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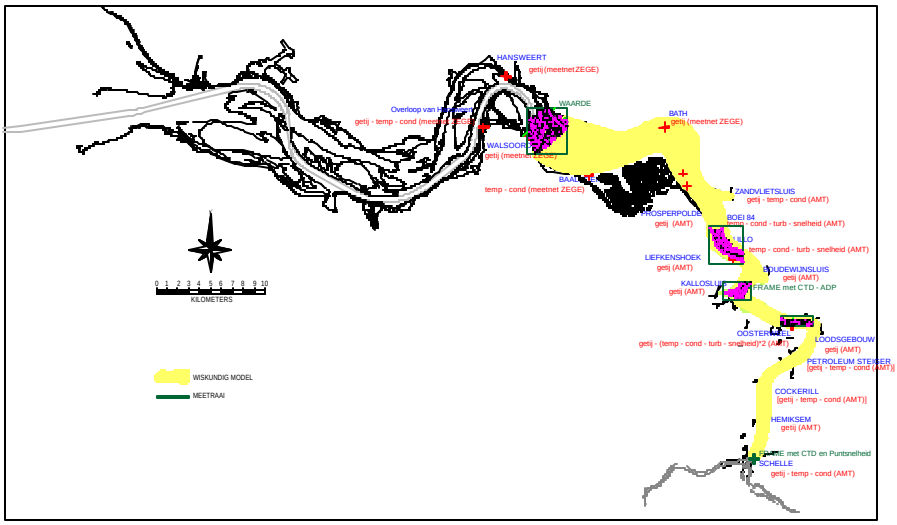
Afdeling Waterbouwkundig Laboratorium en Hydrologisch Onderzoek



STUDIE DENSITEITSSTROMINGEN IN HET KADER VAN LTV

LANGDURIGE STROOM- EN SALINITEITSMETING LANGSHEEN BENEDEN-ZEESCHELDE

28/05/2002 TOT 02/07/2002

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1 INTRODUCTION

1.1 The assignment

On March 1, 2002 the study " Densiteitsstromingen Schelde in het kader van LTV" (16EB/01/01) , assigned by the WLHO (Departement Leefmilieu en Infrastructuur, Afdeling Waterwegen en Zeewezen, Afdeling Waterbouwkundig Laboratorium en Hydrologisch Onderzoek) to WL | Delft Hydraulics in association with IMDC, has started.
The study consists of the following parts:

- The set up and execution of an extensive measurement campaign
- The building of a physical model, including the access channel to a sluice
- The building of a 3D numerical model
- The writing of a report on future possible actions that can be taken in order to obtain a better understanding of the functioning of sedimentation and silt transport in the Lower Scheldt
- The transfer of the numerical models to the WLHO, including the necessary training sessions.

This report is written as part of sub-assignment 1: the set up and execution of an extensive measurement campaign.

1.2 Purpose of the measurement campaign

The long term current measurement campaign carried out at Oosterweel, Deurganckdok, Lillo-ponton, Zandvlietsluis, Schelle and Petroleumsteiger is part of the extensive measurement campaign in the study on density currents in the river Scheldt, in the framework of the Scheldt Long Term Vision (LTV). In addition to long term measurement campaigns at certain designated tidal posts along the river Scheldt, the measurement plan also covered two series of through tide measurements at different locations on June 5th and 12th 2002.

The purpose of the measurement campaign was to supply a coherent set of data which will be not only be applied in the calibration and validation of the numerical and physical models that are being developed in the framework of the study on density currents on the one hand, but which could also contribute to the knowledge of the behaviour of density currents in the river Scheldt, and more specifically around the areas of the Kallo Lock and the future Deurganckdok.

Table 1 gives a survey of themeasurement campaign and the resulting factual data reports. Appendix 4 is a survey of the entire measurement plan, with the locations of the through tide measurement campaigns and the long-term measurement locations.

This report is the factual data report of the long-term salinity and current measurements that took place at the following locations during June 2002 : Lillo -Ponton, Deurganckdok, Oosterweel (2), Petroleumsteiger and Schelle. The measurement data for the locations Zandvlietsluiswere at the completion of this report still lacking. An interpretation and analysis of the measurement data will be made in the analysis report (I/RA/11216/02.045/CMA), which is in preparation.

