Scientific cruise report – MEDOS 2011

By Volker Mohrholz, Toralf Heene, Ingo Schuffenhauer und Sebastian Beier
On board, 09.12.2011

Content

1. Basic information

Ship:	FS Elisabeth Mann-Borgese
Cruise:	06EZ1116 (MEDOS 2011)
Date:	29. November to 08. December 2011
Captain:	Uwe Scholz
Chief scientist:	Dr. Volker Mohrholz, Baltic Sea Research Institute Warnemünde

Objectives

The EMB cruise 06EZ1118 was carried out in frame of the Baltic Sea monitoring activities of the IOW. The main goal of the cruise is to contribute to the knowledge about the mesoscale dynamics in the western and central Baltic. Along a transect from the Darss Sill to the northern Gotland basin towed CTD and current measurements supply hydrographic measurements with a high spatial resolution. This synoptic data set will provide information about the spatial variability of key hydrographic parameters at the time of thermocline erosion in late autumn. Additionally, the gathered data will be used in frame of the Baltic monitoring program and for validation of the IOW numerical modells.
The cruise will also be used for several device tests and mooring maintenance of the GotlandNE long term mooring.

The working program of the cruise consisted initially of the following packages:

1. Measuring of mesoscale hydrographic patterns in the upper layer and the halocline of the Baltic at depth between 0 und 150m with a combined ScanFish/TADCP transect from the Darss Sill to the northern Gotland basin.
2. Maintenance of the long term mooring Gotland NE.
3. CTD transect along the ScanFish transect for covering the deep layers that were not measured by the ScanFish.
4. Test of a new ADCP measuring method, that will allow the contemporary measurement of all main turbulence parameters with a single device.

Staff of scientific crew

	Name	*On board*	*Institution*	*Responsibility*
1	Volker Mohrholz	29.11.-08.12.2011	IOW Warnemünde	Chief scientist, MSS
2	Sebastian Beier	29.11.-08.12.2011	IOW Warnemünde	Moorings
3	Toralf Heene	29.11.-08.12.2011	IOW Warnemünde	VMADCP, Moorings
4	Hans-Ulrich Lass	29.11.-08.12.2011	IOW Warnemünde	CTD
5	Mareike Peterson	29.11.-08.12.2011	IOW Warnemünde	CTD, MSS
6	Günter Plüschke	29.11.-08.12.2011	IOW Warnemünde	Moorings
7	Dietmar Rüß	29.11.-29.11.2011	IOW Warnemünde	TADCP
8	Ingo Schuffenhauer	29.11.-08.12.2011	IOW Warnemünde	ScanFish
9	Lydia Siegfried	29.11.-08.12.2011	Uni Rostock	CTD, MSS
10	Michael Thurm	29.11.-08.12.2011	Uni Rostock	CTD, MSS

Area of investigation

The data collection covered the western and the central Baltic. The stations are organized along a talweg transect through the entire Baltic proper.

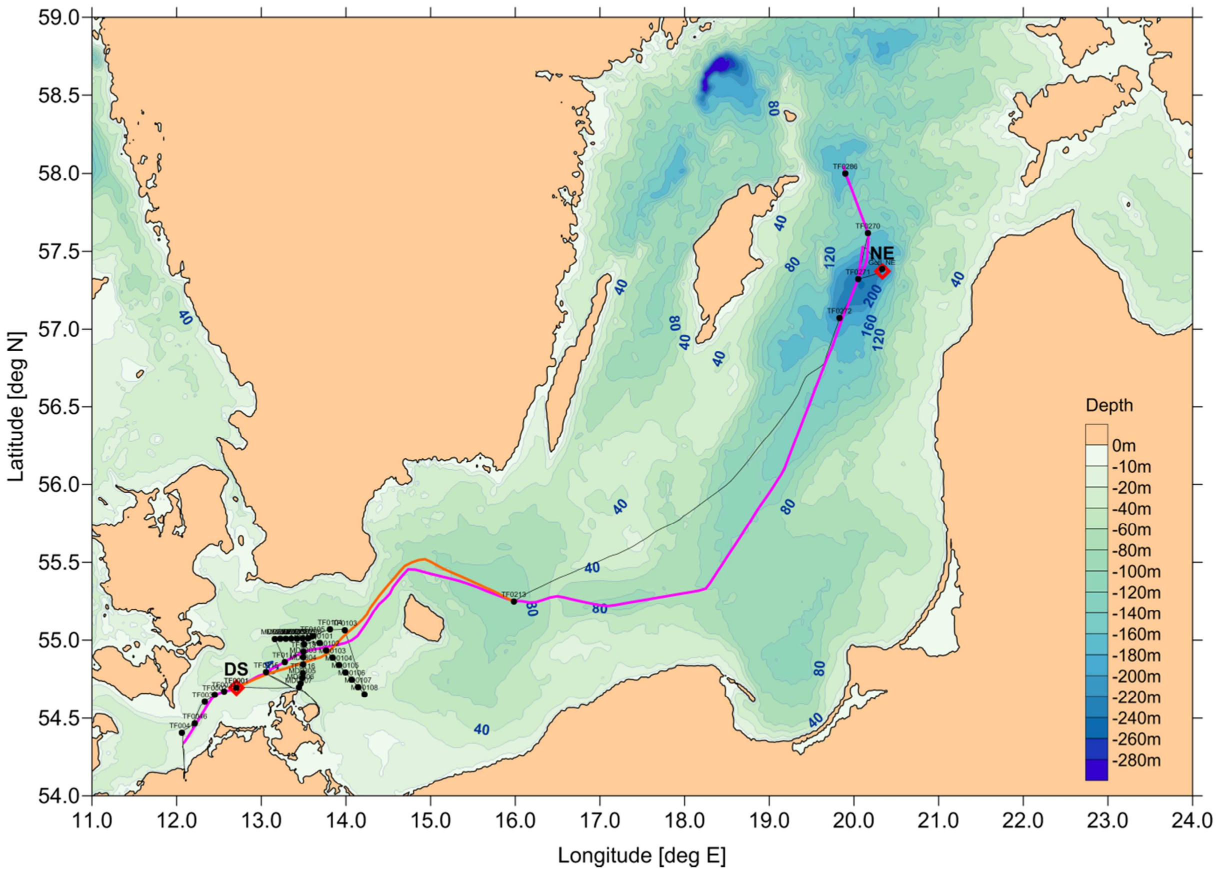

Figure 1: Map of stations and ship track (black line) of EMB cruise 06EZ1116. Black dots and labels indicate CTD stations, the magenta line depicts the ScanFish transect, red diamonds mark the mooring positions.

The following transects and mooring stations were worked during the cruise:

1. ScanFish transect along the talweg from the Darss Sill, through Arkona Basin, Bornholm Basin, Stolpe furrow to the northern Gotland Basin.
2. Mooring maintenance of the long term mooring Gotland NE
3. ScanFish transect from the Bornholm Basin to the Darss Sill.
4. Mooring deployment at the Darss Sill
5. CTD grid in the southern Arkona Basin
6. MSS Time series station at Darss Sill

An overview of the location of CTD stations and the ScanFish transect is given in Figure 1 and 2. A station list is given in Table 2.

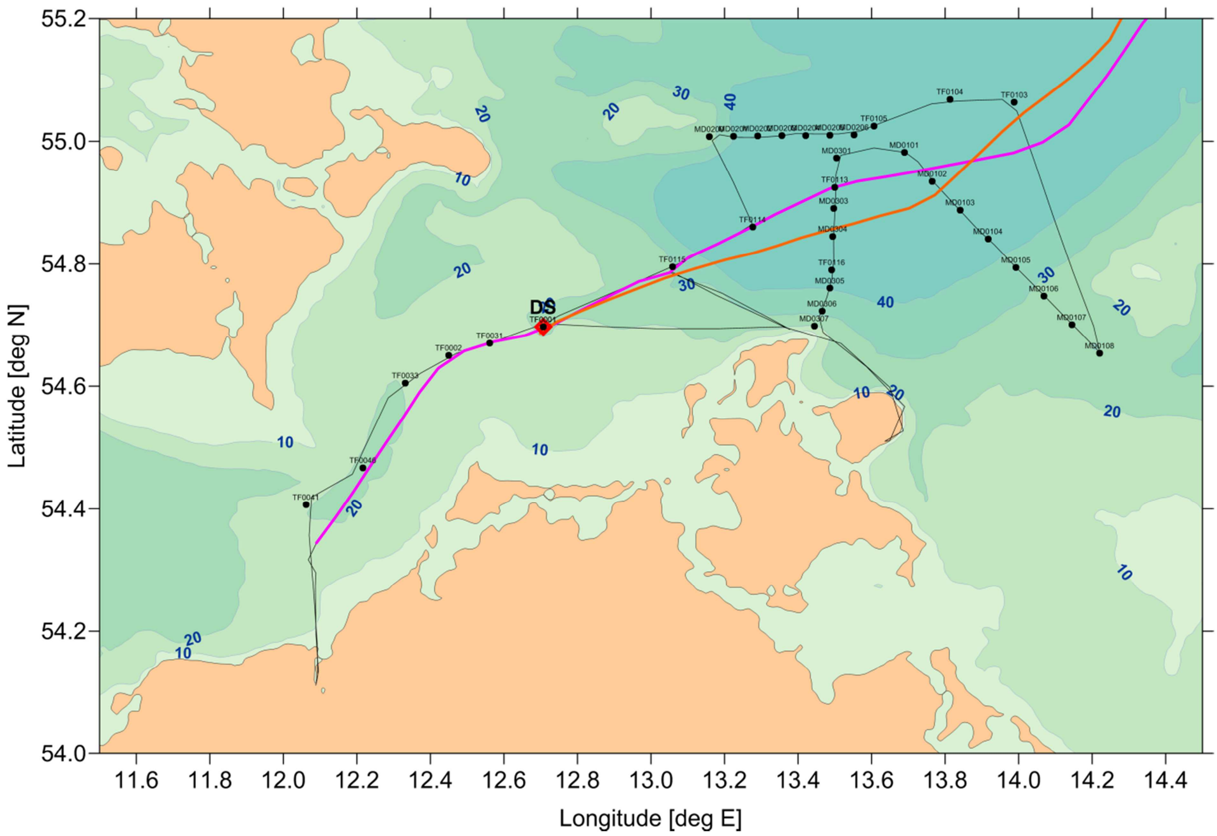

Figure 2: Detailed map of stations and ship track (black line) in the Arkona basin. Black dots and labels indicate CTD stations, the magenta and orange lines depict the ScanFish transects, red diamond mark the mooring at the Darss Sill.

Equipment

Scientific equipment:

- MSS Microstructrure Profiler
- Oceanographic mooring Gotland NE (maintenance during the cruise)
- Oceanographic mooring 54°ADCP (2 day deployment during the cruise)
- Oceanographic mooring High Resolution TS string (2 day deployment during the cruise)
- Towed CTD (ScanFish)
- Towed ADCP catamaran (TADCP)

Ship based scientific equipment:

- CTD SBE 911+ with rosette water sampler
- Vessel mounted ADCP 150kHz Ocean Surveyor (VMADCP) mounted at ship hull
- SES2000 echo sounder
- Thermosalinograph
- Ship weather station

Narrative of the cruise

Due to bad weather conditions during the cruise the initially planned program was modified. The ScanFish transect was truncated in the northern Gotland basin. The TADCP could not be deployed because of the high sea state. The planned time series station at the Stolpe Sill had to be skipped. Instead a one day time series station was worked at the Darss Sill in order to perform the test of the 54°ADCP.

Date	***Time***	***Task***
28.11.2011		Loading of scientific equipment
29.11.2011	09:00	Departure from Rostock Marienehe
	11:00	Start of ScanFish transect, the TADCP could not be used due to problems with the power supply (Darss Sill to central Arkona basin)
	17:00	Start VMADCP measurements
	19:00	Interruption of the transect due to an emergency case
	21:00	Meeting the rescue boat off Arkona
	22:45	Proceeding with ScanFish transect (eastern Arkona basin)
30.11.2011		Proceeding with ScanFish transect (Bornholmgatt to Stolpe furrow)
	21:00	Change of VMADCP configuration due to decreasing number of backscatter particles in the water column
01.12.2011		Proceeding with ScanFish transect (Solpe furrow to eastern Gotland basin)
02.12.2011		Proceeding with ScanFish transect (eastern Gotland basin)
	07:30	Interruption of SF transect for mooring maintenance
	11:00	Mooring Gotland NE successful recovered
	13:30	Mooring Gotland NE deployed, CTD station at mooring position
	15:00	Proceeding with ScanFish transect (eastern Gotland basin)
	23:40	End of ScanFish transect (eastern Gotland basin)
03.12.2011	00:30	Start CTD transect from station TF285 towards the Stolpe furrow
	01:00	Automatic winch control of CTD winch failed
	14:00	Stop of scientific work due to gale (Bft 8/9), course towards the Bornholm basin
04.12.2011		No cientific work due to gale (Bft 8/9), course towards the Bornholm basin
05.12.2011	07:00	CTD cast at station TF0213
	08:00	Start ScanFish transect towards Darss Sill
	10:30	Wind speed increased again to Bft 8/9
06.12.2011	07:20	End of ScanFish transect at the Darss Sill
	08:00	CTD station at Darss Sill
	08:40	Mooring at Darss Sill successful deployed
	09:00	Start work at Arkona Basin CTD grid
07.12.2011	08:00	End of Arkona Basin CTD grid
	10:00	Arrival at Sassnitz port, in order to refill the freshwater tanks
	11:00	Departure from Sassnitz port
	14:30	Start station work at time series station Darss Sill
	15:30	Start of MSS time series measurement
	18:30	Interruption of MSS time series due to bad current conditions (probe drifted below the ship)
	19:10	Proceeding with of MSS time series measurement
08.12.2011	10:00	End of MSS time series measurement
	10:30	Start of CTD transect towards Warnemünde
	15:15	End of CTD transect, and scientific work
	16:30	Arrival of Rostock port
	17:00	Disembarking of scientific crew
09.12.2011	08:30	Unloading scientific equipment
	12:00	End of the cruise

2. Data processing and quality assurance

For all data gathered during the cruise a device specific data processing was carried out to ensure the highest possible data quality and to estimate the residual uncertainty of each data set.

CTD

The CTD-system "SBE 911plus" (SEABIRD-ELECTRONICS, USA) was used to measure the parameters:

- Pressure
- Temperature
- Conductivity
- Oxygen concentration
- Chlorophyll-a fluorescence (683nm)
- Turbidity
- PAR

The CTD has a pumped system. Additionally the CTD-probe was equipped with a Rosette water sampler with 12 Free Flow bottles of 5l volume.
Data were monitored and stored to hard disk with Seasave Version 7. For each station a configuration file (*stationname.con*) was written which contains the complete parameter set, especially sensor coefficients used for the conversion of raw data (frequencies) to standard output format.

A CTD cast started below the sea surface with the pressure sensor usually at about 5m depth to prevent a contamination of the CTD pumping system with air bubbles. Data were collected down to the bottom. Sampling rate of the CTD probe was 24Hz. Data were displayed online to determine appropriate sampling depth and stored on a PC hard drive.
The probe sheds a large amount of water in its wake. Hence, only downcast registration was reliable. For comparison measurements oxygen samples were taken first, followed by water samples for salinity.

The CTD sensors were checked during the cruise by comparison measurements. The CTD probe consists of two temperature sensors (SN 4451 and SN 4449, calibration 26.10.2010). A correction of the first temperature sensor was determined by comparison measurements with a reference system (reversal thermometer). The observed difference was about 0 to 2.7mK. Thus, sufficient accuracy is assumed. However, the small difference between the temperature sensors was eliminated by adding an offset of 0.0017K to temperature sensor 0. For storing the data into the data base temperature sensor 0 was selected.

Salinity samples were taken approximately every second day. The samples were stored in white glass bottles and were analyzed on board. Conductivity (then salinity) of the samples was determined by means of a salinometer AUTOSAL Model 8400B (accuracy of 0.001). The salinometer was calibrated by means of standard seawater (Ocean Scientific International) Batch P148. Cell temperature was 24°C. The ambient temperature was measured between 18 and 19°C. A significant offset of both conductivity sensors (SN 2942 and SN 2936, calibrated on 26.10.2010) was observed. For the first sensor the following offset for conductivity was calculated and applied:

cond0 offset = 0.00037

The salinity standard deviation for the calculated salinity is:

Sal0 std = 0.0032

The conductivity offset of sensor 0 depicted a weak but significant temperature dependency. For storing the data into the data base conductivity sensor 0 and salinity 0 were selected.

