REPORT

**Vlaamse overheid - Departement Mobiliteit en Openbare werken**

Afdeling Maritieme Toegang

# Evaluation of the external effects on the siltation in Deurganckdok

Report 1.3: Annual sediment balance April 2011 - March 2012

24 september 2012 - version 2.0

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# 0. SUMMARY

This report presents the mass balance of Deurganckdok for the year April 2011 – March 2012. Based on bathymetric and densimetric measurements, the density, volume and mass evolution of the dock are presented in figures and tables. Natural siltation rates are estimated from periods without dredging activities. The year April 2011 – March 2012 is the first full year after the construction of the Current Deflecting Wall (CDW) near the northern entrance of the dock, which was finished in August 2011. Limited information about the natural siltation rate and an 18.5% increase of dredged sediment mass compared to the previous year (caused by deeper dredging), has made it very difficult to make a significant conclusion about the effect of the CDW.

# 1. INTRODUCTION

## 1.1 THE ASSIGNMENT

This report is part of a set of reports concerning the project 'Evaluation of the external effects on the siltation in Deurganckdok'. The terms of reference were prepared by 'Departement Mobiliteit en Openbare Werken van de Vlaamse Overheid, Afdeling Maritieme Toegang (16EF/2009/14). The study was awarded to International Marine and Dredging Consultants NV in association with Deltares and Gems International on 8 December 2009.

This study is a follow-up study on the study 'Opvolging aanslibbing Deurganckdok' that ran from January 2006 till March 2009.

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

## 1.2 PURPOSE OF THE STUDY

The purpose of this study entails evaluating the external effects on the siltation in the Deurganckdok. External effects are those effects caused by recent or near-future human operations near Deurganckdok:

- The construction of the Current Deflecting Wall downstream of the entrance of the Deurganckdok.
- The deepening and widening of the navigational channel in the Lower Sea Scheldt between the entrance of the Deurganckdok and the access channels to the locks of Zandvliet-Berendrecht.
- The deepening of the entrance to the Deurganckdok by removing the sill at the entrance.

## 1.3 OVERVIEW OF THE STUDY

This study constitutes of 3 parts:

- Reporting and analysis of existing documents and measurement data
- Execution of specific measurement campaigns to map the siltation and its environmental factors.
- Support in numerical modelling efforts

## 1.4 STRUCTURE OF THE REPORT

Reports of the project 'Evaluation of the external effects on the siltation in the Deurganckdok' are summarized in Table 1-1.

This report is one of a set of reports that gains insight in sediment and water transport between Deurganckdok and the river Scheldt, which belongs to the second part of this project. This report establishes the mass balance of the dock between April 2010 and March 2011, and connects it to measurements from the previous year.

*Table 1-1: Overview of the External Effects Deurganckdok Reports*

| Report | Description |
|---|---|
| **1.** | **Reporting** |
| **I.1 Annual Sediment Balance: Bathymetry surveys, Density measurements, Maintenance and construction dredging activities** | |
| 1.1 | Annual Sediment Balance: year 1: 1/4/2009-31/3/2010 (I/RA/11354/10.067/NZI) |
| 1.2 | Annual Sediment Balance: year 2: 1/4/2010-31/3/2011 (I/RA/11354/10.100/MBO/ANF) |
| 1.3 | Annual Sediment Balance: year 3: 1/4/2011-31/3/2012 (I/RA/11354/10.101/MBO/ANF) |
| **I.2 Boundary Conditions: Upriver Discharge, Salt concentration Scheldt, Bathymetric evolution in access channels, dredging activities in Lower Sea Scheldt and access channels** | |
| 1.4 | Boundary Conditions year 1: 01/04/2009 – 31/3/2010 (I/RA/11354/10.102/MBO/ANF) |
| 1.5 | Boundary Conditions year 2: 01/04/2010 – 31/3/2011 (I/RA/11354/10.103/MBO/ANF) |
| 1.6 | Boundary Conditions year 3: 01/04/2011 – 30/5/2012 (I/RA/11354/10.104/MBO/ANF) |
| **I.3 Synthesis of CDW research** | |
| 1.7 | Synthesis report of research on Current Deflecting Wall (I/RA/11354/10.063/MBO) |
| **I.4 Analysis: evaluation of external effects on siltation in Deurganckdok** | |
| 1.8 | Analysis of external effects on siltation processes and factors (I/RA/11354/10.105/MBO/ANF) |
| **2.** | **Measurement campaigns: Factors contributing to salt and sediment distribution in Deurganckdok: Salt-Silt (OBS3A) & Frame measurements, Through tide measurements (SiltProfiling & ADCP) & Calibrations** |
| **II.1 Through tide measurements fixed transects** | |
| 2.1 | Through tide Sediview measurement: Entrance DGD during spring tide Autumn 2011 (I/RA/11354/10.106/MBO/ANF) |
| 2.2 | Through tide Sediview measurement: Entrance DGD during neap tide Autumn 2011 (I/RA/11354/10.107/MBO/ANF) |
| 2.3 | Through tide Sediview measurement: Entrance DGD during spring tide Winter 2012 (I/RA/11354/10.108/MBO/ANF) |
| 2.4 | Through tide Sediview measurement: Entrance DGD during neap tide Winter 2012 (I/RA/11354/10.109/MBO/ANF) |
| **II.2 Through tide measurements eddy currents** | |
| 2.5[2] | Through tide measurements: Eddy Currents DGD 02/03/2010 (I/RA/11283/10.051/MSA) |
| 2.6 | Through tide measurements: Eddy Currents DGD Autumn I/RA/11354/10.110/MBO/ANF) |

| Report | Description |
|---|---|
| 2.7 | Through tide measurements: Eddy Currents DGD Winter 2012 (I/RA/11354/10.111/MBO/ANF) |
| **II.3 Salt Silt Distribution entrance Deurganckdok** | |
| 2.8[3] | Salt-Silt distribution Deurganckdok 1/4/2009-31/3/2010 (I/RA/11354/10.068/NZI) |
| 2.9 | Sal-Silt distribution Deurganckdok 1/6/2011-31/03/2012 (I/RA/11354/10.112/MBO/ANF) |
| **II.4 Current Salt Silt Distribution CDW Deurganckdok** | |
| 2.10 | Salt Silt & Current Distribution entrance Deurganckdok: frame measurements and throughtide measurements: Autumn 2011 (I/RA/11354/11.131/BQU) |
| 2.11 | Salt Silt & Current Distribution entrance Deurganckdok: frame measurements and throughtide measurements: Winter 2012 (I/RA/11354/10.114/MBO/ANF) |
| **II.5 Quality Control instruments** | |
| 2.12 | Calibration stationary & mobile equipment 16/03/2011 (I/RA/11354/10.113/MBO/ANF) |
| 2.13 | Calibration stationary equipment 2012 (I/RA/11354/12.011/JCA) |

[2]: this report is part of the project Siltation Deurganckdok (11283)

[3]: this report contains report 2.35 of project Siltation Deurganckdok (I/RA/11283/09.085/MSA)

# 2. SEDIMENTATION IN DEURGANCKDOK

## 2.1 PROJECT AREA: DEURGANCKDOK

Deurganckdok is a tidal dock situated at the left bank in the Lower Sea Scheldt, between Liefkenshoek and Doel. Deurganckdok has the following characteristics:

1. the dock has a total length of 2750 m and is 450 m wide at the Scheldt end and 400 m wide at the inward end of the dock
2. The bottom of Deurganckdok is provided at a depth of –17m TAW in the transition zones between the quay walls and the central trench and of –19m TAW in the central trench.
3. the quay walls reach up to +9m TAW

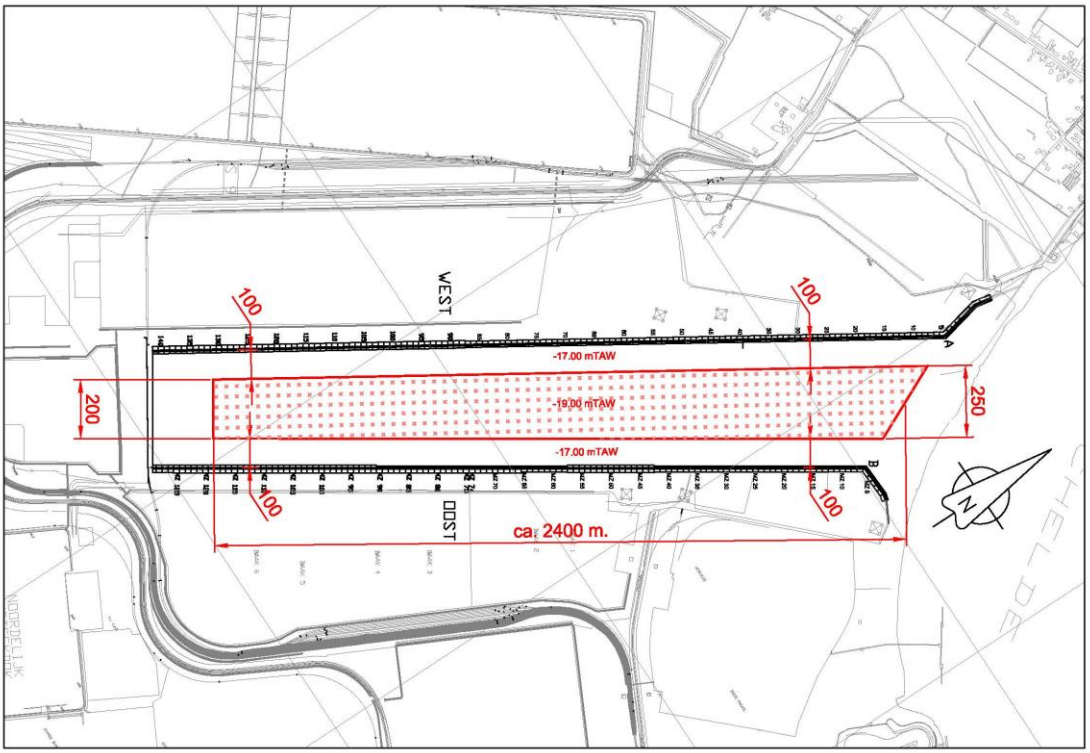


*Figure 2-1: Overview of Deurganckdok*

The dredging of the dock is performed in 3 phases. On 18 February 2005 the dike between the Scheldt and the Deurganckdok was breached. On 6 July 2005 Deurganckdok was officially opened. The second dredging phase was finalized a few weeks later. The first terminal operations have started since. In February 2007, the third dredging phase started and is finalised by February 2008. The dock has been completed in February 2009.

## 2.2 OVERVIEW OF THE STUDIED PARAMETERS

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

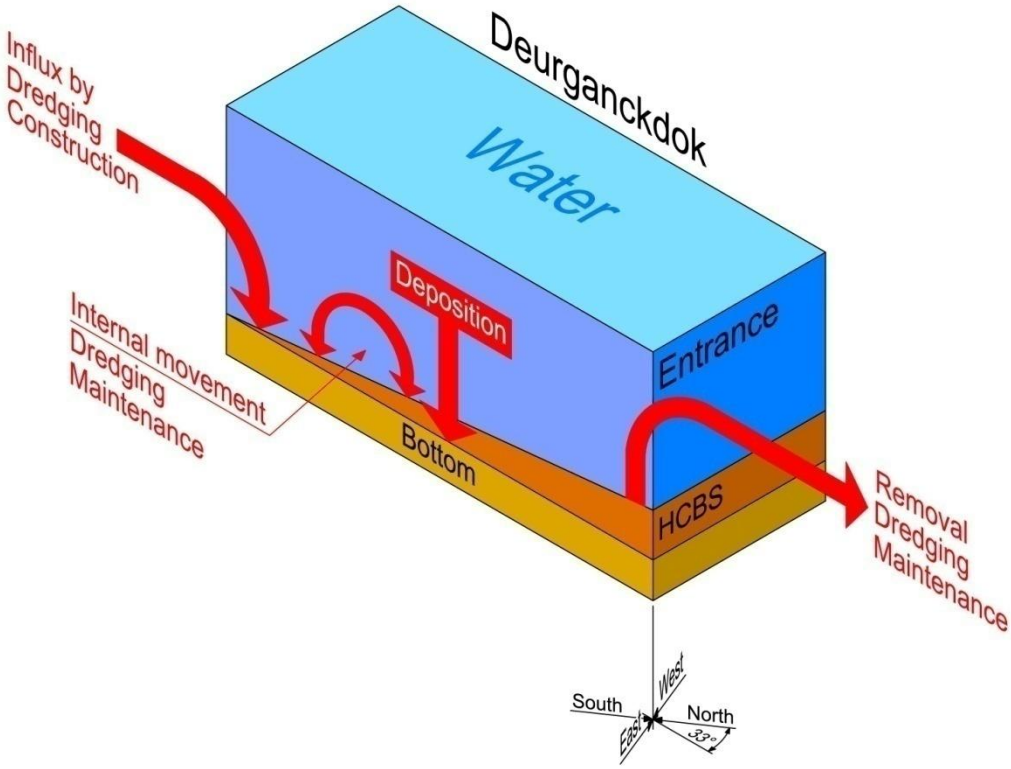


*Figure 2-2: Elements of the sediment balance*

A net deposition can be calculated from a comparison with a chosen initial condition t0 (Figure 2-3). The mass of deposited sediment is determined from the integration of bed density profiles recorded at grid points covering the dock. Subtracting bed sediment mass at t0 leads to the change in mass of sediments present in the dock (mass growth). Adding cumulated dry matter mass of dredged material removed since t0 and subtracting any sediment influx due to capital dredging works leads to the total cumulated mass entered from the river Scheldt since t0.

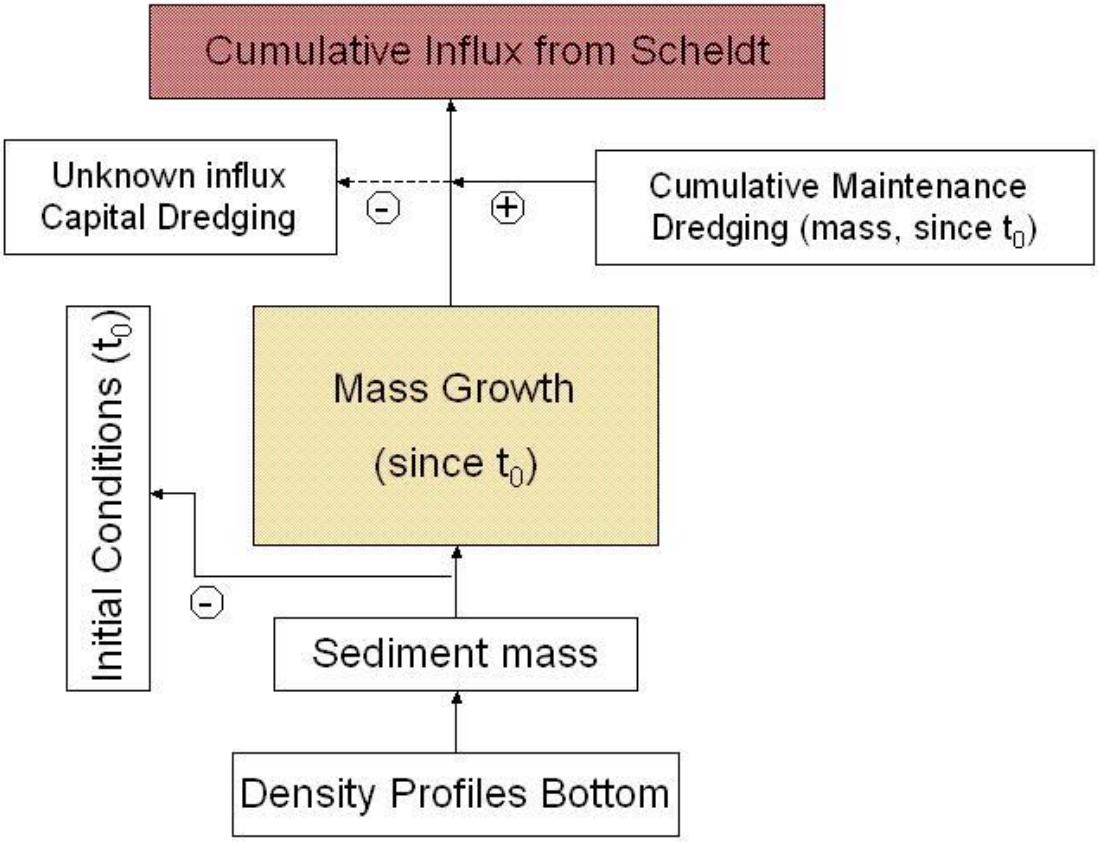


*Figure 2-3: Determining a sediment balance*

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

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

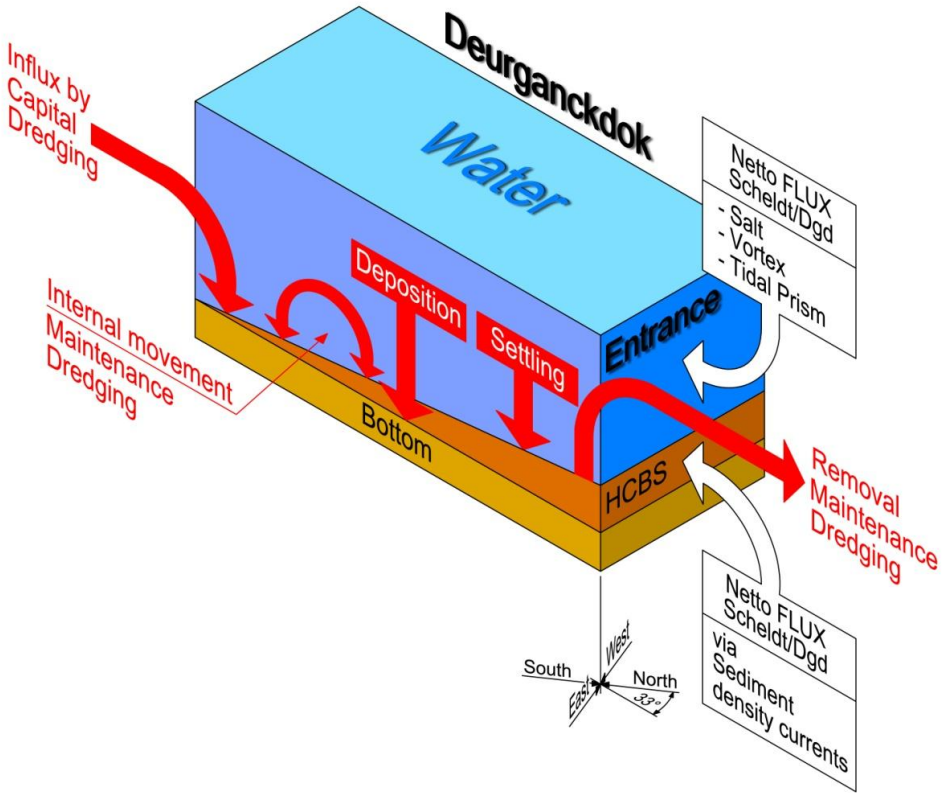


*Figure 2-4: Transport mechanisms*

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

Following data are being collected to understand these mechanisms:

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

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

# 3. MEASUREMENTS

## 3.1 CONVENTIONS

All measurements are reported in ED50 UTM31N coordinates with the depth in TAW. A time convention is not needed in this report, which does not contain time series.

## 3.2 DEPTH SOUNDINGS

Agentschap voor Maritieme Dienstverlening en Kust – Afdeling Kust executes monthly dual-frequency echo-sounder measurements with a 210-33 kC Echo sounder using Qinsy software. The depth sounding measurements are executed in a grid configuration, consisting of sections perpendicular and parallel to the quay wall.

During this measurement period all soundings covered most of the dock.

*Table 3-1: Overview of the available depth soundings suitable for analysis 24/03/2011 – 28/03/2012*

| ***date*** | ***type of measurement*** | ***signal*** | ***Source*** |
|---|---|---|---|
| 24/03/2011* | dual frequency 210 | 210 | Afdeling Kust |
| 22/04/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 06/05/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 09/06/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 08/07/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 02/08/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 01/09/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 30/09/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 31/10/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 28/11/2011 | dual frequency 210 | 210 | Afdeling Kust |
| 18/01/2012 | dual frequency 210 | 210 | Afdeling Kust |
| 29/02/2012 | dual frequency 210 | 210 | Afdeling Kust |
| 28/03/2012 | dual frequency 210 | 210 | Afdeling Kust |

*= reference situation depth soundings (for the difference maps): $t_{0e}$

To calculate a sediment balance it is necessary to analyse the measurements in stationary situation, with no alteration in boundary conditions being dredging operations. Every period is characterized by a depth sounding measurement before ('inpeiling') and one after ('uitpeiling').

A number of analyses were done using the depth soundings in Table 3-1. The raw depth sounding data was processed in ESRI ArcGIS. The 210 kC signal is used in the following analyses as it gives an indication of the water-bed interface.

A reference level was chosen from all depth sounding measurements. The first sounding of the measurement year is chosen as reference situation. However, when dealing with different

measurement years (2009-2011), a single reference situation needs to be selected; it was decided to use the design depth of the dock.

A number of analyses were performed in ArcGIS 9 and a Matlab environment to produce maps, figures and tables with relevant information concerning elevation, elevation changes and volumetric growth (§4.2 to §4.5).

## 3.3 DENSITY MEASUREMENTS

Density measurements are necessary to calculate a sediment balance of dry weight of sediment per surface unit. In order to measure bulk densities, two devices were used, i.e. the Navitracker and the Densitune. The former device was applied until the end of August 2008, after which the Densitune was used. From May 3rd 2010 onward, the Navitracker has been used. During the measurement year 2010-2011 the Navitracker has been used all the time except for the measurement of March 20th 2010 which has still been done with the Densitune. During the measurement year 2011-2012 the Navitracker has been used all the time. The application of different devices is related to a contract change for density measurements in the harbour of Zeebrugge. Some information on both devices is given below.

### 3.3.1 Navitracker

The Navitracker is a patented system to measure the density of fluid mud suspensions, by means of a gamma-density meter. It has been used by the Flemish authorities over 20 years to determine the nautical bed for the port of Zeebrugge.

The Navitracker system can be operated by a computer controlled winch to tow it through the mud (horizontal mode). The Navitracker is equipped with the following sensors:

- The Gamma ray density sensor, mounted on a fork-like tow fish, gives density information.
- The depth sensor gives information of the depth of the sensor.
- The position of the fish is calculated out of the length of the winch cable. Together with the position of the tow fish, following the density level, a dual frequency echo sounder is used to map the hard bottom and the top of the mud. With a speed of 2 to 3 knots, large areas can be covered.

For these measurements the Navitracker was used in a vertical profiling mode, with the probe in vertical position in order to penetrate the soft bottom. The vertical density profiler is used to measure density in thick mud layers with high densities.

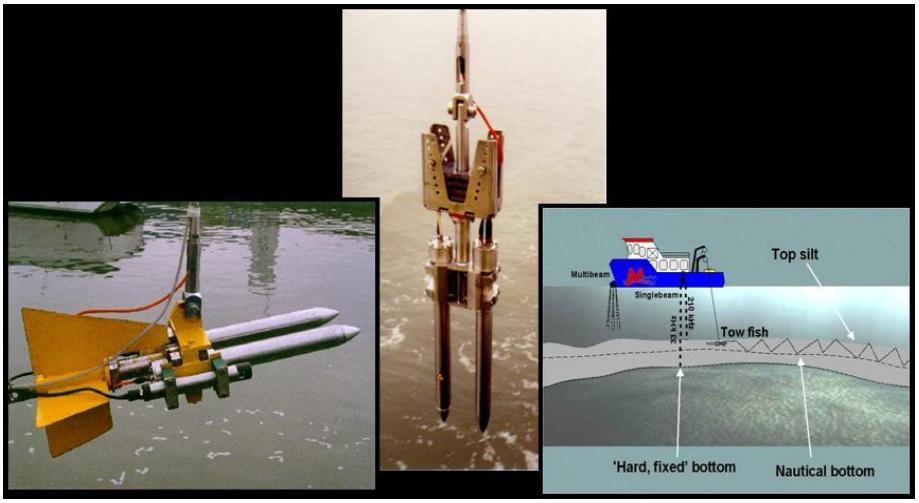


*Figure 3-1: Navitracker*

The Navitracker was calibrated in the laboratory for measuring high densities, formed by very dense water-mud mixtures. For this reason the Navitracker did not detect subtle variations in density caused by changes in salinity. The density deviated from 1.000 ton/m³ only in the presence of a high concentration of sediments.

The Navitracker has a sampling frequency of 10 measurements per second.

### 3.3.2 DensiTune

The DensiTune is a patented system to determine the internal density of liquid silt layers. The measurement system is based on the “tuning fork” principles. One of the legs vibrates with a specific frequency, and the other leg responds with a frequency which depends on the density of the medium in which the DensiTune is inserted. The system measures vertical density profiles in liquid silt layers while lowered.

From previous research (IMDC, 2005), it could be observed that the DensiTune measured higher densities at a specific depth in comparison to the Navitracker. DensiTune therefore identifies densities less deep than Navitracker, i.e. around 25 cm.

### 3.3.3 Data analysis

The resulting density profiles were processed in a Matlab environment and visualized in Matlab and ESRI ArcGIS. Equal density layers were computed. Volume and density information was used to calculate masses of silt. All masses are given in ton of dry solids (TDS) characterized by a density of 2.65 kg/dm³. The water-bed interface is defined as the layer with a density of 1.03 kg/dm³.

To calculate the local sediment mass in the dock, or zones of it, each measured density profile was integrated over its depth. The unmeasured part of the water column, covering the distance between the deepest sampling point and the design depth, needed to be estimated (if not measured). This sediment concentration was estimated as being constant for the unmeasured depth range and being proportional to the deepest measured concentration. As proportionality, a value of 1.02 was applied which was determined from a preliminary analyses of the density profiles near the bottom (measured by Navitracker). A horizontal distribution of

the sediment mass was subsequently obtained by cubic interpolation between the profiling locations onto a grid with a resolution of 5 m.

In this measurement campaign, Navitracker measurements were performed on:

- 31 May 2011;
- 18 August 2011;
- 26 October 2011;
- 9 December 2011;
- 28 December 2011;
- 7 February 2012;
- 28 March 2012;

As a reference situation for the calculation of the sediment mass in the dock, the empty dock will be used at the design depth. The design depths for the different zones are shown in Table 3-2. The different zones are described in §4.1.

*Table 3-2: Reference Situation Density Measurements (t0d)*

| ***Zone*** | ***Design Depth [m TAW]*** |
|---|---|
| Central trench | -19 |
| Berthing zones and transition zones to central trench | -17 |
| Sill | -13.5 |
| Transition sill to navigation channel | Not applicable |

## 3.4 MAINTENANCE DREDGING DATA

All maintenance dredging (except sweep beam) activities in Deurganckdok were collected in the BIS-system. This system gives a standardised output per week, that states the weight, volume and V' removed/dumped in every 5*5m grid cell in the area. In case the density of the dredged sediment in the hopper bin is larger or equal to 1.6 kg/dm³, V' is equal to the volume in the bin. In case the density is smaller than 1.6 kg/dm³, V' is equal to the reduced volume which is defined as the volume the dredged sediment would have in case the density would be equal to 2 kg/dm³ (AWZ 2000). These dredged volumes are important to have an overall view on the sediment balance. Maintenance dredging occurred between 28 March 2011 and 22 January 2012.

The available data on sweep beam activity is not collected in the BIS-system. However, the mode of operation of the sweep beam is explained:

- On the sill (zone 1 & 2): the sediment is swept into the Lower Sea Scheldt
- Inside the dock: the sweep beam sweeps the berthing zones next to the quay walls and moves sediment into the central trench

Therefore an overview is given in Table 3-3 of where and when a sweep beam dredger was working in Deurganckdok (DGD) or on the sill of Deurganckdok (sill DGD) for the period April 2011 - March 2012.

*Table 3-3: Sweep beam maintenance dredging activities in Deurganckdok and on the sill of Deurganckdok between April 2011 and March 2012 (source: Afdeling Maritieme Toegang)*

| ***From*** | ***Till*** | ***Week*** | ***Location*** |
|---|---|---|---|
| 1/04/2011 | 3/04/2011 | 13 | Quays (details unknown) |
| 4/04/2011 | 10/04/2011 | 14 | Quays (details unknown) |
| 11/04/2011 | 17/04/2011 | 15 | Quays (details unknown) |
| 18/04/2011 | 24/04/2011 | 16 | Quays (details unknown) |
| 25/04/2011 | 1/05/2011 | 17 | Quays (details unknown) |
| 2/05/2011 | 8/05/2011 | 18 | Quays (details unknown) |
| 9/05/2011 | 15/05/2011 | 19 | Quays (details unknown) |
| 16/05/2011 | 22/05/2011 | 20 | Quays (details unknown) |
| 23/05/2011 | 29/05/2011 | 21 | Quays (details unknown) |
| 30/05/2011 | 5/06/2011 | 22 | Quays (details unknown) |
| 6/06/2011 | 12/06/2011 | 23 | Quays (details unknown) |
| 20/06/2011 | 26/06/2011 | 25 | Quays (details unknown) |
| 4/07/2011 | 10/07/2011 | 27 | Quays (details unknown) |
| 25/07/2011 | 31/07/2011 | 30 | Quays (details unknown) |
| 1/08/2011 | 7/08/2011 | 31 | Quays (details unknown) |
| 8/08/2011 | 14/08/2011 | 32 | Quays (details unknown) |
| 15/08/2011 | 21/08/2011 | 33 | Deurganckdok (details unknown) |
| 22/08/2011 | 28/08/2011 | 34 | Quays (details unknown) |
| 29/08/2011 | 4/09/2011 | 35 | Quays (details unknown) |
| 5/09/2011 | 11/09/2011 | 36 | Quays (details unknown) |
| 12/09/2011 | 18/09/2011 | 37 | Quays (details unknown) |
| 19/09/2011 | 25/09/2011 | 38 | Quays (details unknown) |
| 26/09/2011 | 2/10/2011 | 39 | Quays (details unknown) |
| 3/10/2011 | 9/10/2011 | 40 | Quays (details unknown) |
| 21/11/2011 | 27/11/2011 | 47 | Quays (details unknown) |
| 28/11/2011 | 4/12/2011 | 48 | Quays (details unknown) |
| 5/12/2011 | 11/12/2011 | 49 | Quays (details unknown) |
| 12/12/2011 | 18/12/2011 | 50 | Quays (details unknown) |
| 23/01/2012 | 29/01/2012 | 4 | Quays (details unknown) |
| 6/02/2012 | 12/02/2012 | 5 | Quays (details unknown) |
| 12/03/2012 | 18/03/2012 | 11 | Quays (details unknown) |
| 19/03/2012 | 25/03/2012 | 12 | Quays (details unknown) |
| 26/03/2012 | 31/03/2012 | 13 | Quays (details unknown) |

An overview of the total dredged mass in all zones (BIS data) is provided in Annex I. The sweep beam tracks are not shown this time, because the added values of such figures is deemed to be low in comparison with the time needed to process the data.

Remark: Since March 2011 the dredging depths in the Deurganckdock are defined by the levels presented in Annex J (zero LAT is 0.72 m below zero TAW) and Table 3-4.

*Table 3-4: Maintenance dredging depths for each dredging zone since March 2011*

| ***Zone*** | ***Zone identification*** | ***Dredging Depth [m TAW]*** | ***Dredging Depth [m LAT]*** |
|---|---|---|---|
| 1 & 3 | Commercial quays | -16.62 | -15.90 |
| 2 | Central trench | -18.22 | -17.50 |
| 4 | Entrance area | -15.92 | -15.20 |

## 3.5 OVERVIEW OF ACTIVITIES AND PROCESSES

To facilitate the data analysis in Chapter 5, Table 3-5 gives an overview of all conducted measurements and human interferences on the natural siltation in the dock. This makes it possible to identify periods of undisturbed siltation of specific zones in the dock, i.e. without any dredging operations. In this way, it is possible to distinguish between the “natural” siltation and “gross” siltation; the latter indicates that human interferences are included in the measurement results too. This is especially important for the determination of the natural volumetric siltation rate, as discussed in §5.2.

*Table 3-5: Overview of measurements and dredging activities in Deurganckdok.*

| | April 11 | | May 11 | | June 11 | | July 11 | | August 11 | | September 11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **activity** | **1 - 15** | **16 - 30** | **1 - 15** | **16 - 31** | **1 - 15** | **16 - 30** | **1 - 15** | **16 - 31** | **1 - 15** | **16 - 31** | **1 - 15** | **16 - 30** |
| *depth sounding* | | | | | | | | | | | | |
| *density measurements* | | | | | | | | | | | | |
| *maintenance dredging* | | | | | | | | | | | | |
| *sweep beam dredging - sill* | | | | | | | | | | | | |
| *sweep beam dredging - commercial quays* | | | | | | | | | | | | |
| *capital dredging* | | | | | | | | | | | | |

| | October 11 | | November 11 | | December 11 | | January 12 | | February 12 | | March 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **activity** | **1 - 15** | **16 - 31** | **1 - 15** | **16 - 30** | **1 - 15** | **16 - 31** | **1 - 15** | **16 - 31** | **1 - 15** | **16 - 29** | **1 - 15** | **16 - 31** |
| *depth sounding* | | | | | | | | | | | | |
| *density measurements* | | | | | | | | | | | | |
| *maintenance dredging* | | | | | | | | | | | | |
| *sweep beam dredging - sill* | | | | | | | | | | | | |
| *sweep beam dredging - commercial quays* | | | | | | | | | | | | |
| *capital dredging* | | | | | | | | | | | | |

# 4. SEDIMENT BALANCE ANALYSES

## 4.1 PROJECT AREA: (SUB)ZONES AND SECTIONS

To calculate volumes and masses for the sediment balance of Deurganckdok it is necessary to subdivide it into 5 zones:

- Zone 1: Between the sill and the navigation channel in the Lower Sea Scheldt.
- Zone 2: Sill at entrance DGD designed at –13.5 m TAW and removed in June 2010.
- Zone 3: Central trench in DGD with a design depth at –19 m TAW (including slope to –17 m TAW)
- Zone 4: Transition between central trench and berthing zones with a design depth at –17.00 m TAW: on both (North (N) and South (Z)) sides of DGD (55 m wide).
- Zone 5: Berthing zones next to quay walls on both (North (N) and South (Z)) sides of DGD (40 m wide)

Zones 3, 4 and 5 are subdivided into subzones A, B, C, D and E. This is shown in Figure 4-1. In addition, results are given for the whole zones 4 North, 4 South, 5 North and 5 South. Each of these takes the northern or southern zone of 4 or 5 across the A, B, C, D and E subzones resulting in the 4 newly defined zones.

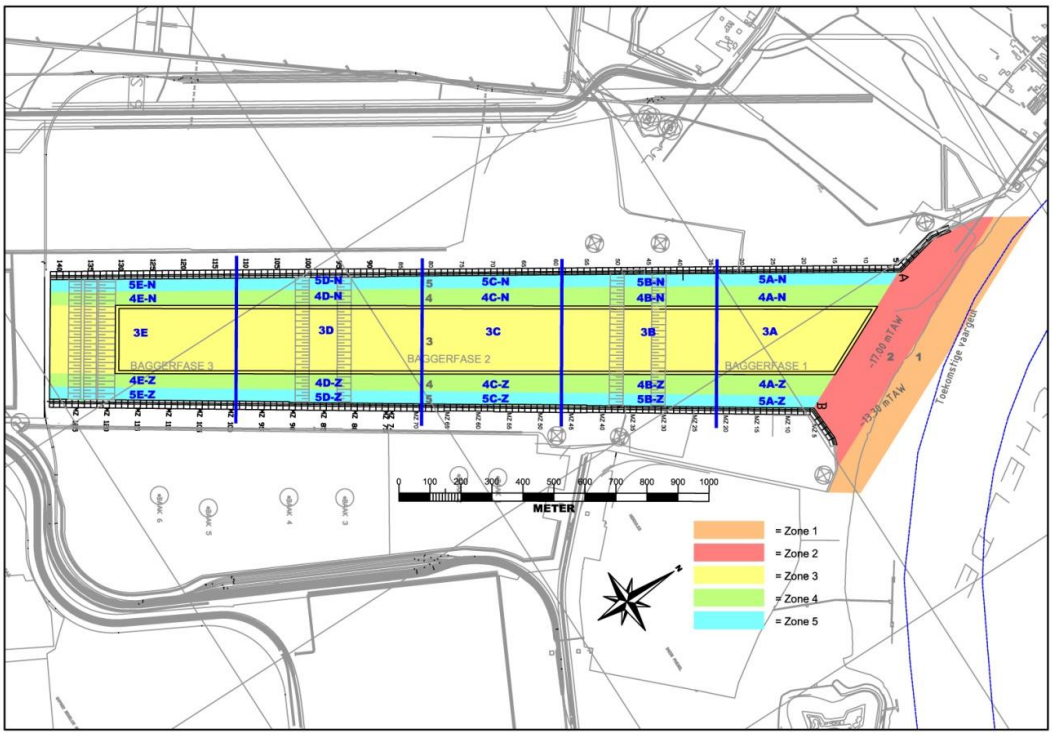


*Figure 4-1 : Deurganckdok: Zones and Subzones*

Sections are defined for this whole area (Figure 4-2):

- D sections are oriented perpendicular to the quay walls inside the dock and parallel to the navigation channel outside the dock (sill and Scheldt). The origin of the sections is taken on the quay wall at the left bank (West side) looking outwards.
- L Sections are oriented along the centreline of the dock and run from the navigation channel towards the inland end of the dock. The origin is situated on the intersection between each L section and section D10.

The coordinates of these sections are given in Table 4-1.

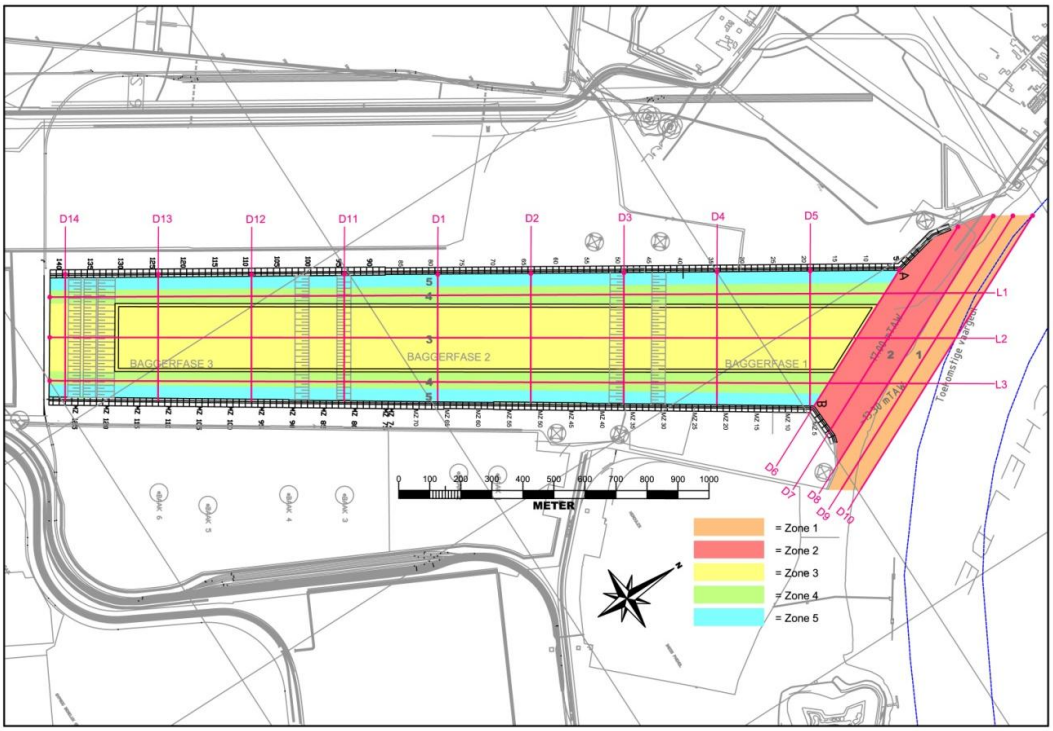


*Figure 4-2: Deurganckdok: D and L Sections*

*Table 4-1: Coordinates of Sections [UTM ED50]*

| ***Name*** | ***Origin*** | | ***End*** | |
|---|---|---|---|---|
| | ***Easting*** | ***Northing*** | ***Easting*** | ***Northing*** |
| ***D Sections*** | | | | |
| D1 | 587773 | 5683253 | 588123 | 5683037 |
| D2 | 587929 | 5683510 | 588283 | 5683290 |
| D3 | 588084 | 5683767 | 588444 | 5683544 |
| D4 | 588239 | 5684023 | 588604 | 5683797 |
| D5 | 588394 | 5684280 | 588765 | 5684051 |
| D6 | 588542 | 5684526 | 588772 | 5684062 |
| D7 | 588521 | 5684761 | 588864 | 5684068 |
| D8 | 588552 | 5684875 | 588972 | 5684027 |
| D9 | 588585 | 5684930 | 589047 | 5683994 |
| D10 | 588617 | 5684984 | 589081 | 5684047 |
| D11 | 587615 | 5682997 | 587962 | 5682783 |
| D12 | 587459 | 5682742 | 587802 | 5682529 |
| D13 | 587300 | 5682487 | 587642 | 5682276 |
| D14 | 587143 | 5682232 | 587482 | 5682023 |
| ***L Sections*** | | | | |
| L1 | 588748 | 5684720 | 587180 | 5682151 |
| L2 | 588825 | 5684565 | 587290 | 5682082 |
| L3 | 588901 | 5684410 | 587409 | 5682007 |

## 4.2 DEPTH OF THE WATER-BED INTERFACE (210 KC)

This is shown as a GIS grid map generated directly from the depth sounding data. The initial and final bathymetries are shown in Figure 4-3, and the enlarged format can be found in Annex A. Additionally the intermediate depth soundings are present.

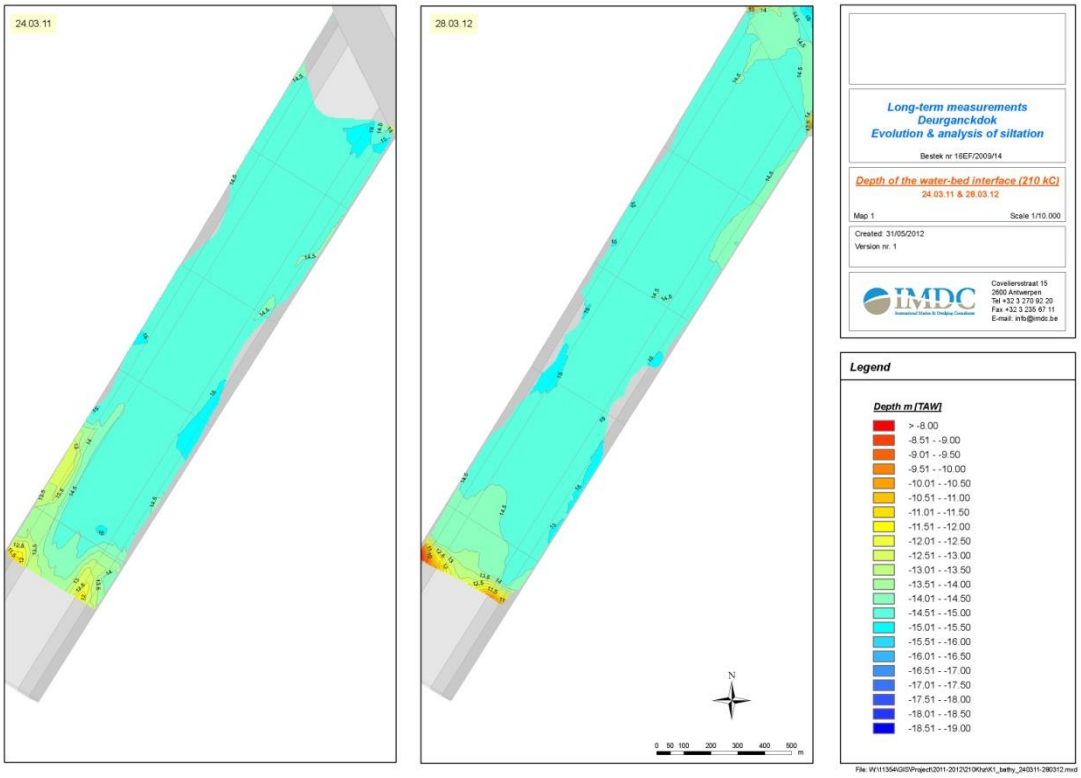


*Figure 4-3: Map showing the depth of the water-bed interface (210 kC) for 24/03/2011 (first measurement) and 28/03/12 (last measurement).*

## 4.3 EVOLUTION OF WATER-BED INTERFACE (210 KC)

GIS grid maps show the difference charts for every depth sounding in relation to a reference situation and to the previous sounding. Figure 4-4 shows such a difference chart covering the period of one year.

The difference in depth between subsequent depth soundings for 210 kC measurements is also shown for all predefined sections. Graphs show a colour plot with Time in the X-axis, Distance to origin of section in the Y-axis and the depth of the top layer [m TAW] as a colour plot. The origin for the D sections is the northern quay wall. The origin of the L sections is the intersection between the L section with the Scheldt edge of zone 1. An example for sections is shown in Figure 4-5. The description of the sections is given in § 4.1.

Maps and graphs are shown in Annex B.

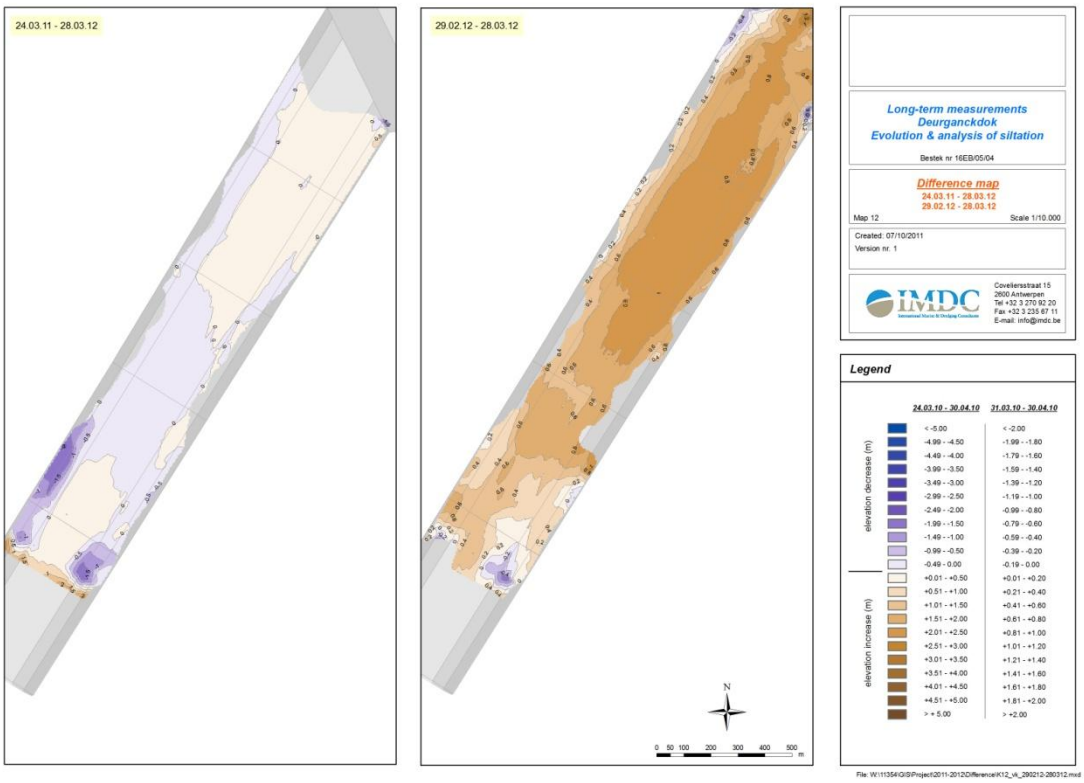


*Figure 4-4: Difference charts of the depth sounding on 28/03/12 in reference to 24/03/11 (left) and to the previous measurement of 29/02/12 (right).*

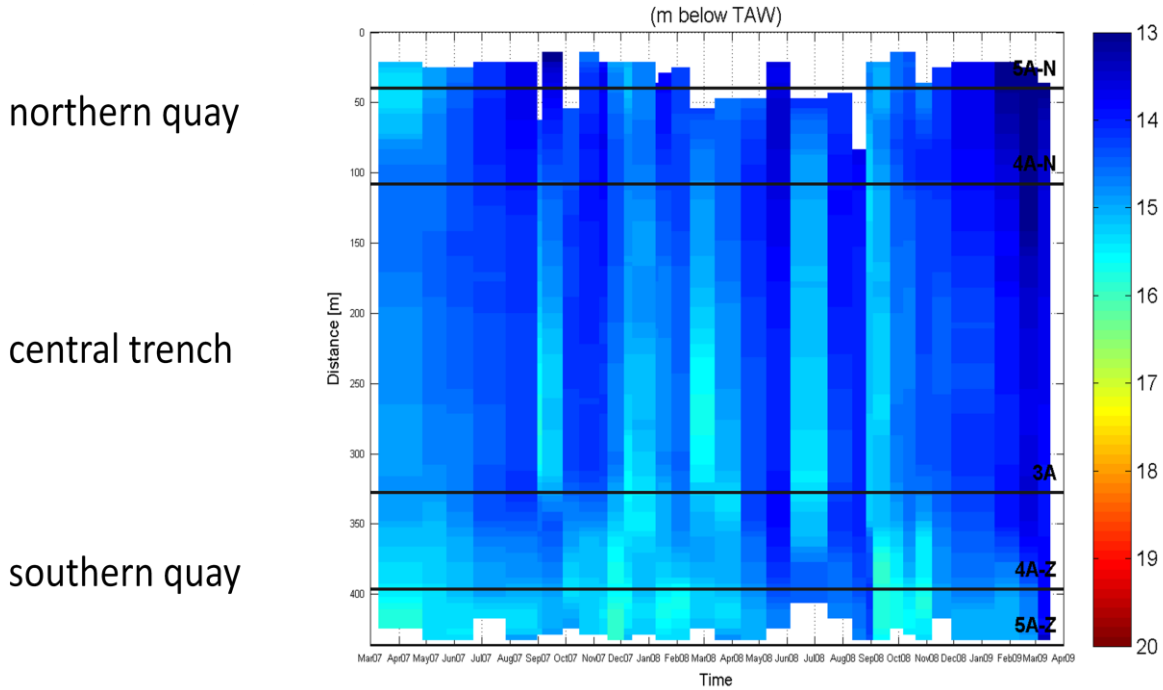


*Figure 4-5: Example of a graph of evolution of the water-bed interface (210 kC).*

## 4.4 VOLUMETRIC SILTATION RATES [CM/DAY] IN DIFFERENT ZONES AND SECTIONS

From the depth soundings, for the different zones and sections the volumetric siltation rates [cm/day] have been determined. A table with monthly average siltation rates for all (sub)zones is given in Annex C.1. Graphs in Annex C show two parameters:

- Average siltation rates [cm/day]: The average siltation rate is the difference in the depth of the water-bed interface and is calculated only for those zones and subzones that have at least a 50% surface area overlap between two subsequent depth soundings. This is done for all successive depth soundings. It is shown in the plots as a bar and is positive for sedimentation and negative for erosion or removal.
- Cumulative bed level change [m]: an initial situation (t0: design depth) is used as baseline. Starting from this reference level the evolution of the average bed level elevation is shown for the particular (sub)zone.

Dredging events from the BIS system are marked on each of these graphs. This is computed for all zones, subzones, sections and Deurganckdok as a whole. As an example we show the siltation rate and cumulative bed level change for the whole dock in Figure 4-6.

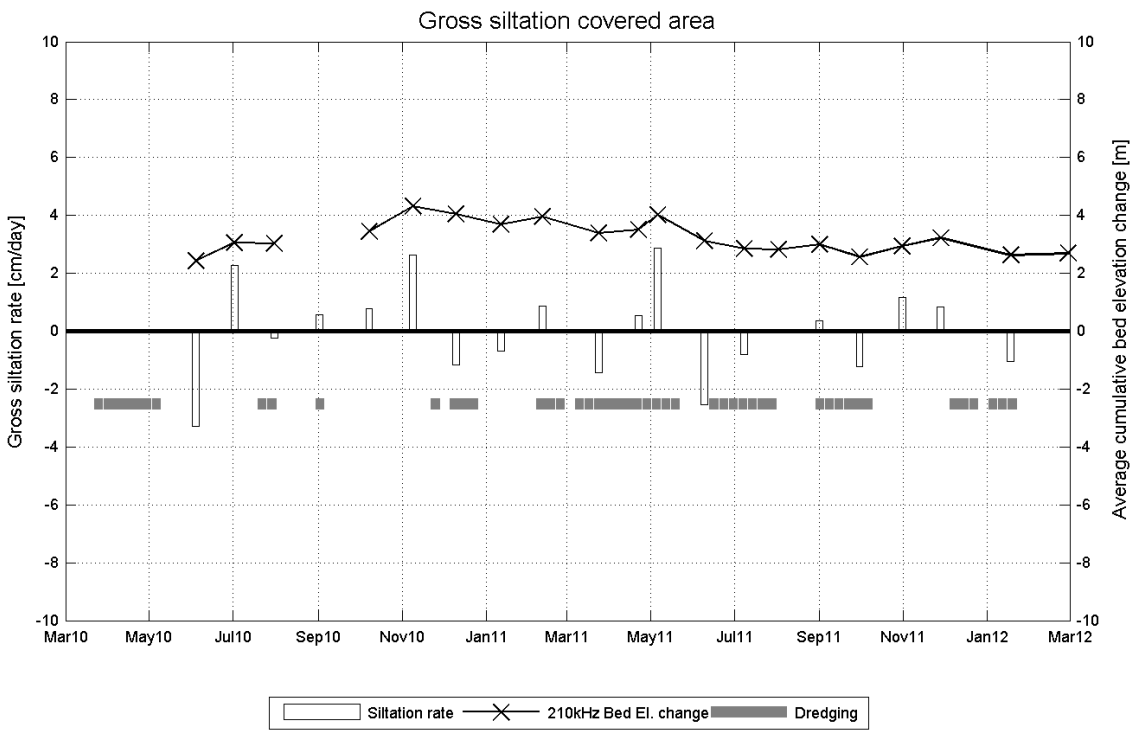


*Figure 4-6: Volumetric siltation rate for the whole dock from April 2010 to March 2012.*

## 4.5 AVERAGE NET MASS EVOLUTION

The average net mass growth [TDS/m²] in all zones and subzones is based on density profile measurements (measured sediment mass). The actual sediment mass present in the dock and measured by density profiling does not take the removed dredged material into account.

The mass removed by dredging can be computed from BIS data (dredged material mass). Only zones spatially covered for 50% and more by density measurements are considered for sediment mass calculations. Unmeasured parts of these zones retrieve a value for the calculations (in order to close the mass balance of the zone), being the average mass per square meter based on the actual density measurements of the considered zone.

By adding measured mass to dredged material mass, the total accumulated mass and hence the growth can be shown (see Figure 4-7). In case this total mass can be computed for the complete dock (or a zone) for two subsequent measurements, an estimation of the net sediment flux into the dock (or zone) during the intermediate period is given by the difference of both total mass values. The net sediment flux into an area can also be defined as the net mass growth (kg/m² or Ton Dry Solids/m²). Division of the net mass growth of a zone by the number of days in between measurements leads to the averaged net mass growth rate. Note that two years of data series are plotted in order to have a good view on the net mass evolution.

The averaged net mass growth rate [kg/m²/day] is computed for each zone and subzone and is shown in Annex H. An example is shown in Figure 4-8 for the whole central trench (zones 3A to 3D, excluding 3E which is hardly dredged). In addition a similar graph is given in terms of total mass variation of the central trench rather than a growth rate per unit area.

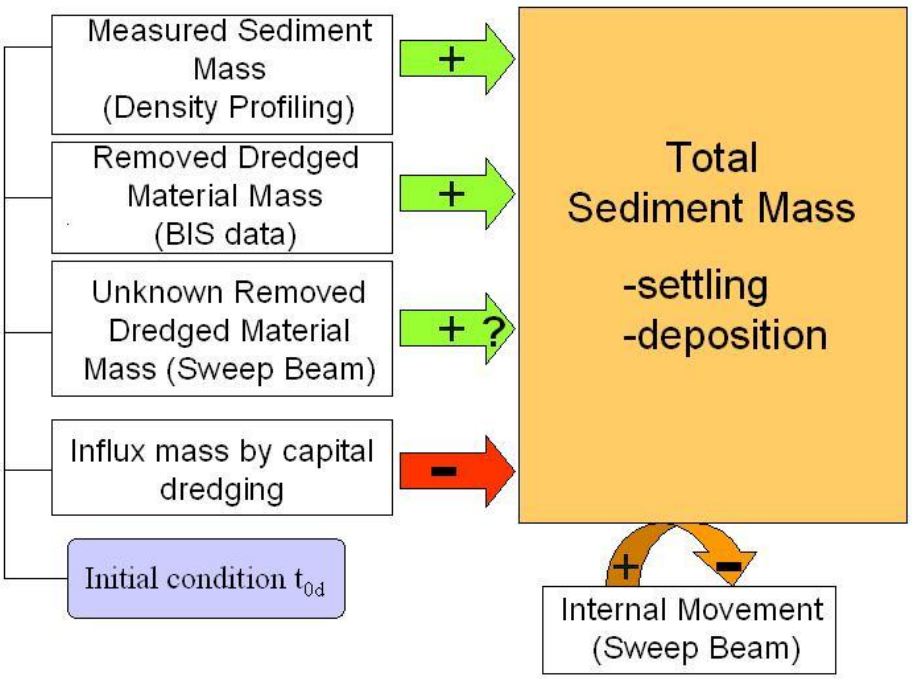


*Figure 4-7: Flow chart with different elements contributing to total sediment mass for (sub)zones and total area*

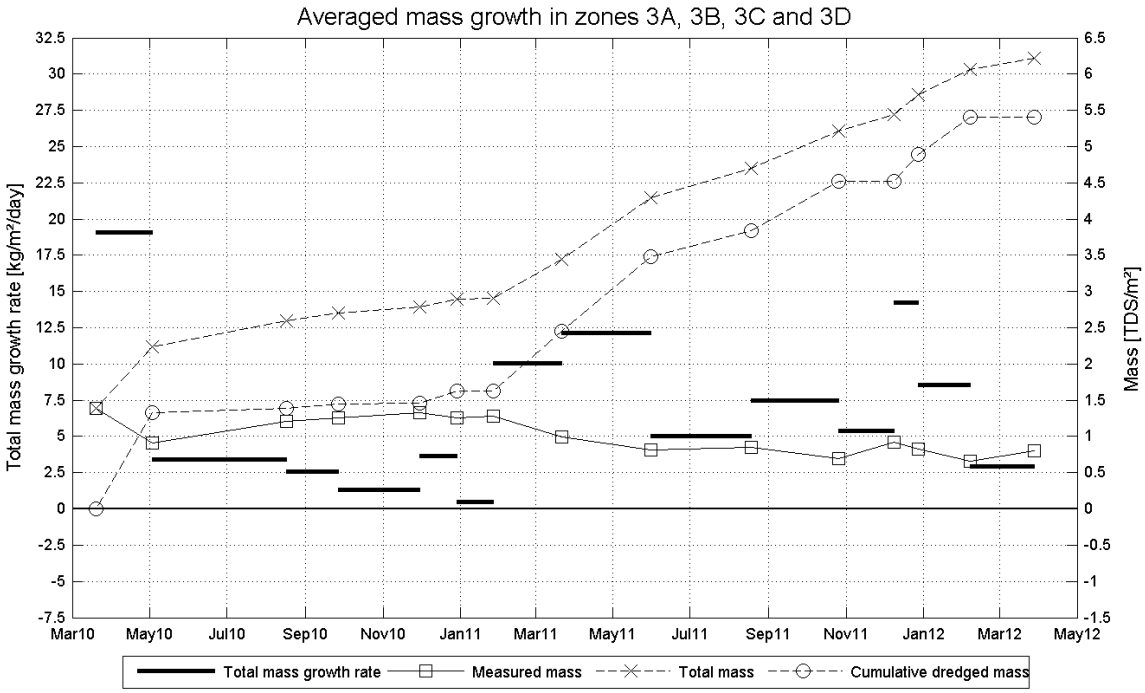


*Figure 4-8: Example of averaged mass growth and mass evolution from April 2010 to March 2012 for the central trench (subzones 3A to 3D).*

Clearly, the sediment mass balance is incomplete because sediment fluxes cannot be derived from the sweep beam data (of which no mass or volume information is available). Internal movements of sediment by the sweep beam (berthing zones to central trench) and removal of sediments from the sill into the Lower Sea Scheldt definitely influence the mass balance for (sub)zones and the total dock.

A table in Annex H.1 gives an overview for all zones and subzones for the following parameters, and this only if data is available for at least 50 % of this (sub)zone:

- Measured Sediment mass [TDS/m²]
- Dredged Material mass (absolute) [TDS]
- Total Sediment mass [TDS/m²]
- Growth rate [kg/m²/day]
- Total area [ha]
- Covered area [ha]: area covered by density profiles
- Percent of zone covered [%]

Additionally, difference maps are presented in Annex G to visualize spatial variations of the total settled mass between two density profile measurements. The measured mass is calculated and interpolated in the whole dock from the density profiles, the mass dredged between the two measurements is not included.

# 5. PRELIMINARY ANALYSIS OF THE DATA

## 5.1 INTRODUCTION

This chapter discusses the measurements on a yearly basis.

With respect to the data analysis and its interpretation, it is important to keep in mind the different contributing terms in the sediment mass balance of each defined zone in the Deurganckdok:

$$\frac{dM_s}{dt} = R_{siltation} - R_{erosion} \pm R_{sweepbeam} - R_{maintenance} \pm R_{capitaldredging}$$

with:

- $M_s$ = local amount of sediment mass [TDS]
- $R_{siltation}$ = sediment mass flux from siltation [TDS/day]
- $R_{erosion}$ = sediment erosive flux [TDS/day]
- $R_{sweepbeam}$ = mass flux from sweep beam dredging operations [TDS/day]
- $R_{maintenance}$ = mass flux from maintenance dredging [TDS/day]
- $R_{capital\ dredging}$ = mass flux from capital dredging [TDS/day]

It is important to note that observations of bed level changes (from depth soundings and density measurements) refer to the gross effect of all contributing terms. Strictly seen, the siltation rate is only observed when no other process takes place at a specific location. With respect to the erosive flux, it is expected that flow velocities and shear forces are so low that erosion can be neglected from the mass balance.

The siltation in Deurganckdok can in fact be described in both a volumetric and a densimetric manner. The sediment volume is difficult to interpret because sediment volume is not conservative, i.e. sedimentation and consolidation increases the local sediment concentration. Sediment mass is therefore a better way of studying the siltation in the dock. However, due to the vast amount of depth soundings performed in this study and their additional information to density measurements, it is interesting to look at these data too.

Firstly, the ‘volumetric siltation rate’ is computed from the temporal bed level change as obtained from the depth soundings. Because different processes result in these observations, it is crucial to understand what is meant by the computed ‘volumetric siltation rate’. For that reason, some definitions are considered important for the data interpretation:

- natural siltation rate: is computed from a time period in which only siltation occurs and no other external process;
- gross siltation rate: is computed from a time period in which other external processes occur besides the natural siltation;

The difference between these two definitions is schematised in Figure 5-1. Note that the gross siltation rate may also be larger than the natural one due to e.g. sweep beam activities, which may import sediment into the considered dock zone.

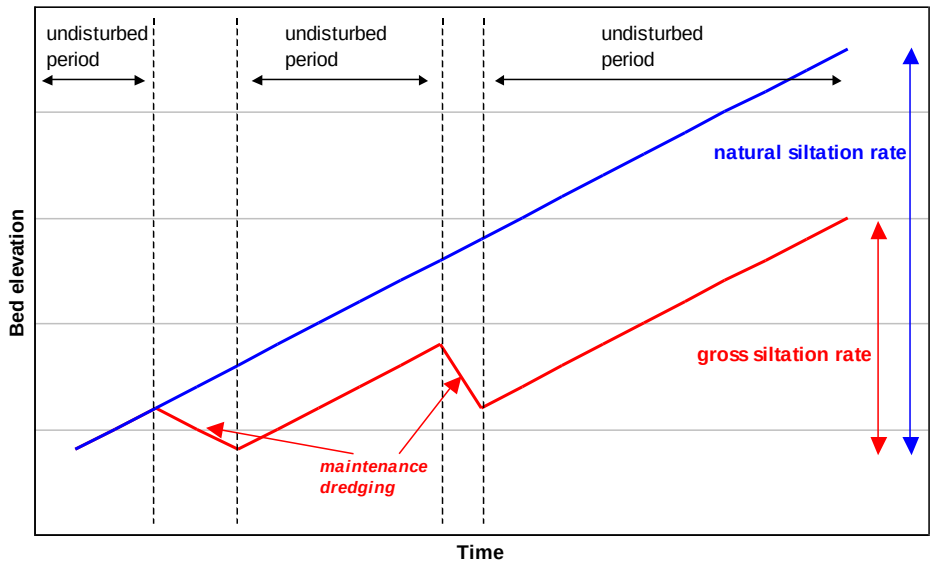


*Figure 5-1: difference between natural and gross (volumetric) siltation rate*

Secondly, the sediment mass distribution and its temporal evolution are studied. Here, densimetric growth rates can be calculated for the different dock zones. Because dredged mass is known, the sediment mass settled in a specific time frame can be computed, similar to the volumetric siltation rate as shown in Figure 5-1. Hence, according to Figure 5-2, the total sediment mass deposition rate (i.e. the densimetric growth rate) is to be computed as:

$$R_{siltation} = \frac{M_{meas,2} - M_{meas,1} + M_{dredge}}{t_2 - t_1}$$

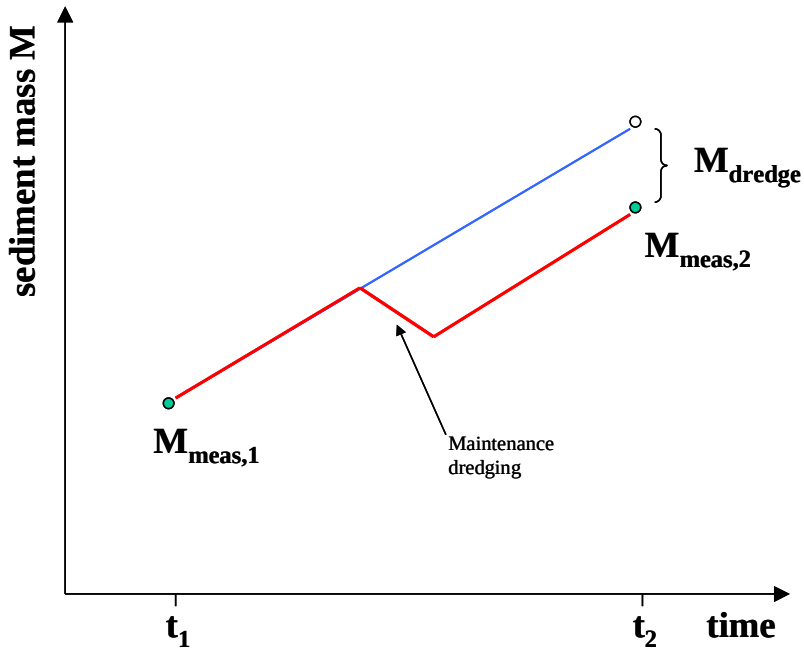


*Figure 5-2: Principle of total deposited sediment mass calculated from the measured mass Mmeas and dredged mass Mdredge*

Seen the nature of collected data and their relation to the sediment balance, the chapter below will discuss the following topics:

- changes in elevation of the water-bed interface, i.e. the volumetric siltation rate;
- the accumulation of sediment mass in the dock, i.e. the densimetric siltation rate; and
- the dredged sediment mass.

## 5.2 VOLUMETRIC ANALYSIS

Depth sounding data was processed to show the evolution of the bed level as detected by the 210 kHz sounder. If more than 50% of the area of a (sub)zone was covered, an average bed level change was calculated.

Below, the natural and the gross yearly averaged siltation rates are discussed.

### 5.2.1 Gross yearly averaged siltation rate

To compute a gross yearly averaged siltation rate for every zone of the dock, the subsequent bed level measurements are used. As a consequence, effects from dredging activities are included in these results. The obtained siltation rates therefore refer to a gross yearly averaged siltation rate. This gross siltation rate is valid for the time period between March 24th 2011 and March 28th 2012. In the case of incomplete depth soundings, such as for example

on May 6th 2011 (cf. Annex C.1), the siltation rate in the missing zones has been calculated between the last good depth sounding and the current sounding.

The results are shown in Table 5-1, which indicate that, in general, gross siltation rates are very small and often negative. This is in accordance with the comparable central trench bed level (3a – 3d) and the lower bed level in zones 5Nd – 4Nd at the end of the year compared to the beginning (cf. Figure 4-3). This table shows a gross siltation rate of around -0.03 cm/day, with more variable estimates in zones 5Z and 5N due to their small size and a lack of data. No siltation rates are given for zone E because no depth soundings are available here. Observations are in agreement with the depth soundings: dredging activities maintained the bed level in several periods between the beginning of April 2011 and the end of March 2012.

*Table 5-1: Gross yearly averaged siltation rates for every zone (cm/day).*

| Zone | 5N | 4N | 3 | 4Z | 5Z |
|---|---|---|---|---|---|
| A | -0.03 | 0.02 | 0.04 | 0.05 | 0.06 |
| B | -0.08 | -0.03 | 0.02 | 0.01 | 0.00 |
| C | -0.15 | -0.05 | -0.03 | 0.01 | 0.00 |
| D | -0.25 | -0.16 | -0.01 | -0.01 | -0.04 |
| E | - | - | - | - | - |

### 5.2.2 Natural siltation rate

The observed siltation rates in §5.2.1 are the result of many processes of which natural siltation is only one. Human interferences such as maintenance and sweep beam dredging indeed largely influence the sediment balance of the dock. Whereas the maintenance dredging removes sediment from the dock, sweep beam dredging along the quays simply relocates the sediment towards the central trench (where it is removed by a subsequent maintenance dredging operation).

Quantifying the natural siltation is important as it determines the necessary dredging frequency. To do so, it is essential to identify undisturbed periods in which no human interferences took place. From the observed bed elevation trend during such a period, the natural siltation rate can be calculated. Note that siltation rates depend on local bathymetric and hydrodynamic conditions. Hence, it is important to acknowledge that calculated siltation rates cannot be generalised. The calculations however return an order of magnitude for the siltation rates and allow the investigation of any spatial distribution of this process variable.

When investigating the siltation in zones A - D (cf. Annex C.1), from Table 3-5 five periods can be identified being undisturbed by maintenance dredging, see Table 5-2. Of these, all periods experience sweepbeam dredging (period 3 in lesser extent: no sweepbeam dredging between 16/10/2011 and 15/11/2011) which may still influence the results. During periods 1, 2 and 4 no subsequent depth soundings were performed and therefore no natural siltation rate can be calculated for these periods. Period 3 is the most representative since it both contains most data and is least subject to sweepbeam dredging. On the other hand, period 5 is the largest maintenance dredging inactive period and is therefore also interesting with regard to the natural siltation rate. The total mass of sediment dredged prior to period 3 represents 71.1% of all sediment dredged from April 1st 2011 to March 31st 2012.

*Table 5-2: Overview of periods investigated for natural siltation rates.*

| | Period | Time period (since last dredging) [days] | Total dredged amount[2] [TDS] | % annual dredged amount[2] |
|---|---|---|---|---|
| **Period 1** | 23/05/2011 – 12/06/2010 | 21 | 637 444 | 32.1 % of 2011-2012 |
| **Period 2** | 01/08/2011 – 28/08/2011 | 28 | 299 866 | 15.1 % |
| **Period 3** | 17/10/2011 – 04/12/2011 | 49 | 475 645 | 23.9 % |
| **Period 4** | 26/12/2011 – 01/01/2012 | 7 | 260 496 | 13.1 % |
| **Period 5** | 23/01/2012 – 28/03/2012 | 66 | 313 841 | 15.8 % |

[2] Dredged amount previous to undisturbed period

The natural siltation rates are determined based on two subsequent depth soundings which both lie within one of the periods of Table 5-2. The available natural siltation rates for the current investigated year are shown in Table 5-3. The following observations can be made:

- Natural siltation rates are higher than gross siltation rates: this is expected from the absence of dredging activities in these periods. The natural siltation rates in zone 5 are sometimes negative, this is probably due to the presence of sweepbeam dredging.
- Natural siltation rates are more than double in period 5 compared to period 3 and lie around 2.0 to 2.5 cm/day. No major capital dredging happened during the period which could contribute to this significantly different siltation rates. Differences in depth of the water-bed interface (-15.5m TAW at the start of period 5 and -15.0m TAW for period 3), the deeper dredging during the dredging campaign of January 2012 (cf. §5.3.1) is most likely the cause. Also seasonal differences in natural siltation rate could be part of the cause.
- Siltation rates are approximately constant or decreasing towards the end of the dock: this corresponds to the observations of 2008-2009 (but not of 2009-2011). However, spatial trends are difficult to establish due to the spatial variation of dredging intensity over the years, which influences how fast the system locally returns to equilibrium. Siltation rates also do not account for mass.
- Again, due to their smaller area and less data, natural siltation rates in zone 5 vary more, especially because sweepbeam dredging may have occurred in the meantime. General orders of magnitude are however in agreement with the previous observations.
- In 2004, sediment transport simulations of Deurganckdok were performed in order to investigate natural siltation rates (IMDC, 2004). The applied mathematical model indicated that the first one third of the dock, near the Scheldt, was characterised with a siltation rate of 1.4 cm/day and decreased when going more inside the dock. The sediment transport simulations of Van Maren (2006a; 2006b) predicted a decrease of the natural siltation of approximately 15% – 18% due to the effect of the Current Deflecting Wall. The siltation rate of 1.4 cm/day then

decreases to 1.19 – 1.15 cm/day. The spatial trend of siltation rates inside the dock is not found back consequently (period 5: yes, period 3: in lesser extent). The value of 1.19 – 1.15 cm/day is comparable to the range of measured values in zones 3a and 3b, but only for period 3 (0.9-1.3 cm/day), during period 5 the siltation rate was more than double that (3.0 cm/day).

The natural siltation rates seem to be in the same order of magnitude as previous years. All this possibly indicate a limited effect of the Current Deflecting Wall, although the evolution of sediment concentrations in the Scheldt river in relation to the deeper dredging of the dock should be considered as well. More natural siltation rates are needed to be able to further evaluate the effect of the Current Deflecting Wall on longer term.

*Table 5-3: Natural siltation rates obtained from undisturbed (except for sweepbeam dredging) measurement periods (empty if no data during measurement period). Siltation rates calculated between two consecutive depth soundings (indicated in table header).*

| ZONE | Natural siltation rates [cm/day] | | | |
|---|---|---|---|---|
| | Spring (period 1) | Summer (period 2) | Autumn (period 3) 31/Oct – 28/Nov '11 | Winter (period 5) 29/Feb – 28/Mar '12 |
| 3a | - | - | 0.89 | 2.96 |
| 3b | - | - | 1.30 | 3.13 |
| 3c | - | - | 1.52 | 2.73 |
| 3d | - | - | 1.02 | 1.91 |
| 4Na | - | - | 0.44 | 1.99 |
| 4Nb | - | - | 0.58 | 2.11 |
| 4Nc | - | - | 0.89 | 1.95 |
| 4Nd | - | - | 1.15 | 1.65 |
| 4Za | - | - | 0.86 | 2.80 |
| 4Zb | - | - | 0.60 | 3.12 |
| 4Zc | - | - | 0.39 | 2.59 |
| 4Zd | - | - | 0.37 | 1.33 |
| 5Na | - | - | | 0.18 |
| 5Nb | - | - | -0.67 | 0.94 |
| 5Nc | - | - | 0.59 | |
| 5Nd | - | - | 0.70 | 1.78 |
| 5Za | - | - | 0.65 | 2.04 |
| 5Zb | - | - | 0.29 | 2.46 |
| 5Zc | - | - | | |
| 5Zd | - | - | 0.34 | 1.09 |

## 5.3 DENSIMETRIC SILTATION RATE

The volumetric siltation rate, computed from 210 kHz depth sounding profiles, does not reveal the amount of mass that settled. Information on the consolidation process remains unknown too. For that reason, a densimetric analysis is performed as well. In this chapter, both the dredging and the sediment mass accumulation in the dock are discussed.

### 5.3.1 Dredged sediment mass

From the BIS data (see Table 5-4), it can be concluded that almost 2.0 million TDS was dredged over the entire measurement period (April 1st 2011 to March 31st 2012, 366 days). This is 3.4% more sediment mass withdrawn from the dock in comparison with the previous measurement period of March 19th 2010 to March 31st 2011, when 1.92 million TDS have been dredged. However, the increase is higher when the dredged volumes belonging to the year preceding the previous year are subtracted (250 000 TDS between March 19th and March 31st 2010). Taking this correction into account, 1.68 million TDS have been dredged in 2010-2011 (April 1st 2011 2010 to March 31st 2011) and 18.5% (instead of 3.4%) more sediment mass was withdrawn from the dock in 2011-2012. For a perfect comparison, the bed level at the beginning and the end of the measurement period should be equal, which is not the case. To give an idea of the uncertainty, a difference in average bed level of 0.5m, over a length of 2.2km, a width of 400m and at a dry density of 0.24 T/m³ (wet density 1.15 T/m³) represents 100 000 TDS. Still, 18.5% is a big difference and cannot be explained by uncertainty alone.

During the year 2011-2012 dredging was done deeper than previous years. This can be seen in the time evolution of the equal density layers in section L2 (cf. Annex F) where the deepest levels reached (due to dredging) by the water-bed interface, the layers of 1100 kg/m³ and 1200 kg/m³ are approximately 0.5 m – 1.0 m lower during 2011-2012 than previous years (2009-2011). This means that during the considered year the density of the dredged material was sometimes higher than previous years, which explains (partly) the 18.5% higher dredged sediment mass for 2011-2012.

According to Table 5-4, more than half of the dredging occurred during two periods, firstly between beginning of April 2011 and end of May 2011 (32.1%), secondly in September and October 2011 (23.9%). 65.2 % of the sediments dredged came from the central trench (zones 3a to 3d), while 16.4 % came from the zones 4N and 4Z, 13.8 % from the sill (zones 1 and 2) and 5.0 % from the end of the dock (zone 3e). No sediment was dredged in zones 5N and 5Z, in which only sweepbeam dredging occurs. During the periods between the density campaigns of 26/10/2011 and 09/12/2011 and of 07/02/2012 and 28/03/2012 (almost) no maintenance dredging occurred.

*Table 5-4 : Dredged mass per zone and dredging period between density measurement campaigns.*

| **Dredged mass (TDS) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Density campaign 1 | 01-Apr-11* | 31-May-11 | 18-Aug-11 | 26-Oct-11 | 9-Dec-11 | 28-Dec-11 | 7-Feb-11 | | |
| Density campaign 2 | 31-May-11 | 18-Aug-11 | 26-Oct-11 | 9-Dec-11 | 28-Dec-11 | 7-Feb-11 | 28-Mar-12 | **Total** | **%** |
| 1 | 17,048 | 42,420 | 15,458 | 0 | 19,379 | 10,265 | 0 | **104,570** | **5.3** |
| 2 | 30,439 | 64,666 | 34,002 | 0 | 23,874 | 15,994 | 0 | **168,974** | **8.5** |
| 3a | 97,607 | 31,416 | 66,347 | 277 | 62,310 | 103,399 | 0 | **361,356** | **18.2** |
| 3b | 113,801 | 39,436 | 59,049 | 500 | 34,907 | 39,161 | 0 | **286,854** | **14.4** |
| 3c | 104,102 | 39,028 | 55,566 | 699 | 28,239 | 33,698 | 0 | **261,332** | **13.2** |
| 3d | 134,572 | 48,552 | 115,151 | 0 | 34,797 | 52,745 | 0 | **385,818** | **19.4** |
| 3e | 28,796 | 11,542 | 52,985 | 0 | 1,457 | 4,415 | 0 | **99,196** | **5.0** |
| 4Na | 9,942 | 5,303 | 10,524 | 0 | 6,746 | 10,659 | 0 | **43,175** | **2.2** |
| 4Nb | 12,279 | 1,401 | 8,295 | 0 | 4,051 | 4,450 | 0 | **30,475** | **1.5** |
| 4Nc | 10,013 | 1,578 | 8,699 | 0 | 3,865 | 6,633 | 0 | **30,788** | **1.5** |
| 4Nd | 18,285 | 2,250 | 11,646 | 0 | 6,864 | 5,957 | 0 | **45,002** | **2.3** |
| 4Ne | 3,067 | 459 | 5,078 | 0 | 38 | 87 | 0 | **8,728** | **0.4** |
| 4Za | 14,475 | 8,147 | 9,219 | 0 | 9,703 | 17,029 | 0 | **58,574** | **2.9** |
| 4Zb | 18,320 | 1,600 | 8,611 | 0 | 10,433 | 3,987 | 0 | **42,950** | **2.2** |
| 4Zc | 11,281 | 384 | 4,868 | 0 | 6,699 | 3,067 | 0 | **26,299** | **1.3** |
| 4Zd | 12,140 | 773 | 7,310 | 0 | 5,658 | 2,193 | 0 | **28,074** | **1.4** |
| 4Ze | 1,176 | 0 | 2,839 | 0 | 0 | 71 | 0 | **4,086** | **0.2** |
| 5Na | 0 | 337 | 0 | 0 | 0 | 32 | 0 | **369** | **0.0** |
| 5Nb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Nc | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Nd | 102 | 0 | 0 | 0 | 0 | 0 | 0 | **102** | **0.0** |
| 5Ne | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Za | 0 | 572 | 0 | 0 | 0 | 0 | 0 | **572** | **0.0** |
| **Total 3a-3e** | **478,878** | **169,974** | **349,098** | **1,476** | **161,711** | **233,418** | **0** | **1,394,555** | **70.2** |
| **Total** | **637,444** | **299,866** | **475,645** | **1,476** | **259,020** | **313,841** | **0** | **1,987,293** | **100** |
| **%** | **32.1** | **15.1** | **23.9** | **0.1** | **13.0** | **15.8** | **0.0** | | |

* no density campaign, start of period considered (April 1st 2011 to March 31st 2012)

### 5.3.2 Densimetric growth rate

All observed growth rates are shown in Table 7-8 (cf. Annex H.1). FOR EACH ZONE shows the time evolution of the settled sediment mass as quasi linearly increasing in time for the central trench area. The growth rates for the separate zones in the central trench are shown in Table 5-5. They are generally higher than the growth rates of 2010-2011, probably a consequence of the deeper dredging of the central trench area (especially zones 3a and 3d) during September – October 2011 and December 2011 – January 2012 (as discussed in §5.3.1) and more sweepbeam activity (almost continuously over the whole year, cf. Table 3-5).

*Table 5-5: Densimetric growth rates in the central trench area, estimated from the total mass.*

| ZONE | Range of growth rate 2011-2012 [kg/m²/day] | Avg growth rate 2011-2012 [kg/m²/day] |
|---|---|---|
| 3A | 5 to 26 | 11.39 |
| 3B | 3 to 9 | 5.47 |
| 3C | 2 to 9 | 5.51 |
| 3D | 2 to 15 | 7.00? |

Table 5-6 shows the influence of dredging on the densimetric growth rates in the central trench, from 2007 to 2012. The difference in growth rates in the presence and absence of dredging can be due to two factors: maintenance dredging results in a lower bed level and a higher siltation rate, while sweepbeam dredging results in an artificial influx of sediment in the central trench. The highest growth rates during dredging are created when dredging occurs deeper than the reference measurement, resulting in a dredged “excess” which also has a higher dredged mass (because of the higher density). This causes the high growth rates not only to include new sediment mass which entered the dock between the considered density measurements but to also include sediment mass which was already in the dock at the reference measurement. The highest total “growth” rates were measured during and after the dredging campaigns of May 2011 and December 2011 – January 2012, during which the bed level has been deepened by around 1.0 m (cf. difference maps in Annex B.1 (09/06 – 06/05; 18/01 – 28/11)).

Densimetric growth rates were similar to slightly smaller near the quays in comparison to the values observed in the central trench, and generally were in the order of -1 to 5 kg/m²/day, with maximum values around 13 kg/m²/day. Growth rates are sometimes negative near the quay walls, where sweepbeam dredging took place (cf. Table 7-8 in Annex H.1). These observations are in accordance with previous measurements.

*Table 5-6: Influence of dredging on densimetric growth rates in the central trench area (3A-D)*

| kg/m²/day | 2007 – 2008 | 2008 – 2009 | 2009 – 2010 | 2010 – 2011 | 2011 – 2012 |
|---|---|---|---|---|---|
| no dredging | 2 – 8 | 1 – 15 | 2 – 8 | -1 – 6 | 2 – 6 |
| dredging | 11 – 20 | 8 – 25 | 10 – 30 | 9 – 19 | 4 – 26 |
| difference | ~10 | ~5 – 10 | ~10 – 20 | ~10 | ~5 – 20 |

### 5.3.3 Total (cumulative) mass

Annex H.1 shows the total cumulative mass for the currently considered year in Table 7-6 and Table 7-7. This is visualised in FOR EACH ZONE for each separate zone and in Annex H.3 for the central trench area. In Figure 4-8 this is shown for the previous and current years (March 2010 – March 2012). These tables present the total cumulative mass calculated in each zone during each density campaign. The total cumulative mass is the sum of the measured mass with reference to the design level (cf.

