

Baltic Earth

Extending the knowledge of the regional
Earth system in the Baltic Sea region



Baltic Earth
Earth System Science for the Baltic Sea Region



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Markus Meier

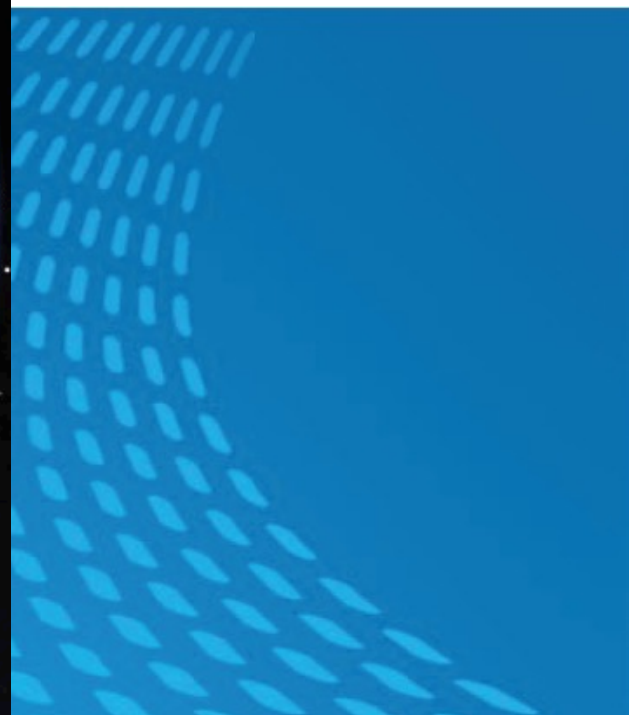
and the Baltic Earth Science Steering Group members

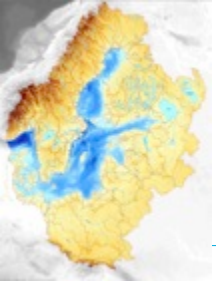


8th GEWEX Open Science Conference
Extremes and Water on the Edge
6-11 May 2018 Canmore, Alberta, Canada

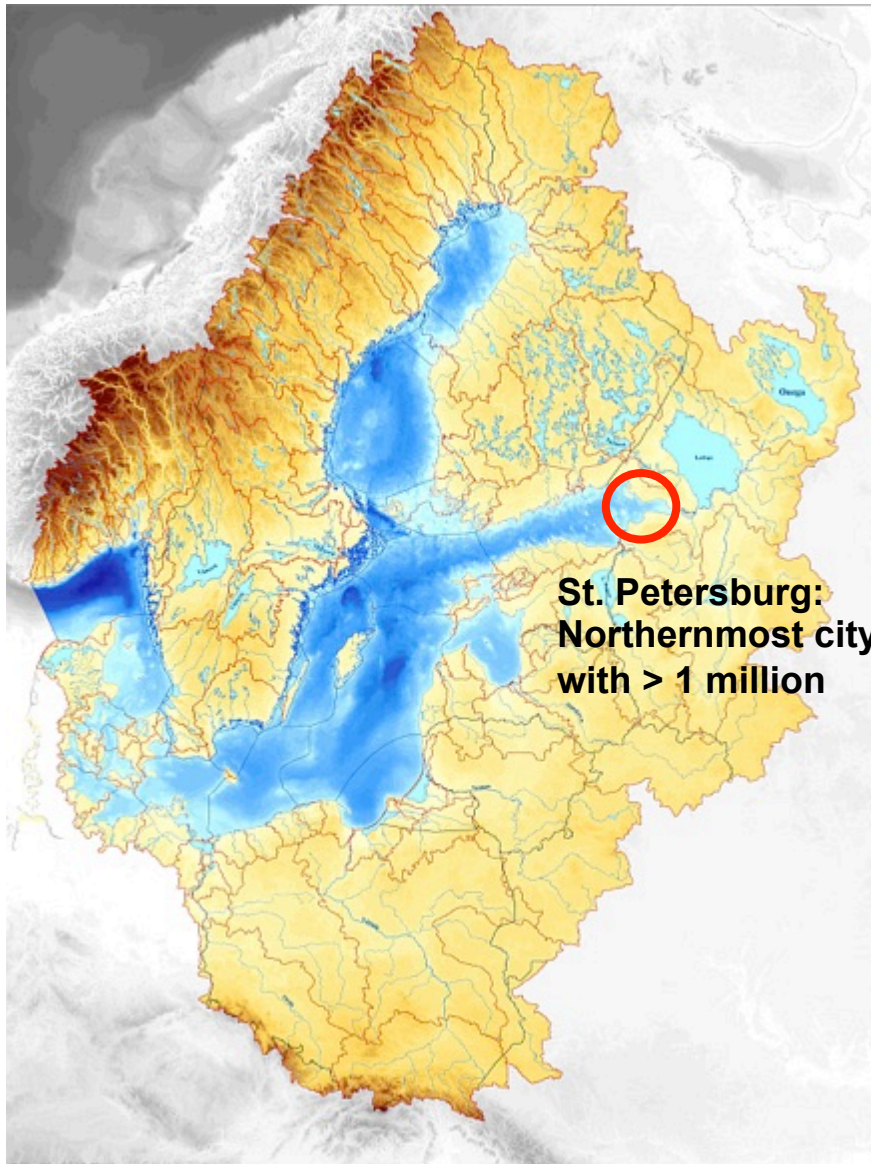
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Geesthacht**
Centre for Materials and Coastal Research

The Baltic Sea region

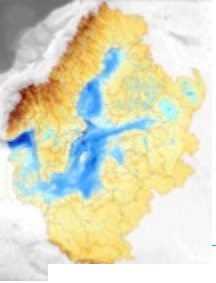




The Baltic Sea region



- Drainage Basin: 2.13 Mill. km²
(20% of the European continent)
- 90 million people in 14 countries
- Baltic Sea: 380 000 km²



The Baltic Sea region



The North ...

