UNIVERSITY OF GOTHENBURG

The Baltic Sea marine system – human impact and natural variations

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Papers

I. Gustafsson, E. and Omstedt, A., 2009. Sensitivity of Baltic Sea deep water salinity and oxygen concentration to variations in physical forcing. *Boreal Environment Research, 14, 18–30.*

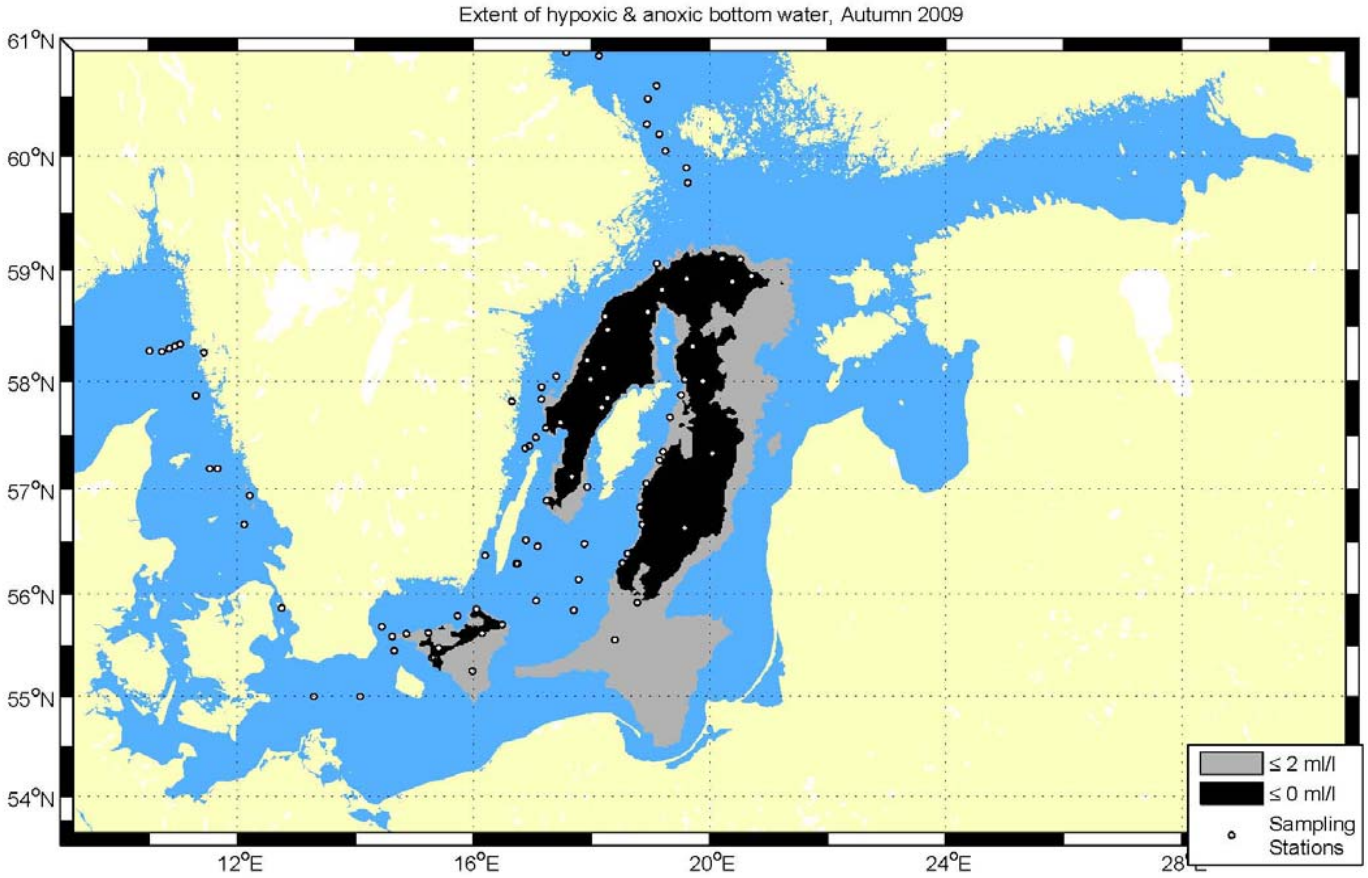
II. Hansson, D. and Gustafsson, E., 2010. Salinity and hypoxia in the Baltic Sea since AD 1500. *Submitted to Journal of Geophysical Research – Oceans.*

III. Omstedt, A., Gustafsson, E. and Wesslander, K., 2009. Modelling the uptake and release of carbon dioxide in the Baltic Sea surface water. *Continental Shelf Research, 29, 870–885, doi:10.1016/j.csr.2009.01.006*.

IV. Gustafsson, E., 2010. Modelled long-term evolution of particulate organic carbon flux to the Baltic Sea deep water. *Submitted to Journal of Marine Systems.*

