# Cruise Report

## F.S. ALKOR Cruise No. AL340-2

12.06. – 15.06.2009

Project:
Student course, physical oceanography

Leg 1
12.06. – 13.06.2009
Kiel - Warnemünde

Leg 2
13.06. – 14.06.2009
Warnemünde – Warnemünde

Leg 3
14.06.-15.06.2009
Warnemünde - Kiel

Port calls
Warnemünde, 13.07.-14.06.2009
Warnemünde, 14.07.-15.06.2009

Institute
Leibniz-Institut für Meereswissenschaften an der
Universität Kiel, Germany
IFM-GEOMAR

Principal Scientist
Dr. Thomas J. Müller

Number of Scientists:
Leg 1: 8
Leg 2: 10
Leg 3: 11

Ship's master
Jan-Peter Lass

## 1. Scientific crew

| | | |
|---|---|---|
| Leg1 | 12.06.-13.06. | Kiel - Warnemünde |
| Leg 2 | 13.06.-14.06. | Warnemünde - Warnemünde |
| Leg 3 | 14.06.-15.06. | Warnemünde - Kiel |

| Name | Given name | Function onboard | Leg 1 | Leg 2 | Leg 3 |
|---|---|---|---|---|---|
| Müller | Thomas | Principal scientist | 1 | 2 | 3 |
| Neumann | Uta | Phd student | 1 | 2 | 3 |
| Link | Rudolf | Technician | 1 | 2 | 3 |
| Abel | Rafael | Bsc. stud. PHER | | | 3 |
| Bauer | Madeleine | Bsc. stud. PHER | | 2 | |
| Busecke | Julius | Bsc stud. PHER | | | 3 |
| Dippe | Tina | Bsc. stud. PHER | | 2 | |

## 2. Scientific Background

On the long average, the Baltic Sea as a humid sea gains more fresh water through rain and river run-off than it looses to the atmosphere by evaporation. This excess of fresh water must

Stations, sections and mooring work as follows; for more details see the complete log in the appendix.

