CARBOSTORE Project – Results for pCO2 and Water Quality in Coastal Regions of Lower Saxony

Lara Luitjens, Dagmar Daehne

FerryBox

- Installed on the RV Burchana since 2016
- Sensors for pH (Meinsberg), oxygen (aanderaa), temperature and salinity (SeaBird Electronics), turbidity (Hach Lange), pCO2 (Contros), chl-a (AOA bbe moldaenke) wet-chemistry analysers for anorganic nutrients (Systea)
- Water Sampler (ICSO) for 24 samples

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CARBO STORE

Carbon Storage in German Coastal Seas

CARBOSTORE Project (2021-2024)

- Funded by the Federal Ministry of Education and Research
- research program "MARE: N - Coastal, Marine and Polar Research for Sustainability" under the umbrella of the Research Framework Program "Research for Sustainable Development" (FONA).

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CARBO STORE
Carbon Storage in German Coastal Seas

CARBOSTORE Project (2021-2024) - Objectives

- Identification of mechanisms for storing carbon in the oceans

  Mechanisms should be identified with the help of the mechanistic and quantitative understanding of the processes involved in carbon storage and their vulnerability and serve as ways to negative CO2 emissions

- Support the decision-making of regulatory and government bodies concerned with mitigating climate change

  Support through the provision of instruments with which scientific knowledge can be translated into management options

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CARBO STORE
Carbon Storage in German Coastal Seas

CARBOSTORE Project (2021-2024) - Objectives

- Investigation and evaluation of the sensitivity and resilience of different carbon stores in the North and Baltic Seas
  - Analysis of interactions of physically driven and biogeochemical cycles (in particular CO2-uptake/biological pumping) under the combined influence of global change and other directly anthropogenic drivers in the North Sea and Baltic Sea
- Prediction of the future development of carbon stores under different scenarios of climate change and anthropogenic changes
  - Developing a hydrodynamic-biogeochemical modelling System (FVCOM/GETM ERGOM) with estimating balances of organic matter, nutrients, total alkalinity and DIC for the North Sea and Baltic Sea region

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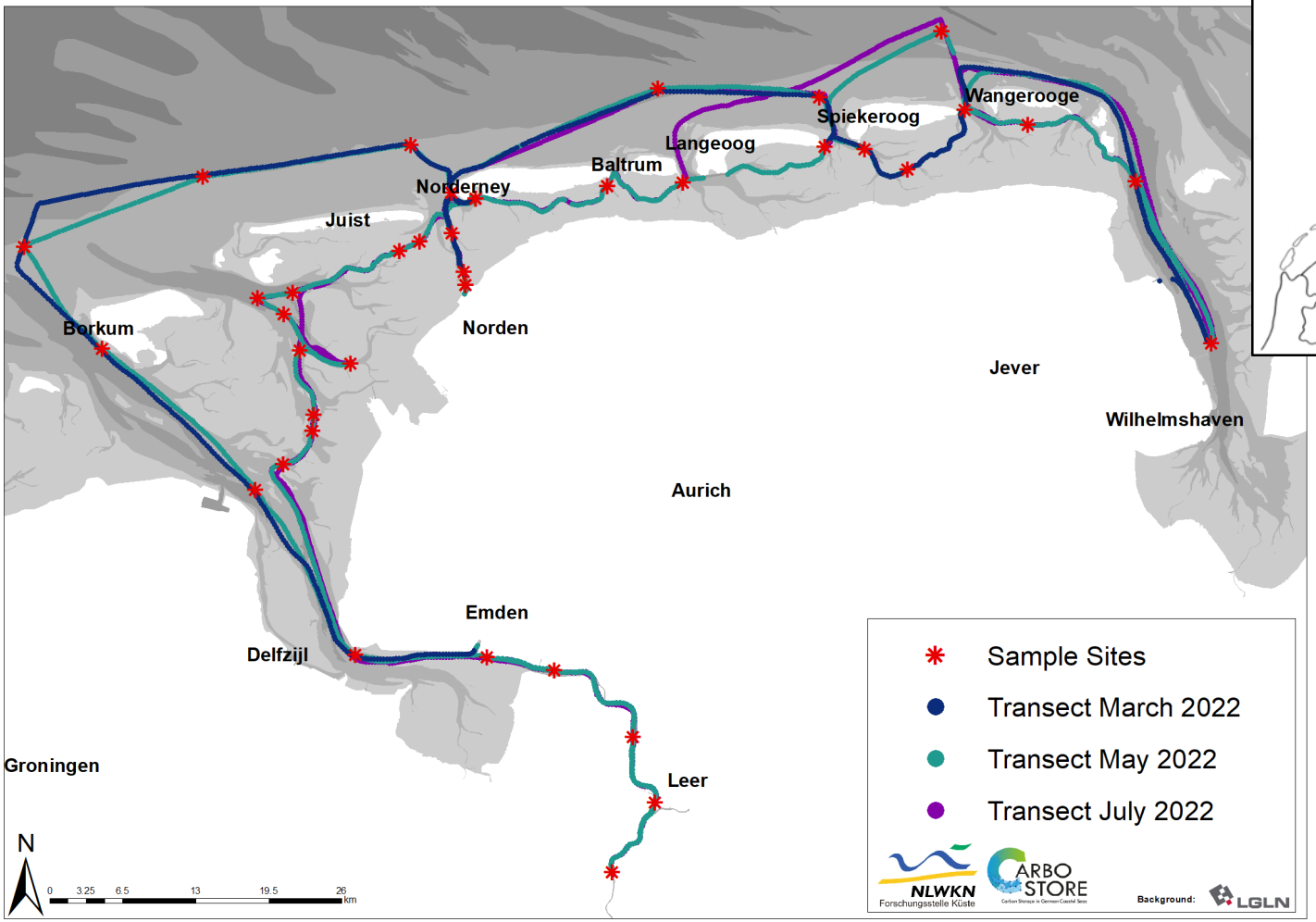
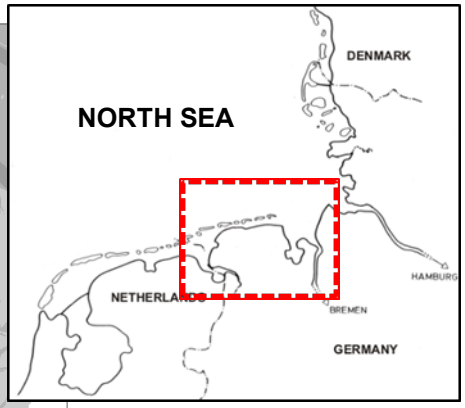
CARBOSTORE Project – Pelagic Realm (WP 1)

- Understanding the role of anthropogenic influences on physical and biogeochemical factors that regulate the uptake and storage capacity of CO2 in the water column
- Influence of Total Alkalinity (TA) changes on carbon uptake
- Characterization of the influence of the assimilation of sulfur on carbon storage as a more resistant, dissolved organic material
- Input of data from nature measurements into the bidirectionally coupled hydrodynamic-biogeochemical model system

→ **NLWKN:** providing ship-based high-resolution transect-data with the FerryBox for the North Sea, Wadden Sea and estuaries on biogeochemistry, nutrients and, in particular, relevant parameters of the carbonate system including collecting samples for the other institutes

