2nd Baltic-C Scientific and Planning Meeting

Baltic Sea Research Institute

Warnemünde, November 9./10. 2009

UNIVERSITY OF GOTHENBURG

Agenda

Monday, November 9:

- **9:00 – 9:10: Welcome address by the Head of the Marine Chemistry Section,**
- **Prof. D. Schulz-Bull;**
- **9:10 – 9:20: Organizational information (B. Schneider)**
- **9:20 – 9:30: Introduction to the meeting (A. Omstedt)**
- **9:30 – 12:00: Presentation and Discussion of Sub-Project Reports: Achievements and**
- **Deliverables (each 30 min)**
- **- University of Lund**
- **- University of Uppsala**
- **- FMI**
- **- IOPAN**
- **(30 min Coffee Break at 10:00 h)**
- **12:00 – 13:00: Lunch**
- **13:00 – 14:30: Continuation of the morning session**
- **- IOW**
- **- University of Stockholm**
- **- University of Gothenburg**
- **14:30 – 15:00: Coffee Break**

Agenda cont.

- **15:00 – 17:00: “Interaction between models and measurements in Baltic-C”**
- **with contributions by A. Omstedt, B. Schneider and others (?).**
- **19:00 Dinner**

Tuesday, November 10:

- **9:00 – 10:30: Planning of the “ALKOR”-Expedition in 2010**
- **10:30 – 11:00: Coffee Break**
- **11:00 – 13:00: Annual Report, BONUS Meeting in 2010, next Baltic-C meeting and**
- **other business**
- **13:00: End of the Meeting**

Introduction to the meeting
A. Omstedt

VERSION: Baltic-C minutes No. 2.doc
DATE: 2009-05-26
Baltic-C First Scientific Study Workshop, 13-15 May, 2009.

Deliverables

- Month 6= 2009-06
  - WP2. Compilation of existing CO2/carbon data
  - WP3. River inflow of alkalinity, pH, total organic carbon, total
  - WP4. Calculated remineralisation rates of organic matter based on existing data
  - WP7. Data set on A_T, C_T, Ca and C_{org} inputs to the Baltic Sea
- Month 8= 2009-08
  - WP5. Acidic deposition for the Baltic Sea drainage basin
- Month 12=2009-12
  - WP1. Lecture and notes on the Baltic Sea CO2 system
  - WP1. Set up Baltic-C web-page
  - WP2. Seasonally resolved pCO2 fields for the entire Baltic Sea
  - WP2. Improved process parametrizations (biomass production, nitrogen fixation)
  - WP2. Concentrations of inorganic/organic carbon species in the major model sub-basins
  - WP2. Trend analysis for Co2/carbon variables
  - WP4. New stratified sediment samples collected covering Arcona Deep, Bornholm Deep, Gotland Deep, coastal areas.
  - WP4. Mineralization rates at the sediment water interface and in the deep water
  - WP5. Compiled present and future scenario land use data for the Baltic Sea drainage basin
  - WP7. Model describing A_T, C_T, Ca and C_{org} inputs from 83 major watersheds during present climate
- Month 13=2010-01
  - WP1. Baltic-C Y1 report

BONUS EPPS Baltic-C WP1

Work package: **WP1 - Programme management, synthesis and assessing and dissemination**
Work package leader: Anders Omstedt <anders.omstedt@gvc.gu.se>

Title	Status	Date
41 - Baltic-C web-page	**approved**	2009-05-11
02 - Assessment of the Baltic Sea carbon dioxide system	**working**	2009-06-24
03 - The Baltic-C data base	**working**	2009-06-24
04 - Lecture and notes on the Baltic Sea CO2 system	**working**	2009-06-24
38 - Baltic-C Y1 report	**working**	2009-06-24
39 - Baltic-C Y2 report	**working**	2009-06-24
40 - Baltic-C final report	**working**	2009-06-24

BONUS EPPS Baltic-C WP2

Work package: **WP2 - Measuring the Baltic Sea CO2 system and carbon inventories**
Work package leader: Bernd Schneider <bernd.schneider@io-warnemuende.de>

Title	Status	Date
05 - Seasonally resolved pCO2 fields for the entire Baltic Sea	**working**	2009-06-24
06 - Seasonally resolved pCO2 fields for the entire Baltic Sea	**working**	2009-06-24
07 - Improved process parametrizations (biomass production, nitrogen fixation)	**working**	2009-06-24
08 - CO2 gas exchange balance	**working**	2009-06-24
09 - Concentrations of inorganic/organic carbon species in the major model sub-basins	**working**	2009-06-24
11 - Trend analysis for Co2/carbon variables	**working**	2009-06-24
10 - Compilation of existing CO2/carbon data	**working**	2009-06-26

BONUS EPPS Baltic-C WP3

Work package: **WP3 - Inventory of river runoff data**
Work package leader: Matti Pertillä <matti.perttila@fmi.fi>

Title	Status	Date
13 - River inflow of alkalinity, pH, total organic carbon, total inorganic carbon, calcium	**working**	2009-06-24
12 - River inflow of alkalinity, pH, total organic carbon, total inorganic carbon, calcium	**working**	2009-06-29

BONUS EPPS Baltic-C WP4

Work package: **WP4 - Mineralization of organic material, deepwater-sediment interaction**
Work package leader: Janusz Pemkowiak <pempa@iopan.gda.pl>

Title	Status	Date
14 - Calculated remineralisation rates of organic matter based on existing data	**approved**	2009-06-29
15 - New stratified sediment samples collected covering Arcona Deep, Bornholm Deep, Gotland Deep, coastal areas	**working**	2009-06-24
16 - Mineralization rates at the sediment water interface and in the deep water	**working**	2009-06-24
18 - Collected sediment cores analysed	**working**	2009-06-24
19 - Mineralisation rates established for a range of environmental conditions	**working**	2009-06-24
20 - Loads of carbon deposited to sediments and return flux of carbon from sediments for the entire Baltic Sea established	**working**	2009-06-24
21 - Carbon burial rates in the Baltic sediments established	**working**	2009-06-24
22 - Data base consisting of CT depth profiles measured in the central Gotland Sea	**working**	2009-06-24
23 - Report on mechanisms of carbon flux to the Baltic sediments	**working**	2009-06-24

BONUS EPPS Baltic-C WP5

Work package: **WP5 - Atmospheric forcing (air-sea interaction, scenarious)**
Work package leader: Anna Rutgersson <anna.rutgersson@met.uu.se>

Title	Status	Date
26 - Acidic deposition for the Baltic Sea drainage basin	**approved**	2009-08-31
24 - Improved parametrisation of the gas exchange transfer velocity	**working**	2009-06-24
25 - Measurements from the first 12 month of the project taken at the Ostergamsholm station	**working**	2009-06-24
27 - Compiled present and future scenario land use data for the Baltic Sea drainage basin	**working**	2009-06-24

BONUS EPPS Baltic-C WP6

Work package: **WP6 - Modelling the organic matter input from terrestrial vegetation and soils**
Work package leader: Benjamin Smith <ben.smith@nateko.lu.se>

Title	Status	Date
30 - Modelling future changes in vegetation, CO2 exchange and DOC production for the BS drainage basin	**working**	2009-06-24
29 - Modelling present and past changes in vegetation, CO2 exchange and DOC production for the BS drainage basin	**working**	2009-06-24
28 - Set-up and validation of vegetation model DOC export algorithm and coupling to river runoff model	**working**	2009-06-24

BONUS EPPS Baltic-C WP7

Work package: **WP7 - Modelling the input of AT, CT, Ca, and Corg from all rivers entering the Baltic Sea**
Work package leader: Christoph Humborg <christop.humborg@itm.su.se>

Title	Status	Date
31 - Data set on AT, CT, Ca and Corg inputs to the Baltic Sea	**approved**	2009-06-23
32 - Model describing AT, CT, Ca and Corg inputs from 83 major watersheds during present climate	**working**	2009-06-24
33 - Model runs and data set on AT, CT, Ca and Corg fluxes from 83 watersheds as a function of land cover changes	**working**	2009-06-24
34 - Model runs and data set on N and P fluxes from 83 watersheds as a function of land cover changes	**working**	2009-06-24
35 - Model runs and data set on N and P fluxes from 83 watersheds as a function of land use changes	**working**	2009-06-24

BONUS EPPS Baltic-C WP8

Work package: **WP8 - Modelling the Baltic Sea physical–biogeochemical system based on CO2 / O2 dynamics and climate change**

Work package leader: Anders Omstedt <anders.omstedt@gvc.gu.se>

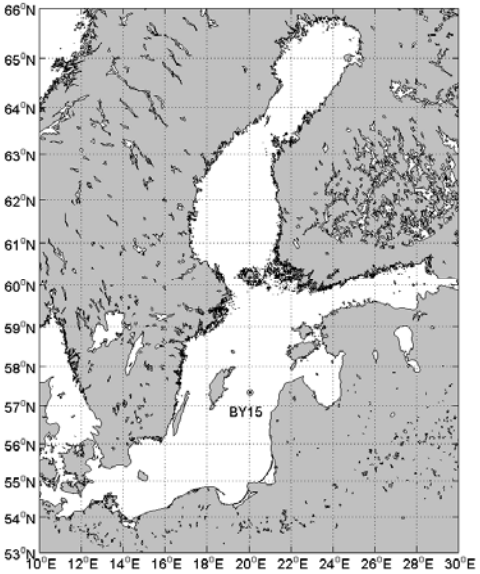
Title	Status	Date
36 - Modelling present and past changes of the Baltic Sea carbon dioxide system	**working**	2009-06-24
37 - Modelling possible future changes in the BS CO2 system	**working**	2009-06-24

