

Leibniz Institute for Baltic Sea Research Warnemünde

Cruise Report

r/v "Prof. A. Penck"

Cruise- No. 07PE / 10 / 07

17 – 27 March, 2010

Western and Central Baltic Sea

This report is based on preliminary data

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1. **Cruise No.:** 07PE / 10 / 07
2. **Dates of the cruise:** from 17 March 2010 to 27 March 2010
3. **Particulars of the research vessel:**
Name: Prof. Albrecht Penck
Nationality: Germany
Operating Authority: IOW
4. **Geographical area in which ship has operated:**
western and central Baltic Sea
5. **Dates and names of ports of call**
6. **Purpose of the cruise**
Monitoring cruise in the framework of HELCOM programme
7. **Crew:**
Name of master: U. Scholz
Number of crew: 10
8. **Research staff:**
Chief scientist: Dr. R. Feistel
Scientists:
Engineers: K.-P. Wlost, P. Menzel
Technicians: S. Trinkler, A. Tschakste, I. Schaub, S. Busch
9. **Co-operating institutions:**
10. **Scientific equipment**
CTDO bathysonde, plankton net

11. General remarks and preliminary results

The cruise of r/v Prof. A. Penck from 17 till 27 March 2010 was carried out under mostly moderate wind (BF3-5) conditions. An exception was a cold front that passed on the evening of 21 March when wind speeds of 22 m/s were exceeded in gusts and harsh sea state prevented scientific work for about 7 hours. North-east of Gotland island, air and water temperatures below 0 °C were observed. Floating ice fields were visible north of 58°33.5N, 19°41.2E on 22 March, north-east of Gotska Sandö. During this cruise, lowest water transparency was 4 m Secchi depth at TF0012, and largest was 13 m at TF0259 and TF0271.

Two preconditions were expected to influence the observation results, (i) lasting unusually cold winter temperatures in January and February 2010 in the Baltic Sea region, and (ii) a short, warm, very salty and moderately oxygenated water inflow event from the North Sea in the 2nd half of November 2009 which was considered the most relevant after the major inflow of 2003. In particular the effect of the latter on water properties between the Bornholm and the Gotland Deep was a question of central scientific interest during this cruise. In particular, it was unclear whether the inflow volume was big enough to completely replace the water residing in the Bornholm Basin below 60 m depth, and whether perhaps some of the most recent inflow water immediately overflowed the Stolpe Sill and propagated farther to the central basins. As measured previously by r/v Argus on 08 December 2009, at the beginning of the inflow the Bornholm deep water had a salinity of 15.7 psu, a temperature of 10 °C and below 1 ml/l oxygen, without H₂S. In the south-eastern Gotland Basin, water of similar signature has been expected to be encountered on this cruise and potentially to precede the actual inflow tongue which originally had 8.5 °C and 21 psu at 40 m depth of the Arkona Basin during the first days of December 2009. Most recently, on 31 January 2010 r/v Heincke observed 9.3°C, 17.2 psu and 3.5 ml/l O₂ at 87 m depth of the Bornholm Basin.

In this report, oxygen values marked with an asterisk refer to raw sensor data that may be corrected by postprocessing after the cruise.*

On 18 March 2010 in the **Arkona Basin**, TF0113, the temperature profile showed minima of 0.28°C at 29.25 m depth and 0.85 °C at 37.75 m, and maxima of 1.31 °C at the surface, 1.77 °C at 36.25 m and 2.16 °C at 45 m. The salinity profile was continuous between 7.35 psu at the surface and 18.47 psu at the bottom, with pronounced gradients at 35.5 m and 41.5 m. The oxygen profile was homogeneous with about 9.0* ml/l down to 20 m, has minima of 6.8* ml/l at 36.25 m and 6.9* ml/l at 45 m, as well as a maximum of 8.2* ml/l at 38 m depth.

In the **Bornholm Basin**, TF0213, the surface layer was very well mixed down to 40 m. Oxygen decreased gradually across the halocline to a minimum of 1.5* ml/l at 76 m and increased farther down again up to 2.2* ml/l at 85 m, with a slight decrease towards the bottom (87 m), where salinity reached a maximum of 16.7 psu. Downward from the halocline, temperature increased almost continuously to 9.7 °C at 80 m, and dropped slightly to 9.3 °C below that level. Some roughness in the vertical T and O₂ profiles indicated quite recent water substitution processes. Compared to the Heincke readings of January, the inflow signal was still similar but had already aged, in particular by oxygen loss. At the Stolpe Sill depth of 60 m, the conditions were found to be 9.2 °C, 14.6 psu and 1.9* ml/l of O₂. At the southern inflow flank to the basin, TF0214, the near-bottom salinity was slightly higher (17.0 psu) at 90 m, and the water was slightly more oxygenated (2.7* ml/l) at 88.5 m.

