Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS)

ALBATROSS

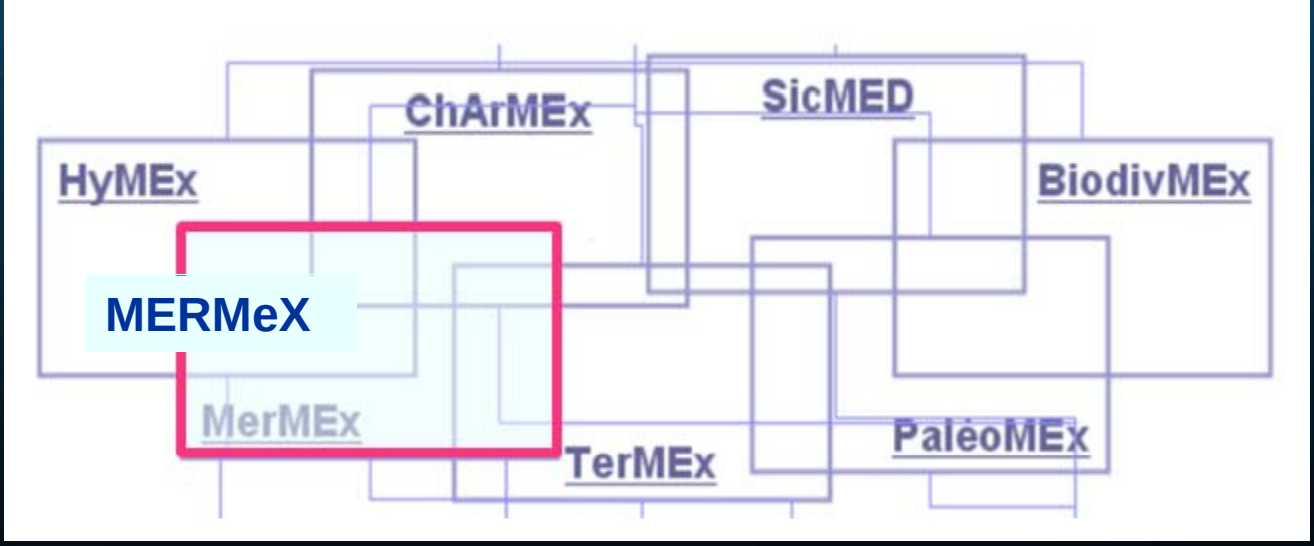
Centre d'océanologie de Marseille

Ifremer

Chantier Méditerranée

"MISTRALS"
(Mediterranean Integrated STudies at Regional And Local Scales)

For ~ 2010-2020



"MISTRALS"
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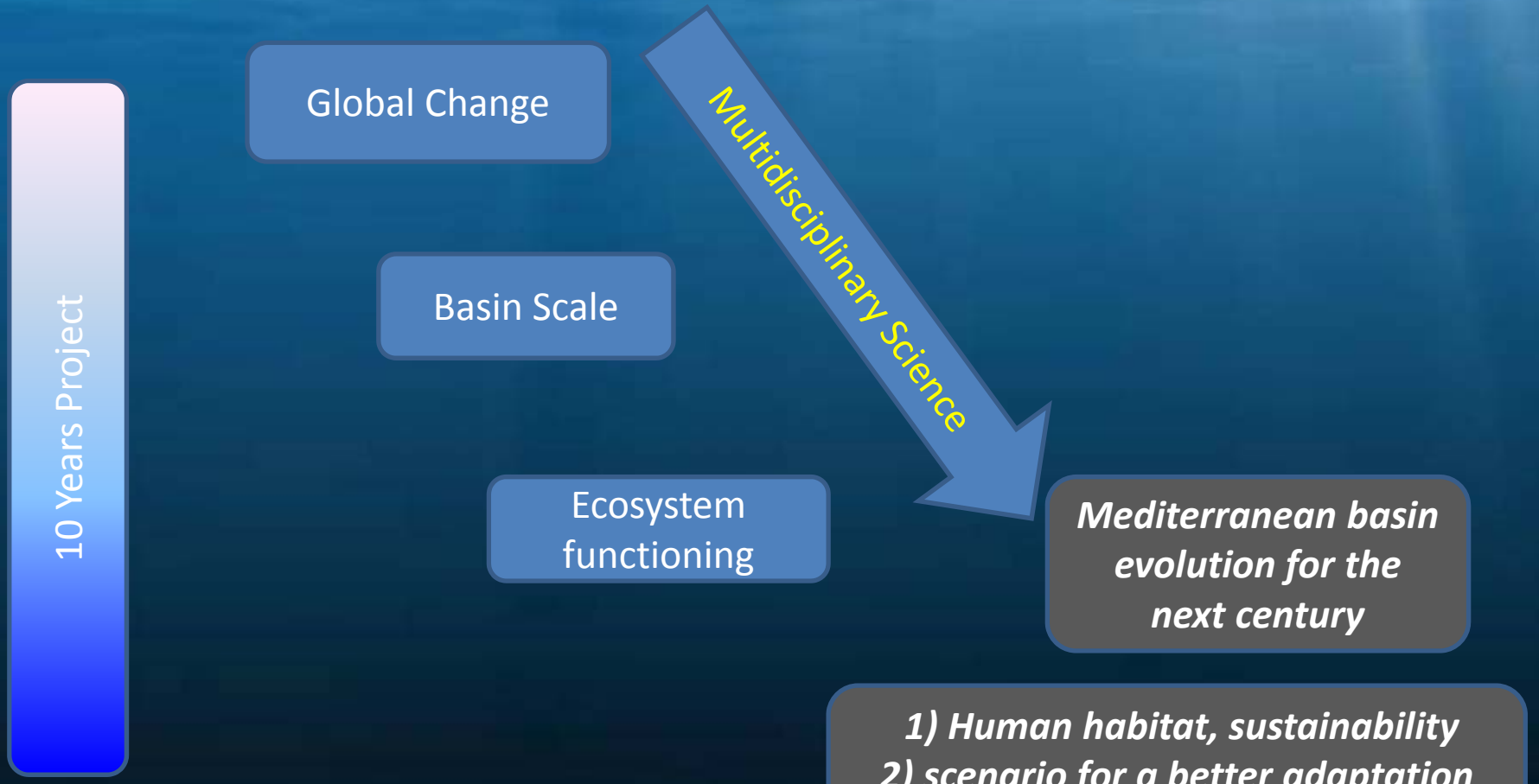


« MISTRALS » is a French initiative to initiate a Euro-mediterranean project involving all the Mediterranean countries.

MERMEX: Marine Ecosystems Response in the Mediterranean Experiment (2010-2020)

Response of the Med. Ecosystems to global change including temperature increase and anthropogenic pressure (contaminants). T

MISTRALS component along with atmospheric chemistry (Charmex), hydrometeorology (HYMEX), Biodiversity (Biodivmex), Paleomex…

PI : X. Durrieu de Madron, C. Guieu, R. Sempéré

MERMEX: Marine Ecosystems Response in the Mediterranean Experiment (2010-2020)

- **Scientific objectives**
  - *1. Circulation and basin scale nutrients budget*
  - *2. Biogeochemical and ecological processes*
  - *3. Intense natural and anthropogenic land-sea interactions*
  - *4. Natural and anthropogenic atmosphere-sea interactions*
  - *5. Societal and economical impacts sanitary, recreation, resources)*

Mediterranean Ocean Observing System on Environment (MOOSE)

Objectives:

- Long term observatory network in the North Western Mediterranean Sea

- A tool for MISTRALS (Chantier Méditerranée) and operational oceanography (SNOCO, Mercator-Coriolis)

- Multidisciplinary network of fixe station & mobile plateform

- Synergy between actors and mean of investigation

- Life time >10 years

MOOSE Network

Objectives:

- Long term observatory network in the North Western Mediterranean Sea

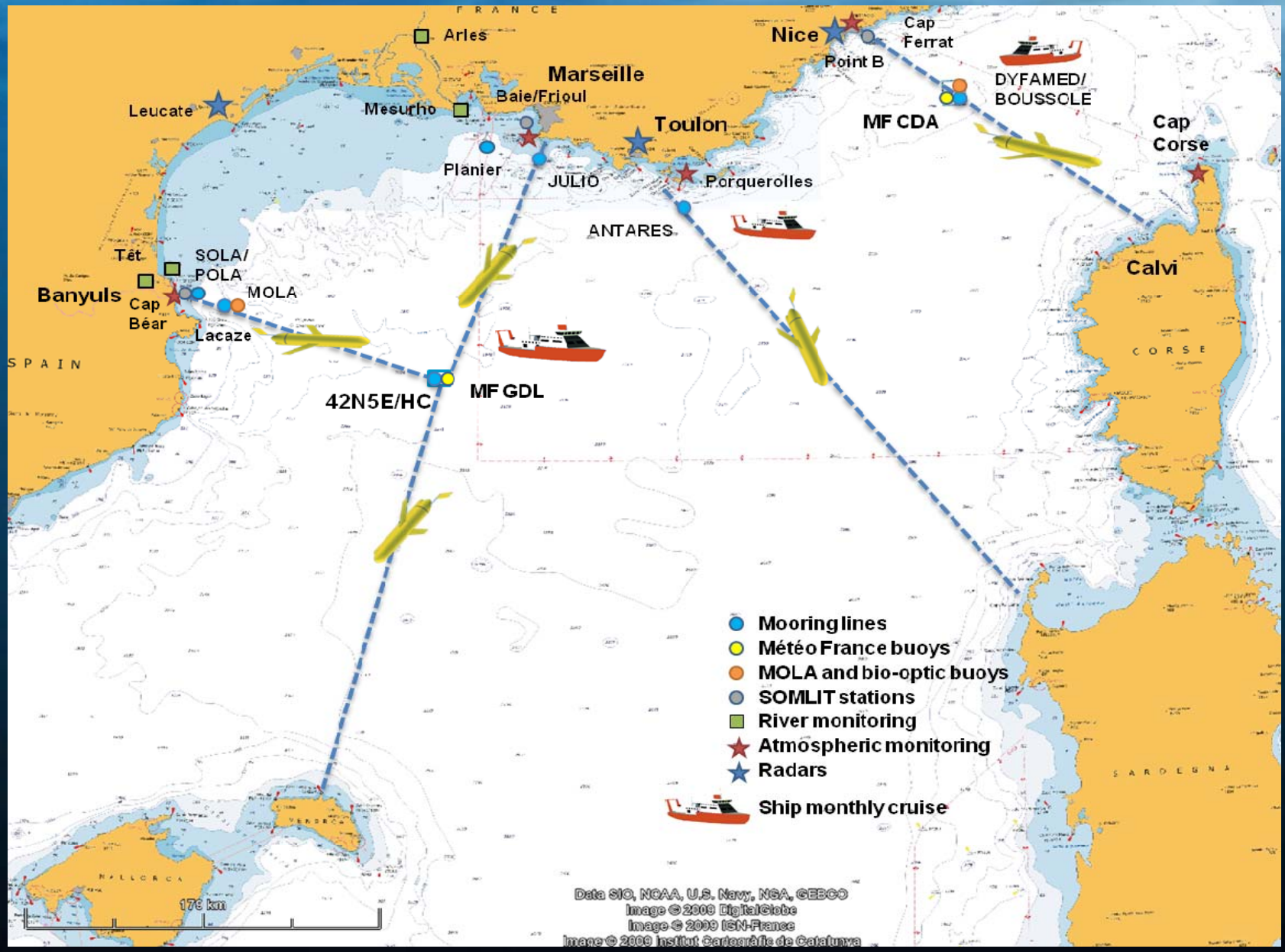
- A tool for MISTRALS (Chantier Méditerranée) and operational oceanography (SNOCO, Mercator-Coriolis)

- Multidisciplinary network of fixe station & mobile platform

- Synergy between actors and mean of investigation

- Life time >10 years

MOOSE STRATEGY



Oceanography around Antares

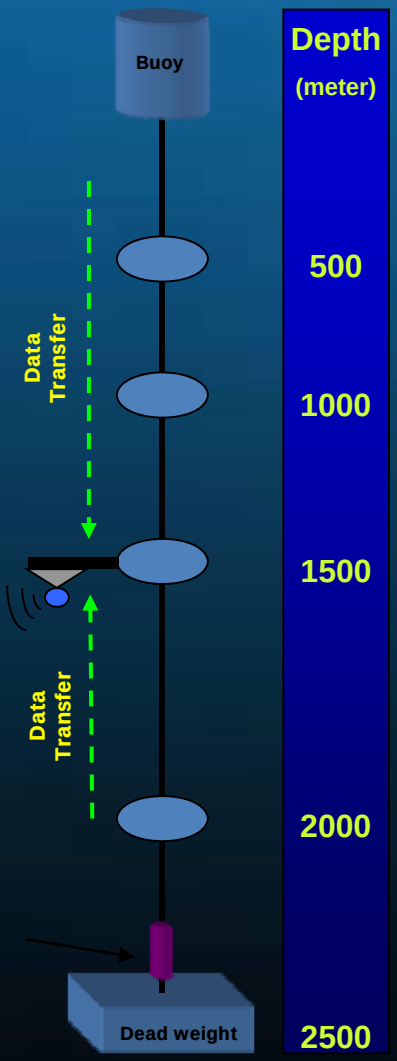
2007 | 2009 | 2009-2010 | 2010 | 2010-2011 | 2011 - 2020

Esonet NoE & EuroSites

POTES | OPERA | - AAMIS | - DARK VADOR | ALBATROSS | ALBATROSS NETWORK

1 Line	1 Line	1 Line	3 or more Lines
1 Depth	4 Depth	4 Depth	4 Depth
1 IODA	4 IODA	4 IODA	4 IODA
1 Microcat	4 Microcat	4 Microcat	4 Microcat
1 Aquadopp	4 Aquadopp	4 Aquadopp	4 Aquadopp
…	….	…	…
0 D, delayed mode	**1 D delayed mode**	**1 D real time Mode**	**3 D real time Mode**

Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS)



- CTD
- $IODA_{6000}$
- Camera
- ADCP
- Transmissometer
- …

- Hydrodynamics
- Water column biogeochemistry
- Marine Ecology
- Geosciences

Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS)

- Develop a tool for real time multi disciplinary science
- Flexibility to welcome any generic sensor