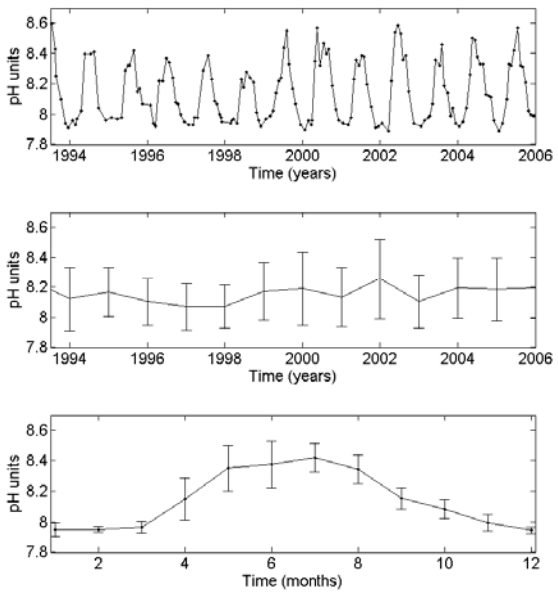
Prel results

Factors influencing the acid-base (pH) balance in the Baltic Sea: A sensitivity analysis

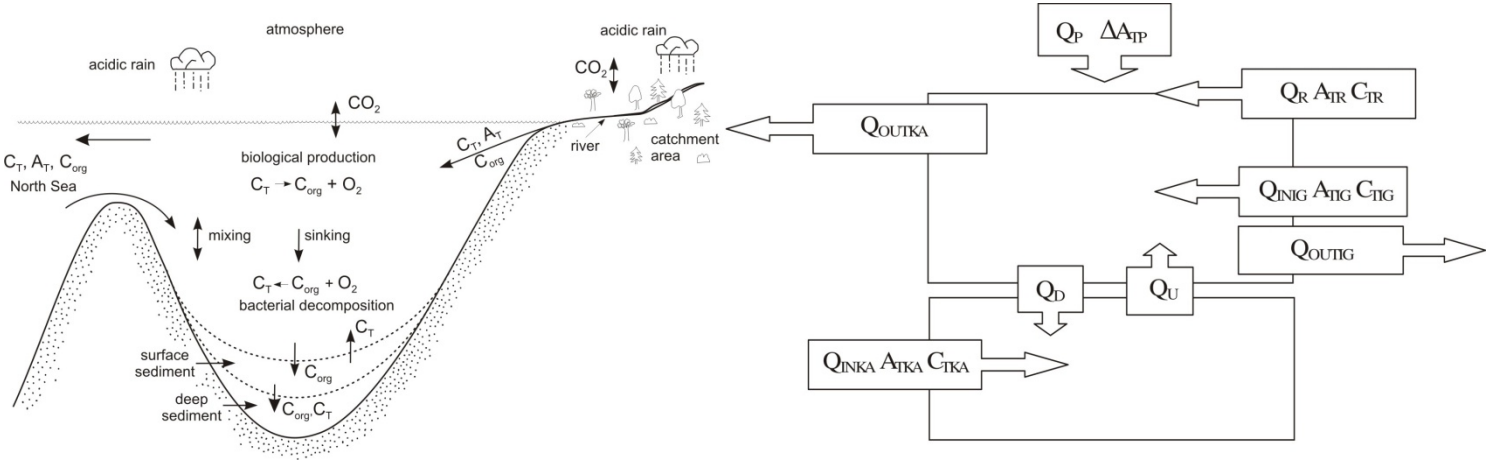
Anders Omstedt, Moa Edman, Leif Andersson and Hjalmar Laudon

Observations

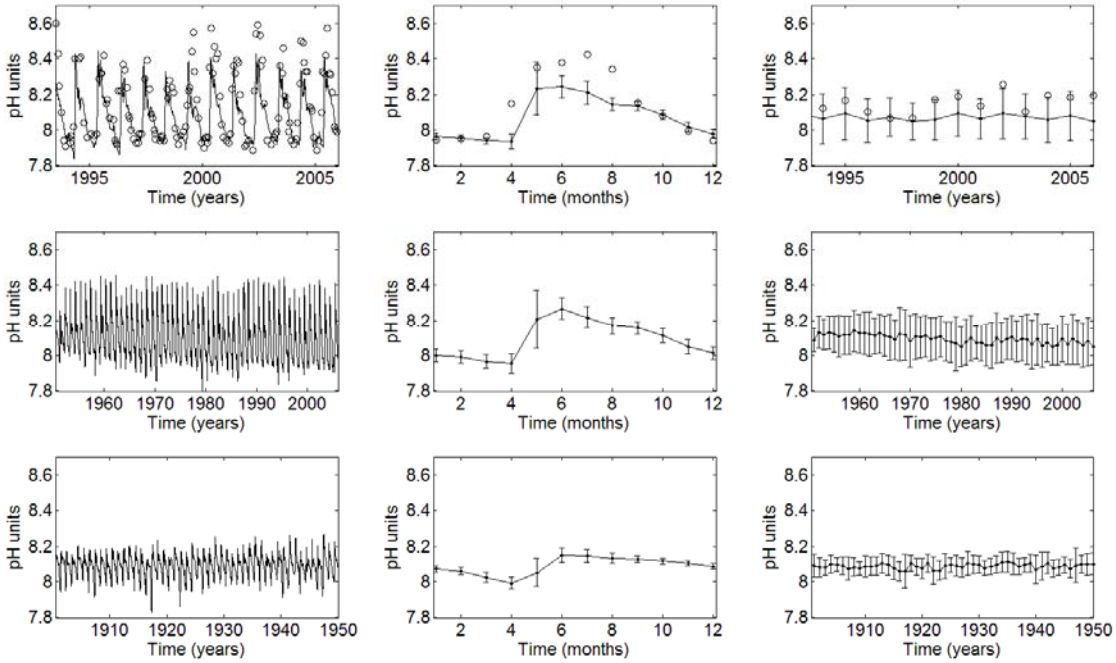




The acid-base (pH) balance in the Baltic Sea



Observed and simulated pH



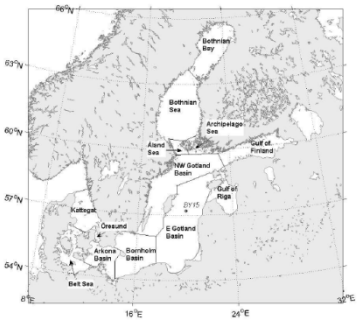
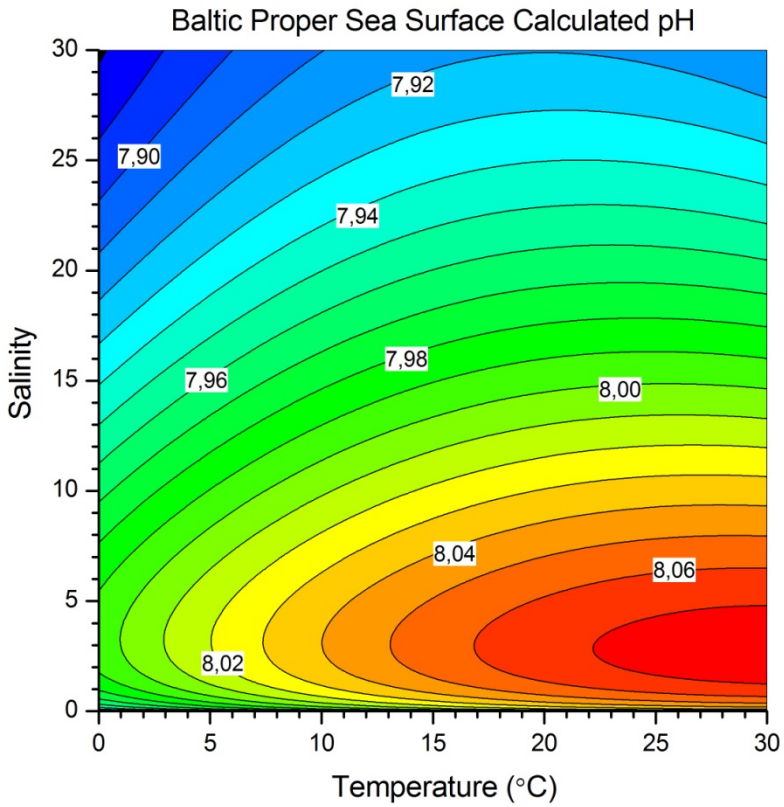