CARBOSTORE Campaigns

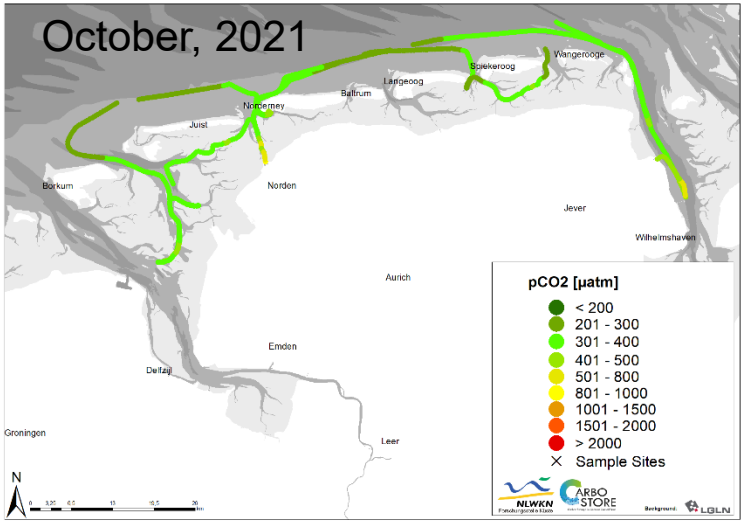


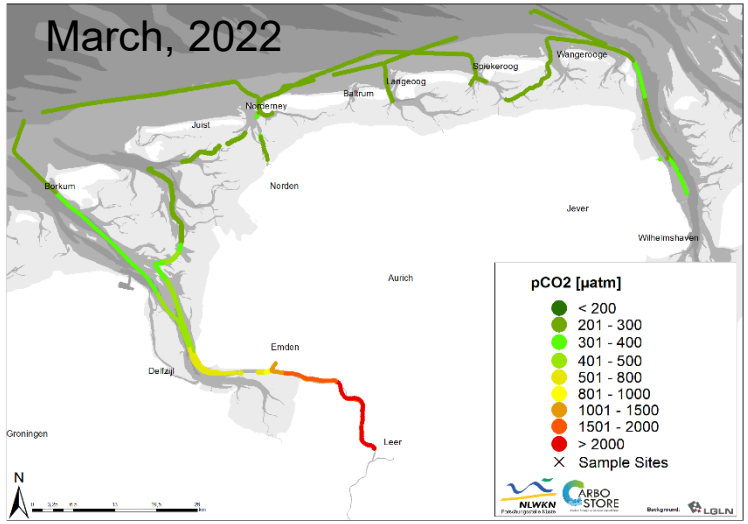


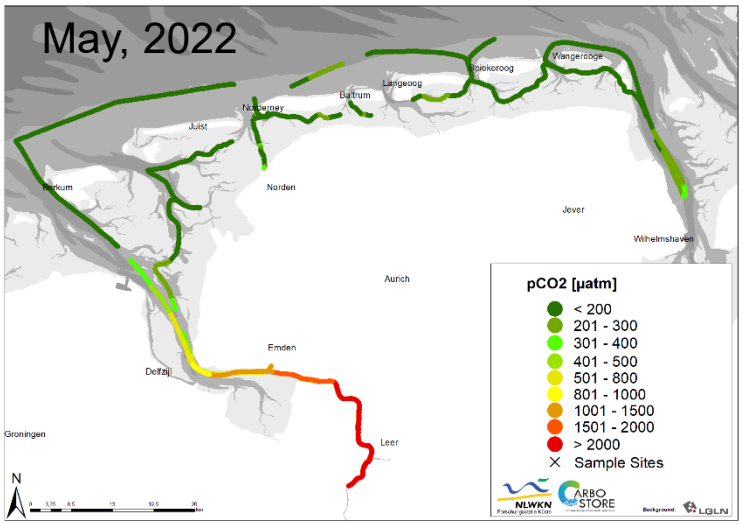
Sampling:
nutrients,
TP/TN,
DON/DOP,
NO3-, DIC-,
H2O-, DOC-
Isotops,
TA, DIC, Rd
(Hereon),

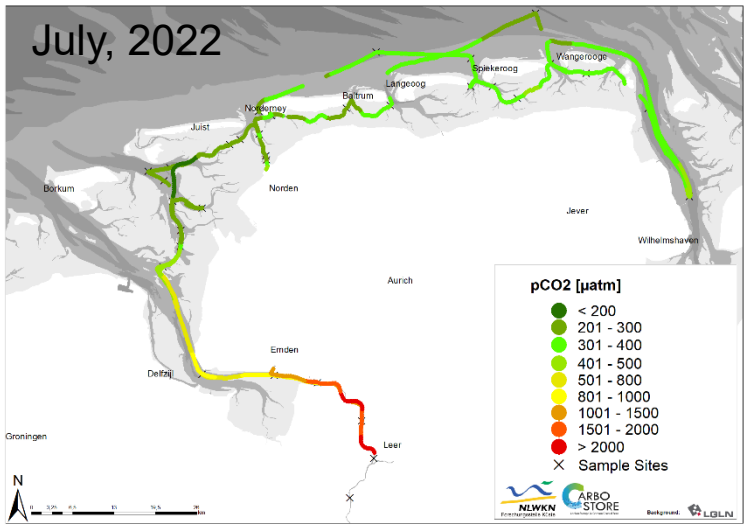
DOM (ICBM)

Seasonal changes of pCO2 in the intertidal region around the North Frisian Islands

