



# Cruise Report

R/V "ALKOR"

Cruise- No. AL331 ( 06AK / 09 / 01 )

28 January - 14 February 2009

This report is based on preliminary data !

Leibniz Institut für Ostseeforschung Warnemünde  
an der Universität Rostock  
Seestraße 15  
D-18119 Rostock- Warnemünde  
GERMANY  
Tel +49-381-5197-0  
Fax +49-381-5197 440

**1. Cruise No.:** AL331 ( 06AK/ 09 / 01 )

**2. Dates of the cruise:** from 28/01/2009 to 14/02/2007

**3. Particulars of the research vessel:**

Name: r/v 'ALKOR'

Nationality: Germany

Operating Authority: Leibniz Institute of Marine Sciences at Kiel University  
( IFM - GEOMAR ) , Kiel

**4. Geographical area in which ship has operated:**

Baltic Sea between Kiel Bight and northern Gotland Sea

**5. Dates and names of ports of call**

02/02 – 03/02/2009 Saßnitz

**6. Purpose of the cruise**

Joint cruise for Monitoring in the frame of the COMBINE program of HELCOM , long term observation program of IOW , BaTRE - Project and IRON - Project

**7. Crew:**

Name of master: J. P. Lass

Number of crew: 11

**8. Research staff:**

Chief scientist: Klaus Nagel

Participants :

28/01 - 14/02/09	Jan Donath	Ursula Hennings
	Enrique Fernandez-Otero	Katrin König
	Ines Hand	Johann Ruickoldt
	Uwe Hehl	
28/01 - 03/02/2009	Birgit Sadkowiak	Doris Setzkorn
	Christian Schnees	Erika Trost
03/02 - 14/02/09	Anja Bachmann	Susanne Lage
	Jenny Jeschek	

## 9. Co-operating institutions:

All institutions dealing with the COMBINE program of HELCOM

- 10. Scientific equipment :** CTD  
water samplers  
plankton net

## 11. General remarks and preliminary results

The cruise AL331 was a joint cruise between the German contribution to the COMBINE program of HELCOM, the long term data series of IOW and the DFG funded projects BaTRE and IRON. The area under investigation covered the Baltic Sea between Kiel Bight and the northern Gotland Basin as shown in the attached maps. Marine meteorological, hydrographic, chemical and biological investigations were performed at 114 stations. The measurements were supplemented by continuous registration of standard meteorological parameters as well as surface water temperature and salinity.

For selected stations, which are characteristic for different regions of the Baltic Sea, preliminary data of hydrographic and hydrochemical parameters in the surface and the near-bottom layer are compiled in the attached tables. These results are also compared with mean values calculated from the measurements performed during the February cruises of the years 1993 to 2007.

Except a two days period between 31/01/2009 and 02/02/2009 with wind speeds of significantly more than 16 m/s, the weather during the cruise was rather calm for this time of the year. Generally wind speed varied between 5 m/s and 14 m/s with only some short periods of lower or higher values. It is notable that no pronounced westerly wind directions were observed during this cruise. Until the 07/02/2009 easterly and southerly wind directions prevailed, slowly moving from SO to ONO and to SW afterwards. Starting on 07/02/2009 wind directions changed to NO to NNW. From the beginning of the cruise until the 06/02/2009 ( western Baltic, Arkona basin and Bornholm basin ) air temperatures varied between +2°C and -4°C. Higher air temperatures were found around the isle of Gotland, with a maximum of +5°C in the early morning of the 08/20/2009.

Except the stations in the Kiel Bight and Mecklenburg Bight surface temperature in the area under investigation varied between 3°C and 4.5°C. Like in February 2008 this is slightly above or at the upper edge of the range expected from long term observations. Highest water temperatures during this cruise were found in the Bornholm basin in the depth horizon of 60 m to 65 m, where water temperatures up to 10.1°C have been measured and between

9°C and 10°C close to the sea floor. In the Gotland basin bottom temperatures are somewhat lower ranging between 5°C to 7°C.

Salinity in the surface layer was within the values expected from long term measurements in all regions of the Baltic Sea and varied between 7 – 8 in all areas except Kiel and Mecklenburg Bight. A halocline was observed between 40 m and 45 m in the Arkona Basin, slightly below 50 m in the Bornholm Basin and between 70 m and 80 m in the Eastern and Western Gotland Basins. Salinities measured in the bottom layer in the central areas of the Baltic Sea are in the range expected from long term observations and varied around 12. However, salinities in the bottom layer of the western Baltic ( 14 - 17 ) and in the Arkona Basin ( slightly above 11 ) are significantly lower than expected. Due to saltwater inflow events in the years before, salinity at the bottom of the Bornholm Basin is almost as high as that in the Western Baltic Sea.

The western Baltic Sea and the Arkona basin were well oxygenated down to the sea floor with oxygen concentrations close to 8 ml/l. Oxygen concentration in the Bornholm Basin dropped below 2 ml/l at depths between 60 m to 70 m, and even near the bottom oxygen concentrations of 1 ml/l were measured. In the Eastern and Western Gotland Basins and in the Landsort Deep H<sub>2</sub>S was detected below 90 to 110 m. Concentrations near the sea floor are up to 3.9 mg/l in the Eastern Gotland Basin, 1.2 mg/l in the Landsort Deep and 1.4 mg/l in the Western Gotland Basin.

