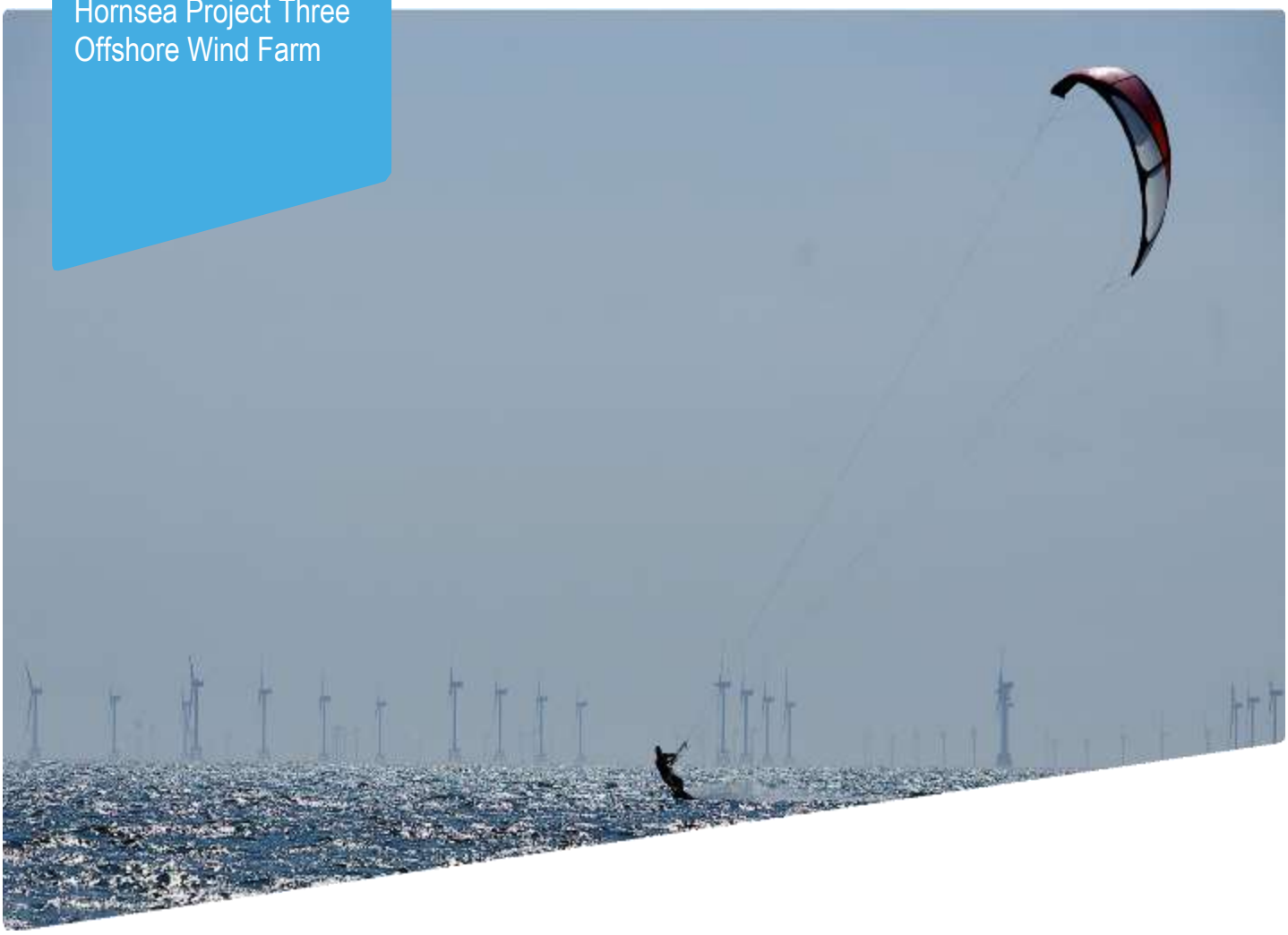
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Appendix 8 to Deadline 2 Submission – Race Bank Sandwave Recovery Report

Date: 21st November 2018

Hornsea 3
Offshore Wind Farm

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Front cover picture: Kite surfer near a UK offshore wind farm © Ørsted Hornsea Project Three (UK) Ltd., 2018.

POST-CONSTRUCTION BATHYMETRIC SURVEYS
UNITED KINGDOM EAST

RACE BANK OFFSHORE WINDFARM
(ROW01)

SANDWAVE RECOVERY REPORT

INTERPRETIVE REPORT

Ørsted

Document: P3407_UKE_INT_SRR_REP_ROW01_181008_R02

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Client details	Ørsted UK Ltd. 5 Howick Place London SW1P 1WG +44 20 78115200 info@orsted.com	
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R00	24-09-2018	Issue for Clients approval	SBY	ALA
R01	02-10-2018	Revised version	SBY	ALA
R02	08-10-2018	Revised version	SBY	ALA

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EXECUTIVE SUMMARY

Introduction			
Deep BV has been contracted by Ørsted Energy to conduct post-construction bathymetrical surveys at the Race Bank (ROW01) Offshore Wind Farm (OWF) in the North Sea, United Kingdom. The surveys were performed in June and July 2018. Survey 3c, Sandwave Recovery Analysis: This data analysis covered 9 study areas (7 array cables routes, 2 areas along export cable routes). The objective of this study was to analyse seabed dynamics and morphology prior, during and after construction to estimate restoration of seabed morphology.			
Executing party	All reporting has been performed by Deep BV.		
Scope of work	• Data preparation and analysis • Processing and reporting		
Horizontal and vertical reference	Datum: ETRS89 Projection: UTM 31 North Vertical reference: LAT (m) (VORF model)		
Survey 3c, Sandwave Recovery Analysis	7 array cables, 2 sections along export cables	9	Corridor: 50 m total width

Sandwave Recovery Report
The bathymetric data of the ROW01 OWF that was acquired in 2018 was compared with bathymetric data from 2016/2017 (after trenching) and with bathymetric data from 2015 (prior to construction). It was found that along most of the 9 study areas, the seabed has completely or nearly completely recovered to pre-construction levels (>75% recovery in all areas).

CONTENT

FIGURES

TABLES

COMMON ABBREVIATIONS

AC	Alter Course
AEZ	Archaeological Exclusion Zone
AIS	Automatic Identification System (automatic tracking system)
AHT	Anchor Handling Tug
AIS	Automatic Identification System
BGS	British Geological Survey
BV	Besloten Vennootschap (Dutch equivalent to Ltd.)
CD	Chart Datum
CE	Conformité Européenne
CMG	Course Made Good
C-O	Computed-Observed
CoG	Centre of Gravity
CPT	Cone Penetration Test
CRP	Coordinate Reference Point
dGPS	Differential Global Positioning System
DoB	Depth of Burial
DoC	Depth of Cover
DP	Dynamic Positioning
DPR	Daily Progress Report
DTM	Digital Terrain Model
EEZ	Economic Exclusive Zone
ENFC	Emergency Notification Flowchart
EPIRB	Emergency Position Indicating Radio Beacon
ETRS	European Terrestrial Reference System
FGDB	File GeoDataBase
FM	Formation (used in a litho-stratigraphic system)
GLONASS	(Russian) Global Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRS	Geodetic Reference System
GPR	Ground Penetrating Radar
HNM	Height Not Measured
HSE	Health, Safety and Environment
HSEQ	Health, Safety, Environment and Quality
HVDC	High Voltage Direct Current
IMO	International Maritime Organization
IOGP	International association of Oil & Gas Producers
ITRF	International Terrestrial Reference Frame
KP	Kilometre Post (Stationing in km)
LAT	Lowest Astronomical Tide
MAG	Magnetometer
MEDIN	Marine Environmental Data & Information Network
MBES	Multibeam Echosounder
MCS	Multi Channel Sparker
MOB	Man Over Board
MRU	Motion Reference Unit
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
MV	Motor Vessel
MW	Mega Watt
NOGEPA	Nederlandse Olie en Gas Exploratie en Productie Associatie
nT	nanoTesla

OD	Ordnance Datum
OOS	Out Of Service (Cable)
OPITO	Offshore Petroleum Industry Training Organization
OSS	Offshore Sub Station
OWF	Offshore Wind Farm
PEP	Project Execution Plan
PLB	Personal Locator Beacon
PPE	Personal Protective Equipment
PPS	Pulse Per Second
PQP	Project Quality Plan
PS	Portside
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
RAMS	Risk Assessed Method Statement
RFC	Request For Change
RHIB	Rigid-Hulled Inflatable Boat
RMS	Root Mean Square
RTK	Real Time Kinematic
ROV	Remote Operated Vehicle
ROTV	Remote Operated Towed Vehicle
RPL	Route Position List
SB	Starboard Side
SBE	Single Beam Echosounder
SBP	Sub-bottom Profiler
SD	Standard Deviation
SCS	Single Channel Sparker
SIT	Surrogate Item Trial
SMP	Safety Management Plan
SNR	Signal to Noise Ratio
SoG	Speed Over Ground
SOLAS	Safety Of Life At Sea
SOPEP	Shipboard Oil Pollution Emergency Plans
SRF	Ships Reference Frame
SSDM	Seabed Survey Data Model
SSS	Side Scan Sonar
SVP	Sound Velocity Probe
THU	Total Horizontal Uncertainty
TVU	Total Vertical Uncertainty
TW	Territorial Waters
TWTT	Two Way Travel Time
UAV	Unmanned Airborne Vehicle
UHF	Ultra High Frequency
UKHP	United Kingdom Hydrographic Office
USBL	Ultra-Short Baseline underwater positioning
UTM	Universal Transverse Mercator
UXO	UneXploded Ordnance
VHF	Very High Frequency
VORF	Vertical Offshore Reference Frame
WFS	Wind Farm Site
WFZ	Wind Farm Zone
WGS	World Geodetic System
WoW	Waiting on Weather
WTG	Wind Turbine Generator

1 REFERENCE DOCUMENTS

Document	Version	Status
Deep QMS (ISO 9001:2008, OHSAS 18001:2007)	08-06-2018	3.11
Deep HSE manual	27-10-2017	2.5
Planning management plan Q6011/08/A	14-02-2018	R00
P3407_PEP_R01	30-05-2018	R01
DEEP VOLANS SMP R11	28-05-2018	R11
Quality Management Plan_R00	14-02-2018	R00
DEEP BoQ East Coast	07-03-2018	R00
Q6011_UK EAST COAST_Submittal Note	21-02-2018	R00
P3407_UKE_MOB_REP_VOLANS_180810_R01	10-08-2018	R01

Table 1-1: Reference Documents

2 INTRODUCTION

ØRSTED Energy awarded Deep BV the contract for the execution of the summer 2018 post-construction surveys at Race Bank (ROW01) Offshore Wind Farms (OWF). The survey areas are located the North Sea with landfalls on the East coast of England near King's Lynn.

2.1 Study objectives

The objective of this report is to analyse the level of disturbance and rate of natural recovery of the seabed morphology during and after trenching activities for the construction of export and array cables for the ROW01 OWF. The study incorporated analysing seabed dynamics from historic (2015, 2016 (along array cables) and 2017 (along export cables)) and recent MBES data (summer 2018) in specific areas where large sediment mobility is expected.

2.2 Project key plan

ROW01 is a 573MW wind farm with a total of 91 turbines, located 27km north of Blakeney Point off the coast of Norfolk. Water depths are ranging from +3m to -41 m LAT. The licence with the Marine Management Organisation (MMO) requires regular surveys of a selection of the wind turbine generators (WTGs) and array cables, as well as the entire export cable routes. For an overview map, see Figure 2-1.

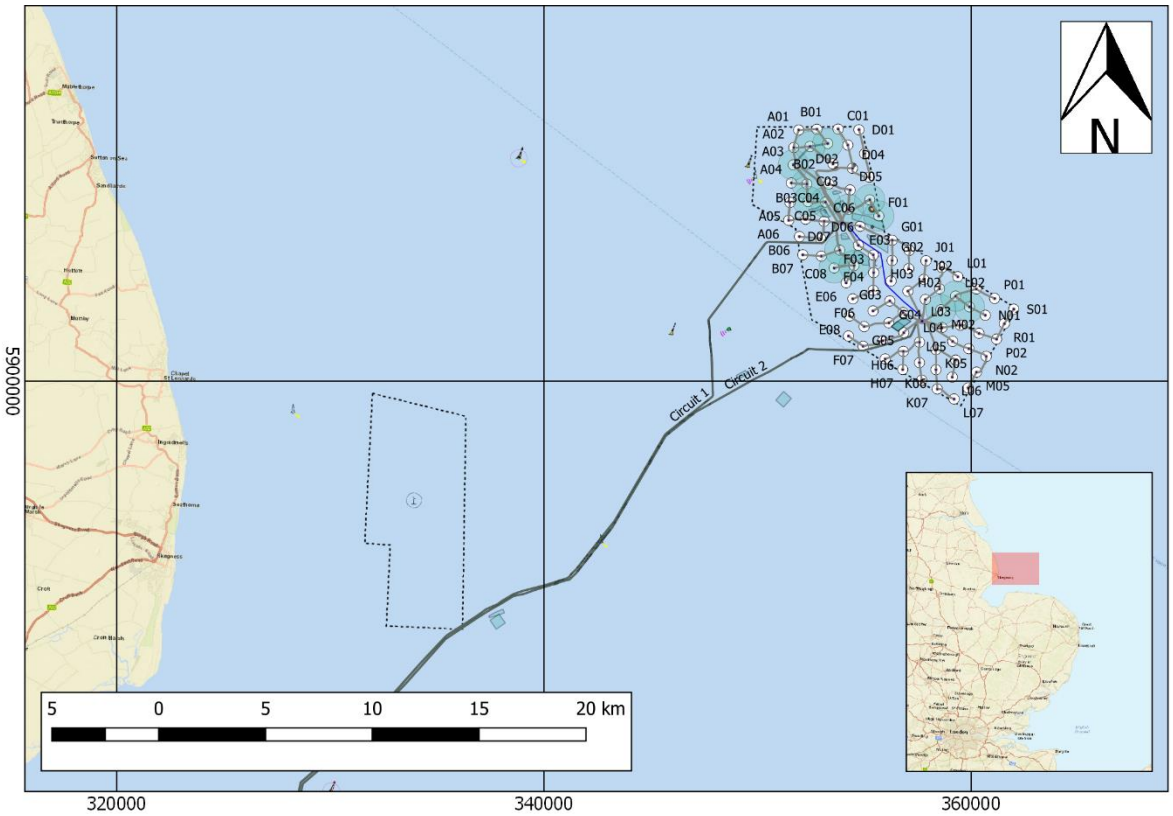


Figure 2-1: Overview chart of the ROW01 OWF.

2.3 Study areas

This document describes the analysis of bathymetric data of seabed morphology in specific parts of the ROW01 OWF and sections of the export cables. The study areas have been selected from areas where dredging occurred in order to make a site representative assessment of sand wave recovery over different parts of the ROW01 OWF; site and export cable routes (nearshore and offshore areas). The following areas are investigated:

Array cables:

- Z01 – C05
- C05 – B04
- B04 – B03
- B03 – A03
- Z01 – D06
- D06 – D05
- D05 – C04

Export cables (dredge areas):

- Along export cables Circuit 1 & Circuit 2 between KP 49.500 and KP 50.500
- Along export cable Circuit 2 between KP 16.200 and KP 17.200

An overview map of the study areas is given in Figure 2-2 and Figure 2-3.

