# WAVES BY SEASONDE

## Preliminary conclusions on the analysis and improvements on wave outputs

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## 1. Introduction

Main target is to access environmental and technology variables that influence the quality of different HFR sites for wave measurement and eventually conclude on the readiness of each site for acquisition of wave measurements.

## 2. Objectives

Establishment of new methods for analysis of wave measurement capability, quality control and performance metrics for any HFR site.

Analysis of the performance of the HFR stations for wave measurement in different situations by modifying configuration parameters available on the radar proprietary software, testing different Software releases and comparing results with other available and overlapping measurements from other in-situ instruments

statistical analysis will be carried out (including average differences, RMSE, correlation…) comparing wave data bulk parameters (significant wave height, wave period and wave direction) from the following sources:

- **HF radar versus wave buoy**
- HF radar versus CMEMS wave model
- CMEMS wave model versus wave buoy

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# 3. Environmental Analysis

## Morphology of the area

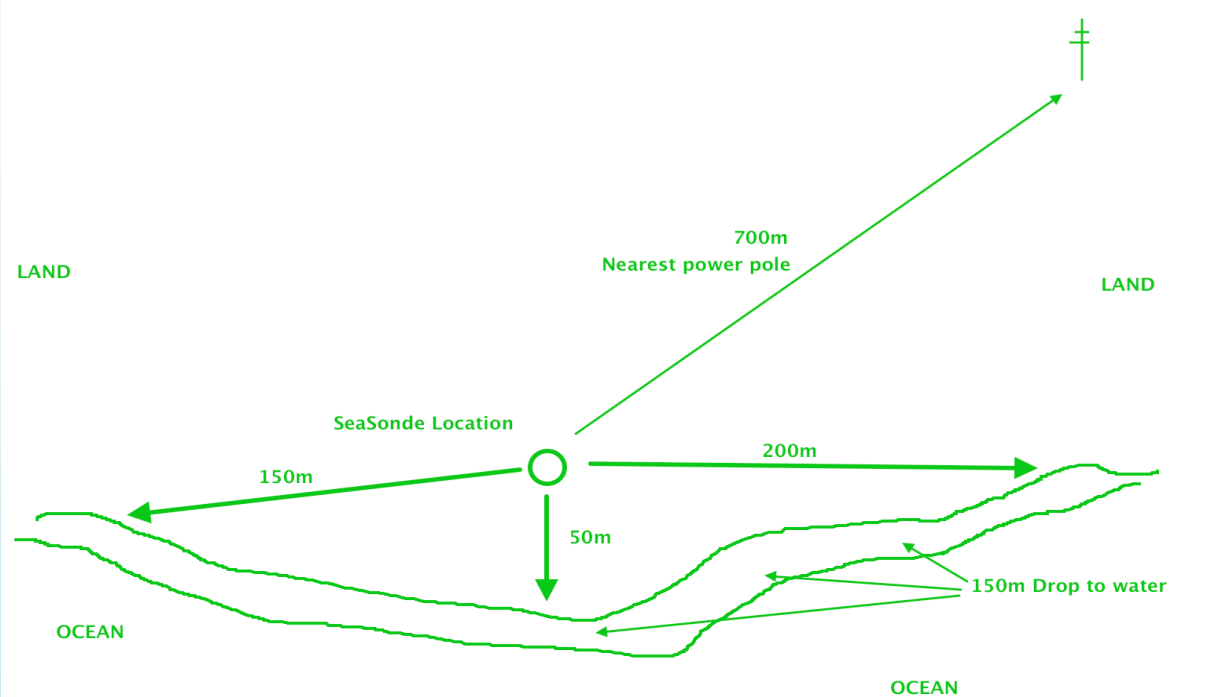
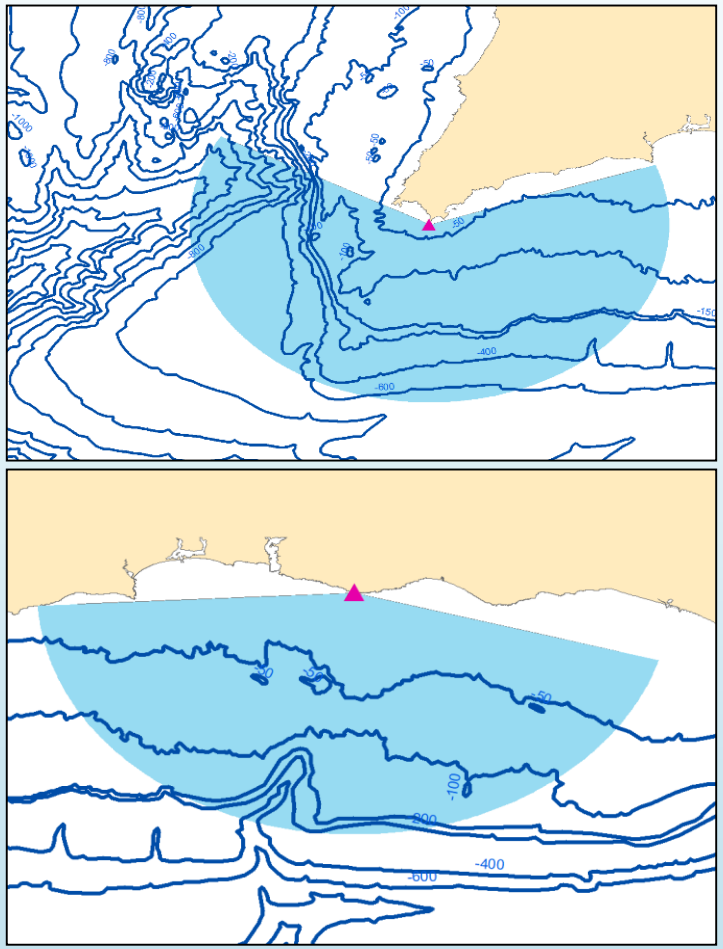



Figure 1. Ideal HF radar station installation (info from CODAR).



SGTR

AFTR

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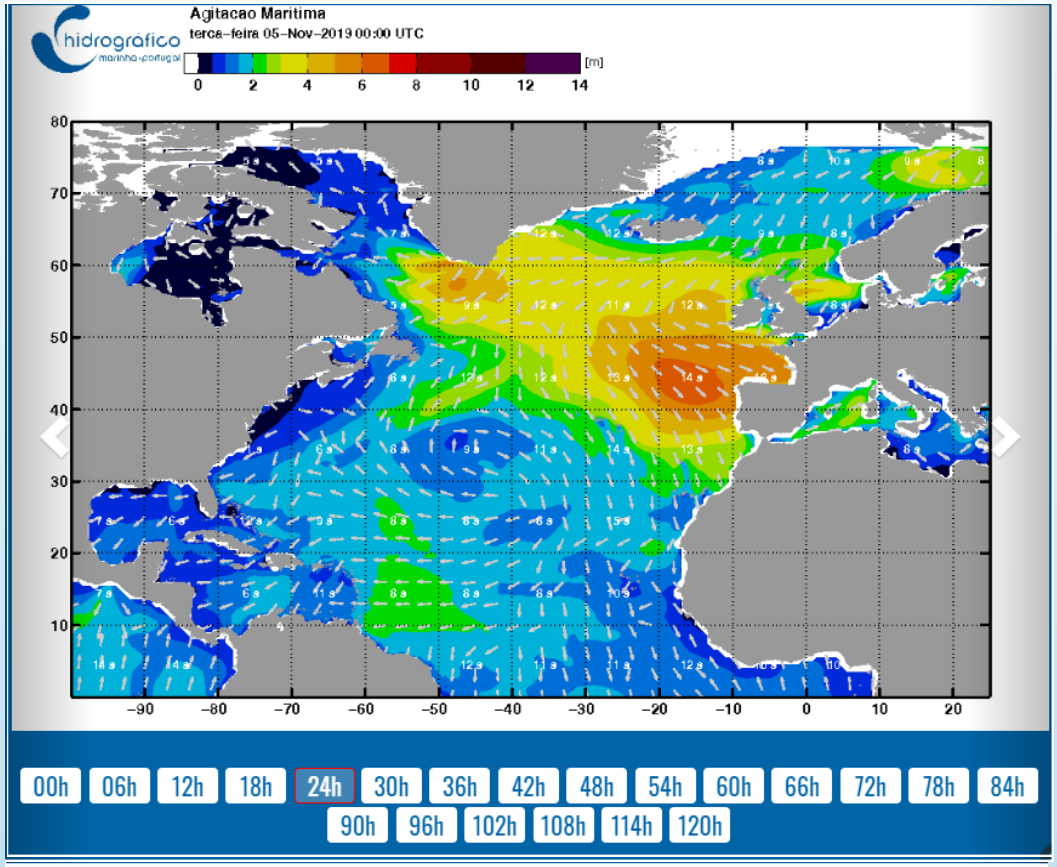
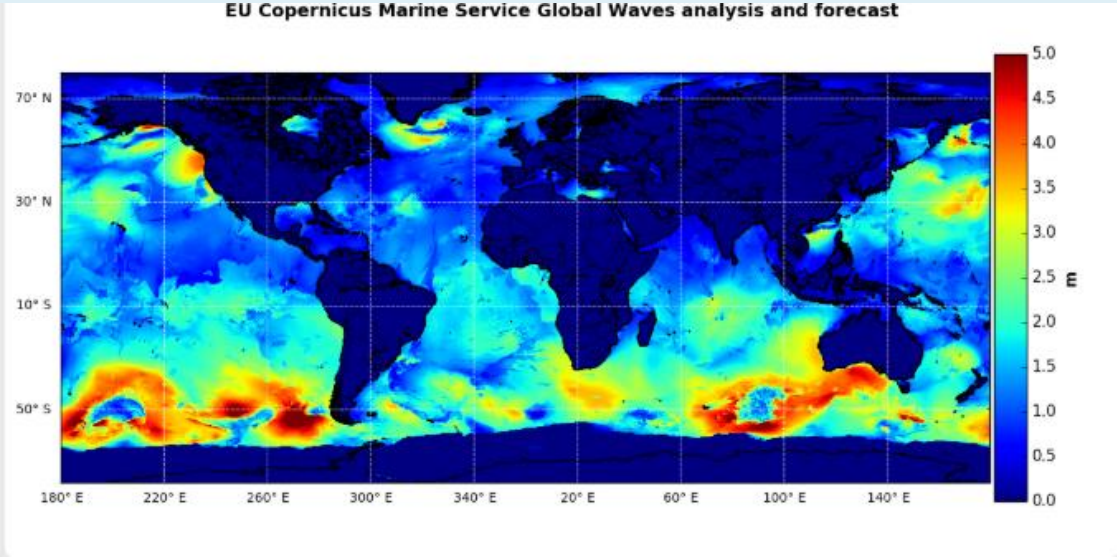
# 3. Environmental analysis