Table 7-3 and Table 7-4 in Annex H.1) and the cumulative dredged mass since March 20th 2010 (cf. Table 5-4).

Zones 3A-D and 4A-D (Z and N) have a 100 % coverage, zones 5 and E (landside end) have a varying degree of coverage, sometimes under 50 % (cf. Table 7-11 in Annex H.1).

The data shows a higher cumulative sediment mass near the entrance of the dock (zone 3a) and increasing again at the end of the dock (zone 3d compared to zone 3c). This is also shown in Table 5-7.

*Table 5-7: Mass settled per subzone in zones 3 and 4 (measured + dredged, in $10^3$ TDS) from March 2011 to March 2012.*

| **Growth in zones 3 and 4 (x$10^3$ TDS) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 22-Mar-11 | 31-May-11 | 18-Aug- 11 | 26-Oct-11 | 9-Dec-11 | 28-Dec-11 | 7-Feb-2012 | |
| | 31-May-11 | 18-Aug- 11 | 26-Oct-11 | 9-Dec-11 | 28-Dec-11 | 7-Feb-2012 | 28-Mar-12 | Total |
| zone A | 99 | 61 | 70 | 37 | 59 | 100 | 27 | 454 |
| zone B | 121 | 47 | 60 | 41 | 28 | 17 | 25 | 338 |
| zone C | 101 | 41 | 54 | 32 | 26 | 26 | 14 | 294 |
| zone D | 123 | 47 | 92 | 35 | 52 | 46 | 16 | 412 |
| **total** | 444 | 196 | 277 | 146 | 165 | 188 | 82 | |

# 6. CONCLUSIONS AND LIMITATIONS

The present report aims at quantifying the different processes that contribute to the sediment balance in order to compute the sediment influx from the Scheldt. The different contributions are schematically shown in Figure 2-4 and the sediment balance equation is to be found in §5.1.

As in 2009-2010 and 2010-2011, the 2011-2012 campaign covered an entire year of densimetric measurements enabling the setup of a mass balance. Different processes of the sediment transport have been considered densimetrically, such as:

- maintenance dredging;
- capital dredging;
- settling and consolidation (measured indirectly by the local sediment densities).

Only one process has been inadequately described, i.e. the sweep beam actions. Although the depth of the rake or plough and its location is known, it is difficult to estimate the transport capacity of it. The question indeed remains whether the rake introduces a momentum so the sediment flows in the direction of the rake movement, or the rake pushes the sediment. The sweep beam data has therefore only been used for data interpretation.

The bed level measured by the depth soundings was approximately the same at the start (24/03/2011) and end (28/03/2012) of the considered year. The natural siltation rate (estimated to be 1 – 3 cm/day) is comparable to – if somewhat higher than – previous years. On the other hand 18.5% more sediment mass was dredged compared to the previous year. This was mainly the result of deeper dredging in the central trench area (especially in zones 3a and 3d) than the previous year which caused sediment with a higher density to be dredged.

Important dredging activities took place from end of March 2011 to the end of May 2011, and accounted for 32.1% of the total dredged mass. Also periods September-October and December-January, during which the deeper dredging occurred, were important (52.7% of the total dredged mass).

The construction of the current deflecting wall (CDW) near the northern entrance of the dock was finished in August 2011. The present considered year is therefore the first complete year where the influence of the CDW can be investigated. Several factors have made it very difficult to make an investigation and a conclusion of the effect of the Current Deflecting Wall:

- The considered year was marked by a lot of dredging activity: Sweepbeam dredging almost all year round and long periods of maintenance dredging have caused limited data with regard to the natural siltation rate;
- Deeper dredging than previous years makes comparison of the dredged mass with previous years not very meaningful with regard to the natural sediment mass growth in the dock.
- The evolution of sediment concentrations in the Scheldt river in relation to the deeper dredging of the dock should be investigated.

More years of measurements are needed to have more periods of inactivity in the dock, which will allow to better evaluate the effect of the Current Deflecting Wall on the natural siltation.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

IMDC (2008t) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing Deelrapport 1.20: Sediment Balance: Three monthly report 1/4/2008 – 30/06/2008 (I/RA/11283/08.076/MSA)

IMDC (2008u) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.20: Through tide measurement Sediview during average tide Spring 2008 – 19 June 2008 (I/RA/11283/08.081/MSA)

IMDC (2008v) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.21: Through tide measurement Sediview during average tide Spring 2008 – 26 June 2008 (I/RA/11283/08.082/MSA)

IMDC (2008w) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing Deelrapport 1.21: Sediment Balance: Three monthly report 1/7/2008 – 30/09/2008 (I/RA/11283/08.077/MSA)

IMDC (2008x) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.22: Through tide measurement Sediview during neap tide Summer 2008 – 24 September 2008 (I/RA/11283/08.083/MSA)

IMDC (2008y) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.28: Through tide measurement ADCP eddy Summer 2008 – 1 October 2008 (I/RA/11283/08.089/MSA)

IMDC (2008z) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.32: Salt-Silt distribution Deurganckdok: six monthly report 1/4/2008 – 30/9/2008 (I/RA/11283/08.093/MSA)

IMDC (2008aa) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.20: Boundary conditions: Six monthly report 1/4/2008 – 30/09/2008 (I/RA/11283/08.096/MSA)

IMDC (2009a) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.23: Through tide measurement Sediview during spring tide Summer 2008 – 30 September 2008 (I/RA/11283/08.084/MSA)

IMDC (2009b) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.29: Through tide measurement SiltProfiler summer 2008 – 29 September 2008 (I/RA/11283/07.090/MSA)

IMDC (2009c) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.34: Calibration stationary & mobile equipment autumn 2008 (I/RA/11283/08.095/MSA)

IMDC (2009d) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing Deelrapport 1.22: Sediment Balance: Three monthly report 1/10/2008 – 31/12/2008 (I/RA/11283/08.078/MSA)

IMDC (2009e) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.24: Through tide measurement Sediview during neap tide Autumn 2008 (I/RA/11283/08.085/MSA)

IMDC (2009f) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.25: Through tide measurement Sediview during spring tide Autumn 2008 (I/RA/11283/08.086/MSA)

IMDC (2009g) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing Deelrapport 1.23: Sediment Balance: Three monthly report 1/01/2009 – 31/03/2009 (I/RA/11283/08.079/MSA)

IMDC (2009h) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing Deelrapport 1.24: Annual Sediment Balance (I/RA/11283/08.080/MSA)

IMDC (2009i) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.26: Through tide measurement Sediview during neap tide Winter 2009 (I/RA/11283/08.087/MSA)

IMDC (2009j) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.30: Through tide measurement SiltProfiler winter 2009 (I/RA/11283/08.091/MSA)

IMDC (2009k) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.31: Through tide measurement Salinity Profiling winter 2009 (I/RA/11283/08.092/MSA)

IMDC (2009l) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.33: Salt-Silt distribution Deurganckdok: six monthly report 1/10/2008 – 31/3/2009 (I/RA/11283/08.094/MSA)

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IMDC (2009n) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.27: Through tide measurement Sediview during spring tide Winter 2009 (I/RA/11283/08.088/MSA)

IMDC (2009o) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 4.20: Analysis of siltation Processes and Factors (I/RA/11283/08.098/MSA)

IMDC (2009p) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.35: Salt-Silt distribution Deurganckdok: nine monthly report 1/04/2009 – 31/12/2009 (I/RA/11283/09.085/MSA)

IMDC (2010a) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.5 Through Tide measurement: eddy currents DGD 02/03/2010 (I/RA/11283/10.051/MSA)

IMDC (2010b) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.8 Sal-Silt distribution Deurganckdok 01/04/2009 – 31/03/2010 (I/RA/11354/10.068/NZI)

IMDC (2011a) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 1.1 Annual Sediment Balance year 1: 1/04/2009 – 31/03/2010 (I/RA/11354/10.067/NZI)

IMDC (2011b) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 1.2 Annual Sediment Balance year 2: 1/04/2009 – 31/03/2010 (I/RA/11354/10.100/MBO/ANF)

IMDC (2011c) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 1.4 Boundary Conditions year 1: 01/04/2009 – 31/03/2010 (I/RA/11354/10.102/MBO/ANF)

IMDC (2011d) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 1.7 Synthesis report of research on Current Deflecting Wall (I/RA/11354/10.063/MBO)

IMDC (2012a) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.1 Through Tide Sediview measurement: entrance DGD during spring tide in Autumn 2011 (I/RA/11354/10.106/MBO/ANF)

IMDC (2012b) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.1 Through Tide Sediview measurement: entrance DGD during neap tide in Autumn 2011 (I/RA/11354/10.107/MBO/ANF)

IMDC (2012c) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.5 Through Tide measurement: eddy currents DGD Autumn 2011 (I/RA/11354/10.110/MBO/ANF)

IMDC (2012d) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.10 Salt-Silt & Current Distribution entrance Deurganckdok: Frame measurements and through tide measurements: Autumn 2011 (I/RA/11354/11.131/BQU)

IMDC (2012e) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.12 Calibration stationary & mobile equipment 16/03/2011 (I/RA/11354/11.113/MBO/ANF)

IMDC (2012f) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 1.5 Boundary conditions year 2: 01/04/2010 – 31/03/2011 (I/RA/11354/11.103/MBO/ANF)

IMDC (2012g) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.3 Through Tide Sediview measurement: entrance DGD during spring tide in Winter 2012 (I/RA/11354/10.108/MBO/ANF)

IMDC (2012h) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.4 Through Tide Sediview measurement: entrance DGD during neap tide in Winter 2012 (I/RA/11354/10.109/MBO/ANF)

IMDC (2012k) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.7 Through Tide measurement: eddy currents DGD Winter 2012 (I/RA/11354/10.111/MBO/ANF)

IMDC (2012l) Evaluatie externe effecten aanslibbing Deurganckdok Deelrapport 2.11 Salt-Silt & Current Distribution entrance Deurganckdok: Frame measurements and through tide measurements: Winter 2012 (I/RA/11354/11.114/MBO/ANF)

IMDC (2012m) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 1.3 Annual Sediment Balance year 3: 1/04/2011 – 31/03/2012 (I/RA/11354/10.101/MBO/ANF)

IMDC (2012n) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.9 Sal-Silt distribution Deurganckdok 01/04/2009 – 31/05/2010 (I/RA/11354/10.112/MBO/ANF)

IMDC (2012o) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 2.13 Calibration stationary & mobile equipment 01/06/2012 (I/RA/11354/12.011/JCA)

IMDC (2012p) Evaluatie externe effecten aanslibbing Deurganckdok. Deelrapport 1.6 Boundary conditions year 3: 01/04/2011 – 31/03/2012 (I/RA/11354/11.104/MBO/ANF)

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

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

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

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Van Maren (2006b). 3D slibtransport model Zeeschelde, scenario 4: Effect CDW op sedimentatie Deurganckdok, nieuw instrumentarium. Z3824.70, rapport IVd, 80 p.

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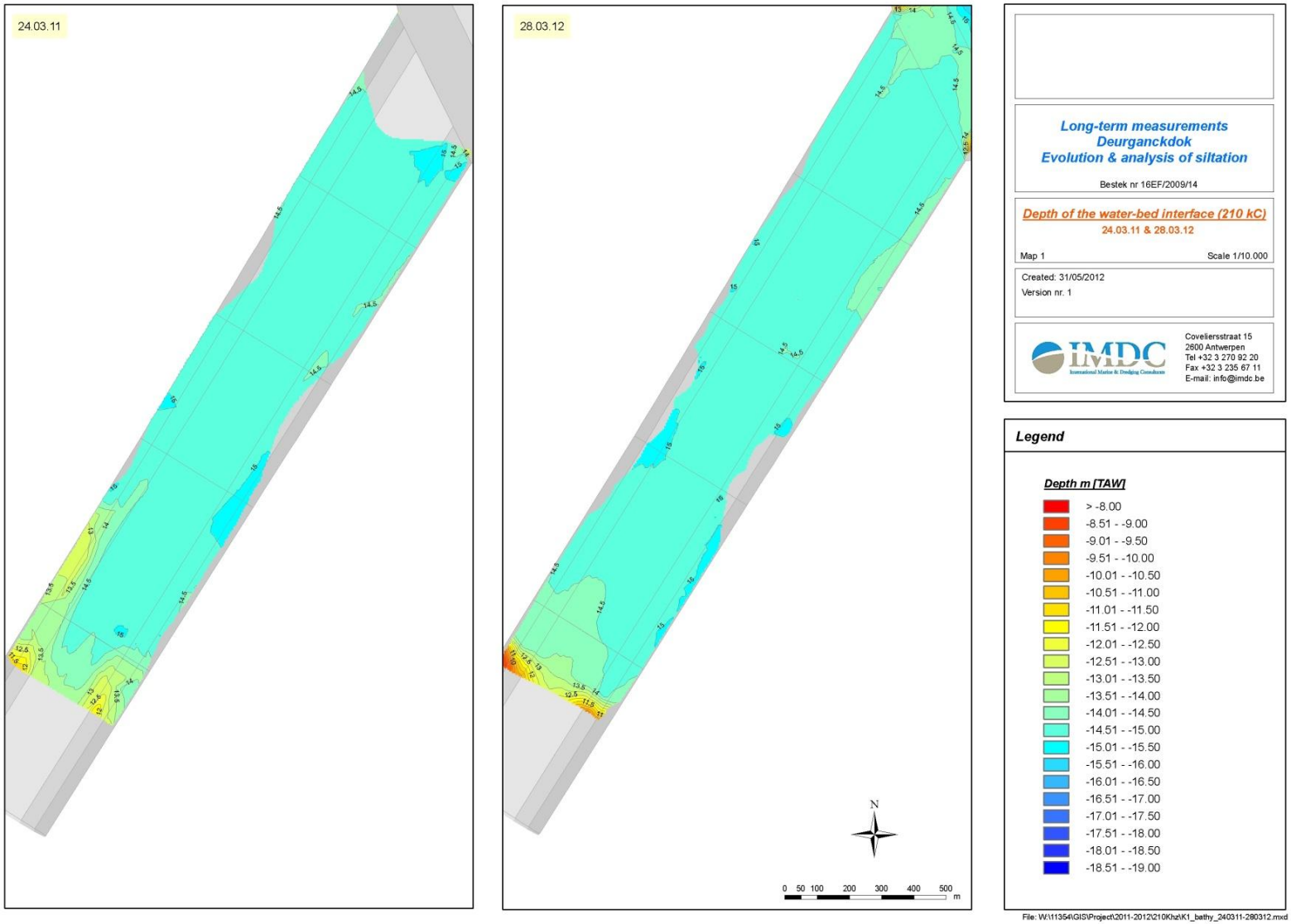
# Annex A Depth of the water-bed interface (210 kHz)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Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EF/2009/14
Depth of the water-bed interface (210 kC)
24.03.11 & 28.03.12
Map 1
Scale 1/10.000
Created: 31/05/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
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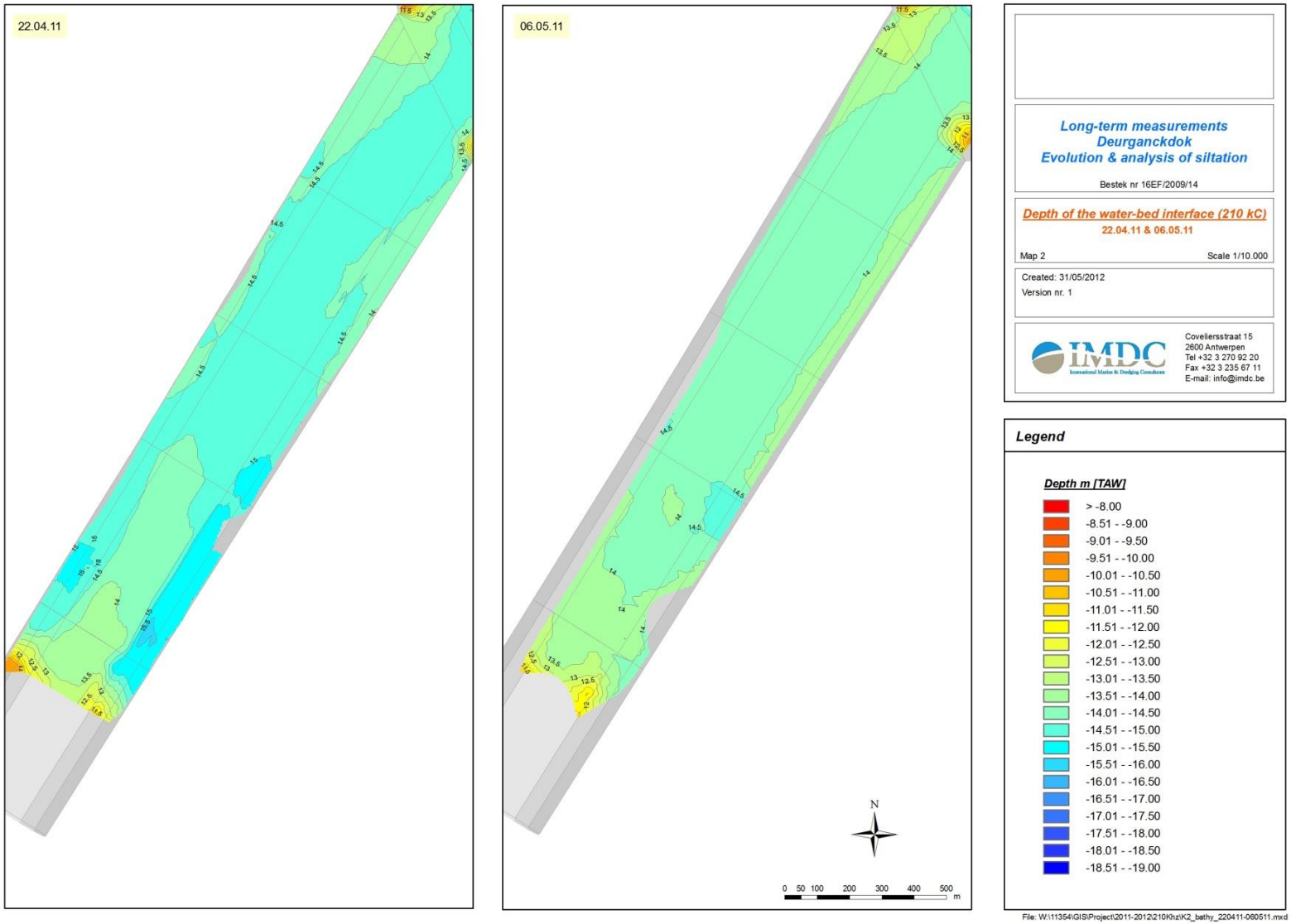
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Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EF/2009/14
Depth of the water-bed interface (210 kC)
22.04.11 & 06.05.11
Map 2
Scale 1/10.000
Created: 31/05/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
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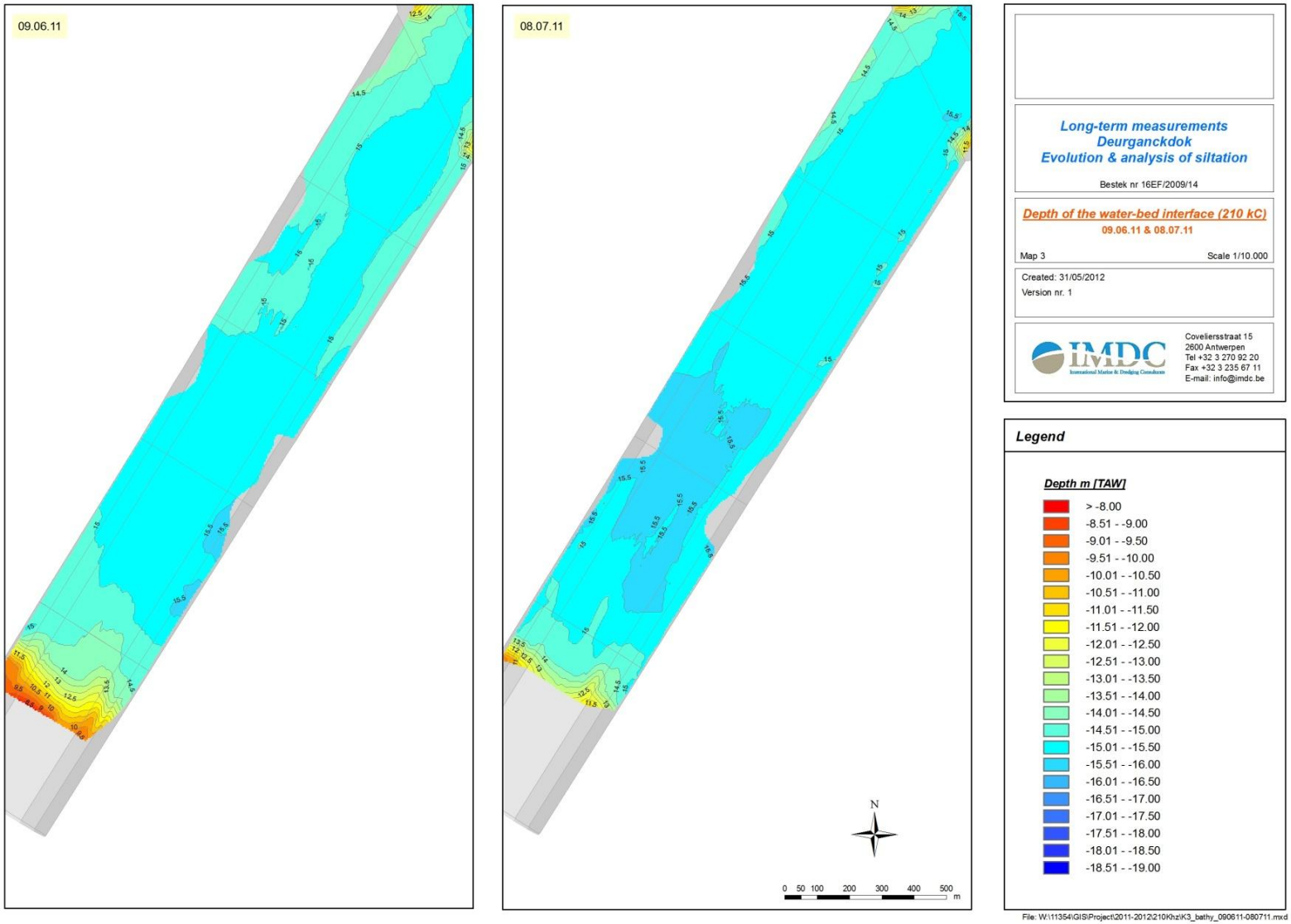
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Deurganckdok
Evolution & analysis of siltation
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Depth of the water-bed interface (210 kC)
09.06.11 & 08.07.11
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Created: 31/05/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
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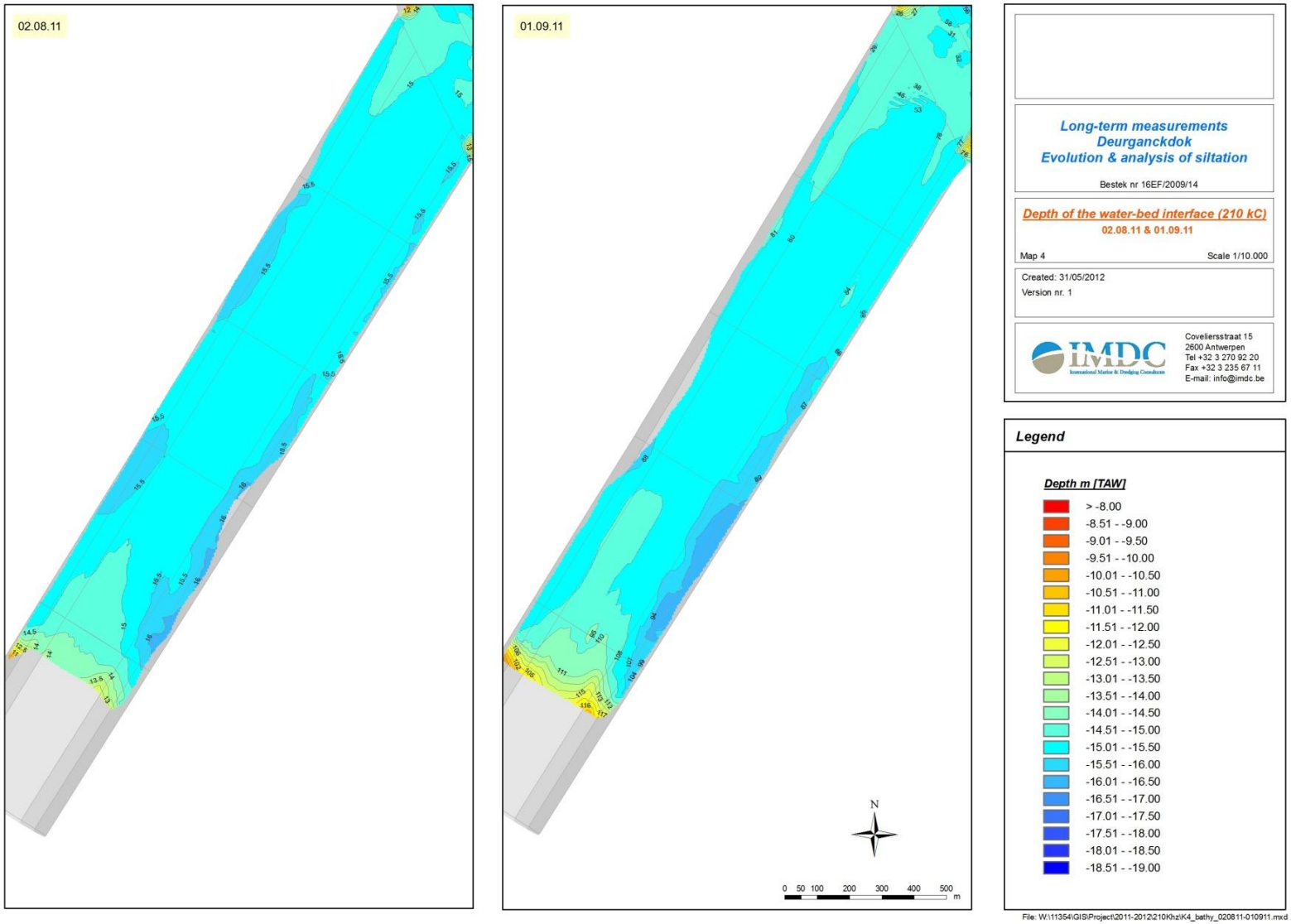
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Deurganckdok
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Depth of the water-bed interface (210 kC)
02.08.11 & 01.09.11
Map 4
Scale 1/10.000
Created: 31/05/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
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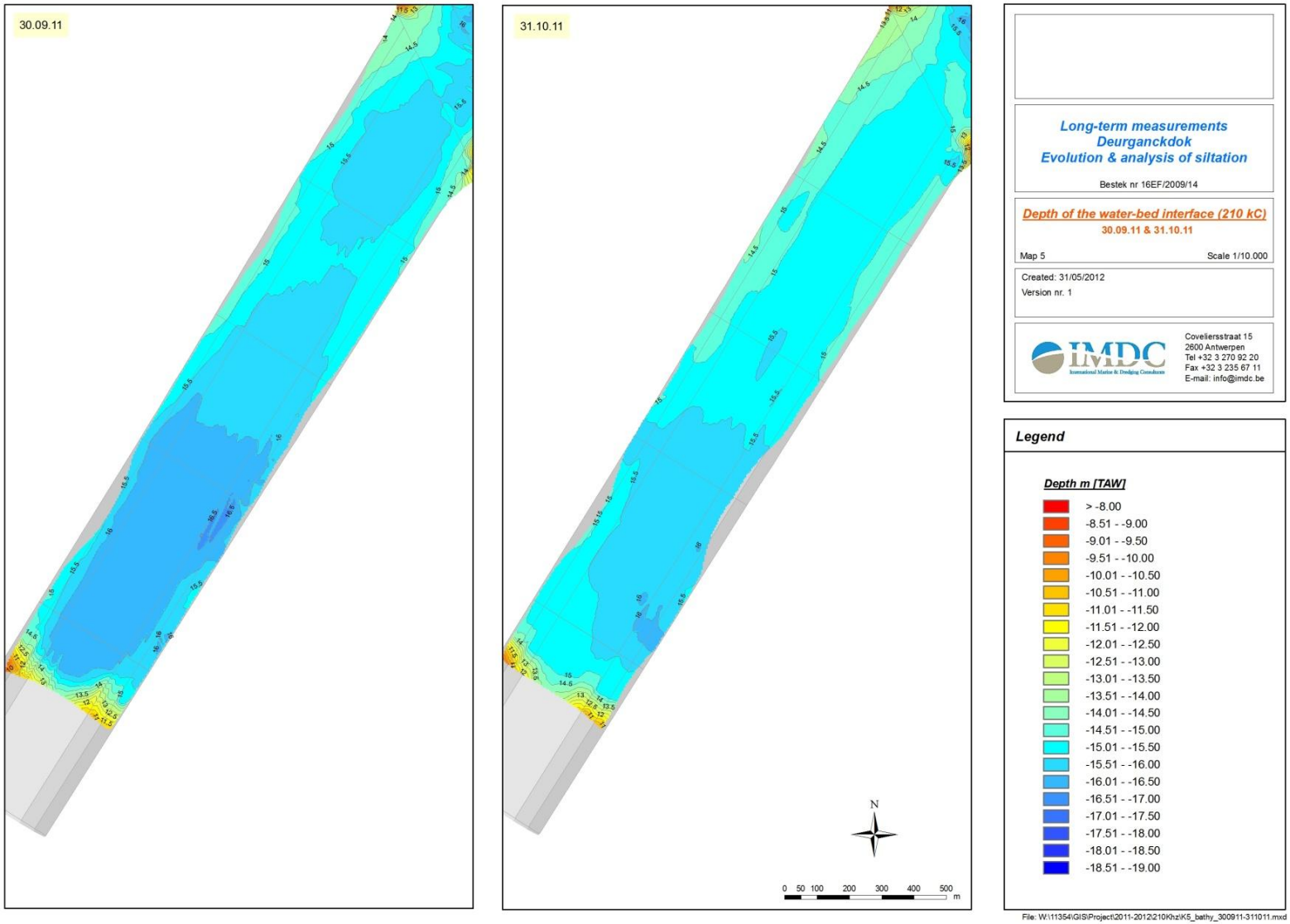
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Long-term measurements
Deurganckdok
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Bestek nr 16EF/2009/14
Depth of the water-bed interface (210 kC)
30.09.11 & 31.10.11
Map 5
Scale 1/10.000
Created: 31/05/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
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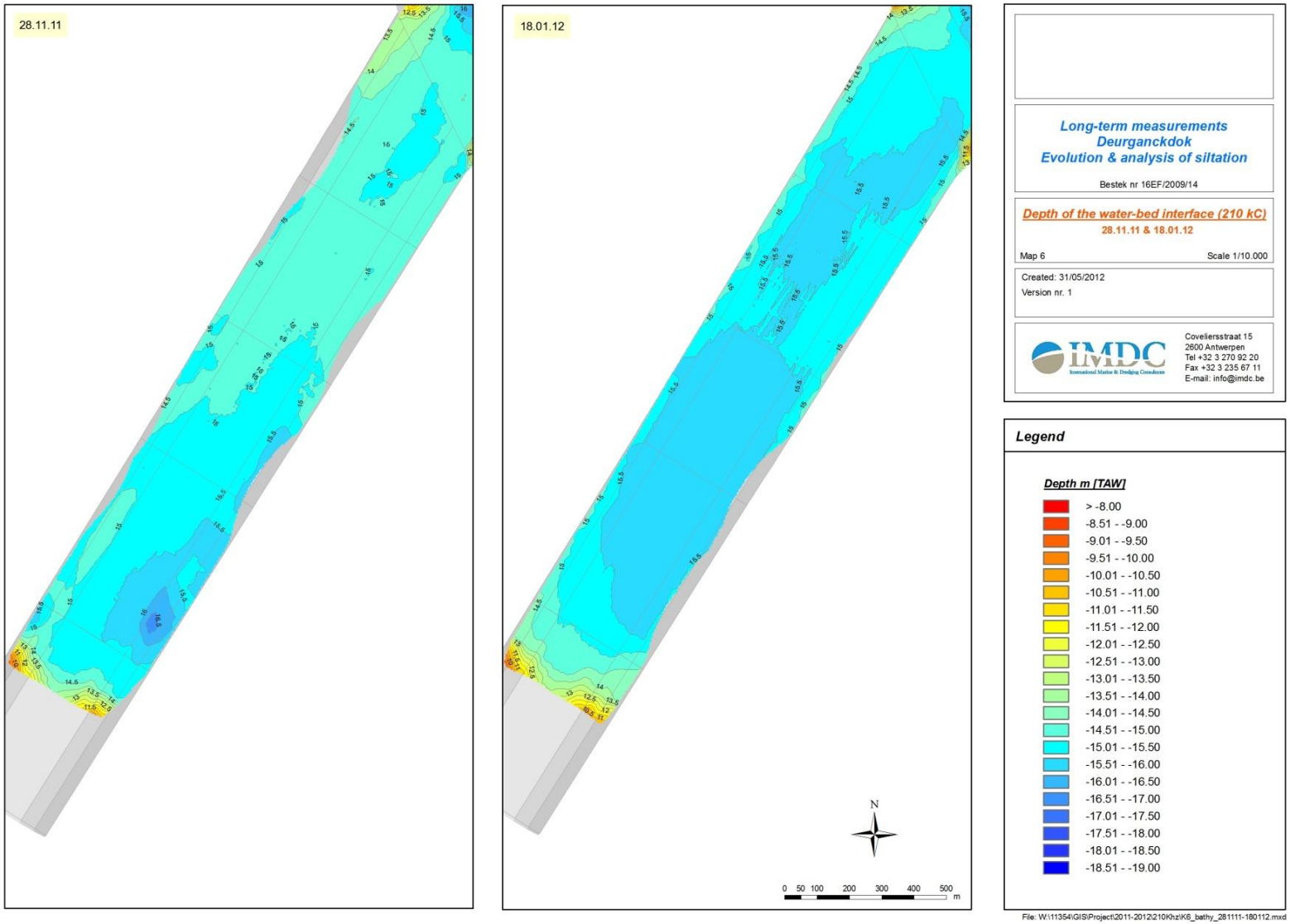
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Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EF/2009/14
Depth of the water-bed interface (210 kC)
28.11.11 & 18.01.12
Map 6
Scale 1/10.000
Created: 31/05/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
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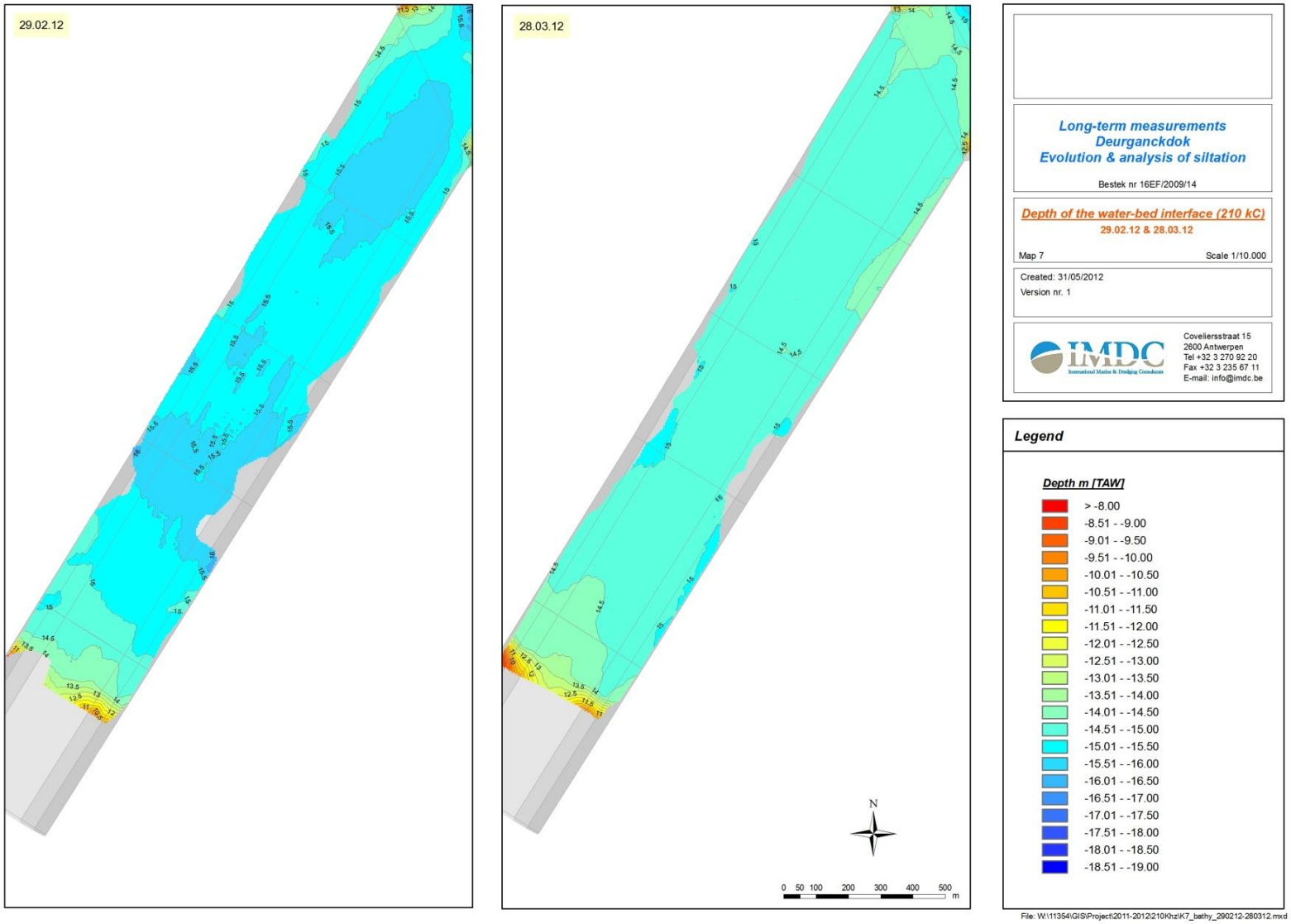
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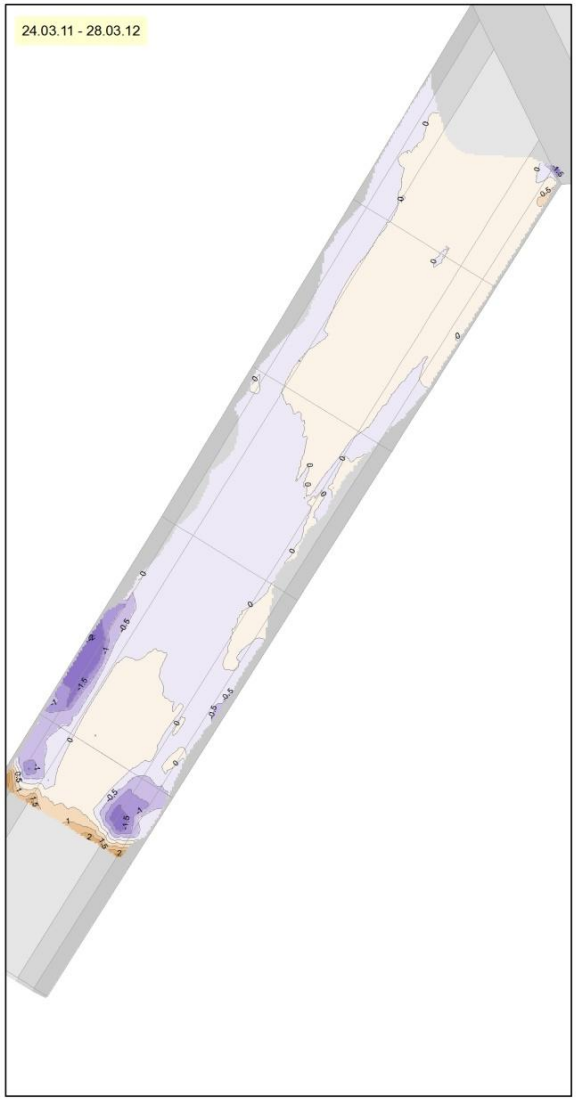
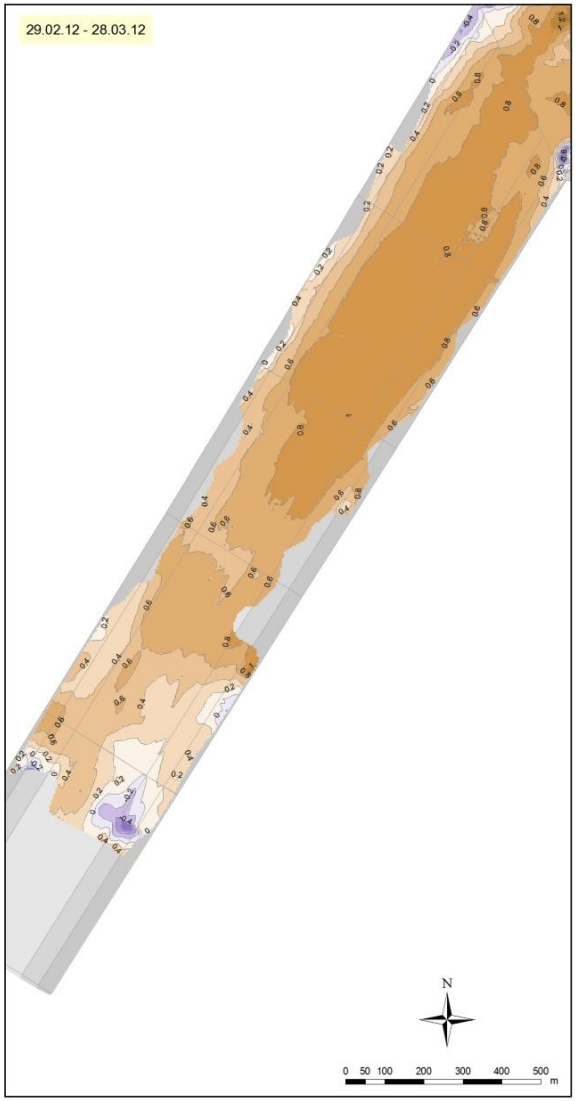
Depth of the water-bed interface (210 kC)
29.02.12 & 28.03.12
Map 7
Scale 1/10.000
Created: 31/05/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Depth m [TAW]
> -8.00
-8.51 - -9.00
-9.01 - -9.50
-9.51 - -10.00
-10.01 - -10.50
-10.51 - -11.00
-11.01 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
-17.51 - -18.00
-18.01 - -18.50
-18.51 - -19.00
File: W:\11354\GIS\Project\2011-2012\210Khz\K7_bathy_290212-280312.mxd

# Annex B Evolution of depth of water-bed interface (210 kHz)

## B.1 Difference maps




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 28.03.12
29.02.12 - 28.03.12

Map 12 Scale 1/10.000

Created: 07/10/2011
Version nr. 1

IMDC
International Marine & Dredging Consultants
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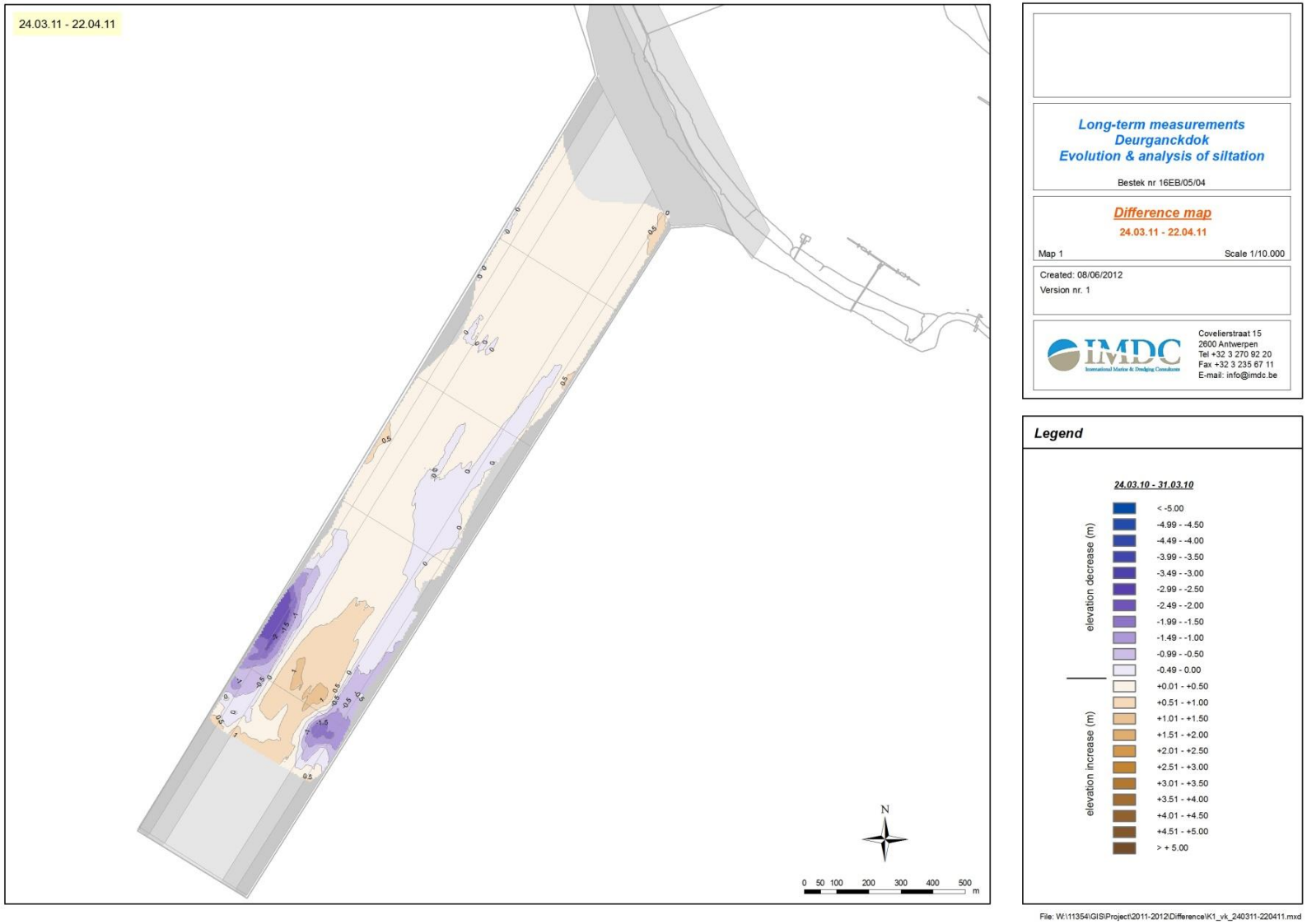
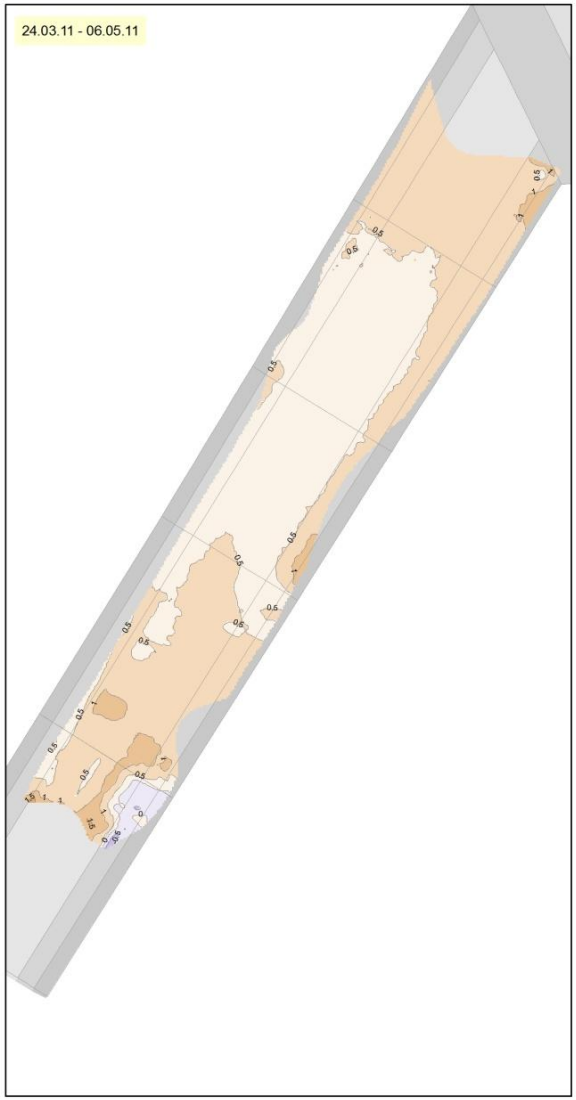
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

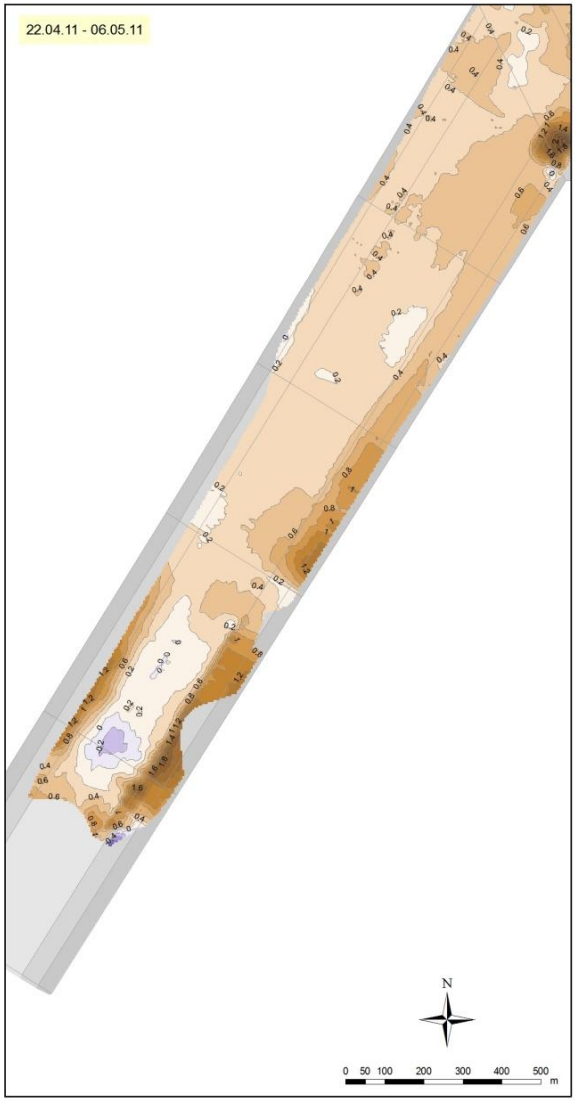
**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K12_vk_290212-280312.mxd


24.03.11 - 22.04.11
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Difference map
24.03.11 - 22.04.11
Map 1
Scale 1/10.000
Created: 08/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
24.03.10 - 31.03.10
elevation decrease (m)
elevation increase (m)
< -5.00
-4.99 - -4.50
-4.49 - -4.00
-3.99 - -3.50
-3.49 - -3.00
-2.99 - -2.50
-2.49 - -2.00
-1.99 - -1.50
-1.49 - -1.00
-0.99 - -0.50
-0.49 - 0.00
+0.01 - +0.50
+0.51 - +1.00
+1.01 - +1.50
+1.51 - +2.00
+2.01 - +2.50
+2.51 - +3.00
+3.01 - +3.50
+3.51 - +4.00
+4.01 - +4.50
+4.51 - +5.00
> + 5.00
File: W:\11354\GIS\Project\2011-2012\Difference\K1_vk_240311-220411.mxd




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 06.05.11
22.04.11 - 06.05.11

Map 2 Scale 1/10.000

Created: 07/10/2011
Version nr. 1

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International Marine & Dredging Consultants
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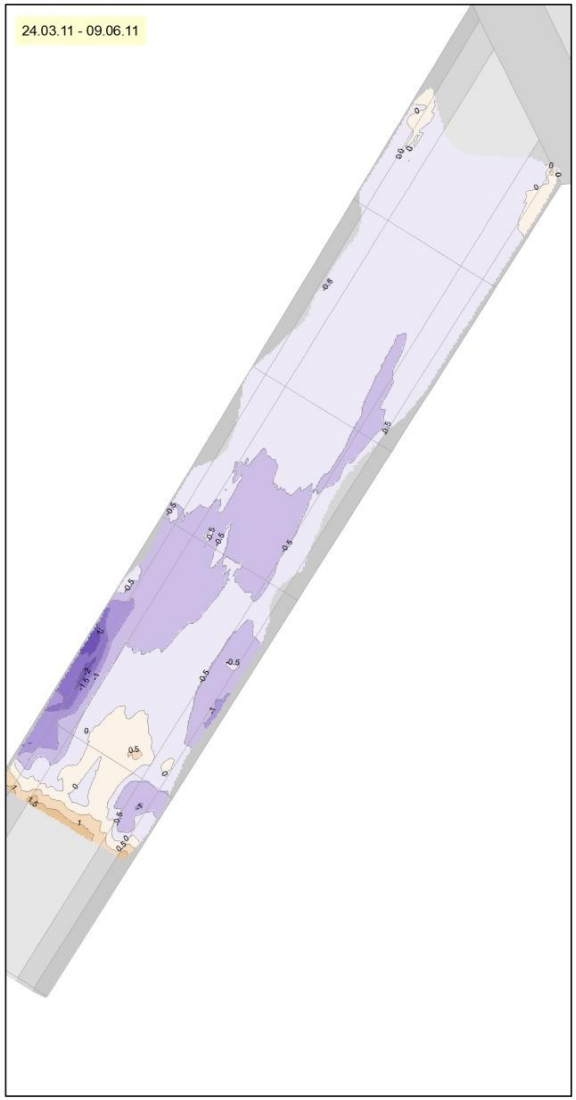
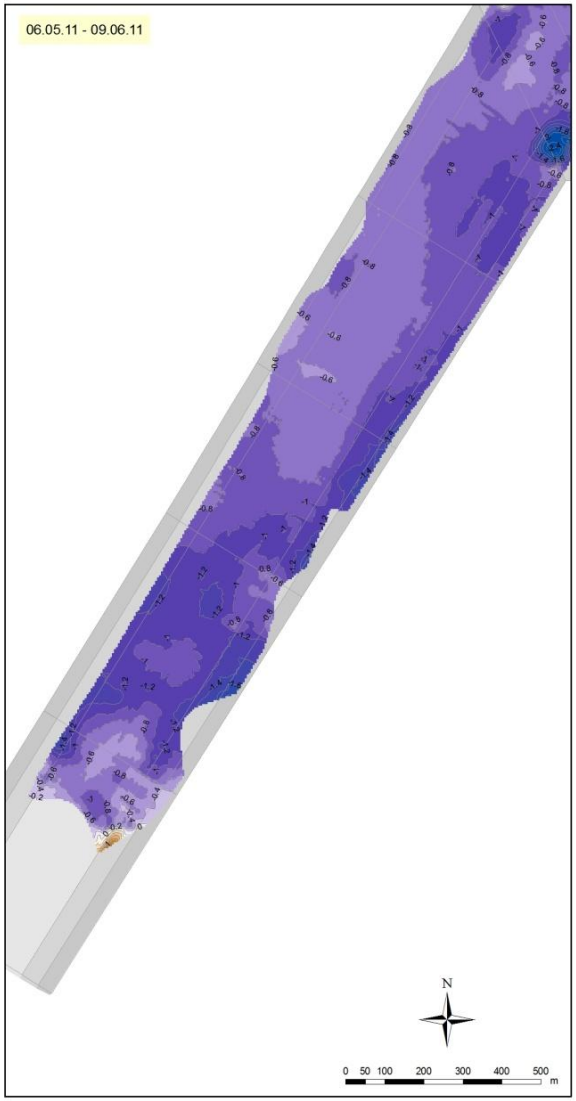
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K2_vk_220411-060511.mxd




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 09.06.11
06.05.11 - 09.06.11

Map 3 Scale 1/10.000

Created: 07/10/2011
Version nr. 1

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International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K3_vk_060511-090611.mxd



**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 08.07.11
09.06.11 - 08.07.11

Map 4 Scale 1/10.000

Created: 07/10/2011
Version nr. 1

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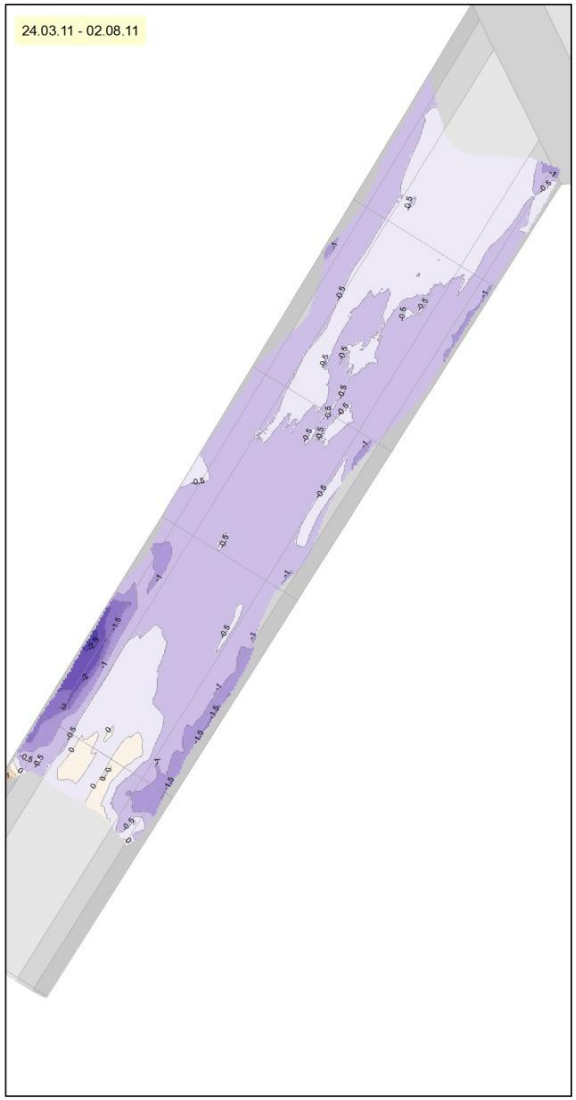
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K4_vk_090611-080711.mxd





**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 02.08.11
08.07.11 - 02.08.11

Map 5 Scale 1/10.000

Created: 07/10/2011
Version nr. 1

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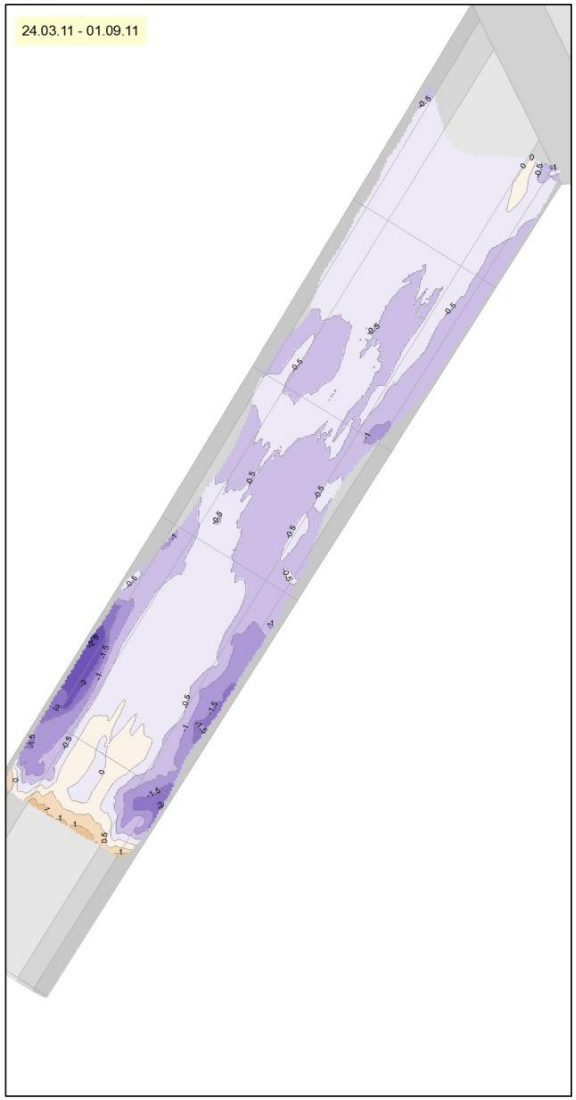
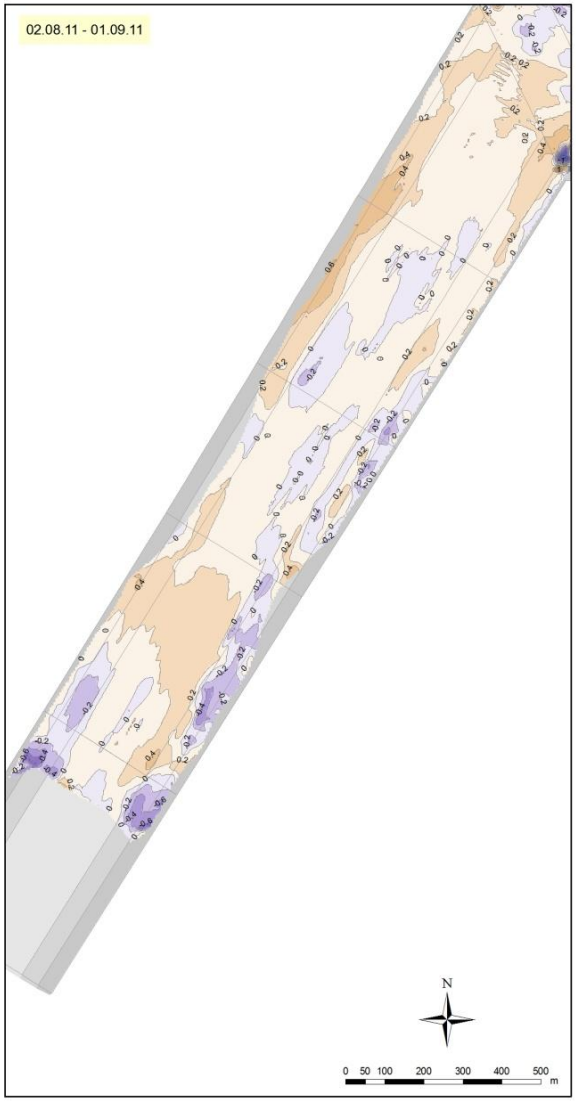
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K5_vk_080711-020811.mxd




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
**24.03.11 - 01.09.11**
**02.08.11 - 01.09.11**

Map 6 Scale 1/10.000

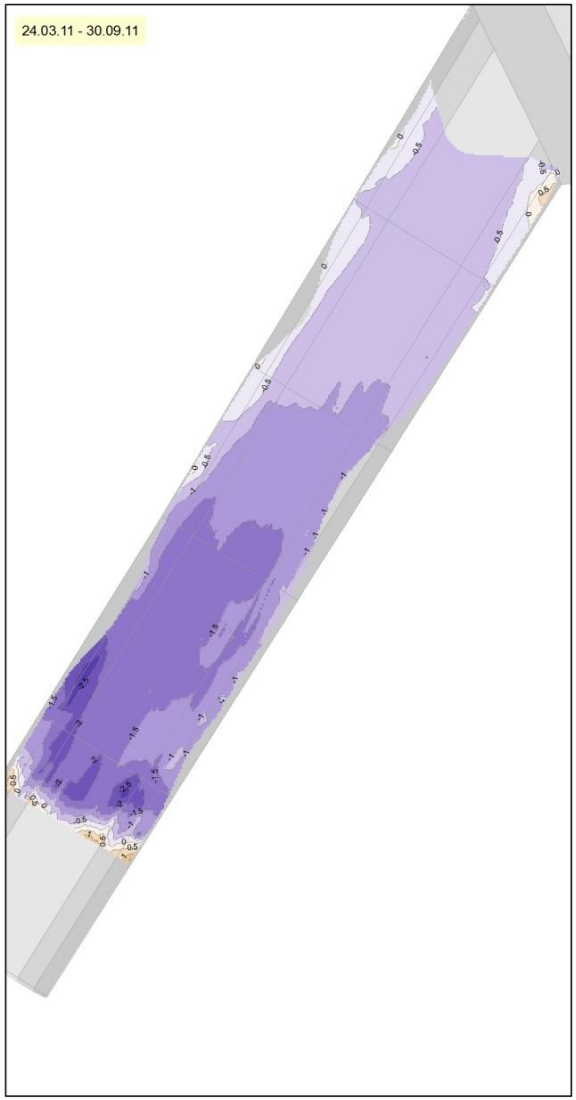
Created: 07/10/2011
Version nr. 1

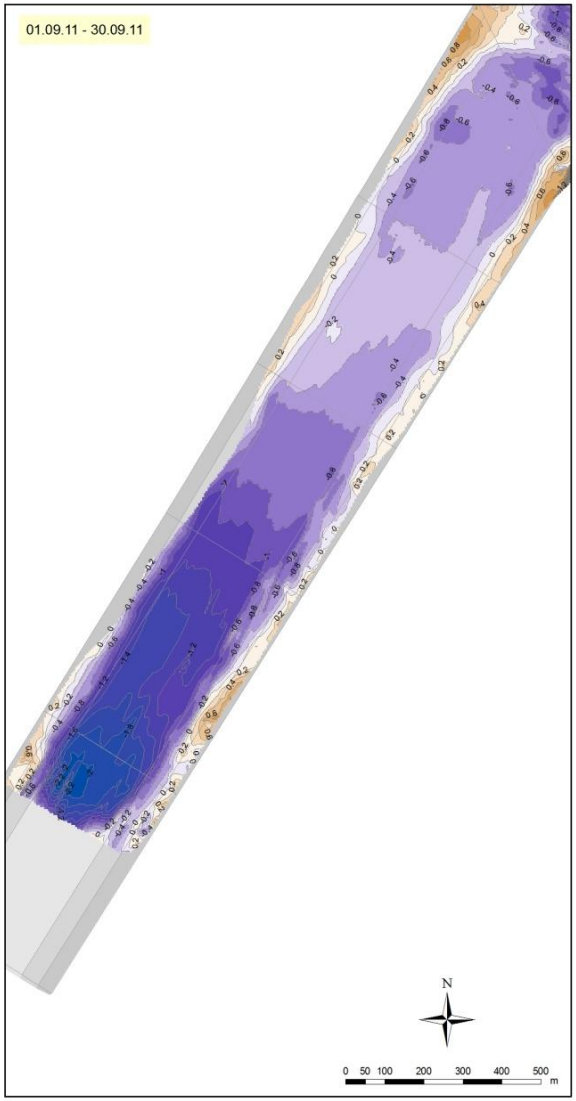
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K8_vk_020811-010911.mxd




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 30.09.11
01.09.11 - 30.09.11

Map 7 Scale 1/10.000

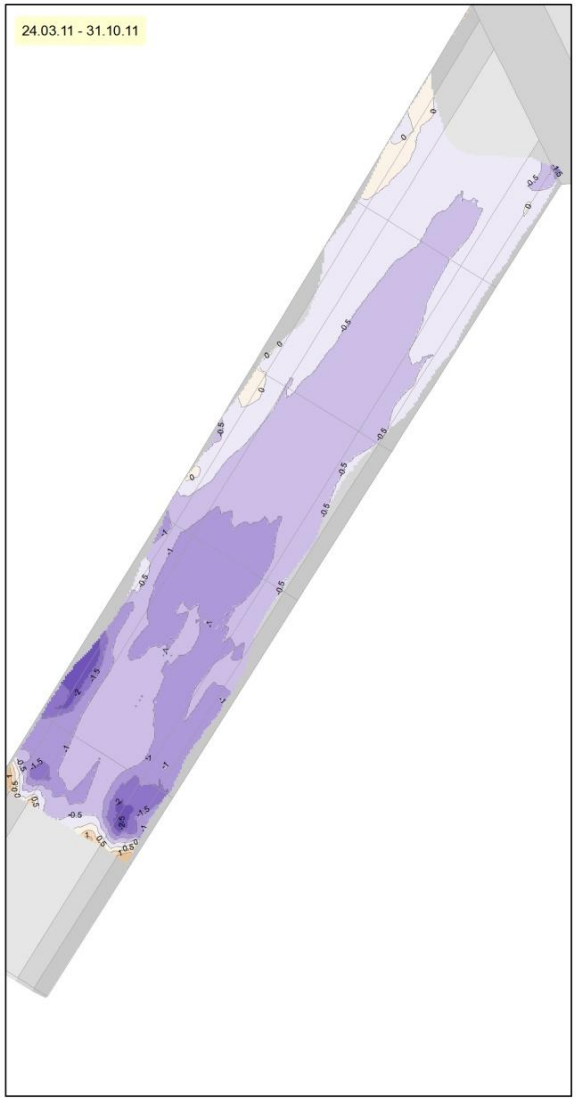
Created: 07/10/2011
Version nr. 1

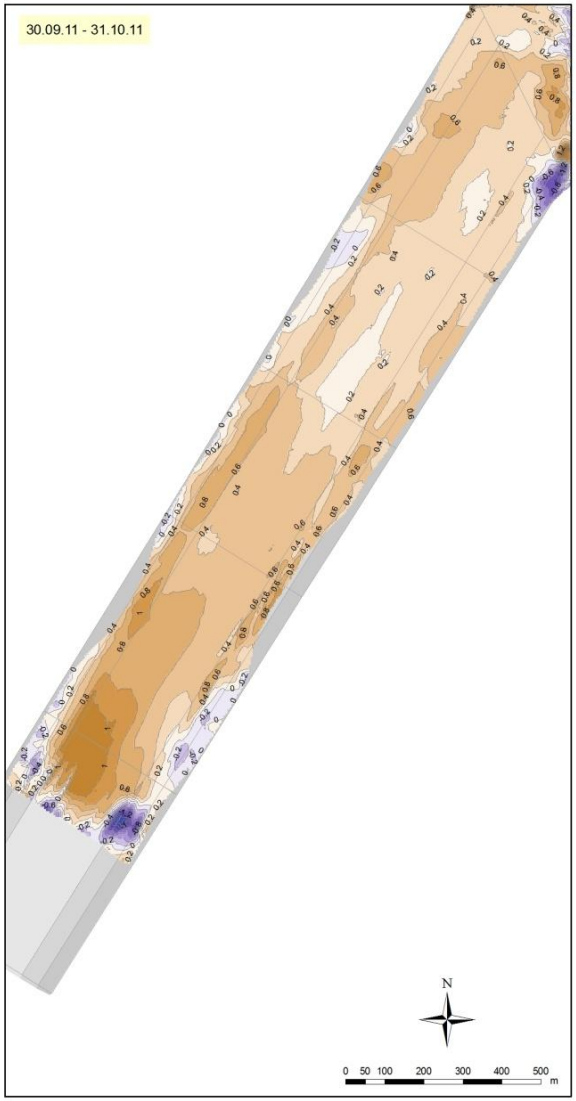
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K7_vk_010911-300911.mxd




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 31.10.11
30.09.11 - 31.10.11

Map 8 Scale 1/10.000

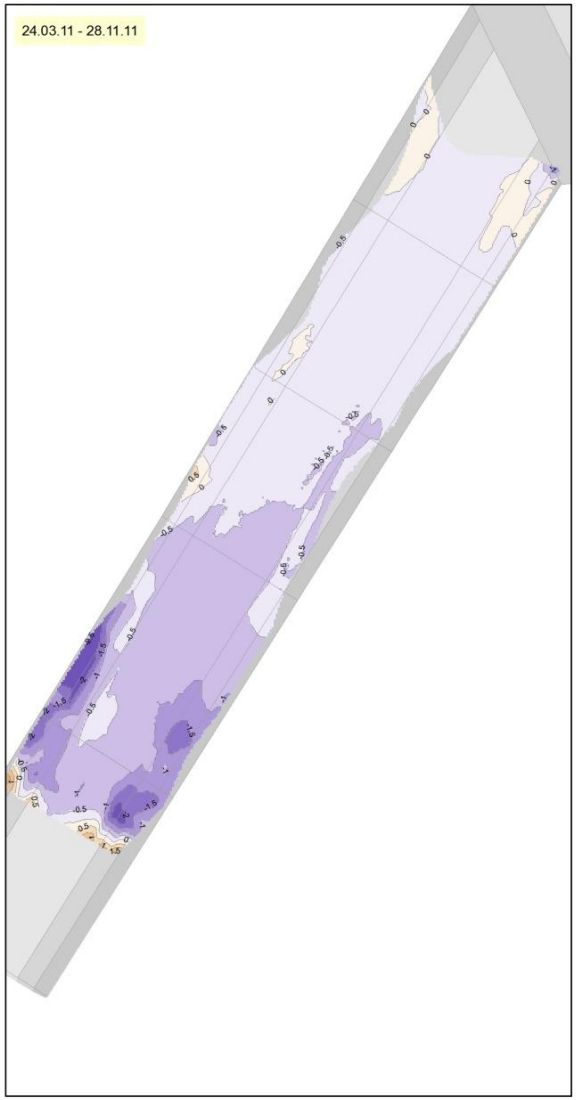
Created: 07/10/2011
Version nr. 1

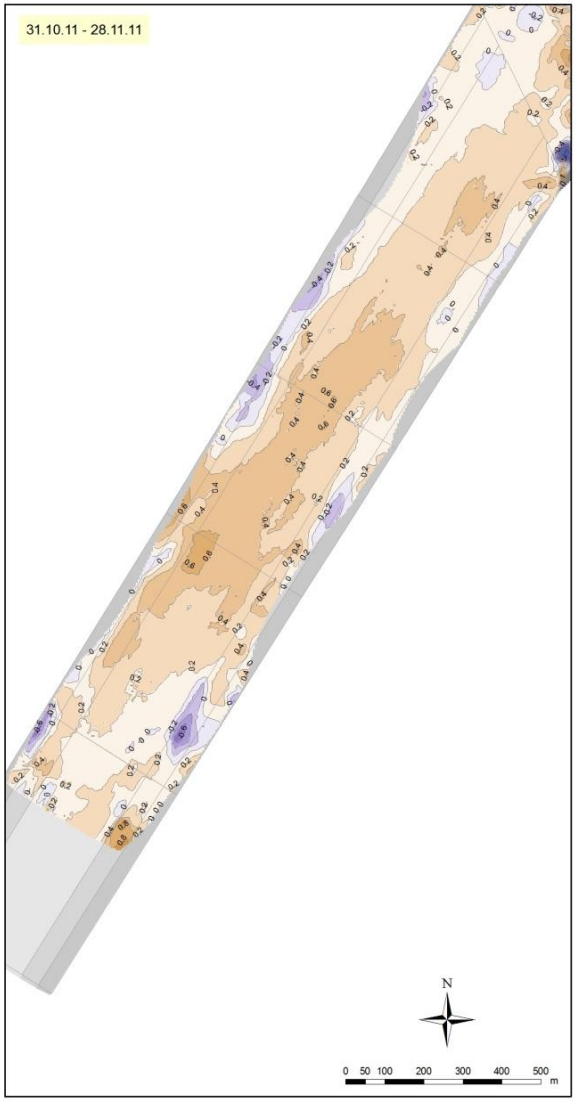
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K8_vk_300911-311011.mxd




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 28.11.11
31.10.11 - 28.11.11

Map 9 Scale 1/10.000

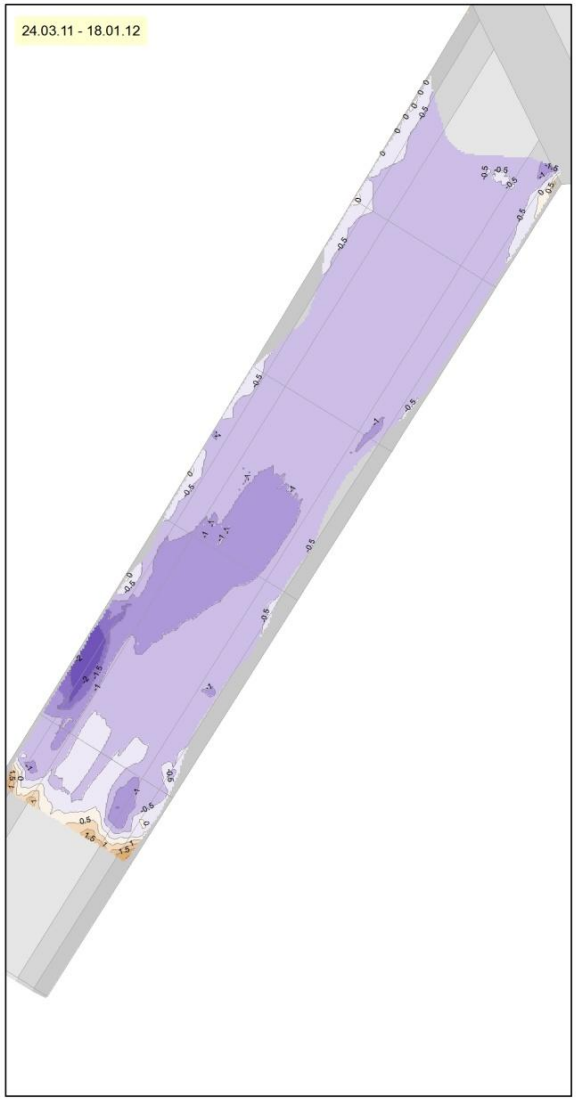
Created: 07/10/2011
Version nr. 1

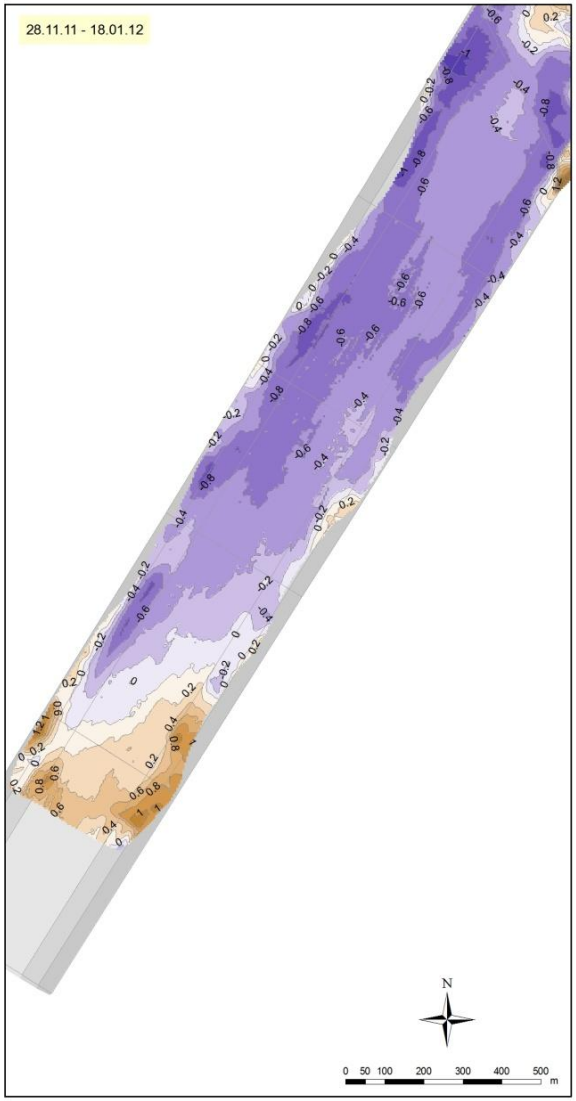
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K9_vk_311011-281111.mxd




**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 18.01.12
28.11.11 - 18.01.12

Map 10 Scale 1/10.000

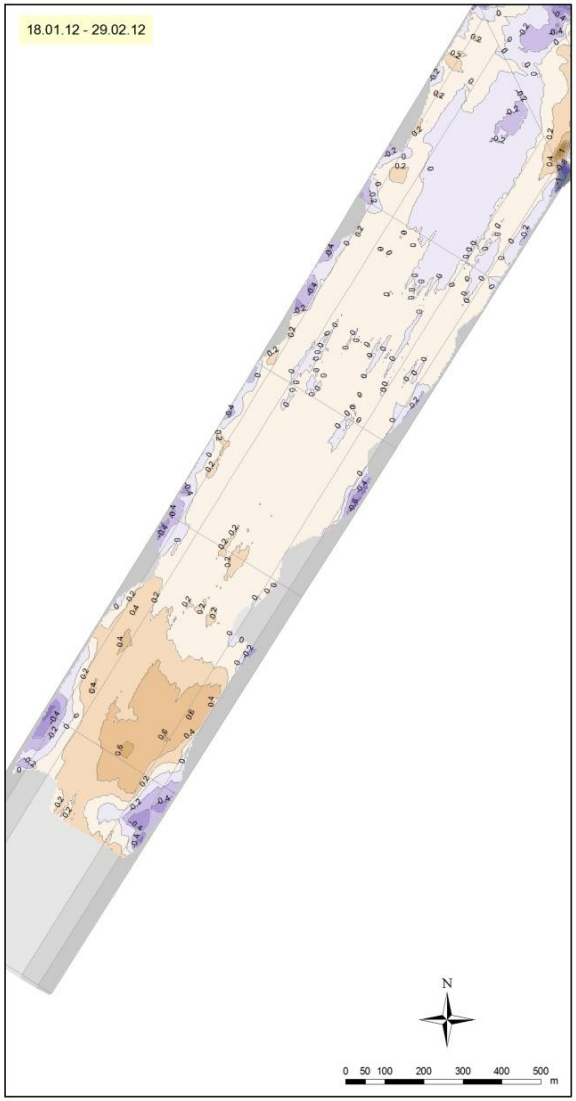
Created: 07/10/2011
Version nr. 1

IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K10_vk_281111-180112.mxd


**Long-term measurements**
**Deurganckdok**
**Evolution & analysis of siltation**

Bestek nr 16EB/05/04

**Difference map**
24.03.11 - 29.02.12
18.01.12 - 29.02.12

Map 11 Scale 1/10.000

Created: 07/10/2011
Version nr. 1

IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be

**Legend**

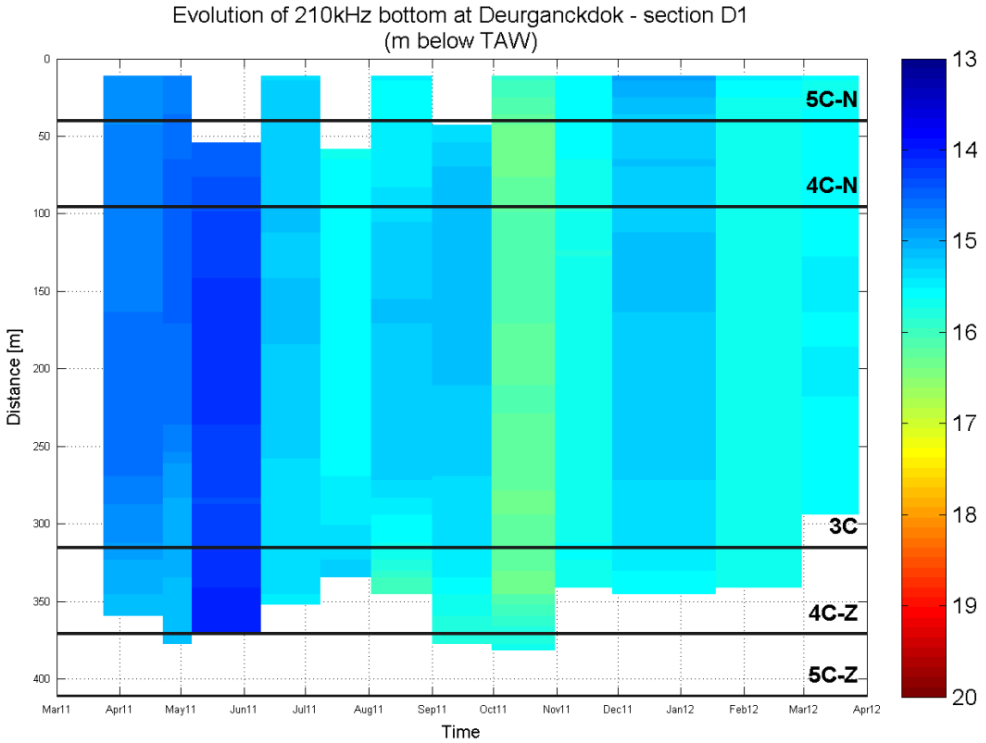
| | 24.03.10 - 30.04.10 | 31.03.10 - 30.04.10 |
|---|---|---|
| elevation decrease (m) | < -5.00 | < -2.00 |
| | -4.99 - -4.50 | -1.99 - -1.80 |
| | -4.49 - -4.00 | -1.79 - -1.60 |
| | -3.99 - -3.50 | -1.59 - -1.40 |
| | -3.49 - -3.00 | -1.39 - -1.20 |
| | -2.99 - -2.50 | -1.19 - -1.00 |
| | -2.49 - -2.00 | -0.99 - -0.80 |
| | -1.99 - -1.50 | -0.79 - -0.60 |
| | -1.49 - -1.00 | -0.59 - -0.40 |
| | -0.99 - -0.50 | -0.39 - -0.20 |
| | -0.49 - 0.00 | -0.19 - 0.00 |
| elevation increase (m) | +0.01 - +0.50 | +0.01 - +0.20 |
| | +0.51 - +1.00 | +0.21 - +0.40 |
| | +1.01 - +1.50 | +0.41 - +0.60 |
| | +1.51 - +2.00 | +0.61 - +0.80 |
| | +2.01 - +2.50 | +0.81 - +1.00 |
| | +2.51 - +3.00 | +1.01 - +1.20 |
| | +3.01 - +3.50 | +1.21 - +1.40 |
| | +3.51 - +4.00 | +1.41 - +1.60 |
| | +4.01 - +4.50 | +1.61 - +1.80 |
| | +4.51 - +5.00 | +1.81 - +2.00 |
| | > + 5.00 | > +2.00 |

