

Controlling processes of seasonal and spatial distribution of methane in the surface water of the Baltic Sea based on long term continuous measurements

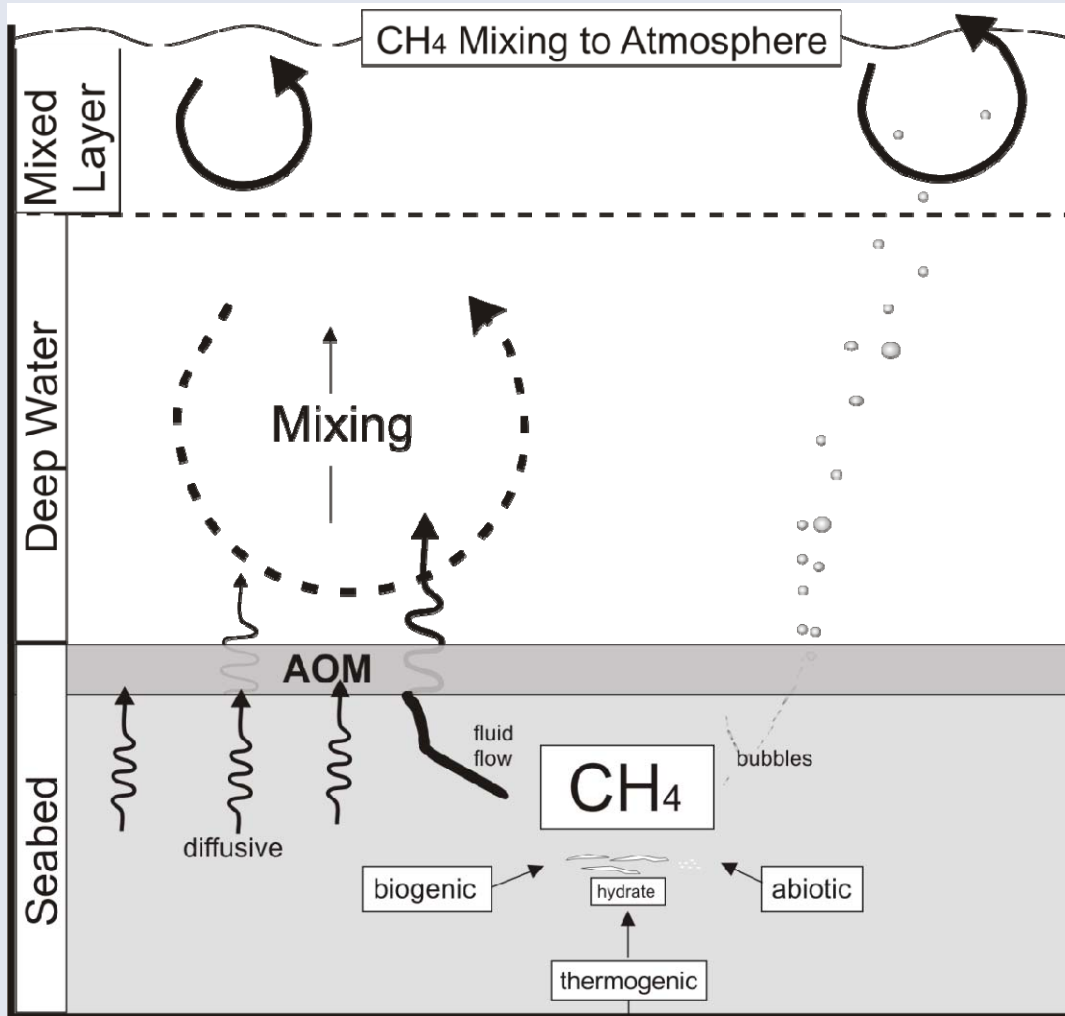
Wanda Gülzow

Jens Schneider v. Deimling

Gregor Rehder

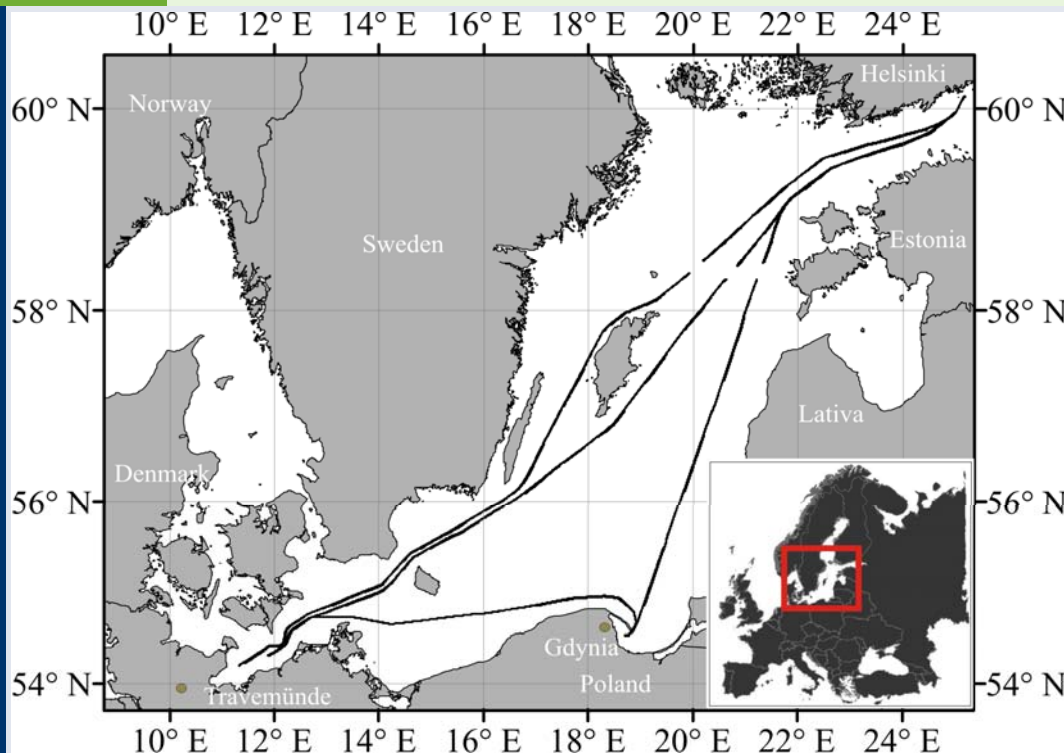
Torsten Seifert





Schneider v. Deimling, J., 2010.

