STRATEGY FOR A OLCI VALIDATION FROM BGC-ARGO FLOATS

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Outline

- Introduction

- Motivations for the chlorophyll validation activities

- Strength of BGC-Argo floats for satellite ocean colour QC

- Results of QC exercises at different scale

- Conclusions and future work perspectives
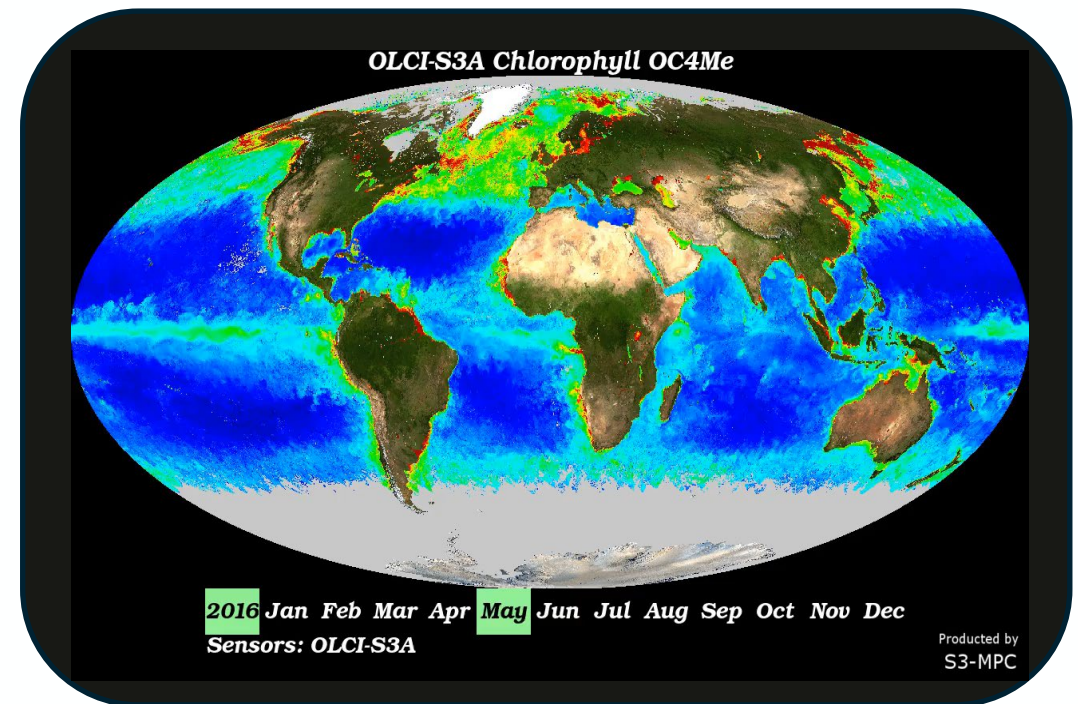
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Introduction

Considering the role of marine phytoplankton in the carbon cycle (responsible for approximately 50% of the Earth's total carbon fixation), the Global Climate Observation System lists the chlorophyll-a concentration as Essential Climate Variables (ECV).

ECV Products and Requirements for Ocean Colour

- Long and consistent timeseries
- Weekly averages (or more frequent)
- With a high spatial resolution (from **1km to 1°**)
- Measurement uncertainty **of 30%**

→ Need in situ observation to ensure satellites observation match the expectations

OLCI-S3A Chlorophyll OC4Me

2016 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Sensors: OLCI-S3A
Produced by
S3-MPC

OLCI and BGC-argo datasets

- In orbit since 2016

- Global coverage every 4 days

- Spatial resolution of 300m

→ Need in situ observation to ensure satellites observation match the expectations

- 102025 Total Chl a Profiles since 2006

- Distributed from pole to pole, regardless the season

- Accuracy/Precision: Max (30%, 0.03 mg Chl$a$ m^{-3}) / 0.025 mg Chl$a$ m^{-3}

https://maps.biogeochemical-argo.com/bgcargo/

Objectives
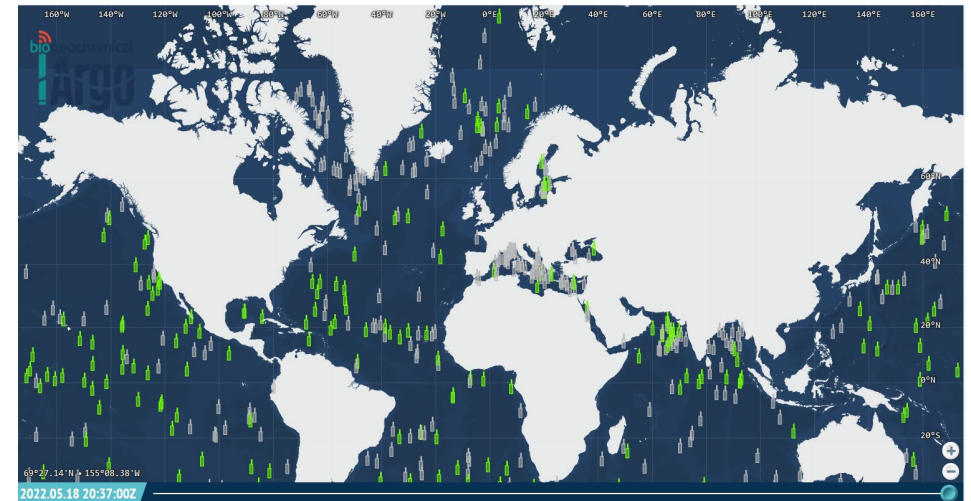
- **Perform validation of ocean colour data with BGC-Argo floats**

