VLAAMSE OVERHEID

DEPARTEMENT MOBILITEIT EN OPENBARE WERKEN
WATERBOUWKUNDIG LABORATORIUM

Langdurige metingen Deurganckdok 2: Opvolging en analyse aanslibbing

Bestek 16EB/05/04

Deelrapport 2.11 : 13-uursmeting Longitudinale Zoutverdeling op 12/03/2008 tijdens springtij – Deurganckdok

Report 2.11 : Through Tide Measurement Longitudinal Salinity Distribution on 12/03/2008 during spring tide - Deurganckdok

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IMDC i.s.m. WL | delft hydraulics en GEMS International

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1. INTRODUCTION

1.1. The assignment

This report is part of the set of reports describing the results of the long-term measurements This report is part of the set of reports describing the results of the long-term measurements conducted in Deurganckdok aiming at the monitoring and analysis of silt accretion. This measurement campaign is an extension of the study "Extension of the study about density currents in the Beneden Zeeschelde" as part of the Long Term Vision for the Scheldt estuary. It is complementary to the study 'Field measurements high-concentration benthic suspensions (HCBS 2)'.

The terms of reference for this study were prepared by the 'Departement Mobiliteit en Openbare Werken van de Vlaamse Overheid, Afdeling Waterbouwkundig Laboratorium' (16EB/05/04). The repetition of this study was awarded to International Marine and Dredging Consultants NV in association with WL|Delft Hydraulics and Gems International on 10/01/2006. The project term was prolonged with an extra year from April 2007 till March 2008.

Waterbouwkundig Laboratorium– Cel Hydrometrie Schelde provided data on discharge, tide, salinity and turbidity along the river Scheldt and provided survey vessels for the long term and through tide measurements. Afdeling Maritieme Toegang provided maintenance dredging data. Agentschap voor Maritieme Dienstverlening en Kust – Afdeling Kust and Port of Antwerp provided depth sounding measurements.

The execution of the study involves a twofold assignment:

- Part 1: Setting up a sediment balance of Deurganckdok covering a period of one year, i.e. 04/2007 – 03/2008
- Part 2: An analysis of the parameters contributing to siltation in Deurganckdok

1.2. Purpose of the study

The Lower Sea Scheldt (Beneden Zeeschelde) is the stretch of the Scheldt estuary between the Belgium-Dutch border and Rupelmonde, where the entrance channels to the Antwerp sea locks are located. The navigation channel has a sandy bed, whereas the shallower areas (intertidal areas, mud flats, salt marshes) consist of sandy clay or even pure mud sometimes. This part of the Scheldt is characterized by large horizontal salinity gradients and the presence of a turbidity maximum with depth-averaged concentrations ranging from 50 to 500 mg/l at grain sizes of 60 - 100 μm. The salinity gradients generate significant density currents between the river and the entrance channels to the locks, causing large siltation rates. It is to be expected that in the near future also the Deurganckdok will suffer from such large siltation rates, which may double the amount of dredging material to be dumped in the Lower Sea Scheldt.

Results from the study may be interpreted by comparison with results from the HCBS and HCBS2 studies covering the whole Lower Sea Scheldt. These studies included through-tide measurement campaigns in the vicinity of Deurganckdok and long term measurements of turbidity and salinity in and near Deurganckdok.

The first part of the study focuses on obtaining a sediment balance of Deurganckdok. Aside from natural sedimentation, the sediment balance is influenced by the maintenance and capital dredging works. This involves sediment influx from capital dredging works in the Deurganckdok, and internal relocation and removal of sediment by maintenance dredging works. To compute a sediment balance an inventory of bathymetric data (depth soundings), density measurements of the

deposited material and detailed information of capital and maintenance dredging works will be made up.

The second part of the study is to gain insight in the mechanisms causing siltation in Deurganckdok, it is important to follow the evolution of the parameters involved, and this on a long and short term basis (long term & through-tide measurements). Previous research has shown the importance of water exchange at the entrance of Deurganckdok is essential for understanding sediment transport between the dock and the river Scheldt.

1.3. Overview of the study

1.3.1. Reports

Reports of the project 'Opvolging aanslibbing Deurganckdok' between April 2007 till March 2008 are summarized in Table 1-1. An overview of the HCBS2 and 'Opvolging aanslibbing Deurganckdok' (between April 2006 till March 2007) reports are given in APPENDIX L.

This report 2.11, is one of a set of reports that gains insight in the vertical salinity distribution along the longitudinal awis of Deurganckdok. In combination with the long-term salinity measurements at the quays and near the entrance of the dock (see IMDC, 2006k to 2006o & IMDC, 2007m to 2007w), these measurements should help to understand the total salinity distribution within Deurganckdok and its tidal dynamics.

Table 1-1: Overview of Deurganckdok Reports

Report	Description
Sediment Balance: Bathymetry surveys, Density measurements, Maintenance and construction dredging activities	
1.10	Sediment Balance: Three monthly report 1/4/2007 - 30/06/2007 (I/RA/11283/07.081/MSA)
1.11	Sediment Balance: Three monthly report 1/7/2007 – 30/09/2007 (I/RA/11283/07.082/MSA)
1.12	Sediment Balance: Three monthly report 1/10/2007 – 31/12/2007 (I/RA/11283/07.083/MSA)
1.13	Sediment Balance: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/07.084/MSA)
1.14	Annual Sediment Balance (I/RA/11283/07.085/MSA)
Factors contributing to salt and sediment distribution in Deurganckdok: Salt-Silt (OBS3A) & Frame measurements, Through tide measurements (SiltProfiling & ADCP) & Calibrations	
2.09	Calibration stationary equipment autumn (I/RA/11283/07.095/MSA)
2.10	Through tide measurement Siltprofiler 23 October 2007 (I/RA/11283/07.086/MSA)
2.11	Through tide measurement Salinity Profiling winter (I/RA/11283/07.087/MSA)
2.12	Through tide measurement Sediview winter 11 March 2008 Transect I (I/RA/11283/07.088/MSA)
2.13	Through tide measurement Sediview winter 11 March 2008 Transect K (I/RA/11283/07.089/MSA)
2.14	Through tide measurement Sediview winter 11 March 2008 Transect DGD (I/RA/11283/07.090/MSA)
2.15	Through tide measurement Siltprofiler 12 March 2008 (I/RA/11283/07.091/MSA)

Report	Description
2.16	Salt-Silt distribution Deurganckdok summer (21/6/2007 – 30/07/2007) (I/RA/11283/07.092/MSA)
2.17	Salt-Silt distribution & Frame Measurements Deurganckdok autumn (17/09/2007 - 10/12/2007) (I/RA/11283/07.093/MSA)
2.18	Salt-Silt distribution & Frame Measurements Deurganckdok winter (18/02/2008 - 31/3/2008) (I/RA/11283/07.094/MSA)
2.19	Calibration stationary & mobile equipment winter (I/RA/11283/07.096/MSA)
Boundary Conditions: Upriver Discharge, Salt concentration Scheldt, Bathymetric evolution in access channels, dredging activities in Lower Sea Scheldt and access channels	
3.10	Boundary conditions: Three monthly report 1/4/2007 – 30/06/2007 (I/RA/11283/07.097/MSA)
3.11	Boundary conditions: Three monthly report 1/7/2007 – 30/09/2007 (I/RA/11283/07.098/MSA)
3.12	Boundary conditions: Three monthly report 1/10/2007 – 31/12/2007 (I/RA/11283/07.099/MSA)
3.13	Boundary conditions: Three monthly report 1/1/2008 – 31/03/2008 (I/RA/11283/07.100/MSA)
3.14	Boundary conditions: Annual report (I/RA/11283/07.101/MSA)
Analysis	
4.10	Analysis of Siltation Processes and Factors (I/RA/11283/07.102/MSA)

1.3.2. Measurement actions

Following measurements have been carried out during the course of this project:

1. Monitoring upstream discharge in the Scheldt river
2. Monitoring Salt and sediment concentration in the Lower Sea Scheldt taken from on permanent data acquisition sites at Lillo, Oosterweel and up- and downstream of the Deurganckdok.
3. Long term measurement of salt distribution in Deurganckdok.
4. Long term measurement of sediment concentration in Deurganckdok
5. Monitoring near-bed processes in the central trench in the dock, near the entrance as well as near the landward end: near-bed turbidity, near-bed current velocity and bed elevation variations are measured from a fixed frame placed on the dock's bed.
6. Measurement of current, salt and sediment transport at the entrance of Deurganckdok for which ADCP backscatter intensity over a full cross section are calibrated with the Sediview procedure and vertical sediment and salt profiles are recorded with the SiltProfiler equipment
7. Through tide measurements of vertical sediment concentration profiles -including near bed highly concentrated suspensions- with the SiltProfiler equipment. Executed over a grid of points near the entrance of Deurganckdok.
8. Monitoring dredging activities at entrance channels towards the Kallo, Zandvliet and Berendrecht locks

9. Monitoring dredging and dumping activities in the Lower Sea Scheldt

In situ calibrations were conducted on several dates to calibrate all turbidity and conductivity sensors, a description can be found in IMDC (2006a; 2007a; 2008f; 2008o).

1.4. Structure of the report

This report is the factual data report of the through tide salinity measurements at Deurganckdok (transect Y) on the 12th of March 2008. The first chapter comprises an introduction. The second chapter describes the measurement campaign and the equipment. Chapter 3 describes the course of the actual measurements. The results and processed data are presented in Chapter 4, whereas chapter 5 gives a preliminary analysis of the data.

2. THE MEASUREMENT CAMPAIGN

2.1. Overview of the parameters

The first part of the study aims at determining a sediment balance of Deurganckdok and the net influx of sediment. The sediment balance comprises a number of sediment transport modes: deposition, influx from capital dredging works, internal replacement and removal of sediments due to maintenance dredging (Figure 2-1).

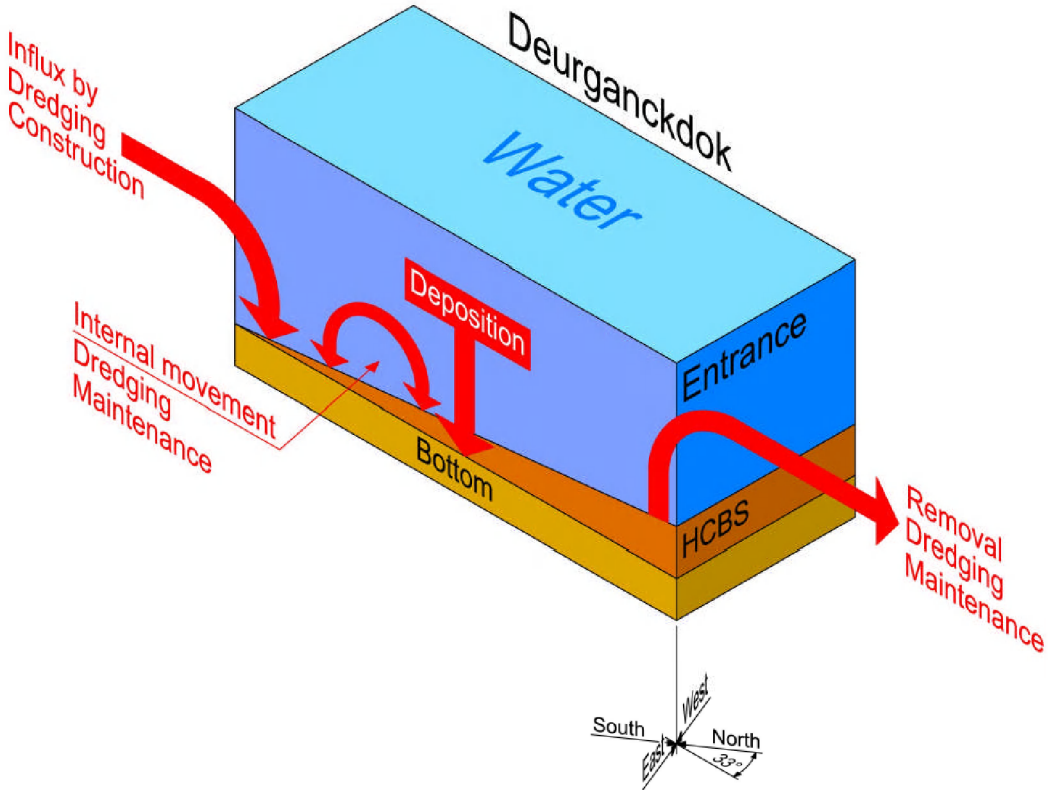

Figure 2-1: Elements of the sediment balance

A net deposition can be calculated from a comparison with a chosen initial condition t_0 (Figure 2-2). The mass of deposited sediment is determined from the integration of bed density profiles recorded at grid points covering the dock. Subtracting bed sediment mass at t_0 leads to the change in mass of sediments present in the dock (mass growth). Adding cumulated dry matter mass of dredged material removed since t_0 and subtracting any sediment influx due to capital dredging works leads to the total cumulated mass entered from the Scheldt river since t_0.

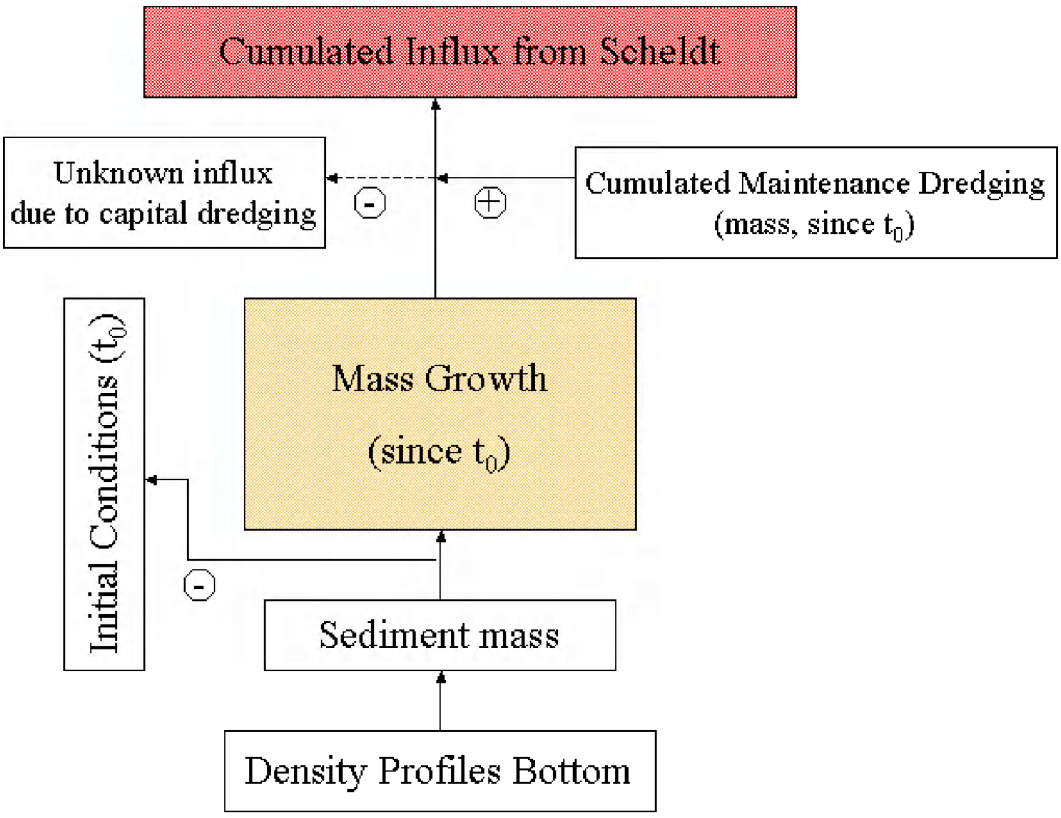

Figure 2-2: Determining a sediment balance

The main purpose of the second part of the study is to gain insight in the mechanisms causing siltation in Deurganckdok. The following mechanisms will be aimed at in this part of the study:

- Tidal prism, i.e. the extra volume in a water body due to high tide
- Vortex patterns due to passing tidal current
- Density currents due to salt gradient between the Scheldt river and the dock
- Density currents due to highly concentrated benthic suspensions

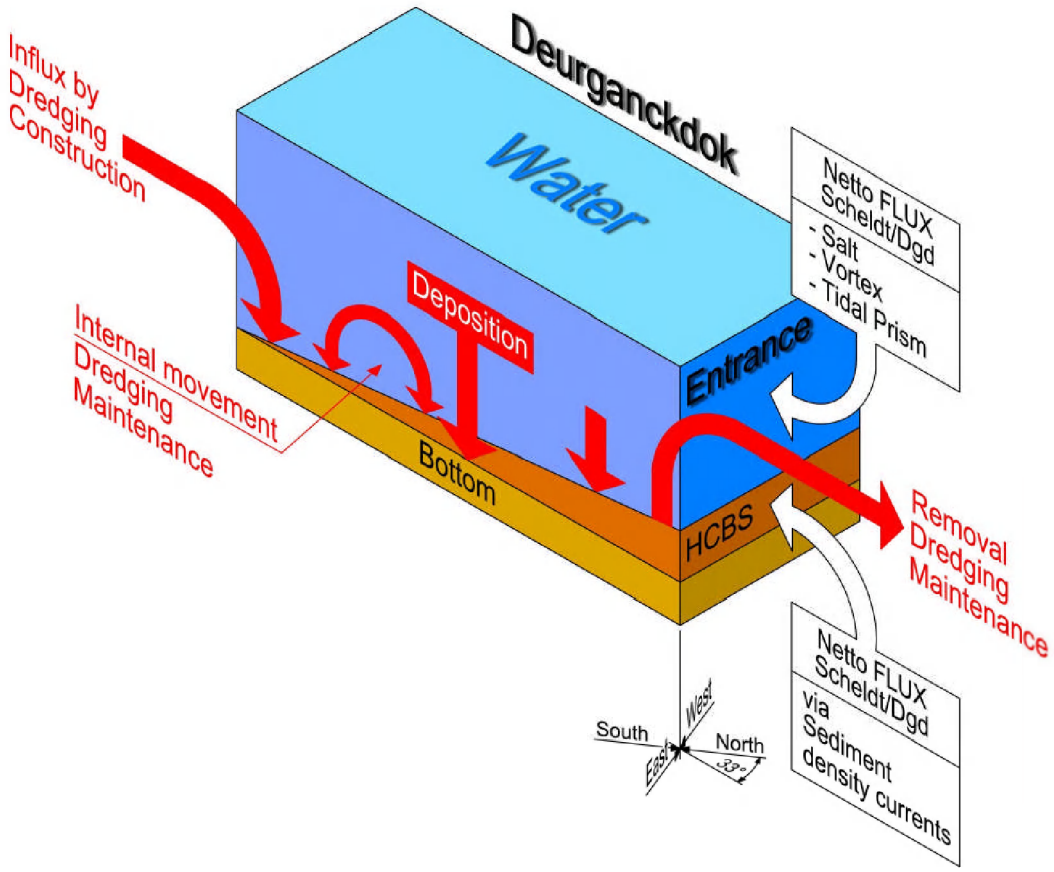

Figure 2-3: Transport mechanisms

These aspects of hydrodynamics and sediment transport have been landmark in determining the parameters to be measured during the project. Measurements will be focussed on three types of timescales: one tidal cycle, one neap-spring cycle and seasonal variation within one year.

Following data are being collected to understand these mechanisms:

- Monitoring the freshwater input (discharge) from the tributaries into the river Scheldt.
- Monitoring salinity and sediment concentration in the Lower Sea Scheldt at permanent measurement locations at Oosterweel, up- and downstream of the Deurganckdok.
- Long term measurement of salinity and suspended sediment distribution in Deurganckdok.
- Monitoring near-bed processes (current velocity, turbidity, and bed elevation variations) in the central trench in the dock, near the entrance as well as near the current deflecting wall location.
- Dynamic measurements of flow pattern, salinity and sediment transport at the entrance of Deurganckdok.
- Through tide measurements of vertical sediment concentration profiles -including near bed high concentrated benthic suspensions.
- Monitoring dredging activities at the entrance channels towards the Kallo, Zandvliet and Berendrecht locks as well as dredging and dumping activities in the Lower Sea Scheldt and Deurganckdok in particular.

In situ calibrations were conducted on several dates to calibrate all turbidity and conductivity sensors.

2.2. Description of the measurement campaign

2.2.1. Purpose of the measurement campaign

Salinity measurements were conducted on the 12th of March, 2006 from 8h04 MET till 20h10 MET.

The purpose of the measurements was to determine the vertical salinity distribution throughout the Deurganckdok. Therefore, salinity was measured at 5 different depths (-2 m, -4.5m, -7m, -9.5m & -12 mTAW) during a complete tidal cycle.

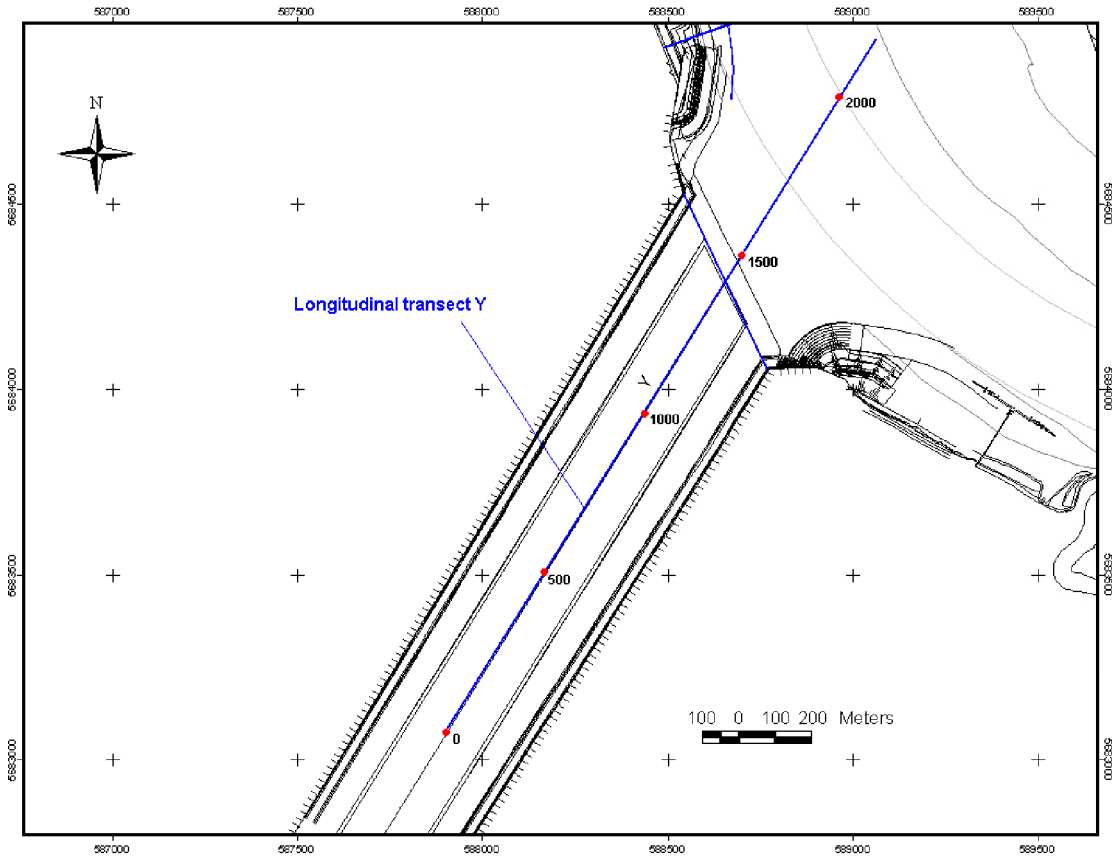

Figure 2-4: Map of sailed transect and calibration points at Deurganckdok on 12th of March 2008

2.2.2. Measurement procedure

From the survey vessel Veremans a measurement cycle was completed every half hour. The vessel with 5 salinity sensors mounted at different depths sailed a fixed transect from the deep end of the dock (dock side) to the navigation channel in the river Scheldt (river side). The theoretical coordinates of the fixed transect are listed in Table 2-1.

Table 2-1: Transect of the Flow Measurements (UTM31 ED50)

Measurement location	*FarLeft Bank Easting*	*Left Bank Northing*	*Right Bank Easting*	*Right Bank Northing*	*Avg Length [m]*	*Avg Course [degr.]*
Deurganckdok transect Y	589059	5684948	587300	5682000	3432	32.4

2.2.3. Setup

5 CTD divers were mounted on a steel cable suspended from a crane (with 2.5 meter difference between each instrument). An additional OBS3A (connected by a datacable with an onboard PC) was mounted on a fish next to the lowest CTD diver.

During the measurement campaign the length of the cable was adapted in accordance with the waterlevel to ensure the instruments were measuring at respectively -12, -9.5, -7, -4.5 & -2 m TAW.

Before sailing a transect the elevation of the instrument was checked and adjusted by combining online tidal data with the OBS 3A probe real time pressure readouts on board the vessel. During the measurements; the vessel sailed a transect at a constant low speed of approximately 3 knots

2.3. The equipment

2.3.1. CTD diver

The salinity measurements on –2, -4.5, -7, -9.5 and –12 mTAW were conducted using Van Essen CTD divers, which were continuously logging time, waterdepth (absolute pressure), temperature and conductivity each 5 seconds.

The resulting record is filled-up with GPS-time, echosounder and planimetric position of the GPS-receiver.

The technical details on the CTD diver are given in APPENDIX B.

2.3.2. OBS 3A

On the vessel Veremans, the OBS 3A device was mounted on a towfish, on the same elevation as the “-12 mTAW CTD diver”.

Measured parameters by the OBS 3A sensor: temperature (°C), conductivity (µS/cm), absolute pressure (m), turbidity (NTU). The instrument was directly connected with an onboard pc to ensure that the instruments were measuring at the correct depth. Data was also recorded as a backup for the CTD diver at –12 mTAW.

The technical details on the OBS 3A are given APPENDIX B.

3. COURSE OF THE MEASUREMENTS

3.1. Measurement periods

At Deurganckdok Salinity tracks were sailed once every 25 minutes for 13 hours, in total 30 cross-sections.

Starting times, start & stop coordinates, the sailed length and the course are given in APPENDIX A.

3.2. Hydro-meteorological conditions during the measurement campaign

3.2.1. Vertical tide during the measurements

The vertical tide was measured at Liefkenshoek tidal gauge. Graphs of the tide at Liefkenshoek on the 12th of March 2008 can be found in APPENDIX C. Table 3-1 lists the most important characteristics (high and low tide) of the tide at those gauges on March 12th of 2008.

Table 3-1: High and Low Tide at Liefkenshoek Tidal Gauge on 12/03/2008

Liefkenshoek Tidal Gauge		
12 March 2008		
	Time [MET]	***Water level [m TAW]***
LW (1)	00:50	0.45
HW (2)	06:00	6.49
LW (3)	13:00	0.93
HW (4)	18:20	6.36

In Table 3-2 the tidal characteristics of the tide on the 12th of March 2008 are compared to the average tide over the decade 1991-2000 (AMT, 2003).

Table 3-2: Comparison of the tidal characteristics of 12/03/2008 with the average tide, the average neap tide and the average spring tide over the decade 1991-2000 for Liefkenshoek.

	Neap tide (1991 - 2000)	***Avg Tide (1991 - 2000)***	***Spring Tide (1991 - 2000)***	***Tide 12/03/2008***
Water level [m TAW]				
LW (1)	0.39	0.05	-0.18	0.45
HW (2)	4.63	5.19	5.63	6.49
LW (3)	-	-	-	0.93
HW (4)	-	-	-	6.36
Tidal difference [m]				
Rising (1 to 2)	4.24	5.14	5.81	6.04
Falling (2 to 3)	4.24	5.14	5.81	5.56
Rising (3 to 4)	-	-	-	5.43
Duration [hh:mm]				
Rising (1 to 2)	5:59	5:34	5:16	5:10
Falling (2 to 3)	6:40	6:50	7:02	7:00
Rising (3 to 4)	-	-	-	5:20
Tide (1 to 3)	12:39	12:24	12:18	12:10
Tide (2 to 4)	-	-	-	12:20
Tidal coefficient				
Rising (1 to 2)	0.82	1.00	1.13	1.18
Falling (2 to 3)	0.82	1.00	1.13	1.08
Rising (3 to 4)	-	-	-	1.06

The tidal coefficients from 1.06 up to 1.18 for the measured tide of the 12th of March 2008 indicate that this tide has a larger tidal range than the average tide for the decade of 1991-2000, and can be classified as spring tide.

3.2.2. Meteorological data

Meteorological data at Deurne was obtained from the Weather Underground website (Wunderground, 2008).

The weather on the 12th of March 2008 was stormy and the wind blew from the west at an average velocity of 29 km/h with maximal gust velocity of 86 km/h. The air temperature varied between 6 and 10°C. The sky was cloudy with some precipitation.

3.3. Navigation information

An overview of the navigation at the measurement location is given in APPENDIX D.

3.4. Remarks on data

The total of 30 transects were successfully taken sailed. During the recovery of the CTD divers, the CTD diver positioned at –4 mTAW was lost in the water and therefore, no data is available at –4.5m TAW.

4. PROCESSING OF DATASETS

4.1. Methodology of processing the data

For each transect, the starting and stopping times of the logsheets were used to select the valid records of the 4 instruments (-2, -7, -9.5 & -12 mTAW) and of the GPS/depthsounder string.

4.2. Computation of Salinity

Salinity was computed according the Unesco PPs-78 formula (APPENDIX E)

4.3. Computation of Waterdepth

d [mTAW] = T – (1000*(X-100)/(9.81*(1000+S))

Where d = position of sensor in mTAW

T = recorded tide of Liefkenshoek [mTAW]

X = recorded depth of sensor in kPA (absolute pressure)

S = Calculated Salinity (ppt)

4.4. Output

General transect information containing start-stop coordinates of each sailed transects with starting time, track length and heading is given in APPENDIX A.

All sailed salinity profiles are presented in APPENDIX F. The following conventions were used:

- Dock side (deep end) is always shown left, river side (entrance of the dock) on the right side
- The waterlevel is presented by a blue line in mTAW
- The distance along the transect is always relative to the theoretical transect

5. PRELIMINARY ANALYSIS OF THE DATA

5.1. Data Winter campaign 2008 (12/03/2008)

The recorded salinity values range between 4.6 and 8.4 ppt. The highest concentrations are measured at -12 m TAW near the riverside just after HW and at the dockside one hour before LW. The lowest salinities near the riverside are recorded near the surface one hour after LW. Near the dockside, the lowest salinities occur 2 hours after LW.

During the first hours, there is almost no vertical gradient, after LW, there is a clear vertical gradient with increased salinity values near the bottom. From just after HW until approximately 2.5 hours after HW, a horizontal gradient from low salinity at the dockside to higher values at the riverside is noticeable. The opposite gradient is recorded from 3 hours after HW up to LW with higher salinities near the dockside.

5.2. Comparison current campaign (12/03/2008) with previous Campaigns (Summer campaign - 29/09/2006 & Winter campaign - 21/03/2006)

On 12/03/2008, the measurements were performed during a spring tide with a tidal range between 1.06 and 1.18. The average daily fresh water discharge measured at Schelle is 350 m³/s (see Figure 5-3).

On 21/03/2006, the winter measurements were performed during a tide with a smaller tidal range than the average tide for the decade of 1991-2000 with tidal coefficients from 0.85 up to 0.92 (see IMDC, 2006c). The fresh water discharge that day was approximately 100m³/s (see Figure 5-1).

During the campaign of 26/09/2006, tidal coefficients range from 1.02 to 1.08 and the fresh water discharge is 31 m³/s (see Figure 5-2).

Compared to the previous campaigns the tidal coefficient of this campaign is higher. Also the daily fresh water discharge and the decade fresh water discharge exceed previous campaigns (see Figure 5-4).

When looking at the results of both winter and summer campaign (see APPENDIX K & APPENDIX H) some conclusions can be drawn.

The recorded salinity values of both winter campaigns are considerably lower than those measured during the summer campaign. The higher fresh water discharges in the winter (both daily, decade and monthly) correspond to lower salinities and can explain this salinity difference between summer and winter. The tidal coefficient seems to be less decisive since the tidal coefficient of the summer campaign is in between both winter campaigns.

Considering only both winter campaigns, salinity values of the 2008 campaign are slightly higher than the salinities measured during the winter campaign of 2006. The 2008 campaign has a higher tidal range and a higher fresh water discharge than the 2006 winter campaign. A higher tidal coefficient implies more input of salt but a higher fresh water discharge implies also more input of fresh water. The difference in tidal coefficient between these campaigns is more relevant than the difference in fresh water discharge.

In APPENDIX I & APPENDIX J, vertical[1] and longitudinal[2] gradients are calculated for each campaign. The vertical gradient is almost always positive and the gradients of the campaigns have more similarity near the river side with a clear peak around LW. The largest gradients and the largest fluctuations are found at 2000 meter along the longitudinal axis of DGD (see Figure 2-4), while the lowest gradients and fluctuations are found inside the dock.

The longitudinal gradient is remarkable similar for the 3 campaigns despite the large differences in salinities and the differences in water depth. The gradient is positive during flood and negative during ebb.

