Comparing the impacts of different atmospheric forcings on the performance of a coupled bio-physical model:

A case study for the North and Baltic Sea ecosystem

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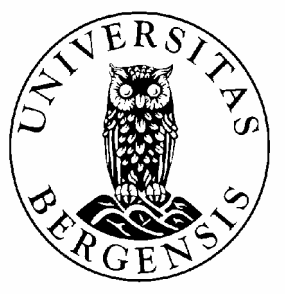


Ecosystem Models: N(utrients) P(hytoplankton) Z(ooplankton) D(etritus)

Primary production

Phytoplankton

-light (SWR)

-nutrients

Secondary production

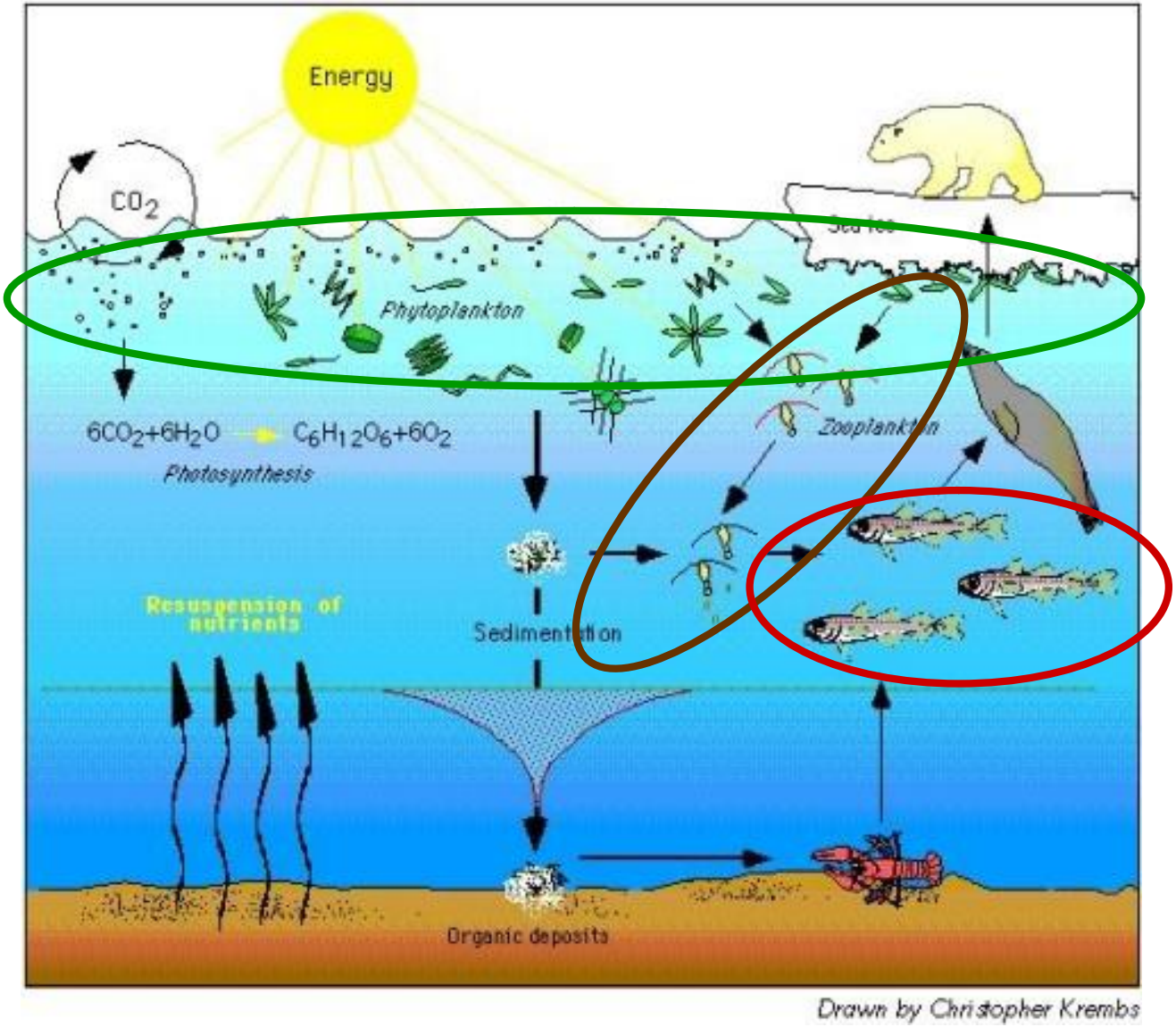
Zooplankton

-Primary production

-Temperature

Tertiary production

Fish



ECOSMO North Sea- Baltic Sea model

ECOSMO (Schrum et al. 2006)

3-D hydrodynamic Model
Based on HAMSOM
Schrum and Backhaus, 1999;
3D-primitive equation model

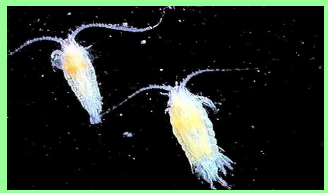
horiz. resolution 10 km

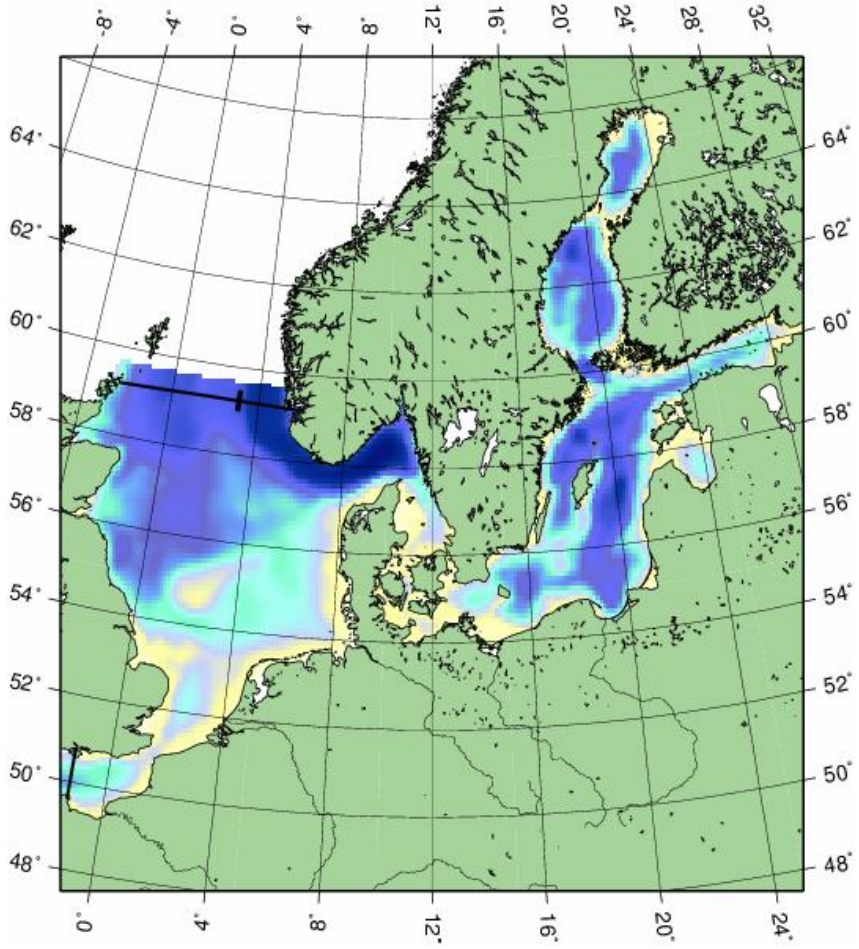
20 vertical layers
Dynamic-thermodynamic sea ice
Atmospheric fluxes, iterative

3-D trans,light, turb, T

NPZD module
(Schrum et al. 2006)

- 3 nutrient cycles (N,P,Si)
- 3 phytoplankton groups
- 2 zooplankton groups
  (herbivor., omnivor.)





