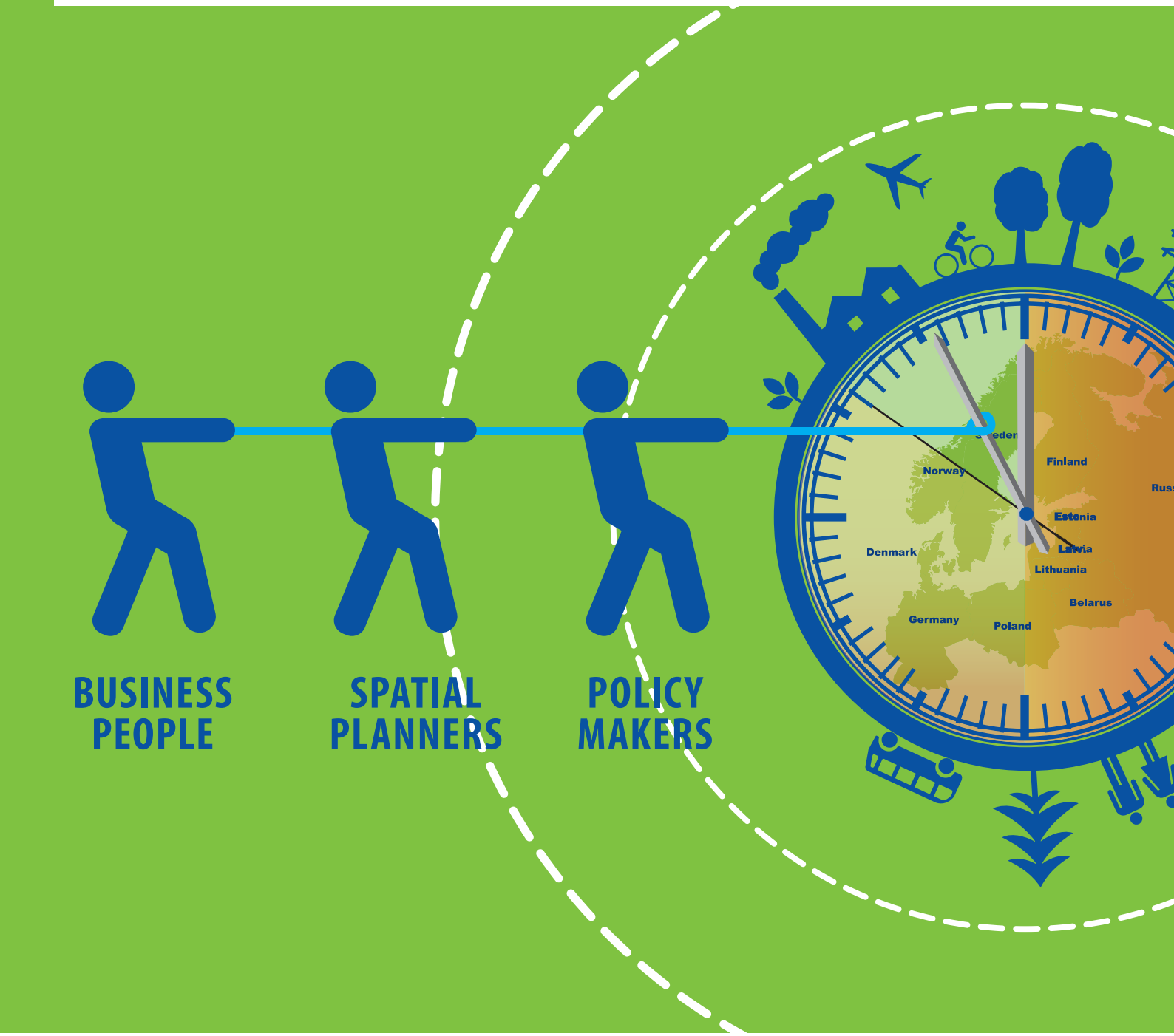
CLIMATE SERVICE CENTER

CSC Report 19

Decision Support Tools as Instruments to facilitate Climate Change Adaptation

The case of the BalticClimate Toolkit for adaptation in the German Baltic Sea region



UNIVERSITY OF COPENHAGEN

CSC Climate Service Center Germany

An institution of Helmholtz-Zentrum Geesthacht

Citation:
L. Roth, R. Birner, C. Henriksen & M. Schaller (2014): Decision Support Tools as Instruments to facilitate Climate Change Adaption – The Case of the BalticClimate Toolkit for adaptation in the German Baltic Sea region, CSC Report 19, Climate Service Center, Germany

Decision Support Tools as Instruments to facilitate Climate Change Adaptation

The case of the BalticClimate Toolkit for adaptation in the German Baltic Sea region

Internship-Report by Laura Roth
Based on the Master of Science Thesis

February 2014

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Content

Acronyms

AR4	-	IPCC Fourth Assessment Report 2007
AR5	-	IPCC Fifth Assessment Report 2013
ARL	-	Academy for Spatial and Research Planning
AHP	-	Analytical Hierarchy Process
BCT	-	BalticClimate Toolkit
CBA	-	Cost Benefit Analysis
CEA	-	Cost Effectiveness Analysis
CC	-	Climate Change
DAS	-	Deutsche Anpassungsstragie, 2008
DST	-	Decision Support Tool
DSS	-	Decision Support System
EU	-	European Union
GHG	-	Greenhouse Gas
HELCOM	-	Helsinki Commission (Baltic Marine Environment Protection Commission)
IPCC	-	Intergovernmental Panel on Climate Change
IAP	-	Integrated Assessment Platform
MV	-	Mecklenburg-Western Pomerania
MCDA	-	Multi-Criteria Decision Analysis
MCDM	-	Multi-Criteria Decision Making
RCP	-	Representative Concentration Pathway scenarios used in AR5
SH	-	Schleswig-Holstein
SL	-	Sea level
SRES	-	refers to the scenarios described in the IPCC Special Report on Emissions Scenarios (2000)
TAR	-	IPCC Third Assessment Report 2001
US	-	United States of America
UNFCCC	-	United Nations Framework Convention on Climate Change

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Acknowledgment

I would like to take the opportunity to thank several people who have considerably contributed to this thesis. First of all I wish to express gratitude to my supervisor from the Climate Service Center Dr. Michaela Schaller for her support in finding a topic and her constant guidance. She always took her time to comment on my work based on her expertise in this field of research - even if she had been in other parts of the world. I would also like to thank my supervisor Prof. Dr. Regina Birner and co-supervisor Prof. Christian Bugge Henriksen for serving as my (co-)supervisors and their assistance and suggestions for improvements. My thanks go as well to all the correctors of my thesis who helped me a lot with their work and to Dennis Ehm from the Academy for Spacial Research and Planning, co-developer of the BalticClimate Toolkit, for supporting my research. Last but not least, I would like to express special appreciation to my family, my friends and boyfriend. Without their constant encouragement throughout the entire process the completion of this thesis would not have been possible.

Abstract

Planning and implementing measures for adaptation to climate change poses challenges to decision makers already today. In recent years so-called decision support tools have been developed in order to support decision makers to cope with the complexity of climate change decision making contexts and thus facilitate adaptation planning processes. This thesis aimed at revealing if decision support tools are actually able to assist decisions in the context of climate change adaptation and what requirements they have to meet in order to be effectively applied. Therefore an already existing web-based and guideline-oriented tool addressing people in the Baltic Sea region was investigated: the so-called 'BalticClimate Toolkit'. Based on semi-structured qualitative interviews with relevant actors from the German Baltic Sea region, strengths and weaknesses of the BalticClimate Toolkit could be revealed and criteria for the success of decision support tools in general be derived from them. It was found that decision making tools can actually be helpful instruments with respect to calling attention to climate change, aggregating information about the topic and providing an approach how to generally structure a decision making process in the context of climate change adaptation. Several factors could be identified that have limited the effective application of the BalticClimate Toolkit so far; barriers hindering climate change efforts in general as well as aspects of the tool itself currently impede its adoption. In the first instance, communication, meaning the promotion and assistance in using decision support tools, seemed to be an indispensible supplement to tools, especially web-based ones. Furthermore the proper kind and amount of information turned out to be important aspects that have to be carefully regarded by decision support tool developers. Based on these findings possibilities to enhance the current low adoption of tools in future are presented.

1 Introduction

Climate change is one of the most tremendous environmental problems that the world is facing nowadays. Scientific evidence shows unequivocally that the climate system is warming (IPCC, 2007a). The impacts of climate change are already beginning to be experienced and no country or region of the world will probably stay unaffected.

Atmospheric greenhouse gas (GHG) concentrations as important factor driving global warming have recently increased markedly. This can primarily be attributed to human activities and the reduction of greenhouse gas emissions is thus essential to avoid climate change impacts.
But as GHGs are long-lived and will remain in the atmosphere for decades to many centuries after they are emitted (C2ES, 2011), some changes in climate will occur no matter what actions are taken to reduce emissions now. Therefore mitigation alone is not sufficient; climate change adaptation is needed in order to limit potential damages and cope with the consequences of climate change.

Adaptation efforts have already been made at federal, state and local levels in many parts of the world; a growing number of countries, states and communities are developing climate change adaptation strategies these days and the process of adaptation planning has gained in importance for various decision-makers at federal, state and local levels, non-governmental organizations, spatial planners, community groups and the private sector.
However, current efforts are facing challenges due to multiple factors. Amongst others regional differing political, historical, institutional and societal backgrounds influence the adaptation processes and determine the choice and effectiveness of various adaptation measures.

In order to facilitate the development and implementation of adaptation measures in future, possibilities are developed to cluster and impart knowledge and to incorporate lessons learned and best practices resulting from previously made experiences in future adaptation planning processes.
So-called decision support tools (DSTs) are information systems that are designed for supporting decision-making activities. In the context of climate change adaptation, DSTs could enable decision makers to compile useful information from a combination of raw data, documents, guidelines and personal experiences to recognize the problem and identify possible adaptation options. Actors, that have an important role in the preparation, financing and decision making related to the implementation of climate change adaptation measures, are not necessarily experts on climate change and thus could be supported by such knowledge transfer instruments.

The research objective of this thesis is thus to investigate if decision support tools can facilitate the process of developing, choosing and implementing specific measures to adapt to climate changes and what the requirements for the success of such decision support tools are.
Today there are several decisions support tools for climate change mitigation and adaptation available; the one chosen for the investigations of this thesis is the so called ‘BalticClimate Toolkit’ (http://toolkit.balticclimate.org/). It addresses different groups of actors - policy makers, spatial

planners and business people – and aims at raising the understanding of climate change, identifying local impacts and developing strategies to deal with climate change by detecting risks and chances.
To investigate, whether the toolkit is regarded as useful by the addressed actors different representatives of the target groups were interviewed. On the basis of these interviews the BalticClimate toolkit (BCT) should be critically reviewed. The question if DSTs are actually wanted or even needed should be clarified and shortcomings and benefits of the tool revealed. Thereby general criteria for success and requirements for DSTs should be developed.

The BCT in particular addresses actors living in the Baltic Sea region, therefore the German Baltic Sea region (Schleswig-Holstein and Mecklenburg-Western Pomerania) was chosen as case study region and people hailing from that area were interviewed. As coastal area the Baltic Sea region is particularly vulnerable to the immediate impacts of climate change mainly due to sea level rise. The development and implementation of adaptation measures is thus of particular concern in this area as climate change is and will be a critical component of planning and resource management. Considerations about climate change impacts and adaptation options are in the course of this thesis thus focused on coastal areas.

As a start **Chapter 2** defines the term “climate change” and provides an overview of recent climate changes and current climate change projections on a global and regional scale. Chapter 2 is meant to establish a sound basis for further considerations about climate change impacts and adaptation.
The meaning of vulnerability in the context of climate change and reasons for the special vulnerability of coastal areas in general are stated in **Chapter 3**. In the following potential climate change impacts in coastal areas are listed and the second part of Chapter 3 attempts to present climate change adaptation options in coastal areas. Therefore it firstly defines the term adaptation and then depicts different adaptation measures that can possibly be taken in coastal regions in order to enhance their adaptive capacity. These options are underpinned by concrete examples of adaptation efforts that have already taken place in the case study region.
In **Chapter 4** the aim of decision support tools is described and brought into the context of climate change adaptation. The BalticClimate toolkit was chosen as already existing tool for the investigations of this thesis and therefore background, overall objective and functioning of the tool are explained in brief.

After introducing the used methodology – qualitative interviewing – that was used to answer the research question in **Chapter 5** the results of the conducted interviews are presented in **Chapter 6**.
An evaluation of the Interview results and literature review are provided in **Chapter 7**. Thereby general barriers to climate change adaptation are identified, benefits and shortcomings of the BalticClimate Toolkit in particular and the actual need for DSTs discussed. Based on these findings general criteria for the success of DSTs are derived. Finally potential sources of errors that impeded the research process and limit the significance of the results are named.
At last a conclusion and outlook for the use of DST is given in **Chapter 8.**

2 Climate change

Climate change can be defined as "[…]a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.[…]" (IPCC, 2007c; page 30)
Changes in the climate have always occurred in Earth´s history. Huge scientific progress has been made in understanding the nature and causes of these changes over the last decades and various reports have dealt with key aspects of climate dynamics and the issue of climate change.

2.1 Global climate change

While this thesis focuses on climate change adaptation in coastal areas and is not aiming at exactly examining the underlying mechanisms of global climate change, it is nevertheless of importance to understand recent changes and to look at projections for future ones in order to understand climate change impacts and their implications for adaptation on a regional scale.
Therefore a brief synthesis is given for climate change observations and projections that are mainly based on the fourth and fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) from 2007 (AR4) respectively 2013 (AR5)[1]. The reason for this choice is that the IPCC holds a unique role as source of agreed scientific or political advice by providing an extensive body of analysis that was produced by collaboration and agreement among lots of scientists and the consensus of policy-makers (McMullen, 2009).

2.1.1 Recent and projected future global climate change

Global atmospheric concentrations of greenhouse gases - with CO_2 as the most important one - have distinctly increased since the Industrial Revolution, in the mid 18th century; recently observed carbon dioxide concentrations considerably exceed pre-industrial values. This rapid increase in the concentration of GHGs is primarily attributed to human activities, mainly to the use of fossil fuels, changes in land use and agricultural activities. In consequence the climate system is warming (IPCC, 2007a).

Projections of future climate changes depend largely on the emission scenario applied; future climate varies in response to the amount of GHGs that will be emitted. As particular scenarios represent different emission choices that society may make (socio-economic conditions) and are thus based on assumptions for future developments, projections are always subject to uncertainty.
For the AR5 a set of four scenarios are used to predict changes in the climate system and are based on a hierarchy of climate models. These scenarios called Representative Concentration Pathways (RCPs) are determined by total radiative forcing in year 2100 relative to 1750 including a scenario with

[1] Just where relevant most recent data from AR5 is taken; one major difference between AR4 and AR5 projections is that Special Reports on Emission Scenarios (SRES) (IPCC, 2007b) are no longer used and instead Representative Concentration Pathway (RCP) scenarios (IPCC, 2013b) are used.

a very low forcing level in the case of successful mitigation (RCP2.6), two stabilization scenarios (RCP4.5 and RCP6) and one assuming high GHG emissions (RCP8.5) (IPCC, 2013a).

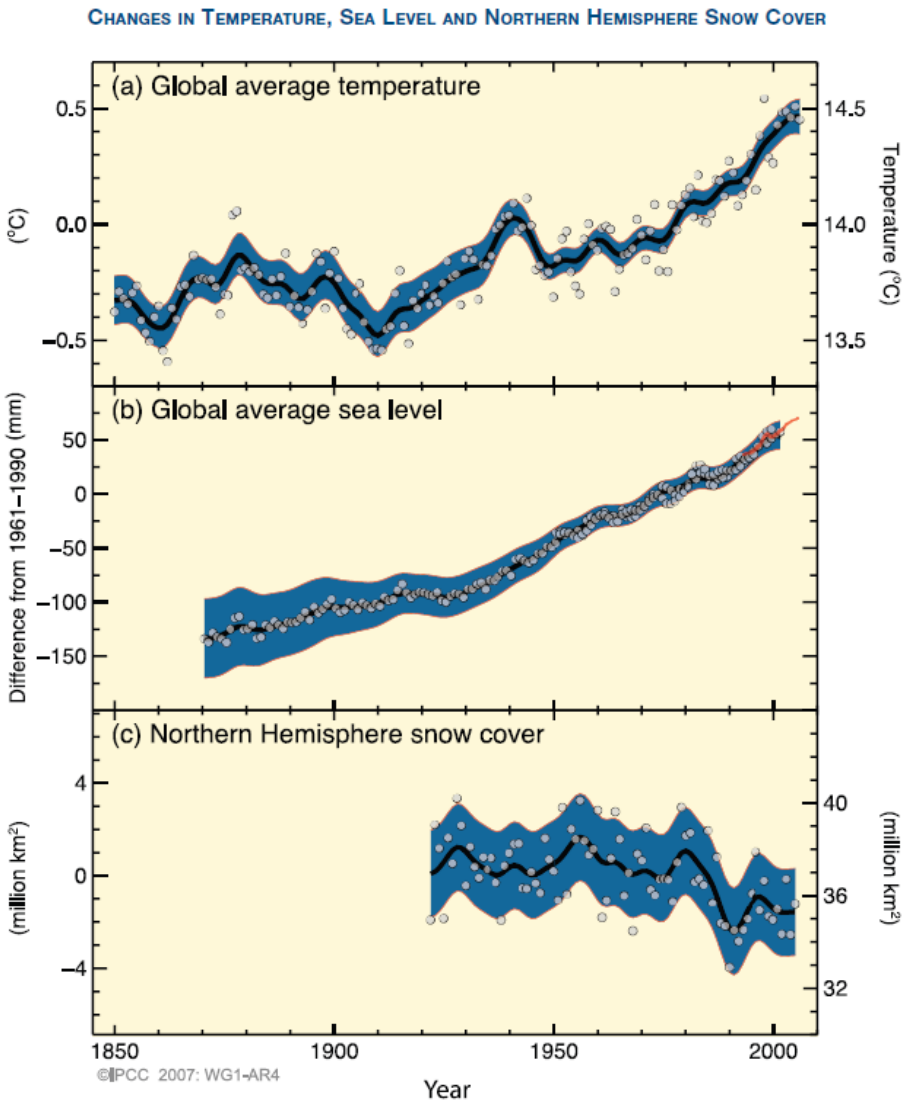

Figure 1: Observed changes (relative to corresponding averages for the period 1961-1990) in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red); (c) Northern Hemisphere snow cover (March-April). Smoothed curves represent decadal average values; circles show yearly values; shaded areas are uncertainty intervals (IPCC, 2007a).

Global average surface temperature has increased by 0.65 °C ± 0.15°C over the past 50 years (1956-2005) and has experienced a quite faster rise than over the last 100 years (0.74°C ± 0.18) (see *Fig.1 (a)*). This linear warming trend has globally been observed and was more pronounced in higher northern latitudes and above land regions (IPCC, 2007b). *Sea surface temperature* has in response warmed about 0.6°C since 1950 (IPCC, 2007c). Furthermore the quantity of extreme temperatures has altered over the last 5 decades; whereas frost, cold days and nights decreased in amount, the occurrence of heat, hot days and nights has increased on the global scale (IPCC, 2007a).

Global average surface temperature and global ocean temperature are expected to further rise during the 21st century. According to all RCP scenarios except the one assuming successful mitigation (RCP2.6) global average surface warming will likely exceed 1.5°C and even 2°C if high GHG emissions are presumed (RCP8.5) with regional variations. Sea surface temperature will probably increase between 0.6°C (RCP2.6) and 2.0°C (RCP8.5) (IPCC, 2013a).
The pattern of extreme temperature change will as well continue: whereas hot days will probably occur more frequently, less cold days are expected (IPCC, 2013a).

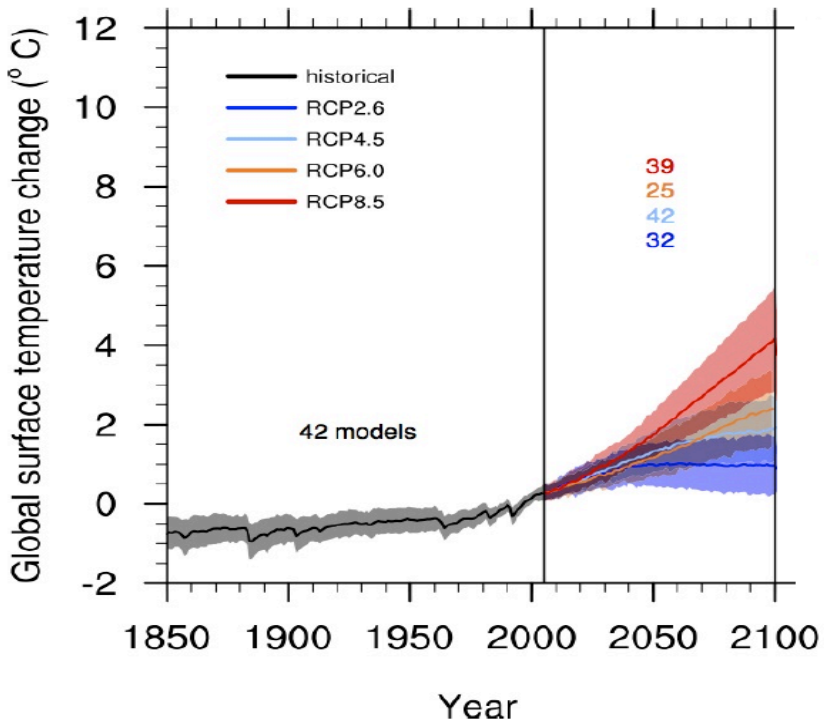

Figure 2: Global average surface air temperature change for each RCP scenario for the multi model mean (solid line) and the 5-95% standard range (±1.64 standard deviation) across the distribution of individual models (shading); Projections are relative to the reference period of 1986–2005 (modified from IPCC, 2013b)

Mountain glaciers and snow cover have on average extensively decreased in the southern as well as in the northern hemisphere (see *Figure 1 (c)*). Greenland and especially Antarctica experienced ice sheet mass losses (IPCC, 2007a). The area of northern hemisphere spring snow cover as well as Arctic and Antarctic sea ice will very likely continue to decrease in the course of the 21st century (IPCC, 2013a).

