Nitrogen turnover in the Baltic Sea

Work package B – Process Studies and Observations

Susanna Hietanen, Helena Jäntii, Christoph Humborg, Barbara Deutsch, Michael Böttcher, Olaf Dellwig, Susann Vogler, Jan-Marcin Weslawski, Lech Kotwicki and Beata Szymczycha

Frederike Korth and Maren Voss

Leibniz Institute for Baltic Sea Research, Warnemünde

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Outline

- What have been measured?

- Results:
  - Objective I: DON uptake along a salinity gradient from the North Sea to the Baltic Sea
  - Objective II: Nitrate turnover during peak outflow of the Curonian and Szczecin lagoon
  - Objective III: Annual cycle: Comparison of environments with contrasting nitrogen loads

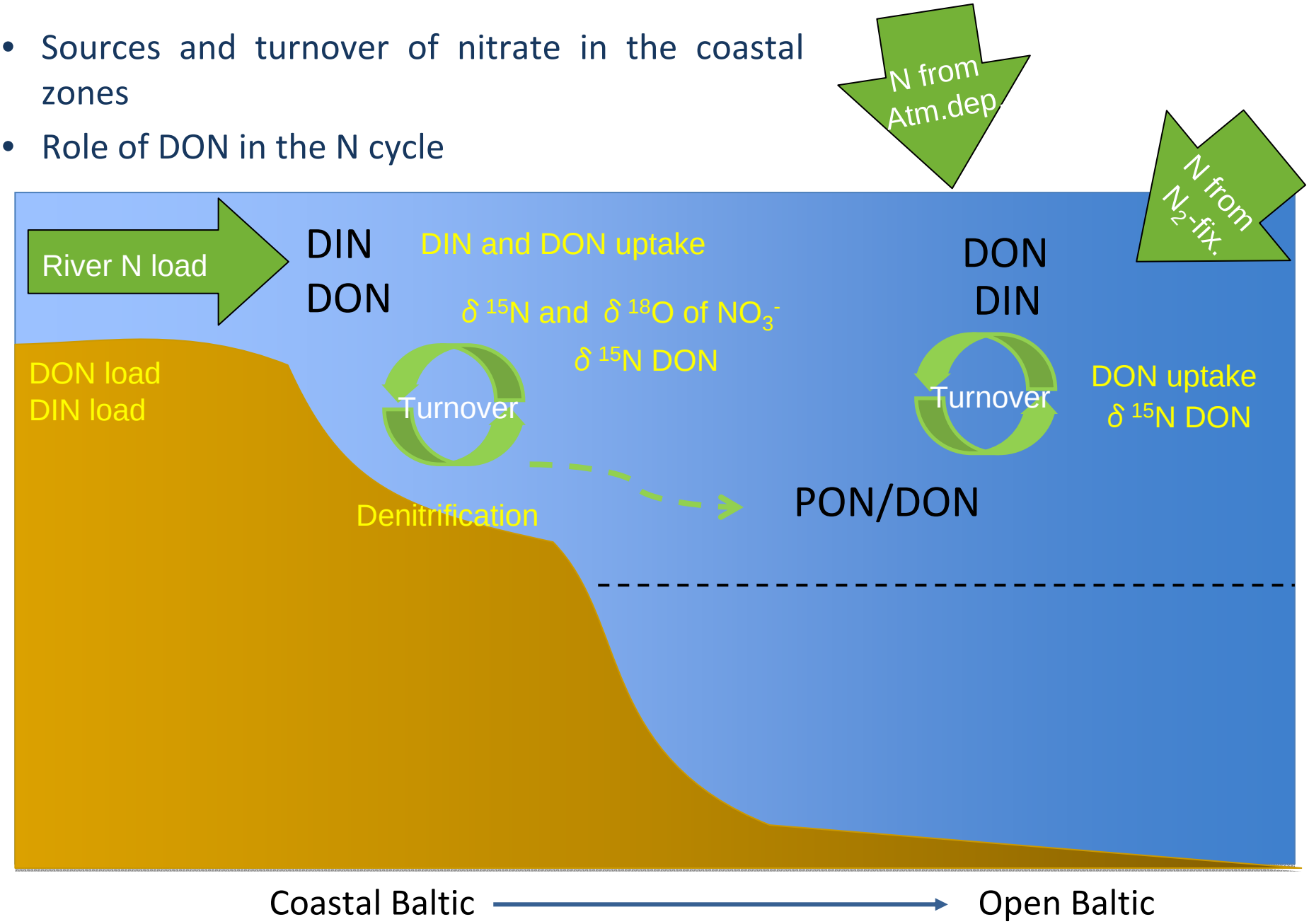
- What is still missing?

- Publications

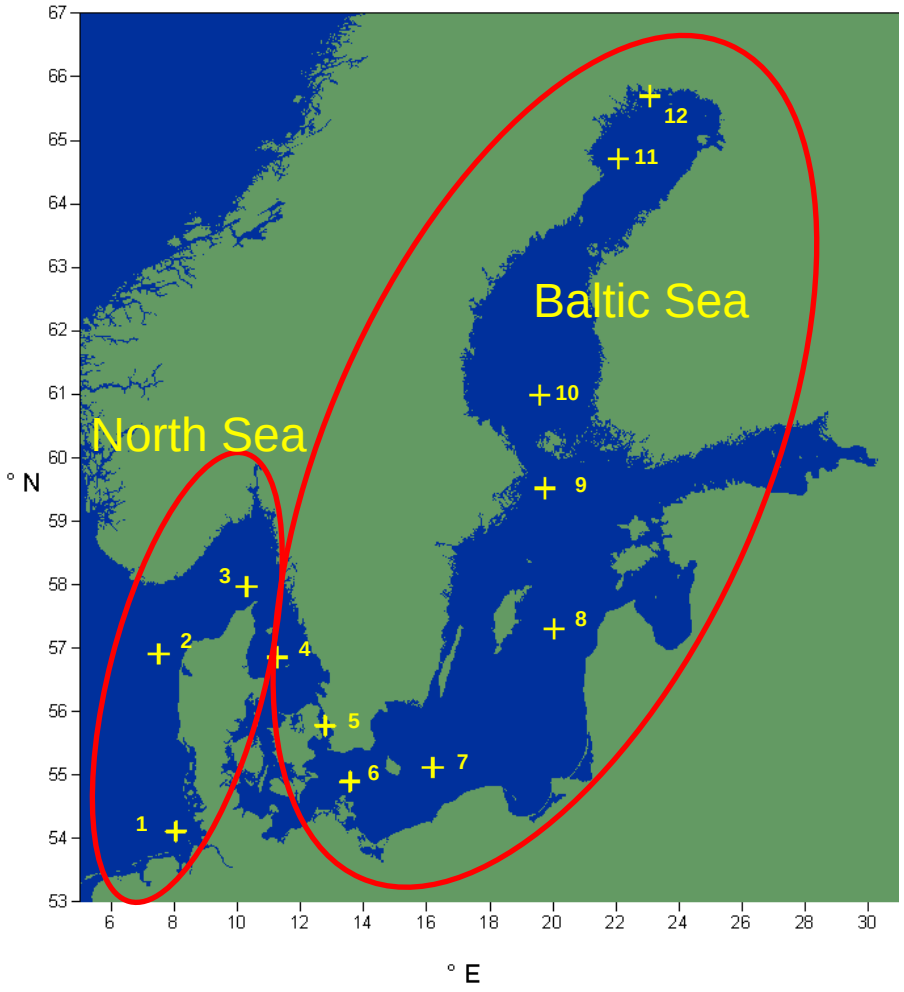
- Relevance of the results for policy and stakeholders

Nitrogen turnover

- Sources and turnover of nitrate in the coastal zones
- Role of DON in the N cycle