- **Define procedures for the quality control analysis of OLCI products**
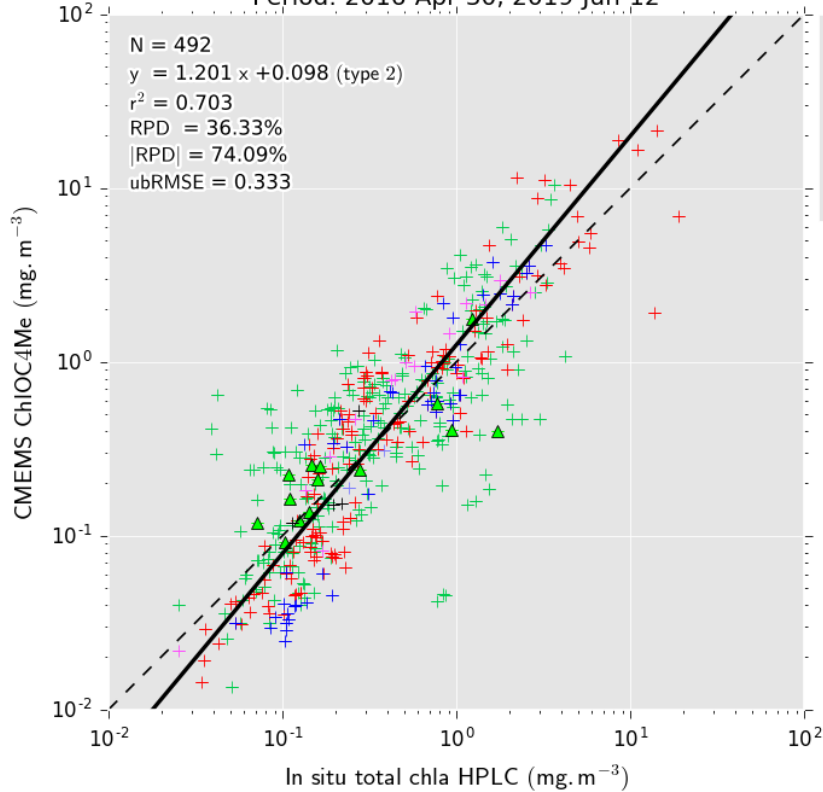
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Improvement in matchup availability

OLCIA (Daily L3, GLOB 4km, CMEMS)
23-Mar-2022: dataset-oc-glo-chl-olci_a-l3-av_4km_daily (ACRI-ST)
Period: 2016-Apr-30, 2019-Jun-12

N = 492
$y = 1.201 x + 0.098$ (type 2)
$r^2 = 0.703$
RPD = 36.33%
|RPD| = 74.09%
ubRMSE = 0.333

	N	PERIOD
MERMAID	254	2016-Apr, 2019-Jun-12
SEABASS	156	2016-May, 2019-May-10
Boussole	14	2016-Jun, 2019-Feb-19
Pangaea	46	2016-May, 2018-May-23
OCDB	2	2017-May, 2017-Jul-15
OC.CCI.V6	16	2016-Jun, 2016-Nov-21
AWI	4	2016-Aug, 2016-Oct-13

MERMAID project
Generated by ACRI-ST

OLCIA (Daily L3, GLOB 4km, CMEMS)
23-Mar-2022: dataset-oc-glo-chl-olci_a-l3-av_4km_daily (ACRI-ST)
Period: 2016-Apr-26, 2022-Feb-15

