Novel biogeochemical sensors: Operation of a newly developed total alkalinity (TA) analyser in combination with a FerryBox

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

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8th FerryBox Workshop 17-19.10.2017
Color Fantasy/Baltic Sea

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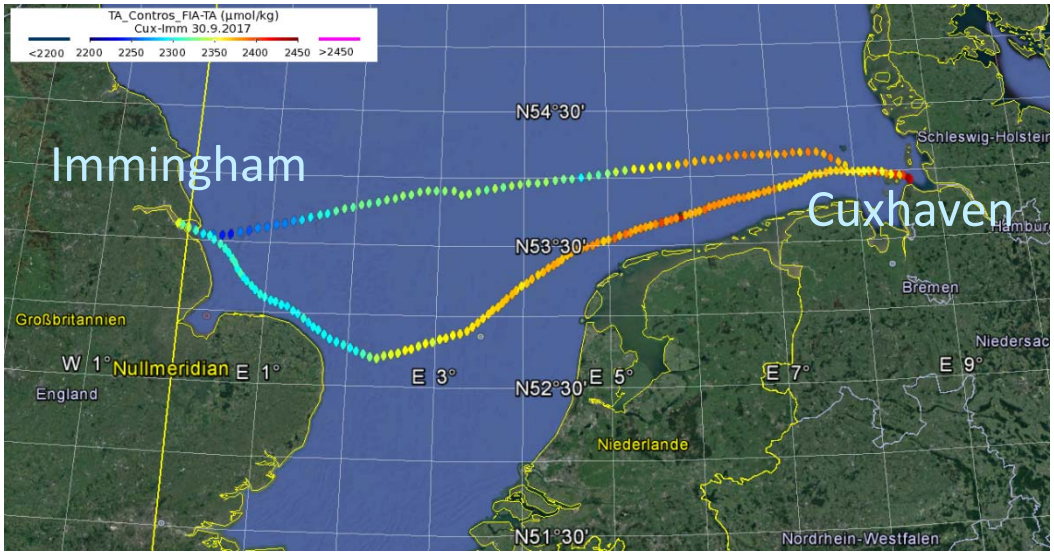
CV Hafnia Seaways Route:
Immingham, UK ⟷ Cuxhaven, DE



The Hafnia Seaways crosses the southern region of the North Sea, between Cuxhaven, DE and Immingham, UK. This is a dynamic region in the North Sea, which could be influenced by major rivers (Elbe, Rhine), the Wadden Sea, and the North Atlantic flow from the English Channel.

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Measurement instruments on Cargo Vessel (CV) *Hafnia Seaways*

HydroFIA-TA

- Autonomous flow-through TA analyser from *KM Contros*

HydroFIA-TA in the laboratory

FerryBox in the engine room on *CV Hafnia Seaways*

FerryBox

- Salinity
- Temperature
- pH
- pCO_2
- Chlorophyll *a*
- colored dissolved organic matter (CDOM)
- Turbidity
- Dissolved Oxygen