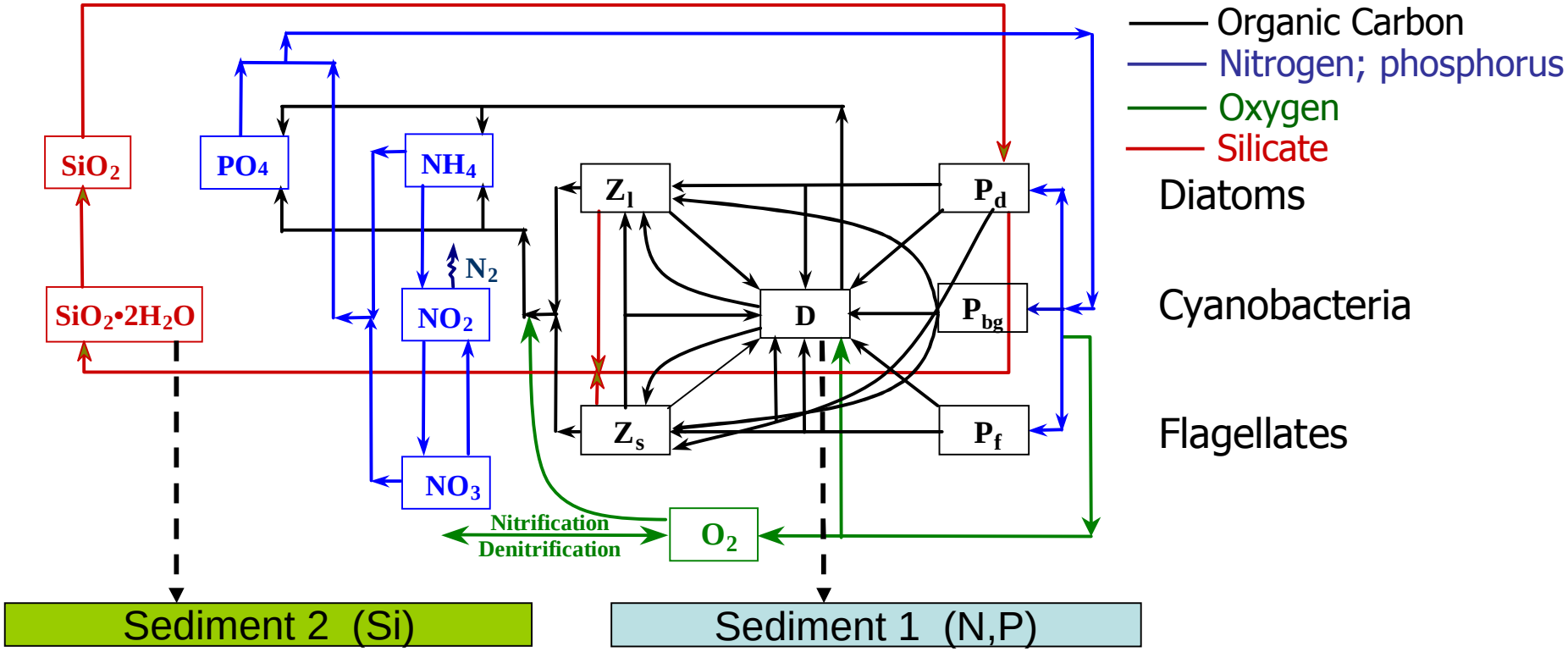
Lower trophic levels-NPZD

Intermediate complexity ecosystem model

3 Phytoplankton: diatoms and flagellates

2 Zooplankton: herbivores (**Zs**) and omnivores (**Zl**)

3 nutrient cycles: N,P,Si



Atmospherical forcing - setup

NCEP/NCAR

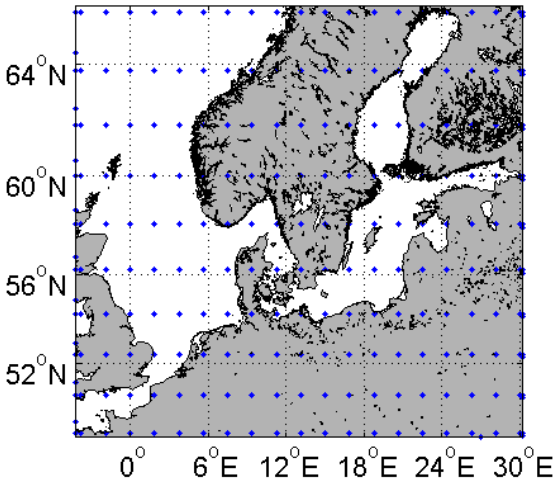
National Centers for Environmental Prediction

4 times daily

from 1948 –

Kalnay et al., 1996

NCEP(1.9°x1.9°)



- Short wave Radiation (SWR)
- Long wave radiation (LWR)
- 2 m air Temperature
- Wind speed (U,V)
- SL Pressure
- Precipitation
- Dew point T (spez. humidity)

ECMWF ERA 40

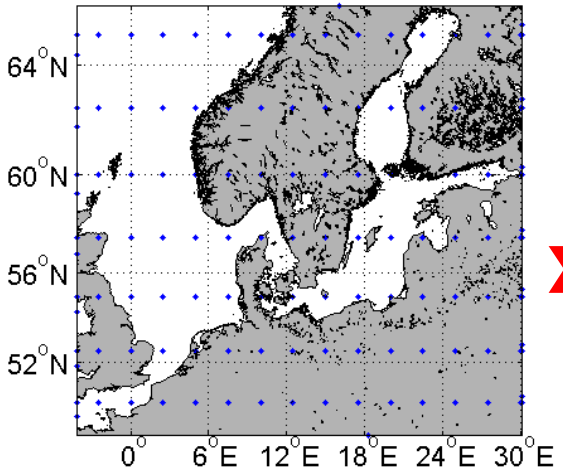
European Center for Medium-range Weather Forecasts

