First results from coupled physical-biogeochemical modelling within the BONUS+ project ECOSUPPORT

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ECO SUPPORT

SMHI

Leibniz Institute for Baltic Sea Research Warnemünde IOW

Baltic Nest Institute

Outline

- Recap of modeling strategy
- Overview of the modeling tools
- Key processes
- First results

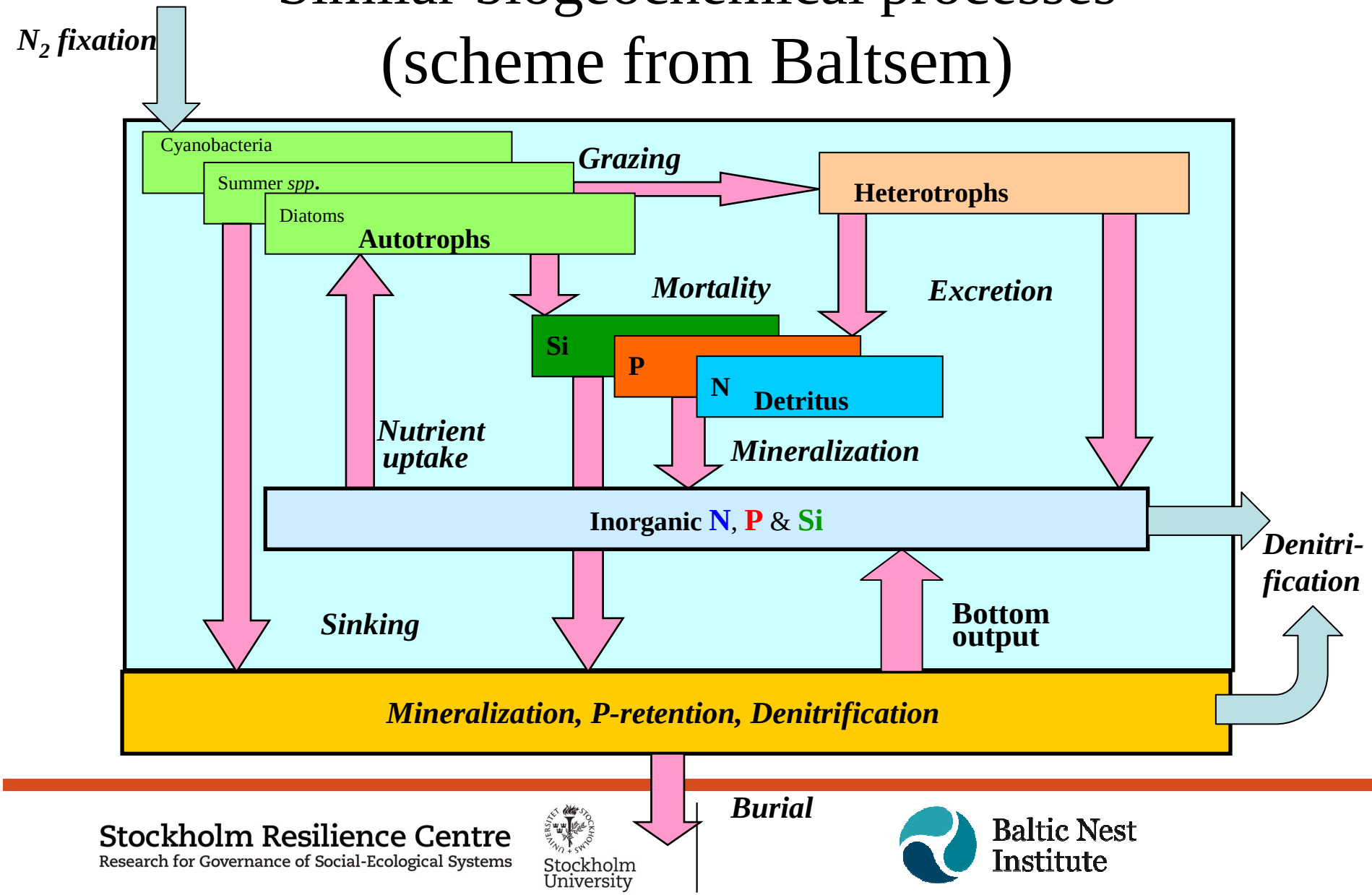
Three time periods

- 1961-2006: Hindcast/validation/control period
- 1850-2006: Hindcast from “pristine” – present
- 1960-2100: Scenarios forced by climate GCM’s

Three models

- BALTSEM
  - 1-D coupled basin model (13 basins)
  - Developed jointly at Stockholm and Gothenburg Universities, now all development at the Baltic Nest Institute, Stockholm University
- ERGOM
  - 3-D high resolution (3nm)
  - Developed at Institute for Baltic Sea research in Warnemuende
- RCO-SCOBI
  - 3-D high resolution (2nm)
  - Developed at SMHI

Similar biogeochemical processes (scheme from Baltsem)



But key differences

- Differences in treatment of dead organic matter: one state-variable for each nutrient vs. a single variable with constant N/P ratio
- Differences in parameterizations of P sediment dynamics, e.g. P bound to FeOOH
- Resuspension/sediment transport: mechanistic description (from waves and currents) vs. simple parameterization
- Resolving coastal boundary and deep pits vs. large-scale integrated basins
- Different vertical resolution

Model validation/intercomparison study

- Same physical forcing 1961-2006
- Somewhat different nutrient loads
- Different initial conditions

-> state-of-the-art models at the beginning of the project

Data from Baltic Environmental Database (BED)

