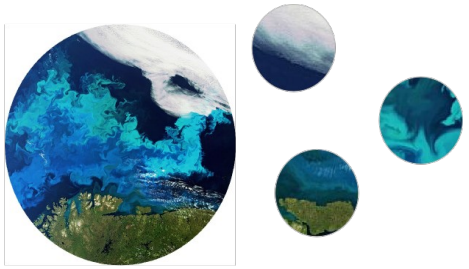


48th International Liège Colloquium on Ocean Dynamics
Submesoscale Processes:
Mechanisms, Implications and new Frontiers
23-27 Mai 2016

Mapping the planktonic community across submesoscale physical features: the 2015 OSCAHR cruise in the NW Mediterranean

A.M.Doglioli, G.Grégori, M.Thyssen, T. Wagener, P.Marrec,
G.Rougier, N.Bhairy, J.Fenouil, A.deVerneil, L.Rousselet, F.Cyr, A.A.Petrenko,
J.-M.André, F.d'Ovidio, A.Pietri, F.Nencioli, L.Jullion,
C.Pinazo, C.Yohia and P.Marsalaix

Mediterranean Institute of Oceanography

LOCEAN

LA

Institut PYTHEAS
Observatoire des Sciences de l'Univers
Aix+Marseille Université

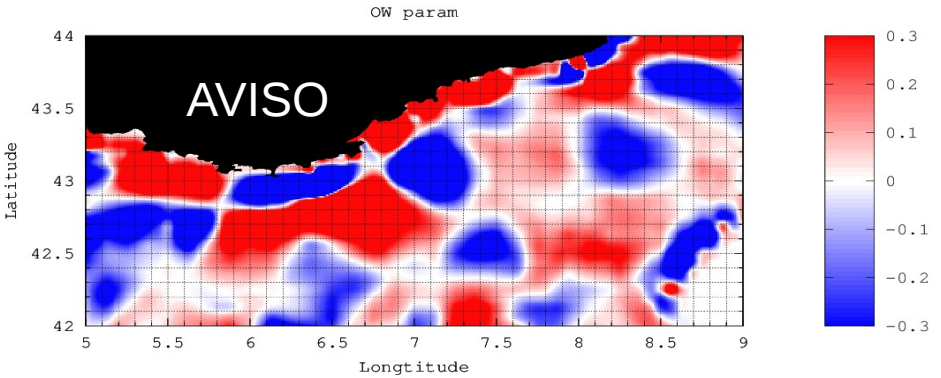
Genavir

PML Plymouth Marine Laboratory

Background

From numerical studies (e.g. Lévy et al.,15) :
a key rôle of the submesoscale in ocean dynamics and physical-biogeochemical coupling

In situ measuring is challenging :
- ephemeral character,
- high frequency biological measurements



OSCAHR

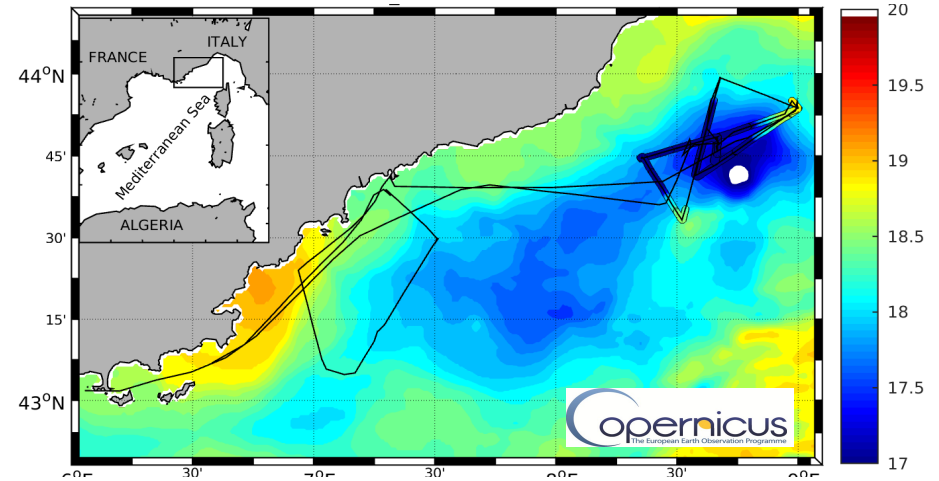
***O**bserving **S**ubmesoscale **C**oupling **A**t **H**igh **R**esolution*

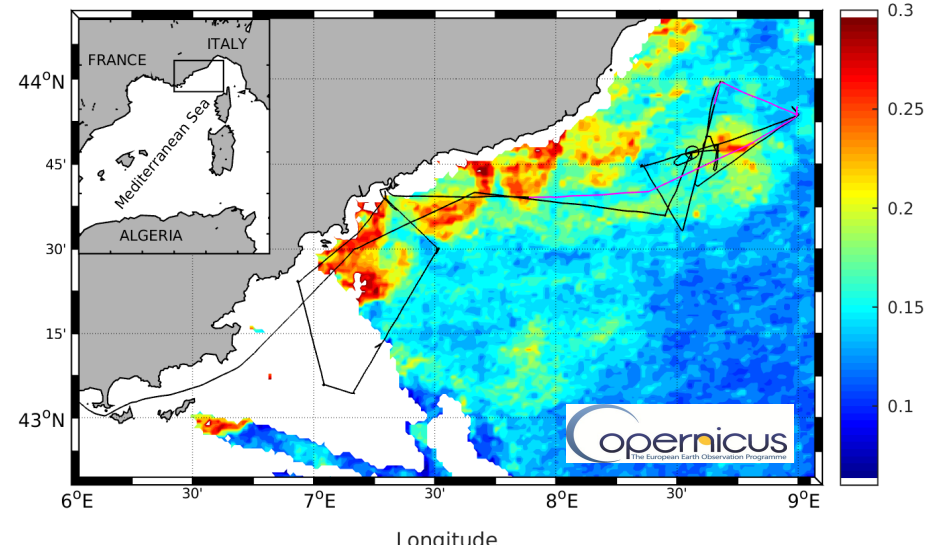
Goals :

1) methodological development and validation of remote sensing measurements (altimetry, sst, ocean color, reconstitution of planktonic assemblages)

2) In situ confirmation of the structuring effect of submesoscale on the first trophic levels and the associated biogenic elements

Cruise :
29 October to 6 November 2015





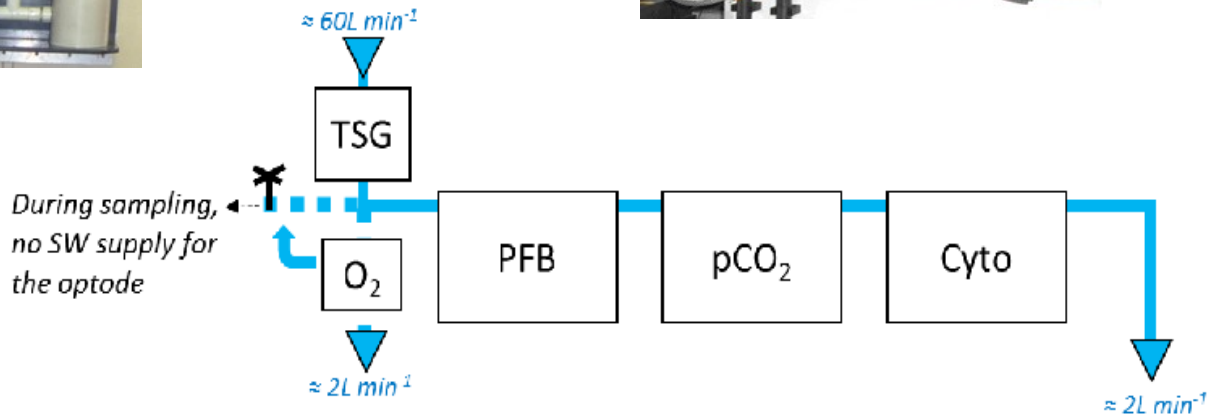
Materials and Methods

Surface Horizontal Mapping

TSG
ThermoSalinoGraph

Fluorimeter

Onboard surface water intake



Thermosalinograph

Fluorimeter

Automated flow cytometer Cytosense

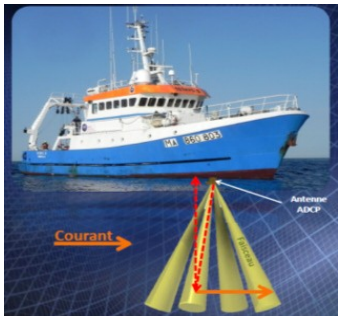
high-throughput sampling
(20' → 3.7 to 2.4 km)

Materials and Methods

Horizontal & Vertical Mapping

Hull-mounted ADCP

150 Khz (vertical resolution 8 m)



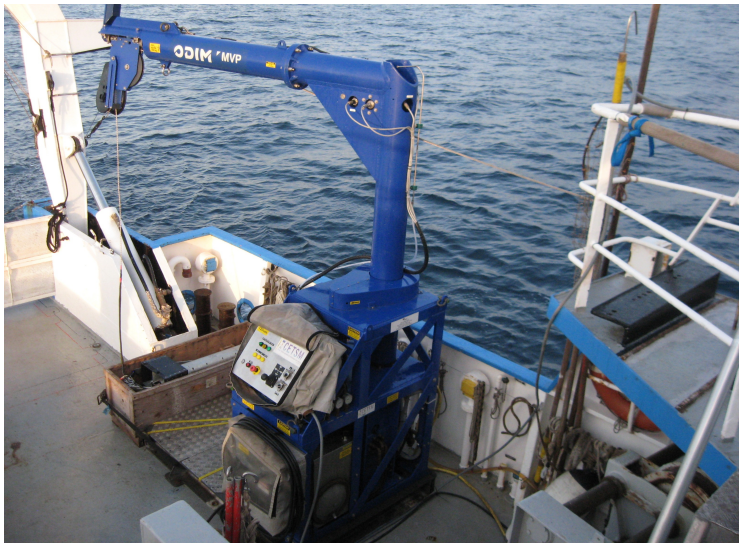
MVP
Moving **V**essel **P**rofiler

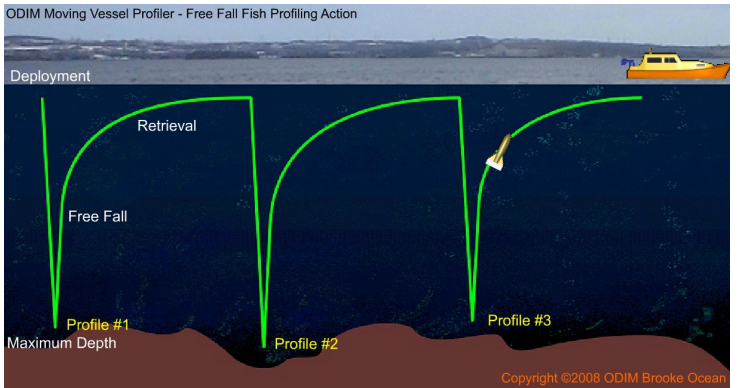
Multi-Sensor Free-Fall Fish:

CTD, fluorescence and LOPC

Laser Optical Particle Counter

~2 km horizontal resolution
~1 m vertical resolution

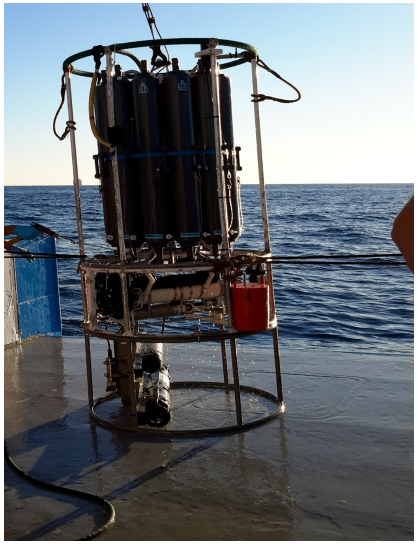




Materials and Methods

High resolution vertical sampling

CTD carousel



12 niskin bottles

ECOVSF3
Three-angle, Three-wavelength
Volume Scattering Function Meter

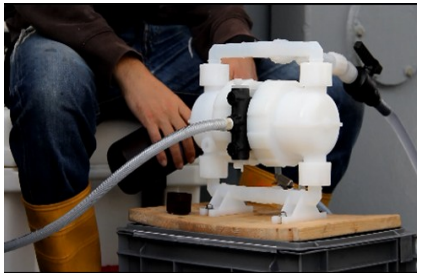
CTD SBE32

LOPC and LISST
Laser Optical Particle Counter

Laser In situ scatterometer and transmissiometer

PASTIS

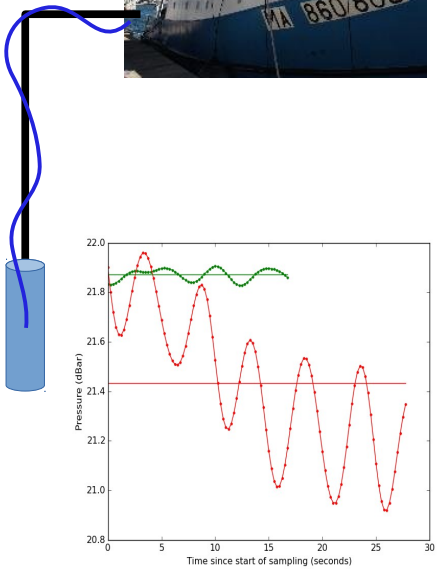
Pumping **A**dvanced **S**ystem **T**o **I**nvestigate **S**eawater

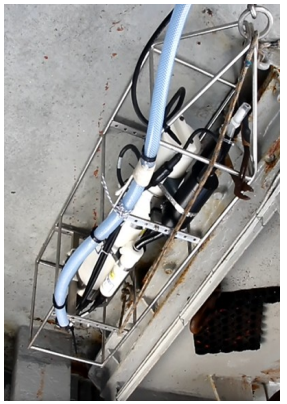


- bellows pump
- 30m PE tube
- CTD SBE19+

Discrete Sampling

vertical precision 0.1 to 1 m





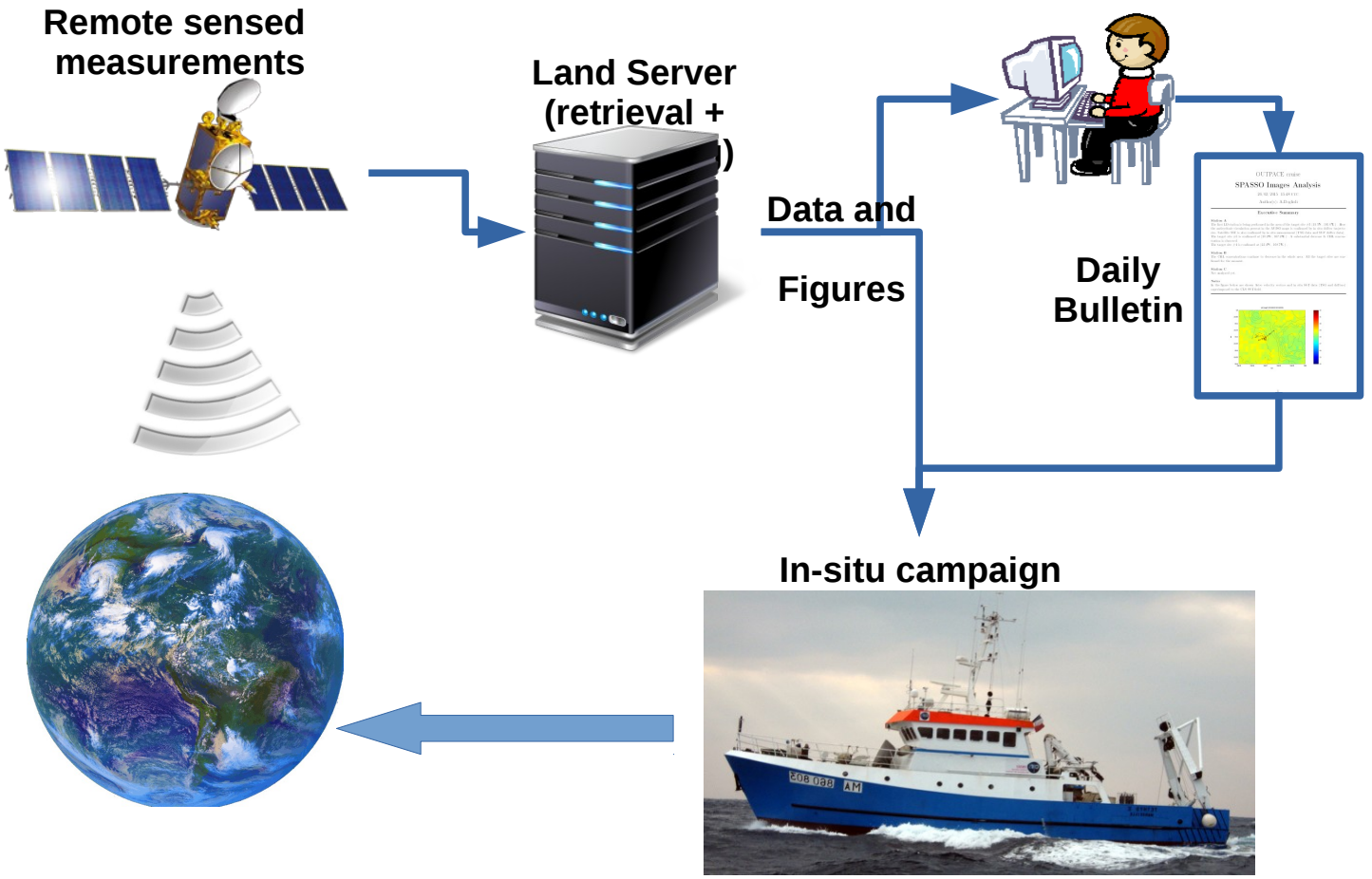
Post-Cruise
Lab Analysis:
Nutrients and Cytometer FACScalibur

Materials and Methods

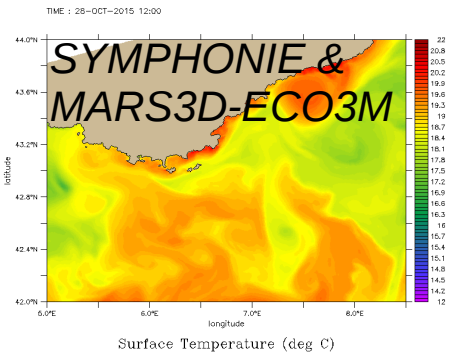
Adaptive Lagrangian sampling strategy

(Target the structures ….)

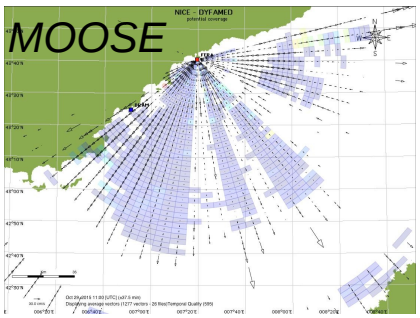
SPASSO
Software Package for Adaptive Sampling Strategy for Ocean campaigns
[d'Ovidio 2010, Nencioli et al 2011]



\+
Numerical Modeling Forecast



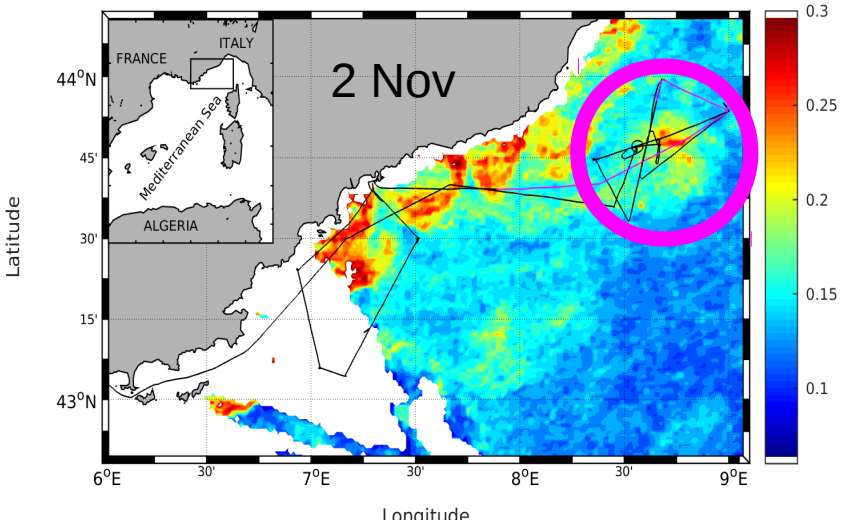
\+
HF radar

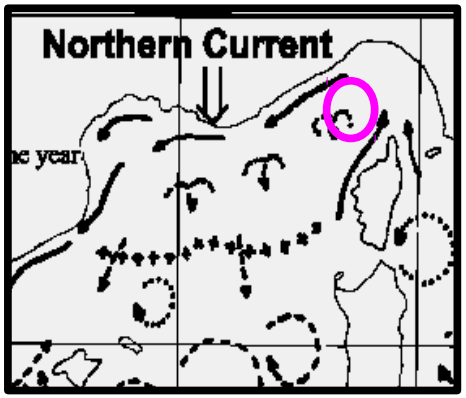


Materials and Methods

Adaptive Lagrangian sampling strategy

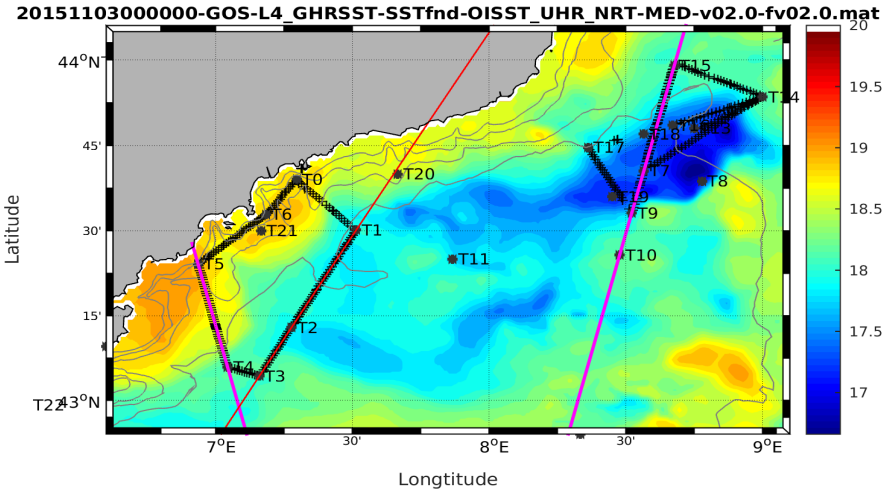
(Target the structures and follow them!)