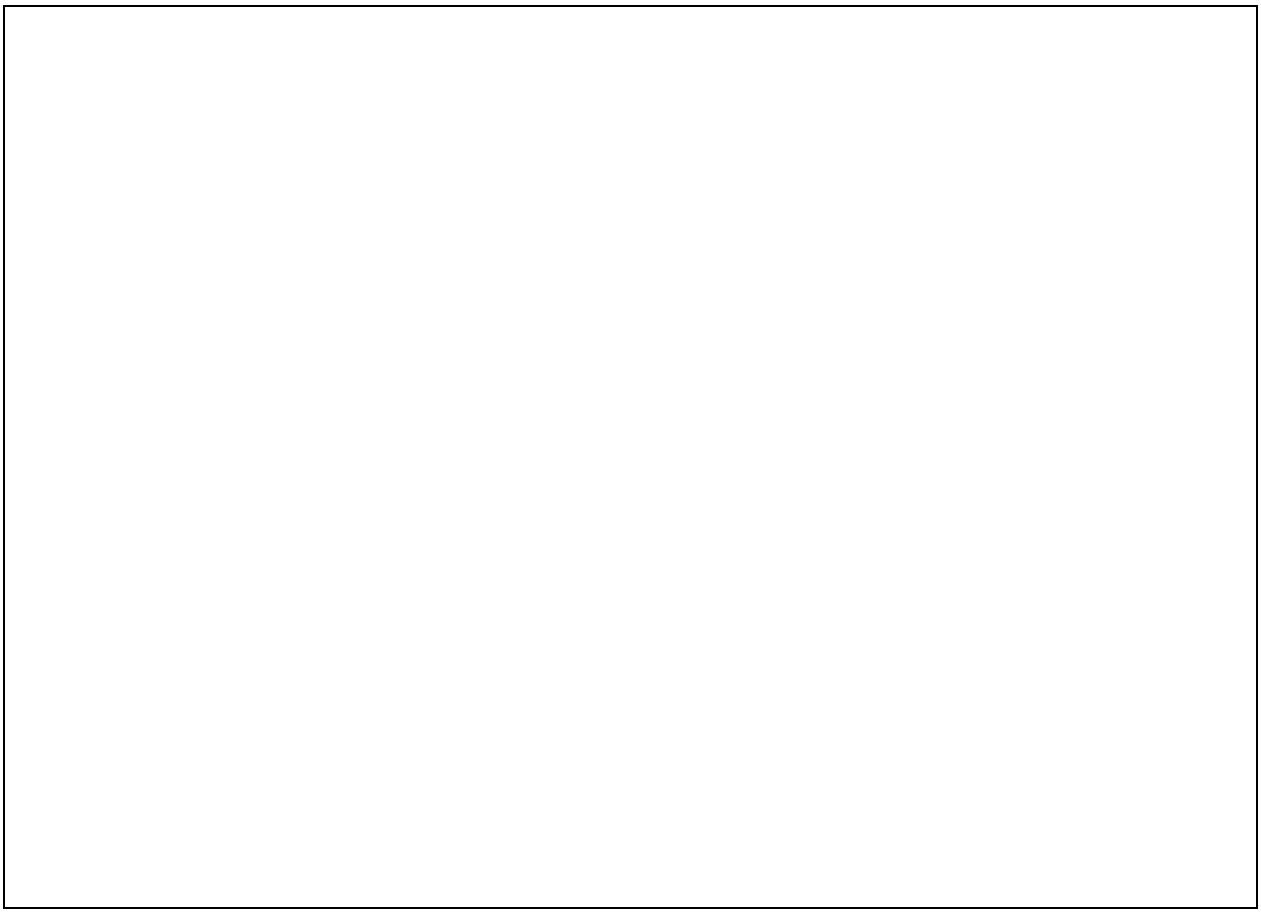

***Fig. 3.1:*** *ALKOR cruise AL340-2, 12.06.-15.06.2009 from Kiel Bight and Fehmarn Belt to Darss Ridge: CTD casts and mooring site V431; CTD sections across Fehmarn Belt (casts 2 – 9, 23 – 28), across Darss Ridge (12 – 17) and non-synoptic from Vejsnaes Gap to Darss Ridge (2, 3, 5, 22 – 18, 10, 11, 14). Port calls in Warnemünde*

AL340-2, 12.06.-15.06.2009: Cruise narrative summary

***Leg 1, 12th to 13th June, Kiel – Warnemünde, for locations of positions see map in Fig. 3.1***

| Date 2007 | Time UTC | CTD cast no. | Action |
|---|---|---|---|
| 12.06.. | 05:30 | | Kiel, embark all participants for leg1, 1 ***no-show-up*** student |
| | 06:05 | | Sail, start DAVIS-SHIP |
| | 08:15 | 01 | Test CTD; |

AL340-2, 12.06.-15.06.2009: Cruise narrative summary (continued)

***Leg 2, 13th to 14th June, Warnemünde - Warnemünde***

| Date 2007 | Time UTC+2 | Position no. | Action |
|---|---|---|---|
| 13.06. | | | Warnemünde, embark student's course 2, 1 ***no show-up*** student, begin leg 2 |
| 14.06. | 04:00<br><br>05:10 | | Sail from Warnemünde; |

