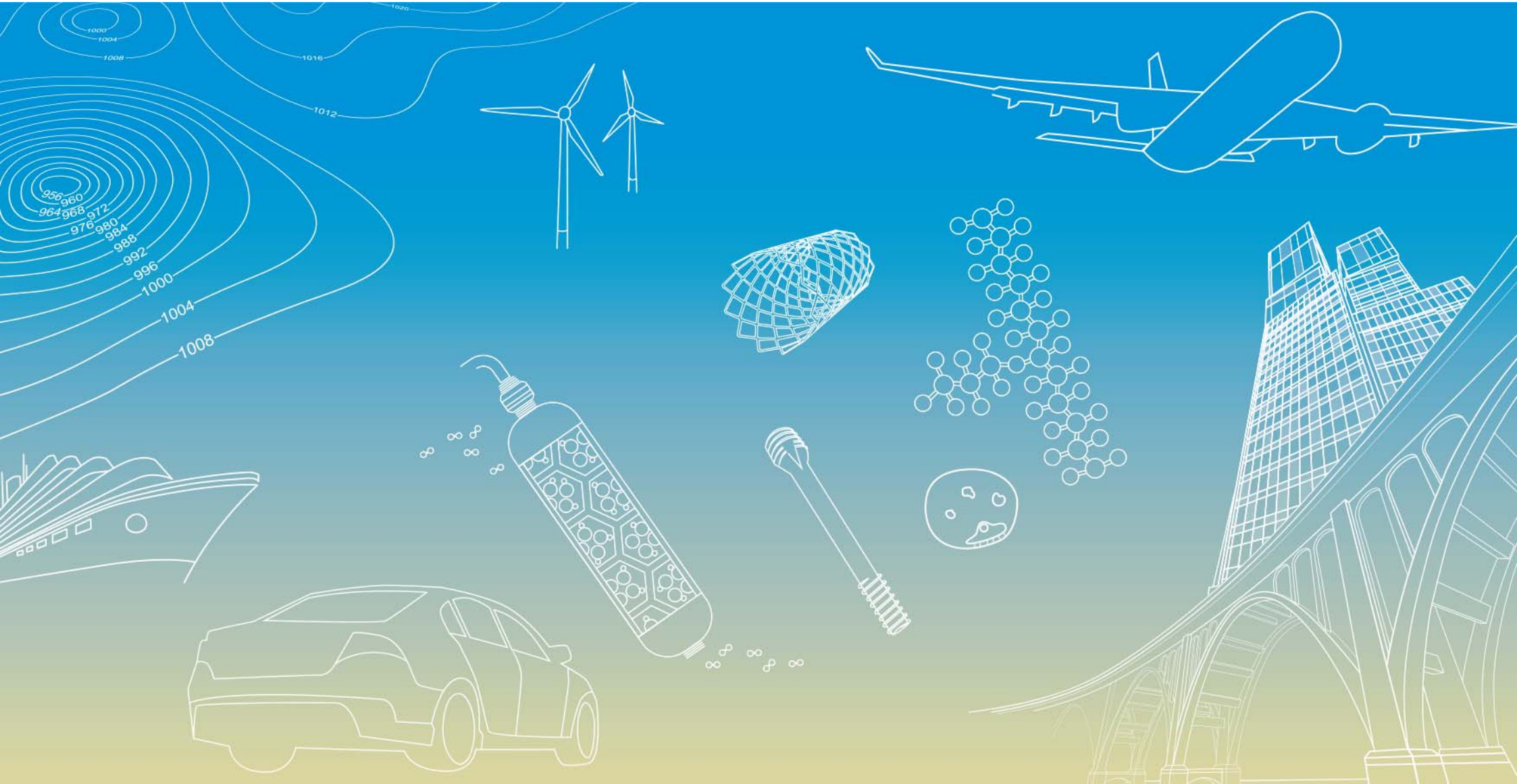


# Carbon Dynamics in the North Sea: Insights from FerryBox Measurements

Yoana Voynova, Wilhelm Petersen



- providing basic measurements of oceanographic parameters (T, S, Turb, Chl-a, oxygen...)
- delivering data to European projects and activities (JERICO-NEXT, CMEMS, EMODNet)
- application of physical parameters (T, S) in data assimilation schemes
- Investigation of biogeochemical processes:
  - nutrient behaviour and impact on algae dynamic along the transects
  - carbon cycle and the importance of different coastal areas as source or sink for atmospheric carbon (pCO<sub>2</sub>, pH, TA)
  - estimation of productivity along the transects from continuous data (oxygen, carbon, chl-a etc.)
  - optimization and validation of biogeochemical models with FerryBox data



# FerryBoxes within Coastal Observing System COSYNA

([www.cosyna.de](http://www.cosyna.de))

## Fixed Routes



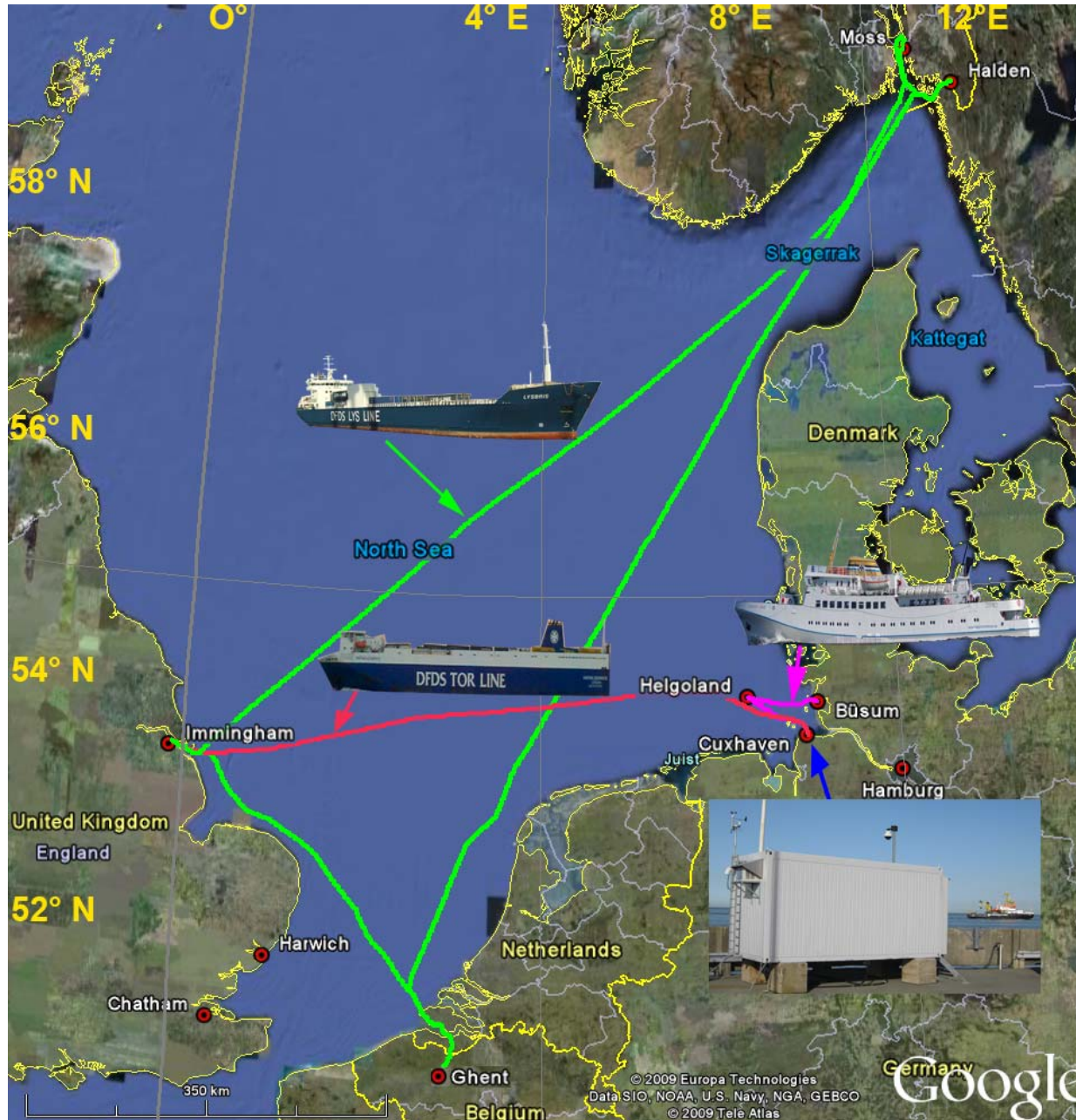
## Research Vessels:



