

Update on Biogeochemical-Argo

AST-19

Ken Johnson & Herve Claustre



Biogeochemical Argo - H x

www.biogeochemical-argo.org

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**biogeochemical
!Argo**

An extension of the Argo program
to include biogeochemical observations

SCIENCE & IMPLEMENTATION PLAN

- ABOUT US >
- PROGRAM LIFE >
- SCIENTIFIC QUESTIONS >
- MEASURED VARIABLES >
- KEY AREAS & PROJECTS >
- DATA >
- LIBRARY >
- DISSEMINATION >
- FLOAT MAP & STATISTICS >

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**biogeochemical
!Argo**

**BIOGEOCHEMICAL
ARGO**

MENU

- > About us
- > Project Origin

MENU

- > Measured Variables
- > General Context

**TOTAL
PROFILES**

**2018
PROFILES**

126223

2342



« BGC-Argo communication



PROGRAM NEWS

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BIOGEOCHEMICAL-ARGO NEWSLETTER # 4

📖 Topics in Biogeochemical-Argo Newsletter # 4

🏷 Tag

[READ IT ONLINE](#)

► [Note from the editors](#)

Note

► [Ocean sciences meeting 2018 BGC-Argo session](#)

Program Life

Note from the editors

We are pleased to share with you the 4th Biogeochemical-Argo Newsletter which highlights the main activities over the last four months.

We would like to welcome three new Scientific Steering Committee Members: Fei Chai (SIO/SOA, China), Satya Prakash (INCOIS, India) and Tom Trull (CSIRO, Australia). Note that Tom Trull will replace Nick Hardman Mountford who we thank for his active contribution in the early phases of BGC-Argo development.

We would like also to invite you to visit our rich "dissemination" webpages where materials for the public in general are available, as well as outreach initiatives. We welcome your projects or your interviews, thank you to send your contributions.

Please do not hesitate to disseminate this newsletter and **subscribe** to carry on receiving it! ... and follow Biogeochemical-Argo on Twitter [@bgc_argo](#)

Hervé Claustre & Ken Johnson
co-chairs of the Biogeochemical-Argo program

Upcoming events
Program Life

Ocean sciences meeting 2018 BGC-Argo session



11–16 February • Portland, Oregon, USA

Please note in your agenda the session on BGC-Argo at the **Ocean Sciences Meeting 2018**, Oregon, USA, on **16 February 2018**, BN53A: **Biogeochemistry and Nutrients in Open-Ocean Waters**: Sustainable Ocean Observations from Profiling Floats and Time Series III

[READ MORE](#)

Upcoming events
Program Life

Japan Argo will host the 6th Argo Science Workshop

Organizers

- Steve Riser
- Ken Johnson
- Lynne Talley

Profiling Floats Worl x

Secure | <https://web.whoi.edu/floats-workshop/>

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Biogeochemical Floats Workshop

HOME WORKSHOP RATIONALE AGENDA STEERING COMMITTEE LOGIS

OCB Biogeochemical Profiling Float Workshop


This workshop will bring together potential users to discuss biogeochemical profiling float technology, sensors, and data management, in order to begin the process of the intelligent design of future scientific experiments. The workshop will be held July 9-13, 2018 in Seattle, Washington.

Register [here](#), registration is first come, first served.



Workshop Sponsors

This workshop is an activity of the Ocean Carbon Biogeochemistry (OCB) program, which is funded by NSF and NASA.



Ocean Obs 19 abstract:

Implementing global BGC-Argo: towards a sustained program synergistically interacting with other components of the global observation system.

