Katrin Hilpert, Franziska Mannke, Philipp Schmidt-Thomé

TOWARDS CLIMATE CHANGE ADAPTATION STRATEGIES IN THE BALTIC SEA REGION

Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region

GTK

Baltic Sea Region
INTERREG III B

Towards Climate Change Adaptation Strategies in the Baltic Sea Region

Guidance for decision-makers, produced in the context of the INTERREG IIIB project "Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region (ASTRA)"

Leading authors:

Katrin Hilpert, HafenCity University Hamburg; Germany, Franziska Mannke, TuTech Innovation GmbH, Germany; Philipp Schmidt-Thomé, Geological Survey of Finland (GTK), Finland

Contributing authors:

Agrita Briede, University of Latvia, Latvia; Klaus Eisenack, Potsdam Institute for Climate Impact Research (PIK), Germany; Simo Haanpää, Helsinki University of Technology, Centre for Urban and Regional Studies (YTK), Finland; Holger Janssen, Baltic Sea Research Institute Warnemuende (IOW), Germany; Dorota Kaulbarsz, Polish Geological Institute (PGI) Gdansk, Poland; Maris Klavins, University of Latvia, Latvia; Johannes Klein, Geological Survey of Finland (GTK); Joerg Knieling, HafenCity University Hamburg, Germany; Are Kont, Tallinn University, Estonia; Zbigniew Kordalski, Polish Geological Institute (PGI), Poland; Walter Leal, Hamburg University of Applied Sciences (HAW), Germany; Samuli Lehtonen, Helsinki University of Technology, Centre for Urban and Regional Studies (YTK), Finland; Lasse Peltonen, Helsinki University of Technology, Centre for Urban and Regional Studies (YTK), Finland; Gerald Schernewski, Baltic Sea Research Institute Warnemuende (IOW), Germany; Michael Staudt, Geological Survey of Finland (GTK); Paavo Taipale, Association of Finnish Local Authorities, Finland; Elena Talockaite, Environmental Centre for Administration and Technology (ECAT), Lithuania; Joanna Zachowicz, Polish Geological Institute (PGI), Poland.

Reviewing authors:

Juergen Kropp, Potsdam Institute for Climate Impact Research (PIK), Germany
Laila Kule, University of Latvia, Latvia

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www.astra-project.org

- Executive Summary -

It is established scientific knowledge that global warming is continuing. An increase in average global surface temperatures can already be observed, and this warming trend can be reduced by abating anthropogenic greenhouse gas emissions. Early adaptation to climate change greatly reduces the financial and humanitarian risks potentially involved. Planned adaptation can also greatly increase our everyday quality of living, by sustaining current recreational possibilities and creating new ones. This underlines the need for societal responses.

The ASTRA-Project: Developing Policies & Adaptation Strategies to Climate Change in the BSR

The issue of adaptation to climate change is assessed in the project "ASTRA - Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region". It has been co-financed by the European Regional Development Fund (ERDF) through the INTERREG IIIB Baltic Sea Region Programme. The present summary is based on the ASTRA publication "Towards Climate Change Adaptation in the Baltic Sea Region", which comprises the main findings of the ASTRA project and presents information and recommendations on how to develop adequate adaptation strategies to deal with climate change.

Climate change in the Baltic Sea Region

Scientific studies show a general trend to an average temperature rise and changes in precipitation patterns for the Baltic Sea Region (BSR). The BSR faces different regional and seasonal challenges in the light of a changing climate. Questions raised include what level of coastal protection is needed in the future, and how to cope with severe flooding events or water shortages.

Adaptation to climate change impacts

The concepts of adaptation and mitigation tackle climate change in two different ways as shown in figure a. Adaptation seeks to moderate negative climate change impacts or exploits beneficial opportunities of climate changes. Mitigation includes measures and strategies to reduce CO_2 and other greenhouse gas emissions.

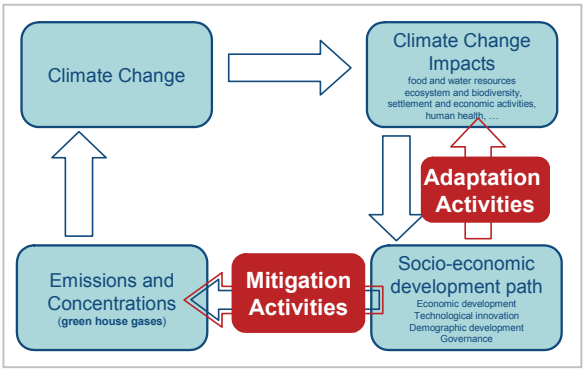

Figure a: Mitigation and adaptation as complementary approaches in climate change policy (adopted from IPCC 2001b: 3)

Both approaches should be regarded as complements. The more successfully both strings are followed, the lower the risks for society due to climate change impacts become.

Current adaptation policies in the BSR

Adaptation to climate change impacts is rather new on the political agenda in the Baltic Sea Region as well as in the European Union. An assessment conducted by ASTRA project partners showed that there are only a few national initiatives (Finland, Germany) or programmes in sectors such as coastal protection, flood protection, or forestry. According to latest expectations on the ongoing change of climate, adaptation should become an integral part of policies, ensuring a sustainable future development.

Recommendations for policy-makers

Public authorities responsible for policy-making on behalf of the public welfare play a key role when addressing climate change issues. Their decisions can benefit sustainability in territorial development. Adaptation to climate change is an issue that affects public as well as private interest.

1. **Adaptation is a cross-cutting issue**, therefore it has to be tackled by the whole society. Public authorities play a key role in addressing the complex issue of adaptation to climate change. In the form of a pull and push strategy they can influence behaviour and demand: information and communication activities raise public awareness and prepare the ground for political and private agency to act. Financial incentives or regulations as push-factors can enhance appropriate activities of private and public actors. Self-organisation and self-responsibility should be fostered so that climate change adaptation can be brought forward by a mix of top-down and bottom-up approaches.
2. **Integrate adaptation needs into policies:** adaptation to climate change impacts should not be regarded as a separate topic. Different fields of policies should be checked to be "climate proof". Examples are regional development plans that should consider future climate change impacts when preparing land for building or cost-benefit analyses of tourism infrastructure that take changing climate conditions into account when making investment decisions.
3. **Development of adaptation strategies needs a step-wise approach**: Figure b provides an overview of the most important steps. Analyses of current and future vulnerabilities and risks as well as of existing policies are the basis for the development of adequate adaptation strategies. Different options should be considered when developing adaptation strategies to identify the most appropriate solutions. Evaluation and monitoring activities should be provided to verify the efficiency of the measures taken and facilitate adjustments.
4. **Adaptation and mitigation go hand in hand**: policy-makers should aim at considering both strings - adaptation and mitigation - in different fields of policies. Only if both concepts are followed can future climate change be moderated and inevitable impacts be tackled.

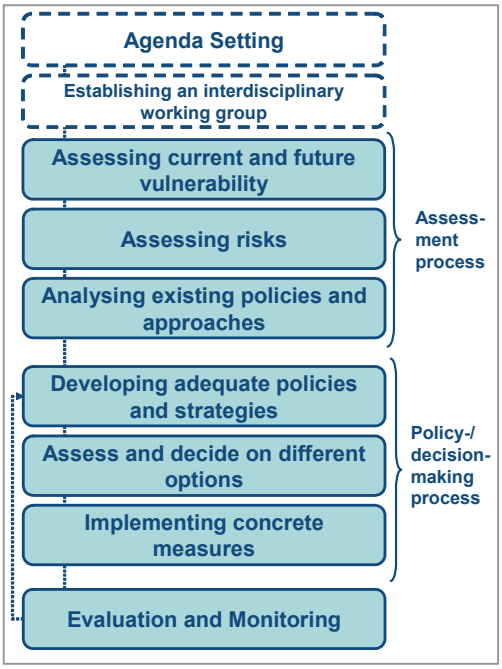

Figure b: General framework for developing adaptation strategies

5. Public authorities need to be involved:

i. **EU:** the European Union plays a key role in climate change adaptation by enhancing the system of structural funding and influencing the climate change policy in European member states.

ii. **Baltic Sea Region:** the Baltic Sea is a common natural resource, as its member states are connected by joint responsibilities and challenges. Neighbouring countries should join their forces in tackling climate change impacts. Activities at transnational level could comprise the initiation of a communication platform enhancing the exchange of local, regional and national experiences or best practices. A further field are joint research activities by research institutes and universities in the BSR that establish information or monitoring on climate change impacts and develop innovative adaptation approaches.

iii. **National level:** climate change adaptation should be recognised as an important topic on the political agenda. At the national level the preconditions for adequate responses are laid in gaining an overview of most vulnerable sectors, regions and groups and setting lasting and powerful information channels, empowering individuals through legal frameworks and maintaining capable structures to enforce policy recommendations, and regulations (territorial development). It is important to guide regional development so that the preconditions of sustainability are maintained.

iv. **Regional and local level:** regional and local actors have to adjust general guidelines to their local needs and implement adaptation strategies, while giving feedback about concrete adaptation demands to higher planning levels. As knowledge on climate change issues and adaptation activities still is not sufficient at regional and local level, capacity building in form of information campaigns, participatory processes and local assessments on potential climate change impacts are of high relevance. Learning from extreme events felt in different parts of the BSR may help to see the various risks involved and ways to overcome them. Past extreme events are a good starting point in considering local adaptation needs. Anticipating the risks in strategies and during planning stages already is economically viable and will save individual human suffering.

Contact:
Philipp Schmidt-Thomé
Geological Survey of Finland
P.O. Box 96
02151 Espoo, Finland
E-Mail: philipp.schmidt-thome@gtk.fi

All ASTRA results are available as downloads under www.astra-project.org.

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Abbreviations

APF	Adaptation Policy Framework
ASTRA	Baltic Sea Region (BSR) INTERREG IIIB project "Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region"
BSR	Baltic Sea Region
CIA	Climate Impact Assessment
CC	Climate change
COP	Conference of the Parties
DSF	Decision Support Frame
EEA	European Environmental Agency
EIA	Environmental Impact Assessment
ERDF	European Regional Development Fund
ESPON	European Spatial Planning Observation Network
EU	European Union
EUSF	European Union Solidarity Fund
FP 7	Seventh Research Framework Programme of the European Union
HELCOM	Helsinki Commission
ICZM	Integrated Coastal Zone Management
IPCC	Intergovernmental Panel on Climate Change
MCII	Munich Climate Insurance Initiative
NAPA	National Adaptation Programme on Action
NGO	Non Governmental Organisation
RSP	Riga Spatial Plan
SEA	Strategic Environmental Assessment
SEAREG	BSR INTERREG IIIB project "Sea Level Change Affecting the Spatial Development of the Baltic Sea Region"
UKCIP	UK Climate Impacts Programme
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

It is established scientific knowledge that global warming is continuing, and can be reduced by abating anthropogenic greenhouse gas emissions (IPCC 2007a: 10). Nevertheless, uncertainties in the projection of future climate change remain, also due to ambiguities in the further development of our social and economic system. Current emission scenarios therefore differ in their assessment of the resulting climate change and potential impacts. However, a general trend towards global warming can be anticipated. Even if the best mitigation strategies, e.g. reducing the current emission of greenhouse gases, were implemented, further changes in climate (e.g. increase in global surface temperature) and corresponding impacts (e.g. sea level rise) cannot be avoided (IPCC 2007a: 17; EEA 2005: 79).

It is estimated that one third of the European population lives within 50 km of the coast (Nicholls, Klein 2003 in EEA 2006: 21). A rise of the sea level of one metre would thus affect more than 13 million people in Europe (EEA 2006: 21). The amount of 5% of the global GDP, regionally going up to even 20% (Stern 2007: iv), as the expected future annual loss due to climate change impacts, highlights the importance of taking action now in order to anticipate negative consequences of climate change later on.

Due to land uplift and subsidence, the Baltic Sea Region is affected by a rise in the sea level to varying orders of magnitude (Meier et al. 2006: 41). But sea level rise is only one impact of a changing climate among others. Climate change impacts do affect the biodiversity of the Baltic Sea, the occurrence of fish species or the state of maritime safety. Furthermore, the neighbouring countries are affected by similar problems, e.g. in coastal protection or the frequency and intensity of storm events.

These issues are taken up in the INTERREG IIIB project “ASTRA – Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region”. The following document is a result of this transnational project that has been co-financed by the European Regional Development Fund (ERDF) through the INTERREG IIIB Baltic Sea Programme.

The present document sums up the main findings of the ASTRA project. The document integrates the different outputs of the ASTRA project and presents information and recommendations for policy-makers[1] and interested stakeholders on adaptation strategies against climate change impacts.

The ASTRA project is a follow-up of the INTERREG IIIB project SEAREG (Sea Level Change Affecting the Spatial Development of the Baltic Sea Region). The SEAREG project analysed the connections between climate change and planning concerns with a focus on sea level rise. A major output of the project was the development of a decision support frame (DSF) that provides a set of tools to support the communication process between research and practice. Four pillars of the DSF together form a communication and learning process of scientists, planners and stakeholders (Schmidt-Thomé 2006a; DSF 2007).

[1] Policy-makers are defined herein as “individuals, especially those in official bodies, who have the authority to make decisions about what problems will be addressed within a particular sector and how these problems will be handled” (http://glossary.eea.europa.eu/EEAGlossary, 29.05.2007). In addition to the given definition all employees shall be included that prepare or implement political decisions.