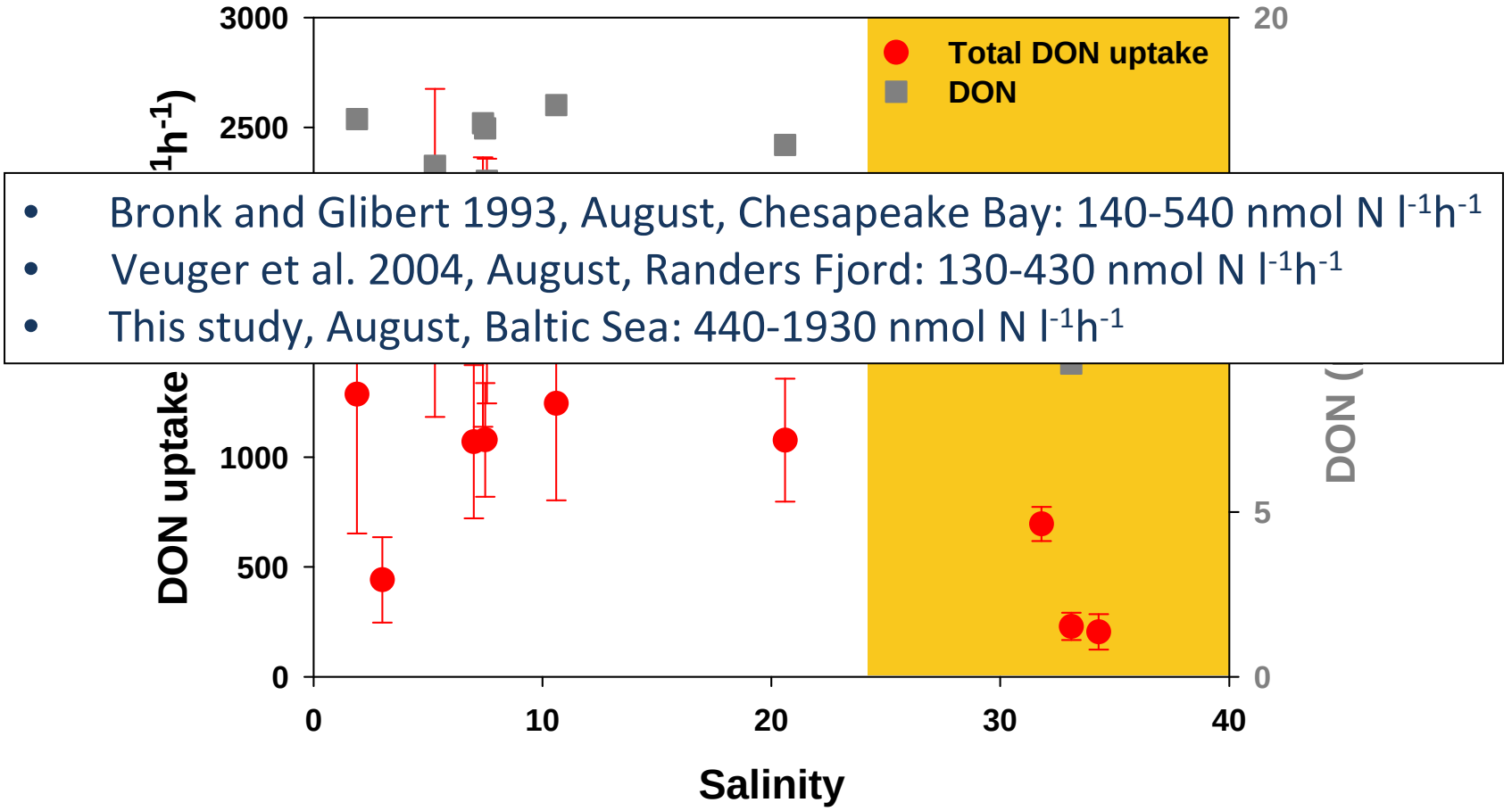
Objective 1:
DON uptake in the Baltic Sea



Aims

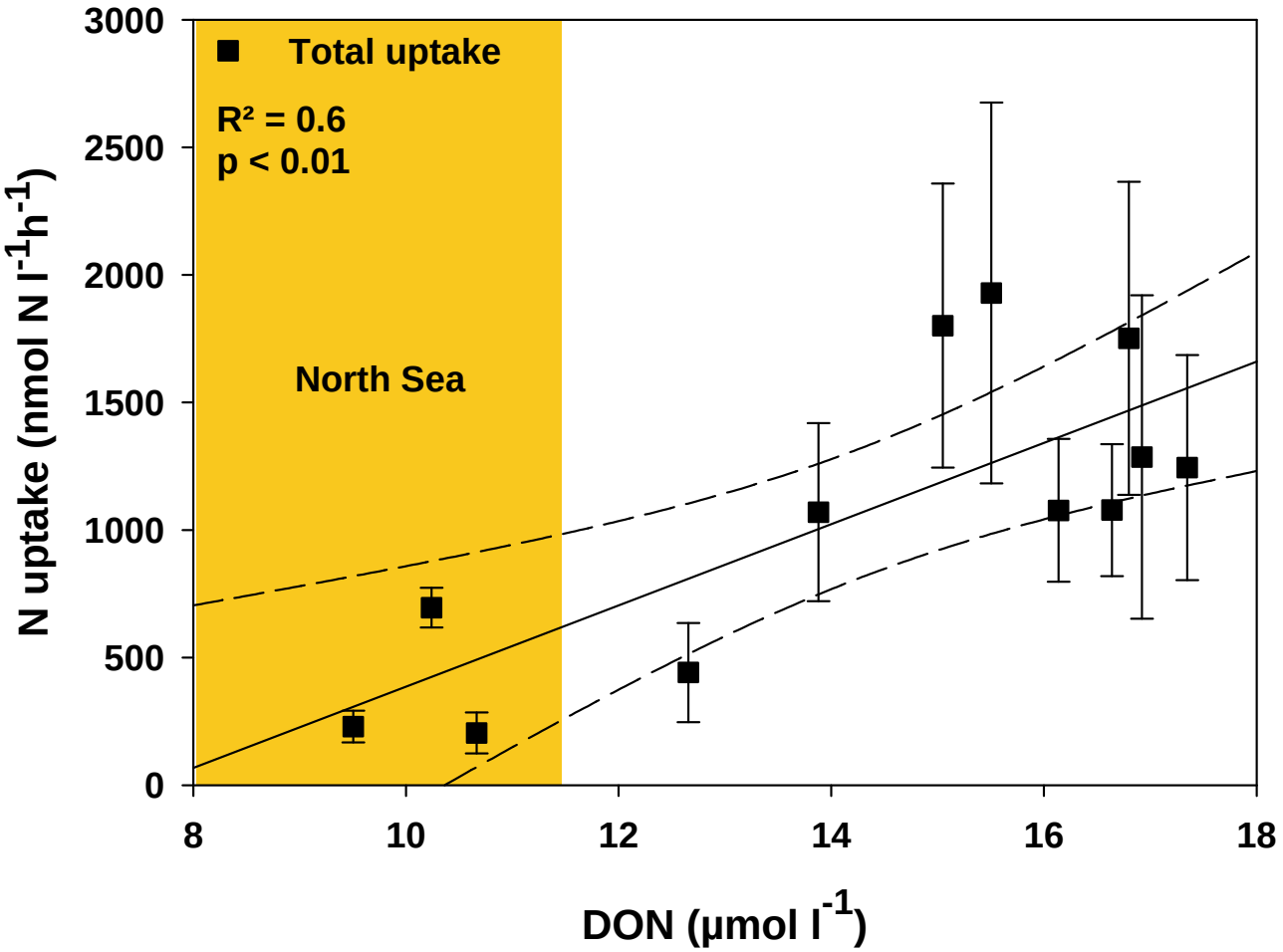
- Measurement of phytoplankton and bacteria bulk DON uptake rates along a salinity gradient from the North Sea to the Baltic Sea in summer 2009.
- Comparison of DON uptake rates of heterotrophic bacteria and phytoplankton in the North Sea and the Baltic Sea.
- Give a first estimation on the role of DON as a potential nitrogen source in the Baltic Sea during summer.