The global average *sea level* has raised by 0.17m ± 0.05m over the 20th century (see Figure 1 (b)), whereby the rate of rise accelerated in the short-term; annual rise was recently 3.1mm yr^{-1} ± 0.7mm yr^{-1} (1993-2003) compared to 1.8mm yr^{-1} ± 0.5mm yr^{-1} in period from 1961 to 2003 (IPCC, 2007a) .
Major components of this observed sea level rise are thermal expansion of sea water in response to increased global ocean temperatures, melting from mountain glacier and ice caps and losses from the polar ice sheets resulting in an increased freshwater discharge into the oceans (McMullen, 2009).

Sea level is anticipated to further rise over the next decades. Whereas thermal expansion contributed the most to past global sea-level rise (until about 1990), ice melting became the predominant driver over the last decade exceeding the contribution from thermal expansion. But as the exact contributions from dynamic Greenland and Antarctic ice sheets discharge, thermal expansion and glacier and ice caps decrease remains unsure, uncertainty exists about estimates of the exact range of future sea level rise (ACE CRC, 2012). Therefore no best estimate or upper bound can be stated; depending on the scenario and model technique applied sea level projections for 2100 differ significantly. AR5 projections anticipate that global average sea level rise will very likely exceed the one observed during the last decades and will likely be between 0.26m and 0.98m by the year 2100 depending on the RCP scenario applied (see Figure 3). The AR5 further designates a geographically uneven distribution of sea level rise and derives its projections from process-based models (IPCC, 2013a). Semi-empirical models however lead to higher rates of sea level rise ranging from 0.5m up to 1.8m until 2100 (Church, Gregory, White, Platten, & Mitrovica, 2011); but according to the AR5 “there is currently insufficient evidence to evaluate the probability of specific levels above the assessed likely range” (IPCC, 2013b; page 18).

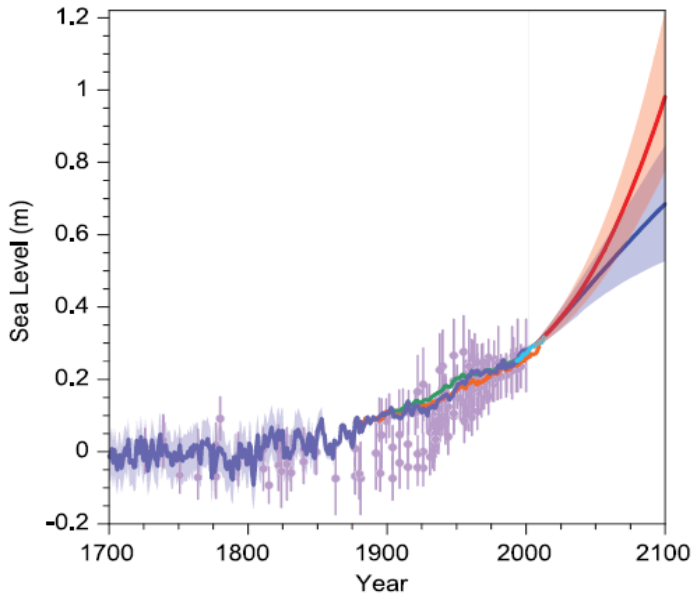

Figure 3: Compilation of paleo sea level data, tide gauge data, altimeter data and central estimates and likely ranges for projections of global-mean sea level rise for RCP2.6 (blue) and RCP8.5 (red) scenarios; all relative to pre-industrial values (IPCC, 2013b).

Connected to a rise in the mean sea level, sea level extremes will very likely occur more often over the next decades. However, it is currently not clear how storminess and associated storm surges will develop (IPCC, 2013b).

Precipitation is a climate element that is subject to high spatial and temporal variations. Nevertheless have increased trends been observed in some regions like in eastern parts of North America and northern Europe, whereas in other parts of the world like the Sahel and southern Africa precipitation amounts have decreased considerably in the long-term (1900-2005). At the same time that the occurrence of heavy precipitation events substantially increased over most land regions, have regional

droughts become more frequent and intense during the past 40 years. Regional increasing and decreasing trends in the quantity of precipitation will very likely carry on in the 21st century. Furthermore will extreme events like heavy precipitation and heat waves probably occur more frequently and intensively even in regions where average precipitation is overall expected to diminish (IPCC, 2007a).

Altered precipitation and evaporation patterns together with an altered run-off and meridional overturning circulation, ice melting and advection, have probably contributed to changes in *ocean salinity.* While in mid- and high-latitude regions surface waters experienced a freshening, low-latitude surface waters have increased in salinity what implies changes in the hydrological cycle over the oceans (IPCC, 2007a). This trend will probably continue: salinity will increase in subtropical regions dominated by net evaporation, whereas high-latitude regions will further experience a freshening (IPCC, 2013b).

Ocean acidification (surface pH decrease of about 0.1 units) has taken place since pre-industrial times probably due to the uptake of carbon dioxide that had been released by human activity. This decrease results in a reduced calcium carbonate dissolution depth, CO_2 ocean buffer capacity and atmospheric CO_2 uptake rate (IPCC, 2007a). Ocean acidification will take further place for all RCP scenarios; surface pH may decrease between 0.06 and 0.32 additional units until 2100 (IPCC, 2013a).

2.2 Regional climate change

When looking at climate change projections in specific regions they are derived using regional climate models. Whereas global climate models describe climate dynamics on wider spatial scales, regional climate models take account of regional characteristics like geographical features and are based on the concept of "downscaling" (Storch & Omstedt, 2008). Different regional climate models have been developed in recent years which can be divided in static (e.g. WETTREG) and dynamical (e.g. REMO) methods (MLUR, 2011a).
According to the IPCC "increasingly reliable regional climate change projections are now available for many regions of the world due to advances in modelling and understanding of the physical processes of the climate system" (IPCC, 2007a, page 849) and for the AR5 "new models have been developed with higher spatial resolution, with better representation of processes and with the inclusion of more processes" (IPCC, 2013b; page 12-8).

2.2.1 Introduction of case study region

As already existing decision support tool the so called BalticClimate Toolkit that in particular addresses actors in the Baltic Sea region was chosen for the research purpose of this thesis (see 4.2). Due to this choice and the fact that the research activities of this thesis were located in Hamburg (Germany) it was decided to interview people from the German part of the Baltic Sea region. In the following general characteristics of the Baltic Sea are described and a short overview of the societal, political and administrative background of the German Baltic Sea region is given.

Figure 4: The German Baltic Sea region (modified from RB-DESKKART, 2013) and its location within the whole Baltic Sea region (HELCOM).

The Baltic Sea is one of the largest brackish seas in the world, with a total surface area of 415 000 km^2 and is located in the transition zone between continental and maritime climate (HELCOM, 2007). It is a highly dynamic semi-enclosed basin that is influenced by large-scale atmospheric circulations and hydrological processes in the catchment area (Storch et al., 2008) covering 1.74 million km² from fourteen countries (HELCOM, 2007). Due to unsustainable human activities, the Baltic Sea suffers from nutrient pollution (eutrophication) and subsequent algae blooms causing severe stress for its ecosystems (Martinez et al., 2011)

Germany borders with two of its states, Schleswig-Holstein and Mecklenburg-Western Pomerania, at the south-western part of the Baltic Sea (temperate region), where the climate can be defined as maritime (Storch et al., 2008). Both Federal States are shaped by a rural settlement structure encompassing predominantly medium and small-sized towns and have a high share of land used for agricultural purposes (Statistisches Amt MV, 2013; MLUR, 2011a). Tourism is in the coastal regions of both states a quite important economic factor and source of income with a long lasting history (Ecologic Institute, 2010).

It is of importance to understand how political and administrative power is distributed in the case study region for the later investigations of this thesis. Planning, also for climate change adaptation measures, falls within the responsibility of different regional and local administrative instances according to the distribution of power.

In Germany as federal State, political and administrative power is vertically distributed between the federation, its constitutive states (`Länder´) and the municipalities. The municipalities are authorized to regulate matters of the local community on their own responsibility as far as activities are in compliance with the law. Counties are territorial authorities that comprise several municipalities and are vested with the right of self-government. Guiding principles that form the legal basis for spatial planning purposes are developed on a federal level and become more concrete on a state level where spatial planning acts adjusted to the specific conditions in a state are developed. Definite planning goals are finally elaborated at local level and have to meet federal as well as state spatial planning specifications (Pahl-Weber et al., 2008).

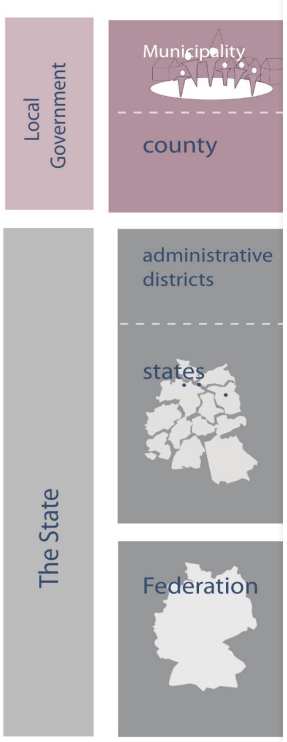

Figure 5: System of the separation of powers in the federal state of Germany (modified from Pahl-Weber et al., 2008)

2.2.2 Recent and projected future climate changes in the Baltic Sea region (Southern part)

As there is no data available for the German coast of the Baltic Sea in particular, the following information is based on data for the southern part of the Baltic Sea region. It furthermore has to be kept in mind that information for future climate changes are taken from different sources and are therefore based on different regional climate models, which limits the actual comparability of data. Whereas HELCOM uses the results of the PRUDENCE project incorporating ten different regional climate models like the HIRHAM in its analysis (HELCOM, 2007), `Norddeutsches Klimabüro´ uses different dynamic regional climate models like REMO as basis for future climate change projections (Norddeutsches Klimabüro, 2013). The following table (Table 2) is meant to provide an overview by summarizing recent and projected future climate changes of the case study region - projections are thereby just based on `Norddeutsches Klimabüro´ (2012) - and comparing them to global climate changes.

The globally observed warming trend has also occurred in the Baltic Sea Basin and the regional rise in average surface temperatures was even somewhat larger than the global mean. Further increases by between 2°C and 5°C are expected towards the end of the 21st century (HELCOM, 2007), which again exceeds the projected global mean warming according to global climate model simulations (Heino et al., 2008). The number of days with maximum temperatures above 25°C also referred to as ´summer

days´ have slightly increased in the German Baltic Sea region and is expected to further increase (Norddeutsches Klimabüro, 2012).

Table 1: Overview of recent and projected future climate changes on a global and local (Baltic Sea region) scale; Changes refer to changes over the last (20th) century and changes that are expected by the end of this (21st) century; data is taken from:[1] (IPCC, 2007a), [2](IPCC, 2013b) and [3] (Norddeutsches Klimabüro, 2012).

Climate element	**Recent climate changes** (20th century)		**Projected future climate changes** (21st century)	
	Global climate[1]	**Baltic Sea region [3] (southern part)**	**Global climate[2]**	**Baltic Sea region [3] (southern part)**
Average surface temperature	Increase: 0.74°C ± 0.18°C	Increase: ~ 0.85°C	Increase: ~ 0.3°C – 4.8°C	Increase: ~ 2.1°C -4.8°C
Sea level (SL)	SL rise: 0.17m ± 0.05m	SL rise: ~ 0.14 m	SL rise: ~0.26m-0.98m	SL rise : exact range unknown
Precipitation	spatial & temporal variations, increase (North America…) & decrease (Sahel…) Increase of heavy precipitation events, more frequent droughts	overall increase, decrease in summer, more intense precipitation in winter	spatial & temporal variations, increase (high-latitudes) & decrease (subtropical land regions) more frequent and intense heavy precipitation events, more frequent droughts	overall increase, decrease in summer, increase in extremes of daily precipitation
Snow/ ice cover	decrease of glaciers and snow cover	decreased duration of snow and ice cover	decrease of glaciers and snow cover	shorter snow seasons, strongly decreased duration of ice cover

As `relative sea level rise´ derives from changes in absolute sea level (eustatic) in combination with land surface movements (isostatic), sea level rise depends much on regional components (tectonic features etc.). This explains large regional variations and the divergence of sea level rise at particular locations from the global average (Boesch et al., 2000).

So sea level rise was not geographically uniform over the entire Baltic Sea Basin over the last century; long-term rates vary between 1mm and 2 mm per year. The German part of the Baltic Sea coast is in addition also experiencing eustatic land sinks (subsidence/ coastal retreat) which makes it especially vulnerable. Future sea level rise is expected to accelerate but projections of the exact range of local sea level rise in the Baltic Sea region are not available (Fröhle et al., 2011).

Precipitation is subject to considerably annual and regional fluctuations in the Baltic Sea region. Whereas the average annual precipitation just slightly increased, there is a shift in seasonal precipitation. Slight decreases were observed during summer in southernmost parts of the Baltic Sea basin (HELCOM, 2007). While summers are expected to become drier, winters, springs and autumns are expected to become even wetter over the next decades resulting in an overall increased precipitation amount (Heino et al., 2008).

No scientific evidence could be found for an increased storm intensity and frequency over the last decades (Norddeutsches Klimabüro, 2012). Projections of future changes in wind patterns vary widely but nevertheless do models generally indicate an increase in the number of storm days and a higher storm intensity (Knoblauch et al., 2012).

3 Climate change vulnerability, impacts and adaptation in coastal areas

3.1 Climate change vulnerability of coastal areas

According to the IPCC vulnerability is "[…] the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC, 2007d, p 6). Vulnerability is furthermore defined as a function of *exposure, sensitivity* and *adaptive capacity*, whereby *exposure* is determined by the "character, magnitude and rate of climate change and the variation to which a system is exposed" (IPCC, 2007d, p 6).

The *sensitivity* of a system to climate change depends on its biophysical and socio-economic properties; currently already stressed systems will suffer greater impact from a hazard than less stressed ones. Together with *exposure, sensitivity* influences the potential impact to a system (World Bank, 2009).

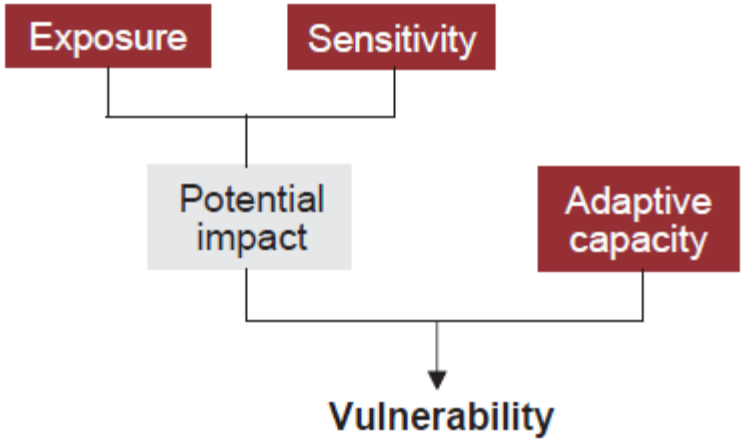

Figure 6: vulnerability and its components – conceptual framework for defining vulnerability (World Bank, 2009)

The third component of vulnerability is the coping or *adaptive capacity* which "is the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behaviour and in resources and technologies" (IPCC, 2007d, p 727). Adaptation can be spontaneous or planned and can be carried out in anticipation or in response (World Bank, 2009).

These definitions can be applied to the specific context of coastal areas. Coastal areas are complex environments where natural and socio-economic systems are strongly intertwined; they are home to a large and growing proportion of the world´s population, have been centres of human activity and accommodate a rich variety of ecosystems and habitats.

Concerning *exposure* coasts are expected to be exposed to increasing risks due to many compounding climate change factors in the future (see 3.2). In addition potential impacts will be worsened by already existent stresses like pollution and overfishing (World Bank, 2009) and a future increased pressure on coastal areas due to human development patterns (intensified utilisation of the coastal zone, coastward migration etc.) leading to an increased *sensitivity* (IPCC, 2007c) . It has

furthermore to be taken into account that coastal areas in consequence of their location are facing climate change impacts coming from both the sea and the land.
The *adaptive capacity* of coastal areas is determined by several factors, which are further discussed in c*hapter 3.3* (climate change adaptation in coastal areas).

3.2 Climate change impacts in coastal areas

Climate change has the potential to affect coastal areas in a number of ways. Environmental and socio-economic impacts are above all expected due to an accelerated sea level rise. But as well increases in sea surface temperature, ocean acidification and changes in precipitation and extreme events will probably exacerbate many problems coastal areas are already facing (EPA, 2013).
Following table (*table 2*) summarizes potential climate change impacts ordered by different sectors that had been selected as they will probably be amongst the most affected ones and are of specific importance for coastal areas like the Baltic Sea region.

Coastal areas are affected in many complex ways to changes of the mean sea level (Australian DCC, 2009); besides permanent inundation of low-lying areas, sea level rise has the potential to reinforce erosion (Stybel, Friedland, Gräwe, Haller, & Schumacher, 2011) affecting the shoreline and coastal stability. An accelerated sea level rise has according to IPCC (2001) “substantial inertia[…]” and is “[…] ultimately questioning the viability of many coastal settlements across the globe” (IPCC, 2007a, p 317). The exact consequences from sea level rise on coastal areas differ significantly from region to region as its impacts depend on bathymetrical, morphological and other factors; they are amongst others influenced by the character of landforms and elevation as the slope of the land mainly determines the extent of inundation (CCSP, 2009).
An increase in mean sea level in combination with a possible increase of storm induced extreme water levels (storm surges) will probably have more adverse effects on natural and human systems than any single factor (Australian DCC, 2009). Extreme events together with rises in the sea level have the potential to cause damages on settlements, buildings and infrastructure, whereas salt water intrusion into coastal groundwater aquifers may threaten freshwater supplies (CCSP, 2009).
Another potential threat coming from the land side are more frequent river floods; higher precipitation amounts will probably entail an increased land run-off (CCSP, 2009).

Table 2: Potential impacts in coastal areas ordered by different affected sectors

Affected Sector	Potential impacts
Settlements/ Infrastructure	damages due to shoreline retreat, beach erosion, coastal flooding, storm surges (IPCC, 2007c), land loss through submergence and erosion of lands, increased salinity of freshwater aquifers (CCSP, 2009), river floods, changes of runoff from inland sources (World Bank, 2009)
Ecosystems	altered distribution and abundance of plant and animal species depending on specific coastal system types, coastal wetland losses (IPCC, 2007c) landward migration of coastal habitats (CCSP, 2009), decline of natural species, migration of invasive species (NWF, 2008)
Agriculture	yield increase through longer growth period and higher atmospheric carbon dioxide content (MLUR, 2011b) Yield reduction/ damages due to longer dry periods (in summer), heavy rainfall events, soil erosion, flooding and salinisation of soil and water resources (IPCC, 2007c), altered soil characteristics (nutrient, moisture content etc.), changes in weeds, crop pests and diseases (AEA, 2007).
Tourism	longer bathing season due to air and water temperature increase (Stybel et al., 2011) negative impacts due to reduced water quality caused by increased algae bloom and pathogen growth (MLUR, 2011b), beach erosion, coral reef degradation (IPCC, 2007c)

Coastal ecosystems are highly sensitive to changes in the climate and in some coastal areas biodiversity has already shown to be affected by climate change. Especially coastal wetland ecosystems, coral reefs and shell-forming organisms have been and will likely be subject to degradation. Coastal societies depending on the goods and services provided by such coastal ecosystems (e.g. fisheries) could be severely impacted in health and economic terms (IPCC, 2007c).

Coastal regions are often characterized by a high share of rural areas where agriculture plays an important role. Climate related increases in crop yields due to higher temperature entailing longer growth periods can be expected in regions like the north of Europe. However negative impacts will arise due to extreme events like heavy destructive rainfalls, dryer summer periods causing heat stress and water shortage and a rising sea level inundating agricultural land and resulting in soil erosion and salinisation (IPCC, 2007c).

Tourism could as well potentially benefit from an increase in air temperature in some regions like the Baltic Sea region as travellers prefer warm coastal destinations (Martinez et al., 2011). More favourable climate conditions could potentially initiate a movement from Mediterranean to temperate destinations (Schumacher et al., 2009). But on the other hand this sector may also be negatively impacted by climate change due to other factors like a reduced water quality (MLUR, 2011b), coral reef degradation and beach erosion (IPCC, 2007c).

Even if the coasts of developing and emerging countries are expected to be most seriously affected by climate change due to their comparable low adaptive capacity (IPCC, 2007c), climate change impacts will as well post important challenges to industrialized countries like Germany.
Coastal damages already occurred in various regions of the southern Baltic Sea as result from extreme sea levels and erosion took place on the German coast (Heino et al., 2008). Flooding is an issue of particular concern for the German Baltic Sea coast due to its low-lying condition – most of Schleswig Holstein´s coastal lowlands are situated lower than three meters above sea level (Hofstede, 2008).

Heavy rainfall events likely flush greater amounts of nutrients from agriculture and other sources with river flows into the Baltic Sea (MLUR, 2011b) . Consequently eutrophication leading to excessive phytoplankton growth and oxygen depletion is likely exacerbated. A variety of other climate change impacts on ecosystems have already been identified in the Baltic Sea basin like range shifts in the migration patterns of birds and altered distributions and abundances of fish species (Storch & Omstedt, 2008).

3.3 Climate change adaptation in coastal areas

As elaborated in foregoing *chapter 2* there is evidence that some changes in climate are unavoidable, even if emissions are reduced. Therefore mitigation alone will not be sufficient, but adaptation is needed as well in order to cope with the consequences of these unavoidable climate changes and limit the damages they will probably cause. Especially in coastal areas adaptation will be essential as they are expected to face various immediate climate change impacts in future as pointed out in *chapter 3.1*. It is expected that "adaptation costs for vulnerable coasts are much less than the costs of inaction" (IPCC, 2007d, p 317)**.**

3.3.1 Definition of adaptation

According to the IPCC *"Adaptation* is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities " (IPCC, 2007d, p 6).

In the context of this thesis adaptation specifically refers to adjustments that are consciously made by humans in order to reduce the vulnerability of systems. Planned adaptation aims at proactively building the capacity to minimise, adjust or take advantage of expected climate change impacts (Australian DCC, 2009).
In order to develop adaptation options it is necessary to identify the specific vulnerability of a region to change and examine its projected exposure and current levels of sensitivity and adaptive capacity. Once the vulnerability of a system is understood, areas for intervention can be identified and different adaptation options developed and evaluated (World Bank, 2009).
It should be kept in mind that the high adaptive capacity of industrialized countries like Germany does not automatically lead to successful adaptation to climate change (IPCC, 2007c).

