Modelling Data Collection Report
Shapinsay (Veantrow Bay), Stronsay Firth

Report to:	Scottish Environment Protection Agency (SEPA)
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1. Introduction

This report presents the survey work undertaken by Scottish Sea Farms Ltd. at the existing Shapinsay (Veantrow Bay) marine fish farm located in Orkney (CAR/L/1003931). A current meter deployment from 2023 is reported which was conducted to provide the hydrographic data to use in modelling for the proposed expansion at Veantrow Bay. A 2018 deployment near the existing site is also reported which is used to model the present configuration. Data collection and analysis follow guidance from the Scottish Environment Protection Agency (SEPA) (SEPA 2019a, SEPA 2019b, SEPA 2022).

2. Site description

The primary survey area is located to the northeast of the existing fish farm within Veantrow Bay positioned approximately 1.6km from the shore (Figure 2.1). This is a location which is influenced by the tidal streams flowing through several firths and sounds that are between the island of Shapinsay and the neighbouring islands to the north, and is exposed to a moderate fetch from the NW through NE. The deployment location in an area of relatively uniform depth at 18-20m.

The proposed expansion of the farm (hereafter referred to as Shapinsay) involves a relocation of the site centre 242m north. Data to represent the existing farm have been collected from a location to the west of the pen group. Details of the existing and proposed infrastructure are found in Table 2.1.

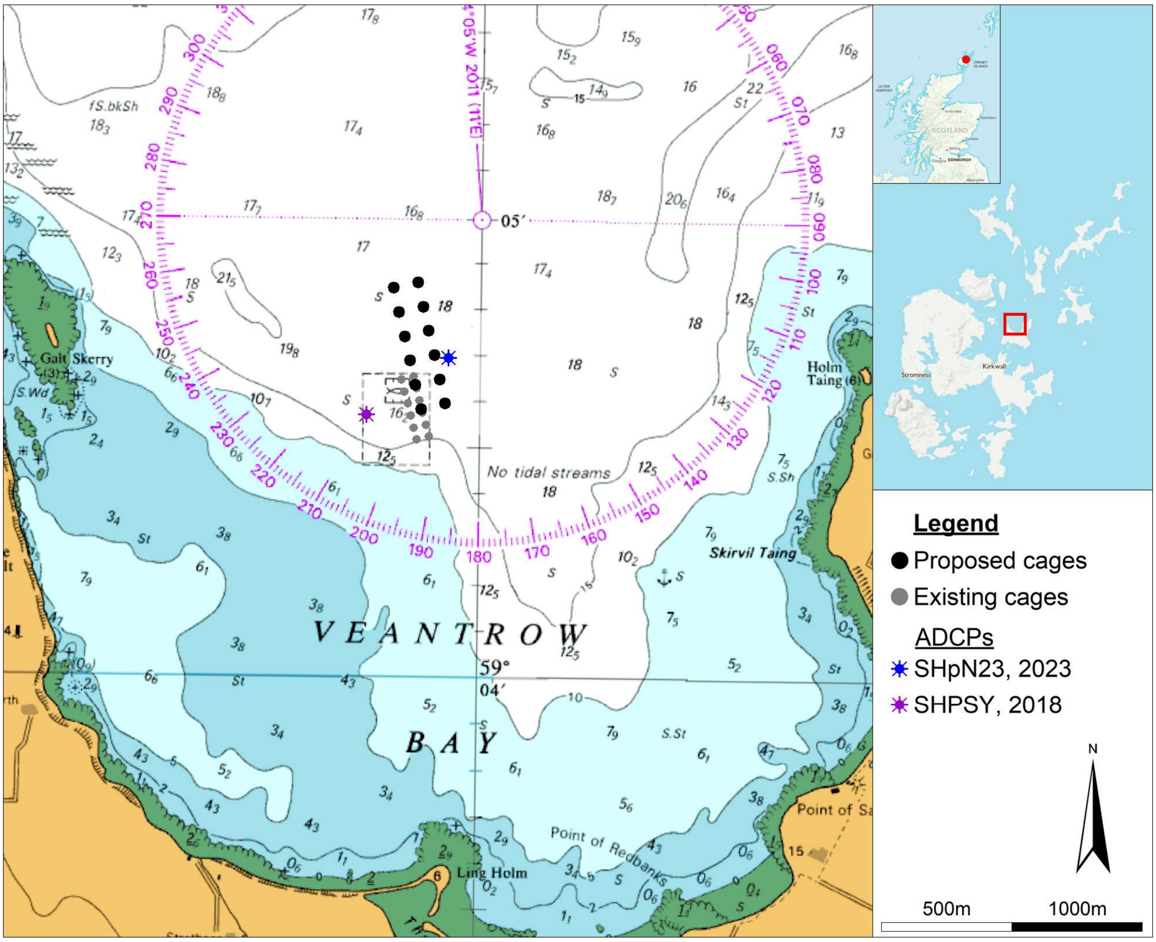


Figure 2.1 Location of the Shapinsay marine fish farm, existing and proposed, and ADCP deployment locations.

Table 2.1 Shapinsay site infrastructure.

	Existing	Proposed
Site centre	350153E, 1021387N	350176E, 1021628N
Number of pens	12	12
Pen circumference	100 m	140 m
Pen net depth	10 m	7.5 m
Mooring grid spacing	50 m	100 m
Layout	2 x 6	2 x 6

3. Scope

To establish the environmentally appropriate biomass and medicine consent limits for the proposal, an assessment is undertaken using NewDEPOMOD configured according to the "standard default" approach as outlined in SEPA 2019b and SEPA 2023. This requires the collection of at least 90 days of hydrographic data from the location. These data also support the validation of the hydrodynamic model developed for the north Orkney area.

Historically a hydrographic survey in 2007-8 at a location to the west of the existing site was used to support the licencing requirements here using AutoDEPOMOD. However, at 320m from the centre of the proposal, a short duration and quality issues mean that these data are not suitable to represent the expansion. The existing site is represented by a longer survey from 2018. A bathymetric survey of the bay was undertaken by SSF in 2018 as the UK Hydrographic Office (UKHO) survey from 2007 only extends as far south as the edge of the proposed mooring grid (UKHO 2020).

4. Methods

4.1 Instrument deployment

An Acoustic Doppler Current Profiler (ADCP) was deployed at Shapinsay on both occasions (Table 4.1).

Table 4.1 Deployment details.

Identifier	SHpN23	SHPSY
Deployment date	27/03/2023	10/07/2018
Data acquisition period	27/03/2023 10:00:00 to 30/06/2023 09:20:00 (94.97 days)	10/07/2018 10:02:07 to 12/09/2018 08:42:07 (63.94 days)
Instrument	Teledyne RDI Sentinel V50	Teledyne RDI Workhorse Sentinel

Instruments were mounted in a gimballed frame and deployed on the seabed at the target positions. An 80m ground rope attached to the frame ran to a clump weight marked with a surface buoy to allow recovery. Each ADCP specification and deployment configuration is given in Section 7. Position fixes were obtained using a Garmin GPSMAP 76S. The GPS position accuracy was compared against a known location and checked for consistency at the end of each survey. The depth at each deployment location was obtained using a Plastimo Echotest II hand-held depth sounder. Readings were later corrected to Chart Datum using predicted tidal heights for the secondary port Tingwall obtained from Admiralty TotalTide software.

4.2 Data processing

Following retrieval of the ADCP the raw data file was downloaded from the instrument and imported into Teledyne's *Velocity* software, automatically averaging the raw ping data using the default screening parameters and generating the corresponding **.pdv* file used for data processing (screenshots are presented at Appendices A - D). These are given an initial inspection (orientation, pitch, roll, heading, pressure) to check that the meter has remained undisturbed and that there are no obvious breaks in the data. Side-lobe interference was removed and the data for the valid bins was exported in ASCII format. These were compiled into a Microsoft Excel workbook and evaluated according to Teledyne's *QA/QC Parameter for Acoustic Doppler Current Profilers* application.

The standard deviation (SD) for each ensemble at each bin is calculated according to:

$$bin\ SD = \frac{single\ ping\ SD}{\sqrt{\frac{(PG1 + PG4)}{100} * no.of\ pings}}$$

Where the single ping SD is specific to the instrument for a given bin size, PG1 (percent good 1) and PG4 are the percentages of 3 and 4 beam solutions respectively (i.e. valid pings) and the number of pings is that per ensemble programmed for each deployment.

Three depth bins were selected as outlined by SEPA guidance and these data were analysed using the SEPA tool *HGdata_analysis_v7.11.xls* (SEPA 2019b & SEPA 2022). All bearings were corrected from magnetic north to grid north using a Grid Magnetic Angle derived from the declination obtained for the survey position and date (survey mid-point) from the World Magnetic Model 2020 Calculator (BGS 2023), and from a grid convergence angle calculated from the deployment National Grid Reference by the HGdata_analysis spreadsheet. Deployment specific values are given in Table 4.2.

Table 4.2 Heading correction parameters.

Identifier	SHpN23	SHPSY
Grid Magnetic Angle	0.52°W	1.64°W
Declination	1.26°W	2.39°W
Grid Convergence Angle	0.74°W	0.75°W

4.3 Data repair

During the SHPSY deployment it is apparent that the pressure sensor malfunctioned during the deployment as it exhibits drift towards increasing depth (Appendix D), while signal intensity values show the range to the surface remains consistent. The first reading, adjusted for tidal height and including frame height, is similar to the sounding collected when the instrument was deployed indicating that the initial readings from the sensor are representative. As the drift is linear it is successfully removed by using the formula that describes a linear trendline applied to the data to calculate the values for the start and end of the trendline, thus giving the total drift over the survey period. This is divided by the number of profiles to get the amount of drift per profile and from that the cumulative drift at each profile which is then subtracted from the raw sensor depth readings.

Additionally, prior to deployment the SHPSY ADCP was synchronised with a laptop clock set to British Summer Time (BST). Therefore processed data have been corrected to GMT.

4.4 Harmonic analysis

For each deployment the astronomic tidal component was derived using harmonic analysis to remove the influence of meteorological effects using the UTide toolbox in MATLAB. This reduces the flow to its harmonic constituents from which the tide only speed and direction are reproduced.

5. Bathymetry

A bathymetry survey was undertaken in Veantrow Bay by Triscom Enterprises Ltd. on 12/06/2018 from the survey vessel MPC *Athenia* over a five-hour period. The vessel followed parrel planned routes, appropriately spaced relative to the anticipated depth to achieve the most efficient coverage of the target survey area (Figure 5.1). Equipment used included:

- Kongsberg GeoAcoustics GeoSwath Plus 250kHz (s/n 318)
- Applanix POS MV 320 GNSS compass (s/n 9214)
- Teledyne TSS DMS05 MRU (s/n 898)
- Valeport Monitor SVP (s/n 25808)

The self-calibrating GeoSwath plus system utilises interferometric sonar technology to capture a fan shaped bathymetry swath via side-scanning sonars rigidly mounted to the vessel. Soundings are georeferenced to known horizontal and vertical datums using dual-GPS while various sources of error in soundings are corrected with ancillary equipment; vessel heave is mitigated using a motion reference unit, errors due to sound velocity are mitigated by profiling the sound velocity in water. A shore-based GPS corrector station is used in conjunction with the POS MV system to increase positioning accuracy and correct for tide. After acquisition, the data are filtered remove water-column noise and other spurious soundings. This resulted in a collection of georeferenced points which are then gridded by amalgamating into a Cartesian plane to provide a three-dimensional graphical representation of the seabed surface (Figure 5.2).