Structure of the document

The document is divided into four parts. Chapter 1 provides definitions of key concepts concerning adaptation, reasons why adaptation strategies are needed and main challenges when coping with climate change issues. In Chapter 2, climate change in the Baltic Sea Region (BSR) and main affected sectors are described. This chapter also includes an overview of the current institutional preparedness regarding adaptation to climate change impacts. Chapter 3 provides an overview of existing adaptation strategies in the BSR. Approaches are presented in different sectors and examples of good practice are highlighted. Chapter 4 summarises recommendations that can be drawn out of the ASTRA project findings. Figure 1 illustrates how this paper incorporates different work packages of the ASTRA project. All ASTRA project studies are available as download on the website: www.astra-project.org.

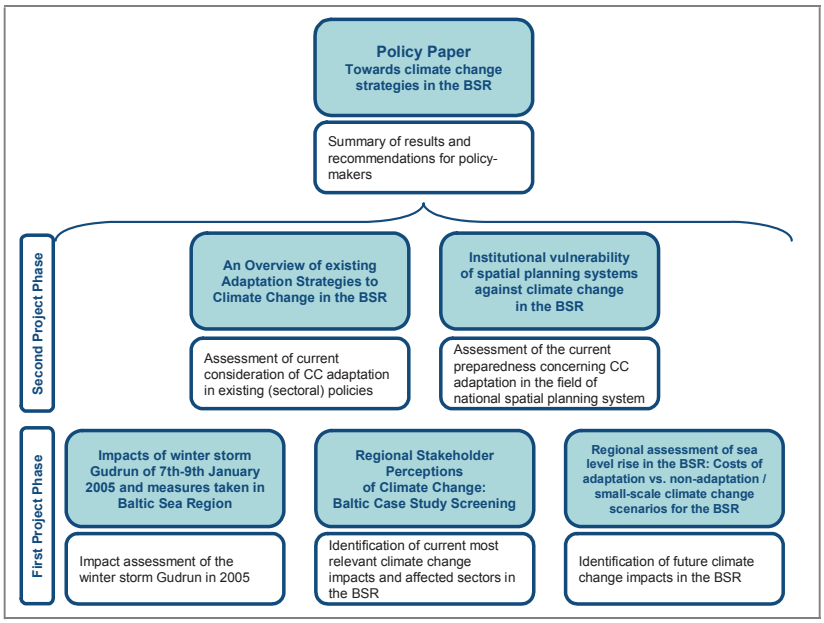

Figure 1: Work packages of ASTRA project partners as basis of the policy paper

1.1. Key concepts and definitions

In order to create a common understanding of the topic, four underlying key concepts are presented in the following paragraphs[2].

I. Climate change is used in the context of this document according to the definition of IPCC, that includes “any change in climate over time, whether due to natural variability or as a result of human activity” (IPCC 2007: 2).

II. Adaptation is defined as any “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPPC 2001b: annex B). The IPPC distinguishes different types of adaptation, such as reactive or anticipatory adaptation as well as autonomous or planned adaptation (IPPC 2001b). The ASTRA project aims at enhancing a strategic

[2] Further definitions are provided in the glossary in annex 1.

approach in order to tackle climate change impacts before they have major effects on society and biodiversity. Thus it focuses on planned and anticipatory adaptation (figure 2).

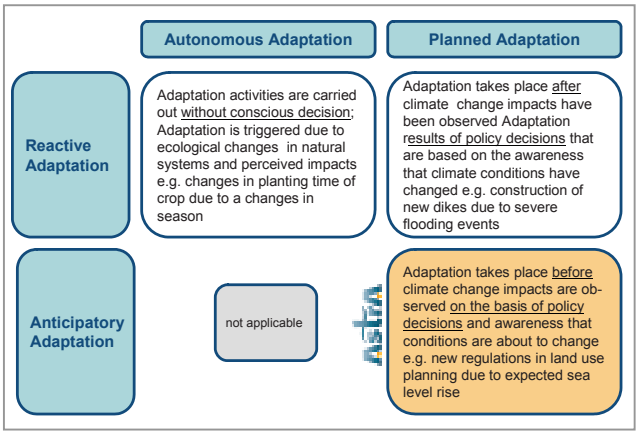

Figure 2: Different adaptation approaches (adopted from IPCC 2001a, Annex B)

III. Mitigation includes measures and strategies to reduce CO_2 and other greenhouse gas emissions. Thus, the concepts of adaptation and mitigation tackle climate change in two different ways as shown in figure 3. The two approaches should not be seen as separate but as mutually complementary. Mitigation activities help to slow down the anthropogenic greenhouse effect, whereas adaptation is needed to cope with those impacts that actually happen. The more successfully both strings are followed, the lower the risks for society due to climate change impacts become. The following chapters focus on adaptation, as this was the main objective of the ASTRA project.

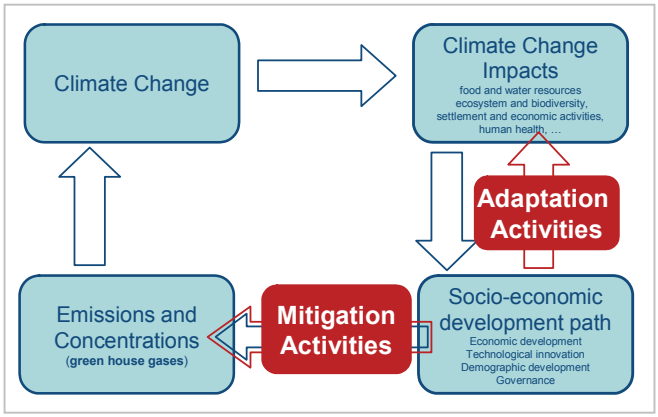

Figure 3: Mitigation and adaptation as complementary approaches in climate change policy (adopted from IPCC 2001b: 3)

IV. The concept of adaptation is closely linked to the vulnerability concept. The more vulnerable a region, sector or a society is, the more severe the consequences of climate change are. There are different dimensions that account for the degree of vulnerability: not only exposure to e.g. natural hazards, but also the sensitivity of the society, e.g. depending on insufficient precautions or the capacity of adequate reaction. Specific groups might be more vulnerable due to health problems, age or disabilities. Some

regions are more vulnerable than others as a result of their geographic position, e.g. coastal and mountainous areas, or as a result of human interference, e.g. by river regulations and deforestation (see figure 5; Fleischhauer 2004: 65; Klein, Schmidt-Thomé 2006: 46).

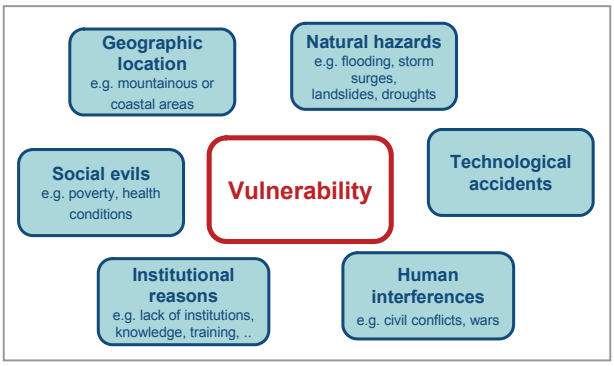

Figure 4: Aspects aggravating vulnerability (adopted from Blaikie et al. 1994: 23 cited in Fleischhauer 2004: 66)

Vulnerability can be reduced by preparing adequate adaptation activities. In conclusion, it is important to assess the degree of vulnerability of regions and/or societies in order to know "who is vulnerable, to what, in what way, and where" (Lim, Spanger-Siegfried 2005: 73) as well as to be aware of potential risks due to climate change impacts.

1.2. Assessing climate change impacts

Scenarios are used to project potential future climate conditions. They are based on different storylines that represent different demographic, social, economic, technological and environmental developments. Development trends in these fields significantly influence the development of greenhouse gas emissions and thereby the climate change variation. IPCC published a set of scenarios in 2001 (so-called IPCC SRES scenarios[3]). Four different storylines represent diverging future development tendencies, taking into account a more economic or environmentally driven development as well as a path focussing more on globalisation or regionalisation.

Figure 5 shows a selection of scenarios, published in the latest IPCC assessment report (IPPC 2007: 14). The grey bars present the likely range of temperature rise in each scenario. The orange line represents a scenario where greenhouse gas concentrations in the atmosphere are stabilised at year 2000 values. All calculated scenarios illustrate a general trend towards global warming. The impacts resulting from an increasing global mean temperature such as an augmentation of water vapour in the atmosphere leading to incraesed precipitation, or an intensification of urban heat islands leading to severe heat stress, highlight the need for adaptation and mitigation strategies.

[3] More information on the SRES scenario can be found in the glossary of this document.

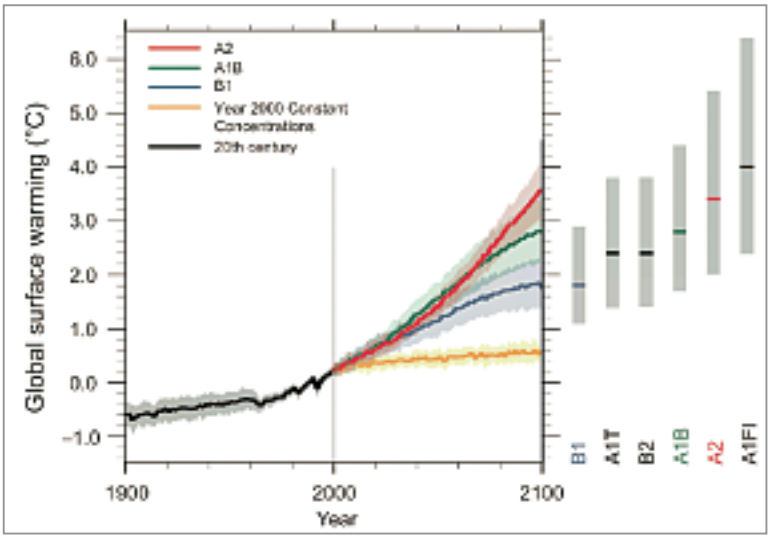

Figure 5: Variations of the earth's surface temperature, years 1900 - 2100 (IPCC 2007: 14)

Furthermore, figure 6 provides an overview of average planning horizons of selected infrastructure and economic activities. Since most of the life spans and business plans cover several decades, sustainable development requires the consideration of potential climate change impacts (e.g. sea level rise) at an early stage of the planning process in order to avoid future costs.

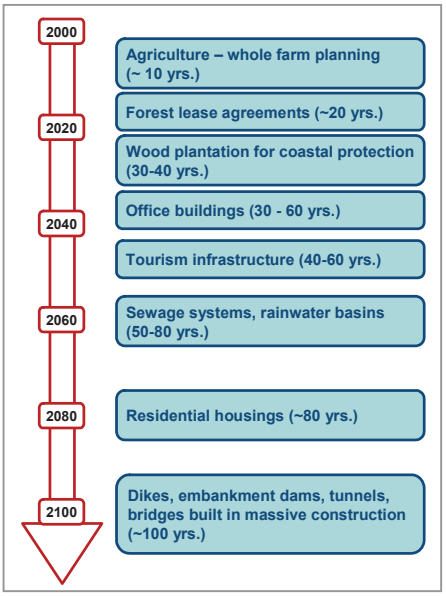

Figure 6: Selection of infrastructure life span planning (adopted from Lim, Spanger-Siegfried 2005: 128, LAWA 2005: Anlage 1-2; Gondring 2004)

Another reason to tackle climate change impacts can be seen in the goal of the European Union to transform Europe into one of the most competitive regions in the world – in a sustainable manner (Lisbon and Gothenburg Agenda). The costs arising from climate change impacts have already been pointed out by different institutions (WBGU 2003: 17; Stern 2007: iv). The joint research centre PESETA of the EC has calculated the costs (in 1995, €) arising from sea level rise with and without adaptation measures by 2020 and 2080. (Commission of the European Communities 2007: 10).

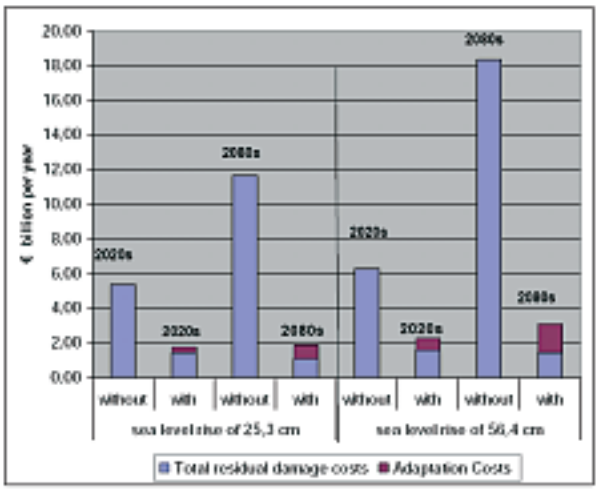

Figure 7: Impact of adaptation measures on damage due to low and high sea level rise. Basis for the calculation has been the IPCC SRES scenario A2 (Commission of the European Communities 2007: 10)

Winter Storm Study: A study of the impact of winter storm Gudrun in January 2005 has been conducted by ASTRA project partners. Extreme weather events, such as storms, are seen to become more common under changing climate conditions. The analysis states the consequences of an extreme weather event exemplarily. Winter storm Gudrun caused economic losses through damage to buildings and forests, energy cuts, flooding and coastal erosion. Often, there is little awareness of costs added to direct losses after the occurrence of an extreme weather event. In the field of forestry for example, costs for clearing up and replanting of fallen trees are accompanied by expenses resulting from a decrease of timber price due to its sudden quantity and poor quality. Further economic losses appear as a result of the unintended interruption of the growing cycle, which has to be started anew. The risk of forest fire increases due to the high number of dry timber and the clearing machines that can set fire while working (Haanpää et al. 2006: 21).

The consensus on the ongoing climate change and unavoidable impacts, the horizon of infrastructure and economic cycles as well as the expected costs due to climate change consequences highlight the need of adaptation strategies. In order to secure sound functioning of the economic, social and environmental system, planned and anticipatory adaptation strategies should be enhanced.

