

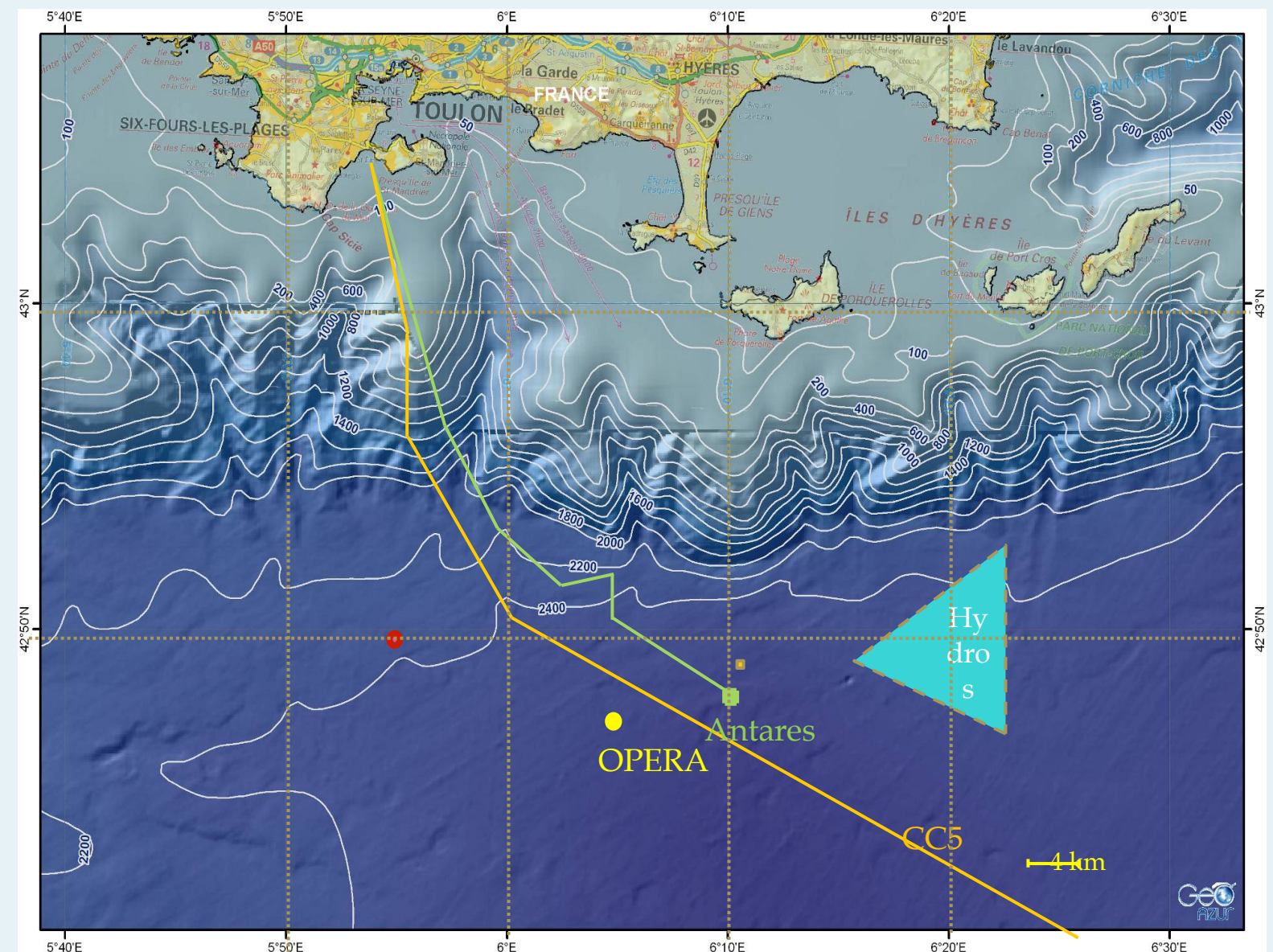
The selection of the MEUST submarine site

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Introduction

- ANTARES site: [42°48'N, 6°10'E] selected > 10 years ago
 - Stable conditions apart for the known seasonal biolum variation
 - Good operational conditions from the logistic point of view

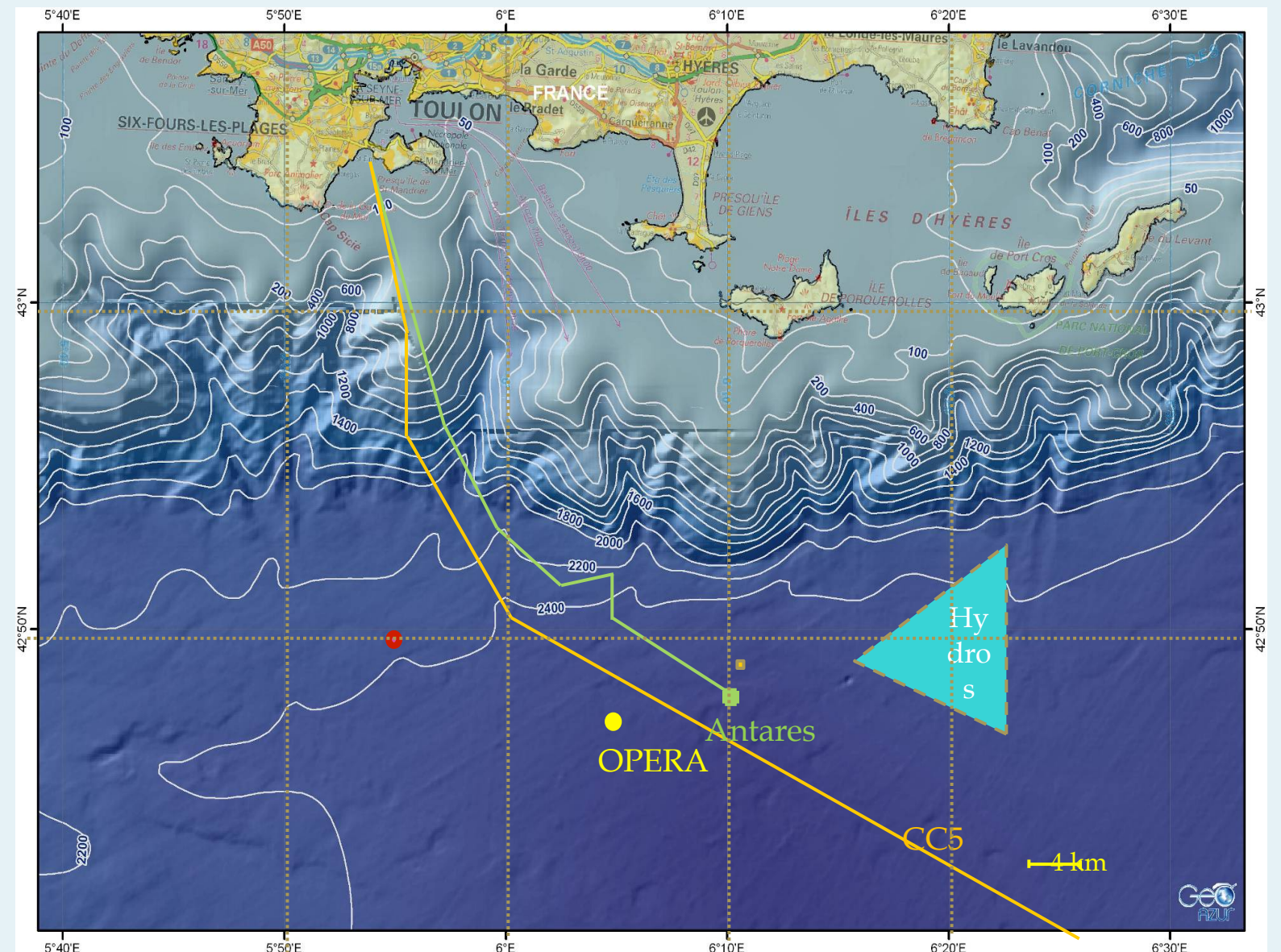
- KM3NeT site: 8 km² needed
 - Antares is limited by the CC5 cable and the Tremail Acoustic Military array
 - Does a more distant site offer better condition ?



Introduction

Study of potential sites around ANTARES:

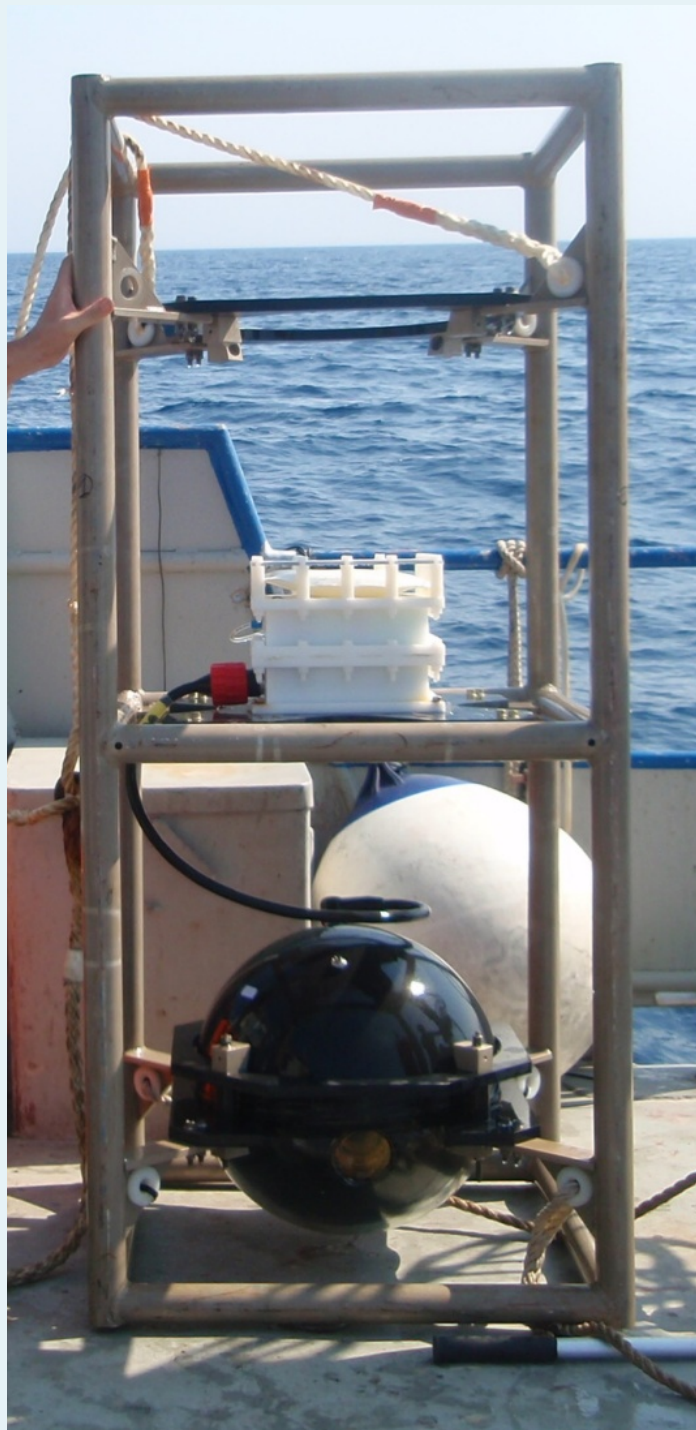
- Organization of sea campaigns on 3 candidates sites + OPERA site
- Development of autonomous optical modules
- Development of Mooring lines = OM + conventional sea science instruments [Current meter, CTD]



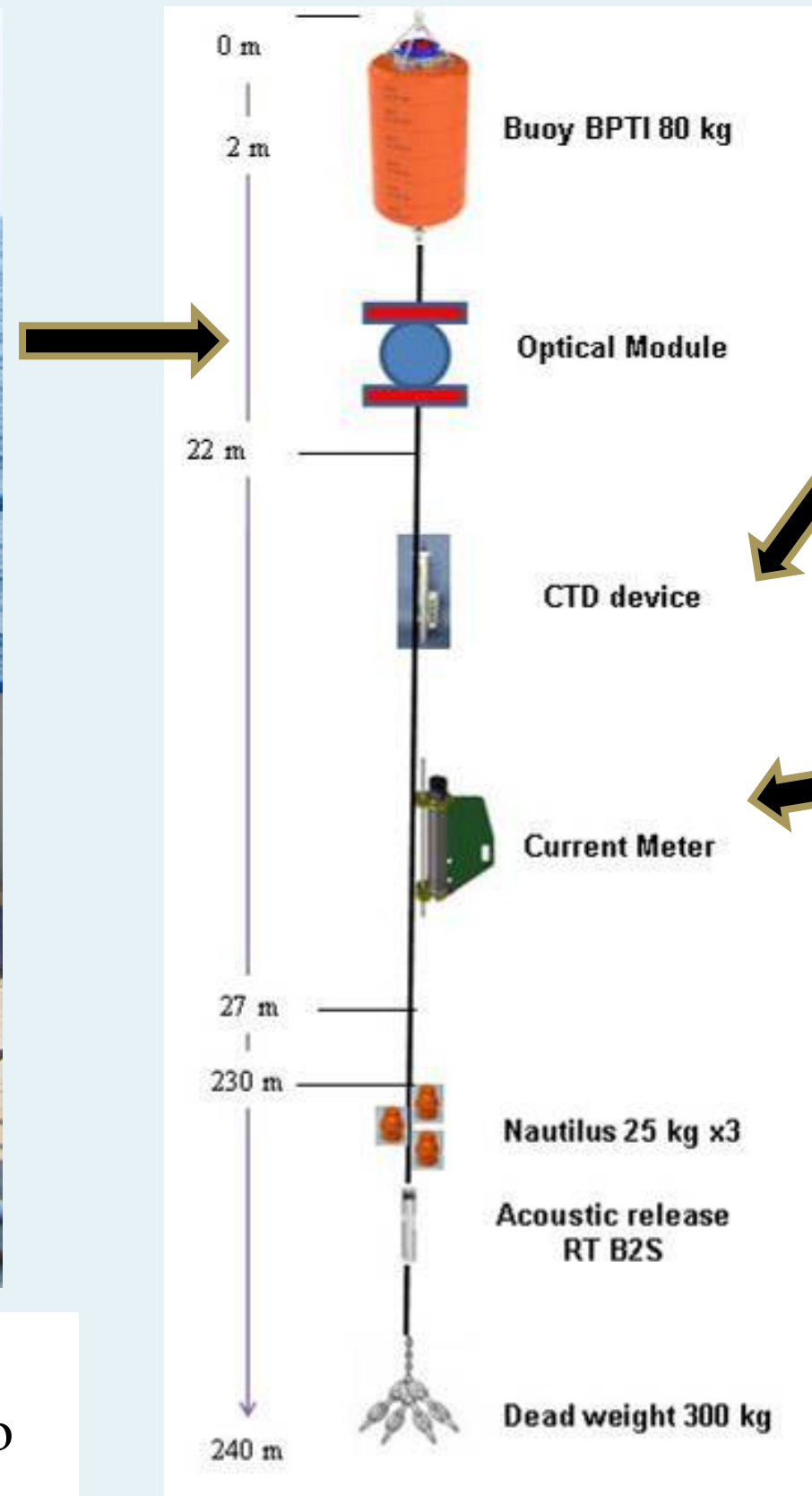
Criteria to select the site:

- Site properties (depth, sea current, temperature....)
- Available space and uniformity of the bathymetry on the site
- OM activities (bioluminescence...)
- Logistics (harbor, distance to the coast, access to the site...)
- Minimum perturbation from outside (Antares, Trémil...)

