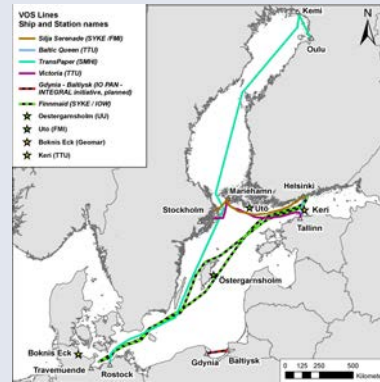
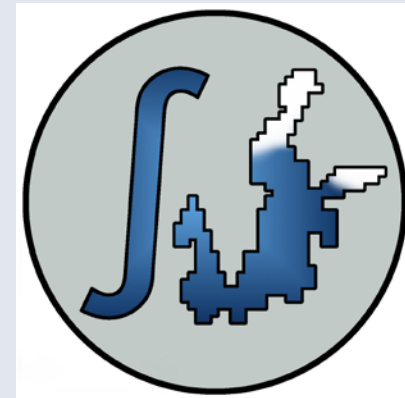


BONUS INTEGRAL

Integrated carbon and Trace Gas monitoring for the bALTic sea



“Using ICOS and similar infrastructure for an improved environmental monitoring of the Baltic Sea”

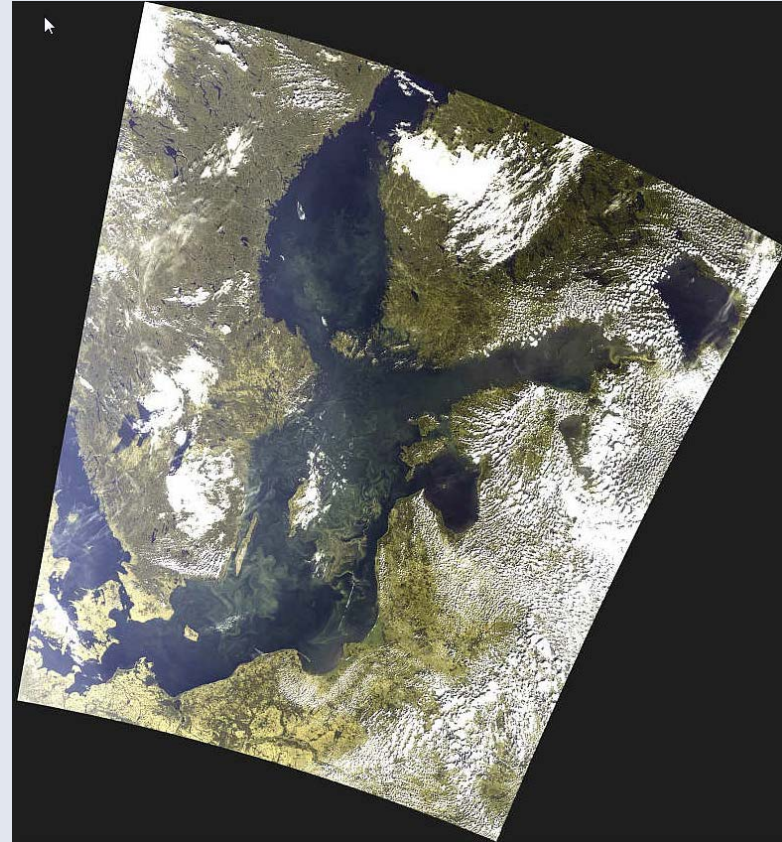




Background

Setting / Nomenclature

- The ecological state of the Baltic Sea is monitored by the surrounding countries as part of their **HELCOM** commitments
- **ICOS** is a European Research Infrastructure, realized by national funding, for the assessment of Greenhouse Gas concentrations and fluxes, with an Atmospheric, Ocean, and Ecosystem branch, and Central Lab facilities
- **BONUS** is an EraNet funding scheme where beneficiaries receive half of the funding by participating national funding agencies, complemented by EU funding



Project Details

- **Funded under the BONUS Blue Baltic programme, 7/2017 – 6/2020, 3 years**
- Budget 2.1 Mio €
- 8 Partners from 5 countries
- Including three current Baltic ICOS stations



Key Theme

5.1 Developing and improving the scientific basis for integrated monitoring programmes for continuous assessment of ecological status and human pressures

Subthemes

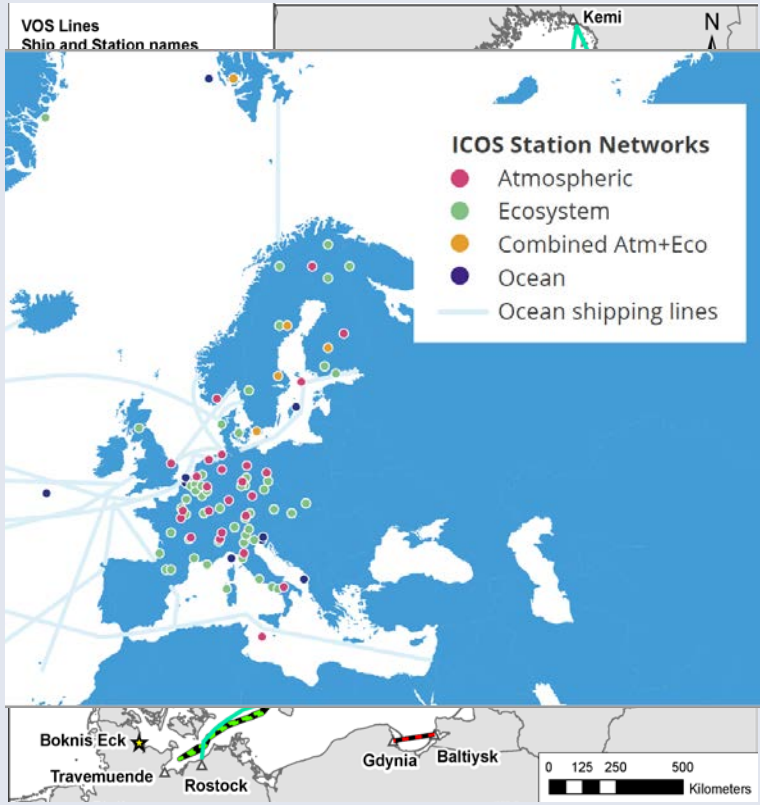
1.1 Ecosystem resilience and dynamics of the biogeochemical processes, including cumulative impacts of human pressures