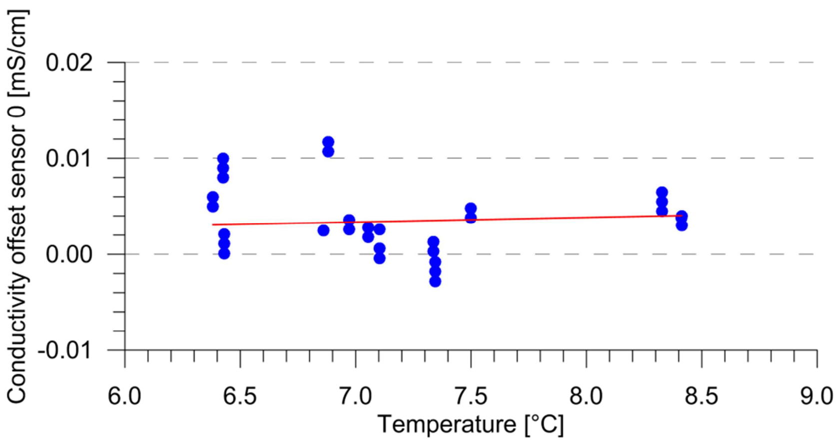

Figure 3: Temperature dependence of conductivity offset for sensor 0

The CTD probe consists of two oxygen sensors (SN 411, calibration 29.04.2011/ (13.07.2011) and SN 0644, calibration 9.06.2009). The sensitivity (slope) of the oxygen sensors SBE 43 was determined by help of water samples. Oxygen content of the samples was determined with a titration set (Winkler method, accuracy of 0.02ml/l). Reference measurements show that the measuring inaccuracy for both oxygen sensors is insignificant (< 1/1000). Therefore, no correction for oxygen data was applied.

Influence of temperature on the oxygen saturation pressure was corrected by a sensor internal thermistor network.

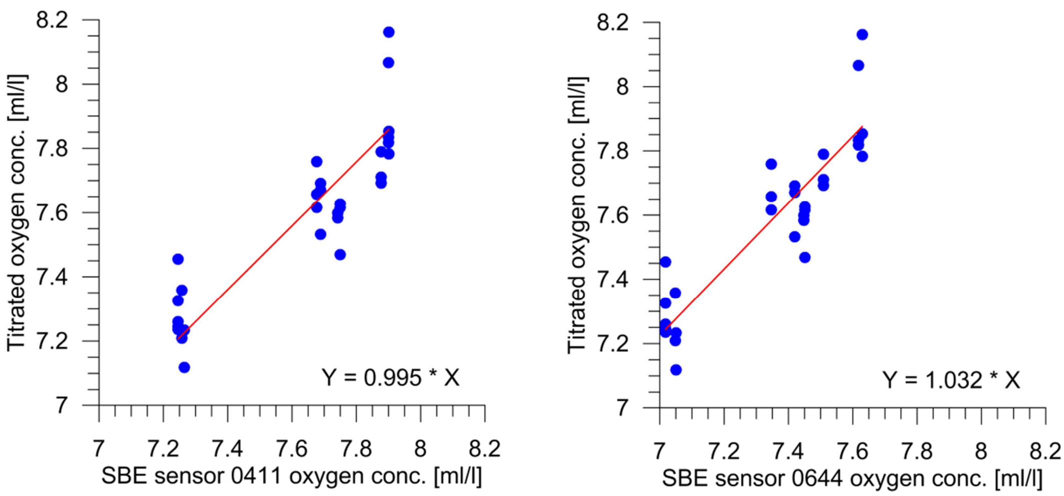

Figure 4 Comparison between unvalidated CTD sensor oxygen concentration and Winkler titration of water samples (SN 411 left panel; SN 0644 right panel).

An online precorrection of CTD pressure measurements (with Digiquartz-pressure sensor SN 100070, calibrated 16.5.2006) on air pressure was done by a default value of 1013hPa. Based on insufficient comparison measurements of air pressure (on deck registration) with air pressure values of the ships weather station, no pressure correction was performed.

Calibration measurements for the fluorometer data have not been done, since no quantitative phytoplankton analysis was performed during the cruise.

The residual errors after validation are listed for each parameter in the following table:

Sensor	***Type***	***SN***	***Applied offset***	***Residual error after calibration***
Pressure	Digiquartz	100070	-	-
Temperature 0	SBE 3	4451	+0.0017K	± 0.002K
Temperature 1	SBE 3	4449	-	Not calibrated

Conductivity 0	SBE 4	2942	-0.00037	0.0032
Conductivity 1	SBE 4	2936	-	Not calibrated
Oxygen 0	SBE 43	411	Slope 0.995	
Oxygen 1	SBE 43	0644	Slope 1.032	
Chl-a fluorescence	WET Labs	RLRT 1300	-	Not calibrated
PAR sensor	WET Labs	70101	-	Not calibrated

The final conversion of binary raw data to ascii data in physical units uses the corrected sensor coefficients. Additionally the following validation steps are applied:

- Air pressure correction of pressure sensor.
- First outlier detection and remove using a Gaussian filter.
- Second outlier detection and remove using a Median filter.
- Align CTD sensors according the flow velocity in the tube system.
- Detect loop like motions of the CTD (caused by surface waves) and cut the data taken during upward motion.
- Correct data for thermal mass of the sensor package.
- Delete not used data columns.
- Calculate derived parameters (Salinity, BVF, Dynamic height, Density).
- Average the data into 25cm depth bins.

After the standard post processing each profile was visually checked. The validated CTD data were stored in the data base of IOW.

VMADCP 150kHz

A 150kHz Acoustic Doppler Current Profiler (VMADCP) Ocean Surveyor (frequency 150 kHz, beam angle 20deg), manufactured by RDInstruments, is mounted downward looking at the ship hull. The data output of the ADCP was merged online with the corresponding navigation data derived from GPS output, and stored on the hard disc using the program VMDAS. Additionally, heading, pitch and roll information was provided by a motion reference unit. The VMADCP was operated continuously during the entire cruise. The following configurations was used for data acquisition.

Table 1: Configuration of 150kHz VMADCP

Command	***Parameter***	***Configuration 1 (depth < 100m)***	***Configuration 2 (depth > 100m)***
Data option dialog of VMDAS software Version7 was used	salinity, temperature	35, measured	
	co-ordinates	use beam co-ordinates	
	bottom track	on	
	heading source	Motion reference unit	
	navigation source	NMEA	
	time per ensemble	1s	1s
	time between pings	1s	1s
	data output	vel, corr, intensity, % good	
	blank after transmit	2m	4m
	number of depth cells	50	65
	bin length	2m	4m
	transducer depth	3.2m	
	band width	Broad band	Narrow band
	amplitude, correlation thresholds	0, 0 counts	
	sensor source	use all	
	heading alignment / heading bias	45.6 deg / 0 deg	
	short term average	60s	60s
	long term average	300s	300s
	data screening	off	

Post-processing of the VMADCP data was carried out using the Matlab® ADCP toolbox of IOW. This software was developed at the IOW and consists of high advanced validation procedures. The main steps of processing are:

- Read binary single ping raw data
- Validate navigation data and velocity reference data (bottom track)
- Clip thresholds for bad device orientation: pitch and roll, echo amplitude, beam correlation,
- Transform velocities to ENU system.
- Clip thresholds for: error velocity and vertical velocity, horizontal velocity
- Calculate target strength and acoustic backscatter cross section
- Calculate bottom range from target strength and reject side lobe range bins
- Interpolating of the single ping data to standard depth bins and average the specified number of ping data to an ensemble average
- Preliminarily plots, output of validated data

The final profiles are 60s averages of the single ping profiles. A list of collected VMADCP data is given in Table 3.

Microstructure Profiler (MSS)

The microstructure-turbulence profiler MSS 90-S (Serial number 055) is an instrument for simultaneous microstructure and precision measurements of physical parameters in marine waters. The MSS profiler was equipped with 2 velocity microstructure shear sensors (for turbulence measurements), a microstructure temperature sensor, standard CTD sensors for precision measurements, an oxygen sensor, a turbidity sensor, and a vibration control sensor.
All sensors are mounted at the measuring head of the profiler, the microstructure ones being placed about 150 mm in front of the CTD sensors. The sampling rate for all sensors was 1024 samples per second. At the time series station Dars Sill a series of subsequent profiles was gathered. The profile to profile interval ranges from 2 to 4min. The profiler was balanced with negative buoyancy, which gave it a sinking velocity of about 0.55 m/s. It was operated via a dedicated winch from the stern of FS Elisabeth Mann Borges. Disturbing effects caused by cable tension (vibrations) and the ship's movement were excluded by a slack in the cable.

The dissipation rate of turbulent kinetic energy was calculated by fitting the shear spectrum to the theoretical Nasmyth spectrum in a variable wave number range from 2 to maximum 30 cycles per meter (cpm). The low wave number cut off at 2 cpm is to eliminate contributions from low frequent tumbling motions of the profiler.

The MSS sensors were calibrated in lab three weeks before the cruise. The pressure sensor was corrected according the measured pressure at the sea surface, which was in range between 0.2 to 0.3dBar. An offset of -0.25 was applied to the original pressure coefficients.

The probe file "MSS055.prb" was used for data acquisition and processing.

Oxygen measurements can not be used due to the long response time of the sensor.
Turbidity measurements are influenced by partial reflection of the emitted light at the protection frame.

During the visual check of the profile data the following profiles with disturbed shear data or other problems were rejected.

Profile	***Comment***
022	tension on the cable, profile not useable for dissipations measurement
089	profile disturbed in the upper 5m
193	profile disturbed in the upper 7m
214	profile disturbed in the upper 6m
234	profile disturbed in the upper 8m
329	short profile, unusable
363	short profile, unusable
423	short profile, unusable

The following batch jobs were used for post processing of the MSS raw data:

shear_c_8002_8003.msb	calculation of physical values and shear from raw data
dissipation_ez1116_p001_ff.msb	calculation of derived parameters and vertical average to 0.5m bins

Moorings

Gotland Northeast (**Gotland NE**)
The mooring Gotland NE is a long term mooring operated continuously since 1999. The main purpose of this mooring is to obtain hydrographic data from the lower water column of the eastern Gotland basin in order to detect inflow events of saline water and to provide date about transient dynamic processes, that contribute to diapycnal mixing. During the cruise the mooring was recovered and redeployed on 02.12.2011.
The mooring consists of a bottom mounted Workhorse ADCP 300kHz, 3 RBR TR1060 temperature recorder, and a MicroCat thermosalinometers SBE37 (Figure 5).

Darss Sill short term mooring (**DSST**)
A second mooring was deployed at the Darss Sill as temporary replacement of the MARNET station Darss Sill, which was recovered for maintenance. Additionally, the mooring is used for a device test of a new 54°ADCP. The DSST consists of a TS string and an ADCP on a separate ground plate connected via a 50m long ground rope. Four MicroCat thermosalinometers SBE37, and four RBR TR1060 temperature recorder are mounted at one string. A fifth MicroCat thermosalinometer SBE37 and a SonTec ADP current profiler are fixed at the mounting frame of the ADCP.

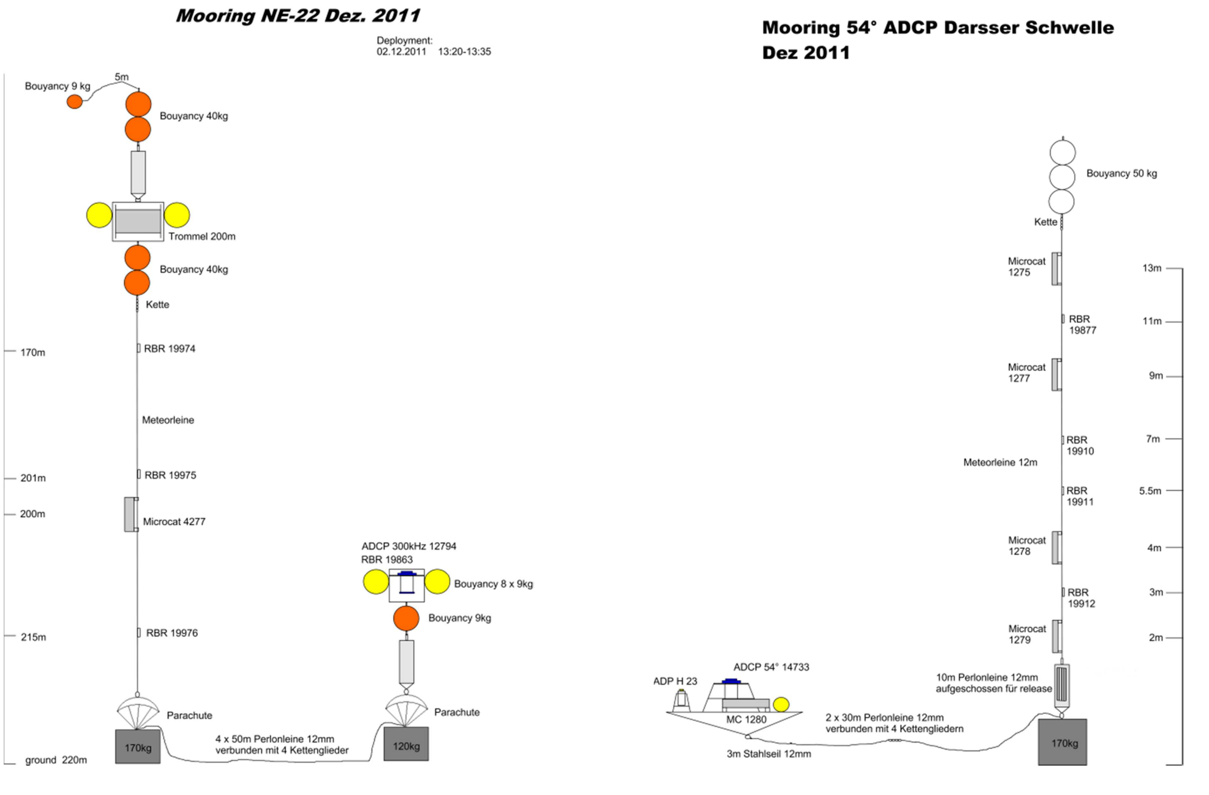

Figure 5: Sketch of the Gotland NE mooring (left) and the mooring deployed at the Darss Sill (right)

ScanFish – towed CTD

The ScanFish towed undulating (moves up- and down in water column) vehicle is designed for collecting profile data in the water column for oceanographic, bathy-metric and environmental monitoring applications.
During the survey the ScanFish was be equipped with a SeaBird CTD SBE911+. Additionally an Oxygen sensor and a fluorometer were mounted at the device. The CTD sensors of the ScanFish CTD were calibrated in the IOW calibration lab prior the cruise.
The ScanFish system comprises the following elements: control PC with ScanFish software; deck unit (PowCom); ScanFish body with controller and sensors; winch and tow cable.

TADCP – towed vessel mounted current profiler

The T-ADCP system consists of an 300kHz Broadband ADCP mounted on a sport catamaran of 5.5 m length.
In shallow waters usually applied Vessel mounted Acoustic Doppler Current Profiler (VM-ADCP) limits substantially the vertical coverage of the current measurements. The range is physically limited by the mounting depth and the side lobe range and a significant part of the profile is disturbed by the ships wave field. In order to get full depth current profiles it was planned to use a Towed ADCP system during the cruise. The main advantage of the T-ADCP is that it can measure an undisturbed flow field in the upper 10 m which is not detected by the VM-ADCP of RV Elisabeth Mann Borgese. The horizontal resolution of current measurements is usually about 50 m.
Due to bad weather conditions the TADCP could not be deployed during the entire cruise.

Thermosalinometer

During bad weather conditions, which were frequent during this cruise, the measurements of the thermosalinometer were strongly disturbed by air bubbles in the system. The position of the inlet tube is not suitable for heavy sea state. The system was switched off for longer periods to prevent problems with the pumps.

Underway measurements

The FS Elisabeth Mann-Borgese is equipped with numerous sensors, which continuously provide many important environmental parameters. This consists of weather parameters, surface water properties, navigation information, rope length, winch speed and more. The data are collected by a data acquisition system DAVIS manufactured by WERUM. All data are stored in a data base and can be extracted by a web interface. A description of all collected parameters is given in the ship specific DAVIS manual.

For on board data analysis a subset of the underway data was extracted. This data set consists of:

- time (UTC)
- latitude and longitude
- ships heading
- depth
- rope length
- air pressure, air temperature
- humidity
- global radiation, infrared radiation, PAR, TI
- Heading
- Surface conductivity
- Surface ChlA concentration, Optical backscattering NTU
- Surface salinity, surface water temperature
- Wind direction, wind speed

All data are snapshots taken and stored every second. After the cruise the full data set was extracted and delivered on hard disc.

3. Preliminary results

The results presented in the following section are preliminary, since they are based in most cases on unvalidated data! The aim of this section is to give a first impression on the collected data set. An advanced data analysis will follow after all validated data sets are available.