NB: Work is in progress

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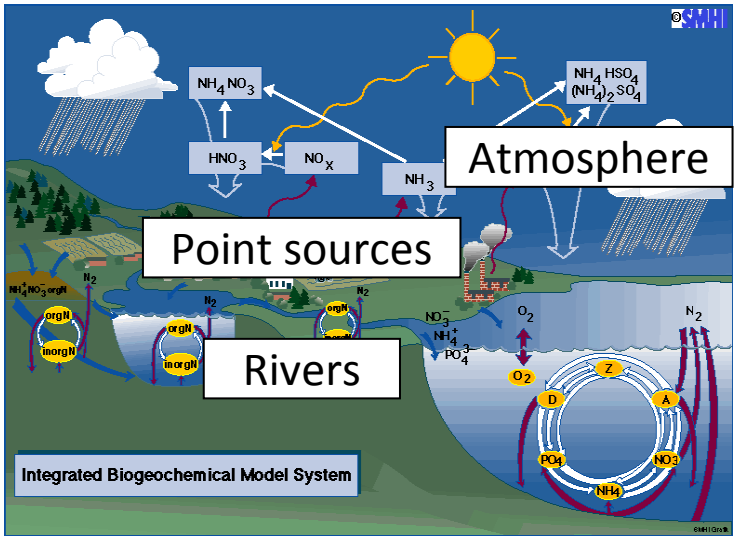
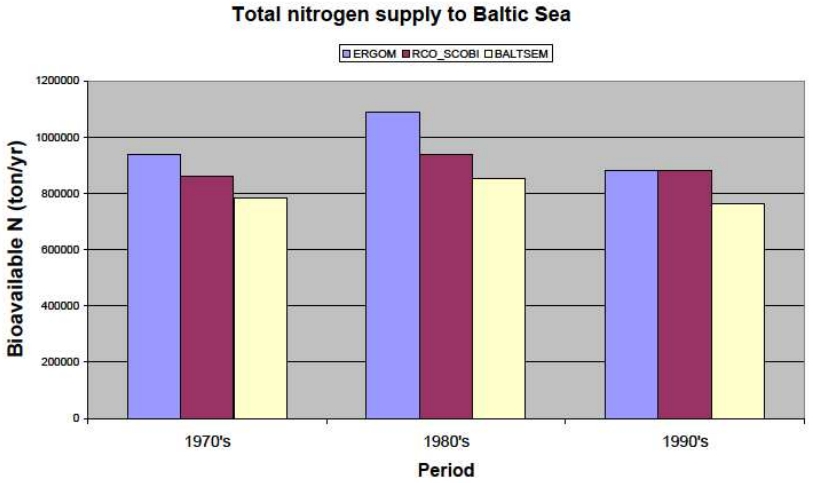
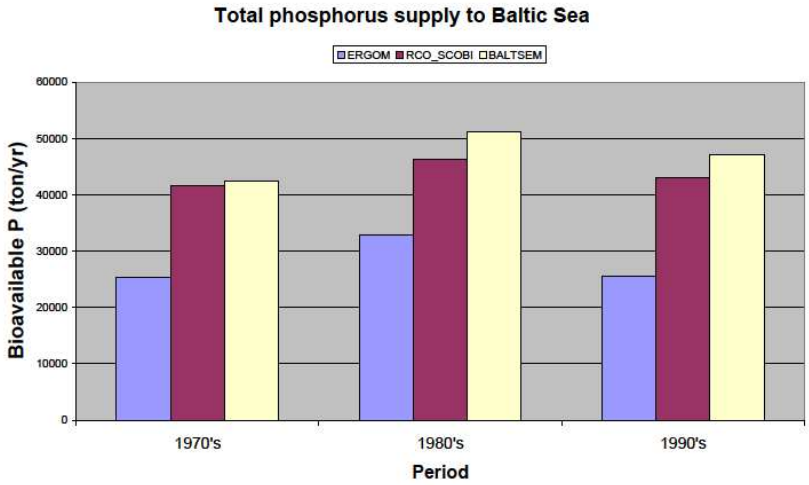
Bioavailable nutrient loads in models



A common nutrient loading to the models is not ready yet!





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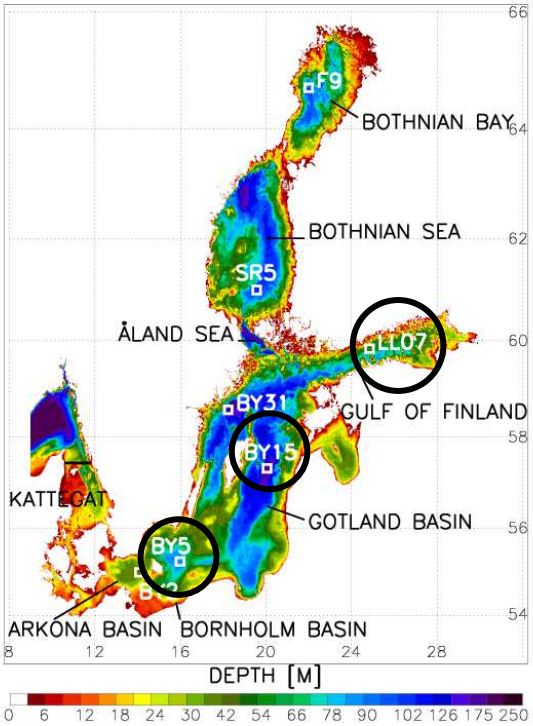
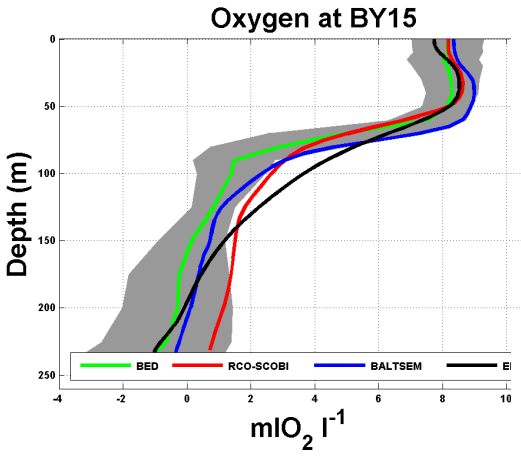
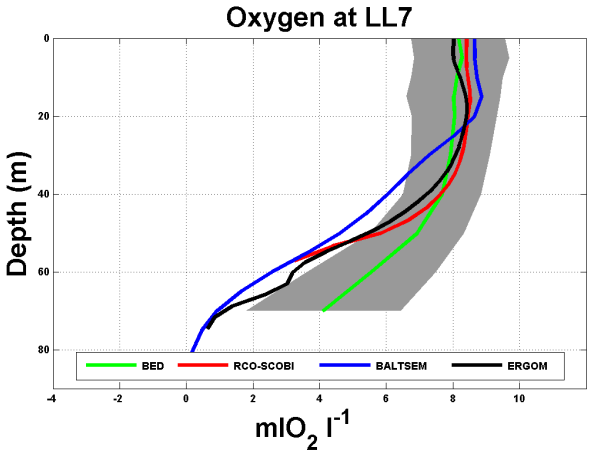
Annual average 1970-2005

