Improving BGC database with BGC profile audits against reference data

9th BGC-ADMT, December 1st, 2020

Raphaëlle Sauzède, Catherine Schmechtig, Antoine Poteau and Hervé Claustre

Contact: raphaelle.sauzede@imev-mer.fr

Institut de la Mer de Villefranche, Laboratoire d'Océanographie de Villefranche

How can we enhance BGC data usability?

- Global Argo reports anomalies:
  - Christine Coatanoan (Ifremer) → T/S anomalies detected using objective analysis (monthly report)
  - Stéphanie Guinehut and Nathalie Verbrugge (CLS) : T/S anomalies detected by comparing satellite SLA to float dynamic height anomalies

- How we can do something similar for BGC Argo parameters:
  - Josh Plant presentation during the 8th BGC-ADMT → DOXY audit: ftp://ftp.mbari.org/pub/BGC_argo_audits/DOXY/

Compare BGC data to reference data

- BGC profiles vs. reference data to detect anomalies:
  - DOXY audit using surface DOXY climatology from **WOA 2018**
  - BBP700 audit using **SOCA-BBP**-derived $b_{bp}(700)$ climatology (for **Satellite Ocean Color merged with Argo data to retrieve b_{bp}**; Sauzède et al. 2016)

AGU PUBLICATIONS

JGR

Journal of Geophysical Research: Oceans

RESEARCH ARTICLE

10.1002/2015JC011408

Key Points:

- A neural network is developed to infer the vertical distribution of the backscattering coefficient
- The neural network requires as input Argo T/S profiles and ocean color remote sensing products
- Validation of the method is highly satisfactory which supports its application to the global ocean

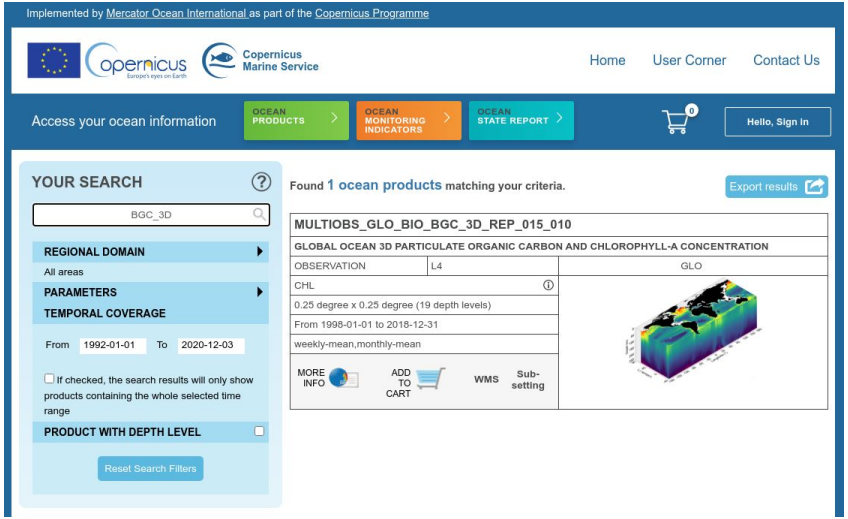
A neural network-based method for merging ocean color and Argo data to extend surface bio-optical properties to depth: Retrieval of the particulate backscattering coefficient

R. Sauzède[1], H. Claustre[1], J. Uitz[1], C. Jamet[2], G. Dall'Olmo[3,4], F. D'Ortenzio[1], B. Gentili[1], A. Poteau[1], and C. Schmechtig[1]

[1]Sorbonne Universités, UPMC Univ Paris 06, CNRS, Observatoire Océanologique de Villefranche, Laboratoire d'Océanographie de Villefranche, Villefranche-Sur-Mer, France, [2]Laboratoire d'Océanologie et de Géosciences, UMR8187, ULCO/CNRS, Wimereux, France, [3]Plymouth Marine Laboratory, Plymouth, UK, [4]National Centre for Earth Observation, Plymouth, UK