- extensive forests, mostly coniferous
- sparsely populated
- mostly rocky coasts
- subarctic climate in winter

The South...

- intense agriculture
- densely populated
- mostly sandy coasts
- moderate climate in winter

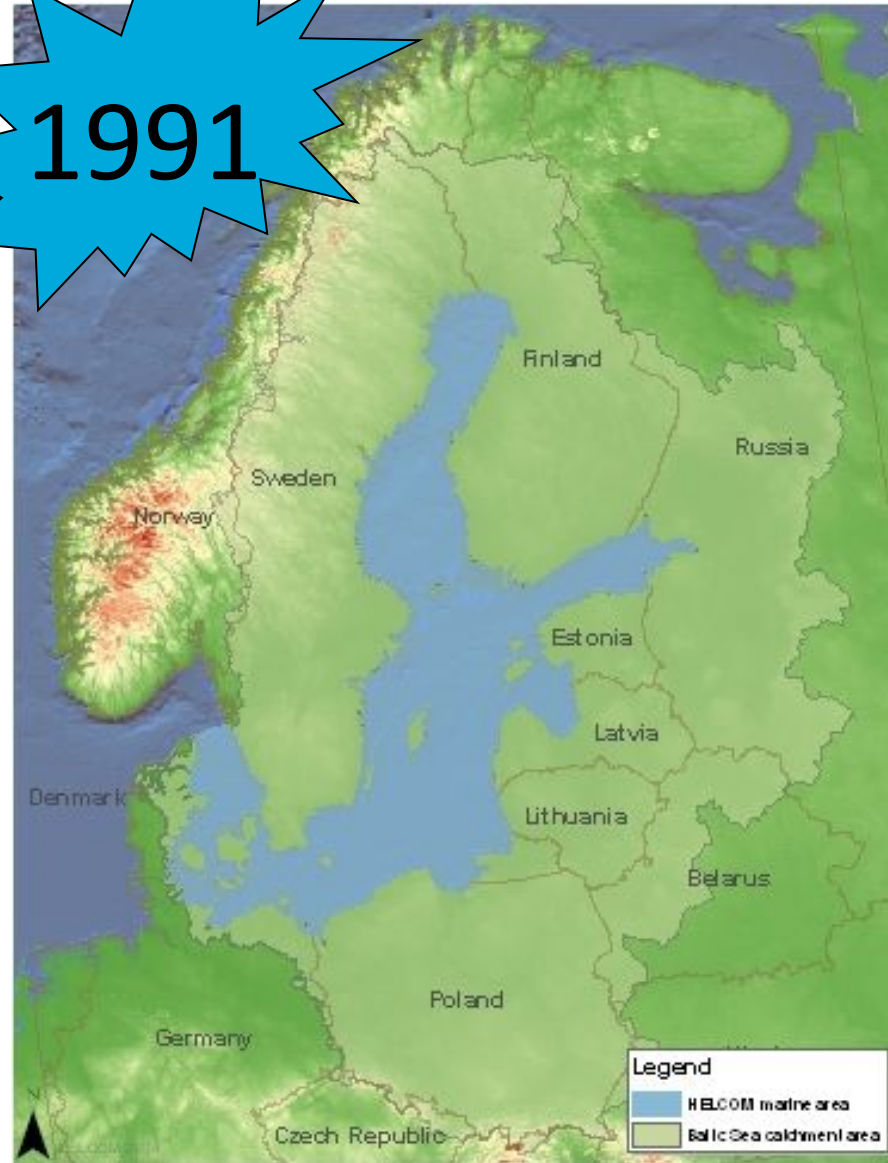




Motivation for an international interdisciplinary research network



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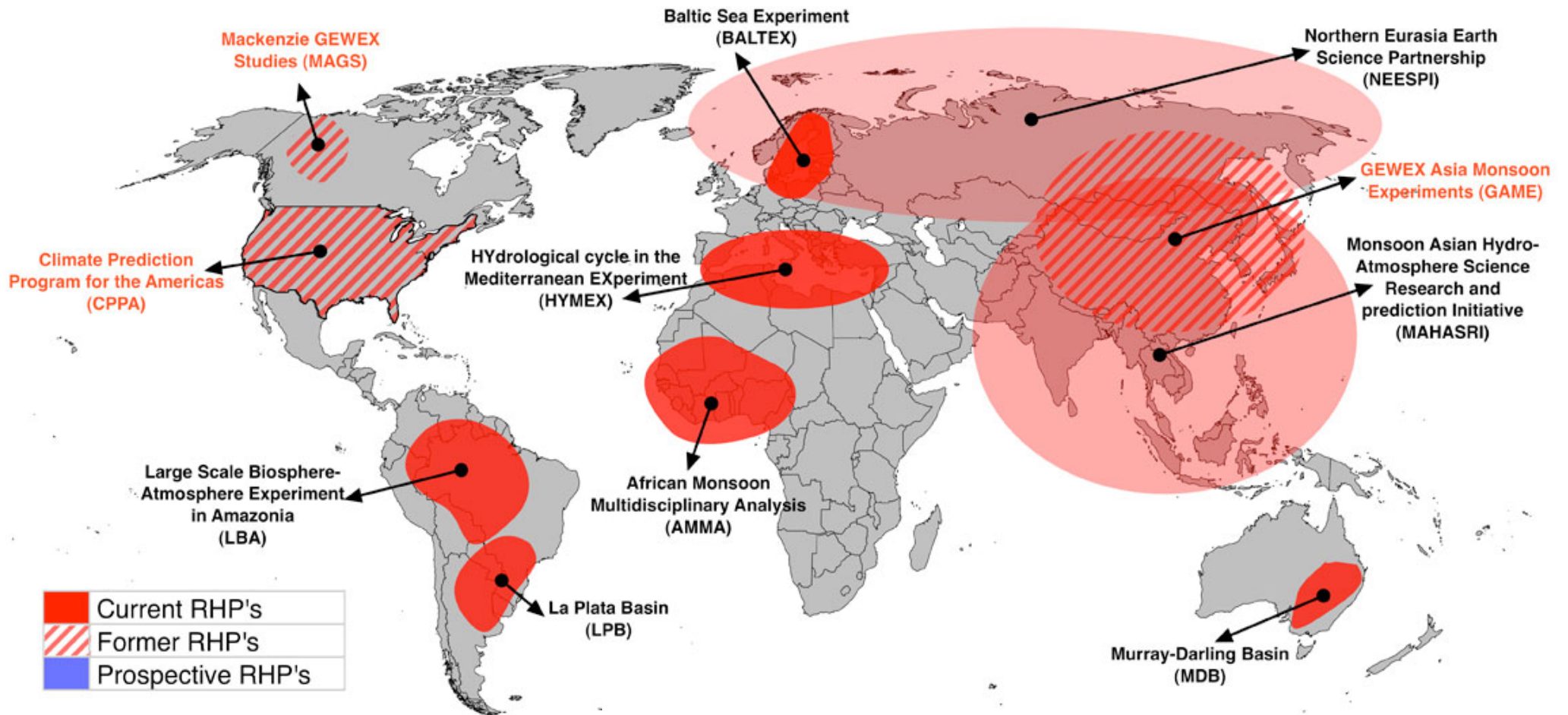
BALTEX was founded in 1992 as part of the GEWEX programme of WCRP



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GEWEX REGIONAL HYDROCLIMATE PROJECTS





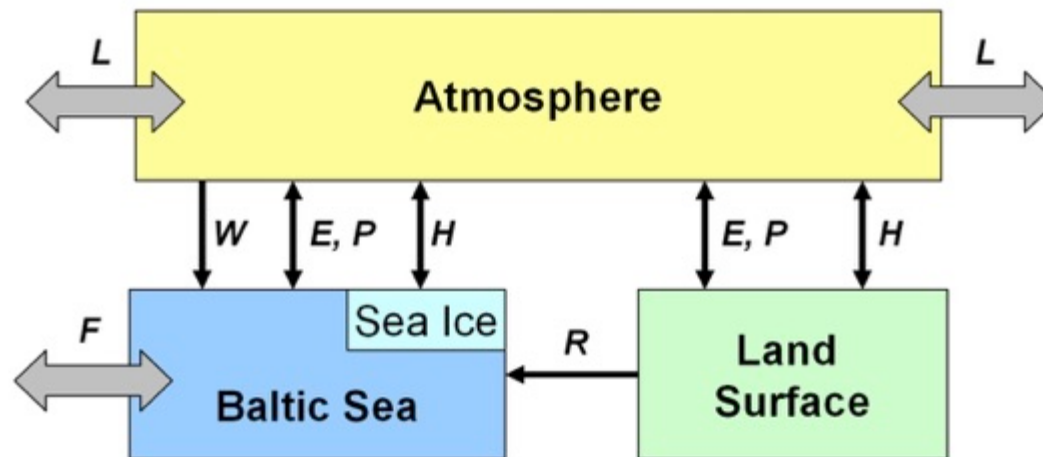
BALTEX Phase I: 1992 – 2003: First 10 year Phase



BALTEX was founded in 1992 as part of the GEWEX programme of WCRP

