Observations of the carbonate system in the Baltic Sea area

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SMHI
Ferrybox Workshop
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SMHI carbonate systems
R/V Svea - background

- Built in Vigo, Spain
- Operational since autumn 2019
- Owned by SLU, Swedish University of Agricultural Sciences
- SMHI responsible for several scientific instrument such as ferrybox, MVP, CTDs
- Main users are SMHI and SLU Aqua for marine monitoring and fish surveys
Ferrybox on R/V Svea

Sensors:
- Temperature SBE45 & 38
- Salinity SBE45
- Spectrophotometric pH, HydroFIA/4HJena
- pCO₂ HydroC-FT/4HJena
- Chlorophyll fluor Wetlabs/SBE
- Turbidity Wetlabs/SBE
- Phycerythrin fluor Turner 7F
- CDOM fluor Trios NanoFlu
- Phycocyanin fluor Trios NanoFlu
- IFCB McLane
- Automated water MAXX Sampler sampling
- 4HSampler for automatic filtration of zooplankton
Svea data 22-08-12 – 22-08-18.
pCO2: HydroC-FT

- Operational since spring 2020
- One calibration turn around so far
- Externally funded project for post processing of the data

pH: HydroFIA

- Start up work since spring 2020
- Problems with integration to the 4HJena software with respect to values selected for salinity and temperature
- After some updates the HydroFIA can now operate with its own setting (sample intervall etc) but still follow the measurement cycle of the ferrybox (wash cycle, harbour mode ec)
- Externally funded project for the work with getting the system operational during the regular monitoring cruises
Raw data pH and pCO2, August 2022
Post processing of HydroC-FT data

- Jupyter notebook used to translate the processing manual from 4HJena into data processing.
- ICOS OTC also had a data reduction work shop in 2020 where this tool was used for processing.
- Available on GitHub
Example of post processing of HydroC-FT data

Zeroing data from 2021 and 2022.
Processed pCO2, April 2022
2022 processed HydroC-FT data
Change of pH sensor for discrete measurements

NBS-electrode: 1994 – on going

HydroFIA bought from 4HJena during autumn 2021.

Dual measurements started on Svea during spring 2022 and will continue for at least one year.
Procedure

- Winkler bottles are used for the HydroFIA samples
- Operate the HydroFIA through the Webb interface
- 10-12 CRM replicates (Dickson) are analyzed in the beginning of each cruise.
- 10-12 CRM replicates are also analyzed on the Ferrybox HydroFIA directly afterwards.
Prel. result summer 2022

Skagerrak

July

August

Baltic Sea

July

August

• **2010**: Installation of the ferrybox is complete. The design is a copy of the SYKE ferrybox on Finnmaid.

• **2015**: Change of route: Lubeck-Oulu-Kemi-Lubeck

• **2022**: Change of route and installation of new ferrybox from 4HJena
In water, 3 m depth
- Flow rate
- Temperature
- Salinity
- Oxygen
- Chlorophyll fluorescence
- Phycocyanin fluorescence
- CDOM fluorescence
- $pCO_2$

In air
- Temperature
- Pressure
- Irradiation, PAR
- $CO_2$
Demounting of old ferrybox
Installation of new ferrybox from 4HJena

- 1 intake pump and 1 out cast pump
- 1 internal debubbler and 1 external debubbler
- 1 large waste water tank
- Communication between ferrybox GO system for salinity, temperature and pressure
2021: Funding start from ICOS Sweden.
ICOS labelling process started and now in stage 2 (data collection for 4-6 months).
Data submitted to Socat för a number of months 2020 – 2021.
National funding through ICOS Sweden for equipment renewal: new LICOR 7180 (CO2/CH4) bought in 2022.
Data submitted to SOCAT

pCO2 in the Baltic Sea 2021
Tavastland ferrybox (SMHI)

Pump issues due to black outs on the vessel

Acknowledgement to Tobias Steinhoff for data compilation and Socat submission!
Example from November 2021

Tavastland 5-8 Nov. 2021
pCO2 at 4 m depth

Temperature at 4 m

Salinity at 4 m
Ongoing work

TAVASTLAND:
- Labelling process started
  - Metadata submitted
  - Measuring period right now
- ICOS standard gases installed on Tavastland during Spring 2021
- Calibration of SBE45 and SBE38 is performed by IOW
- Quality control of the biogeochemical sensors after the change of the ferrybox

SVEA:
- Finish data processing work for HydroC-FT
- QC using data processing tool and data storage in house in order
Thank you!
Questions?

Acknowledgements:
- Crew on Tavastland
- Vessel technicians and crew on Svea
Future work...

- Possibly feed the Webb interface with a txt-file with salinity values

- Possibly change the monitoring program for pH
  - do we need a sample from every discrete depth possible?
  - Do we sample the stations that are most representative for that basin?

- QC Control of data

- Data delivery in house and to external data bases

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2015: Change of route: Lubeck-Oulu-Kemi-Lubeck

2022: Change of route and installation of new ferrybox from 4HJena
Raw data Svea expedition: April 20 – 25
Data submitted to SOCAT

pCO2 in the Baltic Sea autumn 2021
Tavastland ferrybox (SMHI)