Ministerie van de Vlaamse Gemeenschap
Departement Leefmilieu en Infrastructuur
Afdeling Waterwegen en Zeewezen
Afdeling Waterbouwkundig Laboratorium en Hydrologisch Onderzoek

STUDIE DENSITEITSSTROMINGEN IN HET KADER VAN LTV

LANGDURIGE STROOM- EN SALINITEITSMETING TE KALLO 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 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 at Kallo 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 access channel to the Kallo Lock and the future Deurganckdok on the other hand.

Table 1 gives a survey of the measurement 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 with a point velocity meter (electromagnetic) and a vertical doppler profiler (NDP) that took place at Kallo from May 28th till July 2rd 2002. 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 salinity measurement	I/RA/11216/02.039/CMA
Oosterweel	12/06/2002	Through tide current and salinity measurement	I/RA/11216/02.040/CMA
Deurg anckdok	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
Zandvliet	June 2002	Long term current and salinity measurement	I/RA/11216/02.046/FDK
Lillo-Ponton			
Deurganckdok			
Schelle			
Waarde			
Petroleum steiger			
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 of the 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.

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 current measurement took p lace from May 28th 2002 until July 2nd and salinity measurement from May 28th 2002 until June 29th MET and was carried out by Medida.

The purpose of the measurements was to determine the variation in the vertical structure of the velocity distribution from neap to spring tide as well as the variation of the salinity during successive tidal cycles.

Two frames were placed near Kallo: a first frame containing a Nortek stationary 1.5 Mhz vertical beam current meter, a second with an UMI-2SB10 stationary data logger, containing the following sensors: conductivity, temperature, absolute pressure and an EM current meter. The measurement series were interrupted once for checking on the measurements and changing the batteries.

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.
Appendix 5 gives a detailed map of the measurement localisation.

2.2 The measuring equipment

Appendix 2 gives the set up and the details of the equipment.

The UMI-2SB10 stationary data logger is mounted in a dedicated stainless steel squared bottom-frame. The unit is provided with following sensors: conductivity, temperature, absolute pressure, an EM point-current meter consisting of 2-axis Hall sensors and a magnetic compass, and an external D&A OBS-3 turbidity sensor. The instrument has been calibrated by the manufacturer on all sensors.
The system is managed by an internal software "MarineData"-package for programming, timing, recording, calibrating and data extracting purposes.
Calculated parameters are the salinity (from CTD) and the current speed & - direction.
A separate special battery set BPP-4 provides the required power supply.

The NDP-unit is provided with a Doppler vertical beam current meter, a magnetic compass, a temperature sensor and an absolute pressure sensor. Special software packages such as "Deploy" and "ExploreP" were used to enable programming, timing, recording, calibrating and data extracting purposes.
The NDP is mounted on a dedicated gimbal-stand inside a tripod bottomframe. A separate battery set provides the required energy to the system.

3 THE MEASUREMENTS

3.1 Measurement periods

Table 2 gives the measurement periods for both frames, as well as the coordinates (UTM-ed50) of the measurement frames. As was already mentioned in 2.1 the measurements were interrupted once. After 14 days of, the instruments were taken on board for data logging and checking the condition of the instrument (batteries, damage, fouling). These interruptions lasted for about 6 hours.

Position UTM31 ED 50	**Equipment**	**Start logging in the water**	**End logging in the water**	**Parameters**
Kallo: NDP period 1 X= 591254 Y=5680761 Z=-8.62mTAW	NDP N-4674	Date:28/05/2002 Time: 12:50:43	Date:10/06/2002 Time: 10:10:43	Pressure current speed (profiling) current direction (profiling)
Kallo : NDP period 2 X= 591210 Y=5680727 Z=-9.12mTAW	NDP N-4674	Date:10/06/2002 Time: 14:54:38	Date:02/07/2002 Time: 09:34:38	Pressure current speed (profiling) current direction (profiling)
Kallo : UMI period 1 X=591254 Y=5680761 Z=-8.54mTAW (CTD) Z=-8.67mTAW (speed/direction)	UMI : # 2166	Date:28/05/2002 Time: 12:50:02	Date:10/06/2002 Time: 09:50:02	Pressure conductivity temperature turbidity current speed (point measurement) current direction (point measurement)
Kallo : UMI period 2 X=591206 Y=5680726 Z=-9.28mTAW (CTD) Z=-9.41mTAW (speed/direction)	UMI : # 2165	Date:10/06/2002 Time: 15:30:02	Date:29/06/2002 Time: 11:50:02	Pressure conductivity temperature turbidity current speed (point measurement) current direction (point measurement)