## Metocean conditions





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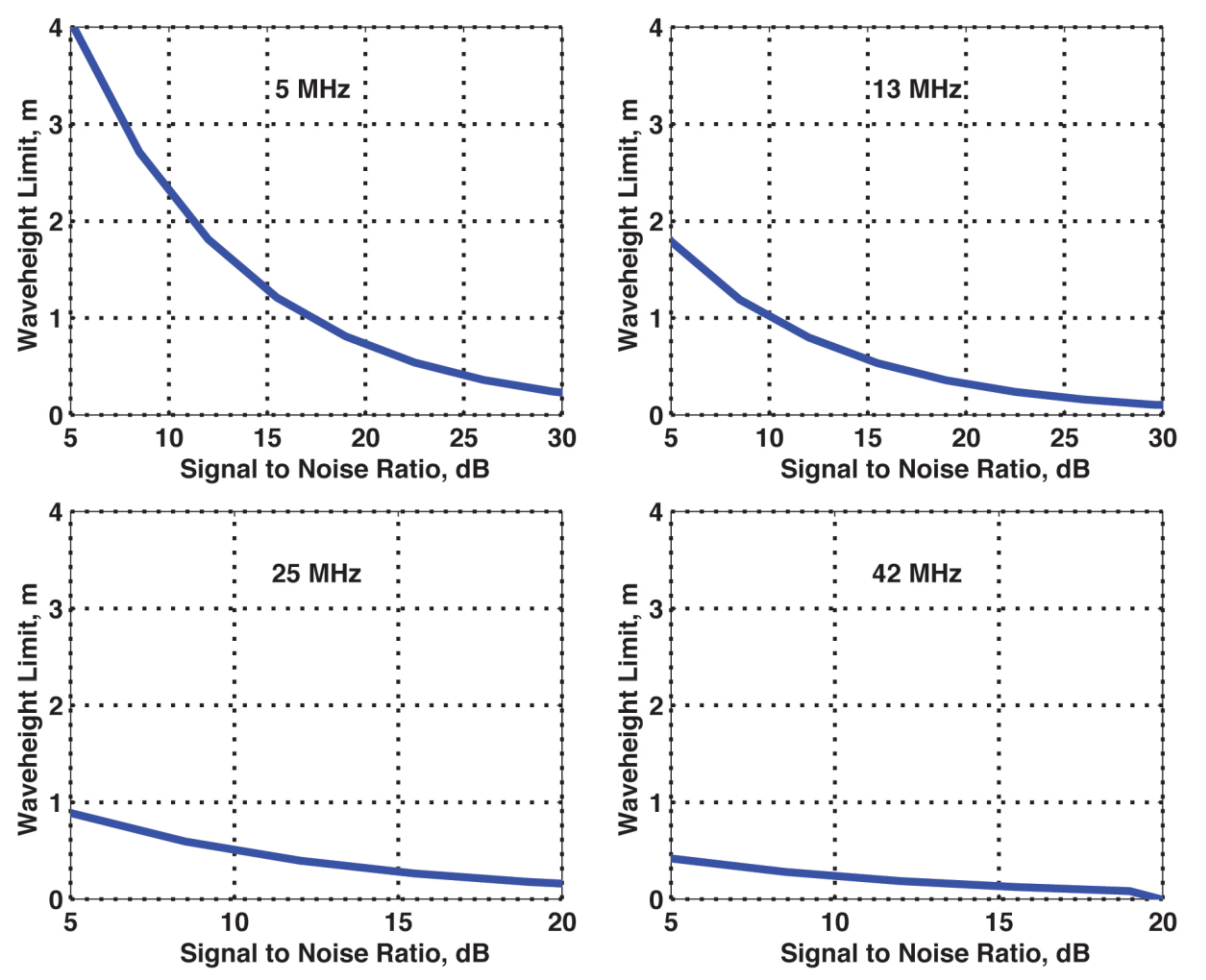
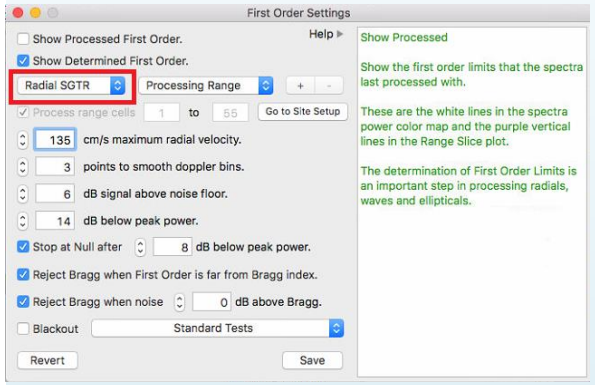
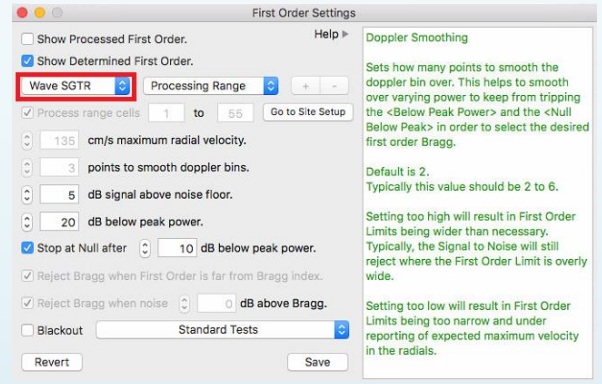
# 4. Software settings

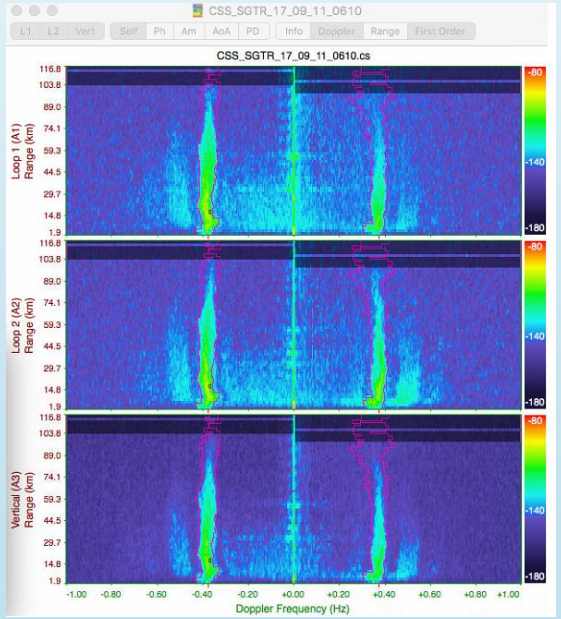


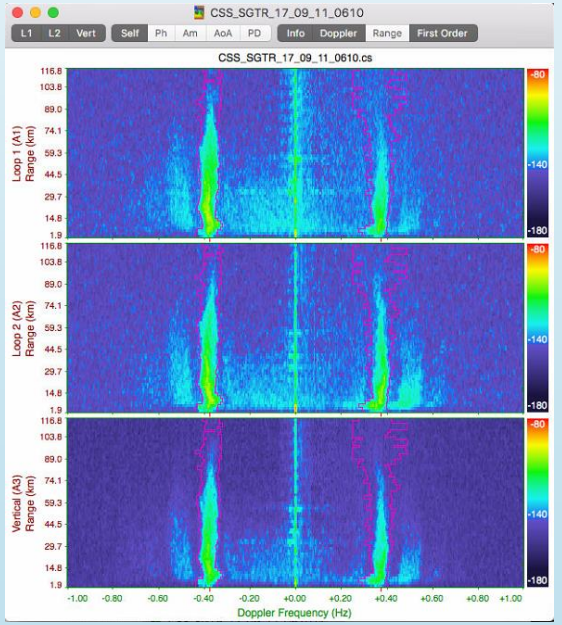

Don Barrick & Belinda Lipa, January 2013

## a) First order settings (FOS)

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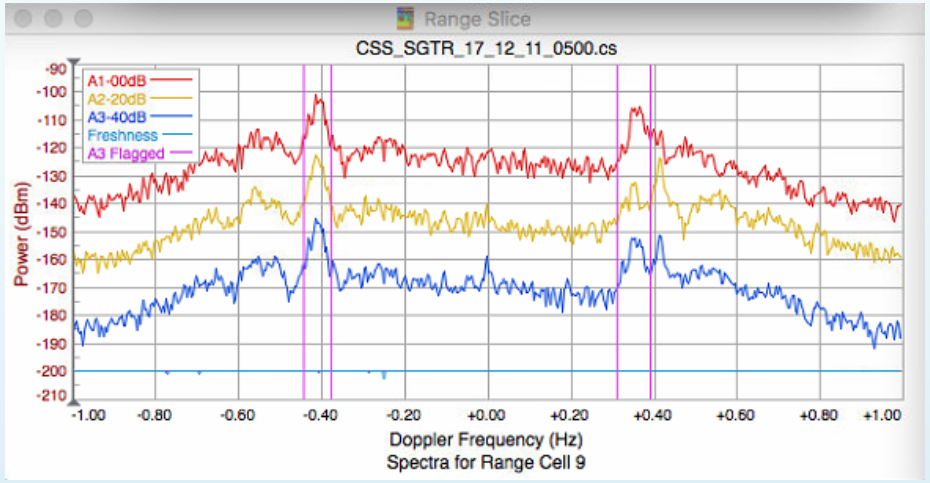
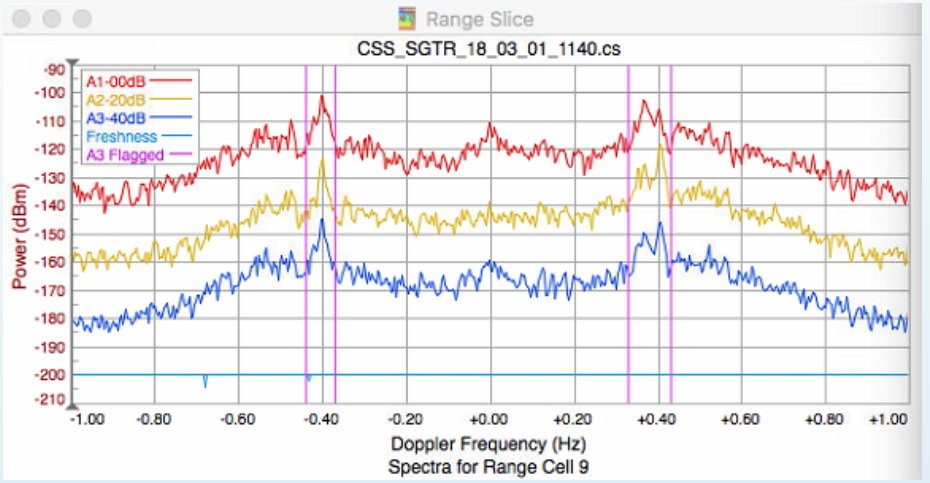
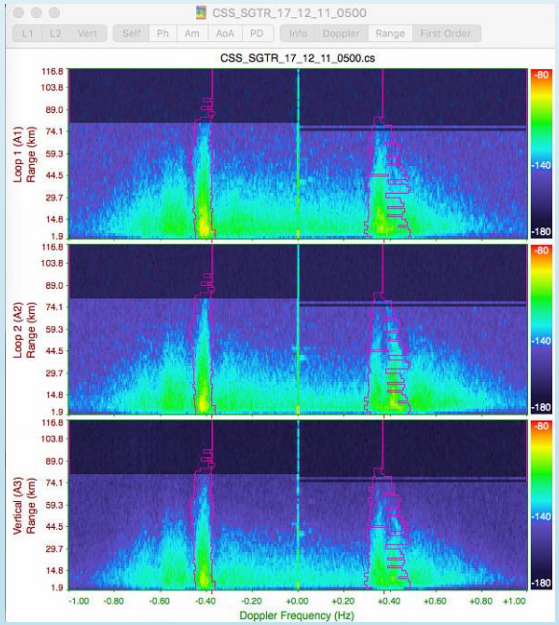
# 4. Software settings