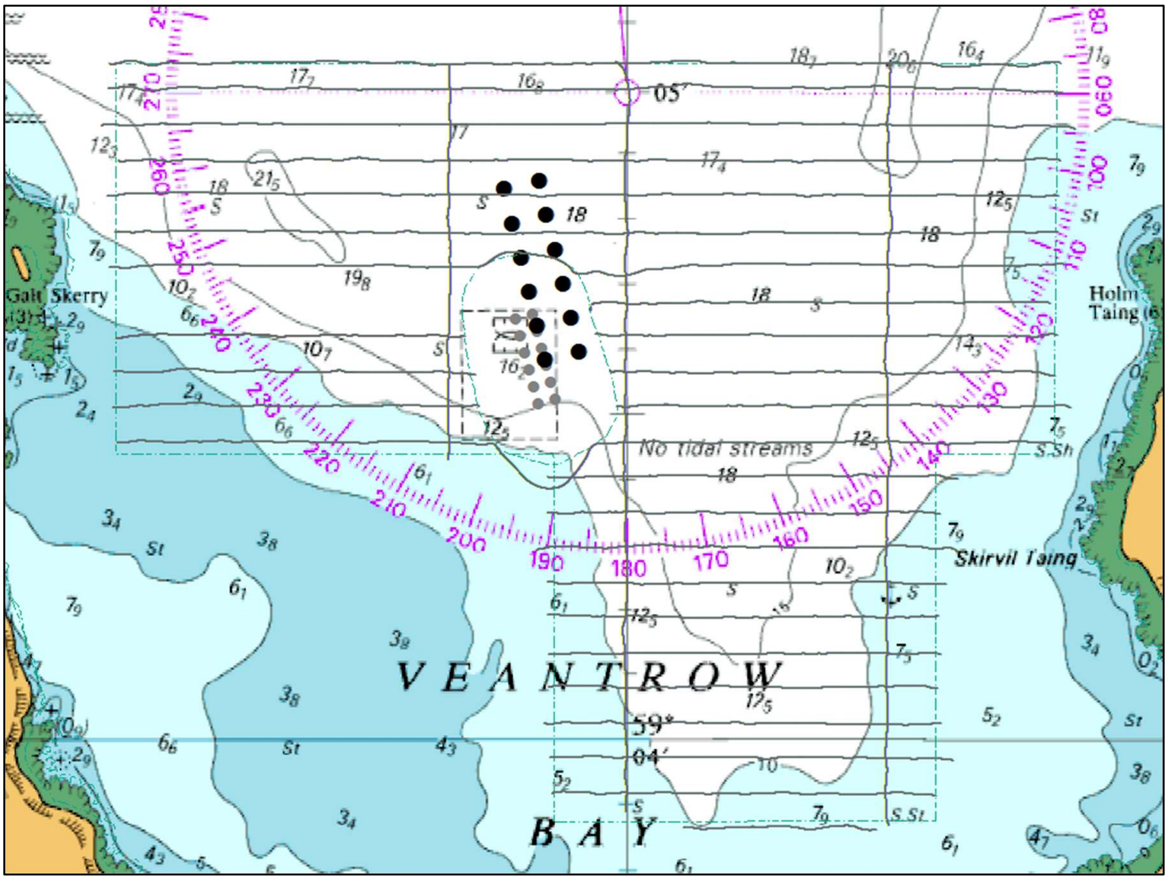


Figure 5.1 Plot of the vessel track from the 2018 multibeam survey at Veantrow Bay including existing (grey) and proposed pens (black).

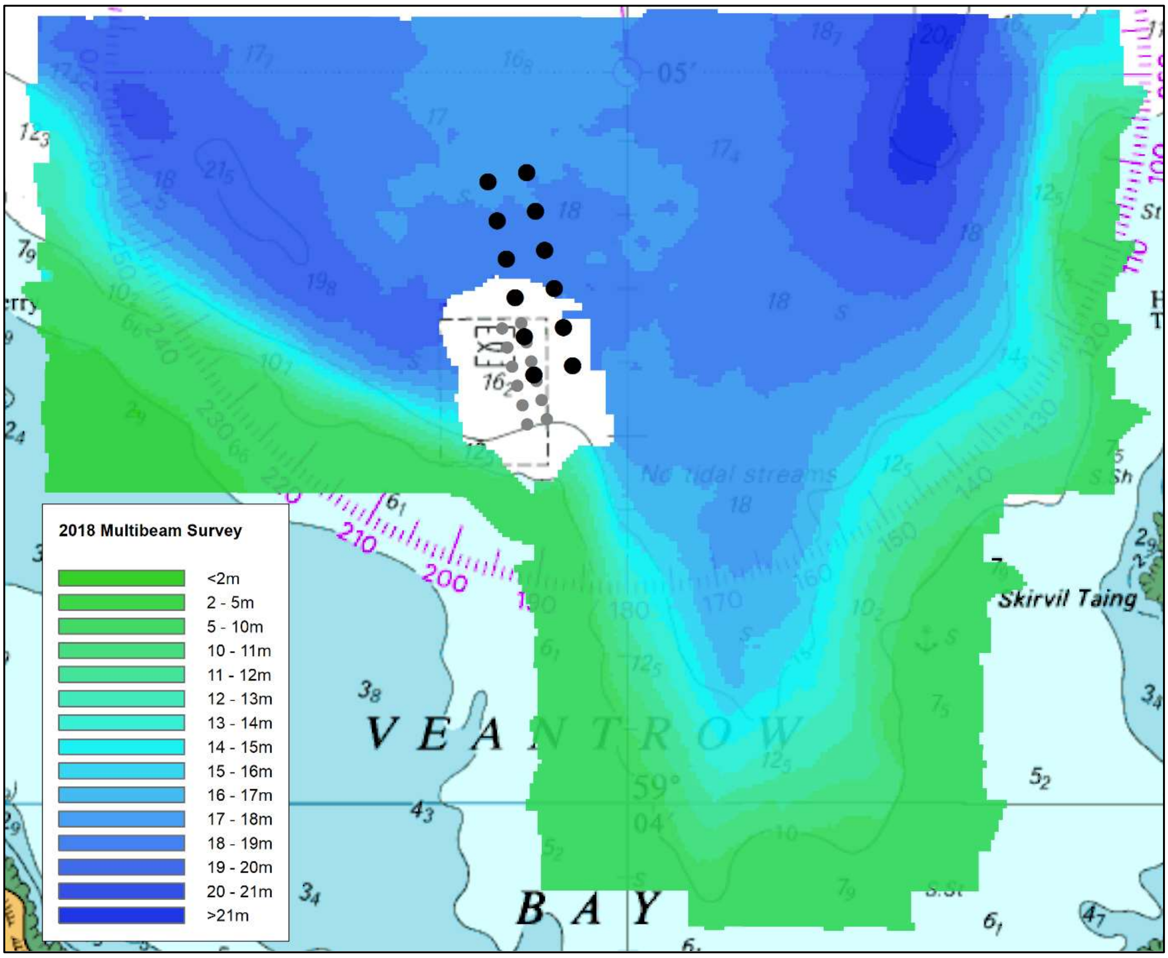


Figure 5.2 Plot of the interpolated bathymetry from the 2018 multibeam survey at Veantrow Bay including existing (grey) and proposed pens (black).

6. Flow data

6.1 Deployment position

The deployment positions are given in Table 6.1 and illustrated at Figure 2.1. SHpN23 was deployed at a location 126m SE of the proposed site centre, 58m from the nearest pen centre. SHPSY was deployed 194m W of the existing site centre, 171 from the nearest pen centre. The raw depth soundings were converted to chart datum using the predicted tidal height for Tingwall (secondary port ID 0279) obtained from Admiralty TotalTide software.

Table 6.1 ADCP deployment positions for Shapinsay, existing and proposed.

Identifier	Date & time (UT)	Easting	Northing	Raw depth (m)	Tide (m)	Depth (mCD)
SHpN23	27/03/2023 09:55	350293	1021578	20.80	1.62	19.18
SHPSY	10/07/2018 09:40	349962	1021350	19.00	1.78	17.22

6.2 Description – SHpN23, 2023

6.2.1 Quality

A total of 6,839 valid ensembles were processed from the SHpN23 deployment. With a 20-minute interval between ensembles this equates to 94.97 days. Heading, pitch and roll sensor data show minor variation during the deployment (Appendix B). The recorded pressure was compared with the estimated tidal heights for Tingwall which shows that both range and timing are consistent with those predicted. The mean depth during the deployment, including the height of the frame, was 20.65m and the minimum depth was 19.04m. This corresponds well with the deployment depth of 19.18mCD.

The mean SD for all 6,839 ensembles for bins 1 to 14 is 0.0035m s^{-1} and is therefore below the SEPA guideline threshold for horizontal precision by not exceeding 10% of the mean velocity recorded (0.112m s^{-1}, bins 1-14).

6.2.2 Depth bin selection

Bins 1, 11 and 14 were selected to represent near-bed, pen-bottom and sub-surface conditions respectively, detailed in Table 6.2. The near-bed bin is at a depth within 3m above the seabed. The pen-bottom bin was selected from a depth corresponding to the bottom of the pens at the mean depth observed during the deployment period. The sub-surface bin was selected from a depth to be within 5 m of the lowest observed tide during the deployment, while being below potential effects from wave breaking or side-lobe interference.

Table 6.2 SHpN23 depth bin selection

	Position of bin centre (metres)			
Bin number	From sensor head	From seabed	From the mean tidal level	From lowest observed tide
1	2.20	**2.70**	17.95	16.34
11	12.20	12.70	**7.95**	6.34
14	15.20	15.70	4.95	**3.34**

6.2.3 Analysis

The summary statistics for a 90-day subset (ensembles 12 to 6,492 equivalent to the period from 27/03/2023 10:00 to 25/06/2023 10:00) of each bin selected are given in Table 6.3. Time series of water depth, velocity and direction are presented at Figures 6.1-6.6. Frequency analysis of direction and scatter plots of easting and northing velocity are given at Figure 6.7.

Table 6.3 SHpN23 summary statistics.

	Near-bed	**Pen-bottom**	**Sub-surface**
Mean velocity (m s^{-1})	0.101	0.118	0.120
Min velocity (m s^{-1})	0.000	0.001	0.002
Max velocity (m s^{-1})	0.417	0.468	0.503
Ranked percentage 0.095 m s^{-1}	55.7%	45.8%	43.7%
Major axis (°G)	110	115	120
Amplitude anisotropy	2.35	2.39	2.11
Residual velocity (m s^{-1})	0.052	0.071	0.072
Residual velocity as % of mean	51.4%	60.6%	60.1%
Residual direction (°G)	119.6	126.4	123.4
Parallel Residual (m s^{-1})	0.051	0.070	0.072
Normal Residual (m s^{-1})	0.009	0.014	0.004
Parallel tidal amplitude (m s^{-1})	0.141	0.160	0.160
Normal tidal amplitude (m s^{-1})	0.060	0.067	0.076
	Min	**Max**	**Range**
Depth (m)	19.0	22.1	3.1