Nitrate concentrations in the surface layer were normal for this time of the year and vary between 2.4 µmol/l and almost 5 µmol/l, which is within the range expected from long term observations for most stations. Phosphate concentrations in the surface layer were close to those found at the same time one year ago and are in good agreement with the values expected from IOW's long term data series. In the bottom layer concentrations of nitrate and phosphate are controlled by the presence of oxygen or hydrogen sulphide and were found in the expected range for most stations. However, due to the ongoing stagnation phosphate concentrations at the bottom were significantly higher ( 7 µmol/l ) and correlate with relatively high amounts of H<sub>2</sub>S.

#### BaTRE - Project

The DFG funded project BaTRE ( Baltic Sea Tracer Release Experiment ) has the following aims :

- to quantify global vertical mixing parameters in the deep Eastern Gotland Basin of the Baltic Sea by means of a tracer release experiment
- to identify the physical processes responsible for the observed integral mixing, in particular to distinguish between the contributions from local vertical mixing and boundary mixing processes

During the first cruise carried out in September 2007, an inert tracer (SF5CF3) was injected into an isosurface of potential density  $9.92 \text{ kg m}^{-3}$  close to station b23. This density surface was found to be located in the depth range between 190 m and 210 m. During following cruises the spreading of the tracer was monitored by taking samples on a dense spatial grid. The distribution of tracer in time and space provides essential information about deep water spreading and mixing.

The cruise AL331 was the fourth and last cruise within the BaTRE project. At 48 stations samples for SF5CF3 analysis were taken ( see attached grid map ). 341 water samples were obtained by the use of a CTD - rosette system equipped with HYDRO-BIOS FreeFlow bottles and transferred into pre-cooled 100 ml glass syringes. Syringes were stored in ice till analysis, which was generally performed within one hour after sampling. The IOW purge and trap system including a gas chromatograph with ECD detection was used for analysis. The depth profile showing the tracer distribution at station b31 is given as an example in the attachment.

#### IRON - Project

Eutrophication, one of the main problems in the Baltic Sea, is reinforced by the annual appearance of diazotrophic cyanobacteria blooms in the central Baltic Sea. These blooms have been increased in intensity, frequency and area during the last ten years. Iron is an important micronutrient for the growth of cyanobacteria and possibly a promoting factor for their growth during summer time.

This study focuses on the distribution and speciation of iron between oxic and anoxic conditions, the Fe(III) reduction to soluble Fe(II) in anoxic deeper waters, and its possible diffusion into the surface layer of the water column in the central Baltic Sea.

Surface Fe(II) concentrations and depth profiles were measured directly on board of the RV 'ALKOR' by using an adapted Chemiluminescence Flow Injection Analysis equipment and samples taken with CTD rosette system. Surface and deep water samples (not acidified) were analysed immediately after sampling.

At the surface Fe(II) concentrations in the Baltic Proper are ranging between 0.6 and 2nM Fe(II) with their minimum in the transition area between Baltic and North Sea. From the basis of depth profiles Fe (II) maxima were found in layers governed by anoxic conditions ( higher than 40 nM, Landsort Deep ) showing a possible pool of Fe(II) in deep waters and a correlation between Fe(II) concentration and oxygen content.

Apart from the measurements mentioned above samples for determination of biological parameters, trace elements and organic contaminants were taken during this cruise for later analysis in the laboratory.

During the cruise four moorings have been recovered and/or deployed :

