

# *Role of changing society in managing the future Baltic Sea ecosystem*

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# Baltic Sea – a vulnerable ecosystem

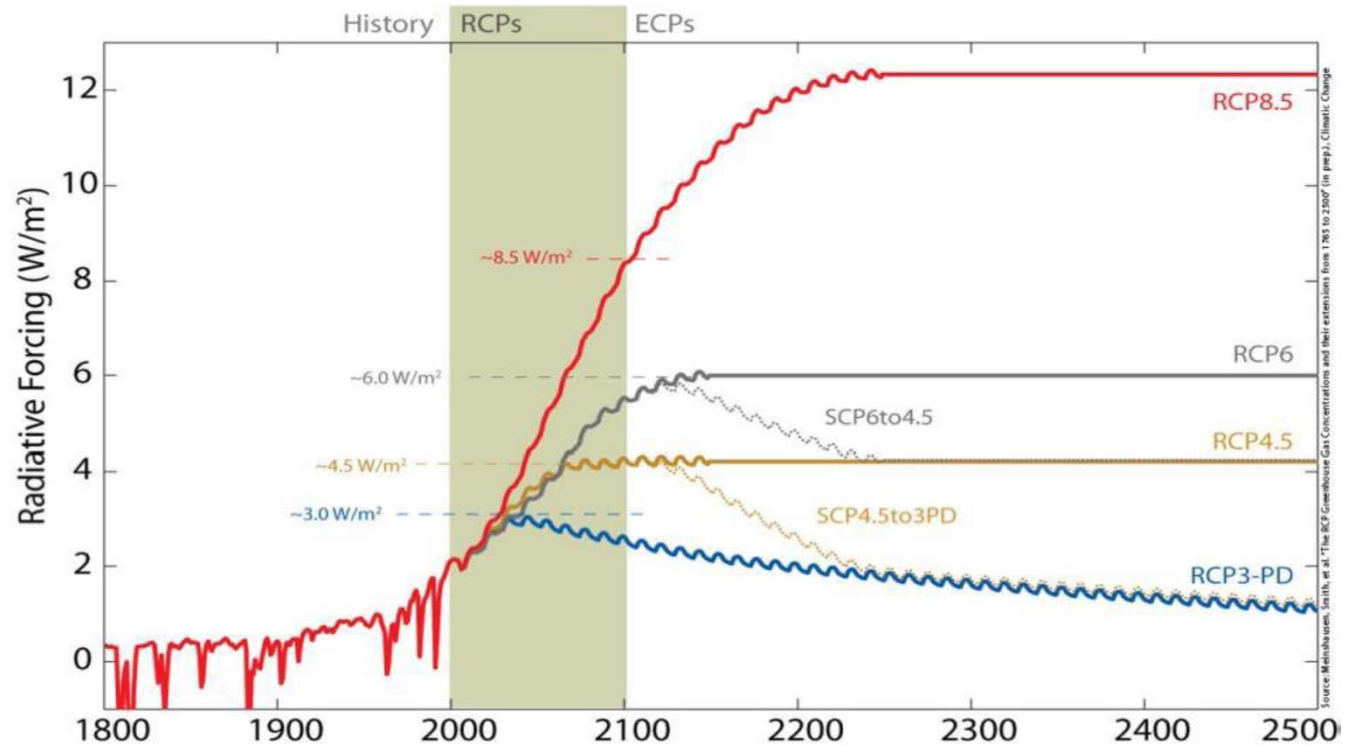
greatly influenced by  
human activities and  
the climatic system

