First Amendment to the Baltic Sea Action Plan

Group 1:

Eero Asmala[1], Moa Edman[2], Susann Haase[1], Maria Røjbek[3] & Alexander Walther[2]

[1]University of Helsinki, [2]University of Gothenburg, [3]Danish Technical University

ASSEMBLED in Nexø, Denmark on the NMA course titled "Climate impacts on the Baltic Sea - from science to policy", on 1 August 2009.

WE ENDORSE the BACC Assessment of Climate Change for the Baltic Sea Basin, in which the causes, mechanisms and processes of climate change in the Baltic Sea are elaborated in more detail.

WE ACKNOWLEDGE that global climate change is affecting the Baltic Sea area significantly in the future. We are able to establish increased air temperature as the major effect. This will have either direct or indirect impact on the Baltic Sea ecosystem and the human activities therein.

WE AGREE that increasing air temperature leads to increasing water temperature, increasing sea level, decreasing ice cover and lengthening growing season.

WE ALSO AGREE that there are drivers affecting salinity, precipitation, stratification, wind patterns and acidification.

WE EMPHASISE the need to follow scrutinously the international agreements on climate change in order to keep the effects of climate change as small as possible also within the Baltic Sea area.

WE STRESS the importance of carrying out the adaptive actions in an environmentally sustainable way.

WE URGE the competent authorities and research institutes to compile and analyze historical data, for achieving adequate time series for science community to further elaborate the future scenarios.

WE ALSO URGE that in the HELCOM monitoring programmes new indicators which are aimed at detecting climate change impacts in the Baltic Sea will be implemented.

WE WILL PREPARE for revising the targets in Baltic Sea Action Plan continuously, emphasizing consequences of climate change.

WE RECOGNISE that the definition of natural state is not static, as changes in climate conditions alter the ecosystems in multiple ways.

WE EMPHASISE that there is a variety of consequences of the climate change which are not touched upon in this paper.

First Amendment to the Baltic Sea Action Plan

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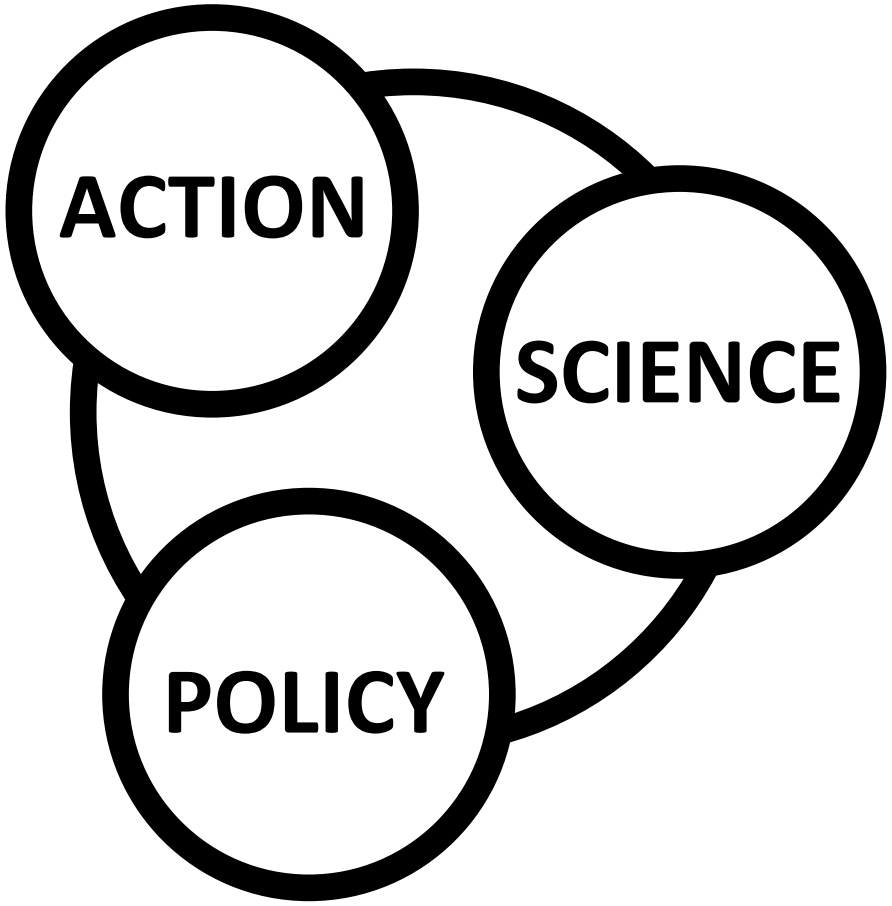
[1]University of Helsinki, [2]University of Gothenburg, [3]DTU Aqua

CONCEPTUAL CHART



Interactive

Dynamic

Adaptive

WE ENDORSE

the BACC Assessment of Climate Change for the Baltic Sea Basin, in which the causes, mechanisms and processes of climate change in the Baltic Sea are elaborated in more detail.

- The BACC assessment is the most concise and detailed summary of climate change effects in the Baltic Sea area, thus making it the obvious choice for a scientific cornerstone.
- We also included multiple other sources of information to formulate this work.

WE ACKNOWLEDGE

that global climate change is affecting the Baltic Sea area significantly in the future. We are able to establish increased air temperature as the major effect. This will have either direct or indirect impact on the Baltic Sea ecosystem and the human activities therein.

- Based on the BACC report, we state that there has been a significant positive trend in the air temperature in the Baltic Sea area over the last century with regional and seasonal variations. This is caused by the human activities especially the increased concentrations of greenhouse gases.
- The temperature has increased 1 ^{0}C in the northern part and 0.7 ^{0}C in the southern part of the Baltic over the last century and the warming trend is largest in spring. The trend is somewhat higher than the global trend.
- Future projections based on a variety of climate models the temperature is predicted to increase with 1.4-5.8 ^{0}C .
- The increase in temperature are believed to have major impact on Baltic Sea ecosystem, so it is important to take into account in the BSAP.

WE AGREE

that increasing air temperature leads to increasing water temperature, increasing sea level, decreasing ice cover and lengthening growing season.

MARIA

- The increase in air temperature has not surprisingly resulted in increased the water temperature during the last century in the Baltic again with a lot of regional variation. This is definitely going to affect the Baltic Sea ecosystem, e.g. warm water species will be favored and coldwater species, like cod, are likely to decrease
- A negative trend of ice cover duration and also earlier ice break up in rivers since the middle of this century has been observed in the Baltic area caused by the rise in temperature
- An observed sea level rise has also been observed caused directly by the thermal expansion and also indirectly by melting of land ice and glaciers. The effect being highest in the Southern part of the Baltic because in the Northern part the sea level rise is counteracted by the land uplift. The increased sea level changes the shorelines and decreases the land area of coastal countries, and also affects the water exchange between Baltic Sea and North Sea.
- Spring season starts earlier and autumn starts later which result in a longer growing season which will affect e.g. primary production both in sea and on land

WE ALSO AGREE
that there are drivers affecting salinity, precipitation, stratification, wind patterns and acidification.

- Not all drivers can be detected and not all causes be attributed with the same level of confidence. Changes will be of different magnitude and direction. These are uncertainties.
- Nevertheless, the knowledge established about the interrelation between the components of the baltic sea ecosystem does not allow for neglecting climate change impacts any longer.

WE EMPHASISE

the need to follow scrutinously the international agreements on climate change in order to keep the effects of climate change as small as possible also within the Baltic Sea area.

- The importance of taking climate change into account is manifested in the reports from the IPCC, providing the most comprehensive and well established summary of climate change science knowledge on a global scale available today.
- The global agreements are setting the frame nd background for actions on the regional scale. As mentioned before, with the BACC report the scientific community provides a comprehensive scientific climate change assessment report for this area.

WE STRESS

the importance of carrying out the adaptive actions in an environmentally sustainable way.

- As urged before, climate change will effect the Baltic Sea ecosystem in many ways. Societies around the Baltic are part of this ecosystem and at the same time are exerting remarkable pressure on it and changing it. Changes in landuse patterns, an increasing sea level and changes in the Baltic Sea fish stocks are just three more examples for future changes to cope with.
- There will be a need for the societies to adapt to the changes to come. This must not create further stress on the ecosystem but has to be done in a sustainable way.
- Adapt societies while taking care of a functional ecosystem.

WE URGE

the competent authorities and research institutes to compile and analyze historical data, for achieving adequate time series for science community to further elaborate the future scenarios.

- Monitoring the current status needs to be complemented with the compilation off long time series, data from validated models and proxy data. This reason is to deal with the many uncertainties.

- Meta analyzes of this new data base to determine the direction of change in the system during historical periods of warming.

- Set dates for the updating of BSAP with the achieved increased harmonized knowledge.

Collect background material ⇨ Build Knowledge ⇨ Take action!

WE ALSO URGE

that in the HELCOM monitoring programmes new indicators which are aimed at detecting climate change impacts in the Baltic Sea will be implemented.

- Needed to make sure that the existing monitoring system is able to give indication of changing conditions caused by climate.
  - Depth of permanent halocline
  - Water levels
  - Integrated salinity and heat
  - Ice coverage

- To validate expected change given from historical data.

- Not to be used as targets, but rather as an agreed basis for changing the targets already defined in BSAP.