## Fixed Platforms:



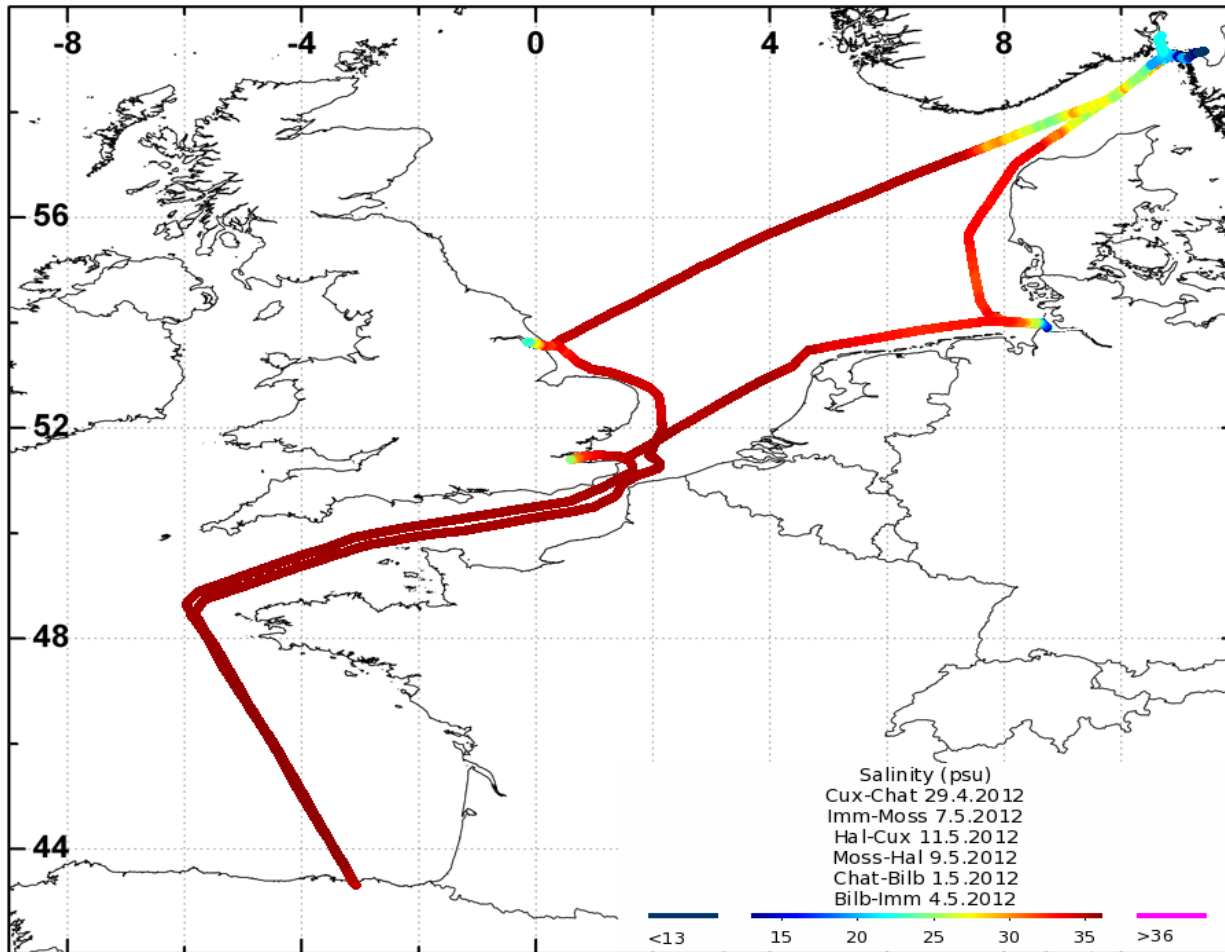
# Underway FerryBoxes operated by HZG in the North Sea



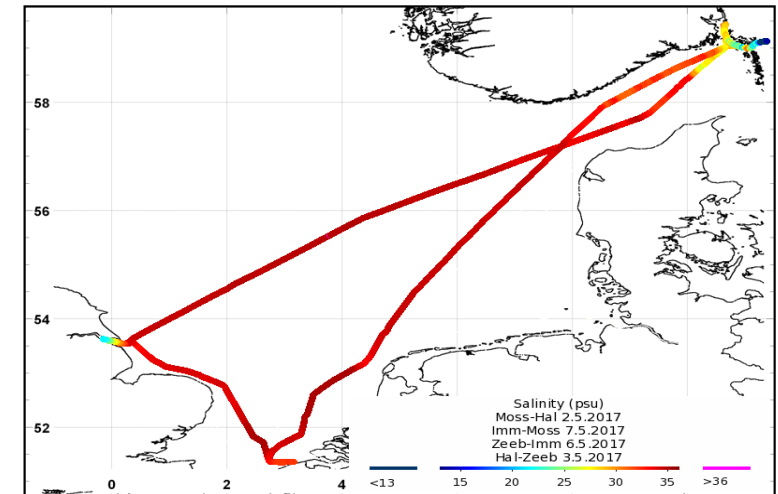


# Lysbris FerryBox Routes: Overview

2010-2012



2009-2010 & 2012-present



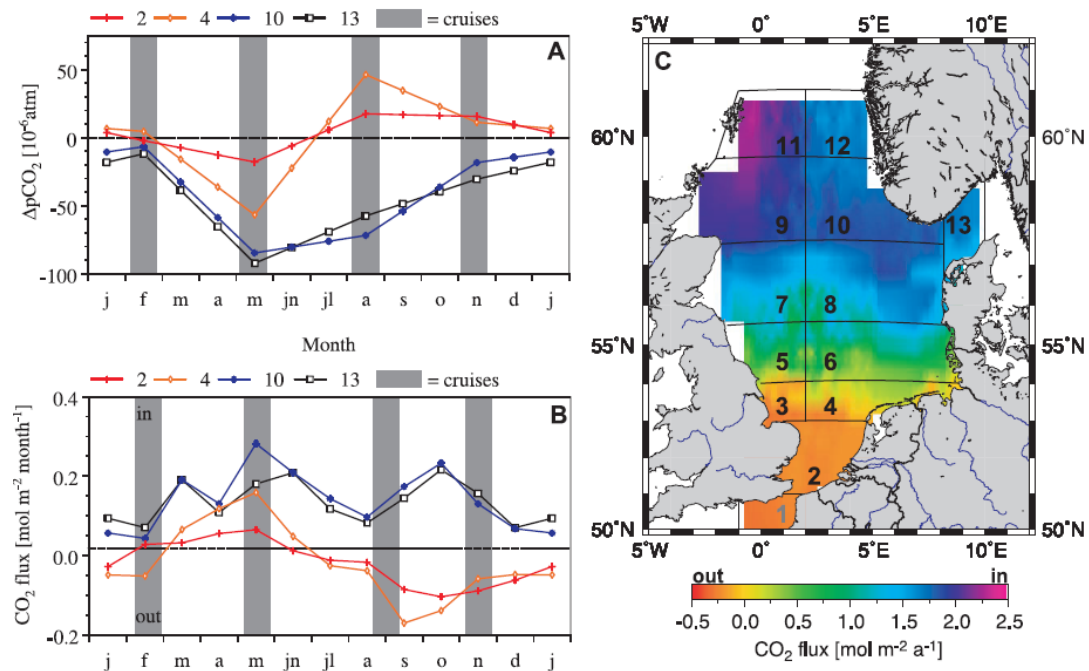
- Immingham-Moss route did not change, getting ~8 year record from this section
- otherwise, we can pick the present route between England, Norway and Belgium

# Motivation of Measuring Carbon Dynamic in the North Sea

*Helmuth Thomas, \* Yann Bozec, Khalid Elkalay, Hein J. W. de Baar, Science 2004*