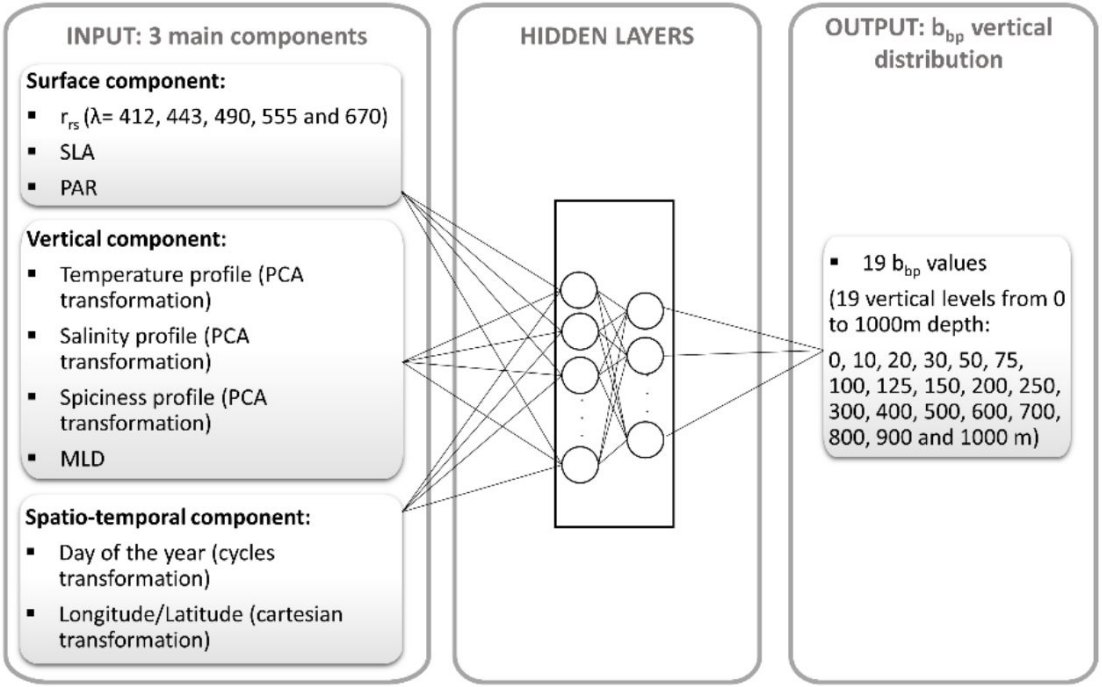
BBP700 climatological product

- Based on SOCA-BBP 2020 improved method used to deliver the POC product for the european service **CMEMS** (Copernicus Marine Environment Monitorng Service)
- Products available at: ➜ https://marine.copernicus.eu/ (in “access to products”: search BGC_3D)
- **Resolution** of CMEMS 3D BGC product:
  - Global ocean
  - Black sea and coastal areas **not represented**
  - 0.25° x 0.25° horizontal resolution
  - 19 depth levels for the vertical resolution
  - Weekly products from 1998 to 2018
  - Monthly climatological products



