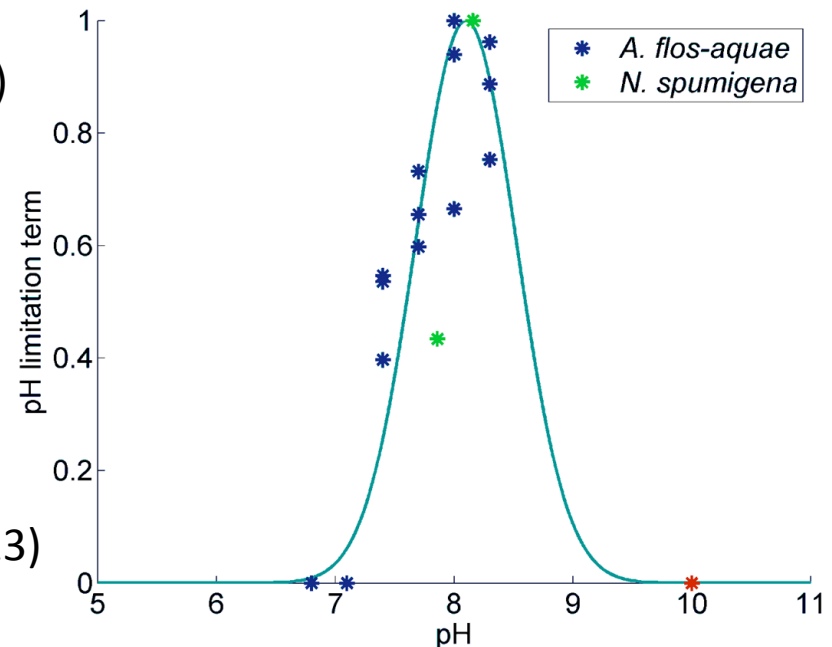


Modelling the response of cyanobacteria to pH-variability on seasonal to decadal time scales

Richard Hofmeister, Jana Hinnens & Inga Hense

Feedbacks in coupled system

- Increase of atmospheric CO₂ concentrations
-> decreasing pH in water
- Eutrophication in late 20th century
increases cyanobacteria growth (P supply)
- growth of cyanobacteria depending
on pH
- Increasing temperatures support
growth of cyanobacteria (Hense et al. 2013)



Implementation in modular, coupled framework

BGC environment

PND
 Hense & Beckmann 2006,2010
 Warns et al. 2013 a,b

ERGOM-Base
 Neumann et al. 2002
 Hense & Burchard 2010

PML carbonate
 Blackford & Gilbert 2007

Halocarbons
 Hense & Quack 2009
 Stemmler et al. 2013

Cyanos

CLC
 Hense & Beckmann 2006,2010
 Hense & Burchard 2010

CLC v2
 Hense & Beckmann 2010

ERGOM-Cyanos
 Neumann et al. 2002

Diatoms

ERGOM-Diatoms
 Neumann et al. 2002

Diatoms
 Warns (thesis, Uni HH)