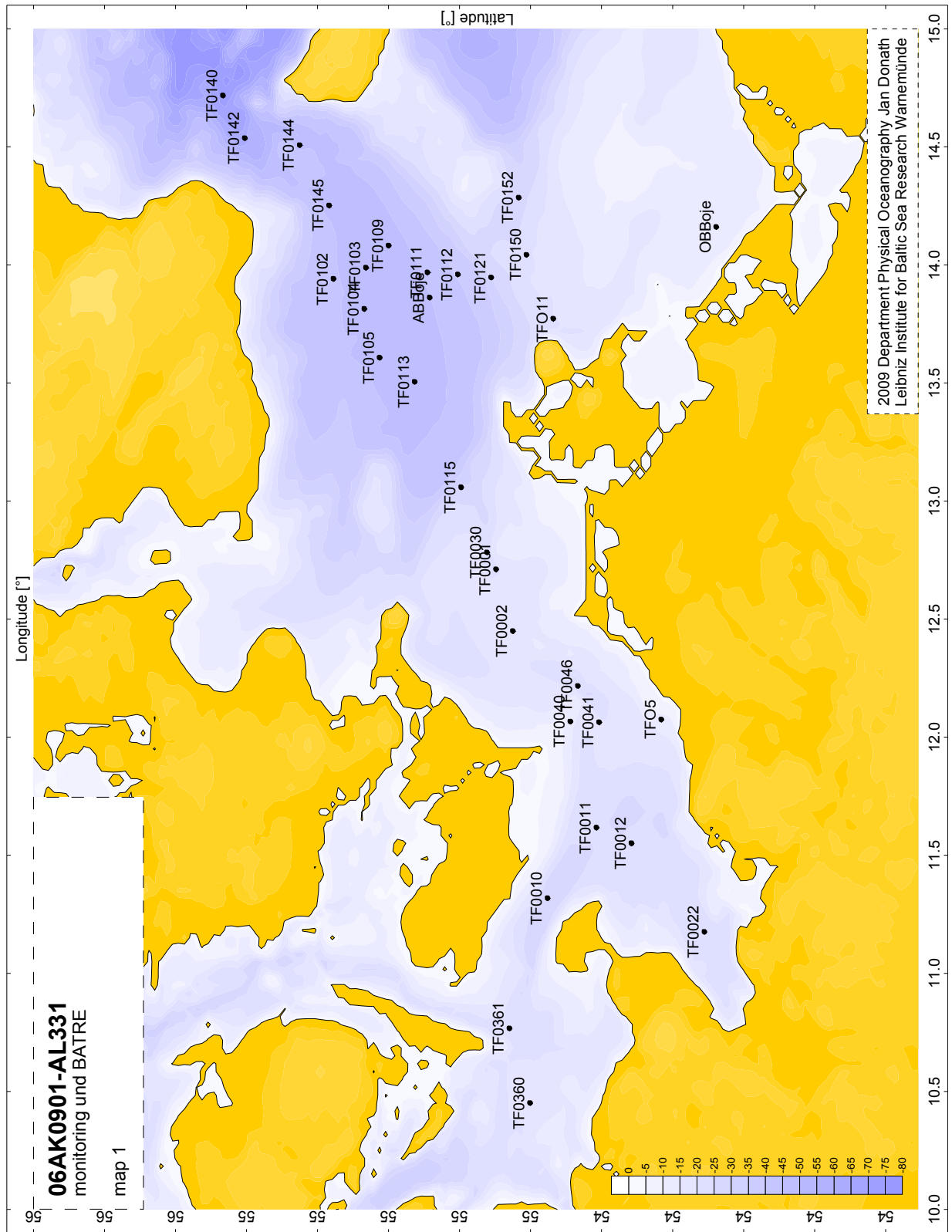
- M209-1 current meter chain 57°21.98' N , 020°20.01' E recovered & deployed

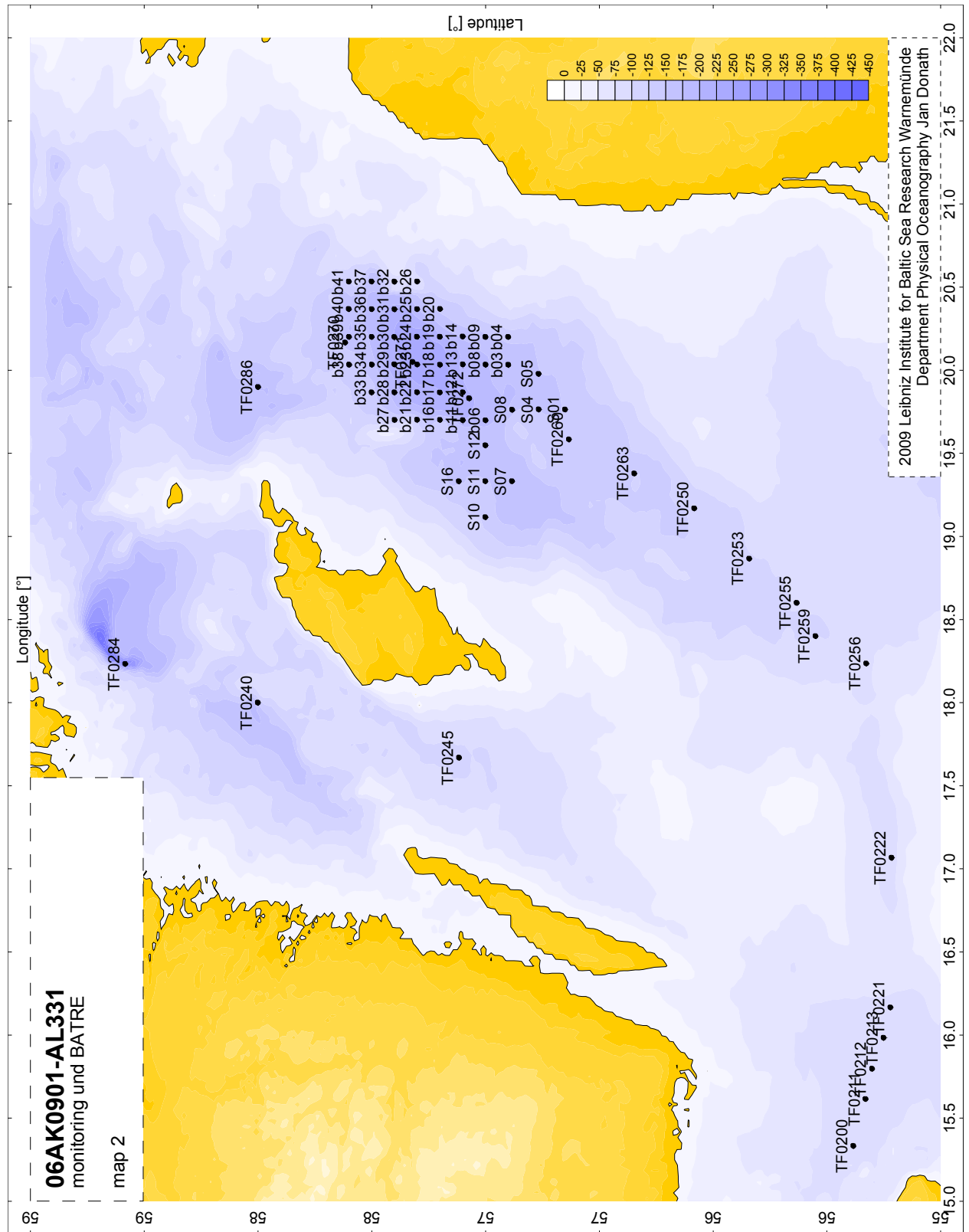
- Gotland.AH sediment trap      57°18.75' N , 020°10.47' E    recovered & deployed
- Arkona B    sediment trap      54°53.00' N , 013°51.32' E    deployed
- BaTRE NE    current meter chain      57°22.23' N , 020°19.88' E    recovered

