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Operation with the RTI dual-frequency ADCP Seaseven SHOM, Brest, France

English-translated version by NEOTEK, from the original SHOM report

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Checked by : Thierry Garlan

30/08/2019

SHOM/DOPS/HOM/SEDIM

RoeCaille Campaign 2019 - Report

Version : 002		
Written by :	Checked by :	Approved by :
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Version log

Date	Version	Writer	Modification	Pages concerned
11/10/2019	001	N. ZEO	Creation of the document	All
16/10/2019	002	N.ZEO	Modification 1µm→50µm + Apendix 1	Pages 51 ; 52-66

Associated documents

Reference	Version	Approved by	Title	Date
	001	T. Garlan	Exploitation de l'ADCP bi-fréquence RTI Seaseven	30/08/2019

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Summary

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1 INTRODUCTION

This report presents the results of the RTI Seaseven dual-frequency ADCP operation in comparison with the RDI's Workhorse 600kHz during the first phase of the RoeCaille 2019 campaign.

The first part presents the study area and the course of the campaign as well as the two instruments used. The different configurations of the instruments will be studied according to the areas prospected (depth, frequency, resolution, penetration). A second part will present the raw results of the campaign, first comparing the attitudes of the two instruments, the raw echo received and the velocities in the water column. The third part focuses on echo backscatter conversions.

2 PART 1 : PRESENTATION OF THE ROECAILLE 2019 CAMPAIGN

2.1 Study area

ROeCAILLE campaigns are made in 2 phases of 10 days in South Brittany. The objective is to target 2 periods of spring tide in order to capture maximum variability to facilitate the calibration of the sensors. The first phase is in winter unstratified (march), while the second phase is in stratified summer (August). The planning and sampling strategy are similar on both phases.

Stationnary measurements are realized at 5 different points. Three of these measurements correspond to the location of the SHOM benthic stations. The last measurement is located at the Loire's estuary which represents one of the major forcings of the sedimentary dynamics of the South Brittany region. Each stationnary measurement lasts 12 hours. Below are the different locations :

Station 1 – Concarneau 47,80°N / 3,95°O - 47,800°N / 3,915°O.
Station 2 – Grande-Vasière 47,25°N / 4,40°O - 47,242°N / 4,378°O.
Station 3 – Saint-Nazaire (Loire) 47,25°N / 2,20°O - 47,149°N / 2,359°O.
Station 4 – Gino 48,30°N / 5,60°O - 48,285°N / 5,672°O.
Station 5 – Morgat (Douarnenez) 48,203°N / 4,478°O - 48,204°N / 4,481°O.

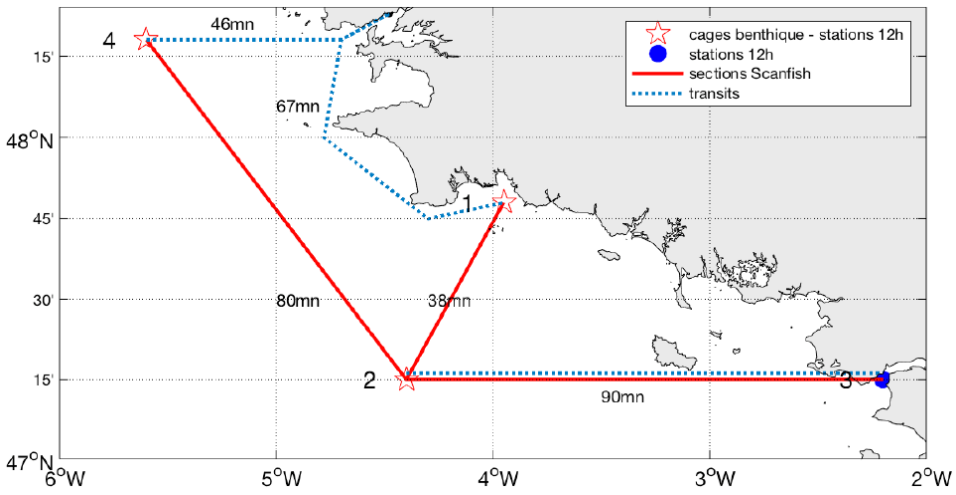

Figure 1 : This map shows the different test locations (except station 5)

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Figure 2: On the front, the two ADCPs used for the tests mounted on the raft

2.2 Equipment used

2.2.1 RTI Seaseven dual-frequency 1200kHz-600kHz ADCP

	600kHz 3" Beams	**1200kHz 2" Beams**	**600kHz** 1" Beams
Broadband	50 m @ 2m Bin Size	20 m @ 1m Bin Size	40 m @ 2m Bin Size
Narrowband	75 m @ 2m Bin Size	30 m @ 1m Bin Size	50 m @ 2m Bin Size
Minimum Blanking Distance	16.0 cm	8.0 cm	16.0 cm
Minimum Bin Size	1.4 cm	0.7 cm	1.4 cm
Maximum Number of Bins	200 bins	200 bins	200 bins
Velocity Resolution	0.01 cm/s	0.01 cm/s	0.01 cm/s
Long-Term Accuracy	± 0.25% ± 2 mm/s	± 0.25% ± 2 mm/s	± 0.50% ± 1.5 mm/s
BB Single Ping Precision	3.5 cm/s @ 2m bin size	3.5 cm/s @ 1m bin size	3.5 cm/s @ 2m bin size
NB Single Ping Precision	20.0 cm/s @ 2m bin size	20.0 cm/s @ 1m bin size	20.0 cm/s @ 2m bin size
Velocity Range	±5.0 m/s (Default); ±20.0 m/s (Maximum)	±5.0 m/s (Default); ±20.0 m/s (Maximum)	±10.0 m/s (Default); ±20.0 m/s (Maximum)
Amplitude Dynamic Range	100 dB	100 dB	100 dB
Amplitude Presicion	0.001 dB	0.001 dB	0.001 dB
Beam Width	2.80°	1.42°	2.16°
Beam Angle	20°	20°	20°

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2.2.2 RDI Workhorse 600kHz ADCP

	600kHz 3" Beams
Velocity accuracy	0.3% of the water velocity relative to ADCP ±0.3cm/s
Velocity resolution	0.1cm/s
Velocity range:	±5m/s (default) ±20m/s (max)
Number of depth cells	1–255
Ping rate	Up to 10Hz
Dynamic range	80dB
Precision	±1.5dB
Beam angle	20°
Configuration	4-beam, convex

2.3 Instruments configuration

CEI	150 sec.	150 sec.	150 sec.	150 sec.	150 sec.
Ping phase	120 sec.	120 sec.	120 sec.	120 sec.	120 sec.
ADCP	**RTI SeaSeven**	**RTI SeaSeven**	**RTI SeaSeven**	**RTI SeaSeven**	**RDI Workhorse**
Beam number / Frequency	3 beams 600 kHz	3 beams 1200 kHz	1 vertical bam 600 kHz	3 beams 600 kHz	4 beams 600 kHz
High depth profiles (>100m)	22 bins 4 m	15 bins 2 m	22 bins 4 m	/	120 bins 0,5 m
Small depth profiles (<30m)	30 bins 1 m	30 bins 1 m	30 bins 1 m	/	120 bins 0,5 m
Deployment	Averaged profiles	Averaged profiles	Averaged profiles	Noise measurement	Averaged profiles
Blanking zone for each location (m)					
Concarneau	1.5	1.5	1.5	25	0.88
Grande vasière	1.5	1.5	1.5	100	0.88
Saint-Nazaire (Loire)	1	1	1	100	0.88
Gino	1.5	1.5	1.5	100	0.88
Douarnenez	0.8	0.8	0.8	100	0.88

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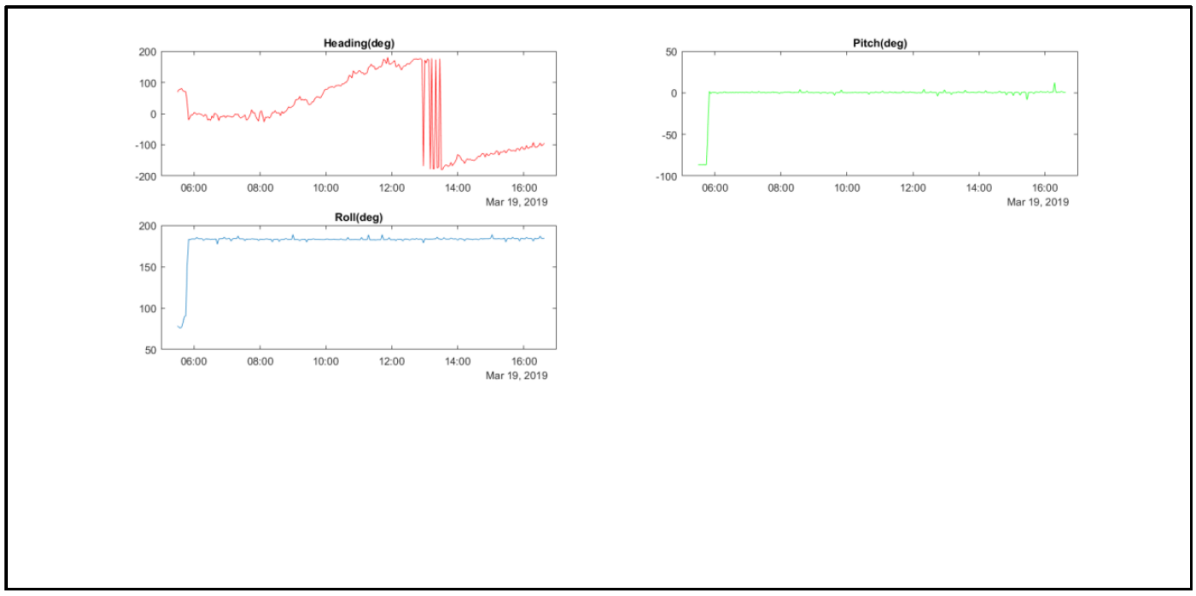
3 PART 2 : ATTITUDES COMPARISON, RAW ECHOE AND BACKSCATTER

3.1 ADCP attitudes

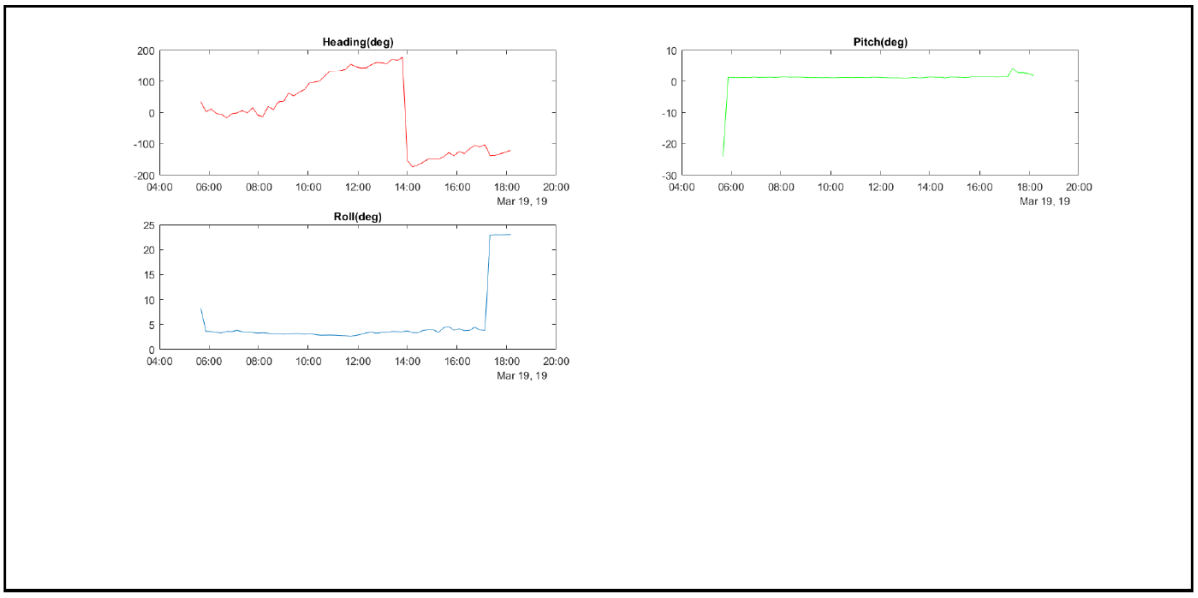
In order to compare these data it must be taken into account that the instruments are placed upside down on the surface of the water, the RTI rotates directly in the data while the RDI will remain at 180 when placed in the water upside down. One should expect to see variations of 180 ° at 0 ° Heading and Roll with the movement of the instrument during the flow and the ebb that places it in inverted situations.

3.1.1 Concarneau

RTI:



RDI:



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Pitch : No big variations, extreme values at the beginning of the profile corresponding to the setting up of the device.

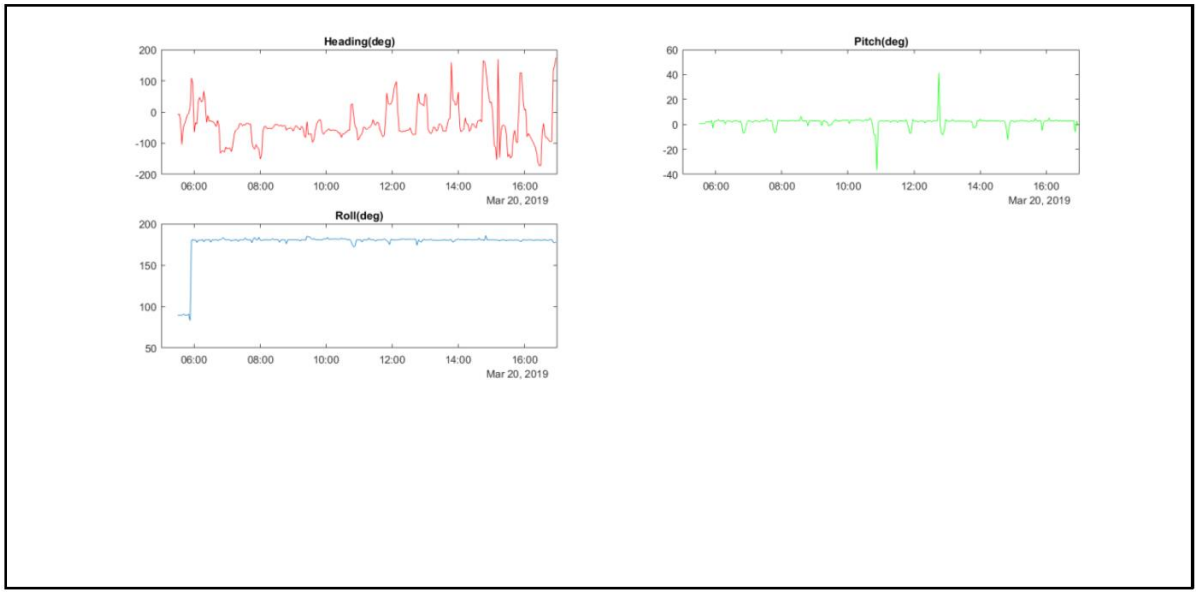
Roll : Fairly stable around 2 ° until resumption of the instrument.

Heading : A change of course visible during the 12h measurement, then drift slowly from 0 to 180 ° on the RDI while the RTI recorded several course changes from 180 to -180 around 14h.

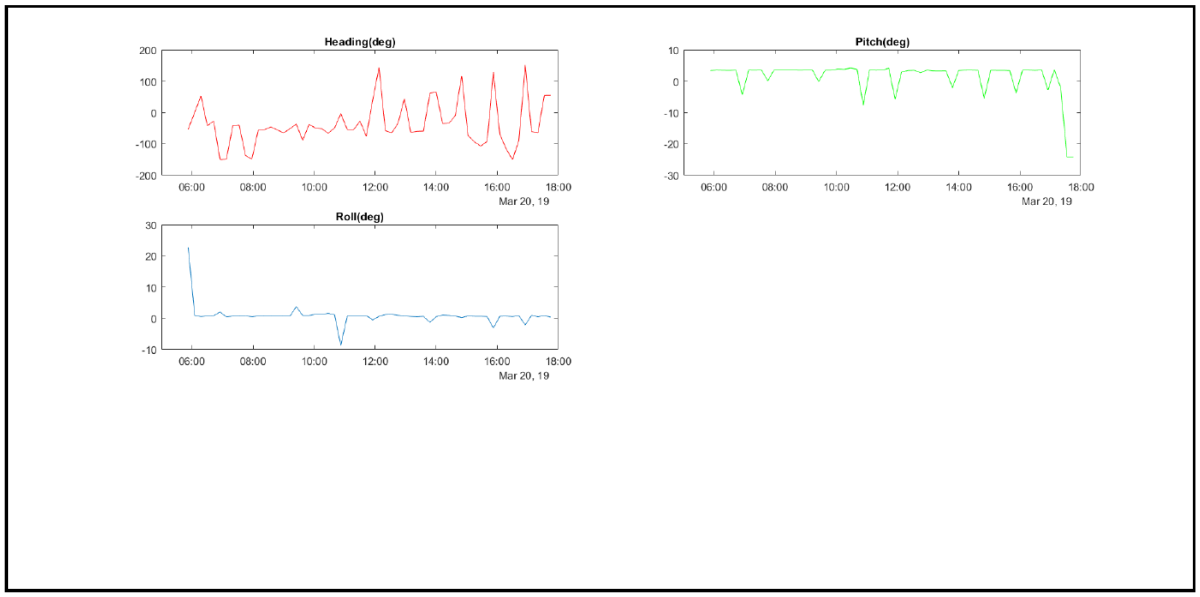
The attitudes of the two instruments are similar.

3.1.2 Grande-Vasière

RTI:



RDI:



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Pitch : Some variations but fairly stable from the beginning to the end of the data, more important variations on the RTI which include some pitch changes up to -40 ° while the extreme values on the RDI reach -10 °.

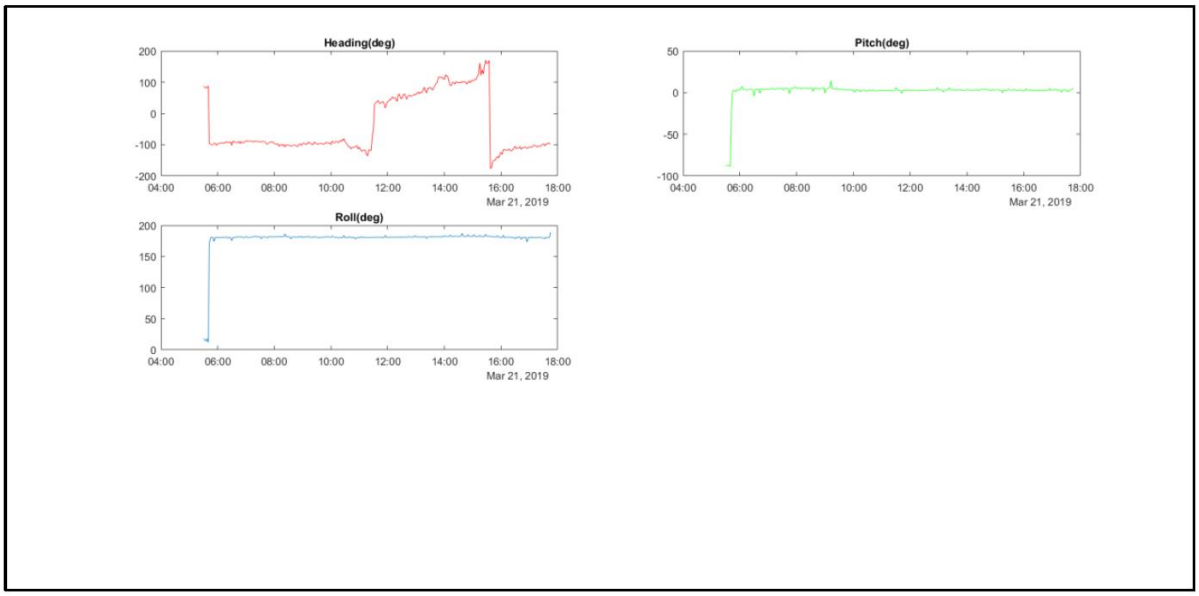
Roll : Small roll with variations around 10 ° for both instruments.

Heading : Several course changes from 0 to 180 ° throughout the station showing that the raft has turned. This could be due to a change in the wave directions.

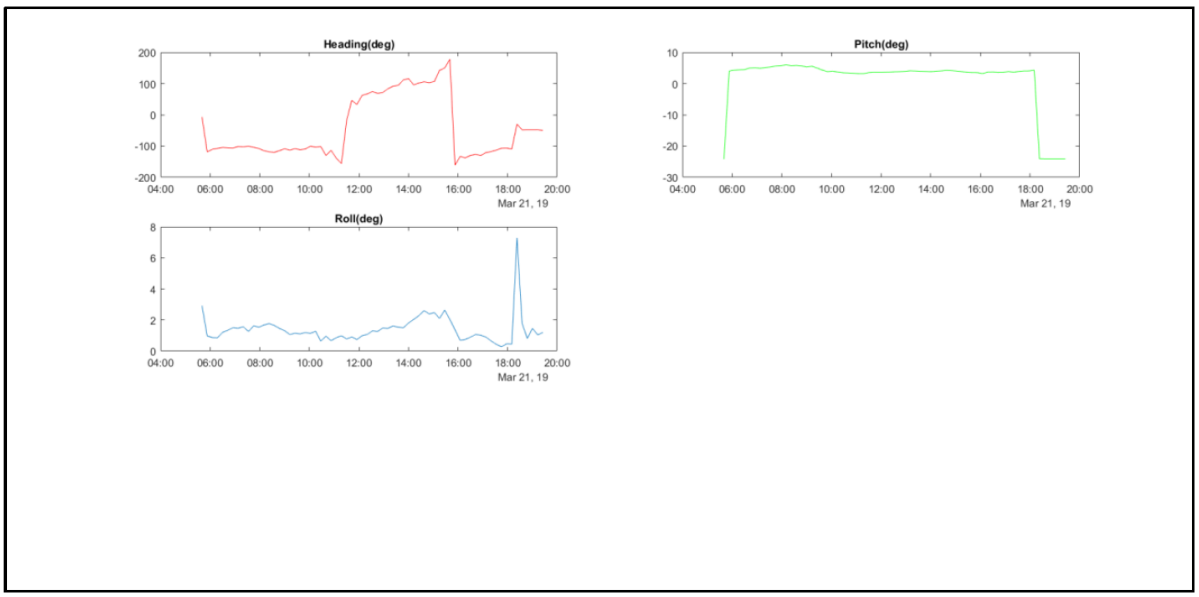
Small swell described on the logbook. Attitudes of the two similar instruments.

3.1.3 Saint-Nazaire (Loire)

RTI:



RDI:



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NOT PROTECTED

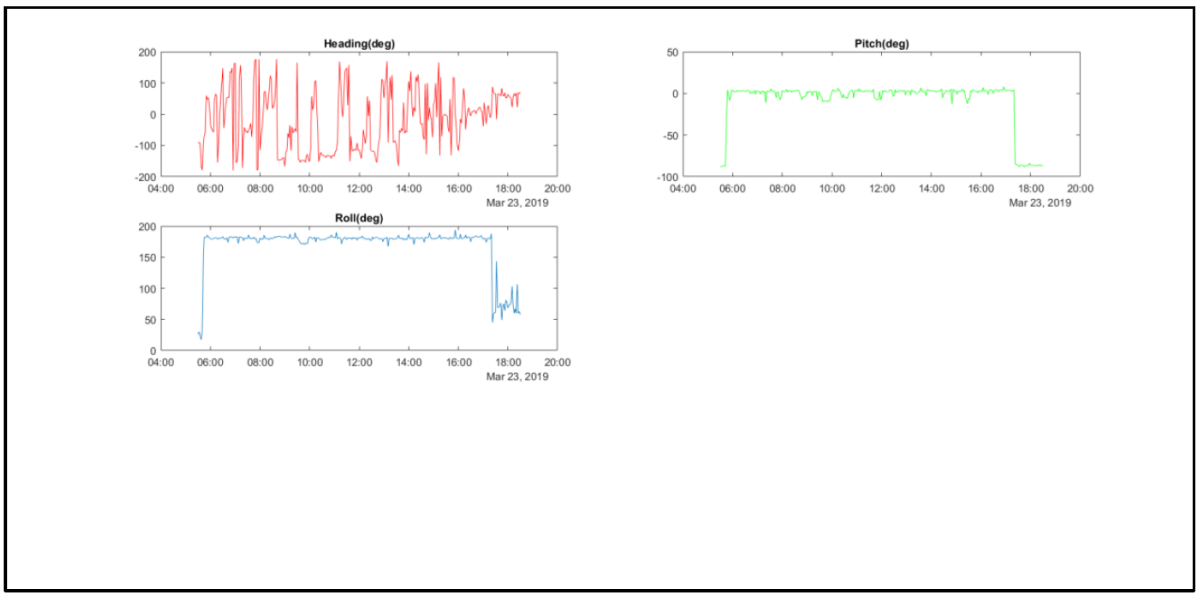
Pitch : Very stable pitch on the RTI and RDI.

Roll : Variations of roll between 0 and 2 ° during the whole measurement, variations higher up to 8 ° maximum but which can correspond to the delivery on the boat of the raft.

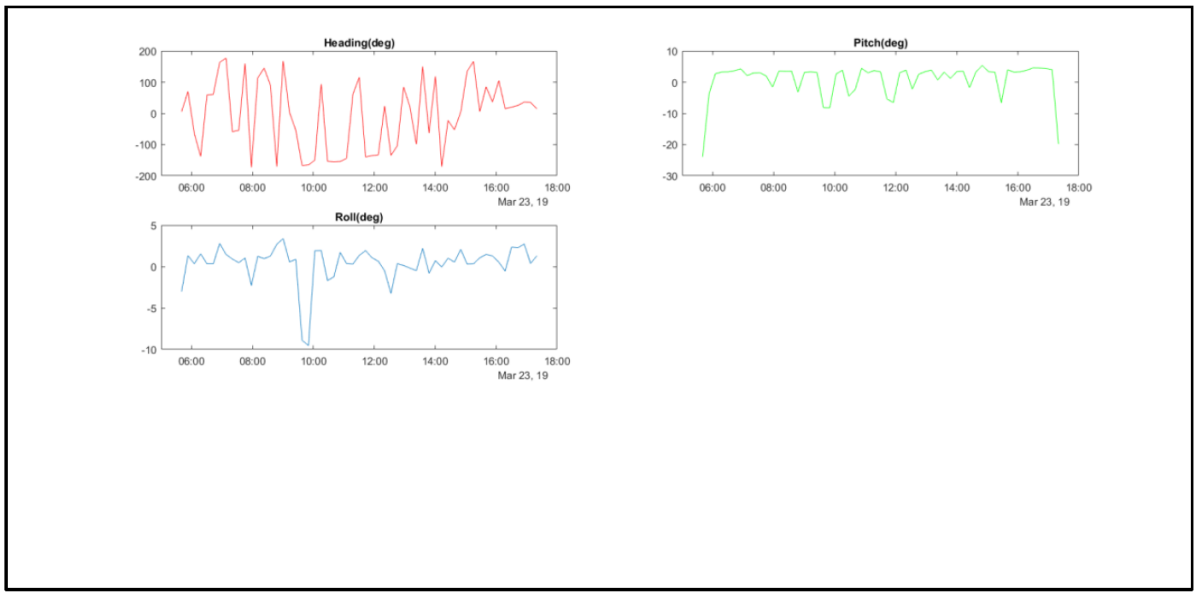
Heading : Cap fairly stable towards -100 ° with a change of - 180 ° to 0 before 12h, then progressive course change up to 180 ° at 16h and finally sudden change to -100 °.

3.1.4 Gino

RTI:



RDI:



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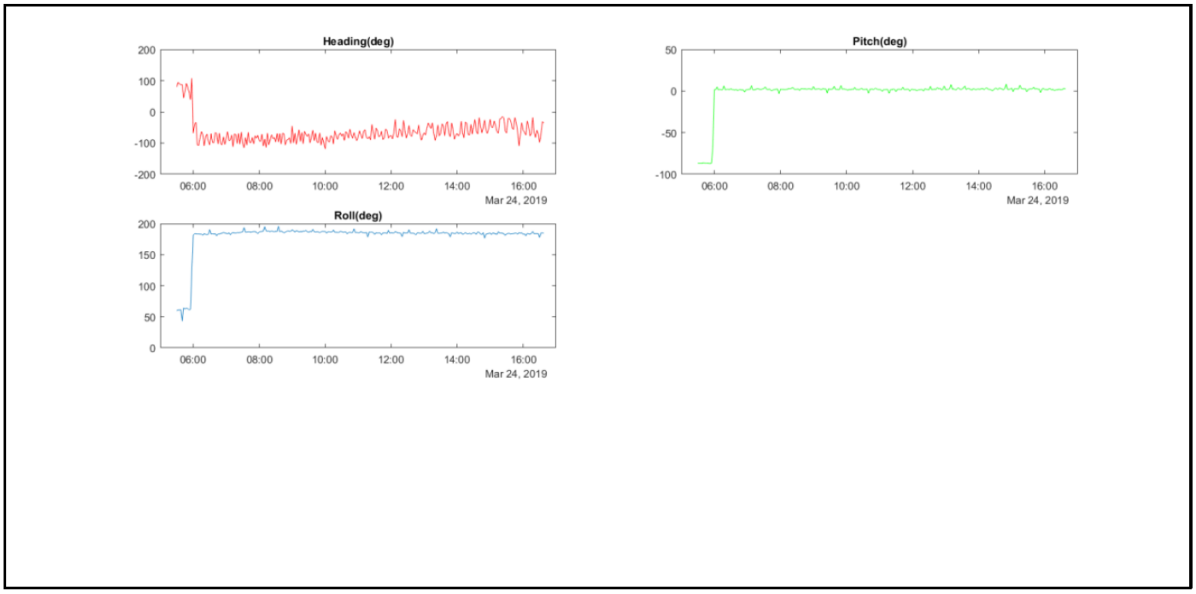
Pitch : Less stable than on other stations, similar variations on the 2 ADCPs between 0 and 10 °.

