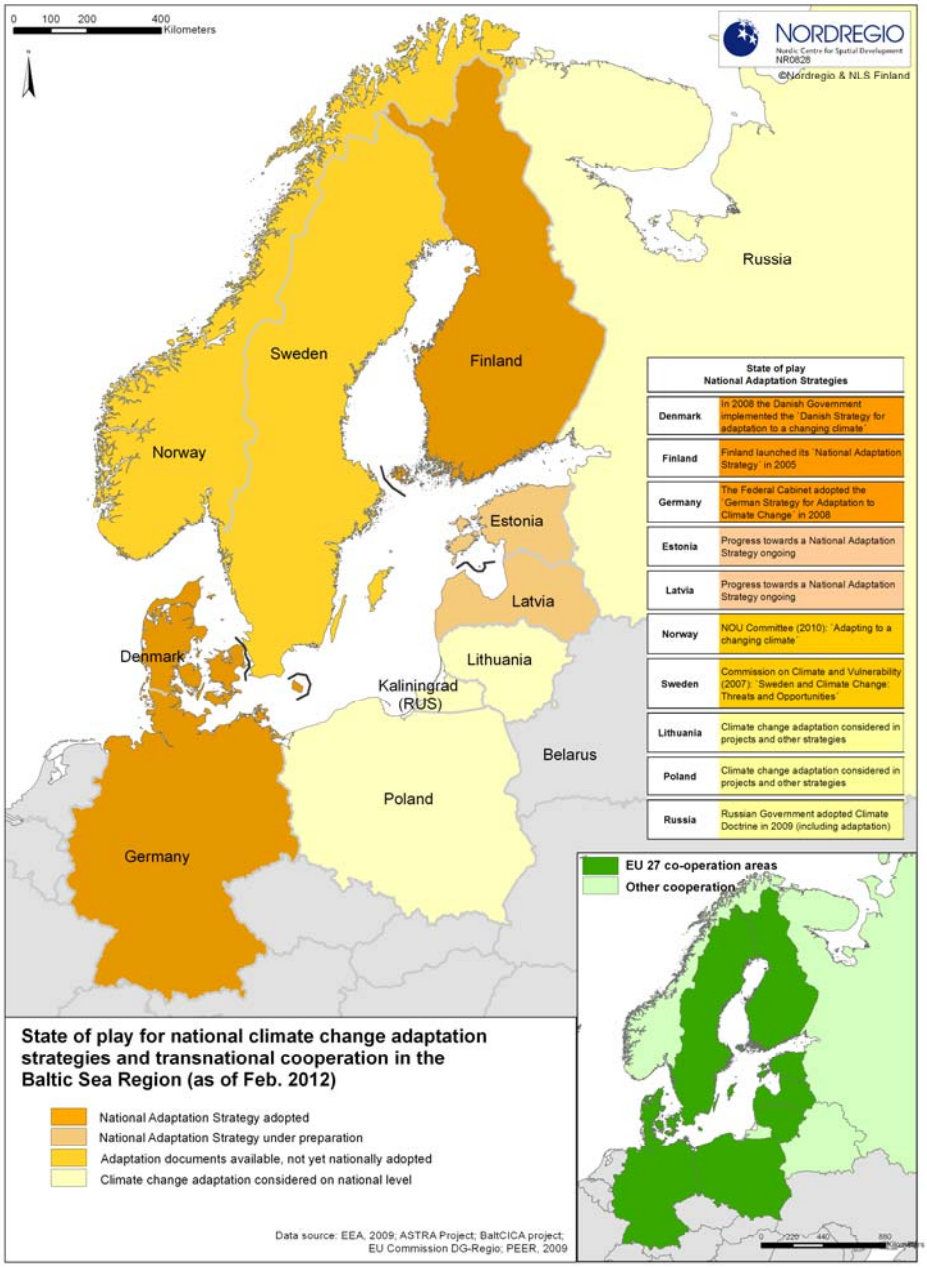

Map 1. State of play regarding national climate change adaptation strategies and transnational cooperation in the Baltic Sea Region.

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BaltCICA's role in implementing the EUSBSR

The *BaltCICA project* consisted of 24 partners from Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway and Sweden pursuing 12 case studies in the Baltic Sea Region. The project consortium involved partner organizations such as research institutes, NGOs, cities and municipalities, (see Map 1.). As approved by the Baltic Sea Region Programme 2007-2013, part-financed by the European Regional Development Fund (ERDF) under the Territorial Cooperation Objective, transnational cooperation is inherent in the project. Despite the variety of initial starting points, perspectives and local circumstances among the project partners, the project facilitated the share of information, exchange of experiences and learning concerning climate change adaptation at local and regional level – largely via "bottom-up" measures utilizing local knowledge and stakeholder opinions.

The efforts and activities performed in BaltCICA can be seen as a starting point towards the development of an informal forum for pan-Baltic cooperation on climate change adaptation. The BaltCICA activities (see Table 1.) takes a closer look at four components as parts of the strategic action that calls for a macro-regional adaptation strategy as described in the EUSBSR (cf. COM 2009b, see Box above). It then depicts concrete examples of activities conducted during the BaltCICA project between 2009-2011 in relation to how the project has begun to address these components.

Chosen components of the strategic action:

1. "Provide a useful framework for strengthening co-operation and sharing information across the region",
2. "Developing a more robust evidence base on the impacts and consequences",
3. "Raising awareness of the need for action" and
4. "Recommending early action to ensure that adaptation is integrated in key policy areas".

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Table 1. BaltCICA activities linked to chosen components of the strategic action.

