COASTAL & MARINE

Coastal Climate Change

Protecting and adapting maritime regions

EUC Coastal & Marine

EUCC-D

Volume 20 • No. 3 2011

Editorial

Dear reader,

Our valuable coasts belong to the most preferred places to live, work and recreate. Low-lying sandy coasts are, however, susceptible to flooding and erosion. If these regions are developed, they need protection or, rather, coastal risk management.
In the Baltic Sea region, especially along its southern shorelines, comprehensive coastal protection schemes are in place. They provide, up to certain safety standards, protection against flooding and erosion. It is obvious that climate change induced sea level rise and higher storm surge water levels will challenge these standards and, therewith, the safety of the inhabitants. Adaptation measures are necessary. As it may take decades before negative impacts of stronger sea level rise become evident, there still is time to develop appropriate adaptation strategies.
Against the background of climate change and its hydrological consequences, sustainable and integrated coastal risk management (ICRM) strategies should, complementary to technical measures, consider other options like regional and urban planning as well as disaster management. Flood-proof housing and information campaigns are good examples. Recognizing the outstanding natural values and functions of our coasts, the ICRM strategies should follow the principles of minimal ecological interferences and working with nature. A number of research projects like BaltCICA and RADOST took up the challenge to develop holistic and sustainable adaptation strategies for the Baltic Sea region and beyond. Examples are described in this issue. Enjoy reading!

Jacobus Hofstede
Schleswig-Holstein State Government
Vice-president EUCC – The Coastal Union Germany

Coastal & Marine Union (EUCC)

The Coastal & Marine Union is dedicated to conserving and maintaining healthy seas and attractive coasts for both people and nature.
EUCC advocates best practice by developing coastal and marine policies, mobilising experts and stakeholders, providing advice and information, and implementing demonstration projects.

Membership dues for 2012
€ 24 for Friends of the Coast;
€ 48 (€ 80 / 3 years) for Student and Private Members;
€ 65 (€ 120 / 3 years) for Professional Members and Non-profit NGOs;
€ 300 (€ 500 / 3 years) for Full Member Organisations;
€ 1000 for Communication Partners;
€ 2000 for Programme Partners.
All EUCC members are entitled to a free subscription to 'Coastal&MarinE-News' and our e-letters in Dutch, French, German and Spanish.
For info: www.eucc.net.

EUCC Coastal & Marine Magazine
Coastal & Marine is free for EUCC members (except Friends of the Coast).
Conferences and meetings are listed on www.coastalguide.org/meetings

Coastal & Marine Union (EUCC)
P. O.Box 11232, NL-2301 EE Leiden
Telephone: +31.71.5122900
E-mail: admin@eucc.net, www.eucc.net
Visiting address: Breestraat 89A, Leiden, NL

Content

Colophon

EUCC's magazine 'Coastal & Marine' Special on protecting and adaptating maritime regions top coastal climate change
(volume 2011-3) , ISSN 1877-7953

Editors: Inga Haller, Susanne Schumacher, Nardine Stybel (EUCC Germany)
Design & Layout: Erik Devilee
Printed by: Veldhuis Media, The Netherlands

Printed on FSC paper (Reviva Silk)

Opinions expressed in Coastal & Marine do not necessarily reflect the official views of EUCC.

Cover photo: © Birte Wehnsen

Photo cover insets: © Alexander Schmidt, Nardine Stybel, Lisa Paglialonga

Thanks for support are expressed to: *Maria Ferreira (EUCC-International), Mara Ort, Holger Janßen (Leibniz Institute for Baltic Sea Research, Warnemünde), Sonja Krauss, Oliver Rathmann and Ramona Thamm (EUCC Germany) and all contributing authors and photographers.*

Funding acknowledgements are given to: *Baltic Sea Region Programme 2007-2013 (BaltCICA, Baltadapt), Federal Ministry of Education and Research Germany (RADOST) and EU Action Programme promoting European NGOs.*

© Birte Wehnsen

Climate Change and Coastal Zones in the Baltic Sea Region – Some General Remarks

The Baltic Sea Region is on the way to a transnational climate change adaptation strategy. In the past years it became more and more evident that climate change will have different impacts on the coasts of the Baltic Sea Region – depending on exposure / sensitivity and the adaptive capacity of specific coastal sites.

- After 2050 increasing risks due to climate change, particularly sea-level rise, are expected. Sea-level is projected to rise with 0.6 m or more. This may result in increased coastal flooding, erosion and ecosystem losses. Two aspects should be considered regarding sea level rise. Firstly, new research results show that sea-level rise could be higher than 1 m until 2100. Secondly, sea-level rise and the consequences differ significantly from region to region since exposure and sensitivity of coastal regions due to climate change impacts depends on bathymetrical, morphological, ecological, and other factors.

- Although information and data about frequency and intensity of future storm events in the Baltic Sea are not completely adequate, possible storm events and their consequences must also be taken into account. Low-lying coastal areas are particularly vulnerable due to erosion and saline intrusion into coastal groundwater aquifers.

- The vulnerability of coastal areas in the Baltic Sea region depends on the adaptive capacity of the different regions. Adaptive capacity consists of a broad set of „soft" and „hard" factors such as:
    - coastal protection measures and its funding,
    - spatial planning instruments,
    - willingness to establish multifunctional use of coastal zones,
    - environmental awareness and knowledge,
    - institutional capacity and economic resources.

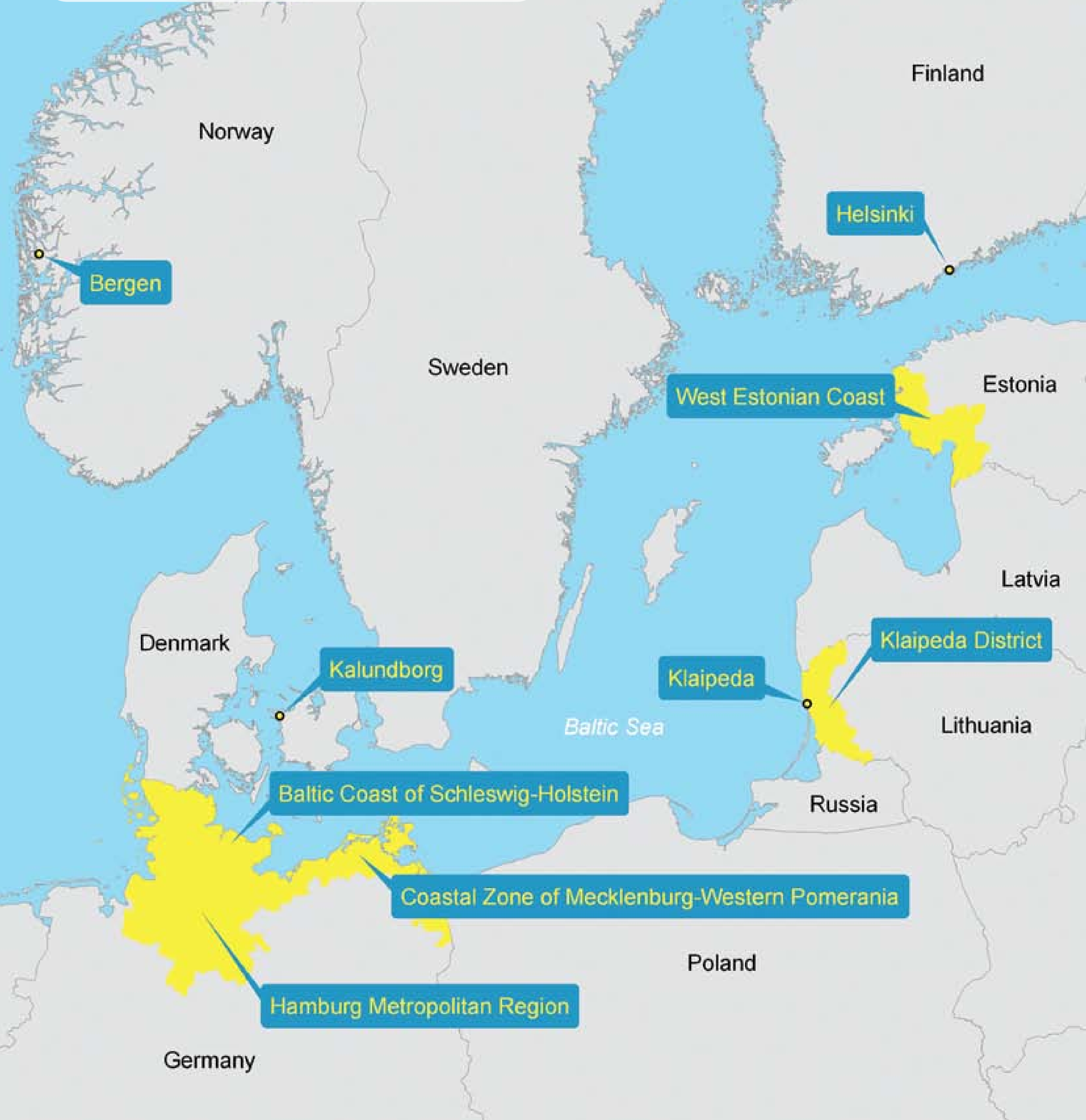
- Spatial planning approaches (legal regulation as well as Integrated Coastal Zone Management) play a prominent role in climate adaptation policies. Most countries in the Baltic Sea region implement adaptation measures in the coastal zone using spatial planning regulations. Spatial planning approaches may be appropriate both in solving conflicts in coastal zones and integrating different land and coastal uses.

Available adaptation strategies, including coastal zones, are a precondition for improving climate change adaptive capacity and implementing concrete adaption measures. The European Commission has established a transnational framework for climate change adaptation by implementing the White Paper on Climate Change Adaption in July 2009. Political will and corresponding activities is one important pillar for appropriate climate change adaptation; enhancing the information and data basis is a second essential pillar. Research projects such as BaltCICA and BaldAdapt and assessments such as BACC generate valuable information for making evidence-based decisions.

Achim Daschkeit,
Federal Environment Agency,
Germany

THE BALTIC SEA REGION

Climate impacts as well as adaptation approaches do often have a specific regional character. This map shows the locations of the case studies that the articles on the following pages present. The majority of the studies have been carried out under the auspices of the projects BaltCICA and RADOST.