Measurement Location	Measurement Period	Type of Measurement	Report number
Waarde	5/06/2002	Through tide current and salinity measurement	I/RA/11216/02.037/CMA
Waarde	12/06/2002	Through tide current and salinity measurement	I/RA/11216/02.038/CMA
Oosterweel	5/06/2002	Through tide current and	I/RA/11216/02.039/CMA

		salinity measurement	
Oosterweel	12/06/2002	Through tide current and salinity measurement	I/RA/11216/02.040/CMA
Deurganckdok	5/06/2002	Through tide current and salinity measurement	I/RA/11216/02.041/CMA
Deurganckdok	12/06/2002	Through tide current and salinity measurement	I/RA/11216/02.042/CMA
Kallo	5/06/2002	Through tide current and salinity measurement	I/RA/11216/02.043/CMA
Kallo	12/06/2002	Through tide current and salinity measurement	I/RA/11216/02.044/CMA
Oosterweel (2) Lillo-Ponton Deurganckdok Schelle *Zandvliet* Petroleum steiger	June 2002	Long term current and salinity measurement	I/RA/11216/02.046/FDK
Kallo	June 2002	Long term current and salinity measurement	I/RA/11216/02.047/FDK
Merelbeke	June 2002	Discharge measurement	I/RA/11216/02.029/CMA
Analysis and Interpretation of the Measurement data			I/RA/11216/02.045/CMA

Table 1: survey of the measurement campaigns that have been conducted for the study on density currents in the river Scheldt. Print in italic denotes incomplete datasets.

1.3 The report

The first chapter forms the introduction, with a short description of the measurement campaign. Chapter 2 describes the measuring equipment used. Chapter 3 includes the proceedings of the measurement campaign. In chapter 4 the processing of the data set and the measurement results are presented.

2 THE MEASUREMENT CAMPAIGN

2.1 Description of the measurement campaign

The long term measurements took place during June 2002. Table 2 gives the exact coordinates of the instruments, the depth of the instrument, the bottom depth at the measurement location and the period during which the measurements took place. All instruments (except Schelle) measured continuously during the entire month. The measurements at Oosterweel, Lillo-Ponton and Petroleumsteiger were carried out using fixed measurement stations from Afdeling Maritieme Toegang (AMT), the measurements at Deurganckdok and Zandvlietsluis were temporary measurement stations, actived for this particular measurement campaign. The measurements at Schelle were carried out by Medida

The measurements at Schelle were interrupted after the first fortnight to control theinstrument and renew the battery pack. All other stations measured continuously.

2.2 The equipment

Appendix 2 gives the details of the equipment.

2.2.1 Oosterweel

At Oosterweel , the measurements were carried out using two sets of Anderaa RCM9 at 2 fixed depths (see Table 2). The devices were set as to record every 10 minutes a string containing the time, flow velocity and direction, the temperature, pressure and conductivity.

2.2.2 Lillo-Ponton

At the measurement station of Lillo-Ponton, the measurements were carried out with the help of an Anderaa RCM 9. The device was set as to record every 10 minutes a string containing the time, flow velocity and direction, the temperature, pressure and conductivity. Contrary to the proposal of IMDC, but consistent with the normal measuring procedure in Lillo of AMT. The Anderaa was not fixed at a certain depth but was hanging from a floating pontoon at a depth of 2 m below the surface. This makes the Z-value (depth of the measurement) variable over time.

2.2.3 Near Deurganckdok (bouy 84)

At Deurganckdok,an Anderaa RCM9 was fixed at a height of 3 meters above the bottom. The instrument was placed by divers at the river bottom, connected to two concrete blocks for stabilisation and was kept in place with the help of a floatable bouy. As at Lillo-Ponton and Oosterweel, every ten minutes a string was recorded containing the time, flow velocity and direction, the temperature, pressure and conductivity.

2.2.4 Schelle

At Schelle, a frame was deployed containing a UMI (Underwater Marine Instrument). This unit is provided with following sensors: conductivity, temperature, absolute pressure, an EM point-currentmeter consisting of 2 -axis Hall sensors and a magnetic compass, and an external D&A OBS-3 turbidity sensor.