Source: Terra Satellite, May 2009



# Climate scenarios: Representative Concentration Pathways (RCPs)

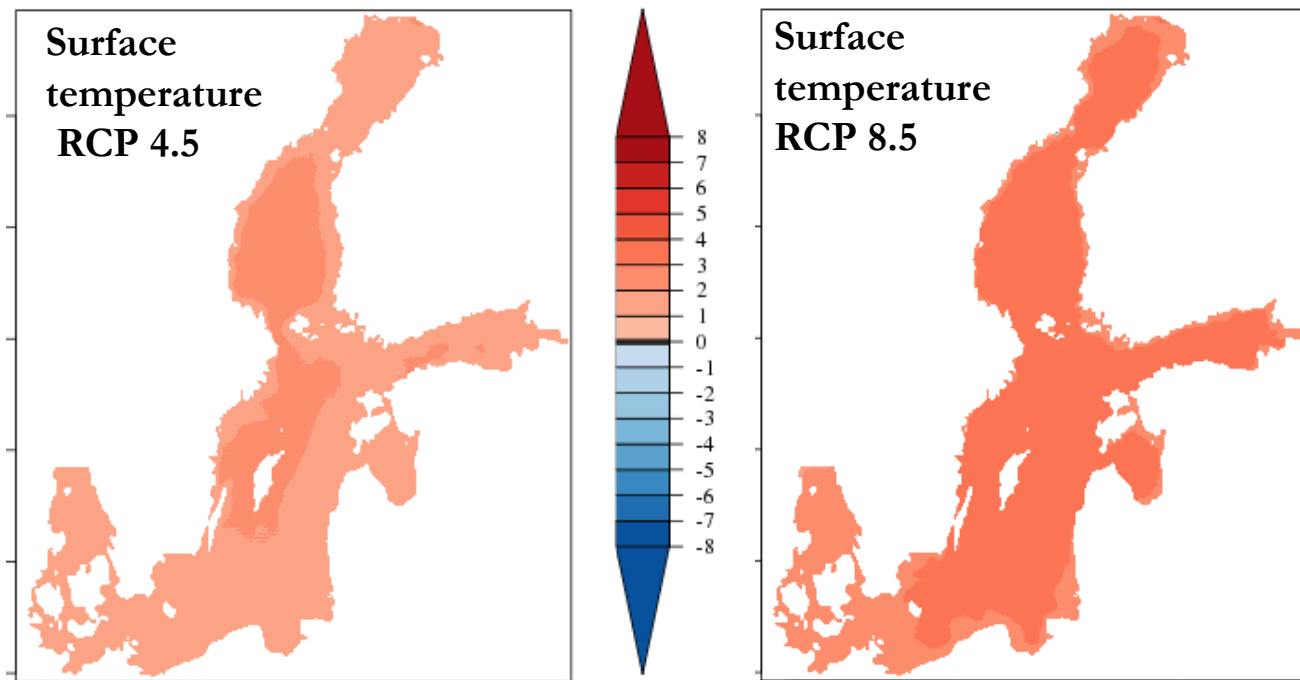
	2081-2100
Scenario	Mean global surface T
RCP2.6	1.0
RCP4.5	1.8
RCP6.0	2.2
RCP8.5	3.7



# Climate change directly impacts the Baltic Sea

Annual average temperature changes between future (2069-2088) and present (1976-2005)

## Temperature changes



**RCP 8.5 max 4 °C temperature change; most of the area: > 3 °C increase**

**RCP 4.5 : < 3 °C temperature increase**



# Society's direct impacts

## Multiple stressors

- Nutrients
- Fisheries
- Shipping
- Plastic
- toxins





# Need for long term socio-economic pathways

- The environmental problems in the Baltic Sea are characterized by **slow human response** and **significant time lags** due to repository capacity of pollutants
  - Environmental targets and objectives can only be obtained in the **long term**
  - Both **societal activities** and the changes in the **climatic system** in the future will impact on possibilities to meet **environmental targets**
  - In order to investigate **challenges and uncertainties** originating from climate and society...
- ⇒ it appears reasonable to apply long time horizons to societal scenarios as is done for climate scenarios and to evaluate and debate the magnitude and extent of environmental change in the Baltic Sea