Implementing sustainable coastal protection in Mecklenburg-Vorpommern

"*Coasts are mosaics in space and time*." This is the basic principle of the coastal protection strategy of Mecklenburg-Vorpommern with a total (inner + outer) coastline of 1,945 km. Coastlines are dynamic and change is their characteristic feature. Acknowledging the dynamic character, the following principles apply in Mecklenburg-Vorpommern:

- 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.

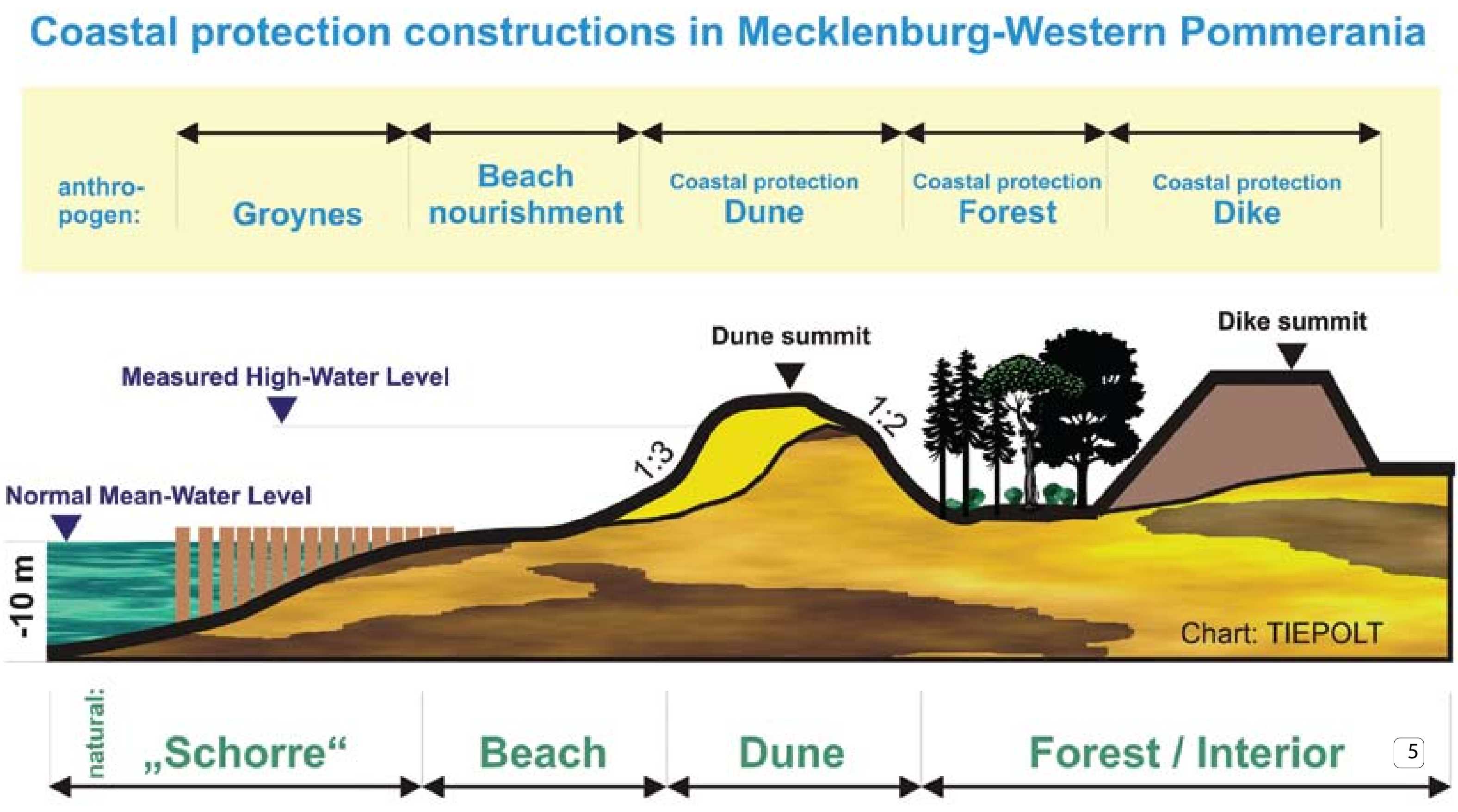
About 65% of the outer Baltic Sea coastline of Mecklenburg-Vorpommern, which is 377 km long, are subject to coastal abrasion processes. Maximal coastal retreat values amount to 1.7 m/year (average value: 0.35 m/year). Furthermore storm surges with values of more than 2 m above mean sea level occur time and again. Against this background environmentally sound coastal protection is necessary both today and in the future.
Beach nourishment has proved to be a crucial and appropriate coastal protection method in addition to dikes, groins, breakwaters, ripraps, and walls. Beach nourishment replaces the material that has been eroded from the coastline over years. Further, natural beach and dune areas are extended to a dimension (height, width, profile) where they show adequate resistance against storm surges.

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 later includes surveys of natural data, planning stadium, approval procedure, construction phase, and monitoring of both the extraction site and the nourishment area.

The beach nourishments have been carried out on a length of 2.5 km using about 222,000 m³ of sand, and amounting to 2.4 Mio Euros in total. In result, the villages of Göhren and Lobbe are safeguarded for the next couple of years against flooding. It is obvious that beach nourishments give only a temporary protection. Due to continuing coastal abrasion processes, they need to be repeated every seven to ten years. And these periodic cycles are a great chance for environment-friendly and climate-adapted coastal protection strategies. They allow for flexible reactions on changing situations in climate, storm tides, infrastructure, and demography. Thus coastal protection can adapt to the actual protection requirements anytime.

Lars Tiepolt
State Agency for Agriculture and Environment Rostock
Department Coast

Holger Janßen
Leibniz Institute for Baltic Sea Research (IOW)



Impacts of climate change and possible adaptation measures for Klaipeda City

Klaipeda city is one of the case study areas of the BaltCICA project. Some territories periodically suffer from high water levels in the Smeltale river. The area at risk is located on the southern part of Klaipeda city, where the small costal river Smeltale flows into the Curonian lagoon. Floods in the Smeltale river are mainly caused by high sea water level in Baltic sea and in Klaipeda channel and heavy precipitation in Smeltale river basin.
The main goals of the project activities in Klaipeda were to assess climate change impact on Smeltale river hydrological regime, to review possible Smeltale river flooding mitigation and adaptation measures, and to start implementation process of selected adaptation measures.
For the forecast of the climate changes in the 21st century, the CCLM climate model was used. Precipitation amount and extremity changes in the 21st century were based on 2 greenhouse gases emission scenarios A1 & B1 (additional scenario A1F was used to foresee sea water level changes). The modelling results discovered that precipitation amount would increase throughout the 21st century in Klaipeda (figure 1).

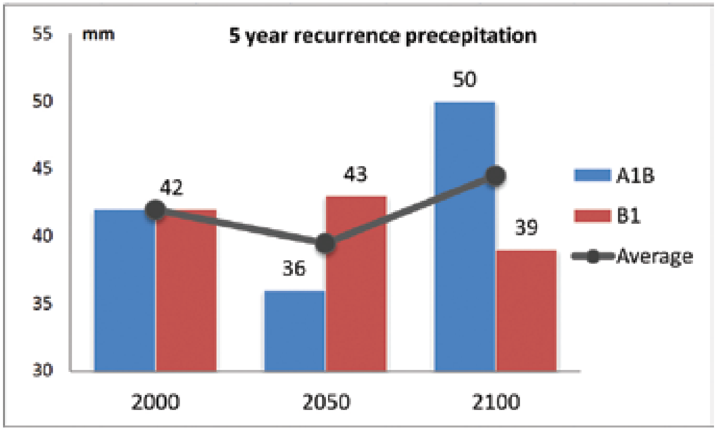
For Smeltale river runoff, modelling results foresee an increase in maximum peak flow during short term heavy precipitation events. Baltic Sea water level rose up to 14.9 cm beside Klaipėda in the 20th century. Even more dramatic sea level changes are expected for the 21st century. Our calculations showed that sea level will increase from 25 cm (B1) to 86 cm (A1F). The calculations were made using averaged value – 52 cm. At least one time per year sea level was 50 cm higher than the 20th century average; and the highest value was 186 cm (1967-10-17). Meanwhile, in 2100 possible height could be 102 cm and 238 cm respectively. Probability of such extremes (> 100 cm) will be much higher in the end of the 21st century. Flood potential territories are shown in figure 2.

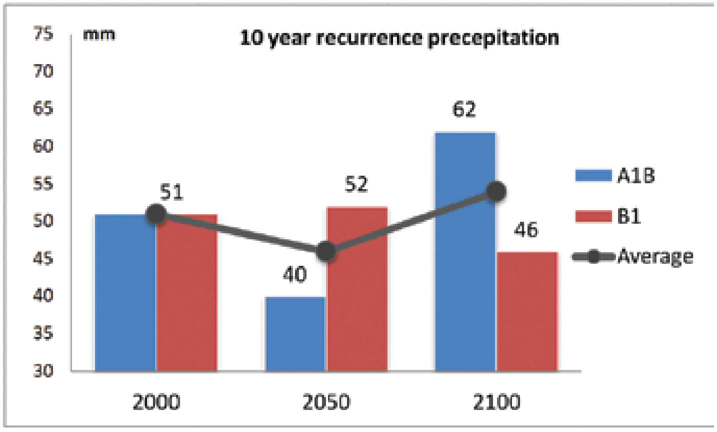
Possible adaptation measures for raised water level caused by heavy precipitation:

- direct water balance measures (partly channelling precipitation waters to other place, allowing water to run more freely in overflows, etc.);
- indirect water balance measures (controlling urbanization of rural part, regulating size of urbanized basin part, etc.).

Possible best solution for elevated sea level could be different embankments. A feasibility study was prepared for Klaipeda city to evaluate all solutions. As overall solution to solve both problems it was proposed to install an embankment along the Smeltale river. The solution was accepted by the city administration. The implementation of the proposed measure will be an important challenge for Klaipeda city.

