Summer Course on Sustainability, River Basin Management and Climate Change in the Baltic Sea Region

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Topic:

Dealing with the challenge of climate change in the Baltic Sea Region:

Promoting regional sustainable development

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Abstract

This essay will discuss the topic "Dealing with the challenge of climate change in the Baltic region: promoting regional sustainable development". The first part addresses the Baltic Sea in general. The focus will be on the genesis, geography, climate, and ecology of the Baltic Sea. In the following an explanation of the climate change and its specific consequences for the coastal region of the Baltic Sea will be given. Subsequently, some select projects sustainably preparing the Baltic Sea region for the chances and risks of the climate change will be presented. At the end, a closing statement summarising the knowledge gained through the work on the topic will be provided.

Data and facts about the Baltic Sea

This chapter is to build the basis for addressing the problem "Dealing with the challenge of climate change in the Baltic Sea Region". Firstly a geographical overview of the Baltic Sea will be given, followed by a brief digression about its formation and an introduction of specific climatic characteristics. Lastly the focus will be on the Baltic Sea as an ecosystem.

The Baltic Sea is an inland sea off the Atlantic Ocean. *(see Lexikon-Institut Bertelsmann (publ.), p. 457)*. It is almost completely surrounded by the European continent; the Baltic Sea separates the Scandinavian Peninsula from the mainland of northern, north-eastern and central Europe. The Baltic Sea borders 11 European countries; with a surface area of 412,000 square kilometres and a volume of circa 21,700 cubic kilometres is considered the largest brackish body of water on earth. *(see Liedtke and Marcinek,(2002))*. On average the sea is 52 metres deep, although the maximum depth reaches 459 m (Landort Deep) because of the heavily fissured sea ground. Specific features of the Baltic Sea are the numerous bays, straits, islands, and firths that shape the unique character of this inland sea.

The late-glacial and post-glacial emergence of the Baltic Sea as well as its development can be explained by the interaction of glacial isostatic adjustments (upward and downward vertical movement of land masses) and a eustatic rise of the sea level. The development can be classified into four main phases (Baltic Ice Lake, Yoldia Sea, Ancylus Lake and Litornia Sea) that are characterised by the changing connection to the ocean and the varying salinity. No further detailed explanation of the processes within these phases will be provided within this essay, though. The present appearances like the channel-shaped and narrow glacier tongue basins of the firths of Schleswig-Holstein and the rugged glacier basins of the Western Pomeranian coastal area result from the melting of the last Nordic continental ice sheet that significantly formed the coastal line of the Baltic Sea. During the past 2,000 years the Baltic Sea desalinated more and more because of the constant fresh water inflow from rivers. Moreover, the salt water inflow was restricted by the Danish straits. *(see Voigt)* Nowadays the salinity of the Baltic Sea fluctuates due to weather and region. The salt content in the western Baltic Sea (Belt Sea) is at 1.7 per cent and between 0.3 and 0.5 per cent in the northeastern part (Bothnian Bay and Gulf of Finland).

The climate of the entire Baltic Sea region is influenced not only by the geographical conditions but also two pressure systems (Azores High and Icelandic Low). The southern, western and eastern part of the Baltic Sea are located in the Temperate Zone, nevertheless there are differences regarding temperature and precipitation amount. These differentiating conditions are caused by the increasing

influence of the continental climate further east. The northern part, particularly the Bothnian Bay, is shaped by the conditions of the Frigid Zone. Due to the consequences of the global climate change the climatic conditions in the region as well as the existing ecosystem will change. At the moment the Baltic Sea is the largest brackish water ecosystem, thus providing a habitat for numerous salt and fresh water species. The Baltic Sea serves as the living environment to grey seals, codfish, mussels and other. A rapid change of the climatic conditions because of the global climate change would be a catastrophe for this relatively young and endangered ecosystem (inflow of nitrogen from agriculture; anthropogenic metal inflow from the mainland).