File: W:\11354\GIS\Project\2011-2012\Difference\K11_vk_180112-290212.mxd

## B.2 Bed elevation - evolution per section

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



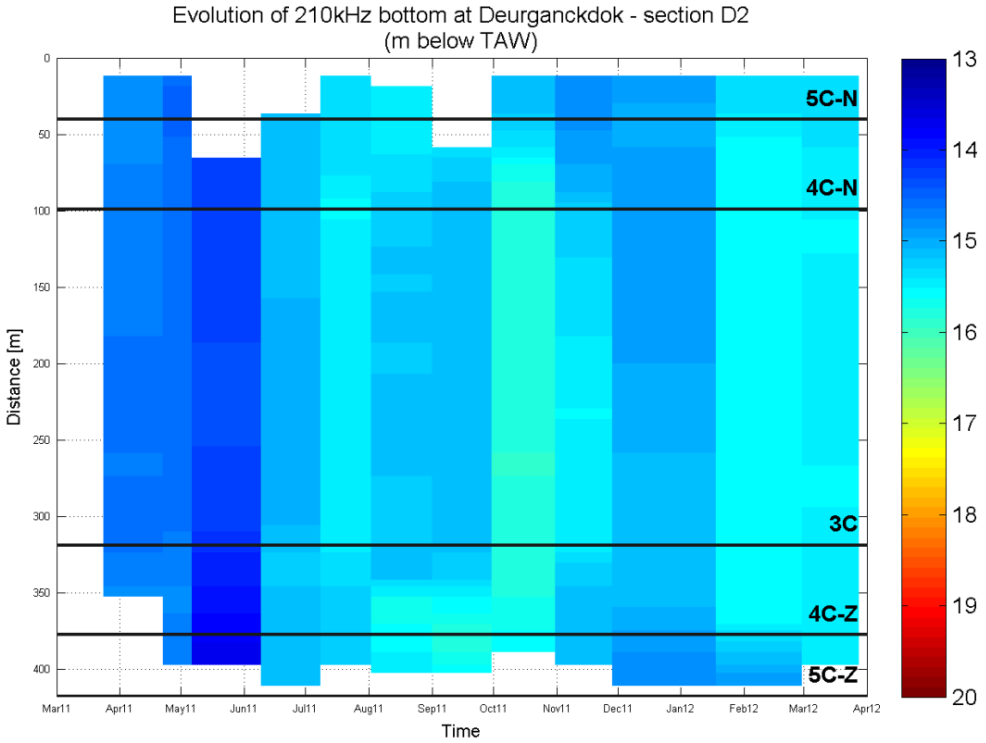

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



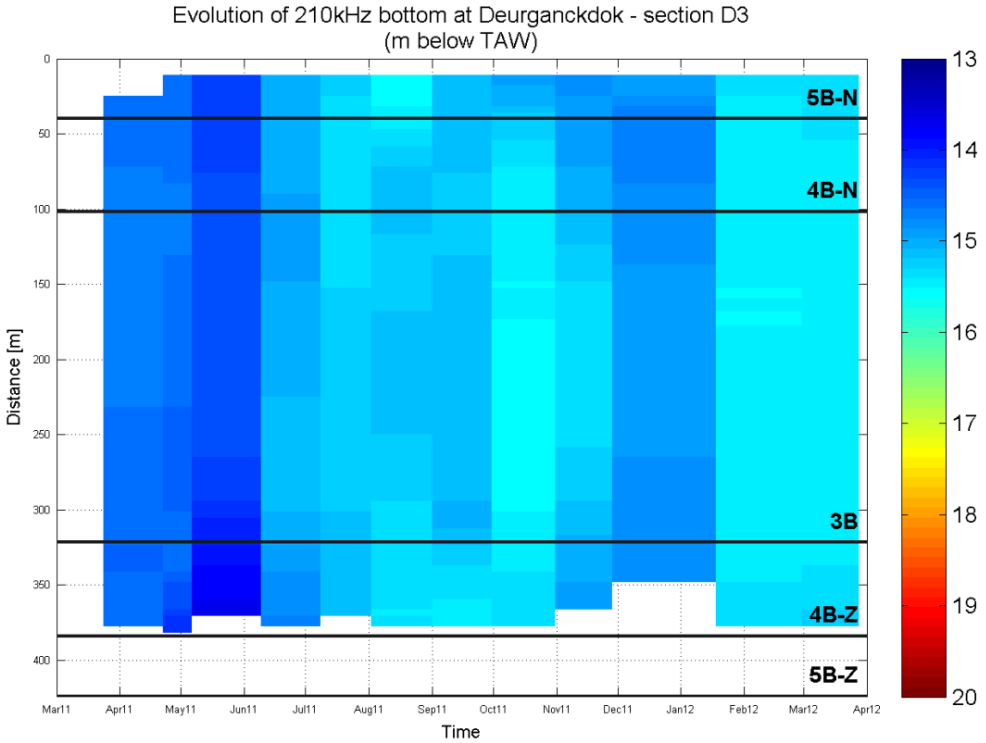

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



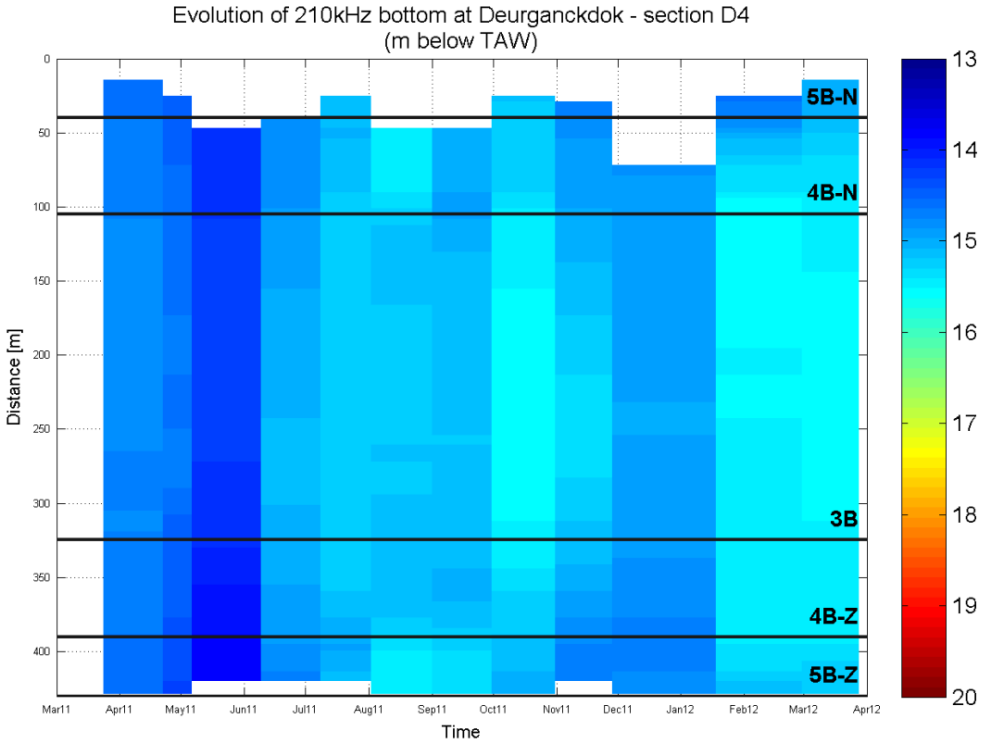

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



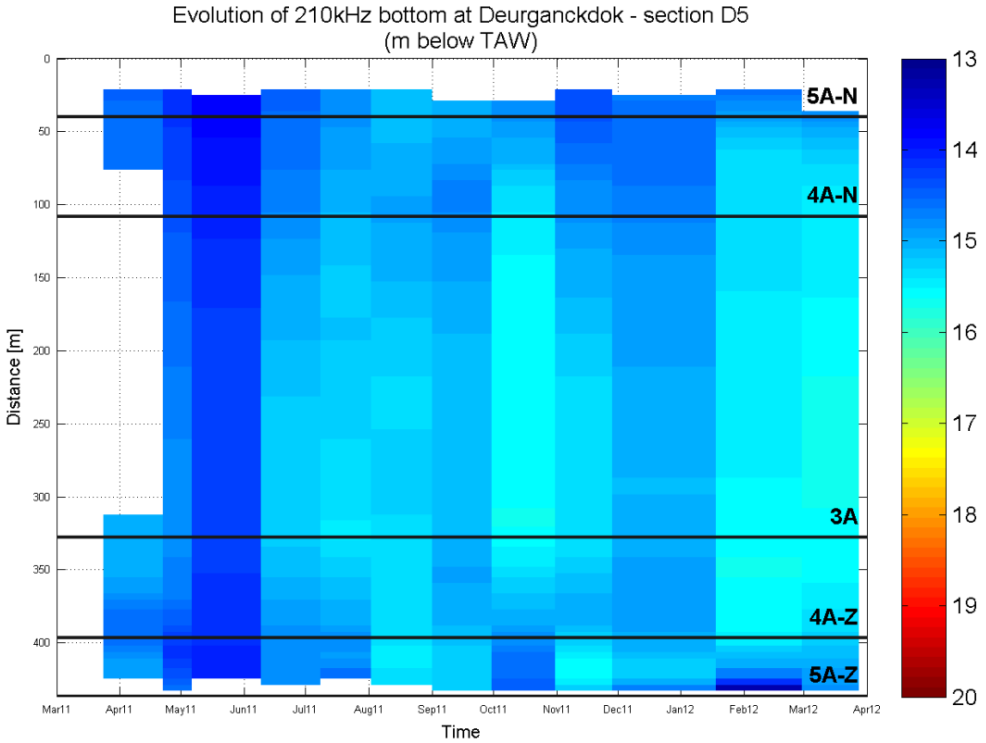

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



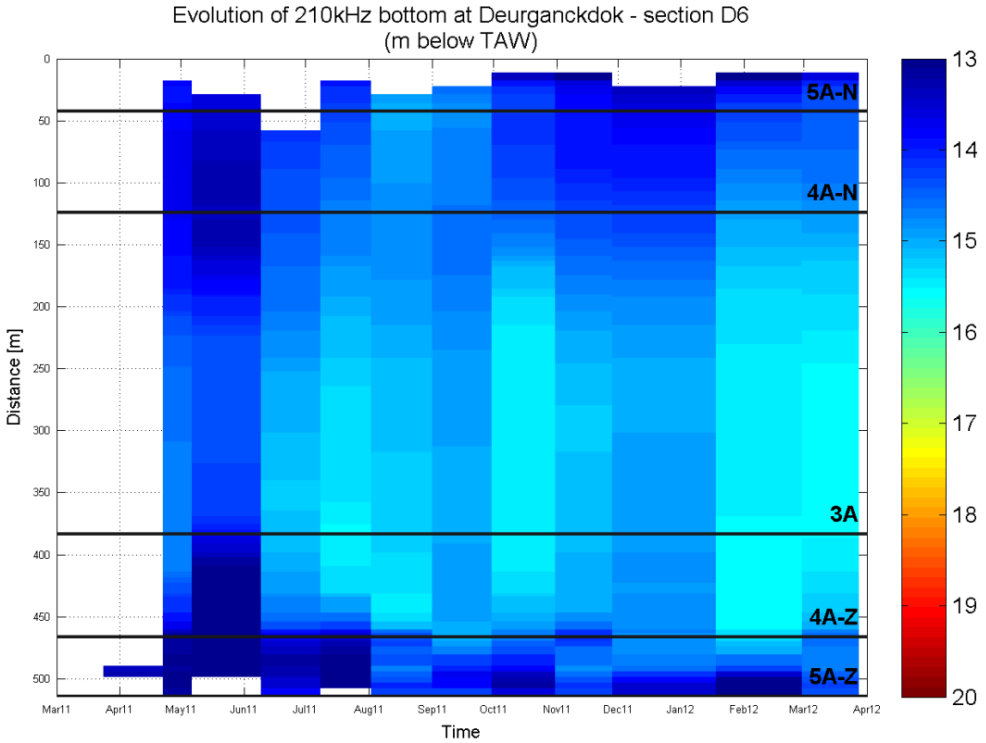

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



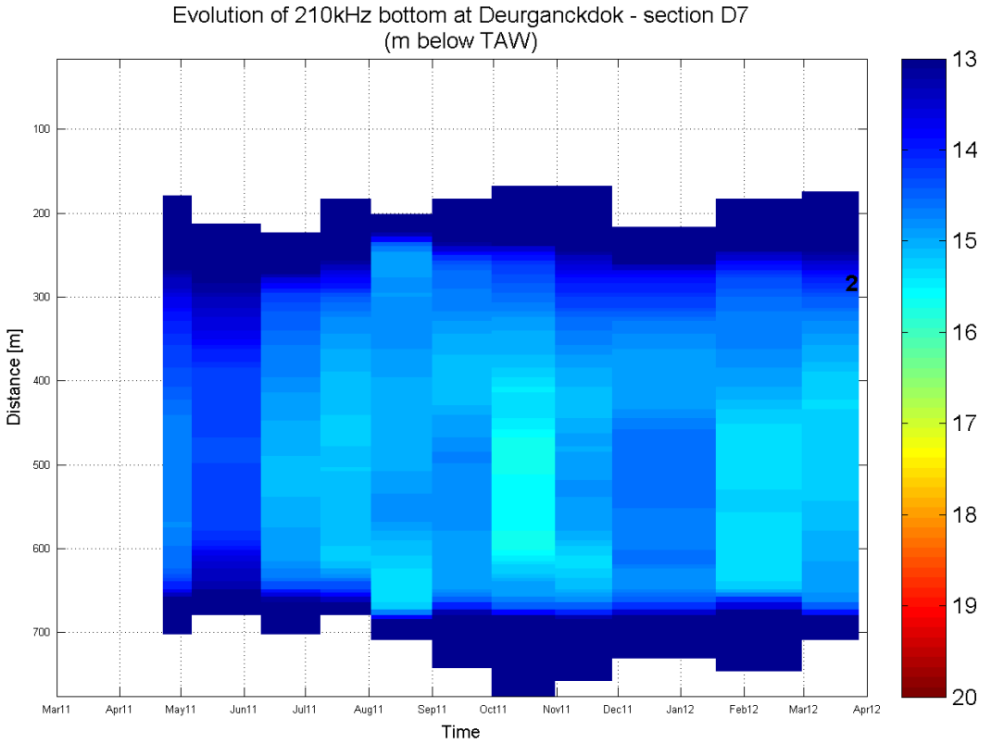

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



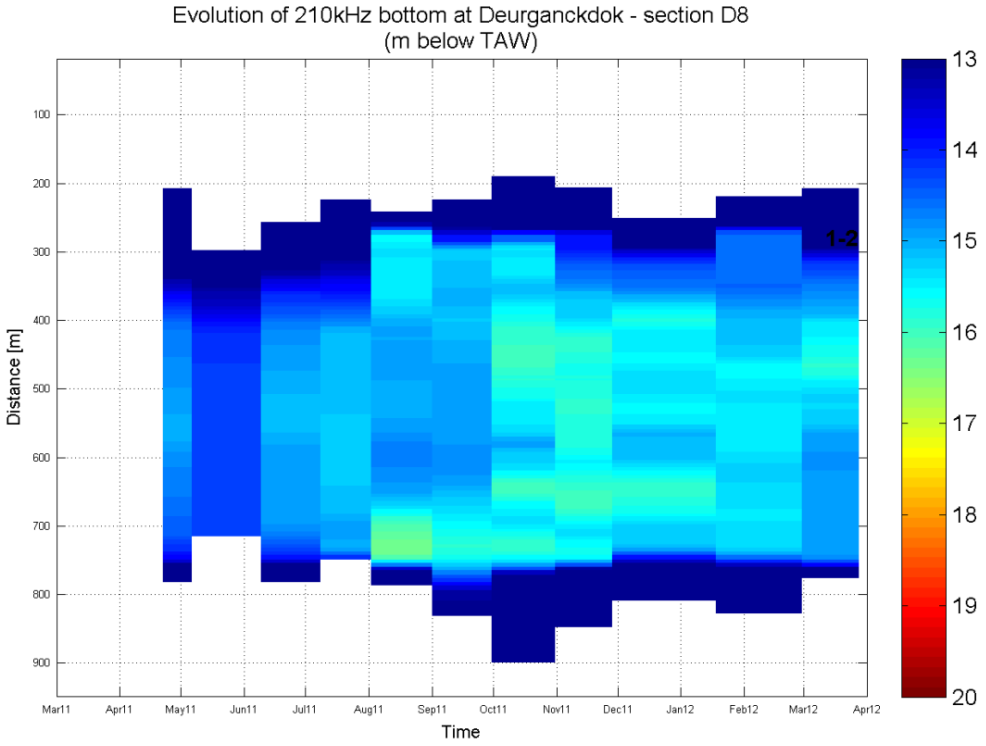

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



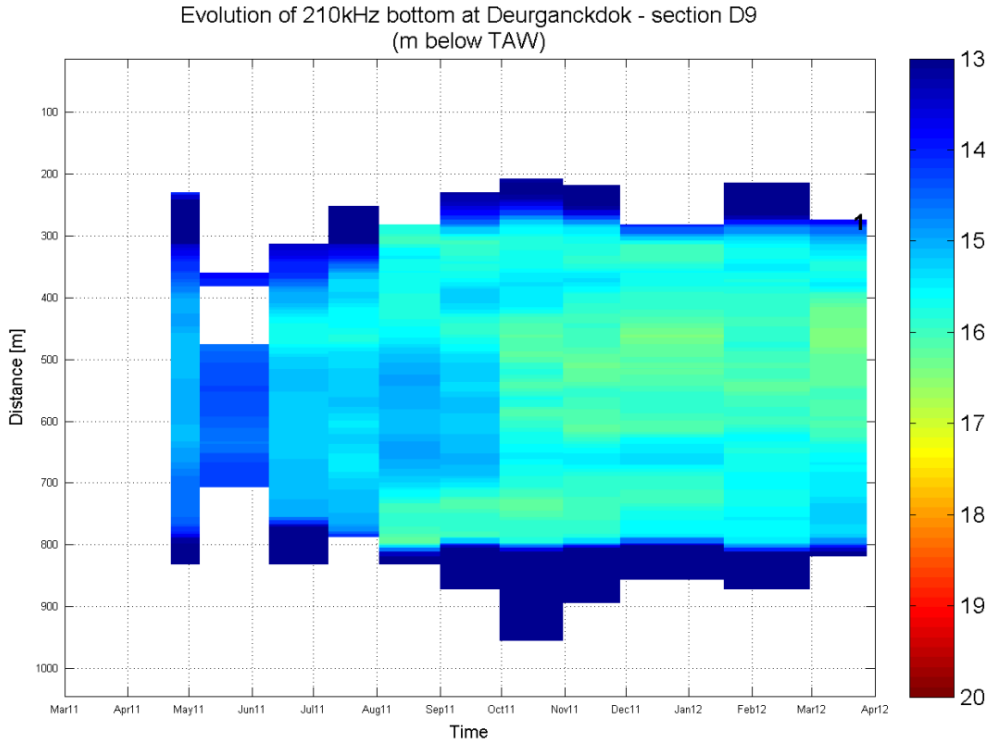

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



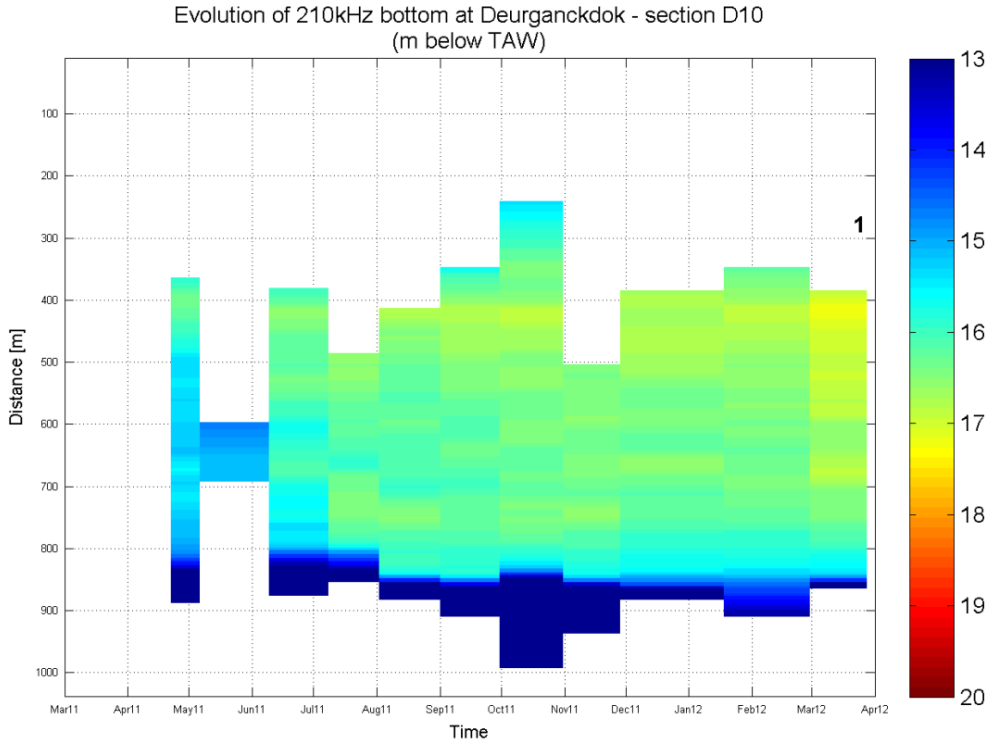

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



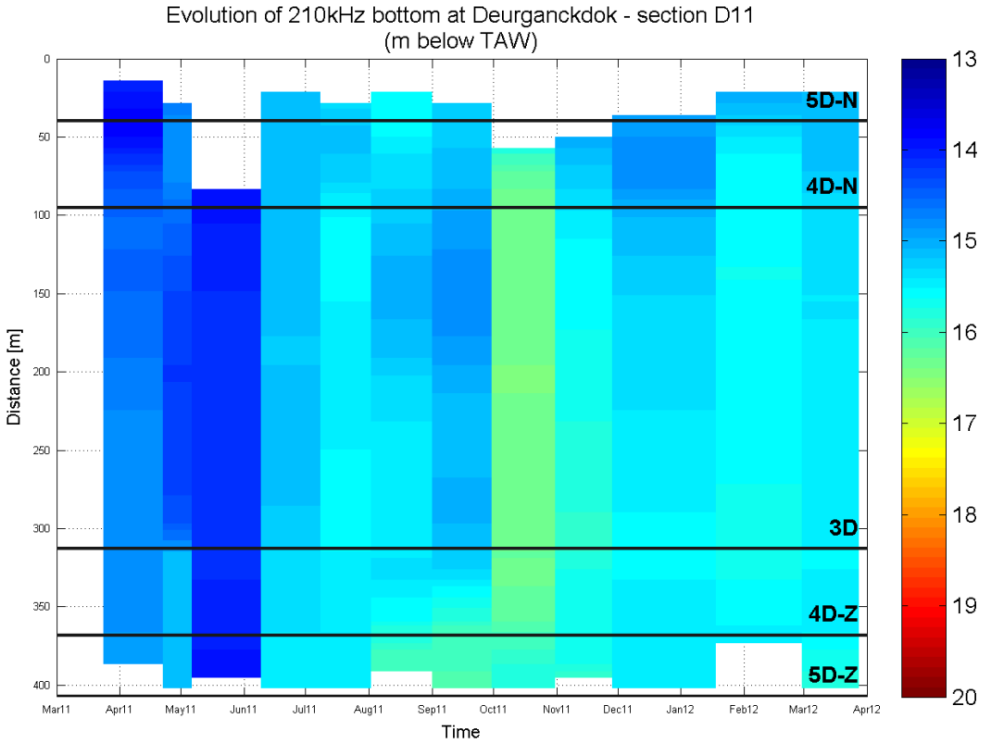

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



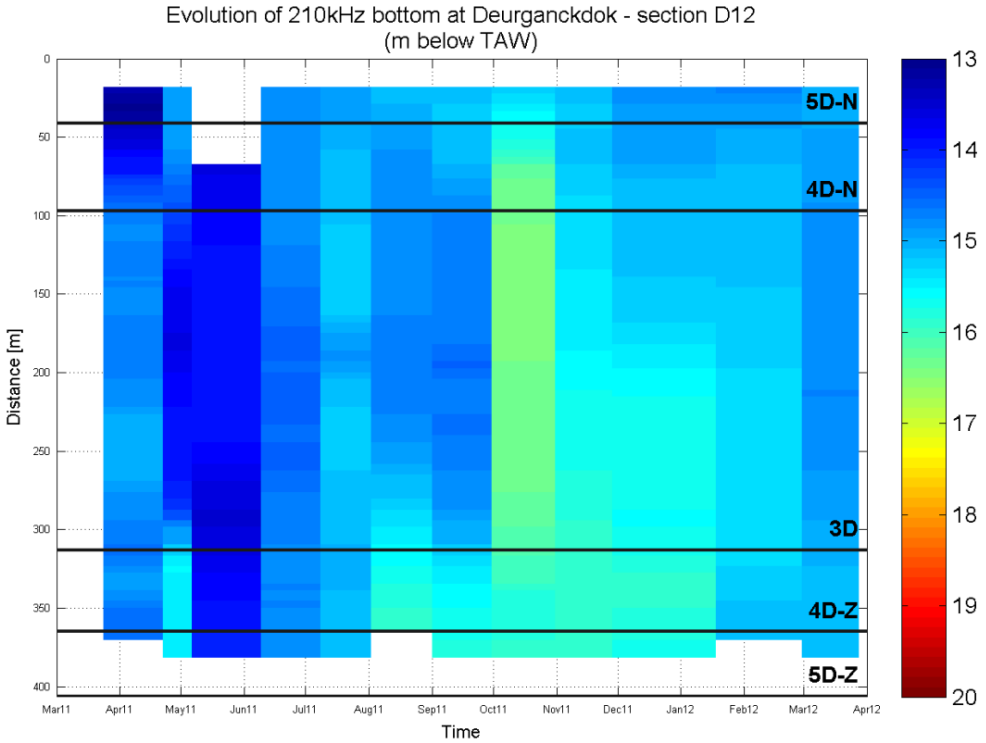

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



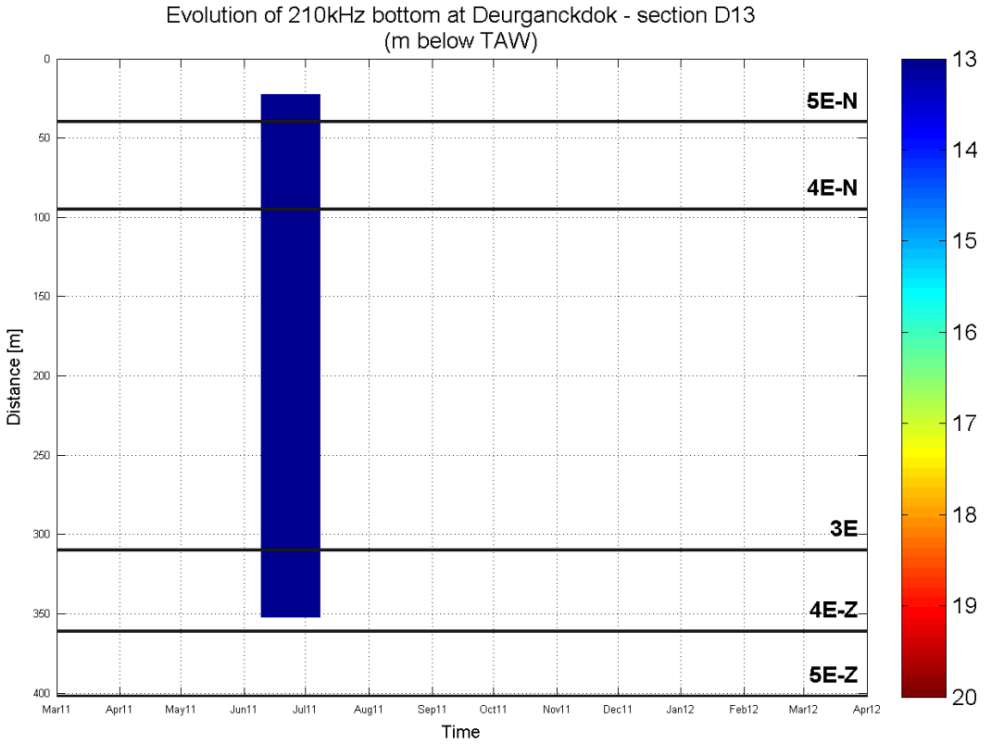

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



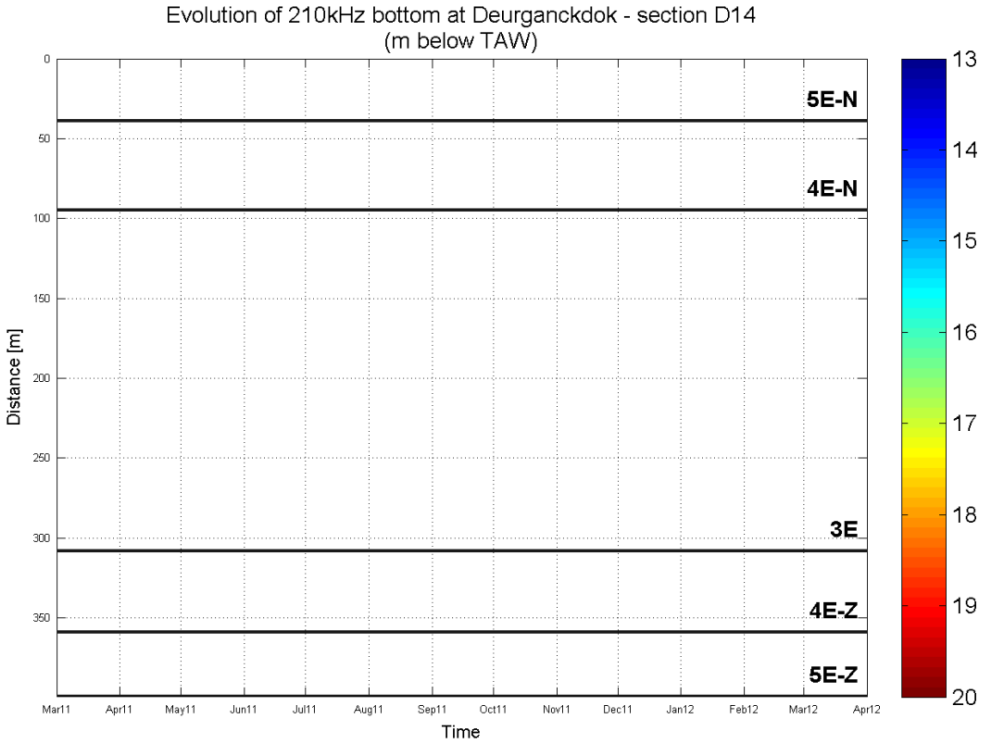

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



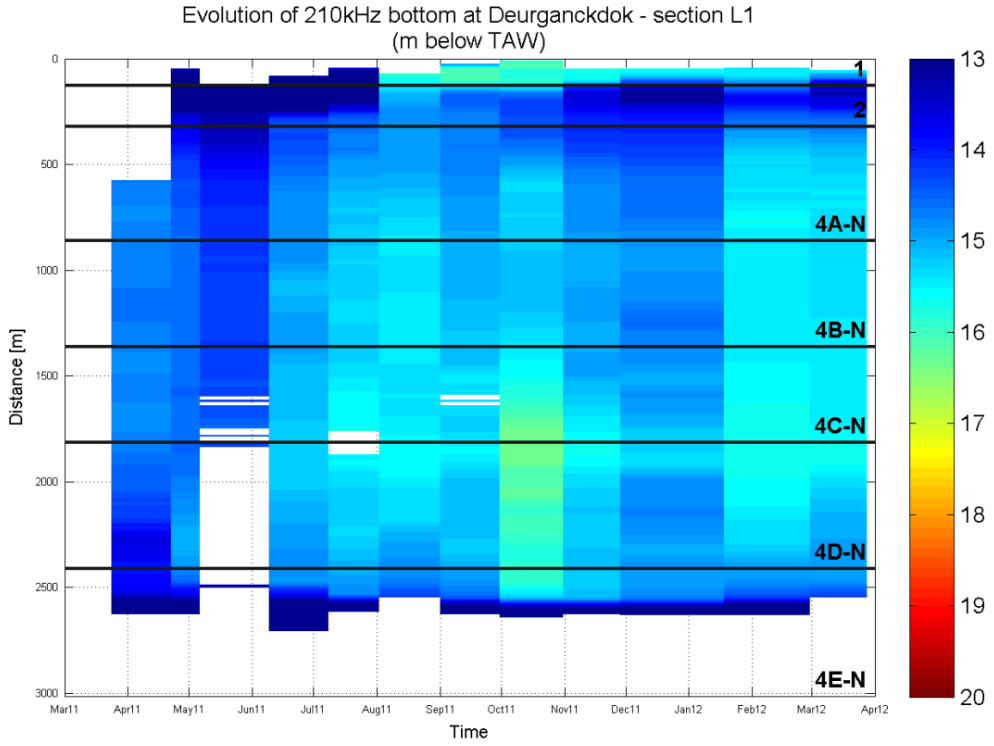

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



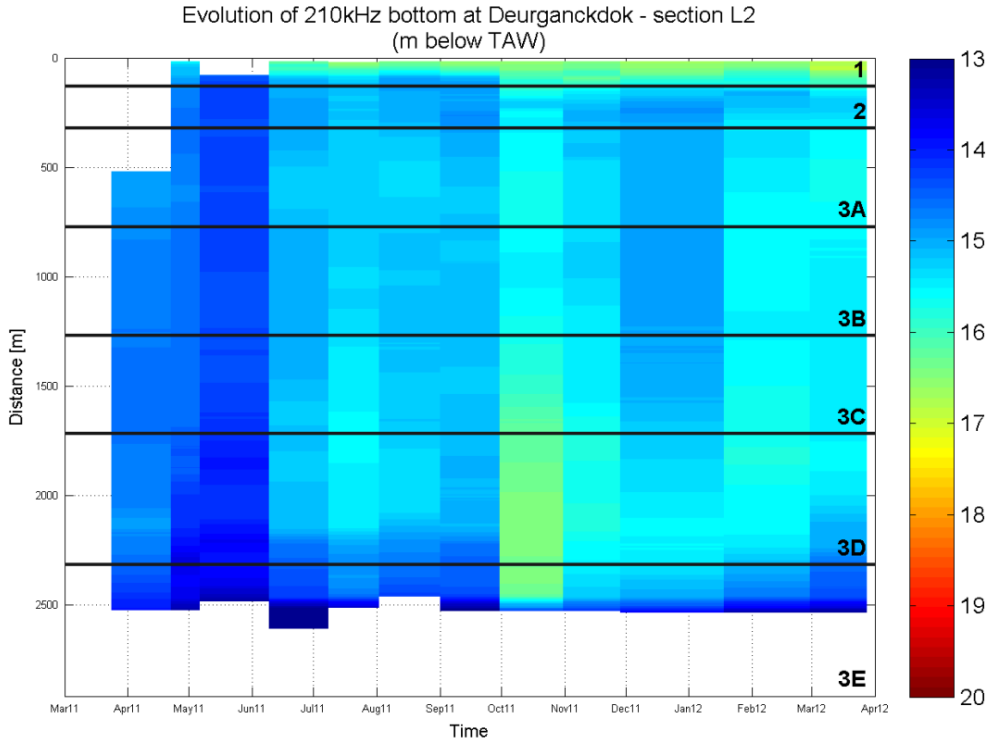

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



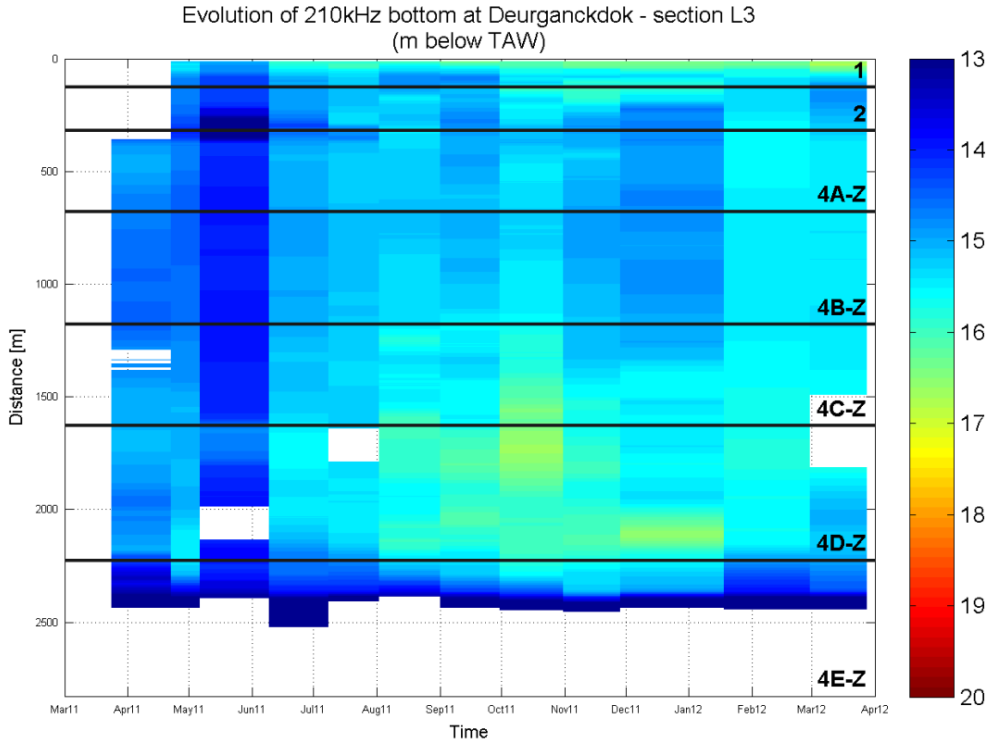

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Evolution 210kHz bottom | Equipment(s): 210kHz depth sounder |
| | Location: DGD |




Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Annex C VOLUMETRIC SILTATION RATES IN DIFFERENT ZONES AND SECTIONS

# C.1 SILTATION RATES (TABULAR)

*Table 7-1: **Siltation rates [cm/day]** per zone at each depth sounding day, based on the water-bed interface level difference between two consecutive depth soundings. For period March 24th 2011 – March 28th 2012.*

| Per zone | 22/Apr | 6/May | 9/Jun | 8/Jul | 2/Aug | 1/Sep | 30/Sep | 31/Oct | 28/Nov | 18/Jan | 29/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NaN | NaN | -0.707 | -1.473 | -1.565 | 1.236 | 4.641 | -2.095 | -3.62 | 0.228 | -0.903 | 1.535 |
| 2 | -2.386 | 0.207 | -1.928 | -0.361 | -1.279 | 0.965 | 3.611 | 0.171 | -3.014 | -0.126 | -0.034 | 1.898 |
| 3a | 0.815 | 3.011 | -2.574 | -0.505 | 0.132 | 0.407 | -1.686 | 1.194 | 0.892 | -1.021 | -0.191 | 2.962 |
| 3b | 0.355 | 2.113 | -2.181 | -0.865 | 0.405 | 0.037 | -1.287 | 0.908 | 1.304 | -1.199 | 0.069 | 3.134 |
| 3c | 0.042 | 2.505 | -2.549 | -1.226 | 1.095 | 0.148 | -2.631 | 1.422 | 1.519 | -1.049 | 0.251 | 2.734 |
| 3d | 1.409 | 1.967 | -3.009 | -1.322 | 1.047 | 0.581 | -4.559 | 1.976 | 1.016 | -0.276 | 0.693 | 1.905 |
| 3e | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Na | 1.585 | 2.685 | -2.191 | -1.067 | -0.573 | 0.872 | -0.746 | 1.407 | 0.435 | -1.591 | 0.193 | 1.993 |
| 4Nb | 0.34 | 2.339 | -2.084 | -1.073 | -0.496 | 0.986 | -0.411 | 0.821 | 0.576 | -1.296 | 0.206 | 2.105 |
| 4Nc | 0.634 | 1.789 | -2.377 | -1.215 | 0.306 | 0.486 | -1.994 | 1.976 | 0.885 | -1.215 | 0.299 | 1.951 |
| 4Nd | -2.151 | NaN | -0.629 | -0.824 | 0.141 | 0.229 | -2.769 | 2.19 | 1.151 | -0.83 | 0.521 | 1.654 |
| 4Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Za | 1.071 | 4.447 | -3.187 | -0.548 | -0.555 | 0.678 | -0.788 | 0.683 | 0.856 | -1.313 | 0.19 | 2.795 |
| 4Zb | 0.225 | 3.725 | -2.892 | -0.664 | -0.425 | 0.306 | -0.82 | 1.237 | 0.604 | -1.133 | 0.078 | 3.121 |

| Per zone | 22/Apr | 6/May | 9/Jun | 8/Jul | 2/Aug | 1/Sep | 30/Sep | 31/Oct | 28/Nov | 18/Jan | 29/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4Zc | -0.101 | 5.714 | -3.36 | -0.393 | -0.744 | 0.127 | -1.619 | 1.663 | 0.385 | -0.554 | 0.208 | 2.592 |
| 4Zd | -1.167 | 6.962 | -3.217 | -0.164 | -1.359 | -0.371 | -1.389 | 1.143 | 0.365 | 0.309 | 0.775 | 1.332 |
| 4Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Na | 1.318 | 3.277 | -2.766 | 0.085 | -2.18 | 0.789 | 1.268 | 1.118 | NaN | -0.636 | 0.041 | 0.176 |
| 5Nb | 0.618 | NaN | NaN | NaN | -1.09 | NaN | 1.23 | 0.416 | -0.668 | -0.294 | -0.311 | 0.942 |
| 5Nc | 1.167 | NaN | -1.378 | -0.918 | -0.083 | NaN | 0.142 | 0.724 | 0.594 | -0.768 | -0.076 | NaN |
| 5Nd | -3.906 | NaN | -0.454 | -0.95 | -0.421 | 0.641 | NaN | -0.033 | 0.696 | -0.097 | 0.023 | 1.775 |
| 5Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Za | 1.614 | 3.554 | -2.788 | -0.926 | -1.457 | 0.361 | 1.746 | -0.666 | 0.653 | -0.276 | -0.434 | 2.039 |
| 5Zb | 0.952 | 3.614 | -3.255 | -0.857 | -1.261 | 0.169 | 0.441 | 1.353 | 0.285 | -0.909 | -0.017 | 2.459 |
| 5Zc | 1.307 | 6.791 | NaN | NaN | -1.91 | -0.595 | -0.171 | NaN | NaN | 0.514 | NaN | NaN |
| 5Zd | -1.337 | NaN | -0.24 | -0.118 | NaN | -1.353 | 0.86 | 0.2 | 0.338 | NaN | 0.458 | 1.094 |
| 5Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Ztot | -0.331 | 5.145 | -2.49 | -1.023 | -0.907 | 0.299 | -1.128 | 1.037 | 0.493 | -0.431 | 0.319 | 2.119 |
| 4Ntot | -0.115 | 2.936 | -1.835 | -1.6 | -0.473 | 0.893 | -1.405 | 1.389 | 0.722 | -1.041 | 0.034 | 2.296 |
| 5Ztot | -0.182 | NaN | -0.513 | -0.869 | NaN | -0.828 | 0.867 | NaN | 0.262 | NaN | NaN | 0.423 |
| 5Ntot | -0.325 | NaN | NaN | -0.768 | -1.457 | NaN | 0.847 | 0.511 | NaN | -0.336 | -0.213 | NaN |

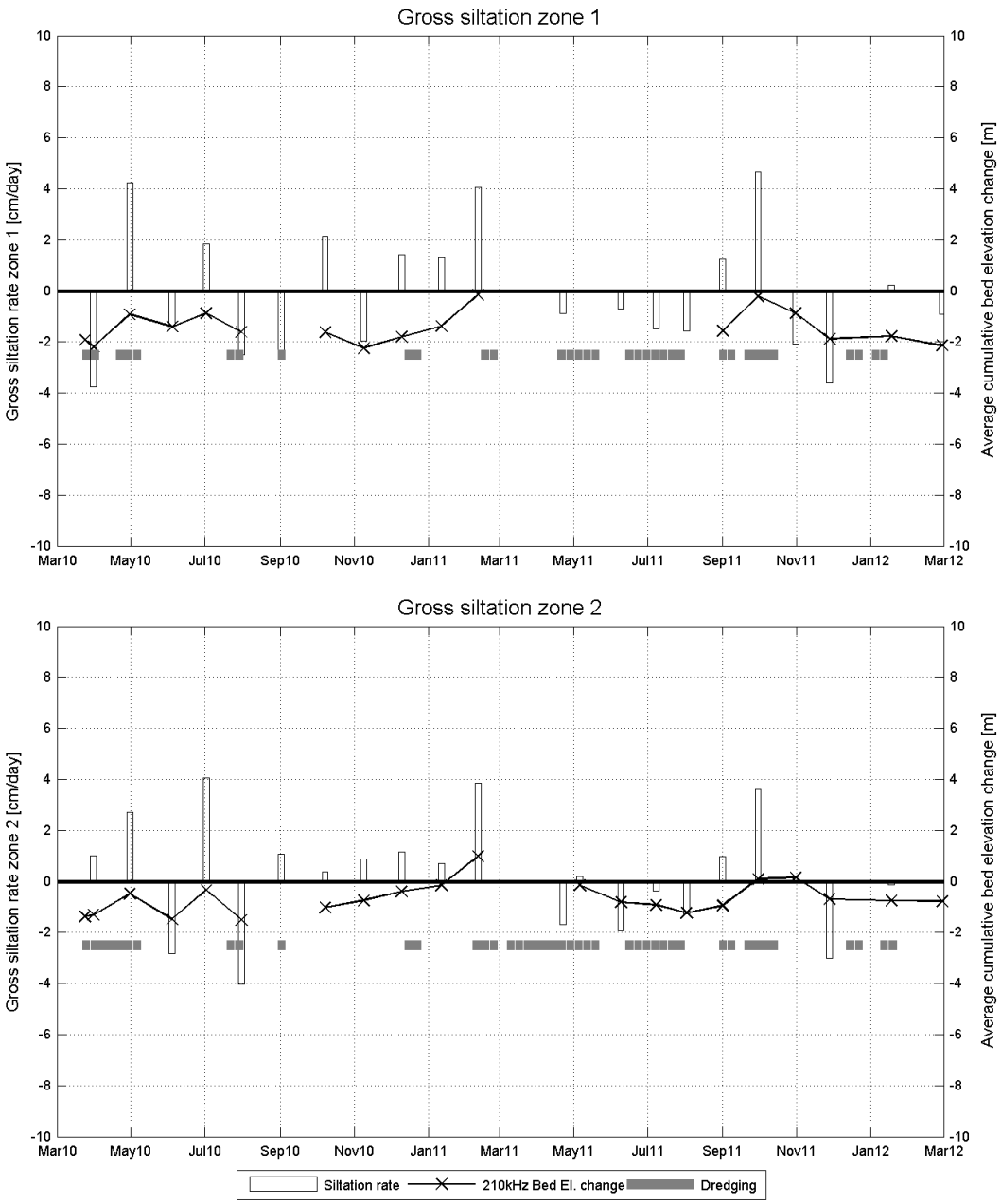
*Table 7-2: **Siltation rates [cm/day]** per section at each depth sounding day, based on the water-bed interface level difference between two consecutive depth soundings. For period March 24th 2011 – March 28th 2012.*

| Per section | 22/Apr | 6/May | 9/Jun | 8/Jul | 2/Aug | 1/Sep | 30/Sep | 31/Oct | 28/Nov | 18/Jan | 29/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D1 | 0.051 | 3.488 | -3.02 | -0.92 | 0.486 | 0.341 | -2.984 | 1.6 | 1.508 | -0.829 | 0.271 | 2.257 |
| D2 | 0.195 | 2.968 | -2.579 | -1.104 | 0.501 | 0.134 | -1.588 | 1.455 | 0.963 | -1.016 | 0.077 | 2.705 |
| D3 | 0.314 | 2.173 | -2.251 | -0.905 | -0.01 | 0.292 | -0.887 | 0.917 | 1.109 | -1.215 | 0.09 | 2.959 |
| D4 | 0.582 | 3.009 | -2.454 | -0.741 | -0.295 | 0.407 | -0.944 | 1.075 | 0.676 | -1.03 | -0.082 | 2.708 |
| D5 | 0.883 | 2.643 | -2.426 | -0.533 | -0.381 | 0.572 | -0.883 | 0.702 | 0.743 | -0.758 | -0.37 | 2.497 |
| D6 | -2.869 | 3.662 | -3.032 | -0.444 | -0.925 | 0.72 | -0.33 | 0.764 | 0.358 | -0.747 | -0.348 | 1.655 |
| D7 | NaN | 0.068 | -1.896 | 0.012 | -1.673 | 1.923 | 3.366 | 0.105 | -3.146 | 0.06 | -0.314 | 2.243 |
| D8 | NaN | NaN | -1.204 | -0.325 | -2.509 | 0.741 | 4.867 | -1.342 | -3.298 | 0.357 | 0.318 | 1.531 |
| D9 | NaN | NaN | -0.234 | -2.105 | -1.716 | 1.525 | 4.129 | -2.507 | -2.94 | 0.472 | -1.442 | 1.999 |
| D10 | NaN | NaN | NaN | NaN | NaN | -0.86 | 5.982 | NaN | NaN | -1.892 | NaN | NaN |
| D11 | -0.161 | 3.932 | -3.36 | -0.814 | 0.229 | 0.615 | -3.51 | 1.945 | 1.111 | -0.474 | 0.333 | 2.199 |
| D12 | 0.523 | 3.98 | -2.545 | -1.457 | 0.454 | 0.196 | -4.228 | 1.982 | 0.595 | 0.354 | 0.744 | 1.22 |
| D13 | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| D14 | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| L1 | 0.438 | 2.475 | -1.517 | -1.548 | -1.333 | 0.786 | -1.318 | 1.569 | 0.939 | -1.119 | 0.165 | 1.818 |
| L2 | 0.662 | 2.065 | -2.031 | -1.455 | 0.509 | 0.437 | -2.931 | 1.336 | 1.128 | -0.627 | 0.186 | 2.596 |
| L3 | -0.385 | 5.335 | -2.567 | -0.983 | -0.919 | 0.264 | -1.053 | 0.897 | 0.486 | -0.384 | 0.351 | 2.117 |
| **Avg** | **0.543** | **2.864** | **-2.555** | **-0.799** | **-0.057** | **0.365** | **-1.211** | **1.171** | **0.841** | **-1.031** | **0.031** | **2.611** |

# C.2 WATER-BED INTERFACE EVOLUTION FOR ALL ZONES

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |




Reference level: design depth

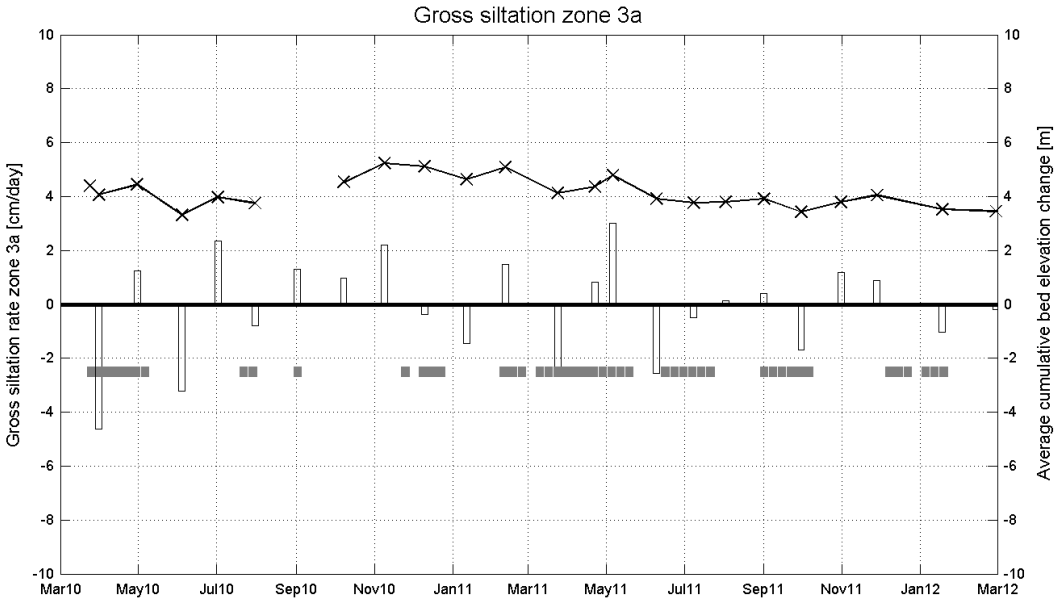
Data Processed by:

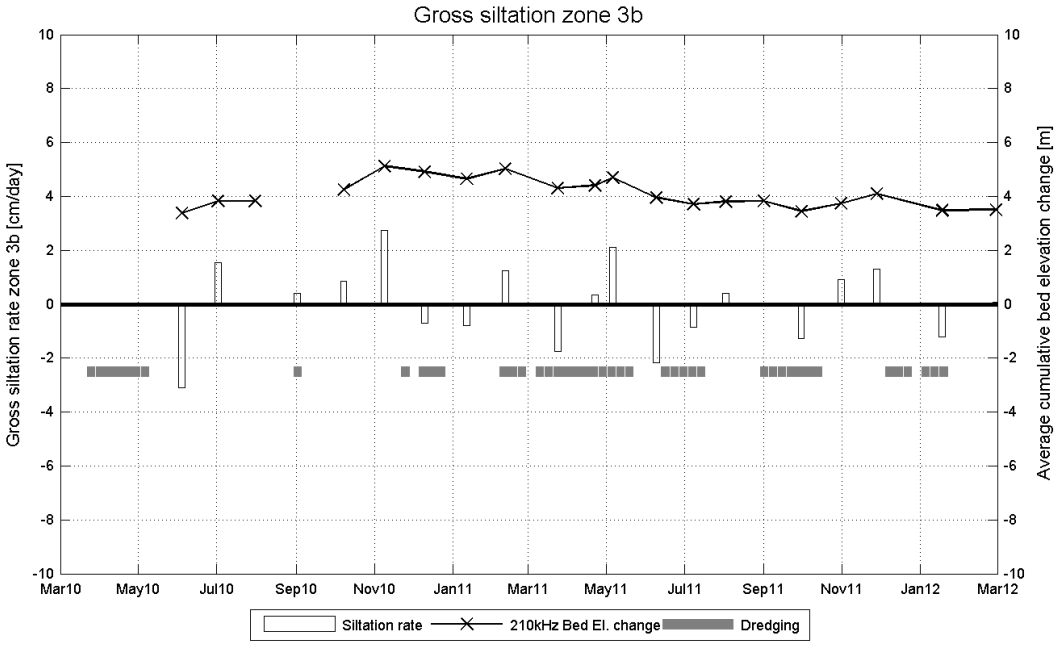
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
|---|---|
| | Location: DGD |




Reference level: design depth

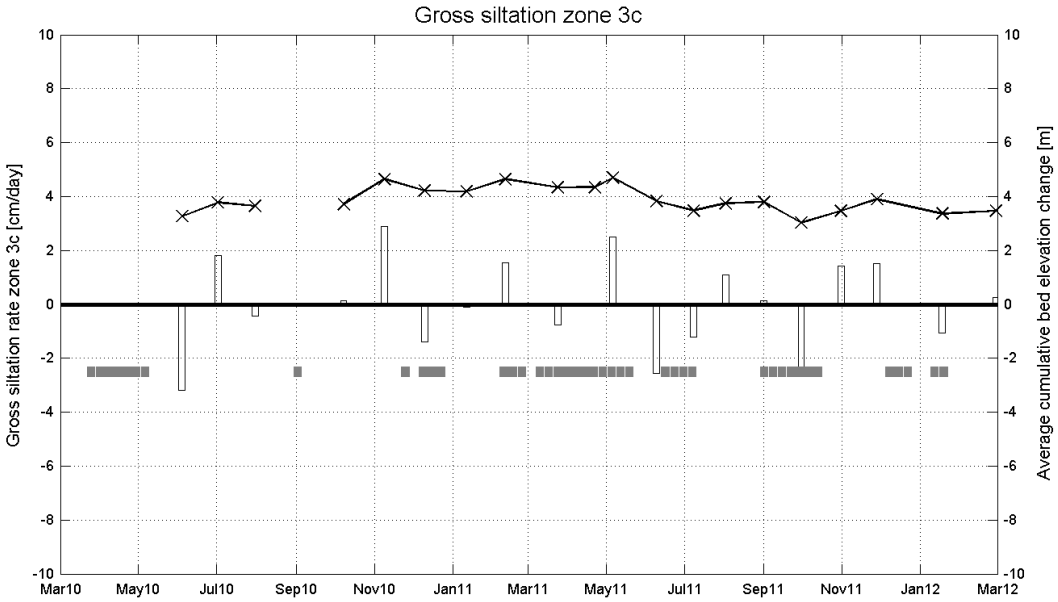
Data Processed by:

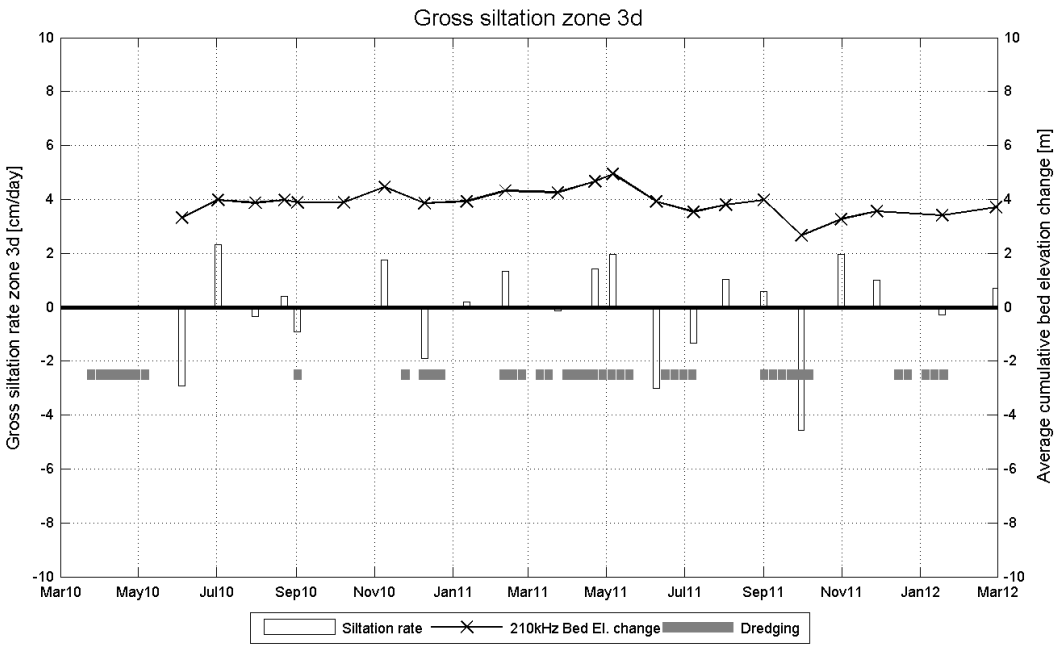
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

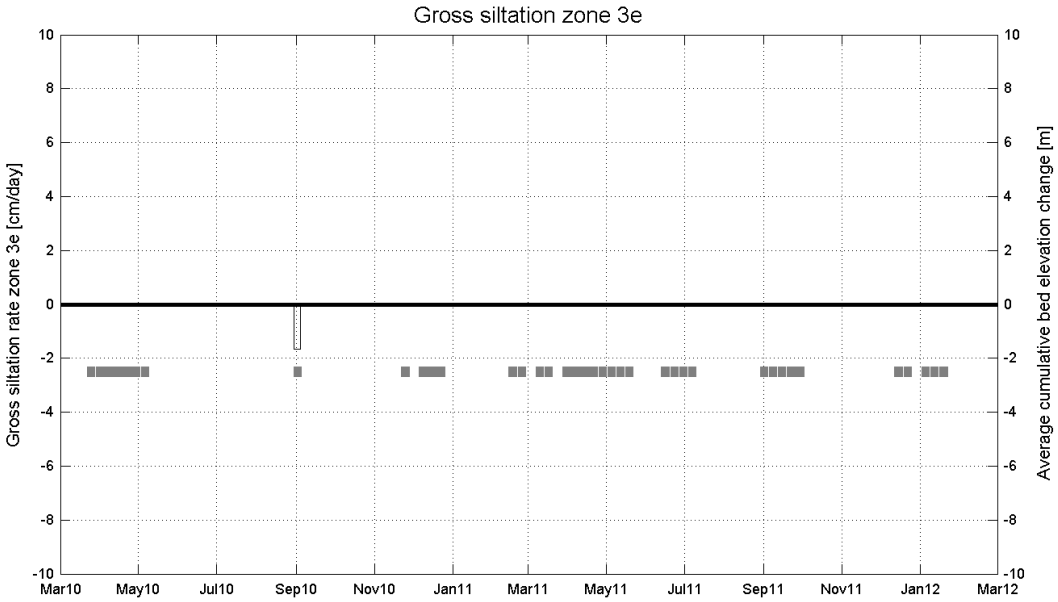


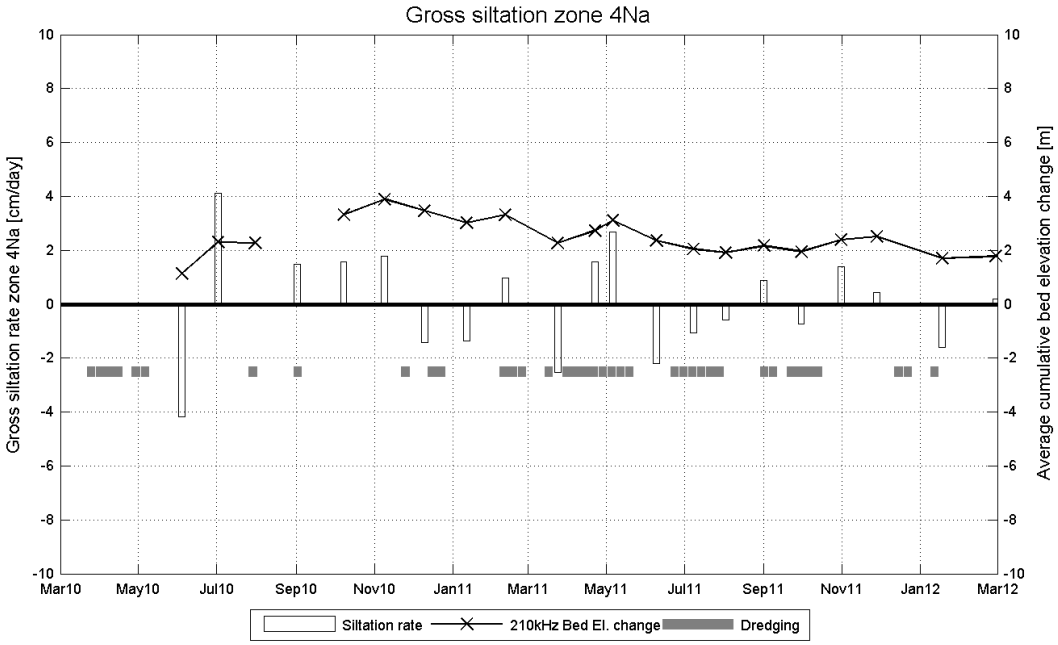




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

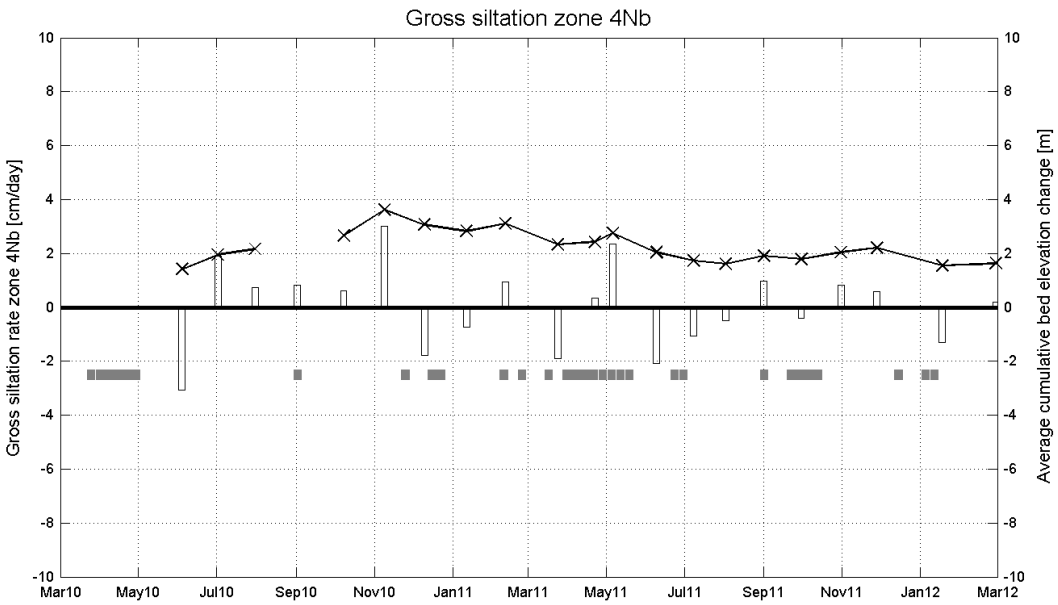


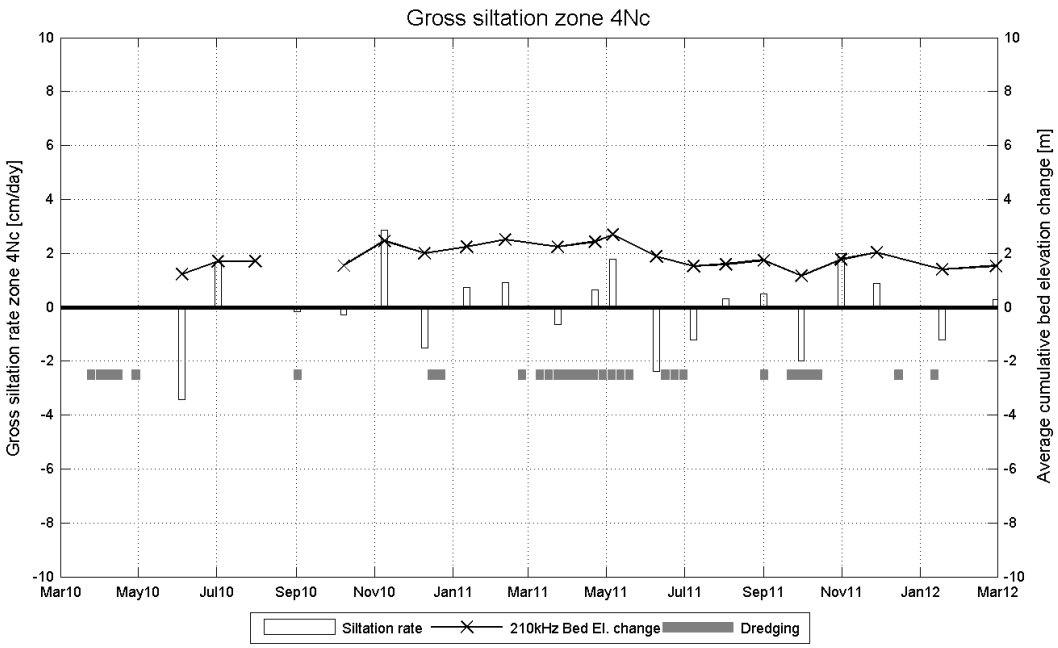




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

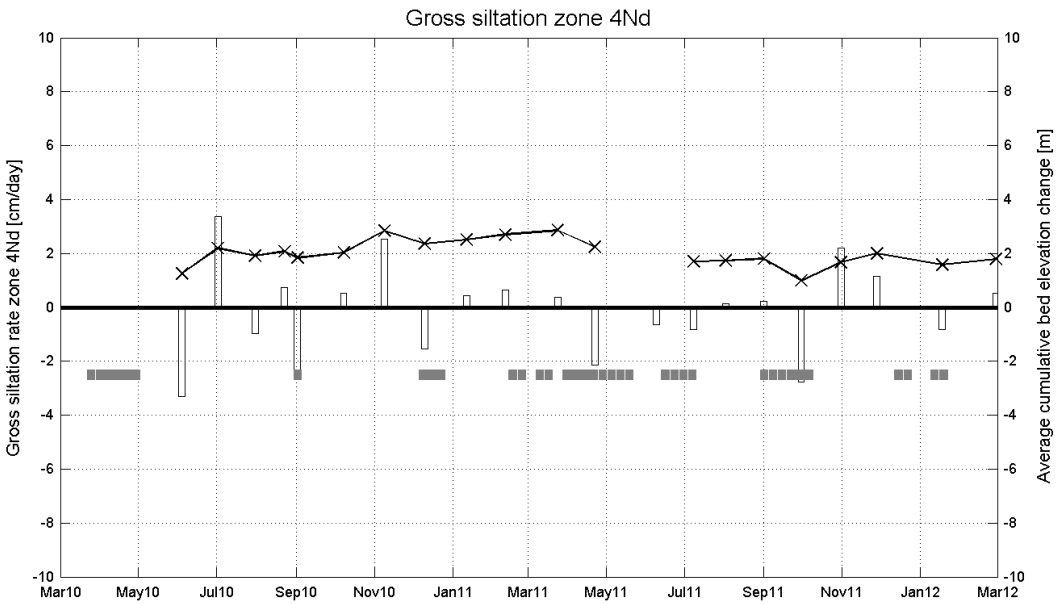


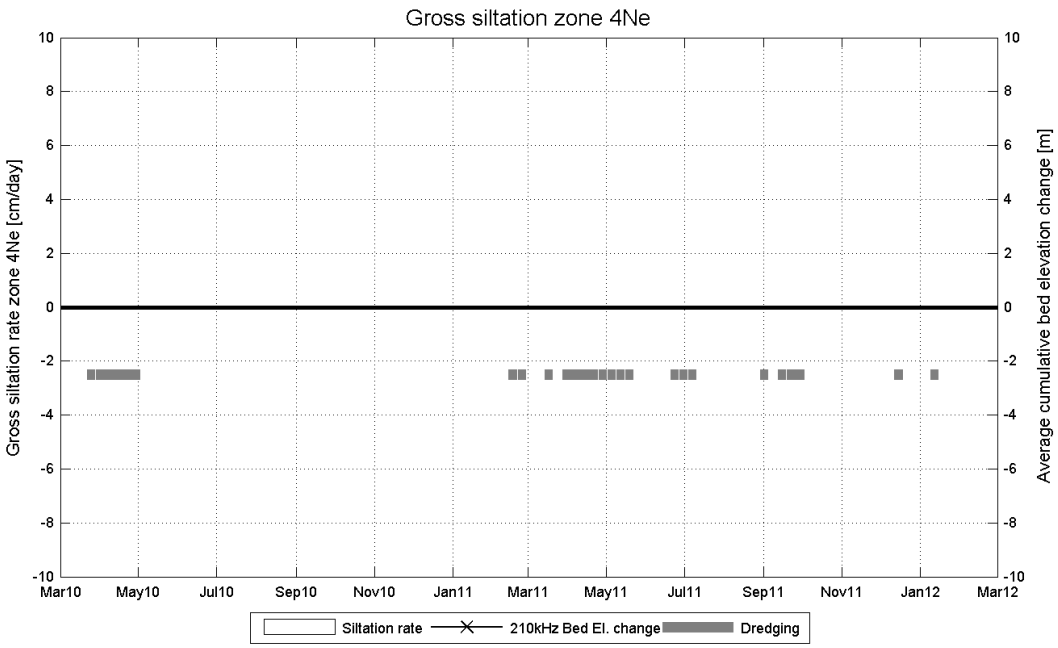




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

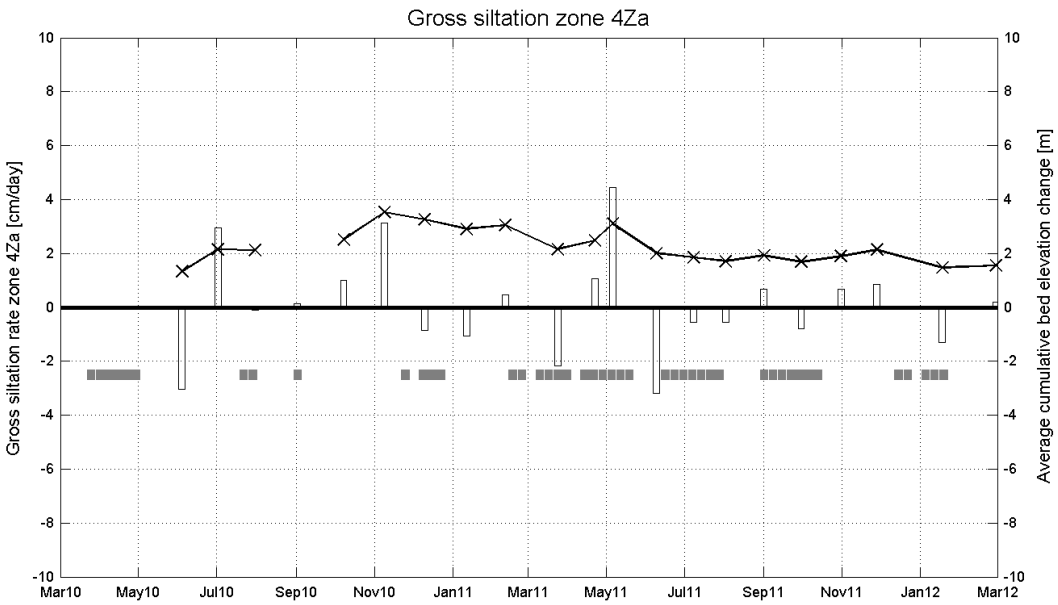


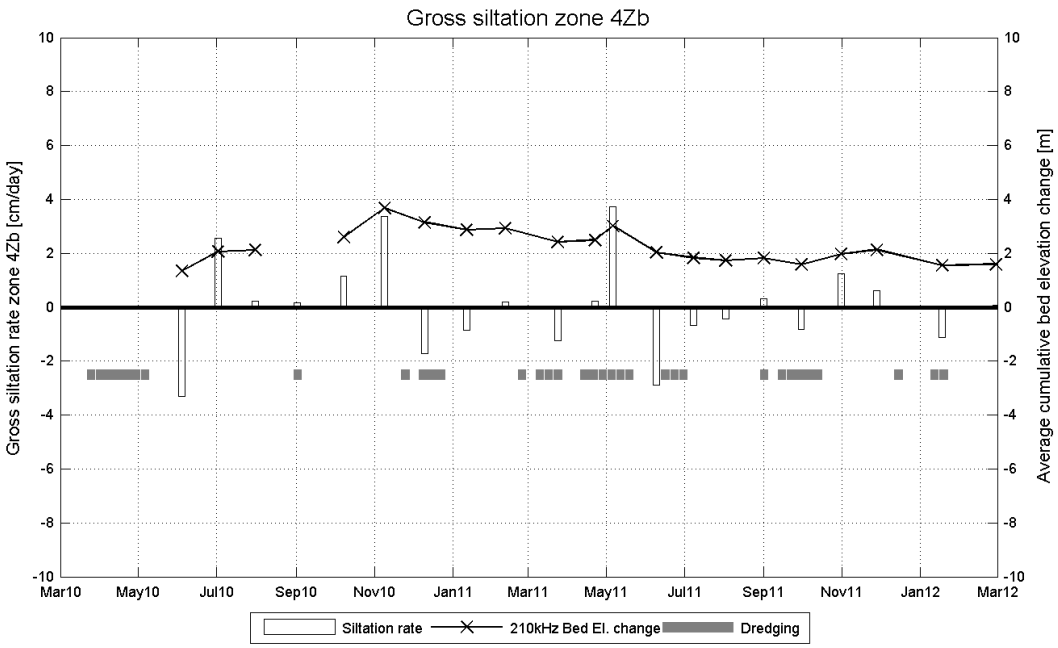




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

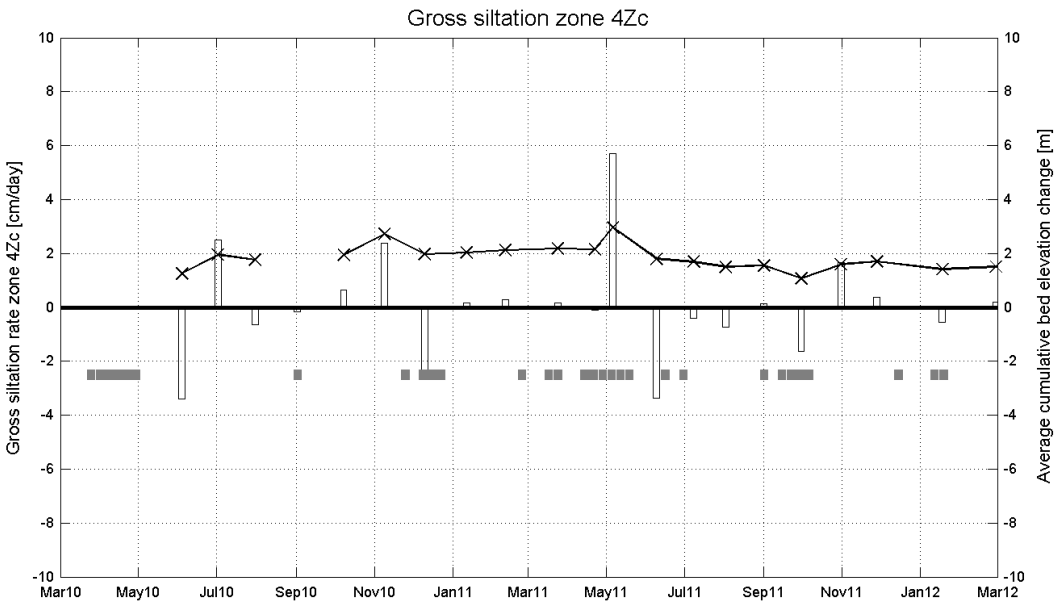


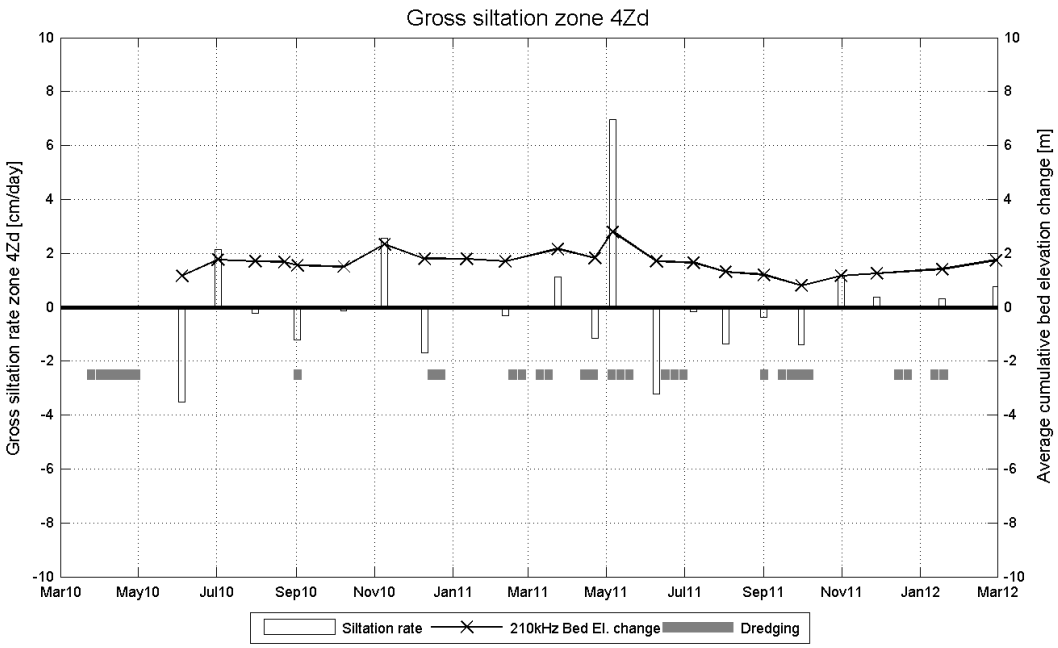




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

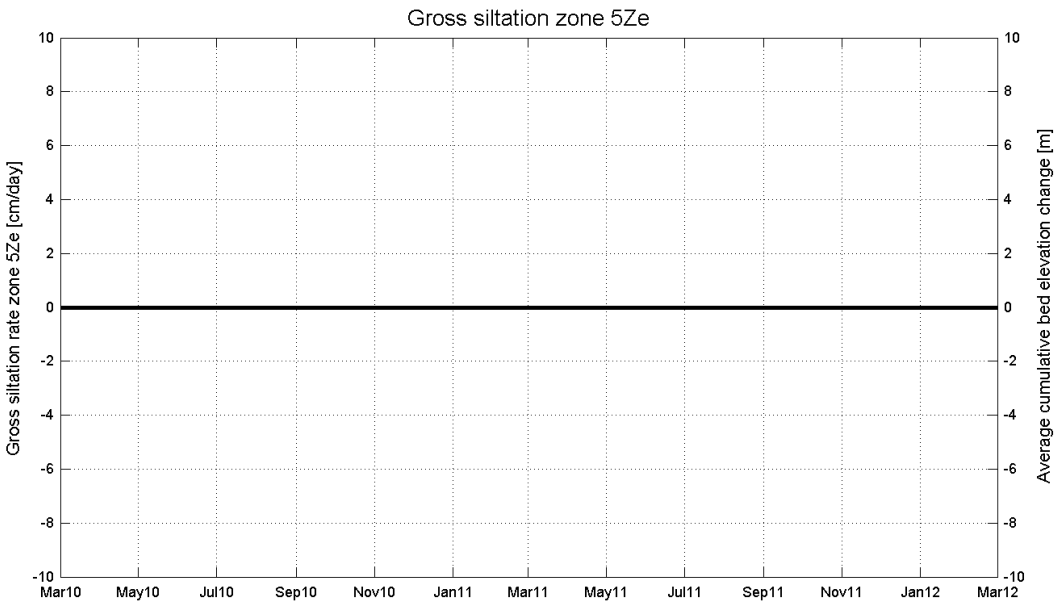


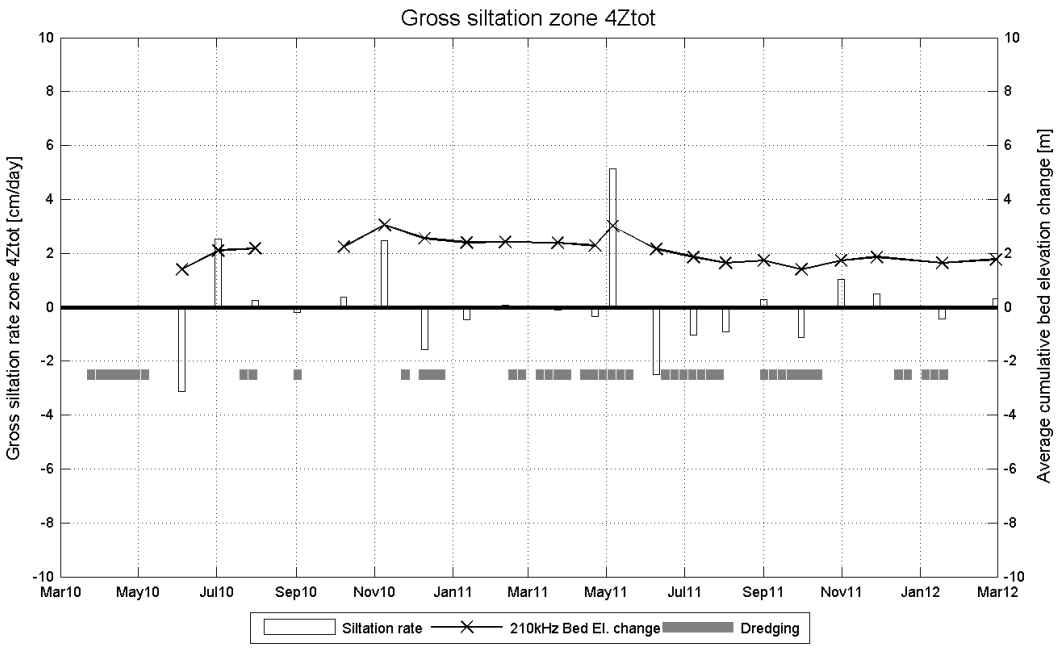




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |




Reference level: design depth

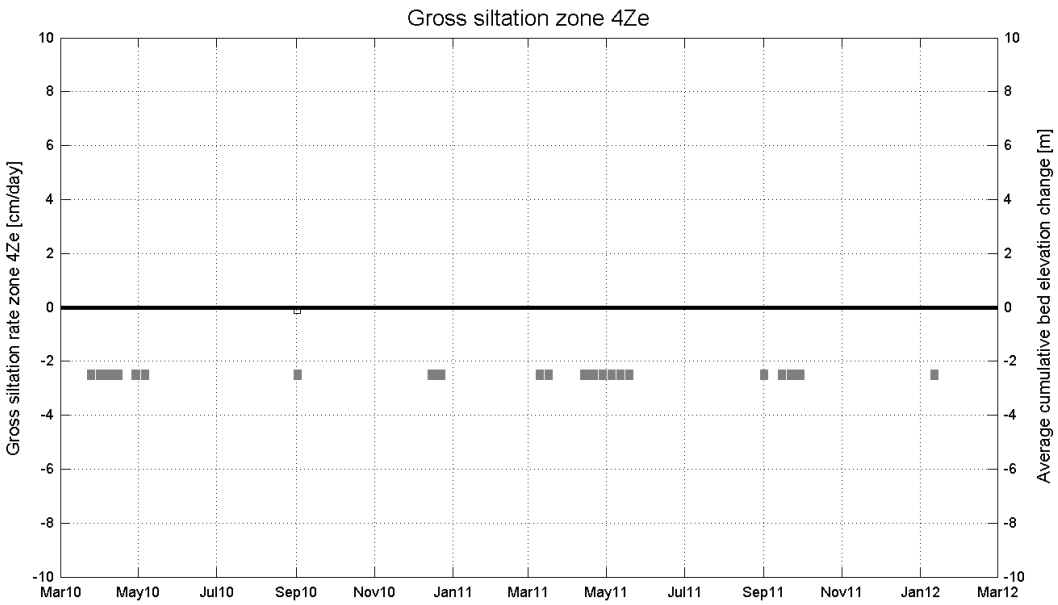
Data Processed by:

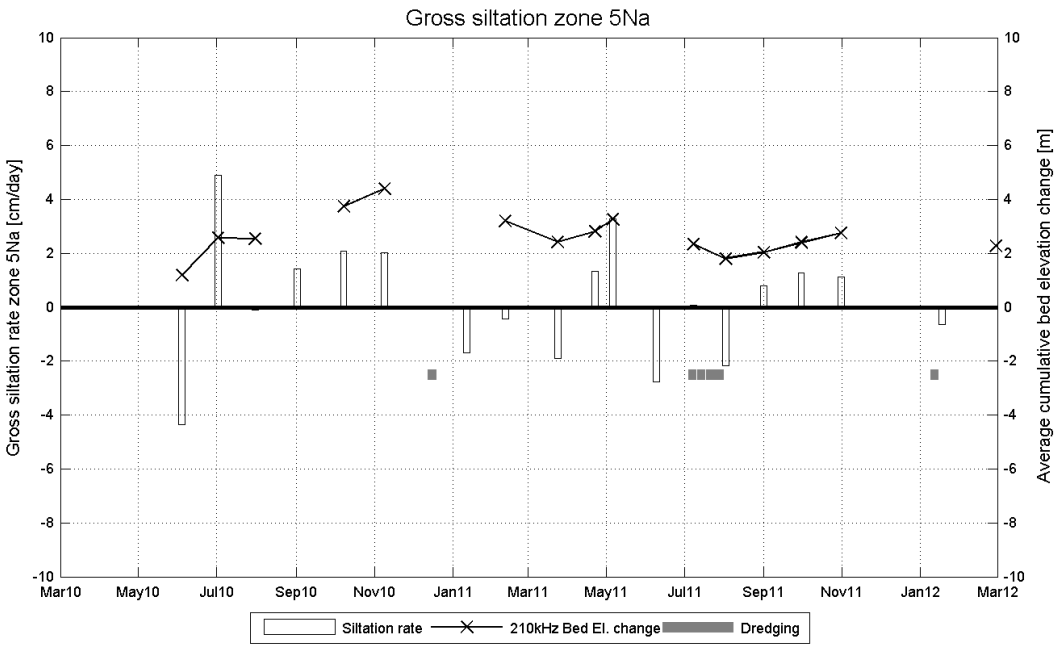
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
|---|---|
| | Location: DGD |

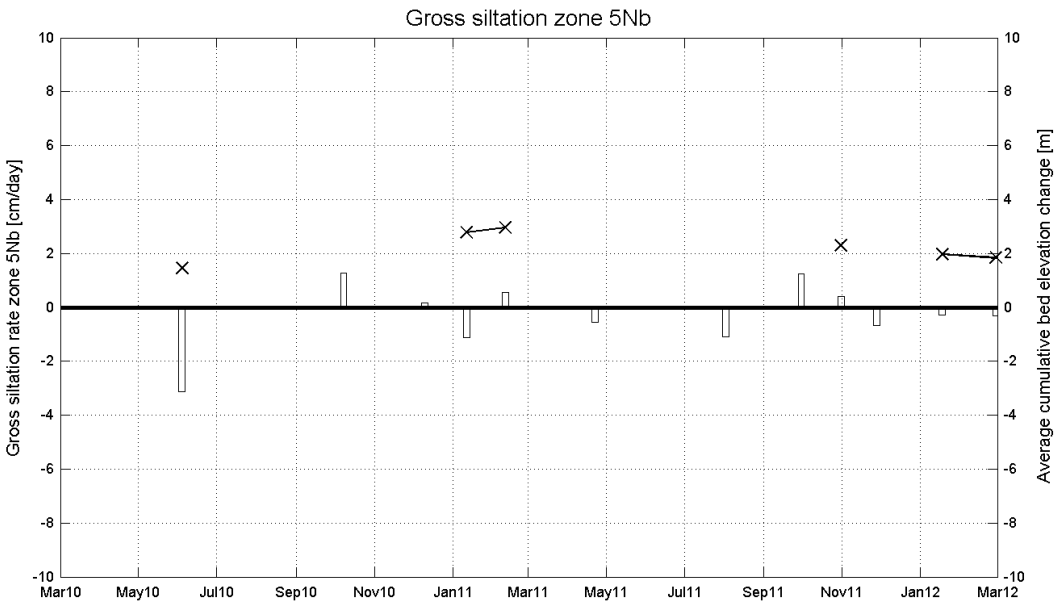


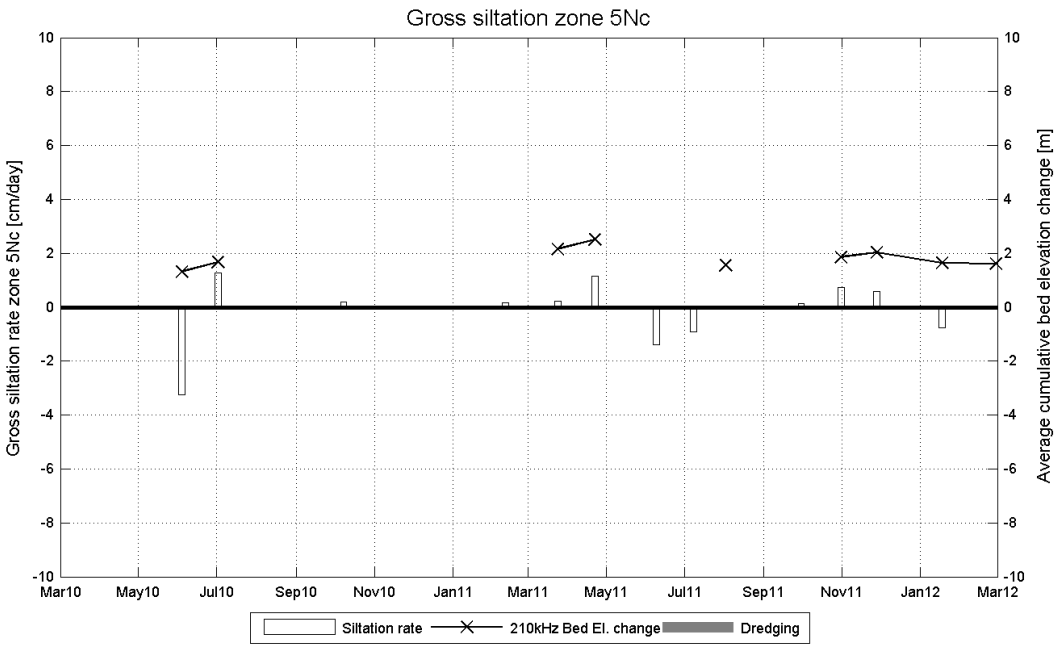




| Reference level: design depth | Data Processed by: In association with : IMDC, GEMS International, Deltares |
|---|---|
| | I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

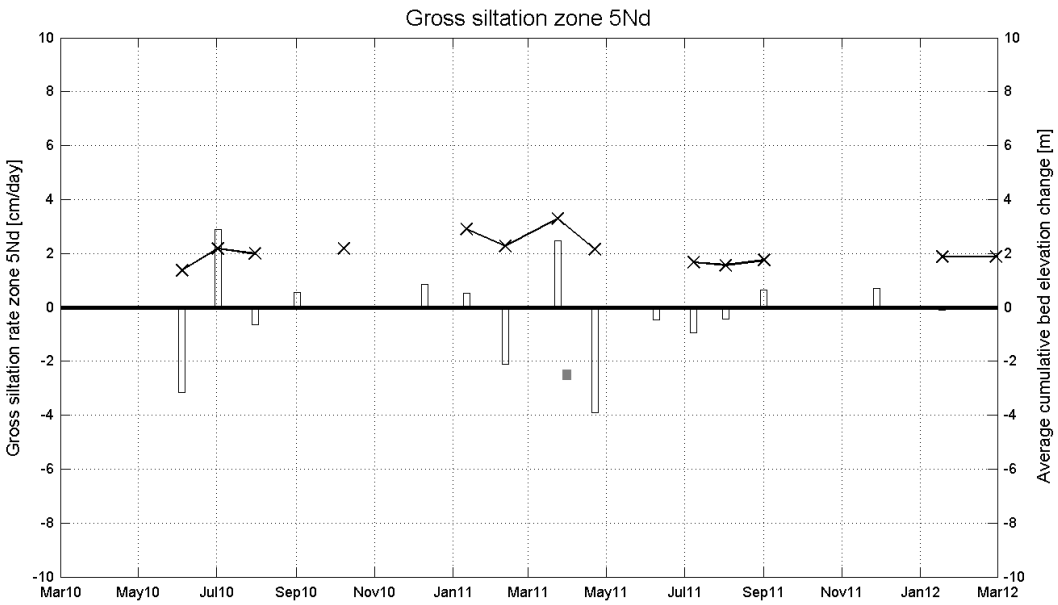


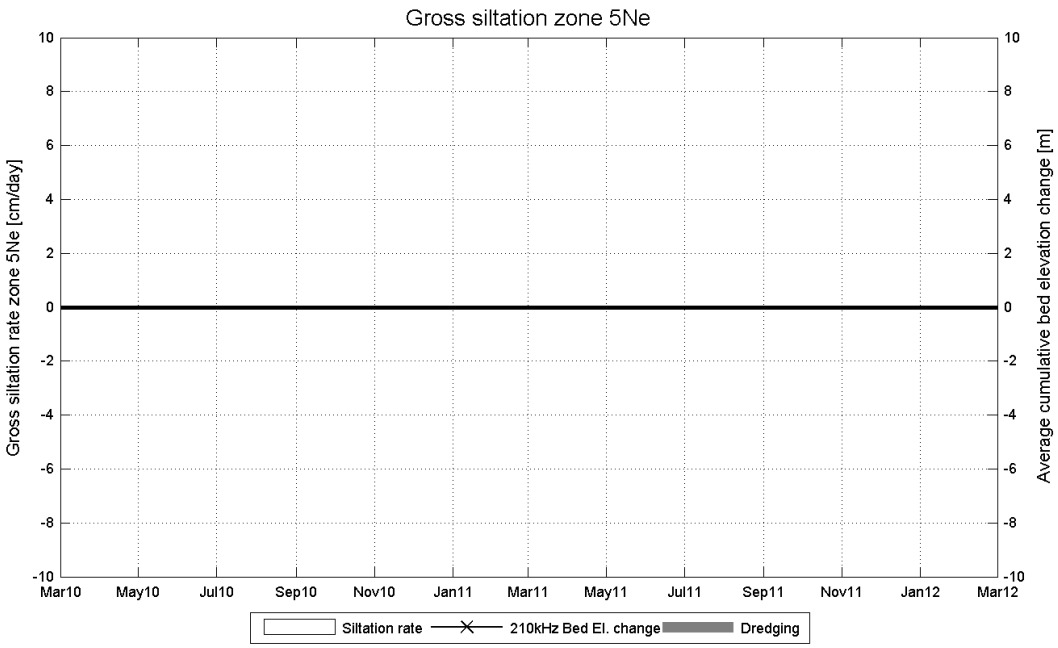




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

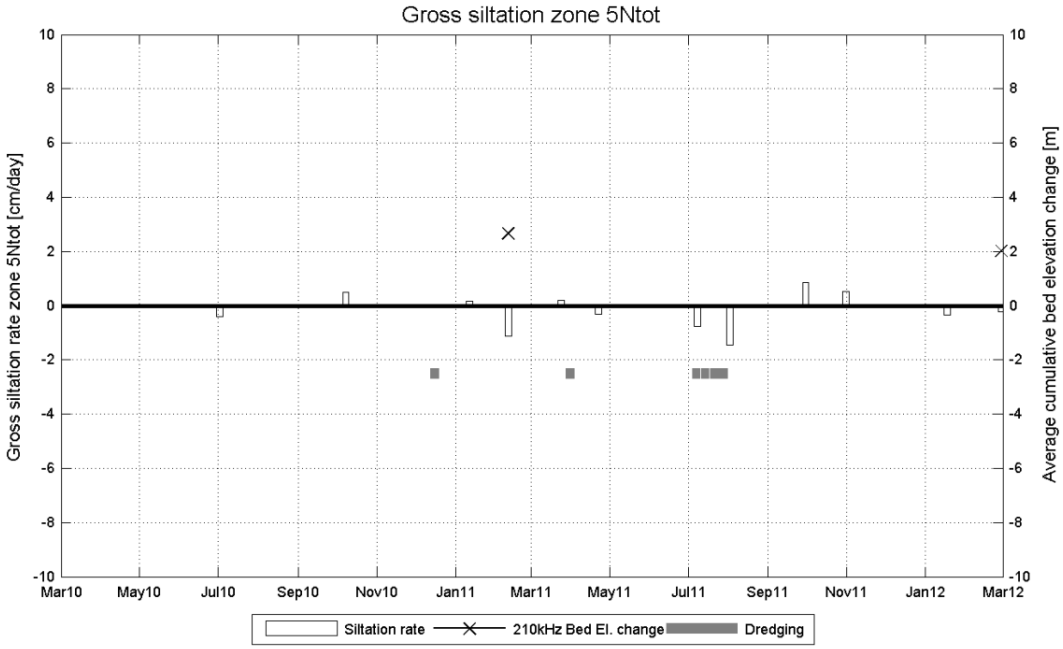



| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |




Reference level: design depth

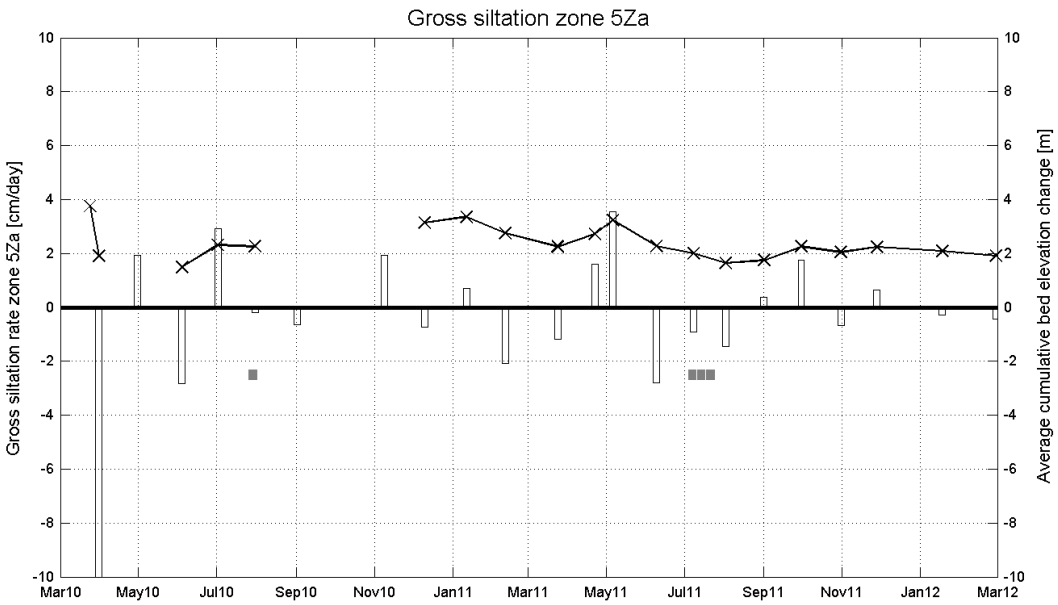
Data Processed by:

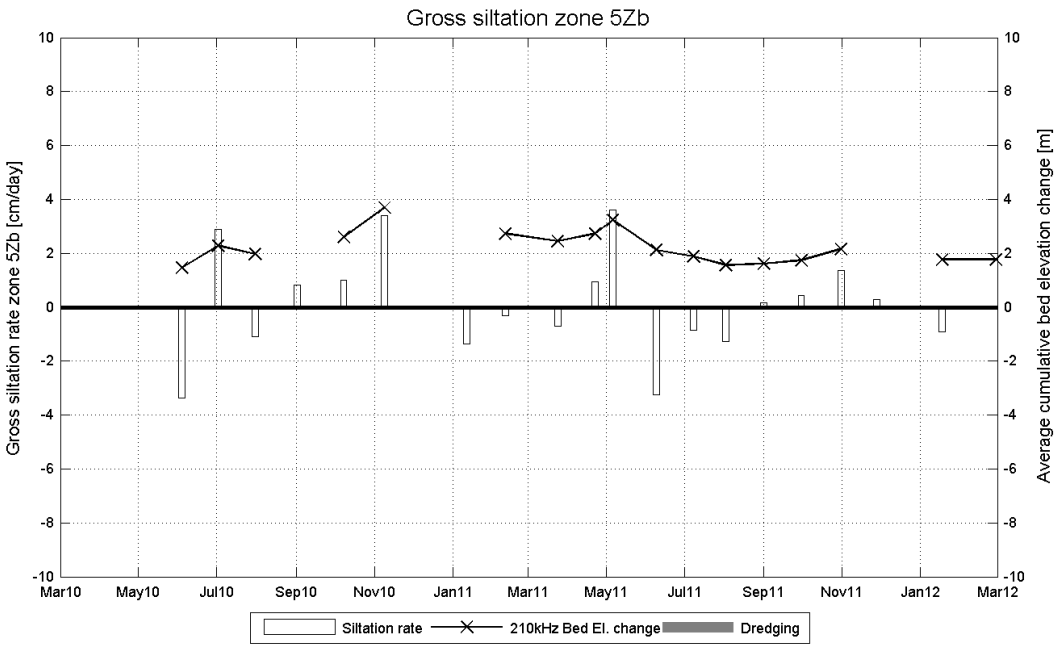
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

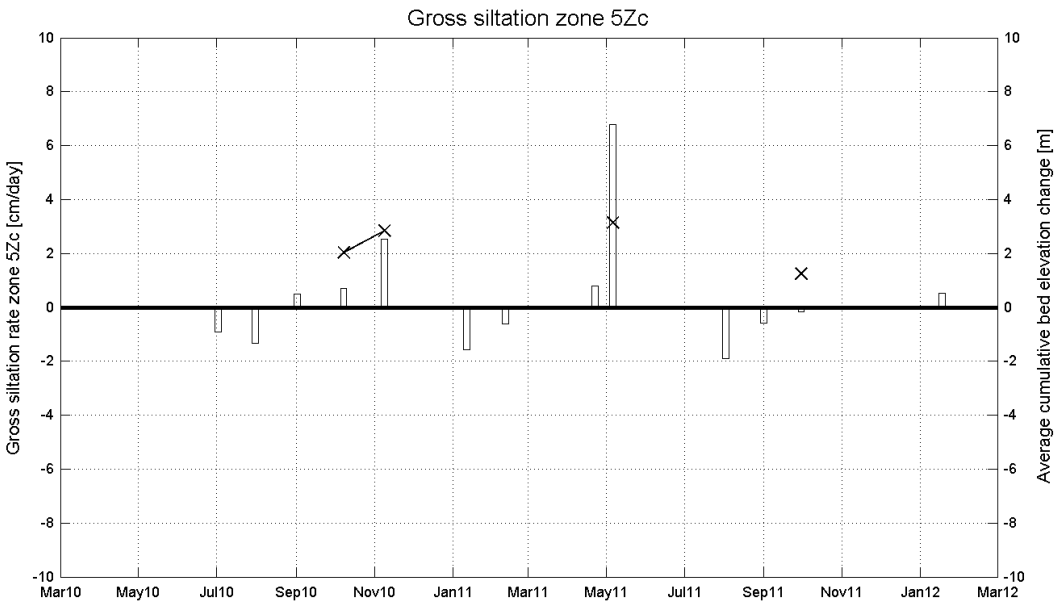


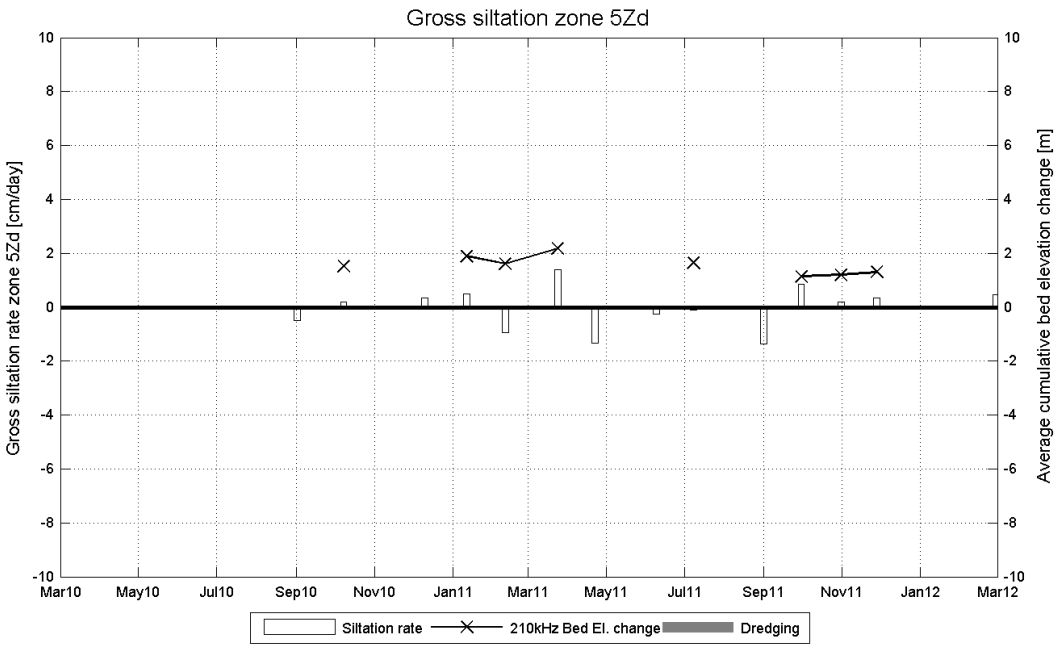




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
|---|---|
| | Location: DGD |

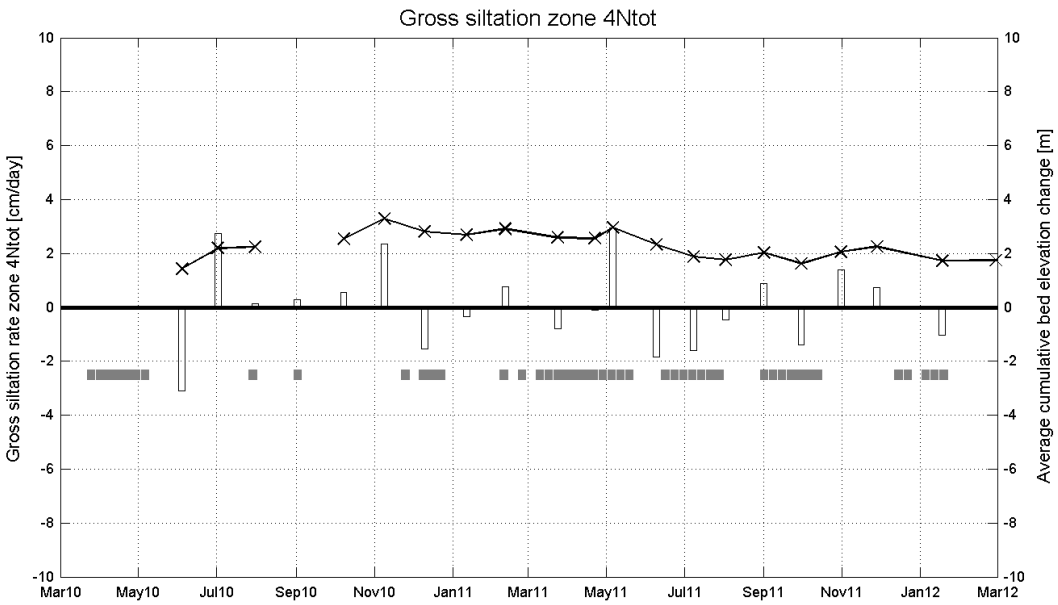


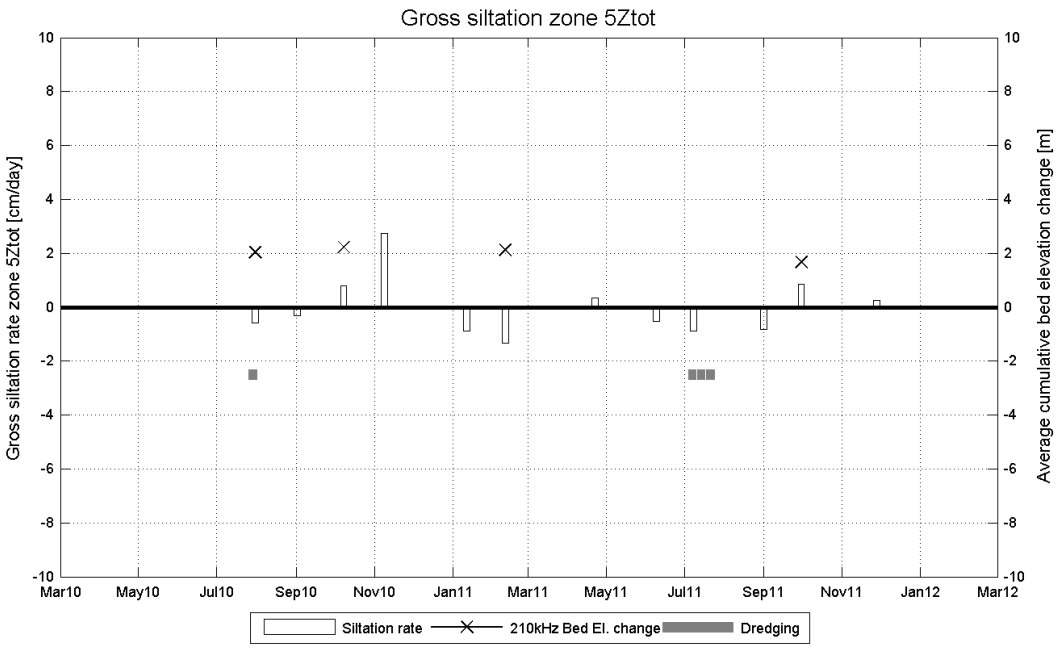




| Reference level: design depth | Data Processed by: In association with : IMDC, GEMS International, Deltares |
|---|---|
| | I/RA/11354/10.101/MBO/ANF |

# Evaluation of external effects on the siltation of Deurganckdok

| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
|---|---|
| | Location: DGD |




Reference level: design depth

Data Processed by:

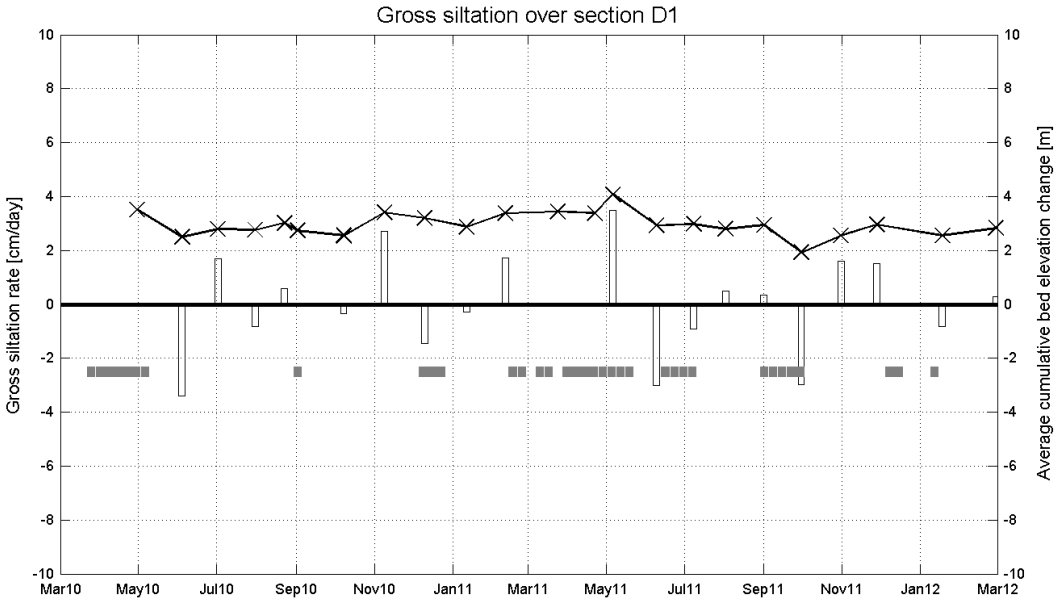
In association with :

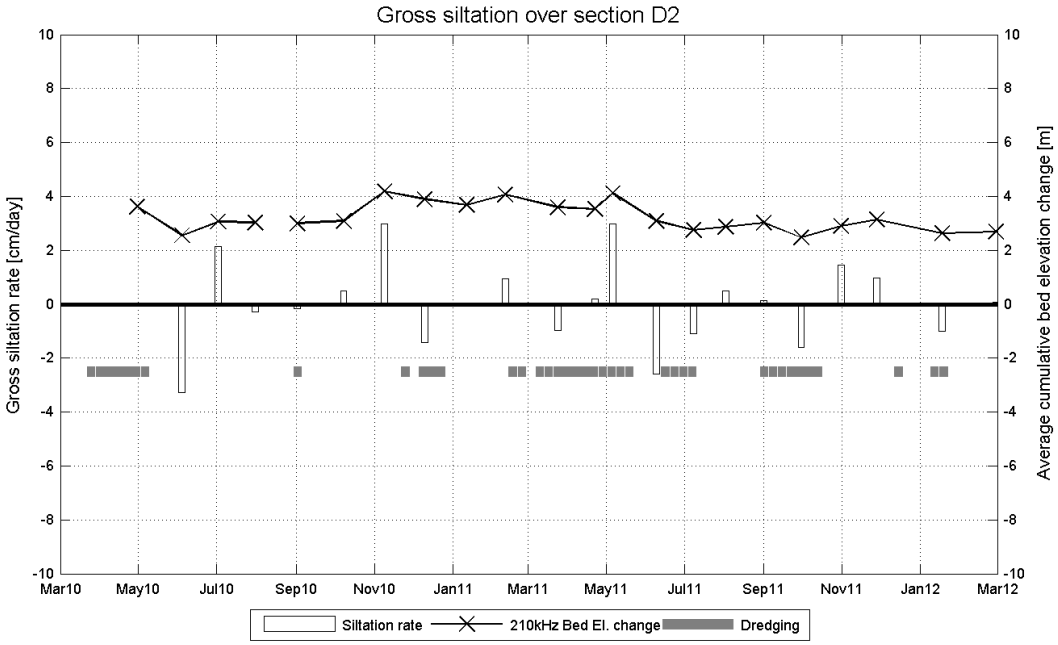
I/RA/11354/10.101/MBO/ANF

# C.3 WATER-BED INTERFACE EVOLUTION FOR ALL SECTIONS

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

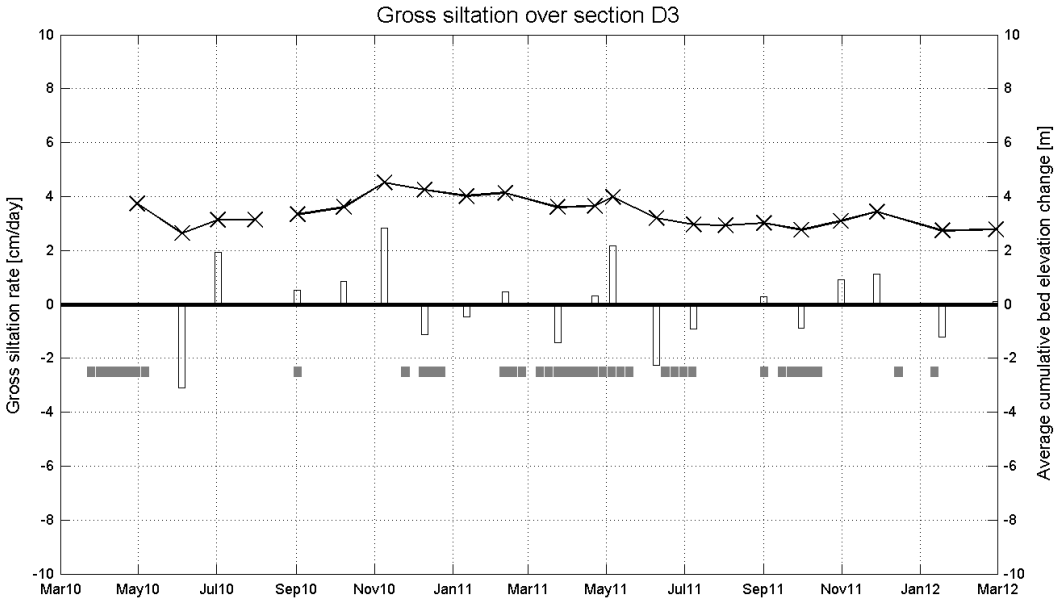


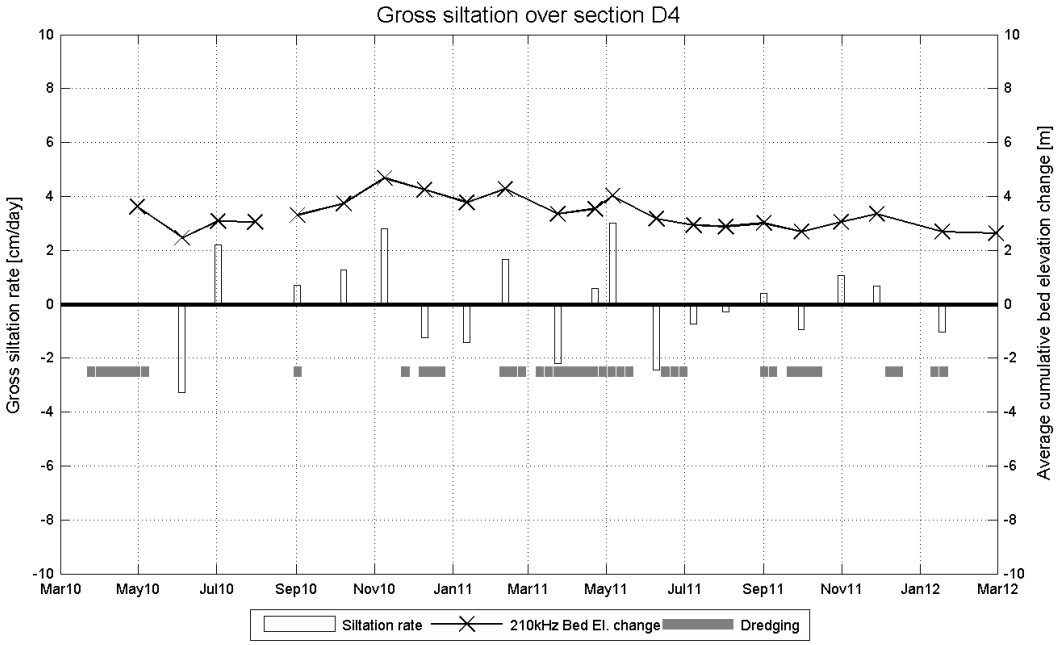




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

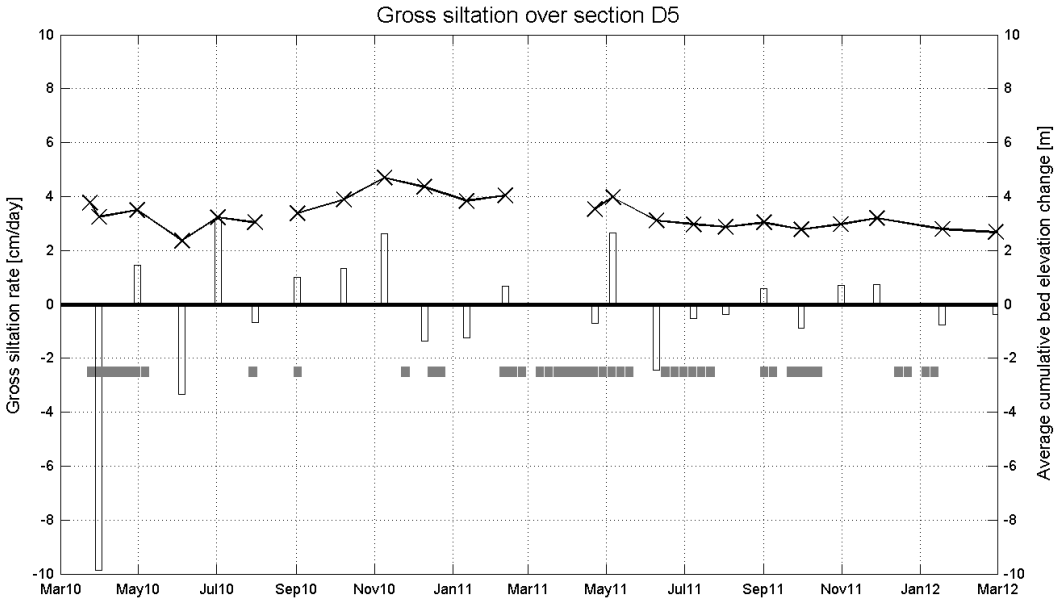


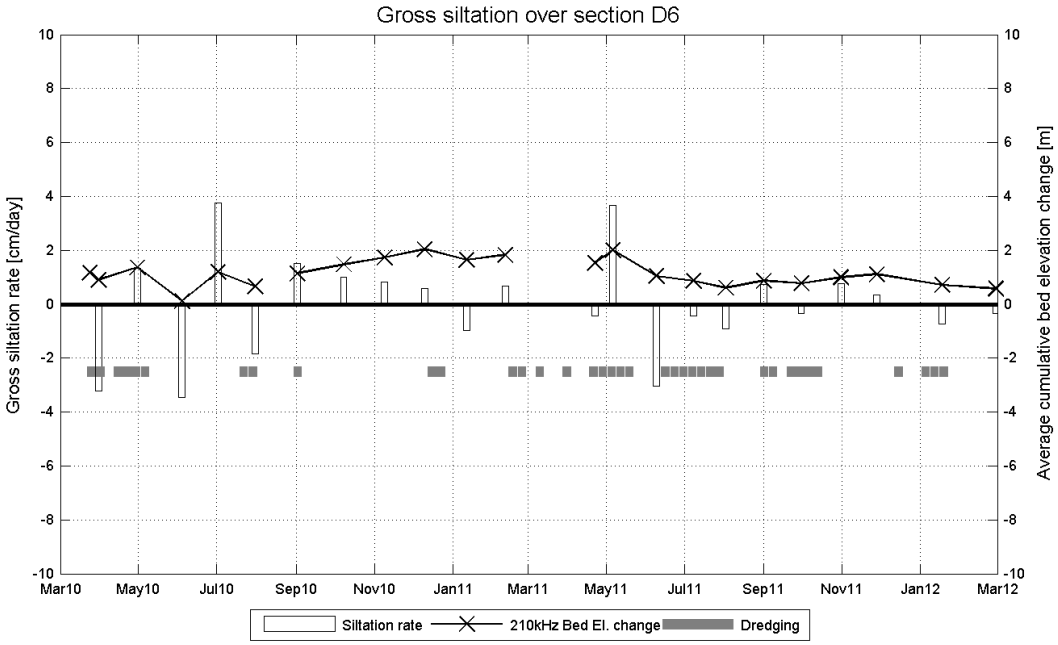




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |




Reference level: design depth

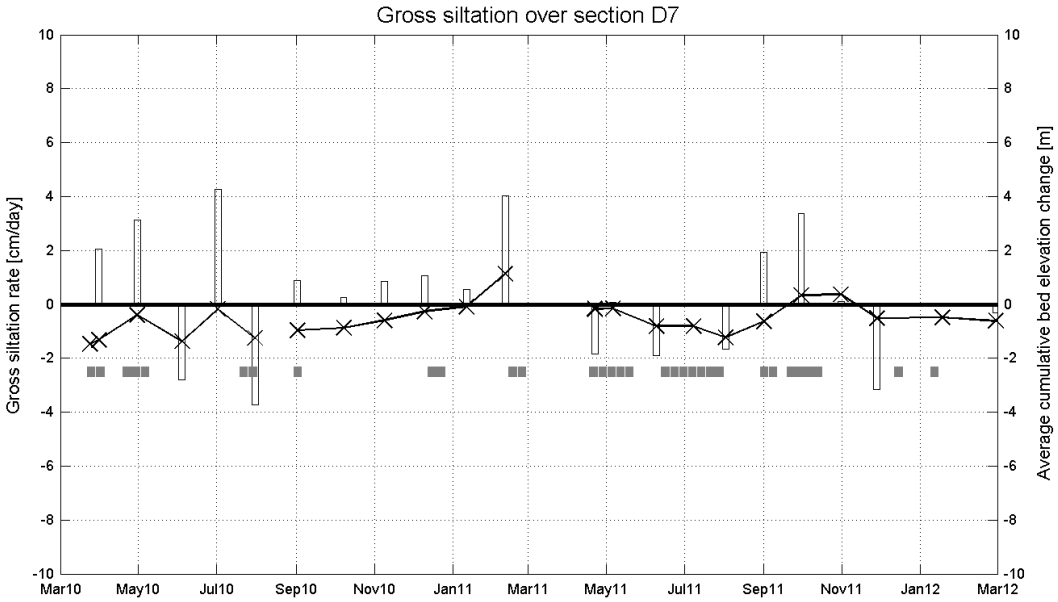
Data Processed by:

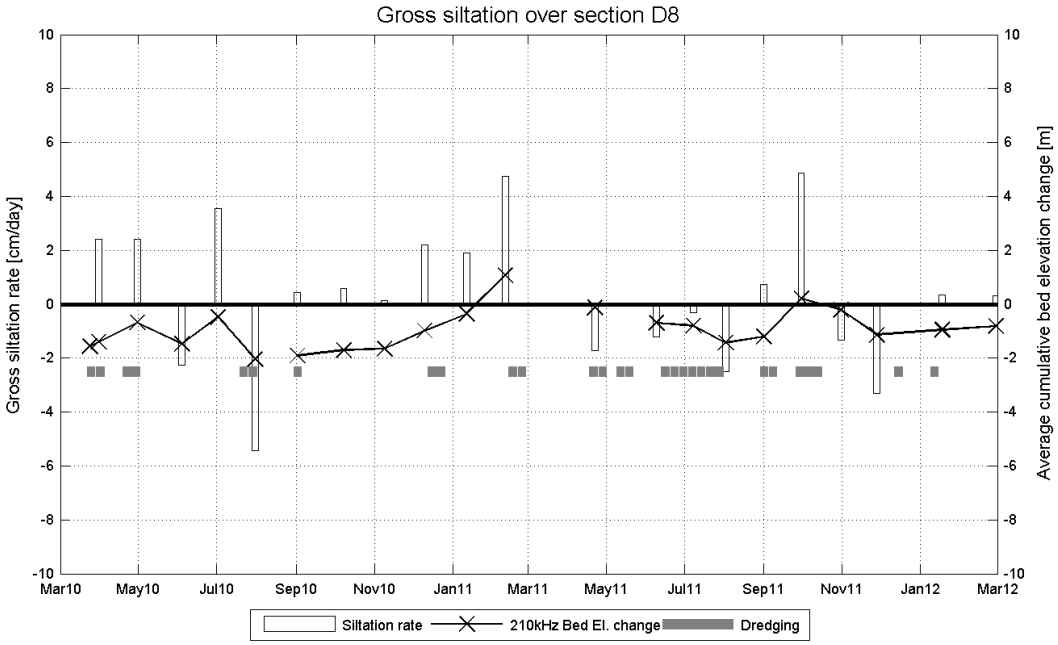
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

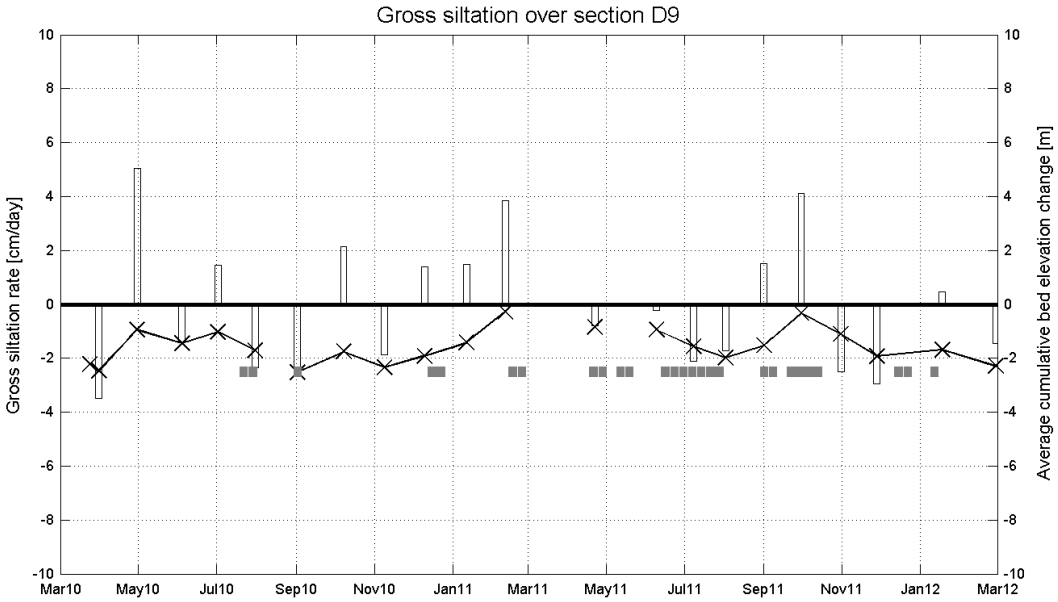


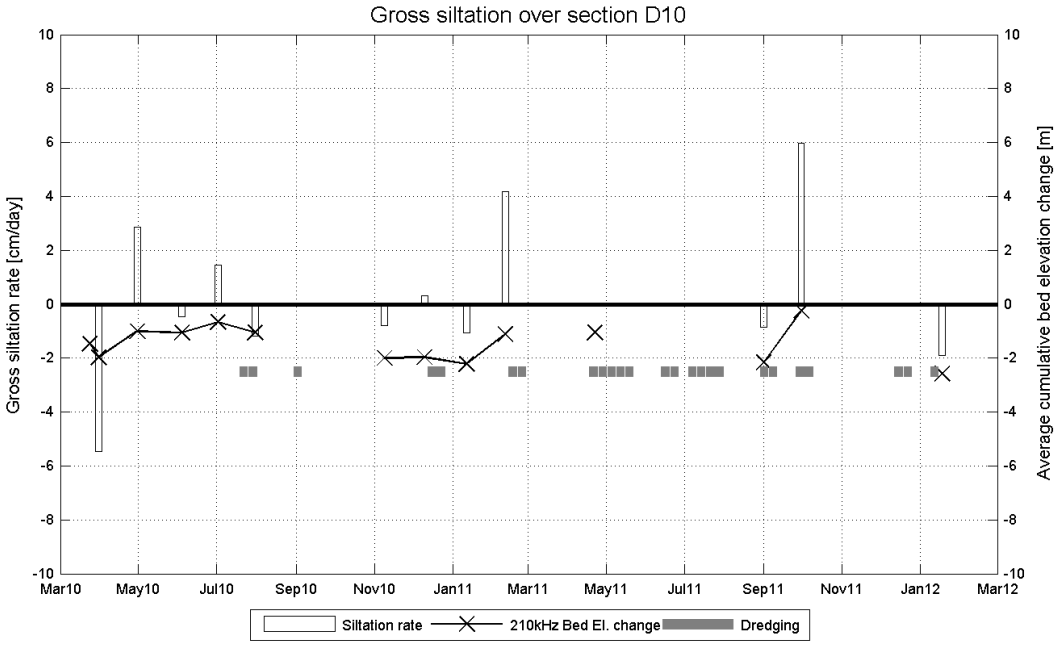




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

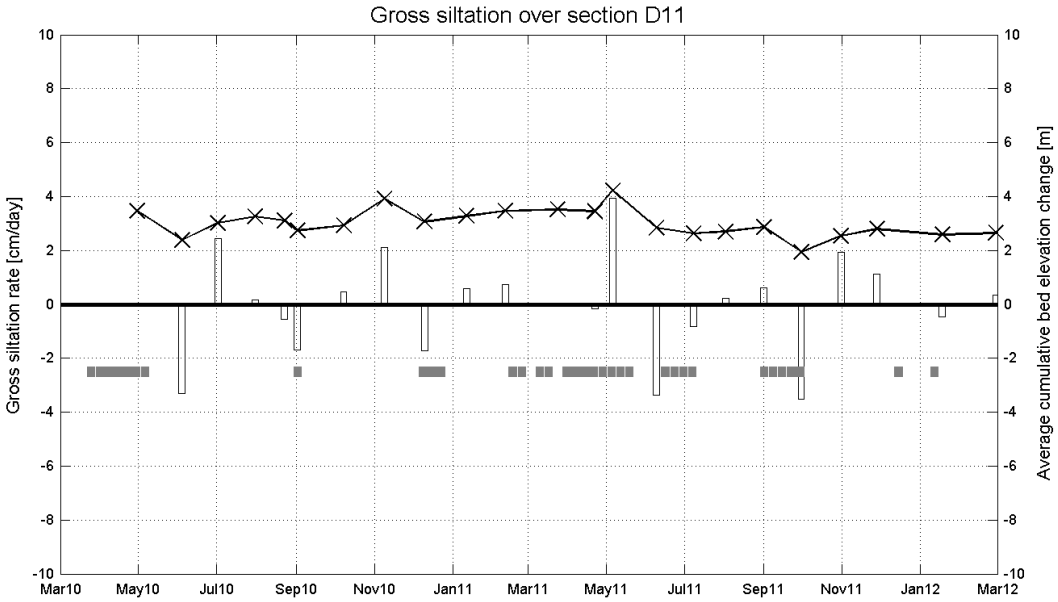


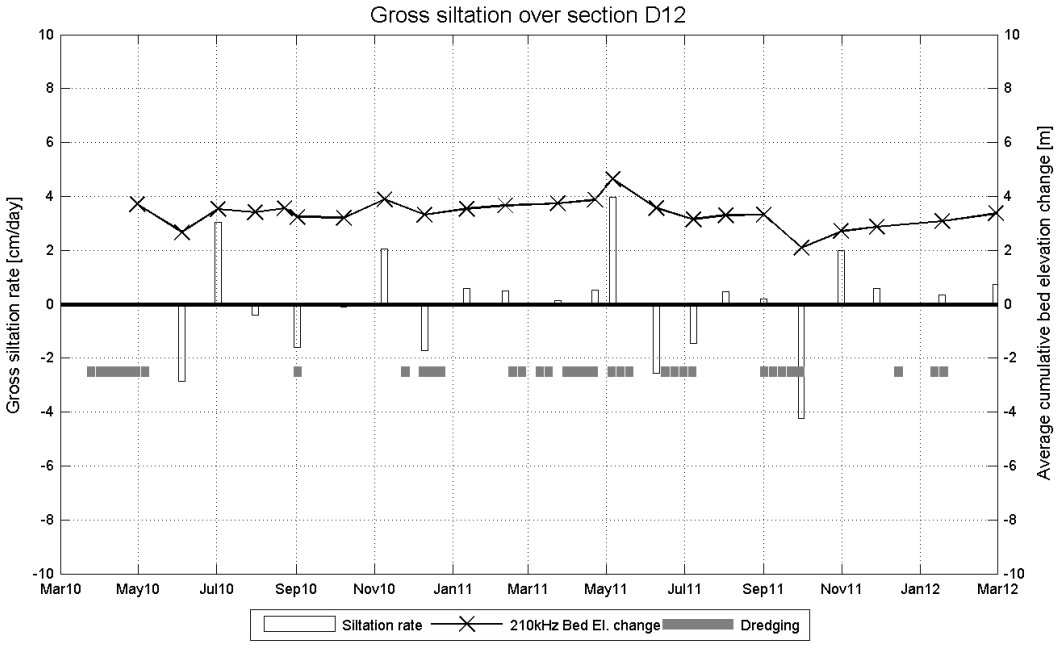




| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |




Reference level: design depth

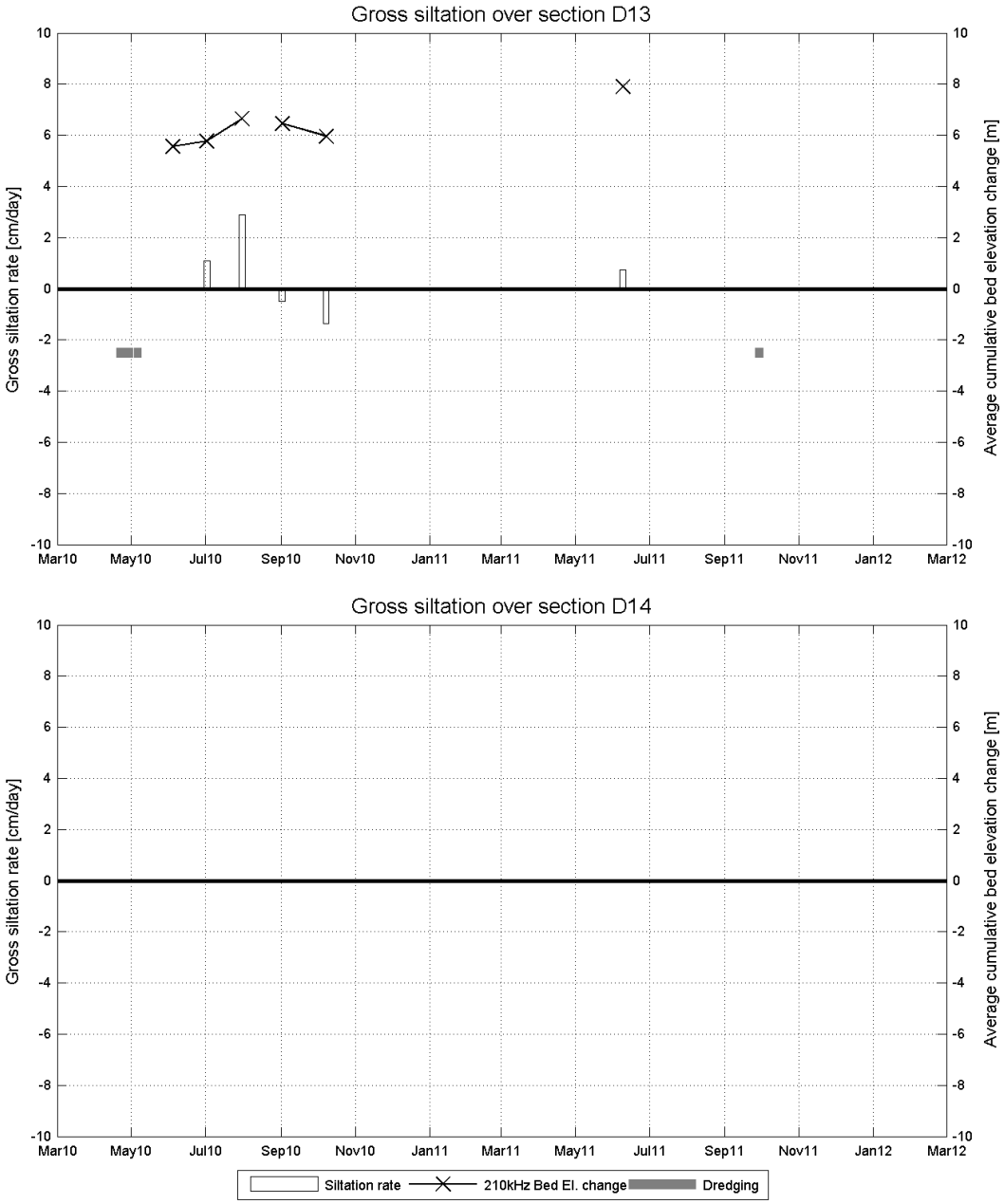
Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
|---|---|
| | Location: DGD |




Reference level: design depth

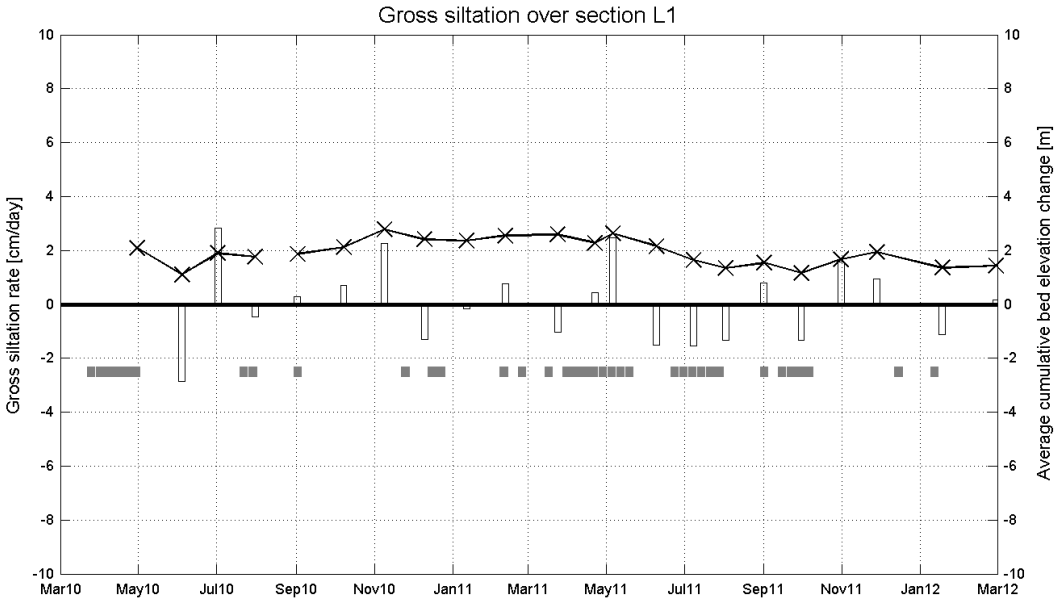
Data Processed by:

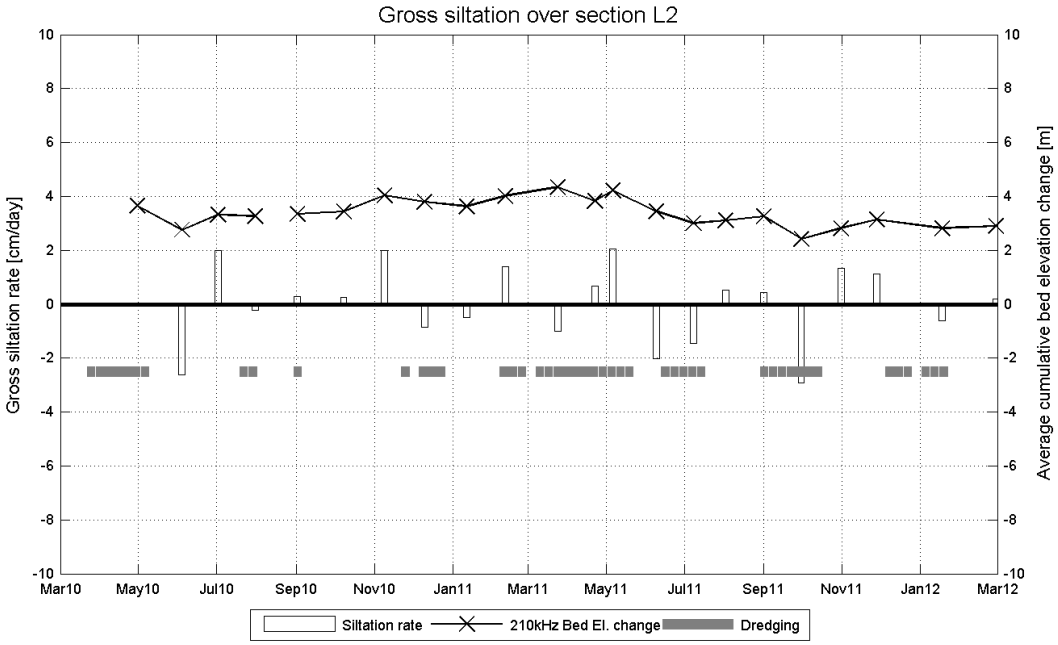
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |

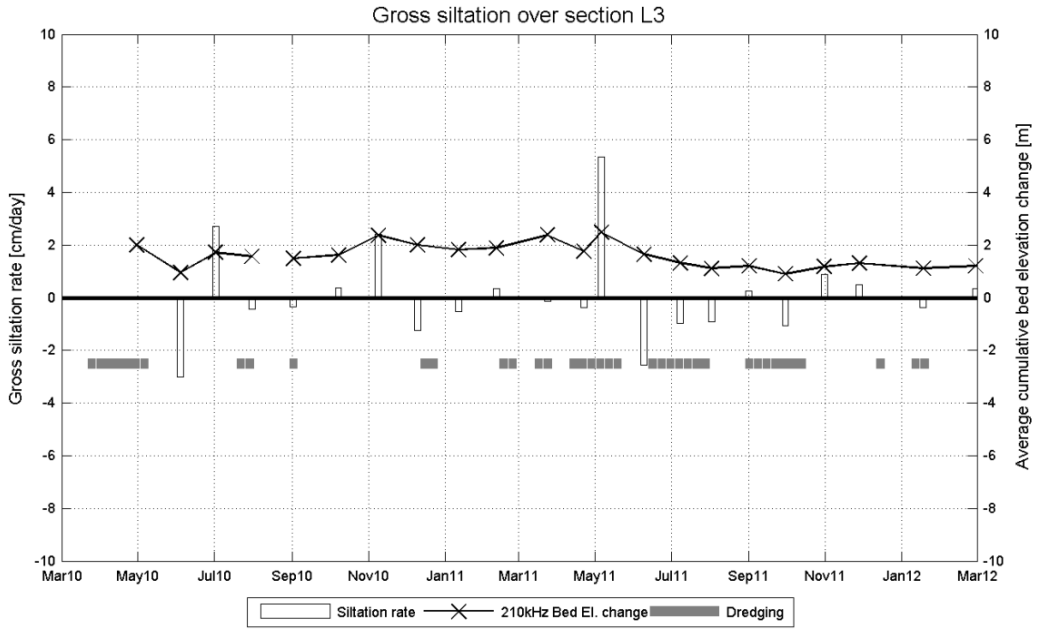



| | |
|---|---|
| Reference level: design depth | Data Processed by:<br>In association with :<br>I/RA/11354/10.101/MBO/ANF |

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |




Reference level: design depth

Data Processed by:

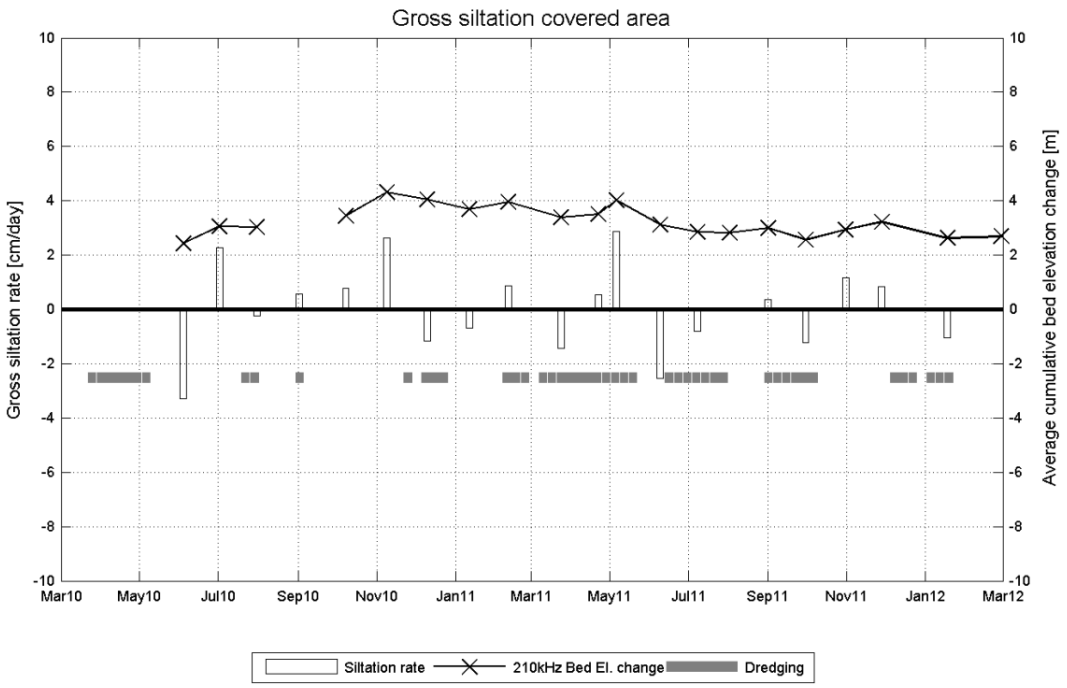
In association with :

I/RA/11354/10.101/MBO/ANF

# C.4 SILTATION RATE COMPLETE DEURGANCKDOK

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Siltation height / gross siltation rate | Equipment(s): 210kHz depth sounder |
| | Location: DGD |



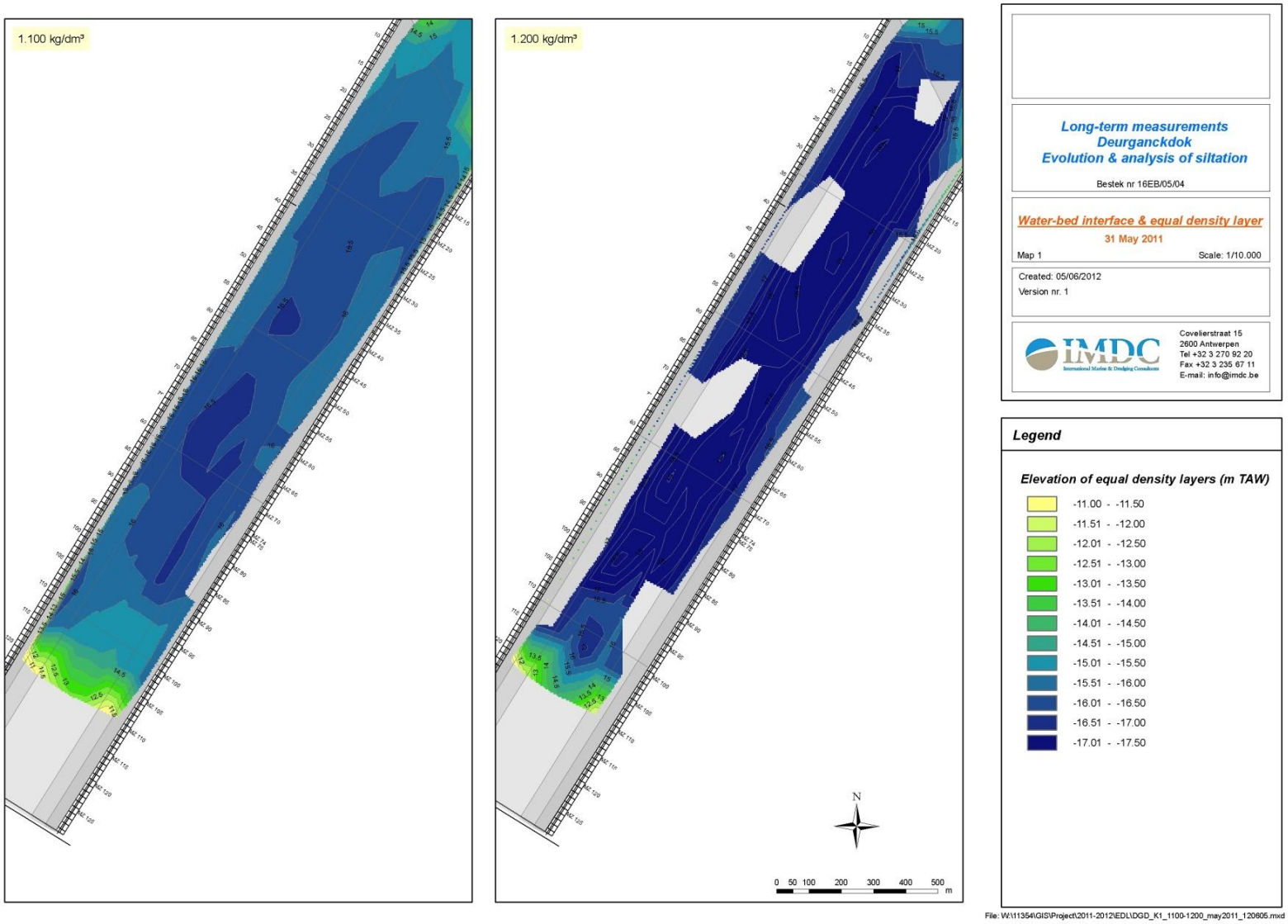

Reference level: design depth

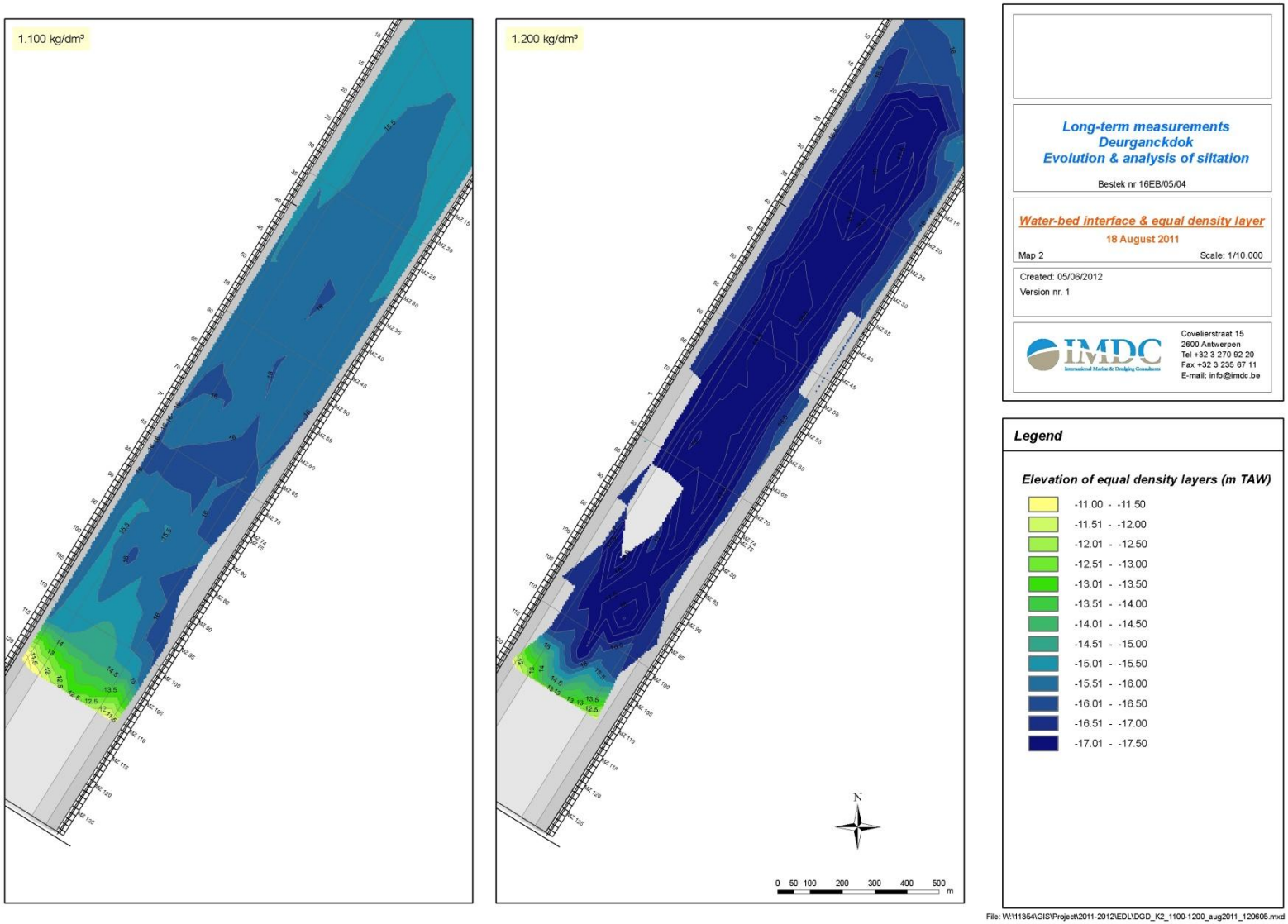
Data Processed by:

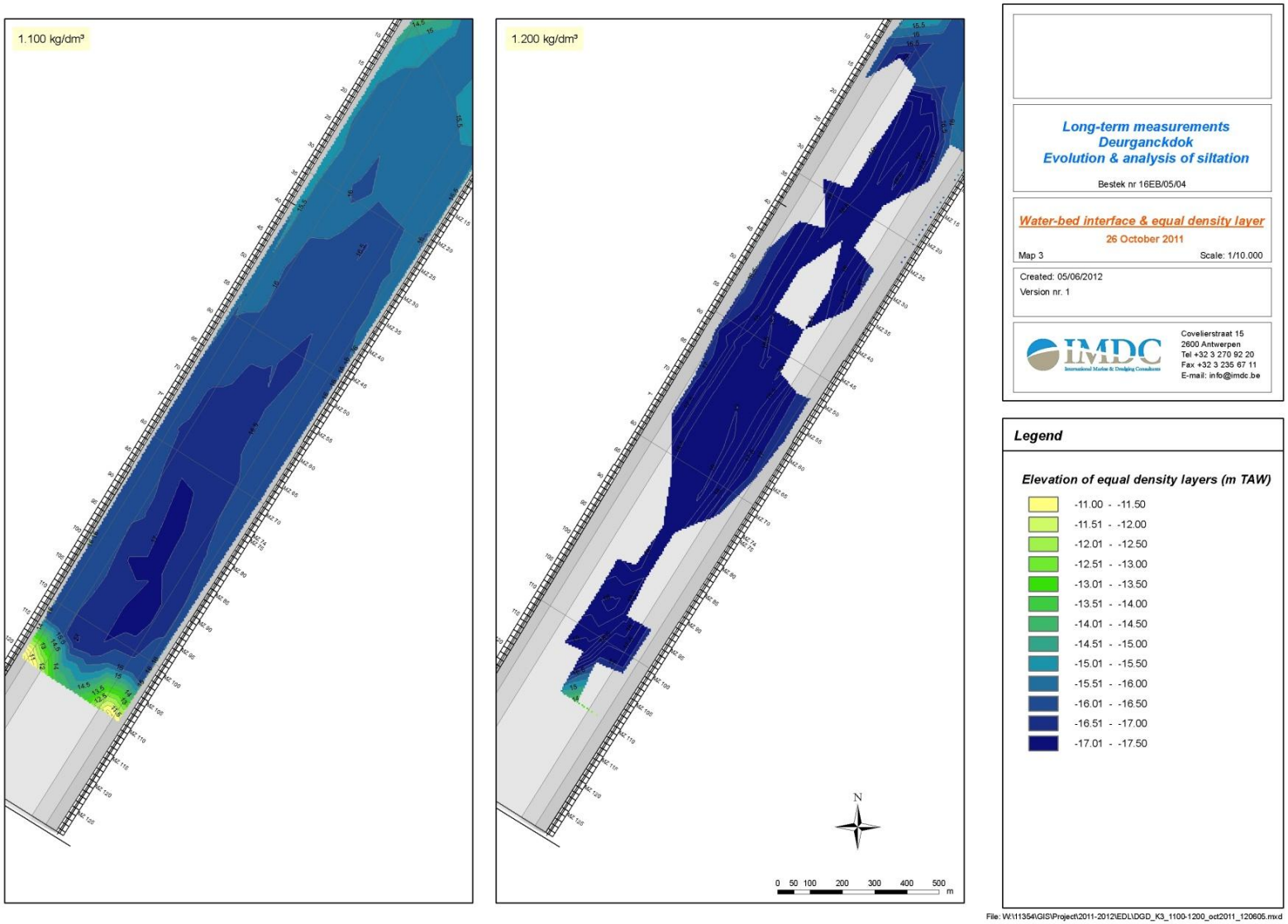
In association with :

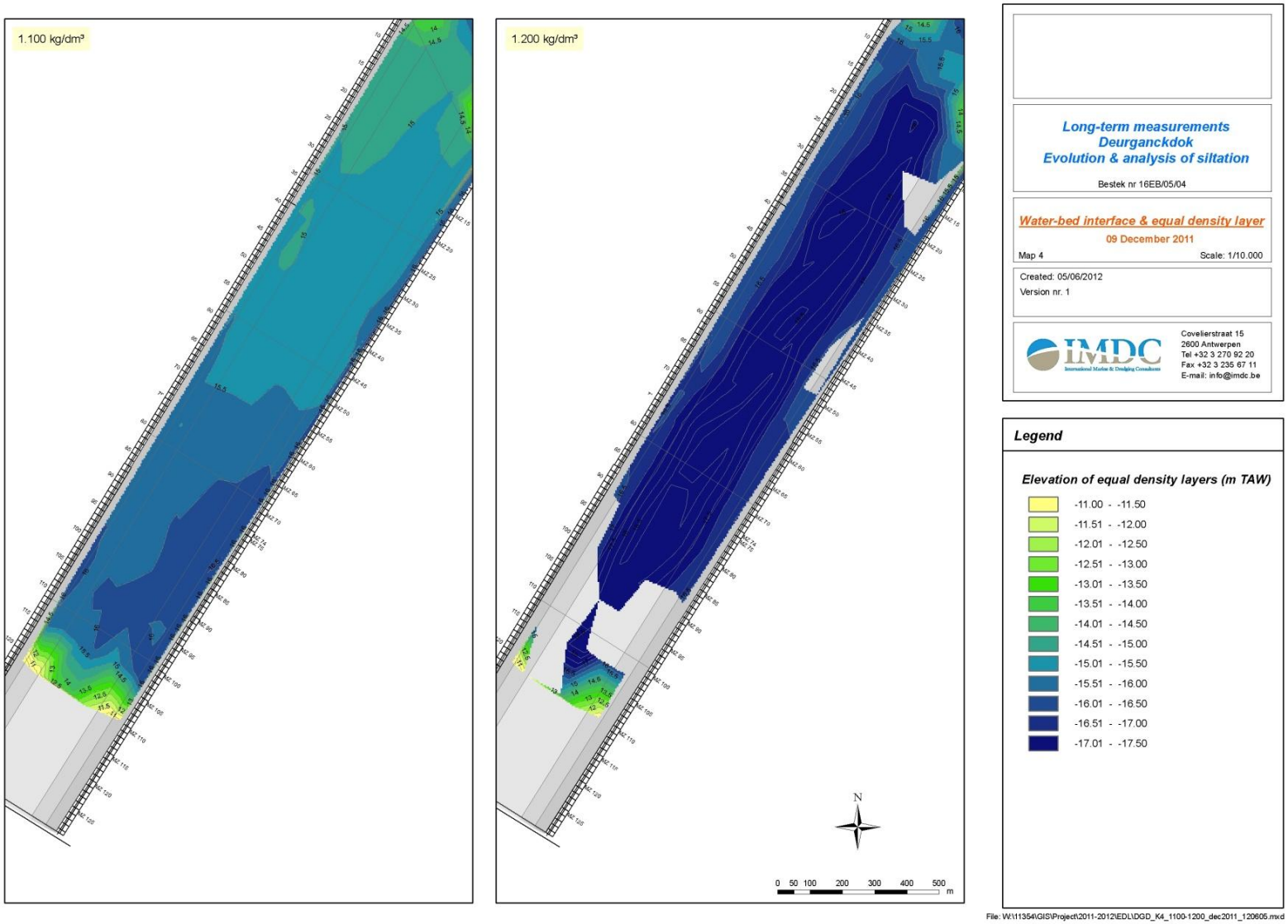
I/RA/11354/10.101/MBO/ANF

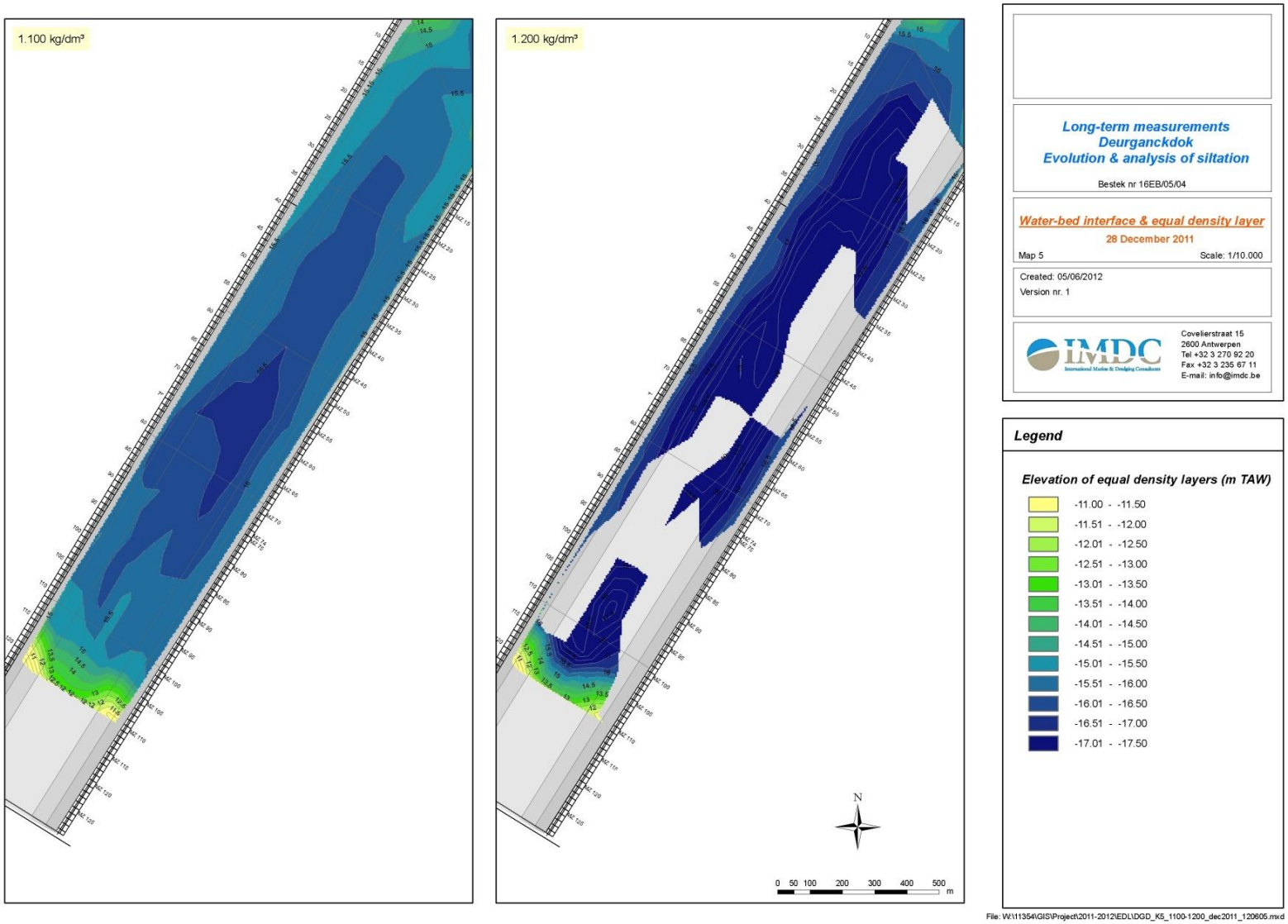
# Annex D DEPTH OF WATER-BED INTERFACE AND EQUAL DENSITY LAYERS