Klaus Nagel  
Scientist in charge

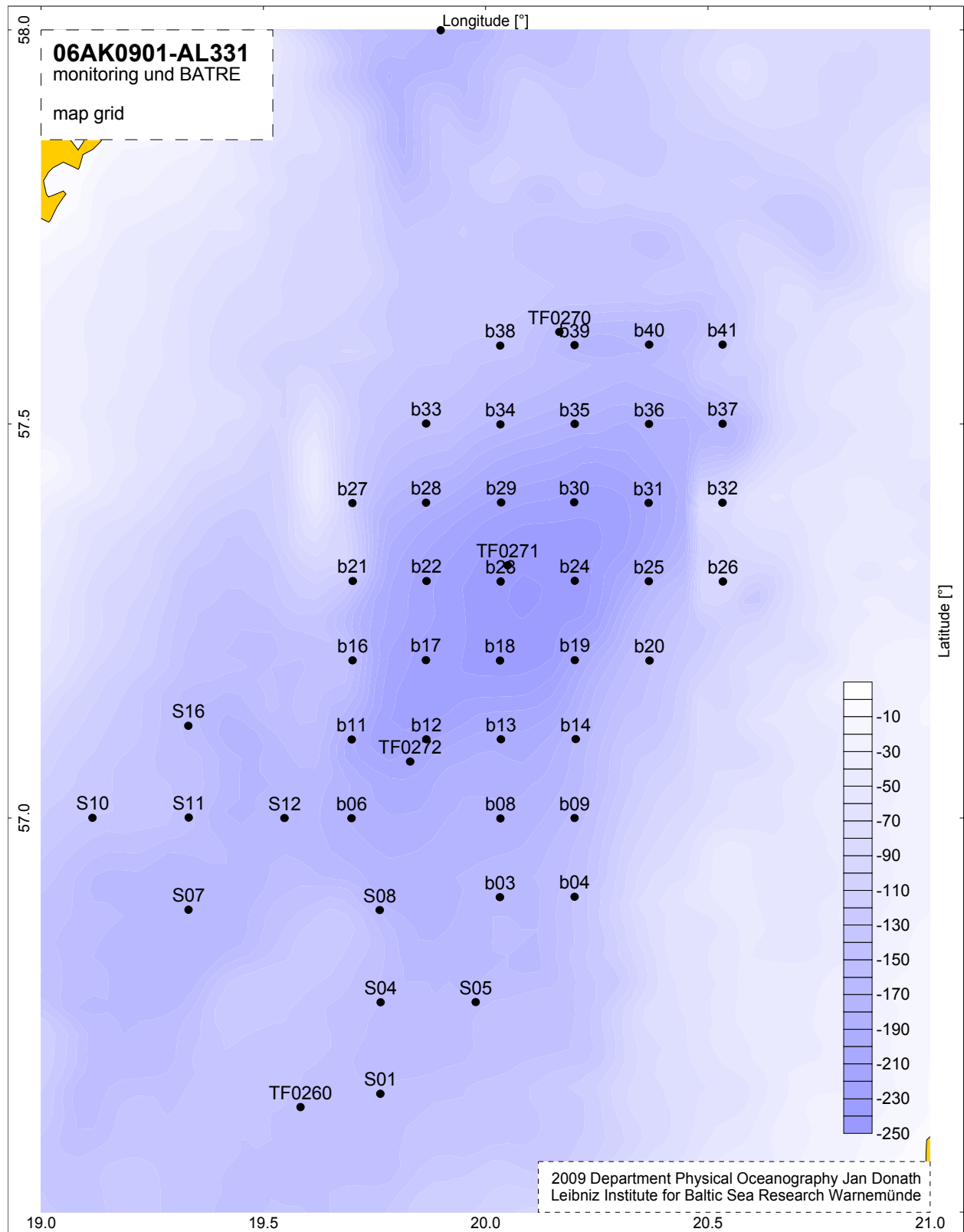
Attachments :

- station charts
- tables of preliminary results for selected stations (surface layer and near bottom layer)
- comparison of actual data with mean values calculated from the measurements during the February cruises of the years 1993 – 2007 (surface layer and near bottom layer)
- transects of temperature, salinity and oxygen concentration between Kiel Bight and northern Gotland Sea
- map showing oxygen concentrations in near the bottom water layer  
( hydrogen sulphide concentration is given as negative O<sub>2</sub> equivalents )
- depth profile showing the tracer distribution at station b31









Preliminary results of hydrographic and hydrochemical parameters at selected stations