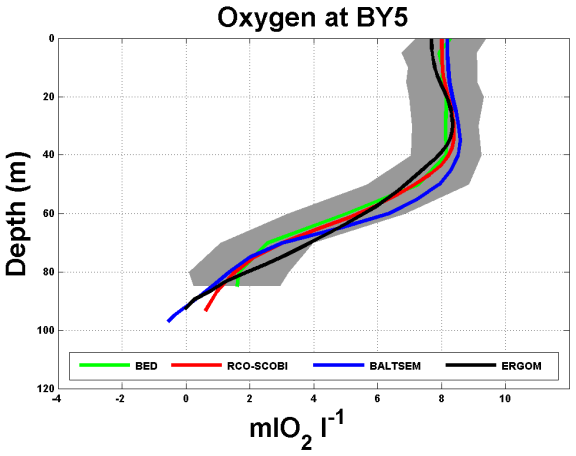


Station list

Oxygen







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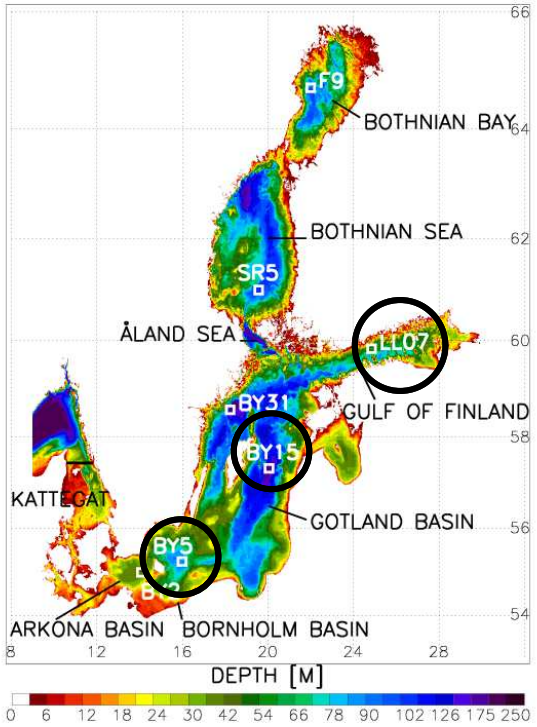
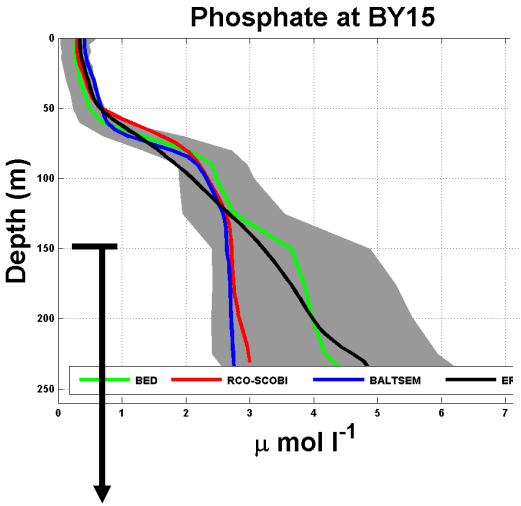
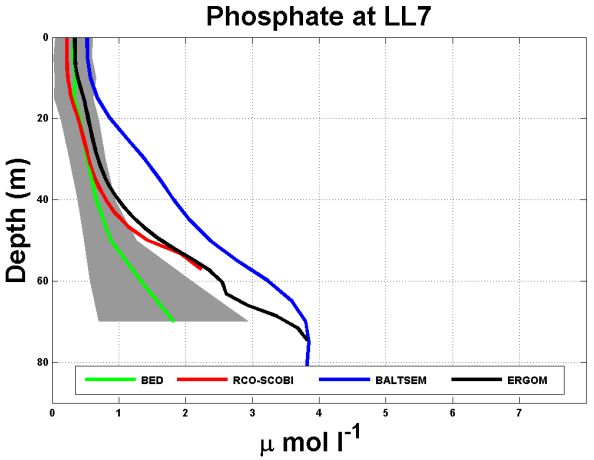
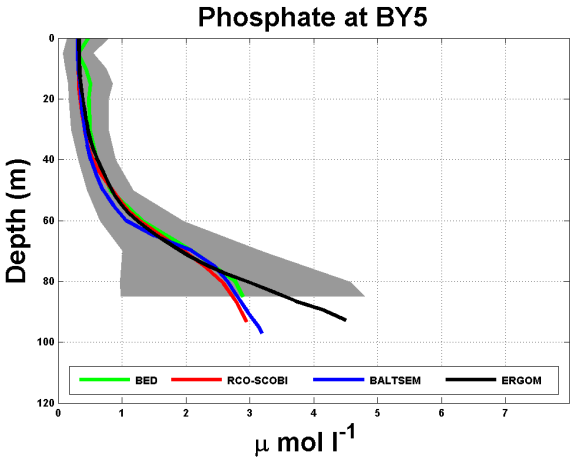


Station list

Phosphate







Note:

Volume below 150m is only about 2-3% of total Baltic proper volume

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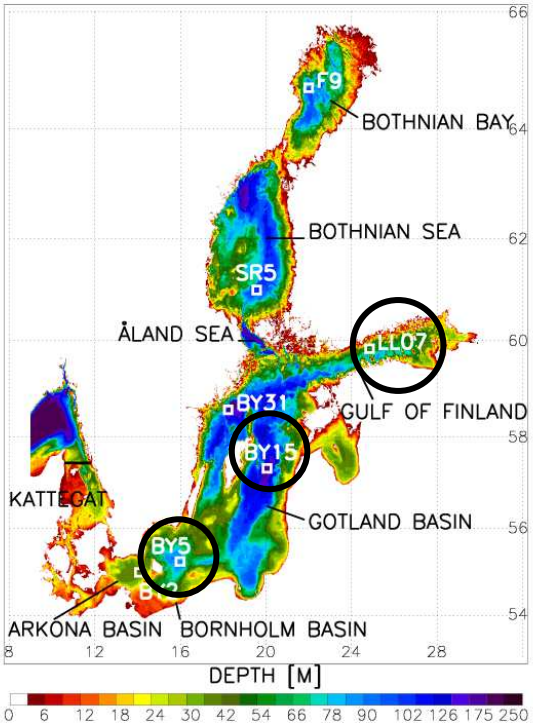
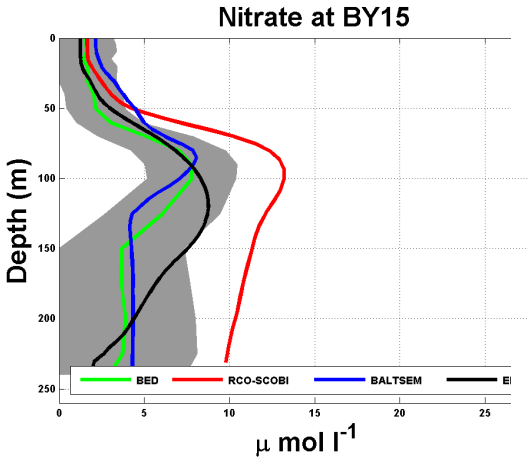
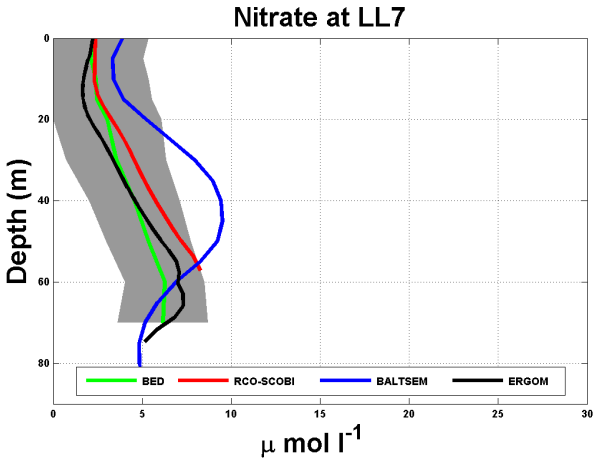
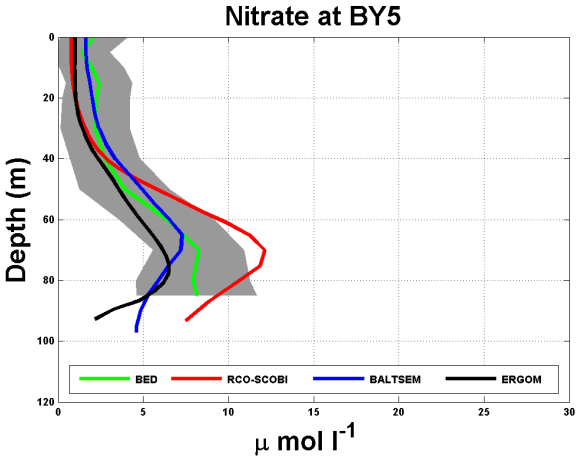