H. Claustre et al.,

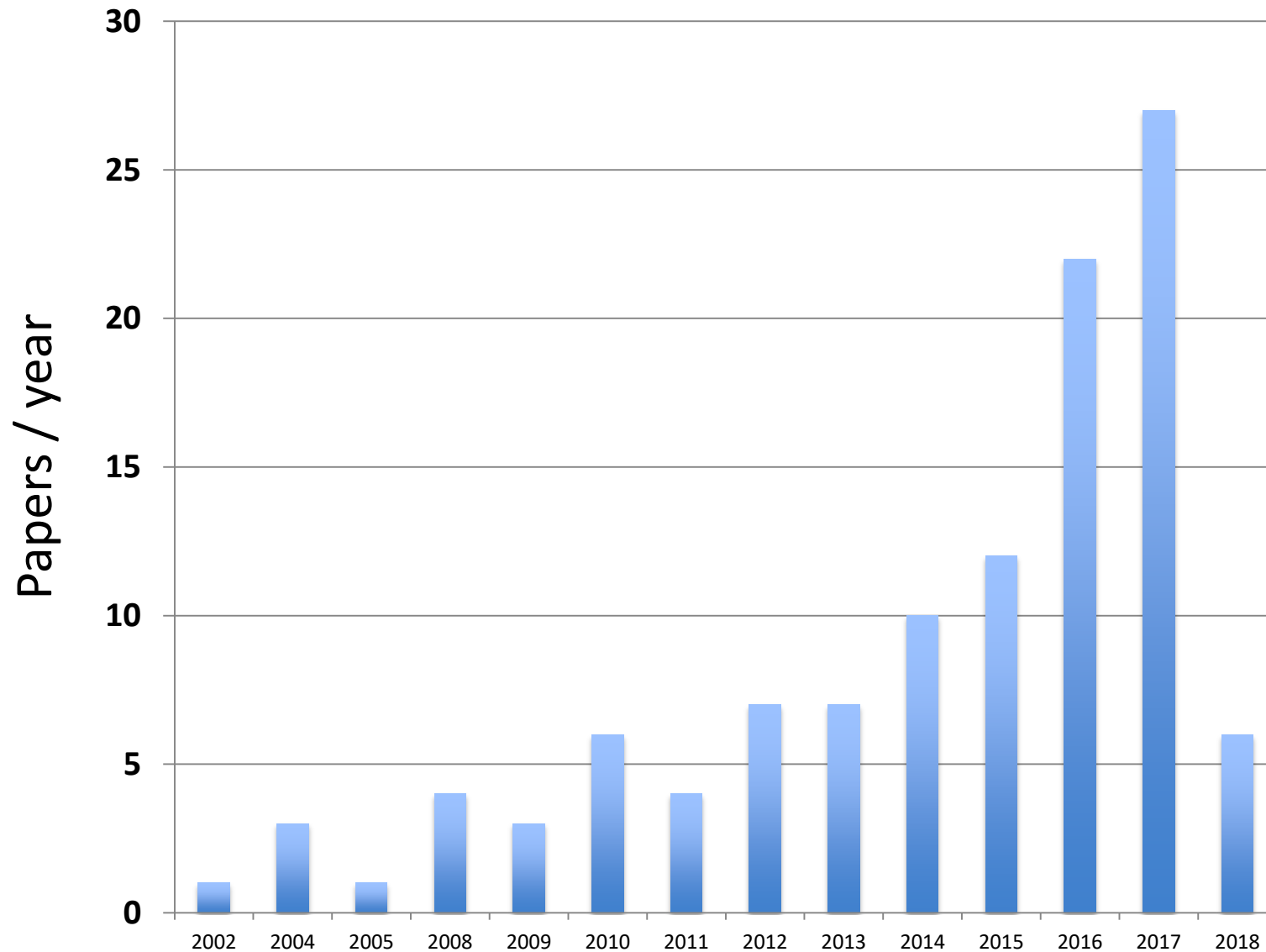
- Need to grow base program beyond research-scale projects,
- Need to build stronger links/synergy with programs such as GO-SHIP, SOCAT, IOCCG (Int. Ocean Color Coord. Group),
- Next step – basin scale, international “experiment” that demonstrates data consistency/capabilities across the many nations and which addresses key science topic, such as basin scale CO₂ flux and biological/physical drivers.