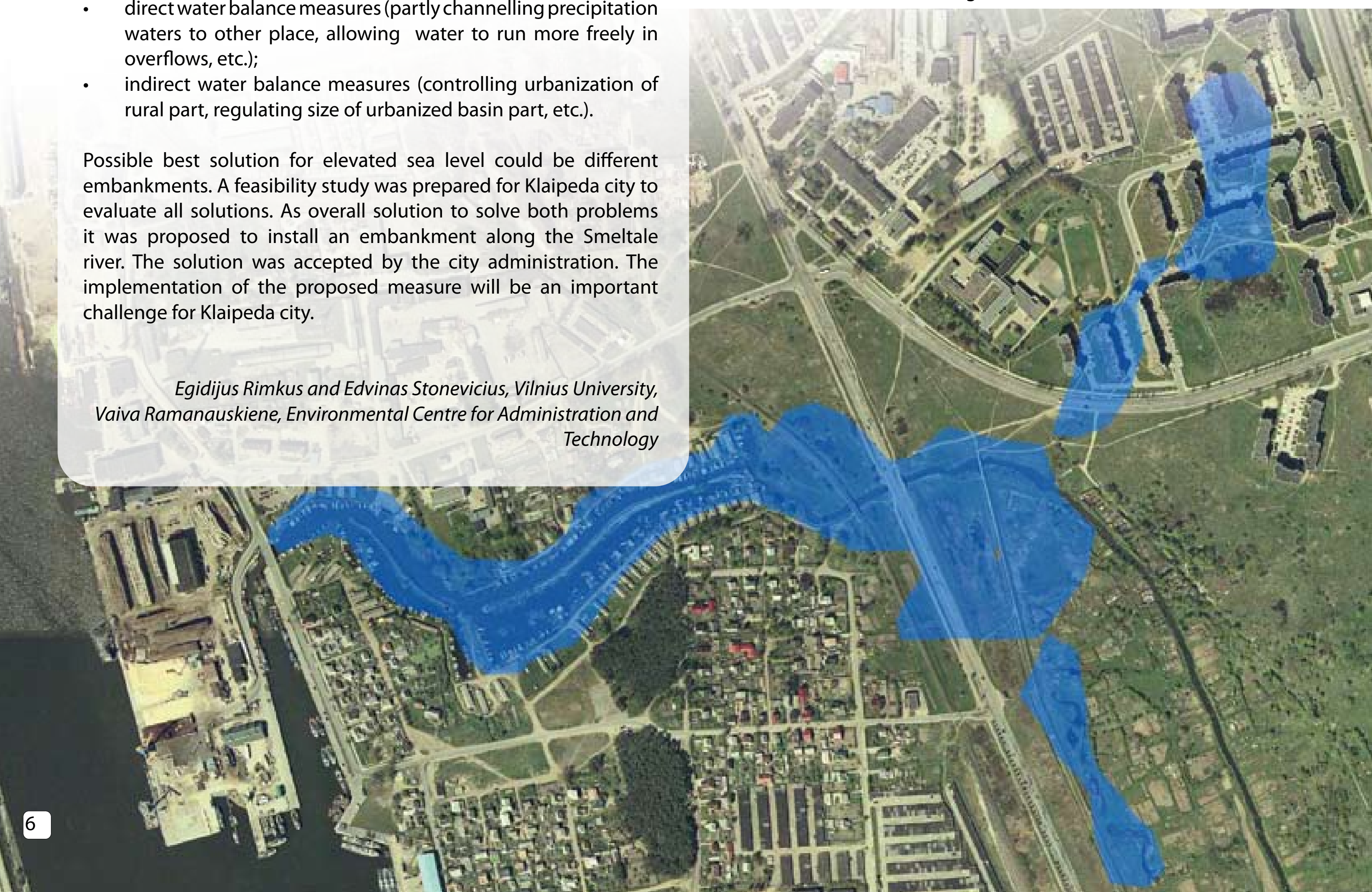
Egidijus Rimkus and Edvinas Stonevicius, Vilnius University, Vaiva Ramanauskiene, Environmental Centre for Administration and Technology





Five-year (top) and ten-year (bottom) return level of annual maximum daily precipitation amount during the 21st century in Smeltale river, Figure 1.

Potential flooded territory in southern part of Klaipėda city caused by sea water level rise 102 cm, Figure 2.



Dynamics of the Karkle beach, Lithuania

Changes of coastlines and beaches have significant economic and social impacts on human populations concentrated in coastal areas. One of case studies of the project "Climate Change: Impacts, Costs and Adaptation in the Baltic Sea Region (BaltCICA)" is the feasibility of establishing the Karkle beach (north of Klaipeda).

In scope of the elaboration of a detailed spatial plan of the projected Karkle beach (Klaipeda City municipality), the analysis of geological and geomorphological conditions was carried out on the basis of available data of monitoring and mapping. Major findings of this study are the following:

The Karkle is a specific coast type characterized by morainic and sandy cliffs of 4.5–6.5 m height. Gravel, cobble and boulders cover 70–90% of the beach surface at Karklė and at Olandų Kepure (Photo 1). The beach is 18–42 m wide and only in the northern part the beach is sandy (Photo 2). The litoral is very uneven, with pits and boulders and is composed by till. Bathing conditions are quite complicated.

Measurements of coastal morphology are carried out since 1993 m (Fig. 1). It was determined that from 1993 up to 2011 the coastline north of Rikine mouth retreated approximately 6 m, but at the Karkle graveyard proceeded towards sea about 2 meters. In some periods more visible changes occurred – for instance during the period 1993–2002 the entire coastline proceeded into the sea 3–6 meters. But having results of the measurements for the period 1993-2011 it has to be concluded, that the morphology of the beach during the period of investigations (18 years) did change rather insignificantly, even storms „Anatolij" (4 December 1999) and „Ervin" (8–9 January 2005) (Photo 3) impact was not much hazardous.

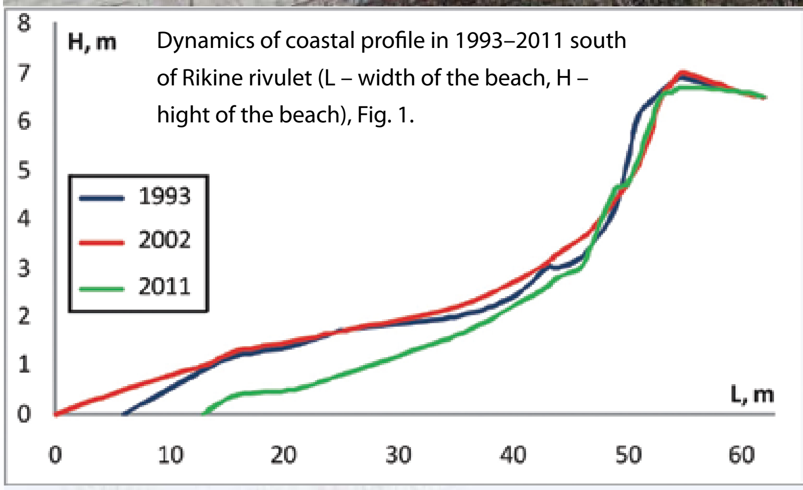
Analysis of historic cartographic materials revealed that during the period 1910–1947 the coastline between Rikine and Cypa rivulets advanced to the sea approximately 15 metres and accumulation of sand on the beach prevailed. However, during 1947–1984 erosion prevailed and the coastline retreated 10 meters. It has to be noted that during this period in 1967 the strongest storm of the 20th century heavily impacted the coastline. Besides 1967, storms occured in 1981 and 1983. Therefore, the mentioned period is characterised by coastal erosion. Later, until end of 20th century accretion processes took place. Analysis indicates that the coastline at the Karke was developing in cyclic manner – erosion periods are followed by accretion. However sand accumulation prevails in the beginning of the 21st century compared with that of the beginning of the 20th century and therefore the state of the beach is better. In spite of that historical trend, the development of Karkle morphology has to be modelled according to predicted sea level changes in the 21st century in order to establish the infrastructure of the Karkle beach and exploit its interesting features.

Jonas Satkunas
Lithuanian Geological Survey

Gintautas Zilinskas & Darius Jarmalavicius
Institute of Geology and Geography, Vilnius

