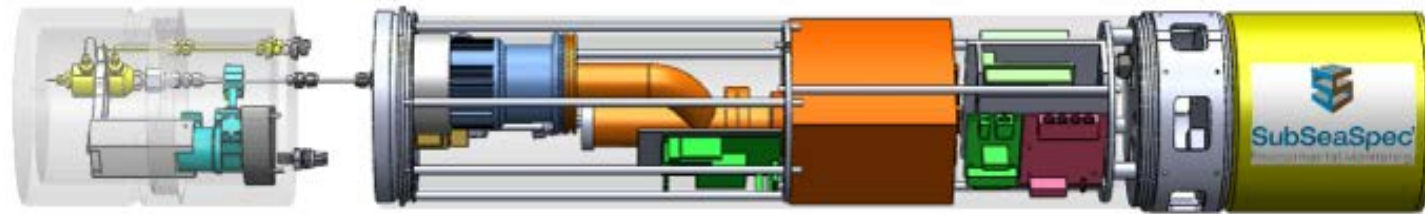


High resolution detection of the dissolved gas composition in aquatic systems by novel underwater mass spectrometry.



Dr. Torben Gentz

Postdoc, Marine Geochemistry
Alfred Wegener Institute

ESTABLISHED METHODS FOR HYDROCARBONS

Water column sampling



Phase separation:
gas phase from aqueous phase



Headspace technique
for analysis of discrete
samples

Gas analysis by gas
chromatography



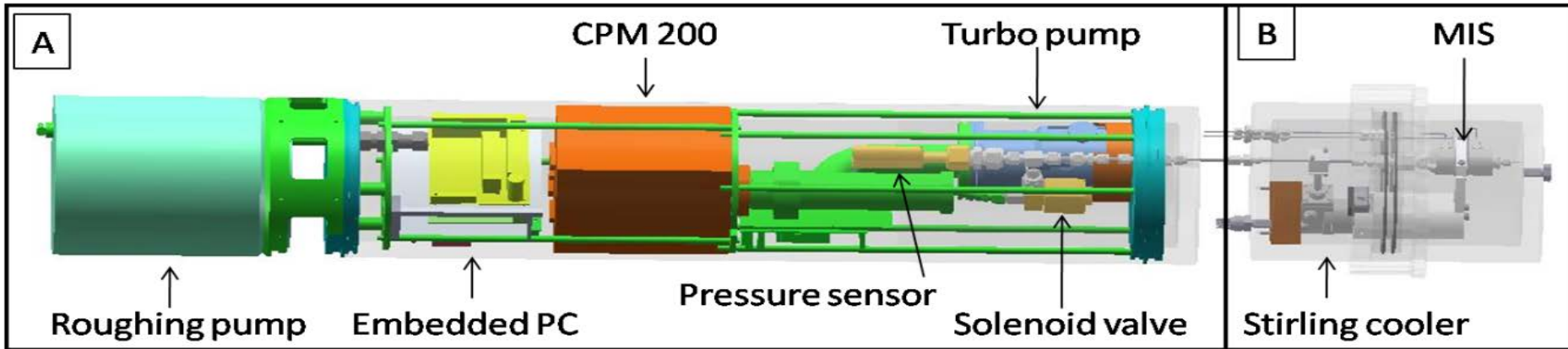
(Lammers and Suess 1994)

Problems:

- time consuming
- coarse spatial and temporal resolution



UNDERWATER MASS SPECTROMETER (INSPECTR200-200)



SPECIFICATIONS

Mass Analyzer

- Quadrupole based
- Membrane introduction source
- Vacuum: Varian turbo molecular with diaphragm backing pumps