2.2.5 Petroleumsteiger

At Petroleumsteiger , the measurements were carried out using a Valeport 602 , at a fixed depth of –6.8 mTAW(see Table 2). The devices were set as to record every 10 minutes a string containing the time,the temperature, pressure and conductivity.

2.2.6 Zandvlietsluis

The data for the measurement stations Zandvlietsluis proved unreliable.

3 PROCEEDINGS OF THE MEASUREMENTS

3.1 Measurement periods

Name	Utm-x (ed50)	Utm-y (ed50)	Depth of instrument (mTAW)	Bottom depth (mTAW)	From	Till
Oosterweel*	595769	5677280	-4.6	-6.2	01/06/2002 00:00	30/06/2002 24:00
Oosterweel*	595769	5677280	-2.6	-6.2	01/06/2002 00:00	27/06/2002 13:40
Lillo-Ponton*	589795	5684420	**	-4.8	01/06/2002 00:00	30/06/2002 24:00
Deurganckdok	589020	5686185	-5.7	-8.7	01/06/2002 00:00	30/06/2002 24:00
Schelle (first period)	592181	5664904	-5	-6.26	28/05/2002 15:20	10/06/2002 11:40
Schelle (second period)	592181	5664904	-5	-6.14	10/06/2002 13:30	2/07/2002 10:20
Petroleumsteiger	594490	5673012	-6.8	-7.8	01/06/2002 00:00	30/06/2002 00:00
Zandvlietsluis*/***	-	-	-	-	-	-

Table 2 Measurement locations and periods.

3.2 Hydro-meteorological conditions, freshwater discharges and dredging activities during the measurement campaign.

3.2.1 Vertical tide during the measurement

Appendix 1 gives the tidal data for 1/06/2002 till 30/06/2002 for the measurement locations:

- Zandvliet
- Liefkenshoek
- Kallo
- Oosterweel
- Antwerpen
- Hemiksem
- Schelle

The tidal data were collected by Afdeling Maritieme Toegang.

3.2.2 Meteorological data

Appendix 3 gives the meteorological conditions for the measurement station Deurne for the period 1/06/2002 till 30/06/2002.

* permanent station of AMT
** the measurement at Lillo was carried out with a suspended device, 2m below water surface
*** data not processed in this report due to missing details

3.2.3 Freshwater discharges

The freshwater discharges during the measurement campaign were registered at various locations for the period 1/06/2002-30/06/2002
Hourly averaged values are available for the following locations : Aarschot, Vilvoorde, Grobbendonk, Wygmaal, Eppegem, Hulshout, Liezele, Malderen and Melle.
Daily averaged values are available for the following locations : Haacht and Dendermonde.

3.2.3.1 Discharge Measurement at Merelbeke

From 10/06/2002 untill 17/07/2002, discharge measurements were carried out at the weir in Merelbeke. Discharge was measured using a combination of a horizontal ADCP and a vertical ADCP. A detailed report of the measurement and the results can be found in report I/RA/11216/02.029/CMA.

3.2.4 Dredging information

Dredging information was provided from the BIS system (bagger informatie systeem) for the days 05/06/2002 and 12/06/2002. The detailed listings can be found in

4 PROCESSING OF THE DATASETS

4.1 Methodology of processing

In the following chapter the results of the measurements will be discussed, as well as the processing of the data. The measurements results from the Schelle location were partly processed by Medida. All other measurements were processed by IMDC.

4.1.1 Oosterweel

The data set was controlled visually. The salinity was calculated from the temperature, pressure and conductivity using the pps-78 formula (UNESCO,1991). Appendix 11 gives the calculation procedure. In case conductivity data showed anomalies, the calculated salinity was set to –999. The conductivity values themselves were not changed. As a pressure value is needed for the calculation of the salinity, and no tidal data were available for the periods 07/06/2002 and 23/06/2002 no salinity values were calculated for these days.

The tidal data are the tidal data for the measurement station Oosterweel, provided by AMT.