- Adjust time scale of maintenance according to sensors characteristics

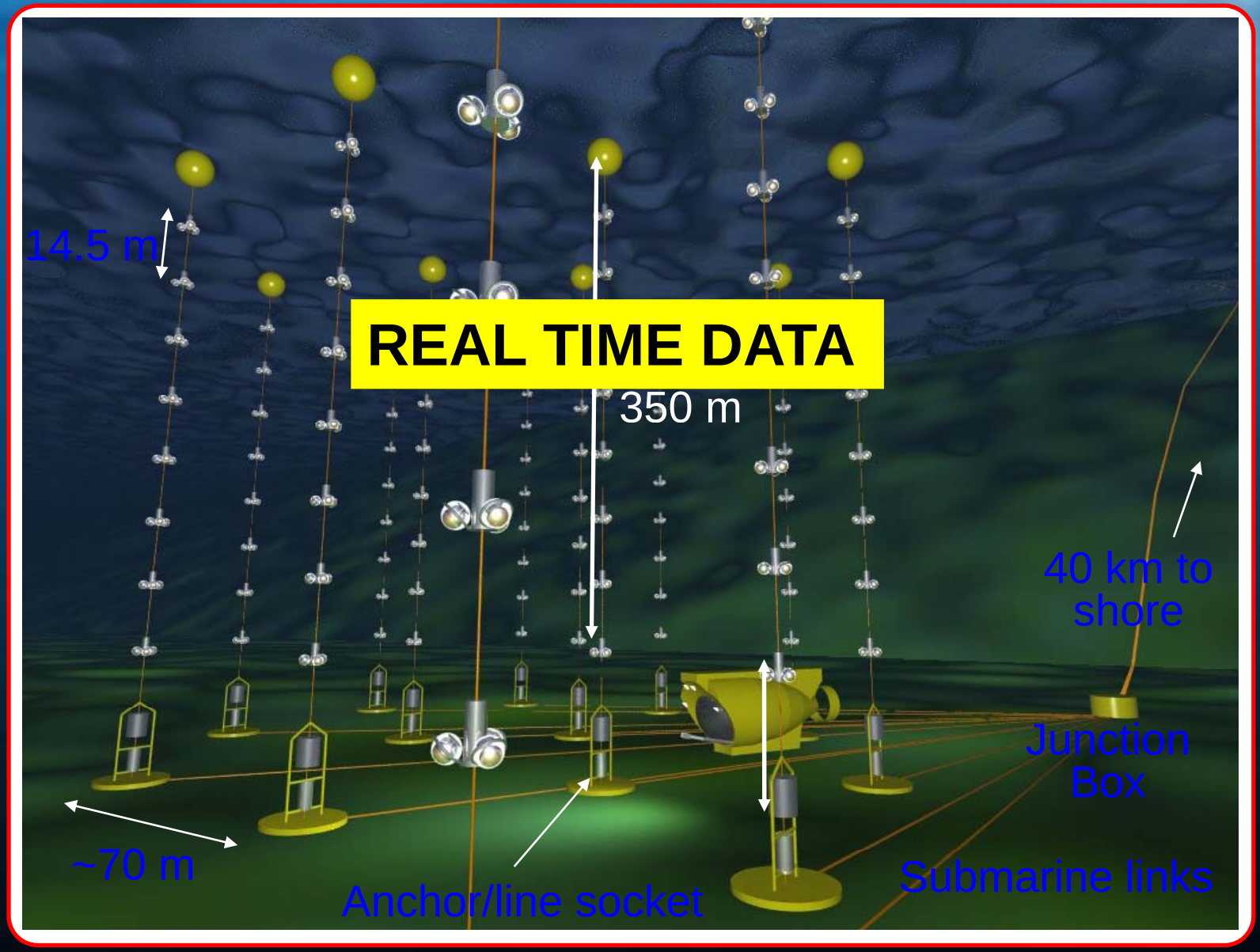
- Export the concept to other cabled site. This proposal intends to demonstrate the necessity of well defined calibration procedures. The final goal of the methodology is to be able to compare measurements on different existing ESONET sites.

Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS)

- Our action is focused
- 1) on standardisation and validation of in situ data transfer using acoustic modem for real time data (procedure...)
- 2) on standardisation and deployment of generic sensor package in view to be linked to an acoustic modem.
- 3) to host any sensor (existing or prototype) for test the data collected available to the Esonet database using a standard procedure. procedure & training
- 4) to make

