International Ocean Colour Science Meeting 2015
Advancing Global Ocean Colour Observations

BREAKOUT SESSION 10:
JOINT USE OF BIO-ARGO AND OCEAN COLOUR

BIO-OPTICAL PRODUCT VALIDATION

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Overview

OCR-504 Multispectral radiometer (Satlantic Inc.)

$E_d(380)$
$E_d(412)$
$E_d(490)$
PAR

Upward casts
at local noon
0.5-250 m
every 1, 2, 3, 5 or 10 days

«PROVOR CTS-4» type (NKE, France)

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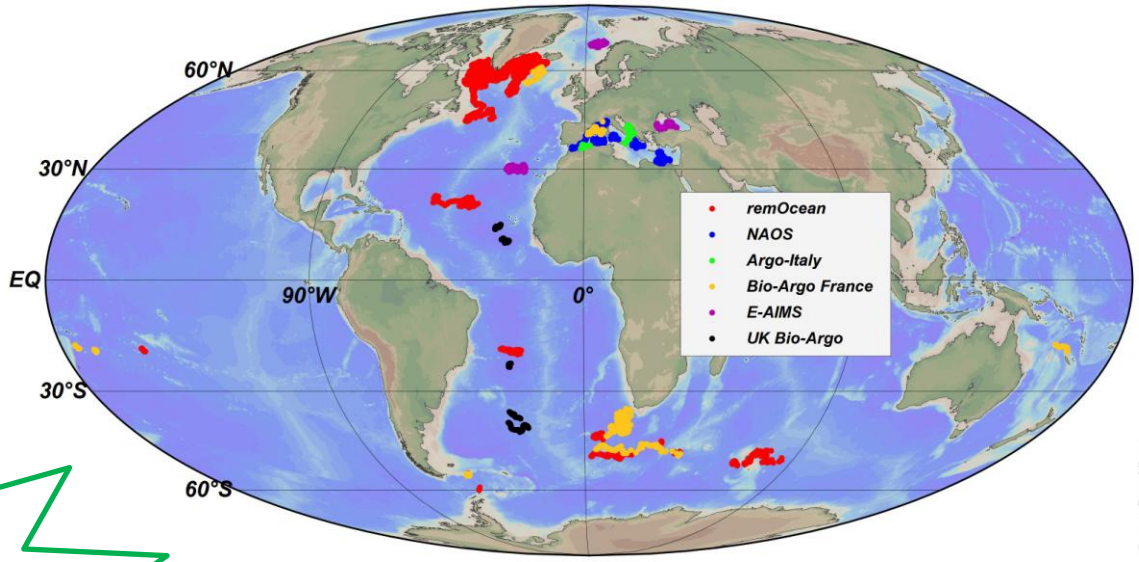


85 Bio-Argo floats

7371 profiles for each radiometric channel

a total of **29484** profiles in 2.5 years

Overview

This high number of autonomous measurements in very diverse open ocean systems can be a useful resource for:

- ✓ defining the bio-optical status of the ocean (i.e., regions characterized by bio-optical anomalies)
- ✓ validating OCR-derived products (e.g., Kd coefficients)
- ✓ understanding biogeochemical processes (e.g., primary production)

As these radiometric data are collected out of operator's control and regardless of metereological conditions, a **QUALITY-CONTROL** is mandatory before any use.

Quality-Control

Main issues:

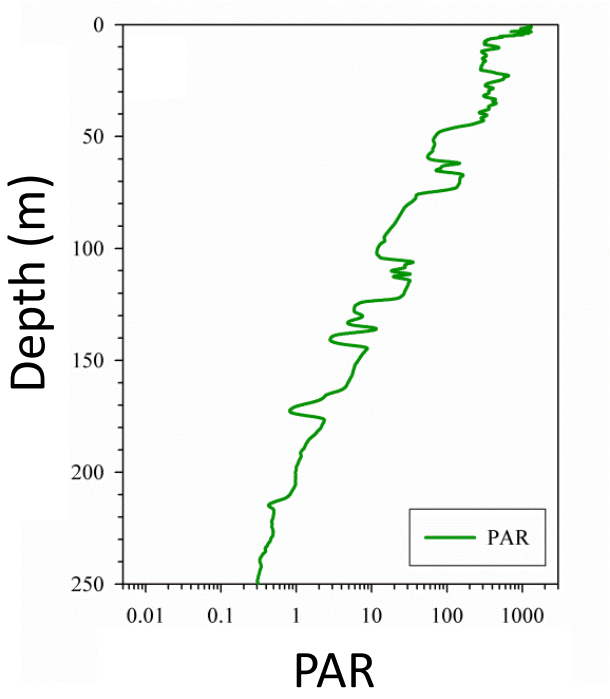
- ✓ Unknown sea and sky conditions
- ✓ No simultaneous above water E_d measurements
- ✓ No routine or post-deployment dark readings

Most of the procedures for quality-controlling radiometry measurements contained in the «**Ocean Optics Protocols for Satellite Ocean Color Sensors Validation**» handbook (Mueller et al., 2003) need to be adapted.

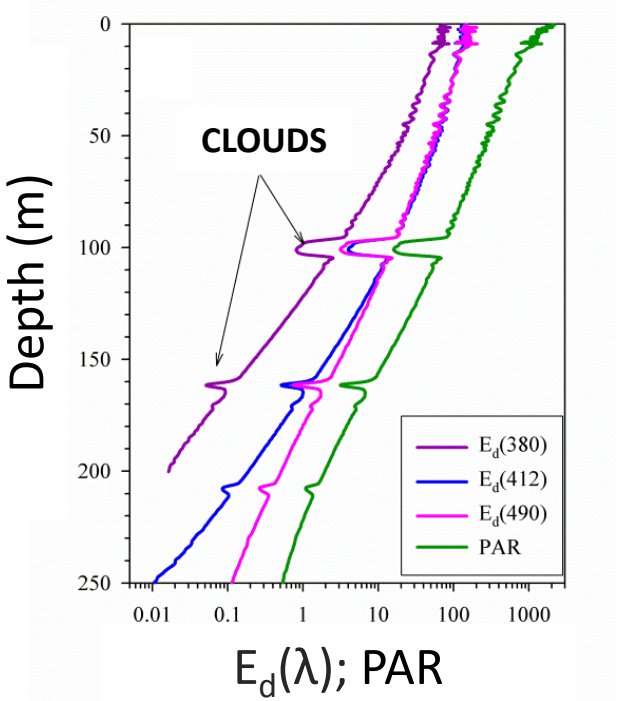
Quality-Control

A specific and automatic data quality-control procedure is developed for identifying:

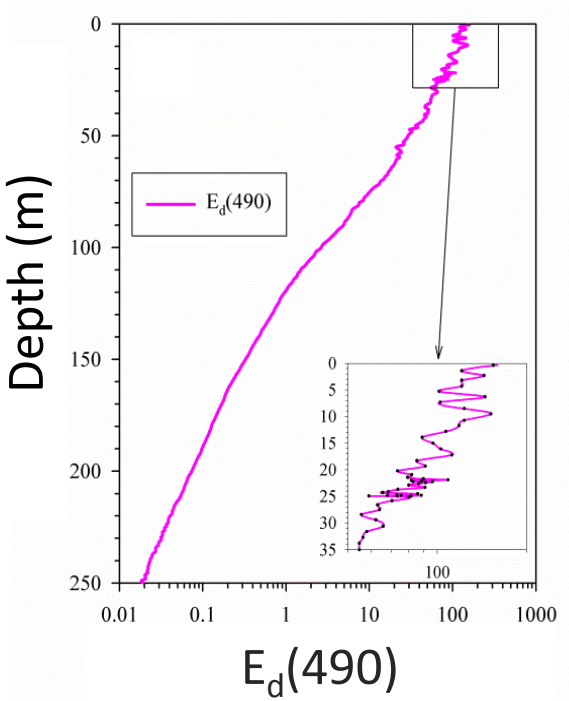
✓ bad profiles



✓ clouds



✓ wave focusing

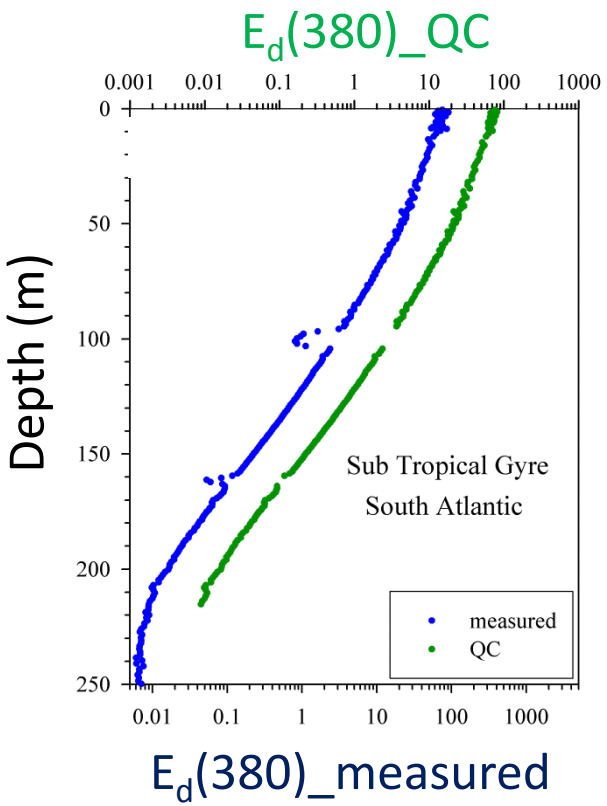


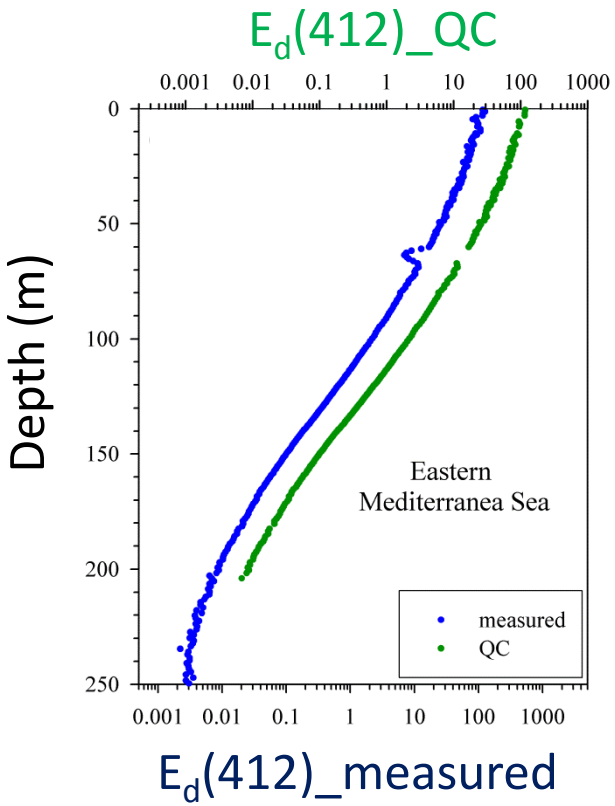
$E_d(\lambda)$ values are expressed as µW cm^{-2} nm^{-1}; PAR values are expressed as µmol quanta m^{-2} s^{-1}

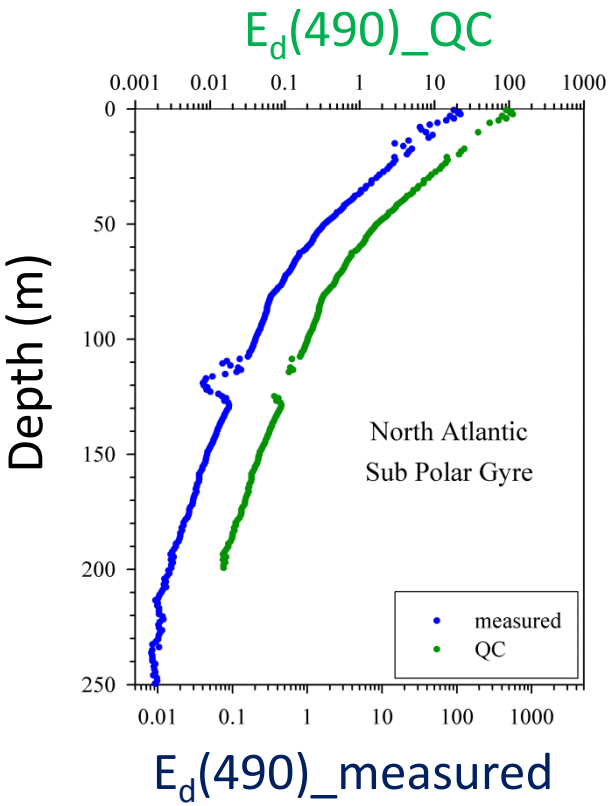
Organelli et al., in preparation

Quality-Control

- Good performances are observed across the global ocean
- Good performances for each radiometric channel
- **60%** of profiles passed the QC (including those cleaned by clouds and wave focusing)







