Simulation of the carbon cycle in the Baltic Sea.

MOM+ERGOM application

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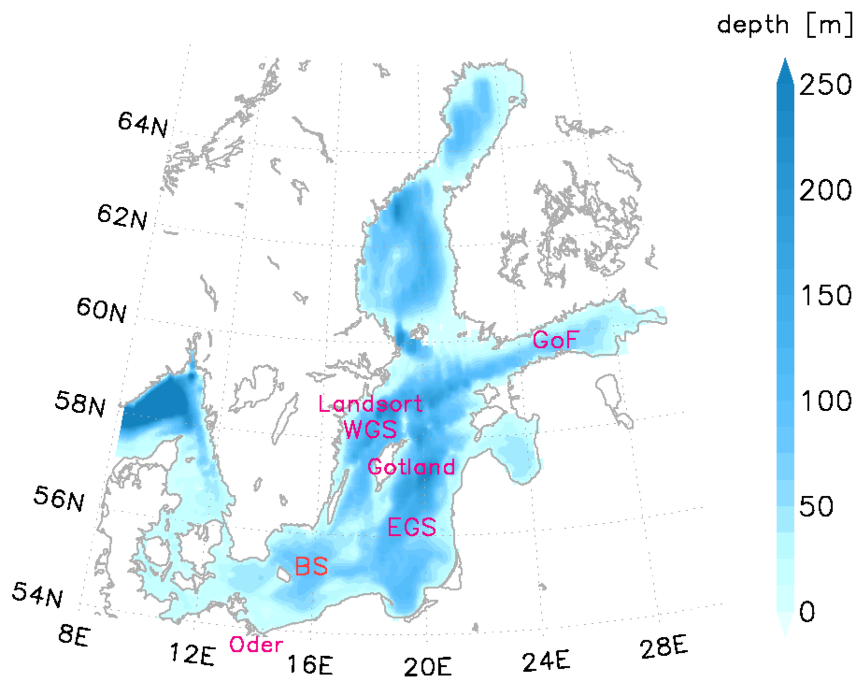
Physical model, MOM

Modular Ocean Model (MOM3.1)

- 3 nm horizontal resolution
- 77 vertical layers 3 m … 6 m
- Open boundary condition towards the North Sea
- 20 Model rivers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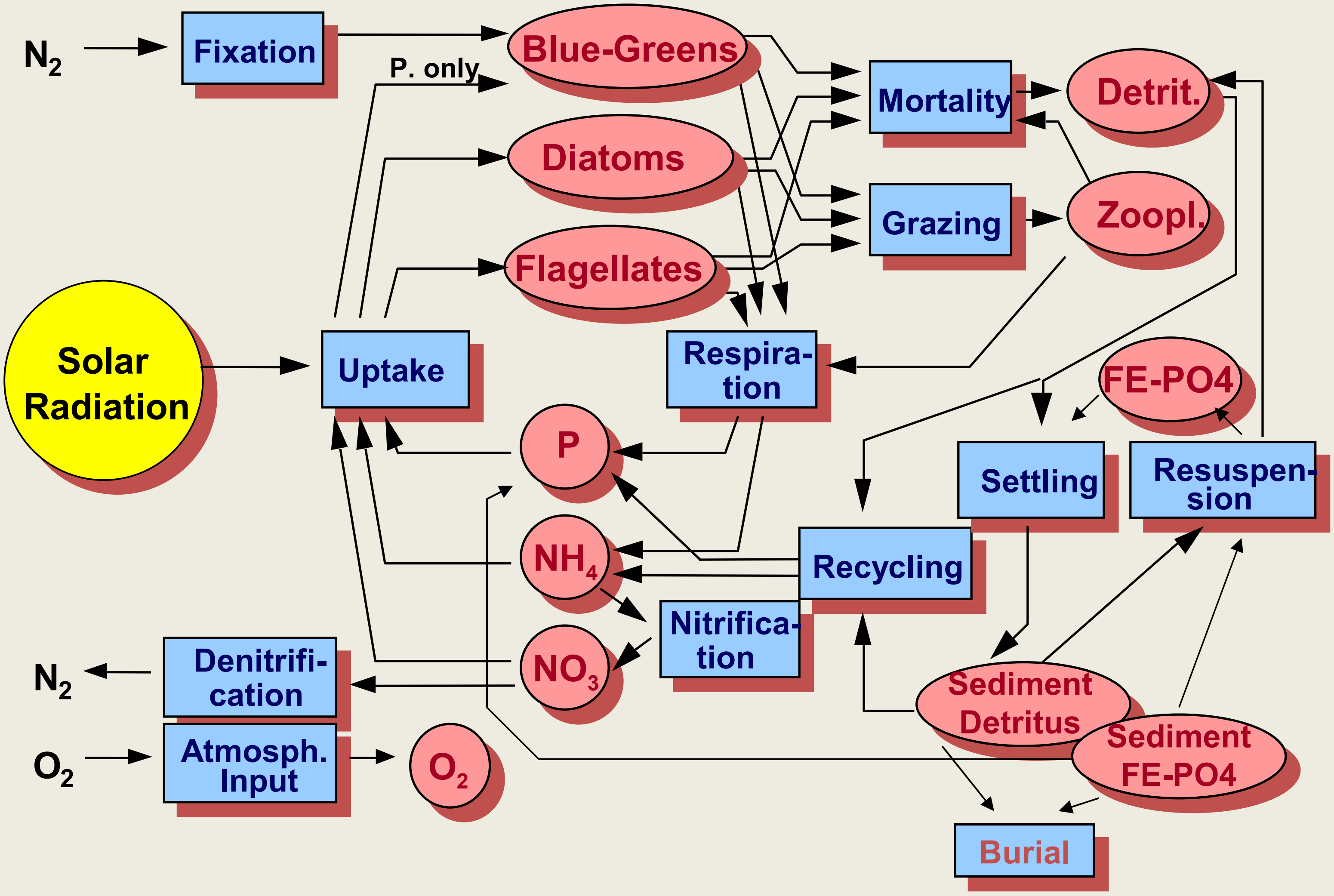
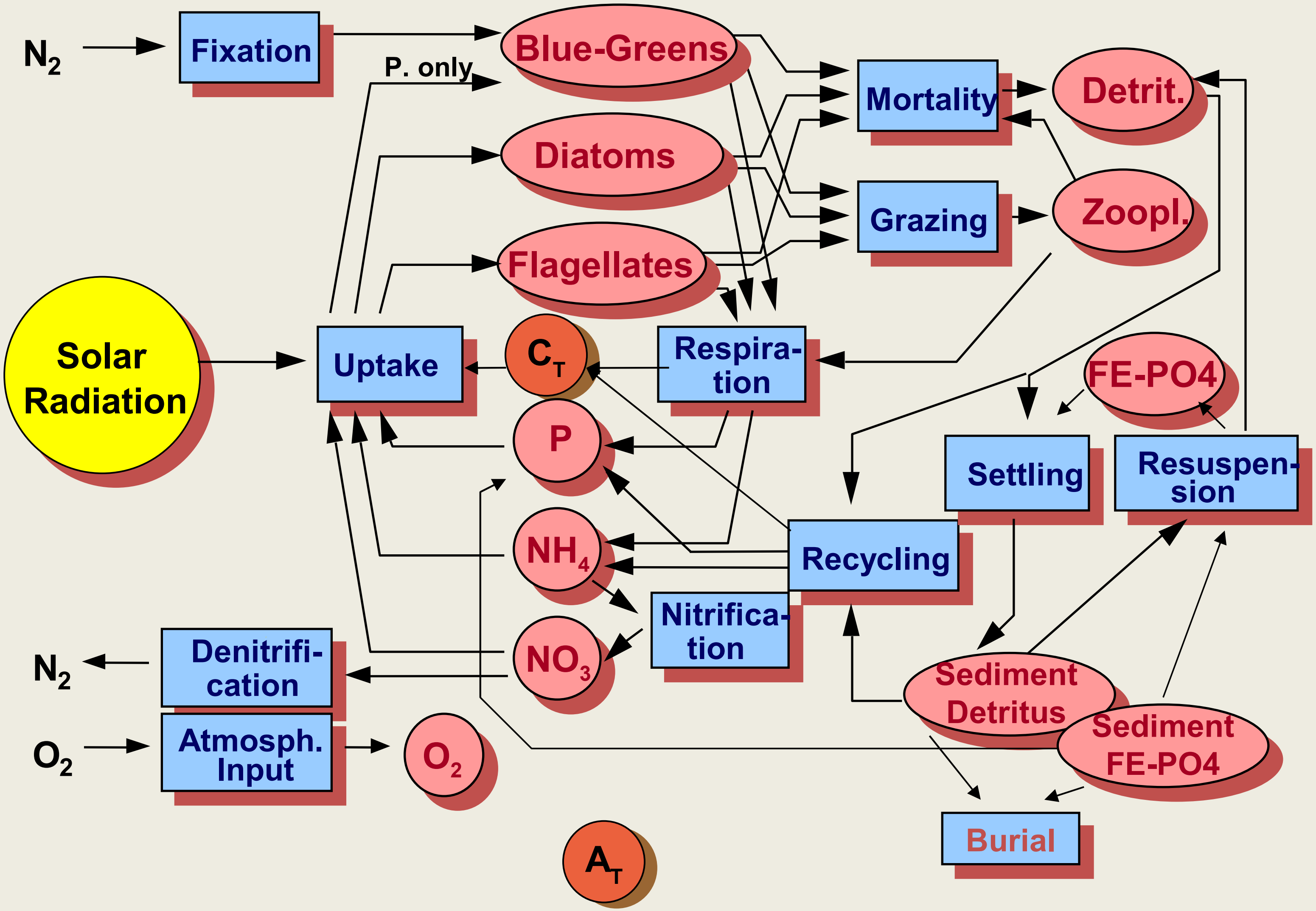
200
150
100
50
0
64N
62N
60N
58N
56N
54N
8E
12E
16E
20E
24E
28E
Oder
GoF
Landsort
WGS
Gotland
EGS
BS