Meteorological conditions

The meteorological conditions during the cruise were difficult. The November 2011 was characterized by a long lasting calm and dry period of nearly four weeks duration. This month was the driest November since more than a century. The stable high pressure conditions ended just before the cruise. From 25 November onwards a series of strong low pressure systems crossed northern Europe and led to a period of strong winds and moderate precipitation.

During the first week of the cruise three pulses of strong to gale force winds from south to south west were observed. The gaps between the pulses were short. It was expected that the strong winds forced the inflow of saline water over the Darss Sill and the Øresound. The strong westerly winds were persistent for the rest of the survey (Figure 6 - Figure 8). Maximum wind speed reached about 30ms^{-1} on 5th December. Mean wind speed during the cruise varied between 12 and 20 ms^{-1}. The main wind direction was south to southwest.

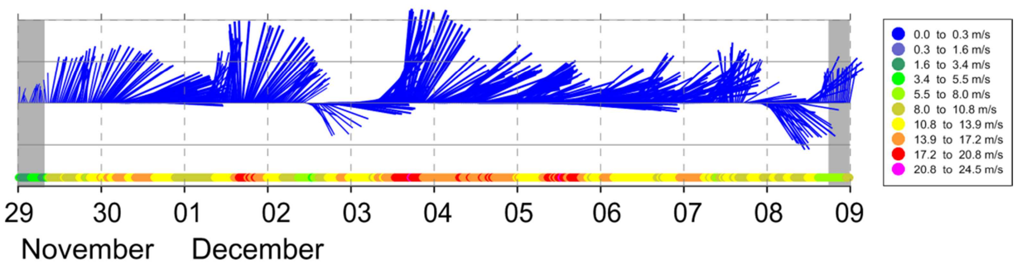

Figure 6: Stic plot of wind vector measured by the ship weather station of FS Elisabeth Mann Borgese. The gray shaded areas indicate the time in port before and after the cruise.

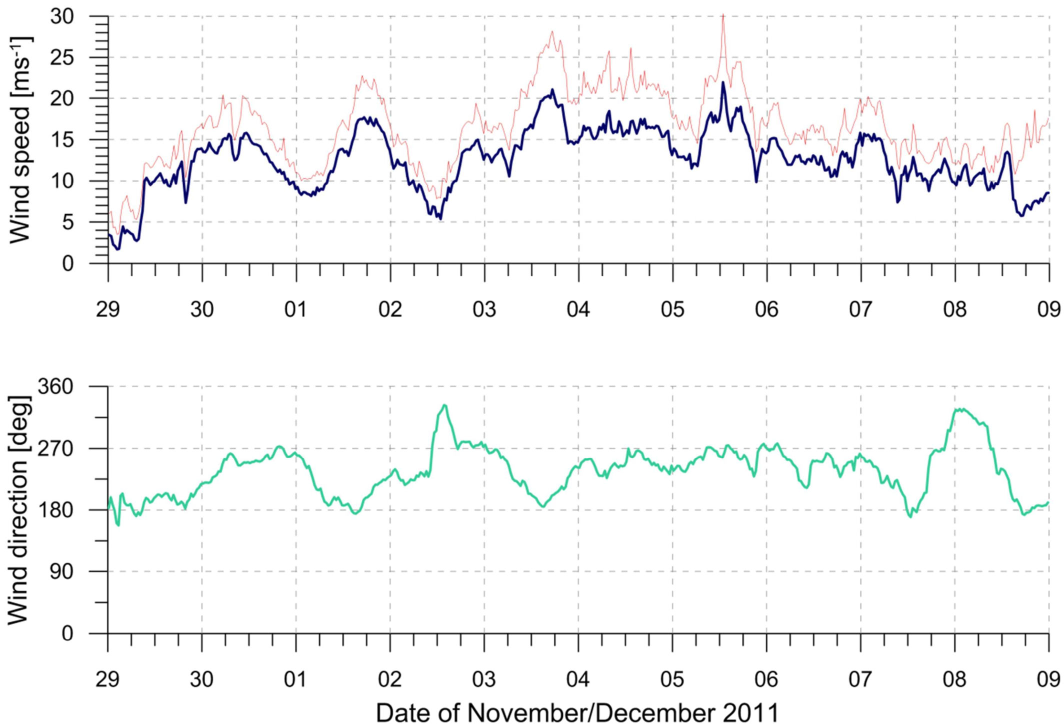

Figure 7: Mean wind speed (dark blue), maximum wind speed (red) and wind direction (green) measured by the ship weather station of FS Elisabeth Mann Borgese.

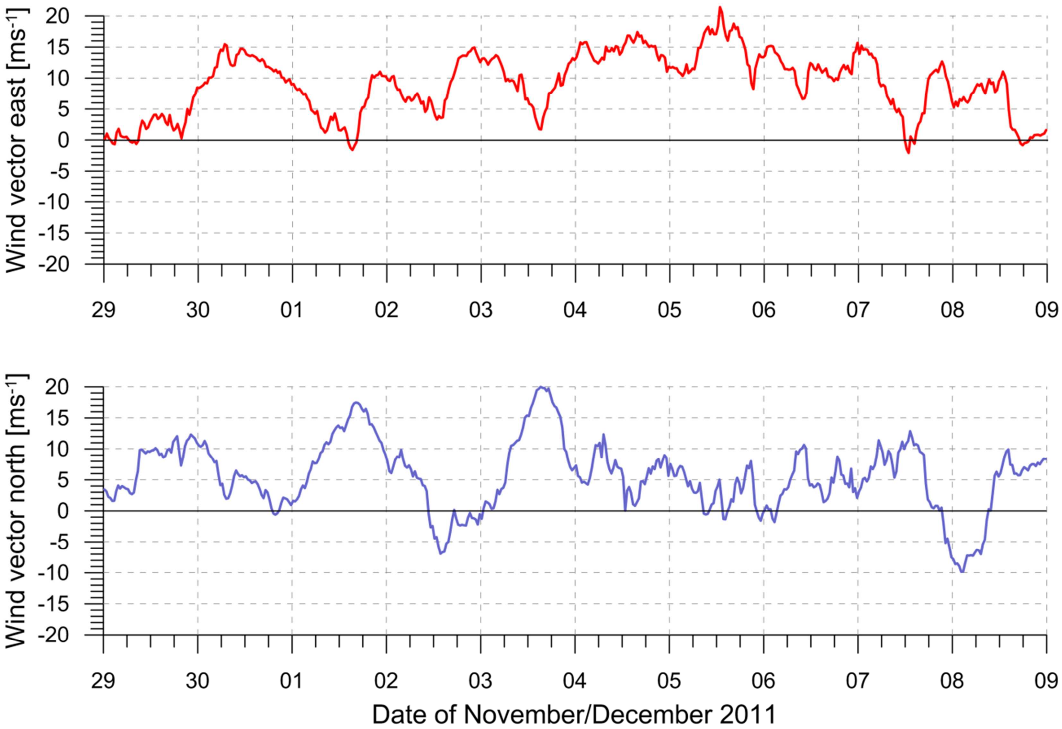

Figure 8: Wind vector east and north measured by the ship weather station of FS Elisabeth Mann Borgese.

The variations of air pressure depict the passing low pressure cells, which arrived with a frequency of about two to three days. Minimum air pressure of 982 hPa was observed on 5th December (Figure 9).

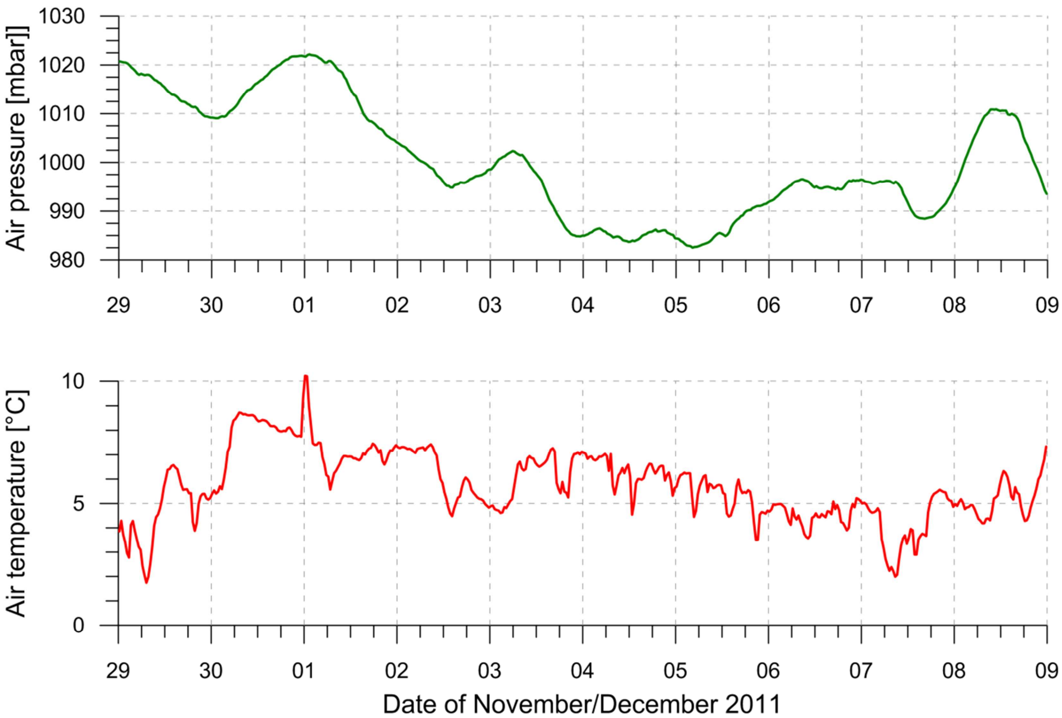

Figure 9: Air pressure and air temperature measured by the ship weather station of FS Elisabeth Mann Borgese.

The air temperature varied according the passing low pressure systems between 2 and 8°C. Due to high cloud coverage only a weak day and night cycle was observed. The humidity was relatively high, between 70% and 100% during the entire cruise.
The global radiation was strongly related to the high cloud coverage. Maximum values, at noon on days with cloud gaps, were about 200 Wm^{-2}(Figure 10).

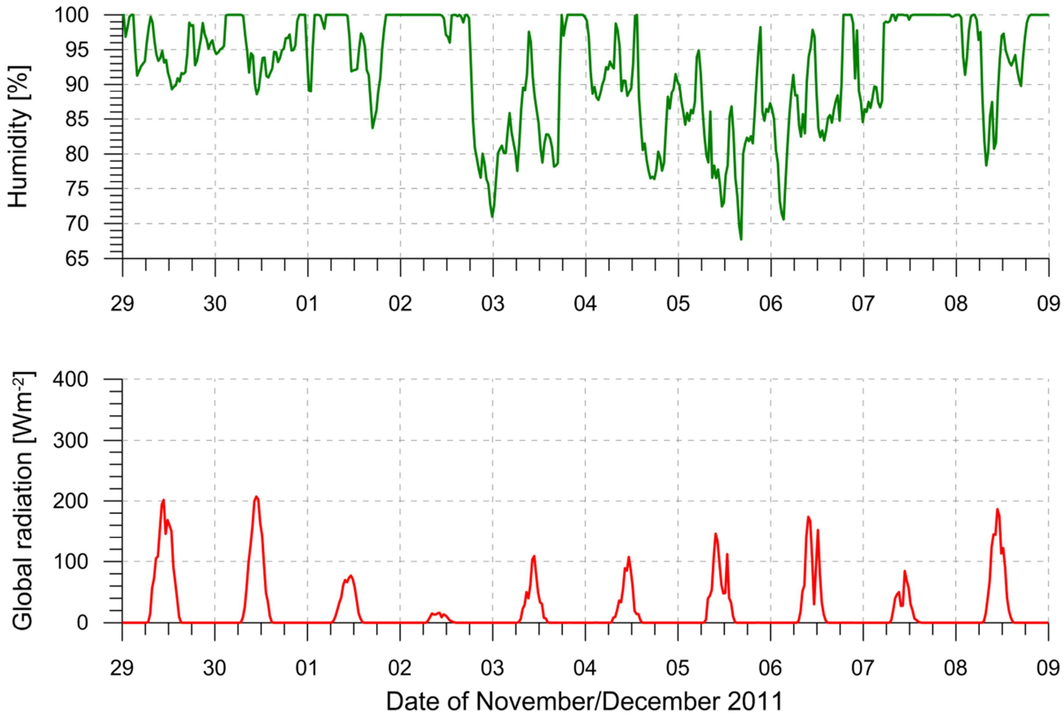

Figure 10: Humidity and global radiation measured by the ship weather station of FS Elisabeth Mann Borgese.

Sea surface conditions

Sea surface conditions were detected continuously with ship mounted sensors for temperature, conductivity, chlorophyll-a concentration and turbidity. The pumped system was not working stable. Air bubbles affected the measurements and the functioning of the pump during heavy sea state. Thus, there are large gaps in the data set.
Sea surface temperature was between 7 and 9°C, with high spatial variability. West of the Darss Sill the sea surface salinity was above 17. It decreased rapidly to 8 in the Arkona Basin and down to 7 in the eastern Gotland basin (Figure 11).
The surface chlorophyll-a concentration decreased continuously between form the western Baltic towards the Gotland basin (Figure 12).

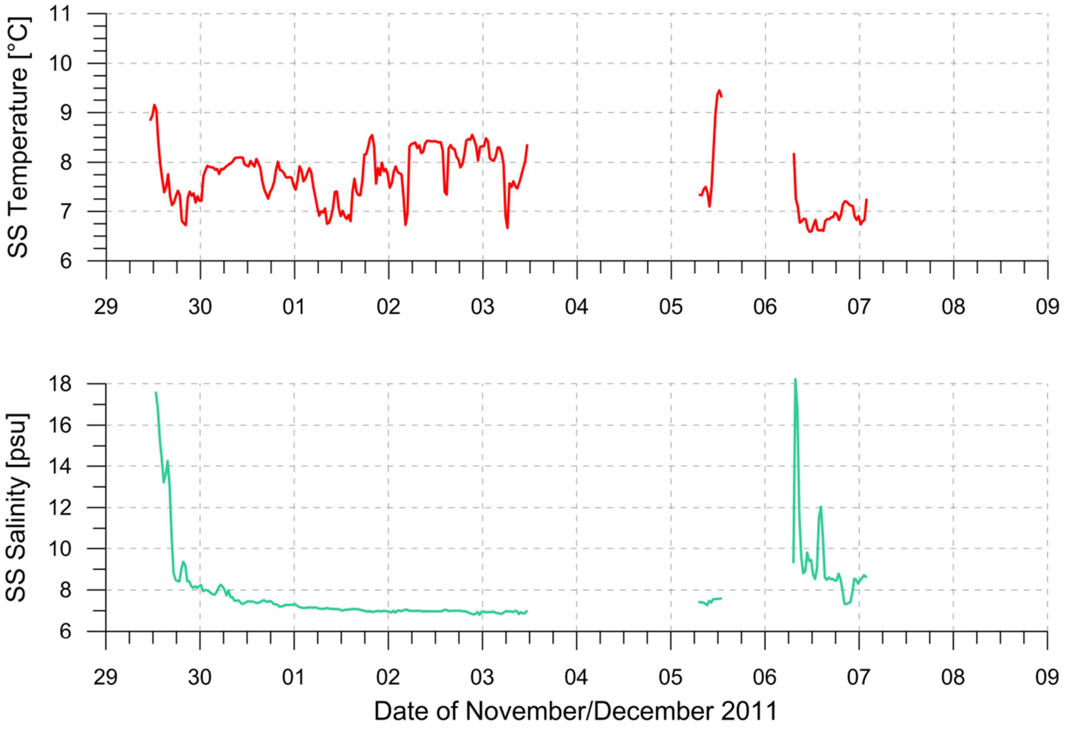

Figure 11: Sea surface temperature and salinity measured by the thermosalinograph of FS Elisabeth Mann Borgese.