The **hydrological cycle** and the **exchange of energy** between the atmosphere and the surface of the Earth (**physical part of the climate system**)

Major disciplines: Meteorology, Oceanography, Hydrology



Major outcomes of BALTEX Phase I (1992-2003):

Building of research and observation network; data exchange and availability, development of coupled regional atmosphere-land-ocean models



BALTEX Phase II: 2003 - 2012: Second 10 year Phase

BALTEX Phase II has evolved into an **environmental research network** dealing with the **Earth system of the entire Baltic Sea catchment** including terrestrial and marine biogeochemical cycles

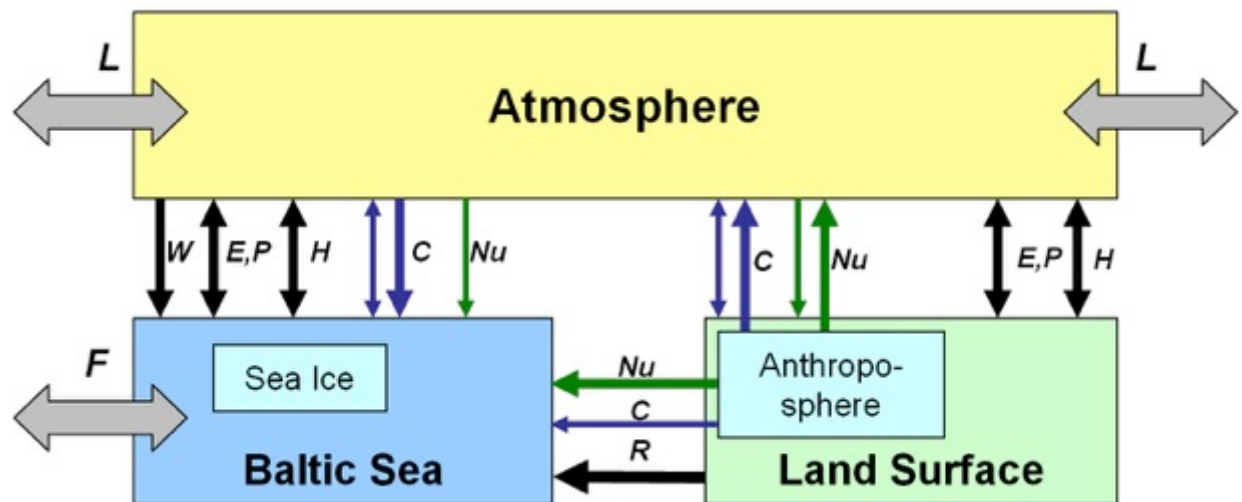
Scientific disciplines (in Phase II):