Flagellates

ERGOM-Flagellates
 Neumann et al. 2002

Dinoflag
 Warns et al. 2013 a,b

Zooplankton

ERGOM-Zoo
 Neumann et al. 2002

Miscellaneous

UV-light
 Hense & Quack 2009
 Stemmler et al. 2013

Implemented in
FABM, usable in

1d: GOTM, GLM

3d: NEMO, GETM
FVCOM, MOM,

ESMF: MOSSCO

Resolving the life cycle of cyanobacteria

ERGOM-Base

Neumann et al. 2002
Hense & Burchard 2010

PML carbonate

Blackford & Gilbert 2007

ERGOM-Diatoms

Neumann et al. 2002

ERGOM-Flagellates

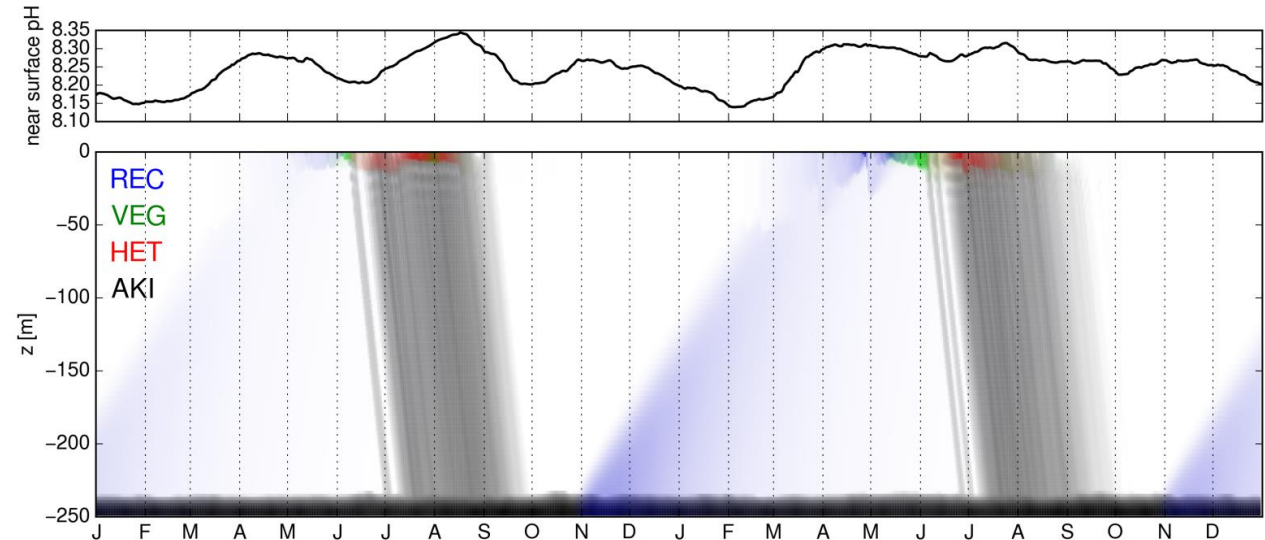
Neumann et al. 2002

CLC

Hense & Beckmann 2006,2010
Hense & Burchard 2010

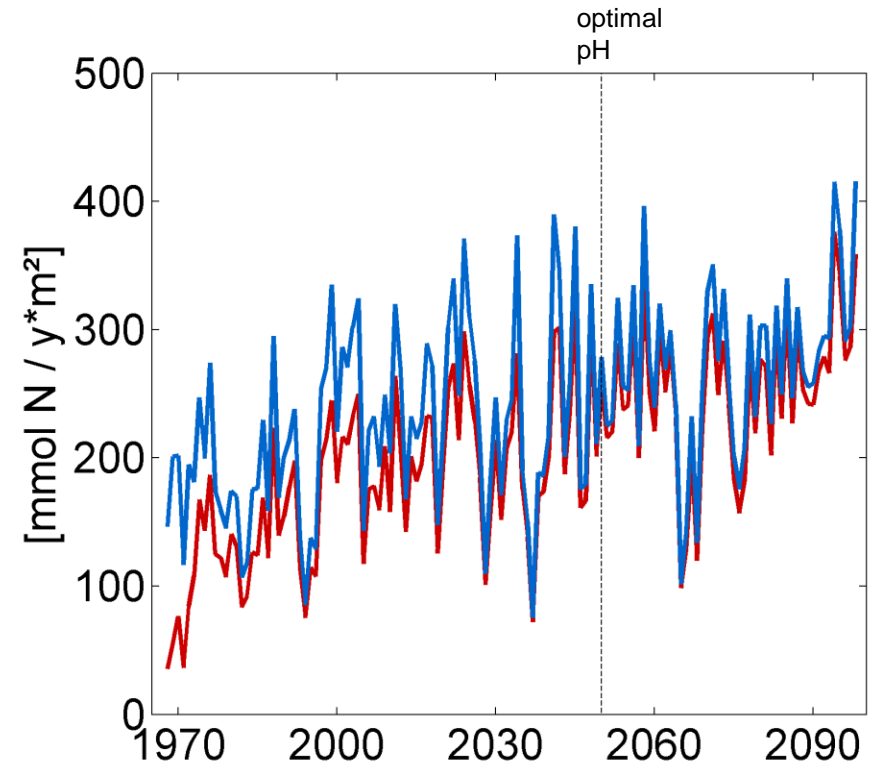
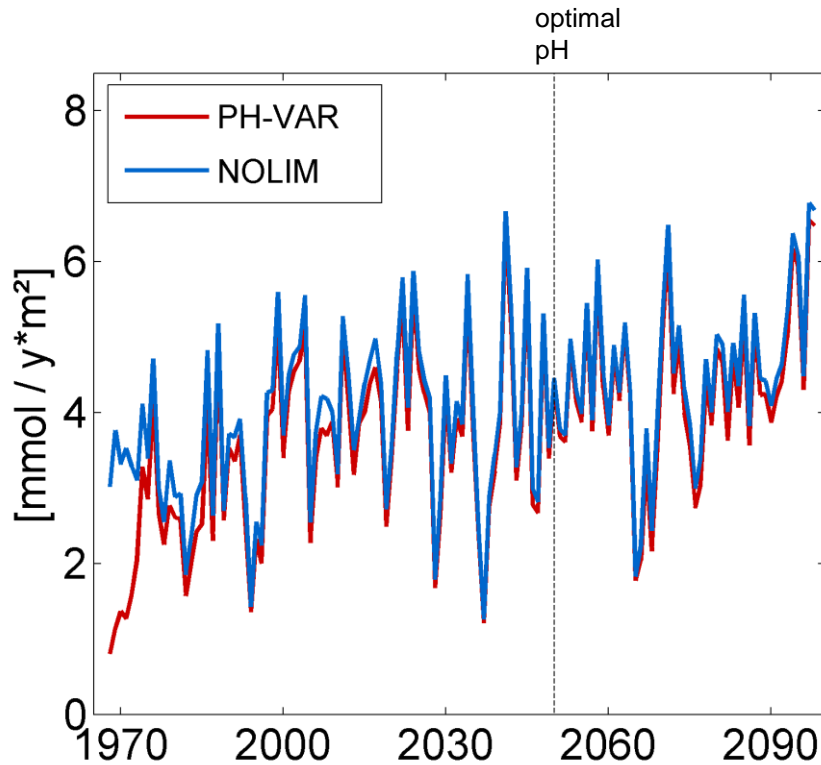
ERGOM-Zoo