Roll : Roll quite important, up to 15 ° on the RTI and 10 ° on the RDI

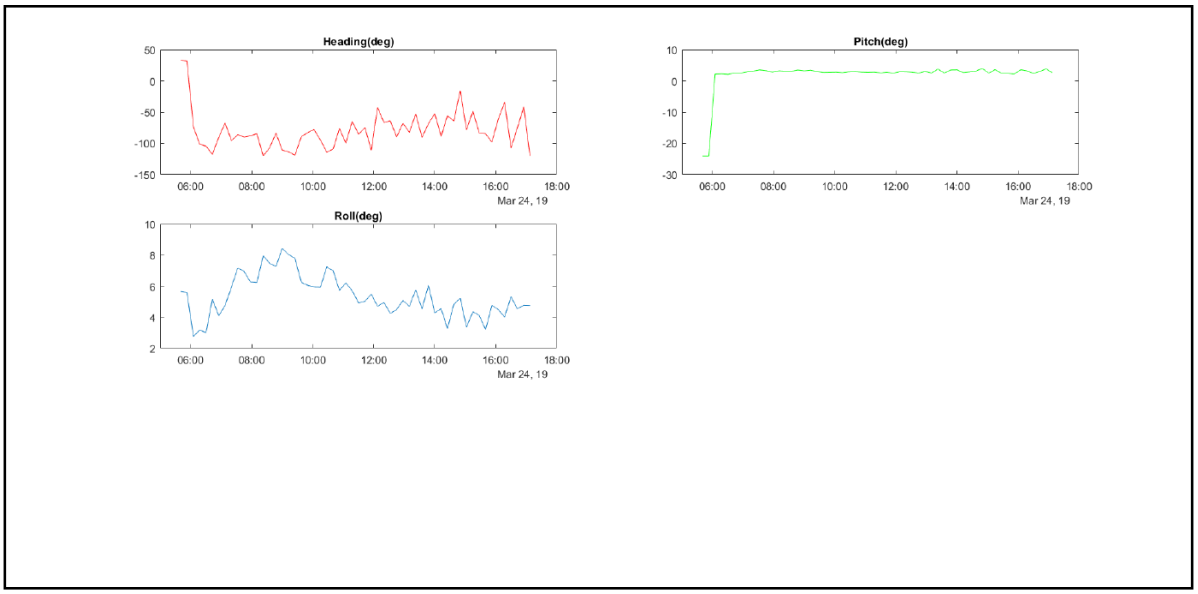
Heading : Many course changes, visible on both instruments.

3.1.5 Douarnenez

RTI:



RDI:



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Pitch : Stable on all data.

Roll : Greater roll, between 0 and 7 ° on the RTI, with high frequency variations up to 15 °, less high frequency variations on the RDI.

Heading : High frequency variations around 100 ° for both instruments, which could be due to small waves.

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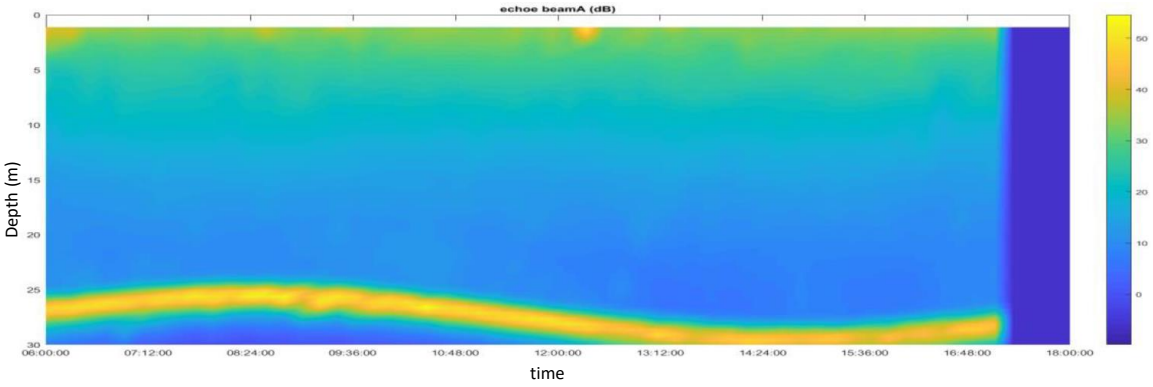
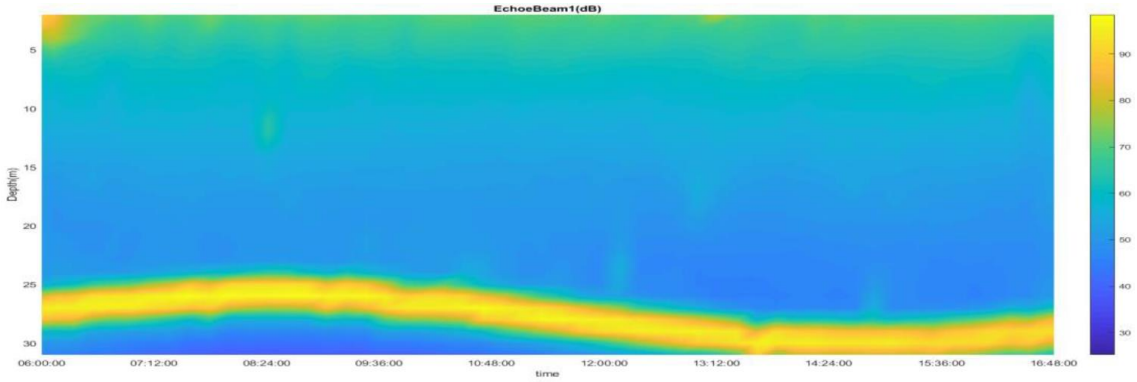
3.2 Raw echoe comparison between the 2 ADCPs

3.2.1 Concarneau

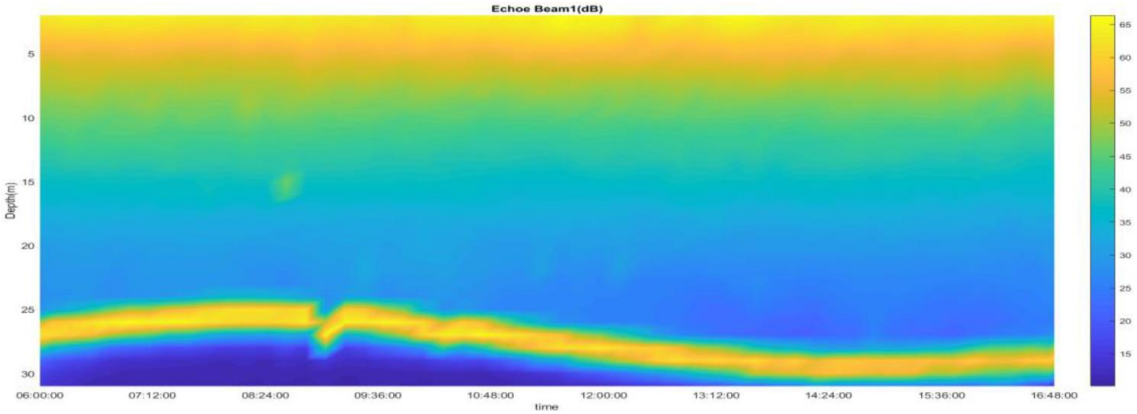
RDI



RTI 600



RTI 1200



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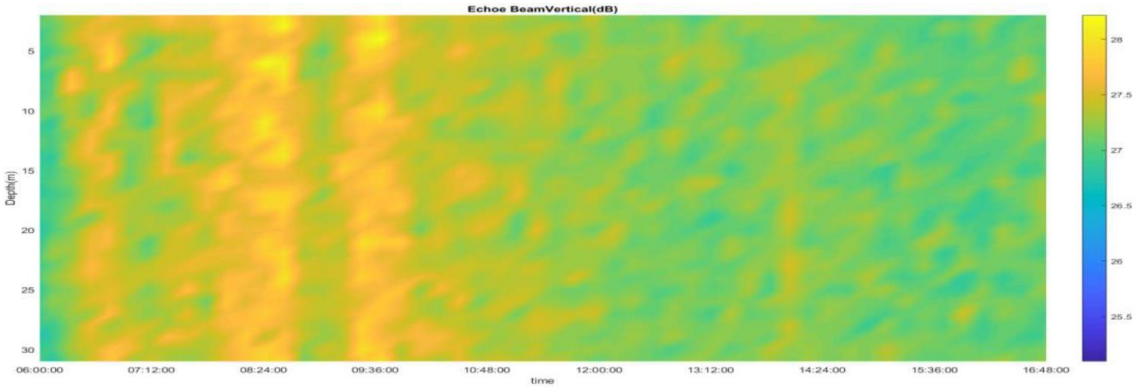
RTI 600 Vertical



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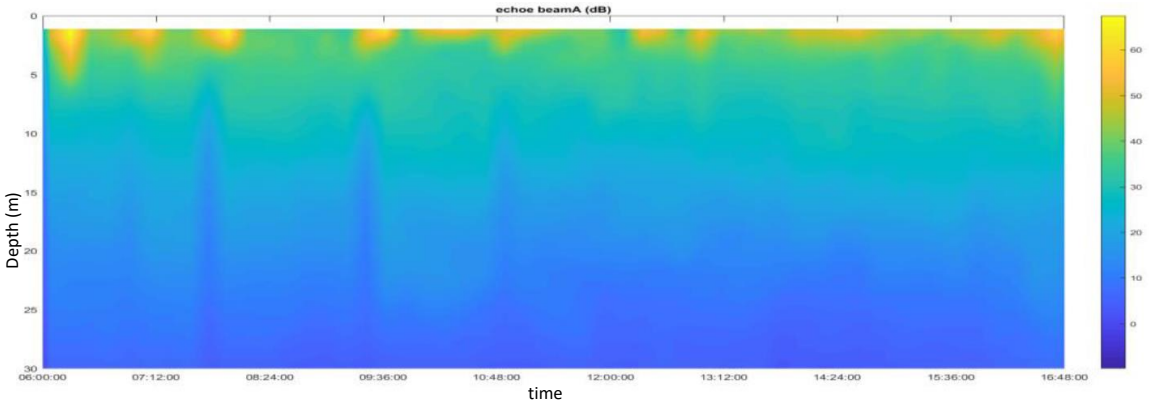
3.2.2 Grande-Vasière

RDI



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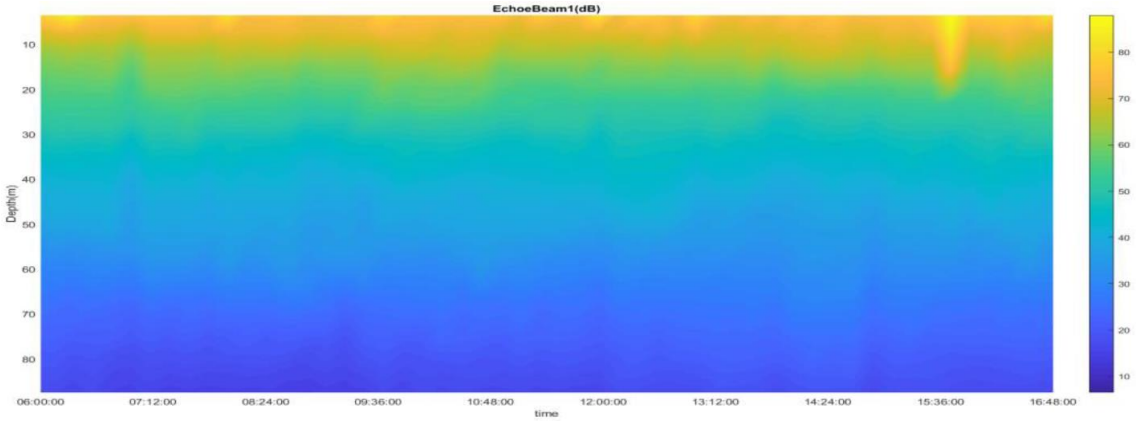
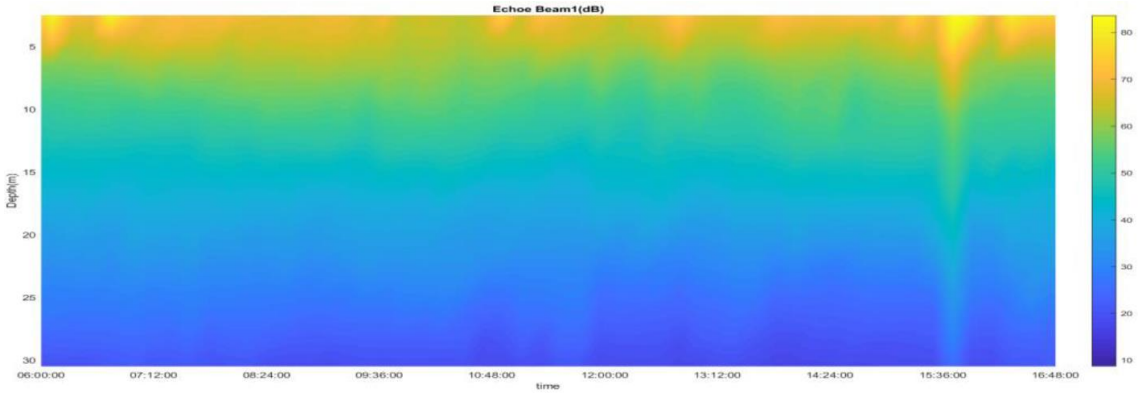


RTI 1200



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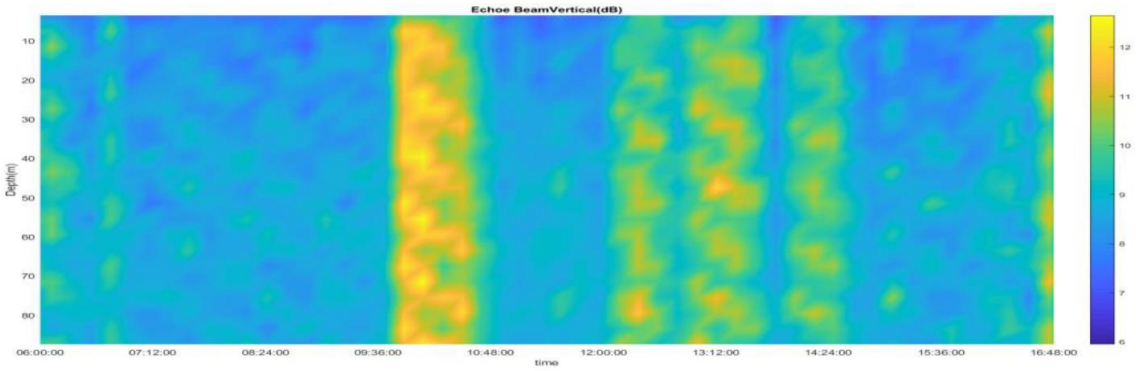
RTI 600 Vertical



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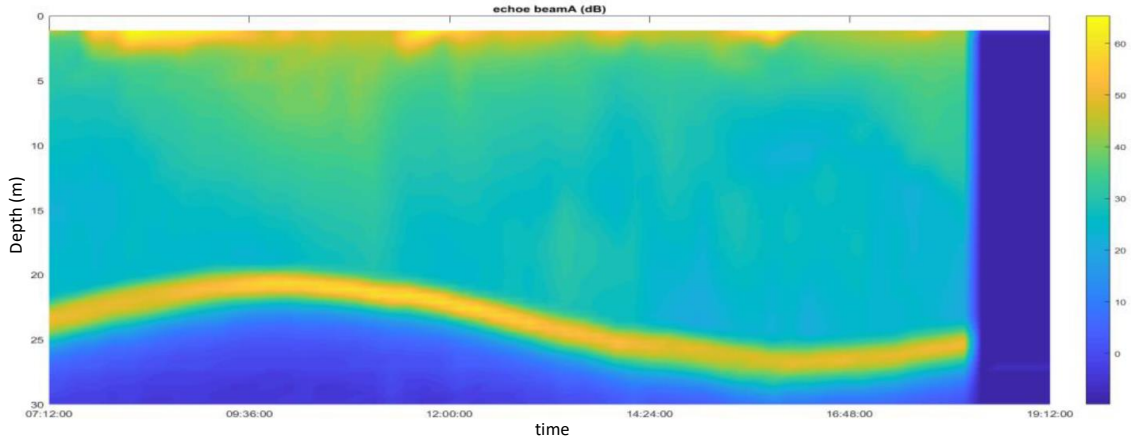
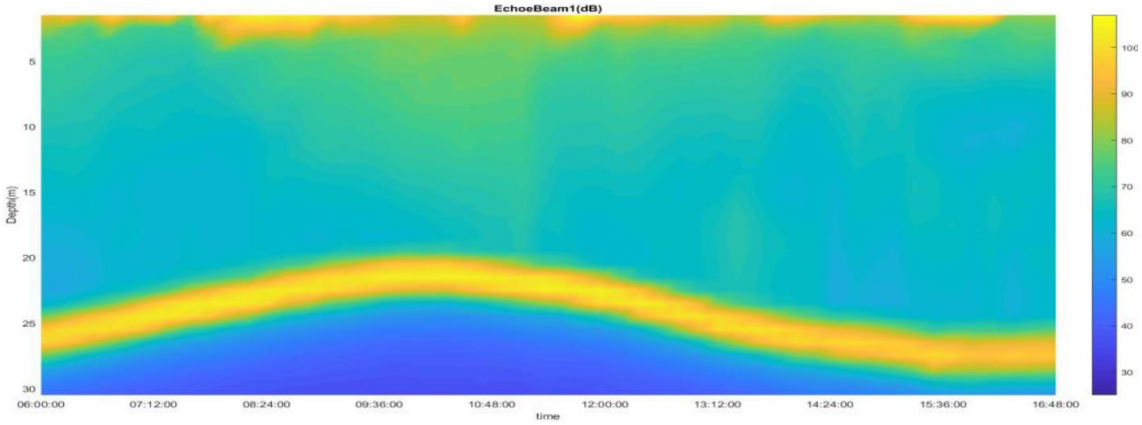
3.2.3 Saint-Nazaire (Loire)

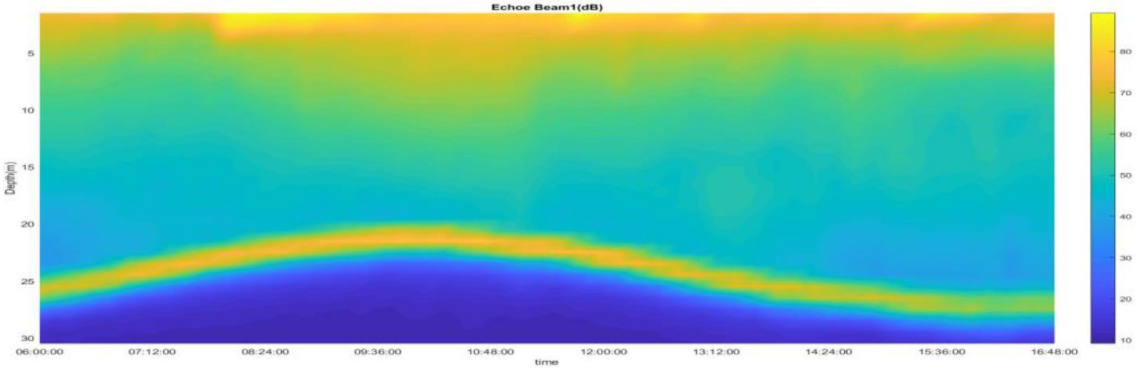
RDI



RTI 600



RTI 1200



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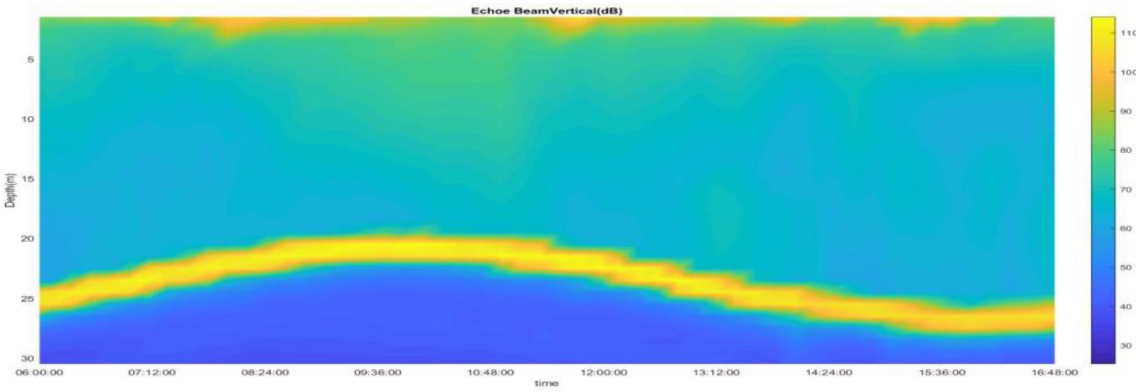
RTI 600 Vertical



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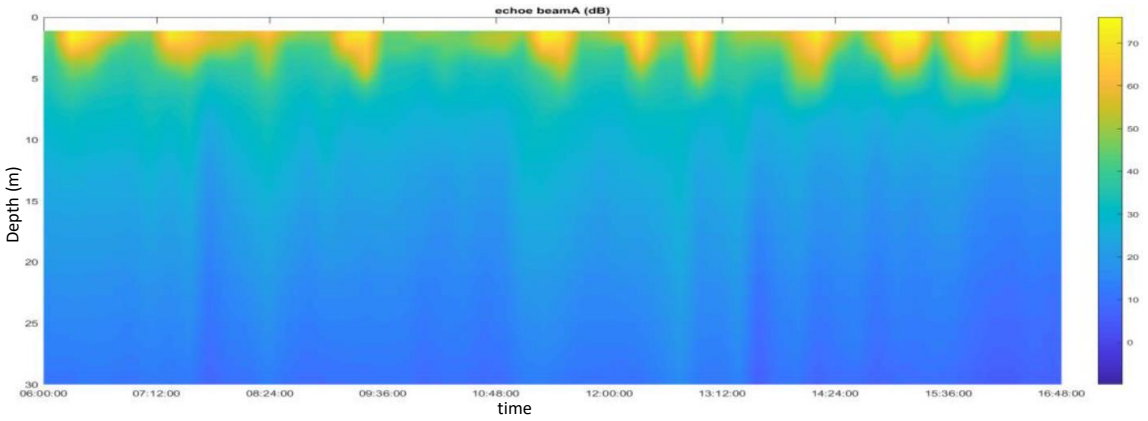
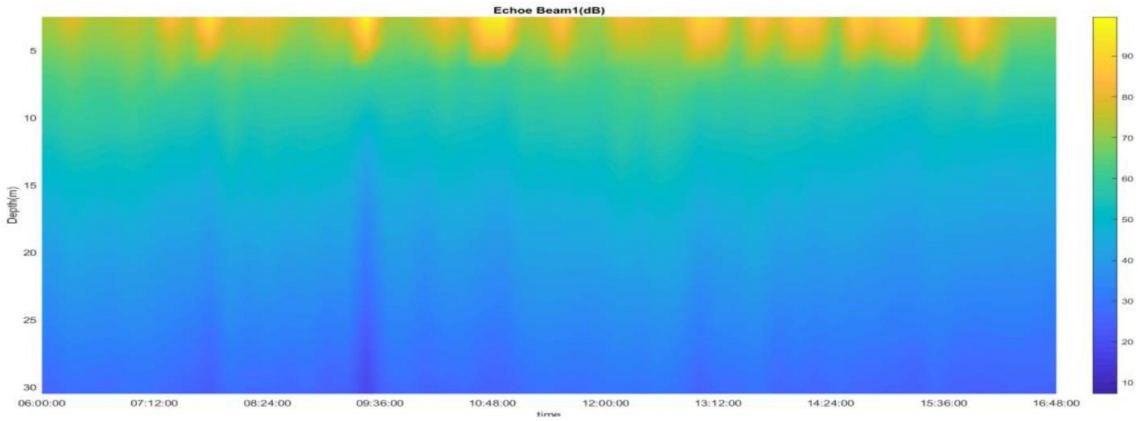
3.2.4 Gino

RDI



RTI 600



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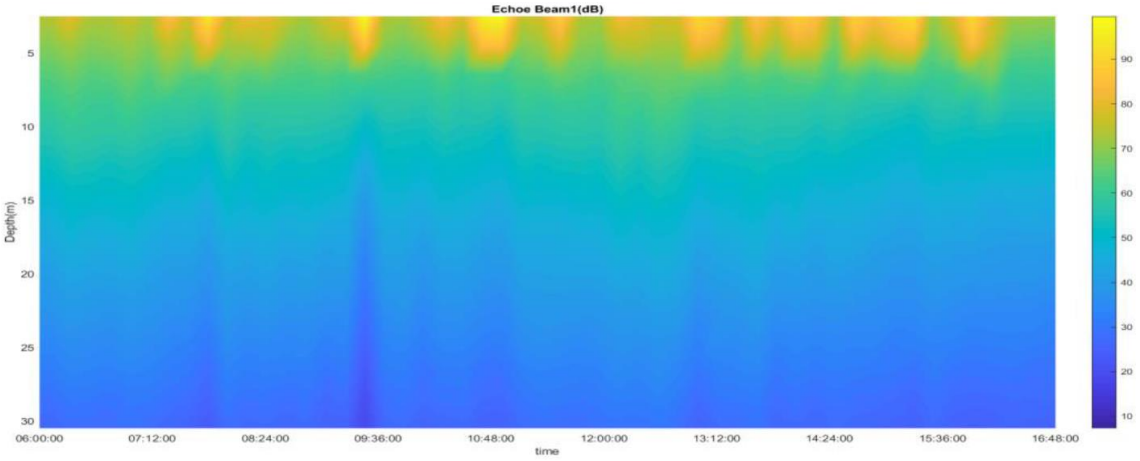

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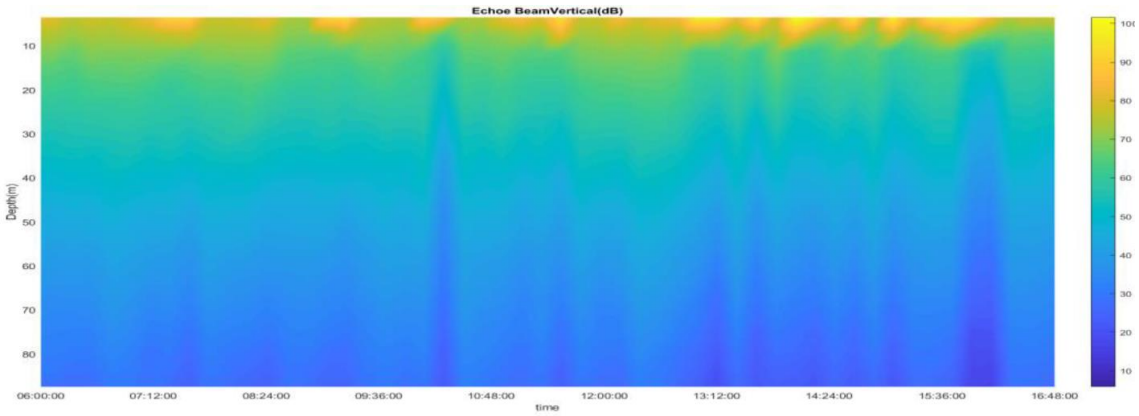
RTI 600 Vertical



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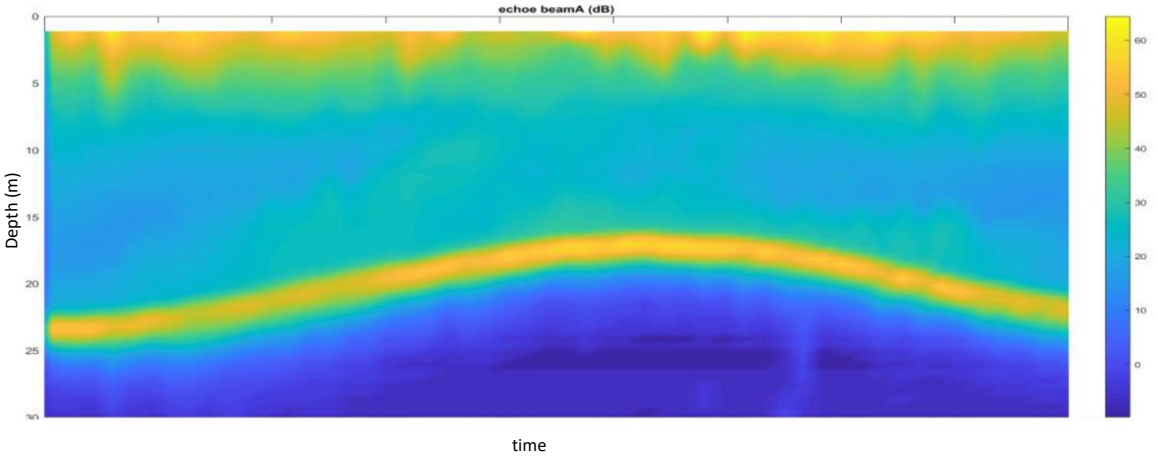
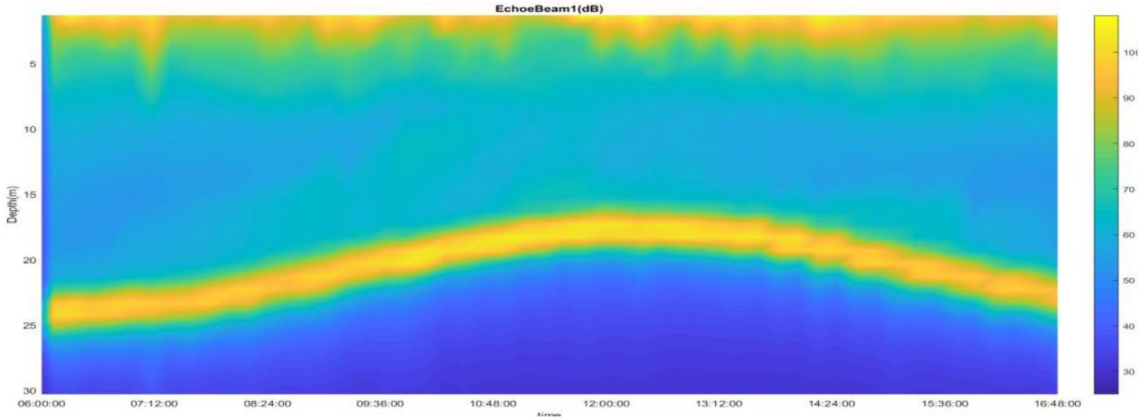
3.2.5 Douarnenez

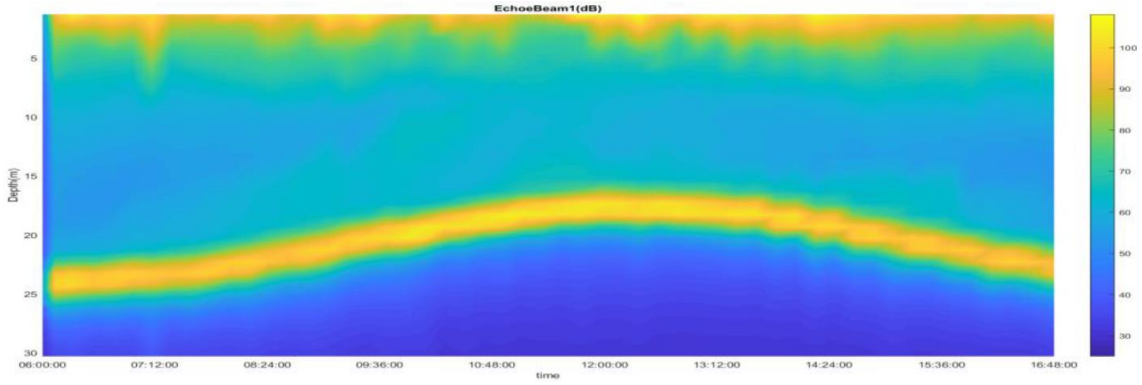
RDI



RTI 600



RTI 1200



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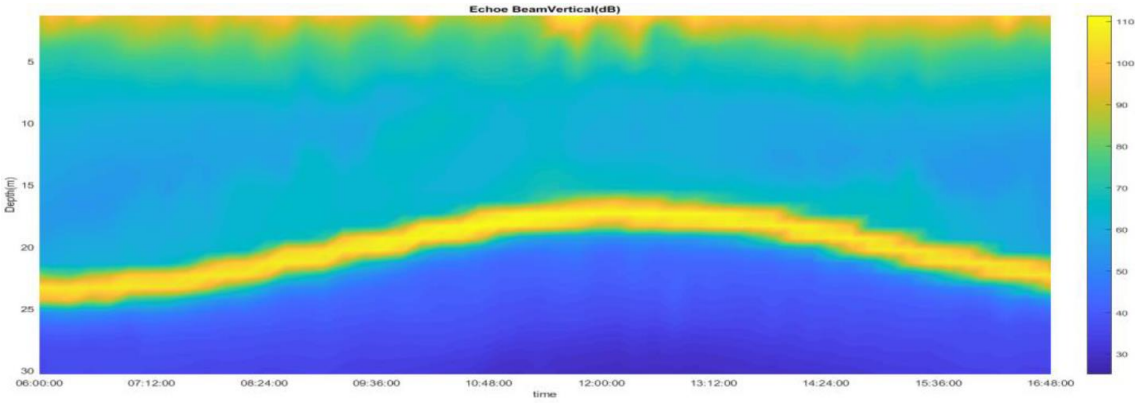
RTI 600 Vertical



3.2.6 Analysis

Concarneau : Small bottom area. Echo transmitted to the bottom, about 28m on the RDI and RTI. For RDI the echo is between 0 and 50 dB with a negative gradient from the surface to the bottom with few particles. For the RTI 600 the echo is between 30 and 90 dB with a similar gradient as on the RDI, some punctual echoes in the 75 dB water column. The RTI 1200 has a similar gradient ranging from 65 to 15 dB but with less echo throughout the entire water column. Few point echoes, echo of the bottom which punctually deepens around 9:00, only on this subsystem (potential problem only perceptible at this frequency). The vertical beam does not seem to work or an obstacle prevents its operation.