1.3. Challenges when tackling climate change issues

It is widely accepted that anthropogenic climate change is a fact and that even strict mitigation efforts will not be sufficient to avoid significant impacts of climate change (IPCC 2007a). It is therefore urgent to complement measures against the causes of climate change with measures to cope with its adverse effects (Stern 2006, Pielke et al. 2007). Nevertheless, there are still challenges to be overcome when tackling the issue of adaptation (Brown et al. 2007, Klein et al. 2005, Schmidt-Thomé, K., Peltonen 2006). Some of them are as follows:

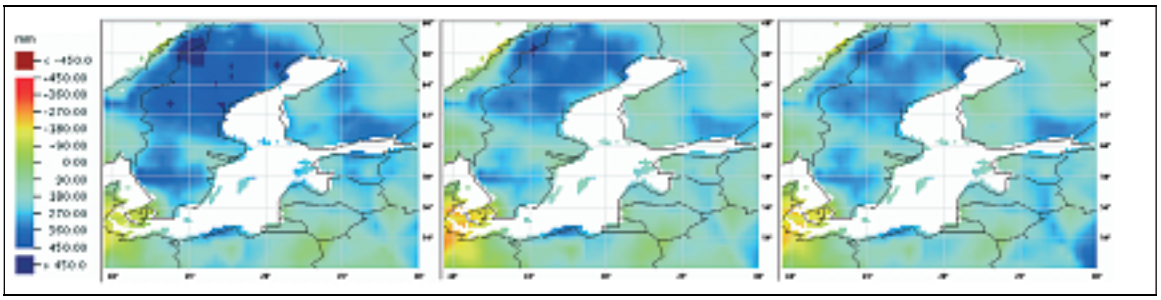

Figure 8: Projections for the annual sum of precipitation from different models based on the SRES A2 forcing scenario (left: CSIRO2, middle: HadCM3, right: PCM). The maps display differences between 2100 and 2000, blue colours mean a wetter, red a dryer climate in 2100. The average sum of the annual precipitation (land/sea) is approximately 750 mm/yr, but with large differences.

a) Uncertainties

As described above, projections of the future climate are based on scenarios that extrapolate current trends by making coherent assumptions about future emissions of greenhouse gases and other factors that influence climate change, economic growth, development of global population, technological progress, etc. Due to the difficulty of predicting these trends, a broad set of coherent scenarios was developed (Nakićenović et al. 2000; see figure 5). Therefore, the scenarios present a range of possible futures for mankind. This kind of uncertainty is not resolvable in a scientific sense. For each scenario the resulting climate change is computed using climate models. Although much progress has been made in climate modelling, there are still some processes not well understood yet, such that different models do not always produce the same results for an identical scenario. Further uncertainties enter when global climate projections are refined to regional scale. However, in many cases the final results are qualitatively very similar (see figure 8). Proactive adaptation policies that address potential future climate change impacts have to take these uncertainties into account. Difficulties in framing future and uncertain developments may hinder the development and implementation of adaptations (e.g. Behringer et al. 2000, Brown et al. 2007). Climate change scenarios provide at least indications to what extent climate change impacts should be considered in decision-making processes (German Advisory Council on Global Change 1999: pp. 2; Peltonen, Haanpää, Lehtonen 2005: 21; Schmidt-Thomé, Peltonen 2006: 9, 12).

b) Cooperation

Climate change impacts affect various sectors, regions and actors (Klein et al. 2005). Some adaptation strategies can have contrary effects between different sectors or regions. For

example, the refortification of dikes can protect one area against the threat of floods; meanwhile it might increase the risk of flooding in other areas downstream. Cooperation is necessary across regions, countries, sectors and administrative levels. Actors need to be aware of the benefits of cooperation to gain positive long-term effects instead of decisions focusing only on short-term benefits. But the discussion of climate change and its impacts is also driven by interests and values. A conflict of interests between different stakeholders and sectors on future development priorities is inevitable in pluralistic societies. Examples of opposing interests can be observed between economic development projects and adaptation measures when developing coastal and lake or riverside areas for housing, leisure or economic purposes. Long-term effects are often neglected in order to achieve short term results. Therefore, adaptation to climate change impacts is a cross-cutting issue – not only across sectors or administrative levels, but also across different groups in society and across national borders. Cooperation and communication are key words in processes addressing climate change impacts.

c) Awareness of climate change adaptation

Climate change and its potential impacts have hitherto often been perceived as an abstract and distant topic *(*for awareness concerning future SLR, see case studies of the SEAREG project: Schmidt-Thomé 2006a, http://www.gtk.fi). Mitigation is considered more often than adaptation to climate change impacts. Concerning adaptation stakeholders are not sufficiently informed about its need and possible strategies. Stakeholders who are aware of climate change issues do not see a lack of availability of general information, but a lack of knowledge, what should be taken into account when considering climate change in planning processes (Eisenack, Kropp 2006, Eisenack, Tekken and Kropp 2007). Therefore the raising of general awareness of climate change impacts and adaptation needs, as well as the dissemination of information on adaptation options, is of main importance.

1.4. The role of policy-making in addressing issues related to climate change

Climate change adaptation cannot be solved by single actors. Impacts do not stop in between administrative borders; the issue concerns all sectors and levels of political, administrative, economic and everyday life. Therefore, actors rely on each other and collective action is required vertically across multiple levels and horizontally across sectors as well as by different actors (public / private). At the same time a society is characterised by varied social and economic conditions as well as diverse interests of different groups. These interests and requirements need to be coordinated (Schmidt-Thomé, K., Peltonen 2006; Schmidt-Thomé, P., Peltonen 2006; Peltonen, Lehtonen 2006).

Public authorities, responsible for policy-making on behalf of the public welfare and safety, have a key role when addressing climate change issues. Policy-makers influence long-term developments by their decisions and can enforce decisions where economic instruments or societal norms fail. Policy-making offers different ways of addressing problems associated with climate change:

- it provides legislative, regulatory and juridical instruments which control, limit or simply forbid undesirable activities,

- it enhances adequate action and behaviour by sending price signals in the form of fiscal instruments (licenses, taxes, subsidies, …),
- it fosters coordination and the development of an integrated approach by optimising internal operation procedures or relations between different institutions,
- it supports awareness-raising and the change of human behaviour through information, education and participation.

1.5. Interim conclusions

Early adaptation to climate change can help to reduce potential financial and humanitarian risks. Although this is known widely, there are still challenges to overcome when addressing climate change issues. Uncertainties in the projection of future climate change remain. Climate change impacts and adaptation needs concern various sectors and regions in diverse ways. Different interests have to be coordinated and moderated. Cooperation among regions, sectors as well as administrative levels is required. Despite the current public debate on climate change, the awareness of adaptation needs is still not sufficient. Also assets of public interest are affected by climate change. Public perception and attitudes towards climate change adaptation are important topics.

Policy-making can assist in developing a positive attitude towards climate change adaptation. A range of policy tools, extending from legislation to communication processes, is available to enhance adequate action and to avoid undesirable activities.

Recommendations for further reading

Climate Change

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Costs of climate change impacts

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Communicating climate change

Eisenack, K., Kropp, J.: 2006: Regional Stakeholder Perceptions of Climate Change: Baltic Case Study Screening, ASTRA document, Potsdam. Download: www.astra-project.org

Eisenack, K., Tekken V., Kropp, J. (2007): Stakeholder Perceptions of Climate Change in the Baltic Sea Region, Coastline Reports 8:245-255.

Leal Filho, W., Mannke, F., Schmidt-Thomé, P. (eds.) 2007: ASTRA-Publication 'Information, Communication and Education on Climate Change – European Perspectives', Frankfurt/Main.

2. Climate change in the Baltic Sea Region

The first part of this chapter presents climate change scenarios for the BSR relating to future changes in mean temperature and precipitation patterns. Areas that are most affected by climate change impacts are described in the second part according to results of the ASTRA project. Finally, conclusions are given on the degree of institutional preparedness in relation to climate change adaptation in the field of spatial planning in the BSR.

2.1. Climate change scenarios for the Baltic Sea Region

The following maps have been calculated by using data available from the IPCC Data Distribution Centre (DDC 2007). They are based on the SRES A2 scenario, computed with the climate model HadCM3 and downscaled to a 10 minutes grid (Schröter et al. 2005, ATEAM). The A2 scenario is associated with an approximately tripling of atmospheric CO_2 with respect to the pre-industrial level. It may thus be called a business-as-usual scenario, meaning that it provides an idea of what could happen when anthropogenic CO_2 emissions continue to rise. The A2 scenario taken here as one example of the IPCC scenarios is one of the most extreme. It is possible that climate change impacts will not be that severe.

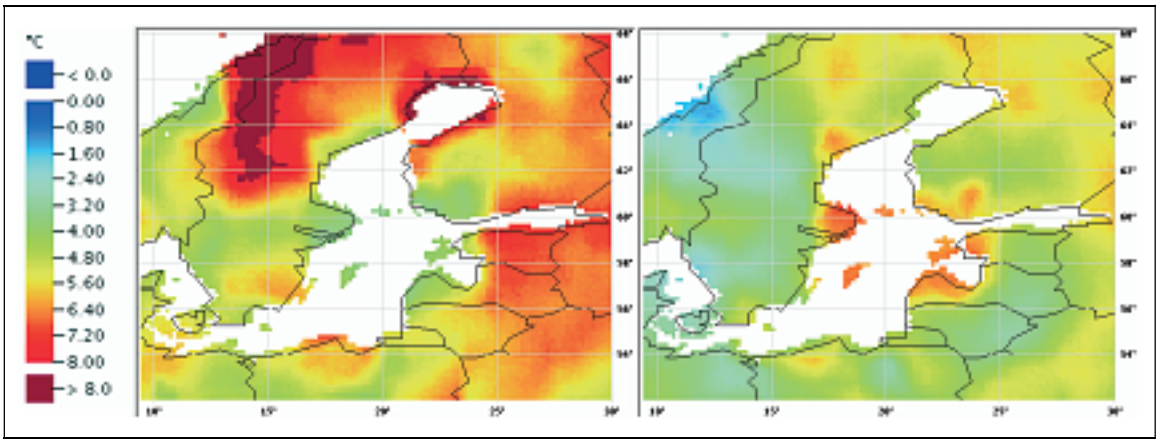


Figure 9: Projected changes of mean surface temperature between 2000 and 2100. Left: winter season (December to February); right: summer season (June to August), SRES A2 scenario, HadCM3. Averaging between different models show that an increase of 3-5 ºC for the mean annual temperature in the BSR by 2100 is very likely.

Winter Storm Study

Flooding and storms (especially during winter season) are already a major threat in the Baltic Sea Region as the ASTRA winter storm study concludes (Haanpää et al. 2006: 15). The impact of storms is enhanced, when extreme weather events follow each other in time span shorter than the recovery time of a given ecosystem. Furthermore, the strength of storms is increasing with prolonged ice free periods due to the mild winter climate (Haanpää et al. 2006: 17).

Changes in temperature

Empirical measurements for the 20th century show an increase in temperature of 1ºC for the Baltic catchment. Simulation runs make clear that until 2100 the increase will be spatially and seasonally very different. In the BSR the increase in winter temperature will be larger (at least 4-6 ºC) than in summer (3-5 ºC). In some regions, e.g. in coastal and mountainous areas in Finland and Sweden the increases in temperature may be even higher (see figure 9). Projected increases of mean summer temperatures are more moderate, ranging from about 2°C to 5°C in some coastal parts of Sweden, Finland, Estonia and Latvia. These strong changes are in line with general expectations that temperature increases are stronger in higher latitudes. Projections for the whole of Europe show that while summer temperature increase is higher in the Mediterranean, the winter temperature increase is higher in Northern and Middle Europe.

Changes in precipitation

Climate change is already observable. For large areas in Sweden, Finland, Estonia, and the Gulf of Gdansk an increase in the annual precipitation of approximately 10-50mm was observed for the 20th century. For Lithuania, eastern Germany, and western Poland it became slightly dryer during this period. The projections show that this trend is likely to continue, implying a further increase in the annual precipitation in the BSR (figure 8). Seasonally and spatially these changes are very unevenly distributed. While in winter an increase in precipitation of approximately 35% might be possible, in particular in the north, the summer will become dryer than today in the southern BSR and only slightly wetter in the north. An example for such a scenario is shown in figure 10. Although overall it will become wetter, in some years the water availability might be limited in certain regions due to higher temperatures and a higher rate of evapotranspiration. The spatial differences will also influence the run-off regimes.

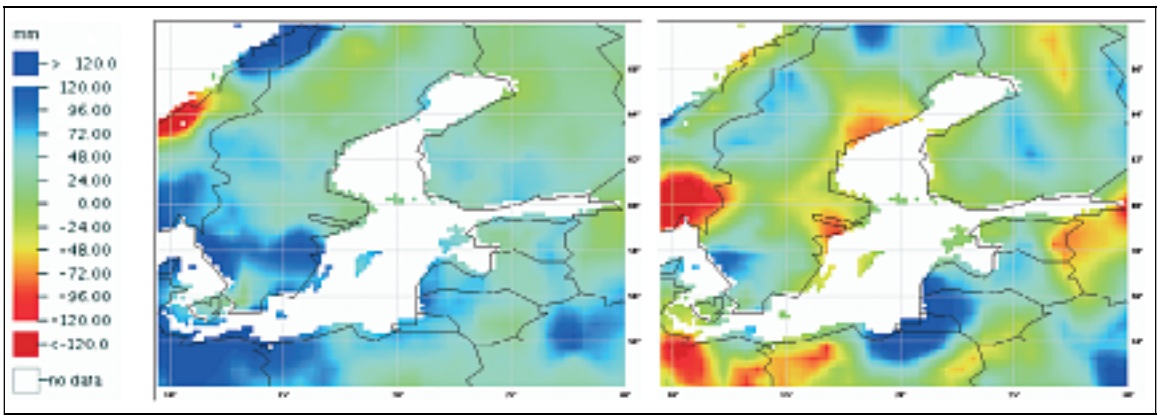


Figure 10: Seasonal changes in precipitation from 2000 und 2100. Left: winter season (December to February); right: summer season (June to August), SRES A2 scenario, HadCM3. Note that the scale is different from figure 8.