- Meteorology
- Hydrology
- Climatology
- Oceanography
- Biogeochemistry

Important elements are

Climate variability and change

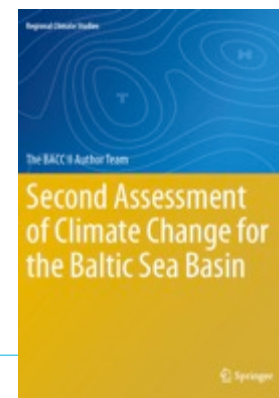
and related impacts on the environment and the human sphere



**BALTEX Assessment
of Climate Change
for the Baltic Sea basin
(BACC, 2008)**



**Baltic Earth Assessment
of Climate Change
for the Baltic Sea basin
(BACC II, 2015)**





Baltic Earth
Earth System Science for the Baltic Sea Region

Vision of the new programme

To achieve an improved Earth System understanding of the Baltic Sea region

- **Interdisciplinary** and **international** collaboration (conferences, workshops, etc.)
- **Holistic view** on the Earth system of the Baltic Sea region, encompassing processes in the **atmosphere**, on **land** and in the **sea** and also in the **anthroposphere**
- “**Service to society**” in the respect that **thematic assessments** provide an overview over knowledge gaps which need to be filled (e.g. by funded projects)
- **Education** (summer schools)
- Inherits the BALTEX network of scientists and infrastructure

 Full GEWEX RHP since 2018



Baltic Earth Science Steering Group

Chair

Markus Meier, Head of Physical Oceanography, Baltic Sea Research Institute, Germany and Swedish Meteorological and Hydrological Institute, Norrköping, Sweden



Baltic Earth Science Steering Group (BESSG)

Excellent, active “young” scientists; country balance, gender balance, discipline balance, institutional balance, currently 19 members; meetings biannually

Senior Advisory Board

Secretariat at Helmholtz-Zentrum Geesthacht near Hamburg, Germany

Publications

14 books

722 peer-reviewed journal articles

65 reports

876 BALTEX/Baltic Earth Conference presentations

55 International BALTEX Secretariat Publication Series issues

9 International Baltic Earth Secretariat Publication Series issues

... all in publication database

Website and social

www.baltic.earth

[facebook/BalticEarth](https://facebook.com/BalticEarth)

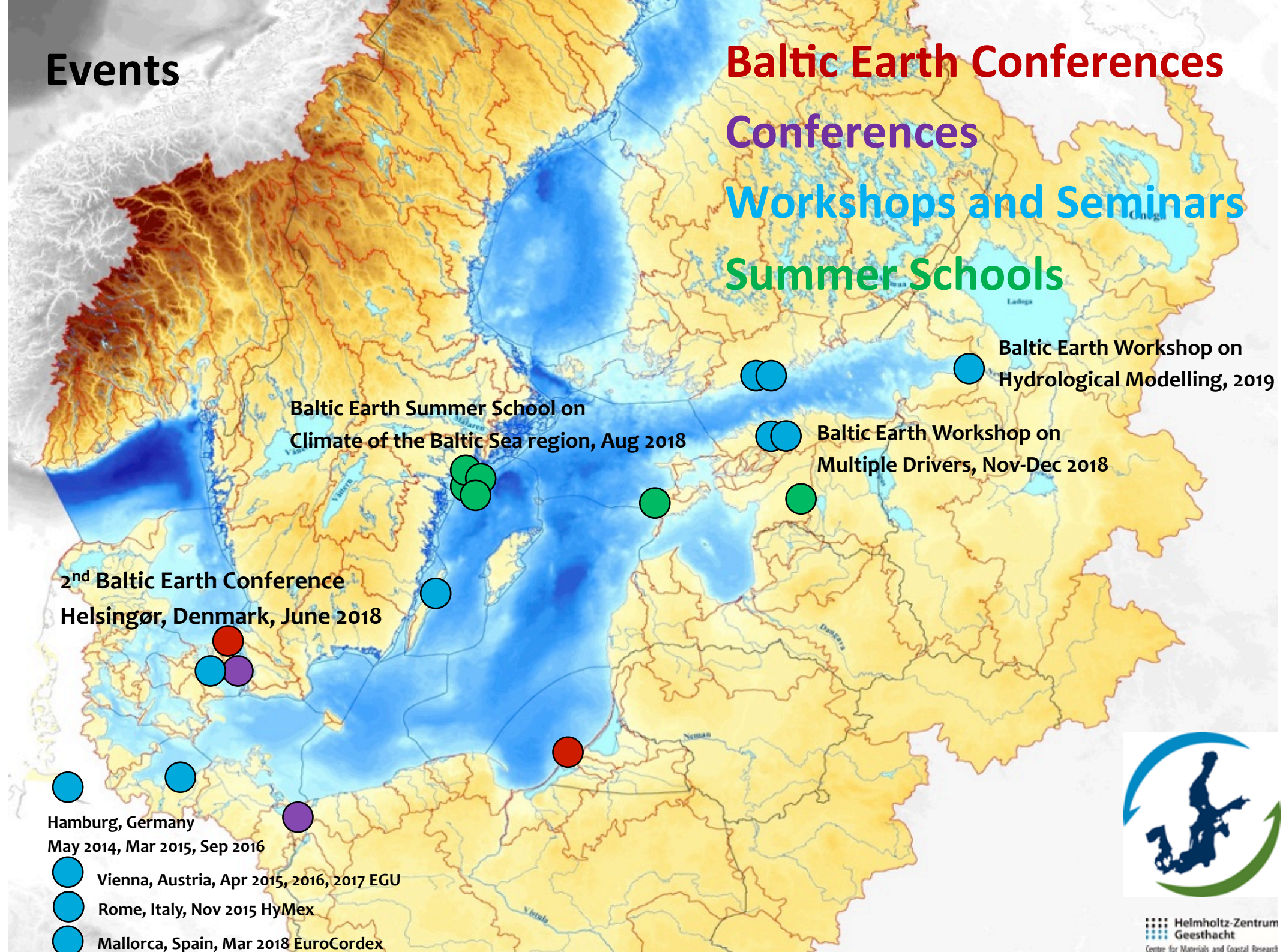
[twitter/BalticEarth](https://twitter.com/BalticEarth)