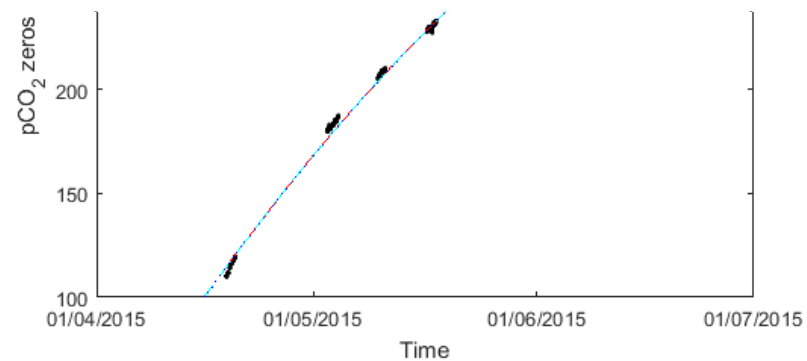
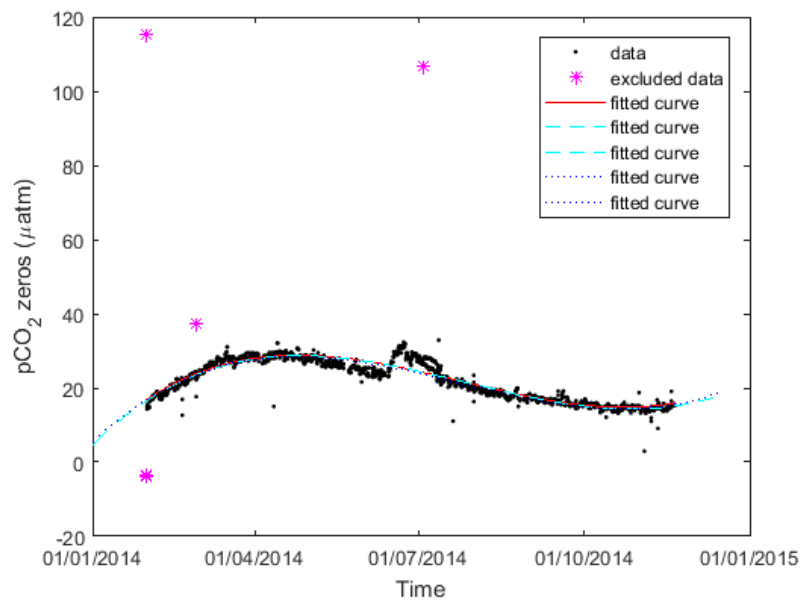
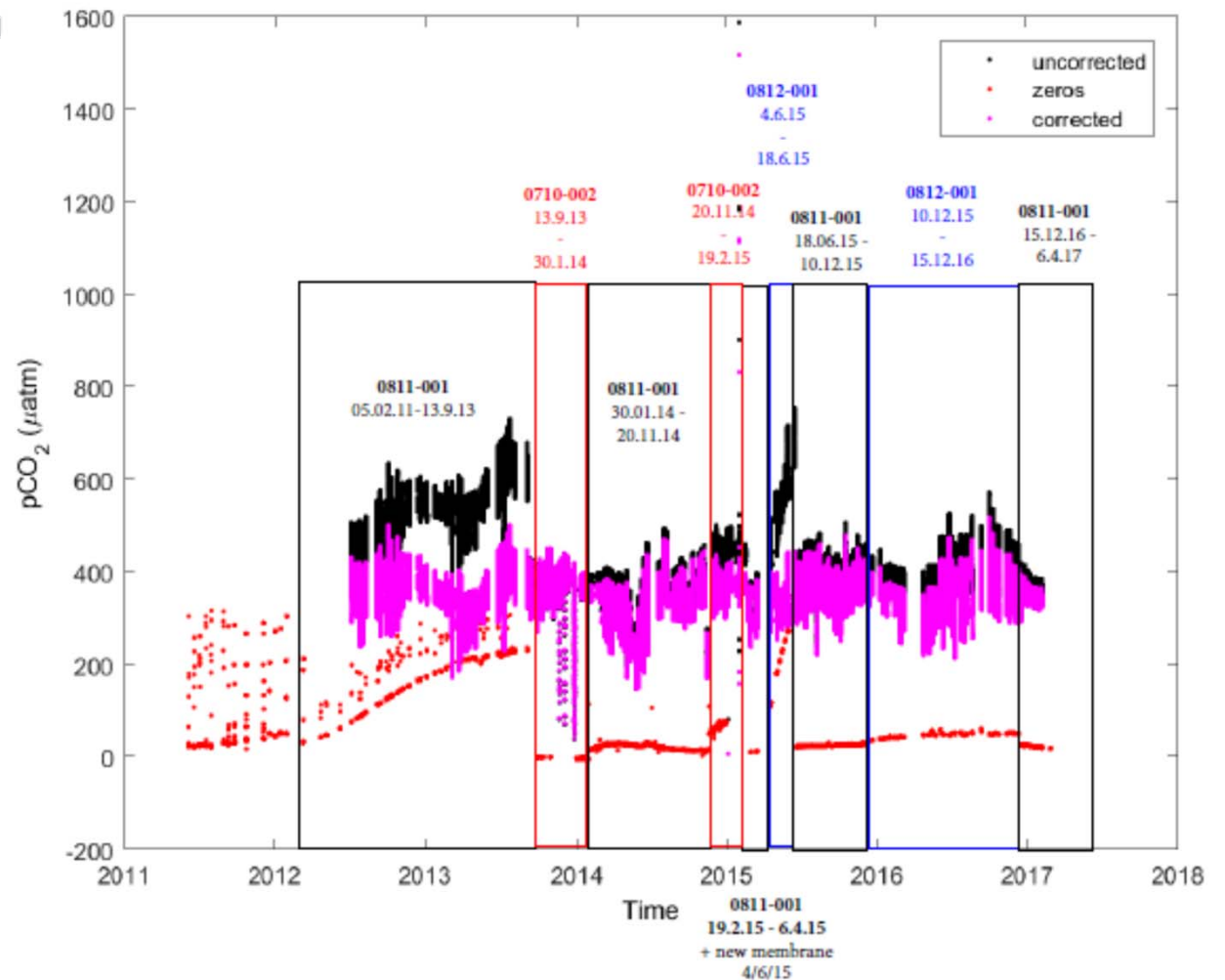
## Enhanced Open Ocean Storage of CO<sub>2</sub> from Shelf Sea Pumping

Seasonal field observations show that the North Sea, a Northern European shelf sea, is highly efficient in pumping carbon dioxide from the atmosphere to the North Atlantic Ocean, ...



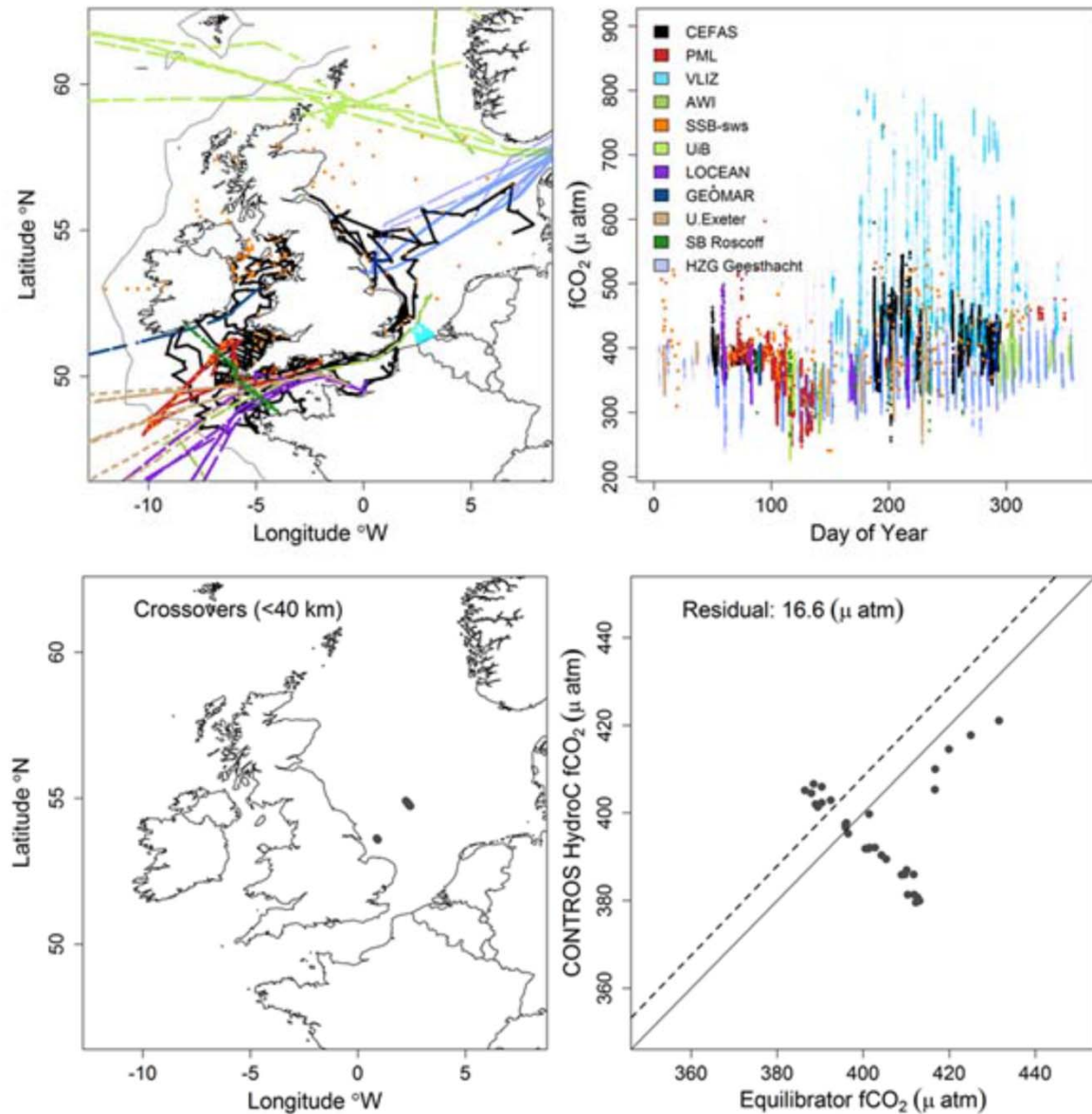
- The North Sea may act as an efficient pumping of carbon dioxide from the atmosphere to the North Atlantic Ocean (Thomas et al. 2004)
- only based on single cruises
- High variability of the carbonate system in this region necessitates high-frequency measurements