Activities within BaltCICA
(1) "Provide a useful framework for strengthening co-operation and sharing information across the region"
Foresight method and governance approach as framework for case study processes
Project meetings (i.e. case study presentations, workshops on common challenges such as stakeholder involvement, raising awareness and communication, targeted discussions, field trips)
Homepage and publications such as reports and brochure to share information within the project consortium and throughout the Baltic Sea Region and even beyond
Summer School on climate adaptation in urban areas
(2) "Developing a more robust evidence base on the impacts and consequences"
Cost Assessment Workshops
Multi Criteria Decision Analysis Workshops
Information gathered within case study processes
Scenario Workshops
(3) "Raising awareness of the need for action"
Stakeholder and citizen involvement at Local Stakeholder Meetings, Scenario Workshops and the Summer School
Reports and publications
(4) "Recommending early action to ensure that adaptation is integrated in key policy areas"
Case study outcomes and reports concerning water management, regional development, agriculture, infrastructure, security and energy
Final project report
Presentations and project dissemination activities

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Policy implications

Adapting to climate change is a complex process challenging local and regional authorities. Despite the fact that the impacts and consequences of climate change can influence localities or regions very differently, project partners appreciated the possibility of exchange and cooperation provided within BaltCICA. Consequently, pan-Baltic cooperation and transnational learning about adaptation processes and measures can contribute to implementing the adaptation strategy for the BSR and as such should be considered as significant elements of the strategy.

Territorial Cooperation projects such as BaltCICA are a good tool to foster and facilitate transnational cooperation and learning on adaptation issues. The 2014-2020 period of the BSR Programme could call for projects that help implementing the macro-regional climate change adaptation strategy once it has been adopted. However, the projects should have a focus on integrated approaches at both macro-regional and local/regional level. Concrete adaptation measures need to be identified and implemented in line with local and regional planning practices. *Adaptation* could thus become an integral part of spatial planning throughout the BSR.

In addition to adaptation strategies that already exist on local, regional and national level, a longer-term perspective/framework is needed in order to trigger *sustainable* adaptation processes in the BSR and avoid maladaptation. Raising awareness for adaptation is still a challenge in most of the BSR countries and could be worth highlighting in policy documents at EU level. This is particularly important to encourage stakeholders in countries where not much attention has been paid to the matter yet and support them in adopting a National Adaptation Strategy (NAS). Stakeholders in countries that do have a NAS in place could need a “boost” to actually implement measures needed. Thus the national level could be activated to play its role in the multilevel governance setting which is inherent in adaptation to climate change. These are some of the points that could be taken up in a macro-regional climate change adaptation strategy as proposed in the EUSBSR (cf. Van Well & Lange 2011) and echoed in future territorial cooperation projects of the BSR Programme. At the same time, policies at national, regional and local level would need to take a macro-regional strategy into consideration and align their adaptation activities accordingly.

Finally, policy efforts at national and pan-Baltic level should find ways to involve extended cooperation with Russia and Poland on climate change adaptation. By developing an integrated approach towards climate change adaptation on macro-regional level, the BSR could be a forerunner and inspiration to other EU macro regions and the EU itself.

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4 Cost benefit and Multi criteria decision analysis

by

Markus Boettle, Diego Rybski, and Jürgen P. Kropp, Potsdam Institute for Climate Impact Research (PIK), 14412 Potsdam, Germany

One focus of the Potsdam Institute for Climate Impact Research (PIK) within the BaltCICA project was the elaboration of assessment instruments for adaptation measures in the context of sea level rise in the Baltic Sea Region. In particular, frameworks for a systematized and transferable cost-benefit analysis (CBA) and a multi-criteria decision analysis (MCDA) have been developed in order to obtain comparable results for different case study regions.

Adverse effects from sea level rise in coastal areas are primarily caused by extreme sea levels (storm surges) which are likely to become more frequent and higher in magnitude due to sea level rise. The potential consequences from storm surges can be manifold: economic, social and ecological impacts need to be anticipated. In order to support the impact assessment in the case studies, PIK organised two workshops, which were held in Potsdam. Among other topics, they were used to discuss potential flood impacts in the case studies and to define common impact categories. Furthermore, impact chains were elaborated to gain a better understanding of the interrelations between impacts (e.g. damages to industrial buildings can lead to chemical pollution of ecosystems). In a next step, adequate indicators were defined to assess the various consequences, which is indispensable for a quantitative analysis. In particular, methods and indicators for the monetary measurement of direct flood impacts have been elaborated. Subsequently, the outcomes of the workshops were used to develop a framework for the damage cost assessment which is a substantial part in a cost-benefit analysis of adaptation measures. Since the occurrence of extreme events cannot be predicted, the impact assessment was preceded by a statistical analysis of extreme water levels considering climate change effects by employing instationary extreme value theory. Finally, the entire framework has been provided to the project partners in the form of a manual and has been applied to the case study region Kalundborg (Denmark) in cooperation with the Municipality. For Kalundborg, a stage-damage curve on the basis of small-scale building and elevation data has been elaborated and was used to determine the expected annual damage and potential effects of changing weather patterns and sea level rise for the region. In addition, the residual damages have been investigated supposing several flood protection measures and a complete cost-benefit analysis, which can help to find an optimal adaptation strategy, has been performed.

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Beside the purely monetary CBA approach, a MCDA framework, which can also take non-monetary aspects into account, has been developed. The goal was to obtain a more comprehensive description of the decision problem than a CBA by considering also social, ecological and cultural values. Again, two workshops in Potsdam with project partners were organised by PIK and GTK, which allowed stakeholders to influence the framework and to keep the conditions as realistic as possible. After the first workshop, which was focused on MCDA methods and algorithms, two real examples from Mecklenburg-Western Pomerania in Germany were discussed in the second workshop and were used to exemplify the approach. This aimed to identify opportunities and needs by performing the entire process in a group. It was finally found, that MCDA can be a useful decision support tool, which is able to achieve acceptance of the outcomes in the society by involving stakeholders and decision makers in the process. Although the workshop also revealed possible barriers and difficulties, it was concluded that the approach should be pursued and several participants expressed their interest in applying MCDA to their case studies.