5.2 Developing and testing innovative in situ, remote sensing and laboratory techniques

2.2 The role of coastal systems in the dynamics of the Baltic Sea

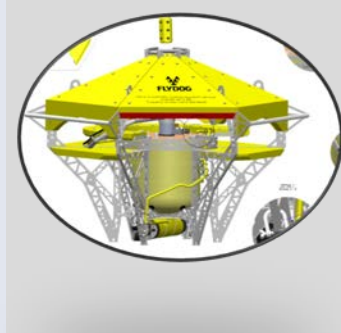
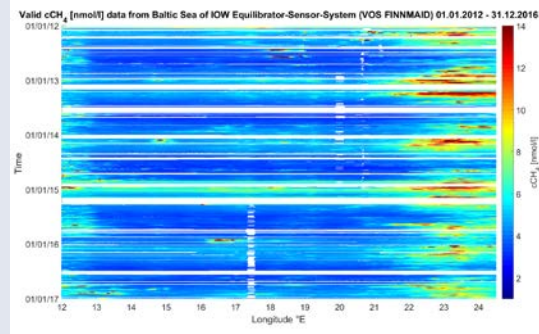
Overarching ideas:

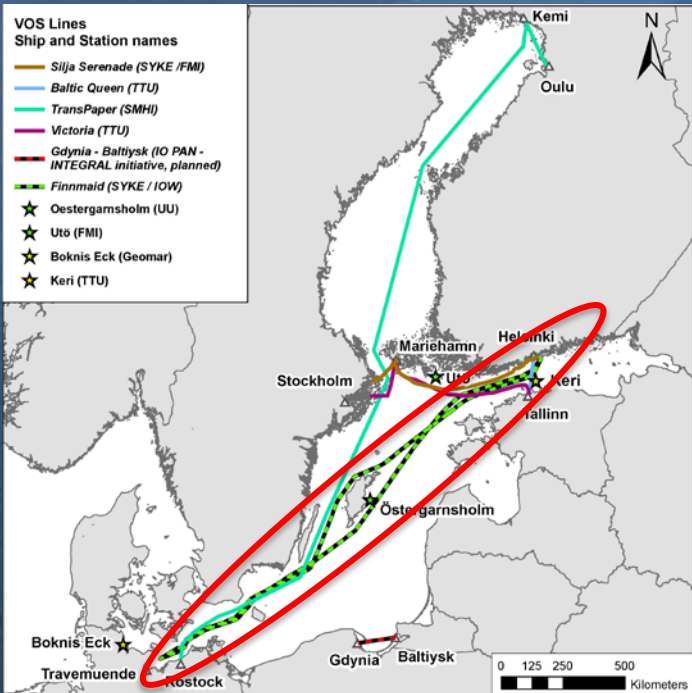
- Use of the (extended) ICOS network for biogeochemical monitoring of the Baltic Sea, in combination to existing monitoring programs
- Provide best experimentally based seasonal concentration charts for carbon dioxide, methane, and nitrous oxide
- Improved ASE-parameterizations for the Baltic Sea
- Full integration of carbon system into high resolution physical biogeochemical model
- Carbon system data as indicator for net production and acidification
- Advice for countries with upcoming ICOS infrastructure
- Model-output based recommendations on effective biogeochemical monitoring



BE-conference contributions

- **10:10** Organic matter mineralization (Schneider, Talk)
- **10:30** Acid Base system (Kuliński et al., talk)
 - Related **B11-Poster** Transformation of the carbonate system in the Odra Estuary (Stokowski et al.)
- Coffee Break: Bloomsail Experiment
- **11:40** Post Spring Bloom (Eggert et al. Talk)
 - Related **B9-Poster** on non Redfieldish stoichiometry for carbon fixation (Neumann and Eggert)
- **F1-Poster** Eckernförde Bight through the Boknis Eck time series station (Bange)
- **12:00** land-based ASE flux studies (Rutgersson et al., talk)
 - **Related B3-Poster:** Methane ASE Fluxes using Eddy Covariance (Lucia Gutiérrez-Loza)
 - **B5 Poster:** Measuring turbulent sea-air CO₂ fluxes with a closed-path gas analyzer (Martti Honkanen)