The global climate change

Before determining the specific consequences of the climate change for the Baltic Sea region, an outline of the global effects caused by this of climate conditions is given. The climate system, consisting of the atmosphere, the oceans, the land surface, the cryosphere and the biosphere, is characterised by variable marginal conditions, external influences, internal processes, and interactions. Those natural influential factors that cause climate change measured by different temporal and spatial scales are considered to be, for instance: tectonic processes, land and sea distribution on the Earth, the character of the ocean basin, the position of the continents within the geographic coordinate system, the formation of high mountain ranges and other processes. Thus, the climate change did not start with human beings interfering with the climate system. *(see Endlicher and Gerstengarbe (publ.) (2007), p. 1 ff.)*Nevertheless, a significant exertion of influence on the climate system has been developing which is mainly generated by the following activities: emission of trace gases and particles; and alterations of the earth's surface. This results in changes of the local landscape and climate; specific climate changes in the area of urban settlements, changes in the air composition, impairment of the stratospheric ozone layer serving as an UV filter; and changes in the earth's radiation and energy budget. *(see Endlicher and Gerstengarbe (publ.) (2007), p. 10)* Statements about the putative anthropogenic climate changes can only be made with the help of climate models. Thereby they are a central element in climate research. Since 1970 an unprecedented rise in temperature has been recorded which has brought about a warming rate of 0.7 degrees Celsius since the end of the 19th century. Striking is the rapid temperature rise since the beginning of the industrialisation in Europe and Central America; and its rocketing emissions. *(see Endlicher and Gerstengarbe (publ.) (2007), p. 44 ff.)* Today's research on climate change is based on a simulation of future greenhouse gas emissions, by means of which the development of the climate system on the earth until the end of the 21st century can be projected. This is done using so-called emission scenarios that are based on assumptions about future demographic, technologic and economic development of the society *(see Endlicher and Gerstengarbe (publ.) (2007), p. 48)*. Independent from the given emissions scenarios, all climate scenarios predict a temperature decrease over the coming decades. The temperature rise estimated by the A2 scenario predicting the worst case is 3-6 degrees Celsius in correspondence to the year 2000. The B1 scenario predicts an average increase of 1.8 degrees Celsius by 2100. In case all emissions stagnated on the level of the year 2000, the temperature increase would still be 0.6 degrees Celsius until the end of the 21st century. Taking the average of all simulations and scenarios, the presumed temperature rise will be approximately 2.8 degrees Celsius. Such a temperature change would have grave consequences for our ecological and socioeconomic living environment. *(see Endlicher and Gerstengarbe (publ.) (2007), p. 50)* One reason is that the oceans and coastal regions influencing the climate system greatly are affected by the reaction of the global climate in response to the swiftly rising greenhouse gas concentration. This leads to an adjustment of the physical, biological, bio and geochemical

composition. This induced modification of characteristics is first reflected in the warming of the open seas in depths of 3,000 metres. This causes the following effects: decrease of the sea ice cover and regional changes of the oceans' salinity, rise of the sea level, more frequent occurrence of tropical hurricanes, shifts of habitats and species, changes in the biodiversity, and heavy strains on sensitive or already weakened ecosystems. In return it is to be expected that the functions of seas and coastal waters will experience numerous impairments and disturbances. *(see Endlicher and Gerstengarbe (publ.) (2007), p. 80)*

The influenc of the global climate change on the Baltic Sea

The Baltic Sea region facing the global climate change and the resulting processes that influence seas and coastal waters more and more is confronted with threatening climate impacts.

Within the scope of the Assessment of Climate Change for the Baltic Sea Basin Project (BACC), 80 scientists from 12 countries try to determine the past, present and future influence of the climate on the Baltic Sea region. According to Prof. Dr. Hans von Storch, Director of the Institute of System Analysis at the GKSS research centre, the BACC report represents a regional variant of the IPCC report (Intergovernmental Panel on Climate Change) on global climate change *(see press release of the GKSS research centre Geesthacht (21.01.2008))*. Concentrating on examining four sectors of influence of the climate change in the past and future as well as climate-related changes in the terrestrial and marine ecosystems the scientists came up with the following results:

The air in the Baltic Sea region has grown 0.7 degrees Celsius warmer over the past, thus heating up more than average (0.5 degrees Celsius) *(see Baltex Assessment of Climate Change for the Baltic Sea Basin (2006), p. 7)*. There are regional differences, though. While the warming in the north was 1 degree Celsius, it was 0.7 degrees Celsius in the south *(see press release of the GKSS research centre Geesthacht (21.01.2008))*. There is a tendency that the vegetation period in the first half of the year starts earlier while the period of frost in the second half starts later. Generally, the number of night frosts significantly decreased and the number of warm days increased. This tendency intensifies during the winter season. Furthermore, the rainfall in the Baltic Sea region increased which especially affected Sweden and the east coast. Especially the winter and spring season became wetter; the southern Baltic Sea region (Germany, Poland), in contrast, experienced drier summers. *(see Baltex Assessment of Climate Change for the Baltic Sea Basin (2006), p. 8f.)*