ANTARES

ANTARES is a 0.1 km^2 (0.05 km$^{3)}$ demonstator detector close to Toulon



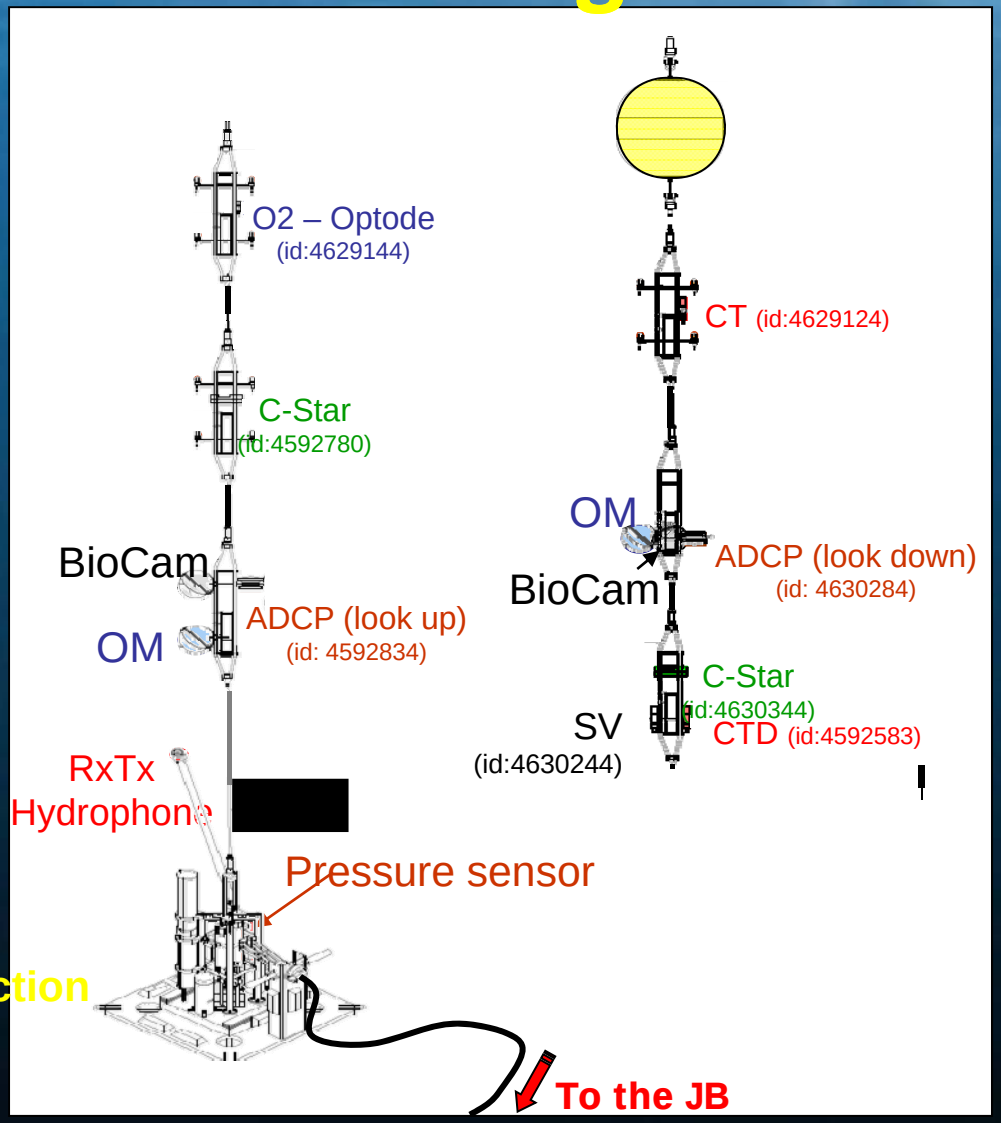
(IL07) Instrumented mooring line

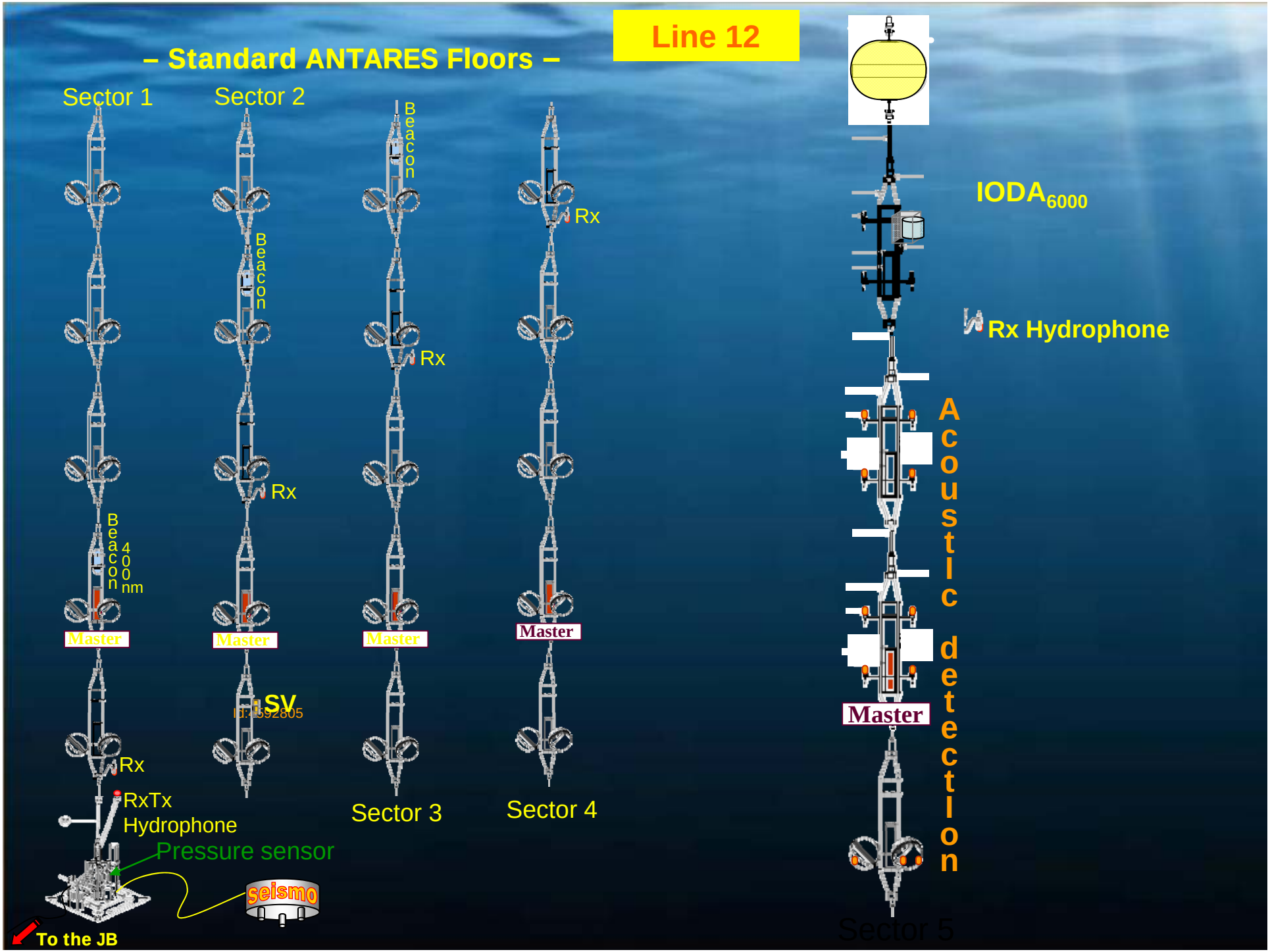
Goals:

• record hydrological parameters

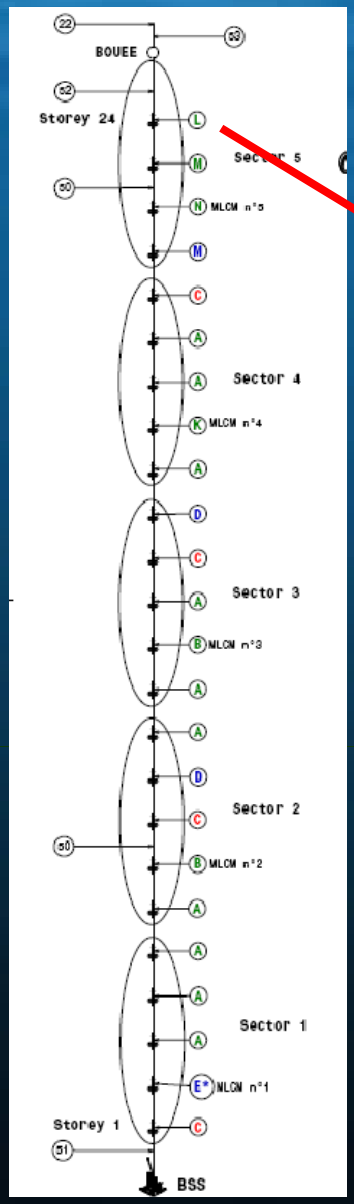
- **CSTAR light transmission @ 660nm**
- **CT = Conductivity-Temperature**
- **SV = Sound Speed**
- **ADCP = Currentmeter**
- **GURALP seismometer**
- **2 optical modules**
- **1 Laser + 2 optical beacon**
- **Acoustic positionning RxTx & Rx**
- **In situ Dissolved oxygen**
- **2 video cameras**

  +
- **3 floors equipped with acoustic detection**

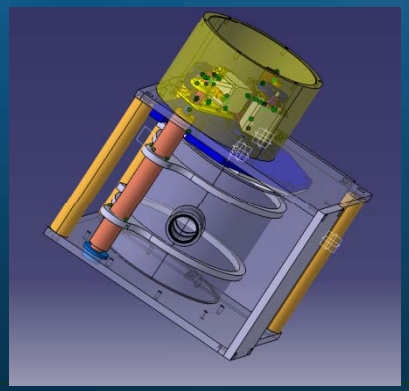


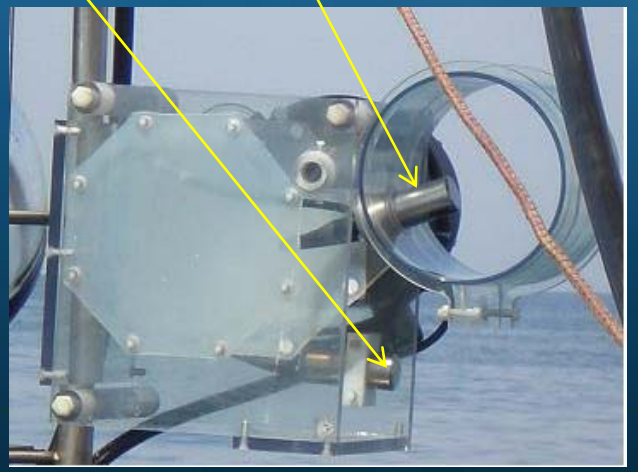

– Standard ANTARES Floors –
Line 12
Sector 1
Sector 2
Sector 3
Sector 4
Sector 5
Beacon
Beacon
Beacon
Rx
Rx
Rx
Beacon 400 nm
Master
Master
Master
Master
Master
SV
Id:2592805
Rx
RxTx Hydrophone
Pressure sensor
seismo
To the JB
IODA6000
Rx Hydrophone
Acoustic detection