- Actions to be taken can be agreed upon before hand, that way being ready for implementation when climate change indicators show that a respons is needed.

WE WILL PREPARE

for revising the targets in Baltic Sea Action Plan continuously, emphasizing consequences of climate change.

- The targets needs to be revised under a changing climate to remain valid!

WE RECOGNISE
that the definition of natural state is not static, as changes in climate conditions alter the ecosystems in multiple ways.

- Definition of natural state needs to be adjusted to the expected changes due to climate change, such as changes in: precipitation, hydrography, acidity, habitat characteristics in marine and terrestrial areas and especially in coastal areas, in biodiversity and species distribution (as a result of increasing temperature and sea level rise).
- To re-define the natural state of the Baltic Sea, open scientific questions concerning trends and impacts of climate change need to be answered.
- The formulation of the ”natural state” needs to finished before 2020 since it is crucial for the next edition of the BSAP.

WE EMPHASISE
that there is a variety of consequences of the climate change which are not touched upon in this paper.

- Besides the earlier mentioned impacts of climate change on the Baltic Sea and the surrounding countries, there are others which are not completly understood yet.
- Nevertheless, they potencially alter the Baltic Sea ecosystem and the abiotic conditions around the Baltic Sea.
- It is therefore recommended to include those consequences into research programs, for instance: thawing of permafrost, precipitation/cloud cover, primary production, transpiration, biodiversity, north-shift of species, change in biochemistry, light attenuation in water, albedo, land use, gas exchange (water-atmosphere, soil-atmosphere, ice-atmosphere/water), social aspects (moving towards north).

The Syndicate Exercise:

"Updating the Baltic Sea Action Plan to take account of climate change"

Group 2

Anna Maciejewska
Elin Renborg
Karin Junker
Taavi Liblik
Zeren Gurkan

Summer course in „Climate Impacts on the Baltic Sea - From Science to Policy"

Bornholm, 2009

Proposed Actions to account for climate change in the Baltic Sea Basin

It is well known that climate change will impose higher stress on the Baltic Sea Ecosystem. Hence, the target values and actions proposed in the previous Baltic Sea Action Plan (BSAP) need revaluation and revision due to the change of the climatological drivers. The calculations of allowable nutrient inputs have to be modified, taking scenarios of climate change into account, as changes in nutrient transport, uptake and release can be expected.

Due to the high uncertainty of the projected impacts of climate change on the Baltic Sea Ecosystem, it is advisable to develop several models for the study of climate change effects in order to get an estimate of the probabilities of certain outcomes by ensemble model runs. These ensemble model runs should be performed or supervised by an independent board of scientists from the participating countries. In order to enhance the quality of the models and to validate them it is of high importance to conduct thorough monitoring programs. All the data collected in these monitoring programs are to be made available to the public.

Also, more research on physical and biogeochemical processes in relation to climate change is needed. Today, it is difficult to differentiate between impacts due to anthropogenic land and water use and climate change. Thus, more research and better data collection are necessary.

Moreover, it is essential to take the terrestrial ecology stronger into account in the research and monitoring efforts. The terrestrial ecosystems are controlling the nutrient exports from land to the Baltic Sea both through atmosphere and river and direct runoff.

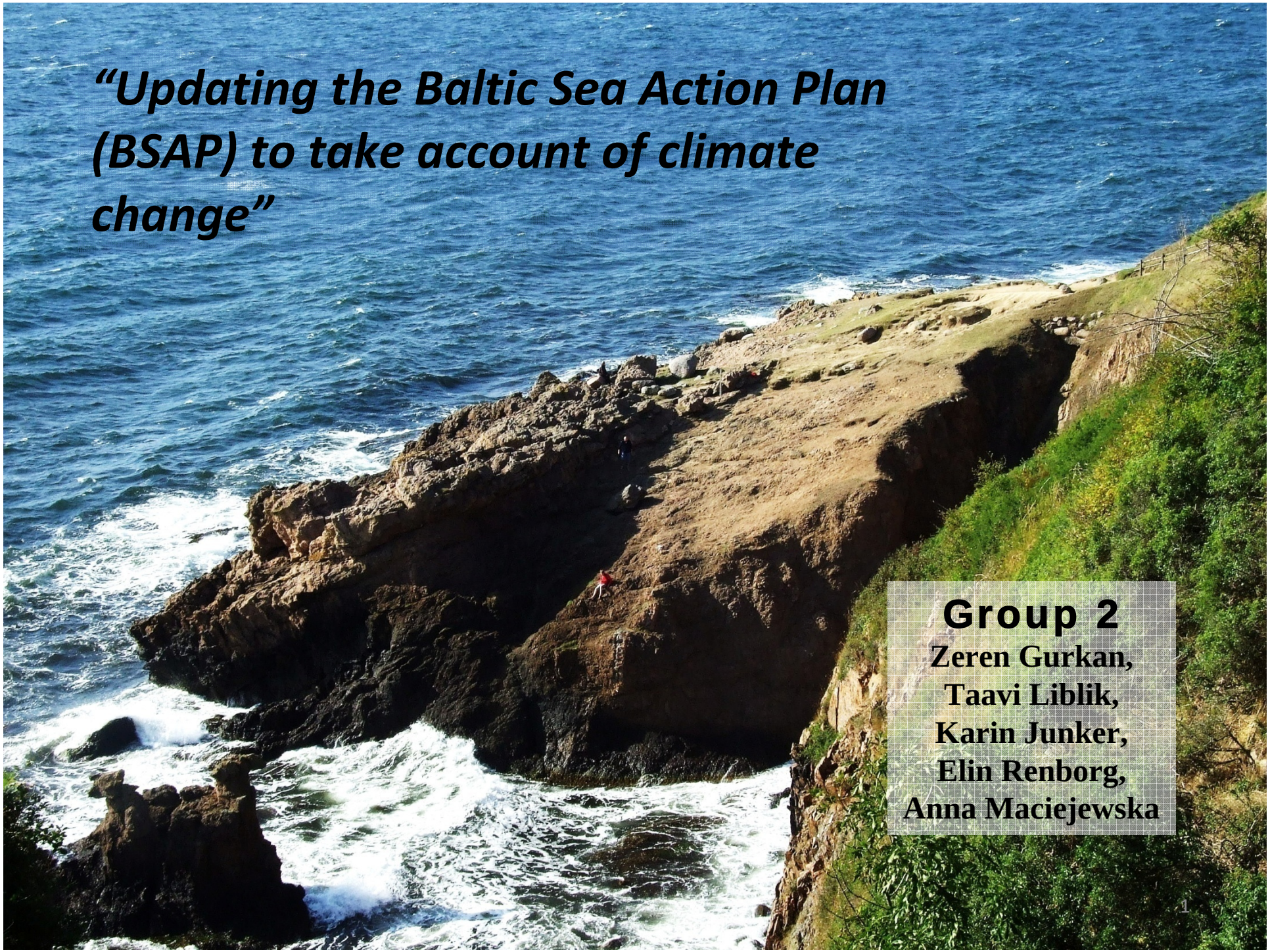
Forestation will possibly lead to mitigation of the effects of climate change through enhancing the water holding capacity of the soil, which would mean less runoff and less nutrient washout. However, since the evapotranspiration will also increase, forestation might affect the ecosystem in another way by depriving it of water.

It is crucial to take better measures to avoid introduction of new species, as climate change could open up new niches for invasive species. Because climate change will impose additional stress on the ecosystem, it is essential to reduce the stress from other factors such as eutrophication, hazardous substances, fishing and other uses of the marine areas, like wind farms. Thus, the efforts to create marine protected areas should be strengthened. This will also help to keep the marine ecosystem services functioning, which will be of direct advantage to the human society.

The spatial planning of the available marine areas should be taken into account in the modelling efforts mentioned above. Vice versa, the models should be used to identify the optimal locations and extent of the marine protection areas to be established.

All countries are advised to take measures to avoid increasing washout of nutrients by managing the vegetation in the Baltic Sea catchment area. This can be done by further limiting the fertilization of farming lands, by actively reducing the washout by planting or conserving adequate vegetation and also restraining drainage of wetlands.

Because of the expected sea level rise and increased flooding, it is also advisable to restrain from allowing new houses to be built in the lower coastal areas. Furthermore, it is advisable to leave these low elevation areas completely free of human usage. In order to mitigate the risk of further washout of nutrients and hazardous substances, these areas should be kept as clean as possible. This might even mean active cleaning of the polluted soils. An alternative could be to build dams around polluted or over fertilized areas, however, the costs of setting up dams and to run and keep them functioning on the long-term will eventually be higher than cleaning.