Apart from decision making, PIK also tried to gain more general insights into the interplay of climate stimuli (e.g. sea level rise or changing storm intensities), adaptation, and flood damages. For this purpose, a damage estimation approach has been developed and was used for general investigations from which several relations of the expected annual damages as well as their standard deviations as functions of sea level rise and protection height could be derived. In particular, these relations show quantitatively how annual damages increase with rising mean sea levels and how the uncertainty of estimations (in terms of standard deviation) depends on implemented adaption measures. Parts of these results were presented at a PIK-initiated session at the European Geosciences Union (EGU) General Assembly 2011[1] and the American Geophysical Union (AGU) Fall Meeting 2011[2]. Furthermore, several articles have been published or submitted to scientific journals and books[3] so far (see references below).

[1] "A cost-benefit framework for adaptation to sea level rise" in session NH5.5: "Storm Surges and coastal areas: extreme events, damages, and risk". http://meetingorganizer.copernicus.org/EGU2011/EGU2011-343.pdf

[2] Invited talk "On the estimation of damages due to coastal floods" (NG43C-02).

http://static.coreapps.net/agu2011/html/NG43C-02.html

[3] "About the influence of elevation model quality and small-scale damage functions on flood damage estimation"; Boettle M, Kropp JP, Reiber L, Roithmeier O, Rybski D, Walther C; Natural Hazards and Earth System Sciences; 11 (12): 3327-3334, 2011, http://www.nat-hazards-earth-syst-sci.net/11/3327/2011/nhess-11-3327-2011.pdf

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"Indirect identification of damage functions from damage records"; Steinhaeuser JM, Rybski D, Kropp JP; submitted 2011.

"The influence of sea level rise on coastal flood damages"; Boettle M, Rybski D, Kropp JP; submitted 2011.

"Coastal Protection and Multi-Criteria Decision Analysis: Didactically Processed Examples"; Boettle M, Schmidt-Thomé P, Rybski D; submitted to book edited by Schmidt-Thomé P; 2012.

"Adaptation to Sea Level Rise: Calculating Costs and Benefits for the Case Study Kalundborg"; Boettle M, Rybski D, Kropp JP; submitted to "Climate Adaptation Governance in Cities and Regions – theoretical fundamentals and practical evidence" edited by Knieling J. 2012

"Examining existent adaptation to climate change"; Lissner TK, Moneo M, Kriewald S, Pradhan P, Wrobel M, Kropp JP; in preparation 2012.

"Natural hazards and adaptation: a framework evaluating costs and benefits"; Boettle M, Rybski, D Kropp, JP; in preparation 2012.

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5 Kalundborg: Citizens vote on local climate change adaptation options

by

Bjørn Bedsted, Søren Gram and Hannibal Rasmussen

In Kalundborg, a municipal climate change 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.

Two specific methods were chosen in combination in order to build up a deliberative decision-making process: A scenario workshop and a citizen summit. 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 socio-economic 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. The idea was that while the scenario workshop involved stakeholders from the case area, the citizen summit involved citizens from the whole municipality. The reason behind this combination of approaches was that local stakeholders contribute with local knowledge and innovative solutions but may have a tendency to look for (costly) protective solutions, while citizens with no personal stakes in the specific area may give higher priority to other adaptation options.

At the citizen summit 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 general trend was that citizens gave the municipality a mandate to engage more actively in climate change adaptation and make decisions that could overrule and disregard the interests of private property owners for the sake of the common interests. 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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At the time of writing (January 2012) the administration of Kalundborg is in the process of drafting a climate adaptation strategy. The plan will include an analysis of expected climate impacts and vulnerable areas in the municipality. It will also include priorities and guidelines with regards to adaptation measures. Once the strategy is completed, it is to be agreed upon among the politicians and it can then be implemented in the Municipality Plan 2013-2024, which is the legal document on which future initiatives in the municipality must be made.

Protecting an area from flooding may benefit landowners but may not be sustainable from a societal perspective in the long run. Thus, small decisions about the instalment of protective measures increase expectations and demands for future decisions about additional protective measures and exclude a democratic debate about alternative possible futures, for example about whether one should continue protecting current land uses or let nature take its course. The methods chosen for the decision-making process in Kalundborg were designed to stimulate such democratic debate. In Kalundborg, knowledge about climate change and adaptation options has been considerably increased among politicians, stakeholders and citizens. As a result of the BaltCICA project, climate change adaptation is now more widely recognized in the municipality as not merely a technical issue but also a political question about future land use, division of responsibilities and priority of interests. Expectations have been raised among citizens and stakeholders for decisions to be taken soon. Property owners will want to know if their assets will be protected in the future or not, because it will matter to decisions they make today, and the administration will think twice before making infrastructure investments in areas prone to future flooding if their future protection is unrealistic or unwanted.

Generally speaking, policy-making has become more complex and reliant on scientific theory, knowledge and models, some of which is more disputed than other. As politician it is increasingly difficult to find ones feet and there is a risk that important decisions are therefore postponed. Stakeholders offer their advice but have their own interest in mind, and opinion polls are too superficial to give politicians a sense of public opinion on complex issues. It is therefore increasingly important to make use of the many tools available for participatory decision-making both on a local, national and global scale. Climate adaptation is a good example of this and we expect the municipality of Kalundborg to benefit from having applied such tools in their management of an uncertain future.