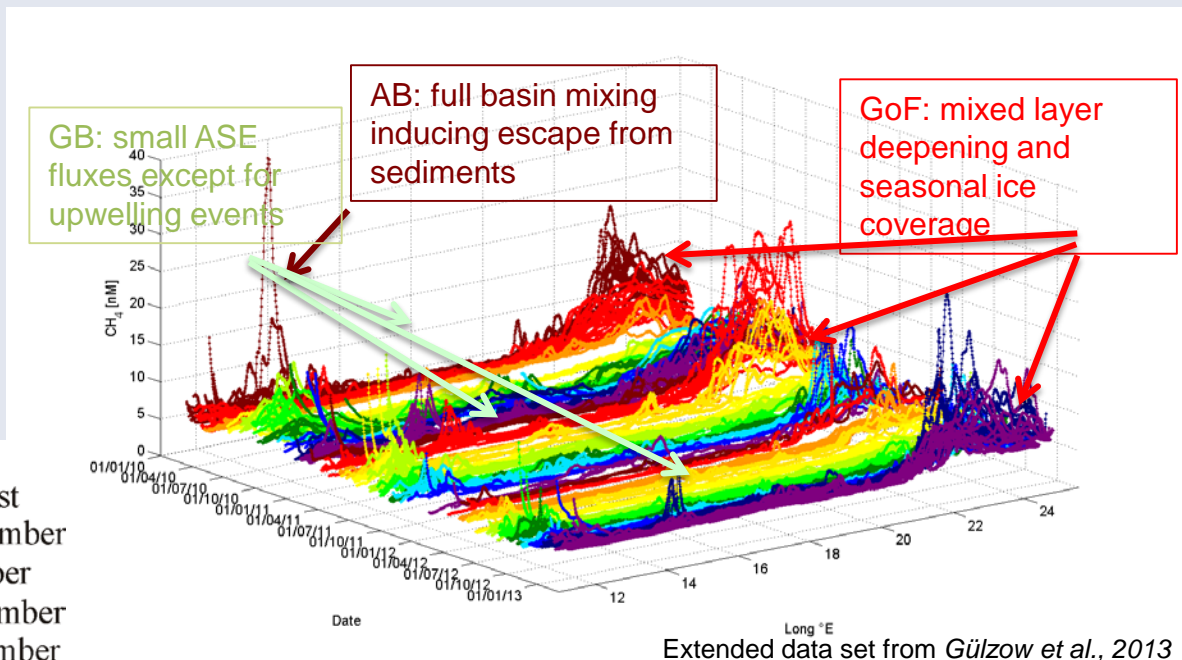
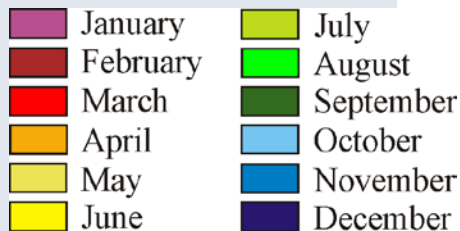
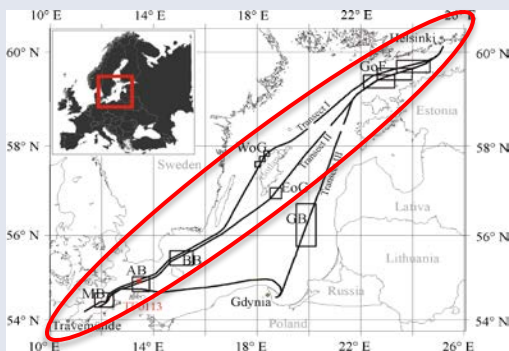






