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Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies

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TABLE OF CONTENTS

1. INTRODUCTION 1
1.1. THE ASSIGNMENT 1
1.2. PURPOSE OF THE STUDY 1
1.3. OVERVIEW OF THE STUDY 2
1.3.1. HCBS2 reports 2
1.3.2. HCBS1 reports 4
1.4. STRUCTURE OF THE REPORT 4
2. THE MEASUREMENT CAMPAIGN 5
2.1. DESCRIPTION OF THE MEASUREMENT CAMPAIGN 5
2.2. THE EQUIPMENT 6
2.2.1. ADCP 6
2.2.2. CTD-OBS 7
2.2.3. Pump Sampler 7
3. COURSE OF THE MEASUREMENTS 8
3.1. MEASUREMENT PERIODS 8
3.2. HYDRO-METEOROLOGICAL CONDITIONS DURING THE MEASUREMENT CAMPAIGN 8
3.2.1. Vertical tide during the measurements 8
3.2.2. Meteorological data 9
3.3. NAVIGATION INFORMATION 9
3.4. REMARKS ON DATA 10
4. PROCESSING OF DATASETS 11
4.1. CALIBRATION OF THE TURBIDITY SENSORS 11
4.2. METHODOLOGY OF PROCESSING OF THE ADCP DATA WITH SEDIVIEW 11
4.2.1. Acoustic backscatter theory 11
4.2.2. Water sampling and transect sailing 12
4.2.3. Calibration for suspended sediment concentration within Sediview 12
4.2.3.1. Calibration workset 12
4.2.3.2. SSC calibration per ensemble pair 12
4.2.4. Sediview configuration 12
4.2.4.1. Discharge and suspended sediment concentration estimates 12
4.2.4.2. Contour plots of the transects 16
4.2.5. Output 16
5. PRELIMINARY ANALYSIS OF THE DATA 17
5.1. DATA OF HCBS2-SUMMER 17
5.2. COMPARISON WITH PREVIOUS HCBS-CAMPAIGNS 17
6. REFERENCES 22

APPENDICES

APPENDIX A. MEASUREMENT EQUIPMENT A-1

APPENDIX B. OVERVIEW OF MEASUREMENTS B-1

B.1 OVERVIEW OF THE MEASUREMENT LOCATIONS FOR THE WHOLE HCBS MEASUREMENT CAMPAIGN (26-27-28/09/2006)........ B-2
B.2 MEASUREMENT OVERVIEW SCHELLE (TRANSECT S) 28/09/2006 .... B-8

APPENDIX C. TIDAL DATA C-1

APPENDIX D. NAVIGATION INFORMATION AS RECORDED ON SITE........ D-1

APPENDIX E. UNESCO PPS-78 FORMULA FOR CALCULATING SALINITY E-1

APPENDIX F. CONTOURPLOTS OF FLOW VELOCITIES, SEDIMENT CONCENTRATION AND SEDIMENT FLUX PER SAILED TRANSECT F-1

APPENDIX G. DISCHARGE, SEDIMENT CONCENTRATION AND SEDIMENT FLUX FOR THE TOTAL CROSS-SECTION G-1

APPENDIX H. TEMPORAL VARIATION OF TOTAL FLUX AND TOTAL DISCHARGE H-1

LIST OF TABLES

TABLE 1-1: OVERVIEW OF HCBS 2 REPORTS 2
TABLE 1-2: OVERVIEW OF HCBS 1 REPORTS 4
TABLE 2-1TRANSECT OF THE FLOW MEASUREMENTS (UTM31 ED50) 6
TABLE 2-2: POSITIONS OF THE CALIBRATION POINTS FOR 28 SEPTEMBER 2006 AT SCHELLE. 6
TABLE 2-3: MAIN CONFIGURATION SETTINGS OF ADCP 600KHZ WORKHORSE 7
TABLE 3-1: HIGH AND LOW TIDE AT HANDSWEERT, LIEFKENSHOEK AND SCHELLE ON 28/09/2006 8
TABLE 3-2: COMPARISON OF THE TIDAL CHARACTERISTICS OF 28/09/2006 WITH THE AVERAGE TIDE, THE AVERAGE NEAP TIDE AND THE AVERAGE SPRING TIDE OVER THE DECADE 1991-2000 FOR HANSWEERT (HAN), LIEFKENSHOEK (LIE) AND SCHELLE (SCH) 9
TABLE 4-1: EXTRAPOLATION METHODS FOR TOP AND BOTTOM VARIABLES 14
TABLE 4-2: SHAPE OF THE EDGES OF THE TRANSECTS FOR EDGE ESTIMATES 14
TABLE 4-3: REFERENCE POINTS ON LEFT AND RIGHT BANK 15
TABLE 5-1: WATER VOLUME DURING EBB, FLOOD AND MEASUREMENT CAMPAIGN ON 17/02/2005 (NEAP TIDE), 19/02/2006 (NEAP TIDE), 23/03/2006 (NEAP TIDE) & 28/09/2006 (AVERAGE TIDE) 20
TABLE 5-2: SS MASS DURING EBB, FLOOD AND MEASUREMENT CAMPAIGN ON 17/02/2005 (NEAP TIDE), 19/02/2006 (NEAP TIDE), 23/03/2006 (NEAP TIDE) & 28/09/2006 (AVERAGE TIDE) 21

LIST OF FIGURES

FIGURE 2-1 MAP OF THE MEASURMENT LOCATIONS IN SCHELLE 5
FIGURE 4-1: UNMEASURED REGIONS IN THE CROSS SECTION (FROM RD INSTRUMENTS, 2003) 13
FIGURE 4-2: MEASURED AND ESTIMATED DISCHARGES AND SEDIMENT FLUXES WITHIN SEDIVIEW (DRL, 2005) .. 13
FIGURE 4-3: BOTTOM ESTIMATE OF THE SEDIMENT CONCENTRATION 14
FIGURE 4-4: EFFECTIVE START- AND ENDPOINTS FOR TRANSECT S 15
FIGURE 5-1: FRESH WATER DISCHARGE 8 - 20 FEBRUARY 2005 18
FIGURE 5-2: FRESH WATER DISCHARGE 15 - 25 MARCH 2006 18
FIGURE 5-3: FRESH WATER DISCHARGE 28 SEPTEMBER 2006 18
FIGURE 5-4: MEAN, HIGH AND LOW FRESH WATER DISCHARGE 1971-2000 19
FIGURE 5-5: SS CONCENTRATION 17/02/2005 (NEAP TIDE), 19/02/2005 (NEAP TIDE), 23/03/2006 (NEAP TIDE) & 28/09/2006 (AVERAGE TIDE) 19
FIGURE 5-6: TOTAL DISCHARGE 17/02/2005 (NEAP TIDE), 19/02/2005 (NEAP TIDE), 23/03/2006 (NEAP TIDE) & 28/09/2006 (AVERAGE TIDE) 20
FIGURE 5-7: TOTAL FLUX 17/02/2005 (NEAP TIDE), 19/02/2005 (NEAP TIDE), 23/03/2006 (NEAP TIDE) & 28/09/2006 (AVERAGE TIDE) 21

1. INTRODUCTION

1.1. The assignment

This report is part of the set of reports describing the results of the extension of the study about density currents in the Lower Sea Scheldt (Beneden Zeeschelde) as part of the Long Term Vision for the Scheldt estuary – Field measurements high-concentration benthic suspensions (HCBS 2)[1]. It is complementary to the study 'Monitoring and analysis of silt accretion in Deurganckdok.

The terms of reference for this study were prepared by the 'Departement Mobiliteit en Openbare Werken van de Vlaamse Overheid, Waterbouwkundig Laboratorium' (16EB/04/13). The repetition of this study was awarded to International Marine and Dredging Consultants NV in association with WL|Delft Hydraulics, dr. R. Kirby and Gems International on 09/12/2005.

'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.

The settling velocity measurements with INSSEV were subcontracted to the Coastal Processes Research Group (SEOES, University of Plymouth), with team leader Dr Andrew Manning.

1.2. Purpose of the study

The Lower Sea Scheldt 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.

Another observation during the last years is that the composition of the sediment dredged at the Sill of Zandvliet became more muddy, resulting in a strong increase in dumping volumes at the allocated dumping sites since 2002.

To deal with these problems, and to facilitate the management of the Lower Sea Scheldt, more knowledge on the fine sediment dynamics is required. This can be obtained from in-situ measurements and the development of an advanced numerical sediment transport model.

In the past, already many surveys have been carried out to increase the understanding of the dynamics of fine sediment in the Lower Sea Scheldt. Also, salinity and turbidity is measured continuously at Prosperpolder and Oosterweel. However, none of these measurements have been carried out in the lower 1 m of the water column.

It is expected that temporary layers of soft mud may be formed in this lower part of the water column, which may move independently of the tidal water movement, in particular during slack

[1] Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies

water. These layers may be remixed during accelerating tide, an indication for which is the observation of mud clouds at the water surface during maximum ebb and flood velocities. If such layers exist, they may contribute significantly to the siltation rate in the Deurganckdok. This would imply that measures (for instance passive constructions) to minimize siltation in the Deurganckdok can only be successful if the dynamics of these soft mud layers are also affected. Therefore it is important to establish the role of these soft mud layers on the sediment dynamics in the Lower Sea Scheldt, both from a qualitative and quantitative point of view.

The goal of the first HCBS study (2005) was threefold:

1. The primary goal of the study (and the survey) is to detect the occurrence of near-bed high-concentration mud suspensions (referred to as **high-concentration benthic suspensions - HCBS**), their dynamic behaviour and the conditions and locations of their occurrence,
2. The second goal is to establish fluxes of fine sediment in the river with the purpose to calibrate a numerical 3D cohesive sediment transport model of the Lower Sea Scheldt,
3. The third goal is to establish the sediment properties required for the cohesive sediment transport model.

The second HCBS survey aims to complete the same HCBS and flux measurements after the opening of Deurganckdok in July 2005. The measurements are repeated under the same (seasonal and tidal) conditions as the original HCBS survey. These are referred to as the winter campaign. Seasonal influences are examined in September 2006 when the survey was repeated in summer conditions, being the summer campaign.

The settling velocity measurements are only conducted in summer conditions (August 2006).

1.3. Overview of the study

1.3.1. HCBS2 reports

The repetition of the study consists of two separate surveys. The first survey is a repetition of the first HCBS measurement campaign (winter campaign) and was conducted in March 2006. The second survey will be held in September 2006.

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

This report, report 11.5, is part of the set of reports for the summer campaign, describing the study. An overview of these reports is given in Table 1-1.

Parallel with this study, measurement campaigns were conducted as a part of study to ‘Monitoring and analysis of silt accretion in Deurganckdok. These measurements (see IMDC, 2006l to 2006o & IMDC, 2007m to 2007w) and in combination with measurements of this report could help to understand the tidal dynamics within Deurganckdok and on the river Scheldt.

Table 1-1: Overview of HCBS 2 Reports

Report	Description
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 Longitudinal Salinity Distribution 26/9 Scheldewacht – Deurganckdok (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)

1.3.2. HCBS1 reports

Reports of the first HCBS campaign are summarized in Table 1-2.

Table 1-2: Overview of HCBS 1 Reports

Report	Description
Test Survey	
1	Test survey 2-3 February 2005 (I/RA/11265/05.008/MSA)
Through tide and DON frame Measurements Winter 2005	
2.1	February survey – Deurganckdok 17 February 2005 (I/RA/11265/05.009/MSA)
2.2	February survey – Zandvliet 17 February 2005 (I/RA/11265/05.010/MSA)
2.3	February survey – Liefkenshoek 17 February 2005 (I/RA/11265/05.011/MSA)
2.4	February survey – Schelle 17 February 2005 (I/RA/11265/05.012/MSA)
2.5	February survey – Deurganckdok 16 February 2005 (I/RA/11265/05.013/MSA)
2.6	February survey – Kallosluis 18 February 2005 (I/RA/11265/05.014/MSA)
2.7	February survey – Near bed continuous monitoring (I/RA/11265/05.015/MSA)
INSSEV	
3	February survey – Settling velocity - INSSEV (I/RA/11265/05.016/MSA)
Cohesive Sediment	
4	February survey – Cohesive sediment properties (I/RA/11265/05.017/MSA)
Ambient Conditions Lower Sea Scheldt	
5.1	Overview of ambient conditions in the river Scheldt – January-June 2005 (I/RA/11265/05.018/MSA)
5.2	Overview of ambient conditions in the river Scheldt – July-December 2005 (I/RA/11265/05.019/MSA)
Analyse	
6.1	Analysis of ambient conditions in the river Scheldt: RCM-9 buoy 84 & 97 (21/09/05-1/10/06) (I/RA/11265.162/MSA)

1.4. Structure of the report

This report is the factual data report of the summer through tide measurements at Schelle (transect S) on the 28th of September 2006. 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 measurement 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. Description of the measurement campaign

Flow velocity, Turbidity, Salinity and Temperature measurements were conducted on the 28th of September from 6h27 MET till 19h38 MET.

The purpose of the measurements was to find fluid mud layers and to determine the cross-section distribution of the suspended sediment concentration, the sediment flux and flow velocity during a complete tidal cycle.

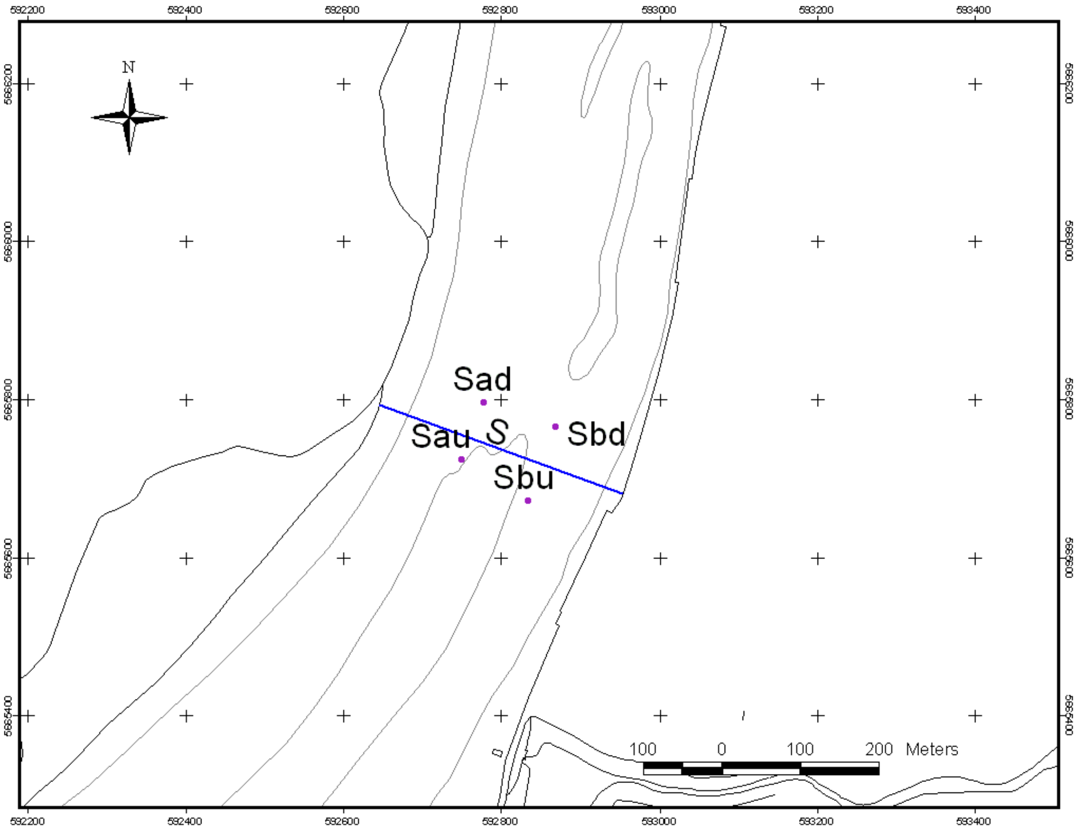

Figure 2-1 Map of the measurment locations in Schelle

From the survey vessel Parel II a measurement cycle was completed every half hour. The vessel with a mounted ADCP sailed a fixed transect from the left bank to the right bank during the flood and from the right bank to the left bank during the ebb (Table 2-1). Profiles were gathered to calibrate the ADCP transects for temperature, salinity and suspended sediment concentration to be used in Sediview.

Two calibration profiles were collected for each transect (Table 2-2):

- One before sailing the transect at the bank where the start of the transect was (Left bank during the flood; Right bank during the ebb)
- One after sailing the transect at the bank where the transect ended (Right bank during flood, left bank during the ebb).

The left bank calibrations were alternated between a location near the left bank (Kbu and Kbd) and one at the right bank edge of the navigation channel (Kdu and Kdd).

During these calibrations, a fish with a CTD-OBS was lowered to the bottom. The downcast was interrupted at two depths, one in the upper half of the water column (between 4 and 7 m from the water surface), and one at 4 meters above the bottom. At these depths samples were taken for calibration, and are used as ‘ground truth’ for all suspended sediment concentration measurements (OBS and Sediview). The other instruments logged continuously during the downcast. Conductivity, Temperature and Depth was logged by OBS 3A.

An overview with all the measurement locations and transects of the HCBS Through Tide measurements can be found in Table 2-1 and Table 2-2.

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

Measurement location	***Left Bank Easting***	***Left Bank Northing***	***Right Bank Easting***	***Right Bank Northing***	***Avg Length [m]***	***Avg Course [degr.]***
transect S	592645	592953	5665794	5665682	247	106

Table 2-2: Positions of the calibration points for 28 September 2006 at Schelle.

Measurement point	***Bank***	***Easting (UTM31 ED50)***	***Northing (UTM31 ED50)***	***Average Depth [m TAW]***
Flood				
Sau	Left Bank	*592750*	*5665725*	-9.1
Sbu	Right Bank	*592833*	*5665673*	-6.5
Ebb				
Sad	Left Bank	*592778*	*5665797*	-8.1
Sbd	Right Bank	*592868*	*5665766*	-7.4

2.2. The equipment

2.2.1. ADCP

The current measurements were conducted using an RD Instruments ADCP 600 kHz Workhorse. For positioning the GPS onboard the vessel Parel II was used. For the measurement of the heading a gyrocompass was installed.

This 600 KHz ADCP system was mounted on a steel pole approximately midships the portside. The transducer set was looking vertically downwards to the bottom. Transceiver unit and computer system were connected to peripherals such as the differential GPS-receiver, the heave compensator and the gyrocompass.

During the measurements the ADCP constantly measured upstream from the vessel. The acquisition software of Winriver was used. The main settings are given in Table 2-3.

Table 2-3: Main Configuration Settings of ADCP 600kHz Workhorse

Main configuration settings:
Cell depth : 0.5 m
Number of Water pings per ensemble: 2
Number of Bottom Track pings per ensemble: 2
Time between ensembles: 0
Averaging: None
Speed of Sound: Fixed 1500 m/s
Salinity 0 psu
3-beam solution: enabled

The technical details on the ADCP are described in the February Survey Reports of the HCBS 1 measurement campaign (IMDC, 2005b).

2.2.2. CTD-OBS

A D&A type OBS 3A was used to measure depth, conductivity, temperature and turbidity.

Measured parameters by the OBS 3A sensor: temperature (°C), conductivity (µS/cm), absolute pressure (m), turbidity (NTU)

On the Parel II, the OBS 3A device was mounted on a towfish. The resulting record is filled-up with GPS-time, sample number, and planimetric position of the GPS-receiver. Sampling frequency is 1 reading per second.

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

2.2.3. Pump Sampler

A water sampler was attached nearby the turbidity sensor taking water samples. Samples were collected in 1 litre sampling bottles. The pumping speed of the water sampler was tested at the start of the measurement campaign on board. Dye was used to time the duration between the intake of the dye and exit at the sampling end of the sampler on board. The duration between intake and exit at the end was 25 seconds.

3. COURSE OF THE MEASUREMENTS

3.1. Measurement periods

At Schelle ADCP tracks were sailed once every half hour for 13 hours, in total 27 cross-sections.

Calibration profiles were taken at 2 locations (left bank, left edge of the navigation channel). During every cycle, 2 calibration profiles were taken (one near the left bank and one at the left edge of navigation channel), resulting theoretically in a total of 54 profiles.APPENDIX B gives the start and end points of the tracks, the sailed length and the course.

3.2. Hydro-meteorological conditions during the measurement campaign

3.2.1. Vertical tide during the measurements

The vertical tide was measured at the Hansweert, Liefkenshoek and Schelle tidal gauges. Graphs of the tide at Hansweert, Liefkenshoek and Schelle on the 28th of September can be found in APPENDIX C. Table 3-1 gives the most important characteristics (high and low tide) of the tide at those gauges on the 28th of September 2006.

Table 3-1: High and low tide at Handsweert, Liefkenshoek and Schelle on 28/09/2006

	Time [hh:mm MET]			**Water level [m TAW]**		
	Hansweert	**Liefkenshoek**	**Schelle**	**Hansweert**	**Liefkenshoek**	**Schelle**
28/09/2006						
LW (1)	23:50	00:50	01:50	0.21	-0.1	-0.07
HW (2)	05:40	06:10	07:10	4.66	5.04	5.28
LW (3)	12:00	12:50	13:50	0.41	0.1	0.14
HW (4)	17:50	18:30	19:20	4.84	5.22	5.49

In Table 3-2 the tidal characteristics of the tide on the 28th of September are compared to the average tide over the decade 1991-2000 (AMT, 2003).

Table 3-2: Comparison of the tidal characteristics of 28/09/2006 with the average tide, the average neap tide and the average spring tide over the decade 1991-2000 for Hansweert (Han), Liefkenshoek (Lie) and Schelle (Sch)

	Neap Tide (1991-2000)			***Avg Tide (1991-2000)***			***Spring Tide (1991-2000)***			***Tide 28/09/2006***		
Water level [mTAW]	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**
LW (1)	0.61	0.39	0.34	0.27	0.05	0.03	0.02	-0.18	-0.18	0.21	-0.1	-0.07
HW (2)	4.29	4.63	4.95	4.76	5.19	5.45	5.11	5.63	5.83	4.66	5.04	5.28
LW (3)	-	-	-	-	-	-	-	-	-	0.41	0.1	0.14
HW (4)	-	-	-	-	-	-	-	-	-	4.84	5.22	5.49
Tidal difference [m]	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**
Rising (1→2)	3.68	4.24	4.61	4.49	5.14	5.42	5.09	5.81	6.01	4.45	5.14	5.35
Falling (2→3)	3.68	4.24	4.61	4.49	5.14	5.42	5.09	5.81	6.01	4.25	4.94	5.14
Rising (3→4)	-	-	-	-	-	-	-	-	-	4.43	5.12	5.35
Duration [hh:mm]	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**
Rising (1→2)	6:14	5:59	5:53	6:02	5:34	5:30	5:54	5:16	5:15	5:50	5:20	5:20
Falling (2→3)	6:25	6:40	6:46	6:23	6:50	6:55	6:26	7:02	7:04	6:20	6:40	6:40
Rising (3→4)	-	-	-	-	-	-		-	-	5:50	5:40	5:30
Tide (1→3)	12:39	12:39	12:39	12:25	12:24	12:25	12:20	12:18	12:19	12:10	12:00	12:00
Tide (2→4)	-	-	-	-	-	-	-	-	-	12:10	12:20	12:10
Tidal coefficient	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**	**Han**	**Lie**	**Sch**
Rising (1→2)	0.82	0.82	0.85	1	1	1	1.11	1.13	1.11	0.99	1.00	0.99
Falling (2→3)	0.82	0.82	0.85	1	1	1	1.11	1.13	1.11	0.95	0.96	0.95
Rising (3→4)	-	-	-	-	-	-	-	-	-	0.99	1.00	0.99

The tidal coefficients from 0.95 up to 1.00 for the measured tide of the 28th of September indicate that this tide has a similar tidal range than the average tide for the decade of 1991-2000.

3.2.2. Meteorological data

Meteorological data at Antwerpen, Hove meteorological station for 28/09/2006 have been obtained from wundergound (2007) as the monthly report from KMI (Koninklijk Meteorologisch Instituut = Royal Meteorological Institute of Belgium) for September 2006 wasn't available yet.

On the 28th of September 2006, the air temperature varied between 13 and 22°C. The wind blew from SSE-WSW at an averaged velocity of 5 km/h. The sky was almost clear and no rainfall occurred.

3.3. Navigation information

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

3.4. Remarks on data

During dataprocessing, shipwakes have been removed by extrapolating data from neighbouring ensembles, as far as these wakes only occurred in the top 5 meter.

4. PROCESSING OF DATASETS

4.1. Calibration of the turbidity sensors

A crucial aspect of the accuracy and reliability of the data concerns the calibration of the instruments before the measurement campaign. These calibration procedures are described in Report 6.1 Winter calibration (IMDC, 2006a).

4.2. Methodology of processing of the ADCP data with Sediview

DRL Software's Sediview was used to process the ADCP data. Sediview is designed to derive estimates of suspended sediment concentration throughout the water column using acoustic backscatter data obtained by ADCPs manufactured by RD Instruments of San Diego, California.

4.2.1. Acoustic backscatter theory

The acoustic theory governing backscatter from particles suspended in the water column is complex, but the following simplified formula serves to introduce the main factors that are relevant:

$$E = SL + SV + Constant - 20\log(R) - 2\alpha_w R$$

Where:

- E = echo intensity,
- SL = transmitted power,
- SV = backscatter intensity due to the particles suspended in the water column,
- α_w = a coefficient describing the absorption of energy by the water,
- R = the distance from the transducer to the measurement bin.

The term 20log(R) is a simple geometric function which accounts for the spherical spreading of the beam. The constant is required because each ADCP has specific performance characteristics.

In order to measure the suspended sediment concentration in the water column it is necessary to relate the backscattered sound intensity to the mass concentration in the water. For the purposes of measuring solids concentration on site, it can be shown that the relationship is as follows (derived from Thorne and Campbell, 1992 and Hay, 1991 in DRL (2003)):

$$Log_{10} M_r = \{dB + 2r(\alpha_w + \alpha_s) - K_s\} S^{-1}$$

Where:

- $M(r)$ = mass concentration per unit volume at range, r
- S = relative backscatter coefficient
- K_s = site and instrument constant
- dB = the measured relative backscatter intensity (corrected for beam spreading)
- α_w = water attenuation coefficient
- α_s = sediment attenuation coefficient, which is a function of the effective particle size

In this expression there are four unknowns: S, Ks, α_w and α_s. These parameters are to be determined within Sediview.

4.2.2. Water sampling and transect sailing

To calibrate Sediview for suspended sediment concentration, two water samples are taken at the beginning and at the end of each transect (see 3.1). Both samples are taken within the range of reliable data of the ADCP. For the near-surface sample this means in bin 3 or 4, for the near-bed sample this means at about one or two meter above the sidelobe.

Water sampling is done together with CTD-OBS measurement in order to have two independent suspended sediment concentration measurements for each sample. OBS measurements were compared to the water samples. The water samples were used for Sediview calibration, while OBS measurements were used as a back up check. The salinity and temperature was used to compute the acoustic water absorption (water attenuation coefficient). All water samples were analysed as is described in 4.2.3.1.

4.2.3. Calibration for suspended sediment concentration within Sediview

4.2.3.1. Calibration workset

The calibration workset consists of ADCP-files, sampling times, sampling depths, SSC obtained from water samples and SSC, temperature and salinity obtained from CTD-OBS readings.

The suspended sediment concentration of the water samples was determined. One-litre samples were filtered over a preweighed desiccated 0.45 micron filter, after which the filter is dried in an oven at 105°C, cooled and weighed (NEN 6484).

4.2.3.2. SSC calibration per ensemble pair

In the Sediview calibration process the following parameters must be defined: the site and instrument constant (Ks), the relative backscatter coefficient (S) and the effective particle size per ensemble-pair (near-surface sample and near-bed sample) in order to fit the Sediview-estimate with the suspended sediment concentration of the water samples. These parameter sets may not differ too much from the previous parameter sets, as the environmental conditions will not change that much over a small time interval. To obtain a smooth progress in time of Ks, S and effective particle size an iterative approach is used.

4.2.4. Sediview configuration

4.2.4.1. Discharge and suspended sediment concentration estimates

The ADCP measures most of the water column from just in front of the ADCP to 6% above the bottom. The shallow layer of water near the bottom is not used to compute discharge and suspended sediment concentration due to side-lobe interference. When the ADCP sends out an acoustic pulse, a small amount of energy is transmitted in side lobes rather than in the direction of the ADCP beam. Side lobe reflection from the bottom can interfere with the water echoes and can give erroneous data. The thickness of the side lobe layer is 6% of the distance from the transducers to the bottom.

Near the banks the water depth is too shallow for the ADCP to profile.

For each of those unmeasured regions, Sediview will make an estimate of the discharges and suspended sediment concentration. The measured and unmeasured regions in the cross section are shown in Figure 4-1 and Figure 4-2.

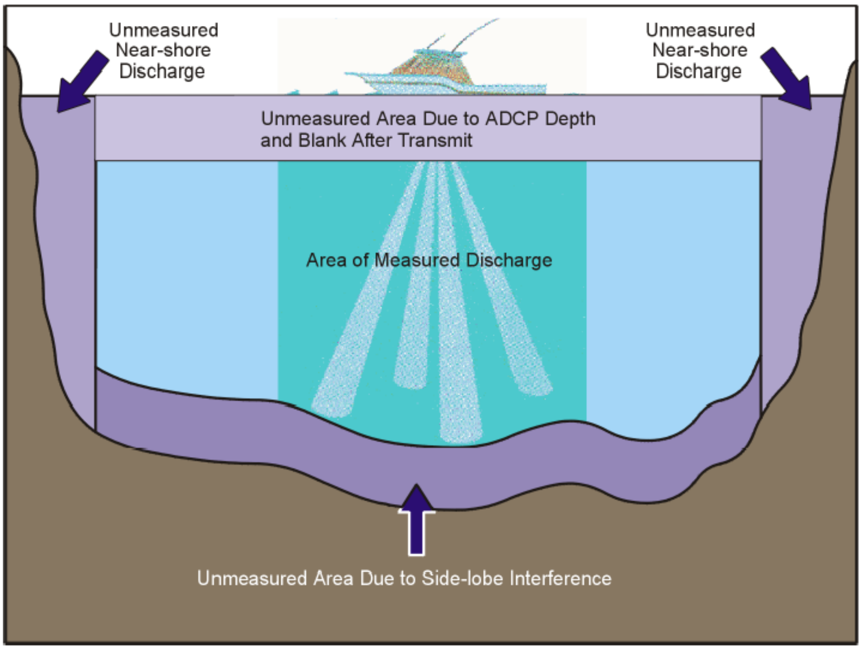

Figure 4-1: Unmeasured regions in the cross section (from RD Instruments, 2003)

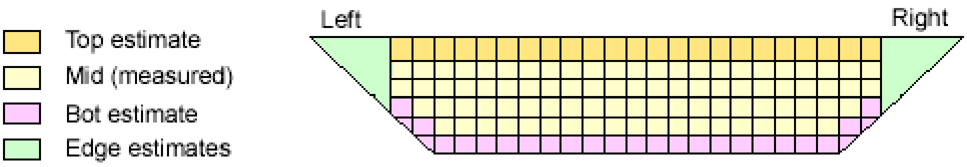

Figure 4-2: Measured and estimated discharges and sediment fluxes within Sediview (DRL, 2005)

4.2.4.1.1 Top/bottom estimates

The sediment concentration and discharge at the top of the water column is assumed to be the same as the concentration and discharge in the first measured bin.

The sediment concentration between the bottom and the lowest valid bin is assumed to be 125% of the lowest valid bin. Siltprofiles taken by the SiltProfiler on board the Oostende XI near Deurganckdok (IMDC, 2005b) and on board the Laure Marie near Deurganckdok (IMDC, 2006d) show that the bottom value of the SSC is approximately 150% of the SSC-value at 2 meter above the bottom (position of the sidelobe). As the concentration grows approximately linear from the lowest valid bin to the bottom, and as Sediview uses a constant concentration factor for these deepest bins, we use a concentration factor of 125% (Figure 4-3).

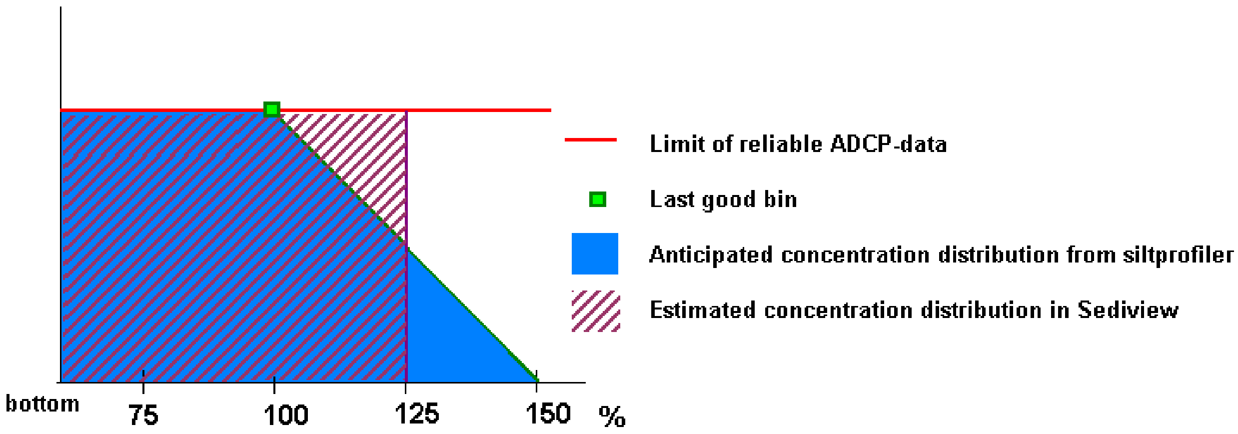

Figure 4-3: Bottom estimate of the sediment concentration

Table 4-1: Extrapolation methods for top and bottom variables

Variable	***Top***	***Bottom***
Discharge Method	Constant	Power
Concentration factor	100%	125%

The discharge for the bottom water layer is estimated by using the power method. Chen (1991) discusses the theory of power laws for flow resistance. Simpson and Oltmann (1990) discuss Chen's power law equivalent of Manning's formula for open channels (with b=1/6) (RD Instruments, 2003).

$$u/u^* = 9.5(z/z_0)^b$$

Where:

- z = Distance to the channel bed [m]
- u = Velocity at distance z from bed [m/s]
- u* = Shear velocity [m/s]
- z_0 = Bottom roughness height [m]
- b = Exponent (1/6)

4.2.4.1.2 Edge estimates

The shape of the edges of the cross section is assumed to be a slope (linear) for the both banks. Five data ensembles are to be averaged to determine the left and right bank mean velocities used for calculation of edge estimates.

Table 4-2: Shape of the edges of the transects for edge estimates

Edge estimates	***Left bank***	***Right bank***
Shape	Linear	Linear

The distance from start- and endpoint to the bank is calculated from the theoretical start- and endpoint at the bank to the effective start- and endpoint. The theoretical points are taken at the end of the mud flats.

Table 4-3: Reference points on left and right bank

Coordinates (UTM31 ED50)	***Easting Left bank***	***Northing Left bank***	***Easting Right bank***	***Northing Right bank***
Transect S	592645	592953	5665794	5665682

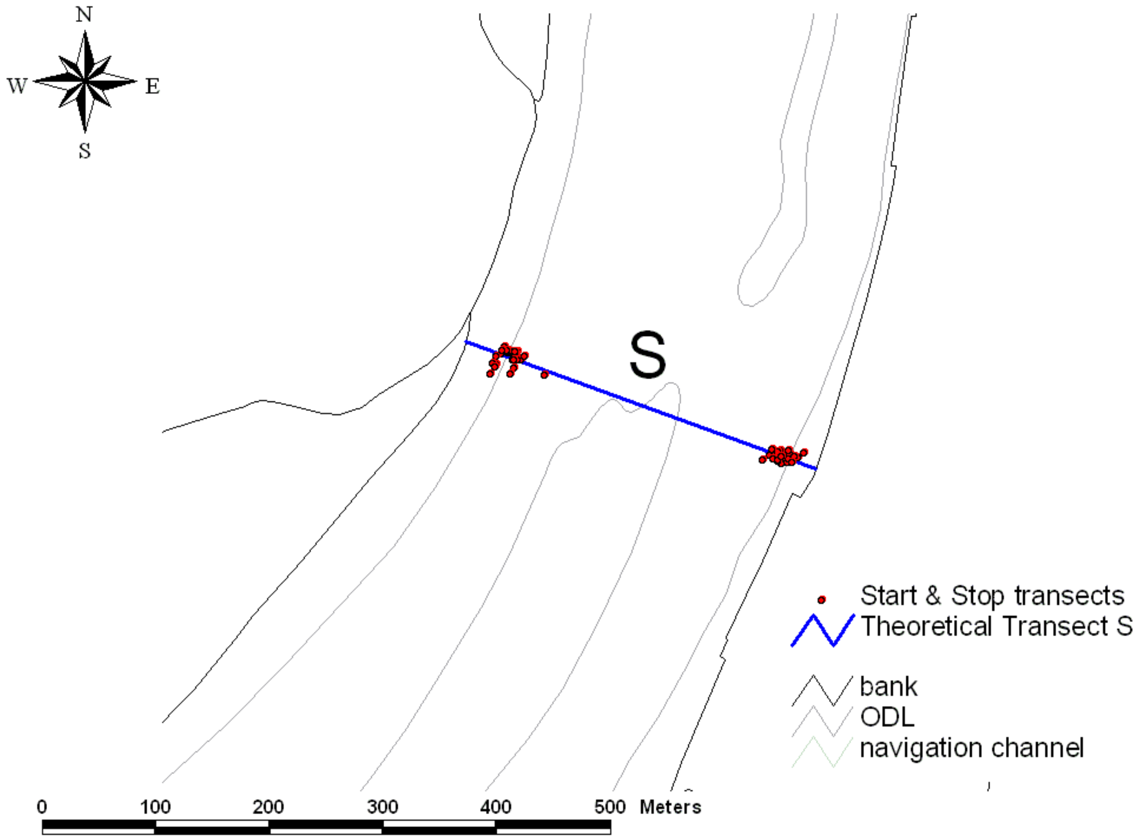

Figure 4-4: Effective start- and endpoints for transect S

The formula for determining the near shore discharge is:

$$Q_{shore} = CV_m L d_m \text{ [m}^3\text{/s]}$$

Where:

C = Coefficient (0.35 for triangular, 0.91 for rectangular shape)

V_m = Mean water velocity in the first or the last segment [m/s]

L = distance from the shore to the first or the last segment specified by the user [m]

d_m = Depth of the first or the last segment [m]

The coefficient (C) on both edges have been set to 0.35 (triangular shape).

4.2.4.2. Contour plots of the transects

All contour plots show perpendicular and parallel projected values on the straightened sailed transects. The heading of the straightened sailed transect is defined by picking 2 points in the straight part of the line after having corrected the heading of the ADCP compass. The compass offset is derived from a comparison of the ADCPs bottom track with the external GPS data.

4.2.5. Output

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

In APPENDIX F, four contourplots were generated for each transect showing the distribution of suspended sediment concentration & sediment flux as well as the flow velocity perpendicular and parallel to the transect. The following conventions were used:

- Left bank is always shown left, right bank on the right side.
- Perpendicular flow velocities and fluxes are positive for downstream flow (ebb), negative for upstream flow (flood).
- Parallel flow velocities are positive for flow going from the left bank to the right bank, and negative for flow going from the right bank to the left bank.
- Absolute Depth is given in meters.

Also a depth-averaged velocity plot was generated for the flow velocity perpendicular to the transect. (See APPENDIX F).

Tables in APPENDIX G give the values for discharges, sediment fluxes and sediment concentrations for the total cross-section:

- Mid = measured part of the cross-section (measured values)
- Top = top part of the cross-section (estimated values)
- Bottom = bottom part underneath the sidelobe (estimated values)
- Edge (left, right) = edge estimates to left & right bank (estimated values)
- Total = Mid+Top+Bottom+ Edge values
- Positive values represent a downstream flux, negative values an upstream flux

The graph in APPENDIX H gives the temporal variation of the total flux and total discharge for the whole through tide measurement at Schelle or transect S.

5. PRELIMINARY ANALYSIS OF THE DATA

5.1. Data of HCBS2-summer

It appears from the recorded data that depth-averaged water velocities are distributed equally over the complete cross-section. The highest water velocities occur at about 2 hours after HW in which velocities exceed 1.5 m/s. The total calculated discharge ranges between 3688 and -4671 m³/s.

Average cross-section concentrations vary from 65 up to about 300 mg/l. The highest measured concentration from a watersample is 350 mg/l (recorded near the left bank at 10 meters deep about five hours before HW).

The maximal calculated flux during ebb occurs 3 hours after HW and is 441 kg/s. During flood, the highest flux is -726 kg/s, 4 hours before HW.

5.2. Comparison with previous HCBS-campaigns

The same transect S was sailed at Schelle during the first HCBS campaign, on the 17th and 19th of February 2005, and the second HCBS measurement campaign, on 23rd of March 2006. On these days HW and LW didn't occur at the same moment as on the 28th of September 2006. In order to make a comparison possible all results were referred to HW. The previous HCBS-campaigns (HCBS1 & HCBS2-winter) show a comparable tidal amplitude (tidal coefficients about 0.75) corresponding to neap tide. HCBS2-summer (28/09/2006), on the other hand, has a tidal coefficient of about 0.99 and is more corresponding to an average tide.

The fresh water discharge from the tributaries prior to the measurements was lower in 2006 (Figure 5-1 & Figure 5-3) than in 2005 (Figure 5-2). On 17th of February 2005 the discharge was around 180 m³/s corresponding to the mean discharge and two days later around 240 m³/s corresponding to the mean discharge +1σ, which is rather high. During the winter campaign of 2006 the discharge was around 100 m³/s corresponding to the mean value -1σ, which is rather low. This summer measurement campaign, the discharge was lower than in March of 2006, around 30 m³/s corresponding to the minimum discharge (Figure 5-4).

The results presented in Figure 5-4 are based on a long-term simulation over a period of 30 year (1971-2000) with the SIGMA-model for MKBA (IMDC, 2006k). The mean discharge is the annual average ten days' discharge, calculated with simulated long-term measurements. The high and low discharges are also annual average ten days' discharges, but with an absolute maximum of mean discharge +2σ and an absolute minimum of mean discharge -2σ.

The suspended sediment concentrations, total discharges and fluxes of all measurement campaigns at Schelle are illustrated in Figure 5-5, Figure 5-6 and Figure 5-7. On Figure 5-6 can be seen that the discharges of this campaign are in general higher than the previous campaigns, especially during flood. The fluxes and SS concentrations of HCBS2-summer are in general higher.

The volume water, crossing transect S during flood or ebb on a measurement day, was calculated by integrating the discharge curve during flood and ebb respectively. Table 5-1 shows the results. During flood on 28th September of 2006, 56 381 000m³ water crossed transect S and during ebb 57 359 000m³. Theoretically, the net volume between flood and ebb is equal to the fresh water volume. The fresh water volume, crossing transect S during the tidal cycle (ebb and flood) on 28/09/2006, was estimated at 1 344 000m³ (based on data of 'Waterbouwkundig Laboratorium – Cel Hydrometrie Schelde) and is in the same order of magnitude of the net volume, 978 000m³ (based on ADCP measurements) (Table 5-1). Compared to the other campaigns, volumes are rather high because the tide of this measurement campaign corresponds to average tide and in the other campaigns to neap tide.

The mass of the suspended sediment, crossing transect S during flood or ebb on a measurement day, was calculated in a similar manner as the volume. The flux curve was integrated. Table 5-2 shows the results. The SS mass during ebb is 7 619 tonnes, during flood 7 981 tonnes. So 362 tonnes were deposited at Schelle during this tidal cycle. This result is different from the HCBS2-winter, where no sediment was deposited (Table 5-2). The deposition is a result of the high measured flux (SS mass) during flood, about 4 hours before HW(3).