BACC Blog

CAOM Forum

Events

Baltic Earth Conferences
Conferences
Workshops and Seminars
Summer Schools



Baltic Earth Science Plan and Grand Challenges



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- Flexible science plan with a continuously on-going definition of core research questions which are identified to be key scientific issues, so-called “**Grand Challenges**” (GCs)
- New Grand Challenges will be identified at conferences and by using **assessments of existing research** by dedicated working groups. Grand Challenges are envisaged to be research foci for periods of about 3-4 years (then terminated or updated).
- The human impact will be assessed at all levels, wherever possible and sensible
- Download at www.baltic.earth



International Baltic Earth Secretariat Publication No. 11, February 2017

**Baltic Earth
Science Plan
2017**



Grand Challenges



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GC1: Salinity dynamics in the Baltic Sea

GEWEX Science Questions
Water and Energy Cycles and Processes

GC2: Land-Sea biogeochemical linkages

WCRP Grand Challenge
Carbon feedbacks in the Climate system

GC3: Natural hazards and extreme events

GEWEX Science Questions
Observations and Predictions of Precipitation
Changes in Extremes

GC4: Sea Level and Coastal Dynamics

WCRP Grand Challenge
Regional Sea-Level Change and Coastal Impacts

GC5: Regional variability of water and energy exchanges

GEWEX Science Questions
Observations and Predictions of Precipitation
Water and Energy Cycles and Processes

GC6: Multiple drivers of regional Earth system changes



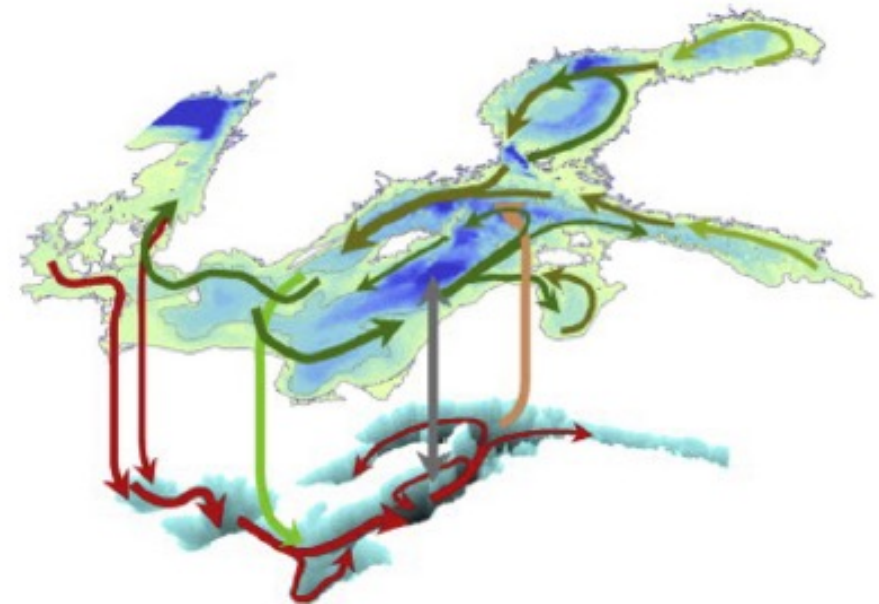
GC1: Salinity dynamics in the Baltic Sea

Andreas Lehman, GEOMAR

Kai Myrberg, FMI

Piia Post, University of Tartu

- Interrelation between **decadal/climate variability** and **salinity**
- Water mass exchange and **major Baltic inflows**
- **Regional salinity distribution/variability** and associated **circulation patterns** (including salinity fluxes between the coastal areas and the open sea and within the sub-basins)
- Changing **precipitation patterns**
- Relevant for **species distributions**



Elken and Matthäus (2008)