# pCO<sub>2</sub> Data Corrections



# Compilation of $f\text{CO}_2$ data NW Shelf 2015

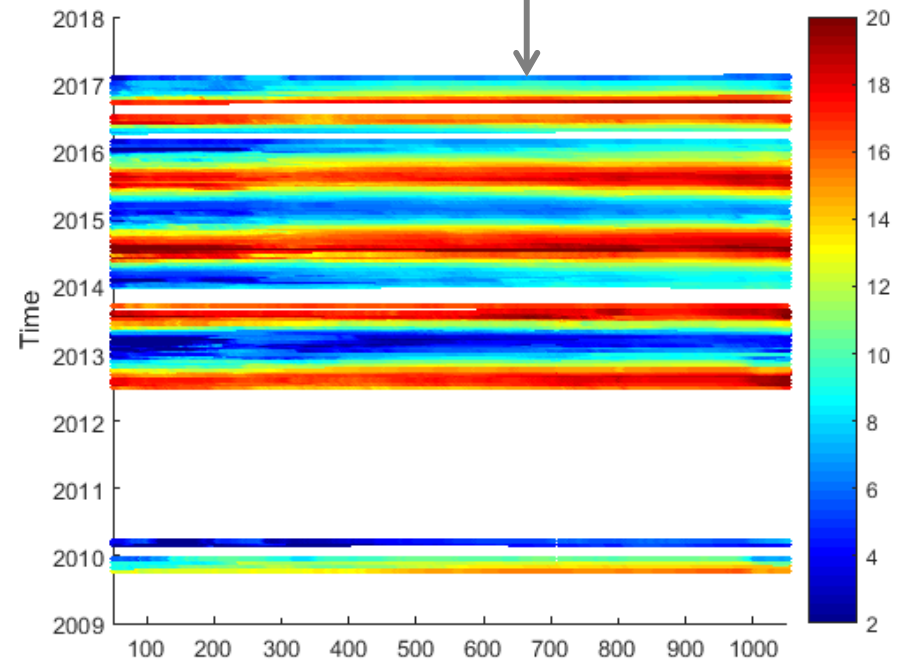
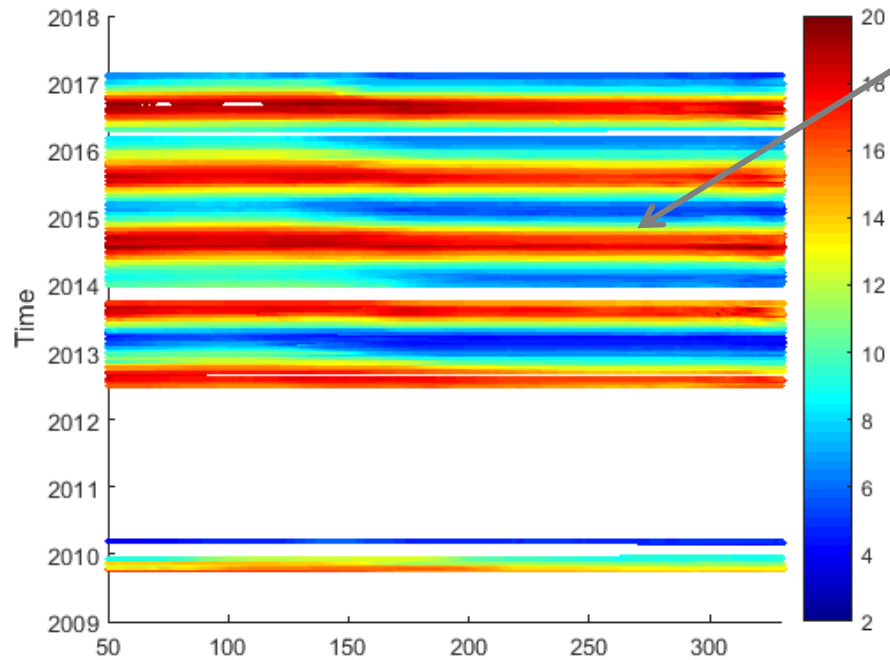
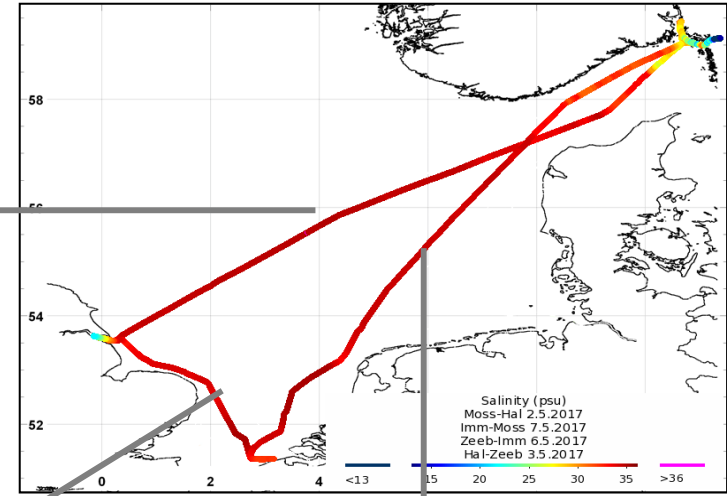
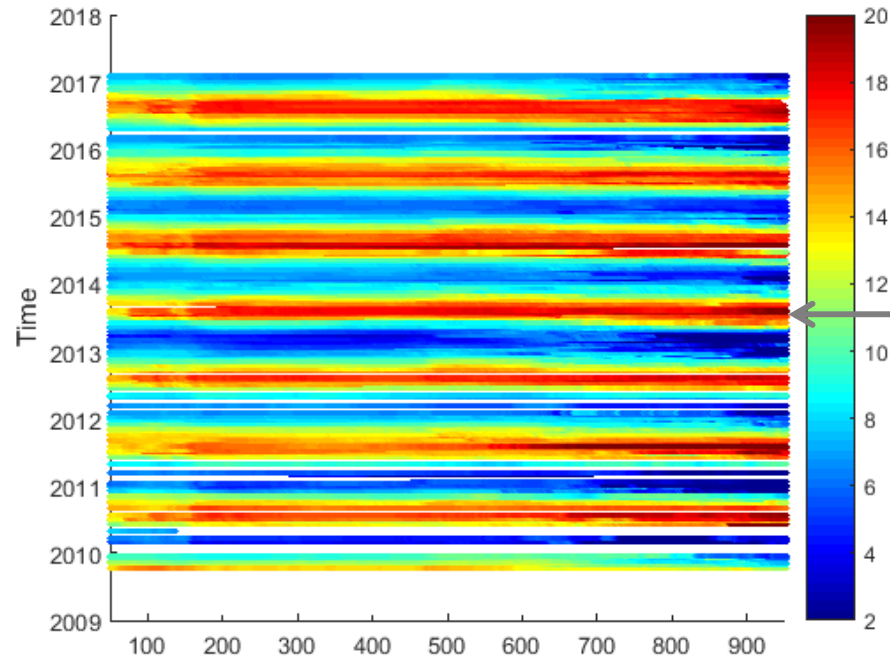
Kitidis et al. in preparation