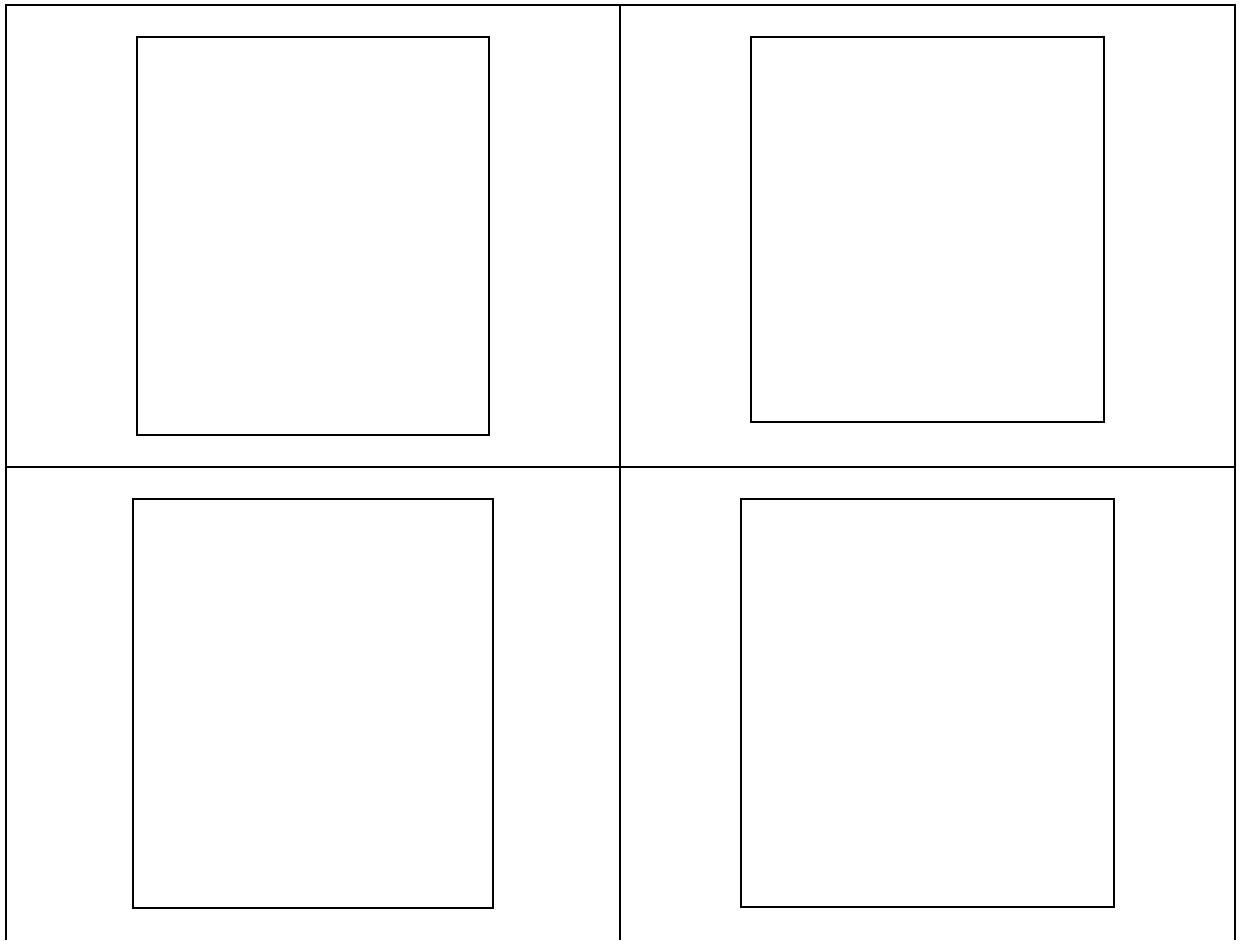

***Fig. 4.1.1:*** *development of bottom air pressure over the North and Baltic seas: 12.06. (upper left),*

West to East variability

The section along the mean in- and outflow axis from Fehmarn Belt to the Cadet Gap (Darss Ridge, casts 02, 03, 05, 22 to 18, 10, 11, 14, Fig. 4.2.2) was taken over 4 days and therefore clearly is non-synoptic. Despite this, the section shows the typical early summer situation with temperature and salinity decreasing from West to East, reflecting the warming from higher winter temperatures in the west, and with lower salinities in the inner Baltic in the East. This general view is disturbed by an eddy structure in the Fehmarn Belt. The coldest water 8°C was measured near the bottom at the mooring position (cast 22, 40 km) where also highest salinity and oxygen content and lowest chlorophyll *a* is found. This patch is the clearest bottom inflow signal.

As noted earlier, the maximum of chlorophyll *a* is found at depths between 5 m and 10 m where still sufficient light is available and due to the summer density interface phytoplankton

Cross gap variability at Fehmarn Belt and Cadet Gap

In gaps, for near-bottom inflows and surface outflows, geostophic balance on the long-term average for the Northern hemispere requires that the flows adjusts their cores on the right-hand side of the channel, looking in flow direction. For the Fehmarn Belt and Cadet Gap dense bottom and less dense surface flows as indicated by high (low) salinity cores are therefore expected on the southern and northern border, respectively.