2.2. Impacts of climate change in the Baltic Sea Region

The changes in temperature and precipitation, shown in the graphs, affect various economic sectors and human activities. A screening study analysed the perception of climate change impacts of ASTRA project partners in the BSR (Eisenack, Kropp 2006). The study identified sectors and impacts that should be considered as sensitive to climate change. The results have been discussed and supplemented in ASTRA project workshops involving various stakeholders from the BSR. The identified sectors are concordant with the results of the IPCC report to a large extent (IPCC 2001).

Table 1 on the following page illustrates the main exposure units of the identified sectors and relevant climate change impacts.

Table 1: Climate change impacts on selected sectors in the BSR (Eisenack, Kropp 2006; Carter, Kankaanpää 2004; Federal Environmental Agency 2005; ASTRA project partners)

Sectors	Units at risk to climate change impacts (Exposure units)	Climate Change Impacts
Urban areas	Urban settlements: private and public buildings, places and cultural heritage Infrastructure: waste treatment, communication infrastructure, water supply systems, energy transmission, flood protection infrastructure, transport infrastructure Inhabitants (esp. elderly people, young children, chronically ill people)	Increased precipitation, changes in precipitation patterns, extreme precipitation events, snowmelt leading to floods and damages, interruption of economic and everyday activities Sea level rise, storm surges damaging urban infrastructure Storms (esp. winter storms), hail leading to damages and economic losses Increased frequency in heat waves, droughts constraining human health and building material
Coastal areas	Coastal and lake shores, riverbanks coast and flood protection infrastructure, beaches	Sea level rise, storm surges, river floods, coastal erosion, changed sedimentation patterns
Water	Water for drinking, irrigation or industrial use water supply systems, sewage systems water intensive economic sectors (hydropower, cooling water) public health	Flooding: water pollution, damage to infrastructure Sea level rise: salinisation of drinking water Higher temperatures (with pollution) affecting water quality, eutrophication, algae blooms Increasing average stream flow and extremes, changed timing of water supply (snowmelt) and droughts leading to changes in water supply Increasing temperatures, irrigation during droughts causing an increasing water demand
Energy	Energy for household, public and industrial use, transmission lines, energy utilities, hydropower, wind power, (public or private)	Storms and hail affecting transmission lines, wind energy production Flooding damages infrastructure Higher temperatures increase the need of cooling water, Changes in energy demand: increased energy demand in summer due to higher temperatures, decreased in winter due to milder temperatures Warmer temperatures decrease efficiency of thermal electric generation
Transport sector	Transportation sector and infrastructure, including harbours, airports, public and private as well as regional and trans-national transport systems	Extreme weather events (heavy rain events or snowfall, flooding) as well as increased humidity (fog) or changing wind conditions affect the operability of transport systems Extreme temperatures result in mechanical failures Mild climate during winter improves conditions for transportation and shipping
Tourism	Local tourism business and tourism industry.	Increase in precipitation, changed sunshine patterns, changes in temperature lead to: Warmer summer seasons and higher water temperatures (including changed water quality) Warmer winter seasons and changed snow conditions Sea level rise and flooding affects coastal tourism infrastructure
Agriculture	Farming, fishery, forestry, manufacturing industry	Extreme weather events (droughts, heavy rainfall, storms) lead to deprivation of crop and livestock (water shortage, forest fires, flooding..) Warmer average temperature increases the occurrence of diseases and pests Warmer seasons affecting growing season and plant productivity Operability of forests reduced as a result of a shorter period of frozen ground Warmer water temperatures lead to changes in salinity of the Baltic Sea, changes in fish species

2.3. Institutional preparedness

Institutional preparedness, here in effect planned adaptation through spatial planning practices, is one factor potentially contributing towards reducing local vulnerability to the impacts of climate change (for the concept of vulnerability see chapter 1.1 and Kropp et al. 2006). In the framework of the ASTRA project, a screening study on the preparedness of actors working in the field of spatial planning has been conducted (Haanpää et al. 2007). The study, based on a qualitative meta-evaluation of national institutional vulnerabilities as seen by individual national UNFCCC focal points in the BSR, offers a perspective on the awareness and interplay of different actors and levels of spatial planning regarding climate change adaptation[4].

Based on the study, in the BSR attitudes towards climate change adaptation range, at all administrative levels, from very positive to almost completely lacking consideration of adaptation. The primary focus remains often on climate change mitigation. There is, however, increasing understanding of the need for adaptation, and pressure is being put on governments to develop adequate adaptation policy guidelines. Nevertheless, multi-sectoral adaptation strategies are still to emerge in almost all countries. The study shows that many of the BSR countries are having shortcomings in formulating programs, policies and legislation addressing adaptation. Also, local capacity to implement adaptation measures lags behind the capacity for gathering information and initiating a dialogue on the issue. The existence of adaptation policy guidelines on the national level would support action on the local level.

Seeing the need for adaptation and being able to act on it are two separate issues. Although climate change is much discussed globally, the awareness of local level actors on the issue and their ability to engage in adaptive practices still varies from one country to another. Mostly, it was still seen to be weak though. As presented by the Hampshire County Council for the ESPACE project's final conference (ESPACE 2007), London, UK, 29th June 2007, awareness does not automatically follow information, and this in turn does not lead to adaptive action.

The study still confirms that the dissemination of information and the need for adaptation on all levels is crucial, but that addressing social knowledge and local issues is important. Successful adaptation on local level also depends on socioeconomic factors and political will. These aspects of adaptive capacity differ from one municipality to another and there is also a need to improve inter-sectoral cooperation, i.e. horizontal governance on the local level. Often, the impacts of climate change would require a more strategic and spatially wider approach. This would support the role of the regional level as a mediator between national strategies and local level action.

[4] The study investigated spatial planning systems' coping capacity from multiple viewpoints; on three different levels – the individual (learning capabilities), organisational (tools for adaptation) and systemic level ('enabling environments') – and covered aspects of institutional vulnerability from policy formulation and implementation to mobilising information and consensus building. This approach gave insights into the complexities involved in implementing recommendations on adaptation into existing spatial planning structures and socioeconomic settings. For more information, please refer to Haanpää et. al. 2007: Institutional vulnerability of spatial planning systems towards climate change in the BSR, download under: www.astra-project.org.

Winter Storm Study: The study of the impacts of winter storm Gudrun in 2005 conducted by ASTRA partners showed that adaptive capacity in the BSR has to increase to minimise negative consequences of extreme weather events. It can be stated that better information sharing as well as coordination between actors and between different sectors are crucial activities in order to reduce regional vulnerability (Haanpää et. al. 2006: 31-33).

2.4. Interim conclusions

There is a general trend related to an average temperature rise and changes in precipitation patterns. Whereas summer seasons become hotter and drier, an increase in precipitation and milder climate may be expected for winter seasons. The expected impacts differ at regional scale. Regions that are affected most by temperature rise are the coastal areas in Sweden, Finland and the Baltic States (in summer) and the mountainous areas in Finland and Sweden (in winter) (figure 9). Also the precipitation patterns differ from region to region (figure 8). Due to these variations, there is a wide range of sectors that are influenced by climate change impacts in the BSR. Table 1 points out the most relevant sectors, seen from a BSR perspective.

The studies evaluating institutional preparedness in the BSR and analysing measures taken after winter storm Gudrun in 2005 confirm the need to strengthen the awareness about adaptation to climate change and to create adequate organisational frameworks. The formulation of strategic adaptation programmes at national level and the implementation of concrete measures at local level need to be enhanced. Learning processes and cooperation among administrative levels are key aspects.

Recommendations for further reading

DDC (2007): IPCC Data Distribution Center, Intergovernmental Panel on Climate Change, www.ipcc-data.org, accessed January 2007.

Eisenack, K; Kropp, J. 2007: Regional Assessment of Sea Level Rise in the Baltic Sea Region: Costs of Adaptation vs. Non-Adaptation Small-Scale Climate Change Scenarios for the Baltics, Potsdam (internal project document).

Haanpää, S.; Peltonen, L. 2007: Institutional vulnerability of spatial planning system towards climate change in the BSR, Helsinki (internal project document).

Schröter D.; Cramer, W.; Leemans, R.; et al. 2005 : Global Change in Europe Ecosystem Service Supply and Vulnerability to Europe. Science, 310, 1333.

3. Existing policies in the BSR on adaptation to climate change

In the framework of the ASTRA project, partners have gathered information about existing adaptation strategies. Three rounds of questionnaires were sent to ASTRA project partners and stakeholders in the BSR in order to identify existing approaches in their countries or regions. The result of the survey provides a general overview of adaptation strategies in the BSR. This chapter starts with an overview of different policy approaches in the field of climate change adaptation at European level. Then, integrated adaptation strategies at national level are described more detailed for Finland and Germany. Further activities at national, regional and local level are described on a sectoral basis with the focus on Integrated Coastal Zone Management, flood protection and forestry, including practical experience.

3.1. General approaches of adaptation to climate change impacts at EU level

The European Union plays a key role in supporting sustainable development through dissemination of information, enhancing exchange and influencing national policies and procedures by directives, recommendations and financial incentives. Whereas mitigation (greenhouse gas monitoring and reporting, European Union Greenhouse Gas Emission Trading Scheme, First European Climate Change Programme) is a highly relevant topic on the European agenda (European Commission 2007), adaptation has only recently been taken up by the EU Green Paper on Adaptation. In the fields of coastal management, flood protection and maritime policy the EU has already recognised climate change impacts as an important issue – fields that also are of high relevance for the BSR.

3.1.1. Regulative approaches

Draft Flood Directive

Severe flood events all over Europe regularly demonstrate the need of adequate protection infrastructure and organisational preparation. Reasons for flooding are also often man-made such as deforestation, straightening of rivers or ground sealing. In addition to these, climate change impacts such as changing patterns in precipitation leading to heavy rainstorms have been recognised by the European Union as cause of an increase in frequency and impact of flooding. Therefore, the proposal for a Directive of the European Parliament and the Council on the Assessment and Management of Floods (2006) recommends the implementation of flood maps and flood risk management plans including long term effects due to climate change. The directive, which is still under preparation, envisages that the flood maps shall be completed by 2013 and the flood risk management plans by 2015 (Commission of the European Communities 2006a).

3.1.2. Informal approaches

Integrated approaches at European level

In 2005, a technical report on “Vulnerability and Adaptation to Climate Change in Europe” was published by the European Environmental Agency (EEA). It states different vulnerabilities in geographic terms (south-eastern parts of Europe, mountainous and sub-Arctic areas, coastal

zones) and identifies relevant sectors (e.g. biodiversity, agriculture, fishery, forestry, water resources). An assessment of adaptation policies in EU member states concludes that adaptation has not been put on the political agenda yet or is only just about to be at European and national levels (EEA 2005: pp 29-41). The report therefore only presents some examples of current and planned adaptation measures. The only examples in the BSR mentioned in the report are taken from Finland.

Adaptation has also been discussed in a working group on impacts and adaptation which was part of the elaboration of the second European Climate Change Programme (ECCP). The working group, consisting of a kernel of 25-30 participants with changing external experts has discussed the issue in a sectoral approach. The outcomes will be summarised in a final report (ECCP Minutes 2006).

The workshop sessions have fed into a Green Paper on Adaptation that was launched on 29 June 2007. The Green Paper points out major climate change impacts and challenges for Europe and options for action. The main component is a flexible four-pronged approach. The first pillar demands that action should be taken at an early stage in various sectors within the European Union. Climate change adaptation shall be integrated into existing and future policies as well as into the community funding programme. Furthermore, new policy approaches shall be developed. The remaining three pillars provide recommendations concerning the integration of adaptation policies into external policies, the need of more profound research and the involvement of European society. As an example of good practice, the ASTRA project is mentioned in the Green Paper (Commission of the European Communities 2007).

The need for strategies of adaptation to climate change impacts has also been recognised in the Territorial Agenda of the European Union. The “regionally diverse impacts of climate change” are stated as one of the major challenges (Territorial Agenda of the European Union 2007).

Integrated Coastal Zone Management

Coastal areas are, due to their location, particularly vulnerable to climate variations. Therefore, coastal protection is one of the fields, where adaptation strategies and measures to extreme weather events have been in practice for a fairly long time, in form of dikes, flood plains or drainage systems. The next step is not only to take into consideration actual threats but also future ones that might be intensified by a changing climate.

The EU acknowledges the importance of climate change impacts in its recommendation 2002/413/EG of the implementation of an Integrated Coastal Zone Management (ICZM) in Europe. ICZM is an informal, communicative approach to integrate ecological, economic, social and legal aspects into one process and elaborate a sound strategy for sustainable coastal development. The recognition of threats “to coastal zones posed by climate change and of the dangers entailed by the rise in sea level and the increasing frequency and violence of storms” is explicitly mentioned in the first chapter of the recommendation (European Parliament, European Council 2002).

Maritime Policy

The Green Paper on Maritime Policy (2006) mentions climate change impacts as a threat to maritime biodiversity, coastal and offshore infrastructure as well as sea defence (Commission of

the European communities 2006b: 5, 15, 25). The Commission recognises the opportunity for European countries to gain a leading role in the development of technologies and strategies against climate change impacts on coastal areas, which can be exported into other parts of the world (Commission of the European communities 2006b: 15). Part of these recommendations is the implementation of a European Marine Observation and Data Network for monitoring the oceanic system and gathering comprehensive data on climate change. Nevertheless, the Commission recognises that the question remains how to provide legislative, institutional and financial steps to build up such a network (Commission of the European communities 2006b: 31).

