7nd Biogeochemical-Argo Workshop
December 4-5 2018, San Diego

Final recommendations

Fundamental decision for the global implementation of BGC-Argo

Evolving capabilities of the ARGO profiling float network

The Executive Council,

I. Global implementation of six new biogeochemical parameters on Argo floats

1. Having examined the evolving capabilities of the Argo profiling float network and the planned global implementation of sensors to measure six new biogeochemical parameters described in IOC/EC-LI/2 Annex 9 Section II,

2. Recognizing the contribution of Argo to measurement of GOOS Essential Ocean Variables, and the potential scientific and societal benefits of the global measurement of the six new biogeochemical parameters,

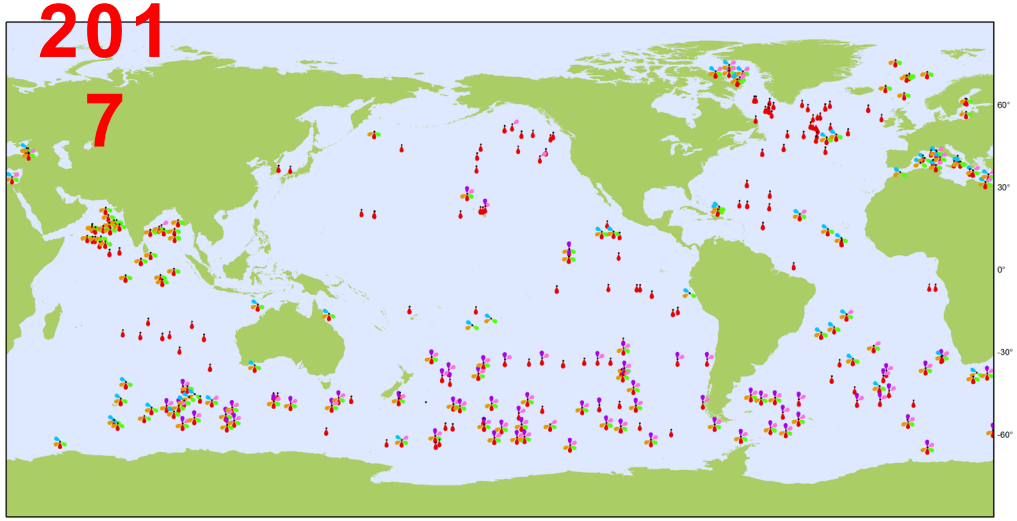
3. Appreciating Argo's pioneering free and open data policy, in compliance with the later IOC Oceanographic Data Exchange Policy (IOC Resolution XXII-6),

4. Approves the global implementation of Argo floats measuring these six parameters—oxygen, pH, nitrate, chlorophyll, backscatter, and irradiance; and

5. Agrees to the continued use of IOC's *Guidelines for the Implementation of Resolution XX-6 of the IOC Assembly Regarding the Deployment of Profiling Floats in the High Seas within the Framework of the Argo Programme* (IOC Resolution EC-XLI.4) for notification to coastal Member States of all Argo profiling floats likely to enter their EEZ, including those measuring these new variables;

6. Recognizing the value of Argo for responding to global challenges on climate variability and change and its role in underpinning ocean and marine services, encourages all IOC Member States to further support and participate in the implementation of the Argo programme, and to facilitate the deployment of Argo floats within their areas of national jurisdiction.