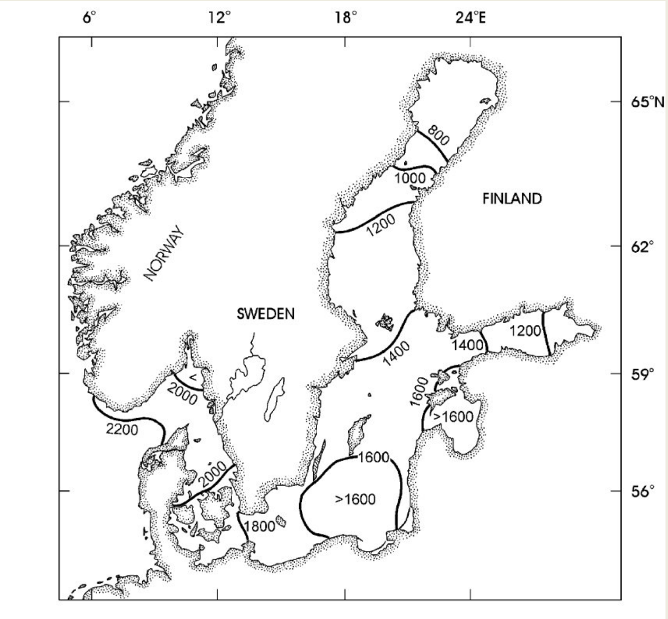
ERGOM model + simple carbon cycle


N_2
Fixation
Blue-Greens
P. only
Mortality
Detrit.
Diatoms
Grazing
Zoopl.
Flagellates
Solar Radiation
Uptake
Respiration
FE-PO4
P
Settling
Resuspension
NH4
Recycling
Nitrification
NO3
N_2
Denitrification
Sediment Detritus
O_2
Atmosph. Input
O_2
Sediment FE-PO4
Burial

ERGOM model + simple carbon cycle


N_2
Fixation
Blue-Greens
P. only
Mortality
Detrit.
Diatoms
Grazing
Zoopl.
Flagellates
Solar Radiation
Uptake
C_T
Respira-tion
FE-PO4
P
Settling
Resuspen-sion
Recycling
NH_4
Nitrifica-tion
NO_3
N_2
Denitrifi-cation
Sediment Detritus
Sediment FE-PO4
O_2
Atmosph. Input
O_2
A_T
Burial