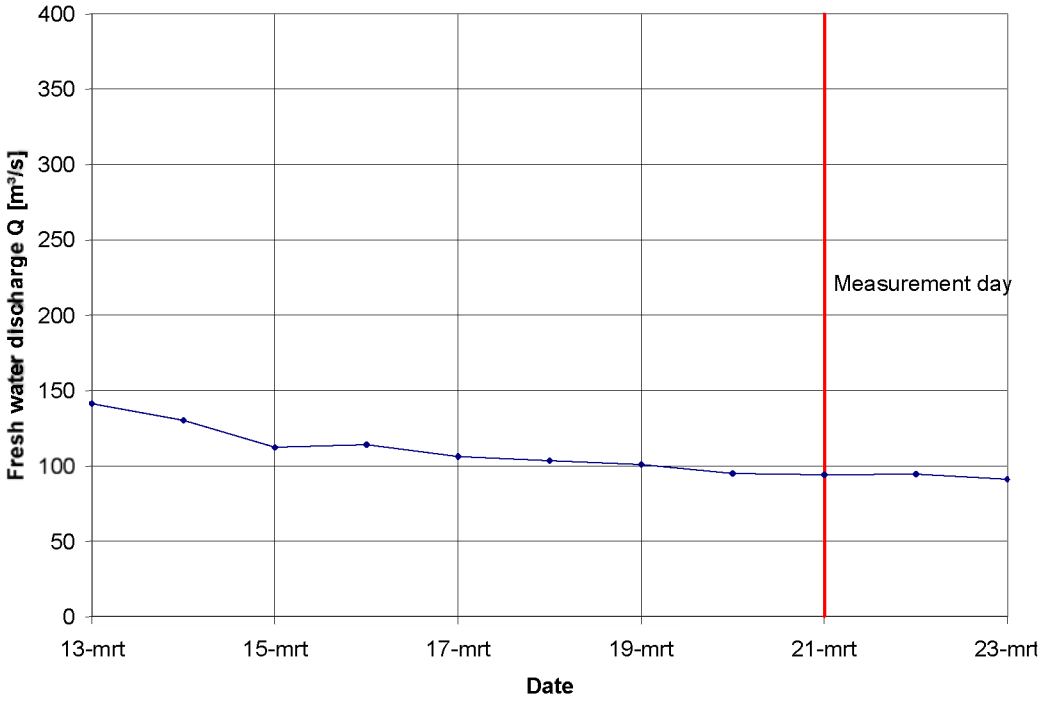

Figure 5-1: Recorded fresh water discharge at Schelle during the winter campaign (March 2006)

[1] a positive vertical gradient stands for higher salinities at the bottom, a negative gradient represents higher salinities at the surface

[2] a positive longitudinal gradient stands for higher salinities in the river than in the dock, a negative gradient represents higher salinities in the dock than in the river

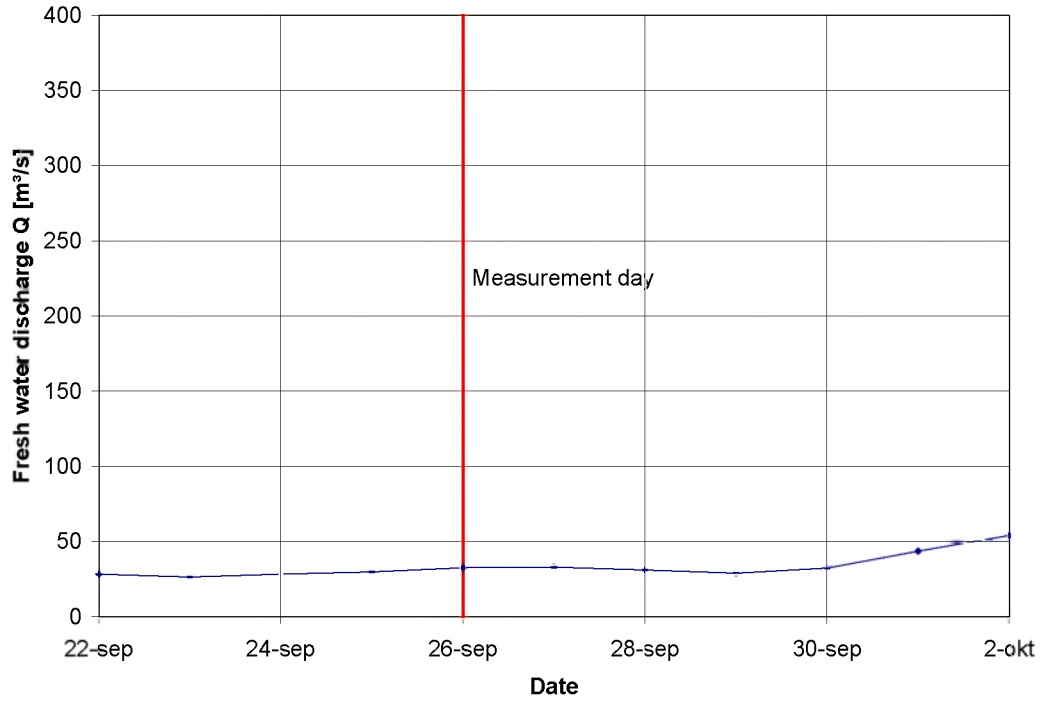

Figure 5-2: Recorded fresh water discharge at Schelle during the summer campaign (September 2006)

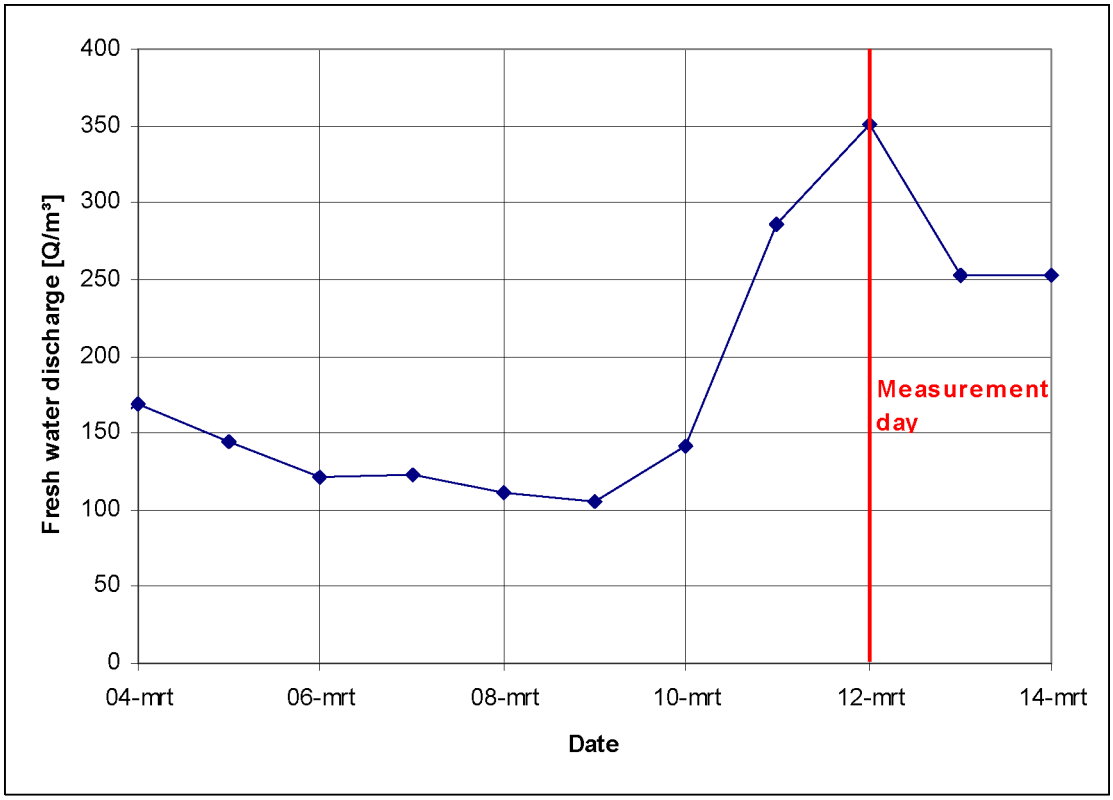

Figure 5-3: Recorded fresh water discharge at Schelle during the winter campaign (March 2008)

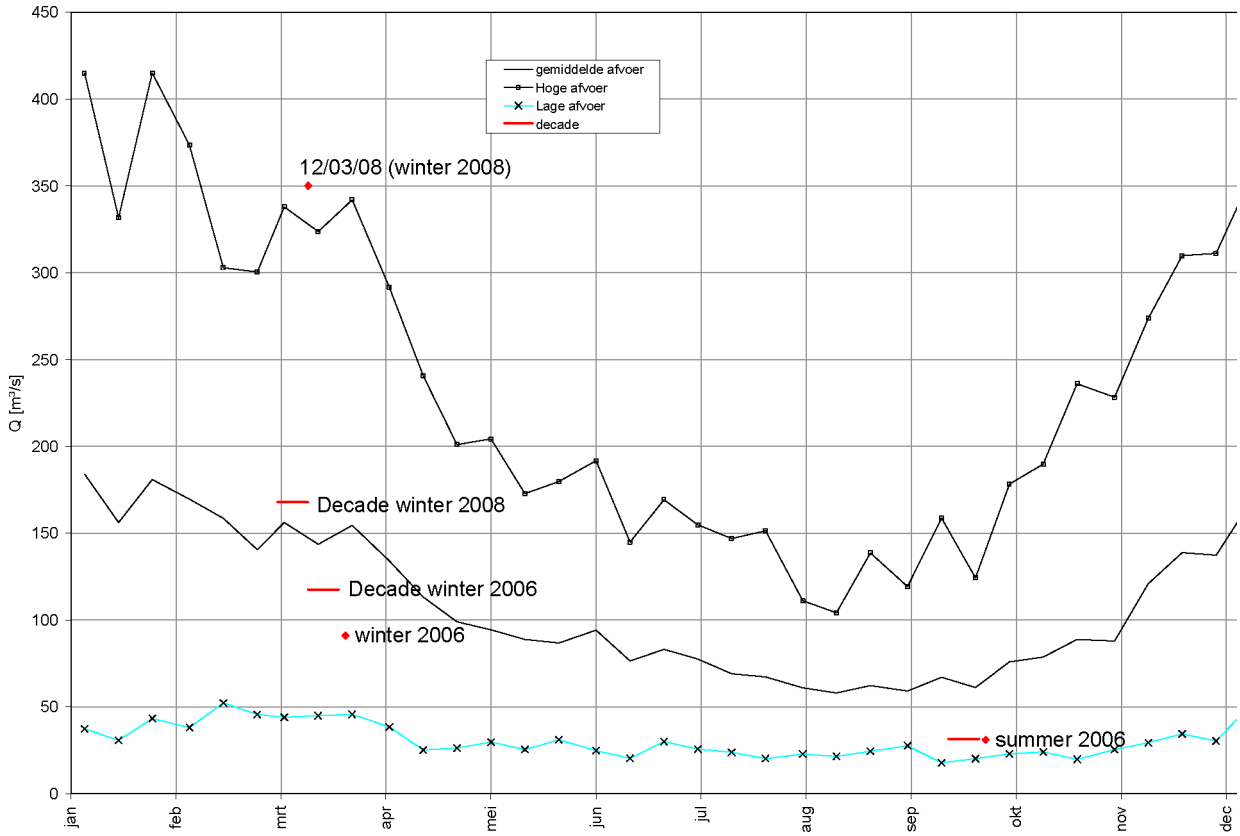

Figure 5-4: Analysis Fresh water discharge near Schelle

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IMDC (2005b). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.1: Deurganckdok 17/02/2005, I/RA/11265/05.009/MSA.

IMDC (2005c). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.2: Zandvliet 17/02/2005, I/RA/11265/05.010/MSA.

IMDC (2005d). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.3: Liefkenshoek 17/02/2005, I/RA/11265/05.0011/MSA.

IMDC (2005e). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.4: Schelle 17/02/2005, I/RA/11265/05.0012/MSA.

IMDC (2005f). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.5: Deurganckdok 16/02/2005, I/RA/11265/05.013/MSA.

IMDC (2005g). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.6: Kallosluis 18/02/2005, I/RA/11265/05.014/MSA.

IMDC (2005h). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.7: Near bed continious monitoring: february 2005, I/RA/11265/05.015/MSA.

IMDC (2005i). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 3: Settling velocity INSSEV february 2005, I/RA/11265/05.016/MSA.

IMDC (2005j). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 4: Cohesive sediment properties february 2005, I/RA/11265/05.017/MSA

IMDC (2005k). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 5.1: Overview of ambient conditions in the river Scheldt January-June 2005, I/RA/11265/05.018/MSA.

IMDC (2005l). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 5.2: Overview of ambient conditions in the river Scheldt July-December 2005, I/RA/11265/05.019/MSA.

IMDC (2006a) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 6.1 Calibration Winter 15 March & 14 April 2006? I/RA/11291/06.092/MSA.

IMDC (2006b) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.1 21 March 2006 Scheldewacht – Deurganckdok, I/RA/11291/06.094/MSA.

IMDC (2006c) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.2 22 March 2006 Parel 2 – Deurganckdok (downstream), I/RA/11291/06.095/MSA.

IMDC (2006d) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.3 22 March 2006 Laure Marie – Liefkenshoek, I/RA/11291/06.096/MSA.

IMDC (2006e) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.4 23 March 2006 Parel 2 – Schelle, I/RA/11291/06.097/MSA.

IMDC (2006f) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.5 23 March 2006 Laure Marie – Deurganckdok (downstream), I/RA/11291/06.098/MSA.

IMDC (2006g) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.6 23 March 2006 Veremans – Waarde, I/RA/11291/06.099/MSA.

IMDC (2006h) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.1 Opmeting stroming en zout- en sedimentbeweging aan de ingang van het Deurganckdok (SiltProfiler), I/RA/11283/06.087/WGO.

IMDC (2006i) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.3. Opmeting stroming en zout-en sedimentbeweging aan de ingang van het Deurganckdok (ADCP), I/RA/11283/06.110/BDC

IMDC (2006j). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 8.1: Vaste meetopstelling in zake bodemgedrag, I/RA/11291/06.100/MSA.

IMDC (2006k) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.6 Zout en slibverdeling Deurganckdok 17/03/2006 – 23/05/2006, I/RA/11283/06.121/MSA.

IMDC (2006l) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 5.3 Overview of ambient conditions in the river Scheldt – Januari-June 2006 (I/RA/11291/06.089/MSA), in opdracht van AWZ.

IMDC (2006m): Studie van de stromingsvelden en sedimentuitwisseling aan de ingang van Deurganckdok. Current and Sediment flux measurements November 17th 2005 (I/RA/15030/06.021/BDC).

IMDC (2006n). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 9: Valsnelheid slib – INSSEV, I/RA/11291/06.102/MSA, in opdracht van AWZ.

IMDC (2006o). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 2.7: Silt distribution and frame measurements 15/07/2006 – 31/10/2006. (I/RA/11291/06.122/MSA).

IMDC (2006p) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 5.3 Overview of ambient conditions in the river Scheldt – Januari-June 2006 (I/RA/11291/06.089/MSA), in opdracht van AWZ.

IMDC (2007a) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 6.2 Summer calibration and Final report, I/RA/11291/06.093/MSA.

IMDC (2007b). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 5.4 Overview of ambient conditions in the river Scheldt – July-December 2006 (I/RA/11291/06.089/MSA), in opdracht van AWZ.

IMDC (2007c). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 11.1 Through tide Measurement Sediview & Siltprofiler 27/9 Stream - Liefkenshoek (I/RA/11291/06.104/MSA), in opdracht van AWZ.

IMDC (2007d). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 11.2 Through tide Measurement Sediview 27/9 Veremans - Raai K (I/RA/11291/06.105/MSA), in opdracht van AWZ.

IMDC (2007e). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 11.3 Through tide Measurement Sediview & Siltprofiler 28/9 Stream - Raai K (I/RA/11291/06.106/MSA), in opdracht van AWZ.

IMDC (2007f). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 11.4 Through tide Measurement Sediview 28/9 Veremans - Waarde(I/RA/11291/06.107/MSA), in opdracht van AWZ.

IMDC (2007g). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 11.5 Through tide Measurement Sediview 28/9 Parel 2 - Schelle (I/RA/11291/06.108/MSA), in opdracht van AWZ.

IMDC (2007h). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 11.6 Through tide Measurement Salinity Distribution 26/9 Scheldewacht – Deurganckdok in opdracht van AWZ.

IMDC (2007i) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.1 Sediment Balance: Three monthly report 1/4/2006 – 30/06/2006 (I/RA/11283/06.113/MSA)

IMDC (2007j) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.2 Sediment Balance: Three monthly report 1/7/2006 – 30/09/2006 (I/RA/11283/06.114/MSA)

IMDC (2007k) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.3 Sediment Balance: Three monthly report 1/10/2006 – 31/12/2006 (I/RA/11283/06.115/MSA)

IMDC (2007l) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.4 Sediment Balance: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/06.116/MSA)

IMDC (2007m) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.5 Annual Sediment Balance (I/RA/11283/06.117/MSA)

IMDC (2007n) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.2 Through tide measurement SiltProfiler 26/09/2006 Stream (I/RA/11283/06.068/MSA)

IMDC (2007o) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.7 Salt-Silt distribution & Frame Measurements Deurganckdok 15/07/2006 – 31/10/2006 (I/RA/11283/06.122/MSA)

IMDC (2007p) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.8 Salt-Silt distribution & Frame Measurements Deurganckdok 15/01/2007 – 15/03/2007 (I/RA/11283/06.123/MSA)

IMDC (2007q) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.1 Boundary conditions: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/06.127/MSA)

IMDC (2007r) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing Deelrapport 1.10: Sediment Balance: Three monthly report 1/4/2007 – 30/06/2007 (I/RA/11283/07.081/MSA)

IMDC (2007s) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.11: Sediment Balance: Three monthly report 1/7/2007 – 30/09/2007 (I/RA/11283/07.082/MSA)

IMDC (2007t) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.16: Salt-Silt distribution Deurganckdok summer (21/6/2007 – 30/07/2007) (I/RA/11283/07.092/MSA)

IMDC (2007v) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.10: Boundary conditions: Three monthly report 1/04/2007 – 30/06/2007 (I/RA/11283/07.097/MSA)

IMDC (2007w) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.11: Boundary conditions: Two monthly report 1/07/2007 – 30/09/2007 (I/RA/11283/07.098/MSA)

IMDC (2008a) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.5: Through tide measurement Sediview average tide 24/10/2007 (I/RA/11283/06.120/MSA)

IMDC (2008b) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 4.1: Analysis of siltation Processes and Factors (I/RA/11283/06.129/MSA)

IMDC (2008c) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.12: Sediment Balance: Four monthly report 1/9/2007 – 31/12/2007 (I/RA/11283/07.083/MSA)

IMDC (2008d) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.13: Sediment Balance: Four monthly report 1/01/2007 – 31/03/2007 (I/RA/11283/07.084/MSA)

IMDC (2008e) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.14: Annual Sediment Balance. (I/RA/11283/07.085/MSA)

IMDC (2008f) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.09: Calibration stationary equipment autumn (I/RA/11283/07.095/MSA)

IMDC (2008g) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.10: Through tide measurement SiltProfiler 23 October 2007 (I/RA/11283/07.086/MSA)

IMDC (2008h) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.11: Through tide measurement Salinity Profiling winter 12 March 2008 (I/RA/11283/07.087/MSA)

IMDC (2008i) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.12: Through tide measurement Sediview winter 11 March 2008 – Transect I (I/RA/11283/07.088/MSA)

IMDC (2008j) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.13: Through tide measurement Sediview winter 11 March 2008 – Transect K (I/RA/11283/07.089/MSA)

IMDC (2008k) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.14: Through tide measurement Sediview winter 11 March 2008 – Transect DGD (I/RA/11283/07.090/MSA)

IMDC (2008l) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.15: Through tide measurement SiltProfiler winter 12 March 2008 (I/RA/11283/07.091/MSA)

IMDC (2008m) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.17: Salt-Silt distribution & Frame Measurements Deurganckdok autumn (17/9/2007-10/12/2007) (I/RA/11283/07.093/MSA)

IMDC (2008n) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.18: Salt-Silt distribution & Frame Measurements Deurganckdok winter (18/02/2007-31/03/2008) (I/RA/11283/07.094/MSA)

IMDC (2008o) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.19: Calibration stationary & mobile equipment winter (I/RA/11283/07.096/MSA)

IMDC (2008p) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.12: Boundary conditions: Three monthly report 1/9/2007 – 31/12/2007 (I/RA/11283/07.099/MSA)

IMDC (2008q) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.13: Boundary conditions: Three monthly report 1/1/2008 – 31/3/2007 (I/RA/11283/07.100/MSA)

IMDC (2008r) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.14: Boundary conditions: Annual report (I/RA/11283/07.101/MSA)

IMDC (2008s) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 4.10: Analysis of siltation Processes and Factors (I/RA/11283/07.102/MSA)

TV SAM (2006a) Langdurige stationaire ADCP stroommetingen te Oosterweel dukdalf 01/2005-06/2005. 42SR S032PIB 2A.

TV SAM (2006b) Langdurige stationaire ADCP stroommetingen te Oosterweel dukdalf 07/2005-12/2005. 42SR S033PIB 2A.

TV SAM (2006c) Langdurige stationaire ADCP stroommetingen te Oosterweel dukdalf 01/2006-06/2006. 42SR S032PIB 2A.

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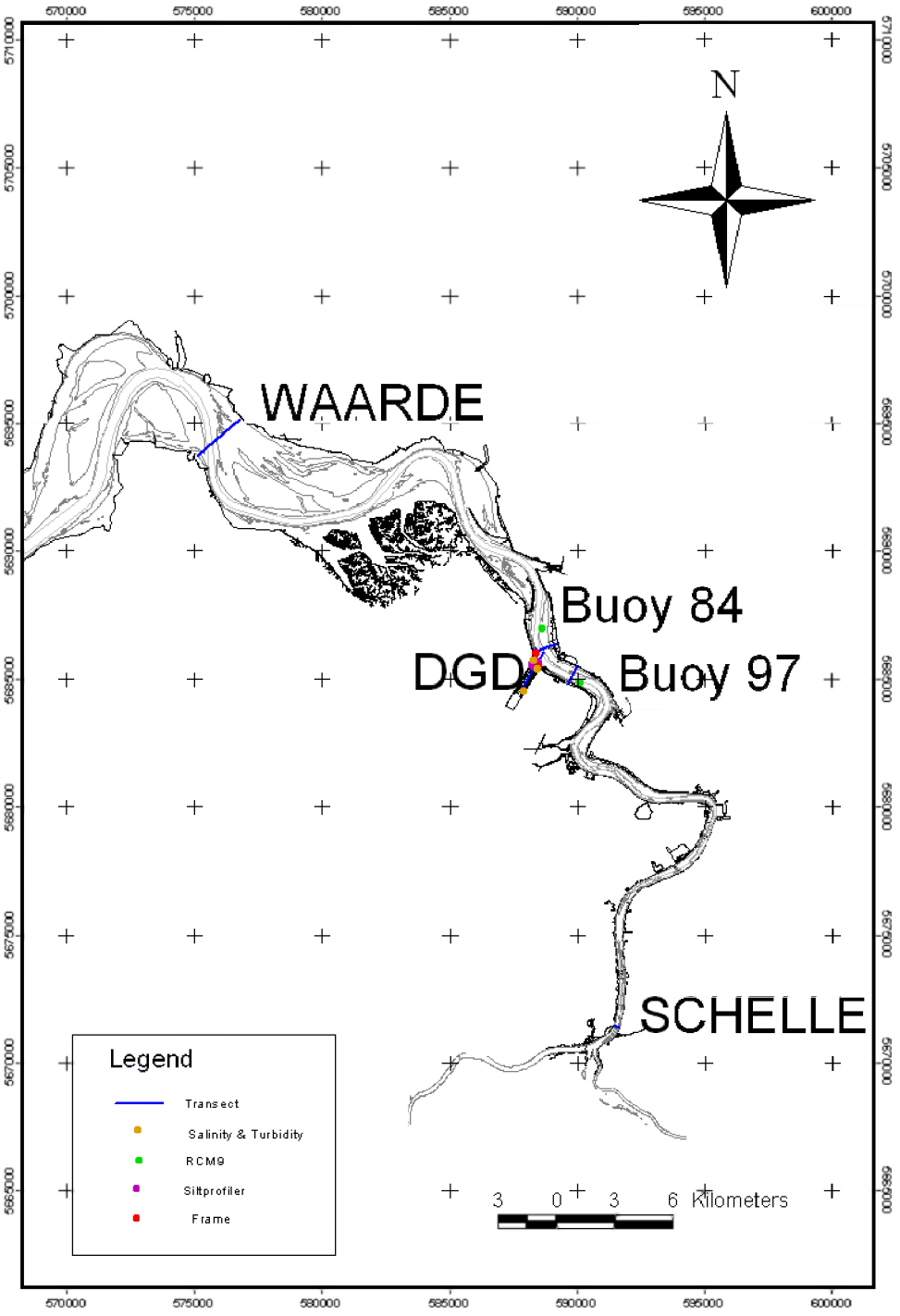
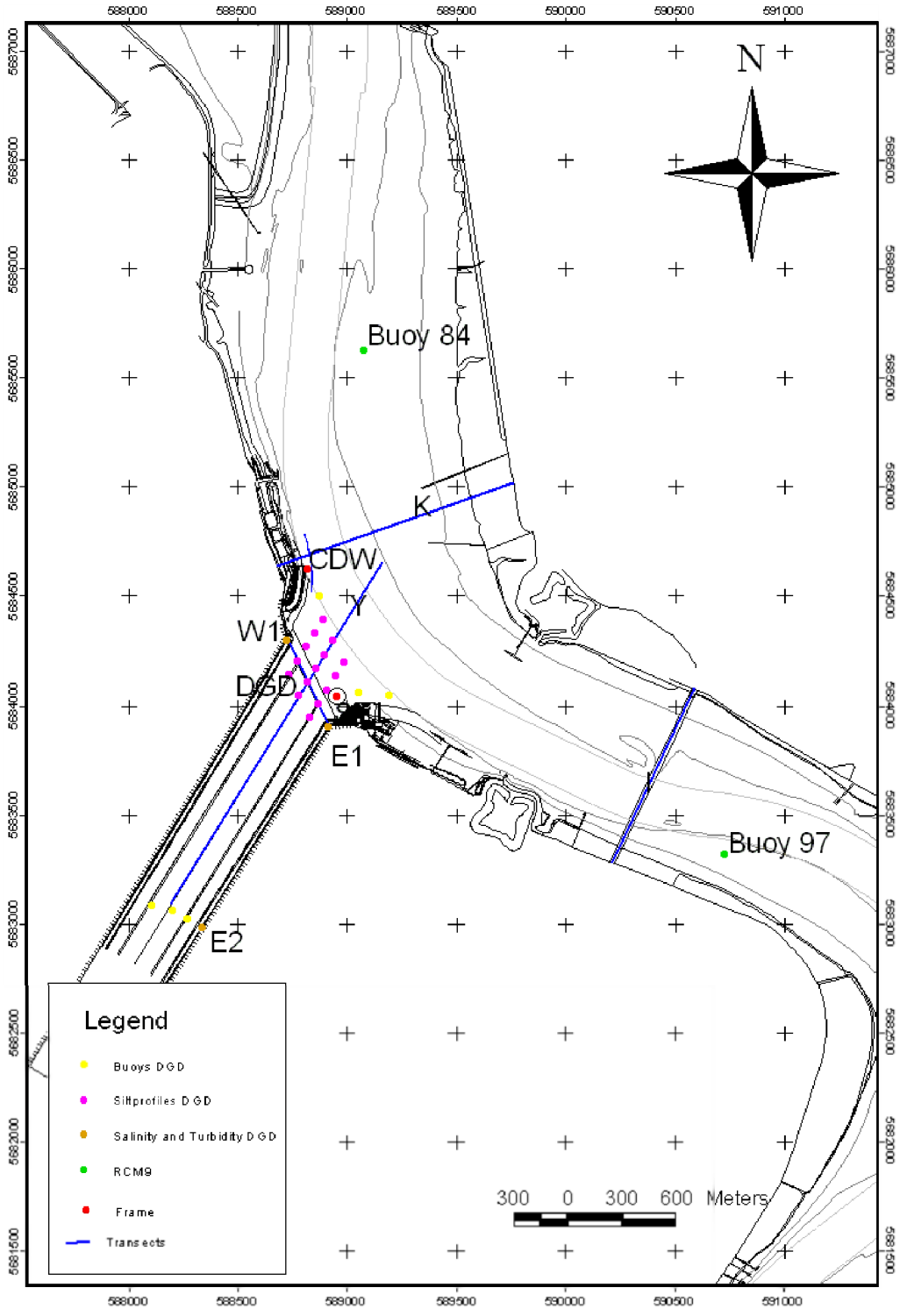
APPENDIX A.

OVERVIEW OF MEASUREMENTS

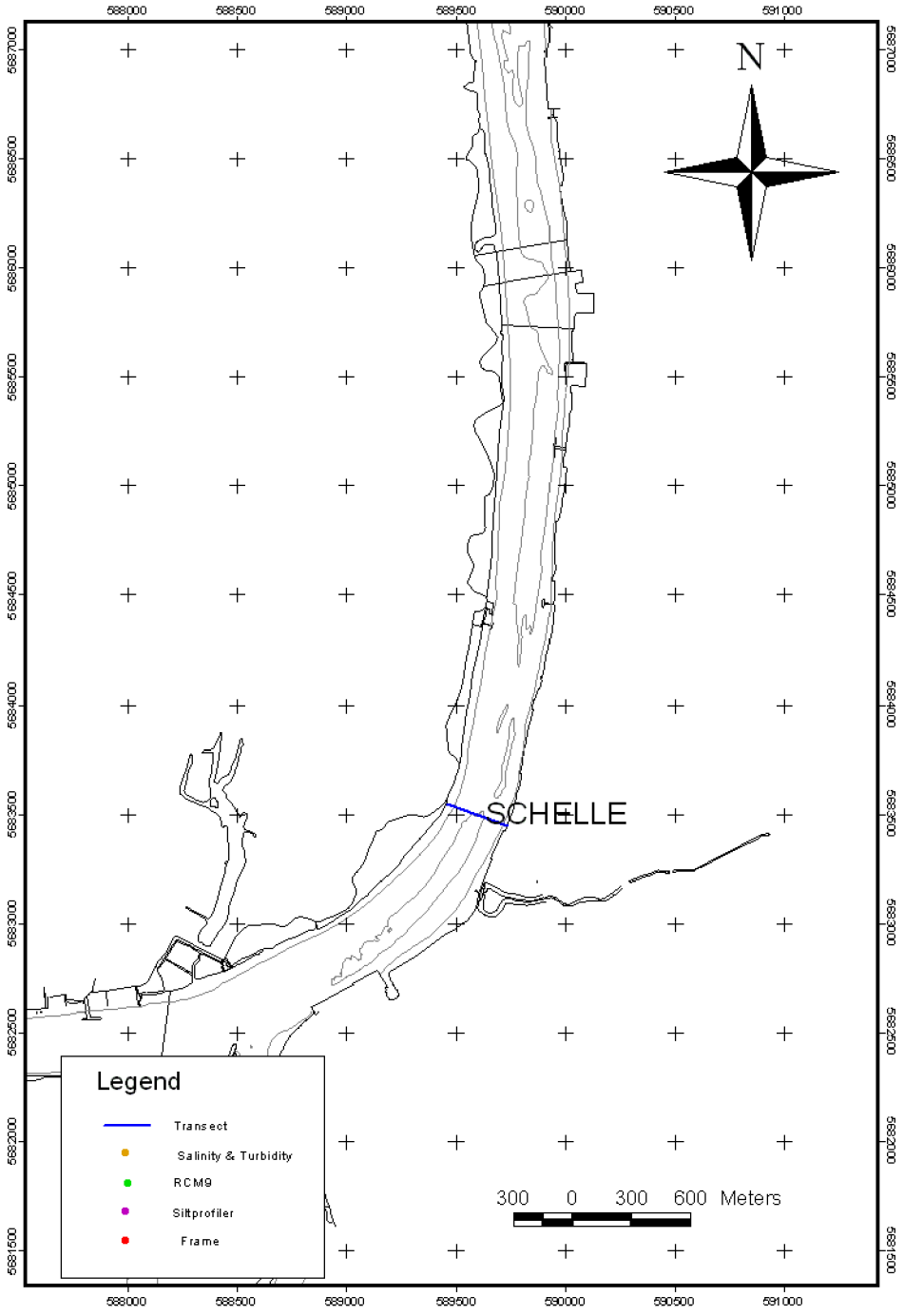
A.1 Overview of the measurement locations for the whole HCBS2 and Deurganckdok measurement campaigns



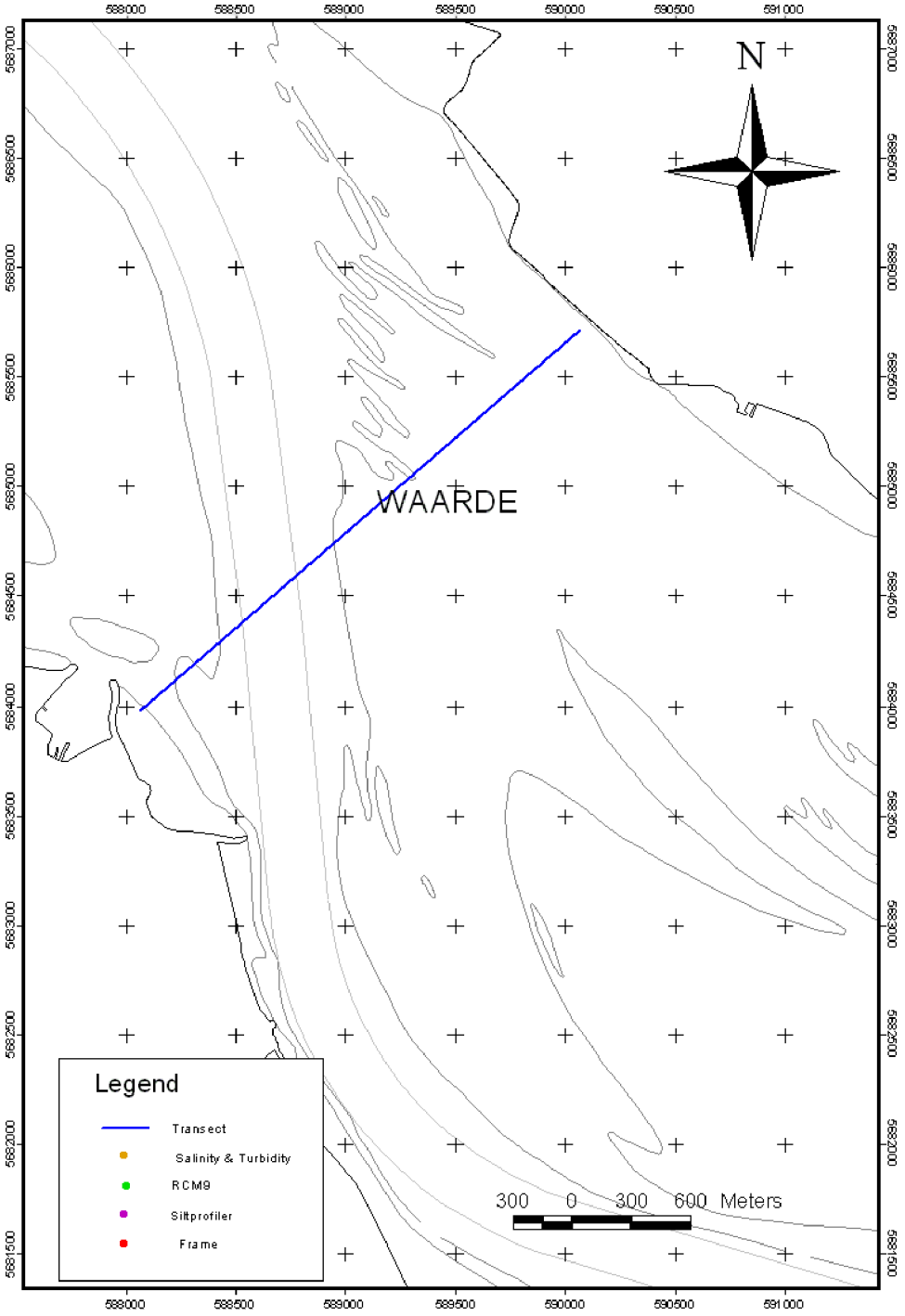
Annex Figure A-1: Overview of the measurement locations



Annex Figure A-2: Overview of the measurement locations at Deurganckdok



Annex Figure A-3: Transect S in Schelle



Annex Figure A-4: Transect W in Waarde

A.2 Overview of all measurement locations HCBS and Deurganckdok measurement campaigns

Annex Table A-1: coordinates of theoretical transects

Transect	Start Easting	Start Northing	End Easting	End Northing
I	590318.00	5683302.00	590771.00	5684257.00
K	588484.00	5684924.00	589775.00	5685384.00
SCHELLE	592645.07	5665794.06	592952.68	5665682.28
DGD	588764.88	5684056.49	588540.95	5684526.94
Y	589059.09	5684948.36	587898.76	5683076.56
WAARDE	573541.00	5696848.20	571318.00	5694932.90

Annex Table A-2: coordinates of SiltProfiler gauging locations

SP	EASTING	NORTHING
1	588737	5684638
2	588690	5684562
3	588643	5684486
4	588596	5684411
5	588549	5684335
6	588606	5684217
7	588653	5684293
8	588700	5684368
9	588747	5684444
10	588793	5684520
11	588850	5684402
12	588803	5684326
13	588756	5684250
14	588709	5684174
15	588662	5684099

A.3 Measurement overview at Transect Y on 11/03/2008

FileName	*Start time [hh:mm MET]*	*Time after HW [hh:mm]*	*Easting Start (UTM31 ED50)*	*Northing Start (UTM31 ED50)*	*Easting Stop (UTM31 ED50)*	*Northing Stop (UTM31 ED50)*	*Transect length [m]*	*Transect heading [°]*
4001Ytu	8:32	2:32	587496	5682130	588766	5684500	2689	28
4002Ytu	9:27	3:27	587503	5682142	588749	5684407	2585	29
4003Ytu	10:11	4:11	587479	5682097	588766	5684371	2613	30
4004Yti	10:39	4:39	588766	5684371	587564	5682239	2447	29
4005Ytu	10:55	4:55	587480	5682089	588745	5684387	2623	29
4006Yti	11:19	5:19	588786	5684462	587502	5682140	2654	29
4007Ytu	11:36	5:36	587496	5682130	588659	5684242	2411	29
4008Yti	11:59	5:59	588659	5684242	587484	5682256	2307	31
4009Ytu	12:37	- 5:42	587440	5682181	588808	5684443	2644	31
4010Yti	13:07	- 5:12	588757	5684357	587475	5682203	2506	31
4011Ytu	13:24	- 4:55	587438	5682142	588747	5684377	2590	30
4012Yti	13:51	- 4:28	588772	5684419	587466	5682232	2547	31
4013Ytu	14:10	- 4:09	587425	5682163	588742	5684345	2549	31
4014Yti	14:33	- 3:46	588746	5684348	587516	5682163	2508	29
4015Ytu	14:52	- 3:27	587487	5682111	588758	5684357	2581	30
4016Yti	15:18	- 3:01	588765	5684369	587531	5682179	2514	29
4017Ytu	15:34	- 2:45	587480	5682089	588810	5684453	2713	29
4018Yti	15:57	- 2:22	588810	5684453	587470	5682118	2692	30
4019Ytu	16:12	- 2:07	587467	5682113	588764	5684389	2620	30
4020Yti	16:37	- 1:42	588758	5684381	587472	5682258	2482	31
4021Ytu	16:53	- 1:26	587499	5682303	588778	5684371	2432	32
4022Yti	17:18	- 1:01	588799	5684406	587438	5682135	2647	31
4023Ytu	17:34	- 0:45	587422	5682109	588805	5684445	2715	31
4024Yti	17:57	- 0:22	588811	5684454	587423	5682196	2651	32
4025Ytu	18:15	- 0:04	587389	5682141	588778	5684397	2649	32
4026Yti	18:38	0:18	588787	5684410	587504	5682218	2540	30
4027Ytu	18:57	0:37	587444	5682114	588768	5684362	2609	30
4028Yti	19:15	0:55	588815	5684442	587485	5682217	2592	31
4029Ytu	19:35	1:15	587502	5682245	588682	5684253	2329	30
4030Yti	19:53	1:33	588748	5684364	587598	5682395	2281	30

APPENDIX B.