4-times daily

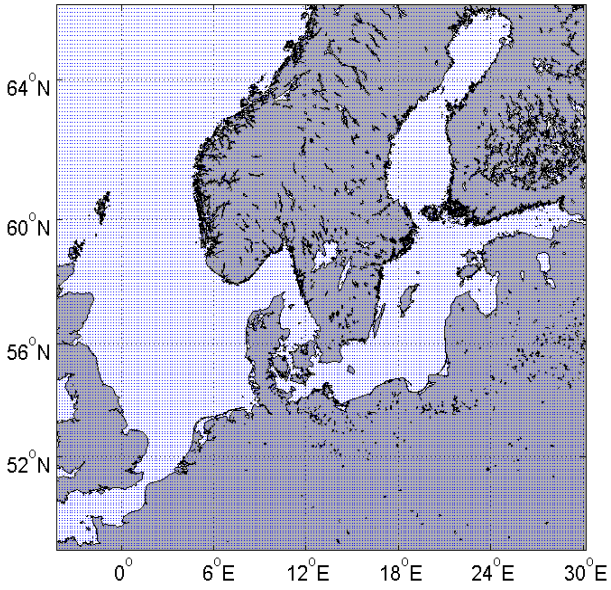
1957/09/01 - 31/08/2002

Uppala et al., 2005

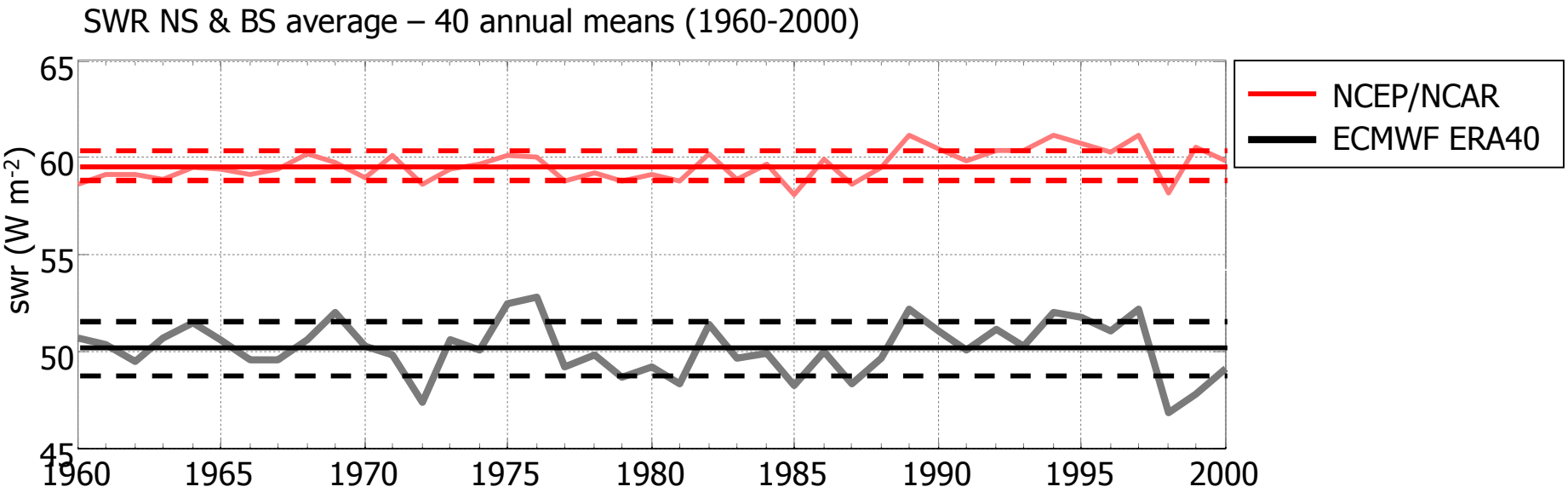
ERA40 (2.5°x2.5 °)

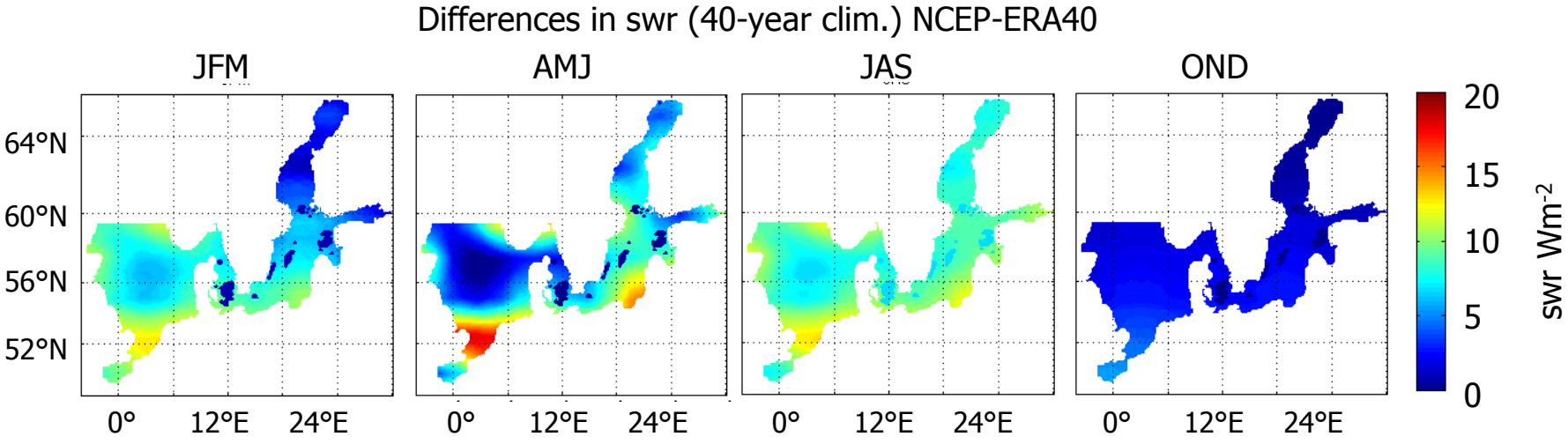


Model grid (6/10° x 10/10°)