The cross Fehmarn Belt section of 12$^{th}$ June 2009 (Fig. 4.2.3, left panel) differs completely. The saline bottom water is found on the northern flank, and also the surface is colder and saltier in the North. Probably the extreme wind has totally changed the stratification by pressing the salty bottom water towards the northern flank and low salinity water from the

Further east, in the Cadet Gap (14th June 2009, Fig. 2.4.4, right panel), the situation is similar to the one in Fehmarn Belt on the 12th June with high density water on the northern margin while the less dense bottom water is found on the southern margin.

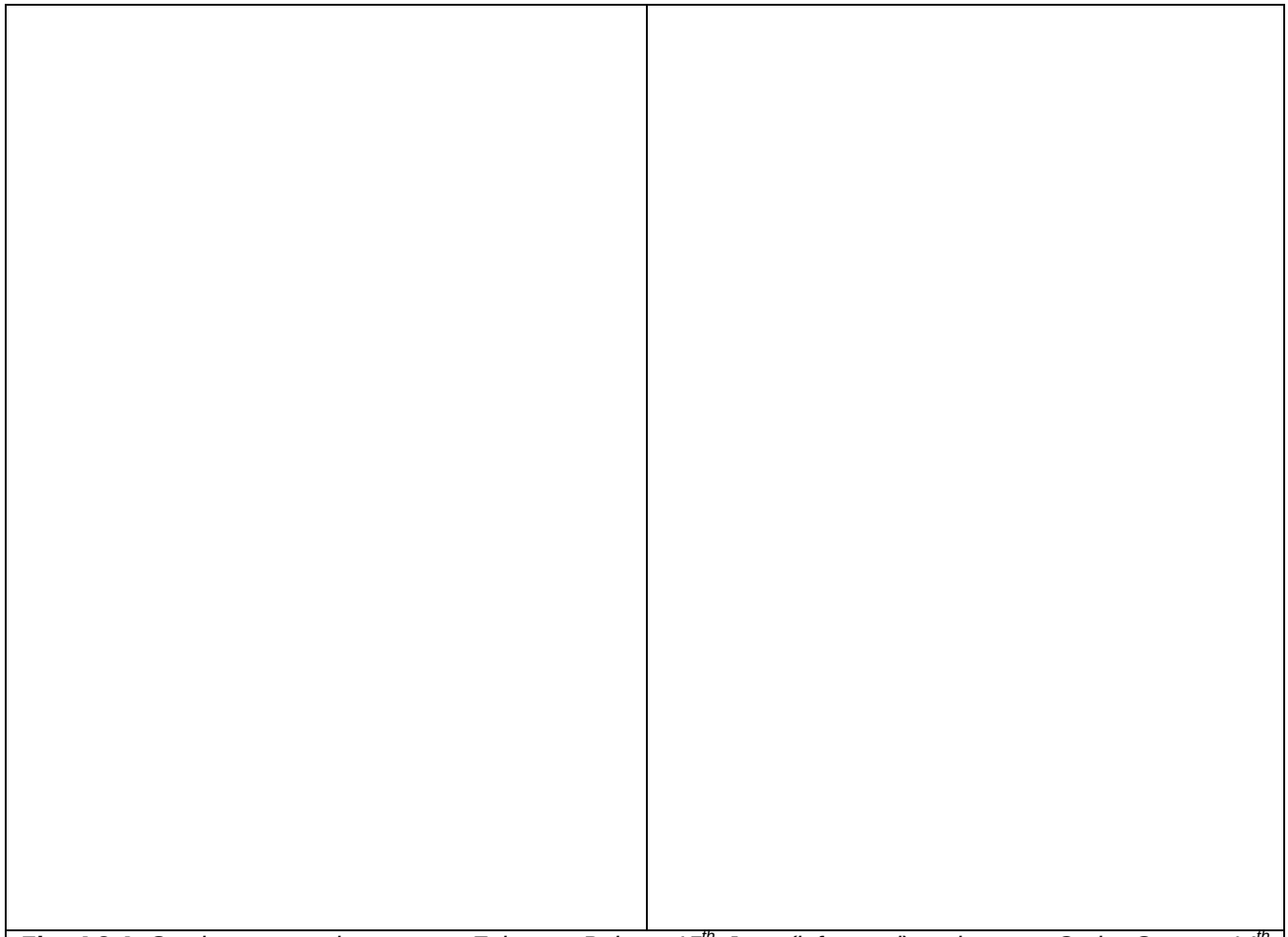

***Fig. 4.2.4:*** *Section across the western Fehmarn Belt on 15th June,(left panel) and across Cadet Gap on 14th June 2009 (right panel) from South (left) to North (right); potential temperature, salinity and density anomaly (top to bottom); extended by objective analysis*