Hypoxia… higher organisms abandon oxygen poor water

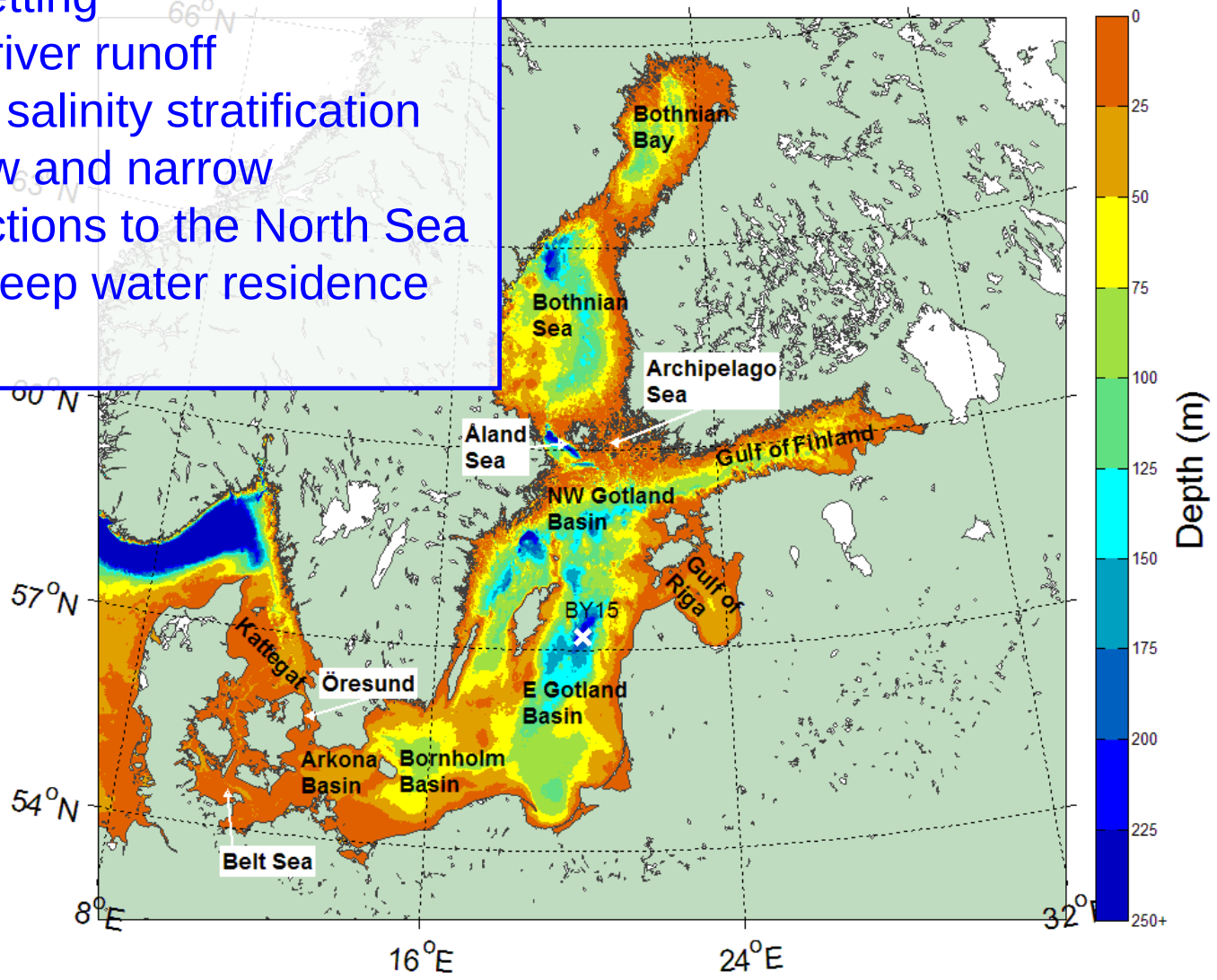
Mobile Bay jubilee
(http://oceanservice.noaa.gov/education/kits/estuaries/media/supp_estuar10d_disolvedox.html)

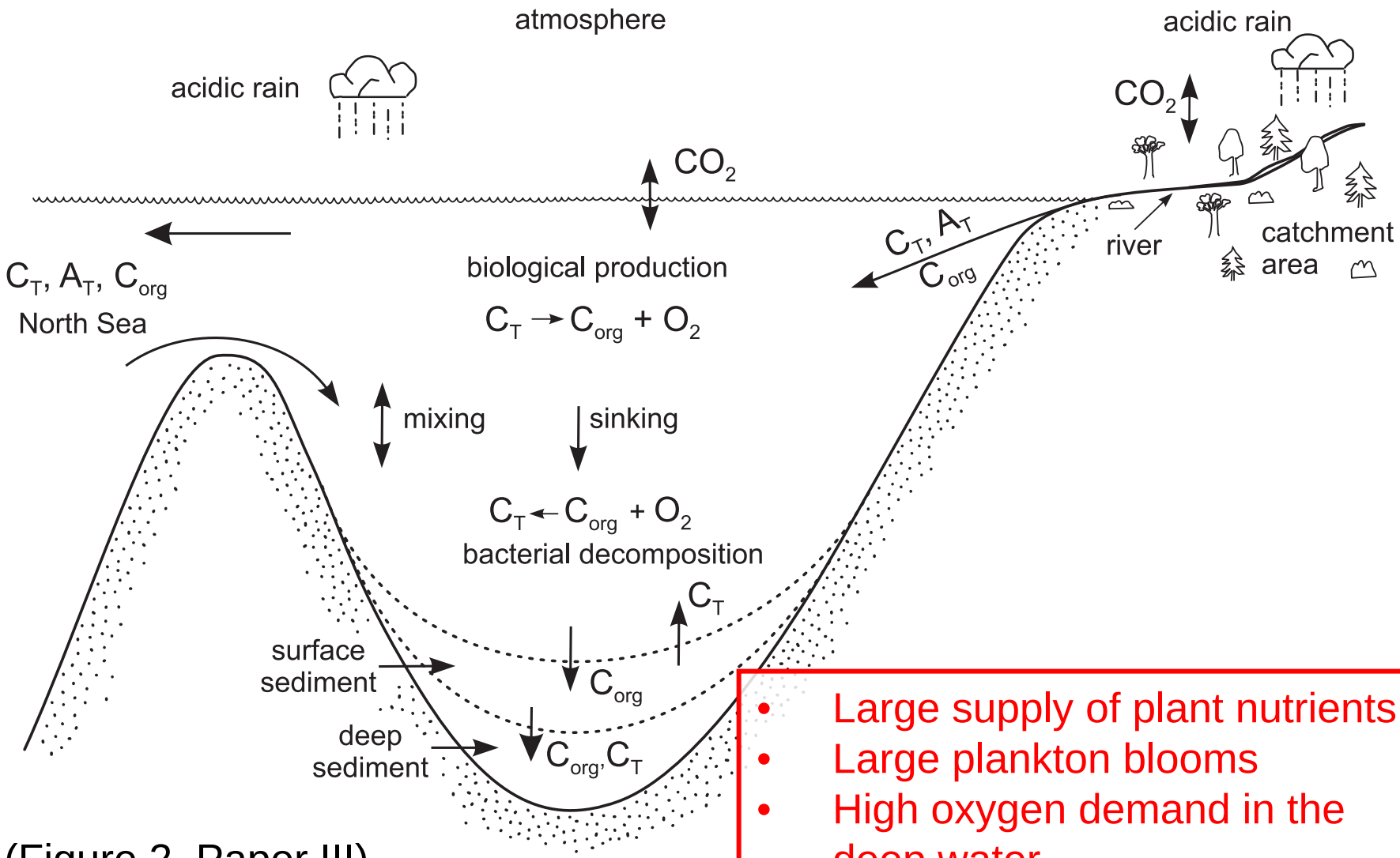


SMHI oxygen survey, autumn 2009 (Hansson et al., 2009)

Physical setting

- Large river runoff
- Strong salinity stratification
- Shallow and narrow connections to the North Sea
- Long deep water residence times



