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Agenda voor de Toekomst
Waves in the estuary

Analysis of wave measurements at Saeftinghe

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Analysis of wave measurements at Saeftinghe

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Abstract

One of the questions within the Agenda for the future research is the importance of waves in the estuary. To estimate these, terrain measurements are necessary. Within project 14_082 : "Waves in the estuary", several measurement campaigns are foreseen, both in the Western Scheldt (Saeftinghe, Hooge Platen) as in the Sea Scheldt (Appels, Notelaer). This report describes the measurements performed at the location of Saeftinghe, in combination with the recorded ship traffic during the same period.

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1 Nederlandse Samenvatting

In de periode 2014-2017 werd het vier jaar durend onderzoeksprogramma “Agenda voor de Toekomst” van het Schelde-estuarium uitgevoerd. Deze Agenda voor de Toekomst kwam tot stand in het kader van de eerste evaluatie van het Verdrag gemeenschappelijk Beleid en Beheer. De Vlaams-Nederlandse Scheldecommissie heeft met deze Agenda ingestemd op de najaarsvergadering van 2013.

Hierop volgend werd een Plan van Aanpak (Beirinckx *et al.*, 2014) opgemaakt, dat de leidraad is voor het onderzoek 2014-2017. Voorliggend rapport kadert in het onderzoek dat het doel heeft de kennis inzake golfbelasting op slikken en schorren te verbeteren. In dit rapport, kaderend binnen project “14_082: Golven in het estuarium” worden de metingen te Saeftinghe besproken.

De metingen werden uitgevoerd aan de oostelijke zijde van het Verdronken Land van Saeftinghe, zoals is aangegeven in Figuur 1. Het druktoestel, is geplaatst nabij de laag waterlijn (+ 0,56 m TAW), tussen de schorrand en de oeverbescherming. De metingen worden uitgevoerd aan een frequentie van 20 Hz. Voor de winddata werd gebruikt gemaakt van VMM data, gemeten te Melsele, op ongeveer 14 km in vogelvlucht van de meetlocaties te Saeftinghe. De atmosferische drukmetingen werden eveneens van deze locatie gebruikt. Voor het splitsen van de data per getijcyclus, werd gebruik gemaakt van de tijmetingen te Prosperpolder.

De winddata worden elke 15 minuten geregistreerd. De gemiddelde windsnelheid gedurende de meetcampagne, lopende van 20 juli tot 23 augustus 2016, bedroeg 1,12 m/s uit noord – noord-oostelijke richting. Een maximale wind werd gemeten van ca. 8 m/s uit noord-oostelijke richting, een minimale windsnelheid van 0,5 m/s. Deze lagere windsnelheden zijn niet uitzonderlijk gedurende een dergelijke zomerperiode.

De ruwe drukdata worden gemeten aan 20 Hz. In 5 stappen worden deze ruwe data omgezet in bruikbare drukmetingen :

1. Compensatie van ruwe data m.b.v. atmosferische drukmetingen en conversie naar waterhoogtes, met TAW als referentieniveau
2. Correctie van de meetseries gebruik makende van een diepte-afhankelijk drukcorrectie
3. Verdeling van de tijdseries per getijcyclus
4. Low-pass filter om het getijsignaal te scheiden van de waterfluctuaties
5. Berekening van de individuele golfkarakteristieken per getijcyclus op basis van de waterfluctuaties

In totaal werden de drukmetingen uitgevoerd over 64 tijcycli. De significante golflengte $H_{1/3}$ per getijcyclus varieert gedurende de meetcampagne tussen 5,5 cm en 9 cm. Voor drie tijcycli bedraagt de significante golfhoogte ca. 10 cm. Voor de maximale golfhoogte ligt het grootste deel van de metingen tussen 40 en 90 cm. Een vijftal maximale metingen van H_{max} variëren tussen 1 en 1,15 m. Voor de significante golfperiode, $T_{1/3}$ is de variatie tussen 4 en 6 s.

AIS of ‘Automatic Identification Systems’ is een systeem om schepen te identificeren en te volgen. Op geregelde basis sturen schepen informatie omtrent hun positie, locatie en richting. Hiernaast is ook statische informatie zoals mmsi nummer en afmetingen beschikbaar in een database. Om de informatie werkbaar te houden, wordt de informatie gefilterd op een bepaalde plaats. Zo wordt een ‘entry line’ gecreëerd in het verlengde van de meetpositie, zoals aangegeven in Figuur 15, waarop de data gefilterd wordt. De data (snelheid, richting, positie) van de schepen die deze ‘entry line’ kruisen wordt geselecteerd, en dit voor het signaal uitgezonden op het punt het dichtste bij die ‘entry line’.

Gedurende de meetcampagne werden 5877 scheepspassages opgemeten langs de meetlocatie, afkomstig van 2117 verschillende schepen. Ongeveer 50 % van de passages was voor de rekening van cargoschepen, 30 % waren tankerschepen. Eveneens kan op basis van de statische informatie een verdeling van de scheeps-lengte en breedte worden afgeleid. Ongeveer 65 % van de passages gebeurde door schepen met een lengte varierende tussen 51 en 150 m. Voor de grootste categorie, 350 – 400 m, wordt een gemiddelde van ca. 3 schepen per getij waargenomen. De meest voorkomende breedte van de schepen ligt in de klasse van 11 tot 20 m. Eveneens wordt de diepgang van de schepen weergegeven. Deze data wordt echter handmatig ingegeven door de bemanning, en is bijgevolg minder betrouwbaar dan de overige informatie uit de AIS database.

In hoofdstuk 6 worden de drukdata gekoppeld met de scheepsdata. Aangezien een grote hoeveelheid schepen passeert gedurende een korte periode, zullen de scheepsgolven van verschillende schepen interfereren. Om een duidelijke relatie te vinden tussen de schepen en zijn scheepskarakteristieken, werden periodes met een lengte van 9 minuten geselecteerd waarin slechts één schip passeerde. Deze periode van 9 minuten werd in Kolokythas et al. (2016) geselecteerd op basis van visuele observatie en vergelijking van de golfkarakteristieken voor kortere en langere periodes. In totaal werden 496 events geselecteerd. In Figuur 24 worden de scheepskarakteristieken snelheid, scheepslengte, afstand tussen de meetlocatie en het schip en het waterniveau gerelateerd met de maximale waterhoogte van de secundaire scheepsgolf. Er konden geen duidelijke relaties worden afgeleid. Eveneens werd een gelijkaardige selectie gemaakt voor grote schepen (> 200 m), waarbij voornamelijke gefocust wordt op de primaire scheepsgolf. Eveneens werd hier een relatie gezocht tussen de golfhoogte en de scheepskarakteristieken. Ook hier kon geen duidelijke relatie worden gevonden tussen deze variabelen.

In hoofdstuk 7 worden de periodes geselecteerd van 30 minuten waarin geen scheepspassages werden waargenomen. Het golfklimaat gedurende een dergelijke periode wordt als representatief beschouwd voor golven die opgewekt zijn door wind. De significante golfhoogte voor deze periodes varieerde tussen enkele centimeters tot maximaal 10 centimeter. De maximale golfhoogtes varieren tussen 2 - 3 cm tot ca 16 cm. Geen duidelijk verband tussen deze golfhoogtes en de windsnelheid of windrichting konden worden vastgesteld.

2 Introduction

In the period 2014-2017 the four-year research program "Agenda for the Future" of the Scheldt estuary was executed. This Agenda for the Future was created as part of the first evaluation of the Treaty Common Policy and Management. The Flemish-Dutch Scheldt Commission (VNSC) has approved this agenda at the autumn meeting of 2013. Following this, an action plan was decided (Beirinckx et al., 2014), which served as the guide for the study from 2014 to 2017. The present report is part of the research that aims to improve the knowledge of wave loading on intertidal areas. In this report, within project "14_082: Waves in the estuary", measurements at Saeftinghe will be discussed.

Waves can be caused by meteorological conditions (wind waves) as by sailing ships (ship waves). In this report the importance of wind- and ship waves is investigated. The relation between wind speed and direction on wave heights is determined. Also a link between the ship characteristics (length, width, speed, distance from the mud flat) and the wave height characteristics is investigated.

In Chapter 3, the location of the field measurements, the devices used in the intensive measuring campaign and the main measurement settings, are presented. Wave and wind data that were recorded during the measuring campaign are included in Chapter 4. Particular attention is paid in the analysis of the wave data measured by high-frequency pressure sensors, which are used in the ship and wind wave analysis. In Chapter 5, information about the shipping traffic during the measuring campaign in the investigated area, is analyzed. The processed information, which included static (type, length, beam, etc.) and dynamic (speed, course, draught, etc.) data about the total amount of ships, was retrieved by the database of the AIS (Automatic Identification System) tracking system. Then, in Chapter 6, the coupling of the wave measurements with the ship passages, is presented. Chapter 7 includes the implementation of a similar methodology for the coupling of the measured wind data with the wave measurements. Finally, in Chapter 8, the conclusions resulting from the ship- and wind-wave analysis are presented.

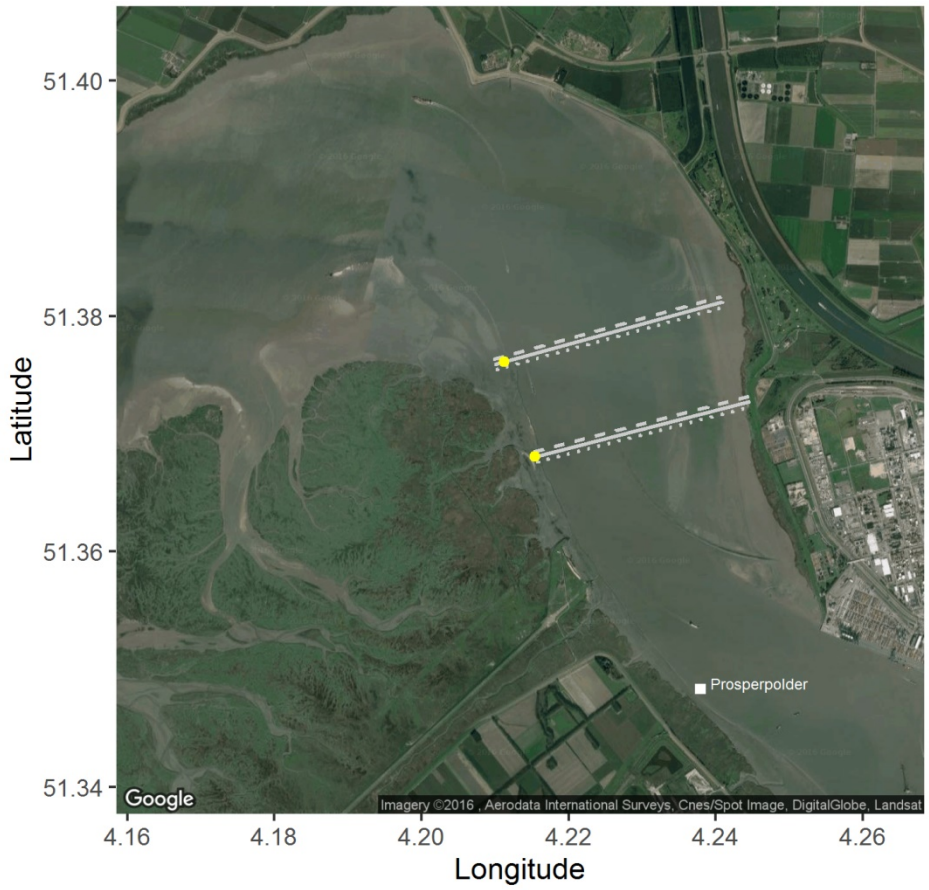
3 Field description

3.1 Saeftinghe and measurement locations

The “Verdronken Land van Saeftinghe” is a nature reserve, consisting of mudflats and tidal marshes, boardering the Western Scheldt. At the east side of the area, between the turn of Bath and the Dutch-Belgian boarder, the navigation channel in the Scheldt is located close to the intertidal areas of Saeftinghe. This area is shown in Figure 1, together with an indication of the measurement positions (yellow dots).

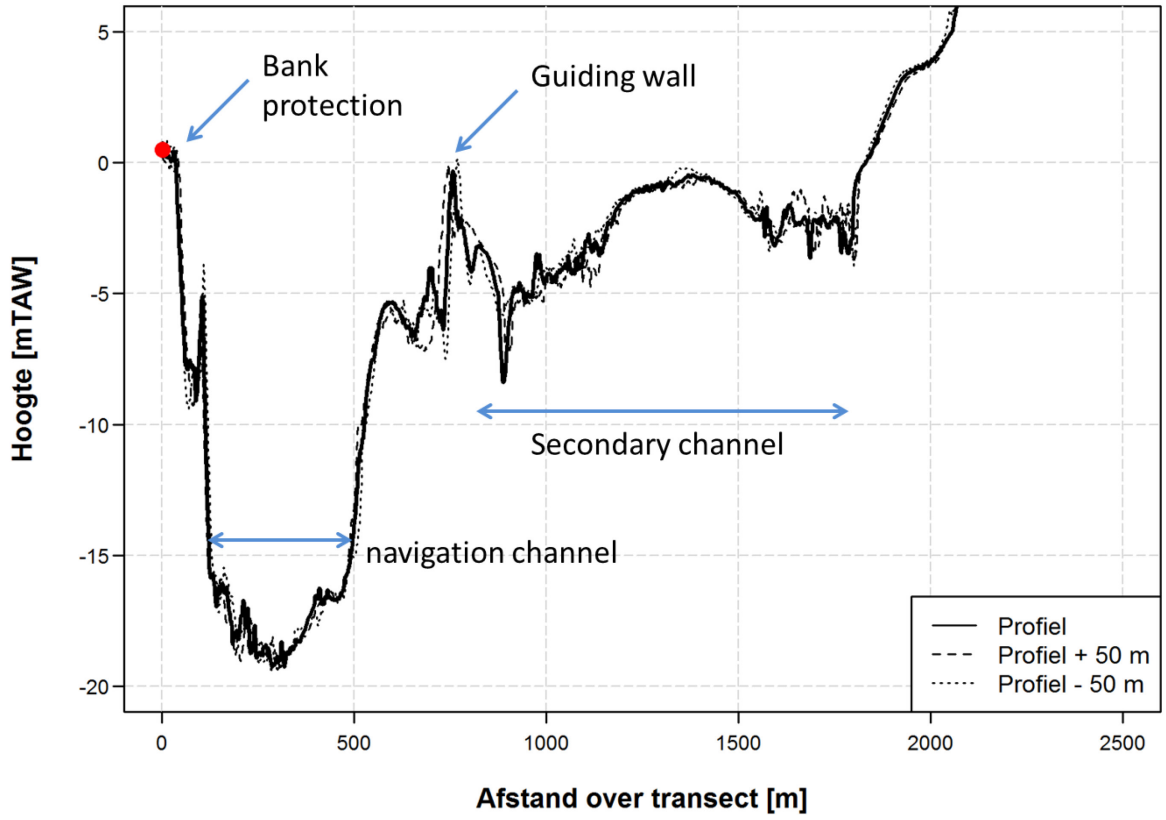
Within the annual evaluation of the monitoring data within the the channel enlargement project “flexibel storten”, the RTK transect at the eastern side of Saeftinghe showed important dynamics. To get a better insight in the processes leading to the marsh edge erosion, this field location was included in the measurement campaigns within the project 14_082: “Waves in the estuary”.

Figure 1 – Measurement positions at Saeftinghe (yellow dots). The position of the cross-sections is also indicated.



The close location of the channel fairway can be observed in Figure 2, which is the cross-section at Saeftinghe – South, as indicated in Figure 1. The first peak in the profile indicates the presence of a bank protection for the intertidal area. At around 750 m another peak can be observed which is a "leidam", constructed in the seventies, to guide the ebb flow to the shipping channel.

Figure 2 – Cross-sectional profile of the river at the measurement location of Saeftinghe-Zuid, together with profiles 50 m up- and downstream as indicated in Figure 1. The position of the sensors are indicated with a red dot.



3.2 Measurement settings

Intertidal measurements

Both pressure sensors, Aquadopps© and a Sedsensor are deployed during the measurement campaign, which lasted from 20th of July till 23rd of August 2016. A set of each was placed on a position north (see Figure 1), another was placed on a position approximately 1 km southward (position south, Figure 1).

Figure 3 – Measurement instruments (NIOZ sedsensor, Aquadopp© and pressure sensor) at Saeftinghe-South location

The sedsensor is developped by NIOZ and measures the height of the mudflat. Optical sensors are measuring the light intensity. Sensors above the ground level capture sunlight, below the ground level no light is detected. As such the interface, thus ground level, can be detected at all low water moments during daylight. As this measurement was a test for the sed sensors to work with an additional light source, the data of this instrument will not be discussed.

The Aquadopp© is deployed to measure the velocities above the instrument on the tidal flat. The results of the Aquadopp© measurements, both at the north and south measurement location of Saefinghe are described in Meire et al., 2019.

The pressure sensors (OSSI-010-003 B/C instruments) measure at a frequency of 20 Hz. The measurement instrument works continuously, except for 20 seconds per day, where the data are saved. Unfortunately, one of the instruments did not generate data during the measurement campaign. As such, only the data collected at the south location are described in this report.

Additional measurementsNext to the main measurements, some additional measurements are necessary for the analysis, which are taken from monitoring posts.

The tidal data are retrieved from the tidal gauge at Prosperpolder. This gauge is located approximately 2 km southward of the south location at Saeftinghe.

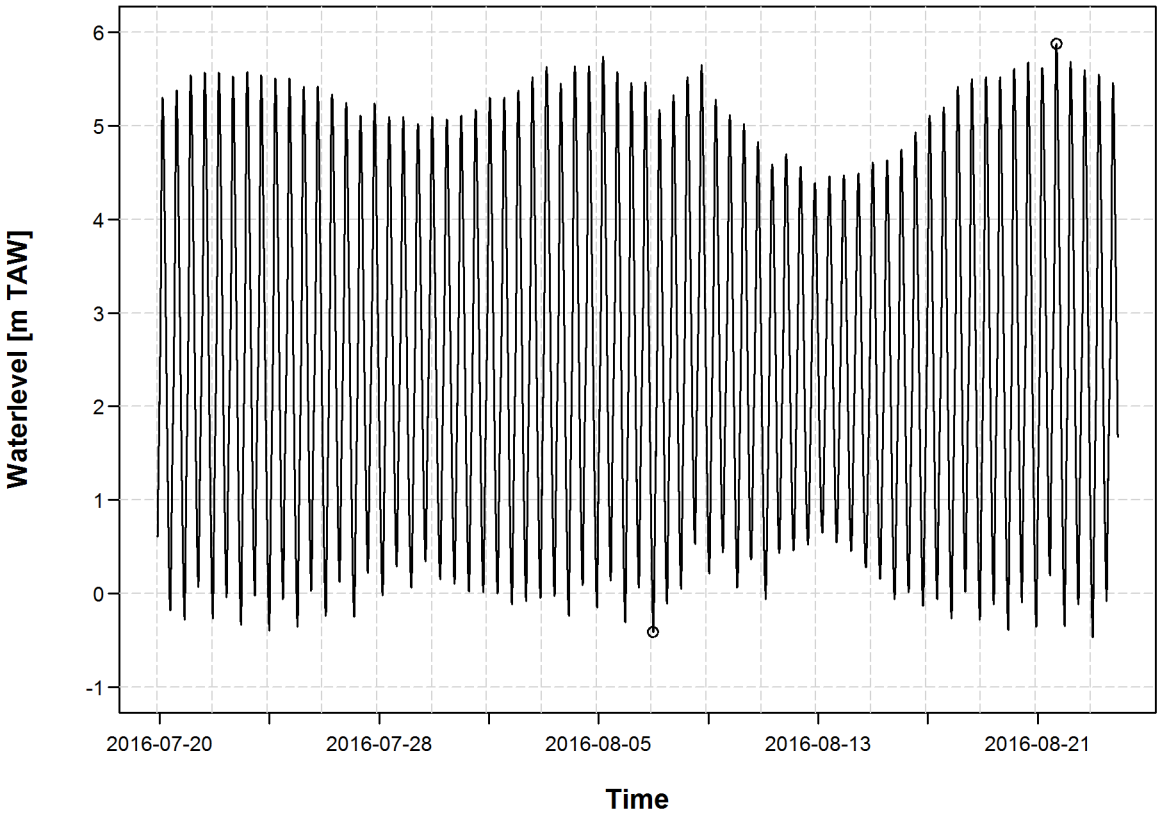
For the necessary meteorological information, namely wind and atmospheric pressure, the closest measurement station in Flanders, of the Flanders Environment Agency (VMM) is used. This measurement station (ME04_001) is located approximately 13 km south of the measurement location at Saeftinghe.

4 Measurements

4.1 Tidal measurements

In Figure 4 an overview of the tidal measurements at Prosperpolder is shown. The average high water is 5.26 m TAW, the average low water 0.03 m TAW. This leads to an average tidal range of 5.23 m. Compared with the average tidal range of 5.01 m during the period 2001- 2010 (Vanlierde et al., 2016), the tidal factor during the concerned period is 1.04. The maximum high water during the measurement period is 5.88 m TAW, the minimum low water -0.41 m TAW. Both points are also indicated in Figure 4.

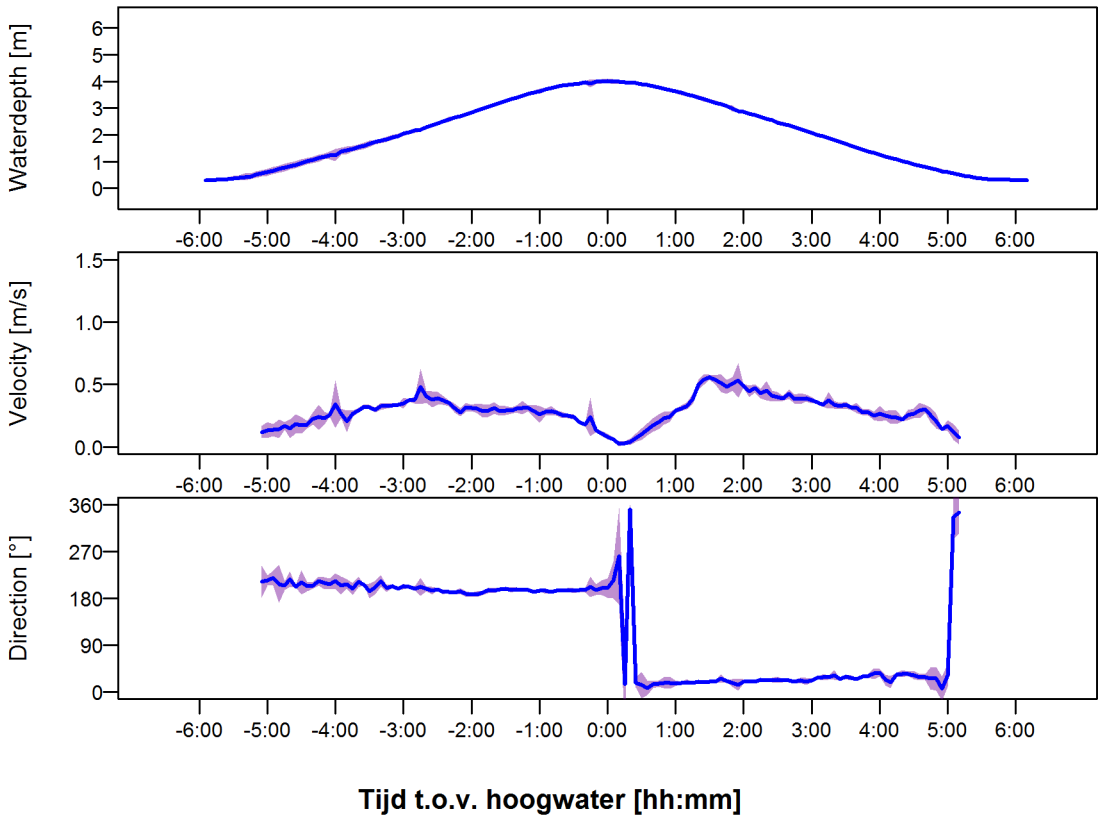
Figure 4 – Tidal measurements at Prosperpolder during the measurement campaign (20/07/2016 – 23/08/2016)



4.2 Velocity measurements

In Figure 5 a representative evolution of the waterdepth above the aquadopp is shown, together with the evolution of the depth – averaged velocity and the velocity direction. It can be seen that the maximum velocity is in general small, with maxima around 0,5 m/s. The velocities during ebb are larger compared to the velocities in the flood phase. The velocity data are described more in depth in Meire et al. (2019).

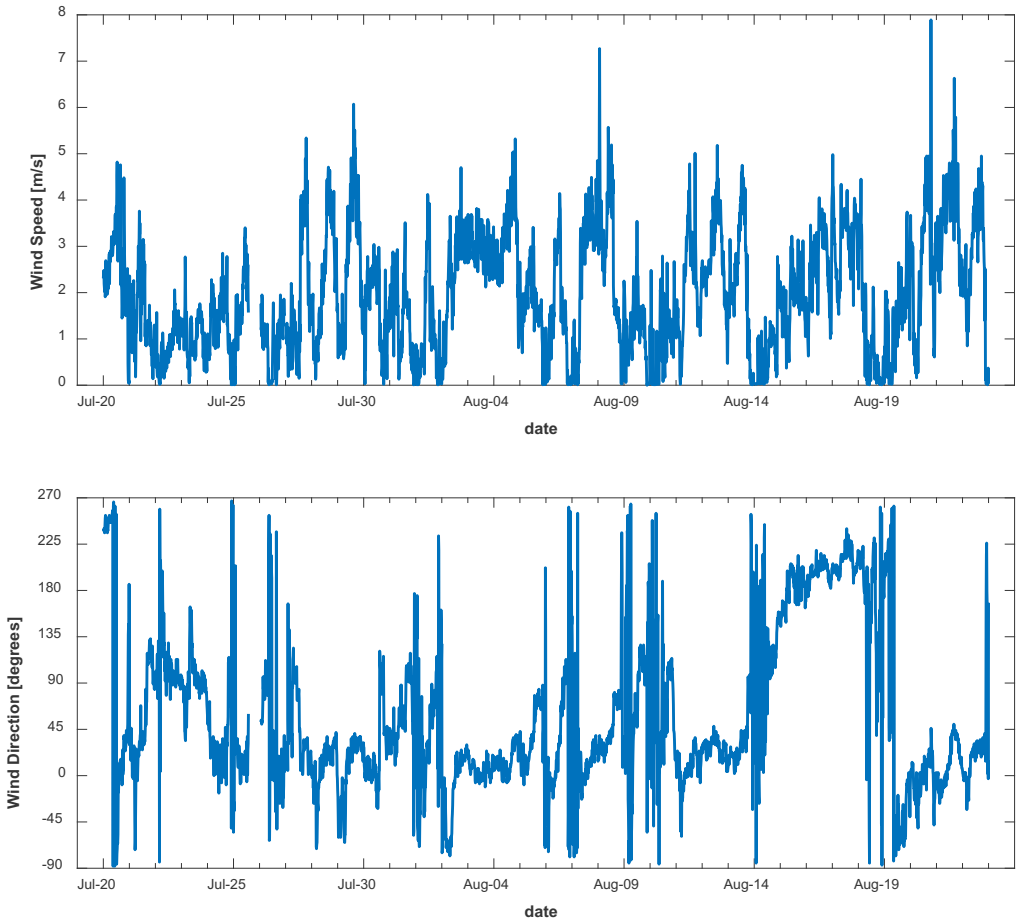
Figure 5 – Evolution of the waterdepth, water velocity (m/s) and direction (°) of the for tides with a higher tidal range.



4.3 Wind measurements

Wind measurements are performed by VMM (Flanders Environment Agency) at Melsele, at a height of 10 m above ground level. The period of the measurements considered ranges from 20/07/2016 to 23/08/2016, and the time interval of the recorded data is equal to 15 min. The variation of instantaneous wind speed and direction during the measurement period are shown in Figure 6. The wind direction follows the nautical convention (North = 0°, East = 90°). In the bottom plot of Figure 6, the 270° - 360° quadrant has been replaced by 0° to -90° quadrant for a better illustration of the wind direction time series.

Figure 6 – Variation of instantaneous wind speed (above) and direction (below) during the measuring campaign (20/07-23/08/2016).



In Figure 7, the average and the maximum daily wind speed are presented. In Figure 8, the average daily wind direction and the direction of the maximum daily wind speed are shown. In both figures the campaign averages are depicted as well. The campaign average of wind speed and direction equals to 1.97 m/s and 22° (north-northeast direction), respectively. The maximum wind speed, approximately 8 m/s, is observed during the 32nd day of the campaign (20/08/2016) and corresponds to a northeast (~45°) wind direction. The maximum average wind speed, ~3.4 m/s, appears on the 33rd day (21/08/2016) and corresponds to a north-northeast wind direction. The minimum daily average is observed on the 26th day (16/08/2016), i.e. 0.5 m/s. In general the wind speeds for the measuring campaign period can be characterized as rather low, which is not unusual during summer period.

Figure 7 – Day-averaged wind speed (blue line), maximum wind speed (red line) and campaign average (yellow line).