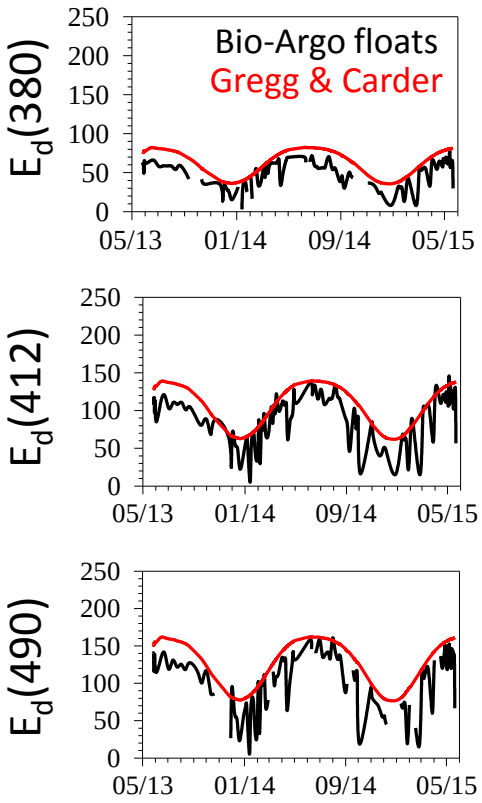
$E_d(\lambda)$ values are expressed as $\mu W\ cm^{-2}\ nm^{-1}$

Organelli et al., in preparation

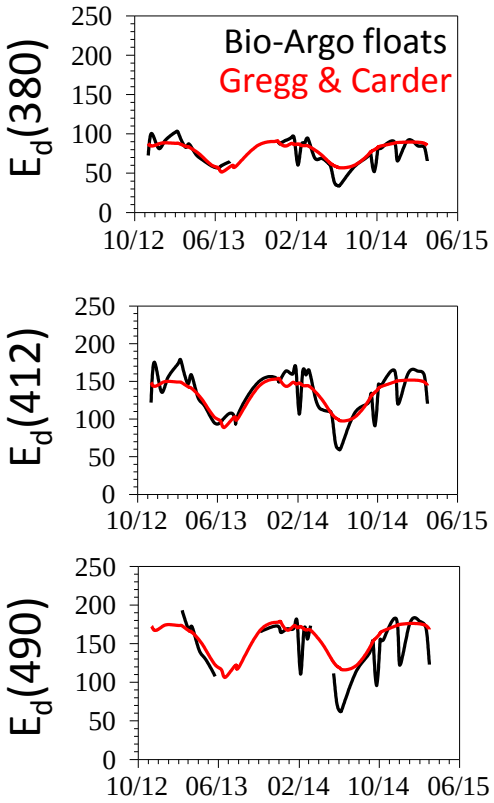
Radiometer performances and Products

✓ $E_d(0^+)$ in agreement with the Gregg and Carder (1990) model

Mediterranean Sea



South Atlantic Sub-Tropical Gyre



$E_d(\lambda)$ values are expressed as µW cm^{-2} nm^{-1}

➢ No evident instrumental drift impacting at the surface

➢ No biofouling

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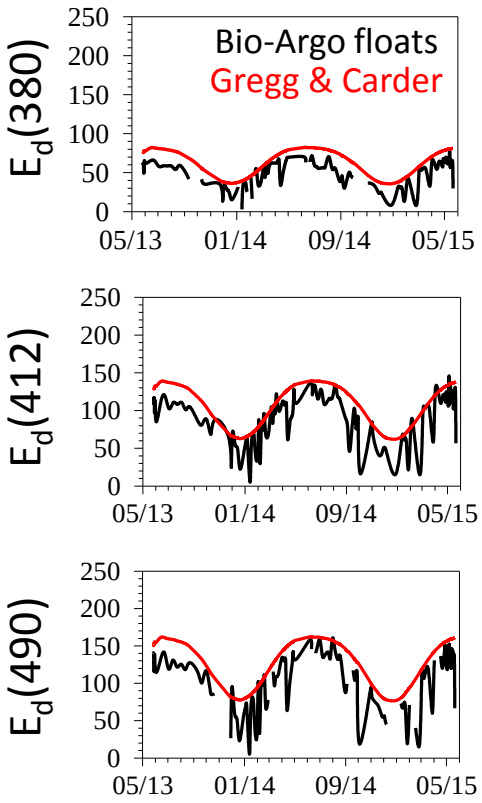

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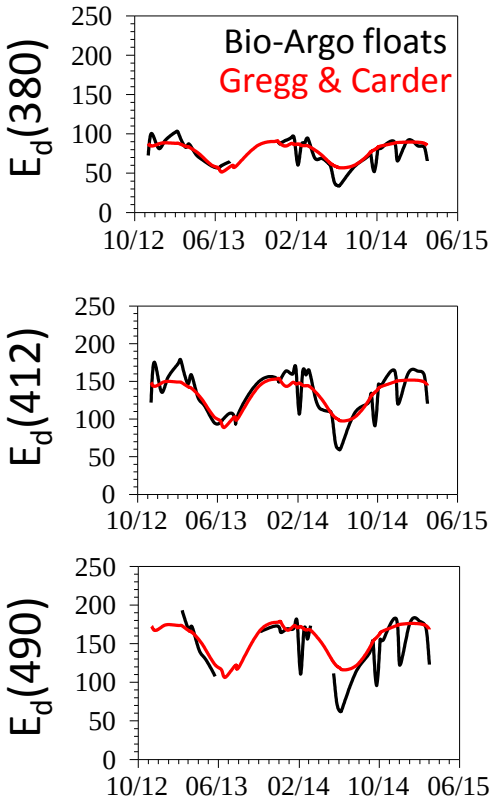
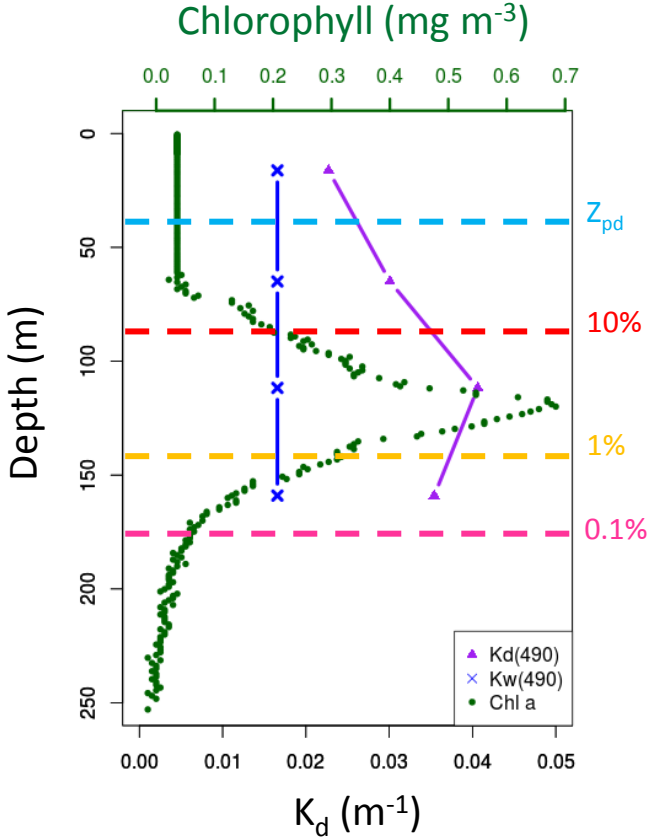