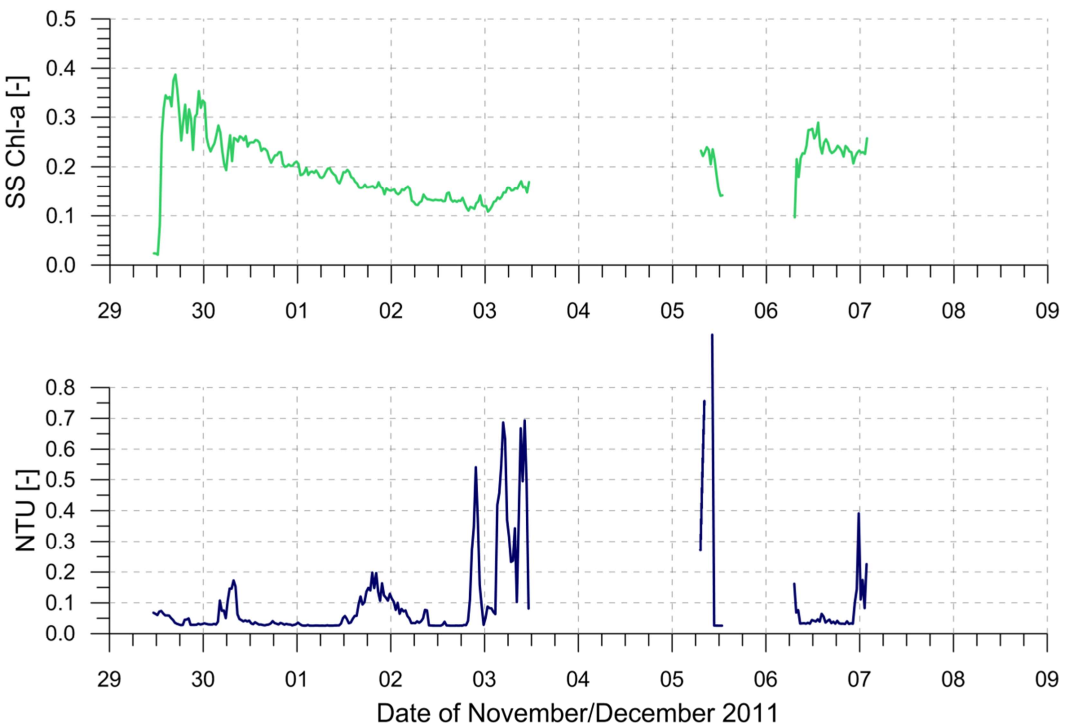

Figure 12: Sea surface chlorophyll-a and turbidity measured by the FS Elisabeth Mann Borgese.

Talweg transect with ScanFish (Baltic transect)

The talweg transect with the ScanFish from the Darss Sill to the eastern Gotland basin was measured from 29th November to 2nd December. The Transect was interrupted twice. For two hours north of Arkona, due to an emergency case and on 2nd December for maintenance of the mooring GotlandNE. The maximum depth reached with the system was 145m. This is sufficient to cover the full water depth on the major part of the transect, except the deeper parts of the eastern Gotland basin. Additional CTD casts were worked on four stations to cover the deep parts of the Gotland basin down to the bottom.
The observed patterns represent typical late autumn conditions in the Baltic (Figure 13). The seasonal thermocline deepened to depth of 45 to 65m. Only a thin layer of the old winter water was found on top of the permanent halocline. The surface mixed layer depicted a patchy structure with strong horizontal temperature gradients. The horizontal scale of the temperature patterns is about 3 to 20 km. At the bottom of the Arkona basin an inflowing dense water body is visible. Its eastern tip has reached the Bornholmgat and spreads into the halocline of the Bornholm basin.

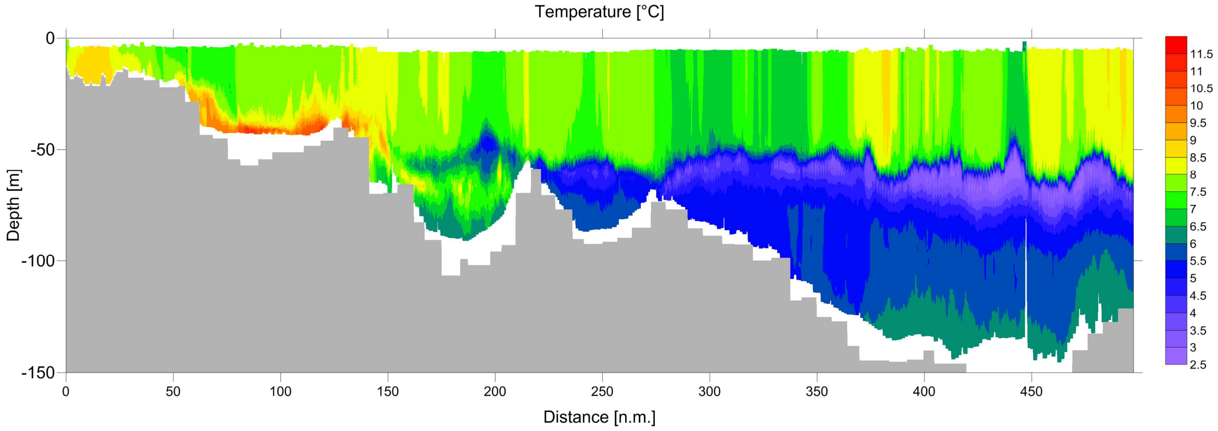

Figure 13: Distribution of temperature along the Baltic transect (29.11. - 02.12. 2011).

The salinity pattern in the western Baltic highlights the inflow activity. Along the transect highest salinity was found west of the Darss Sill (19psu). Here the water column was well mixed and vertical gradients were weak. In the Arkona basin only a thin bottom layer of 10m thickness was covered by saline water. Its TS properties were different from the patch near the Darss Sill. The higher temperature points to an inflow event in October 2011. The surface layer of the Arkona basin was covered by brackish water. Thus, at begin of the cruise the volume of inflowing water was in the order of smaller inflow events.
The depth of the main halocline increases eastward from 60m in the Born holm Basin to 70-80m in the eastern Gotland Basin.

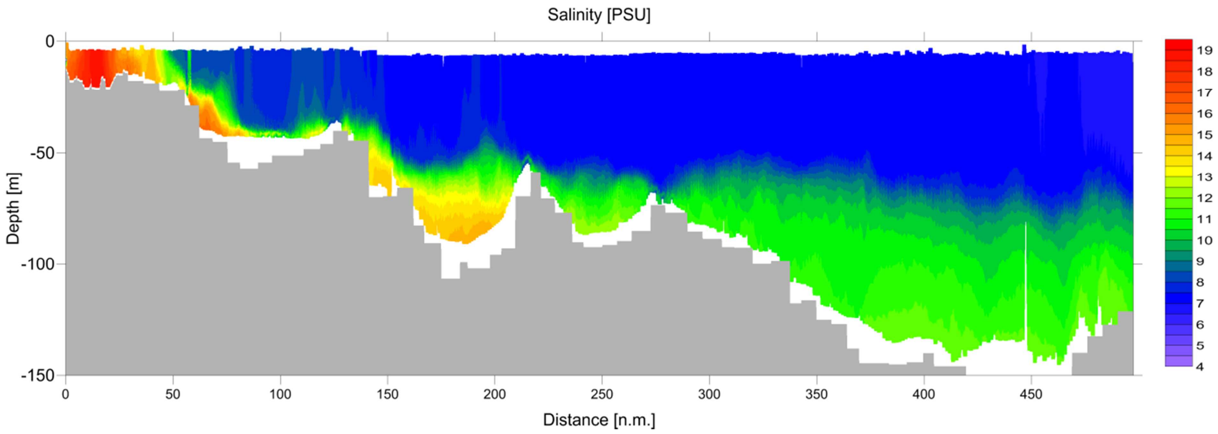

Figure 14: Distribution of salinty along the Baltic transect (29.11. - 02.12. 2011).

The oxygen distribution, gathered with the ScanFish, depict a stratification typical for a longer stagnation period in the central Baltic. The oxycline in the eastern Gotland basin was strongly correlated with the top of the halocline (Figure 15, Figure 18). Only at the southern edge of the basin a slightly increased oxygen concentration at the slope points to an inflow of hypoxic water from the Stolpe channel. There the water below the halocline is characterized by a low oxygen concentration of about 1 to 2.5 ml/l. This water originates from

the halocline of the Bornholm basin. The temperatures indicate that the major part of the Stolpe channel deep water was present since last winter and spring.
The bottom layer of the Bornholm Basin was anoxic.

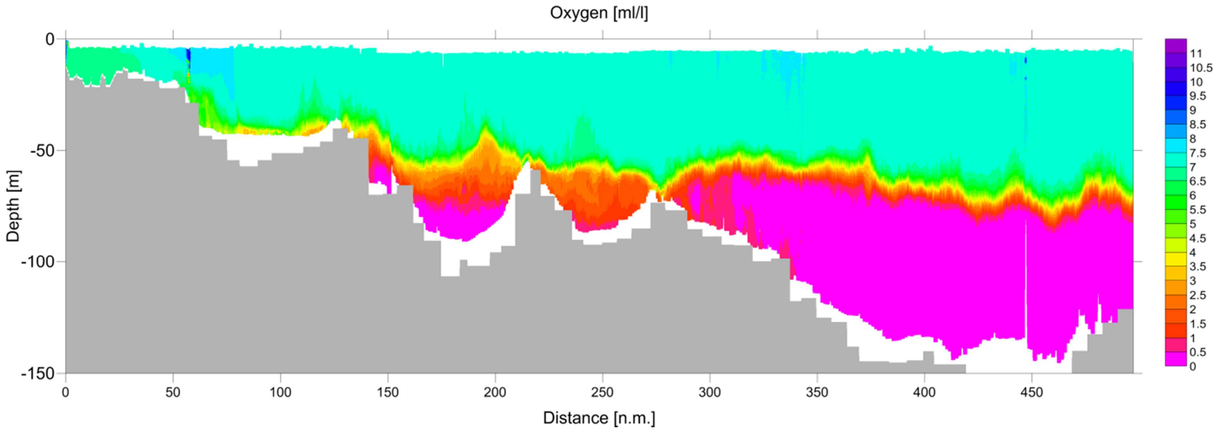

Figure 15: Distribution of oxygen concentration along the Baltic transect (29.11. - 02.12. 2011).

The chlorophyll-a fluorescence was low and decreased along the transect from the western Baltic towards the eastern Gotland Basin. The signal in the upper layer above the thermocline was vertically uniform. Below the thermocline the chlorophyll-a fluorescence signal was weak.

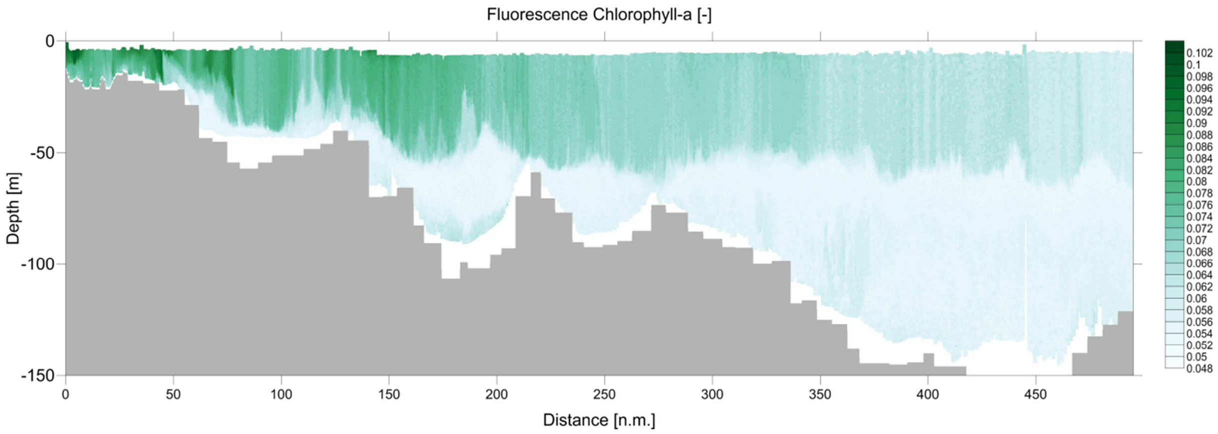

Figure 16: Distribution of chlorophyll-a fluorescence along the Baltic transect (29.11. - 02.12. 2011).

The backscatter signal is dominated by the high values below the thermocline. The strong patches in the Gotland basin may be caused by intrusion of saline water from former small inflow events. In the upper layer the backscatter signal depicted a decreasing amplitude from the western Baltic towards the eastern Gotland Basin (Figure 17).

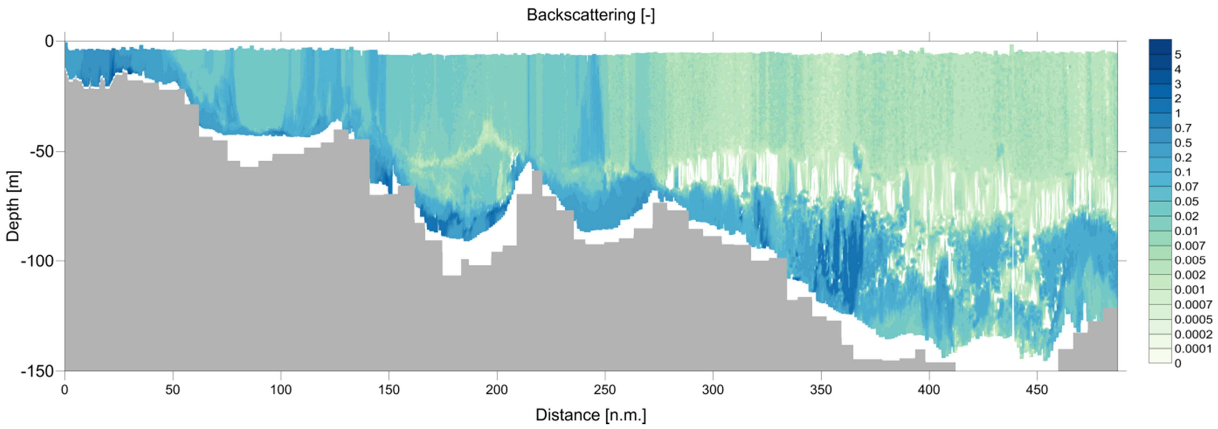

Figure 17: Distribution of optical backscatter (turbidity) along the Baltic transect (29.11. - 02.12. 2011).

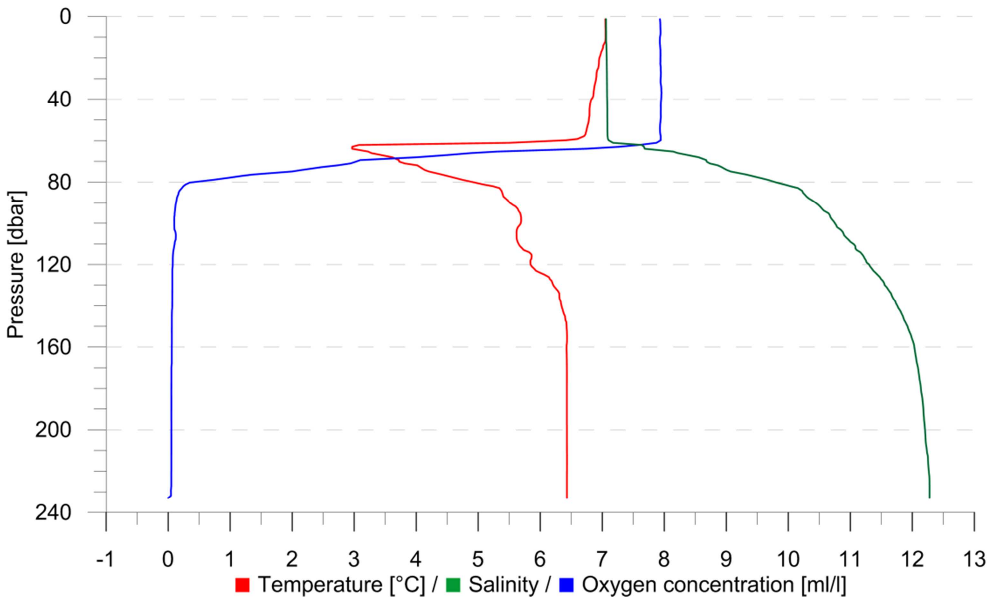

Figure 18: Vertical profile of temperature, salinity and oxygen concentration at TF271 in the eastern Gotland basin, derived from CTD measurements.

The western part of talweg transect was repeated after a week to cover the temporal development of the expected inflow event. Due to the gale force winds a new saline water mass has entered the western Arkona basin via the Darss Sill and the Øresound. This water was colder than the previous inflow and well ventilated. The older saline bottom water was shifted eastward. A greater fraction of this water body has passed the Bornholmgat and spreads along the halocline into the Bornholm Basin (Figure 19).