Objective 1:
DON uptake in the Baltic Sea



- Bronk and Glibert 1993, August, Chesapeake Bay: 140-540 nmol N $l^{-1}h^{-1}$
- Veuger et al. 2004, August, Randers Fjord: 130-430 nmol N $l^{-1}h^{-1}$
- This study, August, Baltic Sea: 440-1930 nmol N $l^{-1}h^{-1}$

Objective 1:
DON uptake in the Baltic Sea



- Positive correlation between DON uptake rates and concentrations
- In environments with higher DON backgrounds plankton has a higher ability to utilize DON

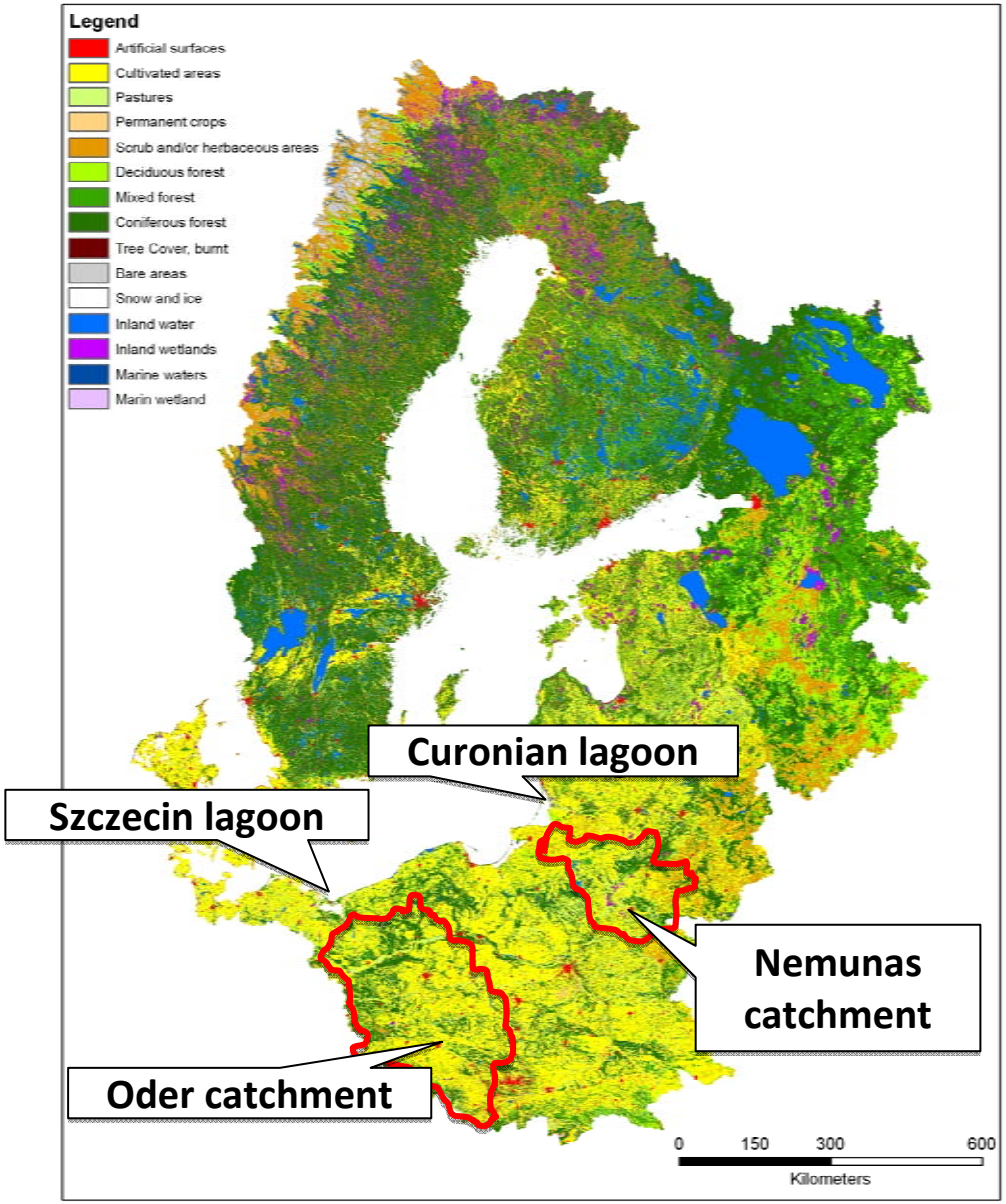
Conclusions

- Both heterotrophic bacteria and phytoplankton exploited components of the DON pool with higher rates in the Baltic Sea than in the North Sea.

➢ DON can be an important nitrogen source in the Baltic Sea during summer when DIN is depleted.

➢ DON can enhances primary production and therefore also fuel eutrophication.

Objective 2:
Nitrate turnover during peak outflow of the Curonian and Szczecin lagoon