**- surface layer -**

Station Date	Stat.Name Stat.No. **)	Temp. °C	Salinity	NO <sub>3</sub> *) µmol/l	PO <sub>4</sub> µmol/l	SiO <sub>4</sub> µmol/l	O <sub>2</sub> ml/l
Kiel Bight 30/01/2009	TF0360 1	2.22	12.89	4.60	0.66	15.3	8.54
Mecklenburg Bight 31/01/2009	TF0012 5	2.49	10.69	4.16	0.64	9.9	8.09
Arkona Basin 01/02/2009	TF0113 15	3.41	8.28	3.21	0.58	8.1	8.00
Bornholm Deep 04/02/2009	TF0213 26	4.03	7.76	3.09	0.69	10.1	8.37
Stolpe Channel 04/02/2009	TF0222 28	3.84	7.63	3.13	0.71	11.4	8.42
SE Gotland Basin 04/02/2009	TF0259 30	4.34	7.58	3.51	0.69	11.5	8.23
Gotland Deep 05/02/2009	TF0271 44	4.01	7.36	3.57	0.58	11.2	8.31
Fårö Deep 10/02/2009	TF0286 87	3.73	7.11	3.82	0.64	12.6	8.42
Landsort Deep 10/02/2009	TF0284 88	3.03	6.98	3.57	0.55	13.2	8.65
Karlsö Deep 11/02/2009	TF0245 91	3.05	7.07	3.52	0.68	13.8	8.63

\*) NO<sub>3</sub> is given as sum of NO<sub>3</sub><sup>-</sup> and NO<sub>2</sub><sup>-</sup> (in most samples NO<sub>2</sub><sup>-</sup> was present only in traces)

\*\*) see attached maps

Preliminary results of hydrographic and hydrochemical parameters at selected stations