In the **Stolpe Channel**, TF0222, the temperature decreased almost continuously from 1.6 °C at the surface to 1.4 °C at 50 m, and increased again further down to 7.4 °C at 88.75 m. the maximum salinity above the floor was 12.7 psu, clearly lower than the value found at 60 m in the Bornholm Basin. Oxygen decreased continuously from 8.6* ml/l at the surface to 3.2* ml/l near the bottom.

As expected in advance, the most interesting and dynamic situation was encountered in the **south-eastern Gotland Basin**. At TF0256, the entire water column was ventilated, with an O₂ minimum of 2.4* ml/l at 73.5 m and a maximum of 4.1* ml/l near the bottom, at 75.5 m. Another O₂ minimum of 5.1* ml/l was located at 65 m, and another maximum of 7.1* ml/l at 66.5 m. Temperature was increasing from the surface to a maximum of 4.25 °C at 64.25 m, decreased sharply to a minimum of 3.60 °C at 65.75 m and reached another maximum of about 6.0 °C in a 3-m layer near the bottom, where the maximum salinity was found to be 11.05 psu. The warm bottom layer was apparently formed by new inflow water, while the other warm layer at about 65 m was less oxygenated and represented older water.

Similarly, at TF0255 the entire water column contained oxygen but the minimum of 0.31* ml/l at 77.25 m was more pronounced while the bottom layer with several oxygen maxima and minima between 2.9* ml/l and 3.8* ml/l was thicker but less oxygenated than at TF0256. Temperature and salinity increased downward continuously to maxima of 6.64 °C and 11.32 psu at 91.75 m. This warm bottom layer may again be attributed to recent November inflow water.

Surprisingly, the station TF0259 that is located between TF0256 and TF0255, and which is commonly considered a representative for the south-eastern Gotland Basin, showed a different signature than its two neighbouring stations. Oxygen concentrations decreased almost continuously from the surface to the bottom where 0.16* ml/l were observed at 87.25 m. Slightly above, an oxygen maximum of 0.55* ml/l was found at 86.25 m. Warmest and saltiest water was measured near the bottom with 6.37 °C and 10.83 psu. The recent inflow is almost invisible at this station; its signal with oxygen levels of about 4* ml/l was apparently confined to a narrow region of the downslope valley.

At TF_0253, an oxygen minimum layer was focused at about 75m with 0.21* ml/l; O₂ increased again up to 1.9* ml/l near the bottom. On the contrary, at TF0250 no significant intermediate oxygen minimum was visible; lowest values of 0.95* ml appeared near the floor at 121 m, slightly pronounced minima and maxima occurred at 89.5 m with 1.3* ml/l, and at 105 m with 1.77* ml/l.