3.1.3. Financial instruments

In response to the severe flooding in Central Europe the European Union has created a financial instrument to provide support to affected regions – the European Union Solidarity Fund (EUSF). The funding provides fast and flexible financial help after a natural disaster has occurred. The current fund does not intend to assist in developing long-term measures but is regarded as emergency funding. The European Union has acknowledged the need of further financial programmes to build up structures that are able to respond in case of likely repetitions of similar disasters. “Coordination” and “prevention” are key terms that shall be taken into account when reviewing the structural funding programmes (European Union Solidarity Fund 2002).

Regarding research activities, the European Union fosters scientific work on climate change adaptation in the 7th Framework Programme. Thematic emphasis is laid on natural hazards, e.g. hazard mapping (see also Schmidt-Thomé 2006b), and on determining the most vulnerable areas, e.g. mountainous or coastal areas.

The need of adaptation to climate change impacts is also acknowledged in the draft INTERREG IV Programme of the Technical Joint Secretariat in the Baltic Sea Region: “… in order to maintain the unique features of the natural environment, also protection and long-term strategies have to be launched, addressing e.g. an adaptation to climate change and prevention of natural hazards” (Joint Programming Committee 2007: 23). Special emphasis is put on coastal areas and water management (Joint Programming Committee 2007: 6, 48, 29).

3.2. Integrated approaches at national level

Only a few countries worldwide tackle climate change adaptation in an integrated manner at national level. First steps are being taken regarding the assessment of vulnerability to climate change impacts. Estonia, Finland and Germany have conducted vulnerability assessments, analysing different sectors and their degree of vulnerability to climate change impacts (Kont et al. 2002, 2003; Finnish Ministry of Agriculture and Forestry 2005; Federal Environmental Agency of Germany 2006). Finland is the country that is most advanced in approaching climate change adaptation. Whereas Finland already has developed a national strategy of adaptation, Germany has initiated a national competence centre for adaptation. These two national approaches are described in the following chapter, added by a private initiative in the insurance sector.

National Strategy for Adaptation to Climate Change in Finland

Finland currently is the most advanced country in developing a national strategy on adaptation in the Baltic Sea Region. The “National Strategy for Adaptation to Climate Change” was initiated by

the Finnish Parliament after having submitted the National Climate Strategy in March 2001 (Finnish Ministry of Agriculture and Forestry 2005). It is implemented as a part of the new Energy and Climate Strategy of Finland that was revised in 2005 (Finnish Energy and Climate Strategy 2005). The propositions of the strategy are implemented through the principle of mainstreaming, meaning that involved sectors should cover adaptation issues within their current realm.

The strategy describes the impacts of climate change in a sectoral manner. The assessment has been conducted by researchers and external experts. A public consultation process has taken place, too. The work was coordinated by the Ministry of Agriculture and Forestry and representatives of different ministries, together with the Finnish Meteorological Institute and Finnish Environment Institute. The adaptation strategy, although progressive, includes only sectorally separated approaches. Strategic aims and clear schedules for the implementation of identified adaptation needs are not provided (Peltonen, Haanpää, Lehtonen 2005; Talockaite 2006).

Nevertheless, the national strategy is an important first step towards forming a holistic understanding about adaptation issues. Because of a general lack of knowledge concerning adaptation to climate change impacts the adaptation strategy recommended the launching of a research programme. The FINADAPT[5] programme ran alongside the strategy work, benefiting both. The executive summary of FINADAPT was published in 2007. The research consortium was funded for the period 2004-2005 as part of the Finnish Environmental Cluster Research Programme, coordinated by the Ministry of the Environment (FINADAPT 2007). The latest initiative has been the launching of a five-year Climate Change Adaptation Research Programme (ISTO) enhancing the search for solutions that support planning of adaptation measures. 15 research projects in different sectors currently are financed by the programme (ISTO 2006). One focus of climate change studies is on dissemination through a Climate Change Communication Programme (Finnish Climate Change Communications Programme 2002). The programme is part of the realisation of the aims of the National Energy and Climate Strategy.

National Competence Centre in Germany

The German Federal Government used to have its main focus on climate change mitigation (e.g. National Climate Protection Programme from 2000, revised in 2005). The issue of adaptation came up first time with a study on vulnerability and adaptation of climate sensitive sectors in 2005 (Zebisch et al 2005). By now, adaptation has been recognised as an important complement to mitigation activities. In this manner, national research programmes on climate change mitigation have been extended to the field of adaptation. Research activities include local communication processes to develop adaptation measures as well as sectoral approaches to enhance the adaptation capacity in different economic fields, e.g. forestry or agriculture (KLIMAZWEI 2004).

In 2005, a workshop session has been started in order to create a network of relevant stakeholders in the field of climate change adaptation. The final objective is the establishment of a national Centre of Competence for Climate Impacts (Kompetenzzentrum Klimafolgen und Anpassung – KomPass 2005). The centre is not intended to conduct research, but to focus on a

[5] For more information on FINADAPT please see
http://www.environment.fi/default.asp?contentid=227544&lan=fi&clan=en or
http://www.environment.fi/default.asp?contentid=228121&lan=fi&clan=en for the Working Papers

pragmatic, demand-oriented exchange of information. Similar to the “United Kingdom Climate Impact Programme (UKCIP)” the main task shall be counselling and support of actors in sectors which potentially are affected by climate change, and decision-makers who have to take decisions under risk (UKCIP 2007b).

The Munich Climate Insurance Initiative

Climate change impacts such as an increase in flooding or severe storms require an adaptation of insurance rates to the changing conditions. In 2005 the Munich Re initiated the Munich Climate Insurance Initiative (MCII) responding to the aspect in the United Nations Framework Convention on Climate Change (UNFCCC) that insurance solutions can play a role in adaptation to climate change impacts. The MCII provides an internet platform for insurers, climate change and adaptation experts, NGOs and policy researchers that aim to find solutions to risks posed by climate change. The initiative is open to interested stakeholders (Munich Climate Insurance Initiative 2005).

3.3. Selected sectoral approaches in the Baltic Sea Region

The findings of ASTRA about existing adaptation strategies focus on a number of sectors – namely forestry, coastal and flood protection. The sector of urban planning has been considered to be mentioned as a separate field of existing adaptation strategies. During the analysis it was concluded that most activities concern flooding problems in urban areas. Therefore it has been included in the section of flood protection. Another sector that has to be mentioned in connection to climate change impacts is disaster control or disaster management. Most countries should have laws, programmes and concepts in relation to civil protection in case of disasters (e.g. Polish Act on National State of Disaster, 2002 or the Civil Protection Conception, 2005). Extreme weather events are covered by these national strategies.

Winter Storm Study: Benefits of a well-organised disaster management have been identified by the ASTRA winter storm study. In 2003 a new law on the responsibility of municipalities at extraordinary events was adopted in Sweden. Since then many municipalities have done risk and vulnerability assessments. Based on these assessments, plans and organisations were developed to be able to act during acute crises. Many county boards regularly perform exercises to be prepared for extreme events; some also have information systems for crisis. During winter storm Gudrun positive effects resulting from the Swedish preparedness could already be observed (Haanpää et al. 2006: 22).

The ASTRA partners tried to integrate different views and opinions by having conducted three international conferences involving altogether more than 200 stakeholders from the BSR. Nevertheless, the results reflect the main concerns of the ASTRA project partners – they might differ when extending the partnership to other regions in the BSR. In order to gain a comprehensive overview of existing adaptation approaches further areas such as the energy, transport, tourism or health sector need to be analysed.

3.3.1. Integrated Coastal Zone Management

As described in chapter 3.1.2, the European Union recommends the elaboration of Integrated Coastal Zone Management to enhance sustainable development in European coastal zone areas. An evaluation of the implementation of ICZM in Europe provides a very heterogeneous picture in the BSR. The elaboration of ICZM strategies at national level has not been carried out in all BSR countries, whereas an intensification of the establishment of ICZM at local and regional level can be made out. However, the study concludes that ICZM is not sufficiently known in the various administrations at local and regional level (Ruprecht consult 2006: 11). One of the main general recommendations for the whole of Europe is to include climate change consequences in ICZM strategies (Ruprecht consult 2006: 21).

Figure 11: Illustrative map of the peninsula of Usedom showing flood-prone areas at different flood heights (GIS IKZM Oder)

A good example in the field of ICZM and the recognition of climate change adaptation can be found in the ICZM-Oder/Odra project. The project represents one of two national German reference projects in the field of ICZM and has been supported by the Federal Ministry of Education and Research (BMBF). Furthermore, the same region is part of a Polish/German Agenda 21 process named “Oder Lagoon”. Project partners of the German ICZM project are mainly research institutes and public authorities. One main working topic was focused on the field of climate change adaptation and has been put into research activities. These activities focused on the quality of water and the level of coastal protection. The latter led to an improvement of coastal defence infrastructure and were implemented by state authorities.

Another research activity has been the assessment of the availability of public information on climate change impacts. The assessment’s conclusion was that the existing information is insufficient. The project therefore initiated a regional information campaign on climate change impacts. Maps are suitable instruments for communicating flood risks and raising awareness. So-called flood maps show prone areas at different flood heights from 0.5-1.5 m above sea level (see figure 11). A follow-up activity, not included in the project activities, has been the elaboration of detailed maps for the purposes of coastal protection.

Even if ICZM strategies have not been developed or implemented yet, general frameworks on coastal protection measures exist among most BSR countries. In Poland the Strategy for coastal area protection (2000) takes into account observed and expected changes of the sea level due to climate change impact. Three different scenarios (0.3; 0.6; 1.0 m sea level rise) are considered. Based on these calculations it is estimated that in the 0.6 m scenario, no action would lead to the loss of 120 km² of land due to erosion, 2,200 km² of land would be occasionally flooded during storms. Approximately 300,000 people would be directly affected and 1.7 million people indirectly affected by flooding, erosion and landslide risks. Therefore the strategy provides basic directions to reduce coastal risks. For example, when modernising or implementing coastal protection infrastructure, climate change impacts either have to be taken into account or a feasible strategy for cheap adaptation in future should be provided. In order to increase the safety of the hinterland, general indicators for five different safety classes for development activities in flood and erosion risk areas have been designated. Waste landfills located in the risk area, for example, have to correspond to the guidelines of the highest safety class. A coastal belt to ensure an adequate level of safety along the coast has been designated as well. Development activities in this belt (e.g. land use plans, spatial strategies, construction permits etc.) must obtain permission from the regional Director of the Maritime Office (Cieslak, 2007). At regional level there is also the Pomorskie Voivodeship Development Strategy (2005), which aims at the modernisation and development of flood protection infrastructure, coastal protection and integrated coastal zone management. Activities of ASTRA project partners will contribute to this objective.

In Lithuania, for example, the current Lithuanian Baltic Sea Coastal Management Strategy (2001), prioritising the preservation of natural landscapes and the natural coastal formation process, recognises the destruction of the coastal area due to an increased frequency of winter storms. The coastal management, therefore, shall be adjusted to prevent future threats (Talockaite 2006).

3.3.2. Flood protection

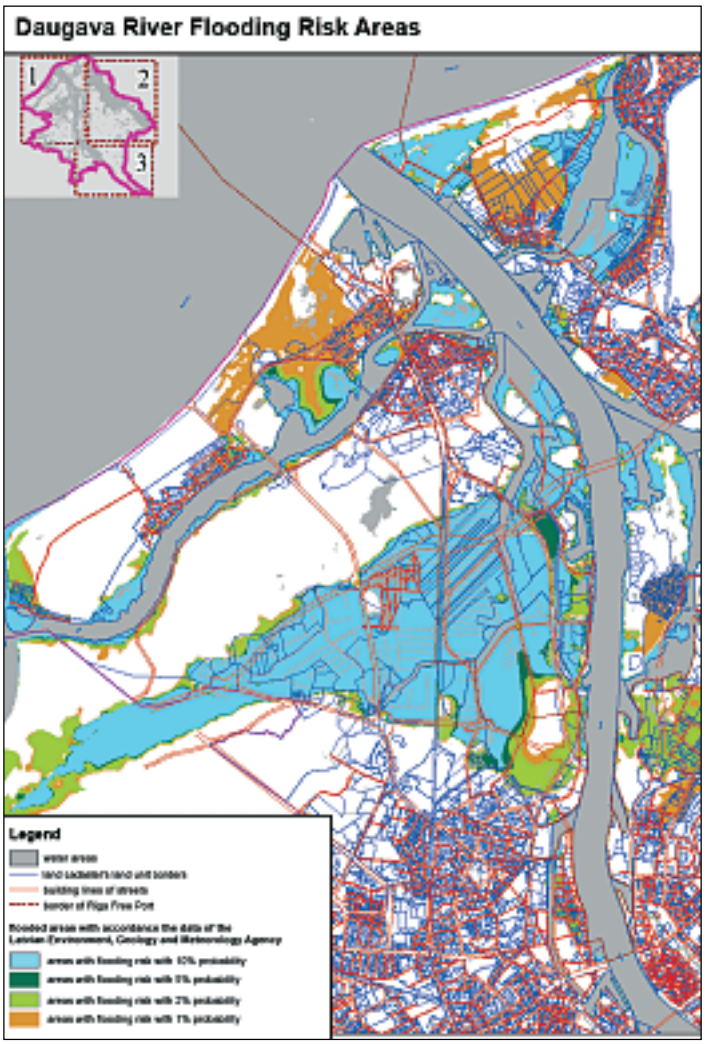
The danger of flooding has already been mentioned. Some flood protection strategies already consider climate change impacts.