Mechanical

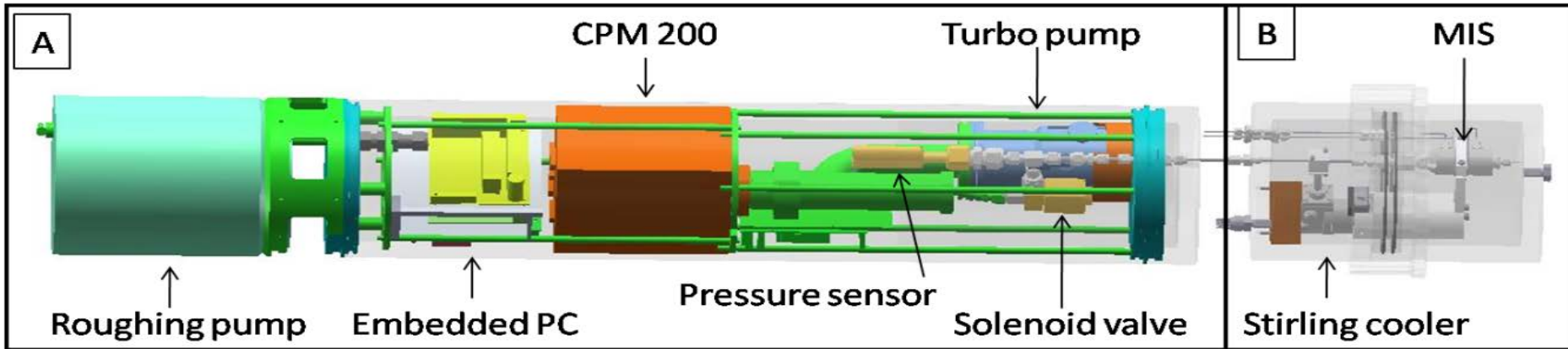
- Dimension:
- UWMS housing: $\varnothing 19.5$ cm x 120 cm
- Cryotrap housing: $\varnothing 19.5$ cm x 30cm
- Weight Air - 38.5kg
Water – neutrally buoyant
- Max .operating depth: 200m standard housing
- Construcion hard anodized aluminium

Electrical

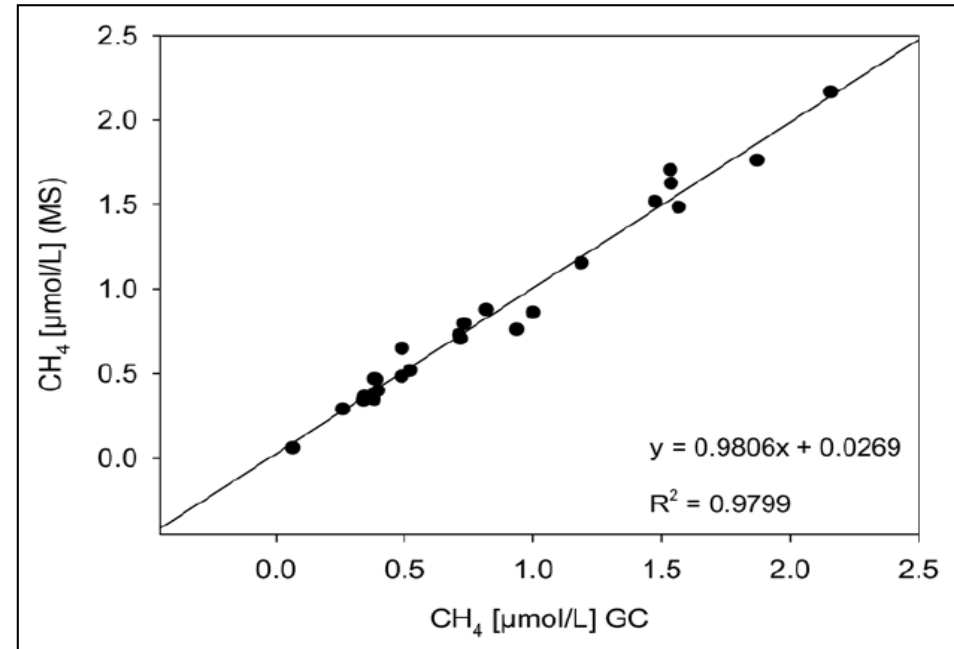
- 24 volts DC external power
- 95 Watts power consumption
- Embedded Pentium™ PC controller
- LAN communications port