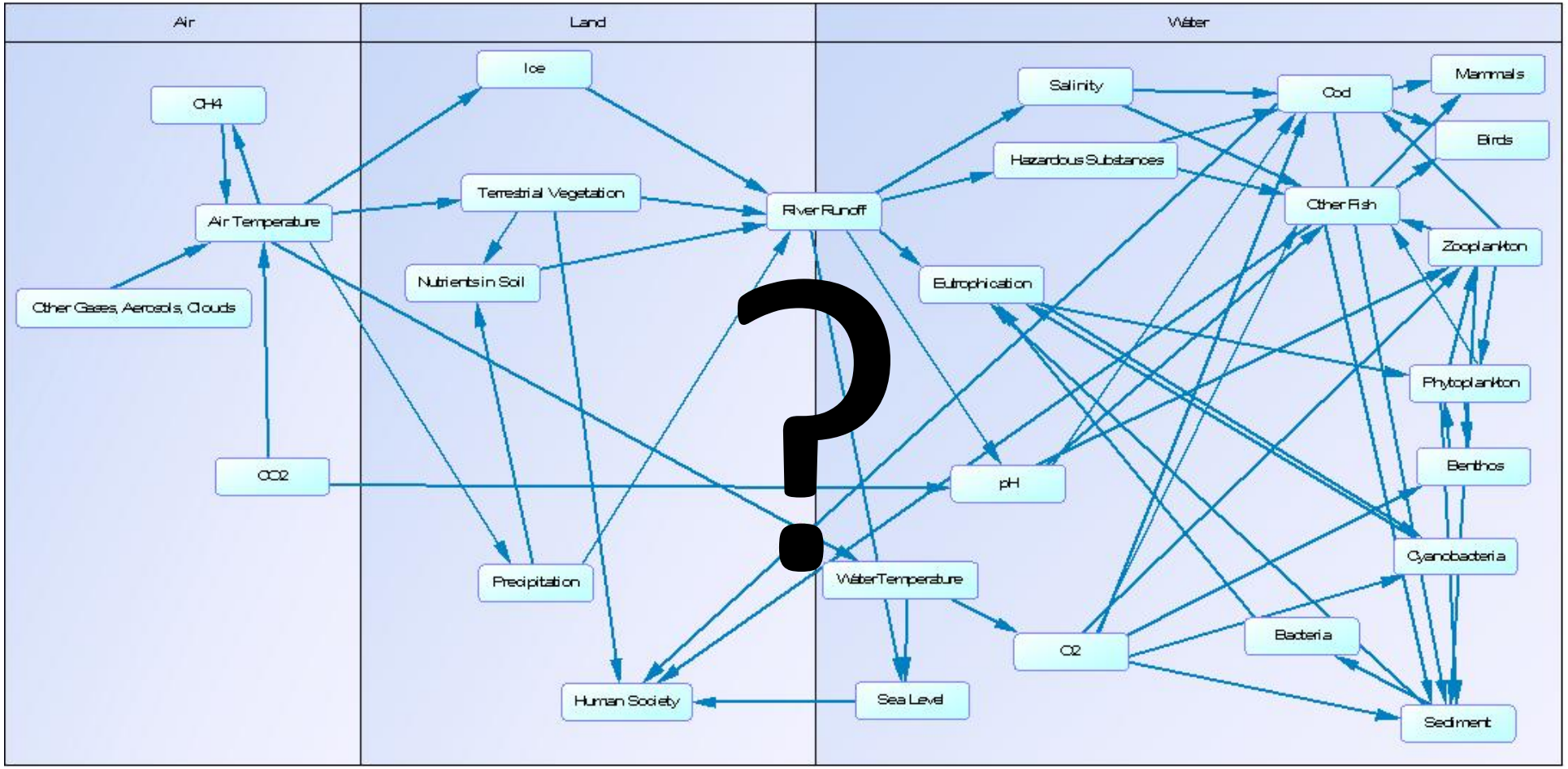


"Updating the Baltic Sea Action Plan (BSAP) to take account of climate change"

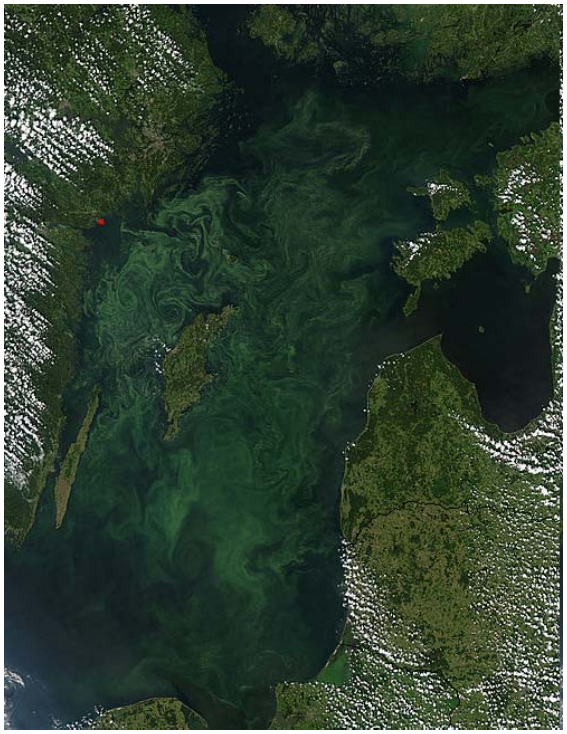
Group 2

Zeren Gurkan,
Taavi Liblik,
Karin Junker,
Elin Renborg,
Anna Maciejewska

Climate change effects in the Baltic Sea basin



BSAP - Eutrophication



- climate change will affect eutrophication
- no direct effects on the target levels for secchi depth
- recalculations of the maximum allowable nutrient inputs
- atmospheric nutrient inputs need to be included

Terrestrial ecosystems

The terrestrial ecosystems will be affected by:

- increase in temperature
- precipitation changes
- flooding

Terrestrial ecosystems affect the Baltic Sea Basin by:

- controlling the inflow of nutrients and hazardous substances into the sea
- influencing the local climate

Actions concerning terrestrial ecosystems

Countries are advised to minimize washout of nutrients and hazardous substances caused by:

- higher precipitation
  - reforestation
  - dams
- flooding
  - dams
  - preserving coastal areas in a natural state:
    - no urbanization
    - no farming

Biodiversity

- Biodiversity is subject to change due to emptying and filling of niches and further stresses on the ecosystem
- Biodiversity should be preserved in a favorable state for ecosystem resilience
- Fast and irreversible changes of ecosystems should be avoided

Actions for Biodiversity

- Under climate change, it is highly important to avoid the introduction of alien and invasive species
  - all harbours should offer treatment of ballast and wastewater from ships free of charge
  - introduction of „enhanced“ (either by genetical engineering or selection) organisms should be avoided
- more and better-planned marine protection areas to reduce the stress on the ecosystem (e.g. fisheries)

Baltic Sea Action Plan - Hazardous substances

1- Distribution of concentrations in phases would be affected by
   - Water acidity
   - Water temperature, stratification
   - Concentration of other substances in water, salinity
2- Change in water currents – transport and spatial distribution in the sea
3- Air deposition to the sea
4- Change in runoff from land – concentrations in water

Baltic Sea Action Plan - Hazardous substances

Existing objectives / targets in the Baltic Sea:

- Natural level of the hazardous substances
- Fish safe for eating
- Healthy wildlife
- Pre-Chernobyl level of radioactivity

Baltic Sea Action Plan - Hazardous substances

We suggest actions to HELCOM countries under climate change keeping these objectives as:

- Industrial and municipal wastewater effluent limits should be updated
  - e.g. Persistent-Bioaccumulating-Toxic-based discharge limits, heavy metals (cadmium, mercury)
- Combustion emissions to air should be accounted
  - may go down (e.g. dioxins)
- Leaks from landfill sites and soil runoff should be accounted
  - e.g. radioactivity
  - may increase (e.g. chemicals from cities, pesticides)

Baltic Sea Action Plan – Maritime activities

- Sewage effluent from ships and offshore facilities contributes to pollution
- Introduction of alien or invasive species to the Baltic Sea ecosystem under changing climate would be important
  - New niches are created
  - There are already new species coming in
- Air pollution contributes to climate change
- Wind farms affect the marine ecosystem

Baltic Sea Action Plan – Maritime activities

Existing objectives / targets in the Baltic Sea:

- No illegal discharges
- No accidental pollution
- Minimum sewage pollution from ships
- No introductions of alien species from ships
- Minimum air pollution from ships
- No discharges from offshore platforms
- Minimum effects from offshore installations

Baltic Sea Action Plan – Maritime activities

We suggest to HELCOM countries that:

- Focus on discharge of sewage from ships
- Pay attention to introduction of new species from ships
- Offshore installations' negative effects

Decision support system

- BSAP is based on NEST, an interlinked system of models
- more elaborate models
- ensemble modelling
- independent board of scientists for validation of model results
- improvement of monitoring