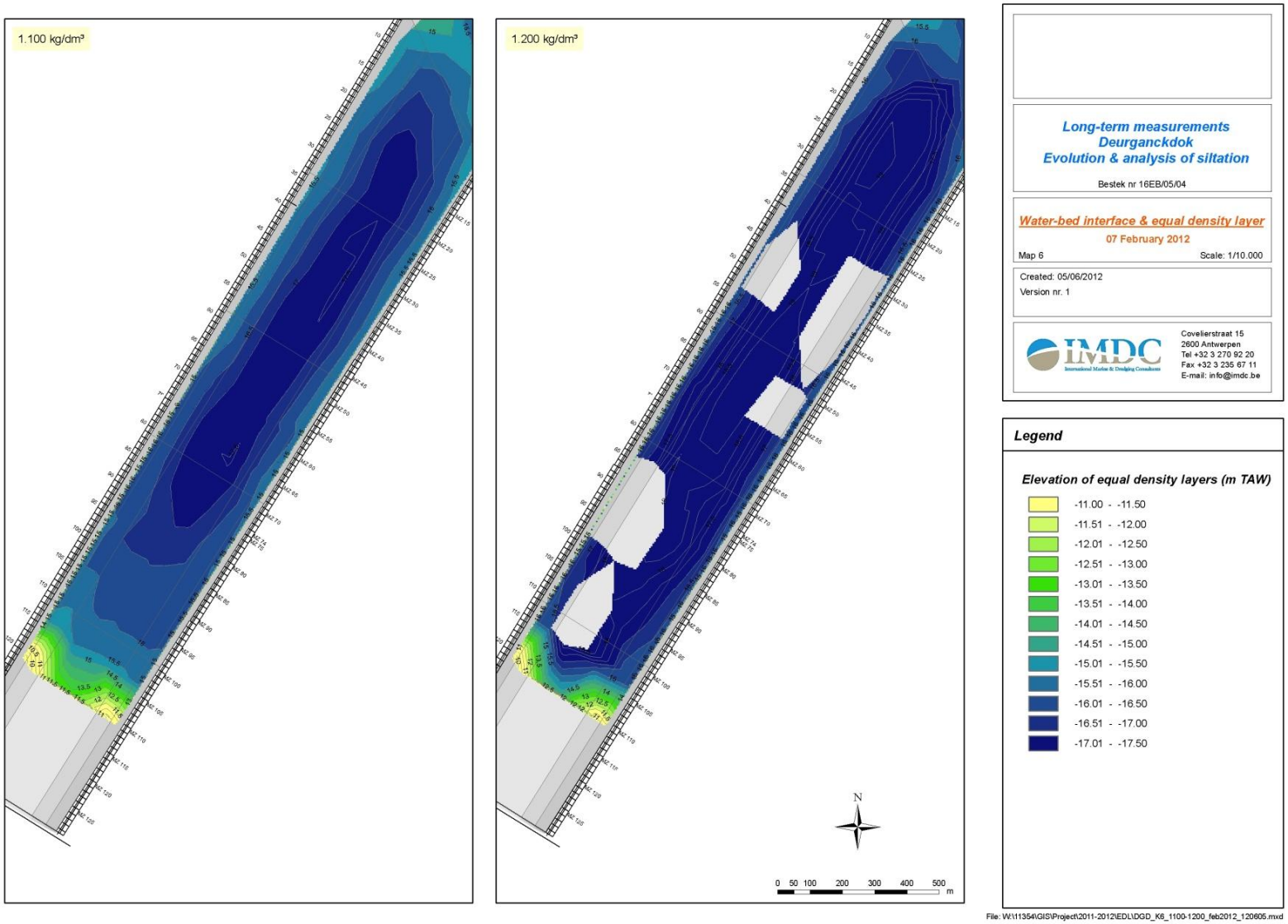

1.100 kg/dm³
1.200 kg/dm³
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Water-bed interface & equal density layer
31 May 2011
Map 1
Scale: 1/10.000
Created: 05/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Elevation of equal density layers (m TAW)
-11.00 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
File: W:\11354\GIS\Project\2011-2012\EDL\DGD_K1_1100-1200_may2011_120605.mxd

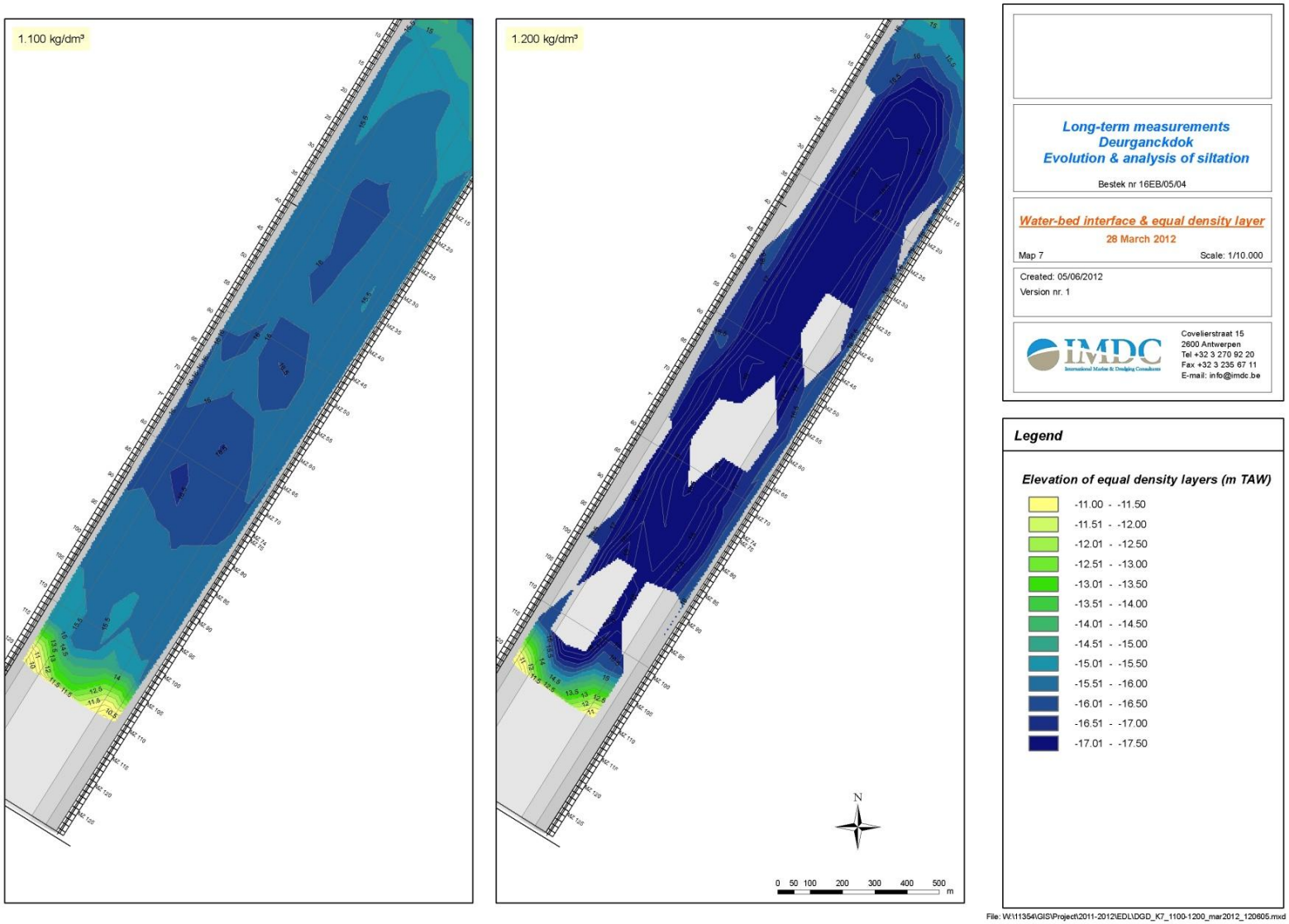

1.100 kg/dm³
1.200 kg/dm³
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Water-bed interface & equal density layer
18 August 2011
Map 2
Scale: 1/10.000
Created: 05/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Elevation of equal density layers (m TAW)
-11.00 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
File: W:\11354\GIS\Project\2011-2012\EDL\DGD_K2_1100-1200_aug2011_120605.mxd


1.100 kg/dm³
1.200 kg/dm³
N
0 50 100 200 300 400 500
m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Water-bed interface & equal density layer
26 October 2011
Map 3
Scale: 1/10.000
Created: 05/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Elevation of equal density layers (m TAW)
-11.00 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
File: W:\11354\GIS\Project\2011-2012\EDL\DGD_K3_1100-1200_oct2011_120605.mxd


1.100 kg/dm³
1.200 kg/dm³
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Water-bed interface & equal density layer
09 December 2011
Map 4
Scale: 1/10.000
Created: 05/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Elevation of equal density layers (m TAW)
-11.00 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
File: W:\11354\GIS\Project\2011-2012\EDL\DGD_K4_1100-1200_dec2011_120605.mxd


1.100 kg/dm³
1.200 kg/dm³
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Water-bed interface & equal density layer
28 December 2011
Map 5
Scale: 1/10.000
Created: 05/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Elevation of equal density layers (m TAW)
-11.00 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
File: W:\11354\GIS\Project\2011-2012\EDL\DGD_K5_1100-1200_dec2011_120605.mxd


1.100 kg/dm³
1.200 kg/dm³
N
0 50 100 200 300 400 500
m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Water-bed interface & equal density layer
07 February 2012
Map 6
Scale: 1/10.000
Created: 05/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Elevation of equal density layers (m TAW)
-11.00 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
File: W:\11354\GIS\Project\2011-2012\EDL\DGD_K6_1100-1200_feb2012_120605.mxd

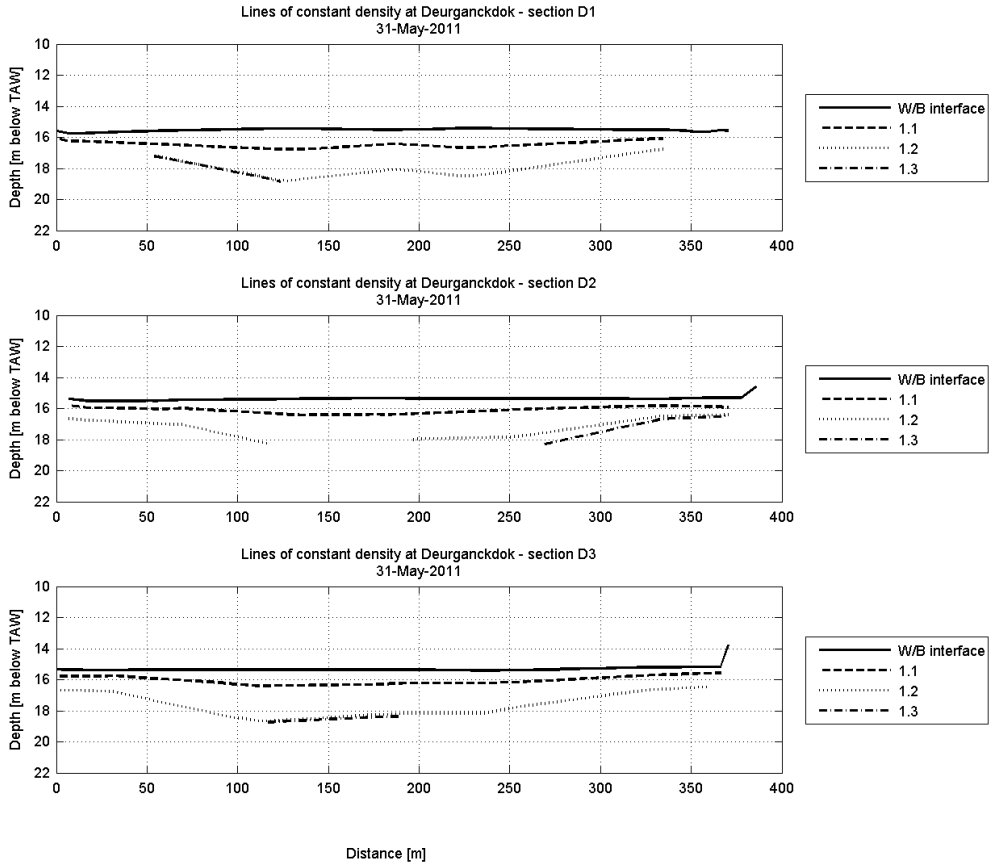

1.100 kg/dm³
1.200 kg/dm³
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Water-bed interface & equal density layer
28 March 2012
Map 7
Scale: 1/10.000
Created: 05/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Elevation of equal density layers (m TAW)
-11.00 - -11.50
-11.51 - -12.00
-12.01 - -12.50
-12.51 - -13.00
-13.01 - -13.50
-13.51 - -14.00
-14.01 - -14.50
-14.51 - -15.00
-15.01 - -15.50
-15.51 - -16.00
-16.01 - -16.50
-16.51 - -17.00
-17.01 - -17.50
File: W:\11354\GIS\Project\2011-2012\EDL\DGD_K7_1100-1200_mar2012_120605.mxd

# Annex E DEPTH OF PLANES OF CONSTANT DENSITY

# E.1 MEASUREMENTS MAY 31st, 2011

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



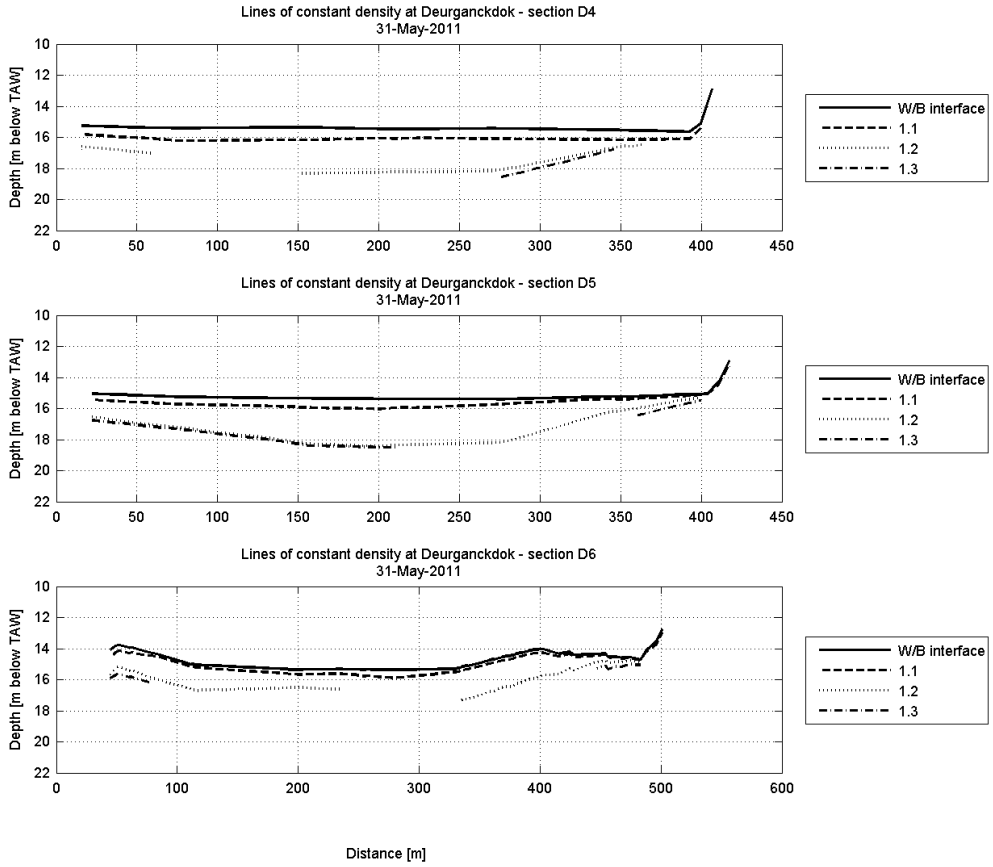

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



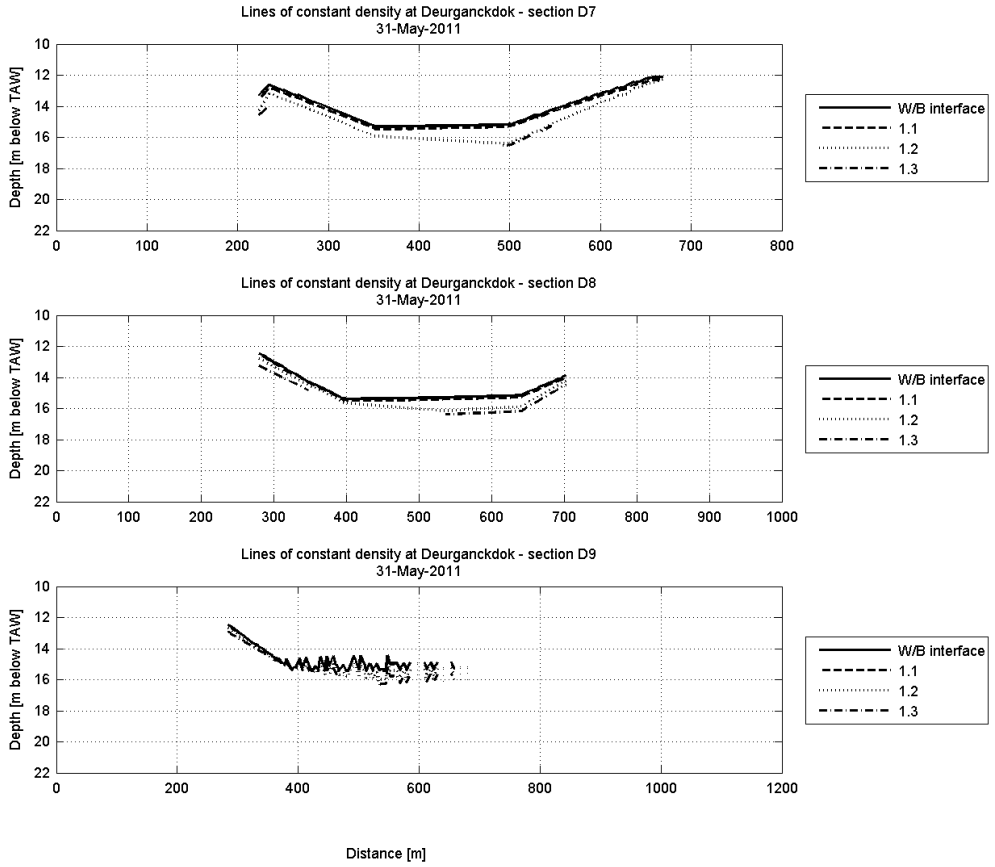

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



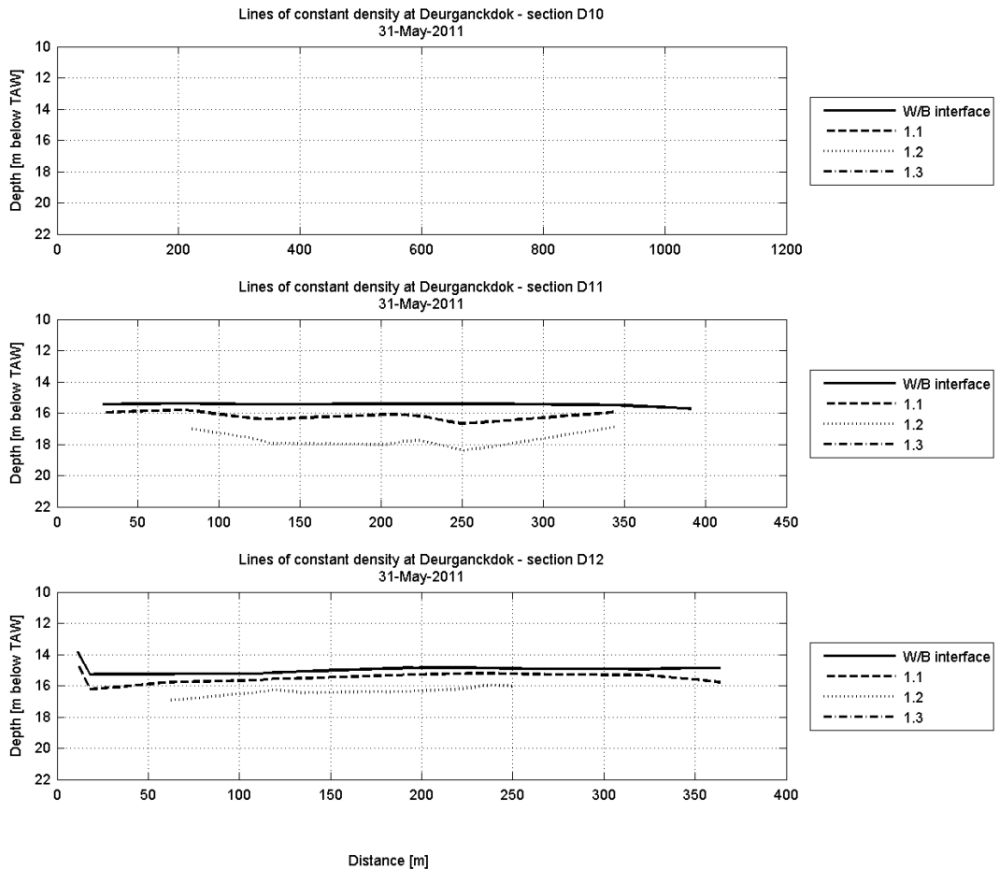

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



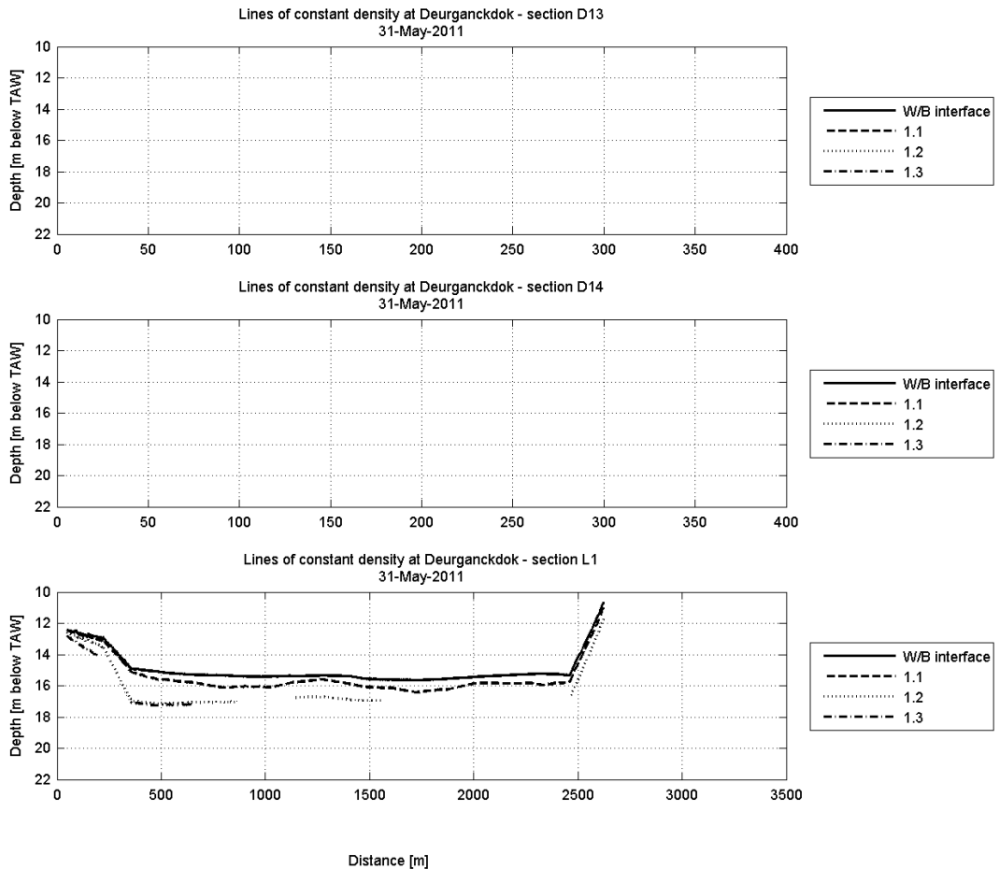

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



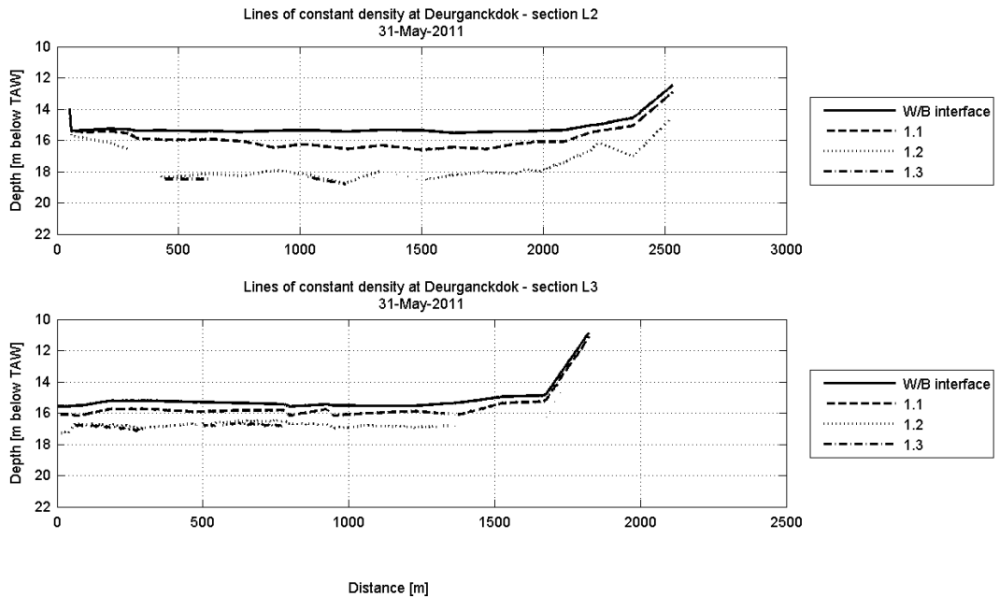

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |




Data Processed by:

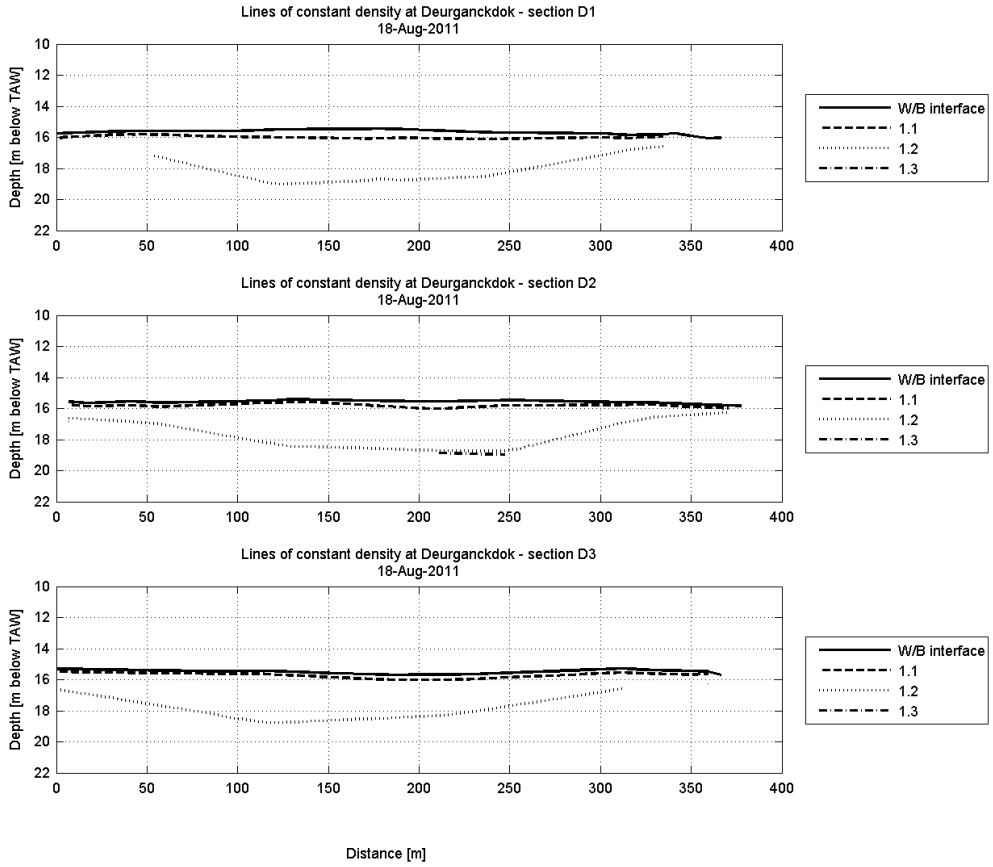
In association with :

I/RA/11354/10.101/MBO/ANF

## E.2 MEASUREMENTS AUGUST 18th, 2011

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



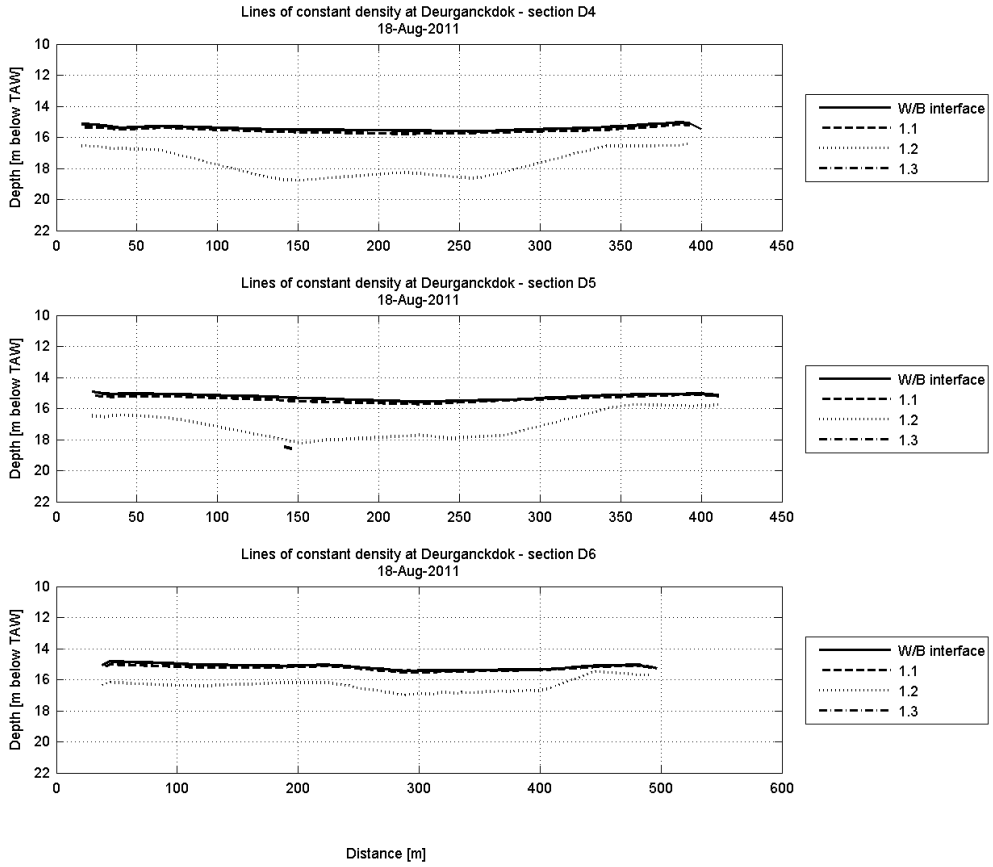

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



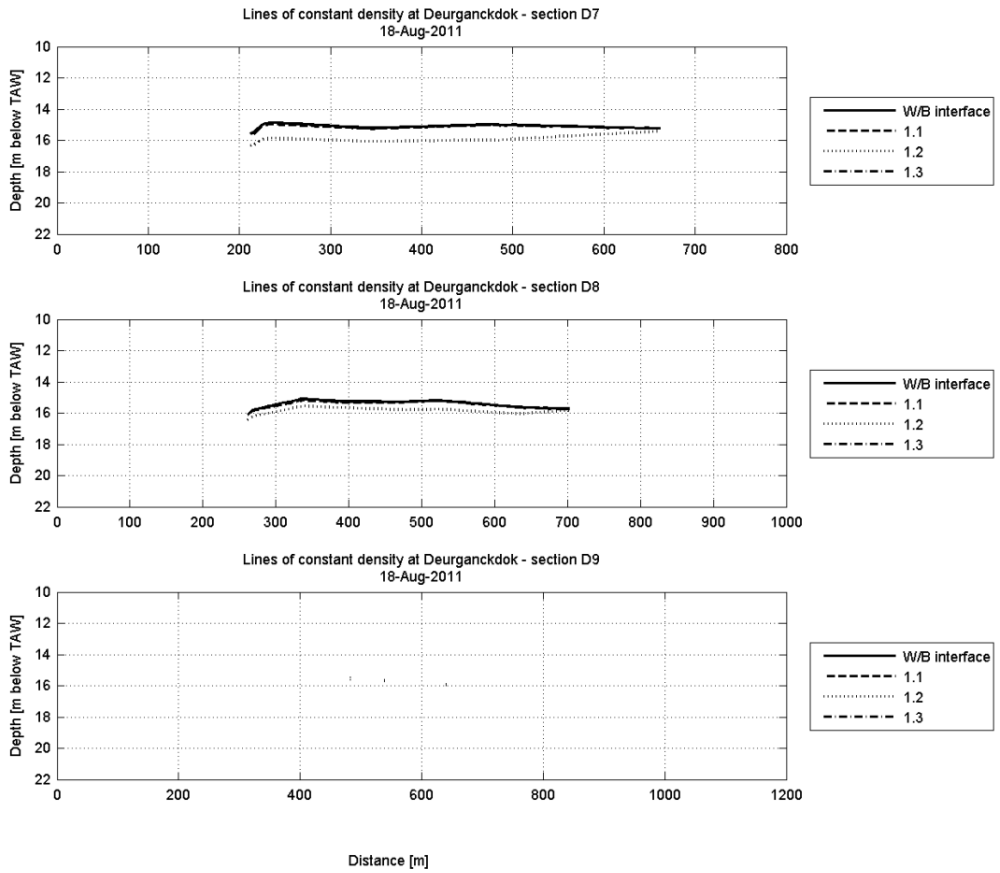

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



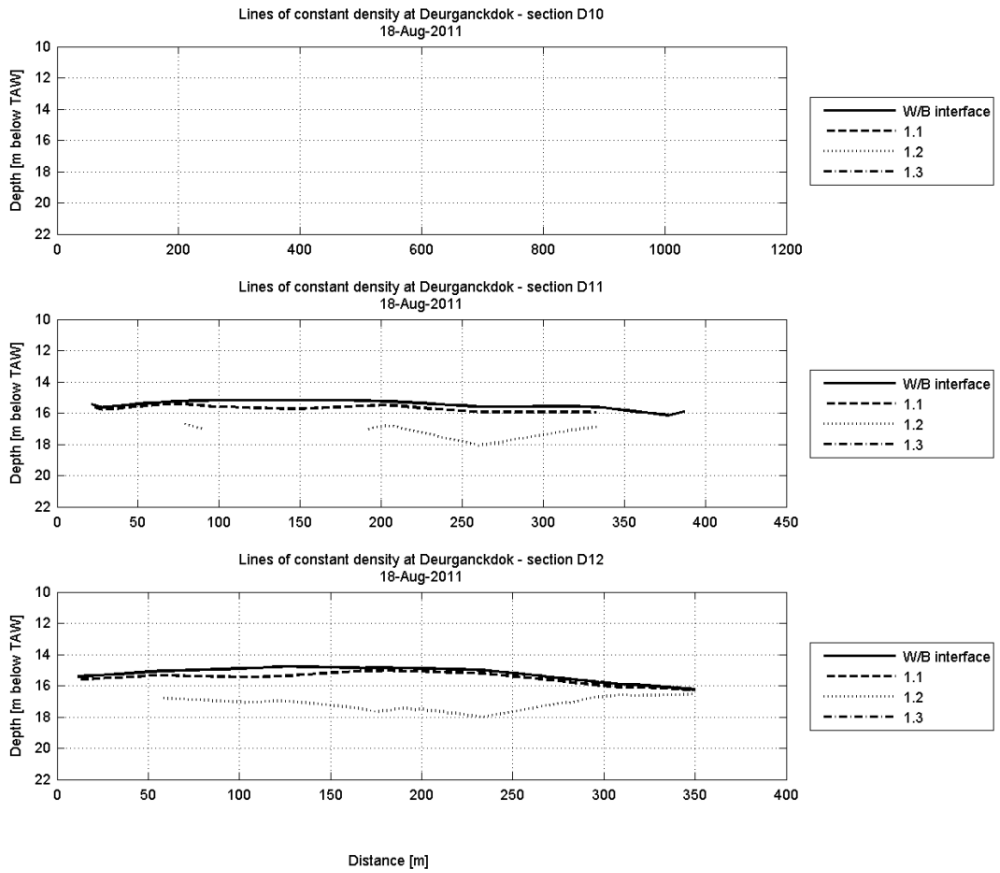

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



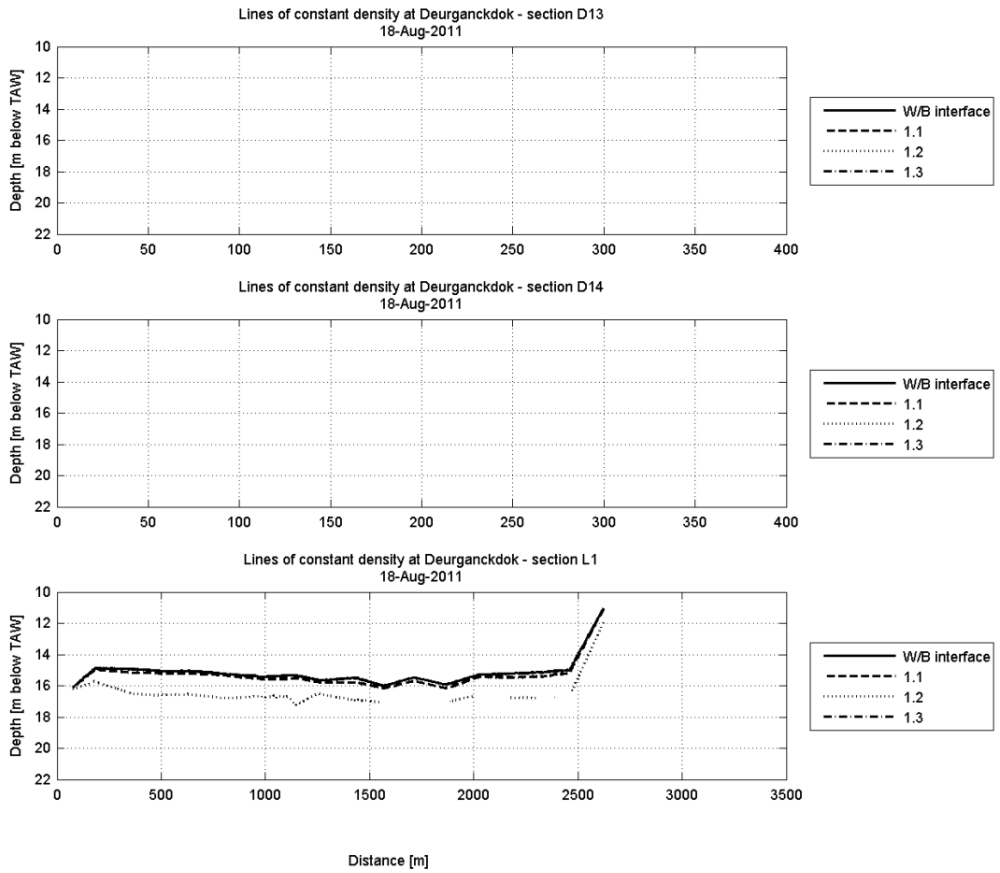

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



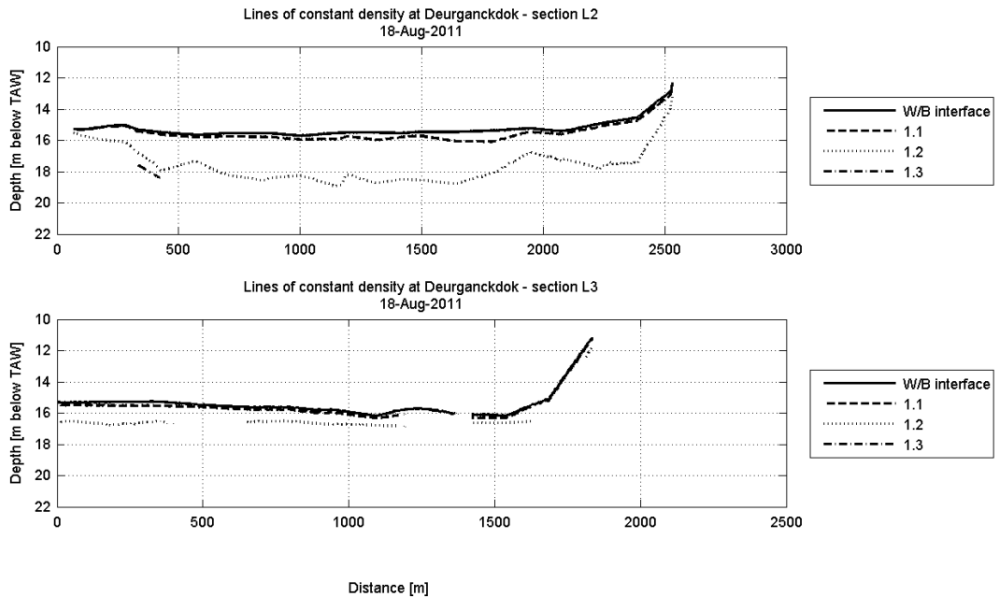

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |




Data Processed by:

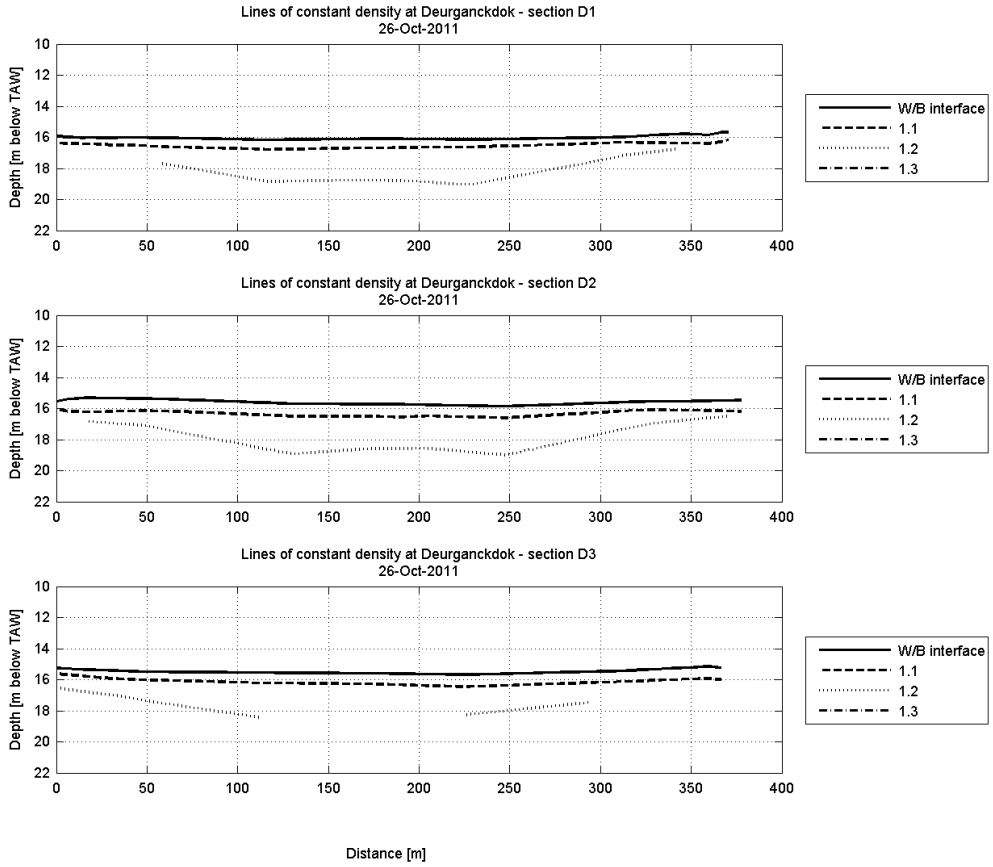
In association with :

I/RA/11354/10.101/MBO/ANF

# E.3 MEASUREMENTS OCTOBER 26th, 2011

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



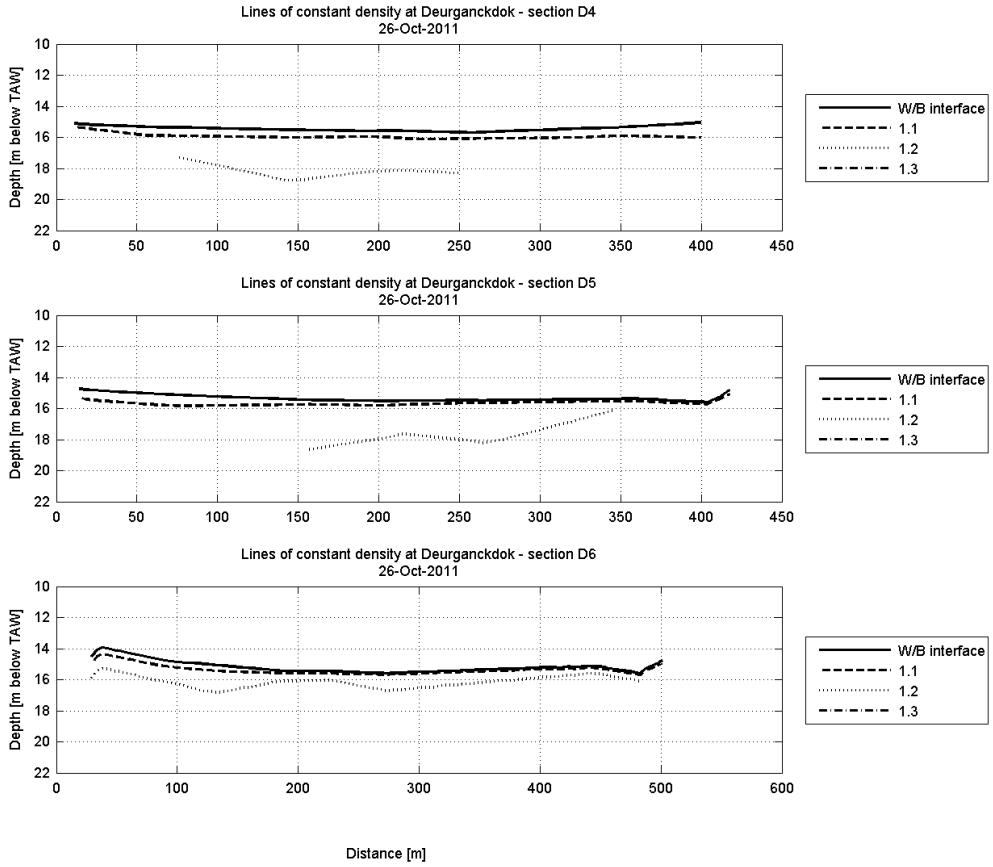

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



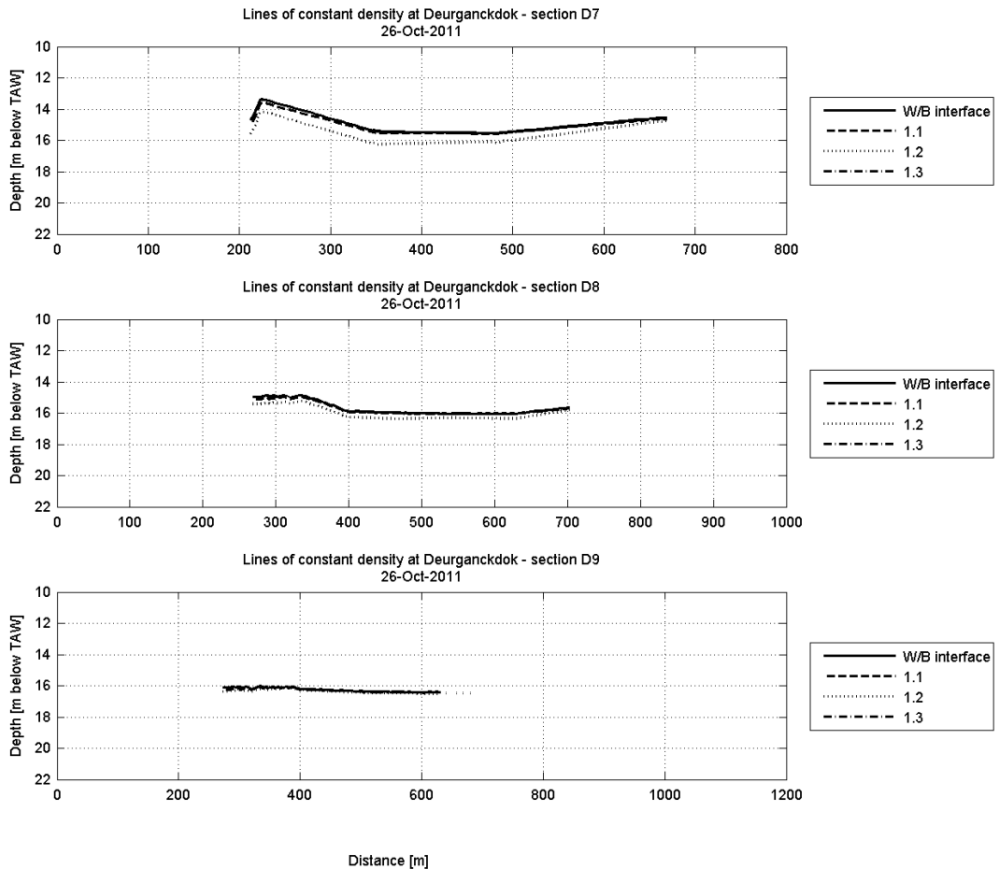

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



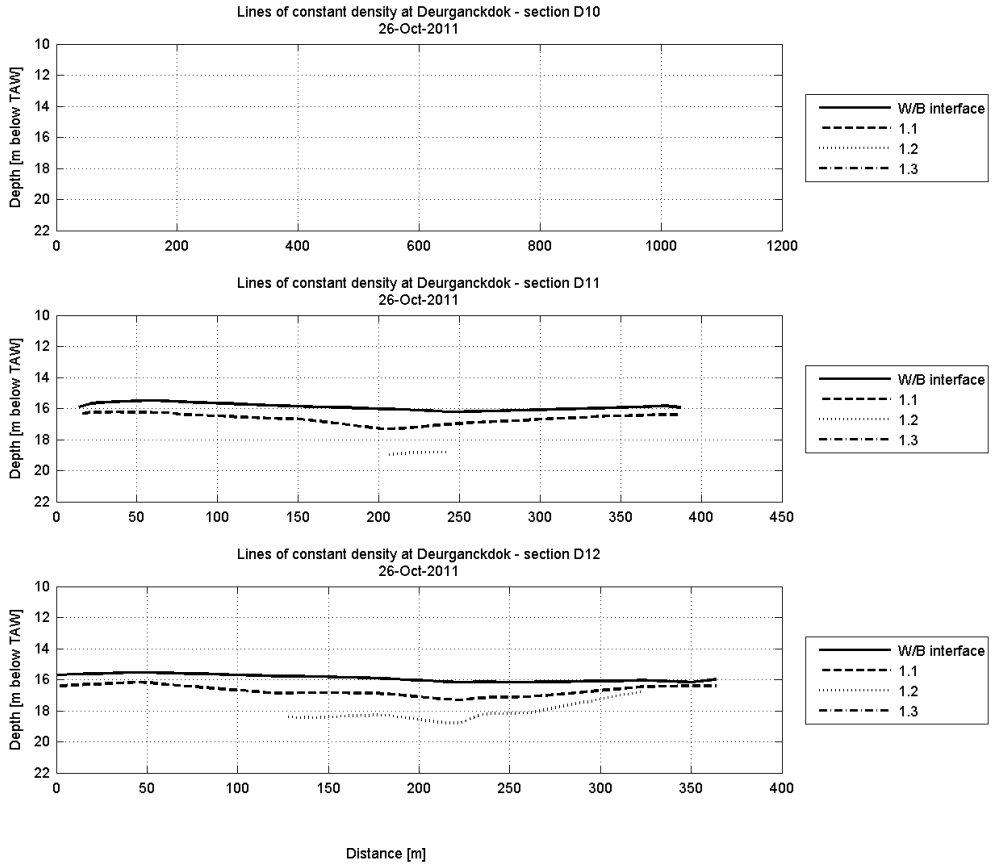

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



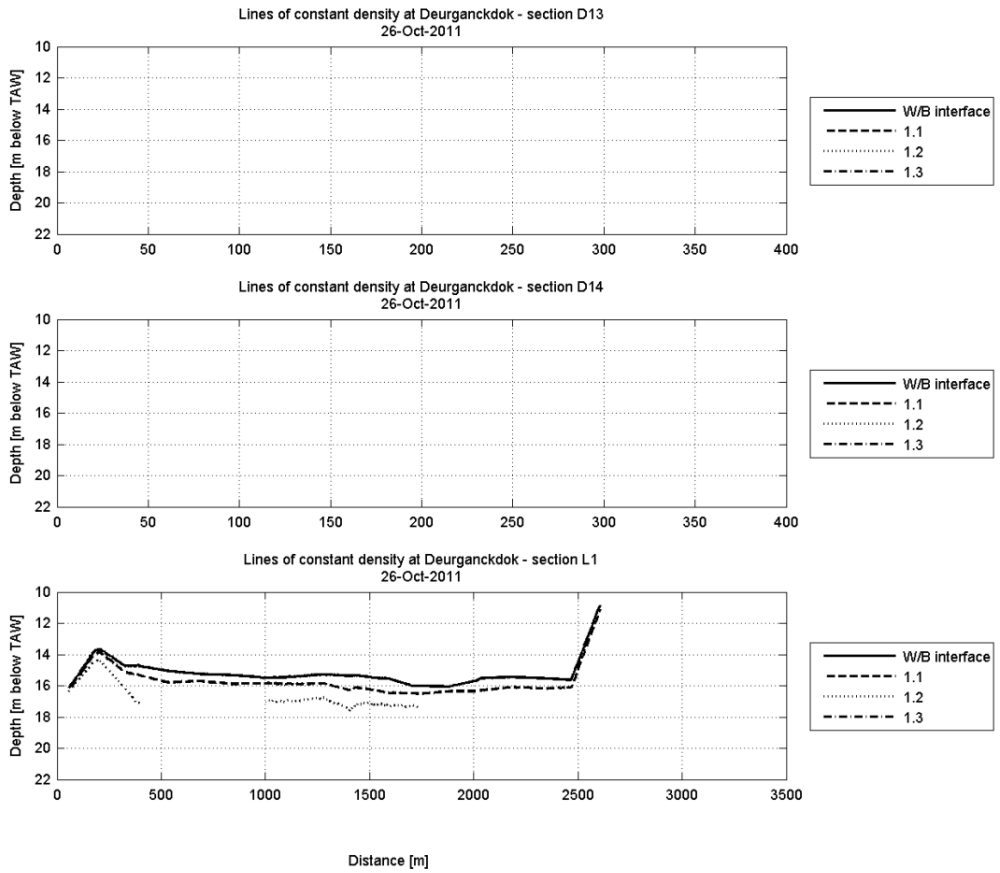

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



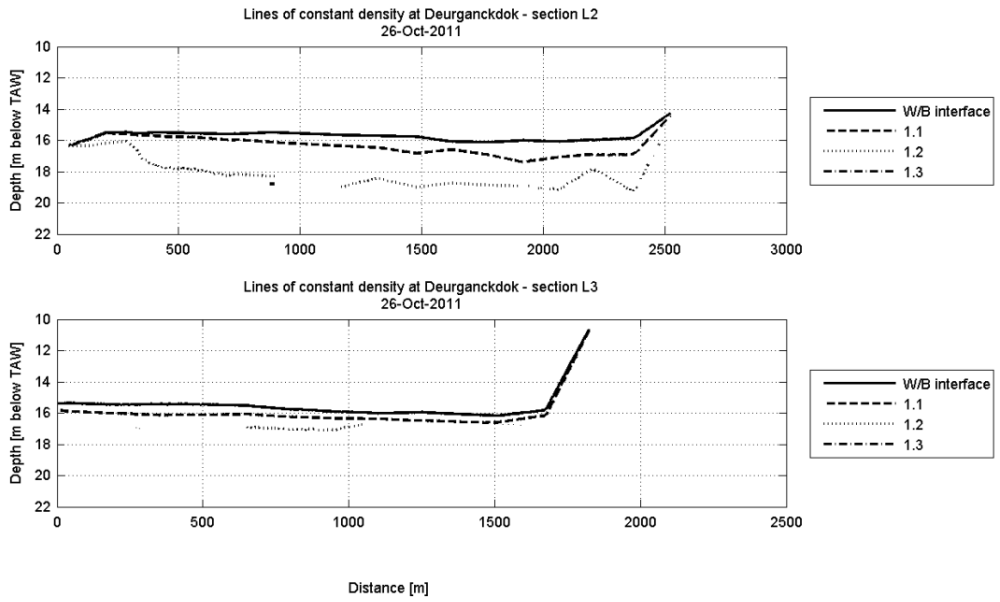

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |




Data Processed by:

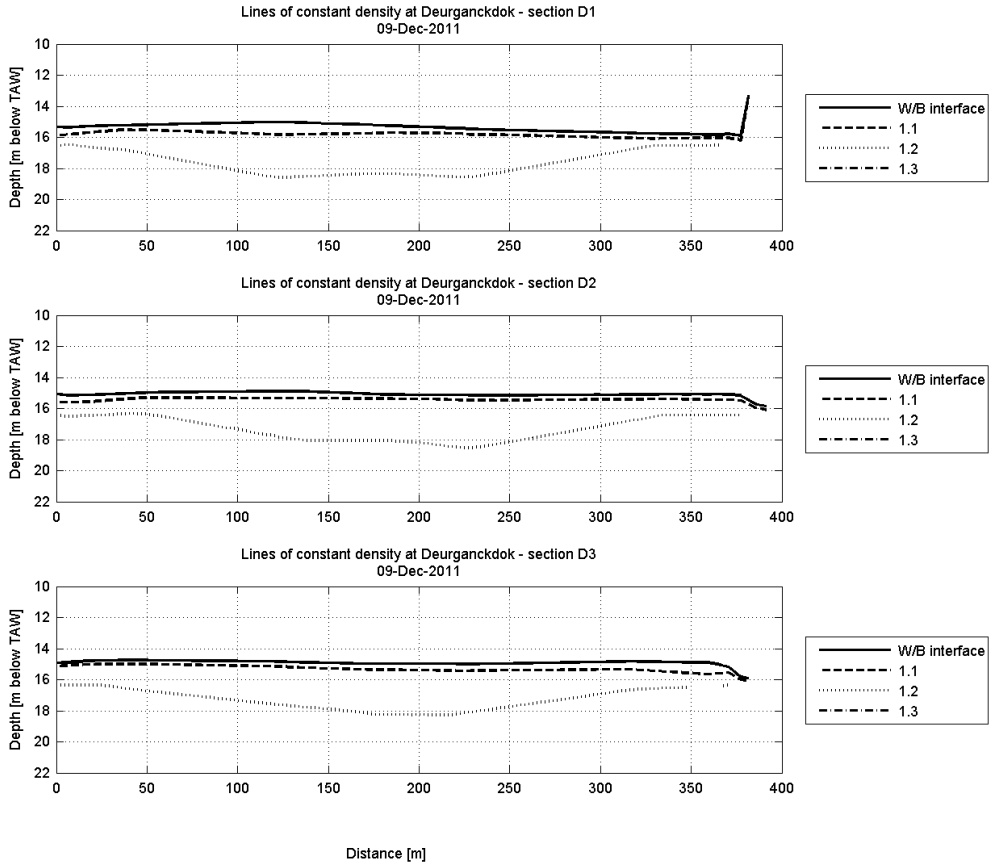
In association with :

I/RA/11354/10.101/MBO/ANF

# E.4 MEASUREMENTS DECEMBER 9th, 2011

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



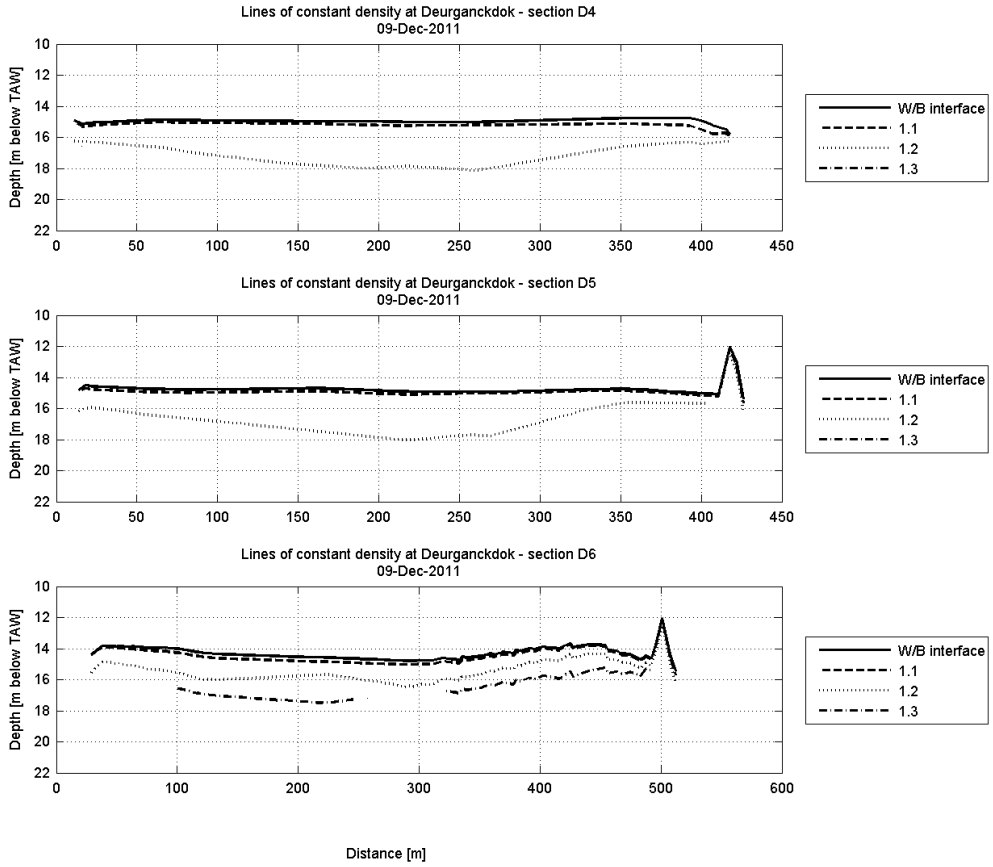

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



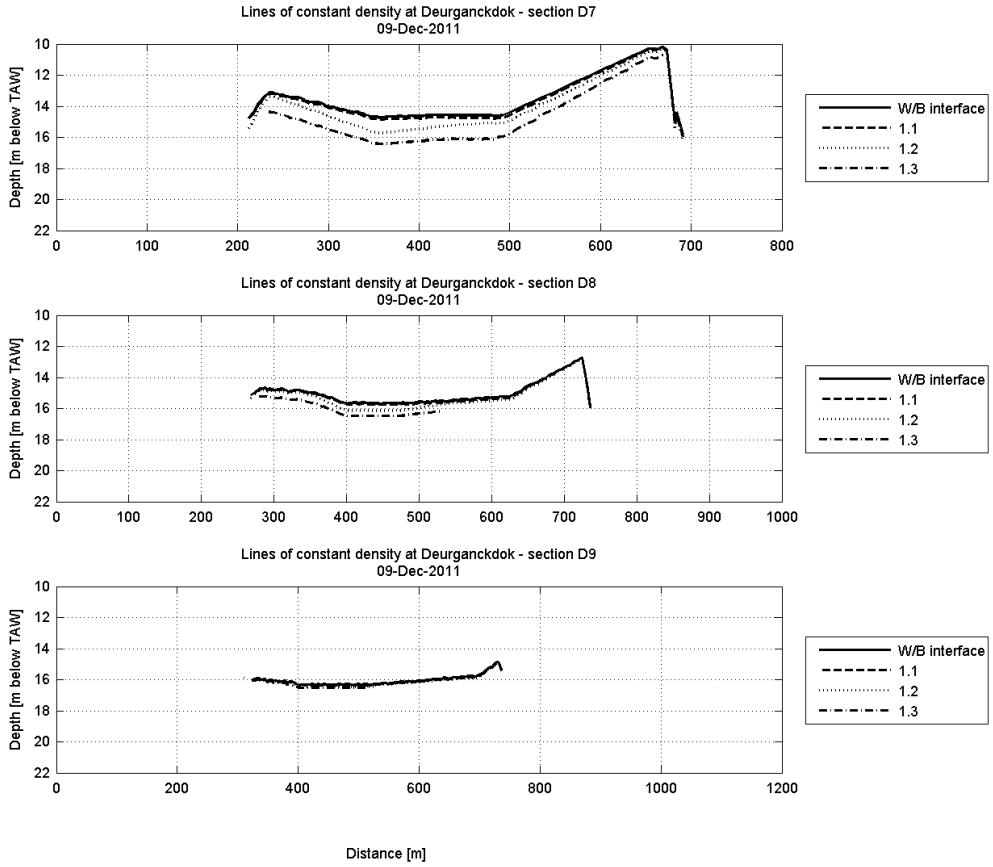

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



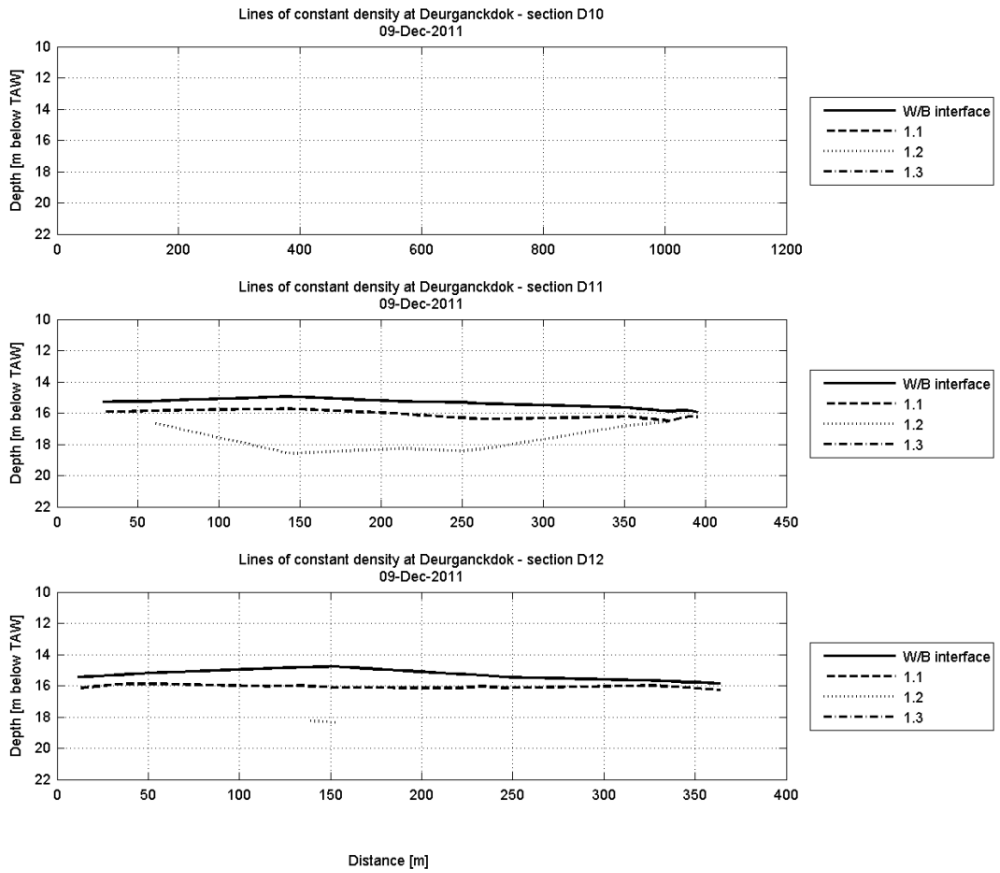

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



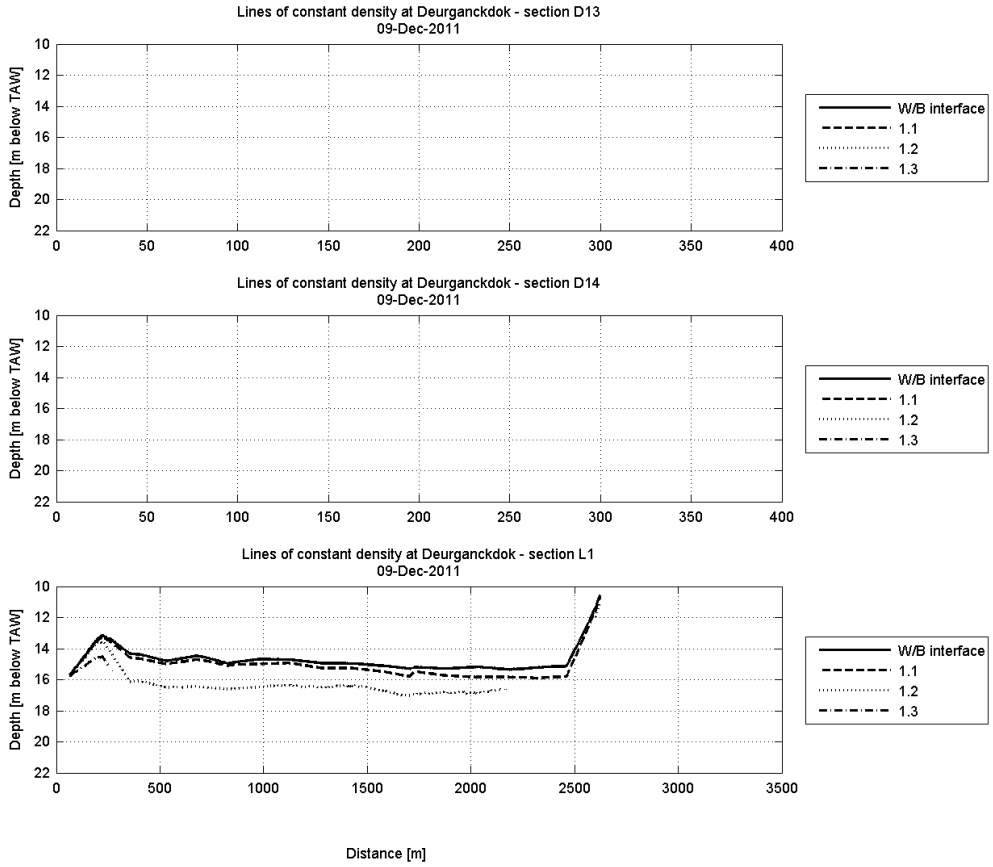

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



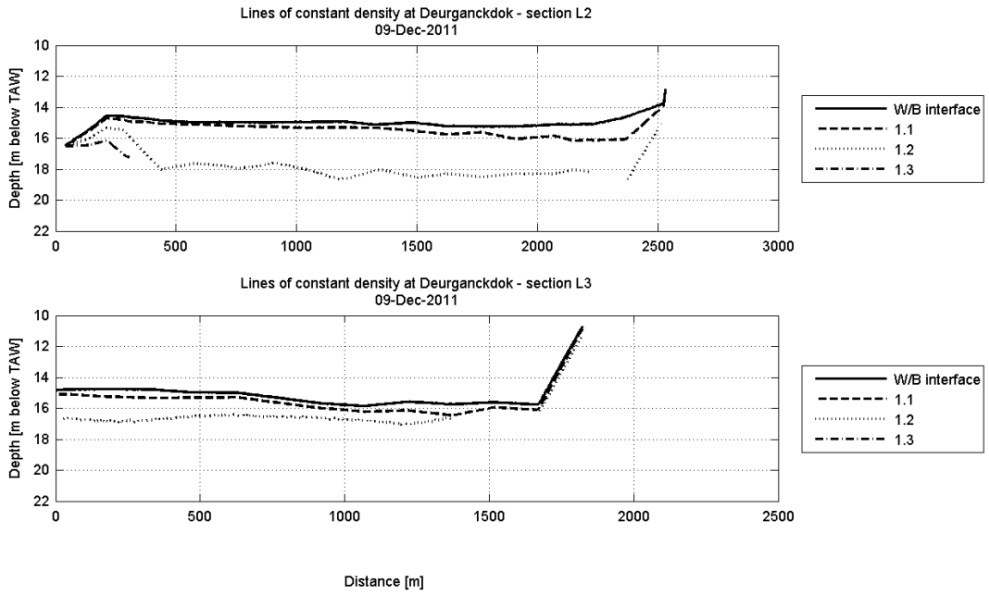

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |




Data Processed by:

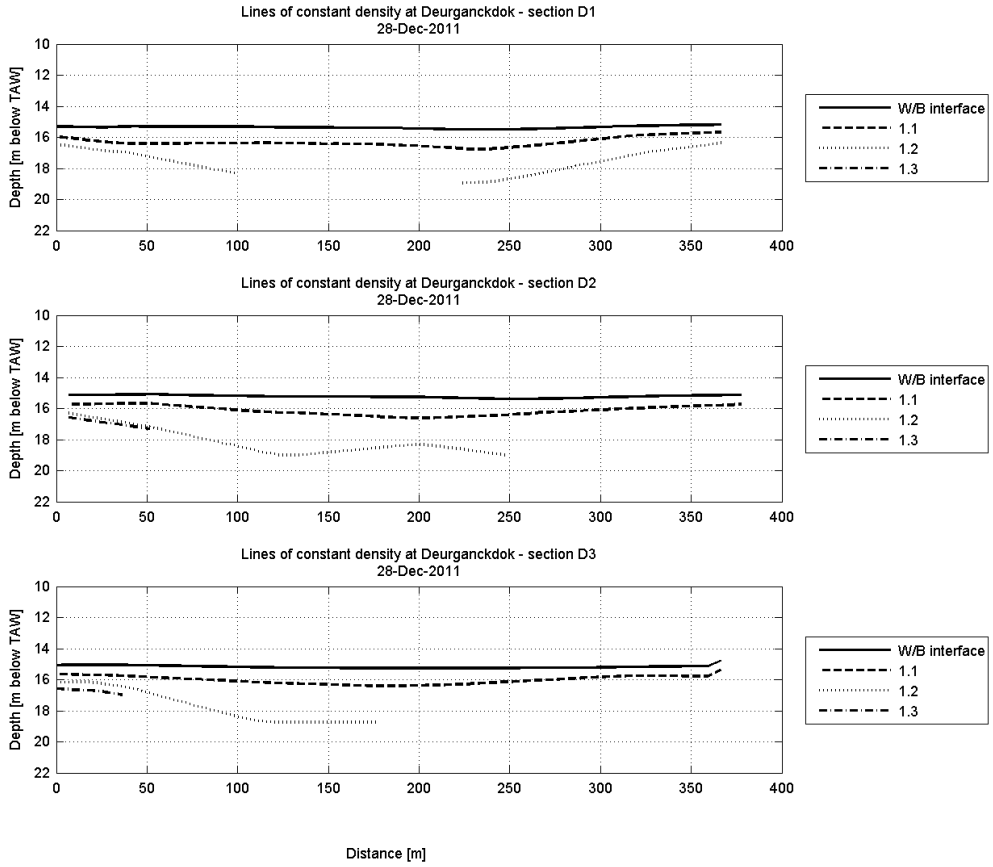
In association with :

I/RA/11354/10.101/MBO/ANF

# E.5 MEASUREMENTS DECEMBER 28th, 2011

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



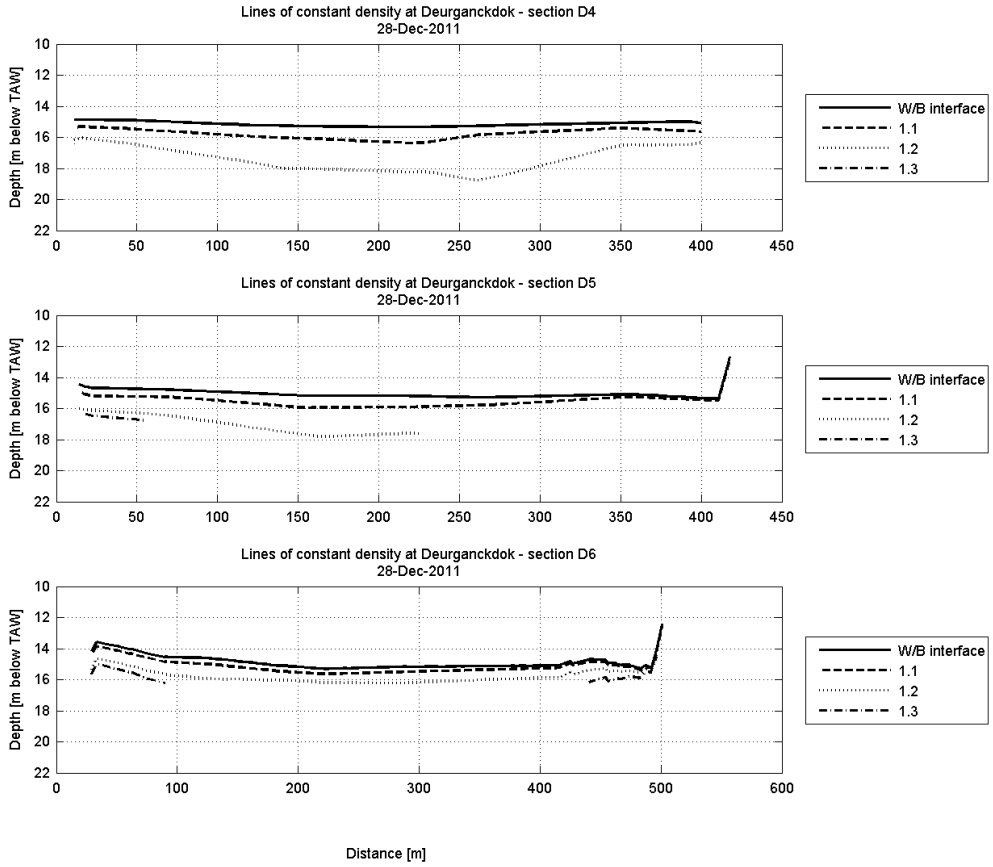

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



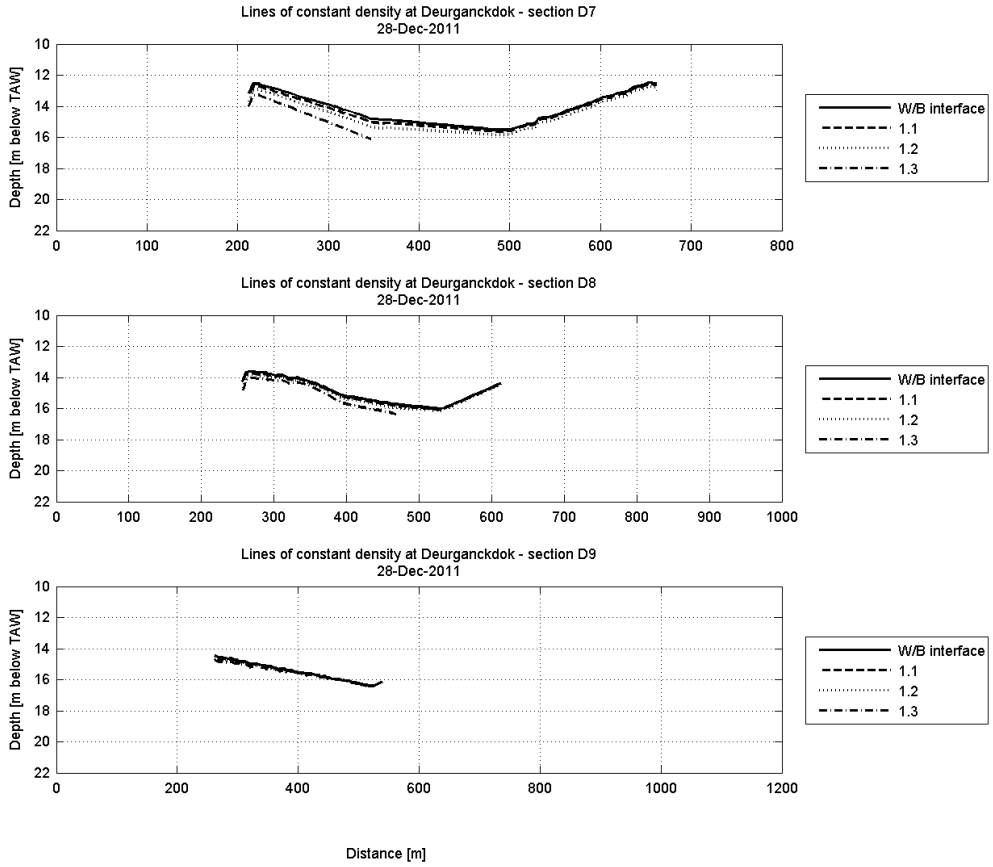

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



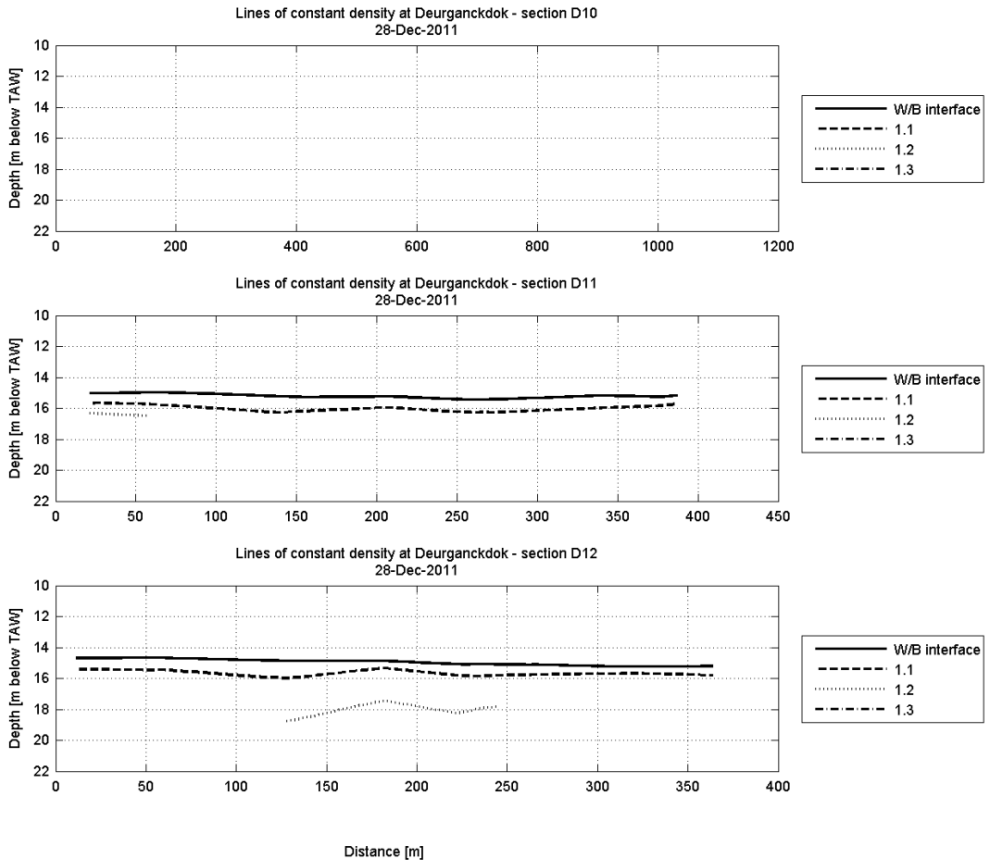

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



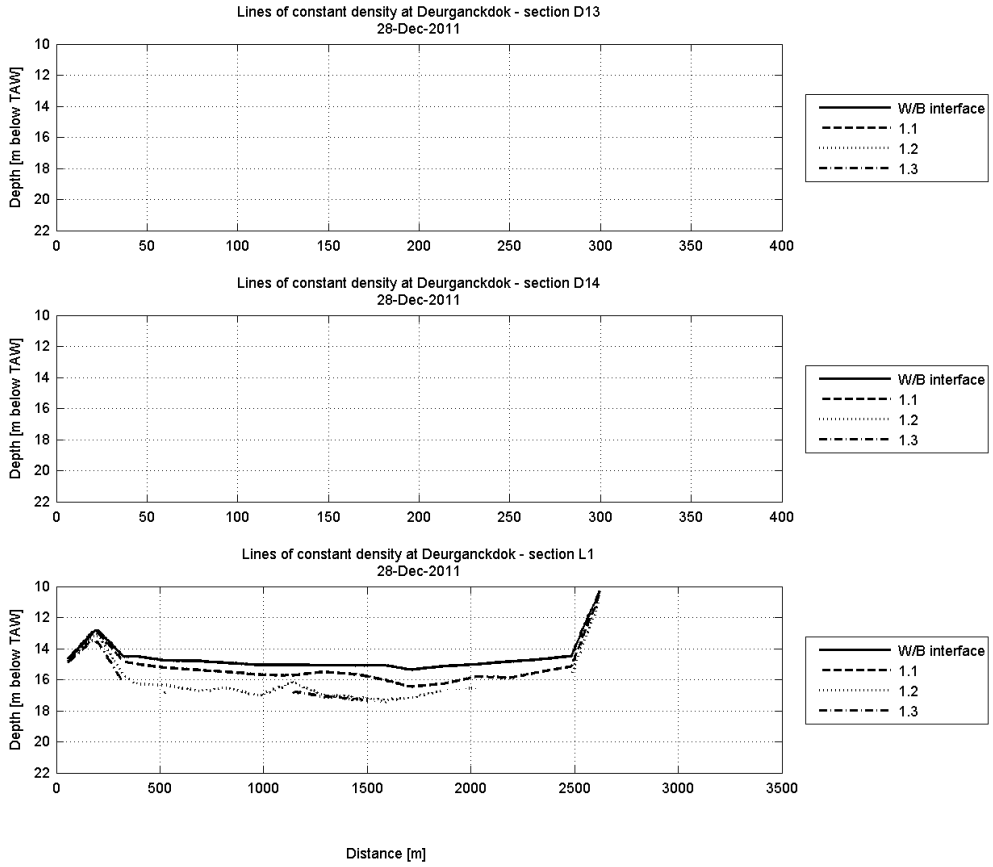

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



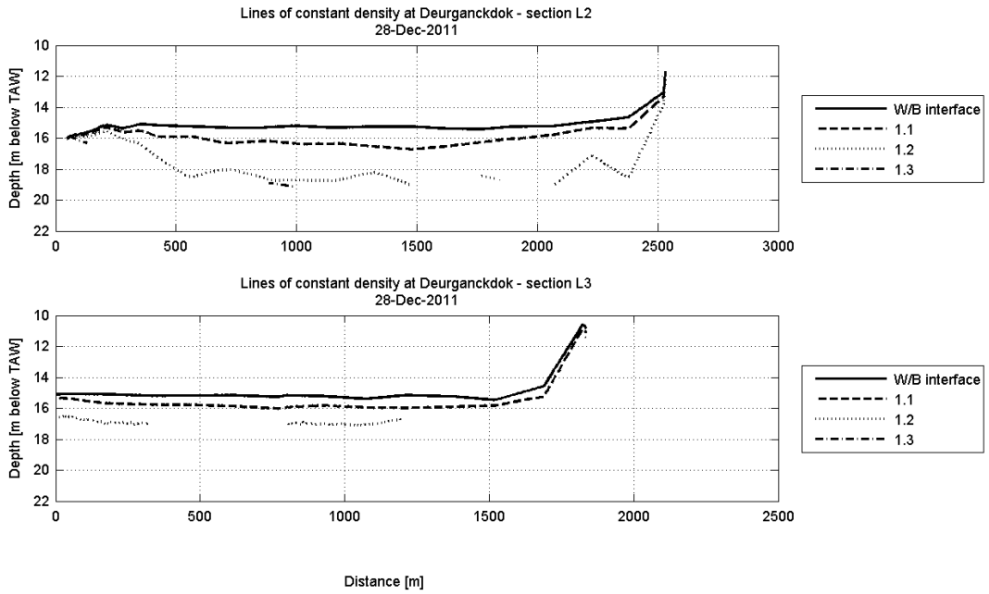

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |




Data Processed by:

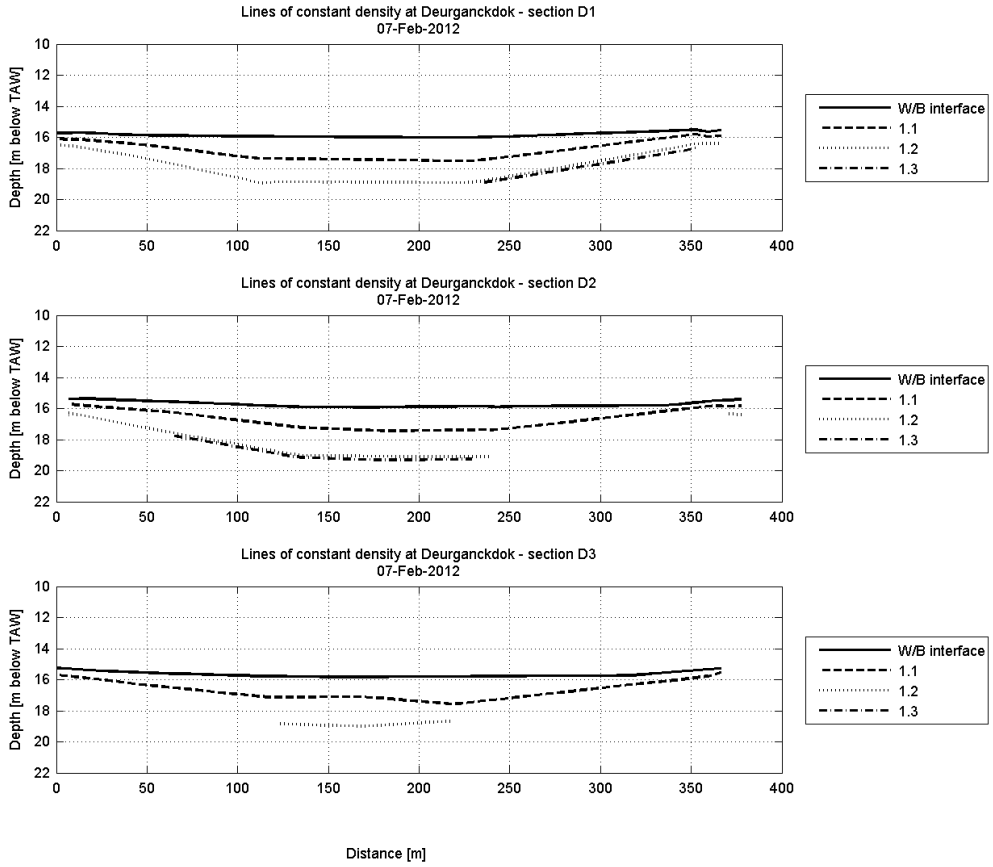
In association with :

I/RA/11354/10.101/MBO/ANF

# E.6 MEASUREMENTS FEBRUARY 7th, 2012

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



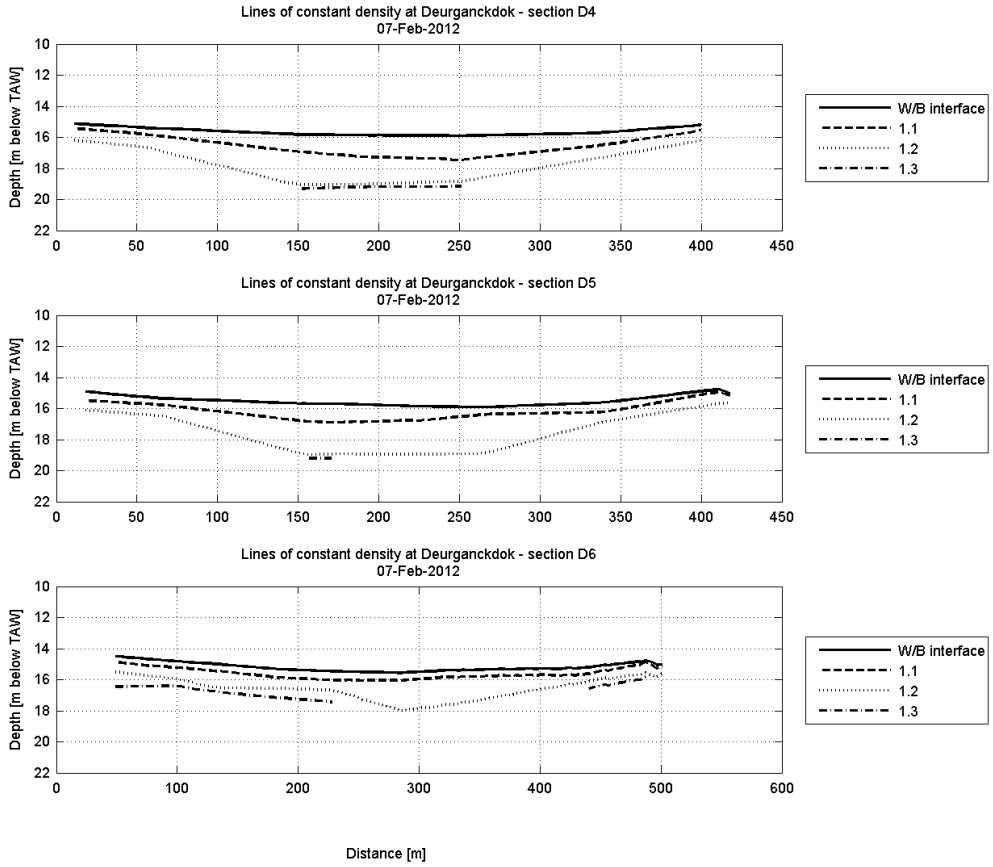

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



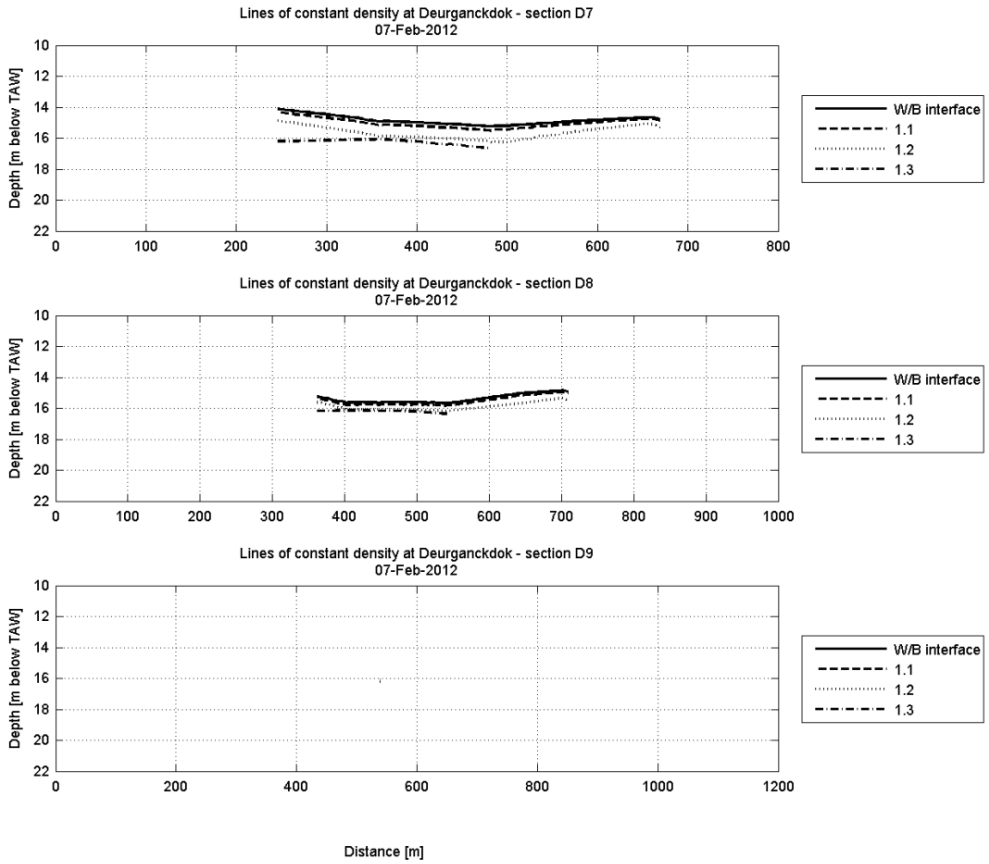

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



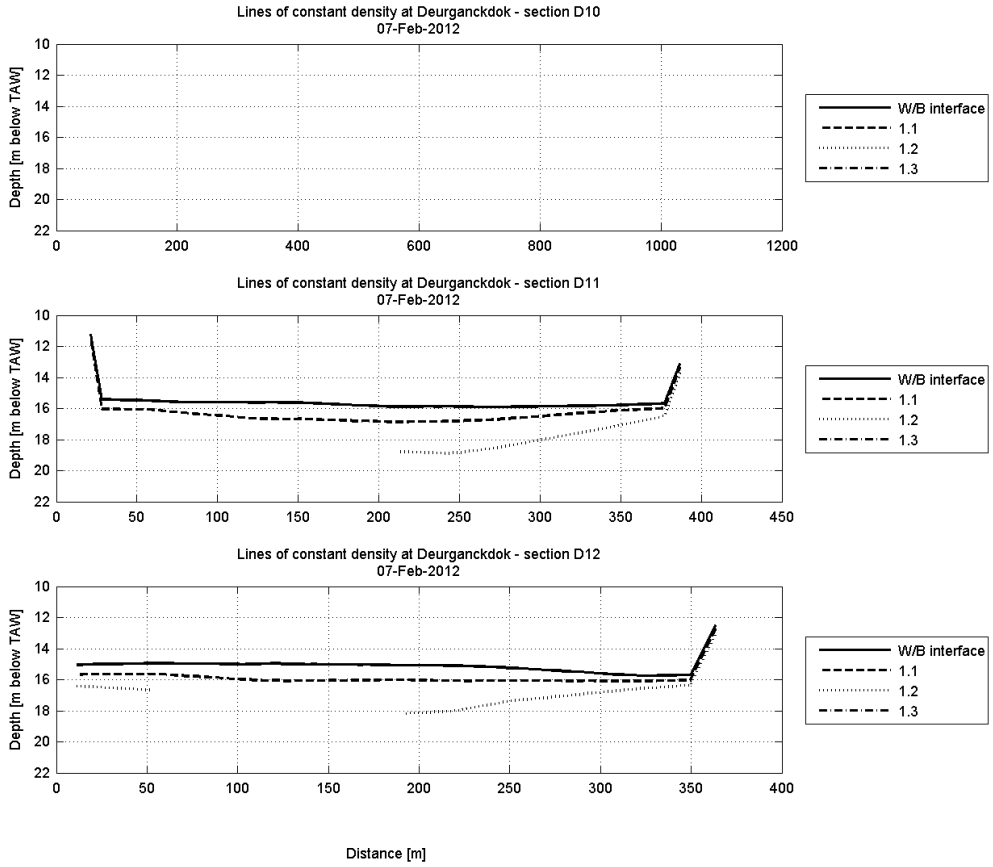

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



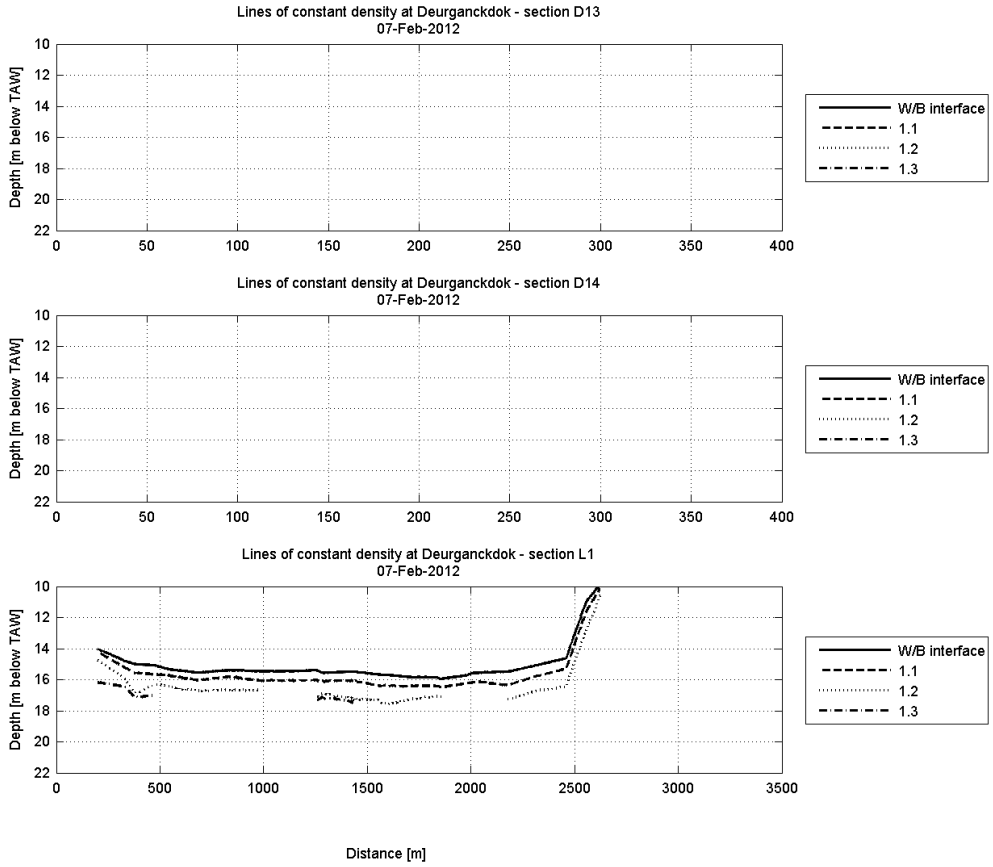

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



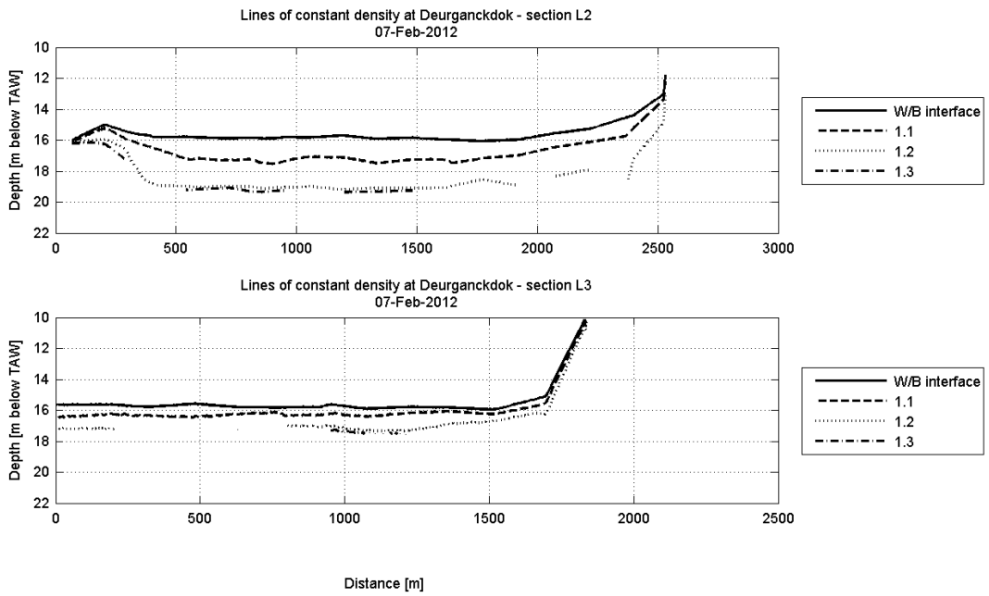

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |




Data Processed by:

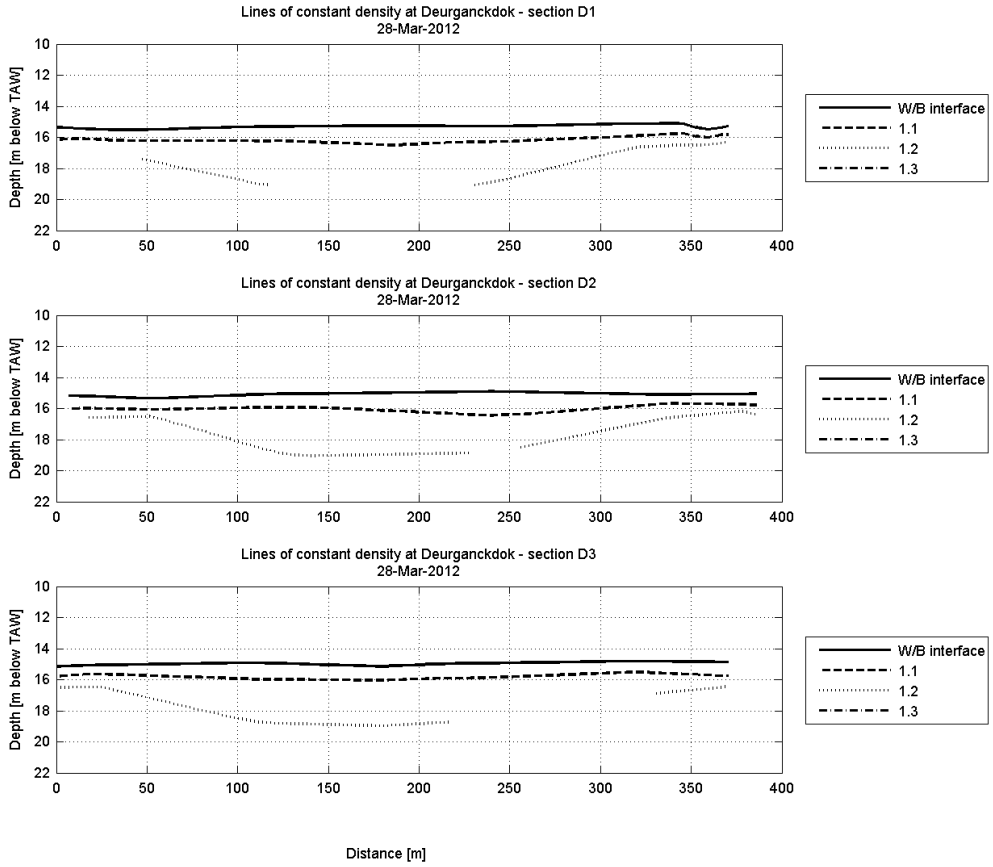
In association with :

I/RA/11354/10.101/MBO/ANF

# E.7 MEASUREMENTS MARCH 28th, 2012

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



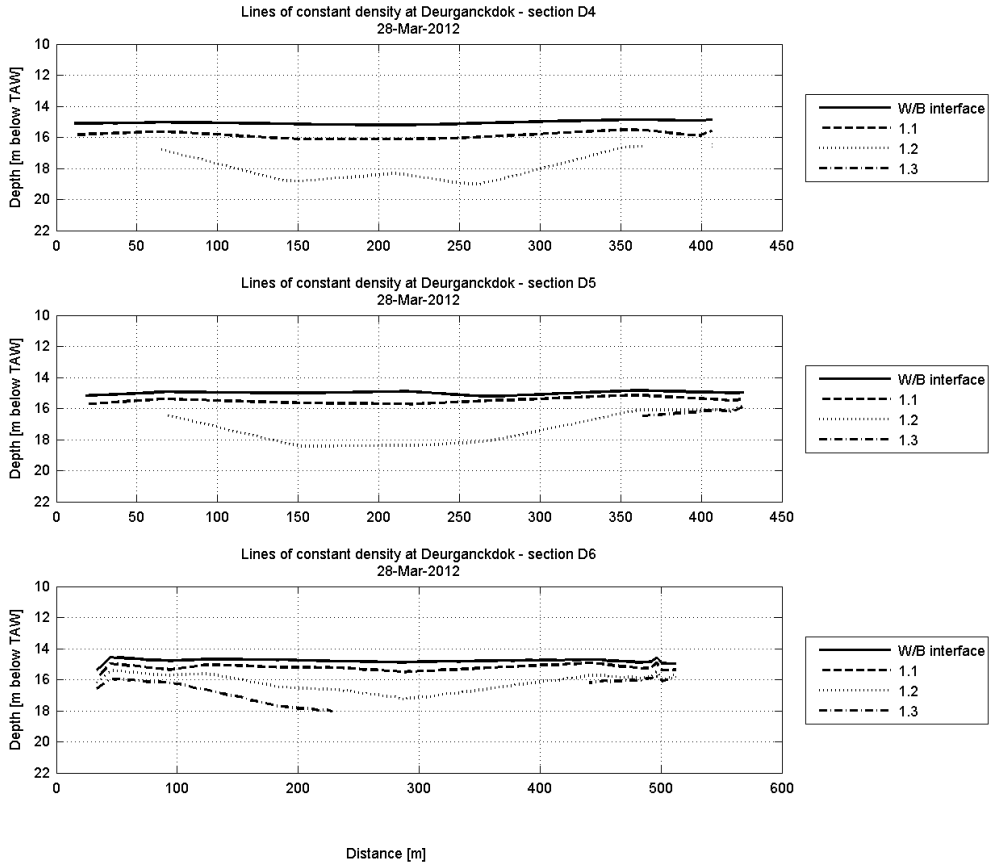

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Cross sections planes constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



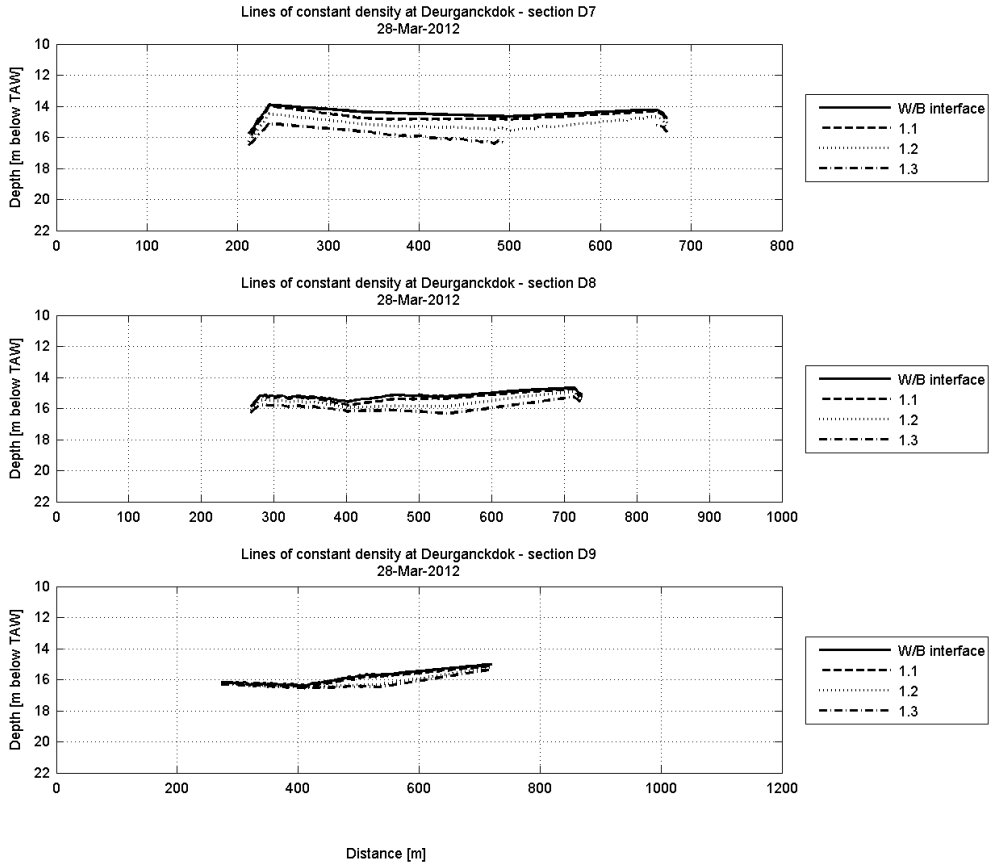

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



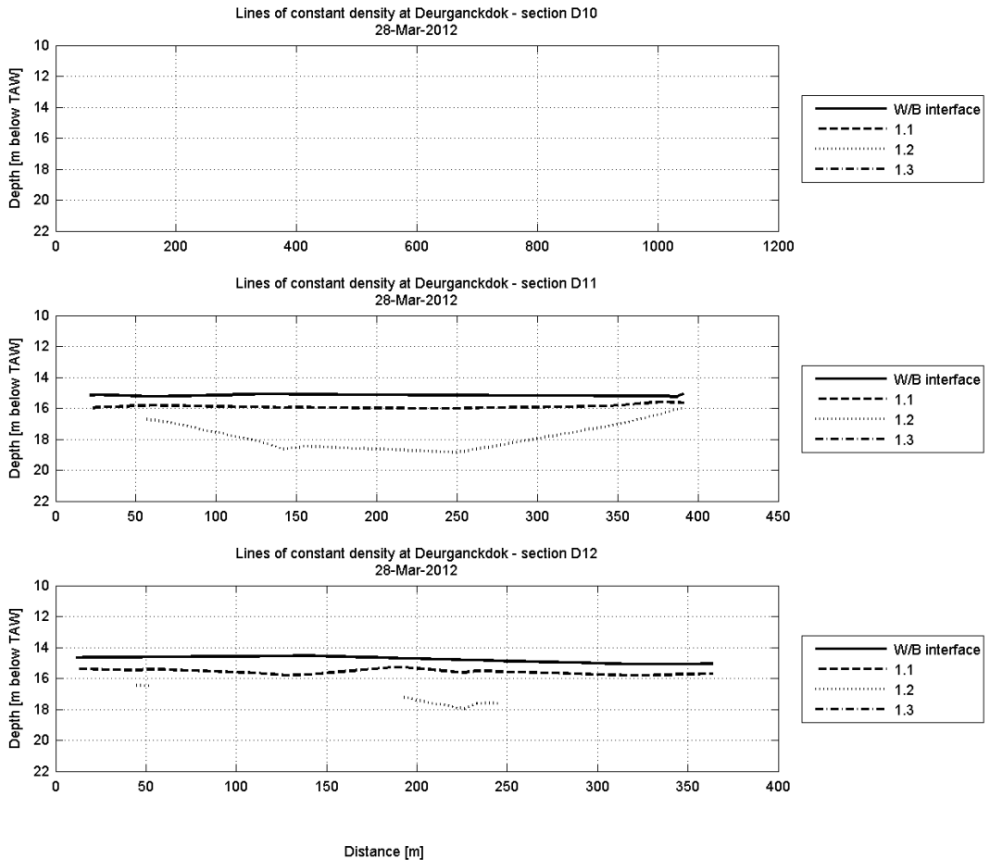

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



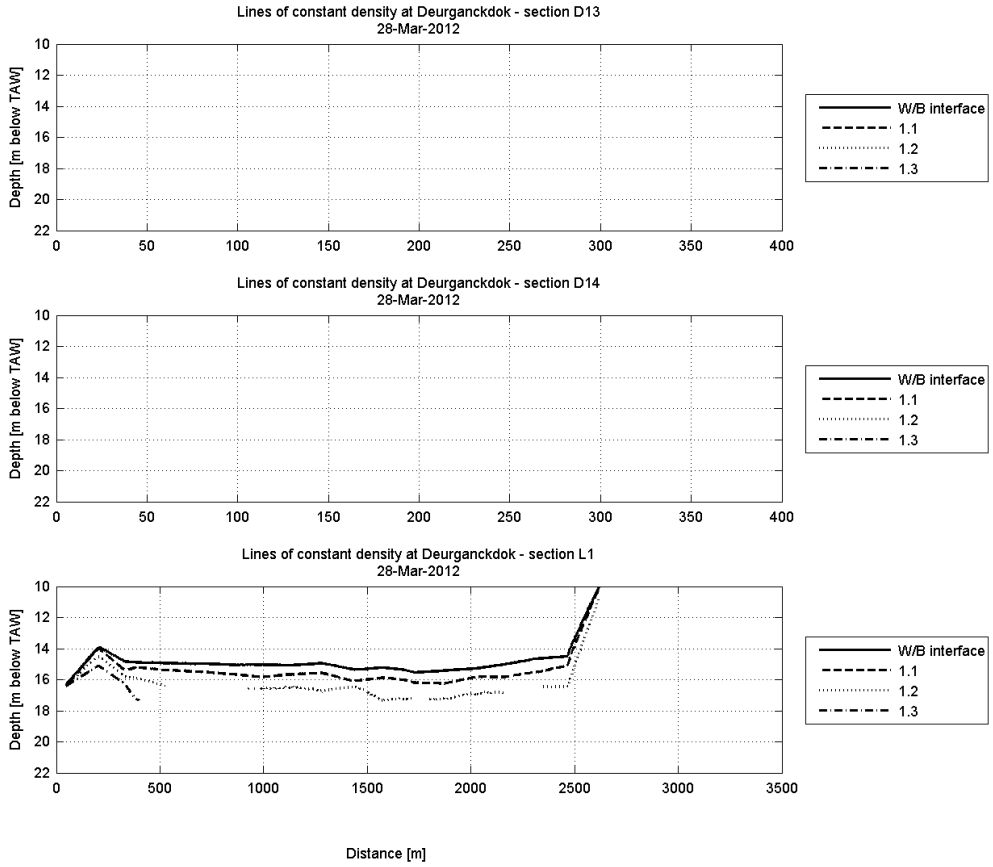

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |



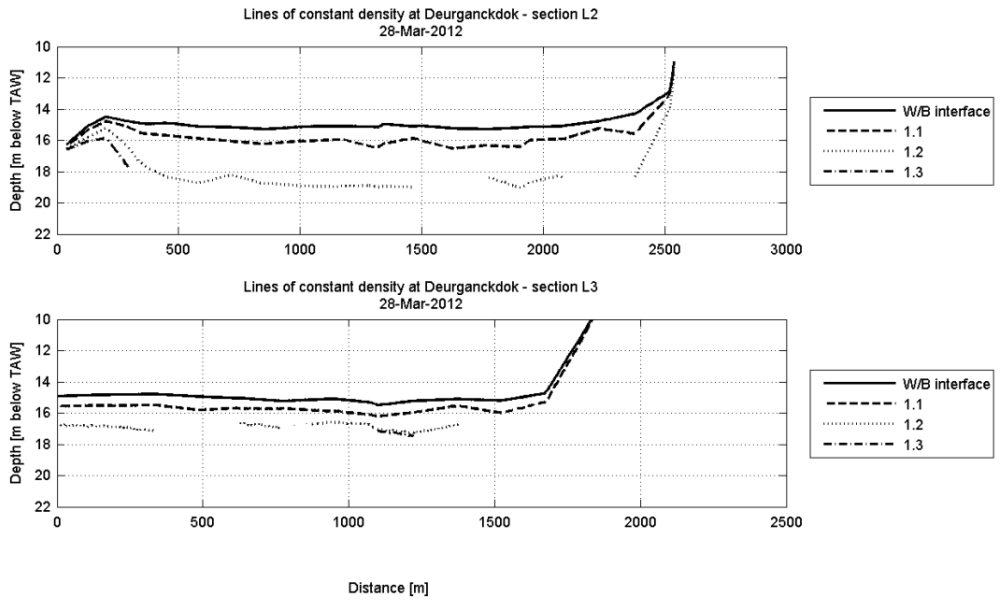

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Cross sections planes constant density | Equipment(s): Navitracker |
| | Location: DGD |




Data Processed by:

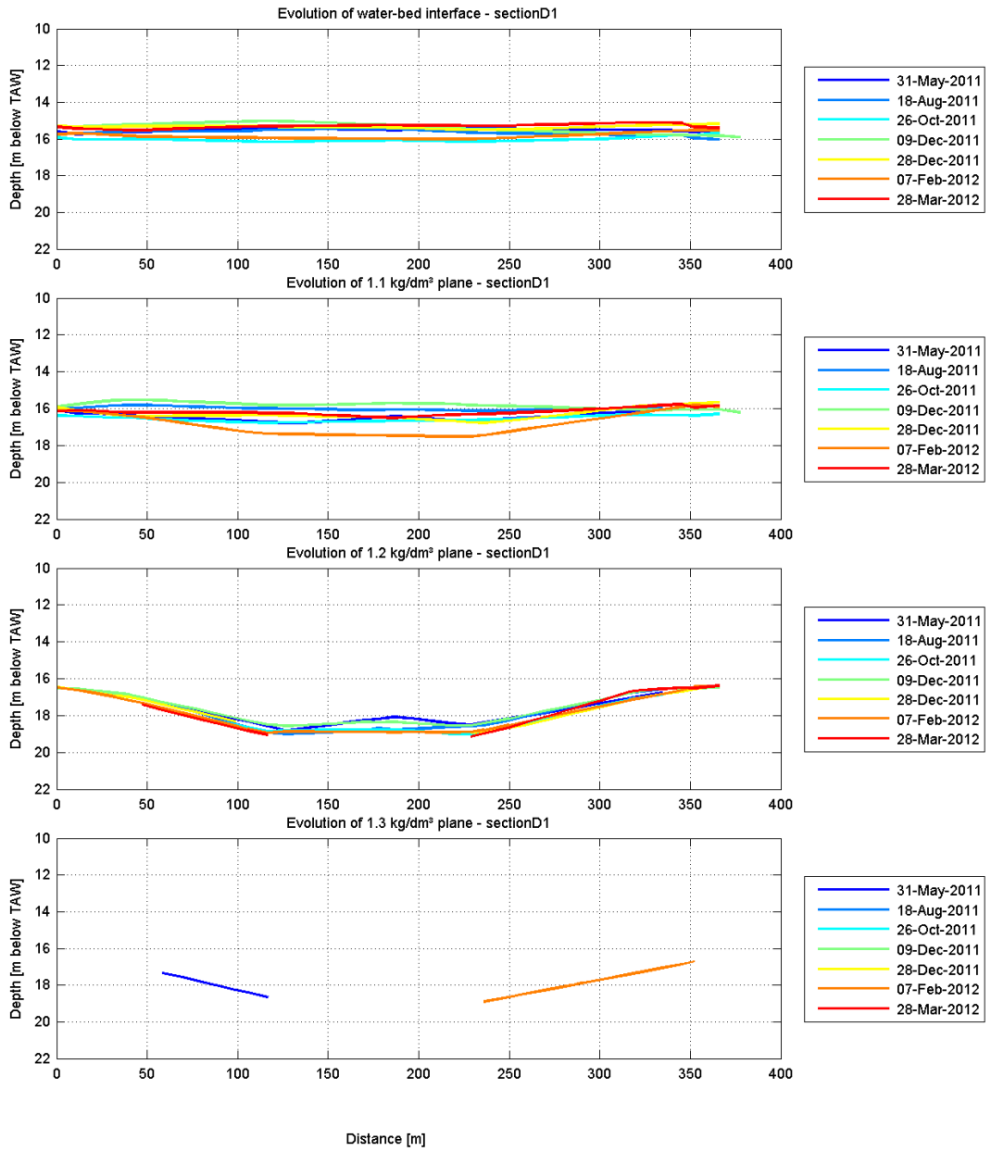
In association with :

I/RA/11354/10.101/MBO/ANF

# Annex F DEPTH EVOLUTION OF PLANES OF CONSTANT DENSITY

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



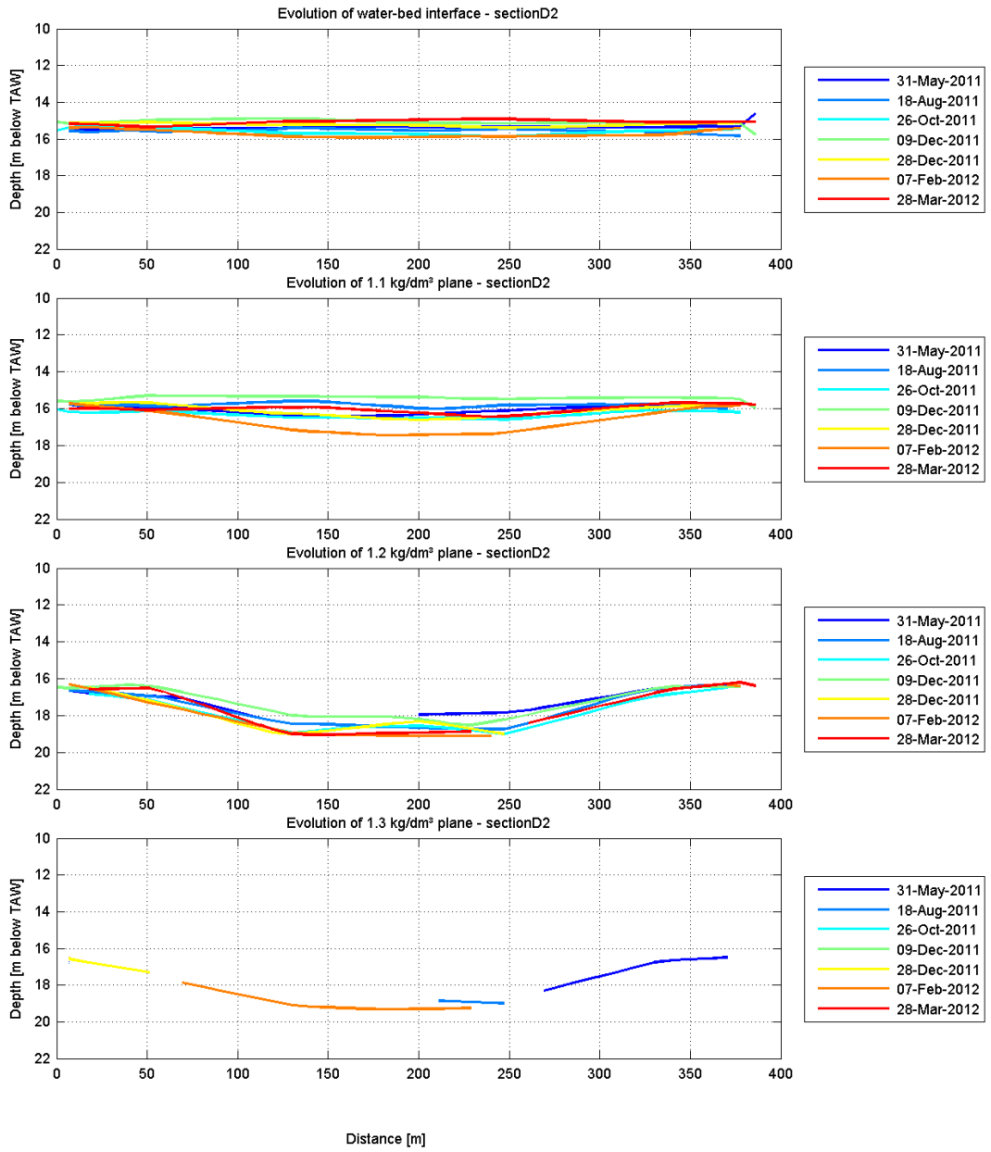

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



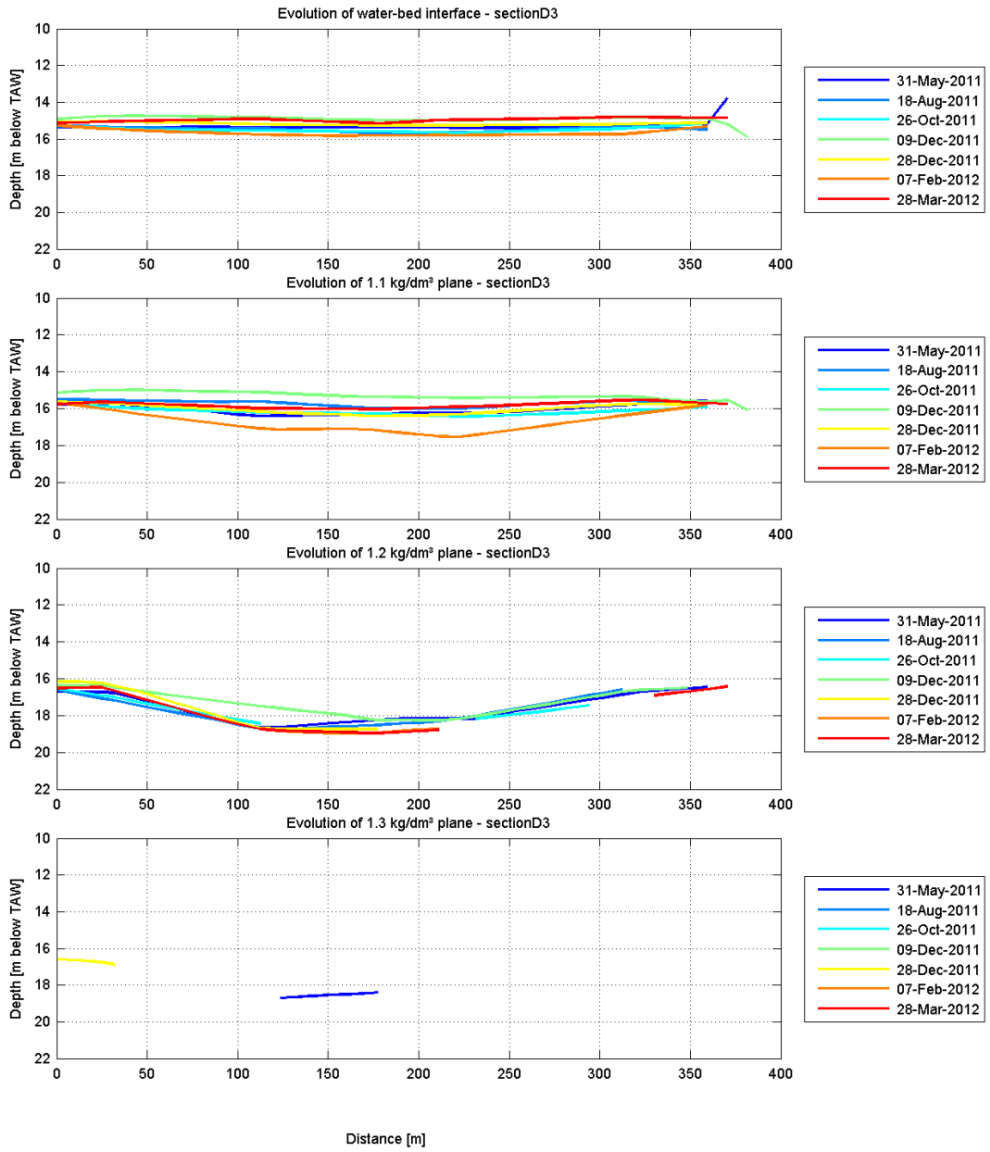

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



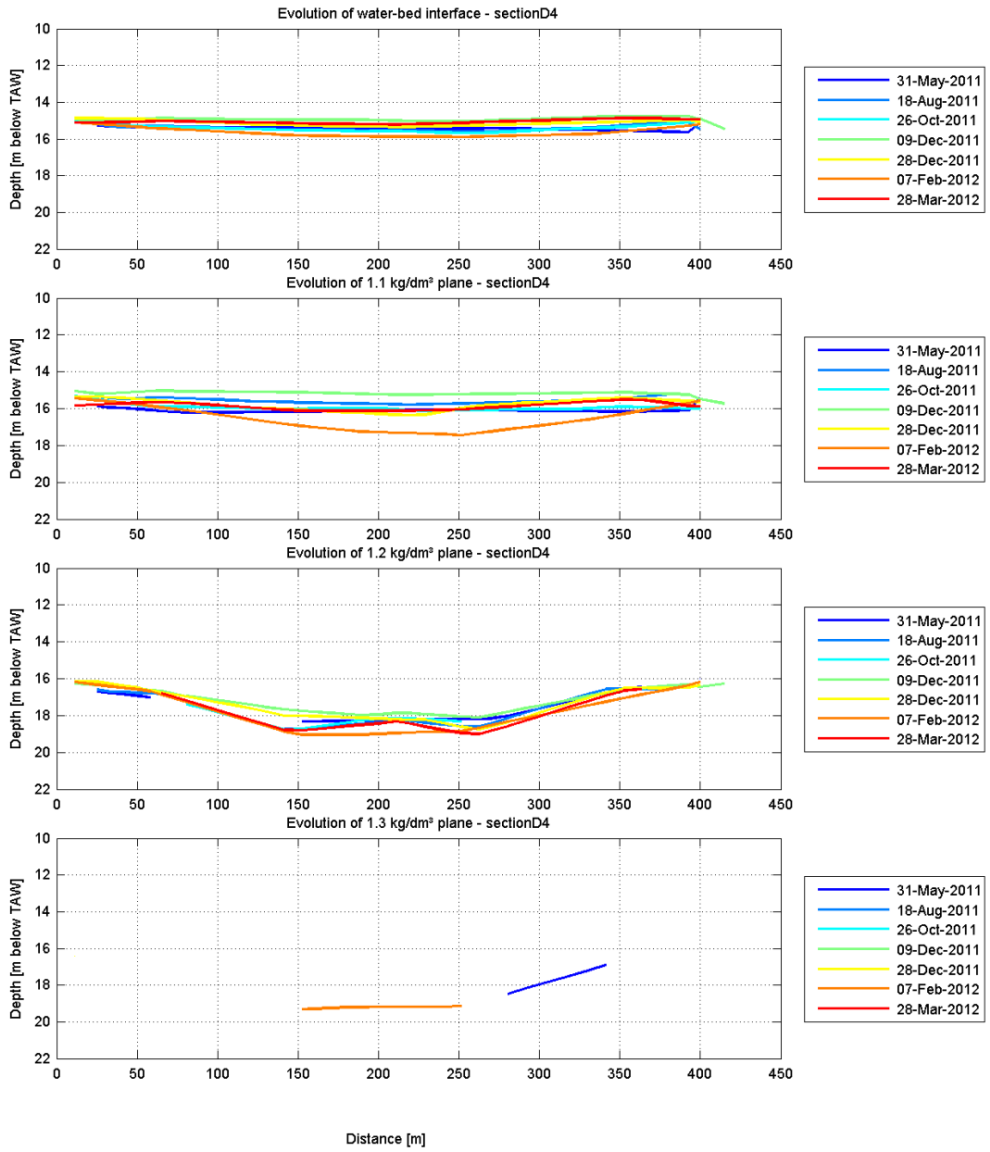

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



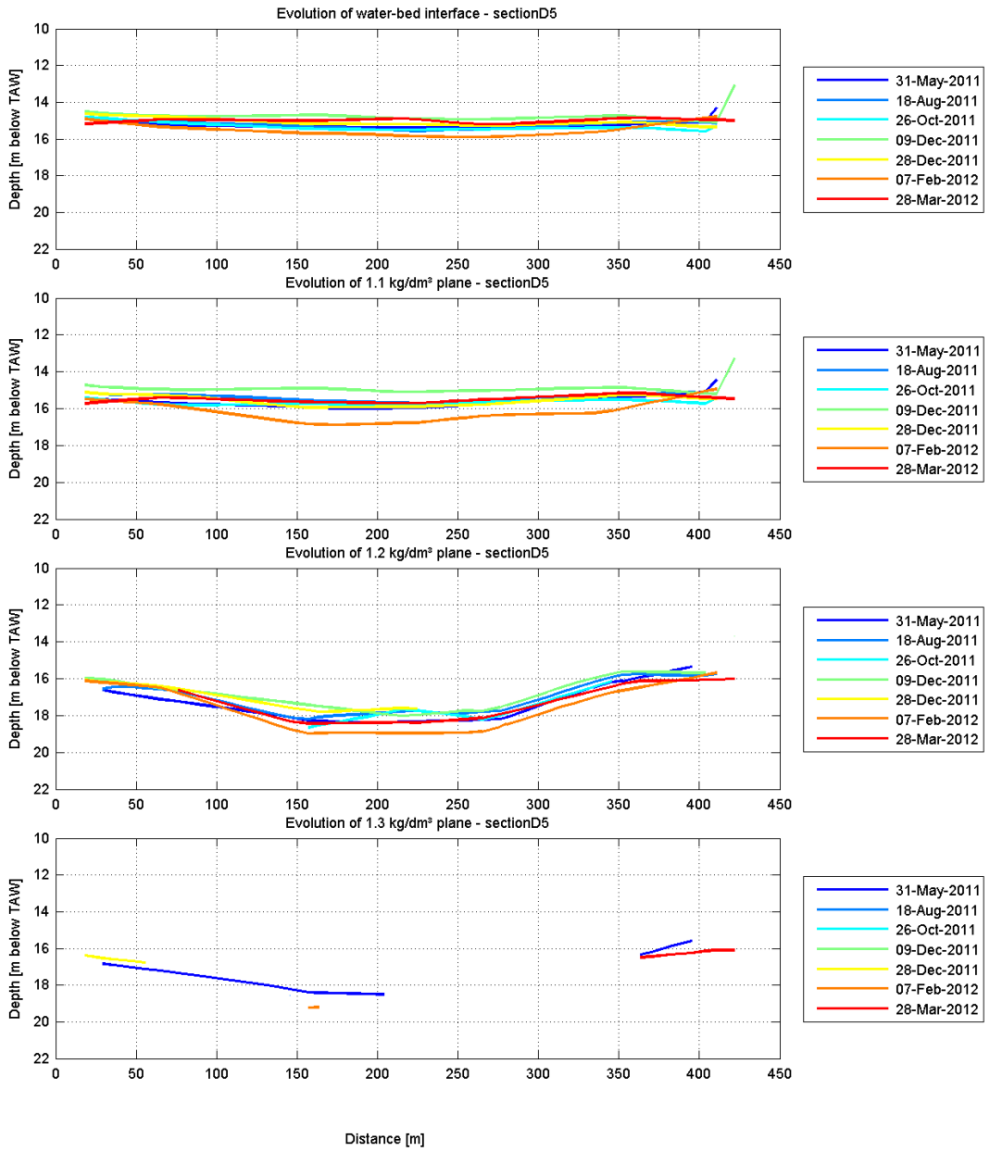

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



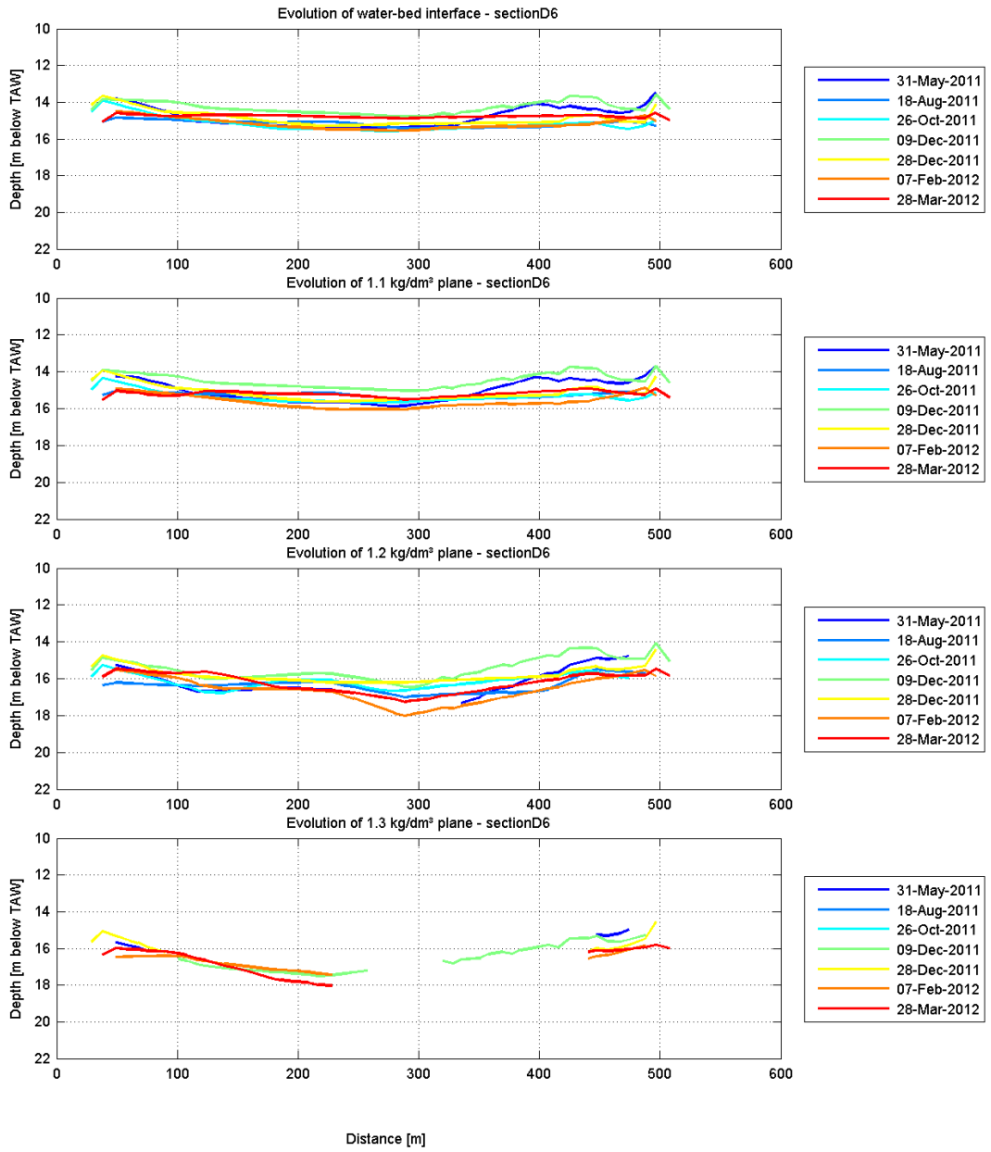

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



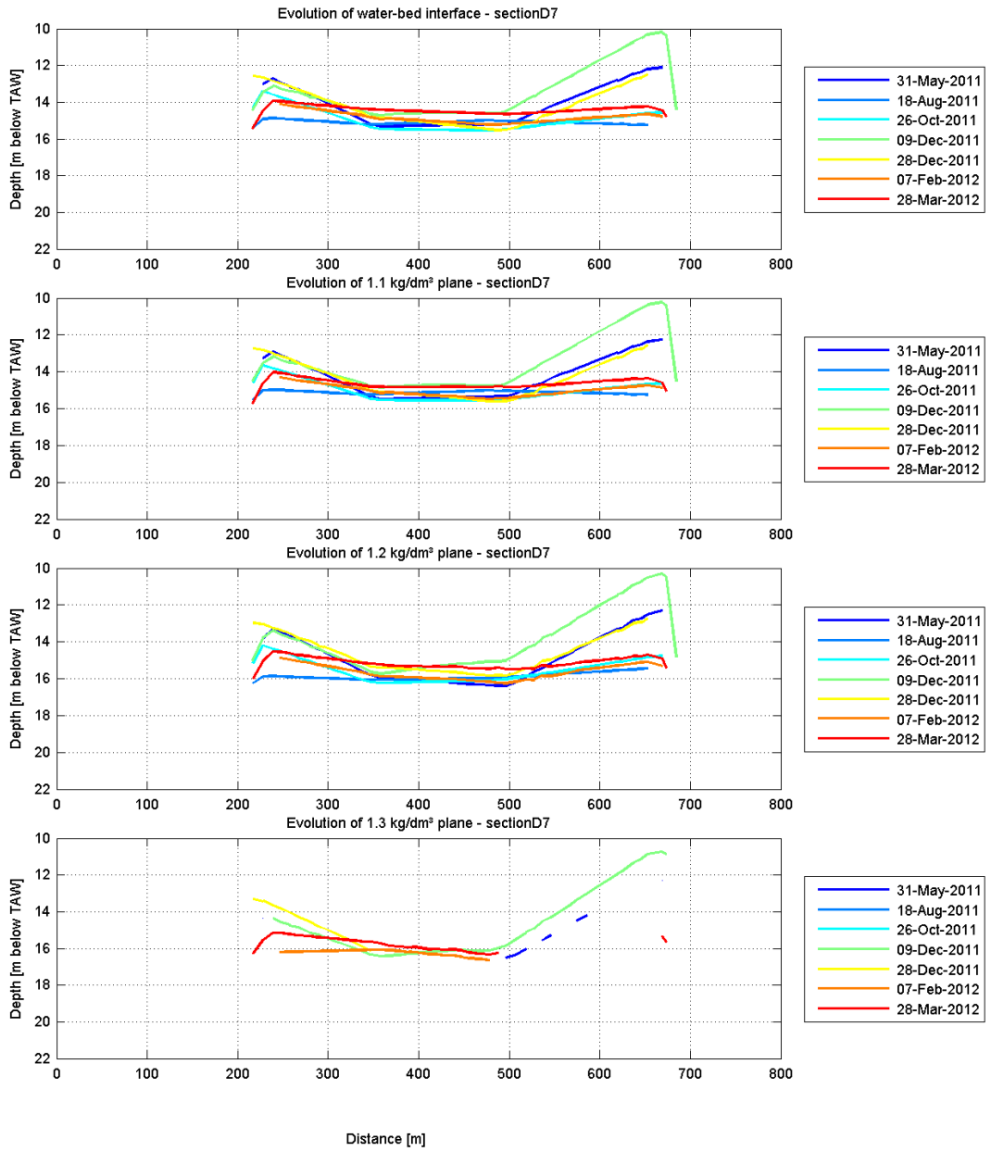

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



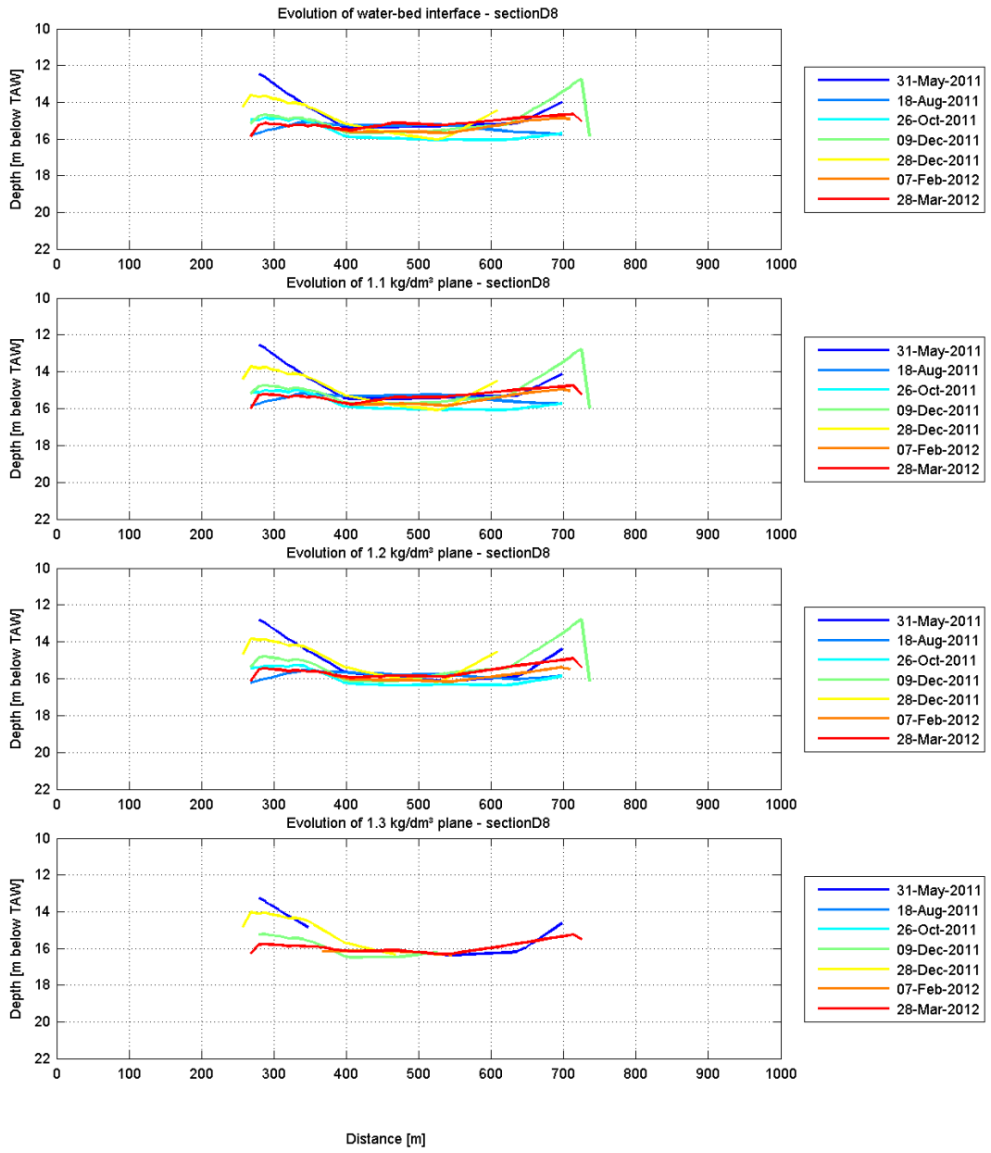

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



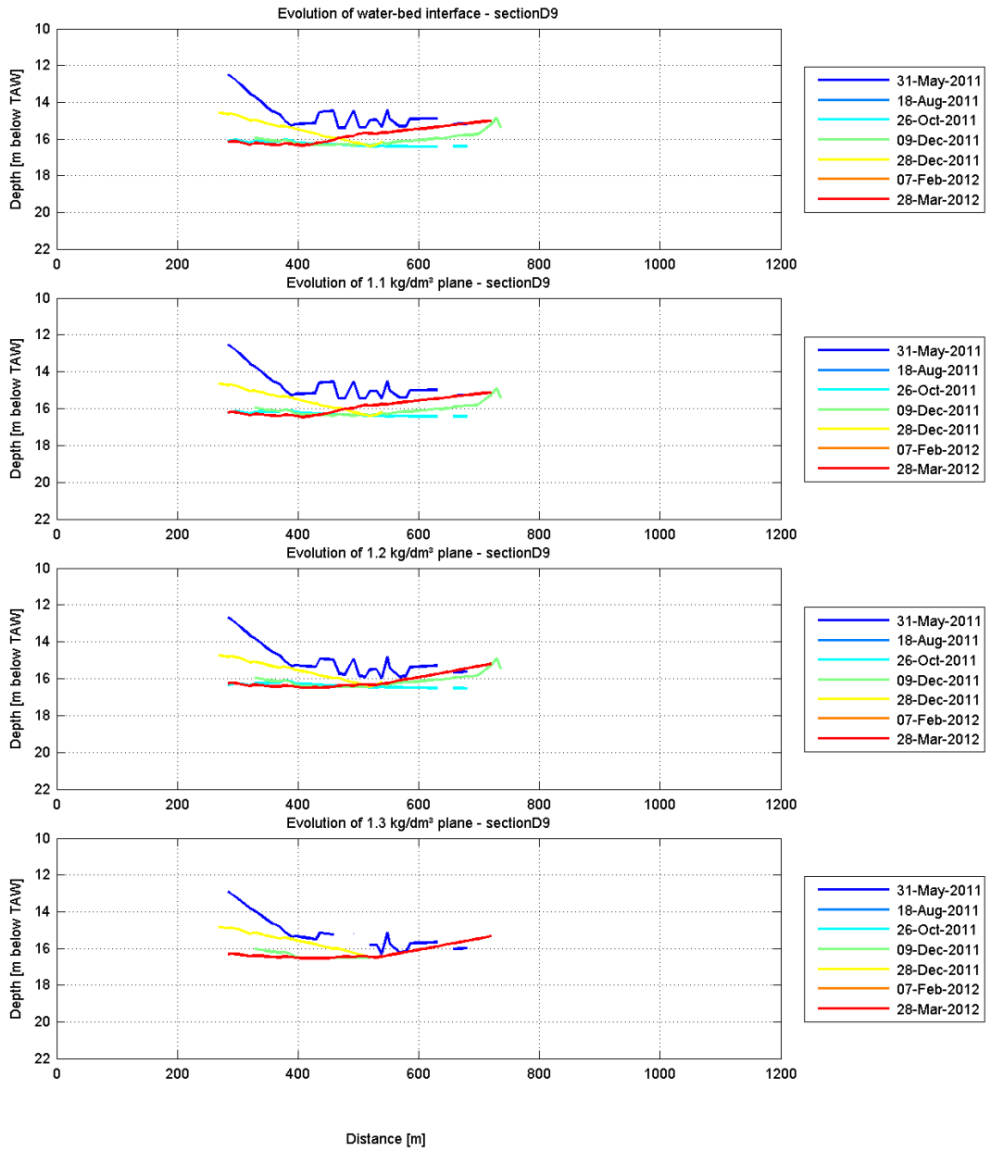

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



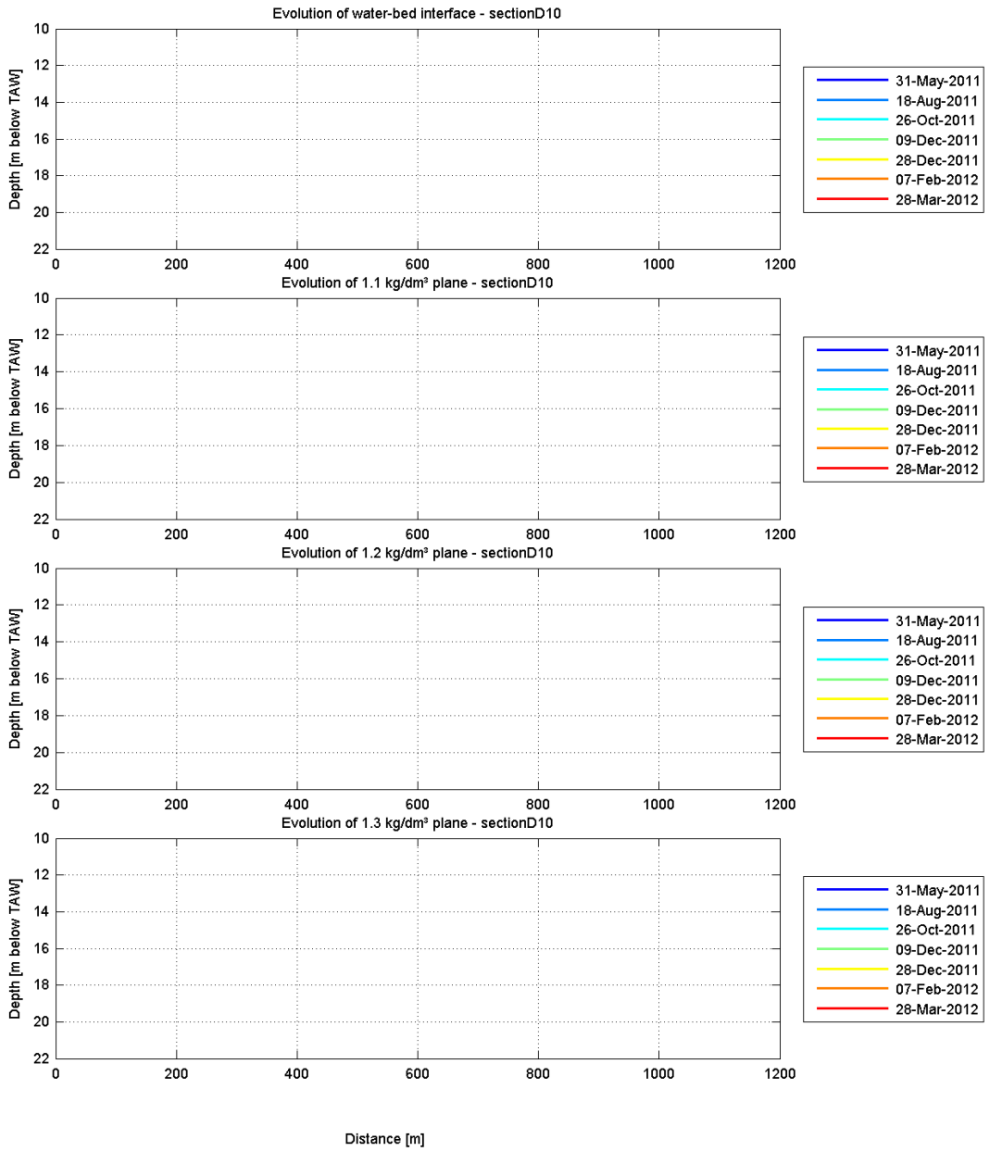

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



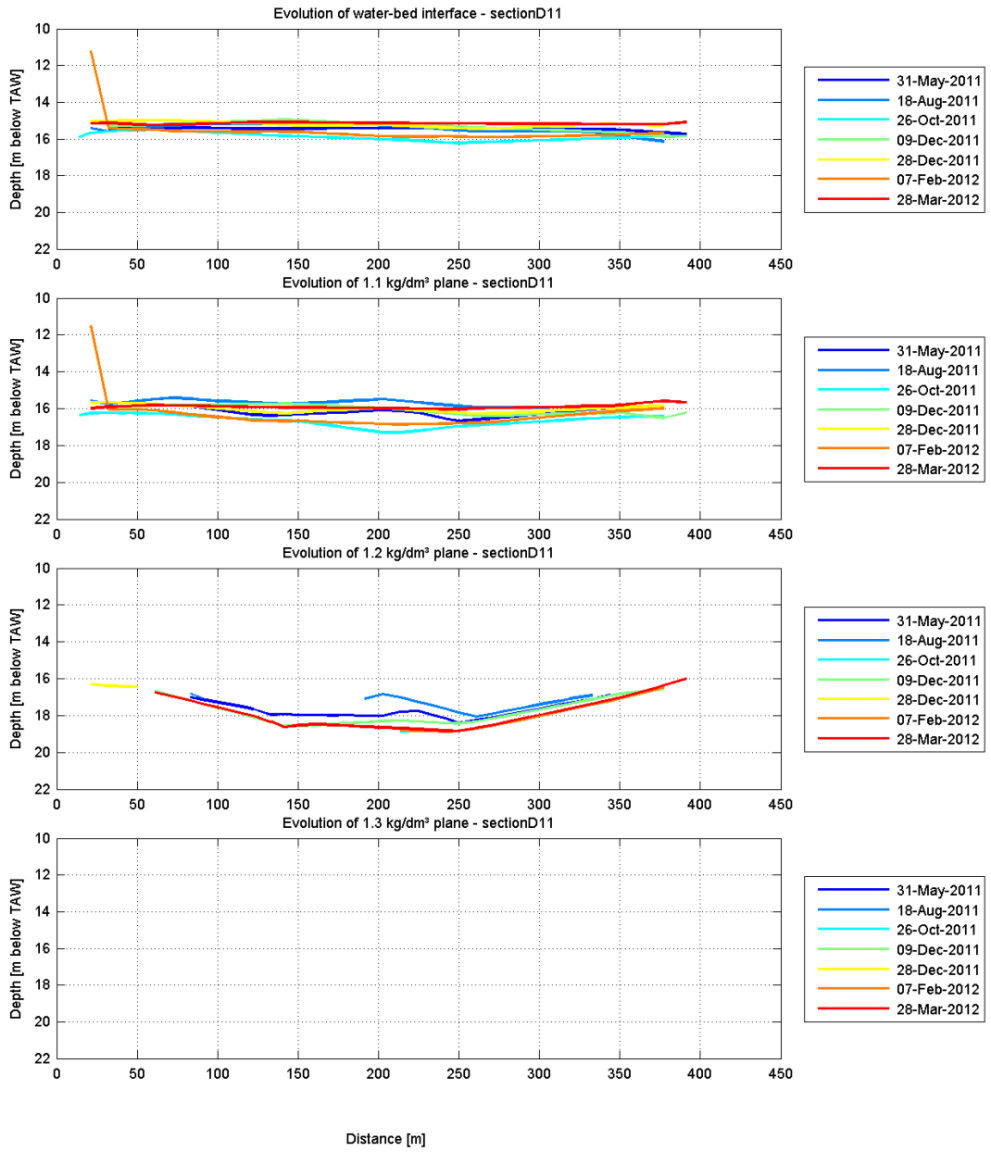

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



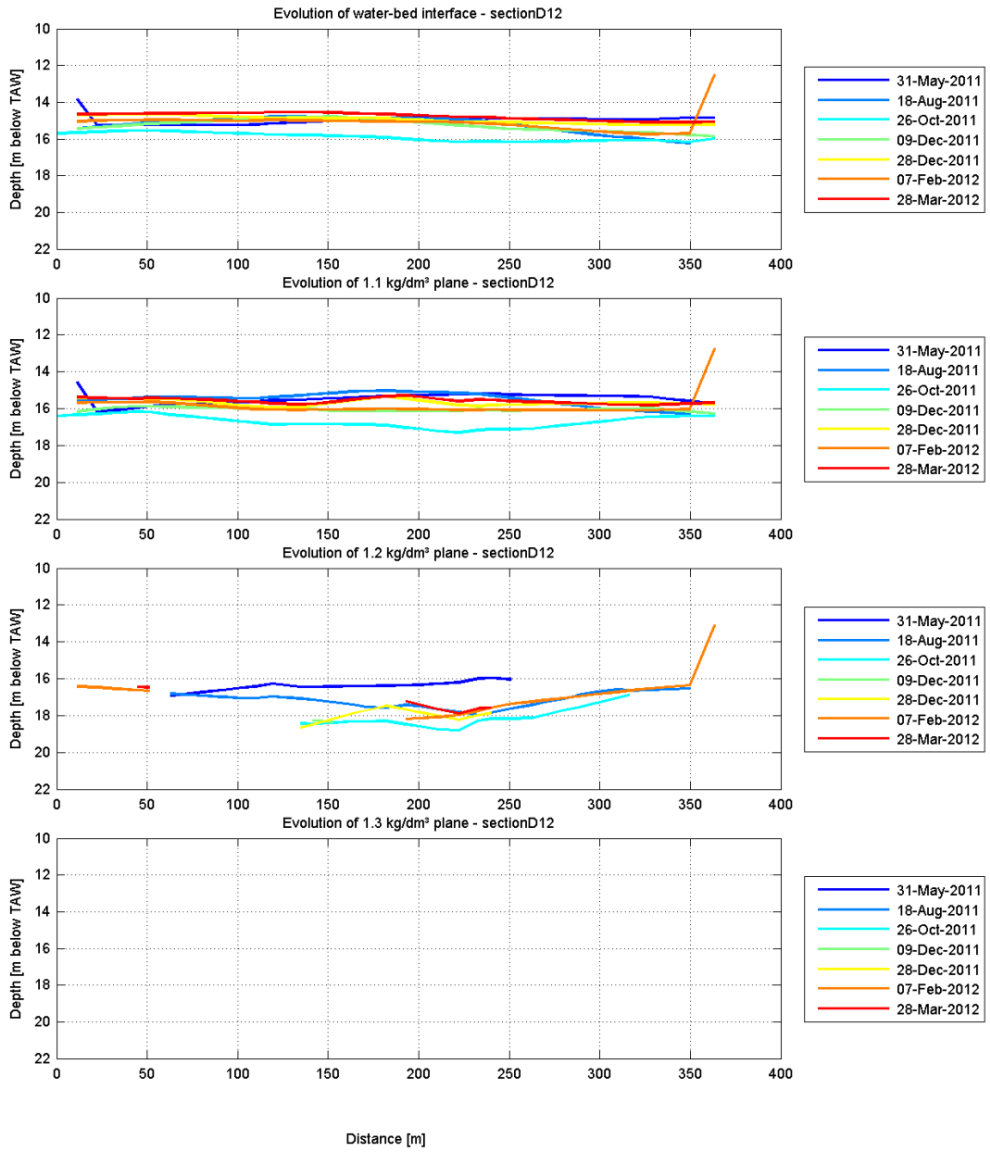

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



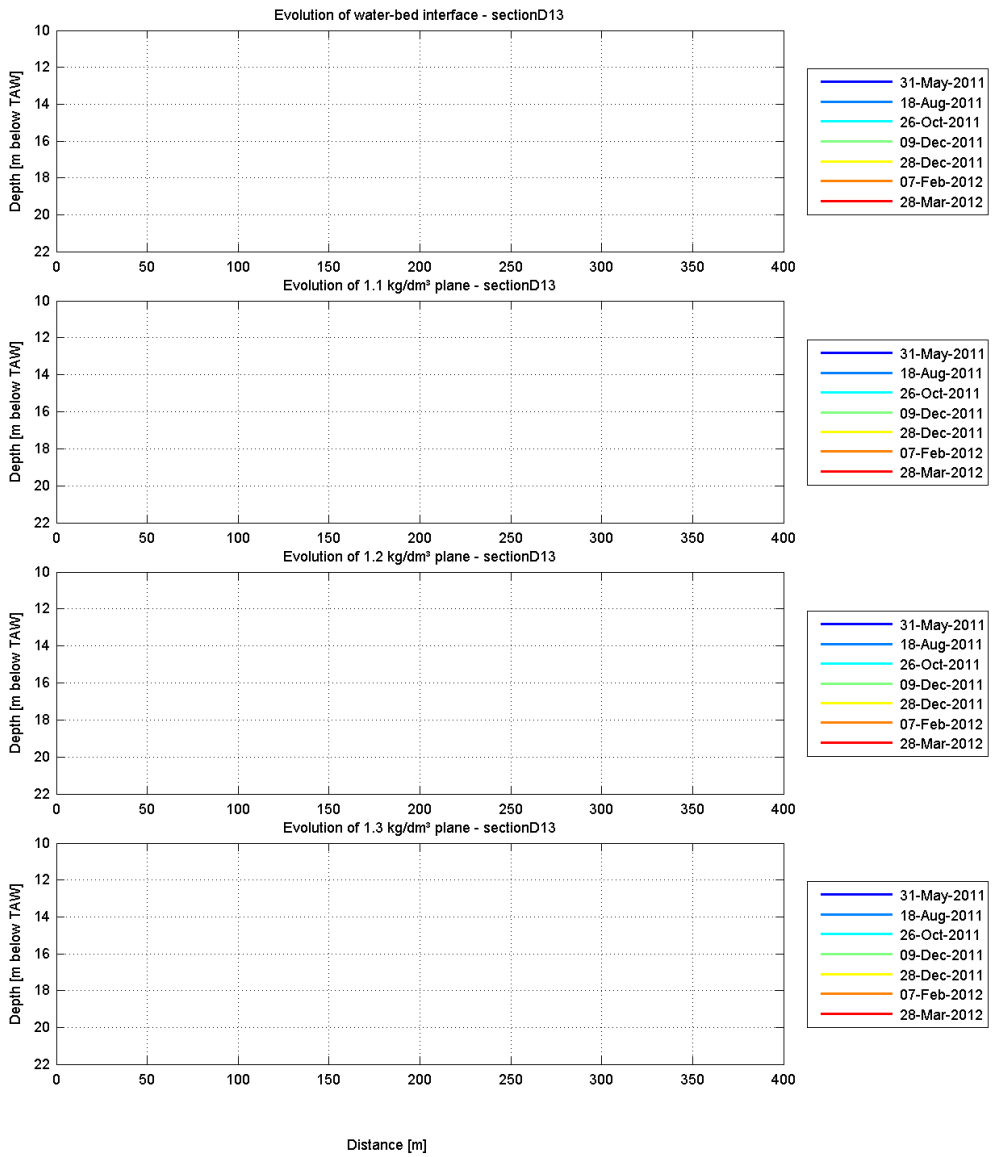

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



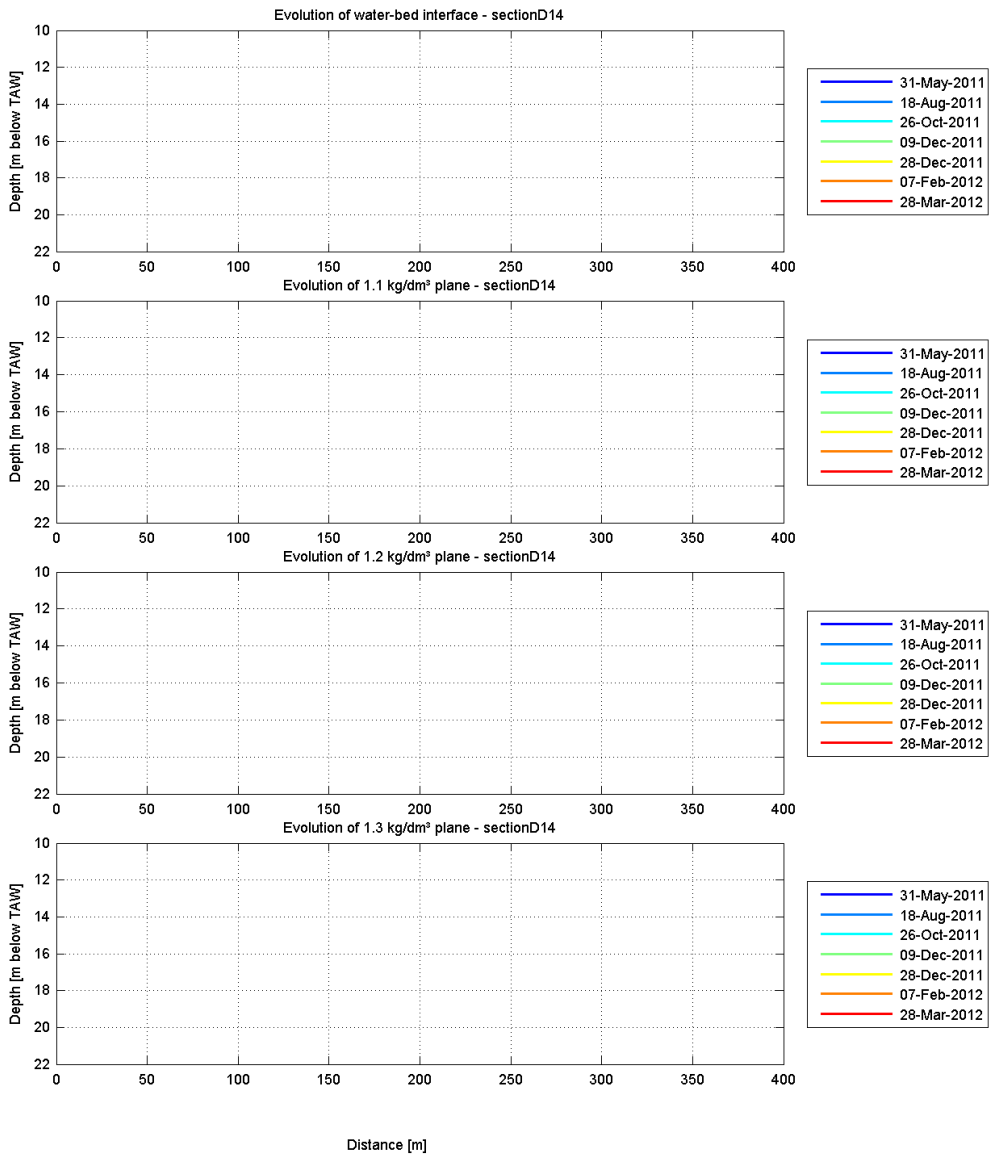

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



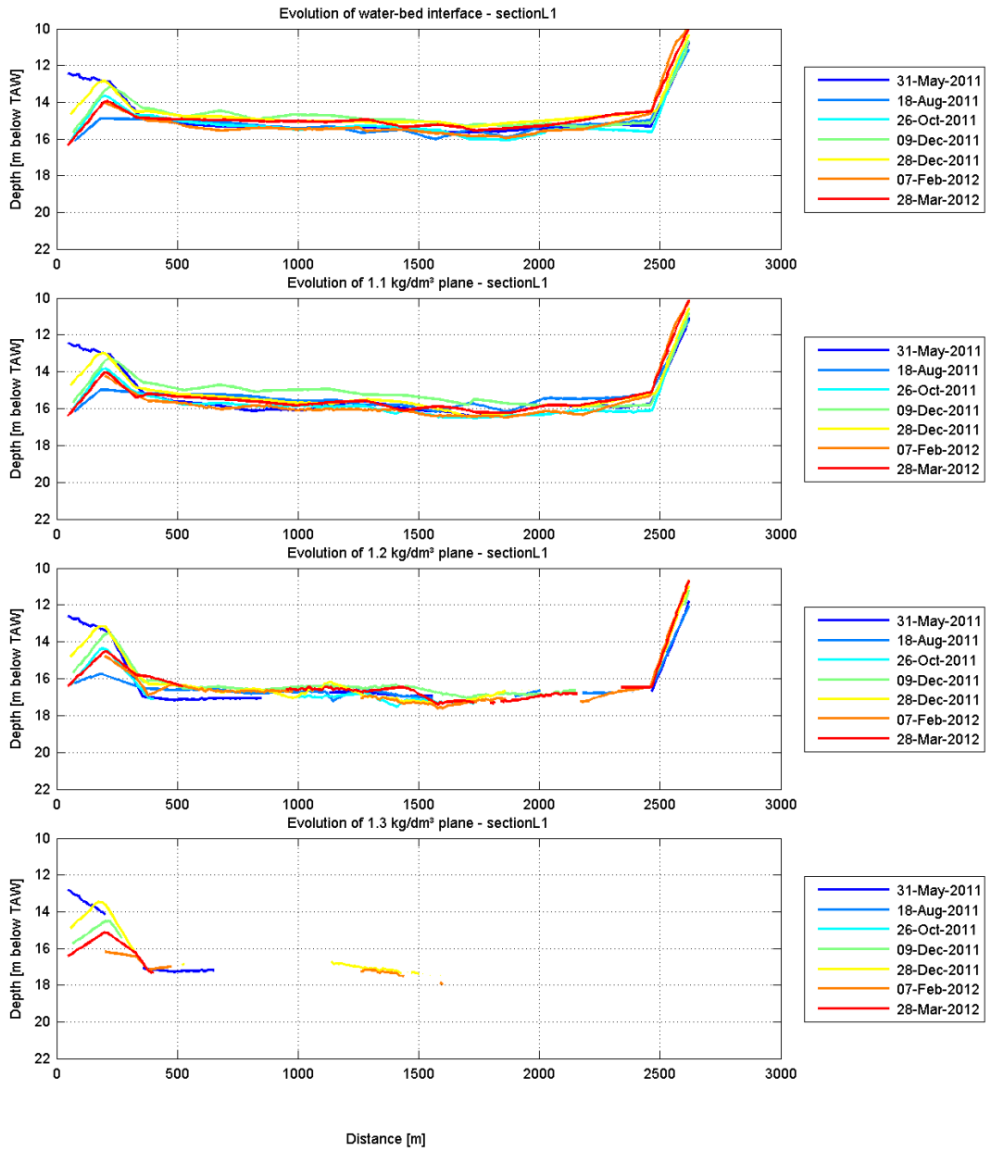

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



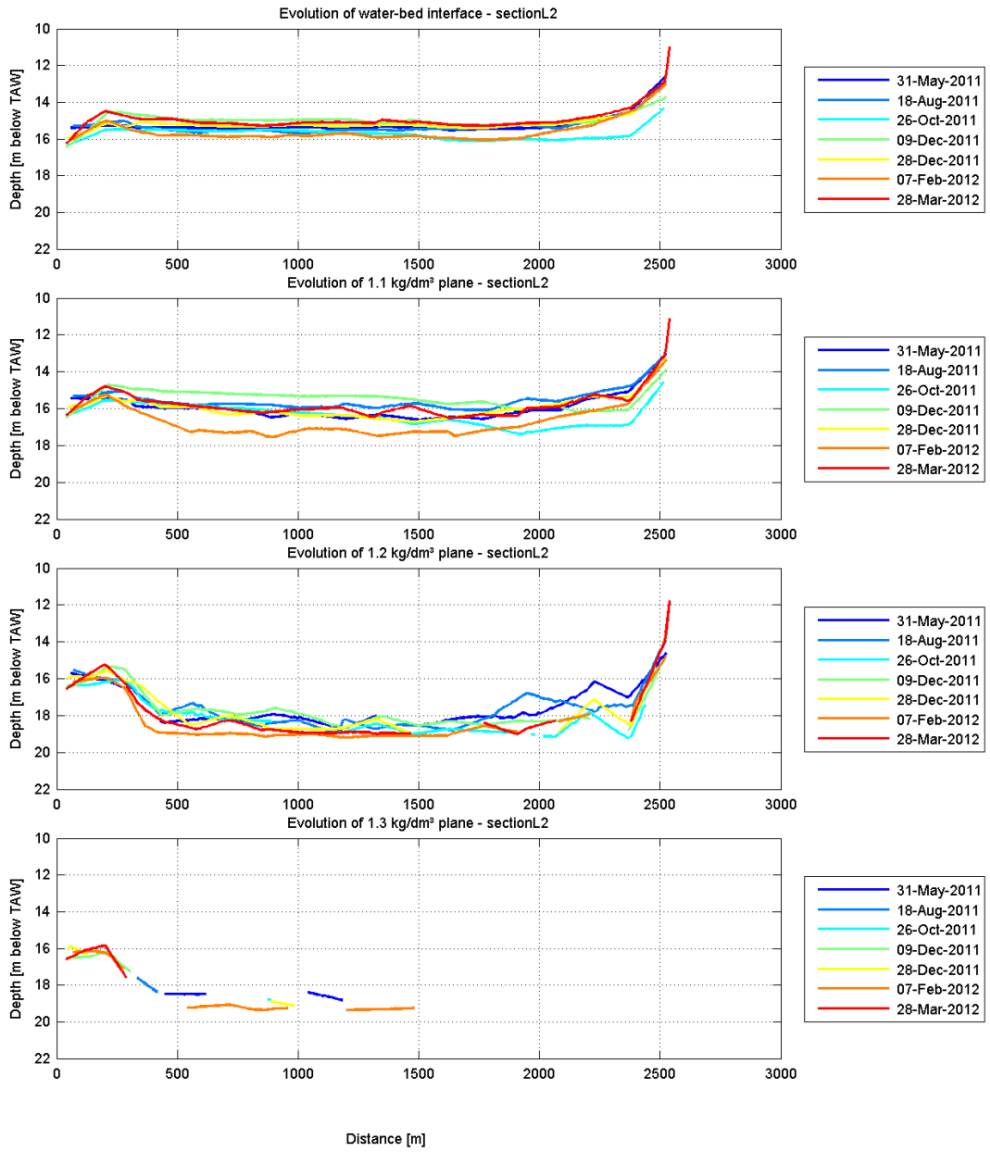

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



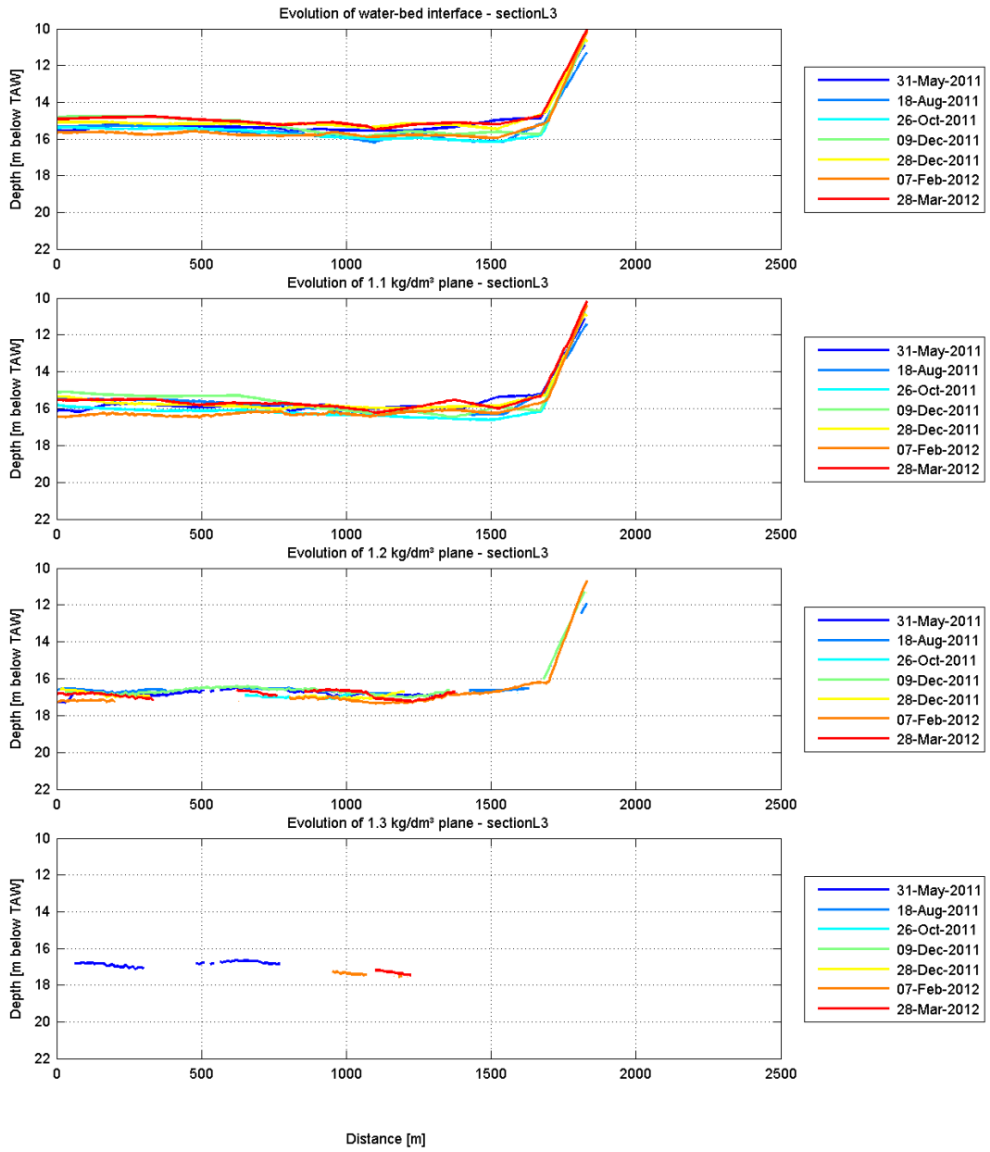

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Evolution of planes of constant density | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