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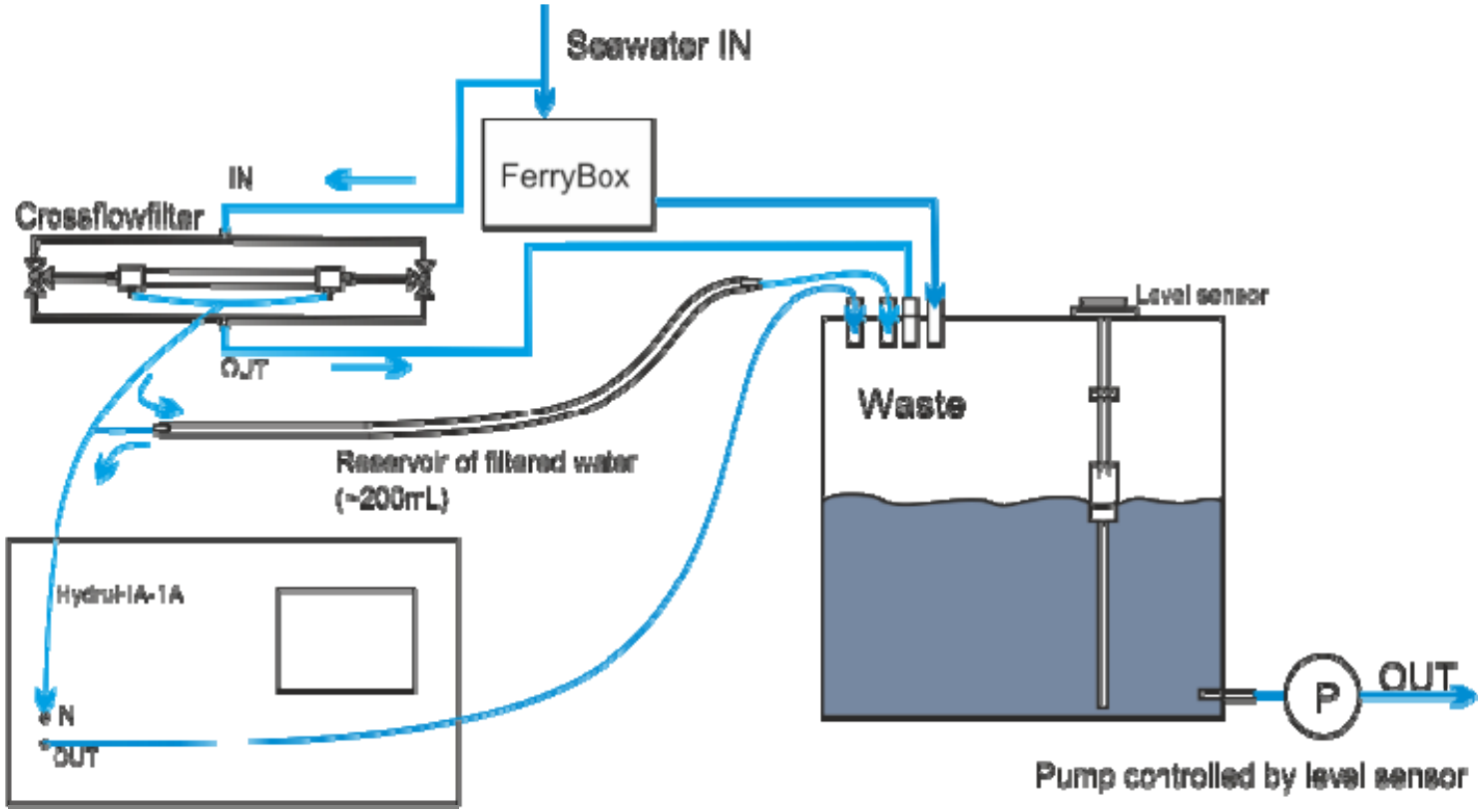
Installation of the HydroFIA-TA analyser:



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Operation characteristics of the TA sensor

- **Reagents:**
  - 500mL of 0.1N HCL
  - 500ml of Bromocresolgreen (BCG) as pH indicator
- **Run time with 1 reagent batch ~ 5 weeks**
- **Calibrant:**
  - Certified reference material (CRM) from Andrew Dickson's Laboratory
- **Internal reference:**
  - filtered North Sea seawater
- **Measurement frequency:**
  - 10 min during the cruises

QC and calibration procedure in the field

1. Flush and measure internal reference with old reagents
2. Change reagents
3. Measure with internal reference and CRM
4. Calibrate 4 x measurements with CRM
5. Measure CRM and internal reference as check