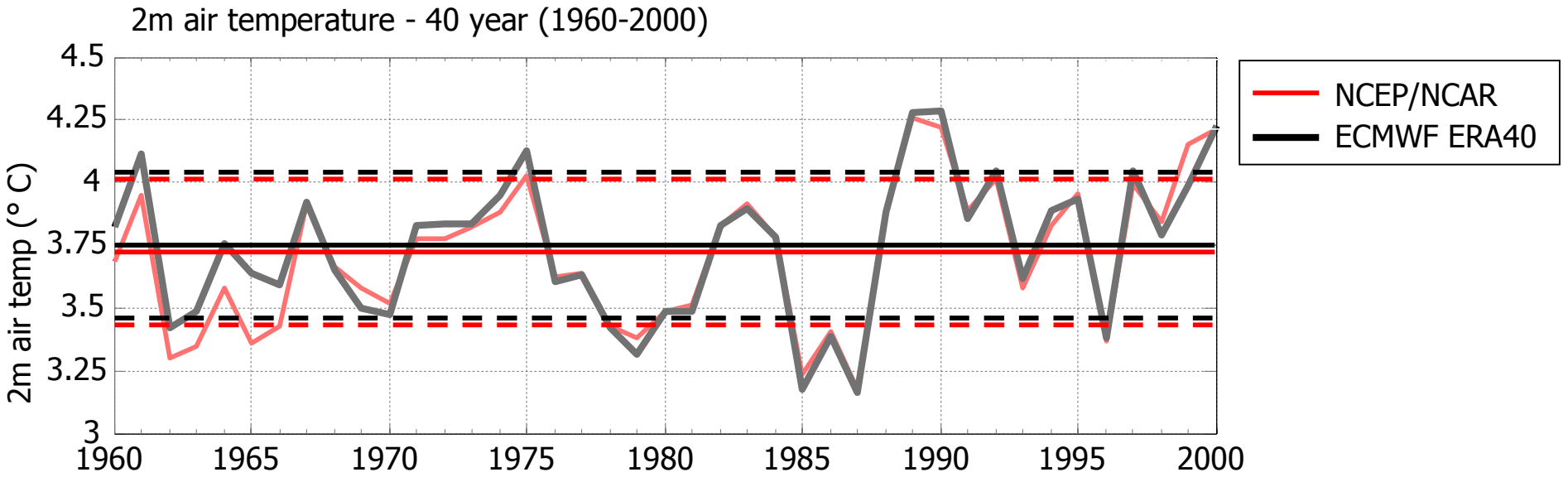


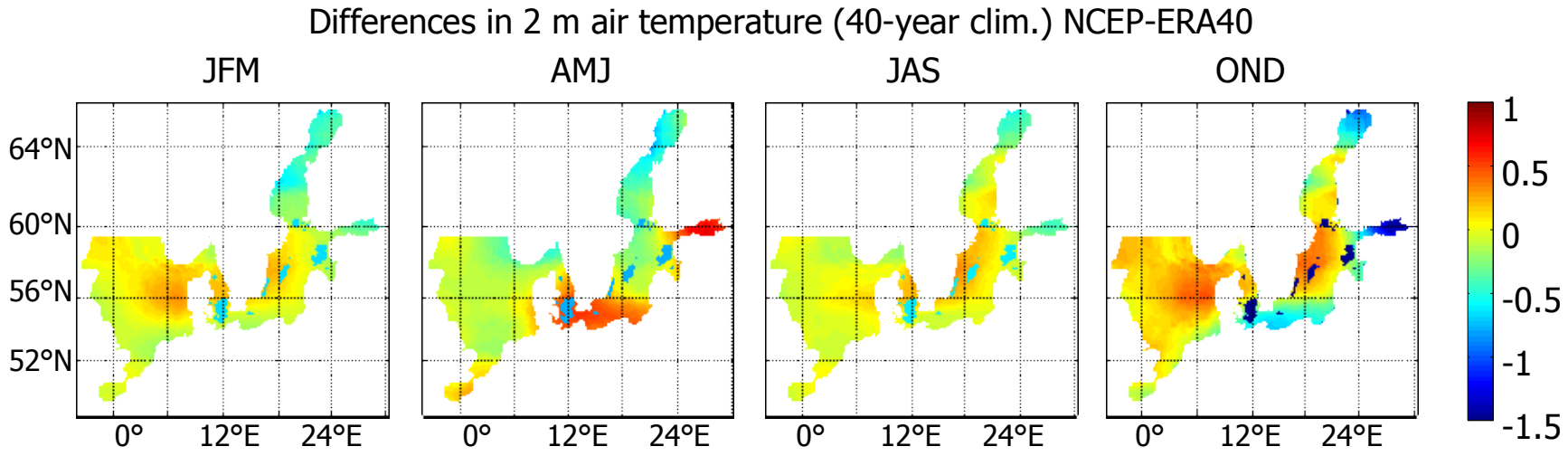
Atmospherical forcing-comparison: Short wave radiation





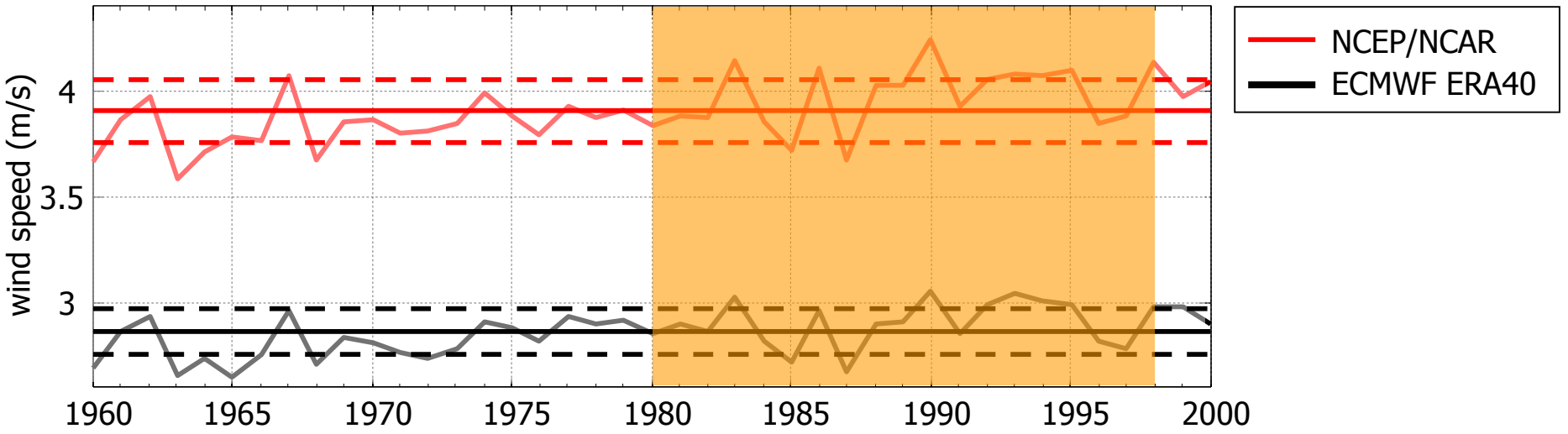
Atmospherical forcing-comparison: 2m air temperature



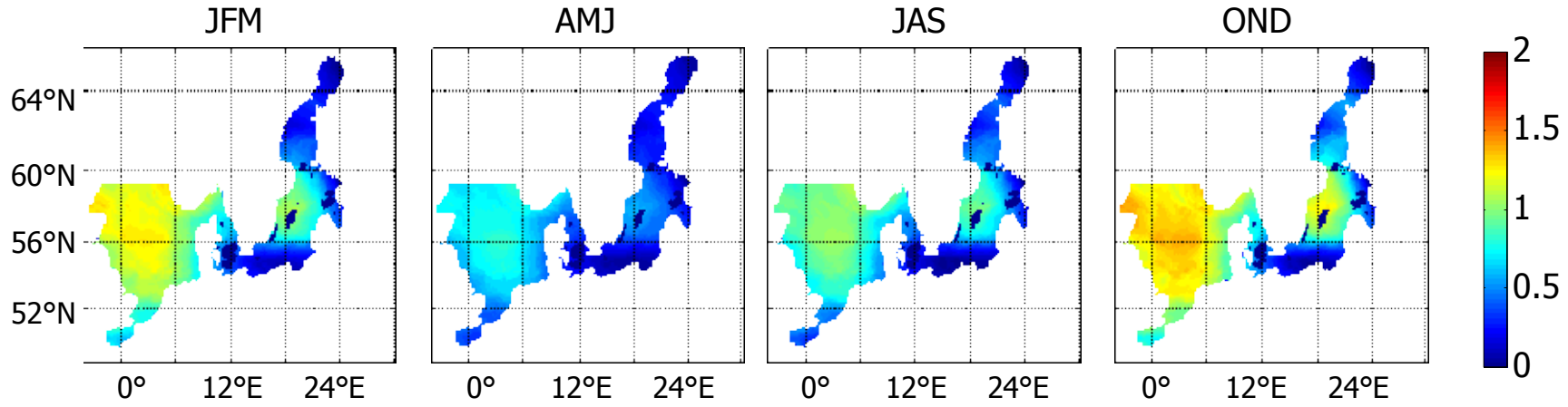


Atmospherical forcing-comparison: Wind speed

Wind speed – 40 year (1960-2000)