$E_d(\lambda)$ values are expressed as µW cm^{-2} nm^{-1}

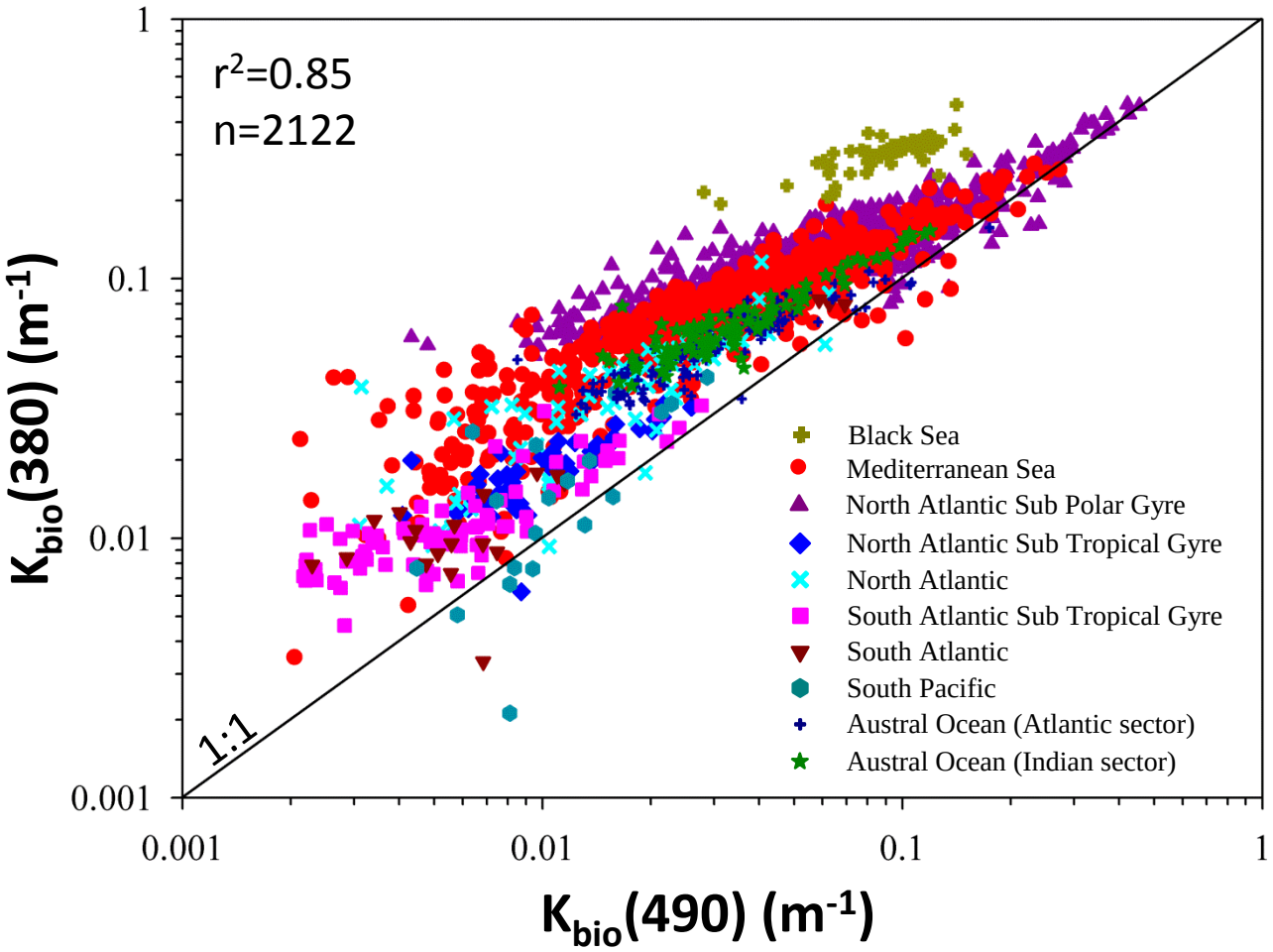
✓ **$K_d(\lambda)$ in 4 layers**:
first optical depth
10% of PAR(0^-)
1% of PAR (0^-)
0.1% of PAR (0^-)