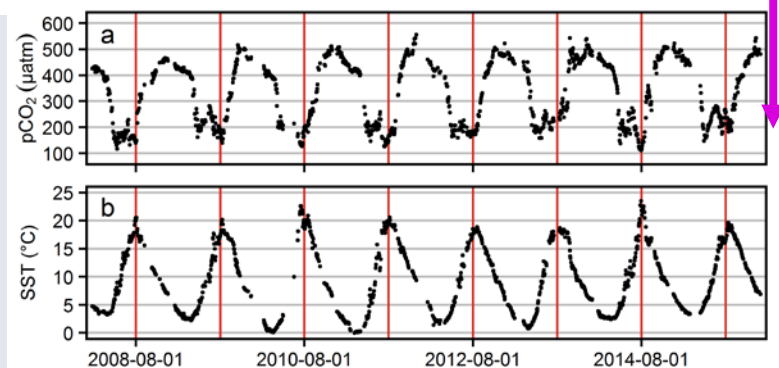
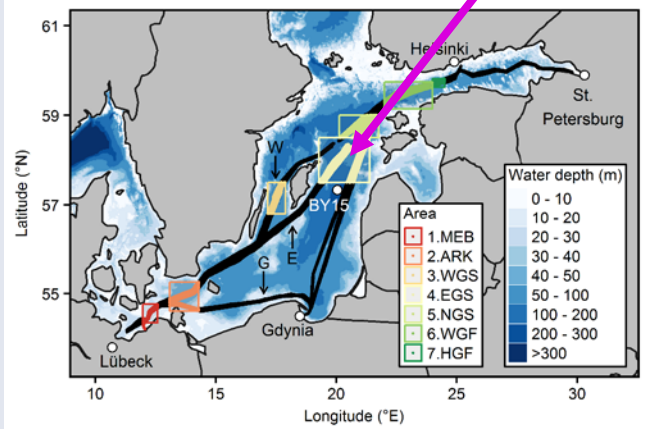
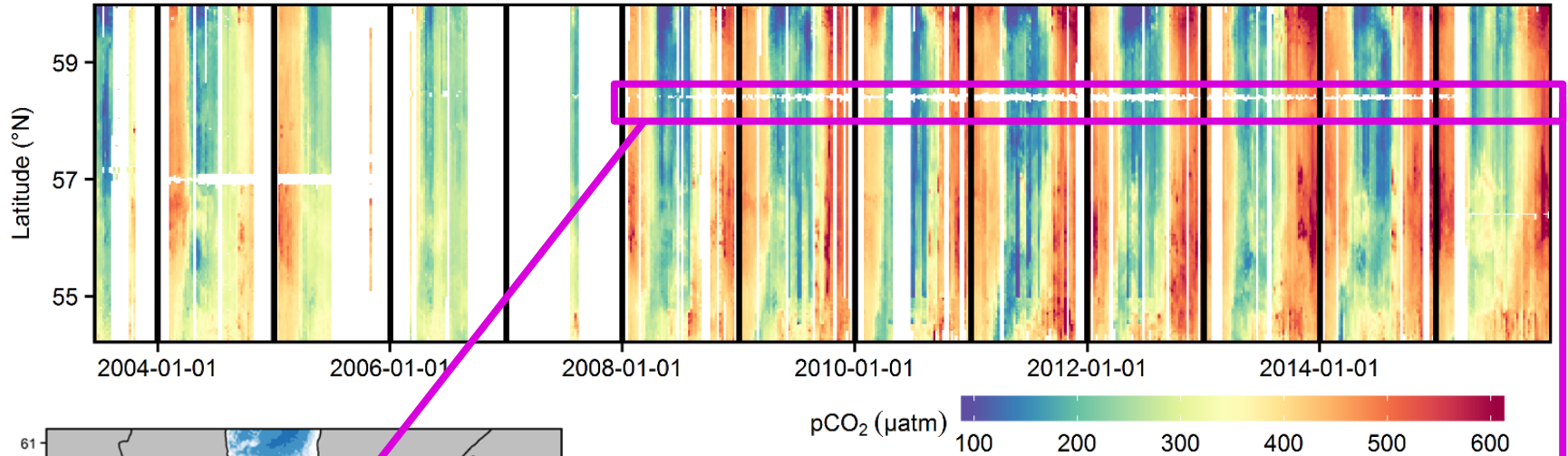
Overview (Methane)

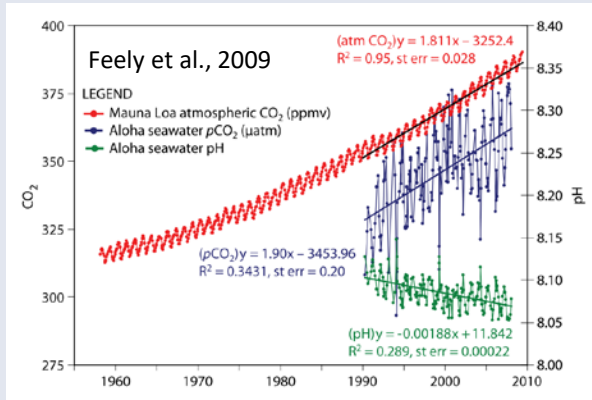
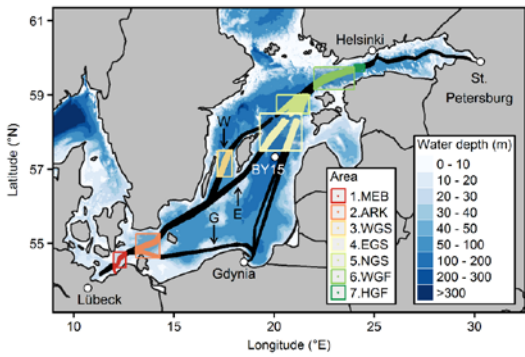
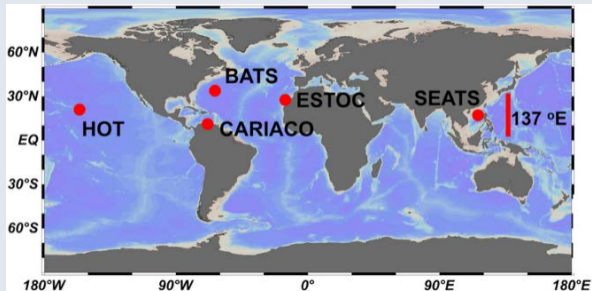
- Continuous measurement of CH₄ using oa-ICOS on the VOS Finnmaid
- Unique spatiotemporal coverage
- Main drivers: SST, mixed layer thickness, upwelling, thermocline stability