- Oceans play uncertain role in global atmospheric CH_4 budget
- Shallow marine waters contribute significantly to the atmospheric CH_4 pool



Off-axis integrated cavity output spectroscopy (ICOS)

since Nov. 2009 more than 300 transects

2-3 days interval

CH₄, CO₂, O₂, T, Sal, P_{atm}, chl_a, nutrients

$T_{CH_4} = 676 \text{ s}$

$T_{CO_2} = 226 \text{ s}$

uncertainty <1%

Gülzow et al. (2011)



In cooperation with S. Kaitala (SYKE), B Schneider (IOW) and Finnlines

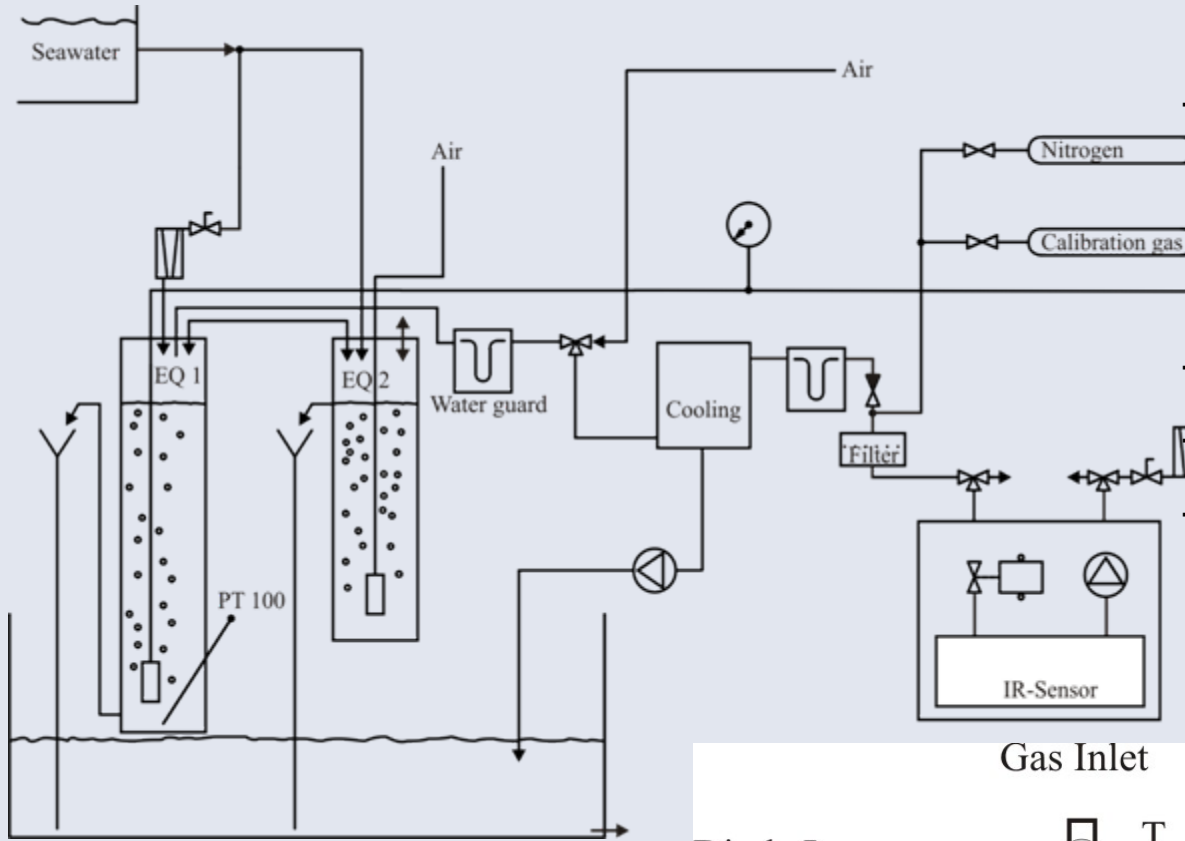
- Los Gatos Research

- Off-axis integrated cavity
output spectroscopy
(ICOS)

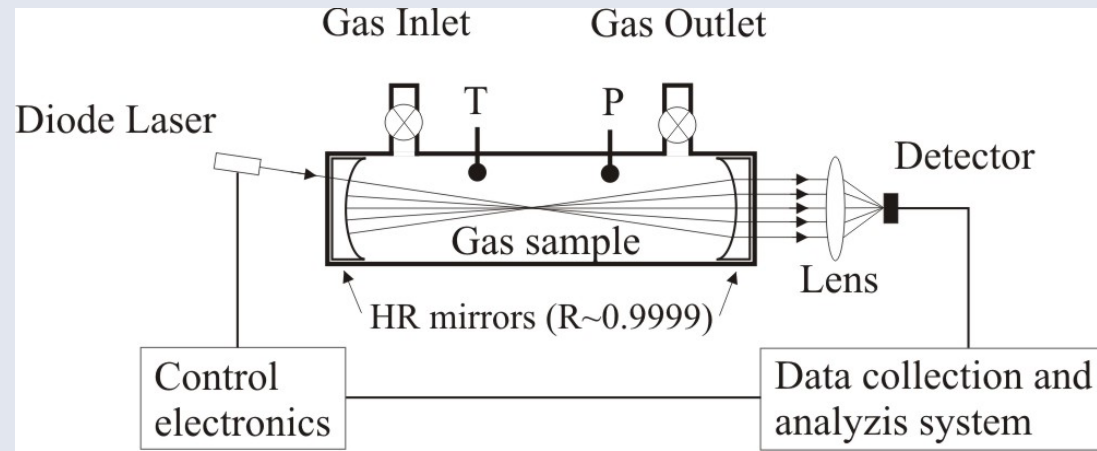
CH₄: 0.1-8 ppmv

CO₂: 200-16 000 ppmv

- total uncertainty ~ 0.1%

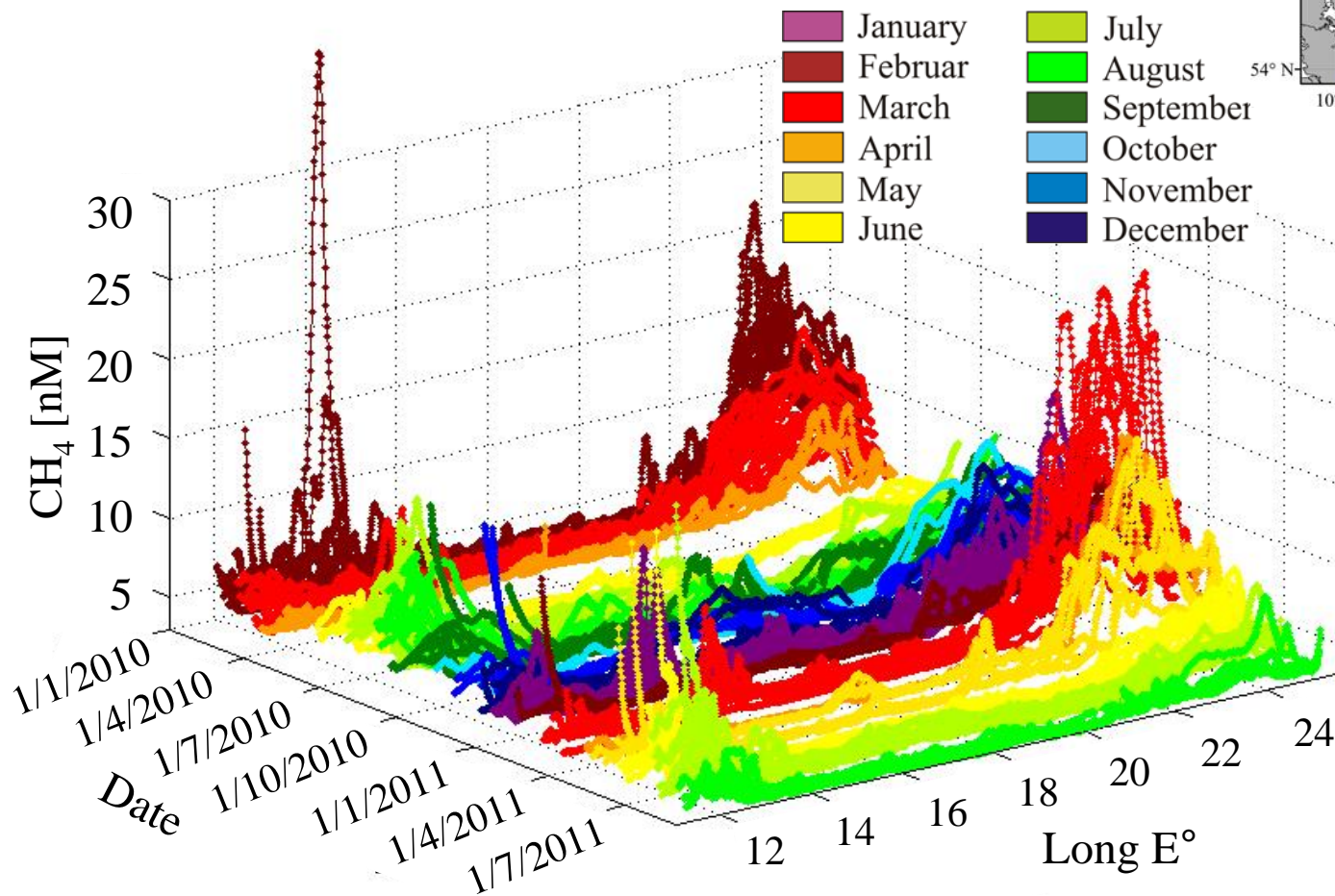
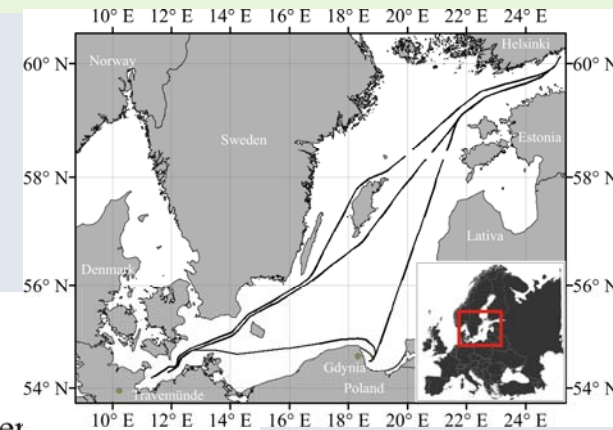