Grande-Vasière : Deep-sea area, penetration up to 60m. The RDI shows some echo on the spot surface at 60dB, it could be bubbles, the echo is between 0 and 65dB. Surface echoes are less visible on the RTI 600 and 1200, both are between 10 and 80 dB. Few particles in the water because only the gradient towards the bottom is visible. The vertical beam does not seem to work, which seems possible when one does not receive the echo of the bottom.

Saint-Nazaire (Loire) : Small bottom area. Bottom at around 25m. RDI echo between 0 and 60 dB with a fairly present surface echo, maybe bubbles. Presence of particles in the rather large water near the surface which gradually fades towards the bottom with an echo of 45 dB on average. Similar echo on the RTI 600 and 1200, the echo 600 is 20dB higher than the 1200. The presence of particles is less visible on the vertical beam with an echo of 30 to 110 dB.

Gino : Deep-sea area. RDI echo between 0 and 70dB, RTI 600 and RTI 1200 echo between 10 and 90 and Vertical beam echo between 10 and 100. The echoes are all similar, with few particles in the water column but a important surface echo may be due to bubbles, rough seas during this measurement.

Douarnenez : Small bottom area. Bottom at around 25 m. Significant surface echo and presence of particles near the bottom. The echoes are similar for each RTI and RDI subsystems. The RDI echo is between 0 and 60 dB, the RTI between 30 and 100 and the RTI vertical between 30 and 110 dB.

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3.3 Comparison of echoes after conversion to backscatter

Conversions done on the raw echo :

The raw echo received conversions are intended to find the intensity of the backscattered volume (**BS** in dB) which depends directly on the concentration of suspended particles in the water column. To find the intensity of this backscattered volume, it is necessary to calculate the target strengh (dB / m^2) **TS** as well as the insonified volume (m^3).

The insonified volume depends on the angle of the solid beam opening which is expressed in steradians (ϕsr), and the distance from the wave to the transducer (R) which depends on the depth (Z) and the beam orientation angle (θ).

The target strengh **TS** of the particles is described by the sonar equation :

TS = RL + DT – SL + 2TL

RL is the reverb level obtained by the ADCP (in counts or dB), **DT** the detection threshold (dB), **SL** the transmitted power requested by the manufacturer (dB) and **TL** the transmission losses (dB).

Here **DT** was set at 83dB. The **SL** of the RDI600 is 217.1 dB, the RTI600's is 221dB and the RTI1200's is 218 dB. The transmission losses are due to the spherical divergence included in the first term of the equation (20 x log (R)) and to the damping by the dissipative medium (AW x R) with AW the attenuation-due-to-water coefficient (calculation and detail below), it depends on the characteristics of the environment as temperature, pressure, salinity.

Parameters :

- φr (radians) =φ (degrees) x π / 180 *; (opening angle converted in radians)*
- φsr (steradians) = π x φr x φr / 4 *; (angle converted in solid angle in steradians)*
- θ=20 *; (beam angle)*
- R= Z / cos (θ)
- V= φsr x (ψ x R)^2 x L *; with ψ =1 and L= transmitted length pulse*

Transmit power :

- Echoe x SIL *; (Sound intensity level)*
- Sal=35 x 0.028571 *; (Relative salinity)*
- f1=exp (Temp x 0.038462) x sqrt (Sal) x 0.78 *; (relaxation frequency for boron)*
- f2=exp (Temp x 0.058824) x 42.0 *; (relaxation frequency for magnesium)*
- fs= 600 x 600 *; (square of the frequency)*

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Frequency dependence to boron and magnesium :

- $ff1 = \frac{f1 \times fs}{fs + f1 \times f1}$

- $ff2 = \frac{f2 \times fs}{fs + f2 \times f2}$

Attenuation :

AW = 1.06E-4 x ff1 x exp ((8-pH) x 10.56) x 5.2E-4 x (1.0 + Temp x 0.023256) x Sal x ff2 x exp(Pressure x -1.66667E-4) + 4.9E-7 x fs x exp (Temp x -0.037037 + Pressure x -5.88235E-5)

Transmission loss :

TL = 20 x log (R) + (AW x R)

Target strength :

TS1 = Echo + (DT - SL) + TL x 2

Backscatter :

BS1 = TS1 - 10 x log (V)

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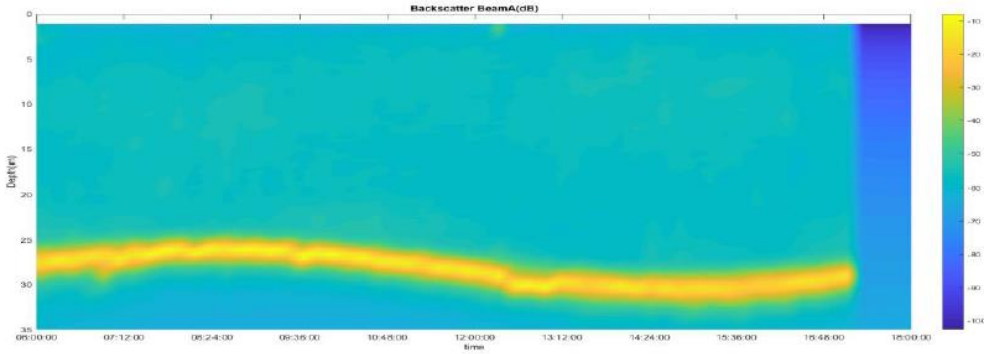
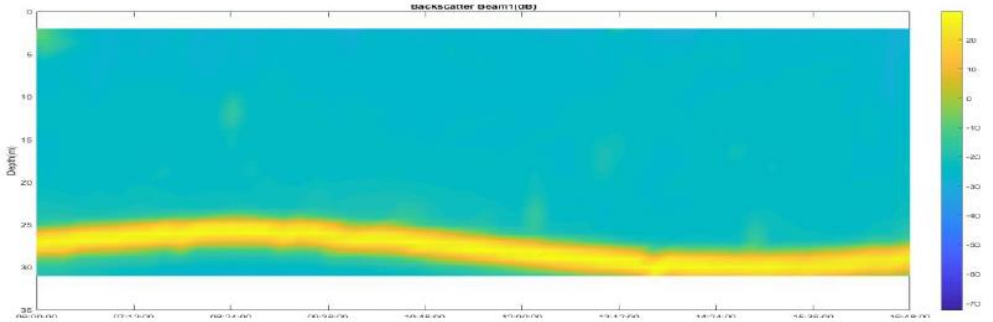
3.3.1 Concarneau

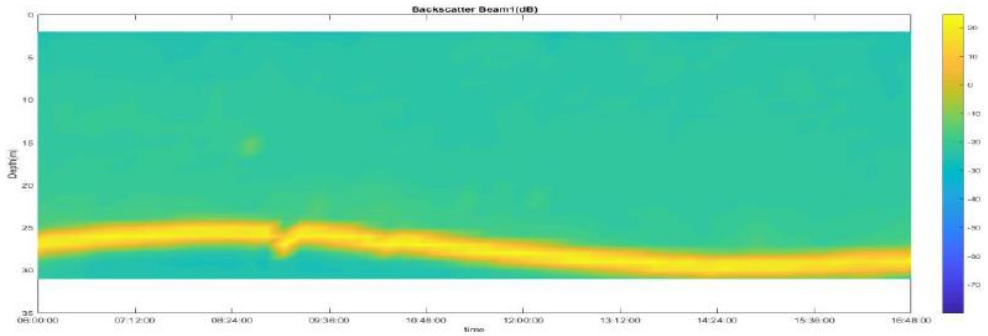
RDI :



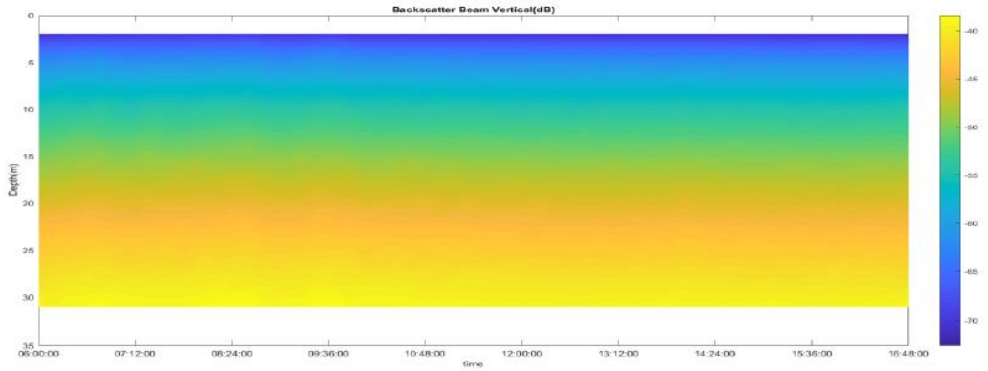
RTI 600 :



RTI 1200 :



RTI Vertical :



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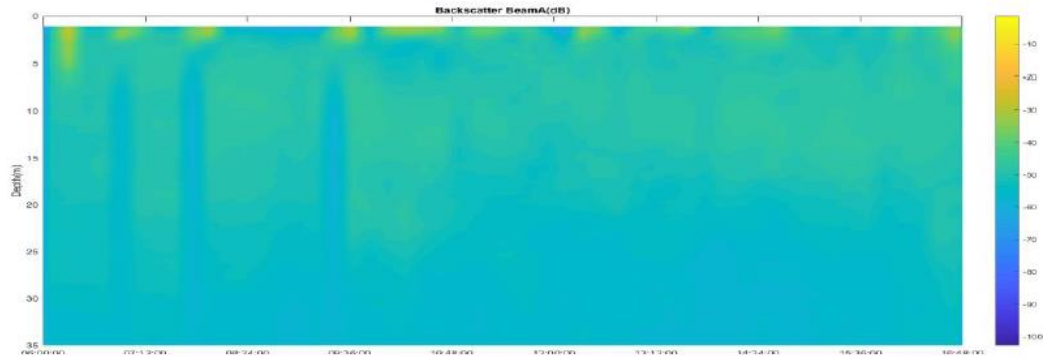
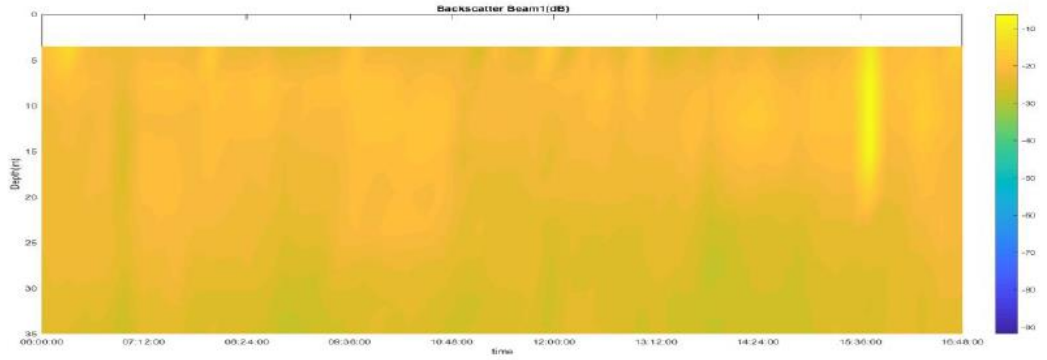
3.3.2 Grande-Vasière

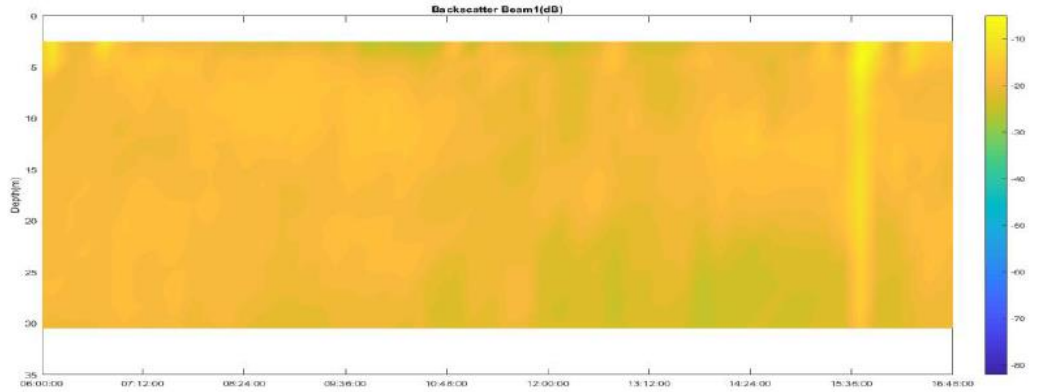
RDI :



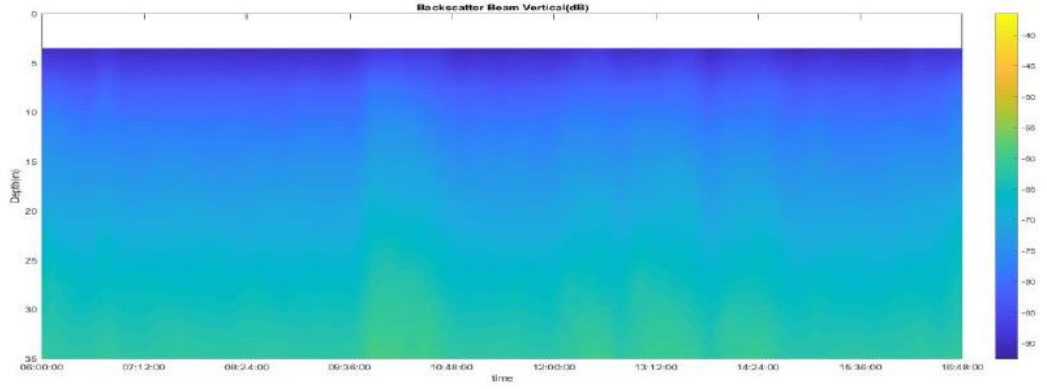
RTI 600 :



RTI 1200 :



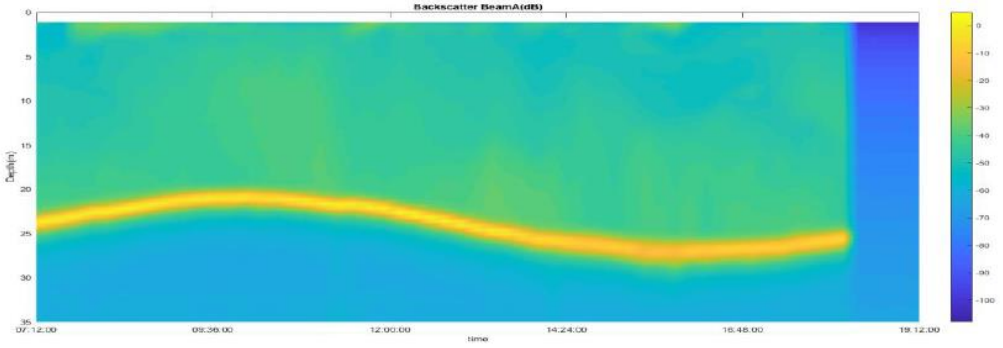
RTI Vertical :



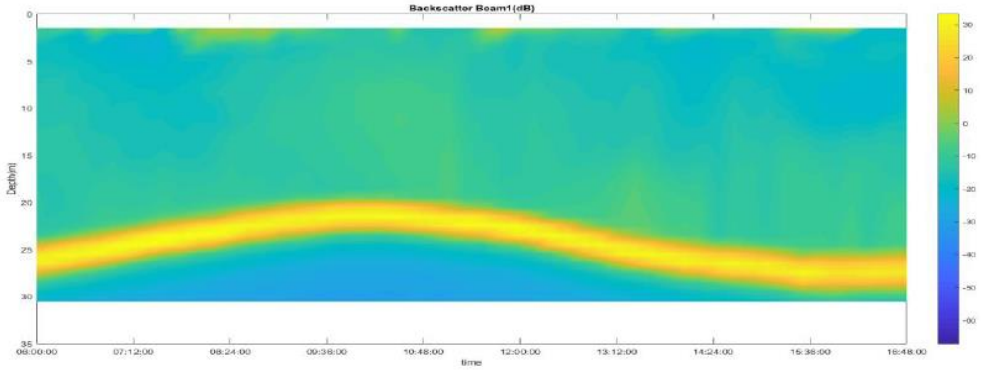
NOT PROTECTED

3.3.3 Saint-Nazaire (Loire)

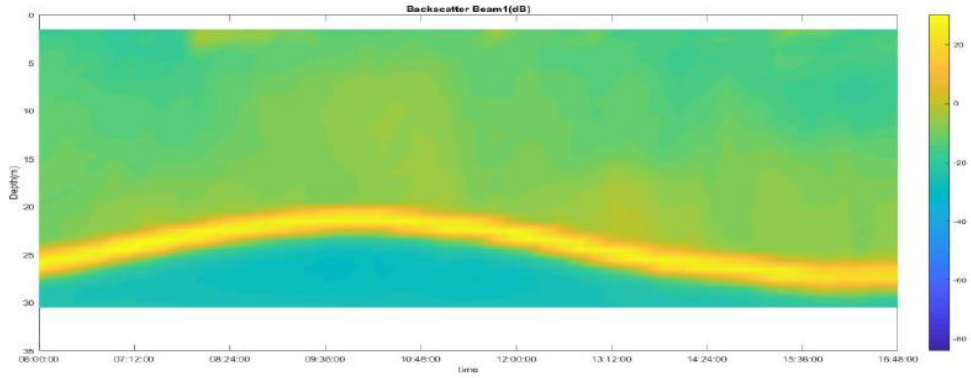
RDI :



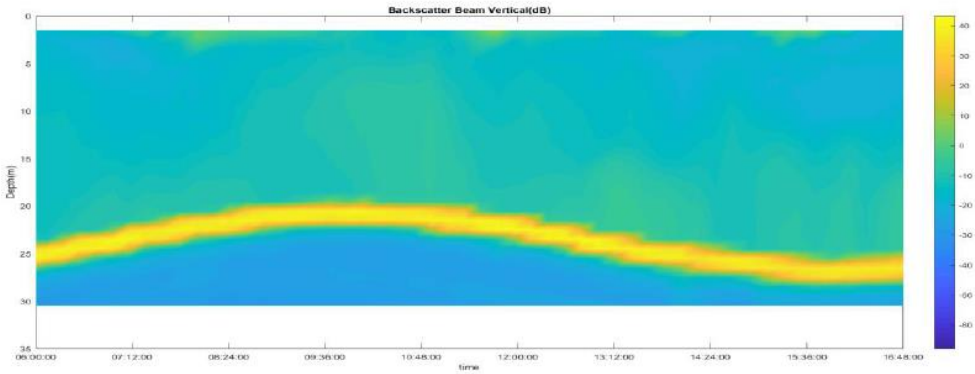
RTI 600 :



RTI 1200 :



RTI Vertical :



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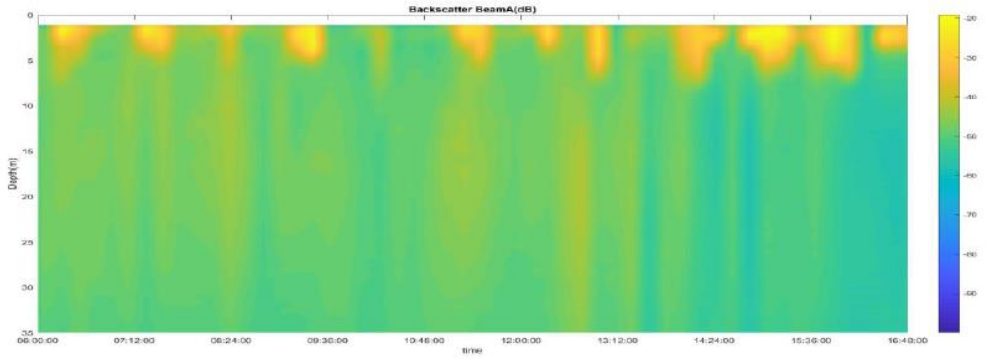
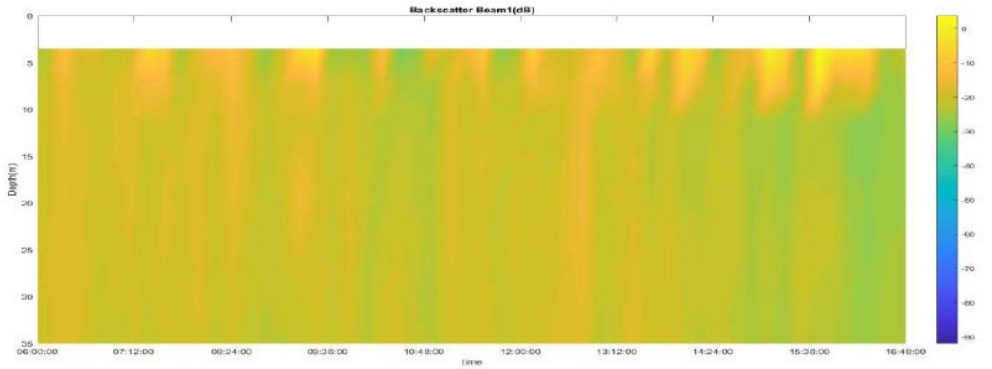
3.3.4 Gino

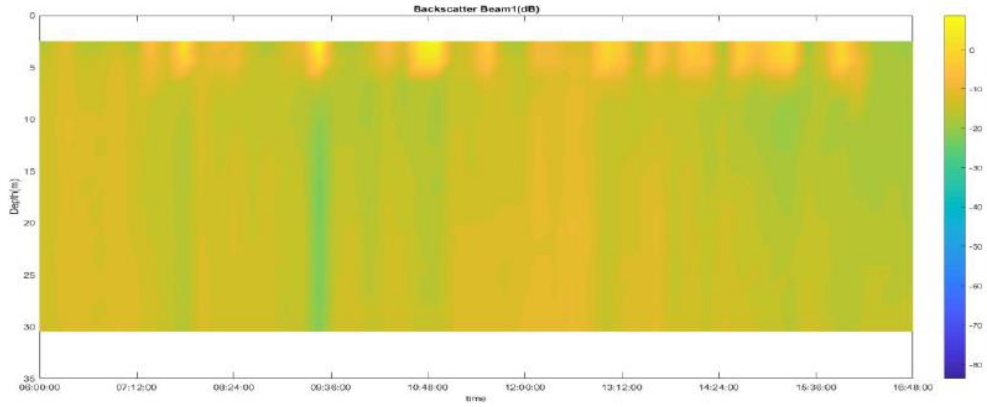
RDI :



RTI 600 :

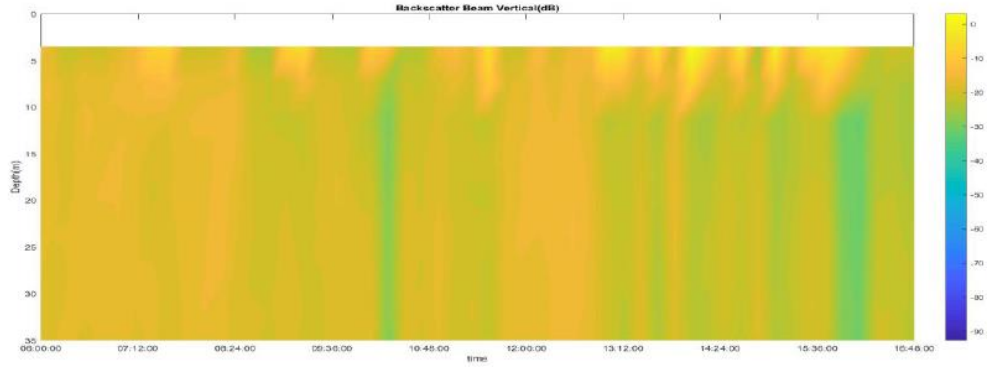


RTI 1200 :



RTI

Vertical :



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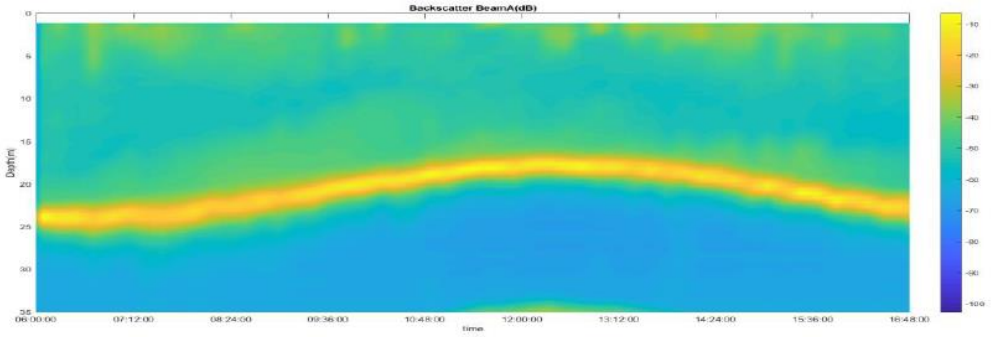
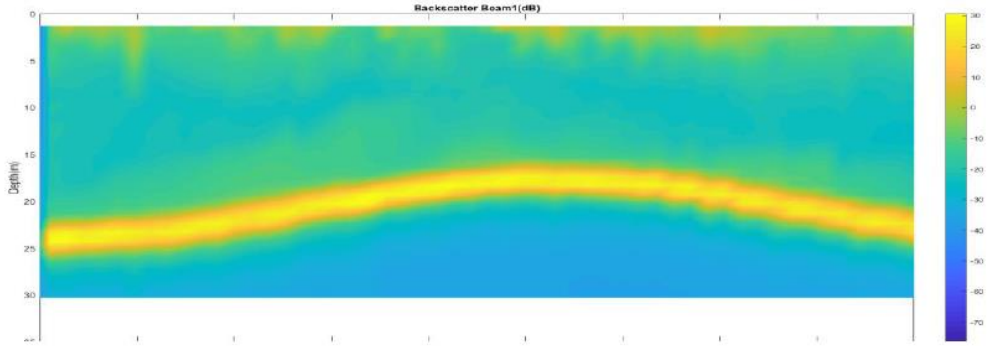
3.3.5 Douarnenez

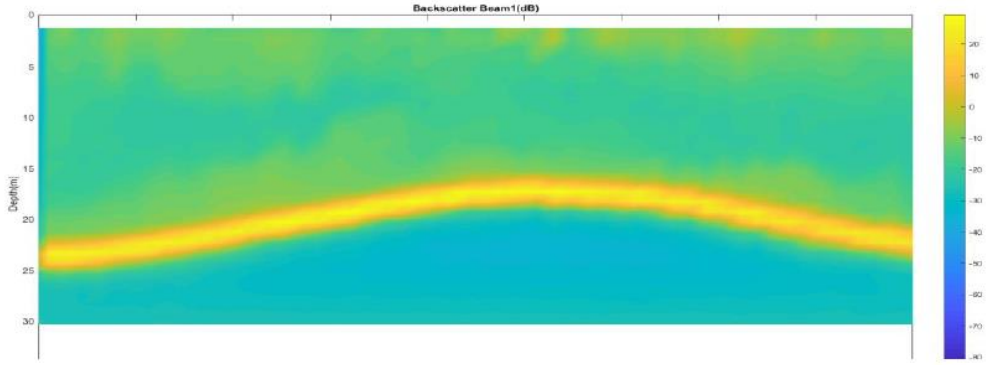
RDI :



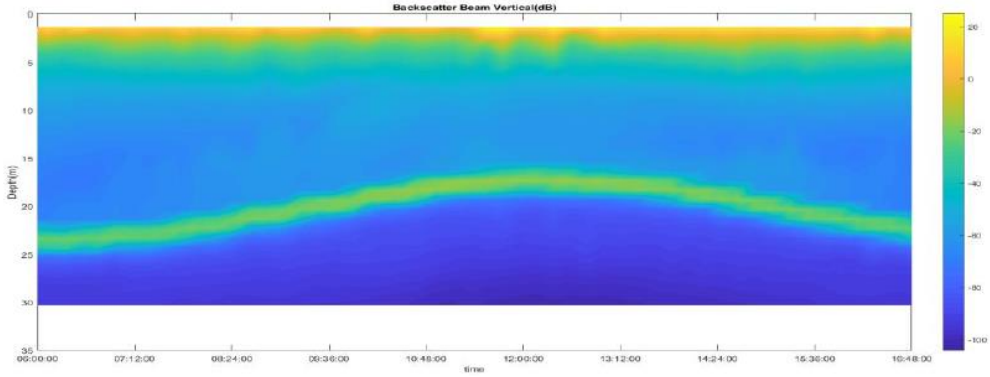
RTI 600 :



RTI1200 :



RTI Vertical :



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3.3.6 Analysis

Concarneau : The RDI treatment removed all raw echoes present, leaving a homogeneous water column with a received echo at -50 dB on average. The RTI 600 keeps occasionnal echoes in the water column with an average of -20 dB. The RTI 1200 removes almost all occasionnal echoes from the water column, with an average echo at -20 dB. The vertical beam is not working so its result is not conclusive, the resulting echo is homogeneous, it presents only a gradient from the surface to the bottom of -70 to -40 dB.

Grande-Vasiere : The column of water after treatment seems rather homogeneous, with only a small visible surface echo on the RDI that may be due to bubbles and some particles up to 15 m depth with an average of -50 dB. The RTI 600 and 1200 have an average of -20 dB. Slight gradient from the surface to the bottom. The vertical beam is homogeneous with a gradient giving values of -90 dB at the surface down to -60 dB near the bottom.