Regulative Approaches

Laws regulating areas where construction activities are forbidden due to flood risks can be found in many countries. In Finland and Germany these regulations take into consideration the latest scientific knowledge concerning climate change impacts, especially concerning expected rises in sea level. In Germany a federal law on flood protection (Hochwasserschutzgesetz) was launched in 2005. The law regulates the zoning of “flood areas” that can be affected by once in 100 years flood events. These zones shall serve as natural flood plains. Furthermore, restricted building regulations have been set up for these areas e.g. the prohibition of new housing developments (Federal Environmental Agency of Germany 2006: 14). In Finland similar legal requirements exist. Regarding flood protection in the city of Espoo, in the building code the lowest construction level is defined along the coast to 3 m above sea level (Espoo Building Code 2007). Construction codes in Finland and Germany include the objective of encouraging good living conditions. As a result climate change impacts such as an increased risk of flooding should already be considered in the latest urban projects. In Finland the ASTRA project has initiated that urban planners pursue these objectives in planning activities.

Flood Protection in Riga – the Riga Spatial Plan 2006-2018

According to latest legislation a Strategic Environmental Assessment has taken place in the elaboration process of the Riga Spatial Plan 2006-2018 (RSP). The environmental review took into account the situation of existing and future flood risks along the coast and the river Daugava.



The RSP acknowledges potential risks including the flood risk of low lying land, shore erosion due to floods and a strong northwest wind (Riga City Council 2005: 83). Regarding the danger of flooding the RSP provides some guidelines for planning:

- the existing garden plots in the city shall be maintained in order to be used as temporary use of land in case of flooding (Riga City Council 2005: 86)
- centralised water supply is to be provided in residential areas at risk of flooding (Riga City Council 2005: 186),
- buildings can only be put up "when there is a risk of them being submerged if all the necessary measures have been taken to prevent it from happening" (Riga City Council 2005: 83).

Figure 12: Flood Risk Zones (Plan 1) in Riga

(Riga Flood Risk Zones 2007)

Despite the acknowledgement of flood risks, the RSP does not mention explicitly potential impacts of future climate change as an additional source for flood risk. Therefore, it remains unclear if the threat of climate change has really been taken into account. However, the identification of potential flood risk areas representing 80 square kilometres of the capital city and surrounding area and including several significant construction projects, has led to a national discussion of how to deal with flood risks and what kind of role municipalities or public bodies should play in risk prevention (Riga Flood Risk Zones 2007).

Gdansk Flood Protection measures

Owing to its geographic location in the Vistula delta, Gdansk is considerably vulnerable to floods caused by intensive precipitation, high discharge of the Vistula River, storm surges and ice jams. In addition, parts of the city and its infrastructure are situated below sea level. As a result the city has developed a network of flood protection infrastructure facilities, i.e. dikes, ditches, culverts, sluices, pumping stations and storage reservoirs (see figure 13). Recurring flood events with severe impacts, i.e. in 2001, have led to analyses of existing flood protection policies as well as analyses of technical condition and modernization of the existing flood protection infrastructure. Predicted water run-off in rivers, resulting from intensity of precipitation and considerable urbanisation of the area in the last 30 years, has been taken into account.

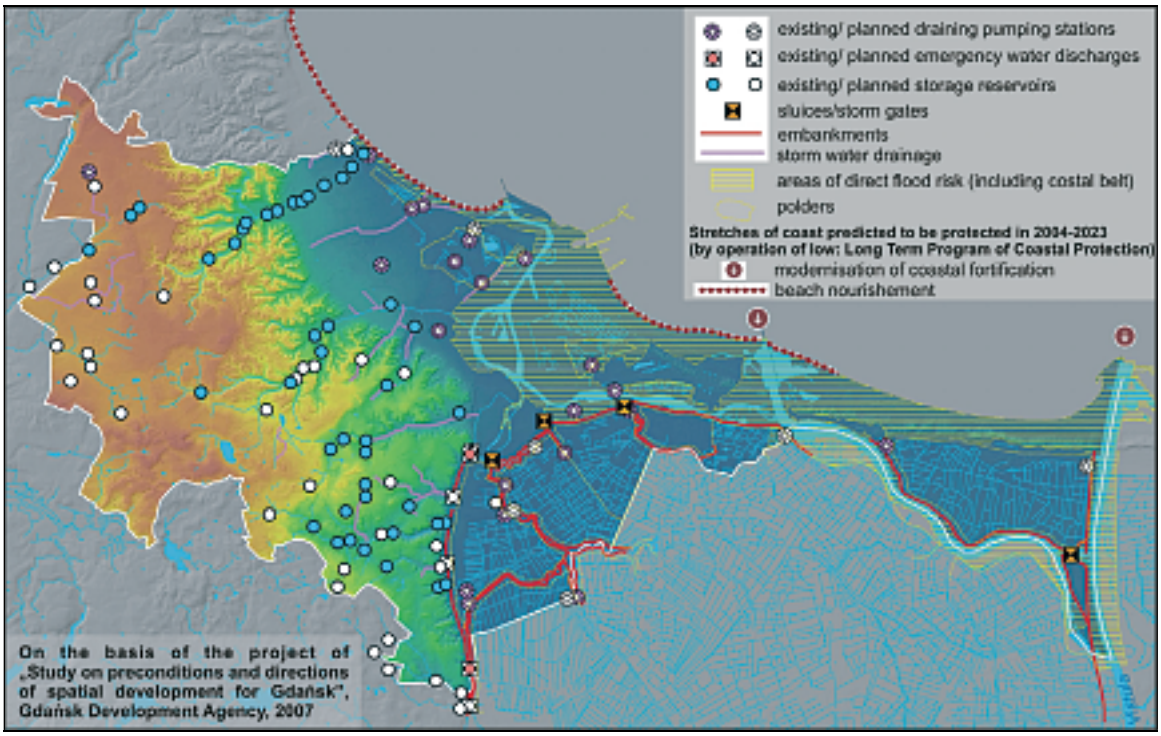


Figure 13: Flood Protection in Gdansk (as presented by Kaulbarsz et al., 2007)

A Polish law on water regulates principles for determination of areas demanding flood protection, i.e. areas of direct flood risk in regions of high socio-economic and cultural value are defined as having a probability of floods occurring once in 100 years. Determining what areas are at risk is the responsibility of Regional Boards of Water Management. These zones shall be considered in local spatial development plans (Burakowska 2007). But in general, climate change impacts have not been considered so far in an integrated approach. ASTRA project partners are elaborating a groundwater vulnerability map that shall function as a tool for further analysis, and support the integration of climate change issues and flood protection measures with planning and decision-making in Gdansk.

3.3.3. Forestry

The concept of sustainability was developed in the sector of forestry more than 250 years ago. It stipulates a form of cultivation that takes care of existing resources to maintain these for future generations. The long-term planning horizons and the principle of sustainable development are probably crucial reasons why climate change impacts are already considered in forest programmes in several countries (Lithuanian Forest Increase Programme 2003-2020; Latvian National Forest Policy; German Forest Programmes in the Federal States). Main aspects in the field of forestry are to avoid monocultures and to develop mixed forests with a focus on tree species with greater endurance in order to strengthen natural resilience.

Research activities

National activities in the field of developing adaptation strategies for the forestry sector also comprise the promotion of research activities. For instance the Latvian State Forest Research Institute “Silava” works on projects like the impact of climate change and environmental pollution on forest stand development, the evaluation of extreme wind speed influence on forest stand stability and the development of decision-making support systems (Silava 2007). Research activities in the field of forestry are also supported by the FINADAPT programme in Finland (Carter, Kankaanpää 2004: 6).

Financial approaches

An example of financial instruments supporting adaptation strategies can be found in Denmark. In 2000 the Storm Council (stormrådet) was established by law (lov om stormflod og stormfald 2000, § 21-23) that can be called up by the Ministry of Environment when a severe storm has occurred. The members are in charge of deciding in which cases financial aid shall be granted to private forest owners. The support covers the clearing away of damaged forest stands and replanting lost timber with sturdy tree species (Haanpää et al. 2006: 27; Stormrådet 2000)

3.4. Interim conclusions

The assessment of policies for adaptation needs displays again that it is a fairly new issue. At European level, first policies are taking the aspects of a changing climate into consideration. But as shown in the field of ICZM, the national, regional and local actors have not yet implemented the recommendations to integrate climate change impacts sufficiently.

Sectoral approaches at national level integrate the consideration of climate change impacts into first programmes and strategies. Nevertheless, the identification of policies considering climate change has been rather difficult in the project. Main obstacles encountered during the survey were the partly missing distinction between adaptation and mitigation strategies as well as the problem of obtaining more detailed information about the extent to which climate change impacts are considered. Most policies refer to climate change only in terms of mitigation. Furthermore, it is unclear whether identified policies referring to climate change impacts are implemented at regional or local level. The assessment conducted by ASTRA project partners could hardly identify local policies that integrate climate change impacts and adaptation needs. It must be concluded that climate change adaptation has not been taken up at regional or local level as yet.

In the framework of the project only a number of sectors could be assessed. A comprehensive investigation would have to analyse further sectors such as energy supply, water management, urban planning, transport and health as well as tourism, and deeper scientific research would be needed for the identified strategies.

Further Reading

Commission of the European Communities 2007: Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – Adapting to climate change in Europe – options for EU action, COM(2007) 354 final, 29.06.2007, Brüssel. Download: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0354:FIN:EL:PDF, 23.07.2007.

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European Environmental Agency 2005: Vulnerability and adaptation to climate change in Europe, EEA Technical report No 7/2005, Download: http://reports.eea.europa.eu/technical_report_2005_1207_144937/en/EEA_Technical_report_7_2005.pdf, 06.09.2006.

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Fleischhauer, M.; Greiving, S.; Wanczura, S. (eds.) 2006: Natural Hazards and Spatial Planning in Europe, Dortmund.

Talockaite, Elena (2006): An Overview of Adaptation Strategies for Climate Change Existing in the Baltic Sea Region, Kaunas, Download: www.astra-project.org.

4. Recommendations for policy-making

The following recommendations are designed to provide provisional advice on how to develop adaptation strategies to climate change. They are addressed to stakeholders at all administrative levels and other interested actors in the BSR.

4.1. Steps towards adaptation strategies

The ASTRA project presents different ways how adaptation to climate change impacts might be approached. Figure 14 distinguishes three different ways how ASTRA project partners assessed and communicated the need of adaptation. The winter storm study, as a hazard-based approach, provided insights into the impacts severe winter storms can have and where bottlenecks need to be overcome. The Lithuanian workshop session, initiated by ASTRA project partners, can be seen as an approach to assessing regional vulnerability by encouraging a conciousness-raising process and dialogue between regional stakeholders. The analysis of current (sectoral) policies provides a starting point for seeing where climate change adaptation is already being considered and where it should be incorporated.

- **Different approaches can be used to initiate a debate about climate change and developing adaptation strategies. The appropriate approach to climate change adaptation should be chosen with reference to local features and requirements.**

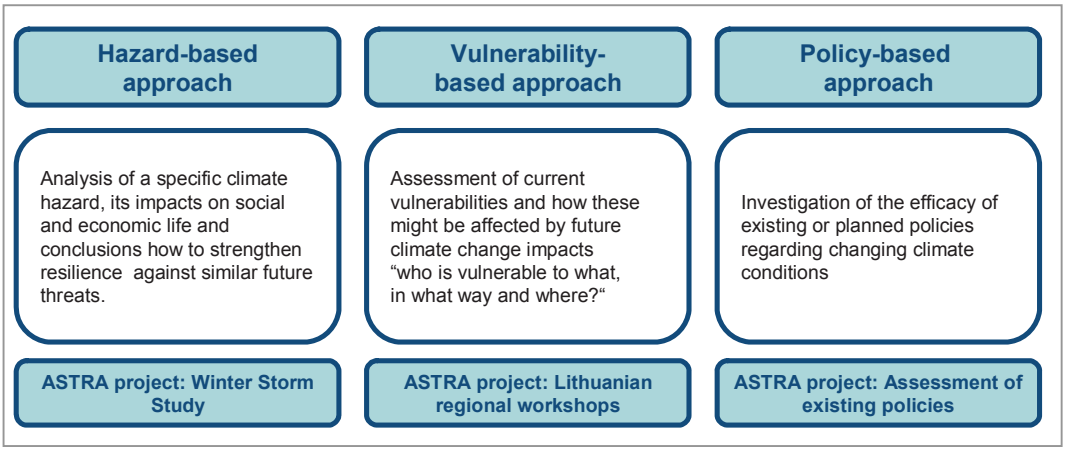

Figure 14: Different ways of approaching climate change adaptation conducted by the ASTRA project partnership (adopted from Lim, Spanger-Siegfried 2005: 43)

Regional workshops in Lithuania: Lithuanian partners of the ASTRA project started a regional workshop session to raise public awareness of the issue of climate change adaptation. 55 regional stakeholders, representing local authorities, subordinate departments of the national Ministry of the Environment, research institutes, businesses, NGOs and the media, attended four workshop sessions. Workshops addressed climate change and its potential effects in general, later focusing on concrete climate change impacts in different sectors of the Klaipeda region and possibilities of adaptation. The final output of the communication process will be guidelines for climate change adaptation that will be presented to local stakeholders in Klaipeda as well as to other interested groups in other parts of Lithuania.

The question remains how to develop adequate adaptation strategies. For this purpose different frameworks already exist and will be presented in the following (Lim, Spanger-Siegfried 2005; Willows, Connell 2003; UKCIP 2003). General steps of such a process are shown in figure 15. The figure implies that the agenda setting process has already taken place, the need for adaptation and the willingness to act already exist among decision-makers and appropriate structures (e.g. an interdisciplinary working group) have been established.