Station list

Nitrate







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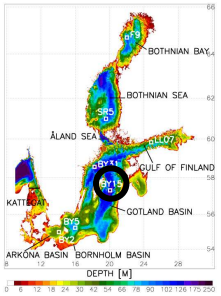
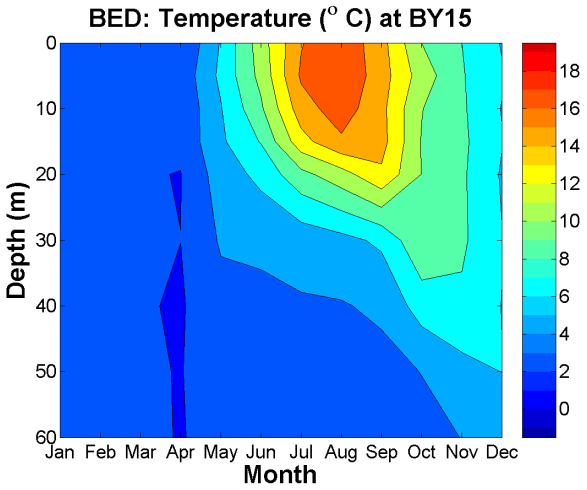
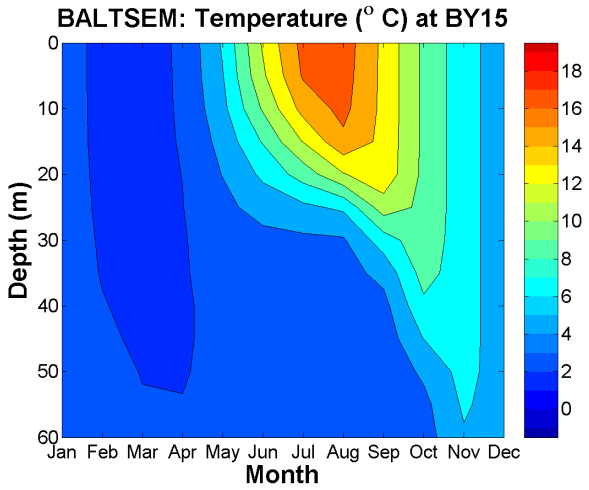
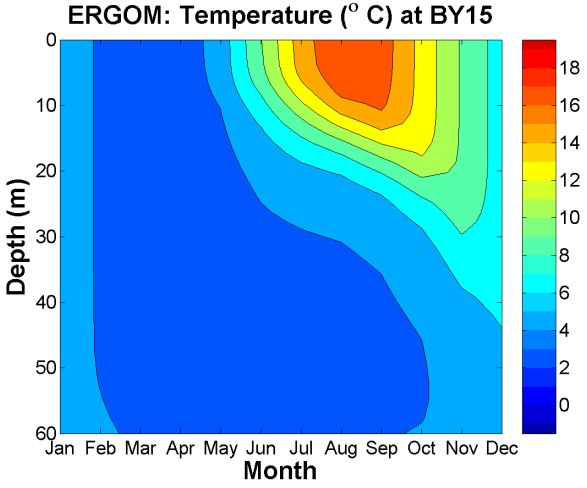
Monthly mean 1970-2005