In the future the body of water of the Baltic Sea will be on average 3 to 5 degrees Celsius warmer; in winter the temperature rises by 4 to 6 degrees Celsius, in the summer months by 3 to 5 degrees. Noticeable are seasonal differences; in the north, the body of water warms up especially in the winter months while the southern part heats up in summer. The milder climate will lead the Baltic Sea's winter ice coverage to shrink by 50 to 80 per cent. Furthermore, an increase in the annual wind speed on the mainland of 8 per cent is to be expected. Seasonal peaks are reached in winter which leads to storm surges bearing a higher risk for the inhabitants of the coastal regions. As a result of the climate change, precipitation and rainfall distribution present themselves differently. Winters will be significantly wetter, with the rainfall increasing 25 to 75 per cent in the north and 20 to 70 per cent in the south, respectively. Summers on the other hand will tend to become drier. The climate simulations presume fluctuation of precipitation between - 5 and + 35 per cent for the northern Baltic Sea region. A 45 per cent decrease is to be expected for the southern Baltic Sea region. Because of the humid autumn and winter months, the salinity of the Baltic Sea will drop by 8 to 50

per cent. This would have a great impact on the flora and fauna of the Baltic Sea. *(see Baltex Assessment of Climate Change for the Baltic Sea Basin (2006), p. 10ff.)*

All components, from bacteria to commercially exploited fish species, of the ecosystem are affected by climatic changes. In consequence of rising temperatures, a shift in the proportion of bacteria and phytoplankton biomass will occur. In addition, a migration of species to the northern part of the Baltic Sea that is less affected by the warming will take place. Besides, in the summer months more algae bloom will be seen especially in the southern Baltic Sea. The declining salinity has an impact on the transformation of the ecosystem in various ways. On the one hand it will cause a modified horizontal and vertical diversification of organisms. This affects the growth and reproduction rate, too. Since there is more fresh water inflow salt water species face a higher osmotic pressure which weakens these species and causes them to migrate to parts with higher salinity or disappear from the Baltic Sea. In a parallel process fresh water species strengthen and become more competitive compared to salt water organisms. Rising water temperature and dropping salinity in combination with chemical pollution of the seas and a decline in oxygen content cause the native species to be less fit which may lead to their displacement. Generally, a drop the number of species has to be expected. One reason for that is the eutrophication of the sea; especially areas near the coast suffer from the high nutrient inflow. This process eventually leads to a break-down of the ecosystem as a result of excessive growth and elevated biodiversity. Afterwards, a new ecological balance has to be redressed which is characterised by a low biodiversity and episodic outbursts of dominant species. *(see Baltex Assessment of Climate Change for the Baltic Sea Basin (2006), p. 18ff.)* This illustrates the urgent need to address this issue regarding the preservation of the ecosystem Baltic Sea as well as the entire region.

Sustainable development in the Baltic Sea region

Preservation of the Baltic Sea region is only possible if sustainable development is regionally promoted. Already in1996 the neighbouring states ratified a local agenda on sustainable development of the Baltic Sea region based on the global agenda 21. The Agenda Baltic 21 ("Baltic 21") was signed and passed 22nd/23rd June 1998 during a session of the Council of the Baltic Sea States (CBSS). Doing this the neighbouring states pledged to work together on regional development in the Baltic Sea region that is characterised by a balanced relation of economy, ecology and social aspects. The Senior Officials Group that was appointed by the CBSS and is supported by a secretariat in Stockholm, Sweden, is in charge of putting the plans into practice. Baltic 21 is active in eight sectors (energy, fishing, industry, agriculture, tourism, transport, environmental education and forests) that are supervised by two involved states or organisations. Beside the CBSS members engaged groups include the European Commission, international financial and science institutions, semi- and nongovernmental organisations. Baltic 21 set its goal in promoting the development of the Baltic Sea region according to sustainability model by coordinating aims and activities as well as improving transnational communication. This is supposed to be achieved by the support of the CBSS relating to the aspiration of sustainable development, strengthened participation in transborder work and contribution to set goals and visions. Additionally, Baltic 21 coordinates the realisation and financing of local lighthouse projects within the limits of the concept of sustainable development. *(see* "Internationaler Umweltschutz, Antarktis Agenda Baltic 21"*(30.01.2009),)* Some of these lighthouse projects are "agora", "asap", "BaltCoast", "Balticforest", "BalticSeaBreeze", "EHSA", "New HAnsa of Sustainable Ports and Cities", and "sustainment". The following is to give a brief overview of the "BaltCoast" and "New Hansa of Sustainable Ports and Cities" projects