Extended data set from *Gülzow et al., 2013*

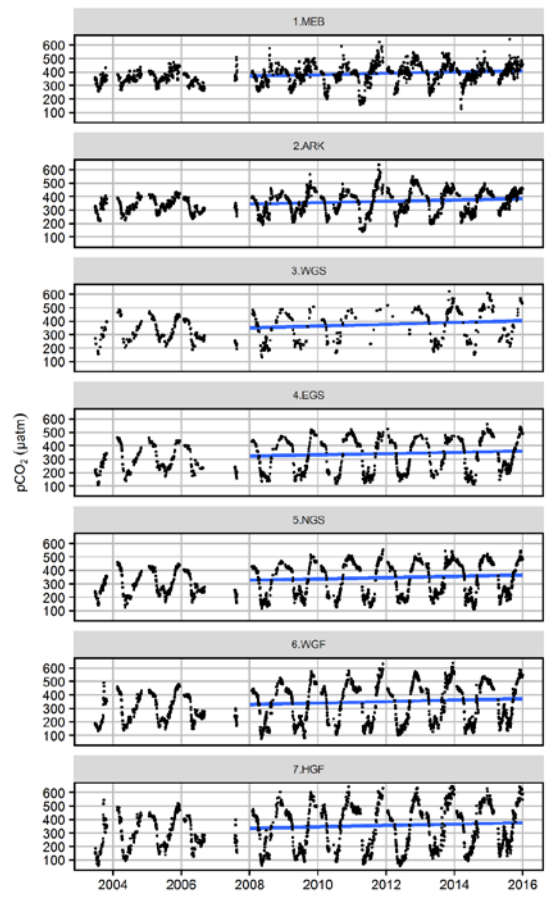
Overview (pCO_2)





	Baltic (2008-15)	BATS (1983-2011)
Slope ($\mu\text{atm yr}^{-1}$)	4.6 - 6.1	1.62
P-value	<0.01	<0.01
R^2	0.007 - 0.023	0.16

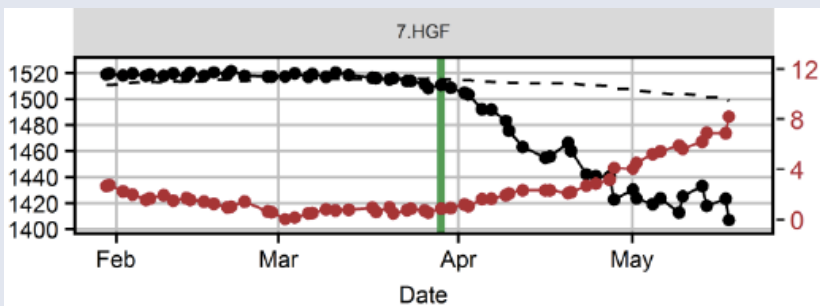
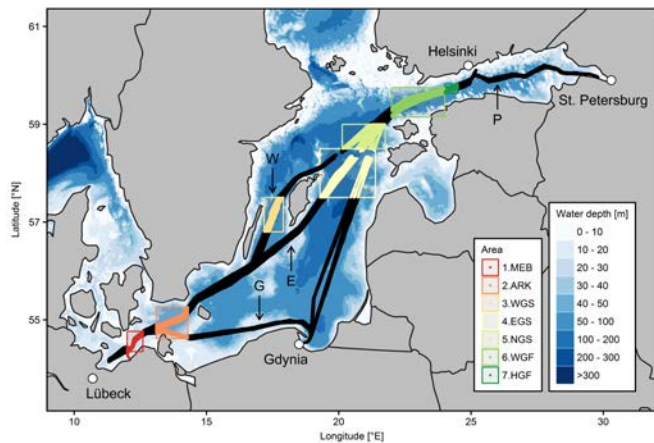
Bates et al., 2012
 Schneider and Müller 2018





Tools for biogeochemical assessment

Example I : Onset of spring bloom

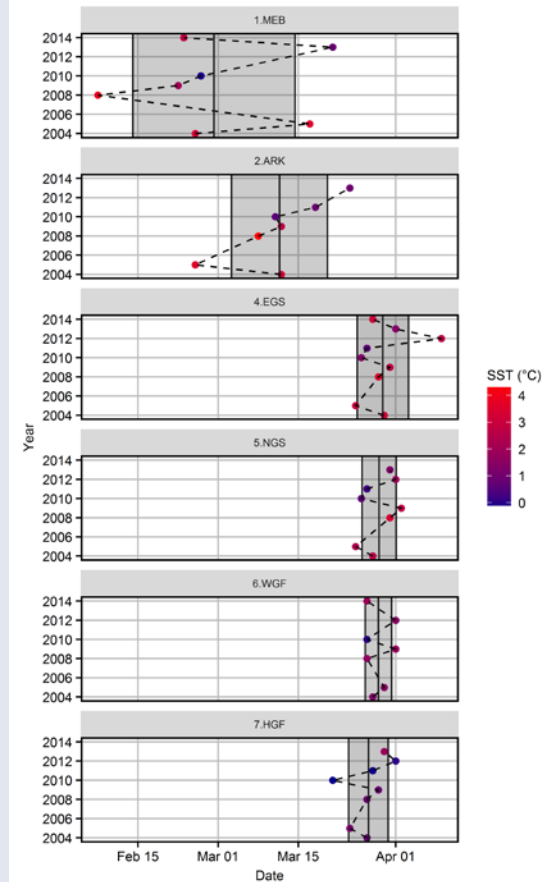


Onset of the spring bloom in the different sub-basins of the Baltic; Threshold is deviation of 1 $\mu\text{mol}/\text{kg}^{-1}\text{day}^{-1}$

Left: diagnostic plot to derive onset (near Helsinki, 2009)

Right: Time and variability of the onset based on data 2004 to 2014 for the different sub-regions

Schneider and Müller, 2008



pCO₂ – Productivity assessment

- Independent of C/N/P stoichiometry

Calculated net carbon production in the different basins during the spring bloom for 2009.