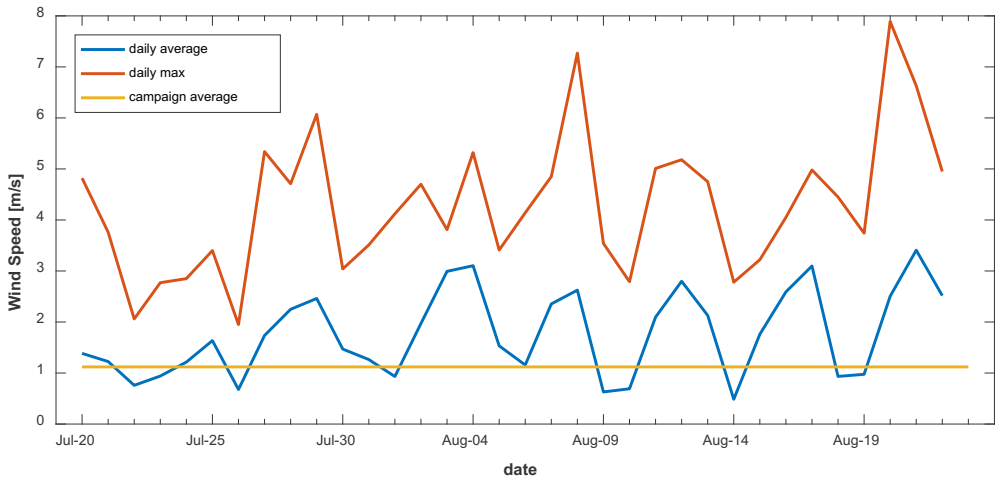
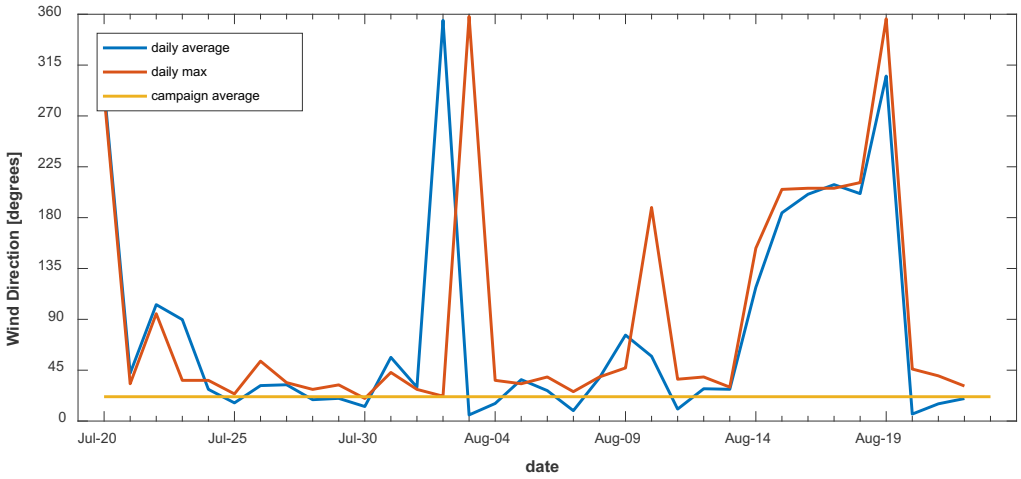
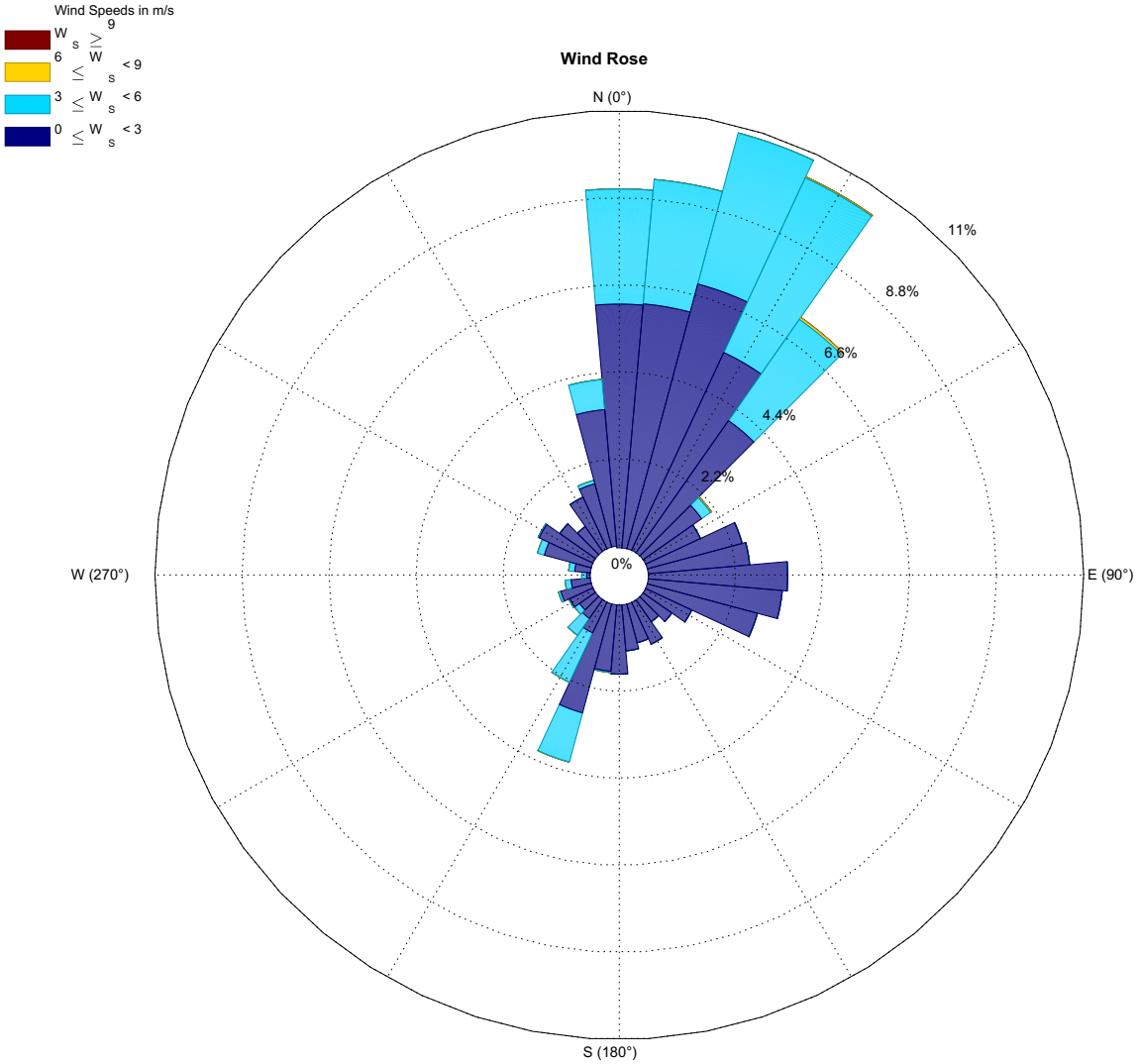


Figure 8 – Day-averaged wind speed (blue line), maximum wind speed (red line) and campaign average (yellow line).



For a deeper insight of the wind measurements during the campaign, a wind rose is presented in Figure 9. In this graph the frequency of wind blowing from a particular directions, together with a wind speed range, are shown. The directional bin amplitude of the direction is 5°. It is indicated that the dominant wind directions range from north to northeast direction. Note that around 60% of the wind directions belong to the North-East quadrant. Furthermore, as indicated by the colored bars, the strongest winds, are also from the northeast direction.

Figure 9 – Wind rose with directional bins of 5°, for the whole campaign period (20/07-23/08/2016).



4.4 Wave measurements

The wave measurements are based on the data recorded continuously by one pressure sensor (wave gauges) during the intensive measuring campaign. The sensor was installed at a low mudflat position (position identifier: Gsa3) at a height equal to +0.57m TAW. The sampling frequency was set equal to 20 Hz and the sensor orifice was located approximately 30 cm above the ground level. The recorded data were stored separately by the gauge in time series of about 24 hours (from 01:00:00 to 00:59:40 of day n), presenting a time-gap of 20 sec between two successive days, which is used for saving the data.

4.4.1 Methodology for data processing

In order to acquire information about wave characteristics in the area of interest, the raw data recorded by the aforementioned pressure sensor were processed by means of MATLAB (version 2016a) scripts. These scripts were developed within another project concerning the analysis of wind and ship waves (described in Kolokythas et al., 2016). An overview of the procedure that was followed includes the following steps:

1. Compensation of raw data due to atmospheric pressure and conversion to water levels using TAW as the reference level
2. Correction of resulting water level time series due to pressure attenuation with depth
3. Division of water level time-series per tidal cycle
4. Low-pass filtering of the data for the separation of the tide from the water fluctuations (waves)
5. Calculation of individual wave characteristics per tidal cycle from the resulting water fluctuations time series

As the pressure sensors used in this campaign are calibrated to read zero at standard atmospheric pressure, 1.01325 bar, the compensation was accomplished by subtracting the fluctuations around the standard atmospheric pressure from the raw pressure data, i.e. $P_{comp} = P_{raw} – (P_{atm} – 1.01325)$. For the compensation due to atmospheric pressure, corresponding barometric measurements at Melsele, were utilized (Figure 10). Then, the conversion of compensated pressure to water level in m TAW takes place, in which pressure is multiplied by a factor equal to 10.1972 (conversion from bars to m H_2O) and the vertical position of the gauge. A typical daily water level time-series in respect with TAW reference level after atmospheric pressure compensation, is represented by the blue line in Figure 11, while the red line corresponds to the corrected ones due to pressure attenuation (step 2).

Figure 10 – Atmospheric pressure variation at Melsele during the measuring campaign (20/07/2016 - 23/08/2016).

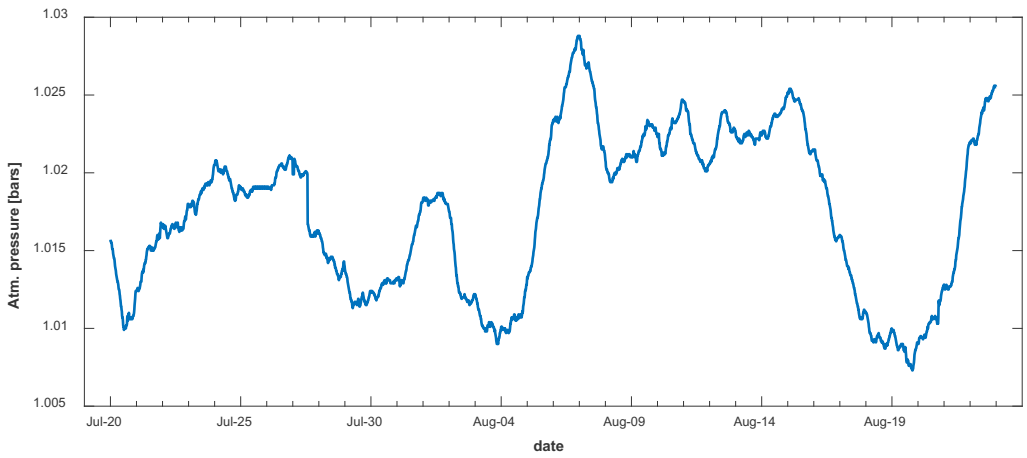
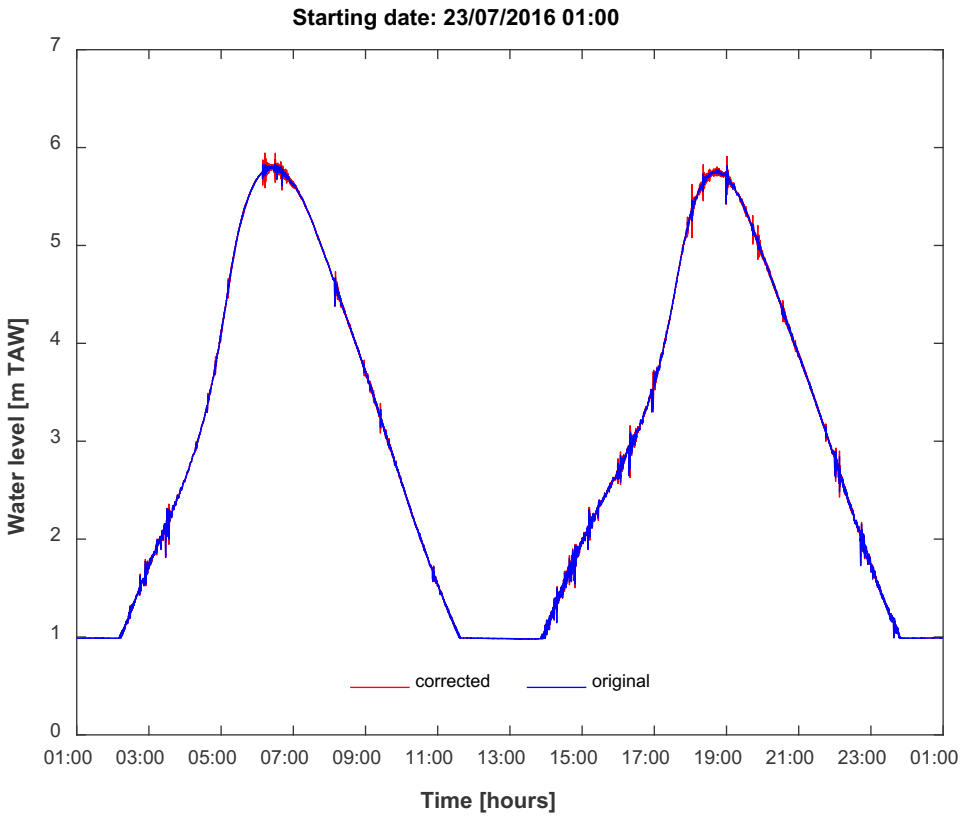


Figure 11 – Typical daily water level time-series in respect with TAW reference level after atmospheric pressure compensation (blue line) and after pressure attenuation compensation (red line).



A correction of the water level time series is required for pressure attenuation with depth. In fact, it is the dynamic pressure component (induced by wave motion) of the measured total pressure that needs to be corrected. The reader is refered to additional sources for deeper insight in theory of pressure sensor time-series (e.g. Kamsteeg, 1997; Ellis et al., 2006). As expected, the correction of wave fluctuations increases for higher water levels compared to the corresponding one at the lower water levels (the correction factor increases with increasing water depth). In Figure 12, which is a detail of Figure 11, the effect of the pressure correction on the water fluctuations, is more clearly demonstrated.

The attenuation correction is only applied over a given frequency range to avoid the over-amplification of high frequency variations. These do not correspond to surface waves, but are regarded as noise. By default the correction is applied over the range 0.05-0.33 Hz (source:

http://neumeier.perso.ch/matlab/waves.html). In the present study a maximum cutoff frequency equal to 0.45 (in stead of 0.33) is used, as was done in Kolokythas et al. (2016). In addition, the maximal correction factor is considered equal to 6.7, again in accordance to Kolokythas et al. (2016) and Verelst et al. (2011). The aforementioned consideration means that the pressure variation measured by the pressure gauge cannot be less than the 15% of the real pressure variation at the water surface.

The division of the daily water level time series to time windows identical to the duration of a tidal cycle, is based on the tide measurements at Prosperpolder. The duration of the tidal cycle is defined by the time interval between two successive low tide levels. In Table 1 the time of the low tide levels resulting from the measurements at Prosperpolder and the corresponding numbering of the tidal cycles, are shown.

Figure 12 – Detail of Figure 11, in which the effect of the pressure correction is more clearly demonstrated

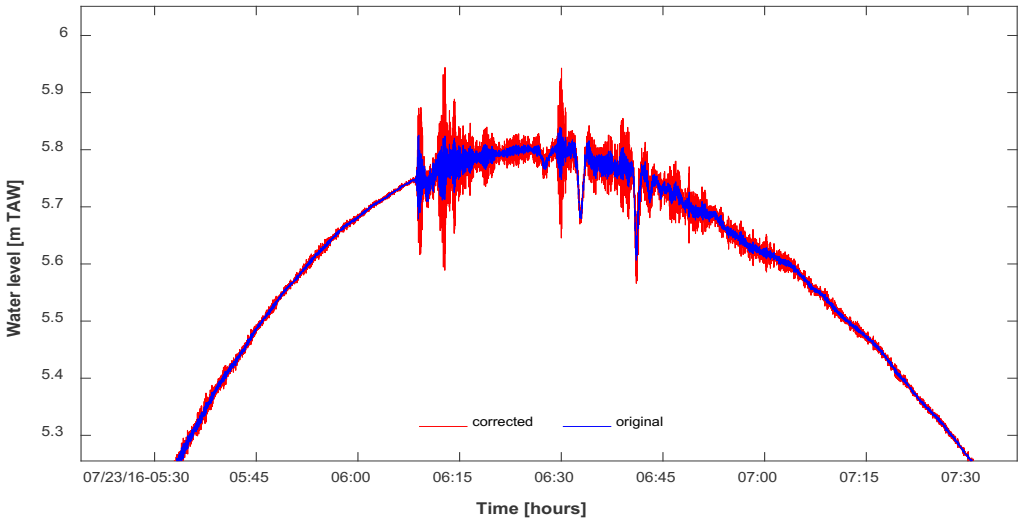


Table 1 – Time of low tide levels measured at Prosperpolder and numbering of tidal cycles of the measuring campaign.

time (mm/dd/yyyy HH:MM)	no. tidal cycle	time (mm/dd/yyyy HH:MM)	no. tidal cycle
20/07/2016 11:09	1	06/08/2016 01:11	33
20/07/2016 23:41	2	06/08/2016 13:06	34
21/07/2016 11:40	3	07/08/2016 01:48	35
22/07/2016 00:21	4	07/08/2016 13:42	36
22/07/2016 12:24	5	08/08/2016 01:59	37
23/07/2016 01:04	6	08/08/2016 14:04	38
23/07/2016 13:05	7	09/08/2016 02:36	39
24/07/2016 01:45	8	09/08/2016 14:36	40
24/07/2016 13:47	9	10/08/2016 03:14	41
25/07/2016 02:27	10	10/08/2016 15:14	42
25/07/2016 14:28	11	11/08/2016 04:01	43
26/07/2016 03:09	12	11/08/2016 15:53	44
26/07/2016 15:15	13	12/08/2016 04:28	45
27/07/2016 04:02	14	12/08/2016 16:58	46
27/07/2016 15:59	15	13/08/2016 05:35	47
28/07/2016 04:51	16	13/08/2016 18:08	48
28/07/2016 17:12	17	14/08/2016 06:50	49
29/07/2016 05:57	18	14/08/2016 19:38	50
29/07/2016 18:24	19	15/08/2016 08:06	51
30/07/2016 07:13	20	15/08/2016 20:47	52
30/07/2016 19:46	21	16/08/2016 09:07	53
31/07/2016 08:26	22	16/08/2016 21:40	54
31/07/2016 20:57	23	17/08/2016 09:56	55
01/08/2016 09:28	24	17/08/2016 22:30	56
01/08/2016 22:03	25	18/08/2016 10:40	57
02/08/2016 10:24	26	18/08/2016 23:21	58
02/08/2016 23:00	27	19/08/2016 11:29	59
03/08/2016 11:18	28	20/08/2016 00:07	60
03/08/2016 23:45	29	20/08/2016 12:08	61
04/08/2016 11:49	30	21/08/2016 00:43	62
05/08/2016 00:26	31	21/08/2016 12:39	63
05/08/2016 12:27	32	22/08/2016 01:32	64

The tidal curve in the measurements, is created by the implementation of a low pass filter (f_{cut} = 0.002 Hz) on the water level time series, transformed in the spectral domain. The separation of the tide from water fluctuations by substracting the measurement series by the created tidal curve. In Figure 14 the resulting tide variation in time after the implementation of the filtering operation is compared to the unfiltered water level variation. In Figure 15 the water fluctuation time-series, which results from the subtraction of the tide from the unfiltered water level, is shown.

The resulting water fluctuations time series were then utilized for the calculation of wave characteristics per tidal cycle. The zero-down crossing method was applied in order to determine individual waves characterized by their height and period. This zero-down crossing method marks all crossings through 0, coming from a top to a through. In Figure 13 the zero-down crossings are indicated with a circle.

Figure 13 – Illustration of zero-down crossing (circles) and zero-up crossing (triangles) in an idealised wave signal

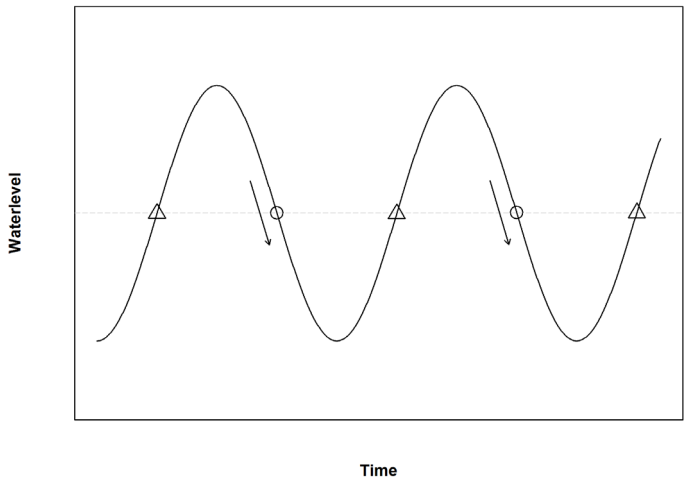


Figure 14 – Tide variation (blue line) in time after implementation of a low-pass filter (fcut < 0.002) versus the unfiltered water level variation.

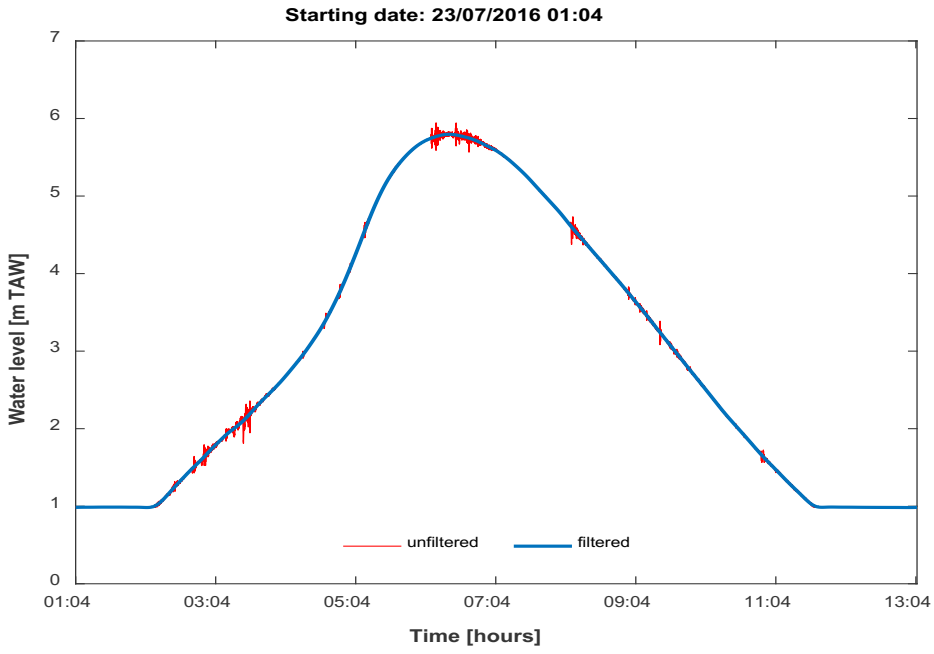
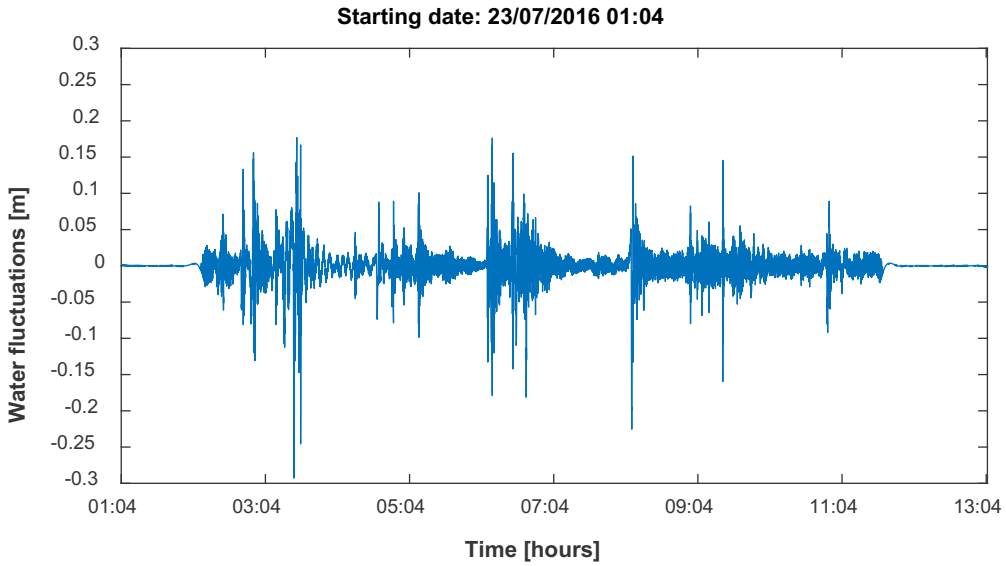


Figure 15 – Water fluctuations resulting from the subtraction of the tide from the unfiltered water level.



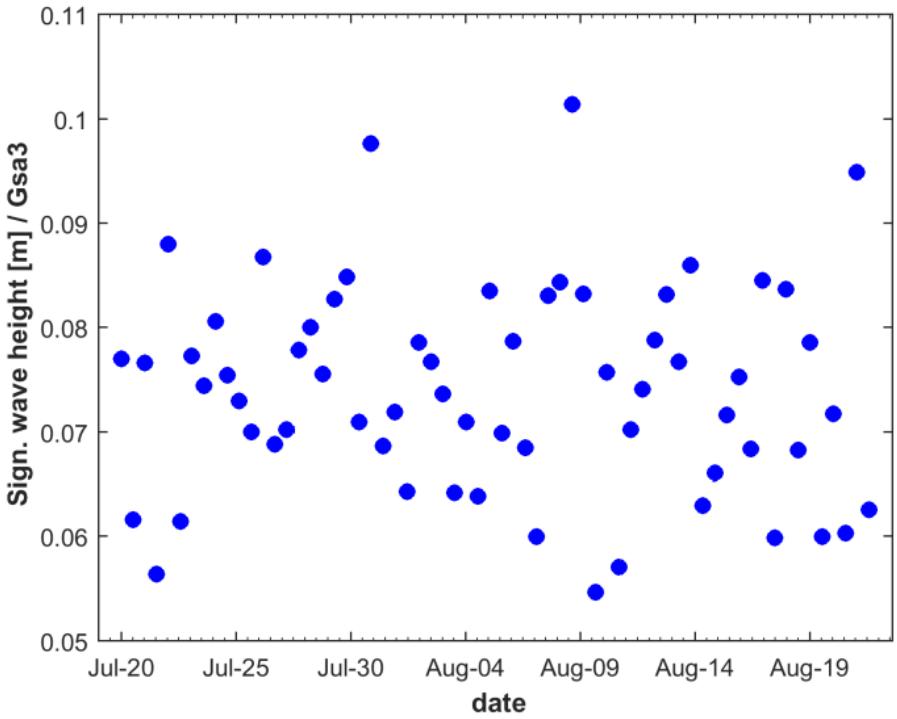
4.4.2 Wave statistics

The significant and the maximum wave height per tidal cycle of the measuring campaign were calculated by means of the resulting individual wave characteristics. The significant wave height, $H_{1/3}$, is defined as the mean of the highest 1/3 of all waves in the record's ranking. In Figure 16, the significant and the maximum wave heights per tidal cycle at location Gsa3 (most southern position shown in Figure 1), are presented. The values of the mean wave period of the highest 1/3 of all waves in the ranking, $T_{1/3}$, and the wave period of the highest wave, T_{max}, per tidal cycle are shown in Figure 17. Note that in outlying T_{max} values are included in separate windows (above), for clarity of the results.

Regarding the variation in significant wave height during the campaign, it is found that it ranges from around 5.5 to 9 cm, except for three tidal cycles (31/07, 08/08 and 21/08/2016) when $H_{1/3}$ is around 10 cm. The maximum wave height (H_{max}) variation presents five peak values (>1 m) on the 24th, 25th and 29th of July 24, and on the 12th and 19th of August, while in the greatest part (more than 85%) of the considered period, H_{max} ranges from ~40 to ~90 cm.

Regarding the variation of $T_{1/3}$ (Figure 17), it is found that almost all of the calculated values, range from around 4 s to around 6 s. The wave period of the highest waves (T_{max}) varies between 2 s and 5 s for the greatest part (90%) of the measurement campaign. Nevertheless, outlying T_{max} values ranging from 35 s to about 200 s, also appear during the measuring campaign.

Figure 16 – Significant, $H_{1/3}$, (top figure) and maximum wave height, H_{max}, (bottom figure) per tidal cycle at Gsa3 location.



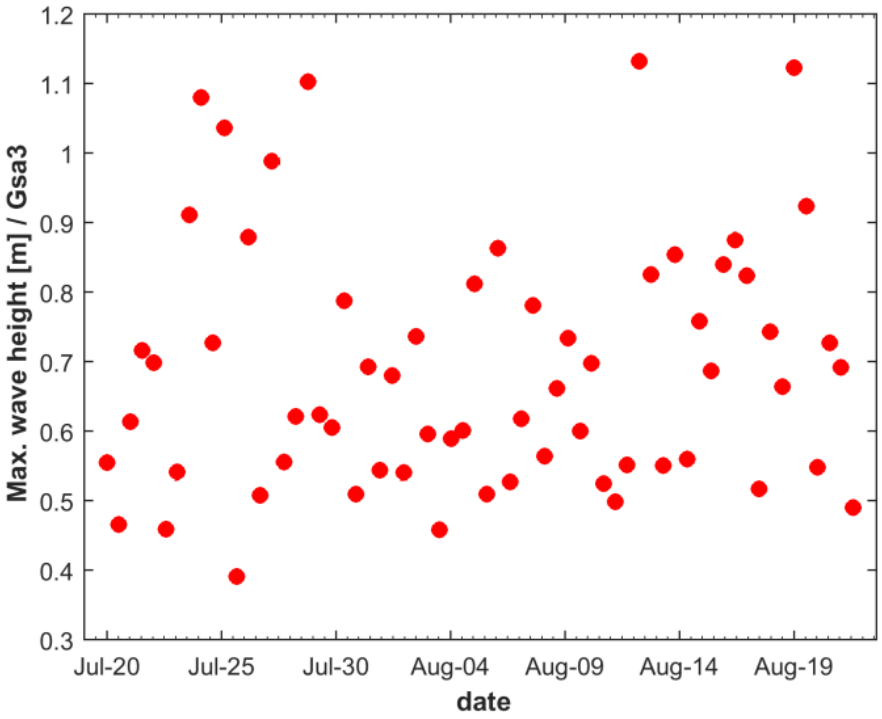
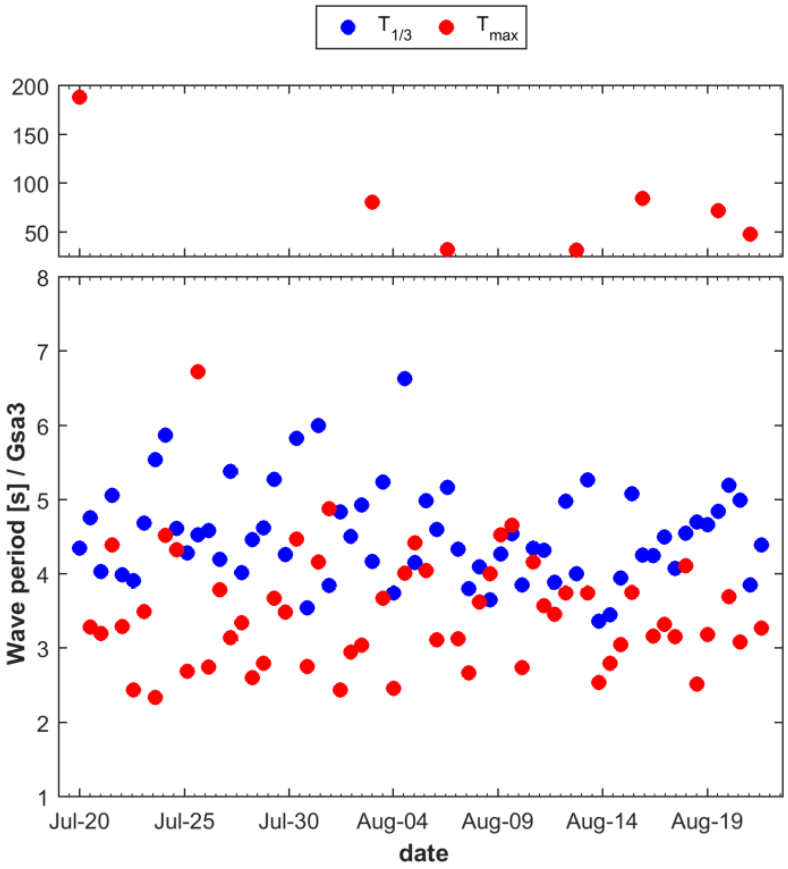


Figure 17 – Mean wave period of the highest 1/3 wave ($T_{1/3}$) and wave period of the highest wave (T_{max}) per tidal cycle at Gsa3 location. T_{max} outliers are denoted in separate window above.



5 Ship data (AIS)

5.1 General information about AIS data

The Automatic Identification System (AIS) is a tracking system used by Vessel Traffic Services (VTS) for identifying and locating ships. Each vessel exchanges data with other ships or base stations containing information on its position, course and speed. On the Western Scheldt and the North Sea AIS data are received by more than 10 base stations, which are logged in a central server operated by the Scheldt Radar Chain and each day approximately 0.5 GB of data are logged (Knowledge Centre Maneuvering in Shallow and Confined Water, 2015).