COMPARISON OF THE INSPECTR200-200 VS. CONVENTIONAL TECHNIQUES



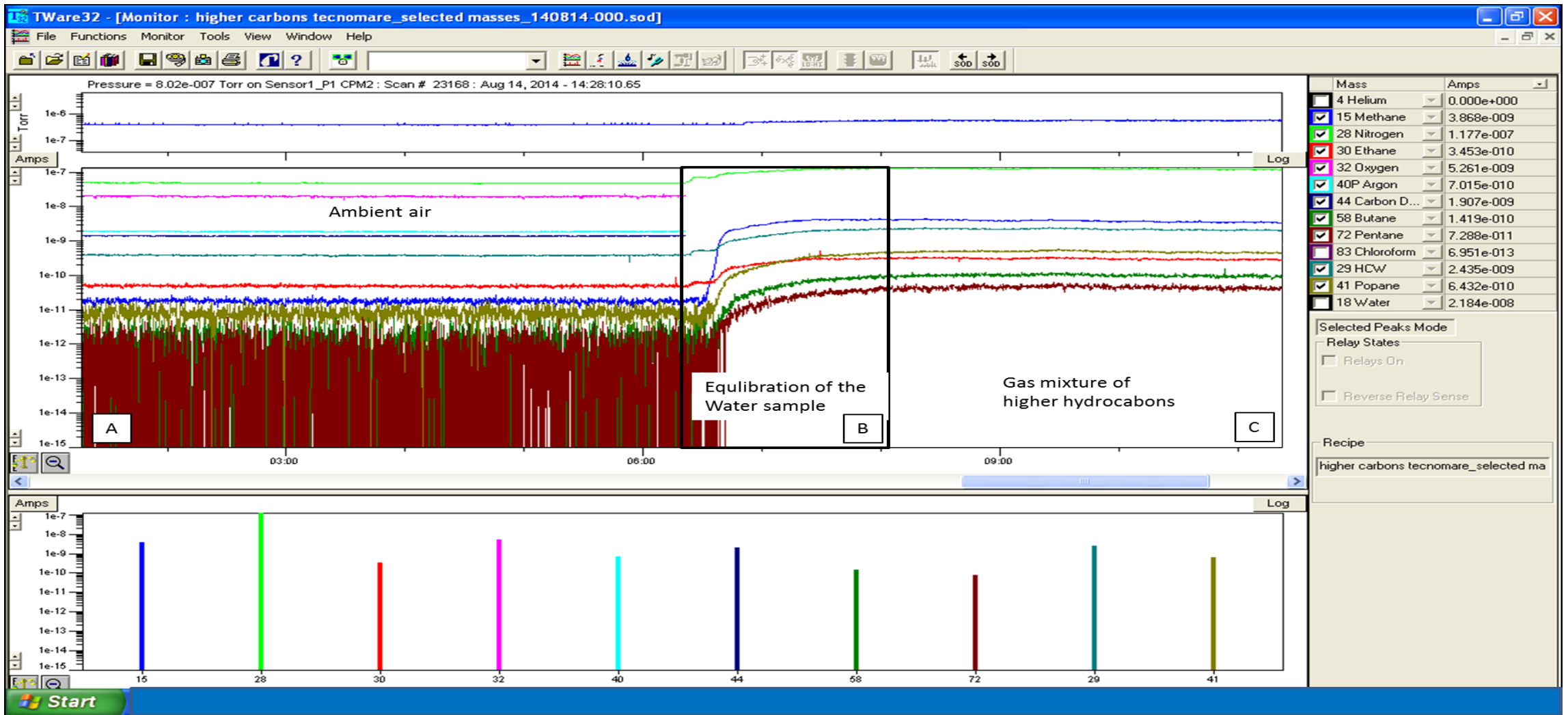
- Both methods are comparable
 - No sampling preparation
 - Simultaneous measurement of the dissolved gases
 - No artefacts during sampling
 - Up to 750 times higher sampling frequency
- **Higher temporal and spatial resolution**