Time averaged surface alkalinity


6°
12°
18°
24°E
65°N
62°
59°
56°
NORWAY
SWEDEN
FINLAND
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1000
1200
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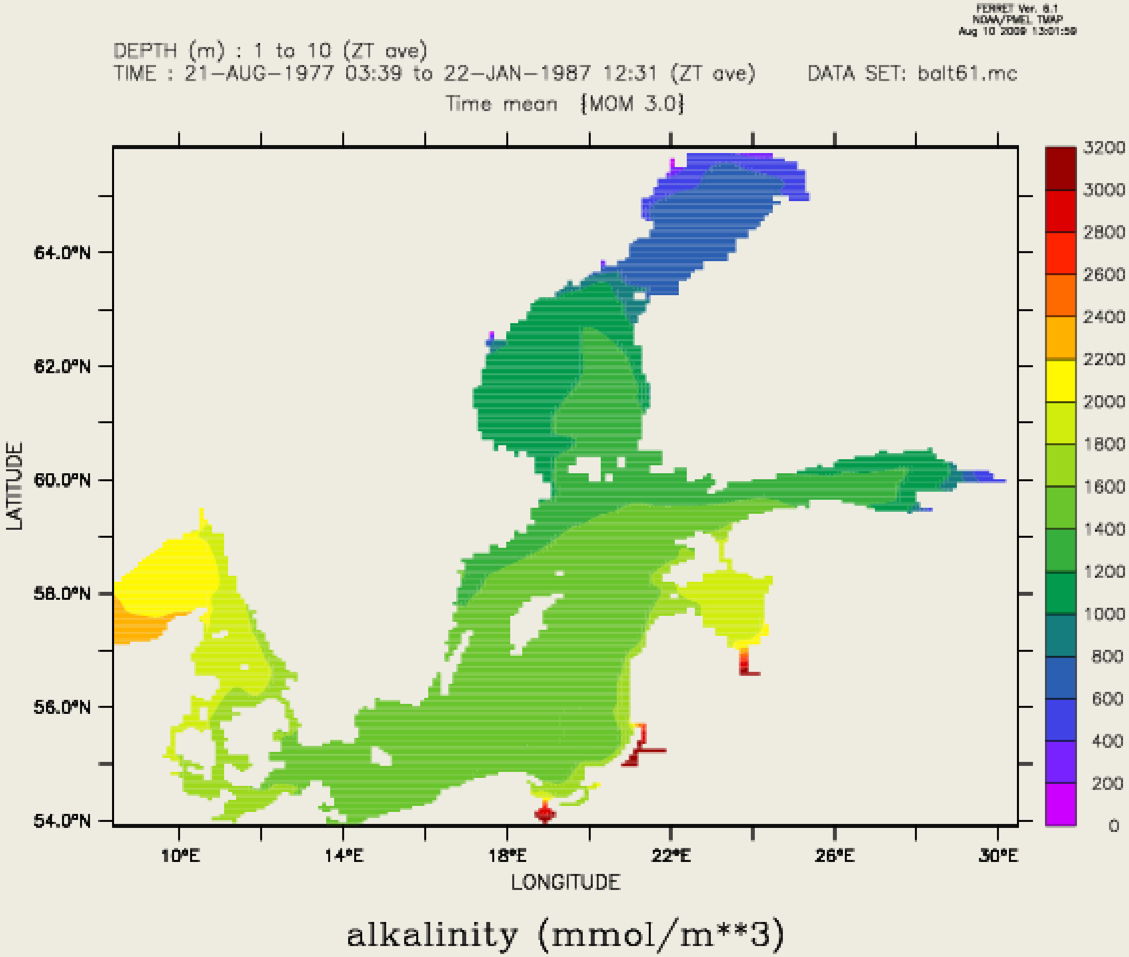
2000
2200
2000
1600
>1600
1800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TIME : 21-AUG-1977 03:39 to 22-JAN-1987 12:31 (ZT ave)
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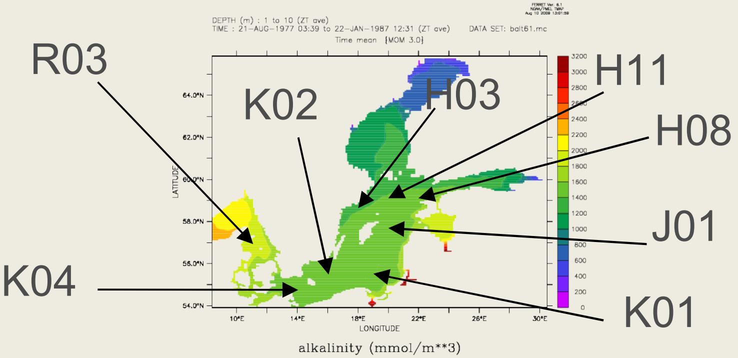
64.0°N
62.0°N
60.0°N
58.0°N
56.0°N
54.0°N
LATITUDE
10°E
14°E
18°E
22°E
26°E
30°E
LONGITUDE
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
alkalinity (mmol/m**3)

Rodhe, 1998

simulation results

The marine ecosystem in changing climate - on the added value of coupled climate-environmental modeling for the Baltic Sea