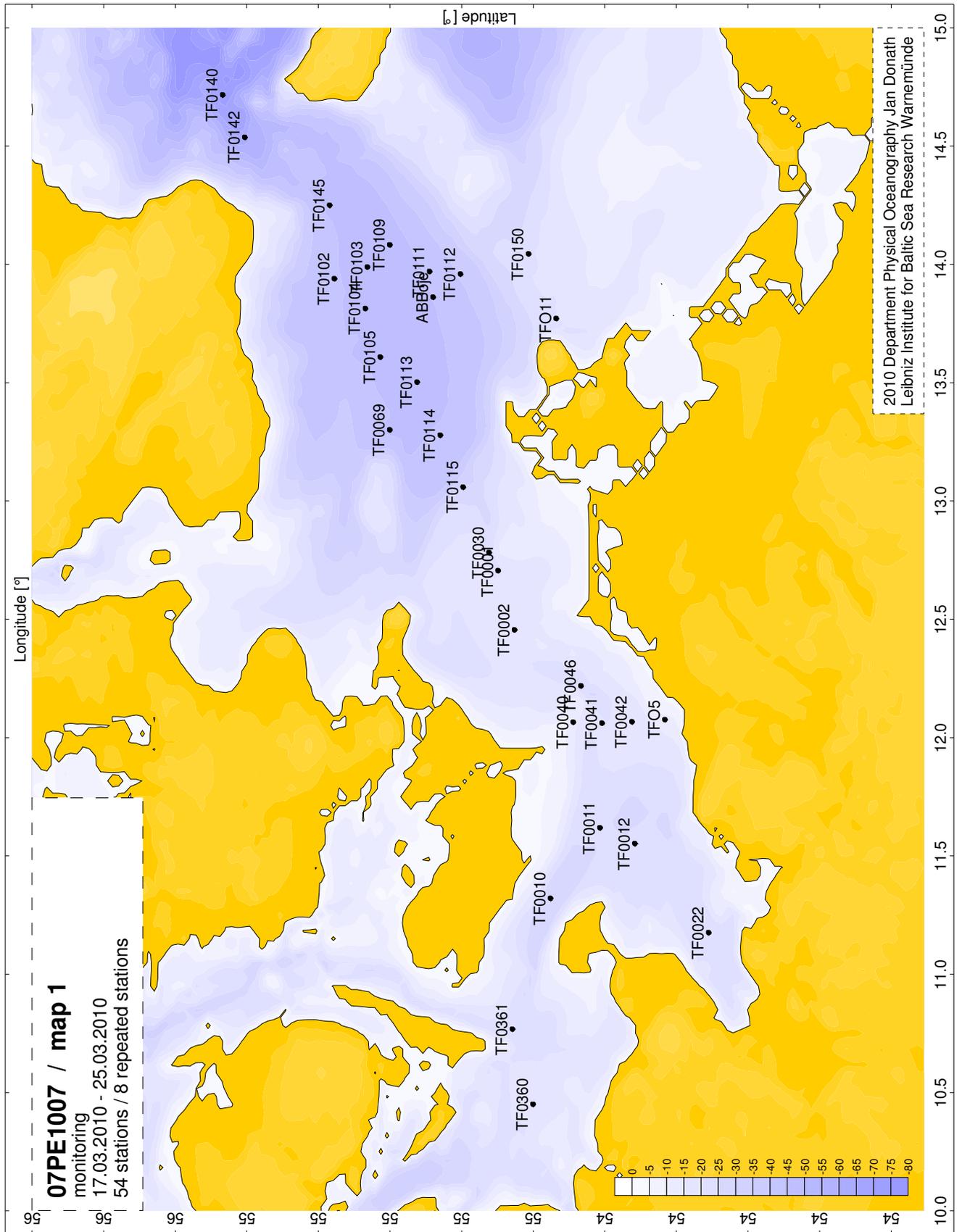
At TF0263 and onward, the effect of the recent inflow was only minor. Less than 0.1* ml/l oxygen was found below 100.75 m, with some weak interleaving maxima of 0.35*ml/l at 112 m and 0.30* ml/l at 120 m. Such only slightly ventilated intermediate layers seem to contain older water from the Bornholm Basin, preceding the actual inflow; they were also characterised by weak temperature maxima of 7.3 and 7.6 °C.

In the **Eastern Gotland Basin**, TF0271, beneath the halocline two layers with about 1* ml/l oxygen were identified at 115 m and at 120 m depth. Below 130 m, oxygen levels were only traces less than 0.1* ml/l, if at all. At 123 m, the temperature showed a maximum of 7.8 °C and fell to 6.3 °C near the bottom. At the **Farö Deep**, TF0286, oxygen was below 0.1* ml/l from 112.5 m downward, at the **Landsort Deep**, TF0284, from 68 m downward, and at the **Karlsö Deep**, TF0245, from 78 m downward.

Rainer Feistel

scientist in charge

- Attachments:**
- station charts
 - tables of preliminary results (surface layer and near-bottom layer)
 - transects of T, S and O₂ from Kiel Bight to Eastern Gotland Basin
 - magnified transects of T, S and O₂ from Kiel Bight to Arkona Basin
 - magnified transects of T, S and O₂ of the Bornholm Basin
 - magnified transects of T, S and O₂ from Stolpe Channel to Eastern Gotland Basin
 - near-bottom O₂/H₂S chart
 - preliminary map showing areas of near-bottom H₂S and O₂ deficiency