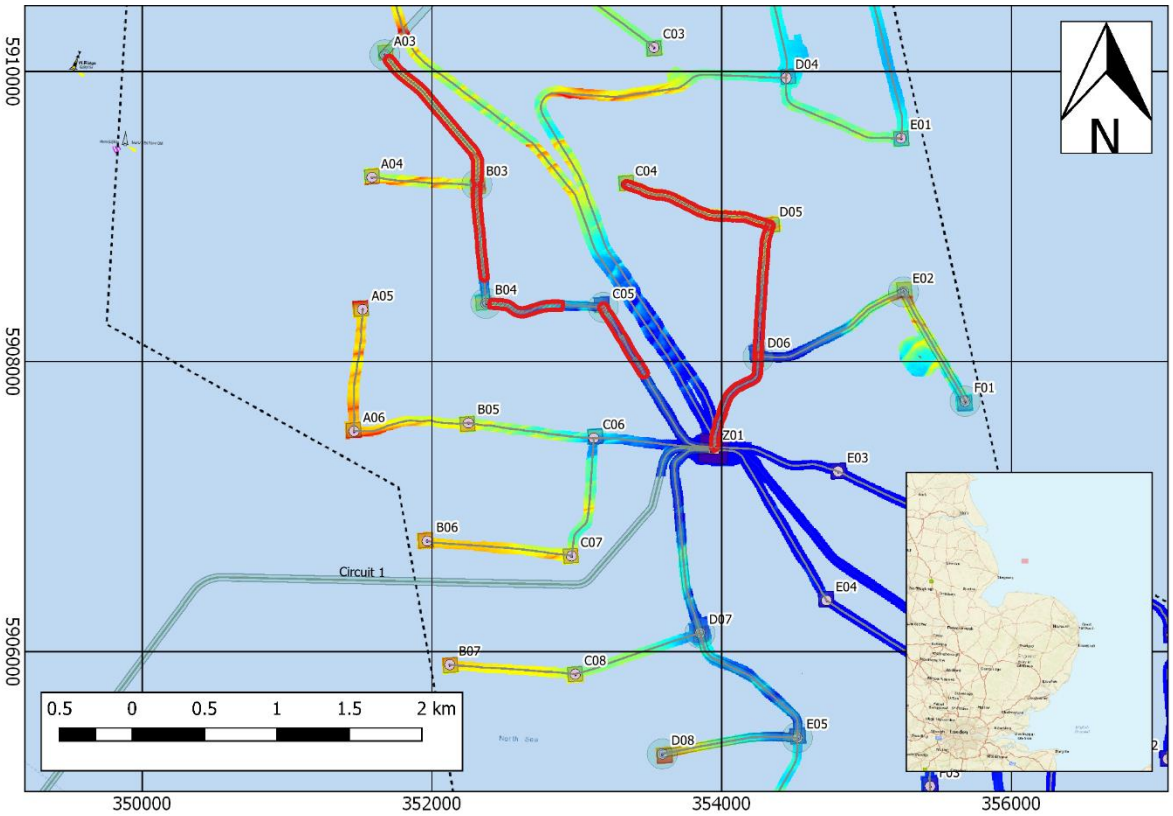


Figure 2-2: Overview chart of the sandwave recovery analysis areas along array cables in ROW01 OWF (indicated in red).

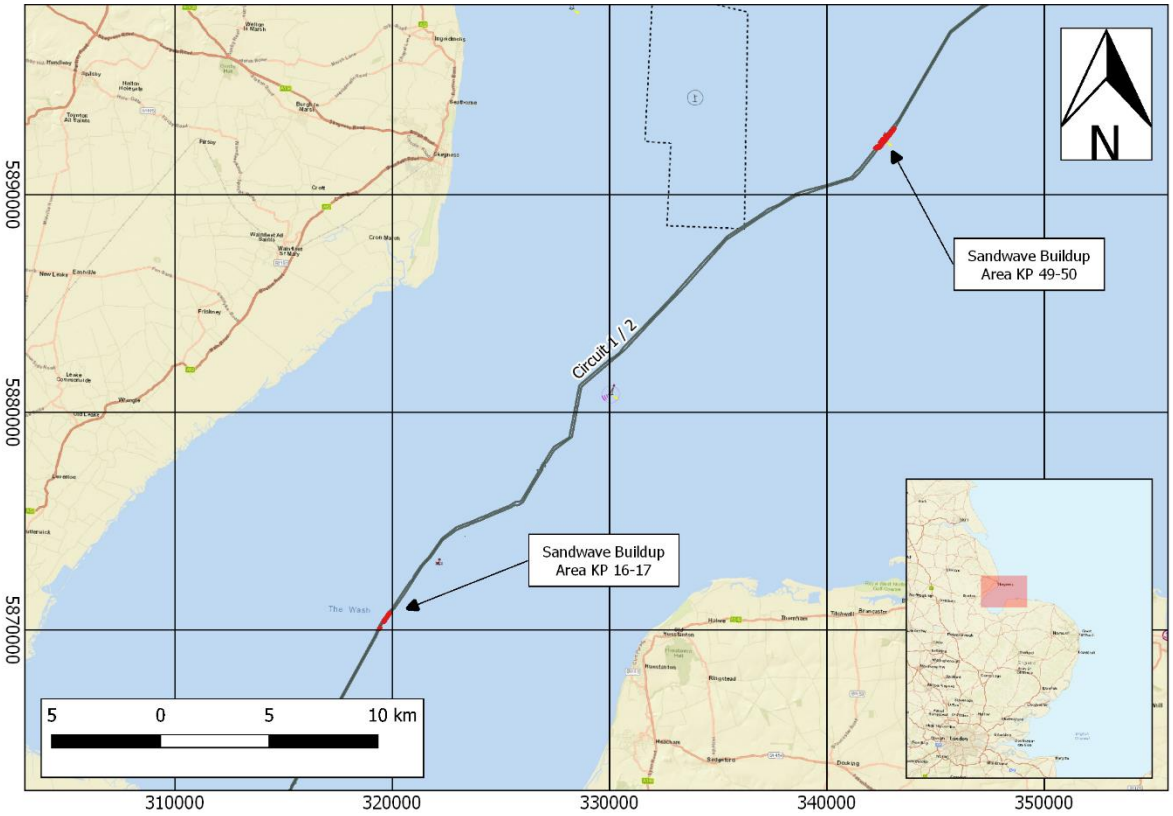


Figure 2-3: Overview chart of the sandwave recovery analysis areas along parts of the export cables. (indicated in red).

3 QUALITY

All data acquisition and processing has been executed in compliance with Deep BV's Quality Management System (QMS) which is NEN-EN-ISO 9001:2008 and OHSAS 18001:2007 certified.

3.1 Positioning

The primary positioning system used on board provided reliable positioning throughout the duration of the project. In some occasions, poor GPRS/4G internet reception resulted in dropping out of receiving GNSS corrections. In these cases the online survey software automatically switched over to the secondary positioning system. Online, comparisons between the primary and the secondary positioning systems have been monitored continuously.

3.2 Bathymetric data

The quality of the recorded data has been monitored continuously throughout the project. Measurements not meeting IHO standards or required THU / TVU values were automatically discarded, resulting in only recording measurements meeting the data quality requirements. Survey coverage of the complete survey areas have been achieved (50 hits per 1 m^2 cell).

All data meet IHO S-44 Special order standard. Further accuracy requirements are defined below;
TVU (Total Vertical Uncertainty) for all processed beams/final data (2-sigma, 95%):
0.15 m (2-sigma, 95%) or better down to 20 m water depths;
0.20 m (2-sigma, 95%) or better from 20 m to 40 m water depths;
0.25 m (2-sigma, 95%) or better below 40 m water depths.

THU (Total Horizontal Uncertainty) for all processed beams/final data (2-sigma, 95%) not to exceed 0.5 m + 2% of the water depth for all processed beams/final data.

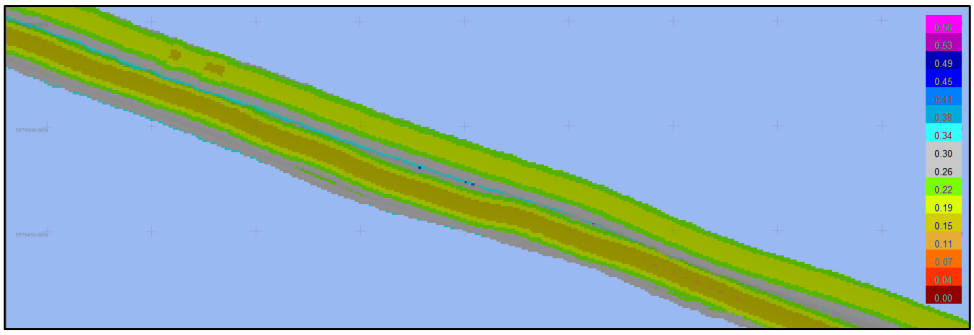


Figure 3-1: Example of grid showing THU values, colour scale set to 0.60m.

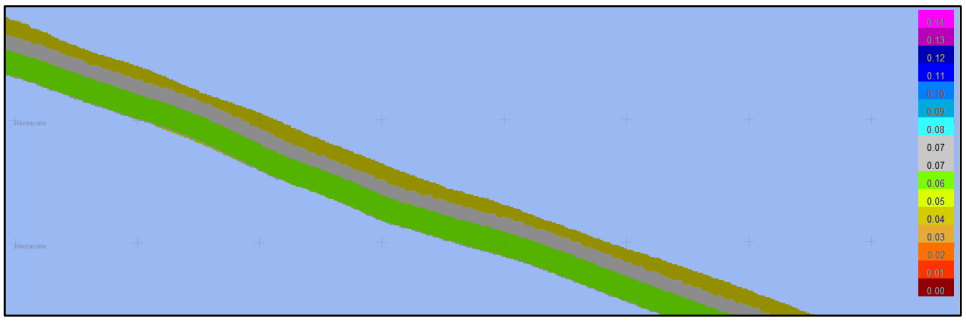


Figure 3-2: Example of grid showing TVU values, colour scale set to 0.15m max.

THU & TVU grids of the data are included in the digital data delivery.

3.3 Height differences

In some parts of the survey area it appears a height offset with data from previous surveys was observed. This height offset might be ascribed to a slight error in height correction from the RTK systems during survey. As it is impossible to say whether this error occurred during this or previous surveys, the offset has not been corrected. After careful studying the offsets between surveys, it was concluded the 2017 survey of array cable routes has shown to be most inconsistent with regards to height consistency.
In locations where a constant offset is visible between data from the 2018 and previous surveys, a remark is provided.

3.4 Sandwave recovery charts

Accompanying this report are a total of 11 charts; 4 covering the export cable routes, 7 covering the array cable routes. These charts are created specifically for the purpose of this report.

The charts contain 4 panels (from top to bottom):

PANEL 1: Bathymetry – Post-construction survey 2018

This panel shows the latest bathymetry in shaded relief colours. From the information within this panel it is possible to determine if there are any trenches left along the routes, as well as an indication of sand dune mobility and recovery.

PANEL 2: Difference – As-trenched survey 2016/2017 versus pre-construction survey 2015

This panel shows a difference model between as-trenched and pre-construction phases. A specific difference colour scale was chosen to visually emphasise any changes in bathymetry and is defined as follows:

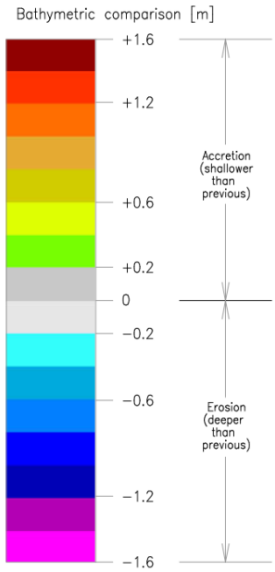
	The colours within this range (from 0 to ≥ 1.6m) indicate accretion (shallowing) compared to older reference data. Every colour step is 20cm difference. In general, grey is no or minor changes. Towards red signifies seabed build-up.
	The colours within this range (from 0 to ≥ 1.6m) indicate erosion (deepening) compared to older reference data. Every colour step is 20cm difference. In general, grey is no or minor changes. Towards blue/magenta signifies seabed erosion.

Table 3-1: Difference model colour map

From this difference model, a trench can be recognised as a blue or magenta area, see example below:

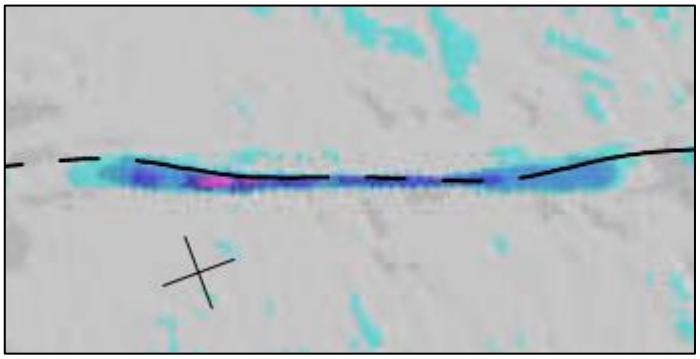


Figure 3-3: Trench example (as-trenched VS pre-construction)

PANEL 3: Difference – Post-construction survey 2018 versus As-trenched survey 2016/2017

This panel shows a difference model between post-construction and as-trenched phases, using the same difference colour map as panel 2.

This difference model will show build-up or erosion since trenching. If the example above is taken for reference purposes, the same area should show a seabed build-up (green/yellow/red) in the same place as the trench was:

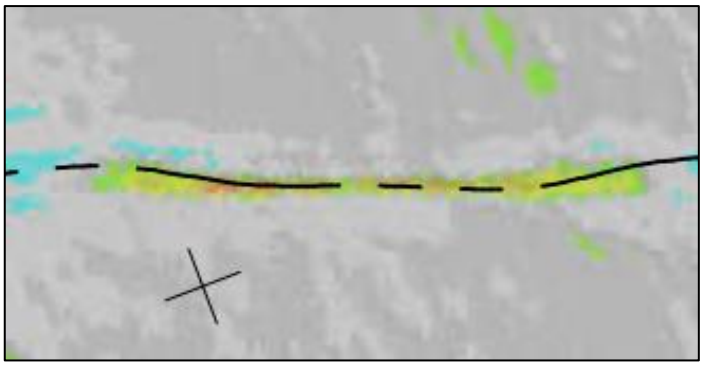


Figure 3-4: Trench example (post-construction VS as-trenched)

This is indeed the case.

PANEL 4: Longitudinal profiles

This panel shows the longitudinal profiles of all phases along the cable route. The vertical scale is 40x exaggerated.

- The black line is the post-construction survey 2018 profile;
- The blue line is the pre-contruction survey 2015 profile;
- The green line is the as-trenched survey 2016/2017 profile

This panel will instantly show the differences between all phases in more detail, but only along the cable route. To see the overall differences, panels 2 and 3 should be used.

4 RESULTS

The profile plots in this chapter have been generated to provide a simple reference to the text. Therefore, the colour schemes used do not exactly match the colour scheme of the official charts. In each profile plot a legend is provided for reference.
The plan view plots in this chapter are to be used for visual comparison. The plan views of different years, but same study area can appear very different, due to differing survey coverage. Even though different zoom levels would improve visibility, it was decided to keep the plan view extents from different years the same.

4.1 Array cables

4.1.1 Z01-D06

Array cable Z01-D06 is located in the northern part of the OWF, cable is running from S to N. In 2015, one clear sand wave with general SW-NE strike was visible at KP 0.140, with height of ~1.5 m. After trenching in 2016 a clear flattening of the seabed was observed, with a depression visible at the former location of the sand wave. In 2018, the sand wave was restored to ~1.5 m height and with a N-wards migration ~20 m (Figure 4-3). Further along the array cable, the seabed has restored to its former state (Figure 4-1 & Figure 4-2).