Surface alkalinity
Black – simulation results
Red - observations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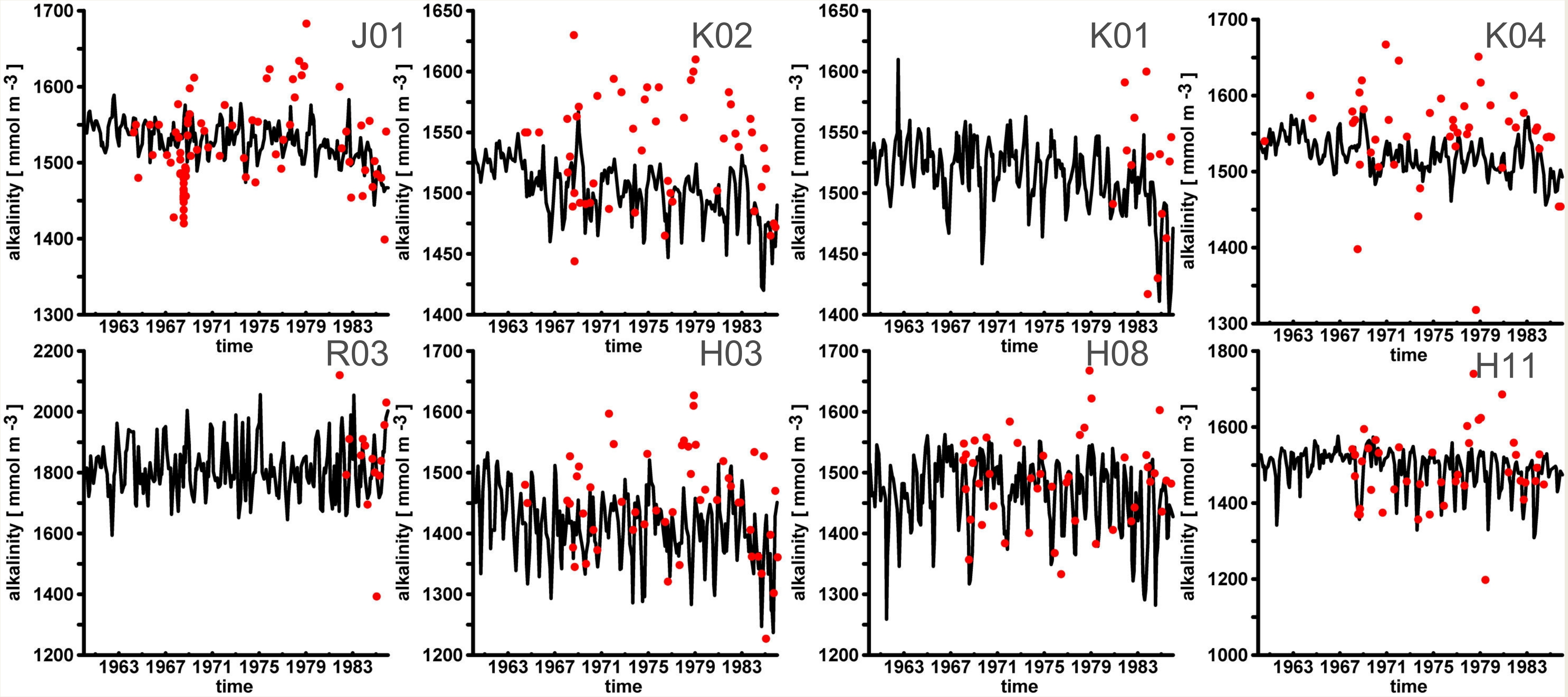
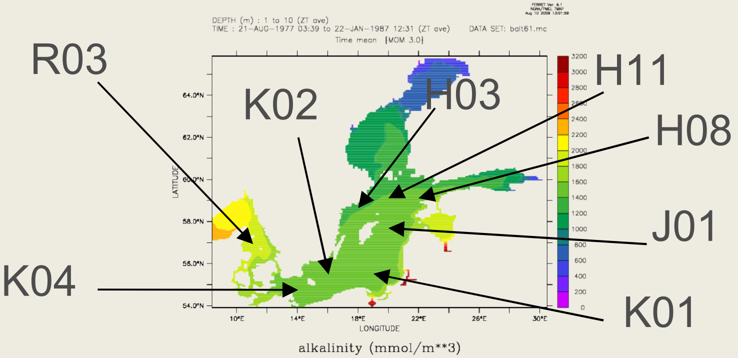
TIME : 21-AUG-1977 03:39 to 22-JAN-1987 12:31 (ZT ave)
DATA SET: balt61.mc
Time mean (MOM 3.0)
R03
K02
H03
H11
H08
J01
K04
K01
LATITUDE
LONGITUDE
alkalinity (mmol/m**3)



The marine ecosystem in changing climate - on the added value of coupled climate-environmental modeling for the Baltic Sea

Time averaged alkalinity vertical profiles
Black – simulation results
Red - observations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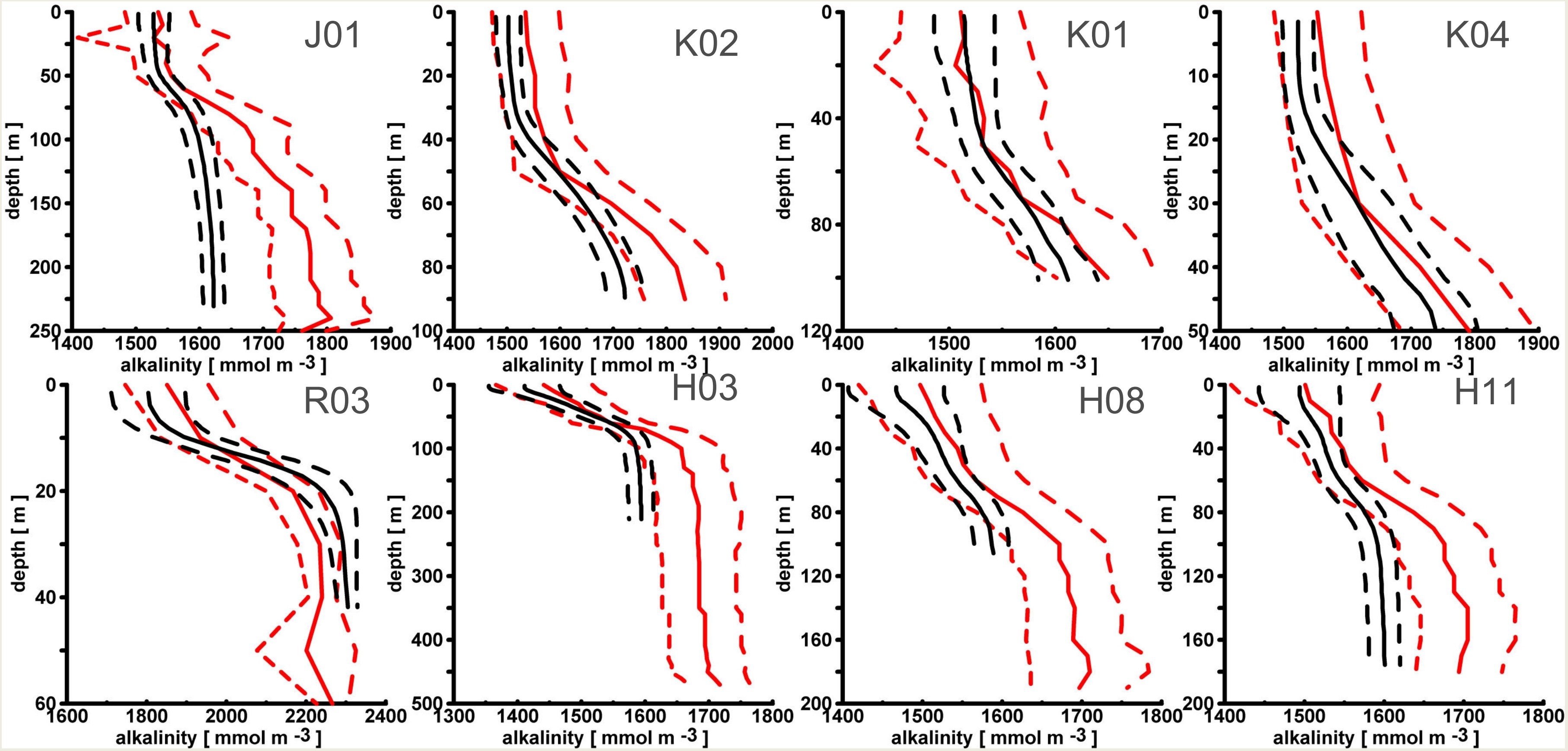
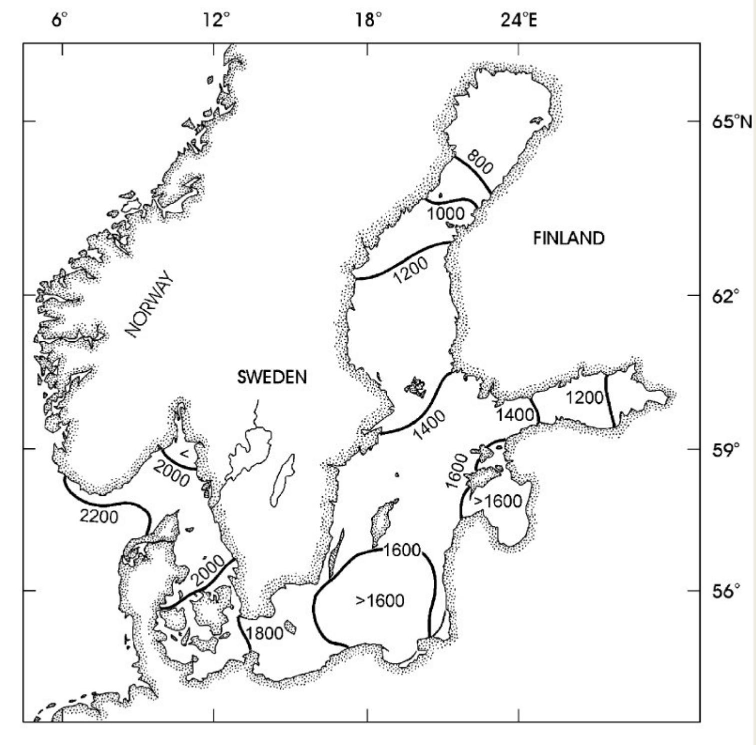
K02
H03
H11
H08
J01
K04
K01
LATITUDE
64.0°N
62.0°N
60.0°N
58.0°N
56.0°N
54.0°N
10°E
14°E
18°E
22°E
26°E
30°E
LONGITUDE
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
alkalinity (mmol/m**3)