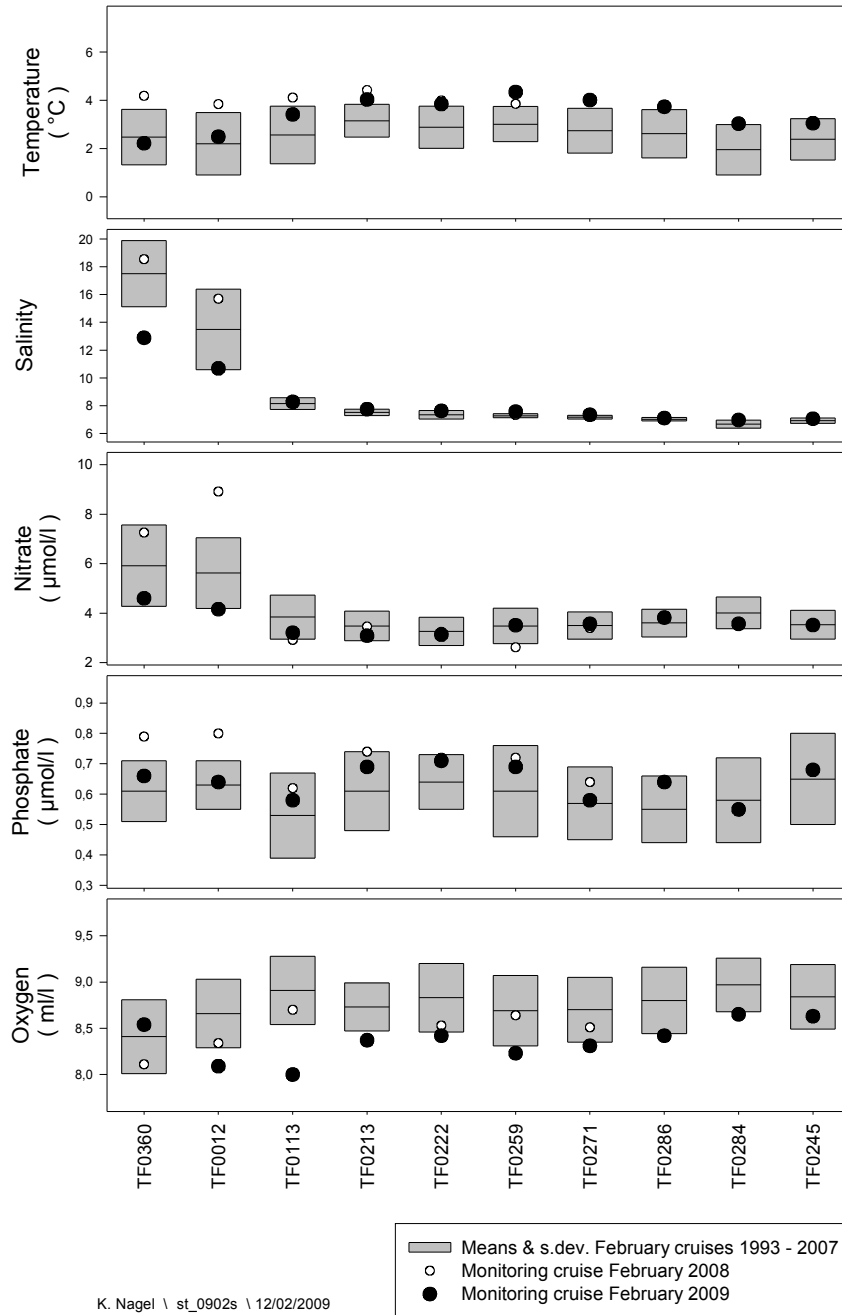
– near bottom layer -

Station Date	Stat.Name Stat.No. **)	Depth m	Temp. °C	Salinity PSU	NO <sub>3</sub> *) µmol/l	PO <sub>4</sub> µmol/l	SiO <sub>4</sub> µmol/l	O <sub>2</sub> ml/l
Kiel Bight 30/01/2009	TF0360 1	18	3.41	17.21	4.72	0.66	15.3	7.99
Mecklenburg Bight 31/01/2009	TF0012 5	24	2.97	14.41	5.26	0.75	15.0	8.09
Arkona Basin 01/02/2009	TF0113 15	44	3.45	11.22	5.07	0.69	10.7	8.03
Bornholm Deep 04/02/2009	TF0213 27	87	9.61	16.07	6.14	1.68	45.9	1.00
Stolpe Channel 04/02/2009	TF0222 29	89	9.12	14.23	7.34	1.69	38.4	2.41
SE Gotland Basin 04/02/2009	TF0259 31	86	6.64	11.09	4.92	2.80	50.7	0.74
Gotland Deep 05/02/2009	TF0271 44	233	6.32	12.56	- / -	7,05	89.2	-5.20 ( H <sub>2</sub> S )
Fårö Deep 10/02/2009	TF0286 87	189	6.29	12.10	- / -	4.95	67.7	-2.29 ( H <sub>2</sub> S )
Landsort Deep 10/02/2009	TF0284 88	436	5.75	10.93	- / -	3.85	62.8	-1.65 ( H <sub>2</sub> S )
Karlsö Deep 11/02/2009	TF0245 91	106	5.25	9.91	- / -	3.75	51.8	-0.31 ( H <sub>2</sub> S )

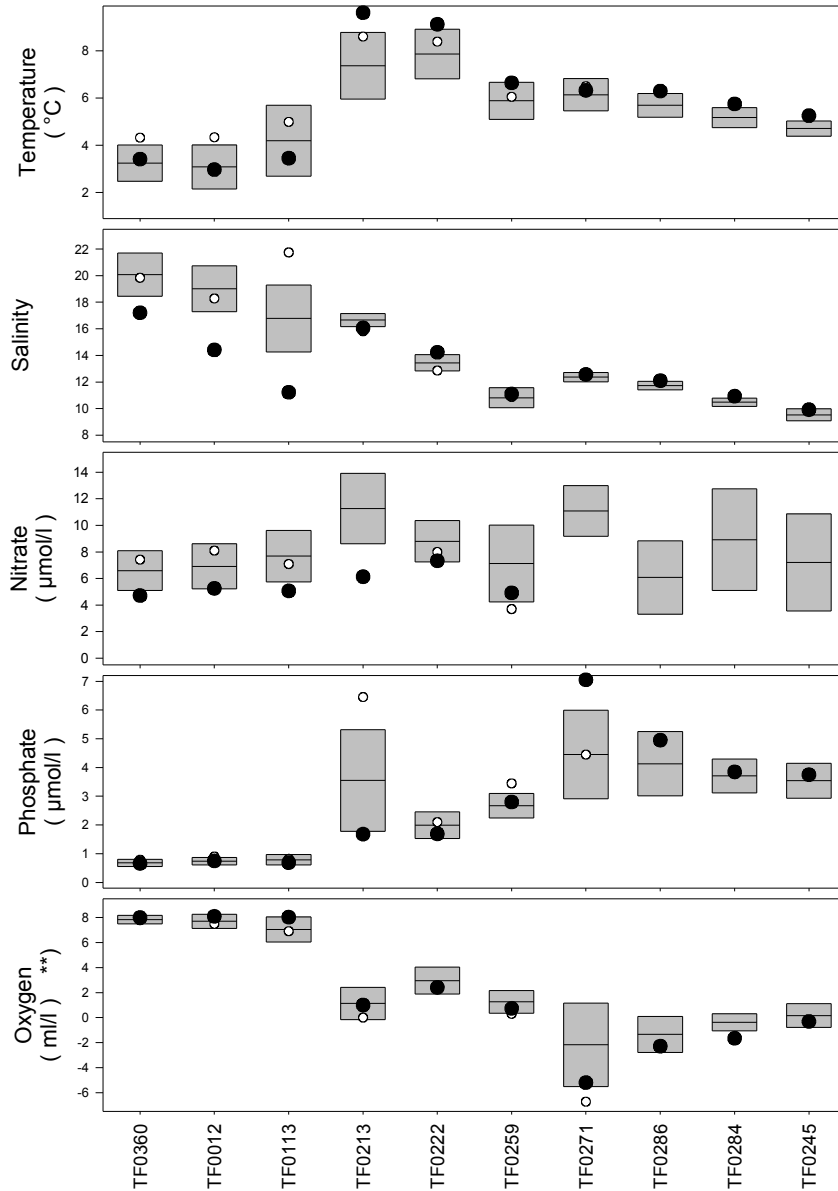
\*) NO<sub>3</sub> is given as sum of NO<sub>3</sub><sup>-</sup> and NO<sub>2</sub><sup>-</sup> (in most samples NO<sub>2</sub><sup>-</sup> was present only in traces)

