INSTITUT FÜR OSTSEEFORSCHUNG WARNEMÜNDE
an der Universität Rostock BALTIC SEA RESEARCH INSTITUTE

Leibniz Institute for Baltic Sea Research Warnemünde

C r u i s e R e p o r t

r/v "Prof. A. Penck"

Cruise- No. 07PE / 09 / 07

21 – 30 March, 2009

Western and Central Baltic Sea

This report is based on preliminary data

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🗐 +49-381-5197 440

1. **Cruise No.:** 07PE / 09 / 07

2. **Dates of the cruise:** from 21 March 2009 to 30 March 2009

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: G. Kasch
   Number of crew: 10

8. **Research staff:**
   Chief scientist: Dr. R. Feistel
   Scientists: J. Unger
   Engineers: I. Schuffenhauer, T. Heene
   Technicians: B. Sadkowiak, C. Schnees, S. Busch

9. **Co-operating institutions:**

10. **Scientific equipment**
    CTDO bathysonde, plankton net

11. **General remarks and preliminary results**

During the time of this cruise **a minor inflow process could be observed** in the Bornholm Basin (station TF 213) beneath 60 m depth, coined by an irregular deep-water temperature profile and slightly oxic (about 3 ml/l) water properties. **Warm splashes** with low oxygen levels were encountered between the Stolpe Channel and the Eastern Gotland Deep, likely as a result of preceding minor inflows. In the Gotland Basin itself, at the stations TF 270, 271 and 272, **hydrogen sulfide** was measured mostly between 150 m depth and the bottom, up to -5.2 ml/l oxygen equivalent.

The cruise was carried out under calm to stormy **wind conditions**. On the beginning, the storm low “Herbert” moved from Denmark via Rügen to Poland. Strong winds over the western Baltic, first from west and later turning north and related high waves prevented the station work from 22 March 11:00 to 24 March 23:00 while the vessel took shelter at Marienehe. Later on, winds decreased to moderate / calm from easterly directions with cold air, clear sight and cloudy skies. Belonging to a subsequent Icelandic low, “Jens”, approaching Scandinavia from the west, a warm front passed the central Baltic on 27 March, followed by a cold front on the same day, both accompanied by strong south-easterly winds and high waves towards the northerly Baltic. Farö, Landsort and Karlsö Deep could not be visited for high wave conditions and lack of available cruise time. Calm, hazy conditions prevailed on 28 March in the south-eastern Baltic. During the cruise, the surface water temperatures varied from 4.0℃ in the Mecklenburg B ight to 2.8 ℃ at the Gotland Basin. The morning air temperatures varied between -0.6 ℃ at the Darss Sill and 4.9 ℃ in the Mecklenburg Bight, both on the beginning of the cruise, and the surface air pressure ranged from 999 to 1006 hPa.

Search for the recently immigrated neozoon jelly fish ***Mnemiopsis leidyi*** was almost in vain, only 1 mature individual of nearly 2 cm size could be caught by net sampling in the Bornholm Sea (TF 213).

Oxygen values reported here with an asterisk are uncalibrated sensor values. The preliminary correction factor to get values in ml/l consistent with titration is 1.38.*

In the **Kiel and Lübeck Bights** (TF 360 and TF 22), surface salinities of 14.8 and 11.9 psu (Table 1, attached) are relatively high and must be attributed to the local wind and wave conditions. Between the Kiel Bight and the Darss Sill, the wind-mixed layer reaches down to about 20 m depth; only beneath this level salinities higher than 20 psu have persisted. The SiO_4 concentrations of about 4 µmol/l are only about half the values of 2008. PO_4

concentrations of 0.1 µmol/l are comparable to those of 2008. While in the Kiel and Lübeck Bight the nitrate is already exhausted (0.04 µmol/l), the Darss Sill and Arkona Basin still show higher levels (0.2-0.3 µmol/l). The oxygen supersaturation is insignificant, if at all.

In the **Arkona Basin** (TF 113), temperatures are rather homogeneous (2.8 °C) from the surface to 30 m depth during the first visit. At 32 m there is a temperature minimum (2.4 °C), and a maximum above the bottom (3.3 °C). This maximum is still rather low and belongs likely to the cold baroclinic inflow that took place across the Darss Sill in January/February 2009. Oxygen has a mimimum of 4.9* ml/l compared to 6.5* ml/l at the surface. The near-bottom salinity of 15.4 psu shows a value consistent with the MARNET record at the Darss Sill at the beginning of the cruise. On the second visit on 29 March, the deeper layers showed discontinuous temperature interleaving, indicating some very recent inflow activity, probably caused by the winds during this cruise. The strong salinity statification at the Darss Sill on 22 March was destroyed by wind mixing in the subsequent days. Temperatures did not exceed 3.8 °C on the second visit, which is higher than the maximum found a few days before and corresponds to the near-bottom temperature east of the Darss Sill (TF 030) registered earlier on this cruise (Table 2). The maximum salinity of the water column increased to 16.5 psu.

On 26 March 2009, the water encountered in the **Bornholmsgat** (TF 140) at 68 m depth (4.1 °C, 14.0 psu, 4.5* ml/l) is warmer than the Arkona Basin bottom water but less salty and slightly less ventilated. Thus, its substitution appears to be in slow progress. A weakly pronounced oxygen maximum was visible at about 19 m, at the lower bound of the currently wind-mixed column.