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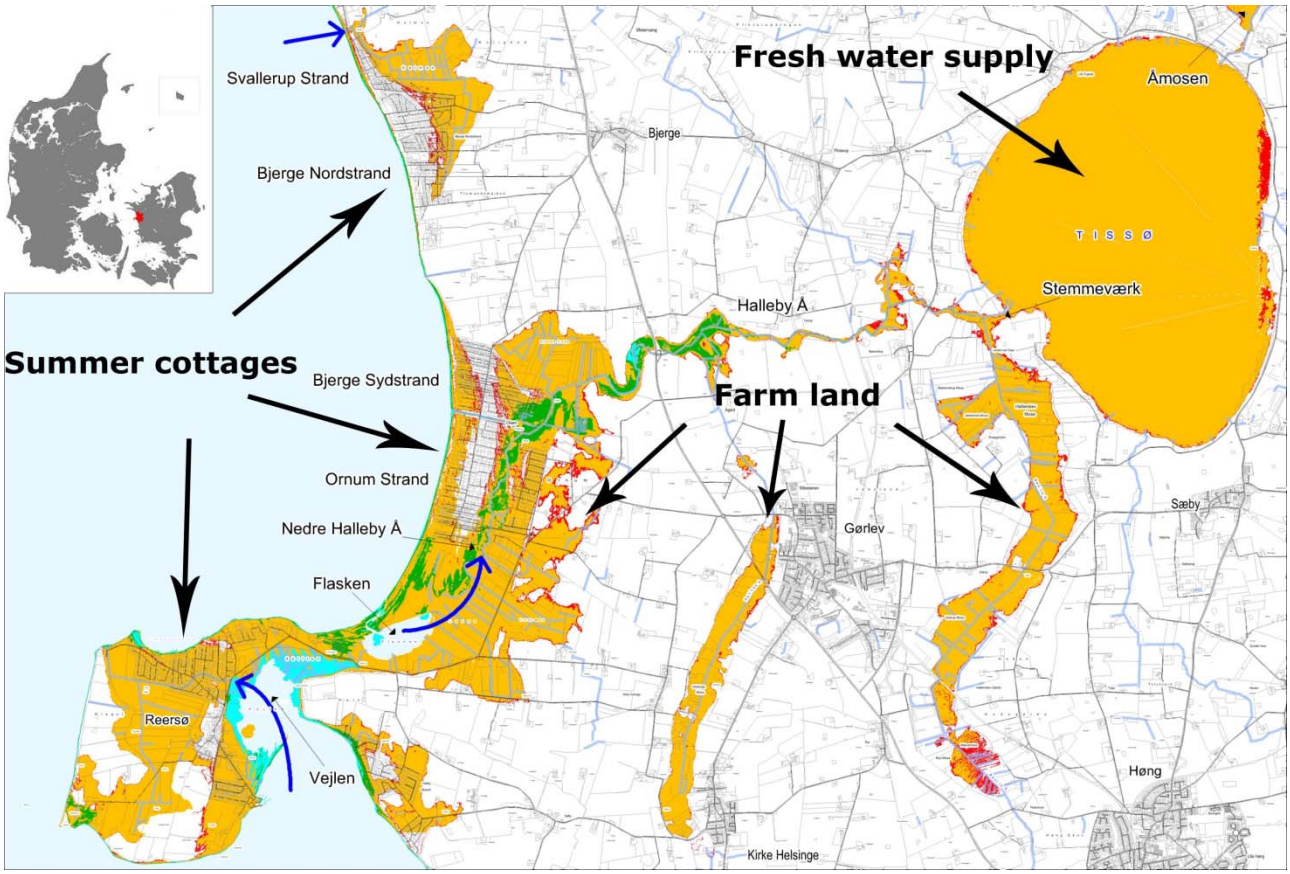
Photo 1. Jørgen Madsen, Citizen summit on climate change adaptation in Kalundborg, March 2011. The Mayor, Martin Damm, is being interviewed for the local news in the bottom right corner.



Map 2. Anticipated flooding in the southern part of Kalundborg Municipality. In 2090, areas marked with blue are expected to be permanently flooded, green areas will be regularly flooded, yellow areas less often and red areas rarely. This will affect fresh water supply from Tissø Lake, summer cottages in coastal areas and farm land in several places.

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6 Adaptation to flood risks in Riga

The capital city and its functional region are situated on the sea coast at the mouths of three large rivers Daugava, Lielupe and Gauja. All three rivers are treated separated in terms of the EU water basin directive that makes Riga case particular challenging from both geographical characteristics and policy making. Riga City's 15 km of the seacoast and about 60 % waterline are vulnerable to sea level rise. Other risks concerning to the climate change adaptation are related to sea storm surges, flash floods due to intensive precipitation and outdated technical infrastructure of the urban water system.

There are estimations by Riga city's planners that the current 1% probability urban flooded area of 31.1 km2 will increase in year 2100 by 28 percent. The projection was made based on IPCC A1B scenario that indicates water level raise by 4.8 mm per year.

Natural and man-made coastal protection exists and traditionally human settlements have not been developed in dune and flood-prone areas in Latvia. There is evidence that since the end of the 13th century Riga has had the coastal protection by wood constructions from the Daugava River waters. One of results of the BalCICA project was a review of historical extreme weather events in Riga area. There are various types of challenges facing Riga's planners today as urban areas are characterized by the large diversity of land use types, including polarized densities and fragmented patterns of residential and economical activities.

Planners of the Riga City municipality and researchers of the University of Latvia covering multi-disciplinary aspects of climate issues by the support of the BaltiCICA project closely cooperate and thus have been providing the transfer and the integration of specialized climate change knowledge into legitimized and operational activities of local government, particularly in the field of spatial planning regulations. Both foreign climate change adaptation experiences from local municipalities around the Baltic Sea as well as methods of multi-criteria decision-making analysis have been learned and will be explored for application in the Riga City.

Stakeholder workshops and meetings have been organised by the University of Latvia to widen the spread of information and consultations outside the Riga City's municipal institutions. Latvia University transfer the climate change adaptation knowledge by involving others the BaltCICA project partners. In close cooperation between experts of the Riga City municipality and the Latvia University possible adaptation options for urban spatial development will be prepared.