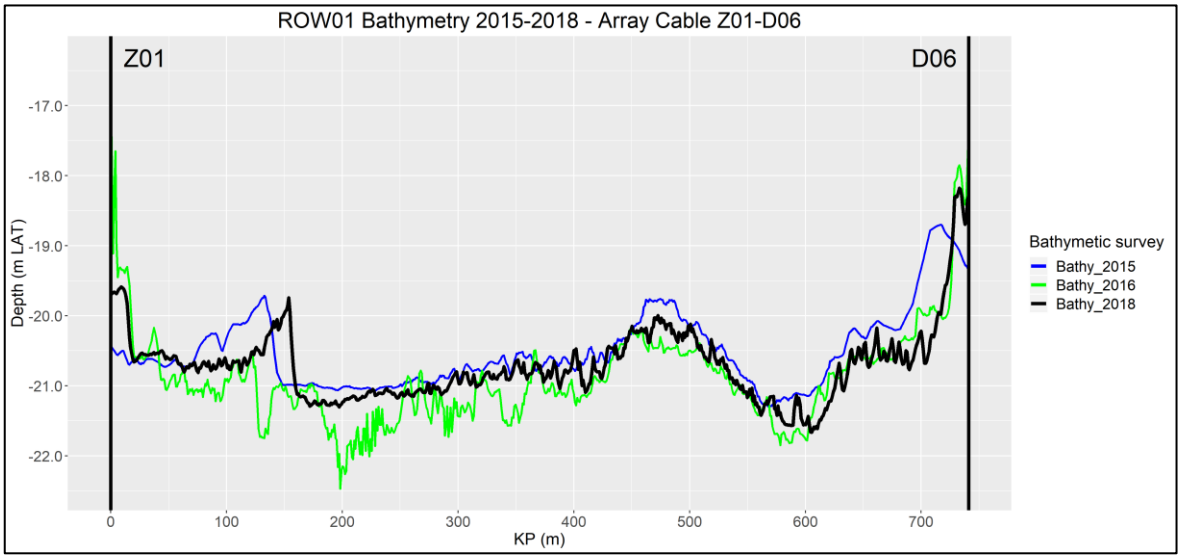
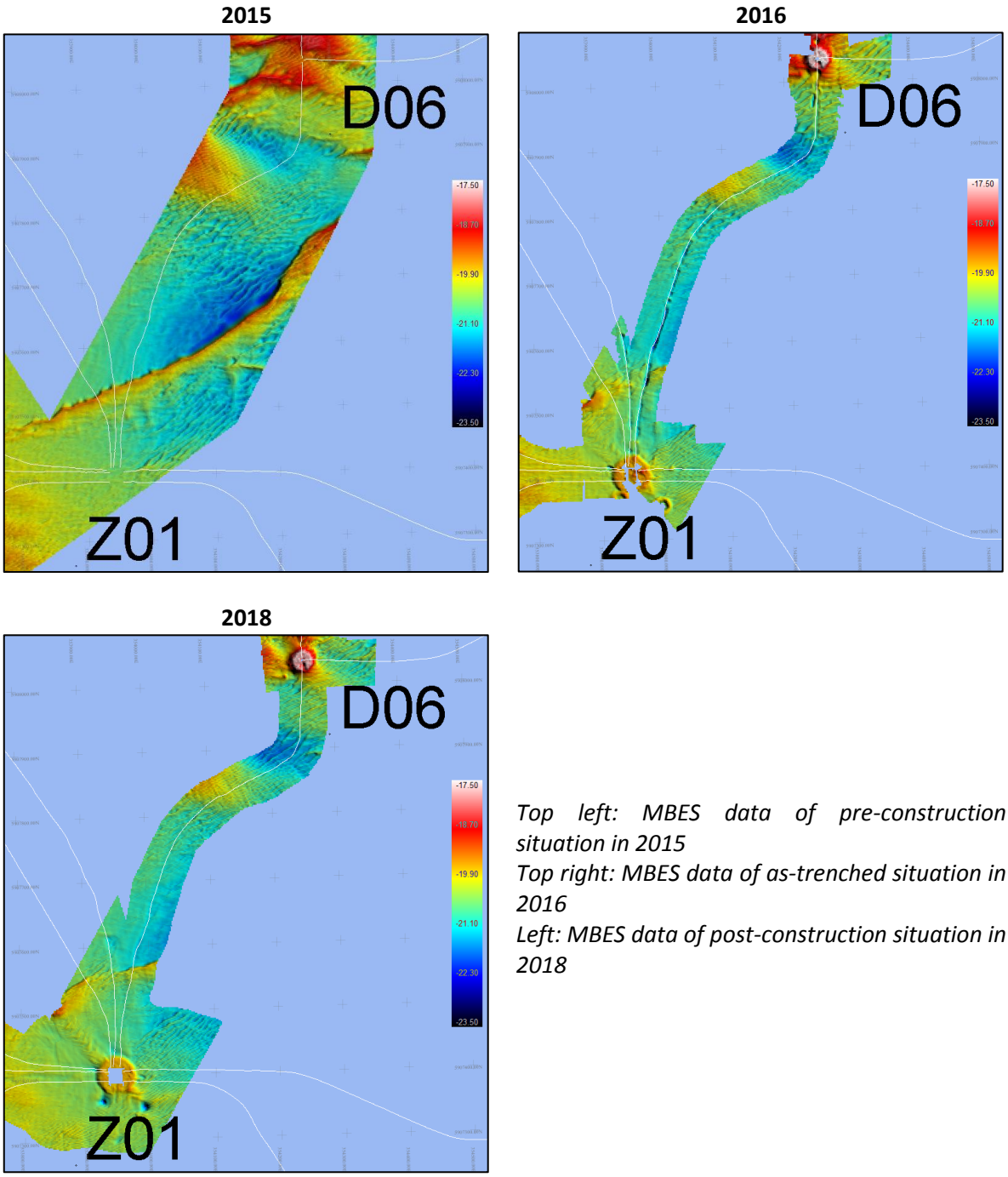
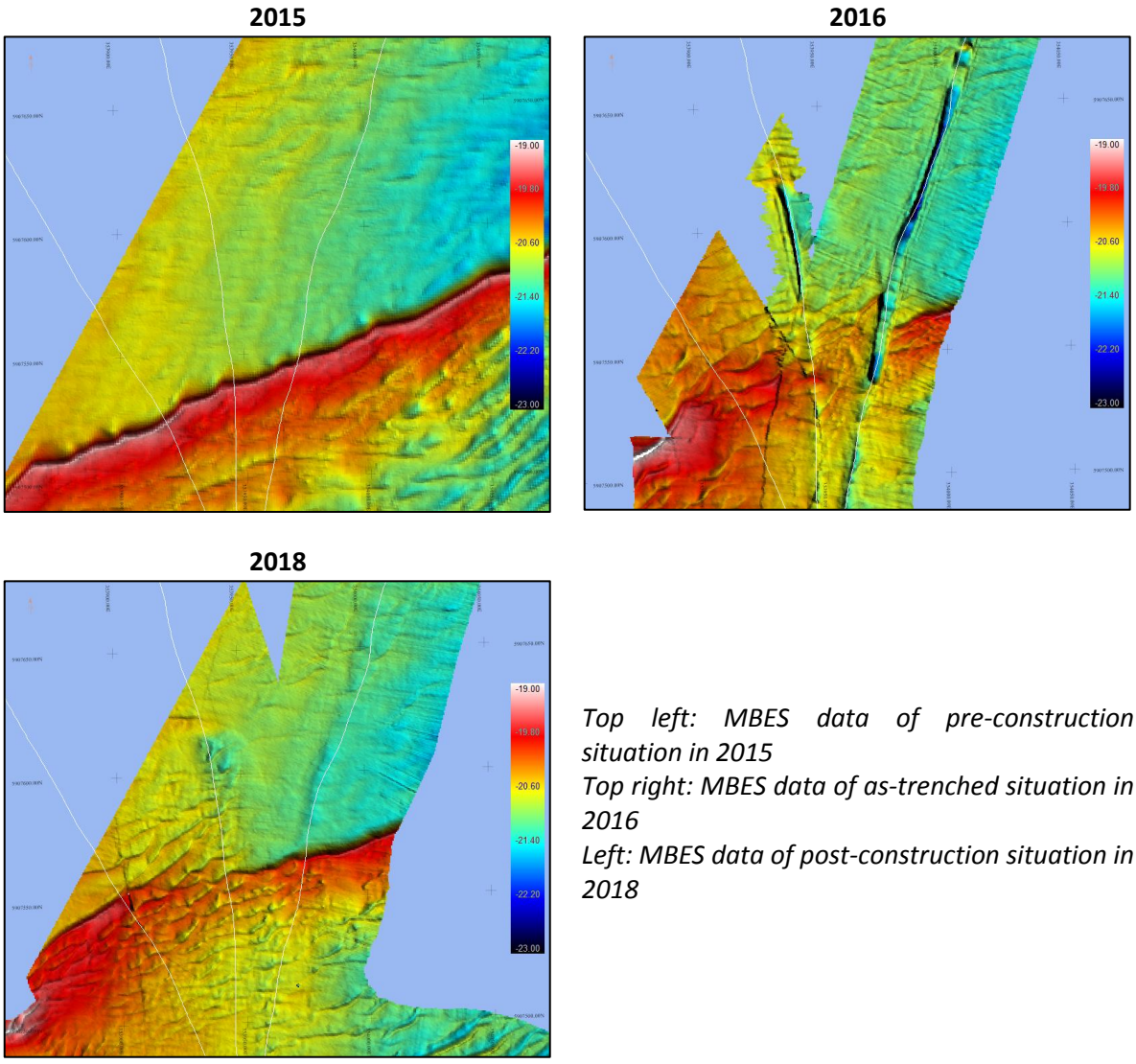


Figure 4-1: Longitudinal profile of MBES data along array cable Z01-D06



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-2: Planview images of MBES data along entire length of array cable Z01-D06



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-3: Planview images of MBES data near KP 0.100 of array cable Z01-D06

4.1.2 D06-D05

Array cable D06-D05 is located in the northern part of the OWF, cable is running from S to N. In 2015, a clear sand wave pattern was observed along this array cable route, with general SW-NE strike and with heights ranging 2-3 m. After trenching in 2016 a clear flattening of the seabed was observed. In 2018, most of the sand wave pattern was restored to with sand waves ranging in height between 1-2.5 m height with a shorter wavelength than in 2015. Comparing the longitudinal profiles of the 2017 and 2018 surveys over the scour protection near D05, it appears there is a offset of ~0.5 m between the 2017 and 2018 surveys (Figure 4-4 & Figure 4-5).

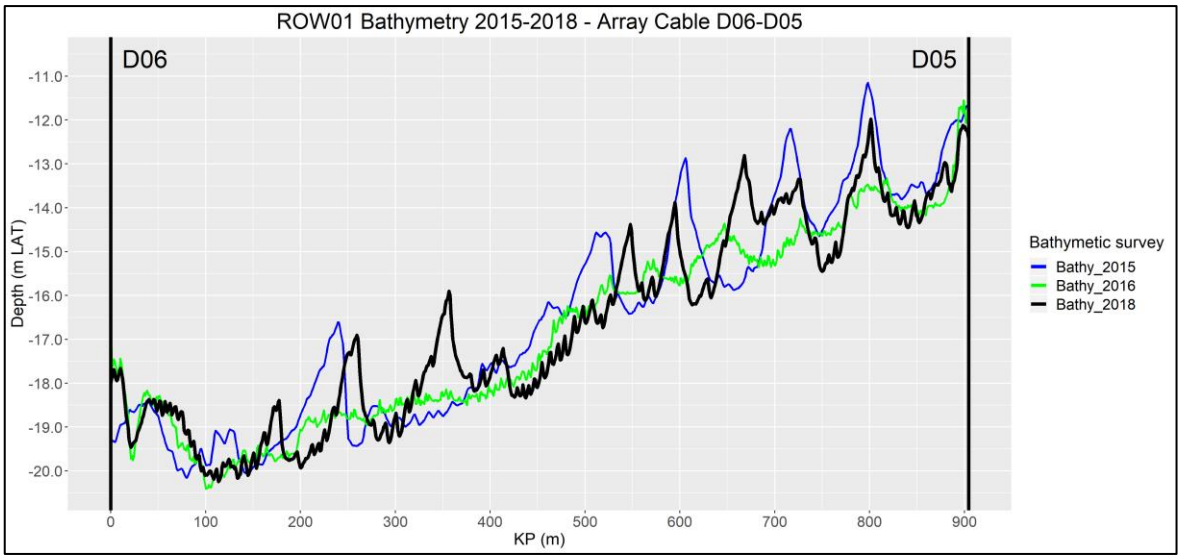
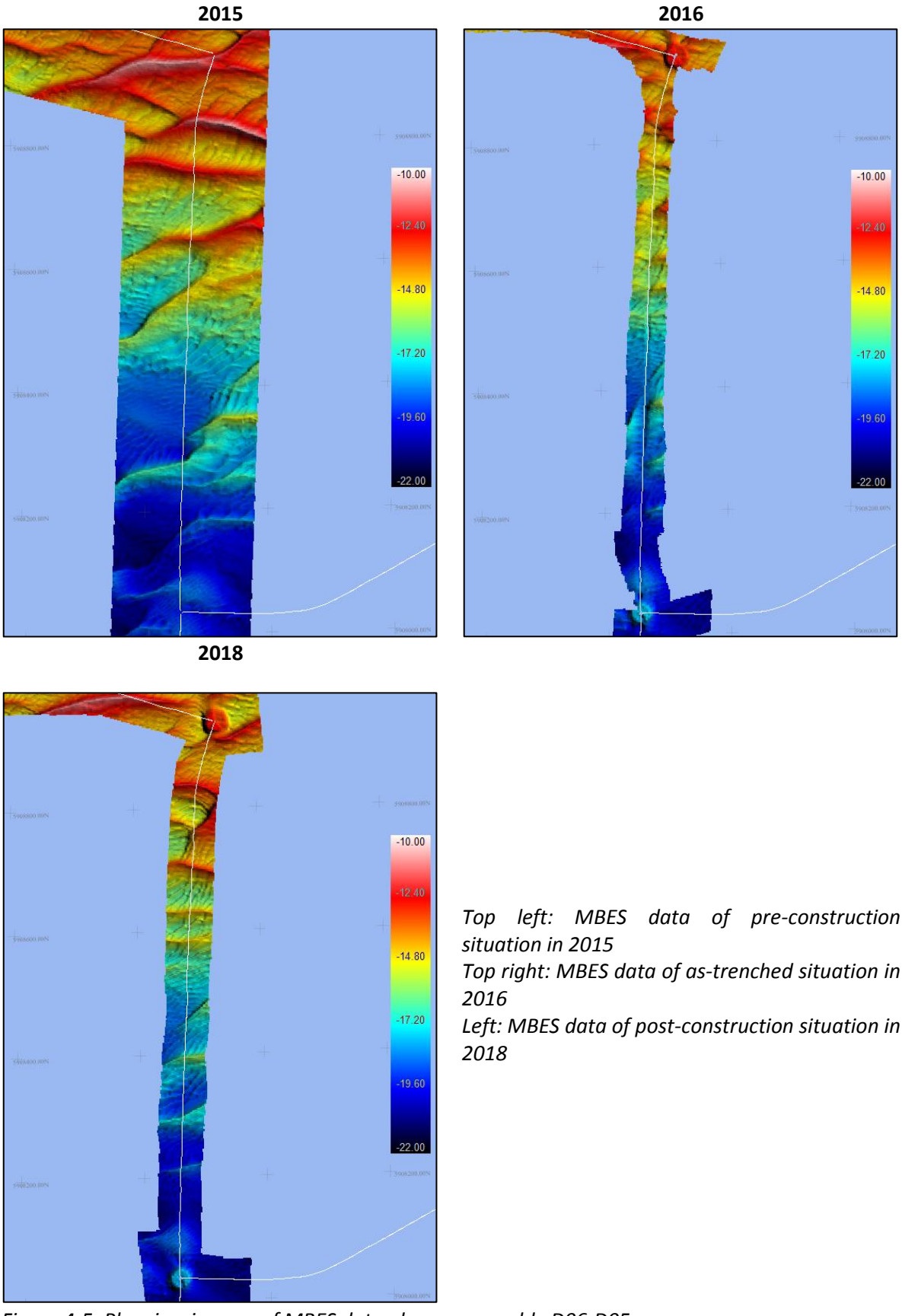


Figure 4-4: Longitudinal profile of MBES data along array cable D06-D05



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-5: Planview images of MBES data along array cable D06-D05

4.1.3 D05-C04

Array cable D05-C04 is located in the eastern part of the OWF, the cable is running from E to W. In 2015, clear sand wave pattern with general W-E strike as well as a distinct SW-NE striking ridge at KP 0.420 were visible. In 2015, the highest sand wave along the profile was a drop of ~2.5 m off the ridge at KP 0.420, as well as a ~1.5 m sand wave crossing at KP 0.720. After trenching in 2016 a clear flattening of the seabed was observed, although the ridge was still present, now ~1.5 high and migrated ~ 50 W-wards. In 2018, most new sand waves developed near WTG D05, the ridge has gained height to ~ 1.9 m. The seabed near WTG C04 still remained flatter than pre-construction, although a new sand wave ridge of ~ 1.0 m developed near KP 0.900 (Figure 4-8). Comparing the longitudinal profiles of the 2017 and 2018 surveys over the scour protection near D05, it appears there is a offset of ~0.5 m between the 2017 and 2018 surveys (Figure 4-6 & Figure 4-7).