In the following (*chapter 3.3.2*) possible adaptation options are described that may be particularly implemented to reduce the vulnerability of coastal areas.

3.3.2 Adaptation options in coastal areas

A lot of coastal communities have already begun to recognize the importance of explicitly examining coastal impacts and vulnerabilities to climate change and to develop options for adaptation while promoting an overall sustainable development (Martinez et al., 2011). Many climate change response strategies are the same as present-day efforts that aim at implementing a sustainable development or substantial environmental management. Climate change often amplifies the problems that are already in existence in coastal areas, thus reinforced challenges have to be taken into consideration. For example existing coastal zone management programs and policies already address current threats including sea level rise but as the exact rate of rise is unsure various accelerated sea level rise scenarios have to be taken into account in future planning (CSO, 2008).
The following table summarizes possible adaptation options for the different affected sectors specified in chapter 3.2.

Table 3: Adaptation options for different affected sectors

Affected Sector	Adaptation options
Settlements/ Infrastructure	Coastal protection strategies: protect – accommodate – retreat; Building of dikes, seawalls etc., beach nourishment, building requirements, early warning systems, emergency plans, awareness rising, setback provisions (IPCC, 2007c)
Ecosystems	Expand restoration areas, create/ restore wetlands, enable upland migration of habitats, natural and/or artificial replenishment of sediments (NWF, 2008), "Living shorelines" (MCCC, 2008)
Agriculture	Changing crop varieties and rotation, new planting/ harvest dates (Frumhoff, McCarthy, Melillo, Moser, & Wuebbles, 2007), switch to alternative crops, climate change resilient crops, improved irrigation efficiency, increased drainage, agricultural insurance (AEA, 2007), crop diversification, nutrient management (World Bank, 2009)
Tourism	Beach nourishment, artificial structures providing recreational facilities, adjustment of season, provision of additional climate independent leisure facilities, awareness rising, emergency plans (Schumacher et al., 2009)

Integrated Coastal Zone Management (ICZM) is an often mentioned and widely promoted cross-sectoral (Feix et al., 2009) holistic spatial planning approach for coastal areas (Hofstede, 2011) that takes account of multiple long-term coastal challenges like climate change and comprises adaptive capacity building. ICZM can help to ensure coordination between various interests and objectives like those from coastal protection and nature conservation and pays attention to legal and institutional frameworks involved in coastal planning and management on local and national scales (IPCC, 2007c).

Three major pathways have been evolved how coastal communities can respond to an accelerated sea level rise. Those planned coastal adaptation practices - *protection, accommodation* and *retreat* - combine technical and non-structural options (IPCC, 2007c).

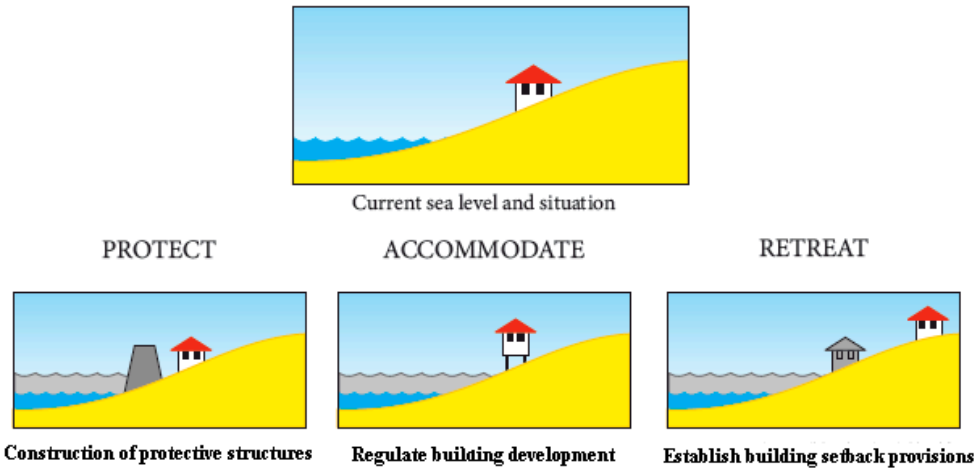

Figure 7: summary of three main planned coastal adaptation strategies (modified from Dorst, 2011).

Protection aims at increasing the robustness of the coastal system (IPCC, 2007c). It typically involves the construction of protective, hard structures like dikes, seawalls or bulkheads forming a barrier between water and land in order to “armour” the shoreline and protect land and buildings from erosion and flooding. This enables coastal assets to stay in their current location, but restricts wetlands and beaches in the area between sea and protective structure which will in consequence of a rising sea level probably displace them (Titus, 2011). Through a repeated beach nourishment it is tried to mitigate and compensate erosion and keep shorelines at their current positions (Hanson et al., 2002).

Accommodation means increasing the flexibility of the coastal system (IPCC, 2007c). Instead of preventing erosion, flooding or inundation by building protective structures, strategies are developed to reduce the impacts of increased hazard events while simultaneously ensure a continued human habitation of the area at risk. Measures include the development of emergency plans and building modifications like requirements for elevated floors (Australian DCC, 2009). Wetlands are thereby allowed to migrate inland if not constrained by buildings (Titus, 2011) .

Retreat is targeted on increasing the adaptability of the coastal system (IPCC, 2007c). In contrary to accommodation or protection, exposure is reduced by moving people away from the source of the hazard. Planned retreat can be accomplished by decisions to prevent new constructions and

withdraw, relocate or abandon assets in highly vulnerable areas (Australian DCC, 2009). Increased setback provisions, like the implementation of coastal buffer zones (Hofstede, 2011), tax incentives or buyouts of properties, are examples to limit additional development in vulnerable areas. Wetlands and other coastal habitats would thereby migrate naturally as sea rises (Titus, 2011).
Today *protection* is commonly used along developed shores characterized by high developed urban areas (Australian DCC, 2009), whereas *retreat* often occurs along less developed shores (Titus, 2011).

To improve the adaptive capacity of ecosystems, restoration areas should be expanded allowing wetland migration and the protection and restoration of natural buffer systems. In some areas specific adaptation strategies might be necessary; those could include the natural and/or artificial replenishment of sediments like beach re-nourishment and "assisted accretion" (NWF, 2008). Living shorelines, like strategically placed plants, stones and sand fill can enhance the natural shoreline habitat while serving as erosion control (MCCC, 2008). Structures like submerged, detached breakwaters can protect coasts and beaches in the same manner, while restoring marine habitats and even creating additional recreational facilities like diving and angling (Harris, 2003).

In the agriculture sector the change to other crop varieties and rotations, the introduction of new planting and harvest dates (Frumhoff et al., 2007) and the switch to other more climate change resilient crops like less water intensive crops (AEA, 2007) should help to counter climate change impacts. New plant populations could potentially be grown in areas where conditions had formerly not been suitable. For example climate change might provide chances for viniculture in some areas like the German Baltic Sea region (MLUR, 2011b). Investments in new, more efficient irrigation methods such as trickle irrigation could help to decrease the amount of water required for irrigation. To promote the use of new management practices, research is needed and farmers should get advisory support (AEA, 2007).

Threats to settlements and infrastructure like flooding and beach erosion pose also risks to the tourism sector. Therefore coastal protection measures like beach nourishment, awareness rising and the development of emergency plans can also avoid damages to tourism. On the other hand there are conflicts between touristic and coastal protection interests: hard structures like dikes disfigure the landscape and constrain touristic utilization of the beach (Lehners, 2011).
More flexible and diverse climate-independent leisure facilities (exhibitions etc.) and a shift of the tourism season to times of the year with more suitable climate conditions are possibilities how this sector could adapt to changes in climate (Schumacher et al., 2009).

Each of these adaptation options can be appropriate under certain circumstances; the choice for one or a combination of some depends on many factors and is largely influenced by local socio-economic conditions. The role and potential use of decision support tools for developing and selecting adaptation measures will be in detail discussed as central theme of this thesis in the following chapter (c*hapter 4*).

3.3.3 Examples from the German Baltic Sea region

Some efforts concerning climate change adaptation that have already taken place on federal, state and local level in the case study region are examined in the following.

At federal level the German Strategy for Adaptation to Climate Change (Deutsche Anpassungsstrategie an den Klimawandel – DAS, 2008) creates a "framework for a medium- term national adaptation process that is to be carried out with the Länder and other social groups" (BMU, 2012; p 5). In this process potential climate change impacts should be identified and possible adaptation options developed and implemented according to the set objectives. In addition to this Strategy that was adopted by the German Federal Government in 2008, an Adaptation Action Plan (Aktionsplan Anpassung, 2012) was drafted that itemizes specific objectives and adaptation activities laid down in the DAS (BMU, 2012).

Schleswig-Holstein as one of the German states (Länder) located at the sea, makes efforts to reduce the threats to its coast by means of a General Coastal Protection Plan (Generalplan Küstenschutz) focusing on particular vulnerable regions like wetlands and low-lying areas (Feix et al., 2009). Integrated Coastal Zone Management (ICZM) plays a central theme in this regional plan enacted in 2001 and it takes account of potential additional climate change impacts through requiring the integration of a climate addition in line with dike reinforcement (MLUR, 2011a).

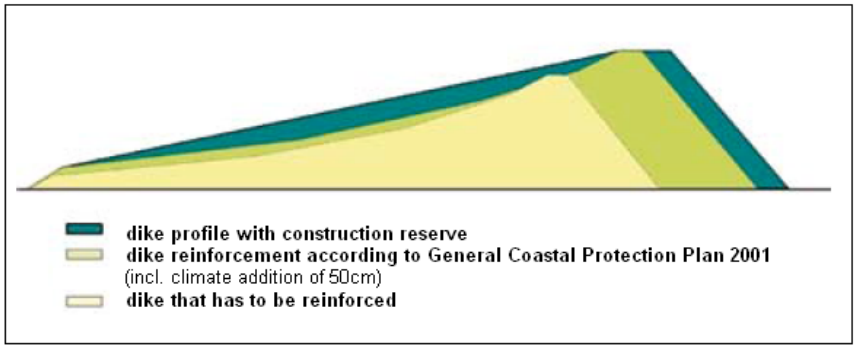

Figure 8: dike reinforcement according to General Coastal Protection Plan Schleswig Holstein from 2001 (MLUR, 2011a).

The so called RADOST (Regional Adaptation Strategies for the German Baltic Sea Coast) project as one of seven projects funded by the German Ministry of Education and Research within the ministry´s initiative KLIMZUG ("regions adapt to climate change") aims at developing adaptation strategies for the Baltic coastline of Schleswig-Holstein and Mecklenburg-Western Pomerania. Thereby cooperation between research institutions, public administrations, businesses and civil society should be supported (Ecologic Institute, 2010).

A concrete example on a local scale is the construction of a sheet pile wall in Timmendorfer Strand, a community situated in the Lübecker Bay with a highly tourism-dependent economy. The planning process of this shore protection project encompassed an intensive stakeholder participation and took a future sea level rise scenario of 0.5m until the end of the 21st century into account (Hofstede, 2008) and was finalized in 2011 (Lehners, 2011).

4 Decision support tools in the context of climate change adaptation

4.1 Aim of decision support tools

The variety of adaptation options that are available to respond to present and future climate changes as seen in 3.3.1 makes it difficult to decide for one or a combination of some.
Complex situations can amongst others be characterized by many involved stakeholders and interrelated causative forces and that they are often difficult to define and may change with time (Bennet et al., 2008). Characteristics that apply to climate change related decision contexts: they involve a variety of actors, sectors and decision-making levels that are interacting with each other (Feix et al., 2009). The process of identifying, evaluating, selecting and finally implementing climate change adaptation measures thus poses a challenge to decision makers. Due to the complexity of the problem, it is essential to take a structured approach to develop relevant solutions. To take a structured approach many different frameworks, tools and approaches have emerged to support decision makers to identify context-relevant adaptation measures (Bierbaum et al., 2013).

A Decision Support Tool, hereinafter referred to as DST and often described as Decision Support System, is in very general terms "any guidance, procedure, or analysis tool that can be used to support a decision" (Sullivan, 2002; page 3); it thereby aims at improving the process of decision making in complex situations (Rippen, 2005). For this thesis DSTs are in a narrower sense interactive computer-based information systems that support decision analysis and participatory processes by compiling and presenting information from different sources and have a dedicated interface that should be easily accessible by the users (Welp, 2001). They aim at supporting decision makers to determine and evaluate possible consequences of their decisions in order to find a decision option that is most suitable to achieve respective targets and are furthermore often problem specific (Makowski, 1994). In the context of climate change adaptation DSTs could support and structure the process of exploring case-specific climate change adaptation options with the help of a combination of different methods, data and/ or models. The information provided should impart knowledge, incorporate best practices and thereby enable users to determine an optimal or best adaptation approach. They can thus also be understood as knowledge-transfer instruments that facilitate dialogue and provide insights for non-experts.

There are currently various tools for climate change adaptation support in existence, but they will not be presented and described in this thesis as focus is placed on one tool in particular: the BalticClimate Toolkit (see *chapter 4.2*). A list of different tools available in Germany tailored to communities and businesses is provided by Germany´s Federal Environmental Protection Agency and can be accessed via the following link (UBA, 2013):
http://www.umweltbundesamt.de/sites/default/files/medien/364/dokumente/kompass-newsletter_24.pdf

4.2 The BalticClimate Toolkit

As coastal regions are specifically vulnerable to climate change as specified in *chapter 3* they are of particular interest when it comes to the development of adaptation measures; the need to take action will likely occur more immediate than in other regions that might be later affected. Therefore an already existing DST that addresses people living in coastal areas had been chosen for the investigations of this thesis: The web-based 'BalticClimate Toolkit', further referred to as BCT, is a process-oriented pathfinder combining different tools and methods and was in particular developed for the Baltic Sea region. As mentioned in *chapter 4.1* there are nowadays several tools in the context of CC adaptation available and as well some focusing on coastal regions in particular; but no German one that addresses people living in a specific region like the BCT does. The choice of interviewees could thus selectively be made like further explicated in *chapter 5.2*.
It has to be mentioned that the toolkit focuses not just on climate change adaptation but also takes climate change mitigation measures into account. For the interview questions focus was set on adaptation but as the BCT takes account as well of mitigation, results received may also be applied to CC mitigation measures to some extent and are thus of general validity.

The toolkit was developed in the framework of the project 'BalticClimate' that was implemented from 2009 until 2011, encompassed 23 partners from 8 countries and was entitled "Baltic Challenges and Chances for local and regional development generated by Climate Change" (Alberth et al., 2011). This partly EU financed project aimed at making people in the Baltic Sea region aware of anticipated future climate change impacts and enabling municipalities, local and regional stakeholders to deal or even benefit from these changes. It thus stresses that climate change can have both positive and negative impacts for the Baltic Sea region (Rogbeck, 2012).
The BCT was elaborated based on experiences that had been made with selected scientifically guided implementation cases within the BalticClimate project. These cases involved adaptation and mitigation measures in the sectors of transport, energy, housing and agriculture and were implemented on local and regional levels in seven target areas around the Baltic Sea. The BalticClimate project´s approach to divide the working process into three stages - inventory phase, vulnerability assessment and capitalisation phase – was thereby generalised and integrated into the toolkit (Koponen et al., 2012).
In particular it addresses three groups of actors that have been identified as playing an important role in the preparation, financing and decision making related to the implementation of climate change mitigation and adaptation measures: policy makers, spatial planners and business people – so both the public and private sector are addressed. These actors do not necessarily have expertise in climate change issues and should thus be empowered by providing knowledge and some kind of guidance to them (SEI, 2012a).

The BCT is available free of charge on the internet (http://www.toolkit.balticclimate.org/) in 11 different languages. At its user interface (see *figure 8*) an overview of climate change issues like explanations of regional climate change scenarios as well as customized information tailored to the needs of the different actor groups can be found. The toolkit leads the users through information and processes and includes examples of different implementation cases and how the tool can be applied (SEI,

2012b). Thereby users cannot execute the presented steps within the tool itself and cannot input any case-specific data; the BCT provides an overall approach and accompanying methods that have to be put into execution externally by the different actor groups.

Figure 9: The user interface of the BCT (BalticClimate, 2011);
horizontally: general climate change issues; vertically: customized information for different actor groups

The different, stepwise approaches introduced for the three actor groups all involve a set of information and different methods to build understanding of the topic, identify challenges and chances generated by climate change and develop strategies to tackle them. The single approaches will not be explained in detail but some crucial information about all three will be given.

The approach for policy makers (*figure 10*) is focused on recognizing the problem and getting into action. This should be done by preparing the ground, assessing the vulnerability of the region or sector of interest, identifying adaptation and mitigation options and finally implementing action plans and new policies or modify already existing ones (SEI, 2012a).

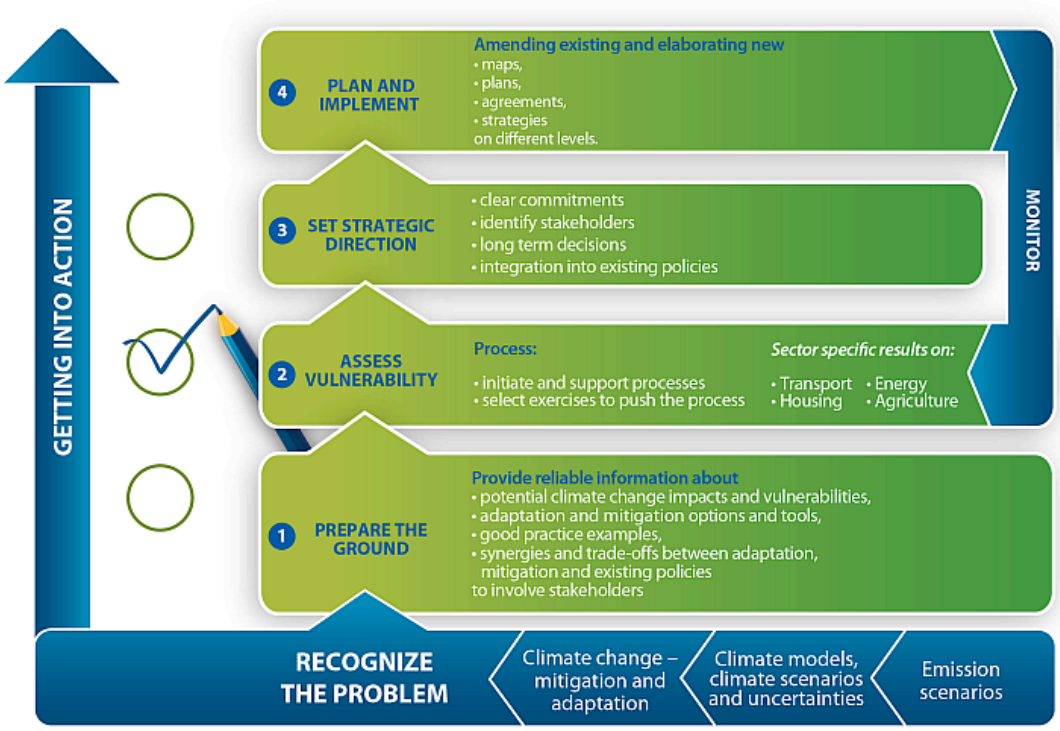

Figure 10: Graphical representation of the BCT approach for policy makers (BalticClimate, 2011).

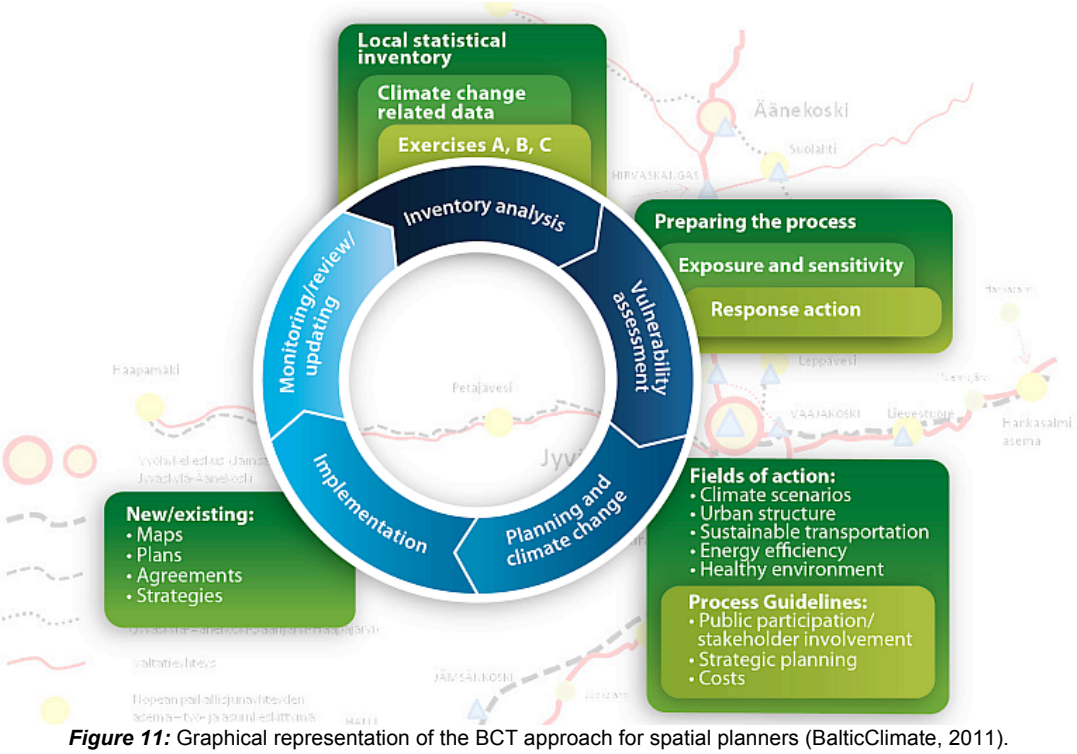

Figure 11: Graphical representation of the BCT approach for spatial planners (BalticClimate, 2011).