According to the Economic Commission for Europe (ECE) (2007), vessel tracking and tracing systems in inland navigation should be compatible with maritime AIS, and therefore, AIS messages should contain:

a) Static information, such as official ship number (mmsi), call sign of vessel, name of vessel, type of vessel
b) Dynamic information, such as vessels position with accuracy indication and integrity status
c) Voyage related information, such as length and beam of vessel combination, hazardous cargo on board
d) Inland navigation specific information, e.g. number of blue cones/lights or estimated time of arrival at lock/bridge/terminal/border

For moving vessels an update rate for the dynamic information on tactical level is foreseen (order of magnitude equals a few seconds). In inland waterway mode it can be set between 2 seconds and 10 minutes depending on the navigational status of the vessel (mainly its speed and course). For vessels at anchor it is recommended to have an update rate of several minutes, or if information is amended.

As mentioned before, AIS data contain useful information that can for example be used to analyze shipping traffic for operational purposes or to analyze specific maneuvers at particular locations. However, the mere size of the data files are a real challenge to work with. To this end, Flanders Hydraulics Research (FHR) has developed a tool to analyze AIS information in a flexible and effective way. Voyage information is structured based on the passing times of predefined entry lines. The data can then be filtered based on different parameters, such as ship characteristics (dimensions, type) or voyage characteristics (destination, in- or outbound sailing, draft, time). For visualisation purposes the tool also provides export options in different formats, which can be opened with Google Earth TM or other GIS-viewers (Knowledge Centre Maneuvering in Shallow and Confined Water, 2015).

5.2 AIS data analysis

In the present study, an entry line was defined at Saeftinghe (SaeZuid, device identifier: Gsa3) where the measuring device was installed. The entry line connects this measurement location properly the other bank of the Scheldt river (Figure 18). Ships passing this line are filtered from the raw AIS database. The data of the ship retained in the new database (especially direction, speed and distance to the measurement device) is from the emitted signal at the moment that the ship is closest to this entry line. The resulting data files contain the following static and dynamic information about the passing ships: (a) time of passage, (b) mmsi number, (c) name of ship, (d) type, (e) length, (f) beam, (g) draught, (h) speed (over ground) and (i) course. The distance from the measuring devices is an extra parameter added in the AIS information.

Figure 18 – Considered entry line at Saeftinghe (SaeZuid), where the data of the passages are recorded.

The total number of ship passages from the (SaeZuid) entry line during the measuring campaign was equal to 5877, which were done by 2117 different vessels. The information about the ship type contained in an AIS-message is a two-digit number, in which the first digit represents the general category of the vessel as shown in Table 2.

Table 2 – Classification of vessel type in regard to the first digit of the AIS code.

Ship type	First digit
Reserved	1
Wing in Ground	2
Special Category	3
High-Speed Craft	4
Special Category	5
Passenger	6
Cargo	7
Tanker	8
Other	9

In certain cases (e.g. Cargo Vessels, Tankers) a second digit provides additional information regarding the subject vessel's type of cargo:

1 = Major Hazard, 2 = Hazard, 3 = Minor Hazard, 4 = Recognizable Hazard

The two-digit identifiers that belong in the Special Category (first digit = 3 and 5, Table 2) correspond to the following main types of vessels:

30 = Fishing, 31,32 = Tug, 33 = Dredger, 34 = Dive vessel, 35 = Military, 36 = Sailing, 37 = Pleasure craft

51 = Search & Rescue, 52 = Tug, 53 = Port Tender, 54 = Anti-Pollution, 55 = Law Enforce

The aforementioned information about AIS coding of vessel type was retrieved by the following URL: https://help.marinetraffic.com/hc/en-us/articles/205579997-What-is-the-significance-of-the-AIS-SHIPTYPE-number-information.

5.3 Graphical representation of AIS data analysis

The number of ship passages with respect to type category during the measuring campaign is shown in Figure 19. It is found that the cargo vessel passages correspond to almost 50% of the total number of passages, while the second and the third place is occupied by tankers (~30%) and other vessels (~10%), respectively. Ship passage frequency with respect to ship length and type is presented in Figure 20. It is indicated that ships of length ranging from 51 to 150 m prevail in the number of passages. They represent a cumulative proportion equal to about 65% of the total number of passages. Third in the ranking are the ships of length between 151 – 200 m, with number of passages equal to about 12% of the total amount. The largest ships, in the category 351 – 400 m pass by with an average of ca. 3 per tidal cycle.

Figure 19 – Ship passage frequency with respect to ship type at SaeZuid entry line during the measuring campaign. Type 'other' includes a small number of WIG, Passenger, Law enforce and Port tender boats.

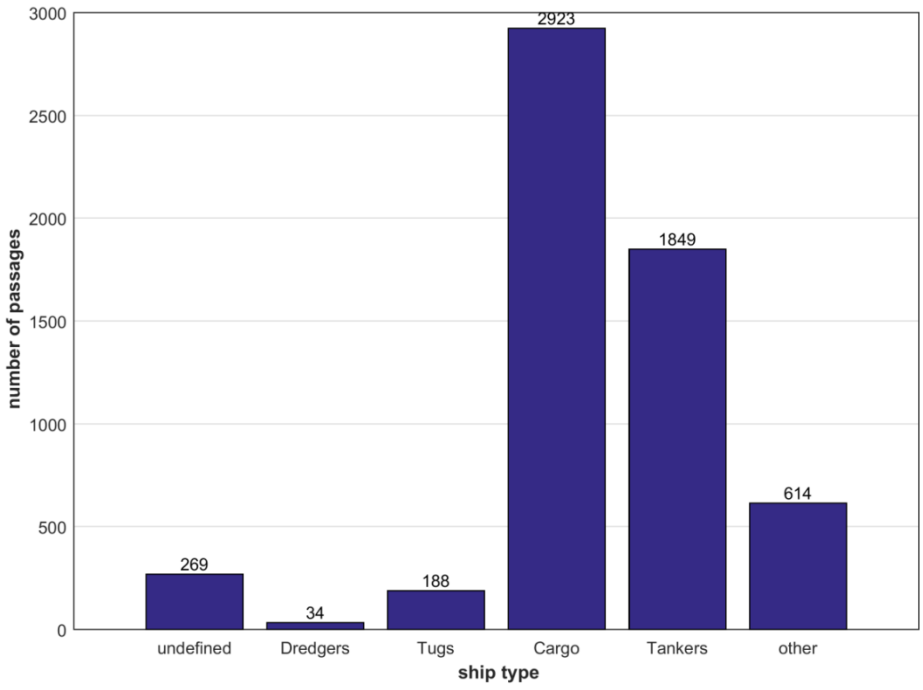


Figure 20 – Ship passage frequency with respect to ship length and type at SaeZuid entry line during the measuring campaign.

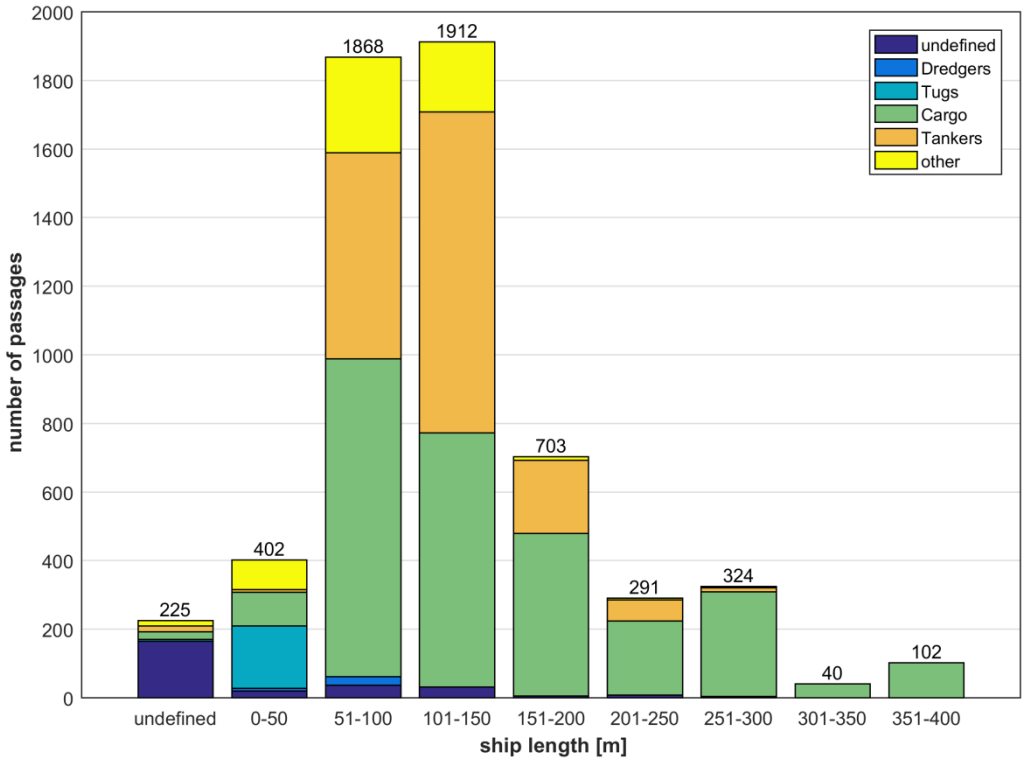
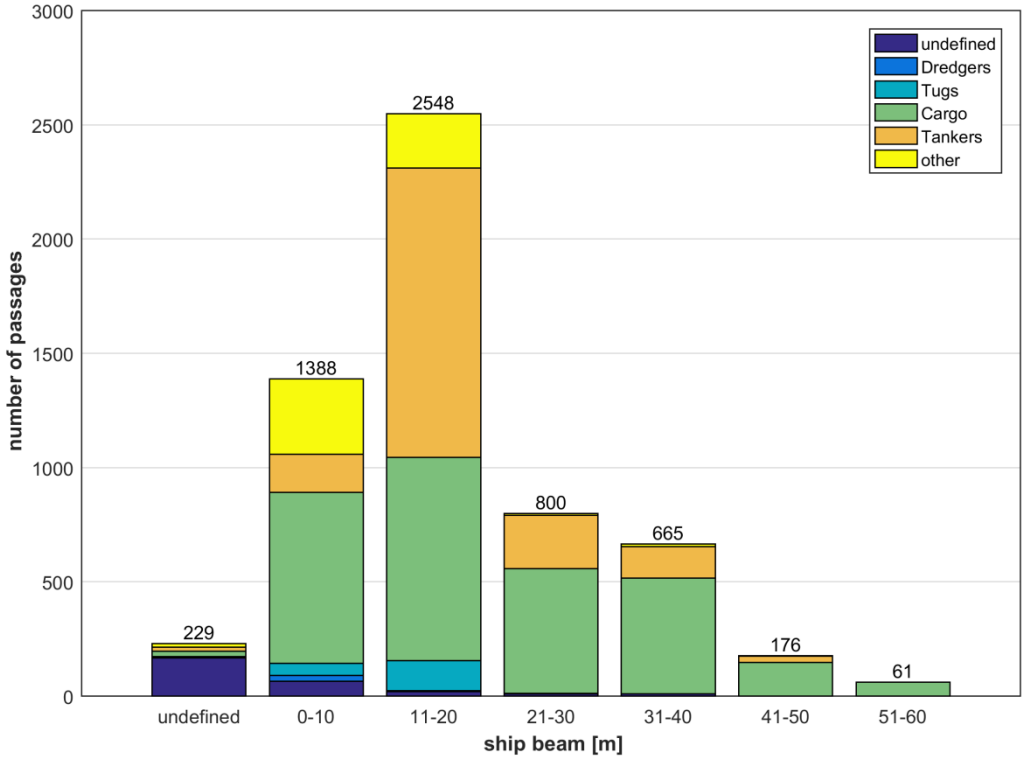
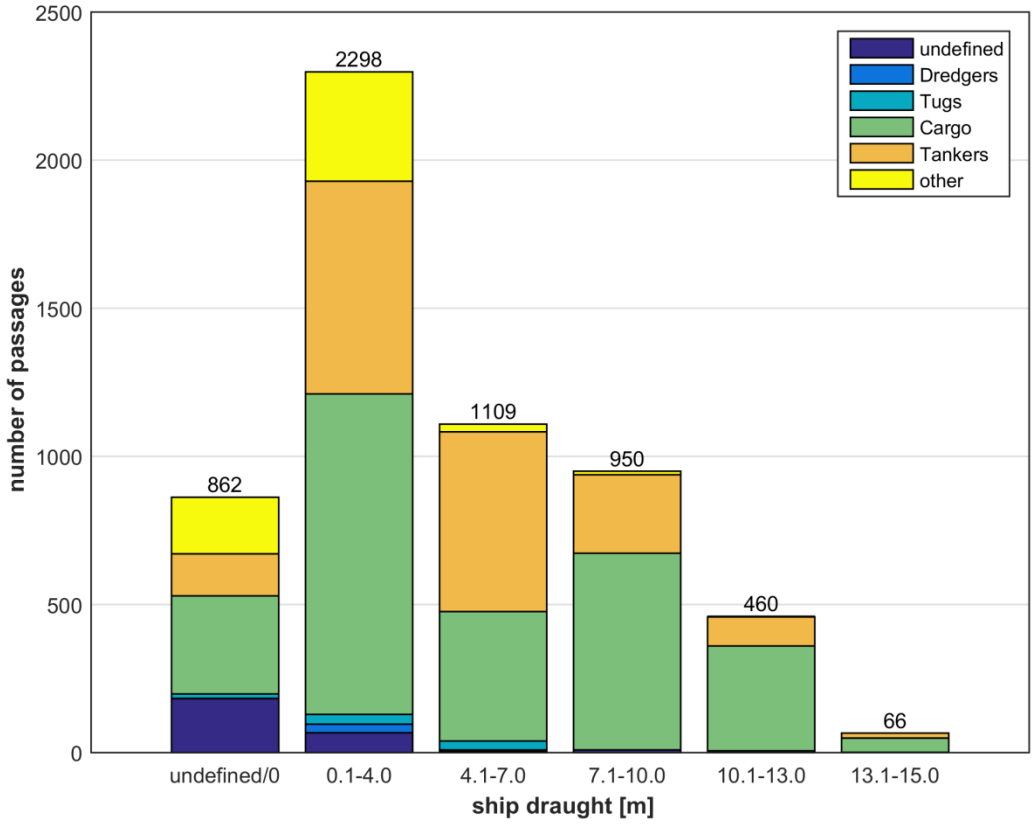


Figure 21 – Ship passage frequency with respect to ship beam and type at SaeZuid entry line during the measuring campaign.



In Figure 21, the number of passages with respect to ship beam and type is presented and it is indicated that ships with a beam in the range 11 to 20 m exhibit by far the highest frequency of appearance (~43% of the total passages). The second place is occupied by relatively small ships of beam less or equal to 10, corresponding to about 24% of the total passages. Finally, ship passage frequency with respect to ship draught is presented in Figure 22. Ships of draught between 0.1 and 4m are the most frequently observed (~40%), while ships of draught in the ranges 4.1-7m and 7.1-10 m cover the 19% and 16%, respectively, of the total number of ship passages. Note that the passages of ships with undefined or 0m draught occupy a significant part (~15%) of the total number of passages. 1% of the ships has a draught higher than the tide-independent treshold of 13.1 m. Sometimes the information about draught may hide inaccuracies, as it is entered by each ship's crew and there is no other confirmation about it. The other characteristics (length, beam) in contrast, are fixed and noted in a database.

Figure 22 – Ship passage frequency with respect to ship draught and type at SaeZuid entry line during the measuring campaign.



6 Ship wave analysis

In this chapter, the coupling of the wave measurements (presented in section § 4.4) with the passages of the vessels from the investigated entry line (SaeZuid) (chapter 5), is presented. The results of this coupling are graphically visualized, illustrating the distribution of wave statistic parameters (H_{max}) with respect to selected static and dynamic information of the ships (AIS data), in order to acquire deeper knowledge about ship-induced waves in the Scheldt waterway around the Saeftinghe area. The methodology followed for the coupling of data is similar to the one presented in detail in Kolokythas et al. (2016). However, small modifications applied in the methodology will be highlighted.

6.1 Single ship events

The Scheldt estuary is a busy waterway, as around 6000 ship passages were recorded at the entry lines during the measurement campaign (~1 month duration). Therefore, often ships follow or cross each other closely in time and/or space resulting in the development of wave signals that consist of various patterns, which are recorded by the wave gauges. As a result, a recorded event that includes multiple ship passages very close to each other may lead to mistaken representation of a single ship's hydrodynamics. For this reason specific criteria for the detection of isolated or single ship events were determined.

6.1.1 Detection of single ship events

The criteria for the detection of single ship events:

- The minimum length of the time windows before and after a ship passage that have to be clear (so no other ships pass by), is considered equal to 9 min. That is, t_i-t_{i-1} > 9 min and t_i-t_{i+1} >9 min (t_i is the time of ship passage i)
- The minimum (recorded) water level above the sensor is + 20 cm

In Kolokythas et al. (2016) the considered single ship event duration was set equal to 9 min. This time period was selected, as no clear wave influence of ships was observed outside this period for a similar project at Galgeschoor. This influence was checked both visually as by comparing the wave statistics of several time windows ranging from 7 to 11 minutes (Kolokythas et al. (2016)). However, compared to the measurements at Galgeschoor, there is an important difference with respect to the starting point of a selected event. Here, the starting point is considered to be 3 minutes before the ship crosses the entryline (so not identical to the time of passage), therefore the time interval after the crossing time is 6 minutes, to account for a total event duration of 9min. This decision was made after visual inspection of the majority of the detected single ship events, in which it was found that in many cases the drawdown of the large vessels was preceding the crossing time (red line, Figure 23). The chosen event duration ensures that the whole ship wave pattern is included in the time window.

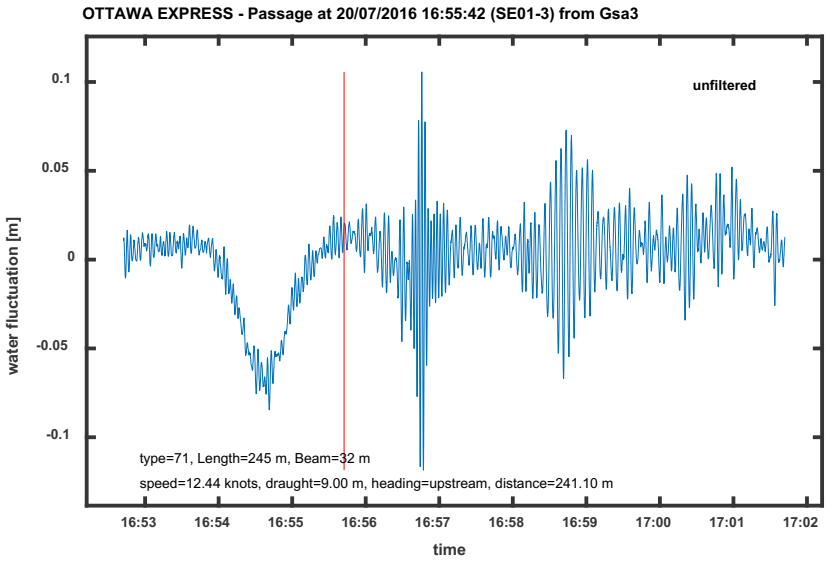
The second criterion was applied in order to remove ship passages that occur during the period in the tidal cycle where the wave gauges were not inundated or the water depth above the sensor was very low.

After the implementation of these criteria, 496 single ship events were detected. This is approximately 8% of the total number of passages (5877). As large vessels are often guided by small tug boats, they are omitted from the analysis. However, it can be assumed that only the large vessel influences the

wave climate at that moment. Therefore, if tug boats and large vessels are passing together the entry line, they are considered as large vessel-tug events, and incorporated in the “single ship” events.

For the case of these multi-ship events, mentioned as large vessel-tug (LV-T) events, only one event was added after implementing the procedure described in section 6.1.2 of Kolokythas et al. (2016).

Figure 23 – A typical single ship (cargo) event recorded at the measuring position (SaeZuid –Gsa3). The red line corresponds to the time of passage from the entry line. The considered event duration of 9 minutes consists of a 3 minutes interval prior the red line and 6 minutes interval after it.



6.1.2 Distinction between ship- and wind-waves

Following the practice applied in Kolokythas et al. (2016) and other similar studies (e.g. Baur, 2008; De Roo, 2013), a critical value of wave period equal to 2 s (f_{cr} = 0.5) was considered as a limit between ship and wind waves. Below 2 s waves are considered as wind waves. This ‘conservative’ critical value, even if it does not stand for all the selected ship events as the ideal threshold, prevents from removing ship wave energy which would lead in underestimation of wave height statistics. Note also that the critical value of 2 s (0.5 Hz) is only applied in the calculation of the ship wave characteristics and not for the case of pure wind wave statistics (no-ship events, Chapter 7), where only the low-frequency oscillations are filtered out.

6.1.3 Results of the analysis

The information related to each single ship event, which combines AIS ship data with hydrodynamic data (wave characteristics, water level) and wind data, was stored in a table (APPENDIX A). Part of a typical table with the aforementioned information is shown in Table 3. Note that

- in the index SExx-x, the number of the tidal cycle is given by the first two numerical digits, while the last digit shows the number of the event in the subject tidal cycle
- the parameter ‘distance’ refers to the distance between the ship and the measuring gauge, measured along the entry line
- the $H_{1/3}$ and H_{max} values resulted from the implementation of the zero-down crossing method, on the filtered signal of each single ship event, after imposing a band pass filter with lower and upper cutoff frequencies equal to 0.1 Hz and 0.5 Hz, respectively.
- Wind speed (WSpeed) and direction (WDir) correspond to the closest (in time), prior to the subject event two-hour average values

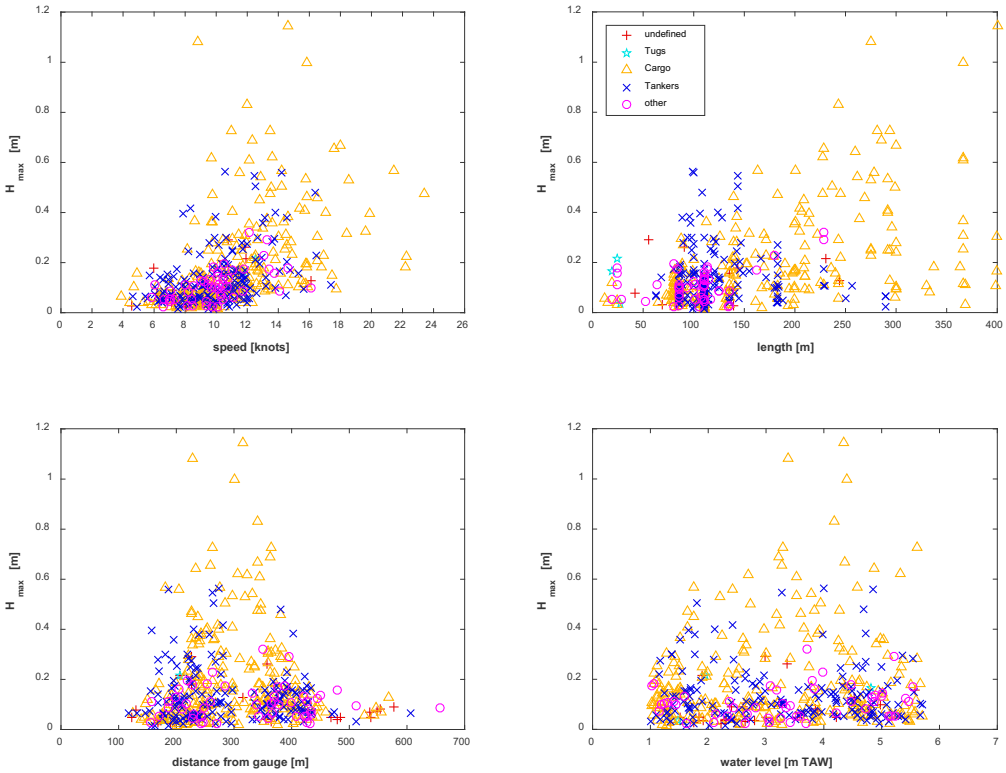
The filtered signal consists of short period waves in the range 2 s < T < 10 s, and includes only the secondary pattern of the ship waves. Therefore, the H_{max} of the filtered signals can be considered as identical to the secondary wave height. Hereafter in this section parameter H_{max} will stand for the secondary wave height.

Using the information for all the events, figures for the distribution of the secondary wave height, H_{max}, with regard to the sailing speed over ground, the ship length, the distance of the ship from the measuring gauge and the water level, were generated (Figure 24). Different colored symbols were used to denote the types of ships. It seems that there is a positive correlation of H_{max} with ship speed, while no clear correlation of H_{max} values with any of the considered parameters (length and water level) is observed. For the distance to the gauge, it is clear that passages on a distance over 500 m do not lead to high waves anymore. 3 ship events presented an H_{max} larger than 1.00 m, while 5% of the H_{max} values were higher than 0.50 m. Note that the highest H_{max} values correspond to cargo vessels.

Table 3 – Typical table with information of the selected single ship events including large vessel-tug events (index with asterisk). The names of the ship are not depicted due to privacy reasons.

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE01-1	29/10/2015 19:37	80	110	12	0.1	8.18	upstream	749.1	2.743	0.036	0.021	5.60	177.8
SE02-1	30/10/2015 02:57	90	86	10	4	10.42	upstream	658.7	2.600	0.030	0.020	4.14	97.7
SE02-2	30/10/2015 05:43	79	80	9	0	3.91	upstream	694.3	5.217	0.034	0.025	4.86	102.1
SE02-3	30/10/2015 07:53	70	89	12	5.3	6.92	upstream	544.8	2.939	0.028	0.022	5.23	106.3
SE03-1	30/10/2015 15:55	52	33	11	3.7	11.55	downstream	399.8	4.217	0.123	0.065	4.99	103.2
SE03-2	30/10/2015 20:05	52	28	12	6.2	11.27	downstream	406.7	3.021	0.069	0.032	4.55	89.3
SE04-1	31/10/2015 03:37	80	77	8	1	7.81	downstream	389.5	2.548	0.022	0.017	3.77	81.9
SE04-2	31/10/2015 03:54	79	113	44	1	4.47	downstream	540.9	2.882	0.029	0.022	3.77	81.9
SE04-3	31/10/2015 04:04	79	110	12	2.5	9.66	downstream	630.0	3.152	0.118	0.050	3.99	86.3
SE04-4	31/10/2015 07:00	79	127	11	0	4.84	upstream	750.8	4.564	0.033	0.024	4.61	90.0
SE05-1	31/10/2015 16:05	52	32	12	5.4	13.76	downstream	372.1	2.955	0.181	0.078	3.05	117.8
SE05-2	31/10/2015 18:09	52	32	12	5.4	8.46	upstream	546.6	5.446	0.021	0.018	2.15	101.8
SE05-3	31/10/2015 19:24	79	135	14	0.4	10.94	downstream	684.6	4.505	0.028	0.019	2.15	101.8
SE05-4	31/10/2015 20:45	73	222	30	10.5	10.79	downstream	618.9	3.128	0.054	0.032	2.14	107.6
SE05-5	31/10/2015 21:17	80	135	12	3.4	11.82	downstream	457.7	2.518	0.035	0.025	2.14	107.6
SE05-6	31/10/2015 21:53	70	199	35	8.9	11.70	downstream	608.1	1.854	0.024	0.016	2.14	107.6
SE06-1	01/11/2015 02:52	80	85	12	2.2	7.76	upstream	576.6	1.745	0.010	0.010	1.82	172.3
SE06-2	01/11/2015 03:10	52	26	12	5.8	9.54	downstream	383.9	1.972	0.134	0.051	1.82	172.3
SE06-3	01/11/2015 04:13	80	151	22	6.7	15.05	upstream	577.4	2.855	0.229	0.083	1.73	138.1
SE06-4*	01/11/2015 04:45	73	260	32	10.2	4.86	upstream	693.4	3.461	0.060	0.030	1.73	138.1
SE06-5	01/11/2015 05:12	90	110	17	3	7.31	downstream	656.5	4.248	0.046	0.027	1.73	138.1
SE06-6	01/11/2015 05:34	70	105	16	6.3	11.99	upstream	568.7	4.978	0.075	0.048	1.73	138.1
SE06-7	01/11/2015 05:45	52	26	12	5.8	7.37	downstream	504.5	5.227	0.148	0.061	1.73	138.1
SE06-8	01/11/2015 06:34	90	83	12	2.4	11.26	upstream	586.4	5.541	0.084	0.045	1.40	102.2
SE06-9	01/11/2015 07:17	69	100	12	0.2	9.43	downstream	396.4	5.152	0.099	0.058	1.40	102.2
SE06-10	01/11/2015 08:26	89	135	11	2	8.36	upstream	584.4	4.053	0.103	0.051	3.74	151.3

Figure 24 – Secondary wave height versus ship speed & length, distance from the measuring gauge, and water level for the selected ship events at the location Saeftinghe Zuid.



6.2 Large vessel events

During the analysis of single ship events presented in the previous section some of the large vessel events of interest were excluded, because of the implemented criteria. In this section the technique for the detection of large vessel events (and the analysis that follows), that was implemented in Kolokythas et al. (2016), is presented.

6.2.1 Detection of large vessel events

The detection of large vessel events on the water fluctuation time series for every tidal cycle was achieved by the application of the following criteria:

- The minimum length of a large vessel is set equal to 200 m
- The minimum speed of a large vessel is set equal to 2.5 knots

Then, the same criterion for the detection of single ship events was applied for the large vessel events, meaning a minimum required waterlevel of 20 cm above the sensor and a time window of 9 minimum clear from other large vessels.

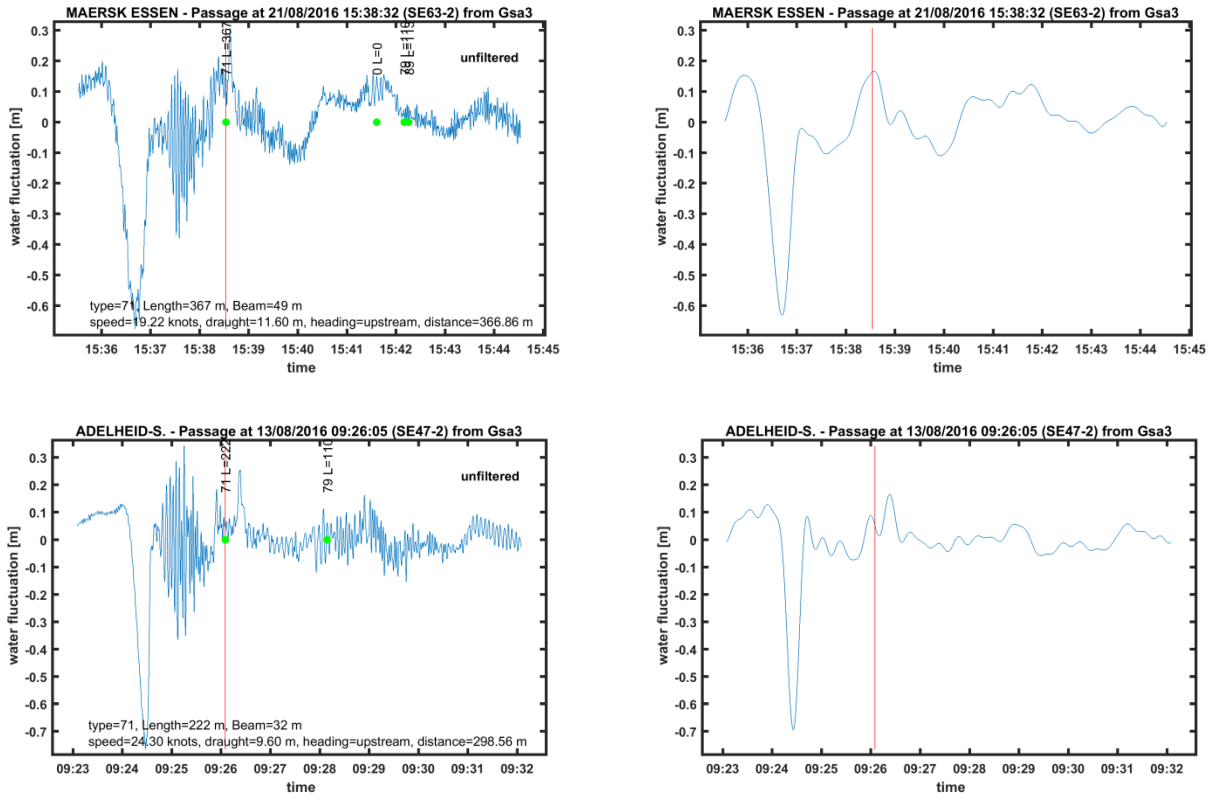
The large vessel event duration was also set equal to 9 min and its starting point is 3 minutes prior to the time that the ship crosses the entry line. Also, the same criterion, as in the case of single ship events, for omitting the periods of the tidal cycle during which the wave gauges were not inundated is used.