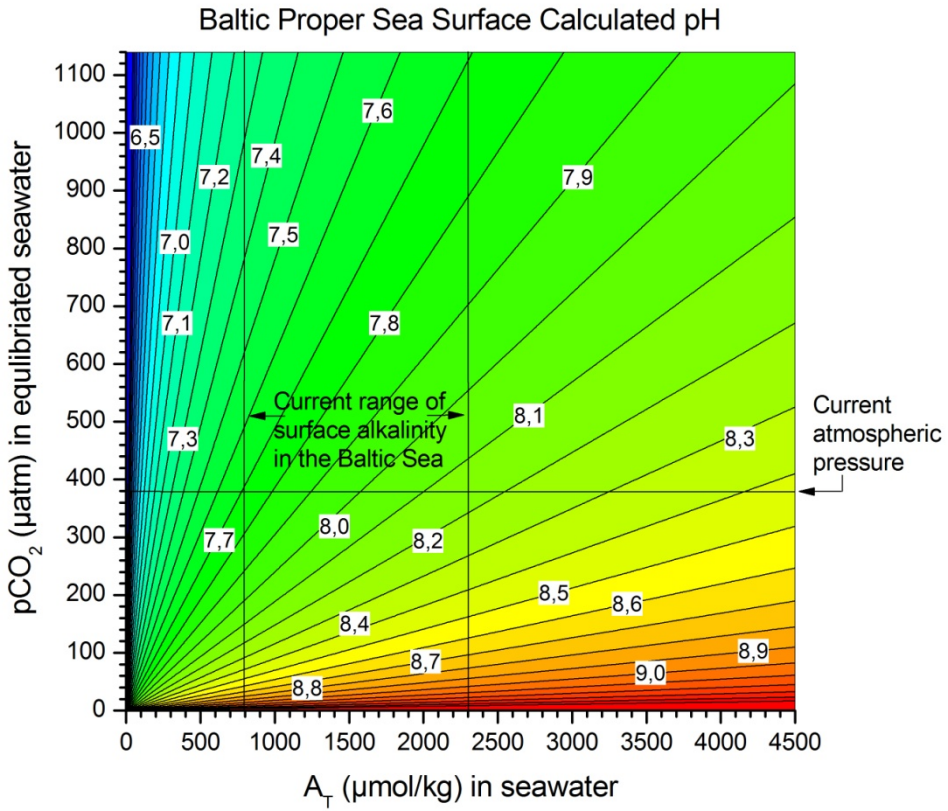
Fig. 1. Map of the Baltic Sea region, showing its division into natural sub-basins used in the PROBE-Baltic model and the position of the BY15 monitoring station in the Eastern Gotland Basin.

Figure 4. The change of pH^{tot} from variations in salinity and temperature. A_T is keep at 1 500 µmol/kg and $pCO_2(W)$ at 380 µatm throughout the calculations.



Change in temperature and salinity will only marginally change the acid-base (pH) balance. Climate change may instead change pH through other processes

Figure 5. The change of pH^{tot} from variations in atmospheric carbon dioxide concentrations and alkalinity. Salinity is keep at 8 and temperature at 0 ° C throughout the calculations.



Increased atmospheric CO_2 levels decrease the pH in water and reduced/increased A_T concentrations decrease/increase the pH in water. A combination of increased atmospheric CO_2 levels and decreased A_T concentrations may cause severe reductions in pH.

The low salinity regimes of the Northern Baltic Sea is much more sensitive resulting in larger changes in pH to any given perturbation of the driving conditions compared to the Baltic Sea Proper.

Figure 6. The change of pH^{tot} in the surface box when $pCO_2(R)$ and $A_T(R)$ are varied in river water of temperature 0° C and zero salinity. All other inflowing concentrations have constant values according to Table 2. The red box in the box model illustrate which pool that are change in present figure.

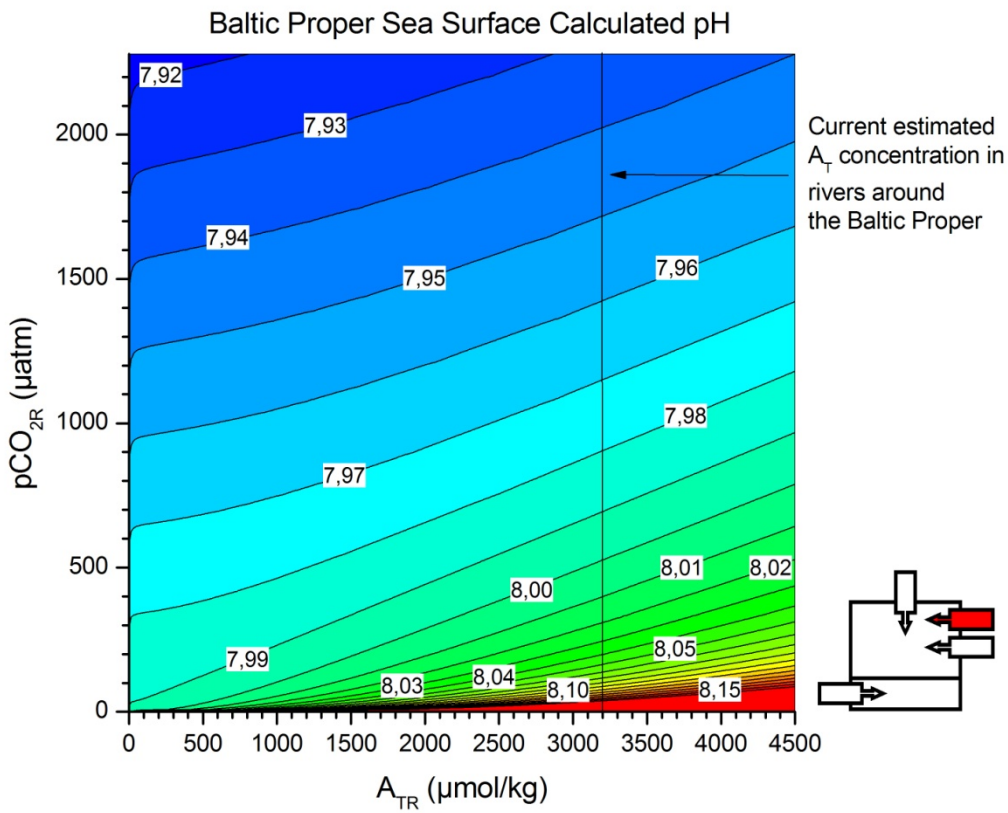
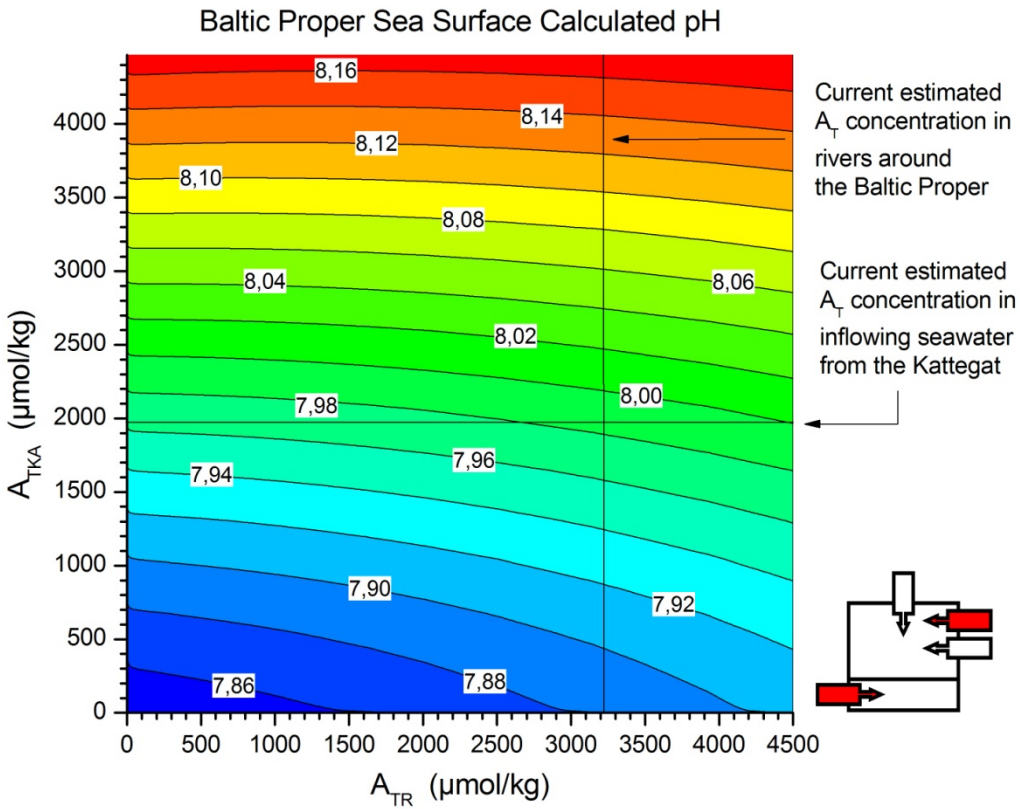