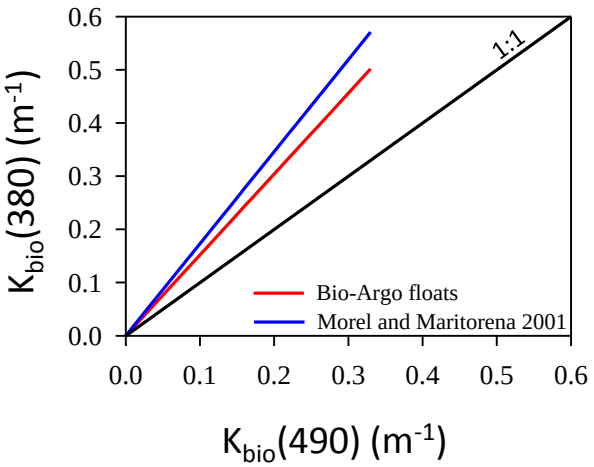


➢ No evident instrumental drift impacting at the surface

➢ No biofouling

K_{bio} ($K_d(\lambda)$-$K_w(\lambda)$) at the global scale

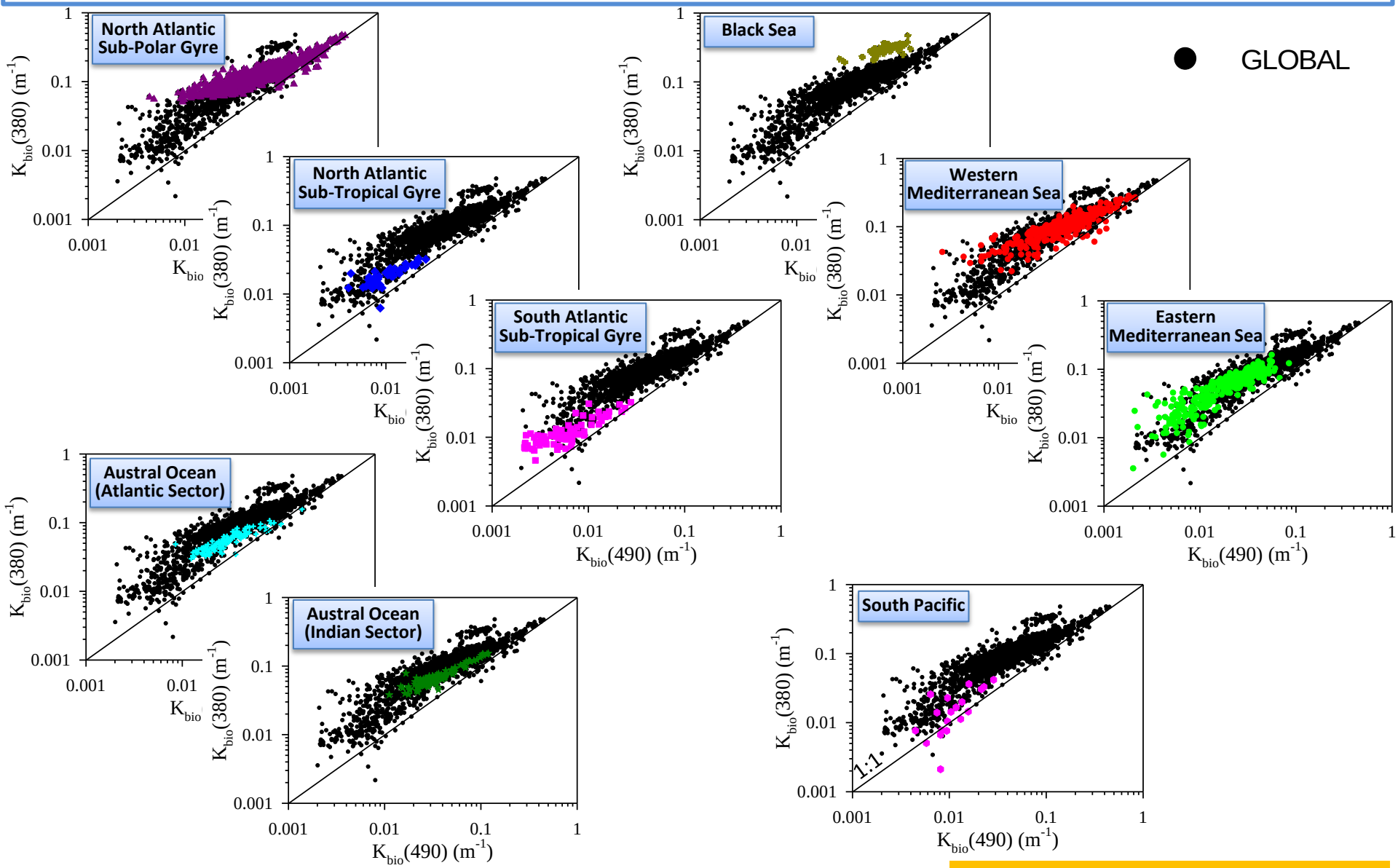




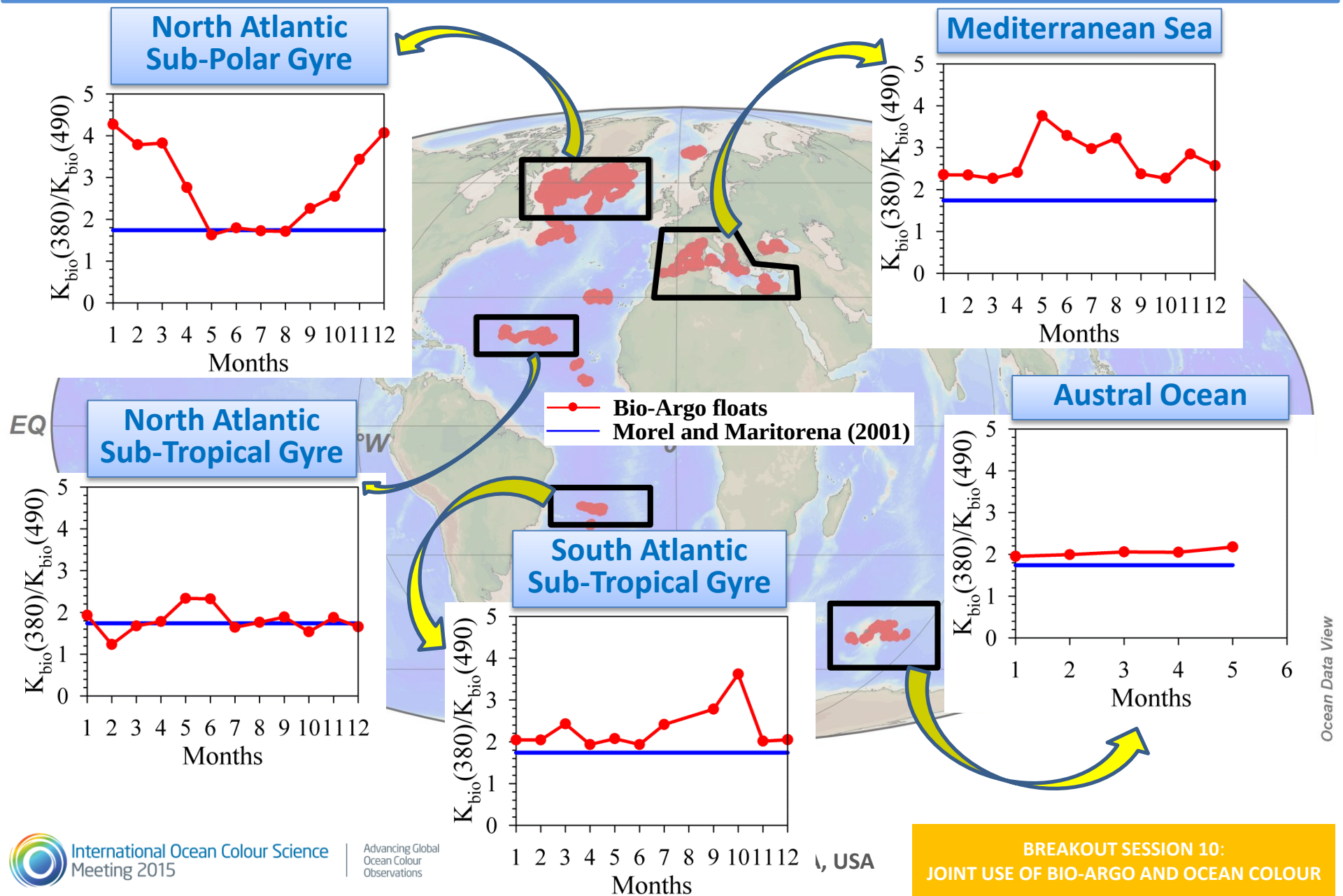
FIRST OPTICAL DEPTH

- $K_d(380)$ are higher than $K_d(490)$, in agreement with global bio-optical models (e.g., Morel and Maritorena, 2001).
- Differences appear among regions.