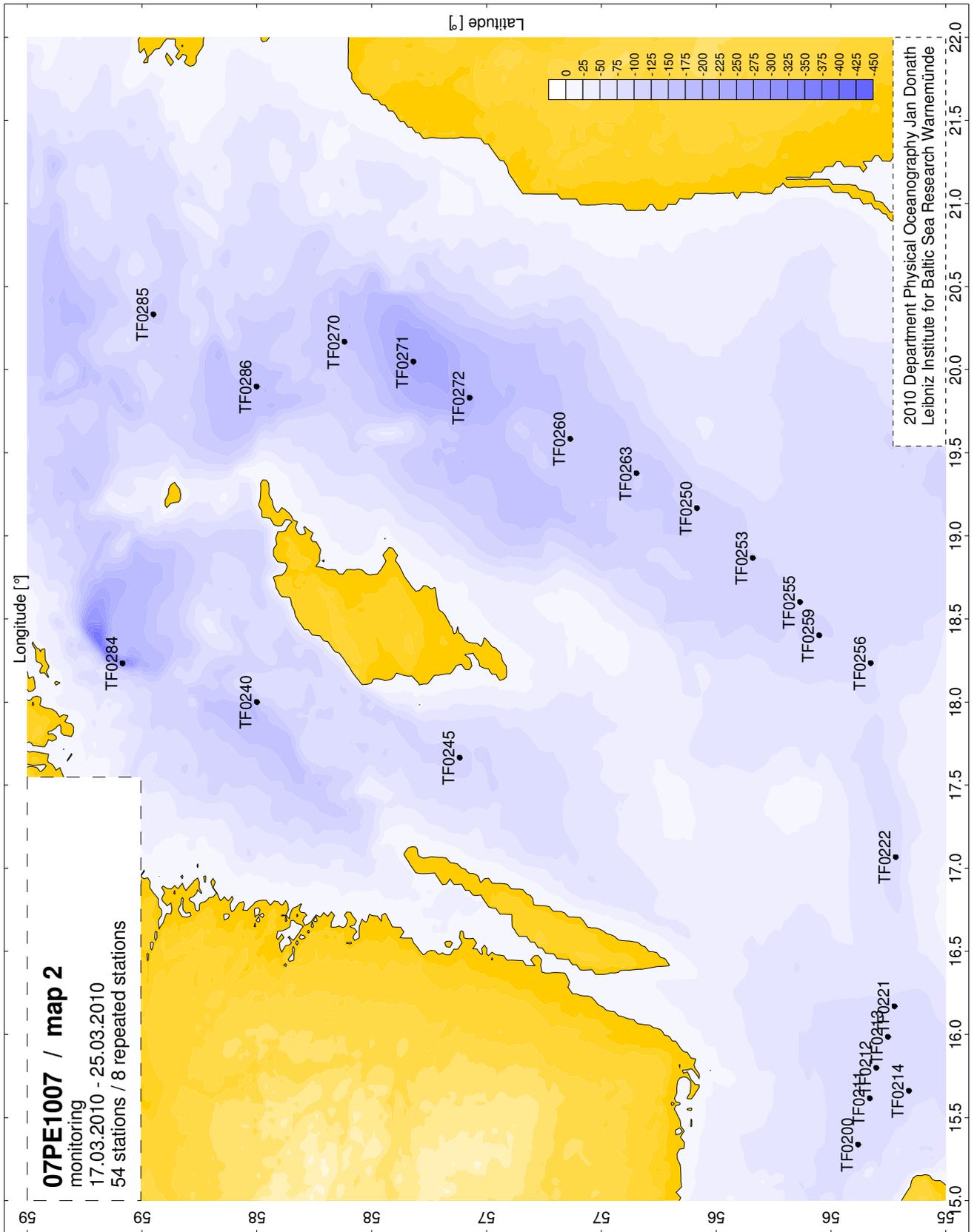


Table 1: Preliminary data of 2010 from the surface layer (2 m) of selected regions.

Oxygen values from titration. In brackets, related data of March 2009 () or March 2008 [].