\*\*) see attached maps

Selected stations / February cruises : near-surface layer

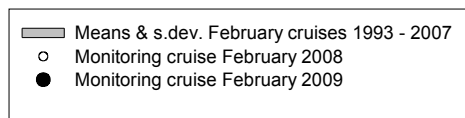


Selected stations / February cruises : near-bottom layer



\*\*) : H<sub>2</sub>S was converted to negative O<sub>2</sub> equivalents

K. Nagel \ st\_08902b \ 12/02/2009

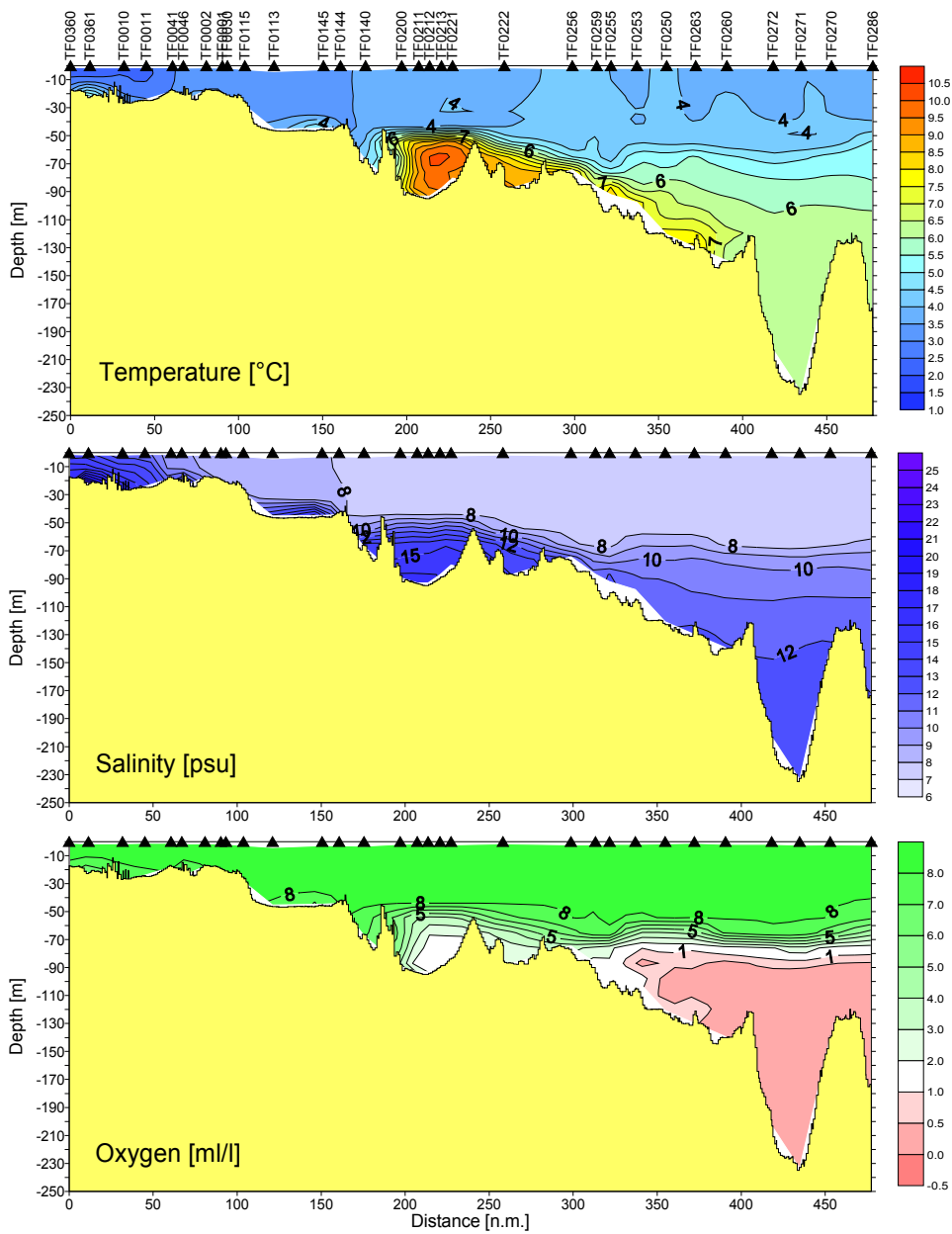
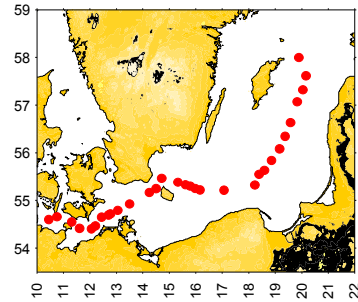