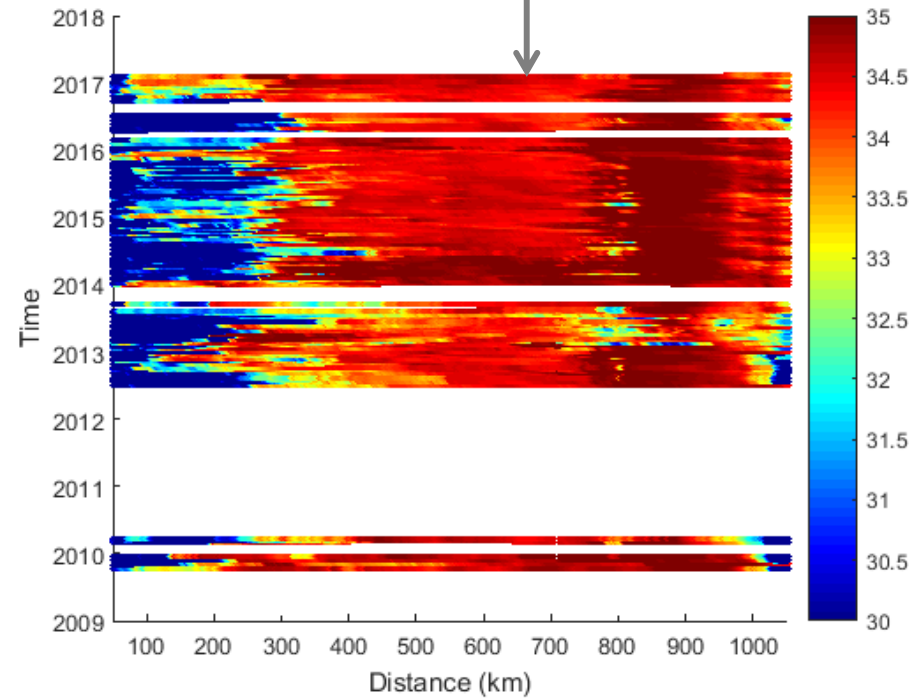
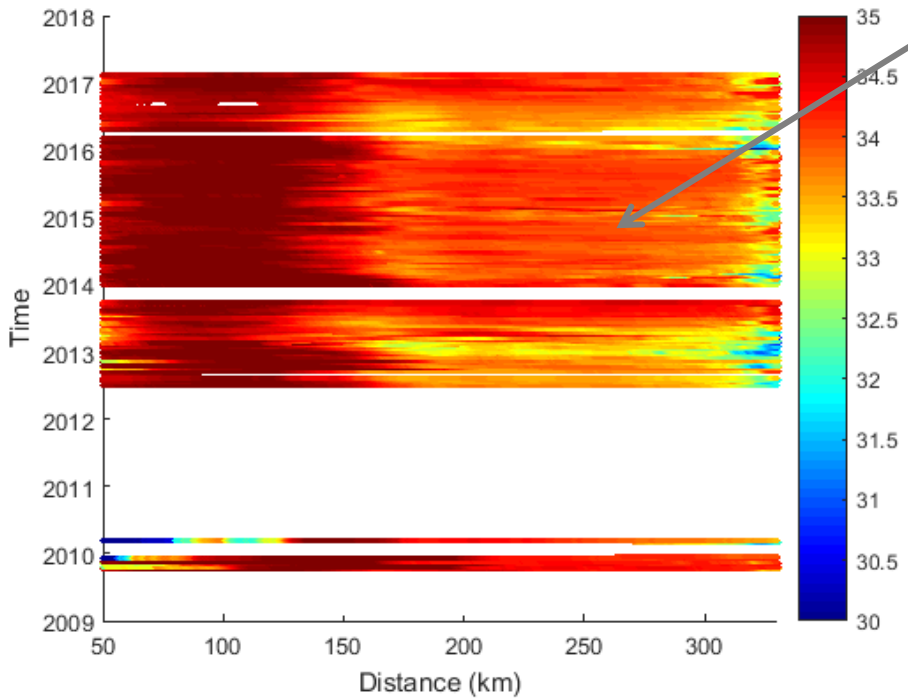
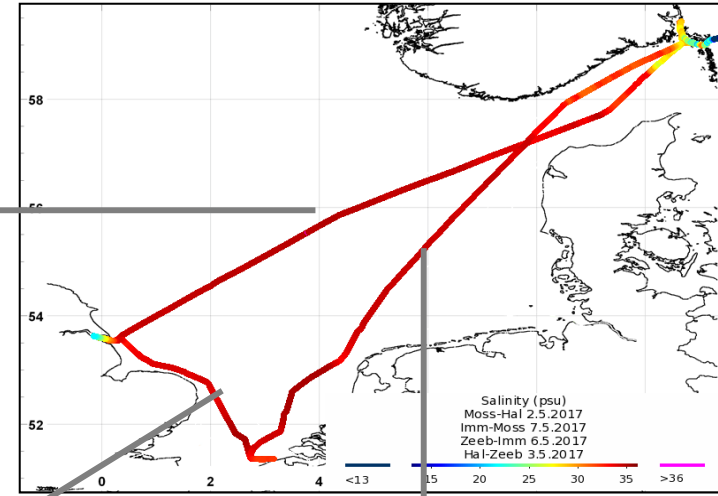
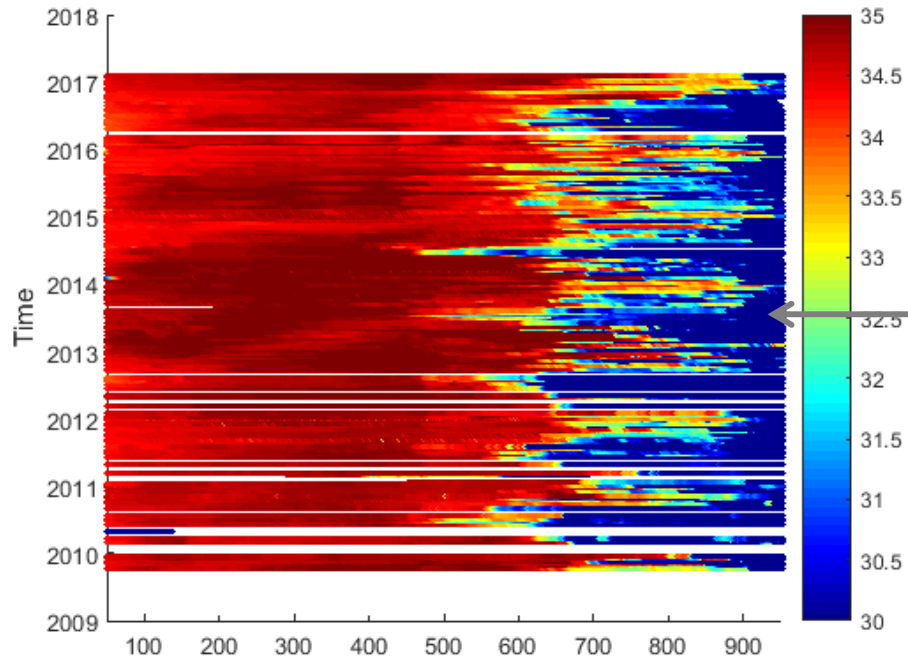
Comparison of headspace  
equilibrator+IR detection (CEFAS)  
with HZG FB data (Contros)