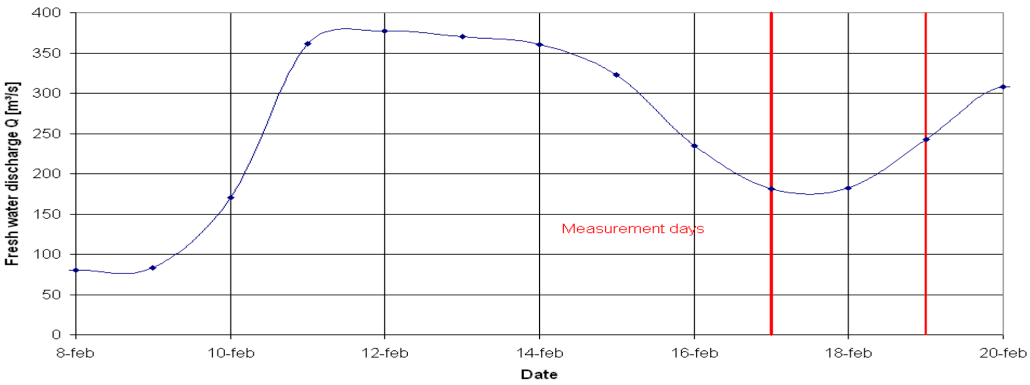

Figure 5-1: Fresh water discharge 8 - 20 February 2005

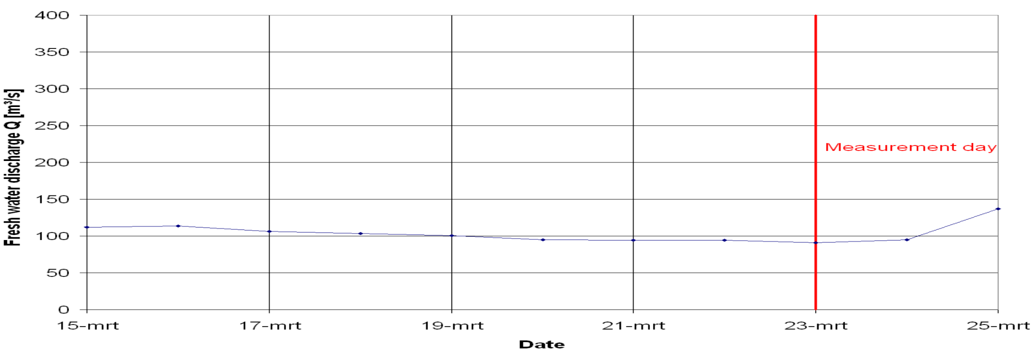

Figure 5-2: Fresh water discharge 15 - 25 March 2006

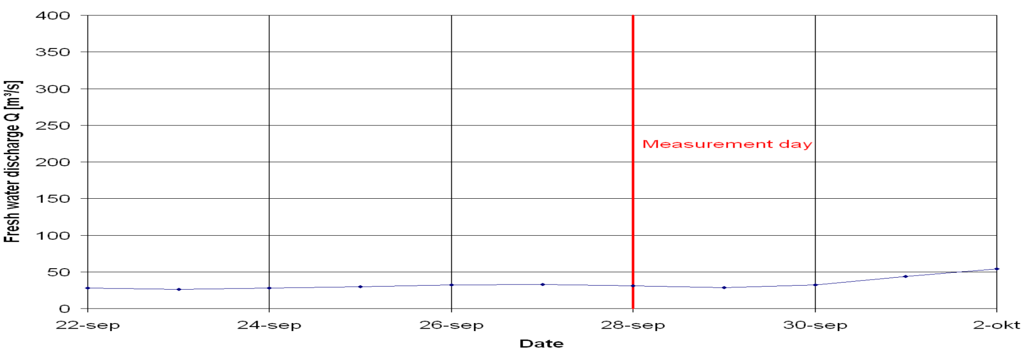

Figure 5-3: Fresh water discharge 28 September 2006

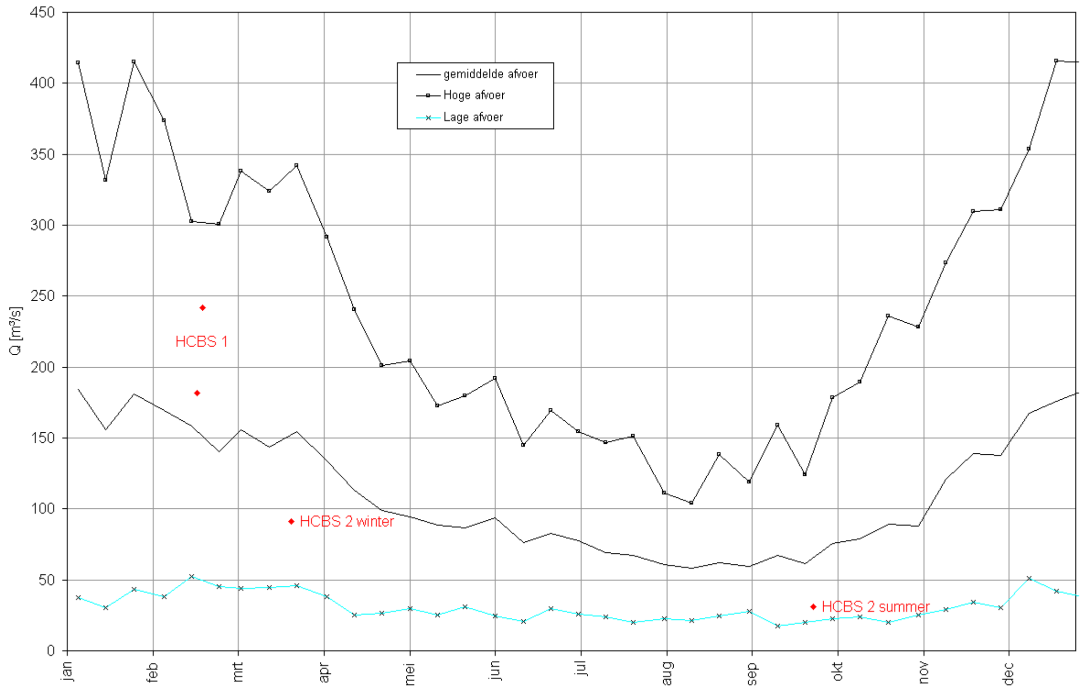

Figure 5-4: Mean, high and low fresh water discharge 1971-2000

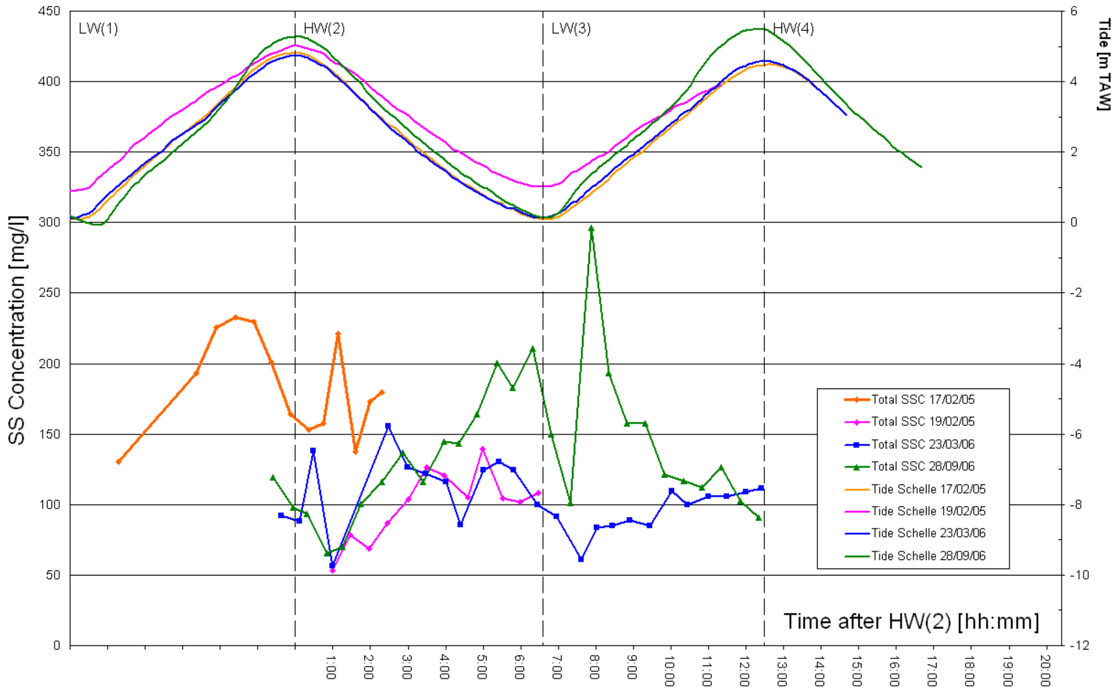

Figure 5-5: SS Concentration 17/02/2005 (Neap tide), 19/02/2005 (Neap tide), 23/03/2006 (Neap tide) & 28/09/2006 (Average tide)

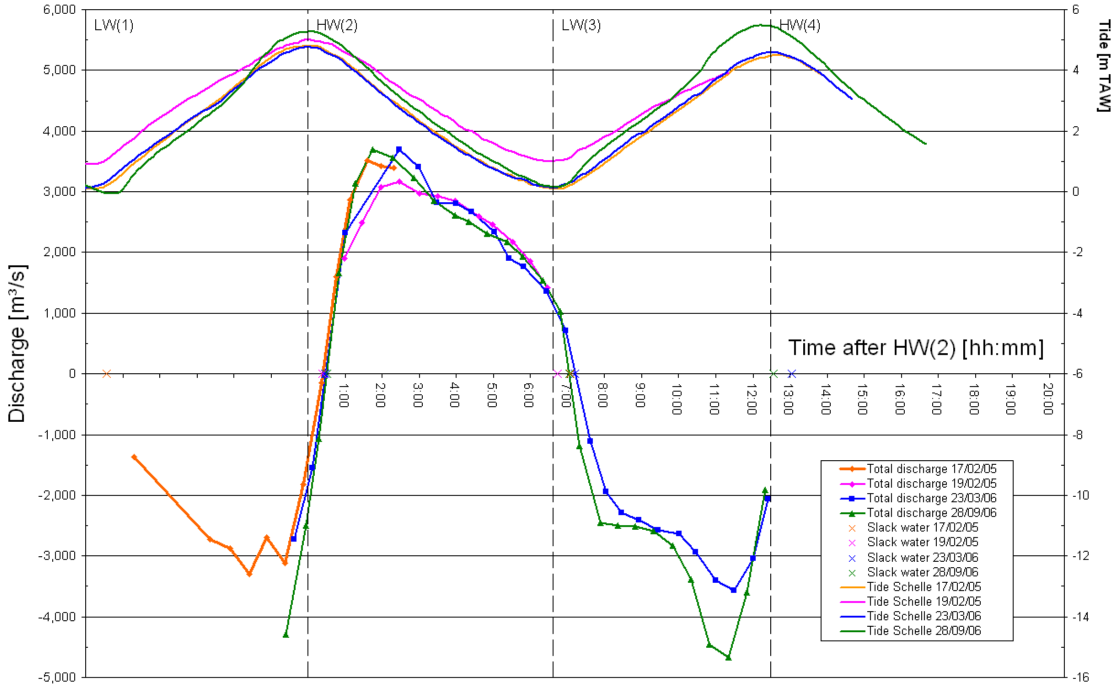

Figure 5-6: Total discharge 17/02/2005 (Neap tide), 19/02/2005 (Neap tide), 23/03/2006 (Neap tide) & 28/09/2006 (Average tide)

Table 5-1: Water volume during ebb, flood and measurement campaign on 17/02/2005 (Neap tide), 19/02/2006 (Neap tide), 23/03/2006 (Neap tide) & 28/09/2006 (Average tide)

Measurement Day		**17/02/2005**	**19/02/2006**	**23/03/2006**	**28/09/2006**
Ebb	Volume [1000x m³]	-	53 559	56 464	57 359
	Duration [HH:MM]	-	6:20	6:44	6:32
	Tidal Difference [m]	-	3.89	4.62	5.14
Flood	Volume [1000x m³]	-44 552	-	-46 849	-56 381
	Duration [HH:MM]	5:50	-	5:50	5:30
	Tidal Difference [m]	3.61	-	4.45	5.35
Net	Volume [1000x m³]	-	-	9 615	978
	Duration [HH:MM]	-	-	12:34	12:02
	Discharge [m³/s]			212	23
Fresh water	Volume [1000x m³]	-	-	4 117	1 344
	Duration [HH:MM]	-	-	12:34	12:02
	Discharge [m³/s]	-	-	91	31

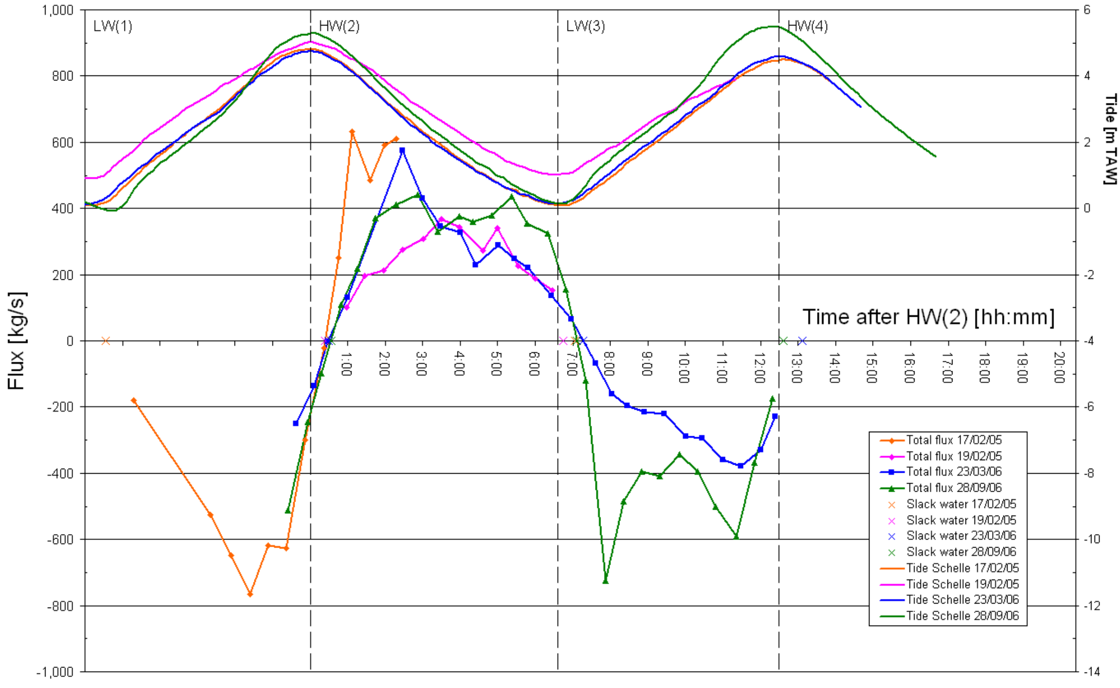

Figure 5-7: Total Flux 17/02/2005 (Neap tide), 19/02/2005 (Neap tide), 23/03/2006 (Neap tide) & 28/09/2006 (Average tide)

Table 5-2: SS Mass during ebb, flood and measurement campaign on 17/02/2005 (Neap tide), 19/02/2006 (Neap tide), 23/03/2006 (Neap tide) & 28/09/2006 (Average tide)

Measurement Day		**17/02/2005**	**19/02/2006**	**23/03/2006**	**28/09/2006**
Ebb	SS Mass [Tonnes]	-	5 335	6 564	7 619
	Duration [HH:MM]	-	6:20	6:40	6:33
	Tidal Difference [m]	-	3.89	4.62	5.14
Flood	SS Mass [Tonnes]	-8 699	-	-4 864	-7 981
	Duration [HH:MM]	5:50	-	5:50	5:30
	Tidal Difference [m]	3.61	-	4.45	5.35
Net	SS Mass [Tonnes]	-	-	1700	-362
	Duration [HH:MM]	-	-	12:30	12:03

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IMDC (2006n) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.4 Through tide measurement Sediview spring tide 27/09/2006 Parel 2 (I/RA/11283/06.119/MSA)

IMDC (2006o) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.6 Salt-Silt distribution & Frame Measurements Deurganckdok 13/3/2006 – 31/05/2006 (I/RA/11283/06.121/MSA)

IMDC (2007a). 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 (2007b). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 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), in opdracht van AWZ.

IMDC (2007c). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 5.6 Analysis of ambient conditions during 2006 (I/RA/11291/06.091/MSA), in opdracht van AWZ.

IMDC (2007d). 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), in opdracht van AWZ.

IMDC (2007e). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 10 Cohesive sediment properties summer 2006 (I/RA/11291/06.103/MSA), in opdracht van AWZ.

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

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

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

IMDC (2007i). 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 (2007j). 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 (2007k). 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 (2007l). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 12 Report concerning the presence of HCBS layers in the Scheldt river (I/RA/11291/06.109/MSA), in opdracht van AWZ.

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

IMDC (2007r) 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 (2007s) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.5 Through tide measurement Sediview neap tide (to be scheduled) (I/RA/11283/06.120/MSA)

IMDC (2007t) 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 (2007u) 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 (2007v) 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 (2007w) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.2 Boundary condtions: Annual report (I/RA/11283/06.128/MSA)

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IMDC (2005a). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 1: Test survey 17/02/2005, I/RA/11265/05.008/MSA, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

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, in opdracht van AWZ.

IMDC (2006a). 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 – January-June 2006 (I/RA/11291/06.088/MSA), in opdracht van AWZ.

IMDC (2006b). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 6.1 Winter Calibration (I/RA/11291/06.092/MSA), in opdracht van AWZ.

IMDC (2006c). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.1 21/3

Scheldewacht – Deurganckdok – Salinity Distribution (I/RA/11291/06.094/MSA), in opdracht van AWZ.

IMDC (2006d). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.2 22/3 Parel 2 – Deurganckdok (I/RA/11291/06.095/MSA), in opdracht van AWZ.

IMDC (2006e). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.3 22/3 Laure Marie – Liefkenshoek (I/RA/11291/06.096/MSA), in opdracht van AWZ.

IMDC (2006f). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.4 23/3 Parel 2 – Schelle (I/RA/11291/06.097/MSA), in opdracht van AWZ.

IMDC (2006g). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.5 23/3 Laure Marie – Deurganckdok (I/RA/11291/06.098/MSA), in opdracht van AWZ.

IMDC (2006h). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 7.6 23/3 Veremans Waarde (I/RA/11291/06.099/MSA), in opdracht van AWZ.

IMDC (2006i). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 8.1 Near bed continuous monitoring winter 2006 (I/RA/11291/06.100/MSA), in opdracht van AWZ.

IMDC (2006j). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 9 Settling Velocity - INSSEV summer 2006 (I/RA/11291/06.102/MSA), in opdracht van AWZ.

IMDC(2006k) Mer Verruiming Westerschelde, Nota Bovenafvoer Scheldebekken,I/NO/11282/06.104/FPE.

IMDC (2006l) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.6 Sediment balance Bathymetry: 2005 – 3/2006 (I/RA/11283/06.118/MSA)

IMDC (2006m) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.1 Through tide measurement Siltprofiler 21/03/2006 Laure Marie (I/RA/11283/06.087/WGO)

IMDC (2006n) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.3 Through tide measurement Sediview spring tide 22/03/2006 Veremans (I/RA/11283/06.110/BDC)

IMDC (2006o) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.4 Through tide measurement Sediview spring tide 27/09/2006 Parel 2 (I/RA/11283/06.119/MSA)

IMDC (2006p) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.6 Salt-Silt distribution & Frame Measurements Deurganckdok 13/3/2006 – 31/05/2006 (I/RA/11283/06.121/MSA)

IMDC (2007a). 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 (2007b). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 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), in opdracht van AWZ.

IMDC (2007c). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 5.6 Analysis of ambient conditions during 2006 (I/RA/11291/06.091/MSA), in opdracht van AWZ.

IMDC (2007d). 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), in opdracht van AWZ.

IMDC (2007e). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 10 Cohesive sediment properties summer 2006 (I/RA/11291/06.103/MSA), in opdracht van AWZ.

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

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

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

IMDC (2007i). 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 (2007j). 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 (2007k). 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 (2007l). Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 12 Report concerning the presence of HCBS layers in the Scheldt river (I/RA/11291/06.109/MSA), in opdracht van AWZ.

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

IMDC (2007r) 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 (2007s) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.5 Through tide measurement Sediview neap tide (to be scheduled) (I/RA/11283/06.120/MSA)

IMDC (2007t) 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 (2007u) 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 (2007v) 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 (2007w) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.2 Boundary condtions: Annual report (I/RA/11283/06.128/MSA)

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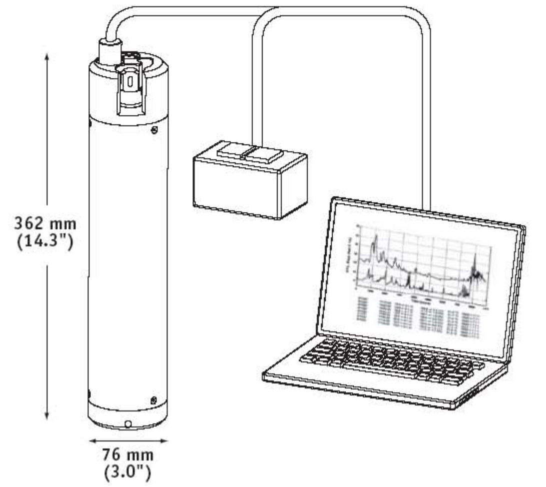
APPENDIX A. MEASUREMENT EQUIPMENT

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

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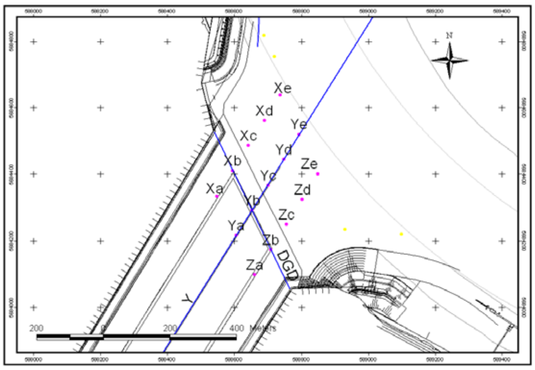
APPENDIX B.

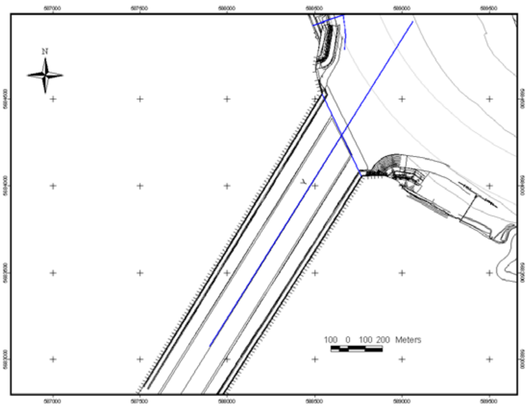
OVERVIEW OF MEASUREMENTS

B.1 Overview of the measurement locations for the whole HCBS measurement campaign (26-27-28/09/2006)

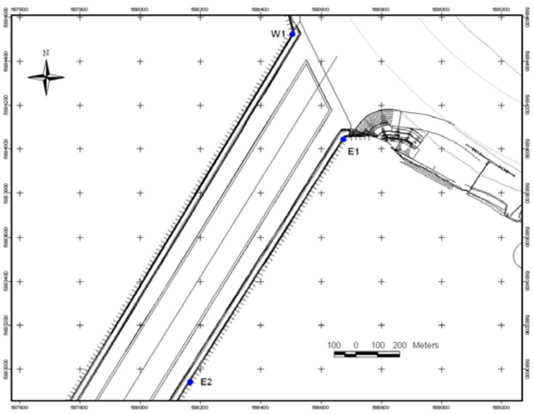
Through tide measurements: Transects					
Location	*Easting (UTM ED 50)*		*Northing (UTM ED 50)*		*Period*
Deurganckdok	*Left Bank*	*Right Bank*	*Left Bank*	*Right Bank*	
(transect Y)	*589059*	591298	*5684948*	*5683077*	26/09/2006
Liefkenshoek	*Left Bank*	*Right Bank*	*Left Bank*	*Right Bank*	
(transect I)	590318	590771	5684257	5683302	27/09/2006
Deurganckdok	*Left Bank*	*Right Bank*	*Left Bank*	*Right Bank*	
(transect K)	588484	589775	5684924	5685384	27 & 28/09/2006
Deurganckdok	*Left Bank*	*Right Bank*	*Left Bank*	*Right Bank*	
(transect DGD)	588765	588541	5684056	5684527	27/09/2006
Schelle	*Left Bank*	*Right Bank*	*Left Bank*	*Right Bank*	
(transect S)	592645	592953	5665794	5665682	28/09/2006
Waarde	*Left Bank*	*Right Bank*	*Left Bank*	*Right Bank*	
(transect W)	573541	571318	5696848	5694933	28/09/2006



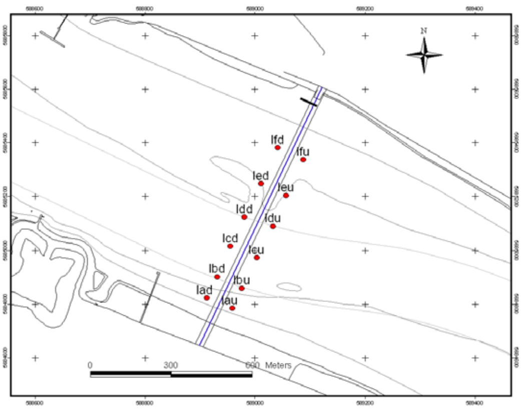
Through tide measurements - Deurganckdok 26/09/2006 (Siltprofiler)



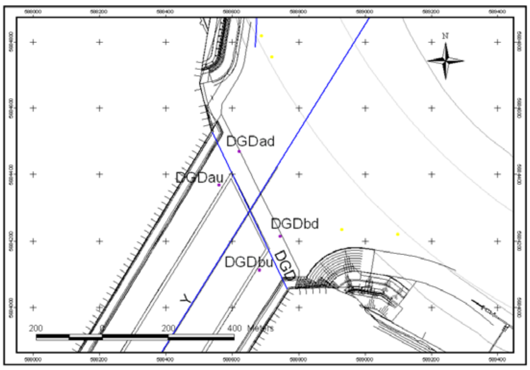
Through tide measurements – Deurganckdok 26/09/2006 (salinity)



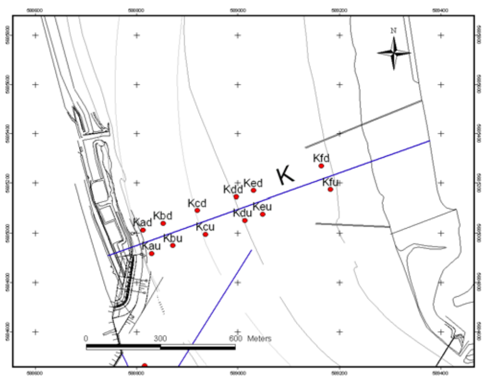
Long term salinity measurements Deurganckdok



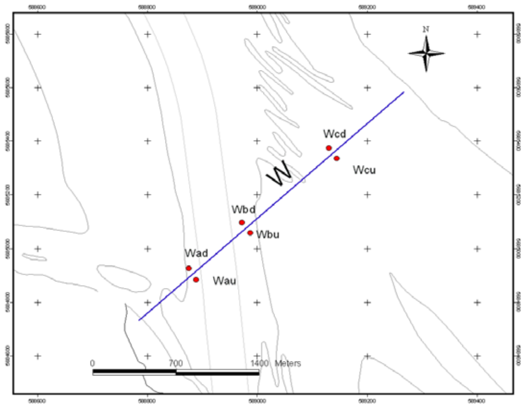
Through tide measurements - Liefkenshoek 27/09/2006 (ADCP+SiltProfiler)



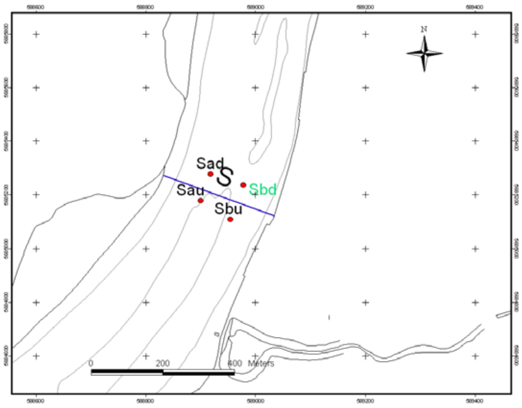
Through tide measurements - Deurganckdok 27/09/2006 (ADCP)



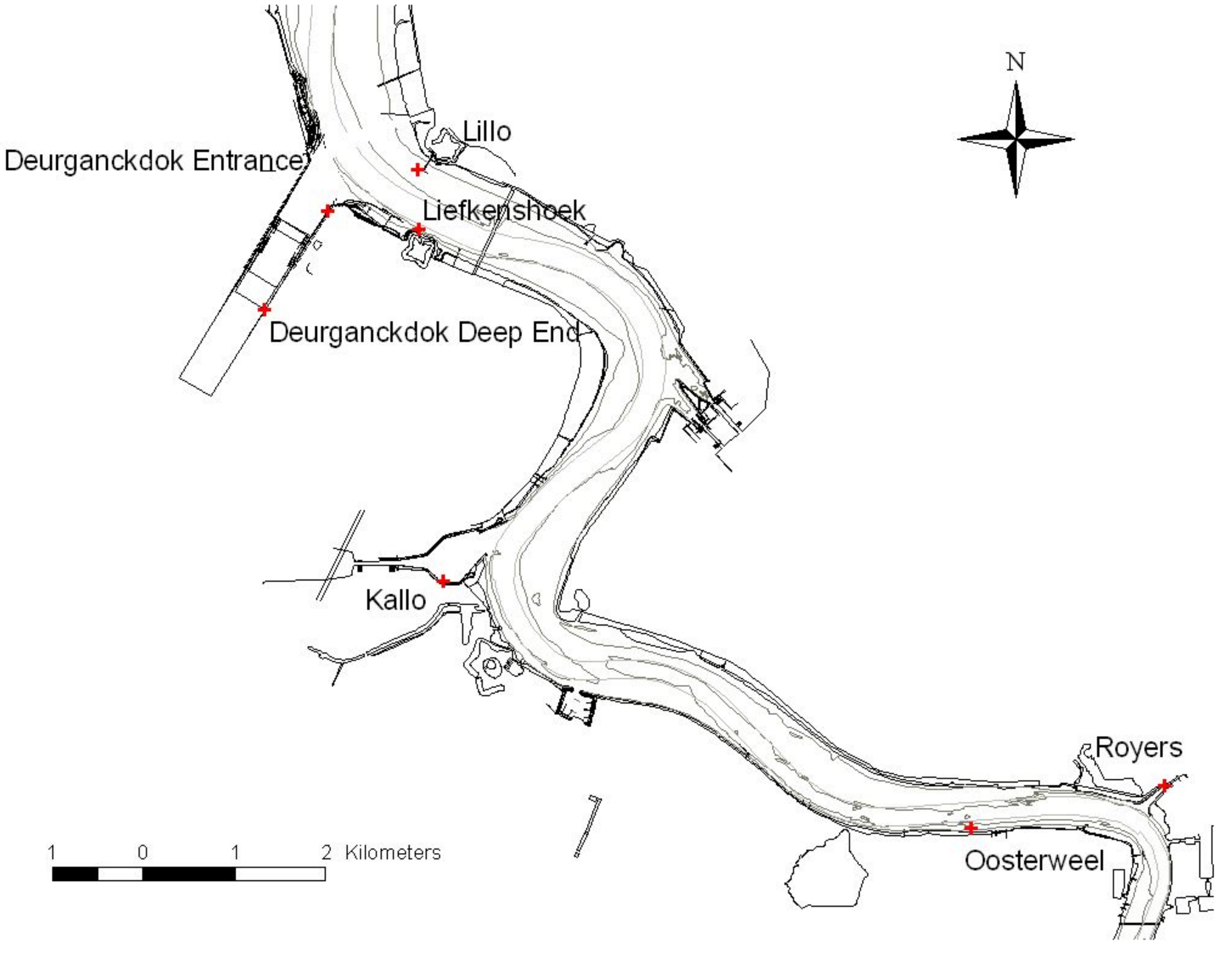
Through tide measurements - Deurganckdok 27/09/2006 (ADCP) & 28/09/2006 (ADCP+SiltProfiler)



Through tide measurements - Waarde 28/09/2006 (ADCP)



Through tide measurements - Schelle 28/09/2006 (ADCP)



Calibration measurements – 23/06/2006 & 18/09/2006

Measurement points

DAY 1 (26/09/2006)

Stream: Deurganckdok (in dock)

Downstream (during ebb)	*UTM-ED50 X*	*UTM ED50 Y*	*Calibration profile + watersample*	*Profile Siltprofiler*
Location 1: Xa	588549	5684335		x
Location 2: Xb	588596	5684411		x
Location 3: Xc	588643	5684486		x
Location 4: Xd	588690	5684562		x
Location 5: Xe	588737	5684638		x
Location 6: Ya	588606	5684217		X
Location 7: Yb	588653	5684293		x
Location 8: Yc	588700	5684368		x
Location 9: Yd	588747	5684444		x
Location 10: Ye	588793	5684520		x
Location 11: Za	588662	5684099		x
Location 12: Zb	588709	5684174		x
Location 13: Zc	588756	5684250		x
Location 14: Zd	588803	5684326		x
Location 15: Ze	588850	5684402		x

DAY 2 (27/09/2006)

Stream: Liefkenshoek

Downstream (during ebb)	*UTM-ED50 X*	*UTM ED50 Y*	*Calibration profile + watersample*	*Profile Siltprofiler*
Location 1: Iad	590346	5683478		x
Location 2: Ibd	590384	5683557	x	x
Location 3: Icd	590433	5683669		x
Location 4: Idd	590485	5683778	x	x

Location 5: Ied	590544	5683899		x
Location 6: Ifd	590607	5684033		x
Upstream (during flood)				
Location 1: Iau	590441	5683440		x
Location 2: Ibu	590476	5683514	x	x
Location 3: Icu	590529	5683627		x
Location 4: Idu	590589	5683744	x	x
Location 5: Ieu	590638	5683857		x
Location 6: Ifu	590701	5683988		x
Veremans: Deurganckdok (downstream)				
Downstream (during ebb)				
Location 1 : Kbd	*588706*	*5685055*	*x*	
Location 2 : Kdd	*588999*	*5685160*	*x*	
Upstream (during flood)				
Location 1: Kbu	*588746*	*5684965*	*x*	
Location 2: Kdu	*589033*	*5685066*	*x*	
Parel II: Deurganckdok (in dock)				
Downstream (during ebb)				
Location 1 : DGDad	*588623*	*5684470*	*x*	
Location 2 : DGDbd	*588745*	*5684214*	*x*	
Upstream (during flood)				
Location 1: DGDau	*588561*	*5684369*	*x*	
Location 2: DGDbu	*588682*	*5684113*	*x*	
DAY 3 (28/09/2006)				
Stream: Deurganckdok (downstream)				
Downstream (during ebb)	*UTM-ED50 X*	*UTM ED50 Y*	*Calibration profile + watersample*	*Profile Siltprofiler*
Location 1 : Kad	*588625*	*5685028*		x
Location 2 : Kbd	*588706*	*5685055*	x	x

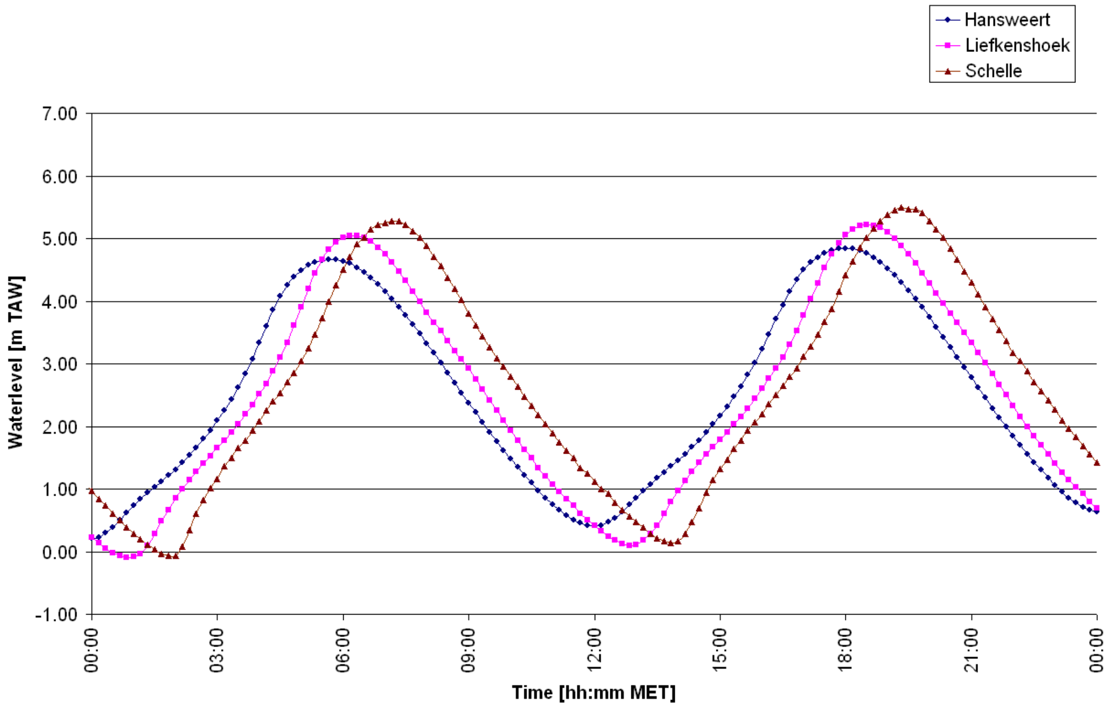
Location 3 : Kcd	*588845*	*5685106*		x
Location 4 : Kdd	*588999*	*5685160*	x	x
Location 5: Ked	*589067*	*5685185*		x
Location 6: Kfd	*589340*	*5685282*		x
Upstream (during flood)				
Location 1: Kau	*588660*	*5684934*		x
Location 2: Kbu	*588746*	*5684965*	x	x
Location 3: Kcu	*588877*	*5685010*		x
Location 4: Kdu	*589033*	*5685066*	x	x
Location 5: Keu	*589104*	*5685091*		x
Location 6: Kfu	*589377*	*5685189*		x
Parel II: Schelle				
Downstream (during ebb)				
Location 1 : Sad	*592778*	*5665797*	*x*	
Location 2 : Sbd	*592868*	*5665766*	*x*	
Upstream (during flood)				
Location 1: Sau	*592750*	*5665725*	*x*	
Location 2: Sbu	*592833*	*5665673*	*x*	
Veremans: Waarde				
Downstream (during ebb)				
Location 1: Wad	*571737*	*5695369*	*x*	
Location 2: Wbd	*572184*	*5695758*	*x*	
Location 3: Wcd	*572909*	*5696379*	*x*	
Upstream (during flood)				
Location 1: Wau	*571798*	*5695275*	*x*	
Location 2: Wbu	*572248*	*5695670*	*x*	
Location 3: Wcu	*572977*	*5696292*	*x*	

B.2 Measurement overview Schelle (transect S) 28/09/2006

Transect name	Start time [hh:mm MET]	Time after HW [hh:mm]	Easting start [UTM31 ED50]	Northing start [UTM31 ED50]	Easting end [UTM31 ED50]	Northing end [UTM31 ED50]	Transect length [m]	Transect heading [°]
7002S_sub.csv	6:34	-00:36	592681	5665789	592932	5665695	268	111
7006S_sub.csv	7:07	-00:03	592668	5665766	592938	5665693	280	105
7009S_sub.csv	7:28	00:18	592687	5665778	592943	5665698	268	107
7012S_sub.csv	8:00	00:50	592684	5665785	592923	5665687	258	112
7015S_sub.csv	8:26	01:16	592694	5665778	592929	5665699	248	109
7018S_sub.csv	8:55	01:45	592677	5665784	592928	5665693	267	110
7021S_sub.csv	9:28	02:18	592683	5665784	592920	5665690	255	112
7024S_sub.csv	10:02	02:52	592683	5665787	592922	5665698	255	111
7027S_sub.csv	10:34	03:24	592692	5665786	592922	5665699	246	111
7030S_sub.csv	11:08	03:58	592691	5665784	592921	5665695	246	111
7033S_sub.csv	11:31	04:21	592690	5665782	592920	5665698	245	110
7036S_sub.csv	12:00	04:50	592691	5665778	592917	5665693	242	111
7039S_sub.csv	12:32	05:22	592688	5665771	592915	5665696	238	108
7042S_sub.csv	12:57	05:47	592692	5665778	592913	5665695	236	111
7045S_sub.csv	13:30	06:20	592698	5665781	592915	5665700	232	111
7048S_sub.csv	13:59	-05:21	592685	5665766	592906	5665691	234	109
7051S_sub.csv	14:30	-04:50	592715	5665765	592916	5665693	213	110
7054S_sub.csv	15:03	-04:17	592689	5665778	592920	5665691	247	111
7057S_sub.csv	15:31	-03:49	592682	5665786	592923	5665694	259	111
7060S_sub.csv	16:00	-03:20	592688	5665786	592926	5665693	255	111
7063S_sub.csv	16:29	-02:51	592683	5665787	592929	5665699	261	110
7066S_sub.csv	17:00	-02:20	592672	5665775	592928	5665689	270	109
7069S_sub.csv	17:30	-01:50	592673	5665781	592931	5665692	273	109
7072S_sub.csv	17:59	-01:21	592669	5665775	592929	5665693	273	108
7075S_sub.csv	18:31	-00:49	592671	5665772	592935	5665694	275	107
7078S_sub.csv	19:01	-00:19	592678	5665786	592933	5665689	272	111
7081S_sub.csv	19:30	00:10	592690	5665785	592923	5665694	251	111

APPENDIX C. TIDAL DATA

11291 HCBS - Summer 2006 SURVEY



Measured tide on 28/09/2006

Location: River Scheldt	Date: 28/09/2006	Data processed by: / In association with: I/RA/11291/06.098MSA

APPENDIX D.

NAVIGATION INFORMATION AS RECORDED ON SITE

Ship:	**Parel II**
Location:	**Schelle**

Nr.	***Time (MET)***	***Ship type***	***Direction (upstream, downstream)***
1	6:40	River-vessel	Upstream
2	7:00	River-vessel	Upstream
3	7:00	River-vessel	Upstream
4	7:11	River-vessel	Downstream
5	7:16	River-vessel	Downstream
6	7:19	River-vessel	Upstream
7	7:36	River-vessel	Upstream
8	7:45	River-vessel	Upstream
9	8:02	River-vessel	Downstream
10	8:10	River-vessel	Upstream
11	8:12	River-vessel	Upstream
12	8:20	River-vessel	Upstream
13	8:27	Yacht	Downstream
14	8:54	River-vessel	Downstream
15	9:07	River-vessel	Downstream
16	9:25	River-vessel	Downstream
17	9:40	River-vessel	Upstream
18	9:48	River-vessel	Upstream
19	10:14	River-vessel	Downstream
20	10:14	River-vessel	Upstream
21	10:16	River-vessel	Downstream
22	10:30	Towboat	Upstream
23	10:47	River-vessel	Downstream
24	10:47	River-vessel	Downstream
25	10:53	River-vessel	Downstream
26	11:03	Towboat	Downstream
27	11:12	River-vessel	Downstream
28	11:29	River-vessel	Downstream
29	11:30	River-vessel	Upstream
30	11:40	River-vessel	Downstream
31	12:08	River-vessel	Upstream

Nr.	Time (MET)	Ship type	Direction (upstream, downstream)
32	12:09	River-vessel	Downstream
33	12:30	River-vessel	Downstream
34	12:43	River-vessel	Downstream
35	12:45	River-vessel	Downstream
36	12:55	River-vessel	Downstream
37	13:06	River-vessel	Downstream
38	13:20	River-vessel	Downstream
39	13:25	River-vessel	Downstream
40	13:40	Flatboat	Downstream
41	13:45	River-vessel	Upstream
42	14:13	River-vessel	Downstream
43	14:15	River-vessel	Downstream
44	14:17	River-vessel	Downstream
45	14:22	River-vessel	Upstream
46	14:30	River-vessel	Upstream
47	14:37	River-vessel	Upstream
48	14:39	River-vessel	Downstream
49	14:45	River-vessel	Upstream
50	14:51	Yacht	Upstream
51	14:52	River-vessel	Downstream
52	14:52	River-vessel	Upstream
53	14:53	River-vessel	Downstream
54	14:54	Towboat	Upstream
55	14:56	River-vessel	Upstream
56	14:59	River-vessel	Upstream
57	15:25	River-vessel	Downstream
58	15:27	River-vessel	Upstream
59	15:57	Towboat	Upstream
60	16:25	River-vessel	Upstream
61	16:34	River-vessel	Upstream
62	16:57	River-vessel	Upstream
63	17:03	Towboat	Downstream
64	17:05	River-vessel	Downstream
65	17:08	River-vessel	Downstream
66	17:14	Towboat	Downstream

Nr.	***Time (MET)***	***Ship type***	***Direction (upstream, downstream)***
67	17:21	River-vessel	Upstream
68	17:28	River-vessel	Upstream
69	17:36	River-vessel	Upstream
70	17:36	River-vessel	Downstream
71	17:45	River-vessel	Upstream
72	17:56	Lighter	Downstream
73	18:00	River-vessel 2x	Downstream
74	18:05	River-vessel 3x	Upstream
75	18:16	River-vessel	Upstream
76	18:18	River-vessel	Upstream
77	18:21	River-vessel	Upstream
78	18:30	River-vessel	Upstream
79	19:20	River-vessel	Downstream
80	19:33	River-vessel	Downstream

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	$R = \dfrac{C}{42.914mS/cm}$	
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	$R_p = 1 + \dfrac{p(e_1 + e_2 p + e_3 p^2)}{1 + d_1 t + d_2 t^2 + (d_3 + d_4 t)R}$	
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	$R_t = \dfrac{R}{R_p \times r_t}$	
Delta S	-0.0010	$\text{Delta } S = \dfrac{(t-15)}{1+k(t-15)}(b_0 + b_1 R_t^{1/2} + b_2 R_t + b_3 R_t^{3/2} + b_4 R_t^2 + b_5 R_t^{5/2})$	
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 FLOW VELOCITIES, SEDIMENT CONCENTRATION AND SEDIMENT FLUX PER SAILED TRANSECT

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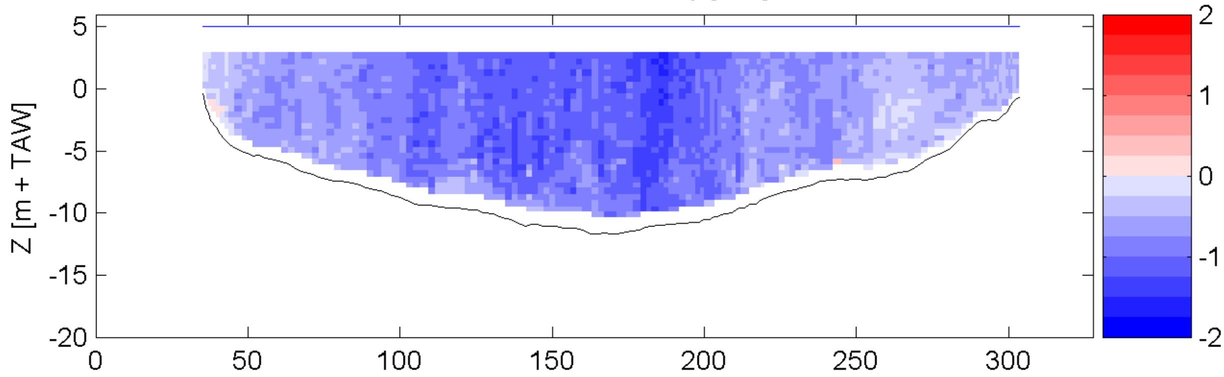
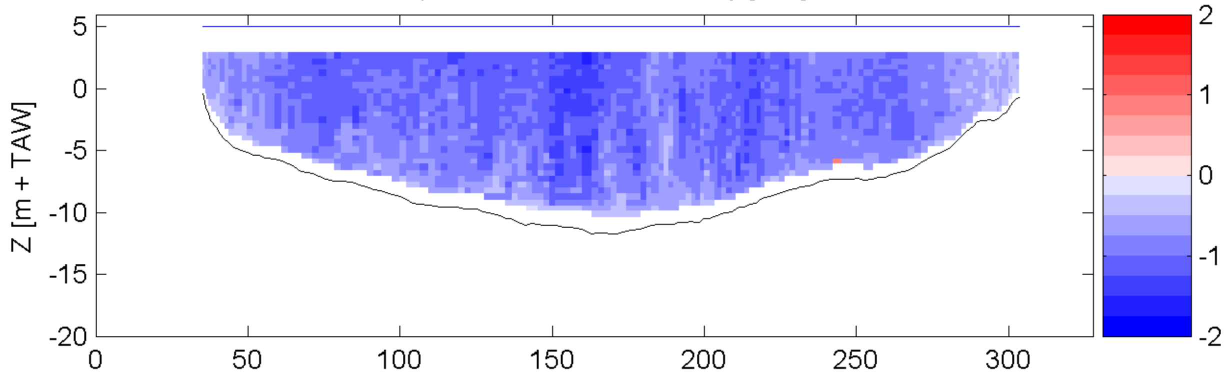
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7002S_sub.csv	Location: Transect S

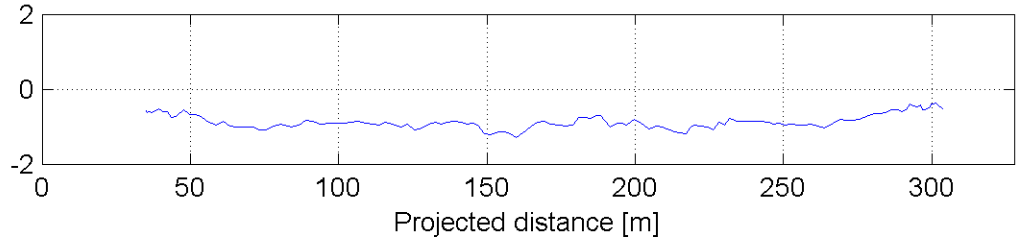
Parallel Current Velocity [m/s]



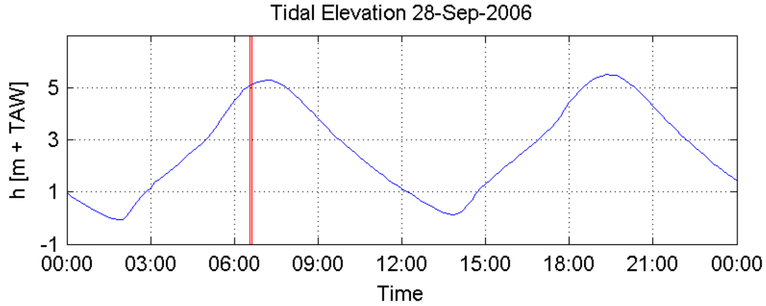
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

06:34 - 06:37

Time after HW [HH:MM]

-0:34

Data Processed by:

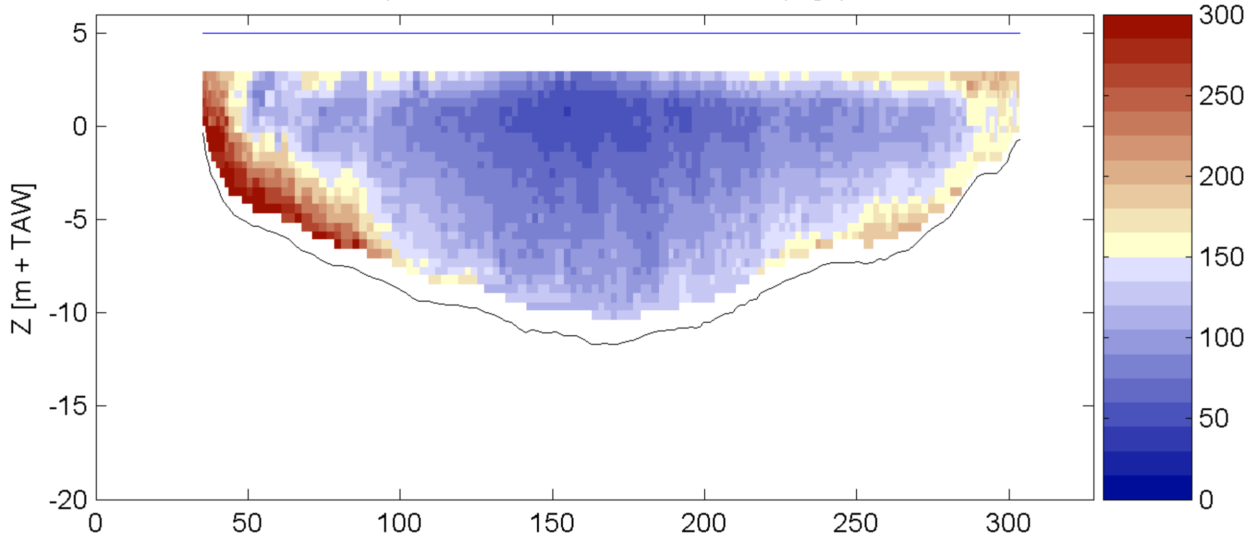
In association with :