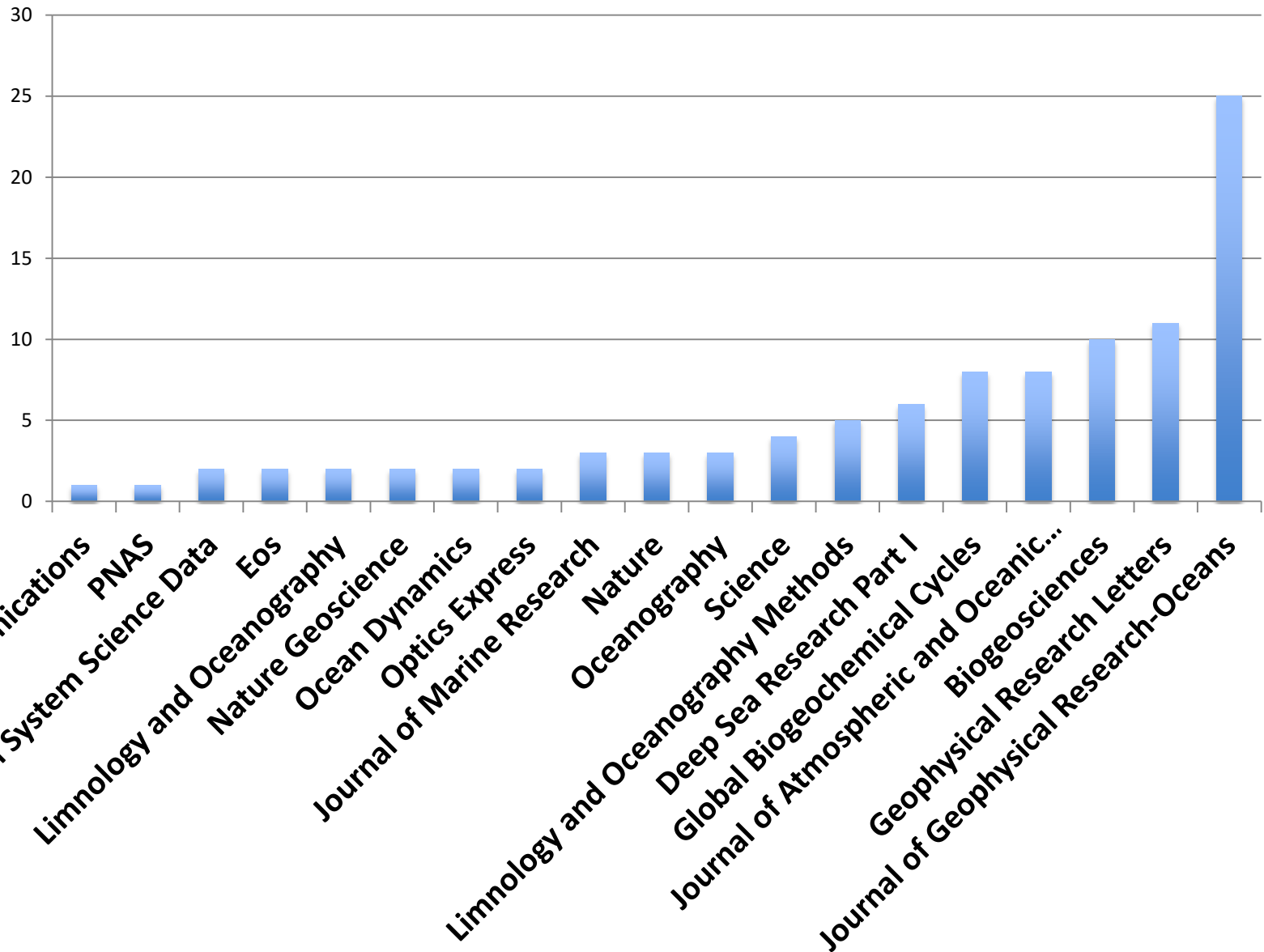
« BGC-Argo best practice » paper

- Contribution to the special issue « Best practices in Ocean Observing » of Frontiers in Marine Science (Ocean Observation section)
- Paper will be organized along the various steps required for in fine producing high quality interoperable data for end-users.
- Paper will rely on « grey literature » (protocols, hand-ones, tools) that will be DOI'd.
- Henry Bittig will lead & community will be contacted soon

BGC-Argo : evolution of scientific production (bibliography maintained at biogeochemical-argo.org)