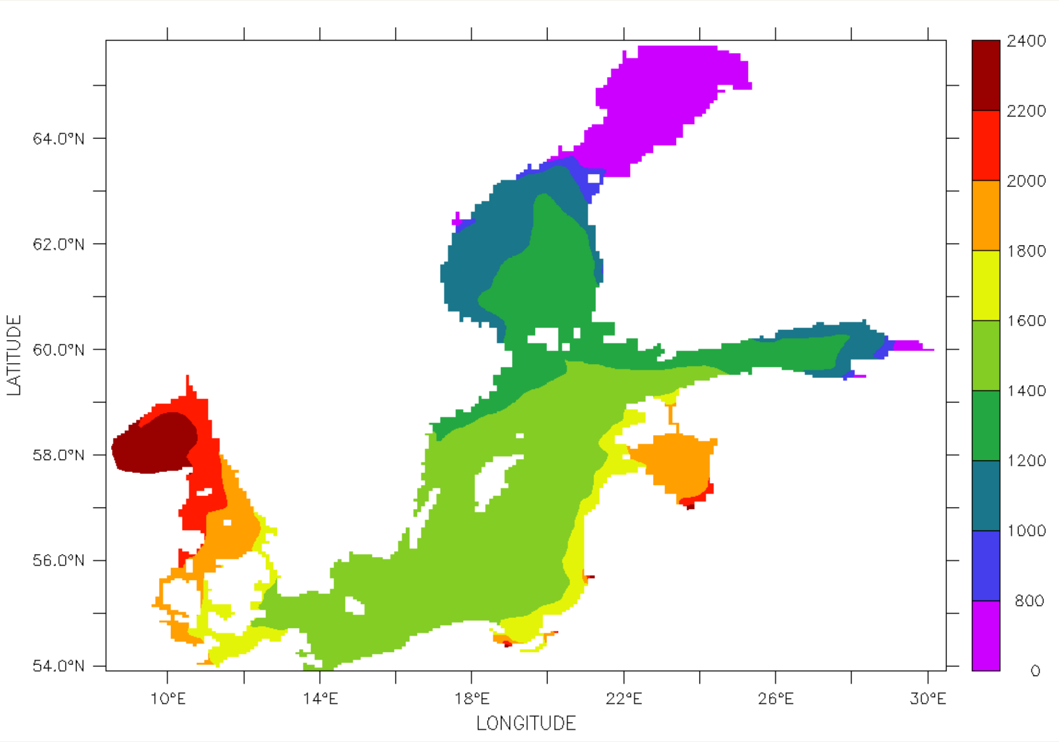


Time averaged surface alkalinity

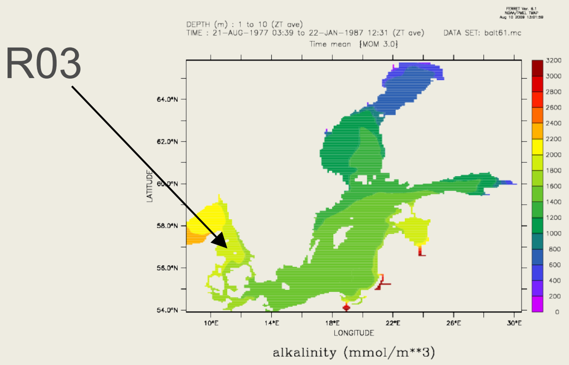
Rodhe, 1998


6°
12°
18°
24°E
65°N
62°
59°
56°
NORWAY
SWEDEN
FINLAND
800
1000
1200
1200
1400
1400
1600
>1600
1600
>1600
1800
2000
2000
2200

simulation results


64.0°N
62.0°N
60.0°N
58.0°N
56.0°N
54.0°N
LATITUDE
10°E
14°E
18°E
22°E
26°E
30°E
LONGITUDE
2400
2200
2000
1800
1600
1400
1200
1000
800
0