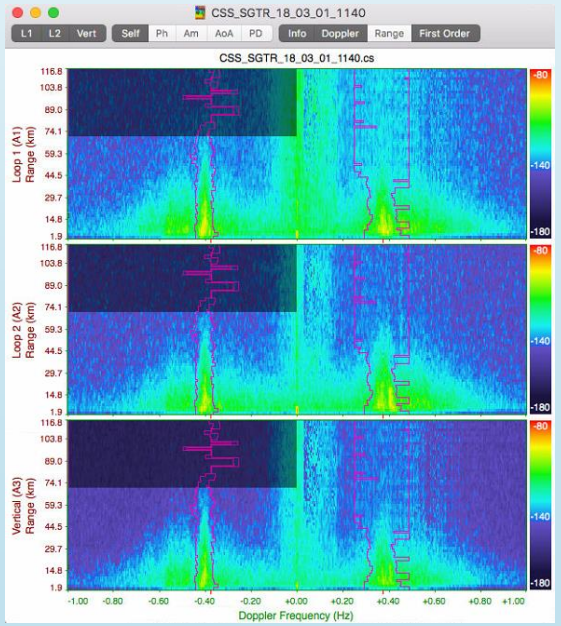
Ana Storm




Emma Storm

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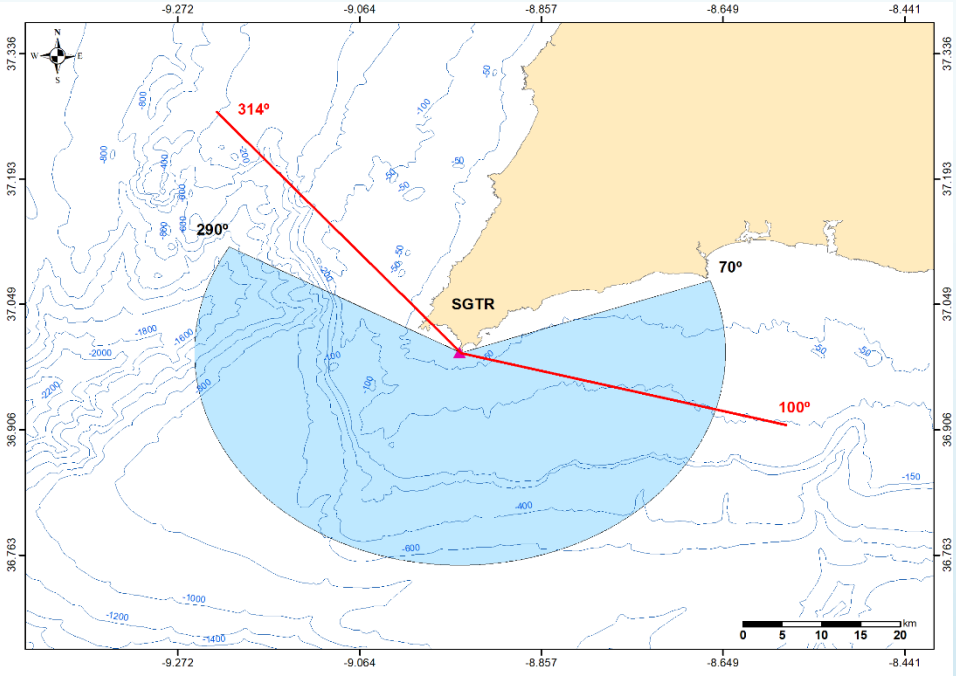
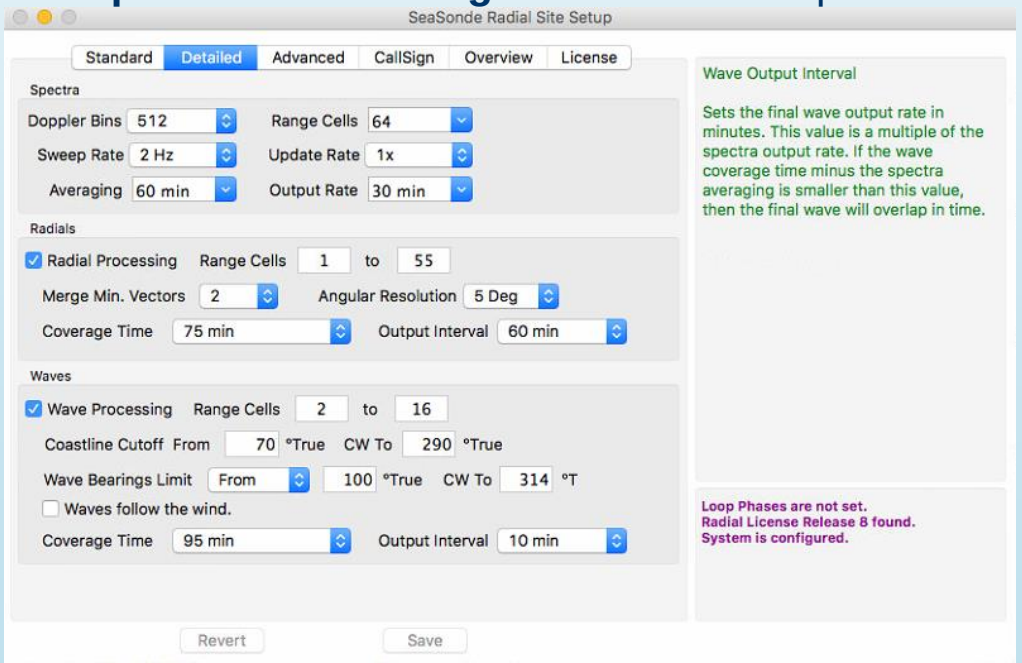
# b) Coastal bearings




| Coastline Settings | Value |
|---|---|
| Coastline Cuttoff | 70º - 290º |
| Wave bearing limits | 100º - 314 º |
| Coverage time | 95 min |
| Output interval | 10 min |
| Range cells | 2 – 16 |

- **coastline cuttoff settings** - best coastline bearings from the site that covers the ocean;
- **wave bearing limits settings -** limits where dominant waves are expected to come from;
- **coverage time settings** - final wave coverage time of merged short-time wave from CSS in minutes;
- **output interval settings -** final wave output in minutes.

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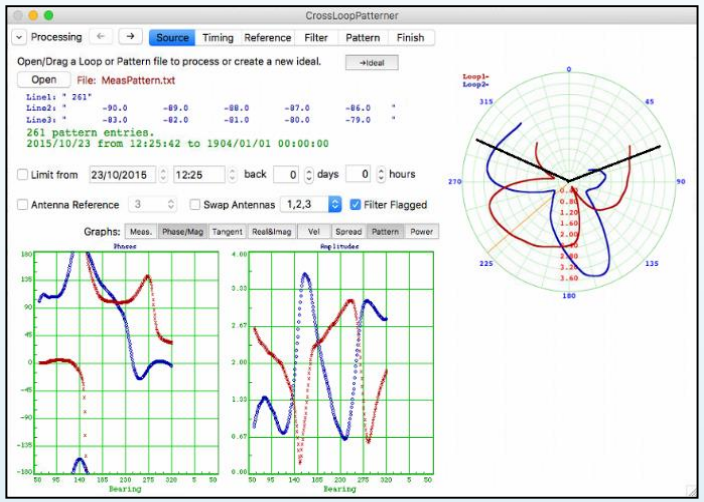
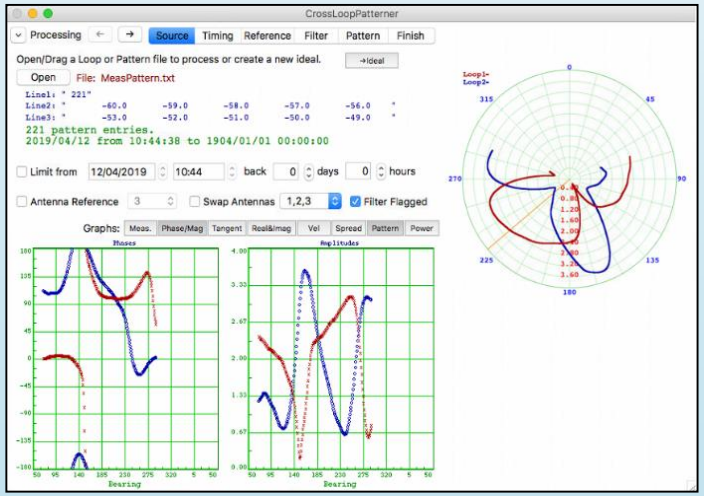
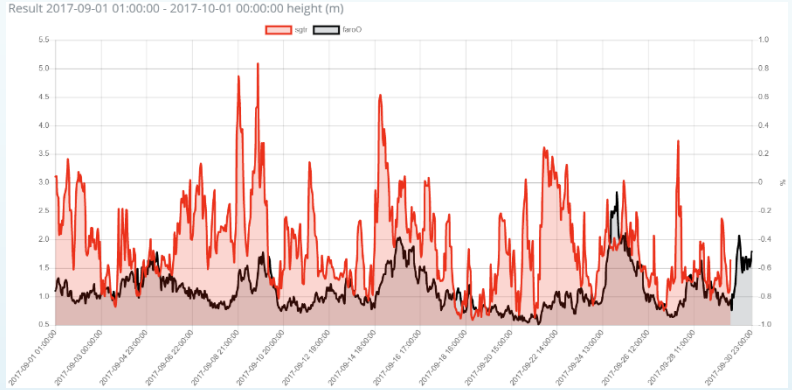
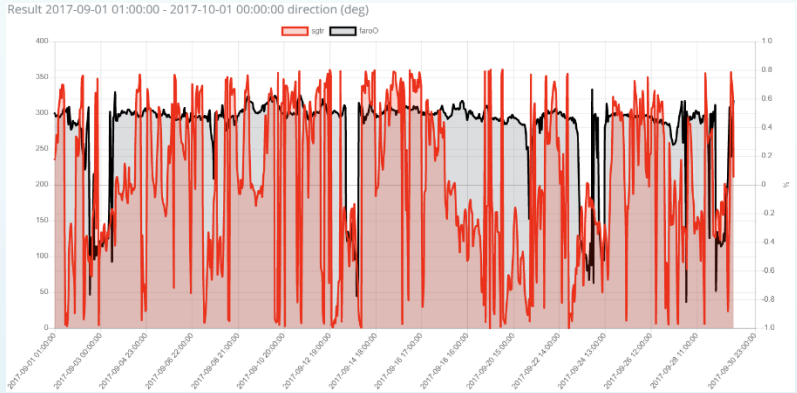
# c) Software versions



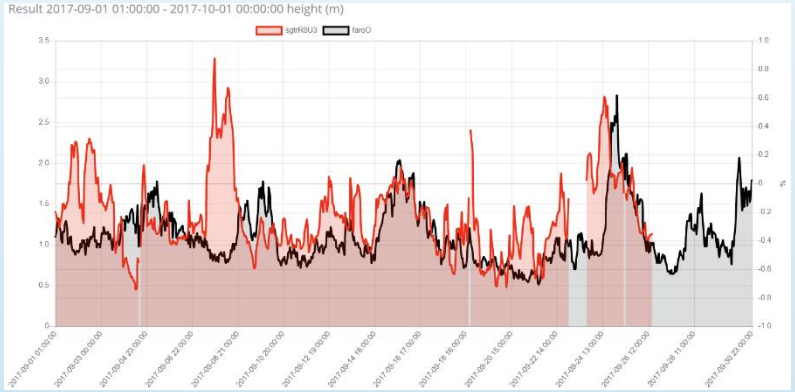



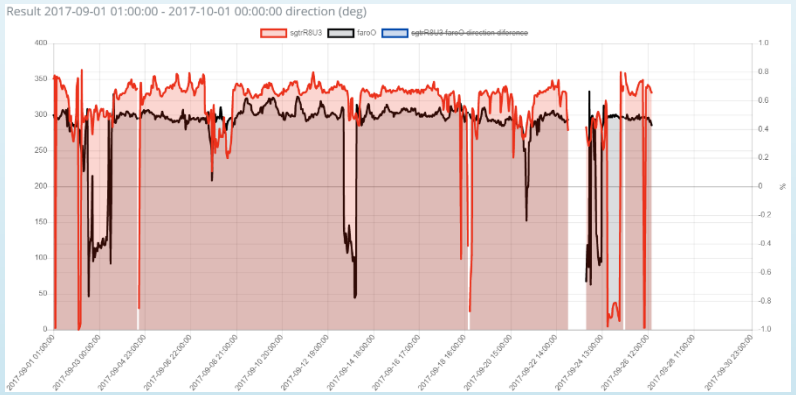

## R7U4




## R8U3




### R7U4

| Variables | Value |
|---|---|
| RMS | 1.12 m |
| CI | 0.231 |
| Availability SGTR | 96.80% |
| Availability buoy | 100.00% |
| Number of data | 720 |
| Average difference | 0.82 |