The autonomous mooring line



Autonomous line with acoustic release system (no need to ROV)



Conductivity, Temp, Pressure

Monitoring the change in the flow of different sea water layers

Sea current: velocity & direction

NORTEK Aquadopp (Sound Doppler effect)
Every 10min
0,5cm/s & 0,1° precisions

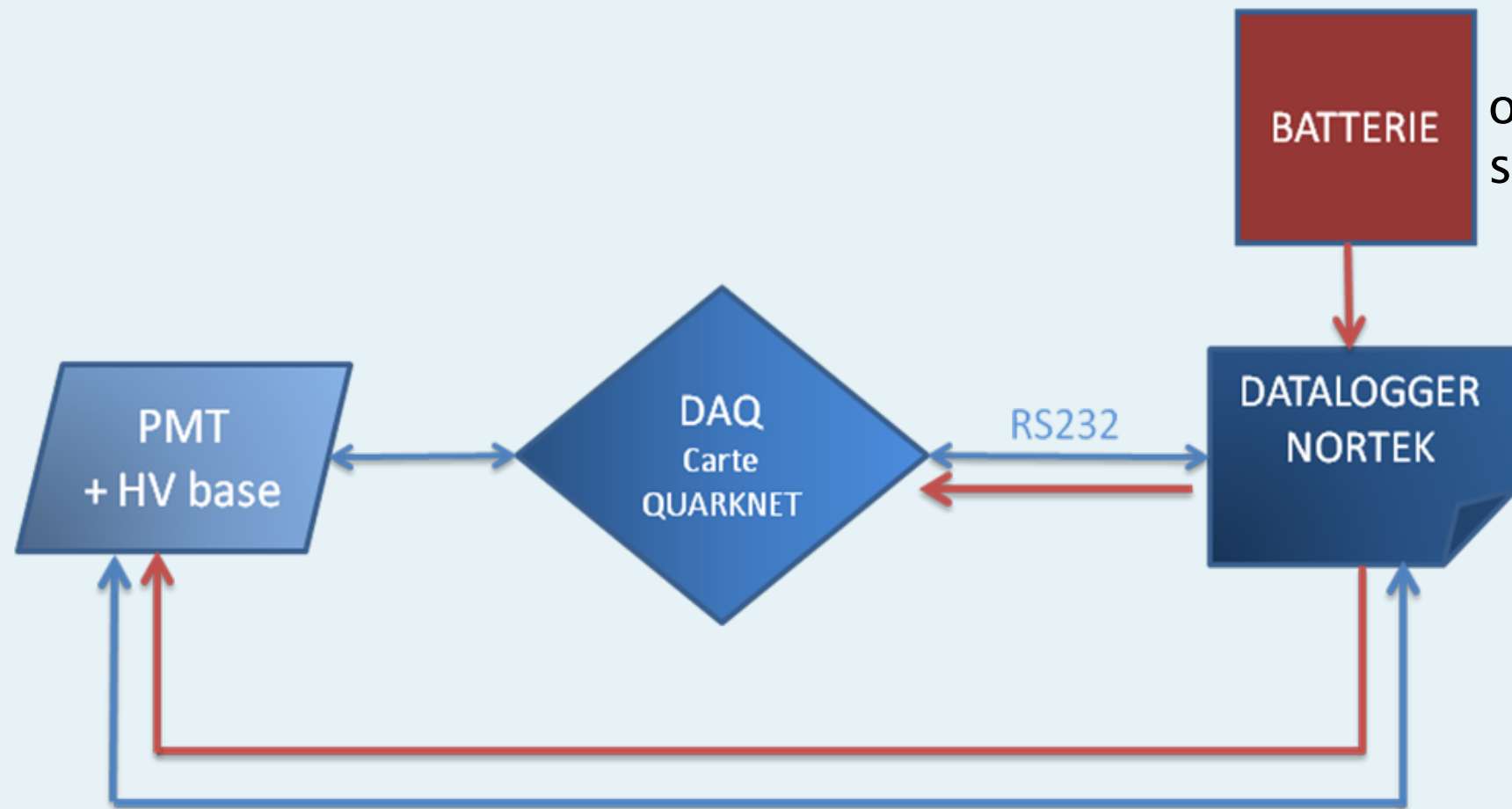


Autonomous OM



BATTERIE outside sphere

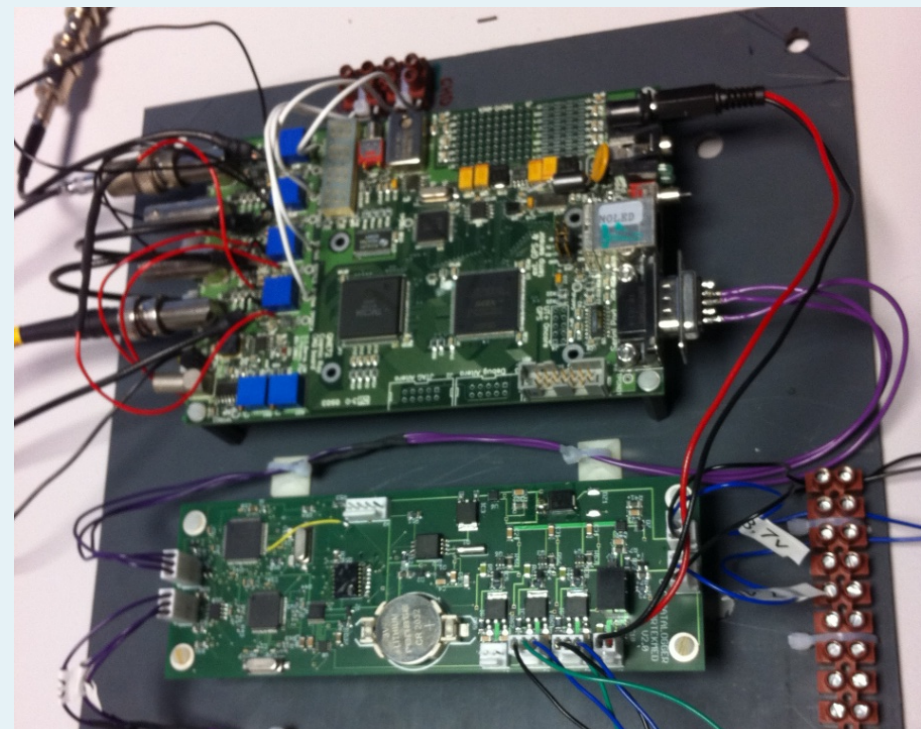
low voltage batteries located in a separate equipressure container
Lithium Polymère 3,7V & 7,4V



2 PMTs



The photomultipliers are 3" Hamamatsu R6233 equipped with a low consumption C11779 active base



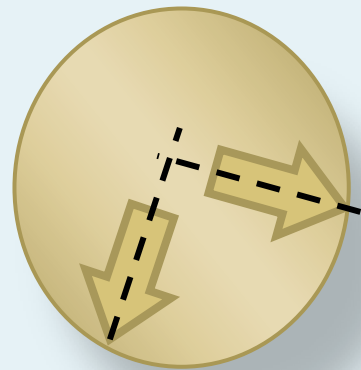
PMT read out by a QUARKNET board which increments a counter per PMT while signal is above the threshold

1 Hz reading of the QUARKNET by a NORTEK data logger and stored in a local memory.

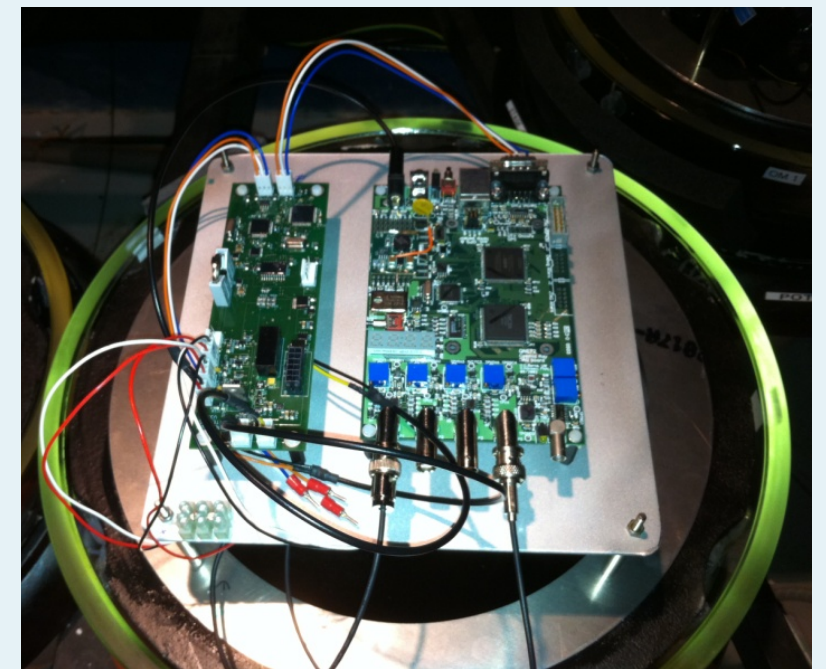
Coincidences between the 2 PMTs are also monitored

OM characteristics

- 2x 3inches PMTs (**Gain # 310^6**) with HV=1350V
- Operating threshold **#0,6pe**
- PMT pointing direction + 33° & -74° / downward

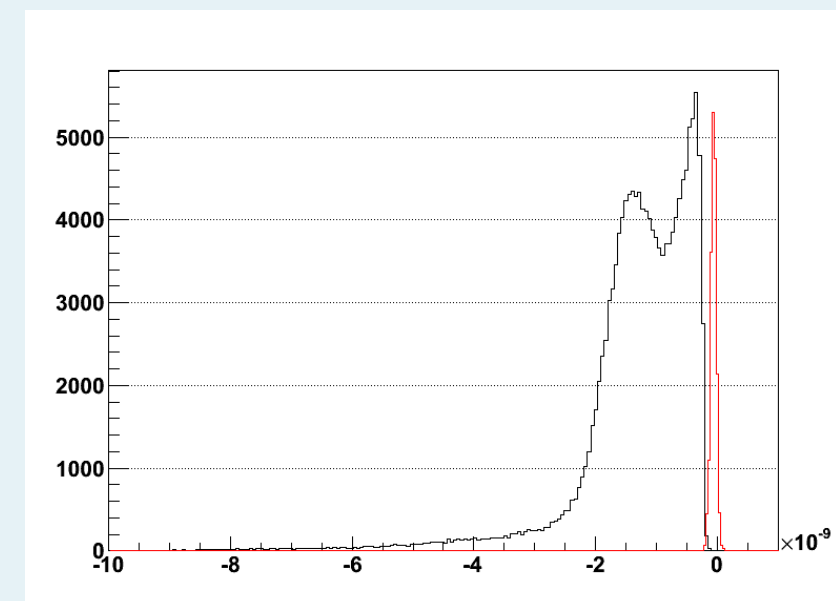
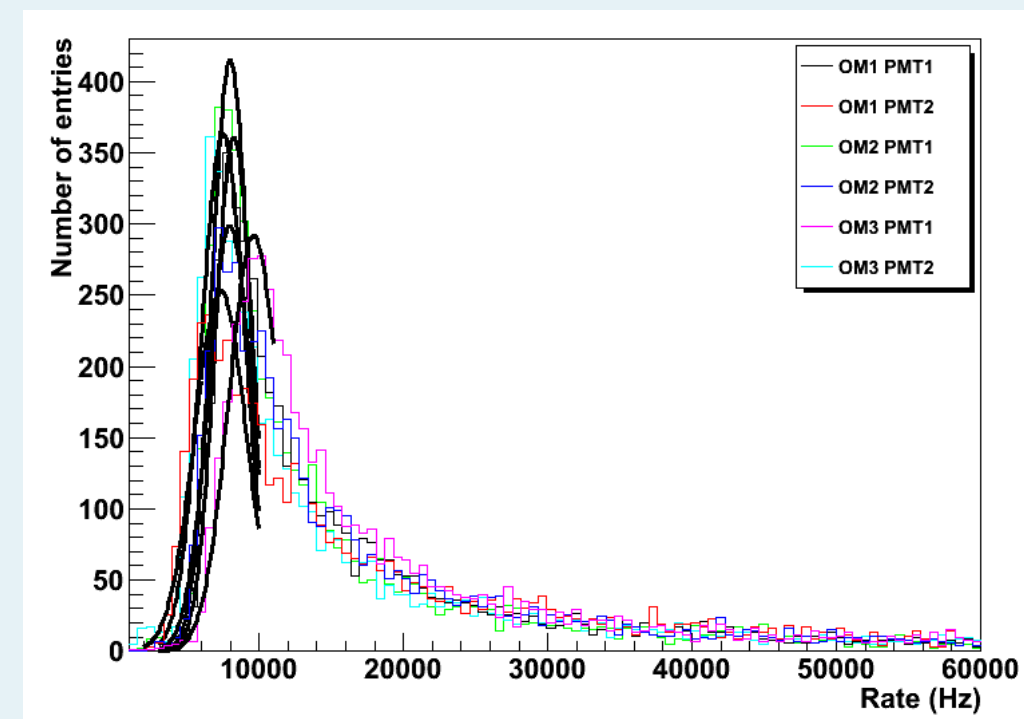
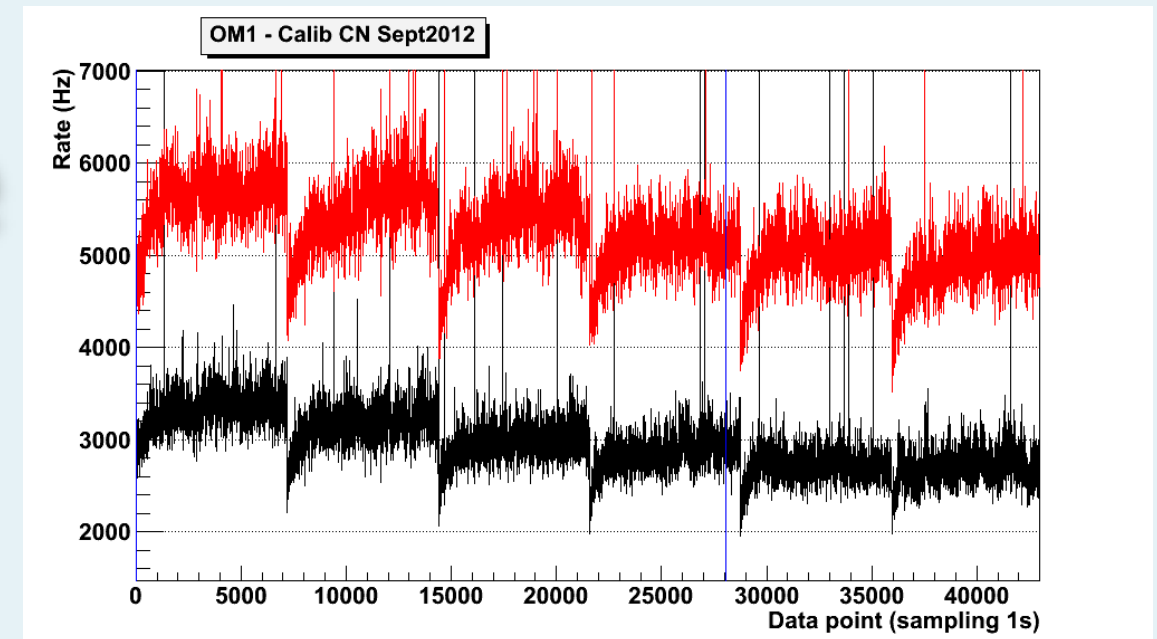


- Total charge 100A.h@7,4V and 26A.h@3,7V
x20 batteries x2 batteries
- OM measurements are activated 50 mn every 4 hours
→ **45d of autonomy**