Table 2: The measurement periods and coordinates of the frames for the long term measurement at Kallo

3.2 The NDP measurements

The set up of the instrument was such that every 10 minutes, a vertical profile was recorded. For every profile, the survey time and the current data per cell were recorded. Every profile ran from 1.1 meter above the bottom to 0.5 m under the water surface. A pressure sensor was used to determine the depth of the water column.

3.3 The UMI 2SB10 measurements

The UMI-2SB10 stationary marine data logger was provided with a CTD sensor and an EM current meter consisting of 2 -axis Hall sensors and a magnetic compass. Every 10 minutes one line of data string was recorded.
The data string consisted of the following: survey time, pressure, temperature, conductivity, salinity, current X, current Y, current speed and current direction.

3.4 Hydro-meteorological conditions during the measurement campaign.

3.4.1 Vertical tide during the measurement

Appendix 1 gives the tidal data for 1/06/2002 till 30/06/2002 for the measurement location Kallo. The tidal data were collected by Afdeling Maritieme Toegang.

3.4.2 Meteorological data

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

4 PROCESSING OF THE DATASETS

4.1 Methodology of processing

In the following chapter the results of the NDP and UMI measurements will be discussed, as well as the processing of the data. The processing of the data was partly carried out by Medida.

4.1.1 Processing of the NDP results

Matlab 6.1 was used to link the NDP files with the data of the pressure sensor (which was used to determine the depth of the water column). As the NDP data recorded in cell just below the water surface are deemed unreliable, a trimming of the cells at 0 to 0.5 meter below the water surface was performed.

Further processing of the NDP data included:

- Drawing a contouring map of the flow velocities (per 2 days) over the water column
- Drawing a contouring map of the flow direction (per 2 days) over the water column

4.1.2 Processing of the UMI results

The CTD probe measured the conductivity, temperature and pressure; the salinity was calculated out of these measured parameters with the formulas of the practical salinity scale (for the formulas please see Appendix 8). A Matlab routine was used to link the CTD data with the data of the pressure sensor (used to determine the depth of the water column) and the tidal conditions.

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

Although the two sensor (EM current meter and salinity measurement) were situated at a sligthly different height above the b ottom, (0.6 m and 0.73 m respectively) salinity and velocity are plotted in the same graphs.(see Appendix 7)

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

4.2 Storage of the data

The contents of the folder “Kallo long term” in the CDROM 11216-1 are the following directories:
-RA02047-LangdurigKallo062002 : the electronic version of this report
-“Processed NDP data”:
KaVNDP1: processed NDP data in the agreed format

KAVNDP2: processed NDP data in the agreed format
KAVNDP3 : processed NDP data in the agreed format

-“processed ctd data” :

KaCTD1 : processed CTD data in the agreed format
KaCTD2 : processed CTD data in the agreed format

-“processed point velocity measurements”:

KaVel1 : processed point velocity measurement data in the agreed format
KaVel2 : processed point velocity measurement data in the agreed format.

Appendix 9 gives the organisation of the files.

5 REFERENCES

N.P.Fotonoff and R.C.Millard Jr (1983) Algorithms for computation of fundamental properties of seawater, Unesco technical papers in marine science, Unesco 1983.

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Medida(2002) Long term current and conductivity measurements at Schelle and Kallo from 28/05/2002 till 29/06/2002 (v010med-2002)

Meyvis en Claessens (1991) Overzicht van de tijwaarnemingen in het Zeescheldebekken gedurende het decennium 1981-1990

Unesco (1991) Processing of Oceanographic Station Data

APPENDICES