Gülzow et al. 2011

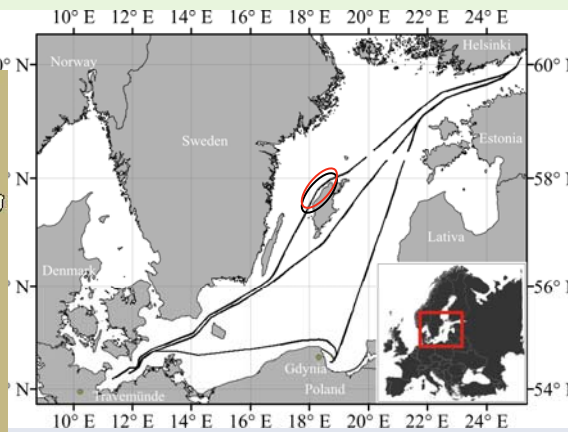
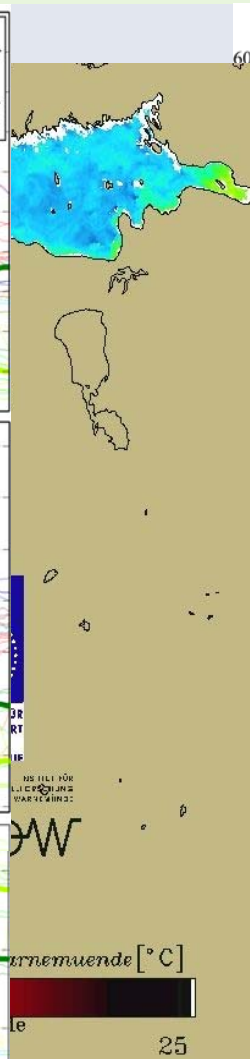
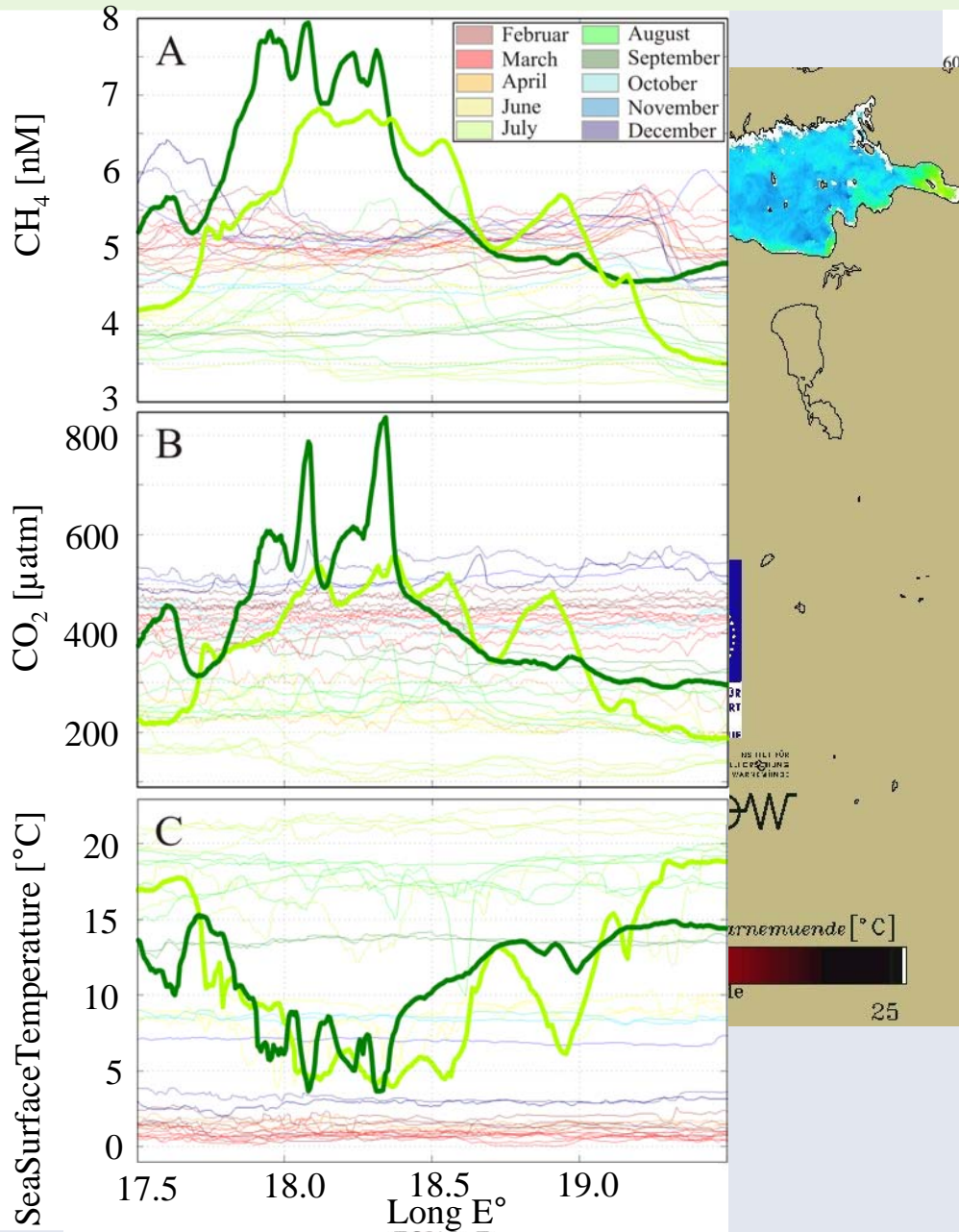
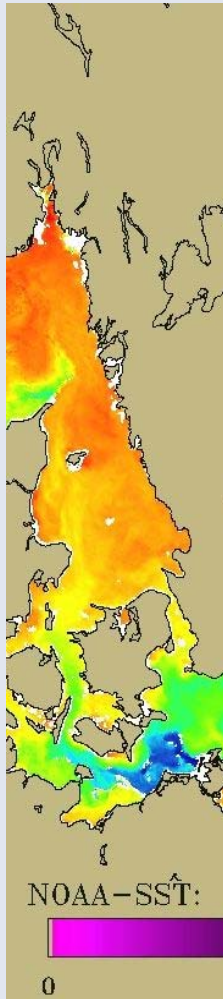