In the **Bornholm Basin** (TF 213), on 26 March 2009, the temperature of 3.2 °C in the well-mixed layer down to 45 m rose quickly at about 55 m depth to a maximum of 9.8 °C at 67.5 m and returned to lower values of 8.8 °C at the bottom, still a much higher value than found in the Arkona Basin deep water. The finding is interpreted as residing warm water from the fall of 2008 being slowly uplifted by small amounts of recent cold inflow water coming in from the Arkona Basin. The bottom salinity of 16 psu in the Bornholm Basin is still higher than in the Arkona Basin; the latter values correspond to a depth level of about 80 m in the Bornholm Basin. This causes the inflow, if so, to be slow and interleaving. Oxygen was found continuously decreasing down to the bottom with values below 1* ml/l but still above anoxic conditions. At the threshold depth of the Stolpe Sill at 60 m, the temperature was 7.9 °C and the salinity 12.0 psu. At the repeat visit of the **Bornholm Basin** (TF 213) on 28 March 2009, further evidence for an ongoing inflow process was observed. Below a fairly well-mixed surface layer of about 45 m thickness with temperatures between 3.3 and 3.4 °C, and a colder winter water layer with a minimum of 2.9 °C at about 50 m on top of the halocline,

water temperatures appeared fluctuating between various alternating maxima and minima, the highest of 9.3 °C at 63 m, and the lowest of 8. 3 °C at 79 m. Lower temperatures were correlated with higher oxygen concentrations, i.e., apparently younger water. Qualitatively similar observations were made at the south-western flank of the **Bornholm Basin** (TF 214) where inflowing jets from the Bornholmsgat tend to be trapped by the topography. The highest temperature of 9.3 °C was found at 68 m, th e lowest of the deep water at the bottom, 8.4 °C at 91 m.

In the **Stolpe Channel** (TF 222), temperature was found increasing continuously from the surface to 8.2 °C near the bottom with a salinity o f only 12.7 psu, fairly well oxygenated at 2.4* ml/l. At the exit from the Stolpe Channel (TF 256), a splash of warm water with 7.0 to 7.7 °C was observed in the layer between 68 m and t he sea floor, fairly oxygenated (2.9* ml/l near the bottom) and pronounced in salinity up to 11.8 psu, in comparison to the adjacent stations.In the **south-eastern Gotland Basin** (TF 256), the surface mixed layer with 3.3 °C and 7.5 psu extends down to 50 m depth. Towards the bottom, temperature is rising up to 6.5 °C and salinity to 10.9 psu. An oxygen minimum of 0.7* ml/l is found at 76 m depth, increasing to 1.2* ml/l near the bottom. At the **station TF 263**, an exceptionally warm bottom layer was detected with temperatures of 7.0 to 7.7 °C below 100 m depth. This apparently marks a splash of water released earlier from the warm reservoir in the Bornholm Basin; it contains slightly more oxygen than the ambient water but is not clearly pronounced in salinity, i.e., it will propagate further downwards only slowly.

In the **Gotland Basin** (TF 271), a temperature of 2.9 °C and salinity 7.4 psu is found in a well-mixed surface layer down to 53 m depth. Below the temperature is gradually rising to a maximum of 7.2 °C at 115 m (salinity 11.5), still s lightly oxygenated (0.8* ml/l). from 160 m to the bottom, the temperature is almost homogeneous at 6.3 °C and salinity reaches its maximum of 12.5 psu. Oxygen is below 0.2* ml/l from 120 m to the bottom. The finding suggests that the warm intermediate layer belongs to some recent inflow water carrying still moderate oxygen.

Rainer Feistel
scientist in charge

Attachments:
- station and track chart
- 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 from Stolpe Channel to Eastern Gotland Basin
- preliminary map showing areas of near-bottom H_2S and O_2 deficiency
- Darss Sill MARNET temperature and salinity record 17 - 31 March 2009
- DWD weather maps from FU Berlin of 23 and 27 March 2009