Saint-Nazaire (Loire) : Presence of particles in the water column from the bottom, with a punctual surface echo with an average of -40 dB on the RDI. Surface echo more visible on the RTI 600, but weaker in the water column with an average of -10 dB. Average echo higher (at 0 dB) on the RTI 1200. Average at 0 dB on the vertical beam, some echoes on the surface but not very visible.

Gino : Highly visible punctual surface echo up to 5m at -30dB with a weaker echo in these places that extends to the bottom. Between these points, the echo seems weak and homogeneous up to the bottom. The behavior of the two instruments is similar.

Douarnenez : Echo close to the surface and close to the bottom, does not seem to be bubbles because we also obtain a deep echo after treatment, with an average value for the RDI of -40dB. Background echo less visible on the RTI, average of -10 dB. Contrast less visible on the 1200. The vertical beam hardly captures the echo contrast.

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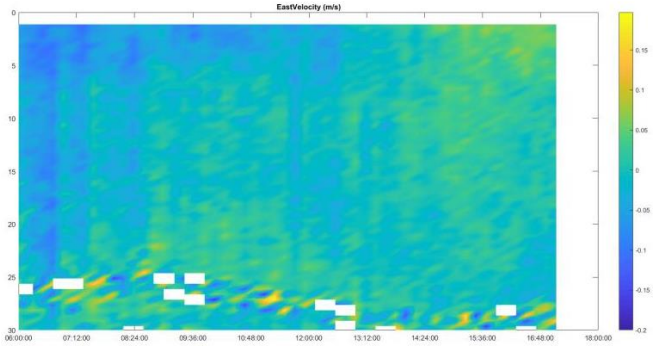
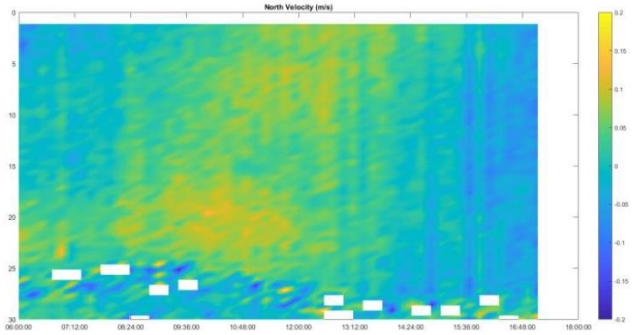
3.4 Speed comparison on the 2 ADCPs

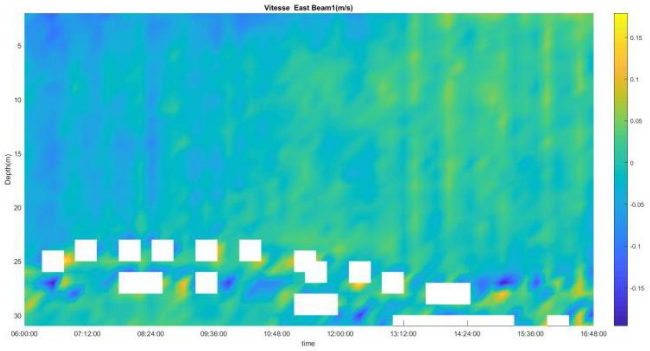
3.4.1 Concarneau

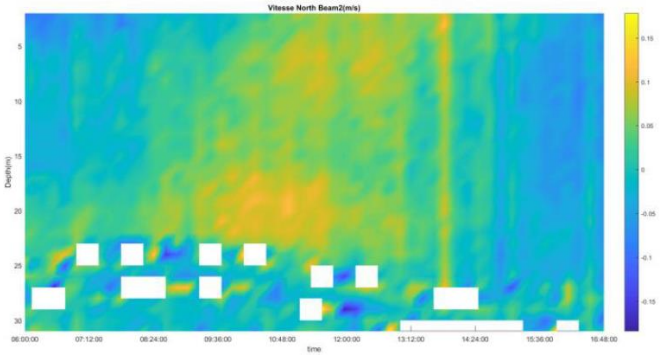
RDI :



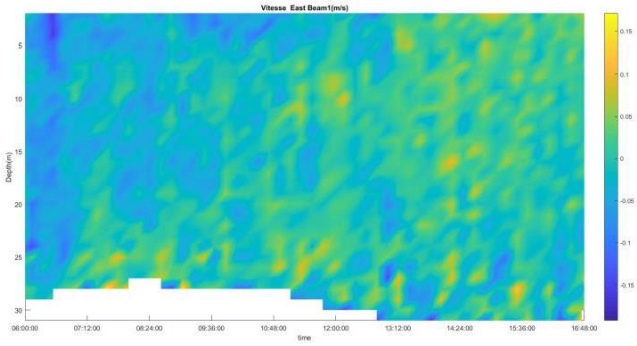


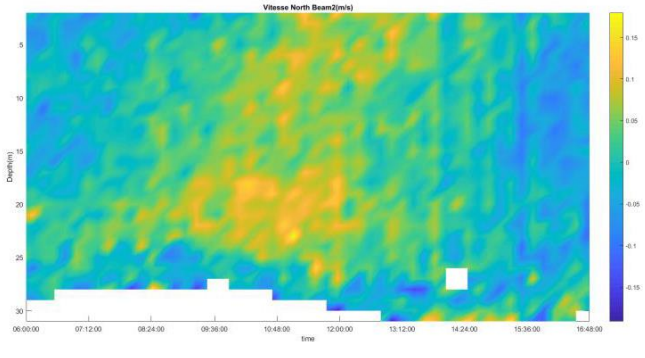
RTI 600 :





RTI 1200 :





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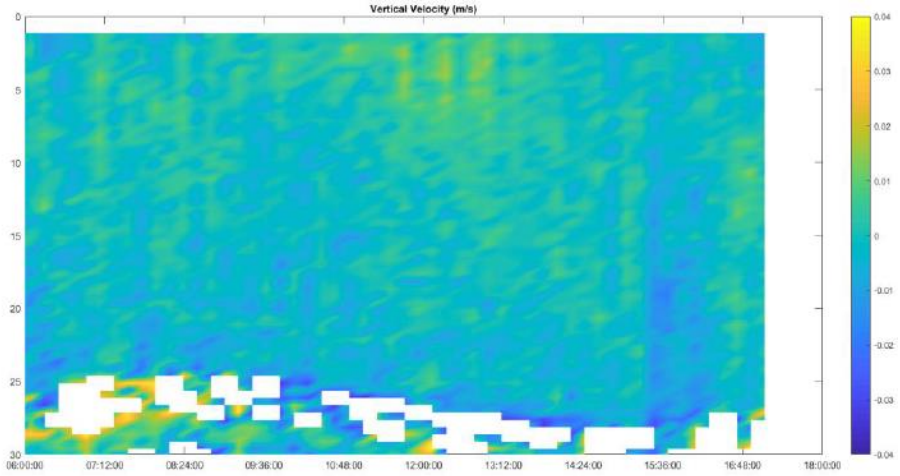
NOT PROTECTED

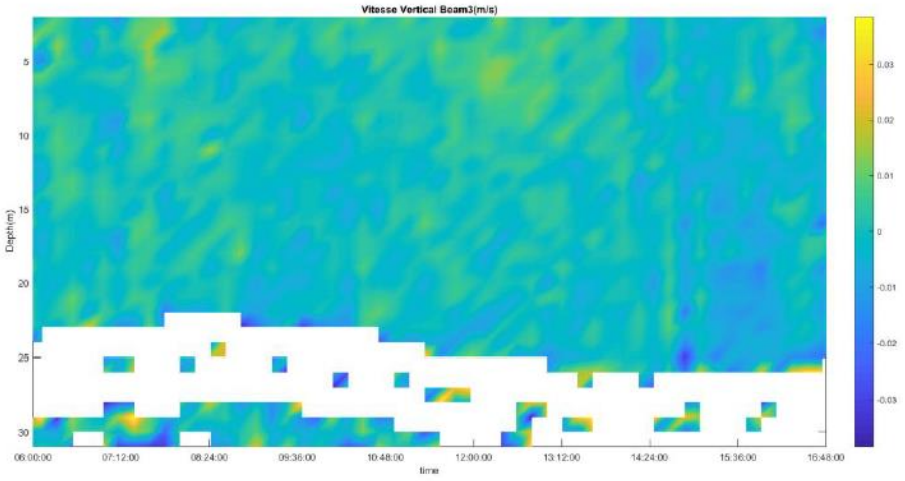
RDI

Vertical :



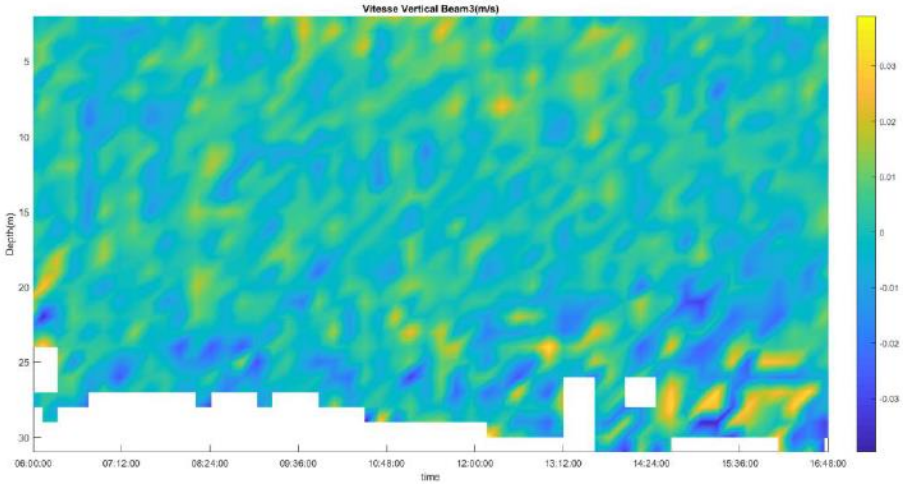
RTI 600

Vertical :



RTI 1200

Vertical :



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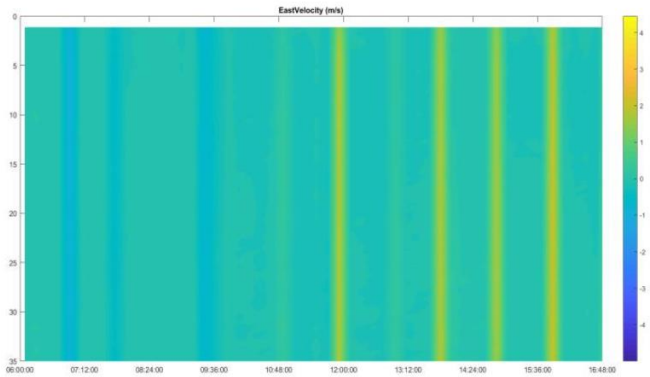
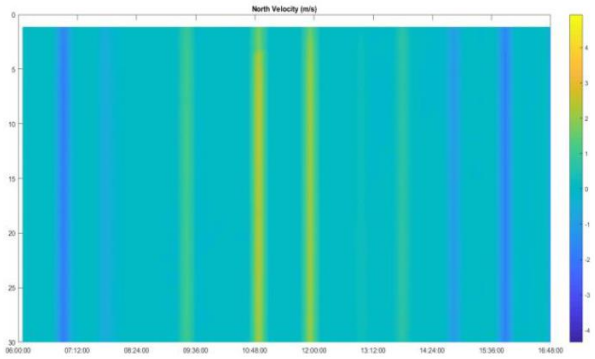
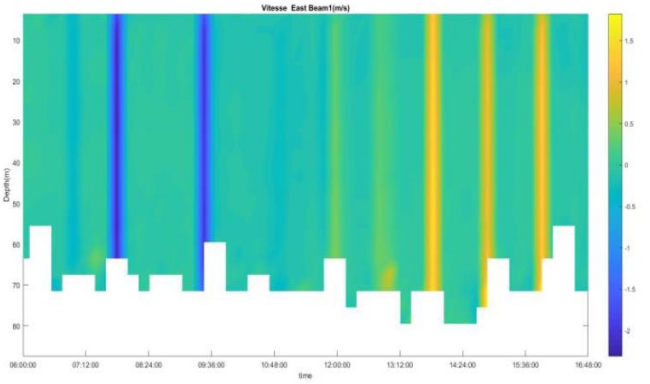
3.4.2 Grande-Vasiere

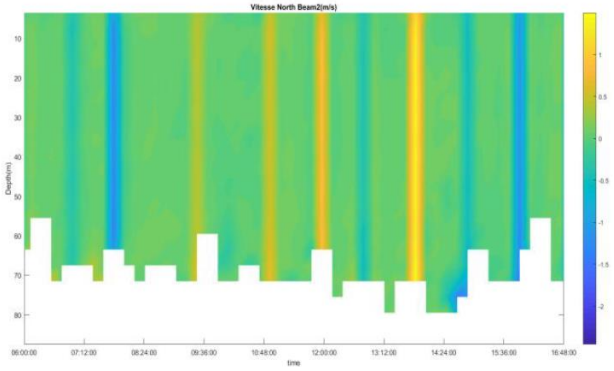
RDI :



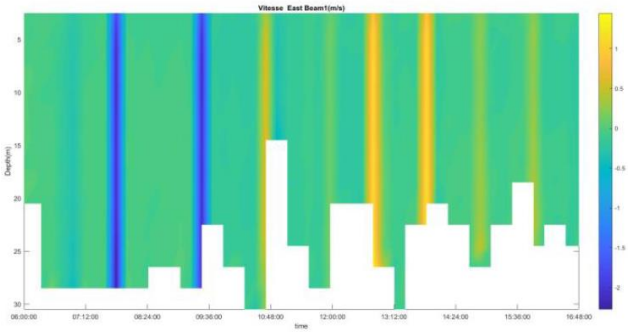


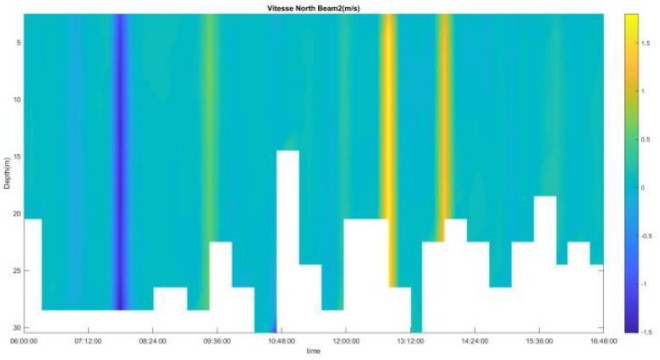
RTI 600 :





RTI 1200 :





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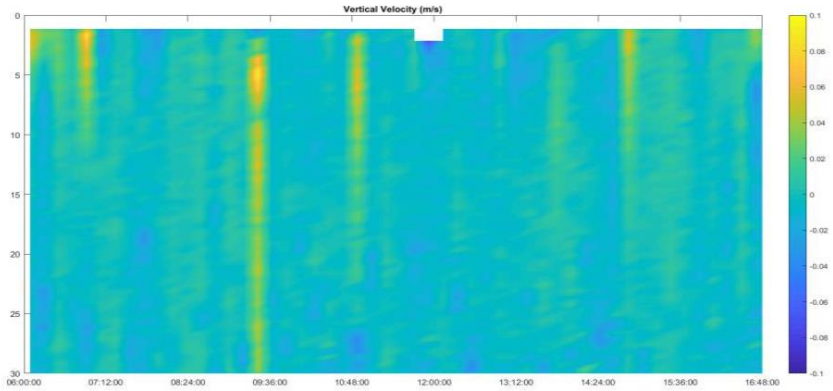
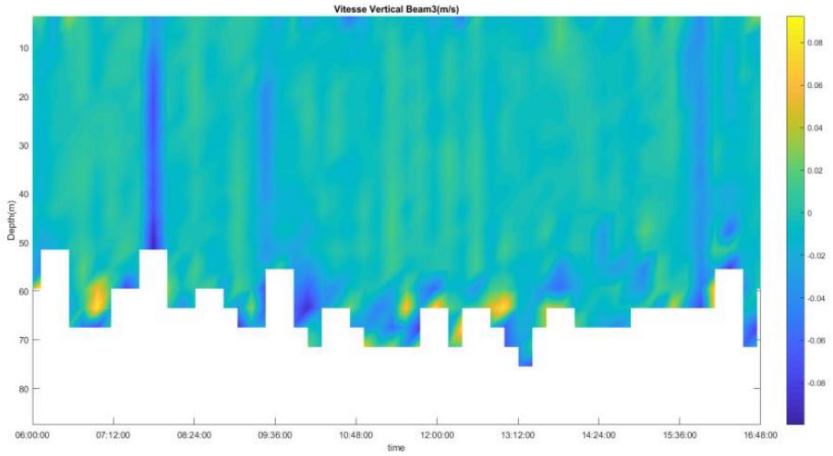
NOT PROTECTED

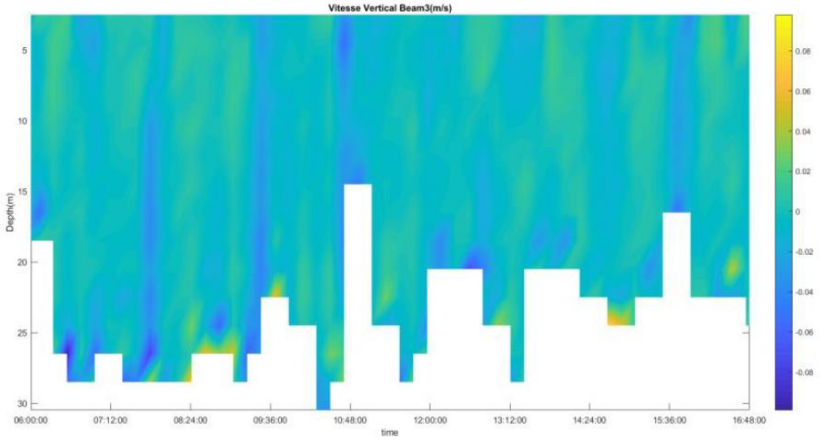
RDI Vertical :



RTI 600 Vertical :



RTI 1200 Vertical :



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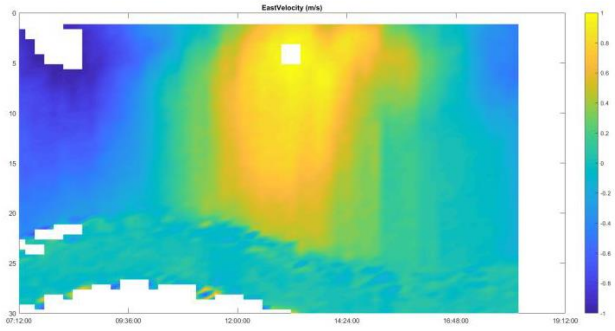
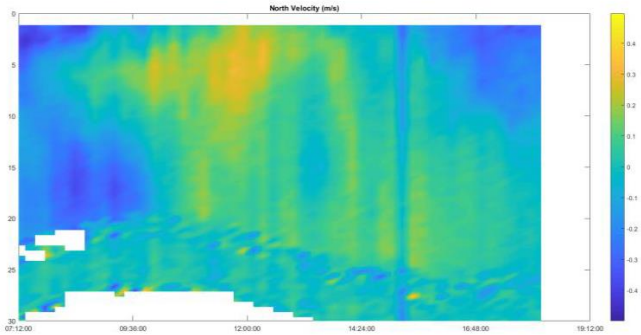
3.4.3 Saint-Nazaire (Loire)

RDI :





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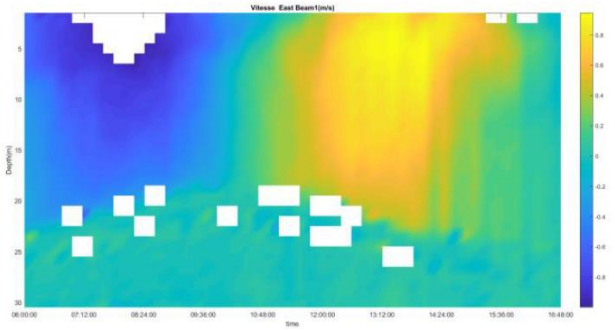
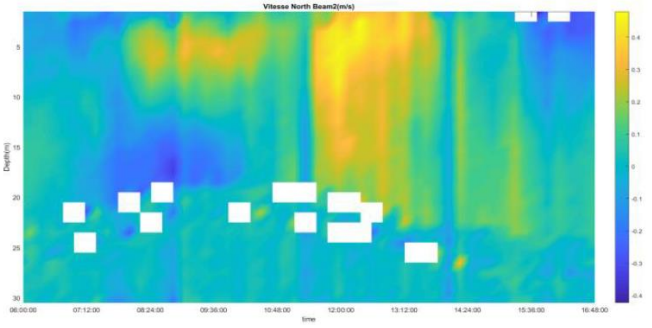
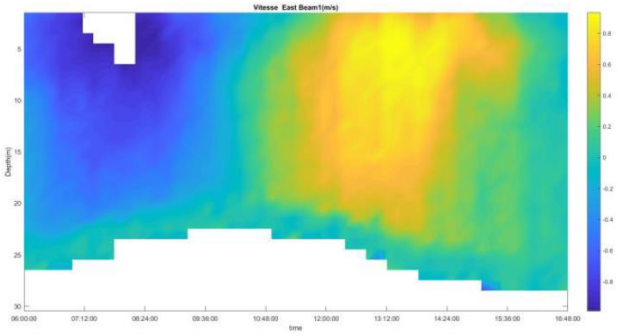
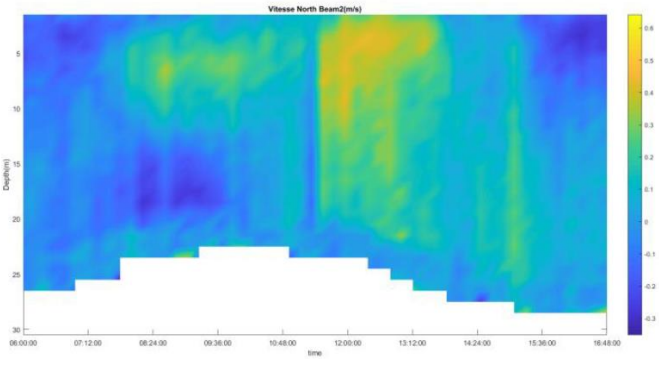




RTI 1200 :





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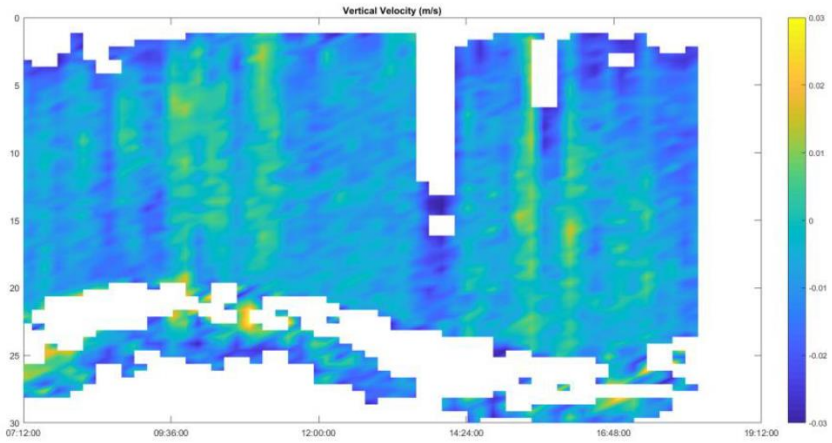
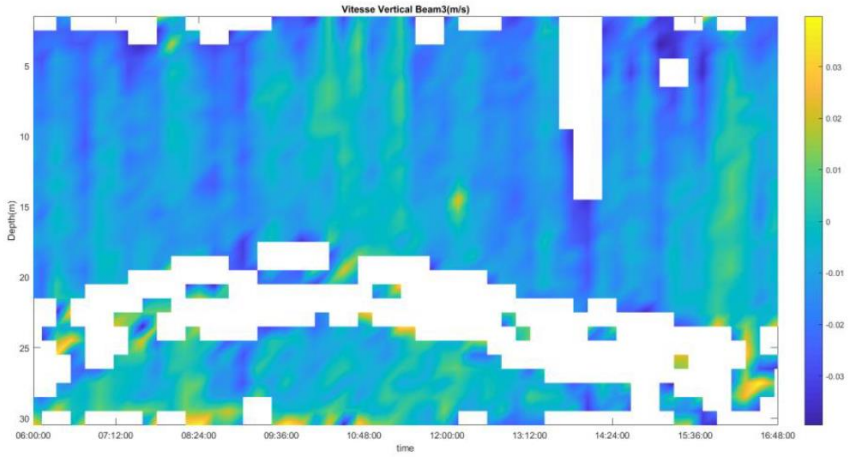
NOT PROTECTED

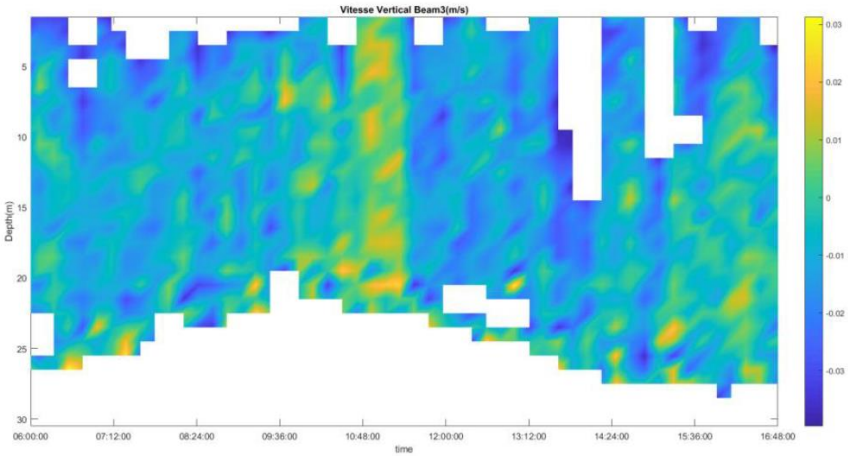
RDI Vertical :



RTI 600 Vertical :



RTI 1200 Vertical :



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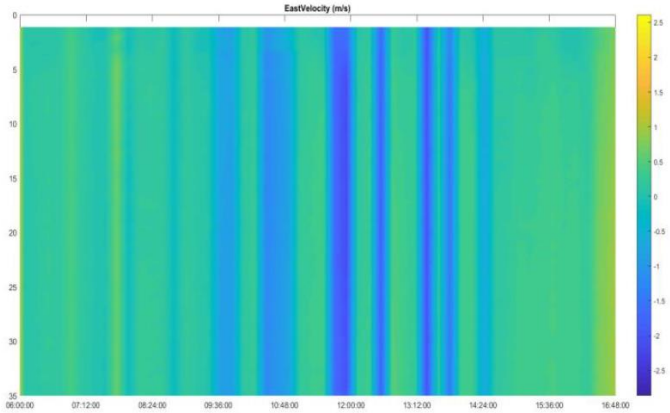
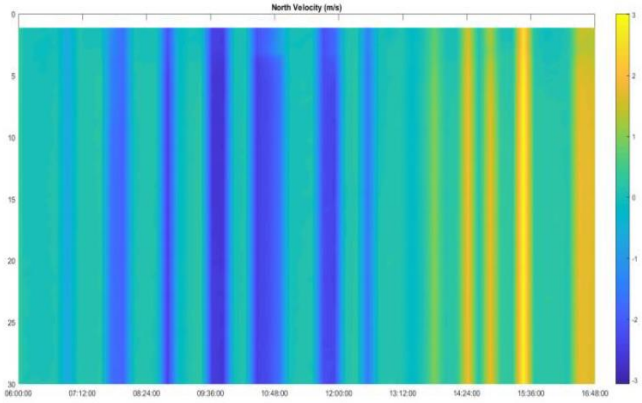
NOT PROTECTED

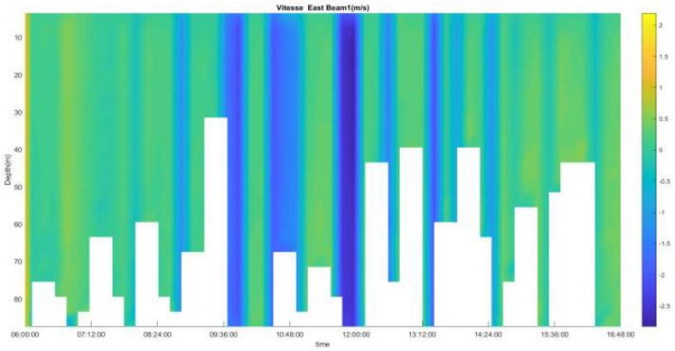
3.4.4 Gino

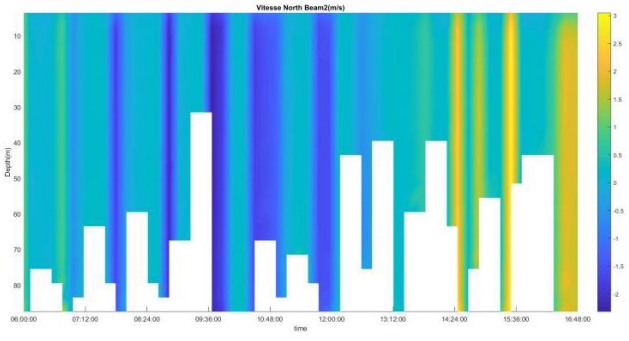
RDI :



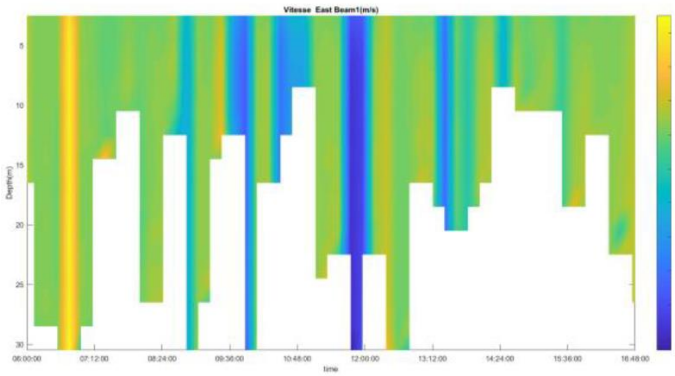


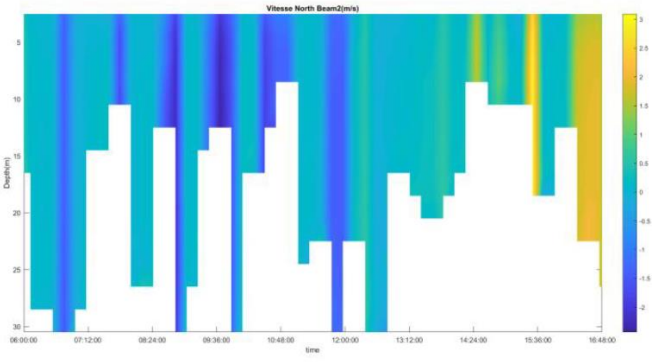
RTI 600 :





RTI 1200 :