N = 5873
$y = 1.092 x + 0.222$ (type 2)
$r^2 = 0.579$
RPD = 128.82%
|RPD| = 156.43%
ubRMSE = 0.383
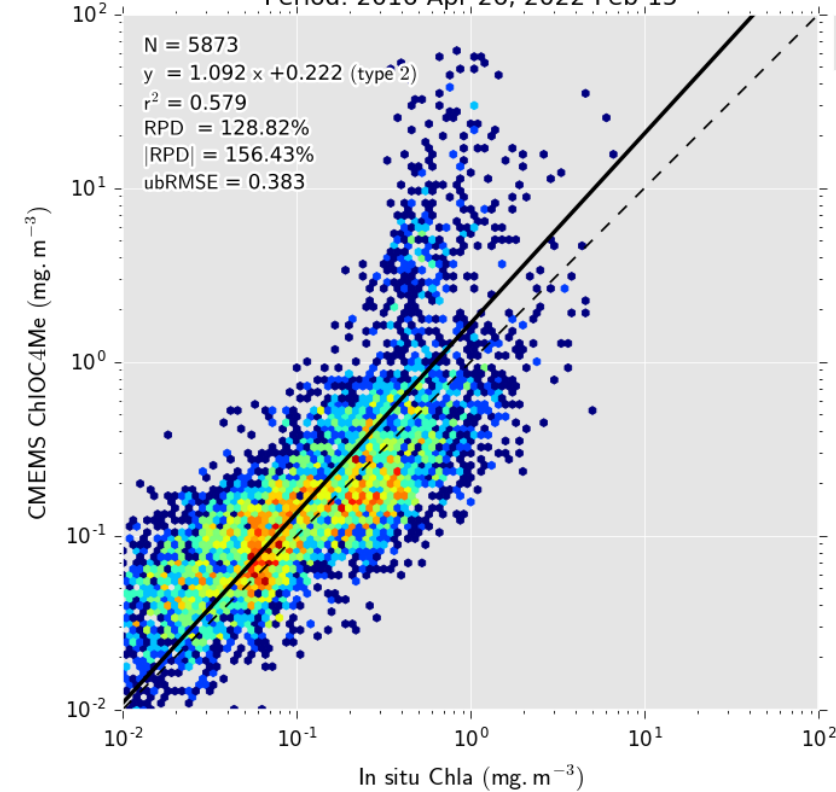
	N	PERIOD
BGCArgo	5873	2016-Apr, 2022-Feb-15

MERMAID project
Generated by ACRI-ST

More than **5873** available matchups with BGC-Argo floats

Less than **500** available matchups with HPLC data

BGC-argo in support of Ocean colour product QC

BGC-Argo floats would allow the development of online tools for the quality control of ocean colour algorithms

The development of regional algorithm, identification of temporal deviation is then supported by temporal and spatial coverage of the BGC-Argo profiles

Still lake of metrics to highlight satellite deviations

Uncertainties estimates
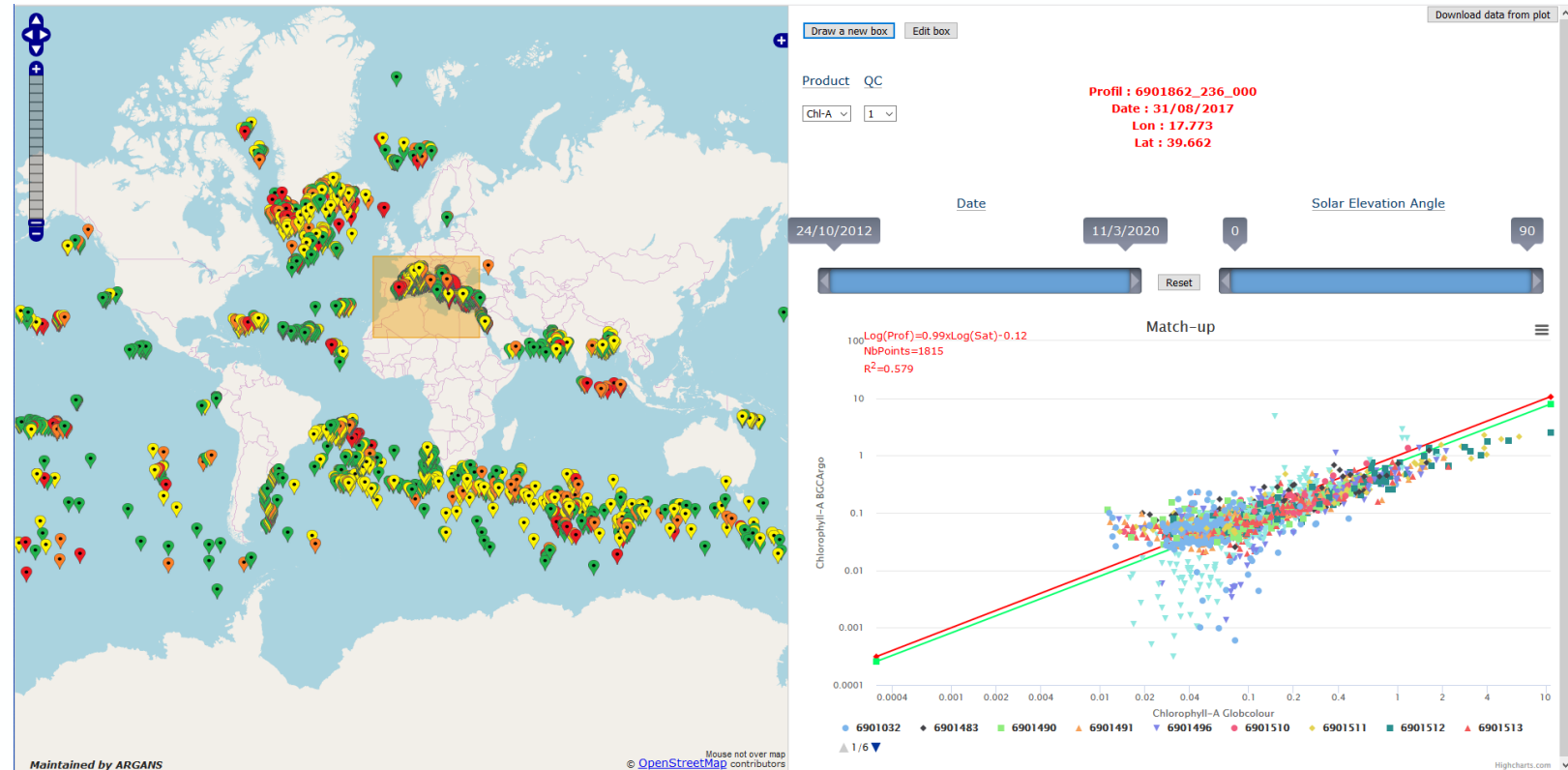
How to qualify good and bad observations ?