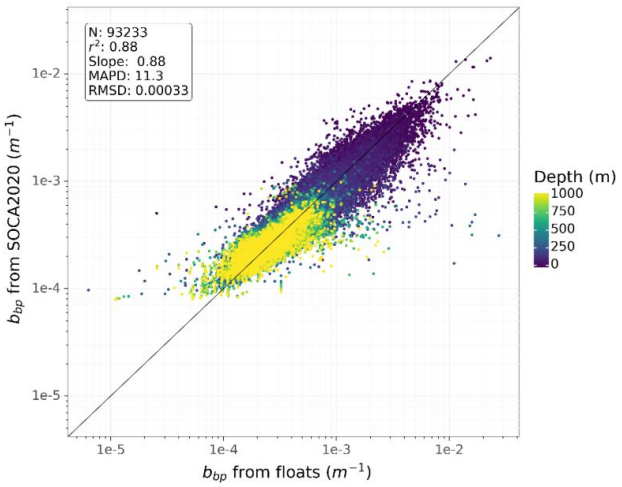
SOCA-BBP upgraded 2020 method

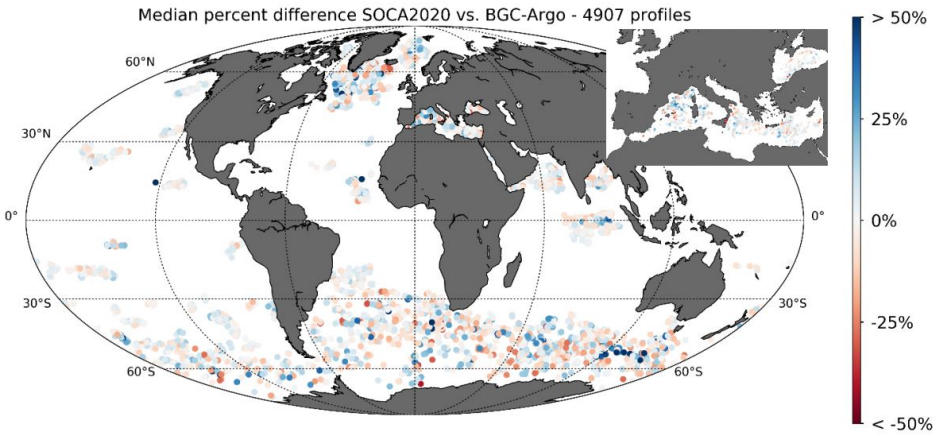
- Ensemble of neural network: average of the 10 best Multi-Layer Perceptrons retrieval
- ~ 25,500 profiles for SOCA2020 training and validation (against ~ 5,000 for SOCA2016)



SOCA-BBP upgraded 2020 method

Validation of SOCA2020 using the validation dataset composed of 4,907 profiles:





→ Creation of weekly BBP700 climatologies (53 files) dedicated to the bbp AUDIT using the SOCA2020 updated method

BBP700 AUDIT methodology

Comparison between observations vs. reference data (same philosophy as DOXY Audit):

- Based on MAD = Median Absolute Deviation to detect outliers
  - M = median of fleet test values (TV)
  - Manom = abs(TV - M)
  - MAD = median(Manom) * B with B = 1.4826
  - Z = Manom/MAD
  - Choose a threshold for Z (5 used for DOXY audit and 5 is used for now for BBP audit)

- Total of 210,895 profiles (81,396 with BBP700 measured)
- 73,262 profiles with good flagged position and date and with at least one BBP700 value
- **60,096 profiles have been compared to climatological BBBP700 fields**

BBP700 AUDIT methodology

- First, the 60,096 BBP700 profiles are compared to weekly climatological BBP700 fields
  ➜ correspond to all data available (with “bad” and “good” flagged BBP700 profiles ➜ PROFILE_BBP700_QC = A/B/C/D/E ou F)
  ➜ **in order to evaluate the audit performance using the QC profiles flag available**

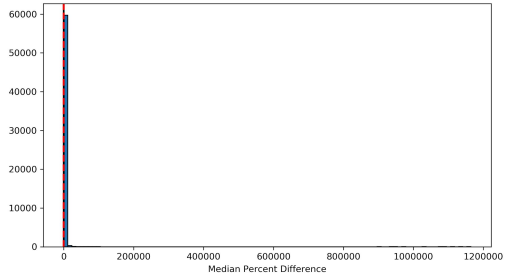
ARGO PROFILE QC

n	Meaning
“ “	No QC performed
A	***N*** = 100%; All profile levels contain good data.
B	75% <= ***N*** < 100%
C	50% <= ***N*** < 75%
D	25% <= ***N*** < 50%
E	0% < ***N*** < 25%
F	***N*** = 0%; No profile levels have good data.