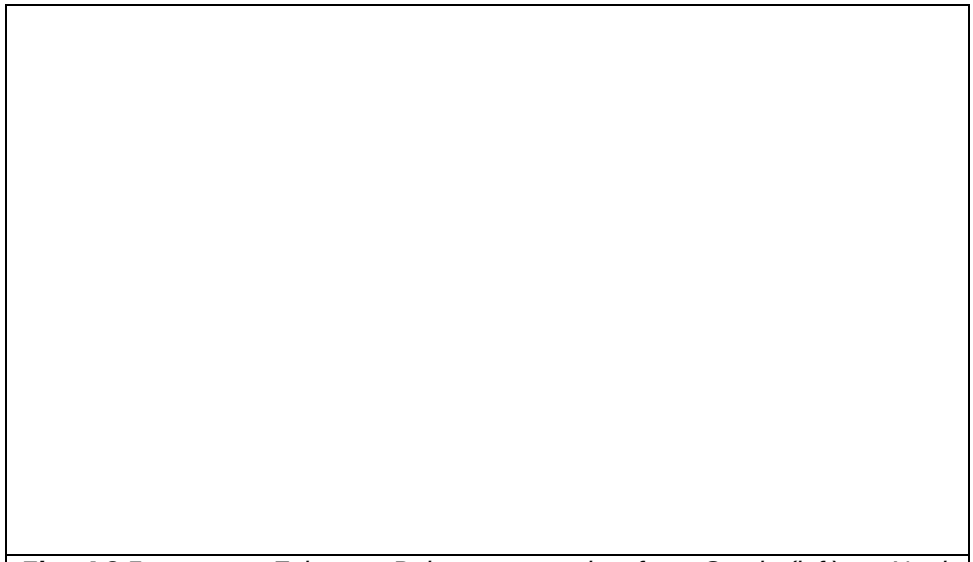

***Fig. 4.2.5:*** *western Fehmarn Belt; cross section from South (left) to North (right), vADCP, zonal velocity;*

Because of the bad weather at the beginning of the cruise, recovery of mooring V431-18 was delayed until the cruise's last day on 15th June. After 9 months deployment it was not re-deployed because of lack of time for a carefull re-fit.

The RDCP had only 1.5 months of good records; from then on, recording had seized completely, probably due to a problem with the battery package.

The usual processing is the following: Raw data are decoded, converted to physical units, processed for spikes and low pass filtered to daily averages. For the current measurements, the coordinate system is rotated by 132° to align one current component to the Belt's main axis (main flow positive to the Southeast). A 7 d low pass filter is applied to both, MC and rotated RDCP data, to investigate long-term changes in the Belt's fow pattern and near botom hydrography.

***Tab. 5.1*** *Mooring details*

| | launched | recovered | ADCP | MicoCat | Releaser |
|---|---|---|---|---|---|
| V431-18 | 30.09.2008 | 15.06.2009 | RDCP600<br>600 kHz,<br>S/N 227<br>T-sensor: yes<br>C-sensor: yes<br>O2: yes | SBE 37 SM<br>S/N 2936 | Benthos 875-A<br>S/N: Hamburg unit<br>12 kHz, code C |
| V431-19 | 29.06.2009<br>(after this cruise; transit of R/V POSEIDON from Kiel to Warnemünde) | | RDCP600<br>600 kHz,<br>S/N 227<br>T-sensor: yes<br>C-sensor: yes<br>O2: yes | SBE 37 SM<br>S/N 2936 | Benthos 875 A<br>S/N 45634<br>RX 12 kHz, Code C |

## 5.2 CTD/rosette and salinometer

The CTD/rosette system is made by *HYDROBIOS, Kiel, Germany*. It is for shallow water (less 3000 m). The CTD package is battery powered, but provides data on-line via a one-conductor cable from the underwater unit to the deck unit where they are recorded by the