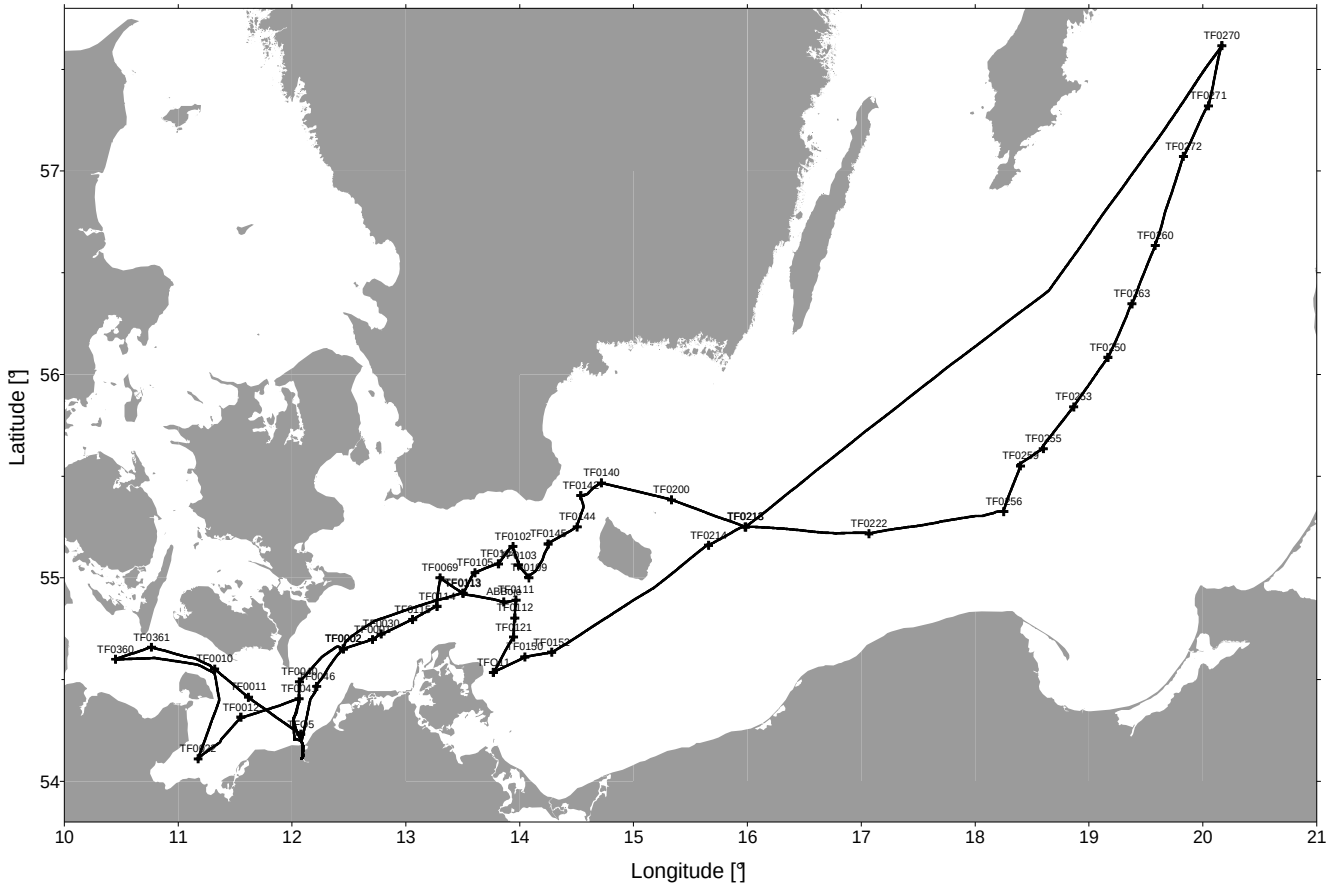
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Table 1: Preliminary data of 2009 from the surface layer (2 m) of selected regions.

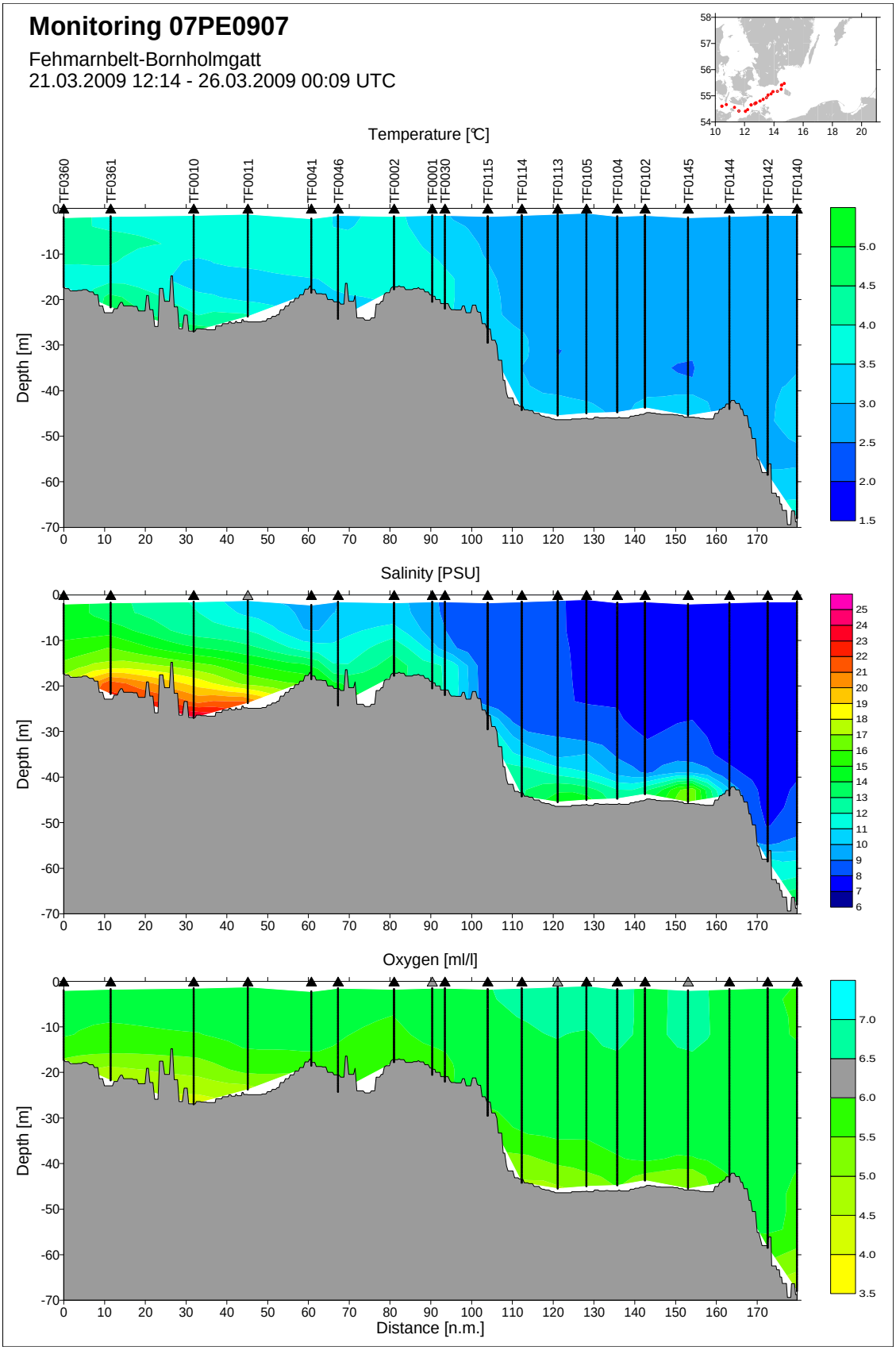
Oxygen values from titration. In brackets, related data of March/April 2008.