Surface alkalinity and pH, R03


R03
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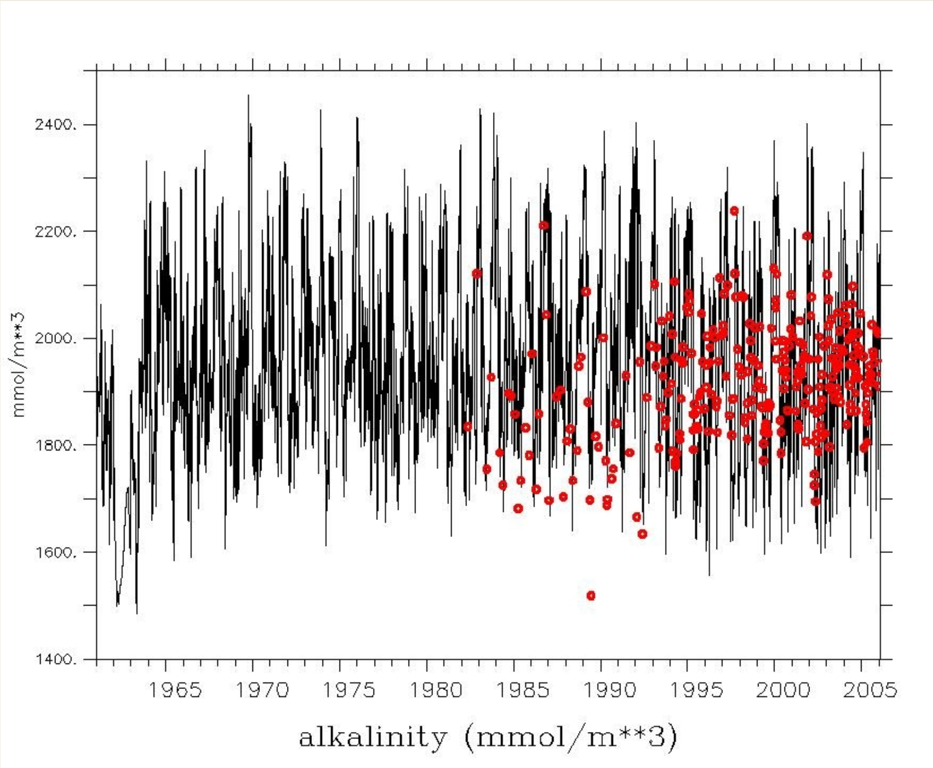
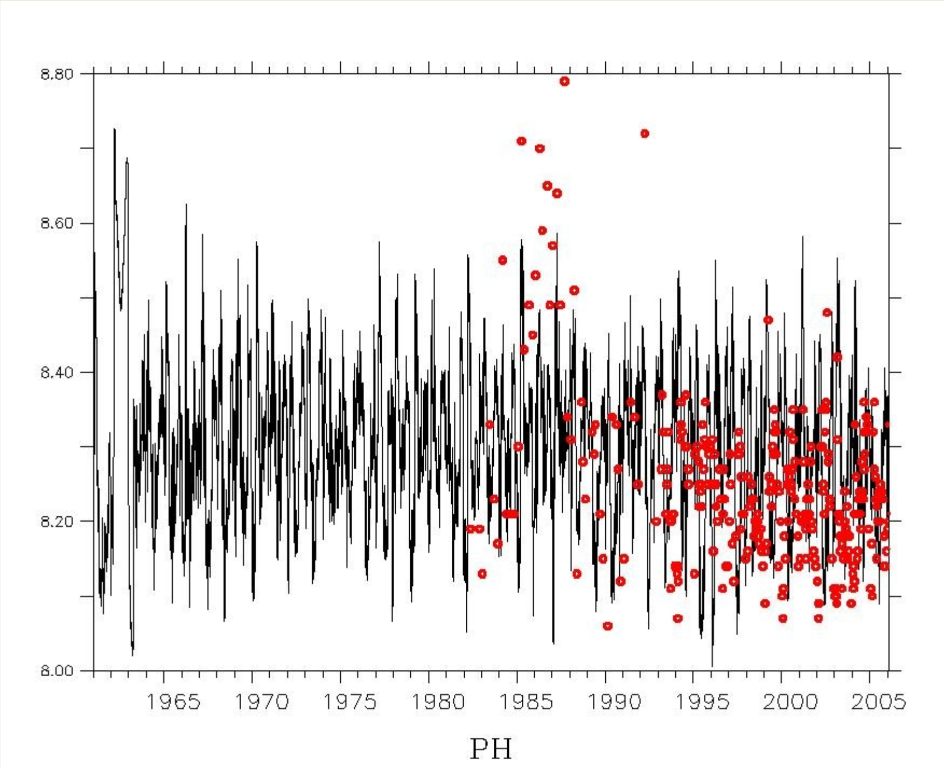
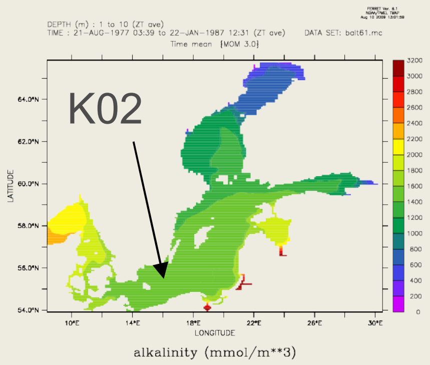
LATITUDE
64.0°N
62.0°N
60.0°N
58.0°N
56.0°N
54.0°N
10°E
14°E
18°E
22°E
26°E
30°E
LONGITUDE
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
alkalinity (mmol/m**3)