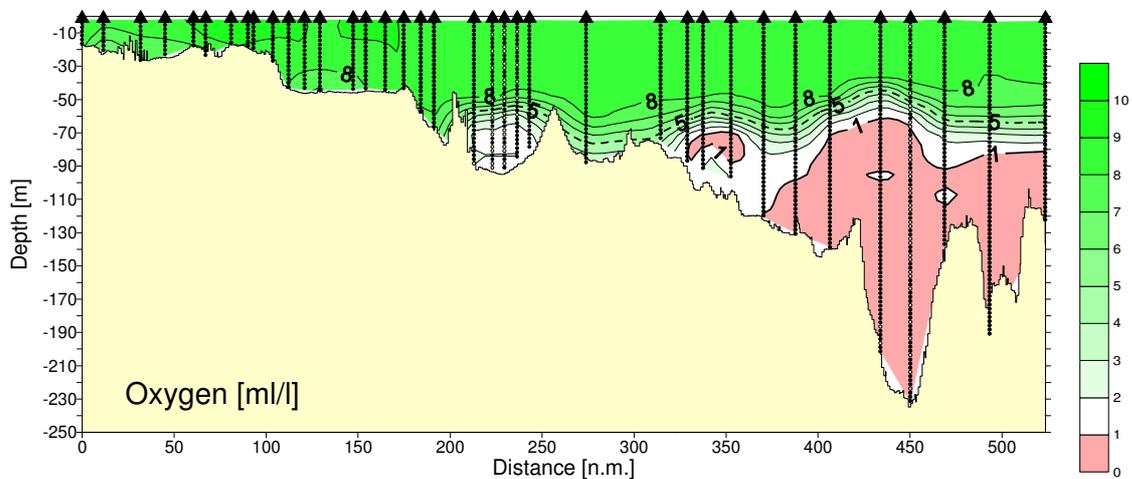
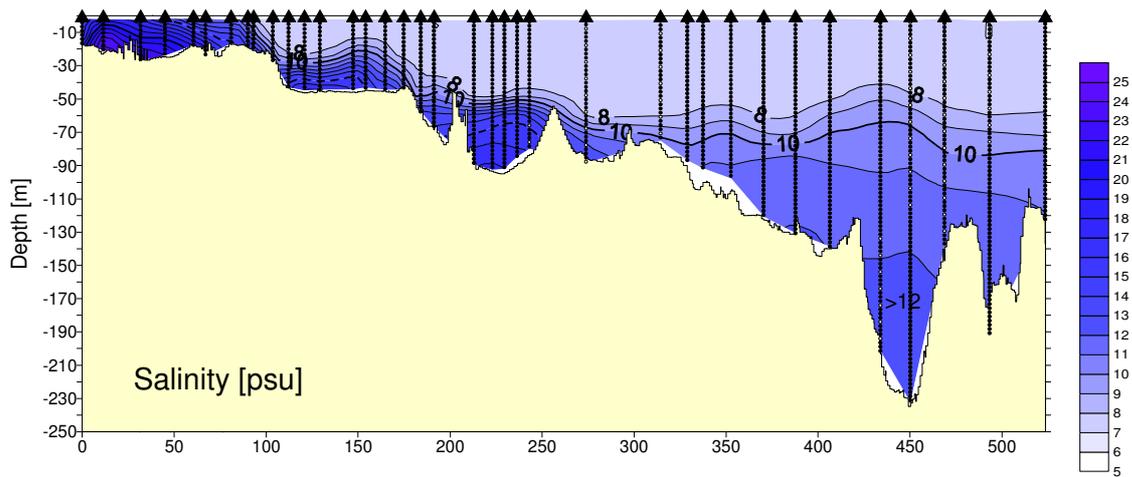
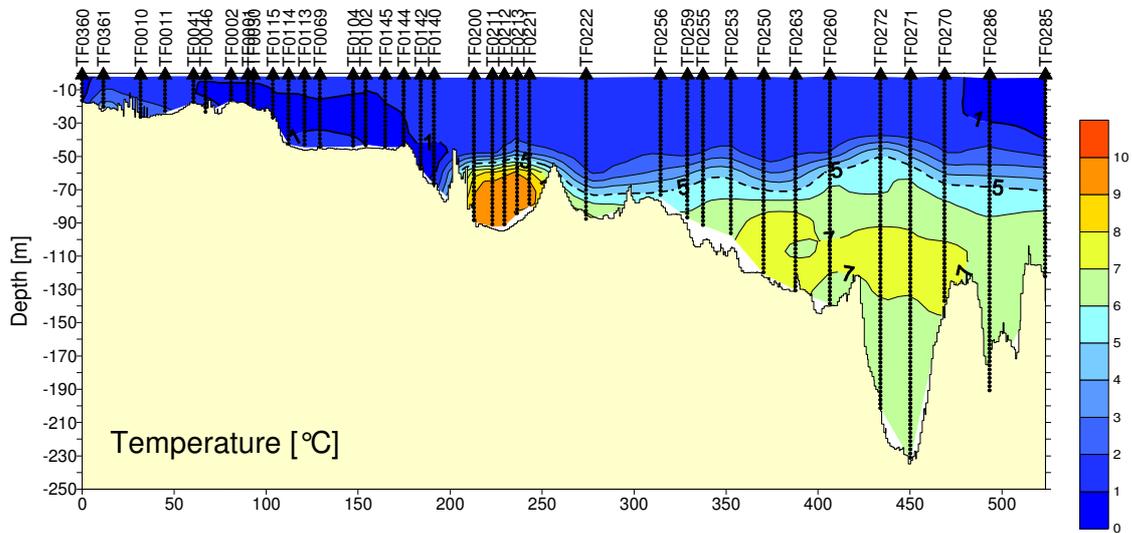
Location / Date	Station / Number	Temp. °C	Salinity psu	O ₂ ml/l	NO ₂₊₃ µmol/l	PO ₄ µmol/l	SiO ₄ µmol/l
Kiel Bight 17.03.2009	TF0360 6	0.80 (4.06)	16.40 (14.77)	9.58 (8.24)	0.16 (0.04)	0.05 (0.13)	0.10 (4.40)
Mecklenburg Bight 18.03.2009	TF0012 8	1.15 (3.92)	14.86 (11.39)	10.17 (8.50)	0.12 (0.06)	0.05 (0.12)	0.90 (2.50)
Lübeck Bight 18.03.2009	TF0022 7	1.05 (4.13)	13.75 (11.94)	10.9 (8.46)	0.04 (0.05)	0.01 (0.10)	0.70 (3.40)
Darss Sill 18.03.2009	TF0030 14	1.18 (3.05)	7.34 (8.55)	9.62 (8.17)	1.79 (0.11)	0.48 (0.23)	14.20 (16.70)
Arkona Basin 18.03.2009	TF0113 18	1.30 (2.93)	7.35 (8.07)	9.60 (9.10)	1.49 (0.02)	0.49 (0.35)	14.90 (7.00)
Bornholm Deep 19.03.2010	TF0213 32	1.63 (3.18)	7.42 (7.70)	9.08 (8.83)	2.84 (1.62)	0.65 (0.55)	14.80 (10.10)
Stolpe Channel 20.03.2010	TF0222 34	1.62 (3.22)	7.40 (7.56)	9.11 (8.71)	2.97 (2.30)	0.61 (0.63)	13.80 (11.50)
SE Gotland Basin 20.03.2010	TF0259 36	1.24 (3.31)	7.28 (7.54)	9.08 (8.55)	3.86 (3.47)	0.55 (0.54)	11.40 (10.20)
Gotland Deep 21.03.2010	TF0271 43	1.52 (2.92)	7.51 (7.41)	9.03 (8.71)	3.82 (3.65)	0.64 (0.55)	12.90 (11.10)
Farö Deep 21.03.2010	TF0286 45	0.34 [3.64]	6.95 [7.27]	9.37 [8.96]	4.60 [1.39]	0.54 [0.32]	14.00 [5.80]
Landsort Deep 22.03.2010	TF0284 47	0.13 [3.27]	6.42 [6.76]	9.45 [9.39]	4.47 [0.09]	0.56 [0.30]	17.00 [8.30]
Karlsö Deep 23.03.2010	TF0245 49	0.64 [3.67]	6.67 [7.25]	9.44 [8.78]	3.43 [1.15]	0.56 [0.35]	16.00 [7.20]