Neumann et al. 2002

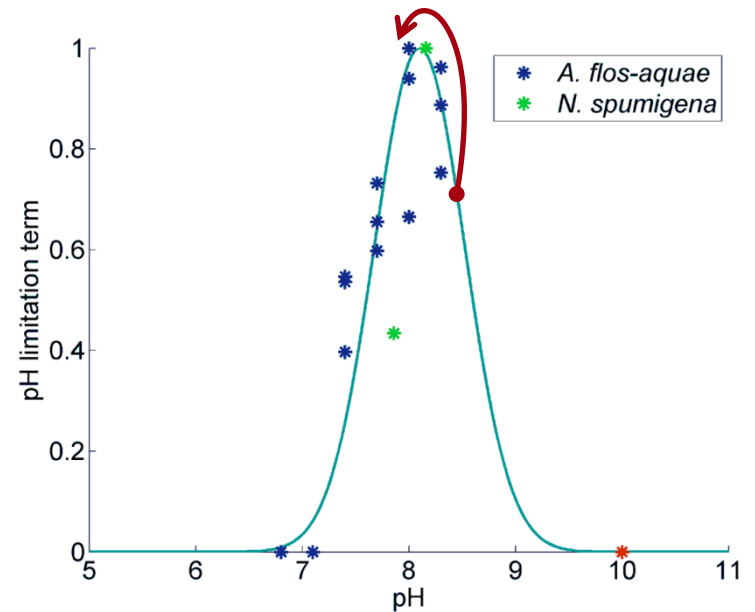
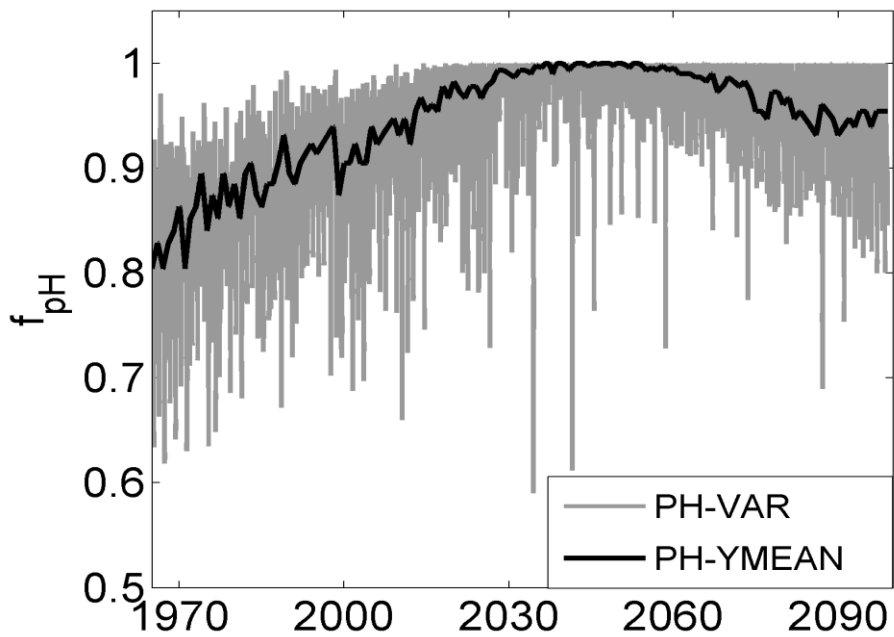
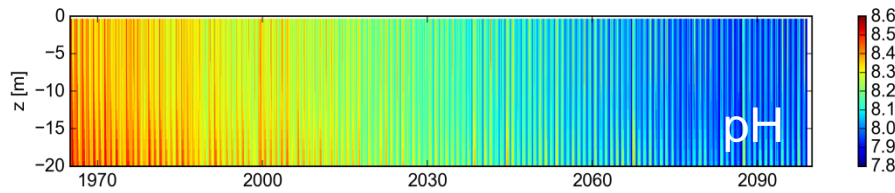