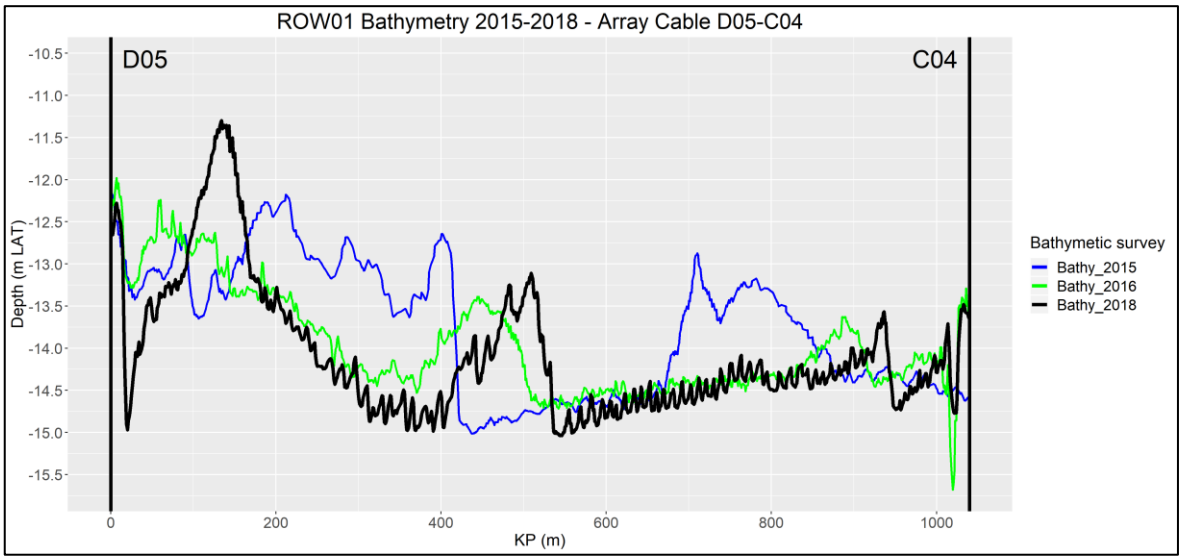
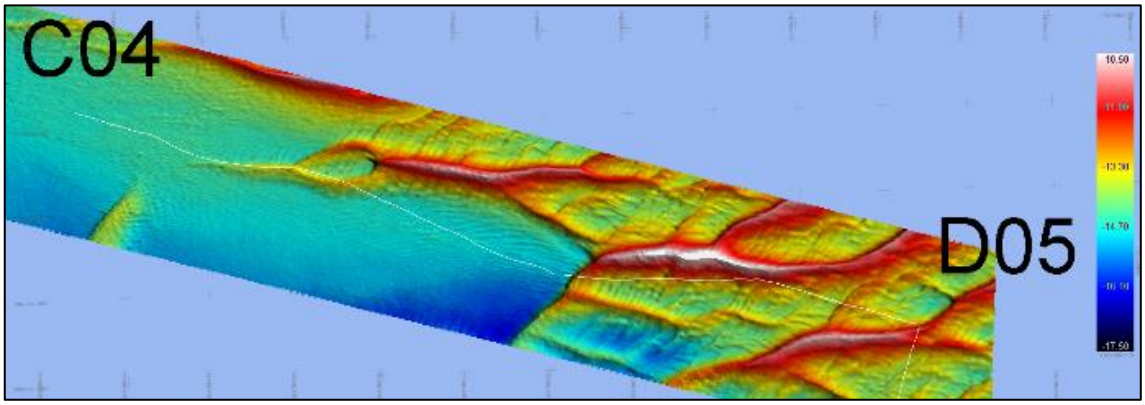
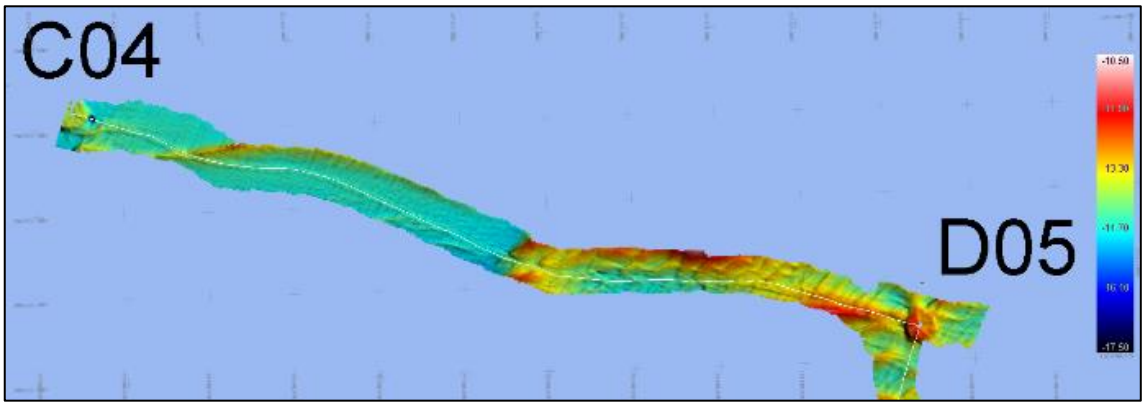


Figure 4-6: Longitudinal profile of MBES data along array cable D05-C04

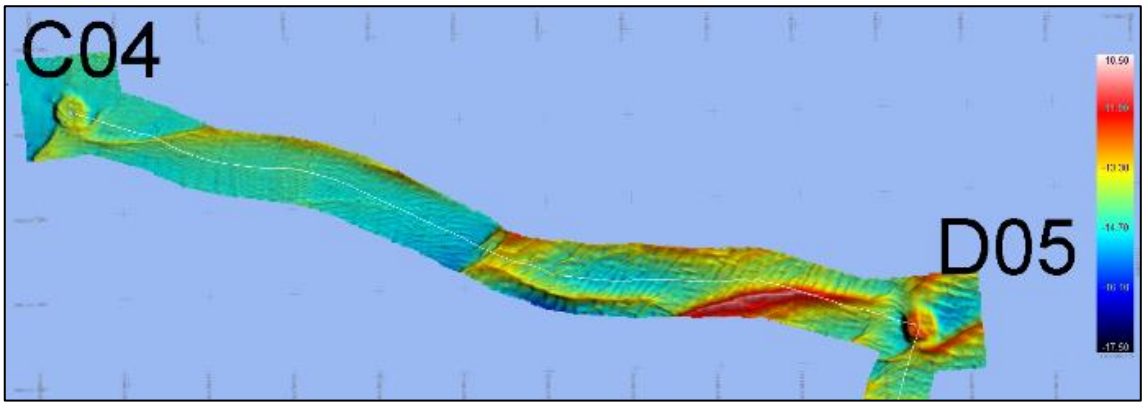
2015



2016



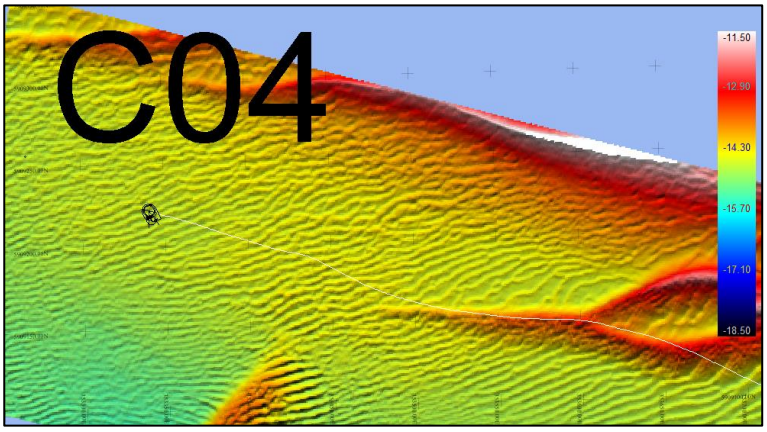
2018



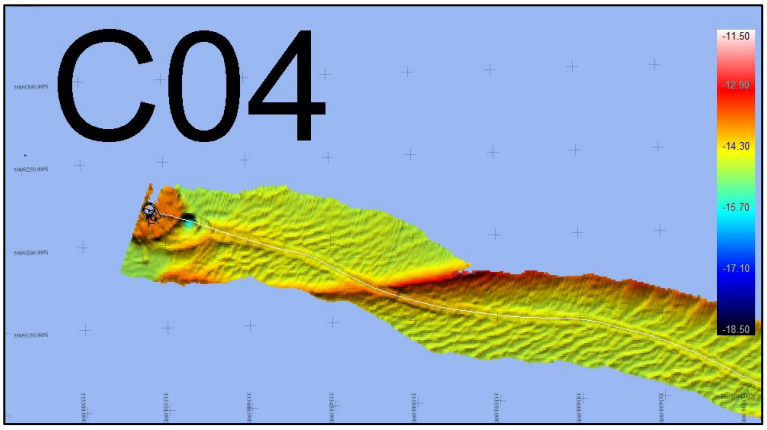
Top: MBES data of pre-construction situation in 2015
Centre: MBES data of as-trenched situation in 2016
Bottom: MBES data of post-construction situation in 2018

Figure 4-7: Planview images of MBES data along array cable D05-C04

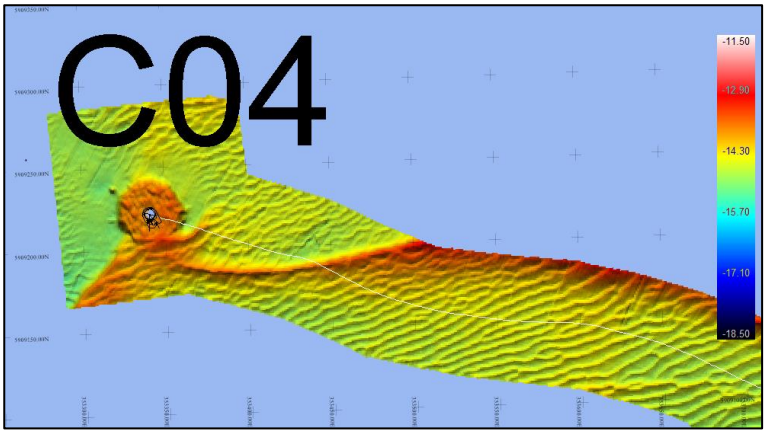
2015



2016



2018



Top: MBES data of pre-construction situation in 2015
Centre: MBES data of as-trenched situation in 2016
Bottom: MBES data of post-construction situation in 2018

Figure 4-8: Planview images of MBES data near KP 0.900 of array cable D05-C04

4.1.4 Z01-C05

Array cable Z01-C05 is located in the northern part of the OWF, cable is running from SE to NW. In 2015, a clear sand wave pattern with general SW-NE strike was visible. In 2015, the two main sand wave ridges along the profile were ~5 m height, with another two ridges ~1.5 m and ~ 3 m high. After trenching in 2016 a clear flattening of the seabed was observed. In 2018, most of the sand wave pattern was restored, with the two major sand wave ridges redeveloped at the same location as pre-construction to ~3 m and ~4 m height (Figure 4-11). The lower sand waves ridges also redeveloped almost completely. Comparing the longitudinal profiles of the 2017 and 2018 surveys over the scour protection near C05, it appears there is a offset of ~0.5 m between the 2017 and 2018 surveys (Figure 4-9 & Figure 4-10).