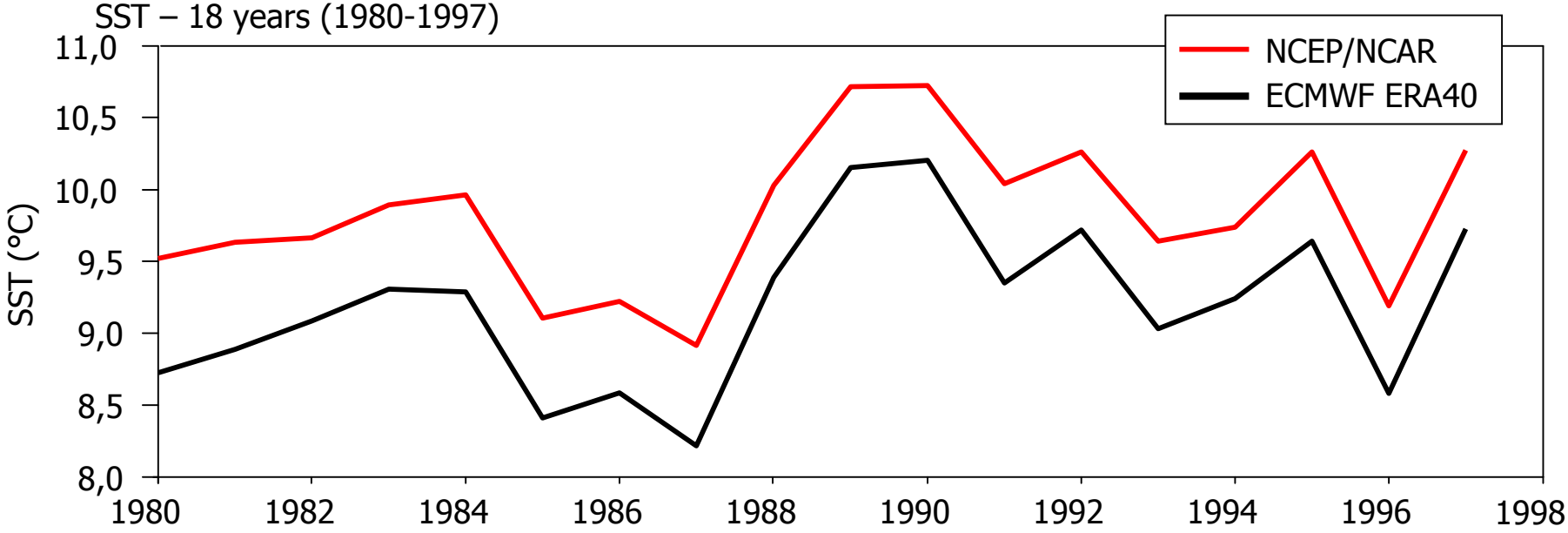


Differences in airtemperature (40-year aver.) NCEP-ERA40

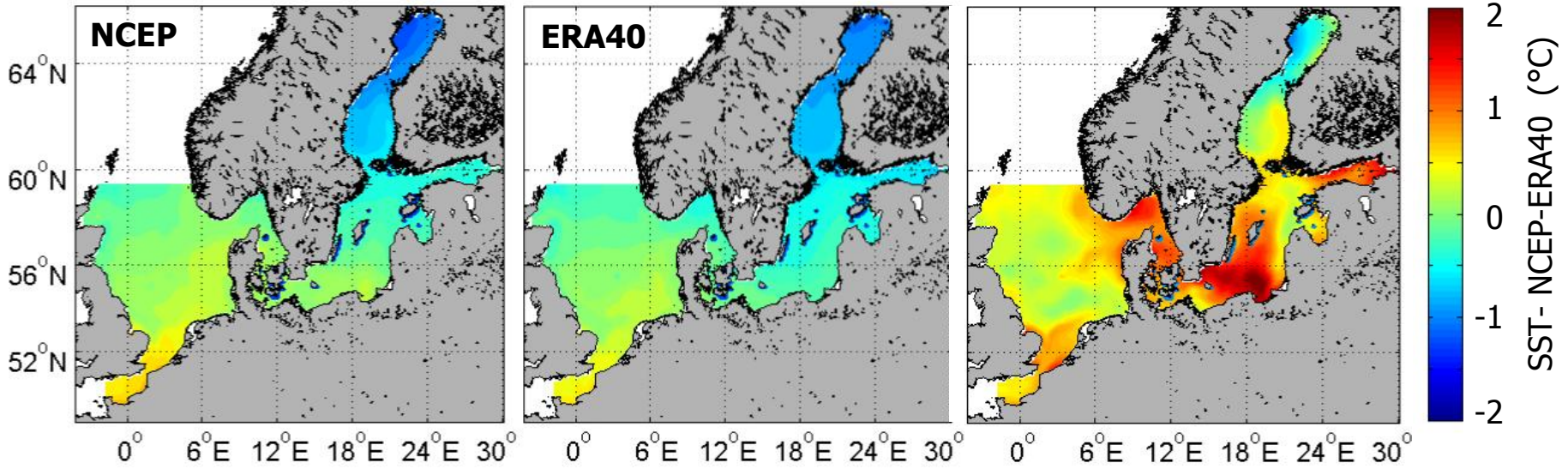


Results - physical parameter SST

SST – 18 years (1980-1997)