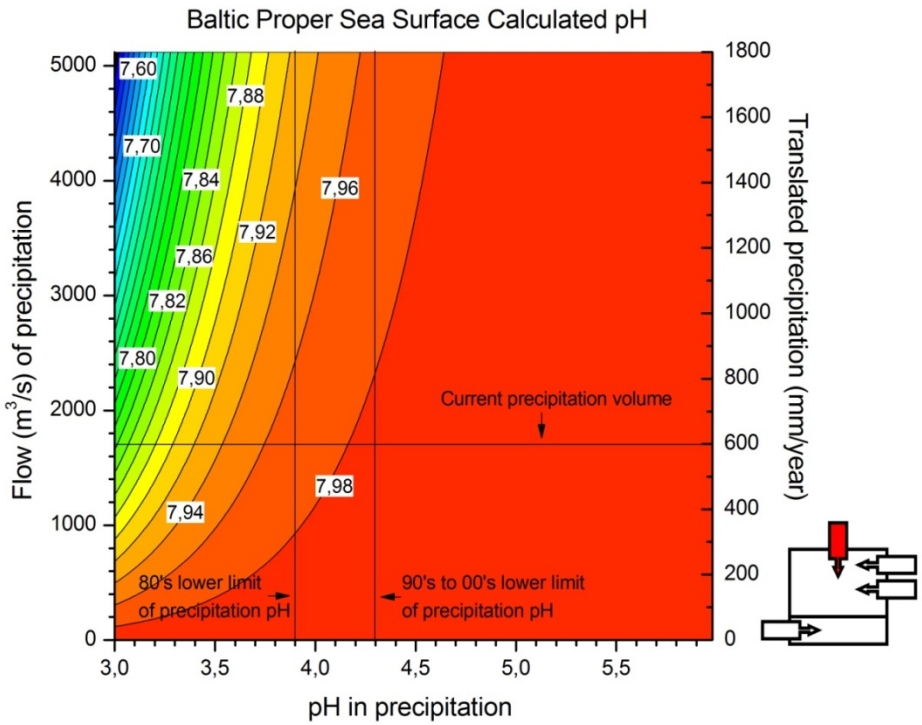
Figure 7. The change of pH^{tot} in the surface box when A_T(KA) and A_T(R) are varied in water of temperature 0° C and salinities in the respective sources according to Table 1. All other inflowing concentrations have constant values according to Table 2. The red box in the box model illustrate which pool that are change in present figure.



The acidification due to river transports of DOC into the marine system seems small. However, the mineralization of DOC into DIC may add extra acidification but is still unknown.

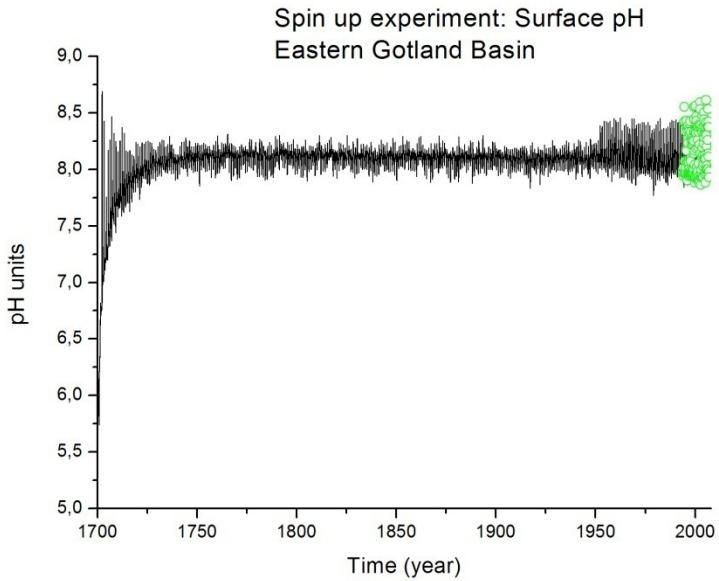
The influence from Kattegat larger than from rivers

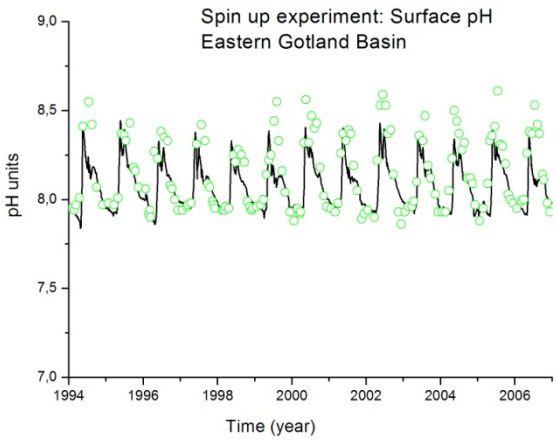
Figure 8. The change of pH^{tot} in the surface box when pH in the precipitation and the precipitation volume are varied. All other inflowing concentrations have constant values according to Table 2. The red box in the box model illustrate which pool that are change in present figure.



The direct effect on sea water pH from acid precipitation over the Baltic Sea surface area is small even for increased precipitation rates. Indirect effects on land (acid precipitation and land use change) may however influence the pH balance.

Spin-up experiment standard experiment





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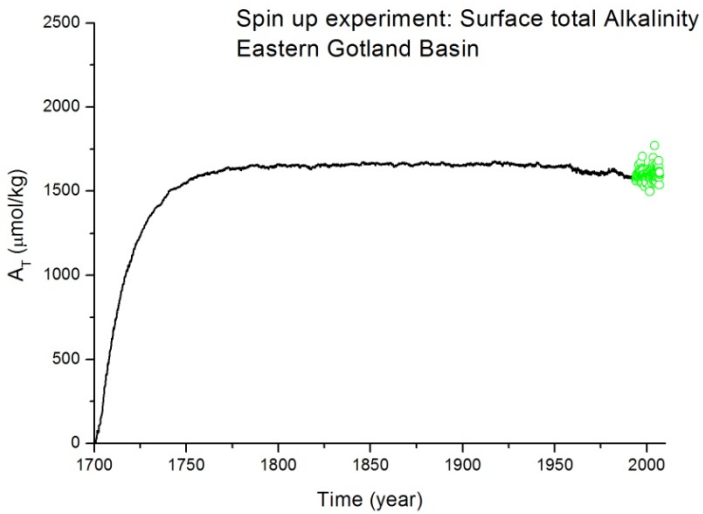
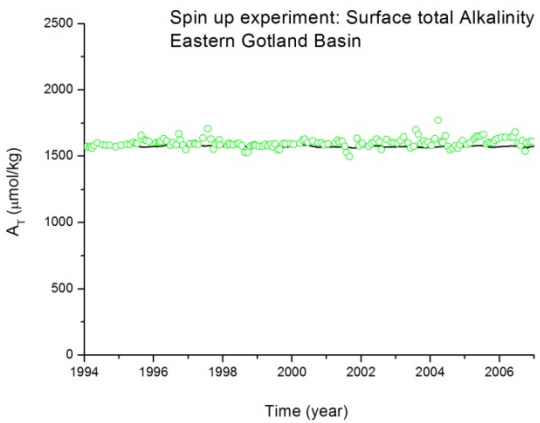




The surface Baltic Sea carbon system is adjusted to the lateral boundary conditions within some decades. Long-term calculations are therefore dependent on the lateral conditions, and thus changes on land, in the atmosphere and outside the Baltic Sea.

Changing fresh water inflow

	10 years mean values		10 years mean values			
Parameter	Observations	Standard run	Qf changes +30% without biology	Qf changes -30% without biology	Qf changes +30% with biology	Qf changes -30% with biology
T	8.4	8.6	8.5	8.7	8.5	8.7
S	5.9	6.2	3.1	10.6	3.1	10.6
pH	8.17	8.06	7.85	7.95	8.07	8.06
A_T (µmol/kg)	1600	1566	1479	1624	1484	1623
C_T (µmol/kg)	1551	1536	1488	1599	1464	1574
pCO_2 (µatm)	313	376	584	470	361	369

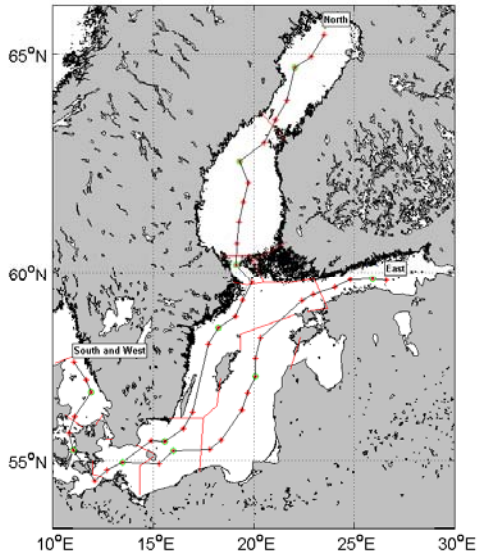
Tables 4. Observed and modelled surface mean properties based on observed and modelled data from the Eastern Gotland Basin (BY15 and the PROBE-Baltic model (sub-basin Eastern Gotland Basin) for the 1997-2006 periods.

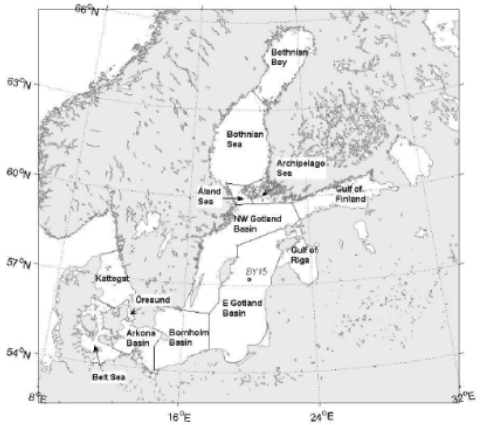
A wetter or dryer climate may not change the acid-base (pH) balance in coastal seas due to compensating effects.