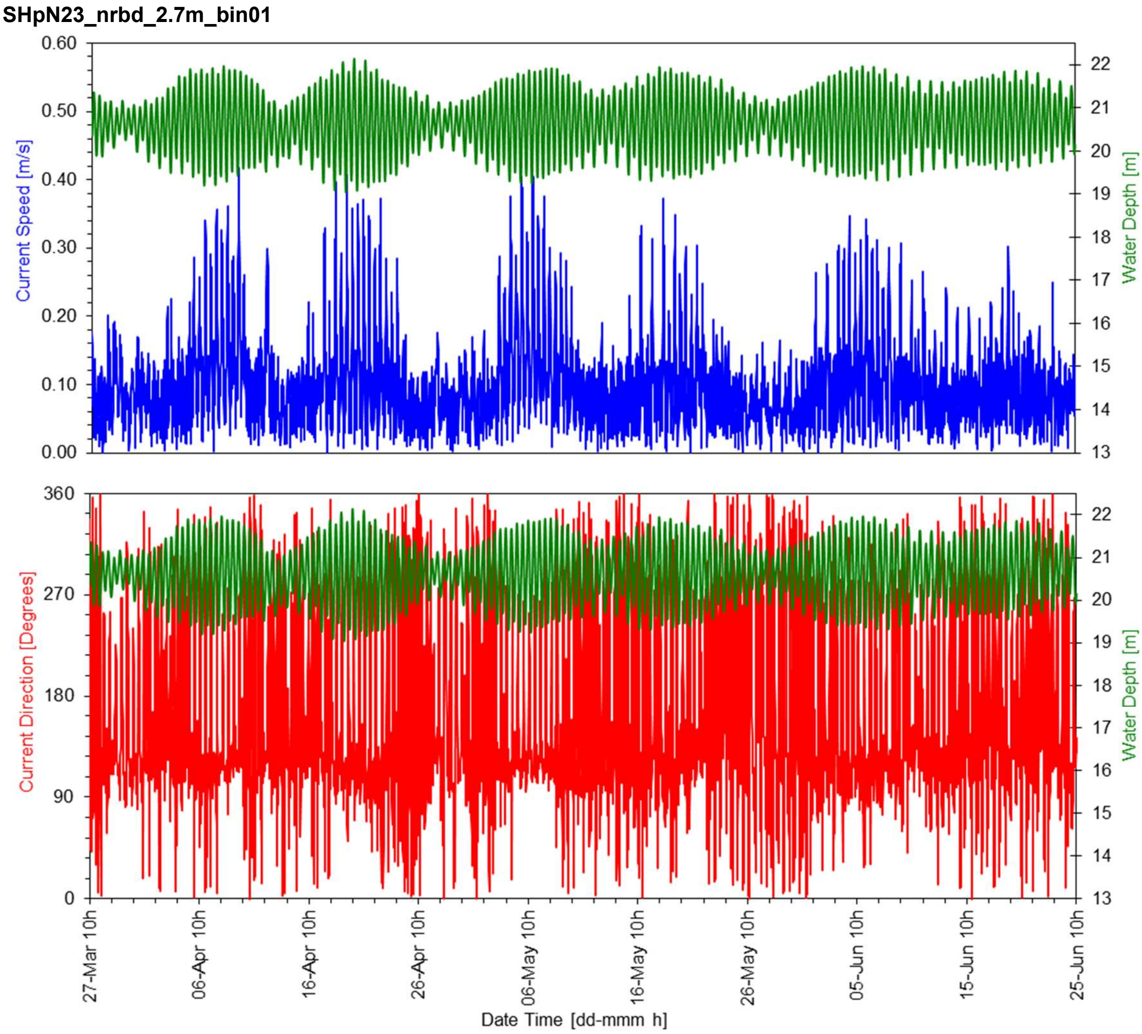


Figure 6.1 Near-bed time series plots for current speed and direction against water level.

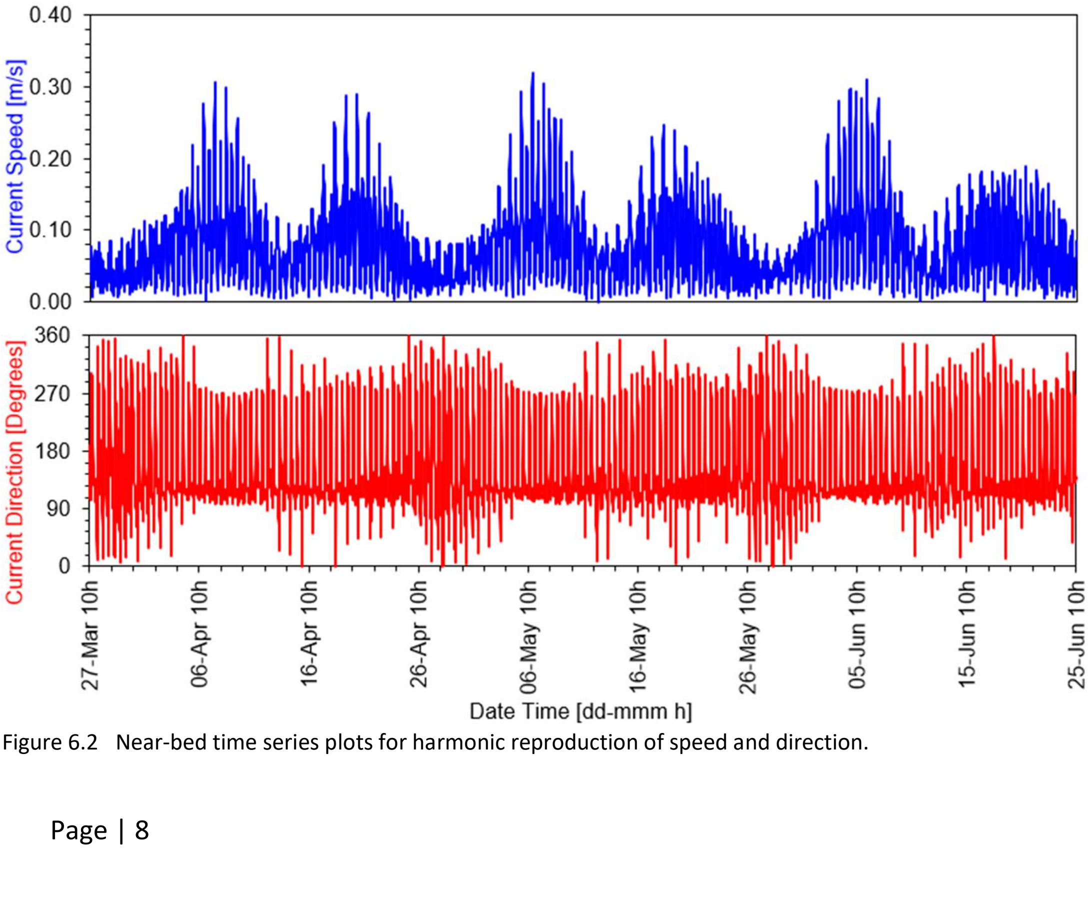


Figure 6.2 Near-bed time series plots for harmonic reproduction of speed and direction.

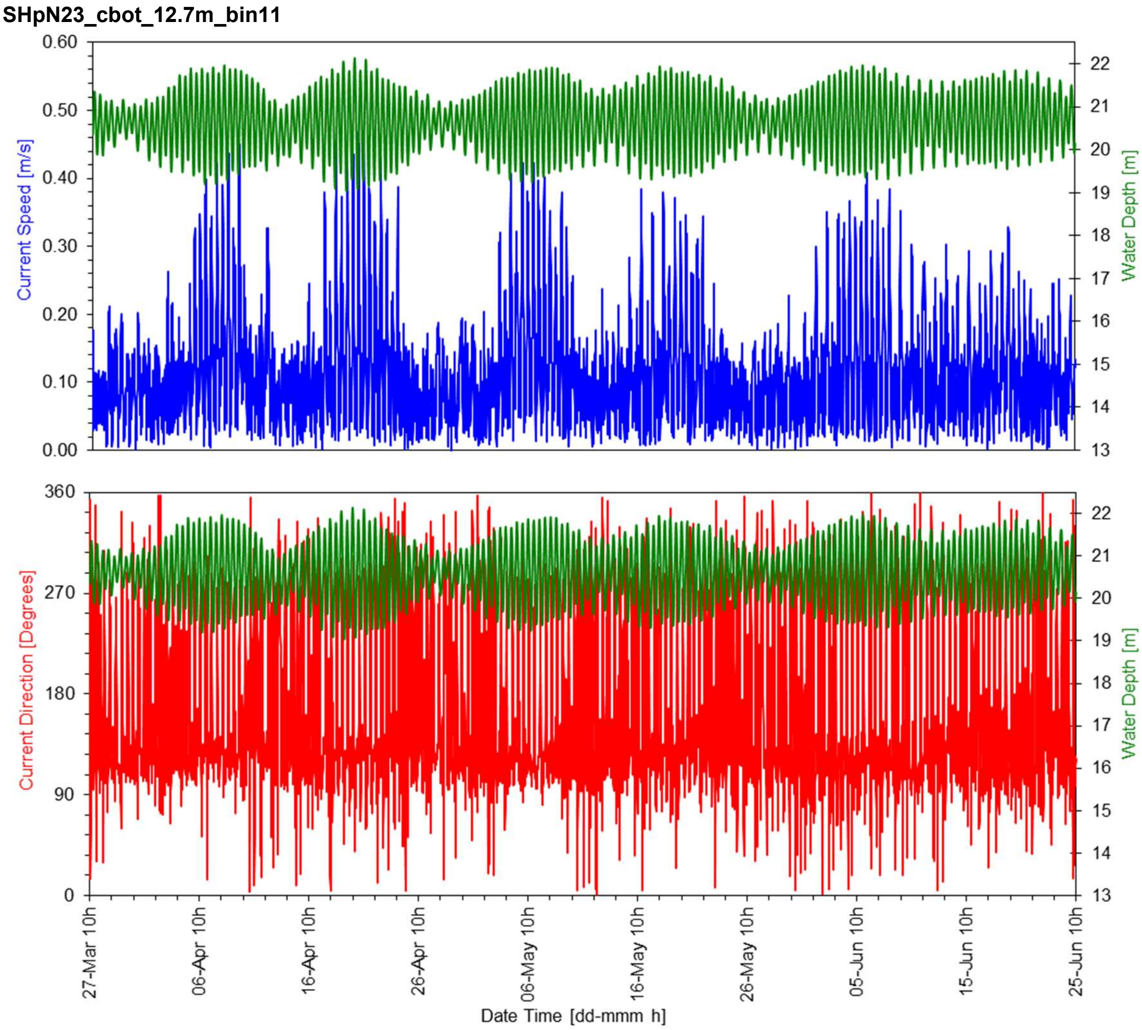


Figure 6.3 Pen-bottom time series plots for current speed and direction against water level.

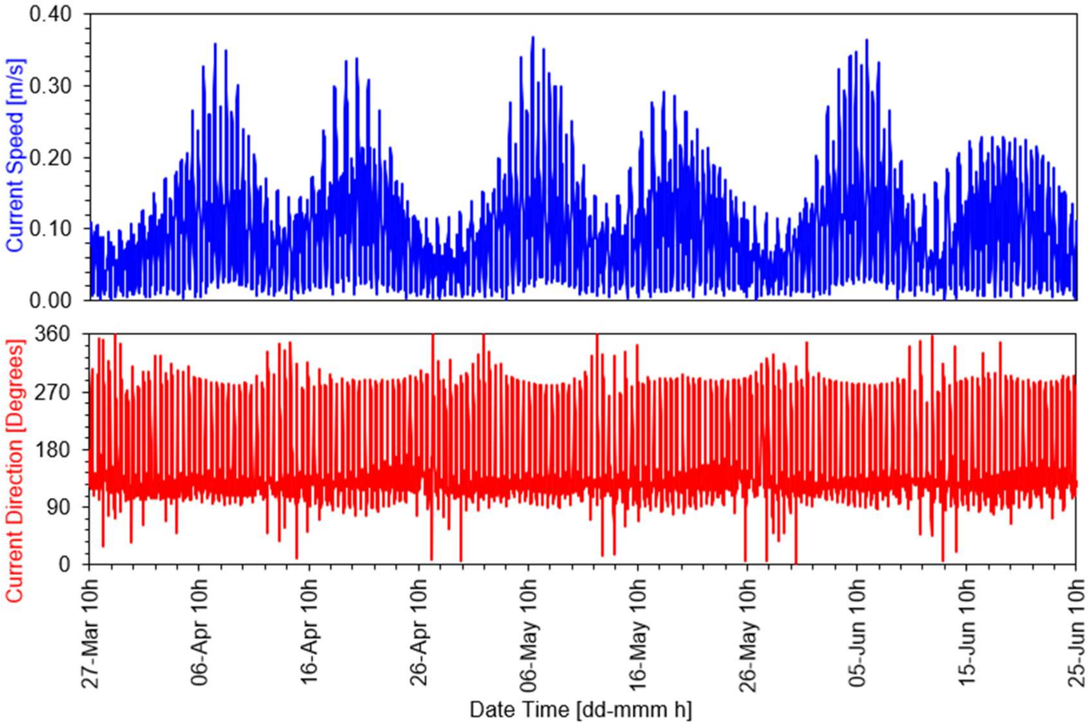


Figure 6.4 Pen-bottom time series plots for harmonic reproduction of speed and direction.