It has to be noted that:

- A minimum speed criterion of 2.5 knots was applied. This was done to avoid the removal of events, where a large vessel was moving close to a very slow vessel. Here it is expected that the very slow vessel will not influence substantially the generated wave signal.
- The criterion about the 9 minute clearance before and after the passage, excludes ships that are not considered as large vessels and large ships with a speed < 2.5 knots.
- Detected ship events having a very small amplitude of primary wave (drawdown < 4 cm) were eliminated.
- The drawdown amplitude was calculated after the implementation of a low-pass filter, with a cutoff frequency f_{cut} = 0.05 (T_{cut} = 20 sec), at the event signal.

The number of the detected large vessel events is equal to 410. In Figure 25 two large vessel events with the highest primary waves are presented as typical examples of enhanced ship wave patterns.

Figure 25 – Typical wave signals of large vessel events that presented the highest primary waves. In the right column the corresponding low-pass filtered signals are shown. The red line corresponds to the time of passage, while information of other ships (green dots not on the red line) that were moving close to the large vessel are also denoted.



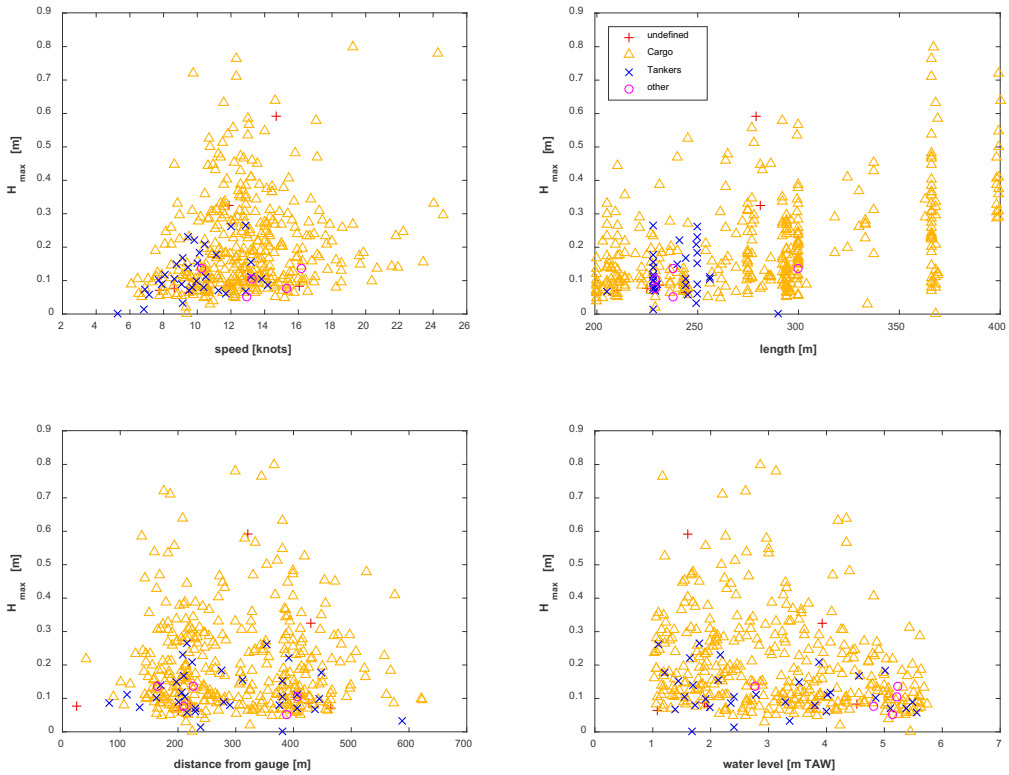
6.2.2 Results of the analysis

The information related to each large vessel event, which includes AIS ship data, wave characteristics, water level and wind data, was stored in tables for each of the measurement locations (APPENDIX A), similar to the tables for single ship events. Note that the primary wave height, denoted as H_{max}, results from the implementation of the zero-down crossing method, as described in §4.4.1, on the low-pass filtered (Tcut = 20 sec) signal of each large vessel event.

Using the ship-related information of the resulting tables (APPENDIX A), figures for the distribution of primary wave height (H_{max}), with regard to sailing speed, ship length, distance of the ship from the measuring gauge and water level, were generated (Figure 26).

In general, a positive correlation is found between H_{max} and sailing speed, i.e. H_{max} increases for increasing speed, while no clear correlation of H_{max} values with any of the considered parameters (length, distance and water level) is observed. It was also found that 18 ship events presented $H_{max} \geq 0.5$ m (~4%), which correspond to cargo vessels (one value corresponds to an undefined vessel type).

Figure 26 – Maximum wave height (primary) versus ship speed & length, distance from the measuring gauge, and water level for the selected ship events at Gsa3 (SaeZuid) location.



7 Wind wave analysis

In this chapter the coupling of the measured wind data during the measuring campaign (presented in §4.2) with the wave measurements at the pressure gauge position (presented in §4.4), is presented. In order to find a possible correlation between these parameters, the results of this coupling are visualized with graphs, illustrating the distribution of wave statistic parameters ($H_{1/3}$, H_{max}) with respect to wind speed and direction.

7.1 Detection of no-ship events

The wind wave analysis was based on the detection of events, where wind should be the only generating mechanism of waves, i.e. shipping traffic did not affect the recorded wave signal.

The criterion determined for the detection of no-ship events is the following:

- The minimum length of the time window between two ship passages that has to be clear, is considered equal to 30 min

The no-ship event duration was set equal to 10 min and its starting point was set 13 min after the passage of the ship from the considered entry line, in order to ensure that preceding ship waves would not affect the considered signal. The duration of 10 min was chosen as a minimum acceptable length of the event time windows, in order to ensure the occurrence of a large number of waves in the signal (>100) for the sufficient calculation of the wave statistics. Moreover, the 10 min duration remained fixed for all the selected no-ship events, even when the time gap between two ship passages was greater than 30 min, for consistency when plotting the $H_{1/3}$ values from different no-ship events in the same graph. In addition, the criterion of 30 min 'clear' windows provided a buffer zone of, at least, 7 min duration between the end of a no-ship event and the passage of a following ship.

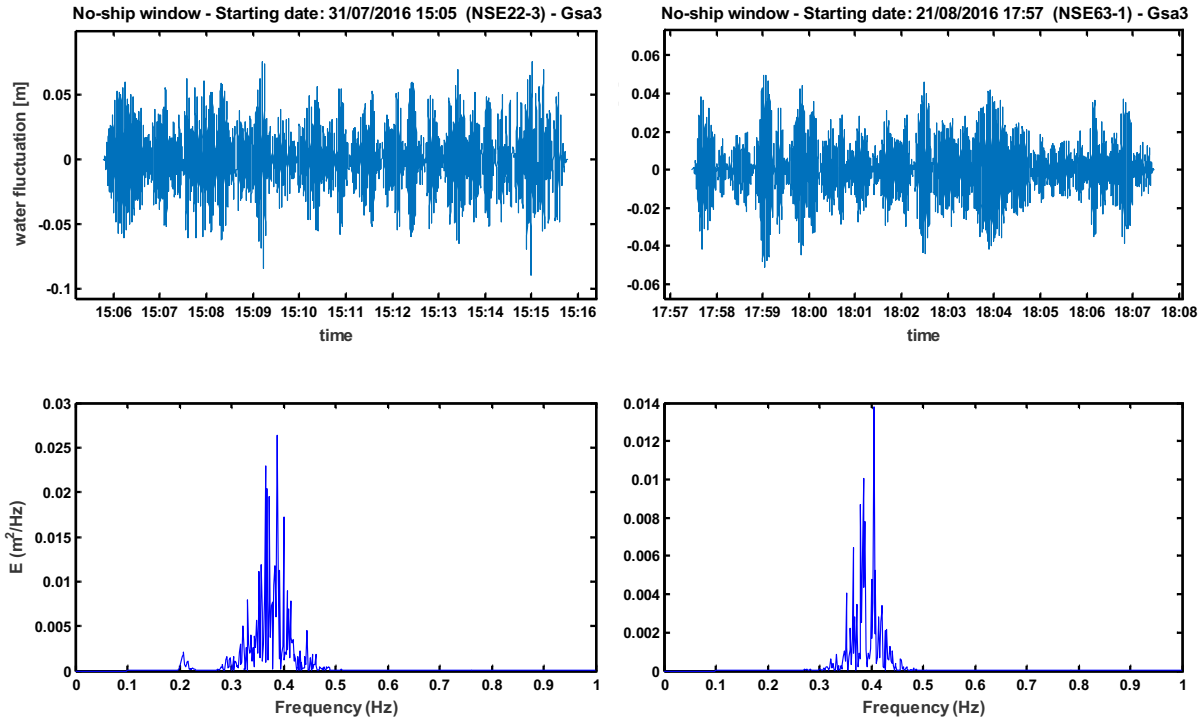
Also, to omit the periods of the tidal cycle during which the wave gauges were not inundated, the same criterion as in the case of ship events was used:

- Critical water level = minimum water level +20 cm

Finally, in order to eliminate any possible interference of the low frequency wave patterns, the high pass filter of a cutoff frequency f_{cut} = 0.1 (T_{cut} = 10 sec), was applied at the wave signals of the selected no-ship events.

The number of events, obeying this "no-ship" criteria, was equal to 149. In Figure 27, two characteristic no-ship event signals are illustrated. The one of the 22nd tidal cycle presented the highest wave height (max and significant) values, while the one of the 63rd cycle was recorded during the highest wind speeds of the measuring campaign (around 5 m/s, direction: NE). Below the wave signals, the corresponding Power Density Distributions (PSD) are presented. It can clearly be seen that for both situations, the maximum energy in the wave spectrum is around 0.4 Hz.

Figure 27 – Upper left figure: The no-ship event signal with the highest H_{max} (tidal cycle 22); Upper right figure: The no-ship event signal during the highest wind speed (tidal cycle 63). The figures below illustrate the corresponding Power Spectral Density (PSD) distributions.



7.2 Results of the analysis

The information related to each no-ship event, which combines hydrodynamic data (wave characteristics, water level) with wind data, was stored in a table (APPENDIX B). Part of this table with the information about the most energetic events, is shown in Table 4. Note that:

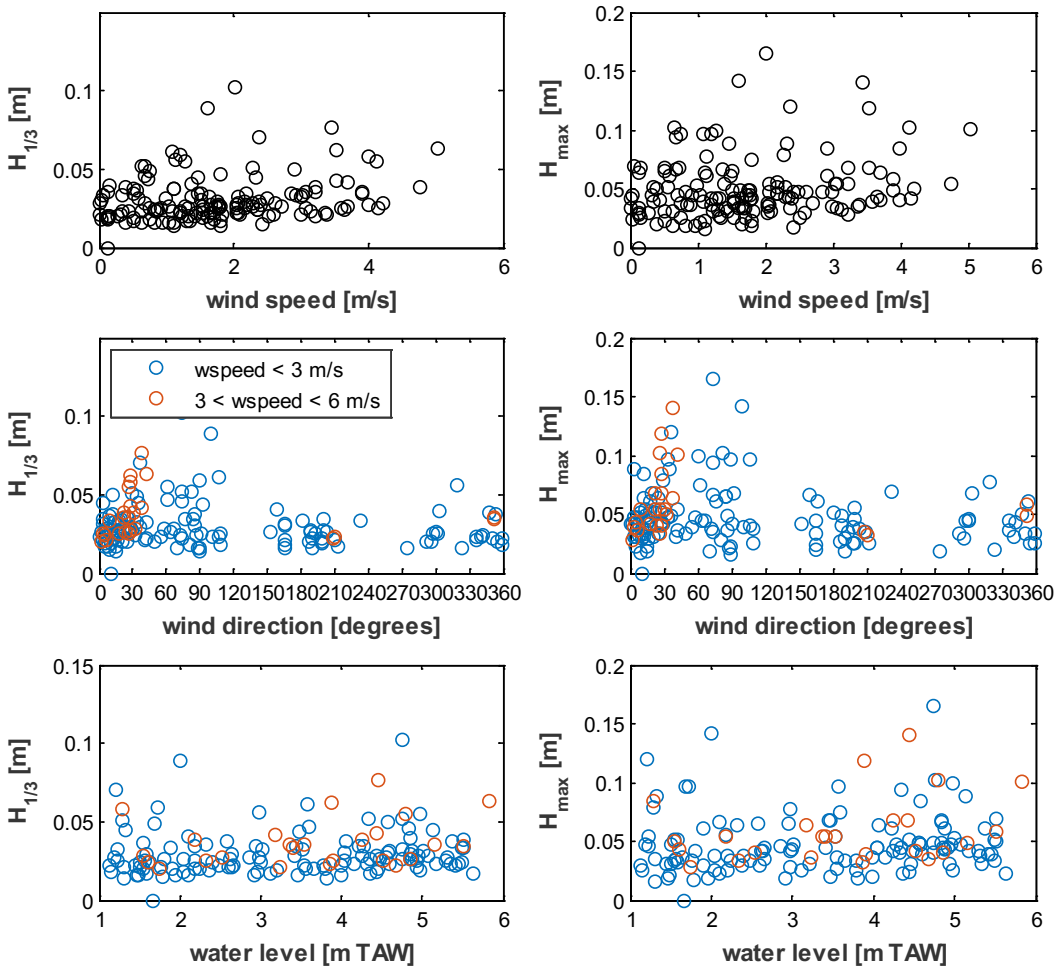
- in the index NSExx-x, the number of the tidal cycle is given by the first two numerical digits, while the last digit shows the number of the event in the subject tidal cycle
- the $H_{1/3}$ and H_{max} values resulted from the implementation of the zero-down crossing method, on the signal of each no-ship event.
- Wind speed (WSpeed) and direction (WDir) correspond to the two-hour average values that are prior and closest to the subject event

Using the information for all the events included in the resulting table (APPENDIX B), a figure for the distribution of significant wave height, $H_{1/3}$, and maximum wave height, H_{max}, with regard to wind speed, direction, and water level was generated (Figure 28). Obviously, due to the low wind speeds during the whole measuring campaign, the wave characteristics are found to be decreased compared to the corresponding ship-induced ones. The maximum $H_{1/3}$ values are about 0.10 m, while the maximum H_{max} values around 0.15m. Additionally, no correlation between wind speed and wave characteristics was found. However, it has to be noted that e.g. at Galgeschoor, only an effect of the wind speed on the wave climate is found for wind speeds beyond 12 m/s (Kolokythas et al., 2016). Finally, the peak $H_{1/3}$ and H_{max} values are induced by winds blowing from the North-East quadrant (0^o-90^o).

Table 4 – Information of the most energetic no-ship events.

Index	Time (dd/mm/yyyy HH:MM)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	WSpeed (m/s)	WDir (degrees)
NSE22-3	31/7/2016 15:05	4.748	0.165	0.103	2.02	73.5
NSE22-4	31/7/2016 17:57	1.997	0.141	0.089	1.62	99.3
NSE45-1	12/8/2016 10:56	4.447	0.141	0.077	3.45	37.7
NSE47-3	13/8/2016 16:22	1.211	0.119	0.070	2.37	36.3
NSE61-3	20/8/2016 19:40	3.888	0.119	0.062	3.54	27.9

Figure 28 – Significant (left figures) & maximum wave height (right figures) versus wind speed, direction and water level for the no-ship events.



8 Conclusions

In the present study, measurements gathered during an intensive measuring campaign of about 4 weeks at the intertidal area of Saeftinghe, are reported and analysed. This report focuses especially on the waves measured on the lower tidal flat, at the south side. The generating mechanisms of waves that may have a substantial impact on the tidal marshes and mudflats at the area of interest, are related to the navigation of vessels, as well as to the action of wind.

The pressure data is coupled to the ship's data. Since a large amount of ships passes for a short period, the ship's waves of different vessels interfere. To find a clear relationship between the ships and ship characteristics, periods with a length of 9 minutes were selected in which only one ship passed. A total of 496 events were selected. The ship's speed characteristics, vessel length, distance between the measuring location and the ship and the water level is related to the maximum water level of the ship's secondary wave. No clear relationships could be derived.

During the analysis of single ship events, many large vessel events were excluded, because of the implemented criteria. Therefore, an extra analysis focusing on the detection of large vessel events was performed, in order to investigate the induced primary wave patterns. 410 of these large – ship events were selected. Maximum wave heights of around 0.8 m were recorded, with the highest waves coming from cargo ships. Also a relationship between the wave height and the ship's characteristics is looked after. For the ship speed, a weak correlation is found, for the other variables, no clear relationship was found.

The wind-wave analysis was based on the detection of events, where wind was the one and only generating mechanism of waves (no-ship events). An analysis of 149 no-ship events was performed. The significant wave height for these periods ranged from a few centimeters up to 10 centimeters. The maximum wave heights vary between 2-3 cm to about 16 cm. No clear link between this wave heights and wind speed or direction could be determined.

9 References

Beirinckx, K.; Taal, M.; Plancke, Y.; Van den Bergh, E. (2013). Plan van Aanpak Onderzoek Agenda voor de Toekomst.

Baur, T., Peters, K., Teschke, U. (2008). Practical analysis methodology for ship-induced waves in estuaries. ICCE '08, pp. 748-760.

De Roo, S. (2013). Experimental Study of the Hydrodynamic Performanceof a Nature-Friendly Bank Protection Subject to Ship Wavesin a Confined, Non-Tidal Waterway. PhD Thesis, University of Ghent, Belgium.

Economic Commission for Europe (ECE) (2007). International standard for tracking and tracing on inland waterways (VTT), Resolution No. 63, ECE/TRANS/SC.3/176, United Nations, New York and Geneva, p. 57.

Knowledge Centre Maneuvering in Shallow and Confined Water (2015). 21st Newsletter. Retrieved from http://www.shallowwater.ugent.be/EN/kc_nieuws_arch_EN.htm

Kolokythas, G., Meire D., De Roo, S., Plancke, Y., Verwaest, T., Mostaert, F (2016). Wave measurements at Galgeschoor Part I: Analysis of velocities and waves during an intensive measuring campaign. WL_15_054_1. Flanders Hydraulics Research: Antwerp, Belgium.

Meire, D.; Vereecken, H.;Plancke, Y.; Mostaert, F. (2019). Morfologie mesoschaal - metingen IGG Zeeschelde: Deelrapport 4 – Eerstelijnsanalyse van de uitgevoerde stromingsmetingen op de intergetijdengebieden in de Zeeschelde. Versie 3.0 WL Rapporten, 14_024_4. Waterbouwkundig Laboratorium: Antwerpen.

Vanlierde, E.; Michielsen, S.; Vereycken, K.; Hertoghs, R.; Meire, D.; Deschamps, M.; Verwaest, T.; Mostaert, F. (2016). Tienjarig overzicht van de tijwaarnemingen in het Zeescheldebekken: decennium 2001-2010. Versie 5.0. *WL Rapporten*, 12_071. Waterbouwkundig Laboratorium: Antwerpen. XIV, 212 pp.

http://neumeier.perso.ch/matlab/waves.html

APPENDIX A

Table A-1 – Single ship events including large vessel-tug events (index with asterisk).

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE01-1	20/07/2016 13:34	79	86	8	0	11.29	upstream	150.49	1.96	0.119	0.046	3.55	291.8
SE01-2	20/07/2016 15:39	80	110	12	1.6	6.28	upstream	196.64	4.63	0.043	0.028	3.54	4.5
SE01-3	20/07/2016 16:55	71	245	32	9	12.44	upstream	241.10	5.31	0.221	0.072	2.08	4.0
SE01-4	20/07/2016 19:49	70	155	25	6.5	18.43	downstream	371.30	2.61	0.317	0.126	2.80	26.5
SE01-5	20/07/2016 19:59	80	90	14	5.5	9.58	upstream	191.99	2.44	0.280	0.070	2.80	26.5
SE02-1	21/07/2016 01:14	69	110	11	0.2	8.57	downstream	399.76	1.29	0.107	0.047	1.82	40.6
SE02-2	21/07/2016 02:08	80	110	11	0.1	9.80	upstream	157.73	2.02	0.016	0.016	1.20	14.0
SE02-3	21/07/2016 02:22	80	183	32	8	8.88	downstream	371.73	2.23	0.065	0.046	1.20	14.0
SE02-4	21/07/2016 02:37	80	100	18	5.4	10.32	downstream	400.94	2.48	0.156	0.067	1.20	14.0
SE02-5	21/07/2016 03:07	79	399	60	10.9	12.75	upstream	298.59	3.11	0.167	0.092	1.20	14.0
SE02-6	21/07/2016 03:42	89	110	11	2.8	6.40	downstream	427.98	4.23	0.051	0.033	1.20	14.0
SE02-7	21/07/2016 04:00	71	243	32	9	11.14	upstream	246.09	4.82	0.058	0.029	0.83	355.0
SE02-8	21/07/2016 04:22	80	125	11	3.7	12.21	upstream	197.26	5.29	0.096	0.058	0.83	355.0
SE02-9	21/07/2016 04:59	90	162	24	7.1	11.04	downstream	376.19	5.54	0.170	0.090	0.83	355.0
SE02-10	21/07/2016 08:39	0	0	0	0	8.96	downstream	172.85	2.30	0.035	0.023	3.08	25.7
SE02-11	21/07/2016 08:50	70	333	48	11.8	12.19	downstream	373.54	2.09	0.082	0.039	3.08	25.7
SE02-12	21/07/2016 09:41	80	110	11	2	6.63	upstream	175.68	1.27	0.046	0.025	3.08	25.7
SE02-13	21/07/2016 09:56	79	12	9	0.2	7.19	upstream	158.56	1.05	0.058	0.031	3.08	25.7
SE03-1	21/07/2016 13:16	0	0	0	0	7.31	upstream	122.54	1.51	0.048	0.030	2.51	32.4
SE03-2	21/07/2016 15:24	89	94	12	4.6	9.27	upstream	213.92	3.25	0.117	0.033	1.35	47.1
SE03-3	21/07/2016 17:43	79	86	12	3.3	4.41	upstream	176.66	5.47	0.039	0.025	1.22	107.9
SE03-4	21/07/2016 20:42	70	75	12	4.2	3.87	upstream	295.96	2.57	0.066	0.040	0.60	115.4

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE03-5	21/07/2016 21:31	89	115	11	3	12.01	downstream	348.33	1.68	0.085	0.046	0.60	115.4
SE03-6	21/07/2016 21:51	79	86	10	0	11.62	downstream	425.51	1.35	0.040	0.028	0.60	115.4
SE04-1	22/07/2016 01:58	79	110	10	0	6.26	downstream	412.22	1.37	0.055	0.032	0.70	94.1
SE04-2	22/07/2016 02:36	0	231	32	9.2	11.94	upstream	206.37	1.89	0.214	0.049	0.24	102.1
SE04-3	22/07/2016 03:08	70	179	27	8.7	11.41	downstream	369.87	2.34	0.225	0.093	0.24	102.1
SE04-4	22/07/2016 03:26	82	146	24	9.5	14.52	upstream	221.86	2.64	0.203	0.060	0.24	102.1
SE04-5	22/07/2016 03:56	84	113	19	6.9	11.24	upstream	204.60	3.28	0.106	0.036	0.24	102.1
SE04-6	22/07/2016 05:43	79	86	9	1	9.72	upstream	223.68	5.57	0.061	0.036	0.34	181.0
SE04-7	22/07/2016 05:55	80	122	17	6.7	13.61	upstream	221.12	5.53	0.281	0.093	0.34	181.0
SE04-8	22/07/2016 06:38	81	229	32	10.5	11.27	downstream	373.27	5.10	0.175	0.056	0.58	166.0
SE04-9	22/07/2016 07:31	89	110	12	3	7.79	upstream	168.37	4.22	0.106	0.045	0.58	166.0
SE04-10	22/07/2016 07:52	80	110	11	0.2	11.90	downstream	358.87	3.85	0.142	0.070	0.58	166.0
SE04-11	22/07/2016 08:07	79	24	6	0	8.40	downstream	144.11	3.60	0.047	0.027	0.40	105.5
SE04-12	22/07/2016 09:41	71	243	32	9.2	15.63	downstream	357.28	1.87	0.116	0.054	0.40	105.5
SE05-1	22/07/2016 16:28	70	207	30	9.7	11.02	upstream	253.56	3.65	0.403	0.095	1.39	93.7
SE05-2	22/07/2016 17:54	79	110	12	2.3	8.55	upstream	223.92	5.52	0.076	0.037	1.39	93.7
SE05-3	22/07/2016 19:37	0	144	24	6.5	5.97	upstream	226.28	4.37	0.177	0.106	1.40	98.6
SE05-4	22/07/2016 21:21	70	300	48	11.2	13.67	downstream	326.81	2.52	0.239	0.099	1.25	96.9
SE06-1	23/07/2016 02:25	71	141	22	7	9.23	downstream	448.52	1.02	0.105	0.069	1.42	50.0
SE06-2	23/07/2016 03:10	84	155	22	6.4	11.24	downstream	434.16	1.70	0.166	0.056	1.42	50.0
SE06-3	23/07/2016 04:02	80	110	12	1.5	10.85	upstream	211.13	2.49	0.024	0.019	1.04	63.4
SE06-4	23/07/2016 04:15	79	19	11	4	11.97	downstream	389.08	2.72	0.120	0.072	1.04	63.4
SE06-5	23/07/2016 04:37	70	236	39	8.9	13.06	upstream	276.96	3.25	0.178	0.084	1.04	63.4
SE06-6	23/07/2016 05:08	89	130	18	5.4	12.52	downstream	422.62	4.33	0.210	0.094	1.04	63.4
SE06-7	23/07/2016 07:39	79	110	10	0	7.21	upstream	255.65	4.84	0.075	0.045	0.35	100.5
SE06-8	23/07/2016 08:35	0	0	0	0	9.06	downstream	553.66	3.86	0.082	0.058	1.25	150.8
SE06-9	23/07/2016 09:23	70	143	16	4.9	10.73	upstream	309.47	2.99	0.282	0.076	1.25	150.8

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE07-1	23/07/2016 16:18	74	299	48	8.5	13.51	downstream	346.86	2.73	0.499	0.128	1.52	84.4
SE07-2	23/07/2016 17:17	79	88	12	3.4	10.13	upstream	224.39	3.87	0.058	0.035	1.52	84.4
SE07-3	23/07/2016 20:53	80	146	24	8	11.88	downstream	391.23	3.72	0.168	0.062	0.73	92.5
SE07-4	23/07/2016 21:44	89	110	14	3.4	10.11	upstream	198.13	2.83	0.176	0.051	0.73	92.5
SE07-5	23/07/2016 22:22	80	290	11	0.3	5.42	upstream	131.73	2.12	0.065	0.040	0.64	79.2
SE07-6	23/07/2016 23:01	33	93	20	3.5	16.11	downstream	376.56	1.44	0.098	0.052	0.64	79.2
SE08-1	24/07/2016 03:47	80	86	11	2	11.31	upstream	199.42	1.58	0.030	0.023	1.32	32.2
SE08-2	24/07/2016 05:26	90	135	14	0	8.11	upstream	246.08	3.43	0.027	0.018	1.68	29.6
SE08-3	24/07/2016 05:39	80	86	11	0.5	8.07	downstream	379.33	3.90	0.123	0.044	1.68	29.6
SE08-4	24/07/2016 07:05	71	209	30	9.1	11.51	upstream	241.59	5.51	0.180	0.078	1.11	15.2
SE08-5	24/07/2016 07:34	80	120	20	8.3	13.74	upstream	281.36	5.36	0.294	0.078	1.11	15.2
SE08-6	24/07/2016 08:22	79	135	17	0	8.55	upstream	286.10	4.71	0.083	0.043	1.23	20.4
SE08-7	24/07/2016 08:54	71	243	33	8	11.97	downstream	341.48	4.17	0.830	0.203	1.23	20.4
SE08-8	24/07/2016 10:24	79	110	12	2.5	10.03	downstream	375.18	2.55	0.017	0.014	1.38	13.6
SE08-9	24/07/2016 10:39	71	169	27	9	22.20	downstream	371.47	2.27	0.181	0.089	1.38	13.6
SE08-10	24/07/2016 11:27	80	125	12	0.3	6.59	upstream	198.85	1.44	0.133	0.057	1.38	13.6
SE09-1	24/07/2016 15:35	89	110	14	0	9.47	upstream	162.55	1.63	0.015	0.015	2.04	21.2
SE09-2	24/07/2016 16:41	0	0	0	0	7.37	upstream	479.18	2.46	0.040	0.023	1.90	19.7
SE09-3	24/07/2016 17:14	80	110	12	0.3	11.78	upstream	197.89	2.91	0.116	0.043	1.90	19.7
SE09-4	24/07/2016 20:59	83	120	19	6.9	8.22	upstream	237.25	4.30	0.244	0.068	0.64	82.7
SE09-5	24/07/2016 21:26	70	227	32	8.5	23.42	upstream	341.16	3.84	0.477	0.162	0.64	82.7
SE09-6	24/07/2016 21:44	71	366	52	10.7	12.13	upstream	344.63	3.53	0.608	0.109	0.64	82.7
SE09-7	24/07/2016 21:53	71	275	33	10.3	8.83	upstream	227.99	3.39	1.081	0.182	0.64	82.7
SE09-8	24/07/2016 22:04	71	286	40	9.5	12.32	downstream	362.61	3.21	0.689	0.158	0.13	25.7
SE09-9	24/07/2016 22:38	0	135	14	0	7.17	upstream	244.55	2.60	0.088	0.045	0.13	25.7
SE09-10	24/07/2016 23:20	80	149	24	9.2	15.30	downstream	353.22	1.80	0.156	0.081	0.13	25.7
SE09-11	25/07/2016 00:02	71	194	28	8.7	13.32	downstream	350.36	1.11	0.094	0.047	0.26	337.2