MEASUREMENT EQUIPMENT

CTD-Diver datalogger

Schlumberger WATER SERVICES

Applications

- Aquifer recharge projects
- Saltwater intrusion projects
- Surveillance against (illegal) discharges
- Surveillance on waste disposal sites
- Monitoring groundwater or surface water quality

CTD-Diver: reliable in all conditions

Where there is a need to monitor not only groundwater levels but also salinization, salt-water intrusion or contamination in the case of (illegal) discharges and landfill sites, the CTD-Diver is the instrument of choice. Besides a pressure and temperature sensor, the CTD-Diver has a four-electrode conductivity sensor for determining conductivity across a substantial measurement range (0-80 mS/cm). For each measurement, the date and time, groundwater level, temperature and conductivity are recorded. There are two options for conductivity measurement: display the measured conductivity or a specific conductivity at 25 °C. The CTD-Diver is accommodated in a ceramic casing which is resistant to corrosive conditions. The CTD-Diver has a memory with a maximum storage capacity of 16,000 measurement data per parameter.

Highlights:

- 3 year warranty
- Long-term and frequent measurements
- Various measurement methods:
  - fixed
  - event dependent
  - pumping tests
- Simple calibration
- Temperature corrected measurement
- Reliable and accurate measurement data
- Compact size
- Robust construction:
  - ceramic
  - corrosion resistant
- Measures three parameters:
  - conductivity
  - temperature
  - pressure

Specifications:

Dimensions	Ø22 mm x 185 mm
Memory	16,000 measurements (non-volatile)
Sample rate *	0.5 sec to 99 hours
Housing material	ceramic (ZrO_2)
Temperature range	-20 °C to 80 °C
- accuracy	±0.1 °C
- resolution	0.01 °C
Conductivity:	
- range	0 to 80 mS/cm
- accuracy	±1% of reading
- resolution	0.1% of reading
Battery life	10 years (depending on use)
Weight	150 grams

CTD-Diver® Technical specifications (pressure)

Type	DI 261	DI 263	DI 265	DI 500 (Baro)
Range	10 m H_2O	30 m H_2O	100 m H_2O	15 m H_2O
- accuracy**	1 cm H_2O	3 cm H_2O	10 cm H_2O	0.5 cm H_2O
- resolution	0.2 cm H_2O	0.6 cm H_2O	2 cm H_2O	0.1 cm H_2O

* various measuring methods available (fixed, event based and pumping tests)

** within temperature compensated range (0°C to 40°C)

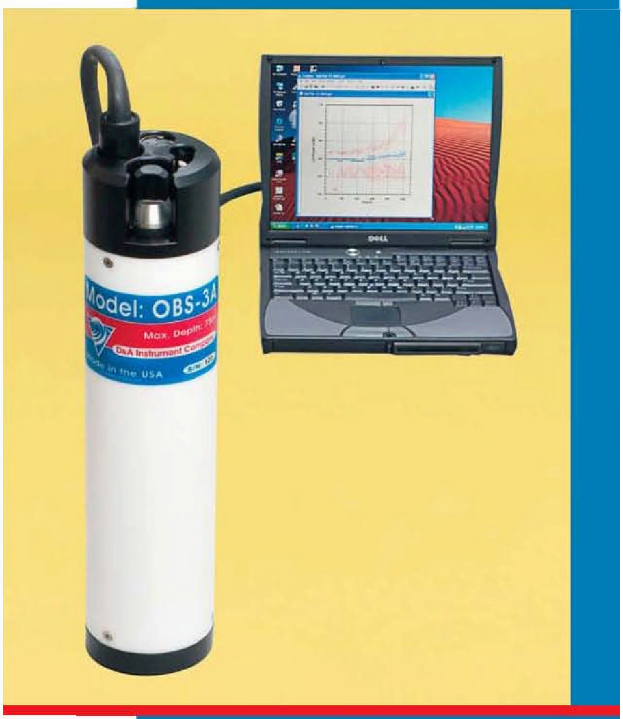
OBS®-3A

Sediment Instruments for all Environments

Innovative logger of suspended solids, pressure, temperature, and salinity.

NEW FEATURES!

- No cable required, runs 1,500–8,000 hours on 3 "D" cells
- Measures sediment concentrations to 5,000 mg/l & turbidity to 4,000 NTU with field-proven OBS® technology (U.S. Patent No. 4,841,157)
- Logs depth, wave height, wave period, temperature, and salinity
- Records 200,000 lines of data in FLASH
- Compact package — 76 mm (3") by 362 mm (14.3")
- Program setpoints & sampling times



APPLICATIONS

- Record turbidity at remote sites
- Monitor dredging & mining operations
- Wastewater effluent measurements
- Sediment transport research
- River and stream gauging
- Permit compliance

DESCRIPTION

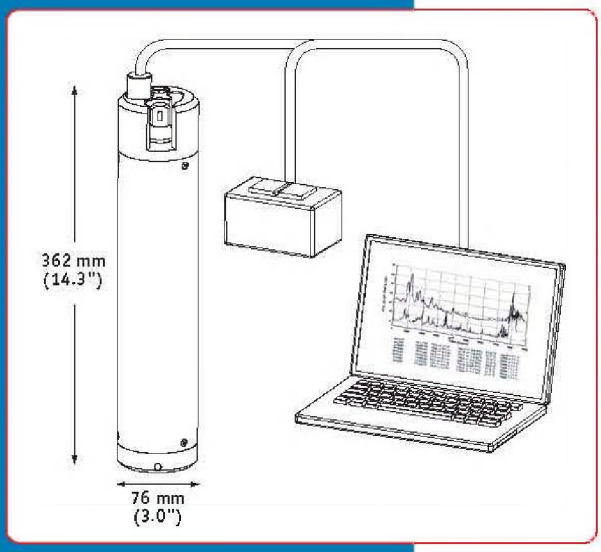
The OBS-3A combines our OBS probe with pressure, temperature, and conductivity sensors in a battery-powered recording instrument. The monitor is operated with software running under Windows® 98, 2000, and XP.

NEW OPERATIONS!

Users can program sampling schedules with a PC. When surveying, data are displayed in real time as they are recorded. During autonomous operation, the unit records data in FLASH which can be post-processed and graphically displayed with EXCEL or LOTUS.

D&A
INSTRUMENT COMPANY

OBS-3A®



RANGES

Turbidity		0–4,000 NTU
Concentration[1]	Mud	0–5,000 mg/l
	Sand	0–50 g/l
Pressure		0–200 dBar[2]
Temperature		0–40° C
Conductivity		0–65 mS/cm

[1] Range depends on sediment type.
[2] 1 dBar is equivalent to about 1 meter of water.

ACCURACY

Turbidity	0–100	0.5 NTU
	100–500	2 NTU
	500–4,000	10 NTU
Concentration	Mud	0.5 mg/l
	Sand	0.5 g/l
Pressure		0.2% of f.s.[3]
Temperature		0.05° C
Conductivity		0.07 mS/cm

[3] f.s. = 50, 100, or 200 dBar

OTHER DATA

PC interfaces	RS-232 / 115 kbps
	RS-485 / 115 kbps
	USB
Maximum data rate	25 Hz
Infrared wavelength	875 nm
Maximum depth	300 m
Drift	< 2% / year
Connector	MCBH-7-FS, wet-pluggable

ORDERING INFORMATION

- Consult the manufacturer about your application.
- Specify cable length.
- Choose sensor options for application.

PAYMENT AND SHIPPING TERMS

VISA and MasterCard accepted. COD, prepay, or LC without credit approval; Net 30 Days otherwise. EXW Port Townsend, Washington, USA

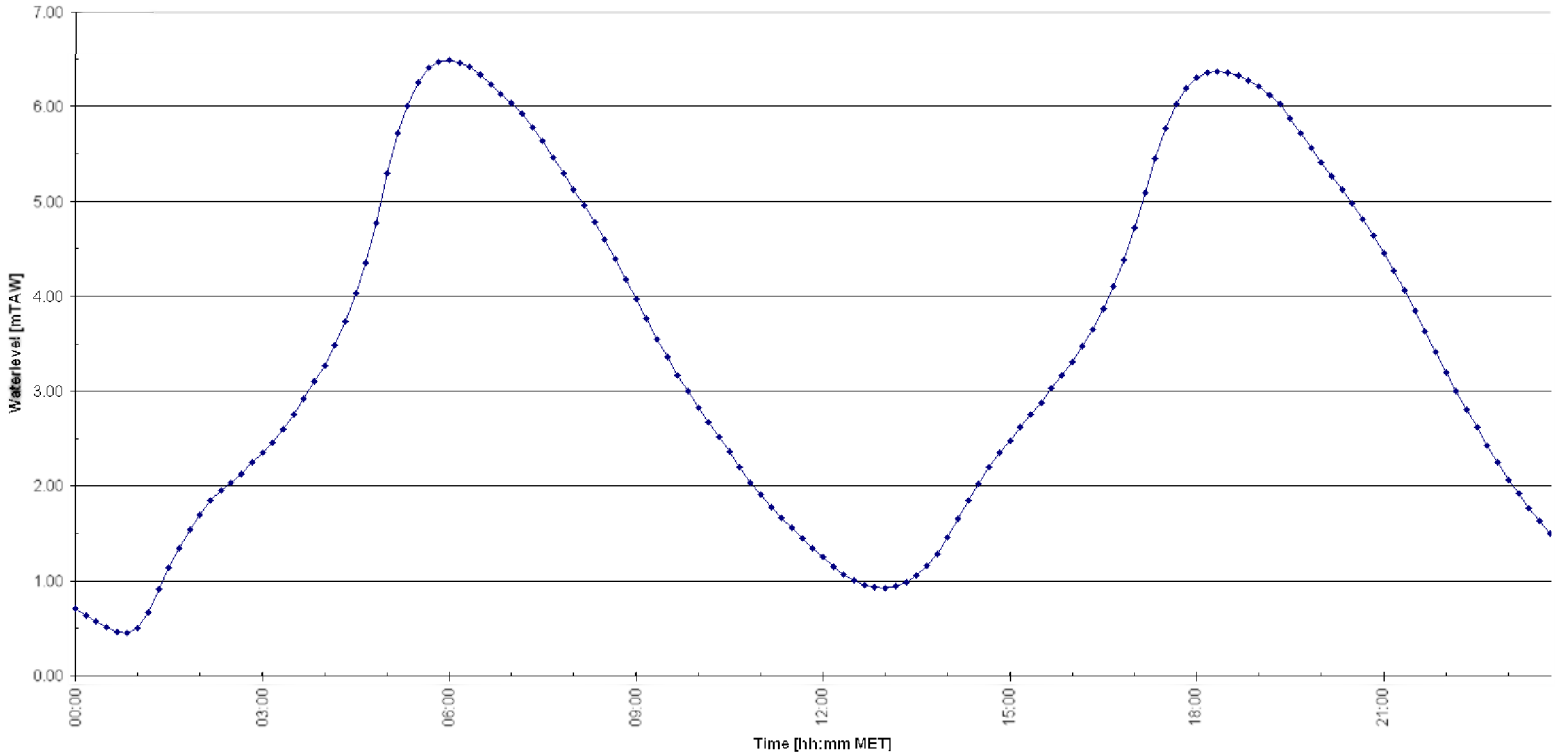
Represented by:

D&A
INSTRUMENT COMPANY

24 Seton Road, Port Townsend, Washington U.S.A. 98368
Phone: (800) 437-8352 • (360) 385-0272 • Fax: (360) 385-0460
e-mail: products@D-A-Instruments.com • website: www.D-A-Instruments.com

APPENDIX C. TIDAL DATA

11283 DGD 2 – March 2008 SURVEY



Measured tide on 11/03/2008 at Liefkenshoek

Location:	Date:
River Scheldt	12/03/2008

Data processed by: IMDC

In association with: WL | delft hydraulics, GEMS International

I/RA/11283/07.087/MSA

APPENDIX D.

NAVIGATION INFORMATION AS RECORDED ON SITE

Ship:			***Veremans!***
Location:			***Deurganckdok (transectYl)***
Nr.	***Time (MET)***	***Type ship***	***Direction (Upstream, Downstream)***
1	8:18	Containerschip Maersk	invarend
2	8:25	Sleepboot Union 7	*invarend*
3	8:42	Sleepboot	invarend
4	8:55	Scheldewacht II	stationair
5	8:05	Sleepboot Union 8	Uitvarend
6	8:10	Scheldewacht II	stationair
7	8:11	Union 11	Invarend
8	8:15	Binnenvaart Camaro	Uitvarend
9	9:30	Brabo, dienst	Uitvarend
10	9:40	Rotterdam, tanker	Invarend
11	9:45	Scheldewacht II	stationair
12	9:56	Scheldewacht II	stationair
13	10:00	Binnenvaart So Long	Uitvarend
14	10:15	Binnenvaart Antigoon	Uitvarend
15	10:35	Scheldewacht II	stationair
16	10:40	Scheldewacht II	stationair
17	10:55	Container Antigoon	Invarend
18	11:02	Ad-fundum	Invarend
19	11:20	Scheldewacht II	stationair
20	11:20	Independent II	Invarend
21	11:22	DN-31	Uitvarend
22	11:22	Scheldewacht II	stationair
23	11:40	El-Blajo	Invarend
24	12:00	Zeeschip Monte Pascoal	Invarend
25	12:00	Union 9	Invarend
26	12:00	Uinion Emerald	Invarend
27	12:00	Union Anton V	Invarend
28	12:28	Binnenvaart Vela + Alpina	Invarend
29	12:30	DN-31	Invarend
30	12:30	So Long	Invarend
31		Union 9	Uitvarend

Ship:		*Veremansl*	
Location:		*Deurganckdok (transectYl)*	
Nr.	***Time (MET)***	***Type ship***	***Direction (Upstream, Downstream)***
32		Union Emerald	Uitvarend
33	12:45	SPN 14	Invarend
34	12:46	Anton V	Uitvarend
35	13:19	Tanksschip Varik	Uitvarend
36	13:20	Rotterdam	Uitvarend
37	13:25	Tankschip Imperial	Invarend
38	13:30	Binnenvaart Nautiek	Invarend
39	13:34	Tankschip Amalia	Uitvarend
40	13:35	Duwbak Schelde + Duwer Nairobi	Uitvarend
41	13:38	DN-31	Uitvarend
42	13:43	Union Emerald	Invarend
43	13:44	Union 9	Invarend
44	13:48	Binnenschip Pretoria	Invarend
45	13:50	Scheldewacht II	stationair
46	13:51	Union Ruby	Invarend
47	13:54	Scheldewacht II	stationair
48	13:56	DN-31	Invarend
49	14:01	Tankschip Elveba	Invarend
50	14:10	La Prorinnie	Uitvarend
51	14:12	Zandschip Rio 4	Uitvarend
52	14:20	Union 9	Uitvarend
53	14:25	Binnenschip Karveel	Invarend
54	14:26	Tankschip Rotterdam	Invarend
55	14:30	So Long	Uitvarend
56	14:30	Scheldewacht II	stationair
57	14:34	Union Kodak	Invarend
58	14:35	Binnenschip Sarina	Invarend
59	14:36	Scheldewacht II	stationair
60	14:44	Baggerschip Jade River	Uitvarend
61	14:51	Politieboot SPN 14	Invarend
62	14:55	Union Ruby	Uitvarend
63	15:13	Scheldewacht II	stationair

Ship:		*Veremansl*	
Location:		*Deurganckdok (transectYl)*	
Nr.	***Time (MET)***	***Type ship***	***Direction (Upstream, Downstream)***
64	15:20	Union Emerald	Uitvarend
65	15:21	Scheldewacht	stationair
66	15:31	Union 8	Invarend
67	15:33	Baggerschip Jade River	Invarend
68	15:38	Binnenschip Brutus	Invarend
69	15:36	Karveel	Uitvarend
70	15:38	DN-31	Uitvarend
71	15:51	Zeeschip Vegaland	Invarend
72	15:54	Scheldewacht II	stationair
73	15:55	DN-31	Invarend
74	16:00	Ad-fundum	Uitvarend
75	16:01	Scheldewacht II	stationair
76	16:02	Sarino	Uitvarend
77	16:05	Zeeschip GrenoLine	Uitvarend
78	16:05	Veronique	Uitvarend
79	16:08	Margreta	Invarend
80	16:10	Union Ruby	Invarend
81	16:35	Scheldewacht II	stationair
82	16:40	Scheldewacht II	stationair
83	16:51	Binnenschip	Invarend
84	16:52	Schelde 12	Invarend
85	16:53	Union 8	Invarend
86	16:56	Melek B	Invarend
87	17:13	Union Emerald	Invarend
88	17:15	Union 9	Invarend
89	17:16	Scheldewacht II	stationair
90	17:21	Scheldewacht II	stationair
91	17:50	Independent 1	Uitvarend
92	17:50	Independent 2	Uitvarend
93	17:52	El Blajo	Uitvarend
94	17:54	Sint Antonius	Invarend
95	17:55	Scheldewacht II	stationair
96	17:56	Imperial	Uitvarend

Ship:		*Veremans!*	
Location:		*Deurganckdok (transectYl)*	
Nr.	***Time (MET)***	***Type ship***	***Direction (Upstream, Downstream)***
97	18:00	Scheldewacht II	stationair
98	18:06	Lieve Govaert	Uitvarend
99	18:14	DN-31	Uitvarend
100	18:35	Scheldewacht II	stationair
101	18:37	Antigoon	Uitvarend
102	18:39	Scheldewacht II	stationair
103	18:46	DN-31	Invarend
104	18:50	Union 9	Uitvarend
105	18:50	Union Emerald	Uitvarend
106	19:00	DN-31	Invarend
107	19:07	Nautiek	Uitvarend
108	19:14	Scheldewacht II	stationair
109	19:20	Scheldewacht II	stationair
110	19:30	Pretoria	Uitvarend
111	19:53	Odessa	Uitvarend
112	19:54	Scheldewacht II	stationair
113	19:56	Scheldewacht II	stationair
114	20:22	Alpina	Uitvarend
115	20:40	Sownent	Invarend
116	20:45	Colommer	Invarend

APPENDIX E.

UNESCO PPS-78 FORMULA FOR CALCULATING SALINITY

Practical Salinity Scale (PPS 78) Salinity in the range of 2 to 42

Constants from the 19th Edition of Standard Methods

R cond.ratio	0.0117	$R = \frac{C}{42.914 mS/cm}$	
C Cond at t	**0.5**		**Input conductivity in mS/cm of sample**
t deg. C	**22.00**		**Input temperature of sample solution**
P dBar	**20**		**Input pressure at which sample is measured in decibars**
Rp	1.0020845	$R_p = 1 + \frac{p(e_1 + e_2 p + e_3 p^2)}{1 + d_1 t + d_2 t^2 + (d_3 + d_4 t)R}$	
rt	1.1641102	$r_t = c_0 + c_1 t + c_2 t^2 + c_3 t^3 + c_4 t^4$	
Rt	0.0099879	$R_t = \frac{R}{R_p \times r_t}$	
Delta S	-0.0010	$\text{Delta S} = \frac{(t-15)}{1+k(t-15)}(b_0 + b_1 R_t^{1/2} + b_2 R_t + b_3 R_t^{3/2} + b_4 R_t^2 + b_5 R_t^{5/2})$	
S = Salinity	**0.257**	$S = a_0 + a_1 R_t^{1/2} + a_2 R_t + a_3 R_t^{3/2} + a_4 R_t^2 + a_5 R_t^{5/2} + \text{delta S}$	

a0	0.0080	b0	0.0005	c0	0.6766097	d1	3.426E-02	e1	2.070E-04
a1	-0.1692	b1	-0.0056	c1	2.00564E-02	d2	4.464E-04	e2	-6.370E-08
a2	25.3851	b2	-0.0066	c2	1.104259E-04	d3	4.215E-01	e3	3.989E-12
a3	14.0941	b3	-0.0375	c3	-6.9698E-07	d4	-3.107E-03		
a4	-7.0261	b4	0.0636	c4	1.0031E-09				
a5	2.7081	b5	-0.0144						
		k	0.0162						

R = ratio of measured conductivity to the conductivity of the Standard Seawater Solution

Conductivity Ratio R is a function of salinity, temperature, and hydraulic pressure. So that we can factor R into three parts i.e.

R = Rt x Rp x rt

R = C(S,t,p)/C(35,15,0)

C = 42.914 mS/cm at 15 deg C and 0 dbar pressure ie C(35,15,0) where 35 is the salinity

Ocean pressure is usually measured in decibars. 1 dbar = 10^-1 bar = 10^5 dyne/cm^2 = 10^4 Pascal.

APPENDIX F. CONTOURPLOTS OF SALINITY PER SAILED TRANSECT

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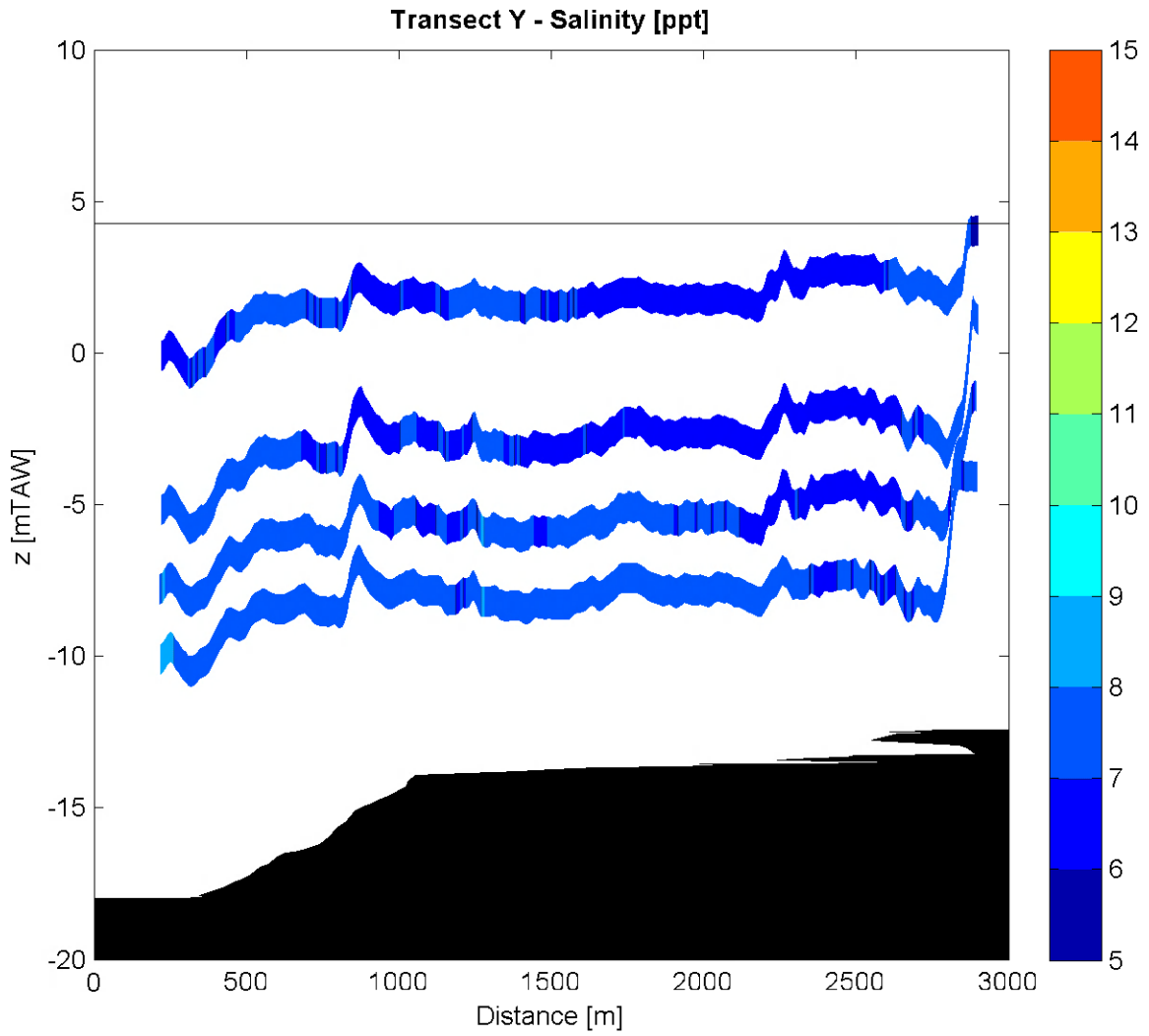
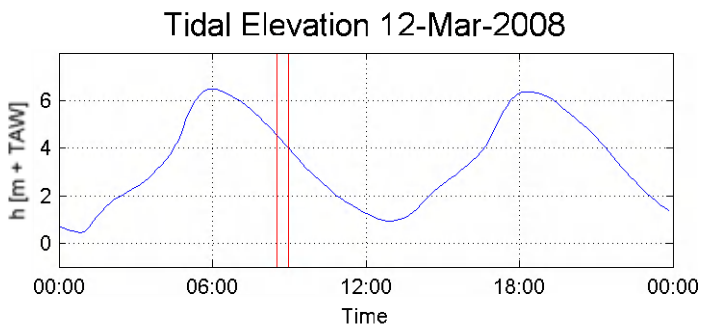
Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
08:32 - 08:58

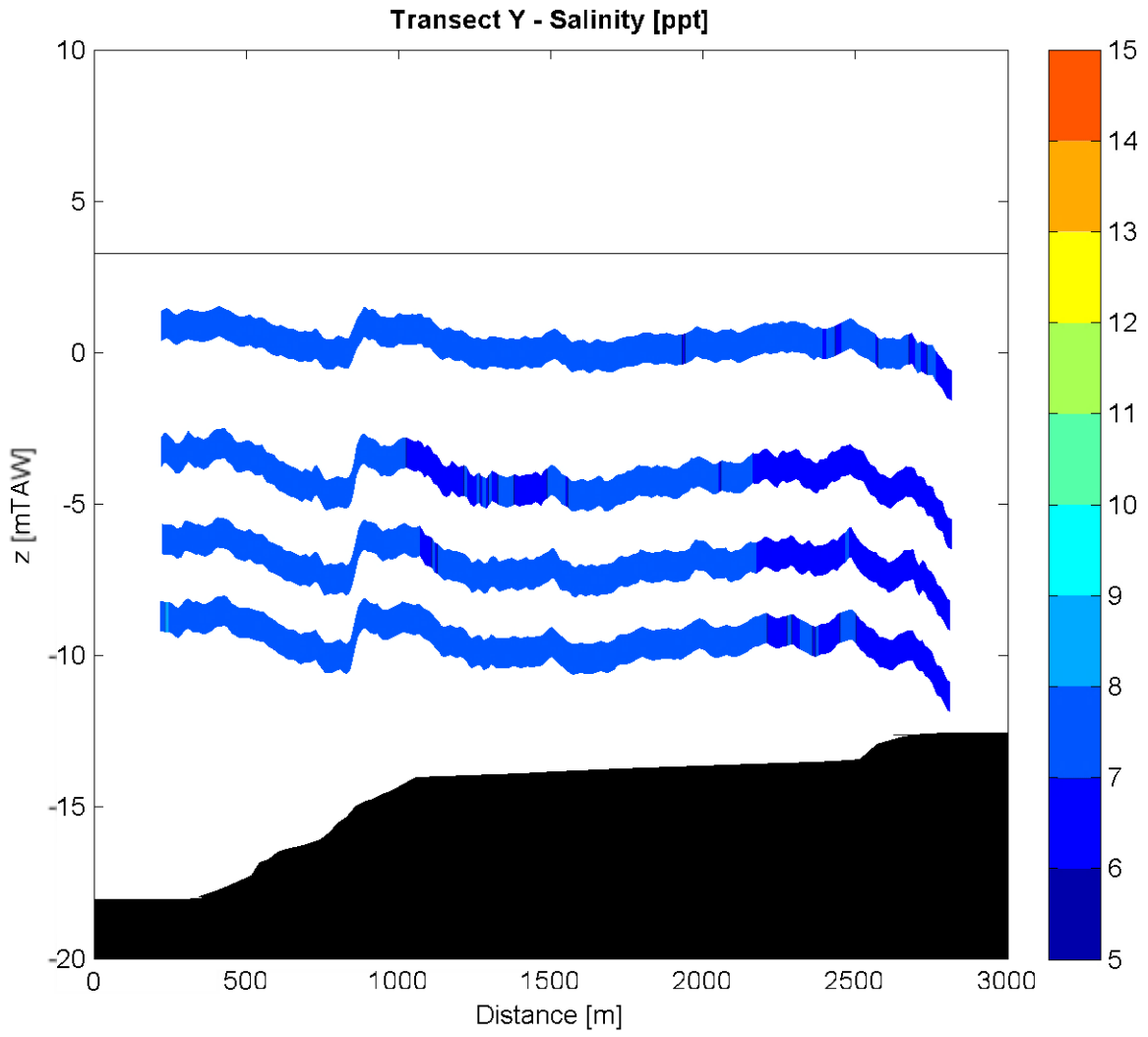
Time after HW [HH:MM]
2:45

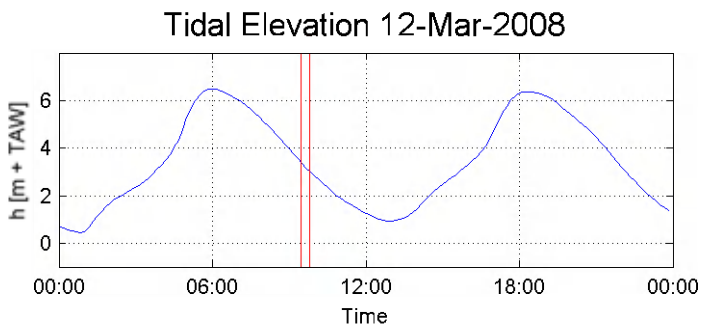
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
09:27 - 09:49