$IODA_{6000}$ for ANTARES Line 12



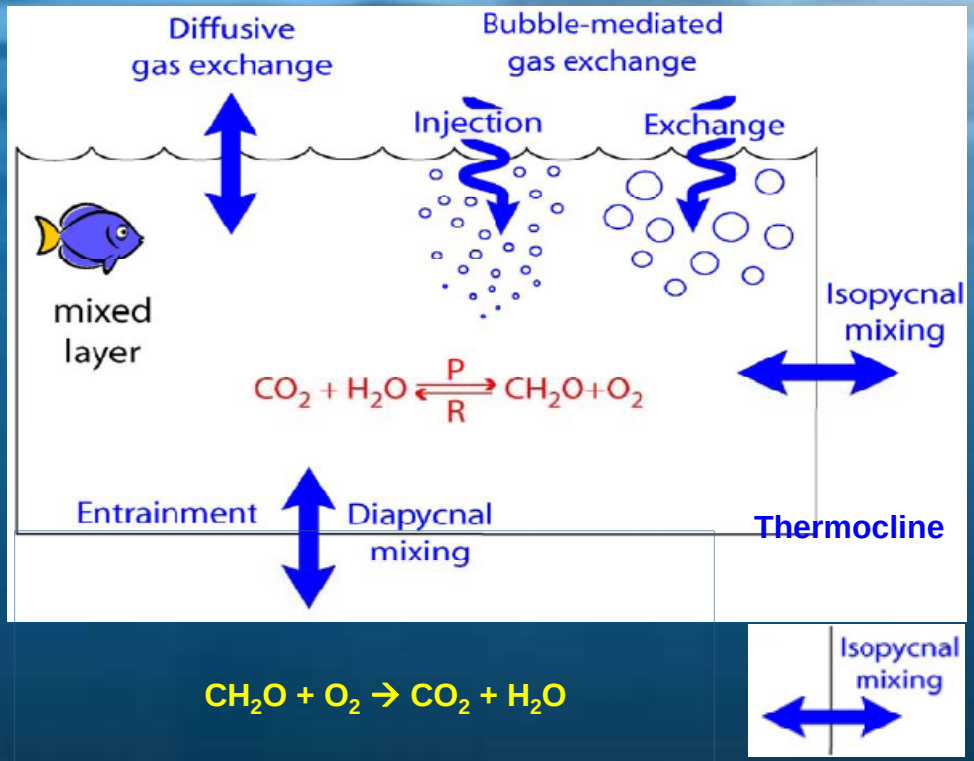
2 O_2 optode sensors: 1 external and 1 internal 435m from the bottom





$IODA_{6000}$: In situ Oxygen Dynamics Auto-sampler

25th level @ Z= 1935 m



$\delta[O_2]/dt$ = diffusive gas exchange + bubble exchange + diapycnal mixing + **isopycnal mixing** + BIOLOGICAL PRODUCTION

(Photosynthesis + **Respiration**)

Why monitoring Deep in situ Oxygen [AOU=f(t)]

→ To follow a decrease in oxygen concentration related to an increase in temperature (reducing the deep ocean ventilation), and linked to climate change

→ To follow water mass changes

→ To follow the deep oxygen consumption due to biological activity

- → CO_2 increase, ocean acidification
- → Carbon exportation to the deep ocean.

In Situ long term survey of TS-O_2

$[O_2]$ = in situ oxygen concentration ← O_2 optode sensor

CTD ↙ ↙ $IODA_{6000}$

$[O_2]$ = f(T, S, p) & Biological activity

C* = O_2 solubility
(Benson & Krause, DSR 1984)

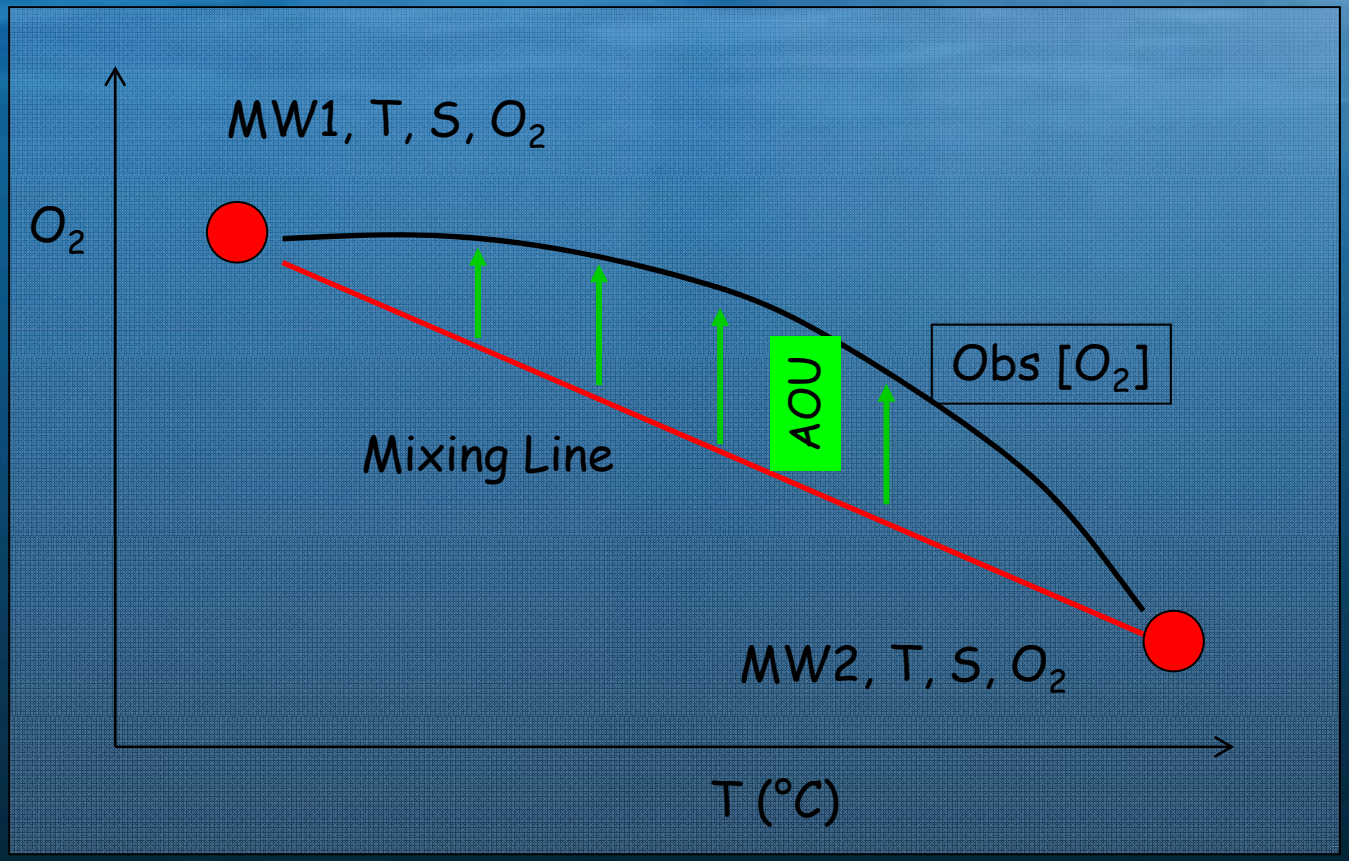
Bacteria O_2 consumption in the deep ocean

→ C* value will be determined during the deep-sea formation at the **ocean surface**

→ **Apparent Oxygen Utilisation** (AOU) = C*- $[O_2]$

AOU is providing an estimation of the biological oxygen consumption since the water has left the ocean surface.