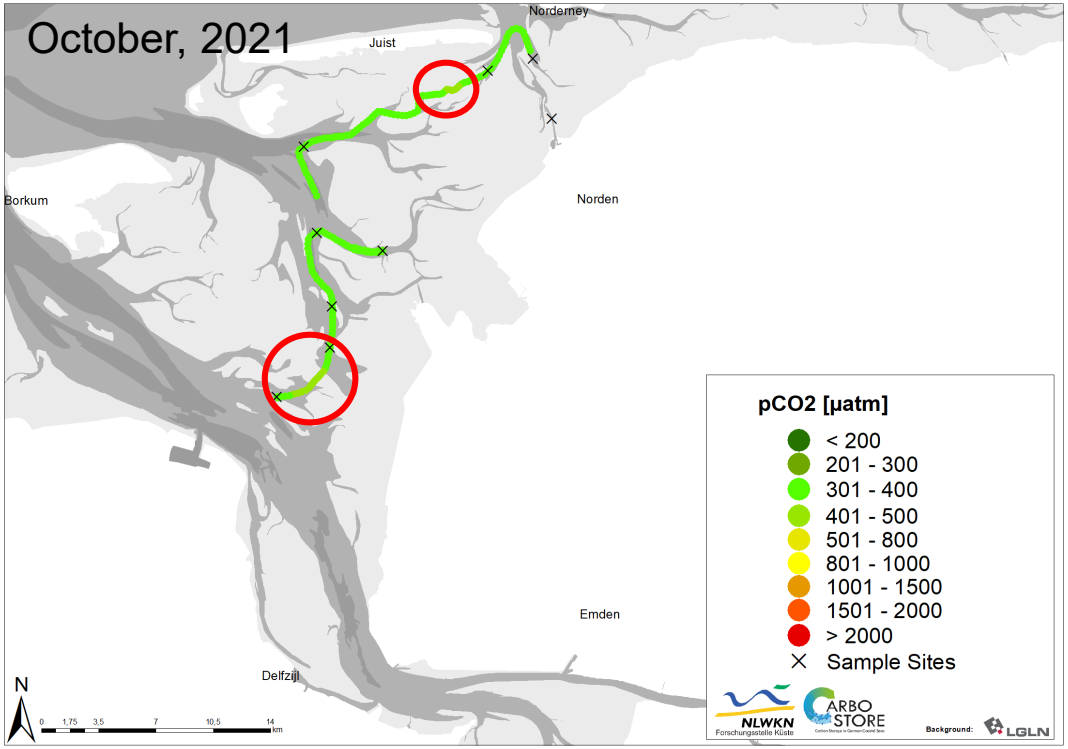


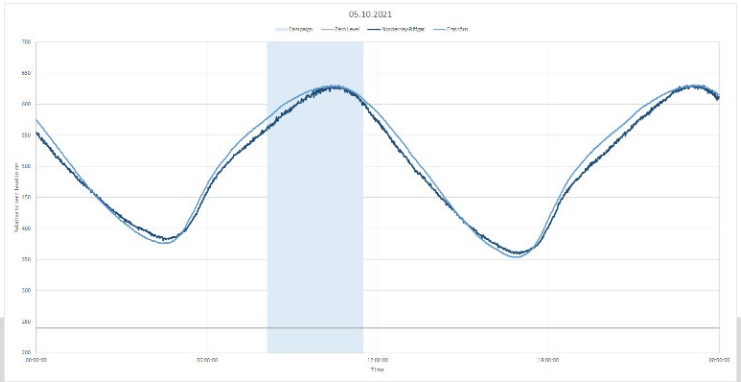


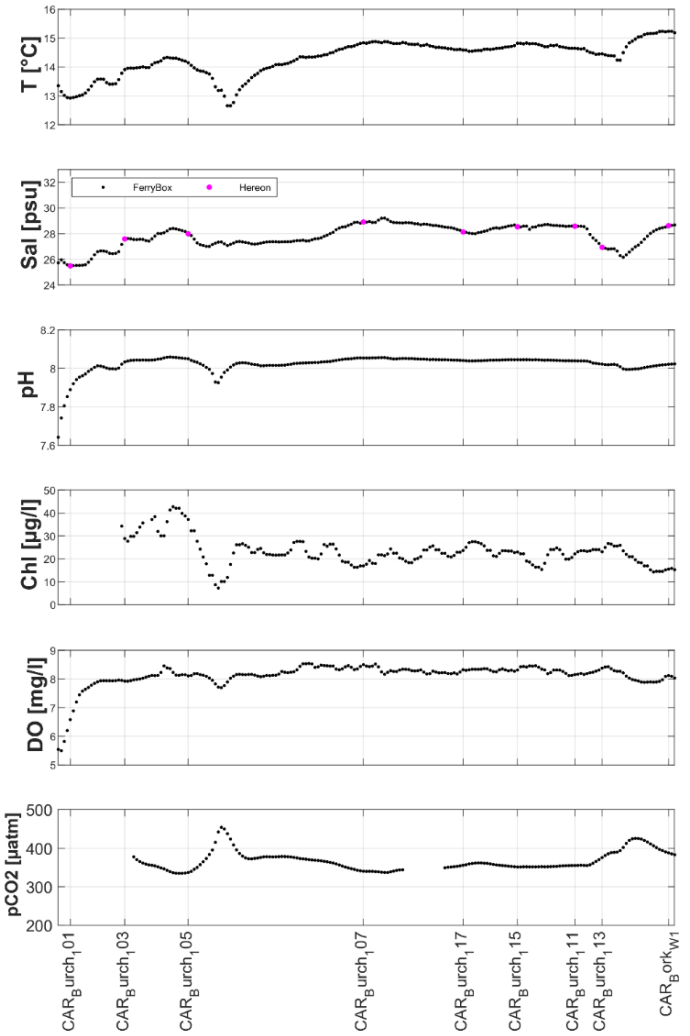




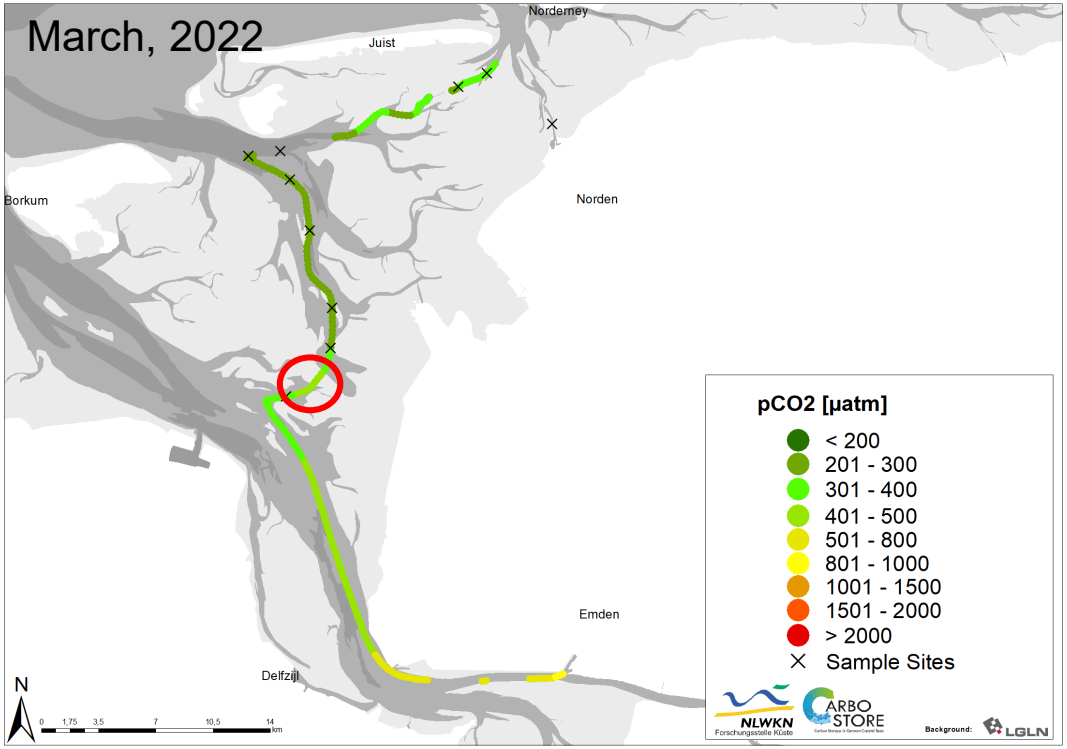
pCO2 vs other water parameters

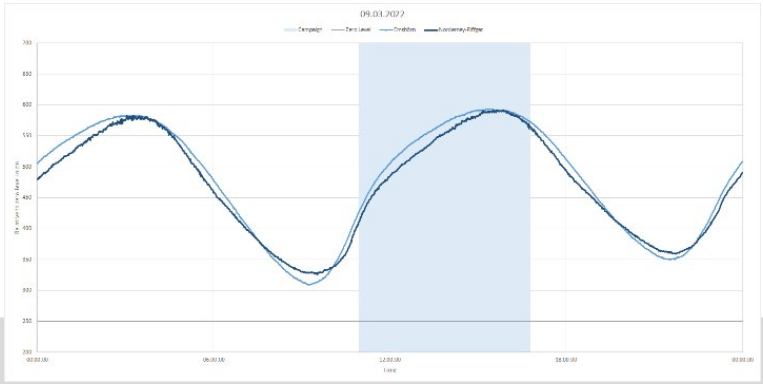


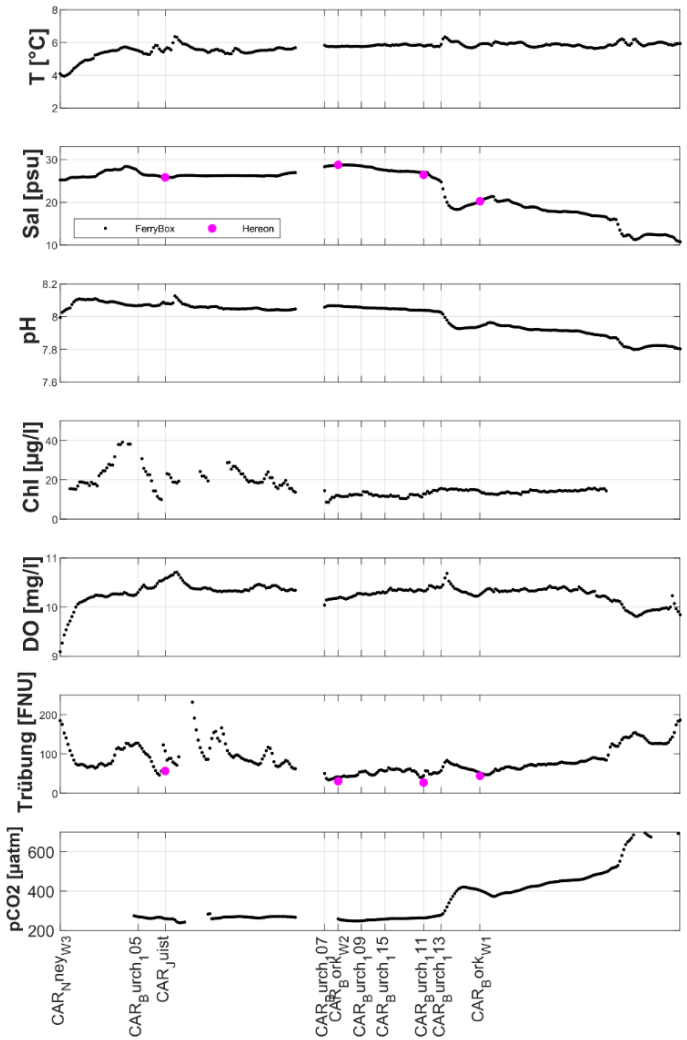




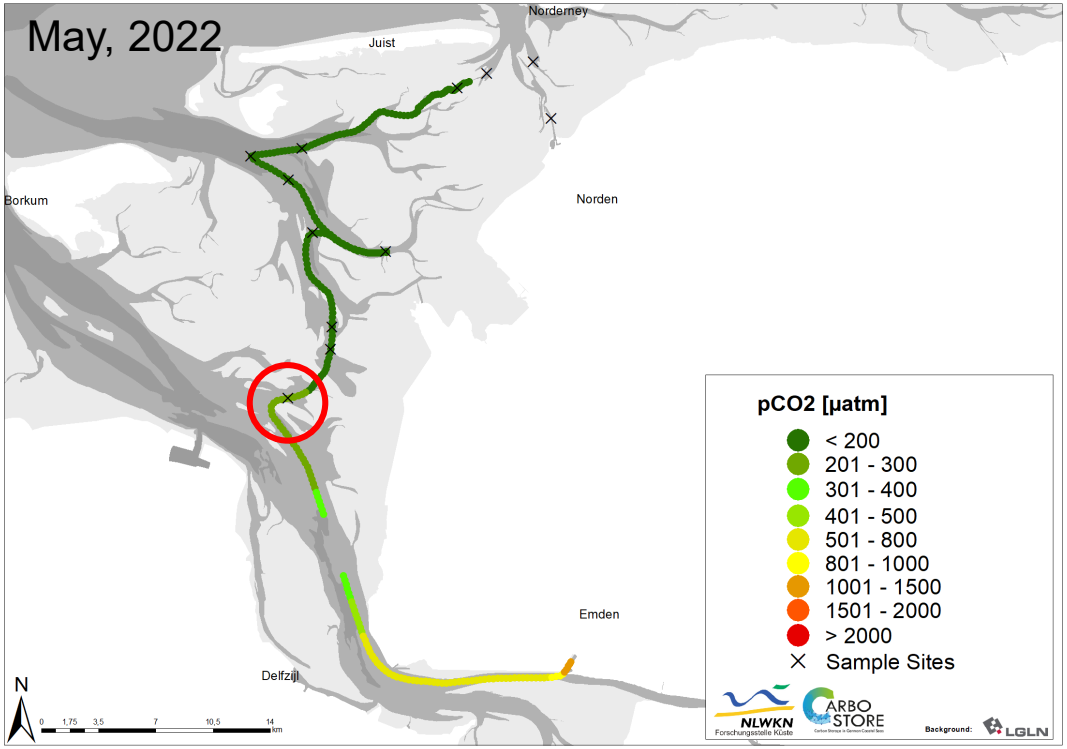