# Socio-economic scenarios or pathways

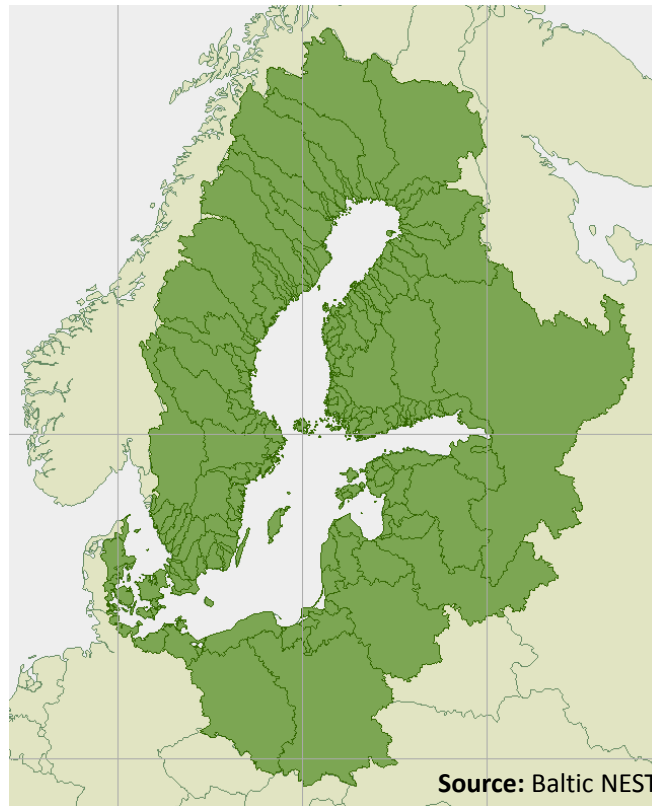
- Stories that describe plausible future societies
- Internally consistent
- Show the range of possible futures



**Overall objective/motivation:** Study the long-term challenges and prospects to reach and to maintain the resilience of the Baltic Sea and sustained provision of marine ecosystem services under *changing climate & society*

**Changing climate**  
RCP4.5 & RCP8.5

**Changing society:**  
SSP1 – Sustainability  
SSP2 – Middle of the road  
SSP3 – Fragmentation  
SSP4 – Inequality  
SSP5 – Fossil-fuel developm.



**Time horizon:**  
**2010 - 2100**

**Themes:**

1. Eutrophication
2. Fisheries – species diversity & food web
3. Marine traffic



# The Global Shared Socio-economic Pathways (SSPs)

5 stories of broad societal trends

Common elements but with different developments

Two elements:

- i) narrative storylines;
- ii) A set of quantified measures of development

 **Economy & lifestyle**

Growth per capita; inequality; international trade; globalization; consumption & diet

 **Policies & institutions**

International cooperation; environmental policy; policy orientation; effectiveness of institutions;

 **Technology**

Development pace; transfer; energy tech change; energy intensity

 **Environment & natural resources**

Fossil constraints; environment status; regulation of land use; agricultural productivity and technological development

**Population growth and urbanisation**

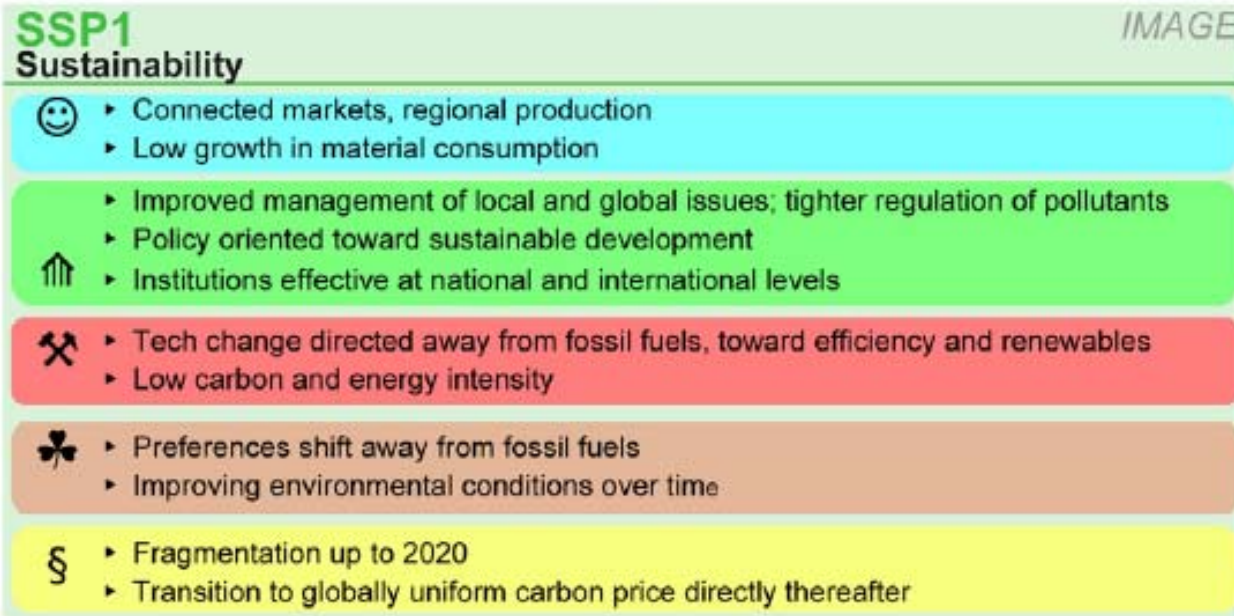
Fertility rate; mortality rate; urbanization rate;