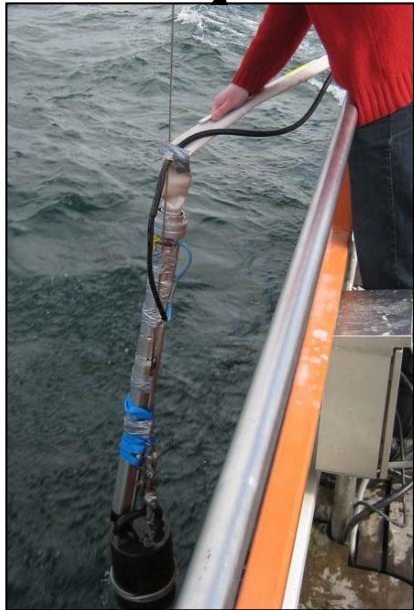
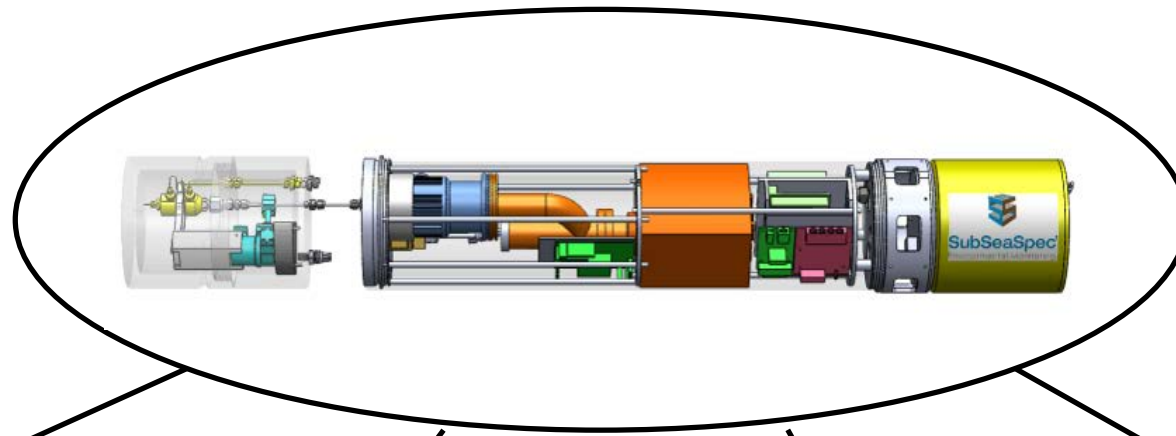
Inspectr200-200 vs. GC