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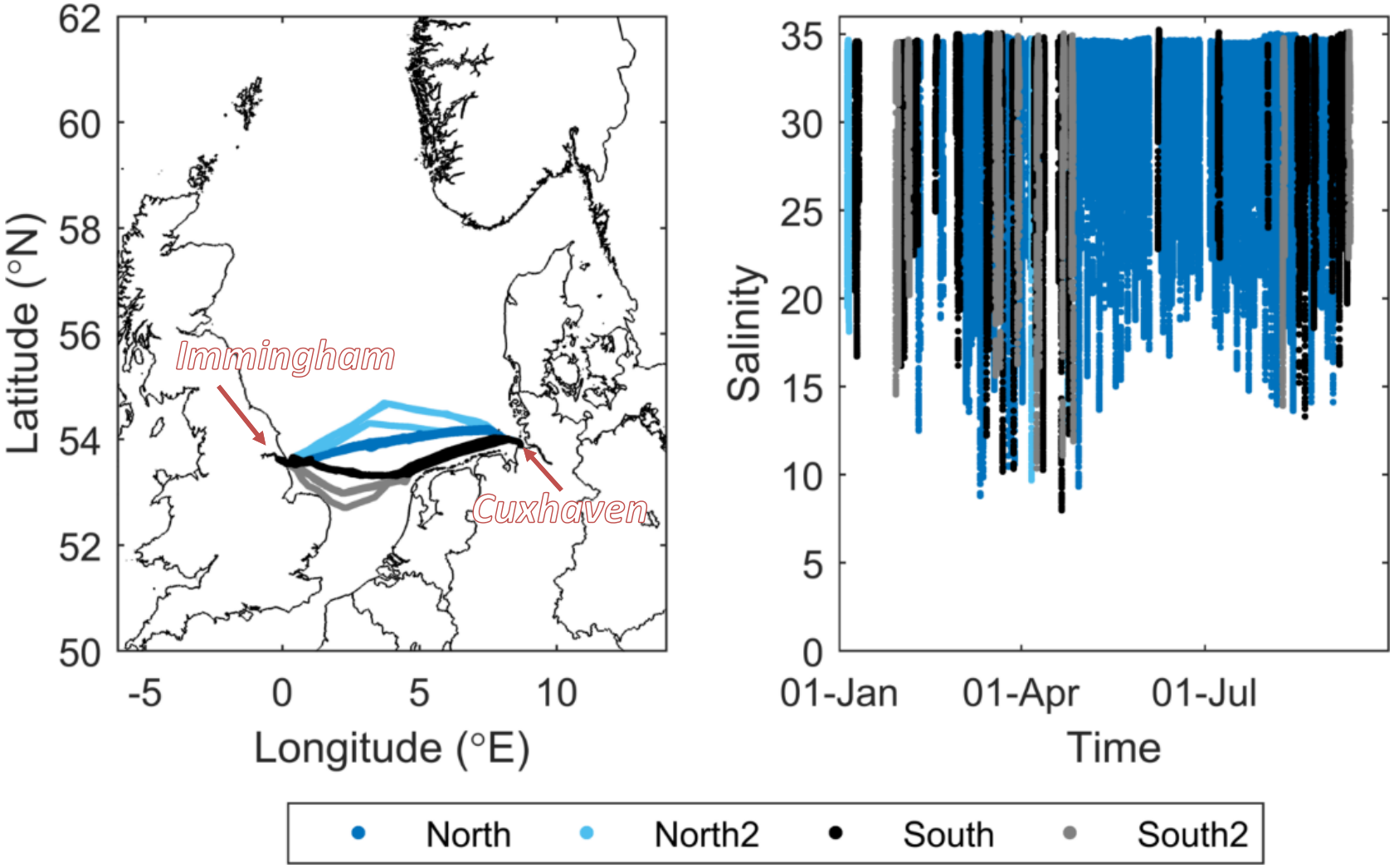
Hafnia Seaways Cruises Immingham - Cuxhaven in 2017:



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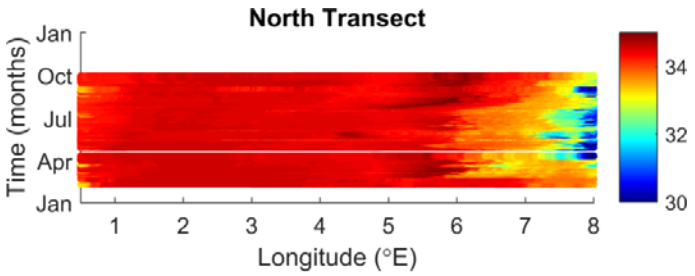
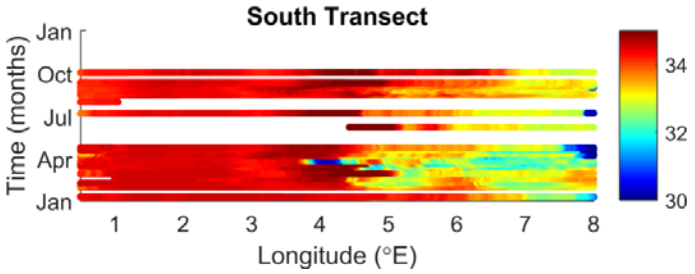
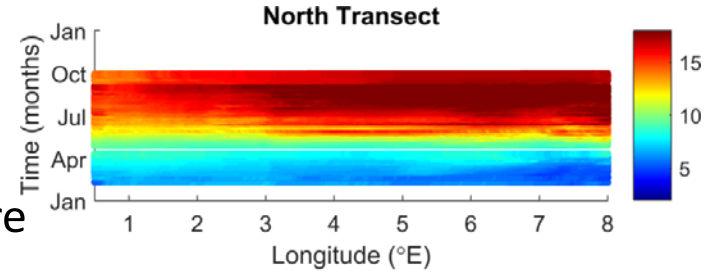
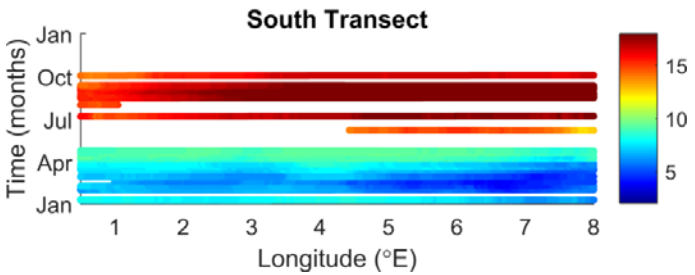
Salinity



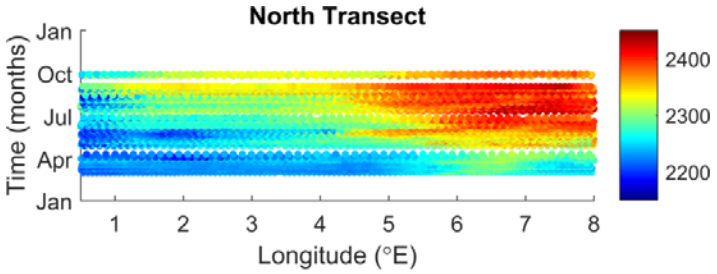


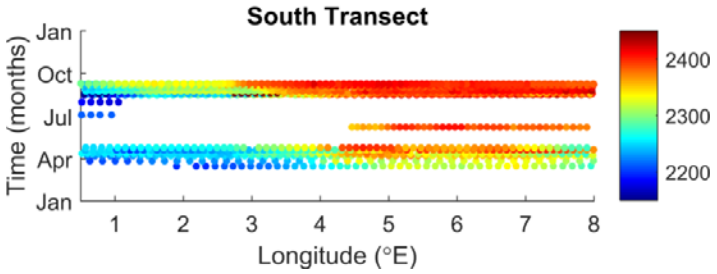
Temperature [°C]



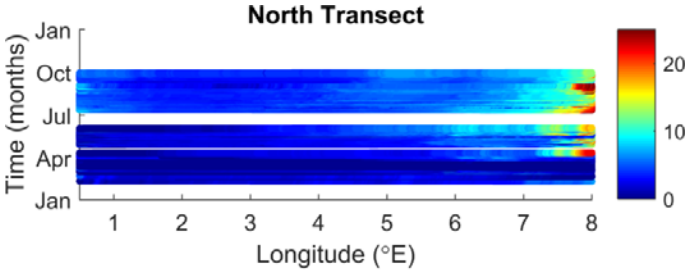


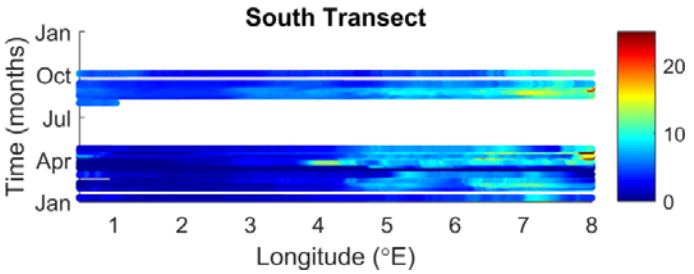
TA [µmol kg^{-1}]