# The Global SSP storylines



## Sustainability (SSP1) - General trends



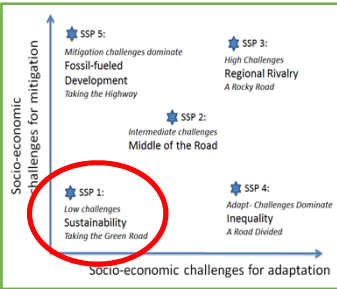
### Global trends


Source: Bauer et al. 2016


### Baltic Sea Region


- Medium term: Full implementation of existing EU Directives and international agreements on the environment
- Long term: strengthened cooperation and strong environmental regulation
- Increased environmental awareness => diet and consumption changes, increased material efficiencies


# Sustainability (SSP1) – Sector trends

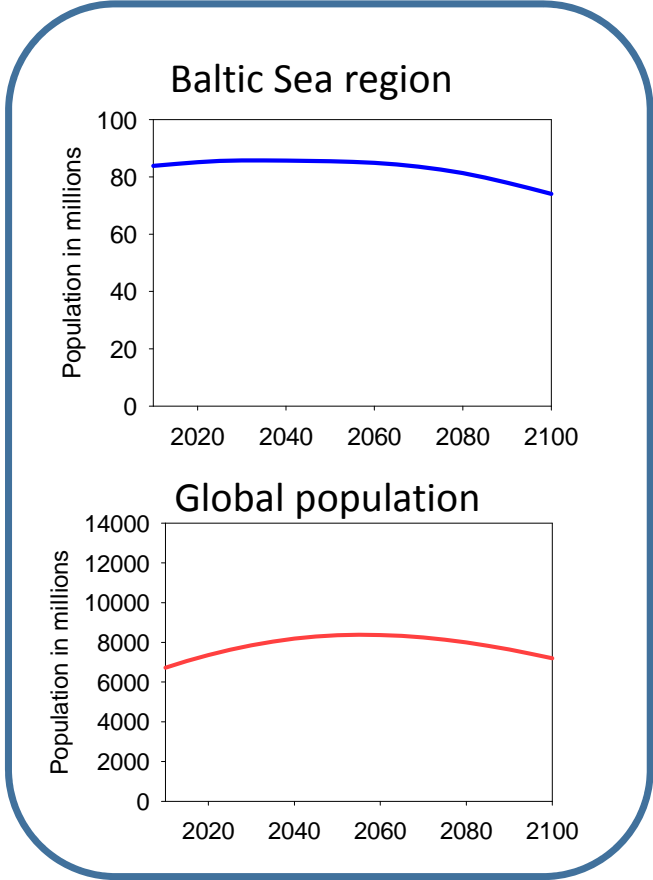


-  Increased plant based diet
- High N efficiency, high share local & organic produce
- Reduced agricultural land cover & livestock

-  Tertiary treatment becomes the standard in sewage treatment
- Separation of rainwater and sanitation
- Advanced on-the-site treatment common in rural areas

-  Tourist shipping increases, bulk and oil shipping decrease
- Electrification in short sea shipping becomes a standard
- Emission of grey water, black water and waste discontinue

-  Sustainable fisheries with high quality products
- Circular economy in aquaculture
- Small-scale, low impact fisheries promoted; avoidance of habitat damaging gear and bycatch



## Fossil-fueled Development (SSP5) – General trends



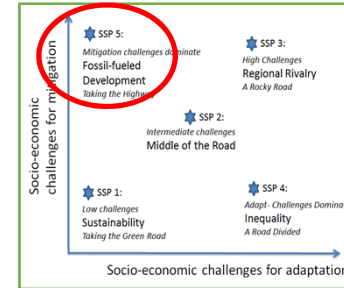
Global trend


Source: Bauer et al. 2016

### Baltic Sea Region


- Lenient environmental legislation=> WFD, BSAP, NECD only relative targets by medium term
- Relative environmental improvements follow technological development
- Agricultural subsidies are gradually removed => international competition & market driven innovation
- General faith in society's capacity to handle climate and ecological systems