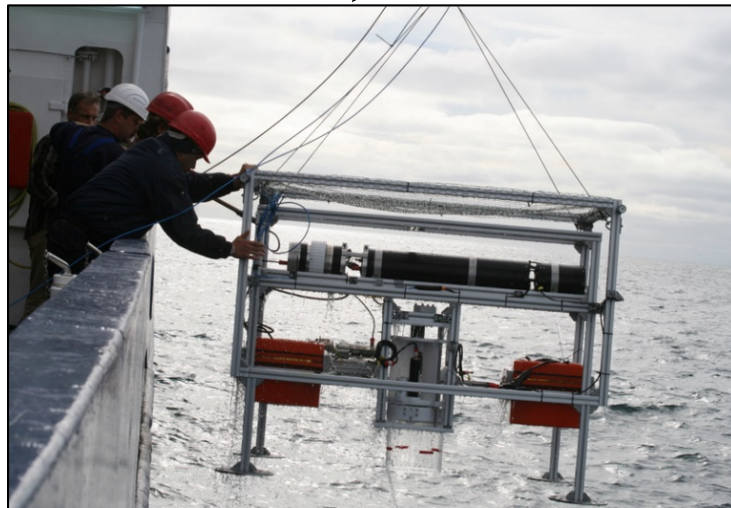
EXAMPLE OF GAS MEASUREMENTS BY UWMS



MODE OF OPERATION



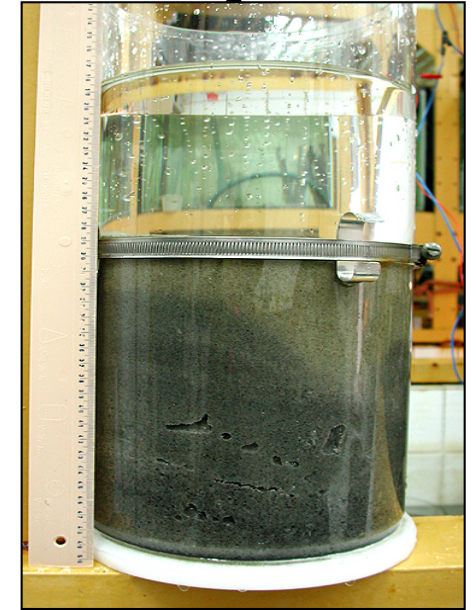
Ex situ



In situ in a frame
including benthic chamber



In situ at sediment-
water-transition-zone



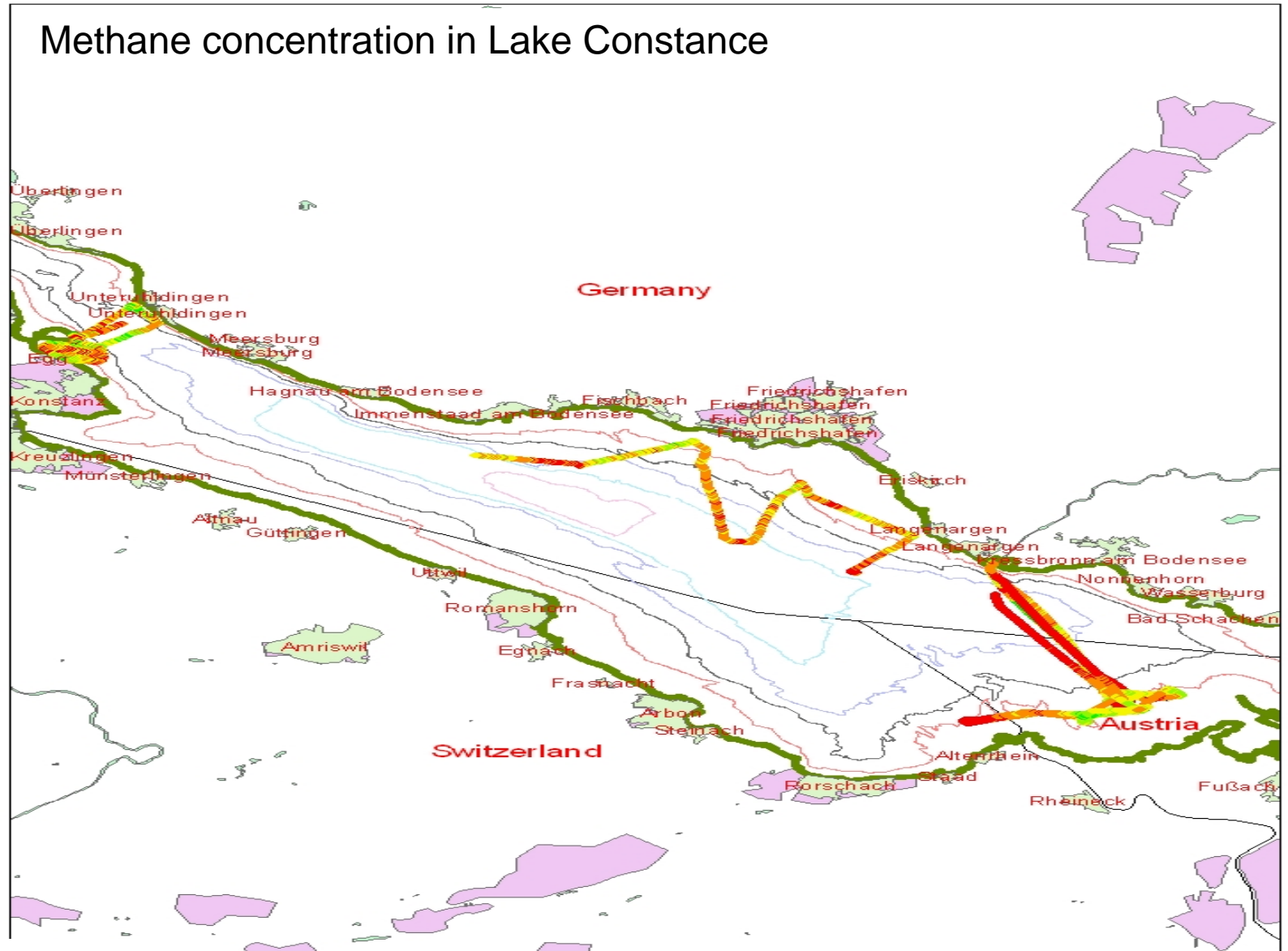
Laboratory measurements

RESULTS: Ex situ by pumping on board



„Grundfos“ pump

- Up to 80 m water depth



over 250.000 samplings in 3 years



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UND MEERESFORSCHUNG

RESULTS: In situ in a frame



UWMS in a frame

- Online up to 100 m water depth
- Offline up to 200 m water depth
- In situ benthic chamber measurements
- Cruise vessel needed