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 21.03.2009	TF0360 5	4.06 (4.53)	14.77 (15.60)	8.24 (8.23)	0.04 (0.04)	0.13 (0.14)	4.40 (9.20)
Mecklenburg Bight 22.03.2009	TF0012 7	3.92	11.39	8.50	0.06	0.12	2.50
Lübeck Bight 22.03.2009	TF0022 6	4.13 (4.16)	11.94 (12.46)	8.46 (8.85)	0.05 (0.32)	0.10 (0.13)	3.40 (9.90)
Darss Sill 25.03.2009	TF0030 12	3.05	8.55	8.17	0.11	0.23	16.70
Arkona Basin 25.03.2009	TF0113 16	2.93 (4.31)	8.07 (8.09)	9.10 (8.71)	0.02 (0.99)	0.35 (0.49)	7.00 (14.40)
Bornholm Deep 26.03.2009	TF0213 27	3.18 (4.13)	7.70 (7.63)	8.83 (8.92)	1.62 (0.11)	0.55 (0.55)	10.10 (16.40)
Stolpe Channel 26.03.2009	TF0222 28	3.22	7.56	8.71	2.30	0.63	11.50
SE Gotland Basin 26.03.2009	TF0259 30	3.31 (3.98)	7.54 (7.41)	8.55 (8.88)	3.47 (0.91)	0.54 (0.60)	10.20 (15.40)
Gotland Deep 27.03.2009	TF0271 37	2.92 (3.95)	7.41 (7.41)	8.71 (8.97)	3.65 (1.67)	0.55 (0.56)	11.10 (12.80)
Farö Deep -	TF0286 -	- (3.64)	- (7.27)	- (8.96)	- (1.39)	- (0.32)	- (5.80)
Landsort Deep -	TF0284 -	- (3.27)	- (6.76)	- (9.39)	- (0.09)	- (0.30)	- (8.30)
Karlsö Deep -	TF0245 -	- (3.67)	- (7.25)	- (8.78)	- (1.15)	- (0.35)	- (7.20)

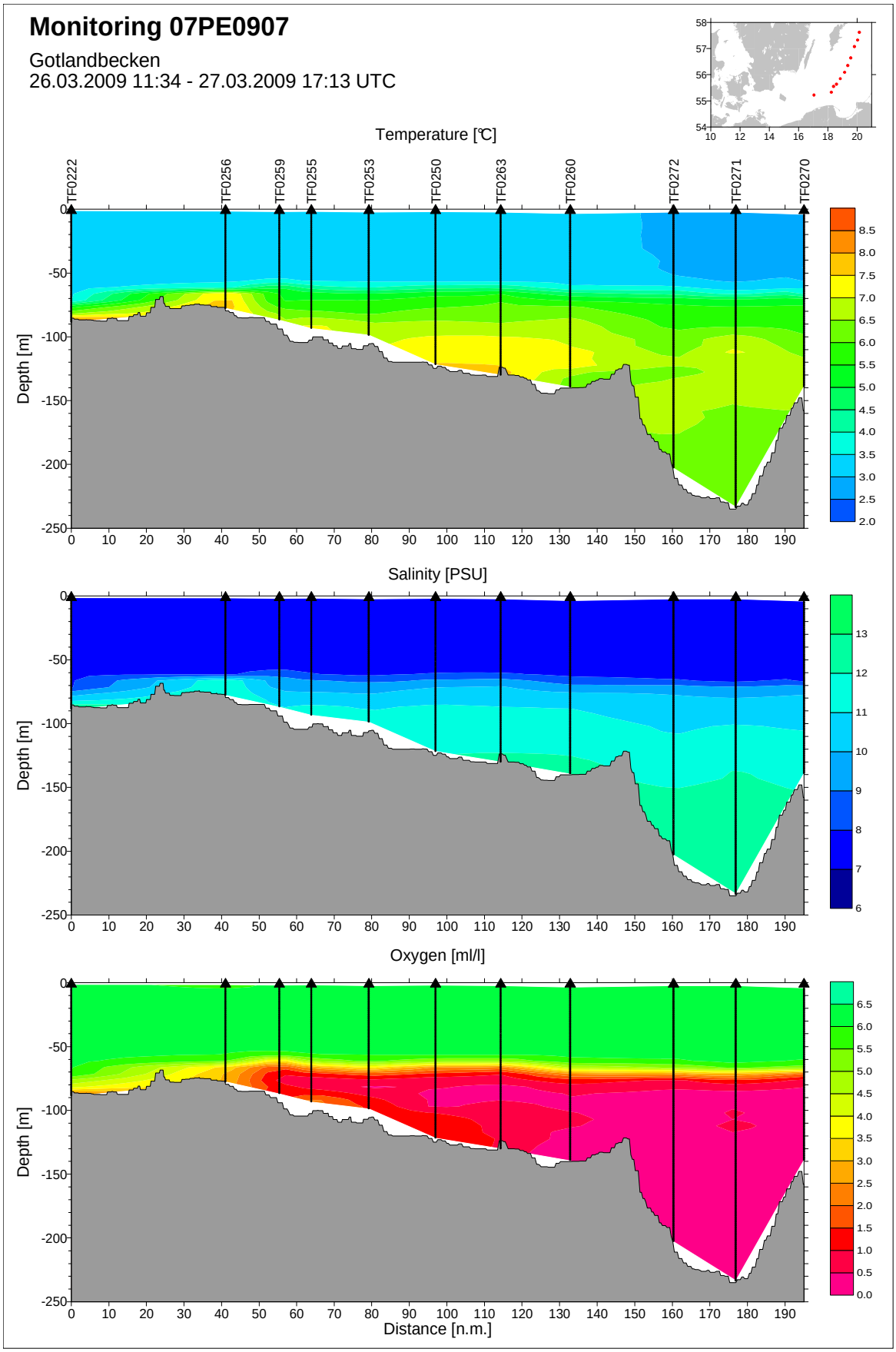
Table 2: Preliminary data of 2009 from the near-bottom layer of selected regions.