I/RA/11291/06.108/MSA

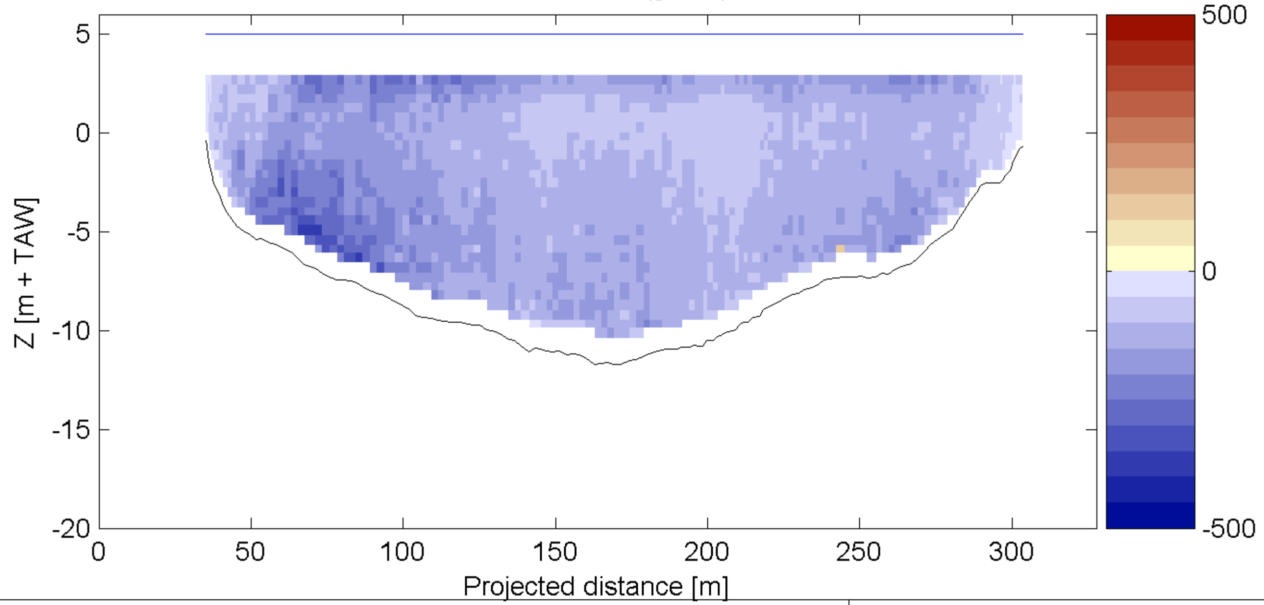
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7002S_sub.csv	Location: Transect S

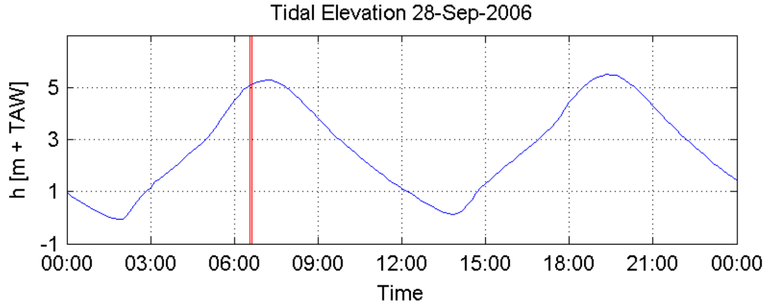
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

06:34 - 06:37

Time after HW [HH:MM]

-0:34

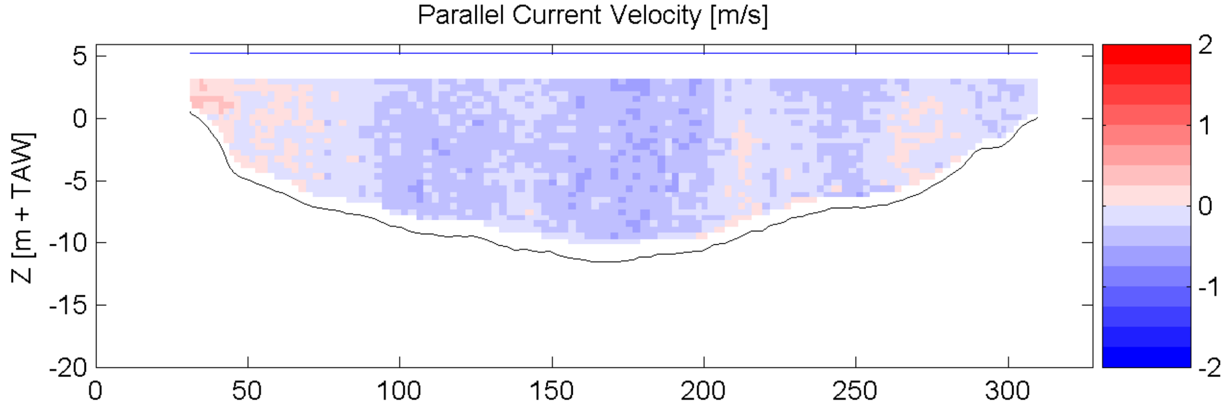
Data Processed by:

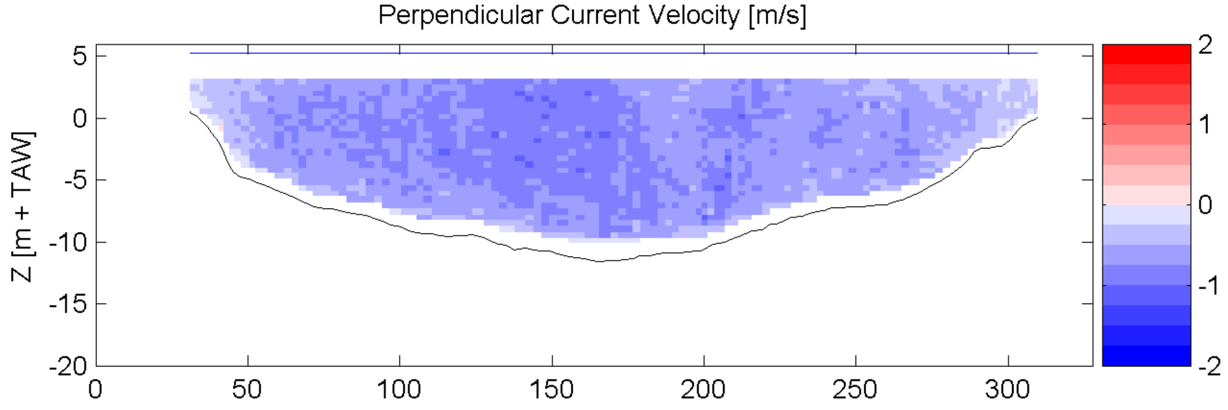
In association with :

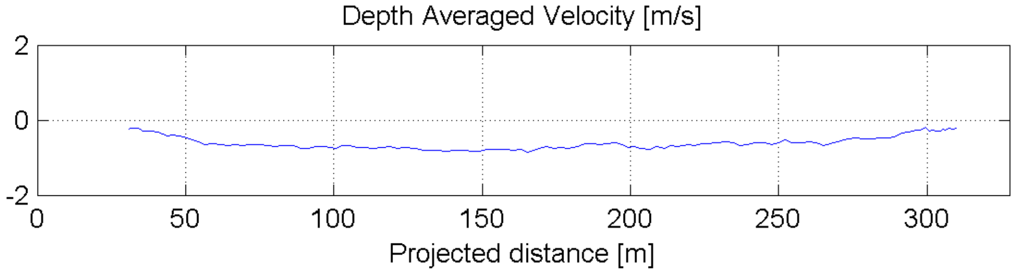
I/RA/11291/06.108/MSA

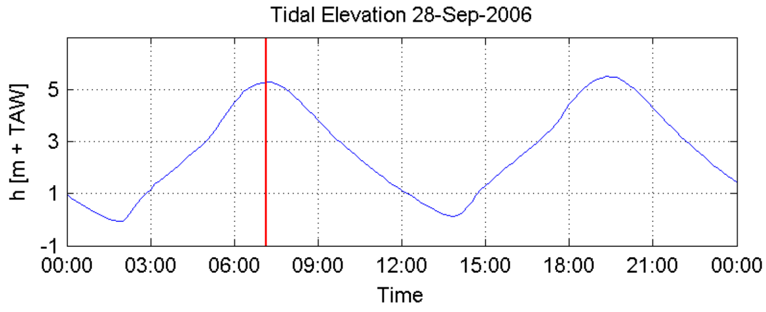
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7006S_sub.csv	Location: Transect S









HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

07:06 - 07:09

Time after HW [HH:MM]

-0:02

Data Processed by: IMDC

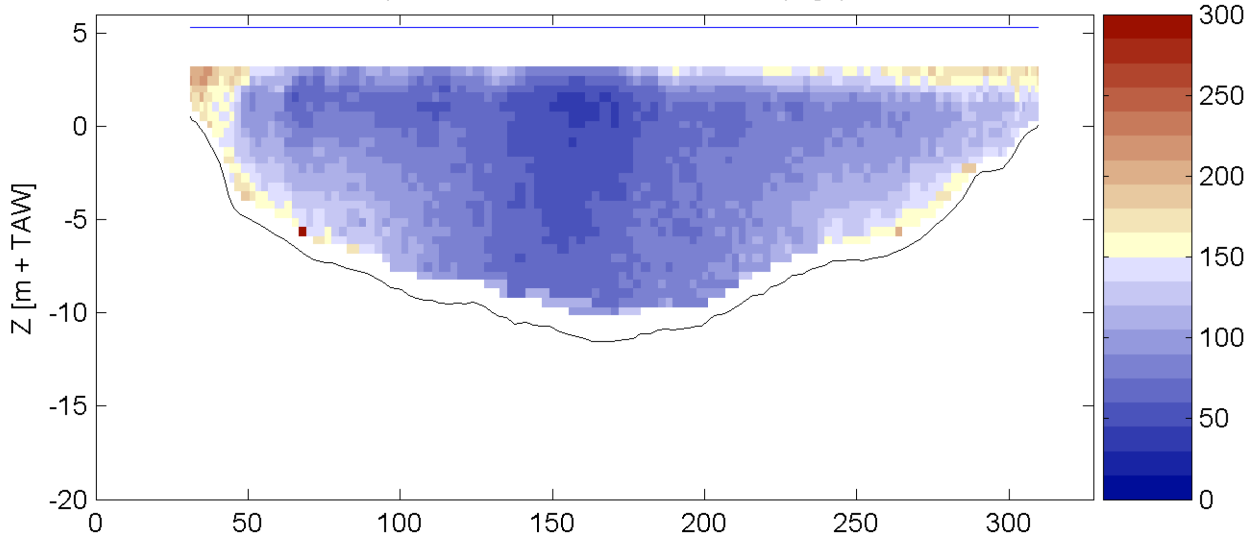
In association with : wl | delft hydraulics, GEMS International

I/RA/11291/06.108/MSA

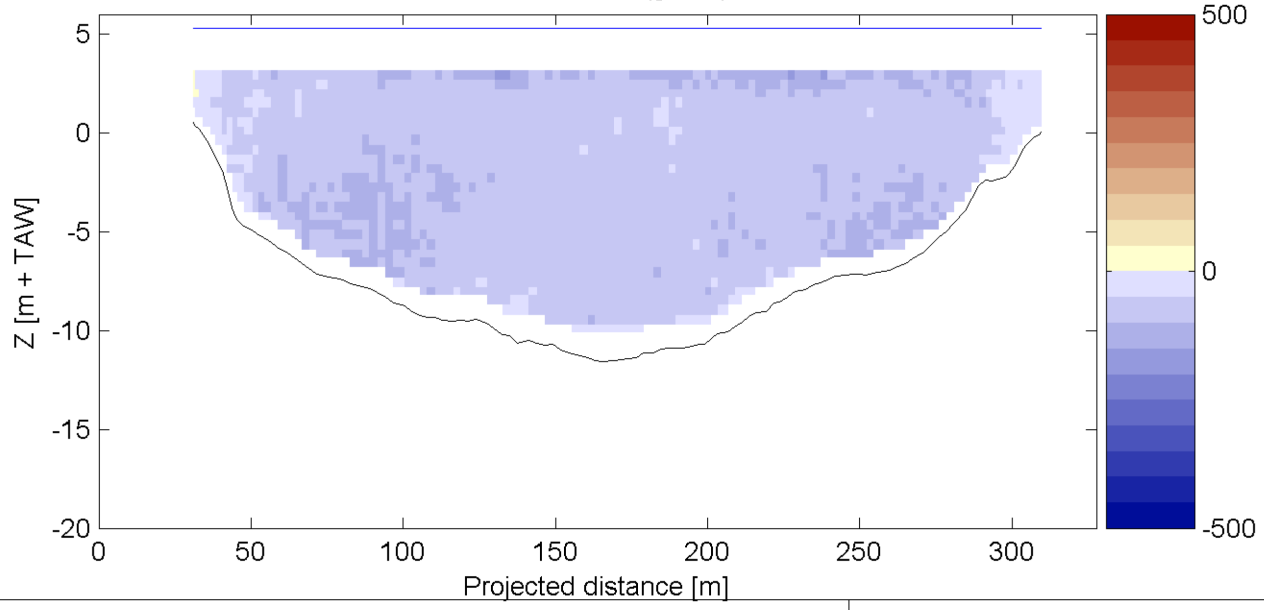
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7006S_sub.csv	Location: Transect S

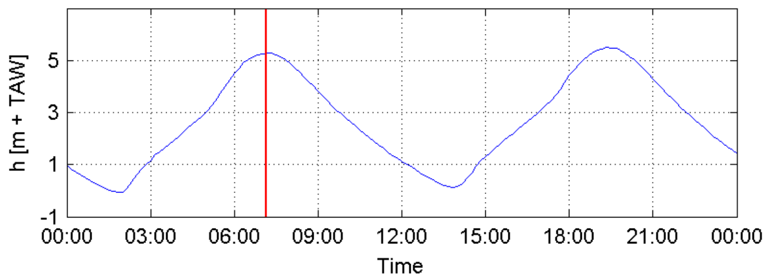
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:

07:10: h = 5.28 m+TAW

13:50: h = 0.14 m+TAW

19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

07:06 - 07:09

Time after HW [HH:MM]

-0:02

Data Processed by:

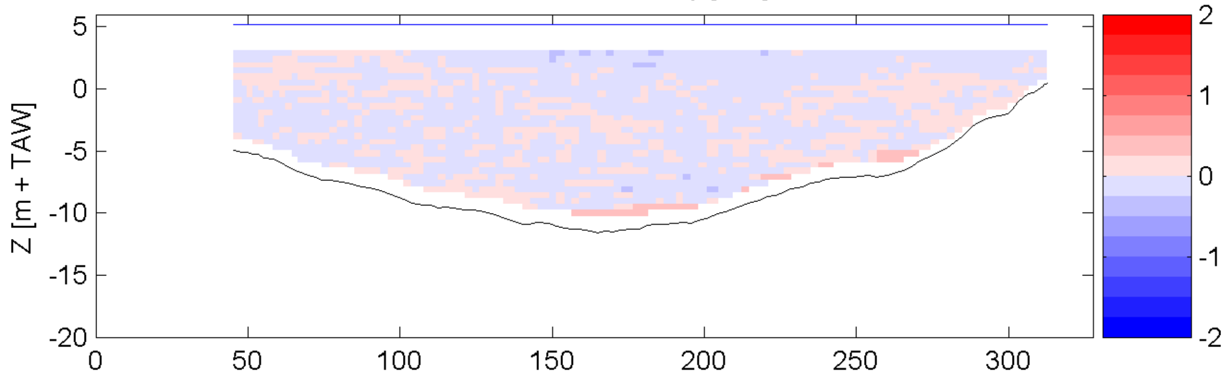
In association with :

I/RA/11291/06.108/MSA

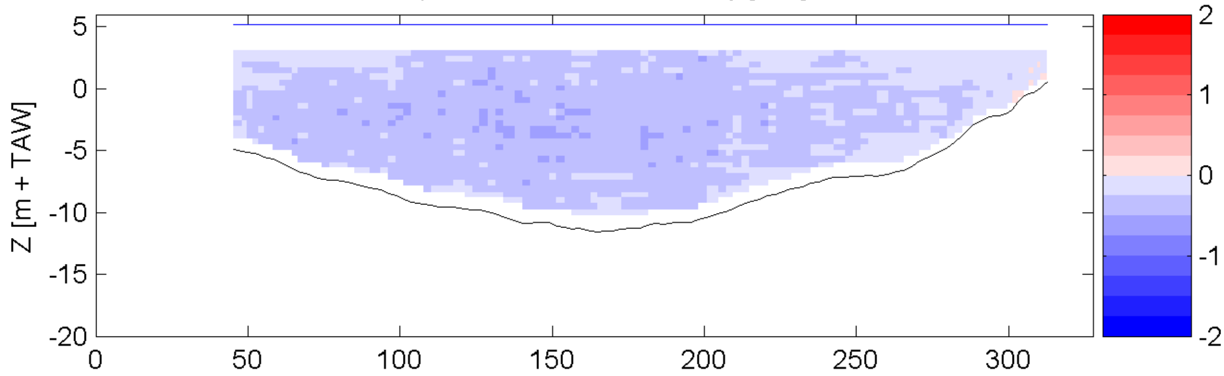
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7009S_sub.csv	Location: Transect S

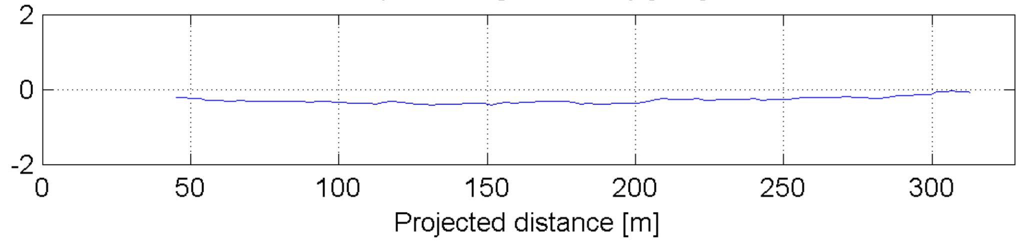
Parallel Current Velocity [m/s]



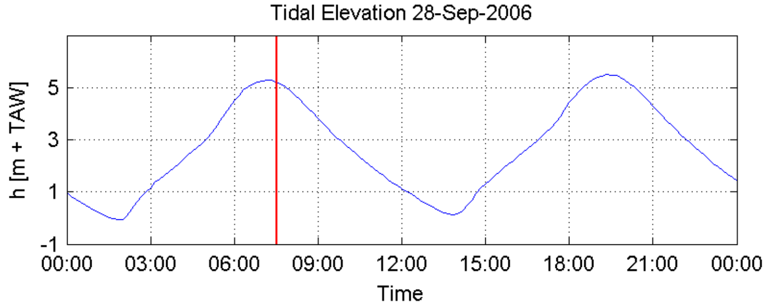
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

07:28 - 07:30

Time after HW [HH:MM]

0:19

Data Processed by:

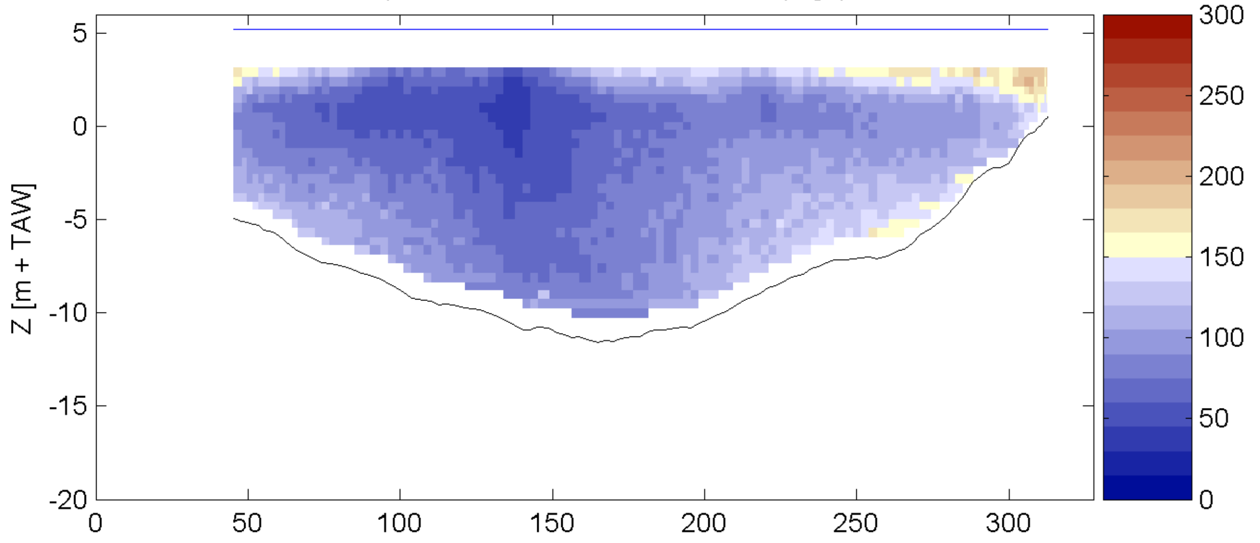
In association with :

I/RA/11291/06.108/MSA

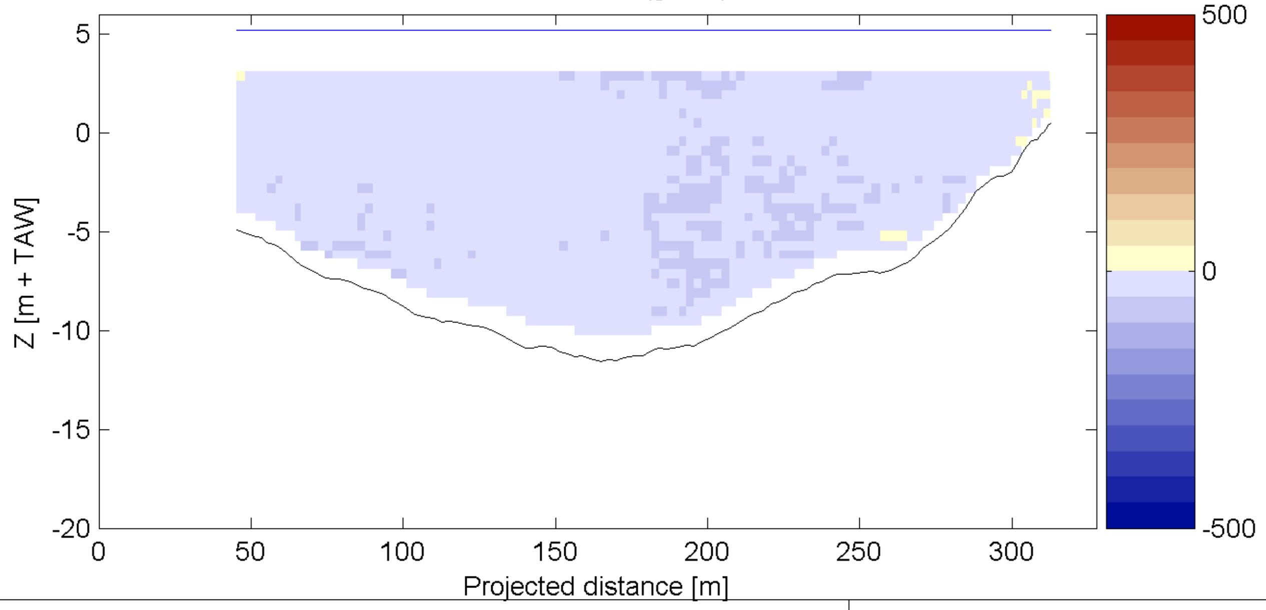
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7009S_sub.csv	Location: Transect S

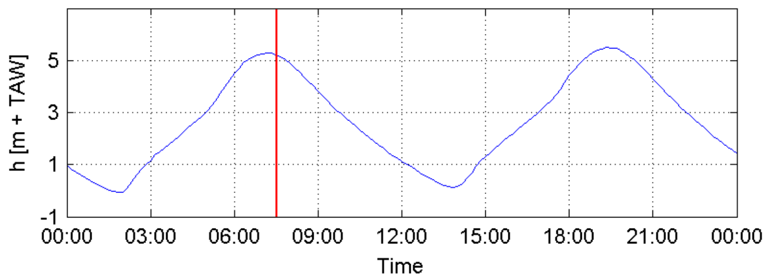
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

07:28 - 07:30

Time after HW [HH:MM]

0:19

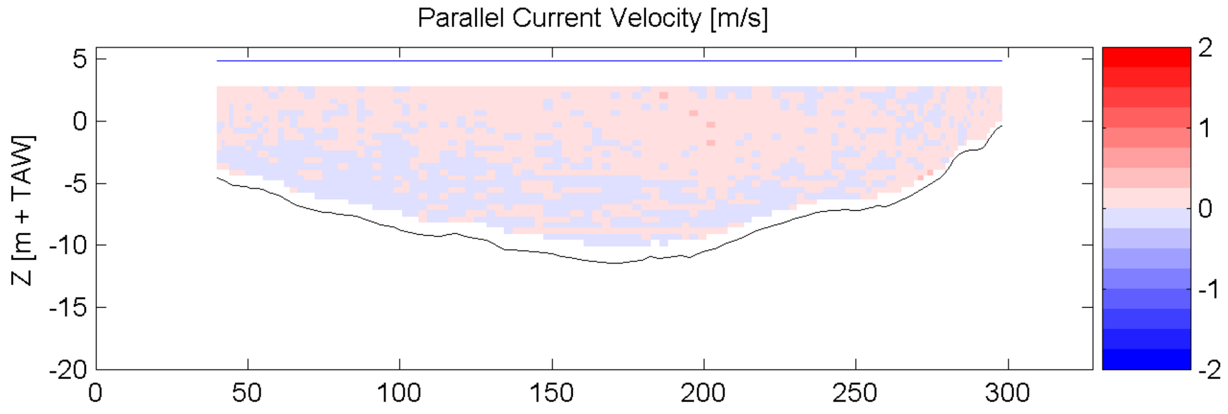
Data Processed by: IMDC

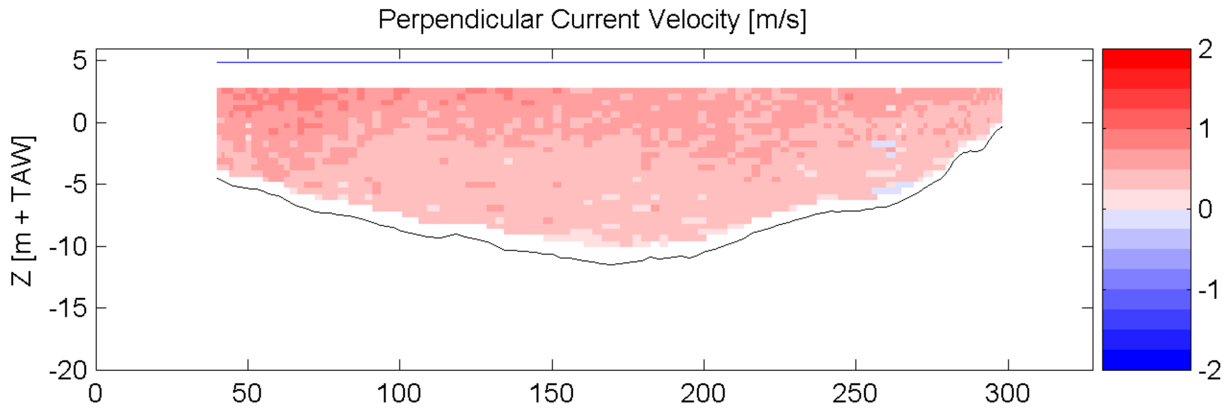
In association with : wl | delft hydraulics, GEMS International

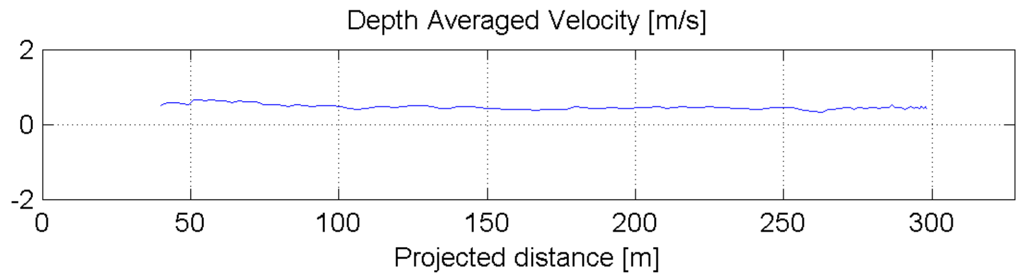
I/RA/11291/06.108/MSA

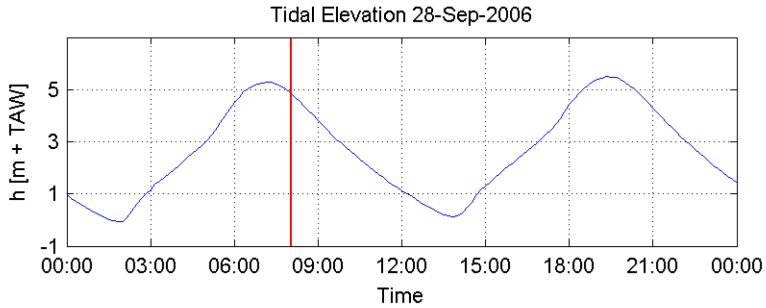
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7012S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
08:00 - 08:02

Time after HW [HH:MM]
0:51

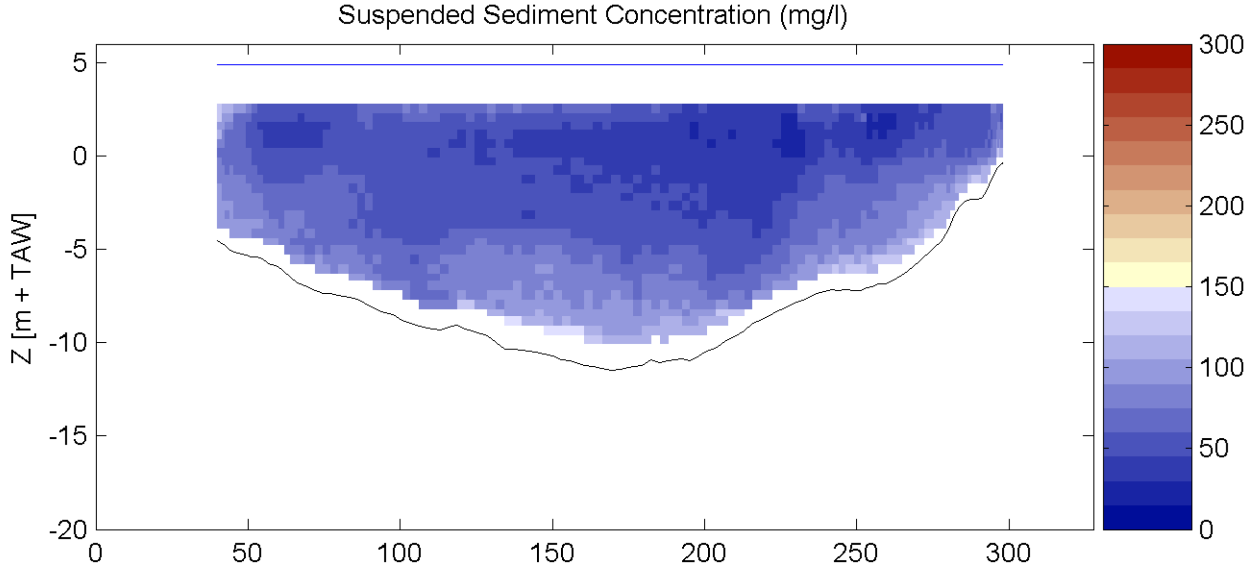
Data Processed by:

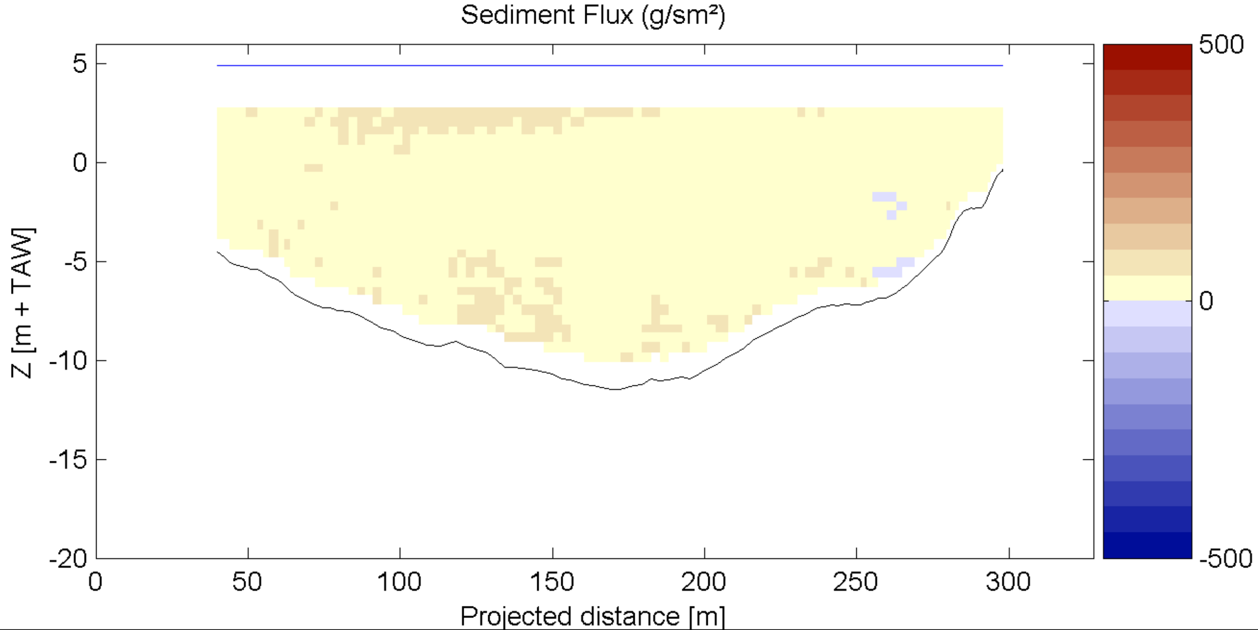
In association with :

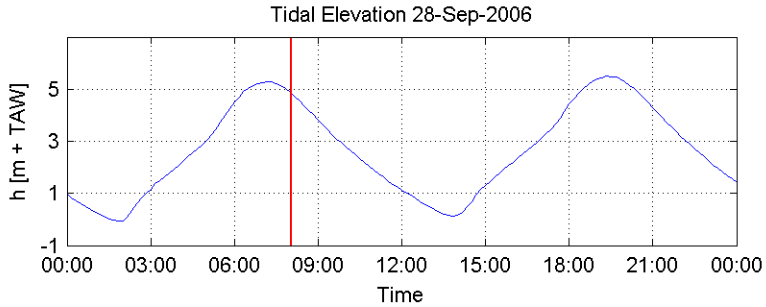
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7012S_sub.csv	Location: Transect S







HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

08:00 - 08:02

Time after HW [HH:MM]

0:51

Data Processed by: IMDC

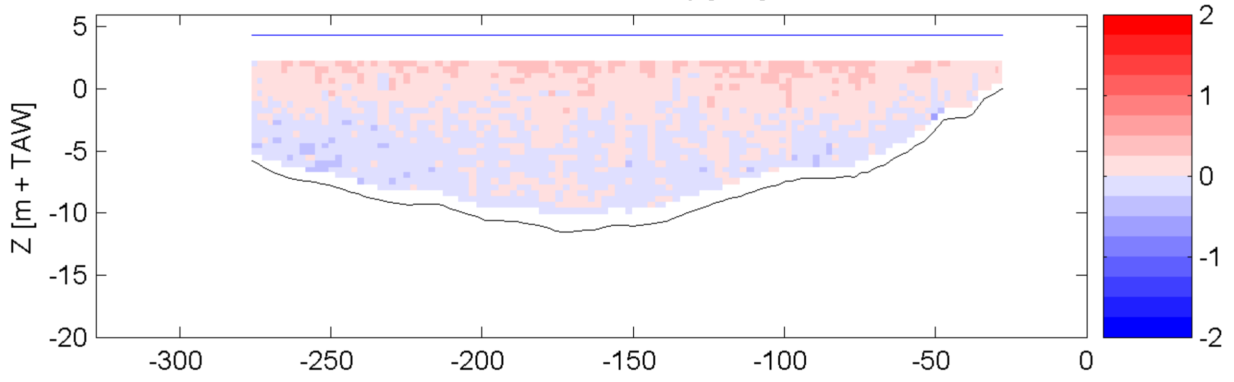
In association with :

I/RA/11291/06.108/MSA

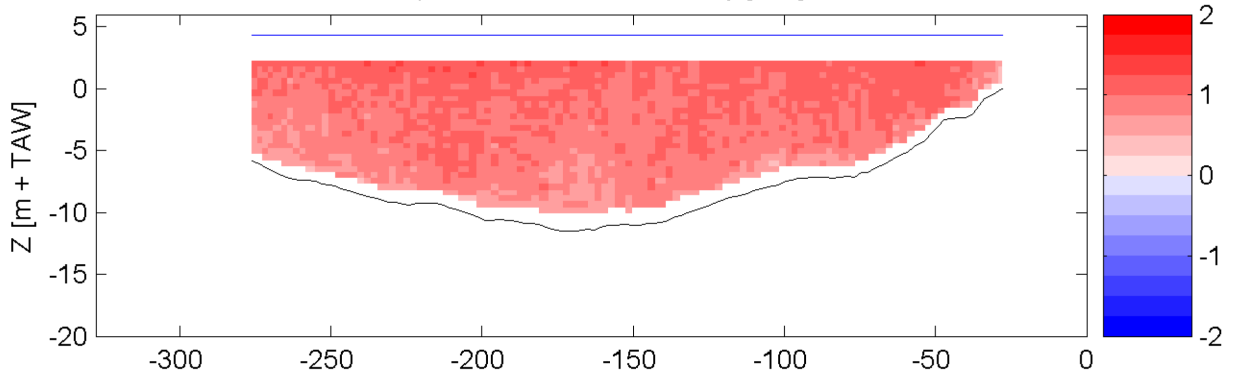
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7015S_sub.csv	Location: Transect S

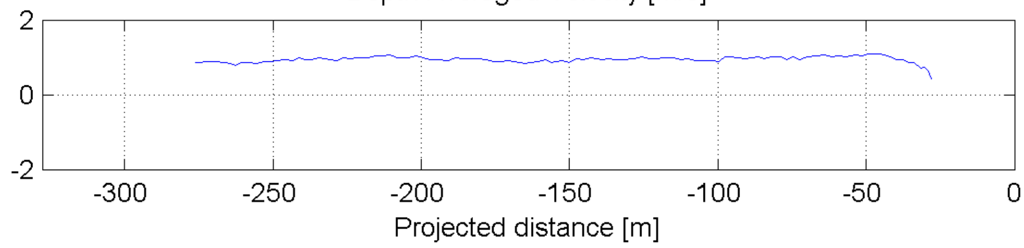
Parallel Current Velocity [m/s]



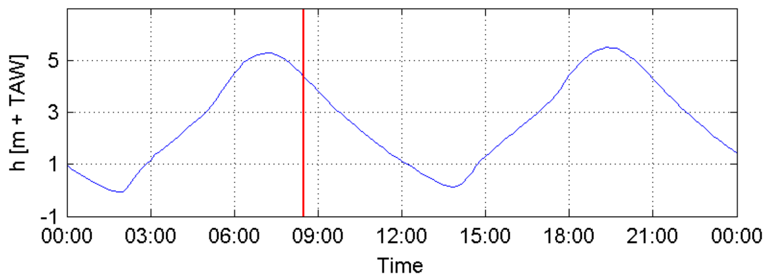
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

08:26 - 08:28

Time after HW [HH:MM]

1:17

Data Processed by:

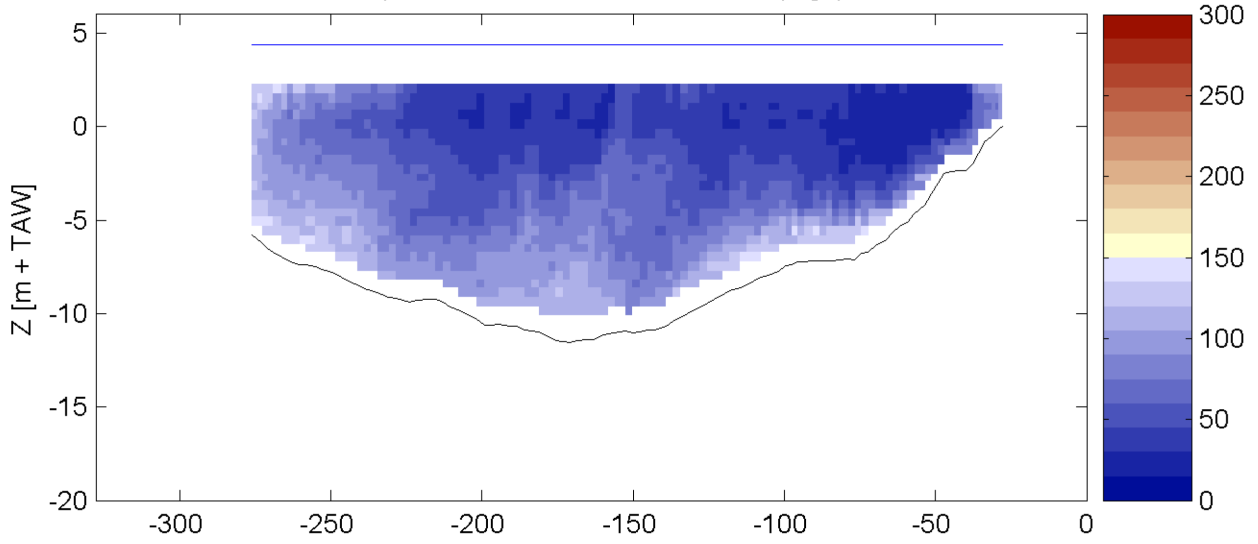
In association with :

I/RA/11291/06.108/MSA

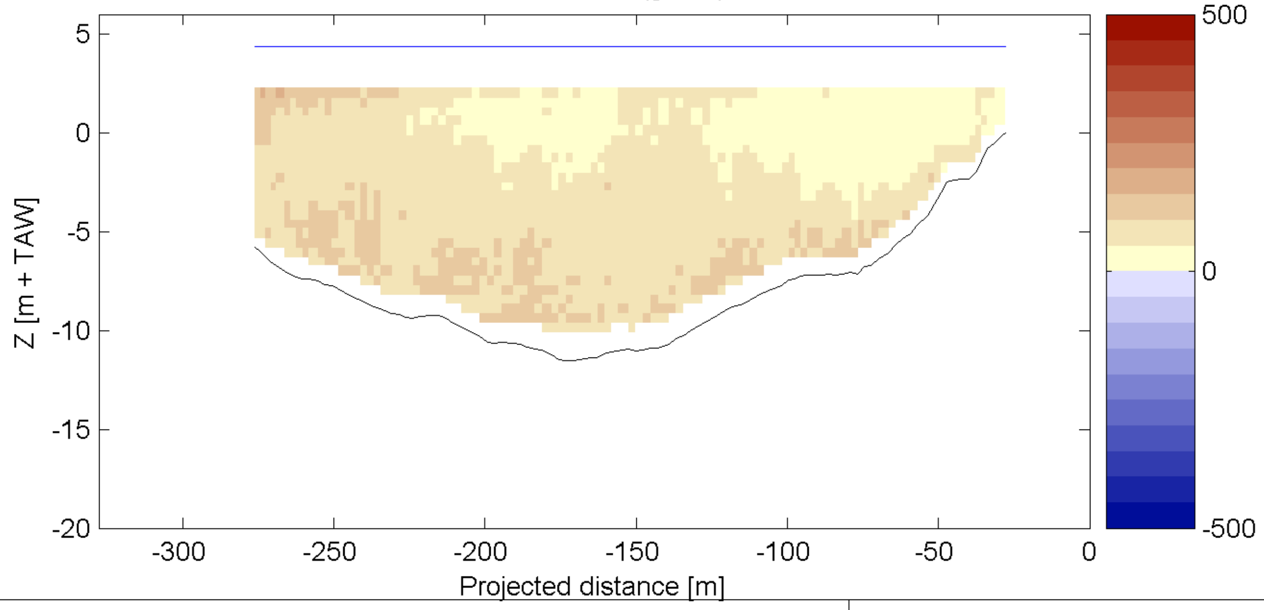
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7015S_sub.csv	Location: Transect S

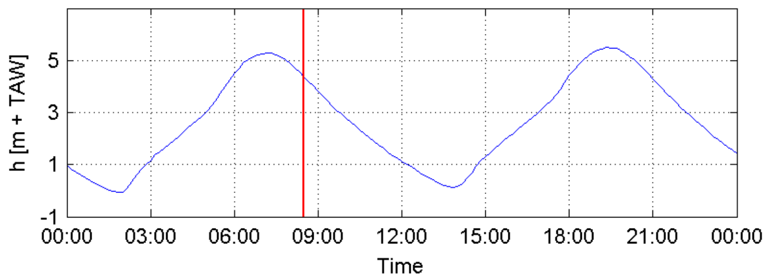
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

08:26 - 08:28

Time after HW [HH:MM]

1:17

Data Processed by:

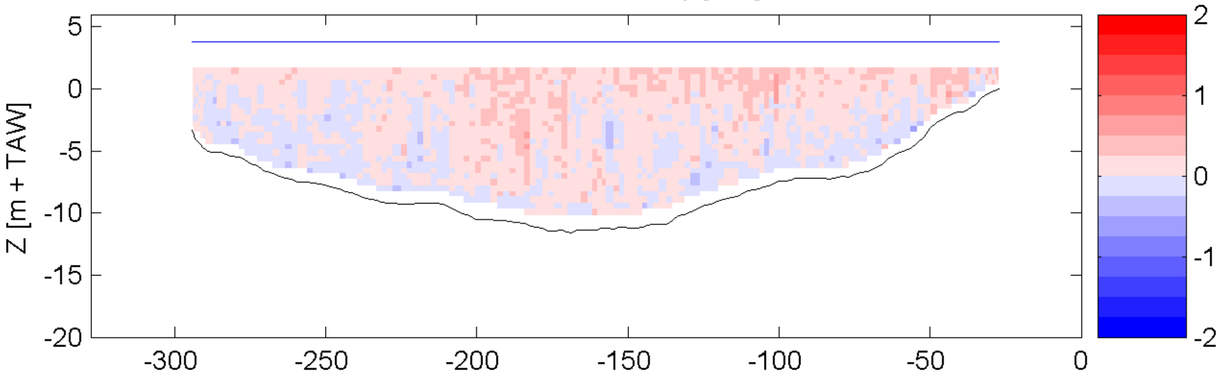
In association with :

I/RA/11291/06.108/MSA

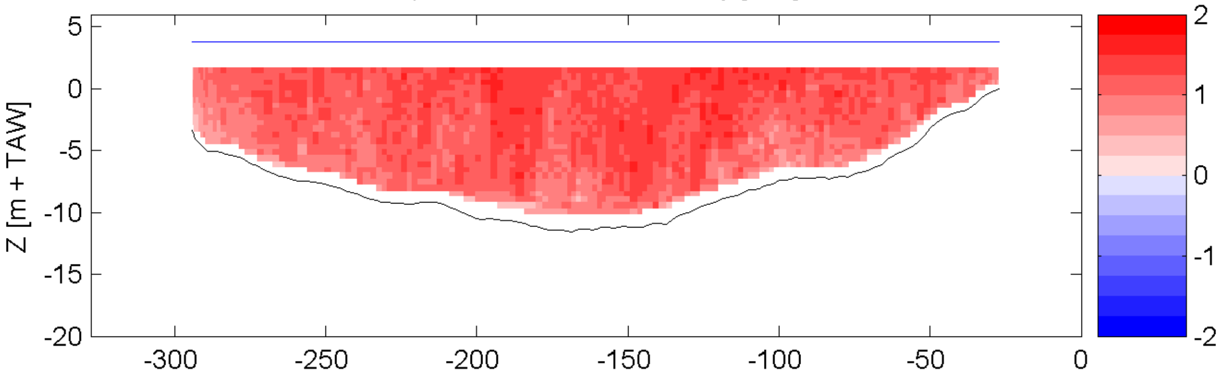
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7018S_sub.csv	Location: Transect S

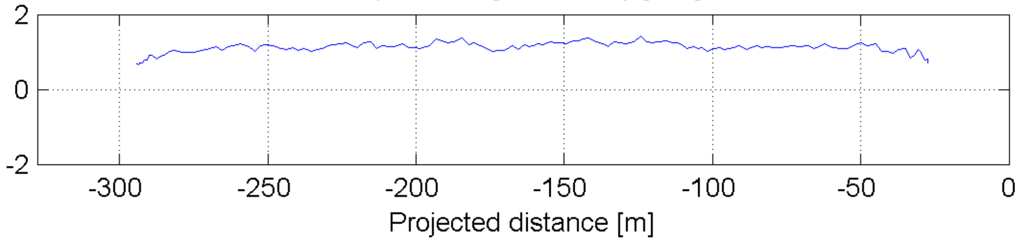
Parallel Current Velocity [m/s]