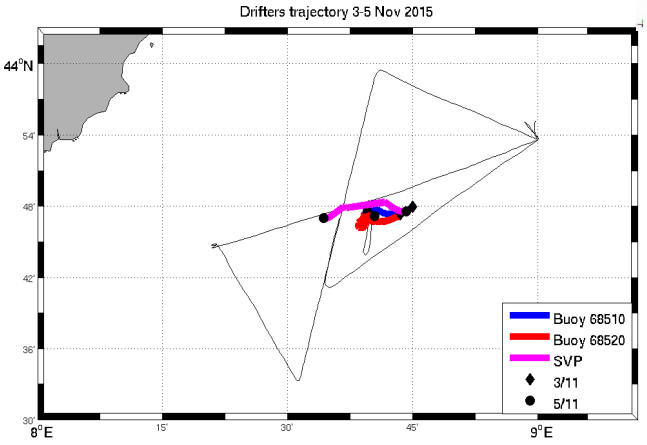


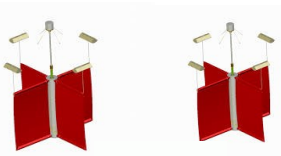
Millot 1998

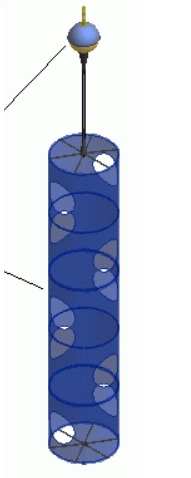
Satellite tracks
SaralAltiKa & Jason2



Lagrangian drifters
2 code and 1 SVP

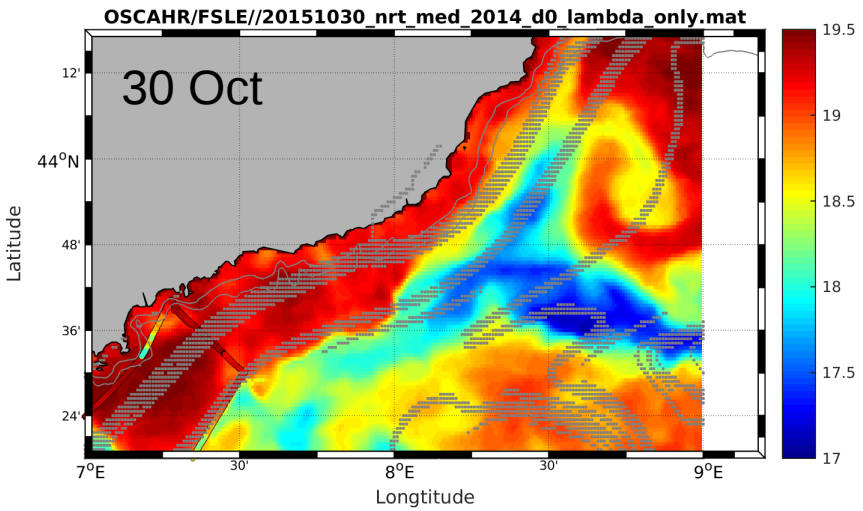




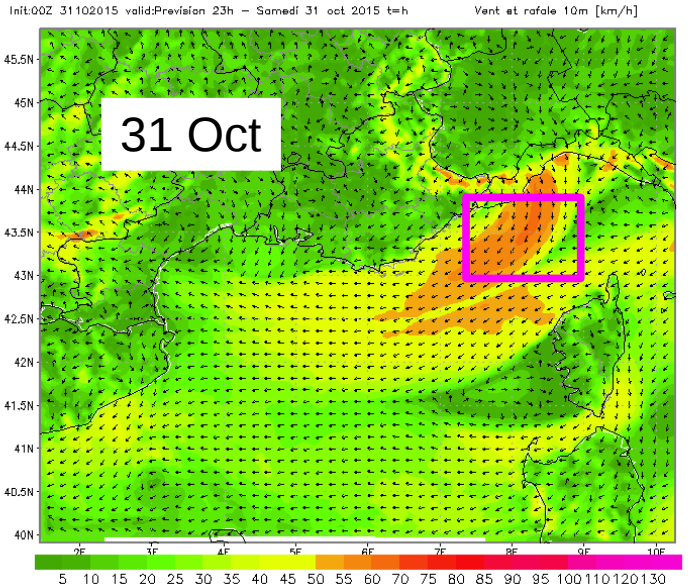


Results

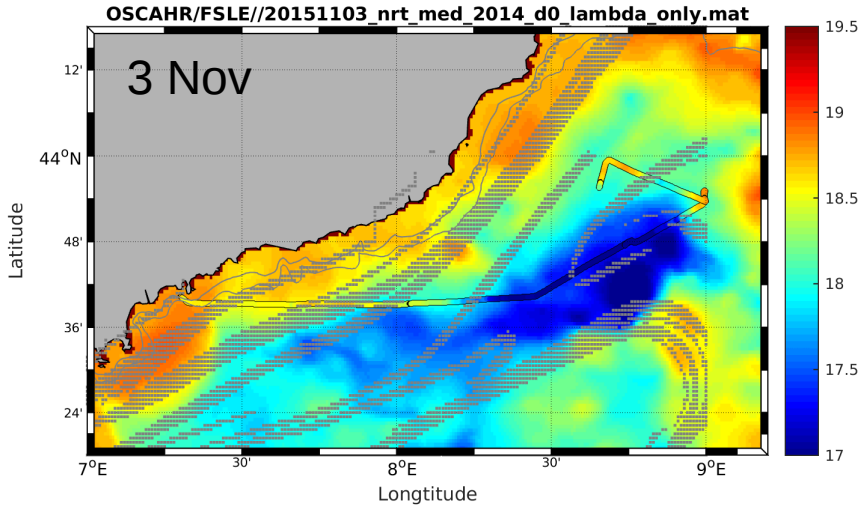
FSLE + SST + SST_tsg

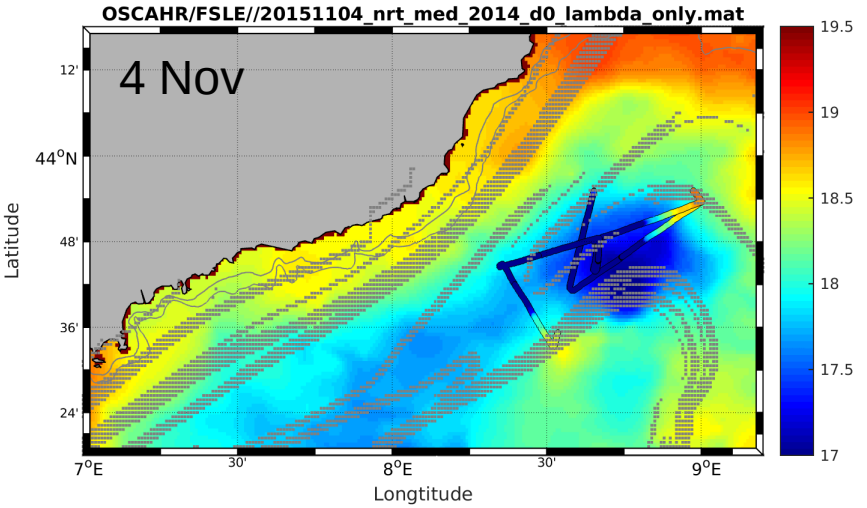


Strong NE Wind



General cooling + structure intensification

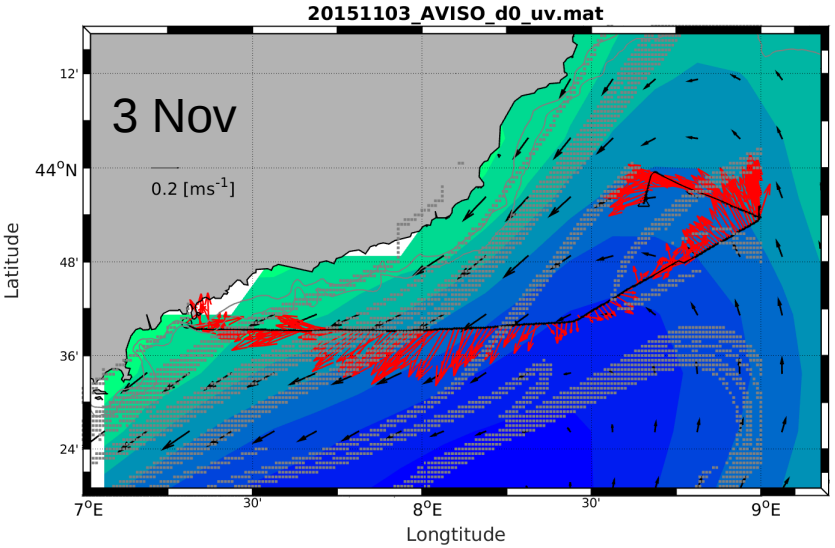


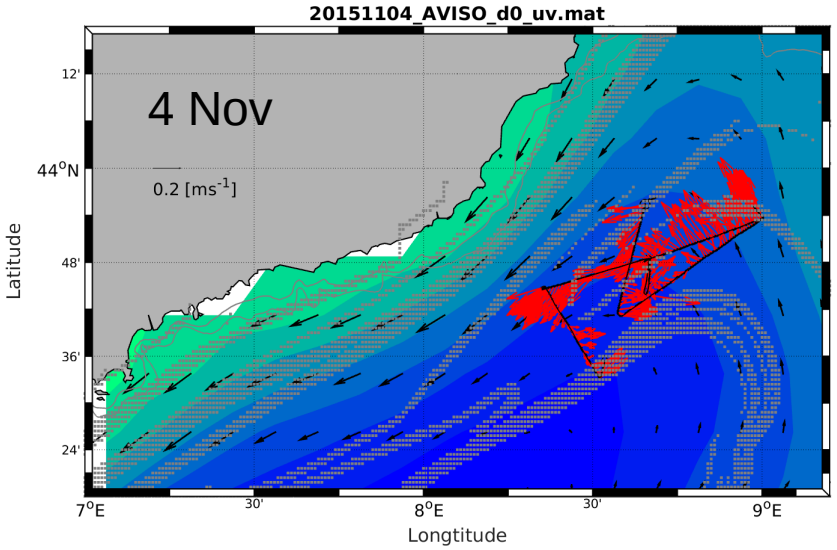


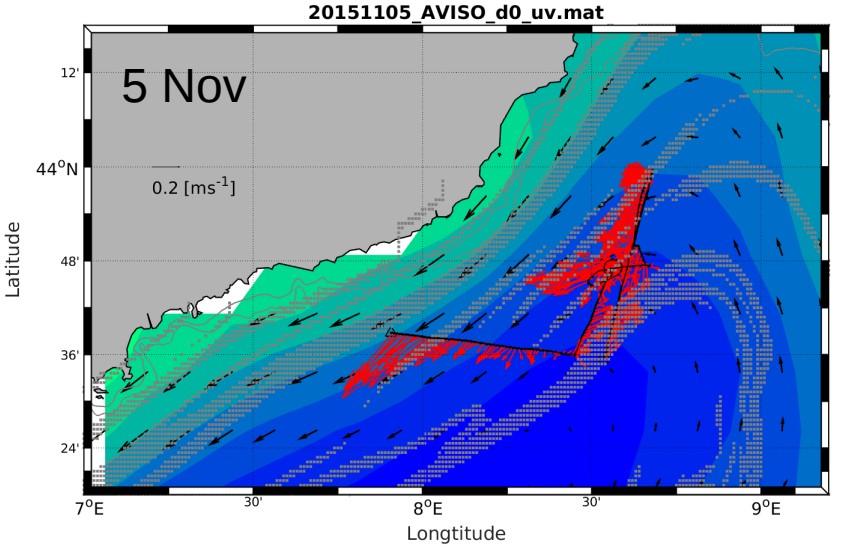
Results

FSLE
+
SLA and AVISO current
+
ADCP (-27 m depth)