pCO2 vs other water parameters

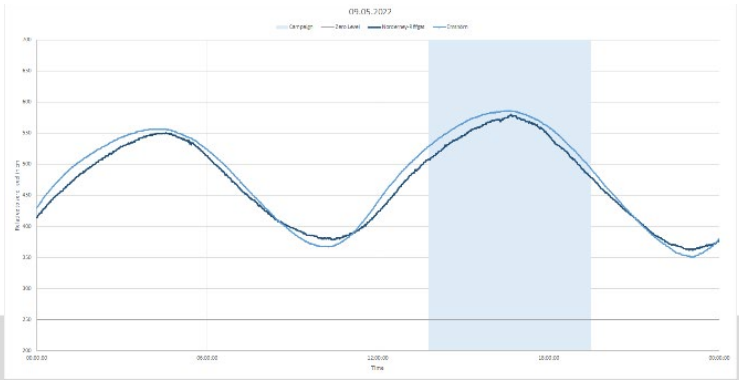


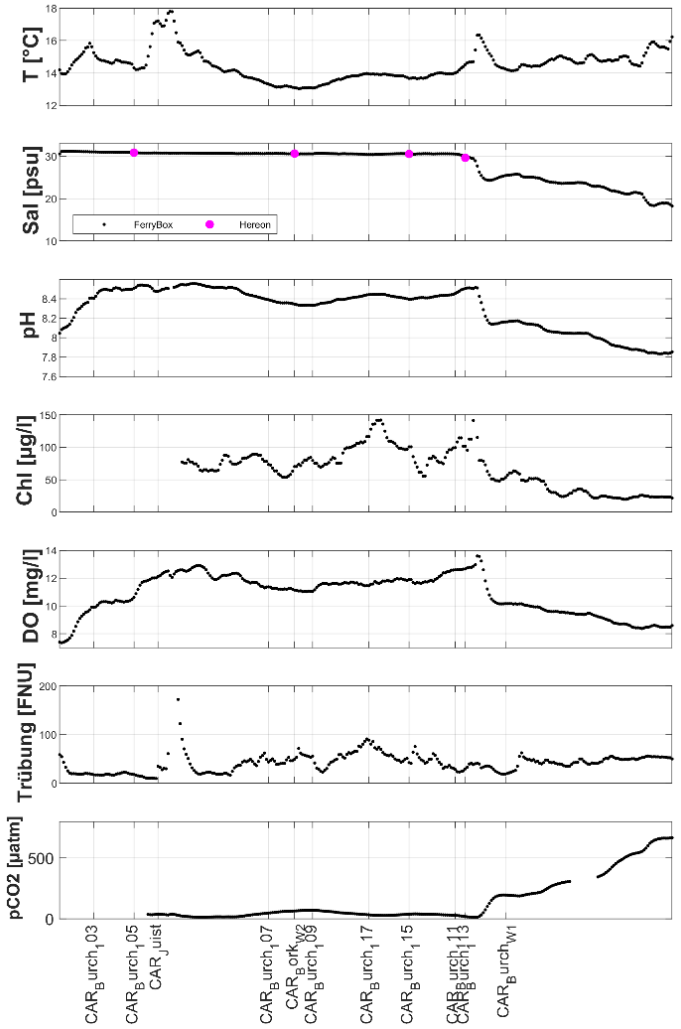




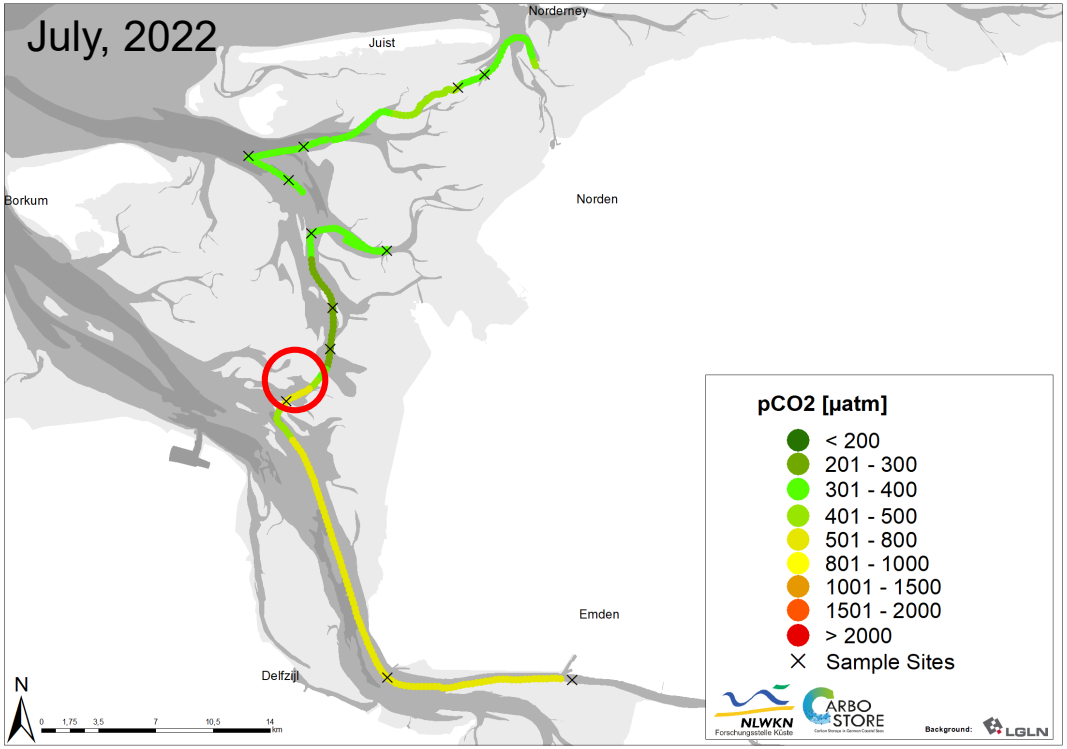
pCO2 vs other water parameters

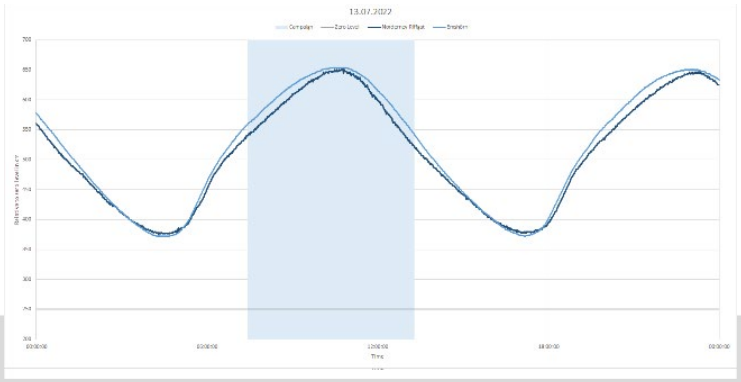


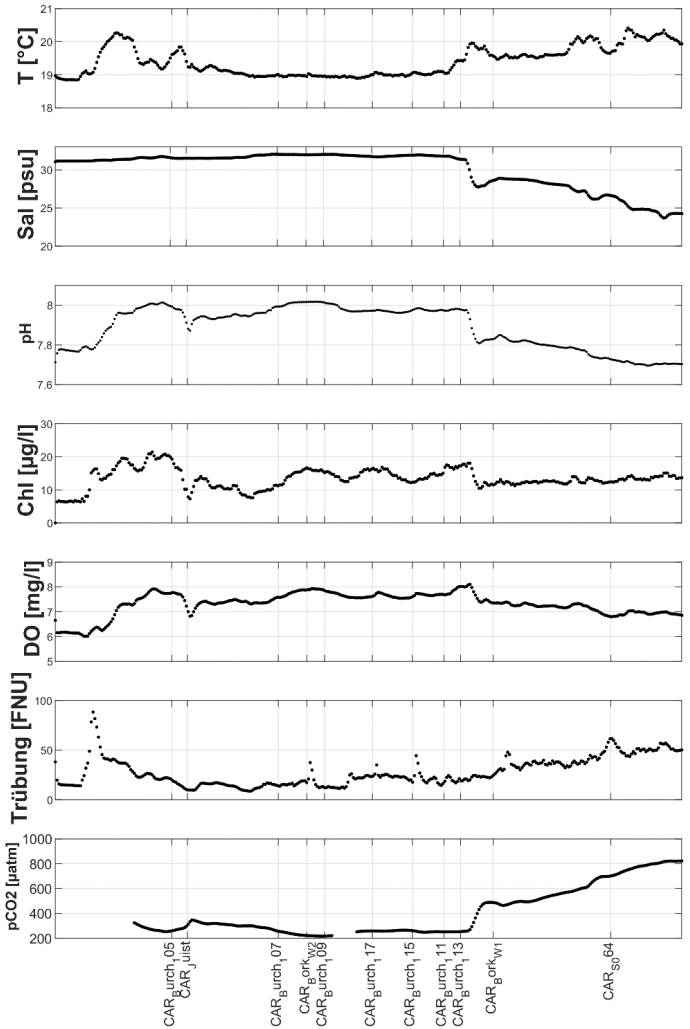




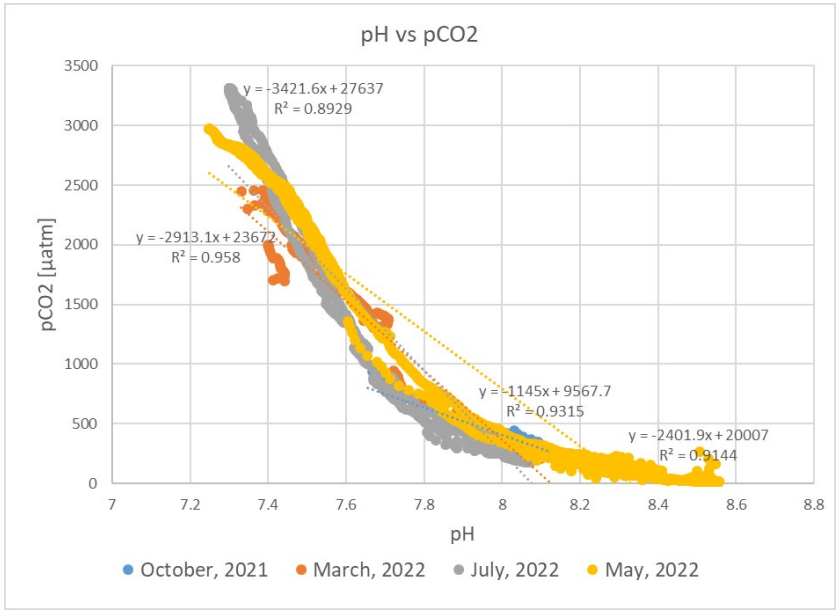
pCO2 vs other water parameters