- The triple collocation methods was applied to estimate the error associated with satellite and BGC-Argo chlorophyll measurements
- Considering 3 independent source of data
  - Satellite observation
  - BGC-Argo measurements
  - Model outputs (NEMO-PISCES)

$$\sigma_{\varepsilon_x} = \sqrt{\sigma_x^2 - \frac{\sigma_{xy}\sigma_{xz}}{\sigma_{yz}}}$$

$$\sigma_{\varepsilon_y} = \sqrt{\sigma_y^2 - \frac{\sigma_{yx}\sigma_{yz}}{\sigma_{xz}}}$$

$$\sigma_{\varepsilon_z} = \sqrt{\sigma_z^2 - \frac{\sigma_{zx}\sigma_{zy}}{\sigma_{xy}}}$$

Source	N	median	mean	stdev	RMSE
Satellite	12651	0.176	0.176	0.097	0.080
BGC-Argo	12651	0.132	0.188	0.169	0.067
Model	12651	0.141	0.197	0.131	0.103

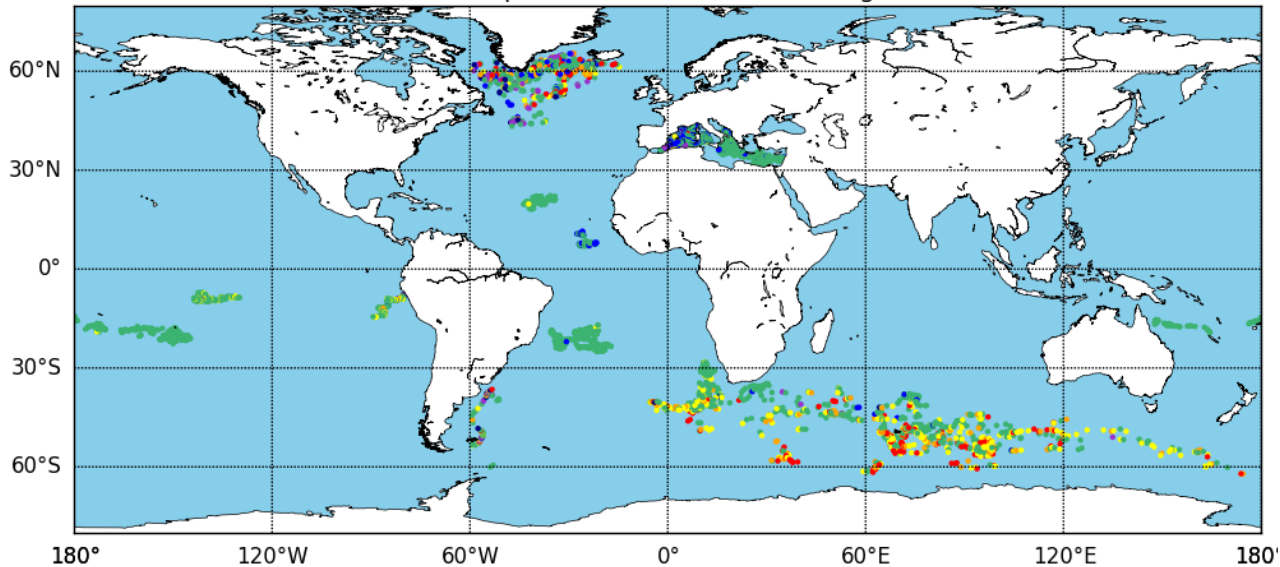**Global error, not a per profile information**