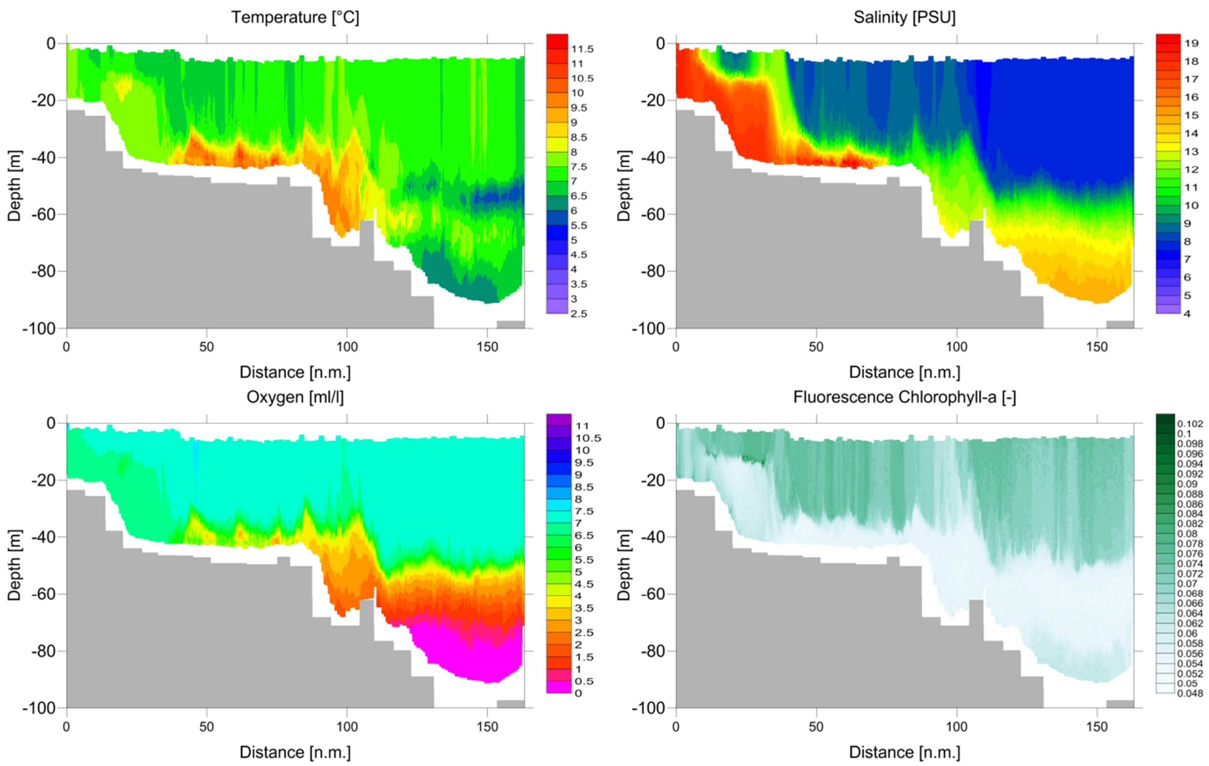

Figure 19: Distribution of temperature, salinity, oxygen concentration and optical backscatter (turbidity) along the western Baltic transect (05. - 06.12. 2011).

The development of the particular water masses properties is shown in the TSO- diagrams of both transects (Figure 20 and Figure 21). The capital letters indicate the following water bodies:

A - Inflow from the Kattegat, passing Darss Sill end of October 2011
B - Inflow from the Kattegat, detected at Darss Sill on 16.11.2011
C - Inflow from the Kattegat, passing Darss Sill around 29.11.2011
D - Arkona basin surface water
E - Bornholm basin bottom water
F – Bornholm basin halocline water and Stolpe furrow bottom water
G – Gotland basin deep water
H – Intermediate winter water of central Baltic
I – Central Baltic surface water
K - Inflow from the Kattegat, passing Darss Sill/ Øresound after 30.11.2011
L - Intermediate winter water of Bornholm basin

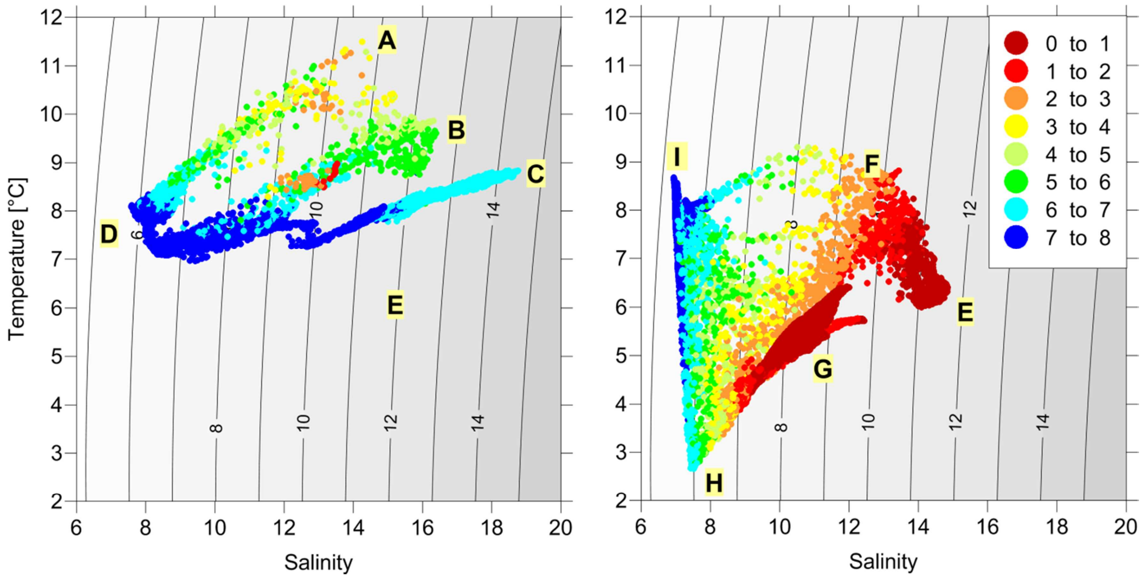

Figure 20: TSO-diagram of the ScanFish transect (29.11. - 02.12. 2011). Western Baltic up to the Bornholmgat (left panel) and central Baltic (right panel). The oxygen concentration [ml/l] is color coded.

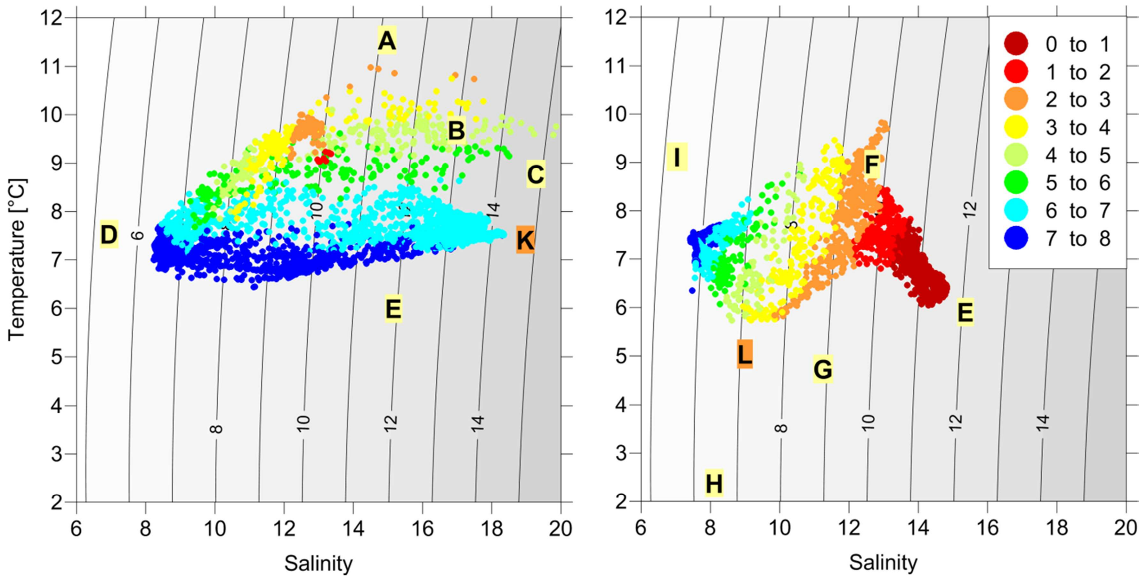

Figure 21: TSO-diagram of the ScanFish transect (05. - 06.12. 2011). Western Baltic up to the Bornholmgat (left panel) and Bornholm basin (right panel). The oxygen concentration [ml/l] is color coded.

Tle left panel of Figure 20 depict the TS-properties at the Darss Sill and the Arkona Basin at 29./30. November 2001. Water masses from three distinct inflow events can be identified. The temporal sequence is defined by the decreasing temperature during autumn. Water from event A has the highest temperature, but only a salinity of 12 to 13. Also its oxygen concentration is low. The corresponding inflow event was detected at the MARNET station Darss Sill from 31st October to 04th November. Another inflow event occurs mid of November. Unfortunately, the Darss Sill station stopped its operation on 18th November. Thus, only the start of the event (B) was covered with the time series data. The third saline water mass (C) was detected at the ScanFish transect west of the Darss Sill.

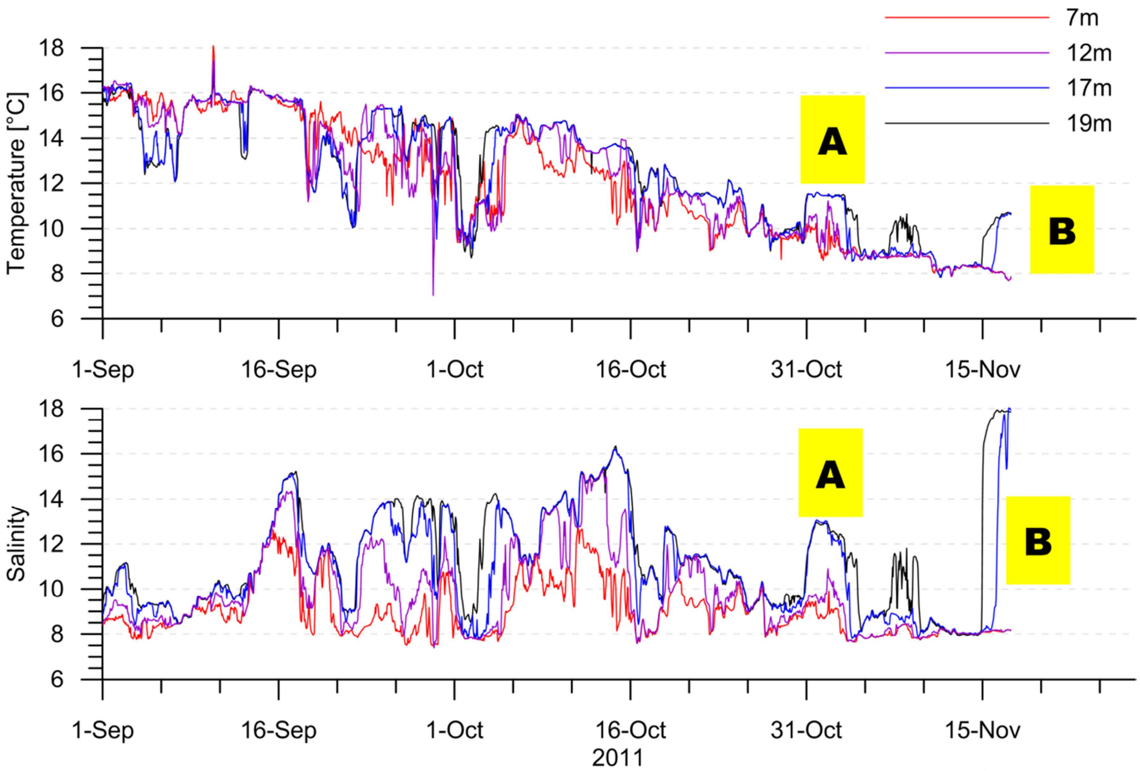

Figure 22: Time series temperature and salinity at MARNET station Darss Sill from 1st September to 19th November 2011. Two inflow events are indicated by capital letters.

Seven days later the TSO properties in the Arkona Sea have changed significantly. The mixing due to strong wind forcing smeared out the former clear structure. Traces of the inflow events A and B were present already, whereas the water body C vanished. In the TSO diagram a water mass K appeared that originates from the active inflow via the Darss Sill and the Øresound. Possibly former water mass C changed its temperature due to surface cooling and was mixed up with K.

The TS properties of Bornholm Basin and central Baltic water masses are depict the typical conditions. The densest water was found at the bottom of the Bornholm basin (E). The halocline water of the Bornholm basin (F) forms also the deep water in the Stolpe cannel. Further distinct water bodies are the Central Baltic surface water (I), the intermediate winter water (H) and the Gotland basin deep water (G). Both, the Bornholm basin bottom water and the Gotland basin deep water are anoxic. In the Bornholm basin first traces of inflowing saline water from the Arkona Basin are visible above the patch of halocline water (F).

Arkona Basin

Detailed information of the spatial structure of inflowing saline water in the Arkona Basin was obtained on two additional CTD transects. Together with the two ScanFish transects they supply a more comprehensive picture for the plume structure in the southern Arkona Basin. The ScanFish transects highlight the temporal development of the inflow between 29th November and 6th December 2011 (Figure 23). On 29th November the Arkona Basin is filled with a thin layer (5-10m) of saline water from the inflow event end of October (A). The salinity is relatively low about 14. The tip of the plume has passed the Bornholmgat and spread into the halocline layer of the Bornholm Basin. Here it advects east ward along the halocline. In the observed current velocities this water mass correlates with the band of strong eastward current in depth of 70 to 80m (Figure

24). In the western Arkona Basin the inflow waters from 16th November (B) covering the lower 20m of the water column. This water mass had a slightly lower temperature and a higher salinity than the previous inflow.

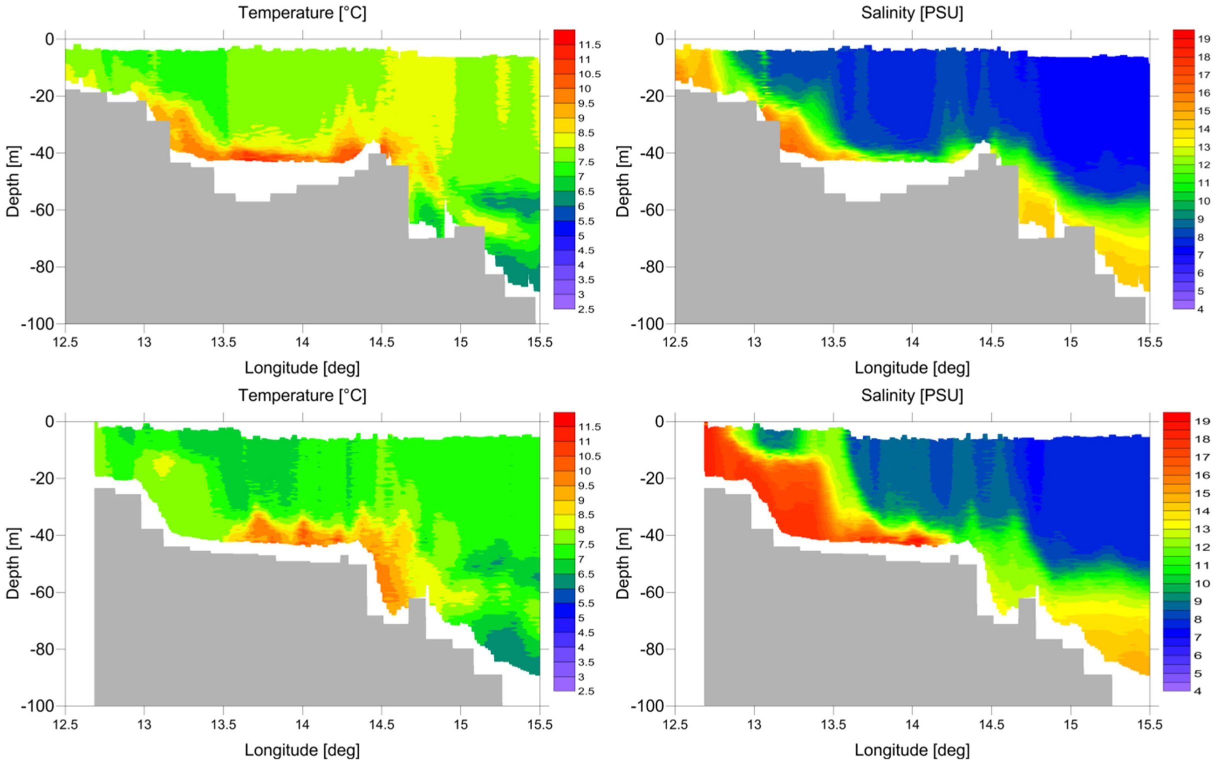

Figure 23: Temperature and salinity distribution along the ScanFish transects on 29th November (upper panels) and on 6th December (lower panels).