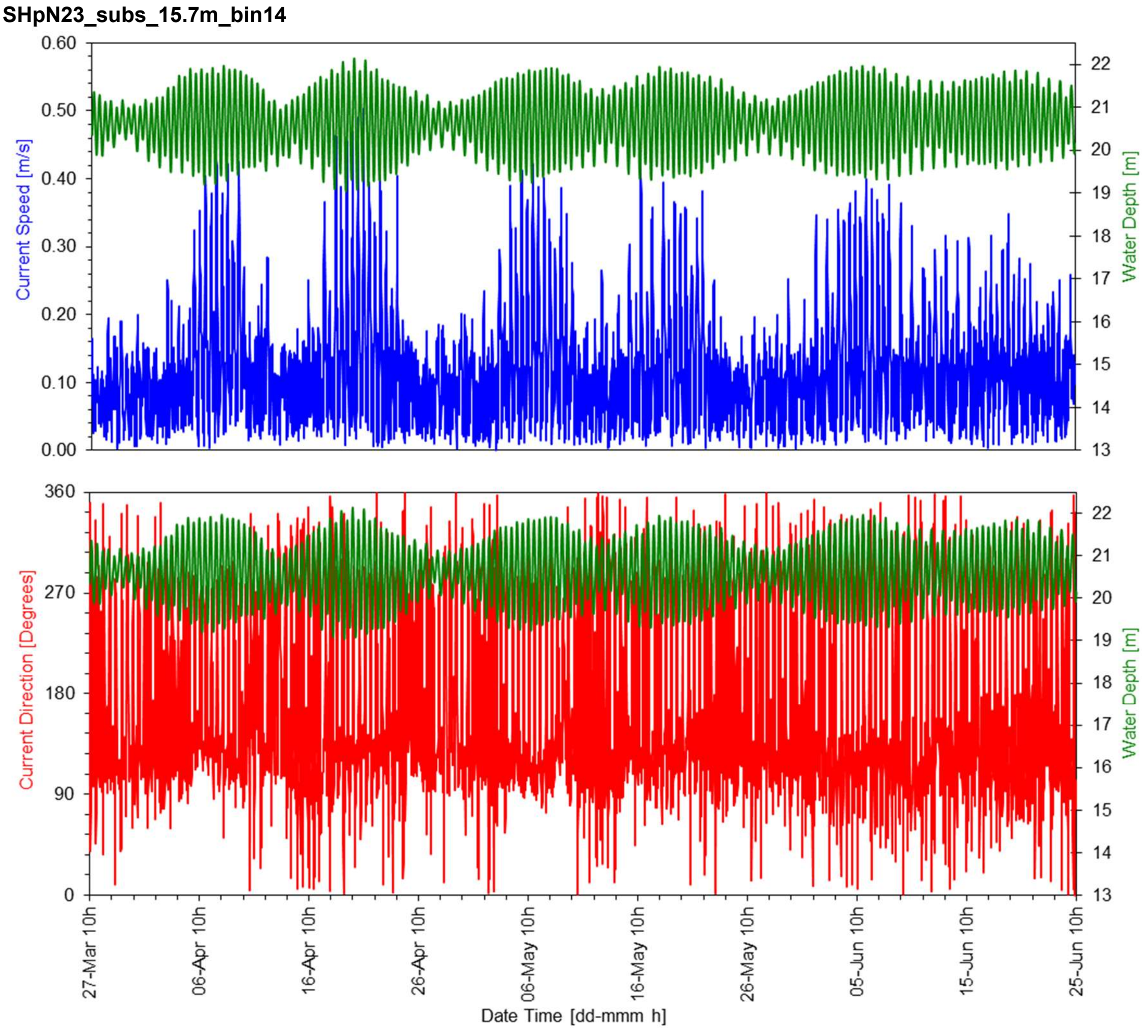


Figure 6.5 Sub-surface (bin 14) time series plots for current speed and direction against water level.

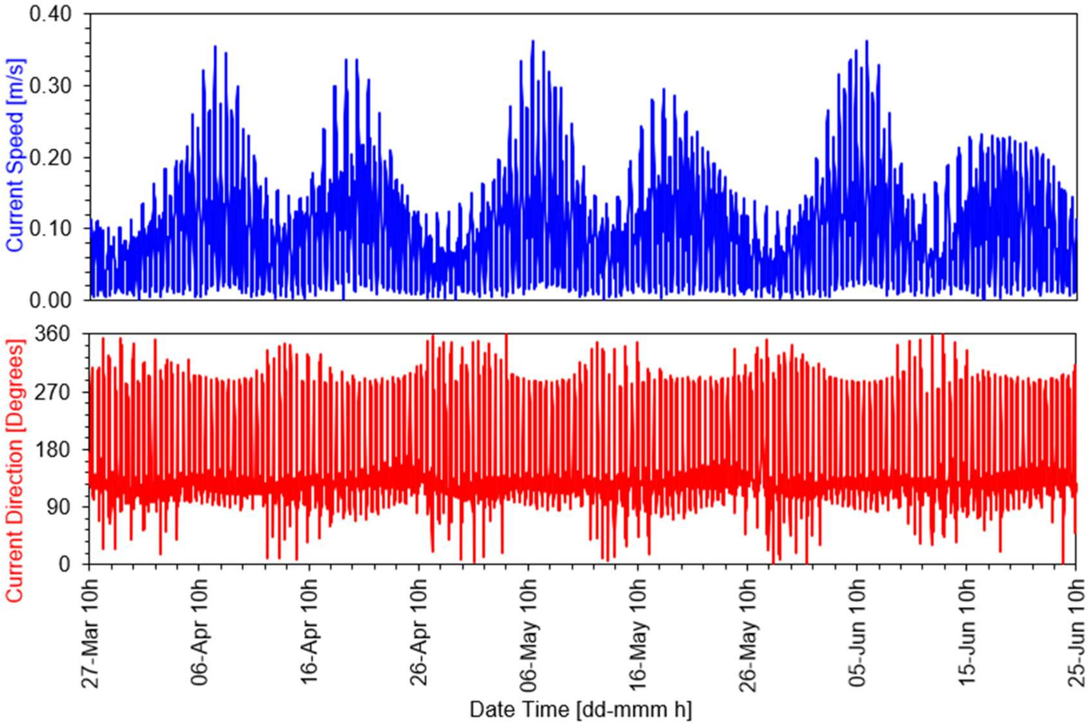


Figure 6.6 Sub-surface (bin 14) time series plots for harmonic reproduction of speed and direction.

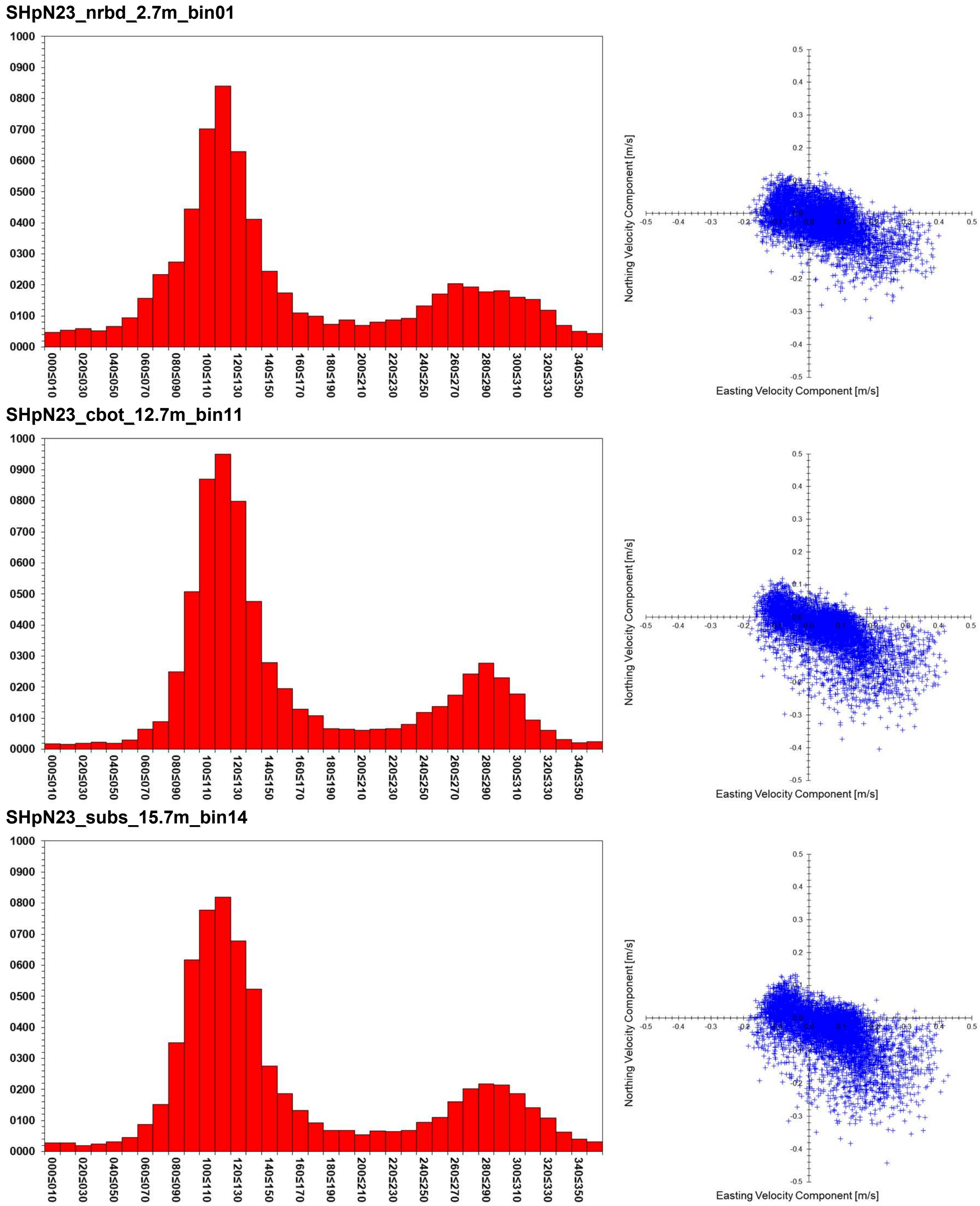


Figure 6.7 Current direction frequency plots and easting and northing velocity component scatter plots. From the top: Near-bed, pen-bottom and near-surface bins.

6.3 Description – SHPSY, 2018

6.3.1 Quality

A total of 4,605 valid ensembles were processed from the SHPSY deployment. With a 20-minute interval between ensembles this equates to 63.94 days. Heading, pitch and roll sensor data show minor variation during the deployment (Appendix D). The recorded pressure after correction was compared with the estimated tidal heights for Tingwall which shows that both range and timing are consistent with those predicted. The mean depth during the deployment, including the height of the frame, was 19.19m and the minimum depth was 17.37m. This corresponds well with the deployment depth of 17.22mCD.

The mean SD for all 4,605 ensembles for bins 1 to 13 is 0.0035m s^{-1} and is therefore below the SEPA guideline threshold for horizontal precision by not exceeding 10% of the mean velocity recorded (0.078m s^{-1}, bins 1-13).

