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The BALTEX/Baltic Earth programs: Excursions and returns

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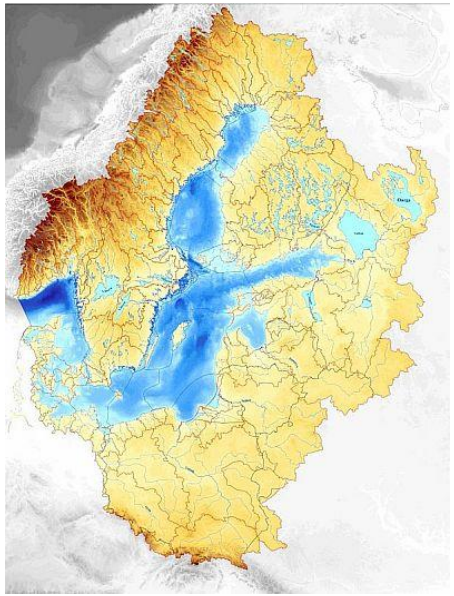
"*The night passed, and the dawn came, and they sailed constantly*.“
Homer Odysseus'



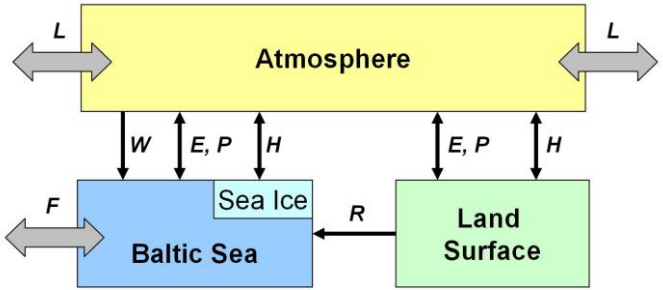
Baltic Sea drainage basin

1 April 2004

The BALTEX phase I (1993-2002), the first start

The goals for BALTEX I:

- To explore and model the various mechanisms determining the space and time variability of energy and water budgets of the BALTEX region and this region's interactions with surrounding regions
- To relate these mechanisms to the large-scale circulation systems in the atmosphere and oceans over the globe.
- To develop transportable methodologies to contribute to basic needs of climate, climate impact, and environmental research.



The BALTEX phase I (1993-2002) the first excursion

Challenges or to put ourselves at risk:

- The end of the Soviet Union open up new cooperation in the Baltic Basin with 14 countries in its drainage basin (Belarus, Czech Republic, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, Slovakia, Sweden and Ukraine)
- Data availability, representativity, and homogeneity
- Net precipitation (P-E), both land and sea
- Satellite climatology
- Weather radar network
- Closure, water, and heat balances
- Numerical and statistical modelling of atmosphere, land, ice/snow, and sea
- Coupling atmosphere-land-ice-ocean

The BALTEX phase I (1993-2002) returned after ten years

The essence of education[1)]

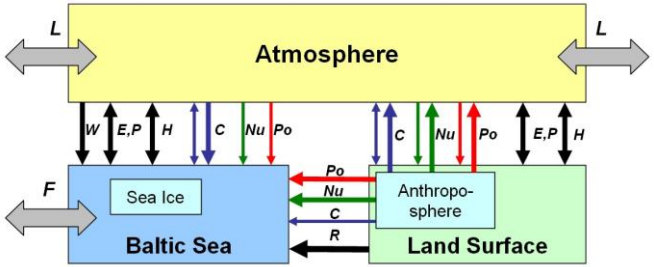
- A new science community formed to solve climate and climate change problems for the Baltic Sea and its drainage basin.
- Major problems addressed: data availability and quality, reconstructions, and model tools needed.
- Meteorological, hydrological, ocean and ice data are becoming more easily available for the research community
- The research identified significant discrepancies between observed and climate-calculated water and heat balance components
- Feedback mechanisms foresee the need for coupled atmosphere-land-ocean models on the regional scale.

1) The essence of education is to learn to solve problems and foresee new problems

The BALTEX phase II (2003-2012), the second start

The goals for BALTEX II:

- Improved understanding of energy and water cycles under changing conditions
- Analysis of climate variability and change and provision of regional climate projections over the Baltic Sea basin for the 21st century
- Provision of improved tools for water management, with an emphasis on extreme hydrological events and long-term changes
- Biogeochemical cycles in the Baltic Sea basin and transport processes within the regional Earth system under anthropogenic influence
- Strengthened interaction with decision-makers, with emphasis on global change impact assessments
- Education and outreach at the international level



The BALTEX phase II (2003-2012), the second excursion

Challenges or to put ourselves at risk:

- A broader science network
- New data sets based on reconstructions such as SMHI 1x1 data, ERA-40, NCEP, Lutherbacher, etc
- New measuring platforms such as Ferry box, Östergarnsholm (UU), Utö (FMI), MARNET (BSH), Darss Sill (the Leibniz Institute for Baltic Sea Research (Warnemünde), etc
- Resolution in GCMs and which GCM should be used?
- Design of RCMs and coupling
- Models for the CO2-O2 system, as a base for Earth system modelling
- The hydrological cycle in atmospheric climate models is severely biased, with unphysical delta change applications.
- Future projections of salinity evolution uncertain
- The heat cycle in atmospheric climate models is severely biased, leading to unphysical delta change applications.
- Assessing climate change and its impact in the Baltic Sea Basin (BACC I)
- Education, outreach, and HELCOM

The BALTEX phase II (2003-2012) returned after ten years

The essence of education[1)]

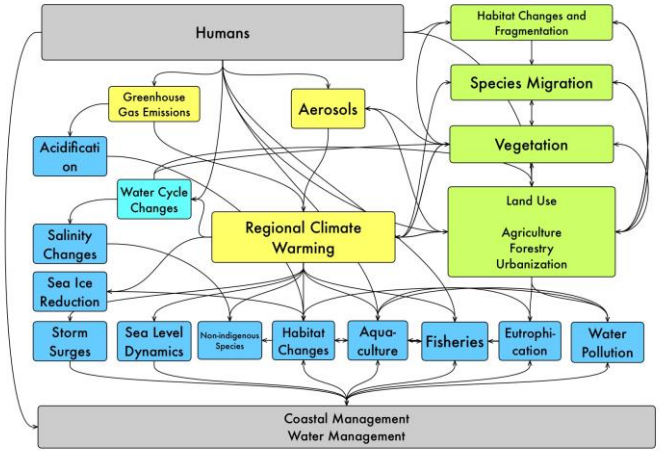
- A broad assessment of regional climate change and impacts (BACC I)
- Climate warming on air and water temperatures, winter runoff, snow, and ice
- No systematic windiness shift was found.
- No clear long-term trends in Baltic Sea salinity
- Significant improvements in open databases with observed and reconstructed data
- Experience using gridded datasets
- Improved ocean and hydrology modelling on decadal-scale
- Centennial reconstructions possible with historical relevance
- Importance of observed data with much higher time and space resolution
- Models were extended into biochemistry, starting to include the carbon dioxide cycles
- The issue of multiple stressors to the Baltic Sea began attracting attention.

1) The essence of education is to learn to solve problems and foresee new problems

The Baltic Earth program (2013 –), the third start

The grand challenges were:

- Salinity dynamics in the Baltic Sea
- Land-Sea biogeochemical linkages in the Baltic Sea region
- Natural hazards and extreme events in the Baltic Sea region
- Sea level dynamics in the Baltic Sea
- Regional variability of water and energy exchanges
- Multiple drivers for regional Earth system changes



The Baltic Earth program (2013 –), the third excursion

Challenges or to put ourselves at risk:

- New program and organization
- Increasing concern about Baltic Sea environment and fishery.
- BONUS, the joint Baltic Sea research and development program 2010-2020.
- BANOS, the Baltic and North Sea Coordination and Support Action 2018-2021.
- UN 2015 adopted Agenda 2030 with its 17 global goals for sustainable development.
- The Covid-19-pandemic 2019 –
- Russian government war against Ukraine 2022 -

The Baltic Earth program (2013 –) returned after ten years?

The essence of education up to 2022[1)]

- A broad assessment of regional climate change and impacts (BACC II)
- Through BACC II and forming of EN-CLIME, the cooperation between HELCOM and Baltic Earth developed
- Impressing work through the BEARs article and need to be evaluated
- Scenarios and assemble means
- Increasing insights in multiple stressors through fishery, climate change, eutrophication, etc.
- Improved number of summer and winter schools
- ..

1) The essence of education is to learn to solve problems and foresee new problems

BALTEX/Baltic Earth programs (1993 – 2022) returned after thirty years

The essence of education[1)]:

- Large naturally variability and strong human influence in many aspects
- Ongoing warming in the region with effects on the heat balance but less clear on the water balance
- Climate change and eutrophication both on the decadal time scales
- Value of systematic long-term science and science cooperation across many disciplines
- Importance of an international secretariat
- Change from course to better resolved numerical models possible due to rapid computer development
- Still unclear best space and time scale design
- Successful science development but the decline in the marine environment
- Going from disciplinarily to multi-disciplinarily to trans-disciplinarily discussions

1) The essence of education is to learn to solve problems and foresee new problems

Attitude changes during the last thirty years?

- From closure to assemble mean calculations
- From BACC books to special issue
- From physics to biochemistry to human sciences
- From natural to human forcing
- From single stressors to multiple stressors
- From monthly to minute, resolved ocean data
- From relaxed climate view to public panic
- From the collapse of the Soviet Union to Russian aggression

Photo: Hillevi Nagel

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Homer Odysseus'

GÖTEBORGS UNIVERSITET

Baltic Earth
Earth System Science for the Baltic Sea Region

Thanks for listening and to all involved