Oxygen values from titration. In brackets, related data of March/April 2008.

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 21.03.2009	TF0360 5	15	3.62	15.86	7.83	0.65	0.23	7.90
Mecklenburg Bight 22.03.2009	TF0012 7	20	3.13	16.82	7.04	2.63	0.52	8.60
Lübeck Bight 22.03.2009	TF0022 6	20	3.28	16.52	5.99	4.13	0.59	14.60
Darss Sill 25.03.2009	TF0030 12	20	3.62	12.30	8.01	0.17	0.24	3.80
Arkona Basin 25.03.2009	TF0113 16	40	2.97	12.51	7.50	0.58	0.47	6.80
Bornholm Deep 26.03.2009	TF0213 27	80	9.06	15.45	1.80	7.68	1.57	37.00
Stolpe Channel 26.03.2009	TF0222 28	80	6.17	10.46	5.72	6.49	1.09	19.00
SE Gotland Basin 26.03.2009	TF0259 30	80	6.21	10.61	1.56	7.41	2.43	39.80
Gotland Deep 27.03.2009	TF0271 37	200	6.28	12.42	-3.66	0.00	5.10	75.90
Farö Deep -	TF0286 -	150	-	-	-	-	-	-
Landsort Deep -	TF0284 -	400	-	-	-	-	-	-
Karlsö Deep -	TF0245 -	100	-	-	-	-	-	-



Oxygen is displayed as an uncorrected sensor value. The preliminary correction factor is 1.38.