**Table 2: Preliminary data of 2010 from the near-bottom layer of selected regions.
Oxygen values from titration. In brackets, related data of March 2009.**

Location / Date	Station / Number	Depth m	Temp. °C	Salinity psu	O ₂ ml/l	NO ₂₊₃ µmol/l	PO ₄ µmol/l	SiO ₄ µmol/l
Kiel Bight 17.03.2009	TF0360 6	15	0.56 (3.62)	16.58 (15.86)	9.47 (7.83)	0.28 (0.65)	0.04 (0.23)	0.60 (7.90)
Mecklenburg Bight 18.03.2009	TF0012 8	20	1.17 (3.13)	18.34 (16.82)	8.96 (7.04)	0.16 (2.63)	0.05 (0.52)	0.90 (8.60)
Lübeck Bight 18.03.2009	TF0022 7	20	1.60 (3.28)	19.15 (16.52)	6.81 (5.99)	7.41 (4.13)	0.87 (0.59)	21.80 (14.60)
Darss Sill 18.03.2009	TF0030 14	20	0.78 (3.62)	15.74 (12.30)	8.91 (8.01)	1.99 (0.17)	0.24 (0.24)	3.40 (3.80)
Arkona Basin 18.03.2009	TF0113 18	40	1.29 (2.97)	16.59 (12.51)	7.80 (7.50)	4.49 (0.58)	0.60 (0.47)	11.40 (6.80)
Bornholm Deep 19.03.2010	TF0213 32	80	9.68 (9.06)	15.80 (15.45)	1.68 (1.80)	7.19 (7.68)	1.85 (1.57)	42.20 (37.00)
Stolpe Channel 20.03.2010	TF0222 34	80	6.77 (6.17)	12.34 (10.46)	4.23 (5.72)	8.18 (6.49)	1.47 (1.09)	32.20 (19.00)
SE Gotland Basin 20.03.2010	TF0259 36	80	5.83 (6.21)	10.04 (10.61)	0.56 (1.56)	5.88 (7.41)	2.72 (2.43)	45.20 (39.80)
Gotland Deep 21.03.2010	TF0271 43	200	6.36 (6.28)	12.37 (12.42)	-4.93 (-3.66)	0.28 (0.00)	5.52 (5.10)	83.90 (75.90)
Farö Deep 21.03.2010	TF0286 45	150	6.64	11.76	-2.12	0.15	4.10	52.90
Landsort Deep 22.03.2010	TF0284 47	400	6.10	10.79	-0.53	0.12	3.62	56.30
Karlsö Deep 23.03.2010	TF0245 49	100	5.40	9.99	-0.58	0.08	3.75	57.90