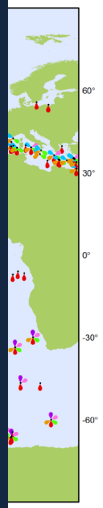
BGC-Argo network evolution over one year



Operational Floats (292)
Suspended particles (148)
Downwelling irradiance (54)
pH (74)
Nitrate (94)
Chlorophyll a (148)
Oxygen (283)

Generated by www.jcommops.org, 07/11/2017

Operational Floats (35



a (210)
2)

org, 12/11/2018

TOTAL PROFILES	2018 PROFILES
155676 TOTAL O_2 PROFILES	12782 2018 O_2 PROFILES ACQUIRED BY 313 SENSORS
28768 TOTAL NO_3 PROFILES	4677 2018 NO_3 PROFILES ACQUIRED BY 135 SENSORS
9311 TOTAL PH PROFILES	2931 2018 PH PROFILES ACQUIRED BY 104 SENSORS
60021 TOTAL CHL A PROFILES	8962 2018 CHL A PROFILES ACQUIRED BY 209 SENSORS
59117 TOTAL SUSPENDED PARTICLES PROFILES	8962 2018 SUSPENDED PARTICLES PROFILES ACQUIRED BY 209 SENSORS
28863 TOTAL DOWNWELLING IRRADIANCE PROFILES	3840 2018 DOWNWELLING IRRADIANCE PROFILES ACQUIRED BY 60 SENSORS