Biological activity evaluation: different time scales



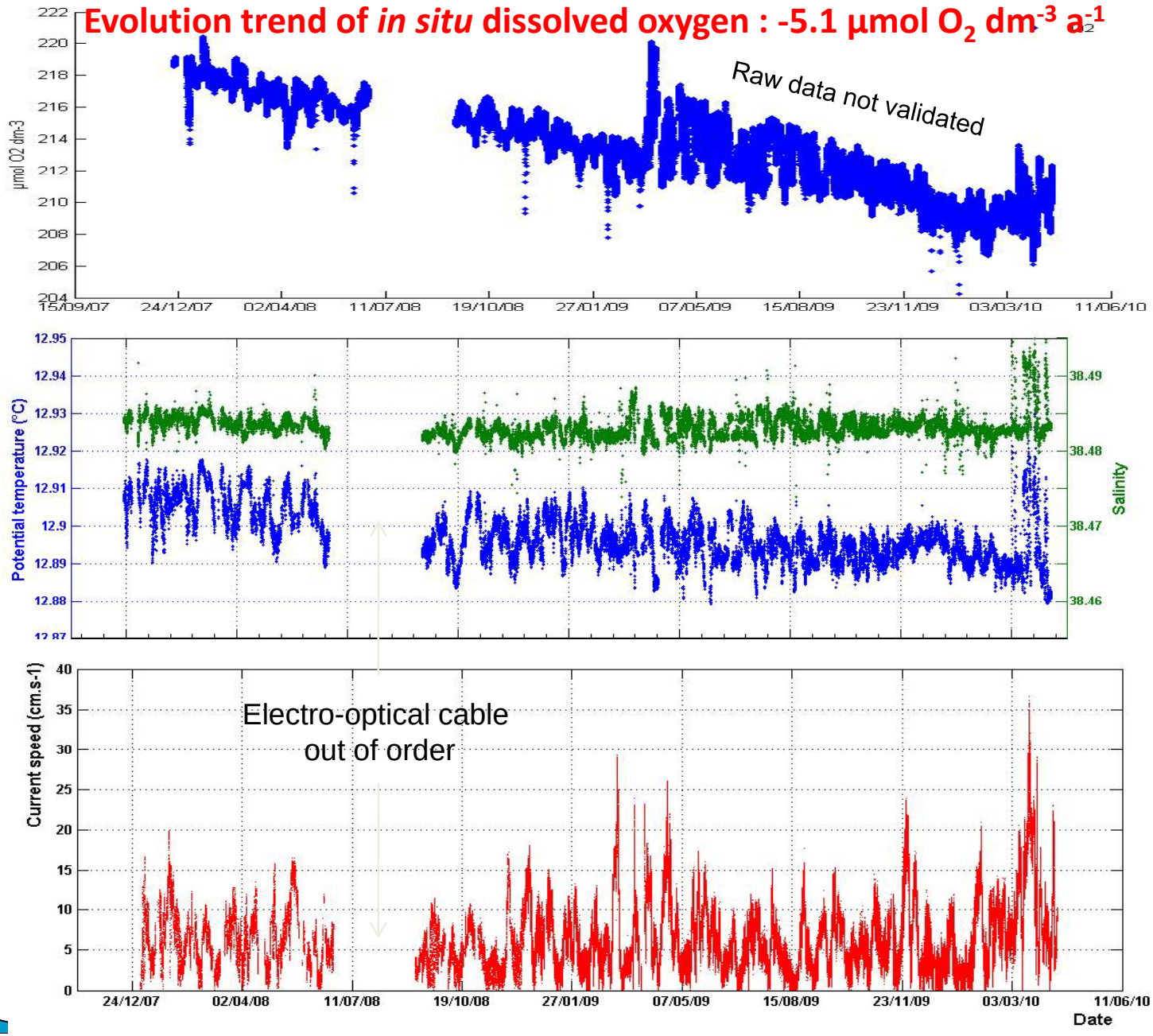
MW = Mode Water

In Situ O_2 = Time integrated Biological Activity
Months to years, upon water circulation

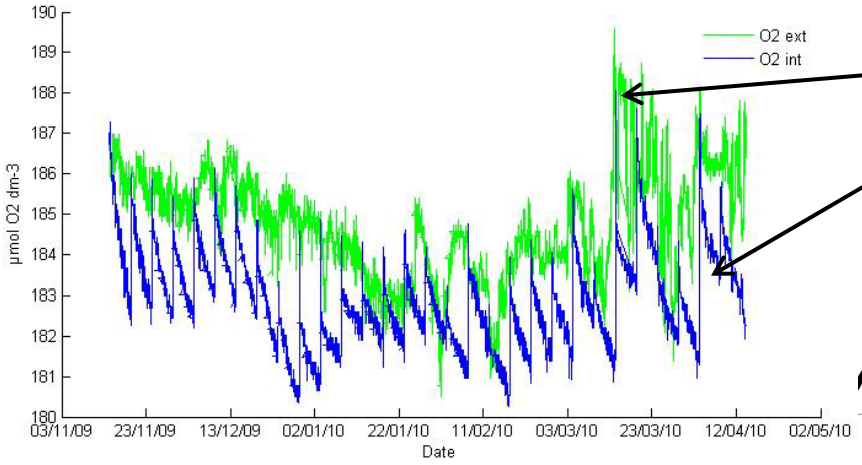
AOU = Departure from mixing line

IODA = Oxygen dynamics : Biological Activity
Daily to weekly scale

Temperature, Salinity, O_2 time-series (IL07)



$IODA_{6000}$ on L12: from Nov. 2009 to March 2010



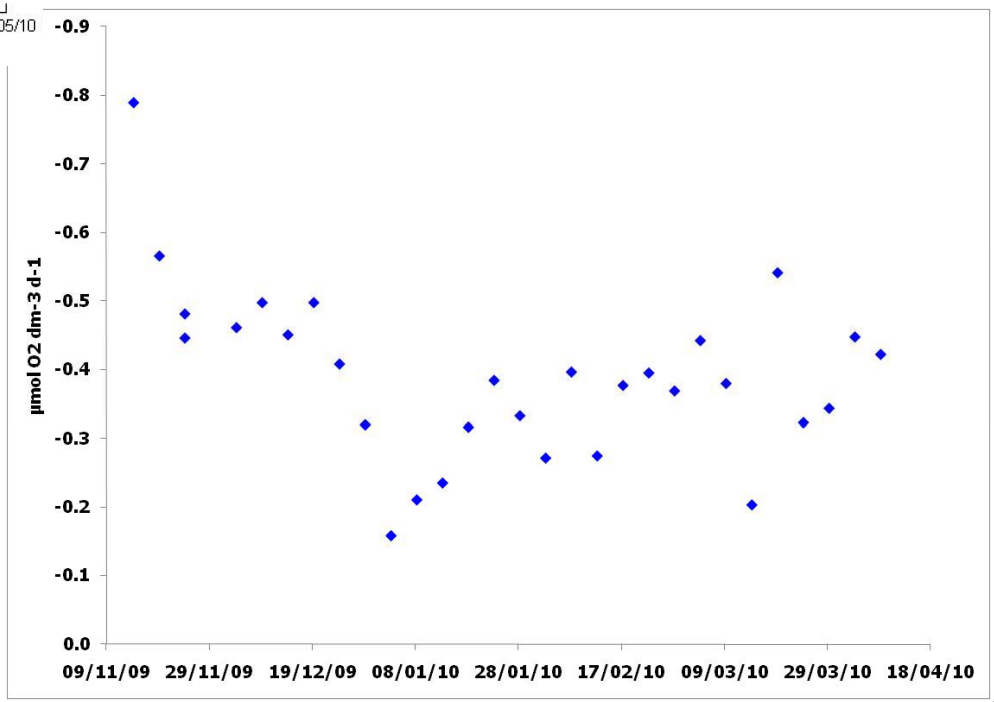
External oxygen

Internal oxygen

Average consumption :