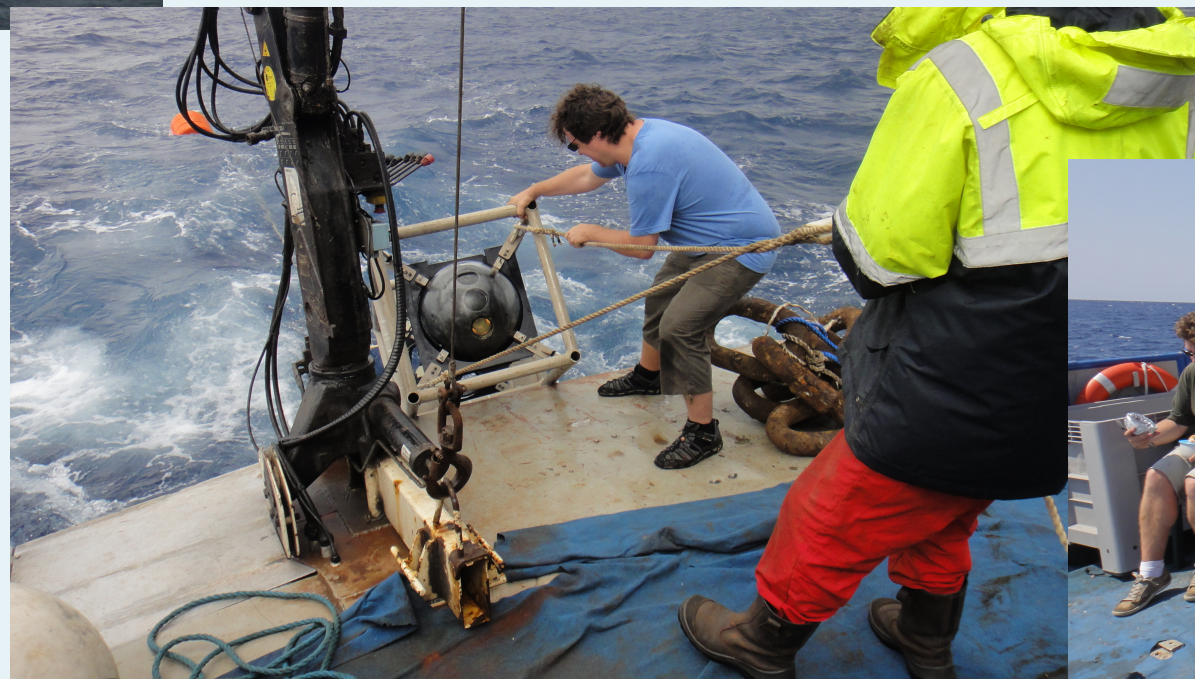
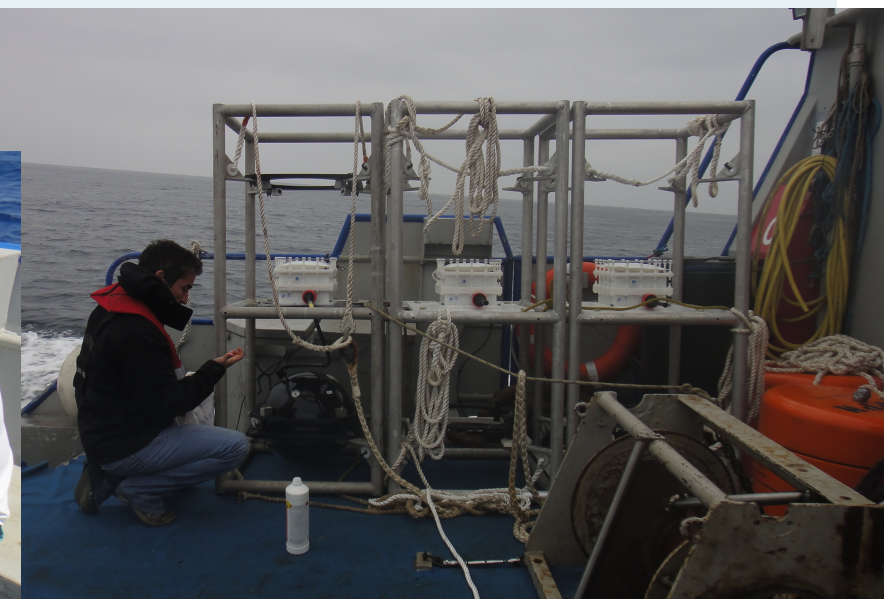
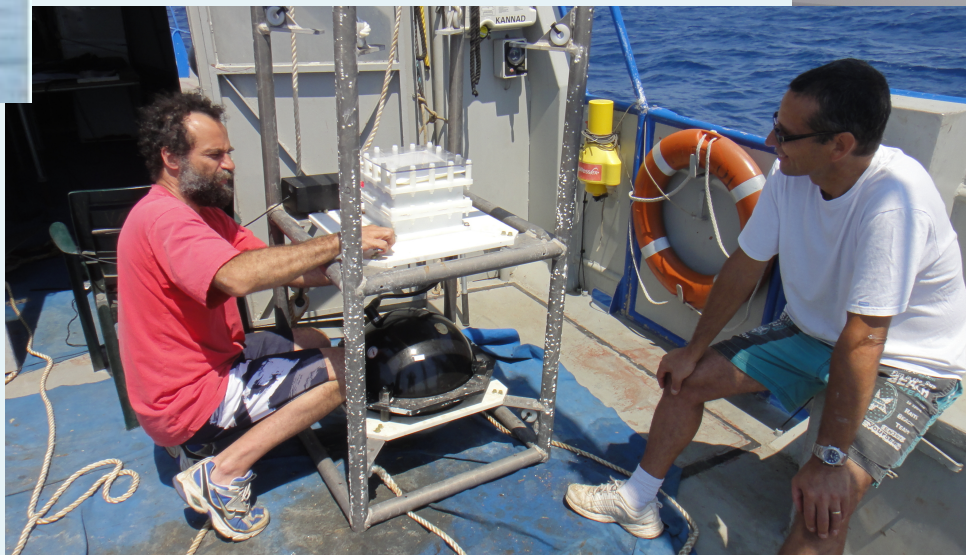


Calibration procedure

- Dark room in water @13°C
→ Dark count rate measurements after few hours stabilization [2-5 kHz]
- Cross calibration in deep sea:
Deployment of all OMs together
2 campaigns: march 2012 & sept 2012
→ check counting rates after baseline subtraction
- Gain measurements
→ Absolute calibration + threshold measurements



Deployments

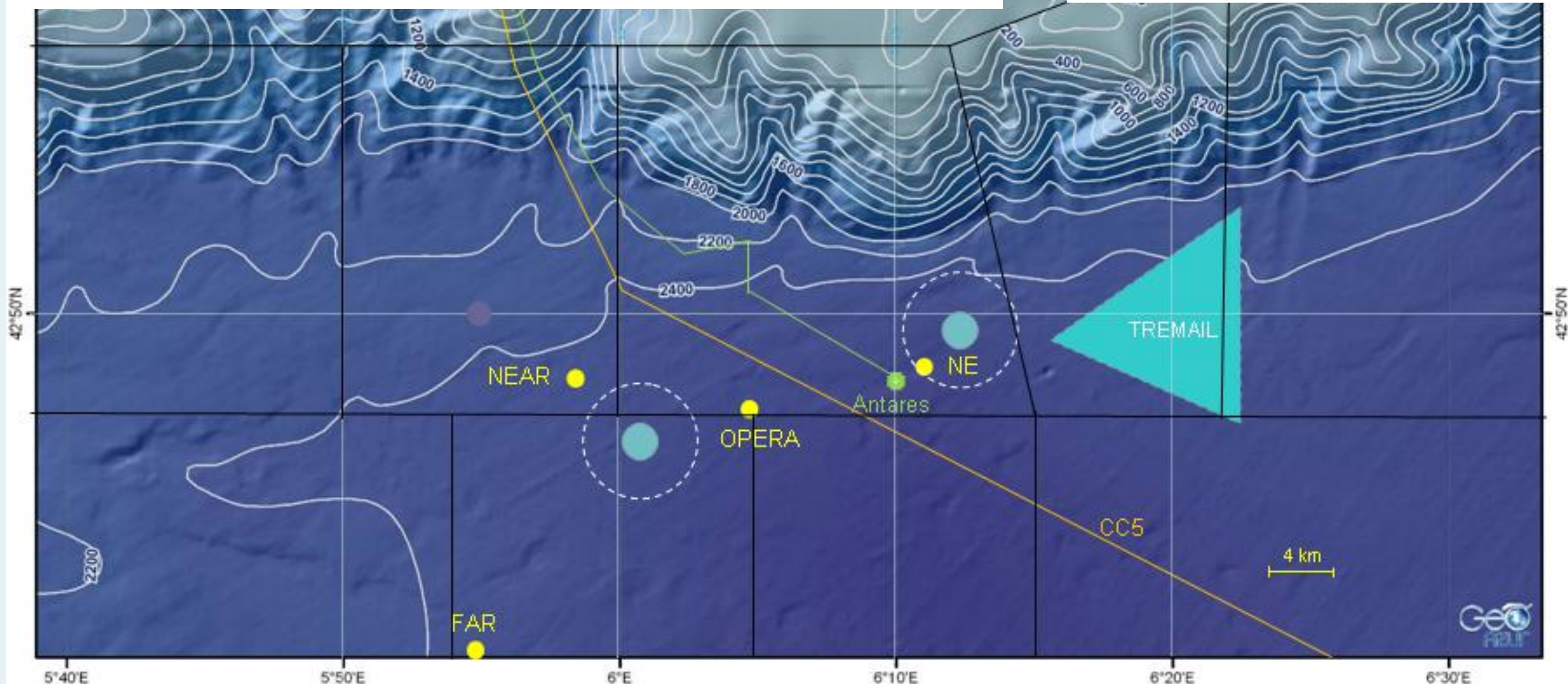


Candidate sites

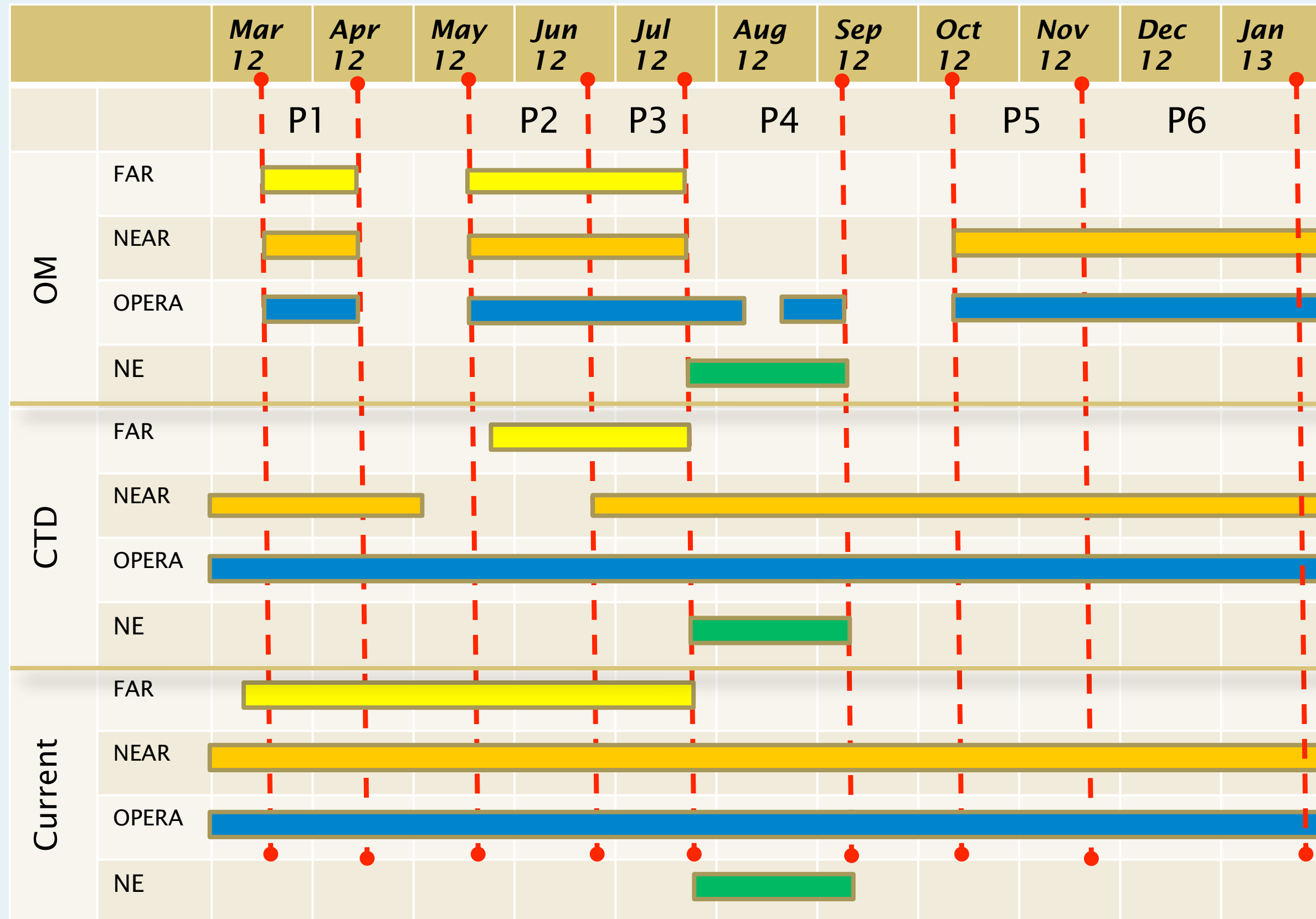


4 sites tested and compared to ANTARES:

- OPERA: $42^{\circ}47'N$, $6^{\circ}05'E$ (studied for several years)
- FAR: $42^{\circ}40'N$, $5^{\circ}55'E$ (20km off talus)
- NEAR: $42^{\circ}48'N$, $5^{\circ}58'E$
- NE: $42^{\circ}48.2'N$, $6^{\circ}10.8'E$ (1km NE of Antares)