The case of Riga city proves that in spite of public finances cuts at national level the local level and the expert community is capable to attract the EU funding (BaltCICA and Life+ project) and

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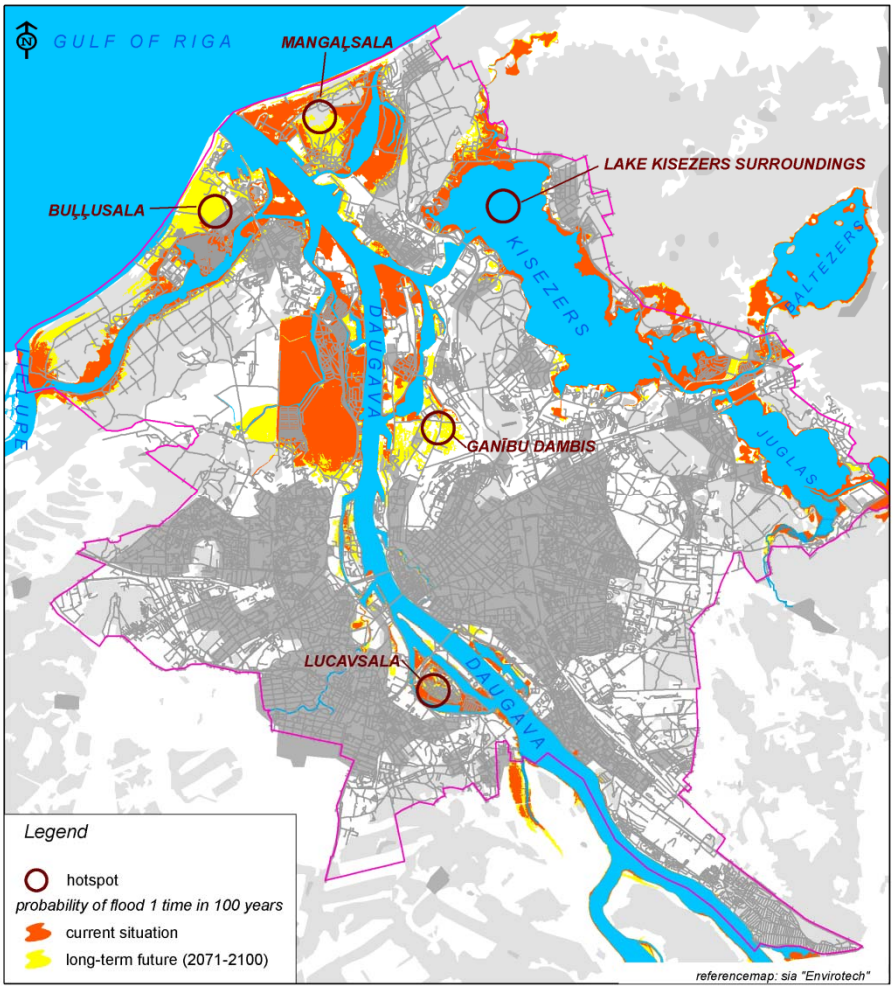
continues to work towards safer places and thus climate change adaptation measures as that fits to their everyday tasks and strategic aims.



Map 3. Hot spots for the discussions or places identified as territories or technical structures for climate change adaptation measures (prepared by Andris Locmanis, Riga City Council)

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Photo 2. Sudden flooding caused by comparatively short duration and high intensity rainfall in Riga's inner city: the crossing of Elizabetes and Marijas streets on July 16, 2009. Author: Leta (National News Agency)

Photo 3. Sudden flooding caused by comparatively short duration and high intensity rainfall in Riga's inner city: Pulkveza Brieza Street on August 17, 2009. Author: Plume

Photo 4. The remembrance sign of flooding at the Riga Dom Cathedral. Author: O.Sparitis

7 Karkle beach (Lithuania) and sea level change

by

Jonas Satkunas, Lithuanian Geological Survey

The Klaipeda City municipality has initiated feasibility and planning studies for determination of conditions for establishment of recreational infrastructure in vicinities of Karkle village (10 km north of Klaipeda) (see Map 4.). Though the Lithuanian coastline of the Baltic Sea in Karkle village is only 1.4 km long, but complex geological processes are present. Besides the climate change driven factors the shoreline area of the Karkle is constantly exposed to increasing human impact (e.g. dredging in Klaipeda harbour) and the latter factor became an independent factor affecting shore-formation processes.

The number of visitors and holliday-makers in Karkle is evidently increasing – their number in summer peak season (July) in period 2001–2011 increased more that 6 times.

Therefore, due to increasing demand of the beach the spatial planning procedures were intitiated by Klaipeda municipality.

The Karkle beach is located in between protected areas – the landscape reserve of Olando Kepure south of Karkle and the Karkle talasological reserve north of Karkle. The Karkle village itself belongs to ethnocultural reserve. Therefore, development of recreational infrastructure is constrained by the occurence of these protected areas. The demand of beach infrastructure in Karkle is related with sharply increasing number of holiday makers.

The Karkle beach is characterised by morainic and sandy cliffs. Beach is 18–42 m wide. Gravel, cobble and boulders cover up to 70–90 % of the beach surface at Karkle and close of the Olando Kepure cliff and only in northern part the beach is sandy. Bathing conditions there are quite complicated, however the beach is picturescue and could provide good recreational conditions.

The geodynamic stability of beaches can be revealed only by analysis of the long-term measurements of morphometric indicators of beaches.During the 20th century the Baltic Sea water level rose up to 14.9 cm at Klaipeda. If the rate of sea level rise of 20th century will remain (1.5 mm/a), the sea level will rise 15 cm. But if rate of sea level rise of last 35 years will remain (3.5 mm/m.), the sea level will rise 35 cm.

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Map 4. Situation of the Karkle beach. Legend: 1 –- proposed territory of the Karkle beach; 2 – active cliff; 3 – inactive cliff; 4 – line of geological cross-section; 5 – line of profile of measurements of coastal dynamics (see Fig. 1–3); 6 – boundaries of reserves.

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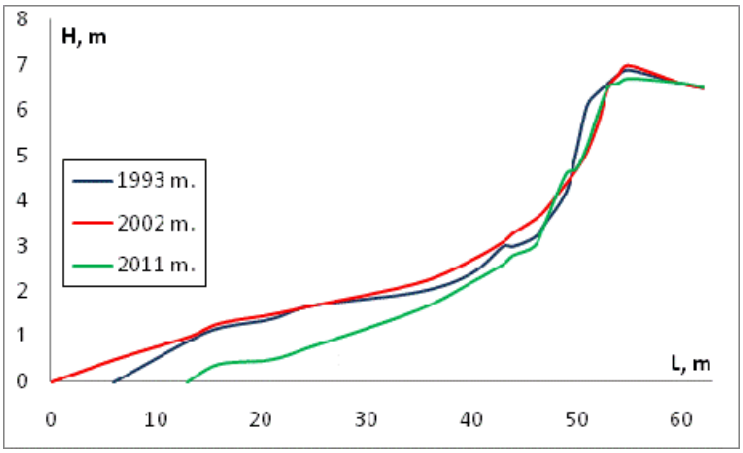

Fig. 1. Dynamics of coastal profile in 1993–2011 south of Rikine rivulet. L – width of the beach , H – hight of the beach.