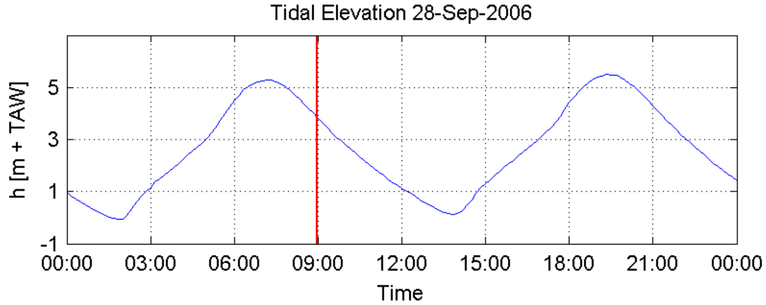
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

08:55 - 08:58

Time after HW [HH:MM]

1:47

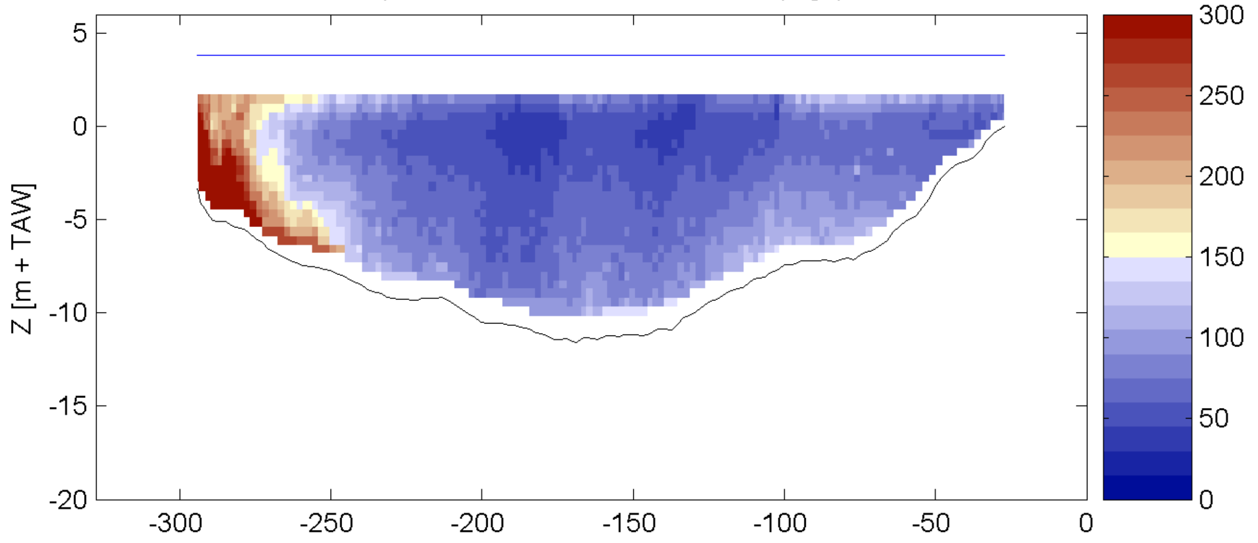
Data Processed by:

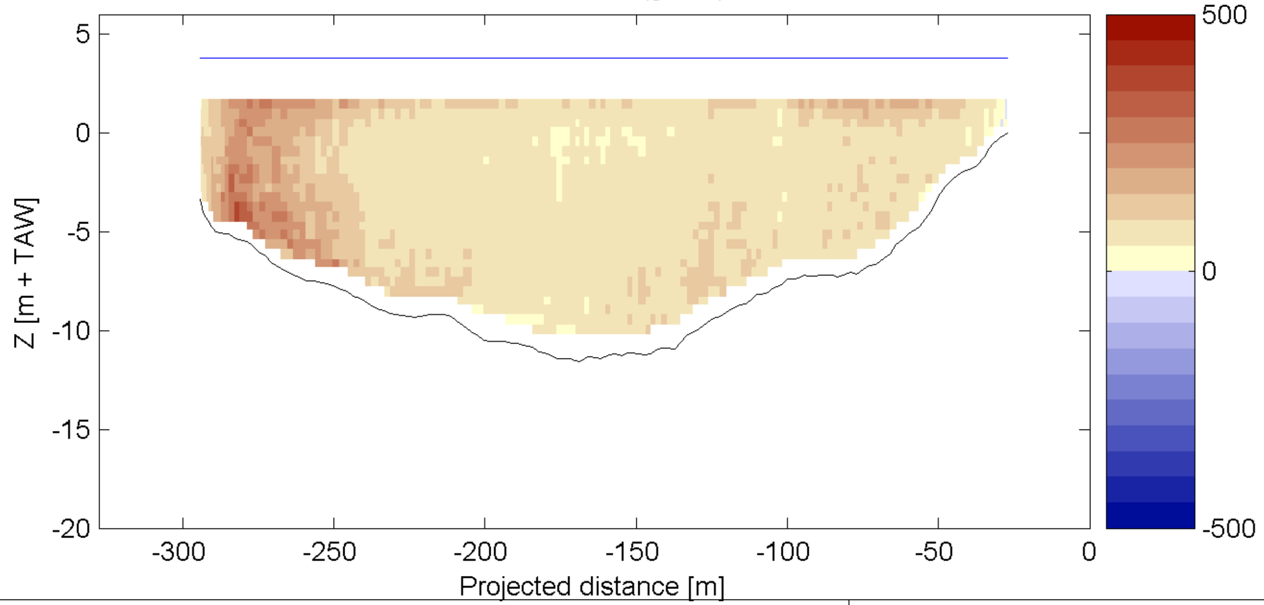
In association with :

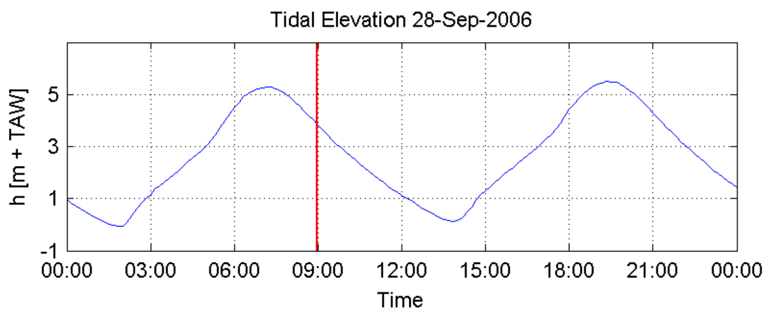
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7018S_sub.csv	Location: Transect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

08:55 - 08:58

Time after HW [HH:MM]

1:47

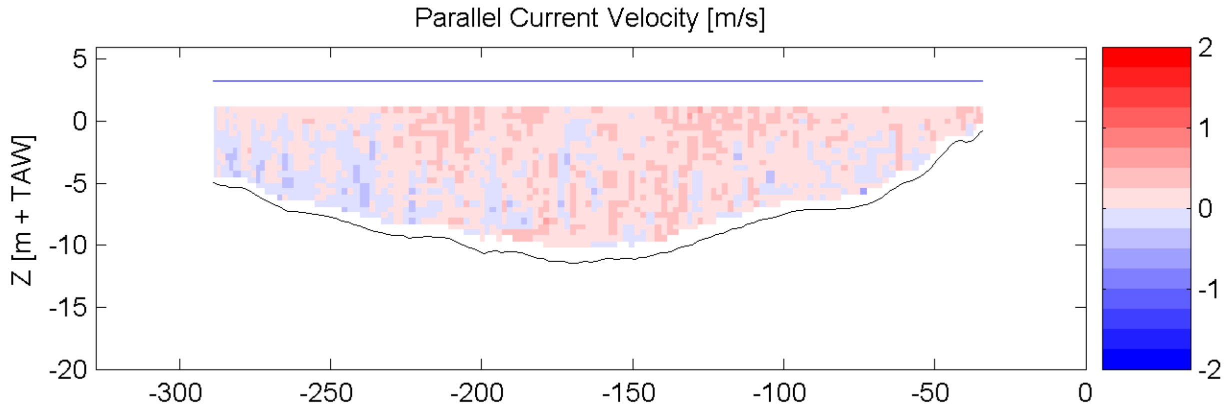
Data Processed by:

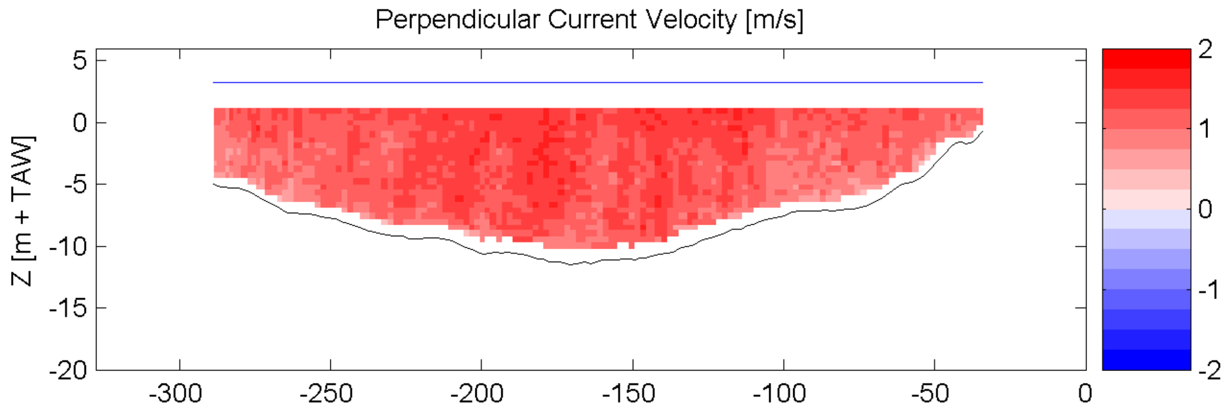
In association with :

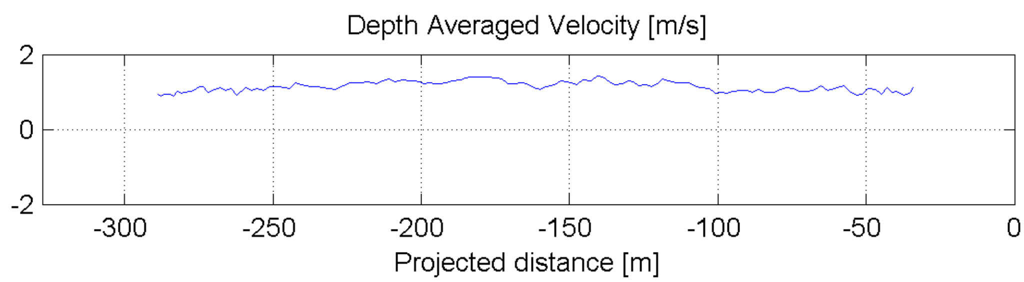
I/RA/11291/06.108/MSA

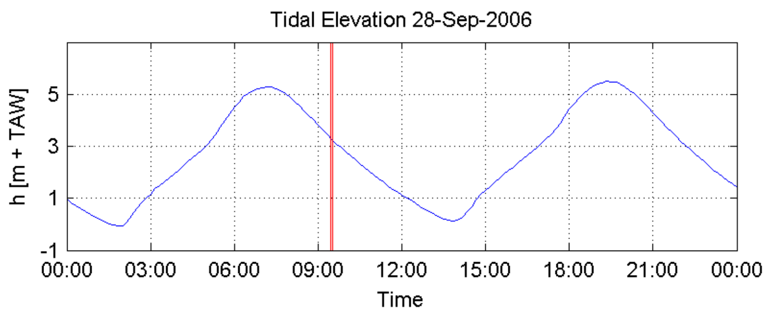
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7021S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
09:27 - 09:30

Time after HW [HH:MM]
2:19

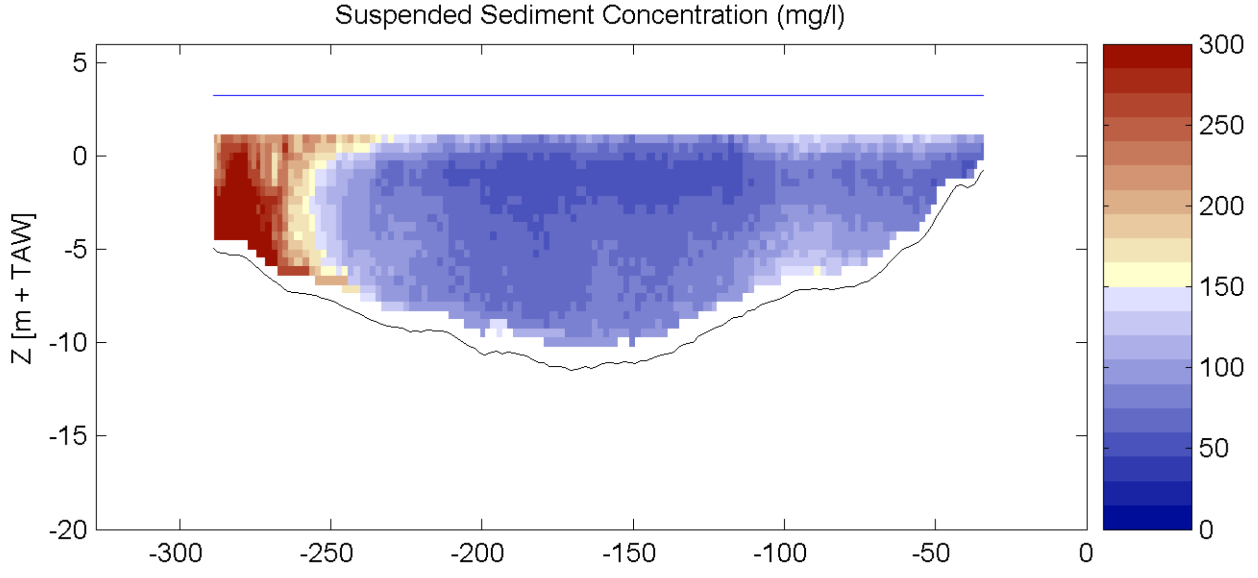
Data Processed by: IMDC

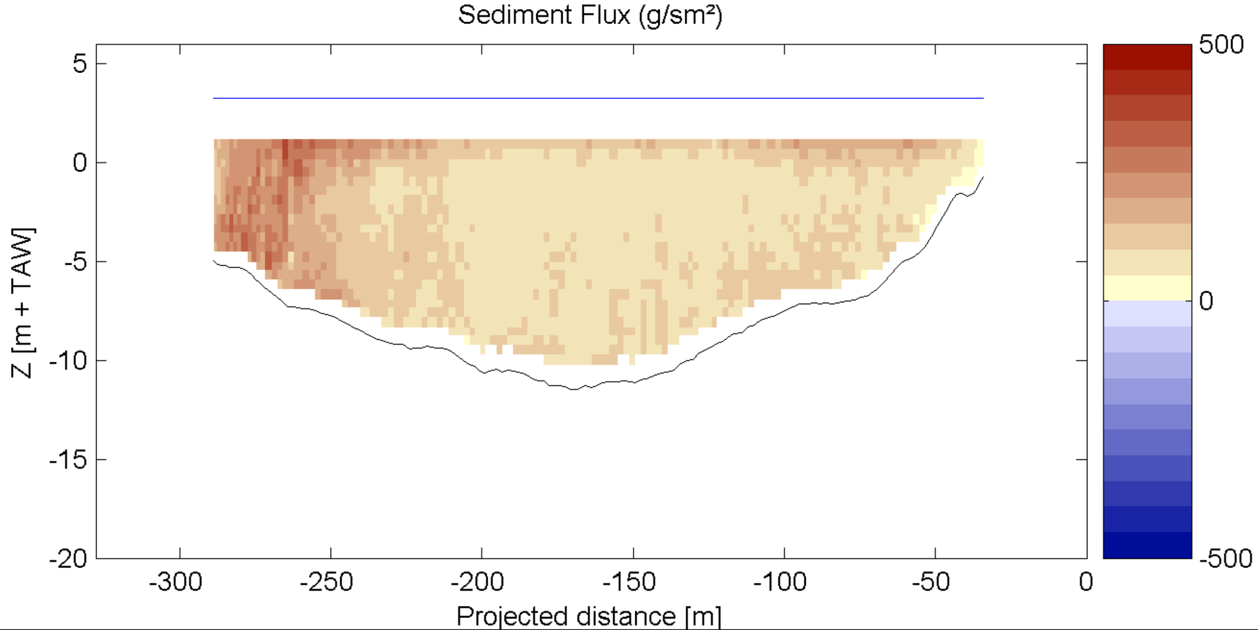
In association with : WL | delft hydraulics, GEMS International

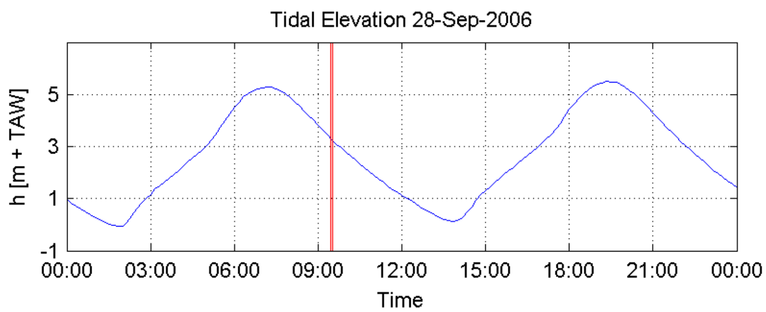
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7021S_sub.csv	Location: Transect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
09:27 - 09:30

Time after HW [HH:MM]
2:19

Data Processed by:

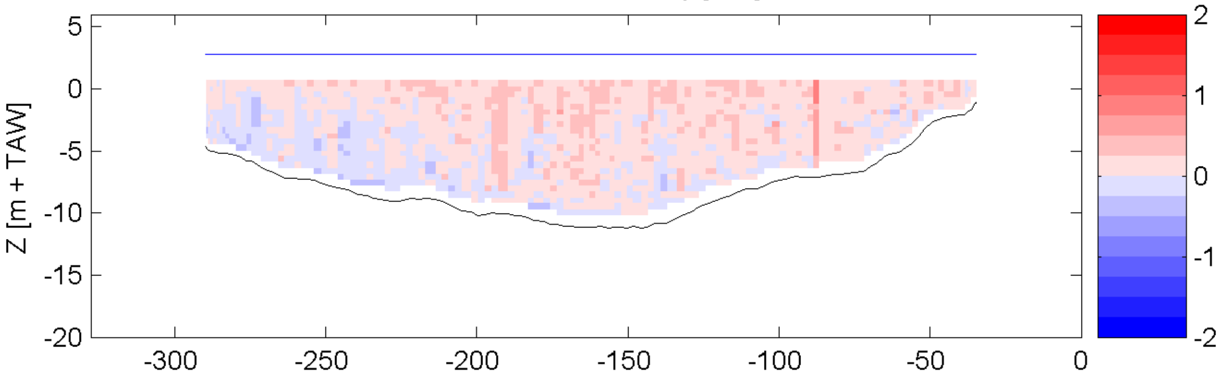
In association with :

I/RA/11291/06.108/MSA

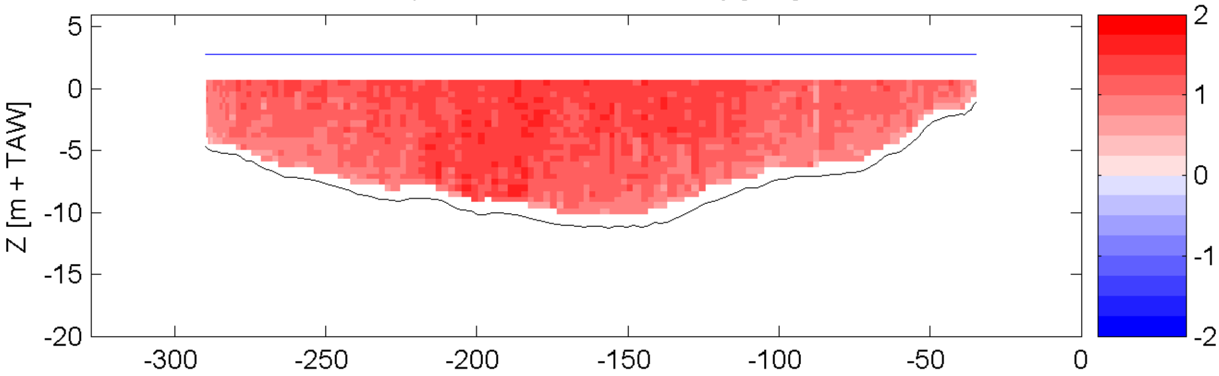
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7024S_sub.csv	Location: Transect S

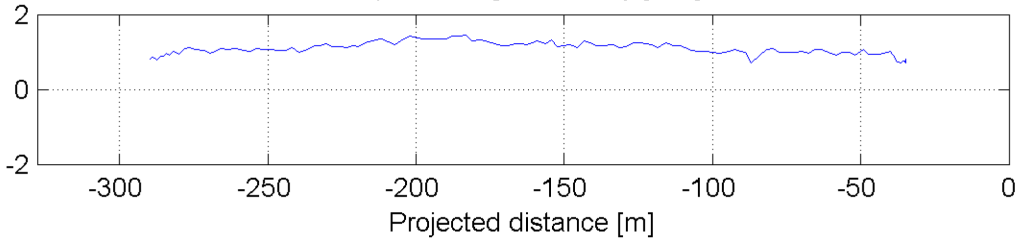
Parallel Current Velocity [m/s]



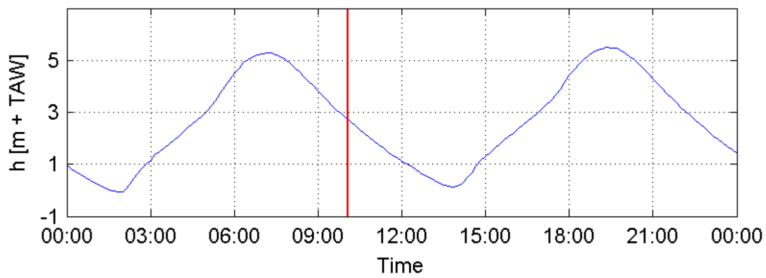
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

10:02 - 10:05

Time after HW [HH:MM]

2:53

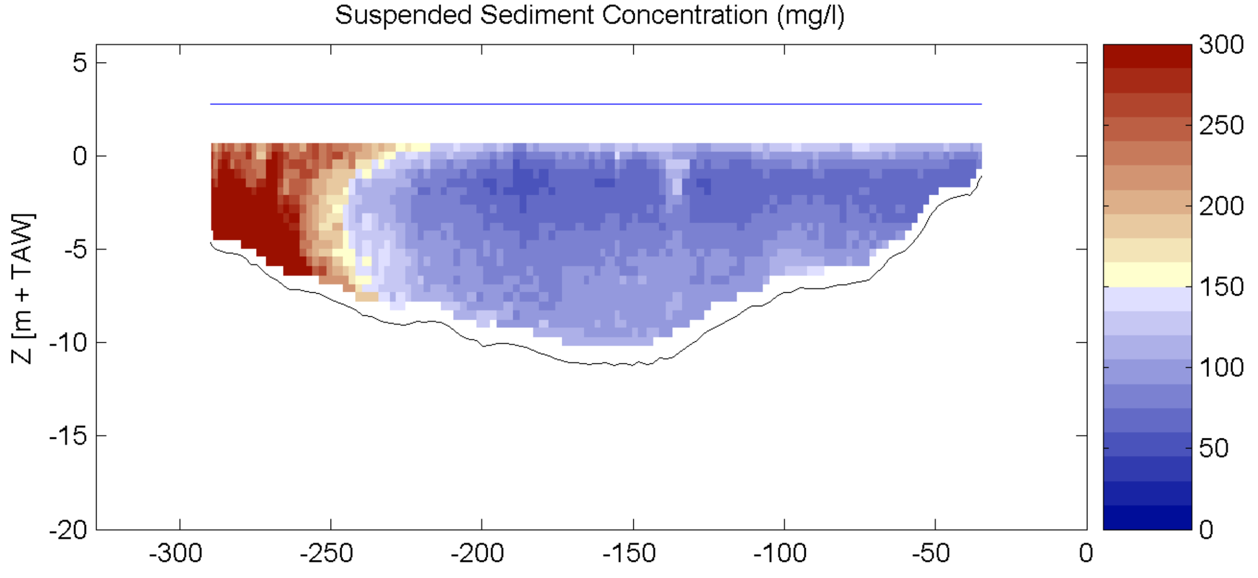
Data Processed by: IMDC

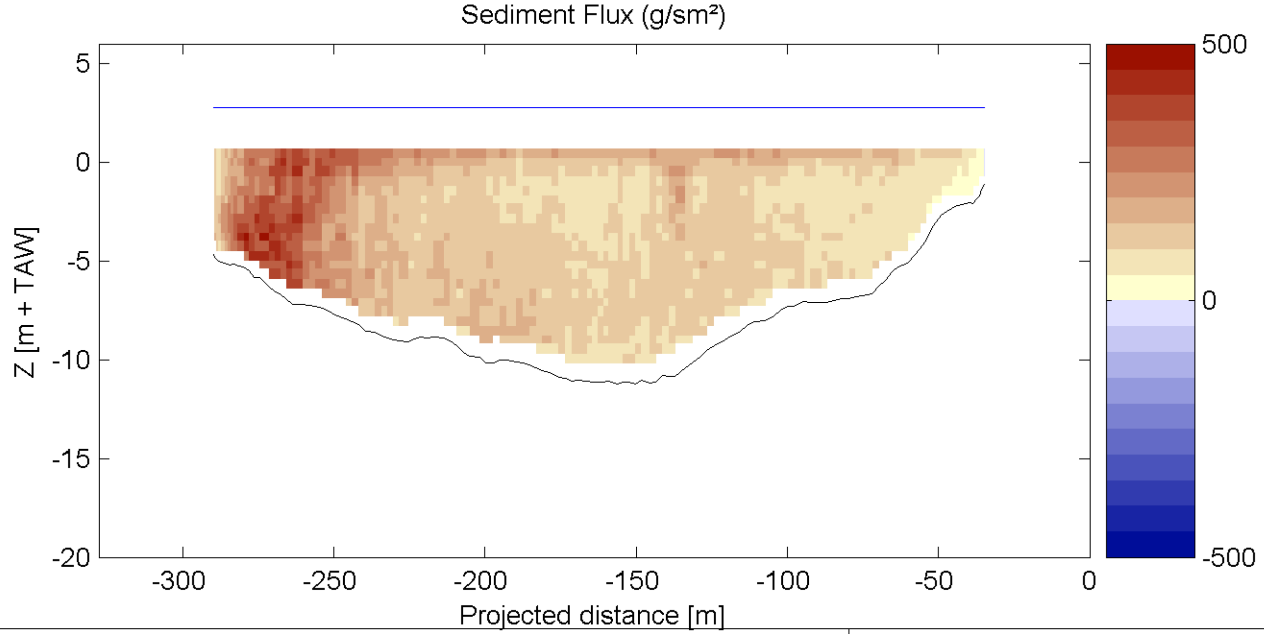
In association with : wl | delft hydraulics, GEMS International

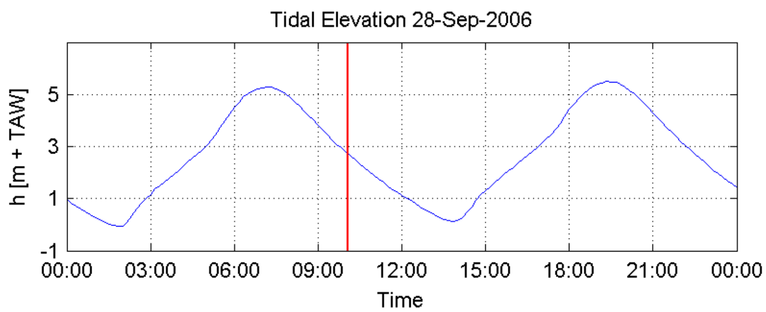
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7024S_sub.csv	Location: Transect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
10:02 - 10:05

Time after HW [HH:MM]
2:53

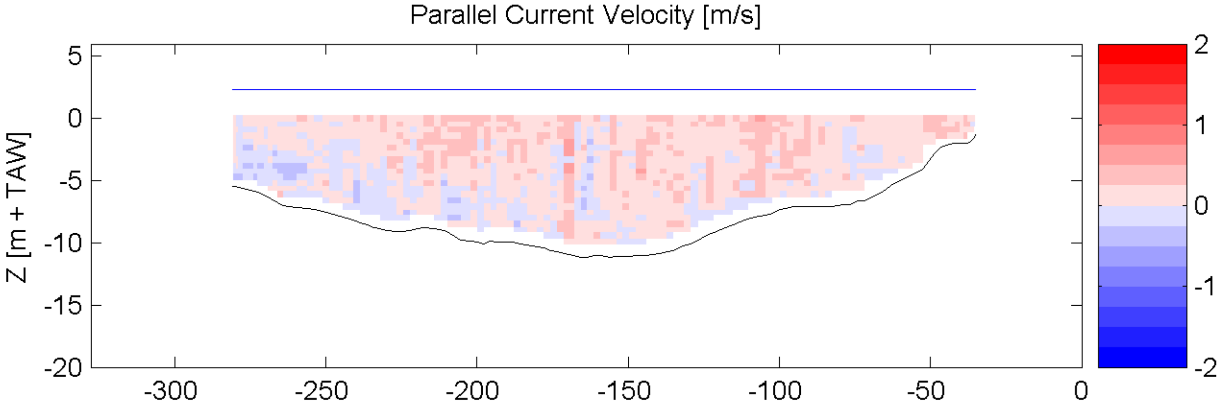
Data Processed by: IMDC

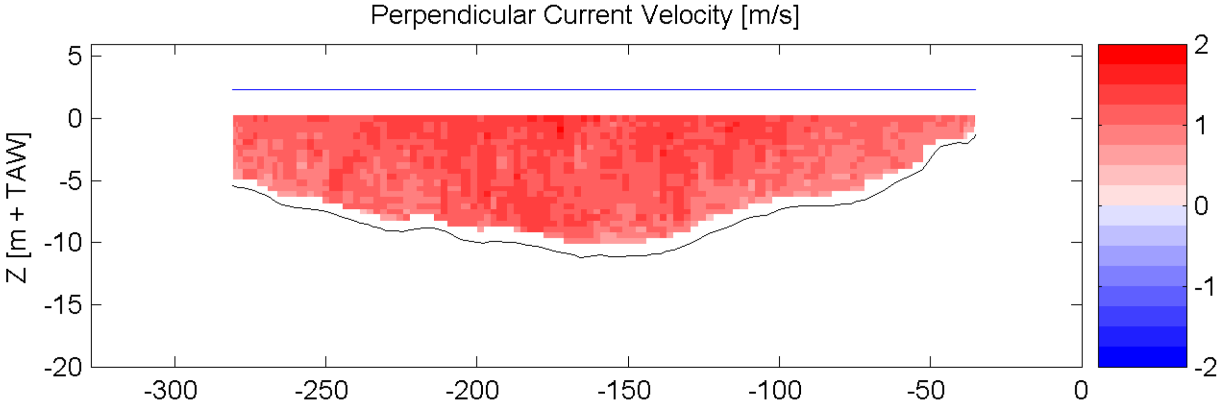
In association with :

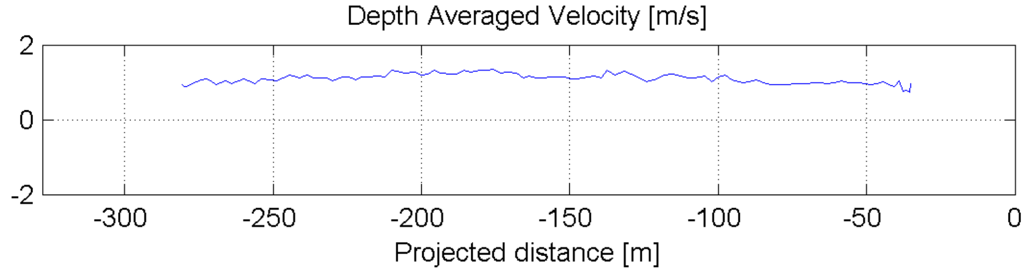
I/RA/11291/06.108/MSA

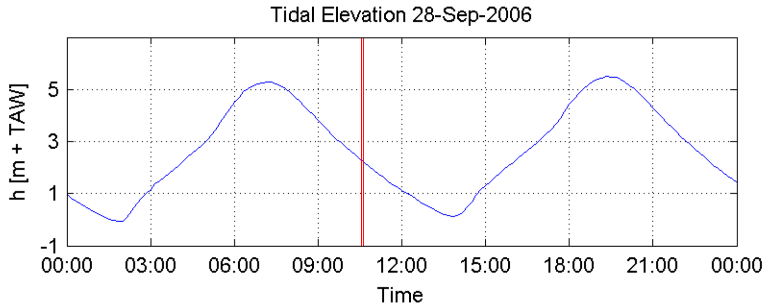
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7027S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

10:34 - 10:36

Time after HW [HH:MM]

3:25

Data Processed by:

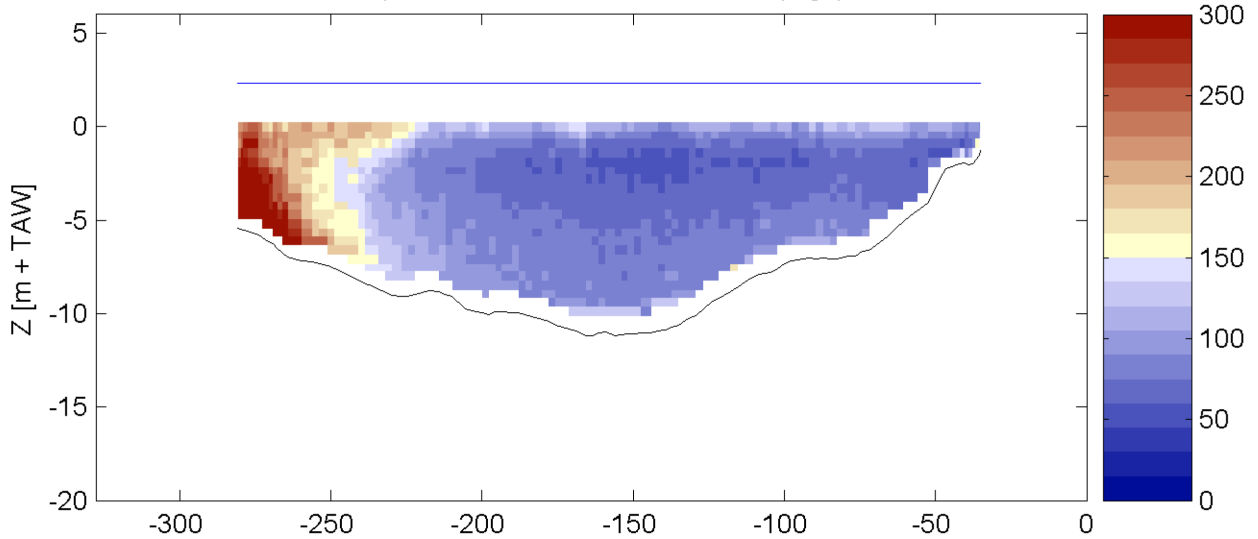
In association with :

I/RA/11291/06.108/MSA

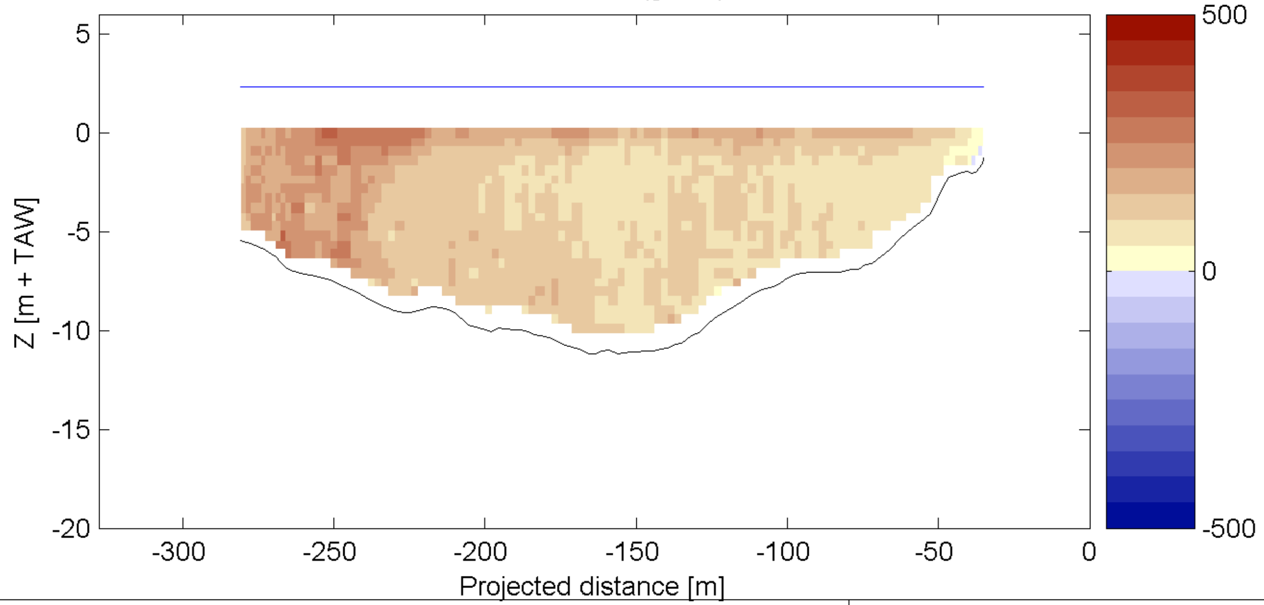
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7027S_sub.csv	Location: Transect S

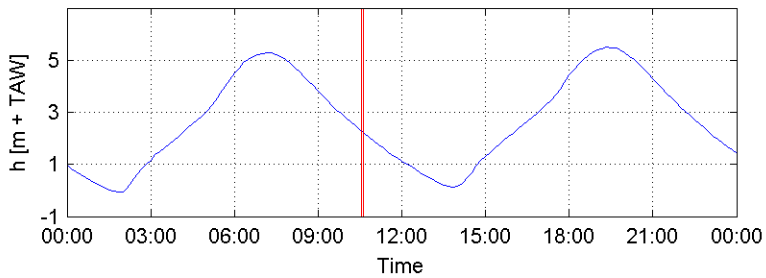
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

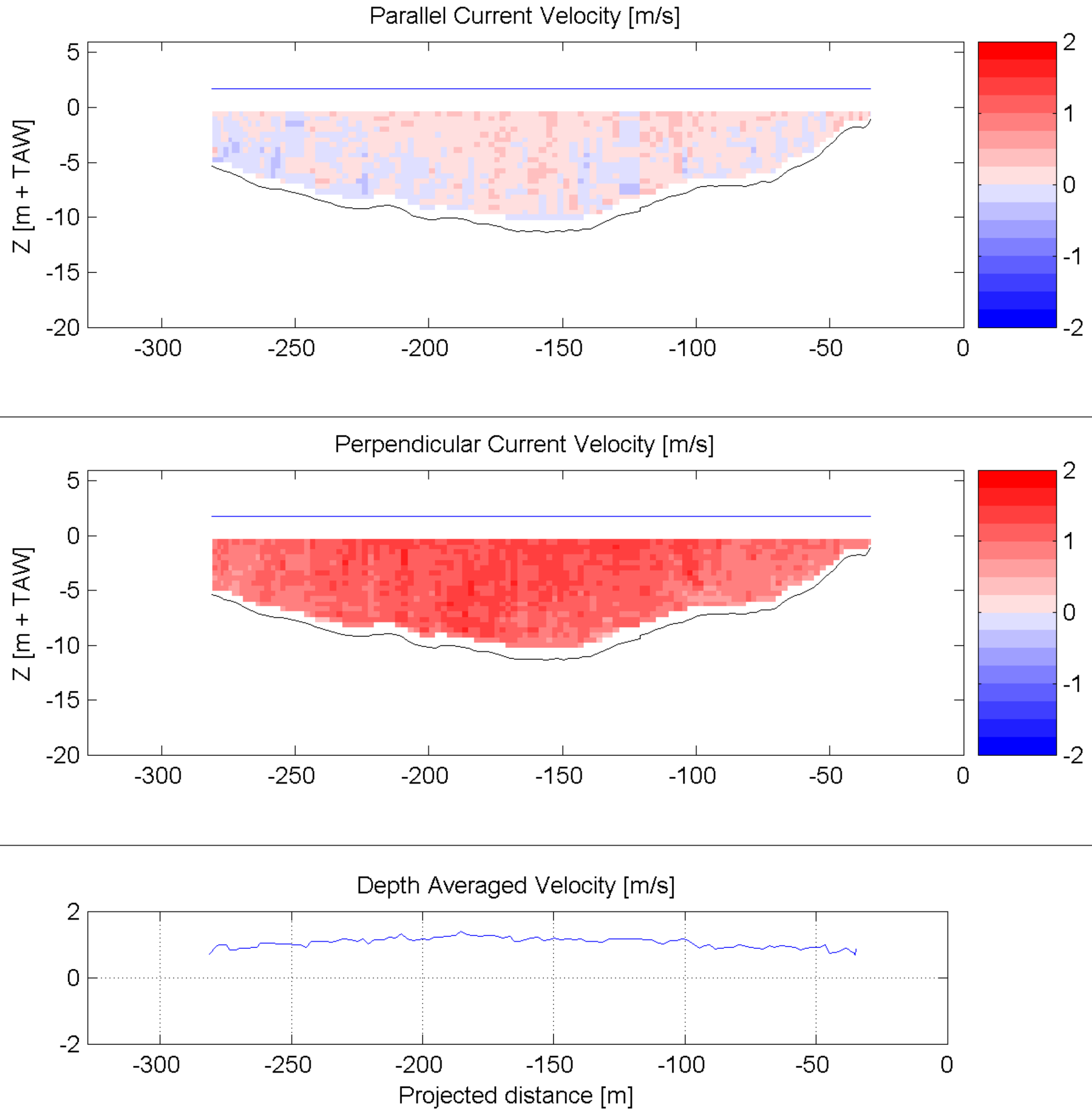
Date / Time [MET] :
28-Sep-2006
10:34 - 10:36

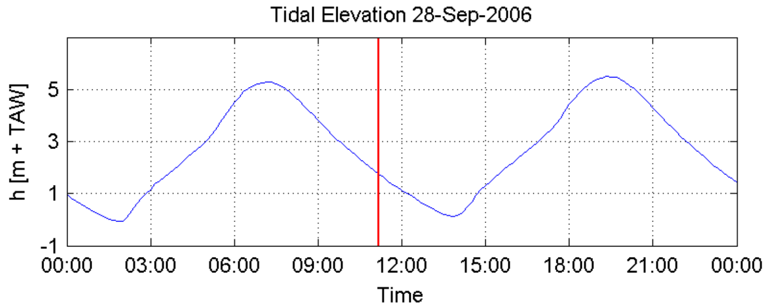
Time after HW [HH:MM]
3:25

Data Processed by:
In association with :
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7030S_sub.csv	Location: Transect S





HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
11:08 - 11:11

Time after HW [HH:MM]
3:59

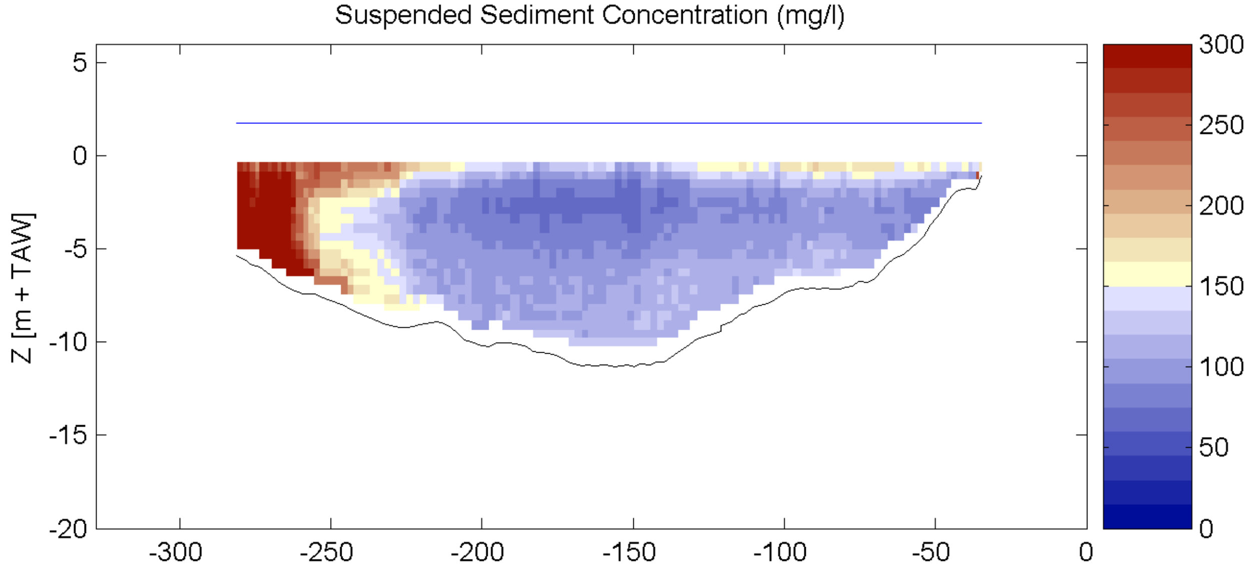
Data Processed by:

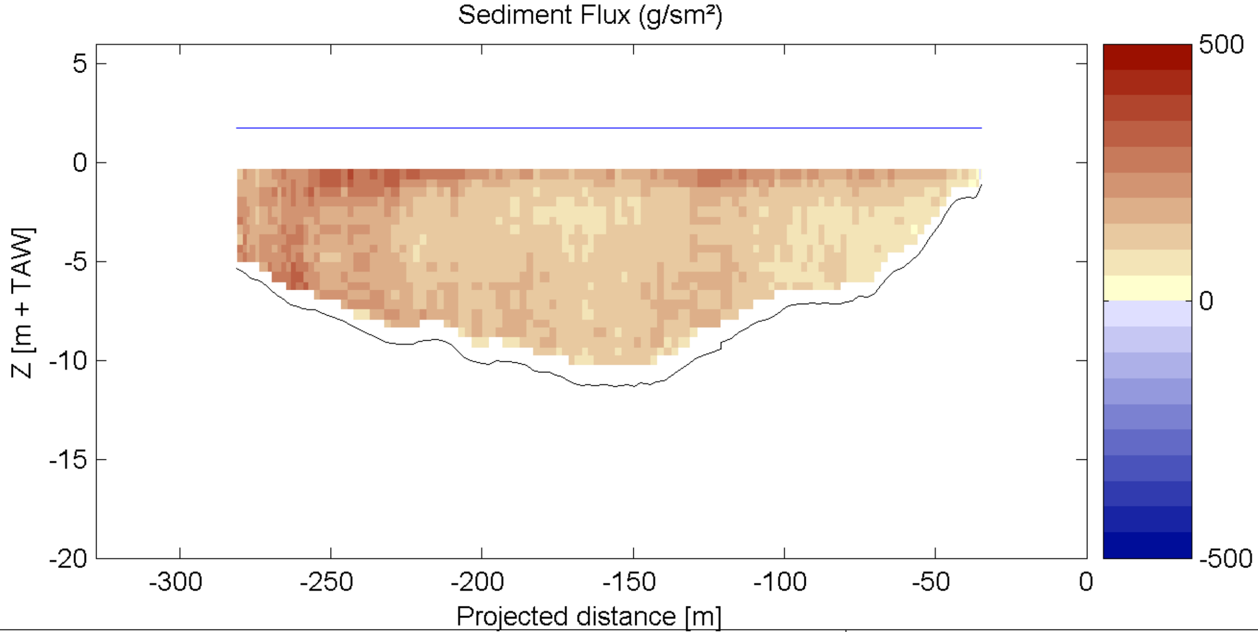
In association with :

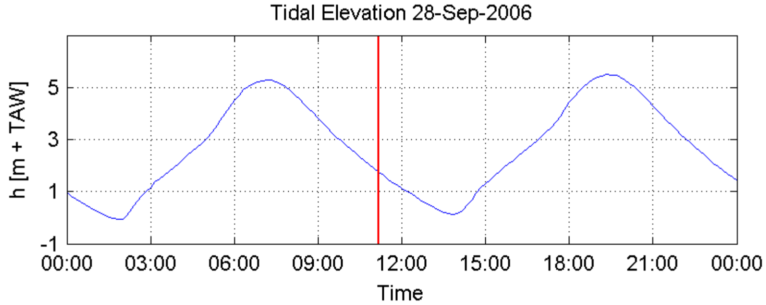
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7030S_sub.csv	Location: Transect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

11:08 - 11:11

Time after HW [HH:MM]