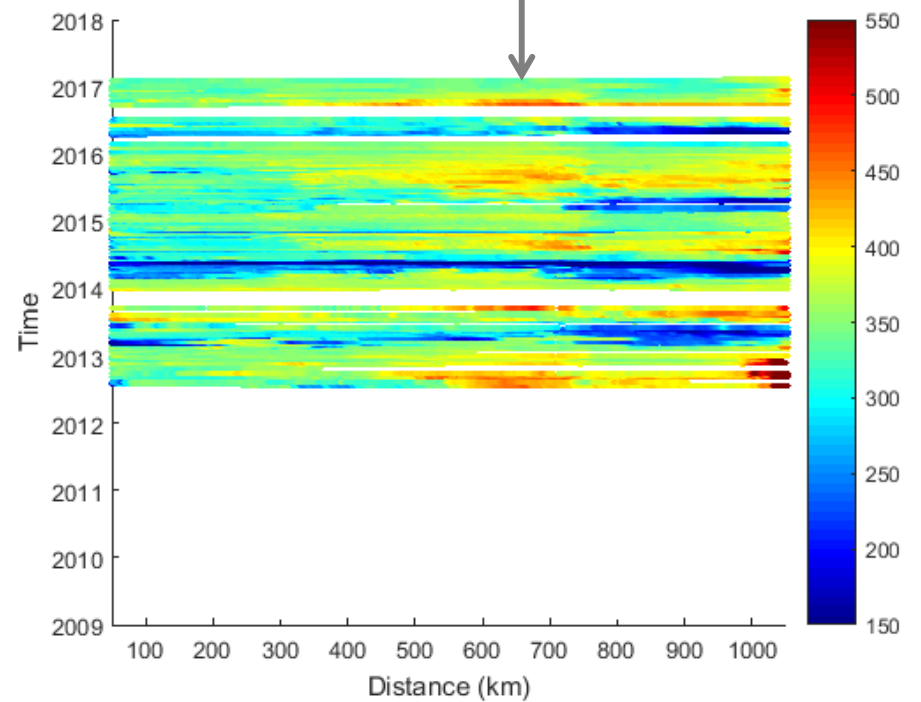
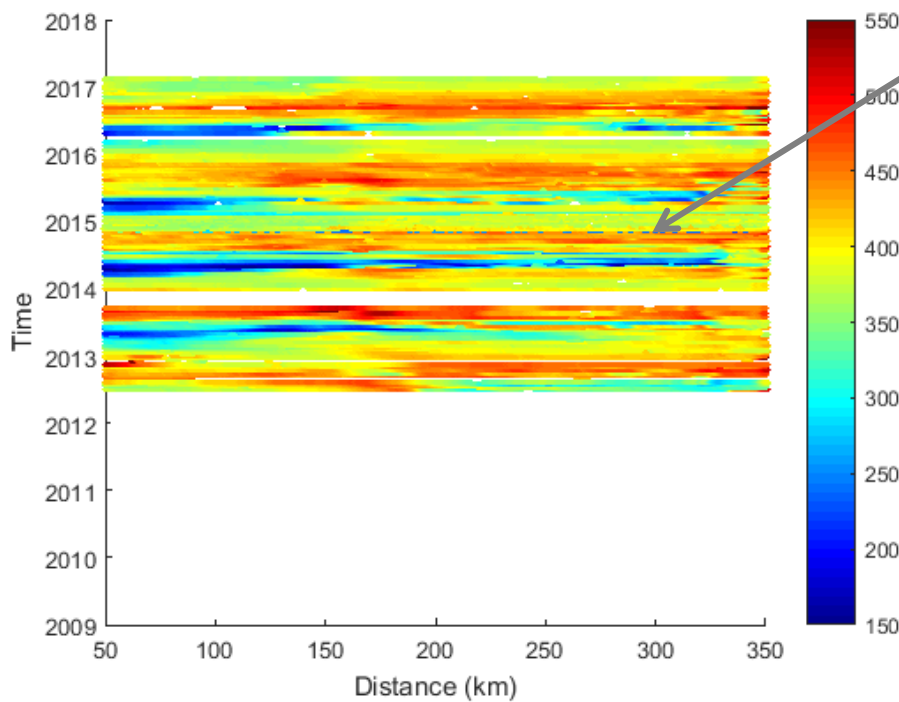
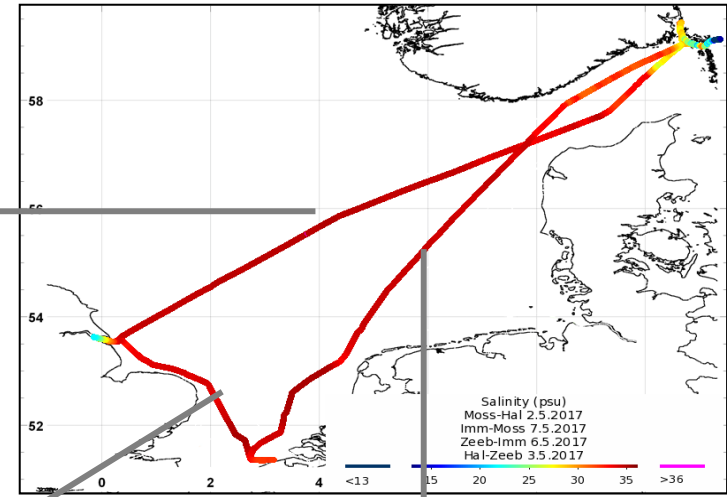
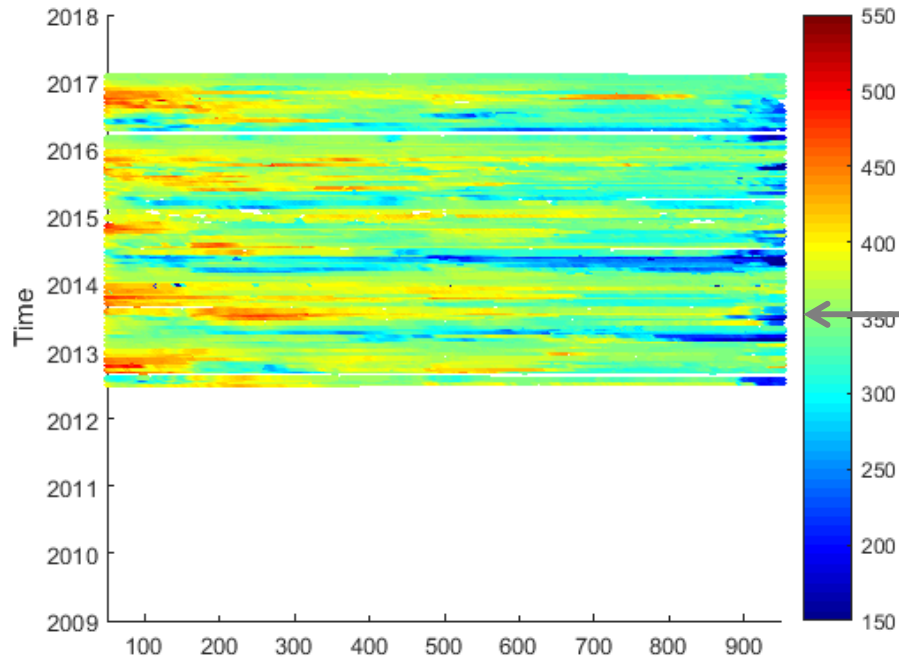


# Temperature



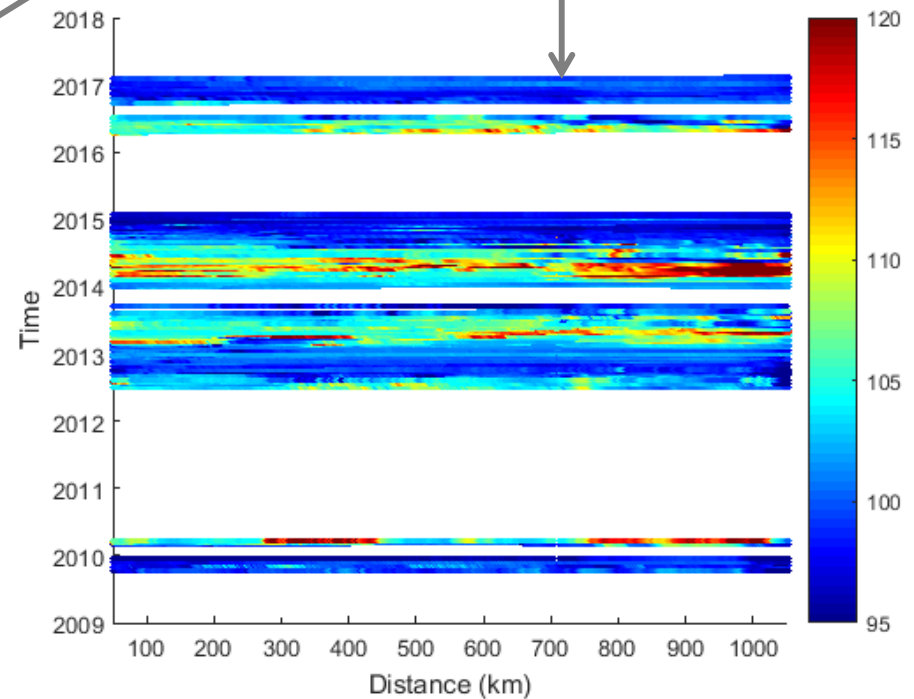
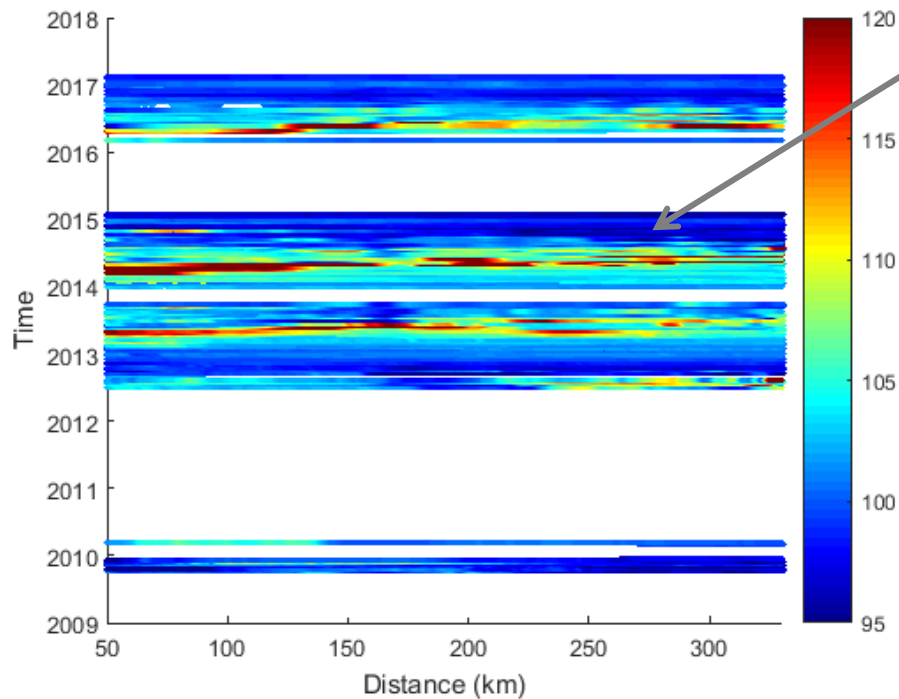
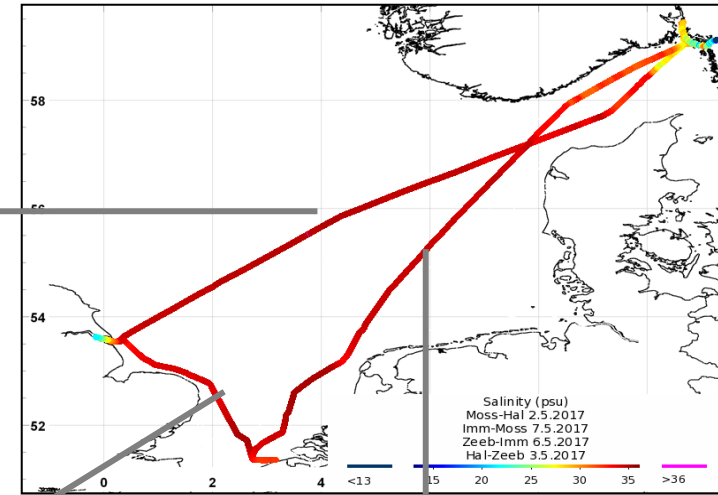
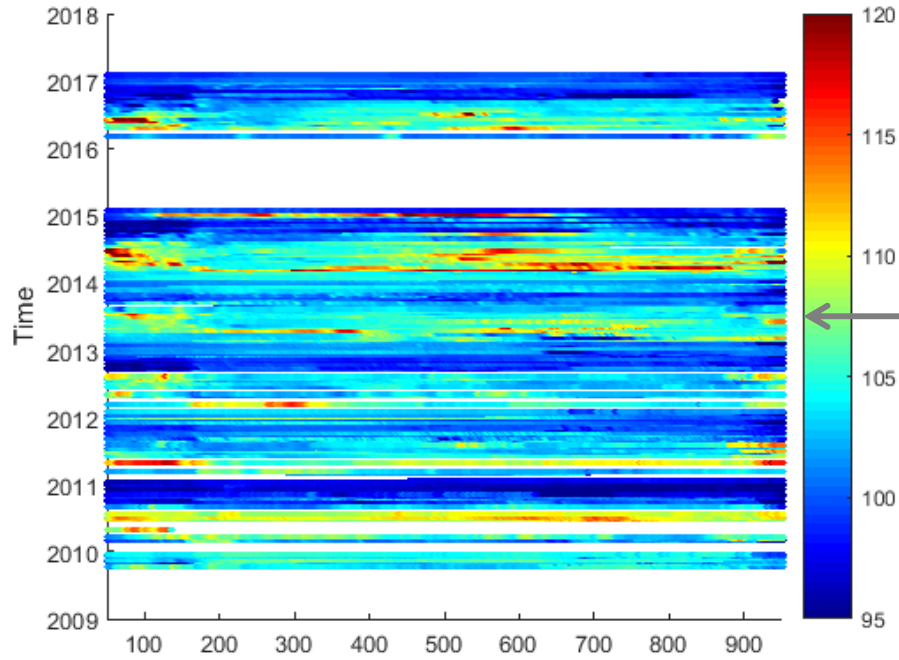
# Salinity