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE10-1	25/07/2016 05:27	80	183	27	7	10.63	downstream	388.19	2.45	0.193	0.116	1.28	15.4
SE10-2	25/07/2016 08:42	80	110	11	1.5	7.21	upstream	176.37	5.00	0.061	0.040	2.10	8.8
SE10-3	25/07/2016 09:52	79	110	11	2.3	9.39	downstream	406.97	3.88	0.033	0.021	2.10	8.8
SE10-4	25/07/2016 10:44	79	85	10	1.3	10.75	downstream	400.19	2.98	0.089	0.054	2.93	17.4
SE11-1	25/07/2016 22:43	70	90	13	3.9	9.64	upstream	221.60	3.28	0.271	0.084	NaN	NaN
SE11-2	25/07/2016 23:17	80	135	15	0.2	9.95	downstream	378.52	2.67	0.040	0.026	NaN	NaN
SE11-3	26/07/2016 00:26	99	24	6	1	8.77	upstream	159.44	1.50	0.329	0.081	NaN	NaN
SE11-4	26/07/2016 00:37	99	24	6	1	15.75	downstream	393.60	1.30	0.109	0.063	NaN	NaN
SE12-1	26/07/2016 04:34	70	85	15	4	12.27	upstream	235.12	1.07	0.097	0.055	1.11	89.7
SE12-2	26/07/2016 05:31	71	161	25	9.2	8.94	upstream	221.58	1.89	0.045	0.031	1.11	89.7
SE12-3	26/07/2016 08:02	74	299	48	9.3	9.00	upstream	220.78	5.16	0.061	0.037	0.04	76.9
SE12-4	26/07/2016 09:47	80	183	32	10.3	10.19	upstream	268.60	4.72	0.269	0.102	0.04	76.9
SE12-5	26/07/2016 09:58	85	117	19	7.1	11.70	upstream	200.96	4.55	0.255	0.064	0.04	76.9
SE12-6	26/07/2016 10:10	71	135	22	7.1	11.31	downstream	386.38	4.36	0.157	0.056	0.00	300.4
SE12-7	26/07/2016 10:38	79	73	9	0.1	11.22	downstream	459.91	3.89	0.070	0.041	0.00	300.4
SE12-8	26/07/2016 11:16	74	205	26	7.8	15.38	upstream	271.74	3.23	0.415	0.153	0.00	300.4
SE12-9	26/07/2016 11:35	79	106	11	2.3	8.67	downstream	362.25	2.90	0.044	0.031	0.00	300.4
SE12-10	26/07/2016 11:49	0	69	9	0.4	8.88	downstream	363.69	2.64	0.033	0.021	0.00	300.4
SE13-1	26/07/2016 20:57	79	105	9	1.4	8.75	upstream	177.28	5.23	0.057	0.034	1.17	2.3
SE13-2	26/07/2016 21:47	80	110	12	0.1	10.71	downstream	366.57	4.82	0.100	0.048	1.17	2.3
SE13-3	26/07/2016 22:09	80	125	11	3.4	7.81	upstream	169.87	4.49	0.052	0.030	NaN	NaN
SE13-4	26/07/2016 22:41	71	269	33	10.3	12.71	downstream	369.10	3.95	0.129	0.053	NaN	NaN
SE13-5	27/07/2016 00:03	70	190	32	9.7	6.98	upstream	252.65	2.60	0.052	0.027	NaN	NaN
SE14-1	27/07/2016 05:57	72	210	30	11.1	11.31	downstream	359.19	1.41	0.264	0.083	1.16	38.4
SE14-2	27/07/2016 06:31	79	275	40	12.3	11.62	downstream	404.22	1.90	0.251	0.105	0.88	86.6
SE14-3	27/07/2016 09:04	90	110	11	0	10.44	downstream	421.15	5.00	0.130	0.042	1.05	94.2
SE14-4	27/07/2016 11:06	70	180	28	6.3	8.53	upstream	334.43	4.10	0.072	0.044	0.72	81.8

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE14-5	27/07/2016 13:09	80	110	12	3.2	15.67	downstream	364.56	2.08	0.096	0.043	1.12	30.2
SE14-6	27/07/2016 13:38	99	80	8	0.3	9.74	downstream	432.35	1.63	0.022	0.016	1.12	30.2
SE15-1	27/07/2016 17:10	99	86	10	0.3	9.70	upstream	339.23	1.18	0.096	0.048	3.66	25.9
SE15-2	27/07/2016 20:38	82	92	14	4.7	8.28	upstream	238.62	4.35	0.052	0.032	2.66	21.9
SE15-3	27/07/2016 20:57	80	99	16	6.7	8.01	upstream	205.58	4.75	0.034	0.024	2.66	21.9
SE15-4	27/07/2016 23:11	70	366	48	11.2	15.80	downstream	301.05	4.39	0.997	0.187	1.56	15.9
SE15-5	27/07/2016 23:23	80	110	11	0.2	10.59	downstream	378.20	4.20	0.124	0.070	1.56	15.9
SE15-6	27/07/2016 23:46	69	110	10	1.3	10.09	upstream	204.99	3.84	0.160	0.079	1.56	15.9
SE15-7	28/07/2016 00:35	80	110	11	1.5	10.71	downstream	421.17	3.06	0.031	0.022	1.54	2.7
SE15-8	28/07/2016 00:46	79	110	12	2.5	7.91	upstream	182.48	2.89	0.085	0.033	1.54	2.7
SE16-1	28/07/2016 06:19	80	250	45	13.5	12.01	upstream	233.11	1.10	0.055	0.024	1.24	355.1
SE16-2	28/07/2016 08:22	0	55	6	0	10.79	upstream	226.00	2.98	0.291	0.101	1.63	14.1
SE16-3	28/07/2016 09:14	82	96	15	6.3	11.62	downstream	406.52	4.17	0.147	0.056	1.63	14.1
SE17-1	28/07/2016 19:04	79	163	21	6.5	21.42	upstream	180.09	1.76	0.567	0.179	3.63	21.4
SE17-2	28/07/2016 21:53	70	125	22	6.3	8.26	upstream	227.73	4.42	0.137	0.067	2.99	33.5
SE17-3	28/07/2016 22:05	84	171	28	10.1	9.16	upstream	244.60	4.63	0.142	0.069	2.29	27.2
SE17-4	28/07/2016 23:12	83	88	16	5.4	10.50	downstream	370.58	5.01	0.151	0.059	2.29	27.2
SE17-5	28/07/2016 23:43	80	142	24	8.7	11.04	upstream	233.13	4.66	0.244	0.093	2.29	27.2
SE17-6	29/07/2016 00:19	70	82	12	4.4	11.72	downstream	406.70	4.13	0.168	0.054	1.13	319.4
SE17-7	29/07/2016 01:53	80	106	11	2.2	11.99	downstream	386.44	2.72	0.040	0.025	1.13	319.4
SE17-8	29/07/2016 02:39	79	110	12	0	5.64	upstream	188.07	1.98	0.045	0.030	0.82	321.0
SE18-1	29/07/2016 08:25	1	274	32	10.2	12.83	downstream	361.08	1.97	0.285	0.086	2.95	19.4
SE18-2	29/07/2016 10:09	99	80	8	0.3	10.52	upstream	218.60	3.80	0.193	0.088	3.35	15.3
SE18-3	29/07/2016 11:26	80	290	11	0.3	4.88	downstream	295.96	4.97	0.023	0.017	3.35	15.3
SE18-4	29/07/2016 12:13	79	110	11	1.5	5.83	downstream	264.12	4.92	0.030	0.023	4.24	26.6
SE18-5	29/07/2016 15:11	0	139	11	0	10.90	downstream	577.45	2.41	0.092	0.055	4.76	30.2
SE19-1	29/07/2016 21:15	79	81	10	2	8.92	upstream	200.61	2.53	0.023	0.018	2.70	33.4

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE19-2	29/07/2016 21:24	71	141	22	7.3	13.02	upstream	228.31	2.65	0.337	0.117	2.70	33.4
SE19-3	29/07/2016 22:25	99	28	7	0	7.35	upstream	169.91	3.58	0.053	0.029	1.52	23.8
SE19-4	29/07/2016 23:12	79	135	15	2	9.35	downstream	358.70	4.53	0.087	0.042	1.52	23.8
SE19-5	30/07/2016 00:08	89	110	12	0	9.45	downstream	406.36	5.08	0.098	0.048	1.11	12.8
SE19-6	30/07/2016 00:21	70	82	12	2.5	9.97	downstream	336.01	5.08	0.076	0.039	1.11	12.8
SE19-7	30/07/2016 01:21	79	169	24	8	14.46	upstream	276.57	4.49	0.310	0.097	1.11	12.8
SE19-8	30/07/2016 01:34	79	89	13	5.9	9.70	downstream	405.76	4.30	0.196	0.073	1.11	12.8
SE19-9	30/07/2016 02:42	80	230	32	8	9.10	upstream	276.42	3.28	0.107	0.057	2.04	10.5
SE19-10	30/07/2016 03:20	70	366	48	12.8	9.68	upstream	322.70	2.69	0.618	0.121	2.04	10.5
SE19-11	30/07/2016 03:33	70	138	21	6.6	10.40	upstream	231.26	2.49	0.221	0.071	2.04	10.5
SE19-12	30/07/2016 03:58	79	132	22	2	9.21	downstream	398.60	2.10	0.085	0.062	2.04	10.5
SE19-13	30/07/2016 04:28	80	106	11	2.3	7.89	upstream	156.60	1.65	0.397	0.084	1.98	10.9
SE19-14	30/07/2016 04:38	70	199	30	9.5	8.67	upstream	283.87	1.51	0.164	0.087	1.98	10.9
SE19-15	30/07/2016 04:48	80	98	14	4.5	9.91	upstream	260.68	1.37	0.298	0.115	1.98	10.9
SE20-1	30/07/2016 08:40	79	110	12	2.5	10.13	upstream	200.44	1.28	0.013	0.013	2.42	9.7
SE20-2	30/07/2016 09:37	70	106	14	5.9	11.35	upstream	260.52	2.06	0.098	0.047	2.42	9.7
SE20-3	30/07/2016 10:56	99	24	6	1	13.76	downstream	478.32	3.19	0.155	0.087	2.41	5.6
SE20-4	30/07/2016 11:35	89	89	14	5.7	13.16	upstream	257.28	3.99	0.378	0.110	2.41	5.6
SE20-5	30/07/2016 12:17	80	110	17	3.5	5.71	downstream	336.24	4.78	0.149	0.056	2.04	343.8
SE20-6	30/07/2016 13:47	0	0	0	0	6.47	downstream	536.21	4.76	0.068	0.036	2.04	343.8
SE20-7	30/07/2016 14:59	77	200	32	7.9	9.76	upstream	225.64	3.72	0.361	0.072	0.93	33.3
SE20-8	30/07/2016 15:09	80	145	23	6.1	11.20	downstream	371.14	3.57	0.055	0.031	0.93	33.3
SE20-9	30/07/2016 16:40	99	85	9	2	11.12	downstream	433.56	2.13	0.060	0.035	0.58	93.5
SE20-10	30/07/2016 17:26	70	171	26	9.5	10.46	upstream	273.59	1.42	0.291	0.146	0.58	93.5
SE20-11	30/07/2016 17:39	99	109	24	3	9.87	downstream	364.68	1.24	0.102	0.062	0.58	93.5
SE21-1	30/07/2016 22:17	71	243	32	10	12.69	downstream	380.97	2.14	0.292	0.097	1.48	33.5
SE21-2	30/07/2016 22:28	72	337	46	12.6	12.60	downstream	342.79	2.27	0.182	0.103	1.48	33.5

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE21-3	30/07/2016 22:56	80	144	24	10.3	11.55	downstream	418.06	2.65	0.111	0.068	1.48	33.5
SE21-4	30/07/2016 23:41	80	110	15	1.9	8.94	upstream	236.69	3.40	0.058	0.030	1.48	33.5
SE21-5	31/07/2016 00:05	71	139	22	6.9	15.03	downstream	412.31	3.91	0.154	0.104	1.75	36.0
SE21-6	31/07/2016 02:10	20	101	8	0	10.42	upstream	258.49	4.88	0.110	0.045	2.06	42.2
SE21-7	31/07/2016 02:21	80	107	16	4.9	11.78	downstream	386.81	4.75	0.138	0.060	2.06	42.2
SE21-8	31/07/2016 02:43	70	183	29	9.3	10.83	downstream	358.35	4.44	0.058	0.034	2.06	42.2
SE21-9	31/07/2016 02:57	80	106	11	2.3	11.78	downstream	357.96	4.23	0.050	0.028	2.06	42.2
SE21-10	31/07/2016 03:27	71	292	32	12.5	10.11	upstream	335.16	3.75	0.247	0.079	2.06	42.2
SE21-11	31/07/2016 04:17	89	120	18	7.2	9.76	upstream	233.88	2.99	0.154	0.049	1.86	26.7
SE21-12	31/07/2016 05:33	79	209	30	9.3	12.81	upstream	237.99	1.74	0.449	0.129	1.86	26.7
SE21-13	31/07/2016 05:44	99	114	23	1.8	9.54	downstream	369.31	1.59	0.130	0.087	1.86	26.7
SE22-1	31/07/2016 12:01	80	166	28	10.3	10.57	upstream	232.86	2.97	0.215	0.102	2.06	57.5
SE22-2	31/07/2016 12:14	80	110	12	0.2	7.37	downstream	364.40	3.20	0.101	0.056	2.06	57.5
SE22-3	31/07/2016 12:58	0	0	0	0	7.74	upstream	173.11	4.22	0.046	0.028	2.06	57.5
SE22-4	31/07/2016 13:08	70	90	14	5.7	14.54	upstream	330.90	4.45	0.271	0.117	2.06	57.5
SE22-5	31/07/2016 17:13	89	87	15	4.6	9.74	upstream	226.05	2.77	0.180	0.108	1.62	99.3
SE22-6	31/07/2016 17:44	79	264	32	13	13.26	upstream	241.76	2.24	0.376	0.153	1.62	99.3
SE22-7	31/07/2016 18:21	80	86	11	0.2	6.86	upstream	270.77	1.63	0.152	0.079	1.02	102.6
SE23-1	31/07/2016 23:27	82	124	17	5.8	13.78	upstream	230.08	2.12	0.398	0.151	0.01	165.3
SE23-2	1/8/2016 0:42	79	167	25	9.3	8.42	upstream	307.34	3.27	0.018	0.014	0.31	336.3
SE23-3	1/8/2016 1:02	80	110	13	3.6	6.65	downstream	414.98	3.74	0.084	0.049	0.31	336.3
SE23-4	1/8/2016 1:50	69	110	12	0	10.77	downstream	450.31	4.88	0.138	0.044	0.31	336.3
SE23-5	1/8/2016 2:07	70	130	16	4.8	9.68	upstream	259.81	5.13	0.024	0.017	0.17	303.2
SE23-6	1/8/2016 3:50	79	78	11	4.2	8.48	downstream	444.15	4.60	0.049	0.027	0.17	303.2
SE23-7	1/8/2016 7:17	70	190	32	7.2	9.23	upstream	254.34	1.24	0.143	0.080	0.56	9.4
SE24-1	1/8/2016 11:31	79	85	10	0	9.47	upstream	169.00	1.79	0.034	0.023	3.39	28.8
SE24-2	1/8/2016 13:33	79	86	8	0	9.89	downstream	238.80	3.58	0.073	0.038	2.27	30.6

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SE24-3	1/8/2016 13:47	79	85	9	0.3	6.49	downstream	405.19	3.91	0.072	0.036	2.27	30.6
SE24-4	1/8/2016 18:08	79	85	10	0.2	11.18	downstream	429.54	2.84	0.089	0.058	0.52	85.4
SE24-5	1/8/2016 19:23	80	121	11	1.8	8.96	upstream	169.99	1.54	0.233	0.070	0.52	85.4
SE25-1	1/8/2016 23:37	77	200	32	8.3	10.63	downstream	429.73	1.31	0.168	0.072	0.41	16.6
SE25-2	1/8/2016 23:52	70	368	51	13	6.08	upstream	299.08	1.53	0.030	0.021	0.41	16.6
SE25-3	2/8/2016 0:07	79	85	10	0.2	7.91	downstream	546.17	1.74	0.084	0.048	0.40	324.0
SE25-4	2/8/2016 3:02	20	101	8	0	7.08	downstream	342.00	5.23	0.052	0.036	0.64	340.9
SE25-5	2/8/2016 3:37	79	96	22	0.3	9.72	upstream	243.94	5.36	0.060	0.034	0.64	340.9
SE25-6	2/8/2016 5:03	71	300	48	11.3	18.00	downstream	340.16	4.36	0.667	0.112	1.61	292.4
SE25-7	2/8/2016 7:38	79	15	5	0	12.32	downstream	283.74	1.70	0.039	0.024	2.93	288.2
SE26-1	2/8/2016 14:00	99	85	8	0	10.67	upstream	217.04	3.29	0.104	0.042	2.92	8.6
SE26-2	2/8/2016 15:33	89	94	12	4	6.53	upstream	338.57	5.42	0.041	0.027	2.92	8.6
SE26-3	2/8/2016 17:26	89	106	11	0.2	9.27	upstream	181.92	4.53	0.109	0.059	3.50	13.4
SE26-4	2/8/2016 18:12	80	110	11	1.5	10.67	downstream	605.55	3.81	0.065	0.041	3.06	16.6
SE27-1	3/8/2016 0:19	89	88	13	4.6	8.18	upstream	235.29	1.27	0.066	0.044	2.98	16.4
SE27-2	3/8/2016 3:07	79	193	28	8.8	7.37	upstream	252.22	4.66	0.027	0.020	3.39	5.7
SE27-3	3/8/2016 3:41	69	100	12	0.2	9.19	downstream	444.84	5.42	0.124	0.077	3.39	5.7
SE27-4	3/8/2016 4:59	71	294	30	10.8	9.51	upstream	280.15	5.35	0.250	0.076	2.91	12.3
SE27-5	3/8/2016 5:37	52	19	6	0	11.70	upstream	296.70	4.82	0.163	0.078	2.91	12.3
SE27-6	3/8/2016 6:12	70	199	32	9.6	12.09	upstream	241.05	4.26	0.354	0.126	2.92	2.6
SE27-7	3/8/2016 6:30	79	237	32	9.7	14.23	upstream	285.05	3.94	0.505	0.146	2.92	2.6
SE27-8	3/8/2016 8:48	71	161	25	8.8	14.87	upstream	219.13	1.49	0.234	0.087	3.23	2.3
SE27-9	3/8/2016 9:02	0	42	7	2.3	6.16	upstream	129.26	1.28	0.079	0.037	3.23	2.3
SE27-10	3/8/2016 9:14	79	85	10	1.6	6.92	upstream	186.64	1.11	0.135	0.044	3.23	2.3
SE28-1	3/8/2016 13:57	71	198	31	9.2	11.29	downstream	378.38	2.33	0.160	0.063	3.06	358.5
SE28-2	3/8/2016 14:12	79	105	10	1.5	8.01	upstream	176.81	2.52	0.048	0.025	2.92	4.8
SE28-3	3/8/2016 15:52	80	110	14	1.7	8.59	upstream	211.35	4.93	0.043	0.022	2.92	4.8

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SE29-1	4/8/2016 2:00	71	275	40	13.2	12.50	downstream	390.87	1.99	0.229	0.073	2.75	15.3
SE29-2	4/8/2016 2:26	69	110	11	0.2	9.51	downstream	370.52	2.36	0.112	0.062	2.75	15.3
SE29-3	4/8/2016 2:42	80	188	22	2.3	9.95	upstream	238.77	2.64	0.048	0.028	2.75	15.3
SE29-4	4/8/2016 3:22	71	294	32	10.2	7.79	downstream	379.93	3.67	0.129	0.058	2.75	15.3
SE29-5	4/8/2016 5:07	70	118	16	5.4	11.92	downstream	382.84	5.62	0.284	0.102	2.37	11.0
SE29-6	4/8/2016 5:52	80	110	12	2.8	7.04	upstream	217.99	5.28	0.051	0.031	2.37	11.0
SE29-7	4/8/2016 6:25	80	110	12	2.7	7.79	downstream	254.30	4.80	0.052	0.030	2.62	7.1
SE29-8	4/8/2016 7:39	90	110	17	4	10.46	downstream	408.58	3.54	0.052	0.035	2.62	7.1
SE29-9	4/8/2016 7:49	99	125	12	0.2	7.04	upstream	185.86	3.35	0.084	0.037	2.62	7.1
SE30-1	4/8/2016 13:06	79	89	10	2	10.03	upstream	232.09	1.31	0.028	0.020	3.52	357.7
SE30-2	4/8/2016 13:47	0	0	0	0	7.11	upstream	172.09	1.91	0.035	0.026	3.52	357.7
SE30-3	4/8/2016 17:38	0	135	15	0	10.56	downstream	397.41	5.58	0.157	0.074	4.14	26.4
SE30-4	4/8/2016 18:35	83	100	17	5.3	7.66	upstream	262.69	4.85	0.070	0.052	4.41	30.3
SE30-5	4/8/2016 18:47	70	80	10	2.2	9.10	downstream	443.82	4.66	0.090	0.056	4.41	30.3
SE30-6	4/8/2016 21:22	71	139	22	7.4	12.23	upstream	240.97	1.96	0.210	0.107	3.69	37.4
SE30-7	4/8/2016 21:53	72	141	22	5.3	17.44	downstream	389.11	1.45	0.148	0.085	3.69	37.4
SE31-1	5/8/2016 4:31	70	98	18	6.7	8.09	downstream	396.28	4.62	0.103	0.064	1.80	14.5
SE31-2	5/8/2016 4:54	79	86	10	0	8.14	upstream	236.54	5.29	0.058	0.039	1.80	14.5
SE31-3	5/8/2016 5:05	70	198	30	6.2	6.45	upstream	224.29	5.48	0.032	0.022	1.80	14.5
SE31-4	5/8/2016 5:47	79	80	8	2.8	8.57	upstream	155.15	5.71	0.050	0.029	1.80	14.5
SE31-5	5/8/2016 5:58	79	139	22	7.5	15.86	downstream	345.20	5.67	0.181	0.079	1.80	14.5
SE31-6	5/8/2016 7:11	70	199	32	8.3	12.65	downstream	350.66	4.75	0.169	0.056	2.04	10.1
SE31-7	5/8/2016 7:45	70	86	10	2.2	9.19	downstream	398.69	4.18	0.063	0.042	2.04	10.1
SE31-8	5/8/2016 9:26	0	0	0	0	8.40	downstream	355.36	2.32	0.039	0.029	2.58	20.8
SE32-1	5/8/2016 19:23	79	260	32	9.4	100.56	upstream	233.11	4.87	0.641	0.156	1.60	69.2
SE32-2	5/8/2016 19:36	77	225	32	8.1	10.75	downstream	396.05	4.65	0.121	0.079	1.60	69.2
SE32-3	5/8/2016 19:59	71	300	48	9.6	4.67	upstream	253.39	4.25	0.104	0.066	1.60	69.2

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE32-4	5/8/2016 22:51	71	398	59	11.5	12.87	downstream	358.54	1.23	0.108	0.053	0.24	24.9
SE33-1	6/8/2016 3:12	80	86	11	0	11.16	upstream	210.59	1.66	0.086	0.036	0.56	349.4
SE33-2	6/8/2016 3:27	80	110	12	2.7	12.83	upstream	195.71	1.87	0.195	0.063	0.56	349.4
SE33-3	6/8/2016 4:36	79	132	22	2	7.08	upstream	218.30	3.13	0.021	0.016	1.12	353.9
SE33-4	6/8/2016 4:48	80	135	12	0.2	9.60	upstream	223.38	3.50	0.040	0.024	1.12	353.9
SE33-5	6/8/2016 5:01	80	121	11	1.8	14.09	upstream	192.62	3.97	0.167	0.060	1.12	353.9
SE33-6	6/8/2016 5:22	83	96	15	5.9	9.99	downstream	401.98	4.72	0.383	0.110	1.12	353.9
SE33-7	6/8/2016 5:33	70	0	0	8	14.35	downstream	361.88	4.98	0.364	0.124	1.12	353.9
SE33-8	6/8/2016 5:44	80	109	11	2.2	8.92	upstream	186.77	5.20	0.064	0.048	1.12	353.9
SE33-9	6/8/2016 7:09	20	117	12	1	8.42	upstream	242.91	5.15	0.053	0.038	1.50	346.8
SE33-10	6/8/2016 7:22	0	183	32	10.9	10.63	downstream	393.32	4.97	0.100	0.041	1.50	346.8
SE33-11	6/8/2016 8:27	79	143	23	4.8	14.64	upstream	242.01	3.89	0.384	0.137	2.85	3.0
SE33-12	6/8/2016 9:08	70	80	10	2	9.82	downstream	416.28	3.19	0.039	0.025	2.85	3.0
SE33-13	6/8/2016 10:07	20	85	10	0	9.37	downstream	426.68	2.09	0.027	0.020	2.99	18.7
SE33-14	6/8/2016 10:19	80	89	14	5.5	17.42	downstream	375.86	1.89	0.113	0.048	2.99	18.7
SE33-15	6/8/2016 11:12	71	363	46	11.8	16.76	downstream	297.22	1.06	0.184	0.082	2.99	18.7
SE34-1	6/8/2016 15:33	0	0	0	0	8.05	upstream	190.29	2.23	0.024	0.016	1.54	71.8
SE34-2	6/8/2016 18:00	80	135	12	3.5	6.40	downstream	379.49	5.09	0.048	0.024	0.99	99.7
SE34-3	6/8/2016 19:07	79	132	11	3	6.51	downstream	543.64	5.34	0.057	0.039	0.99	99.7
SE34-4	6/8/2016 20:02	83	110	12	2.2	9.51	downstream	430.67	4.55	0.068	0.041	0.03	70.8
SE34-5	6/8/2016 20:50	89	94	12	4.9	14.48	downstream	417.83	3.72	0.068	0.036	0.03	70.8
SE34-6	6/8/2016 21:18	80	110	12	2.7	8.67	downstream	434.05	3.26	0.059	0.038	0.03	70.8
SE34-7	6/8/2016 23:05	73	172	28	6.6	16.89	downstream	362.54	1.32	0.230	0.066	0.02	287.0
SE35-1	7/8/2016 3:23	70	152	24	6.5	15.84	upstream	226.10	1.10	0.193	0.059	0.52	296.5
SE35-2	7/8/2016 4:05	70	366	48	15	12.58	downstream	352.51	1.68	0.114	0.068	0.26	296.6
SE35-3	7/8/2016 5:19	71	210	30	9.4	10.54	upstream	245.62	3.12	0.094	0.044	0.26	296.6
SE35-4	7/8/2016 6:46	20	110	11	2.8	6.98	downstream	423.53	5.13	0.054	0.029	1.20	0.1

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE35-5	7/8/2016 7:20	89	115	11	3	7.58	upstream	286.16	5.12	0.030	0.023	1.20	0.1
SE35-6	7/8/2016 7:31	74	214	32	8.9	13.61	upstream	264.04	5.03	0.356	0.131	1.20	0.1
SE35-7	7/8/2016 7:54	79	183	15	0	7.54	upstream	204.74	4.76	0.056	0.035	1.20	0.1
SE35-8	7/8/2016 9:59	90	107	11	0.3	5.83	upstream	230.61	2.67	0.060	0.034	2.48	359.1
SE36-1	7/8/2016 15:54	79	90	11	0	13.10	upstream	208.39	1.87	0.087	0.029	3.66	5.6
SE36-2	7/8/2016 17:28	80	144	22	7.9	12.44	upstream	263.54	3.27	0.547	0.124	3.57	12.2
SE36-3	7/8/2016 18:13	80	0	0	0.1	6.57	downstream	406.79	4.50	0.077	0.042	3.70	23.8
SE36-4	7/8/2016 19:21	70	227	32	8.1	13.61	upstream	306.15	5.32	0.620	0.116	3.70	23.8
SE36-5	7/8/2016 21:18	70	183	12	2.2	6.18	upstream	245.57	3.76	0.107	0.039	3.22	21.8
SE36-6	8/8/2016 0:04	70	300	48	10.7	12.21	downstream	362.54	1.02	0.095	0.053	4.42	25.7
SE37-1	8/8/2016 4:19	79	85	10	0.2	7.95	downstream	555.20	2.07	0.068	0.041	2.81	23.8
SE37-2	8/8/2016 4:40	80	135	17	0	10.21	upstream	223.87	2.36	0.050	0.030	2.81	23.8
SE37-3	8/8/2016 6:01	60	180	28	5.8	13.04	upstream	263.40	3.99	0.229	0.075	2.76	25.1
SE37-4	8/8/2016 7:10	79	89	10	2	8.55	upstream	171.26	5.44	0.034	0.026	2.76	25.1
SE37-5	8/8/2016 12:29	79	135	12	0	8.88	downstream	351.08	1.31	0.160	0.098	4.37	42.2
SE37-6	8/8/2016 12:45	70	81	10	25.5	12.98	downstream	568.29	1.11	0.127	0.084	4.37	42.2
SE38-1	8/8/2016 17:38	0	91	0	3.7	11.88	downstream	356.76	3.37	0.260	0.108	1.65	73.9
SE38-2	8/8/2016 18:04	79	81	10	2	10.89	upstream	242.12	3.78	0.168	0.086	1.39	73.0
SE38-3	8/8/2016 20:30	79	85	10	0.2	8.30	upstream	214.67	5.40	0.092	0.059	0.68	73.5
SE38-4	8/8/2016 21:25	70	200	32	8.9	14.23	upstream	275.86	4.58	0.567	0.171	0.68	73.5
SE38-5	8/8/2016 22:51	79	135	11	2.2	9.80	downstream	351.48	3.16	0.033	0.024	0.52	19.3
SE38-6	8/8/2016 23:01	79	110	12	2.5	7.95	upstream	217.95	2.98	0.085	0.030	0.52	19.3
SE38-7	9/8/2016 0:42	79	135	11	1.5	11.04	downstream	327.89	1.22	0.080	0.051	1.21	34.1
SE39-1	9/8/2016 3:51	70	110	11	0	7.44	upstream	217.94	1.21	0.019	0.016	0.61	203.0
SE39-2	9/8/2016 4:29	81	100	17	6.8	7.64	upstream	268.99	1.75	0.023	0.016	0.64	275.3
SE39-3	9/8/2016 5:17	80	256	43	8.9	8.61	downstream	273.75	2.40	0.107	0.044	0.64	275.3
SE39-4	9/8/2016 5:35	90	134	14	0	10.13	upstream	242.27	2.64	0.023	0.017	0.64	275.3

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SE39-5	9/8/2016 7:00	80	80	9	1.1	7.46	downstream	426.81	4.33	0.173	0.088	0.91	297.2
SE39-6	9/8/2016 7:14	80	110	15	2.5	10.44	upstream	197.64	4.65	0.086	0.046	0.91	297.2
SE39-7	9/8/2016 12:33	79	366	48	12.7	8.63	upstream	233.82	1.51	0.367	0.178	1.90	79.6
SE40-1	9/8/2016 15:35	70	138	21	6.3	10.48	downstream	441.25	1.14	0.087	0.047	1.29	114.3
SE40-2	9/8/2016 18:31	71	228	38	8.1	17.59	upstream	259.57	3.26	0.656	0.201	1.18	106.2
SE40-3	9/8/2016 19:07	71	214	32	8.3	19.87	upstream	251.73	3.92	0.394	0.143	1.18	106.2
SE40-4	9/8/2016 21:55	99	0	0	0	10.28	downstream	367.00	4.22	0.067	0.036	0.28	110.2
SE40-5	9/8/2016 22:53	79	281	32	10.7	10.94	upstream	262.86	3.28	0.727	0.157	0.01	181.8
SE40-6	10/8/2016 0:57	80	110	12	1	9.39	downstream	435.11	1.29	0.068	0.042	0.75	33.5
SE41-1	10/8/2016 5:07	80	100	15	5.2	8.94	downstream	426.16	1.59	0.152	0.073	0.01	201.5
SE41-2	10/8/2016 5:18	80	86	11	0.2	10.85	upstream	239.50	1.73	0.049	0.032	0.01	201.5
SE41-3	10/8/2016 6:38	89	87	15	4	10.75	downstream	368.39	2.89	0.192	0.089	0.17	123.9
SE41-4	10/8/2016 9:14	79	80	14	1	9.66	downstream	298.15	4.94	0.152	0.069	0.99	17.5
SE41-5	10/8/2016 9:24	80	100	10	0	9.14	downstream	429.06	4.87	0.106	0.057	0.99	17.5
SE41-6	10/8/2016 9:39	90	107	11	0.3	8.18	upstream	210.20	4.72	0.083	0.049	0.99	17.5
SE41-7	10/8/2016 10:20	80	110	11	1.5	9.64	downstream	470.44	4.16	0.063	0.036	0.69	66.3
SE41-8	10/8/2016 10:51	80	290	11	0.3	4.61	upstream	145.95	3.66	0.065	0.031	0.69	66.3
SE41-9	10/8/2016 11:31	79	110	11	2.5	10.52	downstream	402.96	3.02	0.021	0.015	0.69	66.3
SE41-10	10/8/2016 13:05	79	366	48	10.5	14.42	downstream	334.62	1.50	0.253	0.092	0.66	36.4
SE41-11	10/8/2016 13:29	99	85	8	0	10.32	downstream	434.02	1.15	0.072	0.047	0.66	36.4
SE42-1	10/8/2016 21:11	70	107	20	6.1	9.87	upstream	190.90	4.81	0.055	0.040	0.85	85.2
SE42-2	10/8/2016 23:22	79	86	10	1	6.98	upstream	146.61	3.20	0.101	0.040	1.66	29.0
SE42-3	11/8/2016 0:58	79	199	27	8.1	9.02	downstream	237.33	1.66	0.052	0.031	1.45	12.3
SE42-4	11/8/2016 1:39	70	140	22	5.6	22.26	downstream	279.16	1.06	0.226	0.076	1.45	12.3
SE43-1	11/8/2016 5:47	71	97	16	4.7	12.13	downstream	410.47	1.22	0.141	0.068	0.44	347.0
SE43-2	11/8/2016 6:25	0	139	11	0	9.86	upstream	168.46	1.74	0.025	0.017	1.67	351.2
SE43-3	11/8/2016 8:24	79	105	10	0	8.92	upstream	200.99	3.94	0.030	0.019	2.64	2.2