Gülzow et al. 2011

Regionality
Seasonality

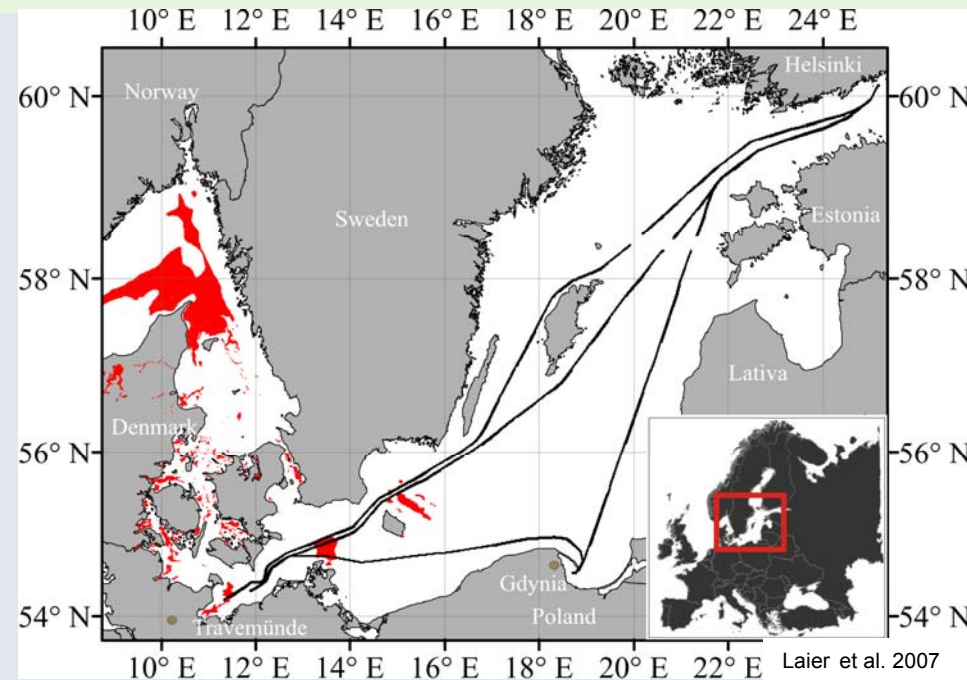


Upwelling

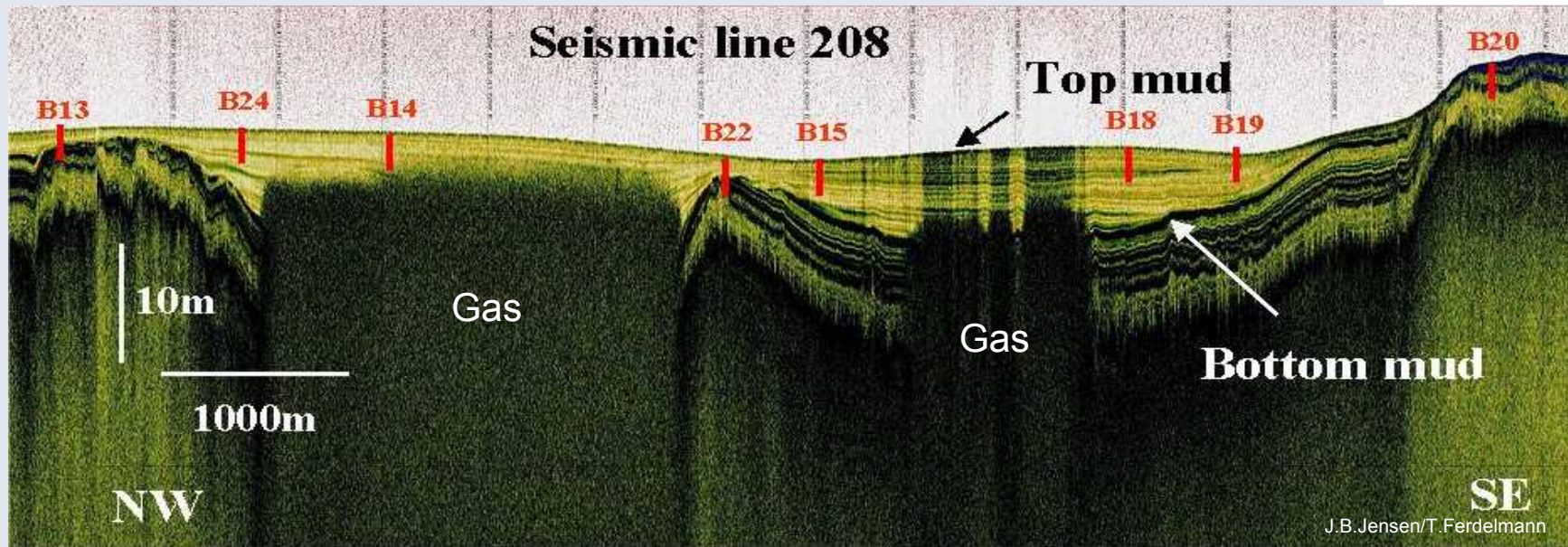


- typical phenomenon in BS
- throughout the year
- T = indicator during summer

- occurrence in many regions of Baltic Sea
- Holocene mud
- Depth of boundary layer of dissolved and free gas influenced by T and P (Wever et al. 2006)



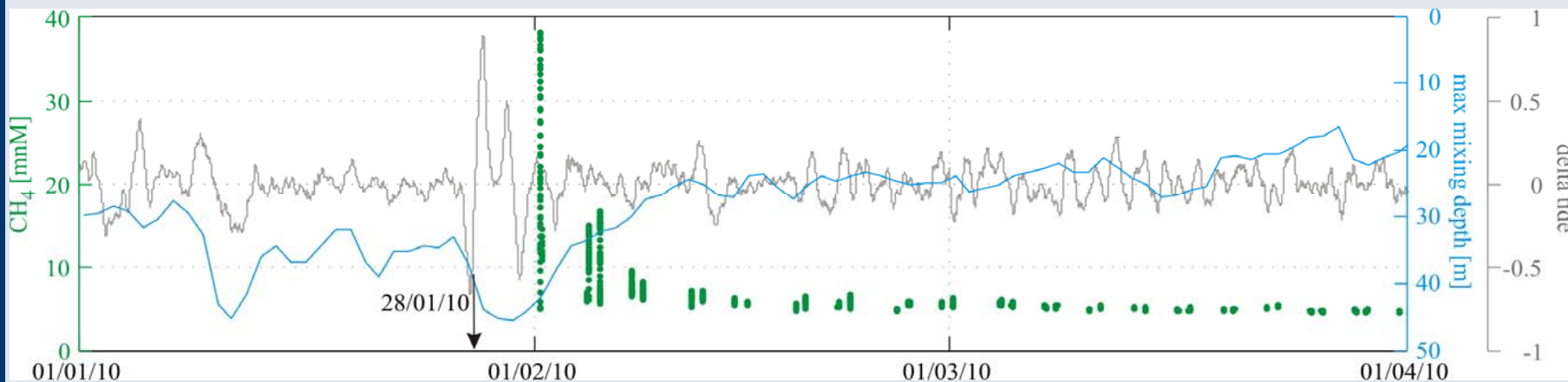
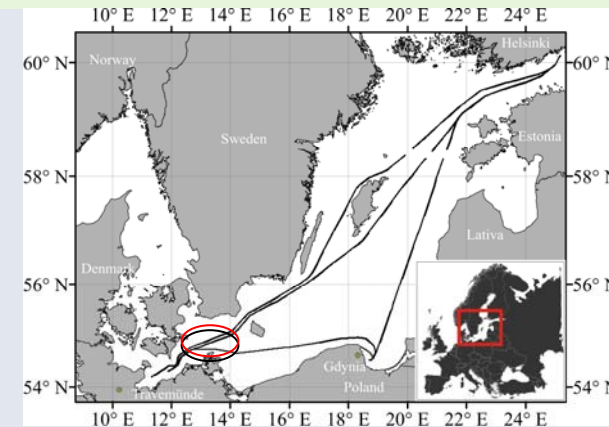
Bornholm Basin