-0.39 ± 0.13 µmol O_2 dm^{-3} d^{-1}

Average respiration rates of each cycle



INSTRUMENTED MOORING LINE
DARK VADOR

Floats 3*25kg

Acoustic release
AR 861 CSNS 229
Arm 0440
Release 0455
Dialog 0449

Weight 500kg

2450 m

Kevlar 8.5 mm = 435 m

Depth = 2000 m

Floats
5*25kg

Kevlar 8.5 mm = 435 m

IODA$_{6000}$

Depth = 1500 m

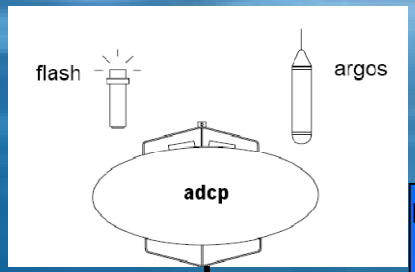
Aquadopp

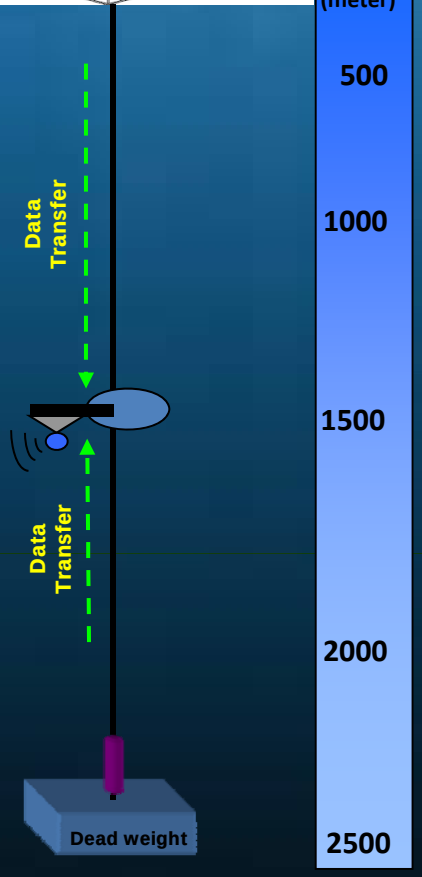
Microcat 37SMP

ANTARES REAL TIME DATA
Autonomous line
ALBATROSS

ROV

ANTARES
BJ – BJS
Acoustic
Modem





Mooring Line

Communication
Inductive

Modification
instrumentation
Electronics

Acoustic Modem

Open to new instrumentation

A Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS)

Scientific instrumentation

On the line:
IODA: 512byte /3 min /storey
CTD : 256 byte /3 min/storey
Aquadopp : 1024 byte / 3min/storey

82 kbyte h-1 Line-1

Data transmission on the line

- Data concentrator for each floor
- Transmission by inductive modem
- Data storage and Acoustic transmission in floor 3

Data Stored : 2 Mbyte per day

Acoustic Data transmission

- Distance from Mii 2000 m
- Multi channel for several lines
- Data transmission @ 200 Bit/s

Data transmission: Compressed and averaged hourly 29 kbyte per day i.e. 20 minutes

1000 BaseT Fx 500 VAC From ANTARES BJ

BJS

100 Base T 400 VDC

Beam pattern : Omni directional
Acoustic source level : **179** dB (1m)
Frequency : 9 – 13.5 kHz

acoustic modem

2350 m

Acoustic Data Transfer

Acoustic transponder (ANTARES acoustic field for positioning during sea operation)

MII

Buoy

Inductive Data Transfer

Inductive Data Transfer

Acoustic release transponder

Dead weight

Depth (meter)

500

1000

1500

2000

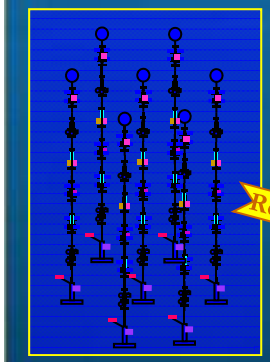
2500

BJ → 400 m BJS → 50 m Acoustic Modem → 2000 m Line

Detailed description of a storey on the Autonomous Line ALBATROSS

Where	Height above seabed	Device type	Manufacturer	Model	Measured parameters
Line	500	CTD	Seabird	SMP37P	Conductivity, temperature, pressure
		Oxygen optode	Aanderaa	4330	Dissolved oxygen concentration, temperature
		$IODA_{6000}$	CPPM/LMGEM	IODA V4	Dissolved Oxygen Dynamics
		Turbidity Sensor	Wet Lab	Wet Lab Eco	Scatering
		ADCP	Nortek	Aquadopp	sea current
					Images
		Inductive Modem	Seabird		(Data transmission)
		Acosutic modem	Not choosen		(Data transmission)
BJS	0	Camera	CPPM		Bioluminescent organisms
BSS	0	Acoustic Transponder	IXSEA	RT661B2T	acoustic positioning

Database and Web site project for interdisciplinary development



Antares

Real time

Antares Data Base

Local DB

Meta Data

Data

Data Quality

Dedicated Web Server

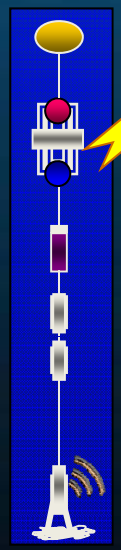
To other Data Base

Internet

Real time

Administration interface

Public Pages



Other Instrumented line as AAMIS ALBATROSS

Secure and user friendly interface.
Data analyse and work space.
(Analyse tools, elog book, etc…)

- Meta Data
- Data Quality
- Site Administration
- …

ALBATROSS
Timing

Thank you

May the force be with you !

- This work is supported by
- ANR POTES, INSU-PACA-APO,
- ANTARES,
- EUROSITES FP7, ESONET NoE,
- HYDROCHANGE CIESM,
- INSU IN2P3 CNRS
- Université de la Méditerrannée

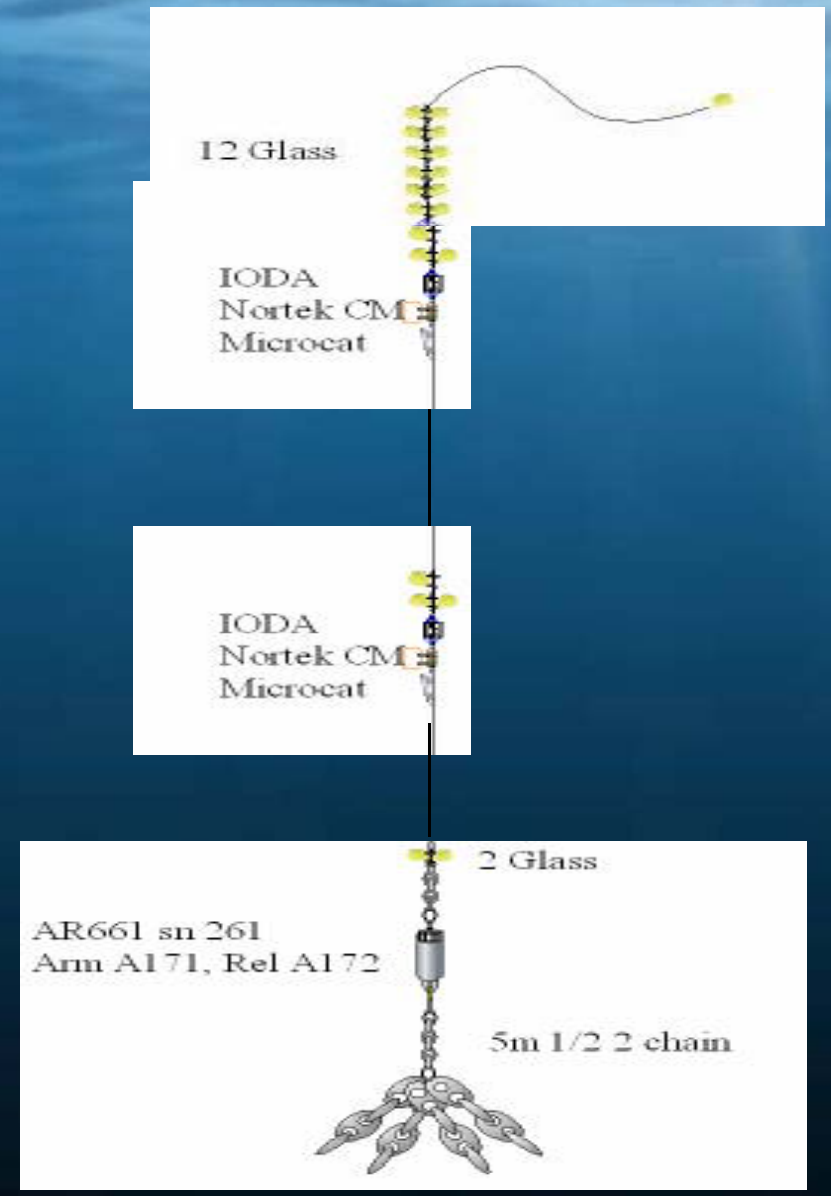
MOORING KEOPS “STATION PLATEAU”