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SE43-4	11/8/2016 12:57	80	135	12	0	7.76	upstream	177.84	2.28	0.066	0.034	3.49	8.5
SE43-5	11/8/2016 13:08	80	147	24	8.7	11.66	upstream	167.81	2.09	0.278	0.076	3.49	8.5
SE43-6	11/8/2016 13:33	82	126	19	6.2	6.90	upstream	222.85	1.68	0.132	0.054	3.49	8.5
SE44-1	11/8/2016 17:06	72	210	32	10.6	11.22	upstream	220.53	1.21	0.143	0.063	3.06	30.4
SE44-2	11/8/2016 21:05	89	86	8	2	10.75	upstream	156.35	4.49	0.154	0.052	1.48	13.1
SE44-3	11/8/2016 21:19	79	102	12	25.5	9.08	upstream	226.47	4.60	0.051	0.032	1.48	13.1
SE44-4	11/8/2016 22:18	70	128	16	4.3	10.17	downstream	366.90	4.60	0.188	0.085	1.77	16.1
SE44-5	11/8/2016 22:33	79	139	22	7.1	15.76	downstream	426.08	4.48	0.115	0.052	1.77	16.1
SE44-6	11/8/2016 23:40	79	80	9	0.3	9.68	downstream	417.56	3.65	0.118	0.062	1.77	16.1
SE44-7	12/8/2016 1:11	80	85	11	2.3	5.58	upstream	198.21	2.34	0.055	0.033	2.39	28.4
SE45-1	12/8/2016 5:58	79	86	9	0.4	10.63	upstream	209.46	1.30	0.070	0.040	2.35	23.2
SE45-2	12/8/2016 6:10	79	110	12	1.5	11.14	upstream	191.48	1.46	0.136	0.060	2.57	27.2
SE45-3	12/8/2016 7:18	82	99	16	7	7.54	upstream	186.29	2.30	0.016	0.016	2.57	27.2
SE45-4	12/8/2016 8:46	80	86	10	0.3	11.45	upstream	224.97	3.61	0.067	0.038	3.09	33.5
SE45-5	12/8/2016 8:58	70	86	11	1.2	8.73	upstream	233.68	3.81	0.025	0.019	3.09	33.5
SE45-6	12/8/2016 12:51	79	132	11	3	10.30	downstream	525.73	3.05	0.057	0.037	3.89	33.7
SE45-7	12/8/2016 14:56	79	105	10	1.5	11.43	downstream	435.48	1.33	0.052	0.031	4.21	32.5
SE46-1	12/8/2016 18:34	80	110	12	3.7	9.43	upstream	229.49	1.35	0.033	0.023	2.74	20.3
SE46-2	12/8/2016 18:49	79	92	11	1	9.04	upstream	244.46	1.54	0.155	0.074	2.74	20.3
SE46-3	12/8/2016 19:51	99	19	11	25.5	6.67	downstream	425.95	2.33	0.053	0.029	2.74	20.3
SE46-4	12/8/2016 22:45	70	400	59	11.3	14.62	downstream	316.19	4.34	1.143	0.249	1.14	14.5
SE46-5	12/8/2016 23:26	71	205	29	7.5	19.59	downstream	382.95	4.27	0.326	0.166	1.14	14.5
SE46-6	13/08/2016 00:26	70	98	17	5.6	5.29	upstream	237.57	3.67	0.039	0.024	1.95	15.3
SE46-7	13/08/2016 00:59	90	110	17	2	7.00	upstream	228.91	3.25	0.044	0.028	1.95	15.3
SE46-8	13/08/2016 01:16	99	52	7	0	9.33	downstream	359.00	3.04	0.045	0.028	1.95	15.3
SE46-9	13/08/2016 01:45	71	214	32	9.1	13.51	downstream	304.74	2.67	0.089	0.042	1.95	15.3
SE46-10	13/08/2016 02:52	80	110	13	4.3	10.07	downstream	387.11	1.77	0.089	0.047	2.17	22.4

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SE47-1	13/08/2016 07:24	82	102	17	7.1	11.10	downstream	419.42	1.70	0.159	0.109	2.41	17.1
SE47-2	13/08/2016 12:53	0	0	0	0	7.21	downstream	548.61	3.90	0.073	0.041	4.16	33.1
SE47-3	13/08/2016 16:09	80	94	12	4.1	10.63	upstream	181.12	1.38	0.300	0.095	2.37	36.3
SE48-1	13/08/2016 19:37	70	199	32	8.4	17.75	downstream	411.83	1.32	0.093	0.069	1.05	88.2
SE48-2	13/08/2016 20:19	80	144	23	8.4	12.52	upstream	265.09	1.80	0.505	0.228	0.14	81.1
SE48-3	13/08/2016 21:24	70	89	16	6	9.89	downstream	422.08	2.56	0.088	0.071	0.14	81.1
SE48-4	13/08/2016 21:39	89	85	10	0	9.99	downstream	358.10	2.76	0.099	0.044	0.14	81.1
SE48-5	13/08/2016 22:17	80	110	12	0.1	10.81	upstream	289.84	3.29	0.099	0.047	0.02	7.2
SE48-6	13/08/2016 22:27	71	139	22	5.8	14.83	downstream	394.13	3.43	0.283	0.122	0.02	7.2
SE48-7	13/08/2016 22:58	79	330	42	14.2	14.00	downstream	408.69	3.85	0.105	0.060	0.02	7.2
SE48-8	14/08/2016 00:10	99	24	6	1	14.60	upstream	228.64	4.46	0.180	0.091	0.02	165.7
SE48-9	14/08/2016 00:22	99	24	6	1	7.97	downstream	426.51	4.47	0.111	0.055	0.02	165.7
SE48-10	14/08/2016 00:54	71	222	32	10.4	11.45	downstream	359.66	4.34	0.313	0.141	0.02	165.7
SE48-11	14/08/2016 01:08	83	106	11	2	6.94	upstream	205.23	4.21	0.115	0.050	0.02	165.7
SE48-12	14/08/2016 02:03	72	292	32	12.4	15.75	downstream	296.63	3.53	0.533	0.176	0.16	355.5
SE48-13	14/08/2016 02:44	71	292	32	11.6	17.03	upstream	273.61	2.97	0.398	0.142	0.16	355.5
SE48-14	14/08/2016 02:55	71	240	32	10.3	14.17	downstream	391.72	2.84	0.158	0.066	0.16	355.5
SE48-15	14/08/2016 03:16	80	110	11	2	12.62	downstream	416.80	2.53	0.076	0.046	0.16	355.5
SE48-16	14/08/2016 04:53	89	110	13	3	7.23	upstream	284.91	1.25	0.145	0.056	0.15	341.5
SE49-1	14/08/2016 07:55	80	110	12	2.7	8.28	downstream	511.38	1.00	0.031	0.024	0.48	23.3
SE49-2	14/08/2016 08:07	82	100	17	7.3	12.97	upstream	276.58	1.14	0.219	0.114	0.12	10.9
SE49-3	14/08/2016 08:34	79	185	31	7.4	13.02	upstream	253.66	1.48	0.156	0.068	0.12	10.9
SE49-4	14/08/2016 09:13	52	24	10	3	12.52	upstream	206.06	1.94	0.217	0.071	0.12	10.9
SE49-5	14/08/2016 13:10	80	121	11	0.1	8.98	downstream	378.92	4.47	0.113	0.062	0.44	106.8
SE49-6	14/08/2016 13:22	70	99	14	5.8	11.51	upstream	270.60	4.42	0.166	0.094	0.44	106.8
SE49-7	14/08/2016 14:24	71	262	32	9.5	12.89	downstream	331.12	3.77	0.540	0.138	1.08	106.2
SE49-8	14/08/2016 15:00	80	86	11	0	11.02	downstream	356.74	3.29	0.104	0.068	1.08	106.2

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE49-9	14/08/2016 15:43	79	110	11	0	9.60	downstream	334.78	2.69	0.129	0.077	1.08	106.2
SE49-10	14/08/2016 16:16	71	275	32	8.8	18.52	downstream	319.57	2.20	0.531	0.128	1.07	114.7
SE49-11	14/08/2016 16:54	79	173	23	7.1	13.33	downstream	375.88	1.65	0.105	0.066	1.07	114.7
SE49-12	14/08/2016 17:22	70	126	22	6.2	16.54	downstream	358.91	1.28	0.302	0.100	1.07	114.7
SE50-1	14/08/2016 21:10	79	135	14	2.6	10.69	upstream	189.27	1.15	0.112	0.040	0.93	146.9
SE50-2	14/08/2016 21:34	70	100	30	8.8	13.80	upstream	214.76	1.45	0.211	0.118	0.93	146.9
SE50-3	14/08/2016 23:11	70	300	48	9.8	11.39	upstream	255.72	2.70	0.095	0.058	2.09	154.2
SE50-4	15/08/2016 00:11	90	229	32	8.2	12.09	downstream	349.85	3.71	0.321	0.083	1.80	152.6
SE50-5	15/08/2016 00:27	80	99	17	5.9	10.56	upstream	274.05	4.00	0.561	0.097	1.80	152.6
SE50-6	15/08/2016 04:12	80	228	32	11.5	13.18	downstream	334.81	2.79	0.107	0.043	1.38	158.9
SE50-7	15/08/2016 04:24	70	112	15	5.8	9.72	upstream	266.95	2.61	0.364	0.098	1.38	158.9
SE50-8	15/08/2016 04:42	79	85	8	1	11.45	downstream	361.60	2.33	0.114	0.060	1.38	158.9
SE50-9	15/08/2016 06:01	81	182	32	11.8	10.67	downstream	392.89	1.16	0.041	0.024	0.92	181.0
SE51-1	15/08/2016 09:42	82	100	16	5.6	11.99	upstream	226.79	1.16	0.275	0.076	1.48	198.3
SE51-2	15/08/2016 10:00	89	182	27	10.8	13.78	upstream	209.35	1.38	0.100	0.067	2.74	200.5
SE51-3	15/08/2016 11:43	82	183	32	7.4	16.44	downstream	392.12	2.65	0.228	0.119	2.74	200.5
SE51-4	15/08/2016 12:50	82	183	32	9.4	8.48	upstream	245.08	3.80	0.040	0.025	2.09	190.8
SE51-5	15/08/2016 14:08	79	135	14	2.5	8.46	upstream	175.78	4.62	0.059	0.036	1.98	181.9
SE51-6	15/08/2016 15:48	0	0	0	0	8.55	downstream	484.37	3.55	0.047	0.028	1.98	181.9
SE51-7	15/08/2016 17:42	79	0	0	0.3	8.38	downstream	330.04	1.80	0.061	0.036	2.04	192.9
SE51-8	15/08/2016 18:12	0	84	10	0.4	4.53	upstream	196.82	1.35	0.029	0.022	2.04	190.6
SE52-1	15/08/2016 22:31	70	88	13	5.5	12.40	upstream	170.42	1.15	0.184	0.048	1.54	178.3
SE52-2	16/08/2016 02:02	70	179	27	9.8	15.28	upstream	229.87	4.56	0.103	0.037	1.77	188.5
SE52-3	16/08/2016 02:58	81	108	17	5.2	16.41	downstream	381.28	4.68	0.481	0.232	1.77	188.5
SE52-4	16/08/2016 03:54	80	183	32	8.7	11.74	downstream	387.31	4.02	0.147	0.054	1.77	188.5
SE52-5	16/08/2016 04:54	89	180	32	11.1	8.53	upstream	254.42	3.09	0.100	0.048	2.51	198.8
SE52-6*	16/08/2016 05:37	80	183	27	8	10.01	downstream	331.30	2.41	0.040	0.026	2.51	198.8

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE52-7	16/08/2016 06:37	79	108	11	0	11.64	downstream	291.12	1.44	0.062	0.035	2.88	195.9
SE52-8	16/08/2016 07:00	79	105	9	1	9.35	downstream	370.94	1.11	0.034	0.024	2.88	195.9
SE53-1	16/08/2016 11:05	80	97	15	5.4	13.02	upstream	195.41	1.52	0.359	0.084	2.70	203.2
SE53-2	16/08/2016 11:25	80	110	12	3.2	12.63	upstream	219.66	1.76	0.300	0.101	2.70	203.2
SE53-3	16/08/2016 12:12	79	65	7	0	8.94	upstream	186.40	2.32	0.040	0.029	3.64	205.4
SE53-4	16/08/2016 15:22	89	115	11	3	9.25	upstream	277.92	4.83	0.051	0.034	3.36	208.3
SE53-5	16/08/2016 19:03	80	110	11	0	6.06	upstream	152.96	1.43	0.071	0.041	3.07	204.9
SE53-6	16/08/2016 19:17	79	80	10	0.2	6.34	upstream	124.36	1.22	0.064	0.043	3.07	204.9
SE54-1	17/08/2016 01:46	81	90	12	3.1	8.55	downstream	297.79	3.56	0.155	0.064	4.14	200.8
SE54-2	17/08/2016 02:27	79	153	21	6.3	15.76	upstream	262.42	4.62	0.197	0.075	2.74	200.7
SE54-3	17/08/2016 03:18	70	88	12	3.7	11.02	upstream	221.81	5.10	0.297	0.072	2.74	200.7
SE54-4	17/08/2016 03:42	79	81	9	0.9	10.13	downstream	363.13	5.03	0.127	0.064	2.74	200.7
SE54-5	17/08/2016 04:02	83	100	17	5.4	14.21	upstream	186.39	4.85	0.561	0.171	2.00	197.2
SE54-6	17/08/2016 04:29	70	190	32	7.9	12.56	upstream	247.91	4.49	0.195	0.063	2.00	197.2
SE54-7	17/08/2016 06:33	71	278	40	12.2	11.49	upstream	204.92	2.43	0.557	0.139	2.19	199.7
SE54-8	17/08/2016 07:20	79	183	32	7.8	9.78	upstream	225.59	1.63	0.470	0.100	2.19	199.7
SE55-1	17/08/2016 13:07	79	80	10	0	9.51	upstream	139.76	2.45	0.038	0.026	3.63	221.7
SE55-2	17/08/2016 16:52	79	85	8	1	9.60	downstream	251.48	4.47	0.060	0.041	2.70	217.1
SE55-3	17/08/2016 17:45	79	139	22	7.1	15.82	upstream	227.12	3.60	0.461	0.124	2.70	217.1
SE55-4	17/08/2016 18:22	0	0	0	0	9.25	downstream	537.07	3.01	0.046	0.028	2.66	208.1
SE55-5	17/08/2016 19:13	79	24	6	0	8.38	downstream	149.95	2.11	0.030	0.018	2.66	208.1
SE56-1	18/08/2016 02:04	70	399	54	13.5	14.02	upstream	285.67	3.01	0.302	0.107	3.14	210.4
SE56-2	18/08/2016 02:54	79	95	13	3.4	7.89	downstream	391.20	4.51	0.096	0.048	3.14	210.4
SE56-3	18/08/2016 03:08	79	167	25	9.2	11.45	upstream	189.56	4.89	0.099	0.035	3.14	210.4
SE56-4	18/08/2016 03:47	79	300	40	9.1	9.76	upstream	220.25	5.38	0.279	0.081	3.14	210.4
SE56-5	18/08/2016 04:29	80	140	11	2	10.38	upstream	222.57	5.28	0.194	0.056	1.54	197.9
SE56-6	18/08/2016 04:42	79	135	16	1.6	11.70	upstream	199.43	5.16	0.184	0.049	1.54	197.9

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE56-7	18/08/2016 05:19	79	80	10	0	12.05	downstream	351.23	4.64	0.124	0.059	1.54	197.9
SE56-8	18/08/2016 06:06	89	85	11	2.3	10.81	downstream	399.04	3.84	0.073	0.046	0.95	190.7
SE56-9	18/08/2016 06:31	99	85	9	0	10.11	downstream	512.54	3.42	0.095	0.048	0.95	190.7
SE56-10	18/08/2016 06:45	70	269	32	8.4	16.54	downstream	381.80	3.19	0.460	0.129	0.95	190.7
SE57-1	18/08/2016 14:02	0	105	10	0.4	7.99	upstream	168.69	2.80	0.036	0.024	0.78	221.6
SE57-2	18/08/2016 16:29	20	85	10	0	10.19	upstream	187.08	5.47	0.112	0.067	0.32	124.7
SE57-3	18/08/2016 17:14	90	110	12	0	10.13	downstream	332.21	5.02	0.145	0.074	0.32	124.7
SE57-4	18/08/2016 20:37	70	80	11	4.3	10.54	downstream	434.19	1.52	0.139	0.077	0.02	100.3
SE58-1	19/08/2016 01:10	52	27	7	2	8.67	upstream	179.95	1.48	0.034	0.019	1.07	202.9
SE58-2	19/08/2016 06:10	0	244	32	9.6	16.08	downstream	314.96	4.53	0.128	0.062	0.25	248.3
SE58-3	19/08/2016 06:26	71	245	32	9	13.45	downstream	346.58	4.27	0.475	0.120	0.25	248.3
SE58-4	19/08/2016 07:28	79	80	10	0	13.37	downstream	300.43	3.19	0.108	0.052	0.25	248.3
SE58-5	19/08/2016 07:39	70	229	32	7.1	14.64	downstream	341.31	2.99	0.110	0.048	0.25	248.3
SE59-1	19/08/2016 15:36	79	110	12	1	9.35	upstream	182.10	3.85	0.051	0.035	2.05	301.1
SE59-2	19/08/2016 18:20	79	110	12	2.5	9.70	downstream	317.18	4.60	0.107	0.062	1.73	300.6
SE59-3	19/08/2016 19:19	89	63	8	0	6.76	upstream	118.01	3.61	0.065	0.035	1.73	300.6
SE59-4	19/08/2016 21:37	79	197	11	2	4.90	upstream	164.21	1.17	0.158	0.065	2.96	349.9
SE60-1	20/08/2016 01:52	70	110	11	0	9.60	upstream	213.94	1.39	0.032	0.019	2.93	4.6
SE60-2	20/08/2016 03:26	71	368	51	12.4	11.59	upstream	240.67	2.95	0.111	0.043	1.70	359.7
SE60-3	20/08/2016 06:30	71	296	38	9	12.62	upstream	239.66	4.90	0.341	0.120	0.85	336.4
SE60-4	20/08/2016 06:50	80	86	10	0.2	8.51	downstream	353.02	4.58	0.058	0.031	0.85	336.4
SE60-5	20/08/2016 07:00	80	183	32	8.7	11.90	upstream	276.92	4.41	0.112	0.042	0.85	336.4
SE60-6	20/08/2016 08:07	79	78	10	1.8	6.76	upstream	269.65	3.23	0.048	0.028	1.95	352.6
SE61-1	20/08/2016 13:34	80	110	12	3.2	11.62	upstream	193.54	1.38	0.133	0.055	3.59	5.4
SE61-2	20/08/2016 13:47	80	109	18	5.6	9.27	downstream	428.43	1.56	0.112	0.069	3.59	5.4
SE61-3	20/08/2016 16:45	90	229	32	8.5	13.24	downstream	395.05	5.21	0.289	0.087	4.15	17.5
SE61-4	20/08/2016 17:09	79	81	10	2	8.94	downstream	340.85	5.60	0.114	0.043	4.15	17.5

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE61-5	20/08/2016 17:19	80	121	11	0.1	7.99	downstream	261.39	5.66	0.103	0.048	4.15	17.5
SE61-6	20/08/2016 19:27	89	68	7	1.3	6.36	upstream	167.45	4.13	0.139	0.069	3.54	27.9
SE61-7	20/08/2016 20:38	80	113	20	6.6	7.95	upstream	213.19	2.88	0.133	0.052	1.82	5.6
SE61-8	20/08/2016 22:18	71	275	33	10.3	8.14	upstream	262.66	1.12	0.252	0.112	2.28	356.9
SE62-1	21/08/2016 02:45	72	292	32	11.8	15.69	upstream	297.64	1.65	0.406	0.097	2.35	342.1
SE62-2	21/08/2016 03:34	80	86	9	0.2	9.84	upstream	192.97	2.40	0.037	0.024	2.35	342.1
SE62-3	21/08/2016 03:45	79	366	48	14.5	11.82	downstream	365.02	2.61	0.309	0.072	2.35	342.1
SE62-4	21/08/2016 04:58	70	210	30	9.3	8.81	upstream	208.31	5.01	0.146	0.080	3.17	346.3
SE62-5	21/08/2016 05:30	89	117	18	7.5	11.22	downstream	377.20	5.55	0.147	0.073	3.17	346.3
SE62-6	21/08/2016 06:07	70	294	32	10.2	13.45	downstream	364.65	5.61	0.728	0.178	3.90	351.9
SE62-7	21/08/2016 06:43	89	110	11	1	6.59	downstream	379.84	5.34	0.053	0.035	3.90	351.9
SE62-8	21/08/2016 07:22	70	80	11	2.9	8.26	upstream	198.62	4.79	0.078	0.041	3.90	351.9
SE62-9	21/08/2016 07:42	80	100	20	4.3	14.75	downstream	392.49	4.46	0.169	0.064	3.90	351.9
SE62-10	21/08/2016 07:57	89	125	11	4.1	13.18	downstream	408.07	4.21	0.140	0.089	3.90	351.9
SE62-11	21/08/2016 08:11	89	63	8	0	10.32	downstream	295.59	3.96	0.070	0.044	3.77	358.9
SE62-12	21/08/2016 08:24	79	135	12	2	11.62	downstream	334.25	3.71	0.080	0.032	3.77	358.9
SE62-13	21/08/2016 09:35	80	144	23	8.7	8.32	upstream	280.08	2.42	0.416	0.110	3.77	358.9
SE62-14	21/08/2016 10:18	80	140	11	2	11.84	downstream	345.91	1.67	0.077	0.048	4.40	8.6
SE62-15	21/08/2016 10:38	71	243	32	10	15.47	downstream	365.79	1.37	0.130	0.058	4.40	8.6
SE63-1	21/08/2016 13:26	90	83	12	4.7	11.78	upstream	283.87	1.03	0.172	0.076	3.99	23.9
SE63-2	21/08/2016 14:13	89	128	20	6	14.52	upstream	239.50	1.77	0.377	0.146	4.57	40.4
SE63-3	21/08/2016 15:02	90	135	14	0	11.74	upstream	249.01	2.45	0.085	0.034	4.57	40.4
SE63-4	21/08/2016 17:07	89	86	11	1.9	6.98	downstream	473.29	4.81	0.069	0.046	5.04	42.8
SE63-5	21/08/2016 17:44	80	110	12	0	9.70	upstream	246.92	5.71	0.097	0.057	5.04	42.8
SE63-6	21/08/2016 19:47	99	110	12	0	9.00	upstream	198.88	4.83	0.129	0.085	4.09	37.9
SE63-7	21/08/2016 20:02	80	110	11	0.3	11.20	downstream	260.21	4.57	0.127	0.068	3.06	26.4
SE63-8	21/08/2016 21:46	79	135	14	2.6	7.74	upstream	192.73	2.64	0.062	0.035	3.06	26.4

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
SE63-9	21/08/2016 23:14	90	113	20	7.4	9.80	upstream	253.40	1.06	0.182	0.059	2.43	11.4
SE64-1	22/08/2016 03:37	71	210	30	9.5	16.50	upstream	237.32	1.89	0.206	0.066	2.20	358.9
SE64-2	22/08/2016 03:53	70	199	32	8.9	15.92	upstream	268.99	2.11	0.102	0.038	2.20	358.9
SE64-3	22/08/2016 04:30	80	110	11	3.2	7.10	downstream	422.12	2.66	0.074	0.033	1.22	342.4
SE64-4	22/08/2016 04:50	99	0	0	0	8.49	upstream	155.87	3.06	0.027	0.018	1.22	342.4
SE64-5	22/08/2016 05:11	90	105	18	4	6.61	upstream	269.82	3.70	0.025	0.019	1.22	342.4
SE64-6	22/08/2016 06:16	79	78	11	3.2	8.98	upstream	200.82	5.58	0.068	0.034	2.16	6.3
SE64-7	22/08/2016 06:30	89	183	27	10.7	12.11	upstream	223.95	5.66	0.055	0.036	2.16	6.3
SE64-8	22/08/2016 07:53	80	98	14	4.5	11.02	upstream	225.44	4.99	0.248	0.095	2.16	6.3
SE64-9	22/08/2016 08:15	79	110	10	0	9.60	downstream	385.29	4.63	0.081	0.053	3.04	22.9
SE64-10	22/08/2016 09:42	90	113	20	7.4	13.37	downstream	387.45	3.07	0.174	0.060	3.04	22.9
SE64-11	22/08/2016 09:56	99	125	12	0.2	14.05	downstream	657.94	2.82	0.086	0.043	3.04	22.9
SE64-12	22/08/2016 10:31	79	81	8	0	9.29	downstream	267.88	2.14	0.104	0.059	3.64	23.4
SE64-13	22/08/2016 10:47	0	0	0	0	9.58	downstream	468.45	1.85	0.048	0.030	3.64	23.4
SE64-14	22/08/2016 10:59	80	184	27	7.6	6.06	upstream	269.99	1.65	0.102	0.046	3.64	23.4
SE64-15	22/08/2016 11:14	33	64	10	0.1	6.05	upstream	158.05	1.40	0.112	0.044	3.64	23.4

Table A-2 – Large vessel events.

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE01-1	20/07/2016 12:30	70	269	32	9.3	15.94	upstream	346.73	1.07	0.241	3.55	291.8
SE01-2	20/07/2016 13:08	71	366	51	12.8	11.76	downstream	269.26	1.61	0.402	3.55	291.8
SE01-3	20/07/2016 16:55	71	245	32	9	12.44	upstream	394.33	5.31	0.081	2.08	4.0
SE01-4	20/07/2016 17:57	71	277	40	10.2	10.44	upstream	431.31	4.47	0.221	2.08	4.0
SE01-5	20/07/2016 20:48	71	293	33	9.3	14.81	downstream	246.24	1.60	0.094	1.93	33.2
SE01-6	20/07/2016 21:21	71	278	40	11.2	15.61	downstream	219.10	1.07	0.281	1.93	33.2
SE02-1	21/07/2016 03:07	79	399	60	10.9	12.75	upstream	277.71	3.11	0.291	1.20	14.0
SE02-2	21/07/2016 05:09	70	222	32	9.8	13.98	upstream	383.15	5.52	0.140	0.83	355.0
SE02-3	21/07/2016 07:38	70	229	32	9.2	11.66	downstream	306.67	3.41	0.080	1.51	3.1
SE02-4	21/07/2016 08:50	70	333	48	11.8	12.19	downstream	213.83	2.09	0.281	3.08	25.7
SE03-1	21/07/2016 13:02	79	294	32	13.7	16.64	downstream	383.35	1.30	0.274	2.51	32.4
SE03-2	21/07/2016 15:33	70	300	48	9.8	8.75	upstream	213.69	3.43	0.054	1.35	47.1
SE03-3	21/07/2016 16:31	70	200	32	7.9	10.92	downstream	247.07	5.06	0.039	1.22	107.9
SE03-4	21/07/2016 17:20	82	245	41	14.6	7.15	upstream	215.11	5.56	0.057	1.22	107.9
SE03-5	21/07/2016 20:10	74	299	48	8.5	6.47	upstream	287.70	3.16	0.104	0.60	115.4
SE03-6	21/07/2016 22:06	70	214	32	7.9	12.48	upstream	149.73	1.10	0.356	0.91	89.0
SE04-1	22/07/2016 02:36	0	231	32	9.2	11.94	upstream	425.58	1.89	0.087	0.24	102.1
SE04-2	22/07/2016 04:31	71	277	40	12.4	14.09	downstream	227.85	4.48	0.245	0.34	181.0
SE04-3	22/07/2016 05:03	70	232	32	9.1	11.72	upstream	206.83	5.31	0.184	0.34	181.0
SE04-4	22/07/2016 06:38	81	229	32	10.5	11.27	downstream	230.86	5.10	0.070	0.58	166.0
SE04-5	22/07/2016 09:19	79	211	32	7.7	13.28	upstream	307.92	2.24	0.178	0.40	105.5
SE04-6	22/07/2016 09:41	71	243	32	9.2	15.63	downstream	175.01	1.87	0.095	0.40	105.5
SE04-7	22/07/2016 10:22	71	243	32	9.1	20.66	downstream	209.23	1.19	0.137	0.62	102.7
SE05-1	22/07/2016 13:33	71	211	32	9.5	15.06	downstream	343.33	1.08	0.105	0.80	103.9
SE05-2	22/07/2016 14:22	70	366	51	13.6	8.44	downstream	342.51	1.77	0.260	0.84	102.2

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE05-3	22/07/2016 14:57	79	399	60	14.8	10.77	downstream	353.20	2.18	0.501	0.84	102.2
SE05-4	22/07/2016 15:59	71	227	36	8.8	13.80	downstream	508.84	3.03	0.239	0.84	102.2
SE05-5	22/07/2016 16:28	70	207	30	9.7	11.02	upstream	197.35	3.65	0.137	1.39	93.7
SE05-6	22/07/2016 17:33	70	294	32	10.7	12.15	upstream	217.86	5.37	0.051	1.39	93.7
SE05-7	22/07/2016 20:01	70	300	48	12.5	11.59	upstream	322.60	3.95	0.237	1.25	96.9
SE05-8	22/07/2016 21:21	70	300	48	11.2	13.67	downstream	219.48	2.52	0.163	1.25	96.9
SE06-1	23/07/2016 02:52	70	210	30	8.1	13.67	downstream	257.87	1.43	0.111	1.42	50.0
SE06-2	23/07/2016 04:37	70	236	39	8.9	13.06	upstream	264.57	3.25	0.115	1.04	63.4
SE06-3	23/07/2016 08:09	71	221	32	10.6	15.82	upstream	349.51	4.31	0.259	1.25	150.8
SE06-4	23/07/2016 10:52	70	207	30	9.7	16.00	downstream	427.10	1.38	0.106	0.75	108.8
SE07-1	23/07/2016 14:28	70	294	32	11.4	9.27	downstream	319.81	1.34	0.110	1.32	94.1
SE07-2	23/07/2016 15:10	71	205	26	7.4	21.81	downstream	126.01	1.92	0.233	1.32	94.1
SE07-3	23/07/2016 16:18	74	299	48	8.5	13.51	downstream	386.85	2.73	0.344	1.52	84.4
SE07-4	23/07/2016 18:04	71	295	33	9.9	10.48	upstream	196.16	5.22	0.067	1.32	90.4
SE07-5	23/07/2016 19:00	71	337	46	12	14.29	downstream	237.21	5.44	0.311	1.32	90.4
SE07-6	23/07/2016 22:00	70	296	37	9.4	11.29	upstream	449.57	2.52	0.195	0.64	79.2
SE07-7	23/07/2016 22:43	71	399	54	10.9	14.13	downstream	242.76	1.74	0.374	0.64	79.2
SE08-1	24/07/2016 04:24	71	292	33	10.6	14.00	upstream	398.69	2.12	0.276	1.68	29.6
SE08-2	24/07/2016 06:06	80	228	32	13.4	7.72	downstream	162.25	4.84	0.101	1.11	15.2
SE08-3	24/07/2016 07:05	71	209	30	9.1	11.51	upstream	402.36	5.51	0.063	1.11	15.2
SE08-4	24/07/2016 08:54	71	243	33	8	11.97	downstream	349.37	4.17	0.067	1.23	20.4
SE08-5	24/07/2016 10:55	72	300	45	10.9	14.27	downstream	416.51	1.96	0.241	1.38	13.6
SE09-1	24/07/2016 16:58	71	366	48	14.3	12.75	downstream	272.67	2.66	0.465	1.90	19.7
SE09-2	24/07/2016 19:22	70	300	48	10.8	13.22	downstream	378.36	5.50	0.117	1.08	55.4
SE09-3	24/07/2016 21:26	70	227	32	8.5	23.42	upstream	157.51	3.84	0.156	0.64	82.7
SE09-4	24/07/2016 21:44	71	366	52	10.7	12.13	upstream	242.76	3.53	0.227	0.64	82.7
SE09-5	24/07/2016 21:53	71	275	33	10.3	8.83	upstream	269.33	3.39	0.331	0.64	82.7