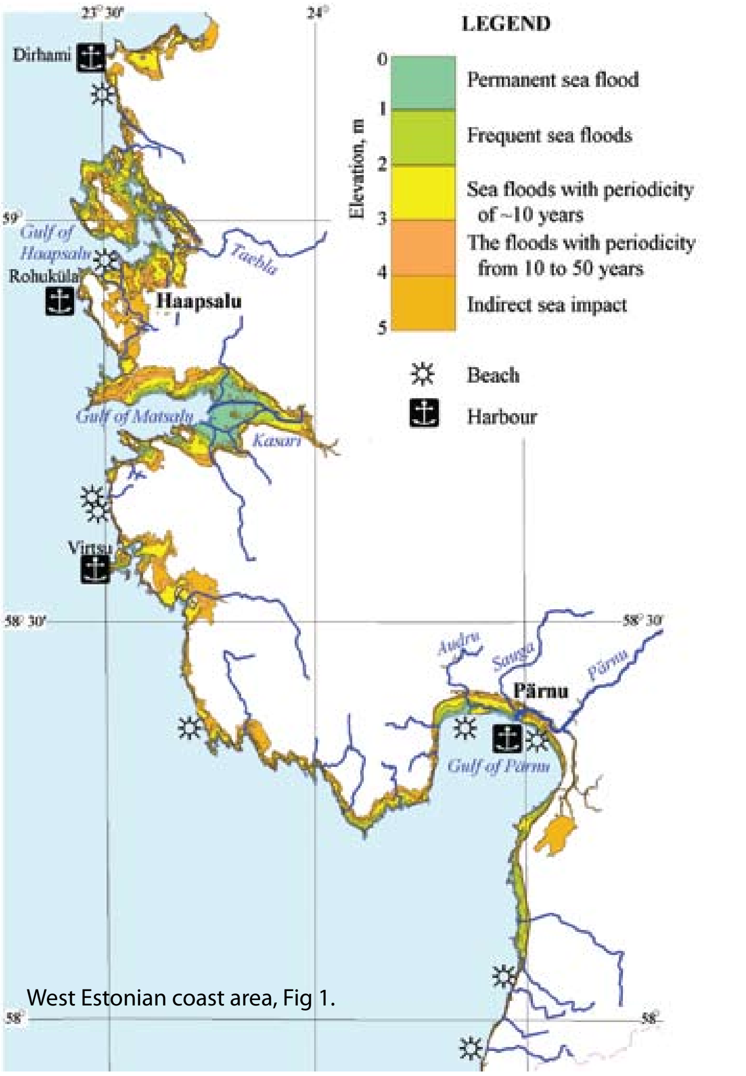

© J. Satkunas, Photo 1


© A. Damusyte, Photo 2

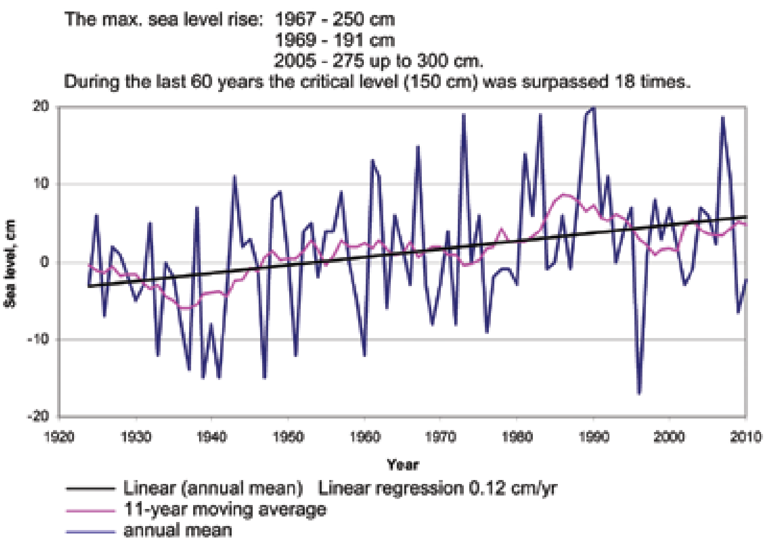


Dynamics of coastal profile in 1993–2011 south of Rikine rivulet (L – width of the beach, H – hight of the beach), Fig. 1.


© G. Zilinskas, Photo 3



West Estonian coast area, Fig 1.



The tide gauge measurements, Fig 2.

Dirhami coast after the January storm 2005, Photo 1

Predicted Impact of Climate Change to the West Estonian Coast

The West Estonian coast (Fig. 1) is the Estonian case study area of the Baltic BaltCICA project. Project activities started in 2009, and the authors have used the results of earlier projects SEAREG, ASTRA and WBGU, Delta Committee, ICCP, and PIK researches. Based on existing results, in the case study area the factual predicted temperature rise will be up to 3-5 °C and sea level rise up to 0.9-1.1 m by the end of the century, taking into account neotectonic movements.

The case study coastal zone comprises principally lowlands. The extent of area up to 1 m above sea level and to be flooded by the sea is almost 146 km^2, the area up to 2 m a.s.l. and to be affected by the sea is 253 km^2, the area up to 3 m a.s.l. is 449 km^2, and the area up to 5 m a.s.l. is 761 km^2.

The coastline is mainly straight in the southern part of the case study area, where the sea is in contact with weakly cemented Devonian terrigenous sediments. The recreational areas of the beach consist of sand, and are edged by forest park. In the northern part, the sea is in contact with Silurian and Ordovician carbonate rocks. In this region, the coastline is often very irregular, recreational areas are less frequent and coastal sand is often mixed with loose carbonate material.

The nature in the recreational areas of the case study area is diverse and there are several objects/sites worth visiting. In addition to typical coastal recreational areas, the Dirhami region in the northern part is enriched with erratic boulders. Of particular importance are Cambrian impact breccia boulders that originate from the ring wall of the Neugrund meteorite crater.

The Matsalu bay forms the nucleus of the largest and richest protected area of migratory birds in northern Europe and the Baltic Sea. It is an unforgettable sight every spring and autumn when thousands of birds – swans, bean geese, white-fronted geese, barnacle geese, mallards, pintails – per day stop to rest in the area and pass it.

Studies during recent years have shown that the relative rise of the ground within the case study area has currently stopped or is replaced by subsidence (Fig 2). The effect of sea water on the coast is firstly expressed by erosion of sandy banks and beaches. The yearly average of withdrawal of banks is up to 1 m, and as a consequence of big storms even more than 10 m. Together with the banks, the forest covering them is also lost (Photo 1).

The above mentioned processes are likely to intensify in the conditions of climate warming and sea level rise during this century, and become more complicated because of the characteristics of geology and hydrology. Additional areas will be covered by the sea or become affected by the sea level rise, causing additional problems. It is realistic that some of recreational beaches (e.g. Valgeranna) will disappear, spreading of salt water in the soil can cause essential changes in the flora of recreational areas, etc. More P, N, Pb, and other elements will be transported from the soil to the sea. Together with petroleum products, these elements cause increased pollution of sea water, increasing water eutrophication. Water level rise in the mouths of rivers and ditches promotes the effect of sea water on the coastal subsoil water and the development of landslides of river banks.

It is an essential part of the project to determine and map the above mentioned processes, to predict their development, to assess minimizing of negative consequences, and to introduce the results to local residents, governments, developers and other stakeholders.

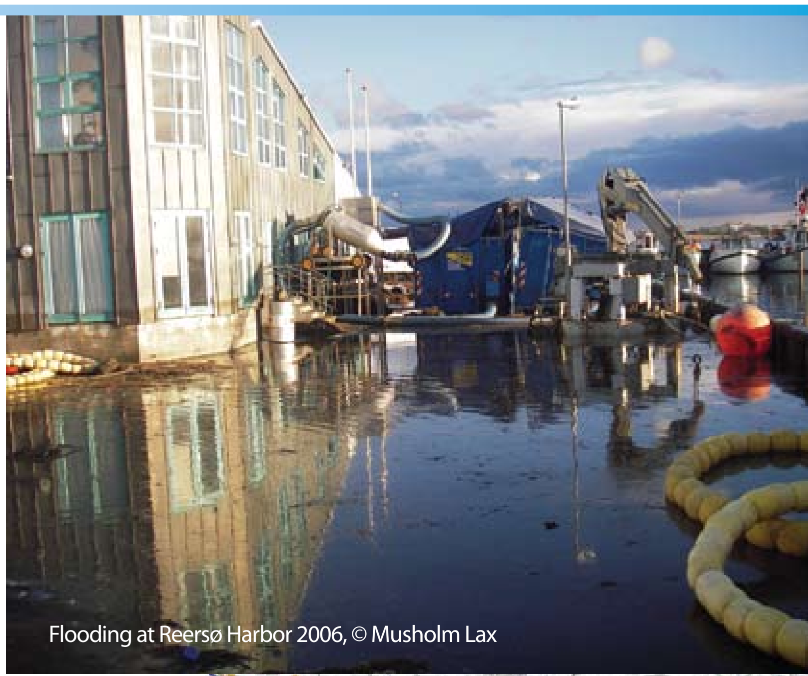
Valter Petersell, Tarmo All, Sten Suuroja
Geological Survey of Estonia (EGK)

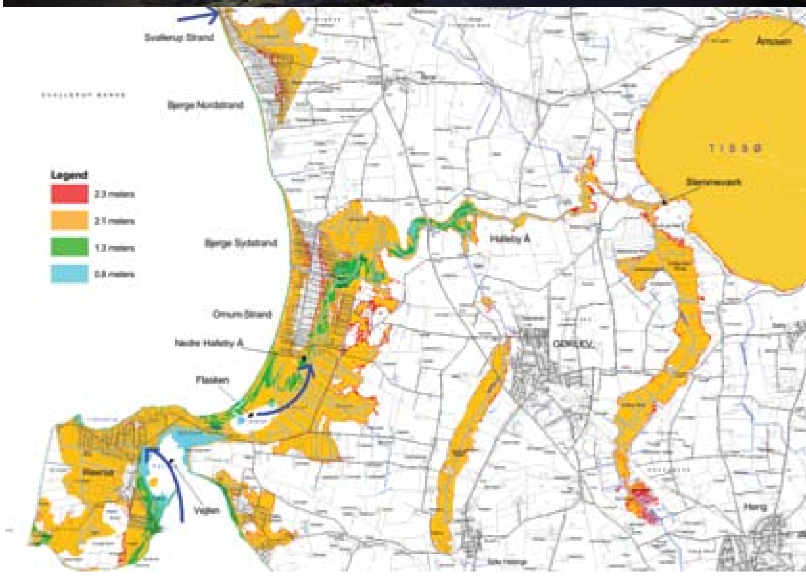
Local climate adaptation - What do the citizens think about it? – an example from the Municipality of Kalundborg, Denmark

One of the case studies in the BaltCiCa project is situated in the Municipality of Kalundborg. The 14000 hectares study area includes a peninsula (Reersø), a large lake (Tissø, 1233 hectare), a large near shore and low-lying summer cottage area and also permanent habitation, large agricultural areas, nature resorts, ground- and surface water interests as well as tourist and cultural assets. Furthermore the land behind the coastline has delta-like characters which make the area vulnerable to extreme weather conditions. Also the area includes infrastructure such as roads, sewages, water supply and draining assets. The case study area has a coastline and lowlands, which are threatened by a rising sea level and changes in precipitation. Figure 1 shows the areas which are at risk of flooding at different sea levels. It is estimated that the total damage costs (mainly on buildings) with a sea level rise of 0.8 meters will be around 260 million EURO from 2010 to 2090 if nothing will be done against it (DBT, Municipality of Kalundborg 2011).
To illustrate different climate change impact scenarios in the area and to carry out local scenario workshops with stakeholders as well as a citizen summit, the case study has been a collaboration between the Municipality of Kalundborg, the Danish Border of Technology (DBT) and Geological Survey of Denmark and Greenland (GEUS).

Two local scenario workshops were completed with the purpose to discuss local solutions, based on three different local climate scenarios. The inspiration and visions from these workshops were analyzed, summarized and disseminated to a larger group of citizens who participated in a citizen's summit in Kalundborg. 8000 citizens from across the municipality were invited, 600 wished to participate and it ended up with 350 people present at the meeting. At the citizen's summit presentations were held, the citizens discussed the solutions in a broader perspective and there were multiple votings about the issues.
Some of the main results is that citizens would like to be involved in future planning of climate adaptation, they prefer that the general strategy for adaptation should be acting and preparing long-term plans taking the expected climate changes into account rather than a wait-and-see strategy. The citizens prefer that the municipality increases its requirements on how the property owners can build new and modify existing buildings. In areas as the case study area they prefer a long term solution where the vulnerable areas (eg. settlements) will be phased out and maybe be transformed to wetlands.
At the BaltCiCa homepage www.baltcica.org you can find out more about the project and the three future scenarios discussed at the workshops, videos and the voting result from the citizen's summit.
The recommendations from the citizen's summit have been discussed with representatives from the Municipal Board of Kalundborg. The results of the summit will be an important input when the Municipal Board of Kalundborg is to pass the climate change adaptation strategy in 2012.