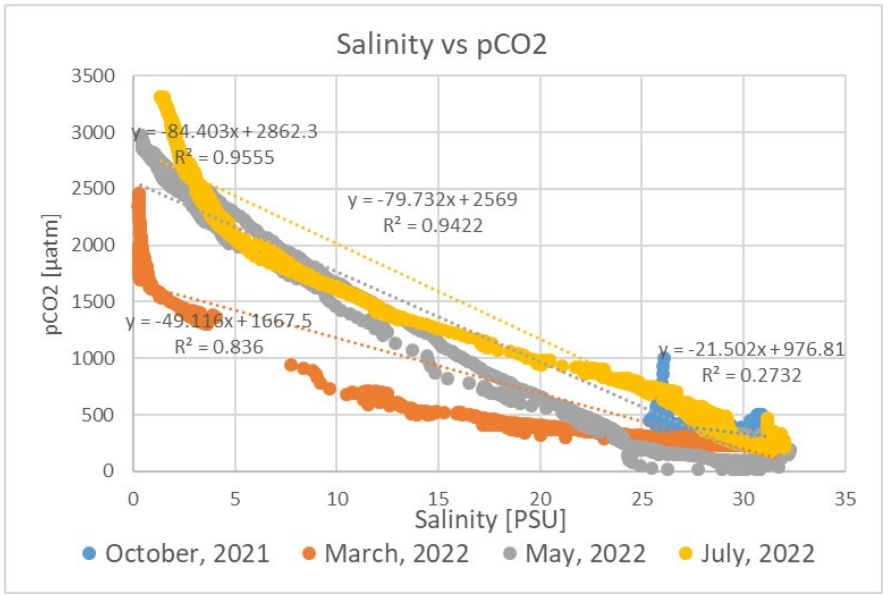


pCO2 Regression



Linear Regression pH vs pCO2
0.89 (July) – 0.96 (March)

Linear Regression Salinity vs pCO2
0.27 (October) – 0.96 (July)

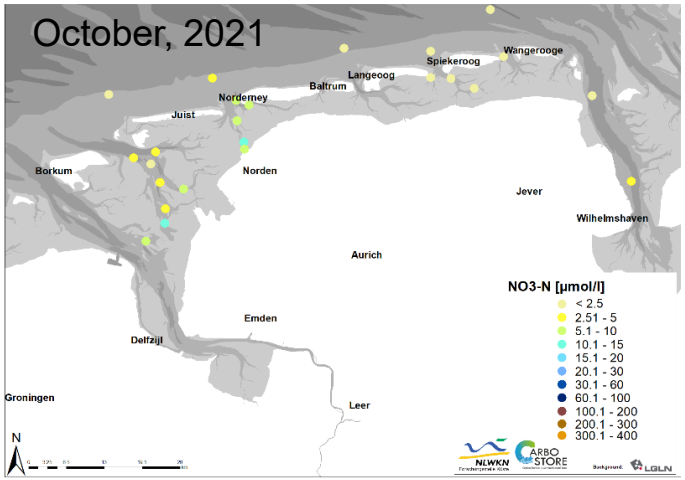


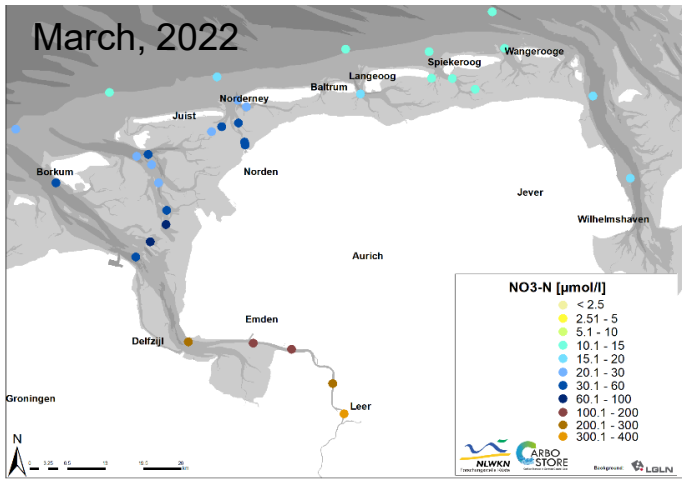
Conclusion

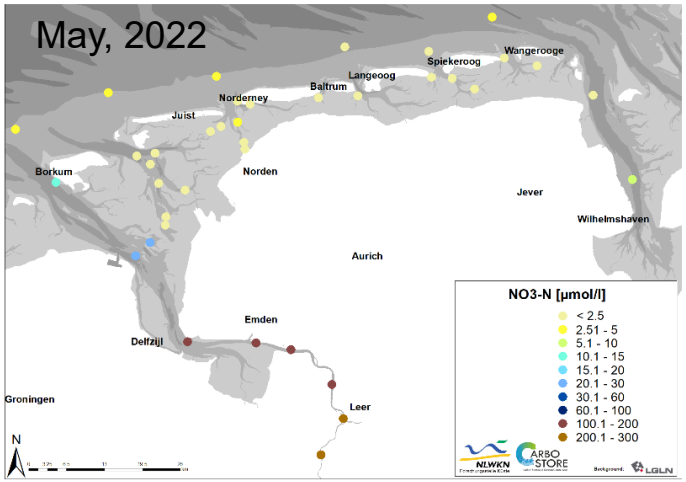