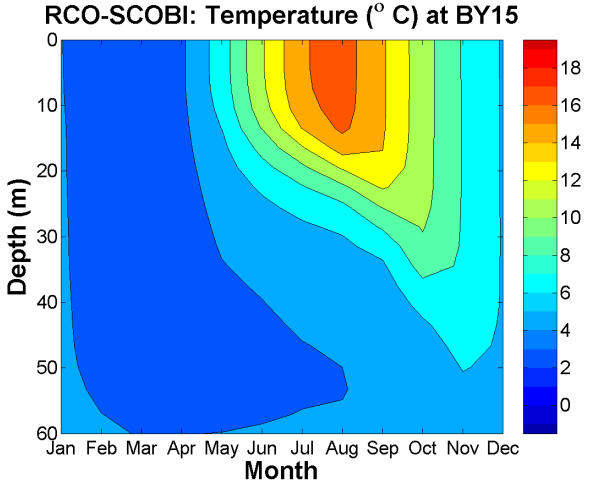
Temperature











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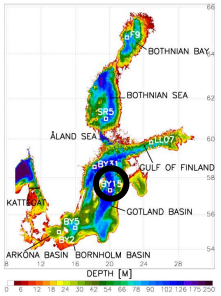
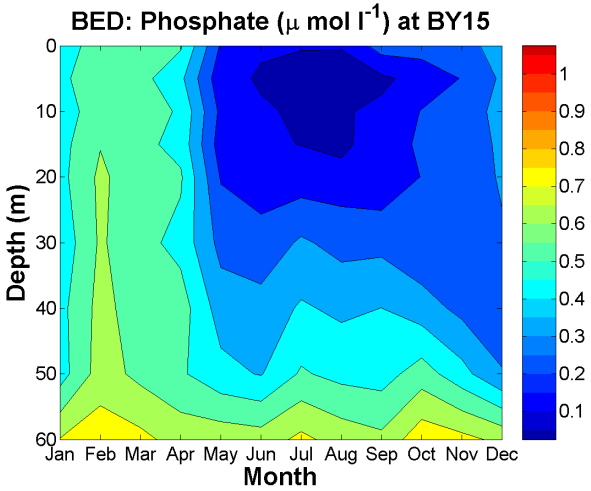
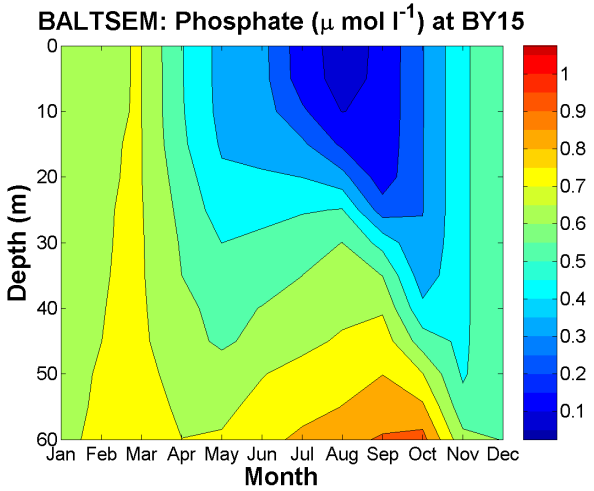
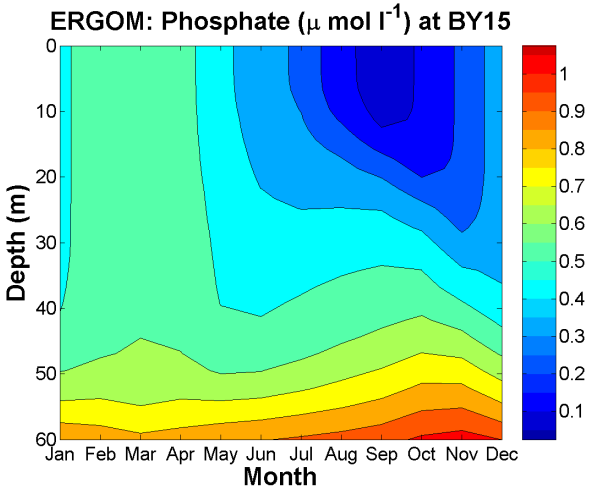
Monthly mean 1970-2005

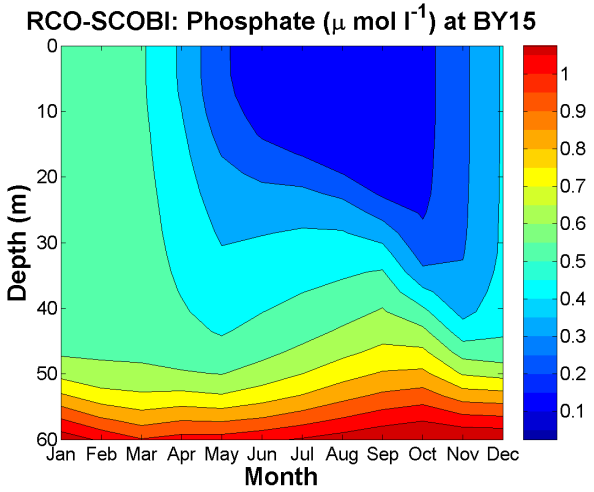
Phosphate











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Monthly mean 1970-2005

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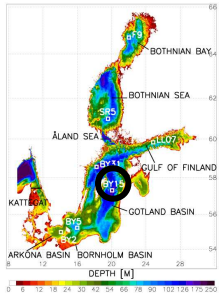
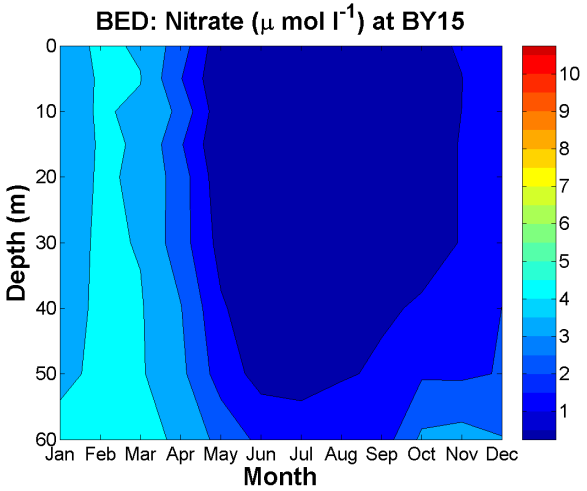
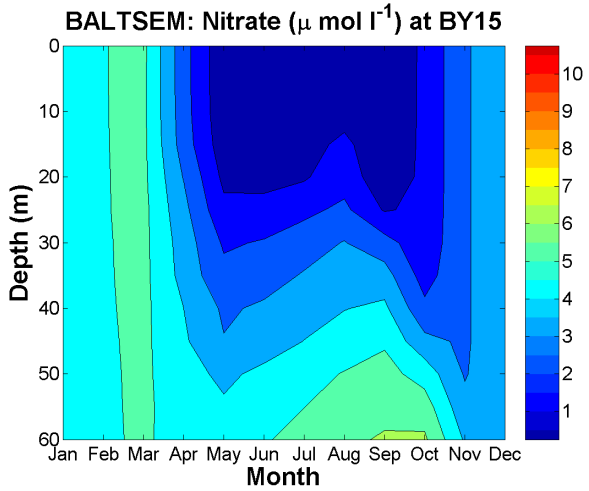
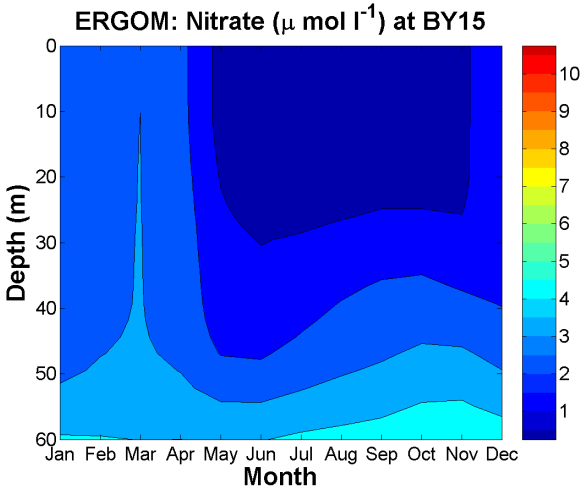
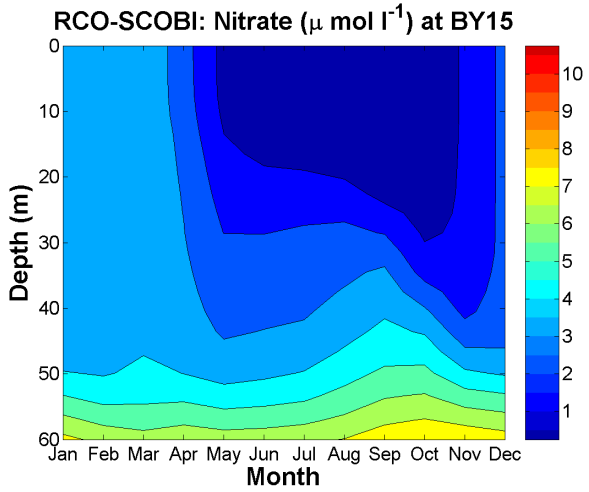