BGC-Argo ms: preferential journals



WORLD VIEW • 13 MARCH 2018

Ocean sensors can track progress on climate goals

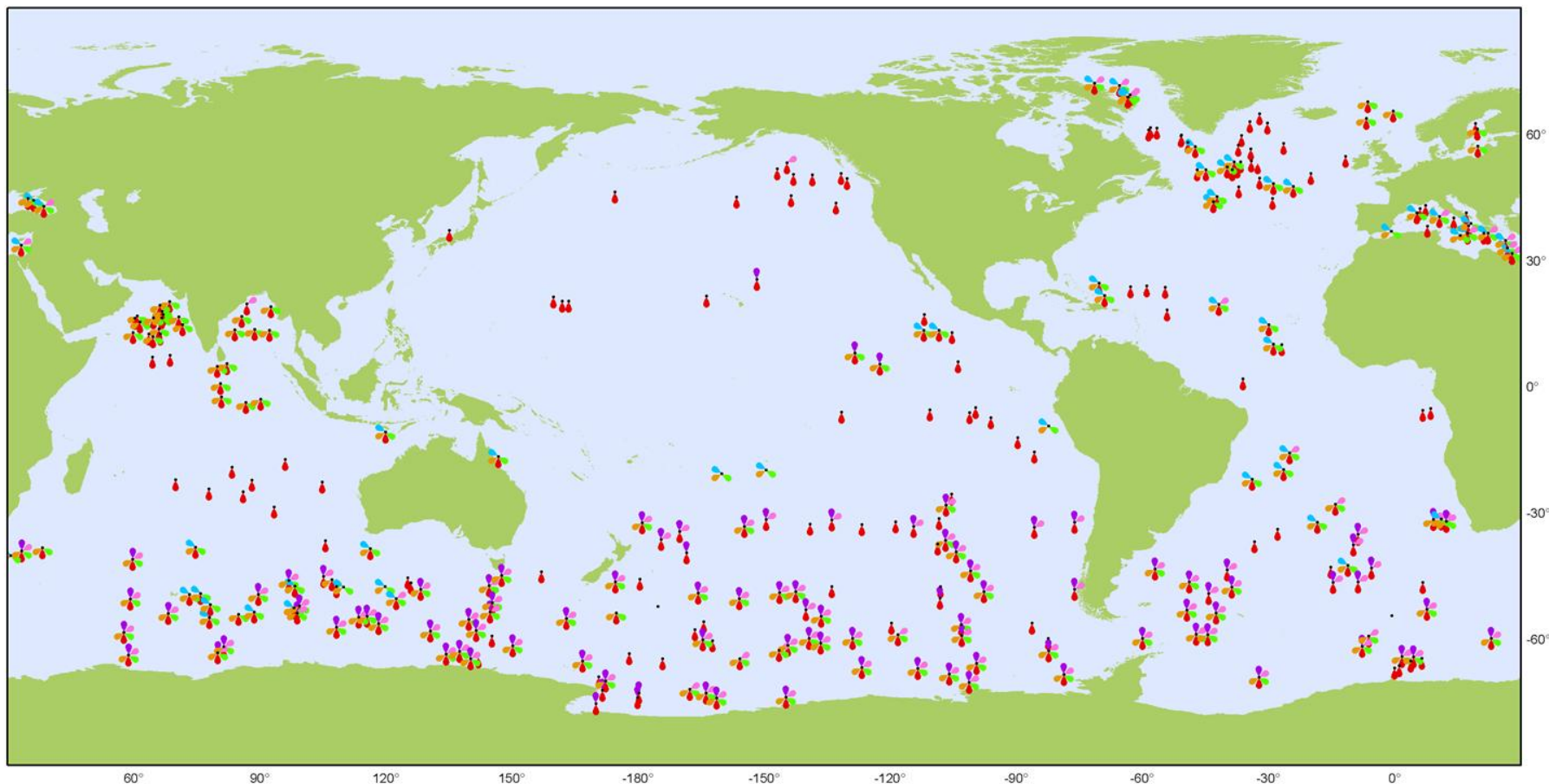


Uncertainties around carbon emissions will make climate agreements tough to enforce. The answer floats in the seas, says Joellen Russell.

Joellen Russell

Almost 200 nations have pledged to reduce their greenhouse-gas emissions under the Paris Agreement on climate change. We need a way to know whether they are succeeding.