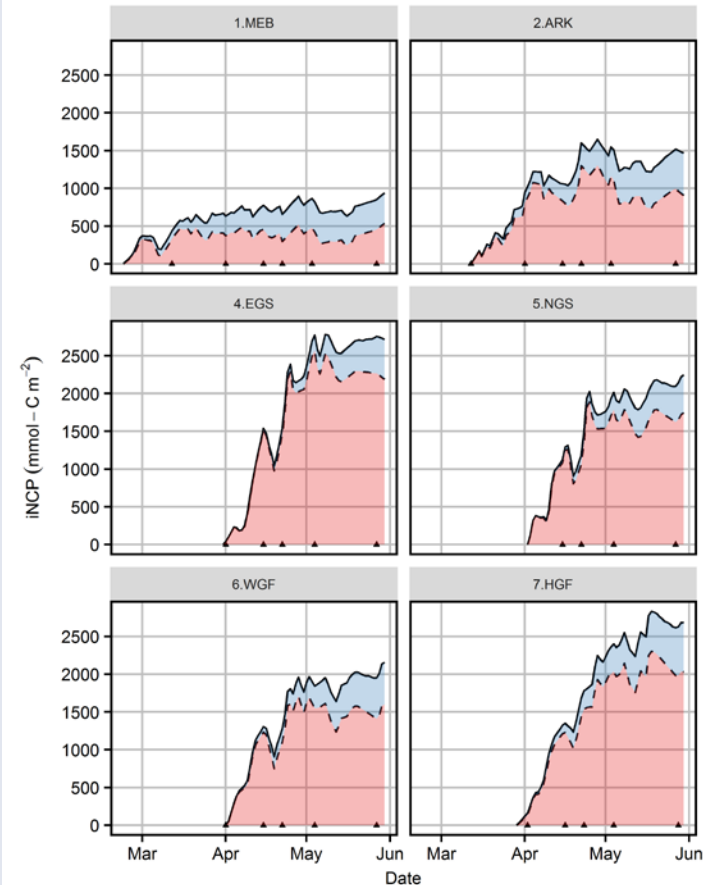
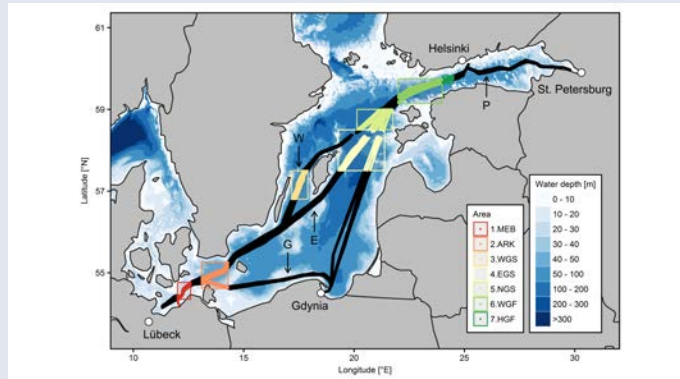
$$iNCP = (\Delta C_T \cdot z_{eff} + F_{AS} \cdot \Delta t) \cdot 0.8$$

F_{AS} – CO₂ exchange with the atmosphere;

Z_{eff} – effective penetration depth;

Δt considered time intervall;