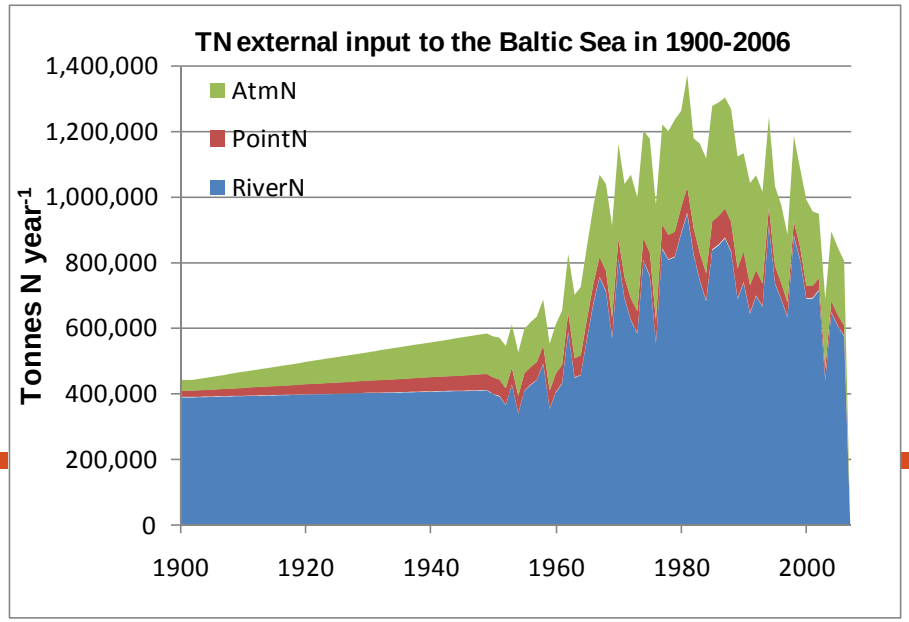
Reconstruction of loads for 1900-2006

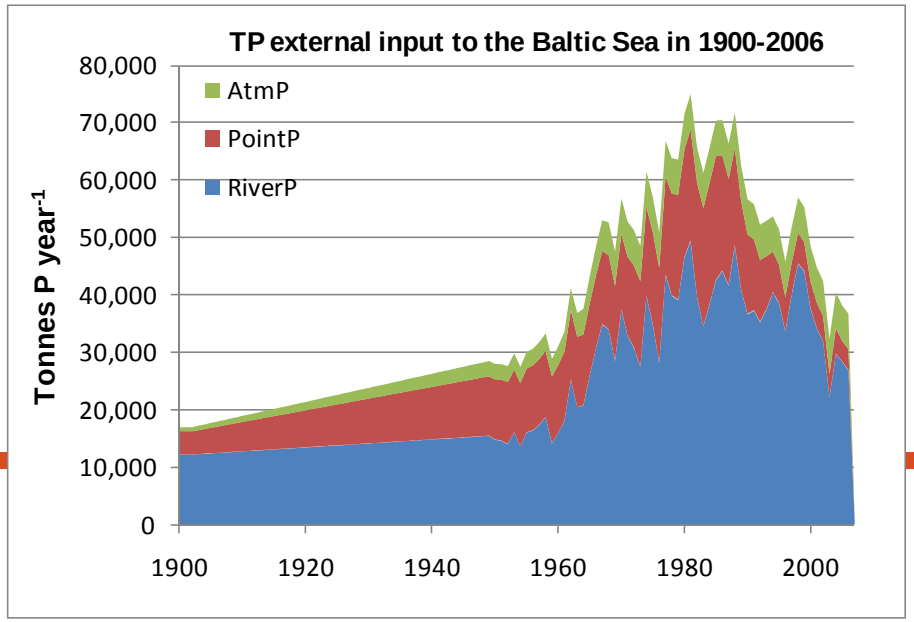
Sources:

- Paper by Schernewski and Neumann, 2005
- Paper by Savchuk et al., 2008

Reconstructed for a century ago:

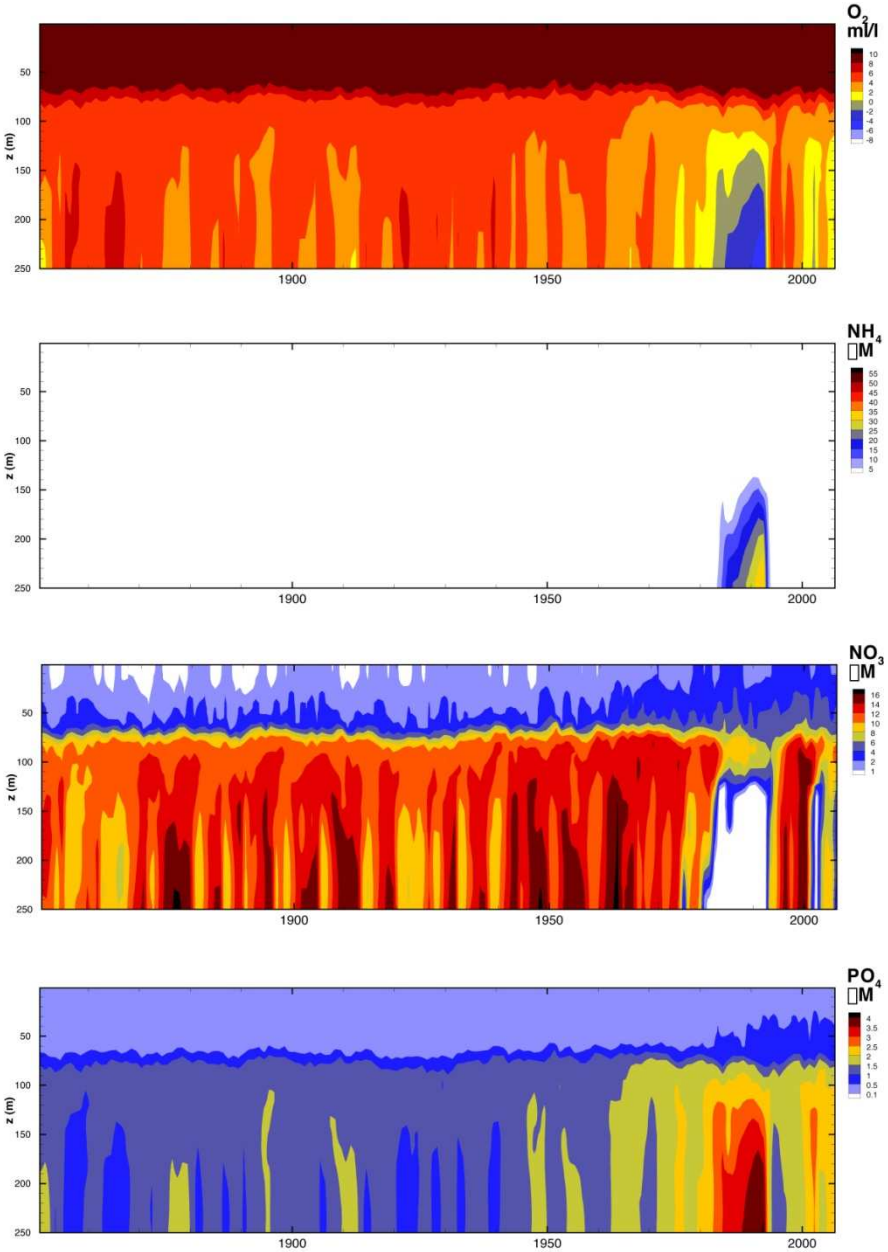
- TN 391 Kt N a century ago vs. 1015 Kt N in 1997-2003, i.e. **2.5** times less
- TP 11.4 Kt P a century ago vs. 42.3 Kt P in 1997 – 2003, i.e. **4** times less

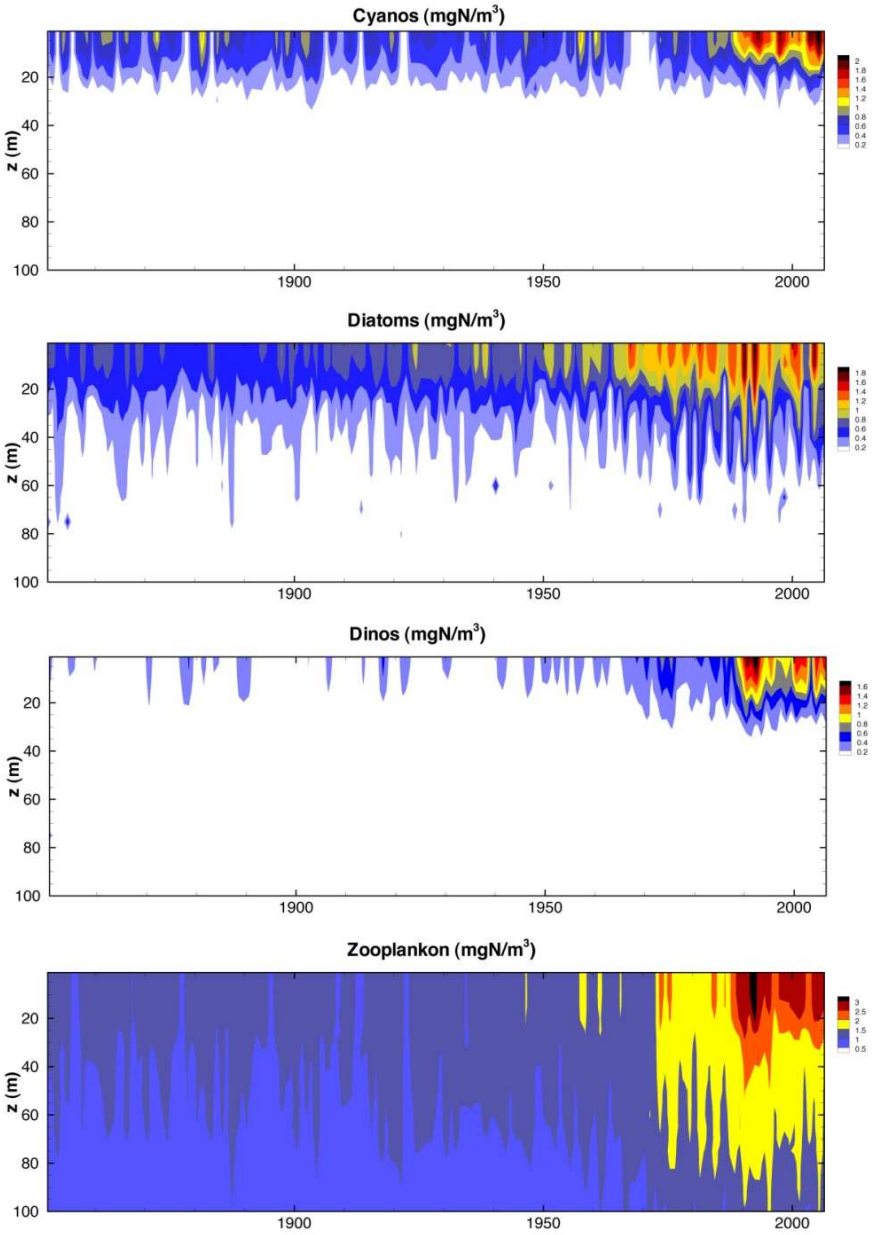




To do in 2010-2011:

What about the past?