Cyclonic circulation

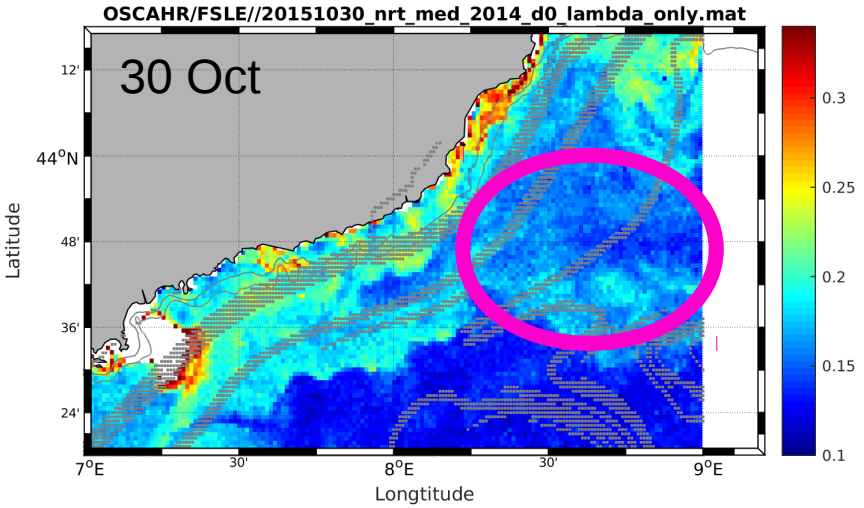


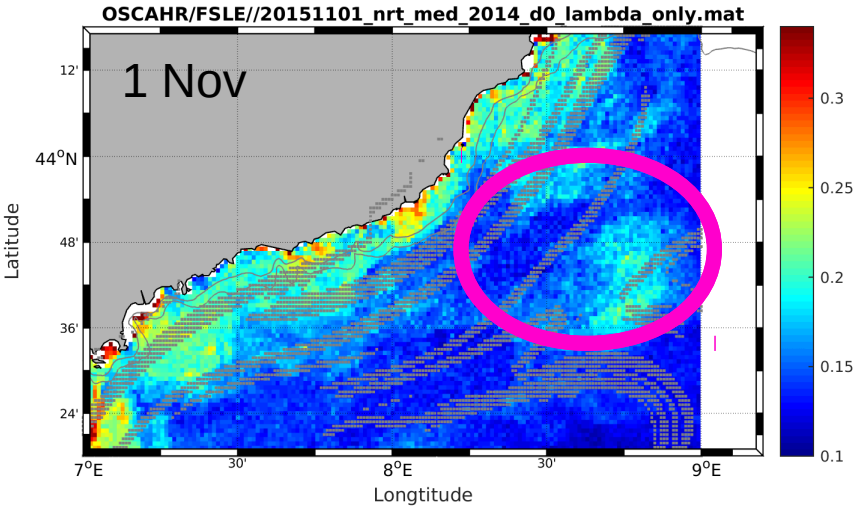


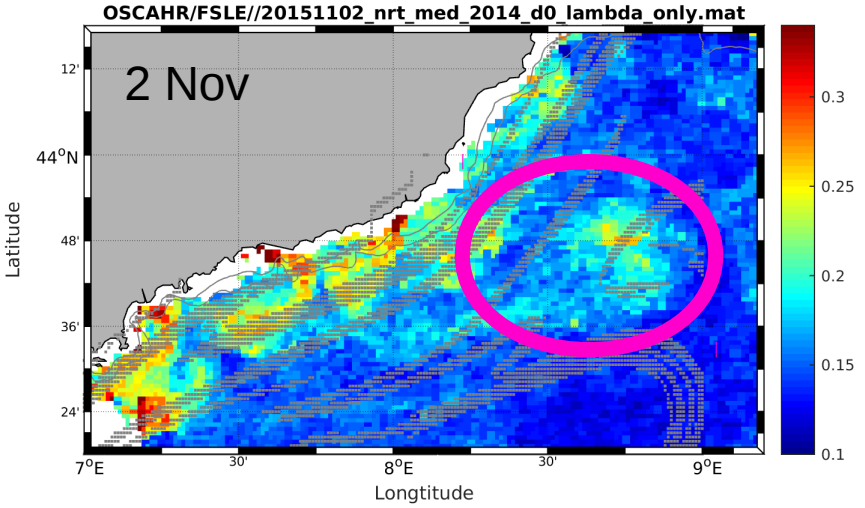


Results

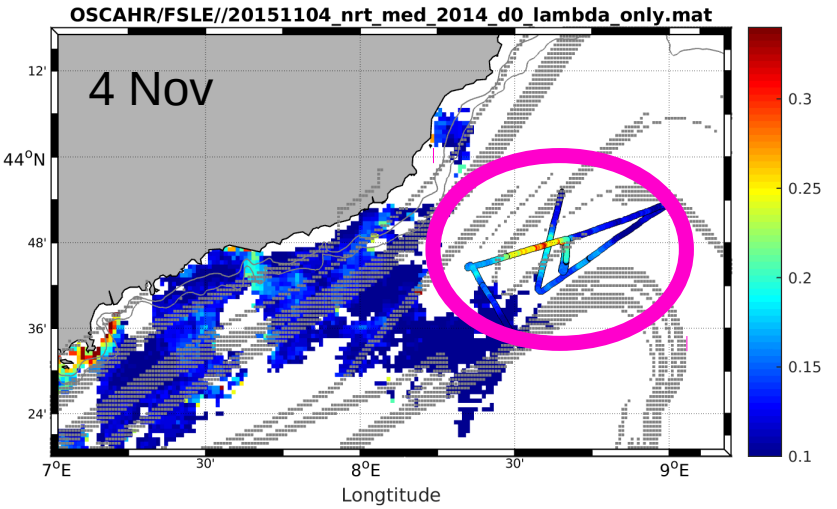
FSLE + CHL







+ CHLtsg

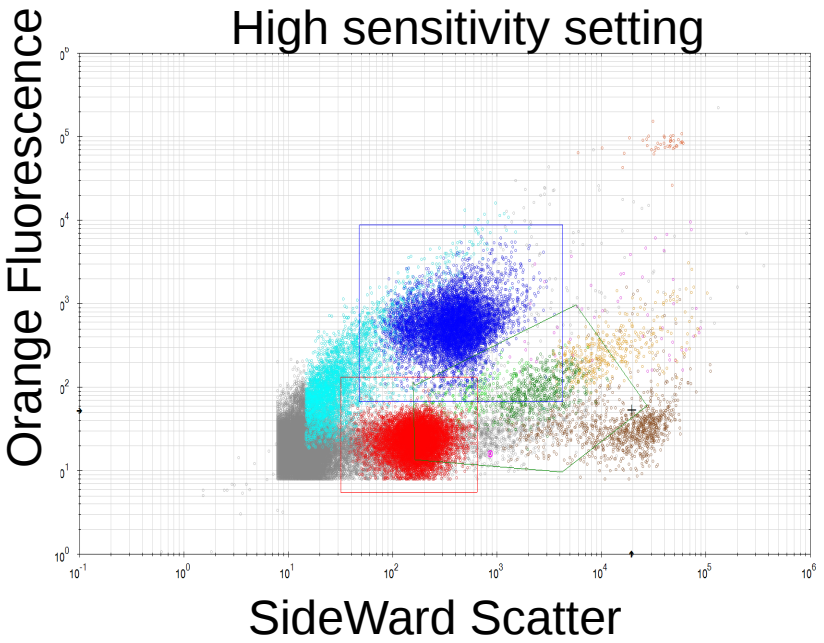


Results

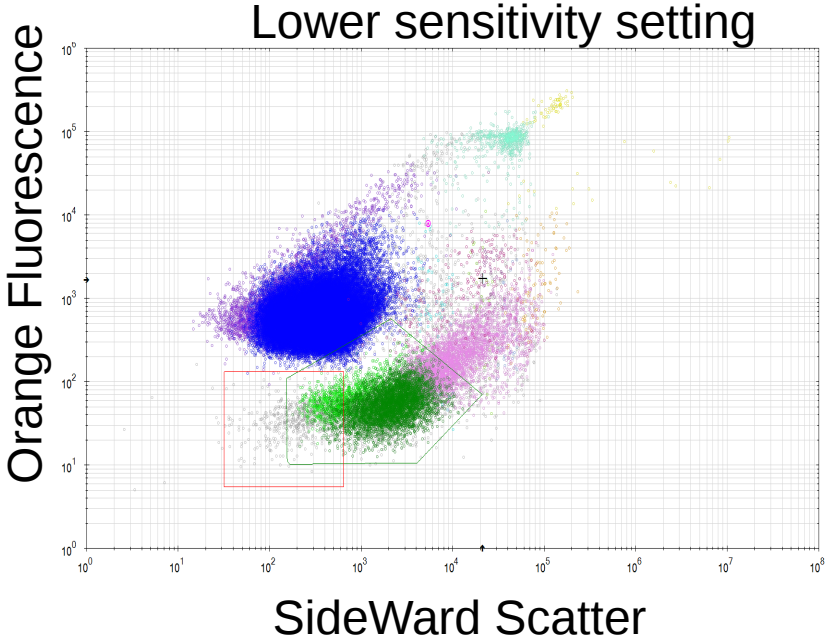
Phytoplankton assemblages

Single cell approach – sensitivity tests

High sensitivity setting



Lower sensitivity setting



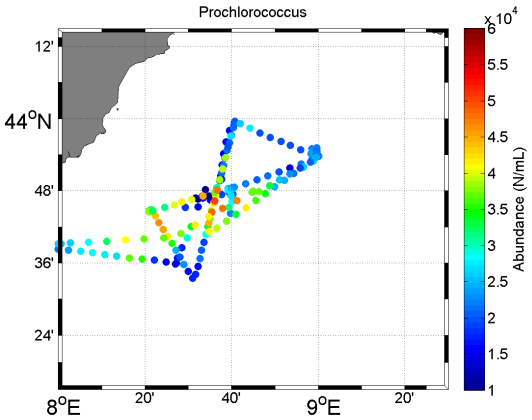
9 functional groups identified:

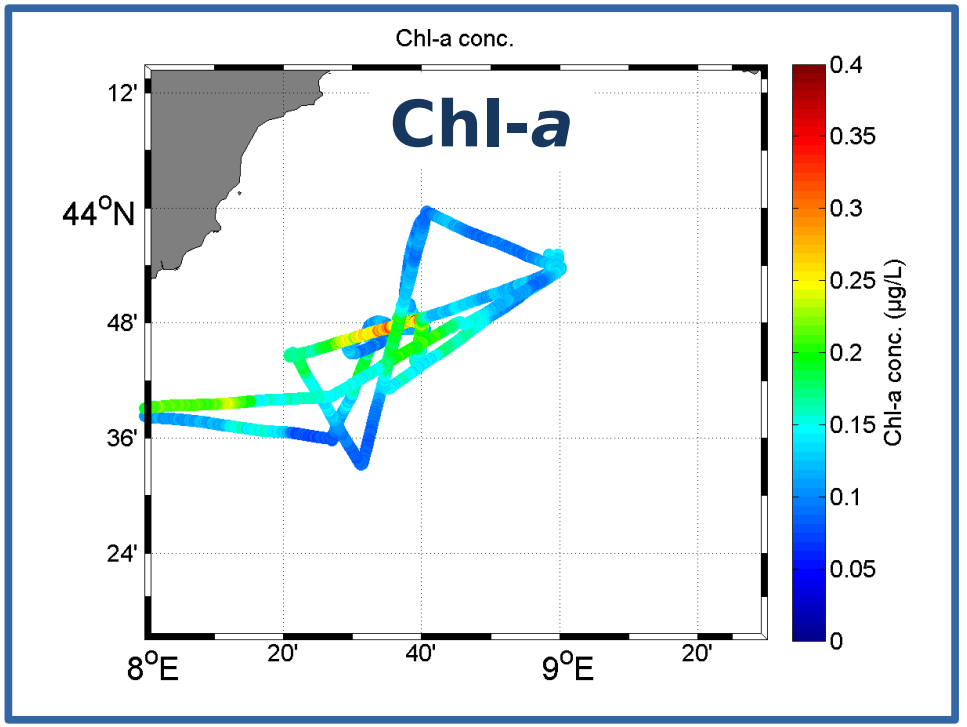
Prochlorococcus
Synechococcus
Picoplancton & Picoplancton High FLR
Cryptophytes
Nanoplancton 1 & Nanoplancton 2
Microplancton & Microplancton High FLO

Results

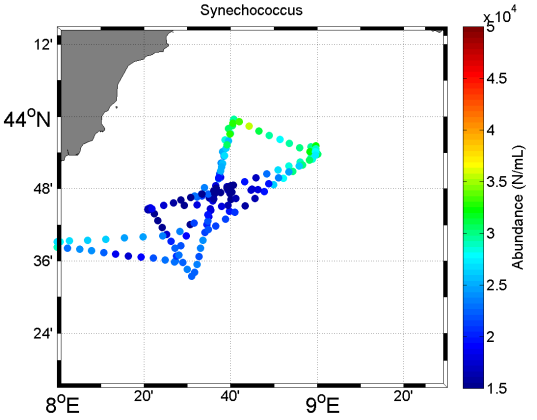
Decomposition of the fluorescence measurements at the surface

Prochlorococcus

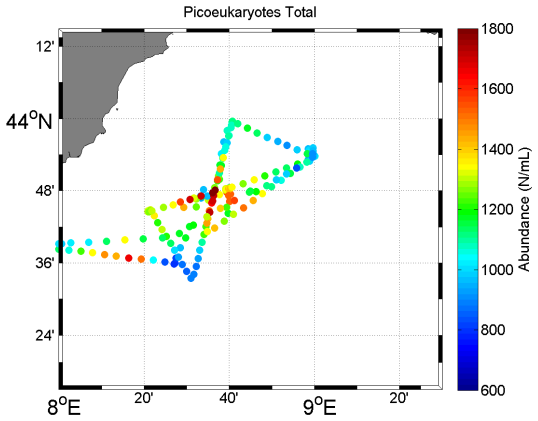




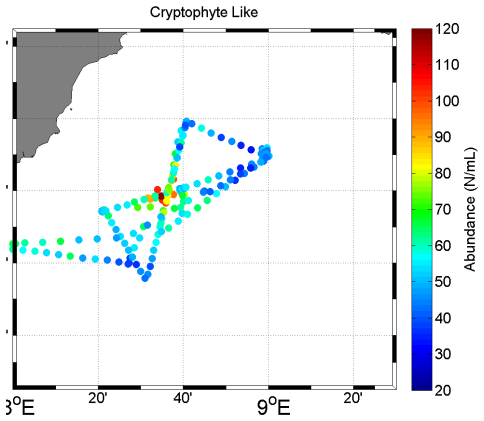
Synechococcus



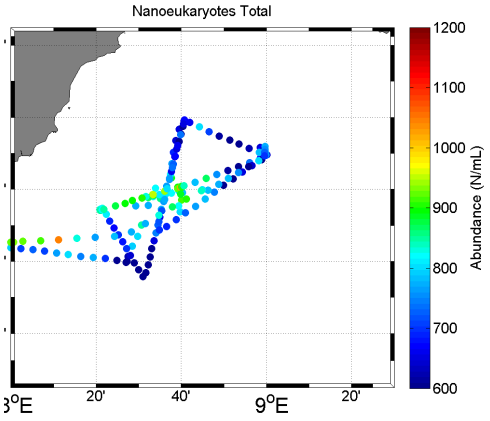
Pico-



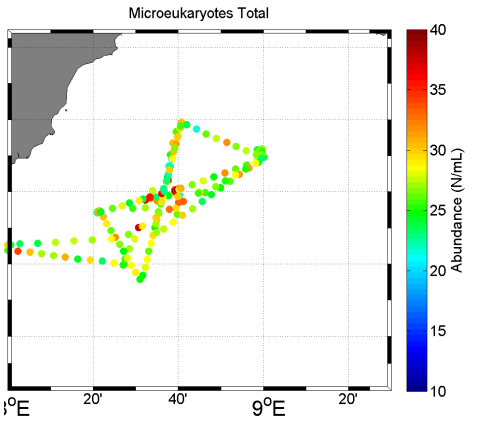
Cryptophytes



Nano-

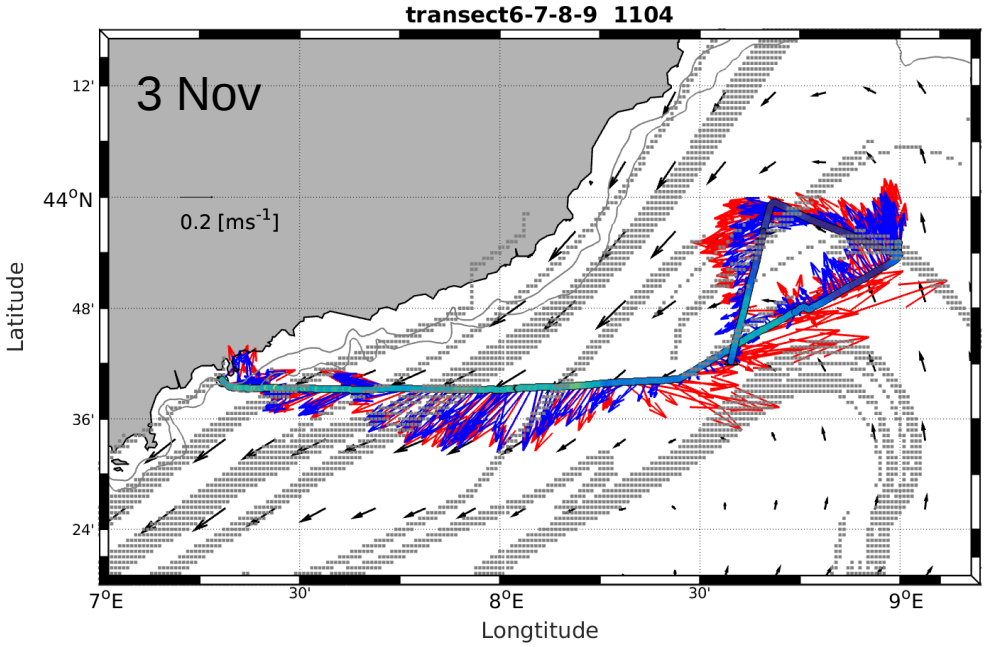


Micro-

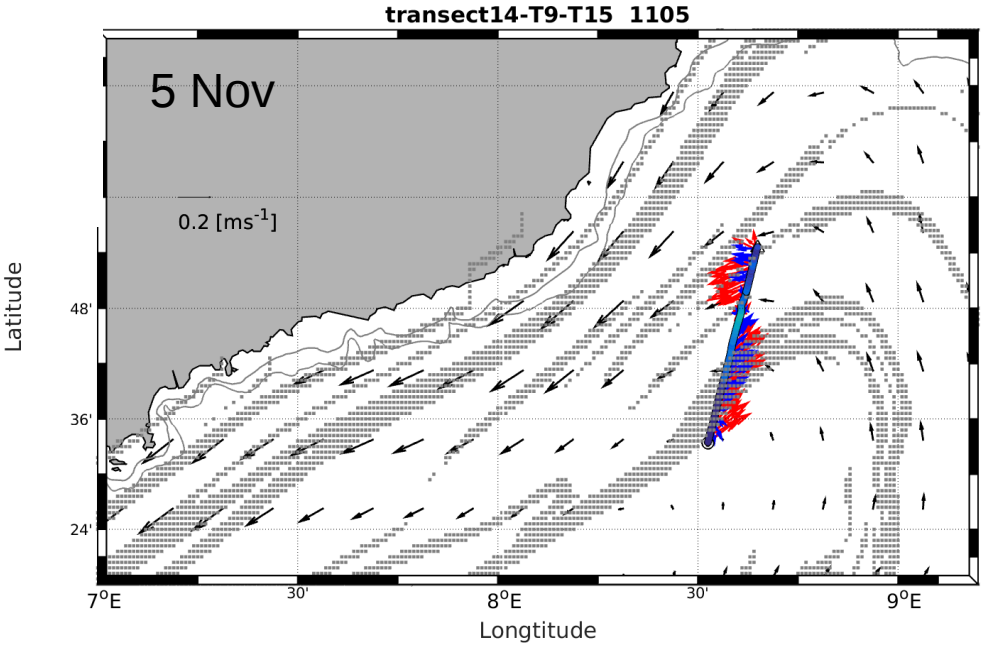


Results

Vertical shear of the currents

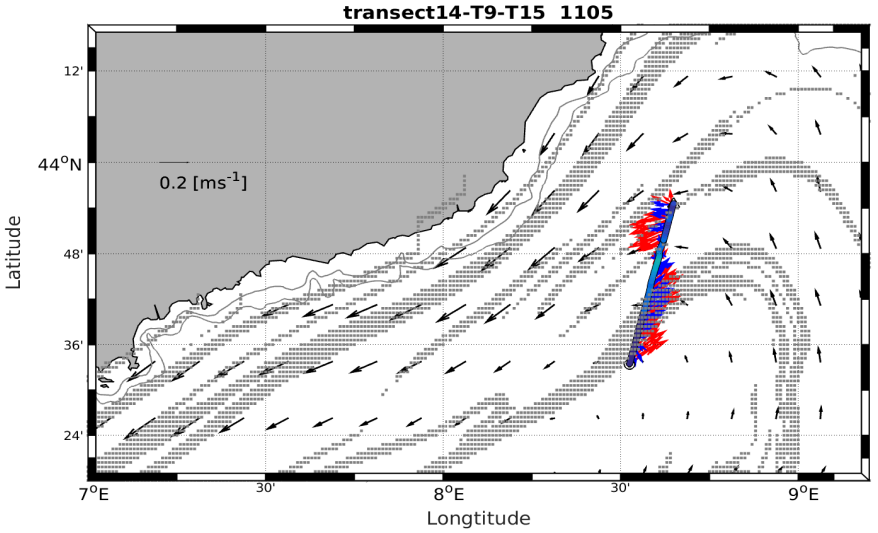


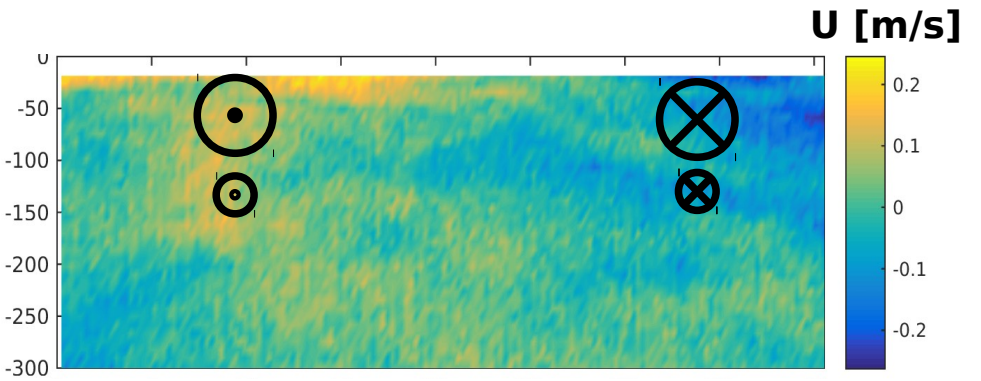
ADCP
-19 m depth (red)
-35 m depth (blue)