Jan Krause Pedersen & Jacob Arpe
The Municipality of Kalundborg


Flooding at Reersø Harbor 2006, © Musholm Lax


Flooding in cases of sea level rises up to 2.3 m, © Map Kalundborg Kommune, Fig. 1.


The pennisula Reersø, © Klaus Petersen

Bergen region, Fig 1.

"Climate change adaptation in Bergen - stakeholder involvement, learning and coordination."

Bergen is the second largest city in Norway with approximately 260 000 inhabitants in 2011. The city is situated at the West coast of Norway in close proximity to the sea and the mountains, and the Bergen region is characterised by fjords, mountains and islands, cf. figure 1.

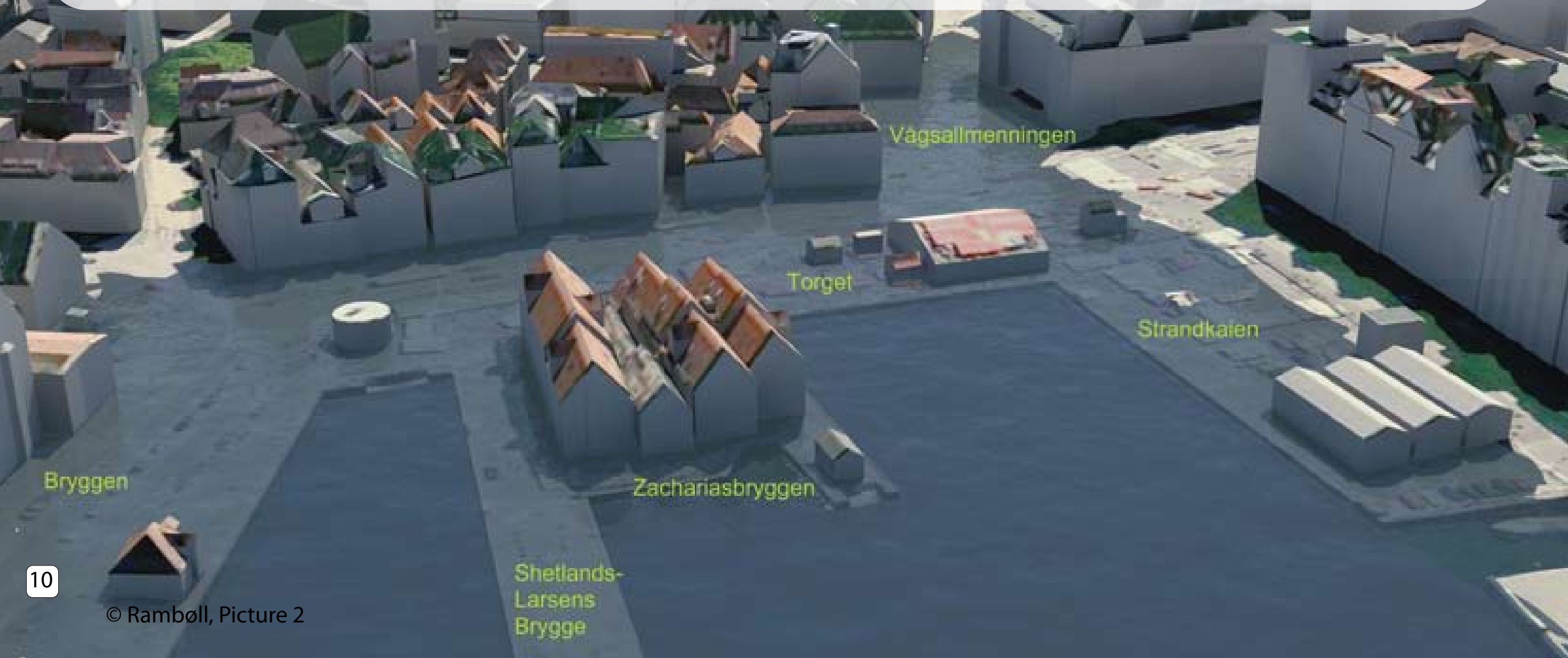
The main challenges related to climate change are flooding by river and precipitation, and landslide. Bergen is the wettest city in Europe with an annual precipitation of 2250 mm and annual precipitation is expected to increase 25-30 percent over the next 50 years. In the near future the largest challenges are related to sea level rise and extreme weather events. During the 21st century the sea level is expected to rise approximately 75 cm in Bergen and the storm surges may increase up to 221-276 cm. This will have devastating impacts on the city's infrastructure, transport system and tunnels, buildings and sewage system. Picture 2 illustrates that central parts of the city will be below water level. The cultural heritage site Bryggen is expected to be flooded several times per year. Several adaptation measures have been discussed in order to prevent damaging impacts from sea level rise. These include movable tide barriers, local barriers alongside the quay and up-lift of critically situated buildings.

Bergen city has a very active climate policy. It has a climate department which coordinates the climate and environment policy and several adaptation measures have been implemented. The city is also involved in many regional, national and international networks and projects dealing with climate change adaptation. BaltCICA is one of these projects. NIBR's primary task in this project is to assist Bergen city with regard to knowledge transfer and learning between projects, and to provide knowledge on how to organise stakeholder involvement and develop adaptation strategies.

The cooperation has taken place in several meetings between Bergen city and NIBR and two surveys have been carried out. The first one was part of an overall survey to all cases in the BaltCICA project aiming at mapping main climate change challenges, adaptation measures and governance issues. The second survey was done as a preparatory step for a workshop focusing on economic and legal responsibility for climate change damages, and on stakeholder cooperation. Participants at the workshop included urban developers, land owners, local environment associations, consultancy firms, insurance companies, as well as national institutions, representatives from city and regional administration, and from the university sector.

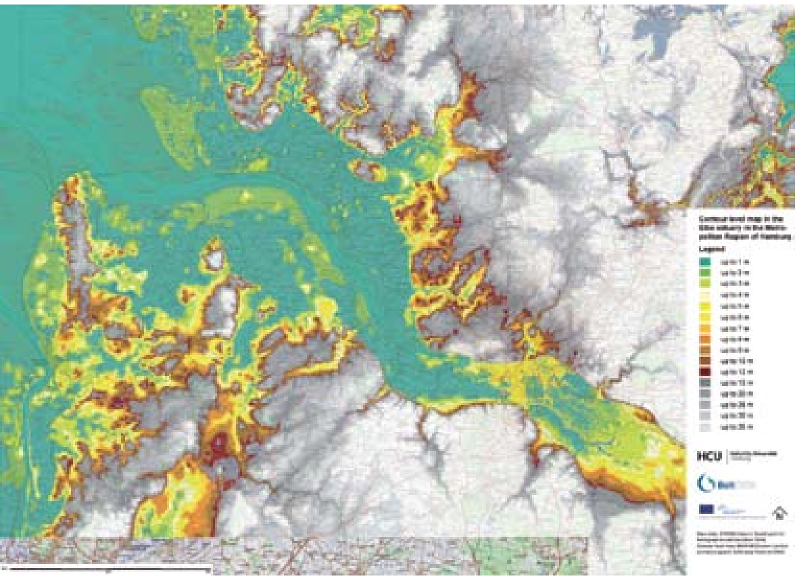
The aims of the workshop were manifold. Firstly, to highlight issues of economic and legal responsibilities for climate change damages in order to create awareness and discuss possible adaptation measures. Secondly, to expand existing networks dealing with climate change and, thirdly, to encourage the business community to play a more active role in climate change adaptation policies. The output of the workshop was a list of issues that the City of Bergen will incorporate in their climate change adaptation strategy and in their work vis-à-vis the stakeholders in urban development. In addition established networks were strengthened.

Ove Langeland, Jan Erling Klausen and Marte Winswold,
Norwegian Institute for Urban and Regional Research



© Rambøll, Picture 2

Flood protection and climate change in the MRH - stakeholder involvement in line with developing adaptation measures



Topography of the Tide Elbe Region, Figure 1.

Stakeholders at the HCU Scenario Workshop, Figure 2.

Map of possible adaptation measures in the Tide Elbe Region, Figure 3

The Metropolitan Region of Hamburg (MRH) is directly connected to the North Sea and close to the Baltic Sea. As a result of this location, the MRH will be exposed to several impacts of climate change - a probable increase of the mean temperature up to 3°C, a shift of precipitation patterns, sea level rise up to 20 cm along the coast line and an increase in storm surges levels up to 110 cm by the end of the century. Not only along the coastline but also in the catchment area of the river Elbe, those impacts will endanger environment, biodiversity and settlement structures. Especially in the tidal affected regions, the vulnerability is quite high, amplified by the fact that the marshland along the river lays only 1- 3m above sea level (see Figure 1).

To reduce the vulnerability, the marshland is protected by a dyke-line. The continuous dyke runs on both sides of the Elbe and is up to 14.5 m high. The latest enhancement was finished in the year 2000.

This dyke-line reduces the vulnerability to a moderate level for the time being. However, as a result of climate change, natural hazards will increase both in terms of frequency and intensity. In this respect, alternative measures have to be taken into account to prevent the impacts of climate change in long term thinking.

Concerning climate change, several interests and concerns of stakeholders exist. Due to the specific aspects of adaptation processes, the cooperation between different groups and responsibilities is essential. Therefore, the interests of costal management, spatial planning and nature protection, besides several more, have to be taken into account. In order to raise the awareness of climate change and its possible impacts, HafenCity University Hamburg hosted a scenario workshop for stakeholders throughout the MRH to discuss vulnerability, possible consequences and adequate adaptation measures. Participants represented local and regional administrations, politics and agencies. In line with three development strategies (“await”, “protect” and “change”), different scopes of action were discussed in order to analyse which one could be most effective and efficient. After that, different strategies with suitable measures along the Tide Elbe were proposed (see Figure 3). These ranged from “sticking to dyke enhancement” to “resettlement in less vulnerable regions”. Based on those measures, the participants developed visions for the MRH on how to realize adaptation measures and to push forward information and communication strategies.These visions were presented to a broader community of regional stakeholders, including politicians and decision makers, on the “Regional Conference for Climate Adaptation in Coastal Regions”. The conference took place in Hamburg in April 2011, and was hosted by the five federal states of Northern Germany.