CDOM





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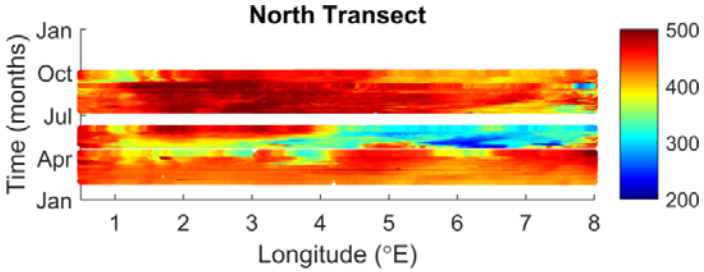
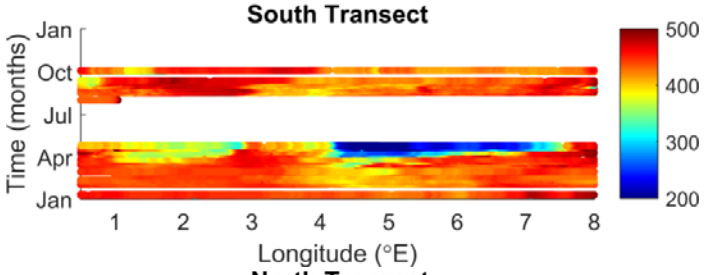
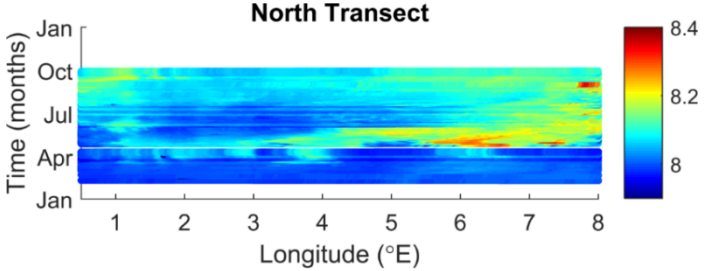
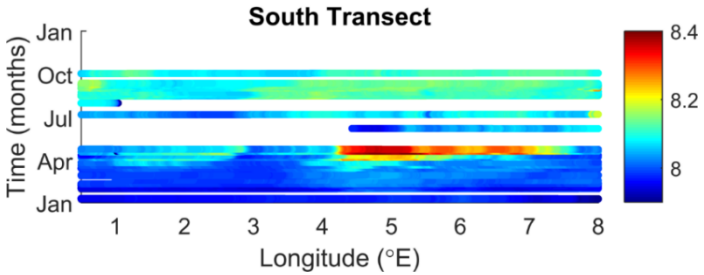
pCO_2 [µatm]