6.3.2 Depth bin selection

Bins 1, 9 and 11 were selected to represent near-bed, pen-bottom and sub-surface conditions respectively, detailed in Table 6.4. The near-bed bin is at a depth within 3m above the seabed. The pen-bottom bin was selected from a depth corresponding to the bottom of the pens at the mean depth observed during the deployment period. The sub-surface bin was selected from a depth to be within 5 m of the lowest observed tide during the deployment, while being below potential effects from wave breaking or side-lobe interference.

Table 6.4 SHPSY depth bin selection.

	Position of bin centre (metres)			
Bin number	From sensor head	From seabed	From the mean tidal level	From lowest observed tide
1	2.09	**2.74**	16.45	14.63
9	10.09	10.74	**8.45**	6.63
11	12.09	12.74	6.45	**4.63**

6.2.3 Analysis

The summary statistics for each bin selected are given in Table 6.5. Time series of water depth, velocity and direction are presented at Figures 6.8-6.13. Frequency analysis of direction and scatter plots of easting and northing velocity are given at Figure 6.14.

Table 6.5 SHPSY summary statistics.

	Near-bed	Pen-bottom	Sub-surface
Mean velocity (m s^{-1})	0.067	0.081	0.085
Min velocity (m s^{-1})	0.000	0.001	0.000
Max velocity (m s^{-1})	0.299	0.383	0.384
Ranked percentage 0.095 m s^{-1}	77.40%	69.60%	68.20%
Major axis (°G)	130	130	135
Amplitude anisotropy	2.56	2.74	2.61
Residual velocity (m s^{-1})	0.005	0.019	0.021
Residual velocity as % of mean	7.0%	23.2%	25.1%
Residual direction (°G)	147.7	146.0	138.3
Parallel Residual (m s^{-1})	0.004	0.018	0.021
Normal Residual (m s^{-1})	0.001	0.005	0.001
Parallel tidal amplitude (m s^{-1})	0.106	0.127	0.130
Normal tidal amplitude (m s^{-1})	0.041	0.046	0.050
	Min	**Max**	**Range**
Depth (m)	17.37	21.03	3.66

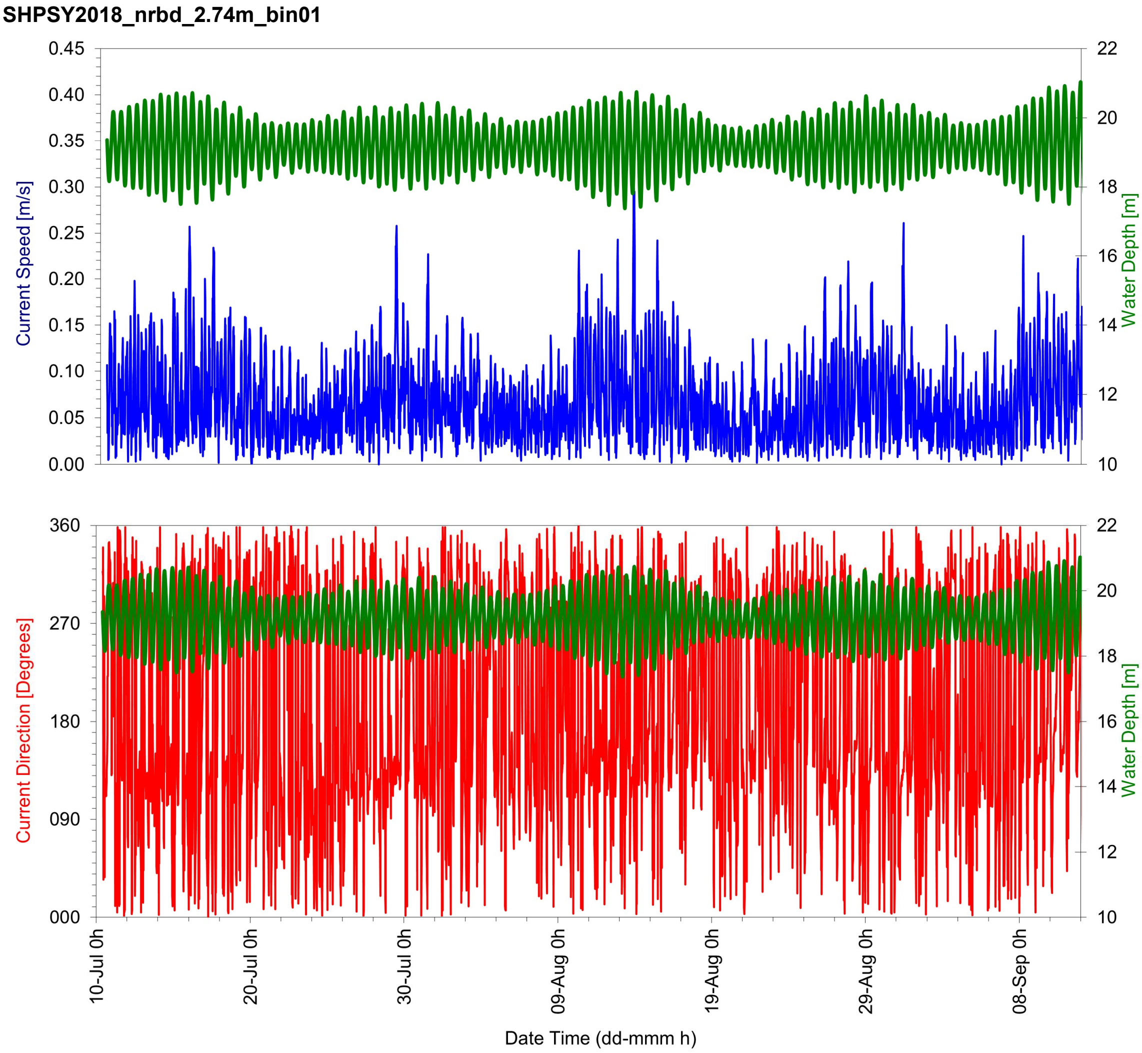


Figure 6.8 Near-bed time series plots for current speed and direction against water level.

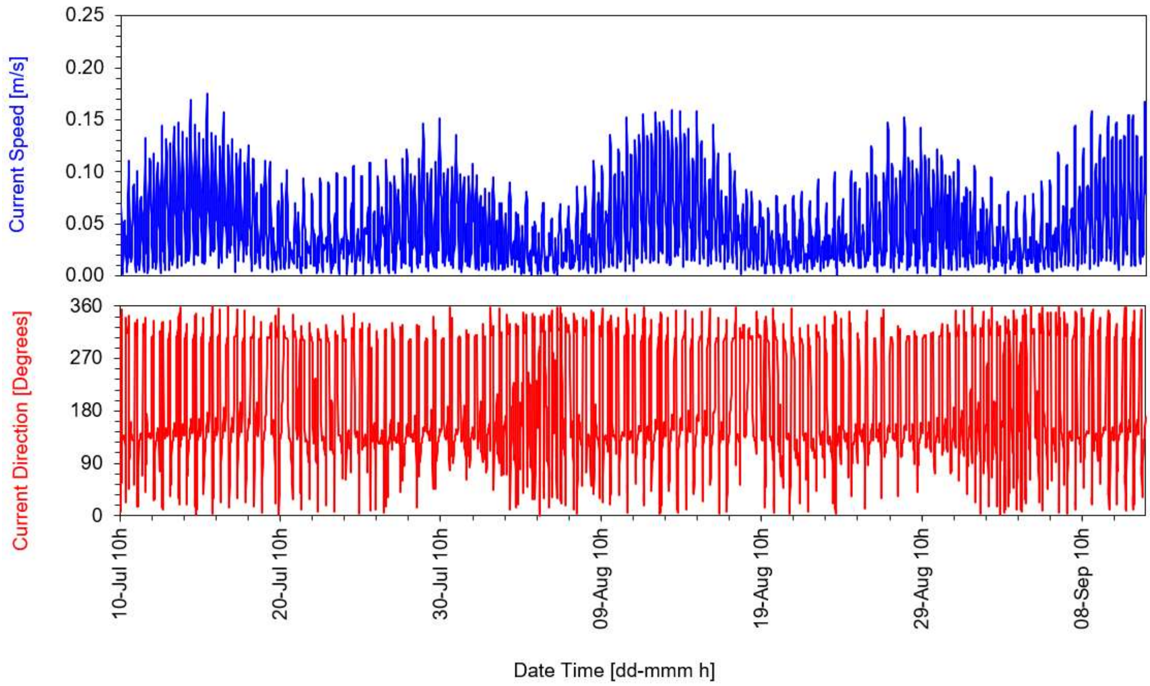


Figure 6.9 Near-bed time series plots for harmonic reproduction of speed and direction.

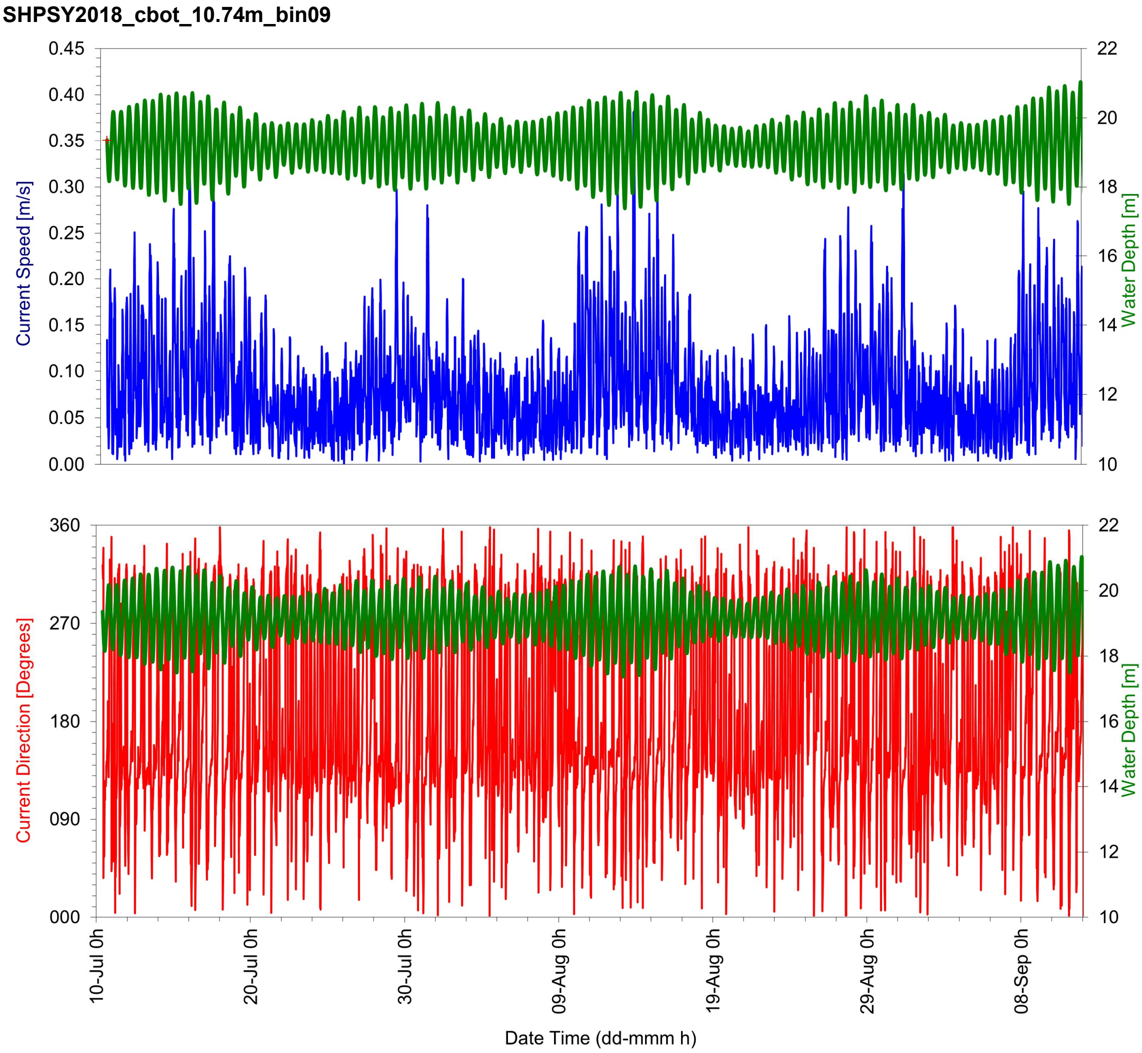


Figure 6.10 Pen-bottom time series plots for current speed and direction against water level.