3:59

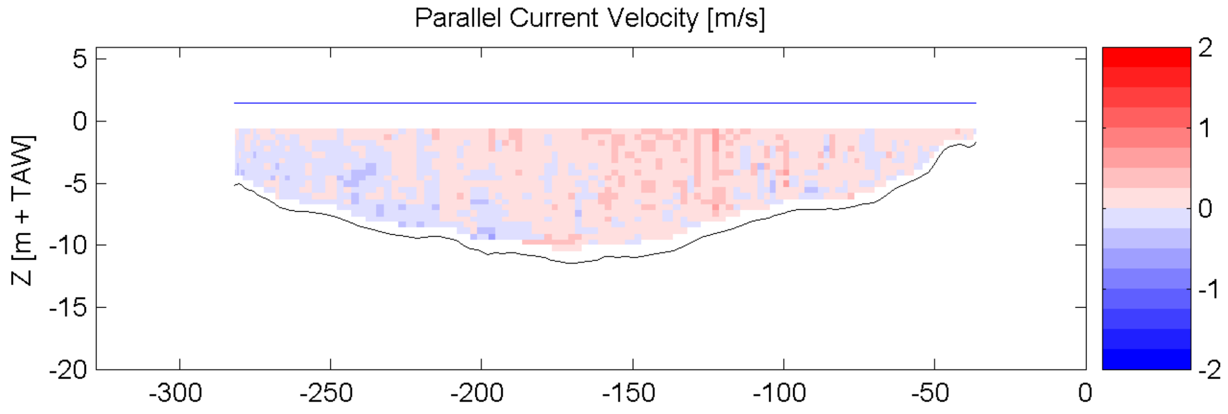
Data Processed by: IMDC

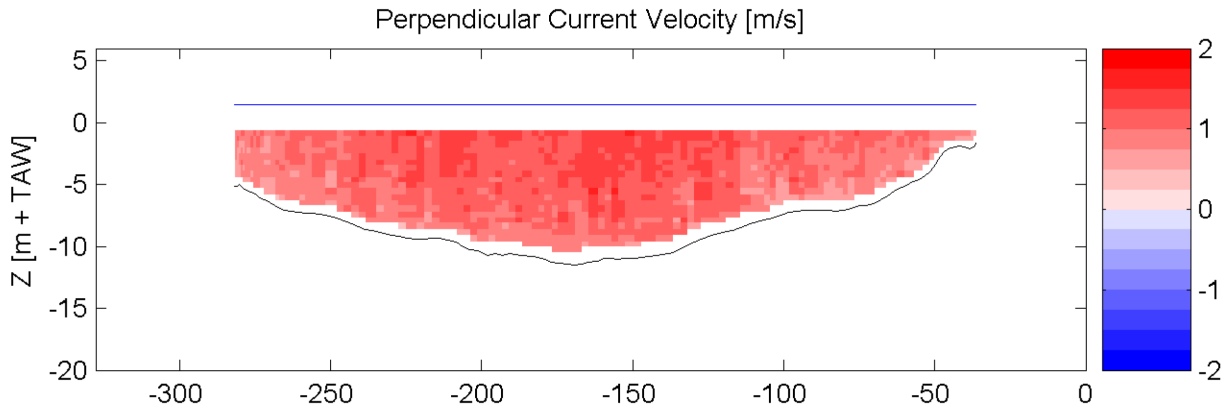
In association with : wl | delft hydraulics, GEMS International

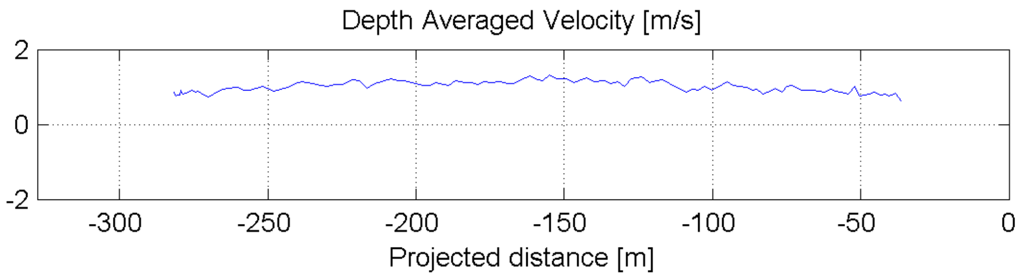
I/RA/11291/06.108/MSA

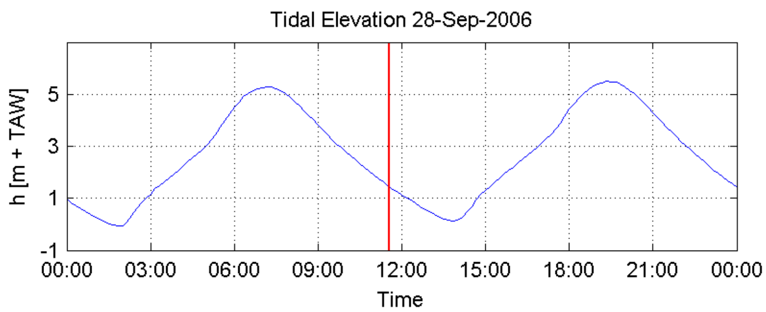
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7033S_sub.csv	Location: Transect S









HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

11:31 - 11:34

Time after HW [HH:MM]

4:22

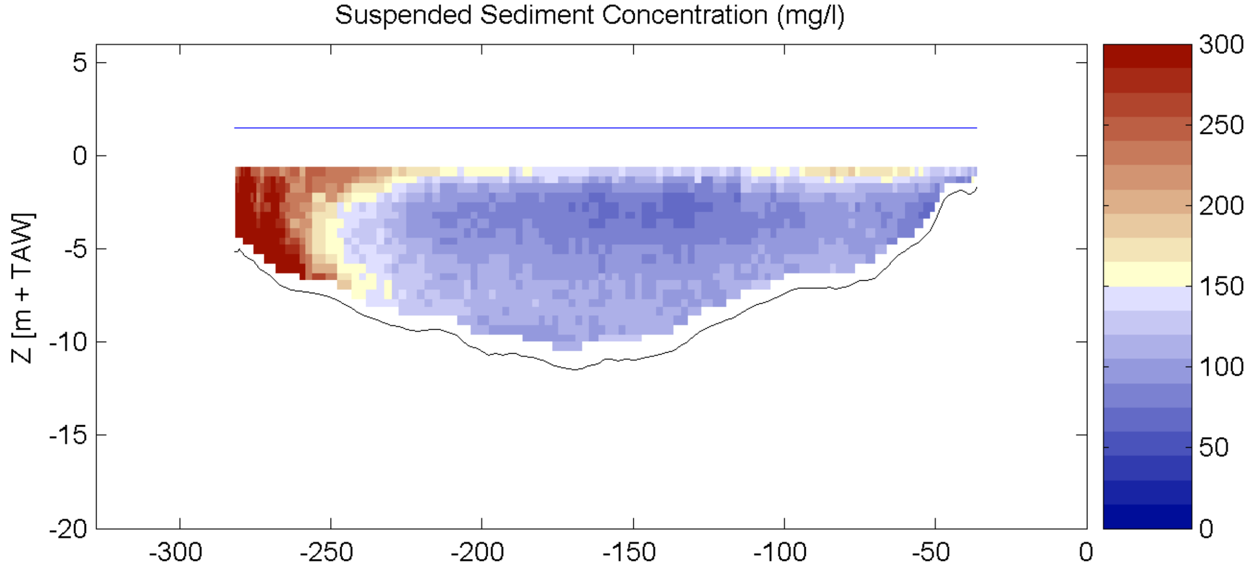
Data Processed by:

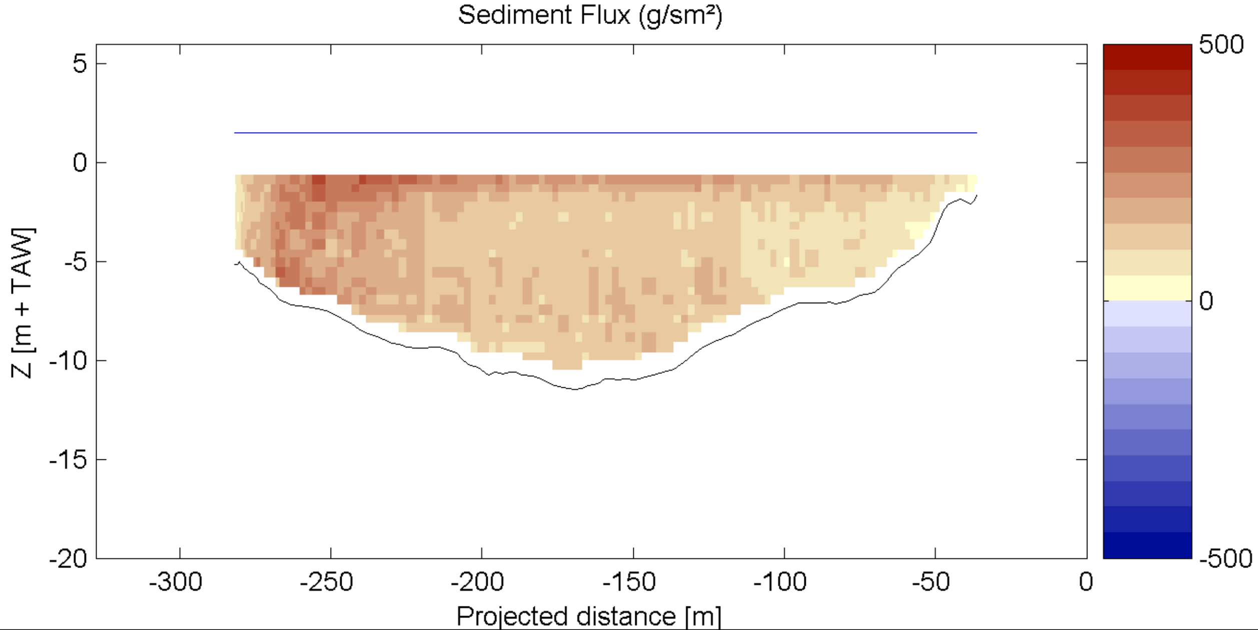
In association with :

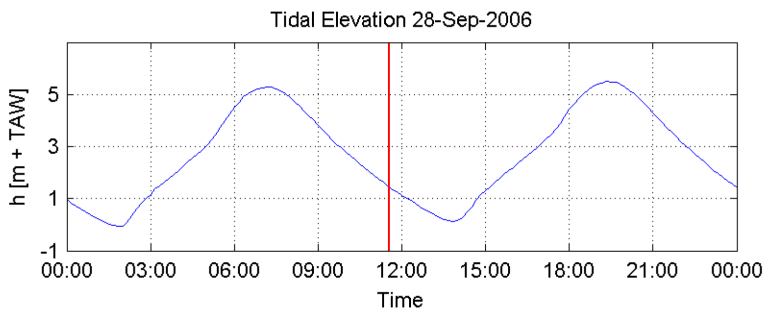
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7033S_sub.csv	Location: Transcect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

11:31 - 11:34

Time after HW [HH:MM]

4:22

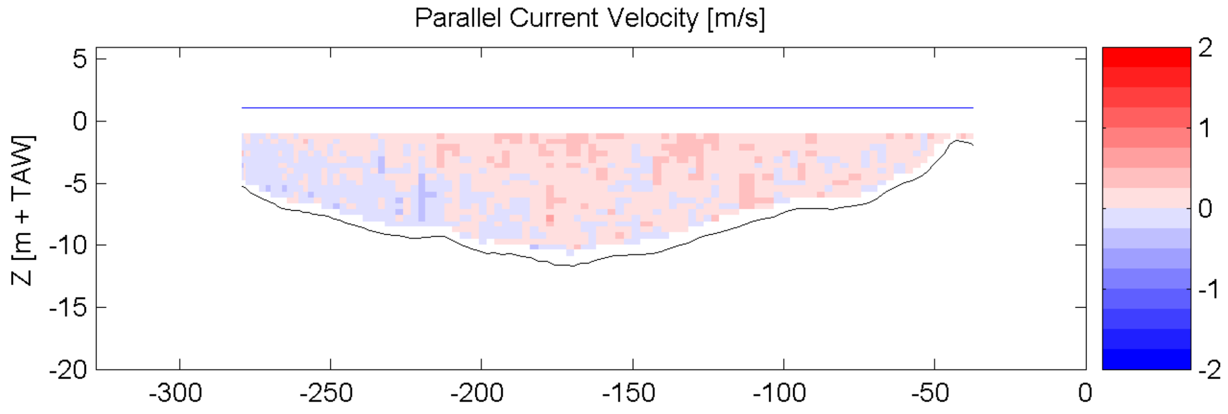
Data Processed by: IMDC

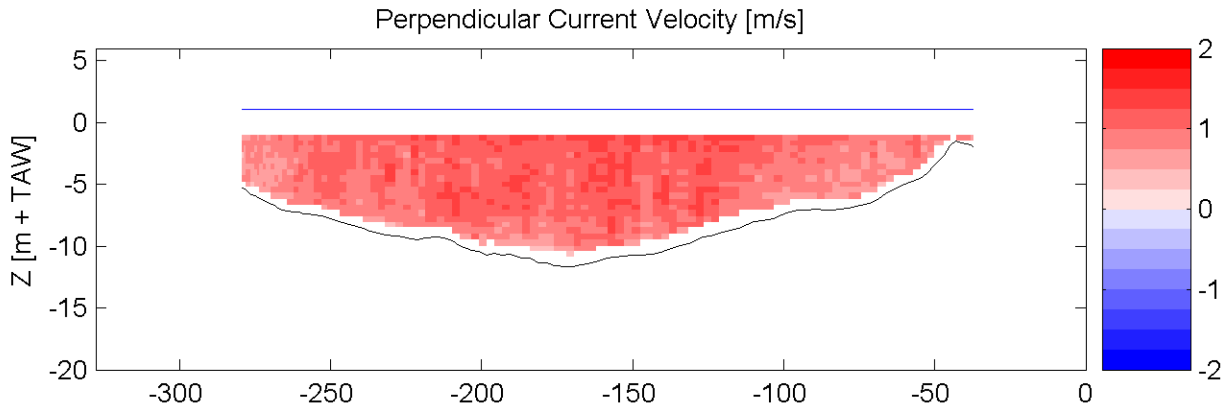
In association with : wl | delft hydraulics, GEMS International

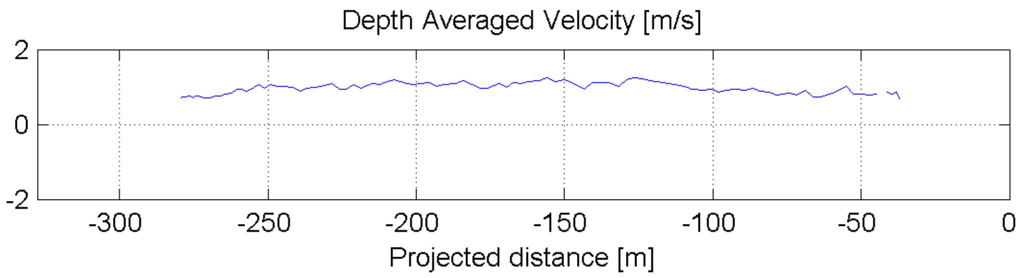
I/RA/11291/06.108/MSA

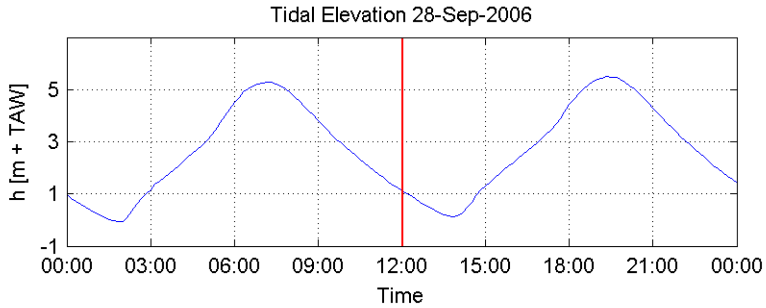
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7036S_sub.csv	Location: Transect S









HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

11:59 - 12:01

Time after HW [HH:MM]

4:50

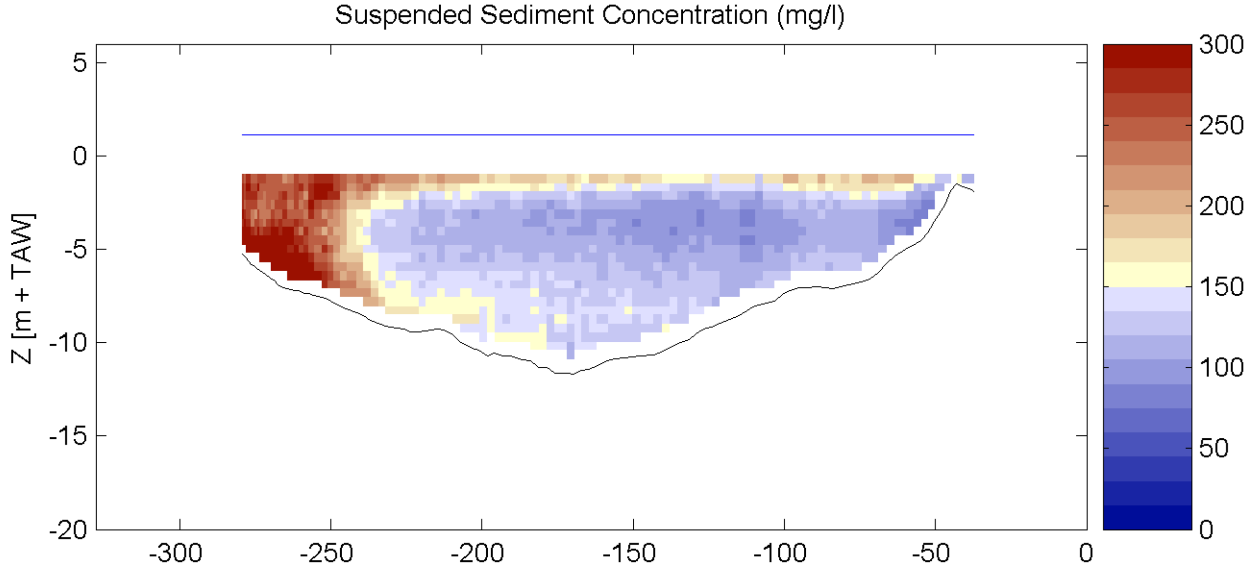
Data Processed by: IMDC

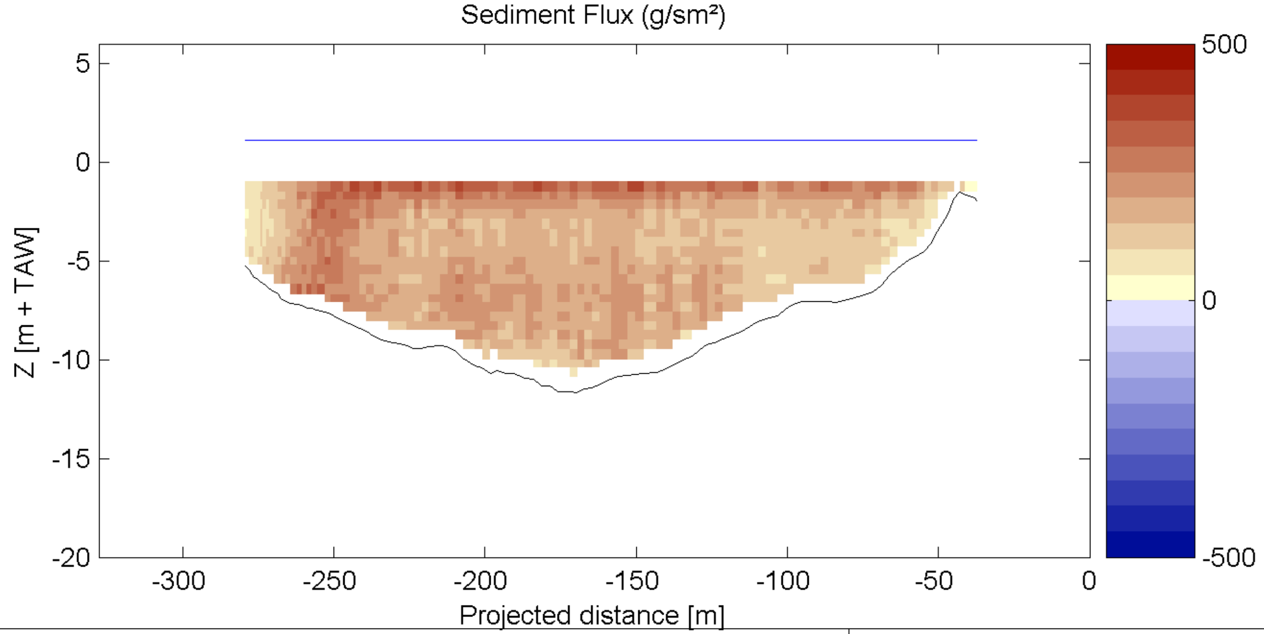
In association with :

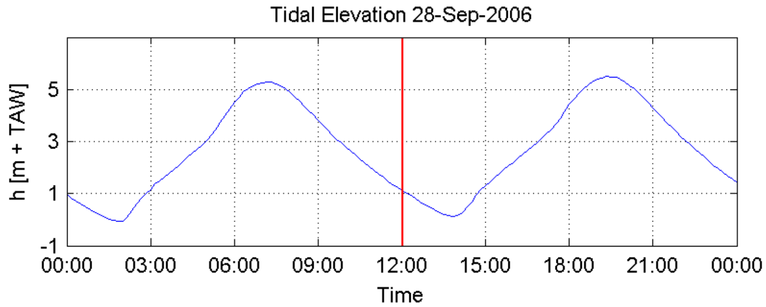
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7036S_sub.csv	Location: Transect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

11:59 - 12:01

Time after HW [HH:MM]

4:50

Data Processed by: IMDC

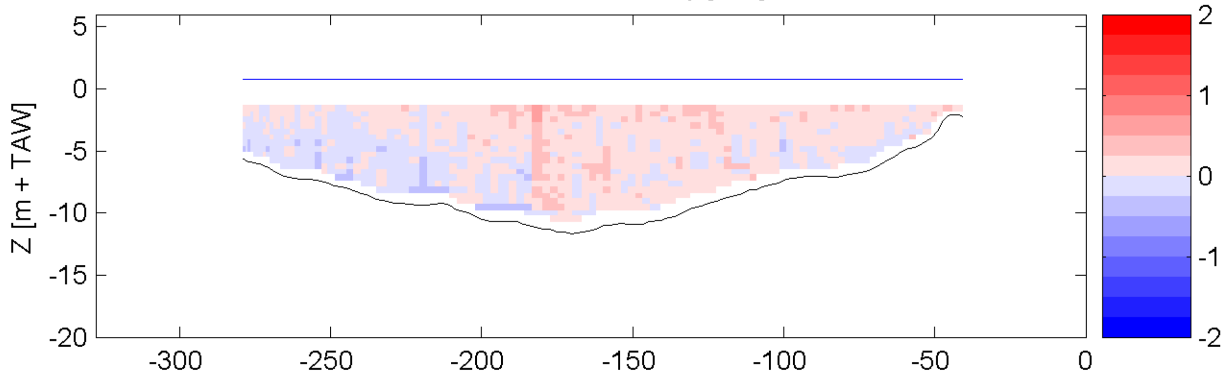
In association with :

I/RA/11291/06.108/MSA

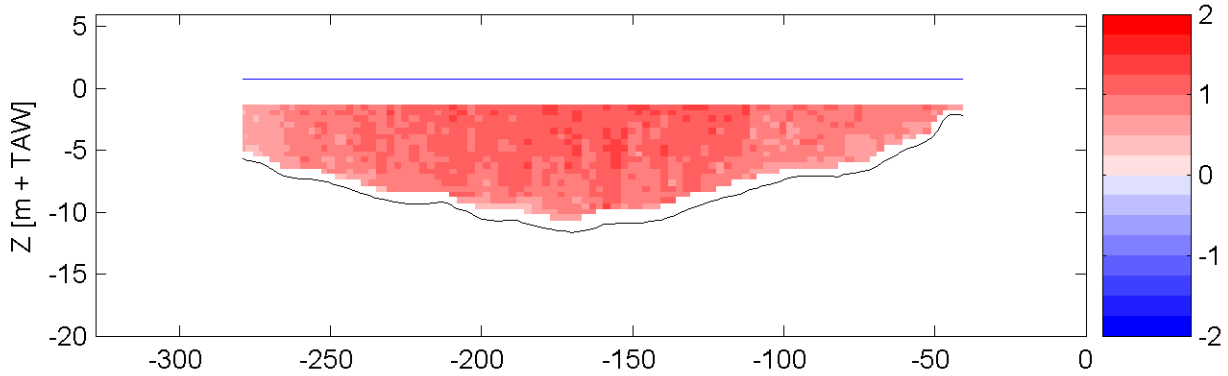
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7039S_sub.csv	Location: Transect S

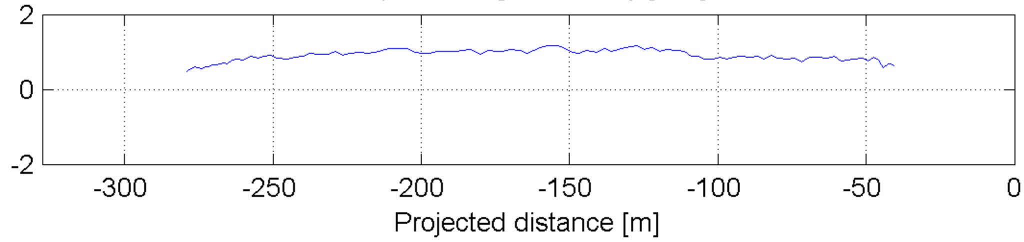
Parallel Current Velocity [m/s]



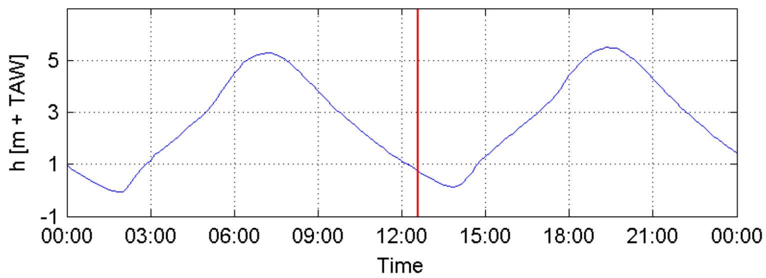
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

12:32 - 12:34

Time after HW [HH:MM]

5:23

Data Processed by:

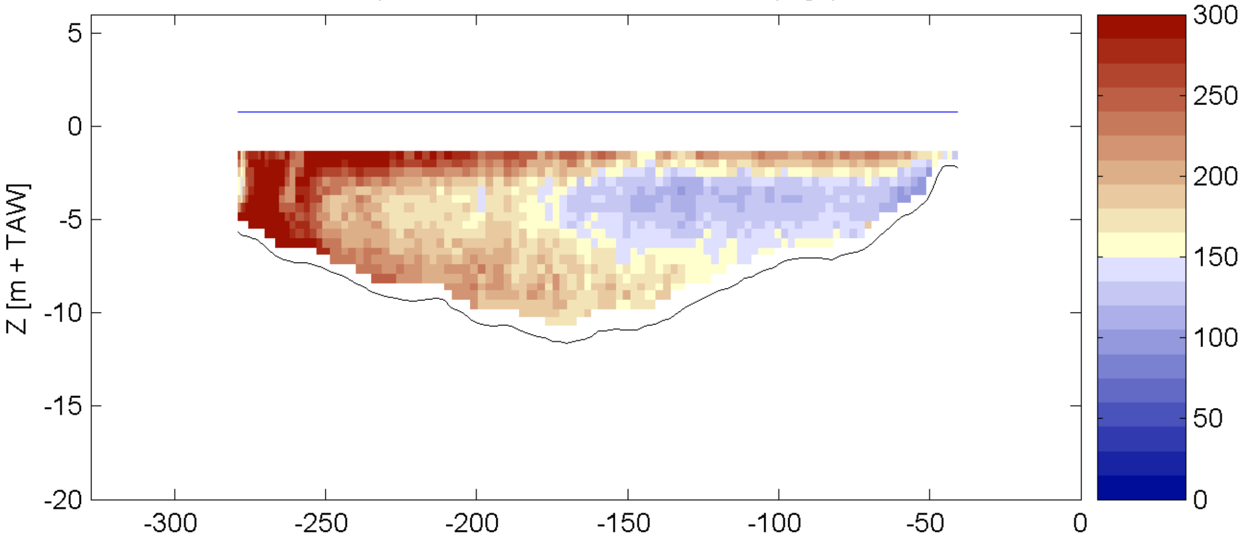
In association with :

I/RA/11291/06.108/MSA

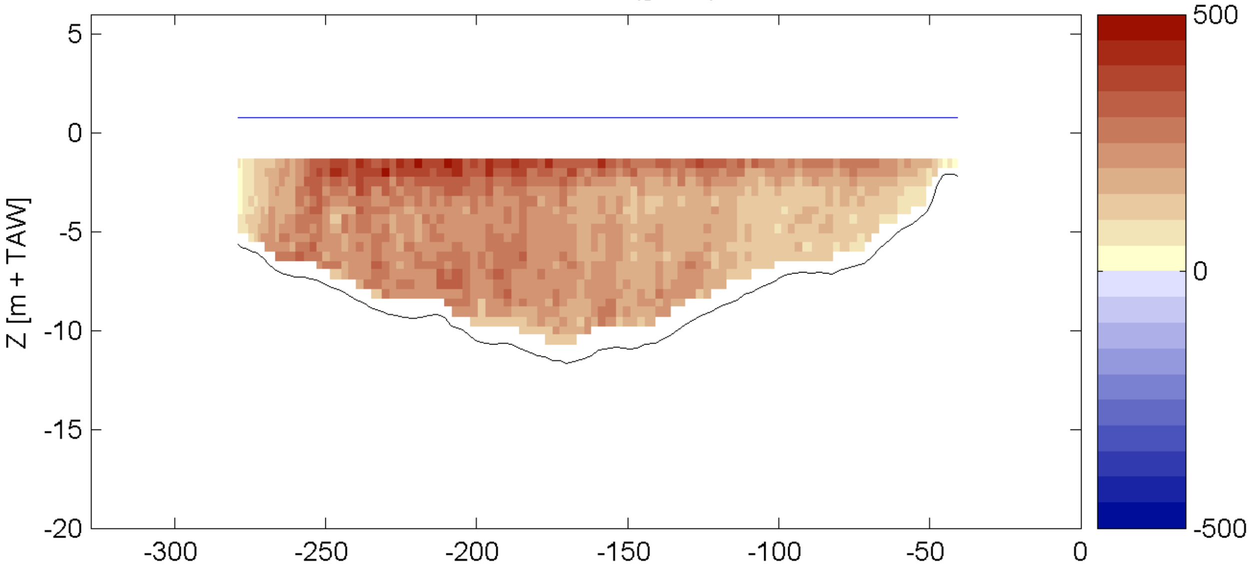
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7039S_sub.csv	Location: Transect S

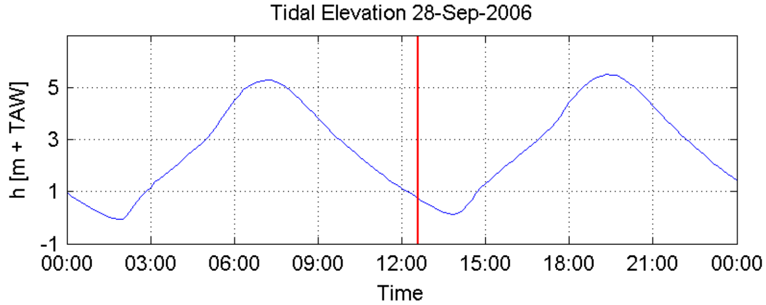
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
12:32 - 12:34

Time after HW [HH:MM]
5:23

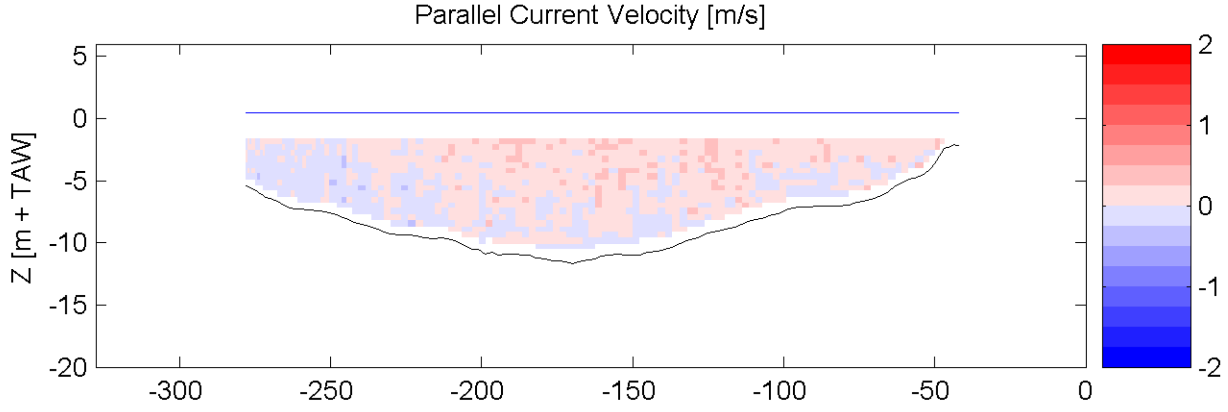
Data Processed by: IMDC

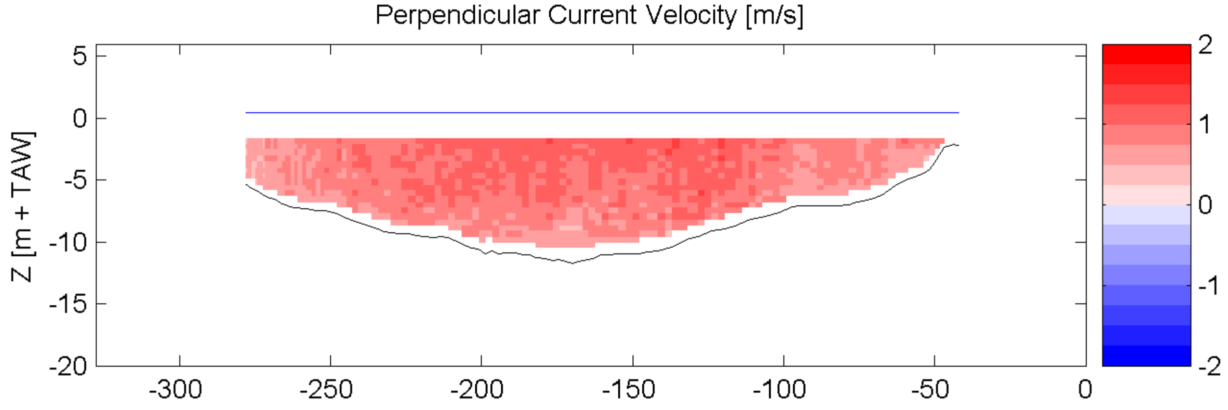
In association with :

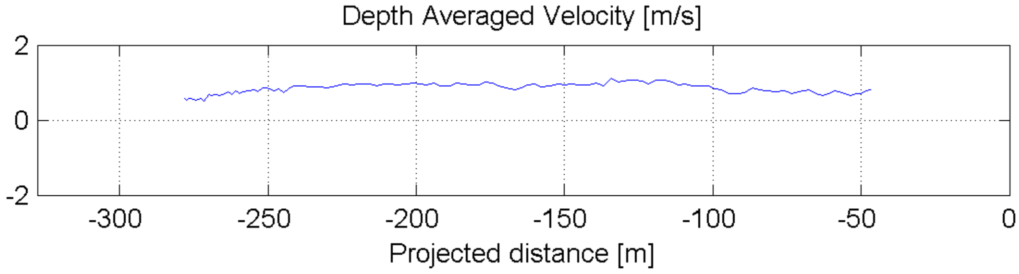
I/RA/11291/06.108/MSA

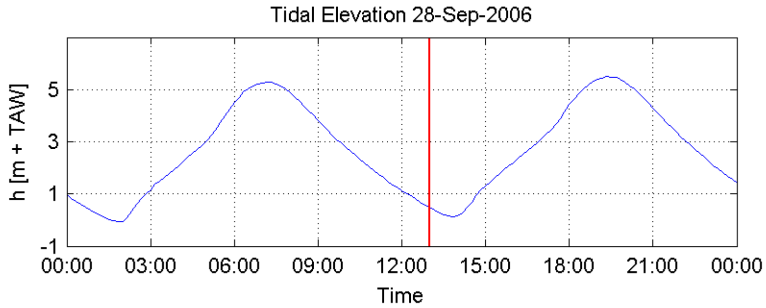
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7042S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

12:57 - 13:00

Time after HW [HH:MM]

5:48

Data Processed by:

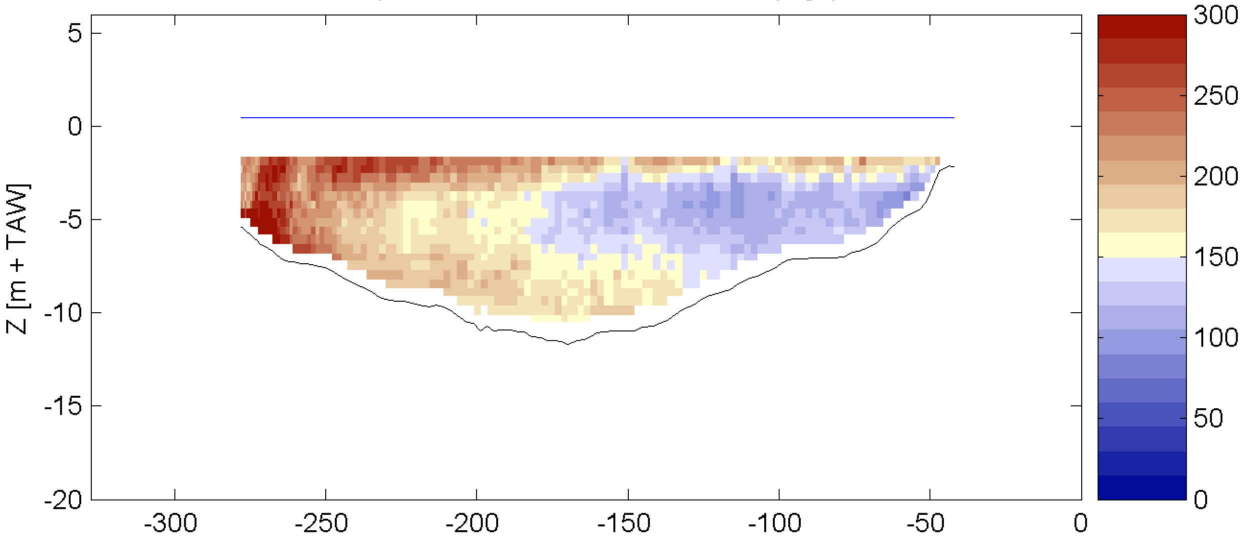
In association with :

I/RA/11291/06.108/MSA

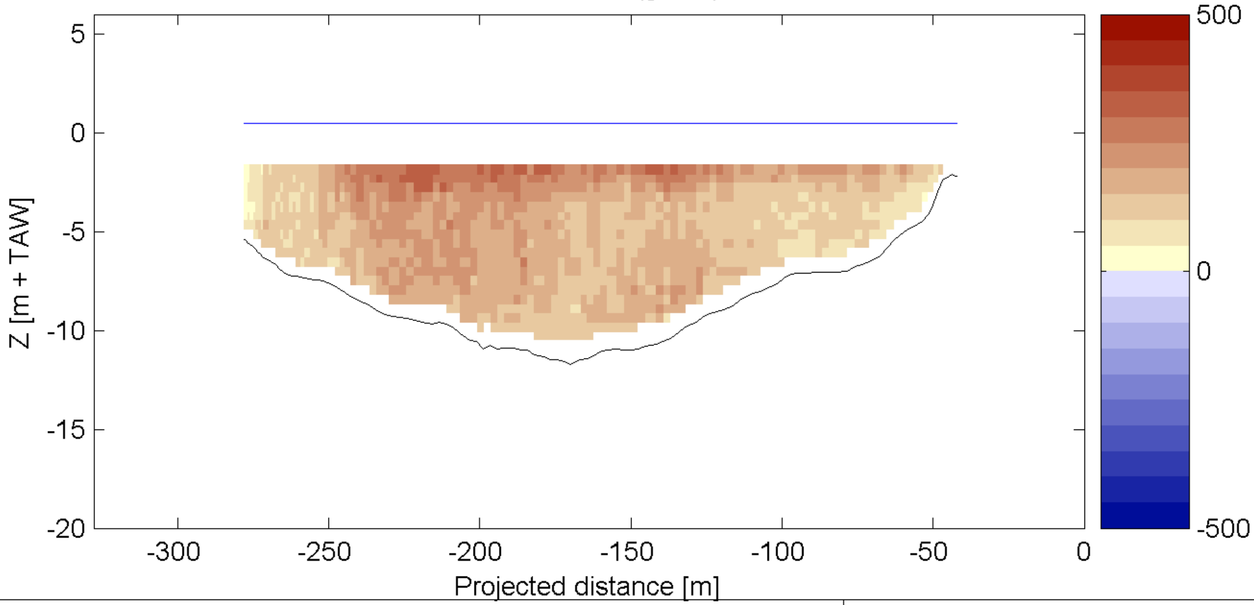
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7042S_sub.csv	Location: Transect S

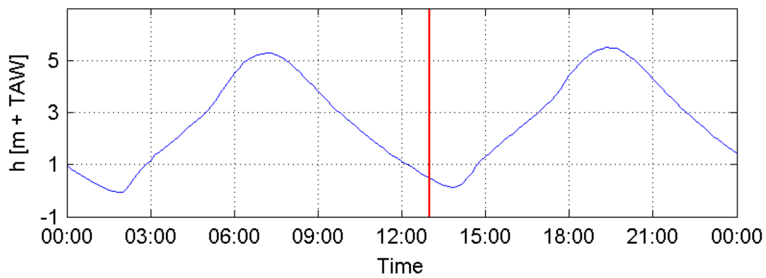
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
12:57 - 13:00

Time after HW [HH:MM]
5:48

Data Processed by:

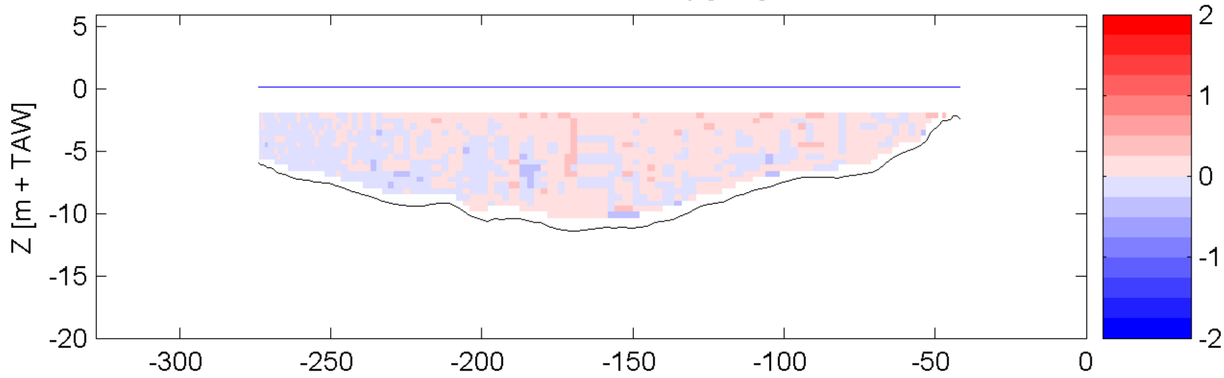
In association with :

I/RA/11291/06.108/MSA

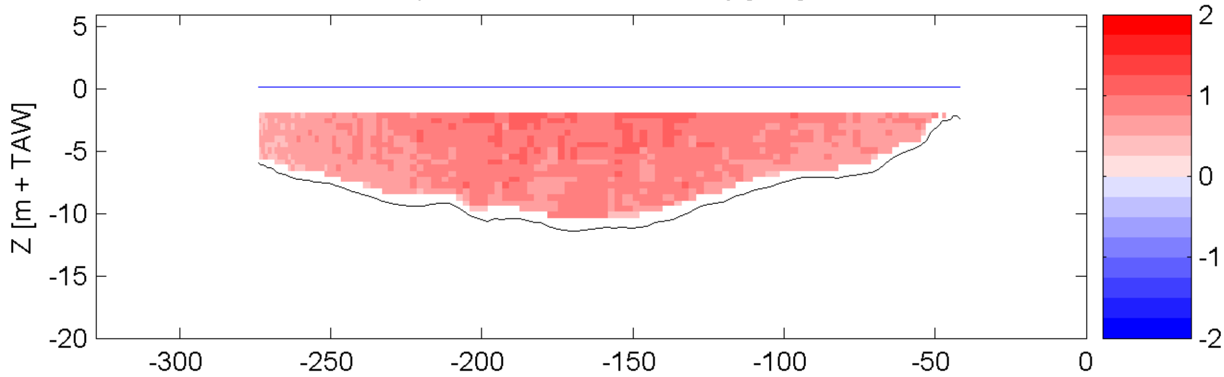
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7045S_sub.csv	Location: Transect S

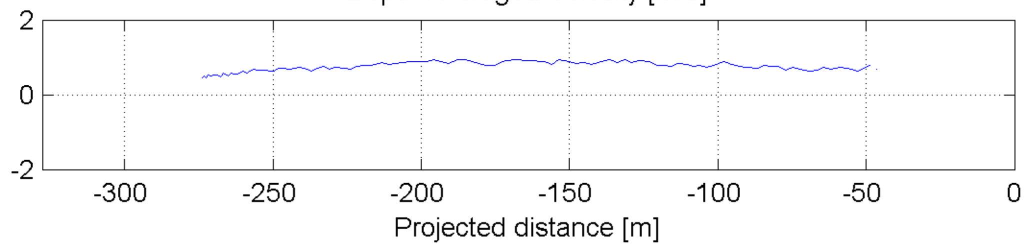
Parallel Current Velocity [m/s]



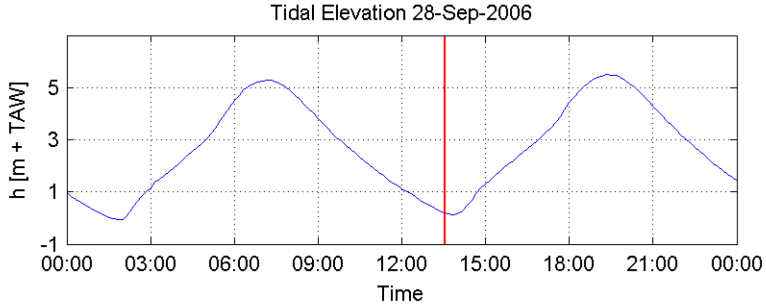
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006
13:30 - 13:32

Time after HW [HH:MM]