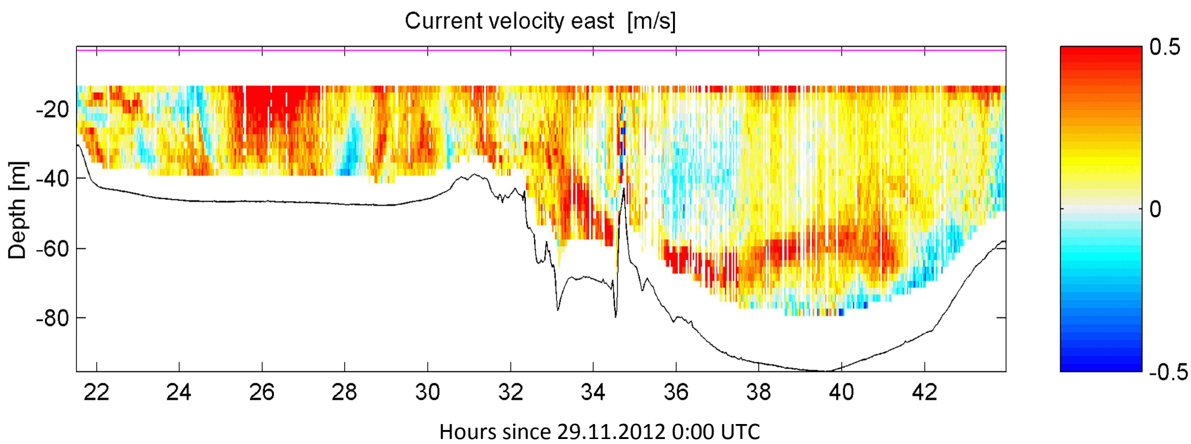

Figure 24: Current velocity east in the Arkona Basin and Bornholm Basin during the first ScanFish transect.

One week later water of this inflow was moved to the eastern Arkona Basin. Due to the gale force winds a third inflow event (C, K) occurred between the 30th November and the 6th December. Waters of this inflow filled the western Arkona Basin between 15m depth and the bottom. The salinity of this water was about 19, temperatures ranged between 7.5 and 8.5°C. The new saline water mass has entered the western Arkona basin via the Darss Sill and the Øresound. This water was colder than the previous inflow and well ventilated. The CTD Transects in the southern Arona Basin revealed the spatial distribution of this inflow water body. Along the northward transect off Arkona the halocline was found at approximately 25m depth. Towards the center of the basin the halocline slopes down to 30m depth. Waters below the halocline had a salinity higher than 16 (Figure 25).

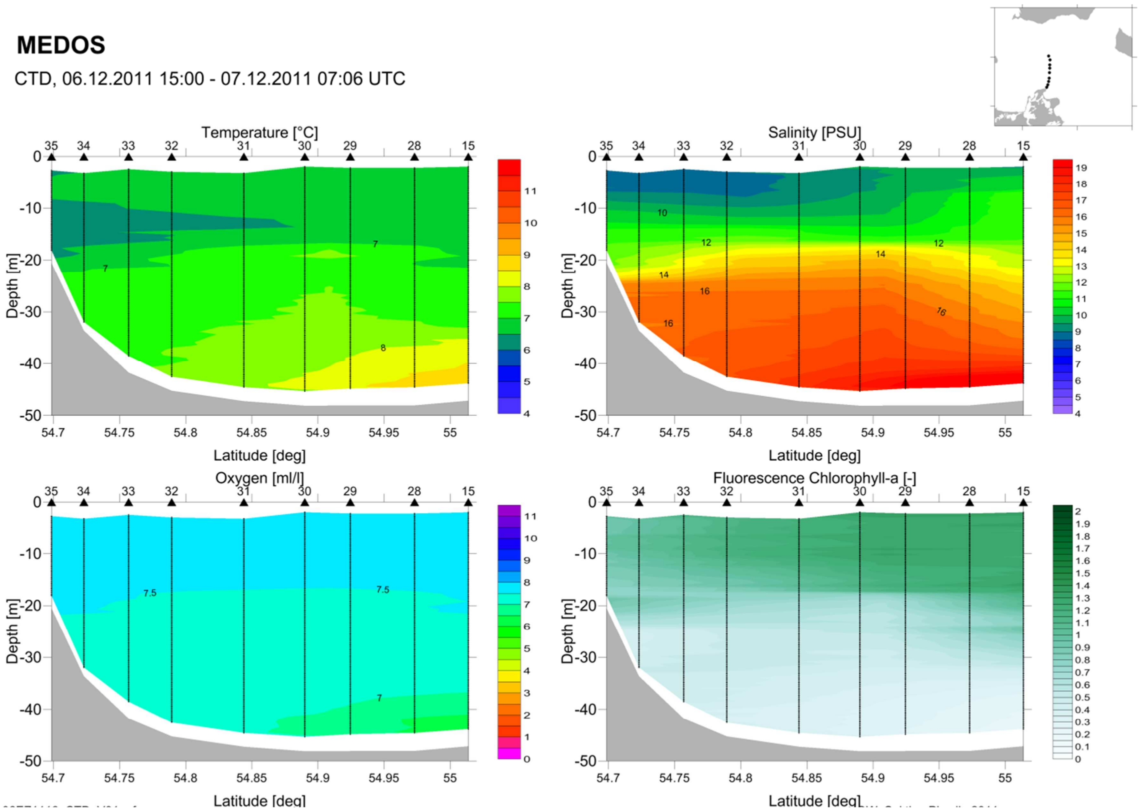

Figure 25: Vertical distribution of temperature, salinity, oxygen concentration and Chl-a fluorescence along the northward CTD transect off Arkona.

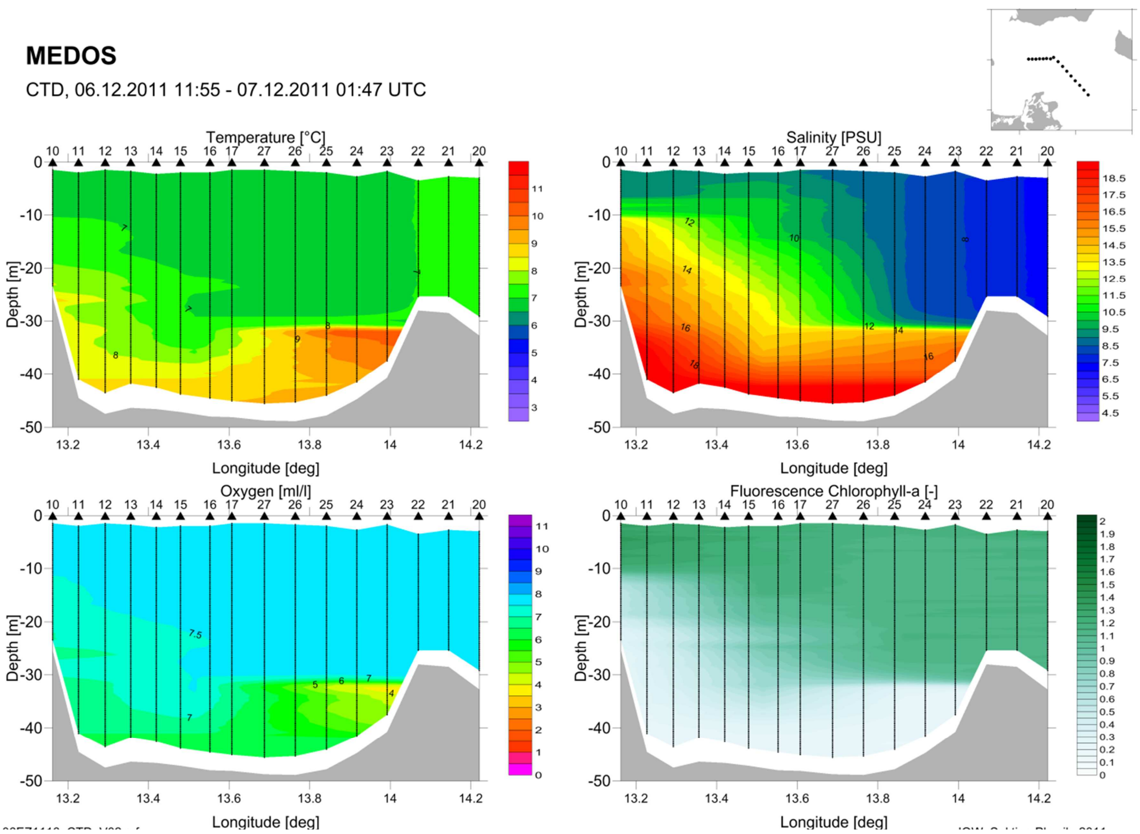

Figure 26: Vertical distribution of temperature, salinity, oxygen concentration and Chl-a fluorescence along the west-east CTD transect in the central Arkona Basin.

The second CTD transect was measured along a line from Kriegers Flak in the west towards the center of the basin, and then turning to the south eastern slope of the basin. Between Kriegers Flak and the basin center the halocline slopes down from 15m to 30m (Figure 26). In this part the deep water is formed from the recent inflow between the 30th November and the 6th December, characterized by low temperatures and high oxygen concentration. In the southeastern part of the basin the halocline is very sharp and nearly horizontally aligned. The water below the halocline (30m depth) depicted a higher temperature (9…10°C) and lower oxygen content. The TS signature of this water body points to the inflow event at 16.11.2011 (event B) as source.

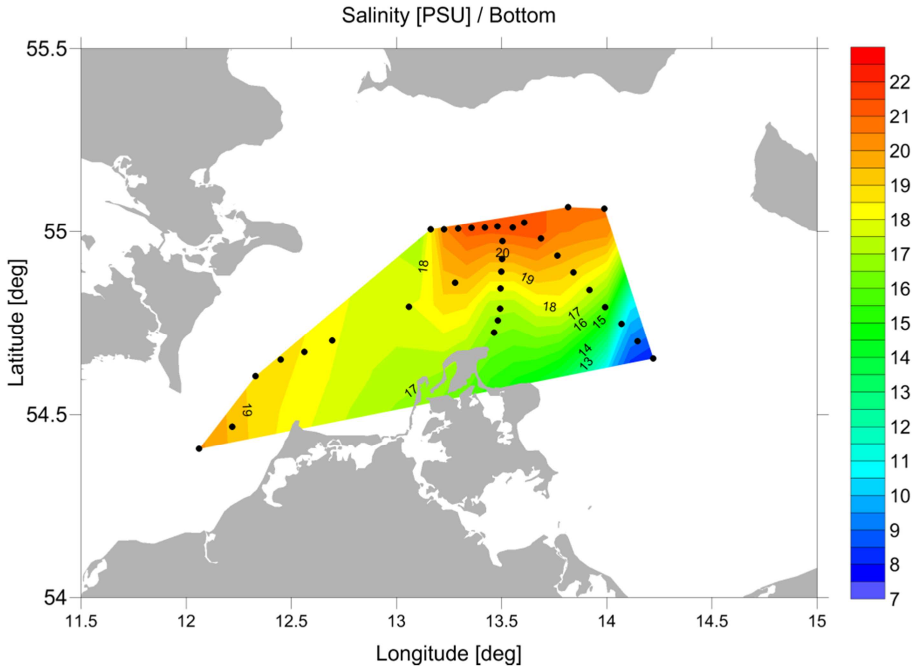

Figure 27: Horizontal distribution of salinity at the bottom of the southern Arkona basin

Close to the bottom the central Arkona basin is covered by high saline water with a maximum salinity of 22 (Figure 27). This water originates from the Øresound. However, with the gathered data the inflow time cannot be estimated.
First raw estimates result in an inflow volume of 30 to 60km³ of saline water (salinity higher than 14psu) for the period from 16.11. to 07.12. 2011.

Time series station at the Darss Sill

At the Darss Sill a time series station was performed in order to observe the short term fluctuations in the stratification at the Sill and to gather a data set for the validation of the 54°ADCP mooring.
The MSS time series cover a period of 19.5 hours from 7th December 2012 14:30 to 8th December 2012 09:00 UTC. The profiling was carried out as fast as possible. In total 597 profiles were gathered with a profiling frequency of about 2 minutes. On 7th Dec. the time series was interrupted between 17:23 and 18:14 due to bad deployment conditions (danger that the probe may drift under the ship).
The data were compiled using the software package MSSpro, provided by the manufacturer of the MSS probe.

The temporal variation in stratification is depicted in the time series of density anomaly. It combines the effect of temperature and salinity. The density time series showed four phases of different stratification pattern (Figure 28), which were related to the changes in temperature and salinity (not shown). The first phase, until the gap in the data, was characterized by moderate, but decreasing stratification. There the strongest vertical density gradient was observed between 8 and 12 m depth, and during the first hour of the time series at the bottom. During the second phase until 21:40 the stratification throughout the water column is very weak. At this time the current changed from north westerly to south easterly direction in the layer below 15 m depth (Figure 31). During the next the eastward current increased and the stratification is building up again. Now two distinct layers of high density gradients are observed. The shallower one at 5 to 6m depth was caused by a thin layer of fresher surface water. The deeper gradient layer at about 15m depth is established due to saline bottom waters.

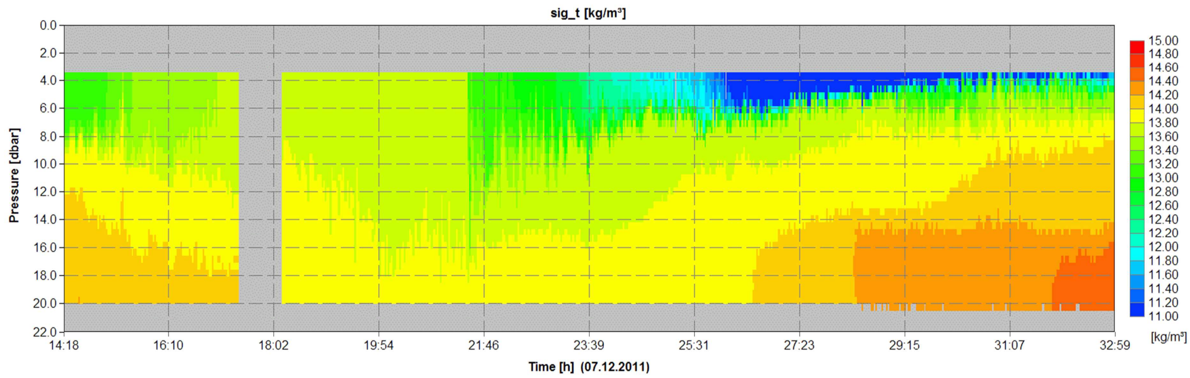

Figure 28: Time series of density anomaly at the station Darss Sill gathered with the MSS profiler (7th/8th December 2011).

The change in stratification is also depicted in the time series plot of the Brunt Vaisälä frequency (Figure 29).

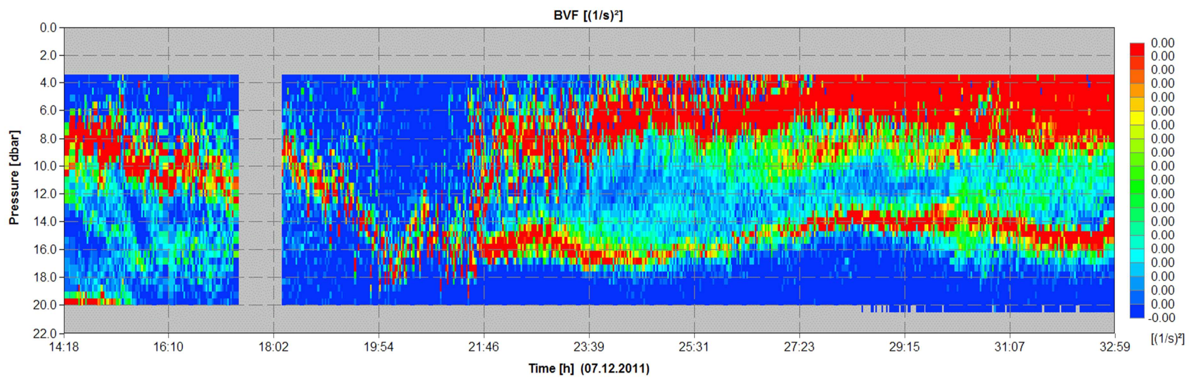

Figure 29: Time series of Brunt Väisälä frequency at the station Darss Sill gathered with the MSS profiler (7th/8th December 2011).

Figure 30 depict the distribution of TKE dissipation. Turbulence is generated at the surface by the action of wind and breaking waves and in the bottom boundary layer due to shear stress. The vertical spreading of TKE is hampered by stratification. Thus, at the beginning and during the second half of the time series a shadow zone for TKE dissipation is observed in mid water, enclosed by the density gradient layers. During the period of weak stratification in the second phase the TKE dissipation is at a high level in the entire water column.