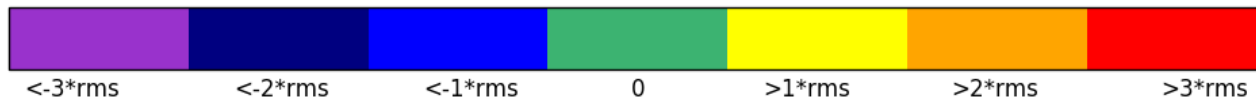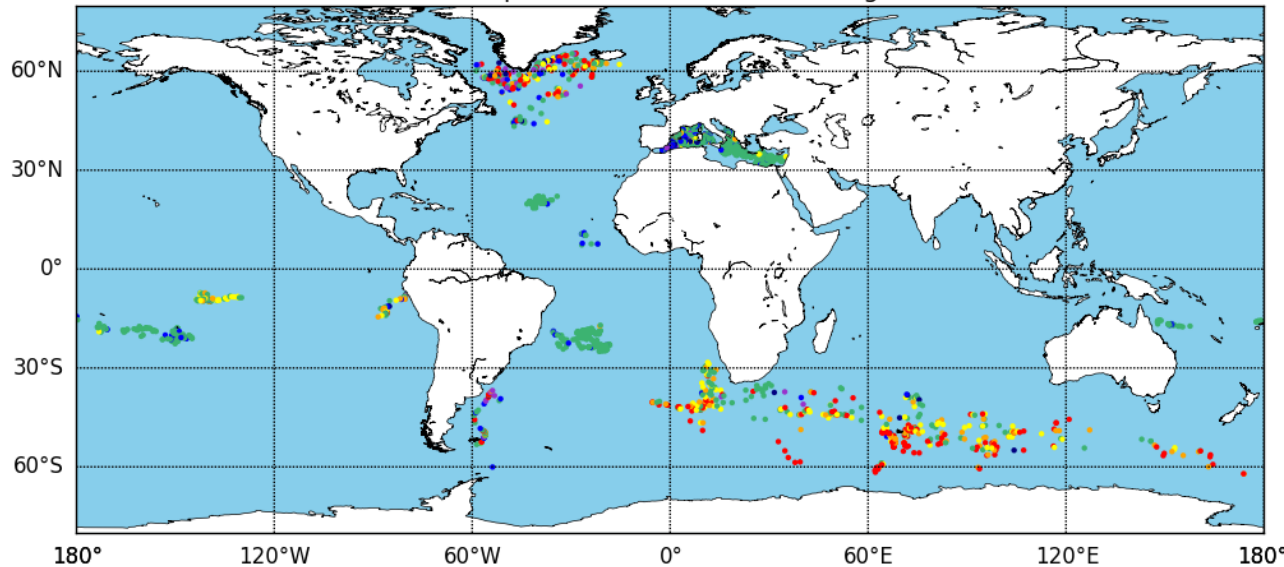# Observation of regional deviations

Based on the error estimates, regional deviation between satellite and BGC-Argo can be detected

$$RMS_{BGC+SAT} = \sqrt{RMS_{BGC}^2 + RMS_{SAT}^2}$$
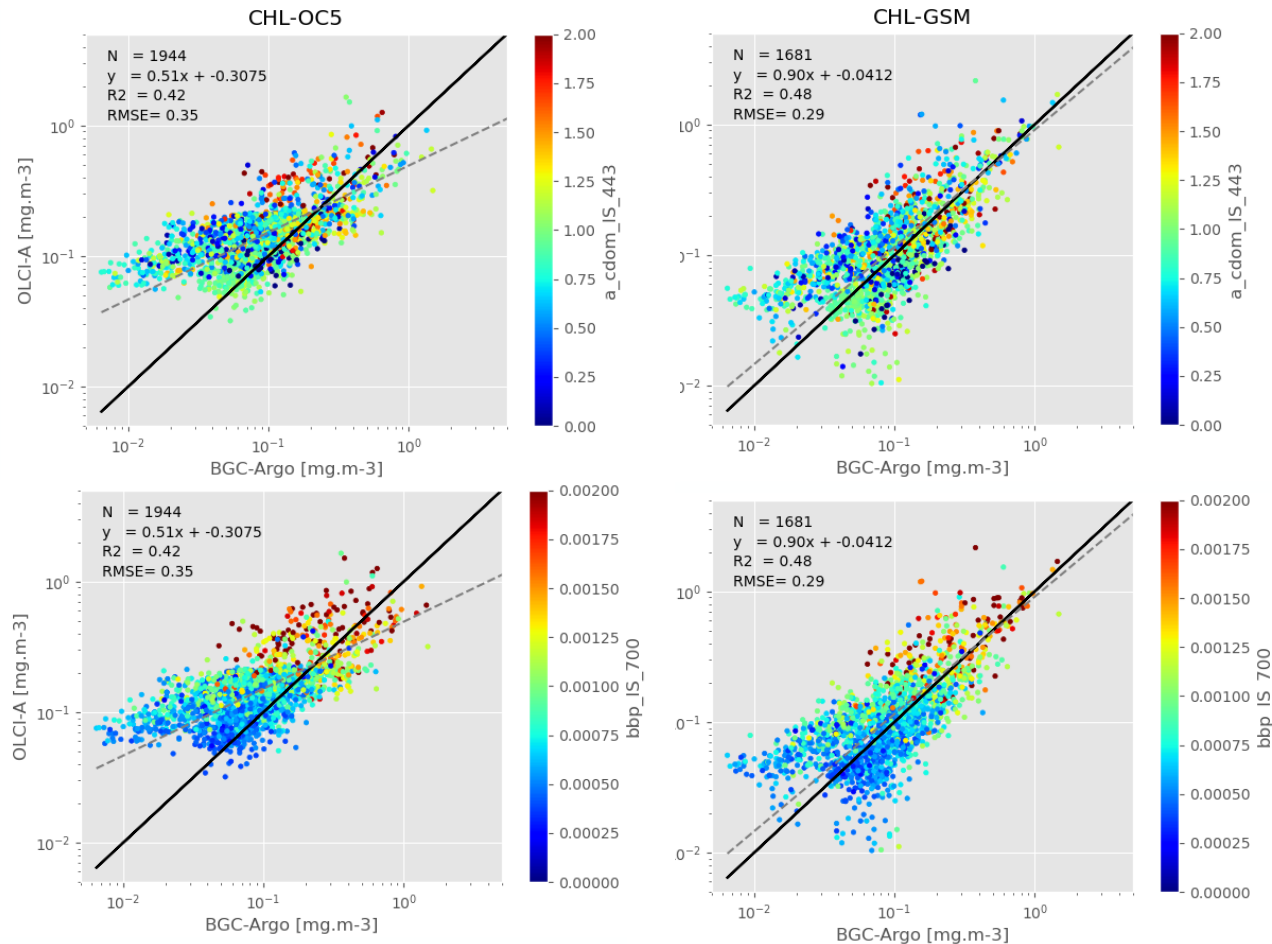