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE09-6	24/07/2016 22:04	71	286	40	9.5	12.32	downstream	382.77	3.21	0.168	0.13	25.7
SE10-1	25/07/2016 04:22	70	293	40	11.3	9.35	upstream	418.74	1.45	0.125	1.28	15.4
SE10-2	25/07/2016 06:49	70	292	32	12.1	13.78	downstream	147.82	4.77	0.166	1.47	3.3
SE10-3	25/07/2016 09:27	79	299	42	11.2	14.89	downstream	328.59	4.30	0.306	2.10	8.8
SE10-4	25/07/2016 12:29	71	366	52	11.8	12.30	upstream	344.88	1.17	0.765	2.13	23.7
SE11-1	25/07/2016 16:43	70	200	32	7.7	12.32	downstream	204.86	1.99	0.066	NaN	NaN
SE11-2	25/07/2016 17:40	80	213	32	10.7	6.80	upstream	369.96	2.70	0.089	NaN	NaN
SE11-3	25/07/2016 20:44	70	293	40	10.9	12.25	downstream	292.93	5.17	0.081	NaN	NaN
SE11-4	25/07/2016 22:12	71	209	30	8.7	10.56	upstream	208.58	3.79	0.074	NaN	NaN
SE11-5	25/07/2016 22:30	71	366	52	9.3	16.97	downstream	200.98	3.49	0.312	NaN	NaN
SE12-1	26/07/2016 05:14	79	275	40	13.8	11.14	upstream	220.45	1.65	0.311	1.11	89.7
SE12-2	26/07/2016 10:49	70	366	48	13.7	12.87	upstream	456.25	3.68	0.384	0.00	300.4
SE12-3	26/07/2016 11:16	74	205	26	7.8	15.38	upstream	391.71	3.23	0.299	0.00	300.4
SE13-1	26/07/2016 16:30	70	369	51	12.3	7.64	downstream	324.71	1.19	0.123	0.82	356.5
SE13-2	26/07/2016 17:06	80	228	32	13.2	9.45	downstream	170.68	1.70	0.139	0.82	356.5
SE13-3	26/07/2016 18:22	71	231	31	9.9	12.44	upstream	443.01	2.63	0.095	1.42	348.3
SE13-4	26/07/2016 22:41	71	269	33	10.3	12.71	downstream	247.14	3.95	0.067	NaN	NaN
SE14-1	27/07/2016 05:42	70	225	32	9.5	10.89	upstream	308.73	1.19	0.178	1.16	38.4
SE14-2	27/07/2016 05:57	72	210	30	11.1	11.31	downstream	271.90	1.41	0.175	1.16	38.4
SE14-3	27/07/2016 06:31	79	275	40	12.3	11.62	downstream	254.84	1.90	0.182	0.88	86.6
SE14-4	27/07/2016 10:23	71	209	30	9.7	17.67	downstream	265.05	4.73	0.209	0.72	81.8
SE14-5	27/07/2016 11:53	71	294	32	8.7	11.64	upstream	198.95	3.33	0.133	0.72	81.8
SE14-6	27/07/2016 13:54	81	205	32	8.2	12.89	downstream	437.26	1.39	0.067	1.12	30.2
SE14-7	27/07/2016 14:17	73	240	32	8.4	7.54	upstream	382.99	1.07	0.188	3.53	10.6
SE15-1	27/07/2016 18:23	70	214	32	9.4	10.90	downstream	380.75	2.14	0.106	4.43	33.2
SE15-2	27/07/2016 19:35	70	294	32	13.7	13.14	downstream	246.85	3.11	0.252	4.43	33.2
SE15-3	27/07/2016 19:50	71	368	51	12.5	7.95	upstream	190.54	3.35	0.080	4.43	33.2

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE15-4	27/07/2016 20:07	71	281	32	10.1	12.89	upstream	330.07	3.67	0.078	2.66	21.9
SE15-5	27/07/2016 20:20	0	281	32	11.6	11.88	downstream	430.38	3.93	0.324	2.66	21.9
SE15-6	27/07/2016 22:42	70	333	48	12	13.02	downstream	556.49	4.84	0.227	1.56	15.9
SE15-7	27/07/2016 23:11	70	366	48	11.2	15.80	downstream	399.66	4.39	0.483	1.56	15.9
SE15-8	28/07/2016 01:51	1	274	32	10.2	7.41	upstream	267.31	1.77	0.189	1.54	2.7
SE16-1	28/07/2016 06:19	80	250	45	13.5	12.01	upstream	354.01	1.10	0.262	1.24	355.1
SE16-2	28/07/2016 11:57	71	398	56	13.6	10.83	upstream	310.53	4.26	0.306	2.17	12.5
SE16-3	28/07/2016 12:28	0	210	26	10.4	7.76	upstream	465.15	3.77	0.070	2.78	22.7
SE16-4	28/07/2016 12:45	71	294	32	8.7	14.56	downstream	436.05	3.50	0.081	2.78	22.7
SE16-5	28/07/2016 12:56	71	293	33	9.4	10.54	upstream	307.64	3.34	0.148	2.78	22.7
SE17-1	28/07/2016 21:03	71	368	51	14.4	7.58	downstream	143.16	3.37	0.112	2.99	33.5
SE17-2	28/07/2016 21:15	70	200	32	8.5	14.38	upstream	303.81	3.62	0.101	2.99	33.5
SE17-3	28/07/2016 21:34	71	292	32	10.5	10.73	downstream	146.43	4.01	0.103	2.99	33.5
SE18-1	29/07/2016 08:25	1	274	32	10.2	12.83	downstream	322.94	1.97	0.178	2.95	19.4
SE18-2	29/07/2016 09:26	74	299	48	11.2	9.37	upstream	214.42	2.89	0.152	2.95	19.4
SE18-3	29/07/2016 10:35	71	300	49	12	13.04	upstream	333.59	4.34	0.567	3.35	15.3
SE18-4	29/07/2016 12:27	71	231	31	9.5	16.15	downstream	445.38	4.79	0.144	4.24	26.6
SE18-5	29/07/2016 12:39	70	243	32	10.1	12.46	downstream	390.72	4.64	0.085	4.24	26.6
SE18-6	29/07/2016 13:58	72	337	46	11.6	10.89	upstream	217.78	3.51	0.180	4.24	26.6
SE18-7	29/07/2016 16:00	73	240	32	10.1	17.13	downstream	167.68	1.65	0.470	4.13	32.1
SE19-1	29/07/2016 20:22	70	294	32	9.5	14.31	upstream	117.57	1.85	0.143	2.70	33.4
SE19-2	29/07/2016 22:50	71	399	60	14.2	10.42	downstream	327.69	4.09	0.361	1.52	23.8
SE19-3	29/07/2016 23:27	74	205	26	7.8	21.95	downstream	329.04	4.77	0.138	1.52	23.8
SE19-4	30/07/2016 02:18	71	366	48	11.3	11.51	upstream	224.38	3.62	0.305	2.04	10.5
SE19-5	30/07/2016 02:42	80	230	32	8	9.10	upstream	278.32	3.28	0.089	2.04	10.5
SE19-6	30/07/2016 03:20	70	366	48	12.8	9.68	upstream	217.05	2.69	0.308	2.04	10.5
SE19-7	30/07/2016 05:04	79	206	28	8.7	10.50	upstream	228.40	1.17	0.069	1.98	10.9

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE20-1	30/07/2016 10:38	72	295	32	10.6	12.75	upstream	499.59	2.89	0.141	2.41	5.6
SE20-2	30/07/2016 11:14	70	200	32	8.8	15.51	upstream	458.80	3.54	0.087	2.41	5.6
SE20-3	30/07/2016 11:55	70	299	48	12.9	9.58	upstream	194.69	4.42	0.113	2.41	5.6
SE20-4	30/07/2016 13:04	70	229	35	14.5	8.88	upstream	497.07	5.07	0.129	2.04	343.8
SE20-5	30/07/2016 14:23	70	292	32	10.3	16.70	downstream	411.09	4.27	0.233	0.93	33.3
SE20-6	30/07/2016 14:59	77	200	32	7.9	9.76	upstream	196.47	3.72	0.067	0.93	33.3
SE20-7	30/07/2016 17:00	71	286	40	8.6	13.55	upstream	472.15	1.80	0.451	0.58	93.5
SE21-1	30/07/2016 22:17	71	243	32	10	12.69	downstream	87.70	2.14	0.104	1.48	33.5
SE21-2	30/07/2016 22:28	72	337	46	12.6	12.60	downstream	163.00	2.27	0.429	1.48	33.5
SE21-3	30/07/2016 22:42	74	299	48	11.3	13.37	downstream	418.47	2.45	0.186	1.48	33.5
SE21-4	31/07/2016 01:43	74	262	32	9.8	16.25	upstream	427.89	5.08	0.104	1.75	36.0
SE21-5	31/07/2016 01:54	72	295	32	10.6	10.05	downstream	106.73	5.02	0.079	1.75	36.0
SE21-6	31/07/2016 03:27	71	292	32	12.5	10.11	upstream	170.39	3.75	0.101	2.06	42.2
SE21-7	31/07/2016 05:02	79	200	24	6.6	13.59	downstream	424.57	2.25	0.069	1.86	26.7
SE21-8	31/07/2016 05:33	79	209	30	9.3	12.81	upstream	163.72	1.74	0.306	1.86	26.7
SE22-1	31/07/2016 17:44	79	264	32	13	13.26	upstream	142.07	2.24	0.459	1.62	99.3
SE23-1	31/07/2016 22:45	70	300	48	7.6	13.67	downstream	179.58	1.55	0.389	0.01	165.3
SE23-2	1/8/2016 3:19	79	206	28	8.6	11.80	downstream	170.16	5.05	0.086	0.17	303.2
SE23-3	1/8/2016 4:50	71	300	45	11.4	14.17	downstream	187.96	3.65	0.212	0.51	5.3
SE23-4	1/8/2016 5:03	73	300	49	10.5	13.82	downstream	100.11	3.45	0.148	0.51	5.3
SE23-5	1/8/2016 6:13	79	209	32	8.3	12.54	upstream	251.08	2.26	0.111	0.56	9.4
SE23-6	1/8/2016 6:41	71	283	32	11.7	18.56	downstream	155.09	1.78	0.130	0.56	9.4
SE24-1	1/8/2016 11:47	80	228	32	13	6.90	downstream	133.09	1.99	0.073	3.39	28.8
SE24-2	1/8/2016 12:05	71	300	48	11	8.46	upstream	481.33	2.20	0.210	2.27	30.6
SE24-3	1/8/2016 14:10	70	285	40	12.2	9.37	upstream	463.77	4.56	0.114	1.27	60.5
SE24-4	1/8/2016 19:34	71	257	32	8	16.81	downstream	371.85	1.37	0.160	0.52	85.4
SE25-1	1/8/2016 23:37	77	200	32	8.3	10.63	downstream	164.10	1.31	0.072	0.41	16.6

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE25-2	1/8/2016 23:52	70	368	51	13	6.08	upstream	212.15	1.53	0.088	0.41	16.6
SE25-3	2/8/2016 0:54	71	277	40	13.9	11.95	upstream	140.81	2.37	0.182	0.40	324.0
SE25-4	2/8/2016 5:03	71	300	48	11.3	18.00	downstream	41.10	4.36	0.217	1.61	292.4
SE25-5	2/8/2016 6:10	70	285	40	11.2	15.10	downstream	369.10	3.24	0.114	2.93	288.2
SE26-1	2/8/2016 12:05	71	366	52	11.7	8.48	upstream	390.23	1.54	0.146	2.86	9.6
SE26-2	2/8/2016 12:32	0	225	30	8.3	8.61	upstream	23.79	1.96	0.078	2.86	9.6
SE26-3	2/8/2016 12:48	79	264	32	11.3	9.99	downstream	185.54	2.16	0.157	2.86	9.6
SE26-4	2/8/2016 13:04	70	203	26	7.6	10.36	upstream	171.14	2.39	0.050	2.86	9.6
SE26-5	2/8/2016 16:05	81	250	44	8.4	7.91	upstream	201.40	5.49	0.091	3.50	13.4
SE26-6	2/8/2016 17:09	71	214	32	7.9	12.85	upstream	183.38	4.80	0.088	3.50	13.4
SE26-7	2/8/2016 18:24	79	294	32	10.4	7.87	upstream	176.05	3.62	0.116	3.06	16.6
SE26-8	2/8/2016 19:35	71	324	42	8.4	12.30	upstream	156.00	2.34	0.198	3.06	16.6
SE26-9	2/8/2016 20:08	79	275	32	9.7	16.25	downstream	158.85	1.78	0.158	3.16	16.8
SE26-10	2/8/2016 20:49	71	261	32	10.7	13.43	upstream	182.93	1.15	0.306	3.16	16.8
SE27-1	3/8/2016 1:04	70	368	51	14.2	8.09	downstream	144.43	1.92	0.209	2.98	16.4
SE27-2	3/8/2016 1:16	70	231	32	9.2	16.25	upstream	413.00	2.10	0.195	2.98	16.4
SE27-3	3/8/2016 4:31	71	236	36	9.8	14.15	downstream	212.28	5.57	0.091	2.91	12.3
SE27-4	3/8/2016 4:59	71	294	30	10.8	9.51	upstream	329.51	5.35	0.063	2.91	12.3
SE27-5	3/8/2016 5:26	79	294	32	11.2	17.11	downstream	394.42	4.99	0.177	2.91	12.3
SE27-6	3/8/2016 6:30	79	237	32	9.7	14.23	upstream	353.07	3.94	0.201	2.92	2.6
SE27-7	3/8/2016 7:11	70	210	30	11.4	16.27	downstream	419.86	3.22	0.097	2.92	2.6
SE27-8	3/8/2016 7:57	81	244	42	8.5	14.17	downstream	81.36	2.35	0.087	2.92	2.6
SE28-1	3/8/2016 12:25	71	294	32	8.8	11.78	upstream	360.86	1.06	0.083	3.06	358.5
SE28-2	3/8/2016 12:35	80	228	32	8.2	11.16	upstream	447.33	1.20	0.178	3.06	358.5
SE28-3	3/8/2016 14:59	80	249	44	13.9	9.14	upstream	587.84	3.36	0.033	2.92	4.8
SE28-4	3/8/2016 16:51	70	296	37	9.5	15.90	upstream	281.52	5.40	0.168	2.49	3.8
SE28-5	3/8/2016 19:55	71	399	54	11.6	9.76	upstream	174.72	2.61	0.720	3.03	9.6

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE29-1	4/8/2016 1:03	79	221	32	9	12.15	upstream	149.11	1.15	0.113	2.62	11.2
SE29-2	4/8/2016 1:16	79	294	32	11.5	10.46	downstream	410.43	1.35	0.137	2.62	11.2
SE29-3	4/8/2016 2:00	71	275	40	13.2	12.50	downstream	170.25	1.99	0.308	2.75	15.3
SE29-4	4/8/2016 3:09	71	324	42	12.3	13.16	downstream	574.97	3.25	0.409	2.75	15.3
SE29-5	4/8/2016 3:22	71	294	32	10.2	7.79	downstream	300.56	3.67	0.054	2.75	15.3
SE29-6	4/8/2016 4:57	71	398	59	13.9	11.45	upstream	469.53	5.61	0.288	2.37	11.0
SE29-7	4/8/2016 9:19	71	265	32	11	11.27	upstream	526.29	1.69	0.480	3.15	4.5
SE30-1	4/8/2016 14:04	79	221	32	9.8	12.36	downstream	497.53	2.12	0.292	3.79	5.6
SE30-2	4/8/2016 15:20	77	225	32	7.8	13.67	upstream	203.00	3.13	0.118	3.79	5.6
SE30-3	4/8/2016 17:17	71	366	52	13.2	10.79	downstream	410.43	5.62	0.187	4.14	26.4
SE30-4	4/8/2016 17:56	70	296	37	10.9	12.73	downstream	202.09	5.42	0.092	4.14	26.4
SE30-5	4/8/2016 19:04	70	292	32	9.4	10.50	upstream	572.99	4.36	0.085	4.41	30.3
SE30-6	4/8/2016 20:42	71	214	32	9.3	15.32	downstream	311.47	2.70	0.080	3.69	37.4
SE31-1	5/8/2016 2:49	71	265	32	10.2	12.69	downstream	420.85	2.16	0.172	1.31	7.9
SE31-2	5/8/2016 6:12	70	243	32	10.1	15.05	downstream	334.25	5.57	0.071	2.04	10.1
SE31-3	5/8/2016 8:17	71	363	46	11.2	10.21	upstream	386.34	3.61	0.289	2.58	20.8
SE31-4	5/8/2016 9:06	70	243	32	9.4	20.35	downstream	621.27	2.69	0.098	2.58	20.8
SE32-1	5/8/2016 13:56	80	228	32	8.3	9.68	upstream	375.95	1.73	0.080	2.24	44.2
SE32-2	5/8/2016 14:15	71	245	32	9.8	14.15	upstream	351.08	1.99	0.273	1.77	66.6
SE32-3	5/8/2016 14:51	71	399	54	14.4	13.20	downstream	368.98	2.43	0.410	1.77	66.6
SE32-4	5/8/2016 15:31	79	294	32	10.2	10.57	upstream	409.62	2.91	0.107	1.77	66.6
SE32-5	5/8/2016 15:45	71	304	40	10.5	10.73	upstream	270.97	3.09	0.088	1.77	66.6
SE32-6	5/8/2016 19:23	79	260	32	9.4	100.56	upstream	165.45	4.87	0.133	1.60	69.2
SE32-7	5/8/2016 22:03	70	294	32	9.6	11.10	upstream	398.74	2.03	0.256	0.24	24.9
SE32-8	5/8/2016 22:51	71	398	59	11.5	12.87	downstream	182.68	1.23	0.327	0.24	24.9
SE33-1	6/8/2016 4:12	70	200	32	7.8	15.16	upstream	362.77	2.60	0.048	1.12	353.9
SE33-2	6/8/2016 6:30	71	245	32	10.1	12.25	downstream	206.69	5.45	0.059	1.50	346.8

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE33-3	6/8/2016 6:44	80	229	32	8.2	9.51	upstream	407.26	5.38	0.071	1.50	346.8
SE33-4	6/8/2016 8:53	79	210	30	7.9	16.91	downstream	408.23	3.46	0.095	2.85	3.0
SE33-5	6/8/2016 9:31	70	200	36	8.5	12.83	upstream	379.29	2.77	0.136	2.85	3.0
SE33-6	6/8/2016 10:38	74	264	32	9.1	8.57	upstream	220.28	1.58	0.084	2.99	18.7
SE33-7	6/8/2016 11:12	71	363	46	11.8	16.76	downstream	225.56	1.06	0.344	2.99	18.7
SE34-1	6/8/2016 14:29	79	294	32	10.2	12.34	downstream	331.14	1.39	0.239	1.54	71.8
SE34-2	6/8/2016 14:41	72	337	46	13.7	12.19	downstream	453.74	1.54	0.452	1.54	71.8
SE34-3	6/8/2016 16:11	74	205	26	8.1	24.01	downstream	393.02	2.68	0.331	1.51	85.8
SE34-4	6/8/2016 16:50	70	272	40	9.2	12.03	upstream	230.78	3.27	0.279	1.51	85.8
SE34-5	6/8/2016 17:17	80	249	44	9.5	10.42	downstream	225.38	3.87	0.207	1.51	85.8
SE34-6	6/8/2016 19:35	70	200	32	8.3	12.97	upstream	391.32	4.98	0.122	0.99	99.7
SE34-7	6/8/2016 20:23	79	236	36	8.4	10.65	upstream	328.20	4.18	0.066	0.03	70.8
SE34-8	6/8/2016 22:02	71	366	48	11.7	14.91	downstream	213.06	2.46	0.203	0.02	287.0
SE34-9	6/8/2016 22:36	70	294	32	12.1	15.96	downstream	426.06	1.81	0.193	0.02	287.0
SE35-1	7/8/2016 3:47	89	250	44	8.7	10.03	downstream	380.53	1.44	0.153	0.52	296.5
SE35-2	7/8/2016 4:05	70	366	48	15	12.58	downstream	399.47	1.68	0.472	0.26	296.6
SE35-3	7/8/2016 5:19	71	210	30	9.4	10.54	upstream	186.66	3.12	0.052	0.26	296.6
SE35-4	7/8/2016 7:31	74	214	32	8.9	13.61	upstream	466.21	5.03	0.219	1.20	0.1
SE35-5	7/8/2016 8:17	71	294	32	9.8	7.97	downstream	364.33	4.39	0.068	2.48	359.1
SE35-6	7/8/2016 8:38	80	256	43	8.7	10.54	upstream	405.65	4.03	0.111	2.48	359.1
SE36-1	7/8/2016 16:23	70	200	36	8.8	13.45	downstream	270.71	2.25	0.064	3.57	12.2
SE36-2	7/8/2016 16:46	71	275	33	11.5	6.53	upstream	248.68	2.55	0.061	3.57	12.2
SE36-3	7/8/2016 18:02	71	275	37	10.2	9.95	upstream	192.60	4.17	0.072	3.70	23.8
SE36-4	7/8/2016 19:21	70	227	32	8.1	13.61	upstream	346.40	5.32	0.091	3.70	23.8
SE36-5	7/8/2016 20:19	71	300	48	11	14.99	downstream	181.89	4.72	0.212	3.22	21.8
SE36-6	7/8/2016 22:14	71	300	48	10.1	18.58	downstream	264.10	2.84	0.258	3.99	27.7
SE36-7	7/8/2016 23:04	71	216	27	0	14.07	downstream	160.01	1.96	0.106	3.99	27.7

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE36-8	7/8/2016 23:29	80	244	40	12.8	13.78	downstream	380.07	1.55	0.105	3.99	27.7
SE36-9	8/8/2016 0:04	70	300	48	10.7	12.21	downstream	209.16	1.02	0.162	4.42	25.7
SE37-1	8/8/2016 4:00	71	209	30	9.7	10.21	upstream	403.33	1.83	0.139	2.81	23.8
SE37-2	8/8/2016 4:28	70	285	40	10.5	9.66	upstream	228.34	2.20	0.111	2.81	23.8
SE37-3	8/8/2016 5:50	79	206	30	9.7	18.21	upstream	312.43	3.69	0.163	2.81	23.8
SE37-4	8/8/2016 6:38	71	269	32	12	12.91	downstream	433.48	4.99	0.139	2.76	25.1
SE37-5	8/8/2016 6:52	90	300	45	10.9	10.24	downstream	164.15	5.23	0.137	2.76	25.1
SE37-6	8/8/2016 10:56	70	292	31	11.5	15.51	downstream	193.51	2.72	0.150	4.62	36.4
SE37-7	8/8/2016 11:24	71	208	30	8.5	15.75	downstream	399.16	2.24	0.066	4.62	36.4
SE38-1	8/8/2016 19:40	71	277	40	10	12.27	upstream	252.52	5.60	0.108	1.39	73.0
SE38-2	8/8/2016 19:59	70	200	33	9.7	11.94	upstream	409.01	5.62	0.074	1.39	73.0
SE38-3	8/8/2016 20:53	71	275	37	11	14.00	downstream	415.30	5.09	0.113	0.68	73.5
SE38-4	8/8/2016 21:25	70	200	32	8.9	14.23	upstream	213.39	4.58	0.168	0.68	73.5
SE38-5	9/8/2016 0:19	79	206	30	8.9	19.65	downstream	233.15	1.56	0.148	1.21	34.1
SE39-1	9/8/2016 4:19	0	279	40	13.6	14.71	upstream	321.73	1.61	0.591	0.64	275.3
SE39-2	9/8/2016 5:17	80	256	43	8.9	8.61	downstream	212.61	2.40	0.106	0.64	275.3
SE39-3	9/8/2016 6:50	71	275	33	10.3	11.41	downstream	329.06	4.06	0.183	0.91	297.2
SE39-4	9/8/2016 7:51	70	366	48	11.8	10.71	upstream	231.75	5.19	0.072	0.91	297.2
SE39-5	9/8/2016 8:22	70	255	43	14.3	6.69	upstream	412.10	5.25	0.052	1.52	38.2
SE39-6	9/8/2016 10:45	71	205	29	7.3	19.24	upstream	414.19	3.30	0.268	1.80	61.6
SE39-7	9/8/2016 11:25	72	275	40	9.3	10.44	upstream	228.41	2.63	0.135	1.80	61.6
SE39-8	9/8/2016 12:33	79	366	48	12.7	8.63	upstream	277.82	1.51	0.449	1.90	79.6
SE40-1	9/8/2016 15:45	71	219	32	9.8	12.71	upstream	185.17	1.27	0.182	1.29	114.3
SE40-2	9/8/2016 16:56	80	228	32	8	13.16	downstream	311.58	2.13	0.155	1.47	110.9
SE40-3	9/8/2016 17:35	70	227	32	8.6	10.52	downstream	381.15	2.54	0.072	1.47	110.9
SE40-4	9/8/2016 18:31	71	228	38	8.1	17.59	upstream	143.93	3.26	0.233	1.18	106.2
SE40-5	9/8/2016 19:07	71	214	32	8.3	19.87	upstream	567.93	3.92	0.185	1.18	106.2

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE40-6	9/8/2016 20:34	79	236	36	9.4	13.10	downstream	414.62	5.11	0.095	0.28	110.2
SE40-7	9/8/2016 21:26	71	333	48	10.5	13.72	upstream	199.61	4.65	0.271	0.28	110.2
SE40-8	9/8/2016 22:07	72	260	32	11.2	12.77	downstream	321.80	4.02	0.065	0.01	181.8
SE40-9	9/8/2016 22:53	79	281	32	10.7	10.94	upstream	390.37	3.28	0.447	0.01	181.8
SE40-10	10/8/2016 0:14	71	277	42	10.7	12.13	upstream	193.64	1.92	0.557	0.75	33.5
SE41-1	10/8/2016 8:17	70	366	48	13.4	14.31	downstream	386.40	4.80	0.235	0.99	17.5
SE41-2	10/8/2016 12:41	79	294	32	8.8	7.06	upstream	171.14	1.86	0.106	0.66	36.4
SE41-3	10/8/2016 13:05	79	366	48	10.5	14.42	downstream	387.22	1.50	0.367	0.66	36.4
SE42-1	10/8/2016 16:24	72	275	40	11.8	13.33	downstream	248.87	1.07	0.189	1.26	99.1
SE42-2	10/8/2016 18:12	80	228	32	12.9	6.82	downstream	239.17	2.40	0.015	1.22	100.7
SE42-3	10/8/2016 18:37	70	300	48	8.2	8.18	upstream	344.33	2.72	0.058	1.22	100.7
SE42-4	10/8/2016 19:55	71	276	32	11.3	11.25	upstream	491.84	4.00	0.106	1.22	100.7
SE42-5	10/8/2016 20:05	71	294	32	12.1	9.93	upstream	446.86	4.19	0.089	0.85	85.2
SE42-6	10/8/2016 21:33	74	214	32	9.8	13.86	downstream	403.58	4.73	0.110	0.85	85.2
SE42-7	10/8/2016 22:25	71	333	48	12.2	14.60	downstream	197.15	4.07	0.268	1.66	29.0
SE42-8	10/8/2016 23:11	73	200	30	11.6	10.65	downstream	459.91	3.36	0.064	1.66	29.0
SE43-1	11/8/2016 9:22	80	244	42	14.8	9.12	upstream	209.68	4.56	0.169	2.64	2.2
SE43-2	11/8/2016 12:00	71	366	48	10.8	9.51	upstream	403.93	3.06	0.232	3.49	8.5
SE43-3	11/8/2016 14:05	79	294	32	9.3	24.59	downstream	190.24	1.25	0.298	2.89	9.2
SE44-1	11/8/2016 17:06	72	210	32	10.6	11.22	upstream	233.12	1.21	0.265	3.06	30.4
SE44-2	11/8/2016 19:35	71	398	56	14.7	11.59	downstream	212.09	3.05	0.389	2.19	22.0
SE44-3	12/8/2016 1:23	71	209	30	8.3	9.10	upstream	162.81	2.16	0.055	2.39	28.4
SE44-4	12/8/2016 1:34	71	277	42	11.5	14.52	downstream	253.59	1.99	0.113	2.39	28.4
SE44-5	12/8/2016 1:53	71	240	32	8.7	10.63	upstream	466.05	1.74	0.123	2.39	28.4
SE45-1	12/8/2016 6:47	72	210	32	10.6	13.51	downstream	243.91	1.91	0.132	2.57	27.2
SE45-2	12/8/2016 11:57	71	243	33	10.9	18.56	downstream	465.40	3.81	0.097	3.45	37.7
SE45-3	12/8/2016 12:15	71	228	38	8.6	14.00	downstream	245.12	3.55	0.123	3.89	33.7