### R8U3

| Variables | Value |
|---|---|
| RMS | 0.595 |
| CI | 0.206 |
| Availability SGTR | 82.78% |
| Availability buoy | 100.00% |
| Number of data | 720 |
| Average difference | 0.34 |

### R7U4

| Variables | Value |
|---|---|
| RMS | 1.20 deg |
| CI | 0.218 |
| Availability SGTR | 96.80% |
| Availability buoy | 100.00% |
| Number of data | 720 |
| Average difference | 71.79 |

### R8U3

| Variables | Value |
|---|---|
| RMS | 10.90 deg |
| CI | 0.085 |
| Availability SGTR | 82.78% |
| Availability buoy | 100.00% |
| Number of data | 720 |
| Average difference | 38.59 |

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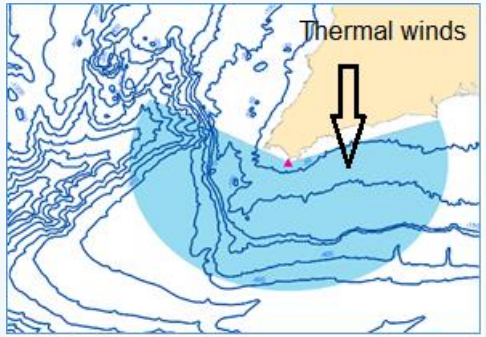
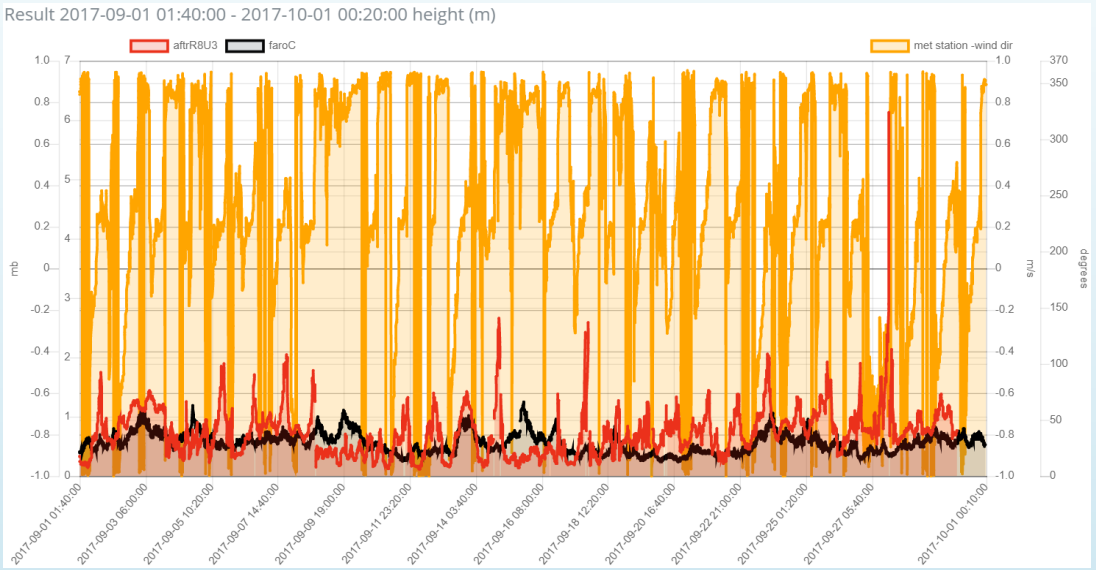
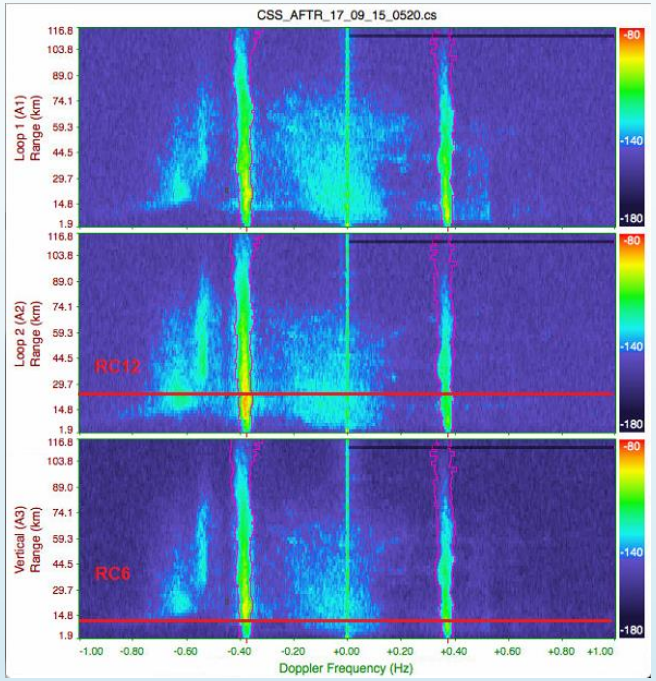
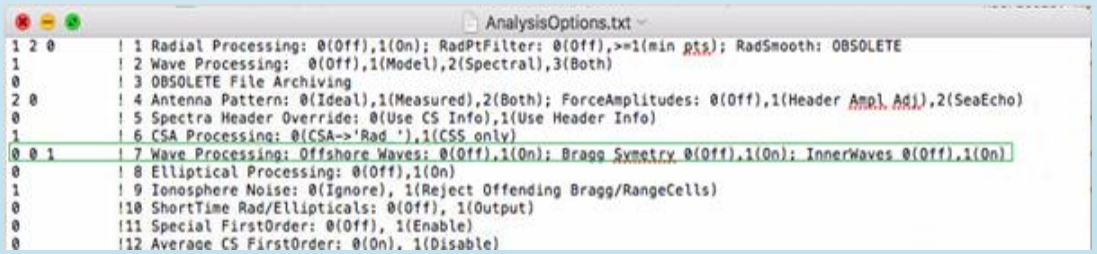
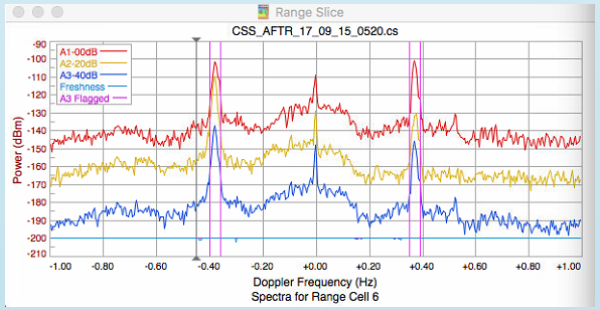
# d) Sidebands

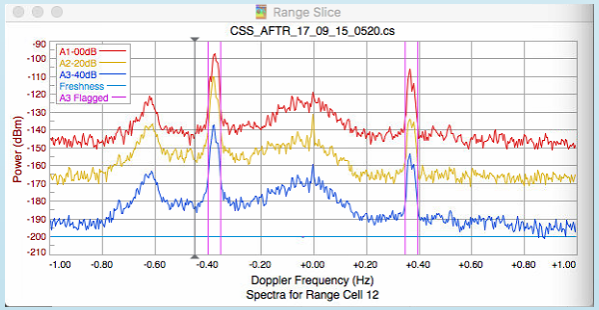
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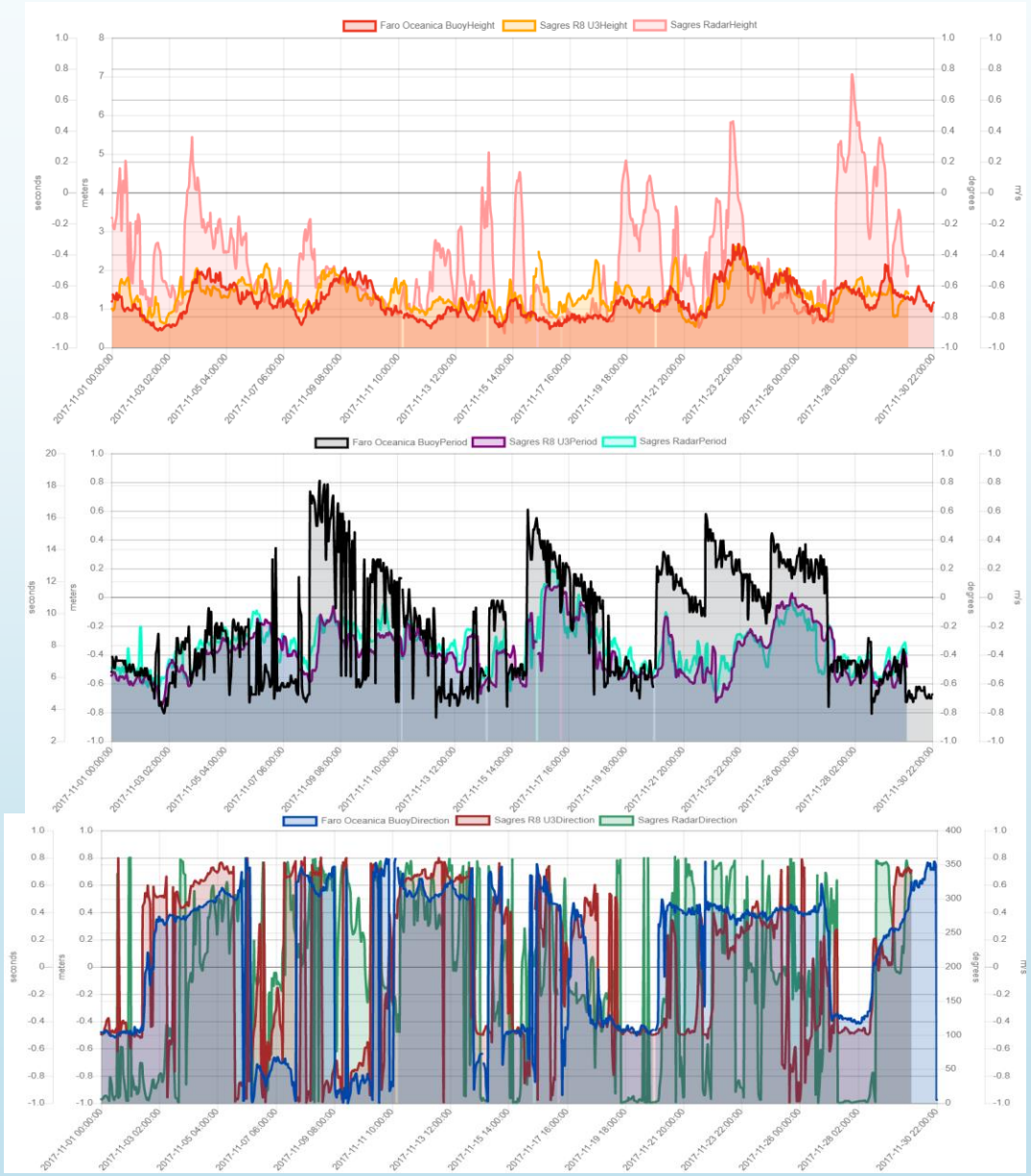
# 5. Radialsite Release 8 versus Release 7




## R8U3

| Variables | Value Hs (m) |
|---|---|
| RMS | 0.398 |
| CI | 0.617 |
| Availability SGTR R8 | 96.66% |
| Availability buoy | 99.58% |
| Number of data | 696 |
| Average difference | 0.302 |

| Variables | Value Tp (s) |
|---|---|
| RMS | 3.497 |
| CI | 0.468 |
| Availability SGTR R8 | 96.66% |
| Availability buoy | 99.58% |
| Number of data | 696 |
| Average difference | 2.546 |

| Variables | Value Dir (deg) |
|---|---|
| RMS | 0.056 |
| CI | 0.364 |
| Availability SGTR R8 | 96.66% |
| Availability buoy | 99.58% |
| Number of data | 696 |
| Average difference | 42.7 |