Monitoring and indicators

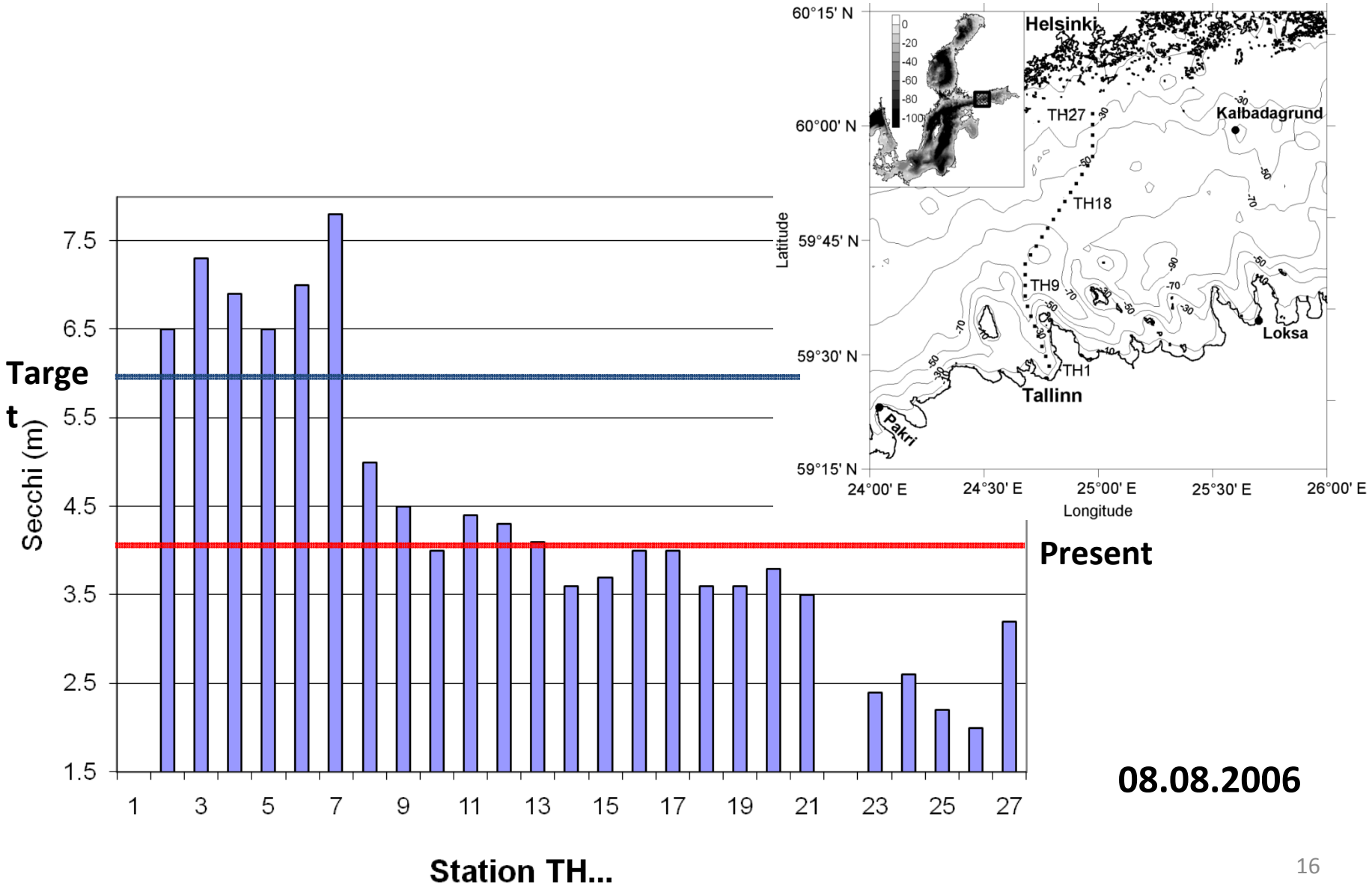
- Lack of long time data series

- Natural variability of indicative ecosystem parameters is very high in space and time. Insufficient measuring frequency

- Water quality estimations by indicators should consider physical situation and other affecting parameters

- Lack of interstate data sharing (for example, Neva river inflow data is not available)

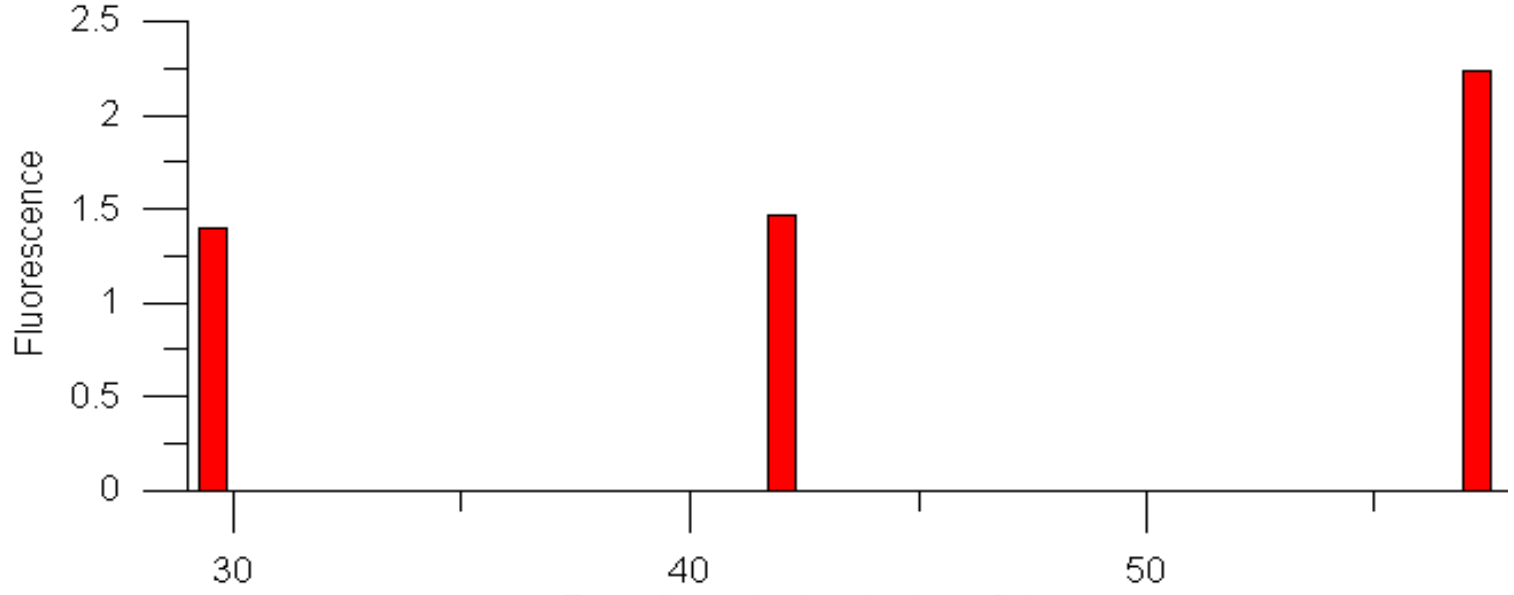
Monitoring and indicators: example 1, Secchi depth



08.08.2006

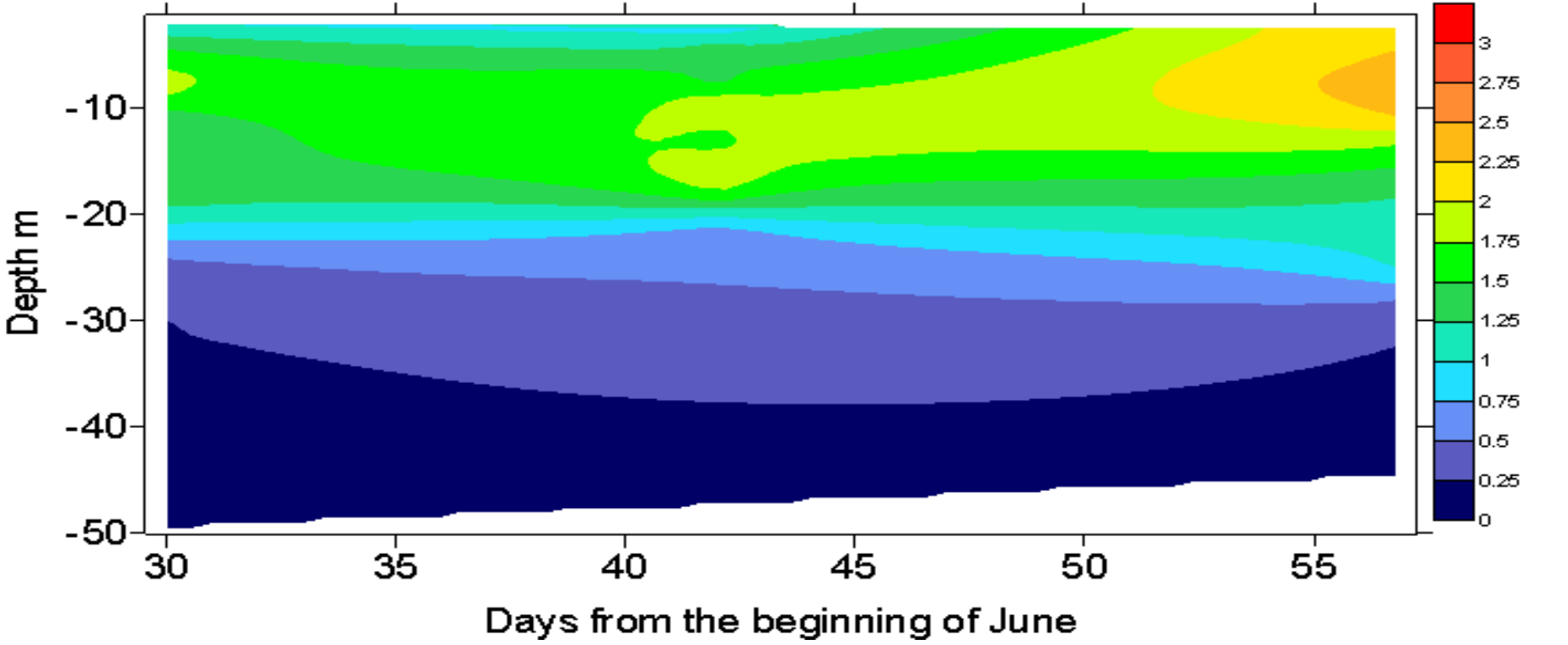
Monitoring and indicators: example 2, ***based on uncalibrated chlorophyll a data from the Gulf of Finland in 2009 summer (Estonian monitoring program)***