For spatial planners the approach (*figure 11*) is based on more scientific and detailed information. A set of exercises and planning guidelines helps to make an inventory of existing local conditions and again assess the vulnerability of a specific region or sector. Thereby the toolkit refers to methods like stakeholder and socio-economic stressor mapping (SEI, 2012a).

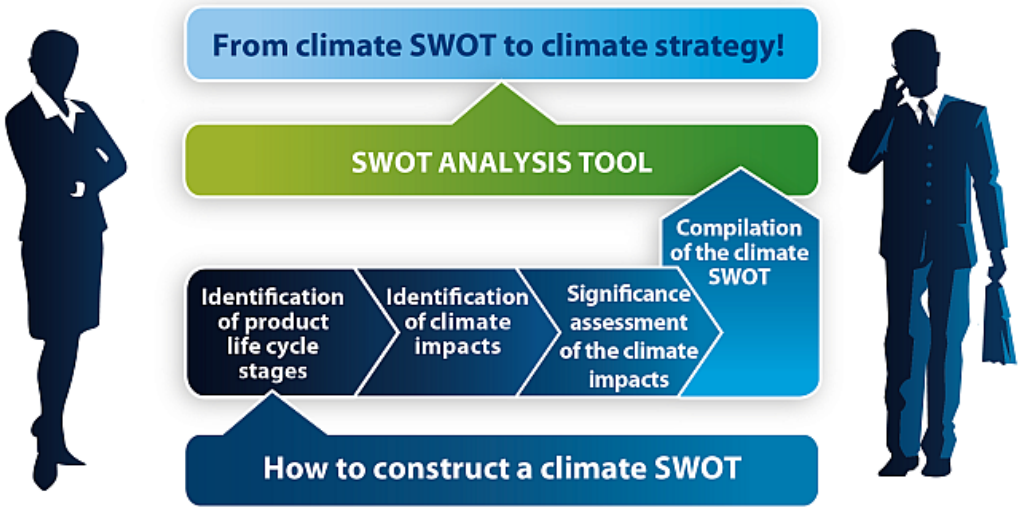

Figure 12: Graphical representation of the BCT approach for business people (BalticClimate, 2011).

The core piece of the approach for business people (*figure 12*) is the SWOT- analysis tool. It provides information about strengths, weaknesses, opportunities and threats that might arise for individual businesses under new circumstances caused by climate change. The series of steps including the identification of product or service life cycle stages support especially small- and medium- sized companies in strategic planning (SEI, 2012a).

5 Research method

5.1 Qualitative interviewing as research method

The objective of this thesis was to answer the research question if decision support tools can facilitate the process of developing, choosing and implementing specific measures to adapt to climate changes and what the requirements for the success of such decision support tools are.
Therefore qualitative semi-structured interviews with representatives of the different actor groups addressed by the BCT were carried out. Furthermore people were interviewed whose work is connected with climate change, climate change mitigation and/or adaptation like persons working in environmental departments of local authorities and who could, due to their work experience, reveal shortcomings and benefits of the tool and estimate if such a tool can be used by the actor groups.

Qualitative interviewing as qualitative research method does not aim at answering questions concerning the amount of something but "refers to the meanings, concepts, characteristics or descriptions of things" (Birner, 2013; slide 4). It is asked for depth and details and therefore issues of mutual interest are explored (Rubin & Rubin, 2005). The interviewees are confronted with the tool in advance and are asked through open-ended, partly prepared questions with the help of an interview guide about their experiences, opinion, estimation and motivations (Heistinger, 2006).

The interview guide was composed of two main parts. The first part should reveal if the interviewee is already familiar with climate change and/ or climate change adaptation and if he had already been involved in any process connected to climate change. It allowed the interviewee to speak from his expertise and gave basic information about the interviewee's perception on and experience with climate change and climate change adaptation. The second part was the central, intrinsic part of the Interview and meant as critical review of the BCT and should draw the relation to decision support tools in the context of climate change adaptation planning. In case the interviewee was already involved in an adaptation planning process as found out in the first part, it should be clarified if he already made use of any decision support tool or the BCT in particular. If the interviewee was not involved in any adaptation planning process so far, he was asked if he used any tool in another context and if he could imagine using the BCT in future. Strengths and weaknesses of the tool should be identified and the interviewee´s experience thereby used to describe areas of improvement and criteria for success.
Slight differences were made for the questions between spatial planners, policy makers and business people and two different versions for the Interview guide produced/ developed (the complete interview guides can be found in the *Appendix 'Interview guides'*). Furthermore not all interview guidance questions were suitable for every interviewee; the interviews developed in different ways and questions and the wording of questions diverged more or less from person to person. Besides several prepared key questions that helped to structure the interview, specific questions occurred during the course of the interviews. In such way it was possible to take account of the interviewee´s individual background and discover and elaborate issues that have previously not been thought of but are of relevance and importance.

5.2 Choice of interviewees

The choice of interviewees was consciously made in advance by defining sample characteristics; the interviewees should work in the case study region (German Baltic Sea region) anyway and:

- represent one of the actor groups: spatial planners, policy makers, business people
- and/or hold an administrative position and have expertise in the field of climate change

With regard to the question how potential interviewees had been found: The Academy for Spatial and Research Planning (ARL), co-developer of the BCT, sent out an offline-version of the tool on a flash-drive to various municipalities, ministries and spatial planning associations in the beginning of 2012. From this distribution list addresses located in the coastal region of Schleswig-Holstein and Mecklenburg Western-Pomerania (German Baltic Sea region) were picked out and contacted.
Furthermore potential interviewees were identified by internet research. They were contacted via mail and phone and asked if they were willed to have a look at the tool on the internet and subsequently answer some questions concerning the tool. In this way around 220 persons had been contacted from whom 30 were finally prepared to give an interview.

The 30 persons interviewed can be classified into four groups according to their work and are in particular occupied in the following fields (see *Table 4*):
For the actor group policy makers, four local politicians from different parties were interviewed. As representatives of municipal councils there were also members of specific committees like the one for economy, transport, security, building and environment.
The five spatial planners interviewed were working in the building departments of municipal authorities, in the area of estate and construction law, in the regional planning association Vorpommern (an administrative district of Mecklenburg-Western Pomerania) and in the department for land use planning, urban and local development of the Ministry of the Interior in Schleswig-Holstein.
The ten interviewees from the business sector were occupied in tourism and regional farmer associations, in engineering companies and in companies that were working in the fields of coastal zone management, sustainable development and as business consultants.
People whose work is connected with climate change in a broader sense – there were eleven of them - were employed in environmental departments of local or regional authorities, working as mitigation managers in districts or cities and in departments of the state ministry or agency of Schleswig Holstein that are specifically occupied with questions concerning energy transition, climate change mitigation and adaptation.

Table 4: List of interviewees ordered according to their work
[1] municipality, city, district or state for which the interviewees were working
[2] level at which interviewees were working (for business people not specified as they are not in particular occupied at a specific level):
l = local level - employed by municipalities and cities; d = district level - employed by administrative districts and regional organizations; s = state level - employed by state ministries and offices

	name	***party***	***commitee***	***location[1]***	***level[2]***
policy makers	Stefanie Paetow	The Green Party - Bündnis 90/ die Grünen	planning and construction	Timmendorfer Strand	l
	Kay Kastner	The Social Democratic Party of Germany - SPD	transport and brand services	Timmendorfer Strand	l
	Hans Brüller	The Independent Voter Community Mönkeberg - UWG	economy, transport, security, building and environment	Mönkeberg	l
	Andreas Engelmann	The Left Party - Die Linke	regional and city planning, environment and public order	Rostock	l
	name	***field of work***	***institute/organisation***	***location[1]***	***level[2]***
spatial planners	Klaus Goede	land-use planning; urban and local development	ministry of the interior	Schleswig-Holstein	s
	Roland Wenk	regional and local development planning	regional planning association	Vorpommern	d
	Erich Reuter	building department	municipal authority	Kappeln	l
	Stefan Gabriel	building department	municipal authority	Oldenburg in Holstein	l
	Ludger Klus	building biologists (estate and building legislation)	ÖkoNOVA-Haus	Leussow	l
	name	***field of work***	***company/organization***	***location of the company***	
business people	Bernd Fischer	Director of tourism association	tourism association Mecklenburg Western-Pomerania	Rostock	
	Dr. Catrin Homp	Director of tourism association	tourism association Schleswig-Holstein	Kiel	
	Constanze Rau	climate protection for camping businesses (also ones located at the Baltic Sea)	ECOCAMPING e.V.	Konstanz	
	Dr. Holger Brandt	Director of the district farmer association	district farmer association Nordvorpommern	Grimmen	
	Dr. Katja Josteit	International project development and management „Maritime Cluster Northern Germany“	Business development and technology transfer Schleswig-Holstein (WTSH)	Elmshorn	
	Thoralf Schlüter	Innovation consultant	Business development and technology transfer Schleswig-Holstein (WTSH)	Elmshorn	
	Lutke Blecken	urban and regional development; integrated coastal zone management	Institut Raum & Energie- Institute for planning, communication and process management	Wedel/Hamburg	
	Dr. Peter Krost	integrated coastal zone management, international project coordinator	CRM - Costal Research & Management	Kiel	
	Dr.-Ing. Toralf Quandt	project manager; coastal protection	WASTRA-PLAN Engineering company	Rostock	
	Berthold Meyer	Coaching bioenergy communities	Academy for sustainable development MV	Güstrow	

	name	***field of work***	***institute/organisation***	***location*[1]**	***level*[2]**
working in a field connected with CC	Dr. Ivo Bobsien	responsible for RADOST	state agency for agriculture, environment and rural areas	Schleswig-Holstein	s
	Dr. Michael von Abercron	climate change mitigation, energy transition, innovation support and renewable resources	ministry of energy, agriculture, environment and rural areas	Schleswig-Holstein	s
	Ingolf Zölfel	department for environment	district authority	Vorpommern-Greifswald	d
	Dr. Sebastian Krug	climate change mitigation manager	district authority	Rendsburg-Eckernförde	d
	Sven Schmeil	environmental management (climate change adaptation)	city authority	Rostock	l
	Martin Beer	climate change mitigation manager	city authority	Flensburg	l
	Susanne Simpson	environmental protection, strategic energy management	city authority	Kiel	l
	Jens Rasmussen	department for environmental protection	city authority	Kiel	l
	Beate Burrow	environmental council	municipal authority	Fehmarn	l
	Barbara Schäfers	department for consumer, nature and environmental protection	city authority	Lübeck	l
	Eckhard Mittmann	environmental officer	municipal authority	Neustadt in Holstein	l

The interviews were all conducted via phone and in German language. No records were made during the interviews but hand-written notes were taken. As overall 30 interviews were conducted their recording and subsequent transcription would have taken too much time within the timeframe of this thesis. Since the aim was to capture general opinions and statements about the BCT, it was considered as justified to summarize most important points and write statements literally down only if it seemed to be important. Subsequently all interview notes were translated into.

6 Results from the interviews

In the following statements given in the interviews are summarized and thematically ordered according to the structure of the interview guideline from which questions given in the boxes are extracted.
In the result part all sources indicated in brackets refer to the interviews; e.g. information annotated with '(Reuter, 2013)' is gathered from the interview with Erich Reuter. Literal quotes inserted are as mentioned before translated from German into English and thus slight deviations from original statements may occur.

6.1 Interviewees' perception of and experience with climate change

» Have you been already confronted with climate change and/or climate change adaptation? «
» Are you aware of possible, future climate changes and their impact? «
» Do you see necessity to include consideration about climate change impacts in decisions? «
» How important do you think are they compared to other issues? «
» Was the issue already involved in any activity? «
» Have you already been involved in any kind of adaptation planning process? «
» In what process had you been involved in? «

It seems that there is already awareness about the topic of climate change to some extent. Every interviewee personally regarded climate change as important and thought that the topic should play a role in decision making. It was stated that climate change is "of course an important issue" (Koglin, 2013) and that "the importance of the topic is not denied" (Gabriel, 2013). Furthermore all interviewees already knew basic facts about climate change and potential climate change impacts in more or less detail, at least from the "general information status in the media" (Reuter, 2013).

Especially spatial planners and policy makers working on a local level recognized the specific vulnerability of their communities since they are located close to the sea. The need to regard climate change was most often seen when it comes to considerations concerning sea level rise, storm surges and related flooding. Three of four policy makers and three of five spatial planners specifically mentioned coastal protection measures like dike enforcements in connection with climate change. It seems that awareness for climate change was especially raised through flood events they already experienced and which made the topic tangible.
Considerations about climate change, according to them, have already emerged but still play a minor role in most of the communities; the topic is "for sure at the back of a few persons' minds [but is] at least not permanently on the agenda" (Brüller, 2013). All spatial planners interviewed stated that climate change consistently plays a role in their work, but that the "main tasks are other ones" (Reuter, 2013). Most often linkages to other existing problems, e.g. storm surges, that as well call for coastal protection measures like dike enforcements, bring considerations about climate change on the agenda. None of the politicians interviewed and just two of five spatial planners had been directly involved in any kind of process directly concerned with climate change mitigation or adaptation. One spatial planner was already involved in the development of a regional mitigation strategy and another

in the project KlimaMORO that aimed at developing regional adaptation strategies by means of application and further development of the spatial planning instrument (Wenk, 2013).

Also business people regarded climate change as topic of relevance for their work. Especially those working in the tourism and agricultural sector that are both highly dependent on weather conditions have begun to notice the necessity to adapt to new circumstances. Tourism associations have climate change on their agenda for upcoming committee meetings and the director of the tourism association Mecklenburg Western-Pomerania would personally not “build a hotel without pool any longer in order to be independent of climate factors” (Fischer, 2013). Business consultants stated that new technologies are indicators that climate change already plays a role for businesses. An innovation that would e.g. be linked to climate change mitigation is the development of hybride drives reducing GHG emissions (Schlüter, 2013).
Amongst the ten business people interviewed two were engaged in actions connected with climate change mitigation and four in ones connected with adaption issues. In the context of mitigation the organization of workshops that deal with energy efficient building (Meyer, 2013) and the support of ‘climate-friendly’ camping sites were specified (Rau, 2013). Concerning climate change adaptation, businesses indicated that they had been partners in the projects KlimaMORO (see above) and RADOST (see 3.3).

People whose work was connected with climate change had most often been involved in climate change adaptation and mitigation projects so far. Six of them – a total of eleven – had already been part in mitigation projects, three in adaptation projects and one even in both.
On their part it was also indicated that climate change mitigation represents a much more present and already established topic compared to adaptation. Considering an environment of intensive renewable energy promotion and a “progressive and restrictive legislation” (Schmeil, 2013) in the context of climate change mitigation over recent years, adaptation efforts tended to be neglected and have just recently begun to emerge.
Quite a few cities in the German Baltic Sea region like Flensburg and Kiel had already developed their own climate change mitigation strategies including amongst others carbon dioxide balance sheets and catalogues of measures to reduce greenhouse gas emissions (Aloe, 2013). Seven of the interviewees were occupied in the context of these strategies; either they were directly in charge of the development or were concerned with projects associated with them. The so-called “Fifty-fifty” project of the city of Kiel e.g. aimed at developing and implementing energy saving strategies at schools and has already been running since 1996 (Simpson, 2013). Furthermore the partly state-aided position of a climate change mitigation manager had been introduced to further the progress of climate change mitigation.
Climate change adaptation actions seemed in contrast not that advanced. Considerations to develop strategies to adapt to climate changes had just recently occurred and started to gain in importance. Besides one interviewee who was also part of the KlimaMORO project, two others are currently involved in the development of adaptation strategies. For the climate change adaptation strategy of the city of Rostock presently in progress, a concrete action plan including middle- and long-term

measures should be drawn (Schmeil, 2013) and for the current project “Adaptation to climate change – flood protection” of the city of Lübeck a warning and planning tool should be developed (Schäfers, 2013). Furthermore the ministry for energy, agriculture, environment and rural areas of Schleswig-Holstein was currently choosing indices for climate change adaptation in cooperation with the Federal Agency for Environment (UBA) for future considerations about climate change adaptation (von Abercron, 2013).

In addition to concrete actions that have already taken place, several options that could theoretically be taken in order to adapt to climate change were mentioned. Spatial planners indicated that the definition of building standards, e.g. the introduction of requirements for insulation (Goede, 2013), dike enforcements and land-use plans localizing risk areas where it should not be built on (Reuter, 2013), are possibilities to adapt. In the tourism sector “everything that implies independency from weather conditions can be regarded as an adaptation option” (Rau, 2013), e.g. the construction of climate-independent accommodations on camping sites. It was stated that agricultural adaptation has already taken place to some extent; in response to periods of water limitation alternative crops were cultivated, a progress that will probably be continued and further intensified. Additionally, climate change resistant crops, e.g. ones that are able to cope with increased temperatures, could be developed (Brandt, 2013).

6.2 The BalticClimate Toolkit as decision support tool

Known tools, approaches and sources of information

> ***» Do you have already experience with any kind of decision support tool? «***
> *» Have you already heard about such a tool/ similar tool before? «*
> *» Do you already have experience with any kind of decision support tool? «*
> *» Did you already hear about some of the methods mentioned/ referred to before? «*
> *» Which sources of information did you use so far? «*

The BCT in particular was known by only four of the 30 interviewees; three had received the toolkit on a flash-drive and one had at least heard about the toolkit before. Also other tools in that format are mostly unknown. Overall just six named specific tools which four of them have already used as source of information, but not practically applied so far. Whereat more or less equally distributed across the different actor groups, none of the politicians were amongst those six. Tools in the context of climate change they mentioned were the city climate guide ‘Stadtklimalotse KlimaExWoSt’[2], the climate compass ‘Klimalotse’[3] and the climate scout ‘Klimascout’[4].

Just two interviewees specified that they had already used decision support tools in other contexts than climate change namely for economic analysis, environmental and demographical issues. So the

[2] decision support system for a climate friendly urban development: http://www.stadtklimalotse.net/
[3] guideline for climate change adaptation: http://www.anpassung.net/
[4] wiki platform supporting municipalities to adapt to climate changes: http://www.klimascout.de/kommunen/

Eco-Management and Audit Scheme (EMAS), an environmental management tool, has already found application (Rau, 2013).

Twice it was referred to the Northern German Climate Compass `Norddeutscher Klimaatlas´ as useful source of information that provides knowledge specifically tailored to the Northern German region about potential climate changes according to the current state of research. Other ways to obtain information about climate change issues and get help in this regard that were individually stated were the consultancy of external experts from universities like scientists from GEOMAR, the use of platforms like the one of the European Energy Award and the orientation on guidelines like the one for local climate change mitigation managers `Kommunaler Klimaschutz´ and the German Adaptation Strategy (DAS).

Even if the complete BCT was largely unknown, the interviewees were already familiar with parts of the provided process approach and specific aspects. Spatial planners and people working in a field connected to climate change had known approaches like vulnerability assessment and stakeholder analysis from other planning processes. The "modular system" (Simpson, 2013) that combines different methods and tools like it is done for the BCT would be a common approach to structure processes. Some business people already heard about the SWOT analysis tool in other contexts than climate change adaptation and have already worked with strengths and weaknesses analysis that is incorporated in SWOT.

First impression and general opinions

> ***» What was your first/overall impression of the tool? «***
> *» Do you like the structure and design of the tool? «*
> *» Is the tool easy to handle/ clearly arranged / well structured/ easy to assess? «*
> *» Is the information adequately presented? «*

A lot of interviewees overall liked and supported the idea of having such a guideline for climate change considerations no matter which actor group they hailed from; the tool would be "in fact a good thing" (Bobsien, 2013) and "in principle make sense" (Josteit, 2013). They appreciated the efforts that had been made to develop the tool, especially as it is an outcome of a cooperative, international and interdisciplinary project. In general the BCT would have the potential to raise awareness on the topic; it is "a good preparation work to sensibilize actors for climate change considerations and adaptation measures" (von Abercron, 2013).

Several positive aspects were specifically mentioned. Most often positively highlighted was the insertion of examples. Nine interviewees approved this aspect because it would be useful to see what changes and impacts other communities are facing and how they are coping with them; seven of them even called for an extension of these examples. The second most positively highlighted aspect, mentioned by six interviewees, was the distribution into different actor groups and the customized information that is in particular tailored to their different needs; "it strikes positively that […] orientation on the actors' topics are in the focus" (Rau, 2013). This distribution would make feel directly addressed and make it easier to access information in that manner.

Paying attention not only to challenges but also to chances that could be generated by climate change was concretely acknowledged by at least two interviewees as the right way to stimulate action. That regions could also benefit from climate change, would act as incentive to take action. It is “acceptable to regard climate change as well as a chance, even if this might sound cynical if you consider that in other parts of the world people lose their livelihood through climate change” (Schmeil, 2013).
The trailer appearing when the toolkit is entered and the fact that the toolkit is available in different languages was mentioned only by single interviewees. The intro movie would be a descriptive entry making it easier to understand the purpose of the tool and providing the tool in multiple languages would remove the ‘language barrier’ to deal with the tool. It would be a disincentive to have information only provided in English as it takes more time to read and understand it even if you are able to speak English.

There was no consistent opinion about the general format and structure of the BCT. Although 14 interviewees commented positively on the structure of the BCT, three concretely expressed a negative opinion. Overall no significant differences between the actor groups could be found; the three interviewees who had been negative towards the BCT’s structure were a policy maker, a spatial planner and a business person. By those in favour with the format and structure, the BCT was regarded as clearly arranged, descriptively represented and overall well structured. The information would be clearly represented and the stepwise basic approach of the tool would give a good overview how to deal with different aspects of climate change. The thematic division into general climate change information horizontally and customized information for the different actor groups vertically was liked and would frame the user interface of the tool. Due to the possibility to go from one question to the next – “to click through” (Schlüter, 2013) - and obtain further information, you always know where you are. The tool was in this regard compared to books for plant taxonomy identifications that guide you by saying “if you want to know that, go to page XY” (Burrow, 2013). On the other hand interviewees stated that they find the structure “a bit confusing” (Kastner, 2013). If you are interested in specific aspects it would be quite difficult to find them and too many sub-items would make it unhandy. Furthermore “the really diverging structure of the toolkit for political decision makers, spatial planners and business people […] makes it confusing if you not just look at your ‘own’ area” (Rau, 2013).