6:21

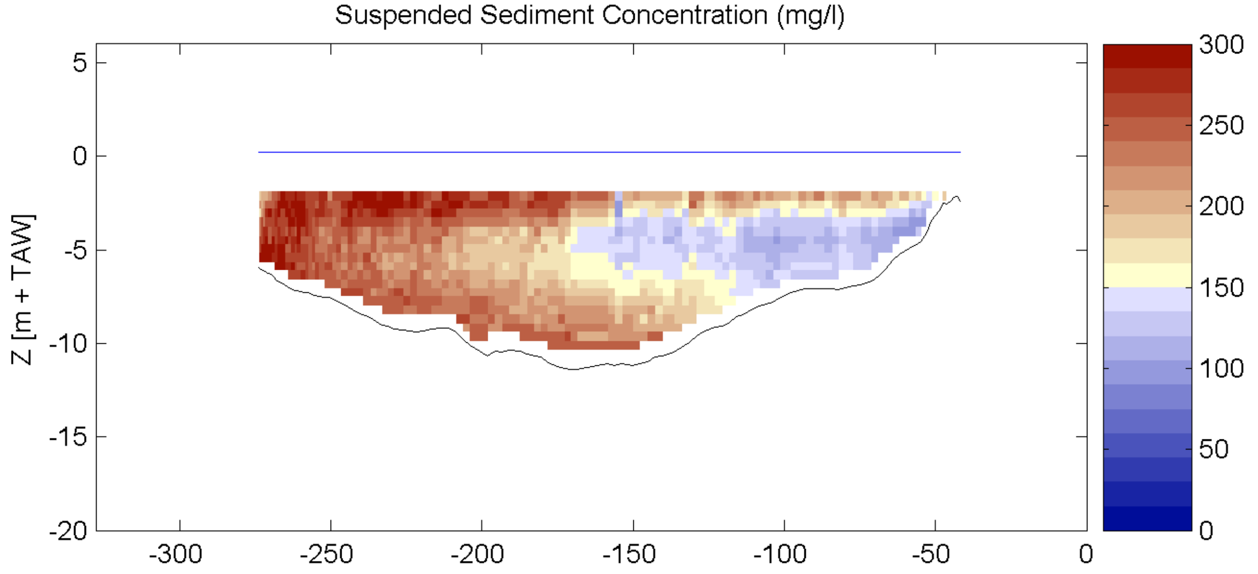
Data Processed by: IMDC

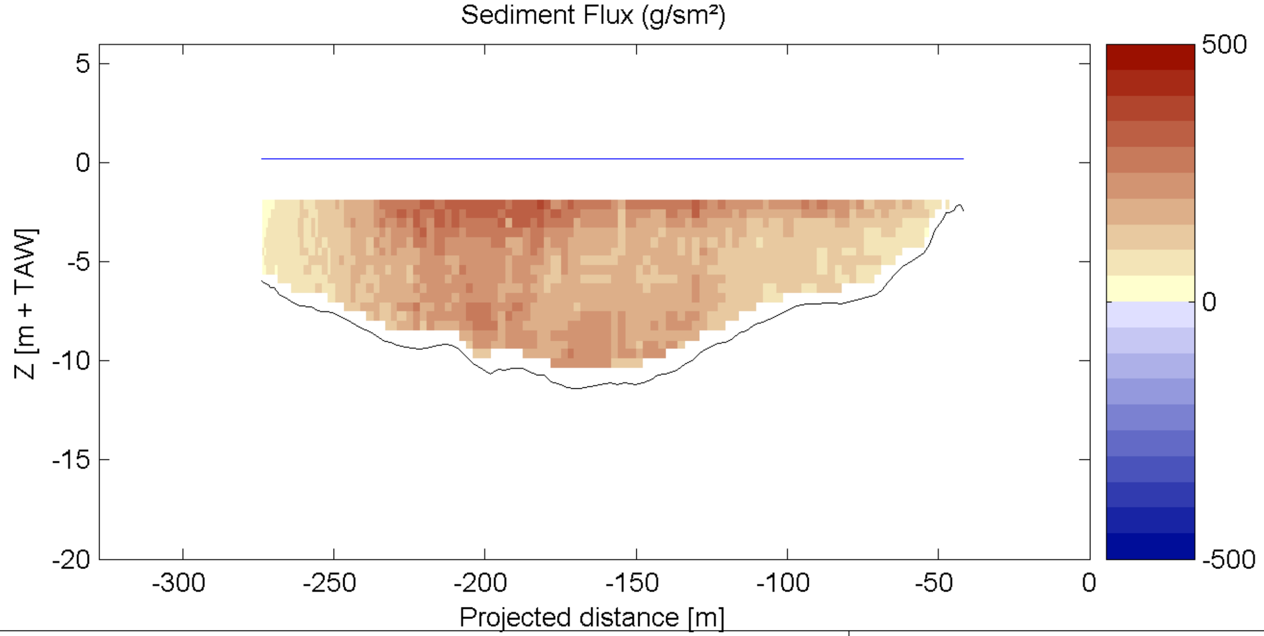
In association with : wl | delft hydraulics GEMS International

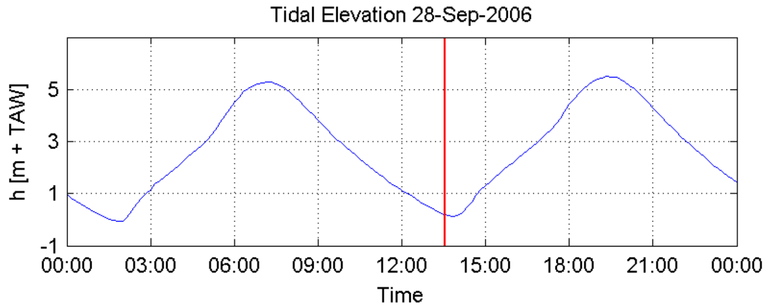
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7045S_sub.csv	Location: Transect S







HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

13:30 - 13:32

Time after HW [HH:MM]

6:21

Data Processed by: IMDC

In association with :

I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291

Equipment(s):

ADCP

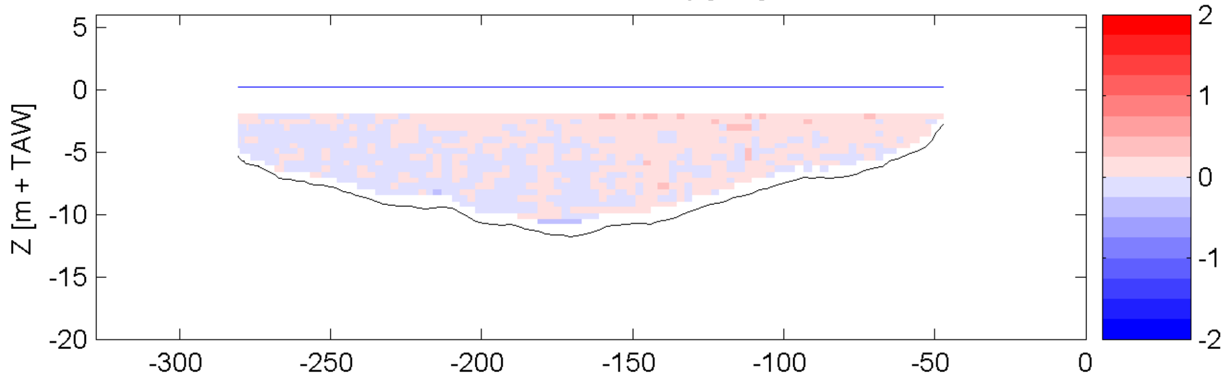
Sourcefile:

7048S_sub.csv

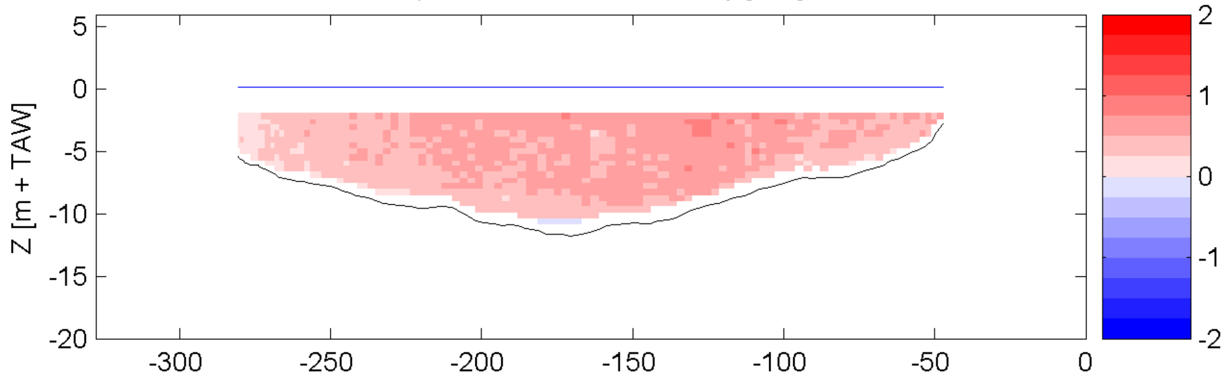
Location:

Transect S

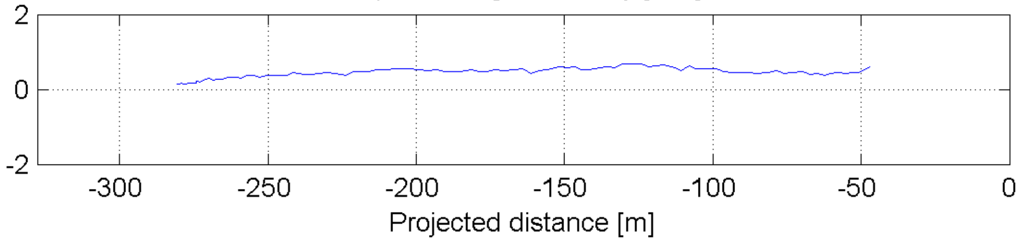
Parallel Current Velocity [m/s]



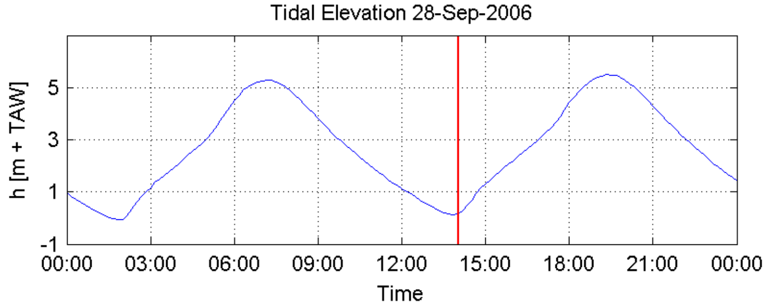
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

13:59 - 14:02

Time after HW [HH:MM]

-5:28

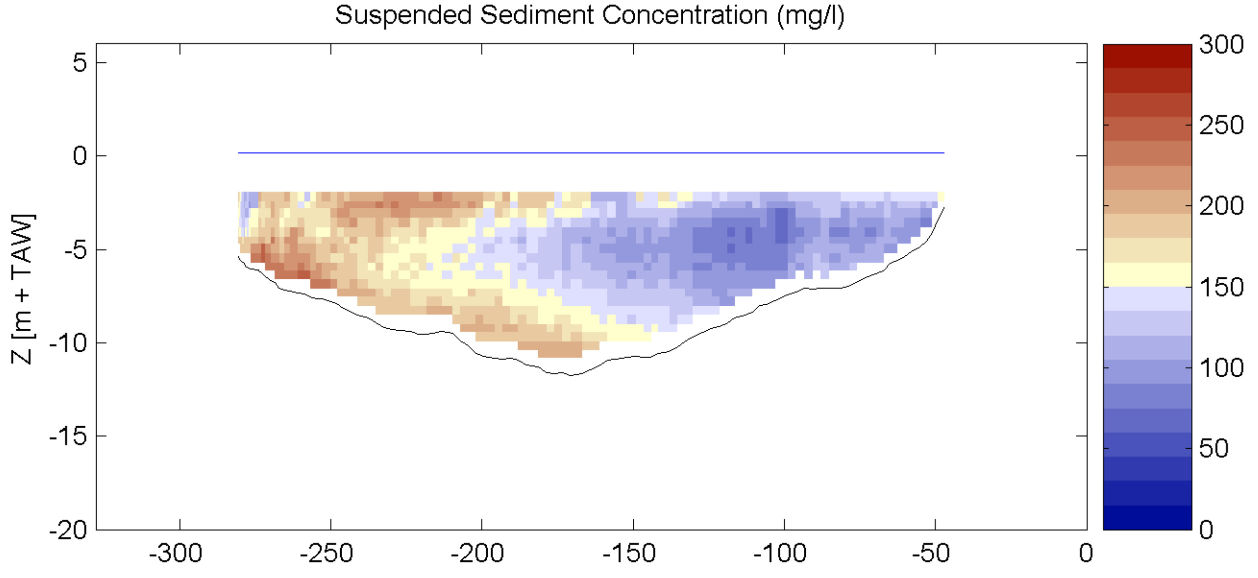
Data Processed by:

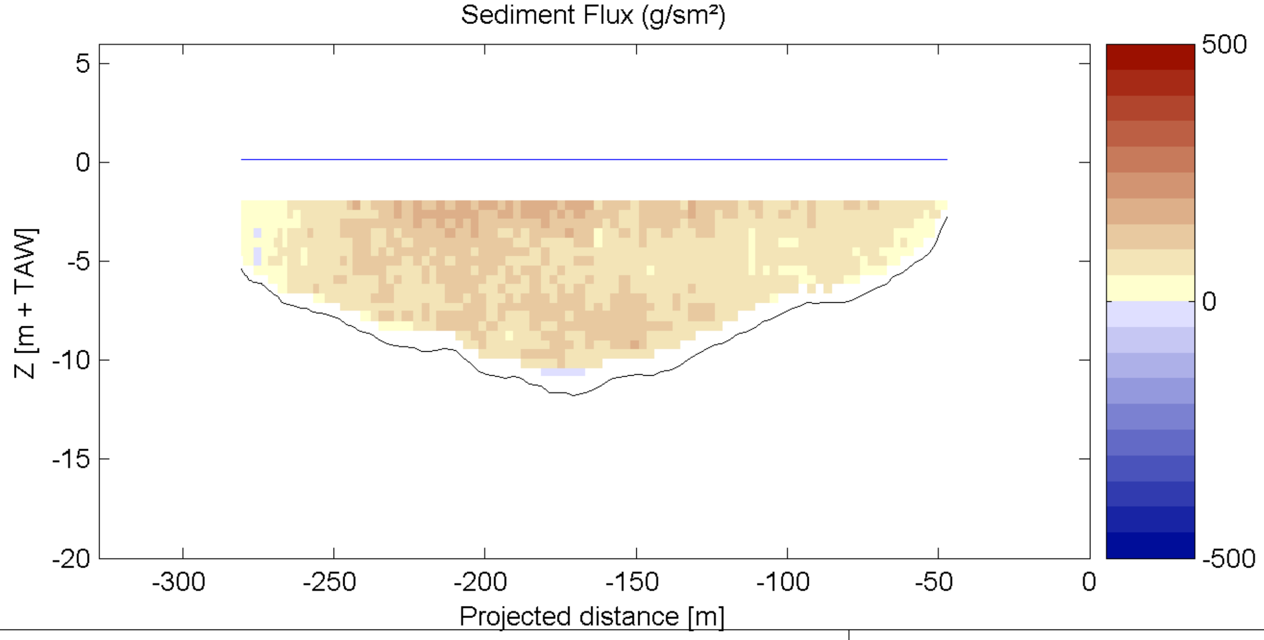
In association with :

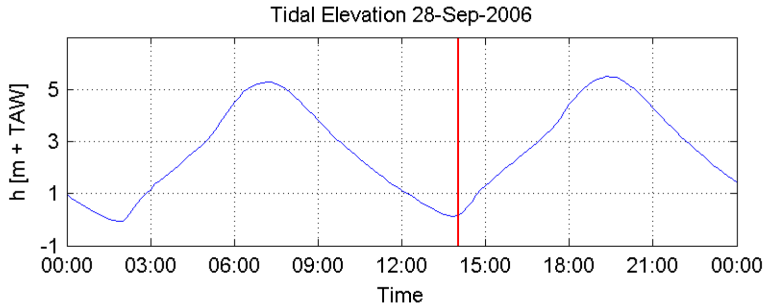
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7048S_sub.csv	Location: Transect S







HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
13:59 - 14:02

Time after HW [HH:MM]
-5:28

Data Processed by: IMDC

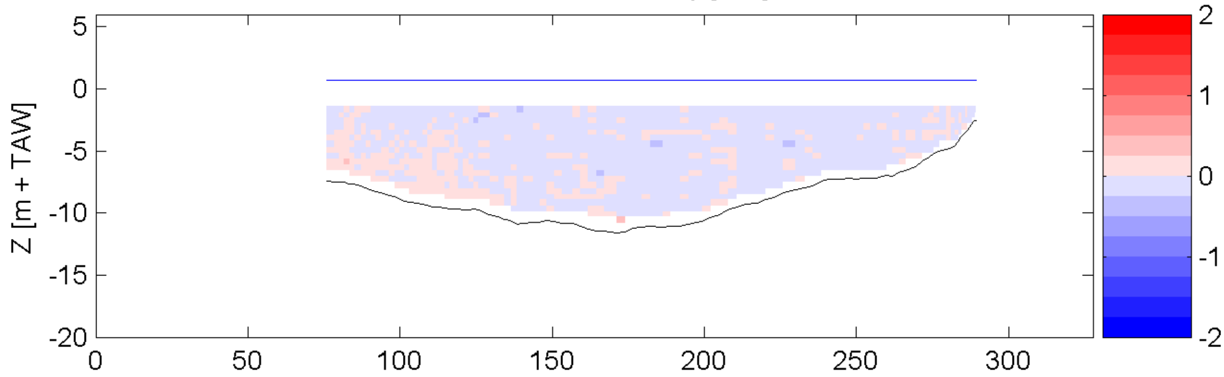
In association with :

I/RA/11291/06.108/MSA

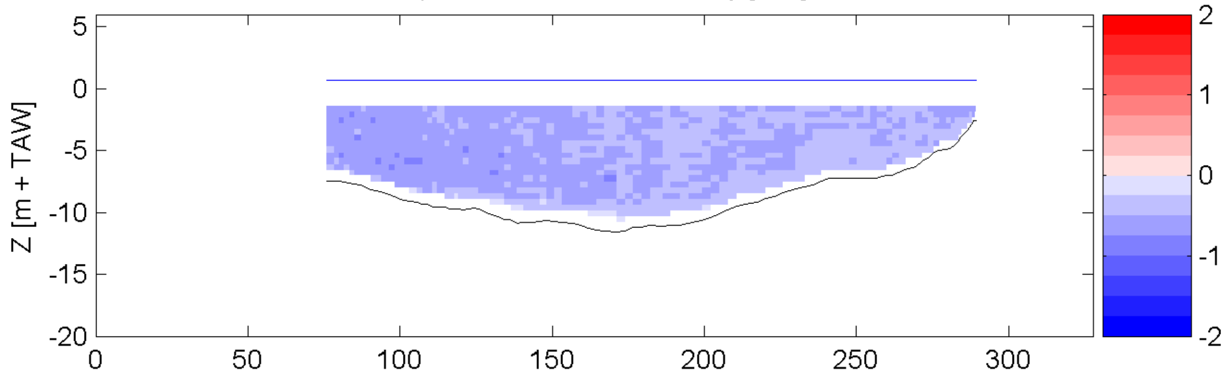
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7051S_sub.csv	Location: Transect S

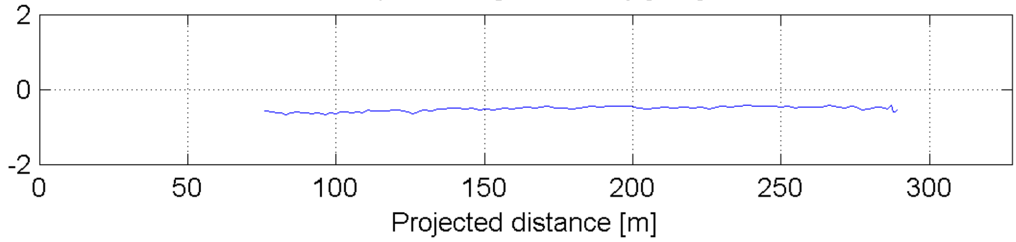
Parallel Current Velocity [m/s]



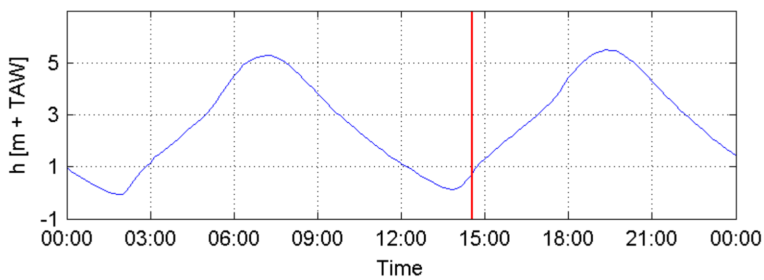
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

14:30 - 14:32

Time after HW [HH:MM]

-4:58

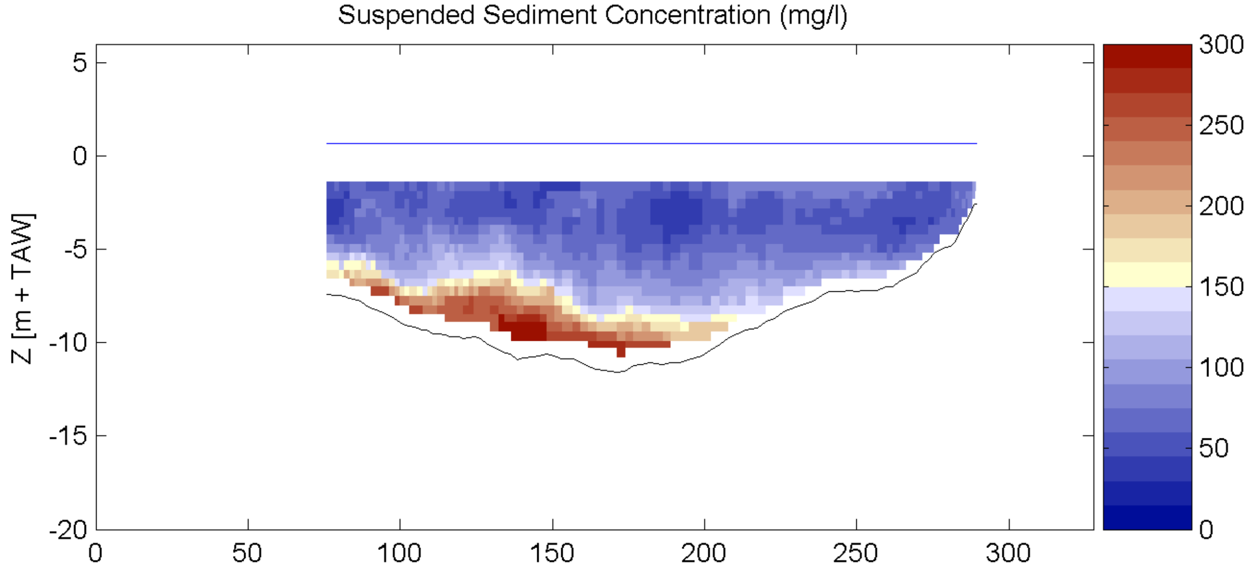
Data Processed by:

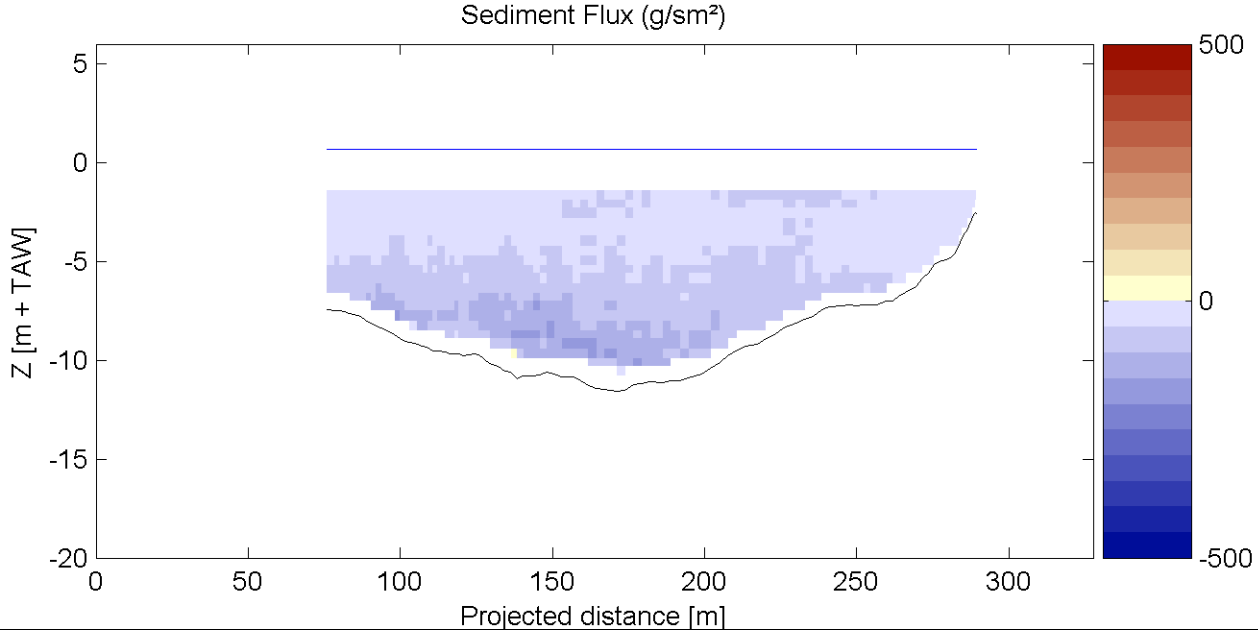
In association with :

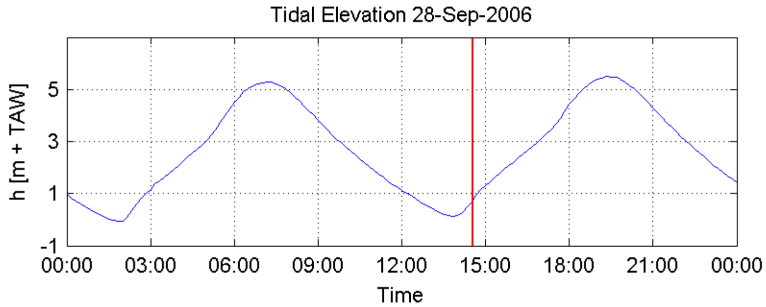
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7051S_sub.csv	Location: Transect S







HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
14:30 - 14:32

Time after HW [HH:MM]
-4:58

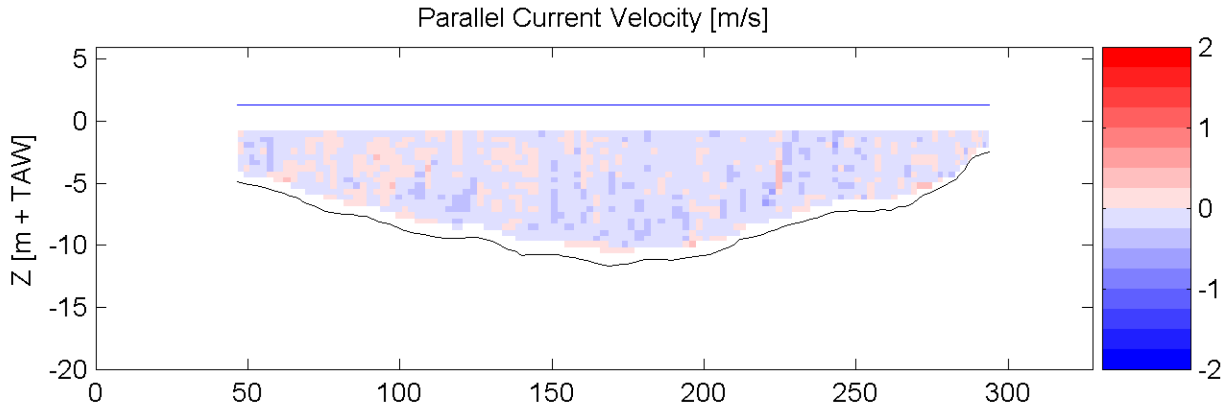
Data Processed by:

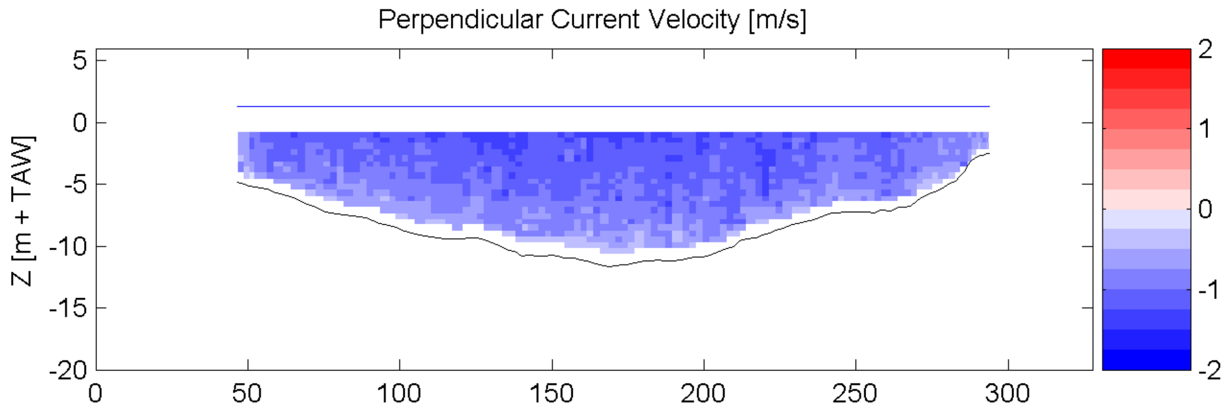
In association with :

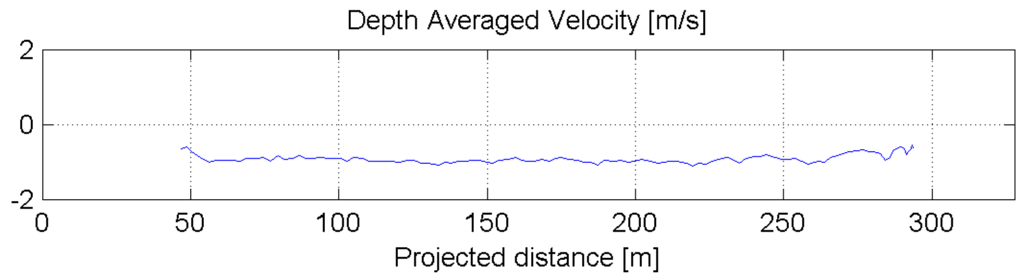
I/RA/11291/06.108/MSA

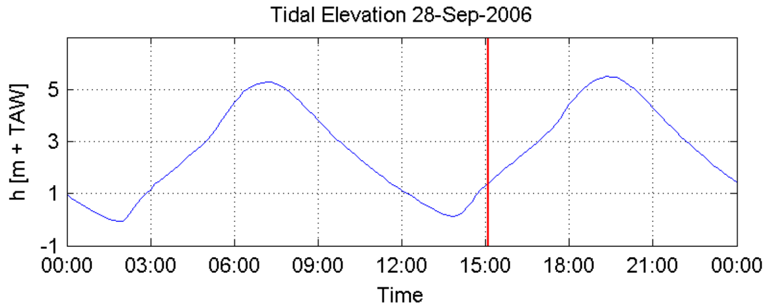
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7054S_sub.csv	Location: Transect S









HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

15:03 - 15:05

Time after HW [HH:MM]

-4:25

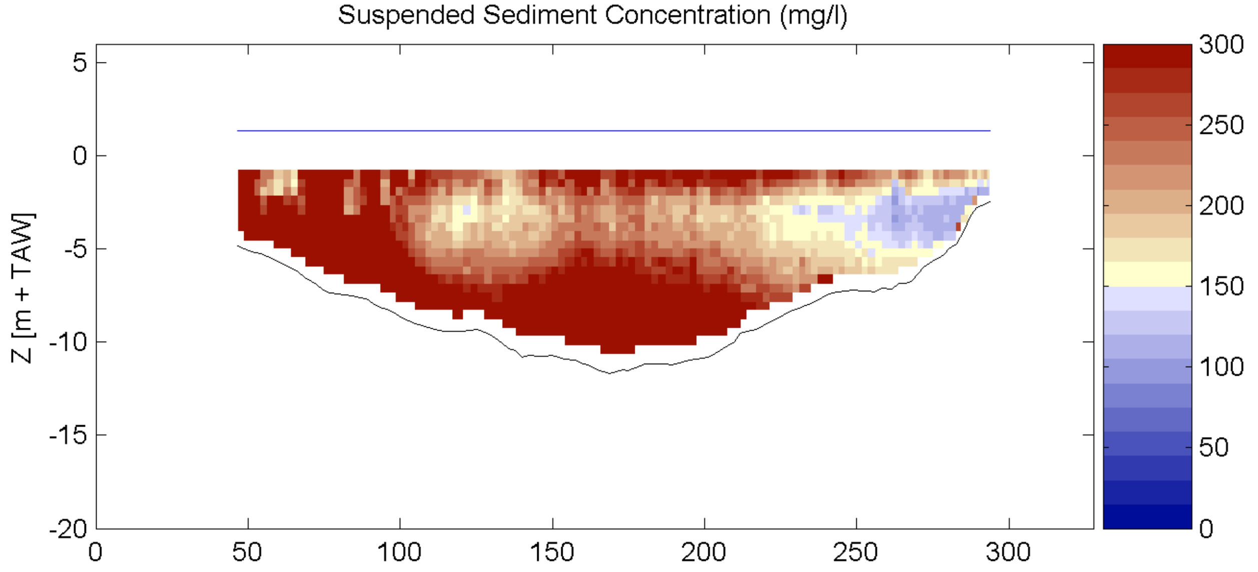
Data Processed by:

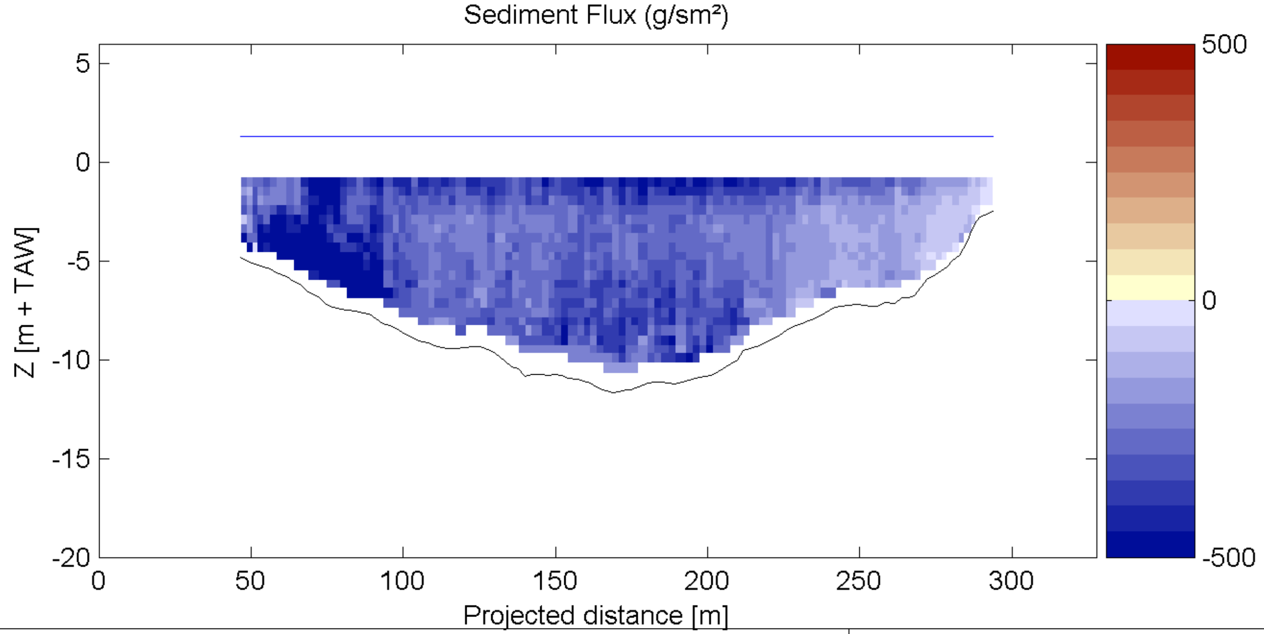
In association with :

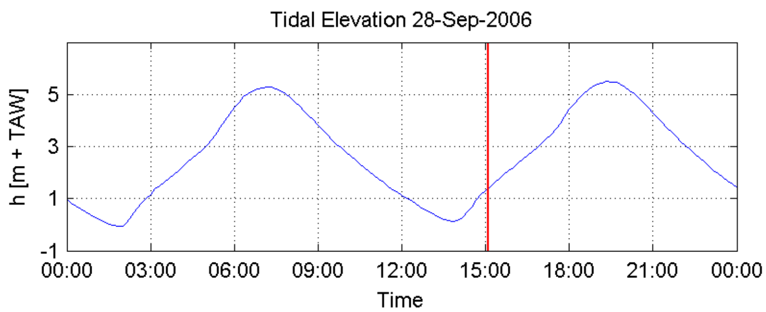
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7054S_sub.csv	Location: Transect S







HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

15:03 - 15:05

Time after HW [HH:MM]

-4:25

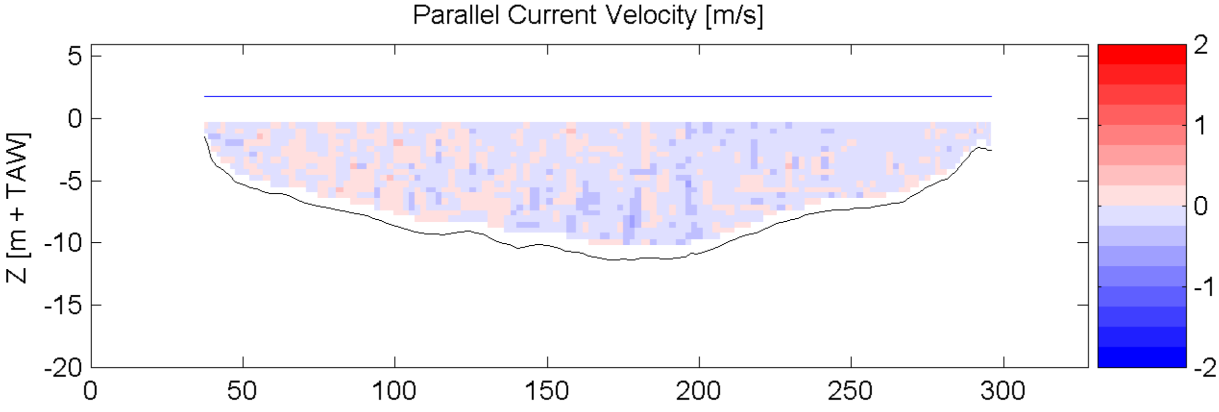
Data Processed by:

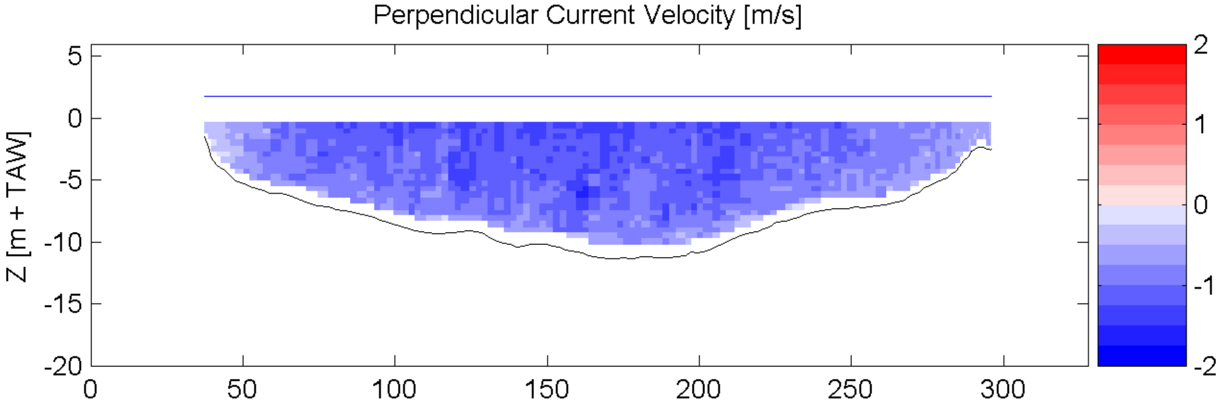
In association with :

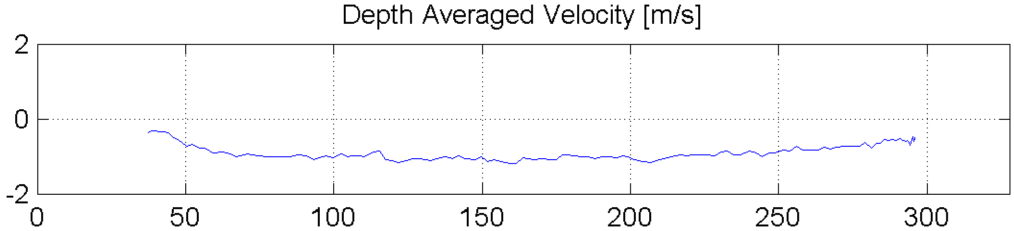
I/RA/11291/06.108/MSA

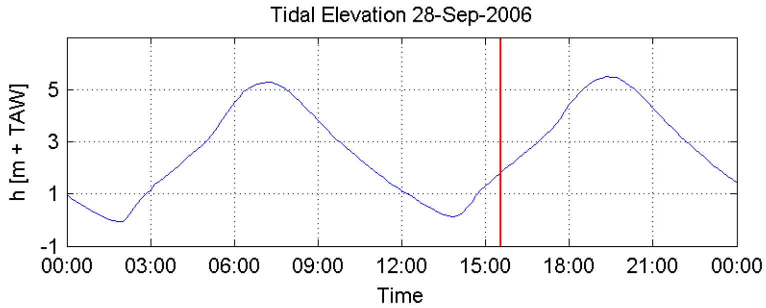
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7057S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

15:30 - 15:33

Time after HW [HH:MM]

-3:57

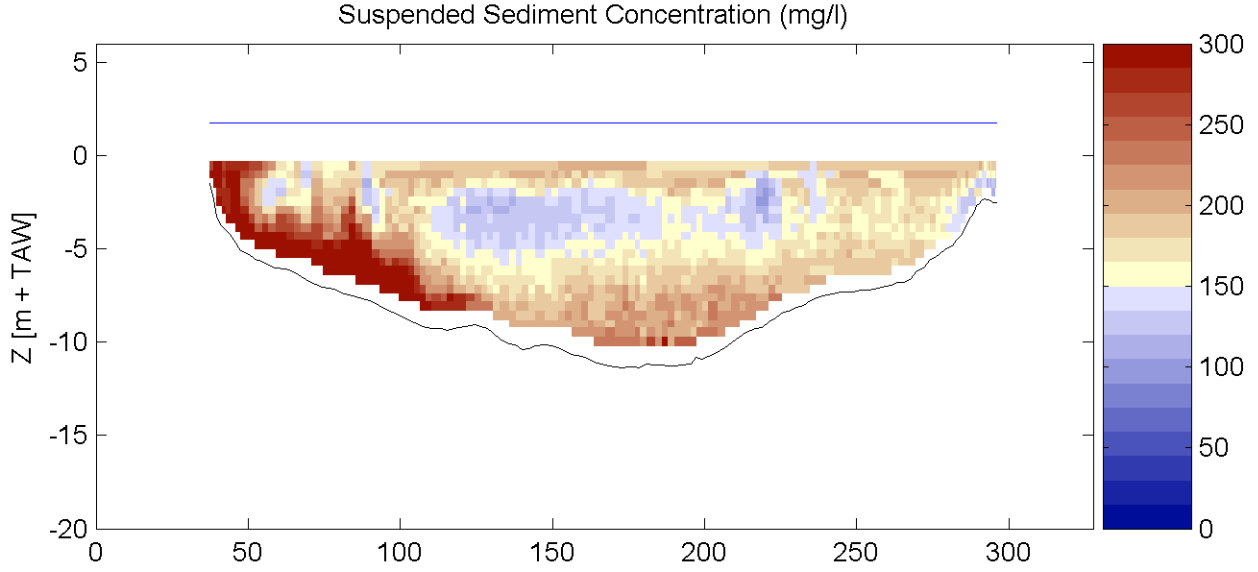
Data Processed by:

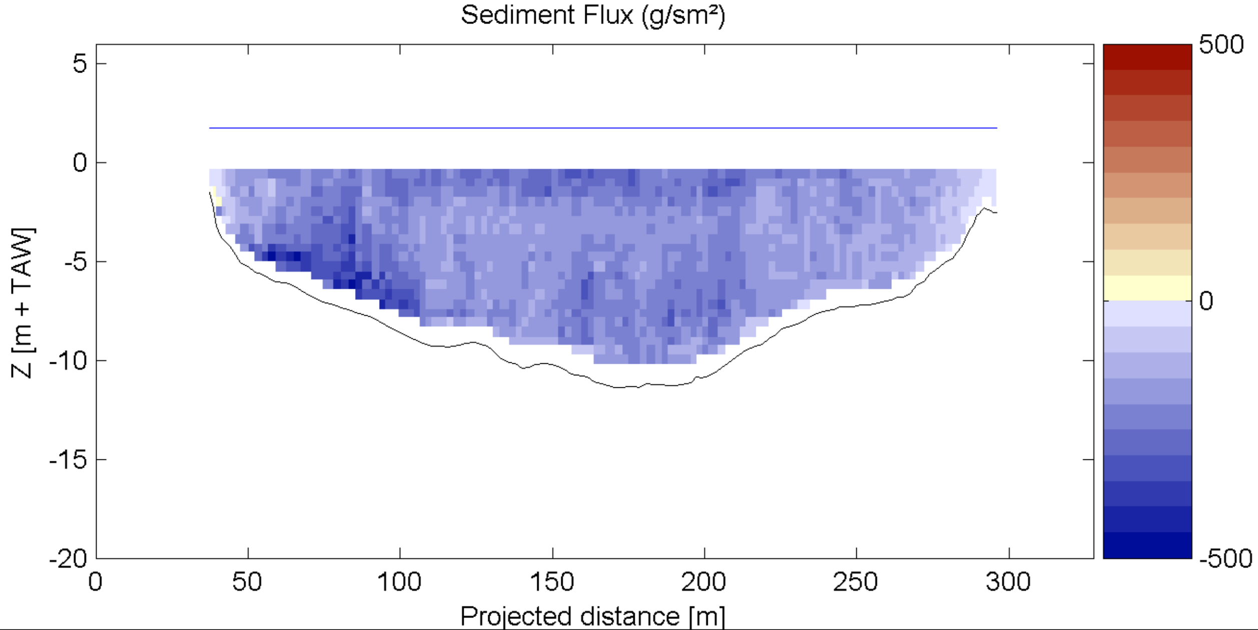
In association with :

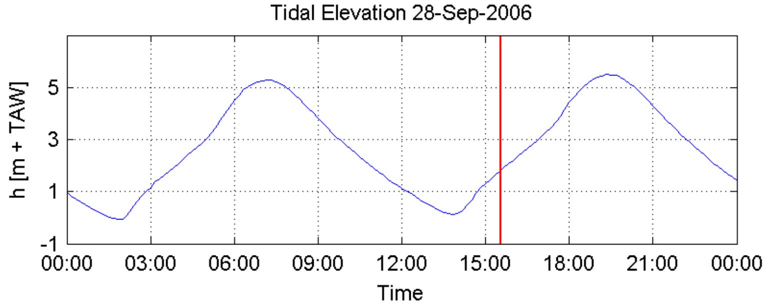
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7057S_sub.csv	Location: Transect S







HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
15:30 - 15:33

Time after HW [HH:MM]
-3:57

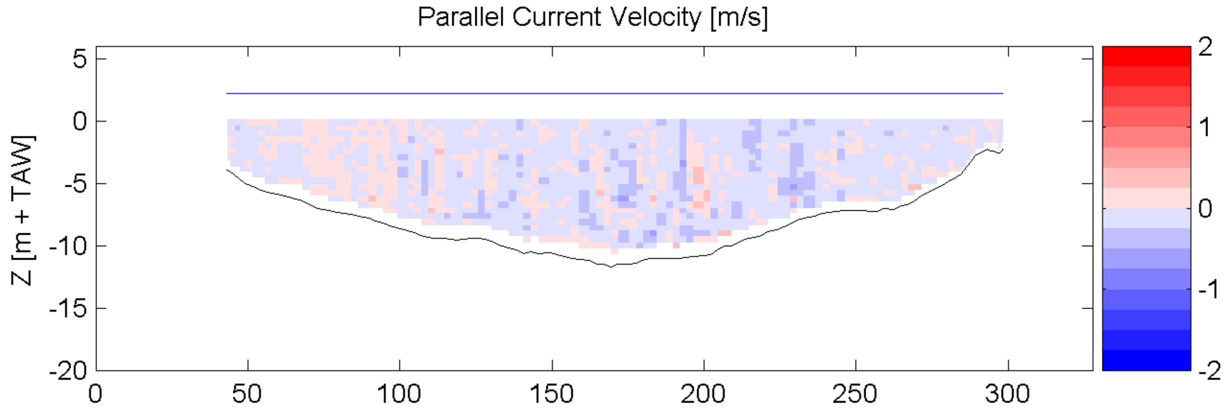
Data Processed by: IMDC

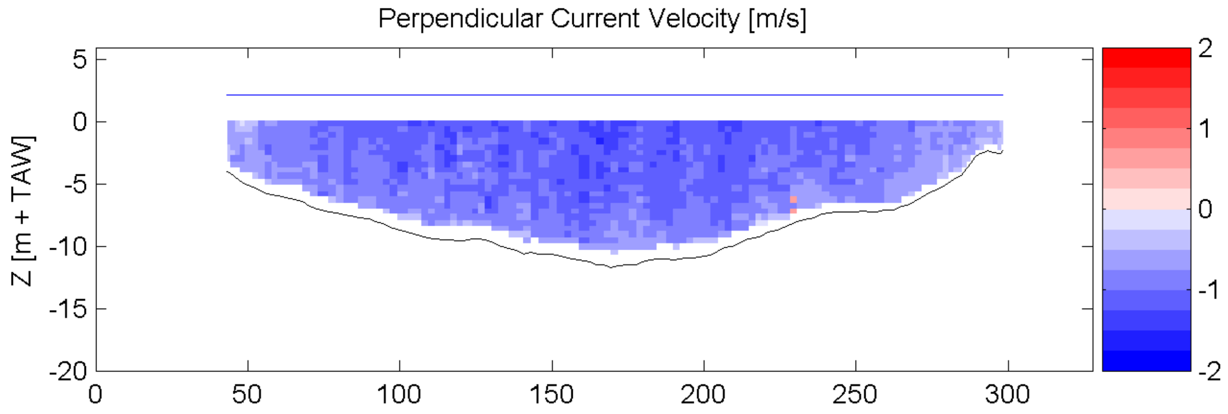
In association with :