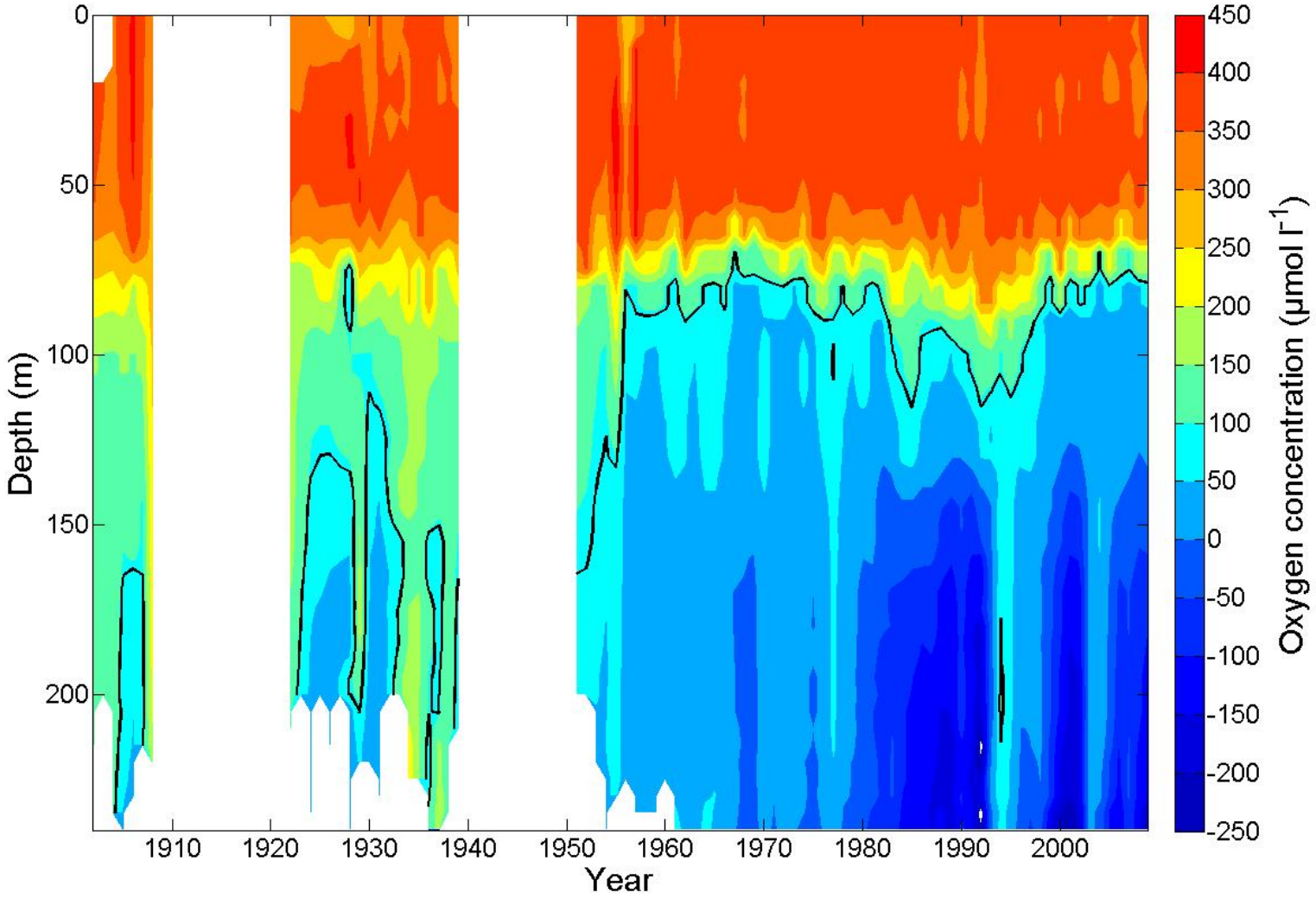


(Figure 2, Paper III)

- Large supply of plant nutrients
- Large plankton blooms
- High oxygen demand in the deep water

→ Oxygen demand > oxygen supply

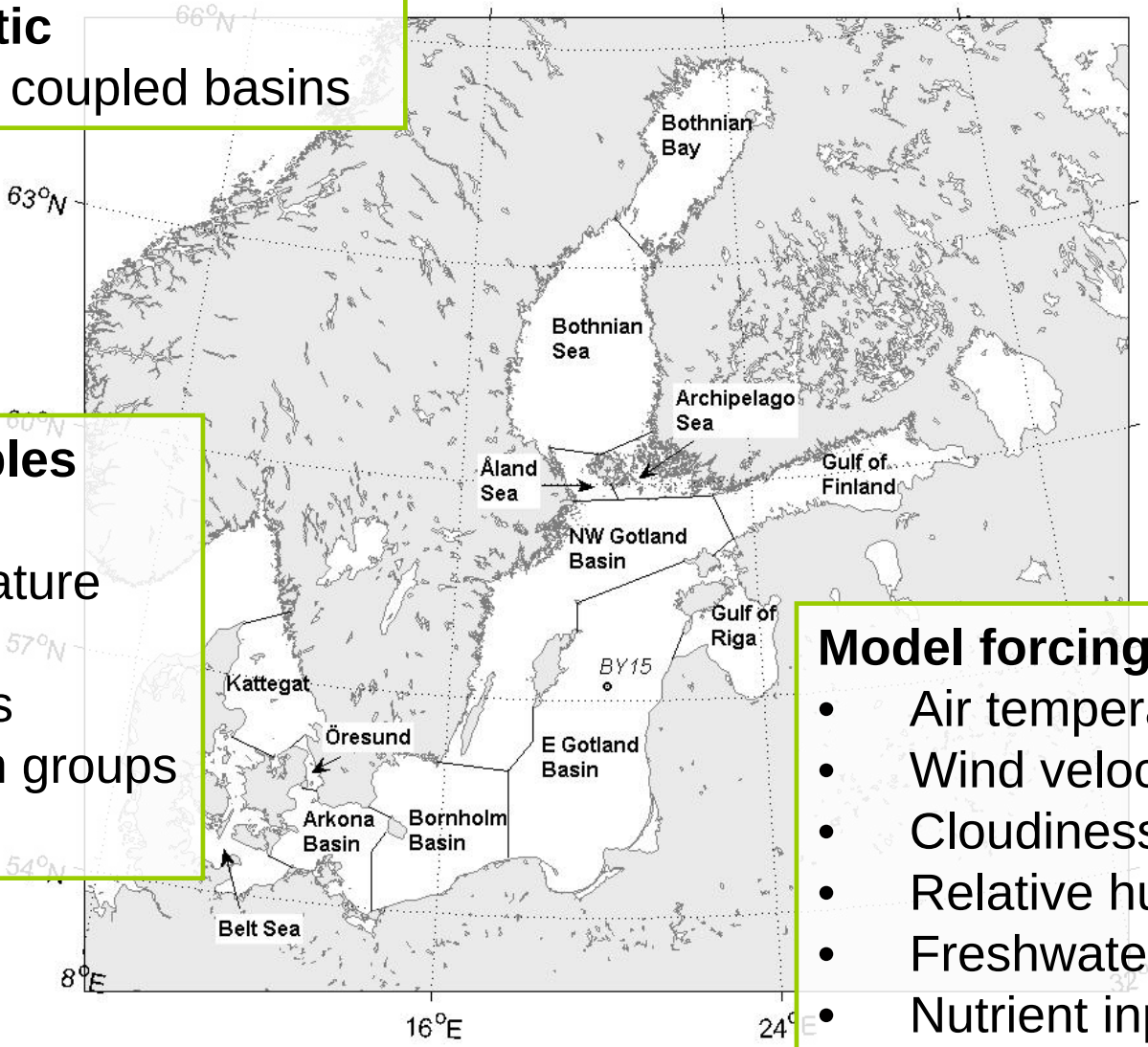
Observed oxygen concentrations in the Gotland Deep



Climate change/eutrophication?