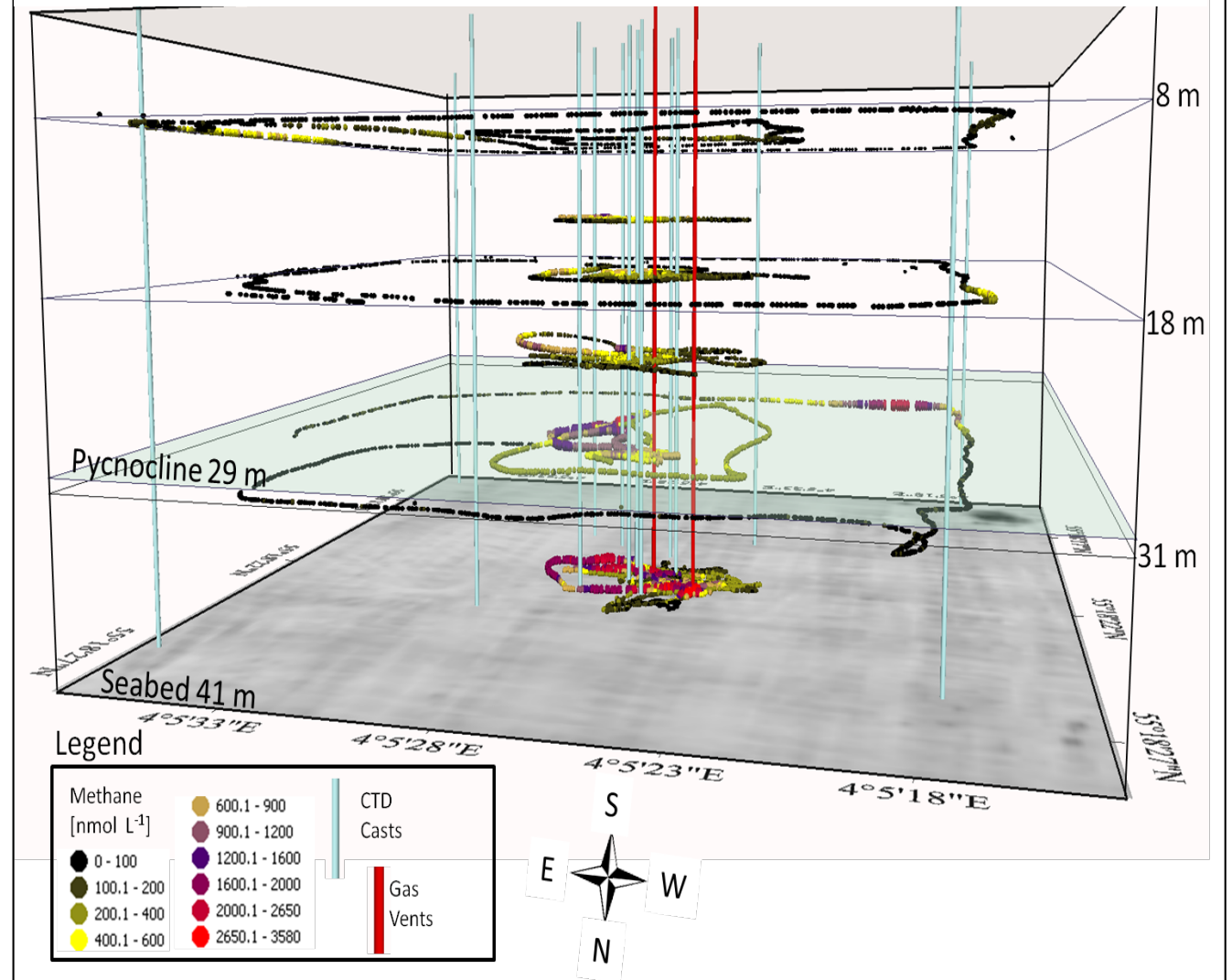


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Environmental Monitoring



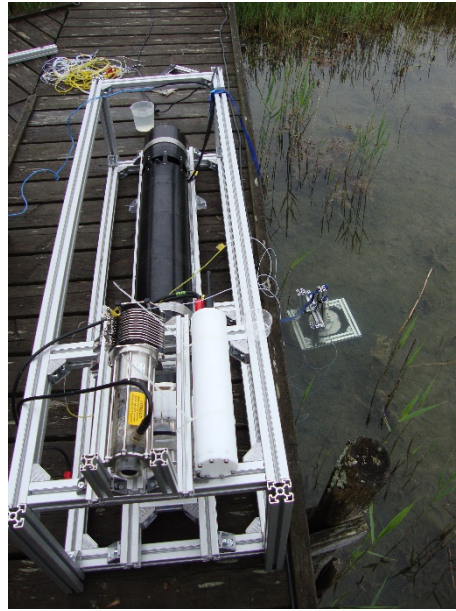
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Methane concentration above a pockmark in the North Sea