- 1960-2100 simulation of Baltic Sea cyanobacteria
- coupled CLC & carbonate system (pH, DIC)
- forced by A1B HadCM regional downscaling

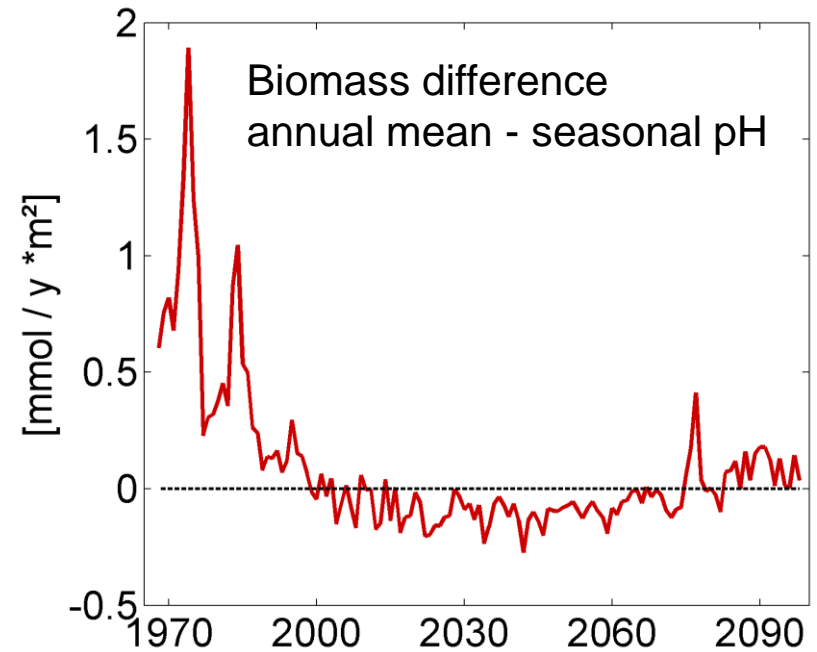
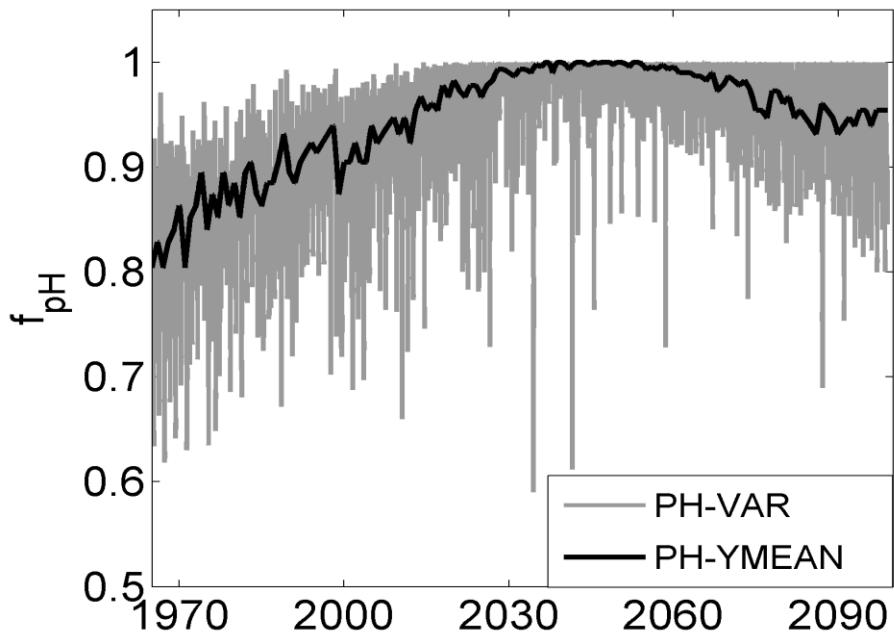
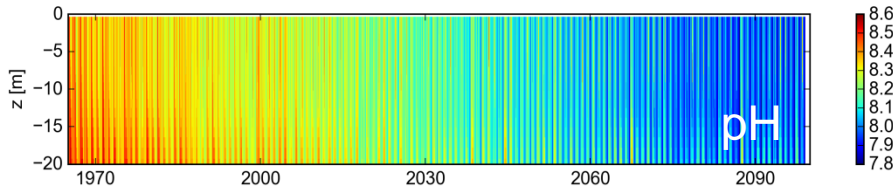
Ocean acidification supports cyanobacteria growth



Effect of seasonal pH variability



Effect of seasonal pH variability



- Coupled carbonate system with cyanobacteria life cycle
- Nitrogen fixation in 20th century determined by decadal change of pH
- Seasonal pH variability has minor impact on cyanobacteria growth
- We make use of a modular model system (to be extended to 3d studies)

