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

Dealing with the challenge of climate change in Baltic Sea Region: promoting regional sustainable development

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Introduction

The water temperature grows every year in the Baltic Sea. News which having a rest at first sight can seem pleasant, will have for local flora and fauna catastrophic influences. And bathing in Baltic waves becomes unpleasant employment.

The water temperature in the Baltic sea for last one hundred years has raised approximately on 0,85 degrees Celsius. Thereby warming in this region on 0,1 degrees has exceeded an average index of global warming. Recently published report of BACC named “Assessment of Climate Change for the Baltic Sea Basin” testifies it. Experts explain it in the following way: as a whole the Northern hemisphere heats up faster than the Southern one as the big water areas of Southern hemisphere and ices of Antarctica reflect sunlight stronger than the large sites of land located in Northern hemisphere do.

Air temperature in the region of the Baltic Sea Basin will raise and in the future scientists start with this thesis in the calculations. If not to accept measures on climate protection, the temperature can raise on 4-6 degrees in the Northern part and on 3-5 degrees in the Southern part of the Baltic Sea Basin.

It can have far-reaching consequences: the water surface temperature will rise on 2-4 degrees. The ice cover formed in winter in northern areas, will be formed later and to thaw earlier. And while the summer becomes drier, in the winter, under forecasts, will drop out more deposits - and within a year it is necessary to expect more rainy days. As a result the salt maintenance in waters of Baltic will decrease.

From a plankton to seals - considerable warming, most likely, will affect all ecosystem of region. Biologists proceed, in particular, from this that there will be problems with flowering of seaweed. If glaciers in northern part of the Baltic region disappear, the Baltic annulate seal - already being under the threat of extinction - will lose today an inhabitancy. Seals grow up on ice of cubs.

Besides, it is possible to assume that those kinds of animals which are adapted for a life in warmer climate will lodge in the Baltic Sea. While in questions of protection of a climate it has not been still undertaken concrete measures, volumes of emissions of harmful substances in waters of Baltic are purposefully reduced last years. The Helsinki commission into which representatives of all countries having an exit to Baltic Sea enter, has made still 15 years ago the list of branches which especially strongly pollute waters of Baltic, - it is a question of plants and cleaning stations. 162 from

these "flashpoints" have entered into the list since 1992 - and harmful influence about half from them has been neutralised.

The territory of the Baltic Sea Basin unites the countries considerably differing on the economic situation and cultural traditions. This variety can be considered as a source of the general prosperity, but it also means that and even to the non-governmental organisations it will be hard for the countries to find the general approaches at a choice of priorities for teamwork.

Tendencies of climate change of the Baltic Sea

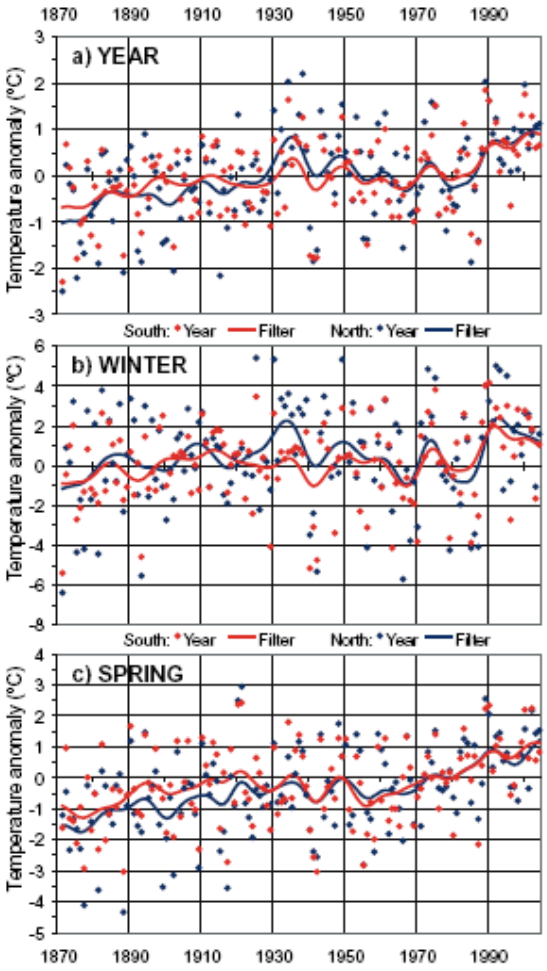
Hotbed effect is not a new problem. In 1827 the French scientist Fure has come out with the assumption that atmosphere of the Earth warms up a surface, passing sunlight to it with a high energy, but without allowing to leave in space of a part of the long-wave thermal radiation reflected from a terrestrial surface. This effect is caused by several hotbed gases, in particular dioxide of carbon and water steam. In the end of the nineteenth century the Swedish scientist Arrenius has come to a conclusion that increase of emissions of dioxide of carbon by the enterprises which have arisen in industrial revolution, has changed the maintenance of gases in the atmosphere and that it can lead to growth of ground temperature.