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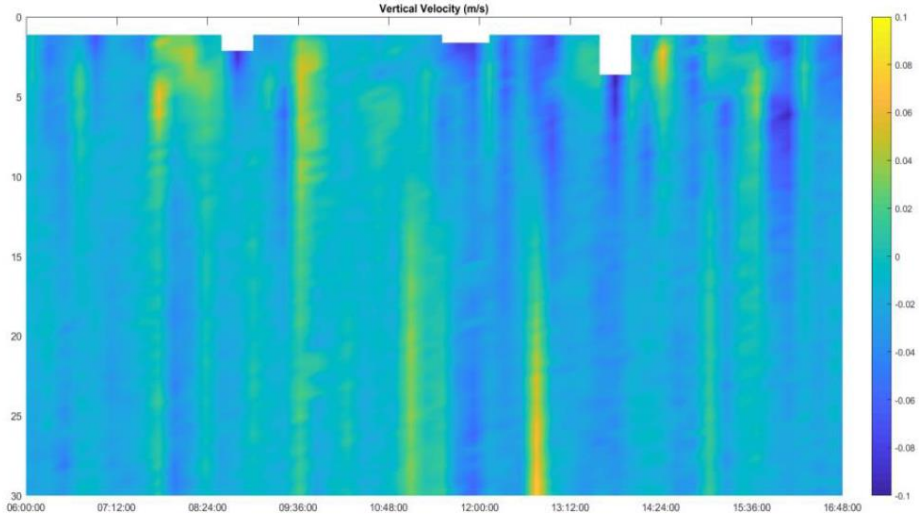
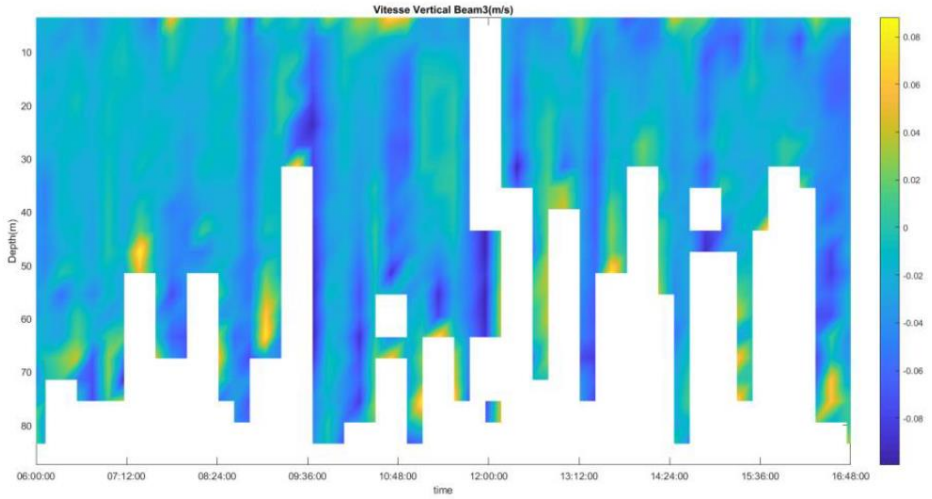
NOT PROTECTED

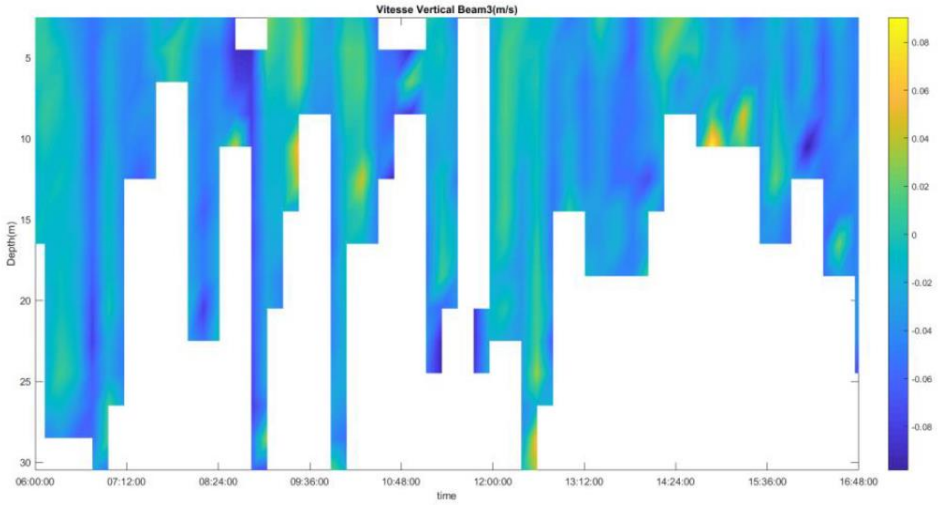
RDI Vertical :



RTI 600 Vertical :



RTI 1200
Vertical :



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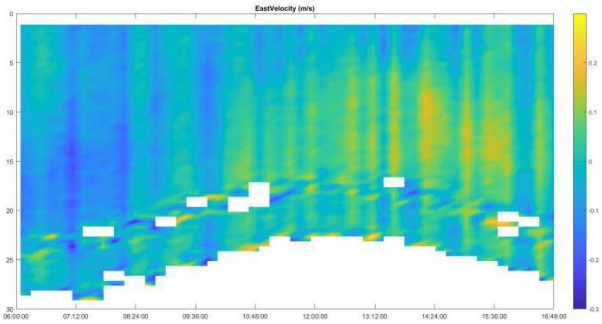
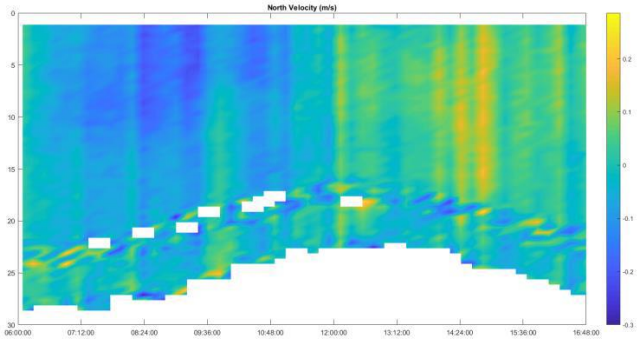
NOT PROTECTED

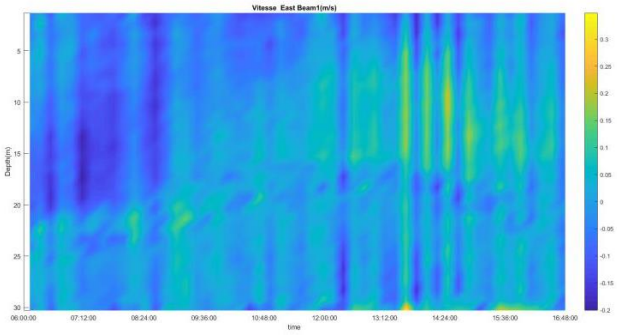
3.4.5 Douarnenez

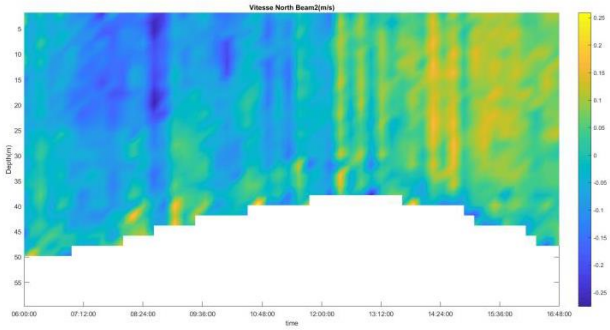
RDI :





RTI 600 :





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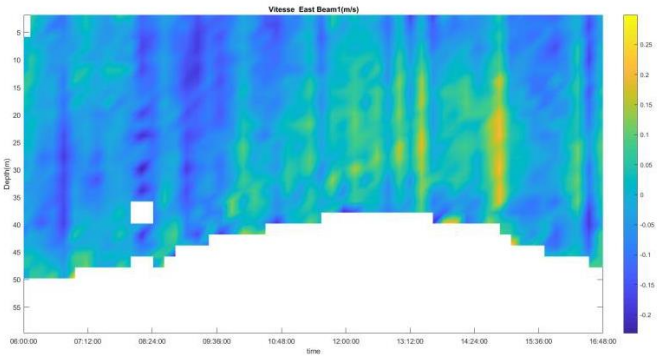

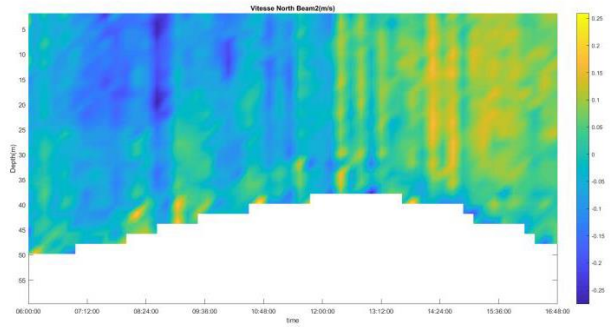

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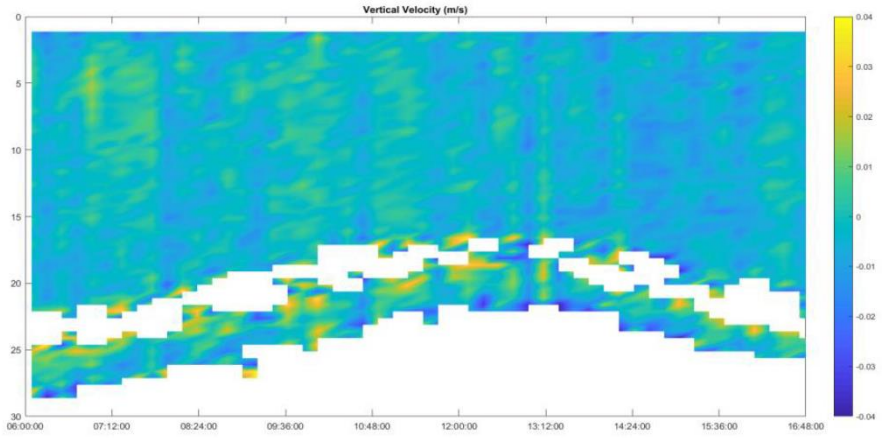
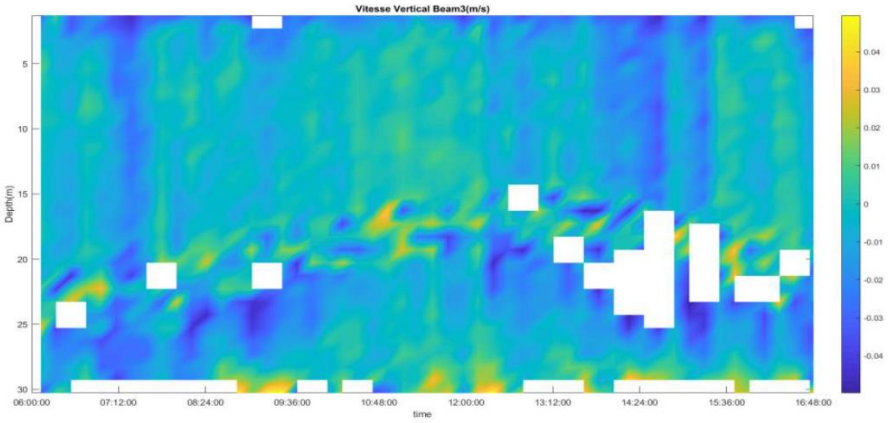
NOT PROTECTED

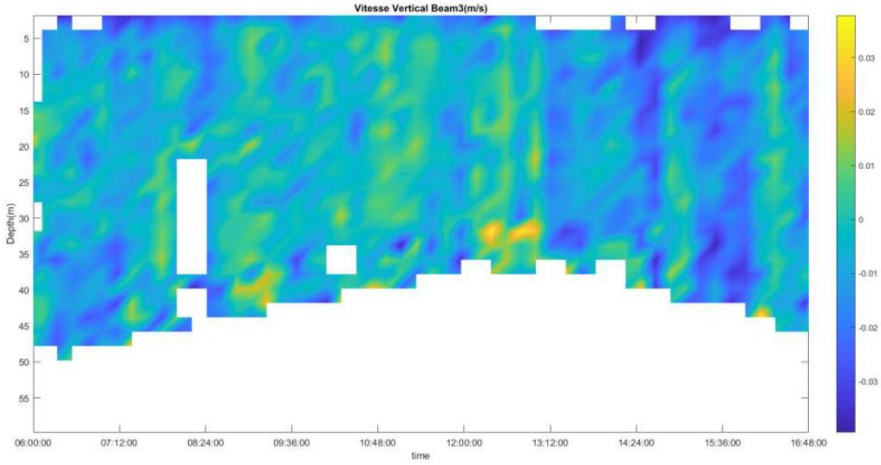
RDI Vertical :



RTI 600 Vertical :



RTI 1200 Vertical :



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3.4.6 Analysis

Concarneau : The speeds of all subsystems are between -0.2 and 0.2 m/s. The North element is larger with 0.15 m/s between 9h and 12h on the entire water column, it can be a tidal stream. The average East current is 0.05 m/s. Presence of some extreme values that have been suppressed on the RDI and the RTI 600. The RTI 1200 allows to have a better accuracy for the currents' speeds in the water column, the strongest currents are barotropes and occur between 10h and 12h. The vertical speeds do not allow to distinguish a specific current, the average speed being at 0.015m/s on both the RDI and the RTI.

Grande-Vasiere : Deep-sea area. No exploitable speeds.

Saint-Nazaire (Loire) : Strong East current of more than 1 m/s on the RDI, probably at mid rising tide, ie between 12h and 14h30 and visible on the RTI, going up to 0.8 m/s. The North component displays currents at 0.4m/s maximum between 10h and 13h, stronger at the surface between 8h30 and 11h. They are mostly visible on the RTI. Potential tidal currents are present from 12h to 14h up to 0.4 m/s on the RTI. Regarding vertical speeds, few remarkable speeds, only a barotropic current visible on the RTI 1200 at 0.03 m/s between 10:30 and 11:30.

Gino : Deep-sea area. No exploitable speeds.

Douarnenez : An East element is only visible on the RDI and a bit on the RTI 1200, with speeds up to 0.3 m/s on the second half of the measurement. The main and barotropic current is present on the North element, also on the second half of the measurement, up to 0.3 m/s. The vertical beam does not display characteristic speeds.

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4 PART 3 : CONVERSION OF BACKSCATTER IN PARTICLE SIZE

4.1 Conversion steps

These conversions were applied only for the so-called "shallow" stations, thus not including the Gino and Grande-Vasiere stations. The calibration of the ADCP has not been done for this station however it is possible to include it in the calculations.

Backscatter difference of two frequencies :

D = BS1200 – BS600

(Calibration of the sensor : Calculated according to the dB representing 99% of the data ; D = D + percentile (99))

Necessary coefficients :

- Lambda1 = $\frac{V_{(sound\ wave\ in\ water)}}{f(Hz)} = \frac{1500}{1200 \times 10^3}$
- Lambda2 = $\frac{1500}{600 \times 10^3}$
- Pi2 = 4.0 x pi x pi
- k1 = $\frac{lambda1 \times lambda1}{Pi2}$
- k2 = $\frac{lambda2 \times lambda2}{Pi2}$
- Lim = 20.0 x $log10(\frac{k2}{k1})$

Beta coefficient :

- D = $10^{(\frac{D}{20.0})}$
- β = $\frac{k2 - D1 \times k1}{D1 - 1}$

Equivalent factor :

- Eq = $\frac{1.0}{\sqrt{2}}$

Equivalent radius (in mm) :

- ae2 = β x Eq
- ae = $\sqrt{ae2} \times 10^3$

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4.2 Representation of conversions

Four figures for each station are shown below:

- The section D, the difference of backscatter 1200-600 in dB
- The histogram of this difference represented between 0 and 12, where 0 denotes an infinitely large particle size and 12 denotes infinitely small particles.
- The section of the logarithm of the equivalent radius (ae) of the particles in the water column in mm.
- The section of the LISST D50 in µm (Ifremer data)
- The histogram of this equivalent radius (ae) giving the distribution of the particle sizes in mm.

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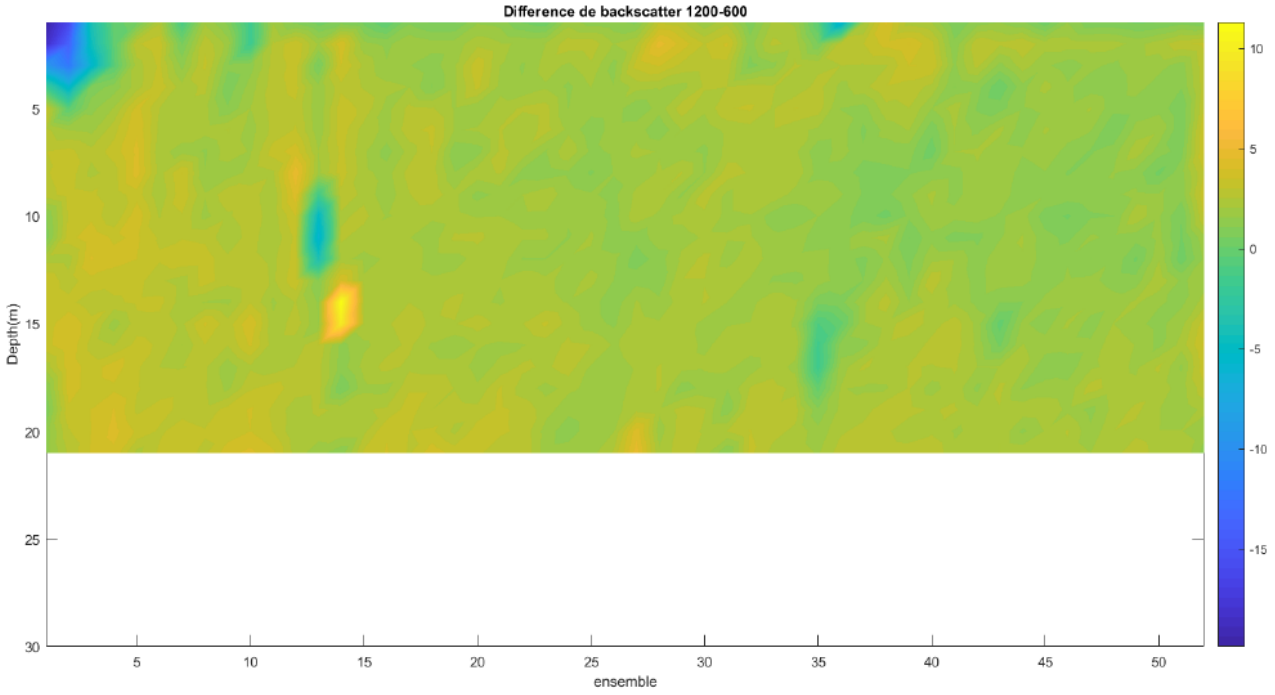
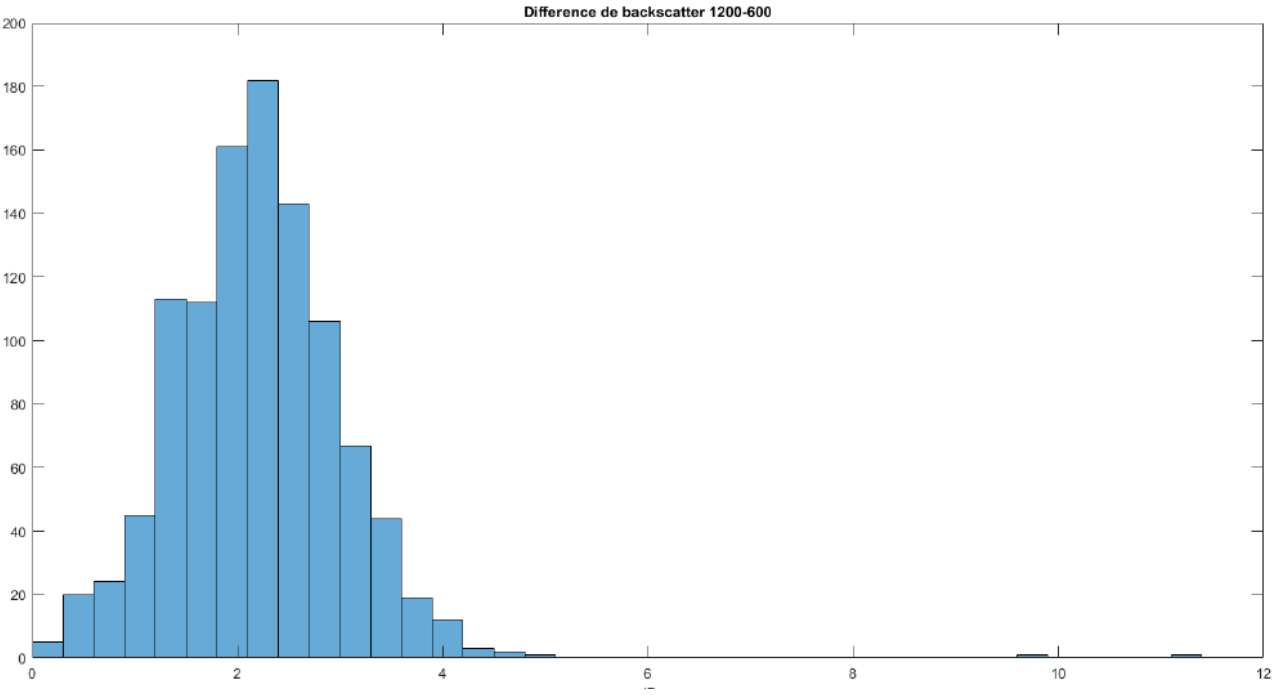
NOT PROTECTED

4.2.1 Concarneau





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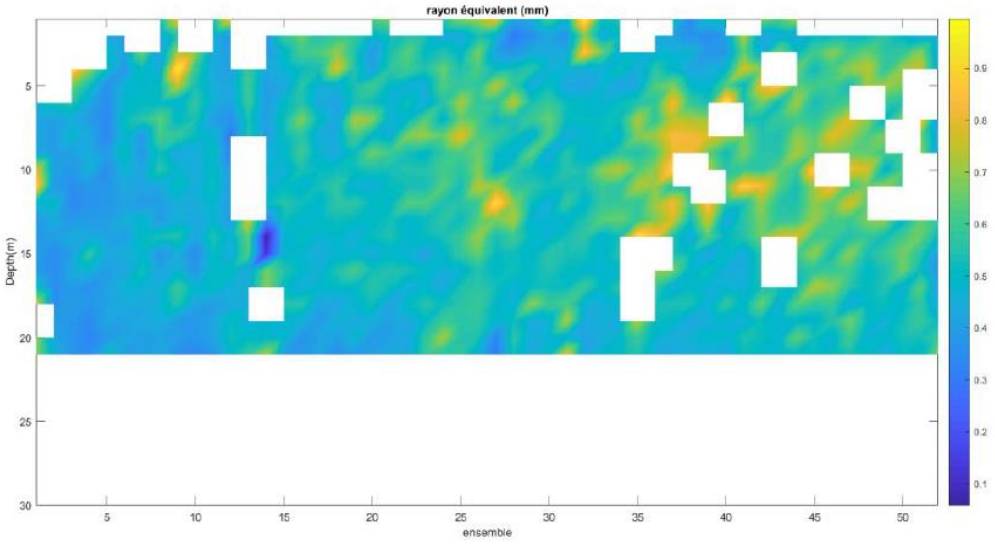

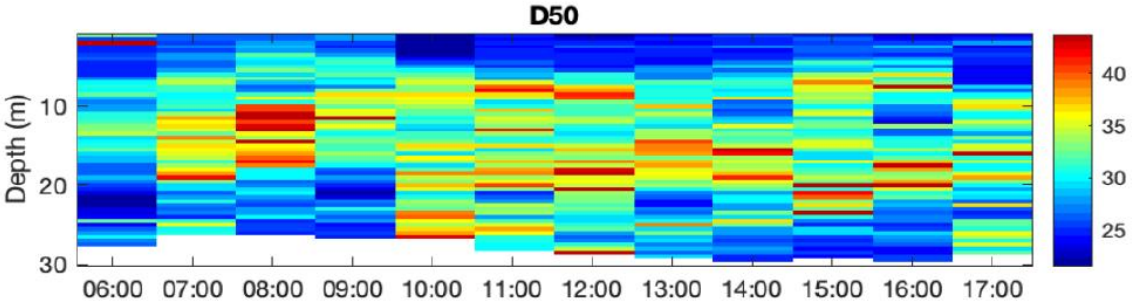

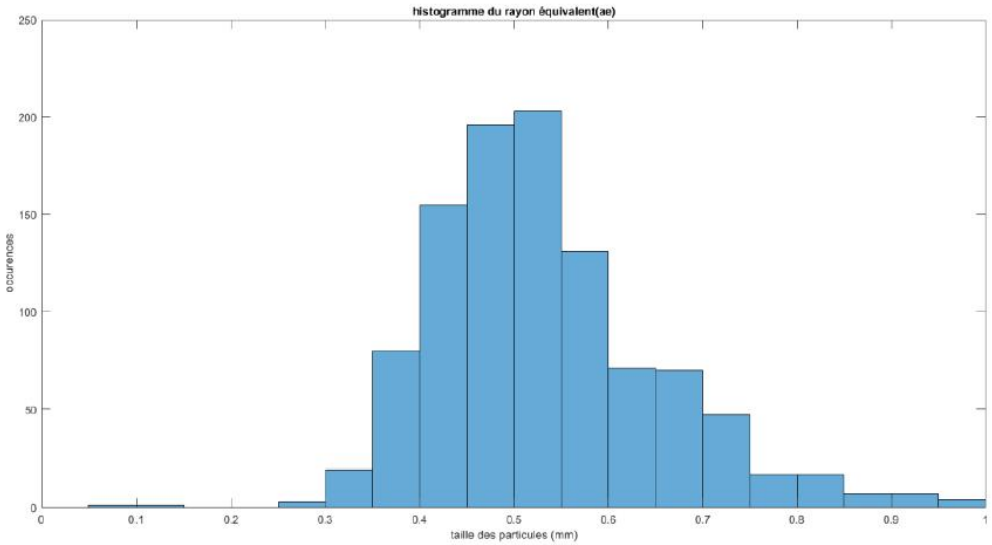

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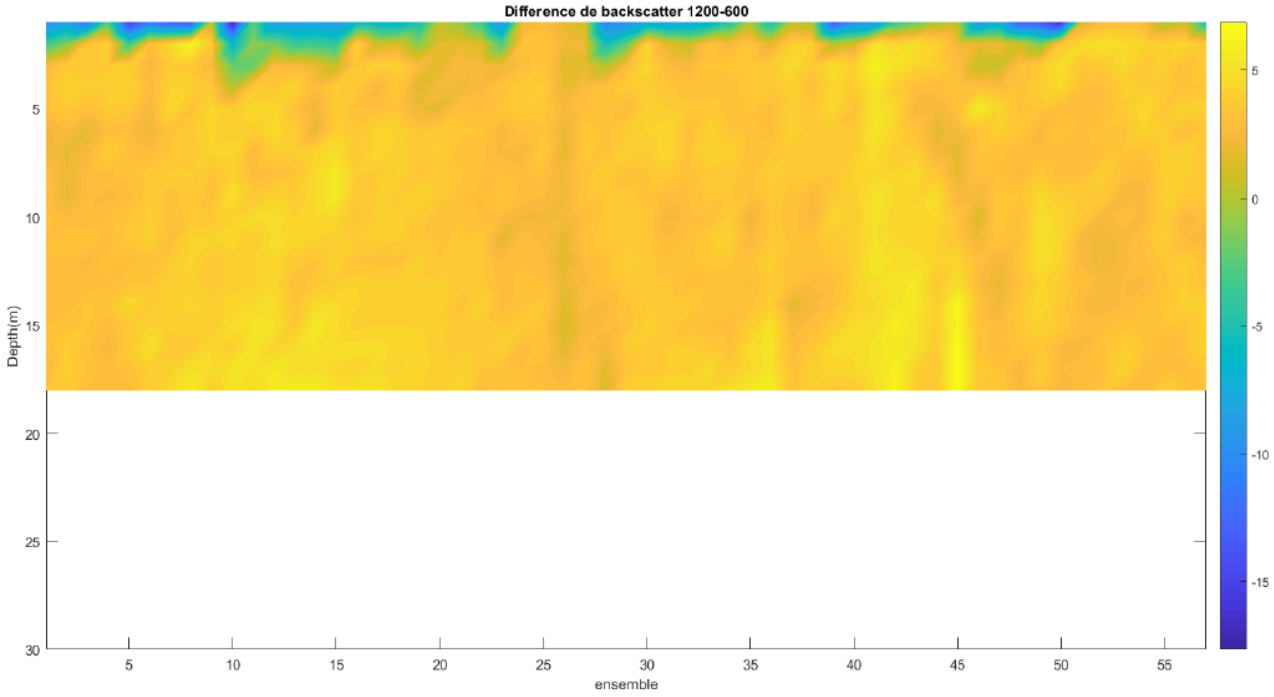
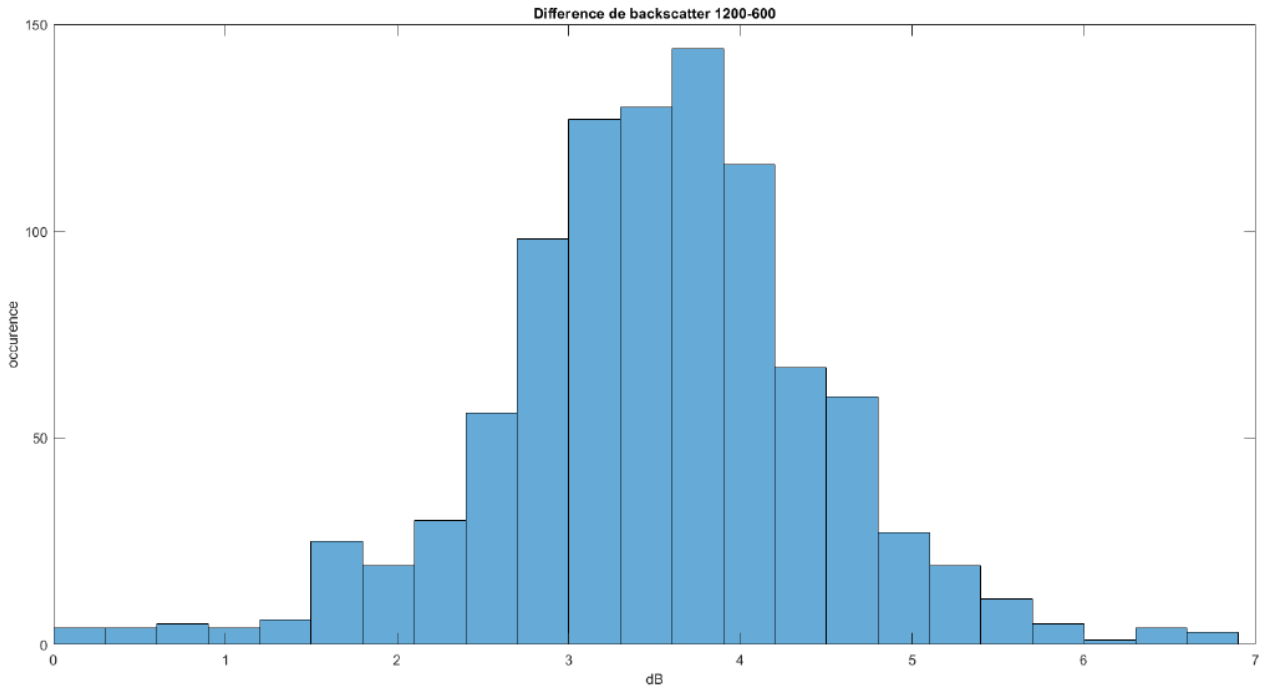
4.2.2 Saint-Nazaire (Loire)