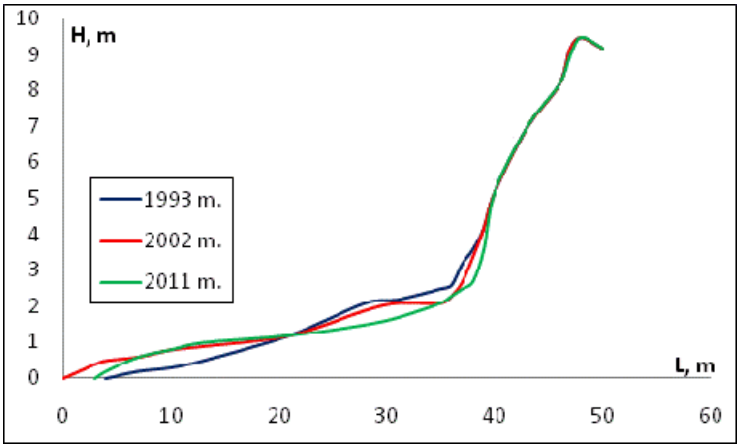

Fig. 2. Dynamics of coastal profile in 1993–2011 near the Karkle cementary. L – width of the beach , H – hight of the beach.

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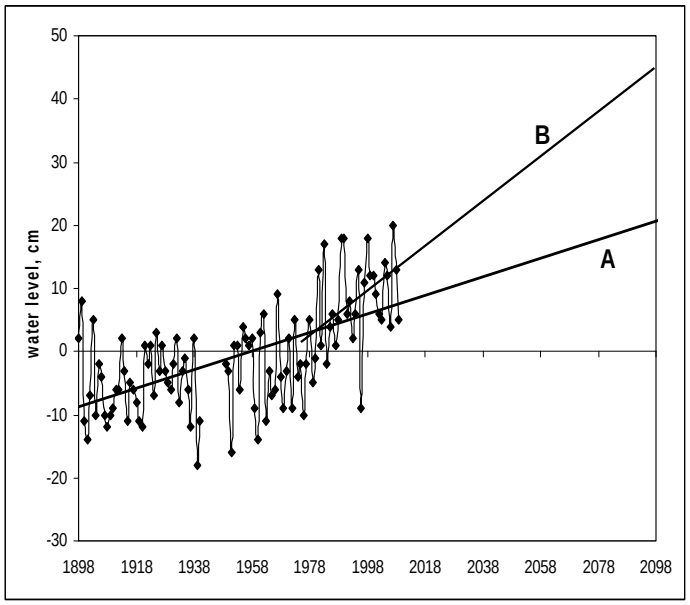

Fig. 3. Forecast of the Baltic sea level rise in Lithuania in 21st century: A – if trend of 20th century will remain, B – if remain trend of last 35 years (by D. Jarmalavicius and G. Zilinskas).

Results of analysis indicate that coastline at the Karkle was developing in cyclic manner – erosion period is followed by accretion period. During period 1993 to 2011 coastline north of Rikine mouth retreated aproximately 6 m, but at the Karkle graveyard proceeded towards sea about 2 meters.

Different coastal sectors or individual profiles may vary considerably due to local geological conditions, morpho-lithological diversity and anthropogenic loads. It is most likely that due to climate change coastline at Karkle will retreat from 3.9 to 4.9 meters. Therefore, the Karkle beach can be developed and be sustainable as recreation facility during at least several decades. The measured morphometric indicators were implemented for planning of coastal infrastructure and adaptation to climatic variations.

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8 Norway - Bergen

by

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Pre- foresight

The City of Bergen is located at the west coast of Norway, directly facing the North Sea. Bergen is Norway's second largest city, with about 250.000 inhabitants. The city region consists of 14 municipalities with about 360 000 inhabitants. Bergen is governed by a locally elected City council. The city Department of Climate, Environment and Urban development is responsible for urban development, environmental affairs, climate, cultural heritage, roads and transport, water and sewerage and social housing. Bergen is the only city in Norway with its own Head of Climate section.

Climatically, Bergen has a very exposed position, and the Bergen population is used to continuous as well as heavy downpour, strong wind, river flooding, landslides and high waves. With future climate changes, these challenges are predicted to intensify, and in addition, Bergen will have to cope with en estimated sea level rise of about 1 meter over the next 100 years. In recent years incidences of extreme weather have resulted in loss of human life and material assets. A risk and vulnerability analysis (RAV) has therefore been carried out in connection with the land-use part of the municipal master plan. Different types of risk maps have been drawn up, mapping, for example, local precipitation, floods, water levels and land-slide risk areas in the whole of the City. These maps will be used in planning processes and developments to reduce the risk of unforeseen incidents.

Future climate changes are expected to lead to sea level rise and more extreme weather events. This will in turn increase the risk of floods and landslides. Bergen participates in several climate change projects in order to build knowledge about local climate models, registration of climate vulnerability and drawing up forecasts and scenarios to help identify what adaptation measures will be necessary in the Bergen area. This work is linked to national and international research communities. Water supply and sewerage are regarded as critical parts of the infrastructure. High quality water provision and secure and reliable wastewater management is a top priority for the city authorities. Priority is also given to the use of water as a structure in the urban environment by opening closed water conduits and installing systems for separating the surface water from wastewater. In the municipal planning work, an overarching risk and vulnerability analysis has been carried out for land use following the principles defined by the Norwegian Directorate for

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Civil Protection and Emergency Planning. The main principles of the analysis have been incorporated into the municipal master plan. Special risk and vulnerability maps have been drawn up for landslides, floods, wind and waves. These thematic maps are linked to the municipal master plan, and the provisions and guidelines in the land-use part of the plan are based on the thematic maps. Bergen is also actively supporting the climate change plan for Hordaland County which focuses on land use and transport, agriculture, aquaculture and waste and economic business development. Bergen is also carrying out a project on climate change and human rights. Bergen has initiated and participates in a wide range of climate change adaptation projects. Among Norwegian cities, Bergen is in front regarding climate change adaptation. Bergen is also partaking in a network called Future Cities, in which climate change adaptation is one important area.