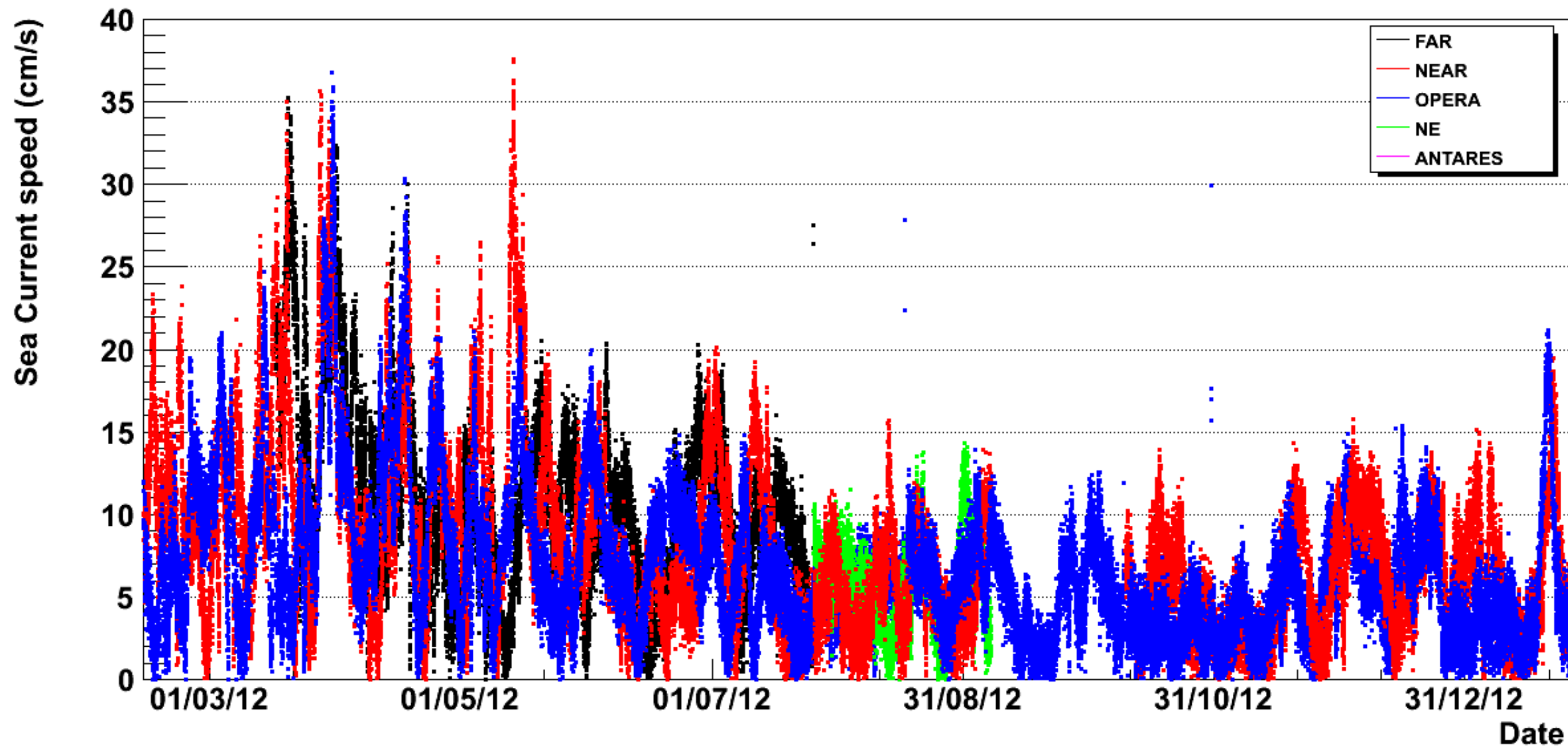


Measurements campaigns

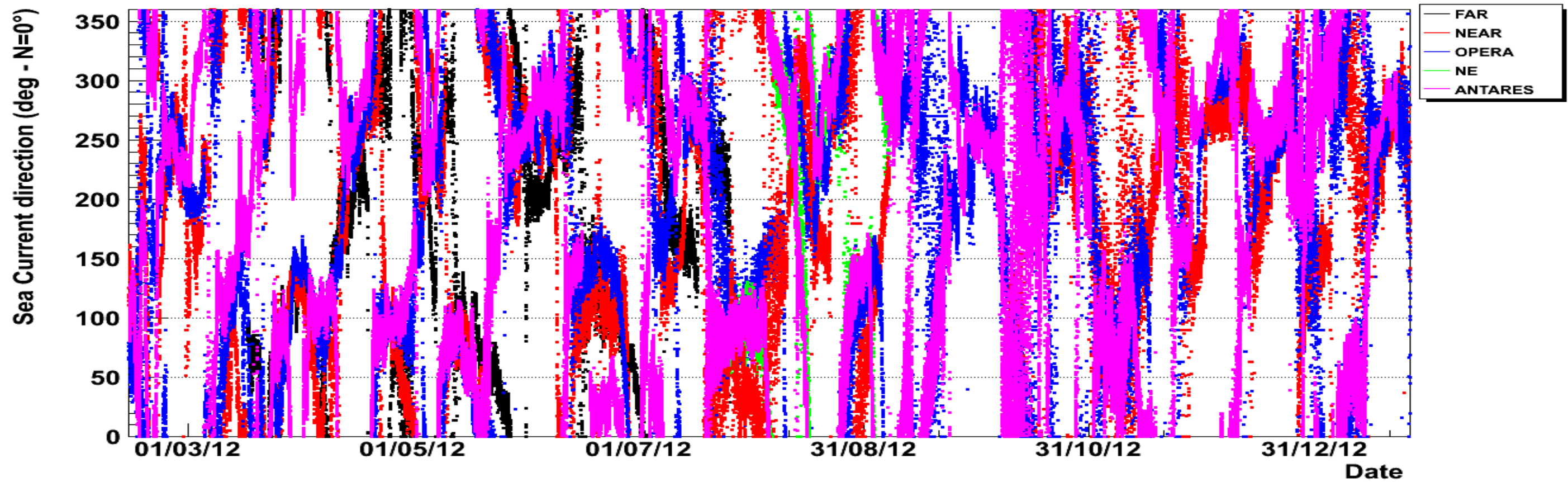
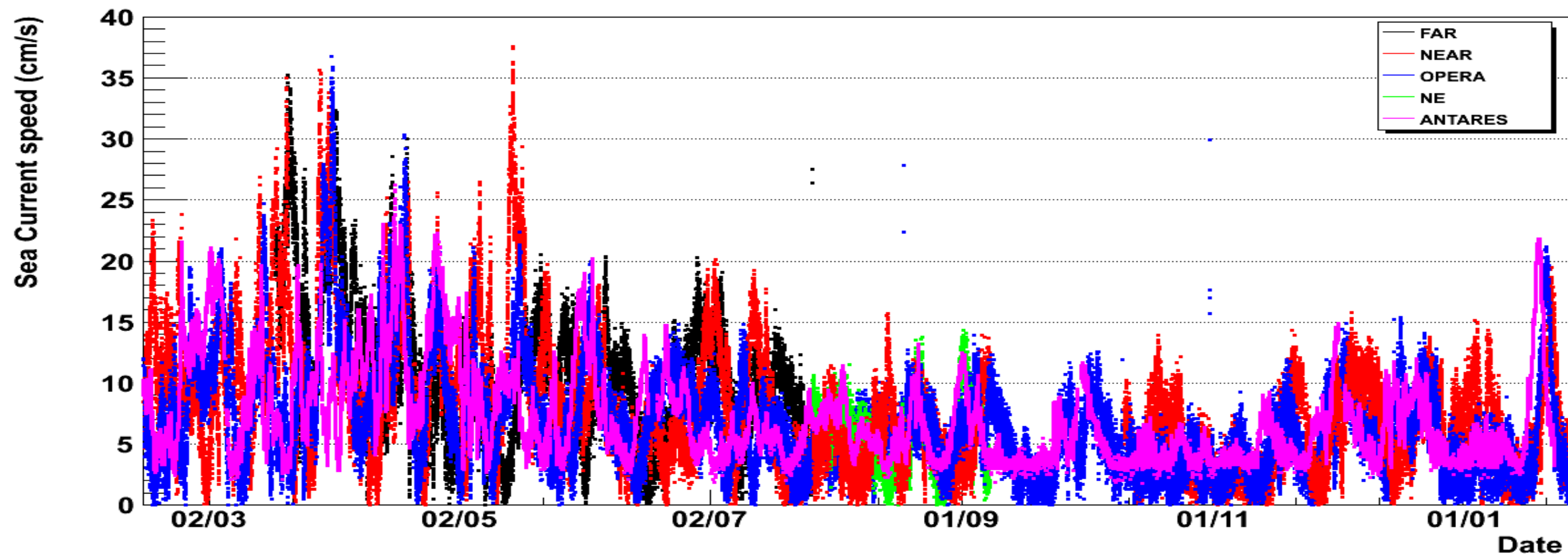


Study of the sea-current

Sea current is a key parameter: string deformation, bioluminescence...
Continuous monitoring every 2 min.

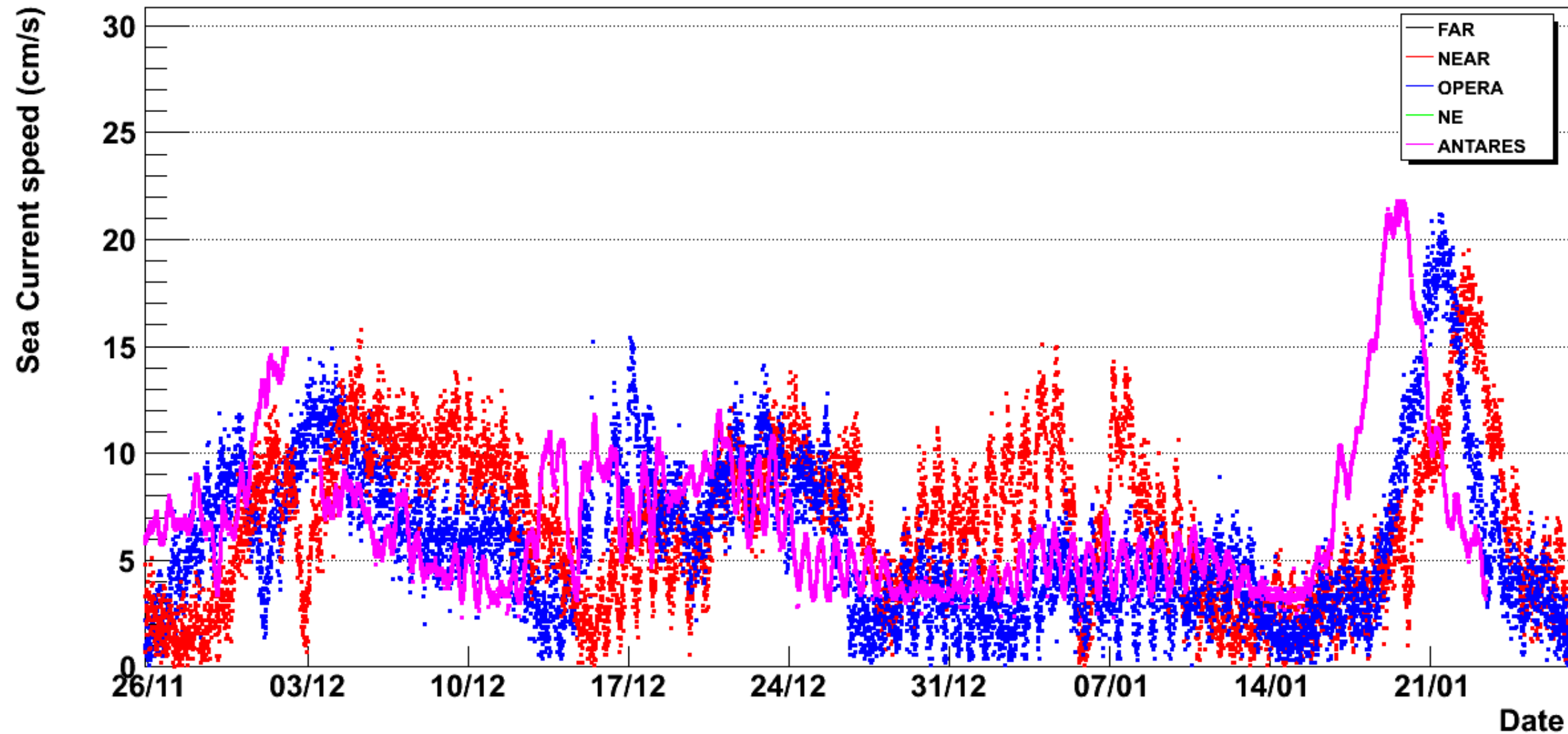


Study of the sea-current

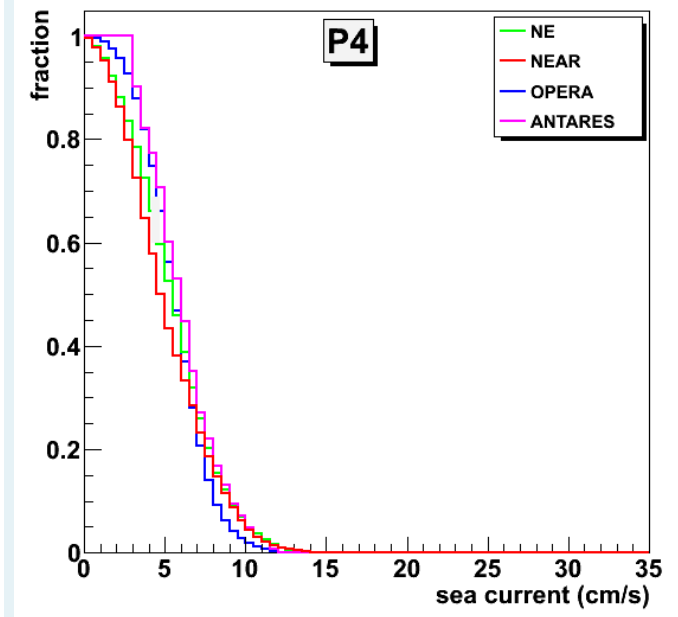
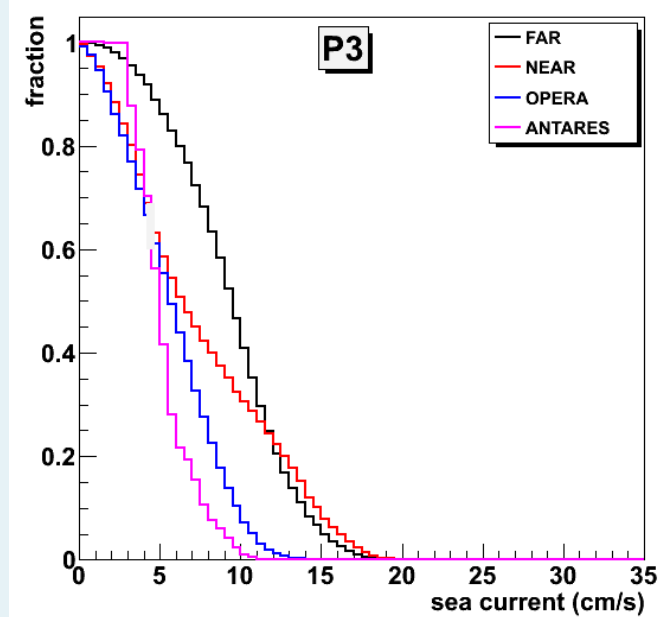
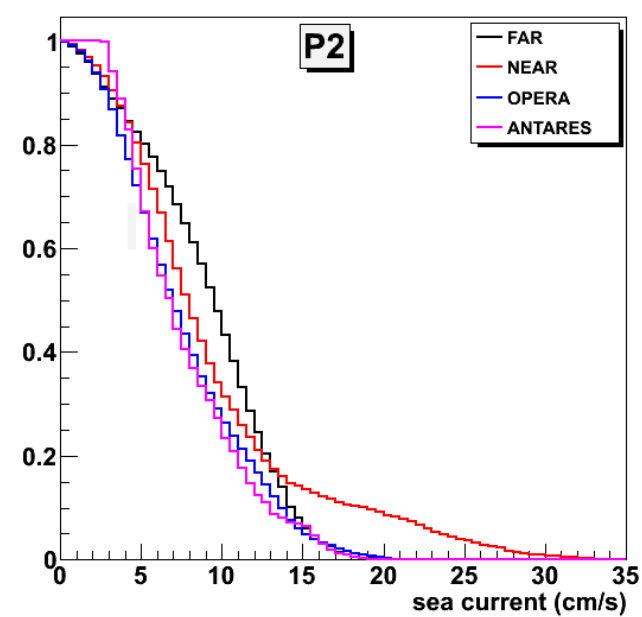
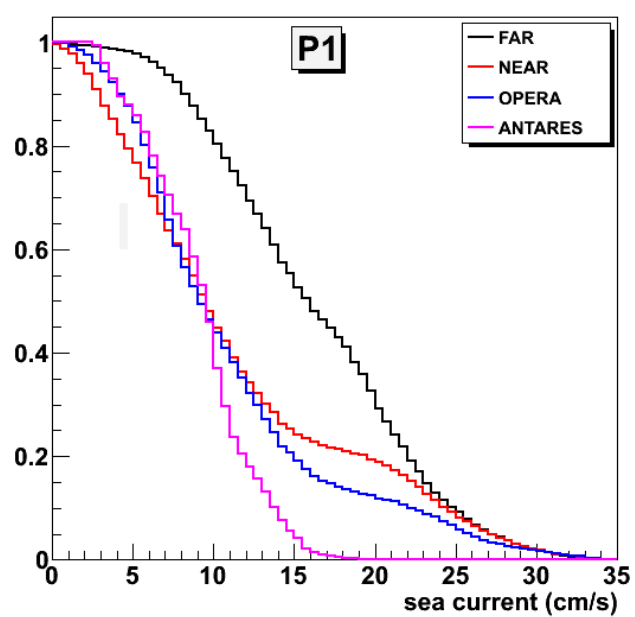
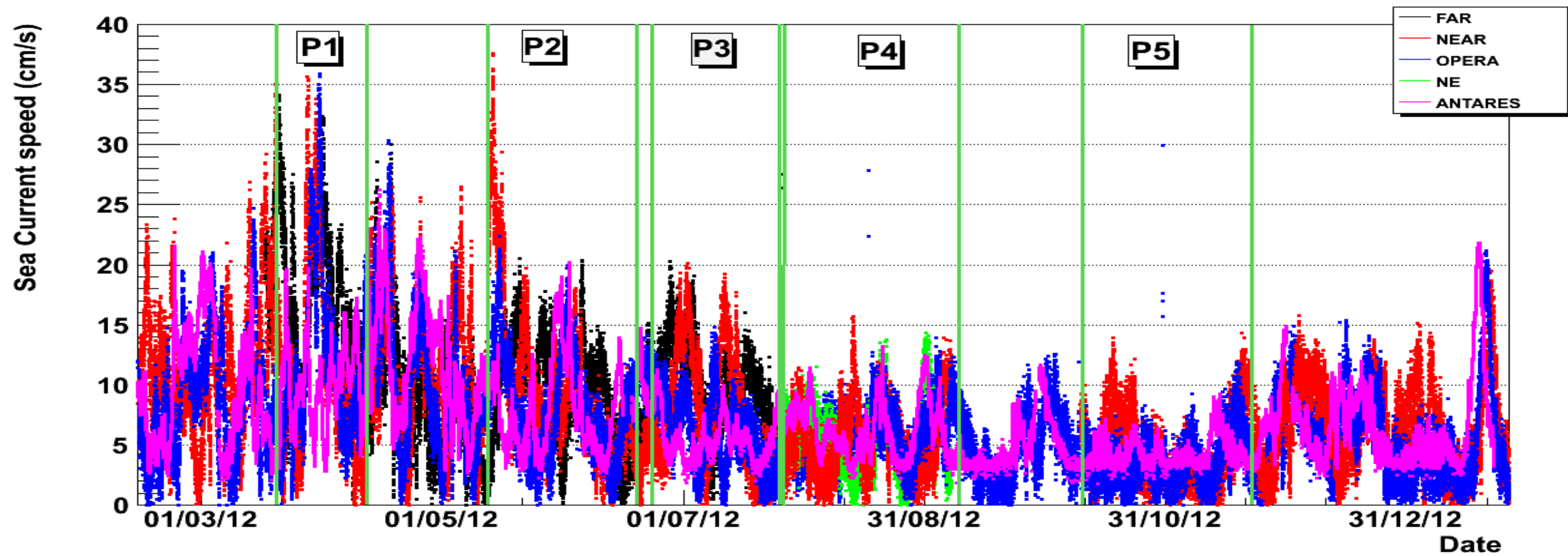