PROBE Baltic

- Thirteen coupled basins

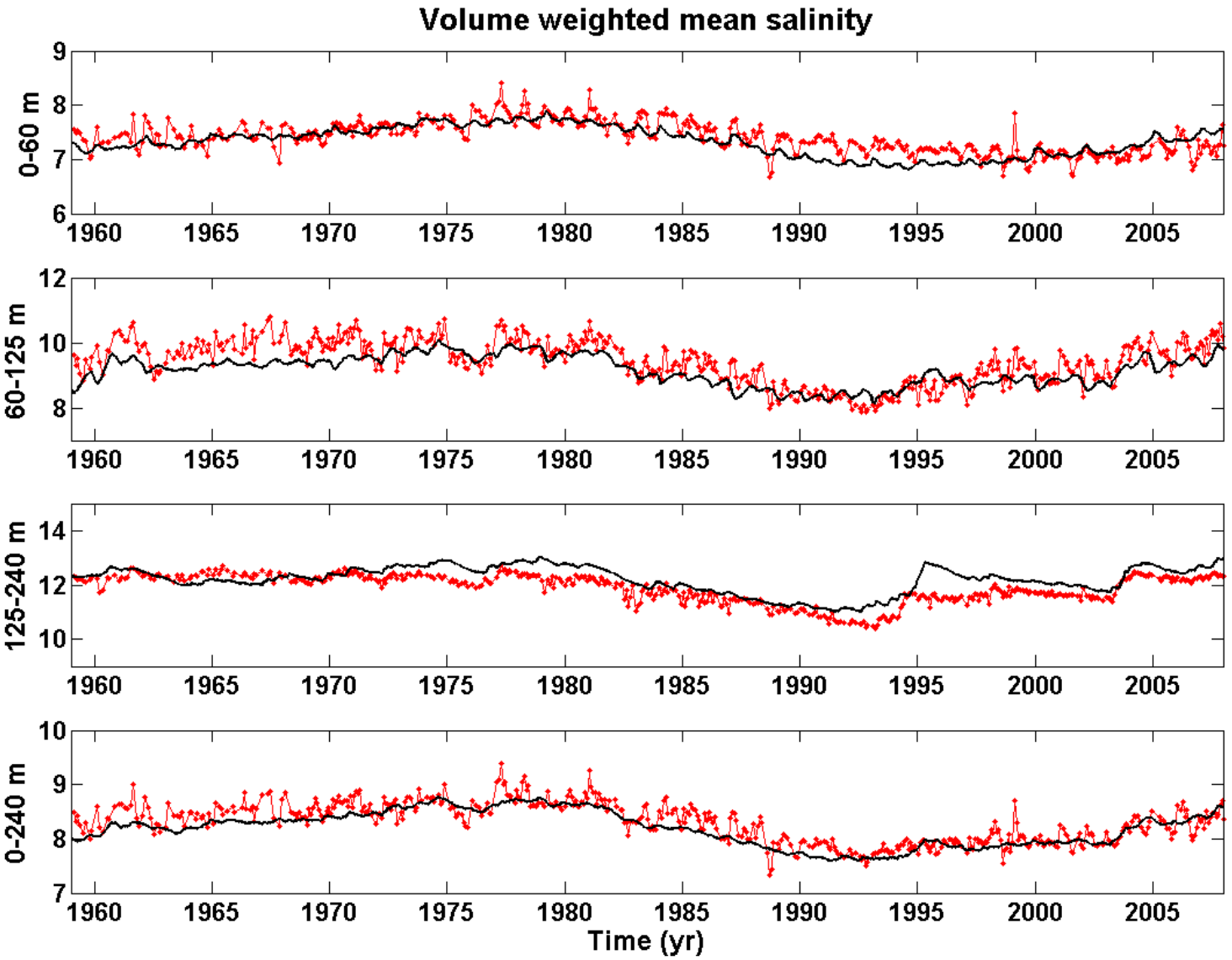


State variables

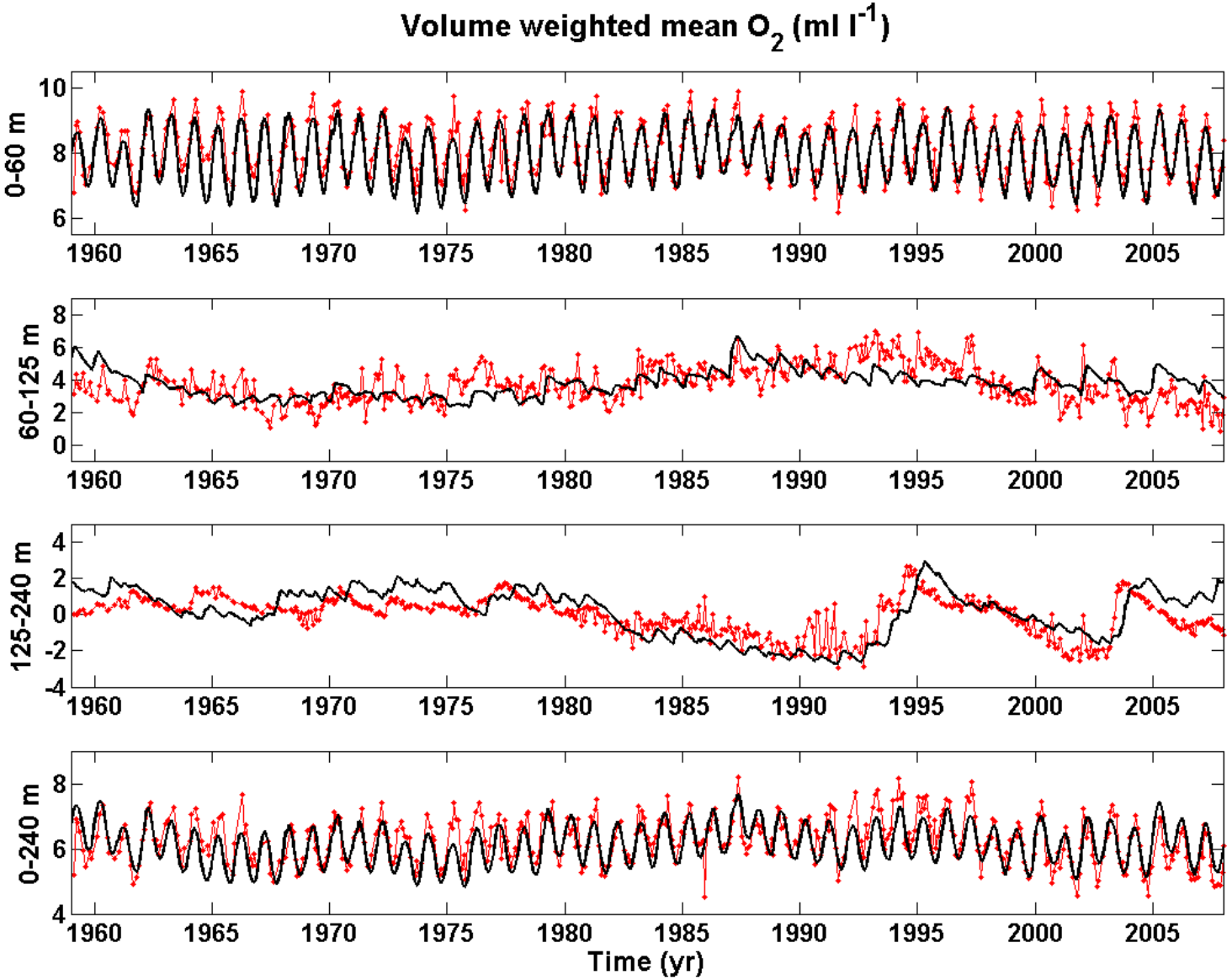
- Salinity
- Temperature
- Oxygen
- Nutrients
- Plankton groups
- etc.

Model forcing

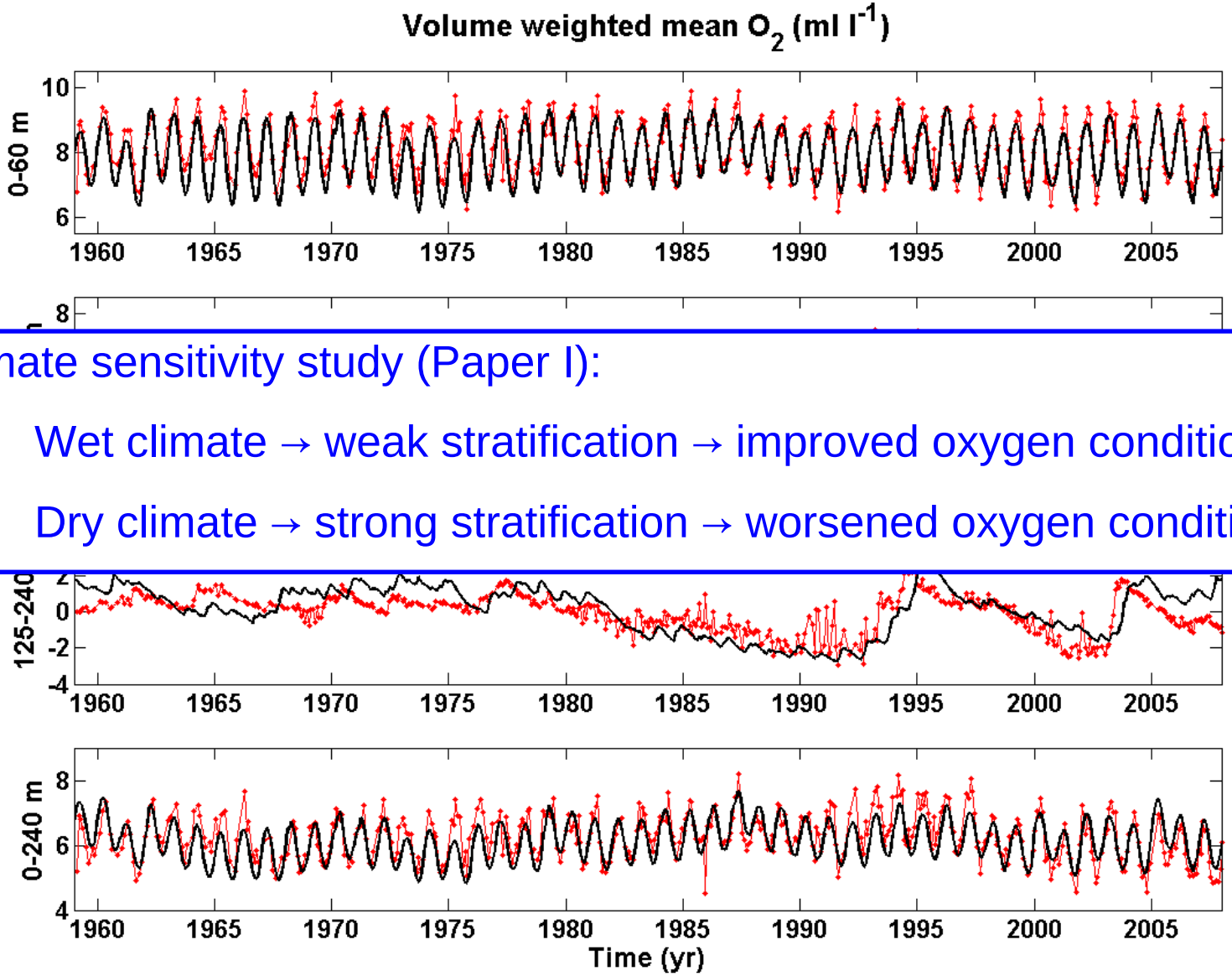
- Air temperature
- Wind velocity
- Cloudiness
- Relative humidity
- Freshwater input
- Nutrient input
- Kattegat water level



(Redrawn from Paper I, Figure 4)



(Redrawn from Paper I, Figure 6)



Climate sensitivity study (Paper I):