Application of the BalticClimate Toolkit

» Did you already use the BalticClimate Toolkit? «
» If you didn´t use the tool yet, could you imagine to use the tool as guidance for you in future? «
» Could it make sense to integrate the tool in future processes? «
» What/ which aspects of the tool could be integrated in your work? «
» What barriers/ difficulties for integration do you see? «
» Do you think it is more or less suitable for some persons/ sectors/ situations…? «

The BCT has not found concrete application at all so far; none of the persons interviewed specifically used the tool. Those four who had already known the toolkit before, have had a look at it, but did not take it into account during any decision making process. Interviewees indicated that the way how the tool has been promoted and distributed might explain why the tool is not widely known and not concretely applied so far. Some interviewees said that they are not sure "how the targeted groups should be made aware of the toolkit" (Rau, 2013). It was stated several times that the internet might not be the suitable medium to reach every actor group addressed. People working in communities like the ones employed by municipal authorities or local politicians would be of an older age really often and not that familiar with the internet. Providing the BCT just as online version would thus restrict the access to the tool and depict a too modern idea that poses problems for people not regularly working with the internet.

As the BCT has not found concrete application so far it cannot be referred to any experience made with the tool and emphasis was placed on the question if the interviewees can imagine to apply the BCT or to use at least some aspects of it in future. Given responses to that question differ widely, especially between the different actor groups.
All politicians interviewed considered the BCT relevant for their work and two of the four wanted to introduce it in the next meeting of their committee to make local politicians in their community aware of climate change issues and to make them understand that action is needed.
In contrast four of five spatial planners rather questioned if they can concretely apply the BCT; even if interviewees from other groups saw the highest potential for application in the spatial planning area as people working in planning positions would be particularly concerned with the development of measures and strategies and could therefore make best use of the tool. Spatial planners stated that the BCT would be in general a nice idea but there would be nothing particularly new about it as the process approach would already be known from other spatial planning projects. One interviewee who knew the BCT before could not use the tool for the adaptation project he was involved in (KlimaMORO) as it would focus rather on single measures and not on an overall planning approach they needed. Two others though were missing concrete recommendations for actions and measures and found the BCT thus too unspecific. Another reason specified that would also hinder the concrete application of the tool by such planning positions would be a lack of time. Quite often it was declared, in particular by people working in the building departments of municipal authorities, that the time is currently not available to have a closer look at the toolkit and work intensely with it. As it is "not possible in 3 days" (Preissler, 2013) to become acquainted with the tool and run through the different steps introduced, additional staff would be required - staff that has to be paid as well. Especially in

really small communities they would have to deal with too many other problems and no time is left to work with things like the BCT.

Business people stated that the BCT would have potential to disclose possibilities how to benefit from introducing climate change into considerations and could support the emergence of new ideas. Furthermore, in the case of new evolving businesses, it could promote the integration of the topic right from the beginning and thus shape their general orientation (Paetow, 2013). But especially bigger businesses would already be engaged in the context of climate change mitigation or adaptation if they expect a competitive advantage from doing so or if they are forced to in the course of complying with any regulations. A few even have their own environmental departments dealing with climate change considerations and contributing their own individual approaches. In this case the topic is already part of their business plans and there is no need for such a tool that provides nothing really new. It was questioned that for those that are not dealing with the topic so far – probably more small- and medium-sized companies – the BCT provides an impulse to involve climate change in future considerations. Business consultants had doubts that the tool would find application in businesses in that format; it would be "a little bit idealistic to think [so]" (Josteit, 2013). The time effort would be too high for single businesses as you have to run through a complicated process before getting concrete suggestions for measures. It was stated that it might make more sense that moderators or facilitators of planning processes like business consultants that are specialized in transferring knowledge and not by business people themselves use the tool.

One interviewee working in an engineering company thought that the tool is not of relevance for him as he has an operational and not a planning function. Engineering companies would be "operational working service providers" (Quandt, 2013) and as such they are responsible for the technical implementation of measures and just conduct what other commissioned to them, whereas the BCT would aim at strategic solutions. The same argument that the tool is not really of relevance as their business have more an operational than a planning function was also raised by the director of the tourism association of Mecklenburg Western-Pomerania.

People working in a field connected to climate change hold different opinions about the direct applicability of the BCT. They saw linkages to their work and considered the tool to be relevant for them; four of the eleven expressed that they might use the tool for different regards in future. At the same time some as well questioned if the tool is applied in that format by the addressed stakeholders.

But even if the "full package" (Schlüter, 2013) might not find application, it was found that the BCT could nevertheless serve several purposes. Interviewees from all groups identified that the tool can be helpful in three overall aspects: it could work as an instrument to raise awareness to the topic, to receive general information about climate change issues and to structure a planning process in the context of climate change.

Most often it was said that the BCT would be good to raise awareness about the topic among people. Several interviewees therefore considered to use it to communicate the topic to others. So it could e.g. be introduced in meetings of political committees as mentioned before; the director of the environmental department of the county Vorpommern-Greifswald could imagine forward the tool to teachers in schools who are often asking for material about the issue (Zölfel, 2013). The director of the

district farmer association of Nordvorpommern thought about representing the results of a SWOT-analysis to politicians and give recommendations for actions based on the results (Brandt, 2013), and the mitigation manager of the district of Rendsburg-Eckernförde expressed that he might use the BCT in future talks to people (Krug, 2013).

Furthermore the BCT could find application for information purposes; the BCT would be "really informative" (Koglin, 2013) and a knowledge gain for the addressed people. It depicts a really complex and detailed collection of data and different aspects are taken into account. Therefore it can be used as "source of information" (Schmeil, 2013), to become familiar with the topic, get an overview and "to tap information without using Google" (Zölfel, 2013).

Besides using the tool as an instrument to trigger climate change considerations, it could be further useful especially for people who have not been working conceptually so far to see how climate change mitigation and/or adaptation planning processes can generally be structured. It gives a hint on how to tackle the problem, provides an overview over which steps such a planning procedure consists of and how such a process should be coordinated in order to avoid a duplication of efforts. In this regard it could act as "kind of matrix" (Simpson, 2013) and as educational instrument to train people what has to be considered. If you are already involved in a process the BCT could show where you are standing in this process; it can help "to take a kind of inventory and to see what has already been done so far and what still has to be done" (Schäfers, 2013).

A general disagreement seems to exist whether people working at a local or regional level should actually apply the tool. It stood out that two interviewees working on a local level allocated the responsibility to take action to people working on a regional level; "it should be in the responsibility of the district to coordinate efforts and give recommendations to communities" (Gabriel, 2013). In contrary two people working on a regional level saw the responsibility in the hands of communities with the exception of measures concerning coastal protection and energy transition.

Identified shortcomings and resulting areas for improvement

> ***» Do you have concrete ideas/suggestions for improvement? «***
> *» Is the amount of information provided appropriate? Should there something be added/ cut out? «*
> *» What should be altered/ presented in different ways? «*
> *» What should be integrated in the tool? «*
> *» Why do you think does such a tool work/ not work? «*

Several shortcomings of the tool were mentioned by the interviewees that call for the improvement of the tool in different aspects.

Concerning the amount and kind of information, thirteen interviewees explicitly found the information given too detailed and broad. Especially politicians called for shorter and condensed information; the tool should be composed of "short, convincing arguments" (Kastner, 2013) and "simple, recipe-like guidelines" (Brüller, 2013). The tool would not be concrete enough was most often emphasized by spatial planners; really often it would just be stated that something has to be done, but not how exactly it should be done. A basic approach would be given, but no specific recommendations for actions. The

BCT could thus be more understood as “a climate feature than an actual instruction for actions” (Goede, 2013).
Business people and persons working in a field connected to climate change both expected something more practical and concrete when they had heard the term `Toolkit´. The excessive amount of information would be “really text heavy” (Krug, 2013) and “rather unspecific” (Fischer, 2013). The BCT could provide a good overview in the beginning, but “then loses itself in too general statements” (Schäfers, 2013).
Eight interviewees spread over all groups got the impression that it is necessary to intensively study all information provided in order to concretely use the tool and get any results; it “requires efforts and time resources“ (Brüller, 2013) to read everything and become familiar with the tool. The apparent work and time intenseness would act as repellent to even start.

A general problem in the era of the internet would not be that there is not enough information available, but that you are “overwhelmed by information” (Reuter, 2013). Facing a huge amount of information the question is thus “how to get rid of unnecessary, dispensable [one]” (Wenk, 2013) and where to find the one that fits to your needs. It was stated that the challenge is thus “to apply Occam´s razzer” (Brüller, 2013) and to condense the information to most important and essential things and extract central aspects. Ways to access concrete information should be shortened to have the possibility “to react faster” (Wenk, 2013). Some indicated that they know about the difficulty to find the right balance between providing too much and too little information. Information should be composed of “as little text as possible” (Rau, 2013), but should still transfer enough knowledge.

Two of four politicians interviewed had problems to understand every data provided. E.g. the differentiation between different climate change scenarios poses a problem for them and thus the tool was considered as “too challenging” (Kastner, 2013). Even if interviewees from the other groups did not express any fundamental problems of understanding, it was also indicated by some of them that the BCT is too academic in some regards and not pragmatic enough.
It would be important to consider the different backgrounds of local politicians. On a local level there are no “occupational politicians who have to come along with such issues” (Reuter, 2013), but politicians are working on a voluntary basis and not all are experienced to deal with scientific data. Business people furthermore found the tool too theoretical and “too abstract [to be] relevant for practitioners” (Homp, 2013). The toolkit would be a nice try but “has not completely understood the needs of the actor groups” (Wenk, 2013). The tool should be even more audience-oriented and different actor groups should be more directly addressed. A division into different actor groups would principally be a good idea, but “there should be more specific subdivisions for the different actor groups” (Homp, 2013).
One interviewee regarded the BCT to some extent as “too patronizing” (Krost, 2013); it depicts the actors as uninformed and considers that they do not have any previous knowledge. One person working in the spatial planning area who was contacted via mail was even not willed to give an interview as he is annoyed of the „impetus that they have to be guided like rednecks“ (Straßburger, 2013).

Different options that might help to solve the problem concerning the amount of information and the different information needs were mentioned: Two interviewees suggested to offer related links to obtain additional information from other sources if wanted and to provide different entries to the tool; depending on the actor´s degree of interest and background knowledge the users could find more or less detailed information. Another interviewee stated that "on-road test […] make sense" (Homp, 2013), meaning the whole process of the tool should be tried to run with the different actors.

The BCT provides an overall overview, but does not provide any site-specific information. The fact that climate change impacts just take the whole Baltic Sea region into consideration and a zooming to specific regions is not possible was perceived negatively by some of the interviewees. They were interested in specific projections and information about regional impacts like those that give sufficient notice of what will happen with the river Trave (Niemann, 2013).

As mentioned before, seven interviewees called for an extension of the given examples. To add more concrete examples instead of just providing scenarios would make the issue more perceptible by showing how other communities deal with certain problems. Really often planning processes would become "deadlocked" (Simpson, 2013). According to the interviewees it could help to have a look at other reasonable and successful concepts that are already in existence and to see what alternatives are available; there "can´t be enough examples, it is just the question how these examples are managed" (Rasmussen, 2013). A compilation of many different examples should thus be arranged in a way that it is possible for users to easily search and obtain information about specific cases they are interested in. It was suggested that the examples could be listed by topic or in categories and related links with contact person information provided.
However, three interviewees took a critical look at the examples provided in the BCT: One regarded them as not representative for the Baltic Sea region, one said that they are nothing new as they show measures that should already be standard practice and another did not find them convincing.
The transferability of different examples and best practices would furthermore be constrained by the "different problem settings" (Rasmusseen, 2013). A generalization of cases would always be difficult because local circumstances are essential and the diverging backgrounds of different countries even present within Europe have to be taken into account. A transfer of measures would just make sense if problems are concretely comparable. More "practical, simple examples from the own world" (Brüller, 2013) facing a similar background people can relate to would thus be needed.

Another problem mentioned was that antiquated information is represented. The scenarios are based on SRES scenarios from 2000 and should thus be updated. The BCT would furthermore represent some misleading information or would at least not clearly demonstrate connections between several aspects. E.g. socio-economic and climate change related data are discretely regarded, but in fact depend on each other and could thus be not treated separately (Schäfers, 2013).

Furthermore the differentiation between climate change adaptation and mitigation was not clear. Two interviewees criticized that the focus would be too much in the adaptation direction; “if the tool claims to deliver the complete package covering both adaptation and mitigation, mitigation is not regarded sufficiently” (Krug, 2013).
One interviewee hinted at the not sufficiently answered question how we know that climate change is actually happening. If climate change is taken as fact without presenting evidence, it will not be possible to persuade climate change skeptics (Bobsien, 2013).
A few business people criticized that the economic benefit should be stressed more directly. It should be obvious from the first page how single businesses can effectively profit from applying the tool. Especially small- and medium-sized companies want to survive and will thus not start to invest in climate change issues if they are not sure about the actual profit.

One fundamental thing explicitly mentioned by one third of the interviewees was that it is “not sufficient to make the whole thing available in the internet” (Homp, 2013) and let users alone with the tool. “Some things require communication” (Paetow, 2013) and any kind of support would be needed to impart the tool to the addressed actor groups. No matter from which actor group they were, interviewees expressed the need for assistance; it should be shown how to handle the toolkit e.g. in workshops or interdisciplinary working groups. Persons acquainted with the tool should thereby guide through the different steps and moderate the process of making people familiar with the tool. One interviewee indicated that institutions that are concerned with transferring knowledge like tourism associations or climate services could be responsible for moderating such a process (Homp, 2013). Business people in particular stressed that “you can´t probably leave business people alone with SWOT” (Schlüter, 2013).
Another point raised was that an online tool like the BCT might “serve as support but can´t replace expert knowledge” (Paetow, 2013). It would be necessary to consult external experts and conduct additional case specific research in order to get more targeted know-how even if this requires additional costs. Only by that it could be ensured that well-founded decisions are taken - what would be important not just because tax payer´s money is used for such projects.

At least four interviewees stated that the BCT does not sufficiently make people feel affected and concerned what would be necessary in order to call attention to the topic and promote actions. Awareness could be raised by emotionally conveying the issue; “emotions have to be provoked” (Krost, 2013). This could be done e.g. by appealing to people´s grandchildren and thus make them feel responsible for future generations (Meyer, 2013). To concretely show how future climate change impacts might look like and what consequences people will probably be facing - “if climate change is happening, THIS hotel will be flooded” (Schäfers, 2013) – would help to find a relation to the topic. Though the interviewees overall did not support the idea to draw horror scenarios, it would be human nature to pay attention to bad news and the will to survive would motivate them to take action (Krost, 2013).

7 Discussion of the interview results

In the following the most important findings of the interviews are summarized, further explained and a literature review should reveal if the statements made in the interviews are of significance. By comparing the results with conclusions reached in other literature, statements might be underlined, refuted to some extent and additional points be added.
It has to be mentioned that literature analyzing already existing tools is currently rare and thus not only literature focusing in particular on climate change issues is reviewed. But as some aspects can be applied universally to all different kinds of DSTs, this approach was considered as acceptable.

7.1 Interviewees' perception of and experience with climate change

The first part of the interview was meant as building the foundation of the interview by figuring out what the interviewee´s perception of and experience with climate change and climate change adaptation was. None of the interviewees denied climate change and even all perceived it as important issue and recognized the necessity to do something about it. This high awareness of the problem is probably also due to interviewees´ interest in the topic. Persons who were willed to give an interview have very likely a general interest in the topic and thus rate the importance of the topic high. It is doubtful though if they can be regarded as representative mean (see *chapter 7.6*).
Nevertheless this finding is supported at least at the part of policy makers by the results of a survey that had been conducted in order to reveal how regional politicians on the German Baltic Sea coast perceive climate change. This assessment indicates that policy makers "see a need to worry about […] climate change" (Bray, 2011; page 7) and to develop adaptation strategies soon. Around 80 % assessed climate change as really important environmental topic for the Baltic Sea region and around 88 % affirmed the question if adaptation measures are necessary (Bray & Martinez, 2011).
Climate change impacts that were most often mentioned by the interviewees were sea level rise and storm surges; both were also identified as the most relevant ones for the German Baltic Sea region by the interviewees of a stakeholder analysis undertaken for RADOST. Around 43 % named sea level rise as well as more frequent storm events as important impacts of climate change. But it was also revealed that there is still disagreement about how climate change will exactly affect the Baltic Sea region; none of the impacts were named at least by half of the interviewees (Knoblauch et al., 2012).

When it comes to concrete actions it strikes that just few efforts for climate change measures have taken place so far compared to the high degree of awareness. Overall 18 from 30 interviewees had been involved in a climate change mitigation and/ or adaptation project (9 mitigation; 8 adaptation; 1 both). Compared to the finding that the importance of climate change was recognized by all interviewees, the number of activities conducted so far was relatively low. Especially policy makers have dealt little or even not at all with the topic in their work and the minority of spatial planners were able to report concrete measures taken.
It should nevertheless be born in mind that measures serving mitigation and adaptation purposes are often taken in response to other existing problems and not exclusively to counteract climate change.

They are thus not necessarily seen as climate change measures and are in consequence not implicitly named as such (Knoblauch et al., 2012).

On the part of interviewees whose work was connected with climate change it became obvious that climate change adaptation is an issue currently not that intensely regarded as climate change mitigation. Logically they were overall the group most frequently engaged in climate change related projects but whereas six of eleven had been involved in mitigation projects, just three were occupied in the context of adaptation. It seems that considerations about climate change adaptation are just beginning to emerge and are currently not really advanced.

The low amount of concrete measures – especially adaptation measures - compared to the definitely existing awareness demonstrates that there must be several factors that generally hinder the concrete involvement of climate change into considerations to date; barriers that in consequence also limit the application of DSTs. To recognize which barriers exist can serve as first step to overcome and translate them into enablers of climate change adaptation (Hill, 2013). Just by overcoming general barriers to adaptation, the foundation can be laid to enable the application of DSTs like the BCT.

7.2 General barriers to climate change adaptation

Uncertainty of climate change projections

One overall barrier that could be identified is the inherent uncertainty of climate change projections. As it is not sure which changes and impacts will occur, in which time frame they will occur and if changes observed can actually be attributed to climate change, it is difficult to take climate change into account for planning processes. That current uncertainty about climate change projections is underpinned by the RADOST stakeholder analysis mentioned before; stakeholders are missing concrete information about climate change impacts and the lack of certainty ranks second when people were asked what prevents adequate adaptation measures. They revealed that there is a great need for action in view of the present uncertainties as they are limiting the effective implementation of adaptation measures. E.g. with regard to coastal protection measures technically it would not pose a huge problem to raise the level of existing dikes, but facing uncertainties about the exact range of sea level rise it remains unsettled which elevation will be sufficient. Therefore additional research is needed concerning regional climate change impacts (Knoblauch et al., 2012).
It will likely never be possible to remove uncertainties entirely as uncertainty also exists about social and demographic issues like the future population growth and economic development that will decisively influence the future climate. Thus a governance challenge will probably remain to adopt deliberate arrangements to deal with these uncertainties in future (Steurer, Bauer, & Feichtinger, 2012).

Risk perception

In this context the current relatively low personal concern and the greater urgency of other problems limit concrete efforts. It became clear that climate change even if recognized as important issue is not perceived as a really pressing problem compared to others. Some of the people interviewed are even not that worried about climate change and pointed at more pressing issues like the construction of the `FehmarnBelt tunnel´ (Mayer, 2013) that would be the real, present problems for coastal communities. Literature refers to these barriers as `informational and cognitive constraints´. Individuals tend to focus on the risks they perceive as most important at a certain point in time and considerations about climate change are thereby pushed aside; "as concern about one type of risk increases, worry about other risks decreases" and climate change "is not 'here and now' or a pressing personal priority for most people" (IPCC, 2007c; page 735).

Some interviewees furthermore stated that the Baltic Sea region will probably be less affected than other German regions and could even benefit from climate change. E.g. bathing tourists might be attracted by the Baltic Sea region as holiday destination when temperatures in the Mediterranean Sea will reach unpleasant ranges. It became thereby obvious that individuals in the Baltic Sea regions have not directly experienced the consequences of climate change and thus no urgent need to become active is currently seen. A few interviewees reckoned that some kind of stress must be present that gives a basis or motive to take concrete actions. Events that directly affect people like flooding events really often trigger climate change considerations and raise awareness for the topic. These findings are consistent with the so called `policy window hypothesis´ according to which "adaptation actions […] are facilitated and occur directly in response to disasters" (IPCC, 2007c; page 733). In contrary there are studies that bring the argument forward that short-term risk reduction in direct response to disasters would be developed under pressure and could not serve effective long-term development goals (IPCC, 2007c).

The time horizon of climate change considerations plays an important role as well; things that lie too far ahead are not perceived as existential. The moment climate change might become directly perceptible lies too far in the future that the necessity to react is realized now. It was seen as a general problem of mankind that individual perceptions of things are concentrated at present and that considerations often do not exceed time periods of employment contracts. For individuals the precise moment is of importance and thus extremes like heavy rainfall events are rather recognized than changes gradually taking place. The time horizon of the general public would be shorter than those of scientists who also incorporate longer time-scales in their considerations.

Lack of resources

Another barrier that could be identified is the general lack of resources – a lack of time, staff and money. Really often the argument arose that they do not have the time to intensely deal with climate change issues and to be concretely engaged in the topic. Especially in small communities personnel resources are generally scarce and the employees are busy with the day-to-day business. Even if there is interest in the topic, the limitation of staff makes it impossible to manage climate change issues besides daily tasks.

Time constraints are strongly connected with money constraints. Financially ruined communities do not have the money to finance specific working positions solely dedicated to climate change. As the process of climate change adaptation requires time and monetary expenditures few efforts are actually made. Only if money is specifically directed to climate change adaptation processes, e.g. through government aids, actions are taking place. Unless directly mandated from federal or state level, financial benefits can be expected or advantage be taken of climate change considerations, e.g. in the context of beach erosion and nourishment, no actions would actually be taken (Koglin, 2013).

Financial barriers to climate change adaption are also identified by the IPCC; "at a […] local level, individuals and communities can be […] constrained by the lack of adequate resources" (IPCC, 2007c; page 734). In the RADOST stakeholder analysis "costs play the major role in preventing the implementation of adaptation strategies" (Knoblauch et al., 2012; page 11).

Unsettled responsibilities

It was furthermore stated that people in the communities often do not feel responsible for climate change as they are not the main emitters and thus believe that they should or cannot do anything. It would be of importance to stress that every single person could contribute. But as people are not willed to forego any comforts and have the attitude that foremost others should change their behavior, it is difficult to persuade individuals to change their own ones.