Comparison CHL-OC5 vs BGC-Argo

Comparison CHL-GSM vs BGC-Argo

Advantages of BGC-Argo variables

Exemple: use case, explore OLCI accuracy over the Mediterranean Sea

- Variables such as BBP and CDOM would help for the Quality control procedure of algorithm development
- BGC-Argo bio-optical parameters would help the explanation of potential discrepencies between satellite and in situ

Advantages of BGC-Argo variables

Exemple: use case, explore OLCI accuracy over the Mediterranean Sea

Hypothesis: Wind speed can affect ocean colour retrieval
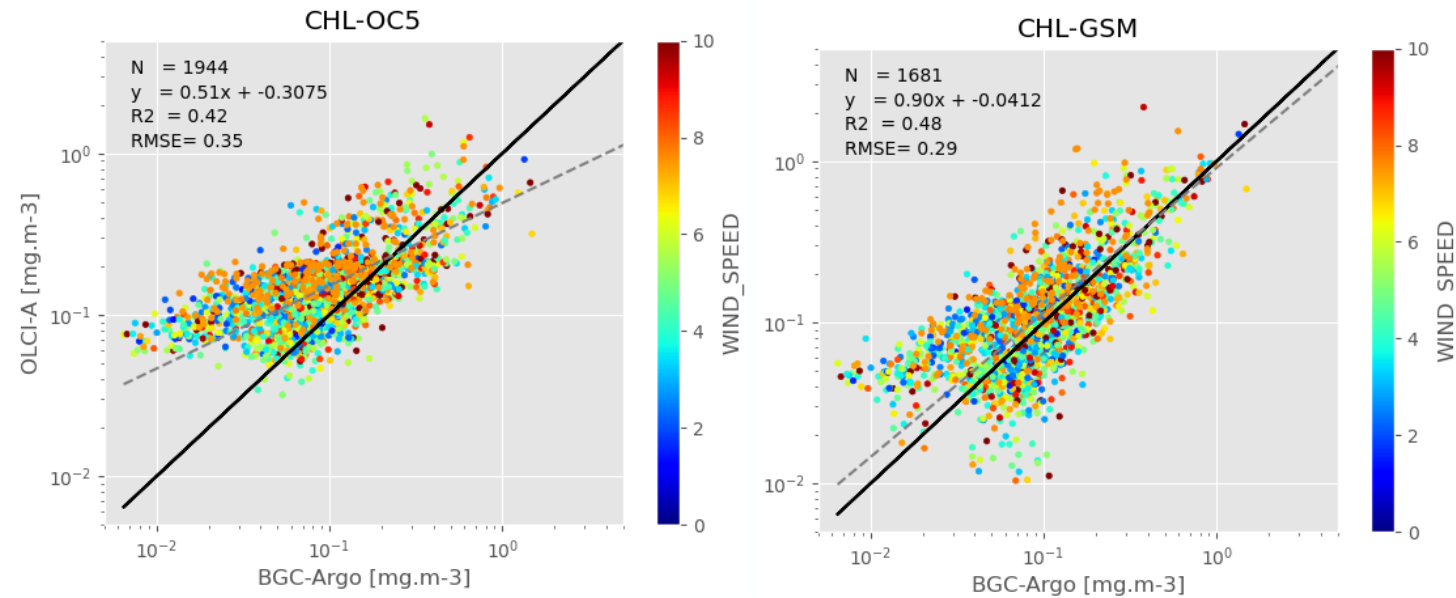
Matchup ocean colour observation, BGC-Argo and satellite scatterometer

OC5 algorithm appears to overestimate low chlorophyll concentrations when wind speed is high

But this need to consider the low spatial resolution (25km)