Source: Baltic Nest Institute

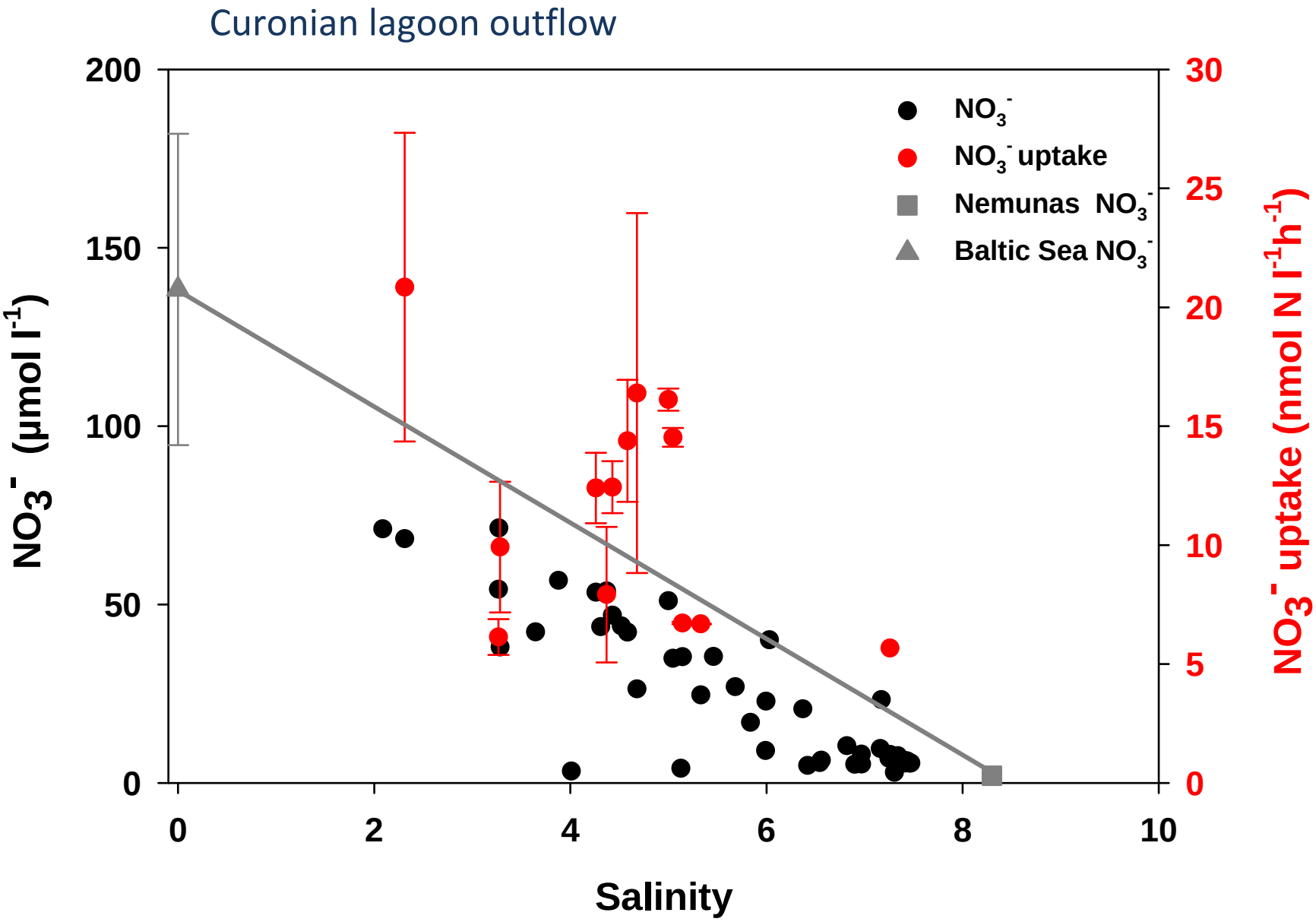
Measurements

- NO_3^- uptake rates in the outflow of the lagoons
- Stable isotopes in NO_3^-

Aims

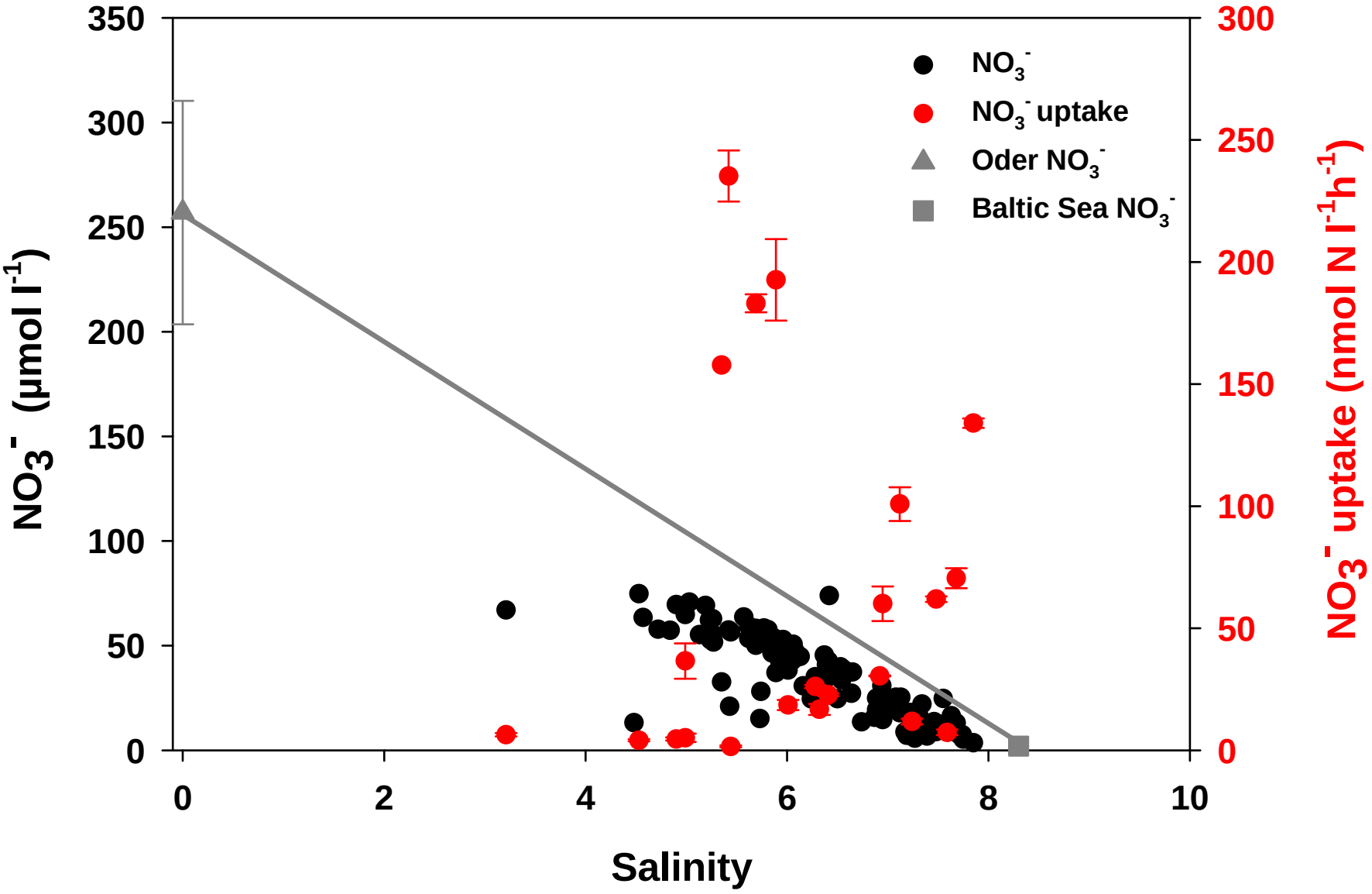
- Gain a better understanding of the dynamics of nitrate in river outflows during peak outflow of the year
- Source and N-transformation processes identification
- Relate the quantities of nitrate to nitrate uptake rates and budget the fate of the riverine loads.

Objective 2:
Nitrate concentrations



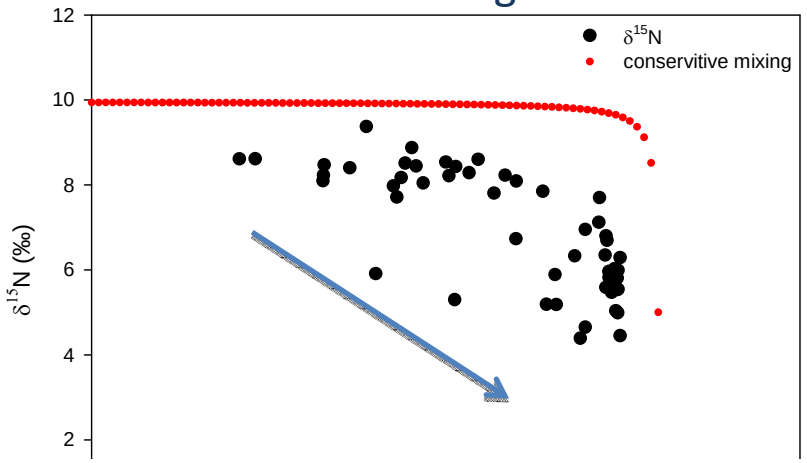
Objective 2:
Nitrate concentrations

Szczecin lagoon outflow



Objective 2:
Nitrate turnover

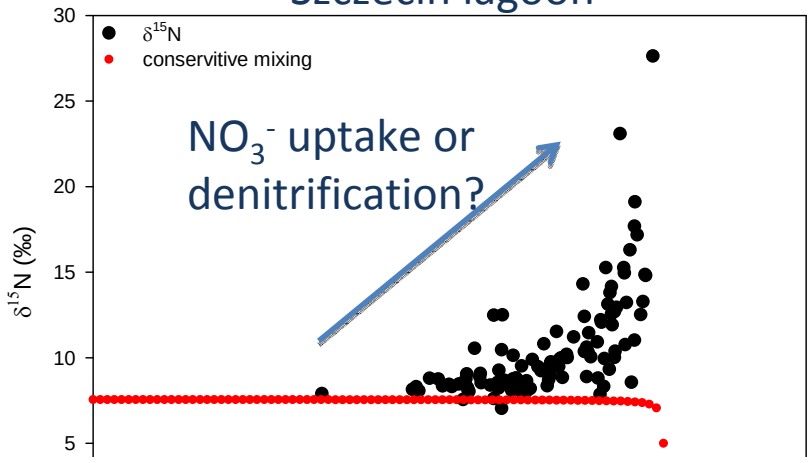
Curonian lagoon



NO_3^- uptake : 0.5 – 1.2 nmol N/m²*d

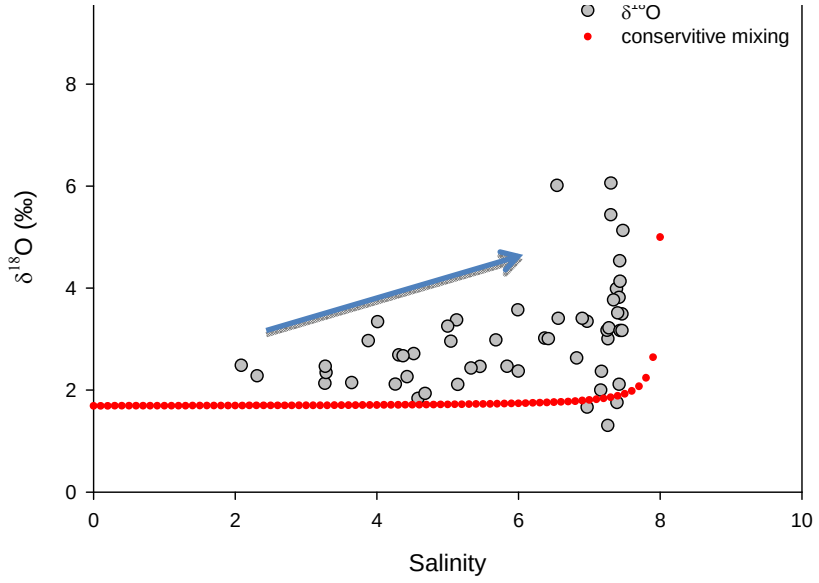
(mean 0.7)