## R7U4

| Variables | Value Hs (m) |
|---|---|
| RMS | 1.548 |
| CI | 0.373 |
| Availability SGTR R7 | 96.59% |
| Availability buoy | 99.58% |
| Number of data | 717 |
| Average difference | 1.053 |

| Variables | Value Tp (s) |
|---|---|
| RMS | 3.391 |
| CI | 0.448 |
| Availability SGTR R7 | 96.59% |
| Availability buoy | 99.58% |
| Number of data | 717 |
| Average difference | 2.516 |

| Variables | Value Dir (deg) |
|---|---|
| RMS | 2.898 |
| CI | 0.309 |
| Availability SGTR R7 | 96.59% |
| Availability buoy | 99.58% |
| Number of data | 717 |
| Average difference | 83.852 |

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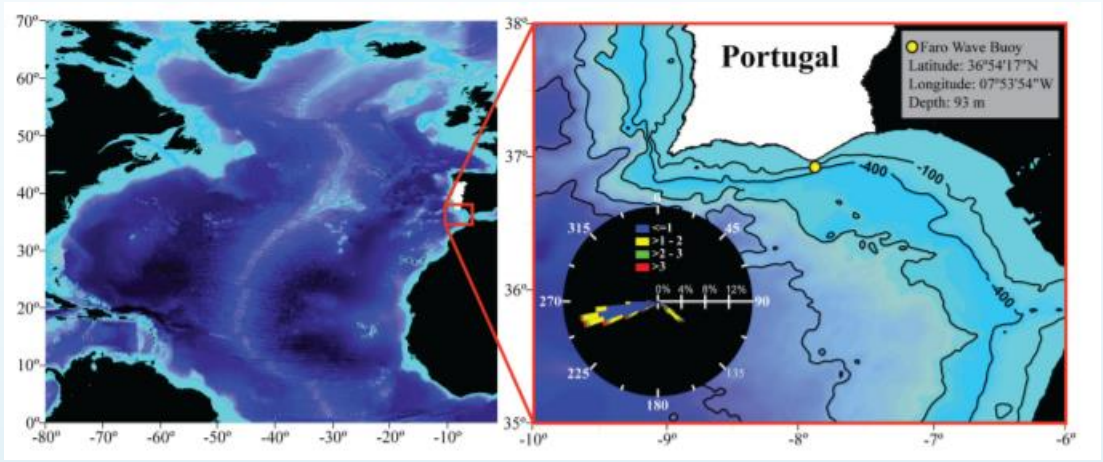
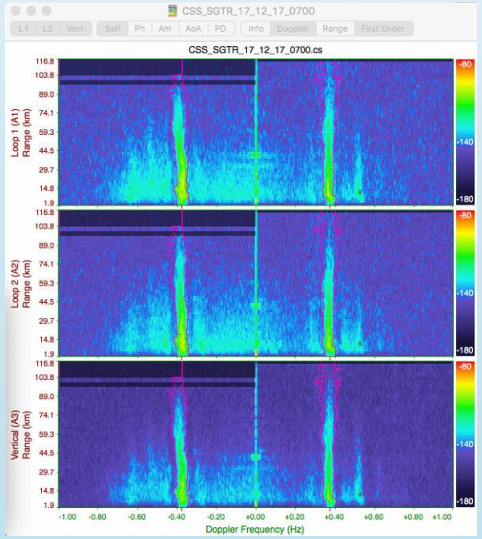
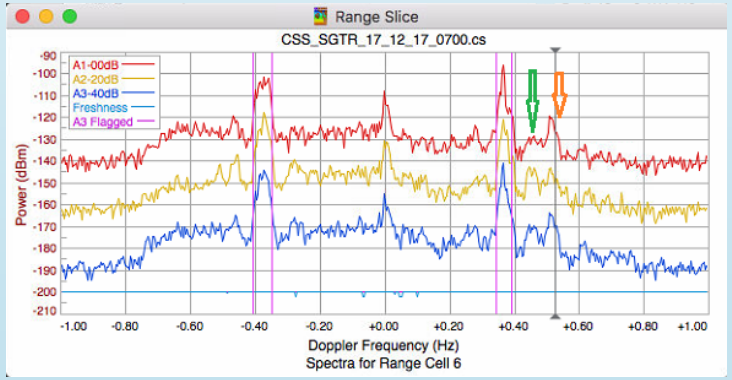
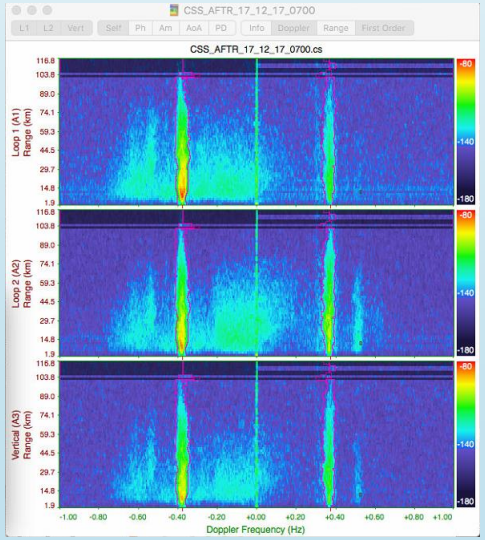
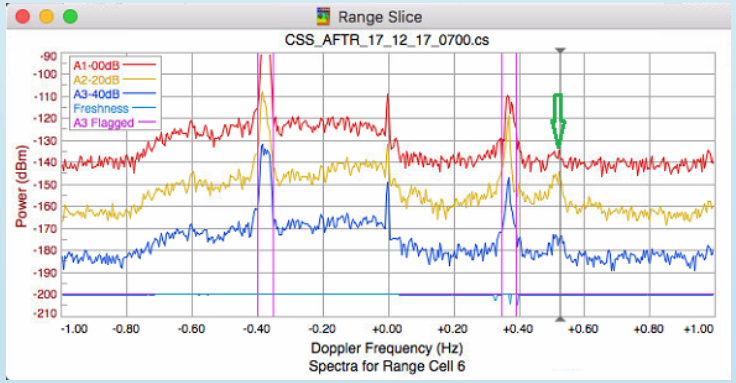
# 6. Importance of wind measurement

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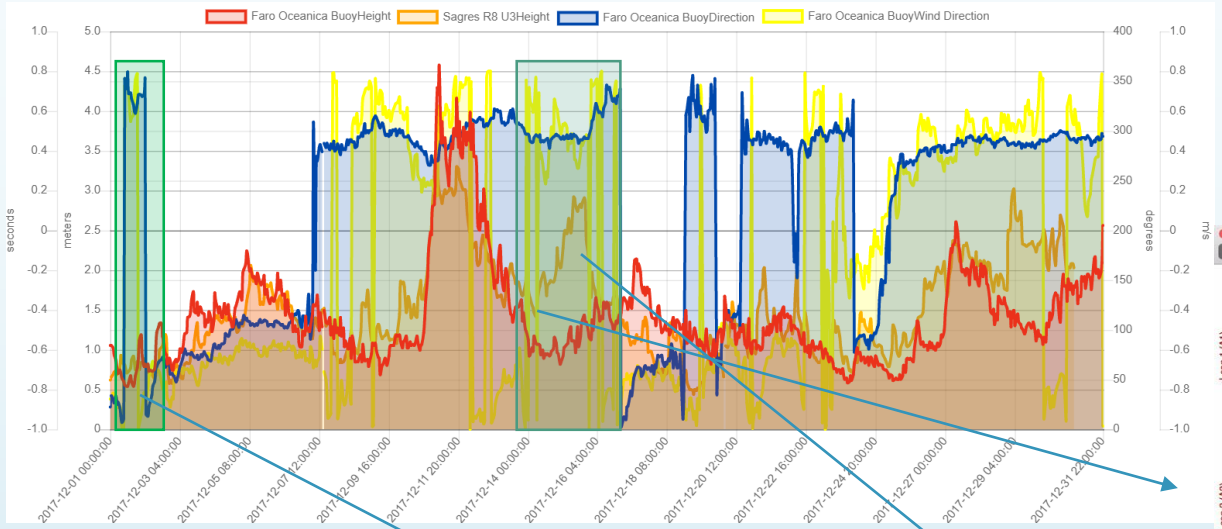
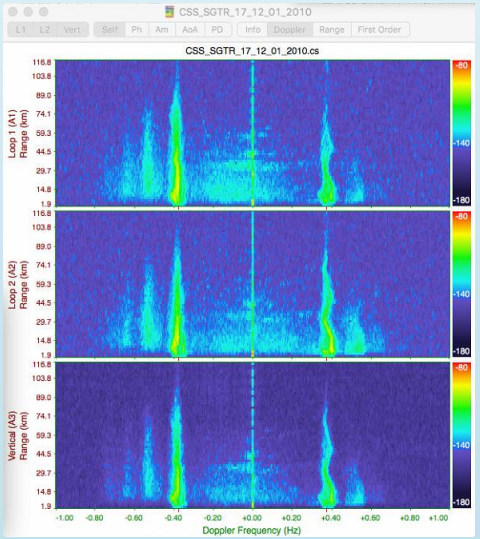
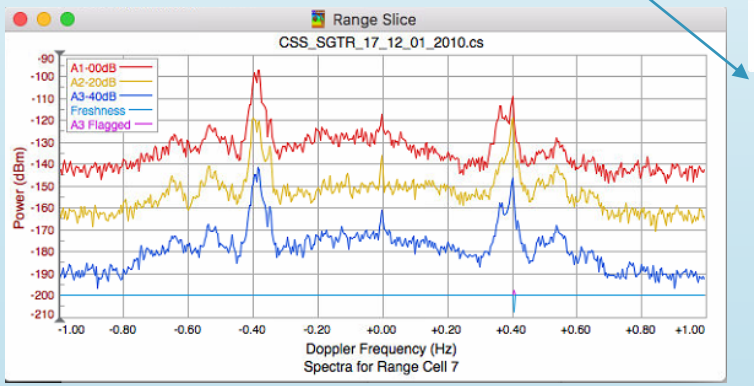
# 7. Variables and conditions that afect data quality

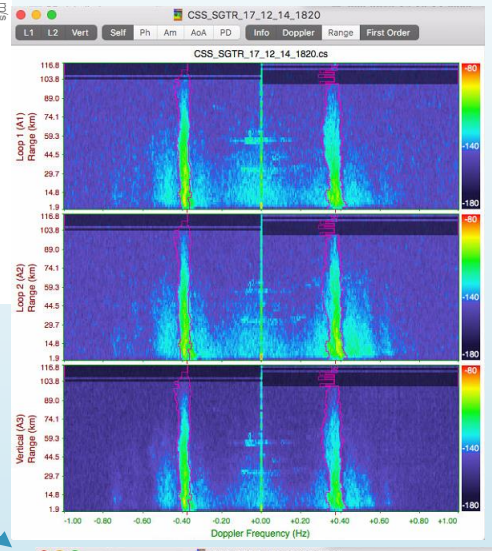
## a) bi-modal seas

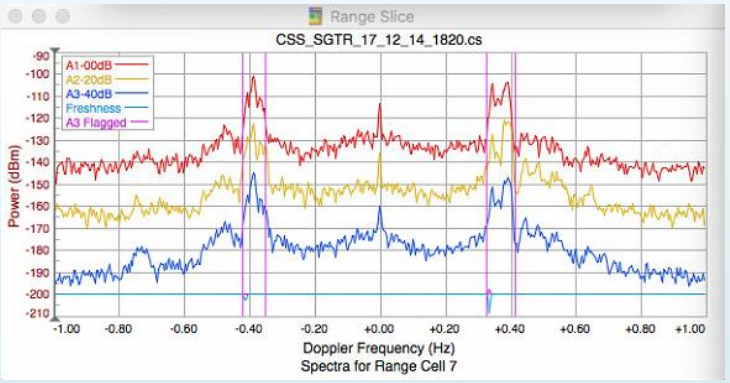
Presence of **bi-modal seas** (which can be checked in CMEMS data and HFR spectra). Bi-modal seas present bi-modal characteristics, meaning that we can have swell mixed with wind waves, both with different directions inducing 2 or more different oceanographic conditions.