BaltCica's task has been to help Bergen integrate the various climate change adaptation projects into one overarching adaptation strategy and to develop a structure for information flow between the projects and between each project and the city, in order to enhance mutual learning. Moreover, the BaltCica team has in cooperation with Bergen City identified blind spots in Bergen's climate adaptation strategy.

Data and inputs

In order to get an overview of the different projects Bergen participated in, a series of meetings with core staff in the municipal administration was arranged, between January 2009 and October 2010. They provided us with information of the projects they were involved in, their plans for future projects and what additional competence they were in need of. In these meetings, we also discussed how the BaltCica project could be connected with and feed into other projects, especially another INTERREG project, MARE. The dates of the meetings were 12.2.09, 17.6.09, 19.11.09, 20.4.10 and 18.10.10.

Through a number of interviews (spring 2010) with different stakeholders in urban planning and development (land owners, developers, house owner organizations, residents' associations, insurance companies, municipal staff etc), two unaddressed topics of high concern were identified: these were the questions of responsibility and cooperation, and it was decided that a workshop should be organised addressing these issues. However, the awareness of the need for climate change adaptation was not very high among all stakeholders. It was a challenge to make them think about what consequences climate change might have for their organization.

As a preparation for the workshop, a number of documents, such as research reports on Bergen City's climate adaptation projects, municipal plans, VAR-analysis etc were reviewed. Additional input was provided through meetings with municipal staff and interviews with stakeholders

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representing different sectors and interests in urban development. Based on these different sources, we developed a set of questions for reflection and discussion, to use at the workshop.

Information transmission

Data from interviews were used as input when making questions for the workshop groups. The overarching question was: How will climate change affect the activities of your organisation? The respondents were asked to assess the consequences of climate change with regard to the following aspects: legal, economic, knowledge, competence, capacity, resources, cooperation, coordination and responsibility. Finally, they were incited to come up with ideas for measures and solutions to the perceived problems. The participants were presented with the questions at the workshop. No additional information, except for the workshop description, was given on beforehand.The results and outcomes of the workshop were communicated to the participants at the workshop, and to the City as a written report.

Interaction

A workshop on economic responsibility, risk and cost sharing and cooperation was organised in October 2010. Stakeholders from the business community, urban development actors, municipal staff, representatives from the County, insurance companies and other interested parties were invited. A one day workshop 25 participants was held in Bergen City. There were four expert introductions followed by group and plenary discussions. The participants alternately pondered questions prepared by the BaltCica team individually discussed these questions in groups of 8-10 people and presented and discuss the group conclusions in plenary sessions (IGP method).

Output

The project has had several aims. One aim has been to coordinate and establish routines for knowledge sharing and learning across municipal sectors and between the municipality and other stakeholders. A second aim has been to identify areas that were not yet covered by Bergen City's vast adaptation strategy. Two uncovered areas turned out to be cost and responsibility issues and cooperation between municipality and developers. The workshop was hence designed to address these questions. The specific aim of the workshop was therefore to raise awareness about these issues and expand the scope of existing networks in climate change adaptation, to include the business community more efficiently and motivate developers and business community to initiate actions and cooperate more closely with the municipality. Another aim was to encourage preventive actions with the developers and the municipality. The outcomes of the workshop were presented to Bergen City as a written note. These are meant to feed into the adaptation policy of Bergen City. The BaltCica team will continue to co-operate with Bergen and preparing the nest BaltCICA project meeting and BaltCICA conference in May 2011.

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9 Flood defence in Klaipeda city

In the southern part of Klaipeda the river Smeltale flows into the Curonian lagoon (port area). The territory is periodically experiencing river flooding, 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 Klaipeda channel.
- Runoff modelling results project increases in frequency and maximum peak flow of heavy precipitation events in the 21st century.

During the 20th he Baltic Sea water level rose by 14.9 cm in Klaipeda. According to climatic models the sea level will increase between 25 cm (B1 scenario) and 86 cm (A1F scenario) in the 21st century. During storm surges the annual flood height is of 50 cm a record height value was 186 cm. Taking sea level rise into account, in 2100 flood heights could reach between 102 cm and 238 cm. The probability of storm surges > 100 cm might increase towards the end of the 21st century.

Map 5. Potential flooded territory in southern part of Klaipeda city caused by sea water level rise 102 cm (in the left) and 238 cm (in the right).

In the frame of BaltCICA project researchers made an assessment of consequences of climate change in the area and presented several scenarios to the local stakeholders. First scenario workshop with local stakeholders took place in Klaipeda on April 16, 2010. Representatives of the Klaipeda city administration, water company, schools, research institutions, local media, non-governmental organizations, Environmental Protection Department under the Ministry of Environment, Klaipeda sea port, local communities were involved in the process. The main goal

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of this workshop was to discuss main reasons of the floods in the southern part of Klaipeda and possible adaptation options. As a main output the list of adaptation measures selected for appraisal procedure was developed.

At later stage the feasibility study of selected adaptation measures was prepared, presented and discussed with local stakeholders during the second workshop that took place in Klaipeda on December 13, 2010. The option that was finally chosen proposes to install flood protection embankments along the river. This selection was later approved by the City Council.