Szczecin lagoon

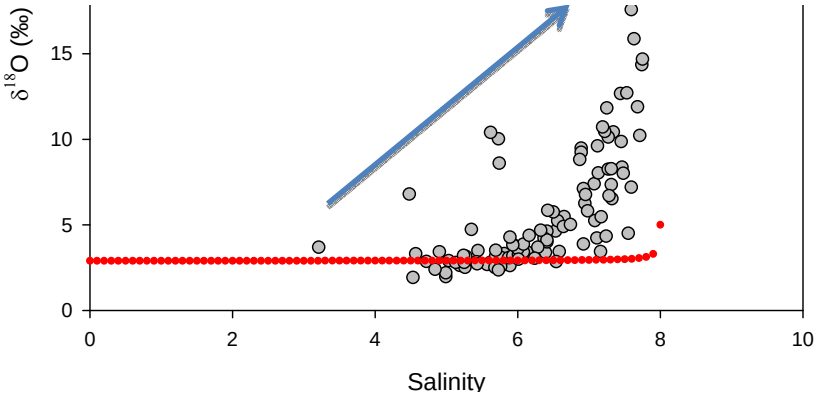


NO_3^- uptake : 0.4 – 11.5 nmol N/m²*d

(mean 5.4)



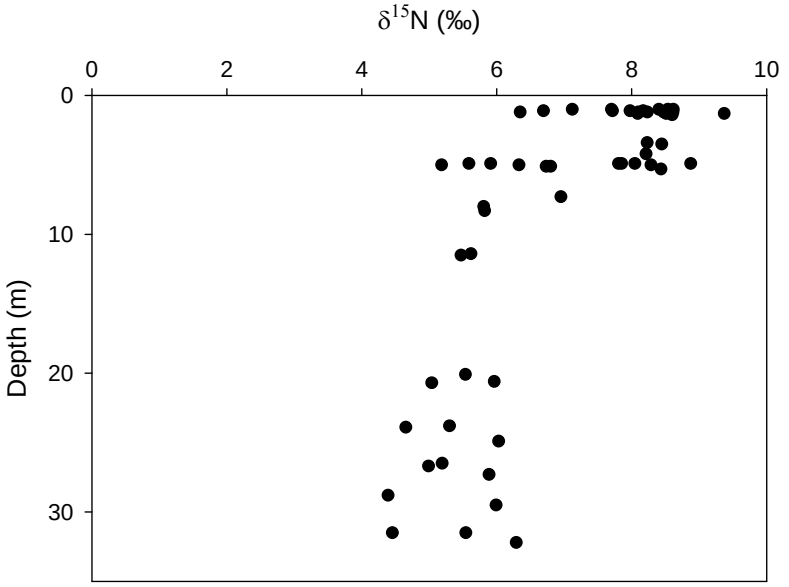
Denitrification: 5000 - 7500 µmol N/m²*d



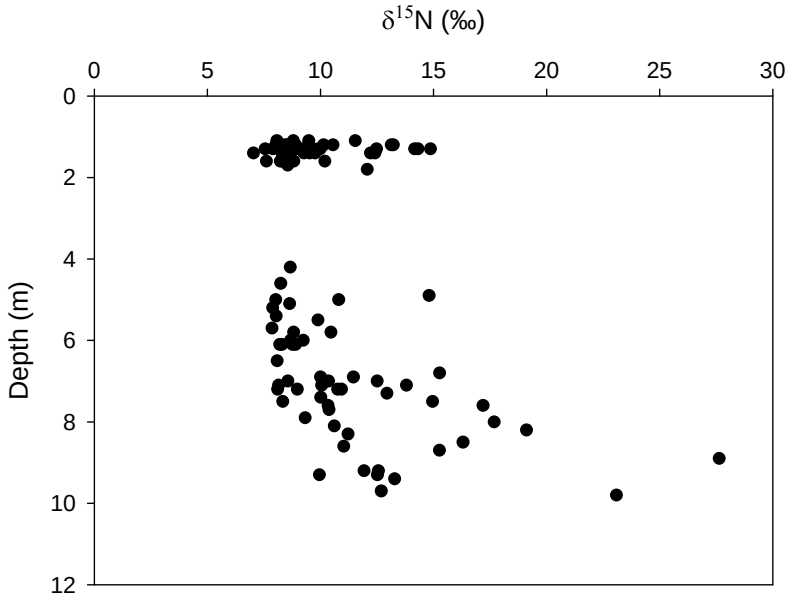
Objective 2:

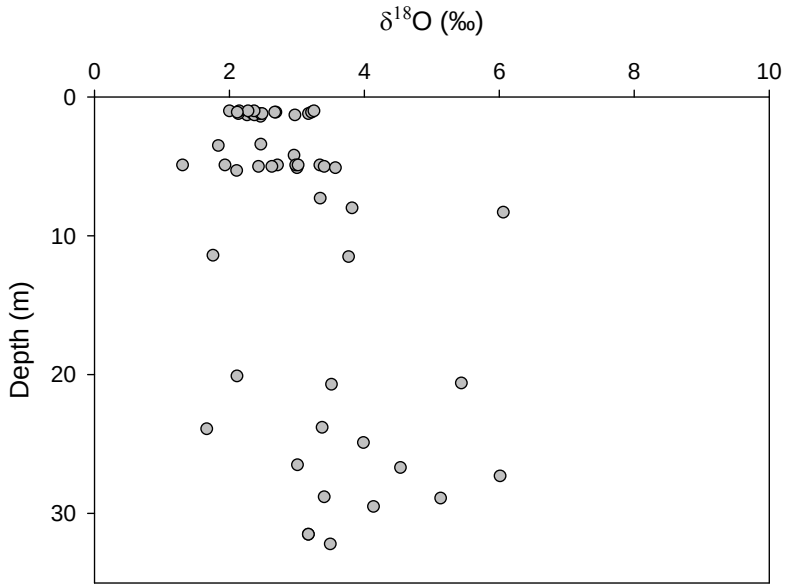
Nitrate concentrations

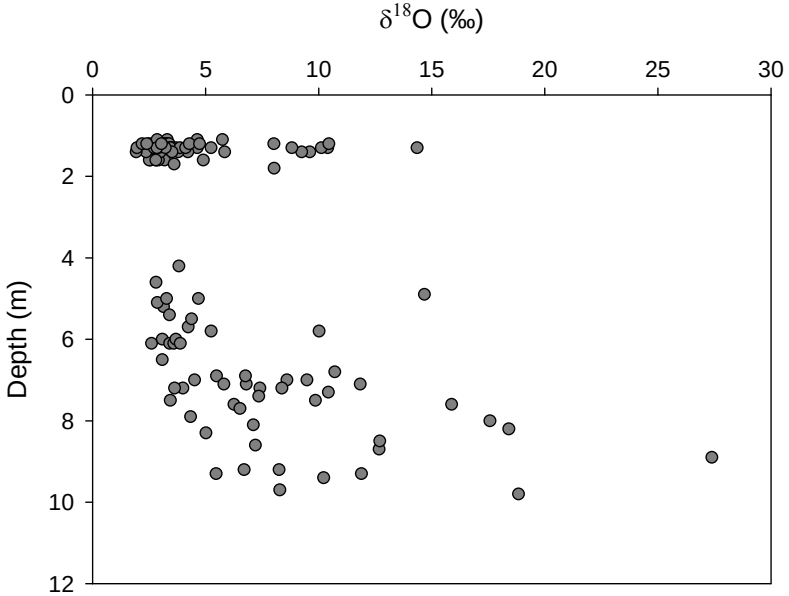
Curonian lagoon



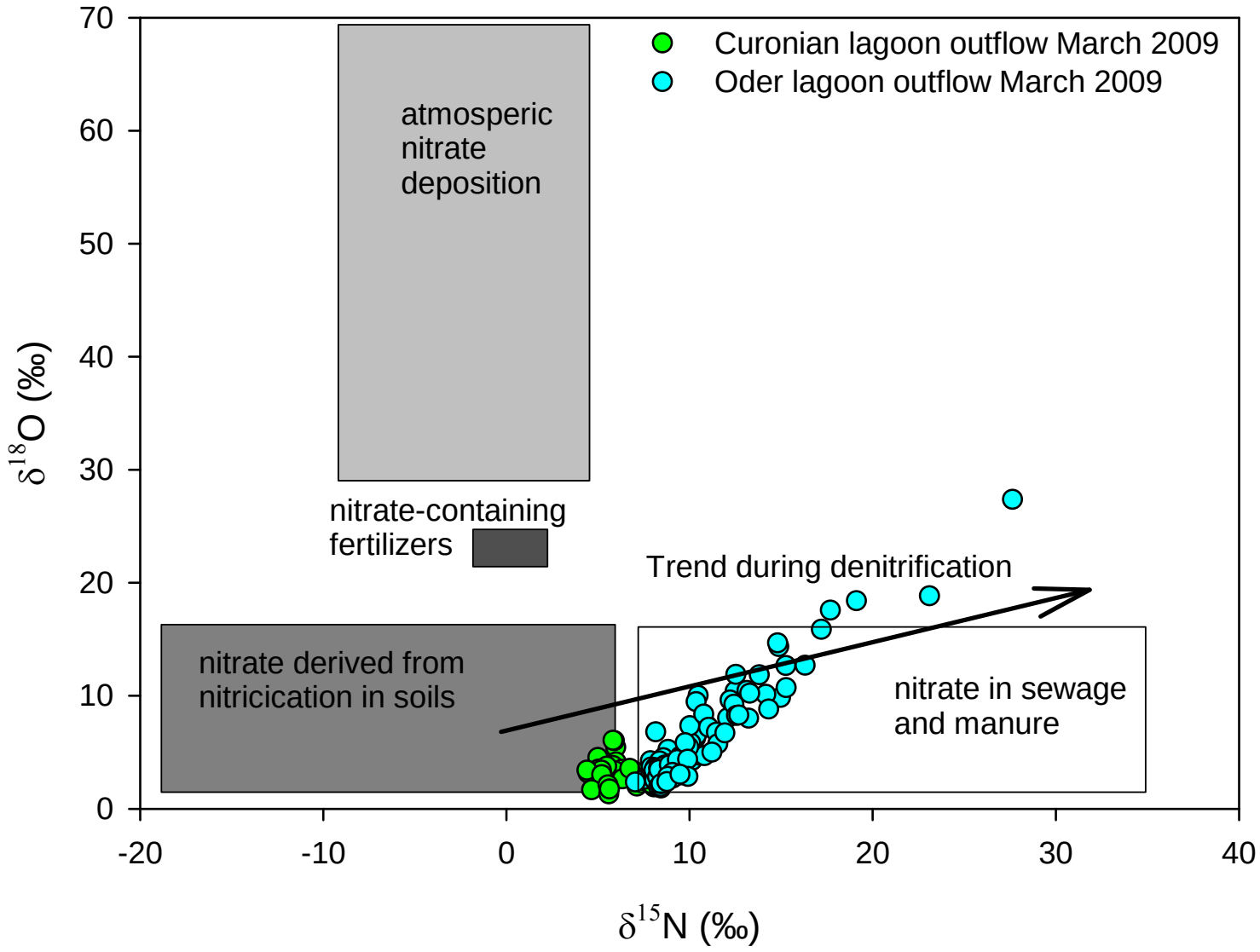
Szczecin lagoon







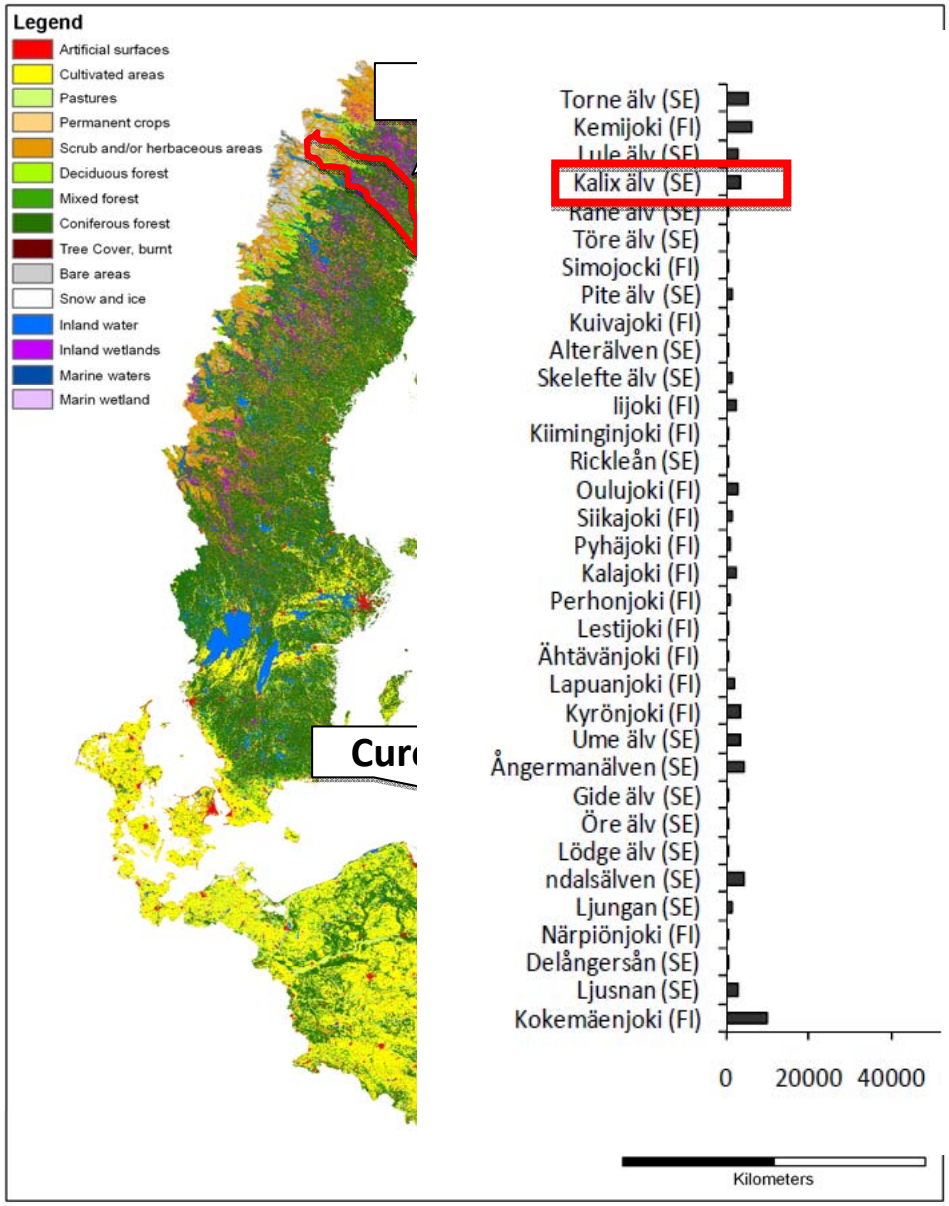
Objective 2:
Source identification

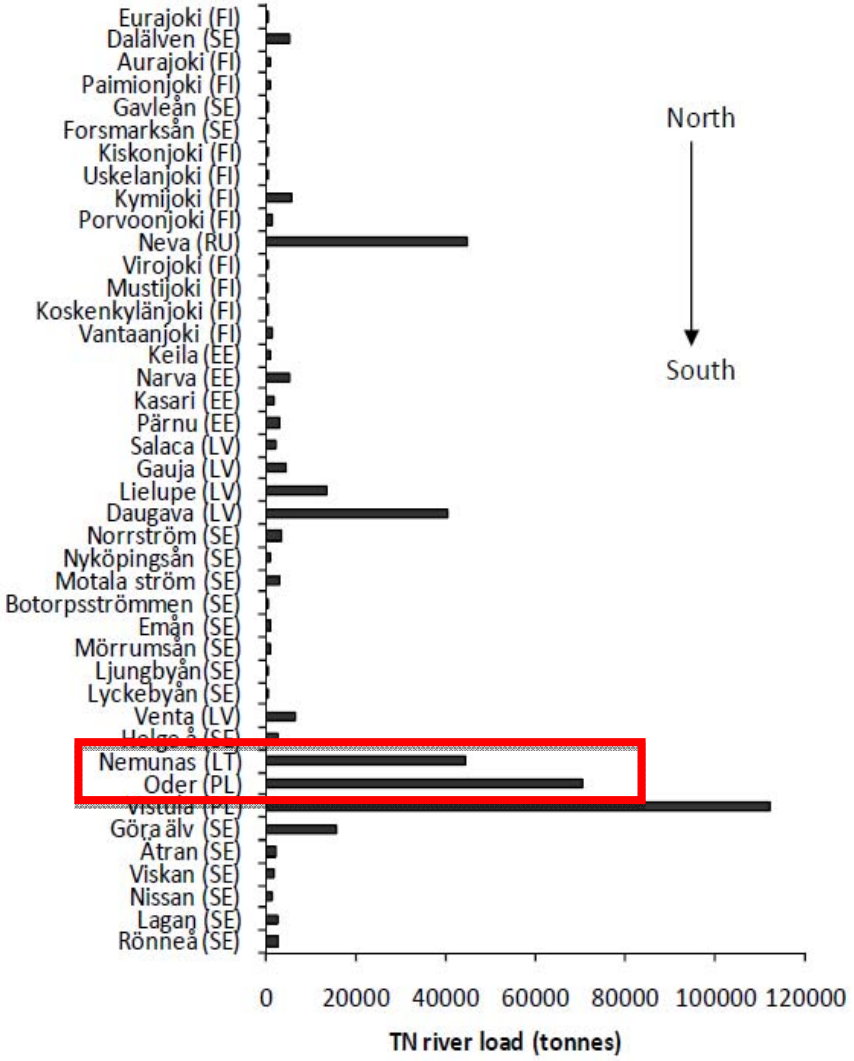


Conclusions

- Two environments with high nitrate loads
- Nitrate concentrations do not show any differences between the two environments
- Stable isotopes can distinguish between different processes and sources