As a high amount of expert knowledge was aspired for the workshop, the number of participants (46 participants out of 300 invitations) was rather disappointing. Nevertheless, the participation of key stakeholders showed that the topic of climate change has become a main issue at the administrational level in the MRH as the development of an adaptation strategy for the city and for the region is right in the middle of the process. The participants indicated that the topics in general as well as the outcomes of the workshop are useful for this ongoing process. Only few pointed out that the field of climate change adaptation would not affect their professional action. Nevertheless, the workshop can be seen as an exemplary communicative instrument to raise awareness for climate change among stakeholders and to use a wide variety of expert knowledge to push forward adequate adaptation measures and processes.

Jörg. Knieling, Lisa Kunert, Philipp Schuster
HafenCity University (HCU)

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 (Figure 1). The Metropolitan Area covers 745 square kilometres and contains a total population of approximately one million, which is about 19 per cent of Finland's population.

The four cities of the Helsinki Metropolitan Area, Helsinki, Espoo, Vantaa and Kauniainen, together with Helsinki Region Environmental Services Authority (HSY) are responding to the challenges that climate change brings to the area. The area has a mitigation strategy in place since the year 2007. However, the cities have also acknowledged the need to prepare for the consequences of climate change. Therefore, they started a joint effort in 2009 to prepare an adaptation to climate change strategy for the area.

The Helsinki Metropolitan Area is situated on the coast of the Baltic Sea and has hundreds of kilometres of coastline. Some of the effects of climate change can already be felt in the area. In the future, the challenges of a changing climate that the area will face include extreme weather events such as heavy rains, warmer summers and more hot days, wetter and warmer winters and sea level rise. To prepare for the consequences of a warming climate, the urban and built environment and coastal areas require early adaptation measures. Assessing possible adaptation options for the area has been carried out within the BaltCICA project.

The aim of the Helsinki Metropolitan Area adaptation to climate change strategy is to assess the impacts of climate change to the area and to prepare for them in order to safeguard the well-being of the citizens and the functioning of the cities also in the changing conditions.

The strategy aims to define both long term goals of adaptation and a set of concrete shorter term adaptation measures for the following sectors: general and cross sectoral measures; land use; transport and networks; building; water and waste management; rescue services and safety; social and health services and research, development and dissemination of information. As the strategy is a regional effort, it concentrates on those impacts, measures and policies that require cooperation between the cities or different sectors within the city governance.

The draft strategy was completed in the end of 2010 and it was sent for comments to the cities and stakeholders from February to May 2011. The citizens were also invited to give their comments through the internet. The Helsinki Metropolitan Area adaptation strategy will be finalised at the end of 2011.

The key question of the strategy is how to achieve real changes on the ground and transfer the policies and measures into action. An essential requirement is that the strategy is useful and relevant to the cities and deals with concrete impacts and risks of climate change in the area. It is therefore important to involve the city planners and experts in the planning process from the start. It is also important to deal with actual and relevant problems related with both current climate variability and expected future changes. To ensure mainstreaming of the strategy to the cities' policies and actions, it is vital that the decision makers approve and support the strategy and its implementation. The strategy is under preparation so the implementation has not started and therefore there are no concrete measures yet.

Susanna Kankaanpää
Helsinki Region Environmental Services Authority

Figure 1

Suomenlinna, source wikipedia, © Michal Pise

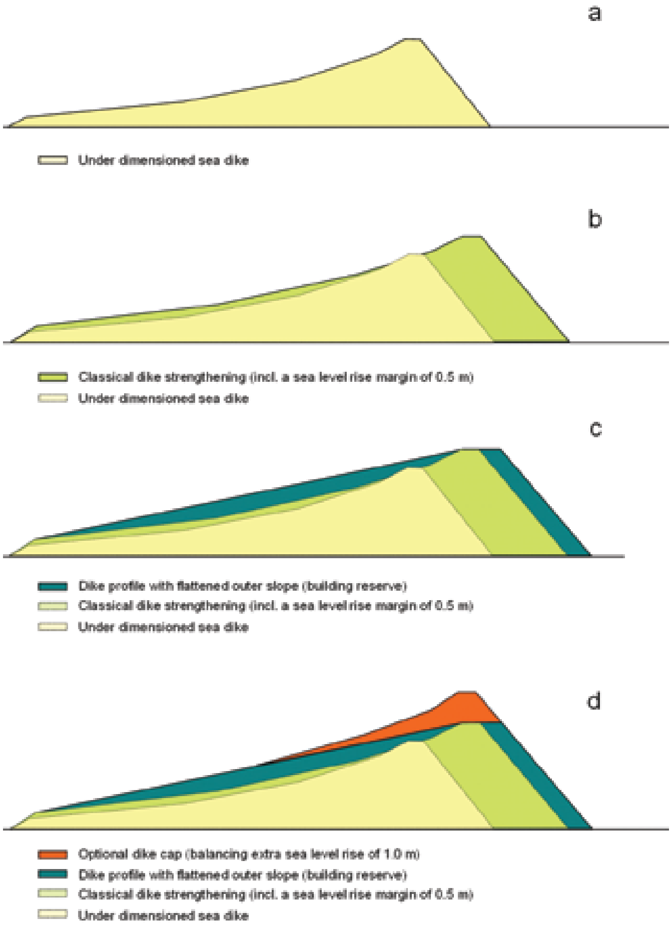
Adapting to climate change - coastal risk management in the German State of Schleswig-Holstein

The Baltic Sea coast of Schleswig-Holstein is characterized by bights and fjords, some of which deeply incise into the mainland. Significant parts of this scenic area possess outstanding natural values and are designated NATURA 2000 sites. Active and fossil cliff stretches (glacial till) alternate with low-lying coastlines. About 182 km (30%) of the coastline underlie long-term erosion. More than 56,000 people (165 per km^2) live in the scattered coastal lowlands. They are protected from flooding by sea dikes with a total length of 121 km.

Current projections indicate that global sea level may rise among 0.2 and as much as 1.5 m till the end of this century (compared to 1990). The actual magnitude is controversially discussed in the scientific community and, still, depends on our future behaviour. Nevertheless, a strong acceleration in sea level rise (SLR) must be accounted for. Already in the year 2001, Schleswig-Holstein State Government decided to consider 0.5 m of SLR in the dimensioning of dike strengthening campaigns. Recognizing the facts that this might not be enough as well as the large uncertainties with respect to the actual magnitude of future SLR, a new concept "building reserves" was introduced in 2009 (Fig. 1). If a safety check shows that a sea dike (Fig. 1a) does not meet the defined safety standards, a dike-strengthening campaign becomes necessary. Applying the classical approach (with varying outer dike slope gradients and including a SLR margin of 0.5 m) a new dike profile is designed (Fig. 1b). In an extra step, the outer dike slope obtains a continuous flat gradient and the dike crest is broadened (Fig. 1c). Thereby, a building reserve for future dike strengthening campaigns is realized. If and when SLR exceeds 0.5 m, with relatively little efforts, a cap can be put on top of the dike (Fig. 1d). The "old" profile is simply being reconstructed on a higher level. With this phased no-regret approach, a total SLR of up to 1.5 m can be balanced. It avoids (too) high investments today and reduces financial burdens for coming generations.

The challenges arising from intensified land-use, climate change and SLR imply that classical defence strategies should be an integral part of a holistic coastal risk management (CRM) that combines technical and non-structural methods. CRM may be defined as a control loop that consists of the components: prevention, protection, preparedness, emergency response, recovery and review (Fig. 2). Schleswig-Holstein State Government is preparing a new master plan for coastal flood defence and protection in which the principles and components of CRM will be integrated.

Jacobus Hofstede
Schleswig-Holstein State Government
Deputy Head of Division Flood Defence, Coastal Erosion and Harbours



Building reserves, Figure 1.

CRM Cycle, Figure 2.

Probstei, Schleswig-Holstein, © Hofstede

Protection of sandy coasts in Mecklenburg-West Pomerania, Germany

The beaches at the Baltic Sea, with their warm white sand that trickles through our toes, are the result of a development that started about 8,000 years ago. Around this time, the Littorina Sea was formed and coastal processes started. Morphological Change is the most significant characteristic of coasts. Erosion at exposed headlands and sedimentation in bights resulted in so called equilibrium coasts. These changes lead over periods of days, years, decades and longer periods to the actual situation with the formation of bays, island and peninsulas. These processes are still going on.

Driving forces for the sediment transport are wave induced currents in combination with turbulence and other currents as e.g. large scale currents caused by water level differences, where they occur. Changes of the coast are clearly visible when storms move across the Baltic Sea and high water levels attack the coast in combination with strong winds and high waves. The forces lead to erosion of cliff coasts as well as low lying coasts and to a retreat of shorelines by several meters within short periods. During storms, the eroded material is mainly moved in cross-shore direction and deposited below the breaker zone in areas with comparatively shallow water. Hence, the sediment budget within a cross-section of the coast during storms is more or less balanced, since long-shore components of the sediment transport mostly can be neglected.

Long-term erosion and accumulation of a coastal stretch can only be explained taking into account long-shore sediment transport, where sand and other material is moved more or less parallel to the shore. Within a physiographical unit sediment is eroded in the erosion area, transported and finally deposited in one or more accretion areas. These processes are also the base for the morphological development landward of the shoreline. After deposition, sand is, by and by, moving landwards driven by the local wind and, finally, dunes, hooks and spits and over long timescales peninsulas are being formed.

Over long periods and within the physiographical units the masses of eroded and accreted sediment are balanced. Nevertheless, this is not necessarily valid for the length of the coastal stretches facing erosion or accretion. Today, we know that 70% of the Baltic coast in the German Federal State of Mecklenburg-Vorpommern is underling more or less severe retreat.