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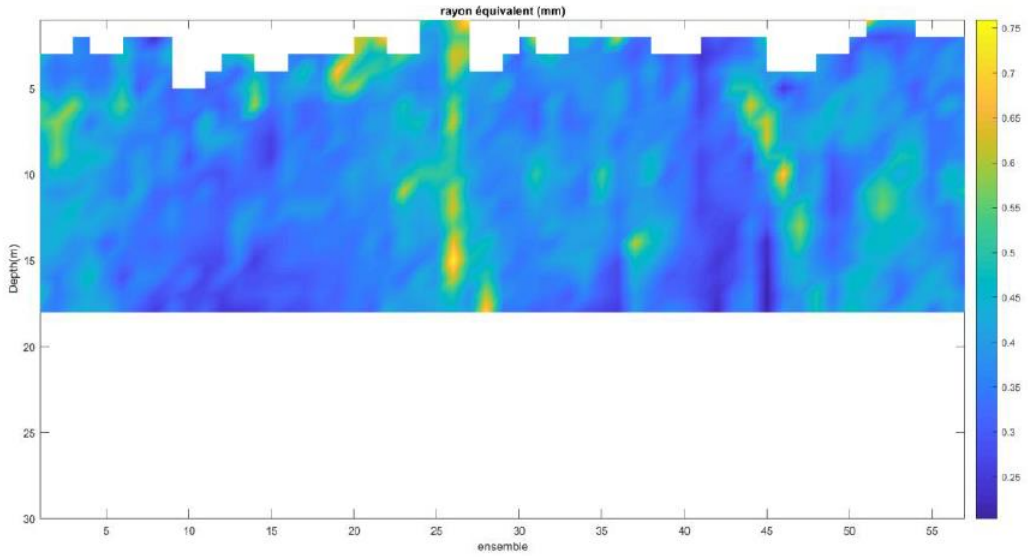
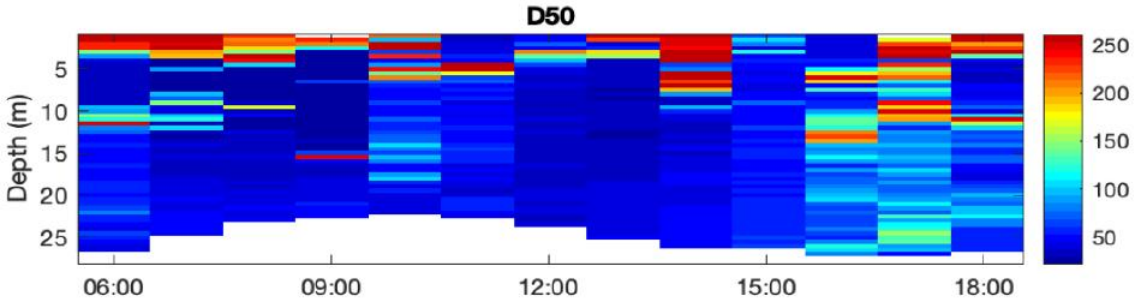
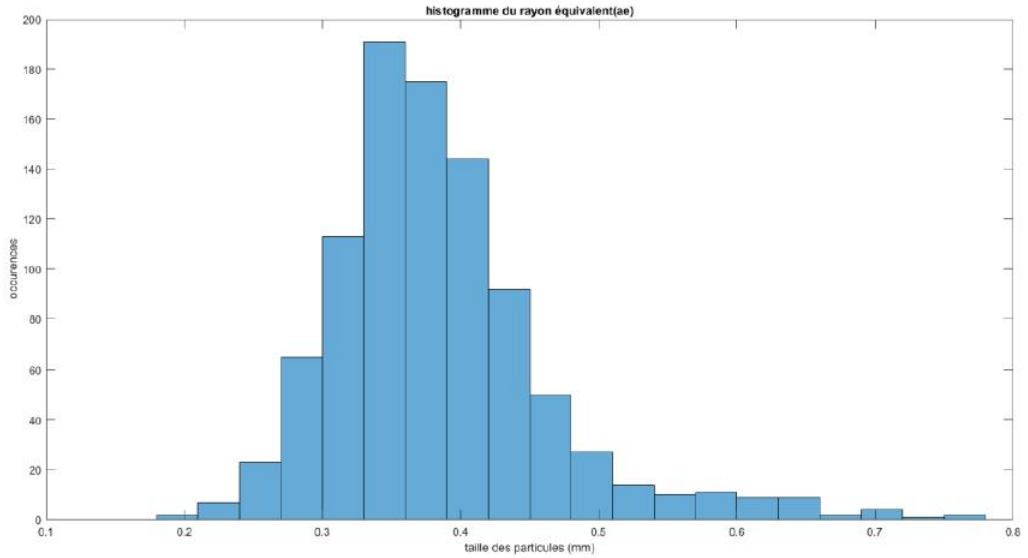
NOT PROTECTED







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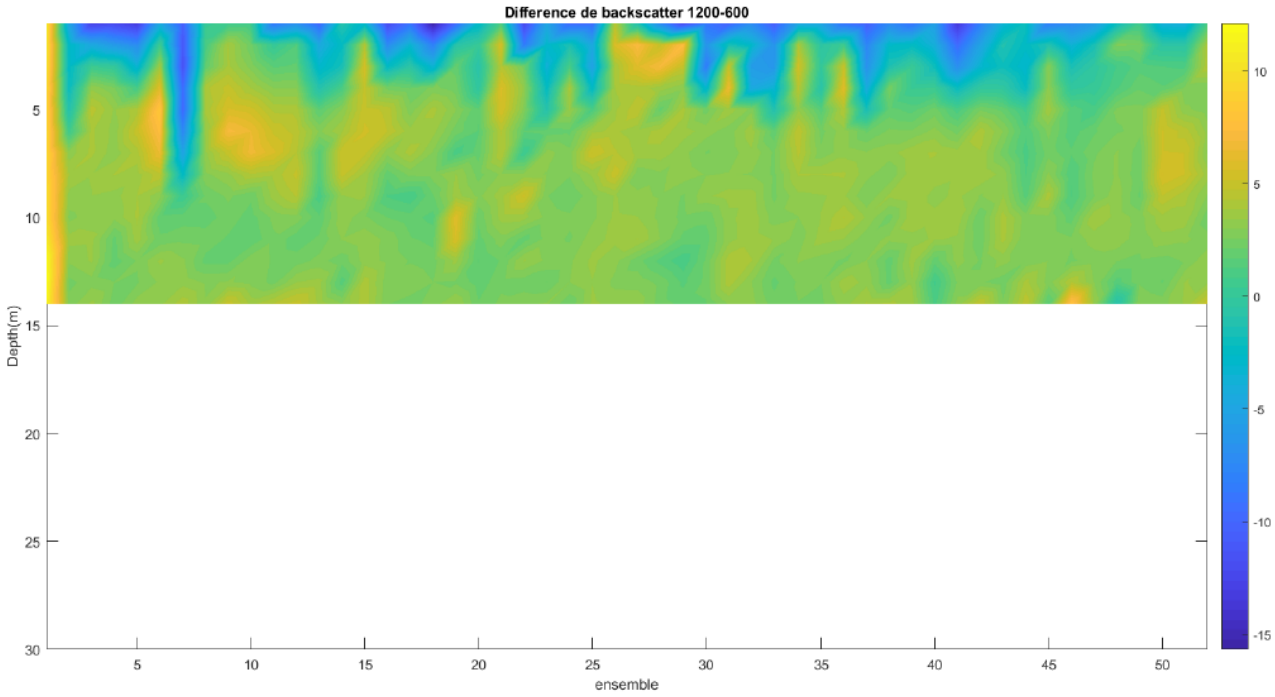
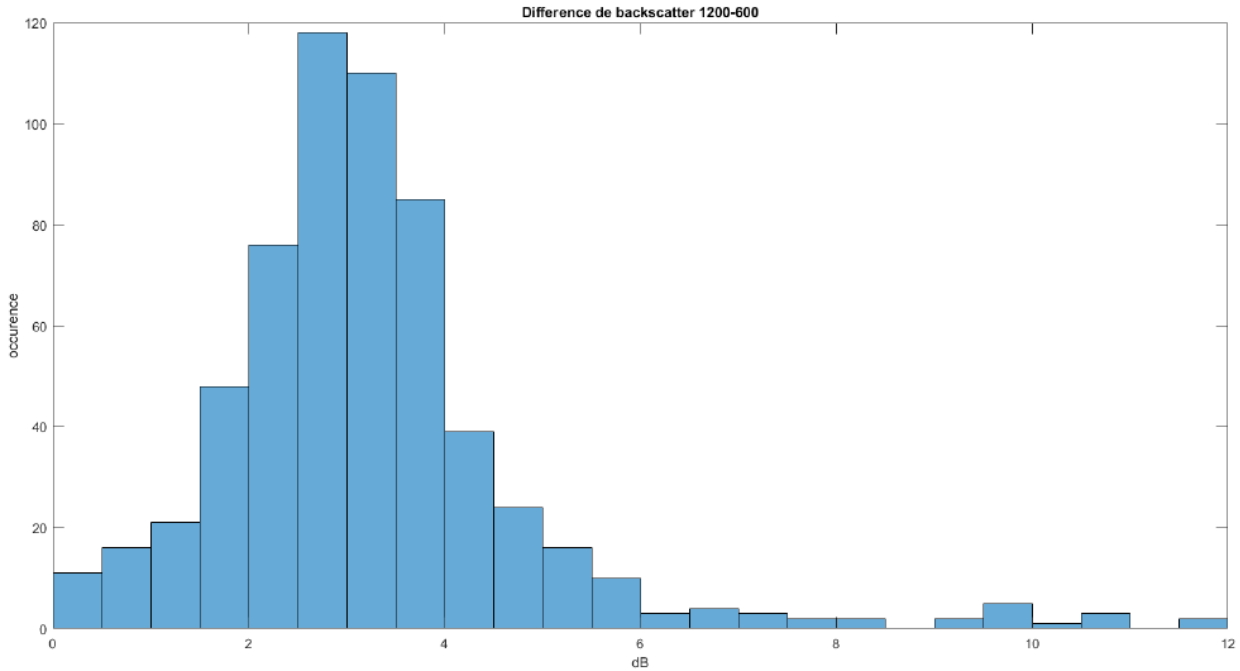
4.2.3 Douarnenez





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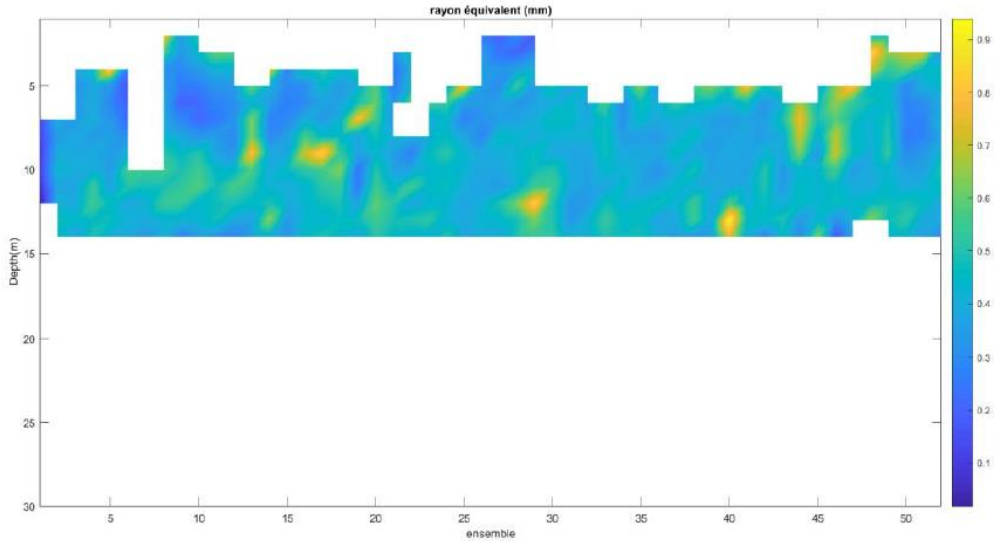
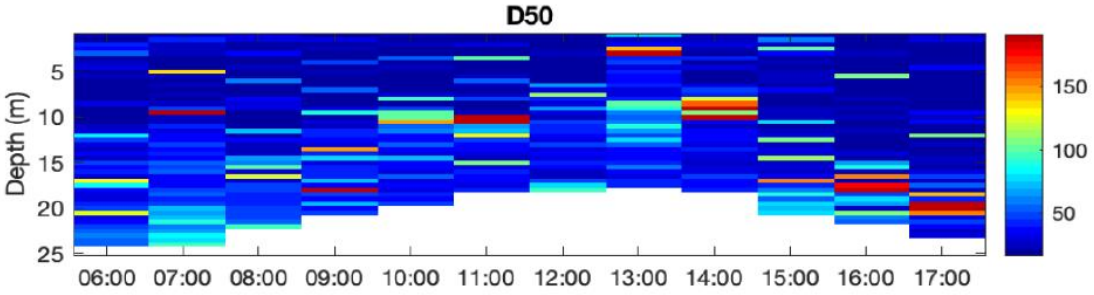
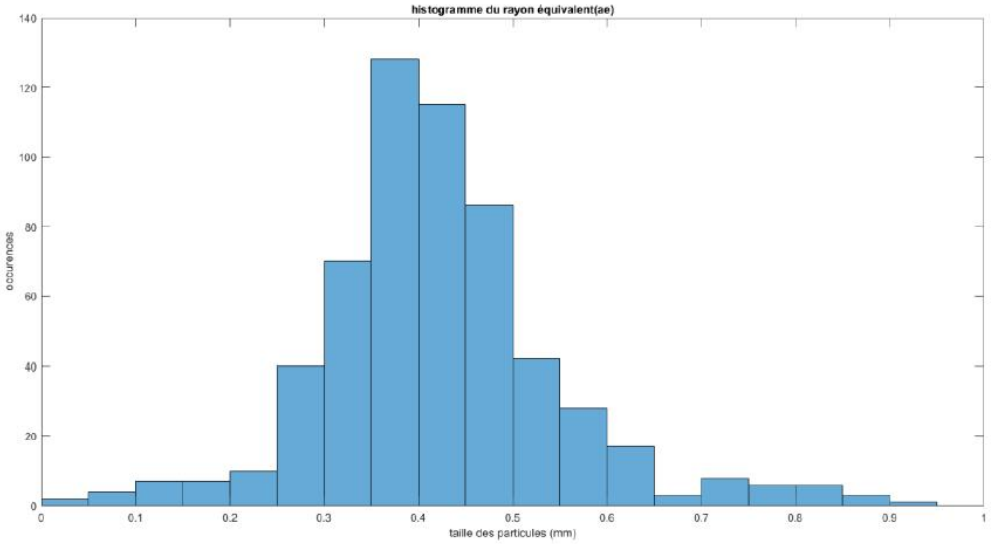
NOT PROTECTED







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4.2.4 Analysis

Concarneau : An average backscatter difference of 2 dB is present, with a max difference of 15 dB at the very beginning of the surface deployment. The histogram of this difference is centered on 2 dB indicating a fairly large particle size.

The equivalent radius is represented in mm, it allows us to distinguish particles distributed rather heterogeneously in the water column, with larger particles near the end of the sets. Their size ranges between 0.9 and 0.1 mm with an average of 0.5 mm. This is the station where we find the largest particles.

Saint-Nazaire (Loire) : The observable backscatter difference is on average around 4 dB with a max difference of -15 dB on the surface. The histogram of the difference indicates a rather large particle size. This station appears to have smaller particles, with a maximum at 0.75 and a minimum at 0.25 mm averaging around 0.37 mm. This station therefore has the finest particles.

Douarnenez : The observable backscatter difference is on average 3 dB with even larger values up to 15 dB at the surface. So here we are also on a relatively large particle size is between 0.9 mm and 0.1 mm, the equivalent radius is on average around 0.4 mm.

After comparison with the LISST D50, we can not see similarities between these two instruments, which could be explained by the ability to distinguish a certain particle size that is different for these instruments. The comparison with an instrument with the same insonification capability may or may not confirm the figures presented above.

5 CONCLUSIONS AND PERSPECTIVES

Positive feedback :

- The data is usable for all stations and comparing with data from the RDI workhorse, it can be seen that the attitude sensors are similar on both instruments. The echo is also similar which makes it possible to work on the dual frequency thanks to a single instrument which reduces the potential sources of error in finding the sizes of the particles present in the water column.
- The different beams of the RTI show very similar results and the echo of the RTI makes it possible to distinguish point reflectors in the water column that are not visible on the RDI. (Concarneau station).
- Particle size conversions can identify a tendency, with particles of a size normally in line with the instrument's insonification potential (around 10-3 mm minimum).

Notes :

- The speeds for the deep-sea stations do not reflect the speeds in depth because the wave is not reflected on the bottom, moreover the bottom track is not activated even for the small bottom stations, so we have only raft drift velocities, these speeds are similar on the RDI and the RTI.
- There is an intensity difference of about 30 dB between the RDI and the RTI.
- It would be necessary to know the calibration of the ADCP in order to convert the echo into particle sizes because a minimal variation of dB greatly affects the calculated particle size. Also there is a minimum radius beyond which the ADCP can not perceive a particle (of the order of 50 µm).

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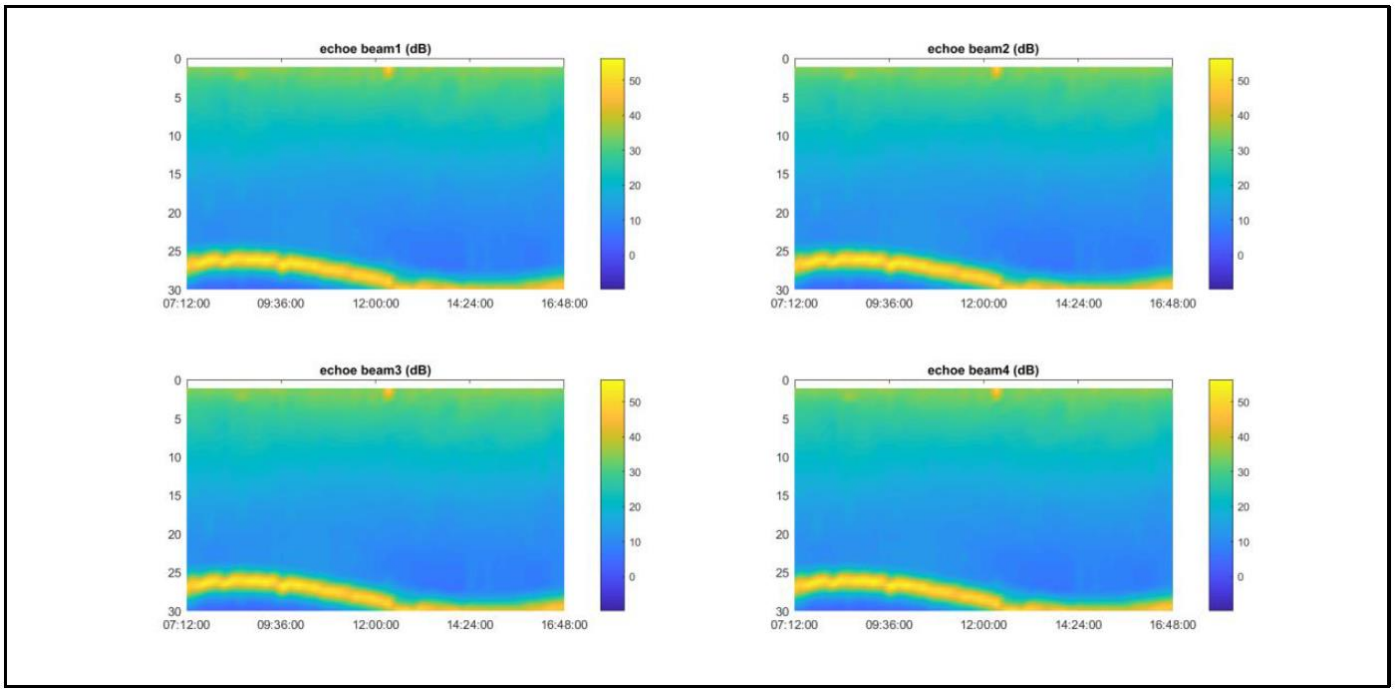
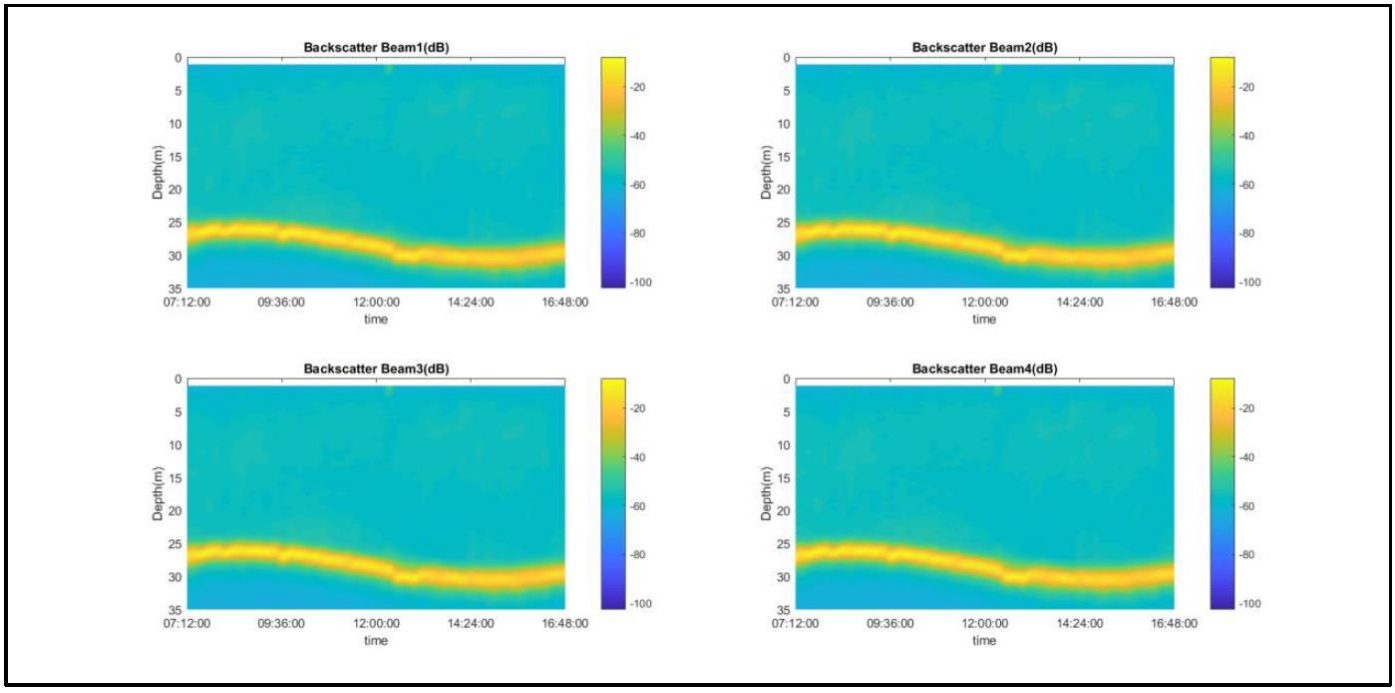
6 APPENDIX 1 – COMPLEMENTARY PROFILES

6.1 Concarneau

6.1.1 Echo / Backscatter RDI





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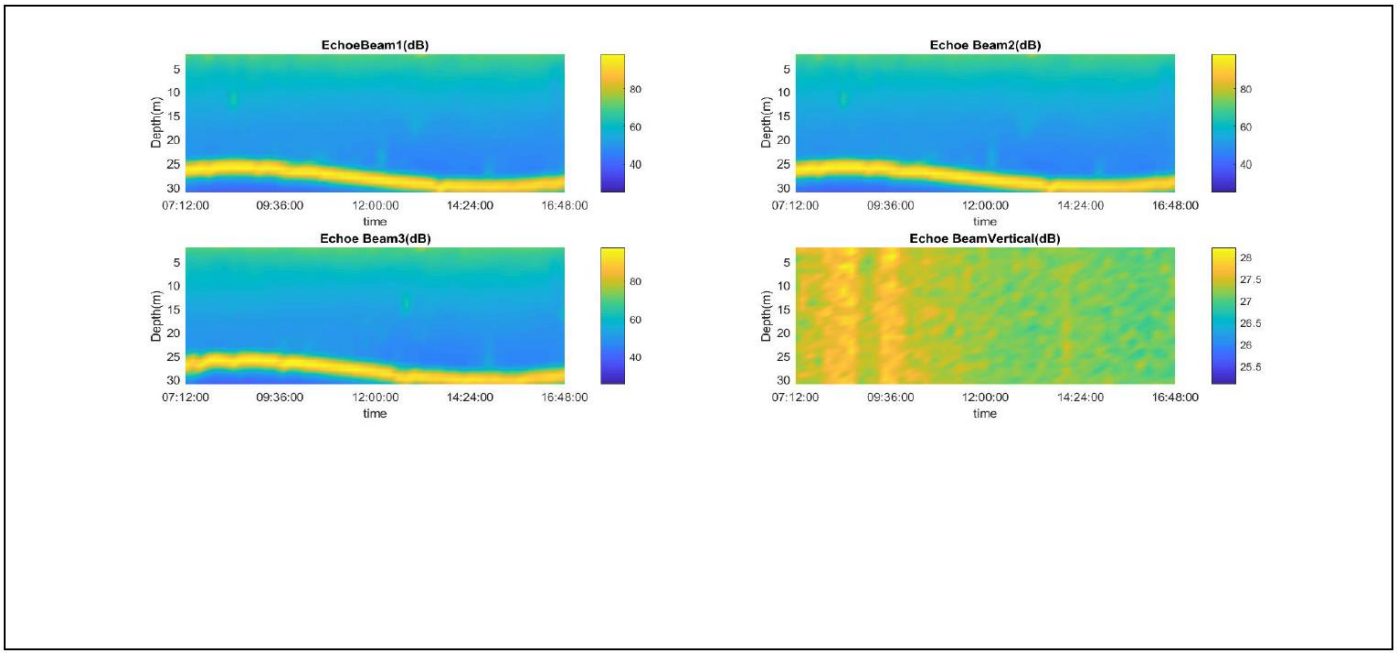
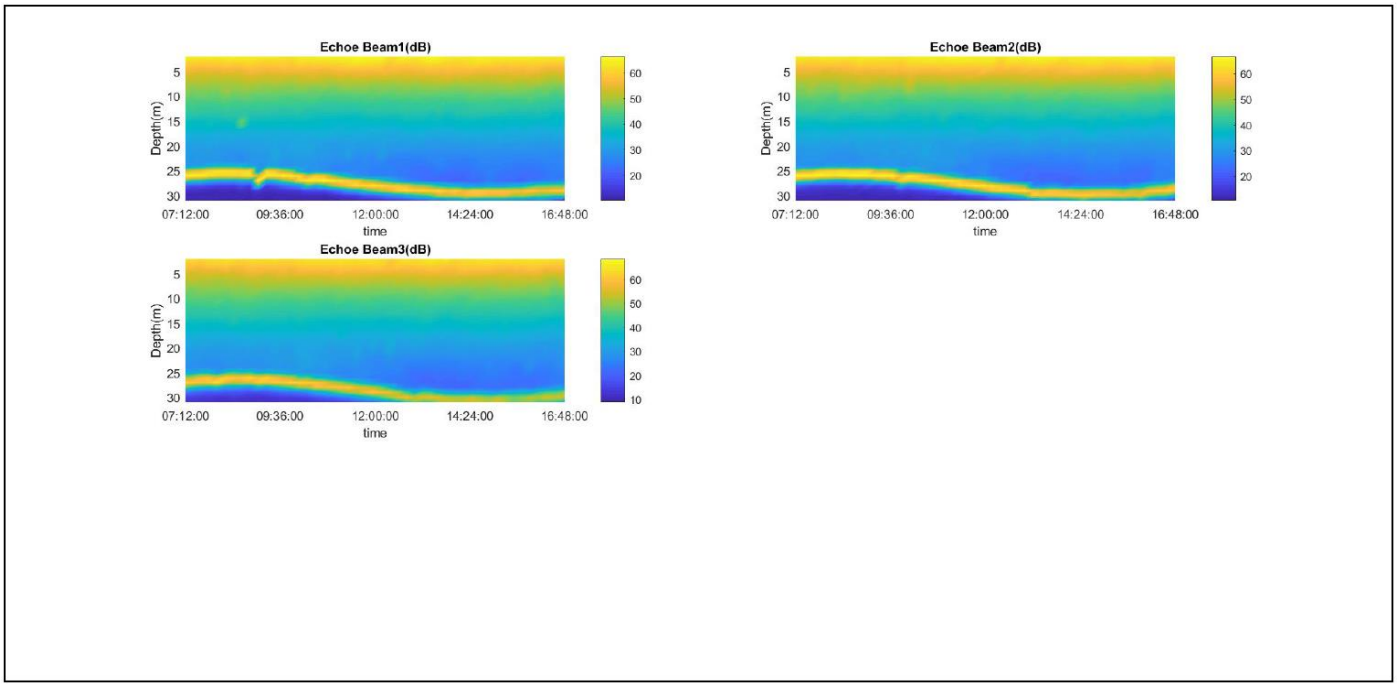
NOT PROTECTED