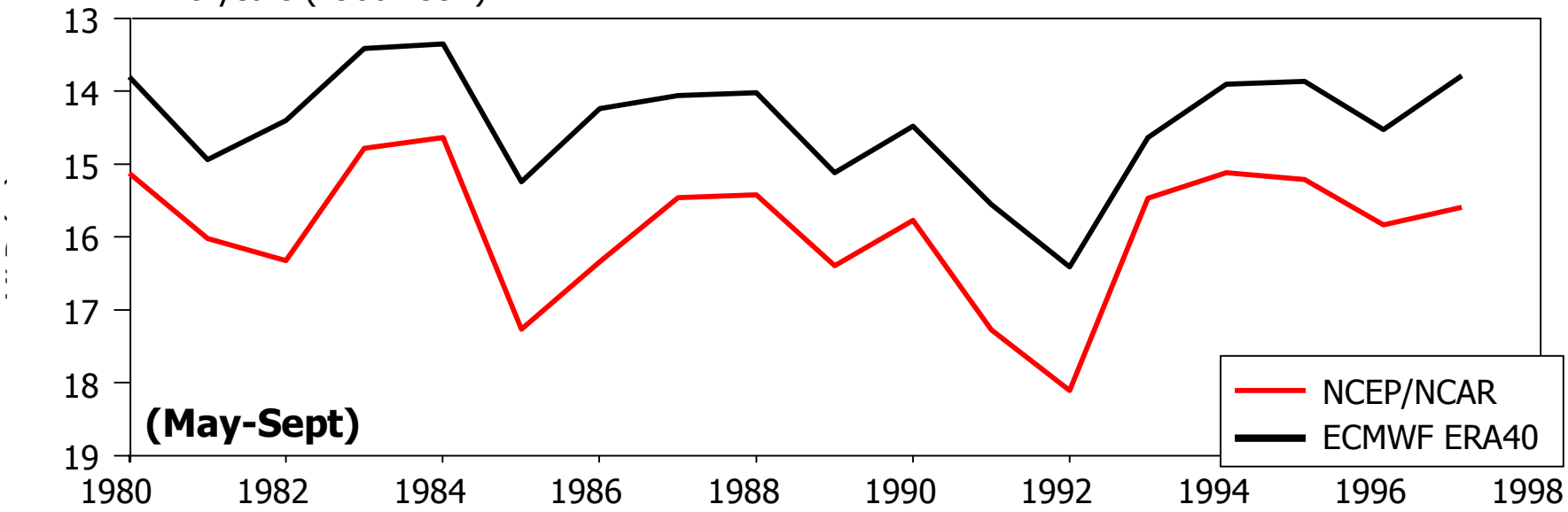


Average annual SST

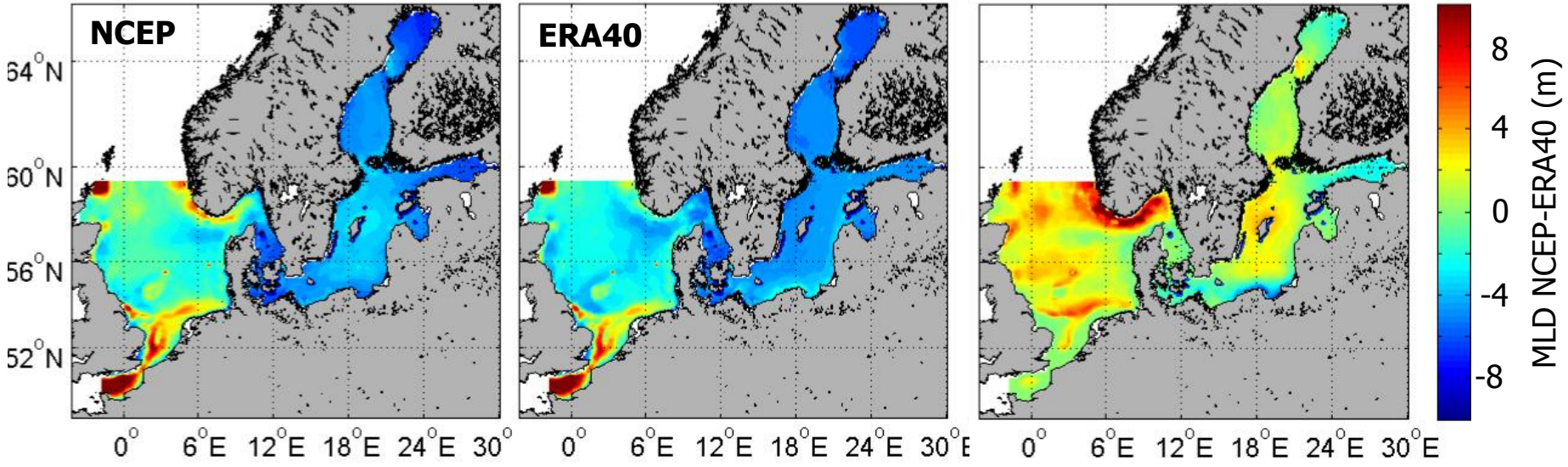


Results - physical parameter Mixed layer depth

MLD – 18 years (1980-1997)

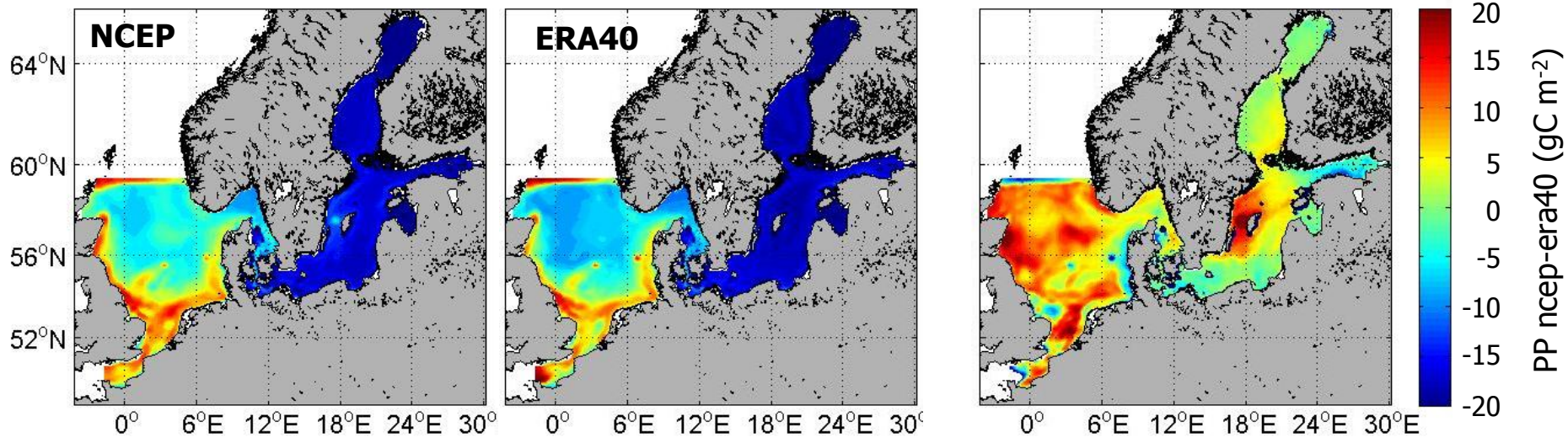


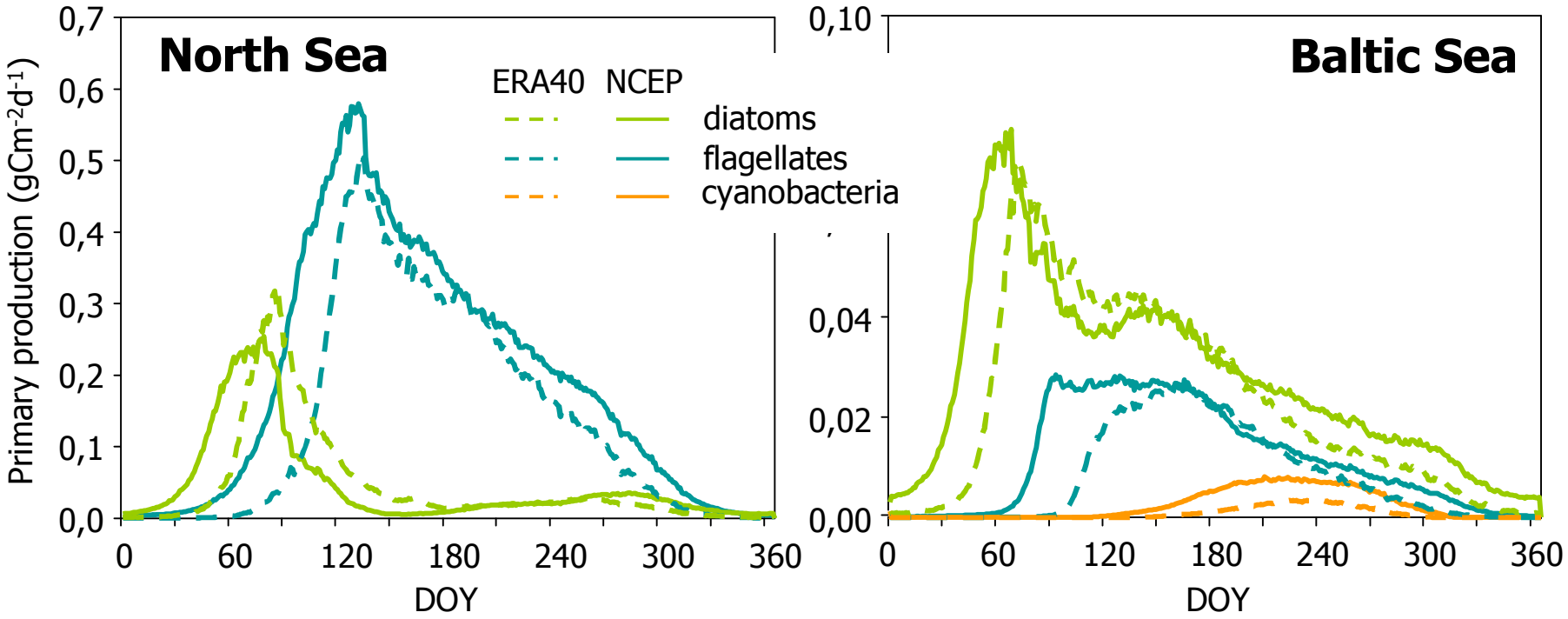
Seasonal average MLD (May-Sept)