biogeochemical Argo

Tracking new deployments

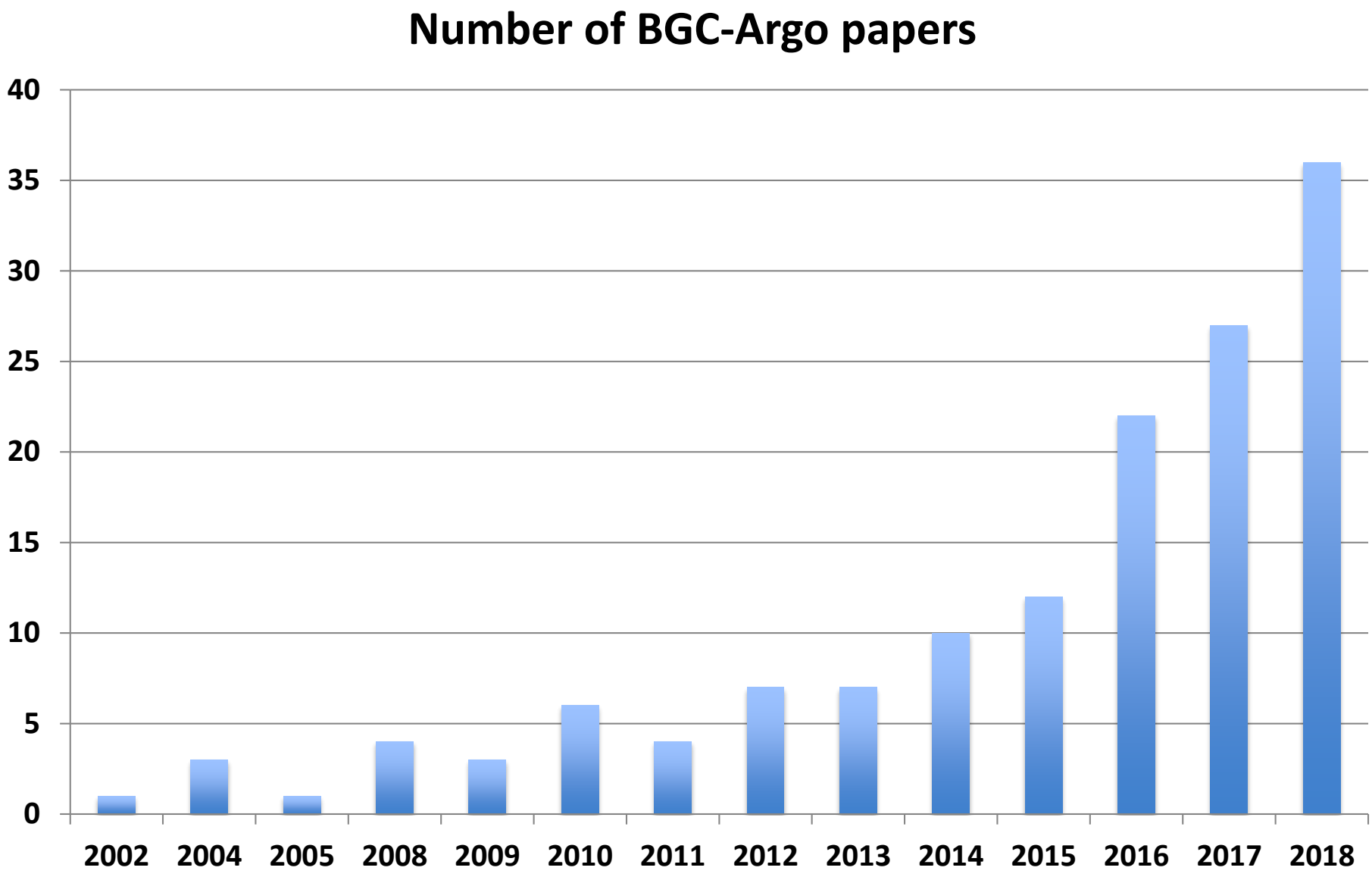
FLOAT DEPLOYMENT HISTORY

SHOW 25 ENTRIES

SEARCH:

WMO	PROJECT Name	PI Name	SENSORS	DATE Start	N° Profiles	LATs	LONs
6903246	Argo-Italy	Pierre-Marie Poulain	O2	2018-10-26	8	34.969	23.232
5905985	UW, SOCCOM, Argo equivalent	STEPHEN RISER, KENNETH JOHNSON	BBP,CHLA,O2,NO3,PH	2018-10-25	4	-41.334	-44.023
5905984	UW, SOCCOM, Argo equivalent	STEPHEN RISER, KENNETH JOHNSON	BBP,CHLA,O2,NO3,PH	2018-10-24	4	-39.207	-41.356
6902902	NAOS	Fabrizio d'Ortenzio	BBP,CHLA,IRR	2018-10-23	13	35.100	28.281
5905983	UW, SOCCOM, Argo equivalent	STEPHEN RISER, KENNETH JOHNSON	BBP,CHLA,O2,NO3,PH	2018-10-22	4	-34.598	-36.123
6902872	GMMC PERLE	Laurent COPPOLA	O2	2018-10-22	8	35.561	28.215
6902874	GMMC PERLE	Laurent COPPOLA	O2	2018-10-22	8	35.089	28.274
6902900	NAOS	Fabrizio D'Ortenzio	BBP,CHLA,O2,IRR,NO3	2018-10-22	17	35.587	28.212
6902904	NAOS	Herve Claustre	BBP,CHLA,O2,IRR,NO3	2018-10-22	12	35.097	28.275
5905982	UW, SOCCOM, Argo equivalent	STEPHEN RISER, KENNETH JOHNSON	BBP,CHLA,O2,NO3,PH	2018-10-21	5	-32.377	-33.659
5905980	UW, SOCCOM, Argo equivalent	STEPHEN RISER, KENNETH JOHNSON	BBP,CHLA,O2,NO3,PH	2018-10-19	5	-27.209	-28.314

BGC-Argo: number of publications



Several discussions and outcomes from last BGC-Argo Workshop

- **Data format**: balance between complex /large files but closer to the reality of the sampling…….vs other "aligned" format, more easy to use (key for end-users) but less close from the reality of the measurement
- **R, A vs D modes** for BGC-Argo data
- **Reprocessing issues**
  - Whole data base reprocessing due to sensors issues (bbp, Chla) clearly identified in peer review literature
  - Objective to provide more rapidly science-quality data to end users.
- Converge to **produce documentation** processing and RT–QC procedure for the 6 core variables