Historical data based on mixed upper layer sample (mixing of water from different depth 0, 5, 10 m).
If we used mentioned methodology and todays measuring frequency (2 weeks) we will get:



Monitoring and indicators: example 2, ***based on uncalibrated chlorophyll a data from the Gulf of Finland in 2009 summer (Estonian monitoring program)***

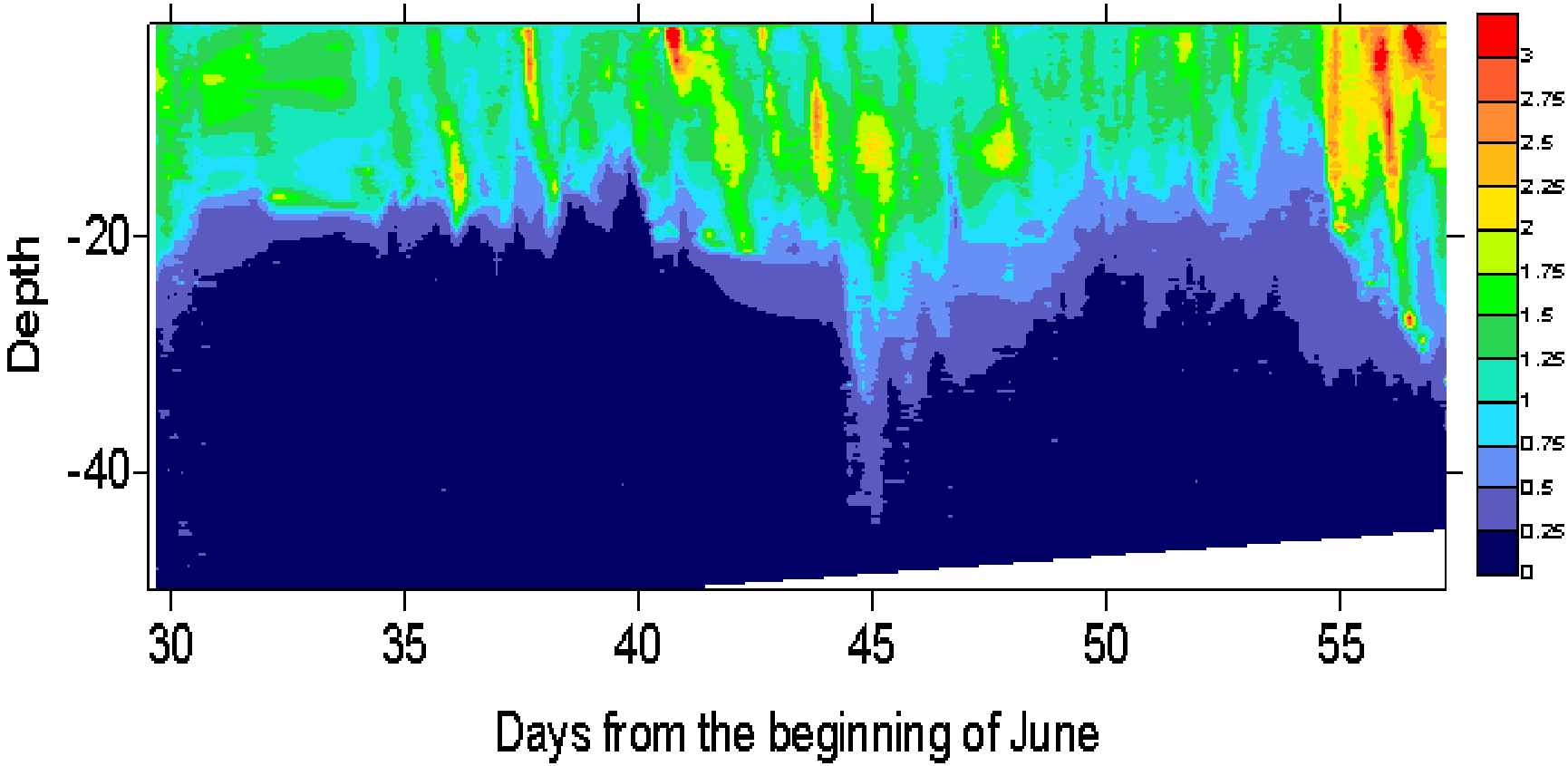
If we used todays methodology (profile) and todays measuring frequency (2 weeks) we get:



30.06.2009 **28.07.2009**

Monitoring and indicators: example 2, ***based on uncalibrated chlorophyll a data from the Gulf of Finland in 2009 summer (Estonian monitoring program)***

If we used measuring frequency of 3 hours we get:



30.06.2009 **28.07.2009**

Thank you

Questions
& feedbacks

Climate changes

GREEN BALTIC

Considerations of Climate change issues for the Baltic Sea Action Plan

Group No. 3 (Annu Oikkonen, Eva Papaioannou, Maren Moltke Lyngsgaard, Timo Arula, Saskia Otto)

For the revision of the BSAP, we took the climate predictions made by the BACC authors (BACC, 2008) into account, i.e. changes in air temperature (yearly mean increase and pronounced increase in spring, milder winters, decrease of temperature range), increase in CO_2, changes in precipitation (general trend of an increase in the northern region particularly in winter, decrease in the southern part mainly in summer), as well as the interactive effects of both parameters (rainfall rather than snowfall in the winter season in the northern region). One of the resulting impacts on the hydrological and terrestrial parameters, we regarded as important, are the predicted increase of water temperature, changes in stratification and in salinity (most likely a decrease in general and an increase in spatial differences), acidification, the decrease of ice cover during winter season and the extension of the growth season. We aimed for a more holistic approach rather than finding suggestions for the particular recommendations for each of the four issues covered in the BSAP:
Our Vision is the establishment of a "Green Baltic", which can only be reached if we think more i) globally and ii) combine economy with the environment. The latter emphasizes the "Cradle to Cradle" (C2C) principle, an economic, industrial and social framework that seeks to create efficient and waste free systems. Furthermore, we recommend iii) the establishments of "green and blue corridors". The underlying idea is to identify the most vulnerable or critical areas/regions, designate them as a corridor and enhance here efforts in necessary measures. Particularly transnational corridors can strengthen hereby cooperation and the public spirit among the Baltic Countries. For each of the three approaches, we have the following suggestions:

i) Think globally:

- Networking (horizontally)
  - Baltic Sea countries → knowledge transfer / setting common goals)
  - Similar countries (e.g. Black Sea countries) → knowledge transfer
- EU-wide → harmonize EU Directives
- Establishment of a regional, economical and political Union (as the Union of the Mediterranean) → „United Countries of the Baltic" (UCB) by 2015
- Financing of measures by the UCB → relative contributions according to GDP
- Regional monitoring programs with inducement of benefits
- Protection strategies / Disaster Management Plan (sea level rise / storms / etc.)
- Networking (vertically): include all stakeholders (e.g. fishermen, fish processing companies, engineers)
- Implementation strategy process with stakeholders
- Launch a PDO-Eco-Label (Protected Designation Origin) for local and / or organically produced agricultural products, meat, fish, etc.
  →Formulation of recommendation guidelines, accreditation of third party certification bodies, subsidies
- Promotion and education of PDO- / C2C idea → media, schools, tourist offices, travel agencies

ii) Economy combined with Environment (C2C)

iii) "Green and Blue corridors":

Green Corridors address primarily reform in current land use to maintain same level of productivity while at the same time reducing and eventually eliminating the input of nutrients. Actions include reforms and adaptations to the current agricultural practises, with the establishment of crop rotation and fallowing, cultivation of nutrient efficient plants, irrigation adaptations for the minimisation of water losses (e.g. 'drip' systems), and the establishment of 'buffer zones', in vulnerable areas around river and waterways. Green corridors address also urban development, transport and energy production.

Blue Corridors include mostly reforms in marine transport, fisheries and offshore renewable energy sources (e.g. windmill parks). With regard to marine transport, actions include the ban of motorboards or their replacement with energy efficient boats and the use of kites for tankers. For fisheries, an overall reform in the current regime is imperative for the sector to reach sustainability. This requires a flexible and immediate change in the current quota system, utilisation of by-catch, improvement of fishing tools, and establishment of MPA's. Also, make benefit of from new valuable (freshwater) species, such as pike-perch. Aquaculture is also an important area of consideration. Suggested actions are the promotion of multi-trophic aquaculture practices

(mussels and macroalgae), reuse of aquaculture by-products as food, bio fuel, and building material (e.g. roads bivalve shells).