ECOSMO results – biological parameter: Primary production

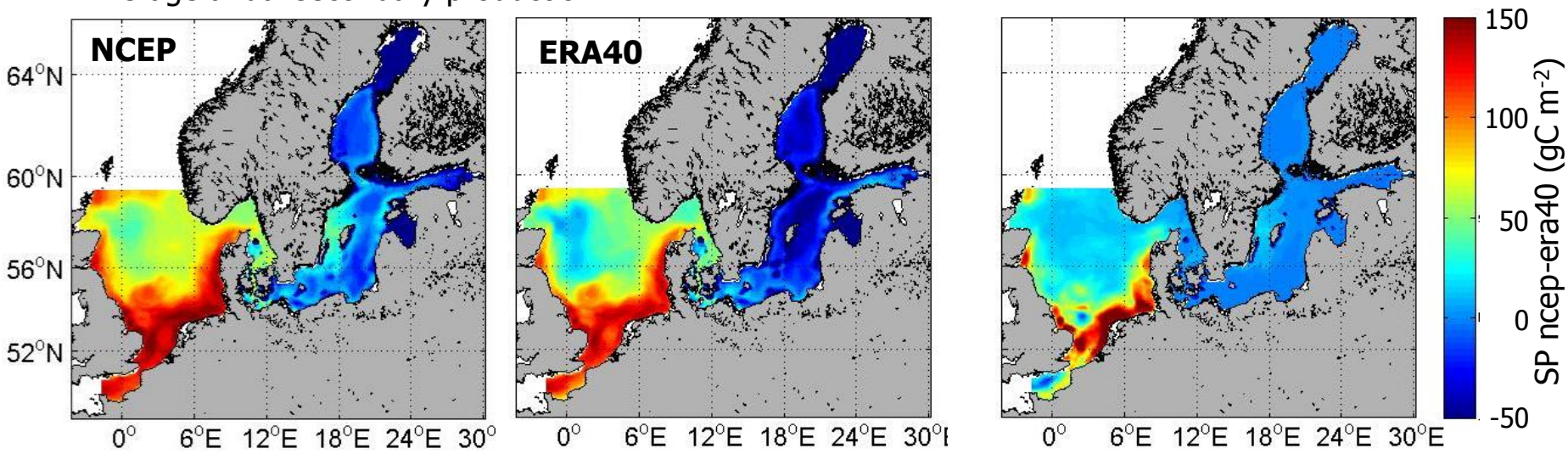
Average anual primary production

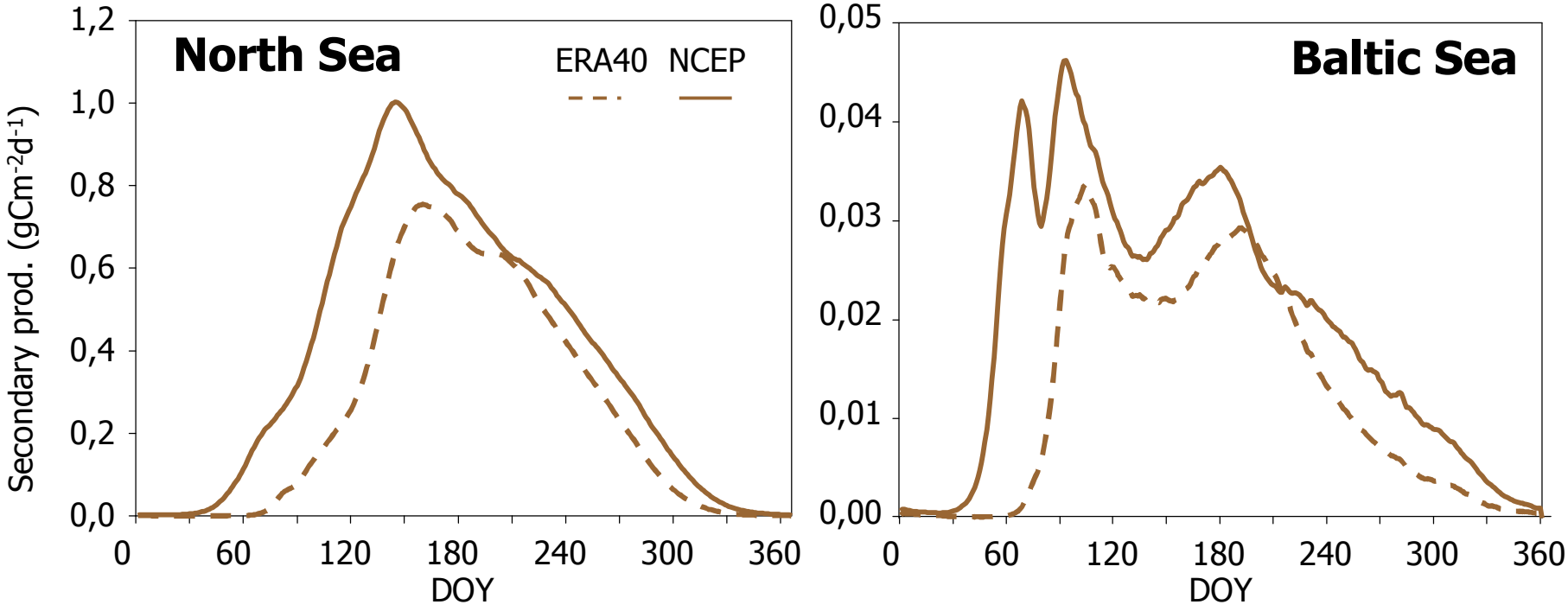




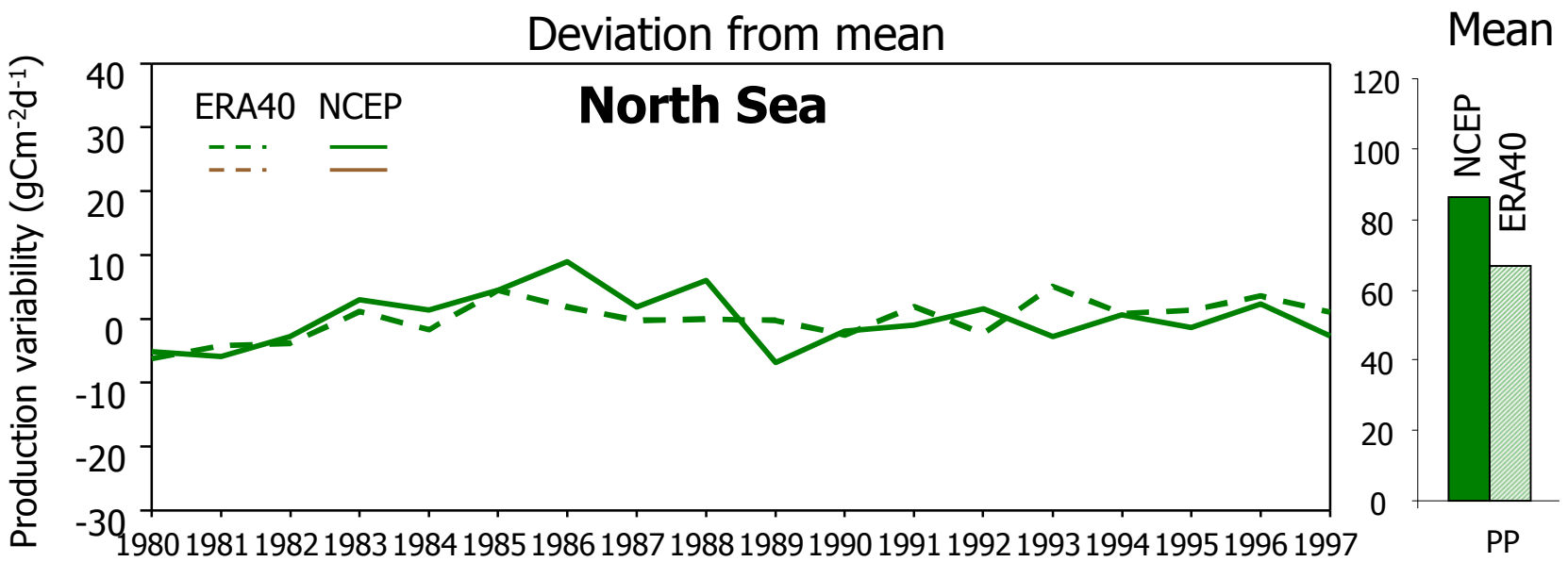
ECOSMO results – biological parameter: Secondary production