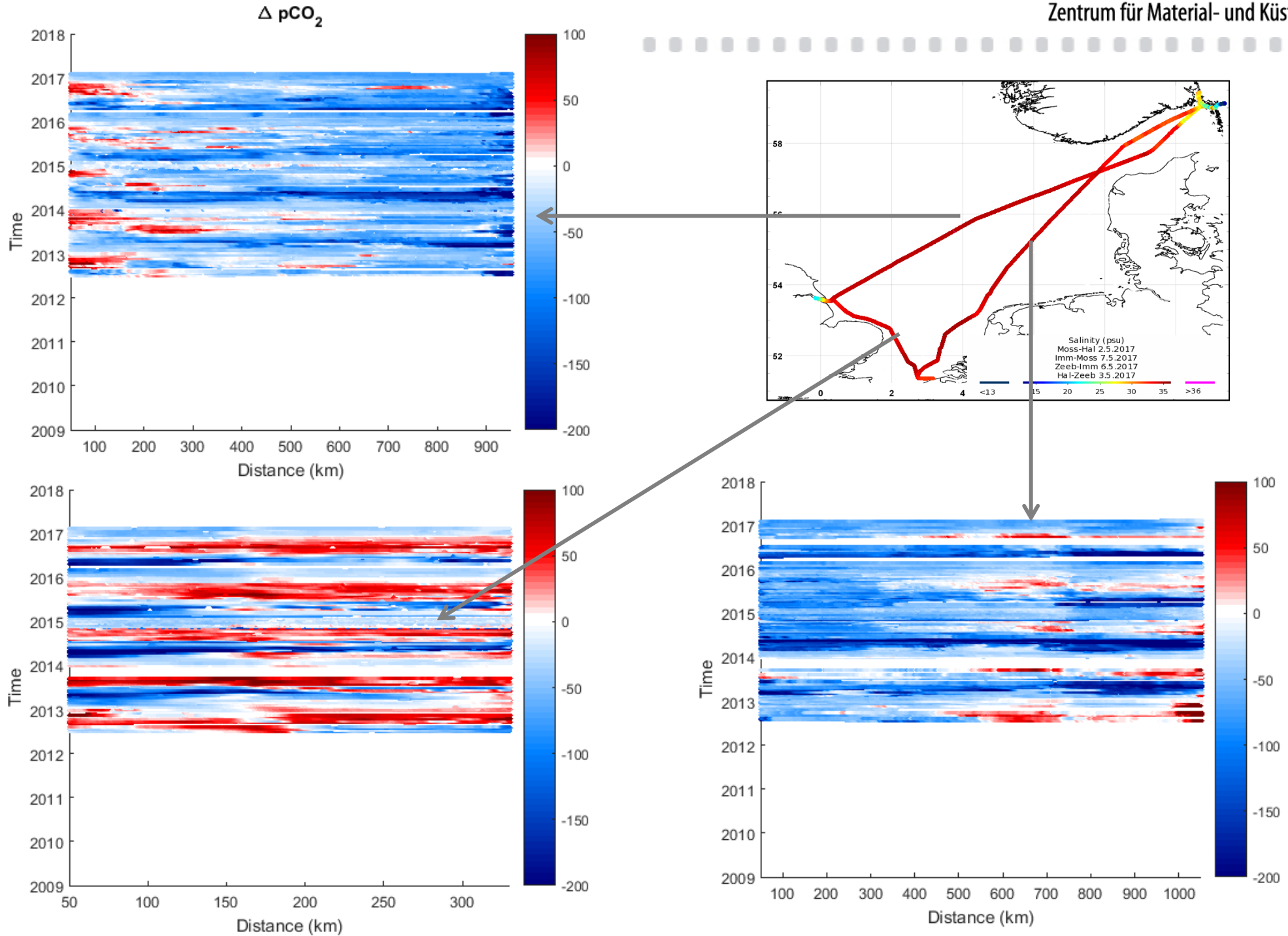




# Dissolved Oxygen (% Saturation)

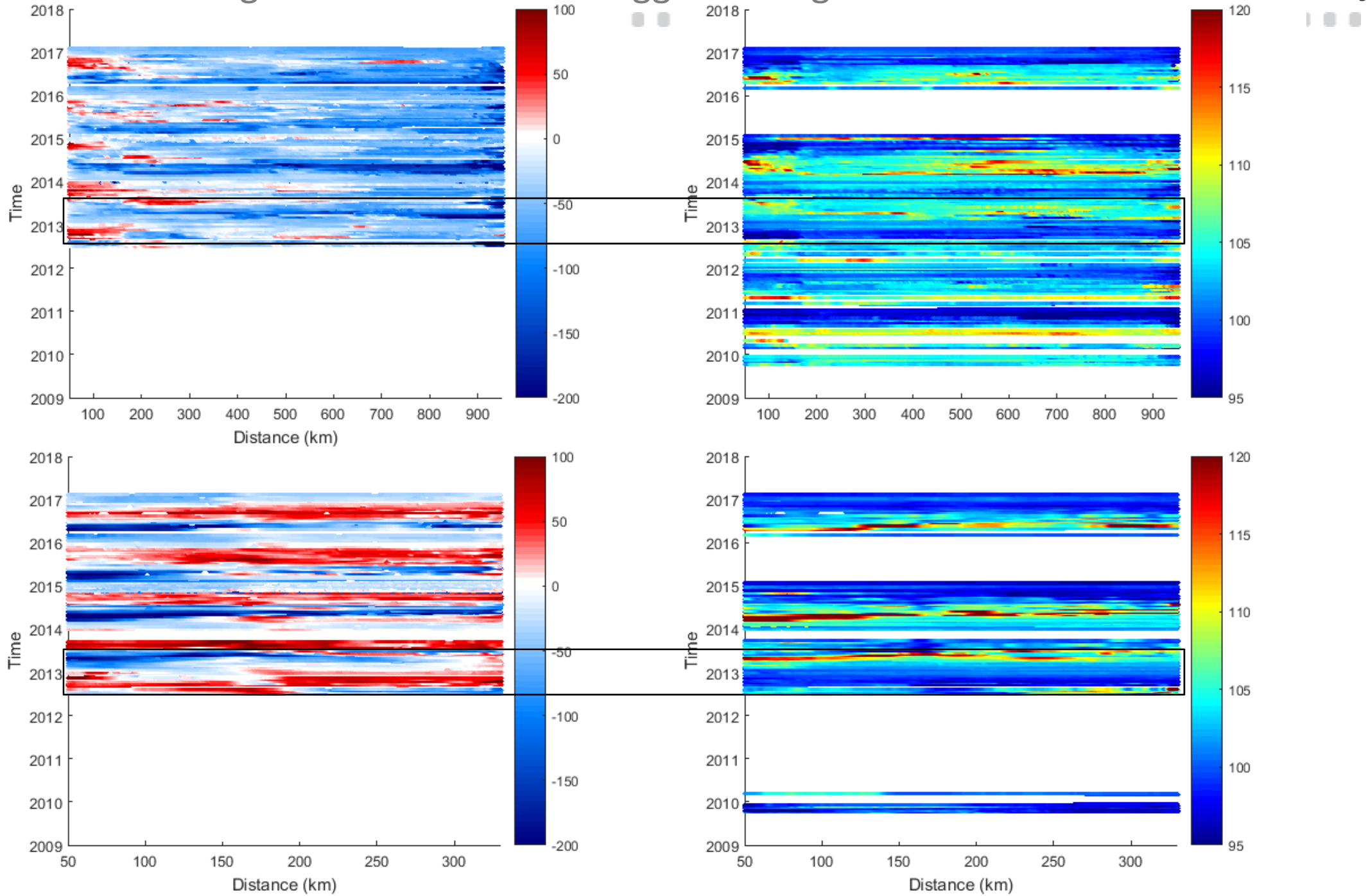


# Delta pCO<sub>2</sub> (Seawater-Atmosphere)



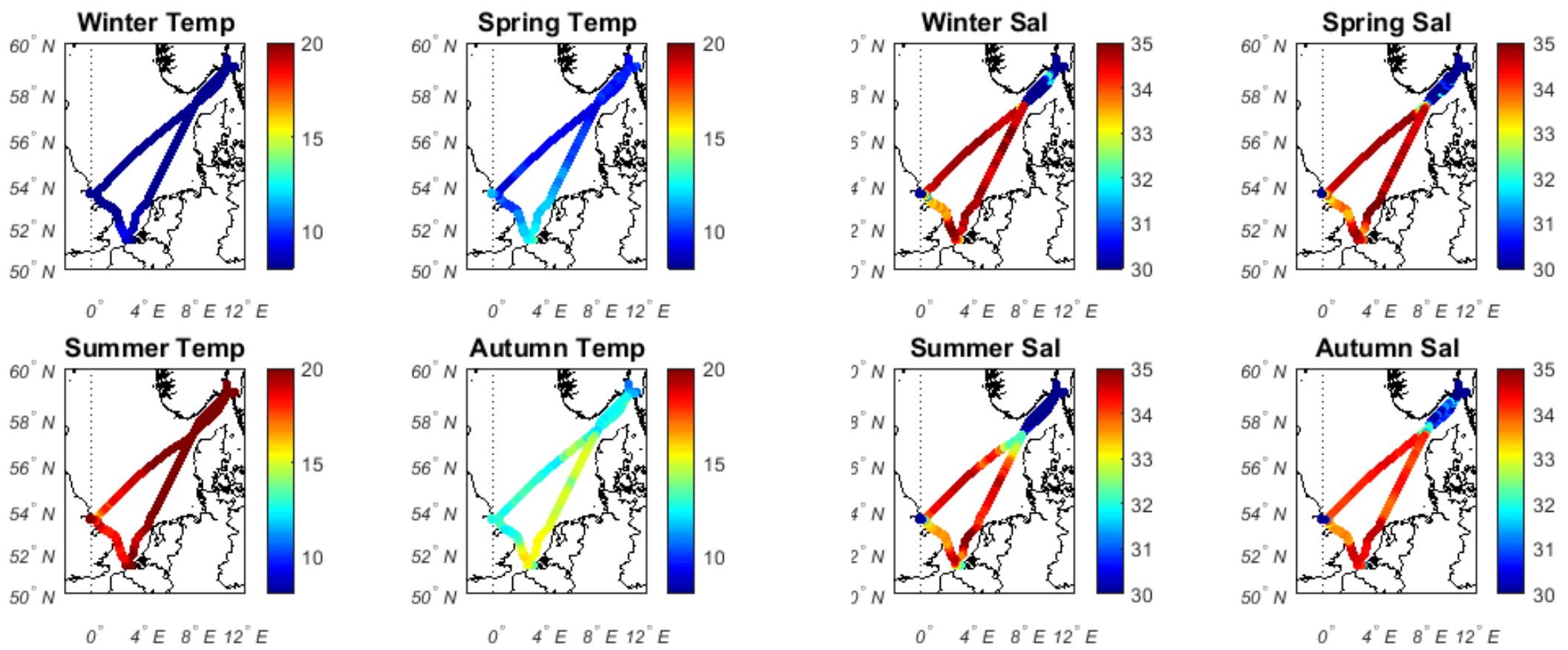
# Delta pCO<sub>2</sub> and DO Saturation

## Transects Immingham-Moss and Zeebrugge-Immingham

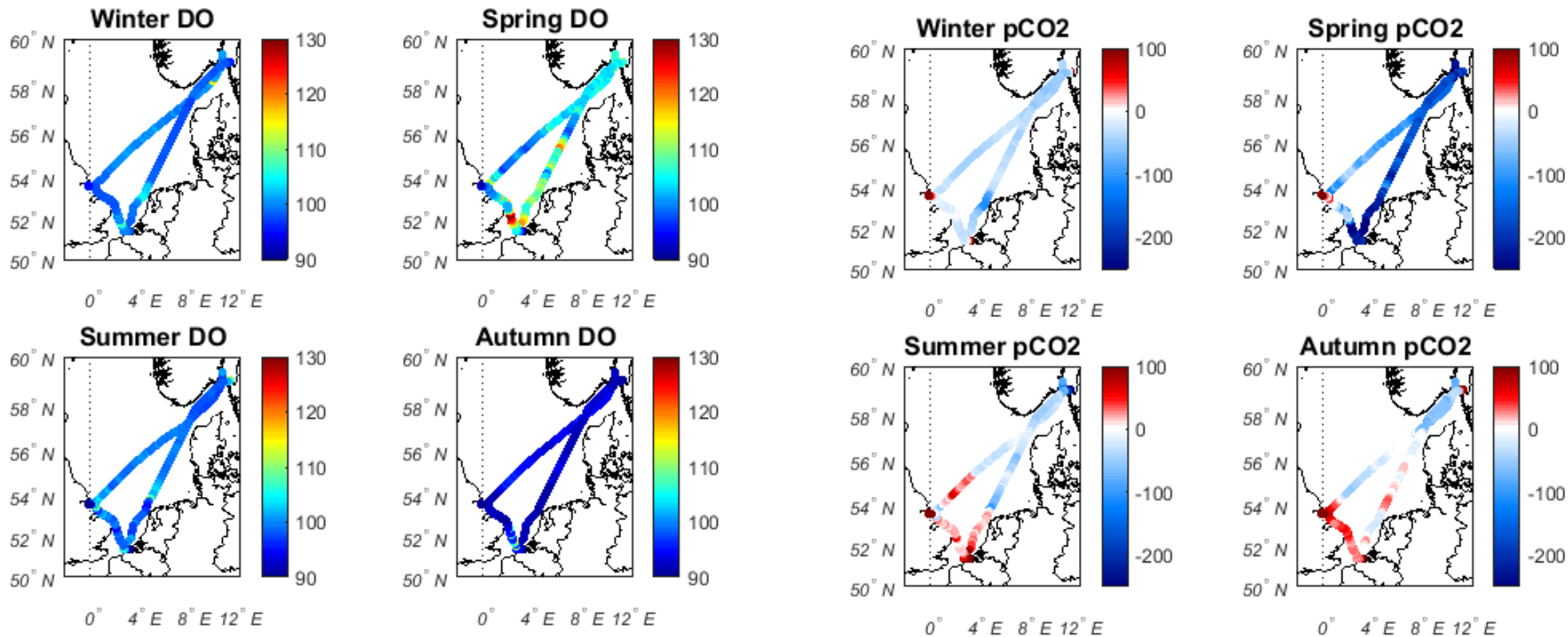




# Exemplary Seasonal Behaviour of Temperature and Salinity in 2014



# Exemplary Seasonal Behaviour of Oxygen Saturation and delta pCO<sub>2</sub> in 2014



- high-frequency measurements of carbon parameters in the Southern North Sea allow better quantification of the role as a source or sink of atmospheric CO<sub>2</sub>
- 5+ years of continuously measured parameters like pH and pCO<sub>2</sub>
- Different behavior depending on fully mixed water columns and areas with strong stratification
- Carbon measurements combined with dissolved oxygen data:
  - quantify the carbon fluxes in the surface waters,
  - potentially derive a time series of productivity estimates



- evaluating of pH data (glass-electrode, have to be corrected for drifts) to get pH values with an accuracy  $\sim 0.03$  pH units)
- estimation of productivity by combination of oxygen and carbon data
- continuation of these measurement together with an alkalinity sensor and a spectrophotometric pH sensor

# Thanks for your attention!

Costal observatory COSYNA:  
[www.cosyna.de](http://www.cosyna.de)



JERICO-NEXT:  
<http://www.jerico-ri.eu/>



FerryBox data:  
<http://ferrydata.hzg.de>