Schneider and Müller, 2018





pCO2 10 Dec - 17 Dec 2017

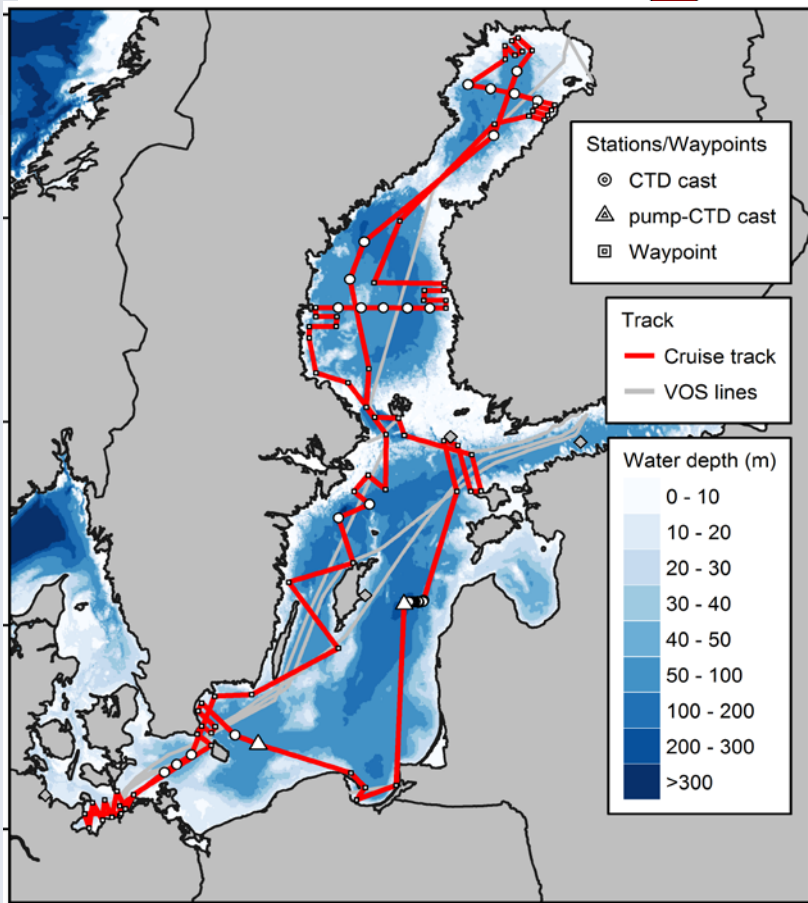
ONUS INTEGRAL

ICOS

INTEGRATED CARBON OBSERVATION SYSTEM

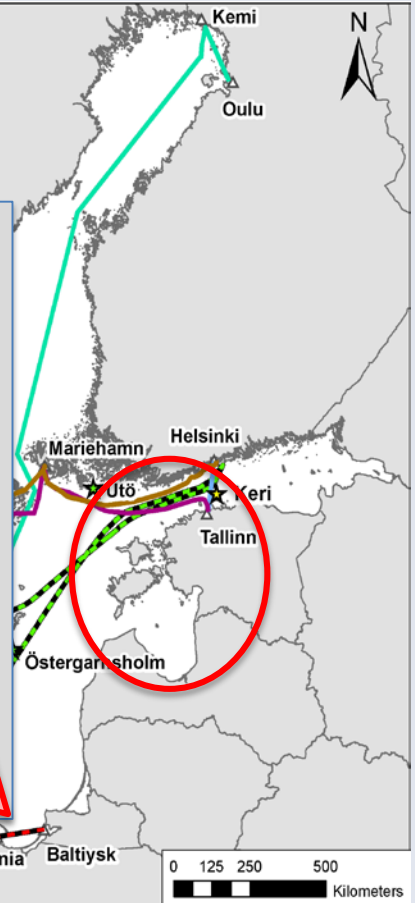
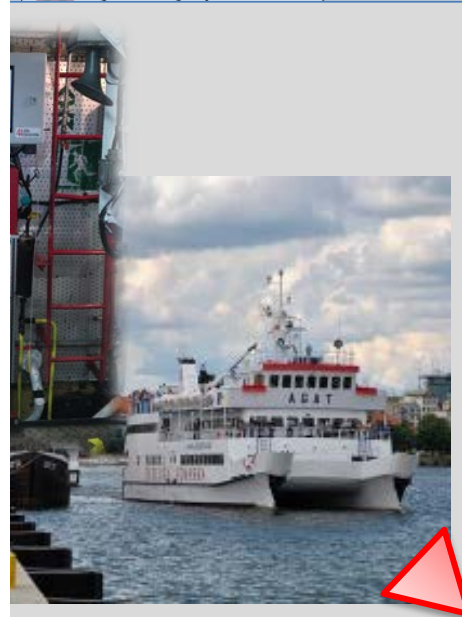


Observational Network



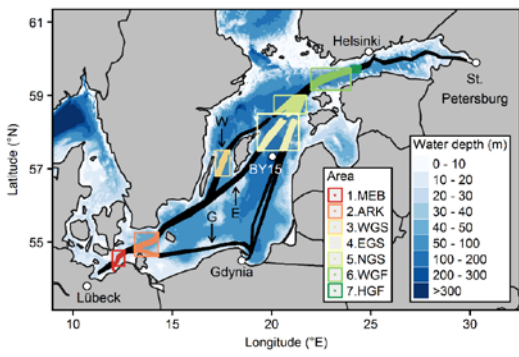
VOS Lines
Ship and Station names

- *Silja Serenade (SYKE /FMI)*
- *Baltic Queen (TTU)*
- *TransPaper (SMHI)*
- *Victoria (TTU)*
- *Gdynia - Baltiysk (IO PAN -*

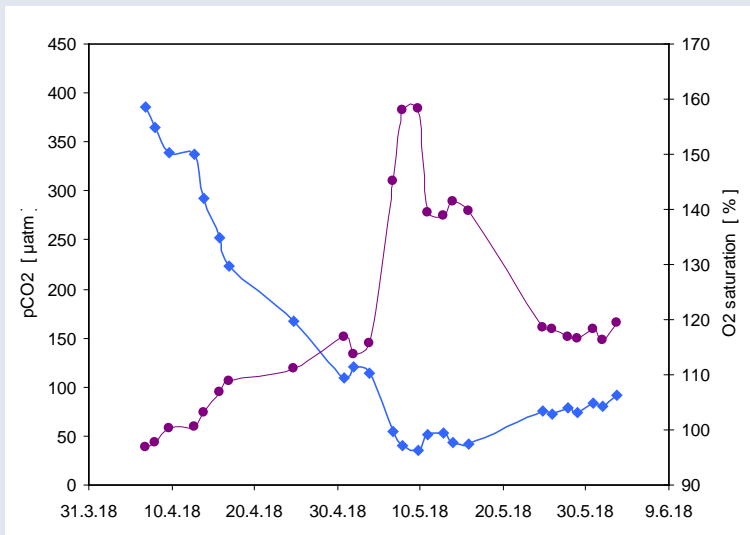
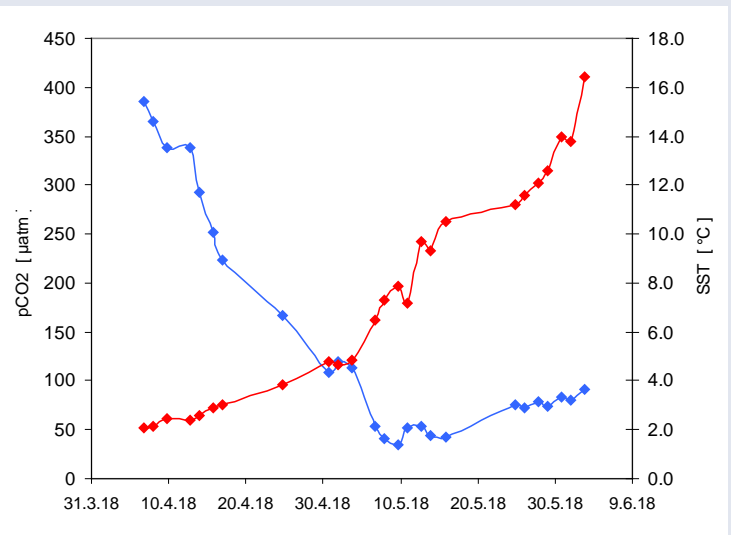