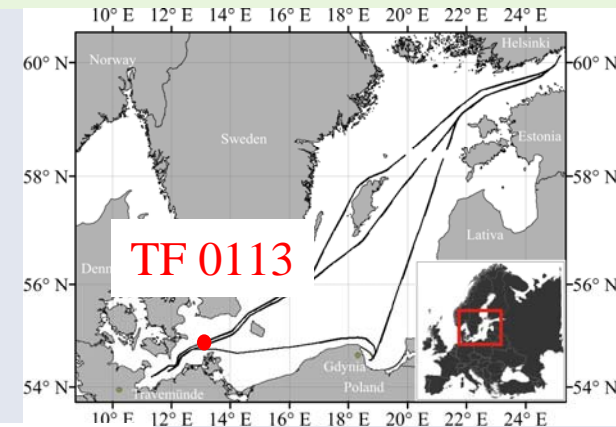
Gassy sediments

- Jan/Feb 2010
- strong wind event
- shift of the sea water level for almost 1,5m within a day (Bundesamt für Wasserbau, Station Sassnitz)

- pressure drop
- seepage

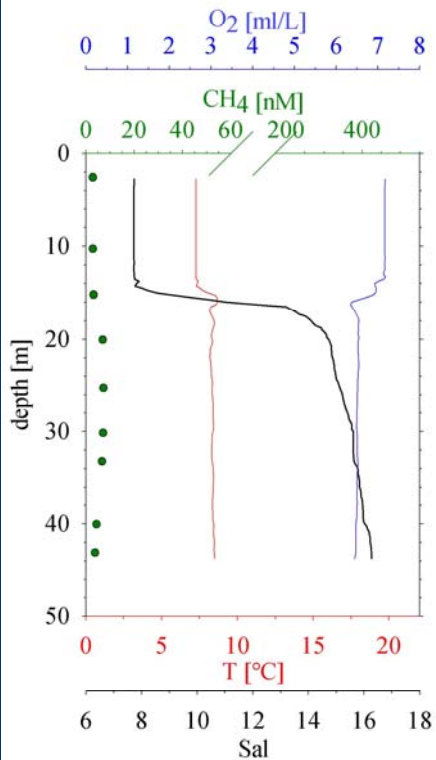


- Monitoring program of IOW
- CH₄ profiles taken since 2010

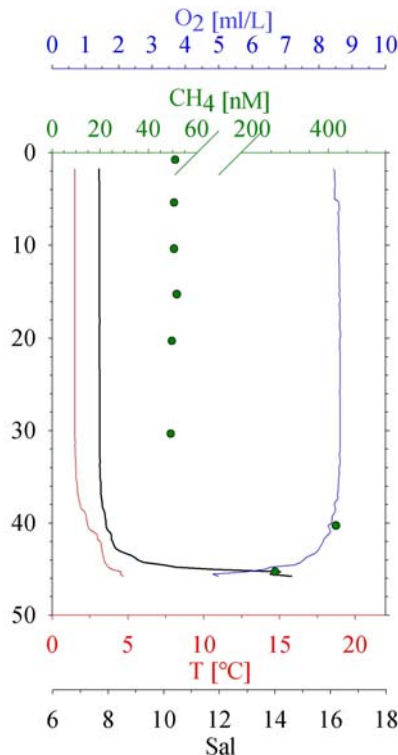


Arkona Event

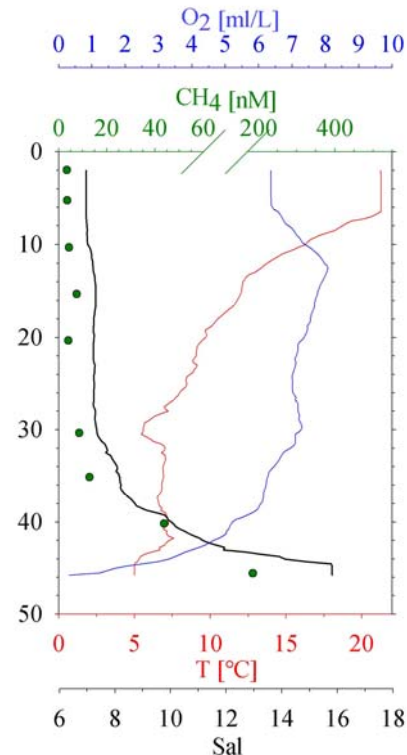
3.12.2009 P392 374020



28.01.2010 TF 0113

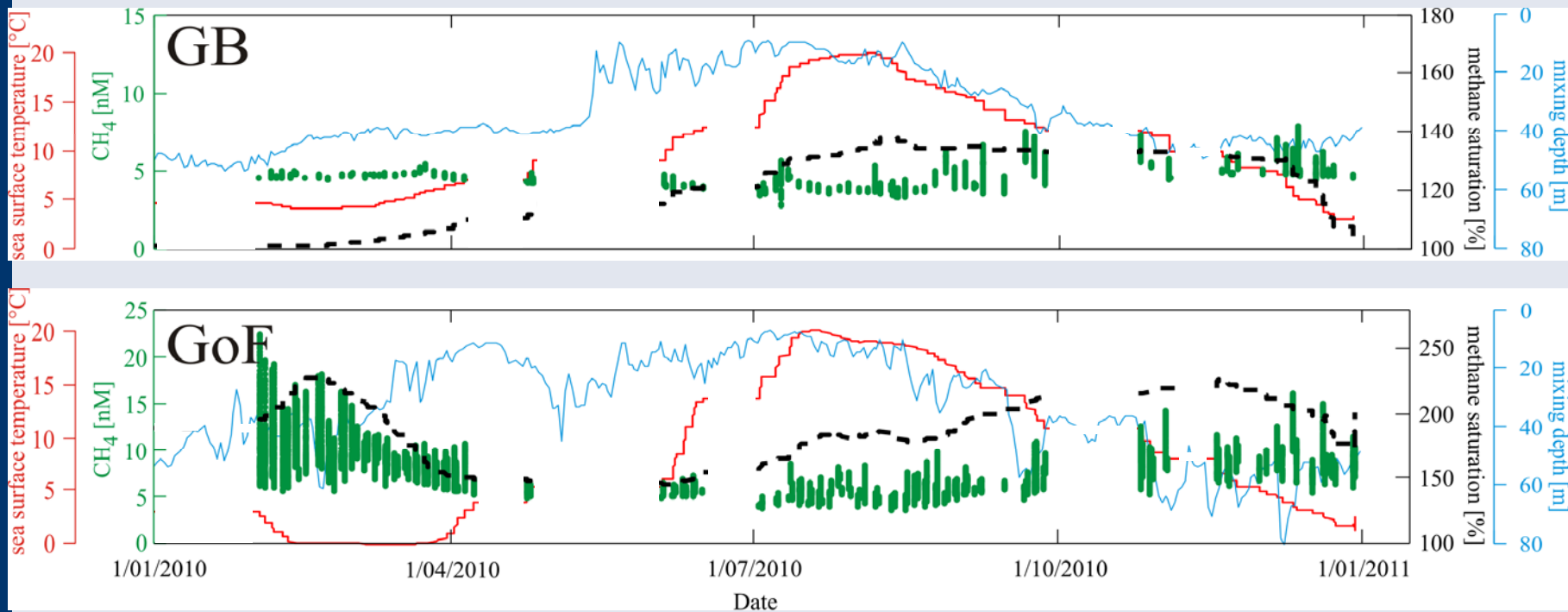


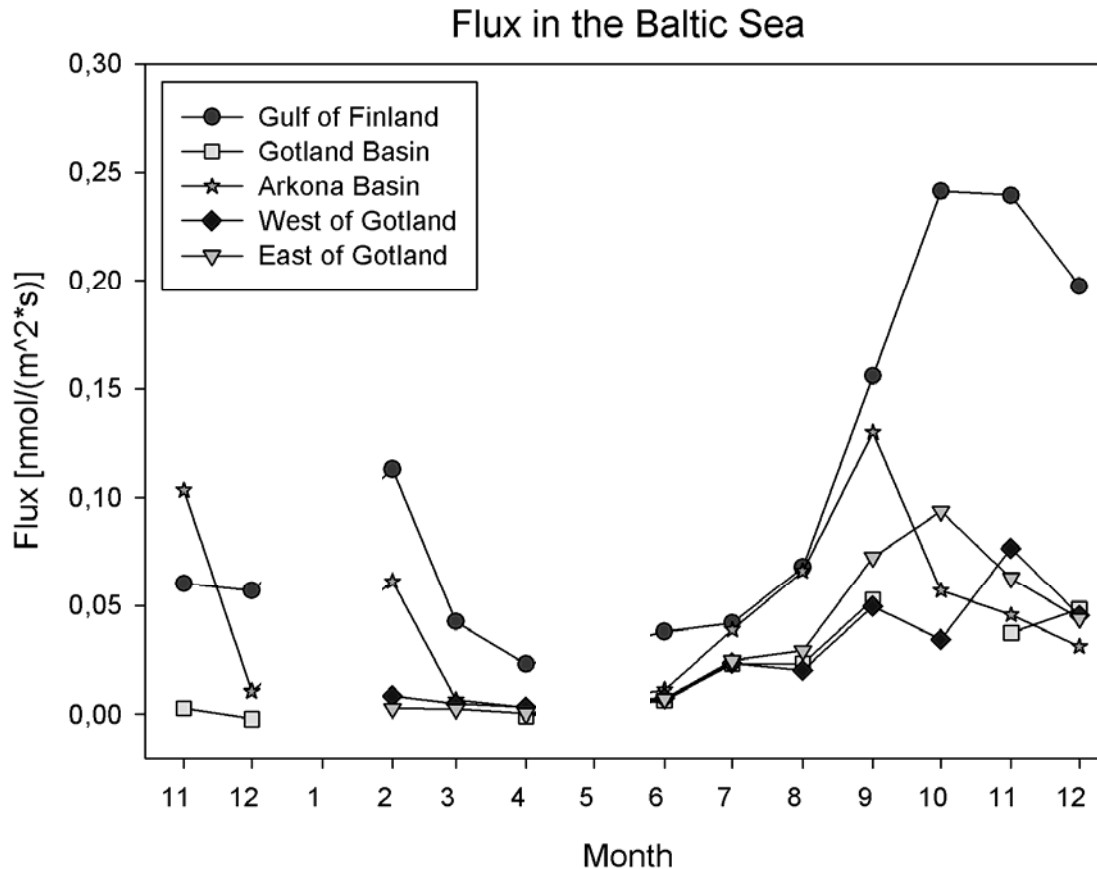
17.07.2010 TF 0113



- temperature induced solubility of methane