# Fossil-fueled development (SSP5) – Sector trends







- Increased meat and dairy in diet
- Globalised, export oriented sector, intensification
- Increased livestock => expansion of agricultural land cover



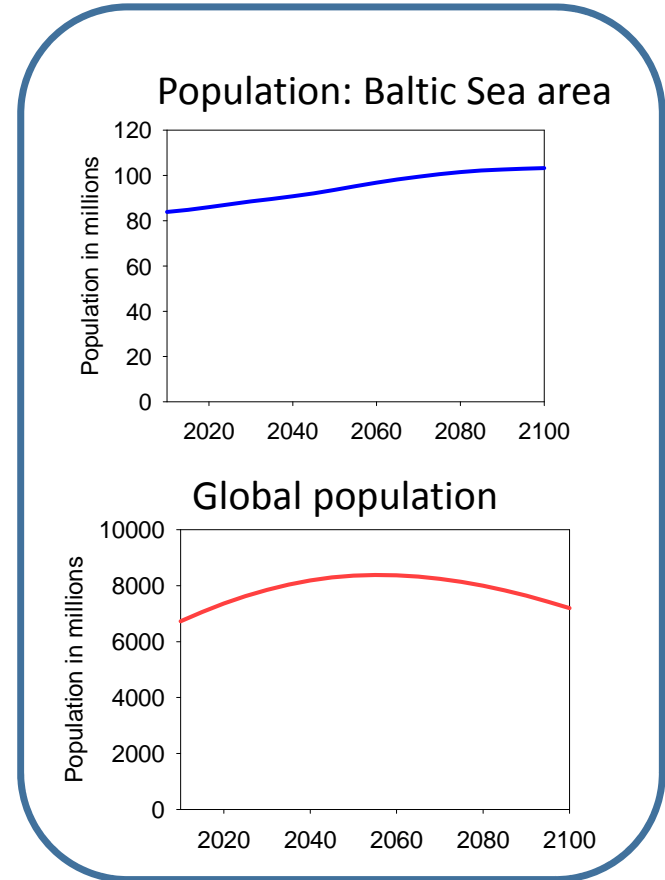
- New investments made to serve growing urban areas
- focus on human health rather than environmental quality
- Some upgrading due to technology spill-overs



- Fast increase in shipping industry, both tourist shipping and in particular oil & bulk shipping
- The emissions to the water and air increase



- Large-scale fishing focusing on maximising profits
- Habitat destructive gear and bycatch allowed
- Industrial scale development of freshwater and marine aquaculture with no nutrient focus



# The narratives are:

basis for detailed quantitative assumptions



input variables to integrated assessment models



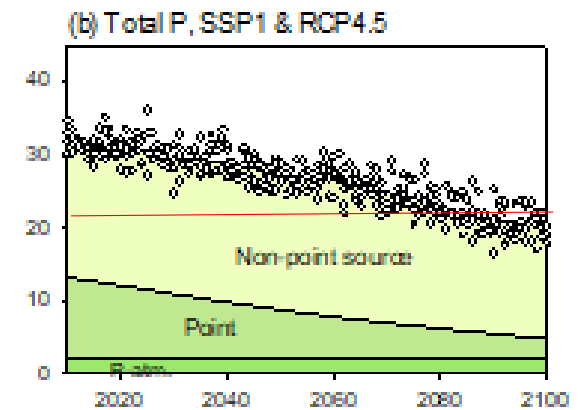
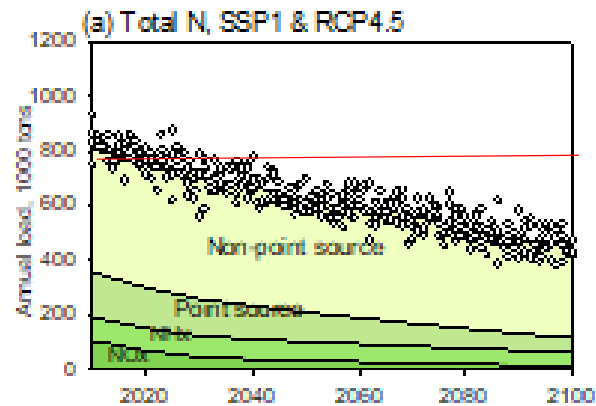
provide scenario-based trajectories of pressures