Data mode: RT, A & D

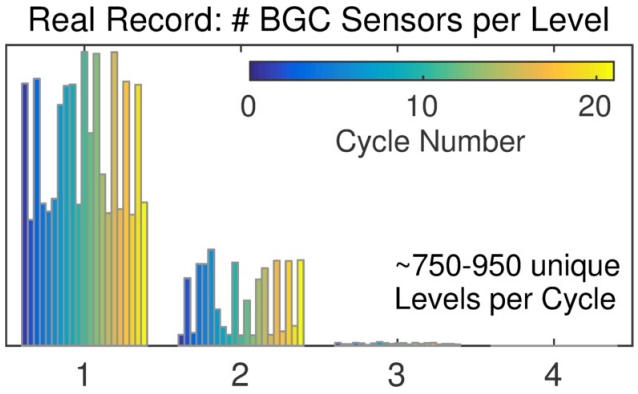
- ADMT 18 recommendation: put a D mode on data adjusted after an operator check (backwards) and A mode (forwards)
- what are requirements for deciding D mode?:
  - At least one year (e.g. core Argo) of data
  - An operator assisted decision with no requirement on acquisition duration
- The BGC-Argo community will have to define /refine the significance of these modes and flags with respect to the specificities of the variables

« Best practices » for new implementation

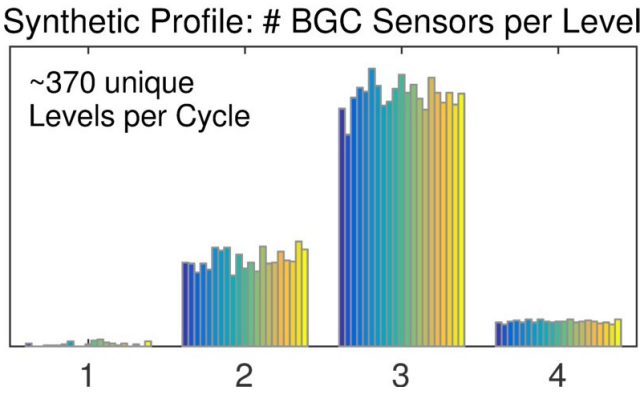
- Any potential improvement has to be first fully tested, results presented and discussed at the ADMT
- If the proposition is agreed then it has to be documented
- Then the reprocessing could be undertaken
  - A Time start and delay have to be agreed by the various DAC
  - Reprocessing “tracks” should be documented in the NCDF files
  - These tracks should be monitored to evaluate the completeness of the reprocessing
  - Announced on the BGC-Argo website (+ newsletter/ announcement)

S-profiles

- Many Sensors on BGC Floats – Rarely (←'never') sampled together
- Made transparent by newer float types; reflected in c- and b-profiles



→ Co-Location of multi-Sensor Data only by Chance !
→ Hard for multi-BGC Analyses...



→ Highest justifiable Co-Location

- Produce 'Synthetic' Profiles by GDACs that
  - align BGC without upsampling, displacing too far, or distorting profile shape
  - add HR T/S profile back in after BGC alignment to allow combined physical/BGC analyses
- Stop producing 'M-profiles' that are just concatenation of c- and b-params

b_{bp} recommandations

- The reprocessing of the whole fleet is almost done
- If deep bbp values are more consistent between sensor models some discrepancies still subsists
  - Need to be analyzed in more details at the regional scale (Antoine)
- No reason to leave bbp in R => b_{bp} (message for end-users) should be passed into the A mode.
  - Scientific_calib_*** have to be filled to justify that no adjustment was performed on purpose
- Proposition of field error to be agreed between Emmanuel MAX (% bbp, signal associated with 3 counts) and Giorgio (uncertainty modeling)
- Once visually inspected, b_{bp} can be move to D mode
- All the proposed updates will be documented

Oxygen

- Corrected typo in B2 exponent: Check whether relevant and reprocess at DAC discretion, latest when float is dead and before DMQC
- Pressure effect time response on deep optode data – under investigation to better assess magnitude / importance
- Adjusted Error guidelines as sum of
  - gain uncertainty
  - calibration uncertainty (O_2 – T calibration method)
  - pressure uncertainty
- RT Adjustment based on WOA surface O_2 saturation where compliant with DAC operations; otherwise strong urge for PIs/DM operators to provide (preliminary) correction of strong ‘storage’ drift within couple of cycles
- In-air observations as best practice
- DM Adjustment based in-air observations should check / compensate effect of (1) ‘carry-over’, (2) temperature-bias, (3) in-situ drift (in order of importance)

pH

- Documentation has been done (processing and QC)
- Besides MBARI, new players are coming
- We need to have knowledge of the various version of the sensor and if engineering changes affect our way to manage / QC the data
- Require some test to decide the depth reference where the adjustment is done