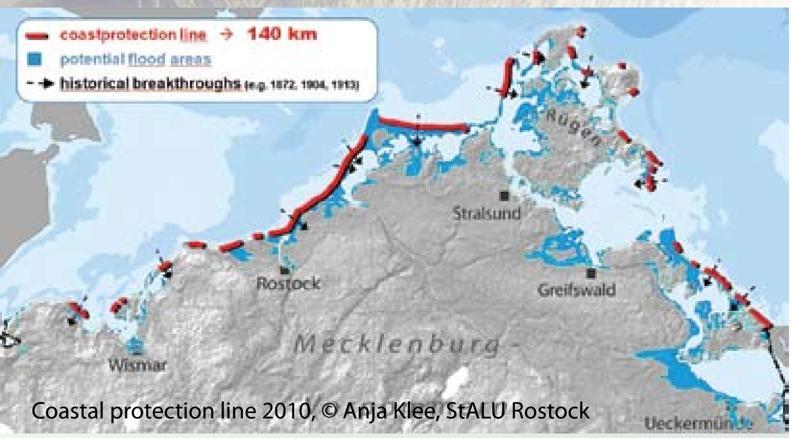
Coastal zones are favourable areas for living and economic development. This economic development was and is interrupted and influenced from time to time by severe floods. One of the worst events was the flood on Nov 12/13th 1872, which led to about 270 casualties in the south-western Baltic Sea. As a consequence of this severe flood and its damages, technical measures were installed to protect the people and their settlements against storm floods. In Mecklenburg-Vorpommern, naturally formed dunes are heightened and reinforced by means of re-shaping and plantation to protect the hinterland. Maintenance of the dunes ensures a sustainable protection. As a result, flood protection dunes lost their natural appearance, especially at those locations, which have transformed from areas with sand surplus to areas with sand deficit.

This situation was the starting point for coastal protection and is the challenge to protect the human use of coasts, especially settlements and infrastructure. In the Federal State of Mecklenburg-Vorpommern coasts with low lying hinterland are approx. 240 km long, where 140 km are protected against flooding. In addition, an average coastal retreat of 0.35 m per year has to be taken into account.

In contrast to heavy protection measures like dikes, revetments and seawalls which are acting like obstacles at dynamic coasts, sandy dunes are more flexible. The main advantage is that they adapt in position and shape to external forces. Together with beaches and foreshore shallow water areas, the dunes form a functional dune coast unit. If the sediment budget of the area is balanced or positive, shore and foreshore contribute to the stability and safety function of the dunes.

Erosion in Stoltera, © StALU Rostock

Coastal decline Rosenort, © StALU Rostock



Coastal protection line 2010, © Anja Klee, StALU Rostock

Erosion in Arenshoop, © StALU Rostock

Erosion of dunes caused by floods is natural and part of the function of dunes as flood protection measure. During a flood the erosive sediment is being transported to the shore and foreshore areas as described above and, in consequence, the water depth on the shore and foreshore decreases and the wave energy input onto the dunes decreases.

In Mecklenburg-Vorpommern most of the flood protection dunes are located in areas with coastal retreat. Hence, additional measures to stabilise the coast have to be installed. Wooden pile groins are frequently used to stabilise the shore and foreshore areas. These groins play an important role for the function of dunes because they are protecting the area in front of the dune over wide long-shore distances and help to ensure a stable basis for the dunes. Being placed orthogonal to the shoreline, groins are shifting the long-shore current field offshore and accumulation and improvement of the foreshore area is initiated between neighbouring groins within a groin field. Sediment is deposited due to the fact that the current velocities decrease within the groin field. The beach and foreshore areas become wider and higher and the shoreline is being stabilised. As a consequence of these processes, the function of the dune improves sustainable since the wave energy input onto the coast is reduced significantly already far seaward the dunes.

Coastal protection of retreating coasts is a permanent task and has to be continued over long periods. For protection against extreme floods, the dune crests along the coast are strengthened to up to 30-35 m in width and to up to 4-5 m above MSL (Mean Sea Level) in height. To balance natural sediment losses, sand is brought to the beaches and shallow water areas by means of beach nourishment. In order to compensate the negative sediment budget at the coasts of Mecklenburg-Vorpommern, 500.000 m^3 of sand are being dredged onto the shores per year. This enormous amount of sand is taken from sand deposits in the Baltic Sea which are located along the shore in a water depth of 10-15 m.

Particularly with regard to changed future conditions, the method of beach nourishment becomes a practical adaptation strategy. Dune sections could be designed significantly larger if it becomes necessary due to climate change induced processes, like an accelerated sea level rise or intensified flooding.

Knut Sommermeier,
Mecklenburg-Vorpommern State Agency of Agriculture and Environment, Coastal Department

Peter Fröhle,
University of Rostock, Faculty of Agricultural and Environmental Sciences

Co-using of coastal protection measures

The coastal zone of the Baltic Sea of Schleswig-Holstein is threatened by loss of sediment and erosion. It is expected that erosion will increase in the future as a result of climate change. Especially, sandy beaches like in the "Probstei" are affected by this development. On the one hand sand nourishments can stabilise the beaches and they can be used for additional touristic activities. On the other hand additional measures are possible, like submerged, detached breakwaters. Such structures are potential tools protecting or restoring beaches, marine habitats, creating fishing grounds or even serving as facility for surfing. For co-using there is the question which artificial types of breakwaters/reefs (coastal parallel breakwaters, geotextiles or reef balls) are best for of the Probstei and perform the following conditions:

1. Coastal protection
   - Creating wider beaches
   - Reduction of wave energy
   - No optical impairment/disturbance
2. Improvement of the habitat
   - New hard rock substrate for fauna and flora
3. Recreational use
   - Surfing, diving, angling
   - Indirect: more space for recreational use of the beach

This research is a part of a series of investigations carried out and developed in the German Baltic Sea Coastal zone. The scope or key-target of this research is to come up with an integrated design and the most suitable submerged coastal engineering alternatives for the Probstei coastline, particularly for the Heidkate, Kalifornien and Brasilien beaches (Fig. 1).

To preserve and maintain this coastal zone, 12 different alternatives, including surfing reefs, shore-parallel breakwater and Reef Balls breakwaters, were proposed for this case study. The integrated design of submerged artificial reef-type structures, together with a selection of reef placement locations, was based on multidisciplinary literature research and above mentioned requirements were integrated in the process of design.

DHI's MIKE 21 and LITPACK numerical models are employed to answer the key-questions of this case study. Longshore sediment transport is modeled with LITDRIFT, while wave transmission coefficients through the structure are calculated from numerical modelling results, obtained with MIKE 21 Boussinesq Wave Module.

One alternative can be suggested for the Kalifornien beach: a submerged breakwater made of geotextiles. The toe shield in front of the structure is highly recommended. Reef Balls can be used for diver attraction and as improvement of the habitat. A breakwater from Reef Balls can also be suggested for the Brasilien beach, if the improvement or creation of the habitat would be the main target. The toe protection and the different size of the gap between structures should be considered then. The latter structure is not that effective in reduction of longshore sediment transport as the first alternative.

Kai Ahrendt
Company for Environment and Coast, Kiel

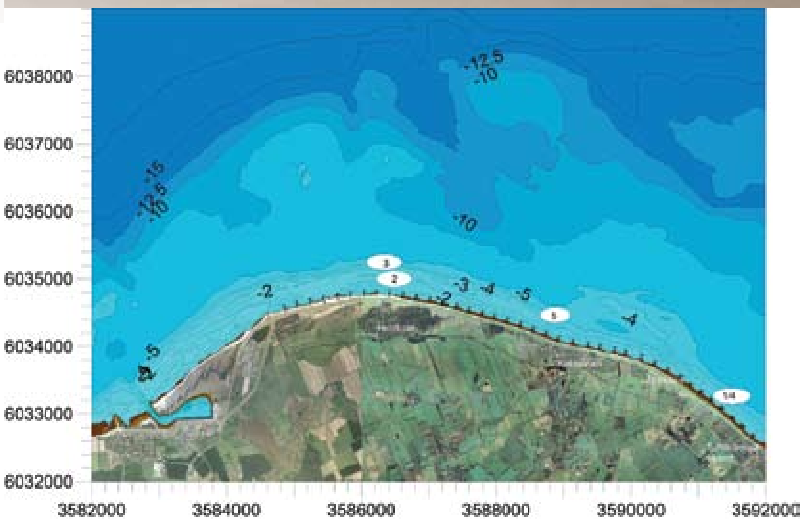


Fig. 1: Overview of the research locations with 5 alternatives (aerial pictures: © GeoBasis-DE/LVermGeo SH)

Fig. 2: Example with two submerged breakwaters (alternative 2) (source: Kliucininkaite 2011)

The influence of Teredo navalis on wooden groyne systems in Mecklenburg-Western Pomerania

At the densely populated coast of Mecklenburg-Western Pomerania coastal protection has a long tradition. One of the oldest protection structure is represented by coastal groyne systems. The first groyne-like structure was built from 1856 to 1863 at a place called Stoltera close to Rostock. At the moment there are 20 groyne systems located in Mecklenburg-Western Pomerania, which cover a coastline of nearly 80 km. There is a total number of 1126 groynes, with a length of approximately 100 km. This in turn means that around 330 000 piles are rammed close to the shoreline. These piles are traditional made from a local tree, the native pine. And that fact includes a big problem.

Whereby the problem is rather of small nature and it requires a closer look from the outside even just to see it. Lots of the groynes are affected by the common shipworm, *Teredo navalis*. Differently than suggested by the name, *Teredo navalis* is a mussel with a wormlike body which is fitted with a drilling unit, that consists of reduced shells. These mussel cause significant damages at the wooden coastal protection structures on the German coastline of the Baltic Sea.

Although the shipworm occurs in the Baltic Sea for a long time, the situation has changed dramatically since 1993. Since that year it was proven that these animals developed a stable population which also reproduced. This is remarkable because the salinity in the middle basin of the Baltic Sea is near the proliferation limit. But various investigations have shown that the mussel can adapt to much lower salinity levels if the temperature conditions are on an optimal level between 15 to 25°C.

In this context, climate change can play an important role concerning maintenance of wooden coastal protection structures in Mecklenburg-Western Pomerania. Based on different climate model calculations, the Baltic Sea's surface water temperature is expected to rise by 2 to 4°C within the next 50 years. This and potentially milder winters with less ice cover could result in an increasing proliferation of *Teredo navalis*. However, possibly increasing rainfalls into the drainage basin of the Baltic Sea and therefore decreasing salinity in all areas of the Baltic Sea would in turn prevent a proliferation of *Teredo navalis*.