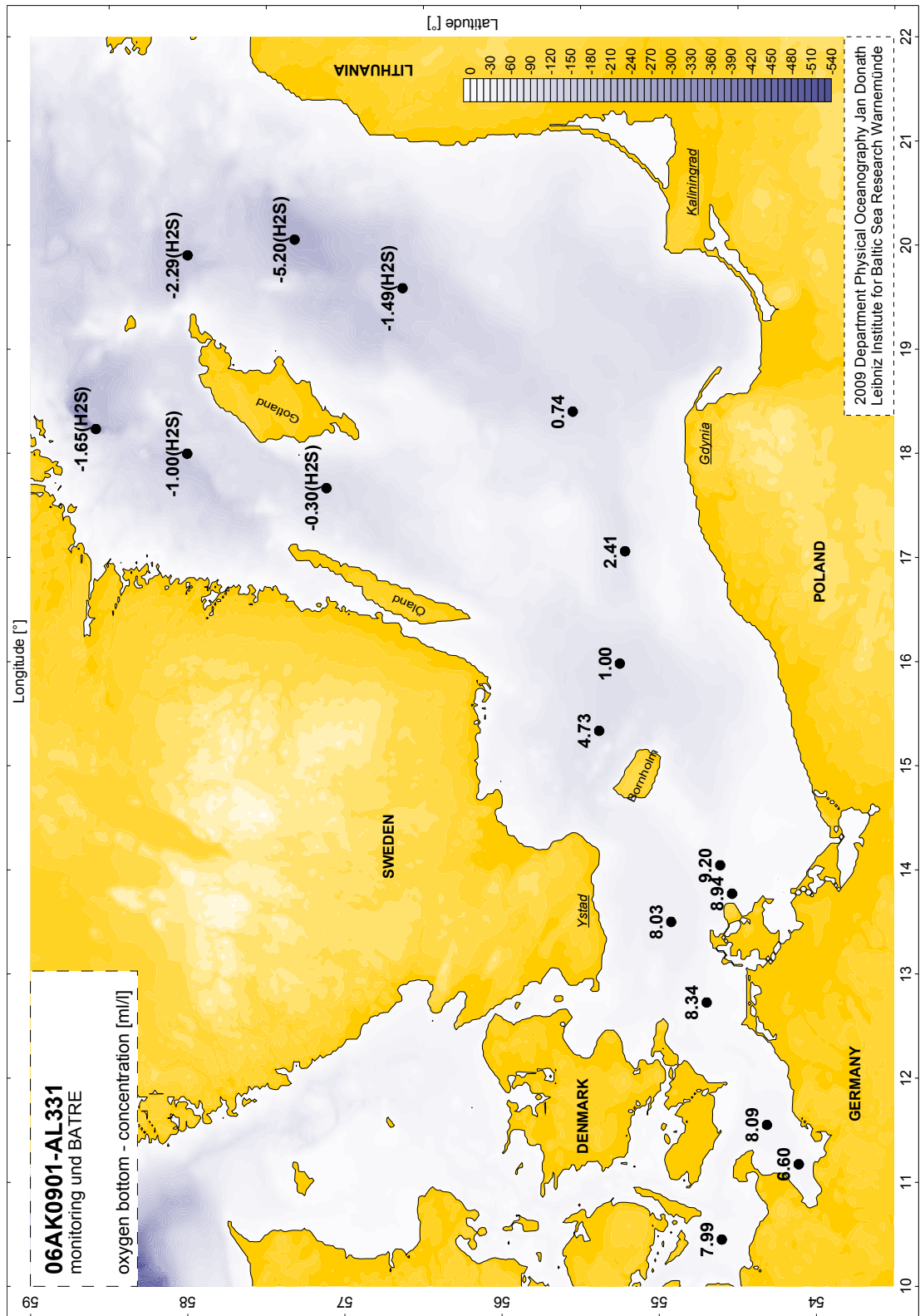
**06AK0901-AL331**  
**monitoring and BATRE**

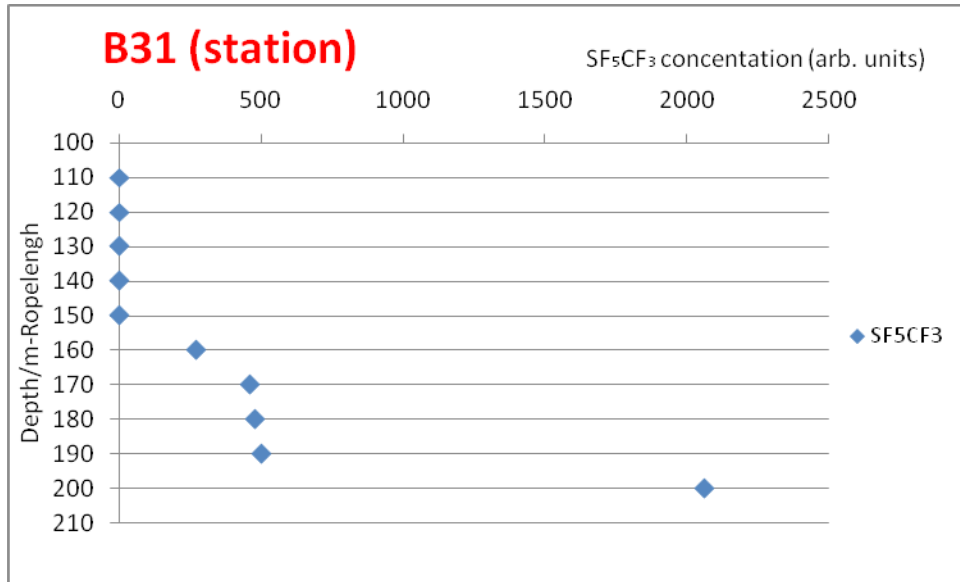
Kiel Bight - Gotland Sea  
30.01.2009 15:24 - 10.02.2009 10:17 UTC

05.srf - data not validate

2009 Department Physical Oceanography Jan Donath  
Leibniz Institute for Baltic Sea Research Warnemünde







Depth profile showing the tracer distribution at station b31