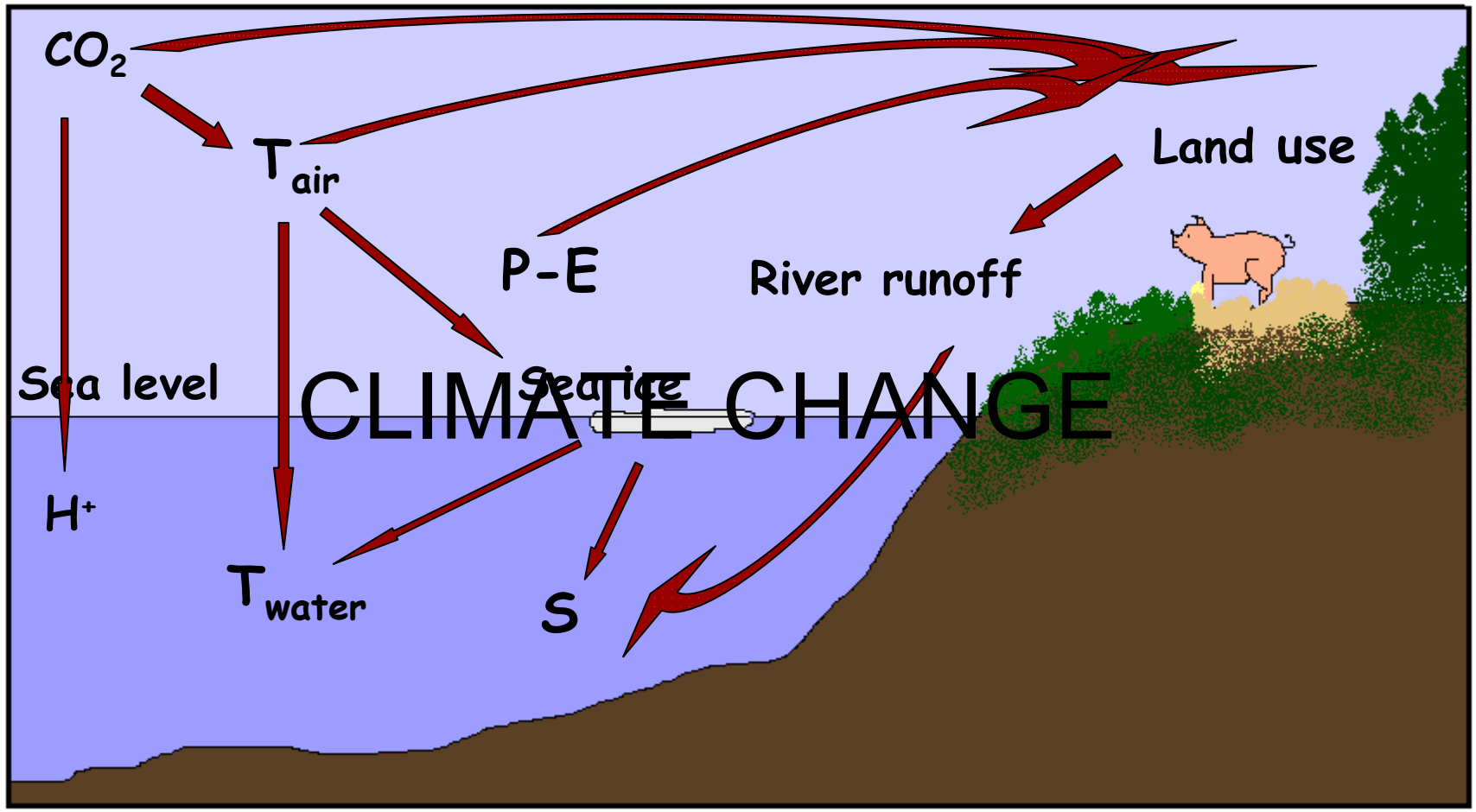
THINK GLOBALLY

GROUP 3

A VISION FOR A ”GREEN” BALTIC

ANNU OIKKONEN ● SASKIA A. OTTO ● EVA PAPAIOANNOU ● MAREN MOLTKE LYNGSGAARD

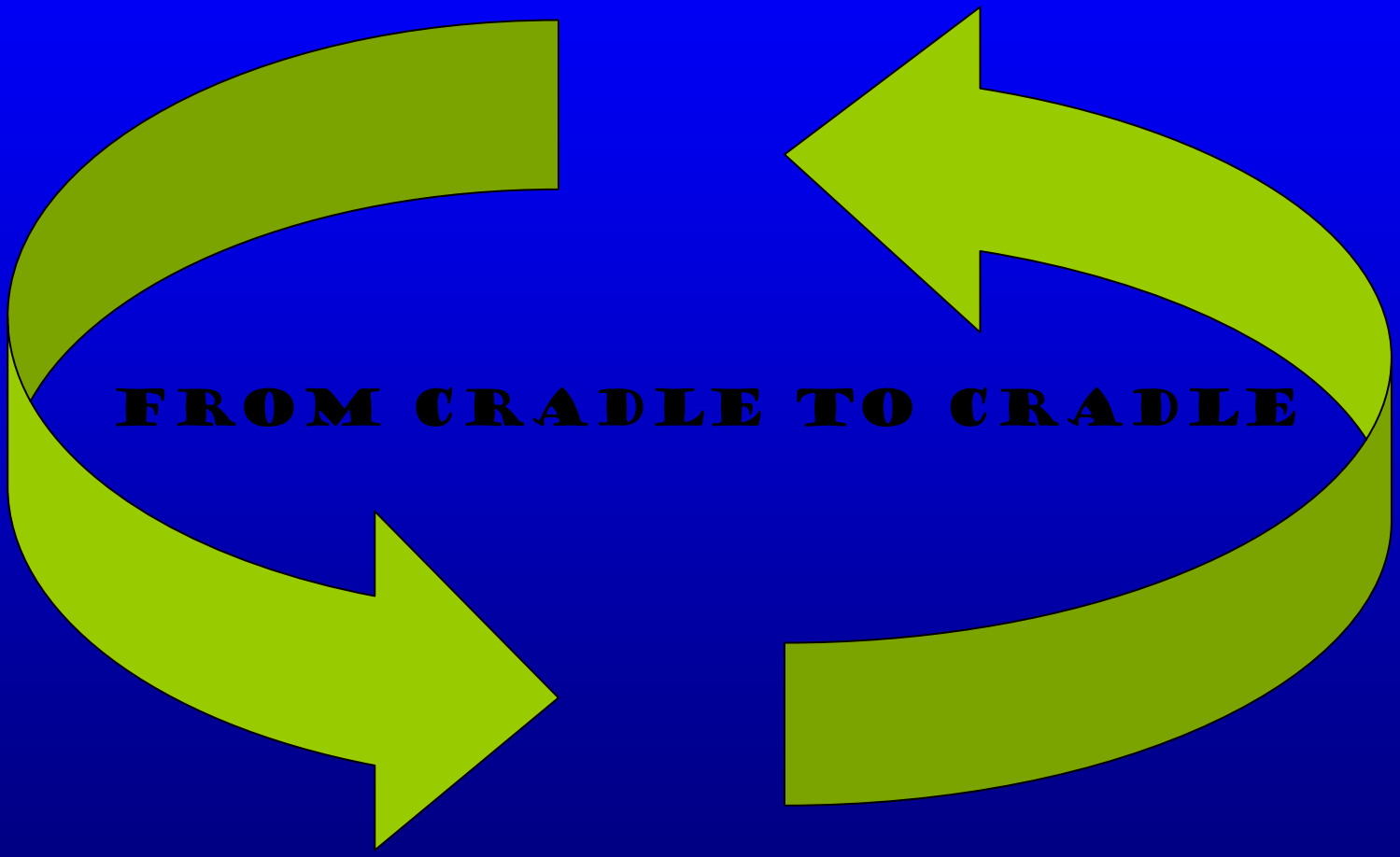
THINK GLOBALLY



RECYCLING

NO FOOTPRINT

THINK GLOBALLY



NO FOOTPRINT

RECYCLING

THINK GLOBALLY

Think globally:

- NETWORKING (horizontally)
  - Baltic Sea countries → knowledge transfer / setting common goals)
  - similar regions (e.g. Black Sea countries) →knowledge transfer
  - EU-wide → harmonize EU Directives
- UNION establishment by 2015
  - regional, economical and political Union of BS countries
  - as the Union of the Mediterranean
- FINANCING of measures by the United Countries of the Baltic → relative contributions according to GDP
- REGIONAL MONITORING programs with inducement of benefits
- PROTECTION STRATEGIES / Disaster Management Plan (sea level rise / storms / etc.)

THINK GLOBALLY

Economy combined with environment

- NETWORKING (vertically): include all stakeholders (e.g. fishermen, fish processing companies, engineers)
- IMPLEMENTATION strategy process with stakeholders
- PROMOTION AND EDUCATION of PDO- / C2C idea
  → media, schools, tourist offices, travel agencies
- UCB, PDO-Eco-Label (Protected Designation Origin) for local and / or organically produced agricultural products, meat, fish, etc.
  - formulation of recommendation guidelines, accreditation of third party certification bodies
  - Provide subsidies

THINK GLOBALLY

THINK GLOBALLY

GREEN AND BLUE CORRIDORS

THINK GLOBALLY

LAND USE CHANGES "Green corridors"

- CLIMATE CHANGE IMPACTS
- VEGETATION MODEL SIMULATION
  - Regional Land Use
- Vulnerable areas identified by 2012
  - Agriculture
  - Forestry
- ESTABLISHMENT of <<Green Corridors>> by 2017

THINK GLOBALLY

- CHANGE in land use
  - maintain same level of productivity & reduce or eliminate the input of nutrients.