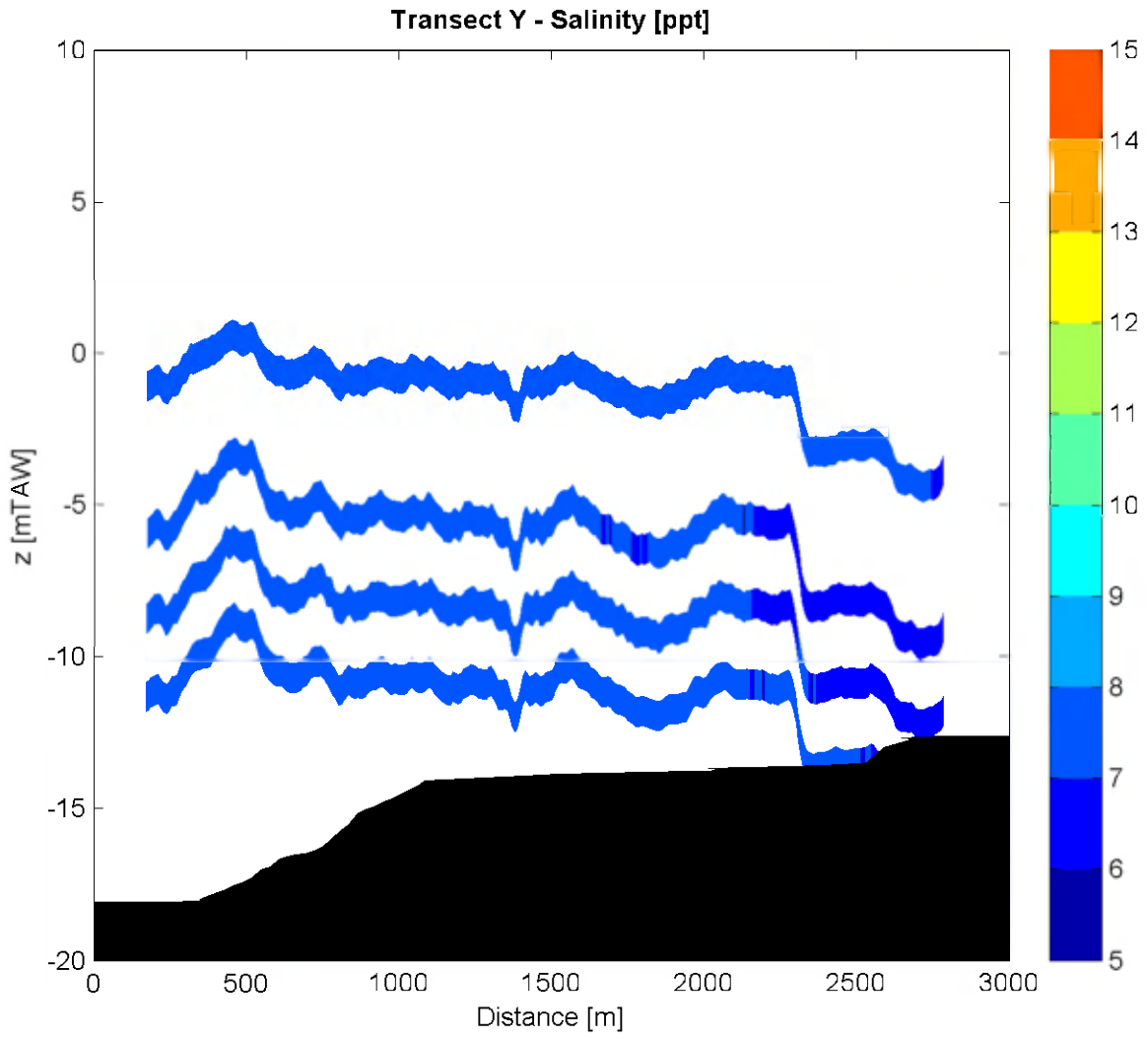
Time after HW [HH:MM]
3:38

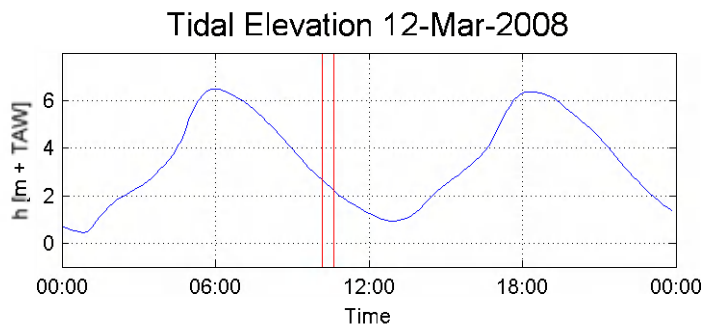
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
10:11 - 10:37

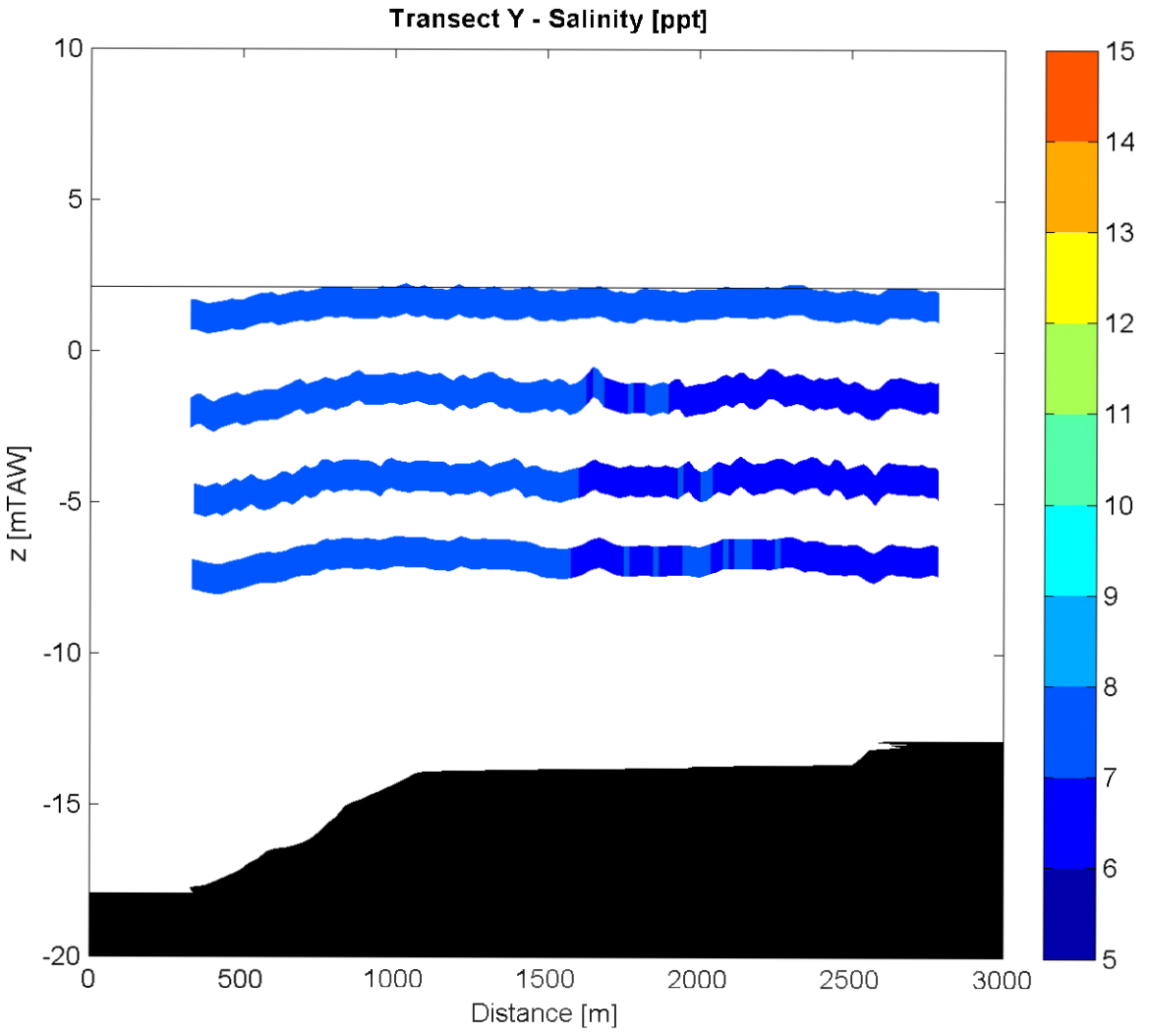
Time after HW [HH:MM]
4:24

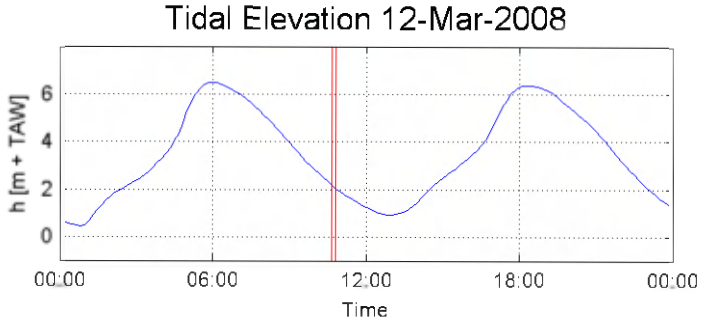
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
10:39 - 10:50

Time after HW [HH:MM]
4:44

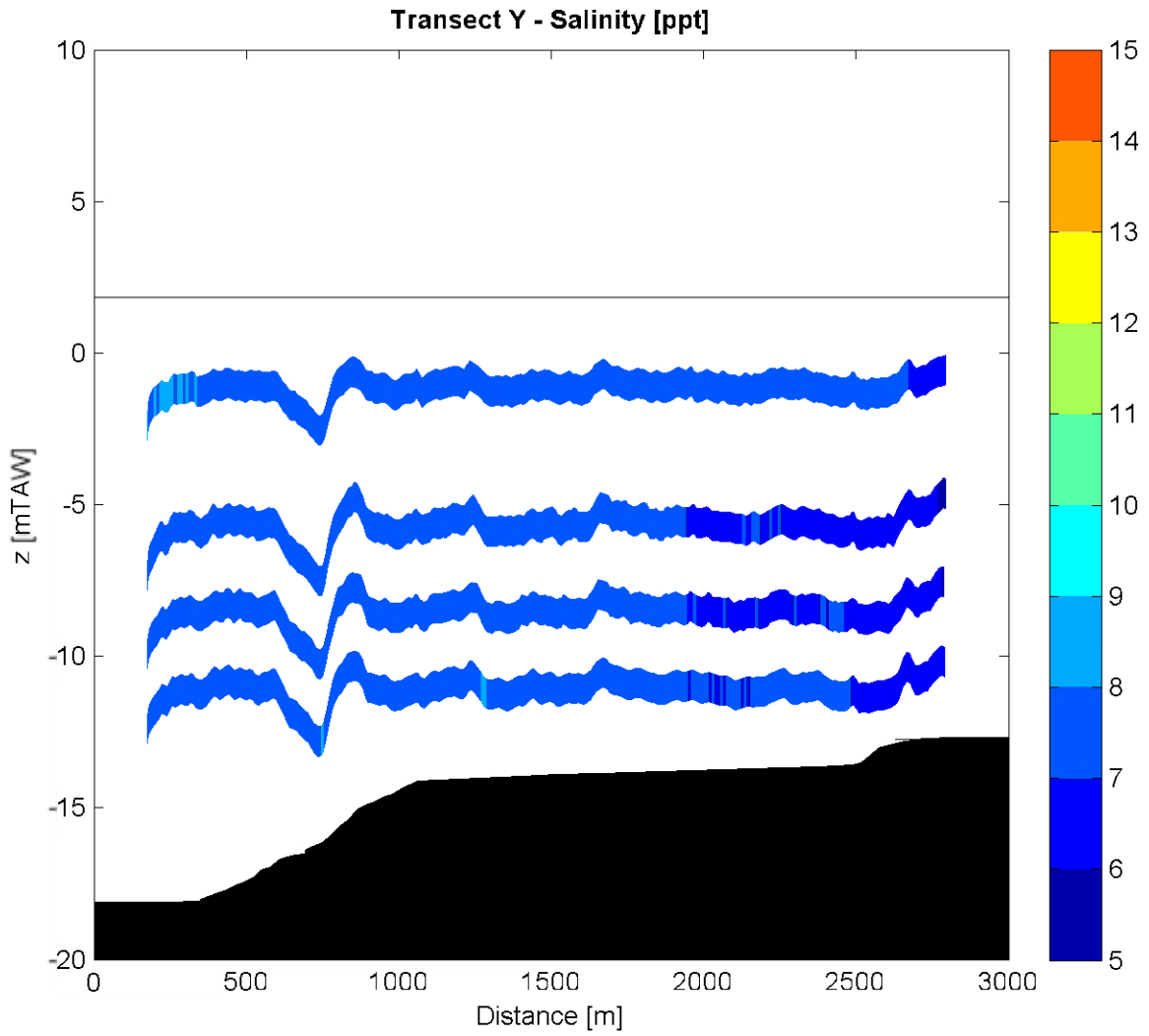
Data Processed by: IMDC

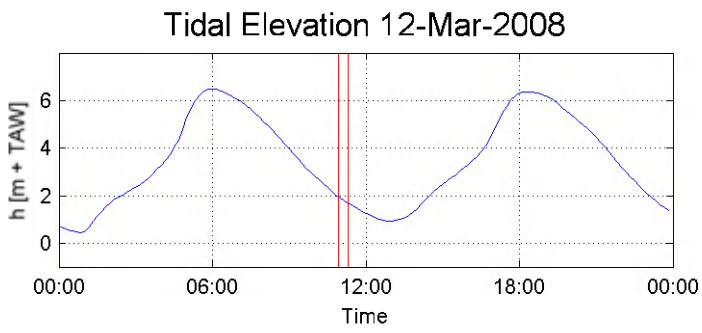
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

10:55 - 11:18

Time after HW [HH:MM]

5:06

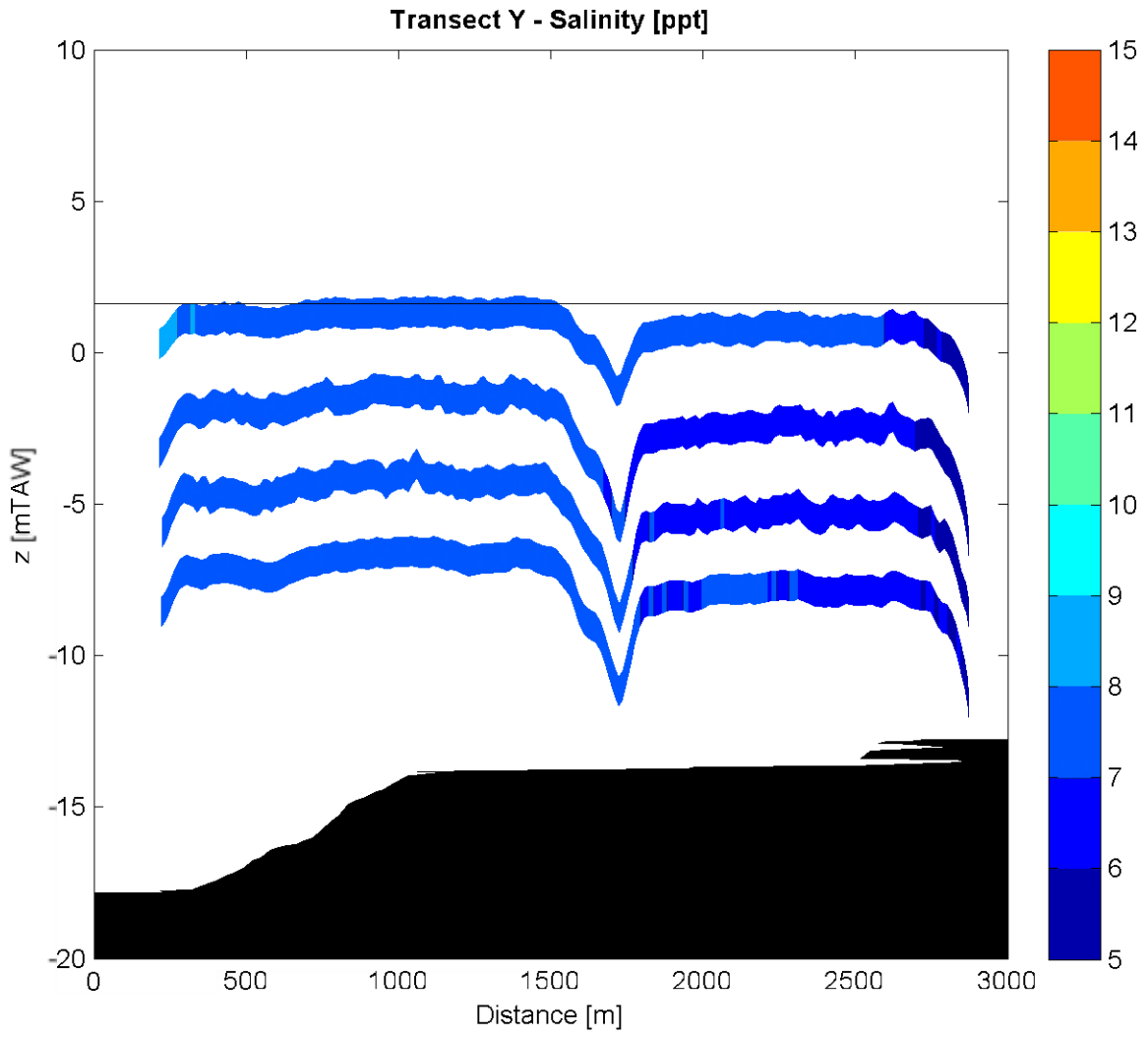
Data Processed by: IMDC

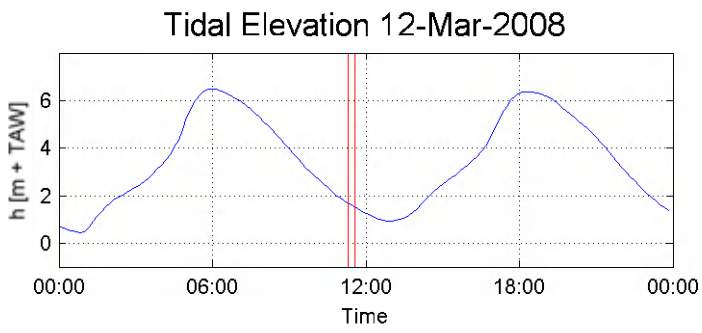
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

11:19 - 11:35

Time after HW [HH:MM]

5:27

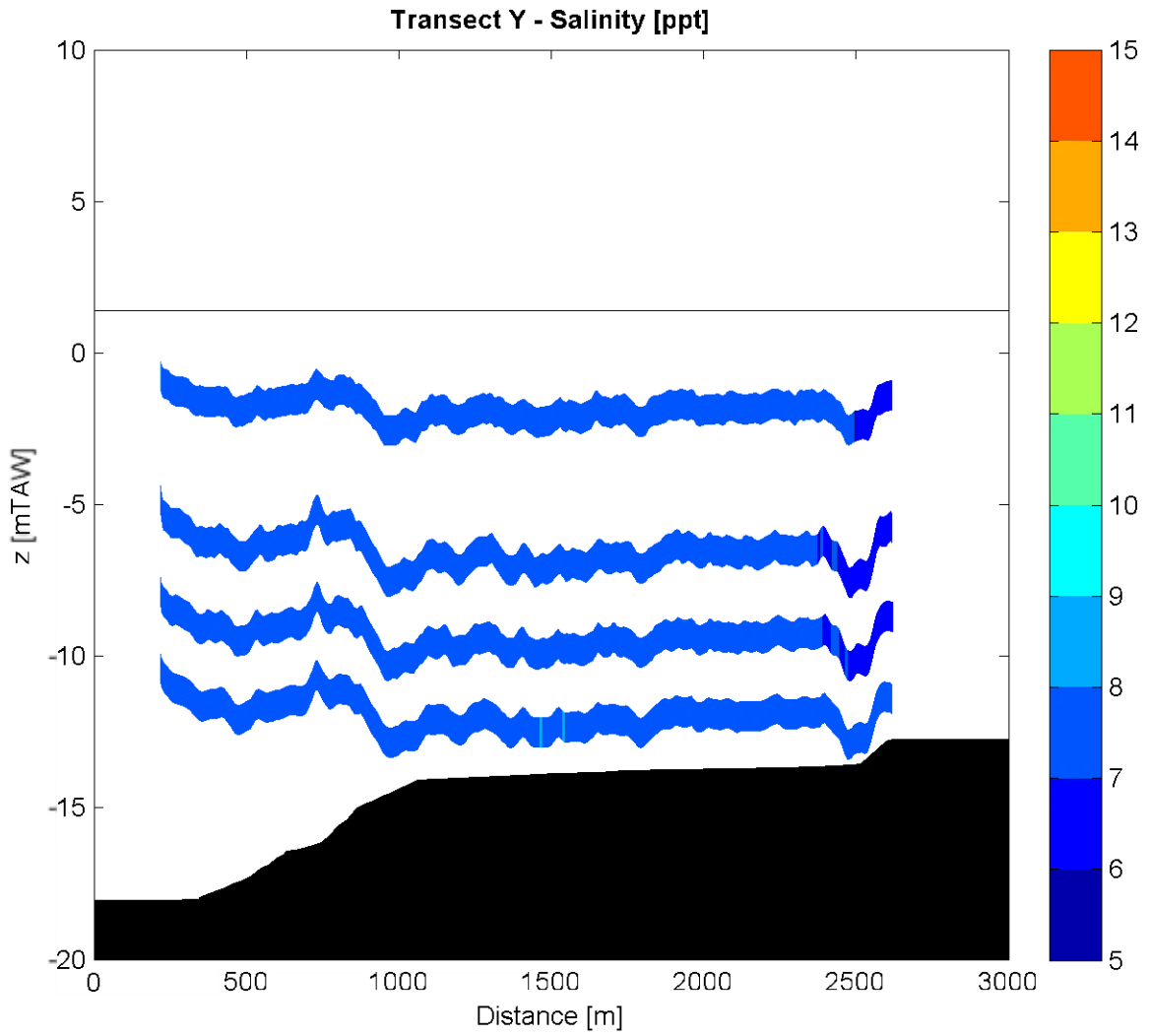
Data Processed by: IMDC

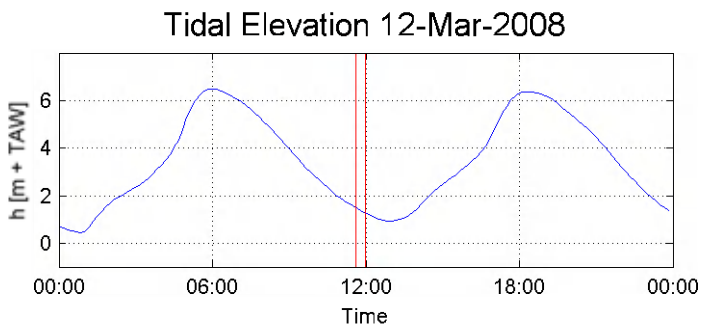
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
11:36 - 11:58

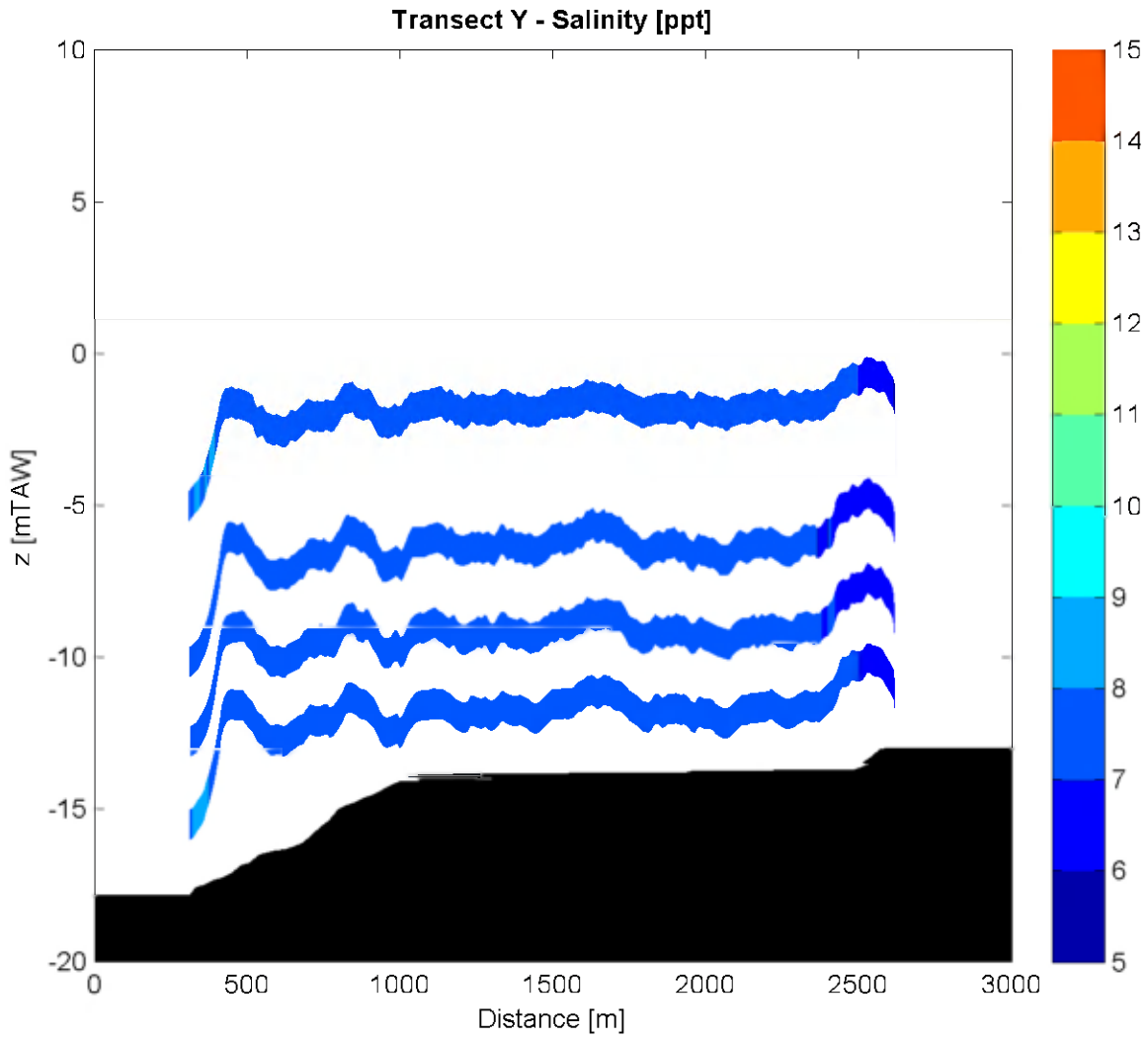
Time after HW [HH:MM]
5:47

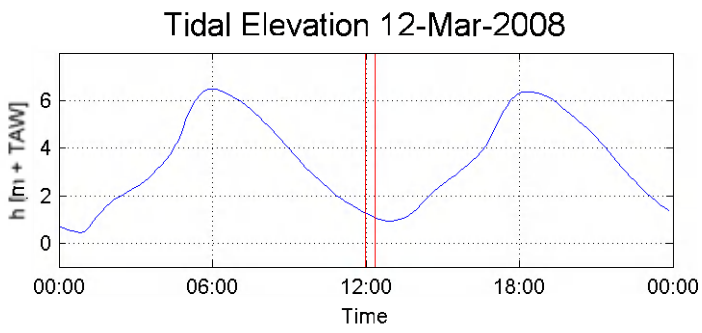
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

11:59 - 12:21

Time after HW [HH:MM]

6:10

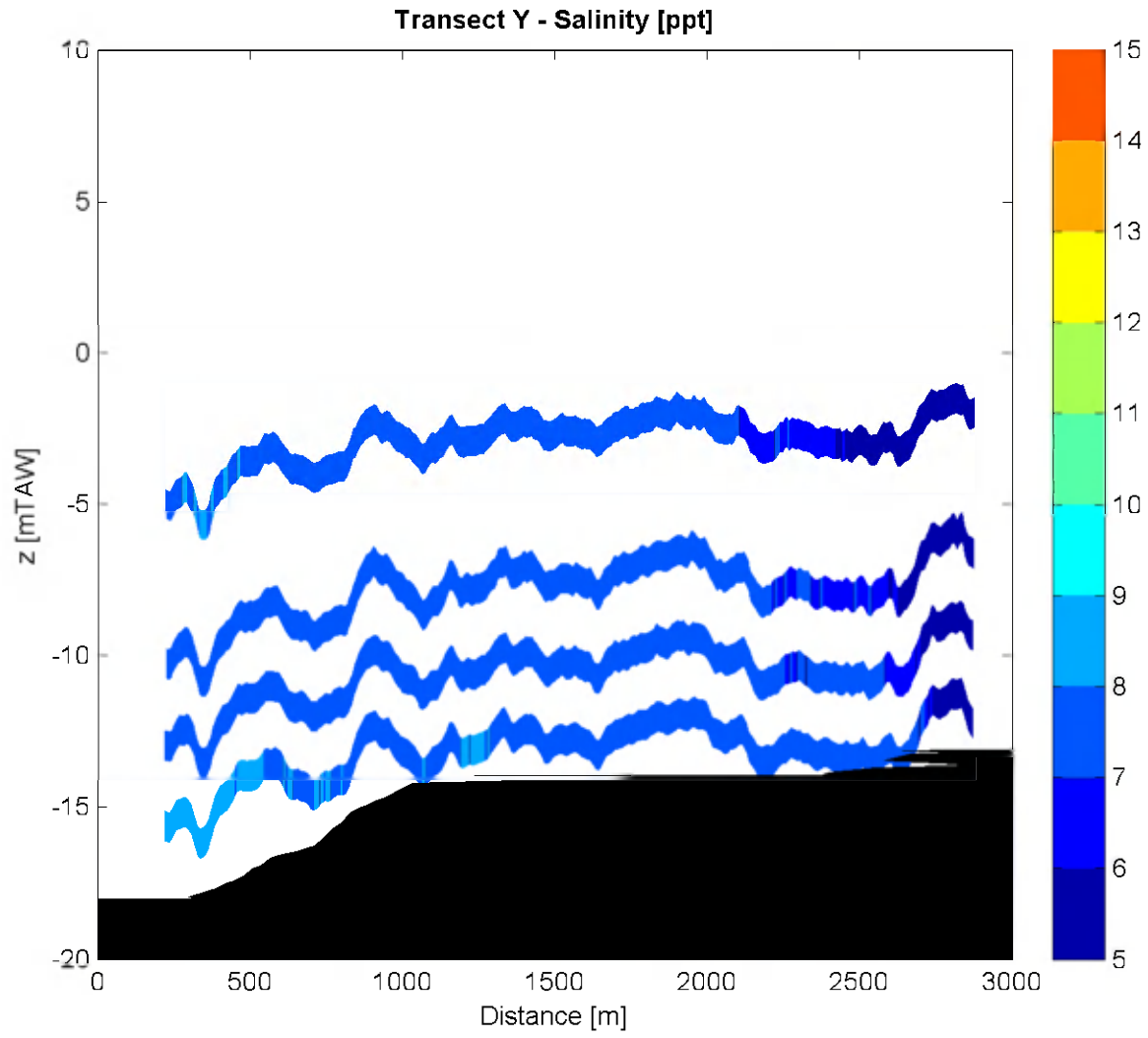
Data Processed by: IMDC

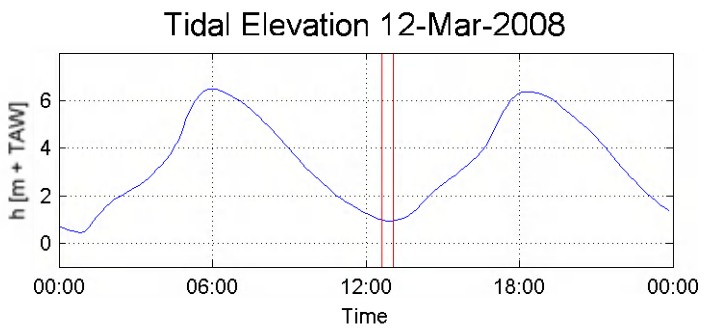
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
12:37 - 13:05