To rectify this, my colleagues and I have been deploying Argo floats in the Southern Ocean that have been modified with biogeochemical sensors to measure oxygen and nitrate levels, pH and more. This project,



Biogeochemical Argo

Sensor Types

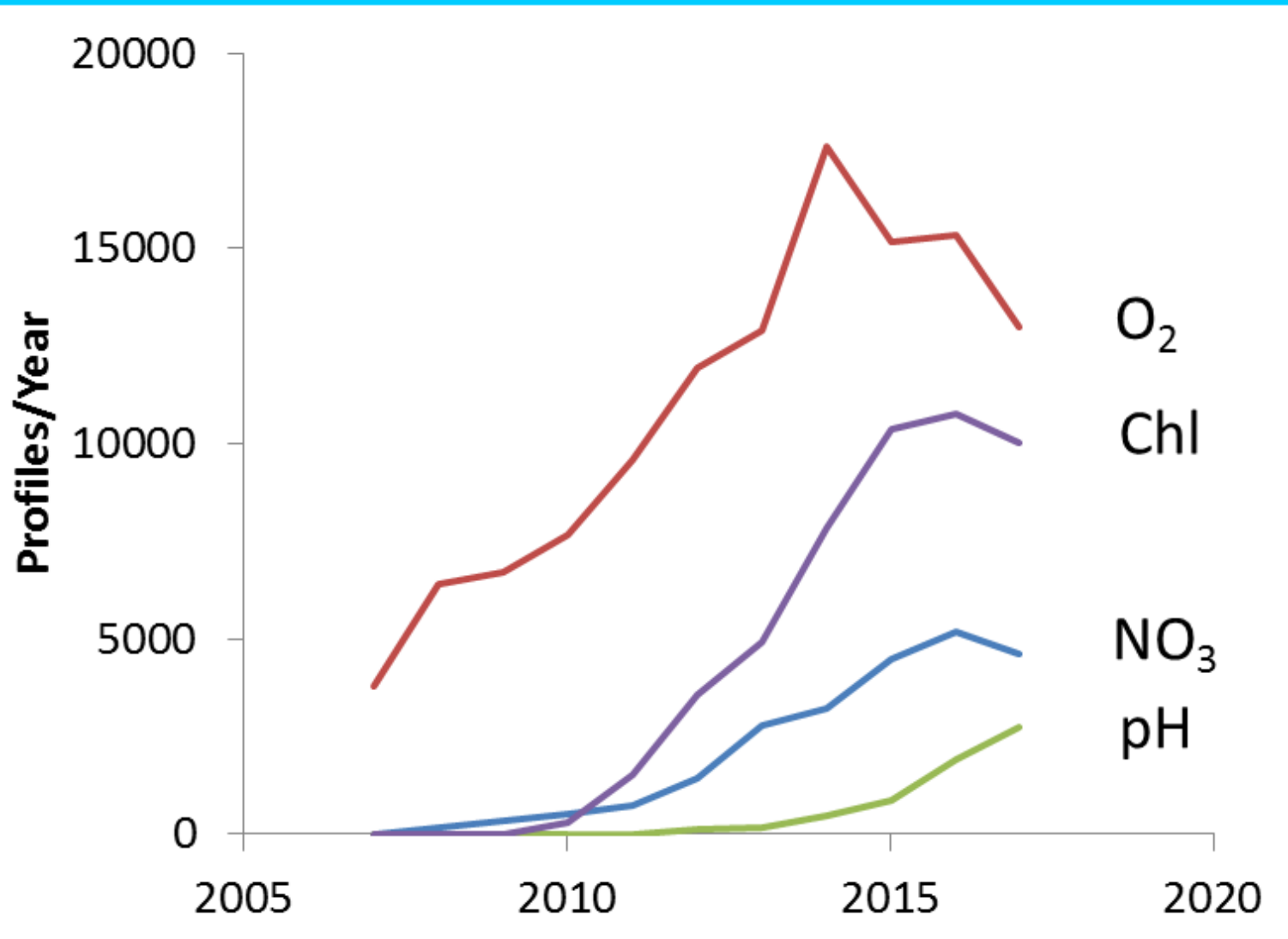
February 2018

Latest location of operational floats (data distributed within the last 30 days)

- Operational Floats (311)
- Suspended particles (175)
- Downwelling irradiance (56)
- pH (103)
- Nitrate (118)
- Chlorophyll a (175)
- Oxygen (302)



Generated by www.jcommops.org, 02/03/2018



BGC-Argo* has become the dominant source of open ocean biogeochemical data!