Till the end of 50th years very few people was interested in this problem, but carrying out in 1957 of the International Geophysical Year has allowed the international scientific community to create a basis for understanding of planetary processes and influence of human activity on them. The wide network of stations on supervision over environment has been created. Supervision have shown at once continuous increase of concentration of dioxide of carbon. One decade later the research, spent by the Massachusetsky institute of technology, have elicited the facts testifying to possible climate change. In 1970 the Secretary general of the United Nations already has been sufficiently anxious by this problem to mention in the report on ecology possibility «the accidents caused by warming»

The Baltic Sea Basin is a region with considerable variations of surface air temperature, both regionally and in time for a brief overview. Due to anthropogenic emissions of greenhouse gases, the interest in variations of air temperature near the surface has increased in recent decades. However, when local or regional air temperatures near the surface are measured, the anthropogenic effect cannot be identified directly. What is measured is the combined effect of an anthropogenic warming

trend superimposed upon a large natural variability of the climate system. It is this combined temperature variability and trend that is analysed in this section.

The changes of the Baltic Sea Basin mean temperatures during 1871–2004 are inferred here using a gridded data set with a 5° by 5° (latitude, longitude) resolution (Jones and Moberg 2003). For this analysis, all 5° grid boxes with at least 50% of the box area belonging to the Baltic Sea Basin were considered. Two area-averaged series have been calculated (Fig. 1), one including all selected Baltic Sea Basin grid boxes north of 60° N and one including those south of 60° N, thus establishing a northern and southern Baltic Sea Basin surface air temperature record, respectively. All data are anomalies from the 1961–1990 standard normal. In terms of temperature variations, the Baltic Sea Basin has been a relative uniform area during the period 1871–2004 (Fig. 1 a). A striking feature in the annual mean series is the early 20th century warming, which is a marked increase in temperature that culminated in the 1930s. This early 20th century warming was followed by a smaller cooling that culminated in the 1960s and then another distinct warming lasting to the end of the series.