- High seasonal variation of pCO2 in the Wadden Sea,
- In spring high primary production coincides with time of high dissolved oxygen, low pCO2, high pH and low nutrient measurements in the Wadden Sea
- In the river Ems during the whole year very high pCO2 concentrations

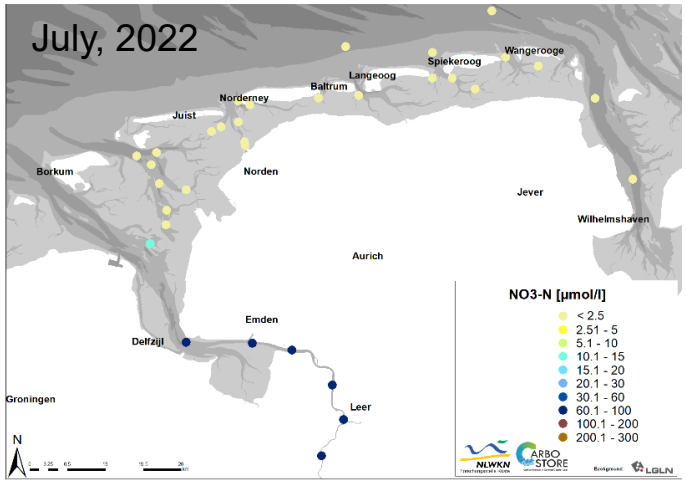

Thank you for
your attention!