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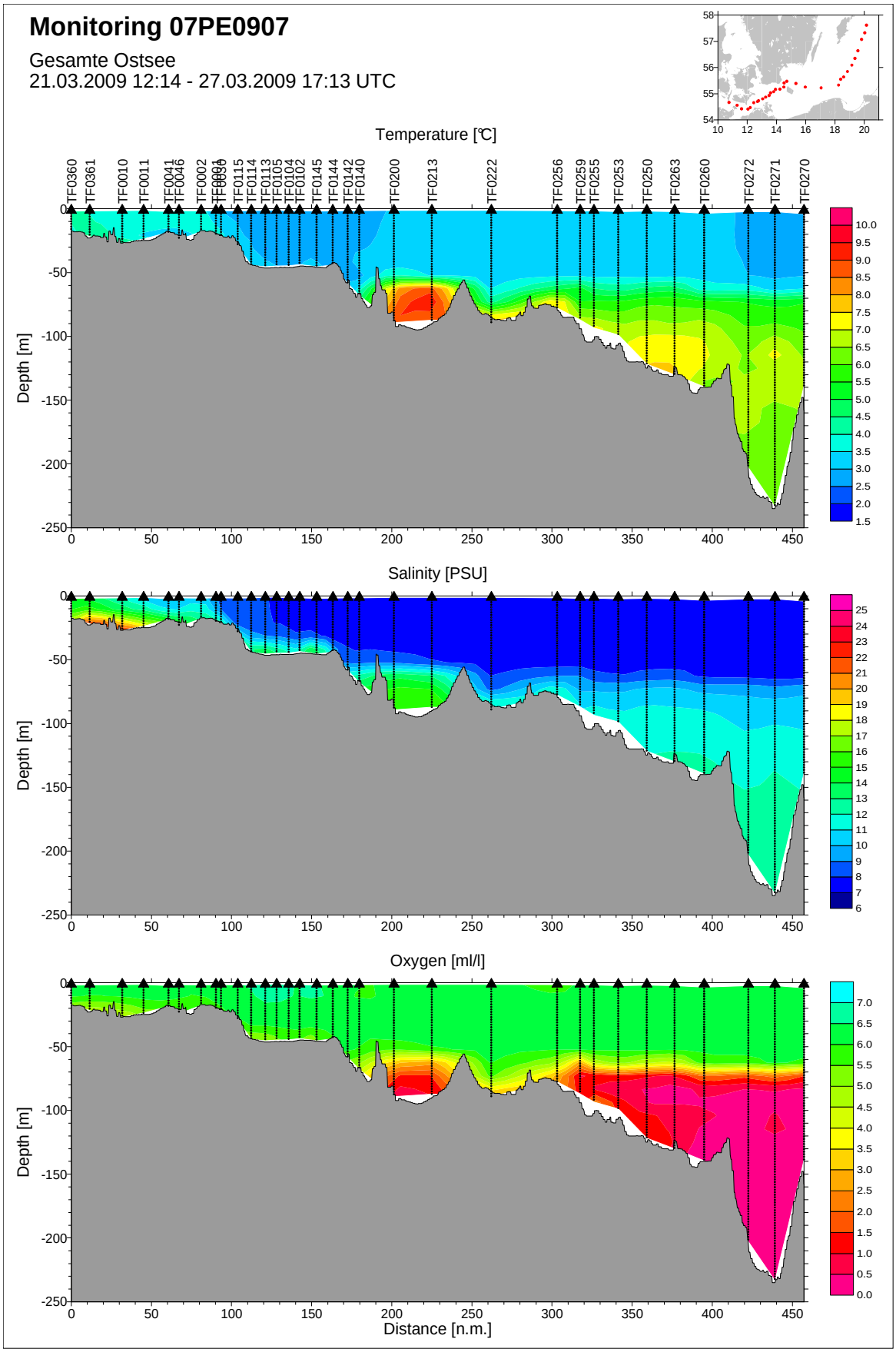