Depth 600 m

Mixed Layer

200 m

600 m

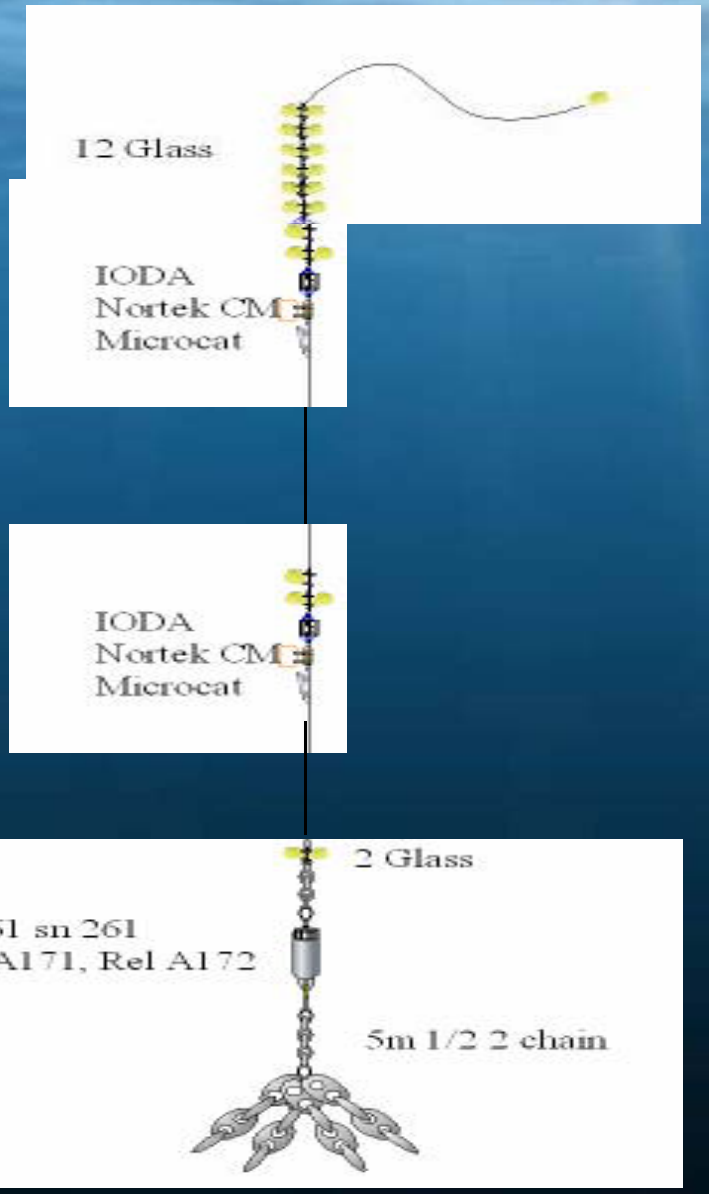


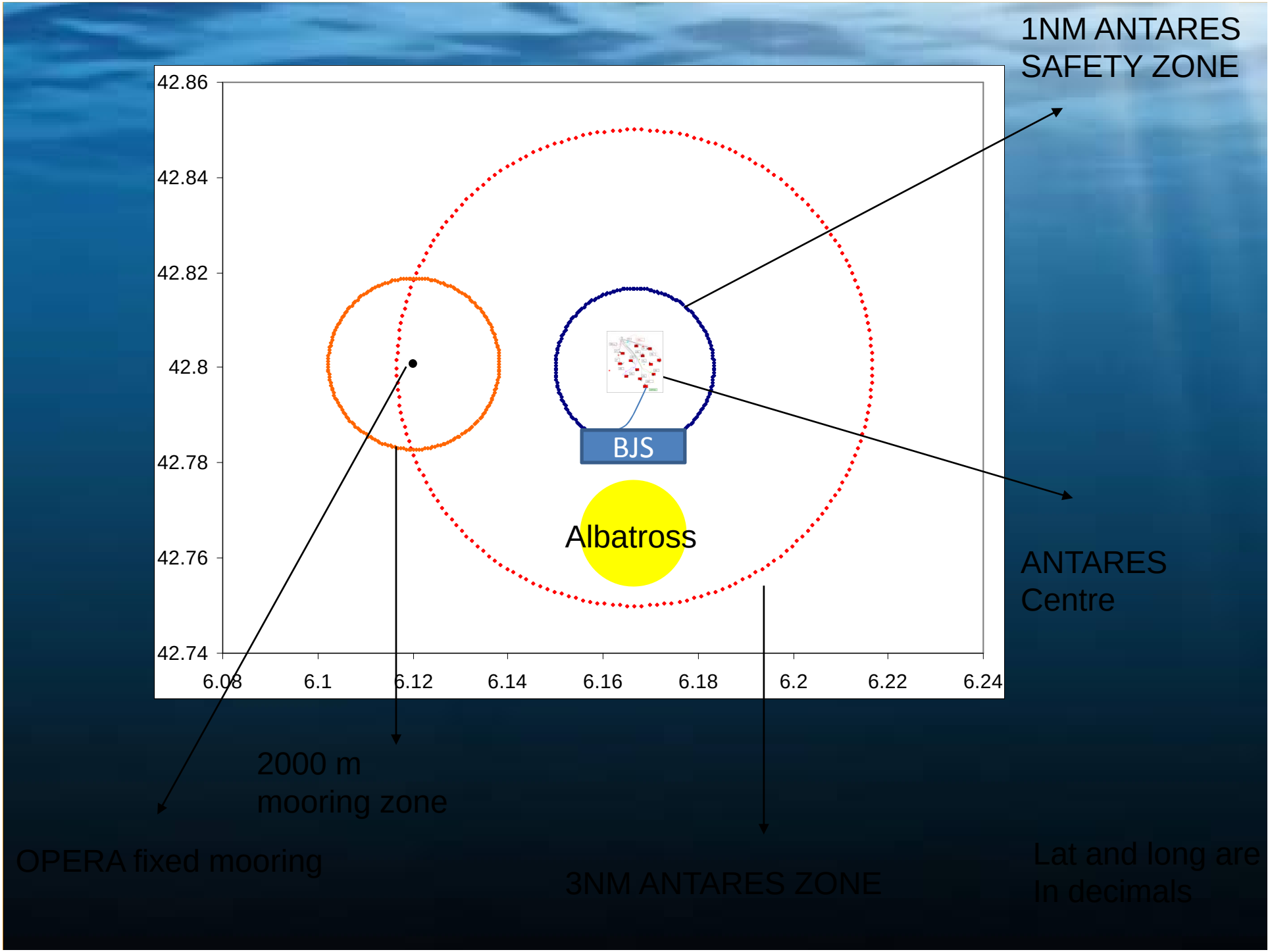
MOORING KEOPS STATION “OPEN OCEAN”
Depth 3500 m

Mixed Layer

200 m

3500 m




1NM ANTARES
SAFETY ZONE
42.86
42.84
42.82
42.8
42.78
42.76
42.74
6.08
6.1
6.12
6.14
6.16
6.18
6.2
6.22
6.24
BJS
Albatross
ANTARES
Centre
2000 m
mooring zone
OPERA fixed mooring
3NM ANTARES ZONE
Lat and long are
In decimals

LMGEM
CPPM
DT INSU
INFN
INVG
IFREMER