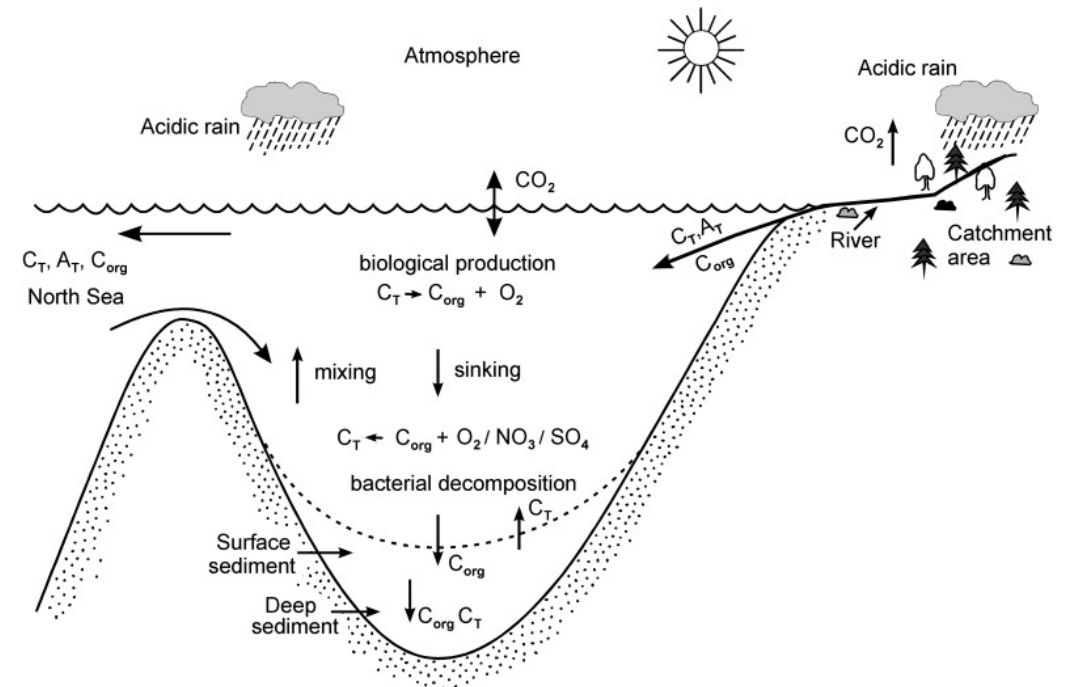
GC2: Land-Sea biogeochemical linkages

Gergor Rehder, IOW

Karol Kulinski, IO-PAN

Benjamin Smith, Lund University

- **C, N, P cycles studies** for understanding primary production mechanisms and organic matter transformations in the Baltic Sea
- **Transformations and pathways** of terrestrial organic matter, influence of the **terrestrial input on the carbonate system**
- Extension of the databases with the **missing terrestrial loads data** of the key chemical substances (e.g. Neva River)



Omstedt et al

WCRP Grand Challenge
Carbon feedbacks in the Climate system

GC3: Natural hazards and extreme events in the Baltic Sea region



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Jaari Haapala, FMI

Anna Rutgersson, Uppsala University

Martin Stendel, DMI,

- Understanding the **underlying causes of natural disasters** increases the ability to **predict the occurrence and severity** and may save human lives as well as mitigate economic losses
- improvement of **monthly to seasonal prediction systems** and **probabilistic estimates** of the extreme events
- specific **attribution analysis** of **past extreme events** to elucidate the possible role of anthropogenic forcing factors
- Analysis of the **vulnerability** of key societal functions to changed hydro-meteorological extremes



WCRP Grand Challenge
Weather and climate extremes

GEWEX Science Questions
Observations and Predictions of Precipitation
Changes in Extremes

GC4: Sea Level and Coastal Dynamics

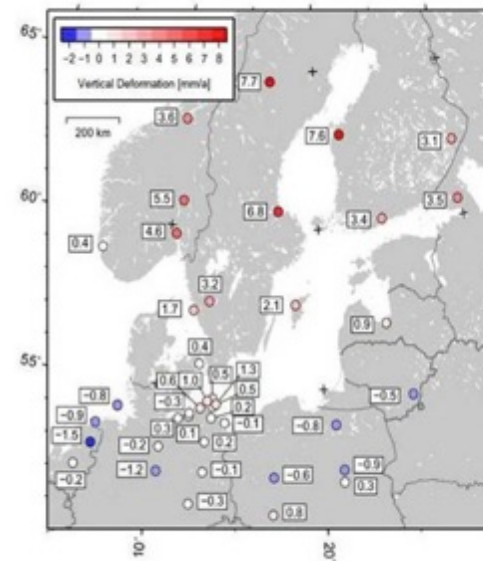


Ralf Weisse, HZG

Anders Omstedt University of Gothenburg

Birgit Hunicke, HZG

- **Future sea level changes** on time scales from seasons to decades (mean and extreme sea levels)
- A systematic **comparison of tide-gauges and high resolution satellite products**, more **high-resolution ocean and atmosphere-ocean regional simulations** of the Baltic Sea
- **Consistent analysis** of all data sets is needed



Estimations of crustal deformation rates in the Baltic Sea Region derived by different methods. From Richter et al. (2011) and Harff et al. (2010).