“Interaction between models and measurements in Baltic-C”

Merian meets PROBE-Baltic

Merian summer 2008 cruise





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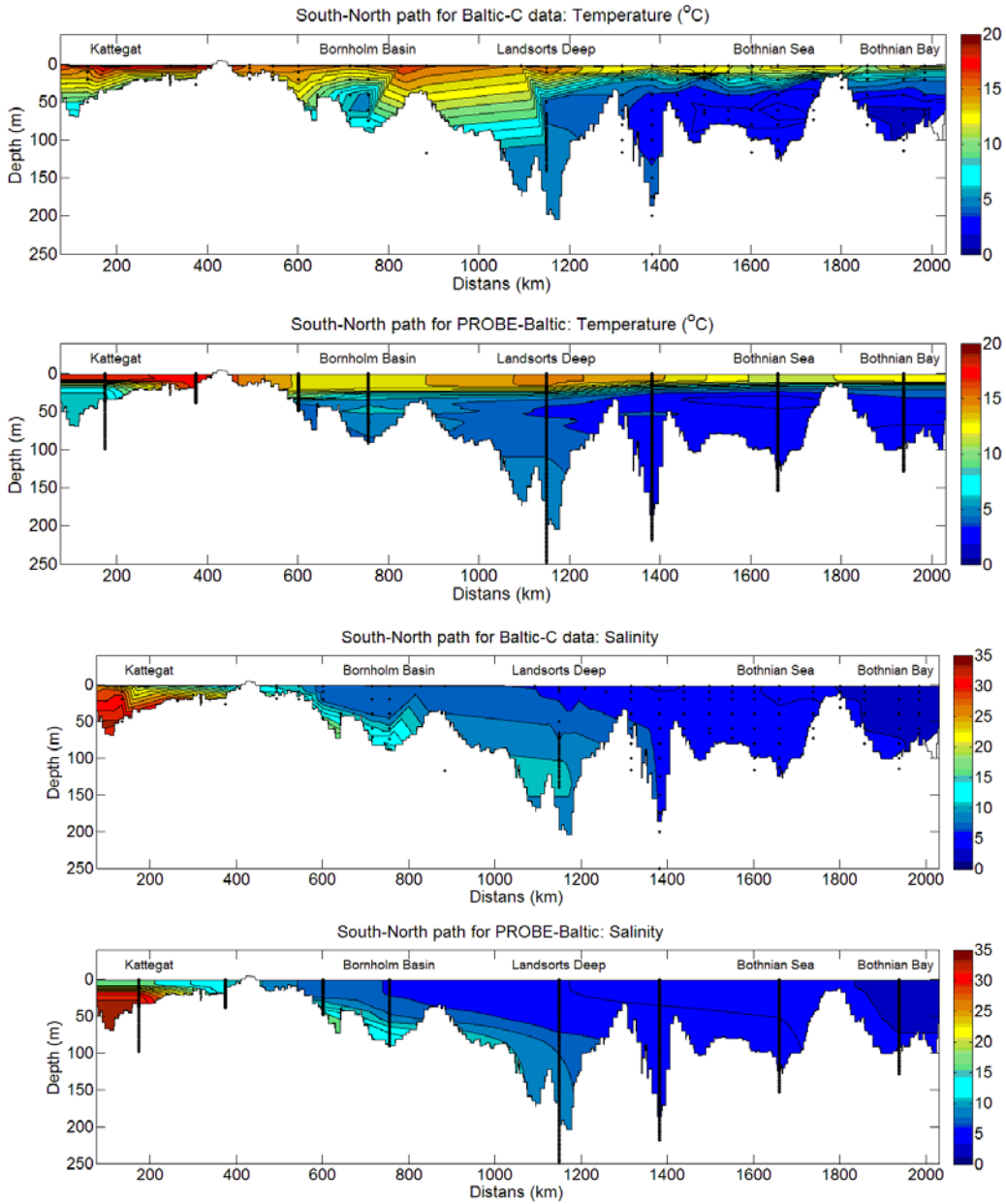
South-North path for Baltic-C data: Temperature (°C)
Kattegat
Bornholm Basin
Landsorts Deep
Bothnian Sea
Bothnian Bay
Depth (m)
Distans (km)
South-North path for PROBE-Baltic: Temperature (°C)
Kattegat
Bornholm Basin
Landsorts Deep
Bothnian Sea
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South-North path for Baltic-C data: Salinity
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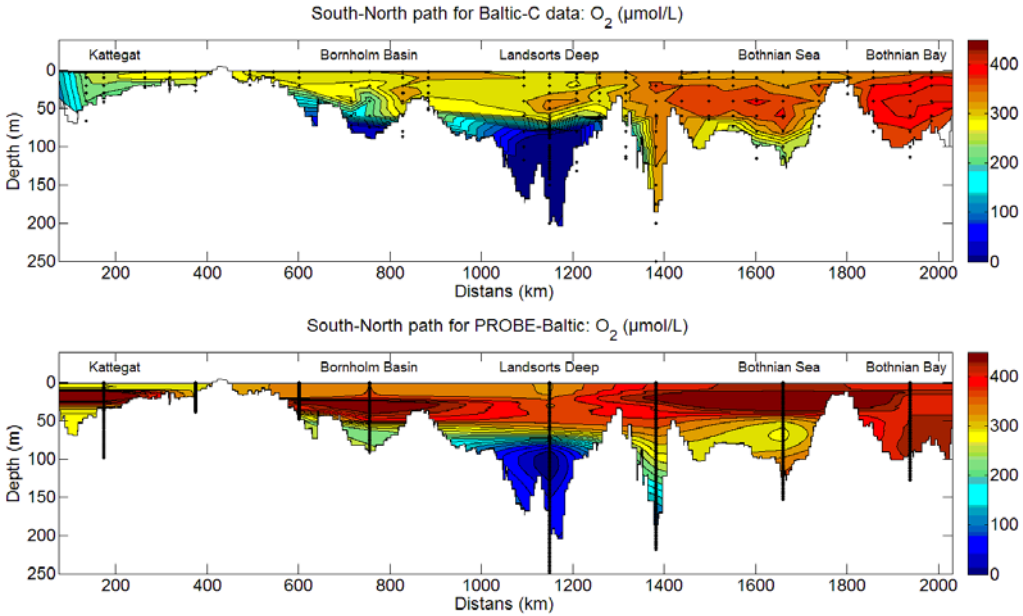
South-North path for Baltic-C data: O_2 (µmol/L)
Kattegat
Bornholm Basin
Landsorts Deep