- CROP ROTATION SYSTEMS & Fallowing
  - Change in growth season

- BIOFUELS in agriculture
  - intensify nutrient recycling
  - Equity use of food/resources – don't burn food

- IRRIGATION SYSTEMS ADAPTATION –
  - Efficient use of water resources - Minimize water and fertilisers use

- 'BUFFER ZONES' established around waterways and in coastal areas
  - Nutrient uptake efficient crops (e.g. Willows)
  - Sea level rise – risk management

THINK GLOBALLY

LAND USE ”Green Corridors”

- URBAN DEVELOPEMENT
  - Sustainable and Green (‘Energy saving’ buildings)
  - Sewage treatment – Target: 100 % removal / recycle of P from effluent / Total ban of P in detergents
- TRANSPORT
  - Promotion of energy efficient transport means (low speed trains, metro) / Biodiesel
  - Infrastructure adaptation (tunnels, extension of existing track lines)
- ENERGY PRODUCTION
  - Renewable energy (wind mills, solar energy) (e.g. SamsØ, Denmark 140% C-Footprint cut-off / 10 yrs)

THINK GLOBALLY

LAND USE ”Green Corridors”

•TARGET

- HELCOM’s maximum allowable input of nutrients into the Baltic should be adjusted to account for projected climate change

•NETWORKING AND COORPERATION:

- Reduction scheme based on encouragement of ‘no-pollution’, not on ‘punishment’

THINK GLOBALLY

BALTIC SEA "Blue corridors"

- Ban effluent discharge + receiving facilities in harbours
- Ban motorboats
  - or change to renewable energy
  - Use kites for tankers
- Sustainable fisheries
  - Immediate action on quota change
  - Pricing
  - Stock enhancement
  - Use by-catch and improve fishing tools – no by-catch discharge allowed
  - Feet aquaculture with organisms from within the BS
- Marine protected areas
  - to improve sustainable fisheries
  - to maintain biodiversity

THINK GLOBALLY

INPUTS TO THE BALTIC SEA "Blue corridors"

- Multitrophic mitigation approach (no nutrients added)
  - Use an ecosystem approach in aquaculture
- Increasing nutrient uptake efficient marine species
  - mussels and macroalgae
  - Use output for: food, bio fuel, building constructions e.g. roads
- Accept possible changes in species distribution
  - Make benefit of new valuable (freshwater) species e.g. Pike perch. Example from Southern Stockholm.
  - Explore aquaculture possibilities
- Make renewable energy e.g. windmill parks

Climate impacts on the Baltic Sea, from science to policy, Bornholm 2009
The Syndicate Exercise, updated Baltic Sea Action Plan.
Group 4: Ericson, H., Höffle, H., Klais, R., Niiranen, S., Szymczycha, B.

Eutrophication and climate change. We expect that nutrient levels will increase due to increasing runoff. Hence, level of primary production will increase, especially that of cyanobacteria, as a result of higher temperatures. Water transparency may decrease due to increased inflow of humic substances, decreasing its value as an indicator of eutrophication. To counteract the changes in target conditions attributable to climate change, WE RECOMMEND to define new decreased allowable phosphorus input levels to all basins to i) deal with increases in cyanobacterial blooms and ii) reduce the organic material flow to the bottom of the Baltic Sea minimizing the impact of processes generating hypoxia. WE SUGGEST establishing a common pool of money (based on country allocations) for additional reductions to be targeted towards the most cost efficient actions (e.g. sewage treatment in Poland). Reduction sites/projects should be determined by a board of experts.

Hazardous substances and climate change. Change in environmental conditions can result in i) increased exposure of organisms to toxins due to increased metabolic rate, (e.g. elevated respiration) and/or higher environmental toxin concentrations (increased riverine runoff), ii) higher sensitivity to toxins due to stress induced by suboptimal conditions. WE RECOMMEND application of more stringent regulations regarding concentrations of toxins in wastewater treatment plant (WTP) effluents. Cost-efficiency is achieved by constructing WTPs efficient in removing both nutrients and toxins. Costs should be covered by manufacturers/importers of chemicals.

Biodiversity and climate change. We expect changes in species composition towards freshwater species and a south-west shift of marine habitats. Disturbance could lead to an even more vulnerable ecosystem potentially facilitating intrusions of invasive species. WE RECOMMEND to i) focus on establishing a network of marine protected areas (MPA) over the entire Baltic region, ii) to ban bottom trawling in the Baltic Sea to protect habitat-forming species, iii) to enforce protection of selected marine species in those areas that will stay marine even under worst-case scenarios.

Maritime traffic and climate change. Climate change might amplify negative environmental effects of maritime traffic. WE RECOMMEND further limit NO_x emissions and wastewater release from ships. The AIS system can be used to detect sources and quantities of emissions, followed by "polluter pays" principle. Speed limits should be introduced in order to reduce NO_x emissions. Ballast water should be replaced before ships enter the Baltic Sea.

Public awareness and climate change. WE RECOMMEND HELCOM to centralize the information campaigns and we stress the importance of informing the public. The public can be involved in monitoring programs (e.g. Secchi depths). By increasing the public awareness of the state of the Baltic Sea and HELCOM actions, we hope to establish political clout to the benefit of the Baltic Sea.

New instruments. WE RECOMMEND increased groundwater monitoring to elucidate the magnitude of ground water inflow into the Baltic Sea. Present data is scarce and significant groundwater inflows could largely contribute to the input of nutrients, trace metals, DIC, DOC etc. into the Baltic Sea. Increased knowledge can contribute to improved models, which could lead to changes in the country allocation scheme of nutrient reductions.

The ~~Baltic Sea~~ Bornholm Action Plan

- BAP -

Hanna Ericson, Hannes Höffle, Riina Klais,
Susa Niiranen, Beata Szymczycha

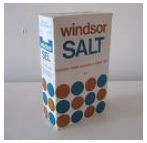
B(S)AP Goals

- A healthy Baltic Sea Environment and a good ecological status that can support human economic & social activities

- Action is taken in the areas of:
  - Eutrophication
  - Hazardous substances
  - Biodiversity
  - Maritime activities

  Measures are to be implemented until 2021.

Projected Climate Change effects on the Baltic Sea

Variable	North	South
T 	+2-4 C	+2-4 C
Ice 	- 80 %	
Precip. 	+ 50 %	+20 %
Sal 	- 0-5 psu	-0-5 psu
pH 	- 0.4 units	- 0.4 units

Eutrophication

- <u>Goal:</u> Reach level of primary production representative of the period before major anthropogenic effect.

T ↑ → earlier spring bloom (mismatch), species composition (cyanobact.)

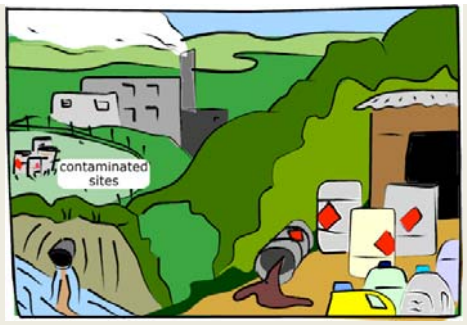
→ ↑ stratification → ↑ hypoxic areas

Run-off & groundwater (winter) ↑

→ ↑ N, P input

<u>Recomm.:</u> Increase P country allocations

- Monitoring
  - Representative coastal and river outlet stations (internat.) → early detection of changes (open-sea forecast)
  - Submarine groundwater monitoring → change in country allocations
- Financing the further reductions
  - A common pool of money (country allocations) → cost efficiency (e.g combined with hazard. sub. reductions)
  - A board choosing reduction sites/projects