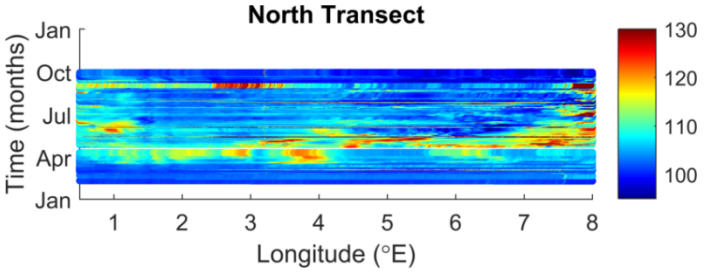


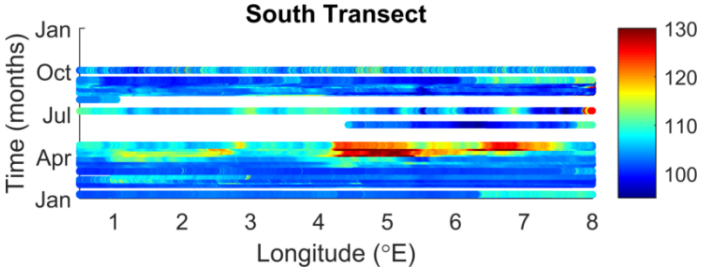
pH



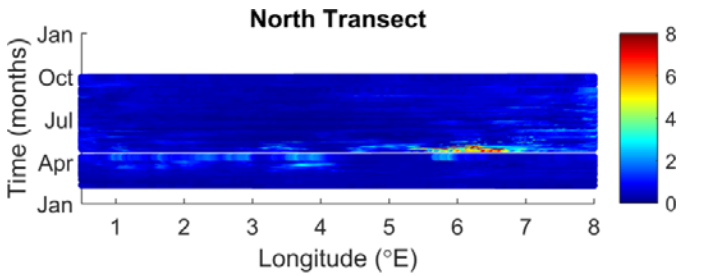


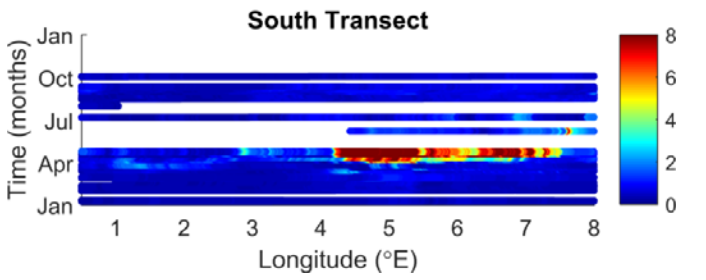
DO [%Sat]





Chlorophyll a fluorescence





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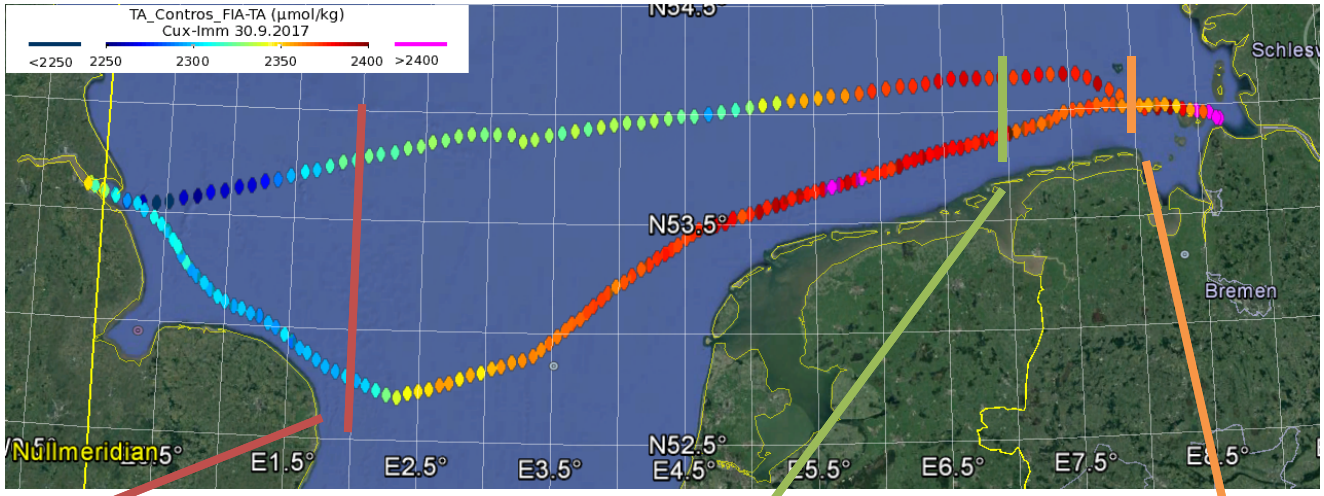
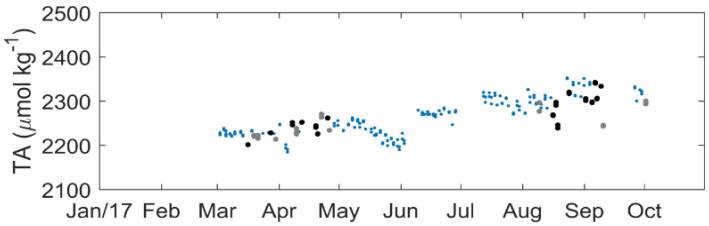
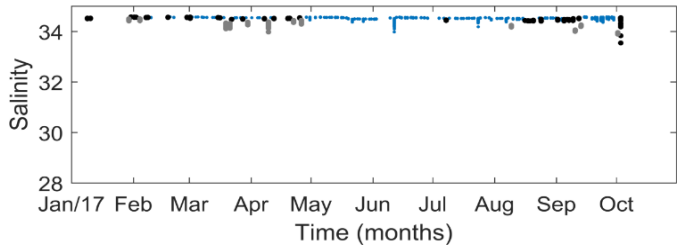
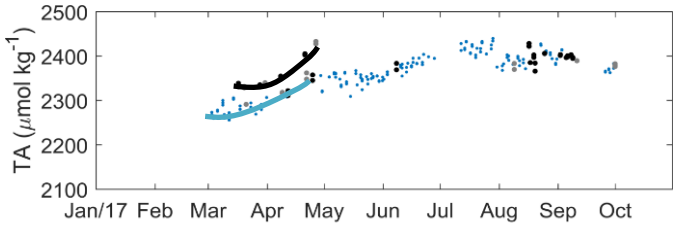