### 5.3.2 Meteorological data

Sensors are installed in the mast; an additional sensor for water temperature sensor in ship's hull. All data are sampled by the *COMBILOG 1020* system of *Friedrichs & Co, Schenefeld, Germany*. Sensors are:

barometric pressure, *Friedrichs type 5002*
temperature and humidity sensor, *Friedrichs type 3030*, port and starboard side
wind speed and direction (*Thiess 4.3324.21.000*), port and starboardside
global radiation, *Kipp & Zonen pyranometer*
IR radiation, *Eppley Lab., Inc., CM11*, S/N 3407F3
water temperature *S-WM4*, last test 02-JAN-2004

*COMBILOG* samples all meteorological data and provides them as combined ASCII string each sampling interval to a RS232 interface. This string is fed into the *DAVIS-SHIP* system (see. Sec. 5.3.6.)

### 5.3.3 Thermosalinograph

A SBE37 thermosalinograph with additional external temperature sensor provides near-surface temperature and electric conductivity data form an inlet at about 3 m depth close the ship's bow. Data are converted and together with calculated salinity (PSS78) fed into the underway sampling and distribution system *DAVIS-SHIP* (see Sec. 5.3.6). Temperature and salinity data maybe calibrated *in-situ* by comparison with near-surface CTD data while on station taking the CTD as correct (Fig. 5.3.3.1).

***Fig. 5.3.3.1****: Thermosalinograph (blue) and near-surface CTD data (red dots), 12.06.-14.06.; temperature median correction (upper panel) is less 0.05 K and salinity median correction (lower panel)on 12th June is + 0.1 psu; on 14th June, the TS-g's pump obviously was not switched on.*

### 5.3.4 Single beam echosounder

A *SIMRAD EK60*, 38 kHz, at reference sound velocity 1.459.7 m/s was used. Data are fed into the *DAVIS-SHIP* system (see Sec 5.3.6). It has been shown during earlier cruises using CTD casts from Vings Grav in the west and the entrance to the Arcona Basin in the east (Position 30) that depth corrections are low ( ca. 0.3 m) indicating that the reference sound velocity of 1459.7 m/s is well chosen. A comparison with new data from cast 22 close to the mooring locations confirms this.

### 5.3.5 Vessel mounted ADCP

A 300 kHz *work horse* ADCP made by *RDI* is mounted in the ship's moonpool. Because of shallow water, it could be used in bottom track mode. GPS navigational data come directly from the *DAVIS-SHIP* system; gyro compass data are converted first from *DAVIS-SHIP* to the special required format and then fed into the ADCP computer where standard software created in the department of *Physical Oceanography* is used for processing.

### 5.3.6 Underway sampling and distribution system (DAVIS-SHIP)

Underway data sampling, distribution and storage is performed by the hard- and software system *DAVIS-SHIP* from WEREUM, Lüneburg, *Germany*. Data sources are:

- Navigational data from main and secondary GPS including date and time
- Gyro compass
- Depths from navigational, sediment and *SIMRAD ER40* single beam sounders
- Meteorological data from the *COMBILOG* and automated weather station the *Deutsche Wetterdienst (DWD)* operates onboard (see Sec. 5.3.2)
- Thermosalinograph made by SeaBird, U.S.A.

Displays and network connections are available in the dry and wet laboratories.

## 6. Acknowledgements

We would like to thank master and crew of RV ALKOR for the helpful advise and support throughout the cruise.

# 7. Appendices

## 7.1 Cruise log AL340-2

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Oz. Praktikum
AL 340-2, 12.06.-15.06.2009
Bezeichnungen:
Datum: YYYY MM DD
Zeit: hh mm
P : Postions Nr. im Praktikum
C: CTD Nr.
Breite: dd mm.mm
Länge: ddd mm.mm
H     : Lottiefe / m
S     : Symbol Nr.
WP    : Wegpunkt