Objective 3:
Comparison of environments with contrasting nitrogen loads

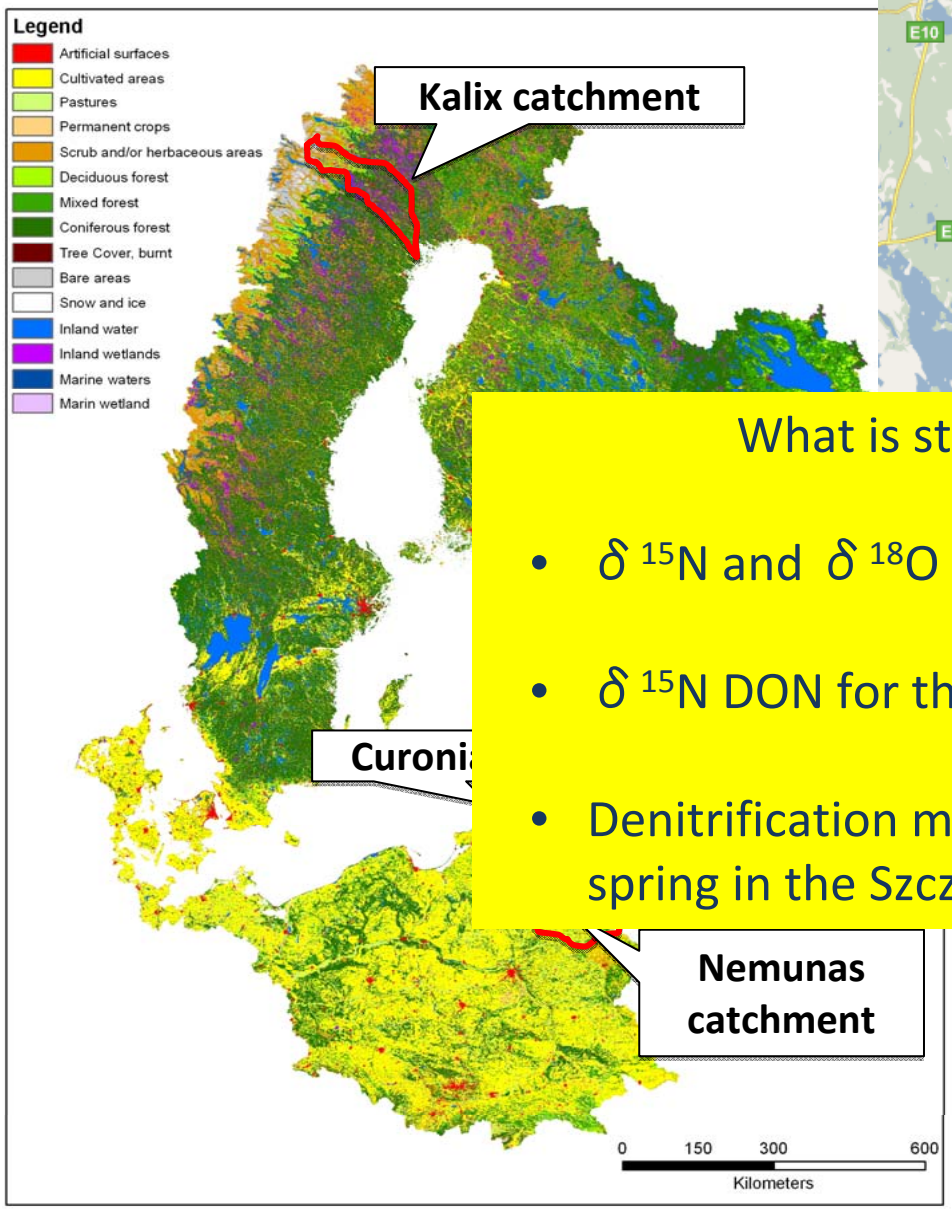




Hägg 2010

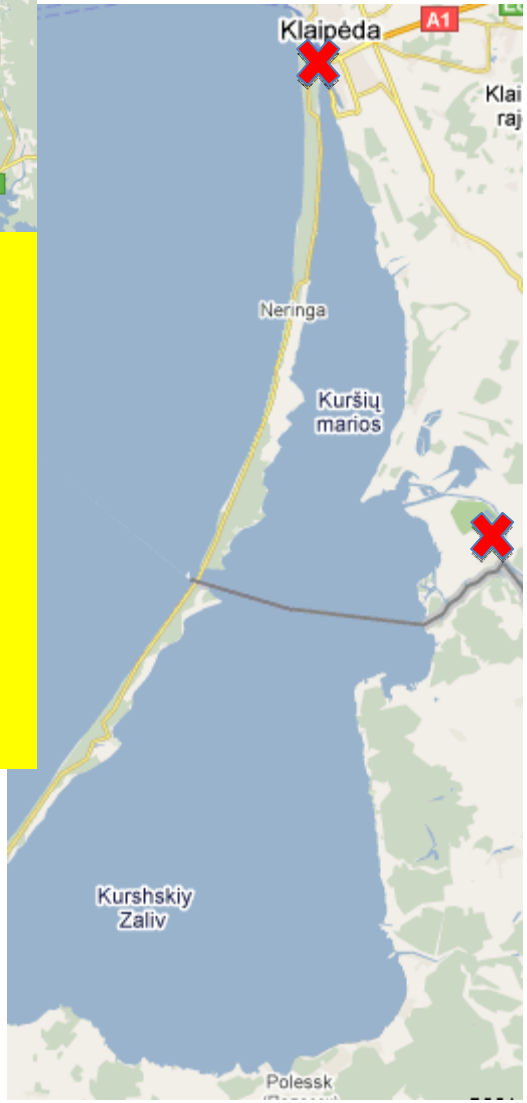
Source: Baltic Nest Institute

Comparison of environments with contrasting nitrogen loads



What is still missing?

- $\delta\,^{15}N$ and $\delta\,^{18}O$ of NO_3^- Kalix river
- $\delta\,^{15}N$ DON for the coastal areas
- Denitrification measurements in spring in the Szczecin lagoon?