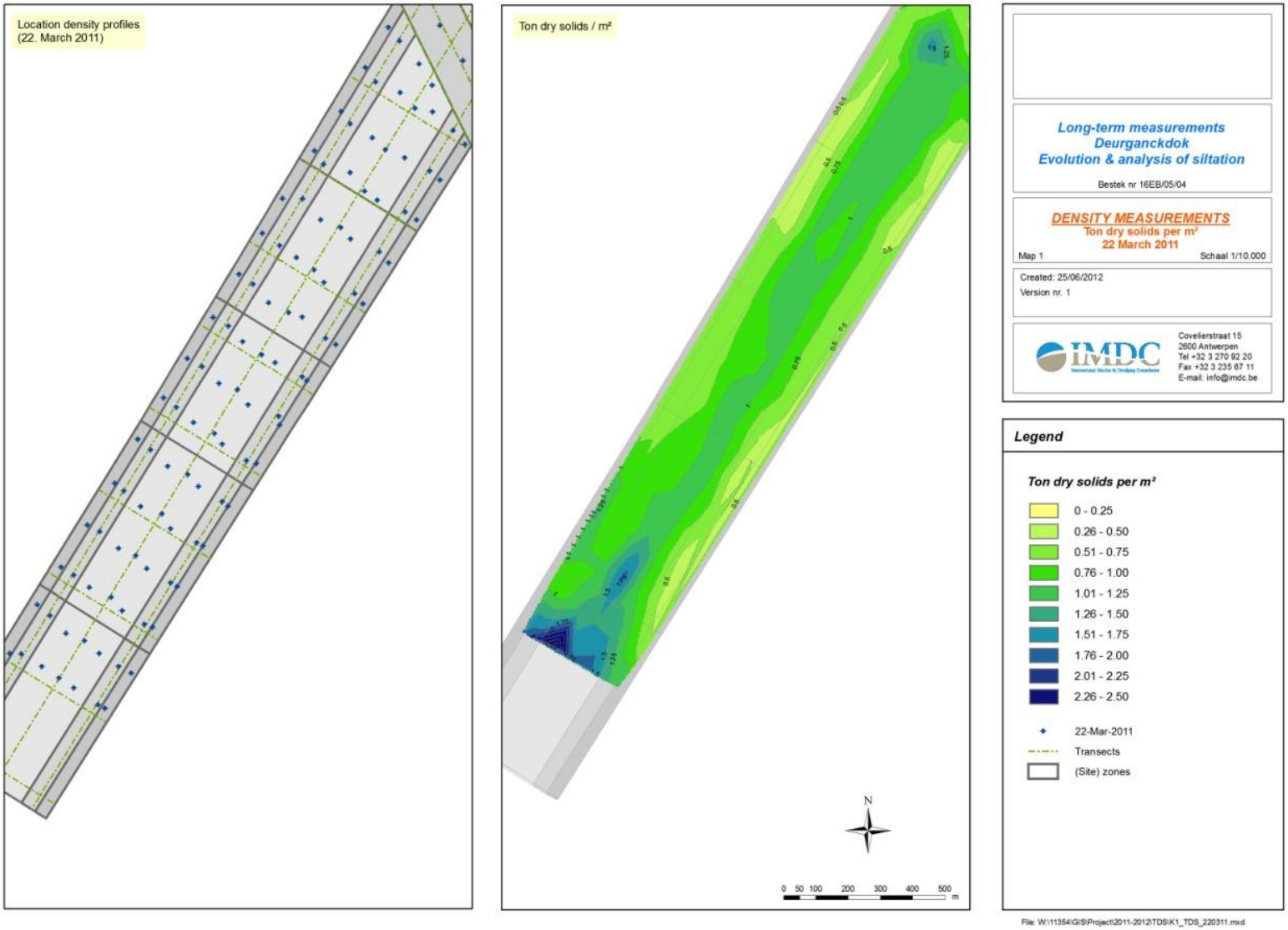

Data Processed by:

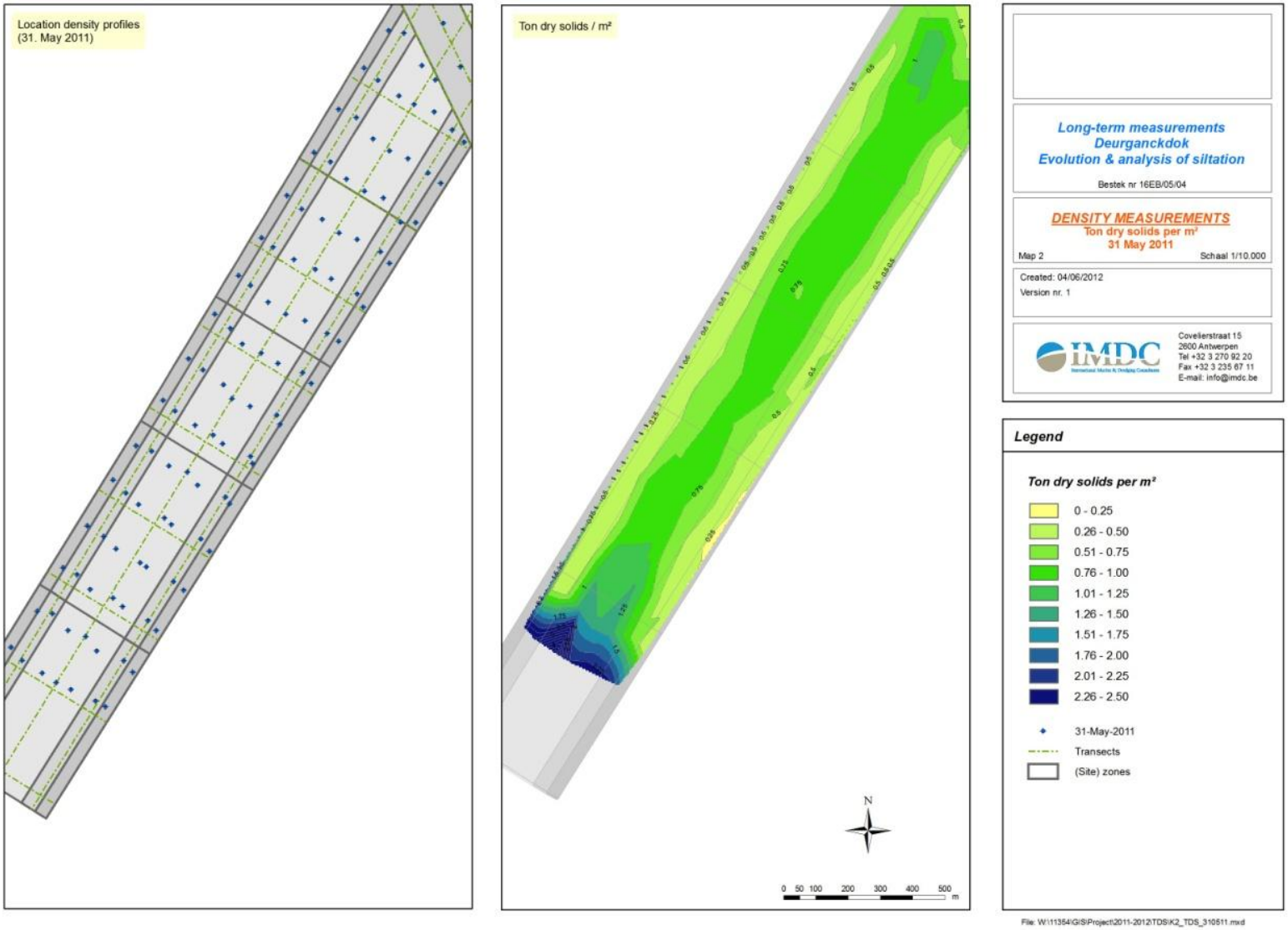
In association with :

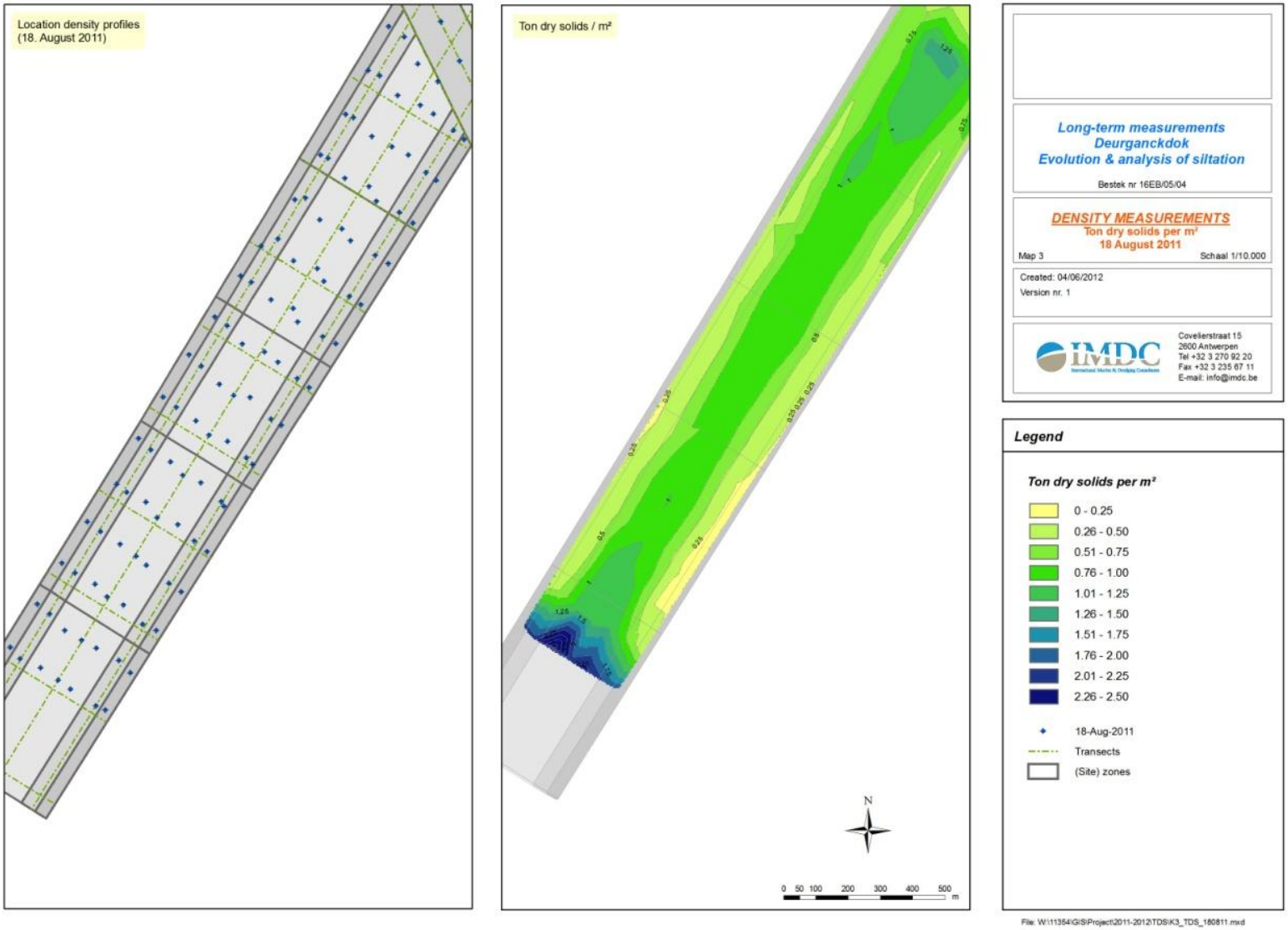
I/RA/11354/10.101/MBO/ANF

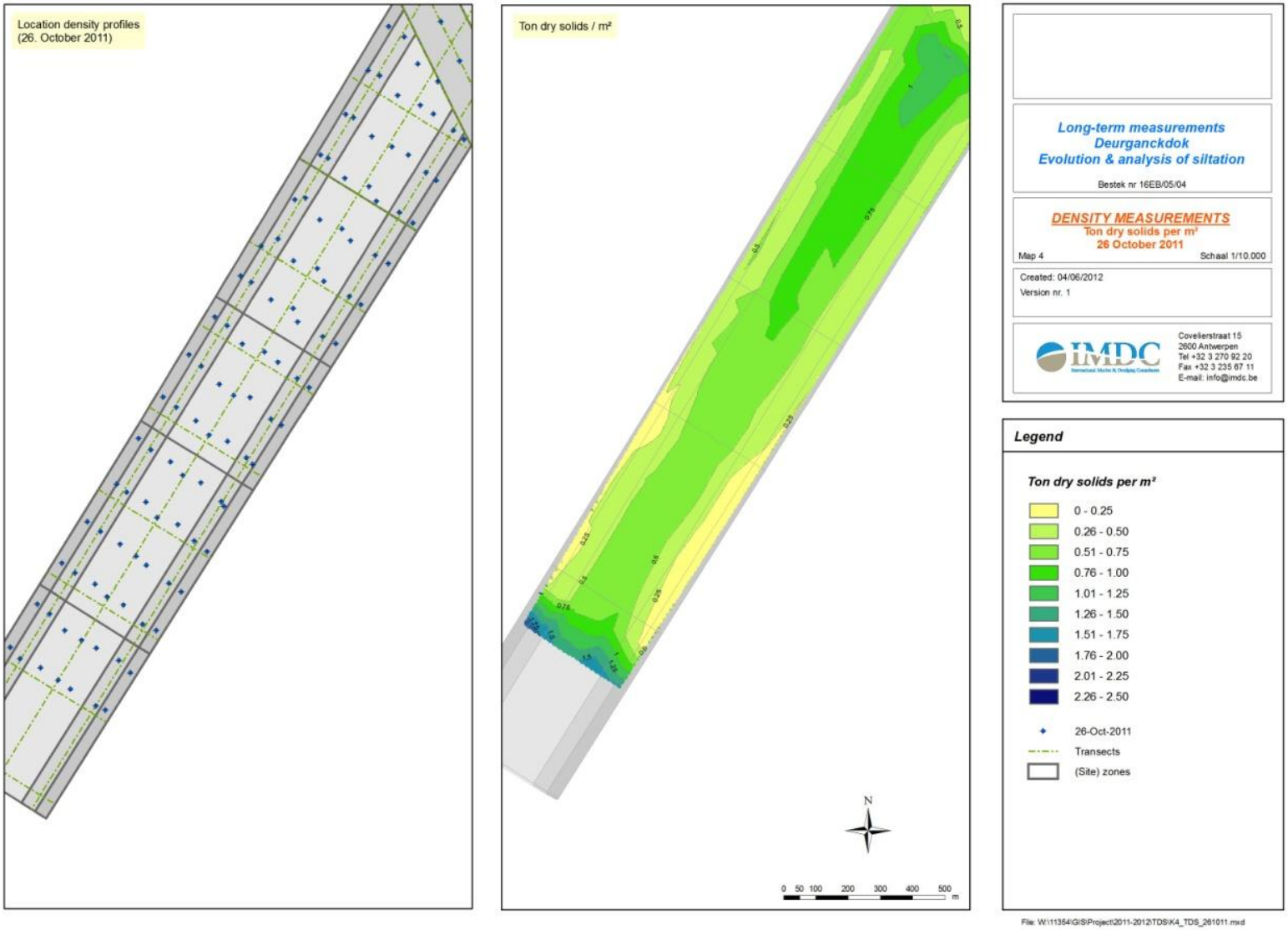
# Annex G SEDIMENT MASS DISTRIBUTION IN DEURGANCKDOK

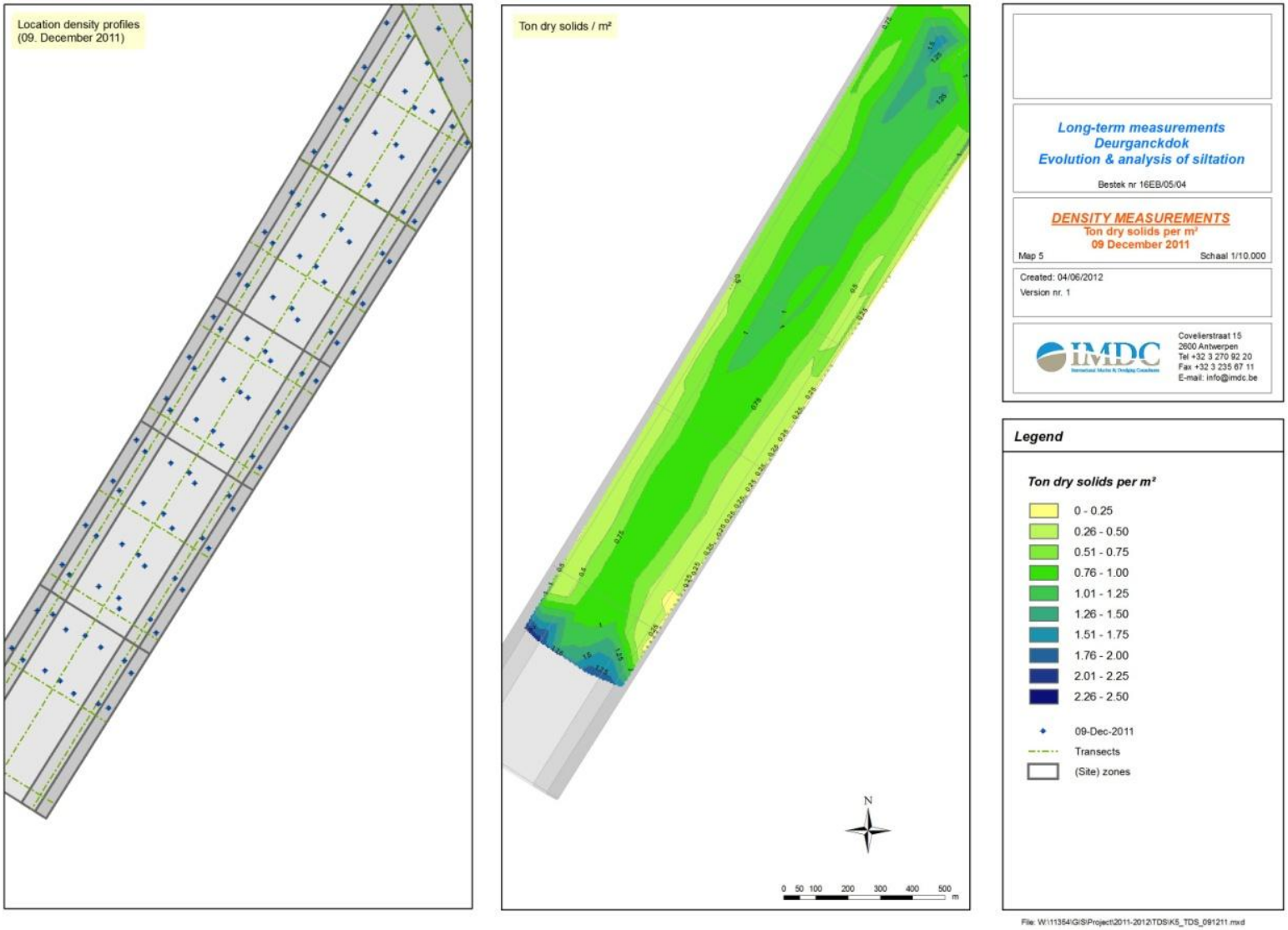
# G.1 LOCATIONS OF DENSITY PROFILES AND MEASURED MASS

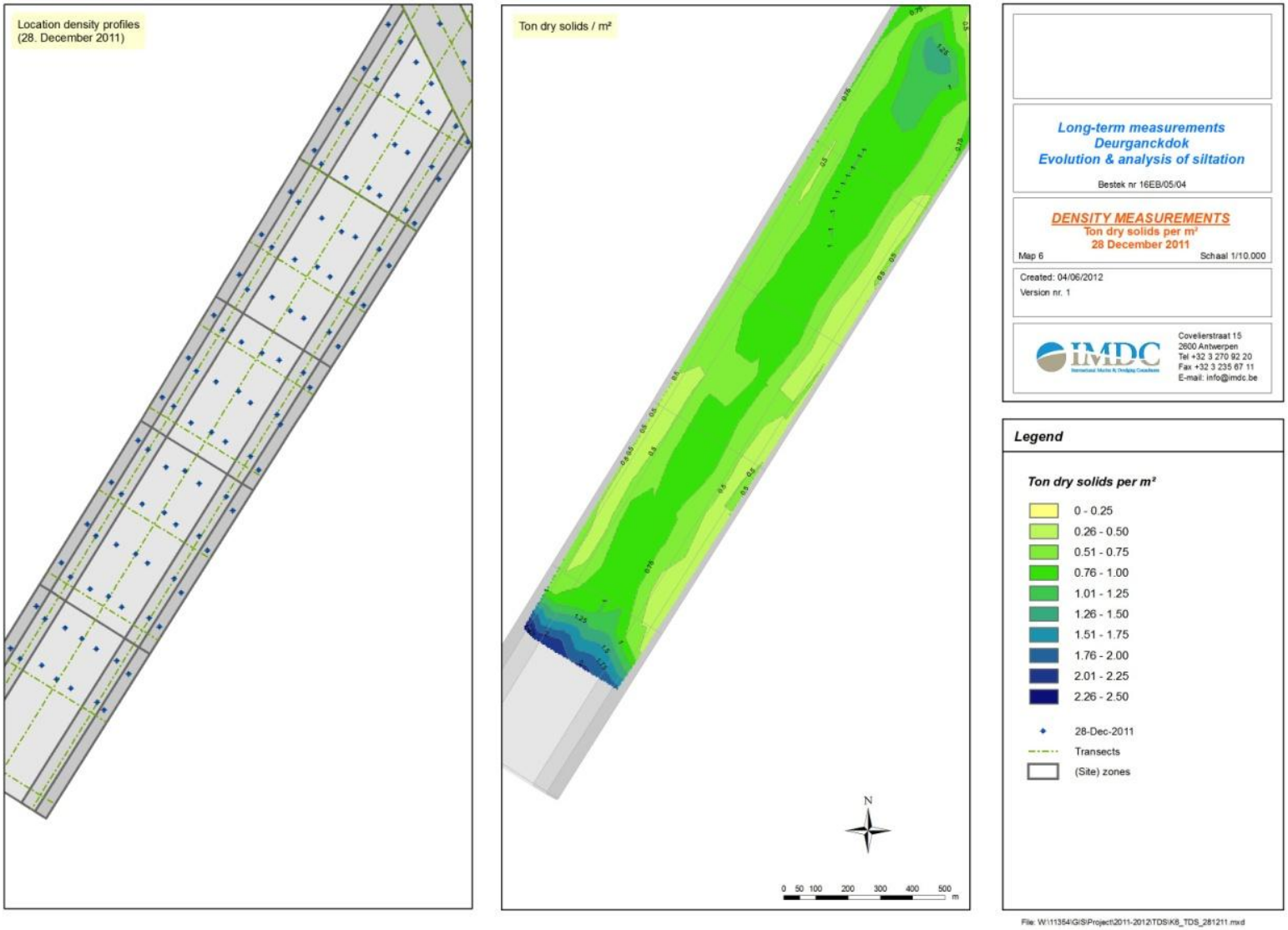

Location density profiles
(22. March 2011)
Ton dry solids / m²
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
22 March 2011
Map 1
Schaal 1/10.000
Created: 25/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
22-Mar-2011
Transects
(Site) zones

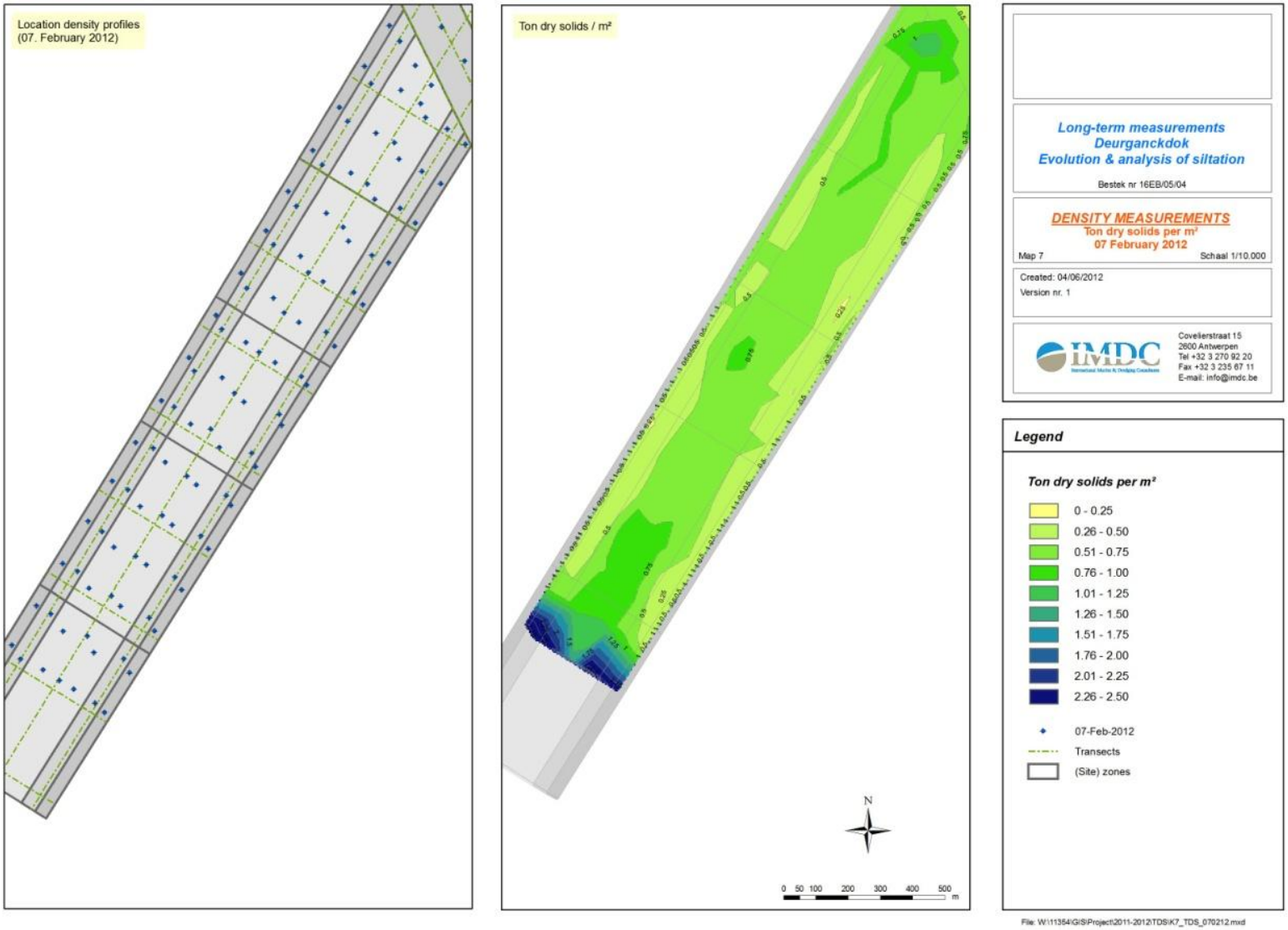

Location density profiles
(31. May 2011)
Ton dry solids / m²
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
31 May 2011
Map 2
Schaal 1/10.000
Created: 04/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
31-May-2011
Transects
(Site) zones

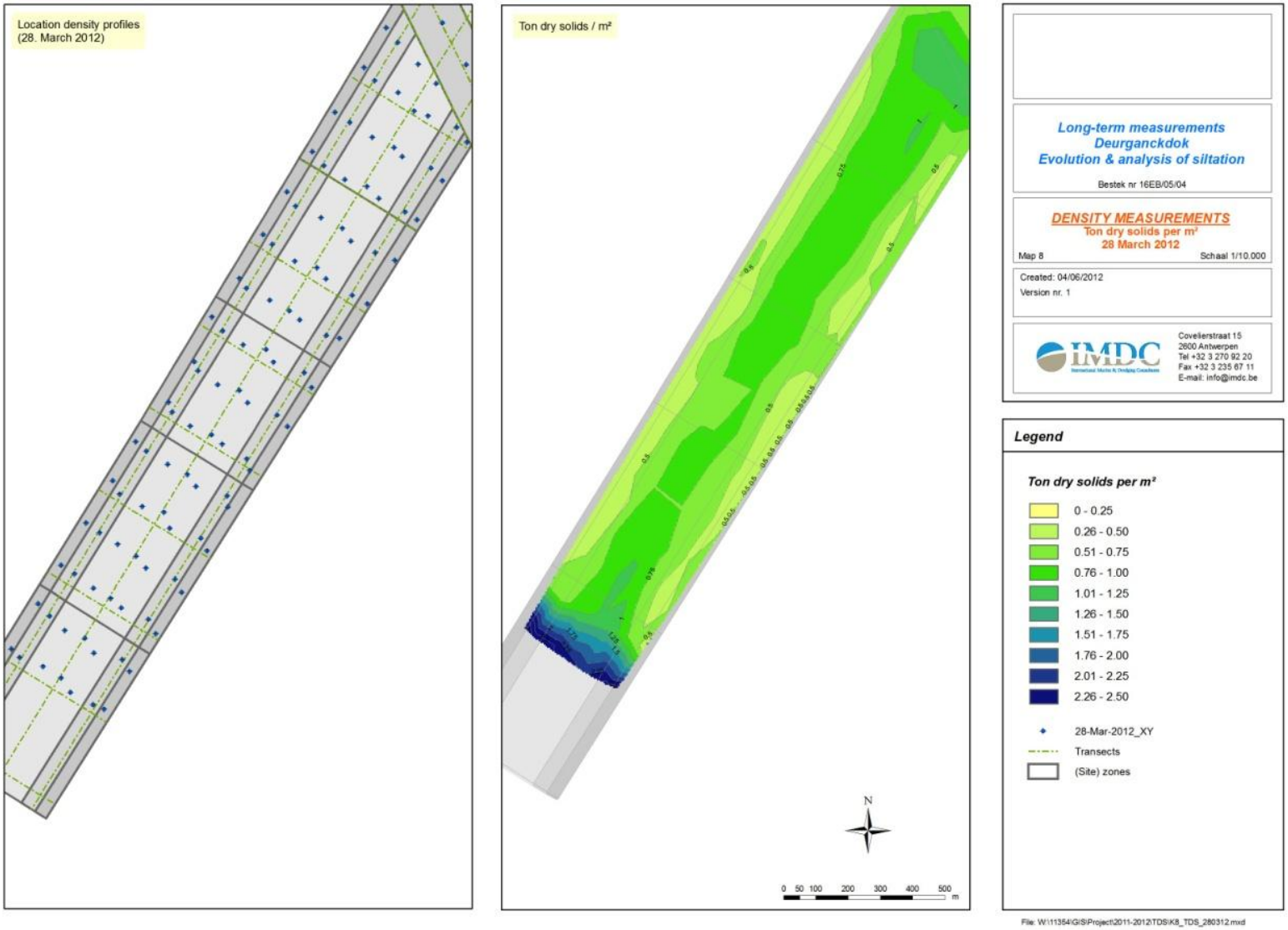

Location density profiles
(18. August 2011)
Ton dry solids / m²
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
18 August 2011
Map 3
Schaal 1/10.000
Created: 04/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
18-Aug-2011
Transects
(Site) zones


Location density profiles
(26. October 2011)
Ton dry solids / m²
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
26 October 2011
Map 4
Schaal 1/10.000
Created: 04/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
26-Oct-2011
Transects
(Site) zones
N
0 50 100 200 300 400 500 m

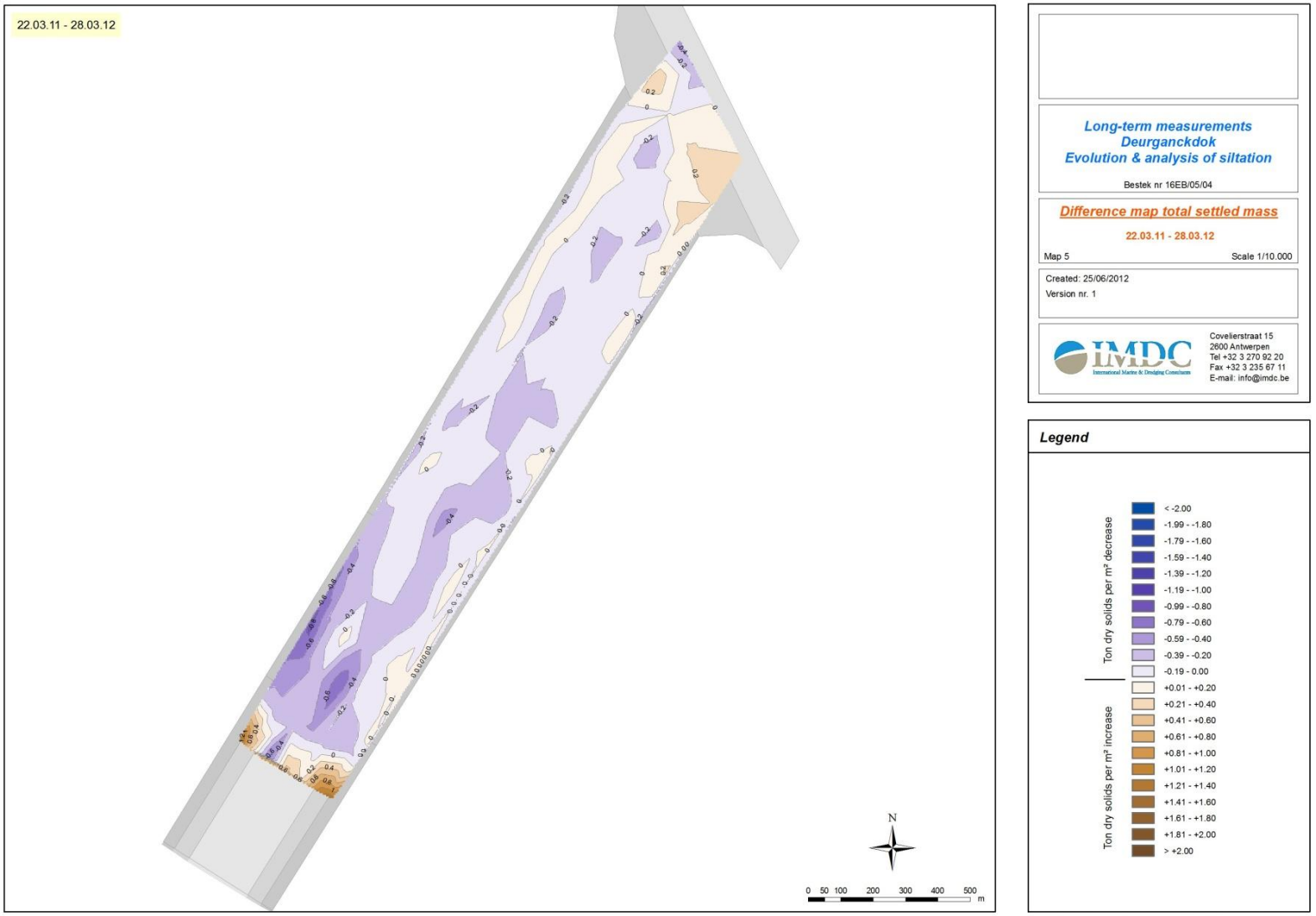

Location density profiles
(09. December 2011)
Ton dry solids / m²
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
09 December 2011
Map 5
Schaal 1/10.000
Created: 04/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
09-Dec-2011
Transects
(Site) zones

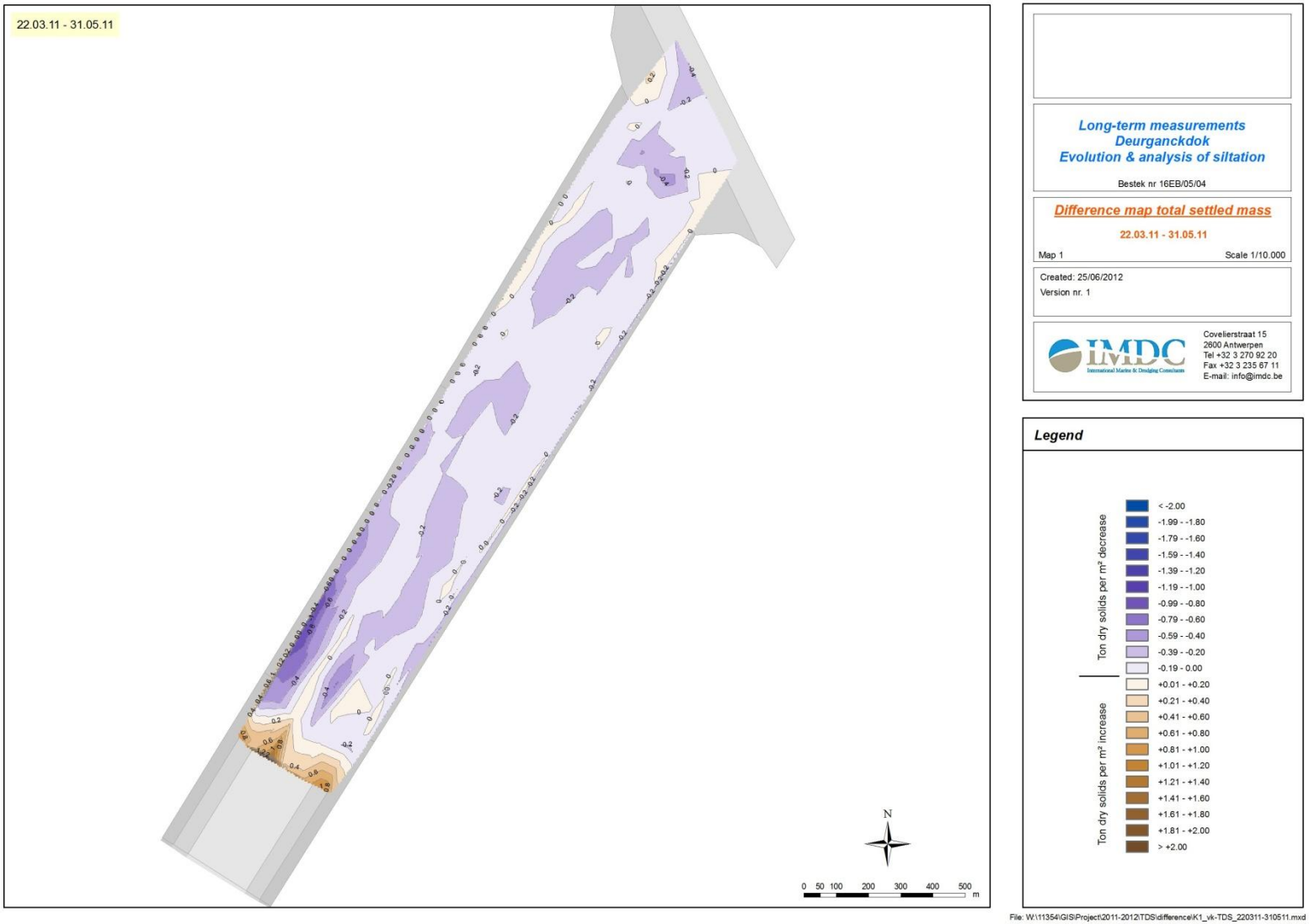

Location density profiles
(28. December 2011)
Ton dry solids / m²
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
28 December 2011
Map 6
Schaal 1/10.000
Created: 04/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
28-Dec-2011
Transects
(Site) zones

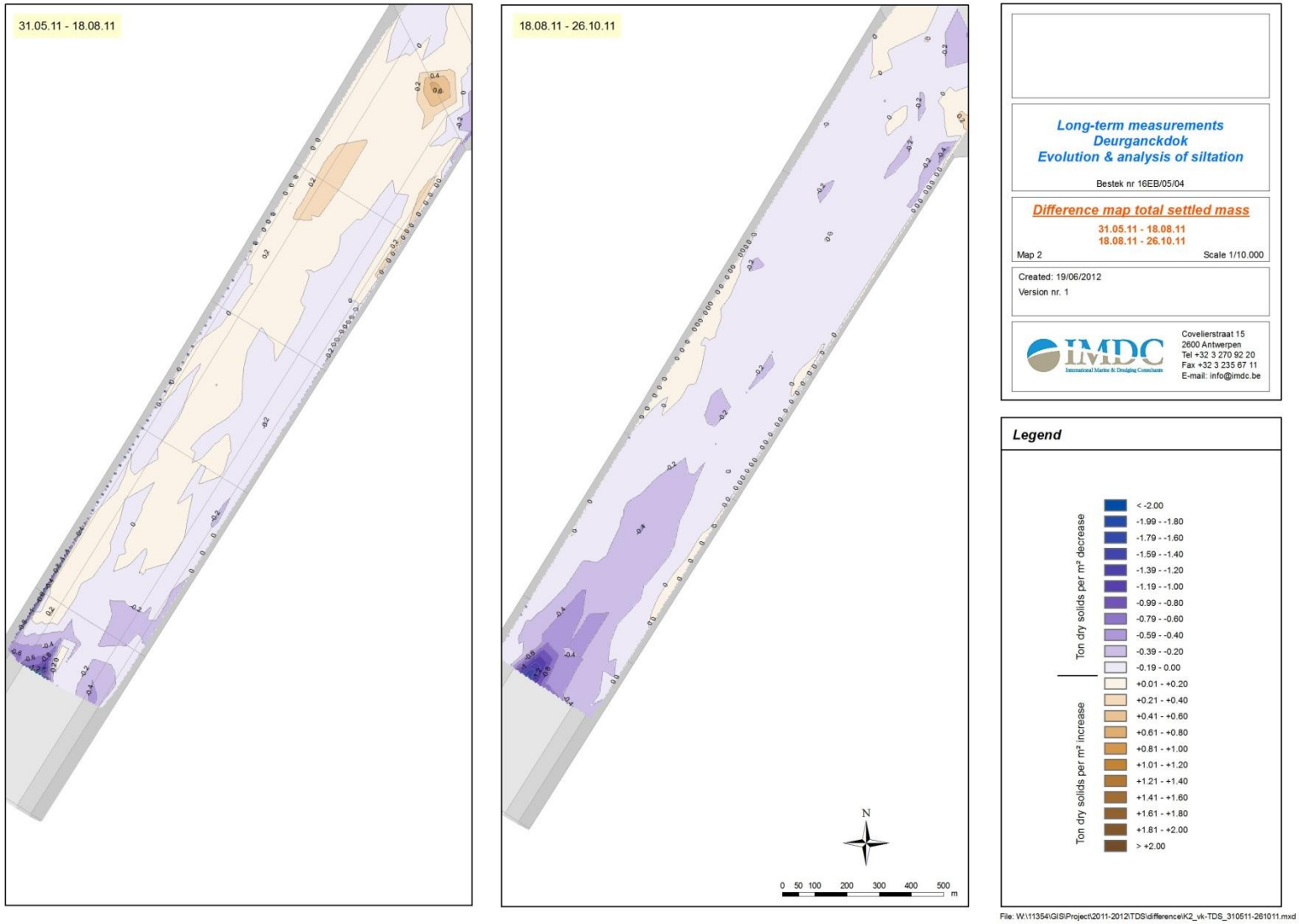

Location density profiles
(07. February 2012)
Ton dry solids / m²
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
07 February 2012
Map 7
Schaal 1/10.000
Created: 04/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
07-Feb-2012
Transects
(Site) zones

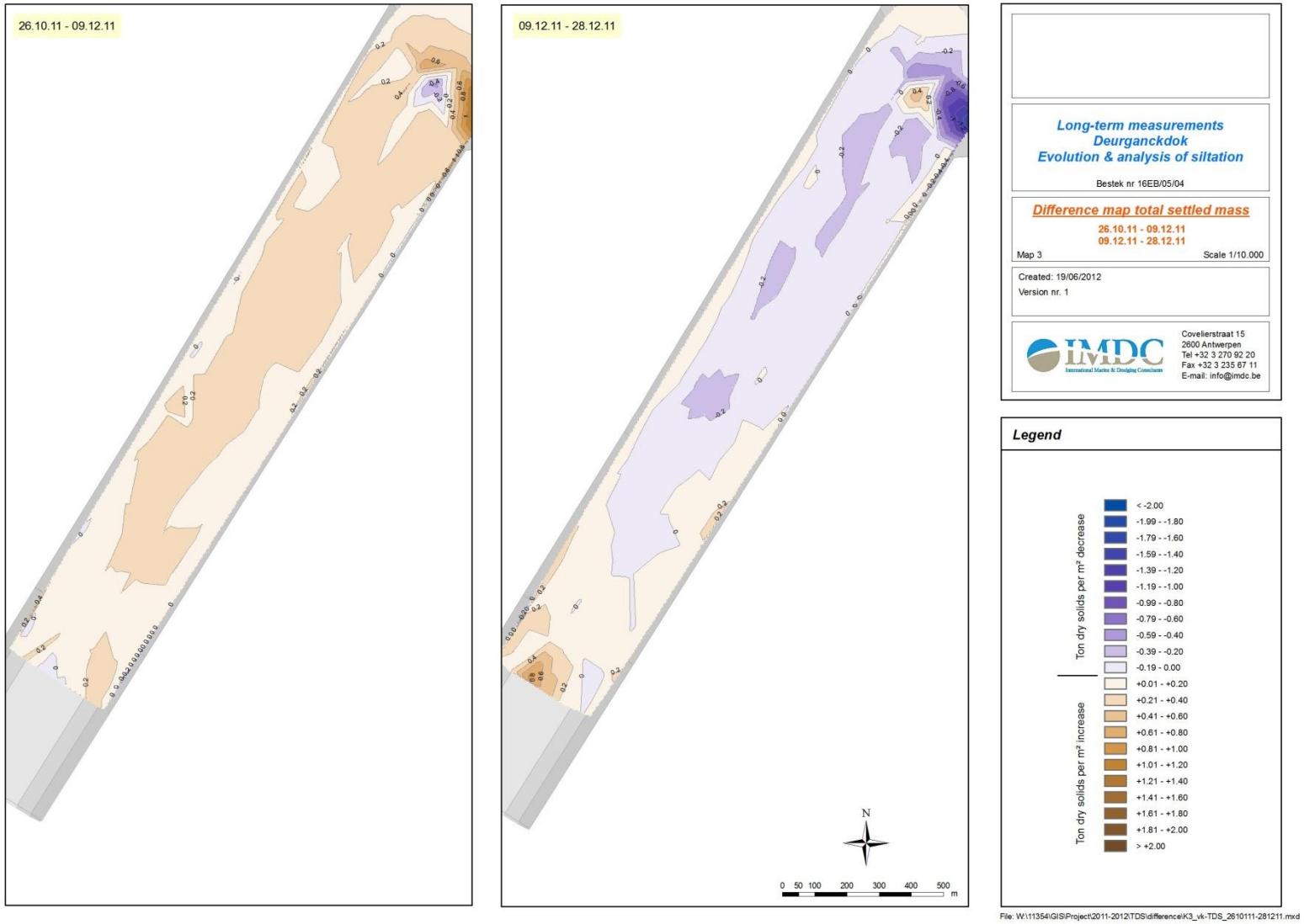

Location density profiles
(28. March 2012)
Ton dry solids / m²
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
DENSITY MEASUREMENTS
Ton dry solids per m²
28 March 2012
Map 8
Schaal 1/10.000
Created: 04/06/2012
Version nr. 1
IMDC
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m²
0 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
1.26 - 1.50
1.51 - 1.75
1.76 - 2.00
2.01 - 2.25
2.26 - 2.50
28-Mar-2012_XY
Transects
(Site) zones

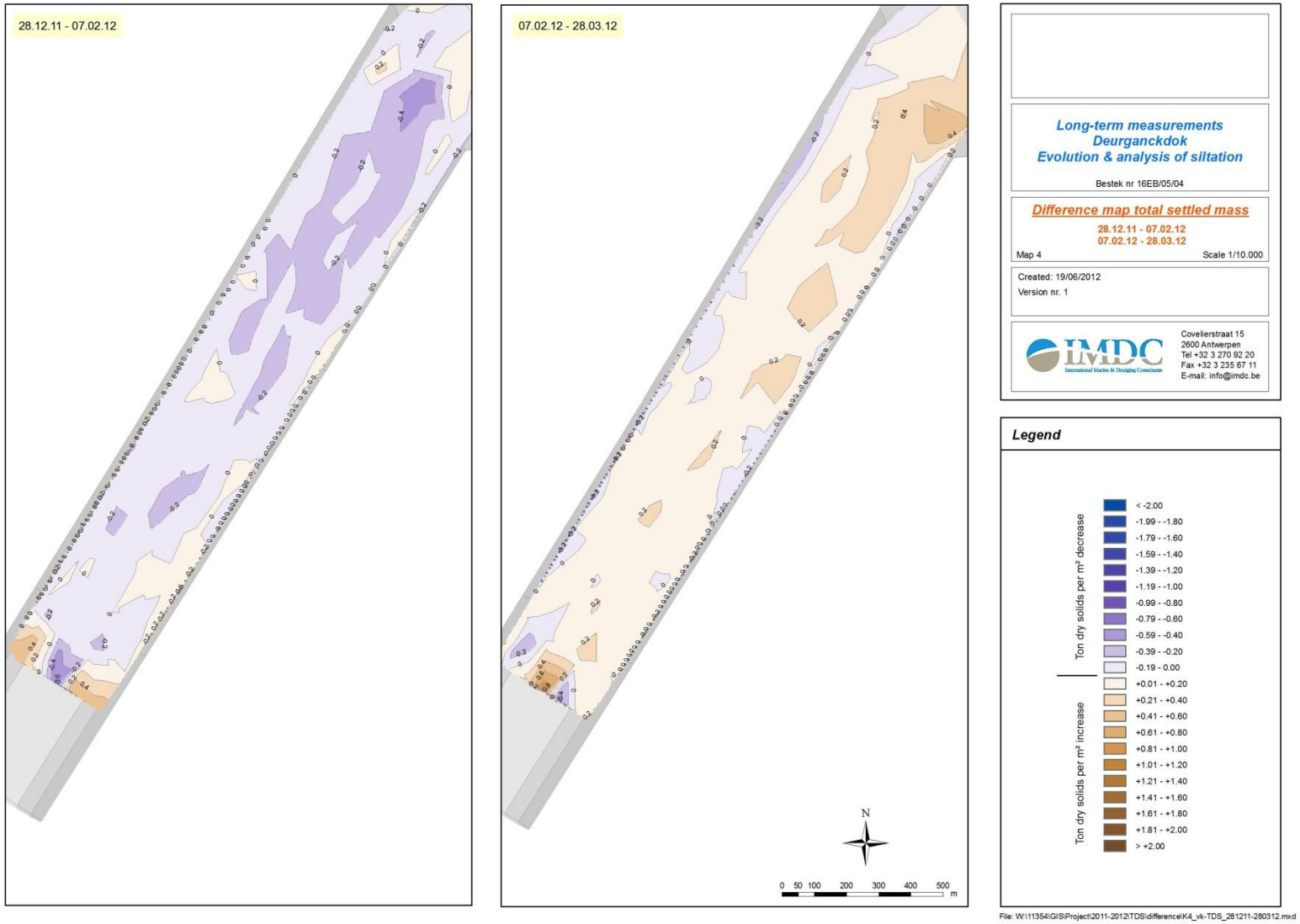
# G.2 DIFFERENCE MAPS


22.03.11 - 28.03.12
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Difference map total settled mass
22.03.11 - 28.03.12
Map 5
Scale 1/10.000
Created: 25/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m² decrease
Ton dry solids per m² increase
< -2.00
-1.99 - -1.80
-1.79 - -1.60
-1.59 - -1.40
-1.39 - -1.20
-1.19 - -1.00
-0.99 - -0.80
-0.79 - -0.60
-0.59 - -0.40
-0.39 - -0.20
-0.19 - 0.00
+0.01 - +0.20
+0.21 - +0.40
+0.41 - +0.60
+0.61 - +0.80
+0.81 - +1.00
+1.01 - +1.20
+1.21 - +1.40
+1.41 - +1.60
+1.61 - +1.80
+1.81 - +2.00
> +2.00
File: W:\11354\GIS\Project\2011-2012\TDS\difference\K5_vk-TDS_220311-280312.mxd


22.03.11 - 31.05.11
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Difference map total settled mass
22.03.11 - 31.05.11
Map 1
Scale 1/10.000
Created: 25/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m² decrease
Ton dry solids per m² increase
< -2.00
-1.99 - -1.80
-1.79 - -1.60
-1.59 - -1.40
-1.39 - -1.20
-1.19 - -1.00
-0.99 - -0.80
-0.79 - -0.60
-0.59 - -0.40
-0.39 - -0.20
-0.19 - 0.00
+0.01 - +0.20
+0.21 - +0.40
+0.41 - +0.60
+0.61 - +0.80
+0.81 - +1.00
+1.01 - +1.20
+1.21 - +1.40
+1.41 - +1.60
+1.61 - +1.80
+1.81 - +2.00
> +2.00
File: W:\11354\GIS\Project\2011-2012\TDS\difference\K1_vk-TDS_220311-310511.mxd


31.05.11 - 18.08.11
18.08.11 - 26.10.11
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Difference map total settled mass
31.05.11 - 18.08.11
18.08.11 - 26.10.11
Map 2
Scale 1/10.000
Created: 19/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m² decrease
Ton dry solids per m² increase
< -2.00
-1.99 - -1.80
-1.79 - -1.60
-1.59 - -1.40
-1.39 - -1.20
-1.19 - -1.00
-0.99 - -0.80
-0.79 - -0.60
-0.59 - -0.40
-0.39 - -0.20
-0.19 - 0.00
+0.01 - +0.20
+0.21 - +0.40
+0.41 - +0.60
+0.61 - +0.80
+0.81 - +1.00
+1.01 - +1.20
+1.21 - +1.40
+1.41 - +1.60
+1.61 - +1.80
+1.81 - +2.00
> +2.00
File: W:\11354\GIS\Project\2011-2012\TDS\difference\K2_vk-TDS_310511-261011.mxd


26.10.11 - 09.12.11
09.12.11 - 28.12.11
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Difference map total settled mass
26.10.11 - 09.12.11
09.12.11 - 28.12.11
Map 3
Scale 1/10.000
Created: 19/06/2012
Version nr. 1
IMDC
International Marine & Dredging Consultants
Coveliersstraat 15
2600 Antwerpen
Tel +32 3 270 92 20
Fax +32 3 235 67 11
E-mail: info@imdc.be
Legend
Ton dry solids per m² decrease
Ton dry solids per m² increase
< -2.00
-1.99 - -1.80
-1.79 - -1.60
-1.59 - -1.40
-1.39 - -1.20
-1.19 - -1.00
-0.99 - -0.80
-0.79 - -0.60
-0.59 - -0.40
-0.39 - -0.20
-0.19 - 0.00
+0.01 - +0.20
+0.21 - +0.40
+0.41 - +0.60
+0.61 - +0.80
+0.81 - +1.00
+1.01 - +1.20
+1.21 - +1.40
+1.41 - +1.60
+1.61 - +1.80
+1.81 - +2.00
> +2.00
File: W:\11354\GIS\Project\2011-2012\TDS\difference\K3_vk-TDS_2610111-281211.mxd


28.12.11 - 07.02.12
07.02.12 - 28.03.12
N
0 50 100 200 300 400 500 m
Long-term measurements
Deurganckdok
Evolution & analysis of siltation
Bestek nr 16EB/05/04
Difference map total settled mass
28.12.11 - 07.02.12
07.02.12 - 28.03.12
Map 4
Scale 1/10.000
Created: 19/06/2012
Version nr. 1
IMDC
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-1.59 - -1.40
-1.39 - -1.20
-1.19 - -1.00
-0.99 - -0.80
-0.79 - -0.60
-0.59 - -0.40
-0.39 - -0.20
-0.19 - 0.00
+0.01 - +0.20
+0.21 - +0.40
+0.41 - +0.60
+0.61 - +0.80
+0.81 - +1.00
+1.01 - +1.20
+1.21 - +1.40
+1.41 - +1.60
+1.61 - +1.80
+1.81 - +2.00
> +2.00
File: W:\11354\GIS\Project\2011-2012\TDS\difference\K4_vk-TDS_281211-280312.mxd

# Annex H AVERAGE MASS GROWTH AND GROWTH RATE

# H.1 TABULAR RESULTS

*Table 7-3: **Measured dry sediment mass above design level [TDS/m²]** per zone based on density profiles of the considered measurement day. For period April 1st 2011 to March 28th 2012.*

| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|
| 1 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | 0.57 | 0.53 | 0.51 | 0.93 | 0.62 | 0.57 | 0.75 |
| 3a | 0.88 | 1.00 | 0.89 | 1.12 | 0.98 | 0.72 | 0.94 |
| 3b | 0.80 | 0.83 | 0.73 | 0.98 | 0.83 | 0.62 | 0.79 |
| 3c | 0.74 | 0.76 | 0.63 | 0.87 | 0.75 | 0.61 | 0.73 |
| 3d | 0.84 | 0.83 | 0.56 | 0.76 | 0.77 | 0.67 | 0.77 |
| 3e | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Na | 0.51 | 0.59 | 0.54 | 0.75 | 0.68 | 0.60 | 0.61 |
| 4Nb | 0.43 | 0.50 | 0.43 | 0.64 | 0.57 | 0.45 | 0.50 |
| 4Nc | 0.41 | 0.41 | 0.42 | 0.57 | 0.53 | 0.46 | 0.46 |
| 4Nd | 0.37 | 0.41 | 0.31 | 0.43 | 0.48 | 0.39 | 0.46 |
| 4Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Za | 0.58 | 0.62 | 0.48 | 0.73 | 0.62 | 0.52 | 0.71 |
| 4Zb | 0.51 | 0.47 | 0.38 | 0.57 | 0.48 | 0.35 | 0.51 |
| 4Zc | 0.50 | 0.41 | 0.35 | 0.47 | 0.47 | 0.41 | 0.50 |
| 4Zd | 0.46 | 0.32 | 0.22 | 0.37 | 0.44 | 0.45 | 0.50 |
| 4Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Na | NaN | NaN | 0.48 | 0.67 | NaN | NaN | NaN |
| 5Nb | NaN | NaN | 0.43 | 0.58 | NaN | NaN | NaN |
| 5Nc | NaN | NaN | 0.35 | 0.50 | 0.59 | NaN | NaN |
| 5Nd | NaN | NaN | 0.29 | NaN | NaN | NaN | NaN |
| 5Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Za | 0.50 | 0.50 | 0.39 | 0.61 | 0.65 | 0.60 | 0.56 |
| 5Zb | 0.42 | 0.41 | 0.37 | 0.45 | 0.48 | 0.50 | 0.52 |
| 5Zc | 0.42 | 0.34 | 0.30 | 0.38 | 0.49 | 0.53 | 0.48 |
| 5Zd | 0.35 | 0.27 | 0.25 | 0.33 | 0.46 | 0.54 | 0.51 |
| 5Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Ztot | 0.57 | 0.50 | 0.38 | 0.57 | 0.55 | 0.50 | 0.62 |
| 4Ntot | 0.50 | 0.53 | 0.46 | 0.63 | 0.63 | 0.56 | 0.58 |
| 5Ztot | 0.44 | NaN | 0.34 | 0.44 | 0.52 | 0.57 | 0.54 |
| 5Ntot | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **Trench area mean** | **0.82** | **0.85** | **0.69** | **0.92** | **0.83** | **0.66** | **0.80** |

*Table 7-4: **Measured dry sediment mass above design level [TDS]** per zone based on density profiles of the considered measurement day. For period April 1st 2011 to March 28th 2012.*

| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|
| 1 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | 70,271 | 65,504 | 63,247 | 115,409 | 77,289 | 71,289 | 92,914 |
| 3a | 86,500 | 98,585 | 88,039 | 111,013 | 96,550 | 70,691 | 92,926 |
| 3b | 87,479 | 91,457 | 80,297 | 108,034 | 91,573 | 68,146 | 86,366 |
| 3c | 73,591 | 75,702 | 61,857 | 86,512 | 74,278 | 60,728 | 72,603 |
| 3d | 109,646 | 107,850 | 72,650 | 99,372 | 100,611 | 87,848 | 100,386 |
| 3e | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Na | 18,447 | 21,286 | 19,464 | 27,412 | 24,675 | 21,885 | 21,997 |
| 4Nb | 13,402 | 15,620 | 13,531 | 19,909 | 17,621 | 14,136 | 15,475 |
| 4Nc | 10,404 | 10,530 | 10,908 | 14,574 | 13,661 | 11,784 | 11,877 |
| 4Nd | 12,081 | 13,419 | 10,071 | 13,995 | 15,597 | 12,823 | 15,017 |
| 4Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Za | 14,020 | 15,083 | 11,497 | 17,703 | 15,090 | 12,474 | 17,213 |
| 4Zb | 15,869 | 14,506 | 11,763 | 17,890 | 14,868 | 10,760 | 15,768 |
| 4Zc | 12,898 | 10,574 | 8,939 | 12,261 | 12,178 | 10,513 | 12,814 |
| 4Zd | 14,733 | 10,404 | 7,179 | 11,930 | 14,225 | 14,379 | 15,995 |
| 4Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Na | NaN | NaN | 11,090 | 15,285 | NaN | NaN | NaN |
| 5Nb | NaN | NaN | 8,537 | 11,645 | NaN | NaN | NaN |
| 5Nc | NaN | NaN | 6,268 | 9,111 | 10,732 | NaN | NaN |
| 5Nd | NaN | NaN | 6,924 | NaN | NaN | NaN | NaN |
| 5Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Za | 6,468 | 6,488 | 5,134 | 8,002 | 8,463 | 7,795 | 7,298 |
| 5Zb | 8,398 | 8,130 | 7,475 | 8,986 | 9,602 | 9,984 | 10,306 |
| 5Zc | 7,643 | 6,149 | 5,474 | 6,763 | 8,746 | 9,461 | 8,692 |
| 5Zd | 8,483 | 6,387 | 5,957 | 7,878 | 11,086 | 12,972 | 12,248 |
| 5Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Ztot | 85,670 | 74,901 | 57,412 | 85,091 | 81,956 | 74,917 | 91,960 |
| 4Ntot | 84,708 | 89,966 | 77,726 | 106,260 | 105,548 | 95,001 | 97,730 |
| 5Ztot | 43,053 | NaN | 33,708 | 43,539 | 51,777 | 56,789 | 53,643 |
| 5Ntot | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **Trench area** | **357,216** | **373,593** | **302,843** | **404,931** | **363,013** | **287,414** | **352,281** |

*Table 7-5: **Cumulative dredged mass in covered area [TDS]** per zone based on measurements during the maintenance dredging (BIS). Cumulative values given on each density measurement day. For period April 1st 2011 to March 28th 2012.*

| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|
| 1 | 17,048 | 59,468 | 74,926 | 74,926 | 94,305 | 104,570 | 104,570 |
| 2 | 30,439 | 95,105 | 129,107 | 129,107 | 152,980 | 168,974 | 168,974 |
| 3a | 97,607 | 129,023 | 195,370 | 195,646 | 257,957 | 361,356 | 361,356 |
| 3b | 113,801 | 153,236 | 212,286 | 212,786 | 247,693 | 286,854 | 286,854 |
| 3c | 104,102 | 143,130 | 198,696 | 199,395 | 227,634 | 261,332 | 261,332 |
| 3d | 134,572 | 183,125 | 298,276 | 298,276 | 333,074 | 385,818 | 385,818 |
| 3e | 28,796 | 40,338 | 93,323 | 93,323 | 94,780 | 99,196 | 99,196 |
| 4Na | 9,942 | 15,246 | 25,770 | 25,770 | 32,516 | 43,175 | 43,175 |
| 4Nb | 12,279 | 13,680 | 21,974 | 21,974 | 26,025 | 30,475 | 30,475 |
| 4Nc | 10,013 | 11,591 | 20,290 | 20,290 | 24,155 | 30,788 | 30,788 |
| 4Nd | 18,285 | 20,535 | 32,181 | 32,181 | 39,045 | 45,002 | 45,002 |
| 4Ne | 3,067 | 3,525 | 8,603 | 8,603 | 8,641 | 8,728 | 8,728 |
| 4Za | 14,475 | 22,622 | 31,841 | 31,841 | 41,545 | 58,574 | 58,574 |
| 4Zb | 18,320 | 19,920 | 28,531 | 28,531 | 38,964 | 42,950 | 42,950 |
| 4Zc | 11,281 | 11,665 | 16,533 | 16,533 | 23,232 | 26,299 | 26,299 |
| 4Zd | 12,140 | 12,913 | 20,223 | 20,223 | 25,881 | 28,074 | 28,074 |
| 4Ze | 1,176 | 1,176 | 4,015 | 4,015 | 4,015 | 4,086 | 4,086 |
| 5Na | 0 | 337 | 337 | 337 | 337 | 369 | 369 |
| 5Nb | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5Nc | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5Nd | 102 | 102 | 102 | 102 | 102 | 102 | 102 |
| 5Ne | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5Za | 0 | 572 | 572 | 572 | 572 | 572 | 572 |
| 5Zb | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5Zc | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5Zd | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5Ze | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4Ztot | 60,243 | 71,659 | 105,827 | 105,827 | 139,339 | 166,228 | 166,228 |
| 4Ntot | 53,613 | 64,614 | 108,855 | 108,855 | 130,419 | 158,237 | 158,237 |
| 5Ztot | 0 | 572 | 572 | 572 | 572 | 572 | 572 |
| 5Ntot | 74 | 402 | 402 | 402 | 402 | 402 | 402 |
| **Total** | **637,444** | **937,310** | **1,412,956** | **1,414,432** | **1,673,452** | **1,987,293** | **1,987,293** |

*Table 7-6: **Total cumulative sediment mass [TDS/m²],** which includes both the measured dry sediment mass above design level and the dredged sediment mass. Cumulative values given on each density measurement day. For period April 1st 2011 to March 28th 2012.*

| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|
| 1 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | 0.81 | 1.29 | 1.55 | 1.97 | 1.85 | 1.93 | 2.11 |
| 3a | 1.87 | 2.31 | 2.87 | 3.11 | 3.59 | 4.38 | 4.60 |
| 3b | 1.83 | 2.23 | 2.66 | 2.92 | 3.09 | 3.23 | 3.40 |
| 3c | 1.79 | 2.21 | 2.63 | 2.89 | 3.05 | 3.25 | 3.37 |
| 3d | 1.87 | 2.23 | 2.84 | 3.05 | 3.32 | 3.63 | 3.72 |
| 3e | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Na | 0.78 | 1.01 | 1.24 | 1.46 | 1.57 | 1.79 | 1.79 |
| 4Nb | 0.82 | 0.94 | 1.14 | 1.35 | 1.40 | 1.43 | 1.48 |
| 4Nc | 0.79 | 0.86 | 1.21 | 1.36 | 1.47 | 1.66 | 1.66 |
| 4Nd | 0.93 | 1.04 | 1.29 | 1.41 | 1.67 | 1.77 | 1.83 |
| 4Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Za | 1.18 | 1.56 | 1.79 | 2.05 | 2.34 | 2.94 | 3.13 |
| 4Zb | 1.10 | 1.10 | 1.29 | 1.49 | 1.72 | 1.72 | 1.88 |
| 4Zc | 0.93 | 0.86 | 0.98 | 1.11 | 1.37 | 1.42 | 1.51 |
| 4Zd | 0.83 | 0.72 | 0.85 | 1.00 | 1.24 | 1.32 | 1.37 |
| 4Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Na | NaN | NaN | 0.50 | 0.68 | NaN | NaN | NaN |
| 5Nb | NaN | NaN | 0.43 | 0.58 | NaN | NaN | NaN |
| 5Nc | NaN | NaN | 0.35 | 0.50 | 0.59 | NaN | NaN |
| 5Nd | NaN | NaN | 0.30 | NaN | NaN | NaN | NaN |
| 5Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Za | 0.50 | 0.54 | 0.44 | 0.66 | 0.69 | 0.64 | 0.60 |
| 5Zb | 0.42 | 0.41 | 0.37 | 0.45 | 0.48 | 0.50 | 0.52 |
| 5Zc | 0.42 | 0.34 | 0.30 | 0.38 | 0.49 | 0.53 | 0.48 |
| 5Zd | 0.35 | 0.27 | 0.25 | 0.33 | 0.46 | 0.54 | 0.51 |
| 5Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Ztot | 0.98 | 0.98 | 1.09 | 1.28 | 1.48 | 1.61 | 1.73 |
| 4Ntot | 0.82 | 0.92 | 1.11 | 1.28 | 1.40 | 1.50 | 1.52 |
| 5Ztot | 0.44 | NaN | 0.35 | 0.45 | 0.53 | 0.58 | 0.55 |
| 5Ntot | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **Trench area mean** | **1.84** | **2.24** | **2.76** | **2.99** | **3.26** | **3.61** | **3.76** |

*Table 7-7: **Total cumulative sediment mass [TDS],** which includes both the measured dry sediment mass above design level and the dredged sediment mass. Cumulative values given on each density measurement day. For period April 1st 2011 to March 28th 2012.*

| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|
| 1 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | 100,710 | 160,609 | 192,353 | 244,516 | 230,269 | 240,262 | 261,888 |
| 3a | 184,106 | 227,608 | 283,496 | 306,741 | 354,623 | 432,211 | 454,454 |
| 3b | 201,279 | 244,693 | 292,583 | 320,820 | 339,266 | 355,000 | 373,220 |
| 3c | 177,694 | 218,832 | 260,553 | 285,907 | 301,912 | 322,060 | 333,934 |
| 3d | 244,218 | 290,974 | 370,926 | 397,648 | 433,685 | 473,666 | 486,204 |
| 3e | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Na | 28,389 | 36,532 | 45,234 | 53,182 | 57,191 | 65,061 | 65,172 |
| 4Nb | 25,681 | 29,300 | 35,506 | 41,883 | 43,646 | 44,611 | 45,950 |
| 4Nc | 20,417 | 22,121 | 31,197 | 34,864 | 37,816 | 42,573 | 42,665 |
| 4Nd | 30,366 | 33,954 | 42,253 | 46,177 | 54,642 | 57,825 | 60,019 |
| 4Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Za | 28,494 | 37,705 | 43,338 | 49,545 | 56,634 | 71,048 | 75,787 |
| 4Zb | 34,189 | 34,427 | 40,294 | 46,421 | 53,832 | 53,710 | 58,719 |
| 4Zc | 24,179 | 22,239 | 25,472 | 28,794 | 35,410 | 36,812 | 39,112 |
| 4Zd | 26,873 | 23,317 | 27,402 | 32,153 | 40,106 | 42,453 | 44,069 |
| 4Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Na | NaN | NaN | 11,427 | 15,622 | NaN | NaN | NaN |
| 5Nb | NaN | NaN | 8,537 | 11,645 | NaN | NaN | NaN |
| 5Nc | NaN | NaN | 6,268 | 9,111 | 10,732 | NaN | NaN |
| 5Nd | NaN | NaN | 7,026 | NaN | NaN | NaN | NaN |
| 5Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Za | 6,468 | 7,061 | 5,706 | 8,575 | 9,035 | 8,367 | 7,871 |
| 5Zb | 8,398 | 8,130 | 7,475 | 8,986 | 9,602 | 9,984 | 10,306 |
| 5Zc | 7,643 | 6,149 | 5,474 | 6,763 | 8,746 | 9,461 | 8,692 |
| 5Zd | 8,483 | 6,387 | 5,957 | 7,878 | 11,086 | 12,972 | 12,248 |
| 5Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Ztot | 145,913 | 146,559 | 163,240 | 190,918 | 221,295 | 241,145 | 258,188 |
| 4Ntot | 138,321 | 154,580 | 186,581 | 215,115 | 235,966 | 253,238 | 255,967 |
| 5Ztot | 43,053 | NaN | 34,281 | 44,111 | 52,349 | 57,362 | 54,215 |
| 5Ntot | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **Trench area** | **807,298** | **982,107** | **1,207,415** | **1,310,961** | **1,429,307** | **1,582,719** | **1,647,582** |

*Table 7-8: **Growth rate [kg/m²/day]**. For period March 22nd 2011 to March 28th 2012.*

| | **22/Mar** | **31/May** | **18/Aug** | **26/Oct** | **9/Dec** | **28/Dec** | **7/Feb** |
|---|---|---|---|---|---|---|---|
| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
| 1 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | 2.29 | 6.10 | 3.70 | 9.54 | -6.03 | 1.96 | 3.48 |
| 3a | 11.44 | 5.58 | 8.21 | 5.35 | 25.53 | 19.17 | 4.51 |
| 3b | 12.49 | 5.00 | 6.32 | 5.84 | 8.84 | 3.49 | 3.32 |
| 3c | 12.52 | 5.26 | 6.11 | 5.82 | 8.51 | 4.96 | 2.40 |
| 3d | 12.18 | 4.53 | 8.88 | 4.65 | 14.53 | 7.47 | 1.92 |
| 3e | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Na | 3.03 | 2.84 | 3.47 | 4.97 | 5.81 | 5.28 | 0.06 |
| 4Nb | 4.22 | 1.47 | 2.89 | 4.65 | 2.98 | 0.76 | 0.86 |
| 4Nc | 2.91 | 0.84 | 5.12 | 3.24 | 6.05 | 4.51 | 0.07 |
| 4Nd | 0.78 | 1.39 | 3.67 | 2.72 | 13.61 | 2.37 | 1.34 |
| 4Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Za | 7.49 | 4.82 | 3.37 | 5.83 | 15.42 | 14.53 | 3.92 |
| 4Zb | 7.18 | 0.10 | 2.72 | 4.46 | 12.49 | -0.10 | 3.21 |
| 4Zc | 4.77 | -0.95 | 1.81 | 2.92 | 13.46 | 1.32 | 1.78 |
| 4Zd | 4.33 | -1.40 | 1.83 | 3.35 | 12.97 | 1.77 | 1.00 |
| 4Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Na | NaN | NaN | NaN | 4.15 | NaN | NaN | NaN |
| 5Nb | NaN | NaN | NaN | 3.55 | NaN | NaN | NaN |
| 5Nc | NaN | NaN | NaN | 3.57 | 4.72 | NaN | NaN |
| 5Nd | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Za | -0.51 | 0.58 | -1.50 | 5.00 | 1.86 | -1.25 | -0.76 |
| 5Zb | -1.86 | -0.17 | -0.48 | 1.72 | 1.62 | 0.47 | 0.32 |
| 5Zc | -1.31 | -1.05 | -0.54 | 1.63 | 5.79 | 0.97 | -0.85 |
| 5Zd | -2.17 | -1.11 | -0.26 | 1.82 | 7.05 | 1.92 | -0.61 |
| 5Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Ztot | 4.94 | 0.06 | 1.62 | 4.21 | 10.69 | 3.24 | 2.28 |
| 4Ntot | 1.65 | 1.22 | 2.75 | 3.85 | 6.52 | 2.50 | 0.32 |
| 5Ztot | -1.48 | NaN | NaN | 2.26 | 4.38 | 1.23 | -0.64 |
| 5Ntot | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **Trench area mean** | **12.17** | **5.05** | **7.46** | **5.37** | **14.22** | **8.54** | **2.96** |