Surface alkalinity and pH, K02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NOAA/PMEL TMAP
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DATA SET: balt61.mc
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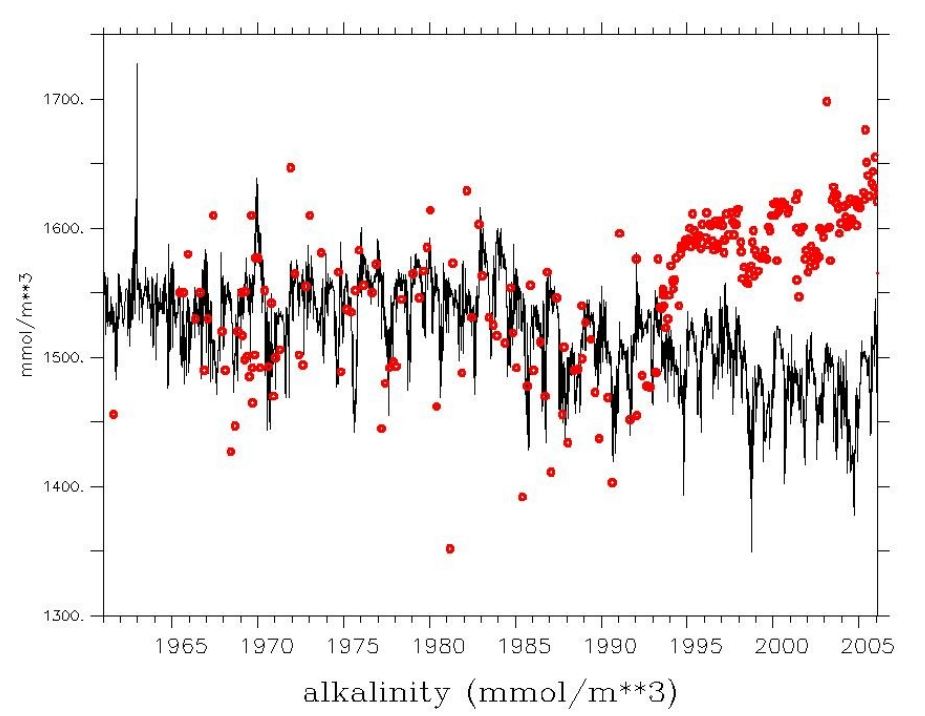
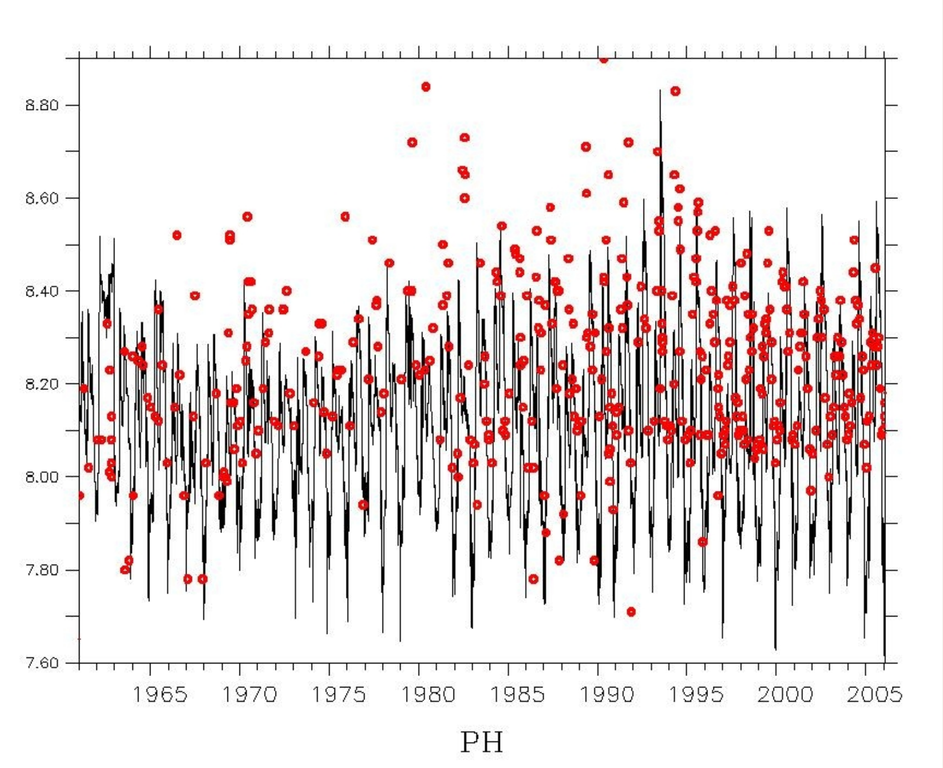
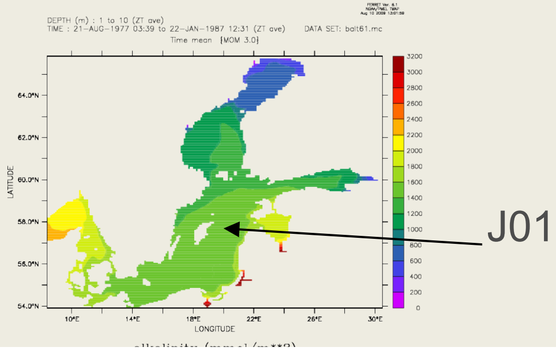
K02
64.0°N
62.0°N
60.0°N
58.0°N
56.0°N
54.0°N
LATITUDE
10°E
14°E
18°E
22°E
26°E
30°E
LONGITUDE
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
alkalinity (mmol/m**3)