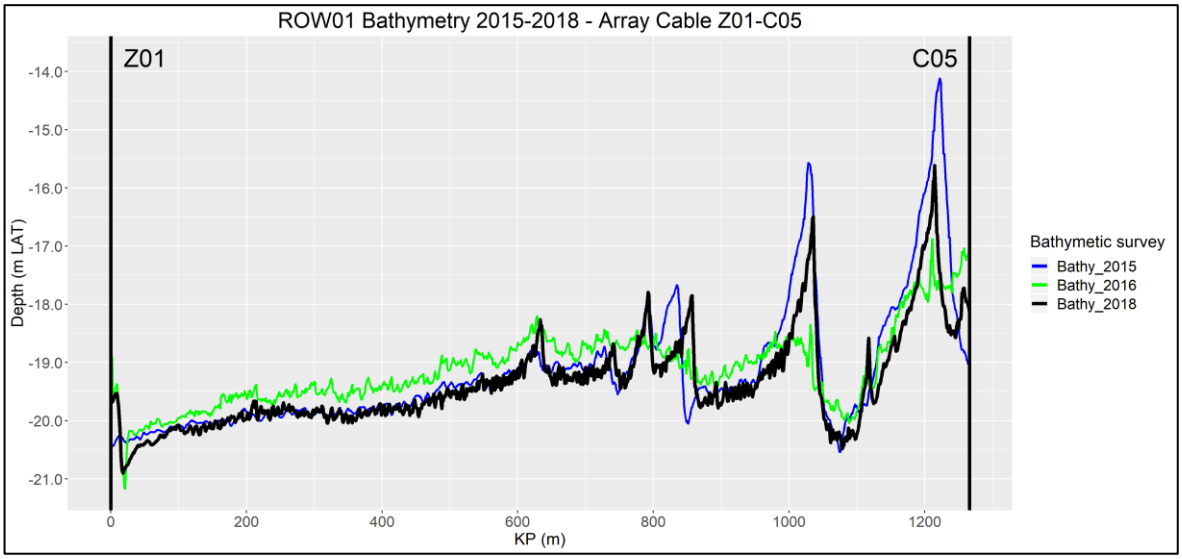
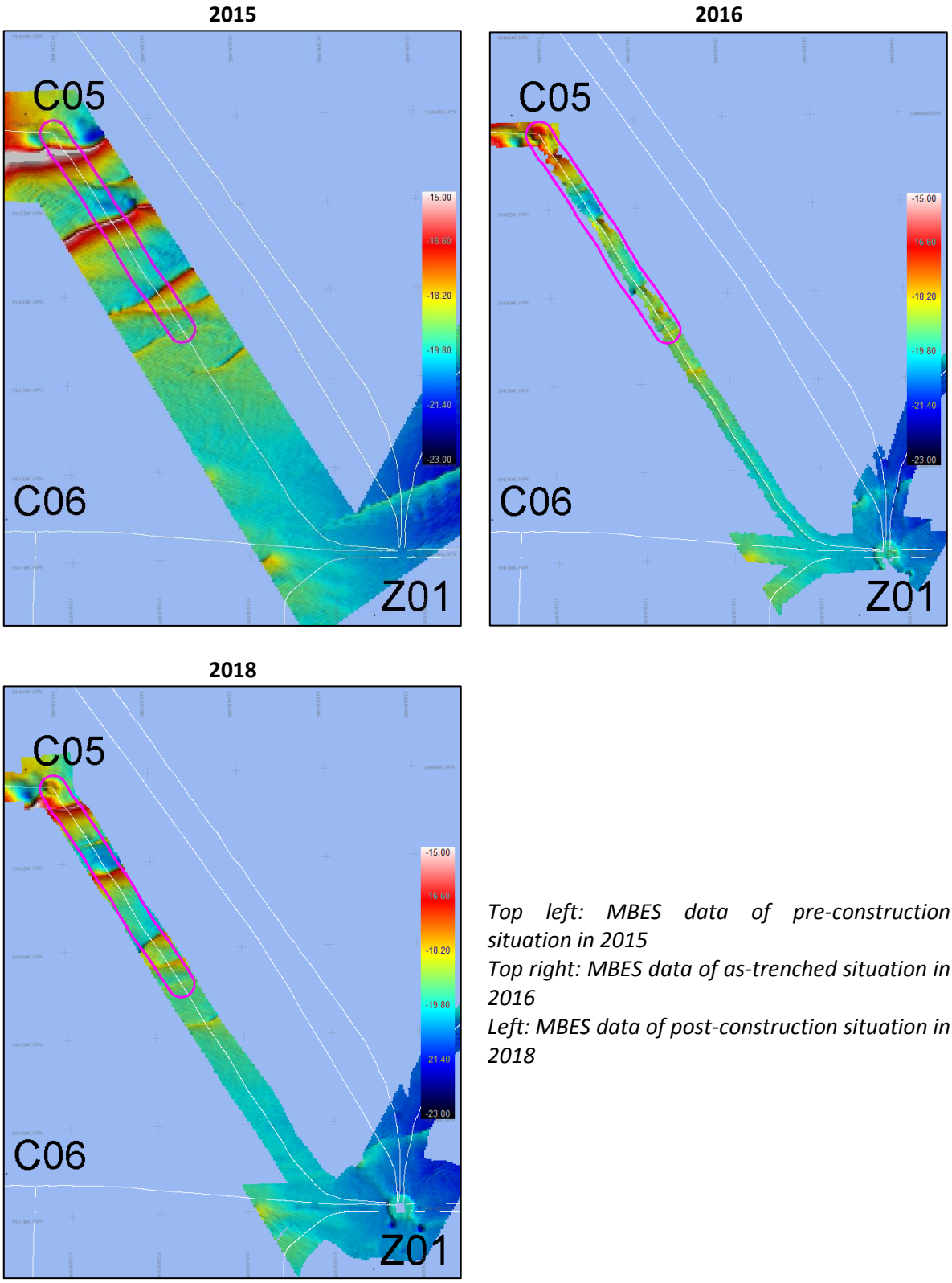
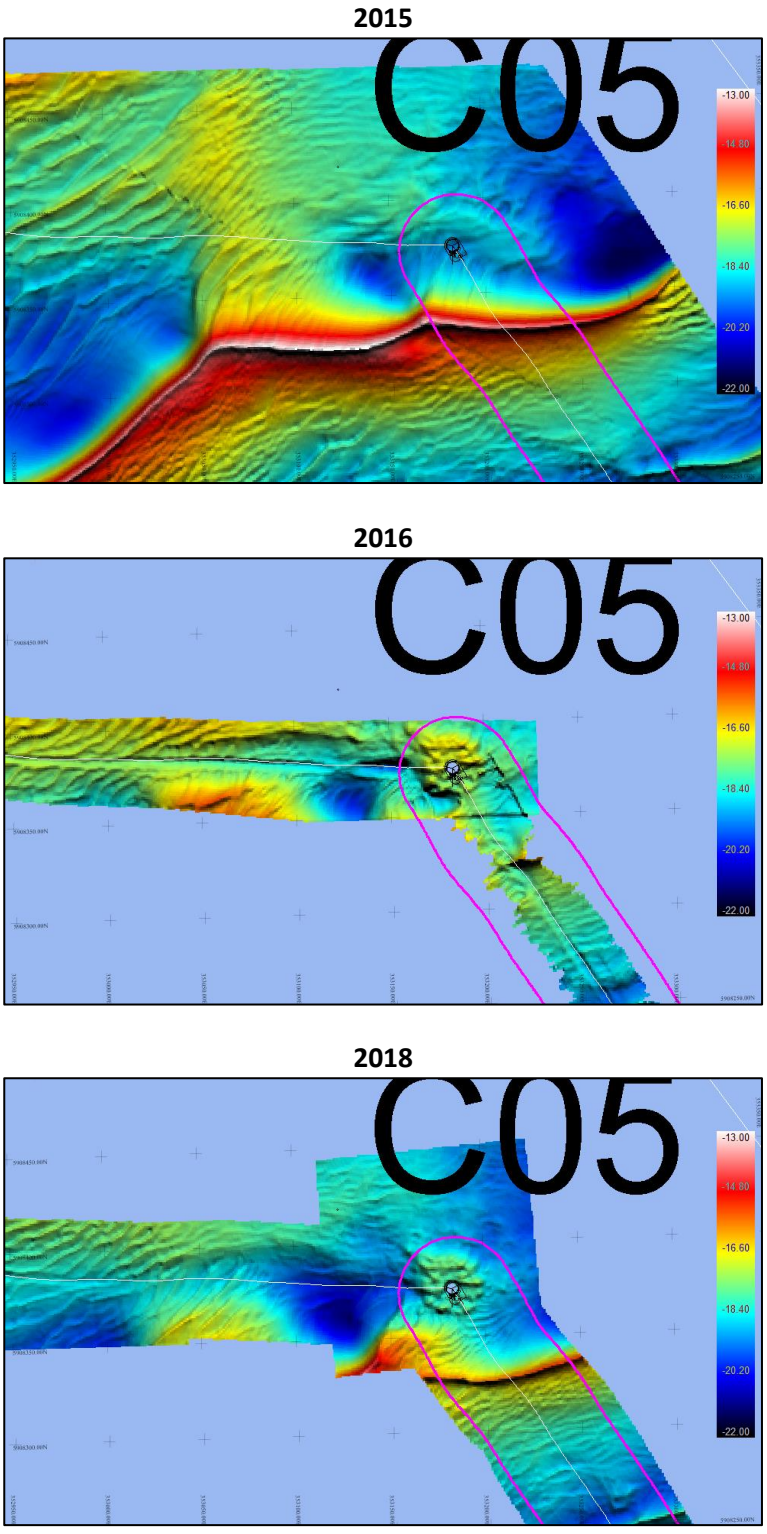


Figure 4-9: Longitudinal profile of MBES data along array cable Z01-C05



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-10: Planview images of MBES data along array cable Z01-C05



Top: MBES data of pre-construction situation in 2015
Centre: MBES data of as-trenched situation in 2016
Bottom: MBES data of post-construction situation in 2018

Figure 4-11: Planview images of MBES data near KP 1.200 on array cable Z01-C05

4.1.5 C05-B04

Array cable C05-B04 is located in the northern part of the OWF, cable is running from W to W In 2015, a clear sand wave pattern with general SW-NE strike was visible. In 2015, the two main sand wave ridges along the profile were ~2.5 m height, with another ridge ~1.5 m high. After trenching in 2016 a clear flattening of the seabed was observed. In 2018, some of the sand wave pattern was restored, with one of the major sand wave ridges redeveloped at the same location as pre-construction to ~1 m height (Figure 4-14). The other sandwave ridges have redeveloped to some extent, but not yet to pre-construction level. Comparing the longitudinal profiles of the 2017 and 2018 surveys over the scour protection near both C05 and B04, it appears there is a offset of ~1 m between the 2017 and 2018 surveys (Figure 4-12 & Figure 4-13).

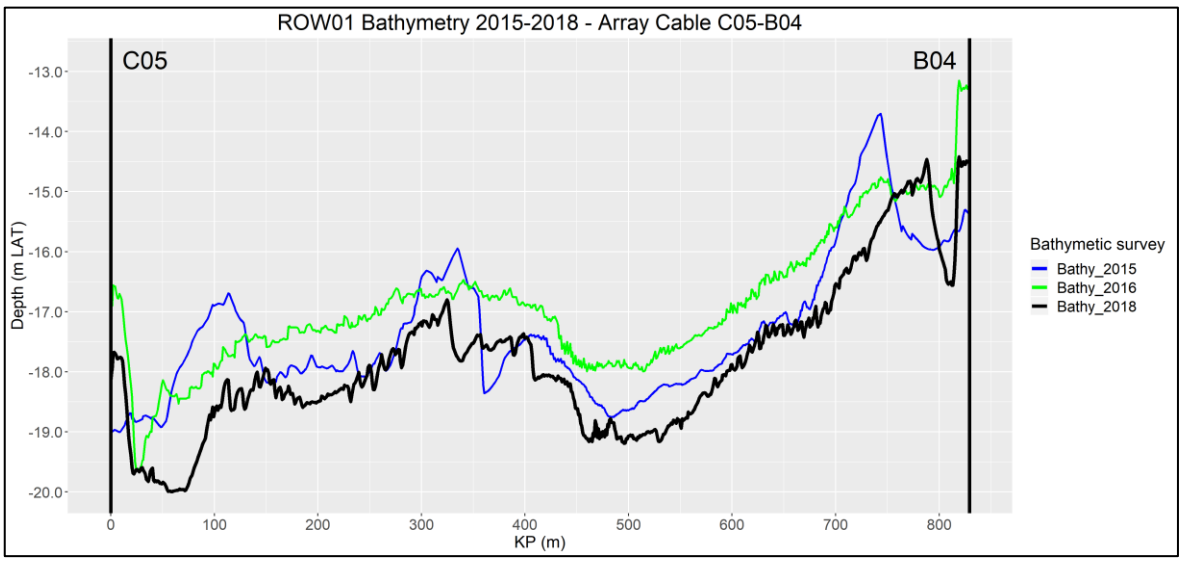
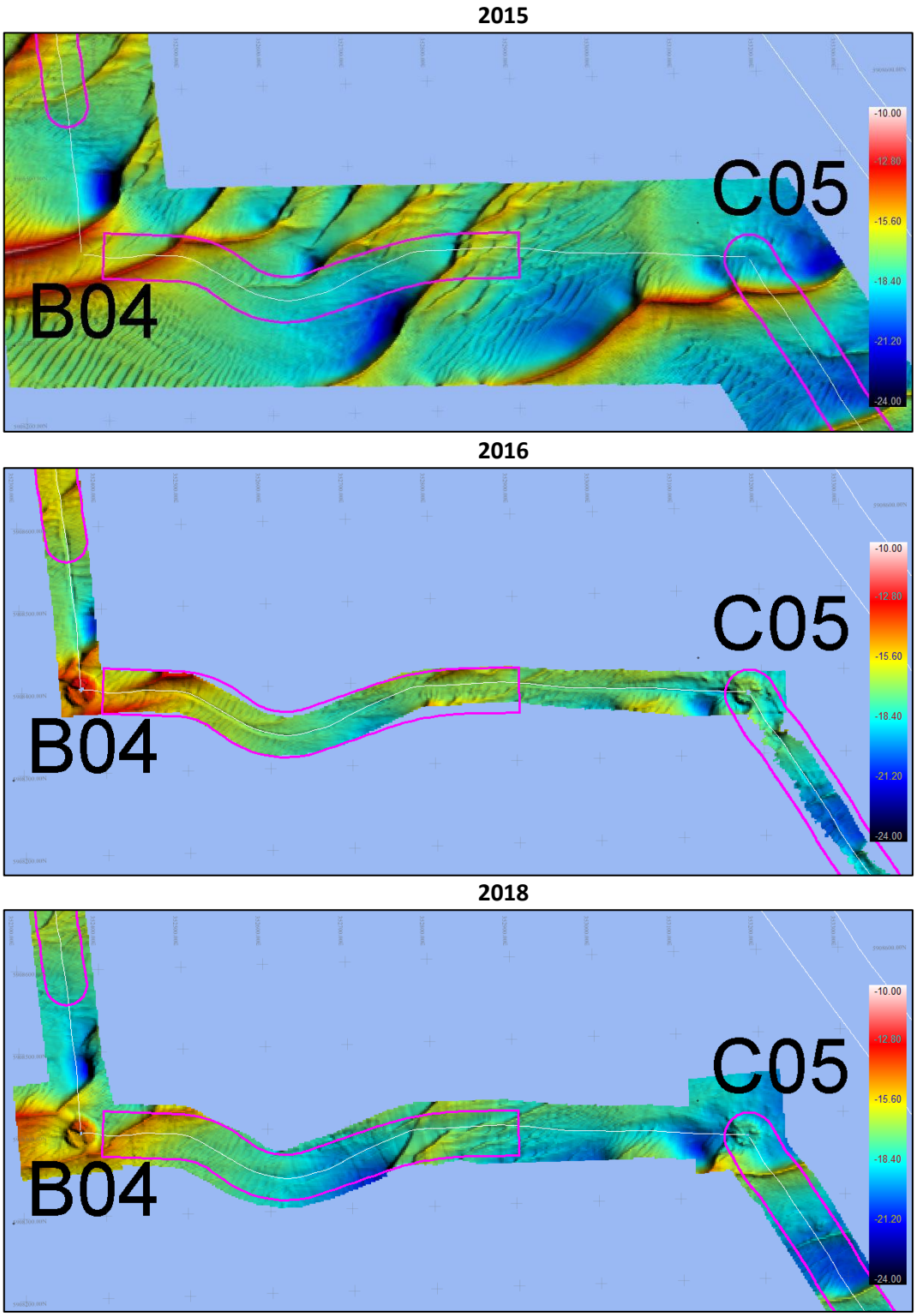
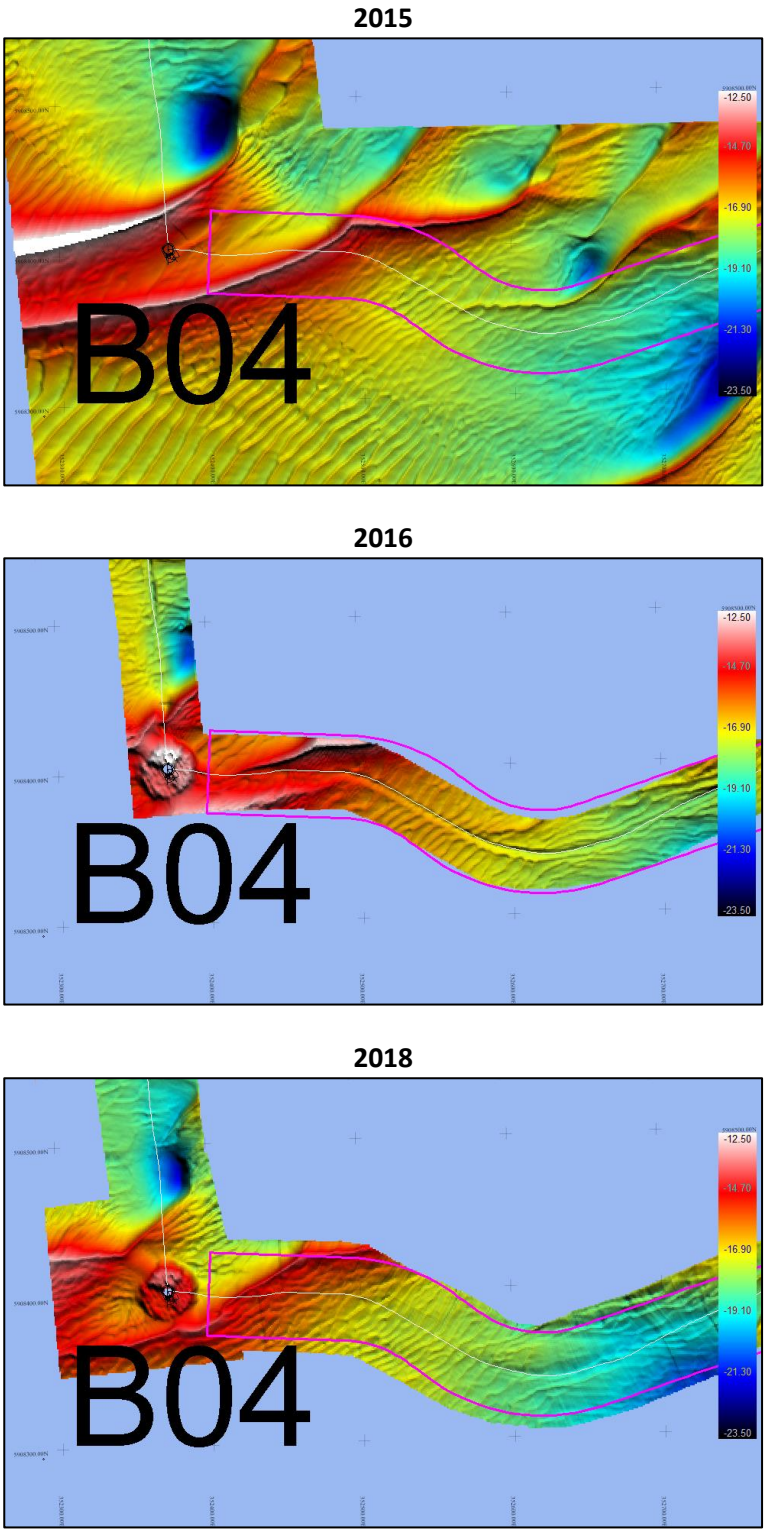


Figure 4-12: Longitudinal profile of MBES data along array cable C05-B04



Top: MBES data of pre-construction situation in 2015
Centre: MBES data of as-trenched situation in 2016
Bottom: MBES data of post-construction situation in 2018

Figure 4-13: Planview images of MBES data along array cable C05-B04



Top: MBES data of pre-construction situation in 2015
Centre: MBES data of as-trenched situation in 2016
Bottom: MBES data of post-construction situation in 2018

Figure 4-14: Planview images of MBES data near KP 0.750 of array cable C05-B04

4.1.6 B04-B03

Array cable B04-B03 is located in the northern part of the OWF, cable is running from S to N. In 2015, a clear sand wave pattern with general SW-NE strike was visible. In 2015, the highest sand wave along the profile was ~5 m height, although most of the sand waves were ~2 m high. After trenching in 2016 a clear flattening of the seabed was observed. In 2018, most of the sand wave pattern was restored, with three major sand wave ridges >2 m high redeveloped. Comparing the longitudinal profiles of the 2017 and 2018 surveys over the scour protection near both B04 and B03, it appears there is a offset of ~1 m between the 2017 and 2018 surveys (Figure 4-15 & Figure 4-16).