Source: Baltic Nest Institute

Puplications

Posters, talks and publications:

- Korth, F., Liskow, I., Humborg C., Voss, M. (2010) Nitrate uptake during spring outflow from the nitrate-rich Curonian lagoon and Szczecin lagoon, BONUS Annual Conference 2010, Vilnius (Lithuania), poster
- Voss, M., Dippner, J.W., Humborg, C., Korth, F., Neumann, T., Hürdler, J., Schernewski, G., Venohr, M. (2011) History and scenarios of future development of Baltic Sea eutrophication. Estuarine Coastal and Shelf Science
- Korth, F., Deutsch B., Liskow I. and Voss M. (2011) Uptake of dissolved organic nitrogen by heterotrophic bacteria and phytoplankton along a salinity gradient from the North Sea to the Baltic Sea, ASLO meeting, Puerto Rico, talk
- Korth, F., Deutsch, B., Liskow I. and Voss M. (2011) Uptake of dissolved organic nitrogen by heterotrophic bacteria and phytoplankton along a salinity gradient from the North Sea to the Baltic Sea, Biogeochemistry, submitted

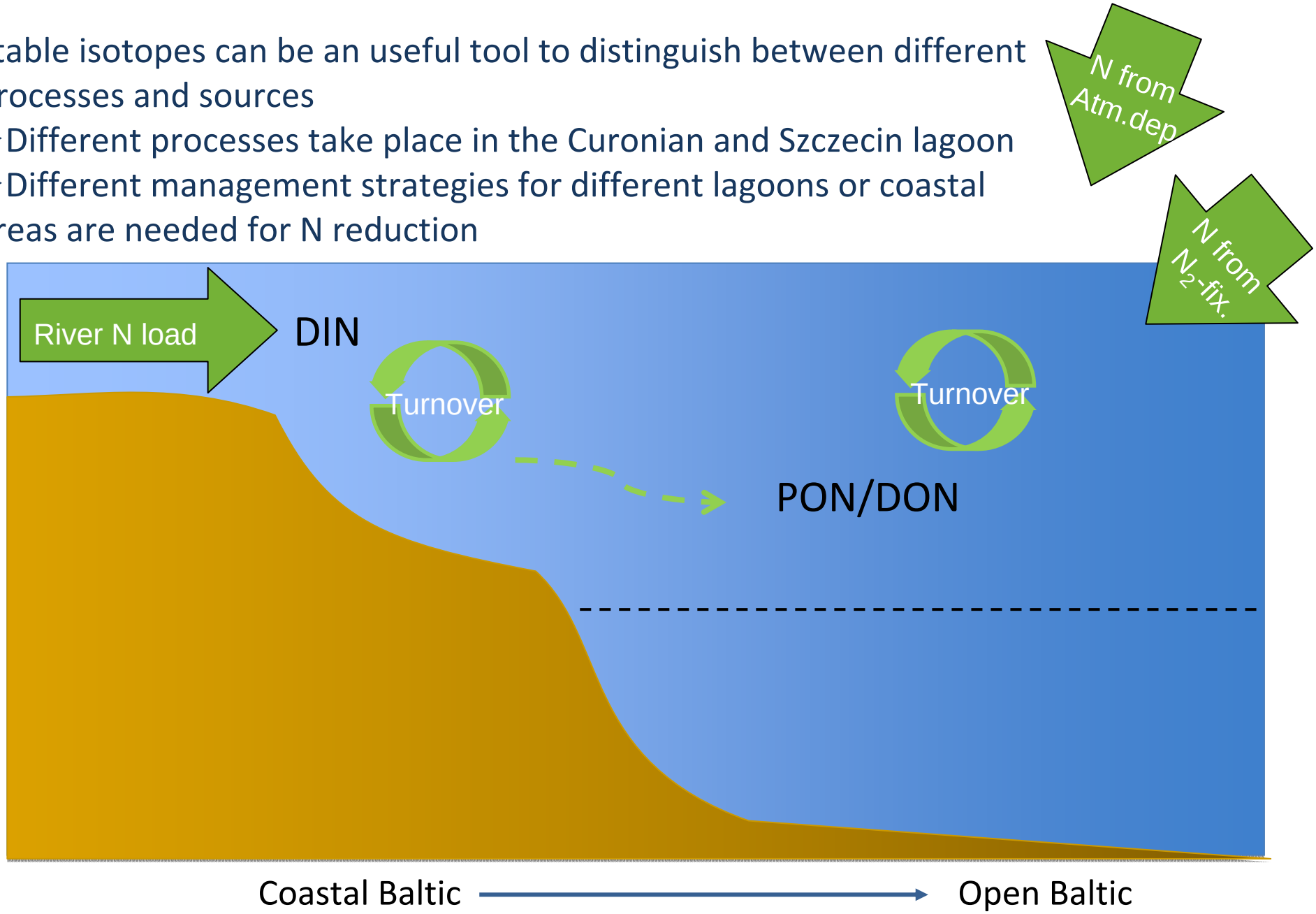
forthcoming publications :

- Korth, F. and Voss M.: Stable isotope composition and turnover of nitrate during spring outflow from the nitrate-rich Curonian and Szczecin lagoon

Relevance of the results for policy and stakeholders

Stable isotopes can be an useful tool to distinguish between different processes and sources

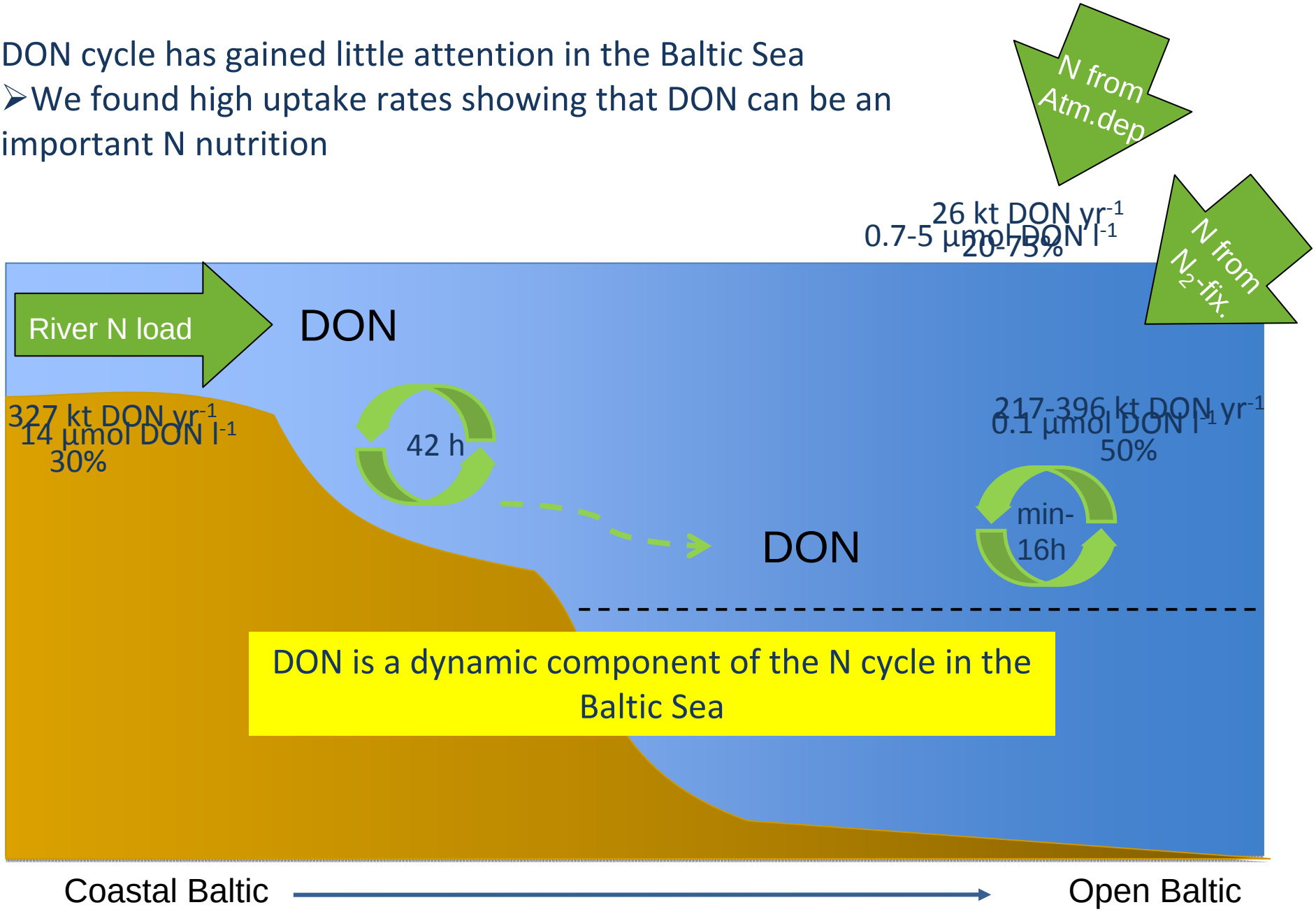
- Different processes take place in the Curonian and Szczecin lagoon
- Different management strategies for different lagoons or coastal areas are needed for N reduction



Relevance of the results for policy and stakeholders

DON cycle has gained little attention in the Baltic Sea

➢We found high uptake rates showing that DON can be an important N nutrition



Thank you for your attention!

Comparison of environments with contrasting nitrogen loads