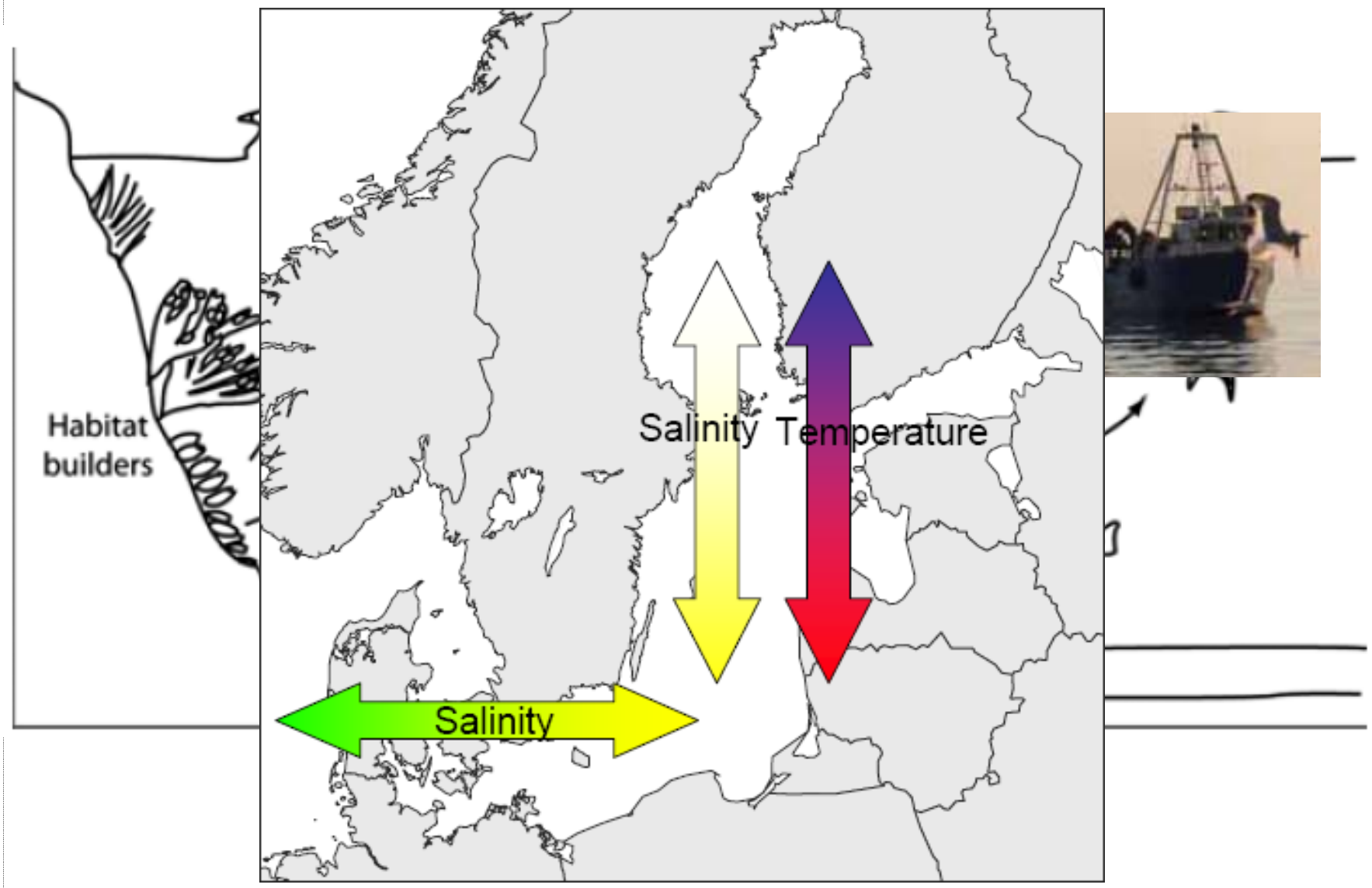
Hazardous substances

- Goal: Close to zero anthropogenic input of hazardous substances.

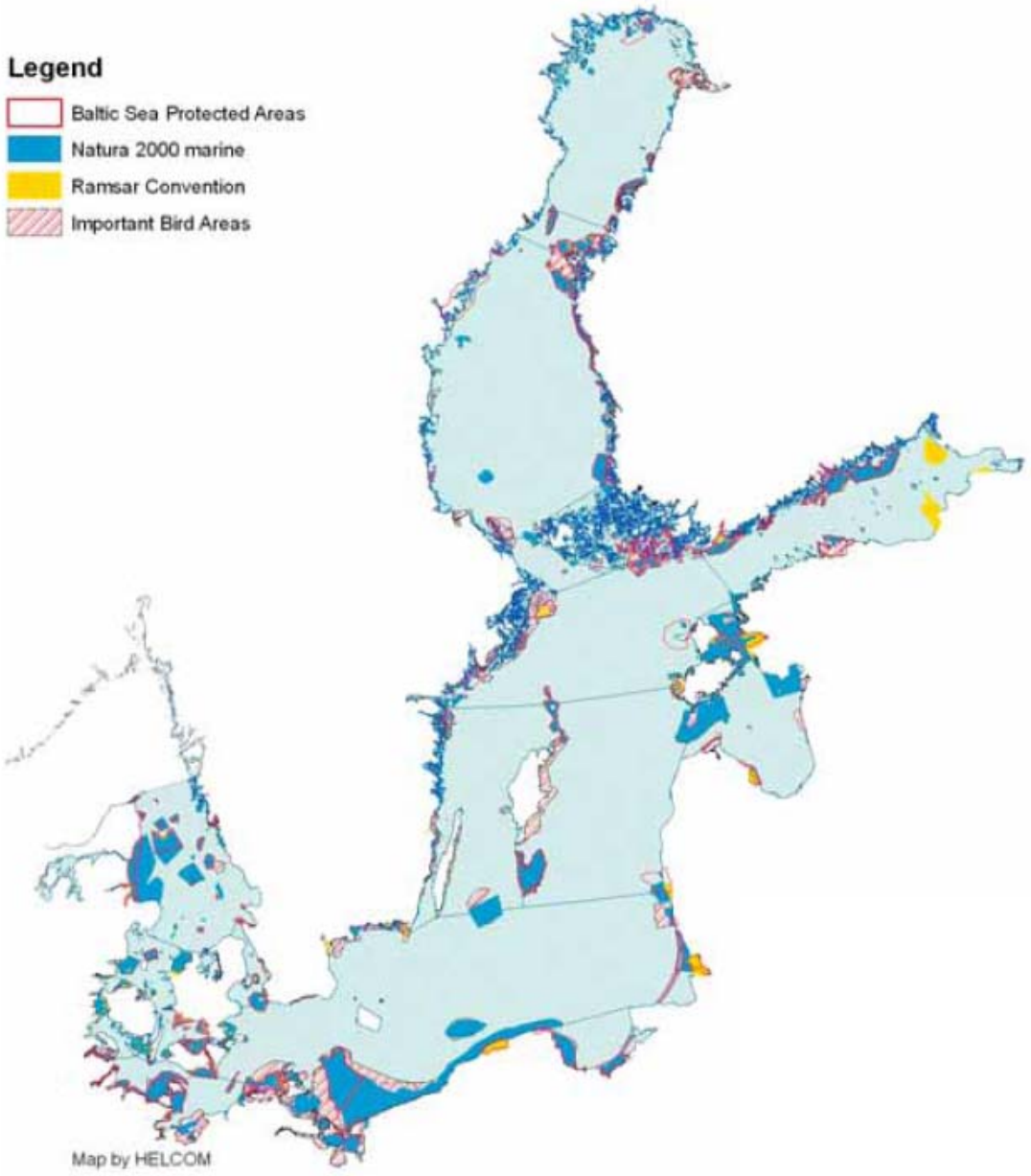
- CC can induce increased stress on marine organisms
- River runoff can increase input
- Increased metabolism (Q10) → increased exposure

- Recommendations: Increase efficiency of water treatment plants (cost efficient if combined with nutrient reductions)
- Organic farming, less biocides (northern countries)

Biodiversity



Biodiversity



Maritime activities

Goal: Environment friendly traffic

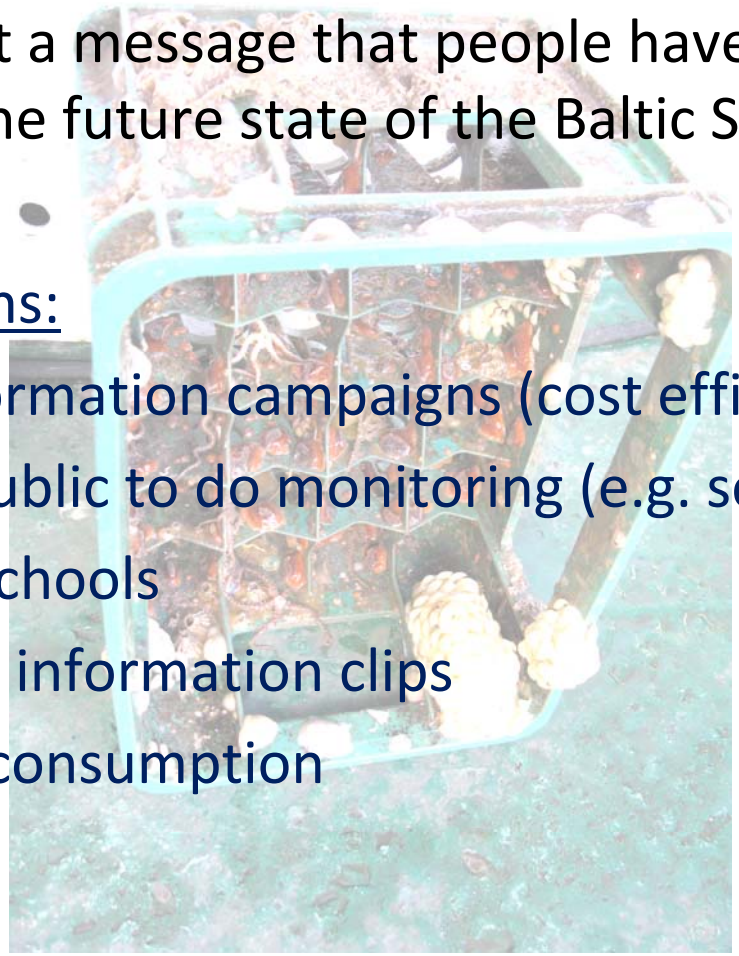
- CC does not influence the emissions, but might amplify the effects

Recomm.: ↓ nutrient release → speed limits (No_x)

- Detect emission sources (AIS) - Polluter pays principle
- Change of ballast water before entering the Baltic
- Decreased response time to accidents as the system might be more sensitive

Public awareness

Goal: To send out a message that people have the power in determining the future state of the Baltic Sea



Recommendations:

- Centralize information campaigns (cost efficient)
- Educate the public to do monitoring (e.g. secchi depth)
- Education at schools
- Prime-time TV information clips
- Reduce meat consumption

THANK YOU FOR YOUR ATTENTION!