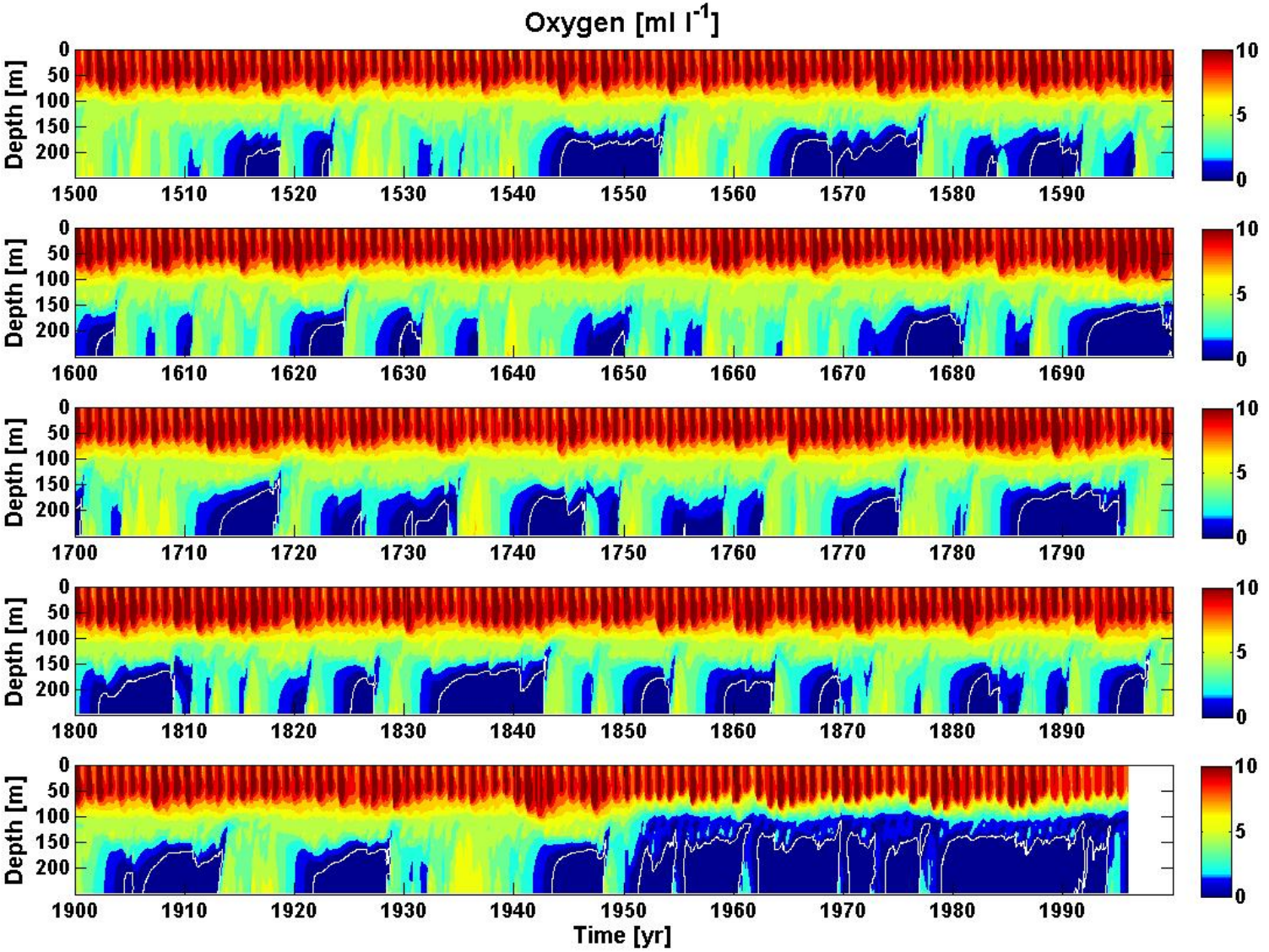
- Wet climate → weak stratification → improved oxygen conditions
- Dry climate → strong stratification → worsened oxygen conditions

(Redrawn from Paper I, Figure 6)

Reconstruction of the past

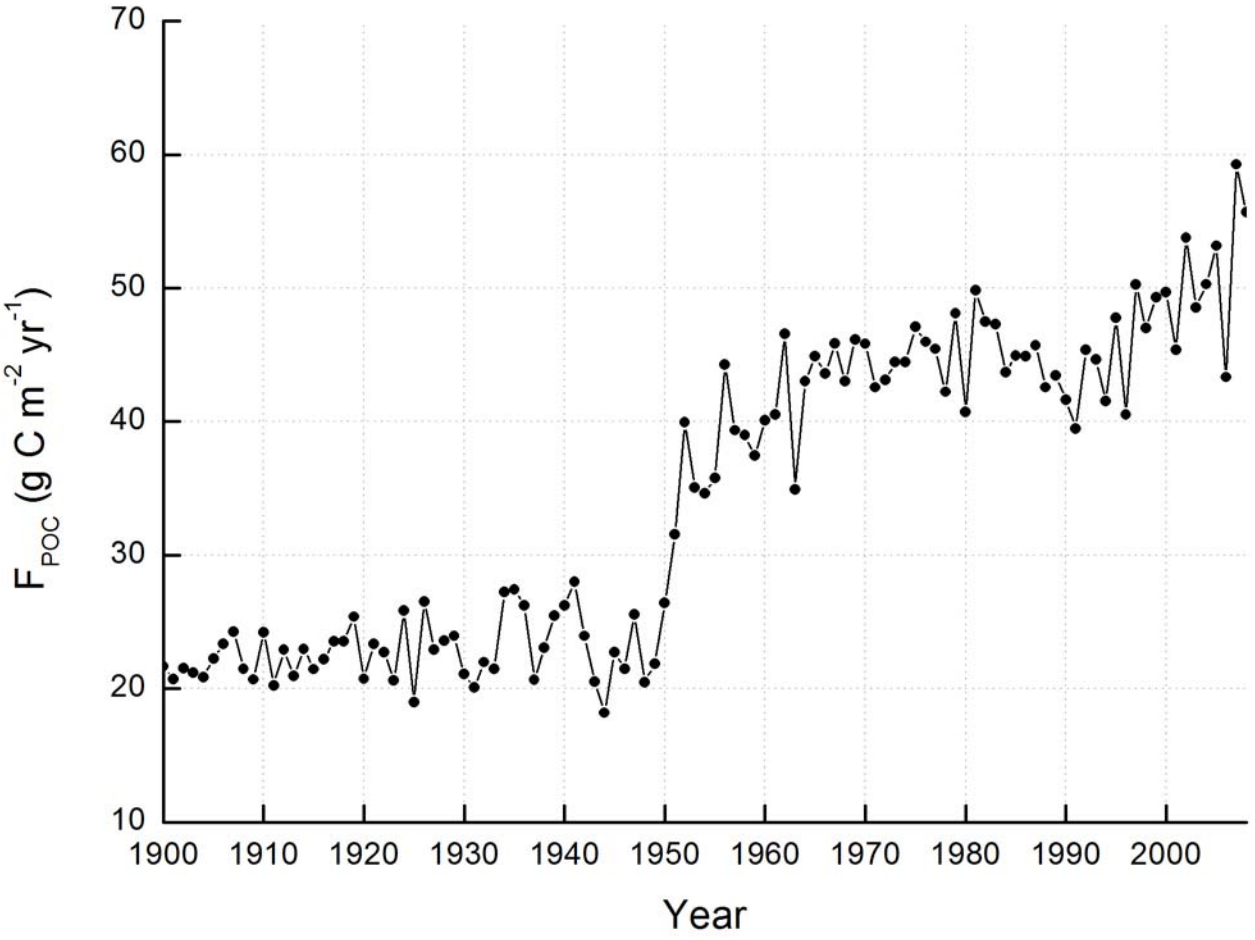
- Tree rings, ice cores, sediment cores, written documents,…
- Reconstruction of seasonal temperature and pressure patterns for the last 500 years (*Luterbacher et al., 2002; 2004*)