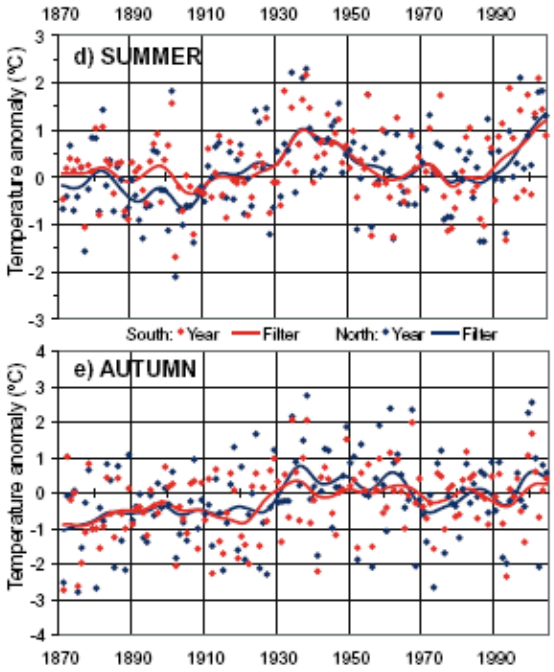


*Fig. 1. Annual and seasonal mean surface air temperature for the Baltic Sea Basin 1871–2004, calculated from 5° by 5° latitude, longitude box averages taken from the CRU dataset based on land stations (from top to bottom: (**a**) = annual, (**b**) = winter (DJF), (**c**) = spring (MAM), (**d**) = summer (JJA), (**e**) = autumn (SON)). Blue colour comprises the Baltic Sea Basin to the north of 60° N, and red colour to the south of that latitude. The dots represent individual years, and the smoothed curves (Gaussian filter, σ = 3) highlight variability on timescales longer than 10 years*

Spring is the only season for which the end of the series is clearly warmer than the maximum of the 1930s when analysed on a decadal time scale (Fig. 1c). The early 20th century warming is more pronounced in the northern area than in the southern, especially during winter (Fig. 1b). For the period 1871–2004, the largest seasonal trends in the Baltic Sea Basin are observed for the spring. Trends in all seasons are positive and most of them are significant at the 0.05 level (Table 1). For the northern area the trend in winter is as high as 0.09˚C/decade, but as the variability is particularly large in this season, the trend is nonsignificant. Annual warming trends (1871–2004) for the northern and southern Baltic Sea Basin, with values of 0.10 and 0.07˚C/decade, respectively, are larger than the trend for the entire globe (1861– 2000), which is about 0.05˚C/decade (IPCC 2001). Neither the Baltic Sea Basin temperature series nor the global series show a monotonous temperature increase on the decadal time scale.

Table 1. Linear surface air temperature trends (K per decade) in the period 1871–2004 for the Baltic Sea Basin, its northern (latitude > 60° N) and southern area (latitude < 60° N). Trends written in bold are significant at the 0.05 level. The trends were also tested by the non-parametric Mann-Kendall test. The results were consistent with the linear trend test

Data sets	Year	Winter	Spring	Summer	Autumn
Northern area	0.10	0.09	0.15	0.06	0.08
Southern area	0.07	0.10	0.11	0.03	0.06

The main differences between the Baltic Sea Basin and global series are: The early 20th century maximum occurs in the 1930s for the Baltic, whereas for the globe it occurs in the 1940s. For the Baltic Sea Basin, the maximum at the end of the series is of about the same magnitude as the one earlier in the 20th century, whereas for the globe the maximum at the end of the series is significantly higher (IPCC 2001) than that in the 1940s. The variability of annual mean temperature of the Baltic Sea Basin series is about five times larger than the variability of the global mean temperatures. The warming trend characteristic in the Baltic Sea Basin has been observed to extend further to the Arctic.

A number of emission scenarios have been published as an "IPCC Special Report on Emissions Scenarios" (SRES; www.grida.no/climate/ipcc/ emission) prepared by economists and other social scientists for the Third Assessment Report of the IPCC. They utilise scenarios of greenhouse gas and aerosol emissions or of changing land use:

(A1) a world of rapid economic growth and rapid introduction of new and more efficient technology,

(A2) a very heterogeneous world with an emphasis on family values and local traditions,

(B1) a world of "dematerialisation" and introduction of clean technologies,

(B2) a world with an emphasis on local solutions to economic and environmental sustainability.

The scenarios do not anticipate any specific mitigation policies for avoiding climate change. The authors emphasis that "no explicit judgments have been made by the SRES team as to their desirability or probability".