WCRP Grand Challenge
Regional Sea-Level Change and Coastal Impacts

GC5: Regional variability of water and energy exchanges in the Baltic Sea region



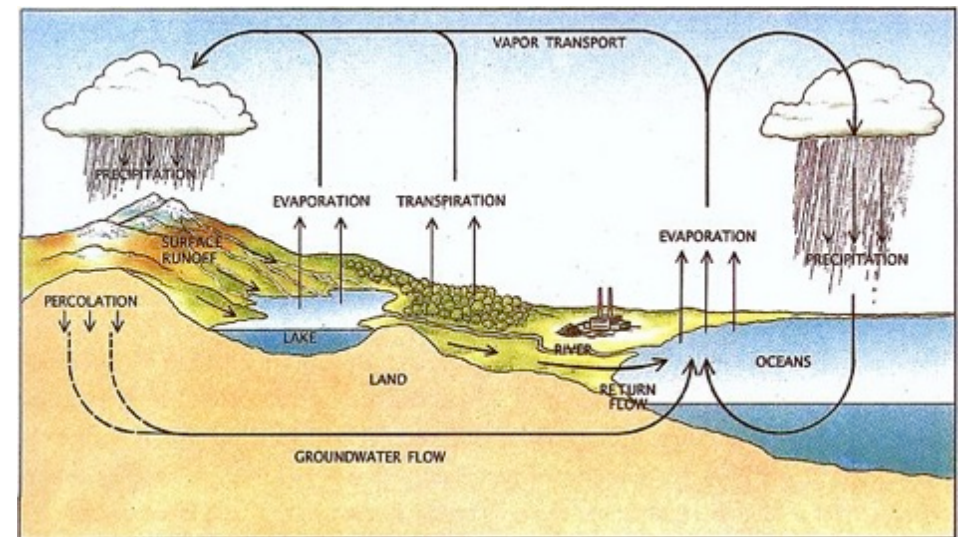
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Sergej Zhuravlev, Saint-Petersburg State University

Irina Partasenok, Centre for Hydrometeorology

Franz Berger, DWD

- review on the **knowledge on river runoff** to the Baltic Sea
- measurement of **hydrological and atmospheric exchange processes**
- analysis of the **natural variability of energy and water components**
- improved understanding of **cloud-aerosol-feedback** mechanisms
- assessment of **past and current hydrological changes** and to **project future runoff and salinity changes**



GEWEX Science Questions
Observations and Predictions of Precipitation
Water and Energy Cycles and Processes