Study of the sea-current

Zoom Dec 12-Jan 13

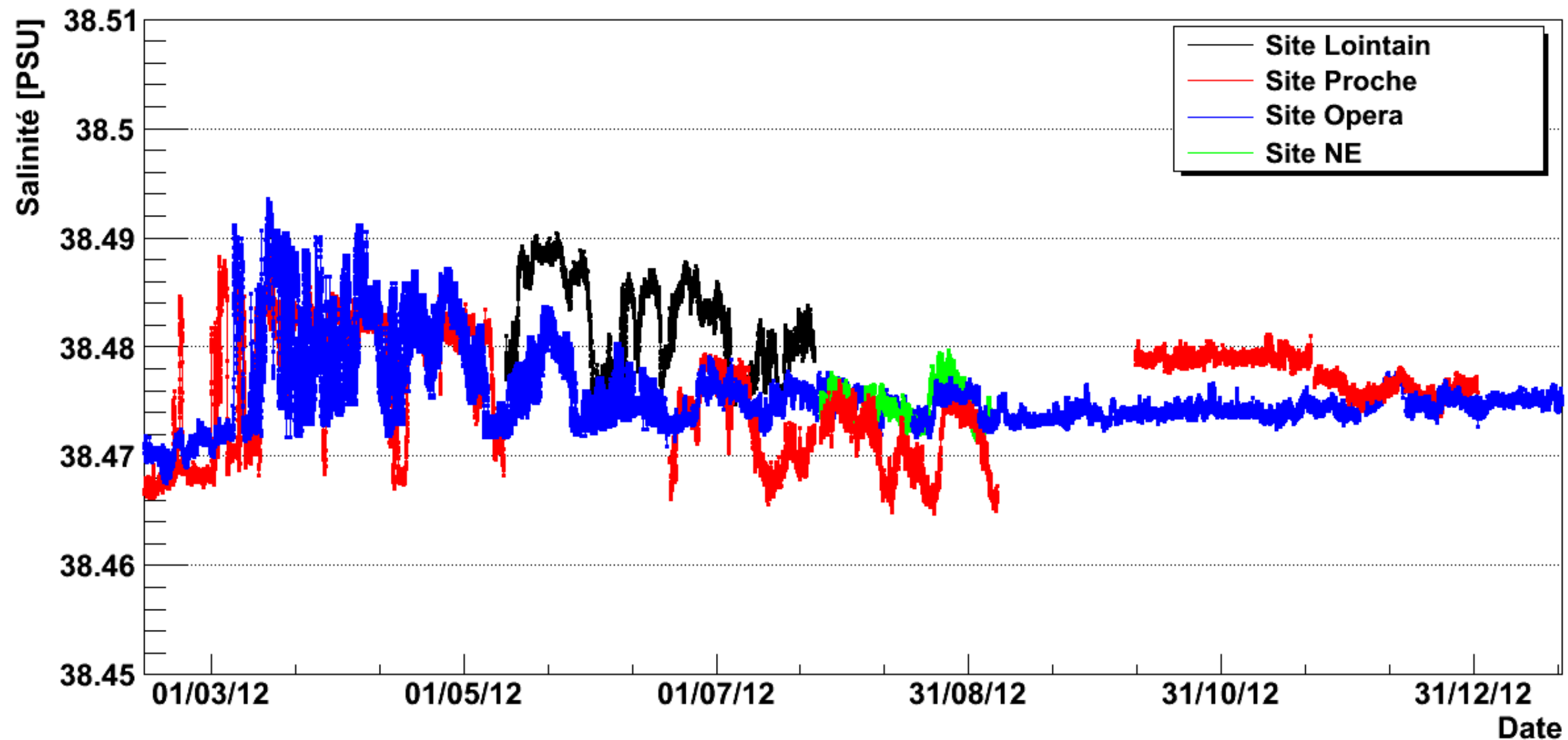


Study of the sea-current



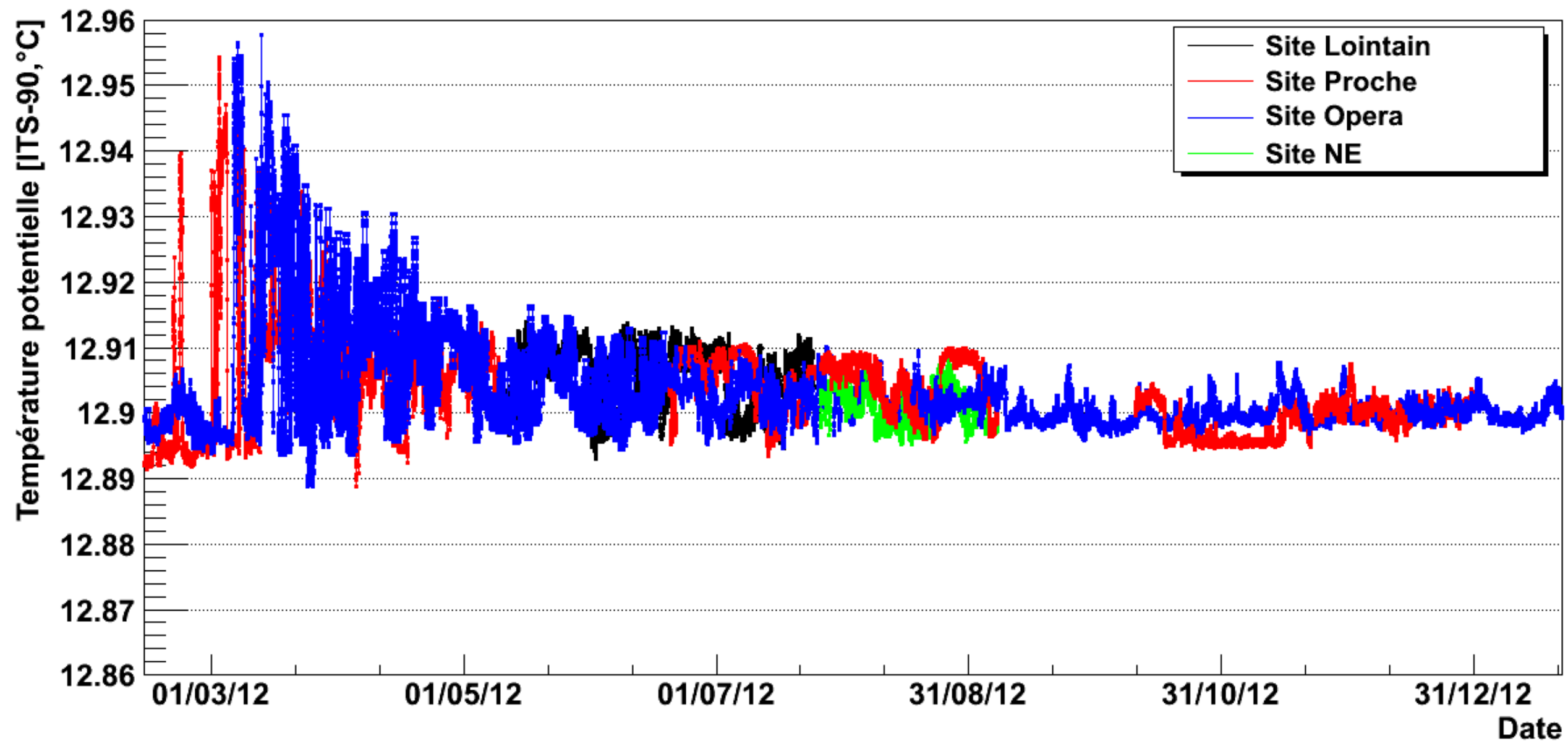
Study of the CTD

CTD measurements (temperature, salinity, conductivity, pressure, O₂...) are important to point to water mass variation
Monitored continuously every 2 min



Study of the CTD

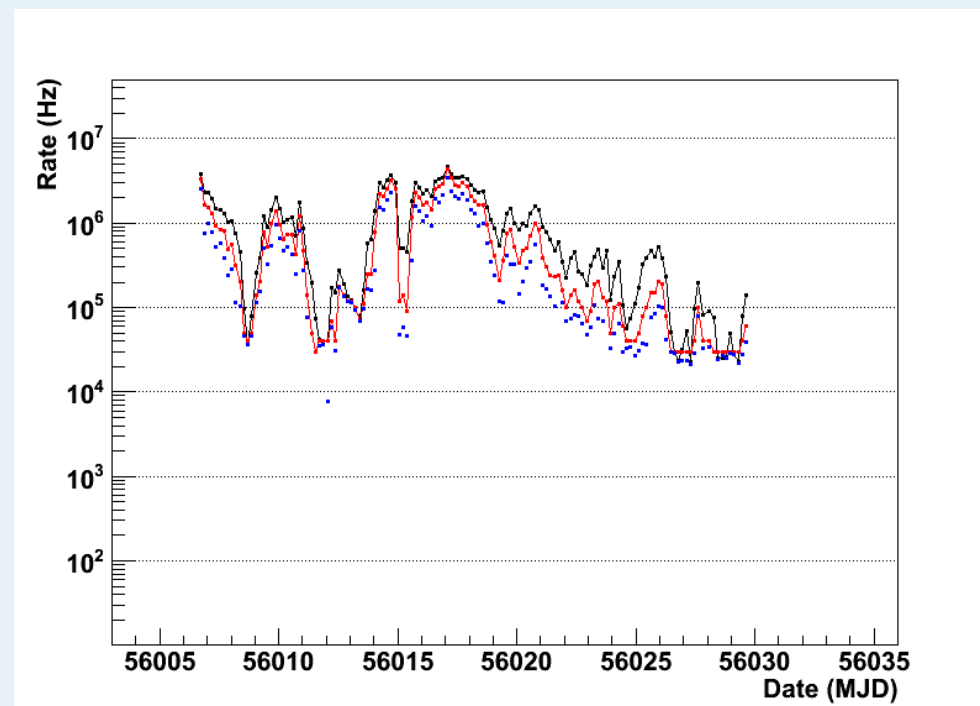
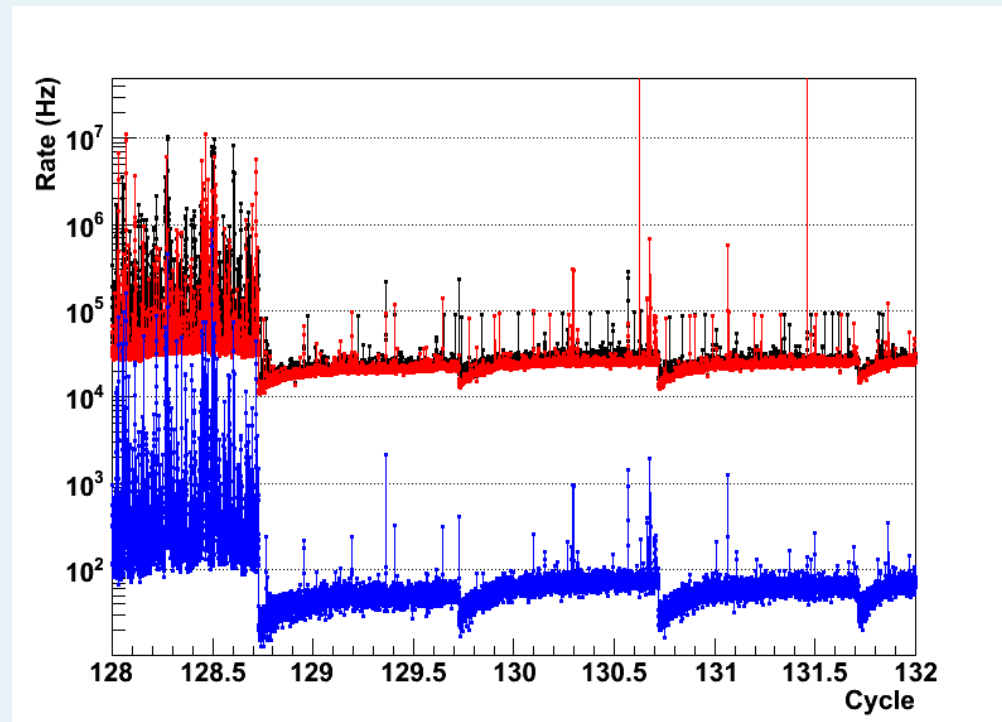
CTD measurements (temperature, salinity, conductivity, pressure, O₂...) are important to point to water mass variation
Monitored continuously every 2 min



Study of the OM data

OM measurements: 50 min data at a rate of 1s every 4 h

Data: rate of the 2 OMs + coincidence rate (Gain $\sim 3 \cdot 10^6$, $th \sim 0.6pe$)



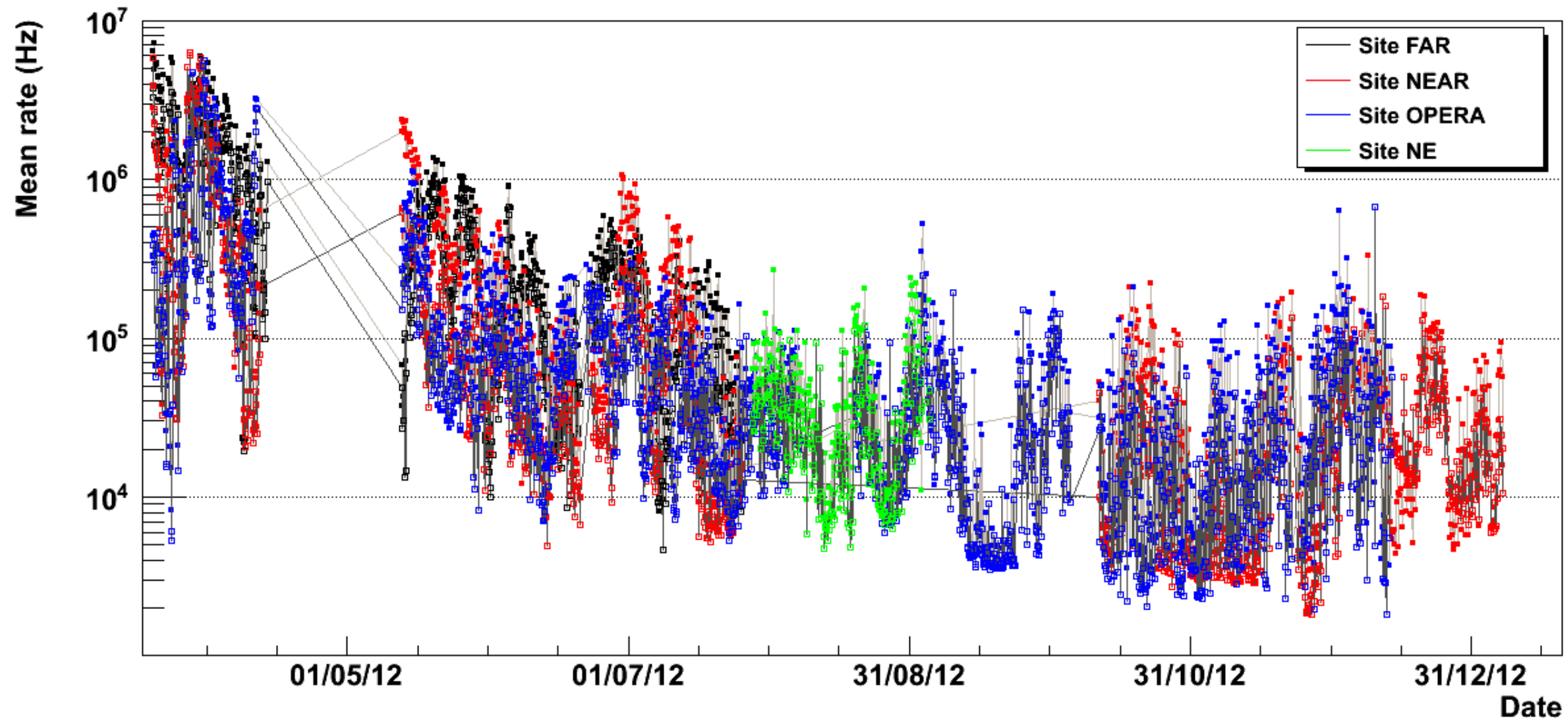
Data are corrected from the dark noise rate of each PMTs measured in dark room