# Results - nutrient projections

without any additional policies or measures

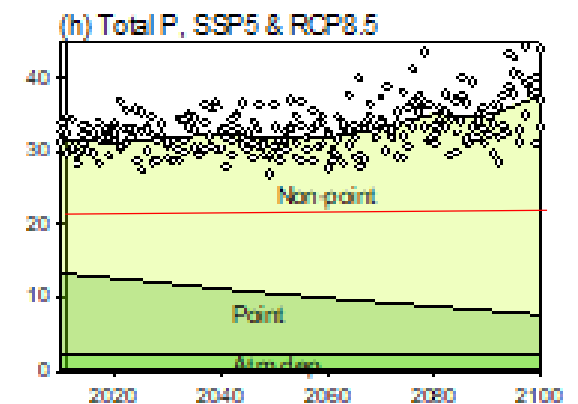
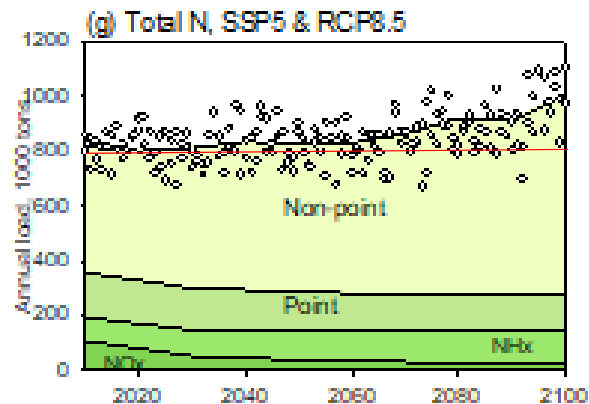
With sustained development (SSP1) and moderate climate change (RCP4.5)

- N load targets will be met early on
- P load targets are met late in the century



For fossil fueled world (SSP5) and extreme climate change (RCP8.5)

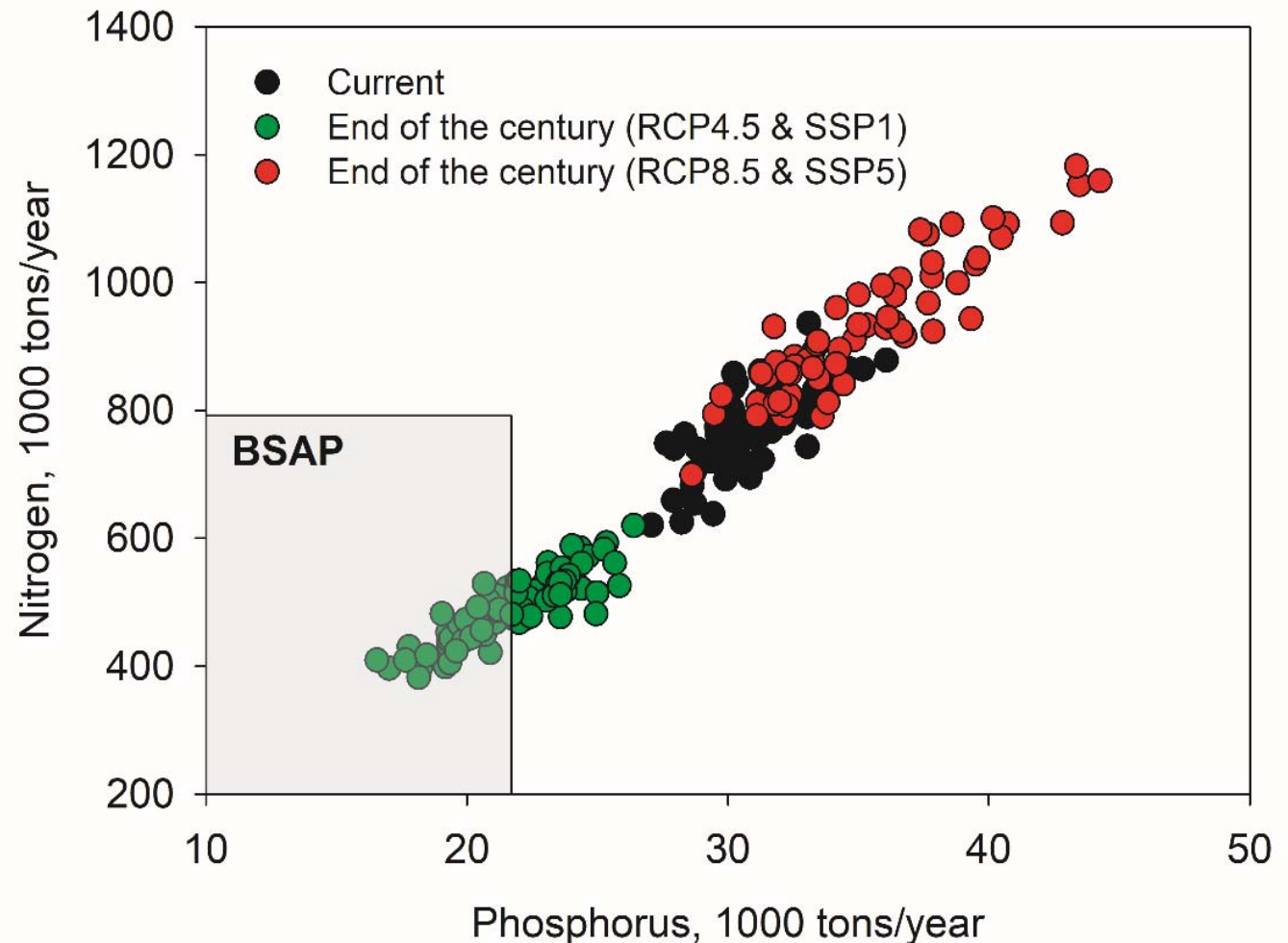
- Nutrient loads will increase
- BSAP is far from reached