- stratification of the water column
- seasonal change in mixing depth

general trend





– after Wanninkhof 1992

– CH_4_{atm} from NOAA
Station Poland

– in general: sea-air
methane flux

– high fluxes during autumn
/ winter

→ increasing mixing depth

– low fluxes during spring /
summer

→ stratification

Bange et al. 1994 (LM86)

winter.: 0.0011-0.17 $\text{nmol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$

summer.: 0.017- 13.9 $\text{nmol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$

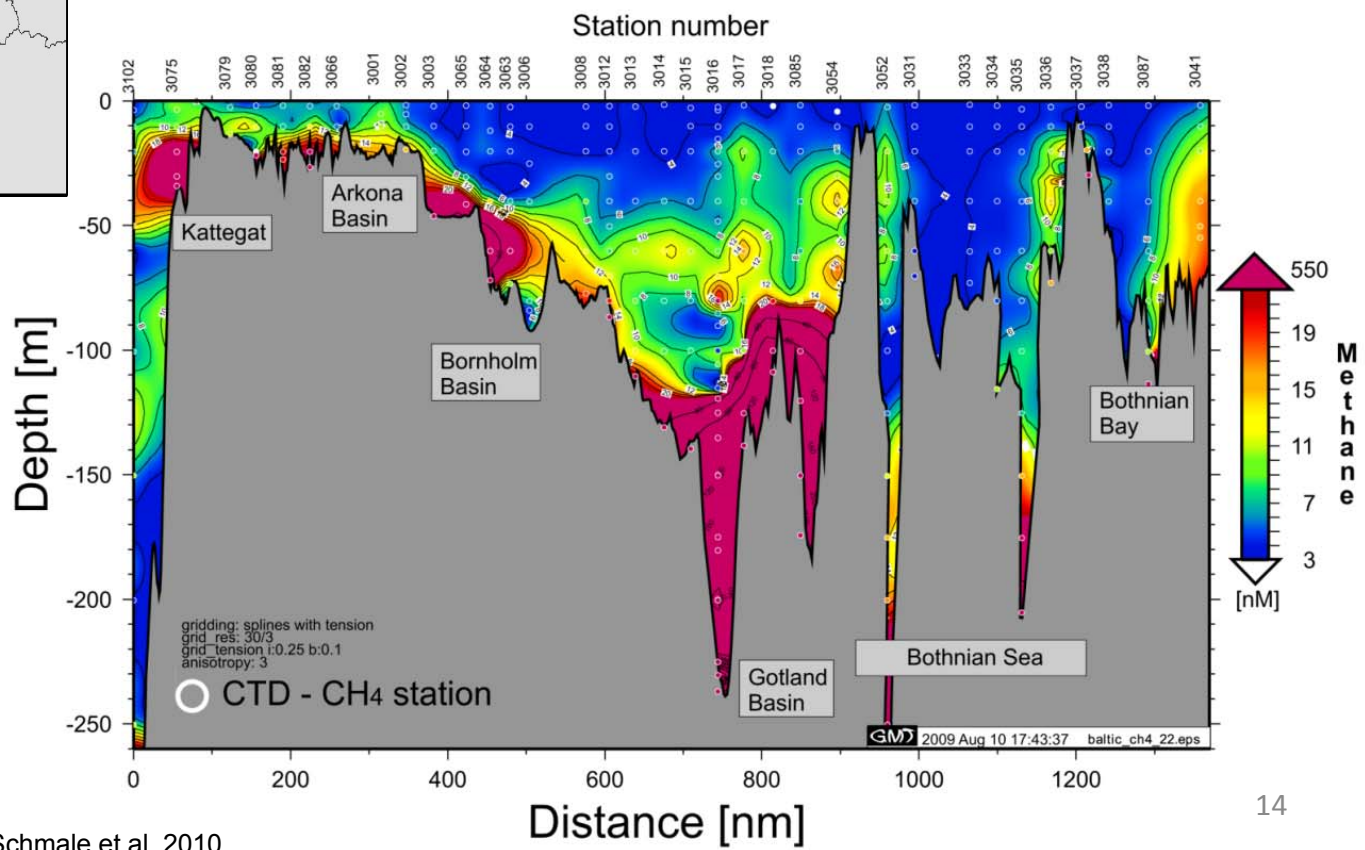
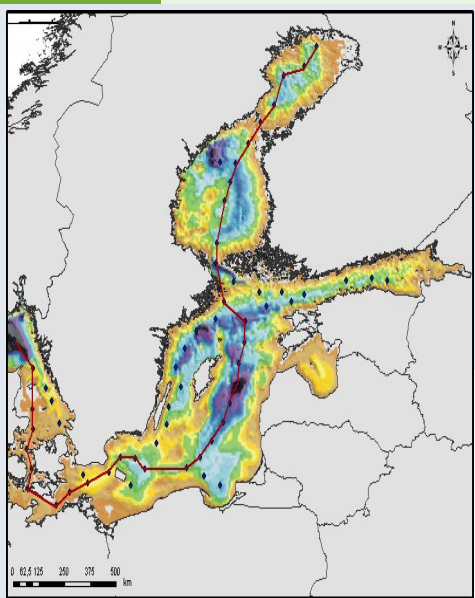
– Gotland Basin: uptake of
methane during winter