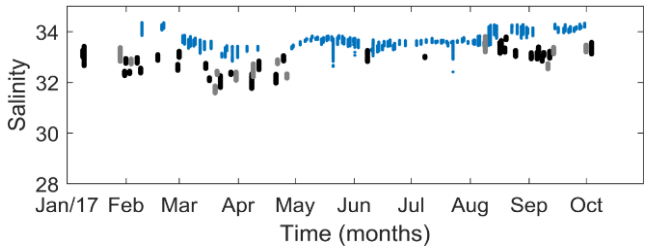
2°E



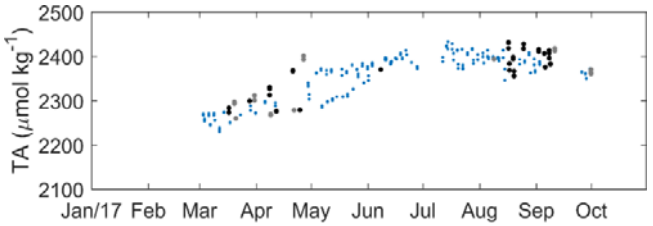


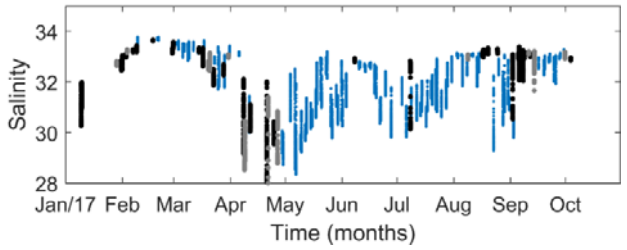
7°E





8°E





North North2 South South2

Conclusions and further studies:

- newly developed sensor for alkalinity has been successfully operated on a FerryBox system for a longer time period
- lowest salinities along the North route are measured in late spring-early summer (April-July) between 6-8°E
- Total alkalinity (TA) did not follow this pattern
  ==> TA is influenced by other sources or sinks
- TA in the east of the transect is significantly higher
- Seasonally, alkalinity increased (from < 2250 to > 2400 µmol/kg), particularly in the region north of the Wadden Sea
  ==> Wadden Sea has an impact on the alkalinity in the adjacent open North Sea. One factor may be the increasing release of organic matter during the summer (indicated by CDOM data)
- Carbon measurements will be continued and soon complemented by a high precision spectrophotometric pH sensor

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Thanks for your attention!

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