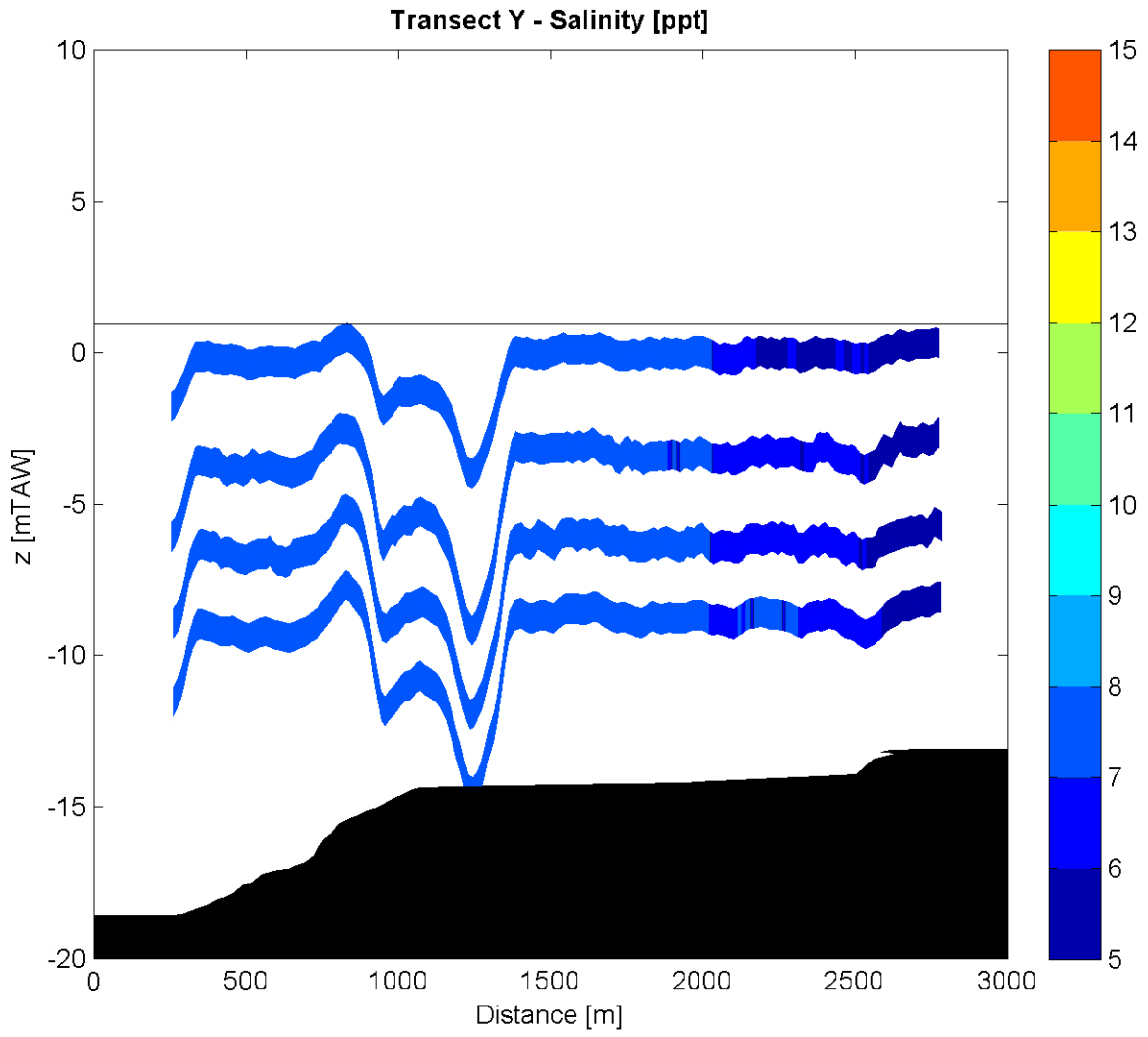
Time after HW [HH:MM]
6:51

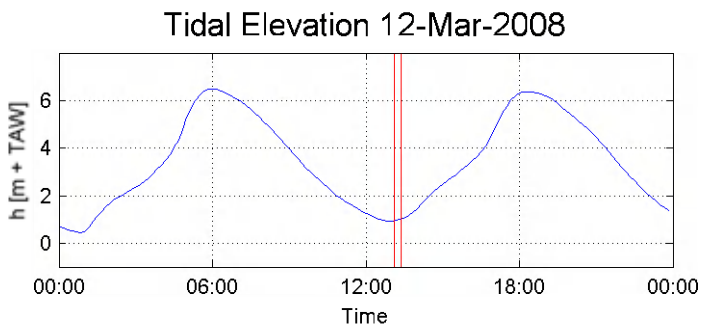
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
13:07 - 13:23

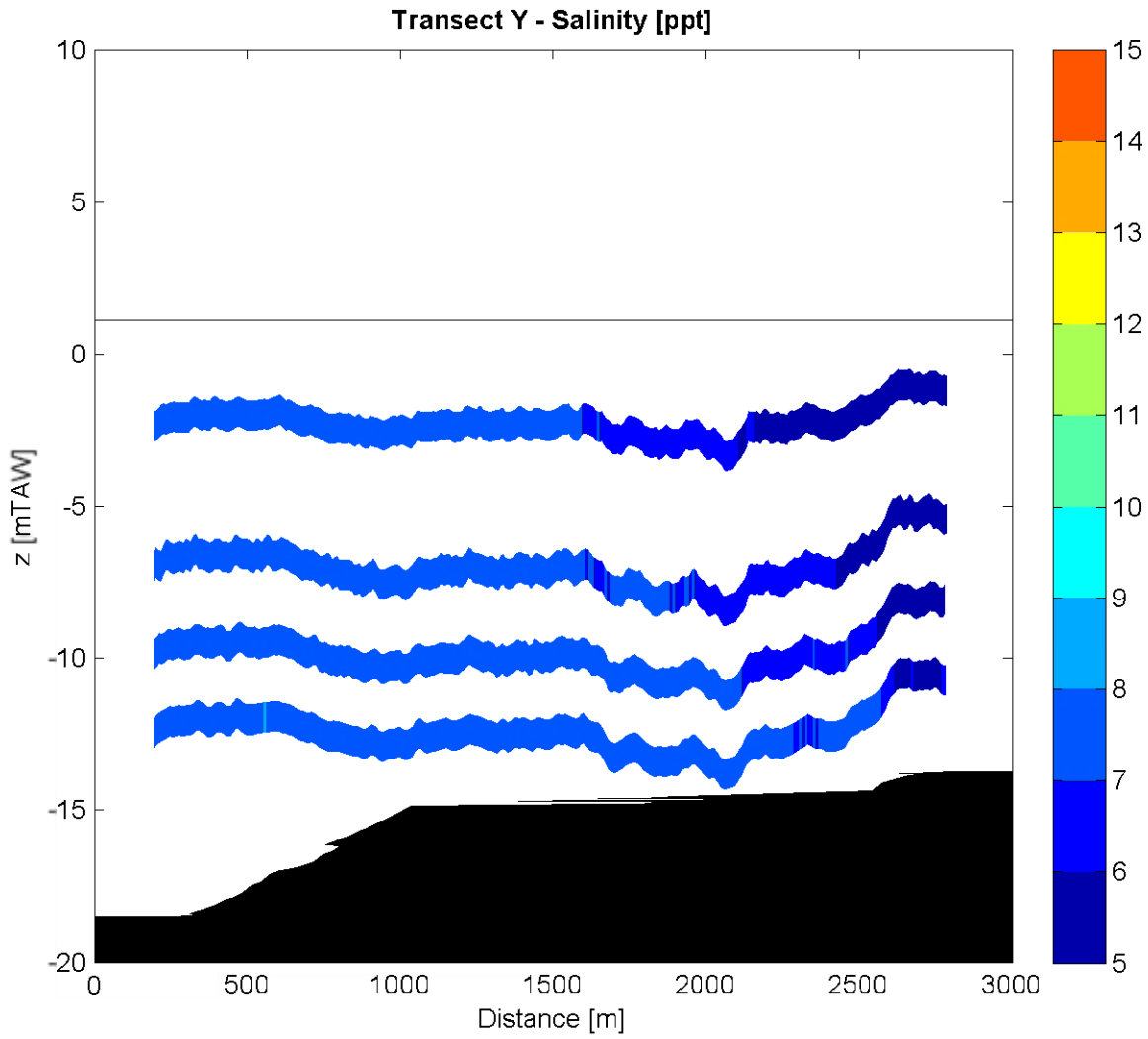
Time after HW [HH:MM]
7:15

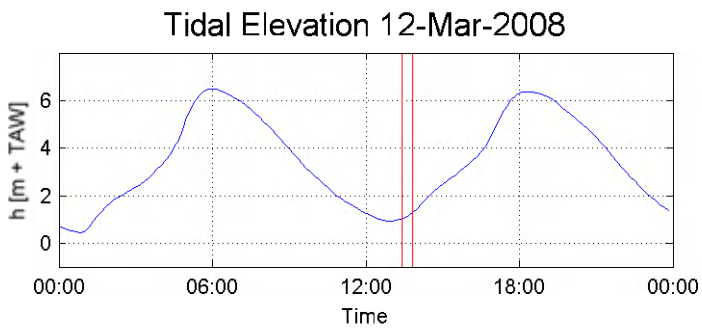
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
13:24 - 13:49

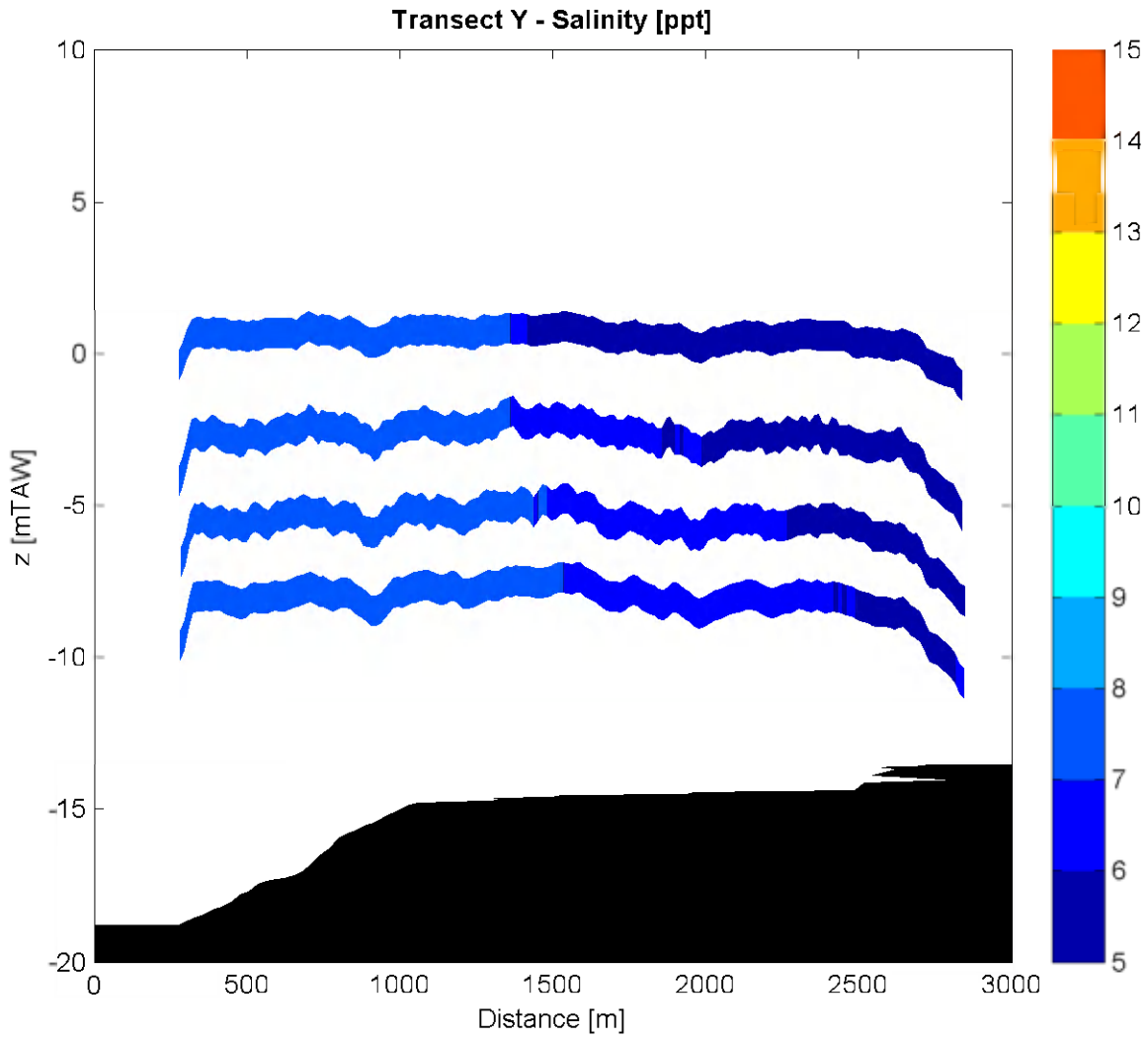
Time after HW [HH:MM]
7:36

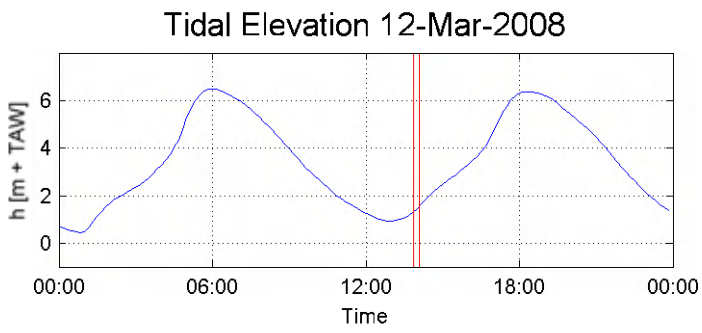
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
13:51 - 14:06

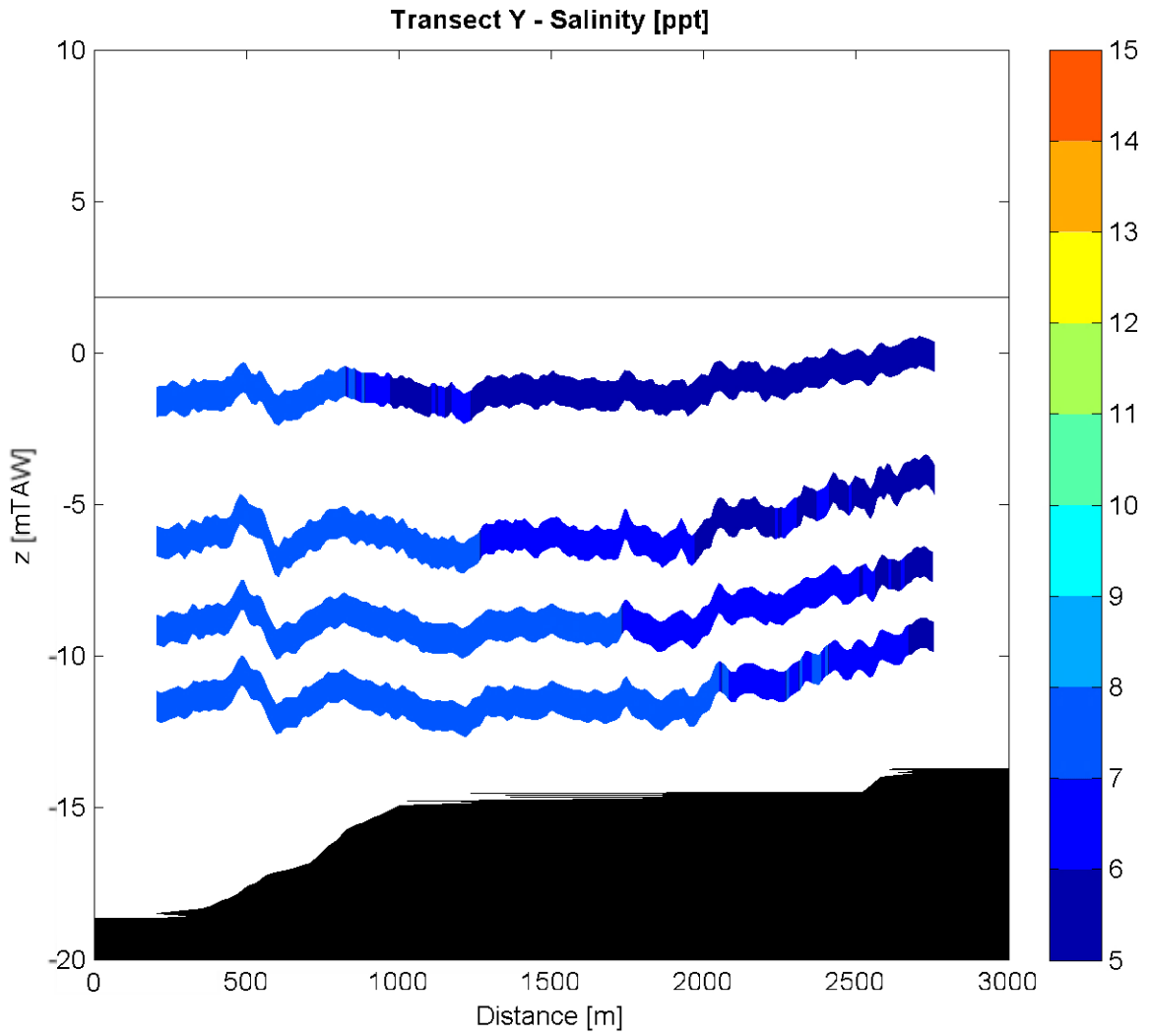
Time after HW [HH:MM]
7:58

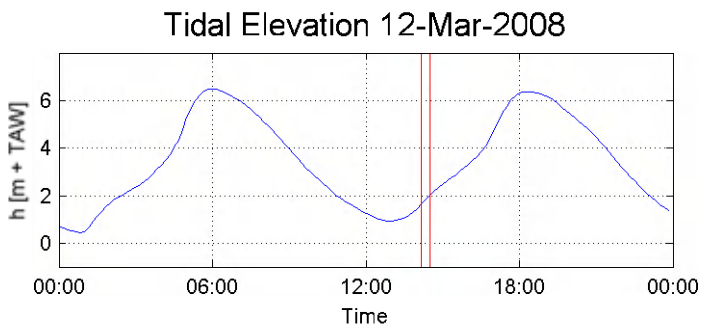
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
14:10 - 14:31

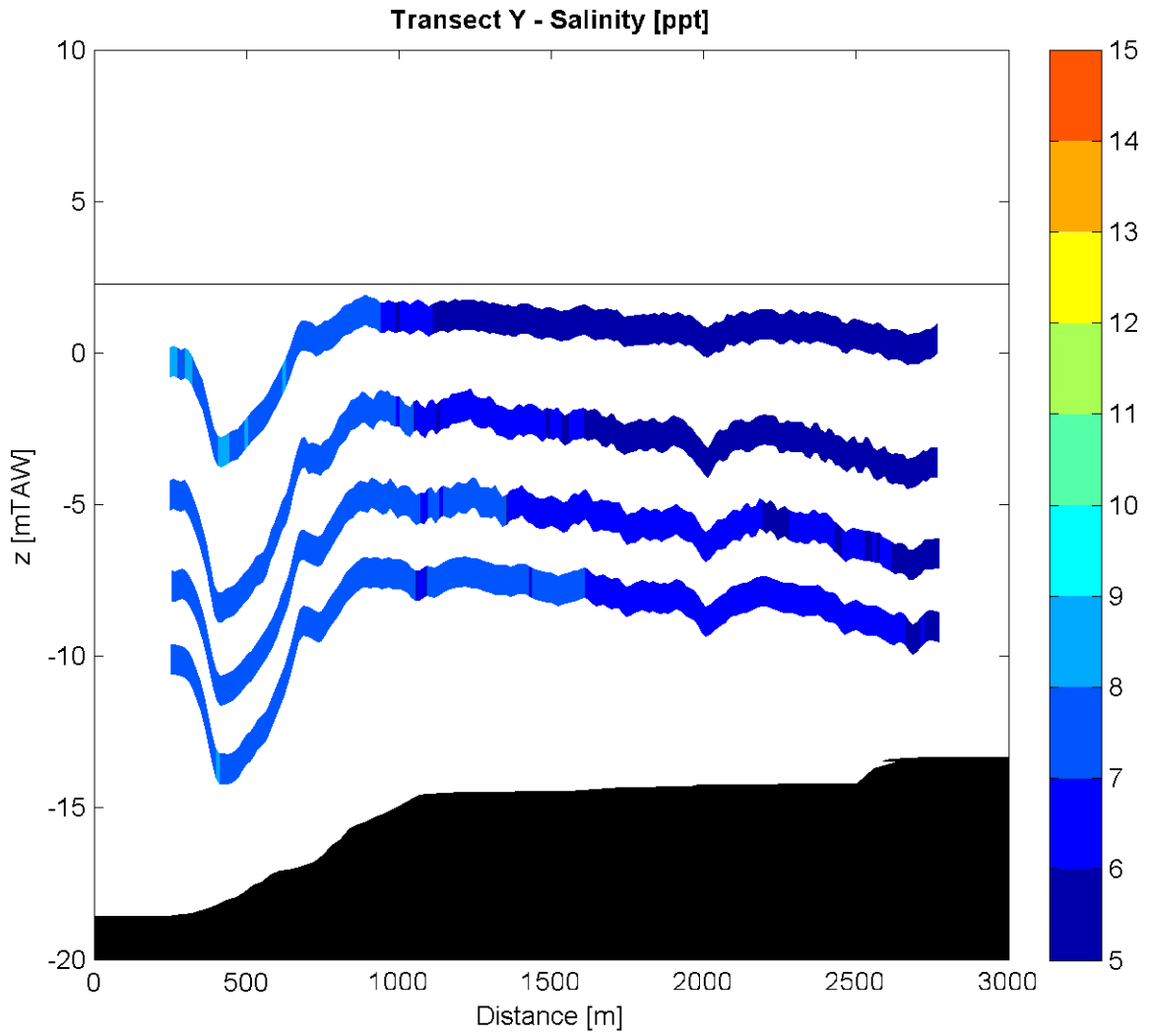
Time after HW [HH:MM]
8:20

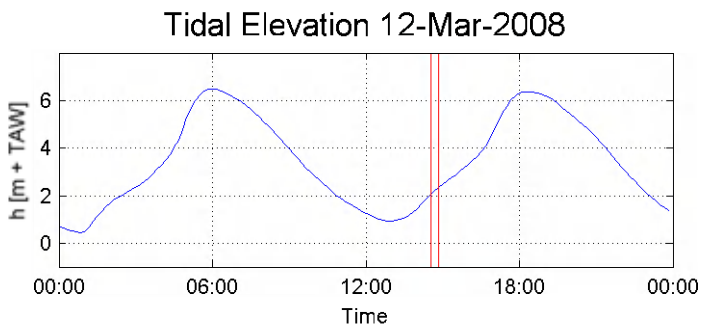
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
14:33 - 14:50

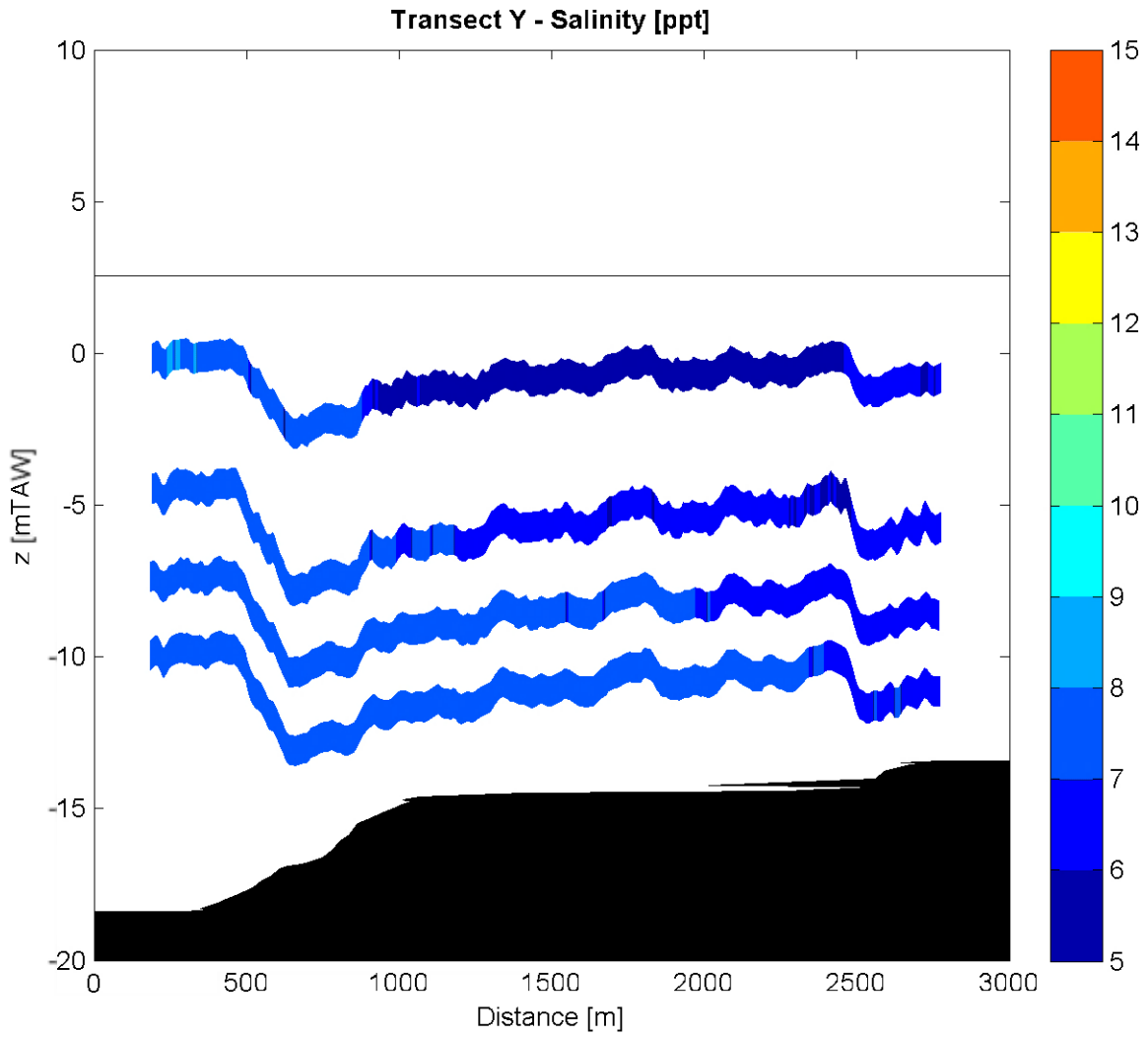
Time after HW [HH:MM]
8:41

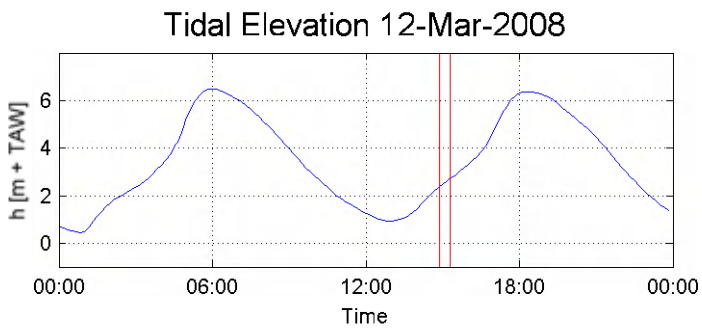
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

14:52 - 15:17

Time after HW [HH:MM]

9:04

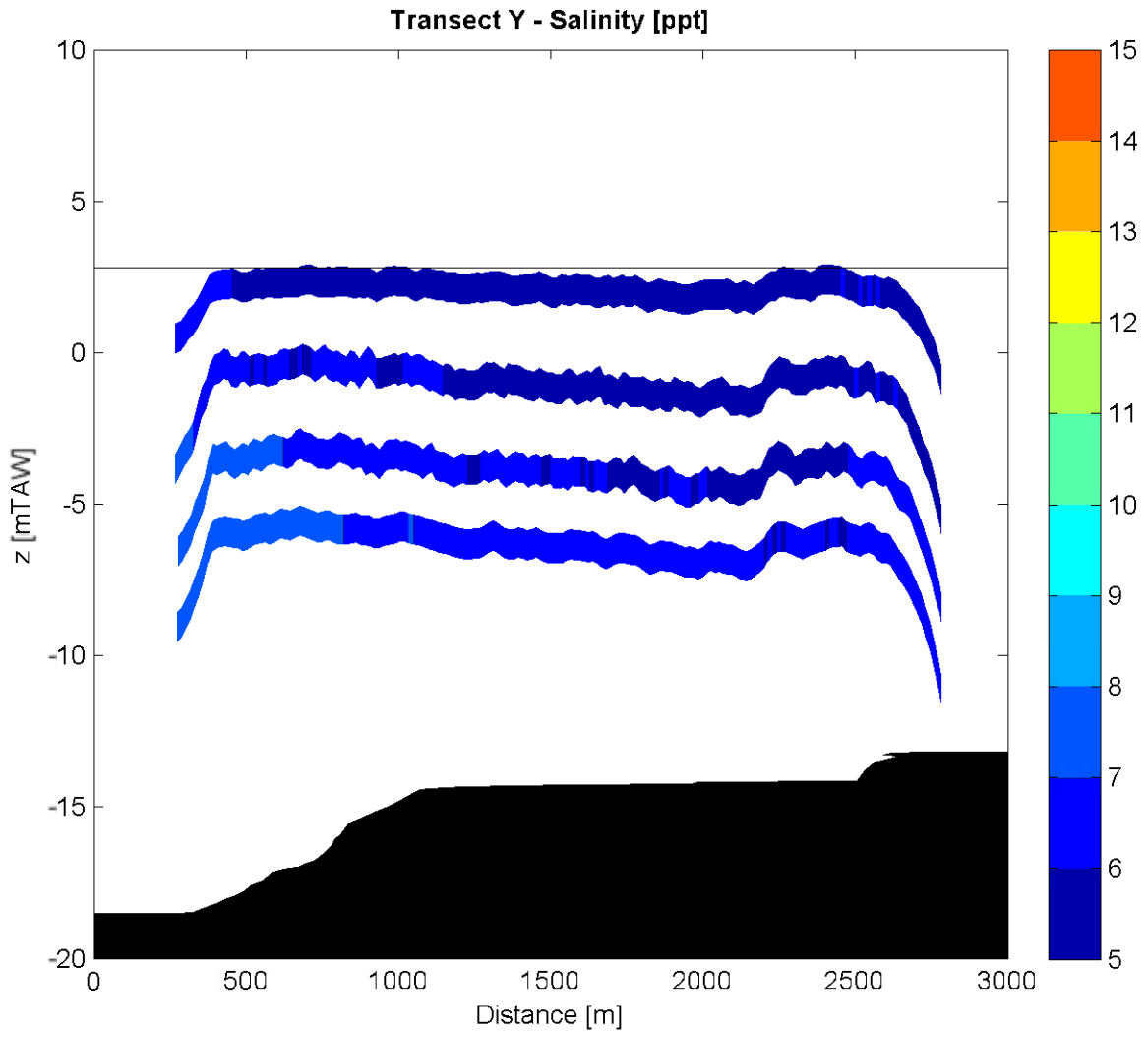
Data Processed by: IMDC

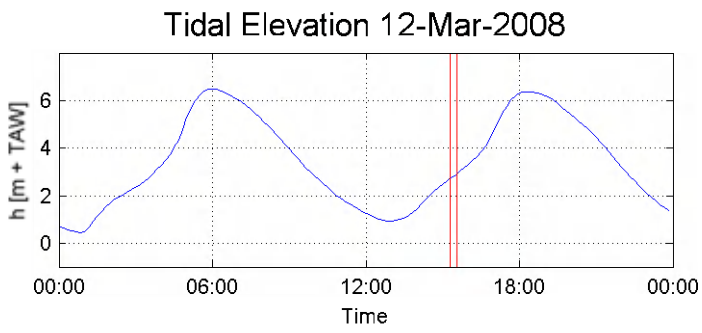
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
15:18 - 15:33

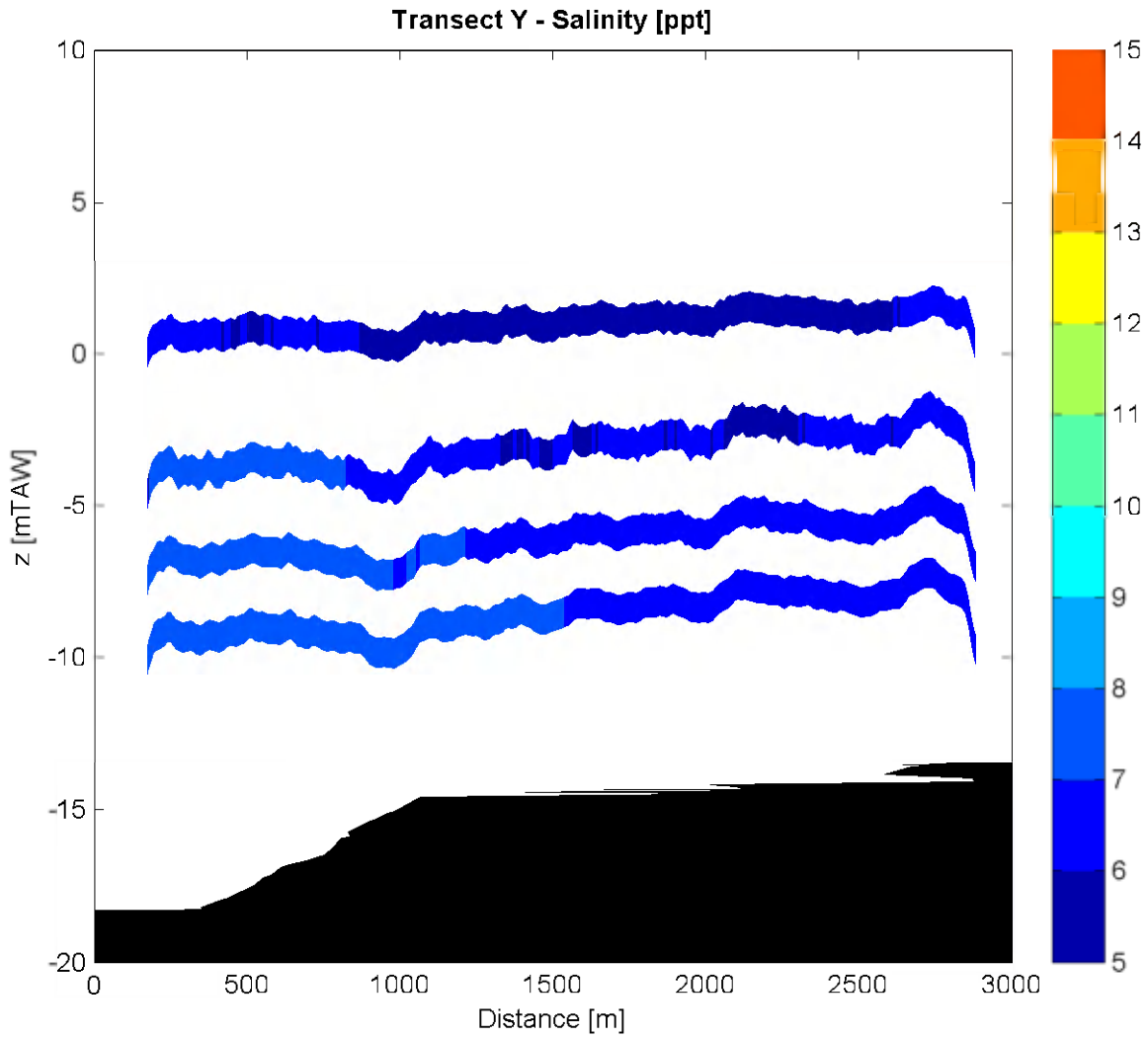
Time after HW [HH:MM]
9:25

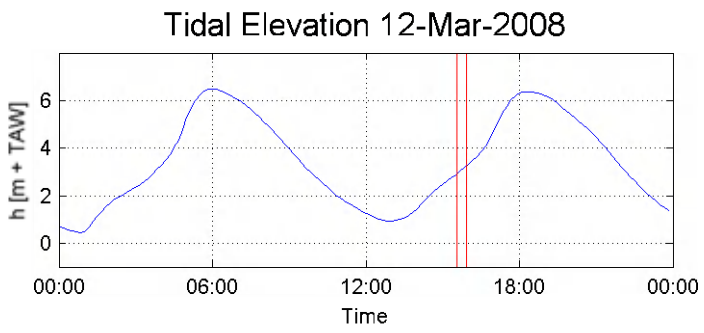
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
15:34 - 15:56