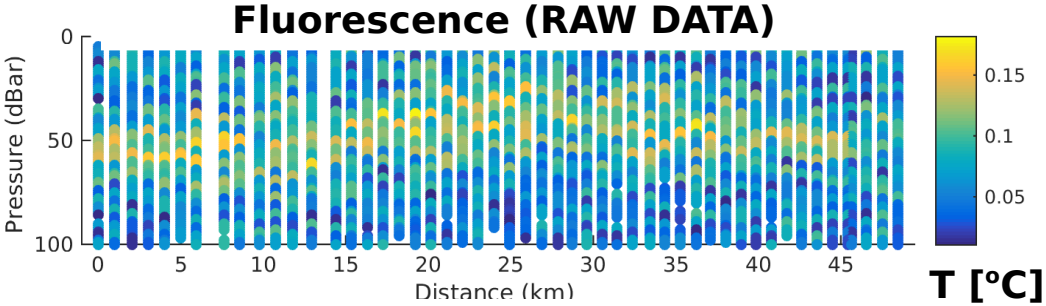


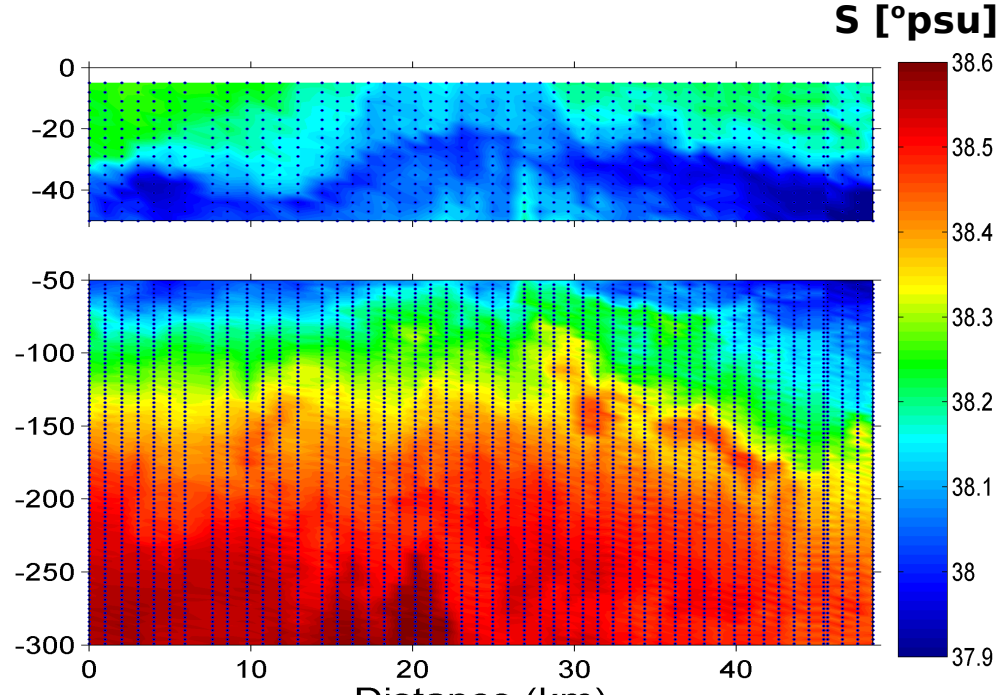
Results

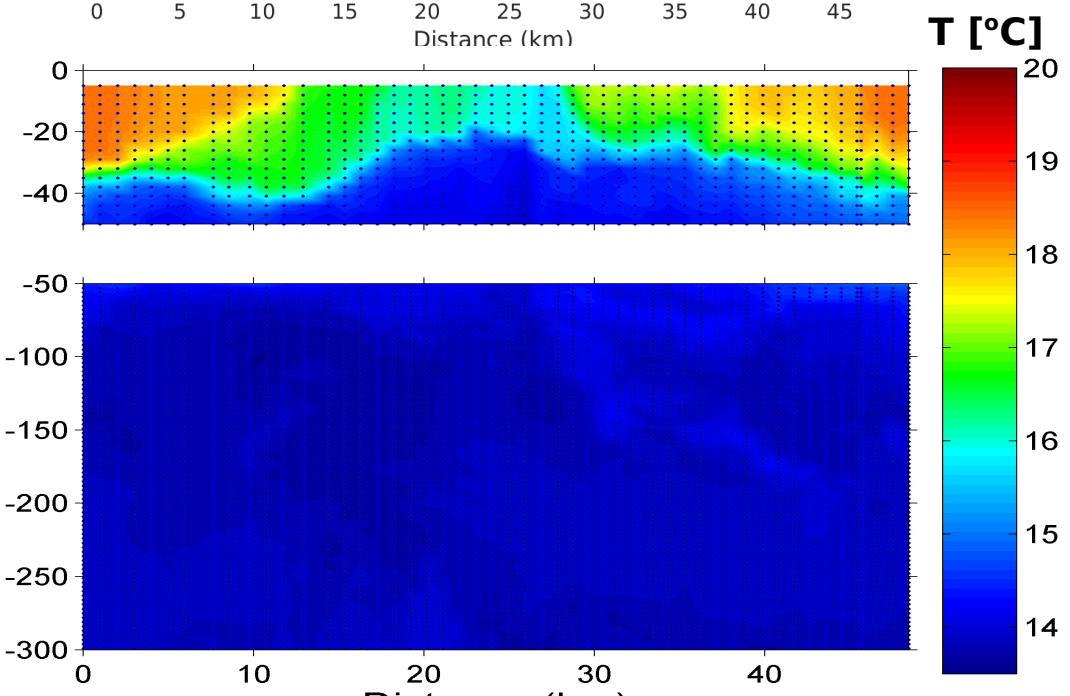
ADCP & MVP Vertical sections





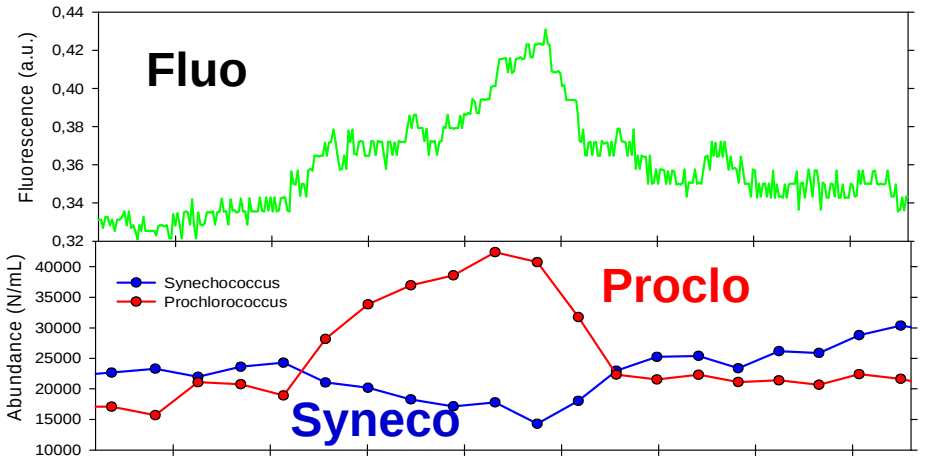


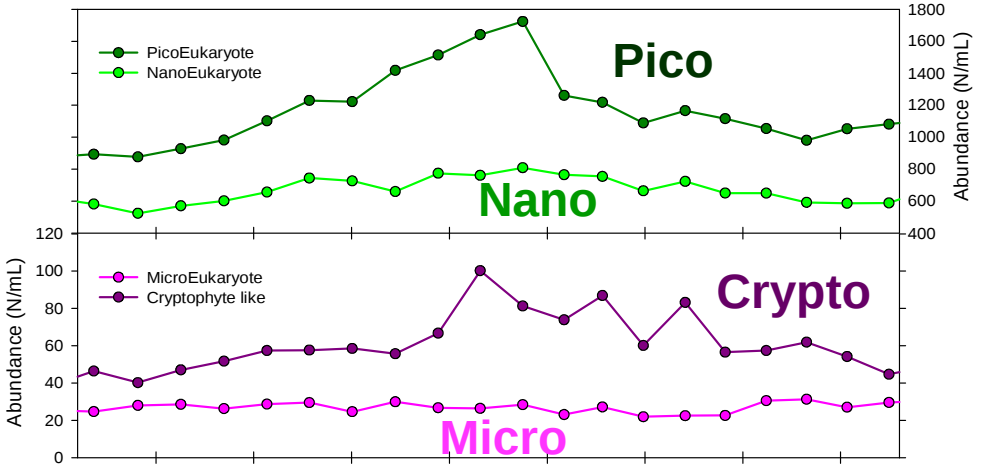


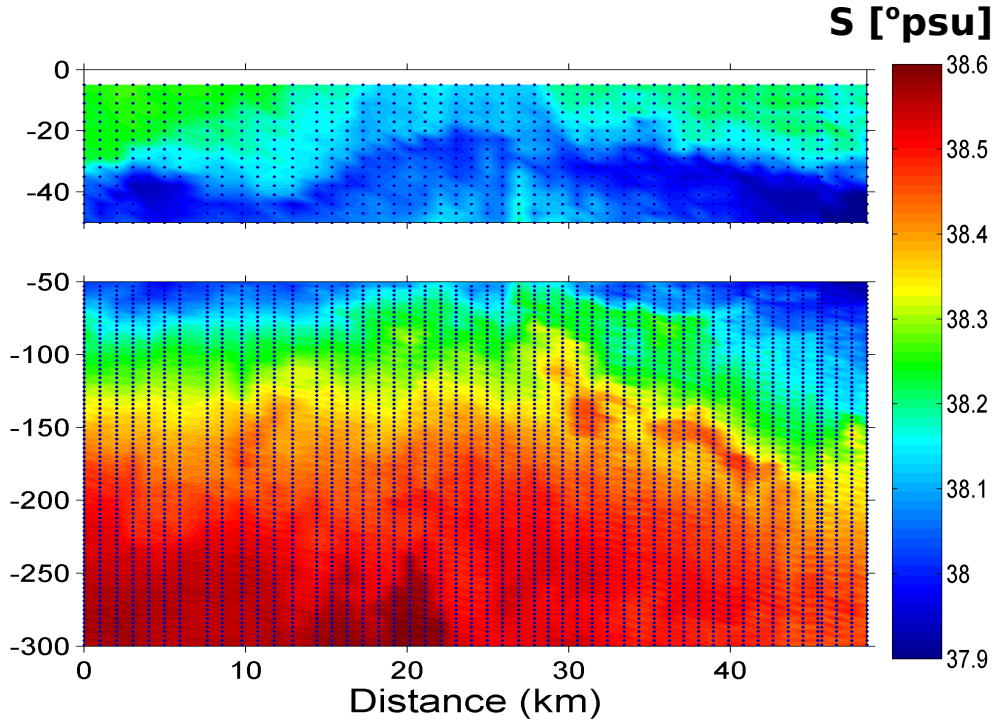


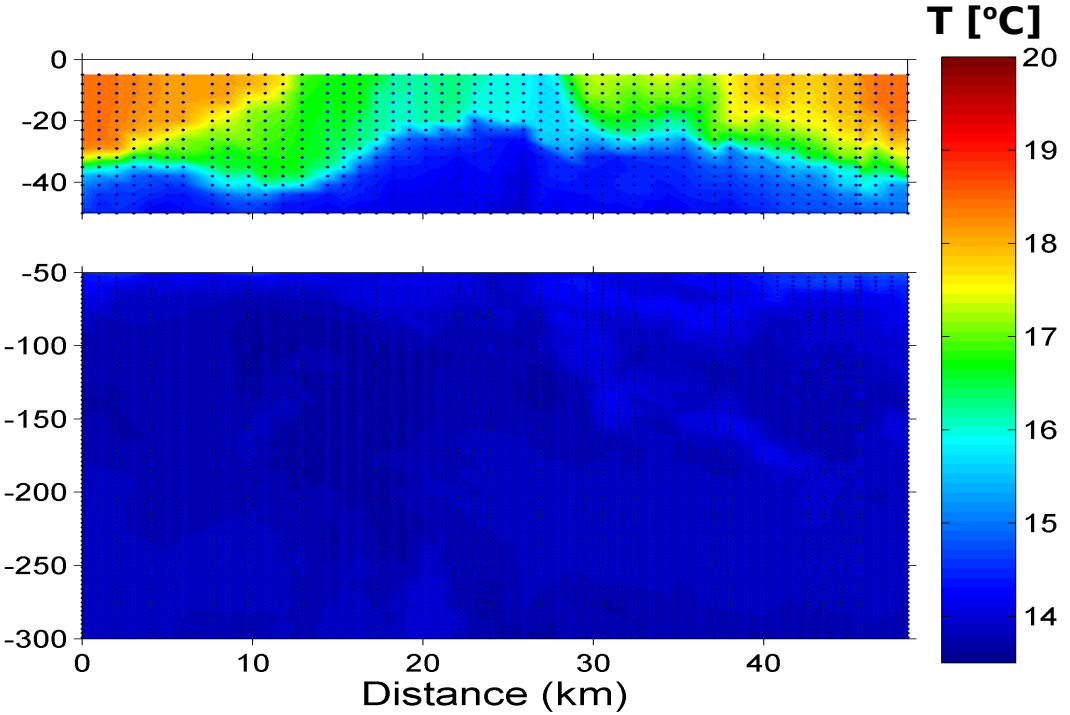