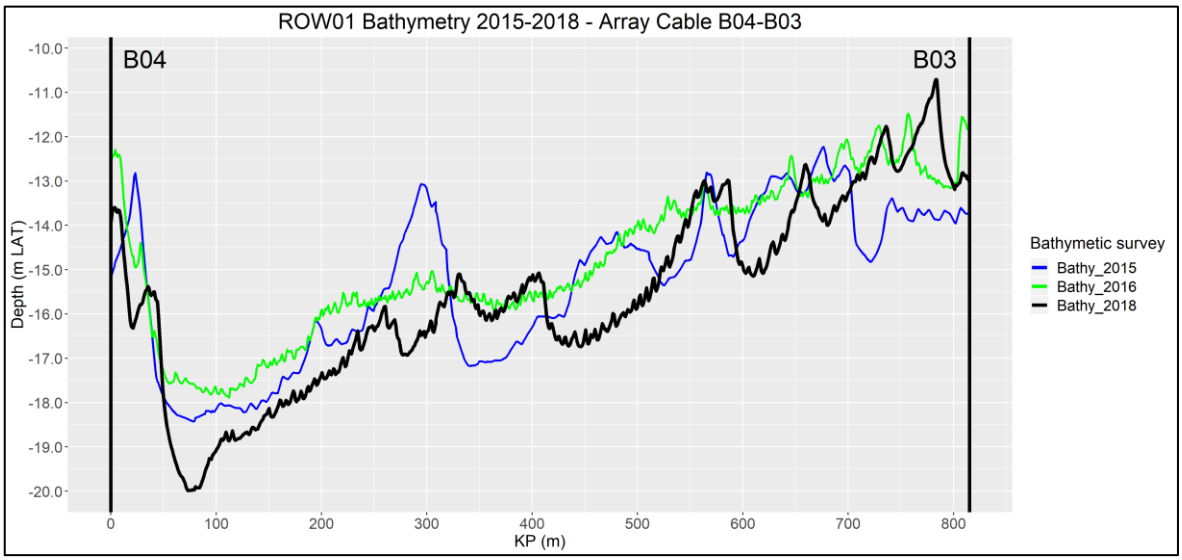
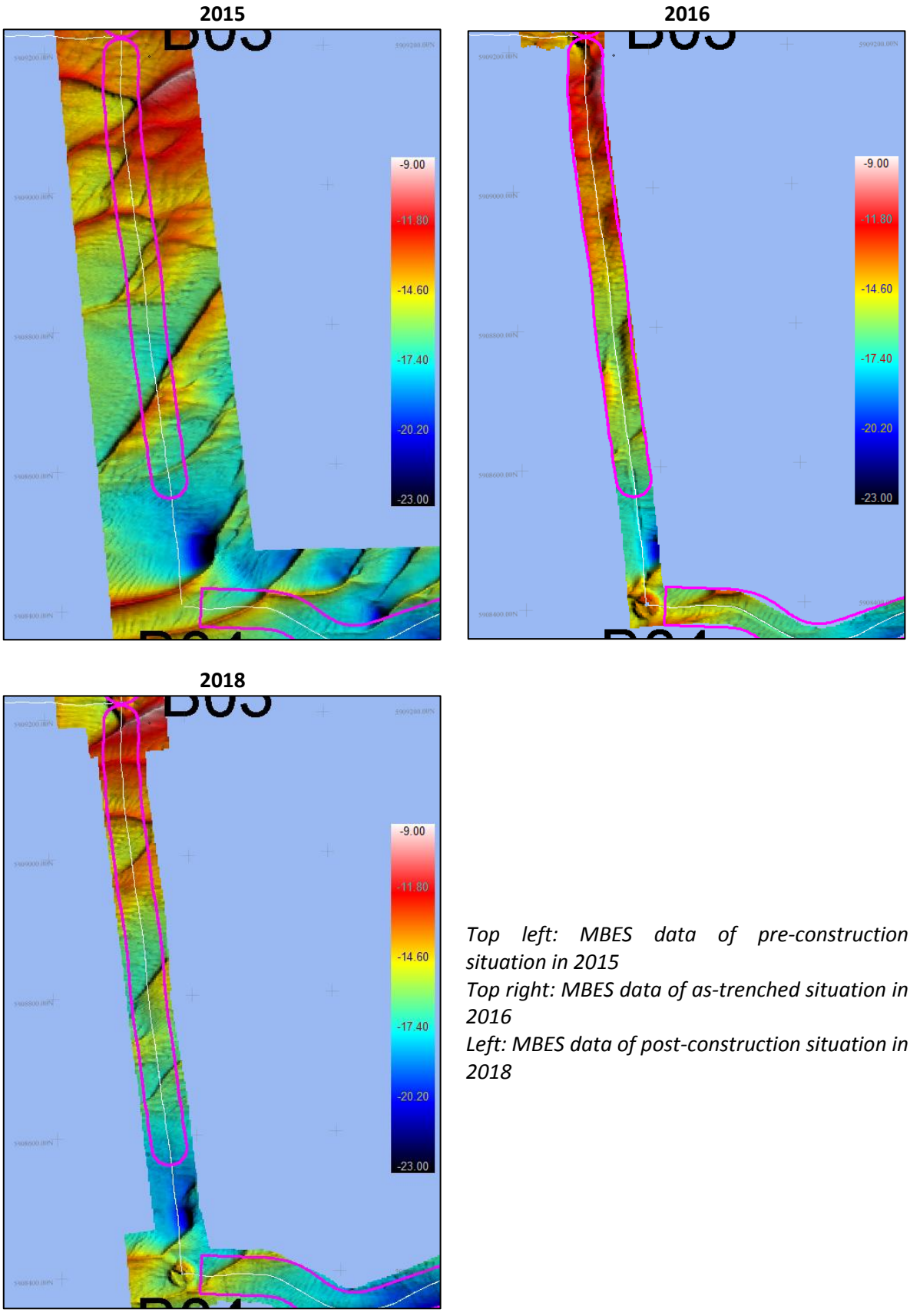
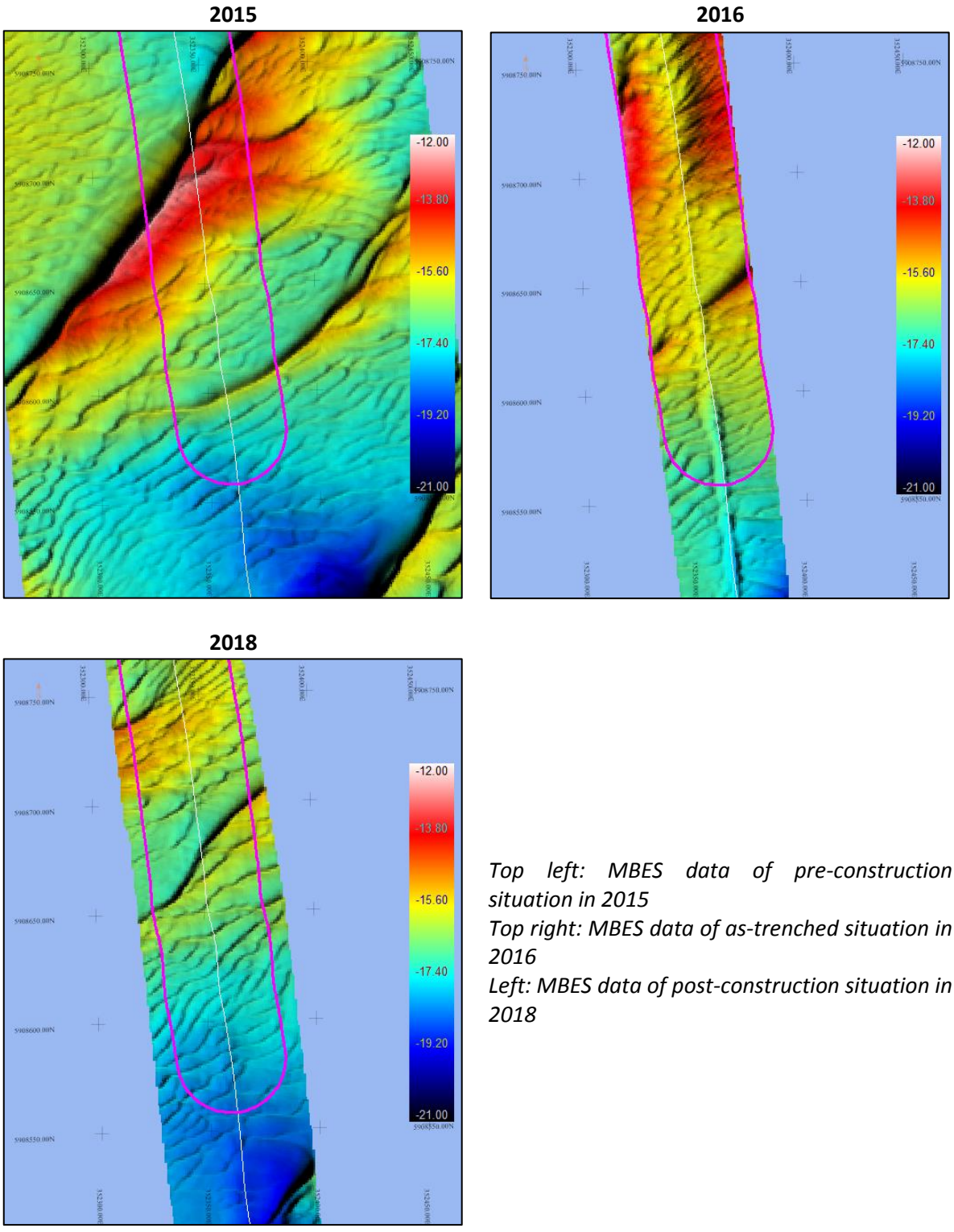


Figure 4-15: Longitudinal profile of MBES data along array cable B04-B03



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-16: Planview images of MBES data along array cable B04-B03



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-17: Planview images of MBES data near KP 0.300 of array cable B04-B03

4.1.7 B03-A03

Array cable B03-A03 is located in the northern part of the OWF, cable is running from SE to NW. In 2015, a clear sand wave pattern with general SW-NE strike was visible. In 2015, the highest sand wave along the profile was >5 m height, although most of the sand waves were ~2 m high. After trenching in 2016 a clear flattening of the seabed was observed, although quite a few sand waves remained. In 2018, most of the sand wave pattern was restored, with the highest sand wave restored to ~4 m height (Figure 4-20). The other sand wave ridges have redeveloped to pre-construction height, although the wavelength has increased. Comparing the longitudinal profiles of the 2017 and 2018 surveys over the scour protection near both B03 and A03, it appears there is a offset of ~0.5 m between the 2017 and 2018 surveys (Figure 4-18 & Figure 4-19).