Regional vs Global scale

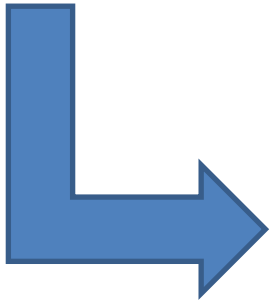


Bio-optical behaviour of oceans



Bio-optical behaviour of oceans

- ✓ The bio-optical behaviour is different among various oceanic areas
- ✓ Seasonality can be observed within regions
- ✓ Bio-Argo floats have the potential for identifying oceanic regions with optical properties departing from global bio-optical relationships



Implications for ocean color applications

OCR product validation

Radiometric measurements by Bio-Argo floats are also a useful resource for validating satellite products

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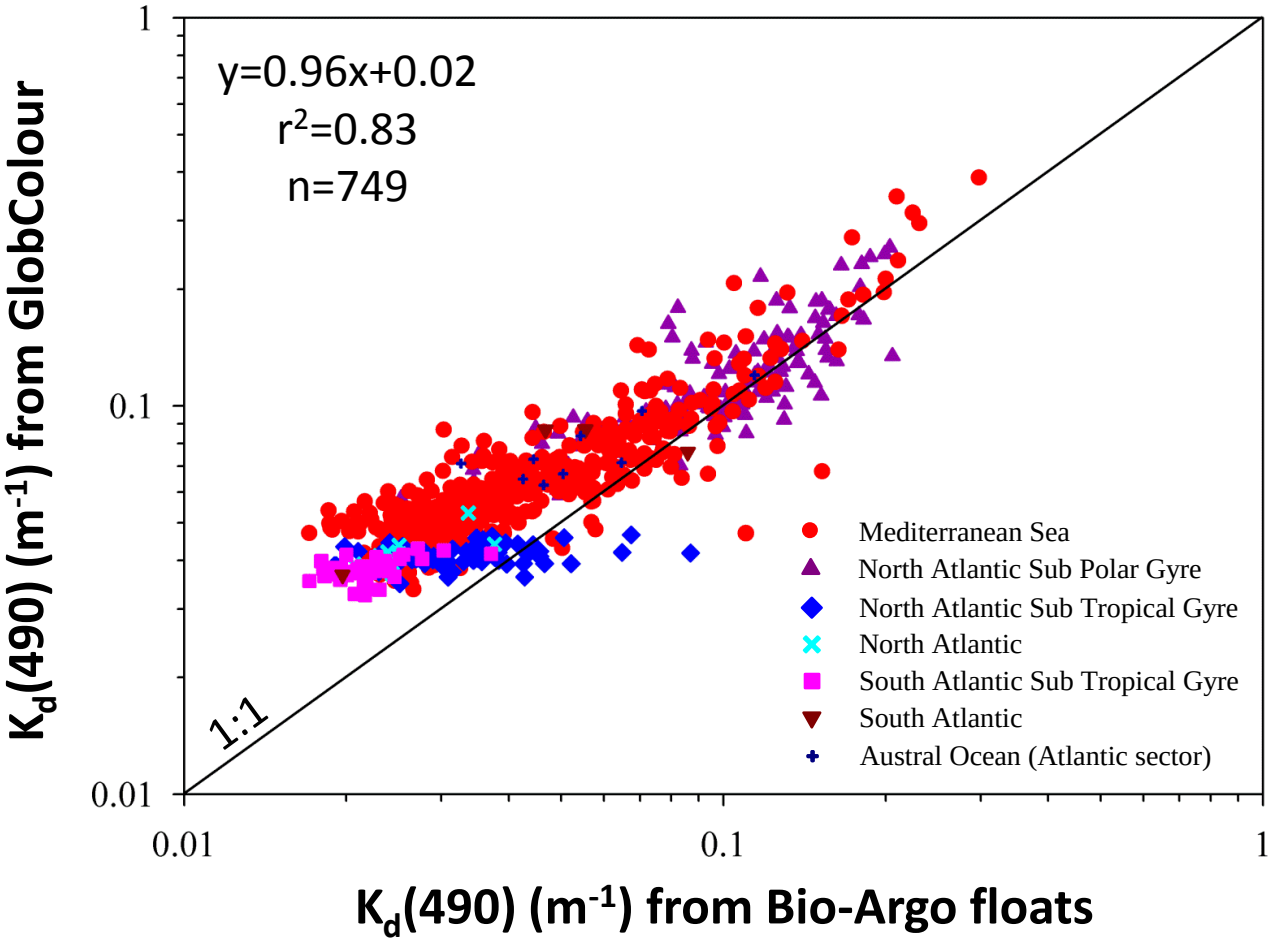


Good agreement between $K_d(490)$ values from Bio-Argo floats and those from GlobColour, but satellite overestimates low *in situ* Kd values.

GlobColour data kindly provided by Romain Serra and Antoine Mangin (ACRI-ST)

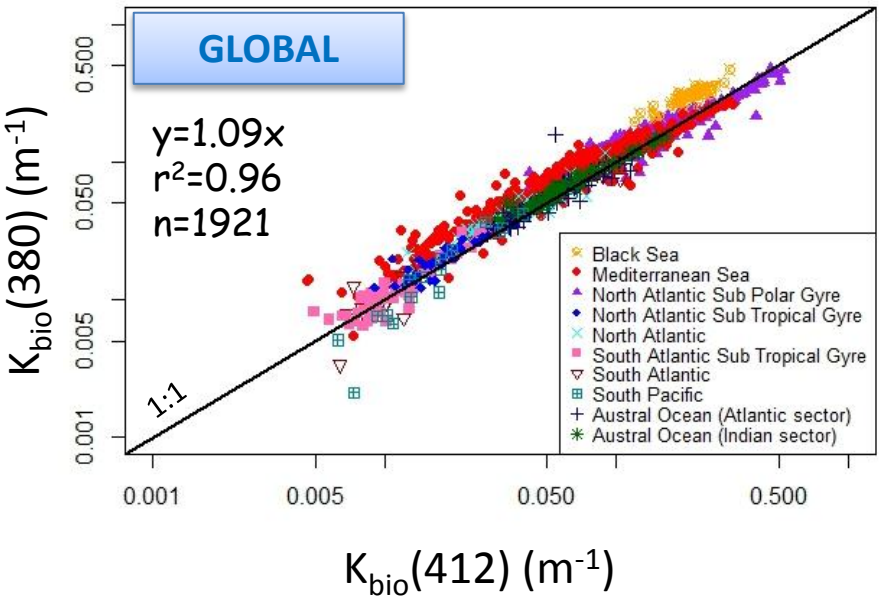
Summary and strategies...