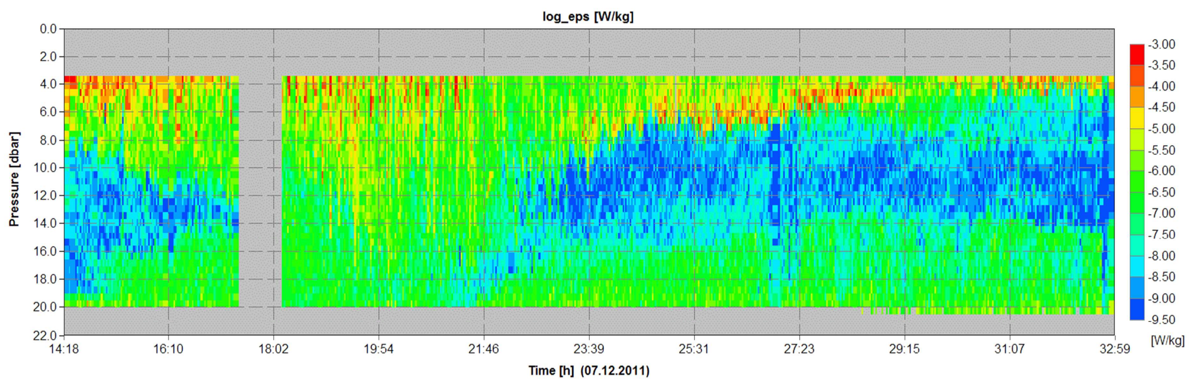

Figure 30: Time series of TKE dissipation rate at the station Darss Sill gathered with the MSS profiler (7th/8th December 2011).

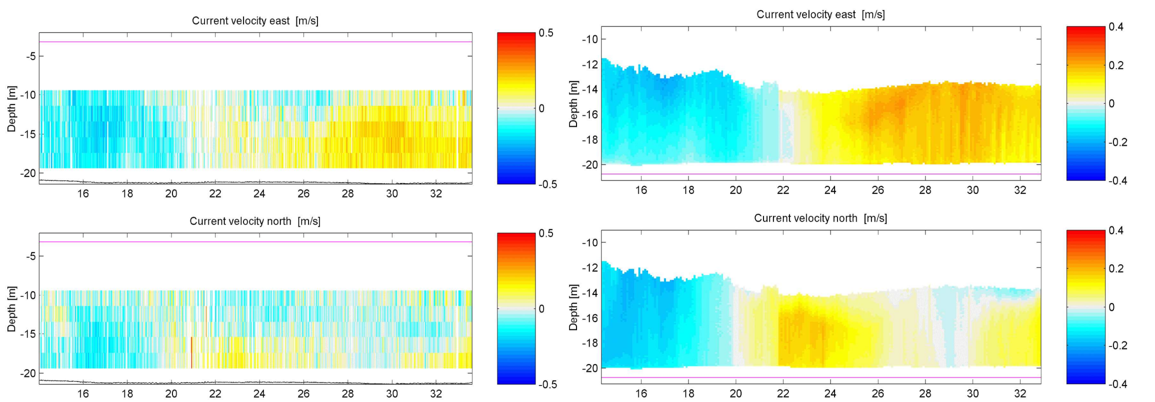

Figure 31: Current velocity at the Darss Sill during the time series measurements. Vessel mounted ADCP data (left) are biased to some amount by the ship in contrast to the undisturbed data from the 54°ADCP (right). The different color and depth scales have to be considered.

Long term mooring Gotland NE

The long term mooring Gotland NE revealed time series of temperature, currents and acoustic backscatter from the bottom layer covering the depth range of 170 to 217m. The purpose of the long term deployment is the detection of inflowing saline waters into the Gotland basin, and the observation of transient processes on shorter time scales. Thus, all instruments were configured to sample with maximum temporal resolution (ADCP 30min, temperature sensors 60s).

During the entire deployment period the temperature fluctuations were very weak. This indicates stagnant conditions with no inflows in the deep layers of the basin. Only a weak decreasing trend in temperature was observed (Figure 32).

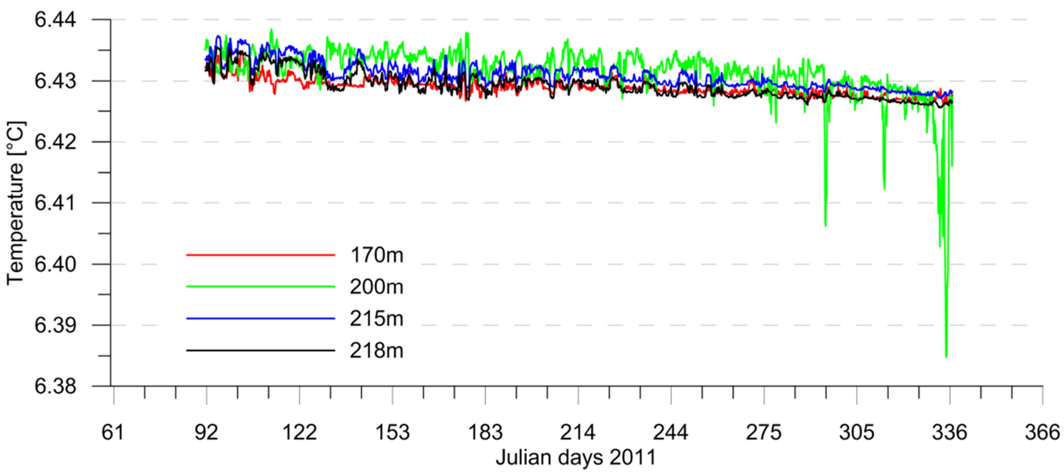

Figure 32: Temperature at different depth at the mooring position Gotland NE.

The current signal is dominated by two main components. Temporal current variations with a time scale of 2 to 5 days are caused by atmospheric forcing at the sea surface (Figure 33). Due to the low concentration of backscattering particles the data between 80 and 110m depth are strongly biased.
Short term fluctuations in current velocity are mainly caused by internal waves. Wave periods are in the order of inertial frequency. An example for these waves is given in Figure 34. This figure shows a fifteen days section of the current time series (Figure 34). The current velocities, associated with the internal waves, were about 10 cm s^{-1}. The observed patterns show an upward directed phase velocity.

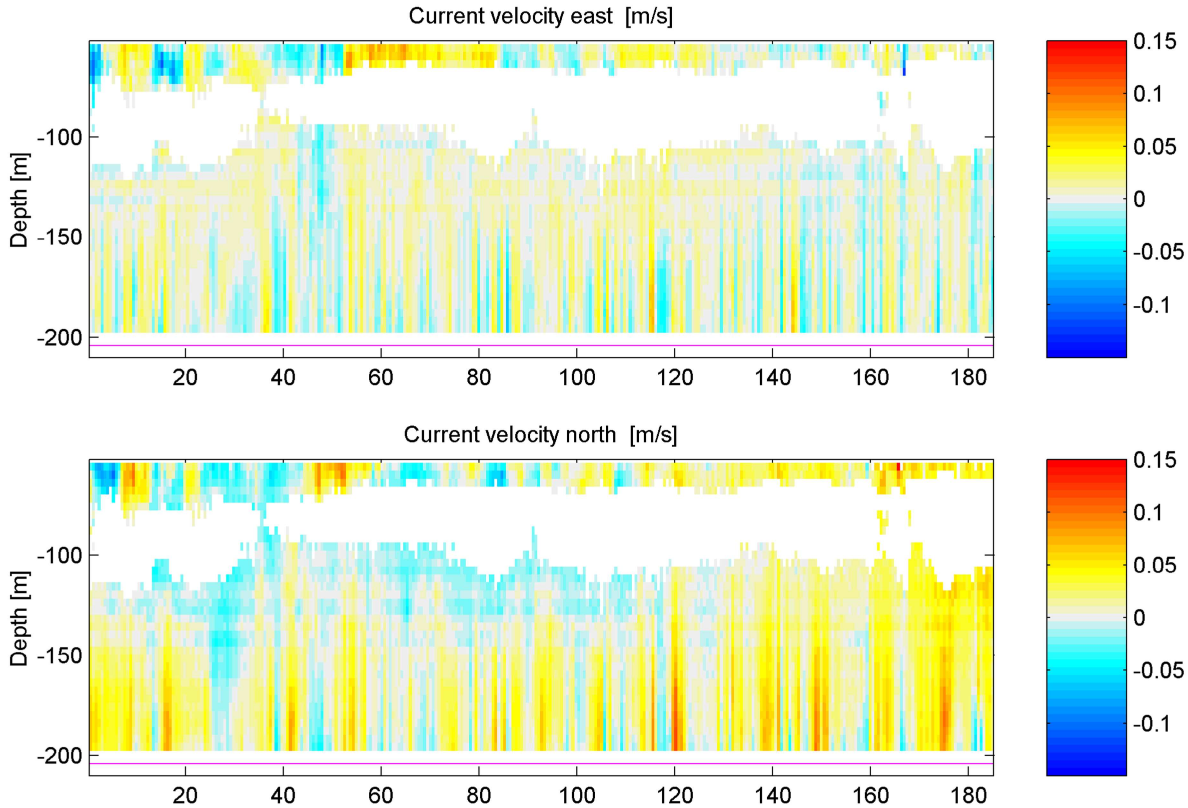

Figure 33: Time series of current measurements at the mooring position Gotland NE (01 April – 03 October 2011). The data are averaged over the inertial period (14 hours).

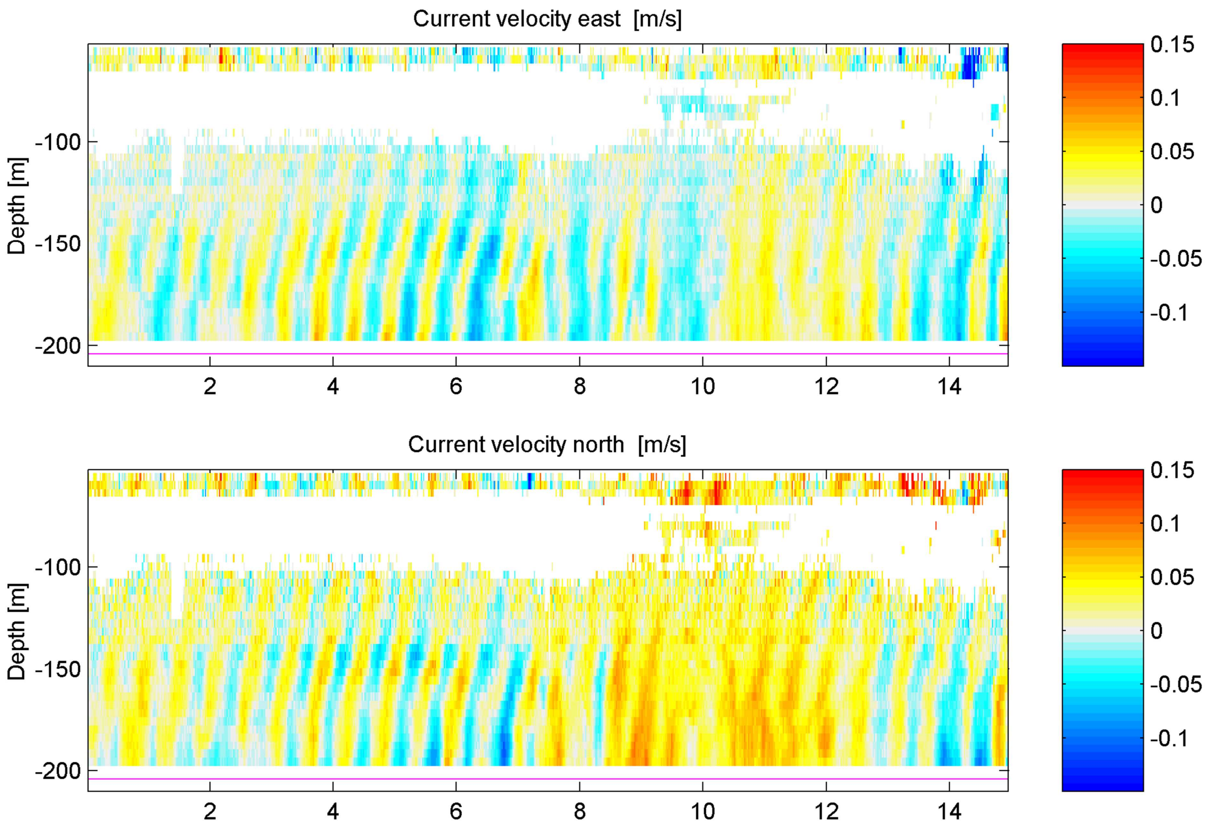

Figure 34: Fifteen days section of current velocity at the long term mooring Gotland NE (01. – 15. September 2011).

Short term mooring Darss Sill

The DSST consists of a TS string and an ADCP on a separate ground plate connected via a 50m long ground rope. Four MicroCat thermosalinometers SBE37, and four RBR TR1060 temperature recorder were mounted at one string. A fifth MicroCat thermosalinometer SBE37 and a SonTec ADP current profiler are fixed at the mounting frame of the ADCP.

The mooring was deployed on 6th December 2011 and successful recovered on 27th January 2012 during a MARMET maintenance cruise. With exception of the ADP, all devices worked properly. However the results in this section are preliminary, since the final data validation is not finished.

Stratification (Temperature and Salinity)

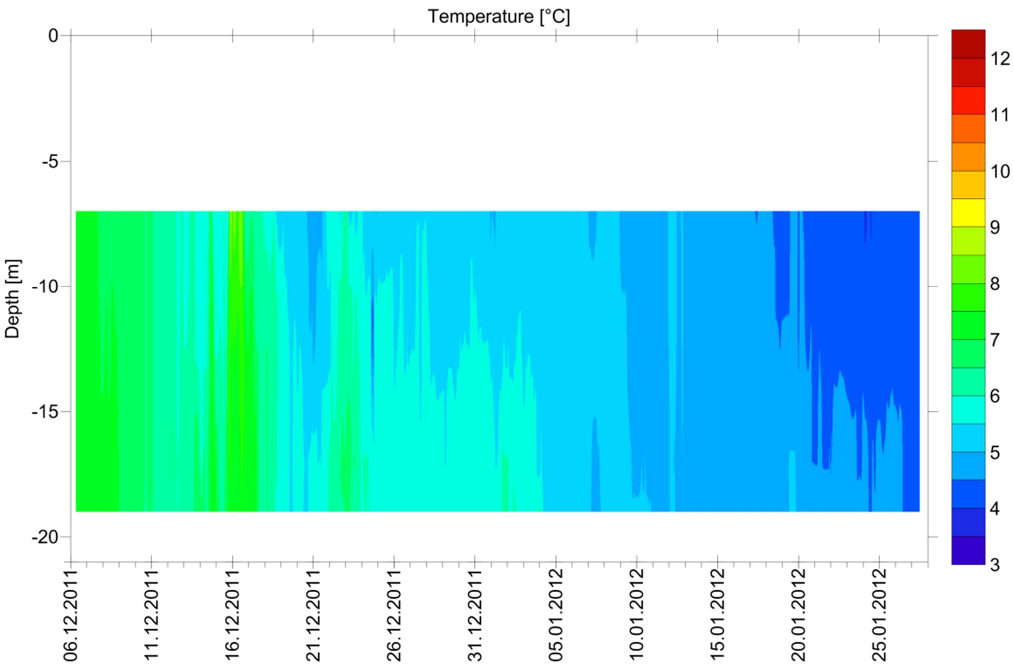

Figure 35: Temperature time series at the DSST mooring Darss Sill.

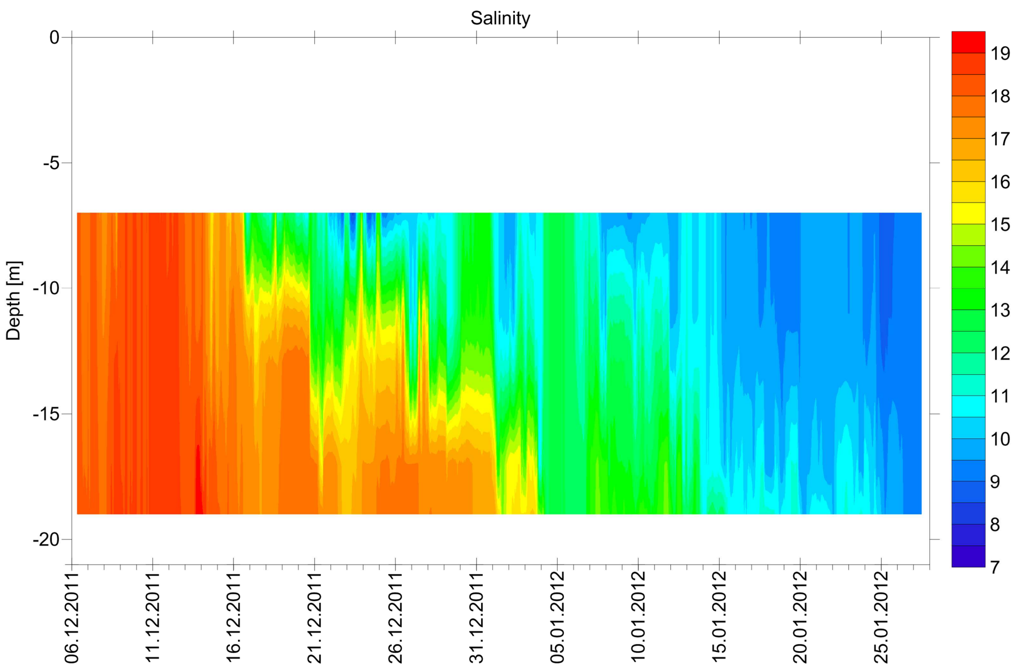

Figure 36: Salinity time series at the DSST mooring Darss Sill.