- **An analysis of current and future vulnerabilities and risks as well as the analysis of existing policies form the basis for the development of adequate adaptation strategies**.

In the analysis care should be taken to assess further factors besides climate change impacts that enhance vulnerability, e.g. the geographic location, settlement structures, economic basis or population development (see chapter 1.1). The assessment is the basic precondition for identifying those sectors, regions or groups whose resilience to climate change impacts has to be improved. Adequate adaptation strategies can only be developed when existing threats and bottlenecks are recognised and a joint baseline as target state is defined, i.e. what degree of risk and vulnerability is generally accepted.

- **Different options should be considered when developing adaptation strategies to identify the most appropriate solutions.**

Methods that help to create transparent decision-making criteria should be used, e.g. cost-benefit or multi-criteria decision analysis. Transparency also facilitates the later adaptation of policies or the implementation of specific measures. In addition, adaptation strategies should not only consider negative but also positive development opportunities. A number of positive climate change impacts were shown in table 1. The expected milder climate in the BSR might attract an increasing number of tourists during summer seasons, provides new possibilities of crop cultivation in the field of agriculture and improved conditions for transportation and shipping in winter.

- **Evaluation and monitoring activities should be provided to verify the efficiency of the measures taken and to facilitate adjustments if needed.**

Figure 15: General framework for developing adaptation strategies

Guidance on the development of adaptation strategies

Further guidance on how to develop adaptation strategies is given in various publications. One of the most comprehensive ones is the "Adaptation Policy Frameworks for Climate Change" (APF), edited by Lim and Spanger-Siegfried as part of the United Nations Development Programme (UNDP) in 2005. The APF is meant to be a user-friendly guidance for policy-makers, project developers, stakeholders and other interested actors. It provides practical information on appropriate adaptation approaches and tools, presenting the process from designing of an adaptation project to the formulation of an adaptation strategy (Lim, Spanger-Siegfried 2005).

Another useful framework, available on the internet (UKCIP Adaptation Wizard 2003), is the adaptation wizard that has been developed within the UKCIP. Similar to the APF the adaptation wizard provides a step-by-step guide that starts with the simple understanding of climate change impacts and leads to the integration of climate change aspects into decision-making processes. The adaptation wizard is composed of simple questions that enable any organisation to consider and discuss its vulnerability or preparedness in relation to climate change impacts. Moreover, the adaptation wizard provides definitions of key concepts and principles of good climate change adaptation (figure 16).

- Work in partnership
- Keep a handle on uncertainty
- Frame your objectives carefully before you start
- Take a balanced approach to managing climate and non-climate risks
- Focus on actions to manage priority climate risks
- Use adaptive management to cope with uncertainty
- Try to find no-regret adaptation options
- Try to find win-win options
- Avoid actions that will make it more difficult to cope with climate risks
- Review your adaptation strategy regularly

Figure 16: Key principles of good climate adaptation of the UKCIP adaptation wizard (UKCIP Adaptation Wizard 2003)

Due to its focus on a participatory, bottom-up process the results of the National Programme on Adaptation (NAPA), developed by the UNFCCC, might be interesting for local processes in BSR. The programme launched by the UN in 1997, addresses adaptation processes in developing countries. The NAPA guidance aims at the identification of urgent and immediate adaptation needs due to present climate variability. It thereby examines traditional knowledge and the existing coping capacity of the local community. The results of NAPA processes are easily understandable, action-oriented and set clear priorities for urgent and immediate adaptation activities. Various documents and assessments that have been carried out are available at the NAPA web site (NAPA 2007).

The frameworks described are recommendations for stakeholders who want to initiate a process on climate change adaptation. Interested readers are encouraged to use the given Internet links and references for more information.

ASTRA Project has influenced planning decisions in Pärnu and Espoo

Having participated already in the former INTERREG IIIB project SEAREG, the town government of Pärnu (Estonia) has decided to wait for the scientific output of the ASTRA project in order to develop a well-founded action plan against flood risks. Due to its geographic location the town of Pärnu becomes a more and more endangered region to sea level rise and flooding. ASTRA project results shall be used to decide about the raising of seashore and riverbanks in Pärnu.

The city of Espoo (Finland) decided to raise the minimum floor elevation for new buildings to three meters above sea level. This measure takes sea level rise and changing flood risks into account for a time horizon of about 150 years.

4.2. Integrating adaptation and mitigation activities

The findings of the ASTRA project have shown that future policies should integrate the issue of climate change impacts in order to enhance the resilience of society and economy so as to maintain competitiveness.

It should be emphasised that adaptation is only one side in the field of climate policies. Adaptation to climate change impacts shall be accompanied by mitigation activities that abate the anthropogenic greenhouse effect (see figure 3). Only if both strategies are followed consistently future sustainable development can be secured. Adaptation and mitigation should become an integral part of every development project and policy approach. Both approaches should not only be regarded from the technical point of view, i.e. what is technically feasible, but also from the point of view of institutional and societal issues. No-regret and win-win options for both adaptation and mitigation should be sought for. However, possible conflicts should also be taken into account, e.g. energy consumption for air conditioning in summer.

- **Policy-makers should aim at developing "climate-proof" policies – integrating climate change adaptation as well as mitigation strategies.**

4.3. Mainstreaming climate change adaptation

Climate change is a cross-cutting issue. Consideration of adaptation needs should be seen as a vital contribution to sustainable development.

- **Hence, adaptation to climate change impacts should not be regarded as a separate topic but instead mainstreamed into policies and planning.**

The integration of climate change aspects into different fields of policy does not exclude the need of a superior authority that secures implementation of climate change policies in general, e.g. a federal environmental agency.

The principle of mainstreaming will be explained here, for illustrative purposes, within the sector of spatial development (other examples could be civil defence or water management planning). Urban areas have been identified as one of the areas of high risk to climate change impacts in the BSR. The integration of adaptation needs should also be considered in policies, strategies and programmes of other sectors such as transport, water management, forestry or health policies (see also table 1 in this document).

In view of these functions, spatial planning can be seen as an adequate field to meet the requirements of steering the complex issue of climate change adaptation (Fleischhauer 2006: 162). Decisions on land use and building regulations have to be based on future forecasts like demographic prognosis and economic trends, as well as climate change scenarios. Furthermore, spatial planning offers a range of tools from "hard" regulations to "soft" supporting instruments. Some of these, providing the opportunity to include climate change adaptation, are presented in the following paragraphs. Uncertainty factors should be taken up in planning processes in order to respect the variety in climate change scenarios. This was exemplarily started in the SEAREG project (Schmidt-Thomé, Peltonen 2006).

Assessing vulnerability and risk

The Strategic Environmental Assessment (SEA), regulated throughout Europe by the Directive 2001/42/EC, can be seen as a starting point for integrating climate change adaptation with existing procedures. The SEA provides a procedure for assessing potential consequences of certain plans and programmes on the environment. The aim is to strengthen the consideration of environmental aspects at an early stage of the planning process.

The directive concentrates on regulating procedural aspects – it leaves enough room to adjust the process to the requirements in EU member states. Regarding the flexibility of the concept and the obligatory steps of the SEA, including the assessment of potential impacts on the environment and an assessment of planning alternatives regarding the expected impacts, Greiving (2004: 13 et sqq.) concludes that the SEA can also be used as an instrument for conducting environmental risk assessments. It would be a logical extension of this to integrate a scoping function into the SEA as to what kind of consequences climate change impacts might have on the plan or programme. In this way not only the impact of the plan on the environment would be assessed but also vice versa. In this way the SEA could integrate a vulnerability and risk assessment in relation to current and future climate change impacts in an early stage of the planning process.

Riley (2000: 714) suggests the introduction of a Climate Impact Assessment (CIA) as a general planning requirement. He compares the suggested procedure of the CIA with the Environmental Impact Assessment (EIA) that assesses the environmental impact of built facilities. The CIA would assess the overall vulnerability of a planned building or infrastructure in relation to expected climate change impacts. The procedure could include the same steps as the EIA. The CIA procedure should be the responsibility of the proponent or owner of the planned building facility, while the planning control authority would have to ensure that the procedure is carried out properly (Riley 2000: 715).

The results of a CIA of plans or planned projects would provide information on possible vulnerability in relation to negative climate change impacts, and could be used as a basis for public or private decision-making processes (e.g. when developing new housing areas or deciding on construction modes).

Implementing adaptation needs

Further to procedural requirements, spatial planning provides the opportunity to regulate building guidelines by law. Local comprehensive and detailed planning as well as the building regulations enable public authorities to integrate necessary measures against expected climate change impacts. Chapter 3.3.2 provides examples where building activities are forbidden in identified flood areas, and a minimum above mean sea level is regulated for buildings and infrastructure. Another example could be the regulation of the housing density. Construction codes also might regulate specific modes of construction, e.g. the use of storm shutters in order to provide protection against storm surges. Based on the results from the ASTRA project, the Cities of Kokkola and Espoo (Finland) have drafted guidelines on minimum floor elevation above sea level rise for housing development.

Formal and informal instruments as supplement to regulation

Spatial planning comprises not only juridical regulations but statutory requirements for public involvement and sectoral coordination, as well as informal communicative supplements.

One task of spatial planning at national level is usually the analysis of current spatial structures and the formulation of general priorities for future development. These priorities present a framework for concretising land uses and development projects at lower levels, so that generally agreed guidelines can be integrated. National spatial concepts could easily integrate identified regions vulnerable to climate change impacts, e.g. coastal or mountainous regions, as well as priorities for future development in these areas.

Spatial plans at every level can also be used to illustrate climate change impacts, e.g. in hazard or flood protection maps. In particular interactive graphics, produced with geographic information systems, provides the opportunity to demonstrate potential impacts of climate variations on housing sites, transport routes, coastal areas or technical infrastructure (water, waste, energy, etc.).

Computer-based systems that integrate climate change data and information on spatial planning offer the opportunity of gaining a comprehensive picture of climate change impacts and regional vulnerabilities. Geographic information systems (GIS) support the compilation of relevant data and secure the compatibility of provided information. In this manner, GIS applications can function as decision support systems, e.g. by indicating areas at flood risk or pointing out areas that need further protection measures. Examples of such applications have already been developed, e.g. by the INTERREG IIIB FLOWS project for the North Sea Region.

Education and training

The wide range of opportunities for mainstreaming climate change issues into daily business should be taken up in the field of education and professional training. Initiating planners in climate change adaptation issues at an early stage of their training will have an effect on their future professional understanding. ASTRA project conferences have shown that there is a general lack of perception of the need to adapt to climate change impacts and that the basic idea of adaptation and possible strategies are not known sufficiently. Training units focusing on the development of a common understanding and fundamental adaptation strategies are needed – not only for students but also for practising planners, architects, construction engineers, environmental specialists, public servants, insurance specialists and politicians.

The UKCIP has started an information and communication campaign, also addressing local planning authorities. In a brochure “Climate Change and local communities – how prepared are you?” general information on climate change is given as well as examples of possible adaptation responses (UKCIP Adaptation Guide 2003).

- **Activities at transnational level could comprise the initiation of communication platforms, information and monitoring systems enhancing the exchange of local, regional and national experiences and best practices (e.g. UKCIP 2007a). In a joint effort of research institutes and practitioners, innovative adaptation approaches should be developed at transnational level.**

All measures would create transnational networks involving multiple actors of the BSR. The communication platform addresses public authorities and planners at national, regional or local level. Initiators could be existing networks, e.g. the Union of the Baltic Cities, VASAB and Helsinki Commission (HELCOM). Tools for establishing a lively exchange could be an internet platform, the creation of a transnational working group as well as regular meetings and conferences about the issue.

4.4. The need for a holistic approach

Climate change impacts affect the whole of society. Chapter 2 provides an overview of potential and already perceivable climate change impacts that affect businesses (e.g. farming, fishery, investors that develop coastal areas) as well as private households that live in vulnerable places. Moreover, in some sectors such as water or energy supply, climate change impacts can interfere with public welfare.

- **Adaptation to climate change is an issue that affects public as well as private interest. It therefore has to be considered by a wide range of actors (see figure 17).**

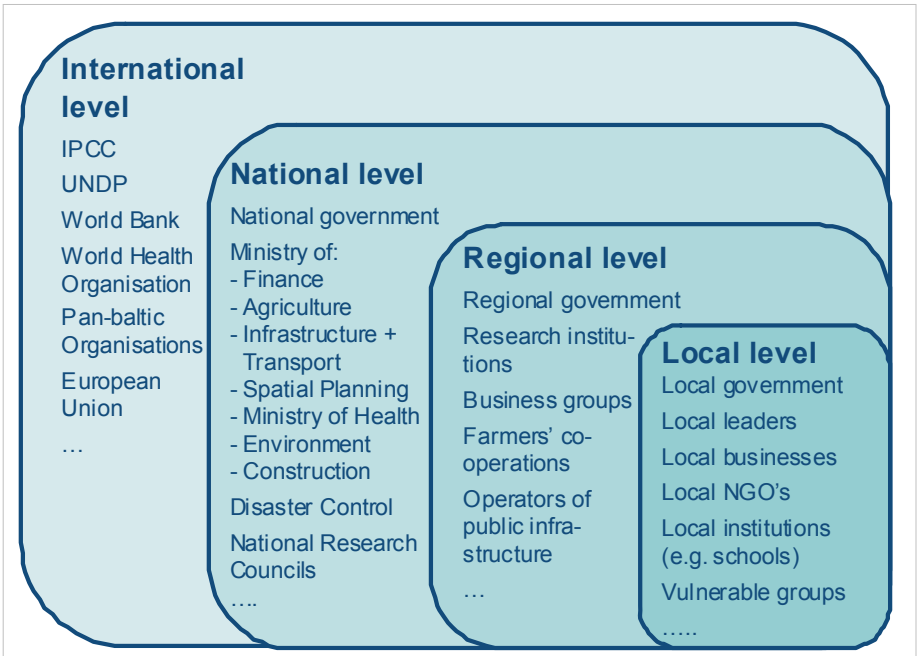

Figure 17: Exemplary mapping of institutions and stakeholders involved in adaptation activities (adopted from Lim, Spanger-Siegfried 2005: 39)

Chapter 1.4 points out that public authorities play a key role when addressing climate change adaptation. However, due to changing conditions (e.g. privatisation tendencies) the tasks of public authorities have changed as well. The concept of governance displays this development. In contrast to government, which is characterised by hierarchical structures, bureaucratic procedures and the dominance of state power, governance comprises policy networks. It acknowledges the involvement of actors external to the political arena in a joint process. Governance builds up capacity for self-organisation by developing partnerships between actors and levels of government, in vertical as well as horizontal terms (Benz 2005: 404 et sqq.).