In general there seems to exist uncertainty as to whom responsibility for climate change measures should actually be allocated to, which became obvious in the course of the interviews. The legal settings for adaptation processes are not clear at the moment. Especially evaluation of projects is currently missing; a consequent and uniform monitoring process would be needed in order to ensure that measures will in fact show success.

Power imbalances and the diverse capacity levels of different governance levels involved are also identified by other studies as a main barrier to climate change measures (Hill, 2013). The different governance levels involved as result of the division of functions in Germany´s federal system (see 2.2.1) seems to create confusion among actors, concerning the question at which level efforts should actually be initiated. The need for cooperation between different governance levels is stressed by the Adaptation Action plan for the DAS (BMU, 2012). But as vulnerability to climate change differs between regions and thus adaptation needs are diverse, adaptation is highly local.

In this context the crucial role of local institutions in adaptation planning processes should be highlighted. It has been shown on the basis of 118 case studies from the UNFCC´s data base that the effectiveness of adaptation efforts highly depends on local institutions and that "adaptation never occurs in an institutional vacuum" (Agrawal, 2010; page 178). Local institutions are key mediating

bodies that structure and facilitate adaptation actions and thus essentially influence the adaptive capacity of communities, whereby "institutionalized monitoring and sanctioning in cases of […] infractions of existing institutional rules are crucial for institutional functioning" (Agrawal, 2010; page 178). Institutional linkages between climate change and decision making are not well developed yet and climate change adaptation has emerged only recently in regional policy (Schmidt-Thomé & Klein, 2011). Doubts, too, still remain which administrative unit (department for environment, for civil protection etc.) should be responsible for climate change adaptation measures within municipal administrations. Depending on how the problem has been institutionalized within municipalities, adaptation is framed differently and the determined scope of action varies (Sælensminde, 2013).

Further barriers

Another general problem of political nature is that municipal councils encompass a heterogeneous formation of people. The different backgrounds of local politicians incorporating different points of view, educational levels, expertise, motivations and interests make it difficult to find a common sense. Additionally every politician wants to be re-elected and would thus e.g. not dare to say in an election phase that people should pull down their houses in areas of high flooding risk and that they should settle somewhere else (Meyer, 2013). Avoiding decisions that court resentment amongst voters would consequently impede adaptation efforts in a *retreat* direction.

A few interviewees took a critical look at climate change adaptation and regard it as a conflicting trend to climate change mitigation. Declaring that climate change adaptation is needed would in practice be equivalent to admit that mankind is not able to stop climate change through appropriate mitigation measures and to accept climate change as given fact. The impression is conveyed that nothing can be done about this fact and that it is just a matter of how to come along with it. The fatal consequence of accepting climate change as given fact could be that no efforts are put any longer in climate change mitigation.

According to the IPCC, adaptation and mitigation may actually be regarded as two separated strategy approaches that compete for limited resources and cannot be carried out simultaneously due to e.g. financial constraints. But even if direct trade-offs between both may exist, they would in reality be rare as "the actors and budgets involved are different" (IPCC, 2007c; page 750). In broader considerations of sustainable development, adaptation and mitigation do not necessarily have to exclude each other; both could be considered as coexistent policy options and even synergies between both could be created, e.g. linked to the cost-effectiveness of measures (IPCC, 2007c).

7.3 Strengths and weaknesses of the BalticClimate Toolkit

The interviewees were asked to take a critical view on the BCT and were concretely queried whether and what suggestions for improvements they had. Focus was amongst others placed on the kind and amount of information and if the interviewees can evaluate in particular with regard to their experience in which aspects the toolkit may work or not work; thereby several aspects were highlighted positively and negatively. In the following identified strengths and weaknesses of the BCT are summarized and further explicated, including a literature review. If not explicitly mentioned, findings apply for all four interviewee groups and no significant differences could be found between them. These findings are later on used to derive and formulate requirements for DSTs in general.

Strenghts of the BalticClimate Toolkit

When asked to retrieve their first impression, most interviewees considered the BCT overall positively and seemed to be interested in such a guideline. Several areas for potential application of the BCT were named that disclose aspects successfully elaborated within the Toolkit framework.

The BCT was developed to act as kind of knowledge transfer instrument that familiarizes the relevant actors with the topic by providing information about general climate change issues, different scenarios and possible impacts (BalticClimate, 2011); an ambition that seems at least to be partly achieved. A lot of interviewees stated that they regard the tool as useful source of information and that it helps to get an overview about different climate change issues. The integration of background knowledge represents the first necessary step in a decision making process; a task that could be accomplished by decision support tools acting as “knowledge brokerage structures” (Steurer et al., 2012; page 4). The BCT thus seems a suitable starting point to trigger further climate change considerations; once people found out about the tool it calls attention to the topic and helps to develop a better understanding of climate change related issues.

Taking an explicit and structured approach can help to make the decision process more efficient (Kiker, Bridges, Varghese, Seager, & Linkov, 2005). According to Power (2013) research revealed that different decision support systems could reduce the time needed for decision making and thus enhance efficiency. The BCT introduces a stepwise approach that should help to structure planning processes in the context of climate change adaptation and mitigation. By compiling different tools and structuring methods the BCT wants to enable the actors to take a systematic, strategic analysis of the challenges and chances generated by climate change. Some interviewees could imagine using the BCT to get an overall overview on the different steps such planning processes are generally composed of and to see how efforts could be coordinated.
The finding that policy makers considered the tool of greater relevance for their work and saw higher potential for future application than spatial planners might be explained by the fact that they are in comparison not that advanced in structuring such planning processes and lack a conceptual approach so far. Especially local politicians who are working on a voluntary basis are spending most time on their actual jobs and oftentimes are members of a committee only for limited time periods. Spatial

planners in contrast are more regularly engaged in planning processes and thus stated that the approach provided by the BCT would be nothing completely new for them. They know from other spatial planning projects what has basically to be taken into account and how to tackle problems arising in connection with planning procedures. The need for a general guideline how to structure a process in the context of climate change seems thus greater for policy makers than for spatial planners.
Even if some business people perceived the SWOT analysis tool as an interesting method to bundle information, they indicated that a lot of companies that expect a benefit from including climate change considerations in their business plans already have their own structuring approaches available, especially bigger ones which might even have their own environmental departments. Therefore DSTs, even if used for information purposes, seem thus as well not that urgently needed by them for getting a generally structured approach.

Quite a lot agreed that the inclusion of examples is an invaluable supplement to the BCT as case studies demonstrate what others have already done so far, reveal different options that are currently available and help to identify best practices to address climate change related challenges. The BCT provides a collection of examples how the tool can be applied in form of exemplary conducted exercises and examples of case studies presented in video-clips (SEI, 2012b). This collection of additional information can help the users to understand the effectiveness of the DST. But in order to evaluate the actual value of different presented options, an independent analysis is inevitable to avoid a biased drawing of success stories (Palaniappan et al., 2008). Such an independent evaluation is not guaranteed for the examples of BCT as they just demonstrate selected implementation cases that were conducted in the framework of the BalticClimate project. Therefore criticism from some of the interviewees regarding the actual relevance and transferability of the stated examples seems justified.

What was overall appreciated is that the BCT does not only place emphasize on challenges but also on chances that can be generated by climate change. It would be good to stress that people in the Baltic Sea region might also benefit from changes if they initiate efforts in order to motivate them.

Even if more interviewees perceived the tool as well structured and the division into different actor groups was appreciated as this would help to take account of specific needs, no entirely consistent opinion existed whether information and the introduced project steps are overall clearly ordered and intelligibly presented. A few interviewees found the structure of the tool confusing and indicated that it is composed of too many sub-items; this aspect is therefore further explicated in '*weaknesses of the BalticClimate Toolkit'*.

Weaknesses of the BalticClimate Toolkit

Regarded as useful source of information, the BCT was at the same time considered as too detailed and complex by a lot of interviewees. The users had to sift through a huge amount of information before being able to effectively apply the toolkit. Especially if they anyhow lack time what seemed to be the case for most actors working in authorities on local or regional level, the impression emerged that the process approach introduced takes too much time and requires a lot of efforts so as to integrate it in daily operations. The apparent work- and time-intensiveness of the BCT thus acted as repellent to a lot of actors to investigate it more closely or even use it. In addition the text-heavy way of representation would not really tease curiosity to invest more time.

The huge amount of information provided seemed especially daunting for policy makers and they explicitly called for shorter and more condensed information. They would just need the really essential things summarized into as little text as possible. Their task would not be to understand the matters in smallest detail but rather to make sense of the basic information they are provided with. The huge amount of information DTSs typically comprise as part of their analysis was also identified as a major problem of decision support tools by Sullivan (2002).

In fact it takes time to read the considerable amount of information that is provided by the BCT and it is thus not unreasonable to mention this aspect. But in order to be able to make well-founded decisions it is probably inevitable to invest at least some time in the topic of climate change. The actual underlying problem is very likely rather that people´s daily work leaves no time to deal with climate change issues and a challenge exists thus in taking this time constraints of actors into account.

It was also negatively highlighted by several interviewees that the need for concrete information could not be met by the BCT. In particular, spatial planners objected that the information given by the BCT is rather unspecific. The toolkit would not provide clear recommendations and just give broad hints on what should be done, but not on how things should exactly be done.

Some complained about the fact that projections, impacts etc. are just given for the overall Baltic Sea region and no zooming in to specific regions is possible. The BCT would provide information that does not allow for a precise determination of specific local circumstances. Compared to model-driven tools the BCT does not provide the possibility to feed in site-specific data and subsequently receive processed data outcomes. The BCT prepares more general guidelines and gives users thereby the impression that they have to conduct everything for their own. The few examples presenting concrete recommendations how exercises can be conducted and what measures can be taken, could not sufficiently offset this impression. In consequence the BCT was regarded by a lot of interviewees as suitable starting point as mentioned before, but for developing concrete measures it was not considered to be the appropriate instrument.

As some interviewees still had problems to understand all information provided, the BCT was on their part perceived as too challenging, academic and abstract and of limited relevance for practitioners. It strikes that a few interviewees indicated that they had expected something more handy and pragmatic when they had heard the term `Toolkit´.

The indication that especially regional policy makers have some difficulties in understanding scientific data was also revealed by Bray (2011) who found that regional policy makers in the German Baltic Sea region regard the results of science not that suitable for decision making and stated that scientists would not completely understand their information needs. Thus they consider information coming from science "only of relative importance in the decision making process" (Bray, 2011; page 8).

That some of the information given is not up-to-date was another point of criticism. The BCT uses the regional atmospheric model RCA3 from the Rossby Centre in Sweden and two SRES scenarios for its climate change projections (Strandberg, 2010). SRES scenarios do not reflect the current state of science any more (see *chapter 2.1*). Even if current available CC projections for the Baltic Sea region are all based on SRES scenarios - also the ones from the regional climate models introduced in *chapter 2.2.2* – other scenarios (RCP) will probably be used in future CC projections and improvements be made in the degree of certainty. As the BCT was actually not further developed or updated after it was completed in 2012, an update will very likely become necessary.

The BCT aims at providing information about both climate change adaptation and mitigation. As they present interlinked aspects this approach might in general be quite justified. It was criticized though by a few interviewees that there is no clear differentiation made between them and that they are not explicated to the same extent; a slight focus would be set on adaptation, what could be acceptable if the toolkit does not endeavour to give equal attention to both. In fact, the BCT does not clearly distinguish if response actions are serving an adaptation or mitigation purpose which apparently led to confusion amongst users. It cannot be acknowledged that the BCT focuses on adaptation, and such criticism might be motivated by the personal preferences of the interviewees; the two interviewees who stated that the BCT would focus on adaptation were both working in a mitigation direction.

Table 5: Summary of main strengths and weaknesses of the BCT (own representation).

strengths ⊕	weaknesses ⊖
calls attention to climate change trigger/ impetus for CC considerations	**too detailed and complex** daunting amount of information
provision of useful information knowledge transfer tool	**unspecific information** no clear recommendations
provision of a systematic approach structuring instrument	**too challenging and academic** difficulties in understanding
inclusion of examples	**out-dated information**
division into actor groups provision of specifically tailored approaches	**unclear attribution of CC measures** confusion about adaptation and mitigation

As mentioned before a few interviewees found the structure of the tool confusing and indicated that it is composed of too many sub-items. The user interface of the BCT leads the actors step-by-step through a climate change planning process. One process step can thereby be composed of up to five information levels organized in sub-items that build up on each other. It may appear thus justified to criticize that information lines to assess a very specific piece of information are sometimes too long; some data can just be received if the user is already at a certain sub-item level. But as the BCT always shows users at which step they presently are and due to fact that the majority of interviewees perceived the tool as user-friendly and clearly arranged, some interviewees´ statements that the structure is confusing and complicated might also be explained by their lack of experience with receiving information online; a point that is further specified in the following paragraph.

During the interview preparation phase it became quite obvious that several problems existed concerning access to the tool. Becoming aware of the tool was notably difficult as most of the persons overall contacted and finally interviewed had not heard anything from the tool before, even if they are directly concerned with climate change issues in their work. This led to doubts whether the internet is the suitable medium to make people aware of the BCT.
It was stated by interviewees that people employed in municipal authorities would really often be in an older age; a generation that is stereotypically portrayed as not being familiar or even not being able to use the internet. That employees in the public sector are often in an older age was confirmed by a study conducted on behalf of the Robert Bosch Foundation. It revealed that the average age of people employed in the public sector in Germany was 44 in 2008. At regional (`Länderebene´) as well as on local administrative level (`Kommunalebene´) the age group from 45 to 54 was the most common one and people younger than 35 years were much lower represented (Robert Bosch Stiftung, 2009). This age-centered workforce structure has probably not changed significantly since 2008.
To the question if elderly are really not familiar with the internet: A recent study determining the level of digitalization in Germany conducted by TNS Infratest showed that not so few elderly made actually use of the internet. Even if the percentage of internet users in younger generations (14-29), with values over 96 %, is significantly higher, still around 79 % of people aged 50 to 59 were currently using the internet (TNS Infratest, 2013). It has however to be taken into account that there are differences between users. People might use the internet, but it is thereby not specified to what extent they use it and if they are actually skilled and experienced in doing so. Internet users categorized as ‘outside sceptics’ by the D21 - Digital – Index were on average the oldest user group. Members of this group were characterized by a low digital competence and having just low internet skills; e.g. just 7.2 % of them were able to properly search for information in the internet (TNS Infratest, 2013).
So, even if older people are using the internet they are presumably not that familiar with the medium and do not necessarily feel confident about receiving information through the internet. The suitability of just making the BCT available on the internet remains thus questionable as this way of availability might still represent an obstacle for application not only due to limited skills but also since some actors might lack access to an adequate internet service (Palaniappan et al., 2008).

7.4 Need for decision support tools

Interviewees stated several times that they are overwhelmed by information in the era of the internet and have problems where to find the one they need without spending too much time on research. Facing a huge amount of information that is currently available in the context of climate change and also in particular to climate change adaptation, the general question arises if DSTs are actually needed in addition. But DSTs like the BCT do not necessarily increase the existing information overload people are complaining about and have in fact considerable potential in the following areas.

Since individual decision makers have just limited capacity to consider and recapitulate all information available, there is a need for any kind of guidance that supports them in handling the huge, challenging and sometimes even contradictory information amount; manageable methods are needed that "aggregat[e] the information in a manner consistent with the values of the decision maker" (Kiker et al., 2005; page 12). DSTs could serve this purpose to provide aggregated versions of the increasing and complex volume of information by collecting essential knowledge from various sources.
Most policy makers in the German Baltic Sea region do not use personal contacts with scientists and scientific outreach programs for information purposes and judge information coming from science as noted above as less relevant for their decisions (Bray & Martinez, 2011). As climate change and climate science are highly complex topics, it poses a challenge to communicate and present information about them in a comprehensible way. DSTs could act as suitable instruments to close the existing gap between scientists and practitioners by translating research findings into pragmatic, user-friendly information.
The complexity of climate change issues requires rational decision making and makes concretely structured approaches absolutely essential (Feix et al., 2009). Besides using DSTs as instruments to trigger climate change considerations, they could furthermore be useful to see how climate change planning processes can generally be structured by providing an overview over the steps such planning processes consist of and how they should be coordinated in order to avoid a duplication of efforts. DSTs could in this regard act as educational instruments to train people what has to be considered and can be used as kind of inventory if you are already involved in an adaptation planning process.

In summary DSTs like the BCT could serve three overall functions in the context of climate change decision making:

1. aggregate information
2. bridge the gap between scientists and practitioners
3. structure a decision making process

As currently available tools and guidelines seem not to be recognized or not perceived as appropriate (Bray & Martinez, 2011), the question arises why DSTs even though they could principally serve several purposes, are practically not regarded and applied so far. In the following reasons for this disregard and several aspects that limit the applicability of DSTs are identified based on the interview results and thereby conclusions for general criteria that may enable a successful application are drawn.

7.5 Requirements for decision support tools

Communication and support

What became probably most obvious is that an active communication is required in order to ensure that DSTs are effectively applied. Even if web-based tools like the BCT try to act as stand-alone instruments trying to lead the addressed groups through the different process steps on their own, it seems inevitable to provide assistance to them. The fact that tools as outcomes of projects are not further communicated and are consequently forgotten seems to remain a general problem. Without further communication they do often not sustain the restricted lifetime of a research project and `die´ in the moment the project is ended.

First of all communication is required in the respect that attention has to be drawn to the DST so that in the first place people become aware of its existence. The need for promotion is clearly indicated by the finding that the majority of interviewees were still not aware of specific tools and sources of information in the context of climate change from which they can receive specific information for their region and/ or area of interest. According to Bray (2011) around 60 % of policy makers in the German Baltic Sea region are not aware of 'Norddeutscher Klimaatlas' (see *chapter 6.2*).
A review of decision-making support tools in the water, sanitation, and hygiene sector revealed that an "effective dissemination is key to the success of a decision-making tool" (Palaniappan et al., 2008; page 19). Promotion might be especially essential in the case of web-based DSTs as the mass of information available in the internet makes it difficult to become aware of one tool in particular. Providing a hard copy besides an online version and distributing it widely to individuals, organizations and institutions that should be addressed may be an option to disseminate a DST (Palaniappan et al., 2008). In the case of the BCT some persons contacted via phone but not finally interviewed stated that they knew the BCT from workshops and conferences like the regional conference 'climate change adaptation in coastal regions' that had taken place in Bremerhaven in 2012 (Voßeler, 2012). Workshops and conferences in which a tool is presented to relevant stakeholders or to a wider audience thus depict a further option to promote and disseminate DSTs.

Subsequently users should not be left alone with the tool, but instead be supported in using it. There is potential for tools but they can just work in combination with permanent dialogue. To get some value out of a tool a 'life-touch' is needed and a real interface should be created. Face-to-face interactions, e.g. in regional workshops in which developers and experts sit together with users and practitioners, offer space for capacity building and mutual learning. In such workshops advice could be provided regarding applications which in turn facilitates the uptake and application of the DST among practitioners (Palaniappan et al., 2008). Participatory workshops that bring people together additionally create a shared understanding of a problem situation what is crucial for the correct evaluation of the different options in a decision making process. Thereby it should be taken into account that persons involved in decision making processes often lack time and thus group activities should be limited to an appropriate time frame (Giupponi, Mysiak, & Sgobbi, 2008).

Besides the need for assistance where to find and how to use a DST, support is also needed when it comes to in-depth knowledge. Even if DSTs try to inform and establish a basic knowledge about the topic of interest, more explicit know-how is required from time to time during the decision making process. Several interviewees stated that they cannot imagine developing appropriate decision options and making a final decision without consulting an external expert. Additional studies have to be conducted as a tool alone cannot provide sufficient site-specific information to allow for a well-founded decision. External knowledge and expert judgments are thus probably inevitable supplements to DSTs, what however also creates some kind of dependency (Elghali, 2002).

The importance of both training and technical support to ensure an effective application of a DST was also highlighted by Sullivan (2002), who carried out a study about various environmental DSTs. Tools in combination with workshops and technical support teams, providing users with the required assistance and resources, may be an option to satisfy both needs (Palaniappan et al., 2008). To the question in whose responsibility it should be to organize and moderate such workshops, interviewees stated that institutions in particular concerned with knowledge dissemination like the Climate Service Center[5] or super-ordinate business organizations like tourism associations should be keen to communicate tools like the BCT to the relevant stakeholders.

Amount and kind of information

Whereas communication and support constitute requirements that cannot be fulfilled by a tool alone, presenting the right amount and kind of information in a proper way are aspects that should be resolved by a DST itself; something that is easier said than done and poses a challenge to DST developers.

The BCT was perceived as too detailed by a lot of interviewees; especially policy makers called for a more condensed and less excessive amount of information. As aggregating information is likely one of the most important roles of DSTs (see 7.3), they should aim at properly reducing and managing the amount of information they use. Developers of a DST should therefore try to investigate how much information users are able to handle and to process without feeling overloaded (Power, 2013). The right balance has to be found between aggregating information as much as possible and still providing as much information as necessary to create a knowledge base that allows well founded decision making.

As especially policy makers called for a condensed amount of information it might probably make sense to provide them with just a few pages of information that contain the most essential things in the beginning. If subsequently, further steps are taken in a planning process more information could be provided later on. Apparently the IPCC has already recognized the need for abstracting information for policy makers; a 'Summary for Policymakers' outlining the most important findings and main conclusions reached by the IPCC's Working Group I is provided for all Assessment Reports that have been released so far (IPCC, 2013c).