6.1.2 Echo RTI 600



6.1.3 Echo RTI 1200



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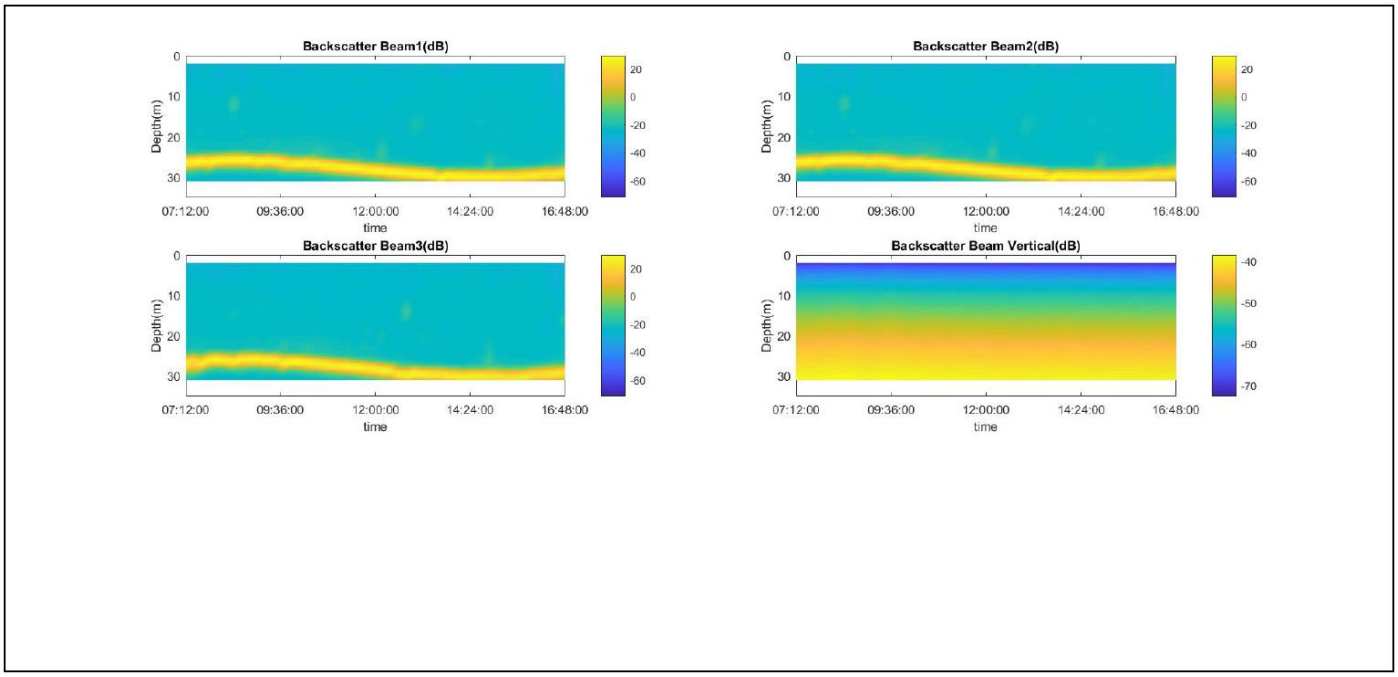
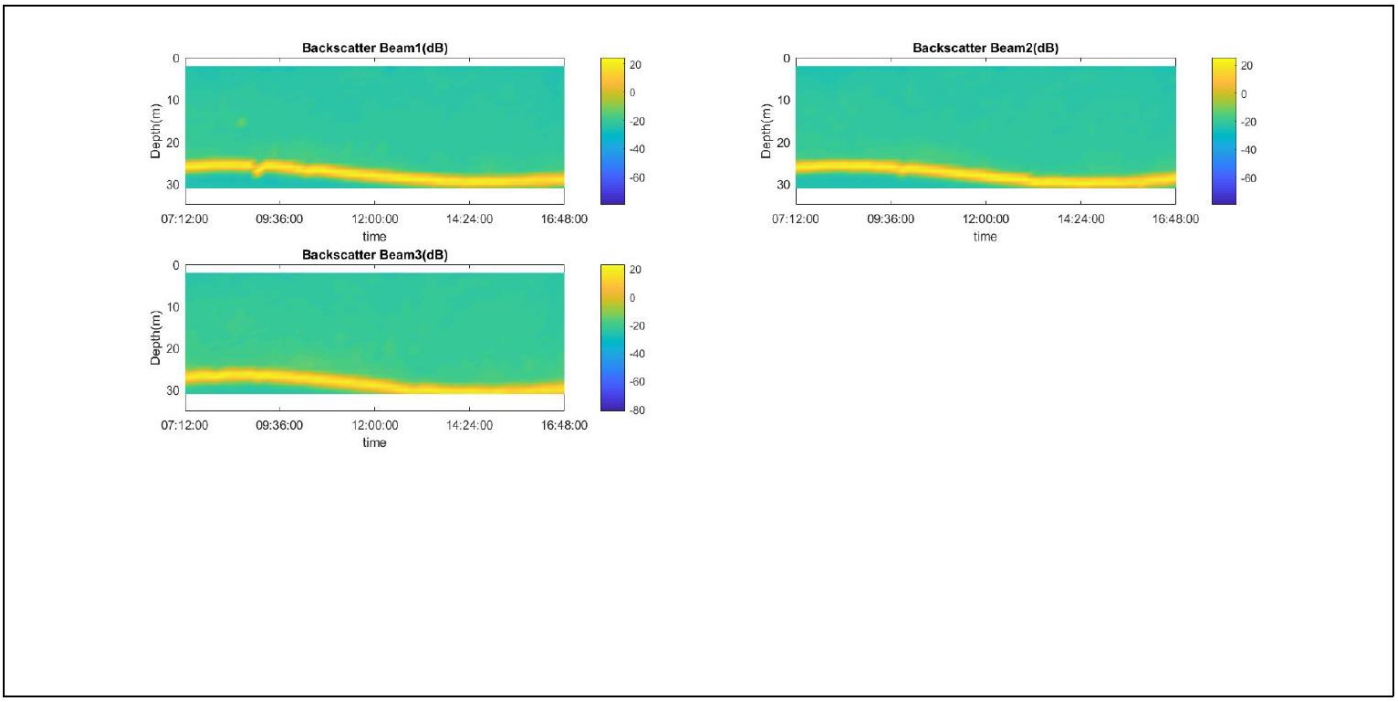
6.1.4 Backscatter RTI 600



6.1.5 Backscatter RTI 1200



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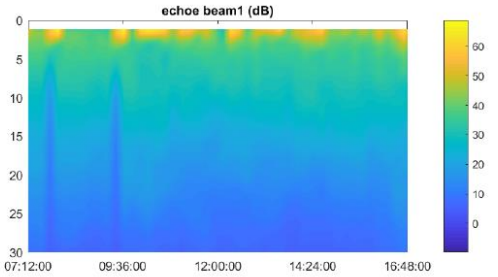
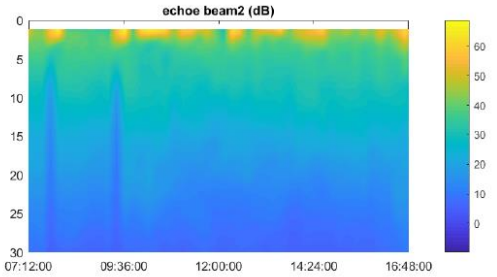
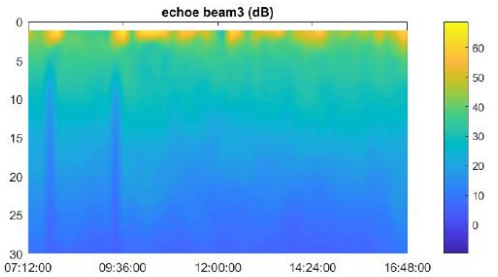
NOT PROTECTED

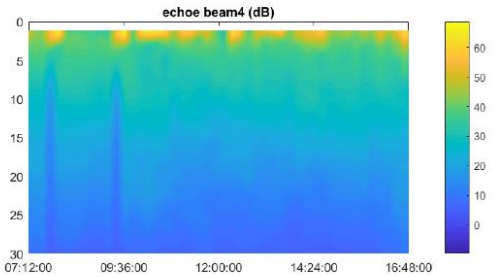
6.2 Grande-Vasiere

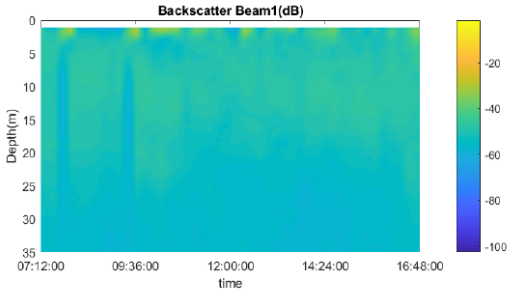
6.2.1 Echo / Backscatter RDI

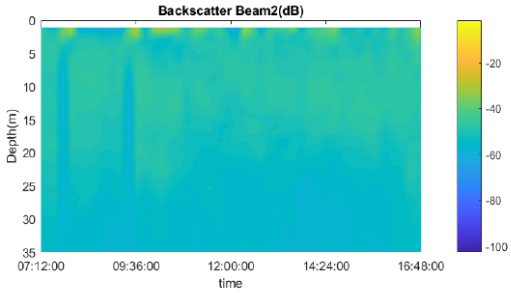


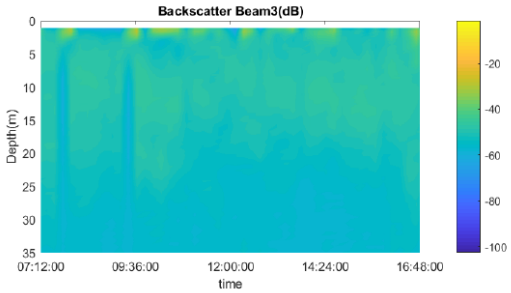


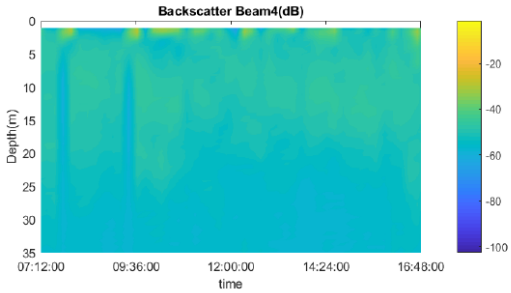












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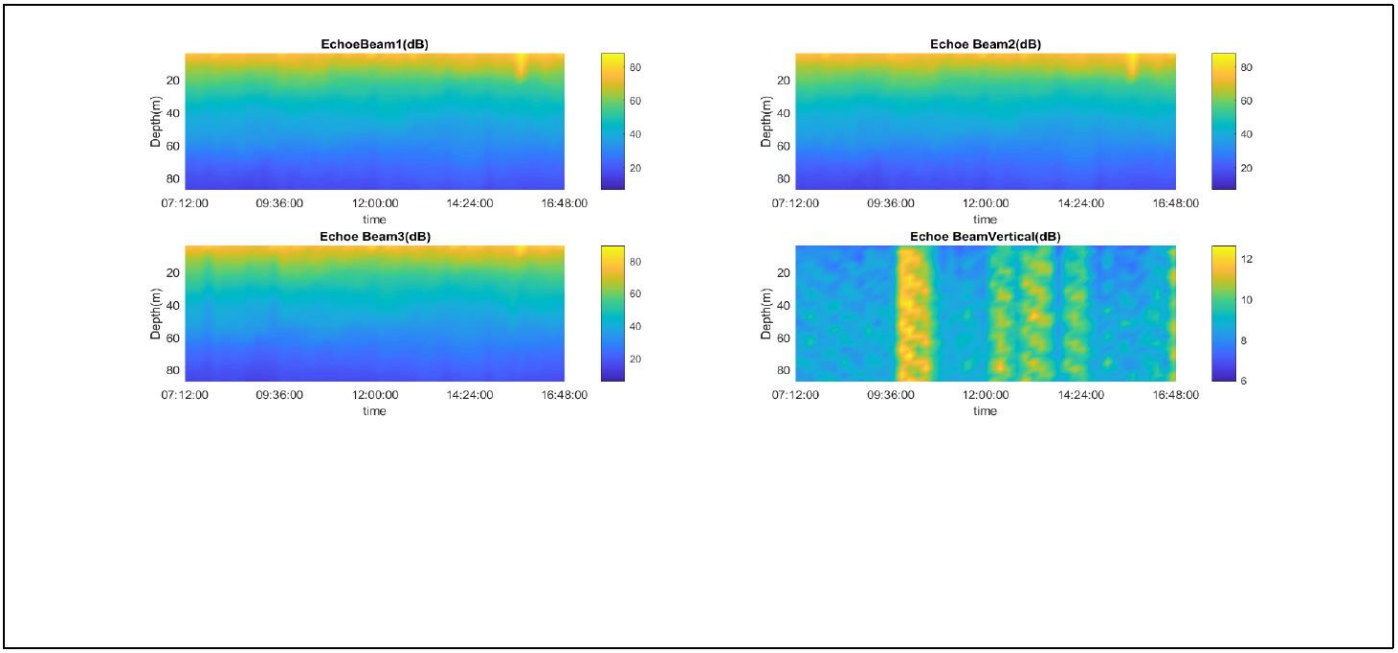
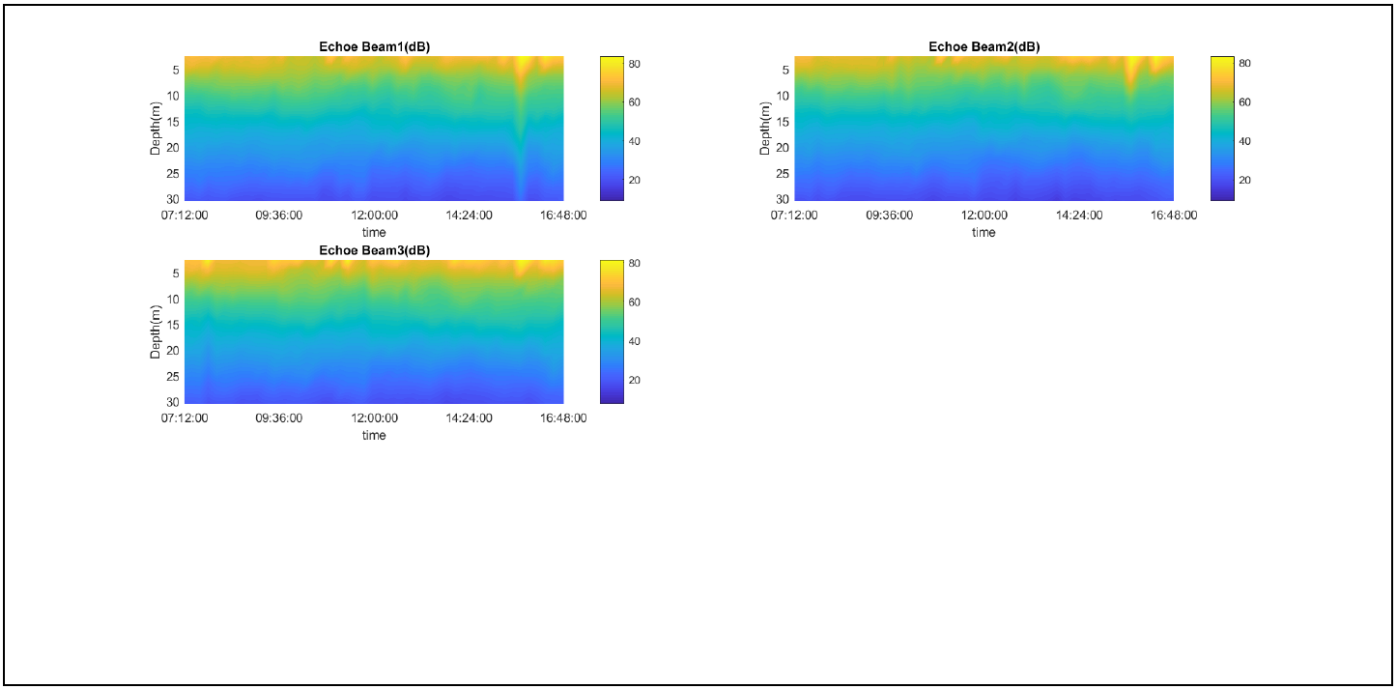
6.2.2 Echo RTI 600



6.2.3 Echo RTI 1200



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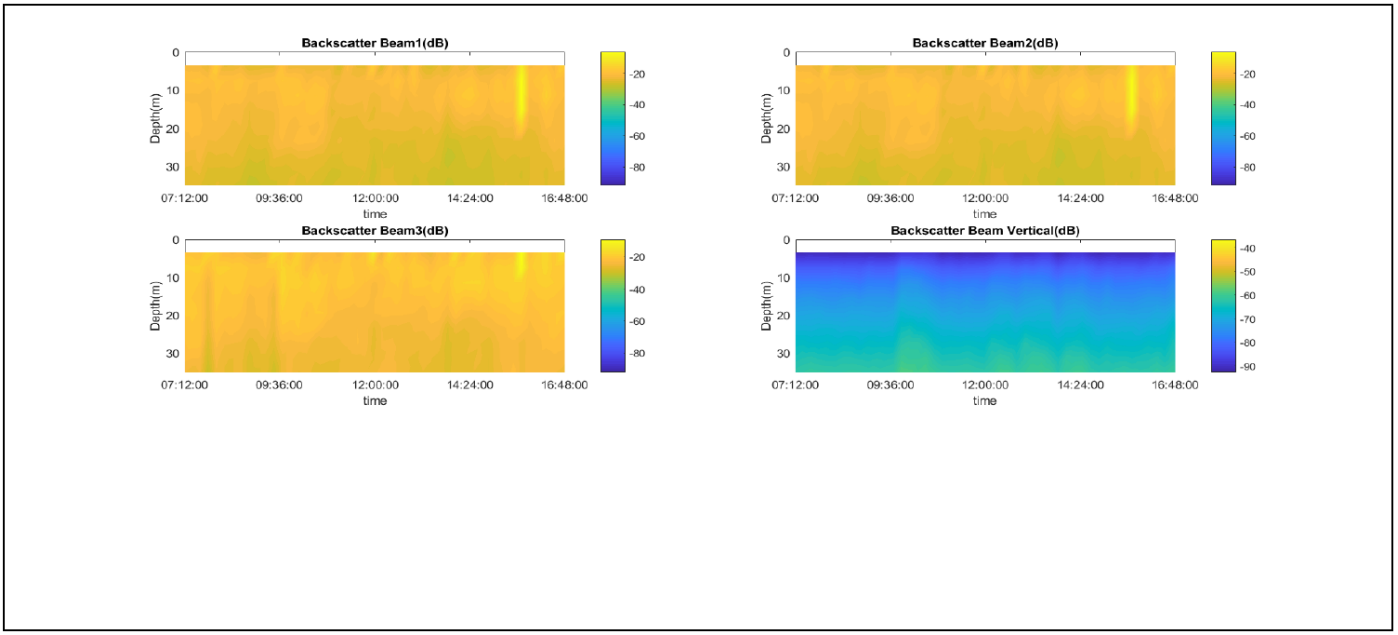
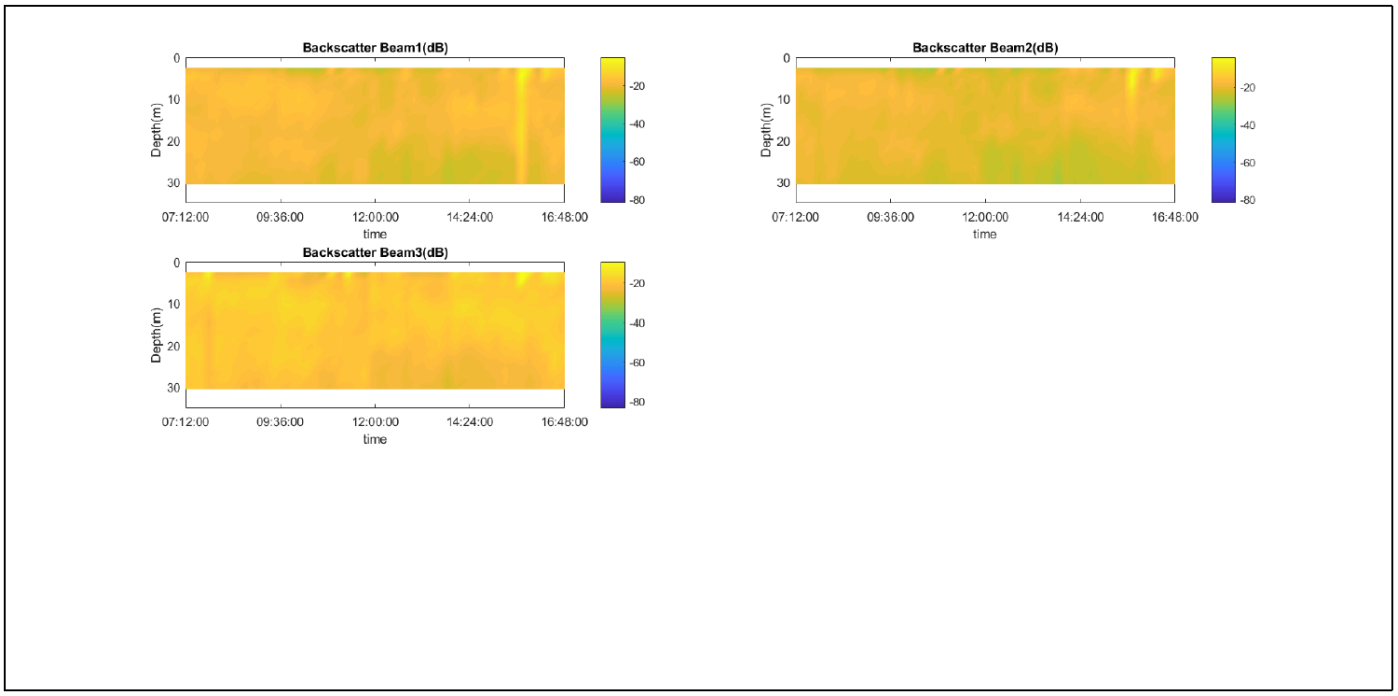
6.2.4 Backscatter RTI 600



6.2.5 Backscatter RTI 1200



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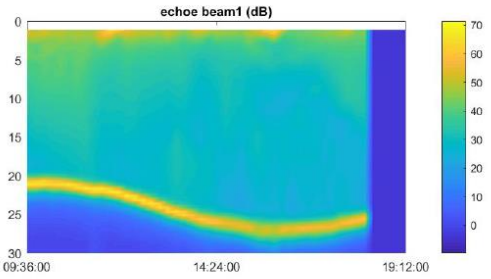
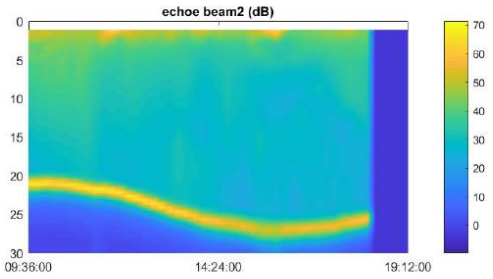
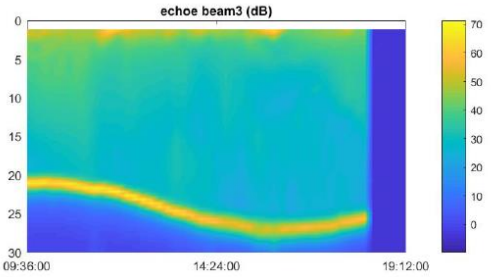
NOT PROTECTED

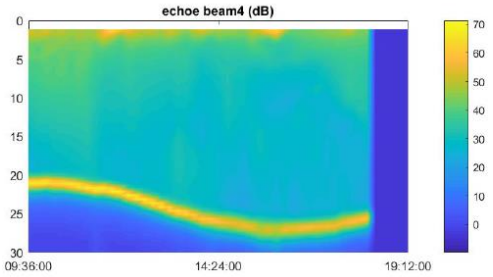
6.3 Saint-Nazaire (Loire)

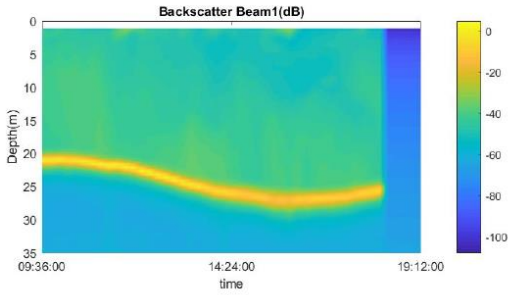
6.3.1 Echo / Backscatter RDI

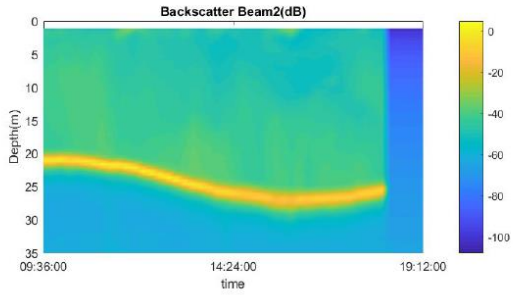


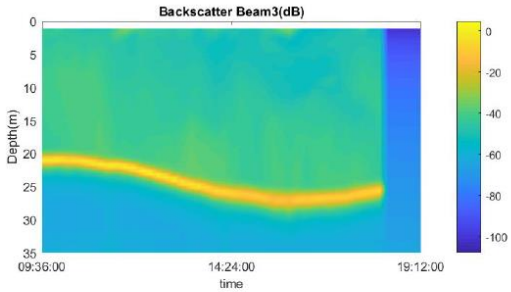


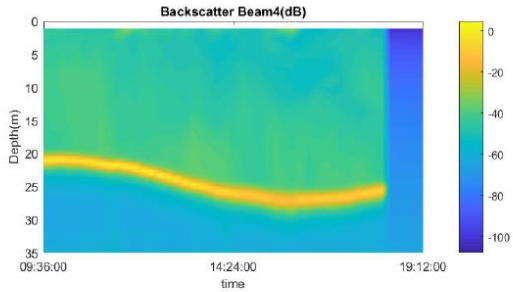












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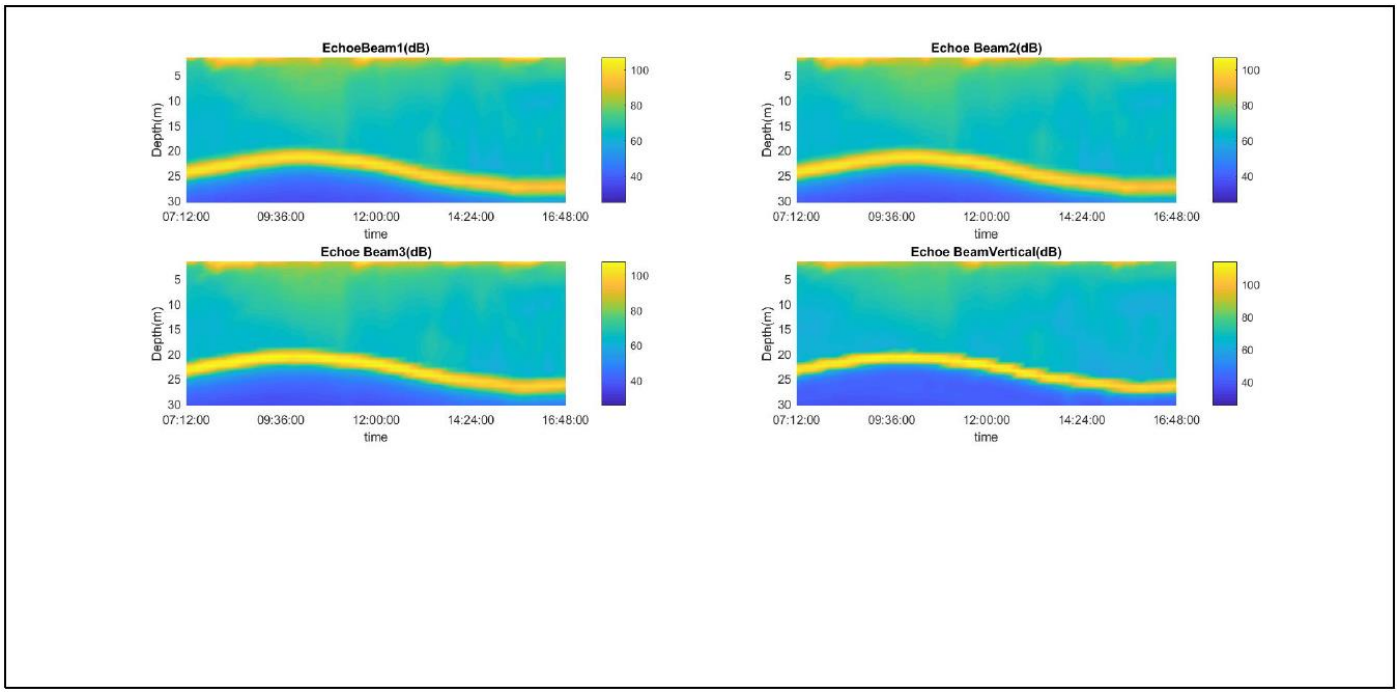
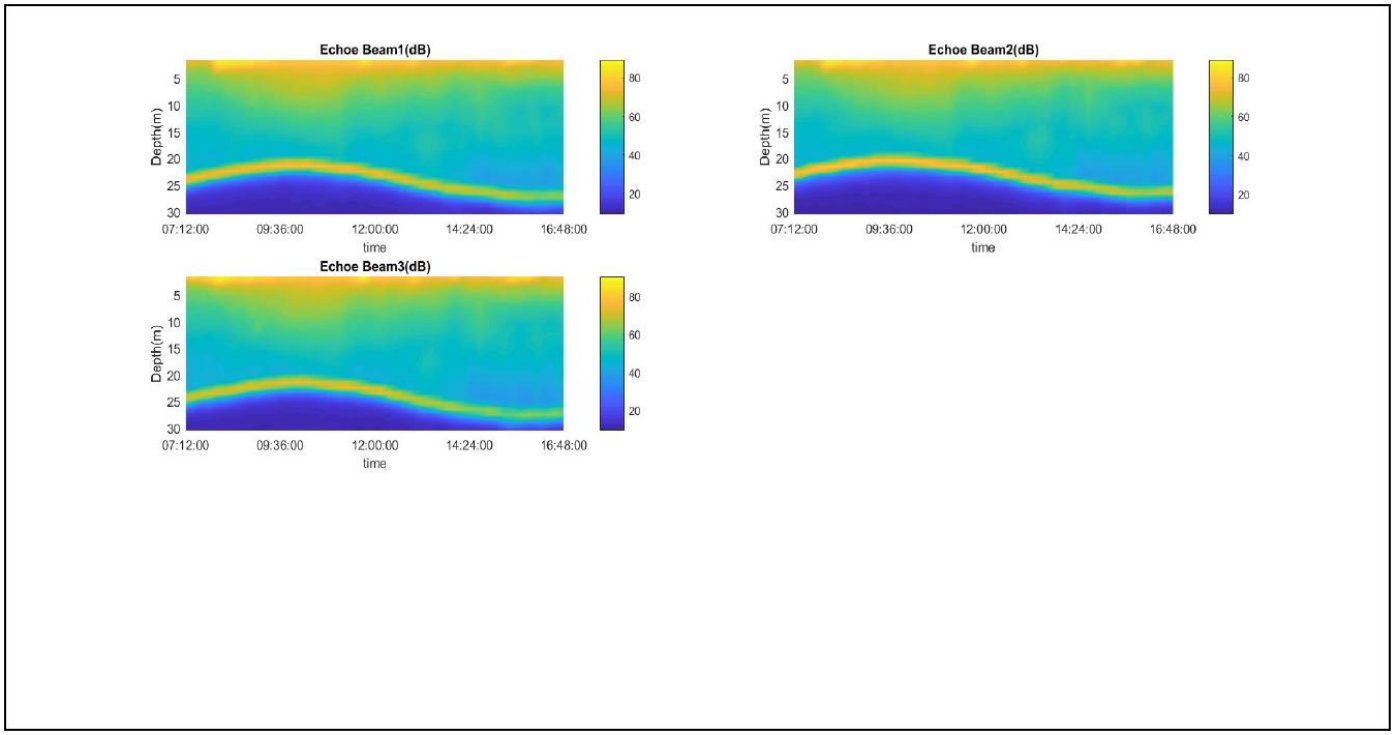
6.3.2 Echo RTI 600