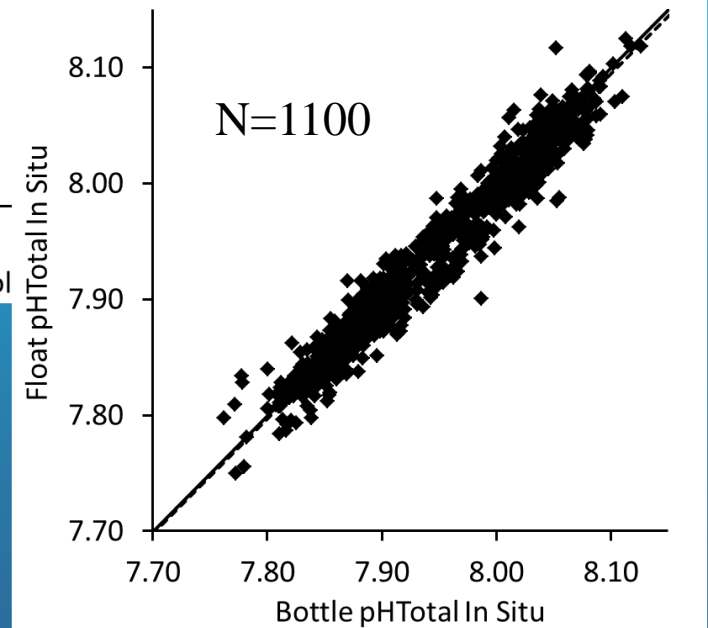
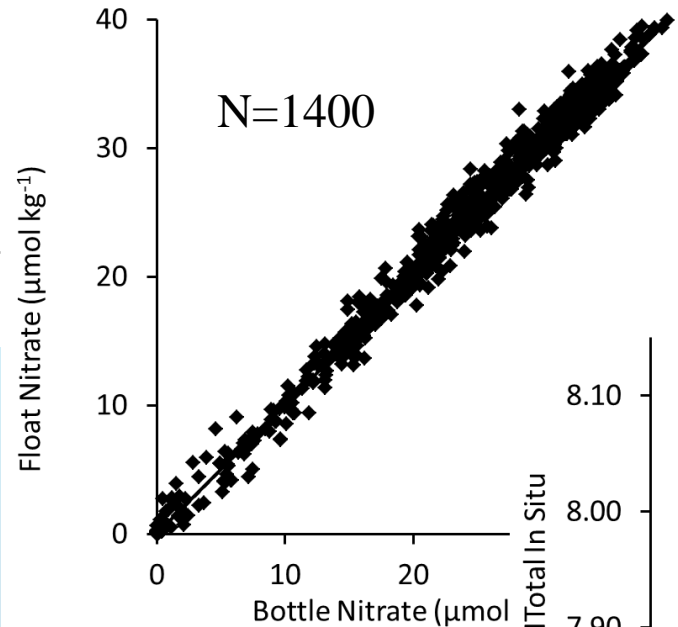
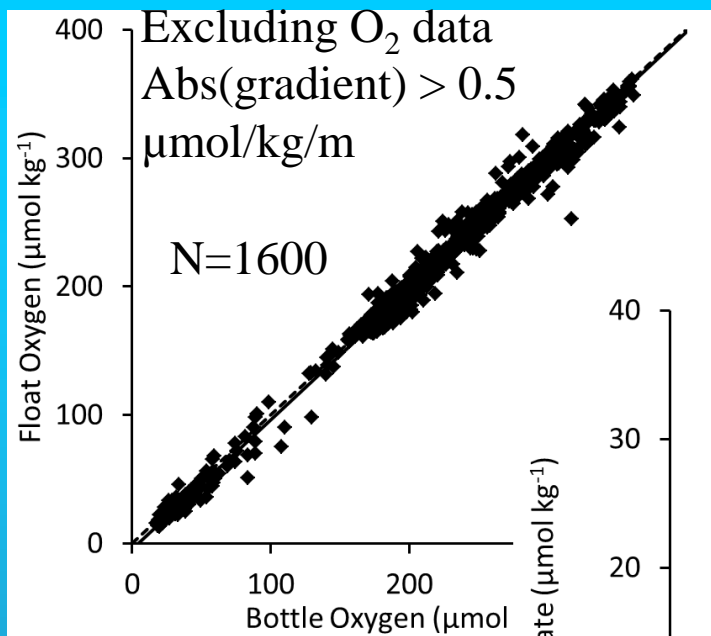
Table 1. Profiles to depth > 900 m.