Associate Mixed Layer depth estimates from BGC-Argo would give more confidence in these results
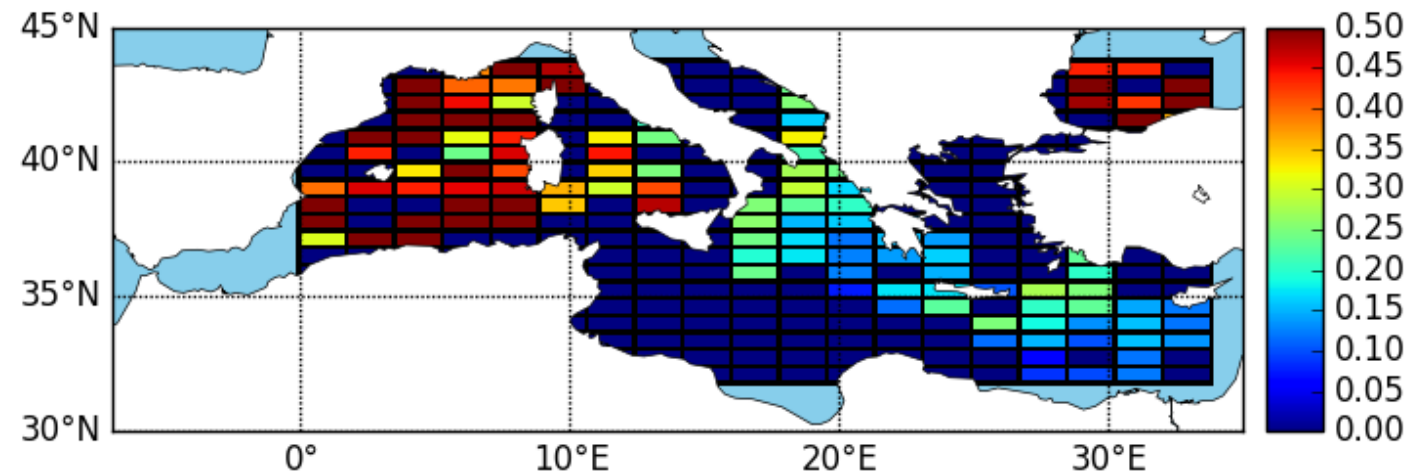
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Wide coverage of BGC-Argo would allow to construct an in situ climatological datasets

Assessments of the quality of the ocean colour data product by biomes.

Test over the Mediterranean Sea with average not convincing

Option to only split the Med Sea in its west/east part.

→ Important to sustain the number of floats operating

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Advantages of the BGC-Argo world wild networks

Wide coverage of BGC-Argo would allow to construct an in situ climatological dataset

Assessments of the quality of the ocean colour data product by biomes as sea water constituent affect the signal retrieval