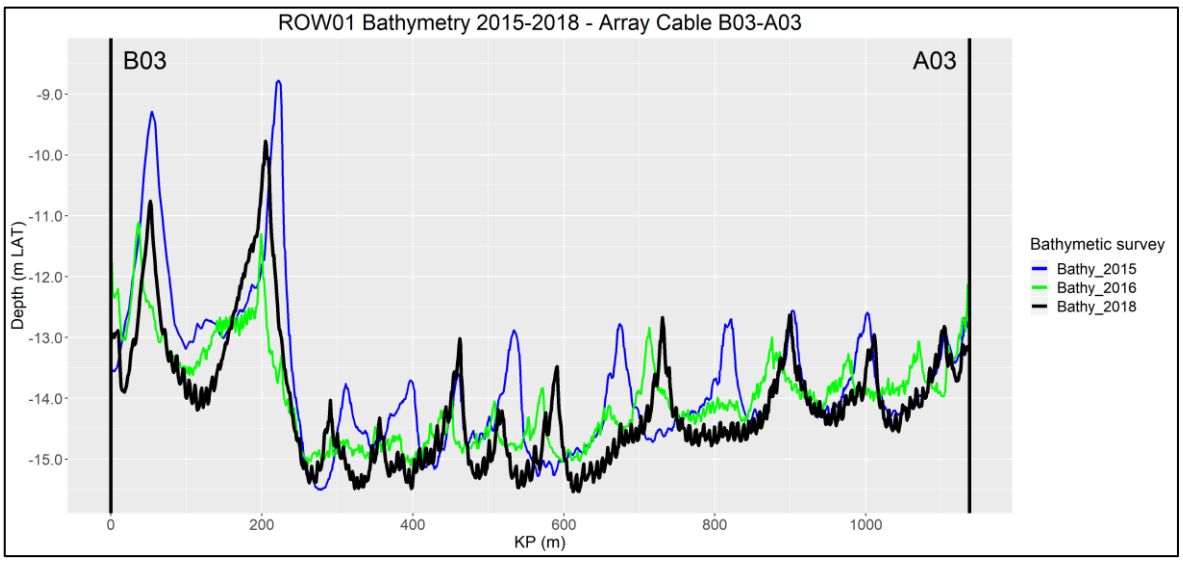
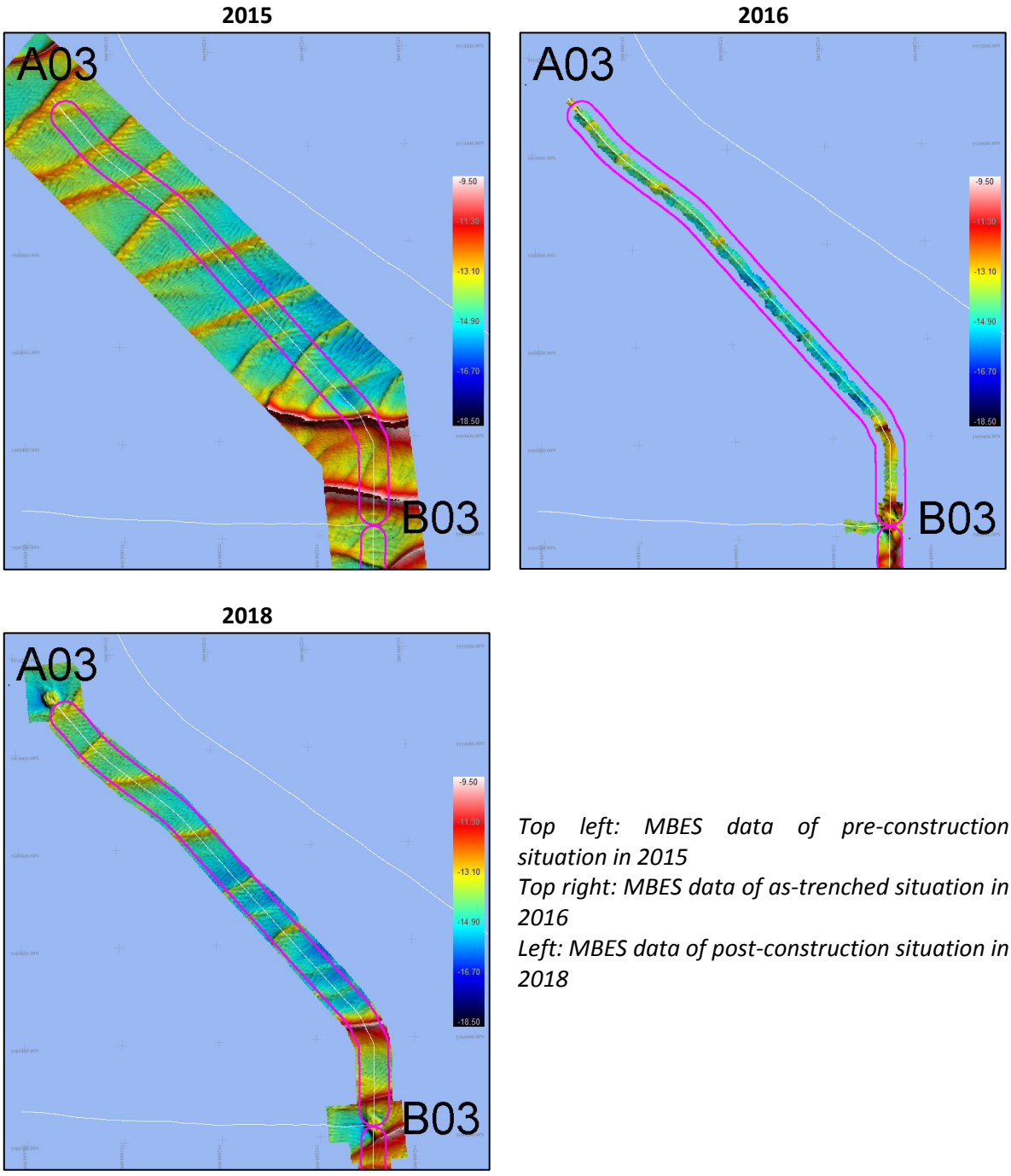
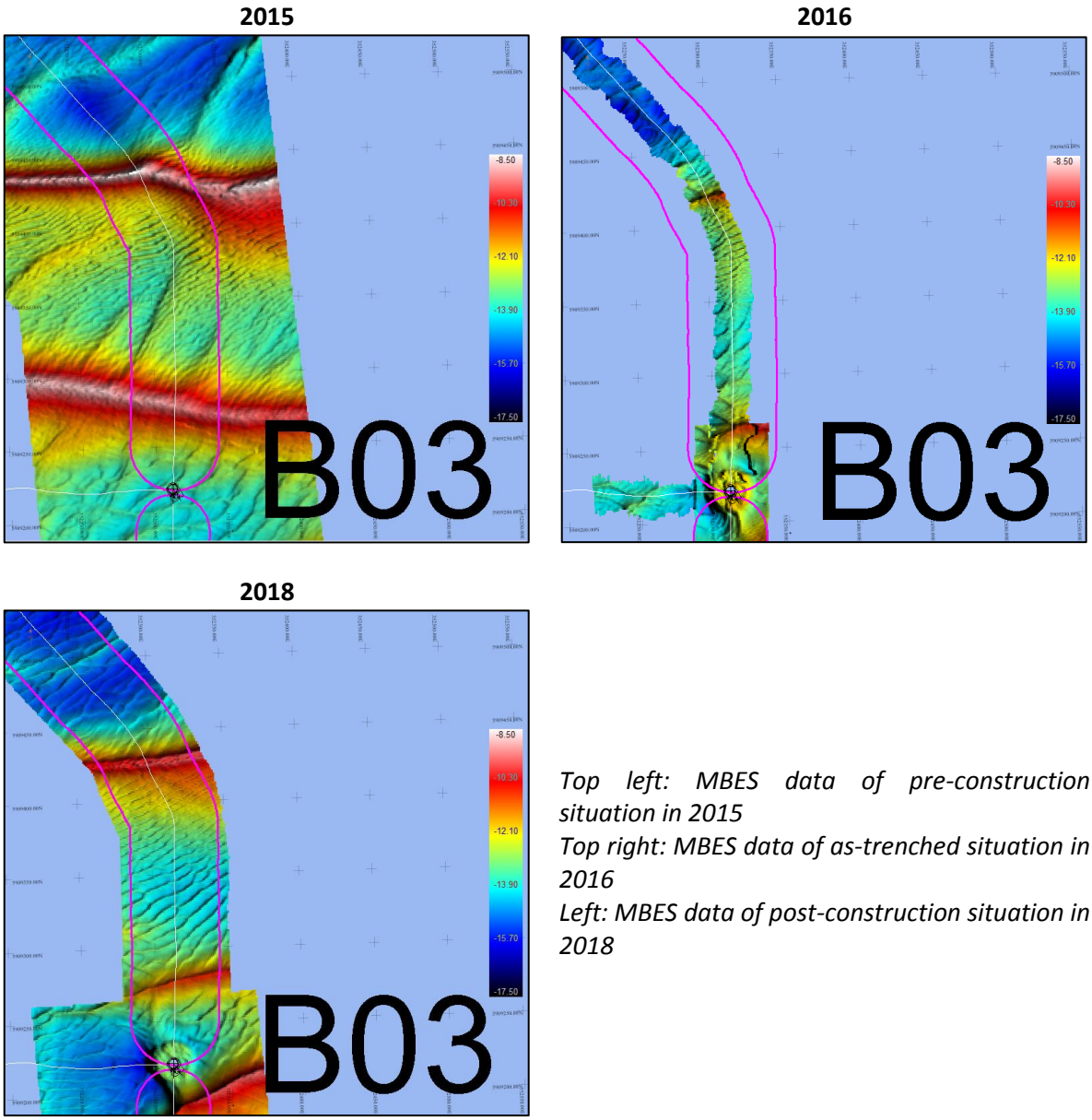


Figure 4-18: Longitudinal profile of MBES data along array cable B03-A03



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-19: Planview images of MBES data along array cable B03-A03



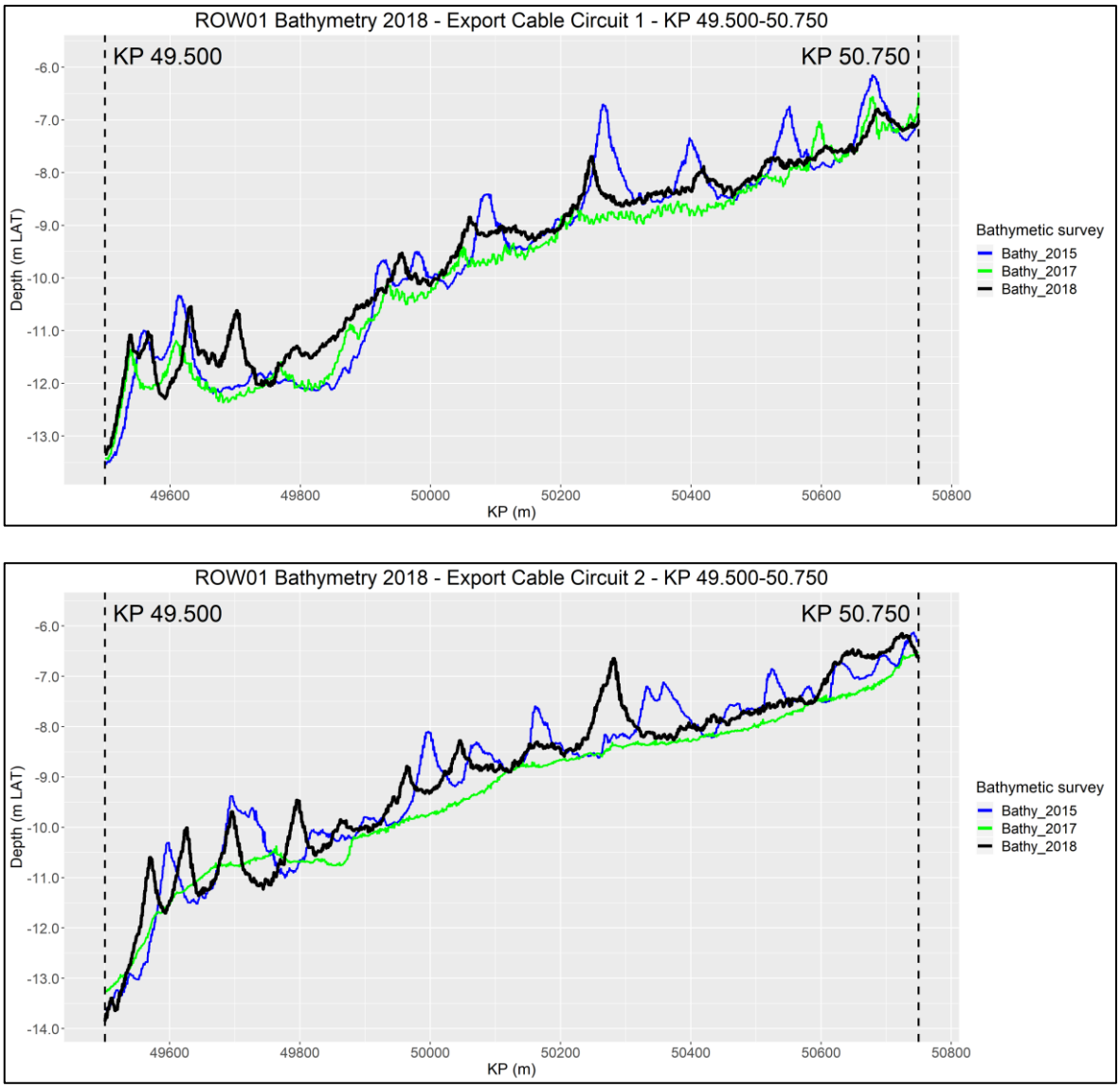
Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2016
Left: MBES data of post-construction situation in 2018

Figure 4-20: Planview images of MBES data near KP 0.100 of array cable B03-A03

4.2 Export cables

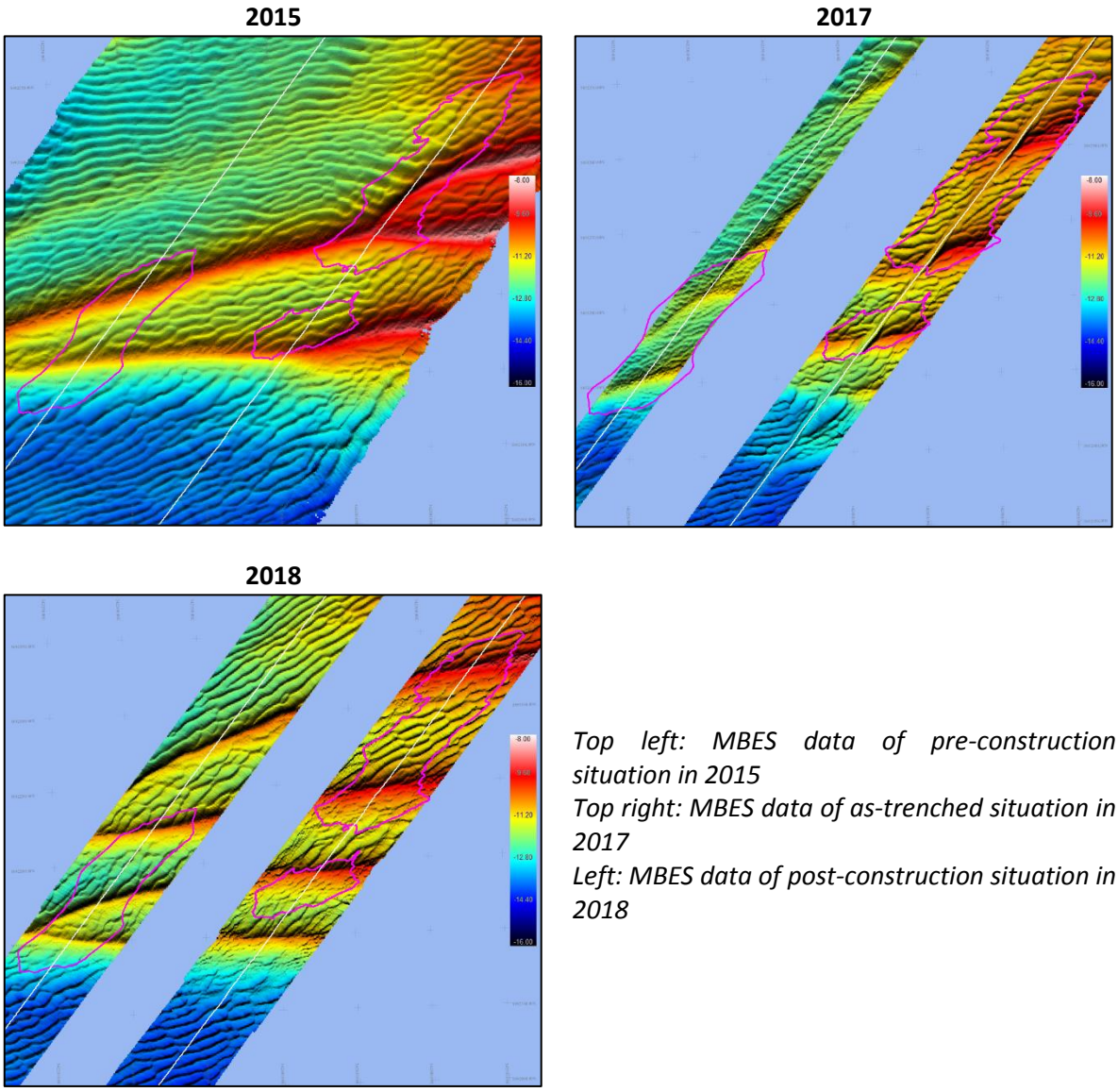
4.2.1 C1 & C2 – KP 49.500 – 50.750

Between KP 49.500 and KP 50.750 along export cables C1 & C2, seabed rises onto a sand bank with sand waves superimposed (Figure 4-23). The sand waves have a W to W strike and were between 1-2 m in height pre-construction in 2015. Just after cable trenching in 2017, the sand waves were depressed and showed a general S-wards migration of approximately 20 m. In 2018, most of the sand waves have recovered in height to pre-construction levels and have stabilised their location (Figure 4-21 & Figure 4-22).