NO3

- Various methods of adjustment proposed in RT and D
- For A Mode : investigate the use of MLR/NN without DOXY as input as a “ reference”
- For Marginal Sea (e.g. Mediterranean Sea): investigate / develop specific MLR/NN
- Require some test to decide the depth reference where the adjustment is done
- When HS is greater 4 uM, NO3 data should be flagged as QC=4
- Finalize the QC in the documentation

Decision table

- Address the impact of a given PARAM (e.g. PSAL, TEMP) on the accuracy of BGC parameters
- Define the acceptable range (QC) and the propagation of the error into the BGC parameter

Chla

RT & A modes

- “Roesler” factor 2: has been done by most DACs. Few floats remaining to be processed.
- Some mismatch between DACs with respect of managing spikes within the “NPQ layer”. For the moment recommendation to stay “conservative” (Xing12 with extrapolation to the surface QC=5)
- Error field: proposition of MBARI vs Boss MAX (% Chla-A, signal associated with 3 counts) to be discussed: Xiaogang and Josh
- To be updated in the QC manual

D Mode

- For the implementation of a new DM method for NPQ correction: Develop a share “global ocean representative dataset” and test the various proposition (Josh and Xiaogang)
- Same for improving dark correction (that could be move on R once validated)

Miscellaneous

- Leave the PIs decide whether or not implementing their “own” dark values (vs factory dark): no impact as the Chla is set to zero. Store this information in SCIENTIFIC_CALIB_COEFFICIENT