*Table 7-9: **Growth rate [TDS/day]**. For period March 22nd 2011 to March 28th 2012.*

| | **22/Mar** | **31/May** | **18/Aug** | **26/Oct** | **9/Dec** | **28/Dec** | **7/Feb** |
|---|---|---|---|---|---|---|---|
| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
| 1 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | 285 | 758 | 460 | 1,186 | -750 | 244 | 433 |
| 3a | 1,130 | 551 | 810 | 528 | 2,520 | 1,892 | 445 |
| 3b | 1,372 | 550 | 694 | 642 | 971 | 384 | 364 |
| 3c | 1,240 | 521 | 605 | 576 | 842 | 491 | 237 |
| 3d | 1,589 | 592 | 1,159 | 607 | 1,897 | 975 | 251 |
| 3e | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Na | 110 | 103 | 126 | 181 | 211 | 192 | 2 |
| 4Nb | 131 | 46 | 90 | 145 | 93 | 24 | 27 |
| 4Nc | 75 | 22 | 132 | 83 | 155 | 116 | 2 |
| 4Nd | 26 | 45 | 120 | 89 | 446 | 78 | 44 |
| 4Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Za | 181 | 117 | 82 | 141 | 373 | 352 | 95 |
| 4Zb | 224 | 3 | 85 | 139 | 390 | -3 | 100 |
| 4Zc | 123 | -25 | 47 | 76 | 348 | 34 | 46 |
| 4Zd | 140 | -45 | 59 | 108 | 419 | 57 | 32 |
| 4Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Na | NaN | NaN | NaN | 95 | NaN | NaN | NaN |
| 5Nb | NaN | NaN | NaN | 71 | NaN | NaN | NaN |
| 5Nc | NaN | NaN | NaN | 65 | 85 | NaN | NaN |
| 5Nd | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Ne | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 5Za | -7 | 8 | -20 | 65 | 24 | -16 | -10 |
| 5Zb | -37 | -3 | -9 | 34 | 32 | 9 | 6 |
| 5Zc | -24 | -19 | -10 | 29 | 104 | 17 | -15 |
| 5Zd | -52 | -27 | -6 | 44 | 169 | 46 | -14 |
| 5Ze | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4Ztot | 738 | 8 | 242 | 629 | 1,599 | 484 | 341 |
| 4Ntot | 278 | 206 | 464 | 649 | 1,097 | 421 | 55 |
| 5Ztot | -146 | NaN | NaN | 223 | 434 | 122 | -63 |
| 5Ntot | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| **Trench area** | **5,331** | **2,213** | **3,264** | **2,353** | **6,229** | **3,742** | **1,297** |

*Table 7-10: **Covered area of each zone [ha]** by density measurements. For period April 1st 2011 to March 28th 2012.*

| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|
| 1 | 2.54 | 2.20 | 2.57 | 3.39 | 1.89 | 1.55 | 3.10 |
| 2 | 7.32 | 7.45 | 7.53 | 7.98 | 7.25 | 6.83 | 7.68 |
| 3a | 9.87 | 9.87 | 9.87 | 9.87 | 9.87 | 9.87 | 9.87 |
| 3b | 10.99 | 10.99 | 10.99 | 10.99 | 10.99 | 10.99 | 10.99 |
| 3c | 9.91 | 9.91 | 9.91 | 9.91 | 9.91 | 9.91 | 9.91 |
| 3d | 13.06 | 13.06 | 13.06 | 13.06 | 13.06 | 13.06 | 13.06 |
| 3e | 4.89 | 4.89 | 4.60 | 4.91 | 4.87 | 4.94 | 4.95 |
| 4Na | 3.64 | 3.64 | 3.64 | 3.64 | 3.64 | 3.63 | 3.64 |
| 4Nb | 3.12 | 3.12 | 3.12 | 3.12 | 3.12 | 3.12 | 3.12 |
| 4Nc | 2.57 | 2.57 | 2.57 | 2.57 | 2.57 | 2.57 | 2.57 |
| 4Nd | 3.28 | 3.28 | 3.28 | 3.28 | 3.28 | 3.28 | 3.28 |
| 4Ne | 1.22 | 1.23 | 1.15 | 1.22 | 1.23 | 1.23 | 1.21 |
| 4Za | 2.42 | 2.42 | 2.42 | 2.42 | 2.42 | 2.42 | 2.42 |
| 4Zb | 3.12 | 3.12 | 3.12 | 3.12 | 3.12 | 3.12 | 3.12 |
| 4Zc | 2.59 | 2.59 | 2.59 | 2.59 | 2.59 | 2.59 | 2.59 |
| 4Zd | 3.23 | 3.23 | 3.23 | 3.23 | 3.23 | 3.23 | 3.23 |
| 4Ze | 1.12 | 1.17 | 1.11 | 1.13 | 1.16 | 1.19 | 1.18 |
| 5Na | 0.61 | 0.74 | 1.24 | 1.31 | 1.02 | 0.74 | 0.97 |
| 5Nb | 0.73 | 0.79 | 1.29 | 1.11 | 0.99 | 0.86 | 0.95 |
| 5Nc | 0.75 | 0.81 | 1.31 | 0.94 | 0.95 | 0.85 | 0.90 |
| 5Nd | 0.93 | 1.02 | 1.56 | 0.93 | 1.14 | 1.03 | 1.04 |
| 5Ne | 0.28 | 0.31 | 0.41 | 0.22 | 0.29 | 0.30 | 0.24 |
| 5Za | 1.03 | 0.90 | 1.01 | 1.31 | 0.97 | 0.98 | 1.29 |
| 5Zb | 1.50 | 1.29 | 1.43 | 2.00 | 1.37 | 1.38 | 1.79 |
| 5Zc | 1.29 | 1.09 | 1.20 | 1.73 | 1.13 | 1.14 | 1.39 |
| 5Zd | 1.59 | 1.30 | 1.41 | 1.82 | 1.31 | 1.34 | 1.51 |
| 5Ze | 0.43 | 0.42 | 0.45 | 0.51 | 0.38 | 0.45 | 0.37 |
| 4Ztot | 12.96 | 13.02 | 12.96 | 12.98 | 13.00 | 13.03 | 13.02 |
| 4Ntot | 14.72 | 14.73 | 14.64 | 14.71 | 14.73 | 14.72 | 14.71 |
| 5Ztot | 5.76 | 4.91 | 5.41 | 7.31 | 5.07 | 5.19 | 6.25 |
| 5Ntot | 2.40 | 2.76 | 4.91 | 3.60 | 3.49 | 2.87 | 3.18 |
| **Total** | **94.02** | **93.37** | **96.05** | **98.27** | **93.71** | **92.55** | **96.31** |

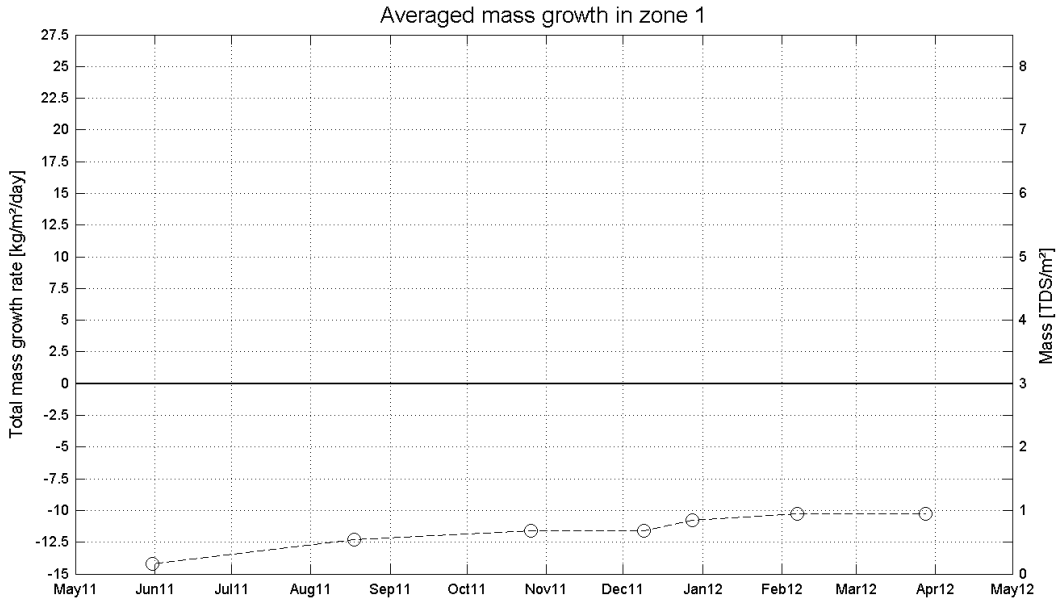
*Table 7-11: **Percent of zone covered [%]** by density measurements. For period April 1st 2011 to March 28th 2012.*

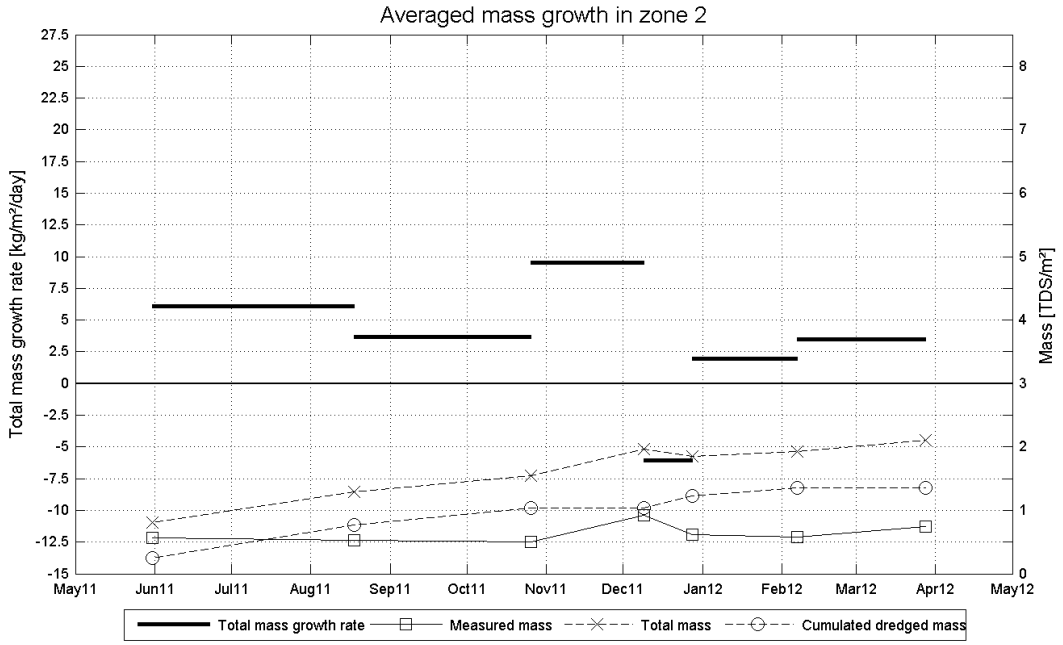
| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar |
|---|---|---|---|---|---|---|---|
| 1 | 23 | 20 | 23 | 31 | 17 | 14 | 28 |
| 2 | 59 | 60 | 61 | 64 | 58 | 55 | 62 |
| 3a | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 3b | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 3c | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 3d | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 3e | 38 | 38 | 35 | 38 | 38 | 38 | 38 |
| 4Na | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Nb | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Nc | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Nd | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Ne | 37 | 37 | 35 | 37 | 37 | 37 | 37 |
| 4Za | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Zb | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Zc | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Zd | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4Ze | 36 | 38 | 36 | 37 | 37 | 38 | 38 |
| 5Na | 26 | 32 | 54 | 57 | 44 | 32 | 42 |
| 5Nb | 37 | 40 | 65 | 56 | 50 | 43 | 47 |
| 5Nc | 42 | 45 | 72 | 52 | 52 | 47 | 50 |
| 5Nd | 39 | 43 | 66 | 39 | 48 | 43 | 44 |
| 5Ne | 12 | 13 | 17 | 9 | 12 | 13 | 10 |
| 5Za | 79 | 69 | 77 | 100 | 74 | 75 | 99 |
| 5Zb | 75 | 65 | 72 | 100 | 68 | 69 | 89 |
| 5Zc | 72 | 60 | 67 | 96 | 63 | 63 | 77 |
| 5Zd | 66 | 54 | 59 | 76 | 55 | 56 | 63 |
| 5Ze | 18 | 17 | 19 | 21 | 16 | 19 | 15 |
| 4Ztot | 87 | 87 | 87 | 87 | 87 | 87 | 87 |
| 4Ntot | 87 | 87 | 87 | 87 | 87 | 87 | 87 |
| 5Ztot | 58 | 50 | 55 | 74 | 51 | 52 | 63 |
| 5Ntot | 22 | 25 | 45 | 33 | 32 | 26 | 29 |
| **Mean** | **69** | **68** | **72** | **75** | **69** | **68** | **72** |

## H.2 FOR EACH ZONE

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



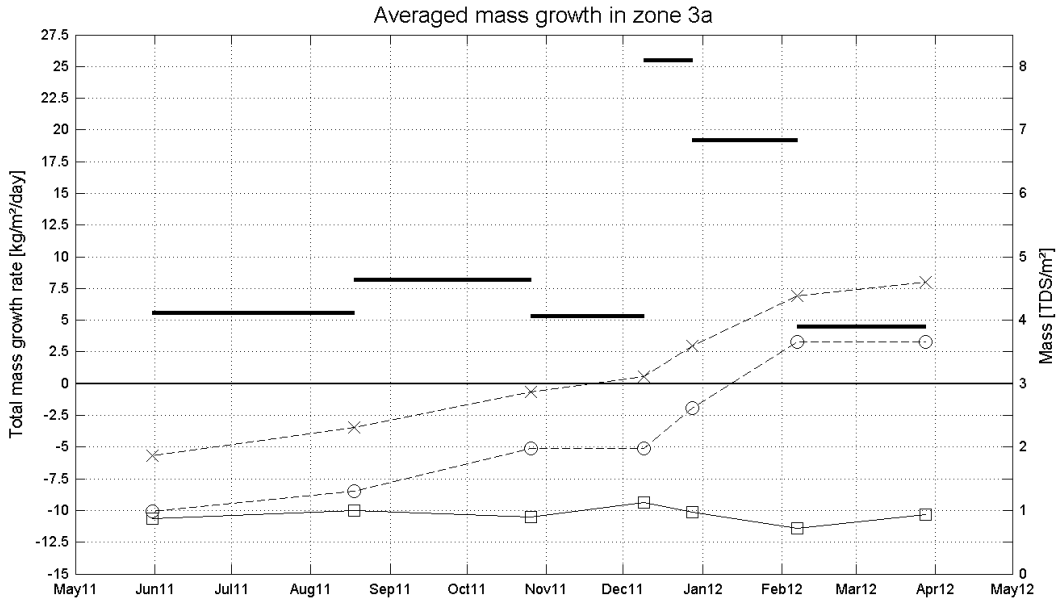

Data Processed by:

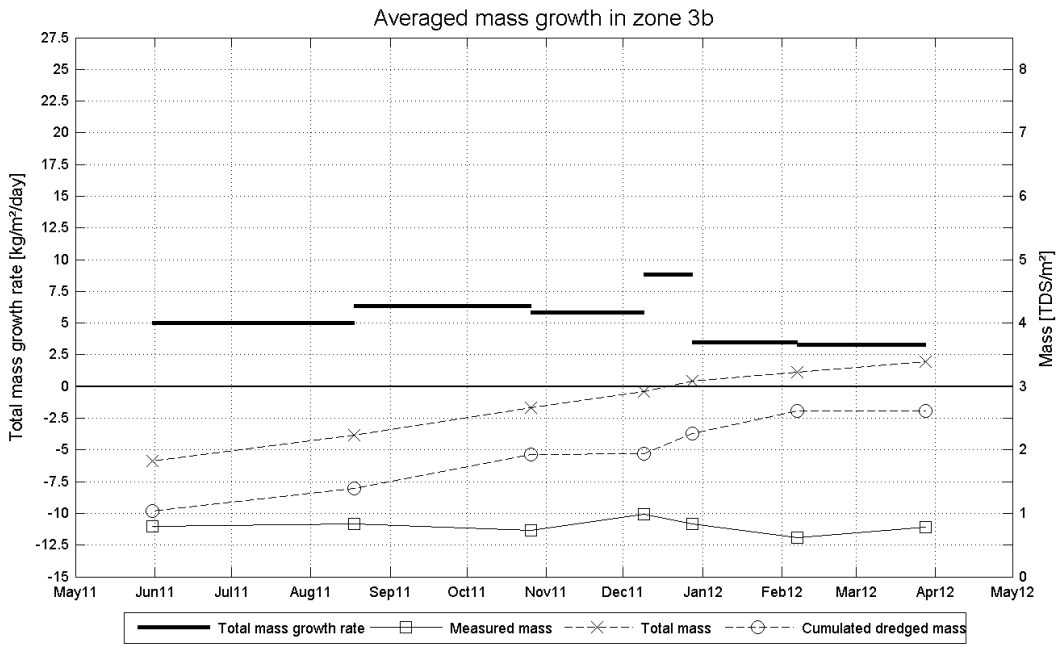
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



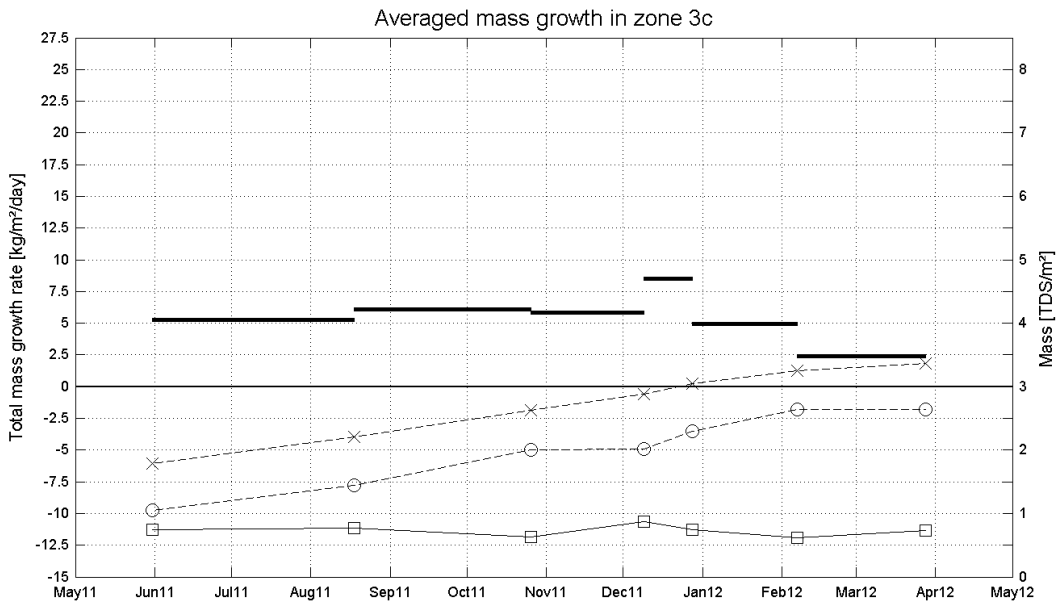

Data Processed by:

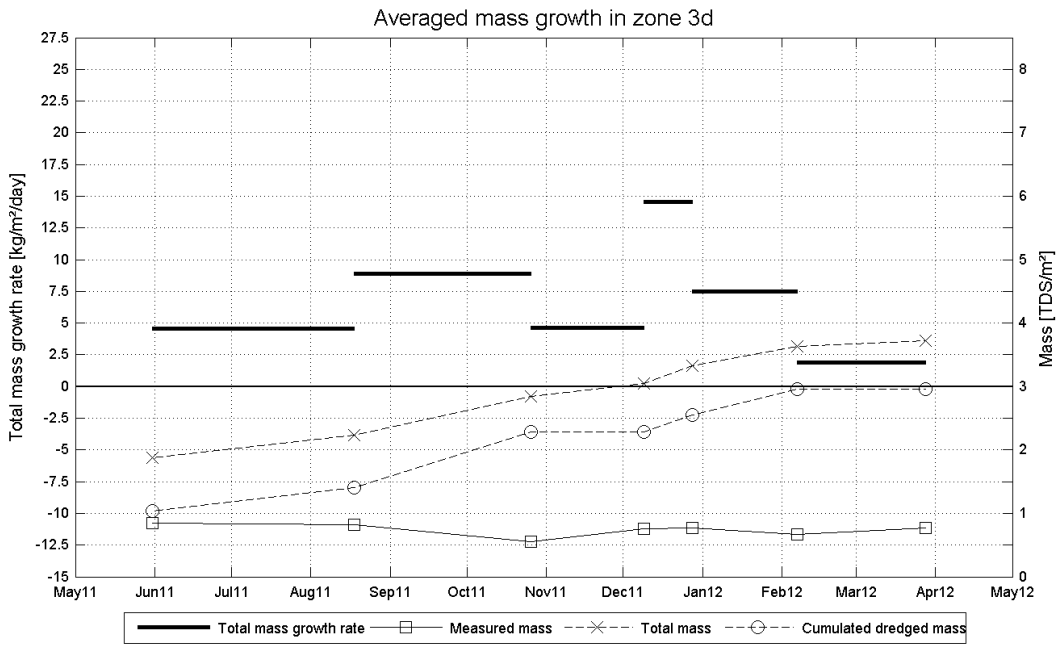
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



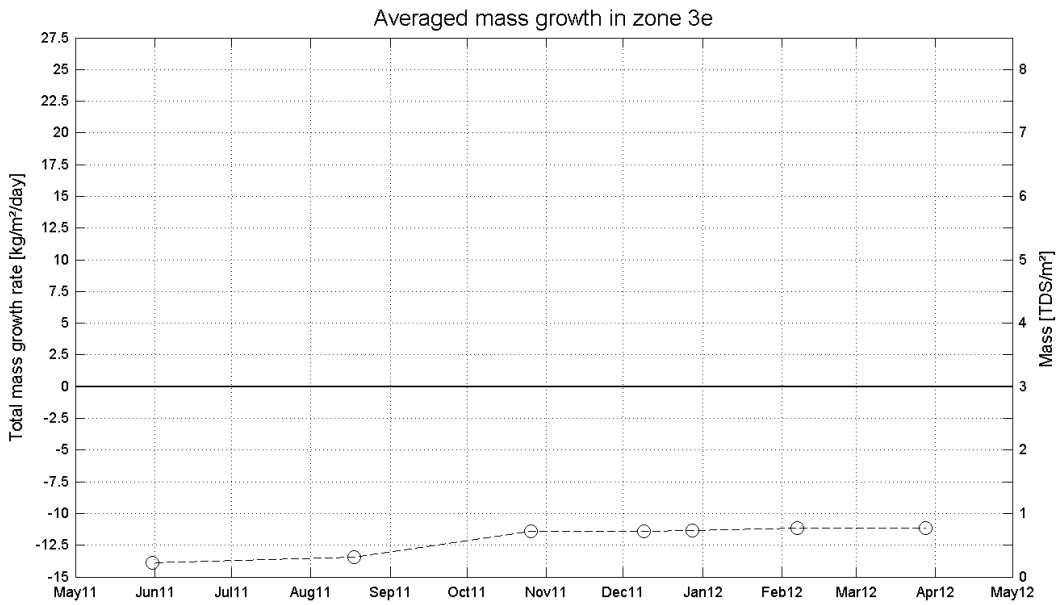

Data Processed by:

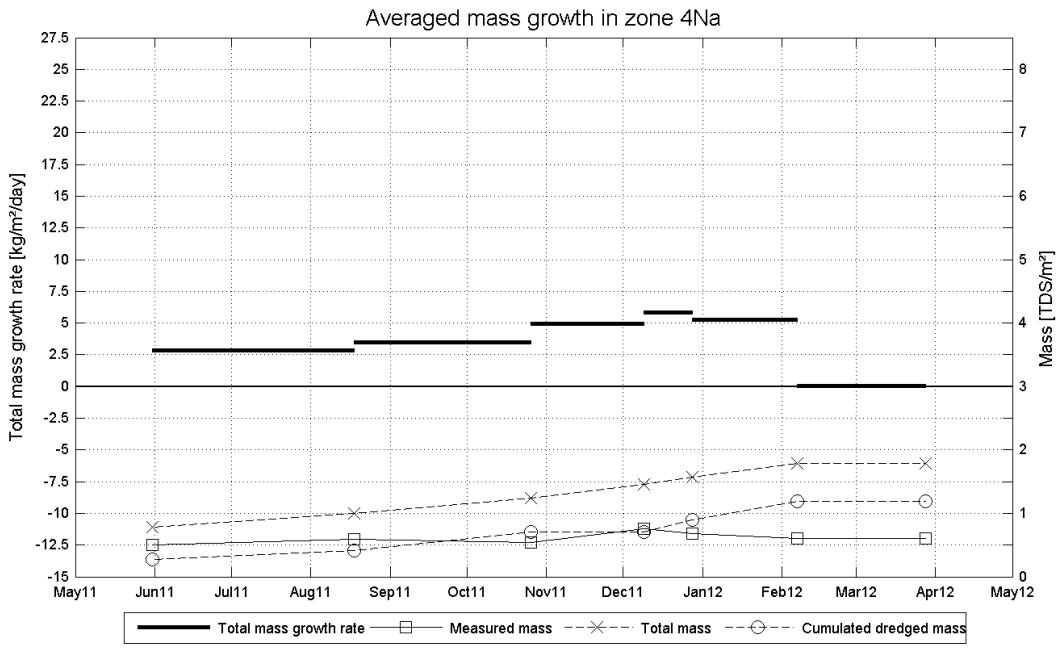
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



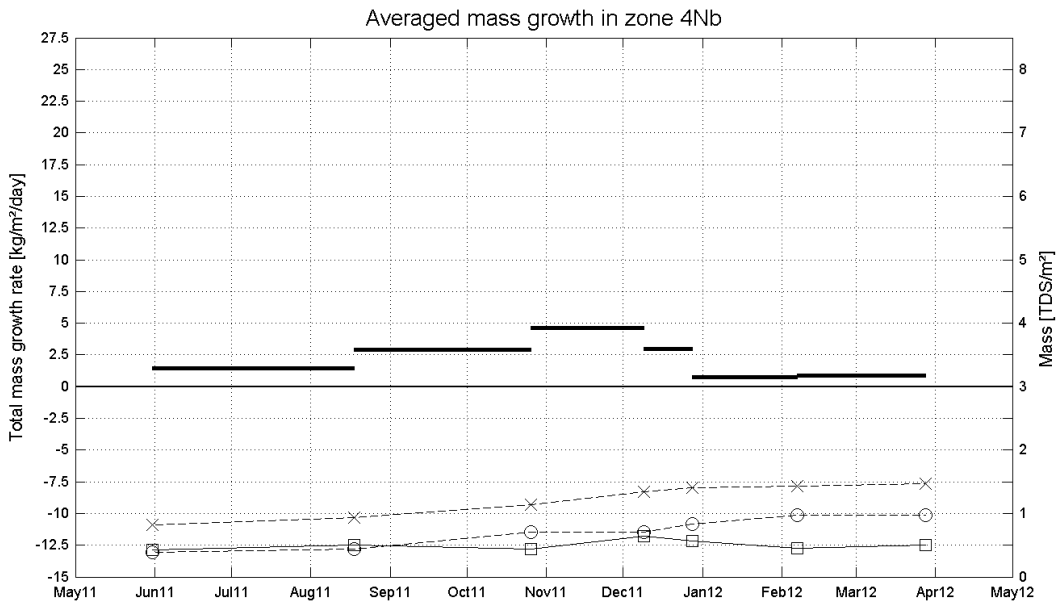

Data Processed by:

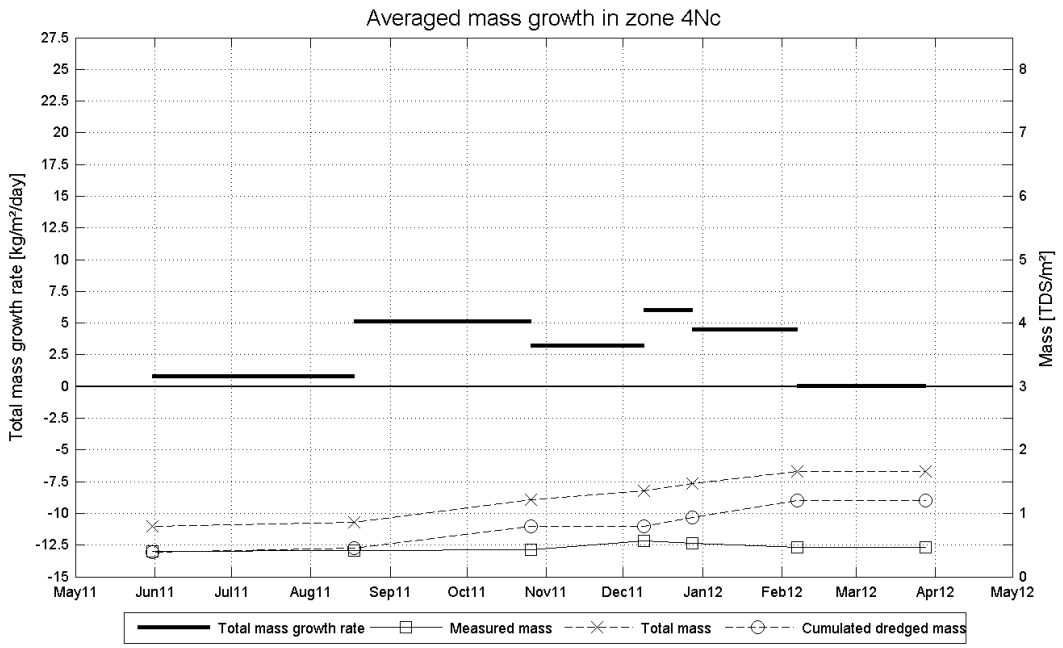
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



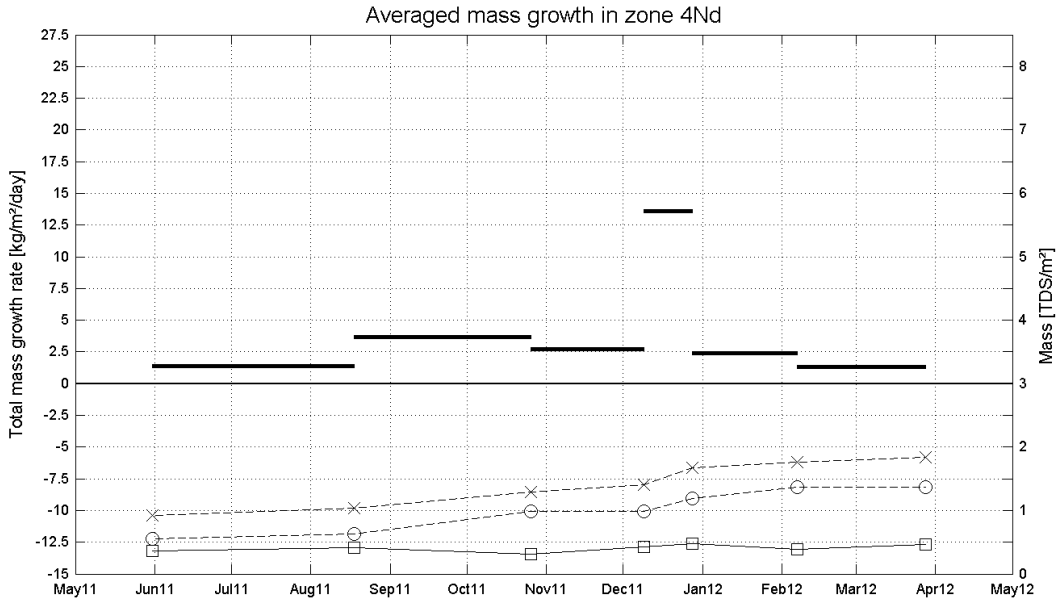

Data Processed by:

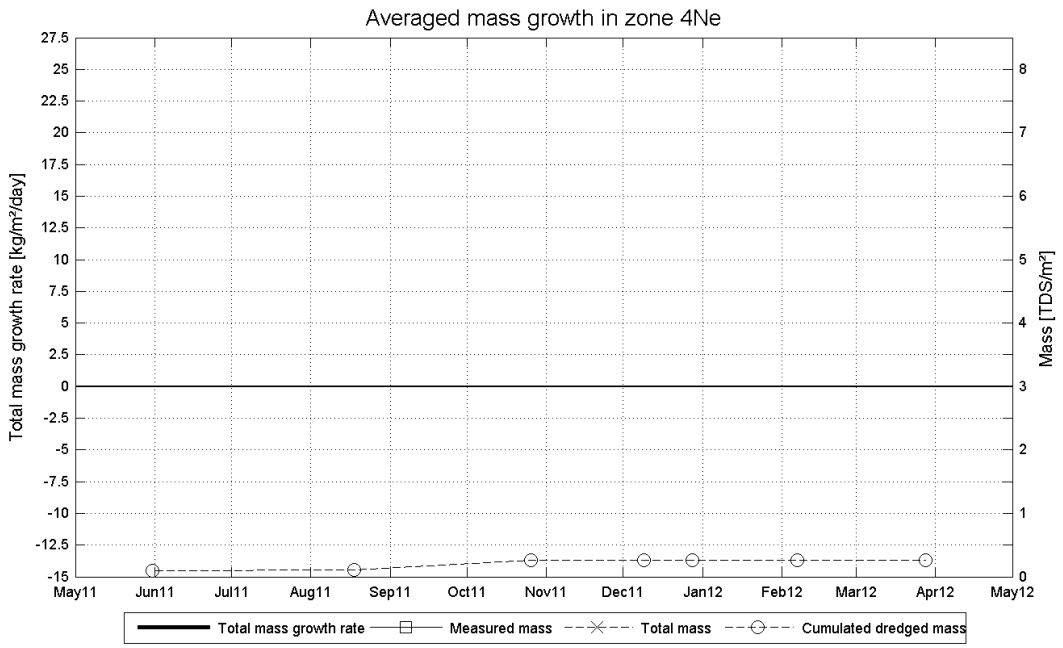
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |




Data Processed by:

In association with :

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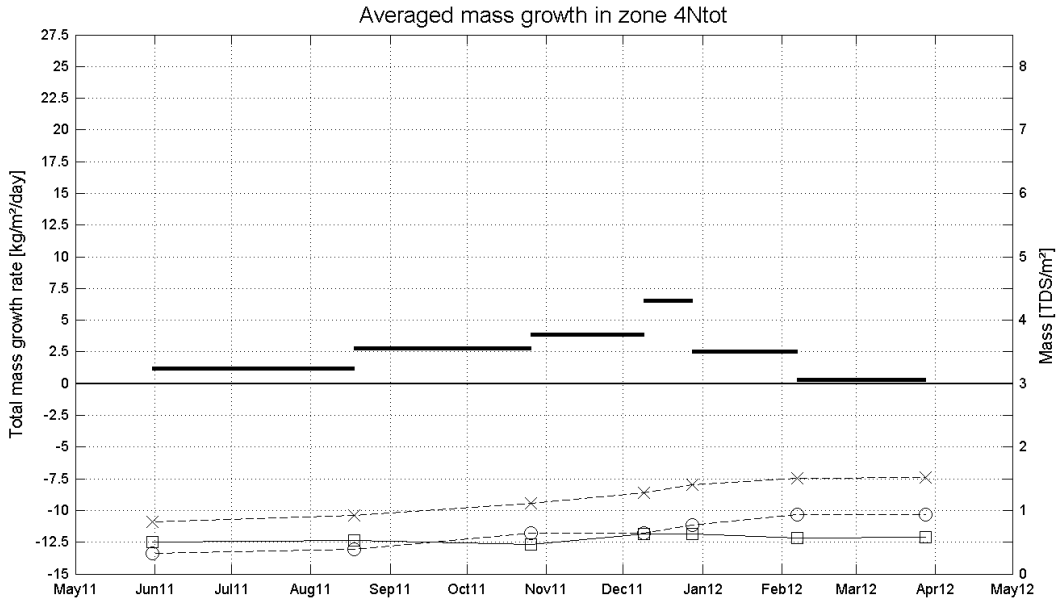
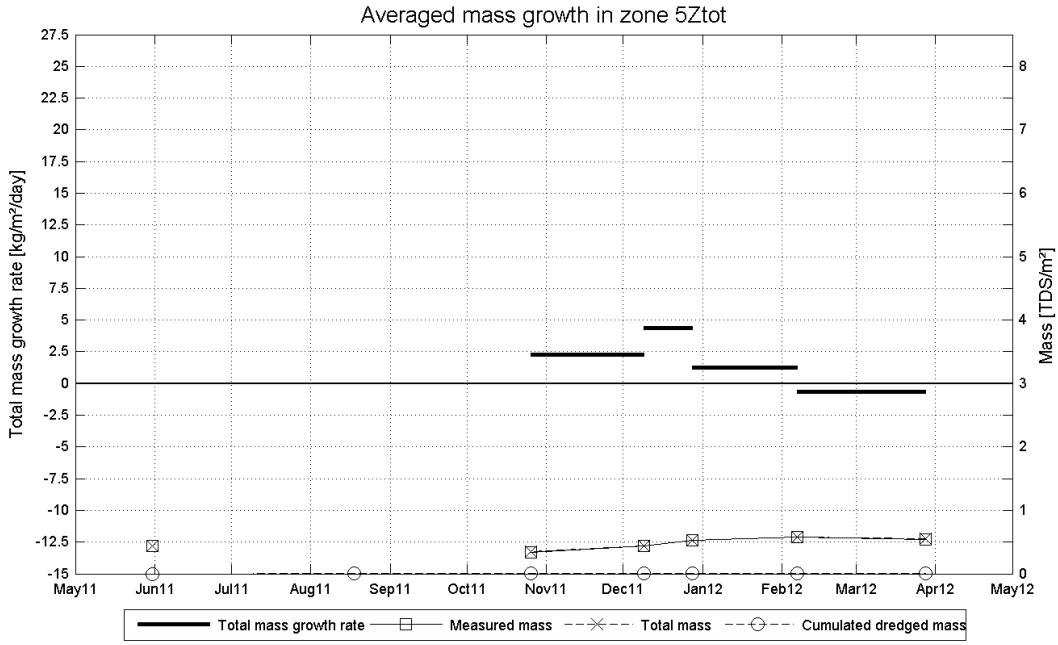
# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



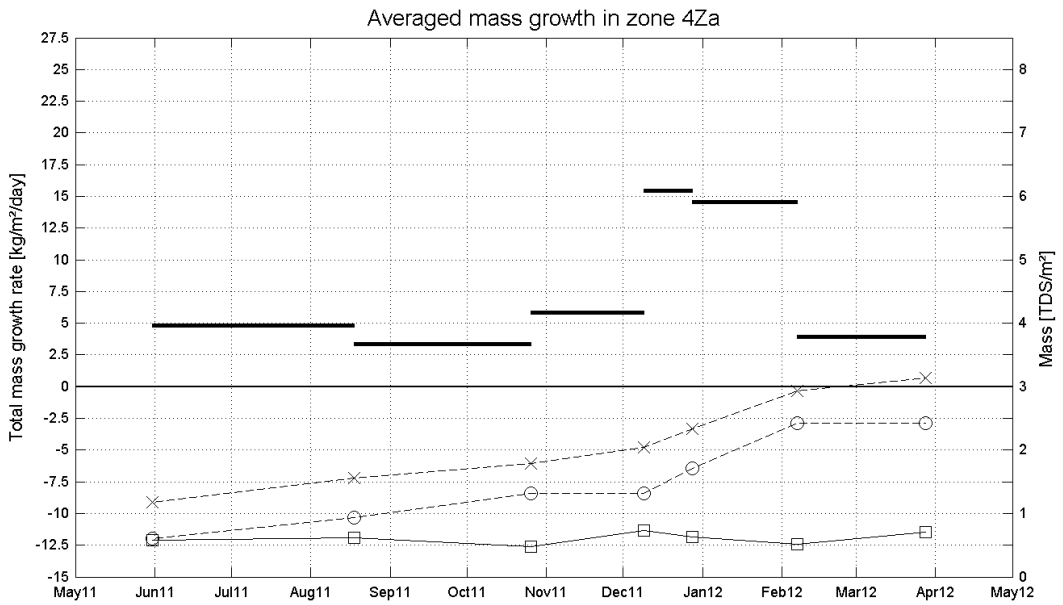

Data Processed by:

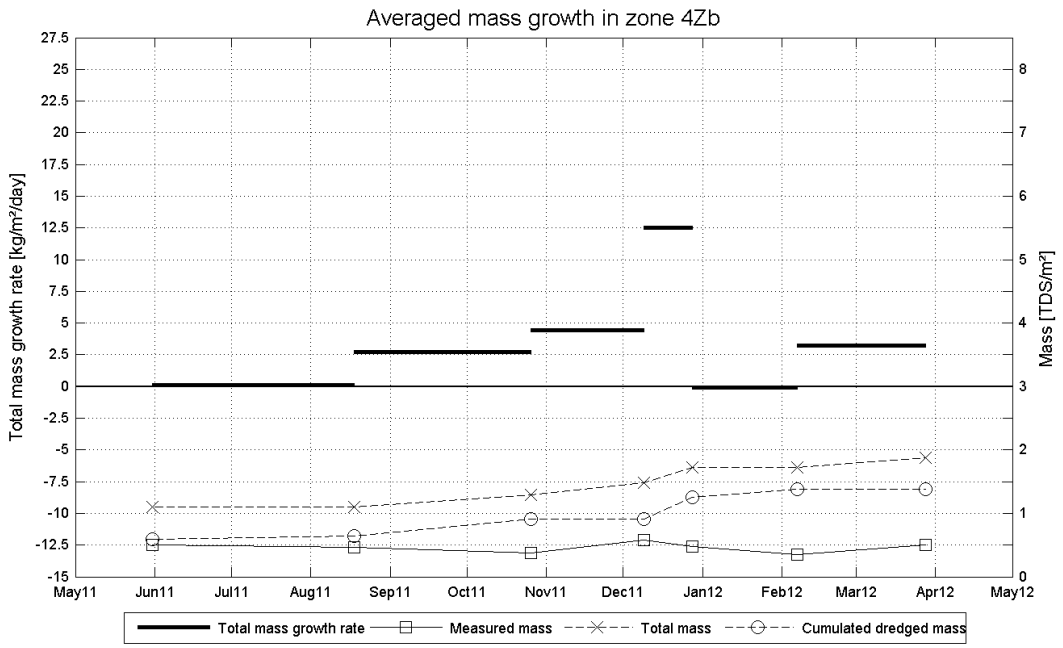
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



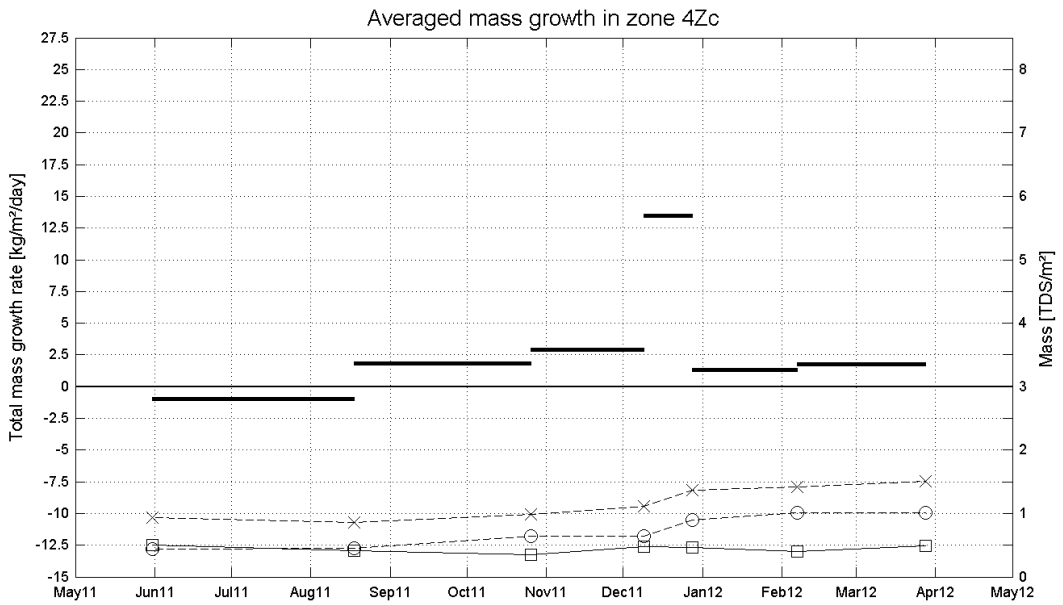

Data Processed by:

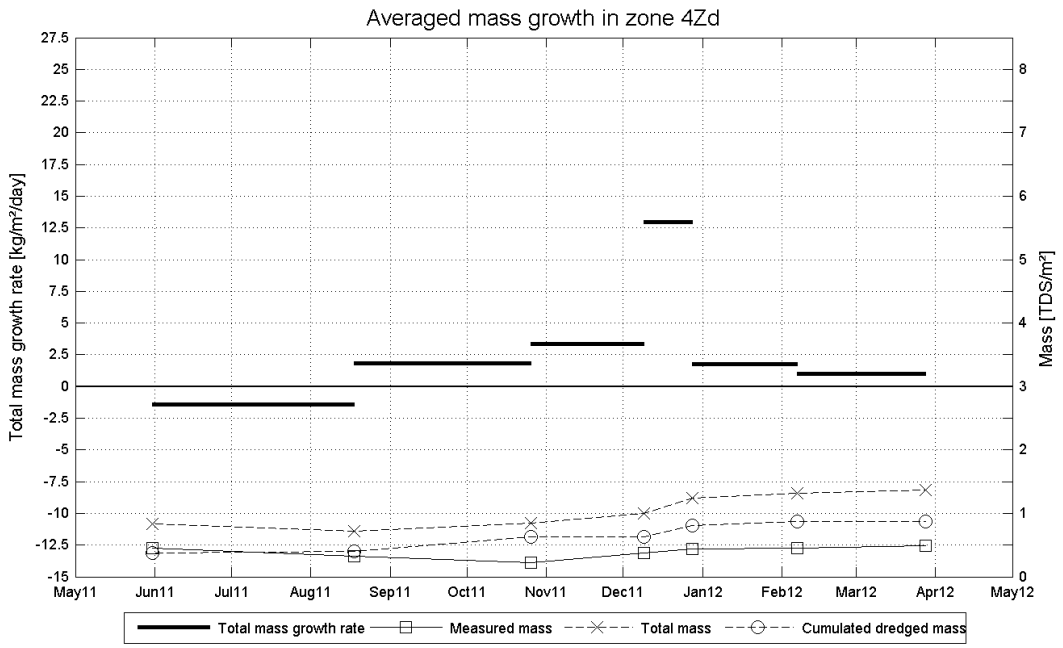
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



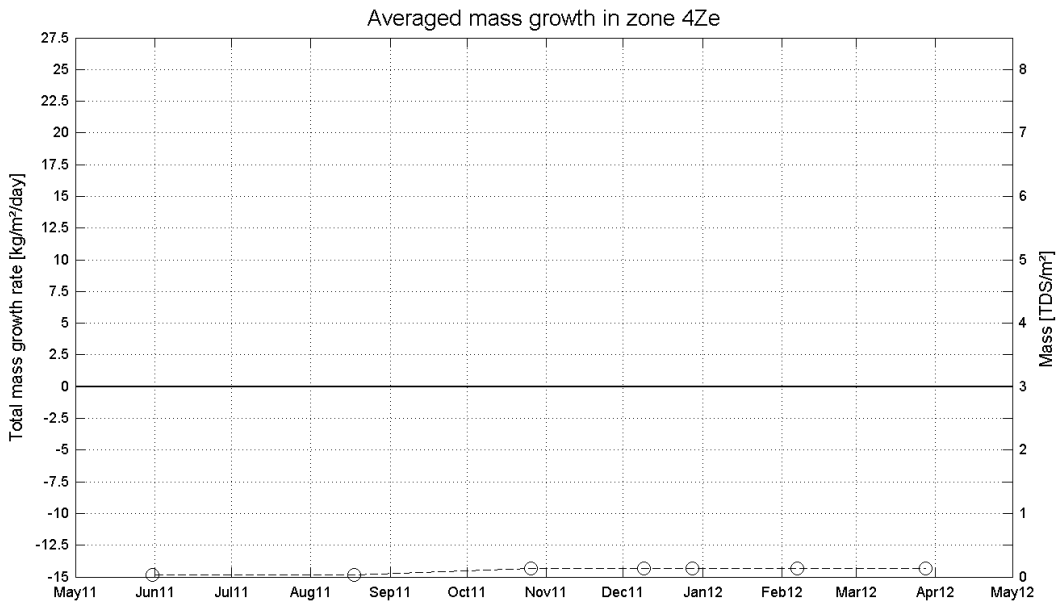

Data Processed by:

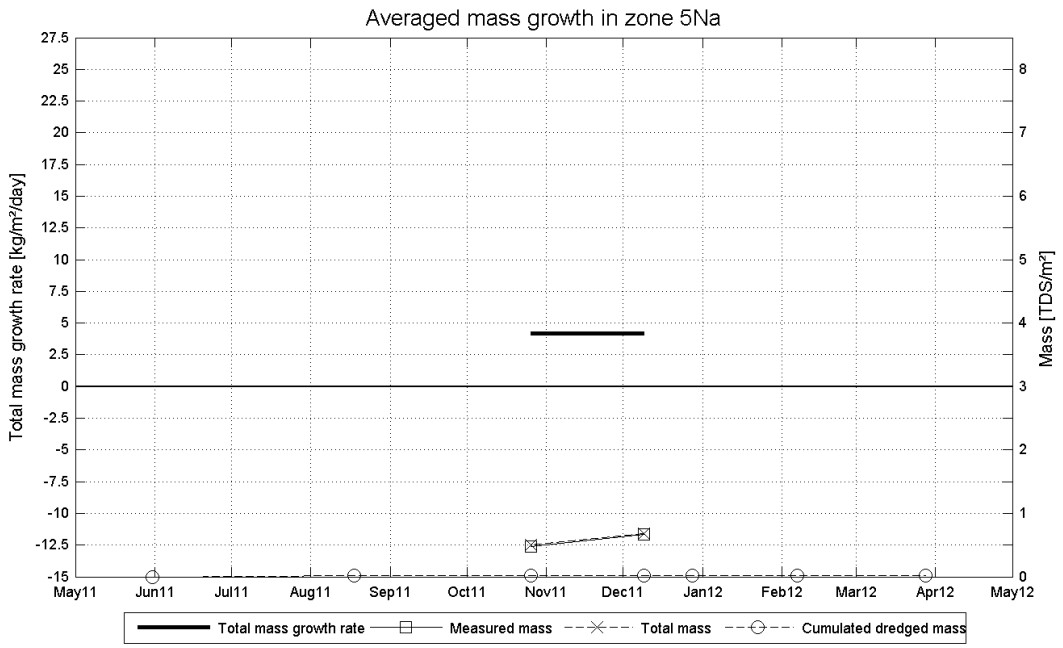
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



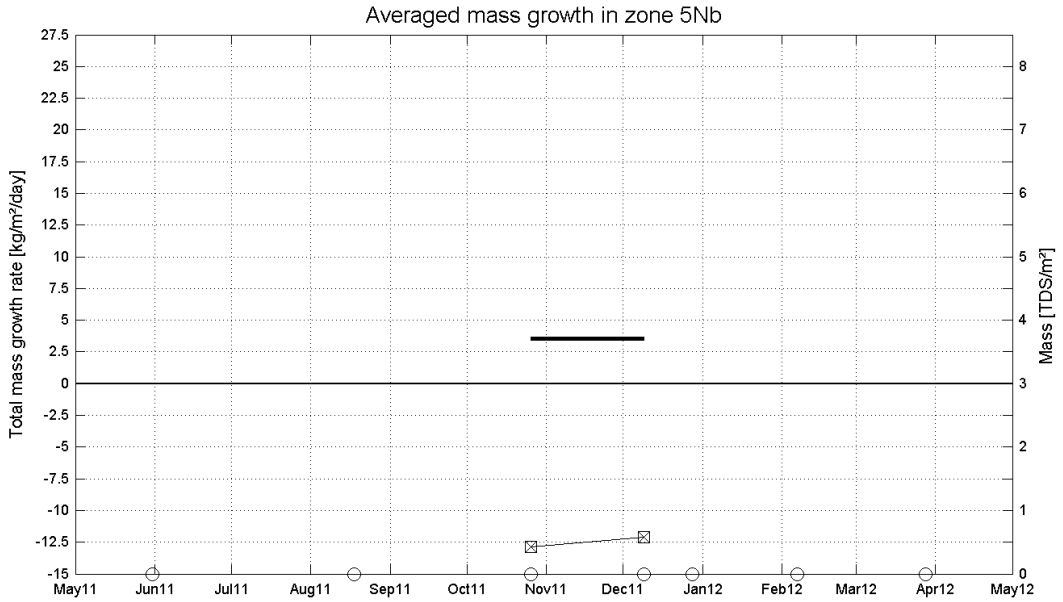

Data Processed by:

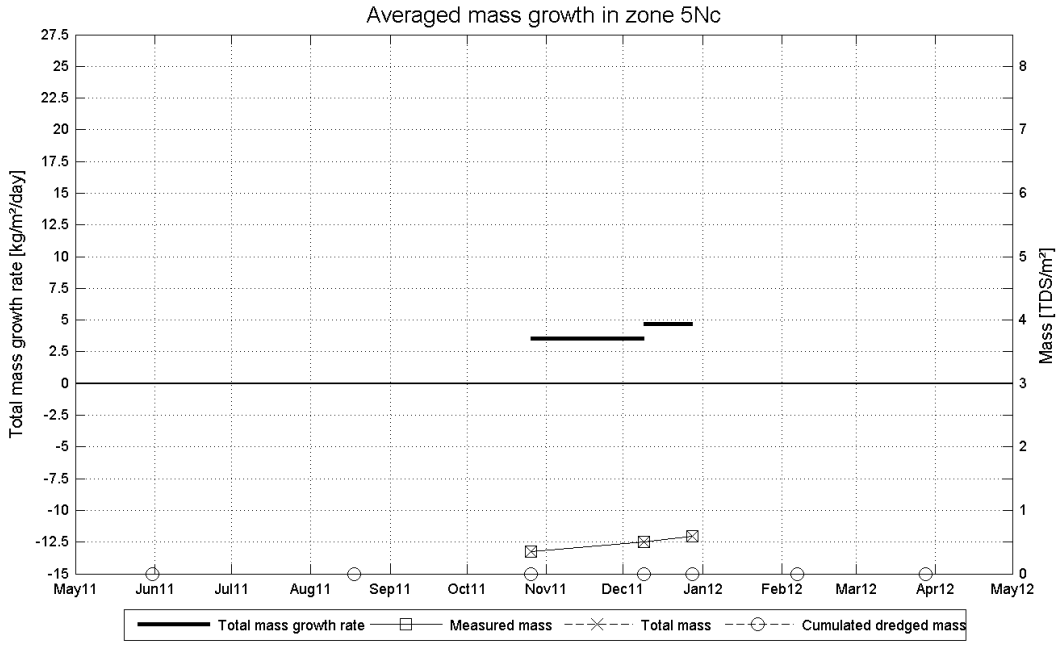
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



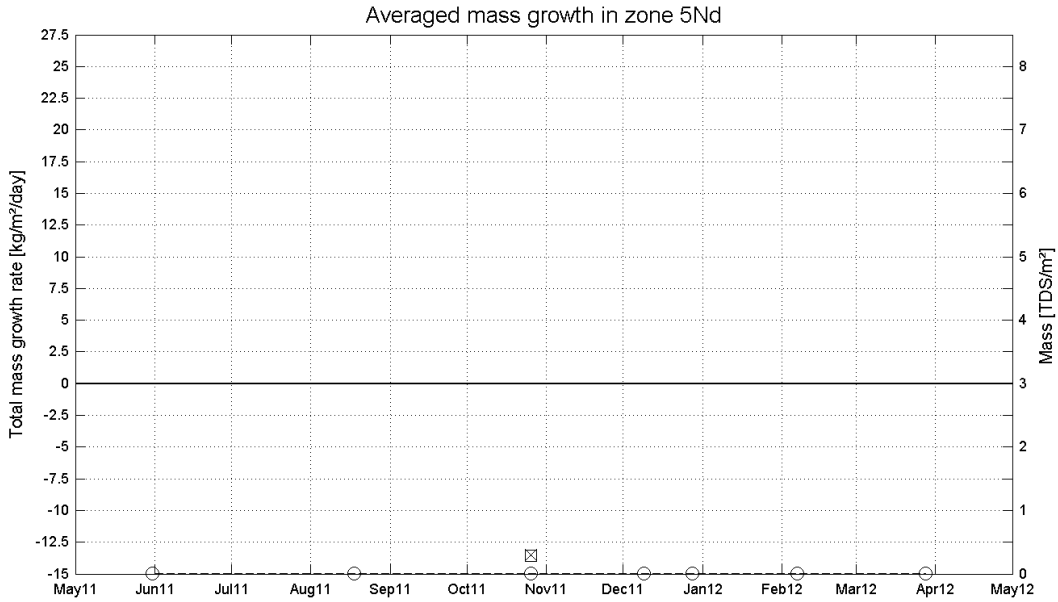

Data Processed by:

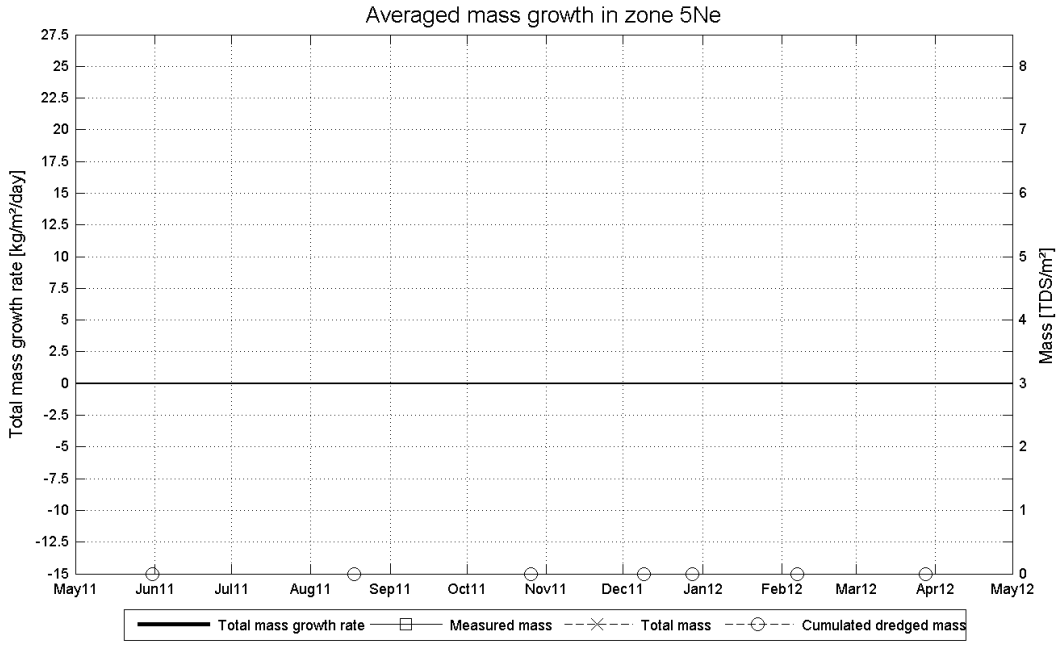
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



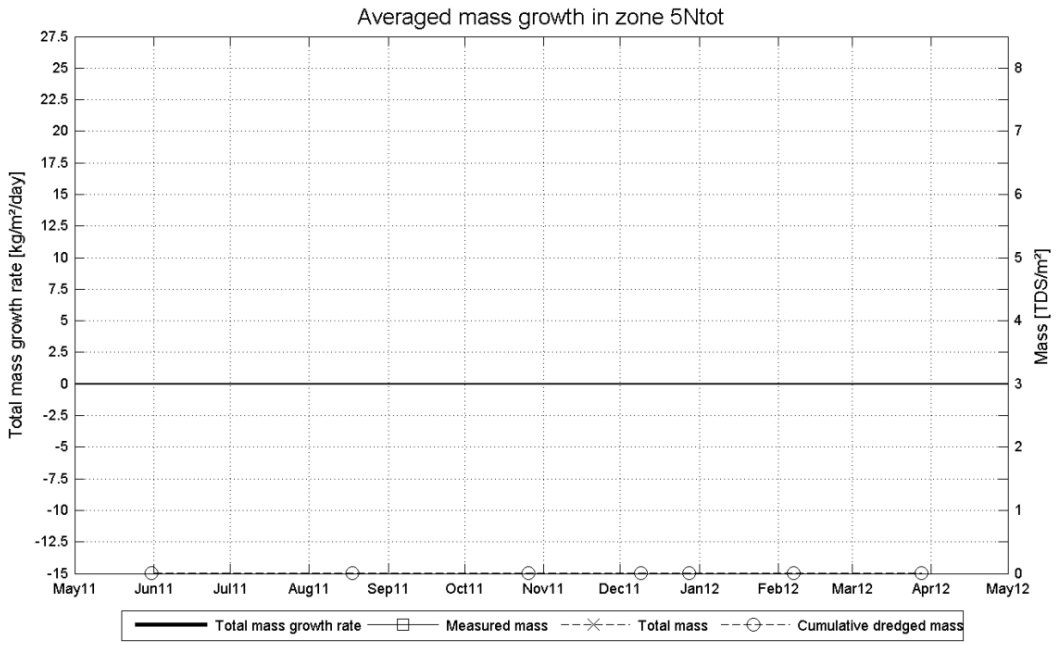

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
| | Location: DGD |



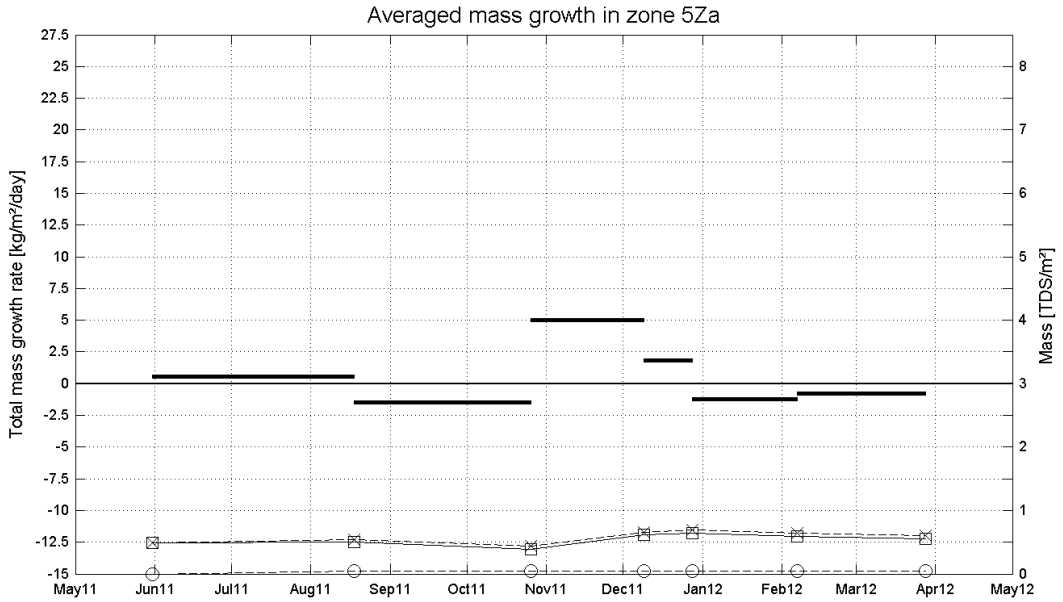

Data Processed by:

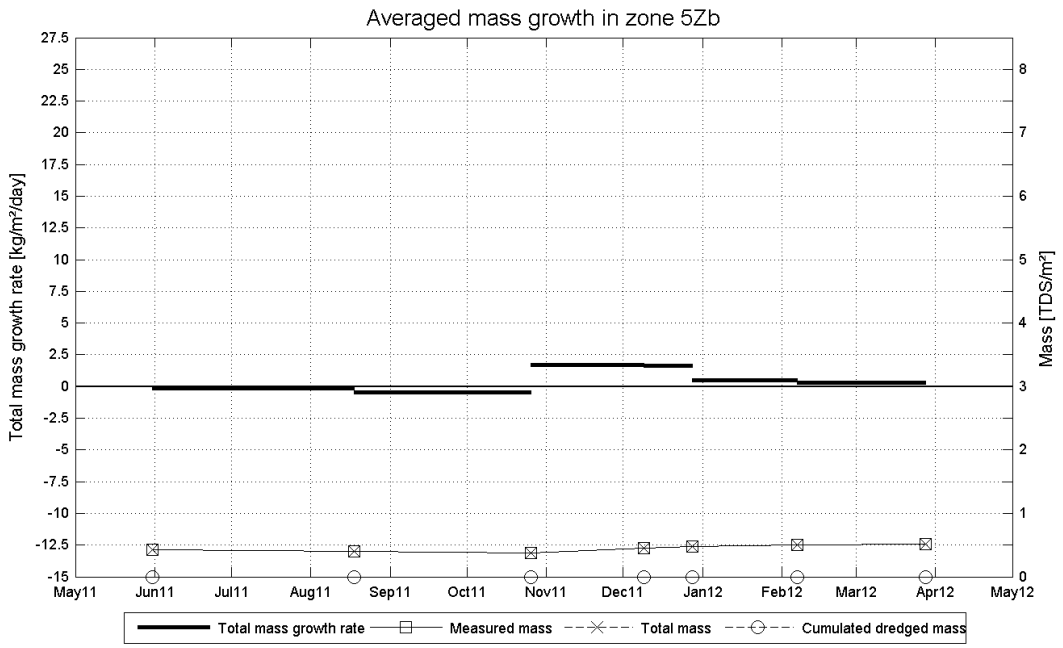
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



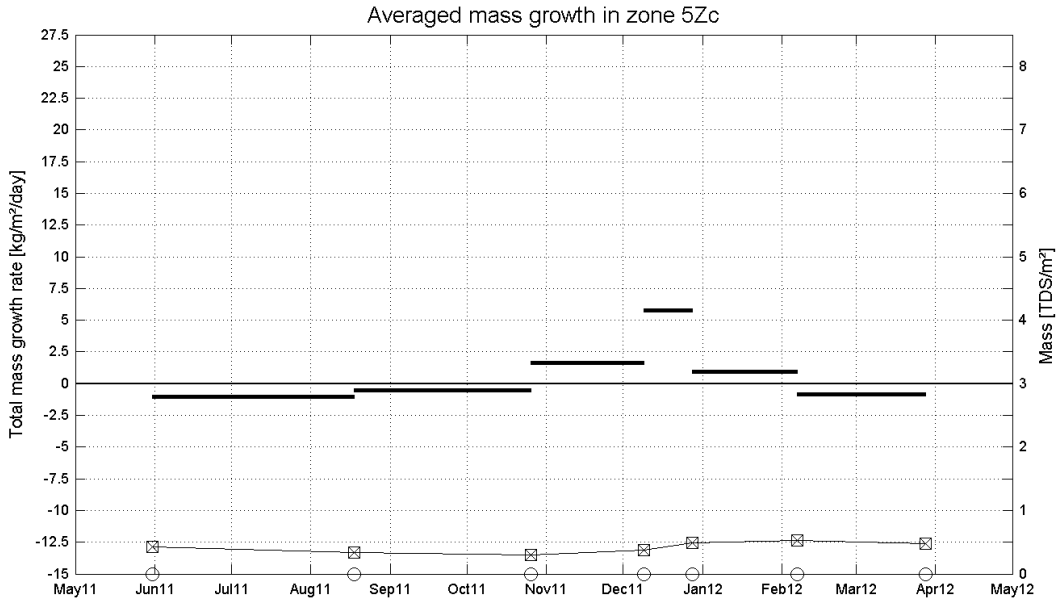

Data Processed by:

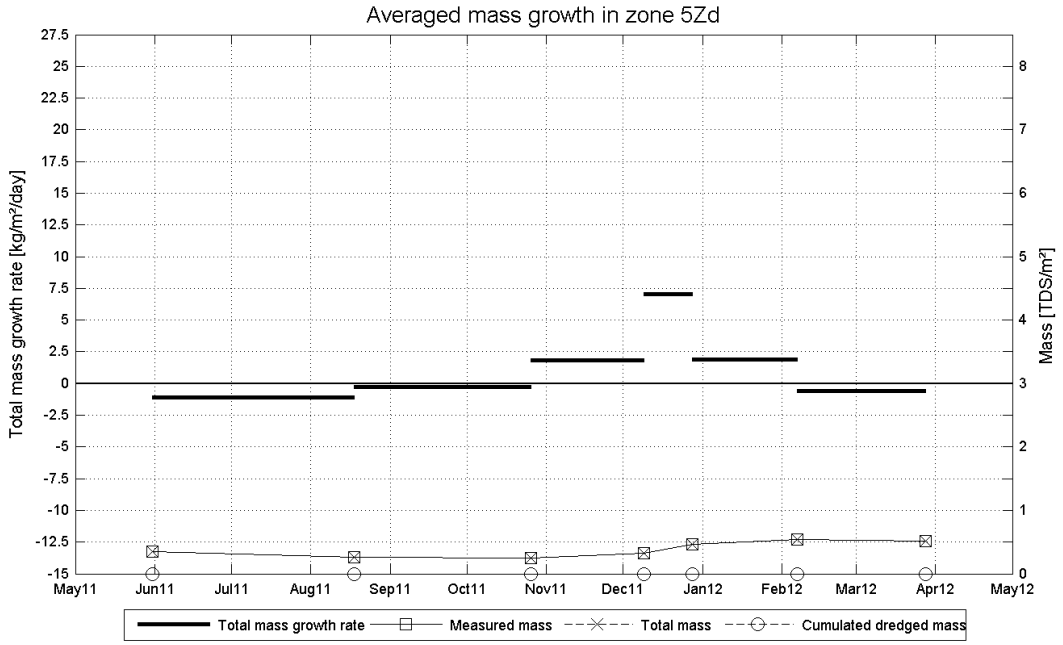
In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



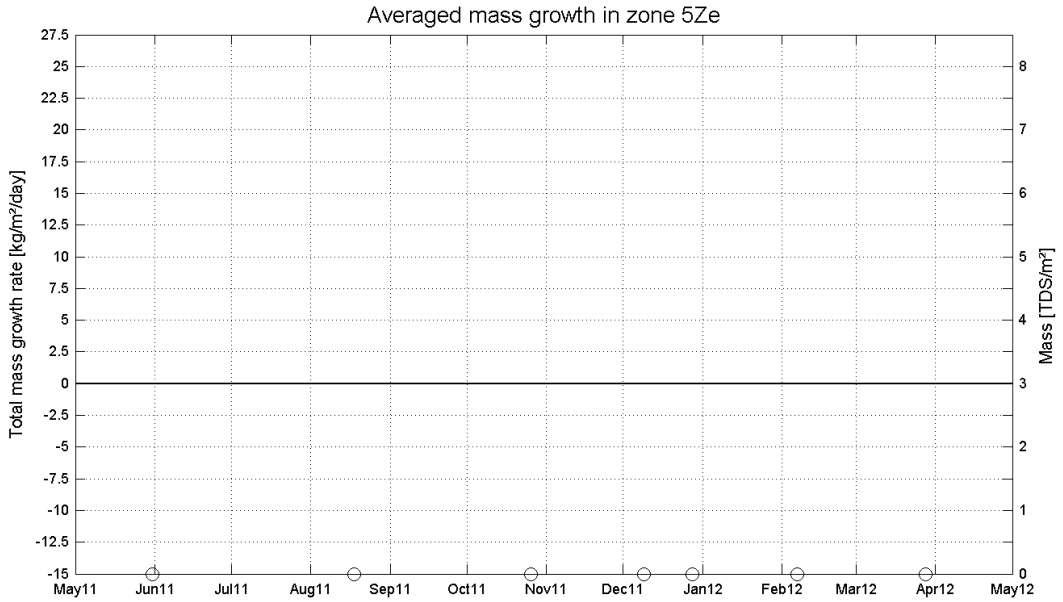

Data Processed by:

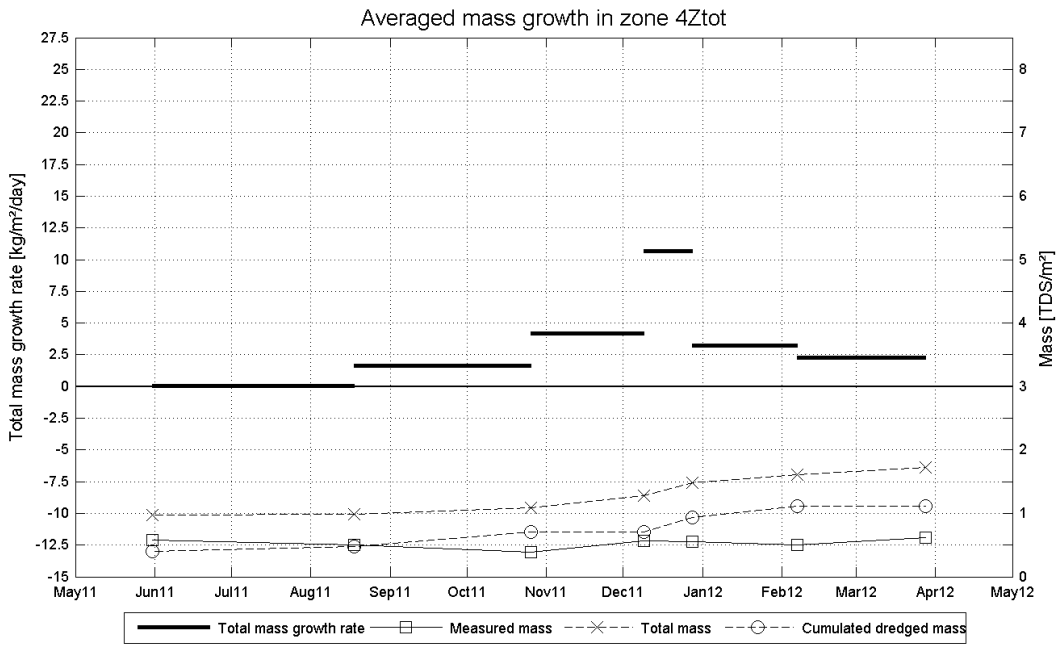
In association with :

I/RA/11354/10.101/MBO/ANF

# Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |




Data Processed by:

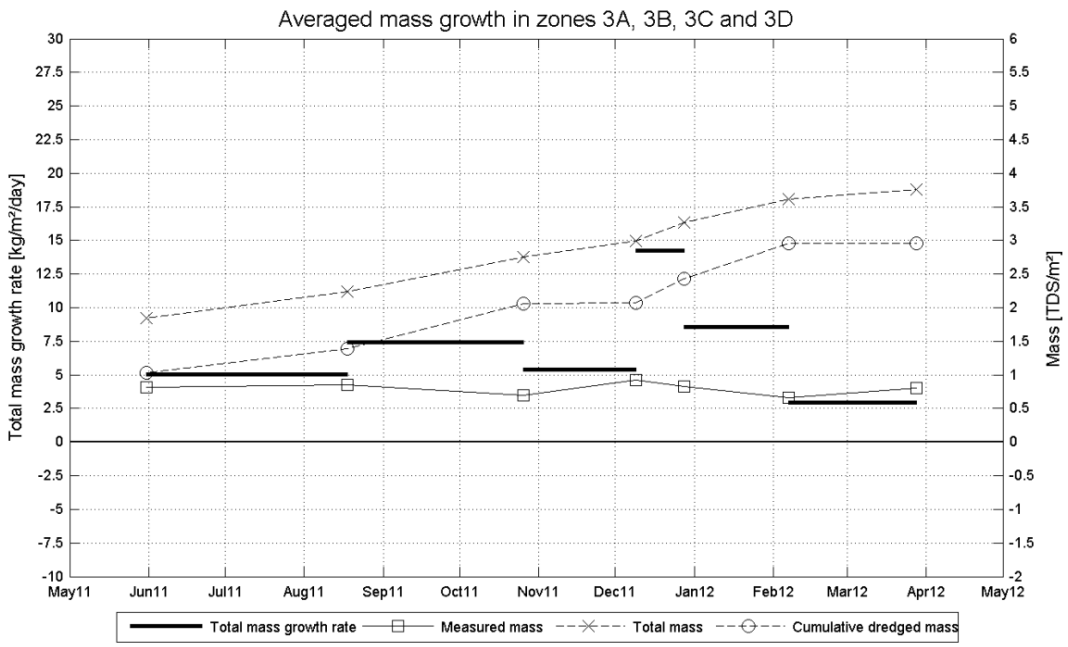
In association with :

I/RA/11354/10.101/MBO/ANF

# H.3 FOR CENTRAL TRENCH AREA OF DEURGANCKDOK

## Evaluation of external effects on the siltation of Deurganckdok

| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
|---|---|
| | Location: DGD |



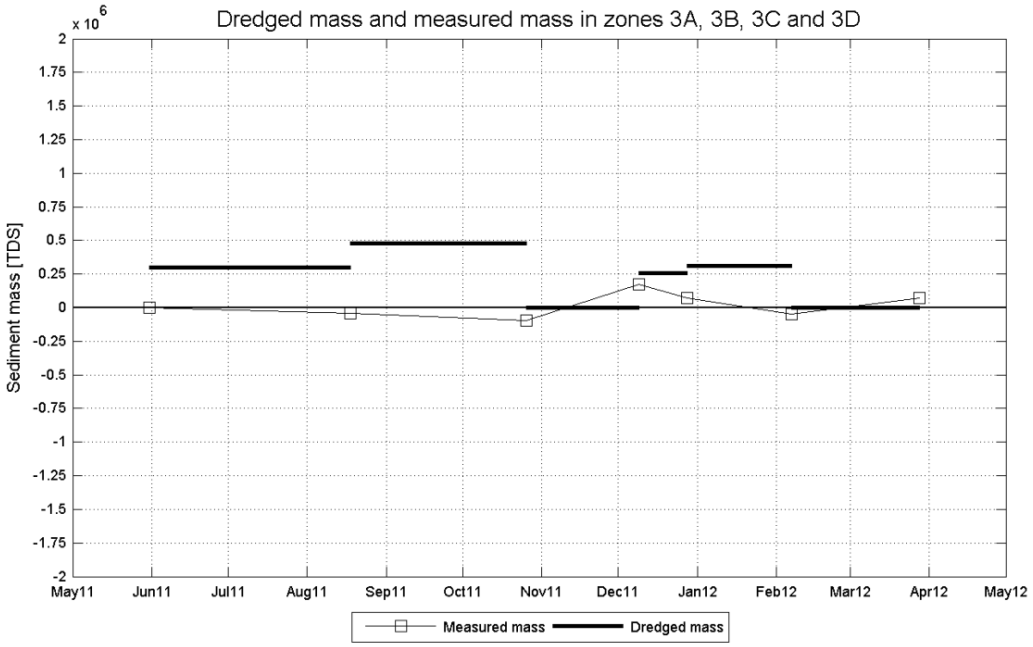

Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

## Evaluation of external effects on the siltation of Deurganckdok

| | |
|---|---|
| Measured/Dredged/Total Mass | Equipment(s): Navitracker |
| | Location: DGD |




Data Processed by:

In association with :

I/RA/11354/10.101/MBO/ANF

# Annex I DREDGING DATA

*Table 7-12: **Dredged mass in covered area [TDS]** between consecutive density measurement campaigns. For April 1st 2011 to March 28th 2012.*

| | (1/Apr) | **31/May** | **18/Aug** | **26/Oct** | **9/Dec** | **28/Dec** | **7/Feb** | | |
|---|---|---|---|---|---|---|---|---|---|
| | 31/May | 18/Aug | 26/Oct | 9/Dec | 28/Dec | 7/Feb | 28/Mar | Total | % |
| 1 | 17,048 | 42,420 | 15,458 | 0 | 19,379 | 10,265 | 0 | **104,570** | **5.3** |
| 2 | 30,439 | 64,666 | 34,002 | 0 | 23,874 | 15,994 | 0 | **168,974** | **8.5** |
| 3a | 97,607 | 31,416 | 66,347 | 277 | 62,310 | 103,399 | 0 | **361,356** | **18.2** |
| 3b | 113,801 | 39,436 | 59,049 | 500 | 34,907 | 39,161 | 0 | **286,854** | **14.4** |
| 3c | 104,102 | 39,028 | 55,566 | 699 | 28,239 | 33,698 | 0 | **261,332** | **13.2** |
| 3d | 134,572 | 48,552 | 115,151 | 0 | 34,797 | 52,745 | 0 | **385,818** | **19.4** |
| 3e | 28,796 | 11,542 | 52,985 | 0 | 1,457 | 4,415 | 0 | **99,196** | **5.0** |
| 4Na | 9,942 | 5,303 | 10,524 | 0 | 6,746 | 10,659 | 0 | **43,175** | **2.2** |
| 4Nb | 12,279 | 1,401 | 8,295 | 0 | 4,051 | 4,450 | 0 | **30,475** | **1.5** |
| 4Nc | 10,013 | 1,578 | 8,699 | 0 | 3,865 | 6,633 | 0 | **30,788** | **1.5** |
| 4Nd | 18,285 | 2,250 | 11,646 | 0 | 6,864 | 5,957 | 0 | **45,002** | **2.3** |
| 4Ne | 3,067 | 459 | 5,078 | 0 | 38 | 87 | 0 | **8,728** | **0.4** |
| 4Za | 14,475 | 8,147 | 9,219 | 0 | 9,703 | 17,029 | 0 | **58,574** | **2.9** |
| 4Zb | 18,320 | 1,600 | 8,611 | 0 | 10,433 | 3,987 | 0 | **42,950** | **2.2** |
| 4Zc | 11,281 | 384 | 4,868 | 0 | 6,699 | 3,067 | 0 | **26,299** | **1.3** |
| 4Zd | 12,140 | 773 | 7,310 | 0 | 5,658 | 2,193 | 0 | **28,074** | **1.4** |

| | (1/Apr) | **31/May** | **18/Aug** | **26/Oct** | **9/Dec** | **28/Dec** | **7/Feb** | | |
|---|---|---|---|---|---|---|---|---|---|
| 4Ze | 1,176 | 0 | 2,839 | 0 | 0 | 71 | 0 | **4,086** | **0.2** |
| 5Na | 0 | 337 | 0 | 0 | 0 | 32 | 0 | **369** | **0.0** |
| 5Nb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Nc | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Nd | 102 | 0 | 0 | 0 | 0 | 0 | 0 | **102** | **0.0** |
| 5Ne | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Za | 0 | 572 | 0 | 0 | 0 | 0 | 0 | **572** | **0.0** |
| 5Zb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Zc | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Zd | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 5Ze | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0.0** |
| 4Ztot | 60,243 | 11,416 | 34,169 | 0 | 33,511 | 26,889 | 0 | **166,228** | **8.4** |
| 4Ntot | 53,613 | 11,001 | 44,241 | 0 | 21,564 | 27,818 | 0 | **158,237** | **8.0** |
| 5Ztot | 0 | 572 | 0 | 0 | 0 | 0 | 0 | **572** | **0.0** |
| 5Ntot | 74 | 328 | 0 | 0 | 0 | 0 | 0 | **402** | **0.0** |
| **Total 3a-3e** | **478,878** | **169,974** | **349,098** | **1,476** | **161,711** | **233,418** | **0** | **1,394,555** | **70.2** |
| **Total** | **637,444** | **299,866** | **475,645** | **1,476** | **259,020** | **313,841** | **0** | **1,987,293** | **100** |
| **%** | **32.1** | **15.1** | **23.9** | **0.1** | **13.0** | **15.8** | **0.0** | | |

# Annex J MAINTENANCE DREDGING DEPTHS SINCE MARCH 2011

| | X | Y |
|---|---|---|
| Zone 1 | 588505.271604 | 5684178.182510 |
| | 587311.737158 | 5682247.812630 |
| | 587265.426963 | 5682276.708890 |
| | 588464.911123 | 5684259.738870 |
| | | |
| Zone 2 | 587311.737158 | 5682247.812630 |
| | 588505.271604 | 5684178.182510 |
| | 588609.771980 | 5683967.018670 |
| | 587481.358925 | 5682141.973460 |
| | | |
| Zone 3 | 588609.771980 | 5683967.018670 |
| | 588647.984190 | 5683889.803260 |
| | 587526.071039 | 5682114.074380 |
| | 587481.358925 | 5682141.973460 |
| | | |
| Zone 4 | 589198.680436 | 5683902.013930 |
| | 589221.337256 | 5683883.253190 |
| | 589260.730756 | 5683852.466390 |
| | 589097.238401 | 5683930.440150 |
| | 589041.483106 | 5683959.642660 |
| | 588983.756403 | 5683985.680780 |
| | 588872.356778 | 5684000.532400 |
| | 588808.593844 | 5683987.683610 |
| | 588748.209964 | 5683960.091350 |
| | 588647.984178 | 5683889.803260 |
| | 588464.911091 | 5684259.738820 |
| | 588614.053379 | 5684522.952730 |
| | 588621.650908 | 5684630.732410 |
| | 588621.334184 | 5684683.549870 |
| | 588609.432982 | 5684773.808940 |
| | 588853.132589 | 5684288.815260 |
| | 589150.027500 | 5683943.945800 |