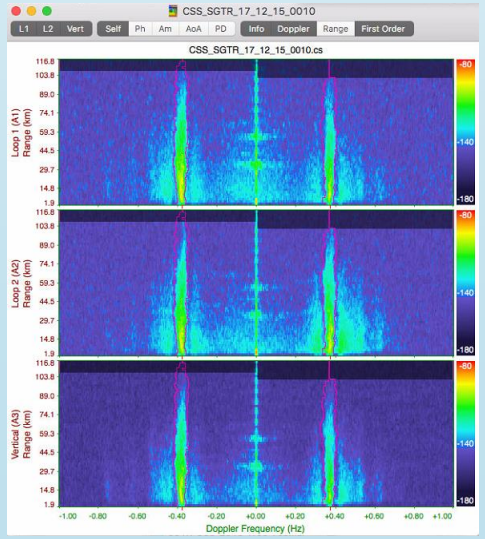


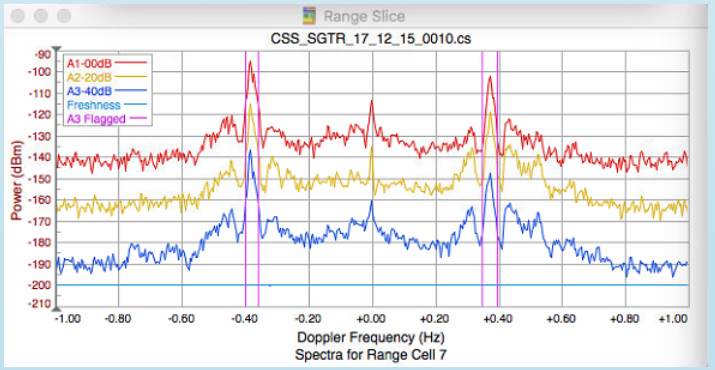

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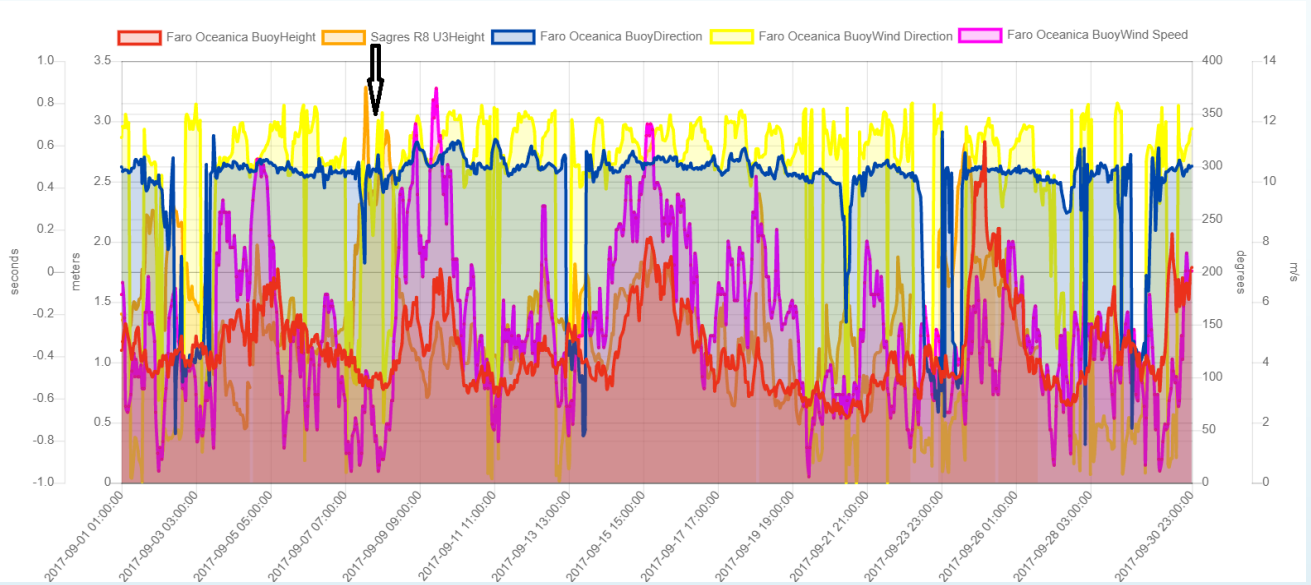
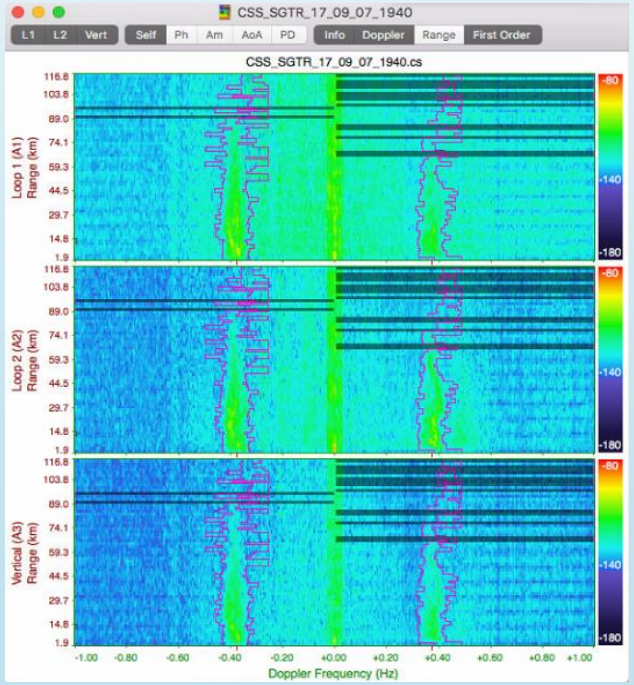
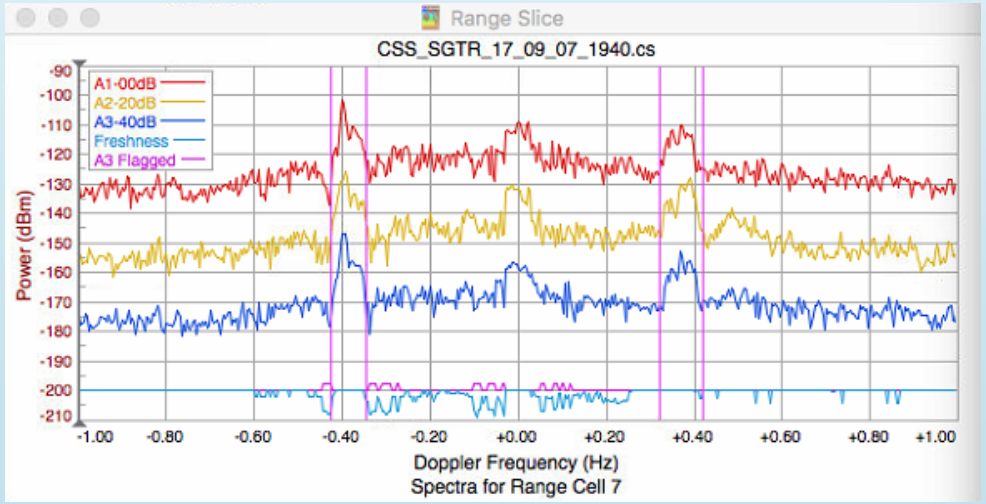
# a) Interference

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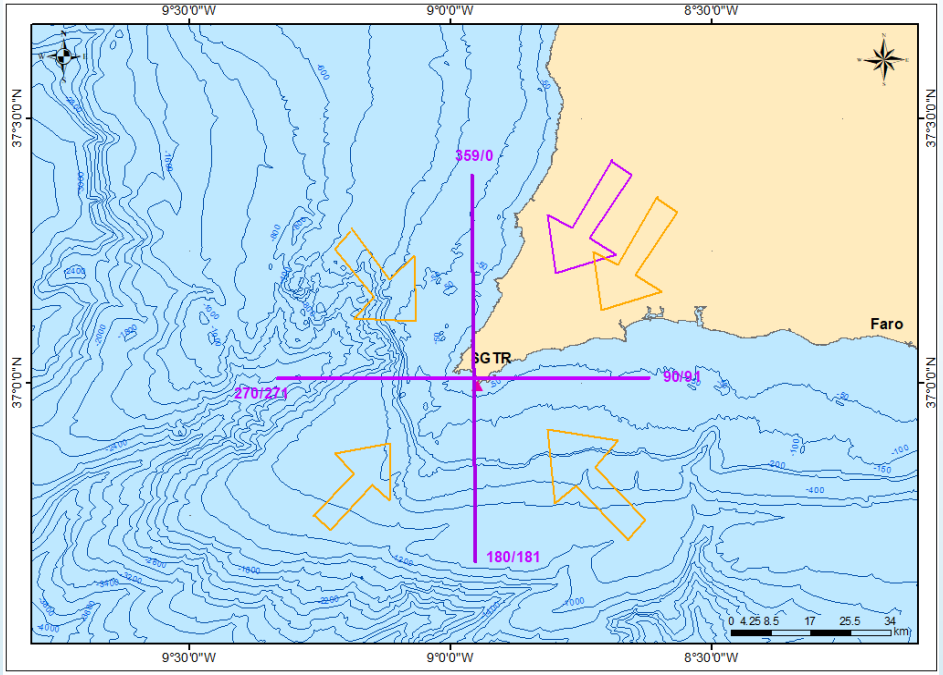
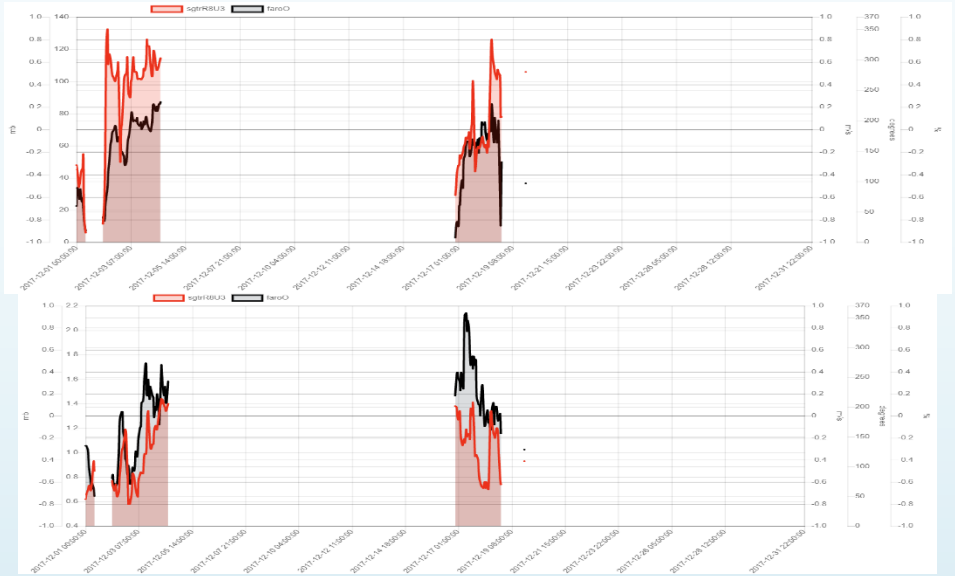
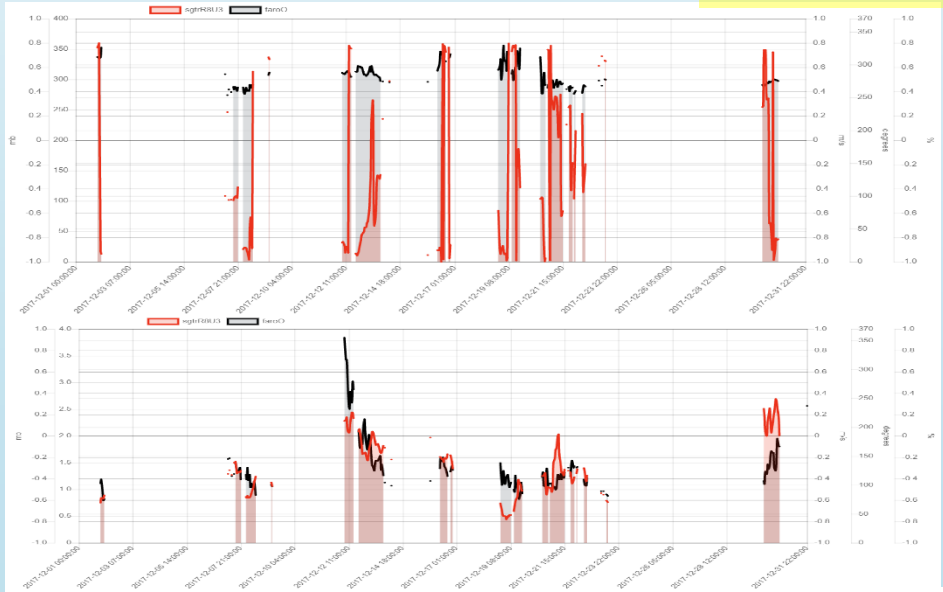
# c) Wind and wave direction