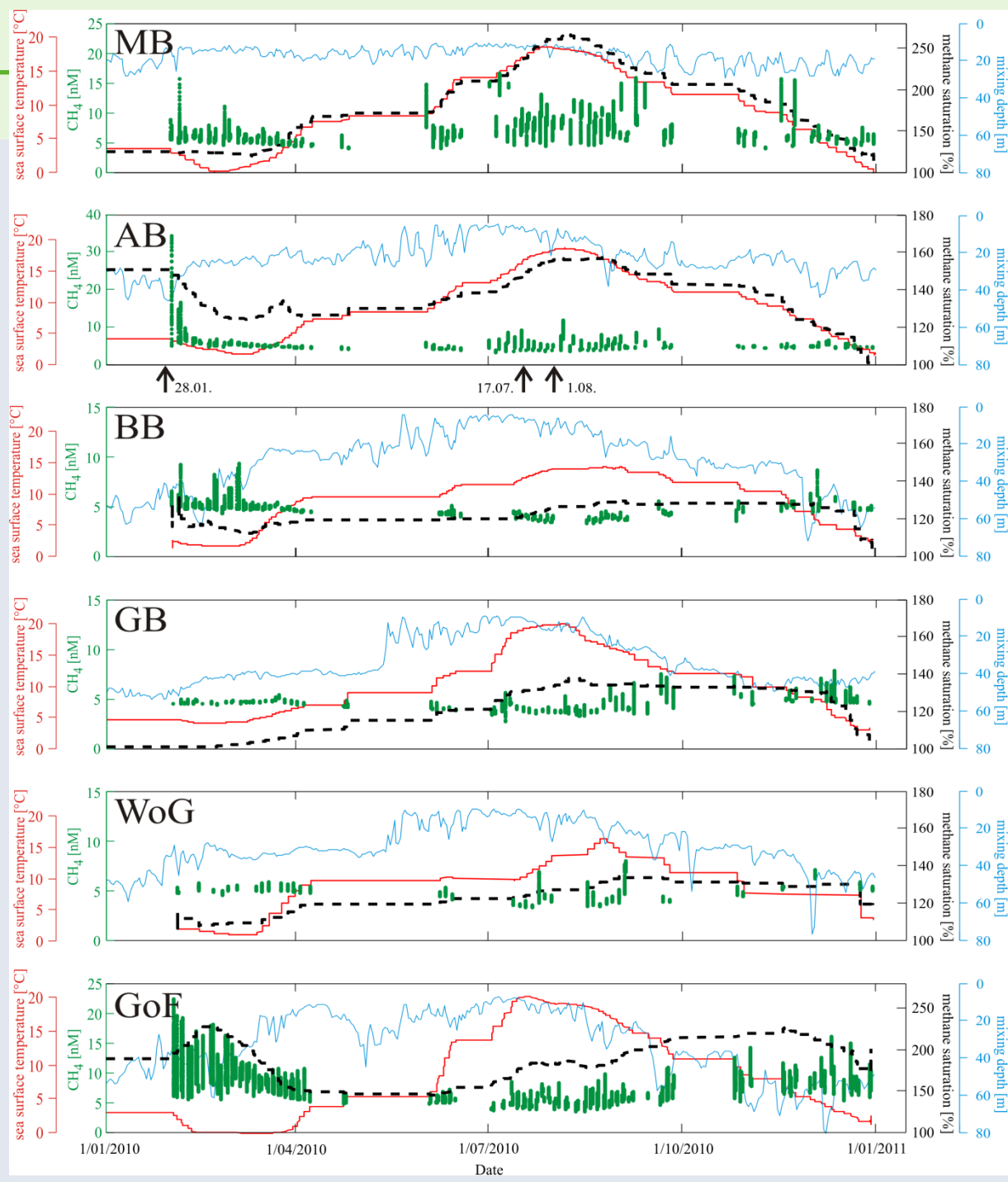
→ solubility effect

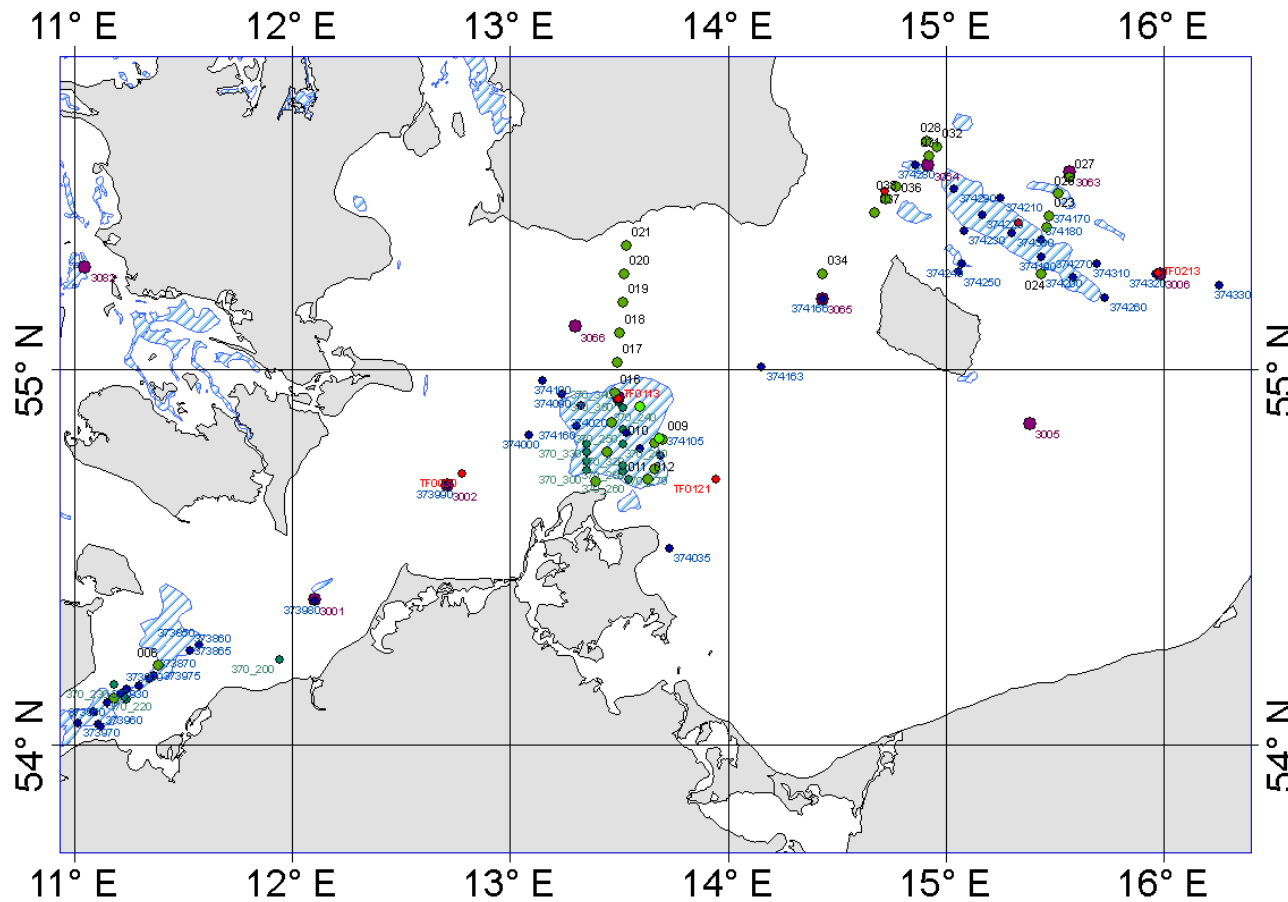
- complex scenario of processes
- Regional:
 - water depth
 - gassy sediments
- Seasonal:
 - temperature induced solubility of methane
 - stratification of the water column
 - seasonal change in mixing depth
- Flux:
 - Baltic Sea is a source of methane to the atmosphere
 - seasonal fluctuations
 - low fluxes in stratified regions
 - high fluxes in shallow/deep but strongly mixed regions
- integration in ICOS
- mobile system on E. Mann-Borgese

Thank you for your attention...

Cruise Merian 0803 July 2008