Seasonal changes of nutrients – Nitrate µmol L^{-1}



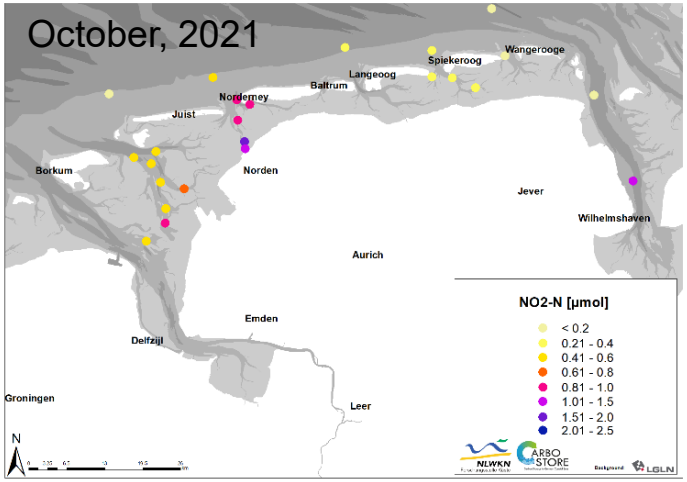


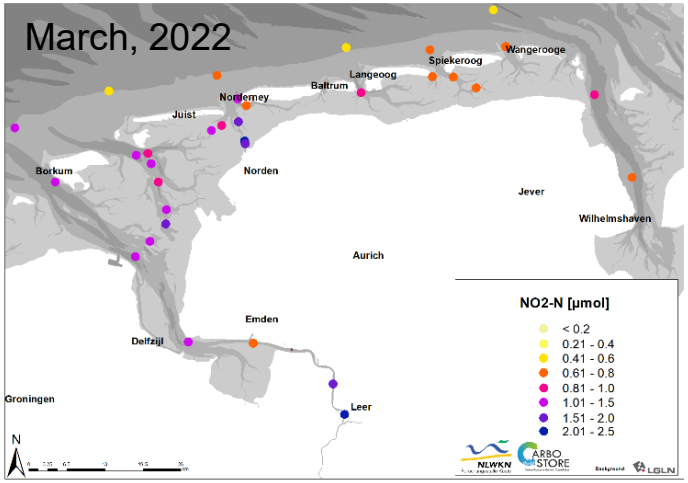


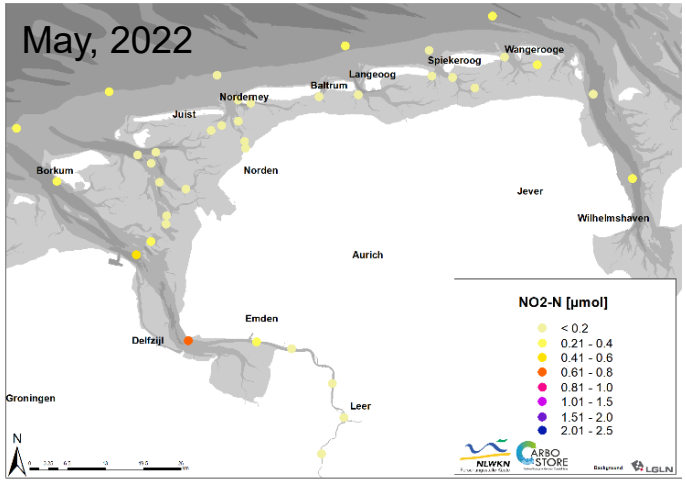


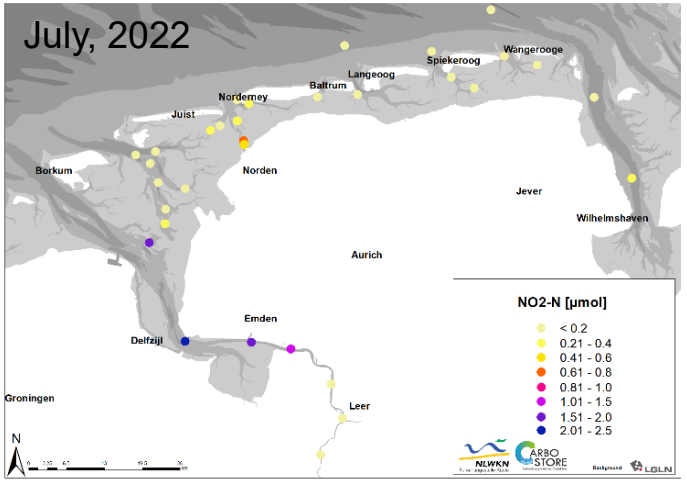
- Maximum reached in March before algae growth begins with a gradient from west to east
- Up to May almost all Nitrate is depleted by phytoplankton in coastal regions, remains low during summer
- Ems estuary with high concentrations
- Remineralisation phase in October