11900 samples in various depth in between 24 hours

RESULTS: In situ at the sediment-water-transition-zone



UWMS on top of a human drawn vehicle and at quay

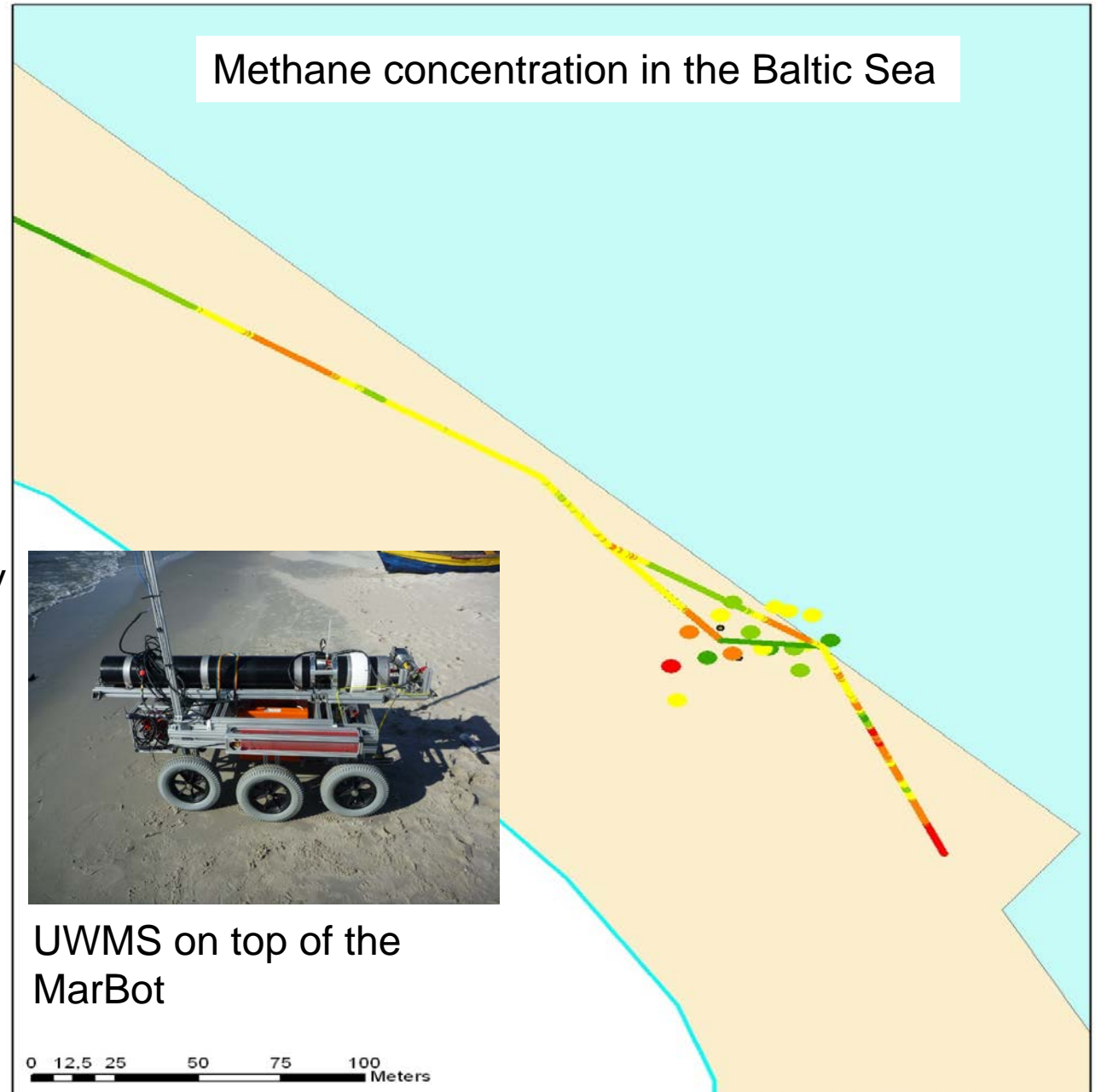
- Battery or external power supply
- Measurements at the seafloor
- In situ benthic chamber measurements
- Only <2 m water depth