Against this background it is important to investigate what influences *Teredo navalis* more: temperature or salinity. Because predicted effects of climate change in the Baltic Sea region could make a further spread to the East possible and probable. In that case many wooden coastal protection structures are at risk in future, above all the groyne systems on the islands of Rügen and Usedom. This is based on the assumption, according to the latest information provided by the State Department of Agriculture and Environment, all groynes piles there are made from pine. An alternative is the use of tropical hardwood from sustainable farming, which due to its inner structure is more resistant against infestation. But increasing use of certified tropical timber means increasing costs in future.

Ronny Weigelt
University of Rostock

Broken pile, © Ronny Weigelt

Gaps in a groyne at the island of Hiddensee, © Ronny Weigelt

Coastal protection in tourism communities – the case of Timmendorfer Strand

In communities with major income from tourism, coastal protection measures are often considered to negatively interfere with tourist attractiveness. The experience of Timmendorfer Strand, a local community in Schleswig-Holstein in Germany, shows that participatory approaches can overcome existing reservations and might also be applicable to future challenges for coastal communities.

The community of Timmendorfer Strand has 9.000 inhabitants and is situated in the south-west part of the Baltic Sea, the Lübeck Bay, approximately 70 km northeast of Hamburg.

Approximately 200,000 tourists spend their holidays here every year with a total of 1.2 million overnight stays. Timmendorfer Strand´s coastline comprises some 6000 m of sandy beaches with shallow waters. The main part of the shore is exposed to the northeast direction. Elevations of the promenade in the eastern part are approximately 3.0 m above sea level (a.s.l.), since the elevations in the western part are considerably lower, between 2.5 and 3.0 m a.s.l, only in a few sections up to 3.5 m a.s.l.

An estimation of the invested values that would be endangered in case of a major storm flood, both private and infrastructural, highlighted the urgent need for modern and efficient coast protection measures. General conditions for a shore protection project were social and economic aspects such as the protection of the resident's lives and property as well as of tourism facilities as livelihood of the majority of the community's inhabitants. The project had to meet the master plan for coast protection in the province of Schleswig-Holstein, existing since 1963 with regularly issued updates, which was in the opinion of the inhabitants not applicable with respect to the special requirements of an urban region depending on tourism.

The community and the authorities of the county finally agreed on the technical conditions of the shore protection project. The design flood should not be the highest previously known flood in the region (average water level 3.4 m a.s.l.) but the centennial flood including an allowance of 0.25 m for future sea level rise, leading to an average water level of 2.5 m a.s.l. This approach led to elevations of the new coast protection buildings between 3.5 and 4.0 m a.s.l., considered acceptable with respect to the sea view from the promenade and houses.

In 1998, positive possibilities of financing were found by 90 % involvement of the province of Schleswig-Holstein (including EFRD share) and 10 % share of the community for the project.

In 1999, project works commenced and in 2001 a competition of planning teams, consisting of civil engineers, biologists and landscaping architects was tendered. In the competition, solutions for shore protection measures had to be found with maximum consensus of all involved parties such as the community, governmental authorities, inhabitants, fishermen and all people involved in tourism (e.g. gastronomes and beach cabin rentals). The project design had to include the protection against flooding as well as the protection of the coastline against erosion, which meant the conservation of the beach as economic base of the community. To meet requirements of tourism, a landscaping project with architectural finishing should follow the coast protection project subsequently in the following year's period.

The community council formed a technical committee for the whole project period. The community and the winning planning established a network to maintain an early and fast information flow throughout the project among all involved parties (technical committee, community administration, authorities, planners and inhabitants). Regular public sessions of the above parties through all developing-steps and sections of the project were the basic centre of information and communication. This led to a maximum conensus and acceptance by all in-volved parties as well as a streamlined process of planning – decision making – design (and redesign if necessary) – approval – execution in the field. The project was at no time hindered in progress by objections of the citizens or any associations.

Design started in 2004 and the execution on site in 2006. The shore protection project was separated in 5 construction sections, the last of which was finished in early summer 2011. Due to the touristic season, the execution of each section had to be performed in the winter period between November and April. Planning, design, approval and tendering of the construction works sections had to be finalized well in advance with respect to the European tender periods.

Regarding the safety of people and property, it is usually not allowed to work on the coast protection facilities in the winter period with higher storm flood probability. To meet the safety requirements, special measures had to be provided during the structural construction works, leading to higher site installation costs. Storm floods, e.g. ´Daisy´ in January 2010, caused additional repair costs. During the execution of works, regular information was given to the public on site by the mayor of Timmendorfer Strand.
The general solution for coast protection is a heavy stone revetment with a retention (sheet-pile) wall at the landside. Locally, adapted solutions had to be designed e.g. as concrete retention walls with flexible revetment at the promenade as well as glazed/mobile retention walls. The crest height of the retention wall is generally 4.0 m a.s.l., in the low-lying sections, the elevation 3.5 m a.s.l. is installed with a construction allowing for another 0.5 m rise. The overall project costs are approximately 30 Mio. € incl. taxes, with a distribution as follows

shore protection structure:	18 Mio. € (community cost share 3.5 Mio. €)
finishing and landscaping:	12 Mio. € (community cost share 6.0 Mio. €)

Maintenance costs are entirely up to the community and had to be clarified already in the design period of the project.
The project was a successful implementation of integration of all involved parties and the public in all stages of an urban coast protection project with major respect to touristic requirements. For the community and the planners, information flow and communication procedures caused a lot of additional work in the beginning of the project but led to a high rate of acceptance and maximum consensus.

Christoph Lehners
Engineering company Dr. Lehners + Wittorf, Lübeck

Photos @ Christoph Lehners

REGIONAL PROJECTS INVOLVED

Baltadapt (2010-2013)

Climate change will influence precipitation amounts and patterns, and lead to an increase in terrestrial and ocean temperatures and a rise in sea level. The resulting changes will jeopardize the integrity of the ecosystem and increase risks caused by natural disasters. The EU Strategy for the Baltic Sea Region recognizes the problem of fragmented experiences of adaptation in the Baltic Sea Region by calling for a Baltic Sea Region-wide climate change adaptation strategy. Focussing on the marine and coastal environment, the project Baltadapt will develop such a – *Baltic Sea Region Climate Change Adaptation Strategy* and prepare the ground for its adoption. The project seeks to improve the knowledge base aiming at an improved institutional capacity and to develop an Action Plan as operational basis for implementation. While it is understood that such a strategy cannot be adopted by Baltadapt, the project brings together political decision makers on the transnational, national and regional level in order to involve them into the elaboration of a draft strategy as the basis for a subsequent political endorsement. Furthermore, the project has the aim to establish a policy forum, which would facilitate the adoption of the strategy by the responsible National Ministries. This Forum shall be integrated within the existing transnational or EU infrastructure to guide the development of the strategy and coordinate future climate change adaptation efforts in the Baltic Sea Region. **www.baltadapt.eu**

Baltic Sea Region Programme 2007–2013
Part-financed by the European Union (European Regional Development Fund)

BaltCICA (2009-2012)

Especially on the Baltic coast are lots of larger cities and metropolitan areas with a high population, which makes these areas very sensitive to climate change. Floods from rivers and the sea, the sea level rise caused by climate change as well as impacts on water availability and water quality endanger these areas on the Baltic coast. So BaltCICA - *Climate Change: Impacts, Costs and Adaptation in the Baltic Sea* is designed to focus on the most imminent problems that climate change will cause in the Baltic Sea Region. Not only the assessment of the impacts, but also the development, appraisal and implementation of adaptation measures (structural ones as well as organisational and institutional measures) has to be promoted. **www.baltcica.org**

Baltic Sea Region Programme 2007–2013
Part-financed by the European Union (European Regional Development Fund)

RADOST (2009-2014)

RA:dOst – Regional Adaptation Strategies for the German Baltic Sea Coast
SPONSORED BY THE Federal Ministry of Education and Research

Climate change is confronting the German Baltic Sea coast with the challenge to develop suitable adaption strategies. RADOST – *Regional Adaptation Strategies for the German Baltic Coast* is aiming at developing these strategies in cooperation with science, economy, administration and the public. The project is equally about minimizing damage to business, society and nature as well as about making use of the development opportunities provided by the change. Another goal is the permanent establishment of stakeholder networks and communication structures in the region and beyond. To demonstrate exemplary adaptation measures, a set of implementation projects in cooperation with partners is planned, compromising amongst others the following topics: Innovative coastal protection, adaptation measures for tourism and ports, aquaculture, optimization of ship hulls, combination of coastal protection and use of geothermal energy.
www.klimzug-radost.de

IMCORE (2008-2011)

Scientists and practitioners involved in coastal management ranging from Ireland, the UK, France, Belgium and the Netherlands have worked closely together, during the last 4 years, to develop local adaptation strategies in respect to climate change. This has been done under the auspices of IMCORE -*Innovative Management for Europe's Changing Coastal Resource*, a project partly-funded by the INTERREG IVB programme. A range of flexible techniques and tools used by IMCORE helped to set out the process in order to develop local adaptation strategies, thoroughly evaluate these and build adaptive capacity at the local level.
The project has produced a guide and training tool for effectively developing coastal adaptation strategies which is freely available to all in a dedicated website – ***Plan to Adapt to Coastal Climate Change*** - ***www.coastaladaptation.eu*** - the training tool combined with an e-learning module provides an easily accessible didactic resource that supports both experienced and less experienced coastal managers in developing adaptation strategies!.

EUCC - The Coastal Union Germany (EUCC-D)

EUCC-D was established as a non governmental association (NGO) in 2002, forming the German branch of the Coastal & Marine Union (EUCC), the largest European coastal and marine organisation. The main objective of EUCC-D is to strengthen German activities within the field of Integrated Coastal Zone Management (ICZM) by bridging the gap between coastal science and practice. EUCC-D provides relevant information, consults and educates coastal practitioners, hosts workshops and conferences and runs demonstration projects in the field of coastal and marine management. We develop information systems, create tools (e.g. databases, learning modules) for international networks and disseminate coastal and marine information via our German Küsten Newsletter or in shared media with our international colleagues.

EUCC-D offers memberships for professional and private individuals, and other non-profit organisations. The German membership also includes membership with EUCC International. Please visit www.eucc-d.de/mitgliedschaft for more details.