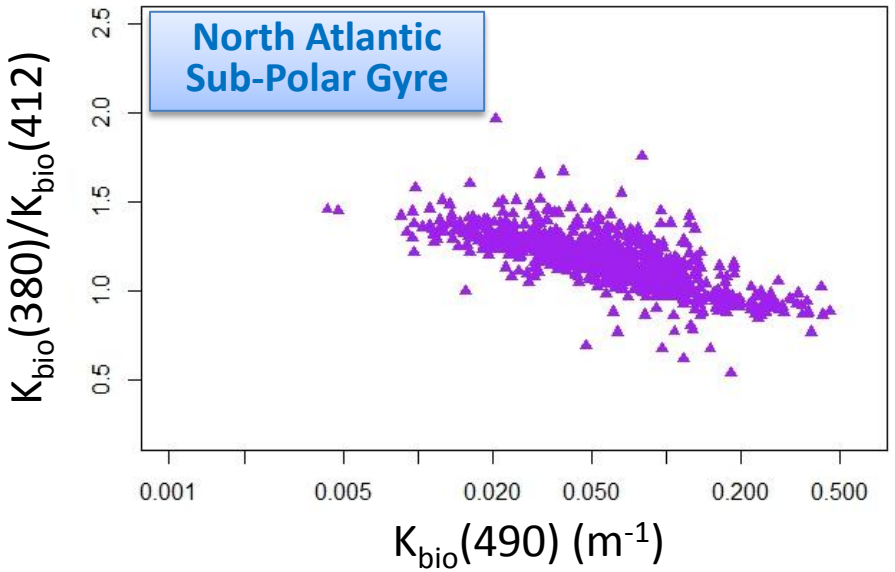
Summary and Strategies

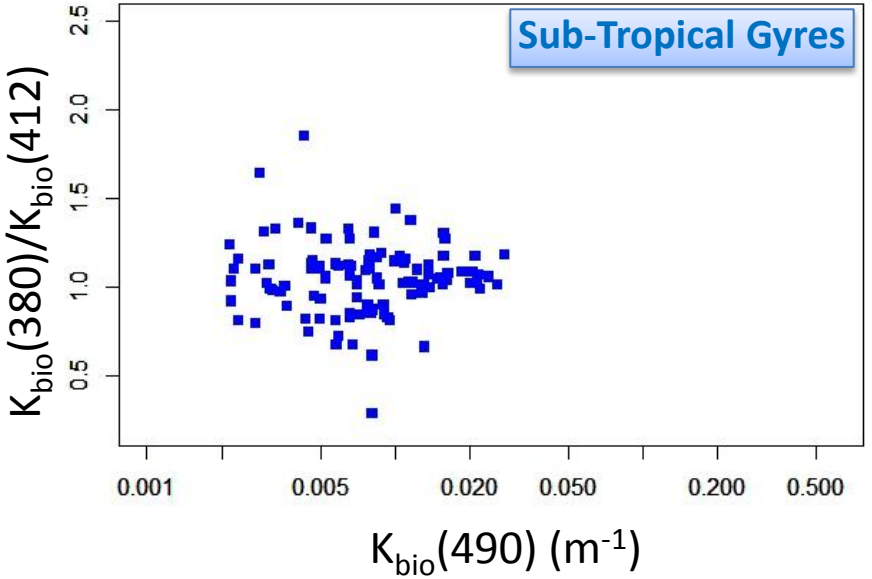
- ✓ Bio-Argo floats supply the ocean color community with **thousands of radiometric data in a very short time**
- ✓ Through a **statistical approach**, it is possible to:
  - ❖ Identify regions with **bio-optical anomalies** and where difficulties in retrieving biogeochemical parameters from satellite data could be encountered
  - ❖ Validate OCR products
- ✓ Delineation of «anomalous» regions can be useful **to plan dedicated cruises**, for **setting mooring buoys** (like BOUSSOLE and MOBY) or using **CAL/VAL floats** (ProVal) in order **to improve Ocean Color applications**

Some perspectives...

Perspectives: the use of $E_d(412)$





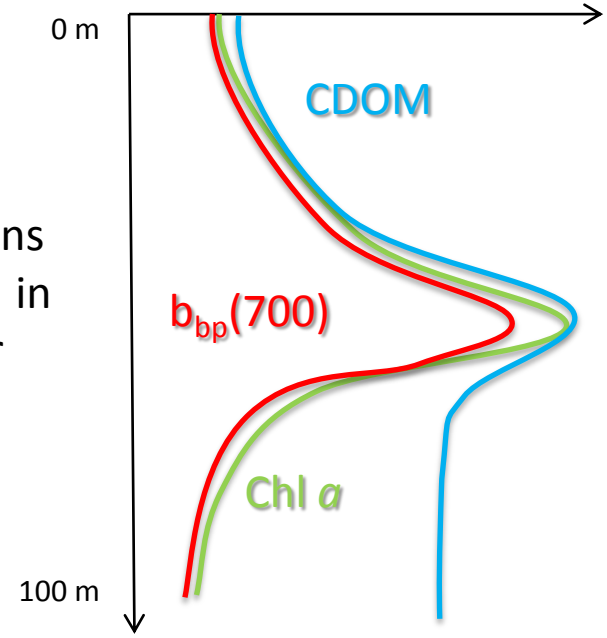


K_d values at 412 nm could be useful for better understanding the influence of CDOM and algal pigments in light attenuation and its variability across the oceans.

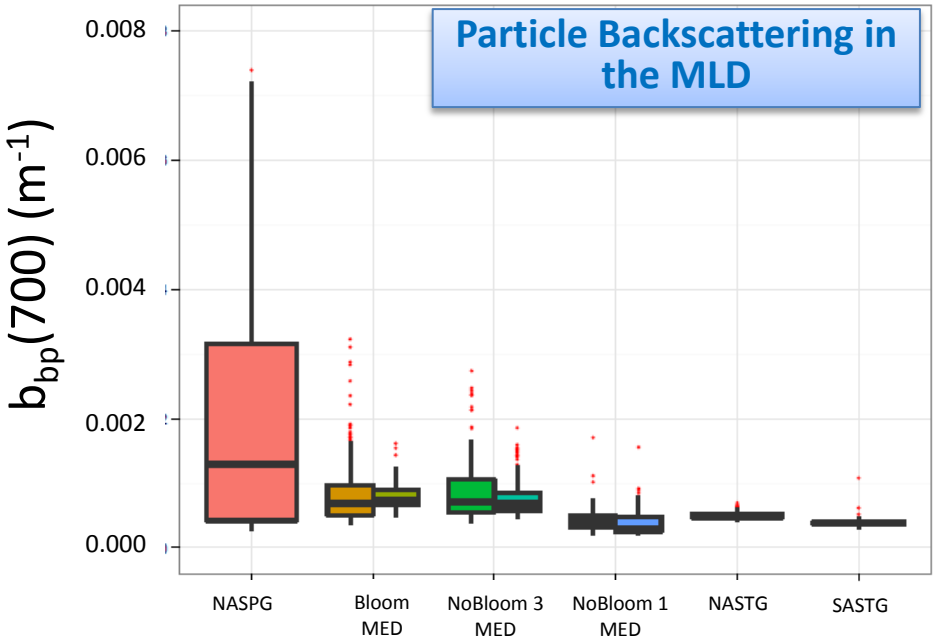
Perspectives: IOPs and bio-optical variables