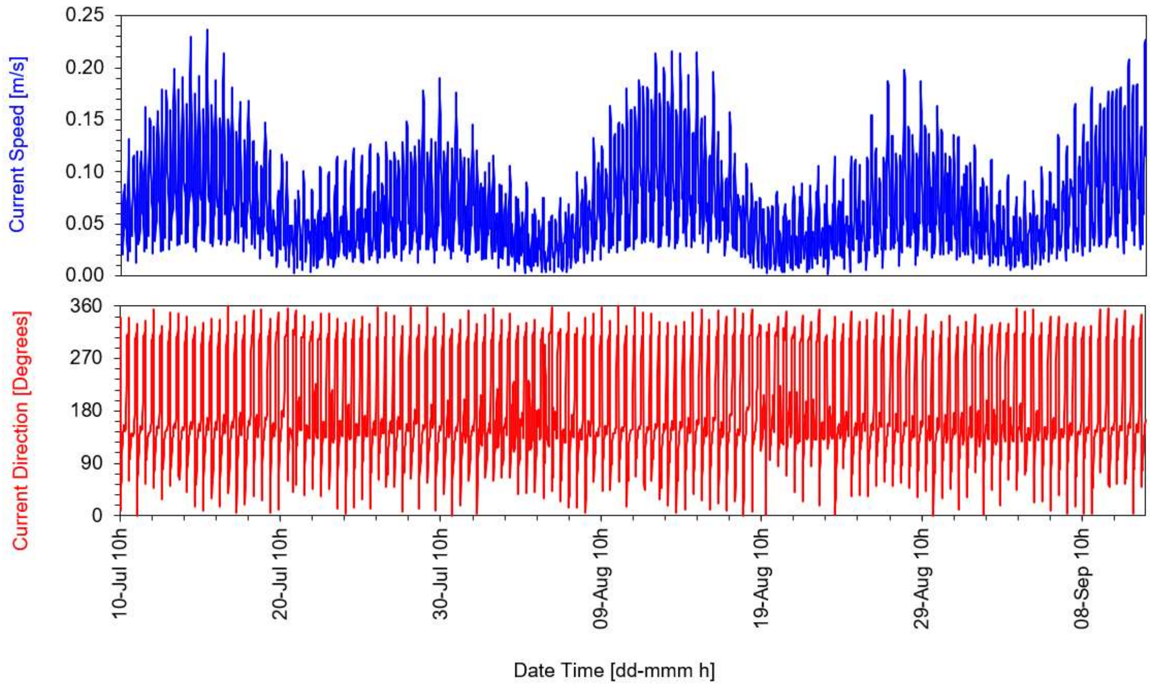


Figure 6.11 Pen-bottom time series plots for harmonic reproduction of speed and direction.

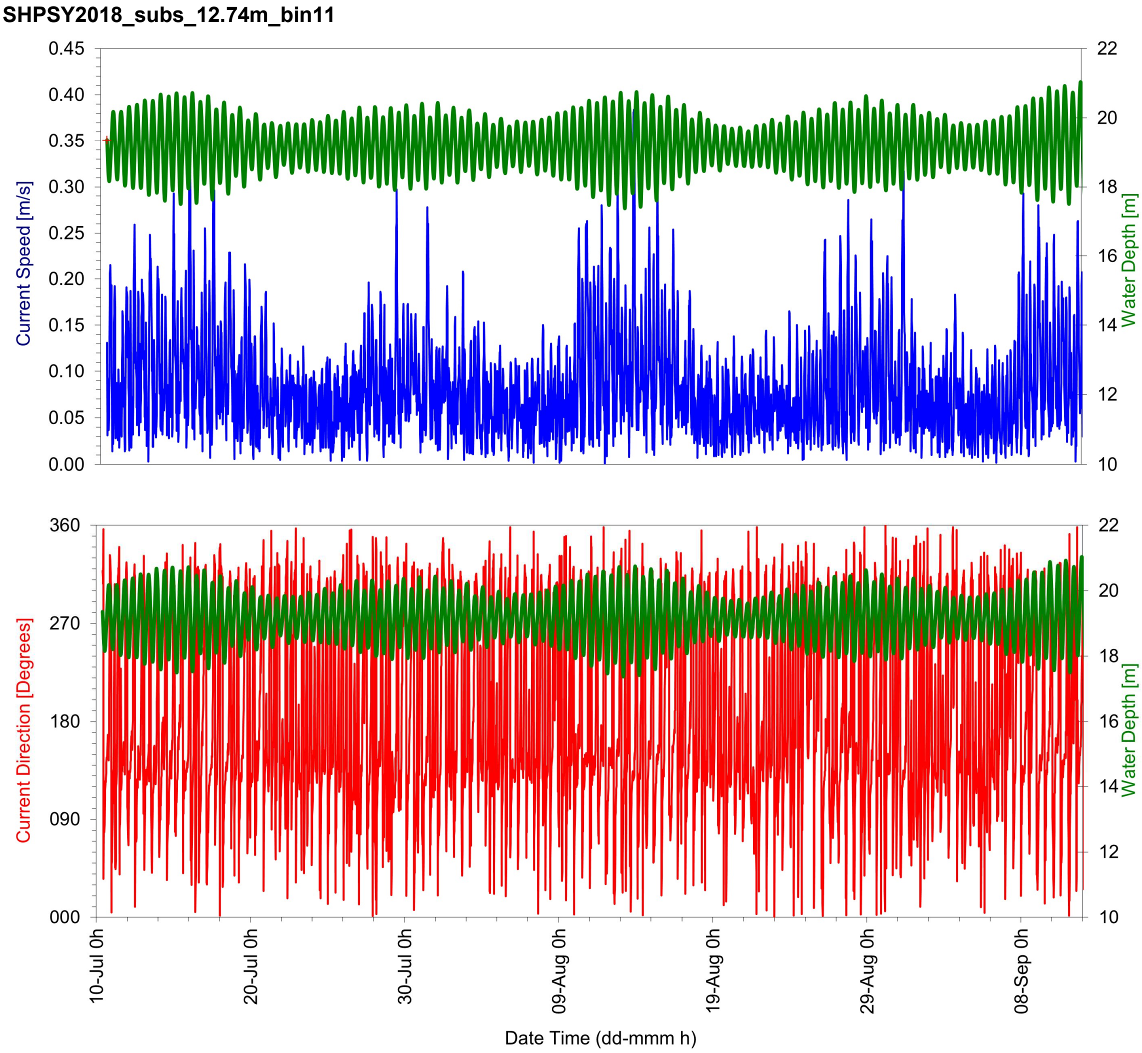


Figure 6.12 Sub-surface time series plots for current speed and direction against water level.

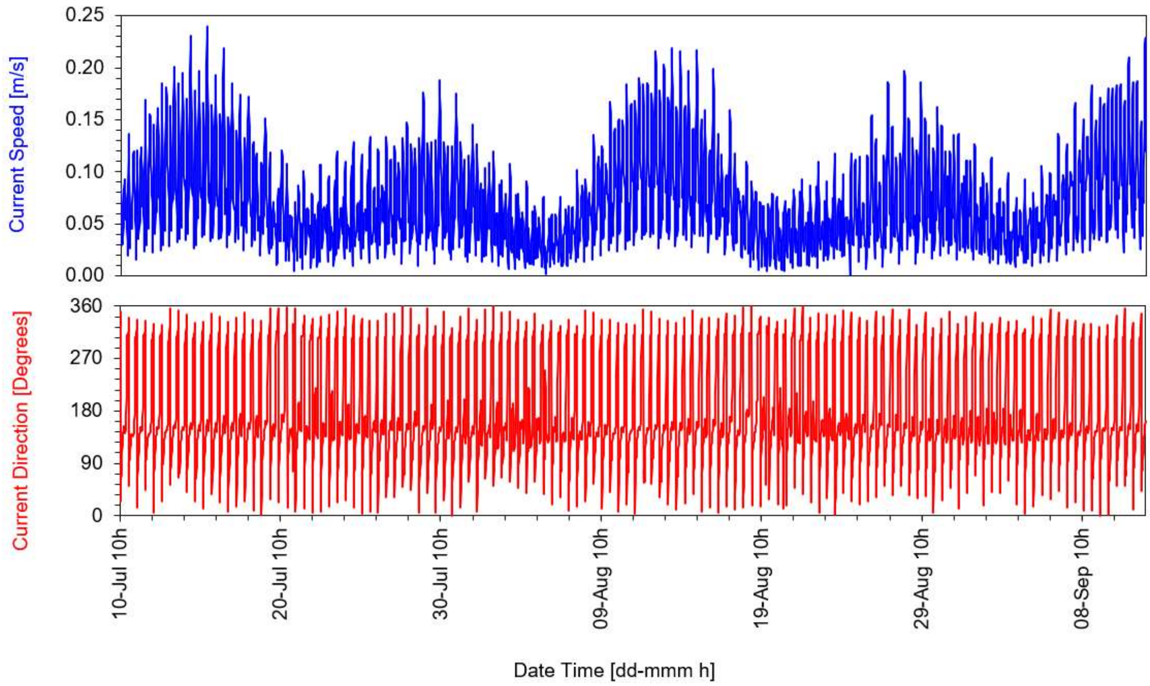


Figure 6.13 Sub-surface time series plots for harmonic reproduction of speed and direction.