Results

MVP vertical section and phytoplankton assemblages



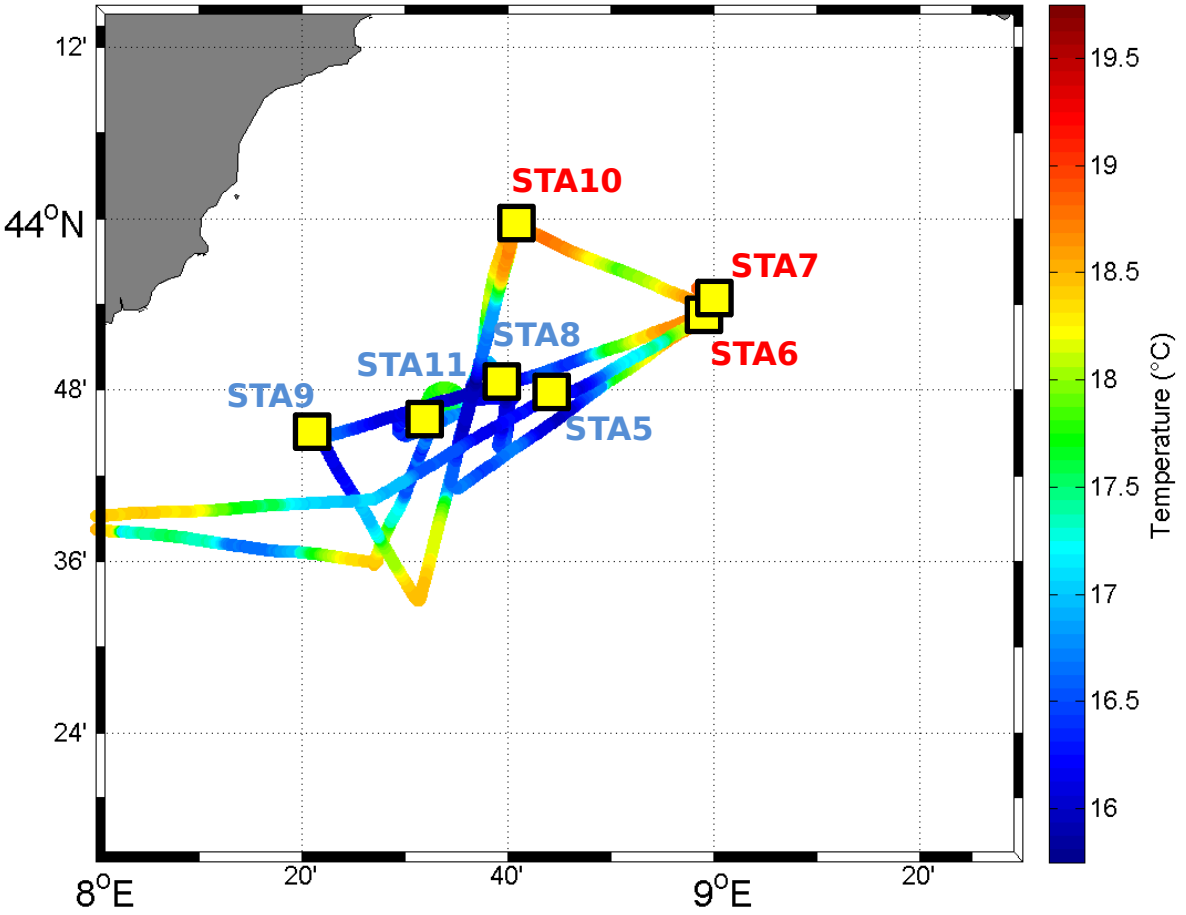






Results

PASTIS measurements
at 7 stations

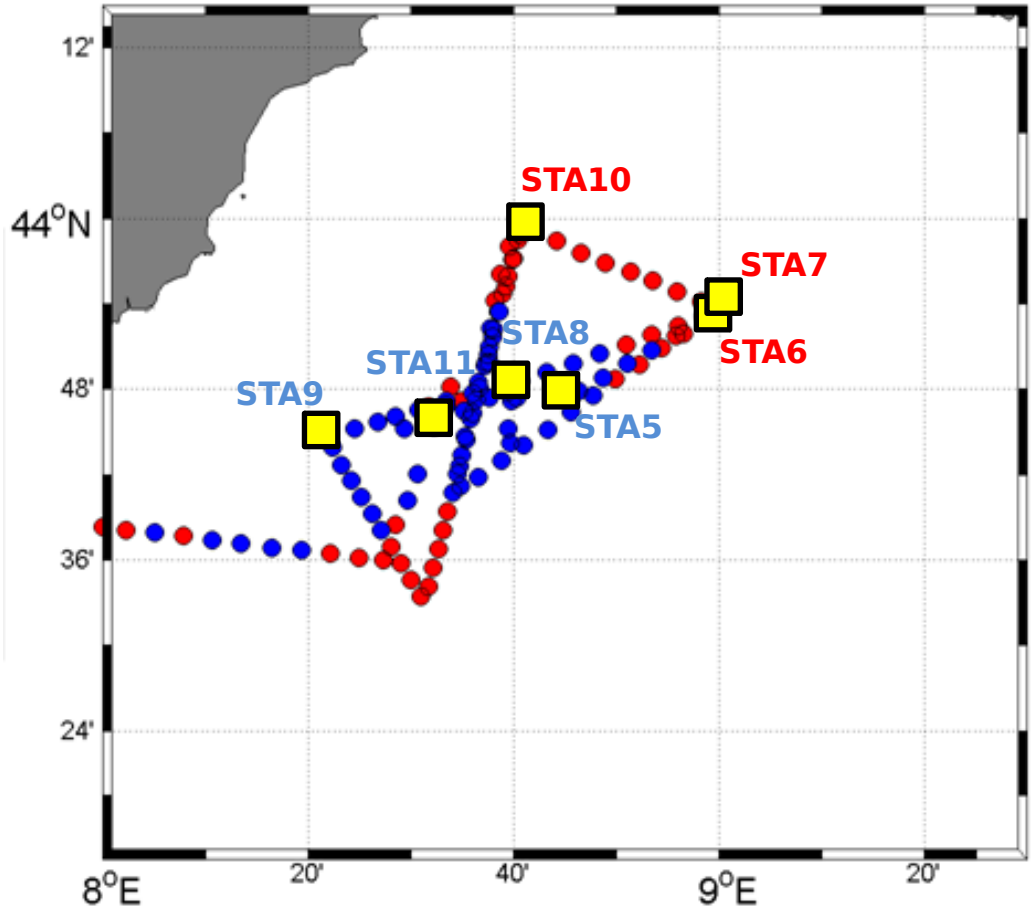


Results

PASTIS measurements
at 7 stations

Warm Stations
SST > 17,5°C
"Boundaries"

Cold Stations
SST < 17,5°C
"Core"