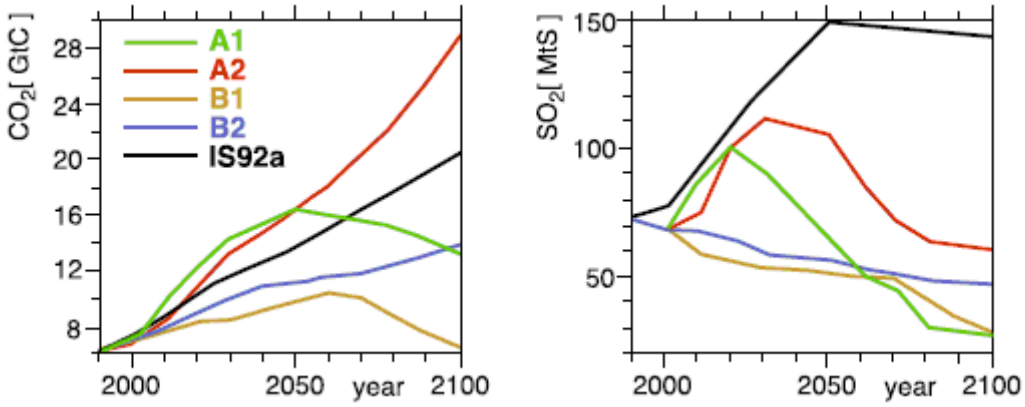


Fig. 2. Scenarios of possible, plausible, internally consistent but not necessarily probable future emissions of carbon dioxide (a representative of greenhouse gases; in gigatons) and of sulfur dioxide (a representative of anthropogenic aerosols; in megatons). A1, B1, A2 and B2 are provided by SRES, IS92a is a scenario used in the Second Assessment Report of the IPCC in 1995 (Nakićenović and Swart 2000)

The Scenarios A2 and B2 are widely used. Therefore, we explain the socio-economic background of these scenarios in more detail (for a summary for the other two scenarios, refer to Muller and von Storch 2004): SRES describes the A2- scenario as follows: ". . . characterised by lower trade flows, relatively slow capital stock turnover, and slower technological change. The world "consolidates" into a series of economic regions. Self-reliance in terms of resources and less emphasis on economic, social, and cultural interactions between regions are characteristic for this future. Economic growth is uneven and the income gap between now-industrialised and developing parts of the world does not narrow.

People, ideas, and capital are less mobile so that technology diffuses more slowly. International disparities in productivity, and hence income per capita, are largely maintained or increased in absolute terms. With the emphasis on family and community life, fertility rates decline relatively slowly, which makes the population the largest among the storylines (15 billion by 2100). Technological change is more heterogeneous. Regions with abundant energy and mineral resources evolve more resource-intensive economies, while those poor in resources place a very high priority on minimizing import dependence through technological innovation to improve resource efficiency and make use of substitute inputs. Energy use per unit of GDP declines with a pace of 0.5 to 0.7% per year.

Social and political structures diversify; some regions move toward stronger welfare systems and reduced income inequality, while others move toward "leaner" government and more heterogeneous income distributions. With substantial food requirements, agricultural productivity is one of the main focus areas for innovation and research, development efforts, and environmental concerns. Global environmental concerns are relatively weak."

In B2, there is ". . . increased concern for environmental and social sustainability. Increasingly, government policies and business strategies at the national and local levels are influenced by environmentally aware citizens, with a trend toward local self-reliance and stronger communities. Human welfare, equality, and environmental protection all have high priority, and they are addressed through community-based social solutions in addition to technical solutions. Education and welfare programs are pursued widely, which reduces mortality and fertility. The population reaches about 10 billion people by 2100. Income per capita grows at an intermediate rate. The high educational levels promote both development and environmental protection. Environmental protection is one of the few truly international common priorities. However, strategies to address global environmental challenges are not of a central priority and are thus less successful compared to local and regional environmental response strategies. The governments have difficulty designing and implementing agreements that combine global environmental protection. Land-use management becomes better integrated at the local level. Urban and transport infrastructure is a particular focus of community innovation, and contributes to a low level of car dependence and less urban sprawl. An emphasis on food self-reliance contributes to a shift in dietary patterns toward local products, with relatively low meat consumption in countries with high population densities. Energy systems differ from region to region. The need to use energy and other resources more efficiently spurs the development of less carbon-intensive technology in some regions. Although globally the energy system remains predominantly hydrocarbon-based, a gradual transition occurs away from the current share of fossil resources in world energy supply."