The temperature and salinity time series show a warm, high saline water body present at the Darss Sill from 6th to 16th of December 2011, covering the entire water column. During the following days the vertical extent of this water body decreases. Around the 4th January 2012 the warm saline water disappeared at the Darss Sill.

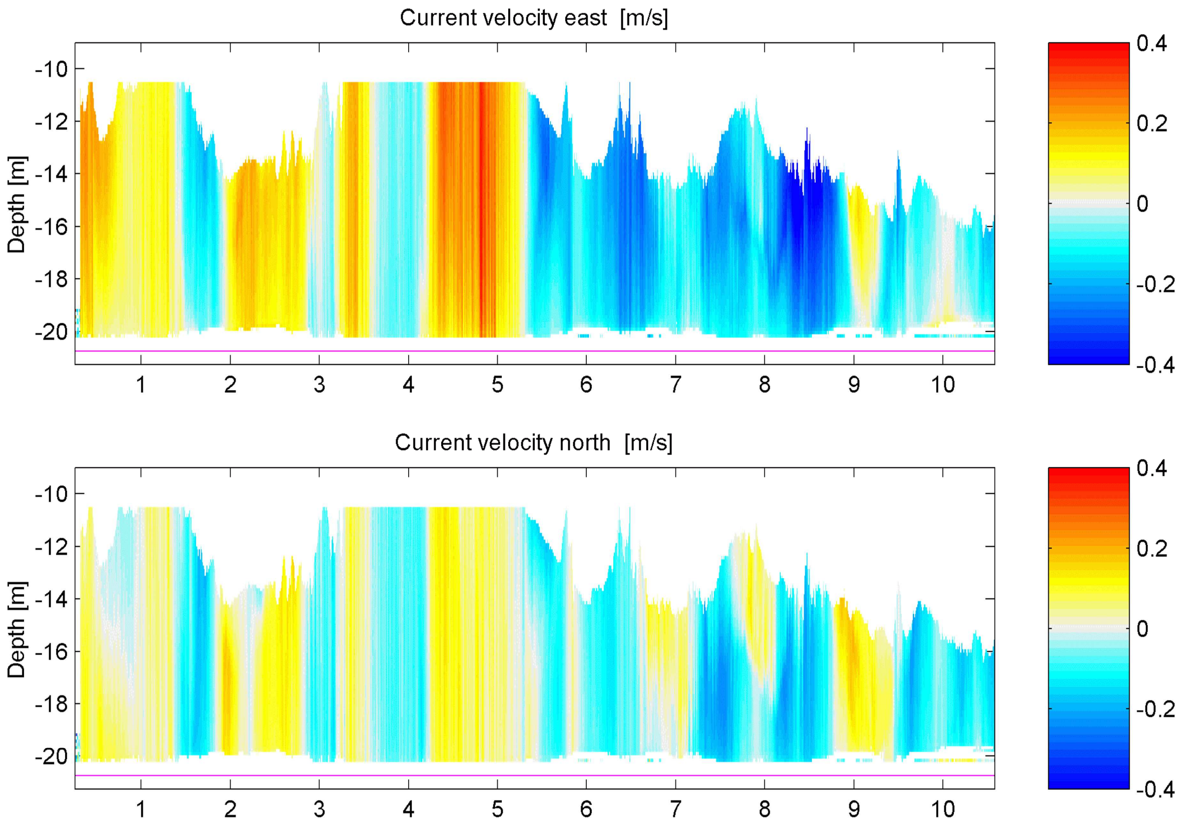

Figure 37: Current velocity at the Darss Sill. The x-axis is scaled in days after 6th Dec 2011 (1 = 7th Dec; 10 = 16th Dec)

Inflowing waters were detected between the 6th and 11th December 2011 superimposed with short interruptions. The vertical and temporal averaged current velocity towards 30°N was 7.99 cm/s for this period. During that time the warm saline water body covered the entire water column with salinities of 17 to 19. To estimate transport the averaged current velocity was multiplied with the cross section area of the Darss Sill (0.95km²; Badewien, 2002). This results in an inflow volume of 32.8 km³ saline water.

Together with the previous inflows from November a total volume of 60 to 90km³ of saline water has entered the western Baltic between 16th November and 10th December 2011. Until the 4th January 2012 minor amounts of saline water might passed the Darss Sill, but an estimate of this volume cannot given yet, since the current data are not available. After the 4th January 2012 no further saline inflow was detected at the Darss Sill.

4. Stations and deployments

A station name and a station number were assigned to all stations, where scientific equipment was used. The station name identifies a geographical position. The station number is an integer number that is increased by one for each new station. The station number was applied according the station number of the ship.

Table 2: List of CTD/LADCP/MSS stations and casts

No.	*Station No. Stat. Name*		*Date*	*Time [UTC]*	*Latitude*	*Latitude*	*Depth*	*CTD casts*	*MSS casts*
1	0001	Begin	02.12.2011	12:52	57°22.01’N	20°20.38’E	239.90	0001_01	-
	X_0001	End	02.12.2011	13:16	57°21.94’N	20°20.07’E			
2	0002	Begin	02.12.2011	14:19	57°19.17’N	20°02.96’E	249.27	0002_01	
	TF0271	End	02.12.2011	14:38	57°19.13’N	20°02.74’E			
3	0003	Begin	03.12.2011	00:03	57°59.77’N	19°53.53’E	202.92	0003F01	
	TF0286	End	03.12.2011	00:22	57°59.58’N	19°53.22’E		0003K02	
4	0004	Begin	03.12.2011	02:39	57°37.00’N	20°10.19’E	149.27	0004_01	
	TF0270	End	03.12.2011	02:51	57°36.92’N	20°10.13’E			
5	0005	Begin	03.12.2011	08:11	57°04.33’N	19°49.78’E	214.90	0005F01	
	TF0272	End	03.12.2011	08:35	57°04.20’N	19°49.85’E		0005F02	
								0005F03	
6	0006	Begin	05.12.2011	06:10	55°14.99’N	15°58.99’E	101.35	0006F01	
	TF0213	End	05.12.2011	06:24	55°14.98’N	15°58.98’E			
7	0007	Begin	06.12.2011	06:54	54°41.82’N	12°42.12’E	21.88	0007F01	
	TF0001	End	06.12.2011	07:12	54°41.82’N	12°42.12’E			
8	0008	Begin	06.12.2011	09:23	54°47.69’N	13°03.51’E	30.88	0008_01	
	TF0115	End	06.12.2011	09:35	54°47.65’N	13°03.55’E			
9	0009	Begin	06.12.2011	10:33	54°51.59’N	13°16.68’E	46.12	0009_01	
	TF0114	End	06.12.2011	10:44	54°51.51’N	13°16.79’E			
10	0010	Begin	06.12.2011	11:51	55°00.38’N	13°09.76’E	25.25	0010_01	
	MD0200	End	06.12.2011	11:57	55°00.33’N	13°09.67’E			
11	0011	Begin	06.12.2011	12:42	55°00.42’N	13°13.63’E	44.62	0011_01	
	MD0201	End	06.12.2011	12:49	55°00.29’N	13°13.53’E			
12	0012	Begin	06.12.2011	13:18	55°00.47’N	13°17.54’E	47.38	0012_01	
	MD0202	End	06.12.2011	13:24	55°00.44’N	13°17.50’E			
13	0013	Begin	06.12.2011	13:45	55°00.59’N	13°21.31’E	46.44	0013_01	
	MD0203	End	06.12.2011	13:54	55°00.56’N	13°21.44’E			
14	0014	Begin	06.12.2011	14:25	55°00.61’N	13°25.21’E	49.12	0014_01	
	MD0204	End	06.12.2011	14:34	55°00.67’N	13°25.07’E			
15	0015	Begin	06.12.2011	14:57	55°00.72’N	13°28.87’E	50.25	0015_01	
	MD0205	End	06.12.2011	15:04	55°00.89’N	13°28.73’E			
16	0016	Begin	06.12.2011	15:35	55°00.64’N	13°33.14’E	49.88	0016_01	
	MD0206	End	06.12.2011	15:39	55°00.64’N	13°33.15’E			
17	0017	Begin	06.12.2011	16:01	55°01.50’N	13°36.40’E	50.25	0017_01	
	TF0105	End	06.12.2011	16:09	55°01.50’N	13°36.43’E			
18	0018	Begin	06.12.2011	16:58	55°04.11’N	13°48.84’E	49.38	0018_01	
	TF0104	End	06.12.2011	17:07	55°03.94’N	13°48.90’E			
19	0019	Begin	06.12.2011	17:57	55°03.81’N	13°59.34’E	49.84	0019_01	
	TF0103	End	06.12.2011	18:06	55°03.78’N	13°59.29’E			
20	0020	Begin	06.12.2011	20:38	54°39.23’N	14°13.36’E	33.00	0020_01	
	MD0108	End	06.12.2011	20:52	54°39.15’N	14°13.28’E			
21	0021	Begin	06.12.2011	21:23	54°42.03’N	14°08.74’E	28.38	0021_01	
	MD0107	End	06.12.2011	21:32	54°41.96’N	14°08.70’E			
22	0022	Begin	06.12.2011	22:03	54°44.85’N	14°04.15’E	28.25	0022_01	
	MD0106	End	06.12.2011	22:11	54°44.83’N	14°04.16’E			

23	0023 MD0105	Begin	06.12.2011	22:40	54°47.65'N	13°59.58'E	42.50	0023_01	
		End	06.12.2011	22:49	54°47.58'N	13°59.55'E			
24	0024 MD0104	Begin	06.12.2011	23:20	54°50.48'N	13°55.18'E	47.66	0024_01 0024K02	
		End	06.12.2011	23:34	54°50.35'N	13°54.96'E			
25	0025 MD0103	Begin	07.12.2011	0:07	54°53.29'N	13°50.53'E	52.81	0025_01	
		End	07.12.2011	0:15	54°53.23'N	13°50.40'E			
26	0026 MD0102	Begin	07.12.2011	0:45	54°56.08'N	13°45.95'E	56.69	0026_01	
		End	07.12.2011	0:54	54°56.06'N	13°45.83'E			
27	0027 MD0101	Begin	07.12.2011	1:44	54°58.86'N	13°41.28'E	53.00	0027_01	
		End	07.12.2011	1:50	54°58.85'N	13°41.17'E			
28	0028 MD0301	Begin	07.12.2011	2:49	54°58.37'N	13°30.26'E	52.75	0028_01	
		End	07.12.2011	2:58	54°58.37'N	13°30.17'E			
29	0029 TF0113	Begin	07.12.2011	3:28	54°55.50'N	13°30.04'E	58.62	0029F01	
		End	07.12.2011	3:38	54°55.43'N	13°30.07'E			
30	0030 MD0303	Begin	07.12.2011	4:03	54°53.41'N	13°29.88'E	48.25	0030F01	
		End	07.12.2011	4:12	54°53.40'N	13°29.90'E			
31	0031 MD0304	Begin	07.12.2011	4:40	54°50.68'N	13°29.68'E	47.38	0031F01	
		End	07.12.2011	4:53	54°50.60'N	13°29.72'E			
32	0032 TF0116	Begin	07.12.2011	5:20	54°47.47'N	13°29.68'E	45.50	0032F01	
		End	07.12.2011	5:32	54°47.33'N	13°29.59'E			
33	0033 MD0305	Begin	07.12.2011	5:58	54°45.48'N	13°28.97'E	42.00	0033F01	
		End	07.12.2011	6:08	54°45.39'N	13°28.87'E			
34	0034 MD0306	Begin	07.12.2011	6:30	54°43.37'N	13°27.85'E	33.62	0034F01	
		End	07.12.2011	6:37	54°43.39'N	13°27.84'E			
35	0035 MD0307	Begin	07.12.2011	7:00	54°41.92'N	13°26.63'E	21.12	0035F01	
		End	07.12.2011	7:08	54°41.90'N	13°26.64'E			
36	0036 TF0001	Begin	07.12.2011	14:04	54°42.06'N	12°41.69'E	22.12	0036_01	001 - 597
		End	07.12.2011	14:11	54°42.07'N	12°41.70'E			
37	0036 TF0001	Begin	08.12.2011	09:05	54°41.97'N	12°41.87'E	22.38	0037_01 0037_02	
		End	08.12.2011	09:18	54°41.96'N	12°41.87'E			
38	0037 TF0031	Begin	08.12.2011	10:09	54°40.23'N	12°33.84'E	18.88	0038_01	
		End	08.12.2011	10:20	54°40.20'N	12°33.71'E			
39	0038 TF0002	Begin	08.12.2011	10:50	54°38.99'N	12°27.00'E	18.88	0039F01	
		End	08.12.2011	10:55	54°38.97'N	12°26.99'E			
40	0039 TF0033	Begin	08.12.2011	11:24	54°36.27'N	12°19.80'E	21.25	0040_01	
		End	08.12.2011	11:32	54°36.23'N	12°19.73'E			
41	0040 TF0046	Begin	08.12.2011	12:25	54°28.08'N	12°12.64'E	26.88	0041_01	
		End	08.12.2011	12:37	54°28.00'N	12°13.07'E			
42	0041 TF0041	Begin	08.12.2011	13:20	54°24.34'N	12°03.74'E	20.12	0042_01	
		End	08.12.2011	13:27	54°24.38'N	12°03.68'E			

Table 3: 150kHz Vessel mounted ADCP deployments

Deployment	*Start date*	*Start time [UTC]*	*End date*	*End time [UTC]*	*Config*	*Comment*
001_000000	29.11.2011	15:56:46	30.11.2011	10:11:19	1 bb	Baltic transect
001_000001	30.11.2011	10:11:20	30.11.2011	22:56:36	1 bb	Baltic transect
002_000000	30.11.2011	22:58:13	01.12.2011	23:49:12	2 nb	Baltic transect
002_000001	01.12.2011	23:49:14	02.12.2011	07:22:22	2 nb	Baltic transect
003_000000	02.12.2011	07:22:38	02.12.2011	22:40:23	2 nb	Baltic transect
004_000000	02.12.2011	22:40:40	04.12.2011	00:59:12	2 nb	Transit to Bornholm Basin
004_000001	04.12.2011	00:59:13	04.12.2011	16:12:58	2 nb	Transit to Bornholm Basin
005_000000	04.12.2011	16:14:45	05.12.2011	10:29:12	1 bb	
005_000001	05.12.2011	10:29:13	06.12.2011	04:43:42	1 bb	Arkona transect
005_000002	06.12.2011	04:43:43	06.12.2011	22:58:16	1 bb	
005_000003	06.12.2011	22:58:17	07.12.2011	17:12:55	1 bb	
005_000004	07.12.2011	17:12:56	08.12.2011	11:23:24	1 bb	Darss Sill time series
006_000000	08.12.2011	11:24:24	08.12.2011	11:24:32	1 bb	Configuration test
007_000000	08.12.2011	11:24:49	08.12.2011	13:40:39	1 bb	

Table 4: ScanFish deployments

Deployment	*Start date*	*Start time [UTC]*	*End date*	*End time [UTC]*	*Comment*
001	29.11.2011	10:23:58	29.11.2011	18:06:23	Series 01 – 08, Baltic transect
002	29.11.2011	21:20:32	02.12.2011	05:11:04	Series 01 – 52, Baltic transect
003	02.12.2011	14:46:57	02.12.2011	22:13:59	Series 01 – 07, Baltic transect
004	05.12.2011	06:34:20	06.12.2011	06:13:42	Series 01 – 24, Arkona transect

Table 5: Mooring deployments

Mooring	*Task*	*Device*	*Date*	*Time*	*Latitude*	*Logitude*
Gotland NE	recovering	all	02.12.2011	11:00	57°22.020'N	20°20.290'E
	deployment	TC - chain	02.12.2011	13:20	57°21.590'N	20°20.030'E
		ADCP	02.12.2011	13:35	57°21.590'N	20°20.130'E
DSST	deployment	ADCP	06.12.2011	08:15	54°41.856'N	12°42.126'E
		TC - chain	06.12.2011	08:40	54°41.827'N	12°42.106'E
DSST	recovering	all	27.01.2012	12:13	54°41.856'N	12°42.126'E