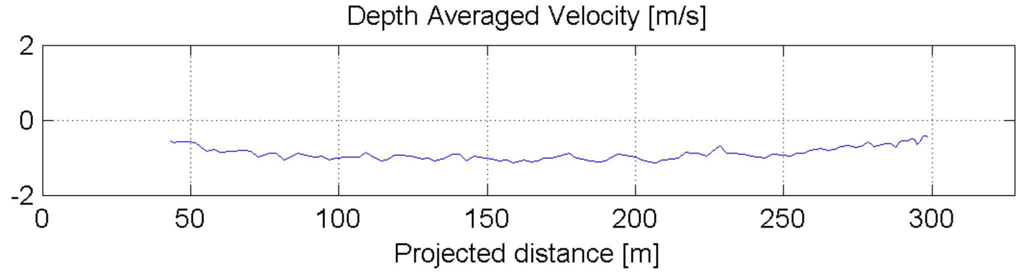
I/RA/11291/06.108/MSA

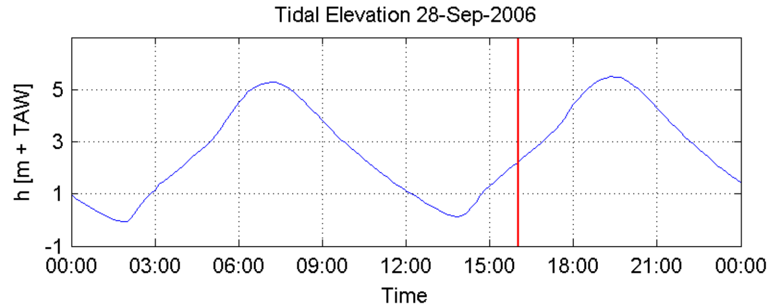
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7060S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
15:59 - 16:02

Time after HW [HH:MM]
-3:29

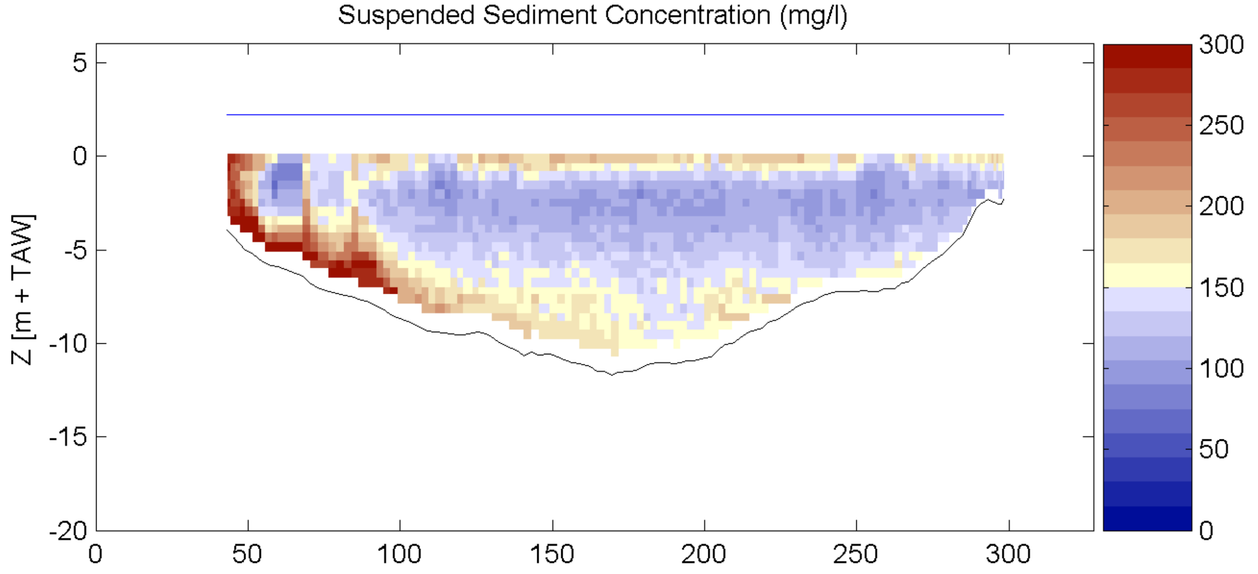
Data Processed by: IMDC

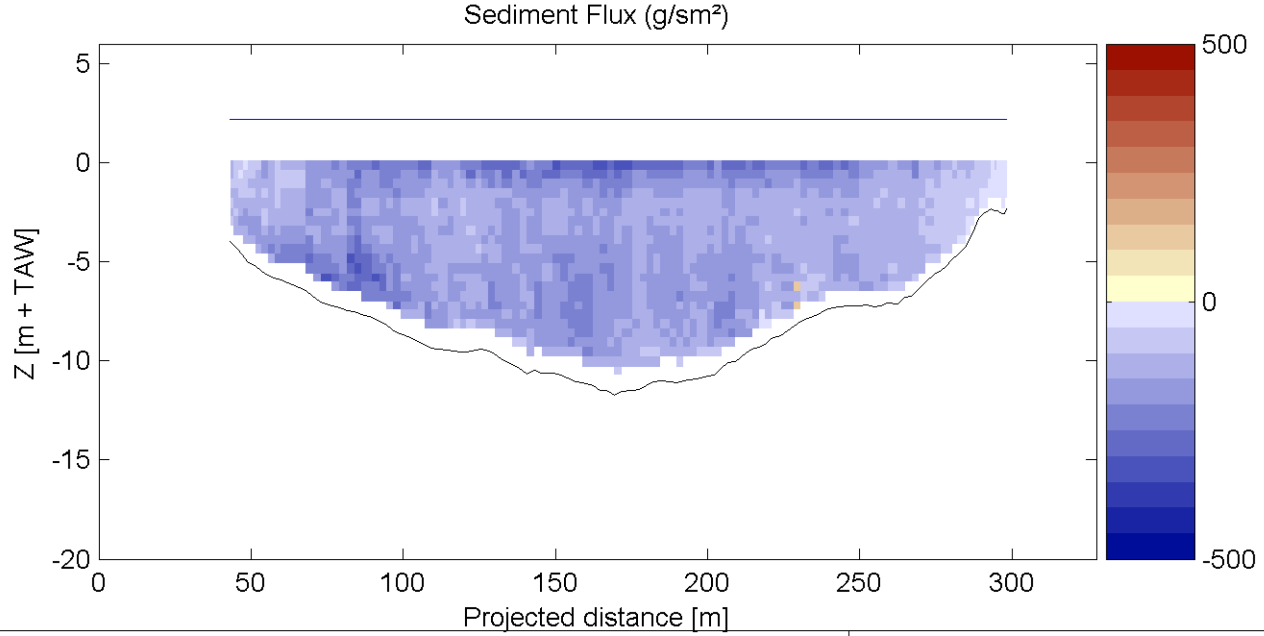
In association with :

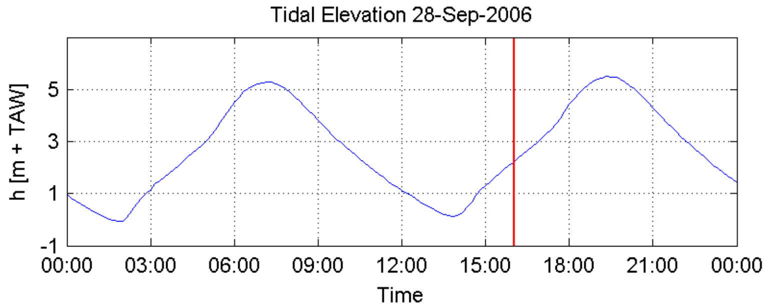
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7060S_sub.csv	Location: Transect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

15:59 - 16:02

Time after HW [HH:MM]

-3:29

Data Processed by:

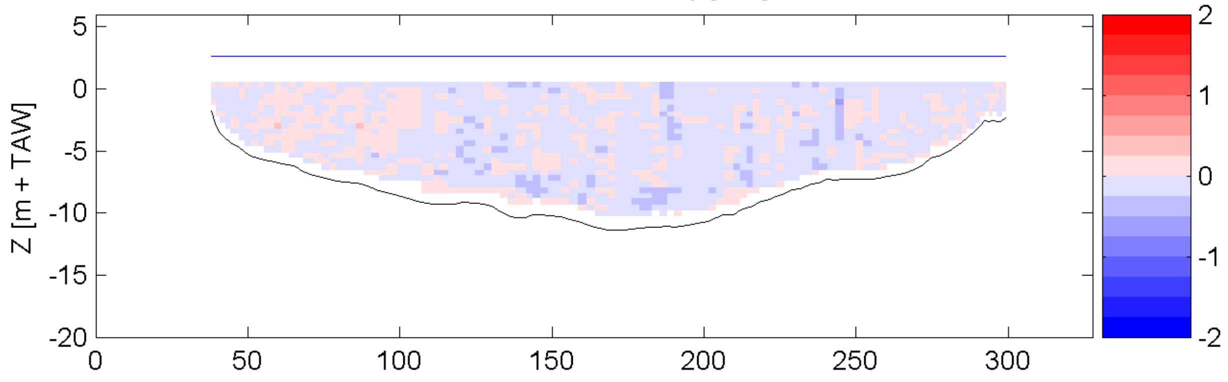
In association with :

I/RA/11291/06.108/MSA

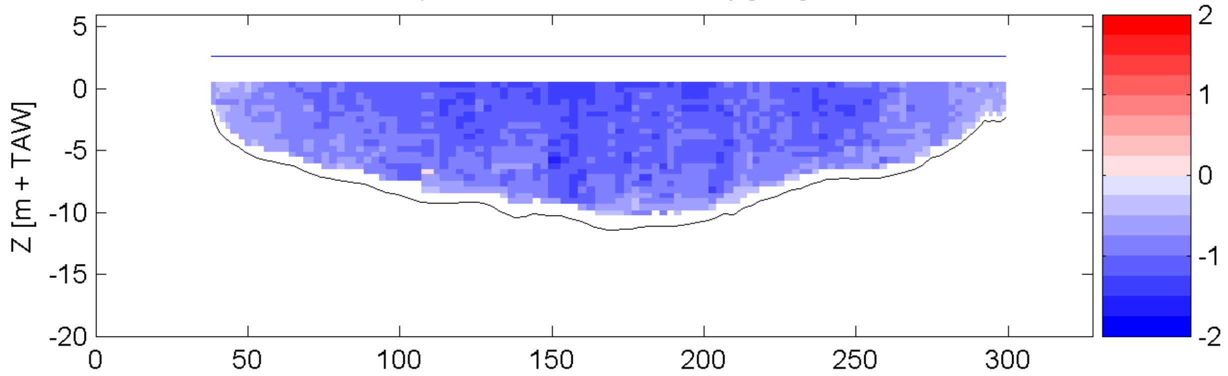
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7063S_sub.csv	Location: Transect S

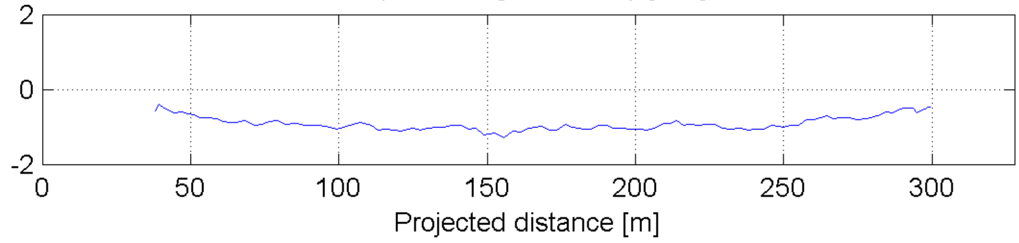
Parallel Current Velocity [m/s]



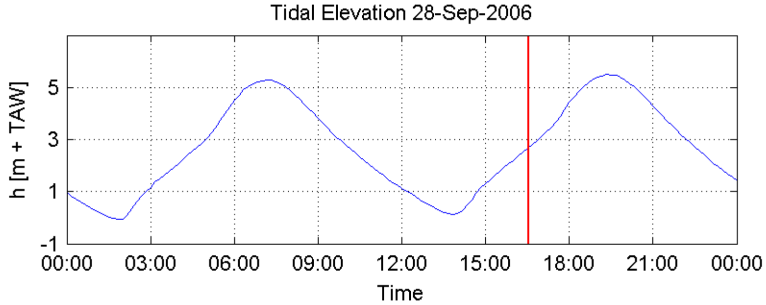
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

16:30 - 16:32

Time after HW [HH:MM]

-2:58

Data Processed by: IMDC

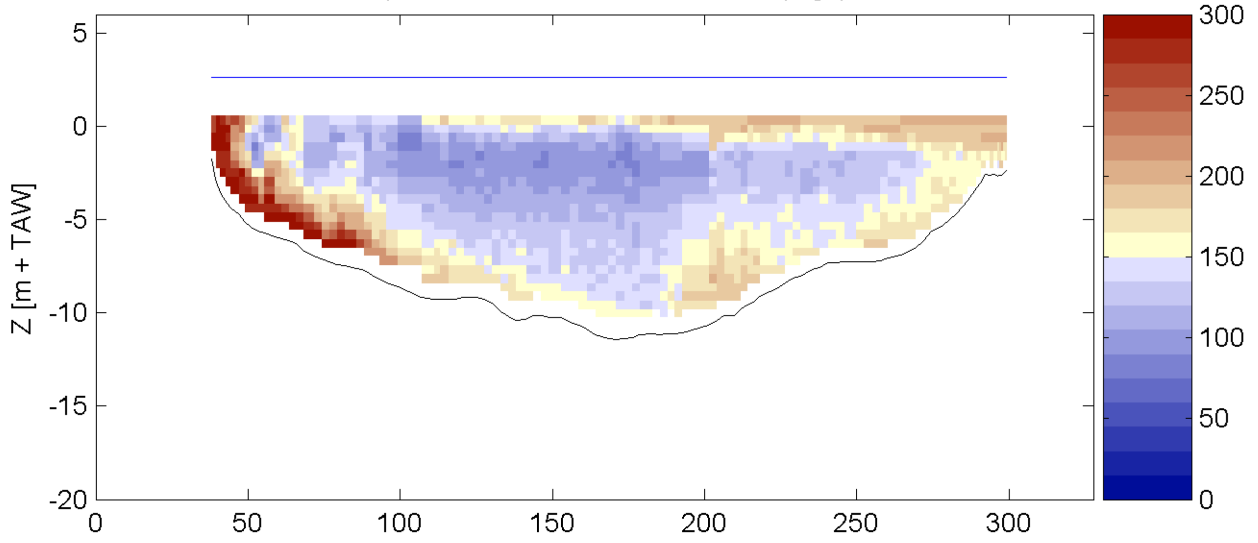
In association with : wl | delft hydraulics, GEMS International

I/RA/11291/06.108/MSA

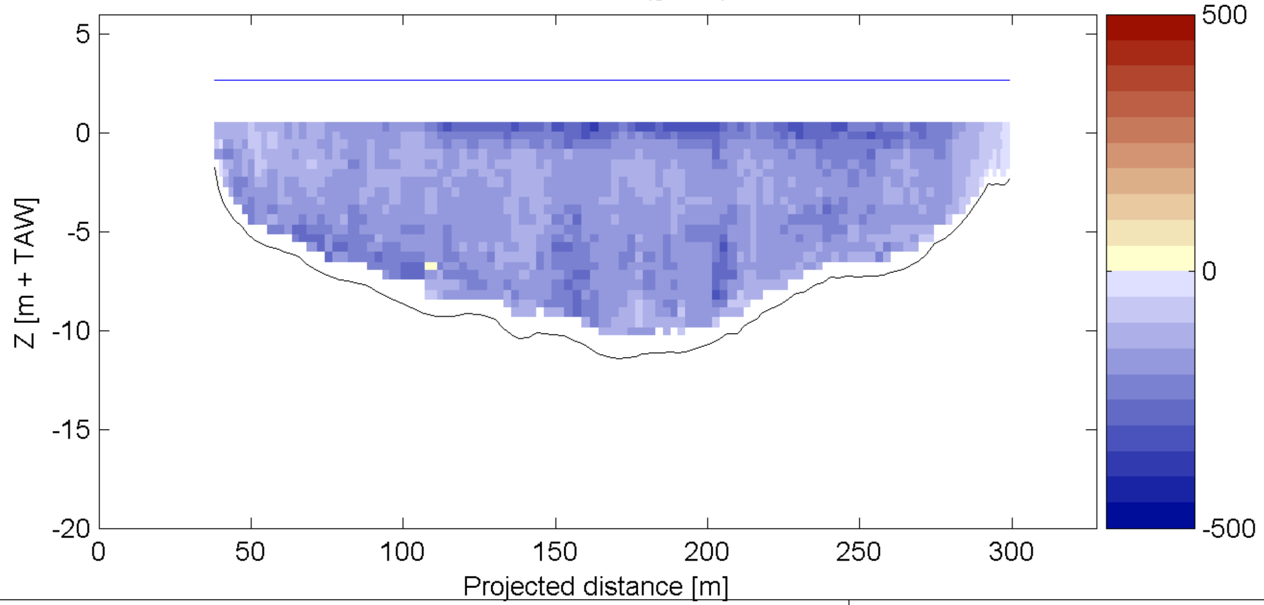
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7063S_sub.csv	Location: Transect S

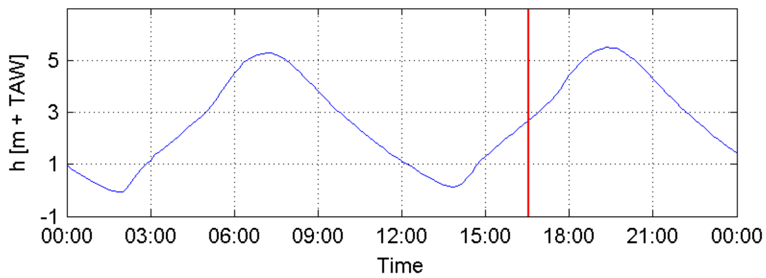
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

16:30 - 16:32

Time after HW [HH:MM]

-2:58

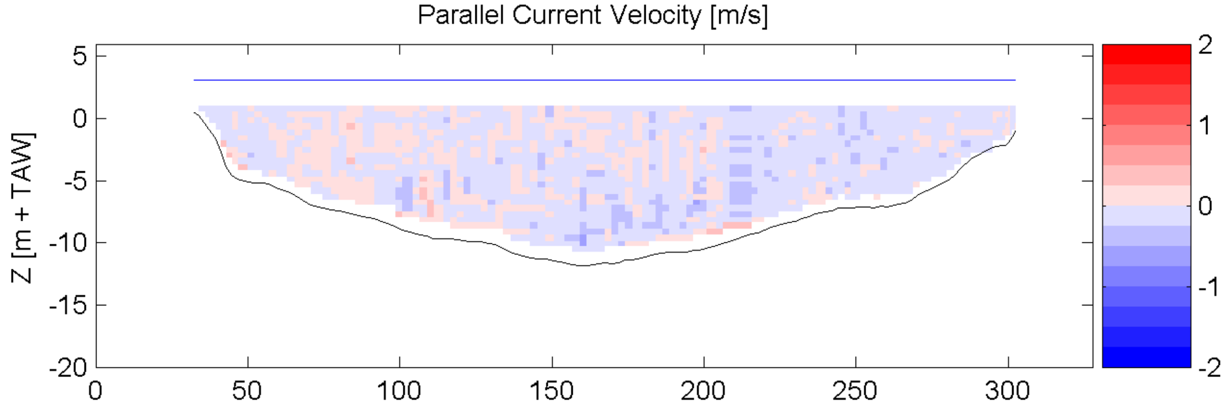
Data Processed by:

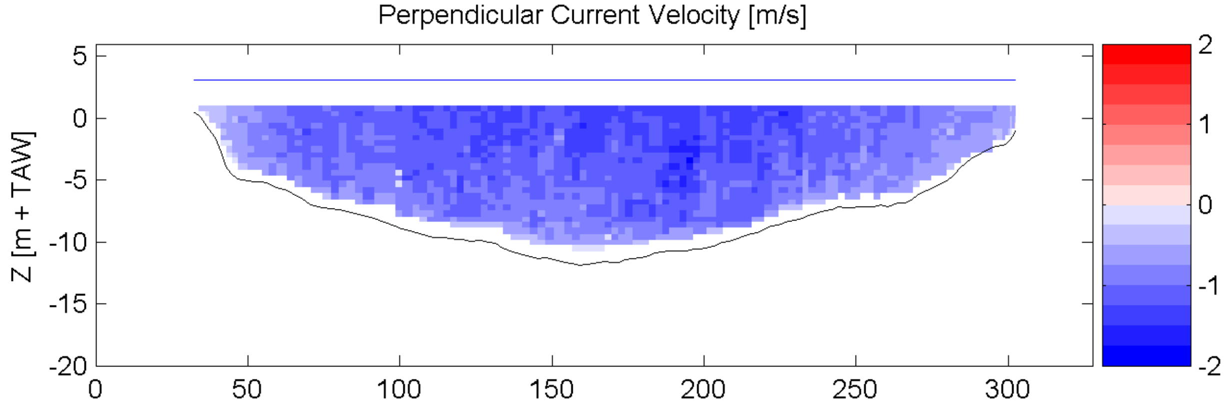
In association with :

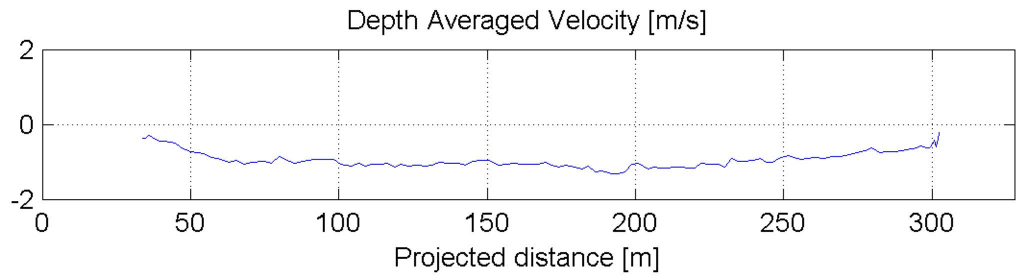
I/RA/11291/06.108/MSA

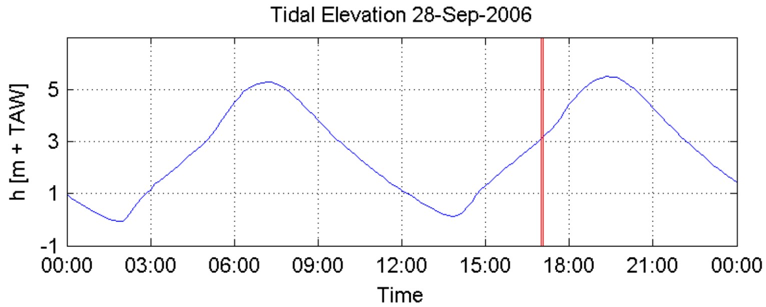
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7066S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
17:00 - 17:02

Time after HW [HH:MM]
-2:28

Data Processed by: IMDC

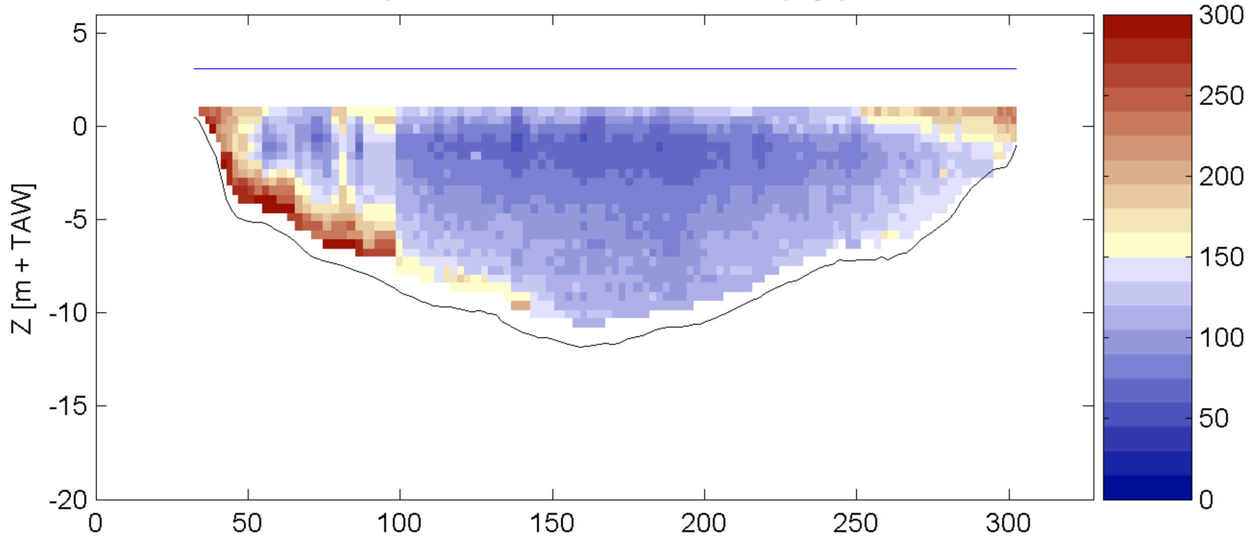
In association with :

I/RA/11291/06.108/MSA

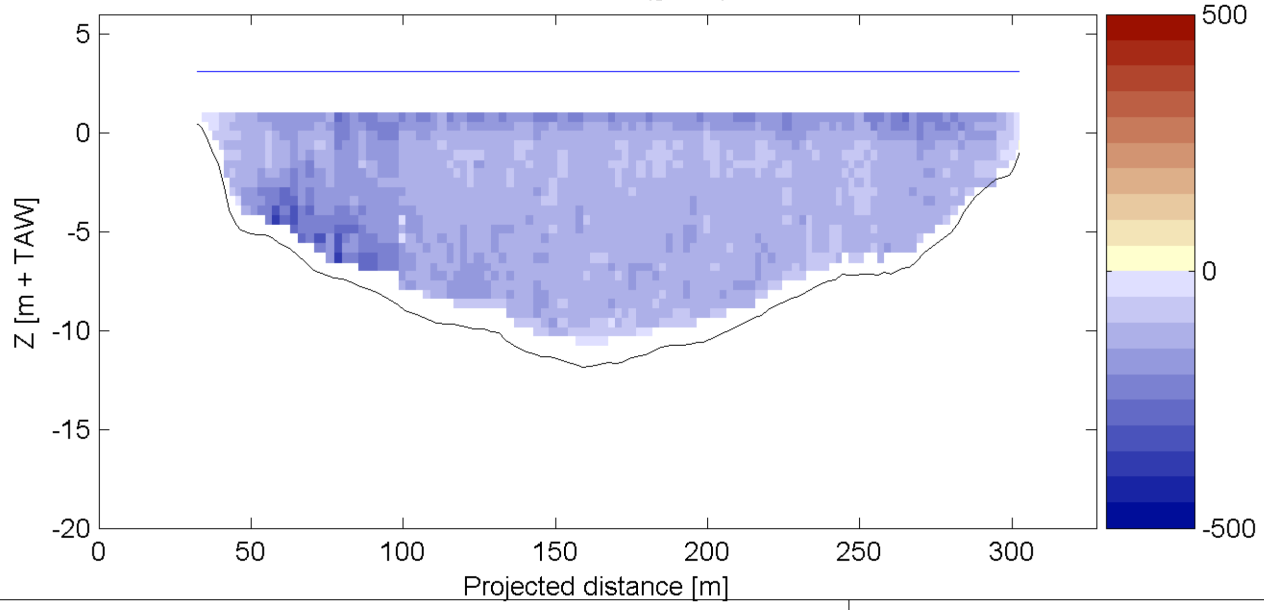
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7066S_sub.csv	Location: Transect S

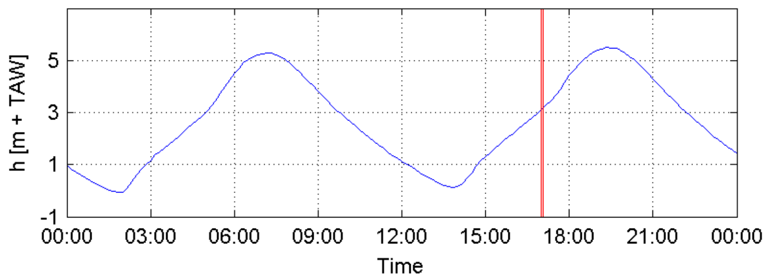
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

17:00 - 17:02

Time after HW [HH:MM]

-2:28

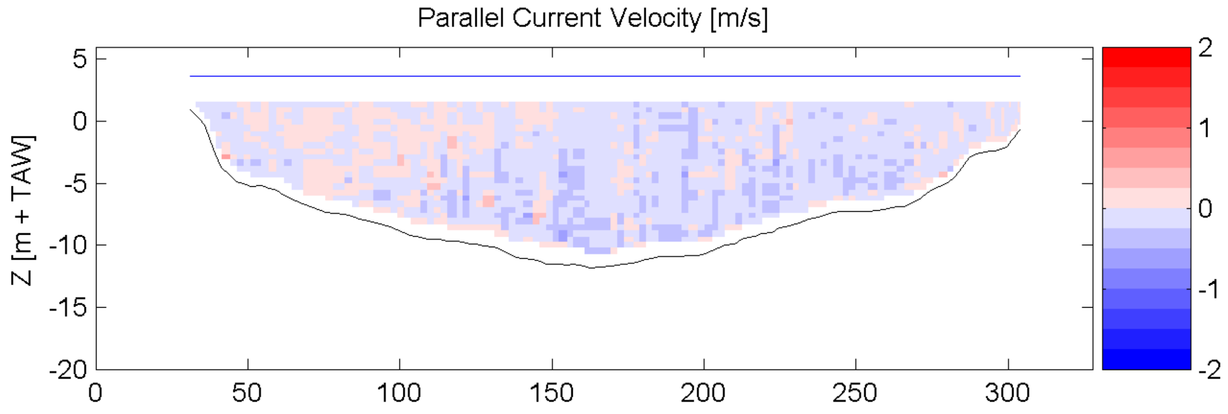
Data Processed by:

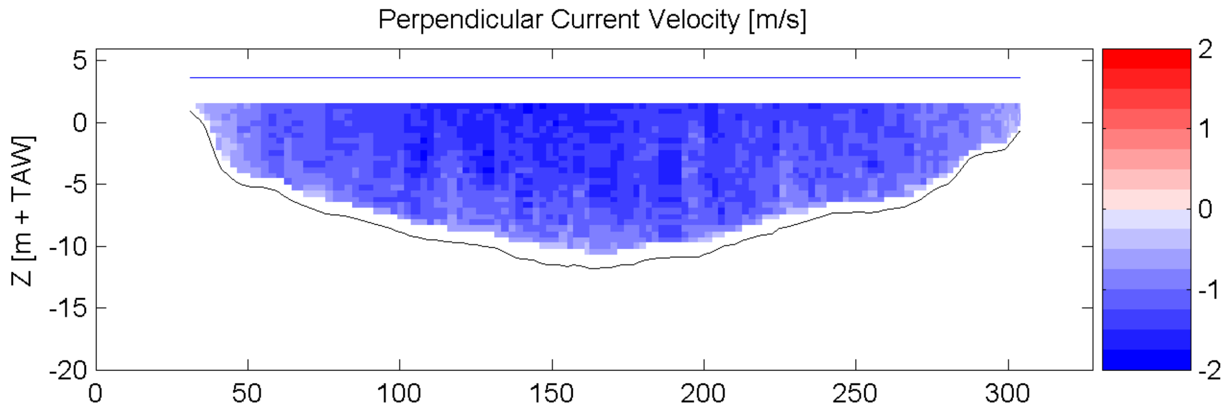
In association with :

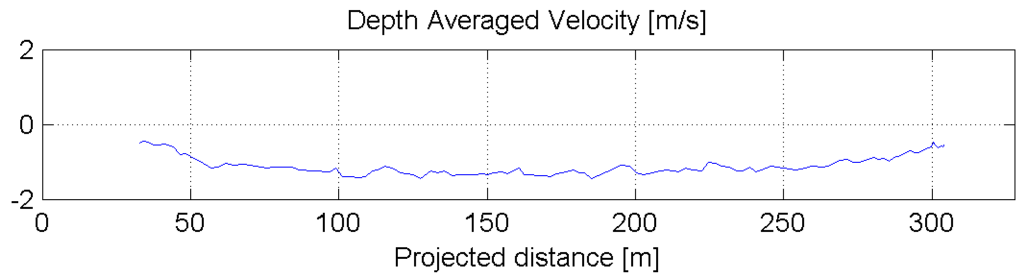
I/RA/11291/06.108/MSA

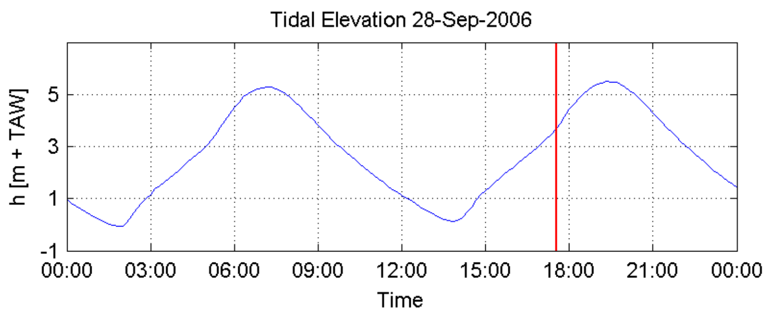
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7069S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

17:30 - 17:32

Time after HW [HH:MM]

-1:58

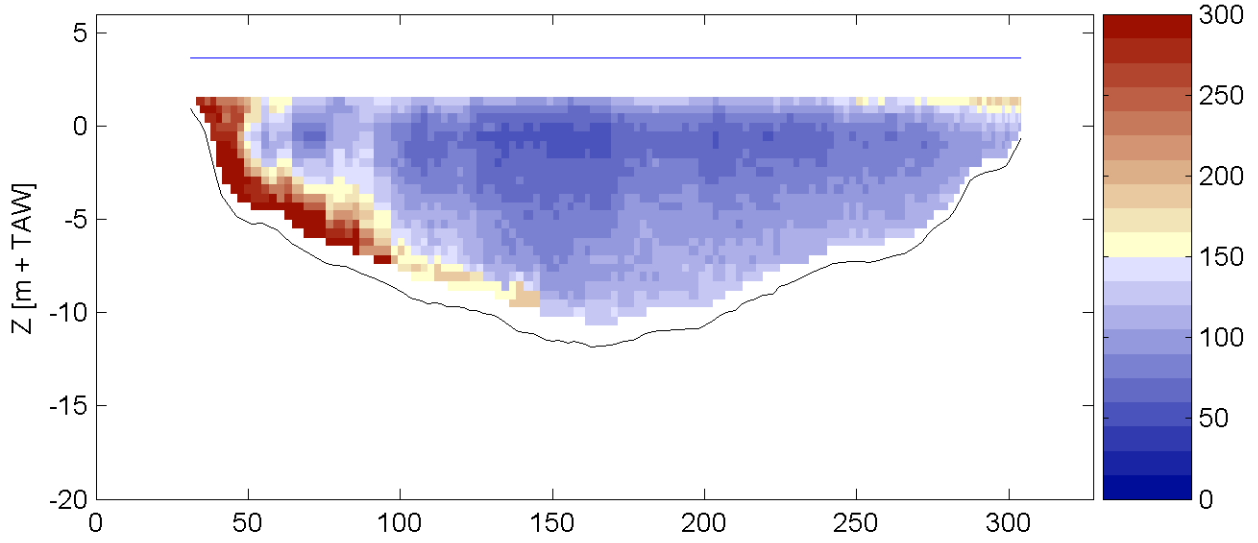
Data Processed by: IMDC

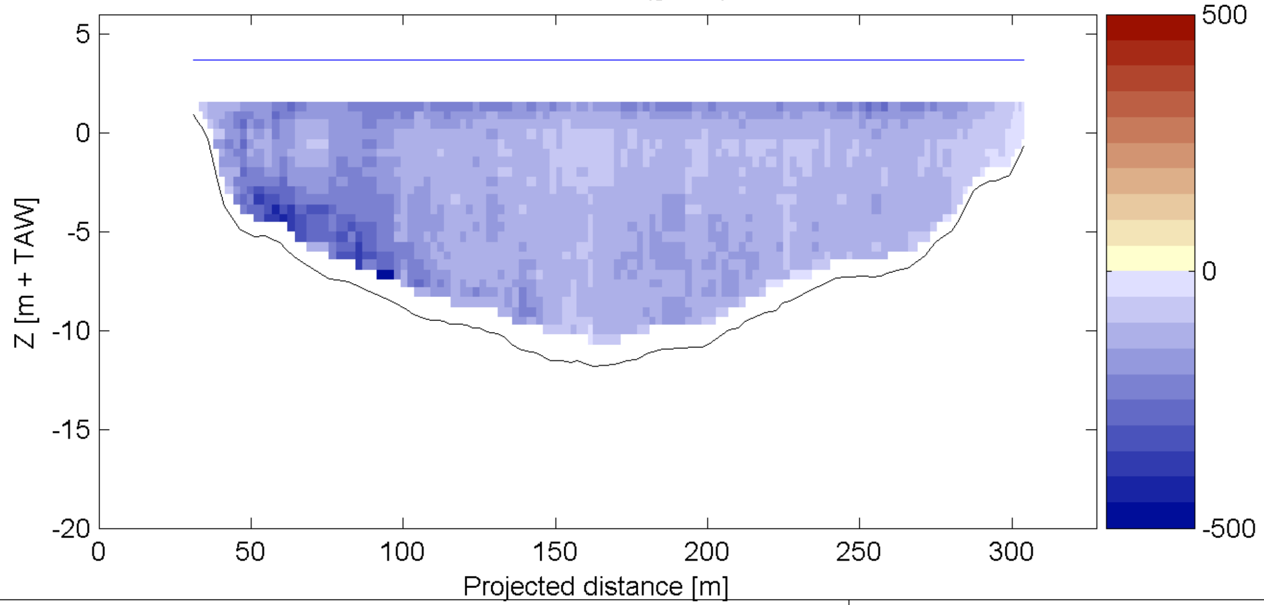
In association with :

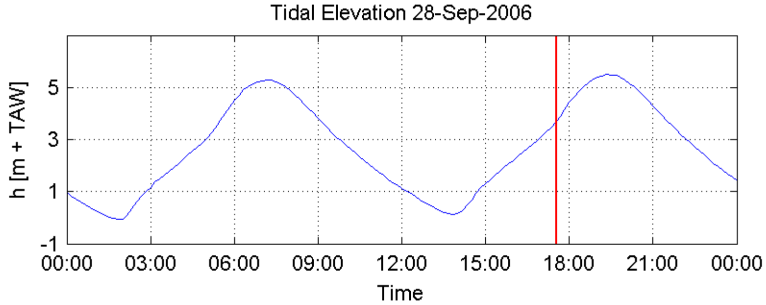
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7069S_sub.csv	Location: Transect S







HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

17:30 - 17:32

Time after HW [HH:MM]

-1:58

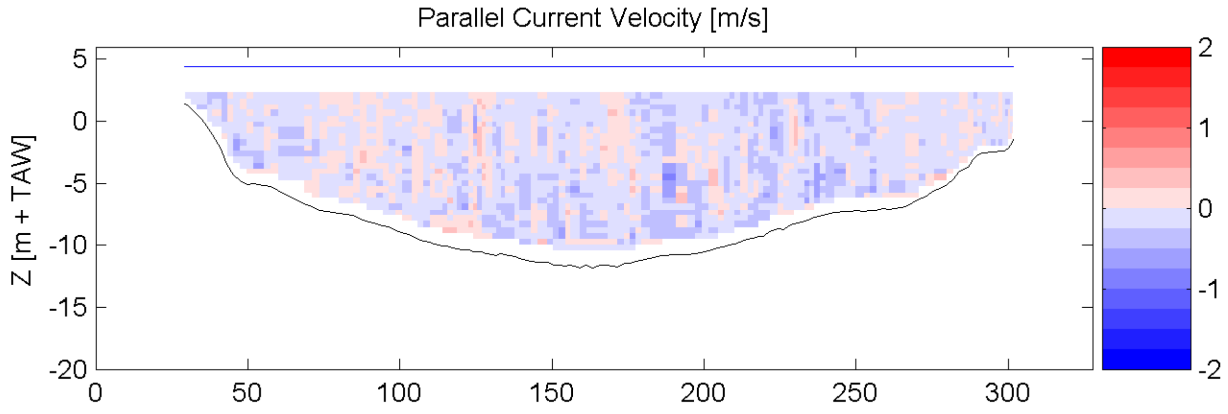
Data Processed by:

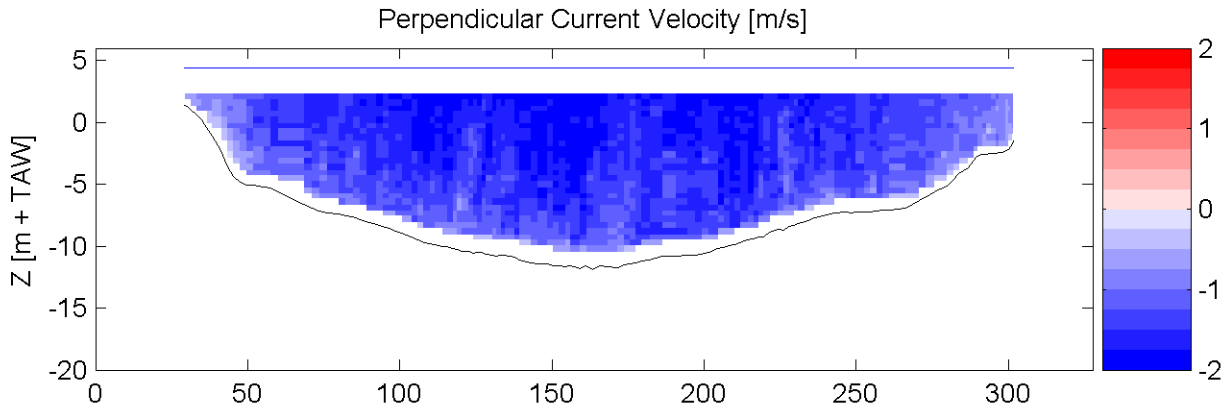
In association with :

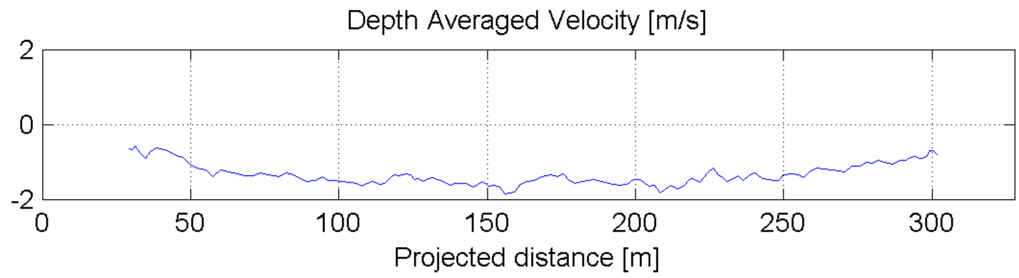
I/RA/11291/06.108/MSA

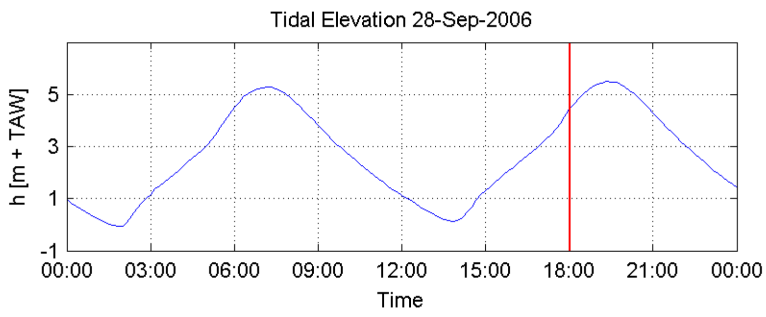
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7072S_sub.csv	Location: Transect S









HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

17:59 - 18:02

Time after HW [HH:MM]

-1:29

Data Processed by:

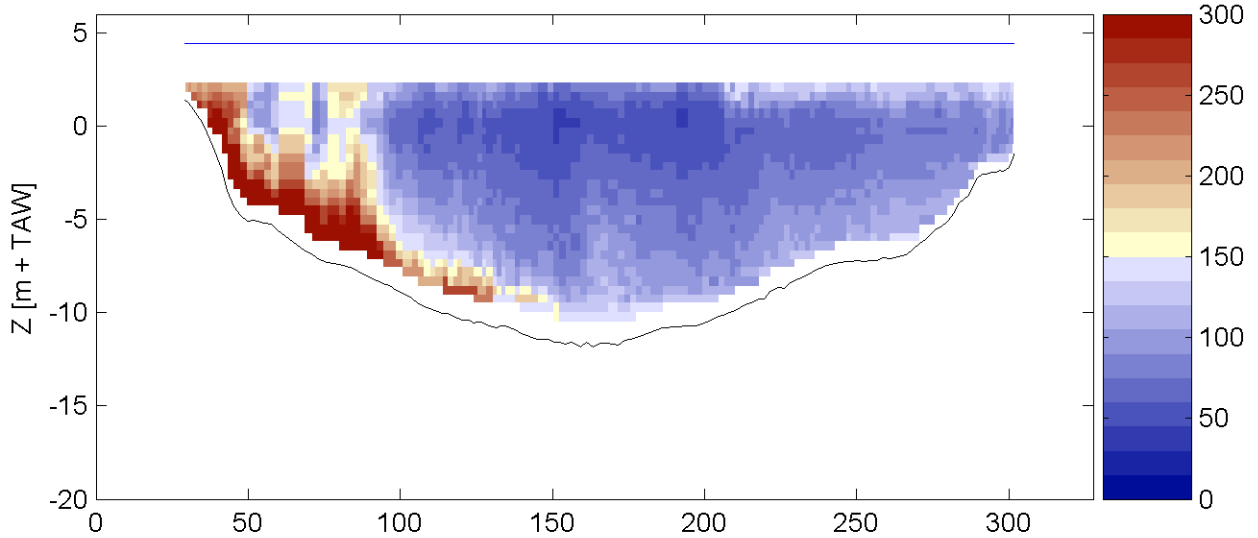
In association with :

I/RA/11291/06.108/MSA

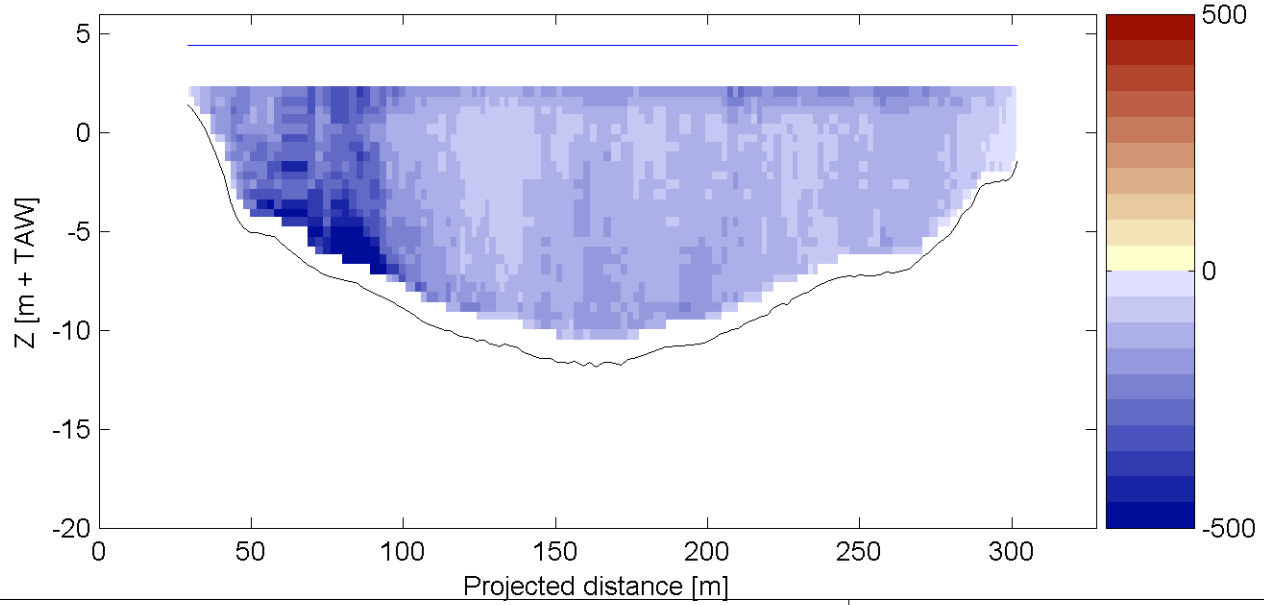
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7072S_sub.csv	Location: Transect S