6.3.3 Echo RTI 1200



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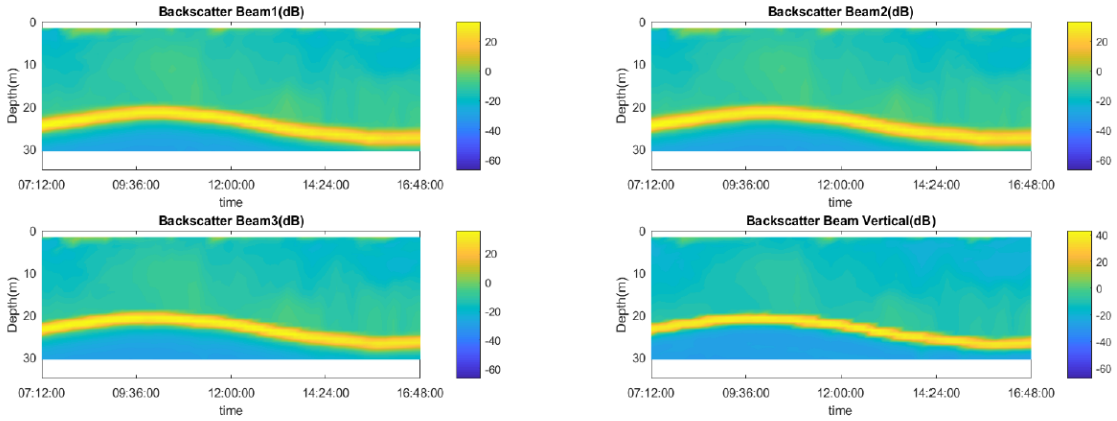
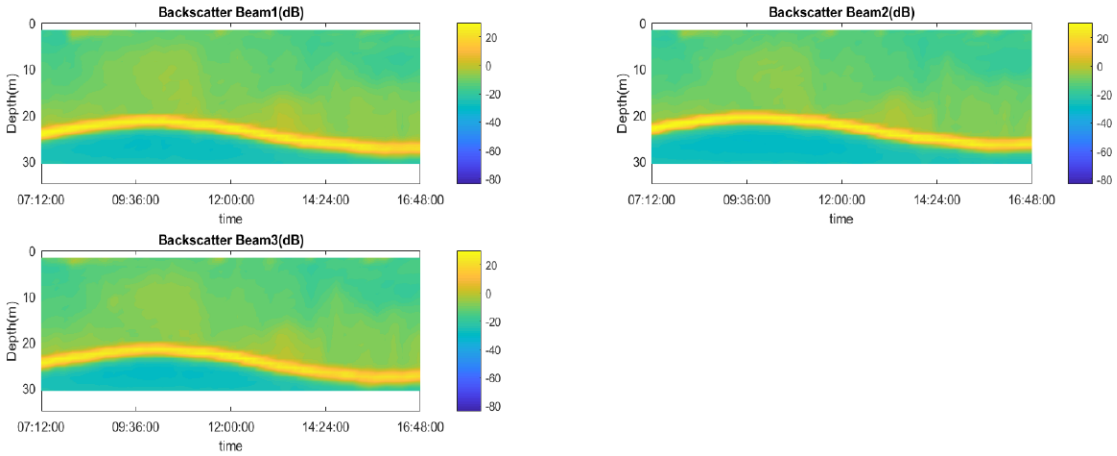
6.3.4 Backscatter RTI 600



6.3.5 Backscatter RTI 1200



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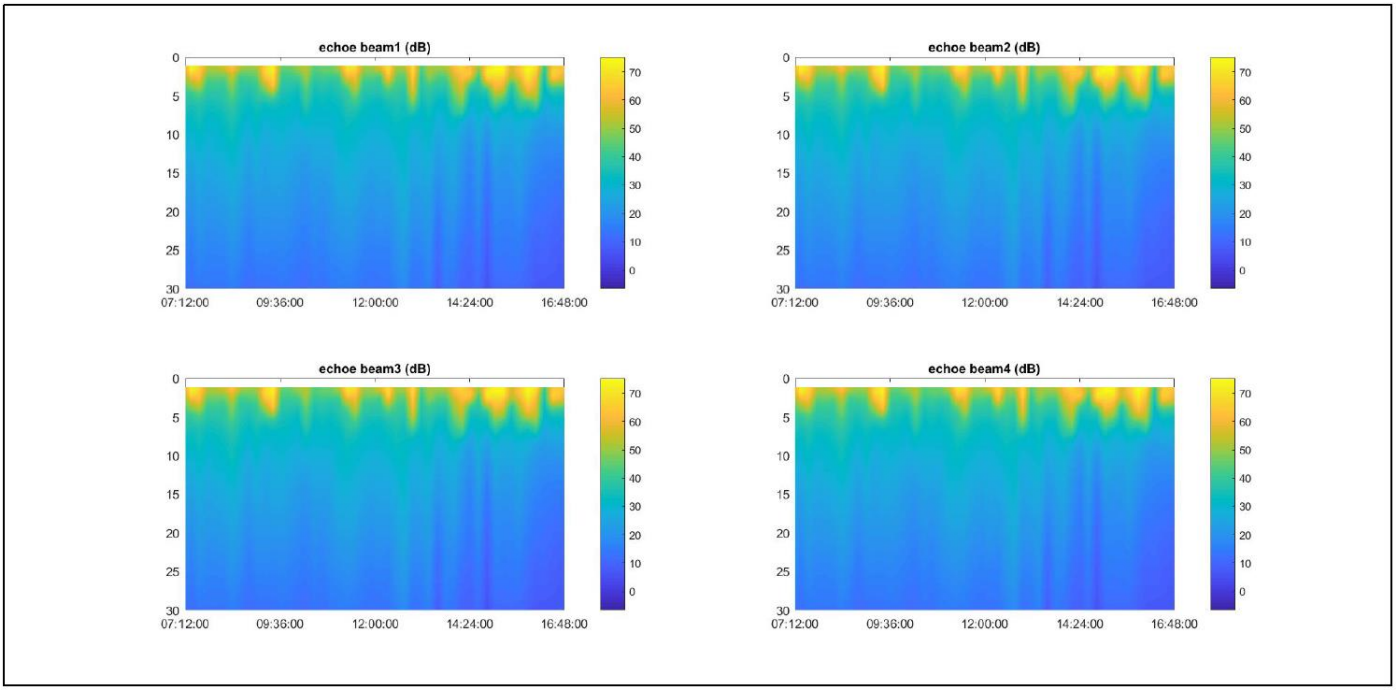
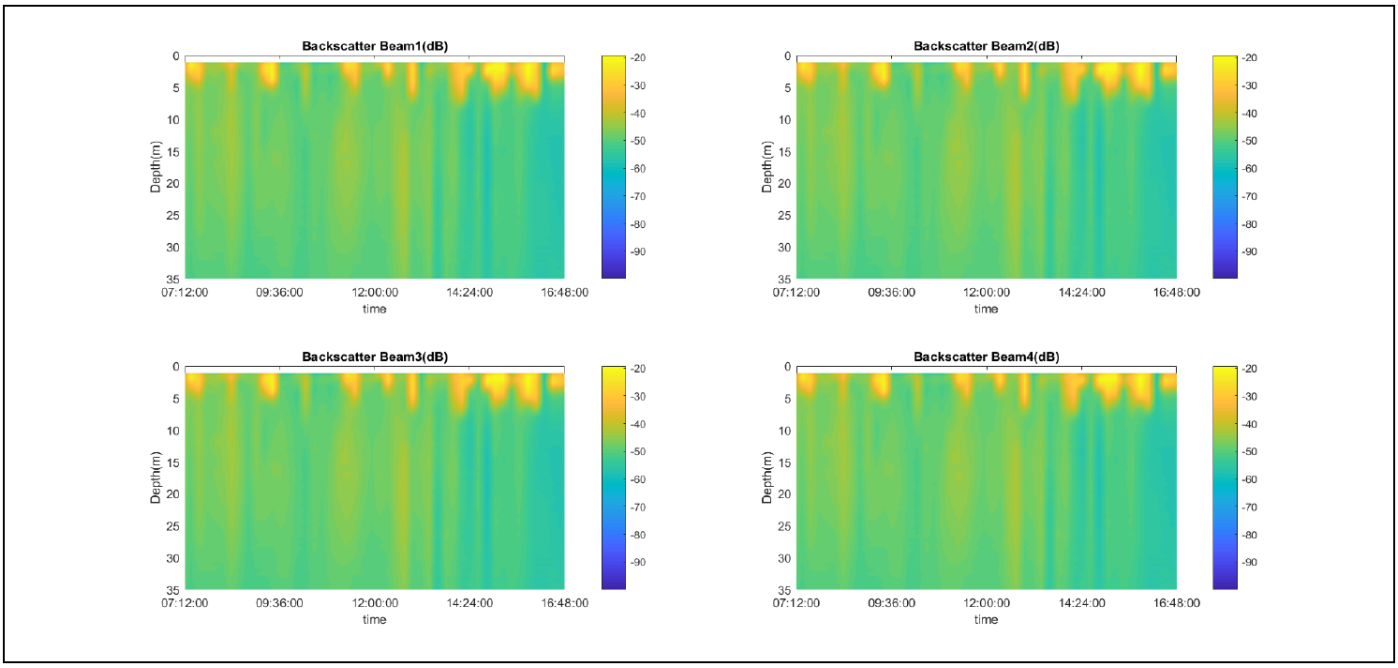
6.4 Gino

6.4.1 Echo / Backscatter RDI





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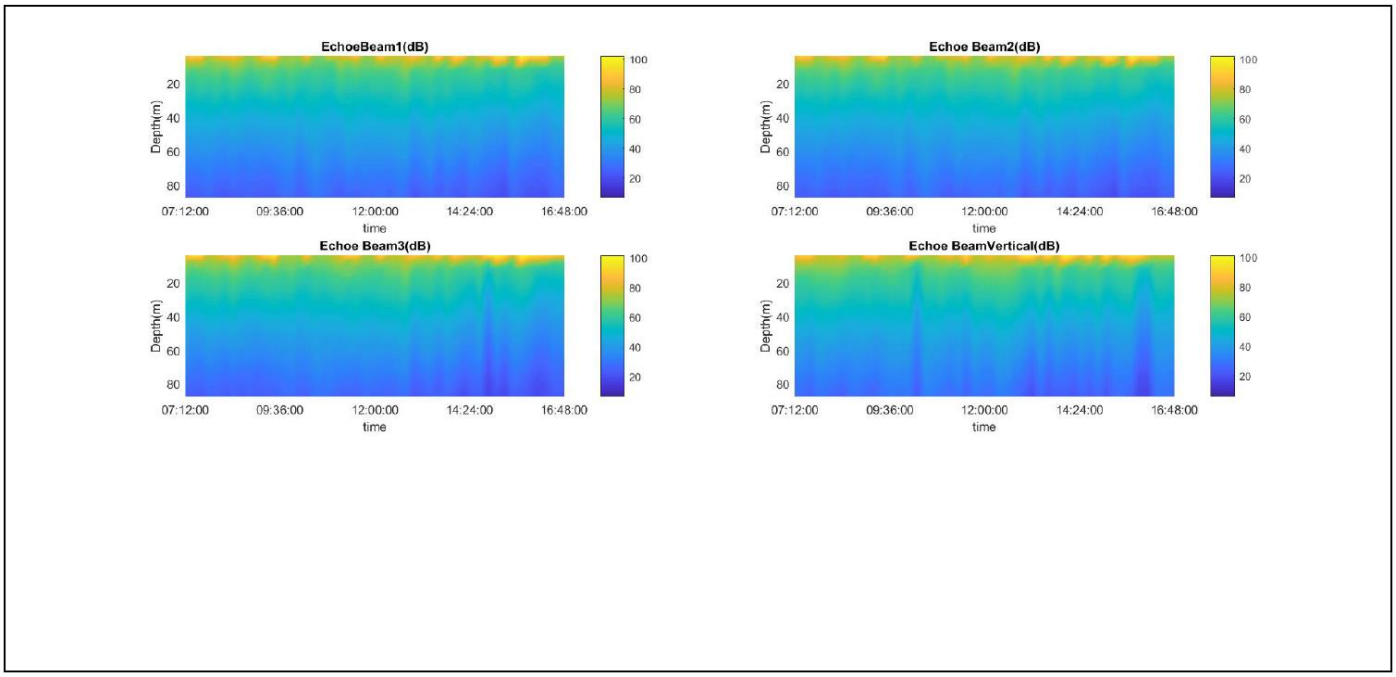
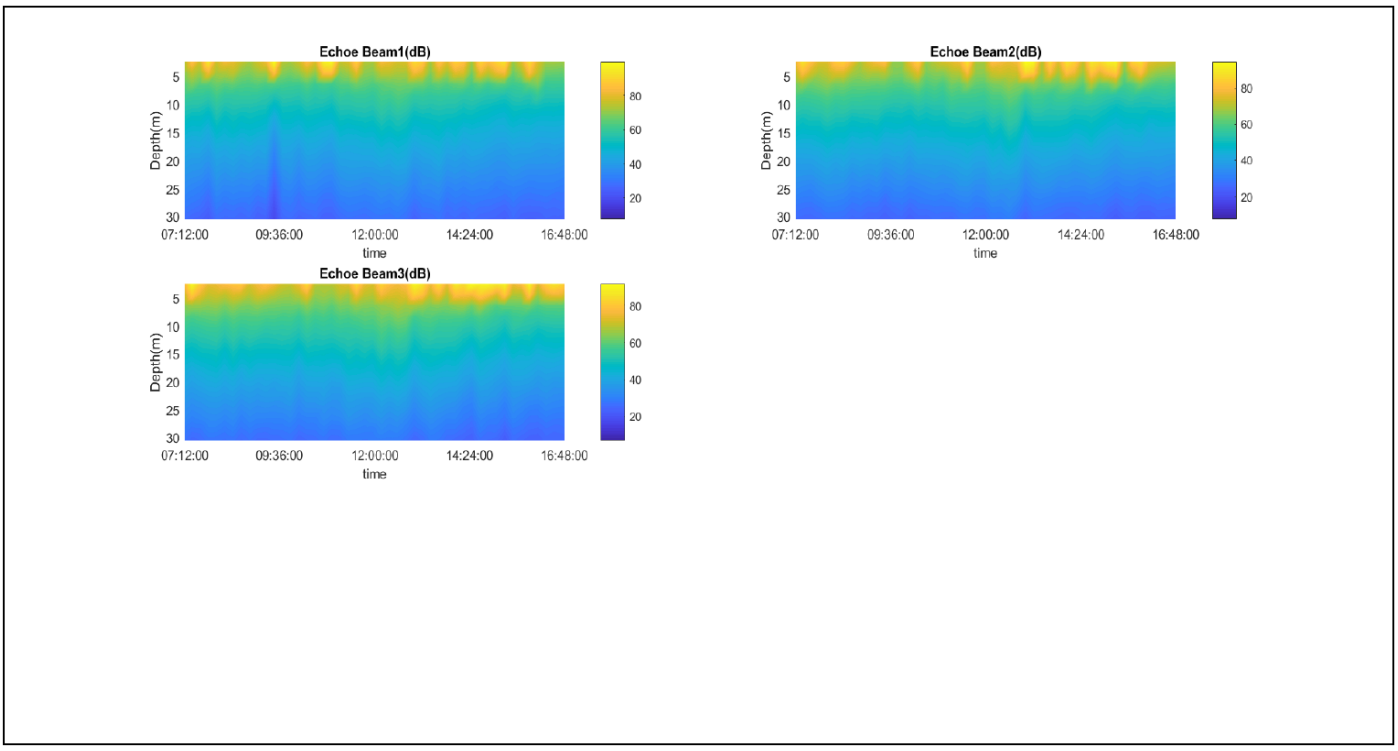
NOT PROTECTED

6.4.2 Echo RTI 600



6.4.3 Echo RTI 1200



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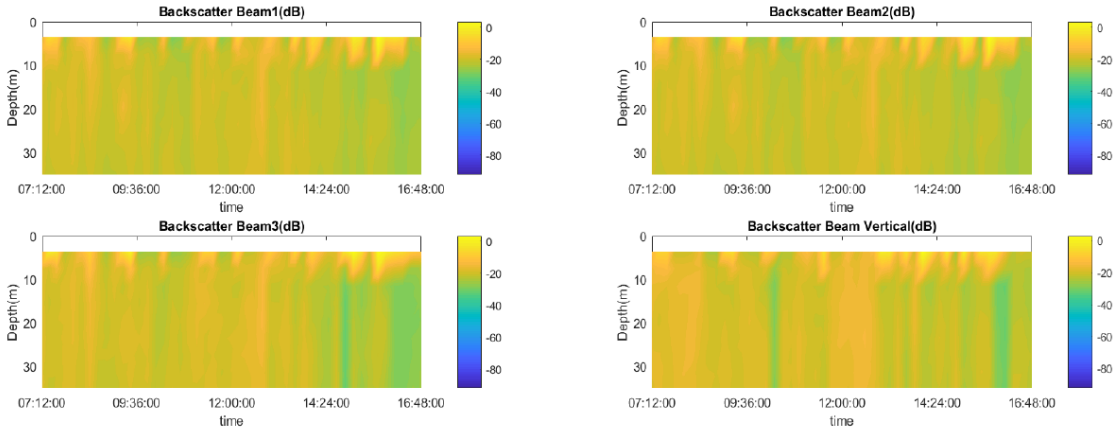
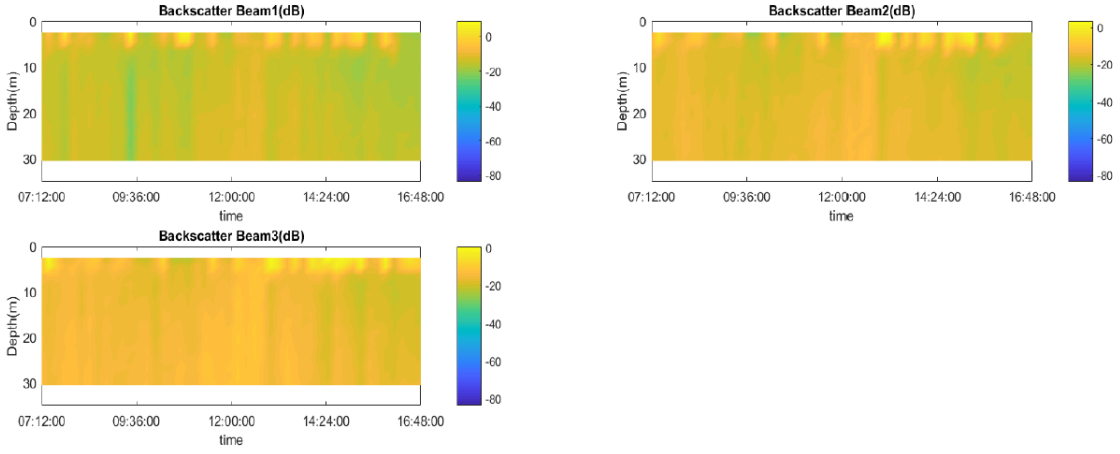
NOT PROTECTED

6.4.4 Backscatter RTI 600



6.4.5 Backscatter RTI 1200



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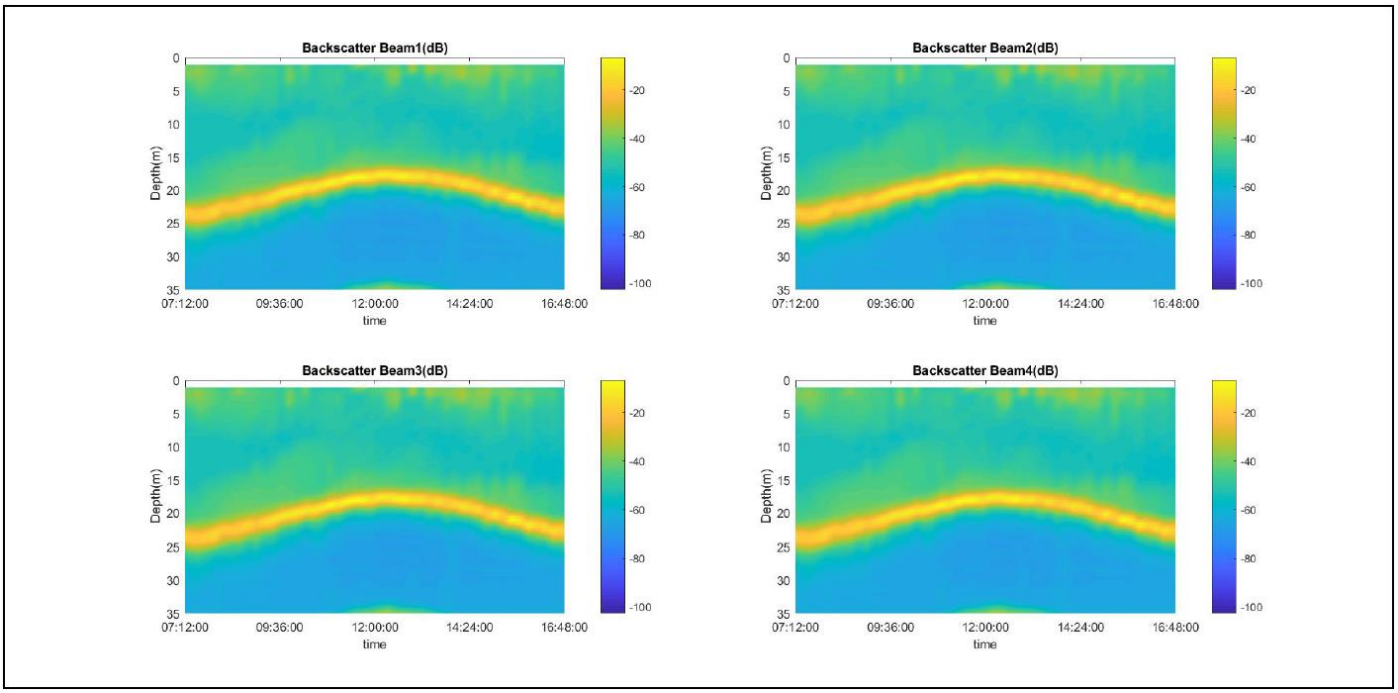
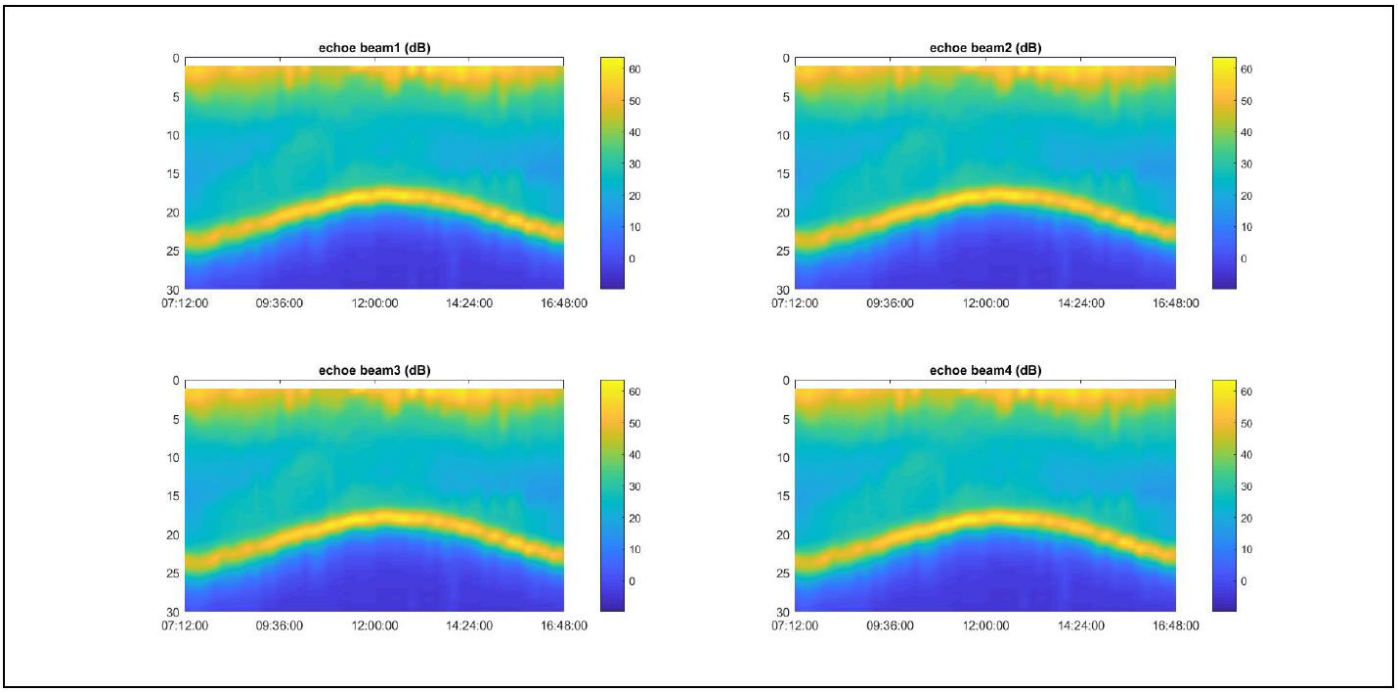
6.5 Douarnenez

6.5.1 Echo / Backscatter RDI





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SAS au capital de 1 420 840 Euros – RCS Lorient B478 468 655
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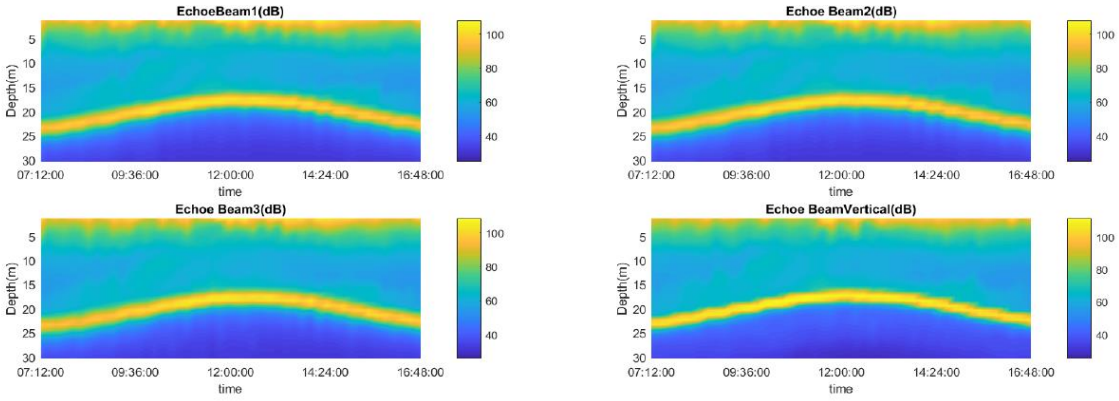
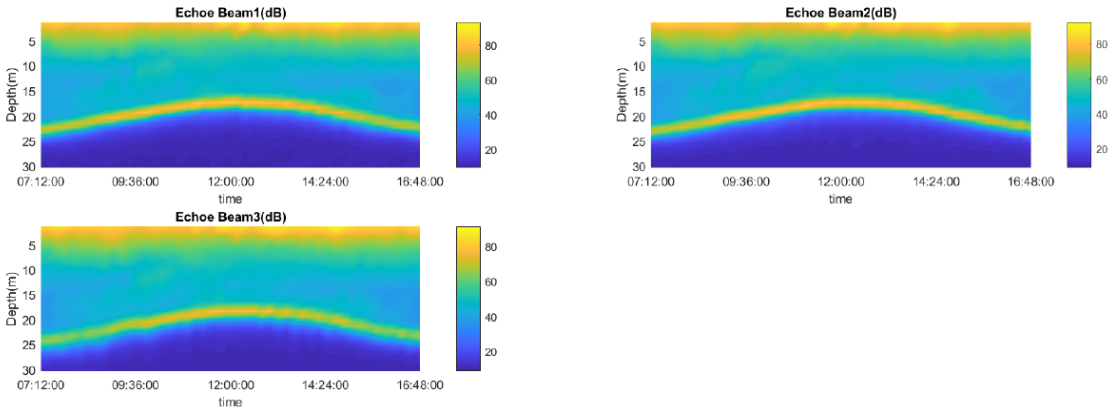
NOT PROTECTED

6.5.2 Echo RTI 600



6.5.3 Echo RTI 1200



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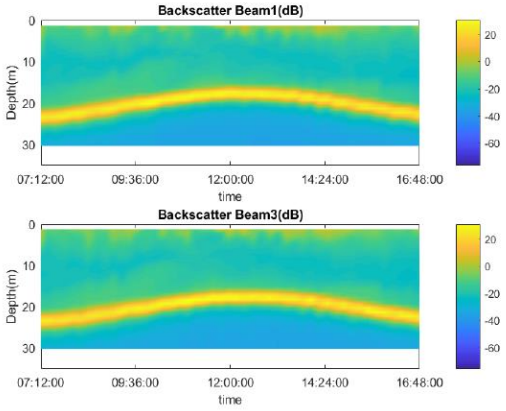
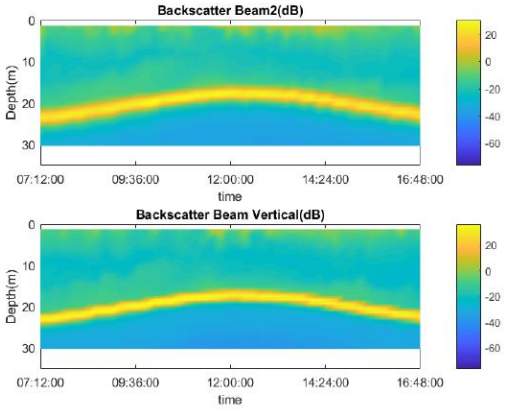
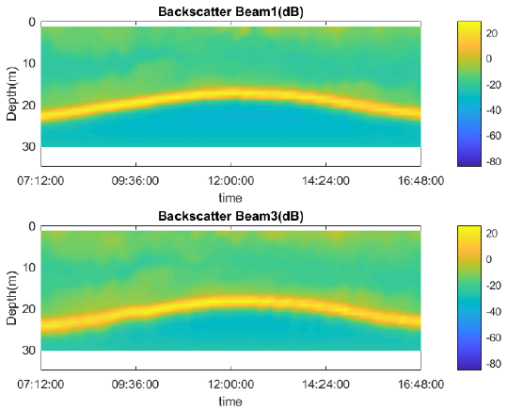
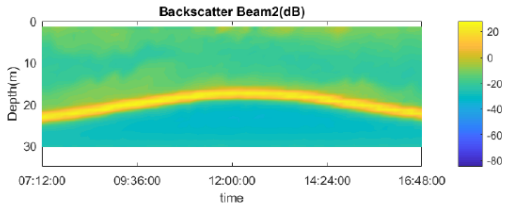
6.5.4 Backscatter RTI 600





6.5.5 Backscatter RTI 1200





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