Photo 5. and Photo 6. Discussion during the scenario workshop with local stakeholders in Klaipeda (left) and Presentation of developed green area plan to local stakeholders and decision makers (right)

The decision to establish a recreational-entertainment green area with all necessary infrastructures along the Smeltale river was taken by the City Council. Main outcomes of the BaltCICA project, as well as climate change adaptation option selected by the local stakeholders and approved by the politicians, were incorporated into the developed green area plan. This plan was presented to and discussed with local stakeholders and decision makers on November 30, 2011. The group of architects who developed this plan made a work plan for the green area establishment with clear phases of implementation. This will allow more efficient allocation of the resources in the city budget and step-by step implementation of the planned activities.

Klaipeda city case is a successful example of planning and implementation of climate change adaptation measures. A dialogue and successful cooperation between researchers, local stakeholders and decision makers played a very important role in the achievement of planned project goals.

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10 BaltCICA, West Estonian coastal zone

by

Sten Suuroja and Valter Petersell (Geological Survey of Estonia)

The west Estonian coastal zone extends 300 km in the north-south direction. Based on studies such as WBGU and PIK, predicted temperature rise will be up to 3-5 oC by the end of the century, and related sea level rise up to 0.9–1.1 m, taking neotectonic movements into account. Sea level rise threatens the existence of many beaches and recreational areas.

The west Estonian coastal zone is mainly lowlands. The area to be permanently covered by sea, now up to 1 m above sea level is almost 146 km2, the area to be flooded or influenced by the sea and currently up to 2 m a.s.l. is 253 km2, the area up to 3 m a.s.l. is 449 km2 and the area up to 5 m a.s.l. is 761 km2, respectively. A considerable portion of Estonians, including scientists and engineers, do not believe in relative sea level rise in the Estonian context. Accordingly, the main project tasks became predicting consequences of sea level rise in the coastal zone, analysing possibilities for mitigating actions and explaining climate change related risks. Presumably, once the population is convinced of the existence and expansion of risks, local and central administration start analysing the situation and applying risk mitigation measures.

Local administration and population were introduced to the problems by discussions and presentations. Informed people included e.g. local government and Ministry of Environment officials, architects and entrepreneurs. Covered topics were natural and man-made causes for climate change, arguments of those denying climate change, and predicted environmental, economical and human damage.

Principal results were compiled in presentations that were forwarded to local governments and environmental officials, for information and to be used in adjusting local development plans. In the Audru and Haapsalu regions, architects promised to ban building of expensive and potentially eco-unfriendly constructions to lower altitudes than 3 m and 2.5 m a.s.l., respectively.

Participation in discussions varied. The number of participants was up to 21 in the regions of wider damage during the January 2005 storm (Audru, Haapsalu, Vormsi island). At some localities, there were less than four participants.

Project results have been partly published, and are being published in newspapers, magazines and radio, likely also in TV. As numerous stakeholders are obviously interested in the results, the most important ones will be published in print.

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Photo 7. and Photo 8. Valgeranna before and after the January storm 2005

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Photo 9. Cambrian impact breccia boulders

Photo 10. Matsalu birds protected area

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11 Mecklenburg-Vorpommern: One spot – three processes

By

Holger Janssen and Inga Haller

Tourism is the most important economic sector in the State of Mecklenburg-Vorpommern. In 2010, about 21.9 million overnight stays have led to a gross income of 3.7 bn Euro. 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 some attention: Coastal tourism is highly climate sensitive as climate is a main element in the decision-making process of tourists. Not only direct impacts of a changing climate such as the increase or decrease of comfort parameters like temperature, humidity or windiness affect tourism. With regard to coastal tourism, climate impacts might also affect 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.

To understand the impacts of climate change on marine and coastal water quality and to identify efficient management measures, numerous simulations of the 21st century have been done by using the 3D bio-geo-chemical ecosystem model ERGOM. These projections have considered different climate change scenarios as well as a number of nutrient emission scenarios including changing policy conditions and land-use patterns. The impacts of the scenarios lead for instance to changes in water temperature, oxygen conditions, extend of anoxic zones, appearance of algae blooms (cyanobacteria) and others more. A lesson learned from these simulations is that policy driven changes (e.g. changes in land-use) have larger impacts on the nutrient regime and thus on the ecosystem of the western Baltic Sea than climate change itself. In general, the reduction of nutrient emissions would therefore be an appropriate adaption measure. Thus the implementation of the Baltic Sea Action Plan (BSAP) could be a solution for climate change adaptation. However, the challenges in achieving the goals of the BSAP seem to be quite demanding, and it remains uncertain whether all states surrounding the Baltic Sea will be able to achieve a good water quality in coastal waters. As a consequence, supporting innovative internal management solutions (e.g. filtration measures within river estuaries) have been researched in collaboration with responsible authorities.

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Sustainable coastal protection has been another pillar of this case study. By acknowledging that coastlines are dynamic and that change is a characteristic feature of coastlines, this case study adhered to following principles:

- Coastal protection is necessary only because of the utilisation of coastal areas by humans.
- Climate Change is an additional variable in coastal processes but it does not modify the system itself.
- Coastal protection measures need a firm regulatory framework for planning, approval and implementation. Protection measures are limited to the protection of built-up areas.
- Materials used for coastal protection purposes should be natural materials like clay, sand, gravel, stones, wood and brushwood fascines.

For the BaltCICA project two beach nourishment measures have been carried out on the Island of Rügen in front of the villages of Lobbe and Göhren. From these measures important findings for environment-friendly coastal protection as well as instruments for the realisation of such measures have been gained. The latter includes surveys of natural data, planning stadium, approval procedure, construction phase, and monitoring of both the extraction site and the nourishment area. The respective beach nourishments have been carried out on a length of 2.5 km using about 222,000 m^3 of sand, unlocking additional third-party funds to the amount of 2.4 m Euro.

To transfer the above mentioned aspects of the two pillars coastal water quality and coastal protection into coastal tourism practice, findings and activities have been discussed with an expanding regional tourism network. The exchange of best practice examples and experiences has led to increasing awareness and climate change competence amongst regional coastal stakeholders.

The BaltCICA process in this case study will be continued in the national climate change adaptation project “RADOST” and contribute to “Baltadapt”, a flagship project under the EU Strategy for the Baltic Sea Region.

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