Surface alkalinity and pH, J01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NOAA/PMEL TMAP
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DATA SET: balt61.mc
Time mean {MOM 3.0}
64.0°N
62.0°N
60.0°N
58.0°N
56.0°N
54.0°N
LATITUDE
10°E
14°E
18°E
22°E
26°E
30°E
LONGITUDE
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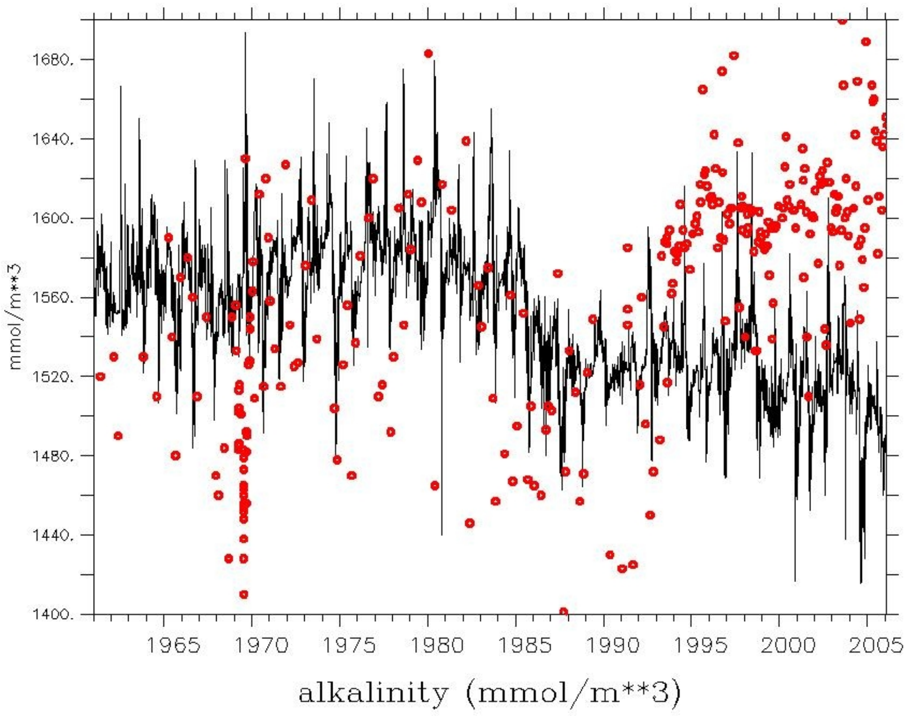
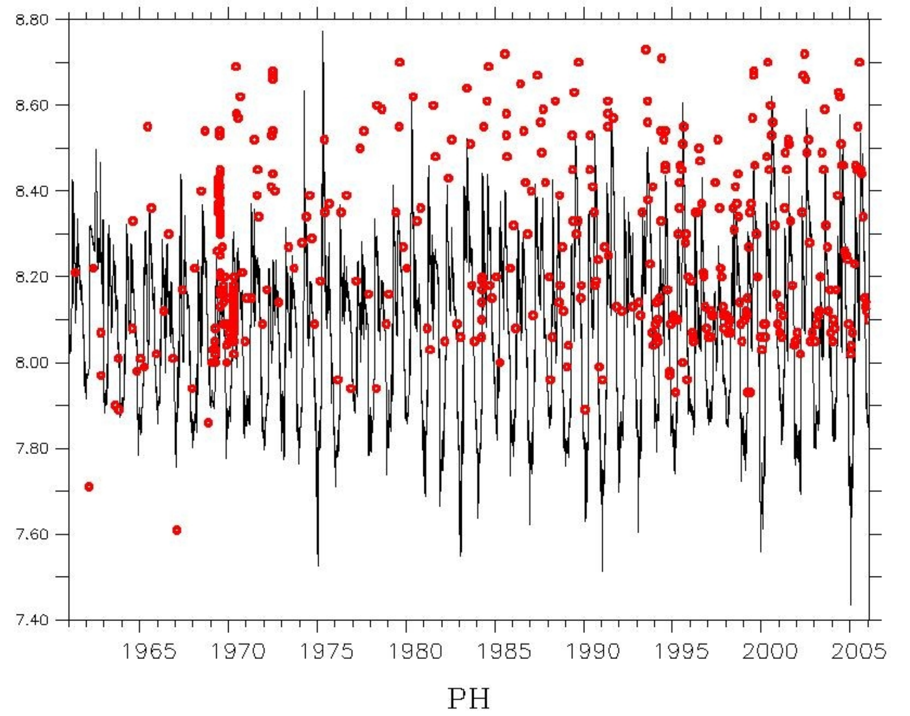
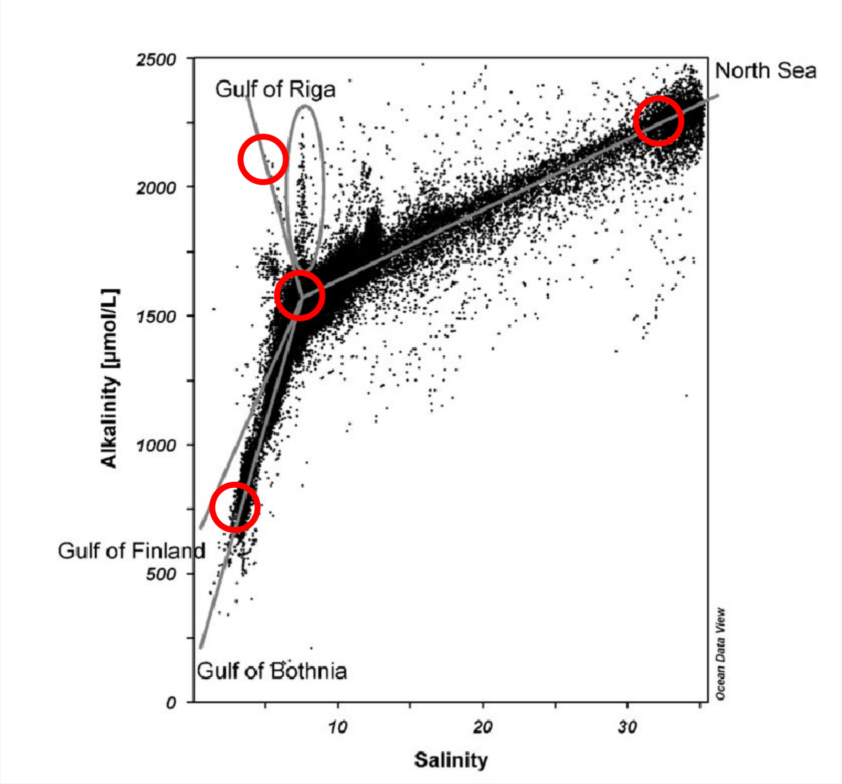
200
0
J01



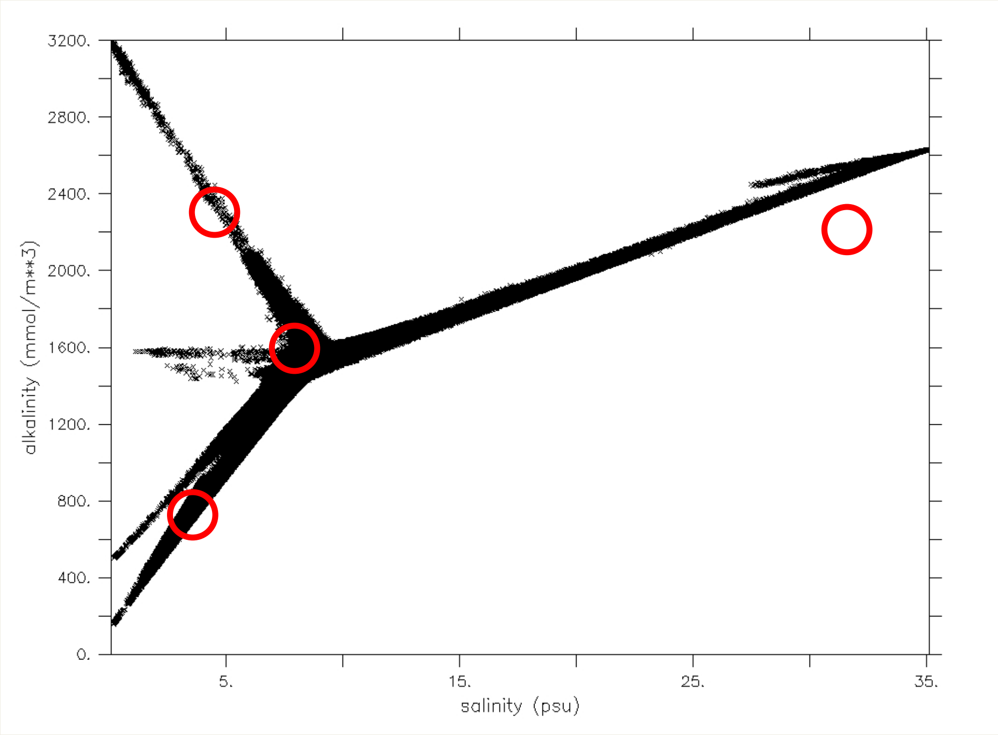


Alkalinity salinity diagrams

Hjalmarsson et al., 2008



simulation results



Summary

Simulation of the carbon cycle in the Baltic Sea. ERGOM application

- Total alkalinity values versus salinity are well reproduced by the model
- Simulated lateral alkalinity gradient (from south-west to north-east) is in satisfactory agreement with observations
- Patterns of vertical distribution of alkalinity are reproduced by the model
- Annual cycle of pH is generally mimicked