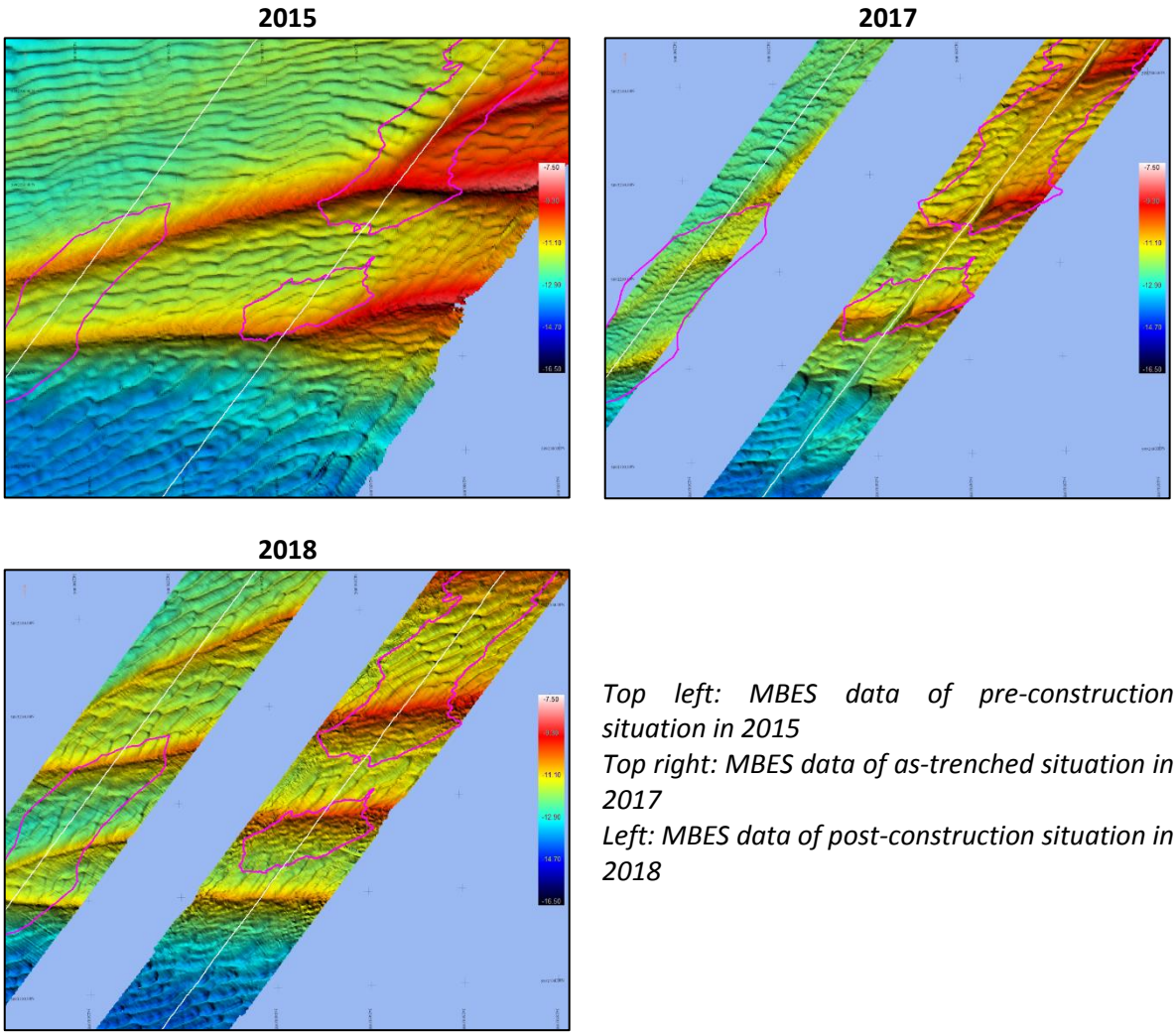
Top: Longitudinal profile along C1
Bottom: Longitudinal profile along C2

Figure 4-21: Longitudinal profiles of MBES data between KP 49.000-50.000 of export cables C1 & C2



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2017
Left: MBES data of post-construction situation in 2018

Figure 4-22: Planview images of MBES data between KP 49.000-50.000 of export cables C1 & C2

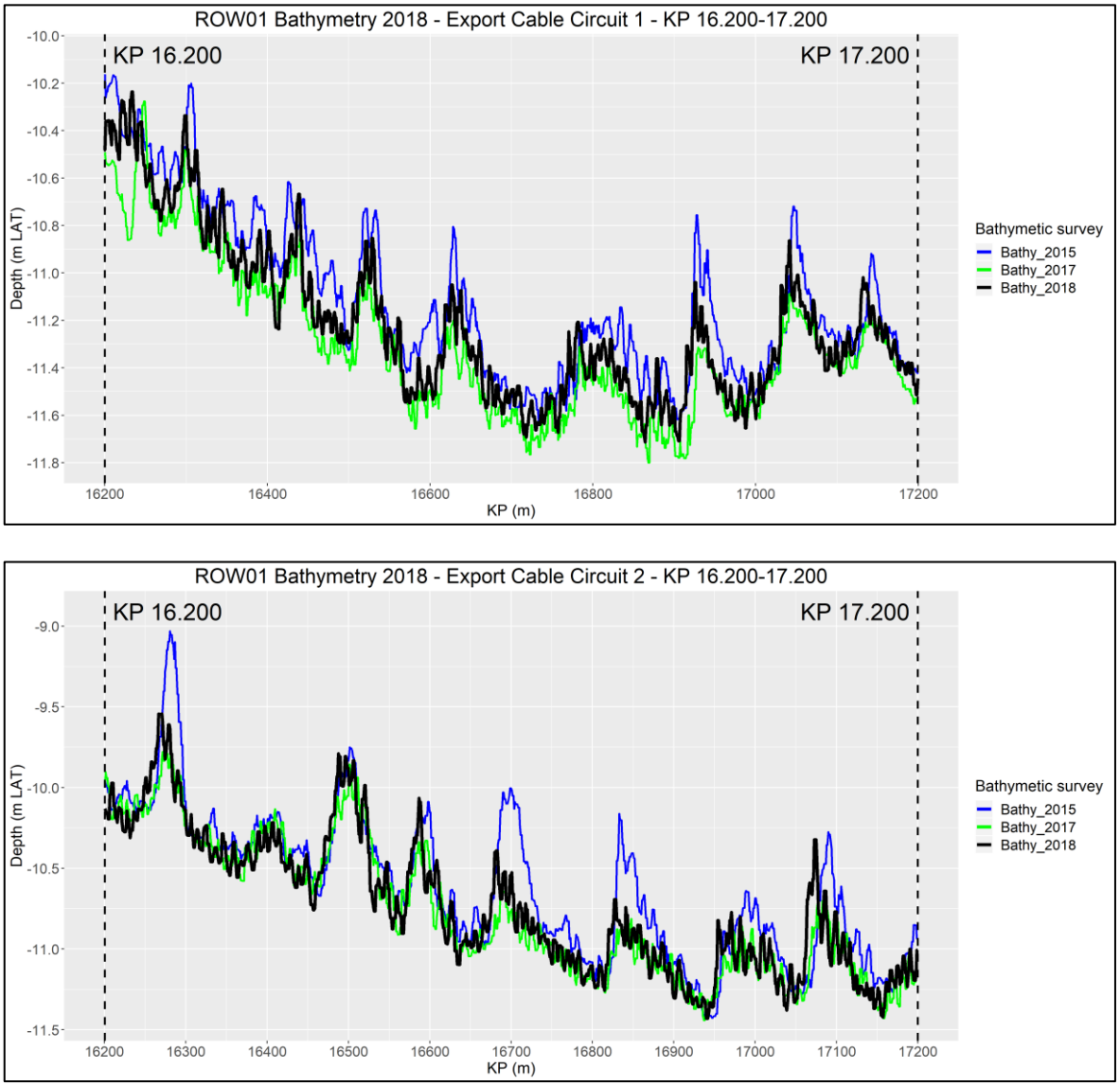


Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2017
Left: MBES data of post-construction situation in 2018

Figure 4-23: Planview images of MBES data near KP 49.600 of export cables C1 & C2

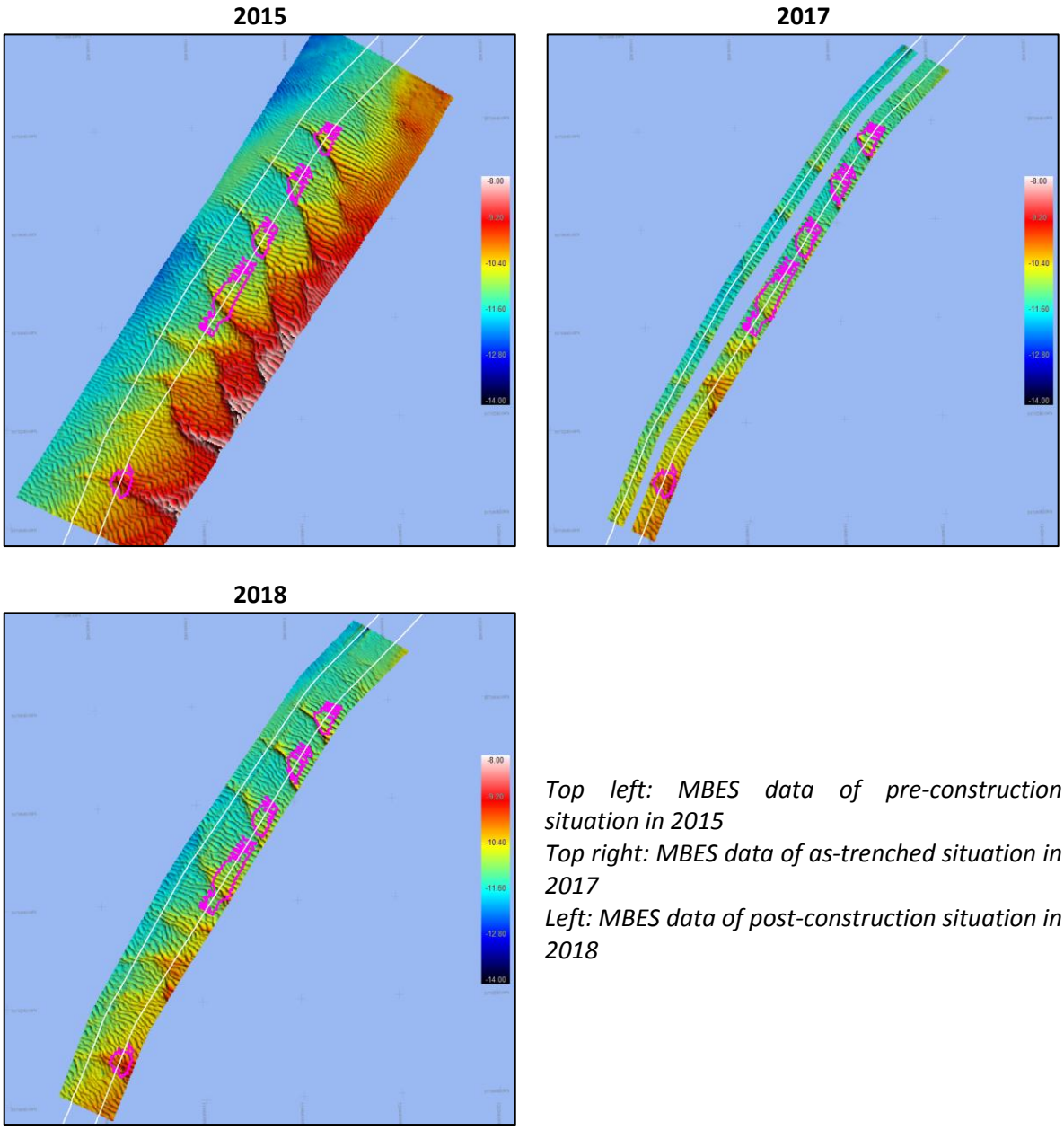
4.2.2 C2 – KP 16.200 – 17.200

In this area a clear sand wave pattern is visible. From the 2015 survey, a number of sand wave ridges of ~1 m was observed (Figure 4-26). After trenching in 2017, some of these ridges were suppressed by ~ 0.5 m, although the majority has remained stable throughout construction. Little change was observed between the surveys of 2017 and 2018 (Figure 4-24 & Figure 4-25).



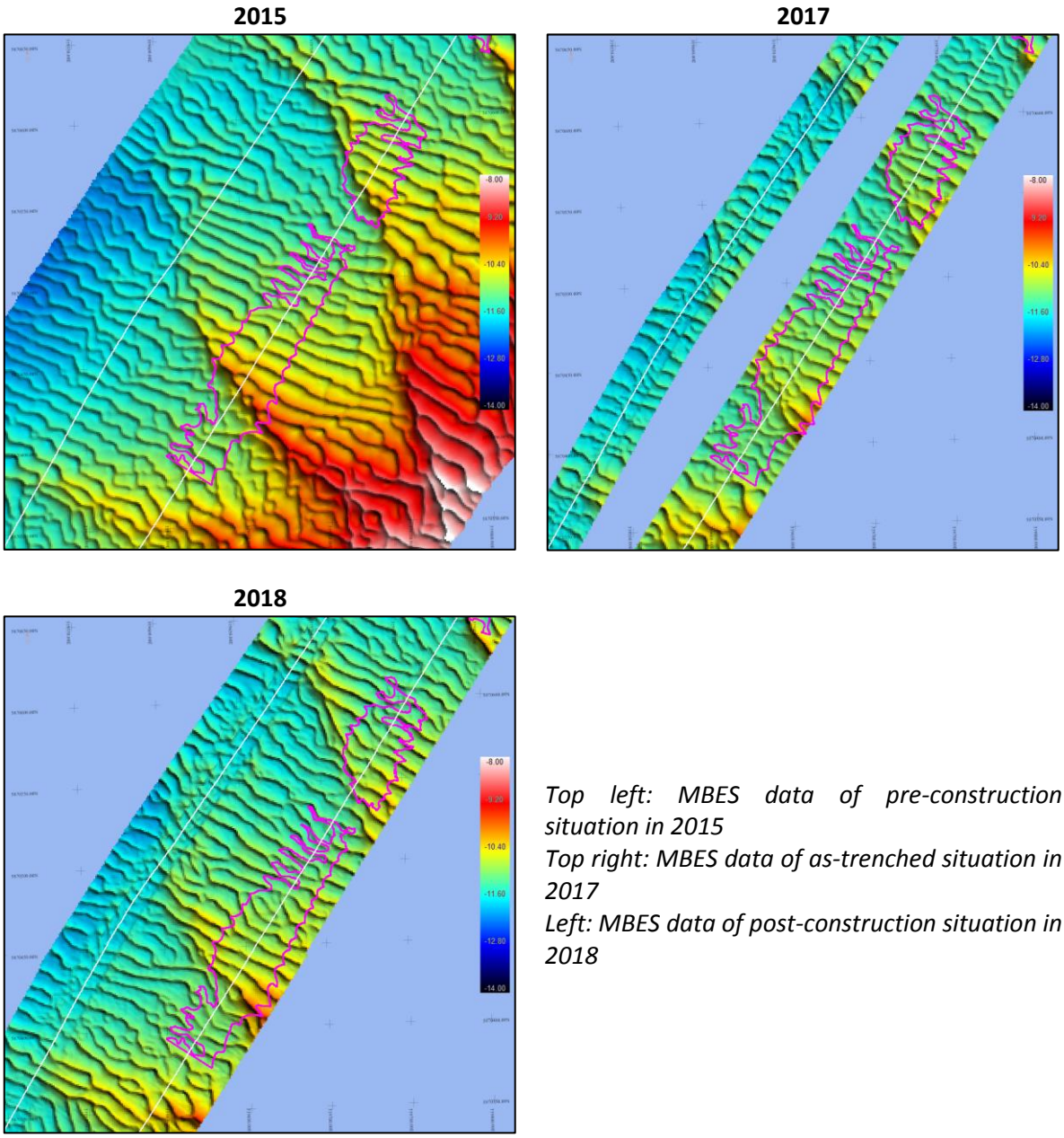
Top: Longitudinal profile along C1
Bottom: Longitudinal profile along C2

Figure 4-24: Longitudinal profile of MBES data between KP 16.200-17.200 of export cables C1 & C2



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2017
Left: MBES data of post-construction situation in 2018

Figure 4-25: Planview images of MBES data between KP 16.200-17.200 of export cable C2



Top left: MBES data of pre-construction situation in 2015
Top right: MBES data of as-trenched situation in 2017
Left: MBES data of post-construction situation in 2018

Figure 4-26: Planview images of MBES data near KP 16.700 of export cable C2