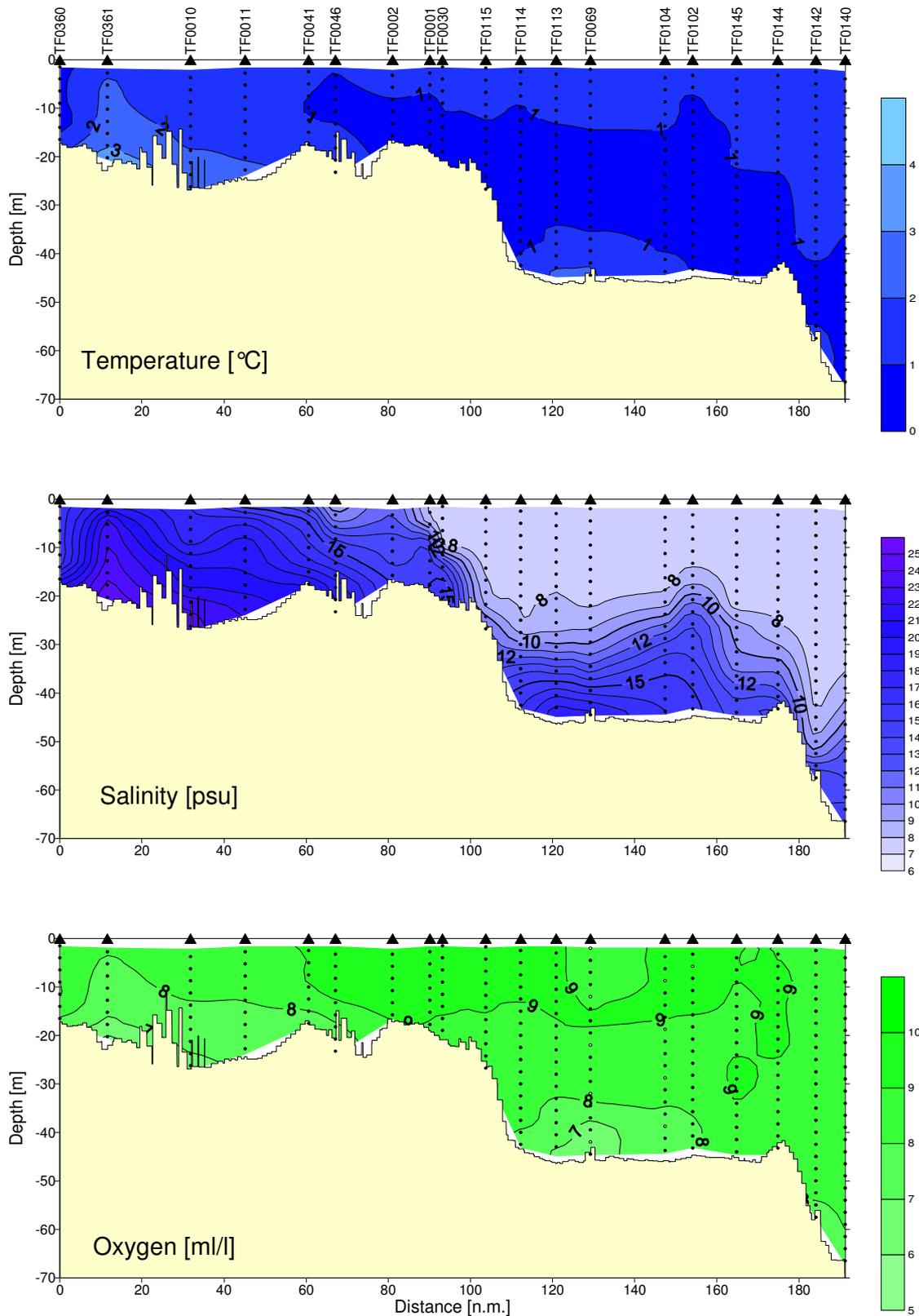
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 17.03.2010 13:30 - 24.03.2010 09:58 UTC