Bothnian Sea
Bothnian Bay
Depth (m)
Distans (km)
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Depth (m)
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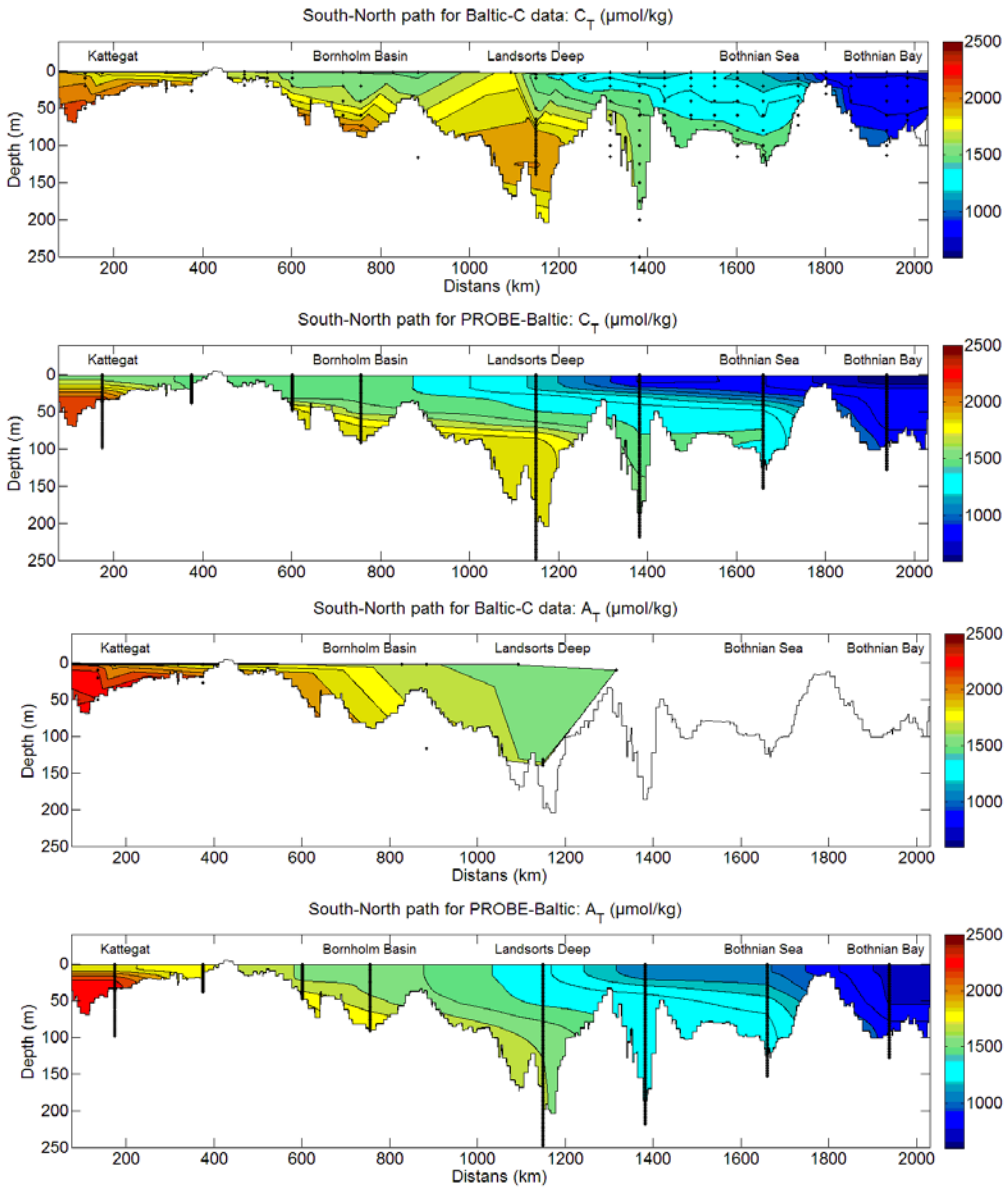
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Landsorts Deep
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Depth (m)
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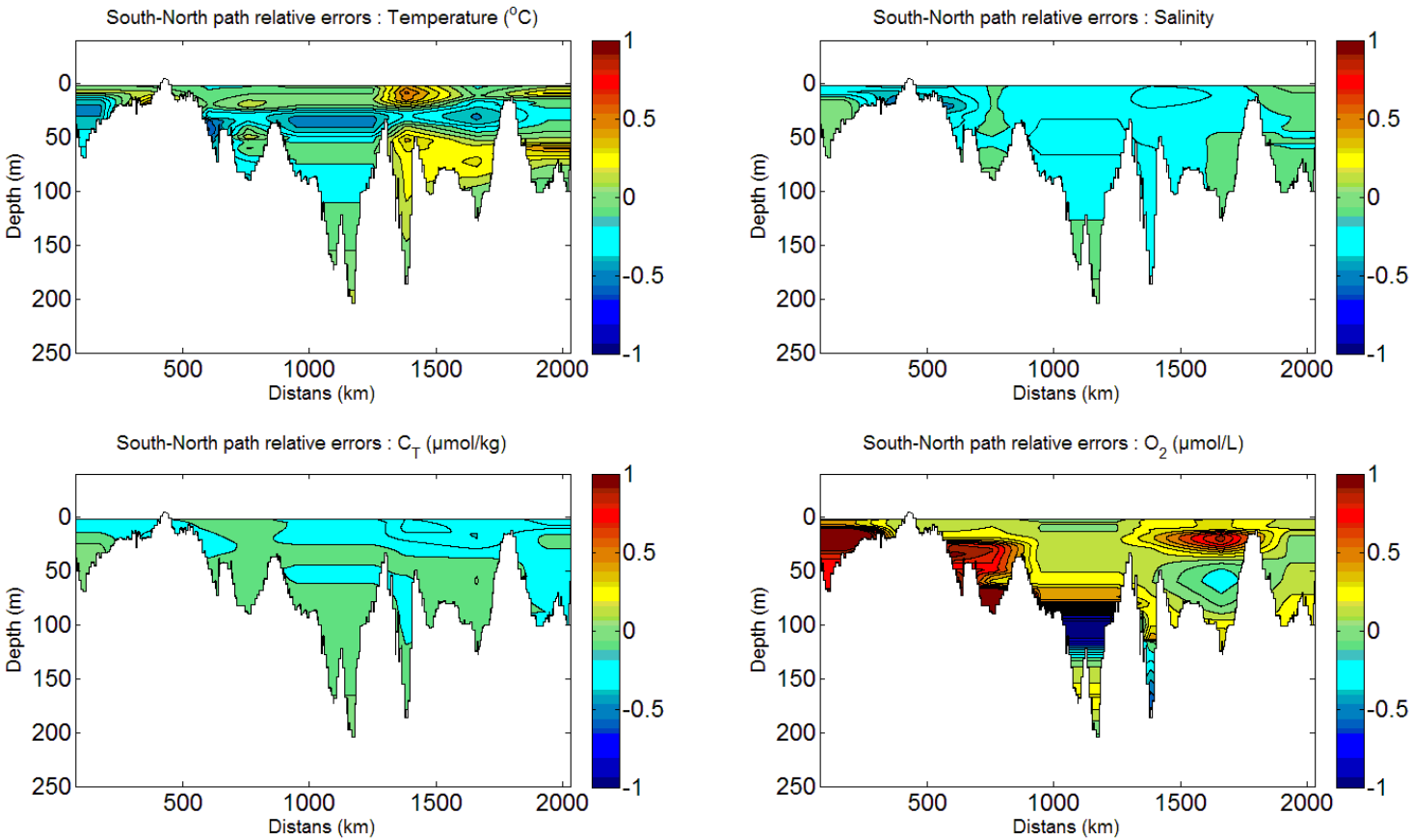
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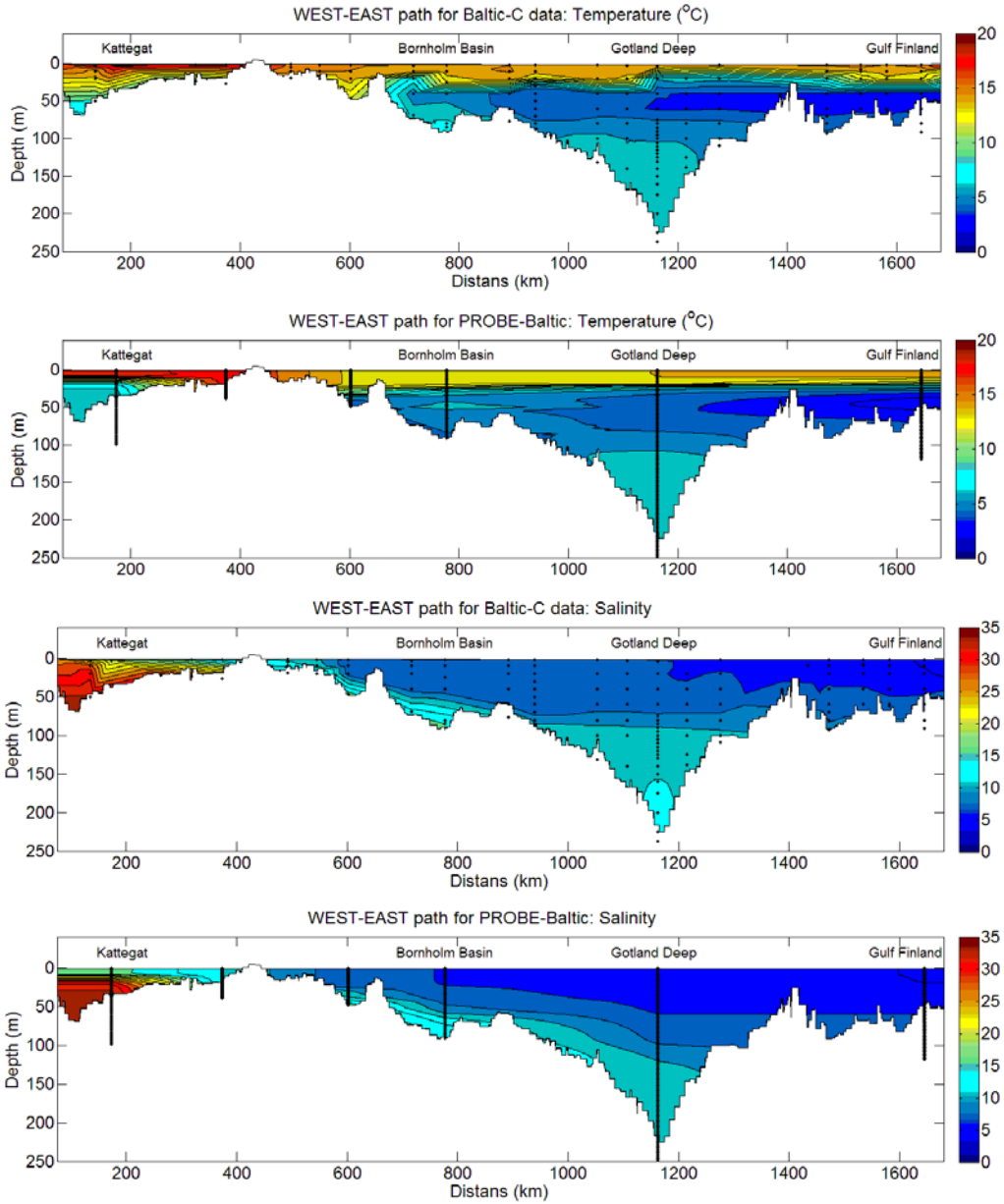
WEST-EAST path for Baltic-C data: Temperature (°C)
Kattegat
Bornholm Basin
Gotland Deep
Gulf Finland
Depth (m)
Distans (km)
WEST-EAST path for PROBE-Baltic: Temperature (°C)
WEST-EAST path for Baltic-C data: Salinity