[5] Institute (belonging to the Helmoltz-Zentrum Geesthacht: http://www.hzg.de/) that aims at refining the knowledge derived from climate research in a practice-orientated way: http://www.climate-service-center.de/

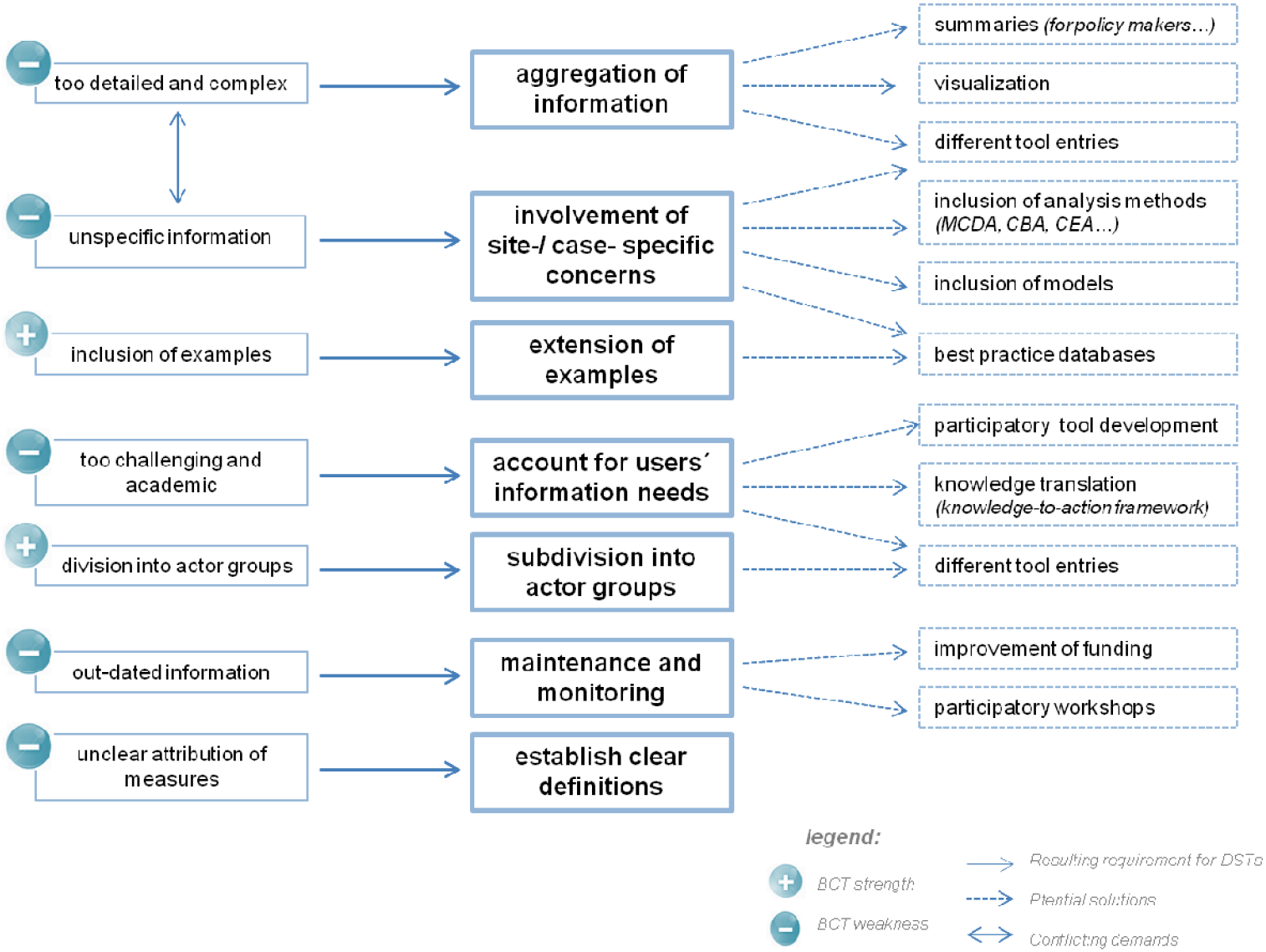

Figure 13: Summary of identified strengths and weaknesses of the BCT and requirements for DSTs in general derived from them (own representation).

At the same time as people criticized the huge amount of information the BCT comprises, the information given was regarded as rather unspecific; site-specific information and concrete recommendations for measures would be missing. In particular spatial planners criticized that the BCT would not be concrete enough.

DSTs always entail a generalization to some extent as they are part of a standardization process that aims at increasing the reproducibility and transparency of decision making processes (Sullivan, 2002). In order to multiply project outcomes, approaches are generalized so that they can be applied under different circumstances. 'One size-fits-all solutions', though, do not take site-specific differences into account. This may be one reason why structured approaches are often "perceived as lacking the flexibility to adapt to localized concerns" (Kiker et al., 2005; page 95). Methods that "conceptually simplify the reality of complex systems" (Elghali, 2002; page 5) may help decision makers to cope with the complexity of situations they are faced with. But as complex decision contexts call for individual and case-specific solutions taking a fully standardized approach is quite difficult or even impossible (Elghali, 2002).

So the collection of additional case-specific information and consultancy of experts to determine specific local circumstances are as noted above most likely inevitable supplements to DSTs which try to simplify complex decision making contexts by providing more or less generalized instructions for actions. The impression that DSTs are too broadly and generally formulated might nevertheless be minimized in different ways of which some are already adopted by other DSTs. In the following, possible options are listed and corresponding DSTs exemplary named:

- One option to become more concrete is to provide more examples of specific measures and of how a DST can be practically applied. As found for the BCT people appreciated examples that show how others are solving similar types of problems and explicitly called for an extension of these examples. Sharing best practices and lessons learned can help to improve the understanding which climate change adaptation activity is more or less suitable under given site-specific circumstances. The development of best practice databases through which users can systematically search for examples might help stakeholders to find best suitable decision options. It has however to be considered that the examples provided should be independently evaluated to ensure an objective appraisal as mentioned in 7.2. One already available adaptation project database was developed in the framework of the global and regional adaptation support platform 'ci:grasp'; it allows to search for projects by means of context, classification and solving capacity. But it seems that the database is still not that advanced, e.g. just few examples for projects in Europe are listed so far (PIK, 2013).
- Decision support systems that allow for high-level 'what if scenario' modelling (Rippen, 2005) and thereby provide the possibility to feed in and analyze specific data and parameters (Power, 2000) could as well help to allay the impression of users that a tool does not take account of local circumstances and that they have to conduct everything for their own. Such software-based or model-driven DSTs make use of mathematical or statistical methods to reflect and predict consequences of decisions in reality (Makowski, 1994). Compared to the BCT that does

not include any kind of software interface and provides recommendations just in the form of guidelines and exercises, other tools already integrate specific kinds of models and underlying software in their analysis. One example for a DST that encompasses a series of linked models and databases is the so-called CLIMSAVE Integrated Assessment Platform (IAP). This web-based tool aims at enabling stakeholders in assessing climate change impacts, vulnerabilities and adaptation options for various sectors. Users of the IAP can thereby vary model input parameters within certain limits and the resulting model outputs are shown in form of maps, tables, graphs etc. It furthermore allows for the determination of the relative costs of adaptation measures (Holman, Cojocaru, & Harrison, 2013).

- Integrating any kind of cost-benefit (CBA) or cost-effectiveness analysis (CEA) like the CLIMSAVE IAP does, might satisfy business people´s demand for making the economic benefit of adaptation clearer. Expressing costs and benefits of adaptation in monetary terms (CBA) or identifying "the least-cost path to reaching a given target" (CEA) (Zhu & Ierland, 2010; page 7) may help a DST to provide `concrete outputs´ people can directly relate to. However, it must be born in mind that great uncertainty exists in the assessment of adaptation costs due to the various influencing local and regional factors and that the evidence-base concerning economic aspects of climate change adaptation measures is currently very low (Holman et al., 2013).
- To include an evaluation and priority ranking of different decision alternatives in form of assigning values and weights to them may be another option to enhance the specificity of a DST. So called multi-criteria decision analysis or making techniques (MCDA/ MCDM) have been arisen in recent years as integrated approaches to serve this purpose; they help to structure and evaluate problems in which multiple attributes and objectives are involved (Huy, 2009).

  MCDA aims at expressing the performance of different alternative courses of action based on the judgement of decision makers and experts on the importance of multiple criteria so that a recommendation for an alternative can be drawn (Zhu & Ierland, 2010). In the context of climate change this could mean evaluating different adaptation policies and measures and selecting the one performing the best (Giupponi et al., 2008). The analytical hierarchy process (AHP) e.g. is an optimization technique that tries to compare different decision options by assigning numerical scores to them. Scores thereby derived from aggregating individual scores that are based on single criterions into one overall score (Kiker et al., 2005). The approach of MCDA techniques also has its shortcomings as it assumes that a choice for one alternative optimizes decision efficiency (Elghali, 2002), but it may depict an opportunity to aggregate preferences in complex decision situations "across different objectives (intra-personal aggregation) and across different actors (inter-personal aggregation)" (Giupponi et al., 2008; page 10). 'DESYCO' (DEcision Support SYstem for COastal Climate Change Impact Assessment) is an example for a Decision Support System that already incorporates MCDA in its analysis. It aims at supporting coastal communities in planning adaptation measures by analyzing different climate related stressors and affected resources. DESYCO thereby introduces a regional risk assessment methodology that is based on MCDA (Torresan et al., 2011).

The way that information is presented should be carefully regarded as well. An overall text-heavy representation acts as repellent and does not help to arise interest and concern as has been found in the case of the BCT. To visualize information e.g. about potential climate change impacts helps people to understand them more easily; creating a 'virtual world' that depicts how a region will likely be affected by climate change can help people to grasp how a possible future may look like.

According to Tergan (2005) visualization has proven to successfully support users in complex problem settings that encompass a huge amount of knowledge and information. Visualizations like diagrams enable users to directly extract information and do not require as much further processing efforts as an equivalent textual representation of information. By reducing the 'cognitive load' of users, their capacity to come along with complex problem solving situations can be enhanced (Tergan & Keller, 2005). Presenting information in form of diagrams etc. thus also offers the opportunity to condense information.

When making use of visualization, it should, however, be refrained from drawing horror scenarios and exaggerate things in order to raise awareness. But visualization can also take place in an objective way that ensures that just scientifically sound facts are adequately provided. That the data to be displayed is reproduced in an unaltered and unbiased way, depicts a basic prerequisite of scientific visualization and is also referred to as 'expressivity' (Schumann, 2000).

Taking account of users' information needs

Another task DSTs should fulfil is to provide information that should bridge the gap between scientists and practitioners. In the case of the BCT this goal seems still not completely achieved as it was perceived as too challenging and academic by some interviewees, especially local policy makers. That there currently still exist misunderstandings between scientists who produce knowledge and practitioners like local politicians who use this knowledge is also indicated by Bray (2011).

One crucial factor seems thus to improve collaboration between scientists and practitioners, and efforts should be made to prepare expert knowledge that is especially tailored to the needs of the target groups (Knoblauch et al., 2012). To just linearly and hierarchically disseminate knowledge can lead to the disregard of local views and limits the potential of tools to find adaption options that meet local needs (Beck, 2013).

The translation of knowledge plays an important role in this regard and refers to the process of not only creating knowledge but also ensuring the actual application of research in decision making. Knowledge translation can be defined as "a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge" (Straus et al., 2009; page 165). The knowledge-to-action framework that is shown in *figure 14* offers a conceptual framework for describing the process of putting knowledge into action.

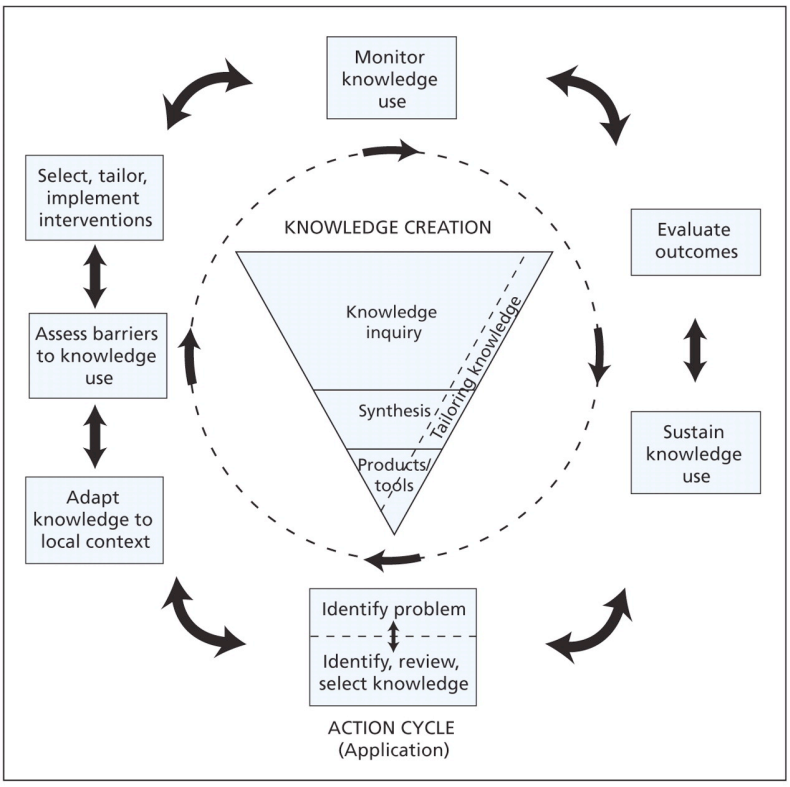

Figure 14: The knowledge-to-action framework (Straus et al., 2009).

The process of knowledge creation also referred to as production of knowledge consists of three stages in the course of which knowledge becomes more and more distilled. The knowledge inquiry depicts the huge unmanageable amount of existing primary studies, the knowledge synthesis aims at compiling the diverse research findings and with the development of decision-making tools and products best quality knowledge should finally be synthesized into user-friendly knowledge. The phases of the action cycle like adapting knowledge to the local context meanwhile encompass the activities required to actually implement and apply knowledge. They can emerge sequentially or simultaneously to the knowledge creation phases and can be influenced by them (Graham et al., 2006).

The provision of such a framework for the complex process of knowledge translation might depict a first step to help knowledge producers and knowledge users to establish a common understanding of what is necessary in order to ensure that research findings are actually applied. The framework furthermore hints at another main purpose of DSTs: namely to condense information (see *chapter 7.4*). According to Graham et al. (2006) tools can be understood as 'third-generation knowledge' that is created in order to provide useful and concise information meeting end-users' informational needs.

The glaring discrepancy between the information needs on the part of decision makers is reflected in the diverging viewpoints that had been found concerning the amount and kind of information the BCT comprises. At the same time as some interviewees perceived the BCT as too challenging others were annoyed that they are considered ignorant about issues like climate change. Whereas the amount of information was subject to criticism by politicians as they called for more aggregated information as

indicated above, spatial planners rather objected the kind of information by designating the BCT as non-specific.

It seems thus to be necessary to design “strategies for tool development in which the need for providing solutions to broad categories of potential users is balanced with the capabilities for tailoring to the specific needs of local end users” (Giupponi et al., 2008; page 26). To take account of the different information needs of actors, a tool should be created in direct cooperation with users (Palaniappan et al., 2008). Developers should not only sit together with potential users for the development of a DST but also afterwards; once it has been created an initial run with target groups could reveal shortcomings and allow for adjustments in accordance with needs. Including a progressive stakeholder feedback e.g. from participatory workshops could help to modify a tool and adapt it to the needs of relevant stakeholders. Whereas users of a tool often have understanding about the dynamics of the decision environment, DST developers could translate the information they receive from them into a working DST.

Before stakeholders are brought together it should be clearly defined what the objective and the target group of a DST are. As objective and target group are DST-specific, tool developers should be well aware of what they exactly aim at and who they want to address.

The usefulness of involving future users in the development process of a tool was also identified by Henning et al. (2011). He even declares that a constructive cooperation between developers and users is a fundamental precondition to the success of tools; by taking participatory development approaches tool usability and user acceptance could be increased (Hennig et al., 2011). A greater end user participation and input during a DST development process may lead to an increased user information satisfaction and consequently to a higher rate of tool adoption (Newman et al., 2000).

So as to address various actors the provision of different entries to a DST seems in principle to make sense not only because some persons might have a better background knowledge than others, but also because different actors require diverging amounts and kinds of information pursuant to what purpose they need it for. The overall idea to divide the initial entry of a DST into different groups of actors and to provide e.g. less detailed information to policy makers as undertaken by the BCT represents a step in the right direction but should be extended as suggested by a few interviewees. A further division into more or less informed actor groups and subdivision into more specific groups of actors could furthermore offer a solution to provide more concrete information tailored to these groups. E.g. the information demands of people working in the tourism sector significantly diverge from those working in the agricultural sector, a further classification could help to provide better suitable and more specific information for both. Sounding like a proper solution, such subdivisions for sure require a high development effort, what impedes the construction of such DSTs.

Further requirements

Another requirement that became obvious is the need for consequent maintenance and monitoring. In order to enjoy a high level of confidence, a DST has to be gradually updated over time (Palaniappan et al., 2008). Scientific knowledge like the one in the field of climate change is subject to regular changes, therefore it is especially of importance to regularly update and integrate most recent scientific findings in the information pools of DSTs. If this is not properly done, users might lose confidence in the reliability of the information given. In addition, long-term monitoring of the performance of a tool is necessary to further (co-)develop it and thus ensure that it is effectively applied. This could as well be done by sitting together with users after the development phase.
One reason why DSTs as project outcomes are not regularly revised after they are once developed is that there is currently a lack of funding for such activities (Palaniappan et al., 2008).

From the criticism that the BCT does not clearly distinguish between climate change adaptation and mitigation measures it can be inferred that a tool should establish clear definitions for different terms and should make clear distinctions where required in order to avoid confusion amongst users. In the case of climate change adaptation and mitigation this could mean to clearly indicate which measures can serve which purpose, even if they are inherently linked in some cases. To prevent this problem right from the beginning it might make sense to focus on one – adaptation or mitigation instead of aiming at giving equally attention to both.

As there are many DSTs currently available that all use different approaches for their analysis and have various thematic orientations and can thus serve more or less different purposes and functions, confusion exists amongst practitioners what tool meets their needs best. Even if probably no tool of the broad range of tool categories available performs the best in every instance, users have to select the one that excels compared to the others in the specific decision context (Sullivan, 2002). Therefore users should be provided with an overview of currently available tools arranged in a user-friendly way that enables them to search according to specific criteria, in a similar manner as well-structured best practice databases.
The need for a regularly updated and maintained centralized source of information that gives an overview of the "daunting array of potentially applicable methods and tools" (UNFCCC, 2008; page 1-1) in the context of climate change adaptation had already been recognized by the UNFCCC in 2004. Their 'Compendium on Methods and Tools for evaluating impacts of, and vulnerability and adaptation to climate change' organizes currently available methodologies and tools according to their type, sectors of application and key cross-cutting themes (UNFCCC, 2008). The catalogue of summarized methods and tools lastly updated in 2009 can be obtained via the following link:
http://unfccc.int/adaptation/nairobi_work_programme/knowledge_resources_and_publications/items/5457.php
Another example for an already existent platform that aims at enabling a systematic search for available tools in the context of climate change vulnerability and adaptation is the web-based MEDIATON platform. It provides information about more than 40 methods and tools and arranges adaptation challenges into sets of decision trees (Wrobel, 2013).

7.6 Sources of errors

In view of above findings, it should be clarified, what challenges and basic conditions existed that complicated the research process prior and during the interview conducting and finally limit the certainty of the obtained results at least in some respects.

In the run-up to the interviews difficulties occurred due to the following factors: Interviewees were found through the distribution list of ARL and internet research, like described in *chapter 5.2*. They had been contacted from the end of June until the beginning of August which fell into the holiday period of both states[6]. Therefore a lot of persons contacted had been on vacations and could not be reached by phone or e-mail. Furthermore addresses on ARL's distribution list were mainly generic addresses of the administration of municipalities, counties and states; just a few concrete contact persons were listed. Due to this fact and that the distribution of the BCT took already place in the beginning of 2012, it was difficult to find out who, back then, had received the flash-drives. In some cases it could be that persons who had received it worked not any longer for the administration as there had been a fluctuation of employees since the beginning of 2012. But in most of the cases the tool got probably lost without being recognized as it did not reach the persons in the right positions. Besides the imprecise addressing, it was probably not considered that many computers of authorities are blocked for external data carriers and the tool distributed on a flash-drive could thus not be opened. Overall just three persons could be found who received the BCT on a flash-drive and were willed to give an interview.
In addition people, no matter if found via ARL's distribution list or internet research, often stated that they would have no time to have a look at the BCT and give an interview. Thus a general lack of time like specified in 'general barriers to climate change adaptation' (*chapter 7.2*) impeded the search for suitable interview partners. Some persons only reacted to the phone or e-mail request after they had already been contacted several times. They probably considered other daily tasks as more pressing and necessary than the request to examine the BCT.

The persons that were finally willed to give an interview can probably not be considered as doubtless representative mean of people working in the Baltic Sea region. In fact, these people are likely those who are principally interested in the topic as already mentioned in *chapter 7.1*. Furthermore the amount of interviewees from the different groups was not evenly distributed; whereas just four policy makers and five spatial planner agreed to an interview, ten business people and eleven persons working in a field connected to climate change could be found. Both people working in the political area as well as spatial planners like those working in local building authorities seemed to be too occupied with their work so that they have little time for other purposes, whereas people specifically occupied in the field and sometimes even concretely employed to deal with climate change issues could more easily invest time to examine the BCT as they saw direct potential relevance for their work. Business people, especially those working as consultants, showed as well more willingness to have a

[6] summer holidays 2013: Schleswig-Holstein 24.06. - 03.08.; Mecklenburg Western-Pomerania 22.06. - 03.08.

look at the BCT and give an interview. The imbalance across the different actor groups for sure impedes the comparability and representativeness of the results. Research was furthermore overall limited to a certain level and type of potential users; whereas 14 interviewees worked at a local level, just three were occupied at district as well as state level (see *table 4*) and not all working areas could be covered. For the actor group `business people´ e.g. it was more difficult to find people directly working in the agricultural and tourism sector like farmers or hotel keepers than persons acting as consultancies in these sectors like ones from tourism and farmer associations.