Expected emissions of greenhouse gases and aerosols into the atmosphere are derived from these assumptions and descriptions. Figure 2 shows the expected SRES scenarios for carbon dioxide (a representative of greenhouse gases; in giga tons per year) and sulfur dioxide (a representative of anthropogenic aerosols; in megatons of sulfur). The SRES scenarios are not unanimously accepted by the economic community. Some researchers find the scenarios internally inconsistent. A documentation of the various points raised is provided by the Select Committee of Economic Affairs of the House of Lords in London (2005). A key critique is that the expectation of economic growth in different parts of the world is based on market exchange ranges (MER) and not on purchasing power parity (PPP). Another aspect is the implicit assumption in the SRES scenarios that the difference in

income between developing and developed countries will significantly shrink until the end of this century (Tol 2006, 2007). These assumptions, the argument is, lead to an exaggeration of expected future emissions.

Thus researches have shown:

- Concentration of hotbed gases continue to increase in result of human activity;
- Set of the available data says that influence of human activity on a planet climate is great enough that it to notice;
- By the end of the twenty first century the average temperature of a surface of the Earth, possibly, will raise approximately on 2 °C with, and taking into account the uncertainty factor this increase can make from 1 to 3,5°C with. Further the temperature will increase within several decades even in the event that the maintenance of hotbed gases in atmosphere by this time is stabilised;
- Rising of sea level on 50 cm by 2020 (estimations fluctuate from 15 to 95 cm) is on the average predicted, and this increase will proceed in the subsequent;
- In the majority of the countries probably realisation of painless actions for economy on restriction of issue of hotbed gases that their quantity in the future has appeared below level, inevitable at preservation of available tendencies. These actions will not entail additional expenses.

Ways and methods of the decision of a problem of climate change.

Baltic Sea is vulnerable, and before it there are many problems. This summer all of us once again had possibility to be convinced how process eutrofication of Baltic Sea has far come, and "flowering" of water because of mass development of blue-green seaweed - only one of bright examples of that, the situation is how much serious. Other negative consequences eutrofication are shown in reduction of a transparency of sea water and decrease in a biological variety. A variety of forms of a life in Baltic Sea decreases, as currently separate sites of a sea-bottom are dead, and some biotopes - are completely destroyed. It, in turn, has led to reduction of number of populations of one kinds while number of others not controlled increases. The observable misbalance testifies that eutrofication is one of the most serious problems who faces natural component of Baltic Sea.

Prevention further eutrofication - an uneasy problem as its decision demands change of our daily way of life. Thus inhabitants of the Central Europe also should bear responsibility for the future

of Baltic Sea as the environmental contamination caused by transport (including exhaust gases), the industry and agriculture in the European countries, influences a state of affairs in Baltiysk region.

On closer examination becomes obvious that many problems of Baltic Sea, have a direct bearing on environment preservation in region all by Baltiysk. Simultaneously, Baltic is also a part of all planet, and it is influenced by climate changes, which, in itself, already steels of one of the largest global environmental problems.

Disturbing symptoms of how warming affects kinds and biotopes in Baltiysk region are already visible. It is important to notice that all countries in region and in Europe as a whole, have reduced emissions CO2. In many countries round Baltic Sea the out-of-date equipment can be easily enough modernized, and new technologies give a wide spectrum of accessible possibilities for real reduction of volume of emissions of harmful gases. However in the decision of this problem we can achieve considerable results only by really purposeful reduction of volumes of atmospheric pollution - that, unfortunately, till now and does not occur.