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE45-4	12/8/2016 12:25	79	330	42	12.7	12.42	upstream	384.72	3.41	0.369	3.89	33.7
SE45-5	12/8/2016 13:21	70	294	32	9.3	9.64	upstream	217.69	2.62	0.090	3.89	33.7
SE46-1	12/8/2016 20:13	71	366	48	12.7	10.67	upstream	253.08	2.62	0.287	1.96	29.2
SE46-2	12/8/2016 21:48	70	300	48	10.2	12.03	upstream	215.04	3.92	0.160	1.96	29.2
SE46-3	12/8/2016 22:01	80	228	32	13.7	8.05	upstream	206.81	4.07	0.117	1.14	14.5
SE46-4	12/8/2016 22:45	70	400	59	11.3	14.62	downstream	208.92	4.34	0.638	1.14	14.5
SE46-5	12/8/2016 23:26	71	205	29	7.5	19.59	downstream	229.87	4.27	0.173	1.14	14.5
SE46-6	13/08/2016 00:07	70	366	51	12.2	8.42	upstream	268.12	3.89	0.110	1.95	15.3
SE46-7	13/08/2016 00:43	70	205	26	7.2	12.34	upstream	145.33	3.44	0.099	1.95	15.3
SE46-8	13/08/2016 03:45	72	292	32	9.5	12.56	upstream	447.42	1.19	0.350	2.17	22.4
SE47-1	13/08/2016 08:19	71	274	32	10.4	13.49	upstream	525.21	2.31	0.166	2.58	16.4
SE47-2	13/08/2016 09:26	71	222	32	9.6	24.30	upstream	298.56	3.14	0.780	2.58	16.4
SE47-3	13/08/2016 10:18	71	294	32	9.3	9.87	upstream	179.79	3.84	0.105	3.56	26.1
SE47-4	13/08/2016 11:01	71	256	32	8.9	11.37	downstream	256.13	4.30	0.093	3.56	26.1
SE47-5	13/08/2016 13:35	70	300	48	9.7	11.35	upstream	326.14	3.35	0.332	4.16	33.1
SE47-6	13/08/2016 14:56	74	286	40	8.5	12.77	upstream	561.48	2.29	0.112	4.10	34.7
SE47-7	13/08/2016 15:13	70	205	26	7.6	21.52	downstream	305.59	2.06	0.143	4.10	34.7
SE48-1	13/08/2016 20:33	71	300	45	9.9	15.10	downstream	202.10	1.96	0.377	0.14	81.1
SE48-2	13/08/2016 22:37	71	366	48	14.2	14.44	downstream	253.26	3.57	0.366	0.02	7.2
SE48-3	13/08/2016 22:58	79	330	42	14.2	14.00	downstream	481.93	3.85	0.261	0.02	7.2
SE48-4	14/08/2016 00:54	71	222	32	10.4	11.45	downstream	202.44	4.34	0.107	0.02	165.7
SE48-5	14/08/2016 02:03	72	292	32	12.4	15.75	downstream	213.50	3.53	0.338	0.16	355.5
SE48-6	14/08/2016 02:44	71	292	32	11.6	17.03	upstream	315.93	2.97	0.578	0.16	355.5
SE48-7	14/08/2016 02:55	71	240	32	10.3	14.17	downstream	463.18	2.84	0.076	0.16	355.5
SE48-8	14/08/2016 04:23	79	300	40	12	12.32	downstream	185.16	1.60	0.170	0.15	341.5
SE49-1	14/08/2016 09:29	79	264	32	12.5	12.77	upstream	189.51	2.11	0.259	0.12	10.9
SE49-2	14/08/2016 10:59	70	366	51	14.2	7.35	downstream	278.52	3.25	0.096	0.44	47.3

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE49-3	14/08/2016 11:16	70	369	51	12.1	9.16	upstream	410.84	3.49	0.117	0.44	47.3
SE49-4	14/08/2016 11:44	71	318	43	12.4	14.33	upstream	477.63	3.88	0.291	0.44	47.3
SE49-5	14/08/2016 12:23	71	274	32	11	12.03	downstream	174.89	4.32	0.102	0.44	106.8
SE49-6	14/08/2016 14:14	74	286	40	9.8	11.20	downstream	193.89	3.90	0.114	1.08	106.2
SE49-7	14/08/2016 14:24	71	262	32	9.5	12.89	downstream	357.03	3.77	0.149	1.08	106.2
SE49-8	14/08/2016 15:19	70	299	48	10.6	12.98	upstream	182.16	3.01	0.534	1.08	106.2
SE49-9	14/08/2016 16:16	71	275	32	8.8	18.52	downstream	401.39	2.20	0.151	1.07	114.7
SE50-1	14/08/2016 22:12	80	228	32	13.7	9.95	downstream	445.00	1.90	0.099	2.09	154.2
SE50-2	14/08/2016 23:11	70	300	48	9.8	11.39	upstream	177.20	2.70	0.152	2.09	154.2
SE50-3	14/08/2016 23:56	70	300	48	11	13.72	downstream	264.05	3.44	0.191	2.09	154.2
SE50-4	15/08/2016 01:52	70	294	32	11.6	9.66	upstream	167.50	4.57	0.087	1.80	152.6
SE50-5	15/08/2016 04:12	80	228	32	11.5	13.18	downstream	111.73	2.79	0.112	1.38	158.9
SE51-1	15/08/2016 10:58	79	292	32	9.3	14.99	upstream	260.92	2.06	0.267	2.74	200.5
SE51-2	15/08/2016 11:14	70	369	51	13.4	12.98	downstream	137.30	2.26	0.586	2.74	200.5
SE51-3	15/08/2016 13:07	70	243	32	9.4	14.60	upstream	266.76	4.08	0.085	2.09	190.8
SE51-4	15/08/2016 14:38	71	318	43	11.3	14.56	downstream	166.27	4.48	0.184	1.98	181.9
SE51-5	15/08/2016 15:32	80	229	32	13	10.36	downstream	289.22	3.80	0.081	1.98	181.9
SE52-1	16/08/2016 00:06	71	277	40	13.3	12.15	upstream	207.62	2.40	0.272	1.32	186.5
SE52-2	16/08/2016 00:33	70	300	48	9.7	12.40	downstream	449.57	2.86	0.151	1.32	186.5
SE52-3	16/08/2016 01:39	70	229	32	14.4	9.31	upstream	324.87	4.23	0.020	1.32	186.5
SE52-4	16/08/2016 04:39	71	264	32	10.1	14.46	upstream	209.36	3.32	0.380	2.51	198.8
SE52-5	16/08/2016 05:57	70	368	51	12.6	8.92	upstream	245.59	2.06	0.297	2.51	198.8
SE52-6	16/08/2016 06:16	70	294	32	11.8	16.91	downstream	439.87	1.76	0.241	2.88	195.9
SE53-1	16/08/2016 10:54	73	366	48	13	10.96	upstream	446.20	1.37	0.305	2.70	203.2
SE53-2	16/08/2016 12:39	70	254	32	10.9	11.08	upstream	173.16	2.71	0.211	3.64	205.4
SE53-3	16/08/2016 14:42	71	257	32	9.2	14.38	downstream	254.69	4.88	0.123	3.36	208.3
SE53-4	16/08/2016 16:12	79	275	32	10.5	10.36	upstream	403.36	4.18	0.131	3.22	205.7

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE53-5	16/08/2016 17:39	71	236	32	9.2	10.05	upstream	414.98	2.81	0.278	3.22	205.7
SE53-6	16/08/2016 18:14	71	366	52	11.9	12.32	upstream	185.97	2.21	0.711	3.07	204.9
SE54-1	17/08/2016 00:06	80	228	36	10.6	12.89	upstream	216.11	1.80	0.265	4.14	200.8
SE54-2	17/08/2016 00:53	71	277	40	11.7	12.89	downstream	390.71	2.46	0.347	4.14	200.8
SE54-3	17/08/2016 02:59	89	250	44	14.4	10.15	upstream	275.43	5.02	0.183	2.74	200.7
SE54-4	17/08/2016 03:32	70	243	32	9.3	16.97	downstream	372.44	5.07	0.110	2.74	200.7
SE54-5	17/08/2016 04:54	71	398	59	11.1	11.41	upstream	330.25	4.10	0.469	2.00	197.2
SE54-6	17/08/2016 05:29	80	240	42	9.3	8.77	upstream	197.03	3.52	0.150	2.00	197.2
SE54-7	17/08/2016 06:33	71	278	40	12.2	11.49	upstream	371.48	2.43	0.513	2.19	199.7
SE55-1	17/08/2016 11:16	73	366	48	12	12.95	downstream	219.71	1.02	0.236	3.69	215.8
SE55-2	17/08/2016 11:26	71	207	30	9.8	12.19	downstream	244.00	1.16	0.140	3.69	215.8
SE55-3	17/08/2016 12:03	80	290	11	0.3	5.29	downstream	381.10	1.67	0.000	3.63	221.7
SE55-4	17/08/2016 14:17	71	208	30	9.5	11.86	downstream	159.97	3.81	0.090	3.25	224.4
SE55-5	17/08/2016 14:31	70	254	32	11.8	13.20	downstream	521.95	4.19	0.190	3.25	224.4
SE55-6	17/08/2016 19:23	70	203	26	8.7	18.25	downstream	184.21	1.92	0.079	2.66	208.1
SE55-7	17/08/2016 20:06	71	245	32	9	10.71	upstream	419.83	1.21	0.527	3.72	199.4
SE56-1	18/08/2016 00:00	0	244	32	9.4	9.51	upstream	201.45	1.08	0.066	3.00	210.0
SE56-2	18/08/2016 00:35	71	278	40	12.8	11.64	downstream	243.68	1.59	0.295	3.00	210.0
SE56-3	18/08/2016 01:16	80	250	45	8.5	9.45	downstream	207.75	2.16	0.230	3.00	210.0
SE56-4	18/08/2016 01:29	72	210	30	11.3	10.61	downstream	215.33	2.35	0.444	3.00	210.0
SE56-5	18/08/2016 02:04	70	399	54	13.5	14.02	upstream	380.75	3.01	0.549	3.14	210.4
SE56-6	18/08/2016 03:22	60	238	32	7.3	12.93	upstream	388.19	5.15	0.053	3.14	210.4
SE56-7	18/08/2016 03:47	79	300	40	9.1	9.76	upstream	405.12	5.38	0.058	3.14	210.4
SE56-8	18/08/2016 06:14	71	294	32	12.3	13.32	downstream	226.08	3.70	0.126	0.95	190.7
SE56-9	18/08/2016 06:45	70	269	32	8.4	16.54	downstream	377.71	3.19	0.068	0.95	190.7
SE57-1	18/08/2016 13:24	71	236	32	9.2	14.05	downstream	171.28	2.30	0.187	1.03	197.7
SE57-2	18/08/2016 14:44	71	366	52	12.9	12.91	downstream	413.98	3.57	0.358	0.78	221.6

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE57-3	18/08/2016 15:25	90	229	32	8.1	15.28	upstream	210.01	4.81	0.076	0.78	221.6
SE57-4	18/08/2016 17:26	71	398	59	13.3	15.41	downstream	398.70	4.82	0.406	0.32	124.7
SE57-5	18/08/2016 17:37	70	200	32	9.3	13.32	downstream	244.17	4.65	0.093	0.32	124.7
SE57-6	18/08/2016 19:16	71	243	33	8.2	15.36	downstream	455.18	2.99	0.067	0.19	105.6
SE57-7	18/08/2016 19:28	60	238	32	7.3	16.21	downstream	226.63	2.77	0.138	0.19	105.6
SE57-8	18/08/2016 19:42	71	296	37	9.8	14.52	downstream	227.98	2.50	0.281	0.19	105.6
SE57-9	18/08/2016 20:23	74	295	32	7.8	6.92	upstream	411.22	1.76	0.078	0.02	100.3
SE57-10	18/08/2016 20:55	71	366	48	12	10.42	upstream	388.26	1.18	0.079	0.02	100.3
SE58-1	19/08/2016 01:51	70	300	48	9.9	9.06	upstream	204.59	2.03	0.154	1.07	202.9
SE58-2	19/08/2016 03:55	70	300	48	11.5	13.98	upstream	499.04	5.14	0.219	1.34	212.3
SE58-3	19/08/2016 06:10	0	244	32	9.6	16.08	downstream	220.08	4.53	0.085	0.25	248.3
SE58-4	19/08/2016 06:26	71	245	32	9	13.45	downstream	209.48	4.27	0.078	0.25	248.3
SE58-5	19/08/2016 06:42	89	250	44	8.6	11.70	downstream	229.87	3.99	0.060	0.25	248.3
SE58-6	19/08/2016 07:39	70	229	32	7.1	14.64	downstream	240.78	2.99	0.053	0.25	248.3
SE58-7	19/08/2016 08:04	70	399	54	12.2	17.24	downstream	411.84	2.50	0.310	0.89	271.2
SE59-1	19/08/2016 13:13	71	227	36	8.2	12.73	downstream	214.04	1.53	0.197	1.32	306.7
SE59-2	19/08/2016 15:53	71	366	48	11.5	13.14	downstream	139.44	4.45	0.242	2.05	301.1
SE59-3	19/08/2016 17:16	70	368	51	12.5	9.39	upstream	224.12	5.45	0.000	1.58	315.3
SE59-4	19/08/2016 17:55	79	300	40	10.5	17.26	downstream	207.88	4.99	0.171	1.58	315.3
SE59-5	19/08/2016 19:46	79	366	48	10.8	11.59	upstream	299.52	3.13	0.332	1.73	300.6
SE59-6	19/08/2016 20:53	70	294	32	9.4	10.38	upstream	212.17	1.90	0.196	2.96	349.9
SE59-7	19/08/2016 21:04	71	231	31	10.3	12.58	upstream	230.22	1.70	0.387	2.96	349.9
SE60-1	20/08/2016 03:26	71	368	51	12.4	11.59	upstream	174.04	2.95	0.322	1.70	359.7
SE60-2	20/08/2016 06:00	70	236	36	9.9	17.73	downstream	192.27	5.32	0.134	0.85	336.4
SE60-3	20/08/2016 06:30	71	296	38	9	12.62	upstream	347.87	4.90	0.245	0.85	336.4
SE60-4	20/08/2016 10:03	72	366	48	12.5	12.79	downstream	282.05	1.12	0.276	3.06	1.5
SE61-1	20/08/2016 13:21	71	231	31	11.1	11.16	downstream	450.31	1.18	0.168	3.59	5.4

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE61-2	20/08/2016 14:39	70	300	48	13.4	10.61	downstream	234.24	2.23	0.284	4.35	4.0
SE61-3	20/08/2016 15:14	74	205	26	7.1	13.49	downstream	388.92	2.72	0.094	4.35	4.0
SE61-4	20/08/2016 15:27	71	334	41	11	10.75	upstream	212.88	2.94	0.031	4.35	4.0
SE61-5	20/08/2016 15:45	71	300	42	10	11.82	upstream	216.53	3.26	0.088	4.35	4.0
SE61-6	20/08/2016 16:45	90	229	32	8.5	13.24	downstream	405.84	5.21	0.104	4.15	17.5
SE61-7	20/08/2016 18:10	79	211	32	8.4	15.36	downstream	267.83	5.36	0.103	3.54	27.9
SE61-8	20/08/2016 18:40	71	294	32	12	17.84	downstream	183.12	4.88	0.269	3.54	27.9
SE61-9	20/08/2016 20:14	79	282	32	10.8	11.10	upstream	281.55	3.31	0.433	1.82	5.6
SE61-10	20/08/2016 21:46	80	241	42	8.2	9.80	upstream	392.49	1.65	0.221	1.82	5.6
SE61-11	20/08/2016 22:18	71	275	33	10.3	8.14	upstream	333.64	1.12	0.247	2.28	356.9
SE62-1	21/08/2016 02:45	72	292	32	11.8	15.69	upstream	324.87	1.65	0.127	2.35	342.1
SE62-2	21/08/2016 02:56	70	366	48	11.2	8.94	upstream	357.59	1.80	0.223	2.35	342.1
SE62-3	21/08/2016 03:09	70	368	51	14.3	11.60	downstream	197.76	1.99	0.339	2.35	342.1
SE62-4	21/08/2016 03:45	79	366	48	14.5	11.82	downstream	159.27	2.61	0.538	2.35	342.1
SE62-5	21/08/2016 04:58	70	210	30	9.3	8.81	upstream	406.87	5.01	0.061	3.17	346.3
SE62-6	21/08/2016 05:39	71	222	30	9.9	10.75	downstream	344.92	5.61	0.086	3.17	346.3
SE62-7	21/08/2016 06:07	70	294	32	10.2	13.45	downstream	395.20	5.61	0.104	3.90	351.9
SE62-8	21/08/2016 10:38	71	243	32	10	15.47	downstream	354.69	1.37	0.125	4.40	8.6
SE63-1	21/08/2016 13:44	70	294	32	9.9	17.42	downstream	206.90	1.33	0.282	3.99	23.9
SE63-2	21/08/2016 15:38	71	367	49	11.6	19.22	upstream	366.86	2.86	0.799	4.57	40.4
SE63-3	21/08/2016 16:25	71	366	48	12	8.81	upstream	623.21	3.60	0.095	5.04	42.8
SE63-4	21/08/2016 16:35	71	296	38	8	12.17	downstream	393.06	3.82	0.066	5.04	42.8
SE63-5	21/08/2016 17:19	71	211	32	8.6	13.20	upstream	382.29	5.19	0.097	5.04	42.8
SE63-6	21/08/2016 18:43	79	282	32	10.7	9.89	downstream	433.66	5.74	0.083	4.09	37.9
SE63-7	21/08/2016 19:05	70	299	48	12.8	15.06	downstream	308.60	5.48	0.202	4.09	37.9
SE63-8	21/08/2016 20:22	71	368	51	14.3	11.59	upstream	381.62	4.19	0.632	3.06	26.4
SE63-9	21/08/2016 20:52	71	300	42	11.6	22.20	downstream	385.16	3.69	0.247	3.06	26.4

index	time (dd/mm/yyyy HH:MM)	type	length (m)	beam (m)	draught (m)	speed (knots)	heading	distance (m)	wlevel (m)	H_{max} (m)	Wspeed (m/s)	Wdir (degrees)
SE63-10	21/08/2016 22:30	71	295	33	10	10.26	upstream	161.31	1.79	0.128	2.43	11.4
SE63-11	21/08/2016 22:43	71	286	40	9.4	16.41	downstream	281.75	1.56	0.102	2.43	11.4
SE64-1	22/08/2016 03:23	71	203	25	9.2	13.59	upstream	429.13	1.68	0.217	2.20	358.9
SE64-2	22/08/2016 03:37	71	210	30	9.5	16.50	upstream	151.08	1.89	0.233	2.20	358.9
SE64-3	22/08/2016 06:42	71	368	51	11.2	12.58	downstream	162.19	5.68	0.134	2.16	6.3
SE64-4	22/08/2016 07:03	72	292	32	11.5	15.94	downstream	387.18	5.58	0.171	2.16	6.3
SE64-5	22/08/2016 09:00	71	261	32	12	12.25	downstream	382.78	3.84	0.050	3.04	22.9

APPENDIX B

Table B-1 – No-ship (wind-wave) events.

index	time (dd/mm/yyyy HH:MM)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
NSE01-1	20/07/2016 17:26	4.93	0.030	0.021	2.08	4.0
NSE02-1	21/07/2016 01:27	1.50	0.030	0.021	1.82	40.6
NSE02-2	21/07/2016 03:20	3.55	0.037	0.022	1.20	14.0
NSE04-1	22/07/2016 05:16	5.49	0.052	0.033	0.34	181.0
NSE04-2	22/07/2016 06:51	4.87	0.061	0.032	0.58	166.0
NSE05-1	22/07/2016 22:03	1.72	0.097	0.059	1.21	89.3
NSE06-1	23/07/2016 03:45	2.24	0.033	0.020	1.42	50.0
NSE06-2	23/07/2016 05:21	4.85	0.045	0.026	1.04	63.4
NSE06-3	23/07/2016 07:52	4.59	0.039	0.024	0.35	100.5
NSE06-4	23/07/2016 10:03	2.19	0.038	0.025	0.75	108.8
NSE06-5	23/07/2016 11:05	1.15	0.026	0.018	0.75	108.8
NSE07-1	23/07/2016 16:31	2.95	0.065	0.035	1.52	84.4
NSE07-2	23/07/2016 19:13	5.30	0.042	0.025	1.32	90.4
NSE07-3	23/07/2016 21:06	3.47	0.068	0.044	0.73	92.5
NSE08-1	24/07/2016 08:35	4.45	0.031	0.020	1.23	20.4
NSE08-2	24/07/2016 11:40	1.22	0.054	0.033	1.38	13.6
NSE09-1	24/07/2016 19:35	5.46	0.039	0.023	1.08	55.4
NSE09-2	24/07/2016 20:30	4.76	0.102	0.052	0.64	82.7
NSE09-3	24/07/2016 22:51	2.32	0.063	0.035	0.13	25.7
NSE09-4	24/07/2016 23:33	1.55	0.033	0.020	0.13	25.7
NSE10-1	25/07/2016 04:43	1.81	0.042	0.026	1.28	15.4
NSE10-2	25/07/2016 07:05	5.13	0.089	0.044	1.47	3.3
NSE10-3	25/07/2016 11:42	1.90	0.061	0.033	2.93	17.4
NSE12-1	26/07/2016 04:47	1.30	0.015	0.014	1.11	89.7
NSE12-2	26/07/2016 05:44	2.11	0.022	0.016	1.11	89.7
NSE14-1	27/07/2016 06:10	1.64	0.036	0.025	0.88	86.6
NSE15-1	28/07/2016 00:59	2.62	0.042	0.026	1.54	2.7
NSE16-1	28/07/2016 09:42	4.75	0.049	0.032	1.63	14.1
NSE17-1	28/07/2016 20:39	3.02	0.047	0.032	2.99	33.5
NSE17-2	28/07/2016 23:25	4.88	0.043	0.026	2.29	27.2
NSE17-3	28/07/2016 23:56	4.44	0.052	0.028	2.29	27.2
NSE17-4	29/07/2016 01:34	2.97	0.078	0.056	1.13	319.4
NSE18-1	29/07/2016 15:24	2.18	0.054	0.038	4.76	30.2
NSE19-1	30/07/2016 01:47	4.07	0.063	0.038	1.11	12.8
NSE20-1	30/07/2016 09:14	1.78	0.017	0.014	2.42	9.7
NSE21-1	30/07/2016 21:28	1.50	0.047	0.024	0.83	33.0
NSE21-2	31/07/2016 00:51	4.85	0.048	0.030	1.75	36.0
NSE21-3	31/07/2016 03:10	3.99	0.036	0.022	2.06	42.2

index	time (dd/mm/yyyy HH:MM)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
NSE21-4	31/07/2016 03:40	3.52	0.054	0.032	2.06	42.2
NSE22-1	31/07/2016 10:08	1.46	0.019	0.016	0.82	70.3
NSE22-2	31/07/2016 13:36	4.96	0.048	0.028	2.06	57.5
NSE22-3	31/07/2016 15:05	4.75	0.165	0.103	2.02	73.5
NSE22-4	31/07/2016 17:57	2.00	0.141	0.089	1.62	99.3
NSE23-1	31/07/2016 22:58:31	1.77	0.033	0.021	0.01	165.3
NSE23-2	1/8/2016 0:05	2.65	0.044	0.021	0.31	336.3
NSE23-3	1/8/2016 3:32	4.85	0.067	0.040	0.17	303.2
NSE23-4	1/8/2016 4:03	4.36	0.023	0.017	0.51	5.3
NSE23-5	1/8/2016 5:16	3.21	0.030	0.019	0.51	5.3
NSE23-6	1/8/2016 6:54	1.54	0.051	0.036	0.56	9.4
NSE24-1	1/8/2016 15:52	4.98	0.100	0.055	1.27	60.5
NSE24-2	1/8/2016 18:21	2.58	0.065	0.037	0.52	85.4
NSE25-1	2/8/2016 1:49	3.46	0.020	0.016	0.40	324.0
NSE25-2	2/8/2016 3:15	5.34	0.031	0.023	0.64	340.9
NSE25-3	2/8/2016 5:44	3.66	0.034	0.020	1.61	292.4
NSE25-4	2/8/2016 8:06	1.23	0.046	0.025	2.17	301.2
NSE27-1	3/8/2016 2:19	3.23	0.037	0.021	3.39	5.7
NSE27-2	3/8/2016 5:50	4.58	0.084	0.050	2.91	12.3
NSE27-3	3/8/2016 8:31	1.75	0.029	0.020	3.23	2.3
NSE28-1	3/8/2016 17:55	4.59	0.048	0.032	2.49	3.8
NSE28-2	3/8/2016 19:09	3.40	0.055	0.033	3.03	9.6
NSE29-1	4/8/2016 4:29	5.49	0.034	0.024	2.37	11.0
NSE29-2	4/8/2016 6:05	5.08	0.047	0.028	2.62	7.1
NSE30-1	4/8/2016 16:20	4.80	0.102	0.055	4.14	26.4
NSE30-2	4/8/2016 20:14	3.18	0.064	0.041	3.69	37.4
NSE31-1	5/8/2016 2:07	1.59	0.032	0.017	1.31	7.9
NSE31-2	5/8/2016 4:07	3.81	0.018	0.014	1.80	14.5
NSE31-3	5/8/2016 5:18	5.64	0.023	0.017	1.80	14.5
NSE31-4	5/8/2016 6:33	5.32	0.038	0.027	2.04	10.1
NSE31-5	5/8/2016 10:23	1.32	0.088	0.045	2.33	35.5
NSE32-1	5/8/2016 16:40	4.22	0.061	0.034	1.48	76.7
NSE33-1	6/8/2016 5:57	5.37	0.062	0.038	1.12	353.9
NSE33-2	6/8/2016 8:02	4.29	0.047	0.034	2.85	3.0
NSE34-1	6/8/2016 15:46	2.40	0.038	0.024	1.54	71.8
NSE34-2	6/8/2016 17:37	4.57	0.049	0.030	1.51	85.8
NSE35-1	7/8/2016 4:18	1.91	0.030	0.020	0.26	296.6
NSE35-2	7/8/2016 6:59	5.17	0.042	0.023	1.20	0.1
NSE36-1	7/8/2016 15:33	1.61	0.043	0.025	3.66	5.6
NSE36-2	7/8/2016 18:26	4.86	0.040	0.026	3.70	23.8
NSE36-3	7/8/2016 20:46	4.25	0.068	0.039	3.22	21.8
NSE36-4	7/8/2016 21:31	3.53	0.054	0.035	3.22	21.8
NSE36-5	7/8/2016 22:30	2.53	0.040	0.028	3.99	27.7
NSE36-6	7/8/2016 23:43	1.29	0.085	0.058	3.99	27.7

index	time (dd/mm/yyyy HH:MM)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
NSE38-1	8/8/2016 16:38	2.66	0.035	0.023	1.65	73.9
NSE38-2	8/8/2016 21:08	4.84	0.067	0.046	0.68	73.5
NSE38-3	8/8/2016 21:38	4.34	0.094	0.052	0.68	73.5
NSE38-4	8/8/2016 22:32	3.45	0.068	0.034	0.52	19.3
NSE39-1	9/8/2016 4:42	1.95	0.019	0.016	0.64	275.3
NSE39-2	9/8/2016 7:27	4.93	0.044	0.025	0.91	297.2
NSE39-3	9/8/2016 10:24	3.60	0.074	0.047	1.80	61.6
NSE40-1	10/8/2016 0:27	1.69	0.096	0.049	0.75	33.5
NSE41-1	10/8/2016 8:53	5.00	0.052	0.031	0.99	17.5
NSE41-2	10/8/2016 11:04	3.42	0.044	0.028	0.69	66.3
NSE42-1	10/8/2016 23:35	2.97	0.041	0.027	1.66	29.0
NSE42-2	11/8/2016 1:11	1.44	0.030	0.022	1.45	12.3
NSE43-1	11/8/2016 7:09	2.48	0.033	0.022	1.67	351.2
NSE43-2	11/8/2016 10:58	3.90	0.039	0.025	3.59	3.3
NSE44-1	11/8/2016 23:10	4.04	0.044	0.025	1.77	16.1
NSE44-2	12/8/2016 0:49	2.64	0.042	0.029	2.39	28.4
NSE44-3	12/8/2016 2:28	1.29	0.079	0.051	2.27	29.4
NSE45-1	12/8/2016 10:56	4.45	0.141	0.077	3.45	37.7
NSE45-2	12/8/2016 14:36	1.54	0.050	0.028	4.21	32.5
NSE46-1	31/07/2016 22:58	1.59	0.052	0.029	2.17	22.4
NSE47-1	13/08/2016 03:05	1.18	0.048	0.027	2.41	17.1
NSE47-2	13/08/2016 06:37	2.60	0.029	0.021	2.58	16.4
NSE47-3	13/08/2016 08:40	1.21	0.119	0.070	2.37	36.3
NSE48-1	13/08/2016 16:22	1.49	0.021	0.015	1.05	88.2
NSE48-2	13/08/2016 19:50	2.97	0.028	0.018	0.14	81.1
NSE48-3	13/08/2016 21:52	4.25	0.042	0.028	0.02	7.2
NSE48-4	13/08/2016 23:31	4.44	0.024	0.018	0.02	165.7
NSE48-5	14/08/2016 00:35	4.05	0.045	0.031	0.02	165.7
NSE48-6	14/08/2016 01:21	2.19	0.026	0.020	0.16	355.5
NSE49-1	14/08/2016 03:38	1.67	0.000	0.000	0.12	10.9
NSE49-2	14/08/2016 08:47	2.37	0.029	0.019	0.12	10.9
NSE49-3	14/08/2016 09:48	4.32	0.040	0.023	0.44	106.8
NSE49-4	14/08/2016 13:35	3.57	0.097	0.061	1.08	106.2
NSE50-1	14/08/2016 14:37	4.48	0.042	0.026	1.80	152.6
NSE50-2	15/08/2016 01:05	3.99	0.020	0.016	1.65	165.0
NSE50-3	15/08/2016 02:48	2.10	0.067	0.041	1.38	158.9
NSE51-1	15/08/2016 04:55	1.56	0.035	0.025	2.04	192.9
NSE51-2	15/08/2016 17:55	1.13	0.029	0.022	2.04	190.6
NSE52-1	15/08/2016 18:25	3.55	0.026	0.020	1.32	186.5
NSE52-2	16/08/2016 01:04	4.75	0.040	0.026	1.77	188.5
NSE52-3	16/08/2016 02:39	4.56	0.049	0.027	1.77	188.5
NSE52-4	16/08/2016 03:11	3.79	0.026	0.020	2.51	198.8
NSE53-1	16/08/2016 04:07	2.04	0.038	0.026	2.70	203.2
NSE53-2	16/08/2016 11:47	4.68	0.036	0.022	3.36	208.3

index	time (dd/mm/yyyy HH:MM)	wlevel (m)	H_{max} (m)	$H_{1/3}$ (m)	Wspeed (m/s)	Wdir (degrees)
NSE54-1	16/08/2016 15:35	2.86	0.046	0.027	2.19	199.7
NSE54-2	17/08/2016 06:07	2.18	0.056	0.035	2.19	199.7
NSE56-1	17/08/2016 06:46	1.31	0.035	0.022	3.00	210.0
NSE56-2	18/08/2016 00:13	3.86	0.032	0.023	3.14	210.4
NSE56-3	18/08/2016 02:32	5.41	0.038	0.022	1.54	197.9
NSE56-4	18/08/2016 04:00	4.98	0.025	0.019	1.54	197.9
NSE56-5	18/08/2016 04:55	2.91	0.018	0.016	0.95	190.7
NSE58-1	18/08/2016 06:58	3.11	0.026	0.017	1.34	212.3
NSE58-2	19/08/2016 02:50	5.52	0.069	0.034	0.06	232.5
NSE59-1	19/08/2016 04:40	4.35	0.044	0.026	1.73	300.6
NSE60-1	19/08/2016 18:33	2.04	0.025	0.018	1.70	359.7
NSE60-2	20/08/2016 02:35	3.78	0.033	0.022	1.70	359.7
NSE60-3	20/08/2016 03:48	5.52	0.050	0.038	0.40	348.4
NSE60-4	20/08/2016 04:48	4.15	0.037	0.023	0.85	336.4
NSE61-1	20/08/2016 07:13	4.52	0.042	0.025	4.15	17.5
NSE61-2	20/08/2016 16:22	4.43	0.068	0.042	3.54	27.9
NSE61-3	20/08/2016 19:06	3.89	0.119	0.062	3.54	27.9
NSE62-1	20/08/2016 19:40	3.00	0.043	0.024	2.35	342.1
NSE62-2	21/08/2016 03:58	5.52	0.058	0.035	3.90	351.9
NSE62-3	21/08/2016 06:20	5.16	0.049	0.035	3.90	351.9
NSE63-1	21/08/2016 06:56	5.84	0.100	0.063	5.04	42.8
NSE63-2	21/08/2016 17:57	3.36	0.054	0.036	3.06	26.4
NSE63-3	21/08/2016 21:08	2.33	0.033	0.025	3.06	26.4

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