GC6: Multiple drivers of regional Earth system changes

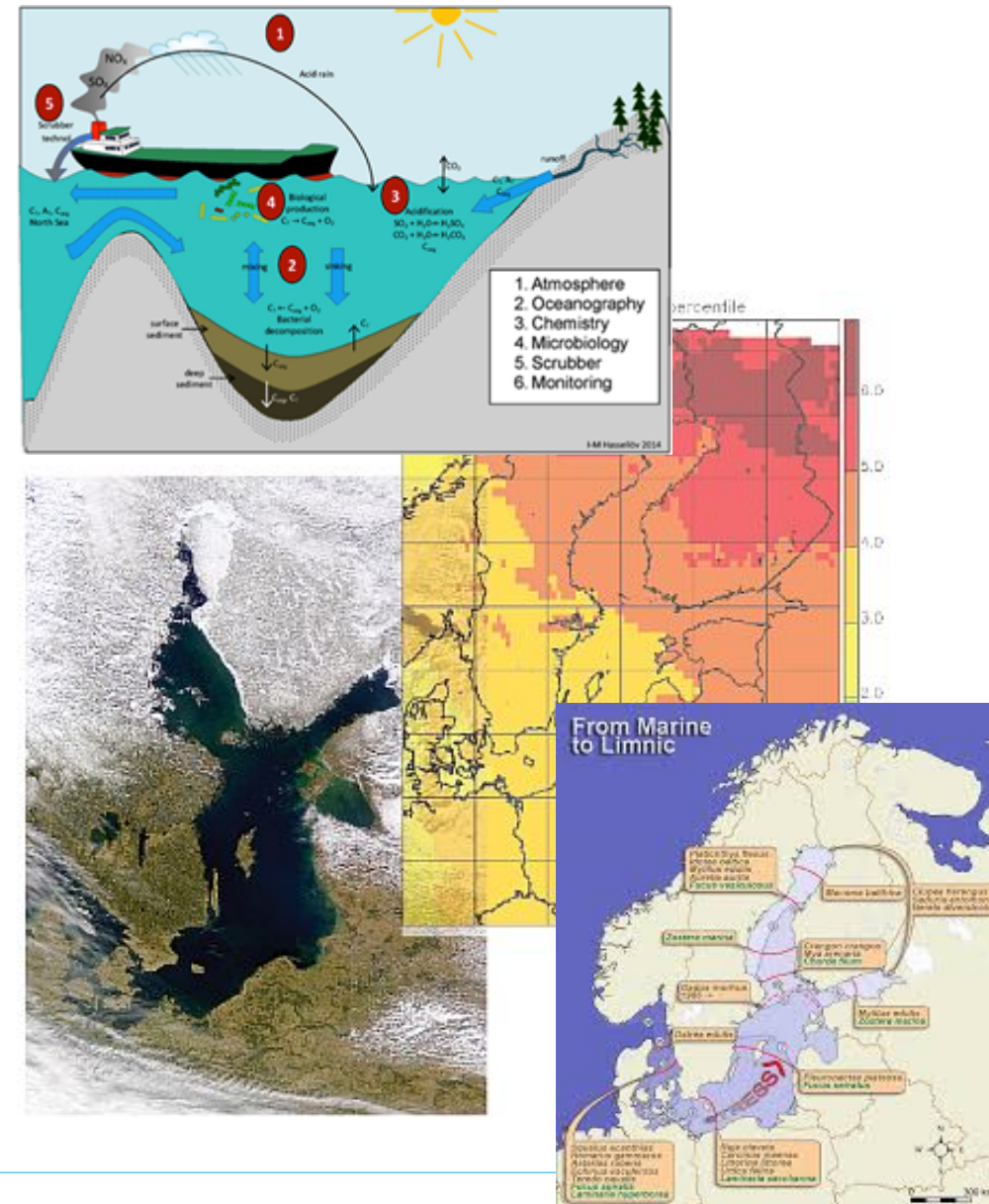


Juris Aigars, University of Latvia

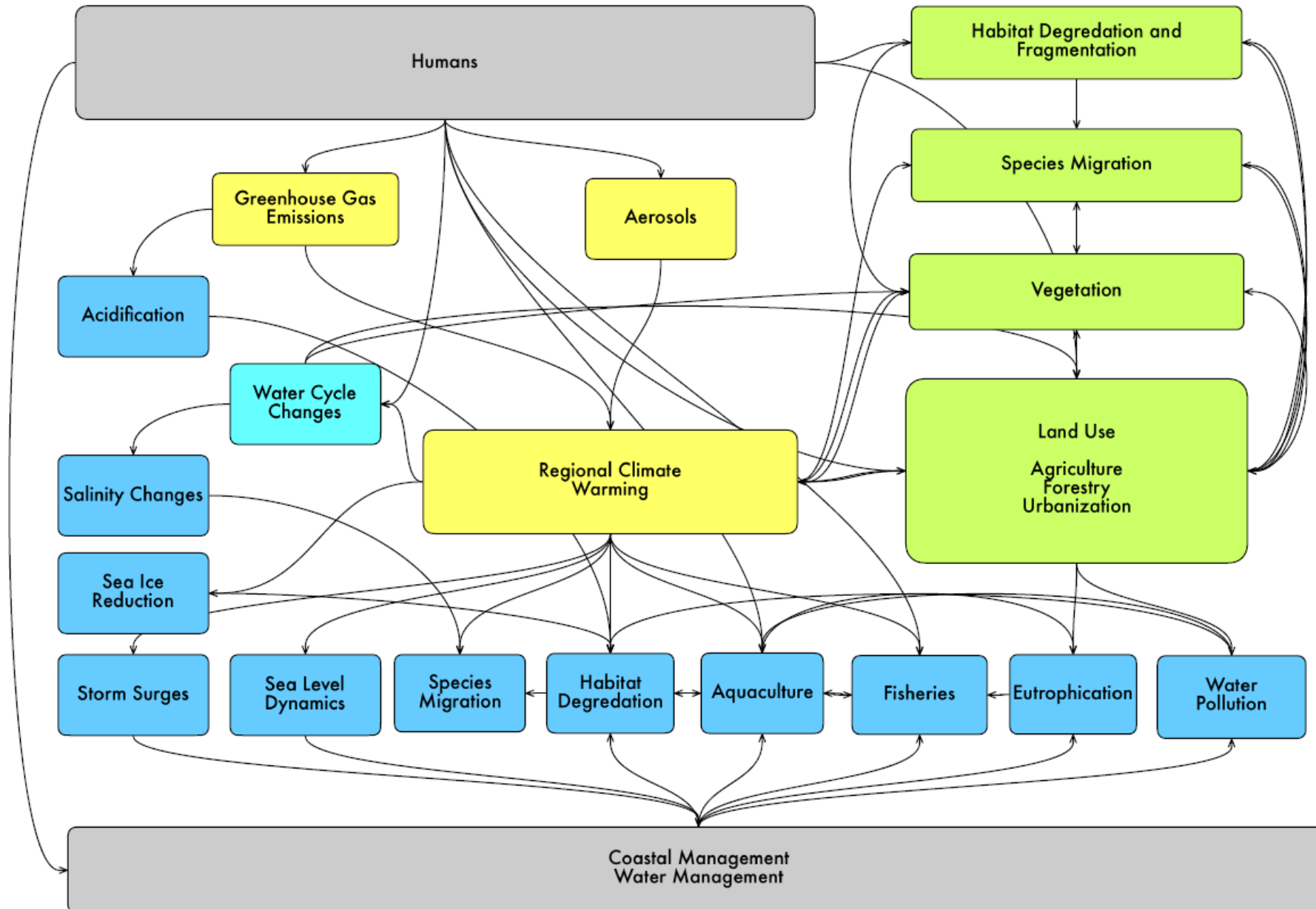
Anneli Poska, Lund University

Marcus Reckermann, Helmholtz-Zentrum Geesthacht

- A mixture of **interwoven factors**, such as **regional climate change, eutrophication, pollution, shipping, fisheries, hydrographic engineering, agricultural and forestry practices and land cover change** are responsible for the current situation and of potential importance as drivers of future changes.
- There is a need for **increased cooperation** among researchers having specialised knowledge of different components of the **coupled biophysical-societal system**.
- Key disciplines include **meteorology and climate science, oceanography, hydrology, marine, terrestrial and freshwater ecology, microbiology and biogeochemistry, economists, human geographers, political scientists and engineers**.



GC6: Multiple drivers of regional Earth system changes



Grand Challenges, WGs and funded projects



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6 Grand Challenges with Working Groups for each Grand Challenge

Additional **overarching WGs** on

- **Coupled Regional Earth system Modelling**
- Outreach and Communication
- Education

Current funded projects



Sustainable Shipping and Environment of the Baltic Sea region

<https://www.sheba-project.eu>



Wellbeing from the Baltic Sea – applications combining natural science and economics <https://blogs.helsinki.fi/balticapp/>



INTEGRAL- Integrated carbon and trace gas monitoring for the Baltic Sea

<https://www.io-warnemuende.de/integral-home.html>

Thank you for your attention!



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