Analysis of the counting rate after stabilization (20 min useful data)
 \Rightarrow Median + mean rate (+ baseline and burst fraction)
 \Rightarrow 1 point every 4 h

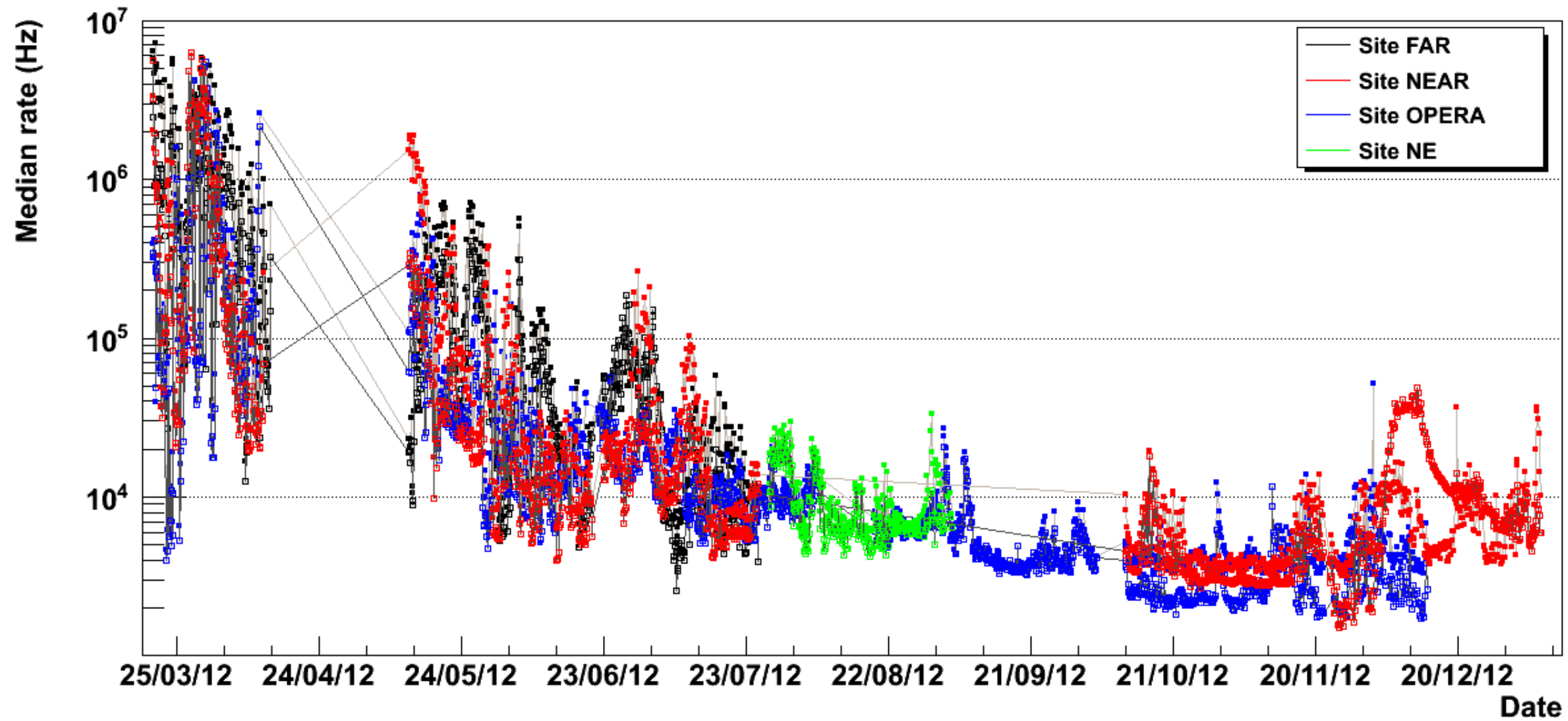
In this analysis, 2 variables used:

- median rate (almost insensitive to bursts)
- mean rate

Study of the OM data



Study of the OM data



Study of the OM data

Cummulative distribution

P1 (50% prob):

Opera: 112 kHz / 141 kHz

Near: 129 kHz / 195 kHz

Far: 602 kHz / 1380 kHz

Antares: HVreduced

P2:

Opera: 18 kHz / 24 kHz

Near: 16 kHz / 27 kHz

Far: 37 kHz / 68 kHz

Antares: 95 / 158 / 158 kHz

P3:

Opera: 8 kHz / 12 kHz

Near: 11 kHz / 16 kHz

Far: 11 kHz / 22 kHz

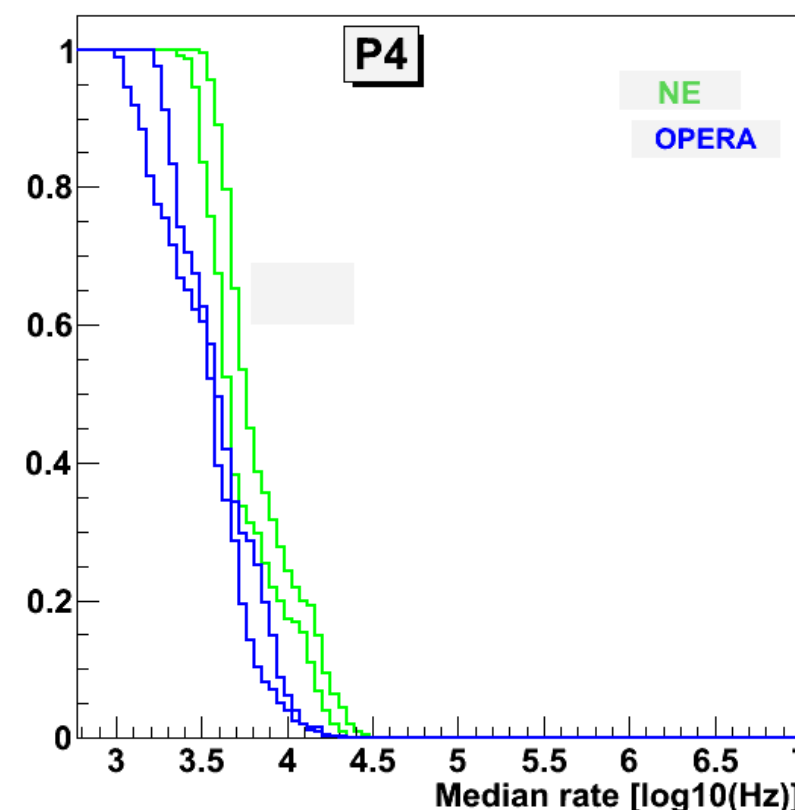
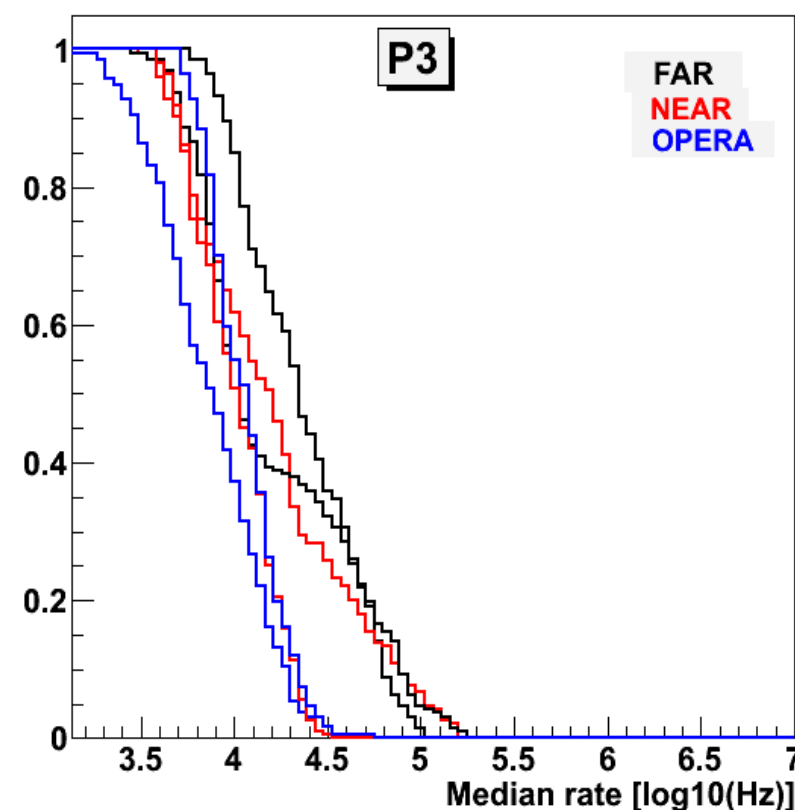
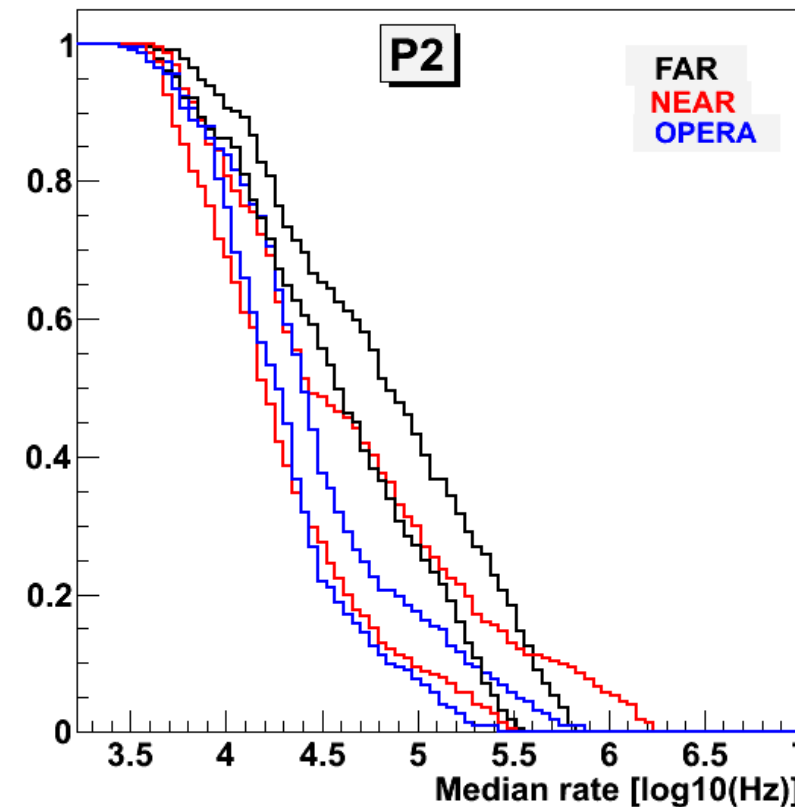
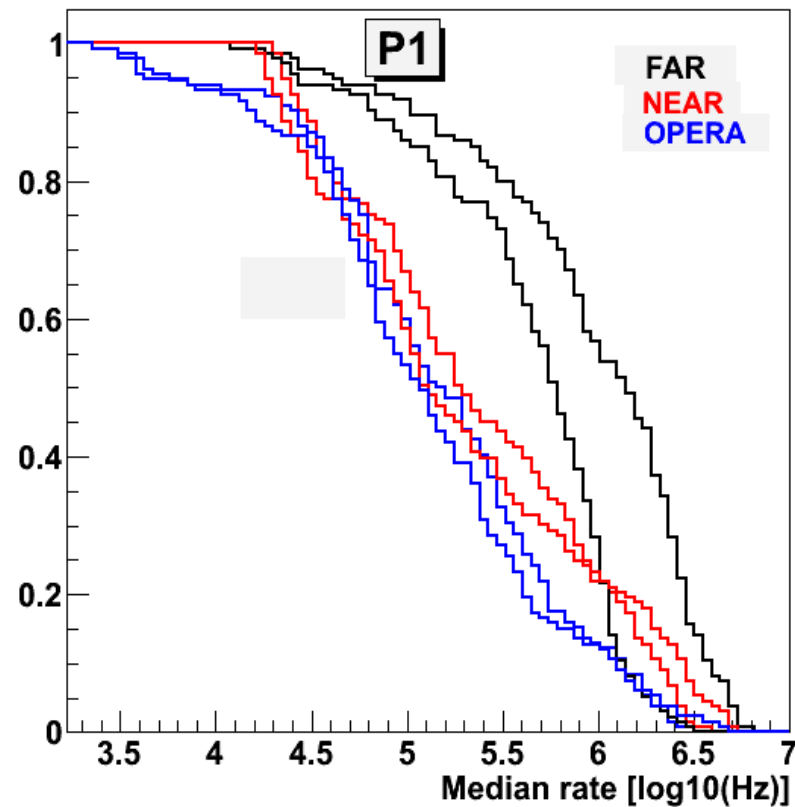
Antares: 72 / 158 / 141 kHz

P4:

Opera: 4 kHz / 5 kHz

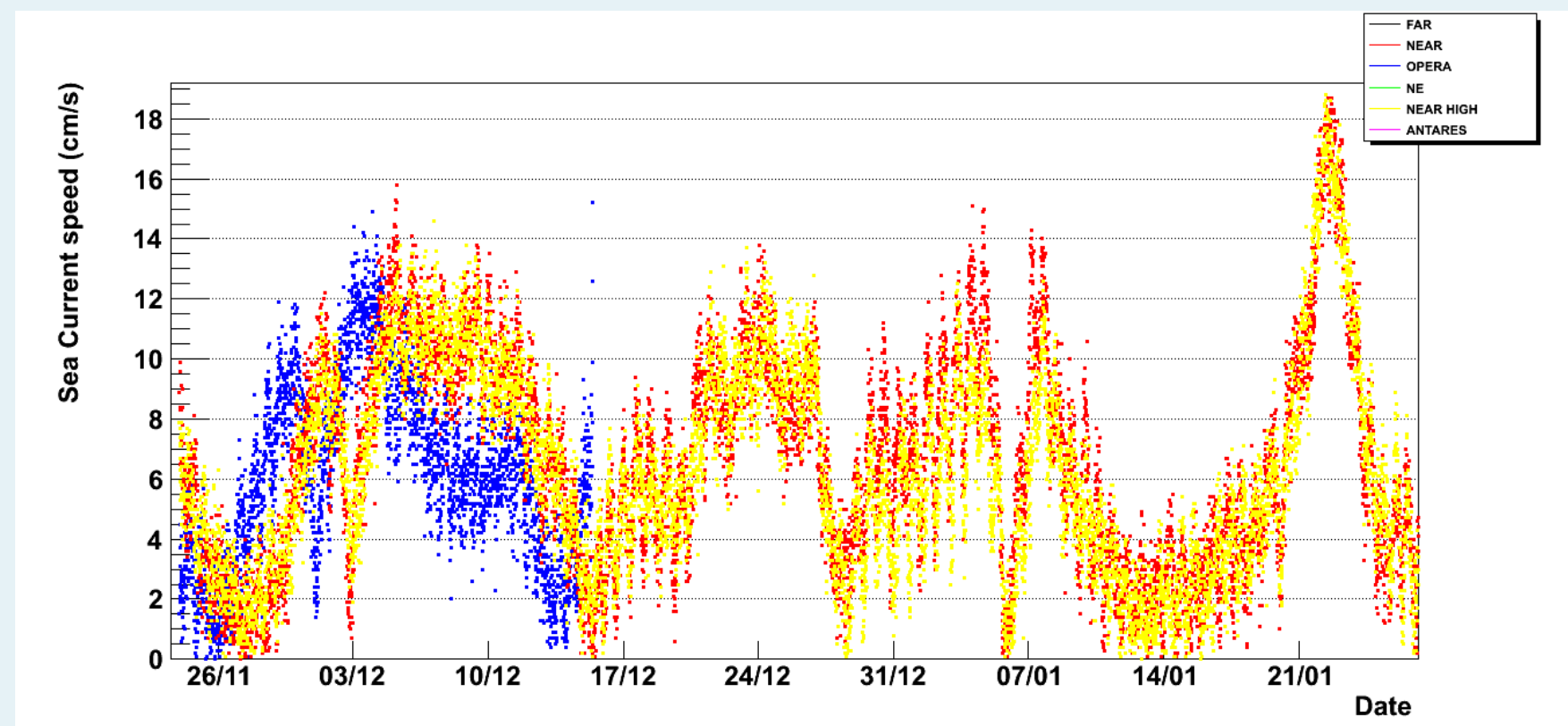
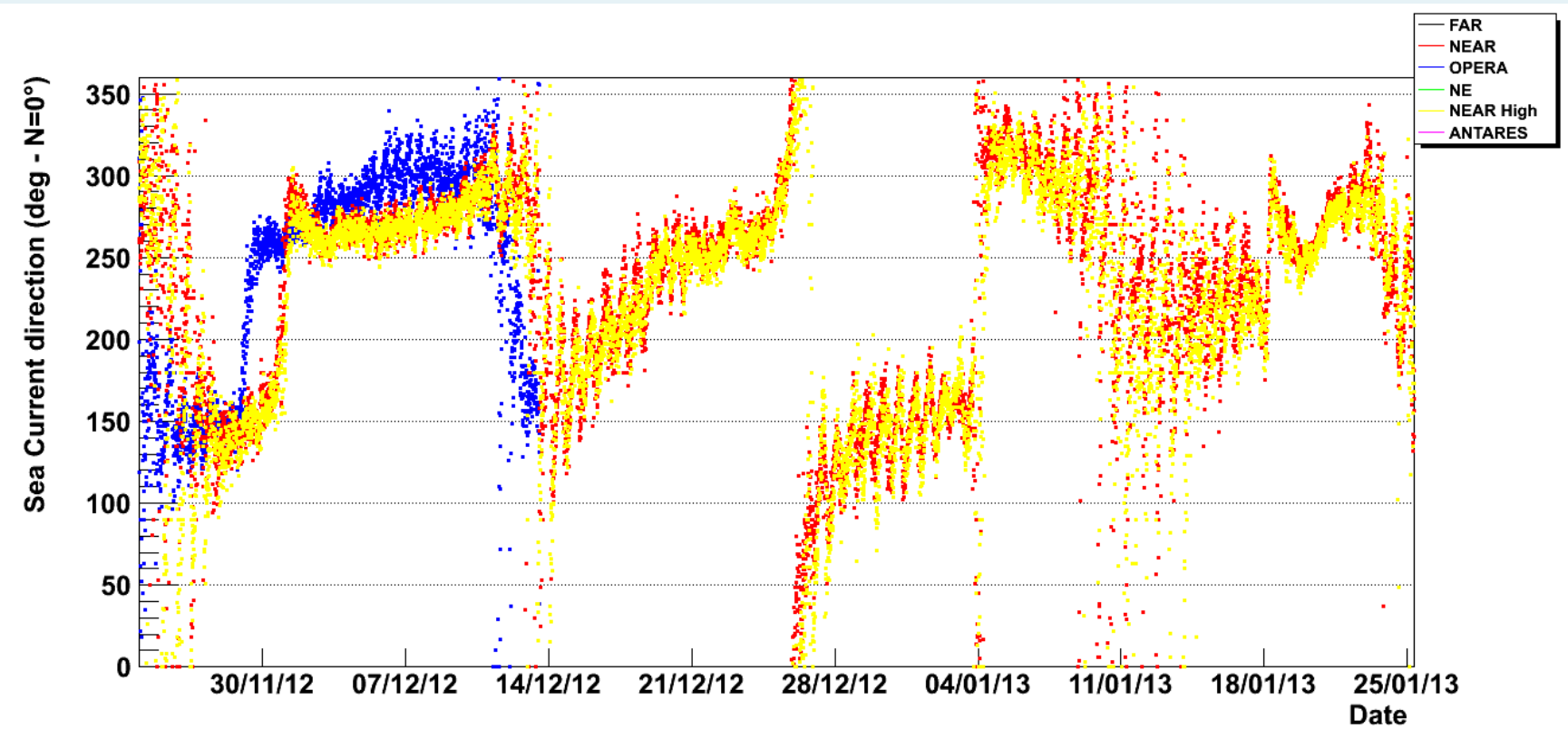
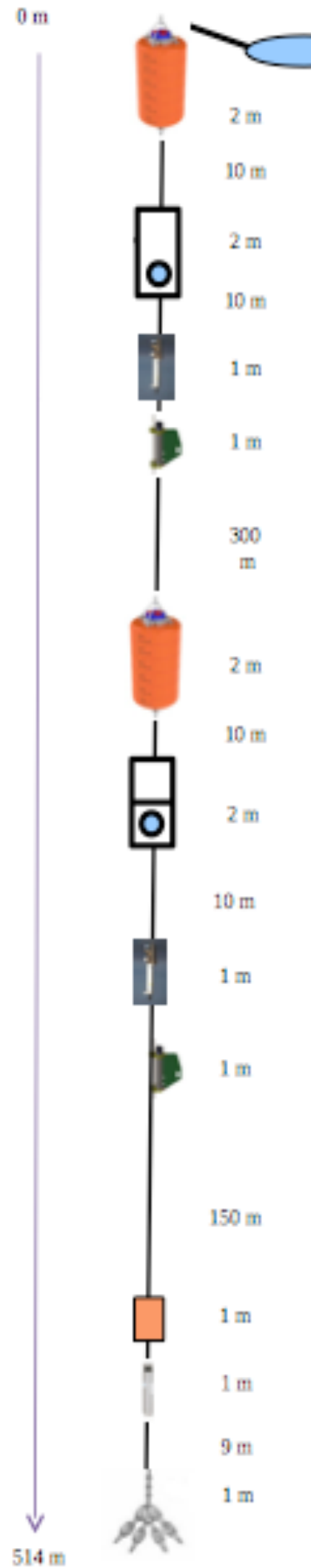
NE: 3.5 kHz / 3.5 kHz

Antares: 63 / 93 / 93 kHz



Specific studies

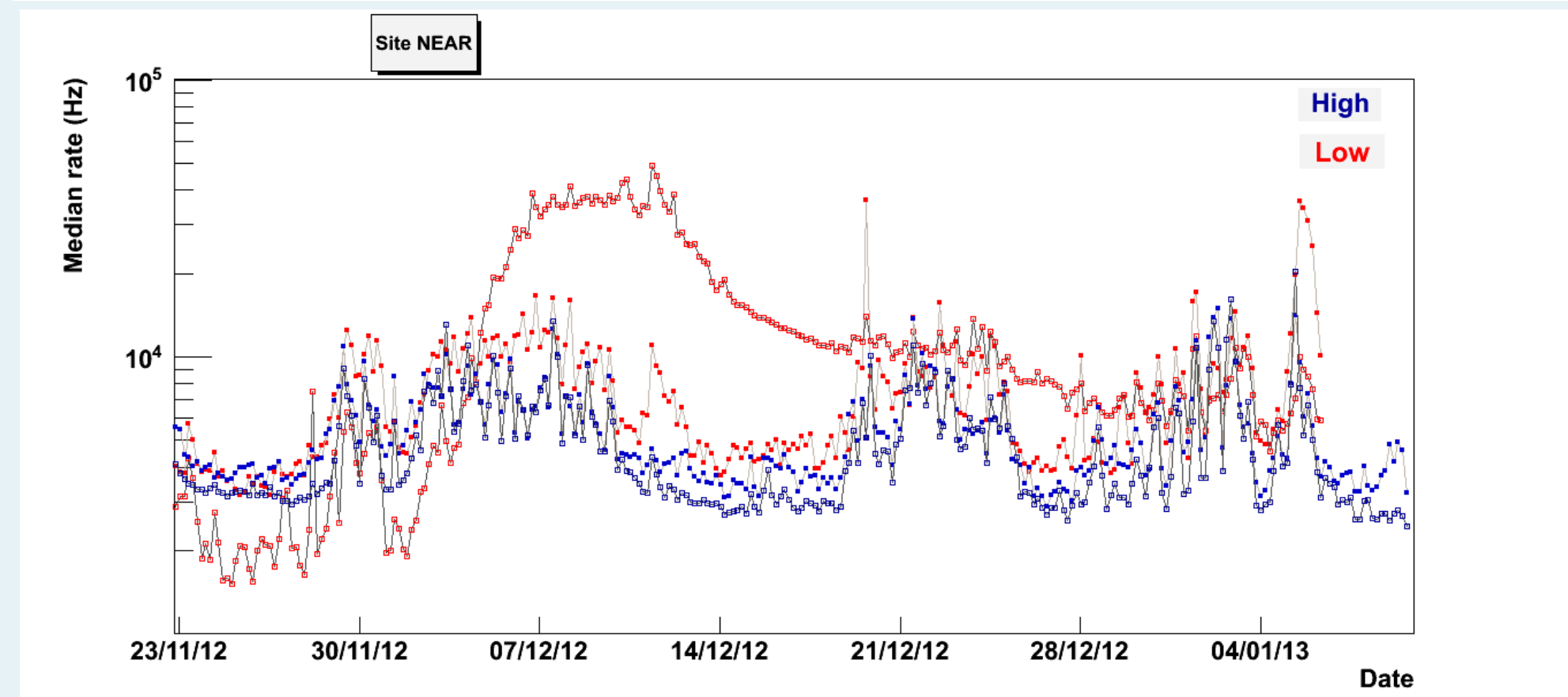
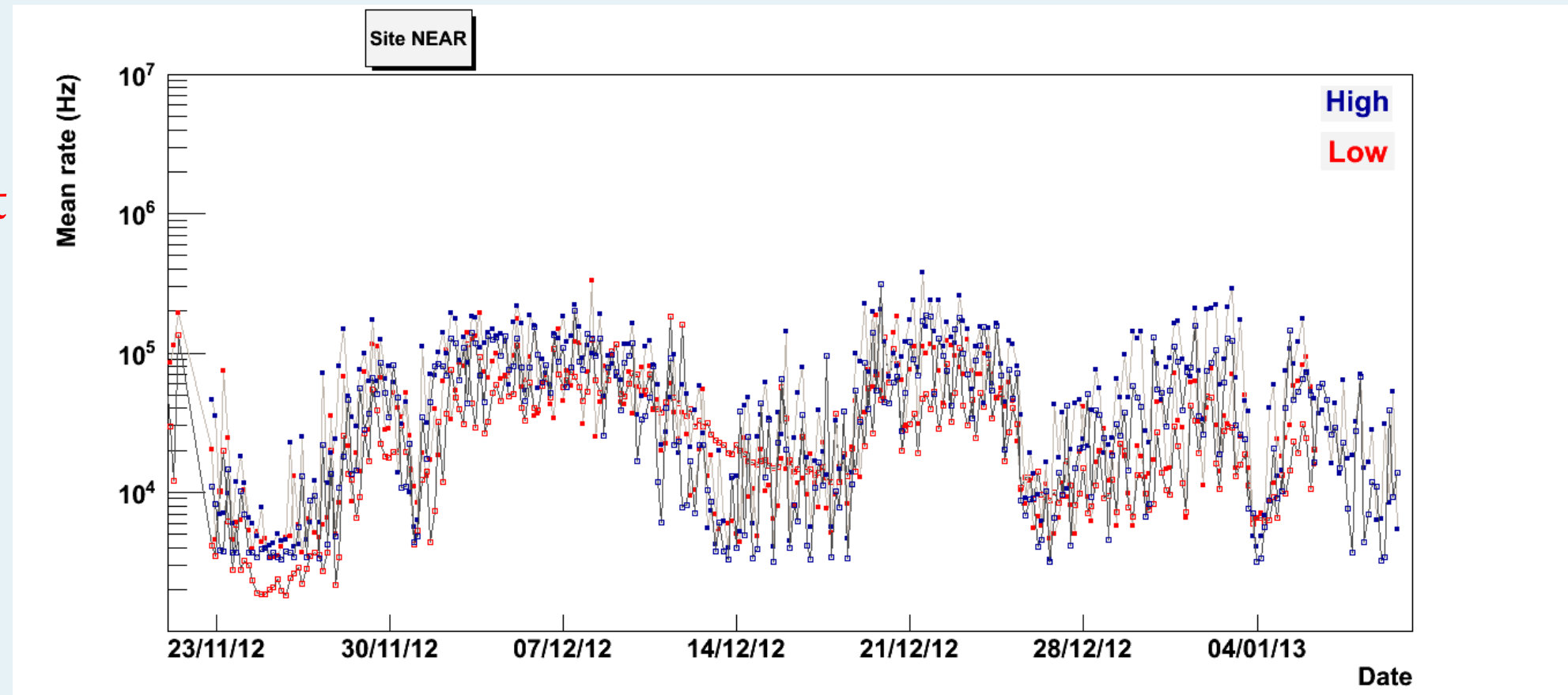
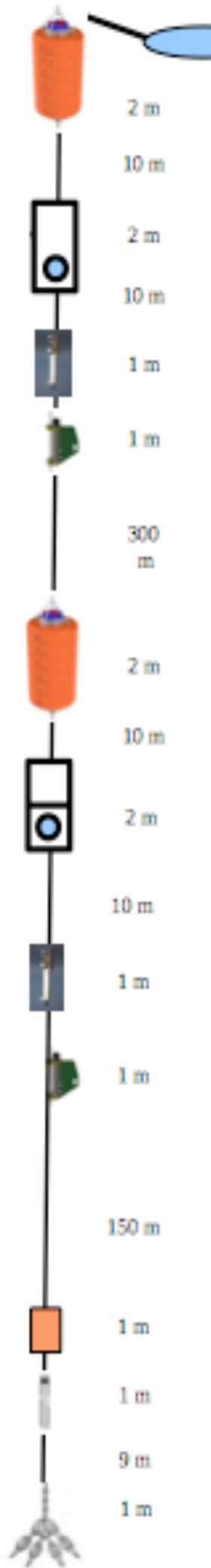
2 setups (OM, CTD, ADCP) at 160m and 480m from seabed



Specific studies

2 setups (OM, CTD, ADCP) at 180m and 500m from seabed

Measurements are ongoing => planned to test an OM at 800m



Results of investigations

The FAR site:

Shows a higher activity than the coastal sites (influence of the Gulf of Lion winter phenomena?)

This observation led to discard the FAR site and to start studying site NE instead.