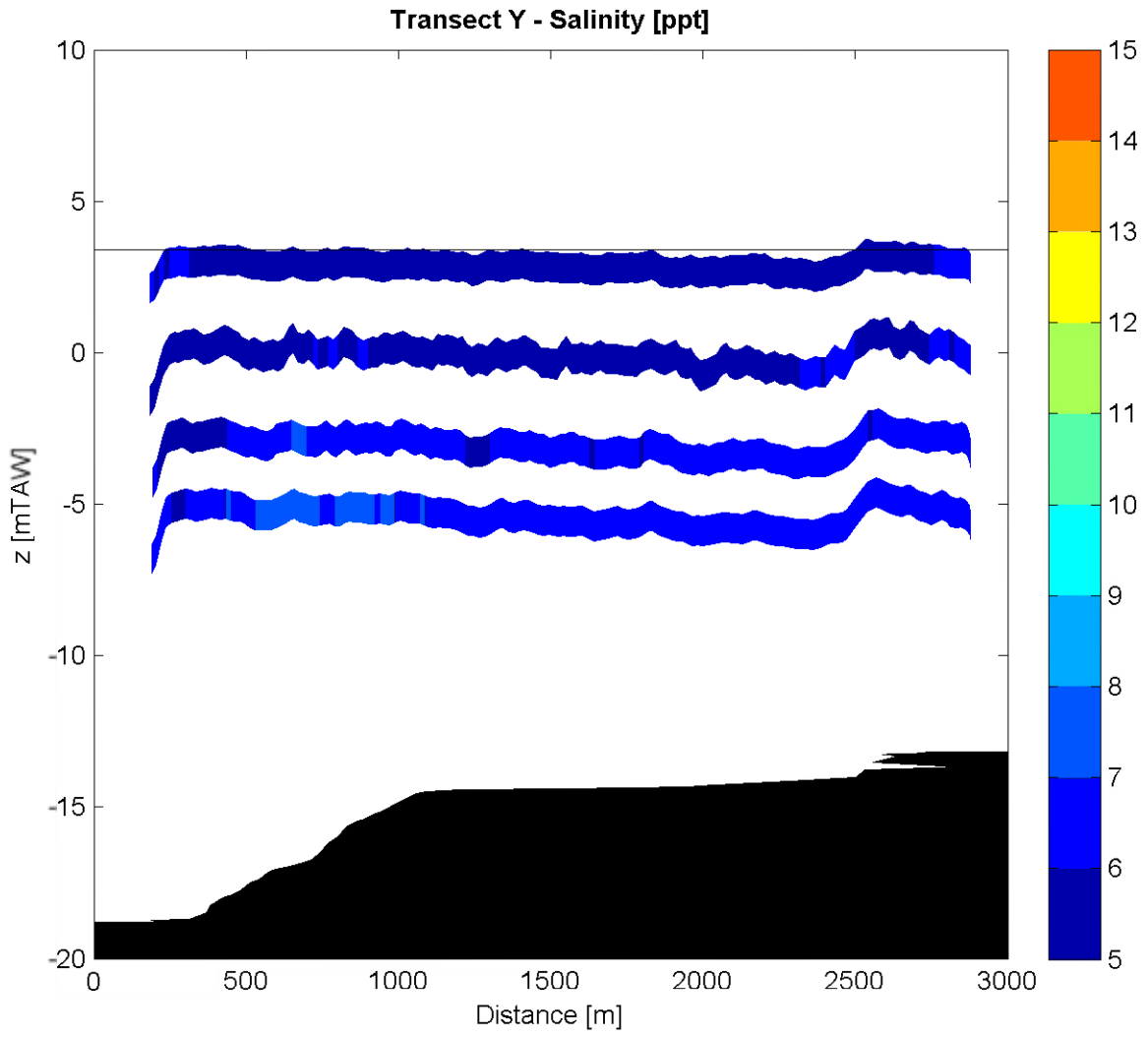
Time after HW [HH:MM]
9:45

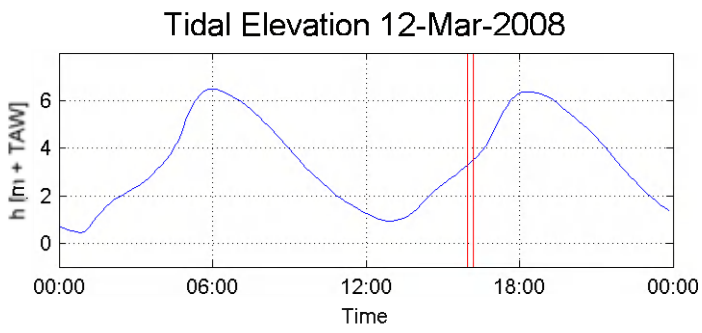
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

15:57 - 16:11

Time after HW [HH:MM]

10:04

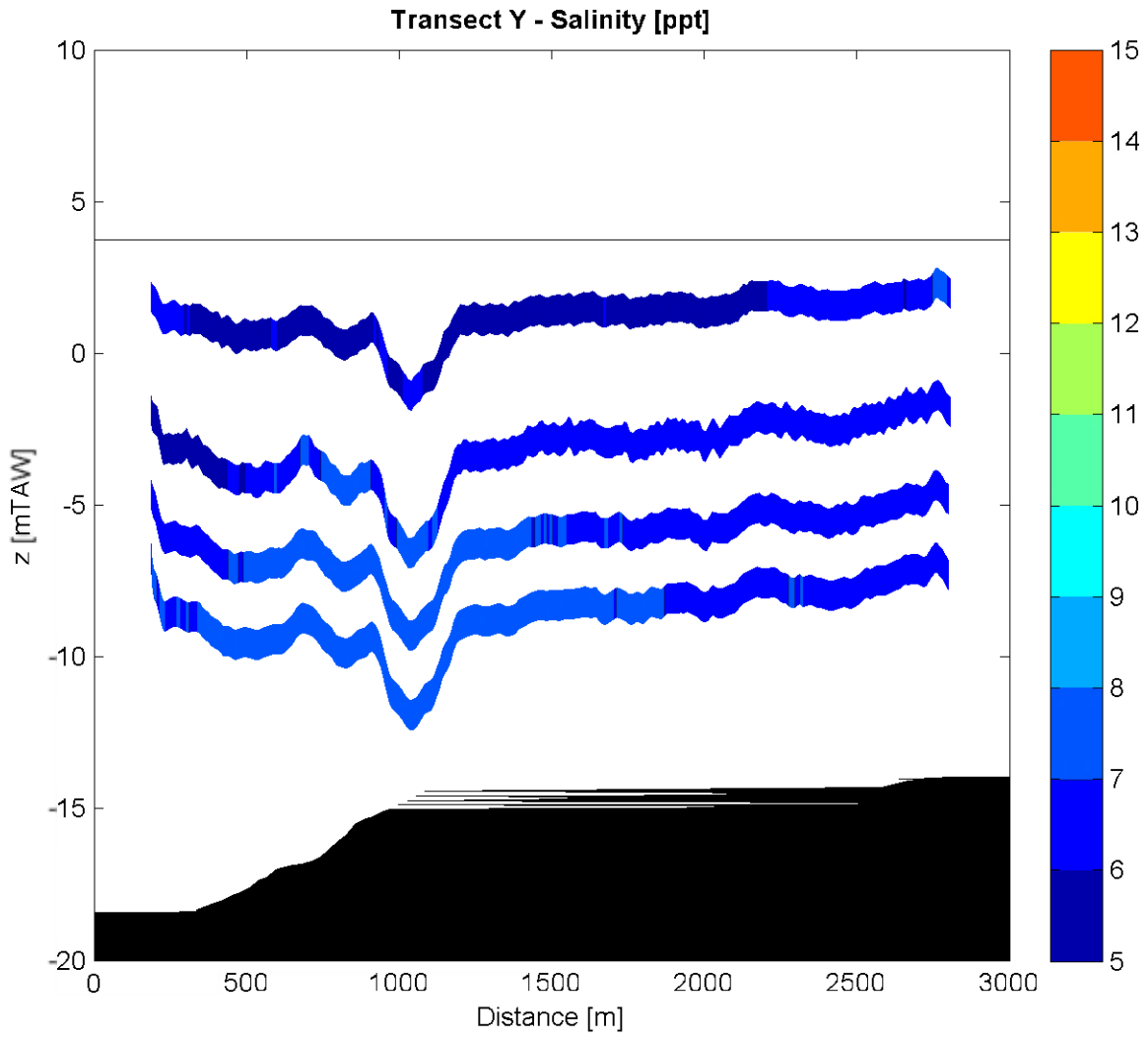
Data Processed by: IMDC

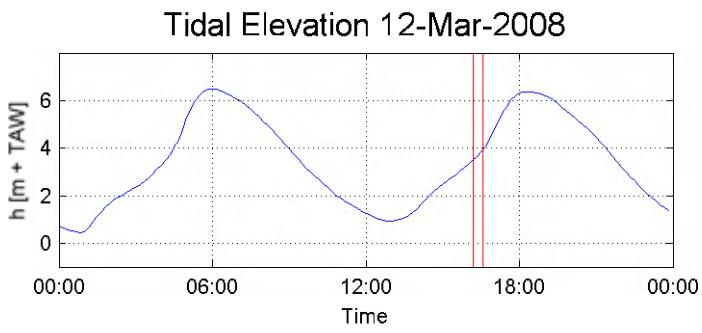
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
16:12 - 16:35

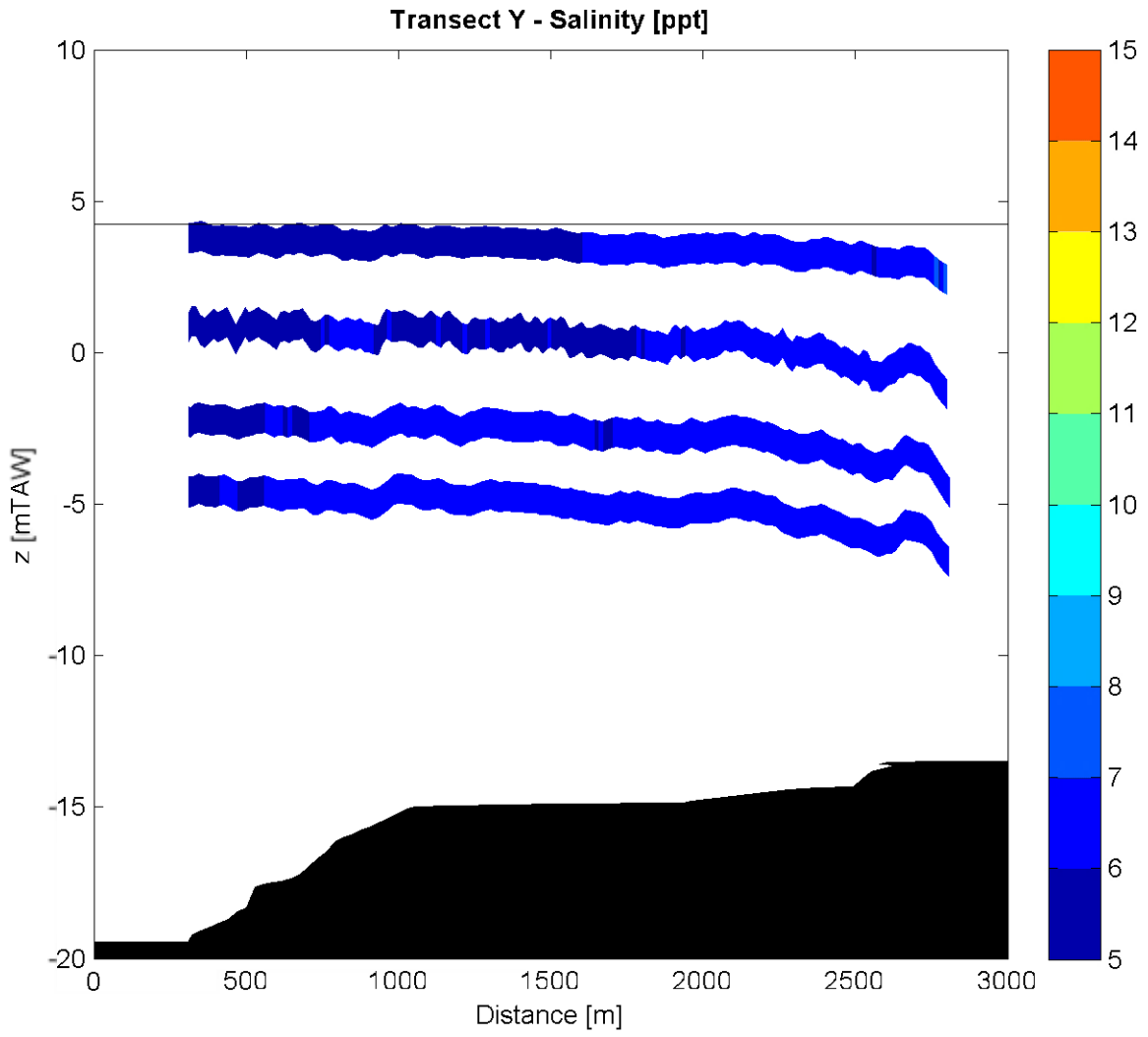
Time after HW [HH:MM]
10:23

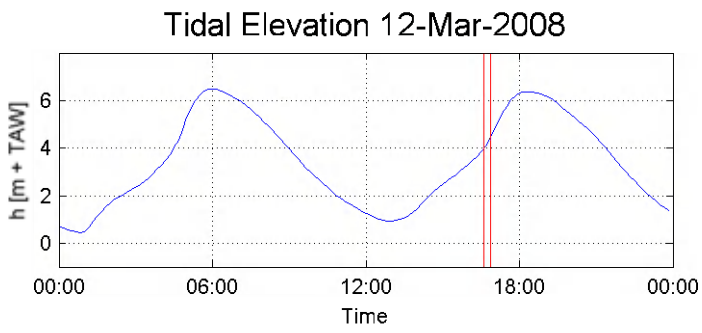
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
16:37 - 16:52

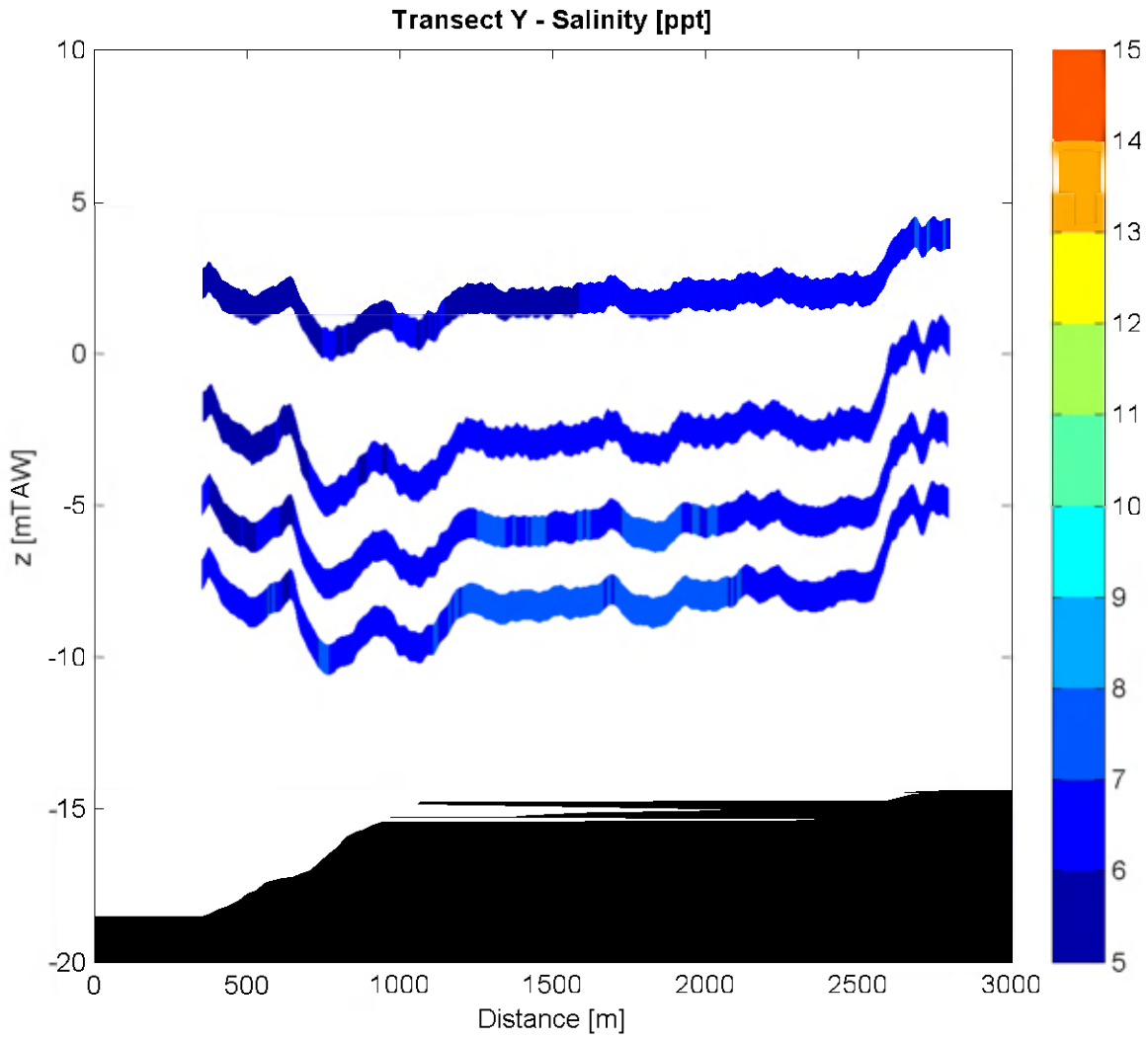
Time after HW [HH:MM]
10:44

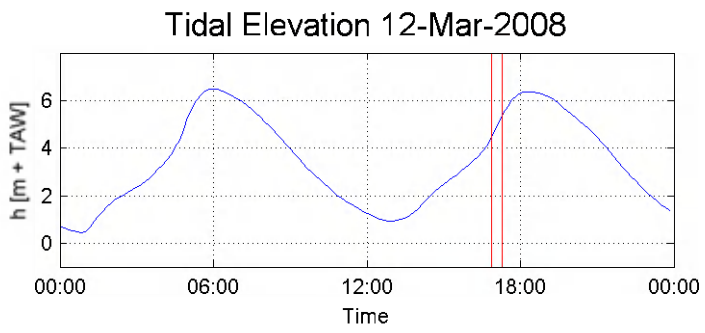
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

16:53 - 17:17

Time after HW [HH:MM]

11:05

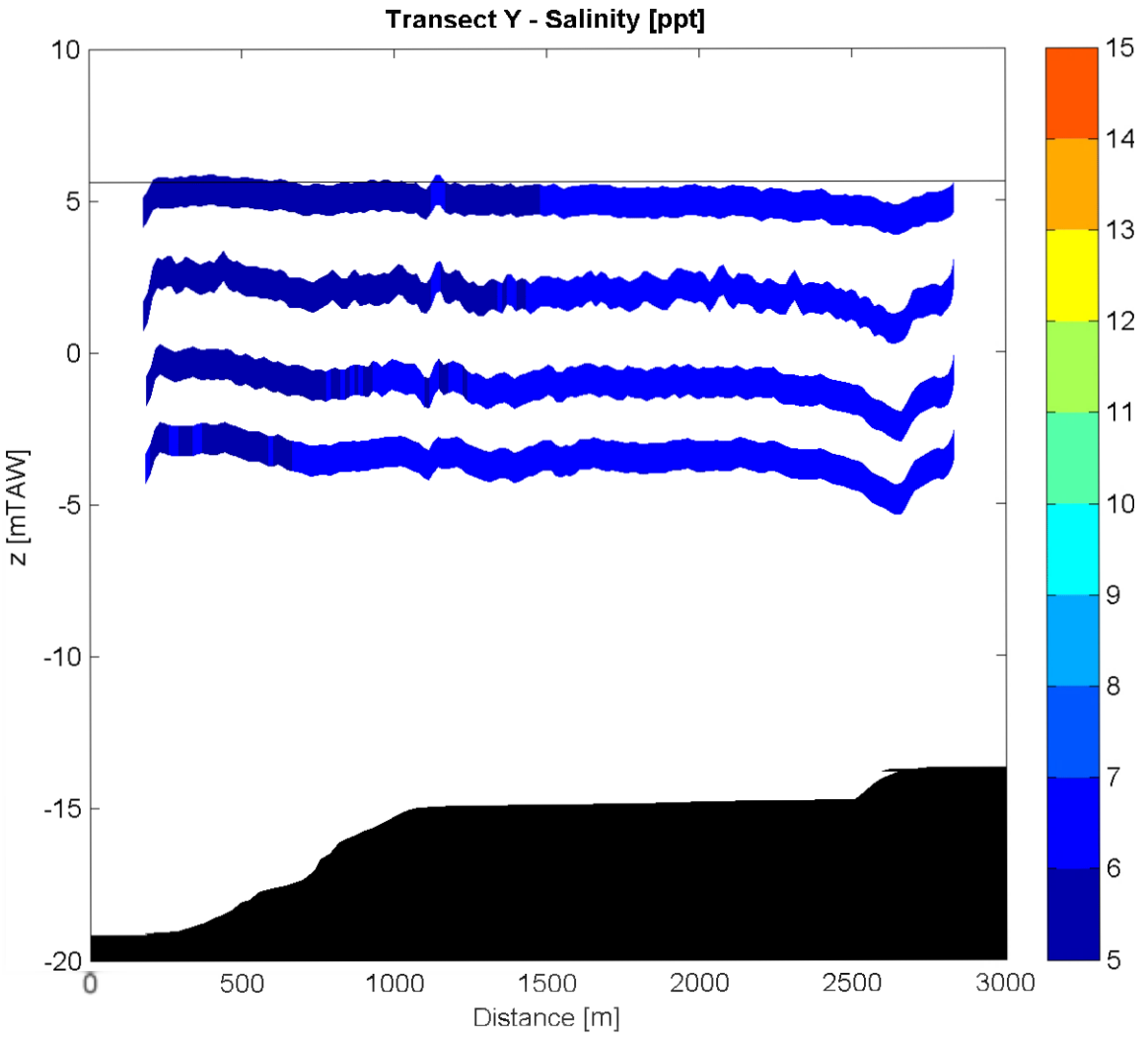
Data Processed by:

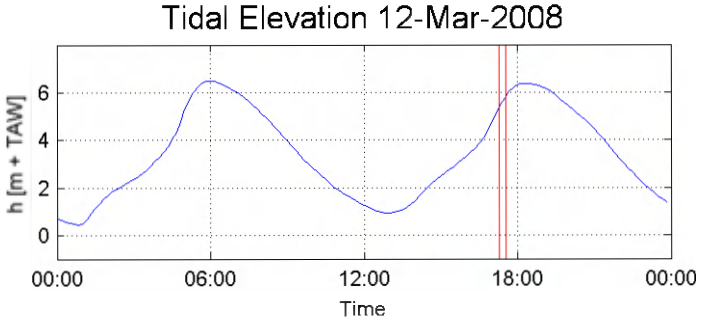
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

17:18 - 17:33

Time after HW [HH:MM]

11:25

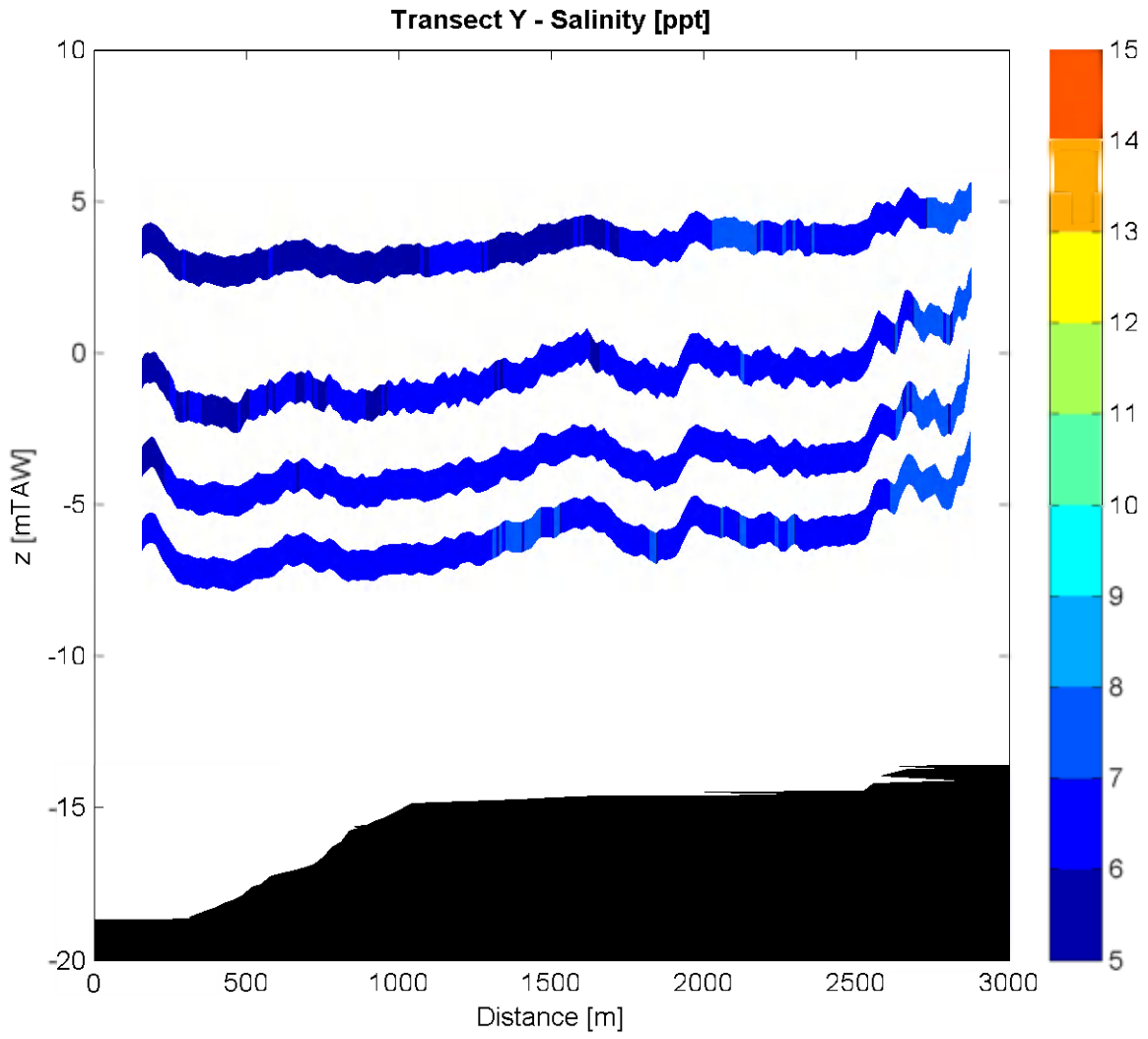
Data Processed by: IMDC

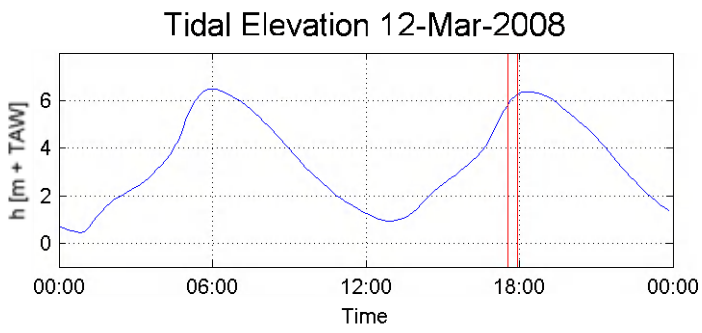
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
17:34 - 17:56

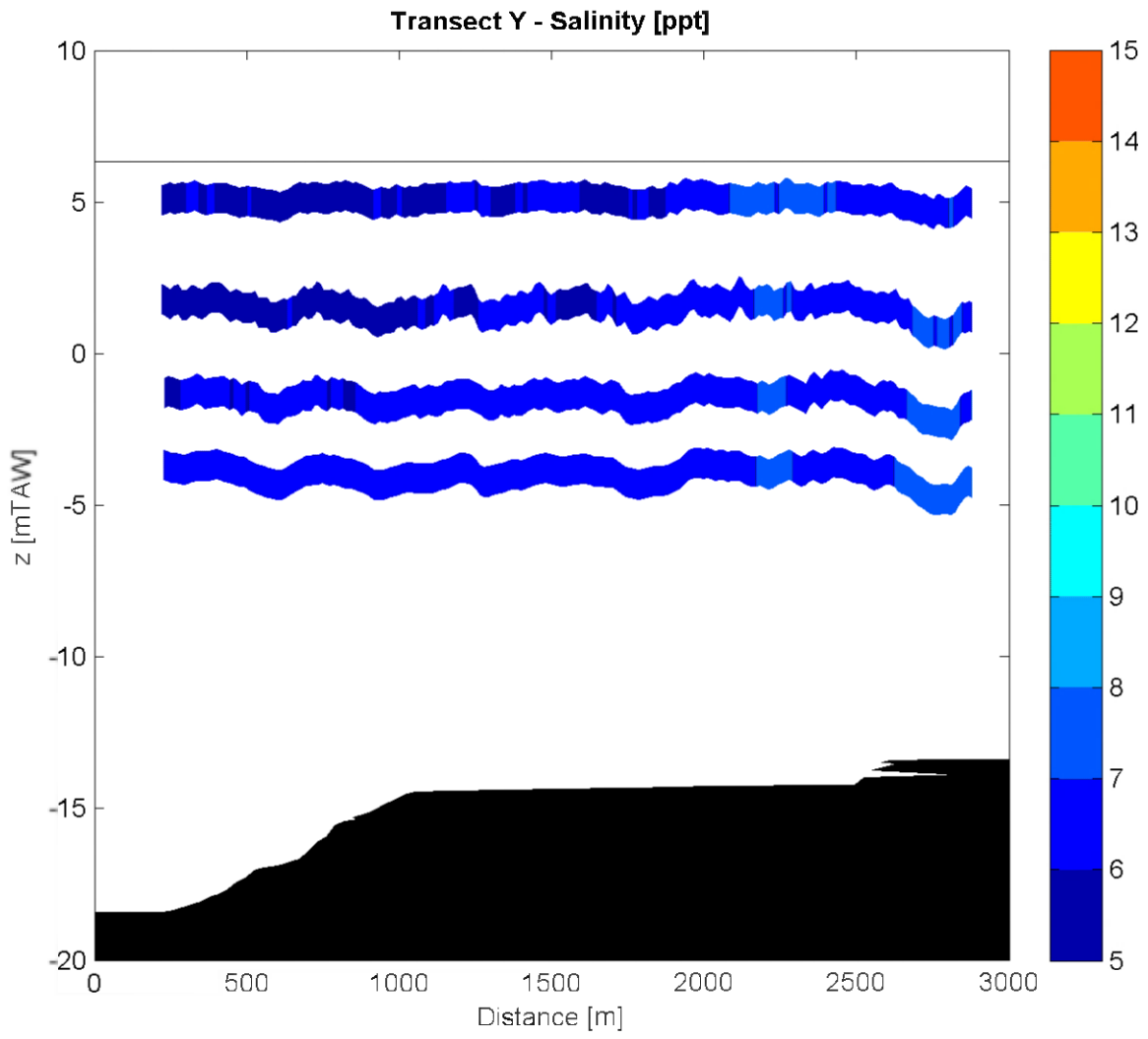
Time after HW [HH:MM]
11:45

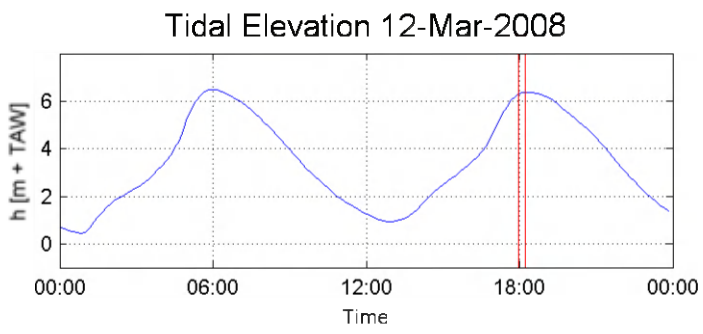
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

17:57 - 18:14

Time after HW [HH:MM]