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RESULTS: Laboratory measurements

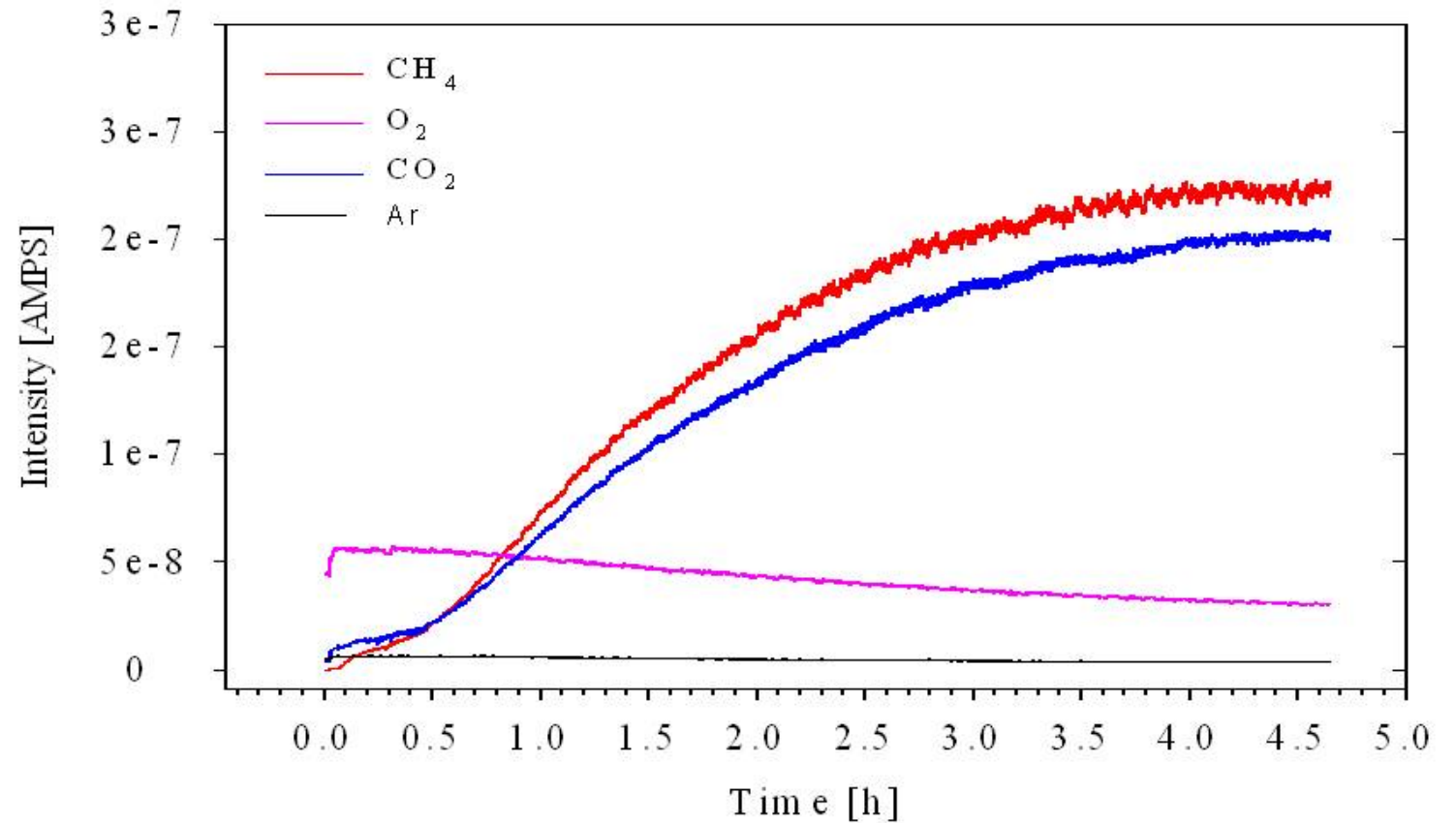


Sediment core

Laboratory analysis

- No power restriction
→ days of operation time
- Simultaneous observation of the dissolved gases

Benthic chamber measurements with the UWMS and GC in the Baltic Sea



Thanks for your attention!

Questions?