Leg 1, 12.06. - 13.06., Kiel - Warnemünde
YYYY MM DD hh mm P  C   Breite      Länge    H  S Bemerkung
2009 06 12 07 00 -9 -9  54 20.00   010  09.0 -9 2 Kiel
2009 06 12 18 05 -9 -9  54.45 0    010.3 0   -9 4 WP Kiel
Kieler Bucht
2009 06 12 08 06 01 01  54  30.0   010  30.0 14 2 Test CTD
Vejsnaes Rinne
2009 06 12 09 53 02 02  54  36.5   010  55.0 22 2 CTD, L West
2009 06 12 10 46 03 03  54  35.5   011  05.0 30 2 CTD, L
Fehmarnbelt quer
2009 06 12 11 25 04 04  54  33.0   011  09.5 17 2 CTD, C Süd
2009 06 12 12 50 05 05  54  34.0   011  11.0 28 2 CTD, C, L
2009 06 12 12 15 06 06  54  35.1   011  12.4 26 2 CTD, C
2009 06 12 12 41 07 07  54  36.0   011  13.4 26 2 CTD, C
2009 06 12 13 04 08 08  54  36.7   011  14.5 21 2 CTD, C
2009 06 12 13 38 09 09  54  38.0   011  15.5 17 2 CTD, C Nord,
2009 06 12 13 47 09 -9  54  38.0   011  15.5 -9 4 Beginn ADCP
2009 06 12 14 59 -9 -9  54  35.1   011  12.4 -9 4 Kursänderung, Sturm, Ende Schnitt
2009 06 -9 -9 -9 -9 -9  54.39 0.0   11.35 0.0 -9 4 WP östl. Fehmarn
2009 06 13 15 21 -9 -9  54.35 0.0  11.2  0.0 -9 4 SW Fehmarn, Schutz
2009 06 13 -9 -9 -9 -9  54.2 0.0   012  00.0 -9 4 WP Anlaufen Warnemünde
2009 06 13 14 00 -9 -9  54  07.00  012  05.50 -9 2 Warnemünde

Leg 2, 14.06., Warnemünde - Warnemünde
YYYY MM DD hh mm P  C   Breite      Länge    H  S Bemerkung
Warnemünde - Darss
2009 06 14 04 00 -9 -9 54 07.0    012  05.5 -9 2 Warnemünde
2009 06 14 -9 -9 -9 -9 54.2 0.0   012  00.0 -9 4 WP Warnemünde
2009 06 15 05 36 15 10  54  24.0   012  10.0 20 2 CTD, L
2009 06 14 06 37 16 11  54  32.0   012  18.0 23 2 CTD, L
Kadettrinne quer
2009 06 14 07 24 23 12  54  33.0   012  30.0 14 2 CTD, D, Süd
2009 06 14 07 53 24 13  54  35.0   012  26.0 17 2 CTD, D
2009 06 14 08 22 25 14  54  37.5   012  23.5 17 2 CTD, D
2009 06 14 08 50 26 15  54  40.0   012  20.0 18 2 CTD, D
2009 06 14 09 15 27 16  54  42.0   012  16.0 20 2 CTD, D
2009 06 14 28 09 43 17  54  45.0   012  13.0 16 2 CTD, D Nord
2009 06 14 09 49 28 -9  54  45.0   012  13.0 16 4 D Nord, Beginn ADCP Schnitt, 7 kn
2009 06 14 12 09 23 -9  54  33.0   012  30.0 14 4 D Süd, Ende ADCP Schnitt
2009 06 14 14 15 14 18  54  21.5   012  00.0 18 2 CTD, L
2009 06 14 -9 -9 -9 -9 54.2 0.0    012  00.0 -9 4 WP Warnemünde
2009 06 14 15 30 -9 -9  54 07.00   012  05.5 -9 2 Warnemünde
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Leg 3, 15.06., Warnemünde - Kiel

| YYYY | MM | DD | hh | mm | P | C | Breite | Länge | H | S | Bemerkung |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Warnemünde - Fehmarnbelt | | | | | | | | | | | |
| 2009 | 06 | 15 | 04 | 00 | -9 | -9 | 54 07.00 | 012 05.5 | -9 | 2 | Warnemünde |
| 2009 | 06 | 15 | -9 | -9 | -9 | -9 | 54.2 0.0 | 012 00.0 | -9 | 4 | WP Warnemuende |
| 2009 | 06 | 15 | 05 | 34 | 13 | 19 | 54 21.0 | 011 50.0 | 23 | 2 | CTD, L |
| 2009 | 06 | 15 | 06 | 22 | 12 | 20 | 54 21.0 | 011 40.0 | 25 | 2 | CTD, L |
| 2009 | 06 | 15 | 07 | 19 | 11 | 21 | 54 27.0 | 011 30.0 | 26 | 2 | CTD, L |