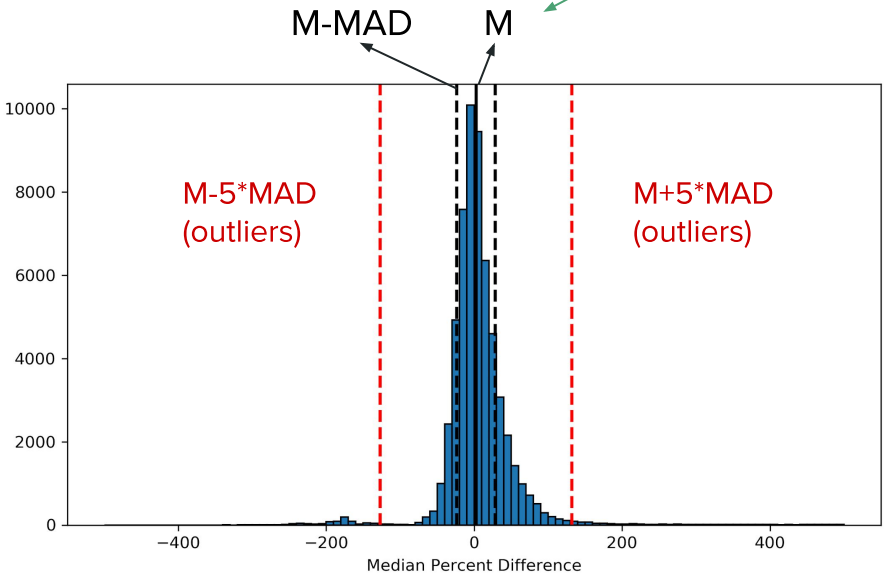
BBP700 AUDIT methodology

- Histogram of the Median Percent Difference computed for each profile with MAD:

All range data



zoom



M+/-5*MAD ~ +/- 130%

BBP700 AUDIT methodology validation

For the validation of the BBP700 audit methodology:

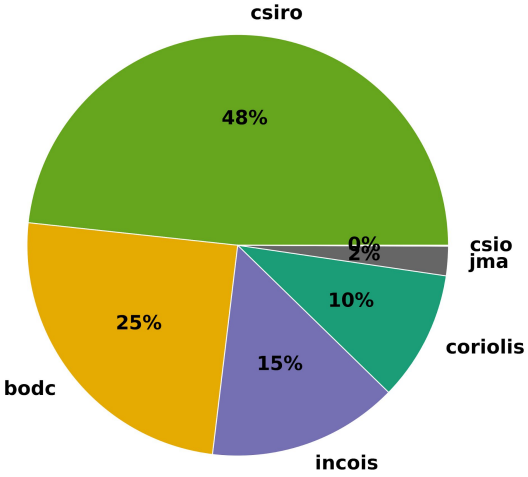
- Use all the BBP700 profiles (whatever PROFILE_BBP700_QC A/B/C/D/E or F)
  - ➔ **3,496 “anomalous” profiles from the BBP700 audit**
  - ➔ from which **2058 profiles were already flagged as bad** in the BGC-Argo database (PROFILE_BBP700_QC = D, E or F)
  - ➔ **~60% of “anomalous” profiles bad for sure**
  - ➔ The 1438 remaining “anomalous” profiles has been visually checked with **only ~150 possible false positive** found (due to coastal influence, regional areas with specific process not represented by the training data used to develop SOCA2020, issue with resolution of acquisition or not full profile available…)

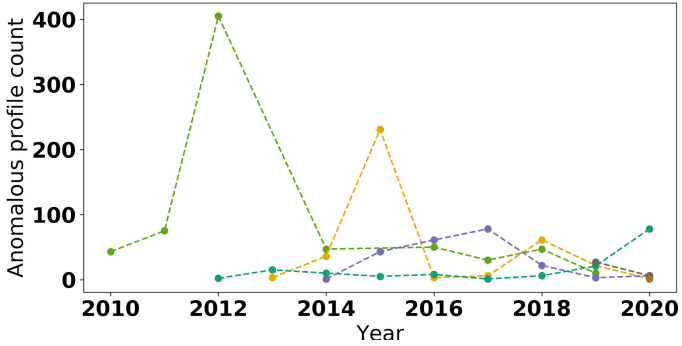
➔ **Validation for more than 95% of the “anomalous” profiles** found with this methodology

BBP700 AUDIT

- Removal of profiles already bad flagged in the BGC-Argo database
  - ➔ profiles with PROFILE_BBP700_QC D/E or F
- New calculation of MAD ➔ “real” BBP700 AUDIT:

csiro	707
bodc	363
incois	214
coriolis	146
jma	33
csio	1
Total	**1464**



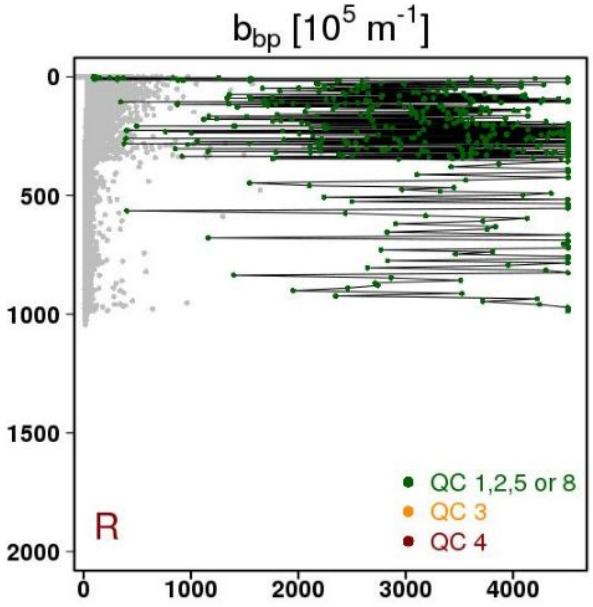


BBP700 AUDIT: examples of anomalous profiles

Find some noisy profiles (e.g. sensor saturation):

- exemple for the float 6902905 (coriolis)

➔ anomalous profile for cycle 211

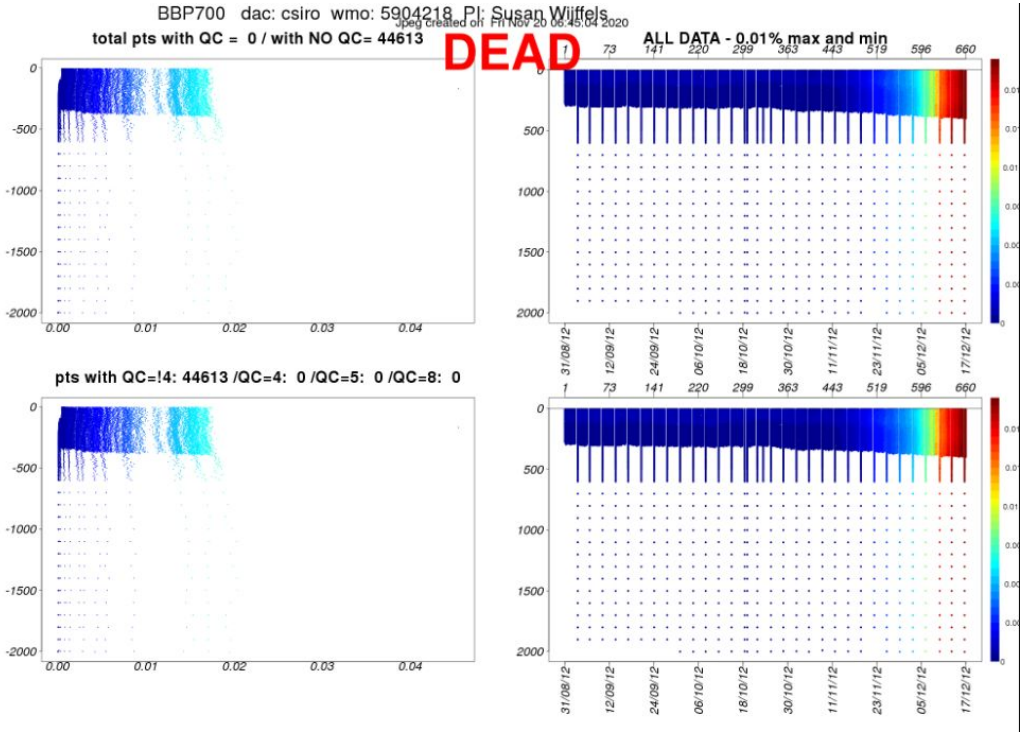


BBP700 AUDIT: examples of anomalous profiles

Sensor drift detection:

- example for float 5904218 (csiro)

➔ anomalous profiles from cycle 479 to the end of time series



Perspectives / conclusion

- Allows to detect noisy profiles in a time series, sensor shift detection, drift…
- Deliver the same documents as Josh Plant for his DOXY audit available online at the same place (maybe BGC-Argo website in the future?)
- Send anomalies report (every 6 months? frequency to establish)
- BBP700 audit method (e.g. statistics) may be updated in the future based on your feedback
- Next year, the same product will be delivered for CHLA (under development as part of the BlueCloud european project) → CHLA audit
- Development of visualization tools for QC data
- see background presentation for more details and links