# End-of-century results

*Annual variability in nutrient loads to the Baltic Sea currently (2010-2030) and at the end of the century (2078-2098) for combinations of global sustainability & medium climate change (SSP1 & RCP4.5) and fossil-fueled development & high-end climate outcome (SSP5 & RCP8.5).*

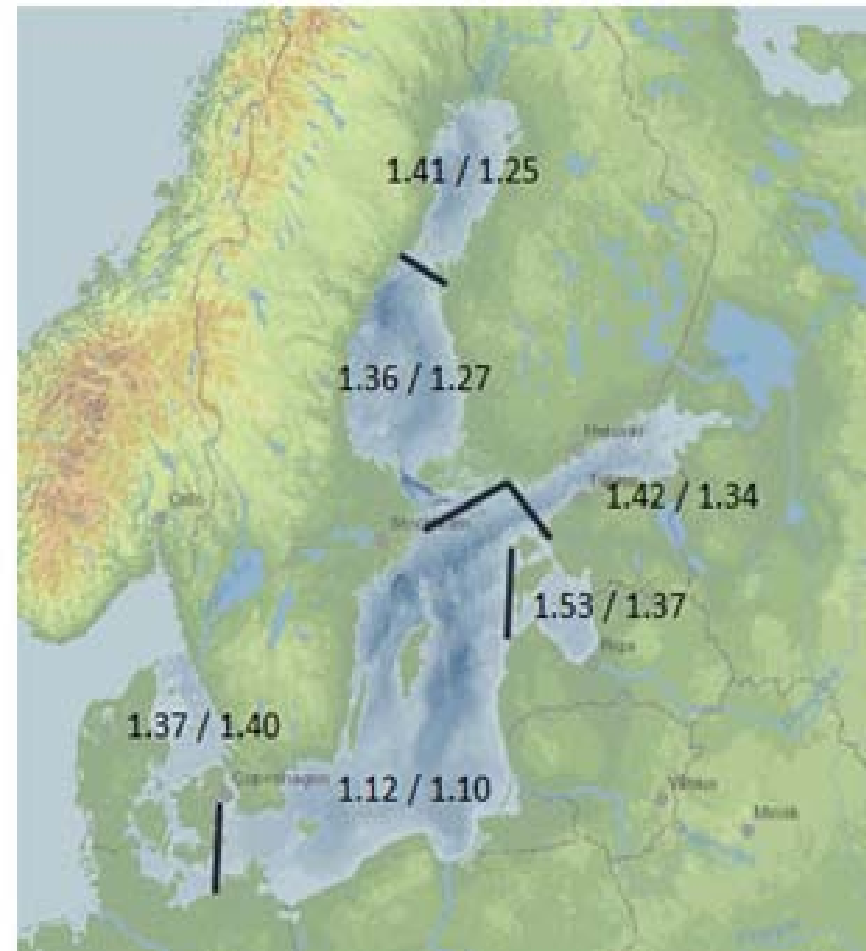
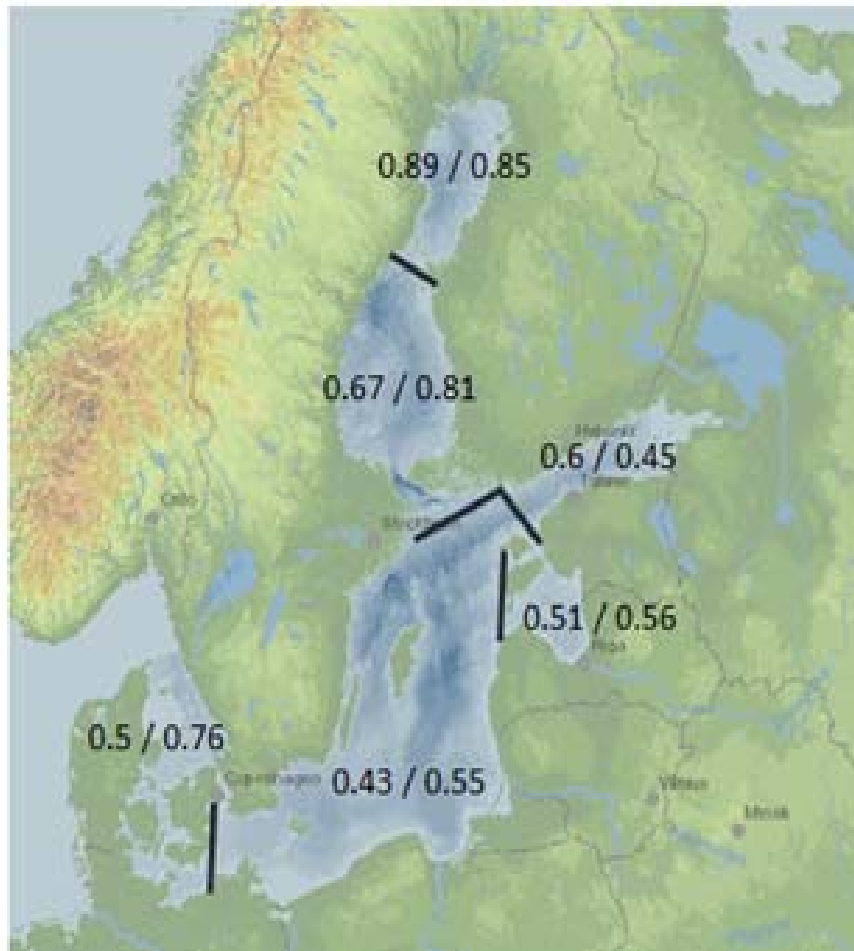


# External nutrient loads (N / P) in year 2100 relative to loads in 2010

*Sustainability in a moderate climate*

*Fossil-fueled development in a high-end climate*

Relative changes in 2100 compared to 2010 of N & P



# My six key points

**Aim 1:** to provide a consistent and long-term context for communicating, debating and analysing a plausible range of futures that will affect the Baltic Sea to varying degrees

**Aim 2:** to quantify the role that different climate/societal futures may play on managing the future Baltic Sea ecosystem

**Global SSPs are useful** due to the long-term challenges of the Baltic Sea and the close connection to global development trends

Added advantage of **combining SSPs with RCPs** for studying the complexity of climatic change in the Baltic Sea

**Societal change** plays a far bigger role than impacts of climate change on future nutrient loading

This means that **achieving good environmental quality** is (still) in the hands of us all in the region.



# Acknowledgements

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<http://https://blogs.helsinki.fi/balticapp/>

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