Landscapes in Europe are changing constantly. Especially the northern European landscapes are subject to constant restructuring because of the ice age, building of settlements, agricultural use, and other activities. This has a heavy impact on the habitats of native animals and plants. The LIFE project Baltcoast being under the patronage of Baltic 21 is to preserve the nature of the Baltic Sea coast. It is aimed at promoting the exchange of experience among neighbouring states regarding the changes, problems and dangers the Baltic Sea is facings and at developing solutions. This is why the project brought together a number of experts, area supervisors, agency representatives, and other important people from five neighbouring states (Germany, Denmark, Estonia, Lithuania, and Sweden). According to this project the focus is supposed to be on the preservation of the natural water balance. Three main steps are to achieve this: re-establishment of the natural hydrology of lagoons and salt meadows. This can be done by blocking drainages and ditches, removing reed and creating hollows in the meadows. Another measure is having cattle and horses graze on those meadows. This is how invasive animal and plant species are reduced and native ones strengthened. By building dune valley and hollows the natural morphology of dunes is restored. All measures are supported by public-relations work - guided tours, excursions and workshops, in order to make the population aware of this kind of coast management. *(see "LIFE-BALTCOAST" (2010))* When examining the LIFE project BaltCoast regarding criteria of sustainable development the ecological component stands out. On the other hand agriculture is being promoted as well by engaging farmers in sustaining meadows using cattle and horses. In consequence, the local economy and society are supported since various classes of society are directly involved in the project and can profit from it. This proves that there are economic, social and ecological aspects combined in the LIFE project BaltCoast which means that all criteria of sustainable are being met. The project creates a working ecosystem of natural salt meadows that - without human influence- has the best chances of adapting to the changing climate conditions by itself.

The "New Hansa of Sustainable Ports and Cities" is a follow-up of the German research project "Realising Agenda 21 in European sea ports, example Lübeck-Travemünde" examining the reduction of harmful chemical by ships in Baltic Sea ports. The project's basis is the issue that there is a conflict of interests between the port economy causing significant emissions and the positive development of tourism. Expanding ports leads to steadily increased sea and ferry traffic which in return increases air pollution because of diesel soot, sulphur dioxide, and nitrogen compounds in the port areas. Additionally, there are further negative effects on the environment caused by the necessity of a ship engines constantly running while in the port to produce electricity and heat. This makes the issue of emissions in Baltic Sea ports worse. The research project was aimed at performing emission checks and calculations in the area of Lübeck-Travemünde including calculations of various emission-reducing concepts as well as examinations of technical possibilities to reduce harmful chemicals and their implementation as emission-reducing measures in ports, on ships and ferries. Concluding from the emission checks, the sulphur dioxide and nitrogen compounds are emitted mostly by ships and ferries. The investigation of various emission-reducing concepts showed that supplying ships during their stay in the port with land-produced electricity is a favourable solution since in this case no motors have to be running which cuts noise and vibration production. In case fuel ,containing less sulphur or catalytic converters are used, the emission of noise and vibration still is a problem. The gained conclusions and resulting solution suggestions are supposed to be put into practice in accordance with the Baltic Sea port cities. In order to support that, the European Commission approved the follow-up project of "New Hansa of Sustainable Ports and Cities" that will be carried out under the umbrella of Baltic 21. *(see ("Frische Luft für Hafenstädte") (25.01.2010))* The waste