Radiometry

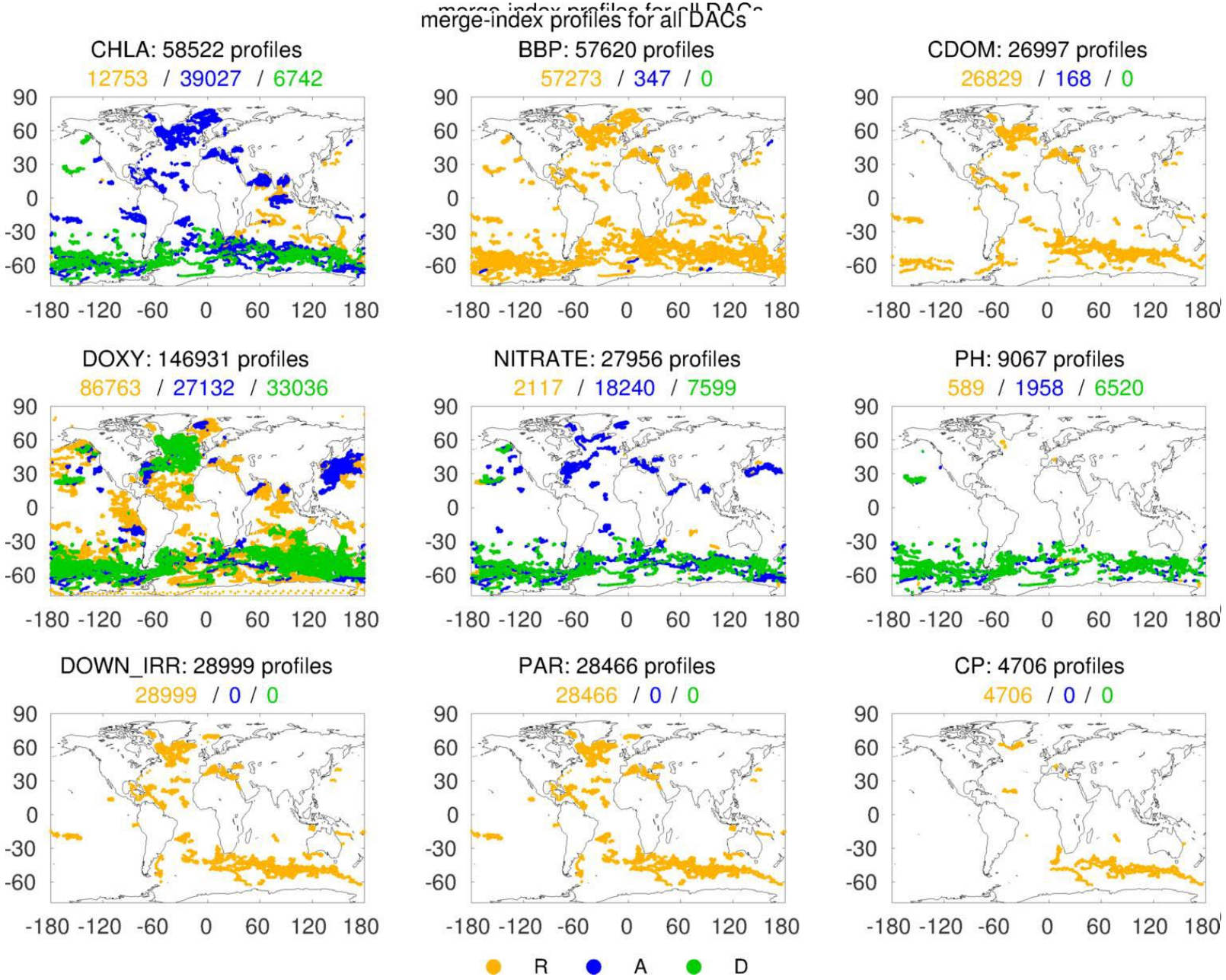
RT

- Method based on a clear sky model (Gregg and Carder) for clear waters to define the maximal possible values of Ed(λ) or PAR
- Define acceptable range (min-max) from this model
- Validated on the global dataset => remove the aberrant data
- Write QC document then implement

DM

- Temperature dependence of the sensor addressed that prevents using (low value) radiometry data in the deep ocean.
- Method for improvement based on « night » in situ measurement during late summer allow to determine in situ the temperature dependence of the sensor
- Wait on a published method and associated validation on the whole float data set to propose and implement as true DM method for the next ADMT (Xiaogang et al.)

Monitoring of the network R, A & D



201
8

Documentation status

Parameters	Processing	Quality Control
O_2	DOI 10.13155/39795	DOI 10.13155/40879
NO_3	DOI 10.13155/46121	
pH	DOI 10.13155/57195	DOI 10.13155/57195
Chla	DOI 10.13155/39468	DOI 10.13155/35385
b_{bp}	DOI 10.13155/39459	
Irradiance	DOI 10.13155/51541	

Legend	Done	On-going

New BGC-Argo products

- pCO2 pH /O2 + MLR /NN
- CANYON B neural network : i.e. nutrient
- Merged Argo Ocean color merged products

- Not Argo files but the products should be announced / publicized on the Argo /BGC-Argo website towards their repository

frontiers in Marine Science | Ocean Observation

Ocean best practices

Research Topic

Best Practices in Ocean Observing

Submit your abstract | Submit your manuscript

Bittig et al. : BGC-Argo best Practices contribution (March

1. Pre-deployment / lab : Sensors + platforms
2. At sea procedures
3. Data management & distribution
4. Data usage

For end-users: « executive summary » of the section 3 & 4 to be posted on the Argo and BGC-Argo websites

Global planning

- Argo2020 and the implementation of BGC-Argo. Need to develop high-level messages (ocean health, fisheries, acidification, desoxygenation…)

- BGC-Argo SSC in phase with AST in Hangzhou China (March 11-15).