Wind 0-90 wave 0-90

Wind 0-90 wave 271-359



| Variables | Wind 0-90 Wave 0-90 | Wind 0-90 Wave 91-180 | Wind 0-90 Wave 181-270 | Wind 0-90 Wave 271-359 |
|---|---|---|---|---|
| RMS | 0.412 m | 0.252 m | 0.314 m | 0.486 m |
| CI | 0.63 | 0.585 | -0.422 | 0.593 |
| Availability SGTR R8 | 15.86% | 10.22% | 0.54% | 20.97% |
| Availability buoy | 15.86% | 10.22% | 0.54% | 21.24% |
| Number of data | 118 | 76 | 4 | 156 |
| Average difference | 0.053 m | 0.019 m | 0.002 m | 0.076 m |

| Variables | Wind 0-90 Wave 0-90 | Wind 0-90 Wave 91-180 | Wind 0-90 Wave 181-270 | Wind 0-90 Wave 271-359 |
|---|---|---|---|---|
| RMS | 3.938º | 11.154º | 54.336º | 7.727º |
| CI | 0.674 | 0.388 | -0.934 | -0.13 |
| Availability SGTR R8 | 15.86% | 10.22% | 0.54% | 20.97% |
| Availability buoy | 15.86% | 10.22% | 0.54% | 21.24% |
| Number of data | 118 | 76 | 4 | 156 |
| Average difference | 27.9º | 10.825º | 104.54º | 76.208º |

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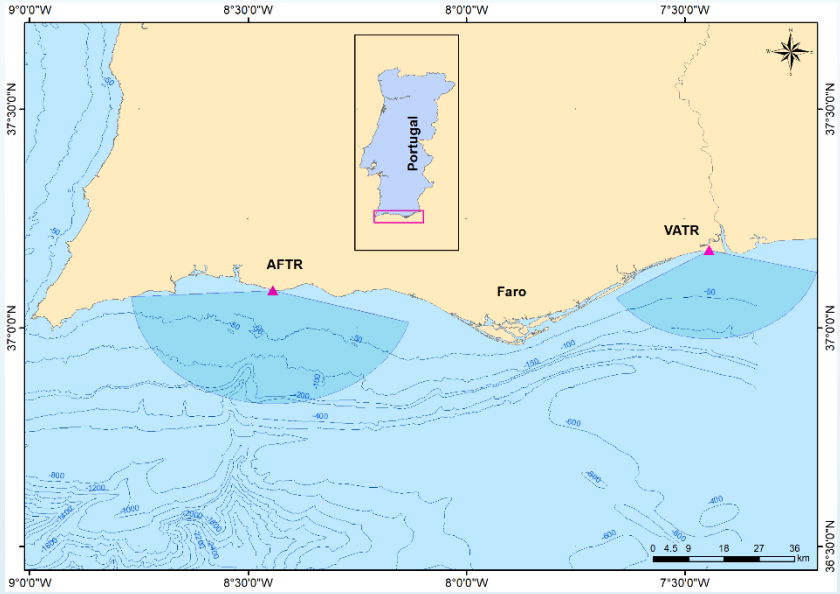
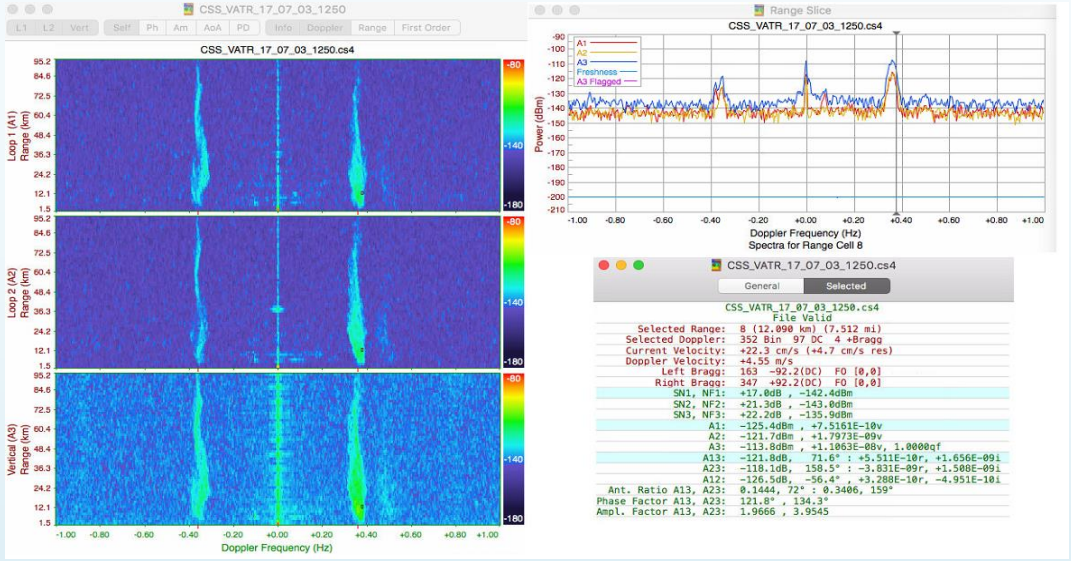
# d) SNR and Noise floor

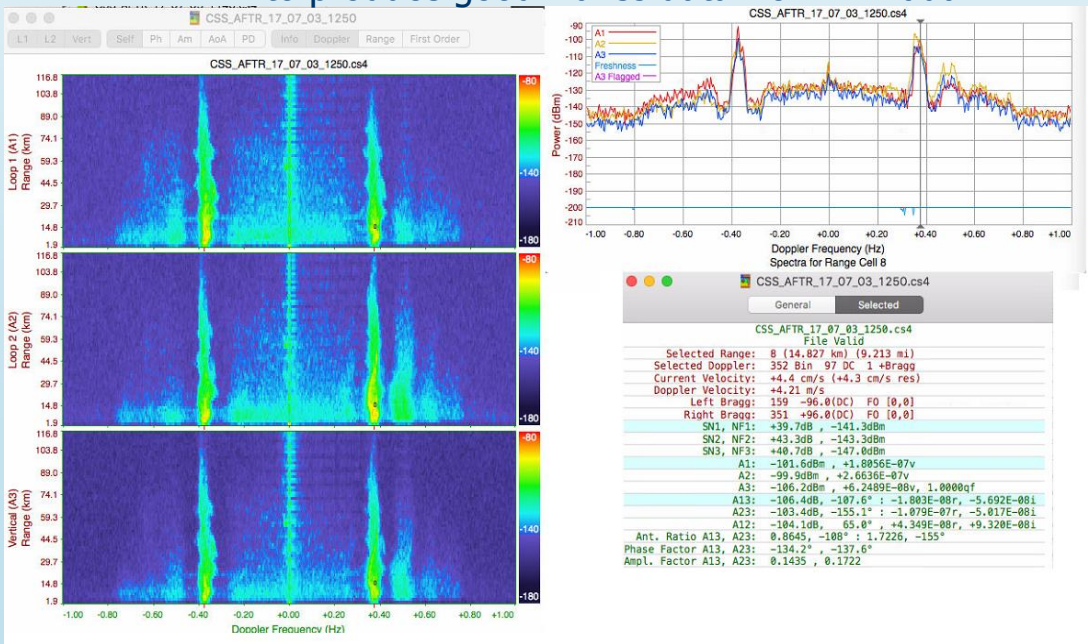
In places where the noise floor is steadily high or the SNR is low, one should expect very low quality/availability of waves data




noise floor is regularly low and the SNR is above 30 db, there is a good potential to produce good waves data from HF radar



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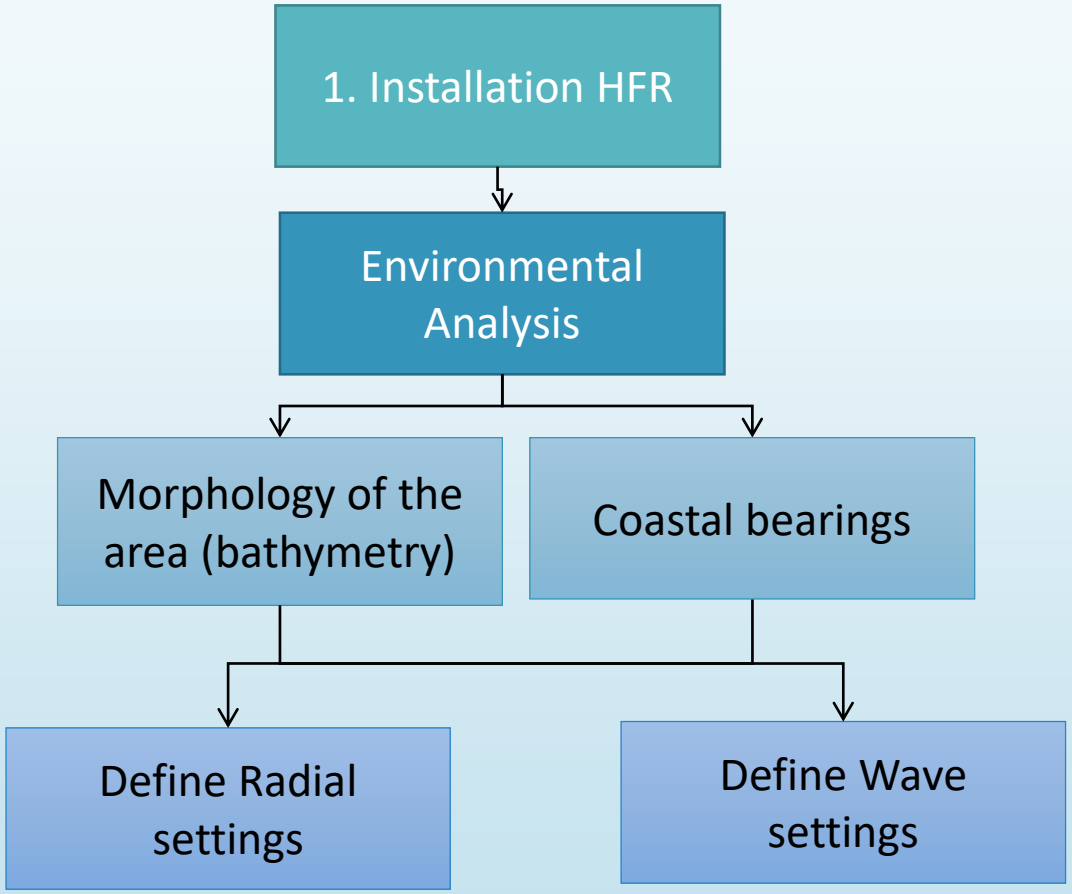
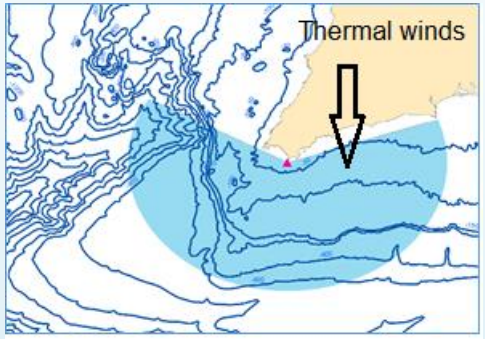
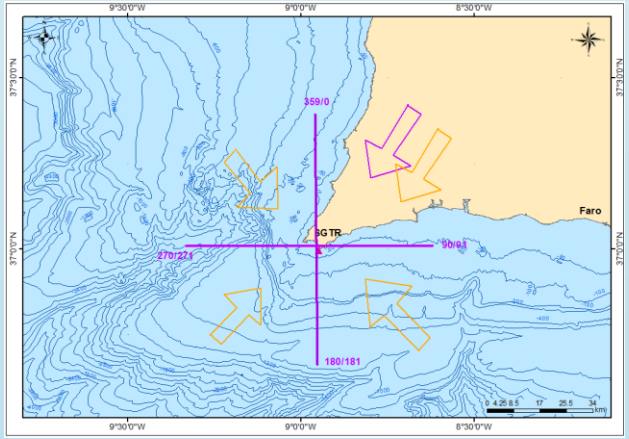
# 7. Conclusions