07PE1007

monitoring - Fehmarnbelt-Bornholmbecken
 17.03.2010 13:30 - 24.03.2010 09:58 UTC

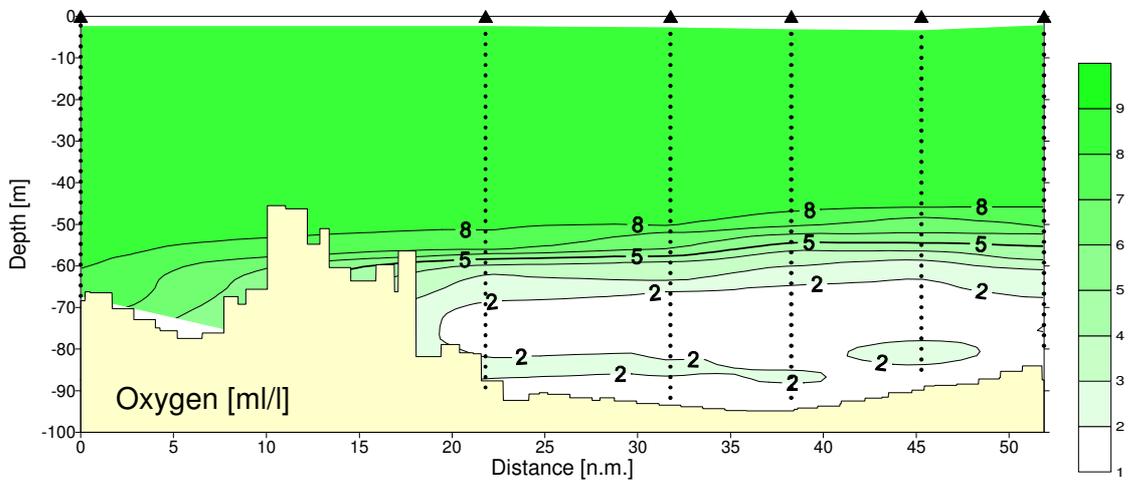
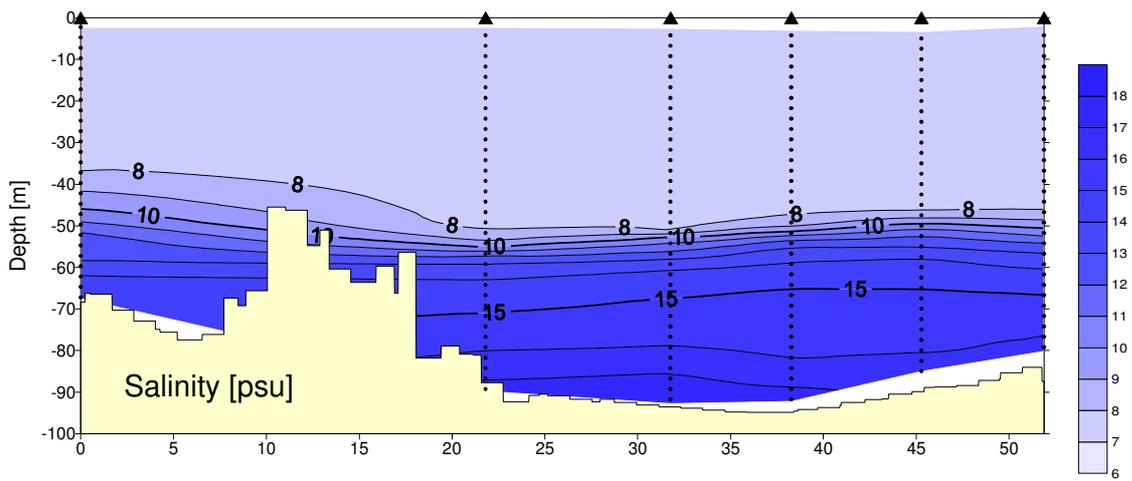
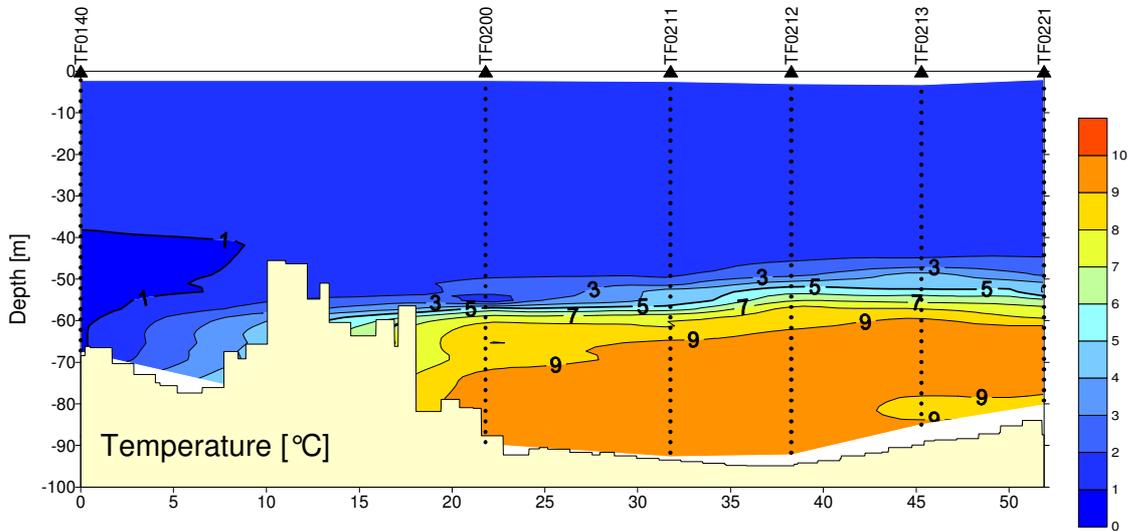


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07PE1007

monitoring - Bornholmbecken
 20.03.2010 01:41 - 24.03.2010 07:14 UTC



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monitoring - Gotlandbecken
20.03.2010 05:26 - 22.03.2010 07:44 UTC