➢ Meteorological forcing files since AD 1500 (cf. *Eriksson et al., 2007; Hansson and Omstedt, 2008; Hansson et al., 2010*)



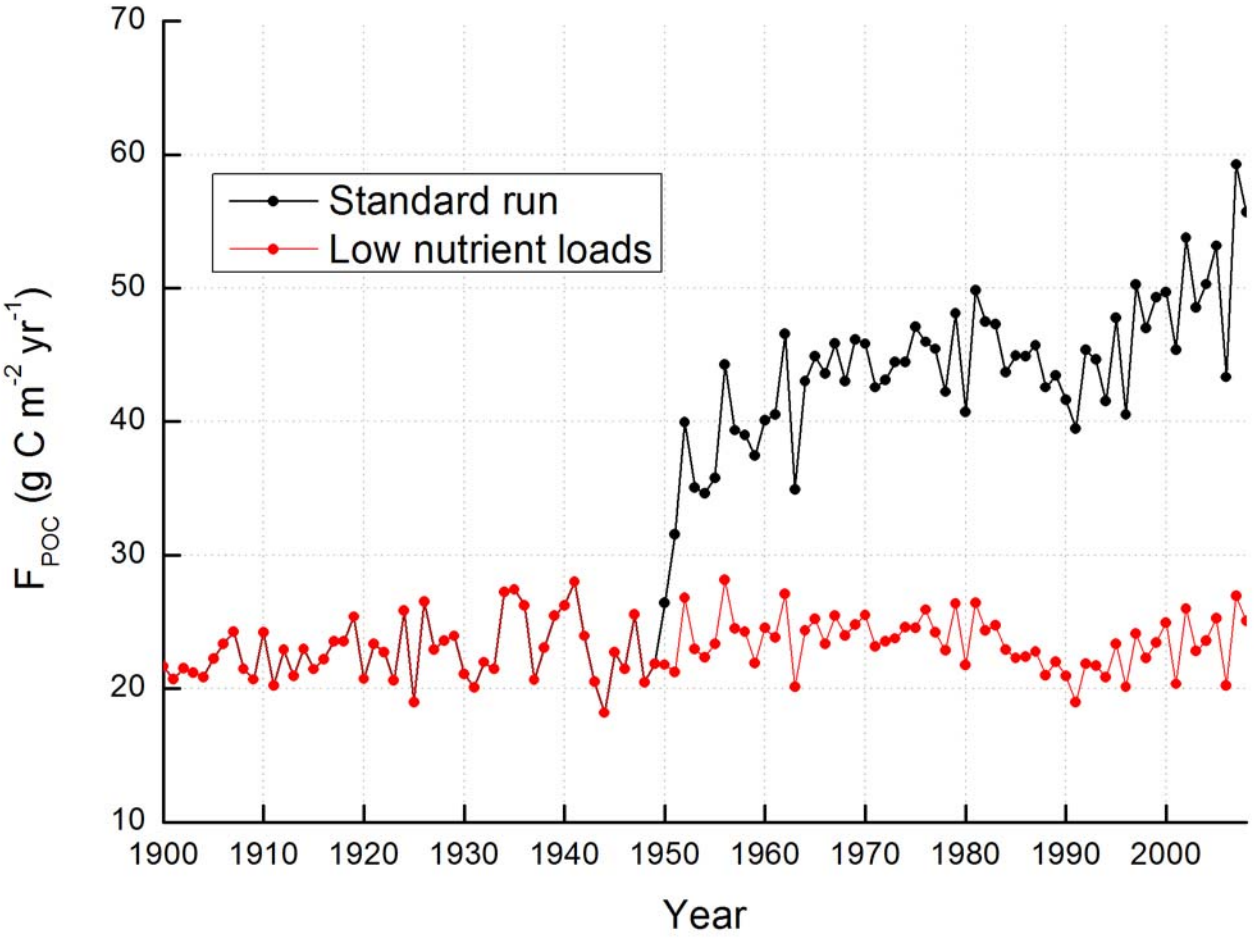
(Redrawn from Paper II, Figure 5b)