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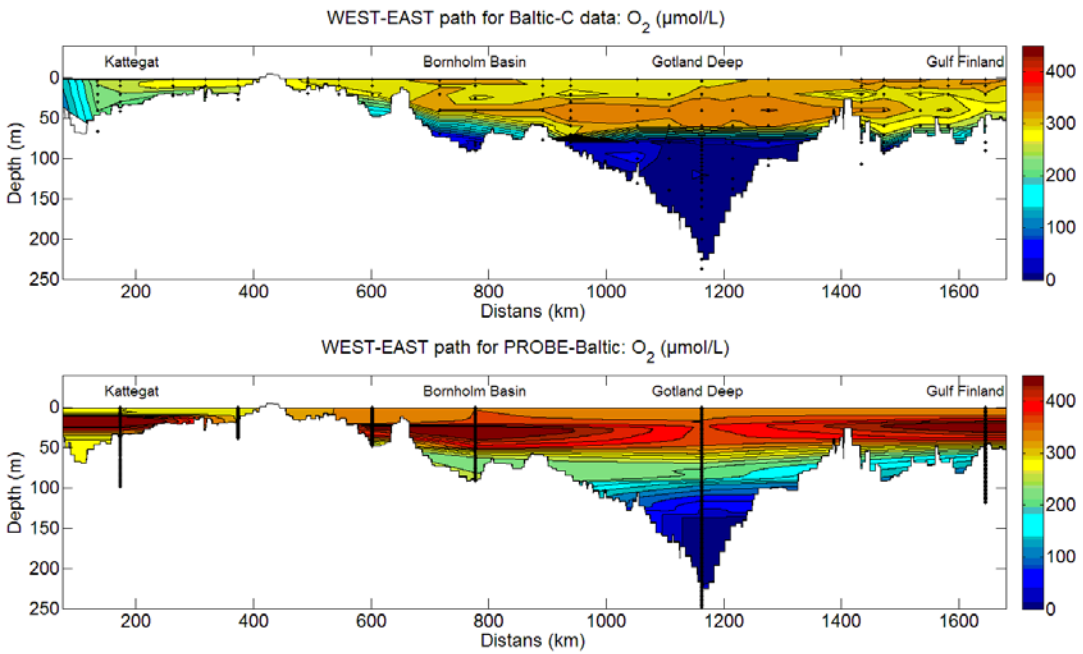
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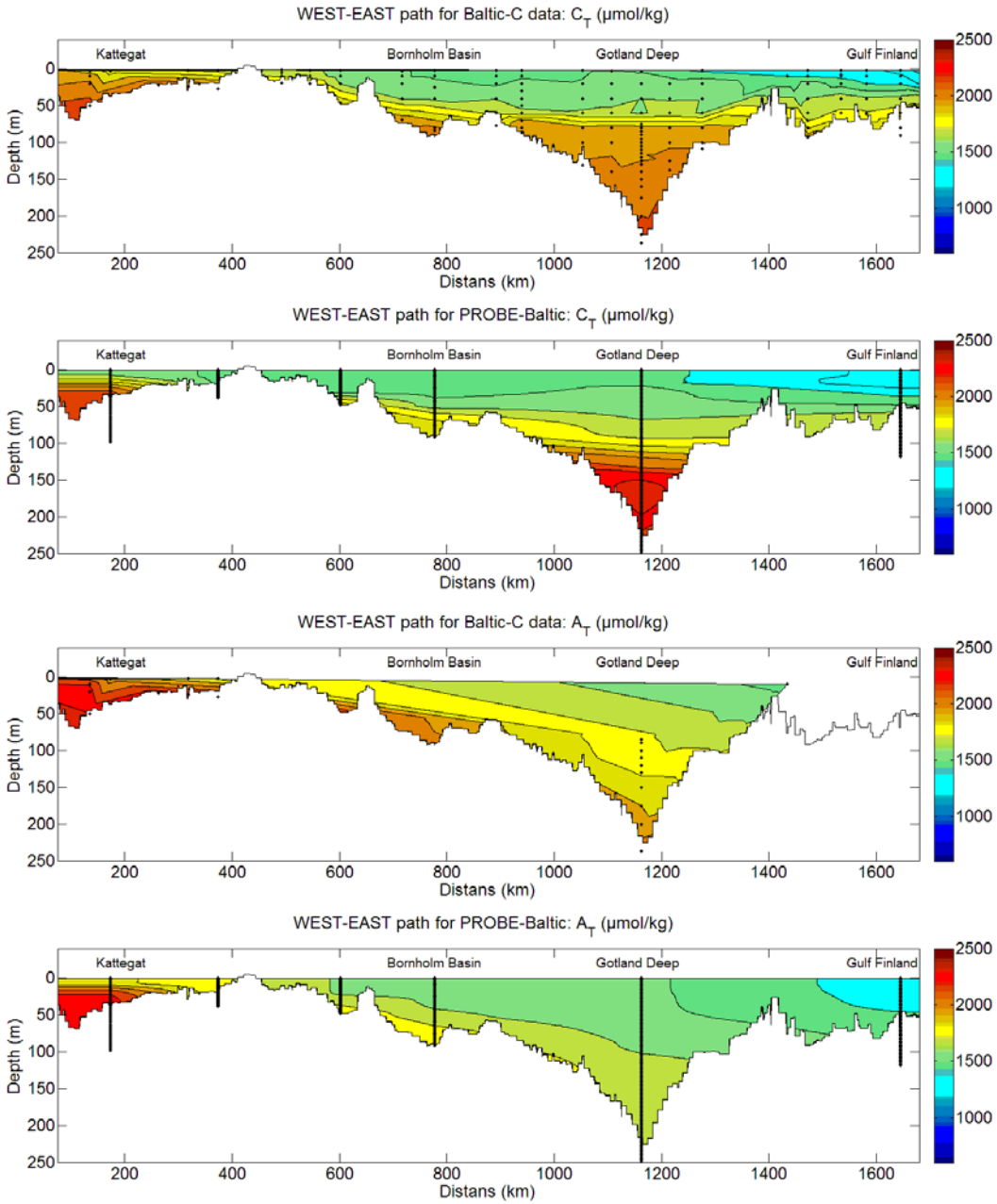
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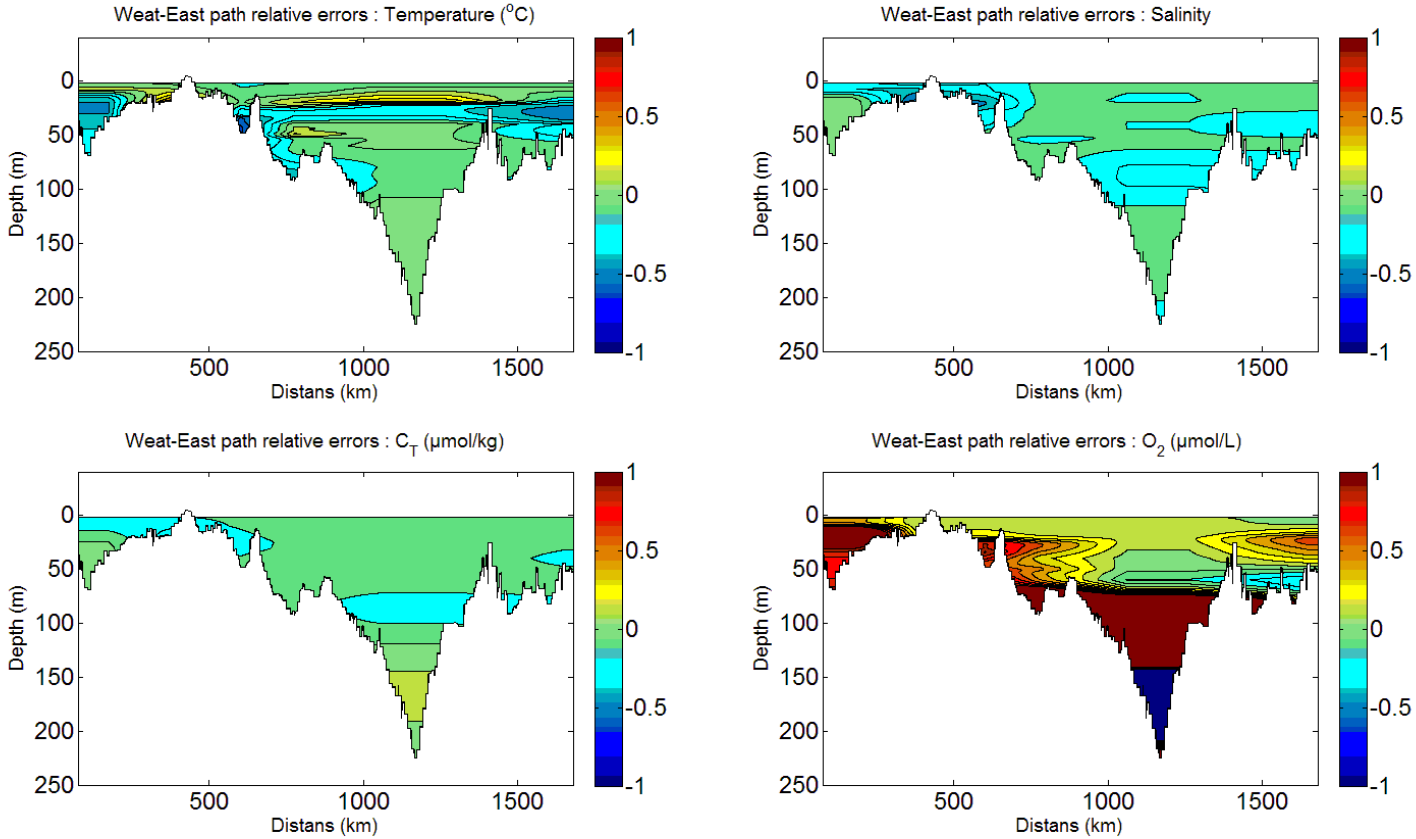
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Weat-East path relative errors : C_T (µmol/kg)
Weat-East path relative errors : O_2 (µmol/L)
Depth (m)
Distans (km)
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500
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1500
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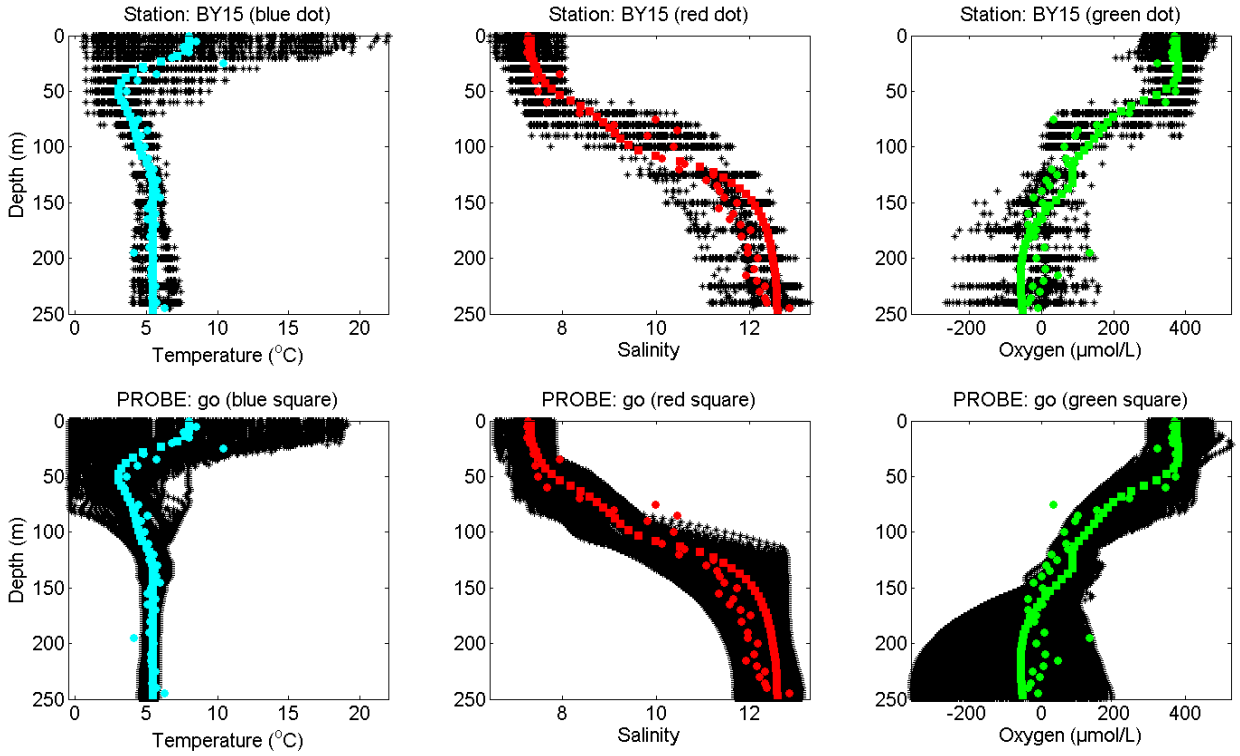
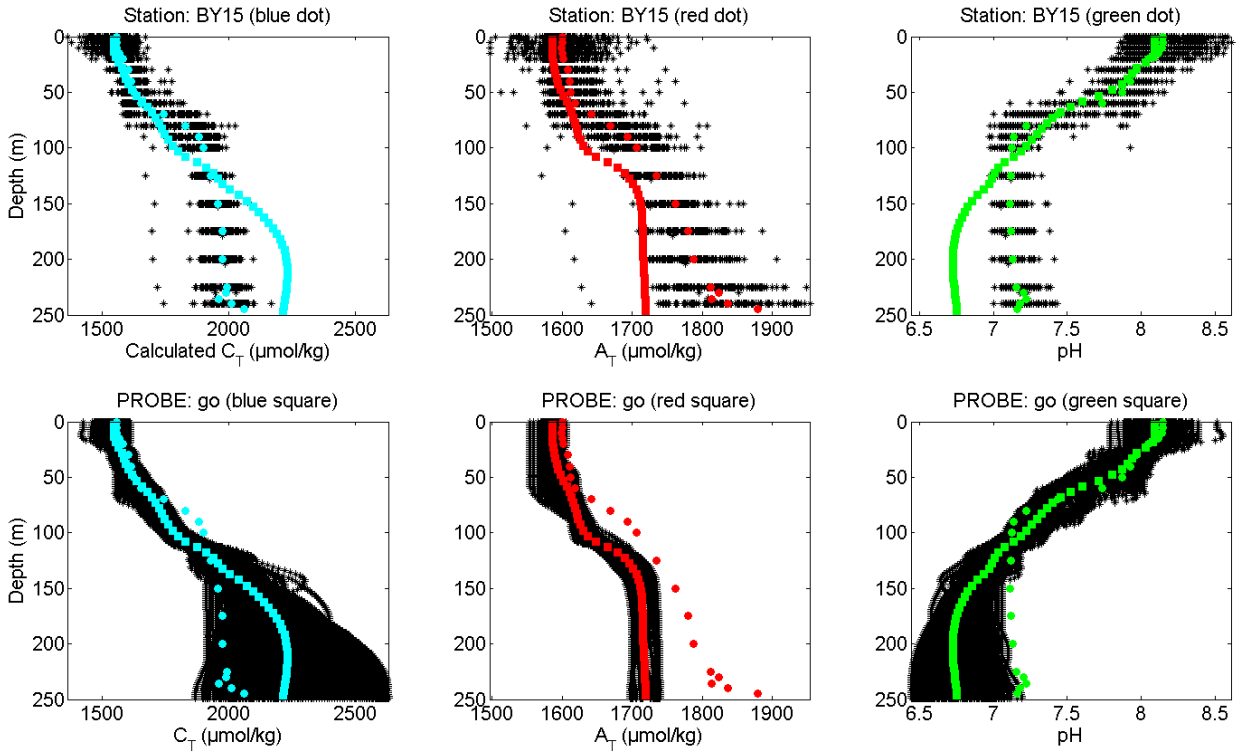
0.5
0
-0.5
-1