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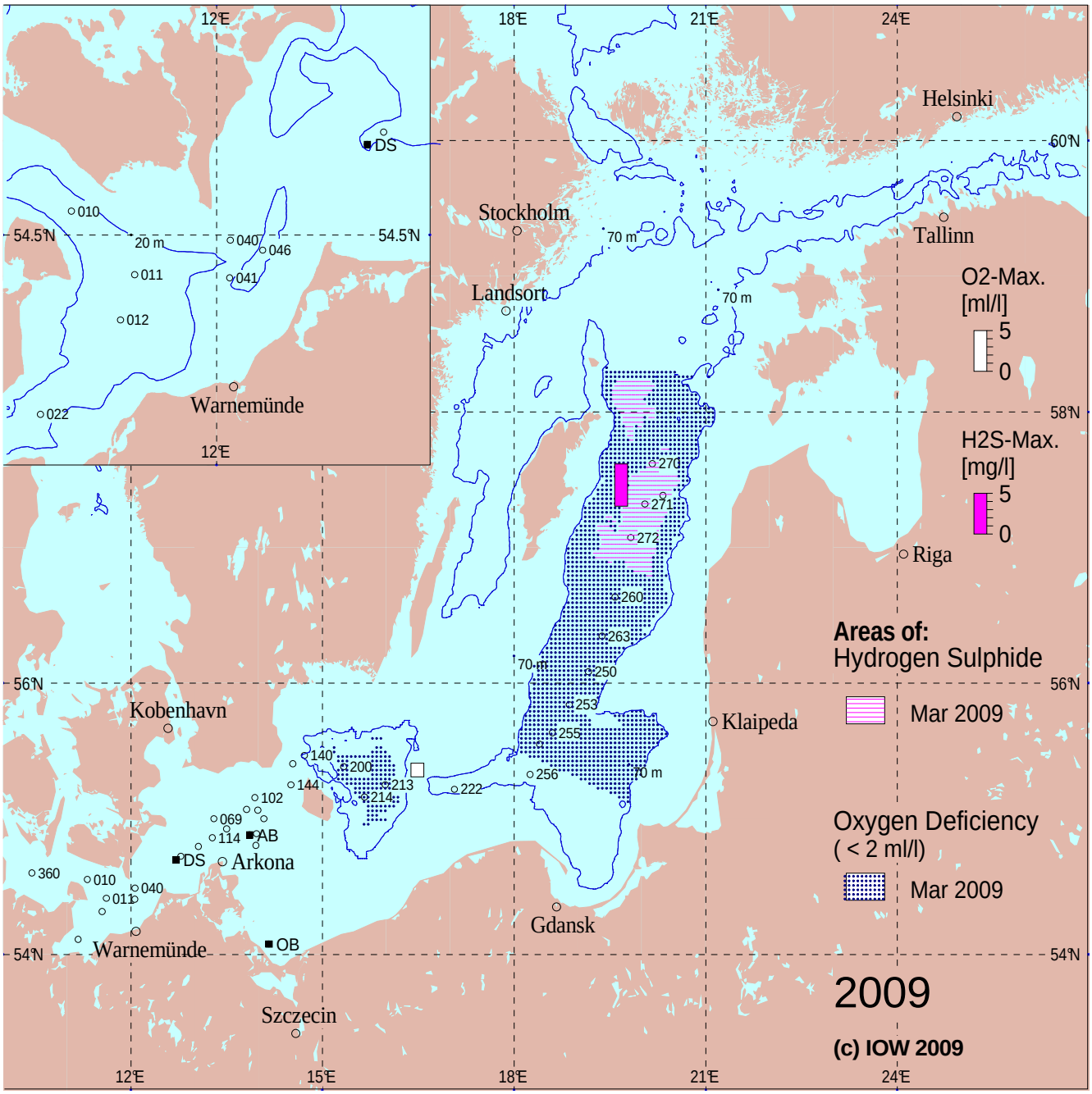
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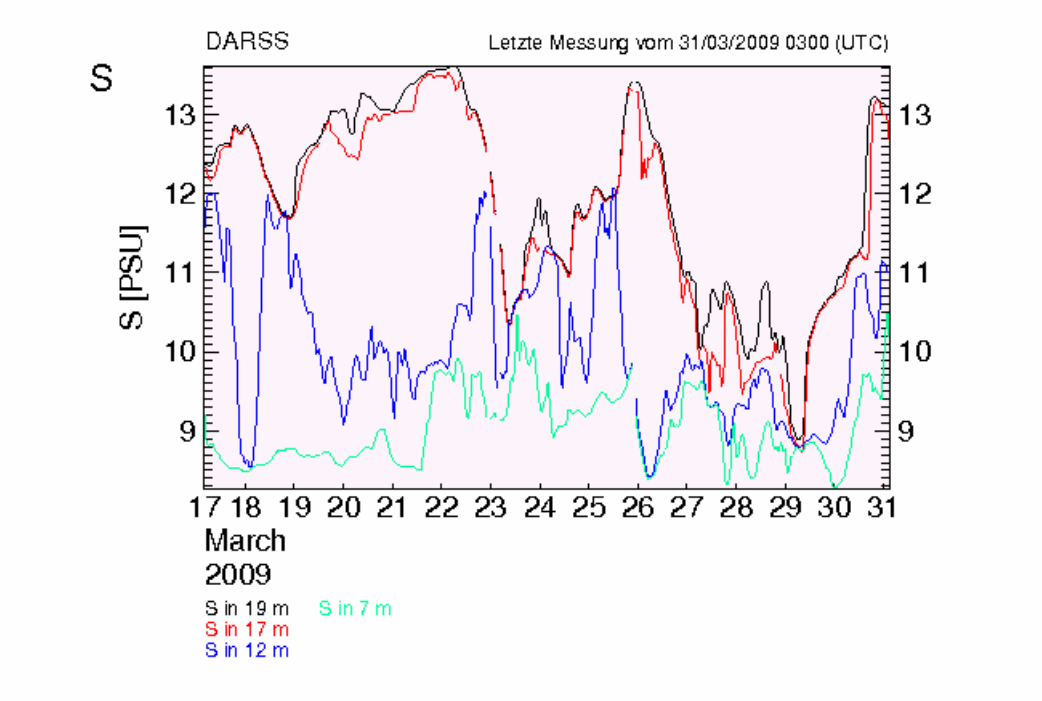
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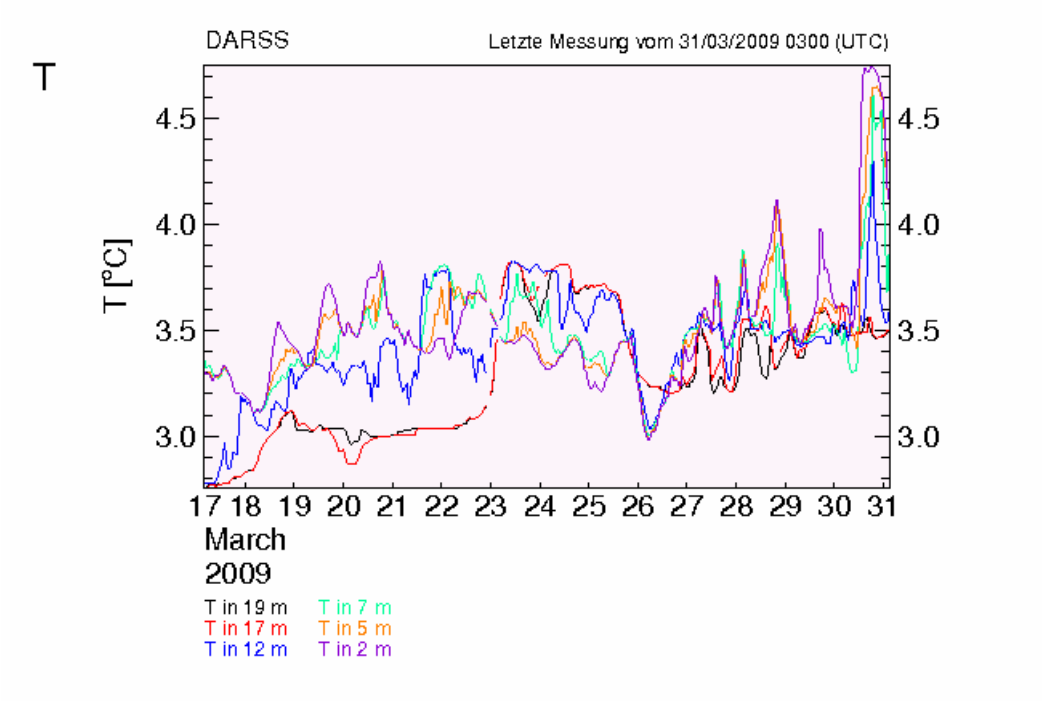