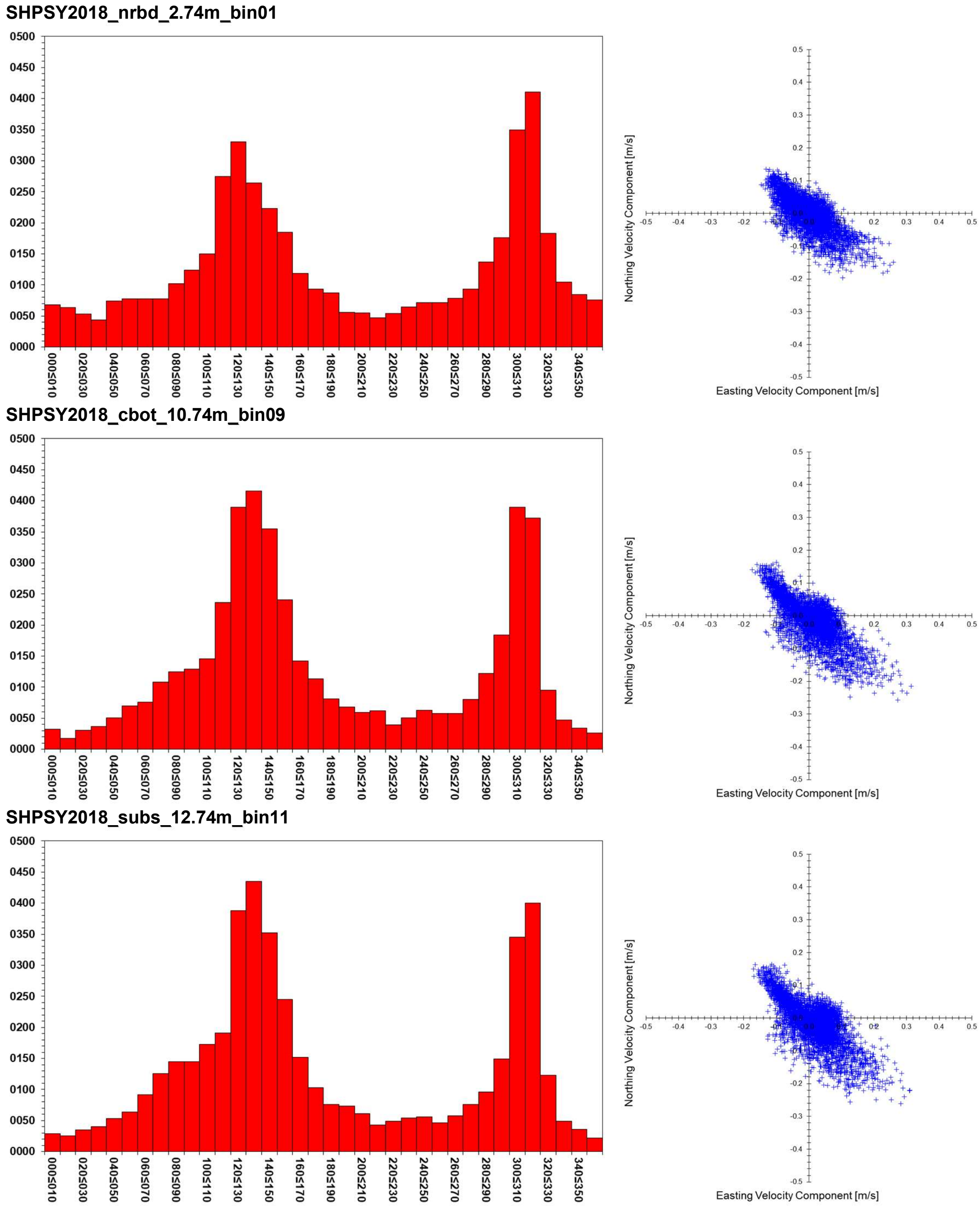


Figure 6.14 Current direction frequency plots and easting and northing velocity component scatter plots. From the top: Near-bed, pen-bottom and near-surface bins.

6.4 Summary

The data for the proposed site are indicative of a moderately flushed location with a dominant tidal signature. Currents are relatively homogenous and aligned along a WNW-ESE axis. Currents to the southeast are stronger and are associated with the early part of the flood tide. The weaker ebb tide has a more variable transport direction, swinging from ENE through north to NW and later back to S/SE before low water. The data are considered representative of conditions at the proposed pens and suitable for use in modelling. The magnitude of the near-seabed residual currents exceeds 35%

of the mean velocity requiring that NewDEPOMOD is forced with flowmetry where the residual current has been removed.

Similar conditions are seen west of the existing site in the 2018 deployment with slightly less energic conditions and a tidal axis closer to NW-SE than the proposed location. The duration of the deployment falls short of the 90-days required for the standard default modelling approach however the clear tidal signature at this location mitigates any impact of this. The predicted tidal range over 64 days is identical to that had the survey been 90 days long.

7. Equipment set-up parameters and specifications

Instrument configurations are detailed in Table 7.1 and manufacturers specifications are shown in Figures 7.1 and 7.2.

Table 7.1 ADCP configurations.

Deployment name	SHpN23	SHPSY
Instrument	Teledyne RDI Sentinel V50 ADCP	Teledyne RDI Workhorse Sentinel ADCP
Serial number	110	15234
Frequency (kHz)	492	614
First viable ensemble (no.)	12	134
Last viable ensemble (no.)	6850	4738
Bin size (m)	1.0	1.0
Blanking distance (m)	1.0	0.88
No. of bins	27	29
First bin range (m)	2.20	2.09
Ensemble interval (s)	1,200	1,200
Number of pings	320	400
Ping interval (s)	0.5	3.0
Ambiguity velocity (m s^{-1})	1.75	1.75
Bandwidth (%)	25	25
Theoretical standard deviation (m s^{-1})	0.0041	0.0035

		V20 (1000 kHz)		V50 (500 kHz)		V100 (300 kHz)	
Depth Cell Size[1]	Depth Cell Size[1]	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow	Range (m)[2,3] Wide/Narrow	Std Dev (cm/s)[3,4] Wide/Narrow
	0.25 m	18.0/22.6	19.2/36.5				
	0.3 m	19.3/24.0	11.1/20.8				
	0.5 m	20.2/24.9	11.1/20.8	44.1/57.6	19.2/36.5		
	1.0 m	22.1/26.9	3.6/6.7	50.5/64.6	7.1/13.5	94.5/120.6	10.9/20.6
	2.0 m	24.5/29.4	1.7/3.2	56.0/70.6	3.6/6.7	103.5/130.4	5.5/10.3
	4.0 m	26.9/32.0	0.8/1.6	63.1/78.2	1.7/3.2	114.6/142.3	2.7/5.2
	6.0 m			67.4/82.8	1.1/2.1	121.7/151.5	1.8/3.3
Self-Contained (SC) Commss and Recording	Wireless/Ethernet[7], Internal memory			802.11 b/g/n / TCPIP; One 16 GB micro SD card included			
Real-Time (RT) Communications	Serial/Ethernet[7]			RS422 / TCPIP (setup) UDP (output)			
Profile Parameters	Center Frequency			V20/V50: 0.3% of the water velocity relative to the ADCP ± 0.3 cm/s; V100: 0.5% of the water velocity relative to the ADCP ± 0.5 cm/s			
	Velocity resolution			0.1 cm/s			
	Velocity range			± 5m/s (default); ± 20m/s (maximum)			
	Ping rate			Up to 4 Hz (SC); Up to 16 Hz (RT)			
Echo Intensity Profile	Vertical resolution			Depth cell size			
	Dynamic range			80 dB			
	Precision			±1.5 dB			
Transducer and Hardware	Beam angle			25°			
	Configuration			4-beam, convex; 5th beam vertical			
	Depth rating			200 m			
	Materials			Transducer, housing, and end cap: plastic; Connector: metal shell			
Standard Sensors	Temperature (mounted on transducer)			Range -5° to 45°C, precision ± 0.4°C, resolution 0.1°			
	Compass (magneto-inductive sensor)			Accuracy 2° RMS, resolution 0.1°, max. dip angle 85°			
	Tilt (MEMS accelerometers)			Pitch range ± 90°, roll range ± 180°, accuracy 2° RMS, precision 0.05° RMS, resolution 0.1°			
	Pressure sensor (mounted on transducer)			Range 300m, accuracy 0.1% FS			
	Recorder			16GB Micro SD Card			

Figure 7.1 Teledyne RDI Sentinel V50 technical specifications.

		1200 kHz		600 kHz		300 kHz	
Water Profiling	Depth Cell Size[1]	Typical Range[2] 12 m		Typical Range[2] 50 m		Typical Range[2] 110 m	
	Vertical Resolution	Range[3]	Std. Dev.[4]	Range[3]	Std. Dev.[4]	Range[3]	Std. Dev.[4]
	0.25 m	11 m	14.0 cm/s				
	0.5 m	12 m	7.0 cm/s	38 m	14.0 cm/s	see note[1]	
	1 m	13 m	3.6 cm/s	42 m	7.0 cm/s	83 m	14.0 cm/s
	2 m	15 m[2]	1.8 cm/s	46 m	3.6 cm/s	93 m	7.0 cm/s
	4 m	see note[1]		51 m[2]	1.8 cm/s	103 m	3.6 cm/s
	8 m					116 m[2]	1.8 cm/s
Long Range Mode	2 m	19 m	3.4 cm/s				
	4 m			66 m	3.6 cm/s		
	8 m					154 m	3.7 cm/s
Profile Parameters	Velocity accuracy	0.3% of water velocity relative to ADCP ±0.3 cm/s		0.3% of water velocity relative to ADCP ±0.3 cm/s		0.5% of water velocity relative to ADCP ±0.5 cm/s	
	Velocity resolution	0.1 cm/s		0.1 cm/s		0.1 cm/s	
	Velocity range	±5 m/s default, ±20 m/s max		±5 m/s default, ±20 m/s max		±5 m/s default, ±20 m/s max	
	Number of depth cells	1–255		1–255		1–255	
	Ping rate	Typical 4 Hz, Max. 10 Hz		Typical 2 Hz, Max. 10 Hz		Typical 1 Hz, Max. 10 Hz	
Echo Intensity Profile	Vertical resolution	Depth cell size, user configurable					
	Dynamic range	80 dB					
	Precision	±1.5 dB					
Transducer and Hardware	Beam angle	20°					
	Configuration	4-beam, convex					
	Internal memory	Two PCMCIA card slots; one memory card included					
	Communications	RS-232 or RS-422; ASCII or binary output at 1200-115,200 baud					
Standard Sensors	Temperature (mounted on transducer)	Range -5° to 45°C, Precision ±0.4°C, Resolution 0.01°					
	Tilt	Range ±15°, Accuracy ±0.5°, Precision ±0.5°, Resolution 0.01°					
	Compass (fluxgate type, includes built-in field calibration feature)	Accuracy ±2°[5], Precision ±0.5°[5], Resolution 0.01°, Maximum tilt ±15°					

Figure 7.2 Teledyne RDI Workhorse Sentinel technical specifications.

8. List of data files

SHpN23	
Raw current meter data	*SHpN23.pd0*
Processed data, *Velocity* format	*SHpN23.averaged.pdv*
Raw current meter data ASCII exports, compiled	*SHpN23_ADCP_Extracts.xlsx*
Processed HG data and summary statistics.	*CurrentMeterData_SHpN23_Surface2023_90d.xlsx* *CurrentMeterData_SHpN23_Middle2023_90d.xlsx* *CurrentMeterData_SHpN23_Bottom2023_90d.xlsx*
SEPA HG Data Analysis workbooks	*SHpN23_NS14_HGdata_analysis_v7.xls* *SHpN23_CB11_HGdata_analysis_v7.xls* *SHpN23_NB01_HGdata_analysis_v7.xls*
SHPSY	
Raw current meter data	*SHPSY000.000*
Processed data, *Velocity* format	*SHPSY000.000.pdv*
Raw current meter data ASCII exports, compiled	*SHPSY_ADCP_Extracts.xlsx*
Processed HG data and summary statistics.	*CurrentMeterData_SHPSY_Surface2018.xlsx* *CurrentMeterData_SHPSY_Middle2018.xlsx* *CurrentMeterData_SHPSY_Bottom2018.xlsx*
SEPA HG Data Analysis workbooks	*SHPSY_NS11_HGdata_analysis_v7.xls* *SHPSY_CB09_HGdata_analysis_v7.xls* *SHPSY_NB01_HGdata_analysis_v7.xls*

9. References

SEPA (2019a). Regulatory Modelling Process and Reporting for the Aquaculture Sector. Version 1.1.

SEPA (2019b). Regulatory Modelling Guidance for the Aquaculture Sector. Version 1.1.

SEPA (2022). Hydrographic Data for Aquaculture Applications.