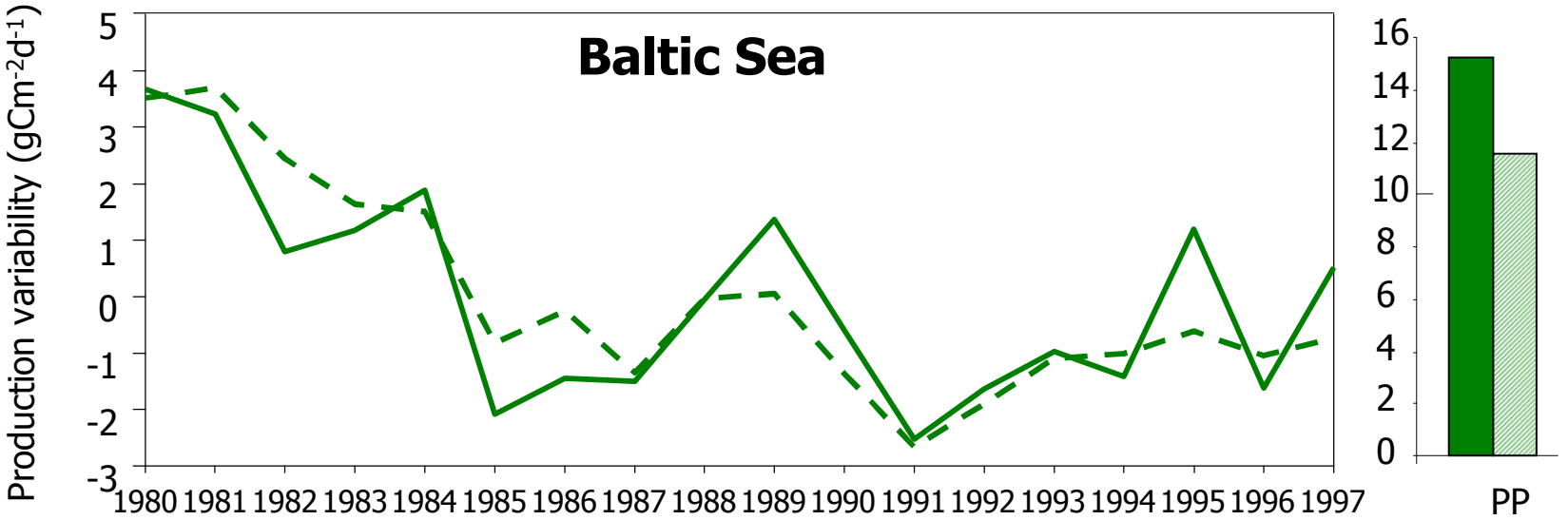
Average anual secondary production





ECOSMO results – biological parameter: Inter-annual variability





Correlation Coefficients

	NCEP		**ERA40**	
	wind	swr	wind	swr
sst	0,61410365	0,61797277	0,53421908	0,69191768
mld	-0,10042972	-0,03219039	0,03265488	0,00703145
PP-NS	0,05513614	-0,29493803	-0,01403342	0,07177984
SP-NS	-0,10165511	0,0487831	-0,14245552	0,09381019
PP-BS	-0,03242633	-0,08367241	-0,04451229	-0,30778371
SP-BS	0,0113906	0,12776716	-0,05423885	-0,21720974

Summery and Conclusion

→ Important differences in the atmospheric reanalysis products

-NCEP offsets in SWR and wind speed

-NCEP & ERA40 have the same interannual variability

→ Physical parameters:

- NCEP → higher SST, deeper MLD
- SST is correlated to SWR & Wind speed
- same inter-annual variability

→ Biological parameters:

-NCEP: earlier onset of primary and secondary production

-higher productions in NCEP → due to higher swr, wind

-different inter-annual variability in NS production

-comparable inter-annual variability in BS production

-no direct correllation to atmospherical forcing

Summery and Conclusion

→The choise of the atmospherical forcing is crucial in simulating PP and SP.

→ Seasonal, spatial and inte-rannual variability is effected.

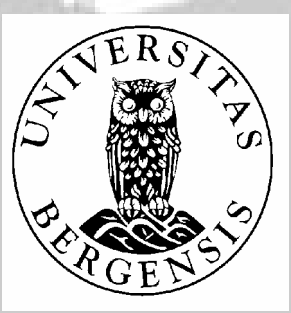
→ the ecosystem response non-linear to changes in the atmmospherical forcing.

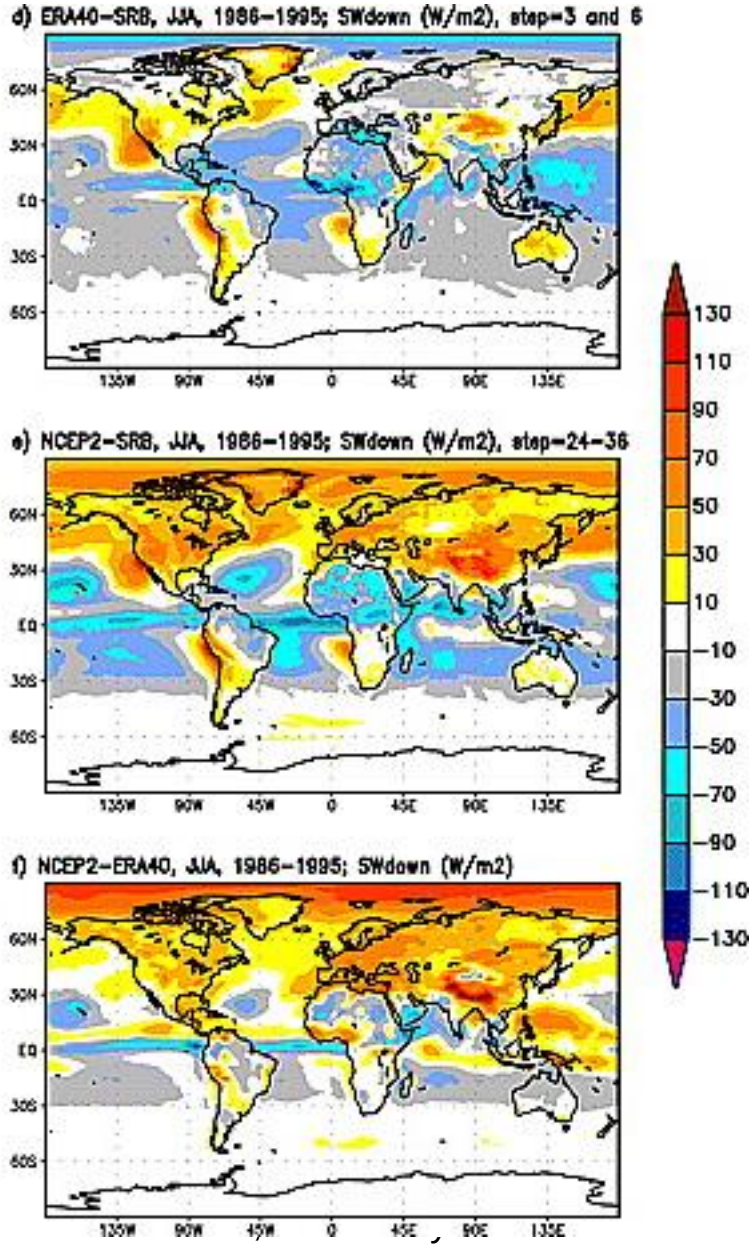
→ Compare to observations.

→ Define a reasonable atmospheric forcing.

→ Identify underlying processes linking atmospheric forcing to changes in production.

Thank you for your attention!




d) ERA40-SRB, JJA, 1986-1995; SWdown (W/m2), step=3 and 6
e) NCEP2-SRB, JJA, 1986-1995; SWdown (W/m2), step=24-36
f) NCEP2-ERA40, JJA, 1986-1995; SWdown (W/m2)
60N
30N
EQ
30S
60S
135W
90W
45W
0
45E
90E
135E
130
110
90
70
50
30
10
-10
-30
-50
-70
-90
-110
-130