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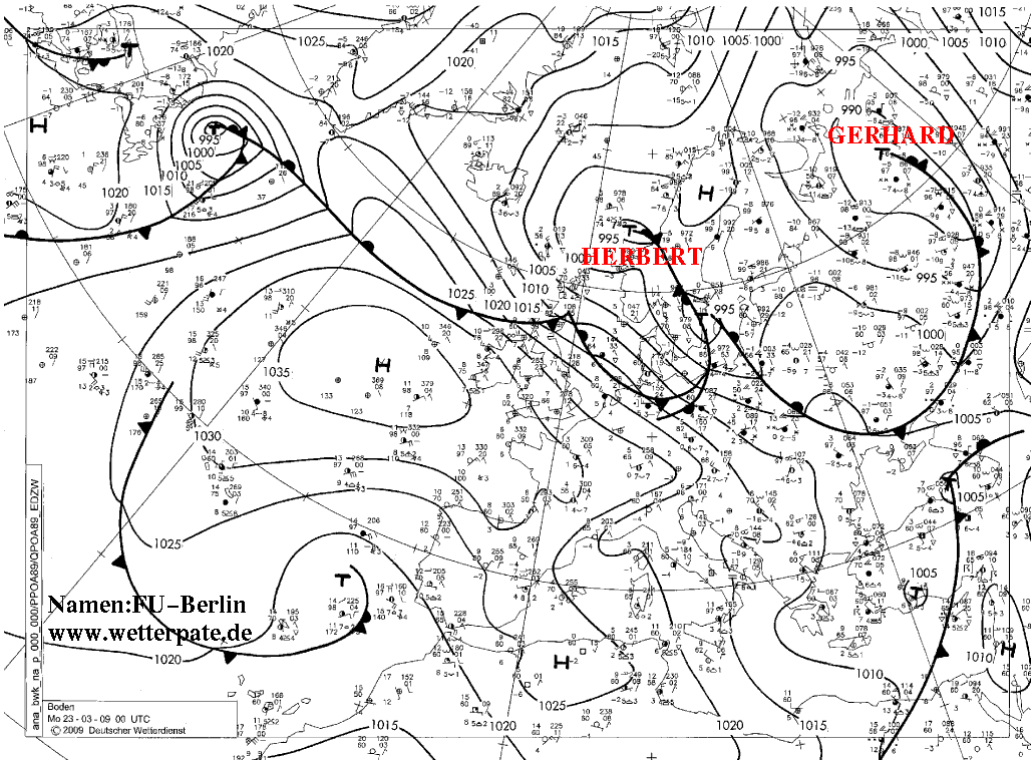
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www.wetterpate.de
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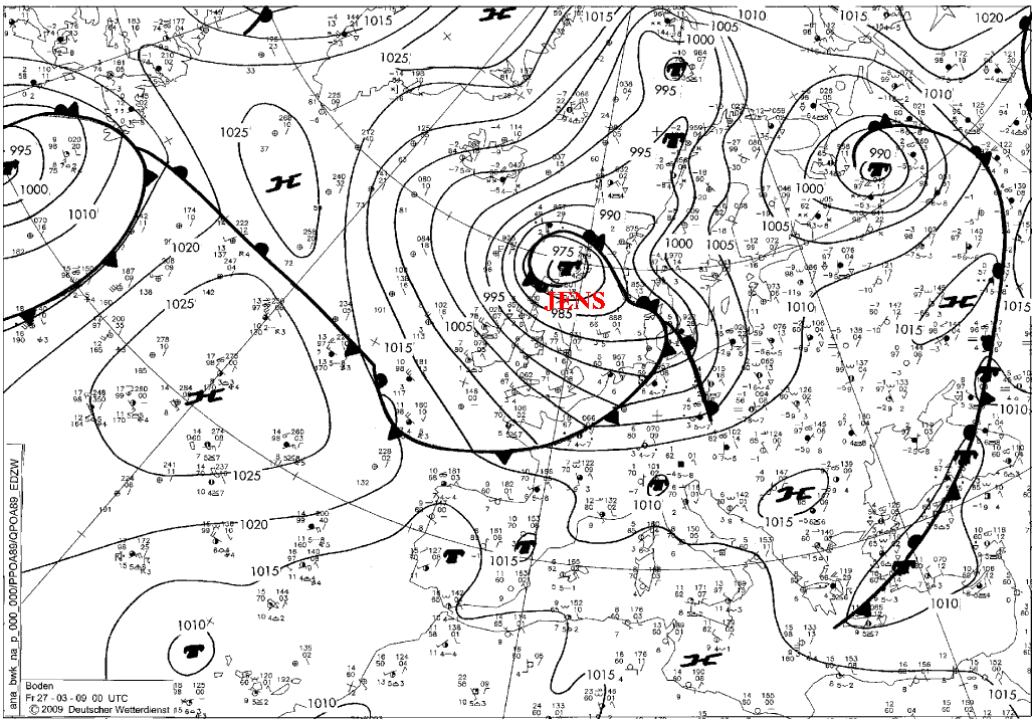
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