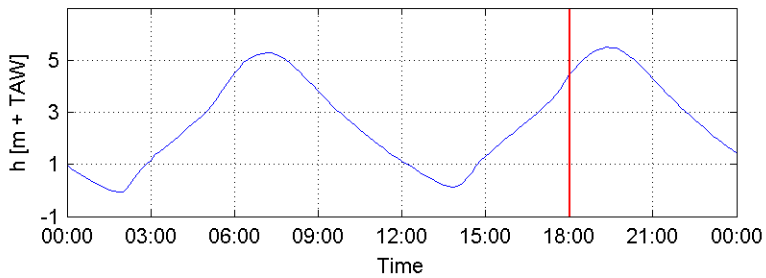
Suspended Sediment Concentration (mg/l)



Sediment Flux (g/sm²)



Tidal Elevation 28-Sep-2006



HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

17:59 - 18:02

Time after HW [HH:MM]

-1:29

Data Processed by: IMDC

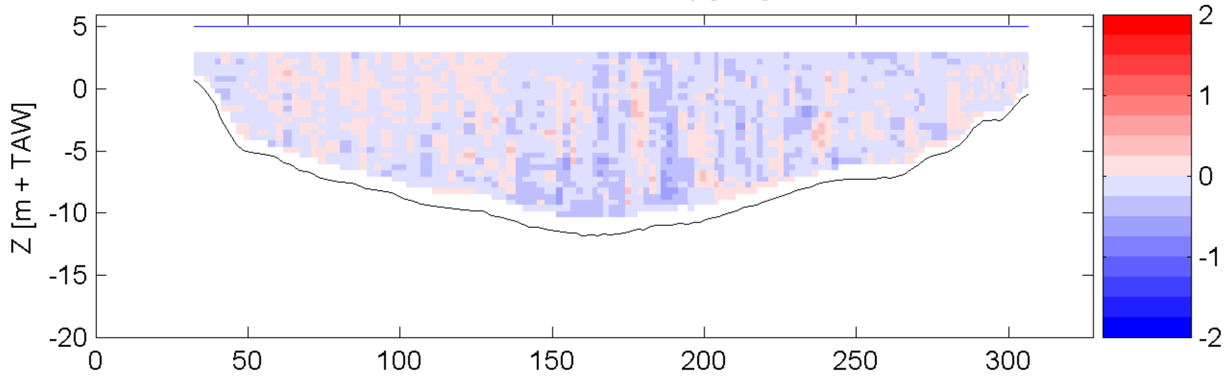
In association with : wl | delft hydraulics, GEMS International

I/RA/11291/06.108/MSA

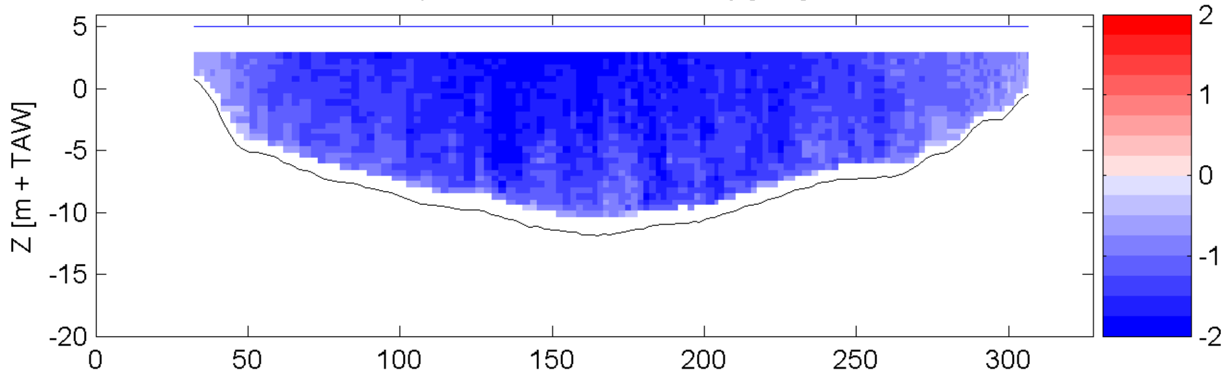
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7075S_sub.csv	Location: Transect S

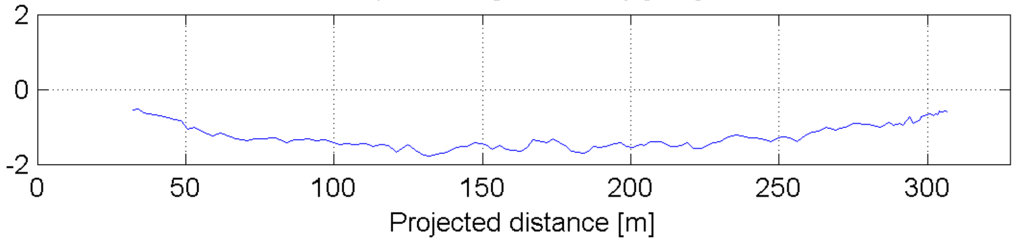
Parallel Current Velocity [m/s]



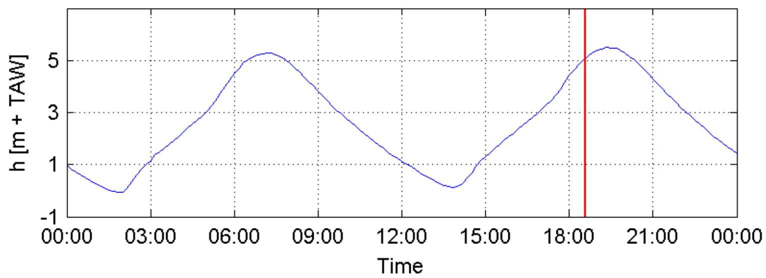
Perpendicular Current Velocity [m/s]



Depth Averaged Velocity [m/s]



Tidal Elevation 28-Sep-2006



HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

18:31 - 18:34

Time after HW [HH:MM]

-0:57

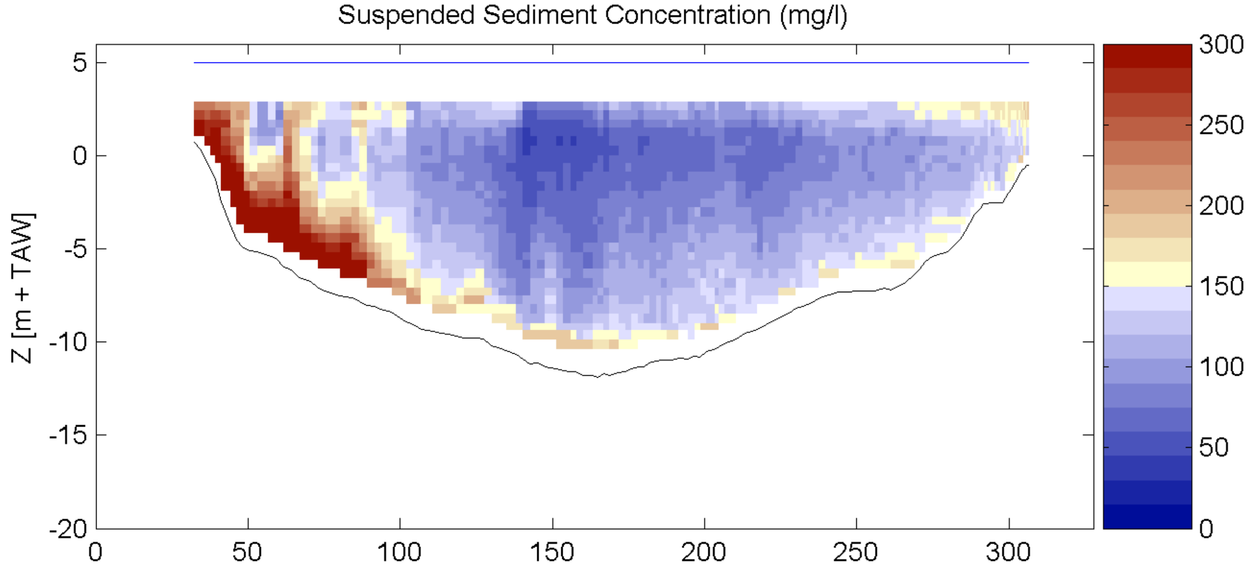
Data Processed by: IMDC

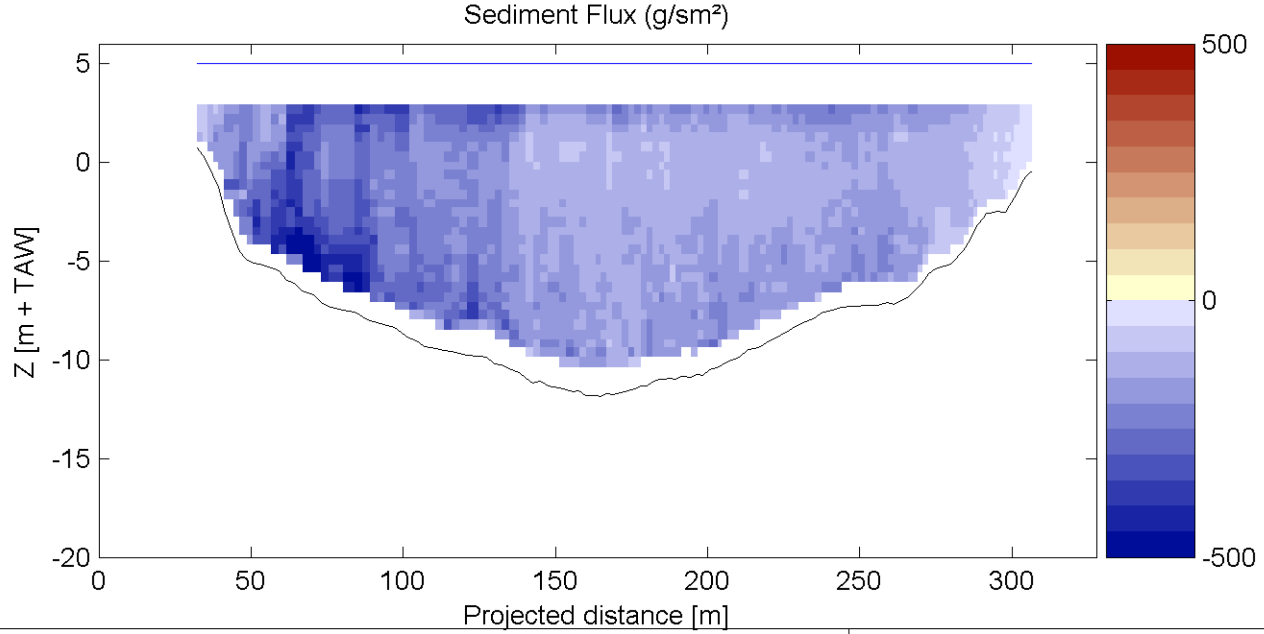
In association with : wl | delft hydraulics GEMS International

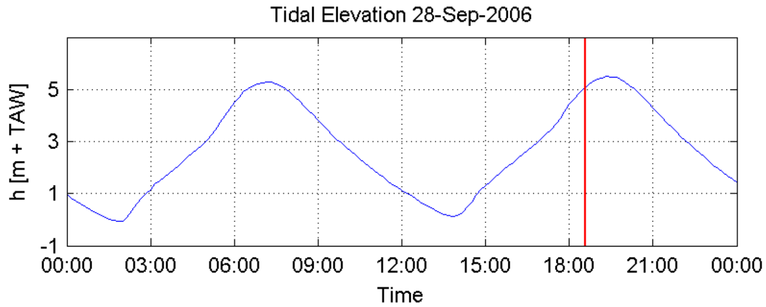
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7075S_sub.csv	Location: Transect S







HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

18:31 - 18:34

Time after HW [HH:MM]

-0:57

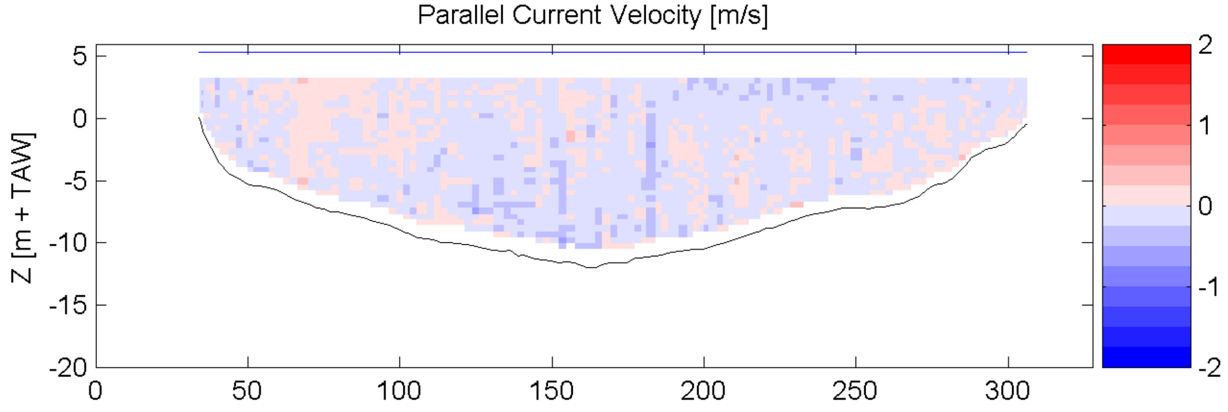
Data Processed by:

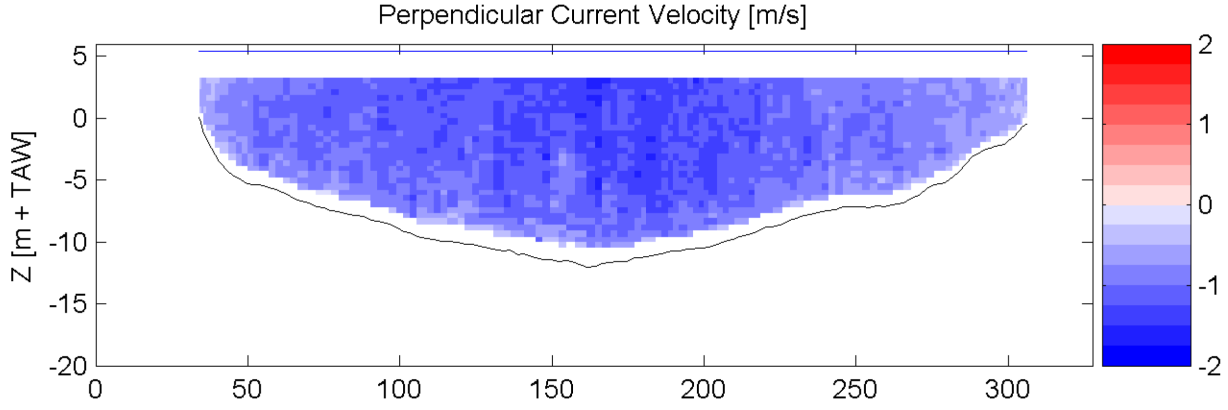
In association with :

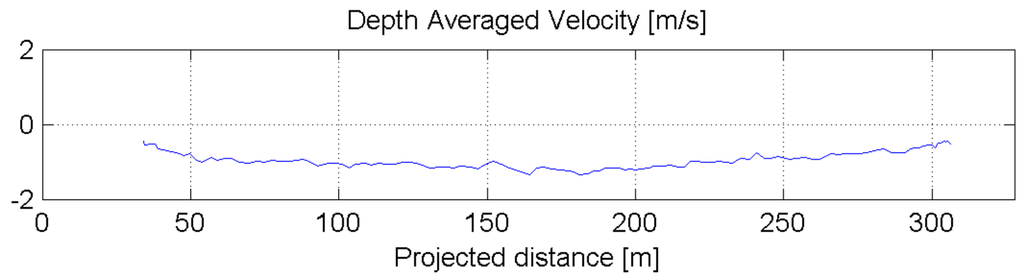
I/RA/11291/06.108/MSA

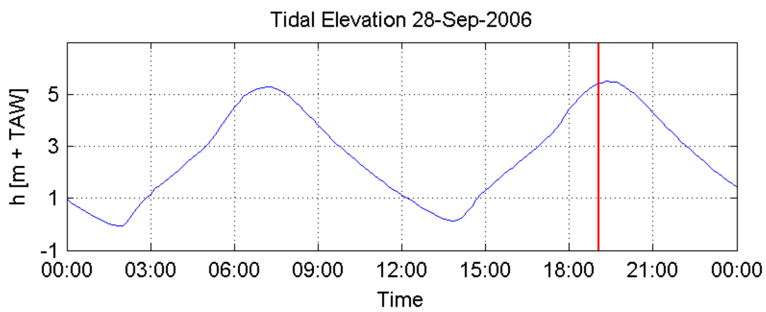
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7078S_sub.csv	Location: Transect S









HW/LW: 07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

19:01 - 19:04

Time after HW [HH:MM]

-0:27

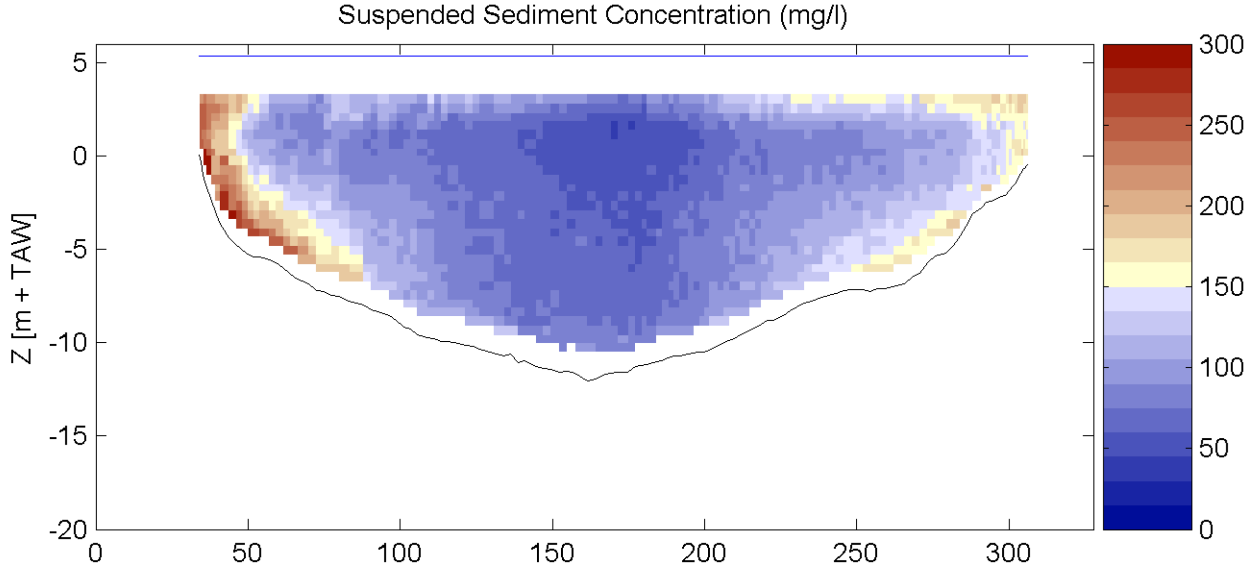
Data Processed by: IMDC

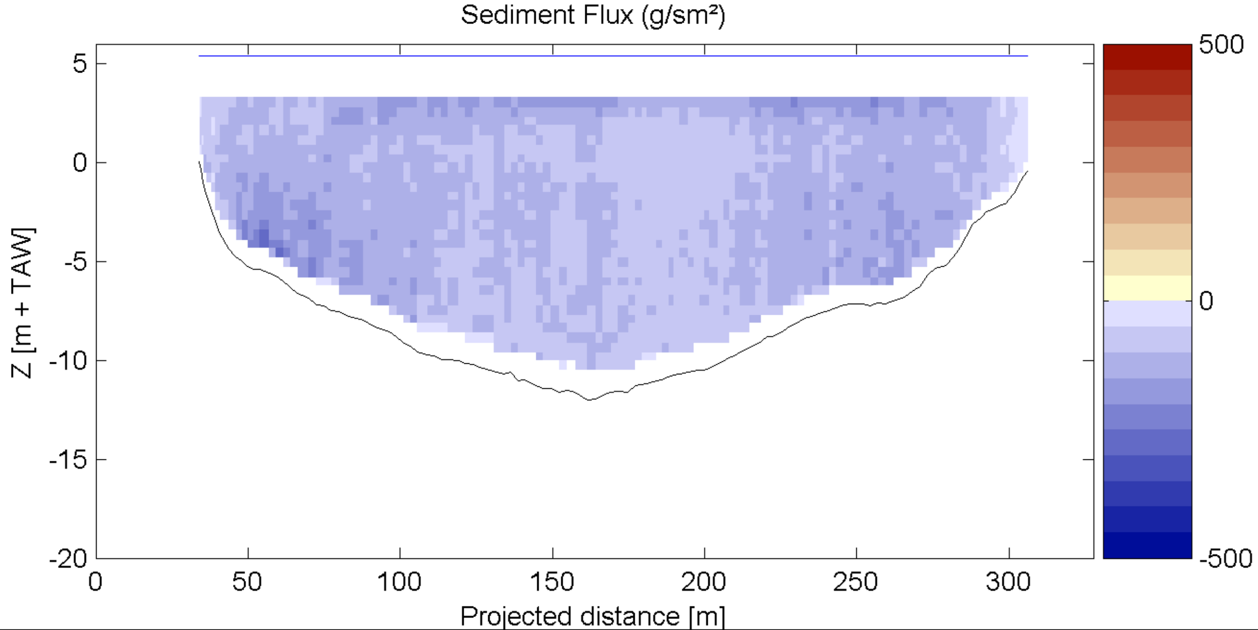
In association with :

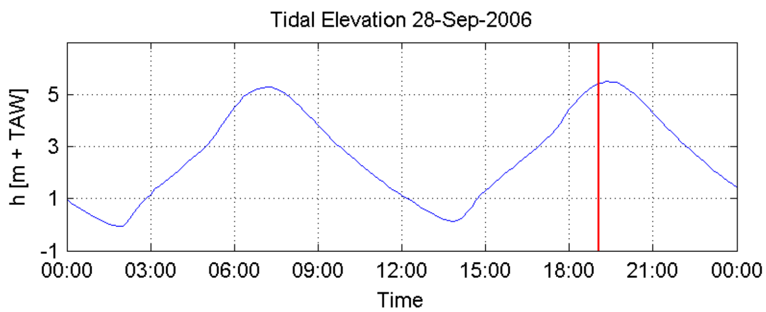
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7078S_sub.csv	Location: Transect S







HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
19:01 - 19:04

Time after HW [HH:MM]
-0:27

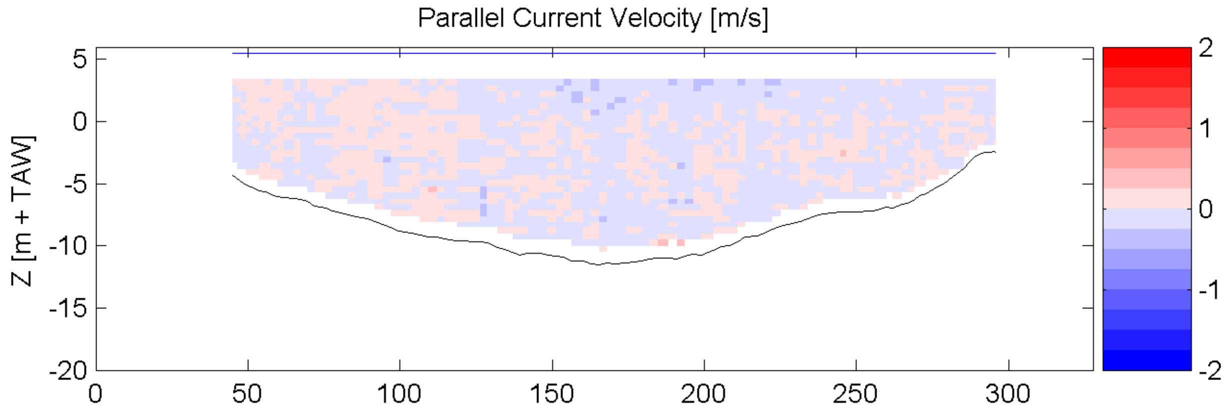
Data Processed by:

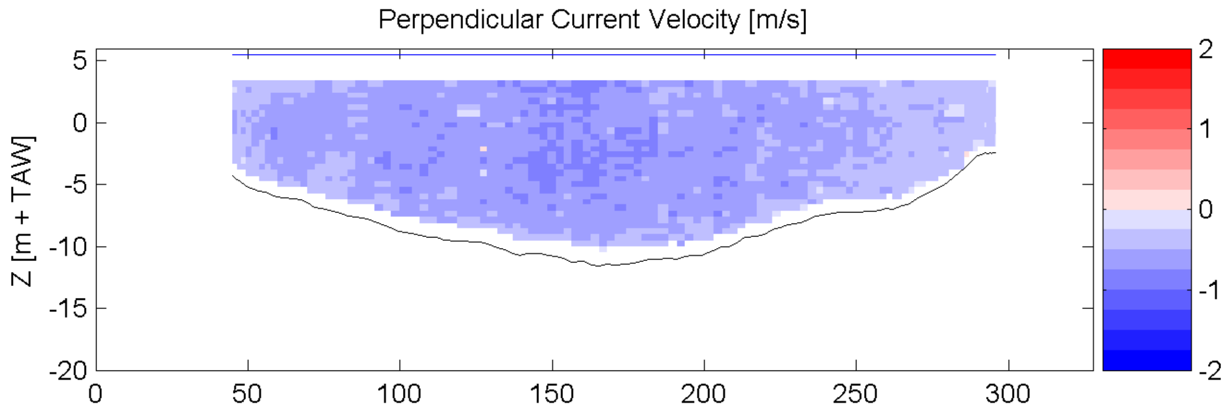
In association with :

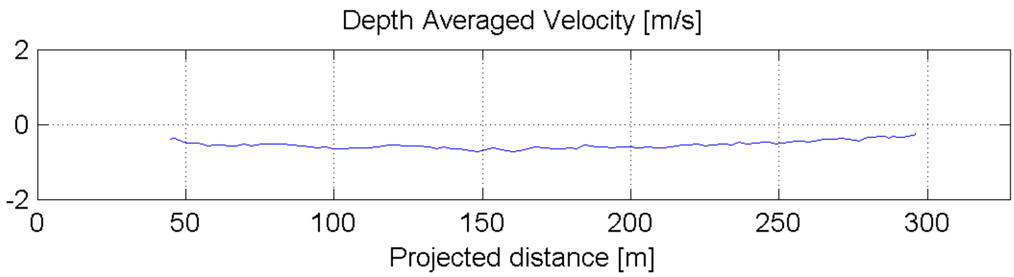
I/RA/11291/06.108/MSA

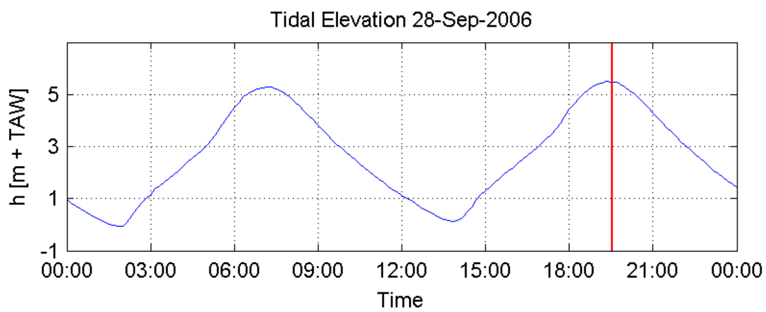
Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7081S_sub.csv	Location: Transect S









HW/LW:
07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :
28-Sep-2006
19:30 - 19:32

Time after HW [HH:MM]
0:01

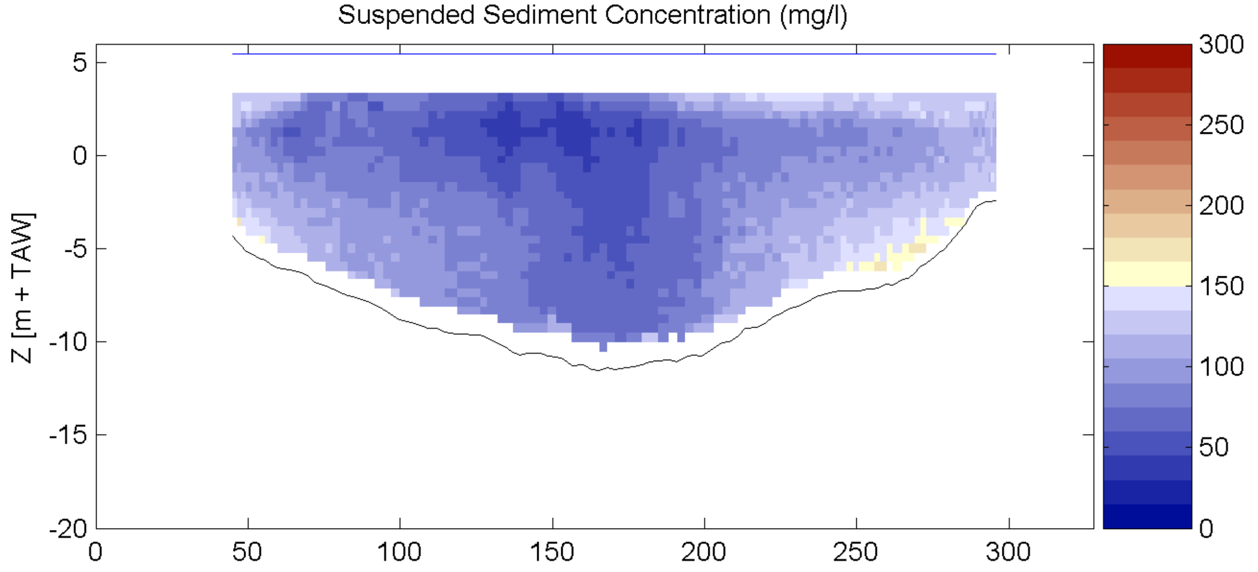
Data Processed by: IMDC

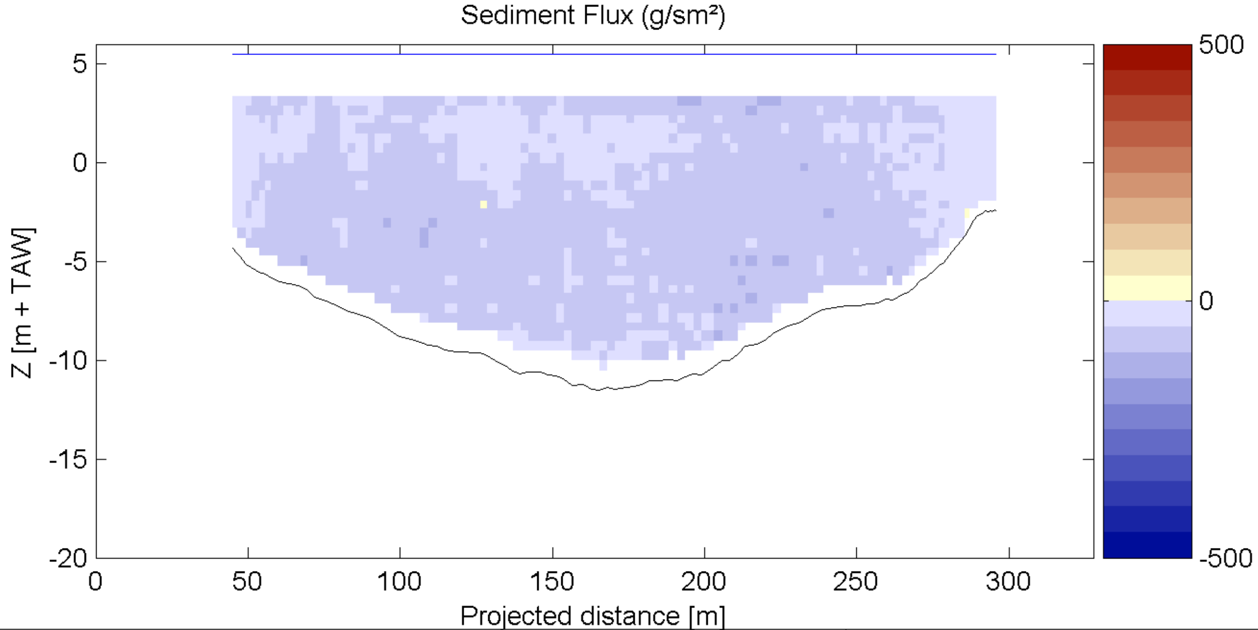
In association with :

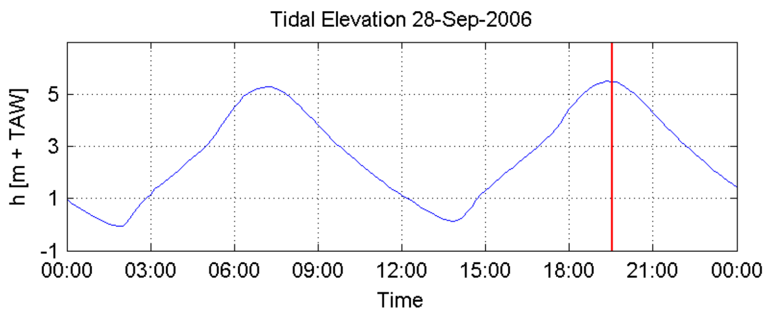
I/RA/11291/06.108/MSA

Measurement Campaign HCBS2

11291	Equipment(s): ADCP
Sourcefile: 7081S_sub.csv	Location: Transect S







HW/LW:

07:10: h = 5.28 m+TAW
13:50: h = 0.14 m+TAW
19:30: h = 5.47 m+TAW

Date / Time [MET] :

28-Sep-2006

19:30 - 19:32

Time after HW [HH:MM]

0:01

Data Processed by: IMDC

In association with : wl | delft hydraulics, GEMS International

I/RA/11291/06.108/MSA

APPENDIX G.

DISCHARGE, SEDIMENT CONCENTRATION AND SEDIMENT FLUX FOR THE TOTAL CROSS-SECTION

Transect name	Start time [hh:mm MET]	Time after HW [hh:mm]	Discharges [m³/s]					
			QMid	QTop	QBottom	QLeft	QRight	QTotal
7002S_sub.csv	6:34	-00:36	-3312	-640	-276	-34	-28	-4291
7006S_sub.csv	7:07	-00:03	-1964	-342	-164	-19	-7	-2496
7009S_sub.csv	7:28	00:18	-842	-110	-69	-39	-1	-1062
7012S_sub.csv	8:00	00:50	1158	306	103	75	23	1665
7015S_sub.csv	8:26	01:16	2223	527	197	164	28	3140
7018S_sub.csv	8:55	01:45	2697	659	243	61	28	3688
7021S_sub.csv	9:28	02:18	2532	637	236	102	49	3557
7024S_sub.csv	10:02	02:52	2299	608	216	82	22	3226
7027S_sub.csv	10:34	03:24	1976	554	195	82	40	2847
7030S_sub.csv	11:08	03:58	1798	519	185	72	29	2603
7033S_sub.csv	11:31	04:21	1698	518	178	84	30	2508
7036S_sub.csv	12:00	04:50	1577	492	170	51	22	2312
7039S_sub.csv	12:32	05:22	1454	468	162	62	27	2172
7042S_sub.csv	12:57	05:47	1296	430	147	58	6	1937
7045S_sub.csv	13:30	06:20	1018	348	115	53	0	1534
7048S_sub.csv	13:59	-05:21	675	241	78	12	23	1028
7051S_sub.csv	14:30	-04:50	-739	-215	-80	-136	-19	-1189
7054S_sub.csv	15:03	-04:17	-1625	-544	-174	-79	-26	-2449
7057S_sub.csv	15:31	-03:49	-1759	-519	-180	-21	-25	-2503
7060S_sub.csv	16:00	-03:20	-1777	-486	-176	-57	-16	-2512
7063S_sub.csv	16:29	-02:51	-1863	-493	-173	-41	-24	-2595
7066S_sub.csv	17:00	-02:20	-2090	-522	-191	-7	-15	-2825
7069S_sub.csv	17:30	-01:50	-2522	-607	-230	-16	-16	-3391
7072S_sub.csv	17:59	-01:21	-3349	-753	-288	-26	-36	-4452
7075S_sub.csv	18:31	-00:49	-3574	-737	-302	-36	-21	-4671
7078S_sub.csv	19:01	-00:19	-2808	-515	-230	-30	-13	-3596
7081S_sub.csv	19:30	00:10	-1487	-239	-119	-47	-23	-1916

[2]

[2] Positive values represent a downstream flow (ebb) or flux, negative values an upstream flow (flood) or flux.

Transect name	Start time [hh:mm MET]	Time after HW [hh:mm]	Concentration [mg/l]					
			C Mid	C Top	C Bottom	C Left	C Right	C Total
7002S_sub.csv	6:34	-00:36	107	133	210	265	179	119
7006S_sub.csv	7:07	-00:03	87	123	159	211	143	98
7009S_sub.csv	7:28	00:18	86	118	145	103	0	93
7012S_sub.csv	8:00	00:50	59	59	136	93	87	65
7015S_sub.csv	8:26	01:16	63	51	142	122	71	70
7018S_sub.csv	8:55	01:45	87	103	177	393	71	101
7021S_sub.csv	9:28	02:18	99	130	169	333	82	116
7024S_sub.csv	10:02	02:52	117	146	190	463	91	137
7027S_sub.csv	10:34	03:24	99	130	159	329	100	116
7030S_sub.csv	11:08	03:58	124	168	189	375	172	145
7033S_sub.csv	11:31	04:21	123	166	180	345	100	143
7036S_sub.csv	12:00	04:50	146	193	206	314	91	164
7039S_sub.csv	12:32	05:22	184	235	247	242	148	200
7042S_sub.csv	12:57	05:47	168	212	218	241	0	183
7045S_sub.csv	13:30	06:20	195	233	261	245	-	211
7048S_sub.csv	13:59	-05:21	141	158	205	167	87	150
7051S_sub.csv	14:30	-04:50	99	65	250	88	105	101
7054S_sub.csv	15:03	-04:17	269	270	557	519	154	296
7057S_sub.csv	15:31	-03:49	182	185	317	333	160	193
7060S_sub.csv	16:00	-03:20	141	175	233	298	125	157
7063S_sub.csv	16:29	-02:51	142	174	237	317	208	158
7066S_sub.csv	17:00	-02:20	110	136	199	143	200	121
7069S_sub.csv	17:30	-01:50	104	130	217	250	188	117
7072S_sub.csv	17:59	-01:21	100	114	240	231	111	112
7075S_sub.csv	18:31	-00:49	114	130	248	278	143	127
7078S_sub.csv	19:01	-00:19	92	120	165	267	154	102
7081S_sub.csv	19:30	00:10	84	100	143	128	130	91

Tide	Concentration [mg/l]		
	Average	Minimum	Maximum
Ebb	134	65	200
Flood	149	101	296

Transect name	Start time [hh:mm MET]	Time after HW [hh:mm]	Sediment fluxes [kg/s]					
			F Mid	F Top	FBottom	F Left	F Right	F Total
7002S_sub.csv	6:34	-00:36	-356	-85	-58	-9	-5	-512
7006S_sub.csv	7:07	-00:03	-171	-42	-26	-4	-1	-244
7009S_sub.csv	7:28	00:18	-72	-13	-10	-4	0	-99
7012S_sub.csv	8:00	00:50	68	18	14	7	2	109
7015S_sub.csv	8:26	01:16	141	27	28	20	2	219
7018S_sub.csv	8:55	01:45	234	68	43	24	2	371
7021S_sub.csv	9:28	02:18	251	83	40	34	4	412
7024S_sub.csv	10:02	02:52	270	89	41	38	2	441
7027S_sub.csv	10:34	03:24	196	72	31	27	4	330
7030S_sub.csv	11:08	03:58	223	87	35	27	5	377
7033S_sub.csv	11:31	04:21	209	86	32	29	3	359
7036S_sub.csv	12:00	04:50	231	95	35	16	2	379
7039S_sub.csv	12:32	05:22	267	110	40	15	4	435
7042S_sub.csv	12:57	05:47	218	91	32	14	0	354
7045S_sub.csv	13:30	06:20	199	81	30	13	0	323
7048S_sub.csv	13:59	-05:21	95	38	16	2	2	154
7051S_sub.csv	14:30	-04:50	-73	-14	-20	-12	-2	-120
7054S_sub.csv	15:03	-04:17	-437	-147	-97	-41	-4	-726
7057S_sub.csv	15:31	-03:49	-320	-96	-57	-7	-4	-484
7060S_sub.csv	16:00	-03:20	-250	-85	-41	-17	-2	-395
7063S_sub.csv	16:29	-02:51	-265	-86	-41	-13	-5	-409
7066S_sub.csv	17:00	-02:20	-229	-71	-38	-1	-3	-343
7069S_sub.csv	17:30	-01:50	-262	-79	-50	-4	-3	-396
7072S_sub.csv	17:59	-01:21	-336	-86	-69	-6	-4	-500
7075S_sub.csv	18:31	-00:49	-408	-96	-75	-10	-3	-592
7078S_sub.csv	19:01	-00:19	-258	-62	-38	-8	-2	-368
7081S_sub.csv	19:30	00:10	-125	-24	-17	-6	-3	-174

[3]

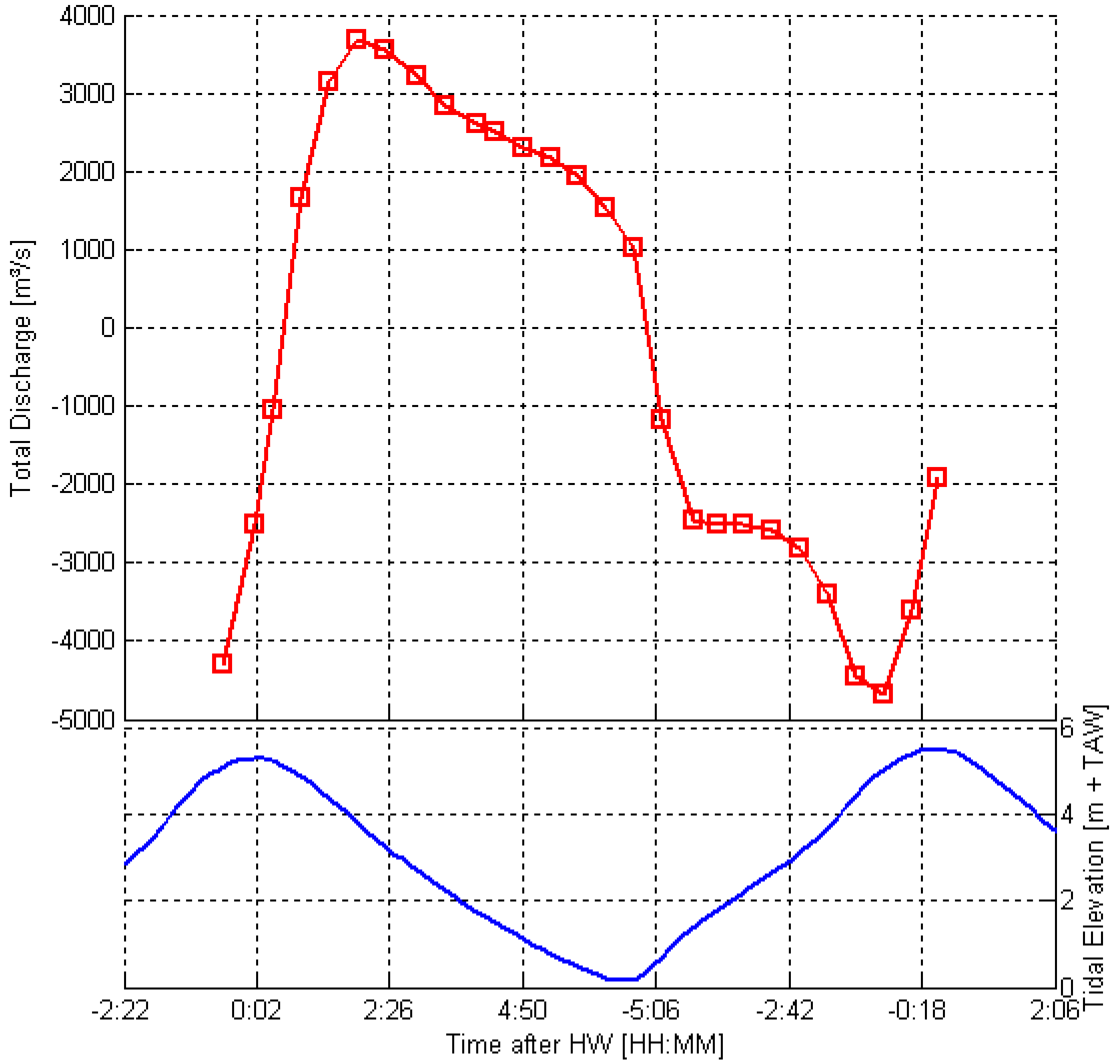
[3] Positive values represent a downstream flow (ebb) or flux, negative values an upstream flow (flood) or flux.

APPENDIX H.

TEMPORAL VARIATION OF TOTAL FLUX AND TOTAL DISCHARGE

Measurement Campaign HCBS2

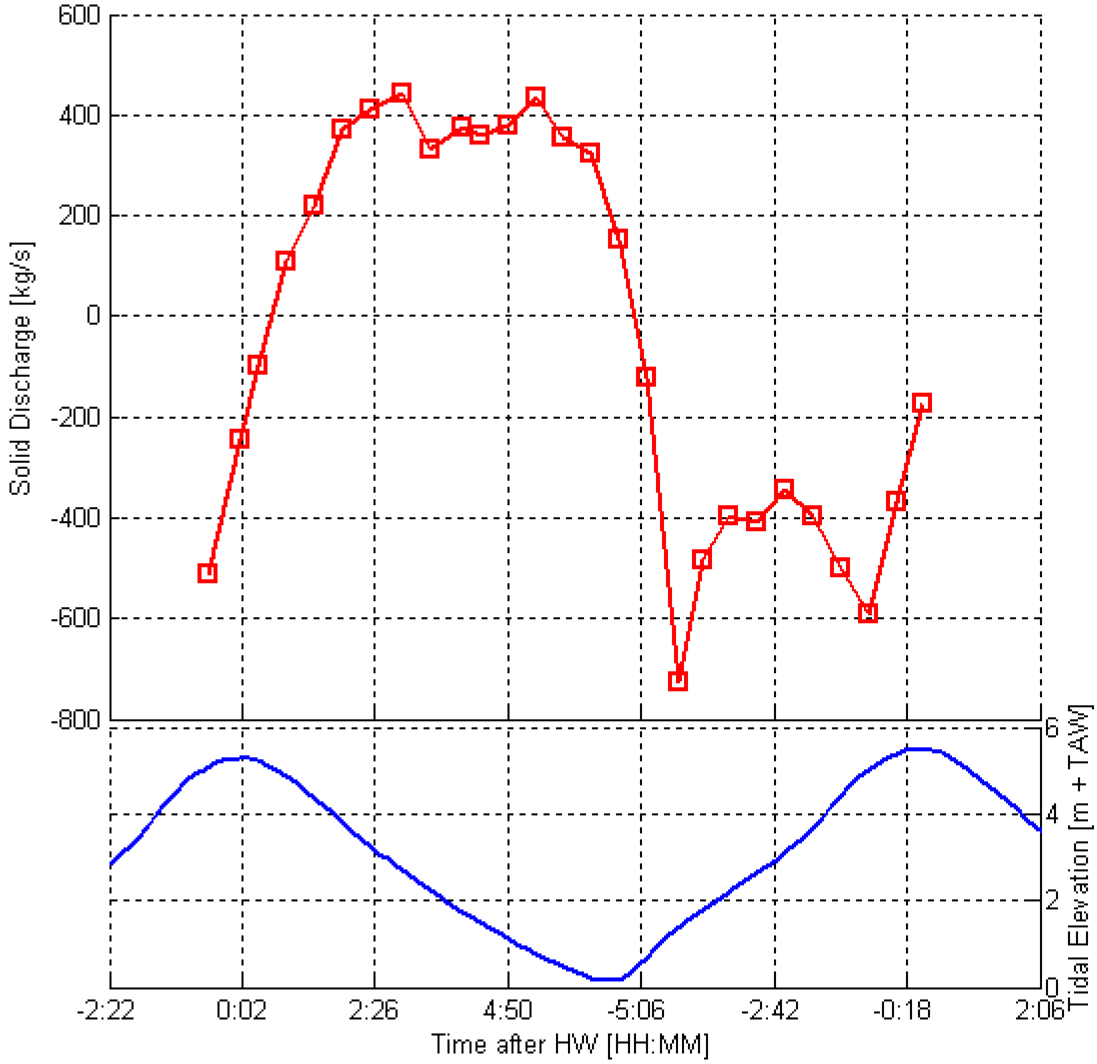
11291	Equipment(s): ADCP
	Location: Transect S



Data Processed by: [4]

[4] Positive values represent a downstream flow (ebb) or flux, negative values an upstream flow (flood) or flux.

Measurement Campaign HCBS2	
11291	Equipment(s): ADCP
	Location: Transect S



Data Processed by:

5

[5] Positive values represent a downstream flow (ebb) or flux, negative values an upstream flow (flood) or flux.