Seasonal changes of nutrients – Nitrite µmol L^{-1}



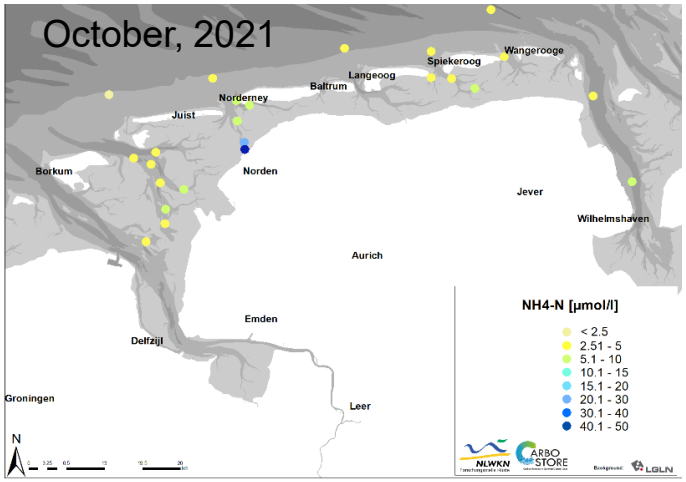


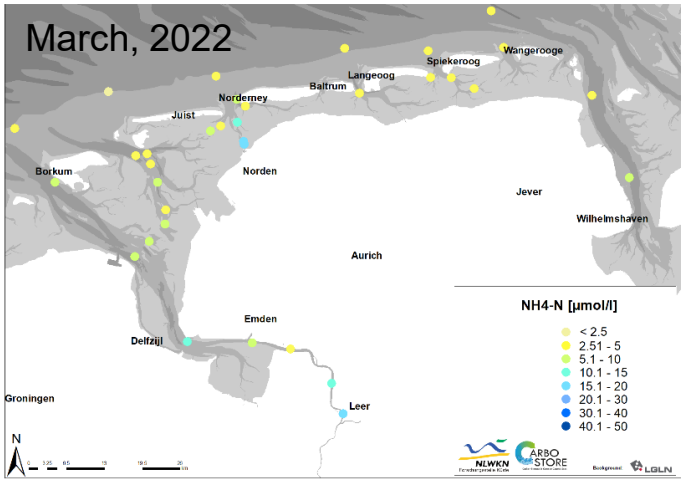


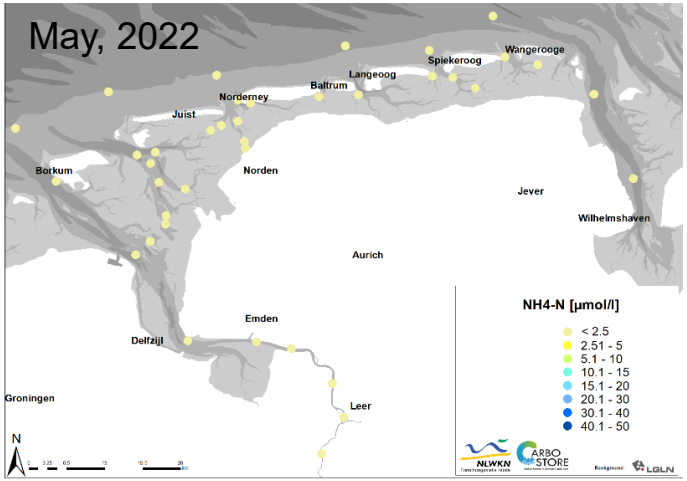


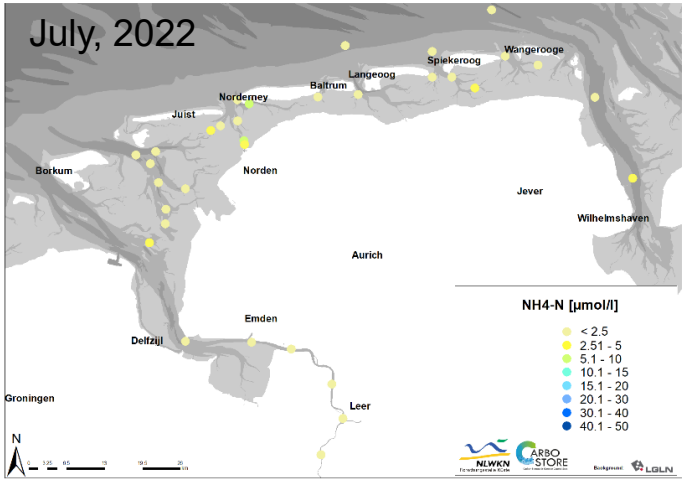
- Highest concentrations in March (max 2.5 mmol/l), lowest in May und July
- lowest conc. in May und July
- Import through Ems river in July
- Remineralisation process in October, high concentrations locally near Norderney

Seasonal changes of nutrients – Ammonium µmol L^{-1}



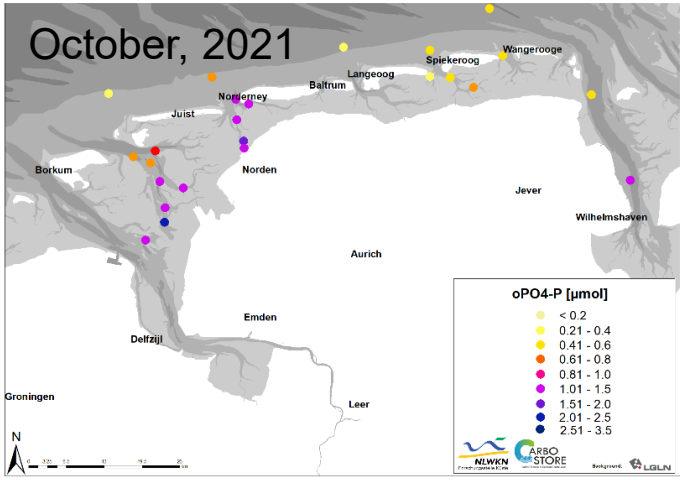


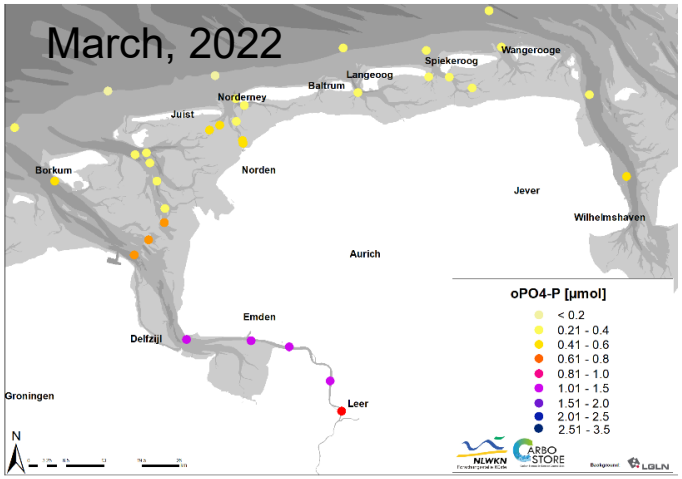


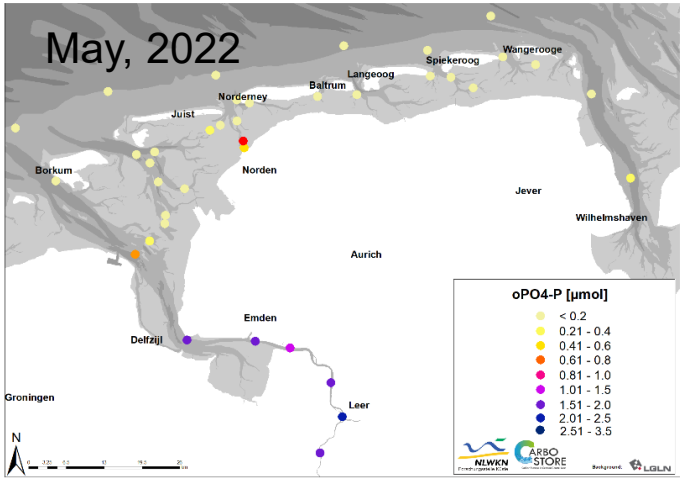


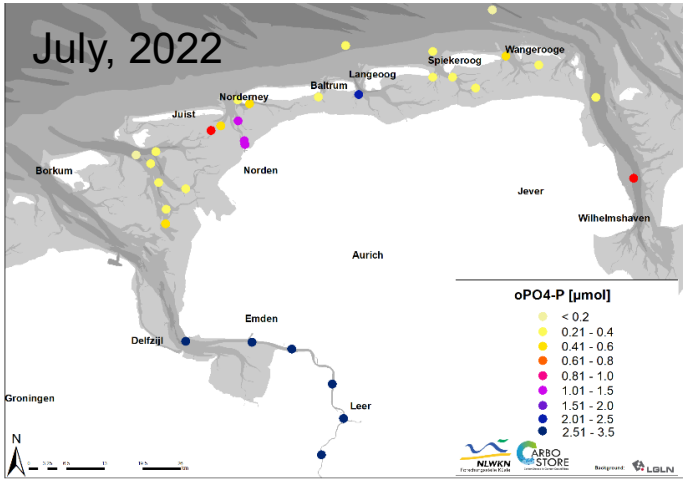
- Highest concentrations in October and March (10 - 20 µmol/l),
- lowest in May and July (not detected)
- Special situation in waterway to Norderney

ortho Phosphate µmol L^{-1}









- Highest concentrations in October (max. 3.3 mmol/l), lowest in May
- Import of Phosphate via Ems river (highest in summer)


Thank you for
your attention!

Seasonal changes of nutrients – Silicate µmol L^{-1}