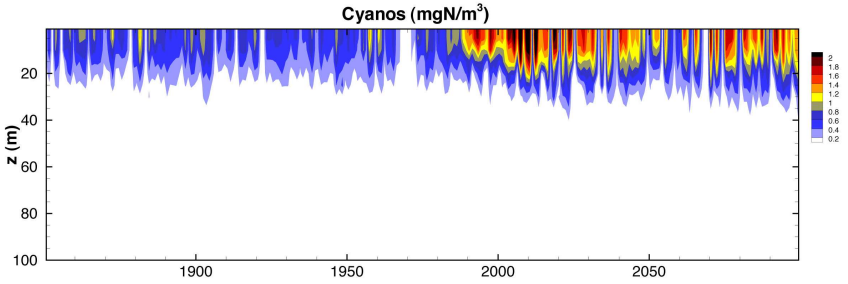


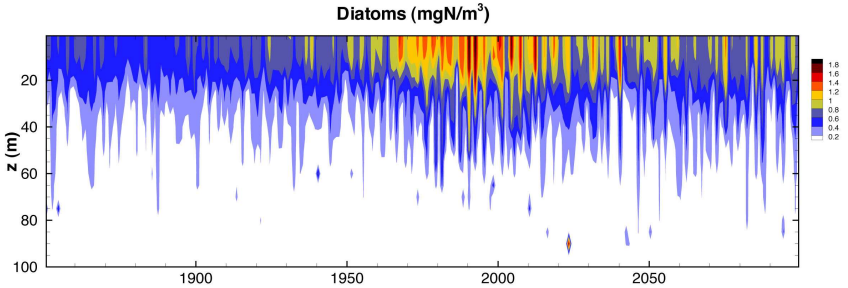


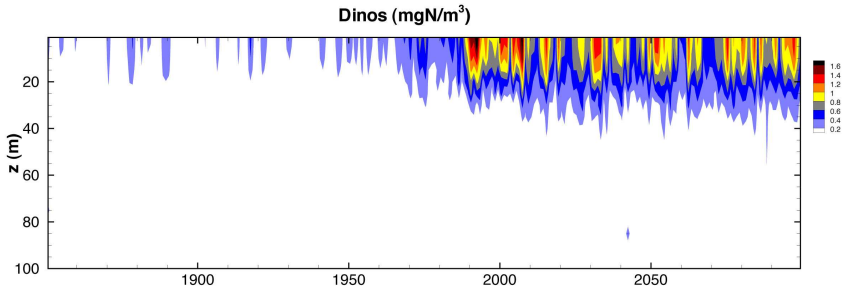
To do in 2010-2011:

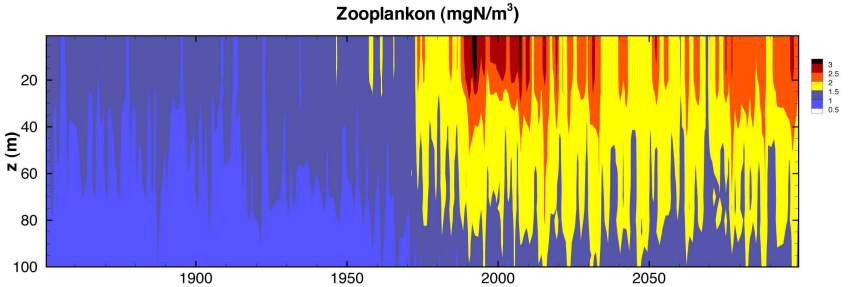
and the future?

better?

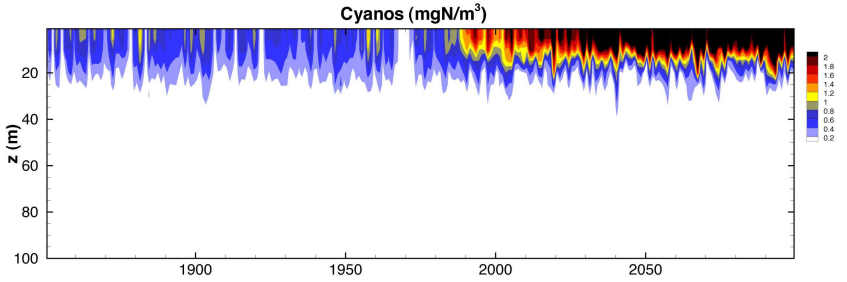


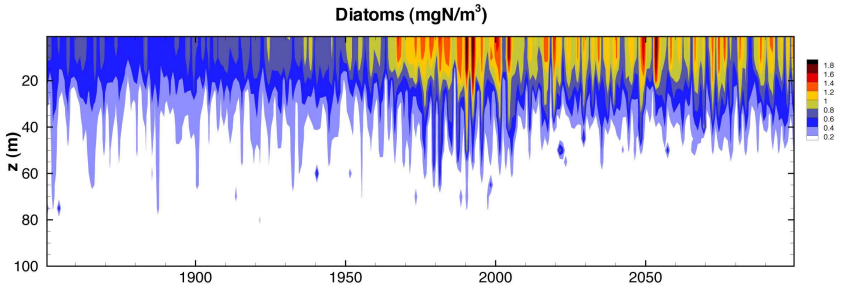


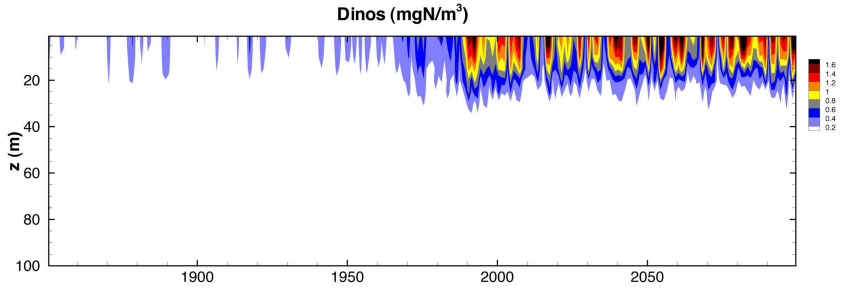


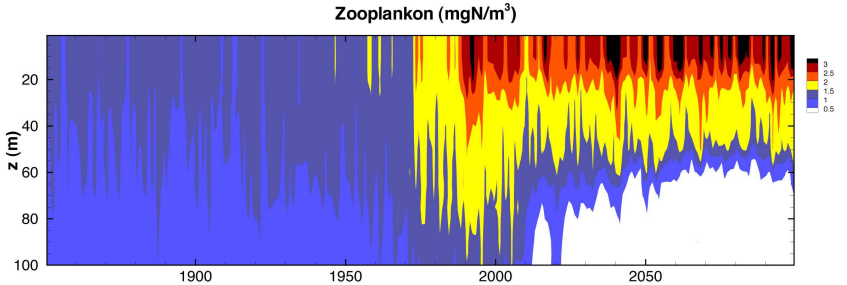


worse?









Conclusions

- Models are generally describing large scale features within natural variability
- Validation will be repeated with updated forcing and final improvements of models