Flux of particulate organic carbon (POC) to the deep water



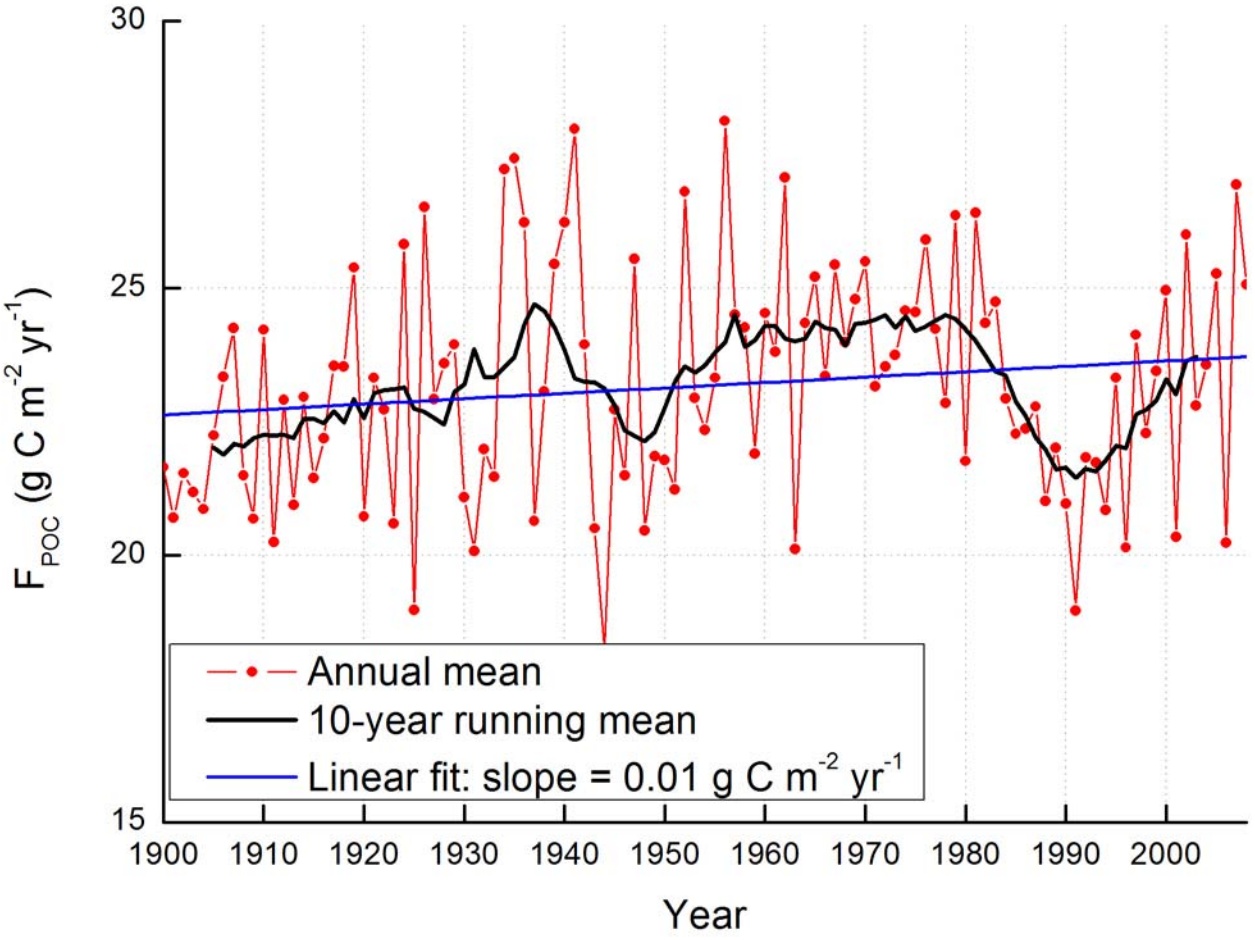
(Redrawn from Paper IV, Figure 7)

Flux of particulate organic carbon (POC) to the deep water



(Redrawn from Paper IV, Figure 7)

Flux of particulate organic carbon (POC) to the deep water – low nutrient loads



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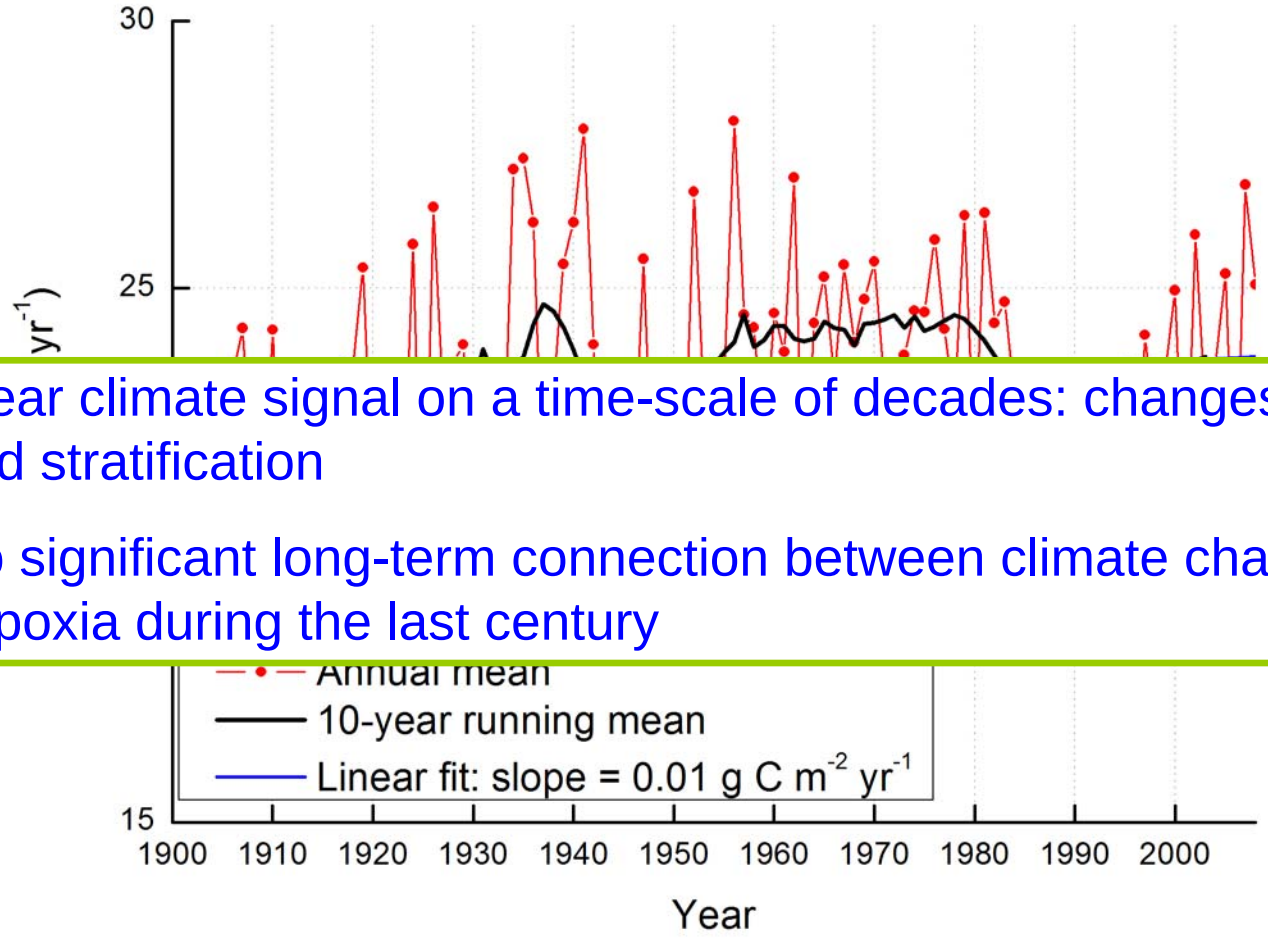

- Clear climate signal on a time-scale of decades: changes in salinity and stratification
- No significant long-term connection between climate change and hypoxia during the last century

(Redrawn from Paper IV, Figure 7)

Concluding remarks

- Development of a tool that can account for the ecosystem response to climate change, eutrophication and acidification.
- Future development?

Picture by Christian Stranne