- **In the form of a pull and push strategy public authorities can influence behaviour by information and communication activities that raise public awareness. Financial incentives or regulations, as push-factors, can encourage appropriate activities on the part of private and public actors.**

If the level of state intervention is reduced, the self-organisation and self-responsibility of civil society is enhanced. Citizens might syndicate in the form of civic commitment (e.g. Agenda 21 processes) to enforce needs or interests that are not met by the state or the market. Furthermore, private households can influence demand in the private sector, e.g. in the field of construction techniques or when buying a plot of land.

The changed demand in turn affects economic activities. Having recognised climate change adaptation as a new marketplace, economic activities might themselves provide new impulses and innovations, e.g. mobile techniques for flood protection. Climate change adaptation can become a field for economic growth and competitiveness.

While public authorities should still keep a stronger influence on the basis of regulations, incentives and information campaigns, businesses and private households should be encouraged to act proactively and to support climate change adaptation themselves.

- **Self-organisation and self-responsibility should be fostered so that climate change adaptation can be encouraged by a mixture of top-down and bottom-up approaches.**

4.5. Final conclusions

Climate change adaptation is a complex task that requires joint societal efforts. Therefore, it should be addressed both by public bodies and by private actors. The market offers possibilities of influencing the public attitude, e.g. by adjusting insurance rates for housing areas or economic activities in vulnerable areas. The development of adaptation measures may become a new market for technological innovation.

Public authorities can encourage private initiatives towards climate change adaptation. Therefore, public activities should focus on establishing a positive attitude towards the issue by raising awareness through information and communication. Especially at European and national level, incentives to tackle the issue can be given in the form of financial support for research activities and pilot projects. Thanks to its regulative competence, the national level can influence communication activities if they do not lead to satisfactory results. The existence of adaptation policy guidelines on the national level would support action on local level.

At regional and local level, tasks concerning climate change adaptation include the adjustment of general guidelines to local needs and the implementation of adaptation measures. Tools and approaches to initiate local processes and for the development of adaptation strategies can be found in various adaptation policy frameworks. It is recommended that such a project should be designed as an open process that involves all affected and interested stakeholders.

One of the main conclusions is the importance of mainstreaming adaptation to climate change impacts in different policy fields. Adaptation strategies should not be regarded as separate, but as an integrated element of every relevant policy.

Conclusions of the ASTRA project for climate change adaptation in the BSR:

- Awareness-raising activities in relation to climate change adaptation still have to be continued; communication, education and professional training are key aspects.
- Vulnerability assessments regarding different sectors should be conducted at national, regional and local level in order to identify needs of adaptation.
- Cooperation across sectors, administrative levels and regions is required when developing adaptation strategies by involving both public and private stakeholders. Climate change should be mainstreamed into existing holistic cross-sector approaches like Integrated Coastal Zone Management (ICZM).
- Organisational structures should encourage learning processes and enhance the transfer of knowledge and information about climate change. These processes as well as cooperation among administrative levels are key aspects.
- The implementation of adaptation strategies and recommendations has to be secured, and monitoring structures should be initiated. New technical options should be developed and pilot projects should be launched.
- Climate change adaptation should not only be regarded from the technical point of view but also in societal, economical and political terms. Adaptation and mitigation strategies should become integrated in everyday life (political and individual).

Further Reading

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Willows, R., Connell, R. (eds.) 2003: Climate Adaptation: Risk, uncertainty and decision-making. UKCIP Technical Report, UKCIP, Oxford.

5. Glossary

The glossary is taken from the third IPCC assessment report (IPCC 2001b), if not indicated differently.

Term	Definition / Description
Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. Anticipatory Adaptation / proactive adaptation - Adaptation that takes place before impacts of climate change are observed. Autonomous Adaptation - Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation. Planned Adaptation - Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state. Private Adaptation - Adaptation that is initiated and implemented by individuals, households or private companies. Private adaptation is usually in the actor's rational self-interest. Public Adaptation - Adaptation that is initiated and implemented by governments at all levels. Public adaptation is usually directed at collective needs. Reactive Adaptation - Adaptation that takes place after impacts of climate change have been observed
Adaptation Assessment	The practice of identifying options to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility
Adaptation Benefits	The damage costs avoided or the accrued benefits following the adoption and implementation of adaptation measures.
Adaptation Costs	Costs of planning, preparing for, facilitating, and implementing adaptation measures, including transition costs.
Adaptive Capacity	The ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities or to cope with the consequences.

Term	Definition / Description
Biological options for mitigation	Biological options for the mitigation of climate change involve one or more of the three strategies: conservation – conserving an existing carbon pool, and thereby preventing emissions to the atmosphere; sequestration – increasing the size of existing carbon pools, and thereby extracting carbon dioxide from the atmosphere; and substitution – substituting biological products for fossil fuels or energy-intensive products, thereby reducing carbon dioxide emissions.
Climate change	Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines "climate change" as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."
Climate impact	Consequences of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts. Potential Impacts -- all impacts that may occur given a projected change in climate, without considering adaptation. Residual Impacts -- the impacts of climate change that would occur after adaptation.
Climate scenario	A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships, that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models. Climate projections often serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional information such as about the observed current climate. A "climate change scenario" is the difference between a climate scenario and the current climate.
Climate Variability	Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability)
Coping capacity	Capacity refers to the manner in which people and organisations use existing resources to achieve various beneficial ends during unusual, abnormal, and adverse conditions of a disaster event or process. The strengthening of coping capacity usually builds resilience to withstand the effects of natural and other hazards (ESPON Glossary 2007).

Term	Definition / Description
Exposure	The nature and degree to which a system is exposed to significant climatic variations.
Extreme weather events	An event that is rare within its statistical reference distribution at a particular place. Definitions of "rare" vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called "extreme weather" may vary from place to place. An "extreme climate event" is an average of a number of weather events over a certain period of time, an average which is itself extreme (e.g. precipitation, temperature and wind).
Hazard	A property or situation that in particular circumstances could lead to harm. More specifically, a hazard is a potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity and probability (ESPON Glossary 2007)
Mitigation	An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.
Mitigative capacity	The social, political, and economic structures and conditions those are required for effective mitigation.
No Regrets Policy	One that would generate net social benefits whether or not there is anthropogenic climate change.
Policy Maker	Individuals, especially those on official bodies, who have the authority to make decisions about what problems will be addressed within a particular sector and how these problems will be handled. (EEA Glossary)
Risk	A combination of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence. More specifically, a risk is defined as the probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environmental damage) resulting from natural or human induced hazards. (ESPON Glossary 2007).
Scenario	A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about key driving forces (e.g. rate of technology change, prices) and relationships. Scenarios are neither predictions nor forecasts, and may sometimes be based on a “narrative storyline.” Scenarios may be derived from projections, but are often based on additional information from other sources.
Sensitivity	Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. Climate-related stimuli encompass all

Term	Definition / Description
	the elements of climate change, including mean climate characteristics, climate variability, and frequency and magnitude of extremes.
SRES Scenario	SRES scenarios are emissions scenarios developed by Nakićenović et al. (2000) and used, among others, as a basis for the climate projections in the IPCC Work Group 1 contribution to the IPCC Assessment Report. The following terms are relevant for a better understanding of the structure and use of the set of SRES scenarios: (Scenario) Family: Scenarios that have a similar demographic, societal, economic, and technological-change storyline. Four scenario families comprise the SRES scenario set: A1, A2, B1, and B2. (Scenario) Storyline: A narrative description of a scenario (or family of scenarios) highlighting the main scenario characteristics, relationships between key driving forces, and the dynamics of their evolution. (Scenario) Group: Scenarios within a family that reflect a consistent variation of the storyline. The A1 scenario family includes four groups designated as A1T, A1C, A1G, and A1B that explore alternative structures of future energy systems. In the Summary for Policymakers of Nakićenović et al. (2000), the A1C and A1G groups have been combined into one “Fossil-Intensive” A1FI scenario group. The other three scenario families consist of one group each. The SRES scenario set reflected in the Summary for Policymakers of Nakićenović et al. (2000) thus consists of six distinct scenario groups, all of which are equally sound and together capture the range of uncertainties associated with driving forces and emissions.
Uncertainty	An expression of the degree to which a value (e.g., the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g. a range of values calculated by various models) or by qualitative statements (e.g. reflecting the judgment of a team of experts).
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

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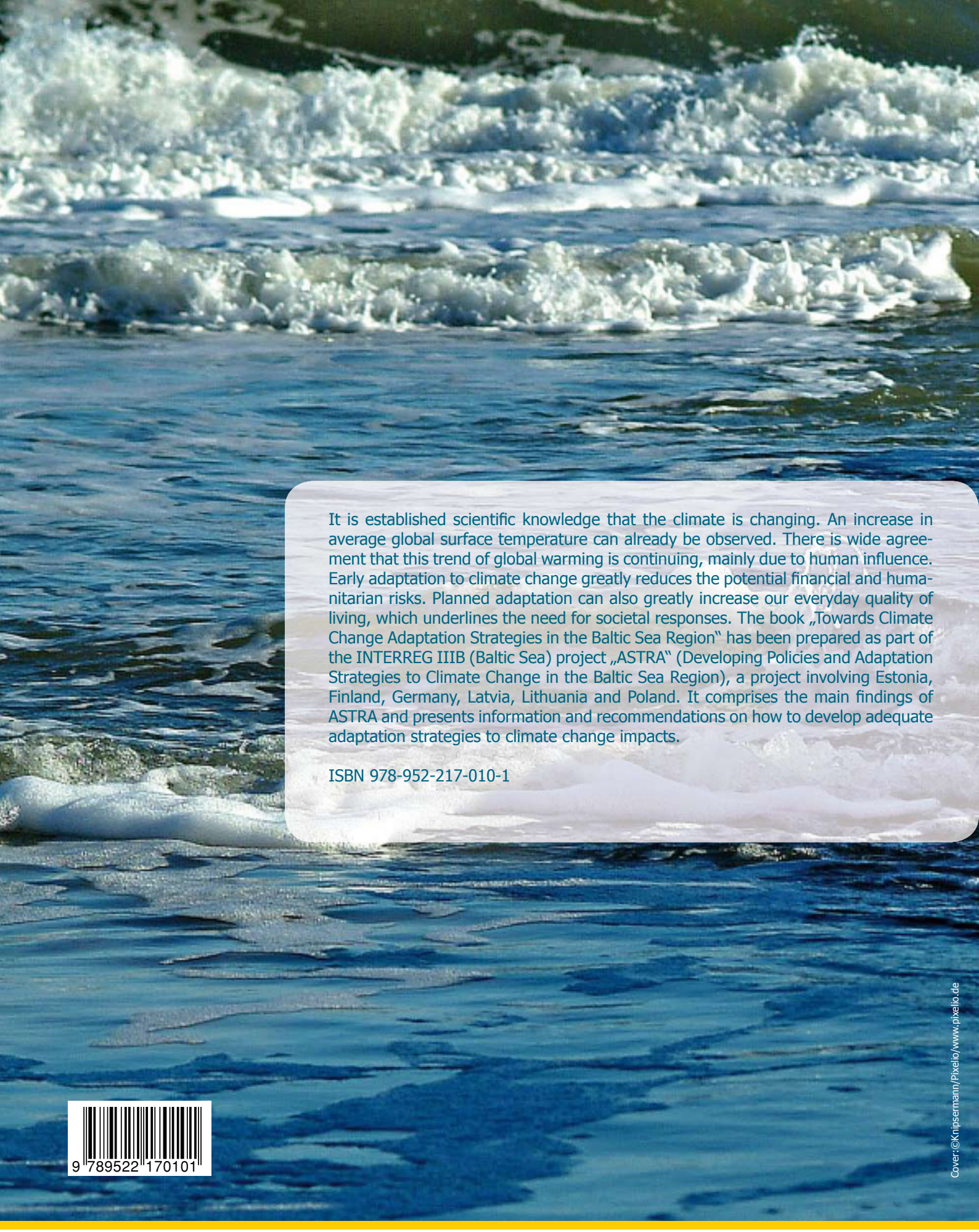

It is established scientific knowledge that the climate is changing. An increase in average global surface temperature can already be observed. There is wide agreement that this trend of global warming is continuing, mainly due to human influence. Early adaptation to climate change greatly reduces the potential financial and humanitarian risks. Planned adaptation can also greatly increase our everyday quality of living, which underlines the need for societal responses. The book „Towards Climate Change Adaptation Strategies in the Baltic Sea Region" has been prepared as part of the INTERREG IIIB (Baltic Sea) project „ASTRA" (Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region), a project involving Estonia, Finland, Germany, Latvia, Lithuania and Poland. It comprises the main findings of ASTRA and presents information and recommendations on how to develop adequate adaptation strategies to climate change impacts.

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