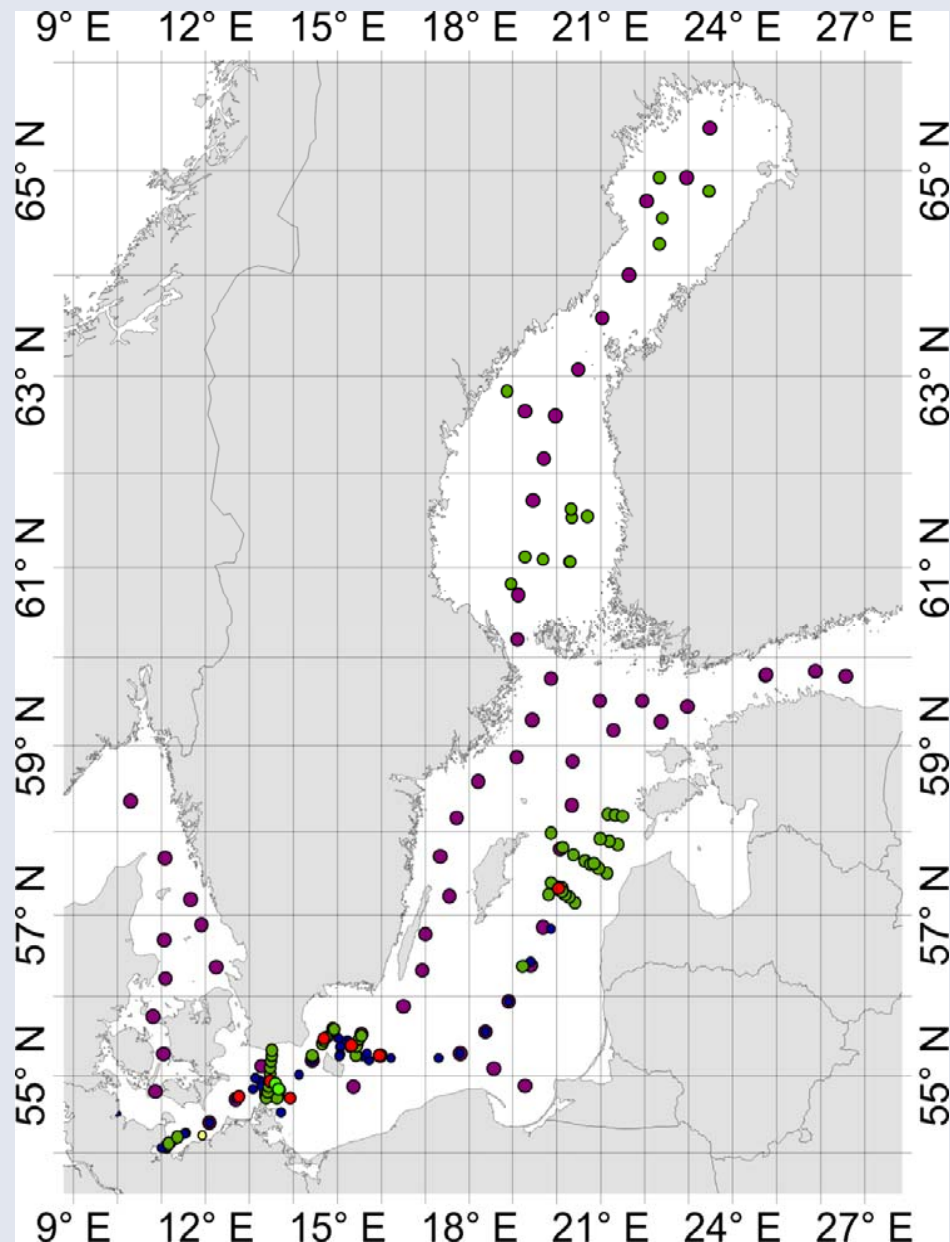






- >100 Stations
- 4 cruises
 - Jul 2008 (O. Schmale)
 - Jan 2009
 - Dez 2009
 - Aug 2010
- 6 monitoring cruises
 - Feb 2010
 - Jul 2010
 - Mar 2011
 - May 2011
 - Aug 2011 (under progress)
 - Nov 2011 (planned)

- seasonal variations in water column methane concentrations
- current induced methane distribution
- phenomenon of methane accumulation in water column along density gradient



- >200 Stations
- 4 cruises
 - Jul 2008 (O. Schmale)
 - Jan 2009
 - Dez 2009
 - Aug 2010
- 6 monitoring cruises
 - Feb 2010
 - Jul 2010
 - Mar 2011
 - May 2011
 - Aug 2011 (under progress)
 - Nov 2011 (planned)