The 4 coastal sites:

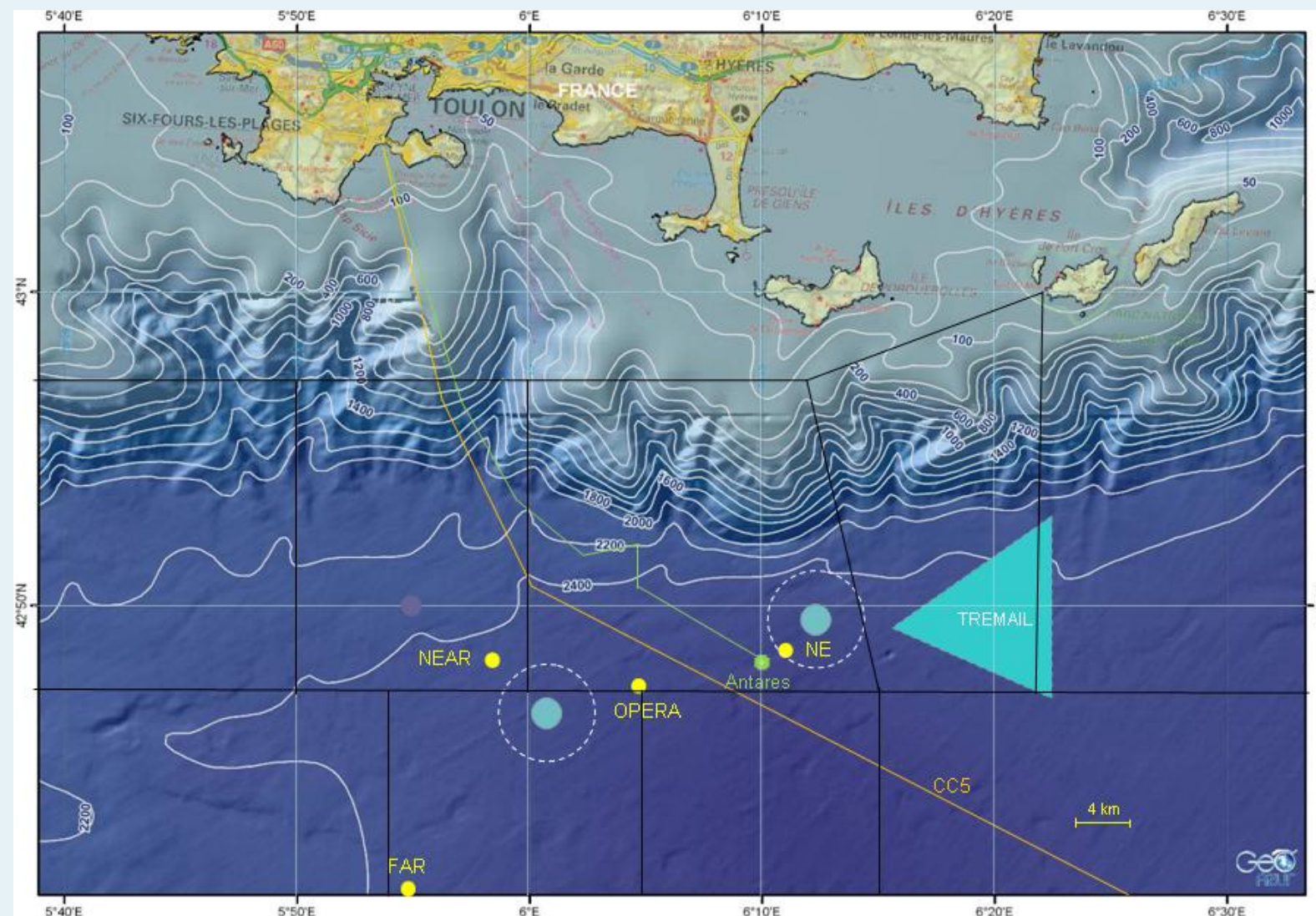
Similar behaviour with some indication that the activity slightly increases from East (ANTARES) to West (NEAR site)

► differences have low significance then logistic & operational aspects become primordial

Need more data to confirm the interpretation of these results

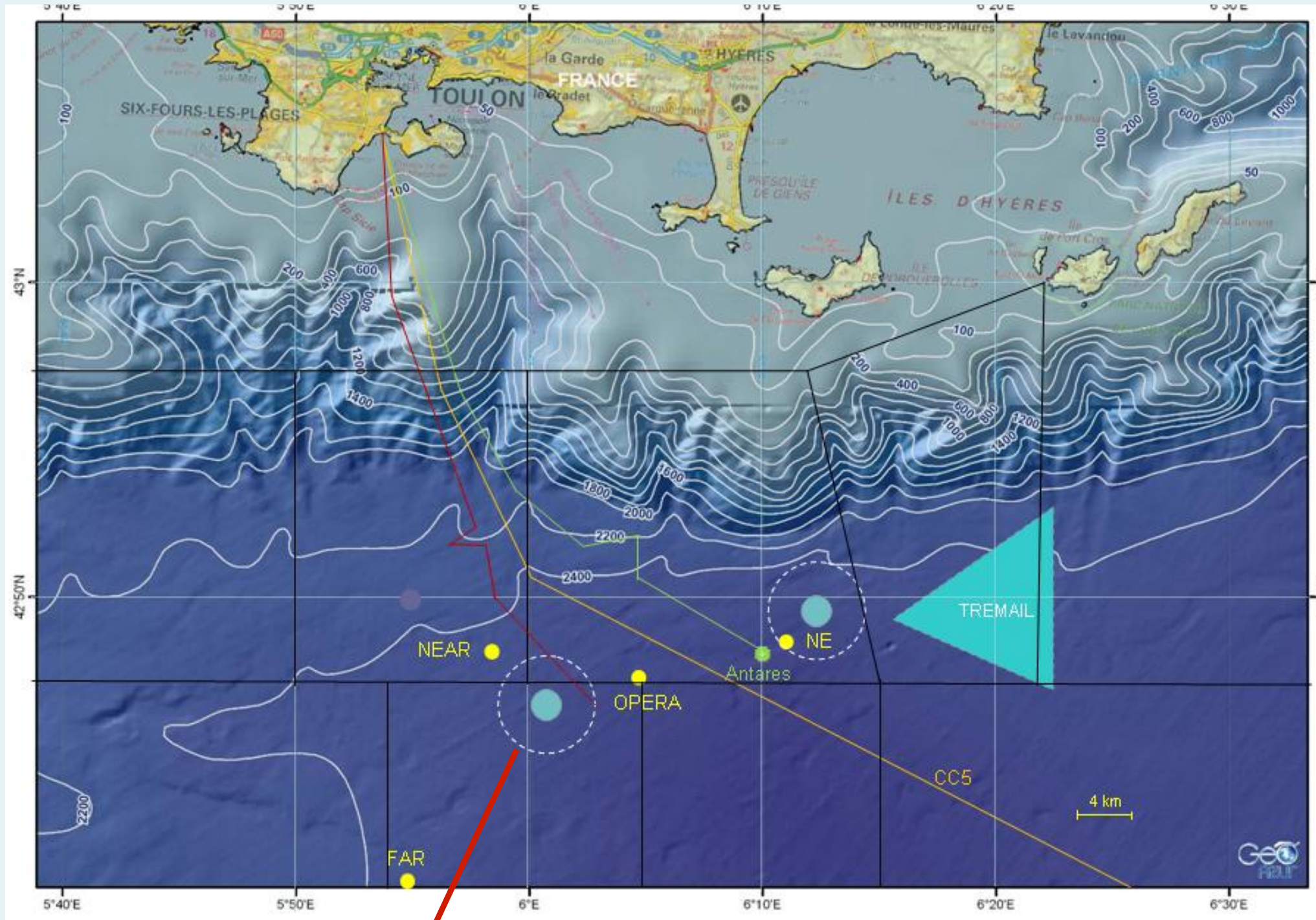
Logistic & operational constraints

- Available space on sea floor is limited around ANTARES (CC5 cable and Tremain array)
- $\geq 5\text{km}$ from the Tremain to limit acoustic interference and military veto for sea operation
- Deployment of MEUST MEOC & Node: risk for ANTARES if too close
- Possibility to redirect ANTARES MEOC if necessary



Site Selected

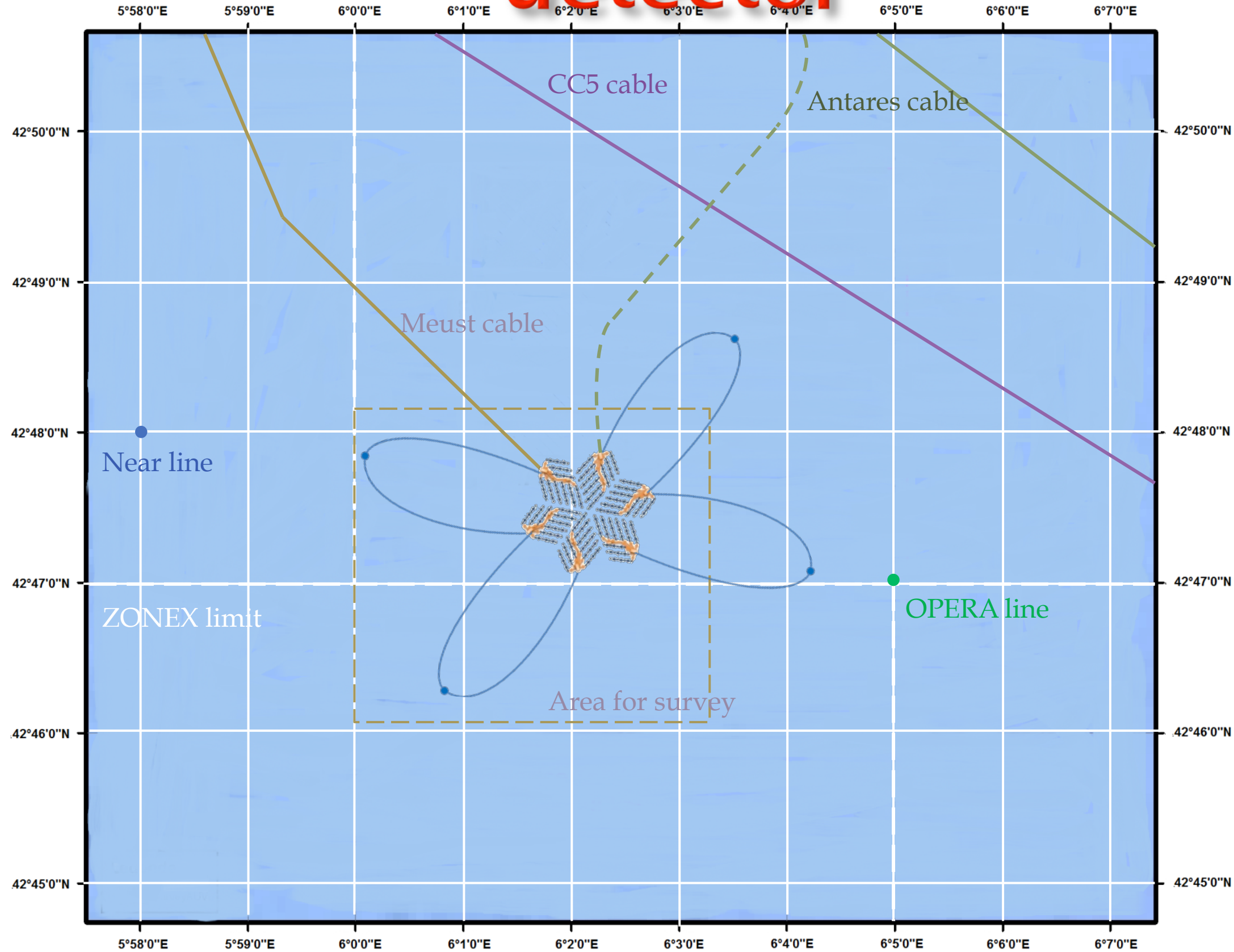
- ▶ Site selected: intermediate region between NEAR and OPERA site



Flexibility to tune the final position

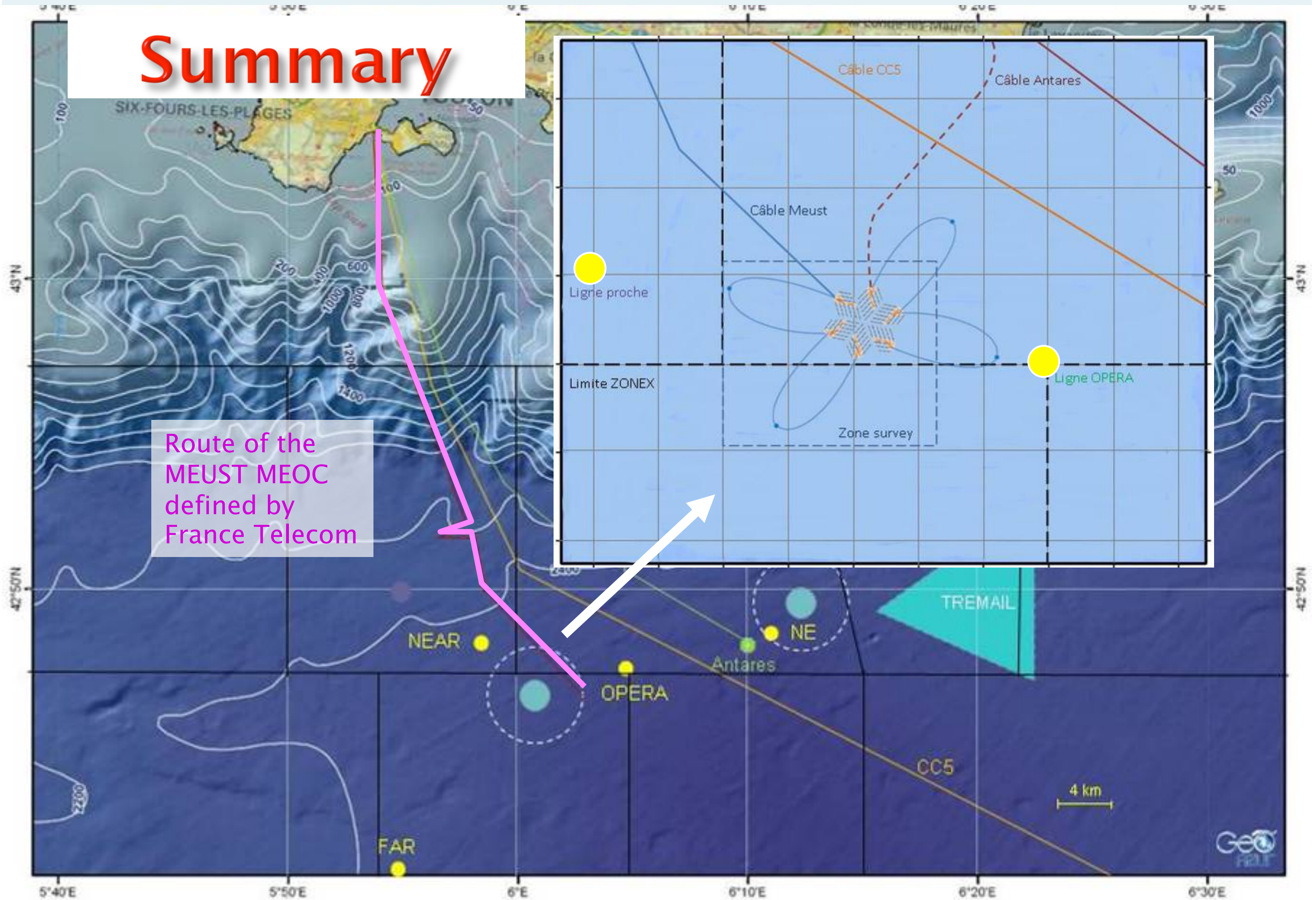
Meust Infrastructure with KM3Net

detector



Done: bathymetry survey of the partial zone by Ifremer
Planned: more detail survey

Summary



Route of the MEUST MEOC defined by France Telecom

The site



30/01/2013

KM3NeT Collaboration Meeting

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Perspectives

The autonomous mooring lines are working fine since 1 year and a great flexibility. The equipment of the line can be changed at each sea campaign. The autonomy is set to 45 days and can be extended to 90 days (reducing the sampling)

Three setups available including: OM with 2x PMTs (3inches) + ADCP + CTD)

Right now, two sites are equipped (Opera and Near) surrounding the selected Meust site.

This device can be available/duplicate to be installed in others KM3Net sites

If necessary, we can upgrade the system to include the last KM3Net PMT+base selected

Internal note in preparation

All the data are available, please inform your colleagues for them