Radiometric measurements can be connected to other simultaneously measured key biogeochemical and bio-optical variables:

- ✓ Chlorophyll *a* Fluorescence
- ✓ CDOM Fluorescence
- ✓ Particle Backscattering coefficient
- ✓ Particle Attenuation coefficient



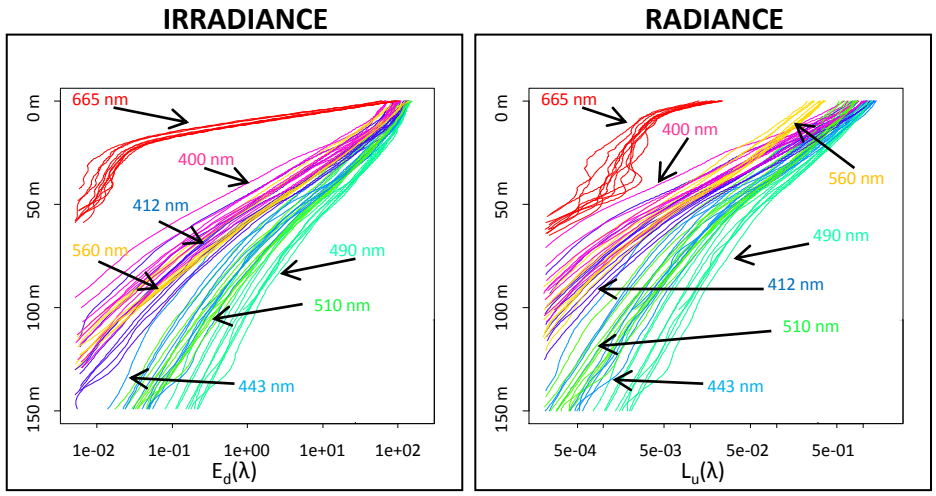
Gulf of Lions (Med Sea) in summer

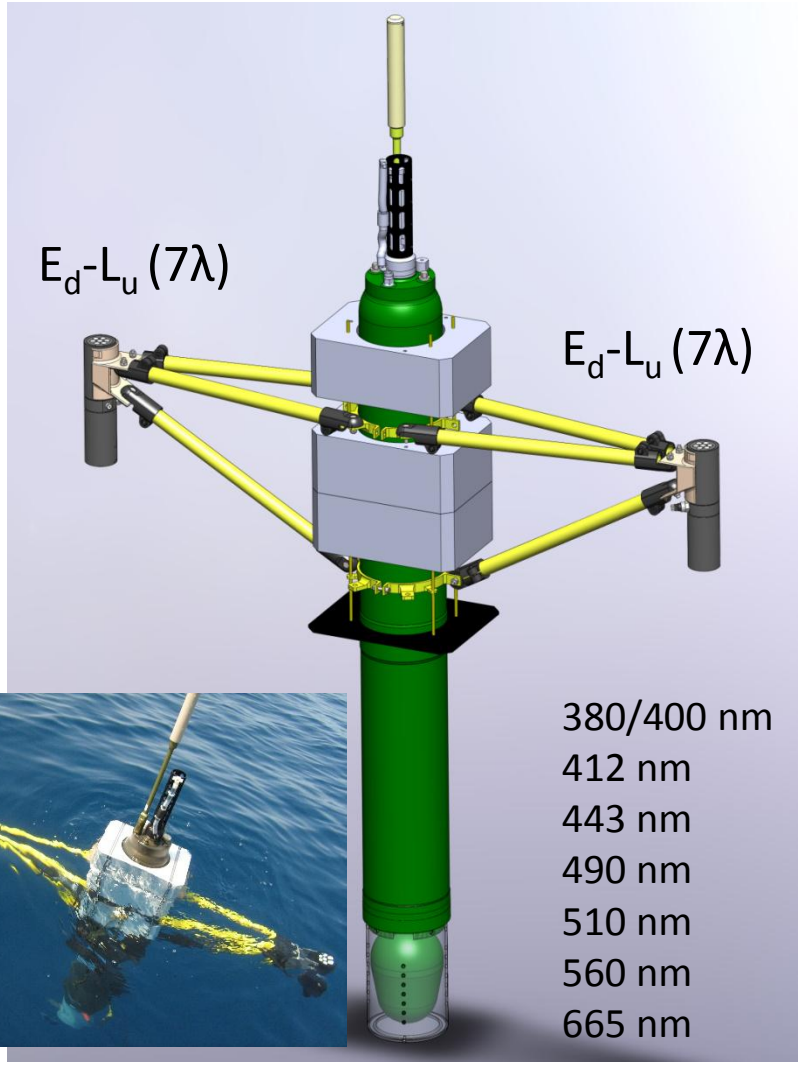


Analysis by Marie Barbieux (LOV)

Perspectives: ProVal floats

- ✓ Specifically designed for Ocean Color data validation (CAL/VAL)
- ✓ Useful for application of bio-optical inversion models using *in situ* Rrs(λ) measurements
- ✓ Useful for studying areas with bio-optical anomalies:
  - ❖1 ProVal in the Mediterranean Sea
  - ❖2 ProVal in the Austral Ocean





Data by Edouard Leymarie (LOV)

All these activities are a contribution to several projects:

Remotely-Sensed Biogeochemical Cycles in the Ocean

and also: **Bio-Argo France**, **UK Bio-Argo**, **Argo-Italy**, **E-AIMS** and **ProVal** projects.

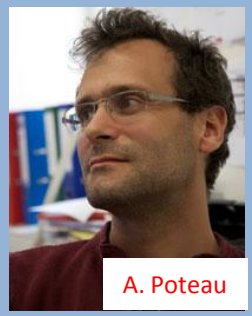
Thanks to all funding organizations:

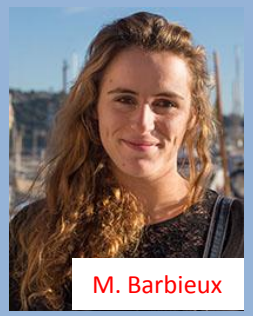
A big thank to all people contributed to this presentation....

LOV


H. Claustre


A. Bricaud


A. Poteau


M. Barbieux

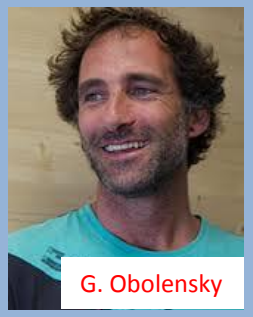

L. Prieur


C. Penkerc'h


C. Schmetchtig


F. D'Ortenzio


J. Uitz


G. Obolensky


E. Leymarie

Takuvik/Univ. China


X. Xing

ACRI-ST


A. Mangin


R. Serra

PML


G. Dall'Olmo

Thanks for your attention!