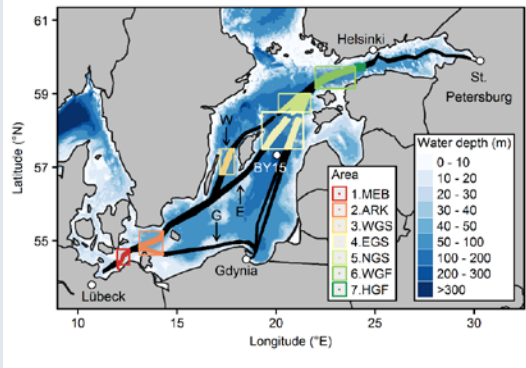


Latest News: Eastern Gotland Sea
57.5° - 58.5° N
„as we speak“

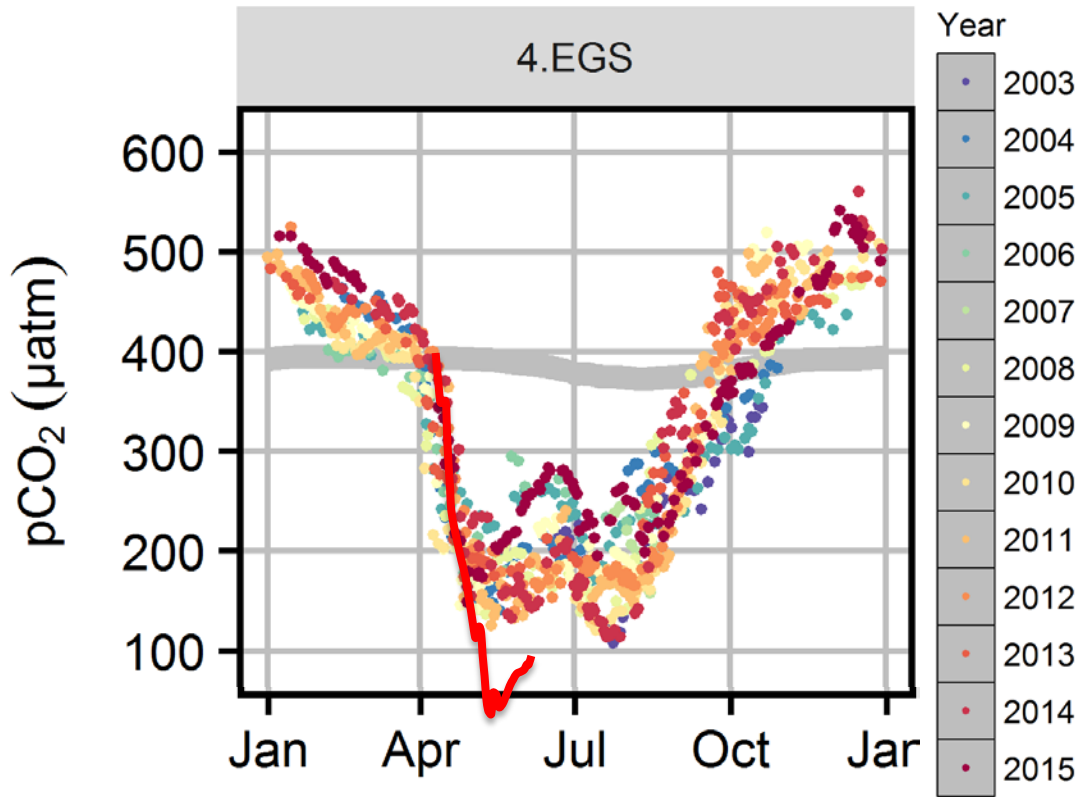


- Extremely low pCO₂ in late spring 2018
- Peak of 170 % O₂ saturation
- Coincidences with prolonged stable weather conditions





Never encountered during the last decade





BONUS

SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION



BONUS INTEGRAL

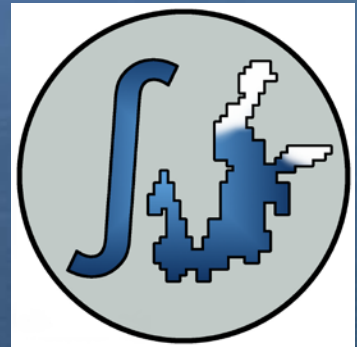
ICOS

INTEGRATED CARBON OBSERVATION SYSTEM



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Thank you for your attention



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