separation of shipping companies is to be made less time-consuming by simplifying the nowadays complicated waste sorting techniques and by harmonising the waste industry in the port area of the Baltic Sea. Furthermore, "New Hansa of Sustainable Ports and Cities" includes a concept of improving the port-internal water management. At the same time an improvement of the Baltic Sea's water quality which was critical especially near ports because of waste water inflow is to be reached. Another aspect of the project is the reduction of the emission of harmful chemicals that was already explained in the description of the research project "Realising Agenda 21 in European sea port, example Lübeck-Travemünde". All those single measures are to serve a superordinate goal. This includes a unified port policy of the Baltic Sea states being written down in a binding agreement. *(see "New Hansa of Sustainable Ports and Cities" (2010))* This project fulfils also conditions that are connected with the promotion of sustainable development in the Baltic Sea region. The following is to provide proof according to the three dimensions of sustainability. Introducing new waste sorting systems at the ports creates orders in the economy and promotes research in the field of recycling technologies which leads to the point that the economic aspect of sustainability is present. An increased use of recycling techniques leads to a reduced needs of raw materials and thereby a conservation of natural resources. In connection with a reduction of the emission of harmful chemicals this is a positive development in the sphere of ecology. The reduced air pollution stabilises the tourism industry and creates jobs in the port region which in turn becomes attractive to the population as a working and living place; thus it works against the migration to the bigger cities preserving the traditions of the coast's inhabitants. This represents the social aspect of sustainable development. Therefore, "New Hansa of Sustainable Ports and Cities" is a project that strengthens the Baltic Sea region and makes it competitive for the future. At the same time it contributes to limitation of the global climate change and its effects because of the achieved emission reductions.

Concluding it has to be uttered that on a medium-term basis it is important to develop not only the ability to adapt to the climate change but also to consequently limit the its dimension and the connected effects with the help of appropriate measures. The neighbouring states of the Baltic Sea are on a good way full of prospects enhancing their numerous projects promoting sustainable development, the local measures they take and their goals they set. But it has to be noted that their pursuit of sustainable development, innovative environmental politics and especially limiting the dimension of climate change can only be successful if it is taken to an international level.

References

"Creating Partnerships for a Sustainable Baltic Sea Region." *Baltic21 brochure*. Baltic 21, Web. 25 Jan 2010. <http://www.baltic21.org/files/File/Info%20Materials/Baltic_21_Brochure.pdf>.

(Baltic21 brochure")

Endlicher, W., and F.-W. Gerstengarbe (publ.). *Der Klimawandel -Einblicke, Rückblicke und Ausblicke*. 1st ed. Potsdam: G & S Druck und Medien GmbH, 2007. Print.

(Endlicher and Gerstengarbe (publ.))

Voigt, Christian . "Infoblatt Entstehung der Ostsee Ausführliche Informationen zur Ostseeentstehung." *Geographie Infothek*. Leipzig: Klett, 2003. Web. <http://www.klett.de/sixcms/list.php?page=miniinfothek&miniinfothek=Geographie&node=Ostsee&article=Infoblatt+Entstehung+der+Ostsee>.

(Voigt)

Lexikon-Institut Bertelsmann (publ.) *Bertelsmann Jugend Lexikon in Farbe*. 1st ed. Guetersloh: Bertelsmann Lexikon Verlag GmbH, 1998. Print.

(Lexikon-Institut Bertelsmann (publ.))

Liedtke, H., and J. Marcinek. *Physikalische Geographie Deutschlands*. 3rd ed. Gotha: Klett-Perthes, 2002. Print.

(Liedtke, and Marcinek)

"LIFE-BALTCOAST." *LIFE-BALTCOAST*. Stiftung Naturschutz Schleswig-Holstein, Web. 29 Jan 2010. <http://www.life-baltcoast.eu/index.php?id=207&L=5>.

("LIFE-BALTCOAST")

"New Hansa." *New Hansa of Sustainable Ports and Cities*. Union of the Baltic Cities, Web. 25 Jan 2010. <http://www.newhansa.net/index.htm>.

("New Hansa of Sustainable Ports and Cities")

"Die Ostsee im Klimawandel - gestern, heute, morgen." *press release of the GKSS research centre Geesthacht* (2008/01/28): n. pag. Web. 24 Jan 2010. <http://www.gkss.de/institute/coastal_research/news/press_release/002492/index_0002492.html.de>.

"Bundesumweltamt." *Internationaler Umweltschutz, Antarktis Agenda Baltic 21*. 30 Jan 2010. Bundesumweltamt, Web. 25 Jan 2010. <http://www.umweltbundesamt.de/ius/baltic.htm>.

("Internationaler Umweltschutz, Antarktis Agenda Baltic 21")

"Bundesumweltamt." *Frische Luft für Hafenstädte*. Bundesumweltamt, Web. 29 Jan 2010. <http://www.umweltdaten.de/publikationen/fpdf-k/k2982.pdf>.

("Frische Luft für Hafenstädte")