“Interaction between models and measurements in Baltic-C”

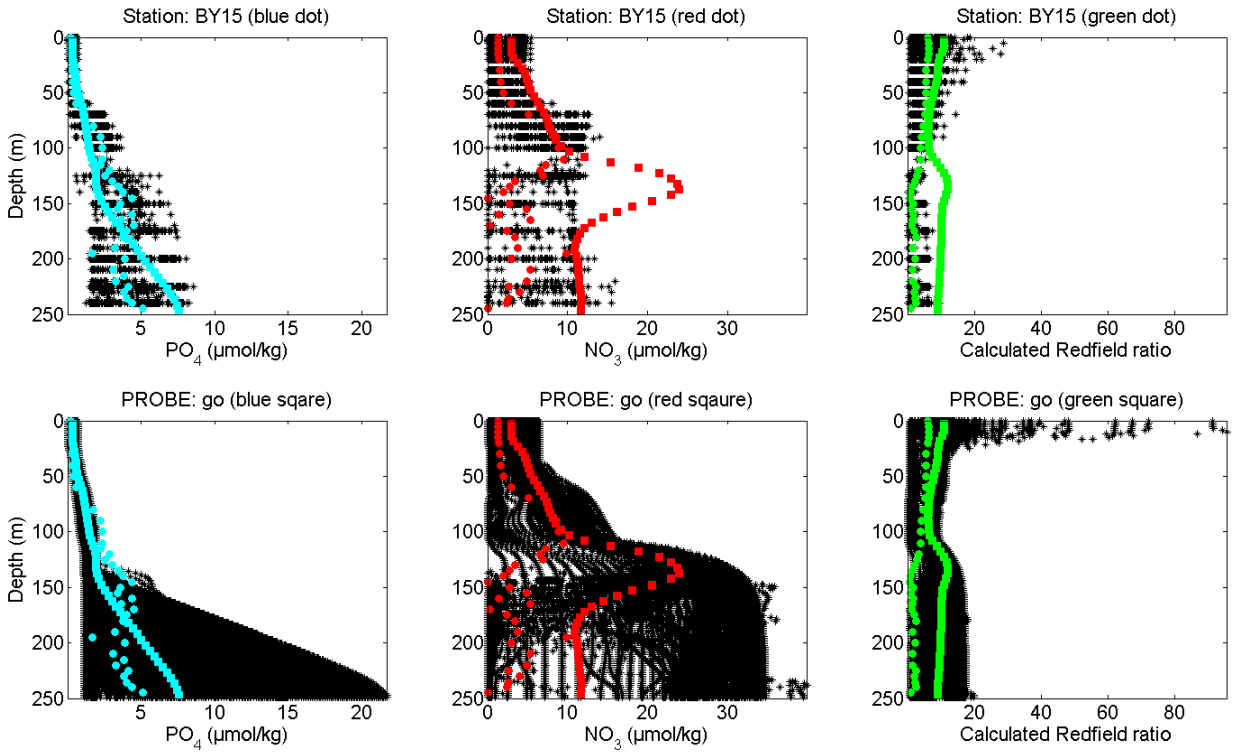
Shark meets PROBE-Baltic 1970-2000



Shark meets PROBE-Baltic 1995-2007



Shark meets PROBE-Baltic 1970-2000



Merian/Shark meets PROBE-Baltic for a number stations. Work in progress.

Thanks for your interest!

Organic Carbon ↔ CO_2 ↔ pH ↔ Alkalinity

Baltic - C