Problems also occurred directly with or in the course of the interviews. First of all it should be kept in mind that all interviews were conducted via phone. Telephone interviews do have some disadvantages in comparison to face-to-face interviews. One aspect e.g. is that interviewer and interviewee do not see each other and consequently non-verbal cues like gestures and body language that are actually of importance for a conversation cannot be perceived and responded to. But in the framework of this thesis conducting a personal interview was not possible due to limited time and money available for travelling longer distances.
Whereas some persons volunteered very quickly and took their time to give an interview, others could only be convinced to give one after they had been asked several times. Overall most interviewees had just limited time available to conduct the interview therefore not all questions could be addressed to every interviewee. They probably spent not only little time on the interview conducting itself but also on investigating the BCT beforehand. Most interviewees likely took just a brief look at the toolkit and their statements are thus not that well-founded; assessments are based on their overall impression and not on an intensive investigation of the BCT.
Furthermore, some of the interviews came about spontaneously for example when people responded to an e-mail via phone and wanted to directly give an interview. It was thus not always possible to sufficiently prepare for the specific background of the interviewee and ask particularly tailored questions.
As mentioned in *chapter 5.2* just hand-written notes were taken during the interviews and no complete records made. This was done as the intention was rather to capture the essential underlying meaning of statements interviewees made than the exact phrasing of them. Nevertheless it should be kept in mind that, due to this, the exact wording of some statements got possibly lost in a few cases.

Overall it should be refrained to expect that qualitative data can claim the status of empirical evidence. Even if 30 interviews were conducted, qualitative interviewing represents a qualitative research method that does not aim at providing reliable quantitative results. Generalizations made are thus not based on the criterion of representativeness but on the reconstruction of typical patterns excerpted from samples that had been consciously selected (Helfferich, 2009).

8 Conclusions and outlook

The objective of this thesis was to determine if decision support tools can facilitate decision making in the context of climate change adaptation and to develop requirements for the success of such tools. The investigation of the BalticClimate Toolkit in fact revealed that even if decision making in the context of climate change adaptation may generally be assisted by DSTs at least in some respects, various factors have to be taken into account to ensure that a DST is effectively applied.

Potential for DST application was overall seen in the following areas: DSTs could be used to call attention to climate change issues, to get better informed about climate change and to receive an approach how to generally structure a decision making process in the context of climate change. Especially in the internet era, ways of processing the huge and diverse information and knowledge amount that is available have become an essential part of human activities. The complexity of the climate change decision making context might often exceed the mental capacity of single decision makers, and approaches are thus needed helping them to get along with the overwhelming amount of information. DSTs could thereby serve as instruments that concentrate knowledge in a task and user-oriented way and provide decision makers with structuring guidelines.

Despite these potentials, the adoption of tools like the BCT seemed to be limited so far. Several reasons behind the low adoption could be revealed and accordingly factors required for a successful DST-application be identified. Both, barriers that generally hinder climate change adaptation efforts and in consequence also impede the application of DSTs as well as essential requirements specifically related to DSTs should thereby be taken into consideration.

Main general barriers to climate change adaptation identified were the uncertainty of climate change projections, the lack of money and time to deal with the topic, the insufficiently answered question of whose responsibility it is to take action and that climate change was not perceived as significant risk compared to other ones by people living in the Baltic Sea region. Before these obstacles are not overcome and the underlying climate change decision making situation is not clarified tools for climate change adaptation will probably not be used. Even if improvements will be made in projecting climate changes by using advanced regional climate models and scenarios (RCPs), some uncertainty will likely remain. Thus robust mechanisms to cope with the existing uncertainty as well as appropriate regulatory conditions that control that resources are also allocated to climate change efforts are needed; without effective institutional support climate change efforts will probably remain resource-constrained. In view of that, roles and responsibilities for climate change adaptation actions have to be clarified. As the distribution of administrative power in Germany seems to create vagueness, cooperation between different administrative levels should be strengthened and local authorities should be better supported in developing climate change adaptation measures, also by higher instances. Adaptation could furthermore be ‘mainstreamed’ into wider sustainable development processes like in overall coastal zone management and thus integrated into superior policy agendas (IPCC, 2007c).

The following aspects that currently hinder the application of DSTs directly connected with tools themselves became apparent on the basis of the interview results.

It was most obvious that DSTs cannot work without communication; an effective communication is essential and probably key to the actual adoption of DSTs. This seems especially holding true for web-based tools because still not every person is sufficiently advanced in using the internet as source of information. Not only promotion is required in order to call attention to and disseminate a tool, but also an active support is needed when it comes to how to use it. Workshops in the framework of regional conferences led by tool experts and/or experts in the area of interest depict an appropriate option to create space for face-to-face interactions serving as impetus and facilitator for the use of DSTs.

One challenge for DST developers exists in finding the proper amount and kind of information. The BCT was perceived as too detailed, complex and challenging; interviewees called for more condensed, less text-heavy, less academic and more pragmatic information. In general it seemed that practitioners favoured as little text as possible, but due to the fact that DSTs should still provide enough knowledge to ensure well-founded decision making and that the BCT was also perceived as not specific and flexible enough to adapt to specific local needs at the same time, the question arises how to bring these diverse demands together. Ways of knowledge transfer have to be found that provide manageable amounts of information on one hand, but still allow users to obtain information precise enough to take account of local circumstances and that ensure well-founded decision making.

Different approaches already adopted by other decision support tools and systems that had been taken up in this thesis might depict possibilities to enhance the specificity of DSTs.
One is to develop best practice databases that allow users to systematically search for specific cases of interest according to different criteria, whereas an objective appraisal of the given examples should be ensured. The utilization of lessons learned has potential to improve the efficiency of decision making, thus a further development of best practice databases makes very likely sense.
Another possibility is to integrate specific models and/or analysis methods like CBA, CEA and MCDA into a DST. Whereas models give users the chance for what-if scenario modelling by the input of site-specific data and parameters, different analysis methods allow for the evaluation of different decision alternatives based on monetary terms (CEA, CBA) or aggregated preferences (MCDA). To combine one or even several analysis methods and/or models with existing tool approaches of so far rather information and guideline-based tools might help to deepen their analysis.
Objective visualization is a further option to provide information in a better understandable and aggregated version. People often can process information more easily if it is presented in a visual way as one given in text form. To use visualization in combination with what-if modelling might help actors to grasp the consequences of their decisions by providing vivid representations of how their region will likely be impacted in response to taking specific adaptation options.

As it has been found that information needs differ between different groups of users depending on their knowledge, experience with climate change, actual daily working tasks and for what purpose they intend to use a DST, further efforts should be made to determine what kinds and amounts of information different users exactly require. Beforehand it should be clarified which target groups are to be addressed and the exact aim of a tool should be clearly defined. Through the involvement of relevant stakeholders in the DST development process, tools could be adapted in accordance to the identified needs and possibly different entries to a tool be prepared if necessary.

It was revealed that misunderstanding currently still exists between knowledge producers and knowledge users, thus the involvement of practitioners in the initial as well as further development of DSTs is of general importance. DSTs have the potential to be conducive to bridge the gap between scientists and practitioners but only if the needs of users are fully understood and taken into account. 'Knowledge translation' that refers to the process of producing, disseminating and actually ensuring the use of knowledge could thereby play an important role. Taking a conceptual framework for knowledge translation in a DST development process into consideration might help to understand what is required to ensure that knowledge is actually applied.

Regular and adequate maintenance and monitoring of DSTs seems to be a so far rather neglected issue. In the case of the BCT no consequent update and further development have taken place after its completion in 2012. In order to gain user's trust in the credibility of a DST it is important to present latest confirmed scientific findings. If no monitoring takes place, the actual rate of application and reasons why a tool is not at all or just restrictedly used remain undetected. Consequently, no modifications and improvements are made to ensure a proper application of a DST. One reason for the disregard of maintenance and monitoring is probably that there is currently a lack of funding for such activities. Whereas tools are often developed in the framework of externally funded projects, maintenance and monitoring are activities that must be undertaken after the end of projects and no money is in particular earmarked for them. Funds should therefore in future not only be channelled to climate change adaptation projects incorporating the development of DST but also in particular to the maintenance and monitoring of them.

As there is currently also a trend to an overwhelming or even daunting amount of tools, it probably makes more sense to invest efforts and money in maintaining and further developing already existing tools instead of developing more and more new ones.
The huge amount and various types of DSTs currently available, also in the context of climate change adaptation, makes it difficult for users to choose the one that is most suitable for a particular purpose. Thus there is a need for a centralized source of information that provides an overview over existing tools and helps decision makers to find the most suitable one. An extension, further development and regular update of already existing catalogues and platforms enabling users to systematically search for specific tools should ensure that all relevant tools are actually captured and allow for a search as precise as possible according to different criteria.

In summary the BCT should be improved in the following respects: There is a need to alter the amount and kind of information that is presented. Information should be further aggregated or summaries provided where possible at least for the actor group policy makers. In addition concernment should more strongly be raised and benefits of applying the tool more clearly presented. To reduce the impression of being too unspecific, the BCT could amongst others provide information for individual Baltic Sea countries, sub-divide the actor groups even further, make more use of visualization instead of text-heavy representations and extend the provided examples. At the moment no efforts are made to further develop or update the BCT, probably as no money is directed to it anymore after the BalticClimate project had finished in 2011. Therefore it should be looked for funding opportunities to finance update tasks as well as regional workshops in which the BCT is presented, users are assisted in applying it and decision makers´ actual needs are revealed in order to adjust the tool.

Overall it should be kept in mind that it will hardly be possible for DSTs to provide specific information for every individual user. DSTs often aim at multiplying project outcomes and thereby always entail a generalization to some extent. But as the complexity of the decision situation in the context of climate change adaptation does not allow taking completely standardized approaches, additional information and support probably will always be required. DST approaches to tackle complex decision making situations, can help to convene people and stimulate thinking, but they will never make actions on their own and are thus not an end in themselves; tools can support but not replace an active examination of the specific decision making situation. They have the potential to improve the efficiency and effectiveness of decisions by providing structuring approaches and incorporating lessons learned but they do not necessarily eliminate 'bad decisions' if their outputs are not critically regarded. Thus DSTs should not only clearly and transparently demonstrate which purpose they can serve but also what they are not able to accomplish.

Finally DST developers may consider the findings of this thesis but to ensure that they can really be used as reliable basis for the development of DSTs in the context of climate change adaptation, further research is required in order to confirm the results given here; especially because there are several reasons that limit the actual reliability of them as specified in *chapter 7.6*. Research should be replicated for more as well as other types and levels of potential users that could not been covered with this thesis. Particularly for the actor group policy makers there is a need for further investigations as comparatively few persons could be interviewed from this group of actors. The provision of incentives may thereby help to motivate people - also ones who are not principally interested in the topic - to give an interview. Furthermore it could be looked for other ways to search for potential interviewees e.g. personally visiting municipal administrations. Conducting personal instead of telephone interviews will probably strengthen the relationship between interviewee and interviewer and potentially improve the interview results. In addition recording all interviews and subsequently transcribing them will exclude the risk of missing the exact wording of some statements. Future research could examine DSTs in the context of climate change adaptation more in detail based on the results of this thesis, whereby also qualitative research could be conducted to investigate the representativeness and empirical evidence of the obtained results.

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Appendix

Interview guide (policy makers and spatial planners)

1. Experience of the interviewee with climate change and climate change adaptation

Have you been already confronted with climate change and/or climate change adaptation as policy maker/spatial planner?
Are you aware of possible, future climate changes and their impacts?
Do you see necessity to include consideration about climate change impacts in future political/planning decisions? Have you already been concerned with the issue?
How important do you think are they compared to other issues?

Has the issue already been broached in your office/agency/municipality/party…? Why?
Was the issue already been considered/involved in any activity?
Have you already been involved in any kind of adaptation planning process?

A If yes:
What exactly got you started?
Can you tell me a little bit about the project you had been involved?
Where do you stand in the process at the moment? Already implemented? Still in progress?
What was your role in the process? Why are you involved?
Did you identify any specific barriers? What hinders the process?
Was there an overall good outcome? Was it successful?
Do you see any barriers to the adaptation process?

Purpose: This is meant as opening of the interview. It should be identified if the interviewee is already familiar with adaptation planning and had already been involved in an adaptation planning process or not.
If yes it allows the interviewee to speak from his/her expertise and experience, and gives basic information about the interviewee's involvement in/experience with adaptation planning.
If not the interviewee´s perception of climate change should be revealed and her/his actual awareness and attitude against climate change and climate change adaptation identified.

2. The Baltic Climate Toolkit as decision support tool

Do you already have experience with any kind of decision support tool?
Have you already heard about such a tool/similar tool before?
Do you have already experience with any kind of decision support tool in another context than climate change?
Did you already heard about some of the methods mentioned/referred to before (vulnerability assessment…)?
Did you already make use of them in another context?

What was your first impression of the tool?
Did you already know the tool before (from USB-stick distribution)? Did you have a look at it? When?
Do you like the structure and design of the Tool?
Is the tool easy to handle/clearly arranged/well structured/easy to assess?
Did it provide new information to you? What was new, what did you already know?
Is the information adequately presented?
Was the amount of information suitable? Too much/not enough?
Are the different process steps (recognizing the problem, vulnerability analysis…) as well as the various exercises easy to understand and traceable?

Did you already use the BalticClimate toolkit?
In which process did you use it? Why?
Was the process induced/inspired by the toolkit? Or was it just used to structure an always existing/planned process?

How exactly did you integrate it in the process? Did you use just some aspects/whole procedure (all stages)?
Did you maybe use one/several of the methods mentioned/referred to (vulnerability assessment, stakeholder mapping…) in your decision making process?
Did you use further sources of information?
How did you carry out different planning process steps if you didn´t use a tool? Which sources of information did you use?

If you didn´t use the tool yet, could you imagine to use the tool as guidance for you in future?
Would it make sense to integrate the Tool in future decisions/processes?
Could it help to consider climate change considerations in future planning?
Do you maybe know about processes that are planned where the tool could find appliance?
What/which aspects of the tool could be integrated in your work?
What barriers/difficulties for integration do you see?
Would it be useful/necessary for you to involve an external expert in the process?

Do you have concrete ideas/suggestions for improvement?
What information did you miss? Which additional information would be helpful/is needed?
Is the amount of information provided sufficient/appropriate? Should there something added/cut out?
What did you miss? Is there a lack of any specific information?
What should be altered/ presented in different ways?
Do you know another tool were information is provided in a better way/which is more useful for you?
How could it be improved? More/less/other kind of information?
From lessons learned/your experience /from the barriers you identified in your planning process:
What are the positive and negative aspects of the tool? What should be integrated in the tool?
Do you have any general suggestions for improvement?

Would you recommend the tool to somebody else? Why/why not?
Do you think it is more or less suitable for some persons/sectors/situations…?
Why do you think does such a tool work/not work?

Do you think the tool can close the gap between scientists (climate experts…) and practitioners (policy makers…)? Can a toolkit in general achieve this?
Do you see any solutions how to cope with the barriers/difficulties to implement adaptation planning/use such a tool?
Does the uncertainty of climate change projections play a role?

Purpose: The second part is the central/intrinsic part of the Interview and meant as critical review of the BalticClimate toolkit. It should draw the relation to decision support tools in the context of adaptation planning. If the interviewee was already involved in an adaptation planning processes as identified in 1, it should be clarified if he/she maybe already made use of the BalticClimate toolkit in particular or any other decision support tool.
Shortcomings and benefits should be identified and the interviewee´s experience thereby used to describe areas of improvement and criteria for success.

Interview guide (business people)

1. Experience of the interviewee with climate change and climate change adaptation

Have you been already confronted with climate change and/or climate change adaptation in your business?
Are you aware of possible, future climate changes and their impacts?
Do you think climate change is of relevance for your business?
Do you see necessity to include considerations about climate change impacts in your business?
Have you already been concerned with the issue in your company?
Do you think your business will benefit or lose by the expected climate changes?

Has the issue already been broached in your company/business?
Are there already approaches made to include climate change considerations in your business?
Do you already have any specific experience with the development and implementation of adaptation measures? Have you already been involved in any kind of adaptation planning process?
Can you tell me a little bit about the project you had been involved?
What was your role in the process? Why are you involved?

Purpose: This is meant as opening of the interview. It should be identified if the interviewee is already familiar with adaptation planning and had already been involved in an adaptation planning process or not.
If yes it allows the interviewee to speak from his/her expertise and experience, and gives basic information about the interviewee's involvement in/experience with adaptation planning.
If not the interviewee´s perception of climate change should be revealed and her/his actual awareness and attitude against climate change and climate change adaptation identified.

2. The BalticClimate Toolkit as decision support tool

Do you already have experience with any kind of decision support tool?
Have you already heard about such a tool/similar tool before?
Do you have already experience with any kind of decision support tool in another context than climate change?
Did you already heard about some of the methods mentioned/referred to before (SWOT analysis…)?
Did you already make use of them in another context?

What was your first impression of the tool?
Did you already know the tool before (from USB-stick distribution)? Did you have a look at it? When?
Do you like the structure and design of the Tool?
Is the tool easy to handle/clearly arranged/well structured/easy to assess?
Did it provide new information to you? What was new, what did you already know?
Is the information adequately presented?
Was the amount of information suitable? Too much/not enough information?
Are the various exercises ("risks and chances for business people") as well as the SWOT analysis steps easy to understand and traceable?

Could you imagine using the tool as guidance for you in future?
Would it make sense to integrate the Tool in your business?
Could it help to consider climate change considerations in future? Could you benefit from climate change adaptation measures?
Is the tool any kind of motivation/impulse for you to regard climate change aspects in future?

What/which aspects of the tool could be integrated in your work?
Do you see any areas for appliance in your business?
Are there already processes planned for which the Toolkit could be used?
What barriers/difficulties for integration do you see?
Would it be useful/necessary for you to involve an external expert in the process?

Do you have concrete ideas/suggestions for improvement?
What information did you miss? Which additional information would be helpful/is needed?
Would it be helpful to have more specific examples?
Is the amount of information provided sufficient/appropriate? Should there something added/cut out?
What did you miss? Is there a lack of any specific information?
Do you know where to find additional information?

Do you know another tool were information is provided in a better way/which is more useful for you?
From lessons learned/your experience/from the barriers you identified in your planning process:
What are the positive and negative aspects of the tool? What should be integrated in the tool?
Do you have any general suggestions for improvement?
What should be altered/presented in different ways?

Would you recommend the tool to somebody else? Why/why not?
Do you think it is more or less suitable for some persons/sectors/situations…?
Why do you think does such a tool work/not work?

Do you think the tool can close the gap between scientists (climate experts…) and practitioners (policy makers…)? Can a toolkit in general achieve this?
Do you see any solutions how to cope with the barriers/difficulties to implement adaptation planning/use such a tool?
Does the uncertainty of climate change projections play a role?
How could the toolkit further distributed/circularized amongst businesses?

Purpose: The second part is the central/intrinsic part of the Interview and meant as critical review of the BalticClimate toolkit. It should draw the relation to decision support tools in the context of adaptation planning. If the interviewee was already involved in an adaptation planning processes as identified in 1, it should be clarified if he/she maybe already made use of the BalticClimate toolkit in particular or any other decision support tool.
Shortcomings and benefits should be identified and the interviewee´s experience thereby used to describe areas of improvement and criteria for success.

List of people briefly commented on the BCT

Table A: List of people whose comments are collected from phone calls or mail contacts (comments in detail can be found on the attached data CD-> '*phone calls and mail contacts*')
[1] municipality, city, district or state for which the person contacted were working
[2] level at which people contacted were working (for business people not specified as they are not in particular occupied at a specific level):
l = local level - employed by municipalities and cities; d = district level - employed by administrative districts and regional organizations; s = state level - employed by state ministries and offices

	name	***party***	***commitee***	***location[1]***	***level[2]***
policy makers	Jens Johannsen	The Green Party - Bündnis 90/ die Grünen	environment, nature, building and traffic	Ostholstein	d
	Anja Evers	Christian Democratic Union of Germany -CDU	environment and energy	Timmendorfer Strand	l
	Wolfgang Niemann	The Social Democratic Party of Germany - SPD	environment, nature, energy and building	Ratekau	l
	Peter Todeskino	The Green Party - Bündnis 90/ die Grünen	city councillor for urban development and environment	Kiel	l
	Imke Mayer	Christian Democratic Union of Germany -CDU	environment	Scharbeutz	l
	Christine Koglin	The Independent Voter Community - WUB	environment	Scharbeutz	l
	name	***field of work***	***institute/ organisation***	***location[1]***	***level[2]***
Spatial planners	Astrid Dickow	department for spatial planning and budget	state chancellery	Schleswig-Holstein	s
	Bernd Straßburger	department for planning, building and environment – district (Lankreis) Ostholstein	district authority	Ostholstein	d
	Herr Preissler	department for regional development, building and environment	district authority	Vorpommern-Greifswald	d
	Gabriele Hoffmann	regional and spatial planning	regional planning association	Westmecklenburg	d
	Katja Klein	regional and spatial planning	regional planning association	Mecklenburg/ Rostock	d
	Marcel Quattek	building department	municipal authority	Heiligenhafen	l
	Ulrich Bendlin	building department	municipal authority	Kappeln	l
	Gerd Aloe	administrative officer	municipal authority	Geltinger Bucht	l
	name	***field of work***	***company***	***location of company***	
business people	Bernd Opfermann	coastal zone protection, canal and port engineering	b&o Ingenieurs	Hamburg	
	Daniel Schade	coastal zone protection, dike construction	Engineering company Mohn	Kiel/Husum	
	Claudia Temps	Spatial planning and urban development	chamber of industry and commerce MV (IHK)	Rostock	
	Kai Retzlaff	Innovation and technology consultant	chamber of industry and commerce MV (IHK)	Rostock	

	name	***field of work***	***institute/ organisation***	***location[1]***	***level[2]***
working in a field connected with CC	Axel Strunk	department for rural development	state agency for agriculture, environment and rural areas (LLUR)	Schleswig-Holstein	s
	Dr. Joachim Voß	department for coastal zones	state agency for agriculture, environment and rural areas (LLUR)	Schleswig-Holstein	s
	Ullrich Buchta	department for energy efficiency and climate protection	ministry for energy, infrastructure and development	Mecklenburg-Vorpommern	s
	Frau Dr. Romberg	department for energy efficiency and climate protection	ministry for energy, infrastructure and development	Mecklenburg-Vorpommern	s
	Prof. Dr. Ralf-Otto Niedermeyer	department for geology and environmental information	state agency for the environment, nature conservation and geology	Mecklenburg-Vorpommern	s
	Jacobus Hofstede	coastal zone protection	ministry of energy, agriculture, environment and rural areas	Schleswig-Holstein	s
	Stephan Latzko	climate change mitigation manager	district authority	Vorpommern-Rügen	d
	Thorsten Mantey	department for natur conservation	district authority	Rostock	d
	Herr Karrolack	environmental officer	municipal authority	Dahme	l

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ISSN 2192-4058

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