- Importance of wind direction versus the coast




- Importance of wind direction versus the waves direction by HF radar

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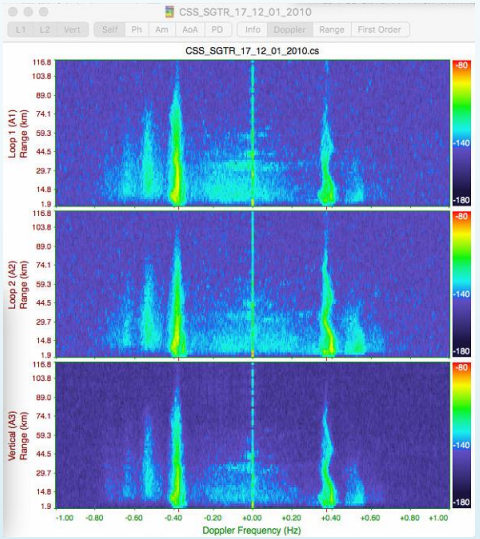
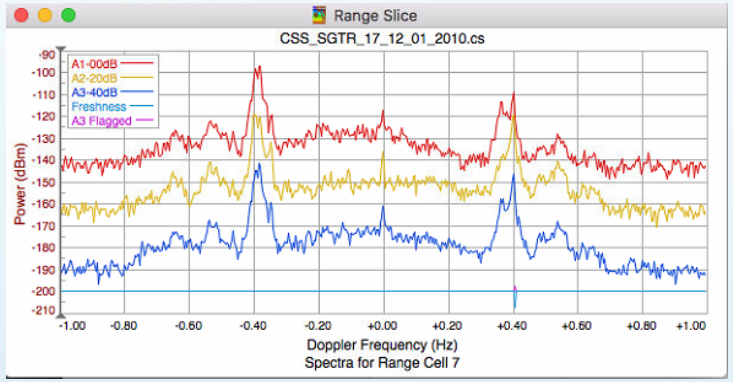
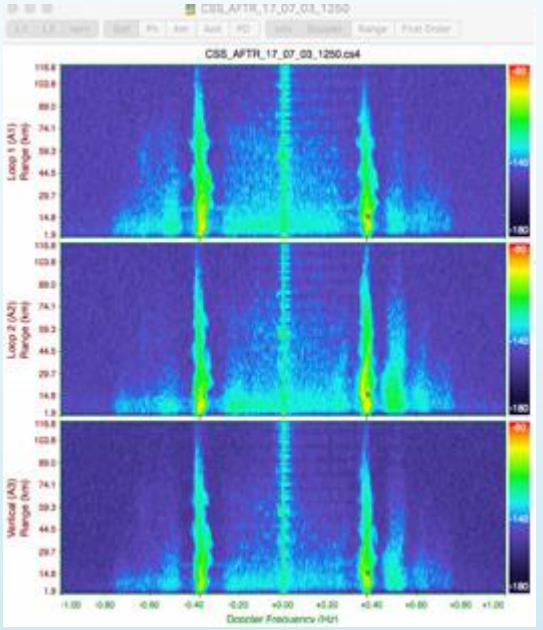
# 7. Conclusions

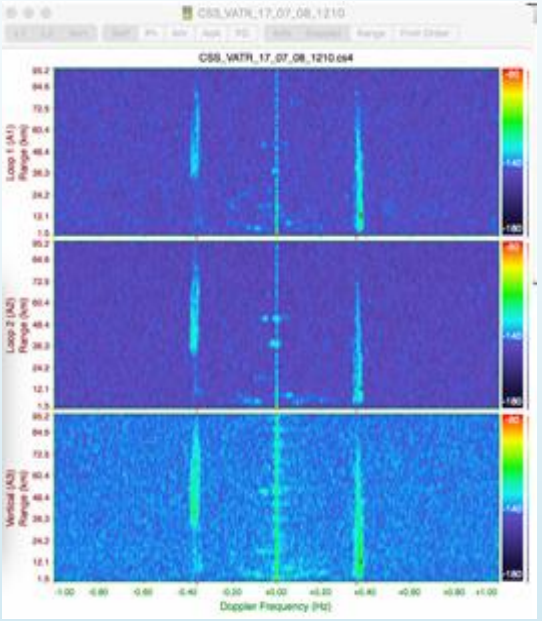
- Importance of bimodal seas



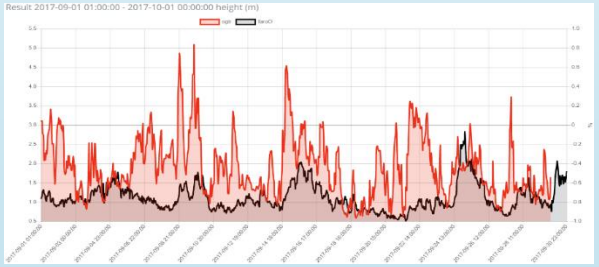



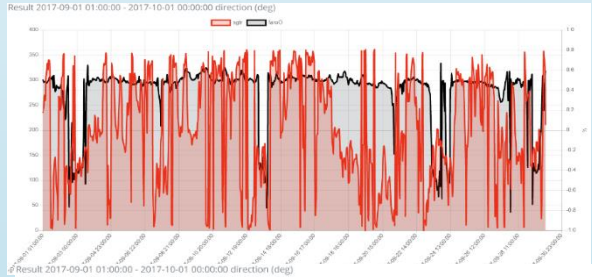

- Importance of SNR and Noise Floor

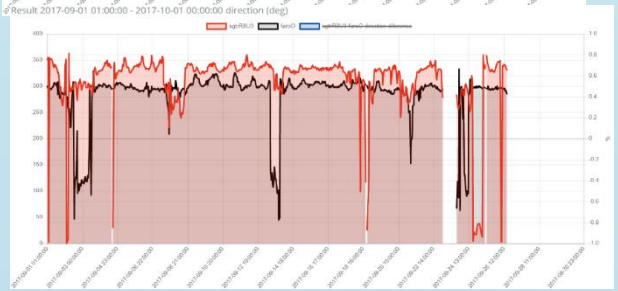



- Improvements on R8U3 vs. R7U4

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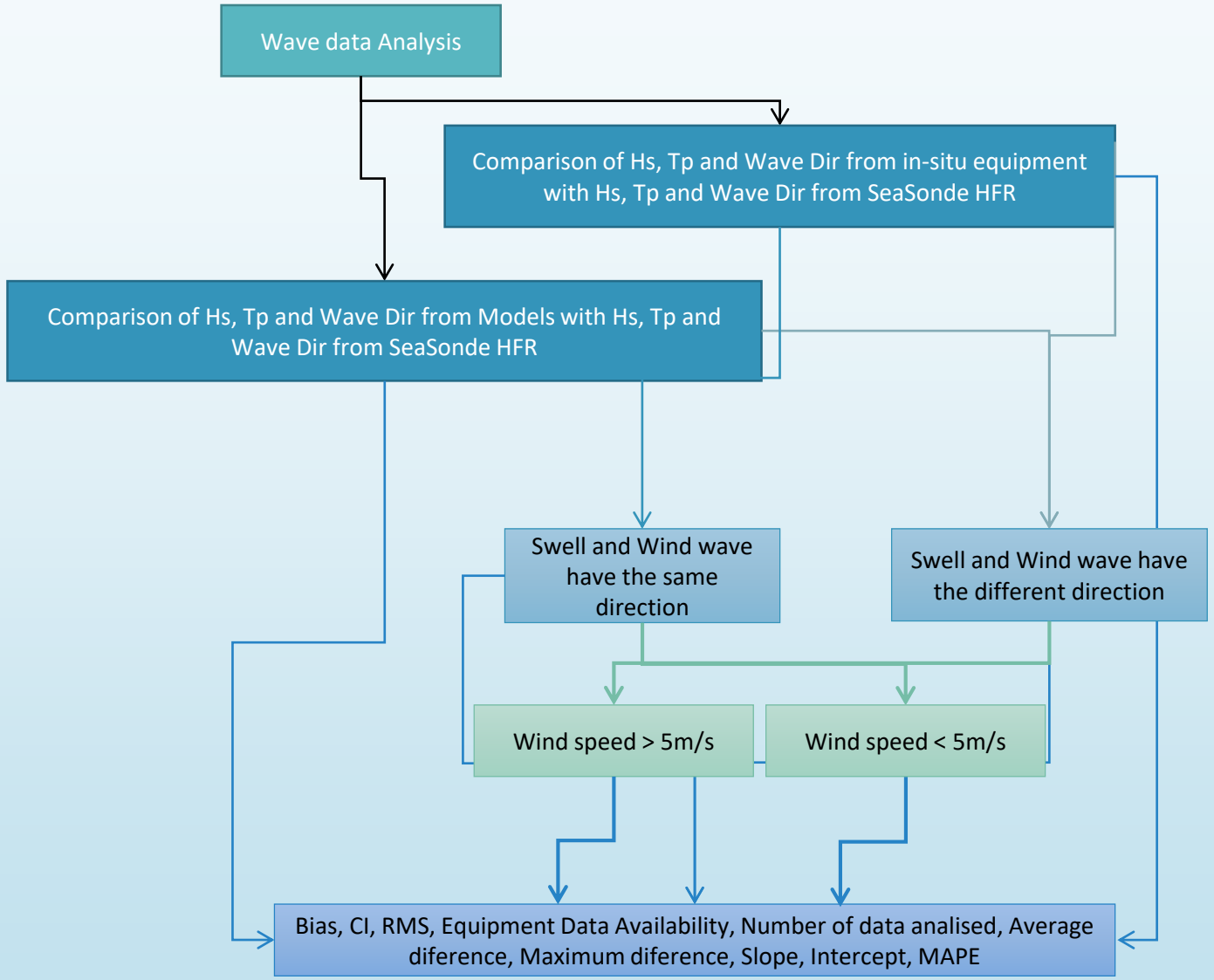
# 7. Conclusions




The final goal is to be able to add a "Quality index" in real-time to SeaSonde wave outputs for each system based on different constraints SNR, waves/winds angles, wind speeds, CI, RMS, etc.…

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# THANK YOU

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