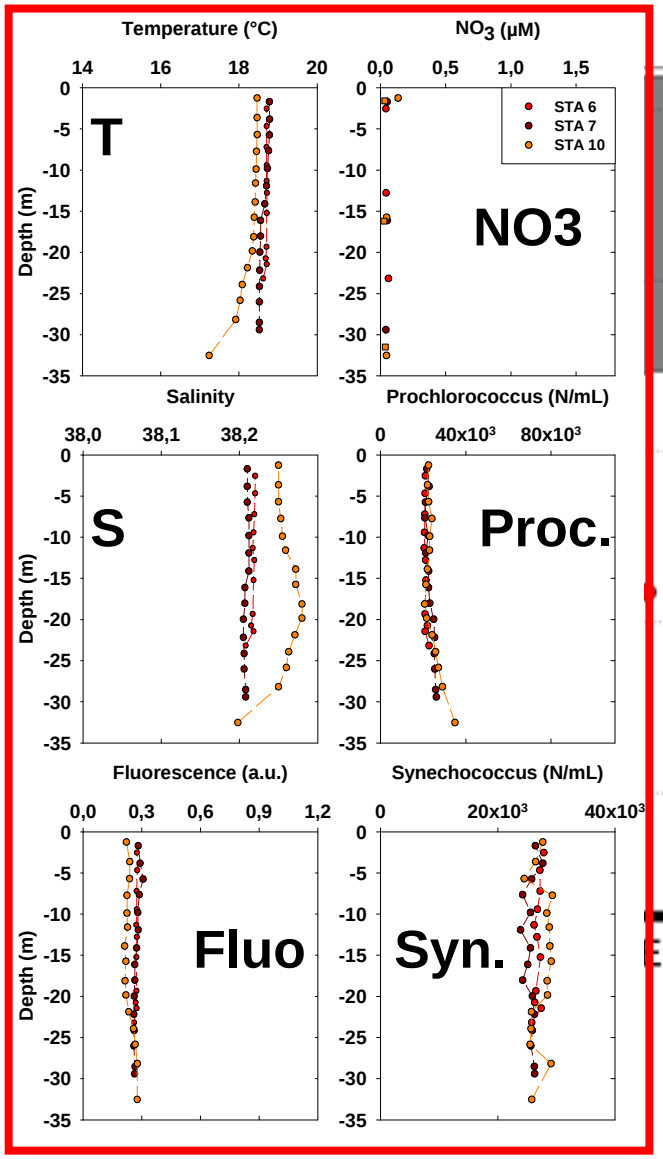


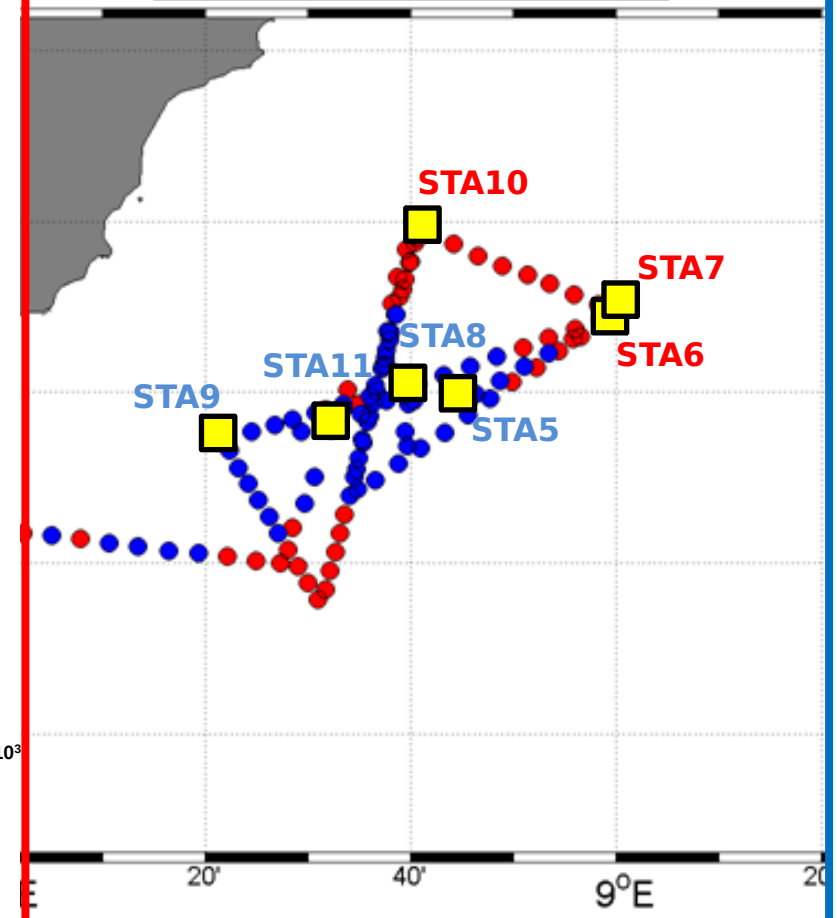
Results

PASTIS measurements
at 7 stations

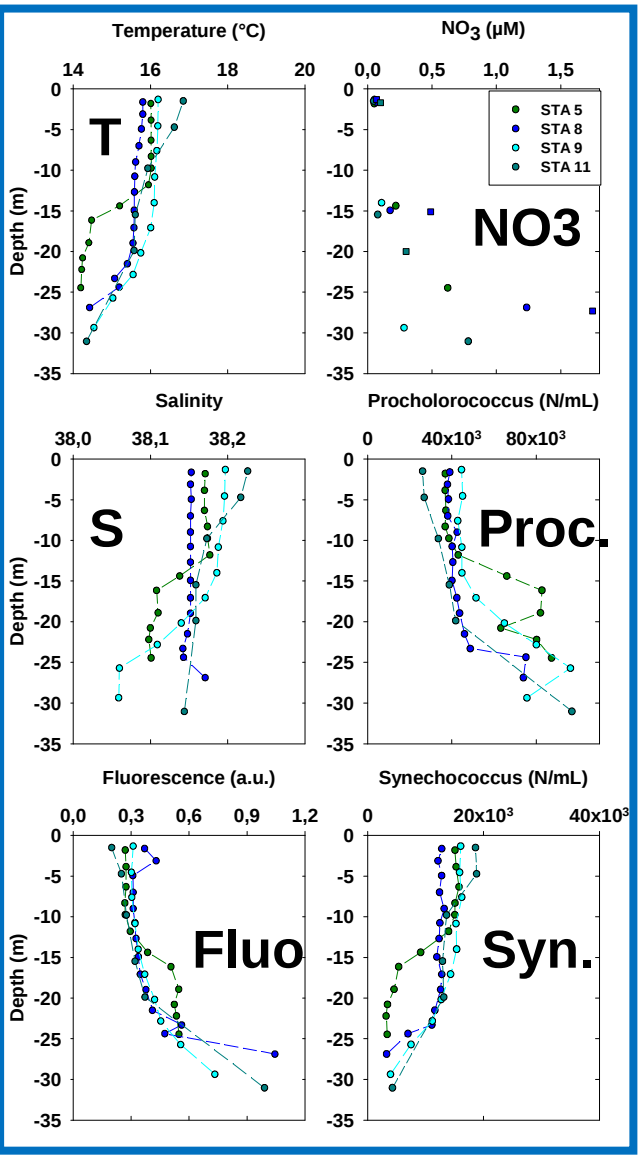
Vertical Profiles
0 - 30 m

Warm Stations
SST > 17,5°C
"Boundaries"

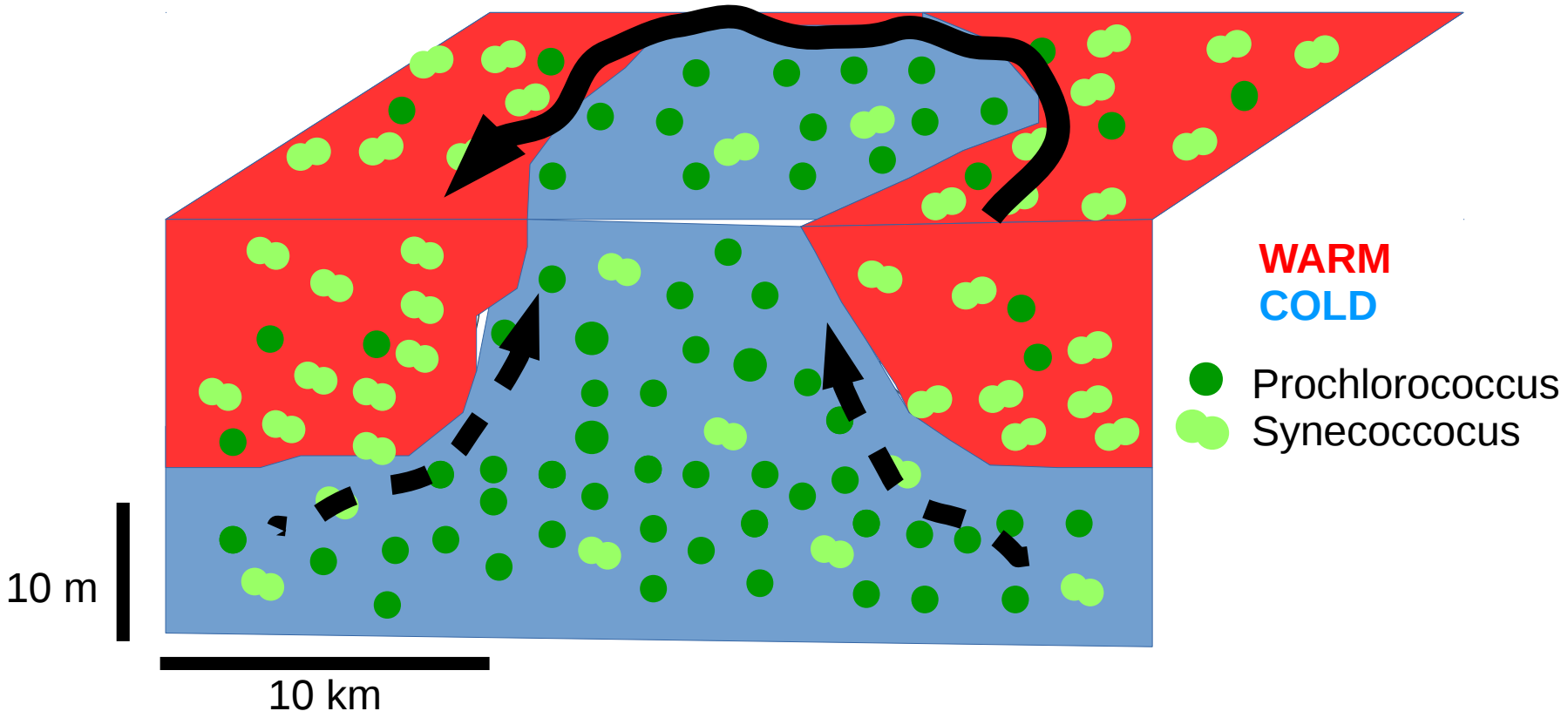




Cold Stations
SST < 17,5°C
"Core"



Summarizing...



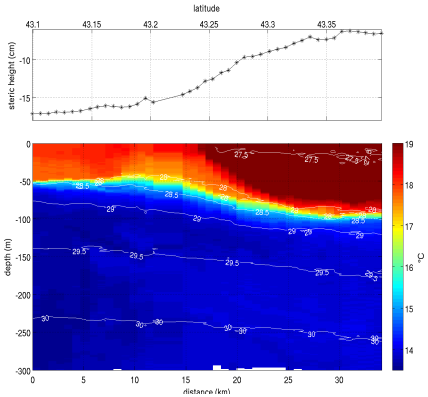
Preliminary conclusion:

the fine-scale structure of the physical field drives

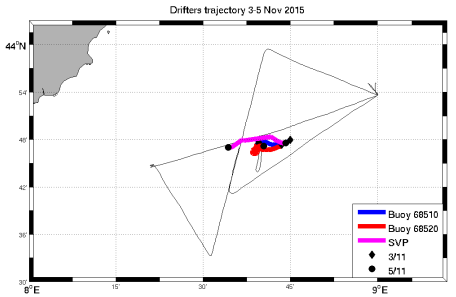
the spatial organization of the plankton functional groups

Outlooks

Description of the physical fine-scale dynamics
MVP and ADCP data
-> vertical mixing, FLSE, altimetry Cal/Val

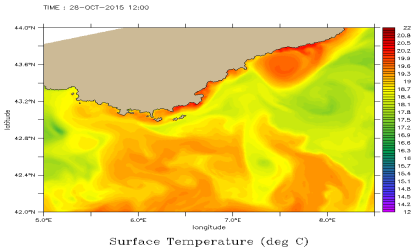


Study of the distribution of the larger plankton
LISST and LOPC data
-> biodiversity estimation



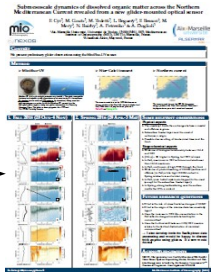
Lagrangian analysis of the cytometry data
-> Plankton growth rate estimation

Comparative study with numerical models
SYMPHONIE and MARS3D-ECO3M delayed-time runs

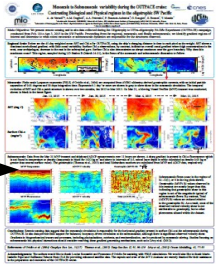


Larger scale dynamics
BIOPROVOR and Glider

F.Cyr poster



A.de Verneil poster



Comparative study with
OUTPACE (SW Pacific Ocean) cruise

OSCAHR project (still under construction!) webpages

www.mio.univ-amu.fr/OSCAHR/

Thanks for your attention!