12:05

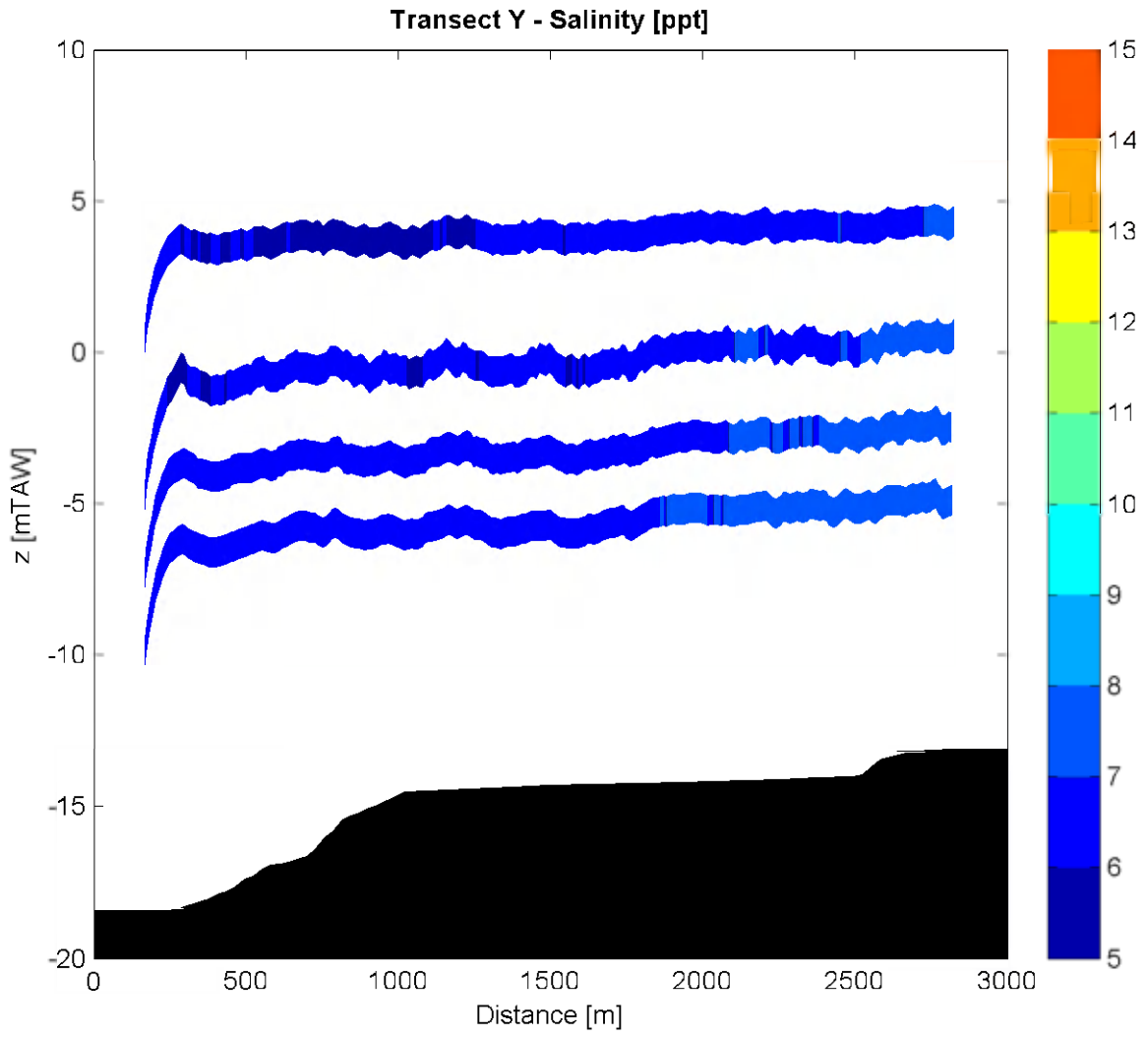
Data Processed by: IMDC

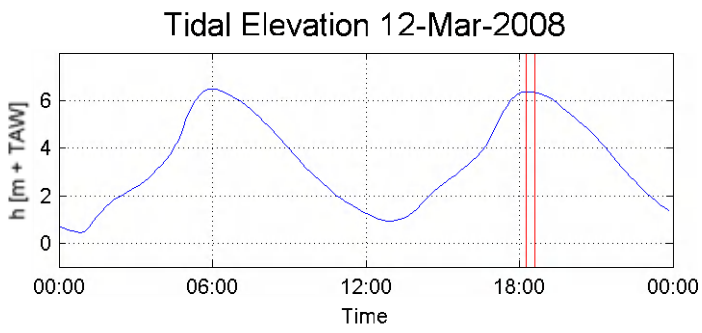
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
18:15 - 18:36

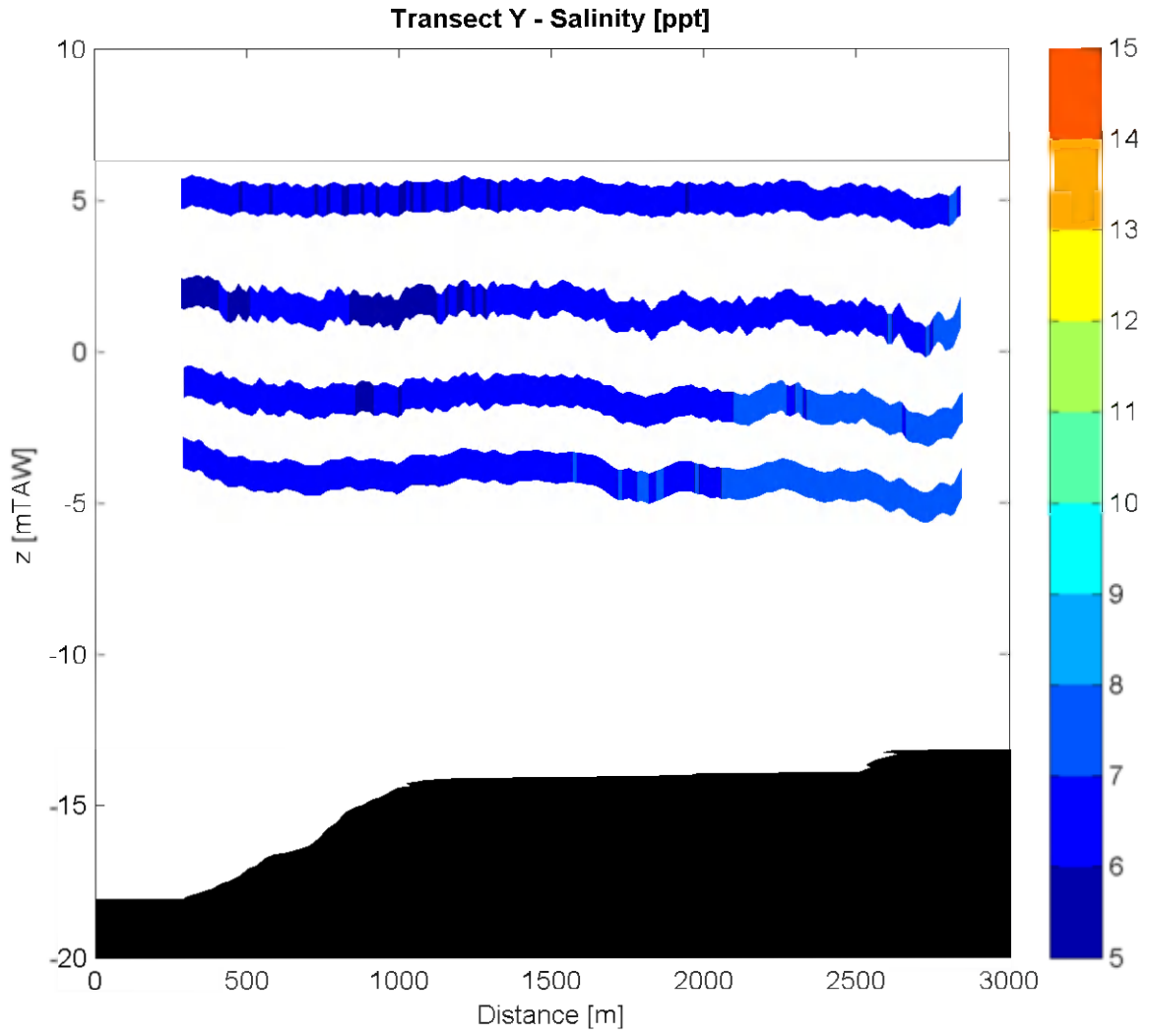
Time after HW [HH:MM]
0:05

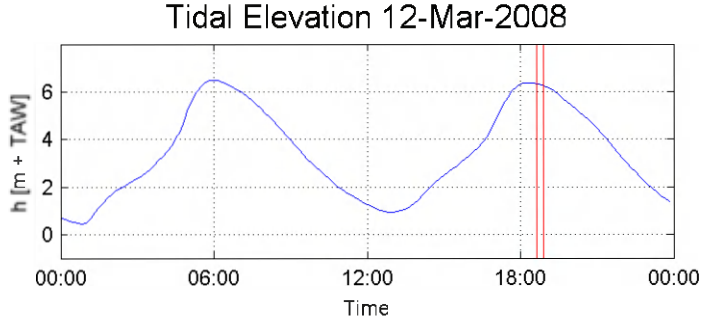
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :

12-Mar-2008

18:38 - 18:55

Time after HW [HH:MM]

0:26

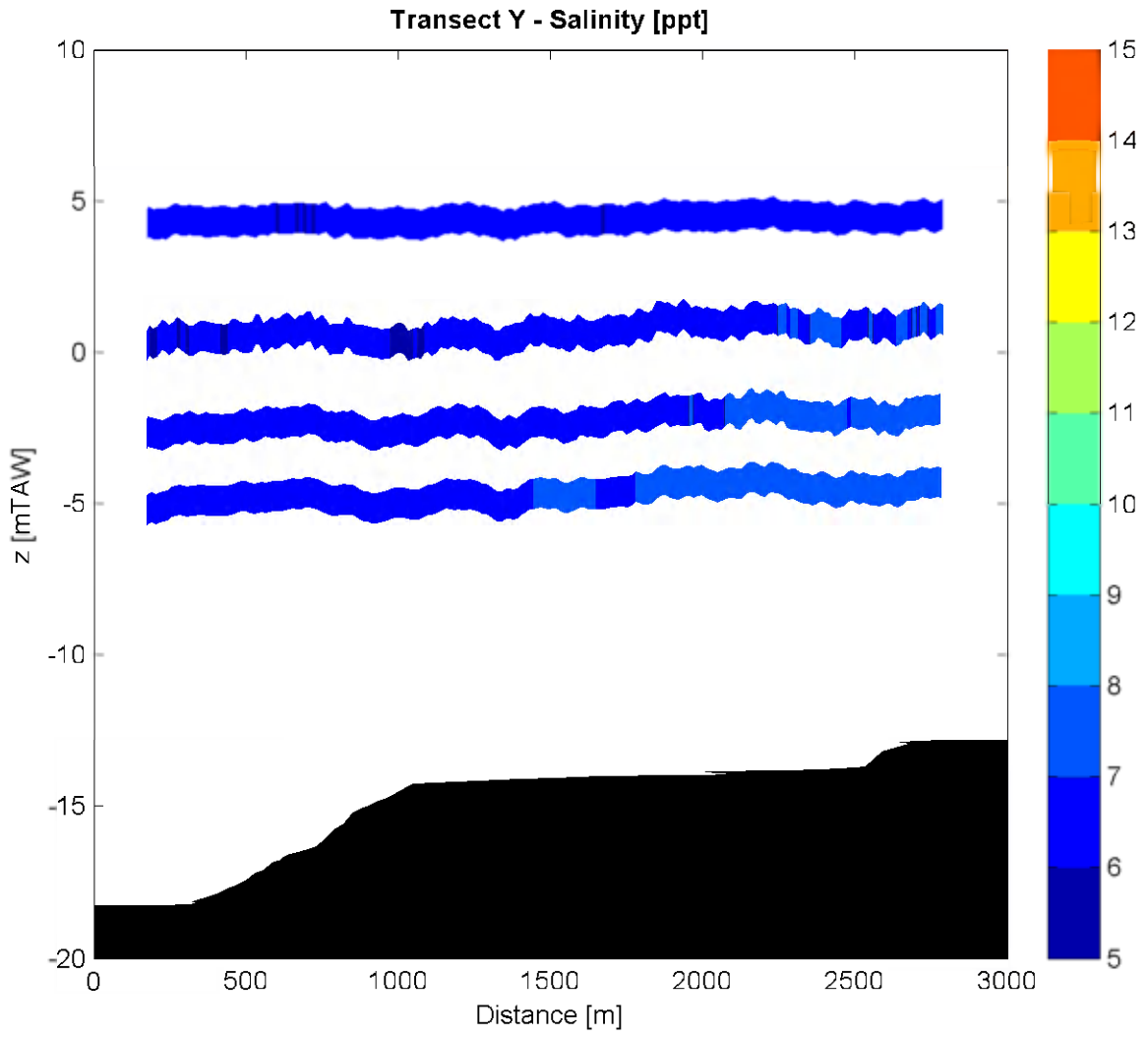
Data Processed by: IMDC

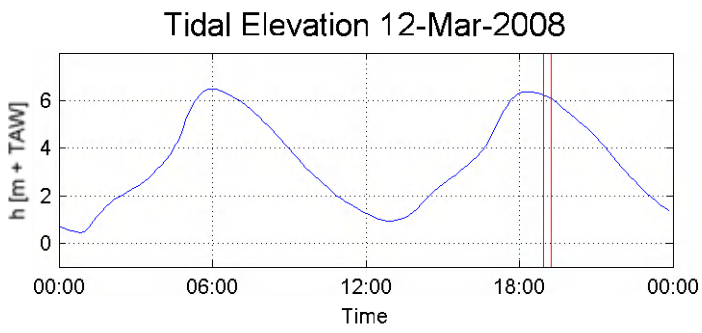
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
18:57 - 19:14

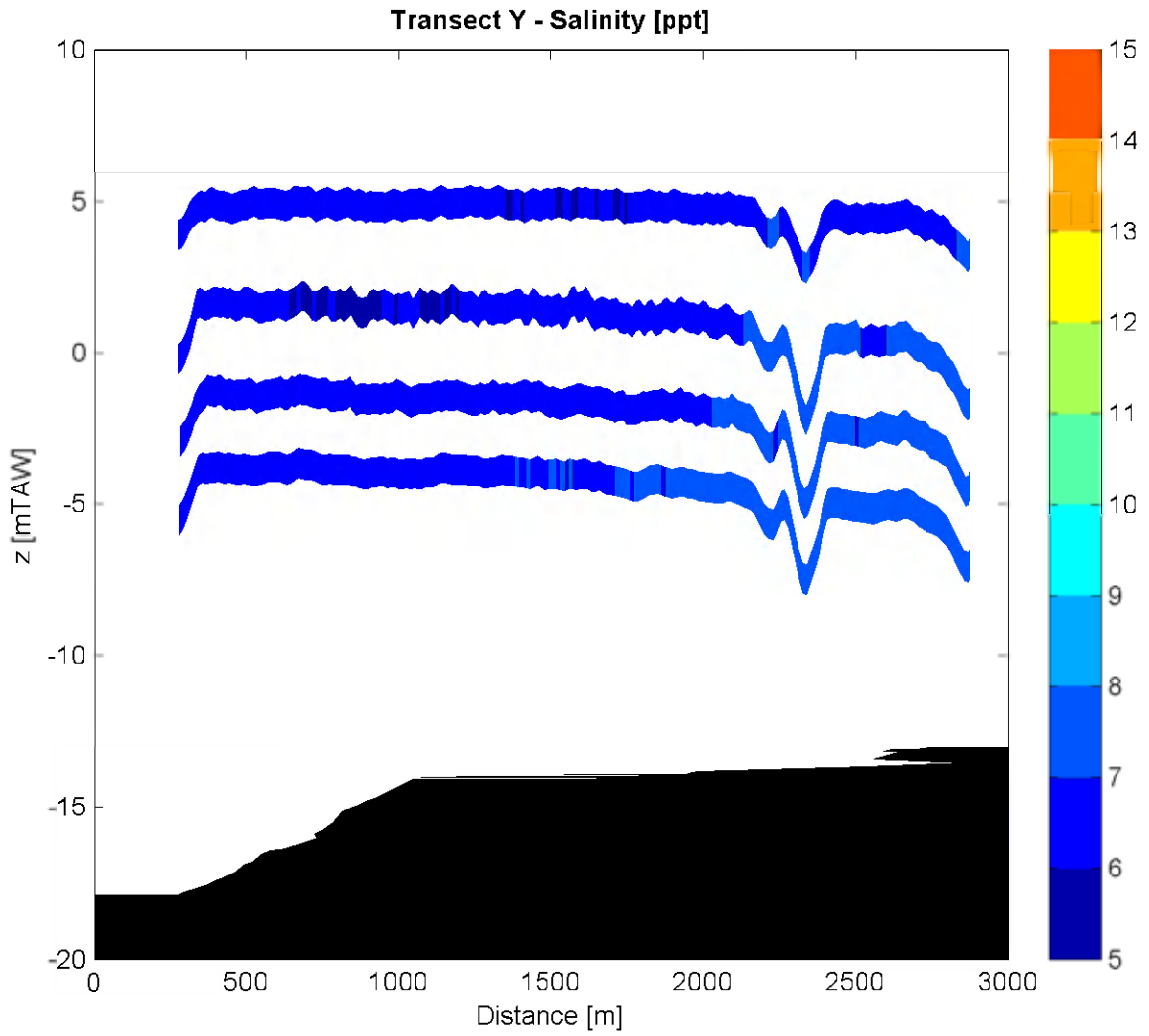
Time after HW [HH:MM]
0:45

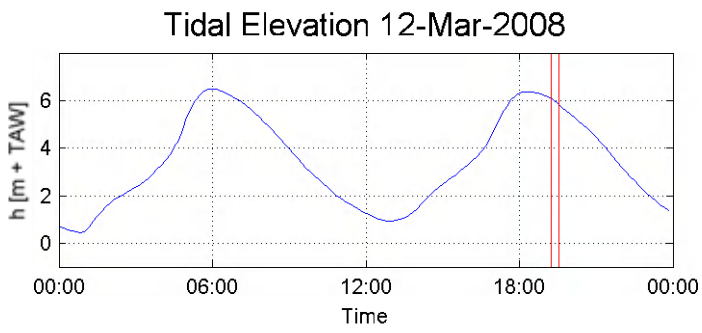
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
19:15 - 19:33

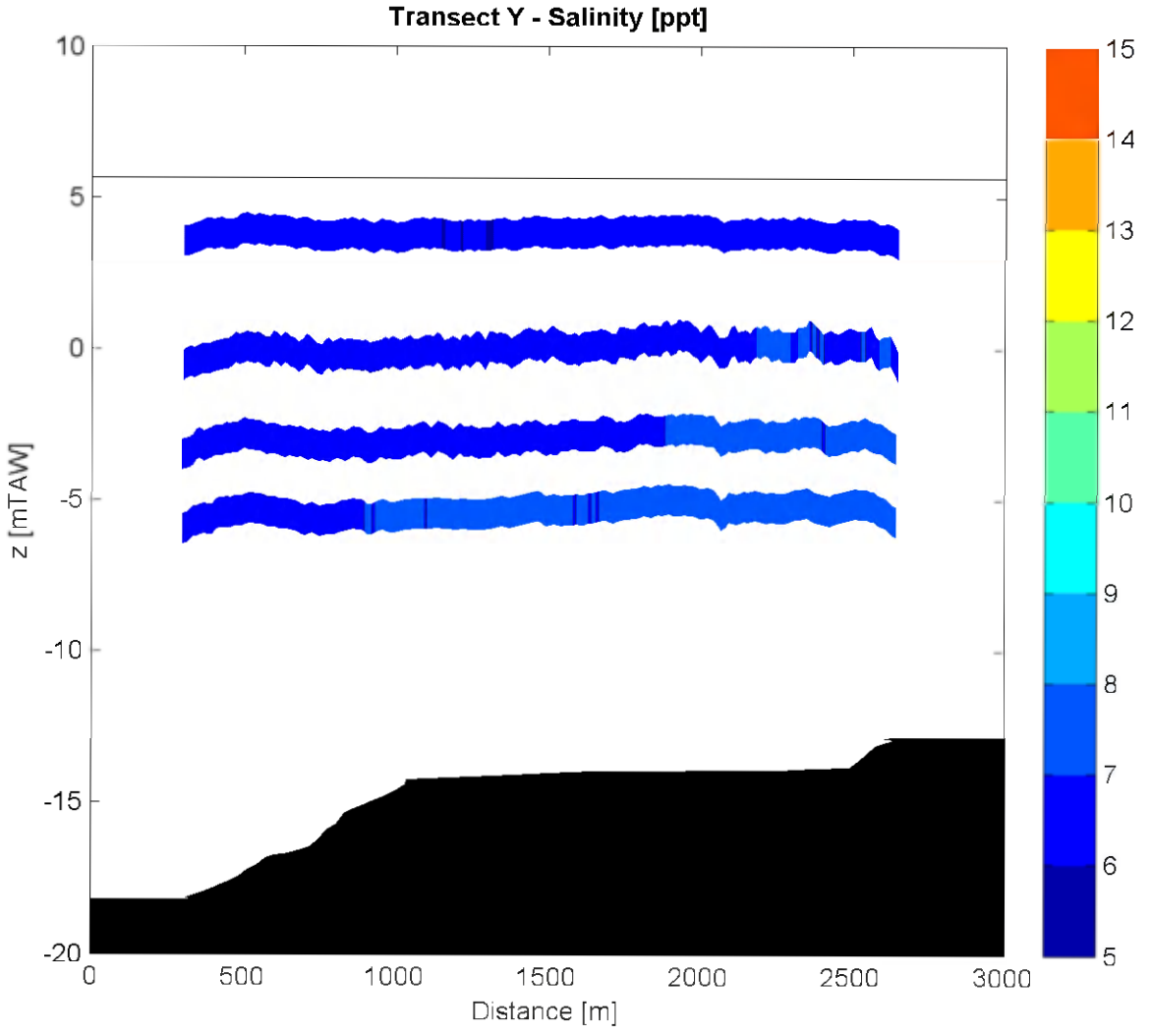
Time after HW [HH:MM]
1:04

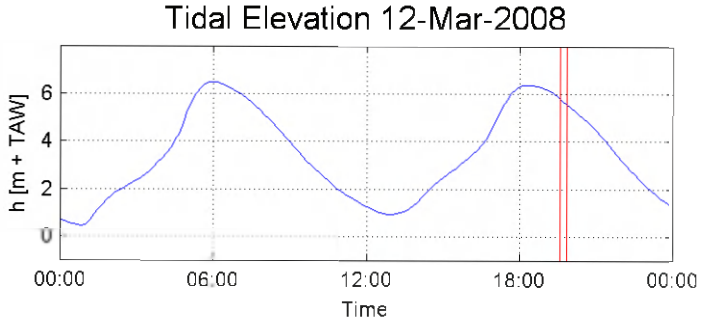
Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
19:35 - 19:51

Time after HW [HH:MM]
1:23

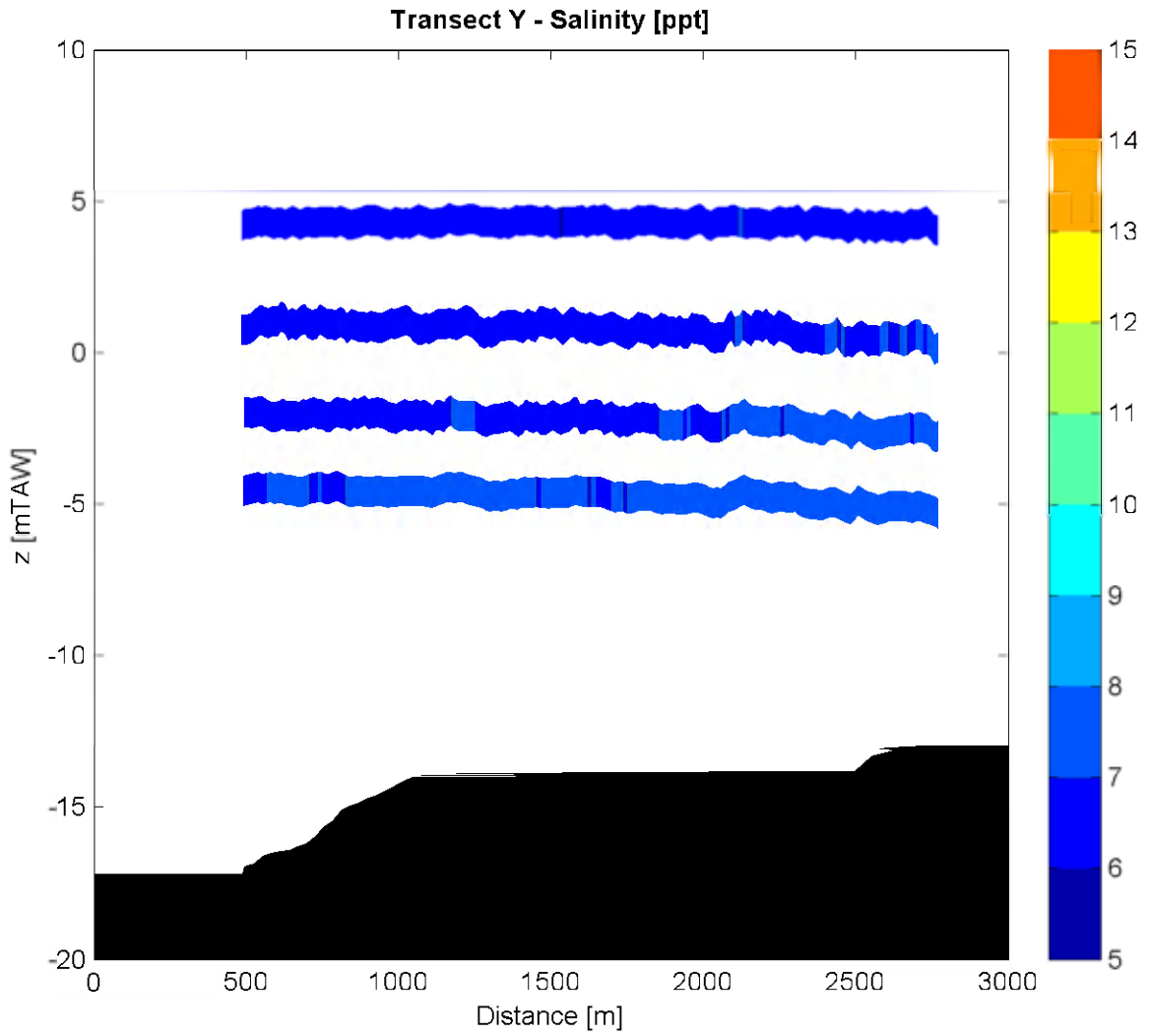
Data Processed by: IMDC

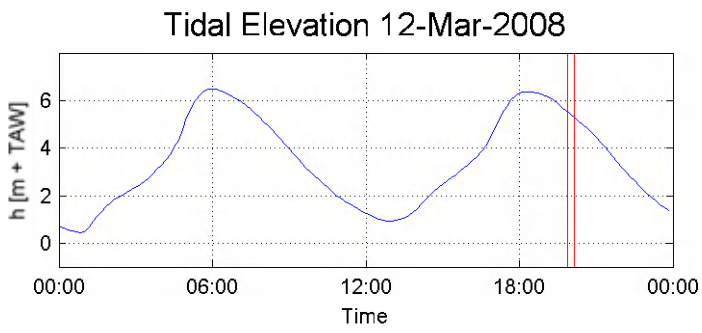
In association with :

I/RA/11283/07.087/MSA

Report 2.11 Longitudinal salinity distribution

11283	Equipment(s): CTD-diver
Sourcefile: *.dat	Location: Deurganckdok





Slack water: 06:00: h = 6.49 m+TAW
13:00: h = 0.93 m+TAW
18:20: h = 6.36 m+TAW

Date / Time [MET] :
12-Mar-2008
19:53 - 20:08

Time after HW [HH:MM]
1:40

Data Processed by: IMDC
In association with :

I/RA/11283/07.087/MSA

APPENDIX G. TIMESERIES OF SALINITY

11283 DGD 2 Salinity Measurements (winter 2008)

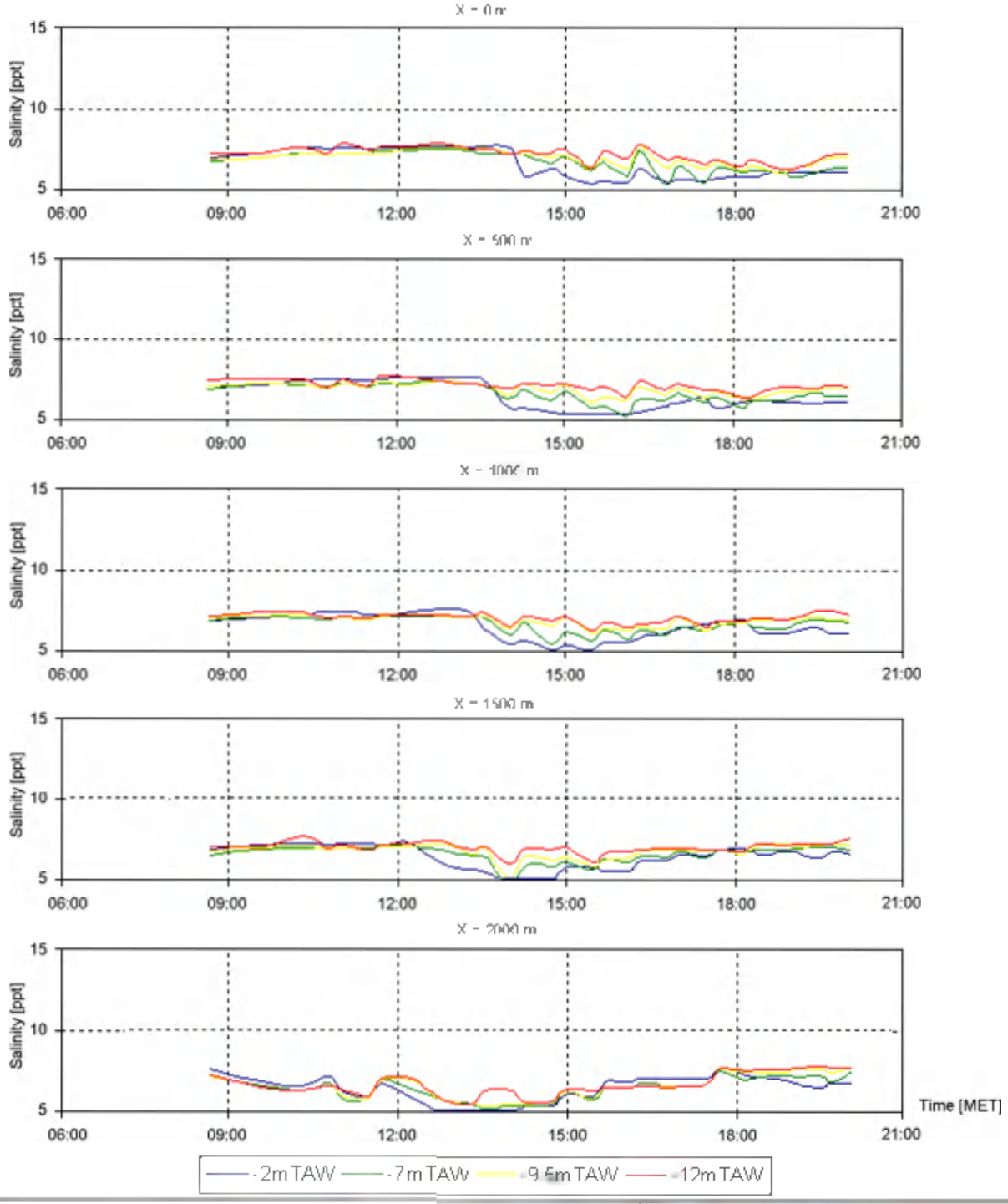
Report 2.11: Longitudinal salinity distribution

Equipment(s):
CTD Diver

Sourcefile(s):
MDC Standard

Location:
Delfzijlerdiep

Timeseries of salinity at 4 depths



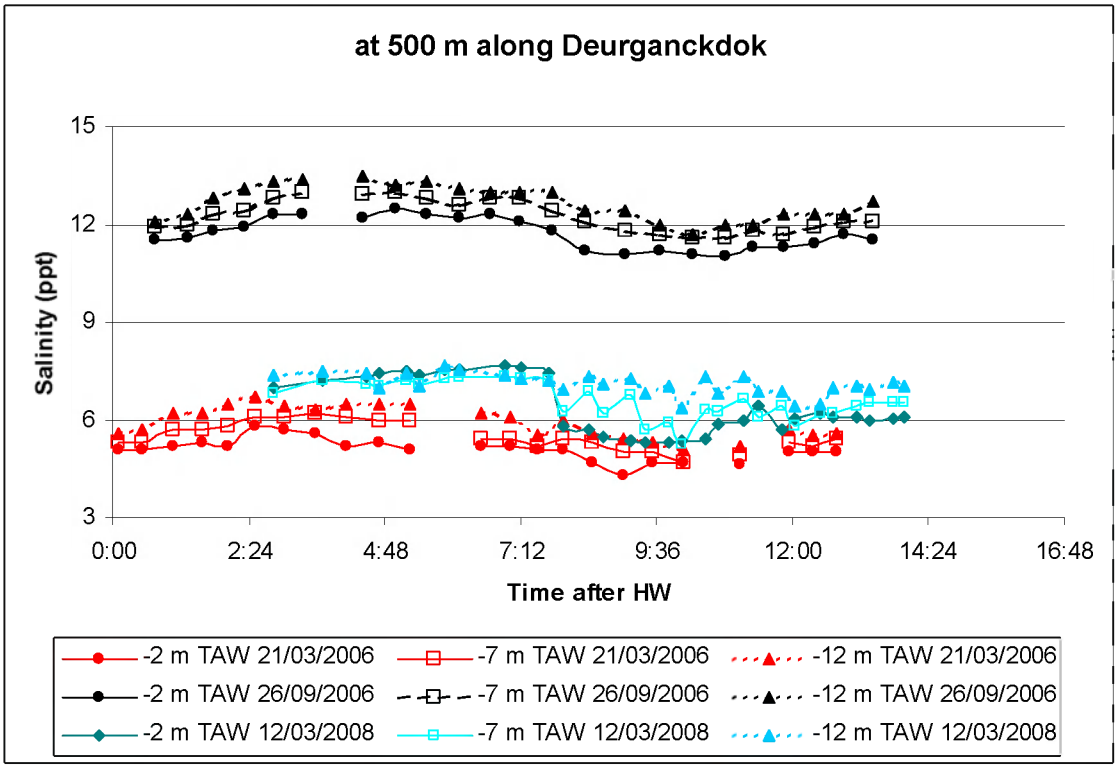
Date:
12-March-2008

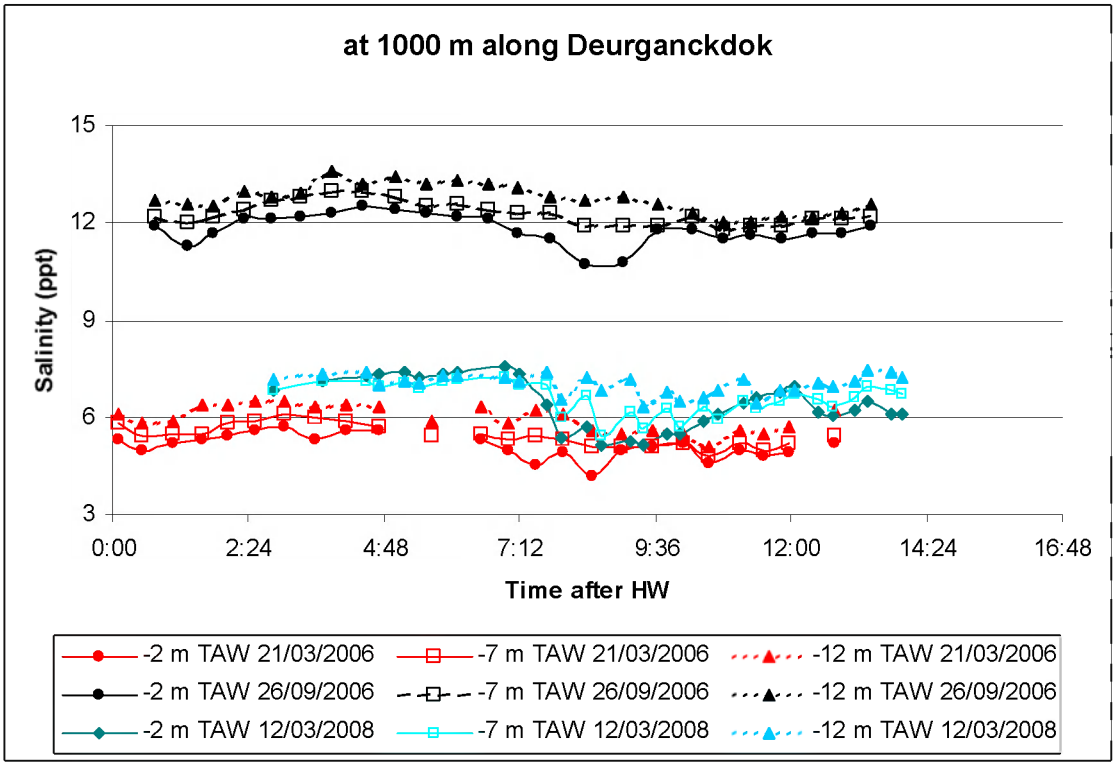
Data Processed by:
MDC

In association with:

DRAFT

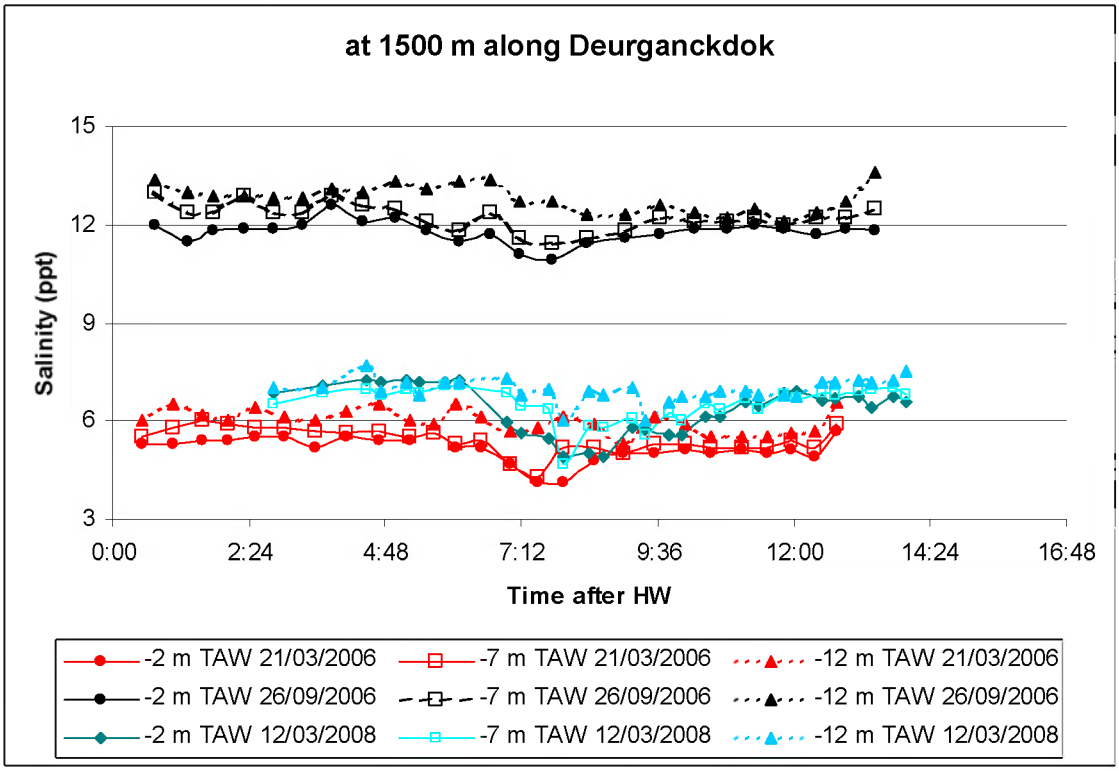
APPENDIX H. COMPARISON OF SALINITIES BETWEEN THE CAMPAIGNS

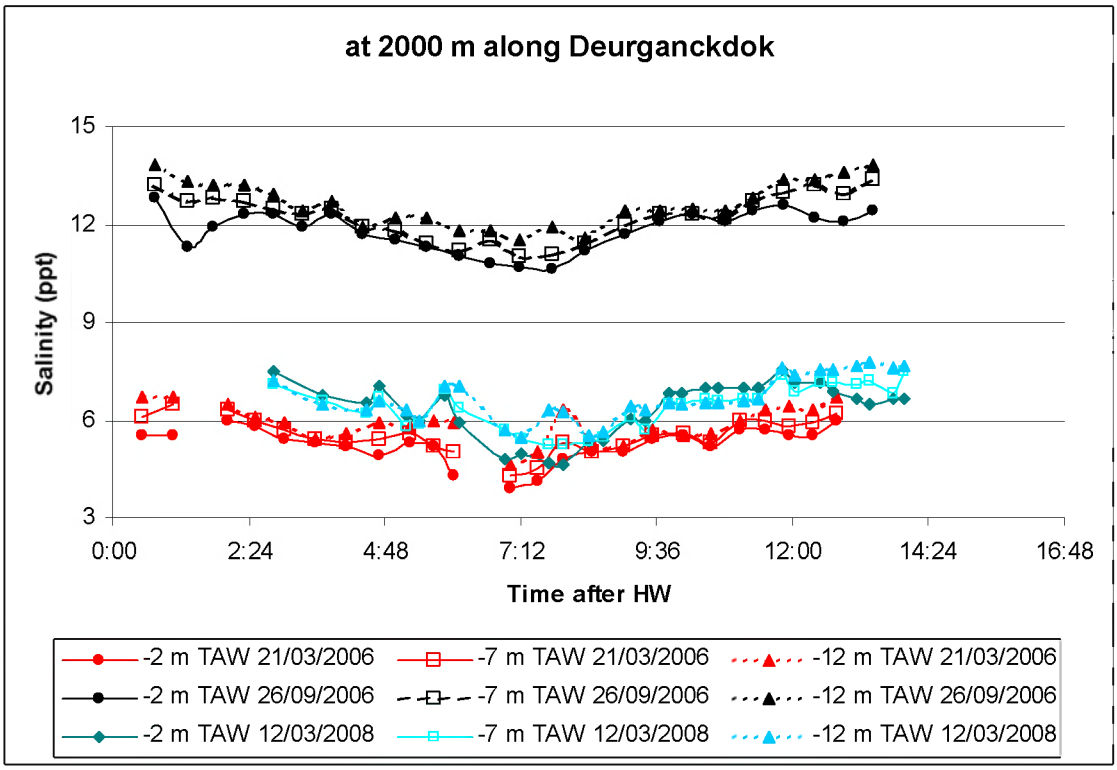




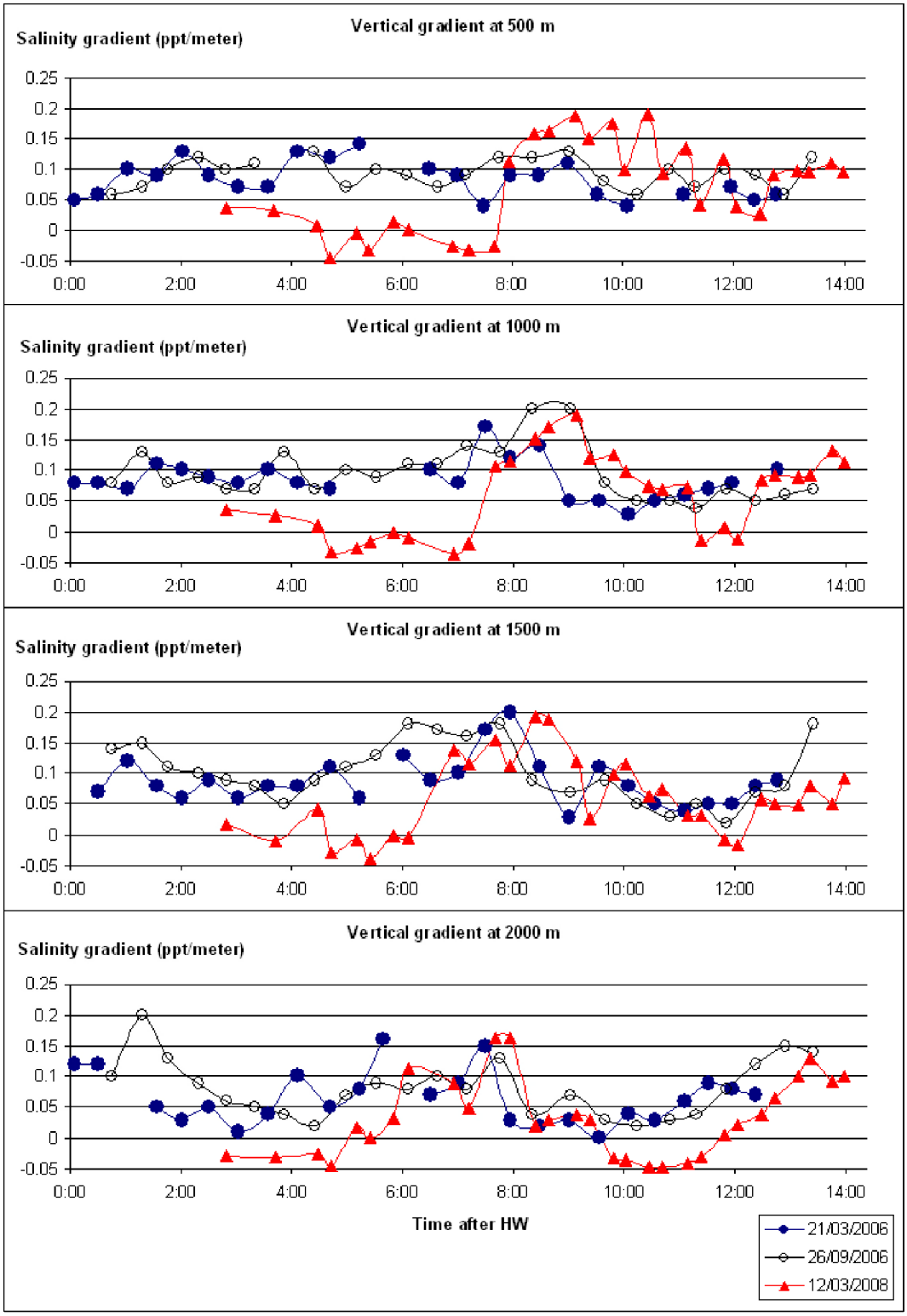
[3]

[3] the longitudinal axis along DGD starts at the dockside and ends at the riverside, so 500 m is near the dockside and 2000 m is near the riverside (see figure 2.2)


at 1500 m along Deurganckdok
Salinity (ppt)
15
12
9
6
3
0:00
2:24
4:48
7:12
9:36
12:00
14:24
16:48
Time after HW
-2 m TAW 21/03/2006
-7 m TAW 21/03/2006
-12 m TAW 21/03/2006
-2 m TAW 26/09/2006
-7 m TAW 26/09/2006
-12 m TAW 26/09/2006
-2 m TAW 12/03/2008
-7 m TAW 12/03/2008
-12 m TAW 12/03/2008


at 2000 m along Deurganckdok
Salinity (ppt)
15
12
9
6
3
0:00
2:24
4:48
7:12
9:36
12:00
14:24
16:48
Time after HW
-2 m TAW 21/03/2006
-7 m TAW 21/03/2006
-12 m TAW 21/03/2006
-2 m TAW 26/09/2006
-7 m TAW 26/09/2006
-12 m TAW 26/09/2006
-2 m TAW 12/03/2008
-7 m TAW 12/03/2008
-12 m TAW 12/03/2008

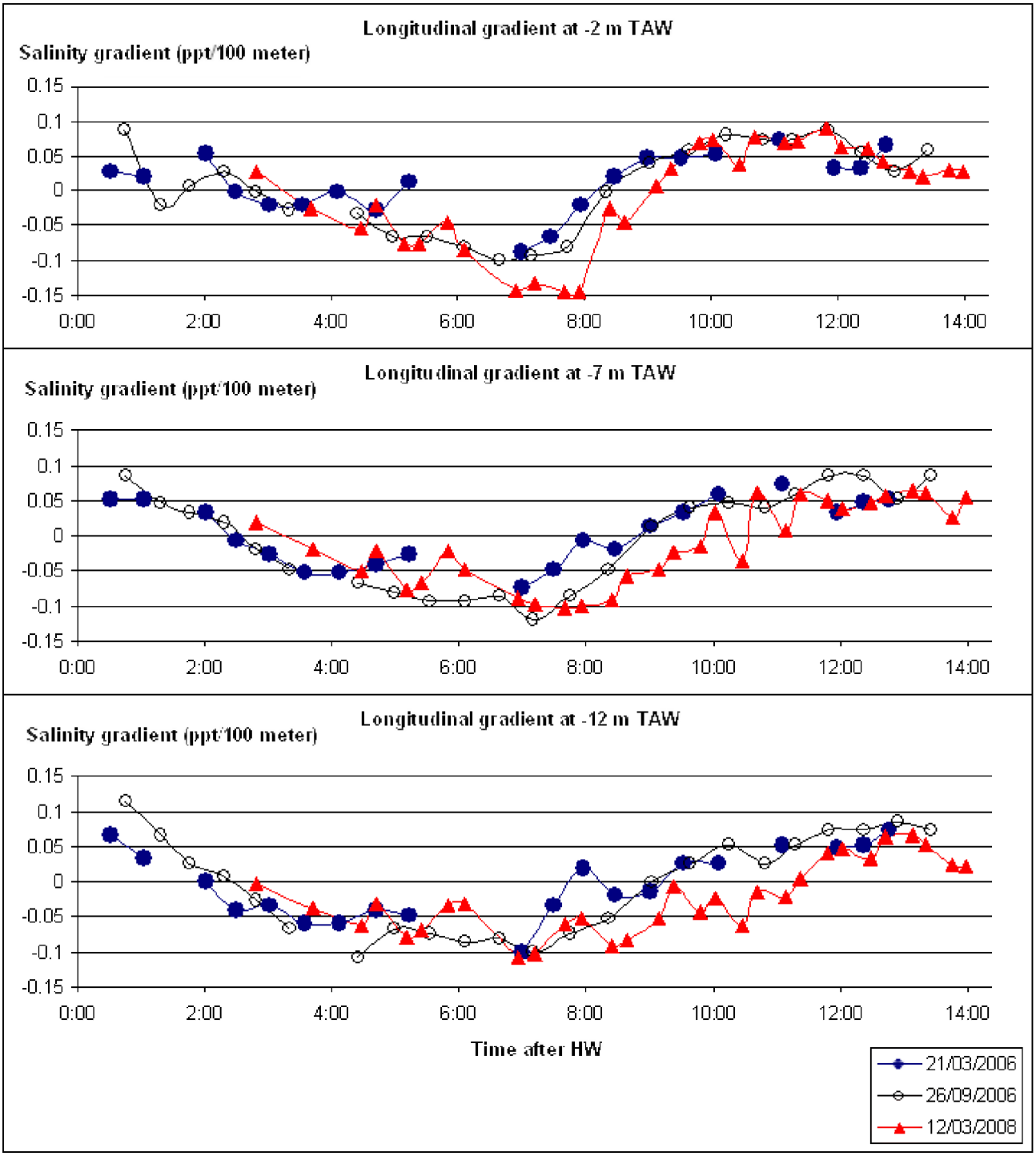
APPENDIX I. VERTICAL GRADIENTS OF SALINITY DURING DIFFERENT CAMPAIGNS



[4]

[4] a positive gradient stands for higher salinities to the bottom, a negative gradient represents higher salinities to the surface

APPENDIX J. LONGITUDINAL GRADIENT BETWEEN RIVER AND DOCK DURING DIFFERENT CAMPAIGNS



5

[5] a positive gradient stands for higher salinities in the river than in the dock, a negative gradient represents higher salinities in the dock than in the river

APPENDIX K. MEASURED SALINITIES DURING THE DIFFERENT CAMPAIGNS

Salinity (ppt)	time after HW	500 m along DGD			1000 m along DGD			1500 m along DGD			2000 m along DGD		
		-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW
21/03/2006 07:15	0:05	5.1	5.3	5.6	5.3	5.8	6.1						
21/03/2006 07:41	0:31	5.1	5.3	5.7	5	5.4	5.8	5.3	5.5	6	5.5	6.1	6.7
21/03/2006 08:13	1:03	5.2	5.7	6.2	5.2	5.5	5.9	5.3	5.8	6.5	5.5	6.5	6.7
21/03/2006 08:44	1:34	5.3	5.7	6.2	5.3	5.5	6.4	5.4	6	6.2			
21/03/2006 09:12	2:02	5.2	5.8	6.5	5.4	5.8	6.4	5.4	5.9	6	6	6.3	6.5
21/03/2006 09:40	2:30	5.8	6.1	6.7	5.6	5.9	6.5	5.5	5.8	6.4	5.8	6	6.1
21/03/2006 10:12	3:02	5.7	6.1	6.4	5.7	6.1	6.5	5.5	5.8	6.1	5.4	5.7	5.9
21/03/2006 10:44	3:34	5.6	6.2	6.3	5.3	6	6.3	5.2	5.7	6	5.3	5.4	5.4
21/03/2006 11:17	4:07	5.2	6.1	6.5	5.6	5.9	6.4	5.5	5.6	6.3	5.2	5.3	5.6
21/03/2006 11:52	4:42	5.3	6	6.5	5.6	5.7	6.3	5.4	5.7	6.5	4.9	5.4	5.9
21/03/2006 12:24	5:14	5.1	6	6.5				5.4	5.5	6	5.3	5.6	5.8
21/03/2006 12:49	5:39					5.4	5.9		5.6	5.9	5.2	5.2	6
21/03/2006 13:12	6:02							5.2	5.3	6.5	4.3	5	5.9
21/03/2006 13:40	6:30	5.2	5.4	6.2	5.3	5.5	6.3	5.2	5.4	6.1			
21/03/2006 14:10	7:00	5.2	5.4	6.1	5	5.3	5.8	4.7	4.7	5.7	3.9	4.3	4.6
21/03/2006 14:39	7:29	5.1	5.2	5.5	4.5	5.4	6.2	4.1	4.3	5.8	4.1	4.5	5
21/03/2006 15:07	7:57	5.1	5.4	6	4.9	5.3	6.1	4.1	5.2	6.1	4.8	5.3	6.3
21/03/2006 15:38	8:28	4.7	5.3	5.6	4.2	5.1	5.6	4.8	5.2	5.9	5	5	5.3
21/03/2006 16:10	9:00	4.3	5	5.4	5	5.1	5.5	5	5	5.3	5	5.2	5.2
21/03/2006 16:42	9:32	4.7	5	5.3	5.1	5.1	5.6	5	5.3	6.1	5.4	5.5	5.7
21/03/2006 17:15	10:05	4.7	4.7	5.1	5.2	5.2	5.5	5.1	5.3	5.9	5.5	5.6	5.5
21/03/2006 17:43	10:33				4.6	4.8	5.1	5	5.2	5.5	5.2	5.3	5.6
21/03/2006 18:15	11:05	4.6	4.9	5.2	5	5.2	5.6	5.1	5.2	5.5	5.7	6	6
21/03/2006 18:41	11:31				4.8	5	5.5	5	5.2	5.5	5.7	6	6.3
21/03/2006 19:07	11:57	5	5.3	5.7	4.9	5.2	5.7	5.1	5.4	5.6	5.5	5.8	6.4
21/03/2006 19:32	12:22	5	5.2	5.5				4.9	5.2	5.7	5.5	5.9	6.3
21/03/2006 19:56	12:46	5	5.4	5.6	5.2	5.4	6.2	5.7	5.9	6.6	6	6.2	6.7

Salinity (ppt)	time after HW	500 m along DGD			1000 m along DGD			1500 m along DGD			2000 m along DGD		
		-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW
26/09/2006 05:55	0:45	11.5	11.9	12.1	11.9	12.2	12.7	12	13	13.4	12.8	13.2	13.8
26/09/2006 06:29	1:19	11.6	12	12.3	11.3	12	12.6	11.5	12.4	13	11.3	12.7	13.3
26/09/2006 06:56	1:46	11.8	12.3	12.8	11.7	12.2	12.5	11.8	12.4	12.9	11.9	12.8	13.2
26/09/2006 07:29	2:19	11.9	12.4	13.1	12.1	12.4	13	11.9	12.9	12.9	12.3	12.7	13.2
26/09/2006 07:59	2:49	12.3	12.8	13.3	12.1	12.7	12.8	11.9	12.4	12.8	12.3	12.5	12.9
26/09/2006 08:30	3:20	12.3	13	13.4	12.2	12.8	12.9	12	12.4	12.8	11.9	12.3	12.4
26/09/2006 09:02	3:52				12.3	13	13.6	12.6	12.9	13.1	12.3	12.5	12.7
26/09/2006 09:35	4:25	12.2	12.9	13.5	12.5	13	13.2	12.1	12.6	13	11.7	11.9	11.9
26/09/2006 10:09	4:59	12.5	13	13.2	12.4	12.8	13.4	12.2	12.5	13.3	11.5	11.8	12.2
26/09/2006 10:42	5:32	12.3	12.8	13.3	12.3	12.5	13.2	11.8	12.1	13.1	11.3	11.4	12.2
26/09/2006 11:16	6:06	12.2	12.6	13.1	12.2	12.6	13.3	11.5	11.8	13.3	11	11.2	11.8
26/09/2006 11:49	6:39	12.3	12.8	13	12.1	12.4	13.2	11.7	12.4	13.4	10.8	11.5	11.8
26/09/2006 12:20	7:10	12.1	12.8	13	11.7	12.3	13.1	11.1	11.6	12.7	10.7	11	11.5
26/09/2006 12:55	7:45	11.8	12.4	13	11.5	12.3	12.8	10.9	11.4	12.7	10.6	11.1	11.9
26/09/2006 13:31	8:21	11.2	12.1	12.4	10.7	11.9	12.7	11.4	11.6	12.3	11.2	11.4	11.6
26/09/2006 14:12	9:02	11.1	11.8	12.4	10.8	11.9	12.8	11.6	11.8	12.3	11.7	12	12.4
26/09/2006 14:49	9:39	11.2	11.7	12	11.8	11.9	12.6	11.7	12.2	12.6	12.1	12.3	12.4
26/09/2006 15:25	10:15	11.1	11.6	11.7	11.8	12.2	12.3	11.9	12.1	12.4	12.3	12.3	12.5
26/09/2006 15:59	10:49	11	11.6	12	11.5	11.8	12	11.9	12.1	12.2	12.1	12.2	12.4
26/09/2006 16:28	11:18	11.3	11.8	12	11.6	11.9	12	12	12.2	12.5	12.4	12.7	12.8
26/09/2006 17:00	11:50	11.3	11.7	12.3	11.5	11.9	12.2	11.9	12	12.1	12.6	13	13.4
26/09/2006 17:33	12:23	11.4	11.9	12.3	11.7	12.1	12.2	11.7	12.2	12.4	12.2	13.2	13.4
26/09/2006 18:04	12:54	11.7	12.1	12.3	11.7	12.1	12.3	11.9	12.2	12.7	12.1	12.9	13.6
26/09/2006 18:35	13:25	11.5	12.1	12.7	11.9	12.2	12.6	11.8	12.5	13.6	12.4	13.4	13.8
12/03/2008 08:49	2:49	7.0	6.8	7.4	6.8	6.8	7.2	6.8	6.5	7.0	7.5	7.1	7.2
12/03/2008 09:41	3:41	7.2	7.2	7.5	7.1	7.1	7.4	7.1	6.9	7.0	6.8	6.6	6.5
12/03/2008 10:28	4:28	7.3	7.1	7.4	7.3	7.1	7.4	7.3	7.0	7.7	6.5	6.2	6.3

Salinity (ppt)	time after HW	500 m along DGD			1000 m along DGD			1500 m along DGD			2000 m along DGD		
		-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW	-2 mTAW	-7 mTAW	-12mTAW
12/03/2008 10:42	4:42	7.4	7.0	7.0	7.3	7.0	7.0	7.2	6.8	6.9	7.1	6.7	6.6
12/03/2008 11:10	5:10	7.5	7.2	7.5	7.4	7.1	7.1	7.2	6.9	7.2	6.1	5.8	6.3
12/03/2008 11:24	5:24	7.4	7.1	7.1	7.2	6.9	7.0	7.2	6.9	6.8	6.0	5.9	6.0
12/03/2008 11:50	5:50	7.5	7.3	7.7	7.3	7.1	7.3	7.2	7.1	7.2	6.7	6.9	7.0
12/03/2008 12:06	6:06	7.5	7.3	7.6	7.4	7.2	7.3	7.2	7.1	7.2	5.9	6.4	7.0
12/03/2008 12:55	6:55	7.6	7.3	7.4	7.6	7.2	7.2	6.0	6.9	7.3	4.8	5.7	5.7
12/03/2008 13:12	7:12	7.6	7.3	7.3	7.3	7.0	7.1	5.7	6.5	6.8	5.0	5.4	5.5
12/03/2008 13:40	7:40	7.4	7.2	7.2	6.4	7.0	7.4	5.4	6.3	7.0	4.7	5.2	6.3
12/03/2008 13:56	7:56	5.8	6.2	6.9	5.4	6.0	6.5	4.9	4.7	6.0	4.6	5.3	6.3
12/03/2008 14:24	8:24	5.7	6.9	7.3	5.7	6.7	7.2	5.0	5.8	6.9	5.4	5.4	5.6
12/03/2008 14:38	8:38	5.5	6.2	7.1	5.1	5.4	6.8	4.9	5.8	6.8	5.4	5.4	5.7
12/03/2008 15:08	9:08	5.4	6.8	7.2	5.3	6.1	7.2	5.8	6.1	7.0	6.0	6.1	6.4
12/03/2008 15:23	9:23	5.3	5.7	6.8	5.1	5.6	6.3	5.8	5.6	6.0	6.0	5.7	6.3
12/03/2008 15:48	9:48	5.3	5.9	7.0	5.5	6.2	6.8	5.6	6.2	6.6	6.8	6.5	6.5
12/03/2008 16:01	10:01	5.4	5.2	6.4	5.5	5.7	6.5	5.6	6.0	6.7	6.8	6.5	6.5
12/03/2008 16:27	10:27	5.4	6.3	7.3	5.9	6.3	6.6	6.1	6.5	6.8	7.0	6.6	6.5
12/03/2008 16:42	10:42	5.9	6.2	6.8	6.1	5.9	6.8	6.1	6.3	6.9	7.0	6.6	6.5
12/03/2008 17:09	11:09	6.0	6.7	7.3	6.5	6.5	7.2	6.6	6.7	6.9	7.0	6.6	6.6
12/03/2008 17:23	11:23	6.4	6.1	6.9	6.6	6.3	6.5	6.5	6.4	6.8	7.0	6.6	6.7
12/03/2008 17:48	11:48	5.7	6.4	6.9	6.8	6.5	6.8	6.9	6.8	6.8	7.5	7.4	7.6
12/03/2008 18:02	12:02	6.1	5.8	6.4	6.9	6.7	6.8	6.9	6.7	6.7	7.2	6.9	7.4
12/03/2008 18:29	12:29	6.2	6.2	6.5	6.2	6.5	7.0	6.6	6.9	7.2	7.2	7.2	7.5
12/03/2008 18:43	12:43	6.1	6.2	7.0	6.1	6.4	7.0	6.7	6.8	7.2	6.9	7.2	7.5
12/03/2008 19:08	13:08	6.1	6.4	7.0	6.2	6.6	7.1	6.8	6.9	7.2	6.7	7.1	7.7
12/03/2008 19:21	13:21	6.0	6.6	6.9	6.5	6.9	7.4	6.4	7.0	7.2	6.5	7.2	7.8
12/03/2008 19:45	13:45	6.1	6.5	7.2	6.1	6.8	7.4	6.7	7.0	7.3	6.7	6.8	7.6
12/03/2008 19:58	13:58	6.1	6.5	7.1	6.1	6.7	7.2	6.6	6.8	7.5	6.7	7.5	7.7
12/03/2008 08:49	2:49	7.0	6.8	7.4	6.8	6.8	7.2	6.8	6.5	7.0	7.5	7.1	7.2

APPENDIX L.OVERVIEW OF HCBS2 AND AANSLIBBING DEURGANCKDOK REPORTS

Report	Description of HCBS2
Ambient Conditions Lower Sea Scheldt	
5.3	Overview of ambient conditions in the river Scheldt – January-June 2006 (I/RA/11291/06.088/MSA)
5.4	Overview of ambient conditions in the river Scheldt – July-December 2006 (I/RA/11291/06.089/MSA)
5.5	Overview of ambient conditions in the river Scheldt : RCM-9 buoy 84 & 97 (1/1/2007 -31/3/2007) (I/RA/11291/06.090/MSA)
5.6	Analysis of ambient conditions during 2006 (I/RA/11291/06.091/MSA)
Calibration	
6.1	Winter Calibration (I/RA/11291/06.092/MSA)
6.2	Summer Calibration and Final Report (I/RA/11291/06.093/MSA)
Through tide Measurements Winter 2006	
7.1	21/3 Scheldewacht – Deurganckdok – Salinity Distribution (I/RA/11291/06.094/MSA)
7.2	22/3 Parel 2 – Deurganckdok (I/RA/11291/06.095/MSA)
7.3	22/3 Laure Marie – Liefkenshoek (I/RA/11291/06.096/MSA)
7.4	23/3 Parel 2 – Schelle (I/RA/11291/06.097/MSA)
7.5	23/3 Laure Marie – Deurganckdok (I/RA/11291/06.098/MSA)
7.6	23/3 Veremans Waarde (I/RA/11291/06.099/MSA)
HCBS Near bed continuous monitoring (Frames)	
8.1	Near bed continuous monitoring winter 2006 (I/RA/11291/06.100/MSA)
INSSEV	
9	Settling Velocity - INSSEV summer 2006 (I/RA/11291/06.102/MSA)
Cohesive Sediment	
10	Cohesive sediment properties summer 2006 (I/RA/11291/06.103/MSA)
Through tide Measurements Summer 2006	
11.1	Through Tide Measurement Sediview and Siltprofiler 27/9 Stream - Liefkenshoek (I/RA/11291/06.104/MSA)
11.2	Through Tide Measurement Sediview 27/9 Veremans - Raai K (I/RA/11291/06.105/MSA)
11.3	Through Tide Measurement Sediview and Siltprofiler 28/9 Stream - Raai K (I/RA/11291/06.106/MSA)
11.4	Through Tide Measurement Sediview 28/9 Veremans - Waarde(I/RA/11291/06.107/MSA)
11.5	Through Tide Measurements Sediview 28/9 Parel 2 - Schelle (I/RA/11291/06.108/MSA)
11.6	Through Tide measurement 26/9 Scheldewacht – Deurganckdok – Salinity Distribution (I/RA/11291/06.161/MSA)

Analysis	
12	Report concerning the presence of HCBS layers in the Scheldt river (I/RA/11291/06.109/MSA)

Report	Description of Opvolging aanslibbing Deurganckdok between April 2006 till March 2007
Sediment Balance: Bathymetry surveys, Density measurements, Maintenance and construction dredging activities	
1.1	Sediment Balance: Three monthly report 1/4/2006 – 30/06/2006 (I/RA/11283/06.113/MSA)
1.2	Sediment Balance: Three monthly report 1/7/2006 – 30/09/2006 (I/RA/11283/06.114/MSA)
1.3	Sediment Balance: Three monthly report 1/10/2006 – 31/12/2006 (I/RA/11283/06.115/MSA)
1.4	Sediment Balance: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/06.116/MSA)
1.5	Annual Sediment Balance (I/RA/11283/06.117/MSA)
1.6	Sediment balance Bathymetry: 2005 – 3/2006 (I/RA/11283/06.118/MSA)
Factors contributing to salt and sediment distribution in Deurganckdok: Salt-Silt (OBS3A) & Frame measurements, Through tide measurements (SiltProfiling & ADCP)	
2.1	Through tide measurement Siltprofiler 21/03/2006 Laure Marie (I/RA/11283/06.087/WGO)
2.2	Through tide measurement Siltprofiler 26/09/2006 Stream (I/RA/11283/06.068/MSA)
2.3	Through tide measurement Sediview spring tide 22/03/2006 Veremans (I/RA/11283/06.110/BDC)
2.4	Through tide measurement Sediview average tide 27/09/2006 Parel 2 (I/RA/11283/06.119/MSA)
2.5	Through tide measurement Sediview average tide 24/10/2007 Parel 2 (I/RA/11283/06.120/MSA)
2.6	Salt-Silt distribution & Frame Measurements Deurganckdok 13/3/2006 – 31/05/2006 (I/RA/11283/06.121/MSA)
2.7	Salt-Silt distribution & Frame Measurements Deurganckdok 15/07/2006 – 31/10/2006 (I/RA/11283/06.122/MSA)
2.8	Salt-Silt distribution & Frame Measurements Deurganckdok 12/02/2007 – 18/04/2007 (I/RA/11283/06.123/MSA)
2.9	Calibration stationary equipment autumn (I/RA/11283/07.095/MSA)

Report	Description of Opvolging aanslibbing Deurganckdok between April 2006 till March 2007
Boundary Conditions: Upriver Discharge, Salt concentration Scheldt, Bathymetric evolution in access channels, dredging activities in Lower Sea Scheldt and access channels	
3.1	Boundary conditions: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/06.127/MSA) including HCBS 2 report 5.5
~~3.2~~	~~Boundary condtions: Annual report (I/RA/11283/06.128/MSA)~~[6]
Analysis	
4.1	Analysis of Siltation Processes and Factors (I/RA/11283/06.129/MSA)

[6] considered in report 5.6 'Analysis of ambient conditions during 2006' (I/RA/11291/06.091/MSA) in the framework of the study 'Extension of the study about density currents in the Beneden Zeeschelde'