As Baltic Sea is our general reservoir, all inhabitants of member countries of the European Union, and also those countries who are going to enter EU, should realise the responsibility for preservation and maintenance of natural riches of its unique ecosystems.

Main Measures to cope with climate change:

- UNFCCC identifies two major measures as responses to climate change:

a) mitigation of climate change by reducing greenhouse gas emission and enhancing sinks (direct damage prevention)

b) adaptation to the impact of climate change (indirect damage prevention)

- Above all importance of international cooperation.

The main international cooperation:

- Convention in the Protection of the Marine Environment of the Baltic Sea Area
- Baltic Sea Joint Comprehensive Action Programme
- The Council of the Baltic Sea States (CDSS)
- The Baltic Sea Region Energy Cooperation (BASREC)
- The Kyoto Protocol

The Kyoto Protocol to the Frame convention of the United Nations on their climate change - a result of the various tendencies directed on globalization in the decision of problems of economy and ecology. It defines those basic structural elements on which in the twenty first century global efforts under the decision of a problem of climatic changes will be based. The agreement provides

the flexible mechanisms, allowing to soften weight of the accepted obligations, and in this sense direct results of the Report not too will affect a state of environment or economy. Realization of such obligations will not stop global growth of issue, will not render notable influence on economy growth. Nevertheless, these obligations reflect a basic course change, and their structure is that that in case of their ratification, realization and deepening at the subsequent stages there will be the effective international system, allowing to solve a problem of climatic changes. In some respects the Kyoto Protocol can appear the most important and basic international agreement of the end of the twentieth century. All Baltic countries are under the Kyoto Protocol.

The Kyoto mechanisms:

- Emission Trading;
- Joint Implementation;
- The Clean Development Mechanism.

The Kyoto Protocol in many respects is the difficult and innovative document. Its main achievement in an establishment of legally significant, quantitatively certain restrictions on emissions of hotbed gases in all industrially developed countries.

The BASREC parties emphasized that the cooperation in the energy sector is a key factor in promoting political stability, economic growth and sustainable development of the region.

Conclusion

The main task is achievement of the stable maintenance in atmosphere of the gases causing a hotbed effect, at that level at which danger of anthropogenous intervention in balance of climatic system of the Earth.

The government of Russia encourages the initiative of young generation in struggle against climate change. Active participation of young people in the Student Summer Sailing and Courses, that organises the Baltic University is widely broadcast in the Russian press and on TV. Participation of young people in given programs and their extended coverage in mass-media allows to involve the increasing and attention in a problem of climate change of Baltic Sea.

I hope that in the near future all inhabitants of the states of Basin of Baltic Sea will think of a problem of climate change of the Baltic Sea. Only working in one group we can solve a problem of climate change of the Baltic Sea.

References

1. Grabb M, Vrolik K, Brek D. The Kiotsky Protocol: the analysis and interpretation. The lane with English - M, the Science, 2001, pp. 303.
2. The BACC Author Team. Assessments of Climate Change for the Baltic Sea Basin. Springer-Verlag Berlin Heidelberg, 2008, pp. 489.
3. Eeva Furman, Harri Dalstrem, Risto Hamari. Baltic sea. The nature and the person. OTAVA, Helsinki 1998., ISBN 951-1-15049-9., pp.159
4. www.wwf.ru
5. www.kioto2004.ru
6. www.ecoportal.ru/news.php?id=26899
7. http://webknow.ru/ekologija_00249.html
8. http://www.ovsem.com/
9. http://www/sea/ee/monit/ohtlik98.htm
10. http://www.helcom.ru/rus/public/public1.shtml
11. http://www.strana.kaliningrad.ru/N151/algae.html
12. http://www.novayagazeta.spb.ru/?y=2002&n=79&id=1