The measured current direction recorded at the uppermost measurement device (-2.6mTAW) has a constant difference of 30 ° with the lowermost measuremen device (-4.6mTAW). Both datasets were compared to the results of long term measurement campaigns of 97-98 5IMDC, 1999a & 1999b). This proved the lowermost to be the most reliable dataset. The directional data from the lowermost device were therefore not included in the plots.

Further processing of the data included:

- Plotting of the temperature and salinity data against time, plotting of the flow velocity and direction against the time, together with the tidal data (one plot per week)

Appendix 5 gives the results of the processing for the Oosterweel data set.

4.1.2 Lillo-Ponton

The data set was controlled visually. The salinity was calculated from the temperature, pressure and conductivity using the pps-78 formula (UNESCO,1991). Appendix 11 gives theprocedure. During the validation, directional values that proved unreliable were set to the dummy value –999. The plots show graphs which differ in shape from the Oosterweel graphs since the instruments more upward and downward during the tidal cycle

The tidal data are the tidal data for the measurement station Liefkenshoek, provided by AMT.

Further processing of the data included:

- Plotting of the temperature and salinity data against time, plotting of the flow velocity and direction against the time, together with the tidal data (one plot per week)

Appendix 6 gives the results of the processing for the Lillo-Ponton data set.

4.1.3 Near Deurganckdok (bouy 84)

The data set was controlled visually. The salinity was calculated from the temperature, pressure and conductivity using the pps-78 formula (UNESCO,1991). Appendix 11 gives the calculation procedure. All data proved reliable.

The tidal data are the tidal data for the measurement station Liefkenshoek, provided by AMT.

Further processing of the data included:

- Plotting of the temperature and salinity data against time, plotting of the flow velocity and direction against the time, together with the tidal data (one plot per week)

Appendix 7 gives the results of the processing for the Deurganckdok data set.

4.1.4 Schelle

The data set from the UMI was processed by Medida. Validation by IMDC showed that at 22/06/2002 the frame containing the sensors must have toppled. The measured values for flow velocities and directions prove unreliable from that moment on and were set to the dummy value –999. The values for the salinity and temperature show no anomalies.

The salinity was calculated from the temperature, pressure and conductivity using the pps-78 formula (UNESCO,1991). From the recorded flow velocities in X and Y directions and the data derived from the internal compass, resulting flow velocities were calculated.

Further processing of the UMI data included:

- Plotting of the temperature and salinity data against time, together with the tidal data (one plot per week)
- Plotting of the flow velocity and direction against time, together with the tidal data (one plot per week)

As the two sensors (EM current meter and salinity probe) were situated at a different height above the bottom, it was preferred to split the further processing of both datasets.

Appendix 9 gives the results of the processing

Because of possible small deviations in the tidal record, the instability of the bottom frame and the tolerance on the atmospheric pressure, the depth of the observation point might vary over the measurement period.

4.1.5 Petroleumsteiger

The data set was controlled visually. The salinity was calculated from the temperature, pressure and conductivity using the pps-78 formula (UNESCO,1991). Appendix 11 gives the calculation procedure. All data proved reliable.

The tidal data are the tidal data for the measurement station Liefkenshoek, provided by AMT.

Further processing of the data included:

- Plotting of the temperature and salinity data against time, together with the tidal data (one plot per week)

Appendix 8 gives the results of the processing for the Petroleumsteiger data set.

4.1.6 Zandvlietsluis

No data were available for the Zandvlietsluis data set.

4.2 Storage of the data

The contents of the folder “Long term” in the CDROM 11216-1 are the following directories:

-RA02.046-BenedenZeesch : the electronic version of this report
-long term measurements :

-dectdveln.txt : long term flow and salinity measurements at Deurganckdok
-lictdveln.txt : long term flow and salinity measurements at Lillo-Ponton
-pectdn.txt : long term salinity measurements at Petroleumsteiger.
-ooctdvelan.txt : long term flow and salinity measurements at Oosterweel, lowermost measurement device (-4.6mTAW)
-ooctdvelbn.txt : long term flow and salinity measurements at Oosterweel ,
-scctd1n.txt & scctd2n.txt : long term salinity measurements at Schelle;
-scvel1n.txt & scvel2n.txt : long term point velocity measurements at Schelle

Appendix 12 gives the organisation of the files.

5 REFERENCES

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APPENDICES