Consider the climatological seasonal chlorophyll concentration for the QC analysis
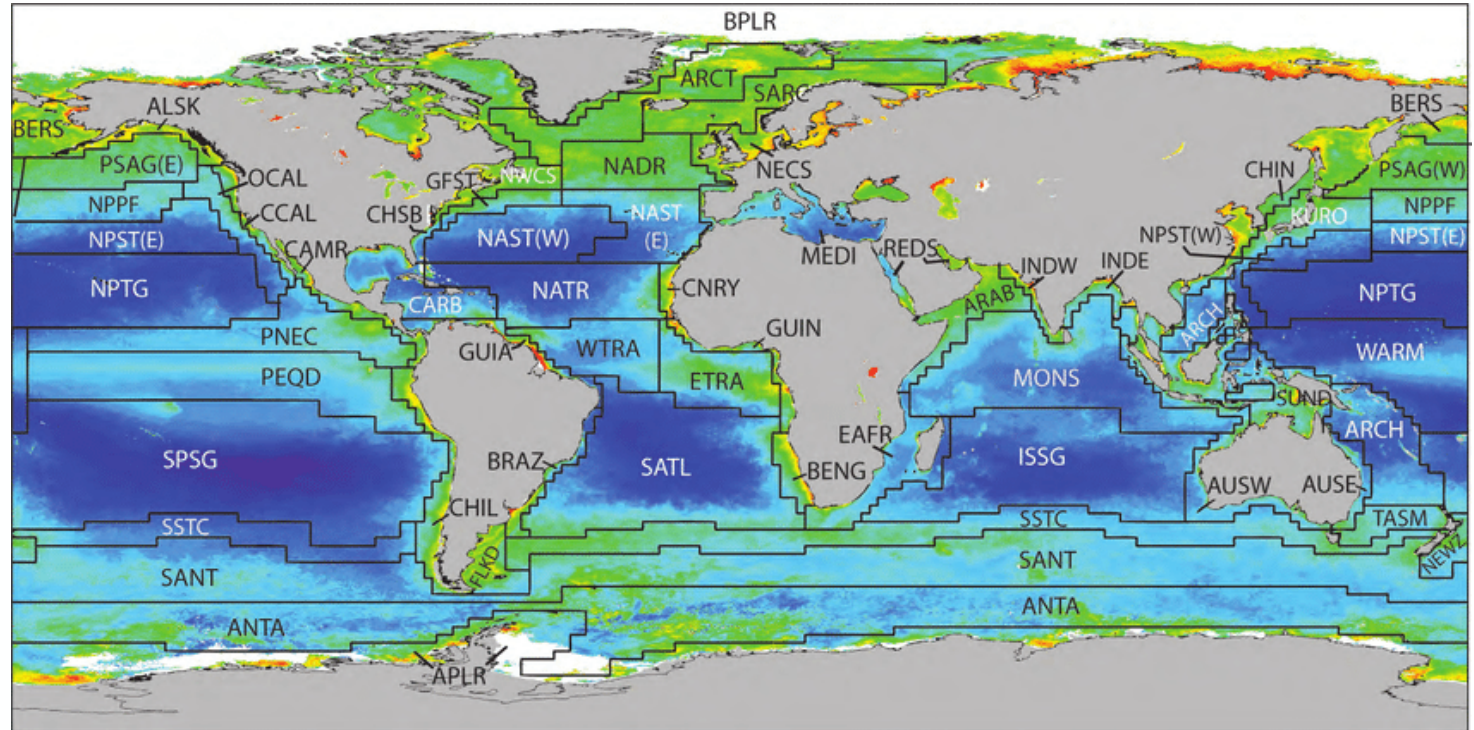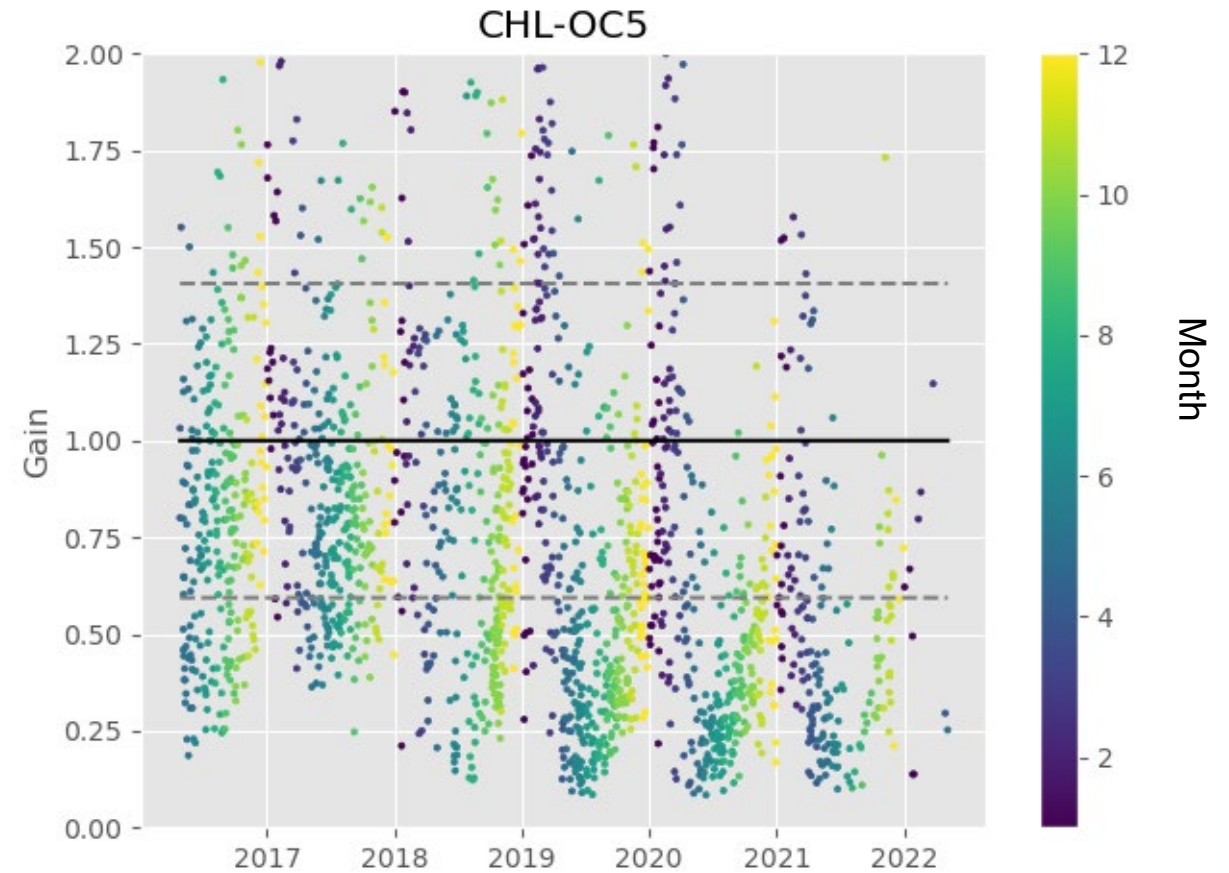
Temporal variability of ocean colour data

Discrepancies between BGC-Argo and satellite observation can be studied with time

$$Gain = \frac{Chl_{argo}}{Chl_{satellite}}$$

Seasonal deviation between OLCI and BGC-Argo chlorophyll a highlighted with the gain

CHL-OC5

Conclusions and futur work

➢ Advantages: spatial and temporal coverage of BGC-Argo floats; Set of parameters measured

  Drawback: lake a uncertainty estimate per profile/floats

➢ It appears to be crucial to maintained the floats deployment to benefit of an elevated number of

  matchups and go forward the validation of chlorophyll observation (not only QC step)

➢ BGC-Argo network will be tested for the Quality control of BBP and Kd ocean colour estimates

➢ Use ocean colour data in support of Quality Control of BGC-Argo

Thank you!

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