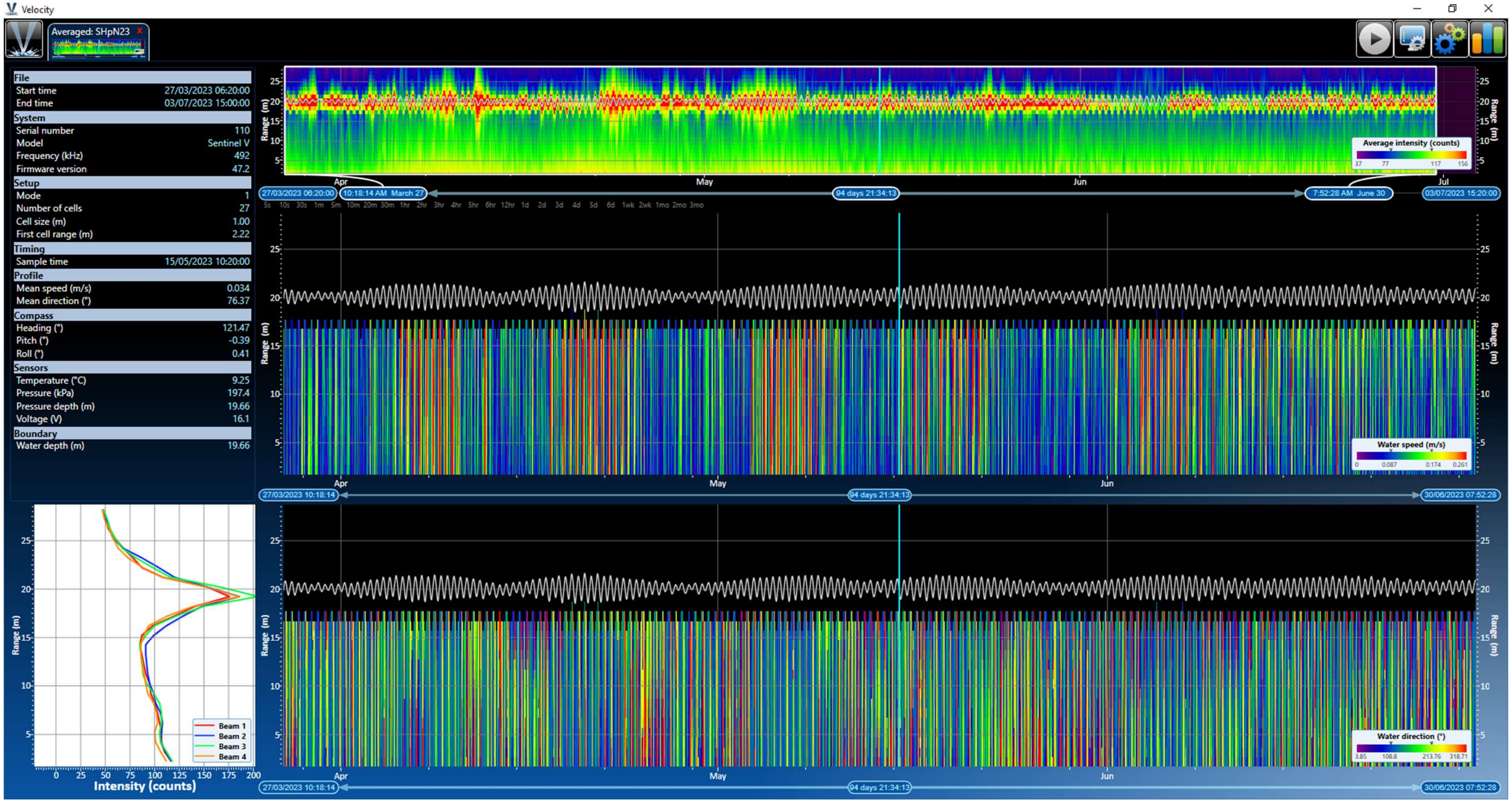
SEPA (2023). NewDepomod Draft Guidance. 14 April 2023.

UKHO (2020). Admiralty Marine Data Portal, Bathymetry Data Service. Available online: https://datahub.admiralty.co.uk/. (Accessed: 09/06/2022).

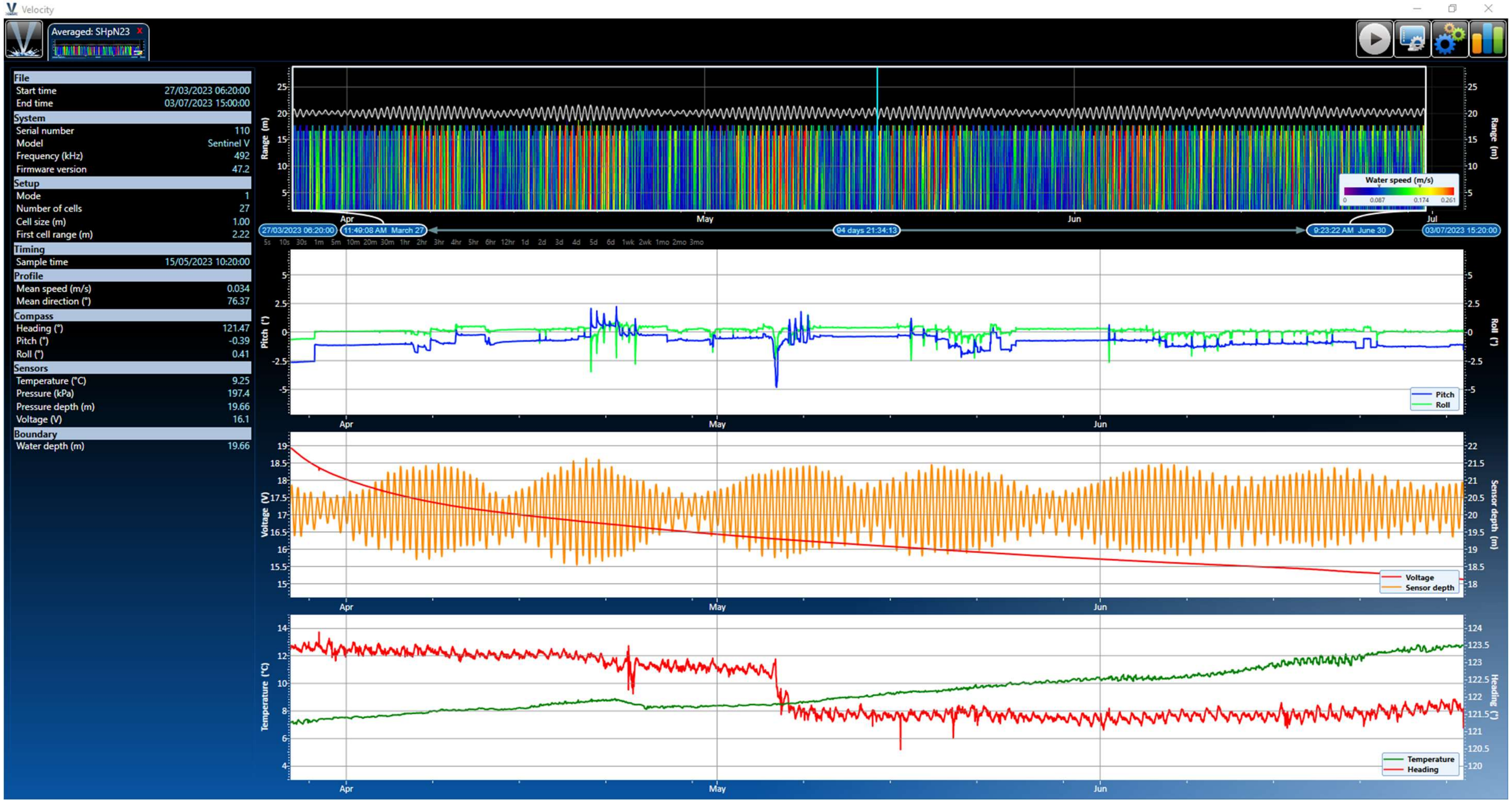
British Geological Survey (BGS) (2023). World Magnetic Model (WMM) 2020 Calculator. Available online: http://www.geomag.bgs.ac.uk/data_service/models_compass/wmm_calc.html. (Accessed: 05/07/2023).

10. Appendices

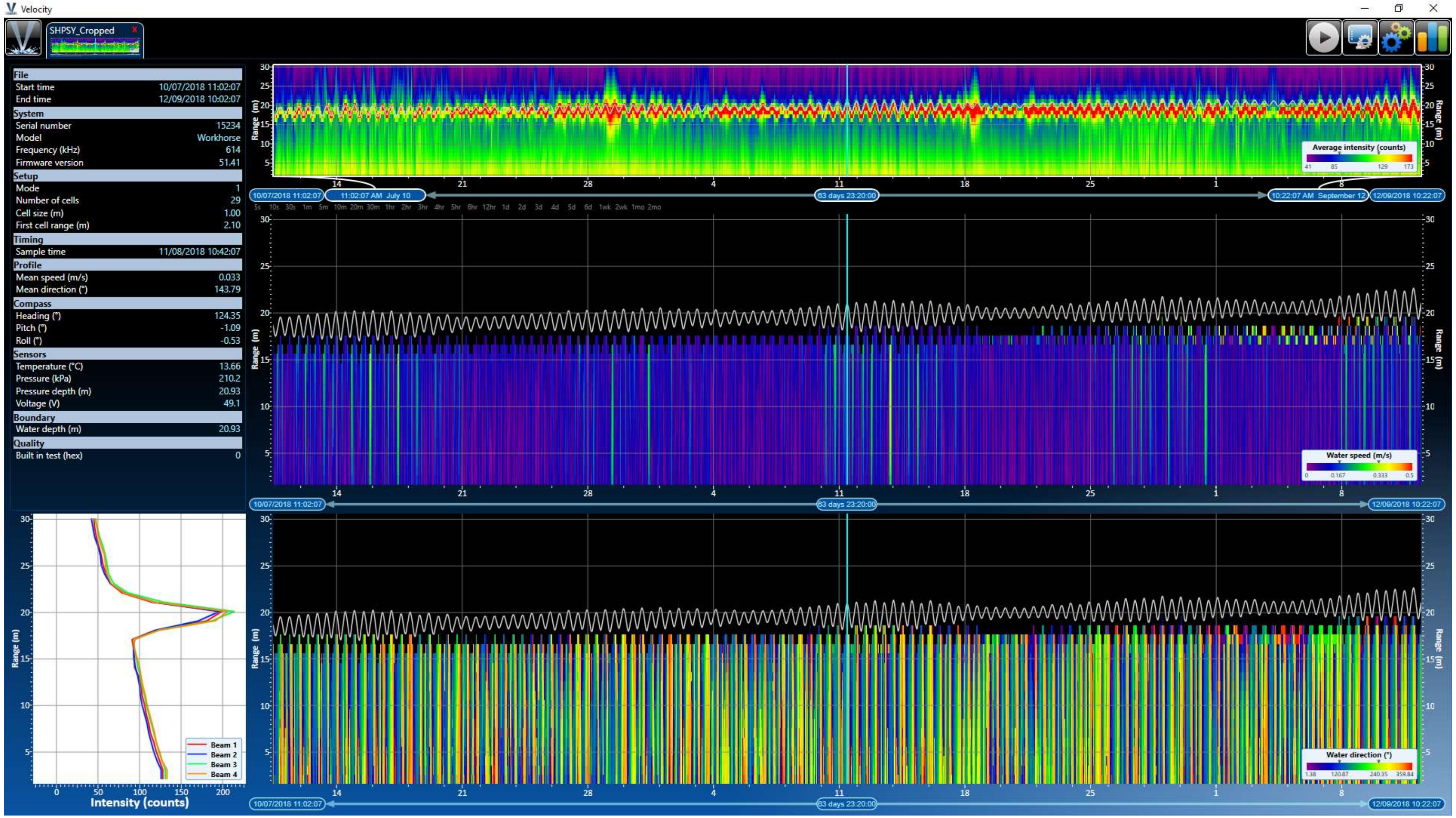
Appendix A Screenshot of *SHpN23.averaged.pdv* from Teledyne's *Velocity* data processing software.



Appendix B Plots of SHpN23 heading, pitch, roll, sensor depth, temperature and current velocity captured from *Velocity* data processing software.



Appendix C Screenshot of *SHPSY000.000.pdv* from Teledyne's *Velocity* data processing software.



Appendix D Plots of SHPSY heading, pitch, roll, sensor depth, temperature and current velocity captured from *Velocity* data processing software.