Parameter	Avg. Ship Profiles per year (2001-2010)	BGC-Argo Profiles per year		BGC-Argo /Ship
		2016	2017	
Oxygen	1730	15324	12969	8
Nitrate	1231	5188	4601	4
pH	460	1892	2736	5
Source	US NODC	Argo GDAC		

* Caveat – While nearly all US data is qc'd in real time, not all nations have implemented these real time qc protocols.



First float profile data after qc compared to bottle samples collected when float deployed (Johnson et al., JGR Oceans 2017).

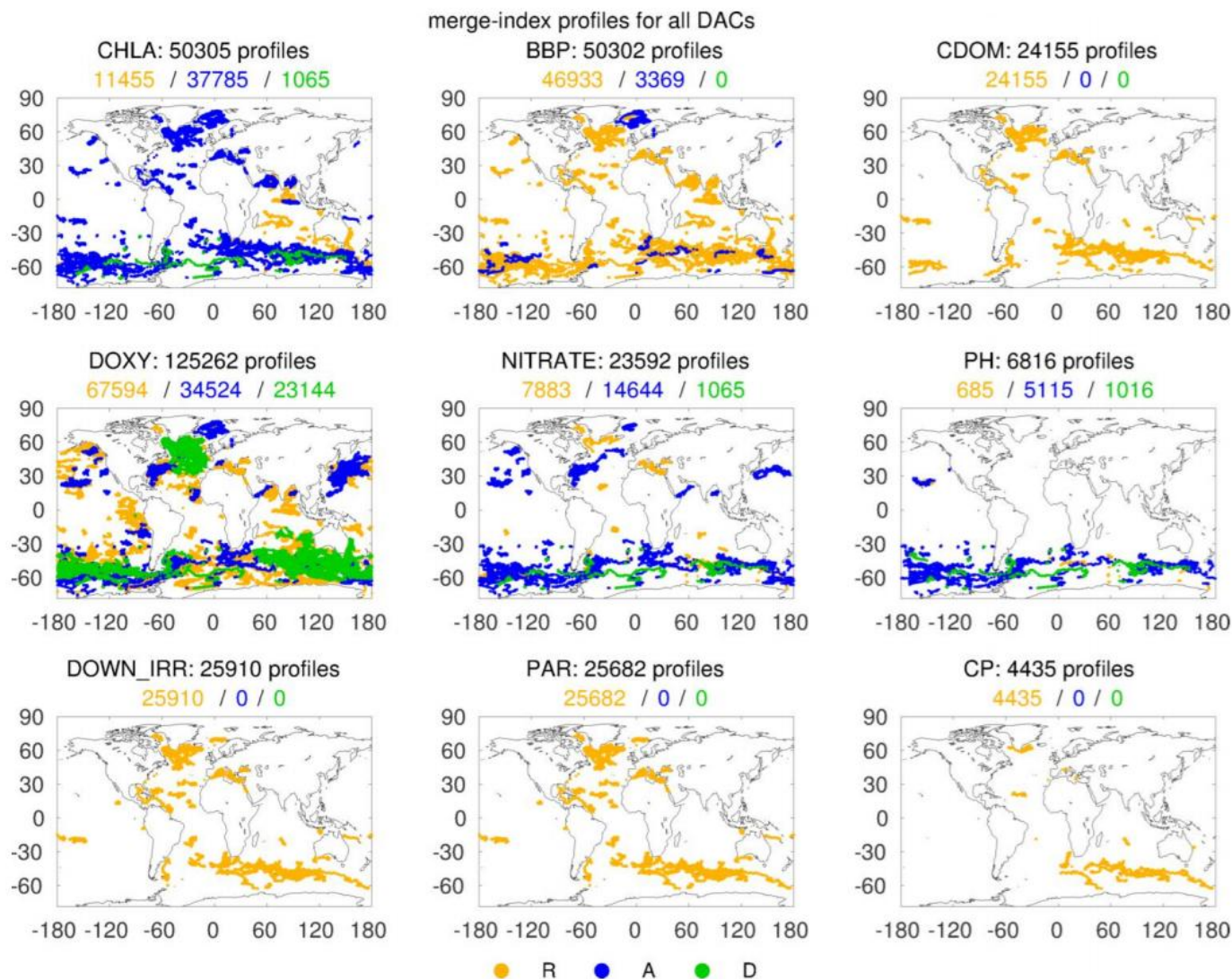


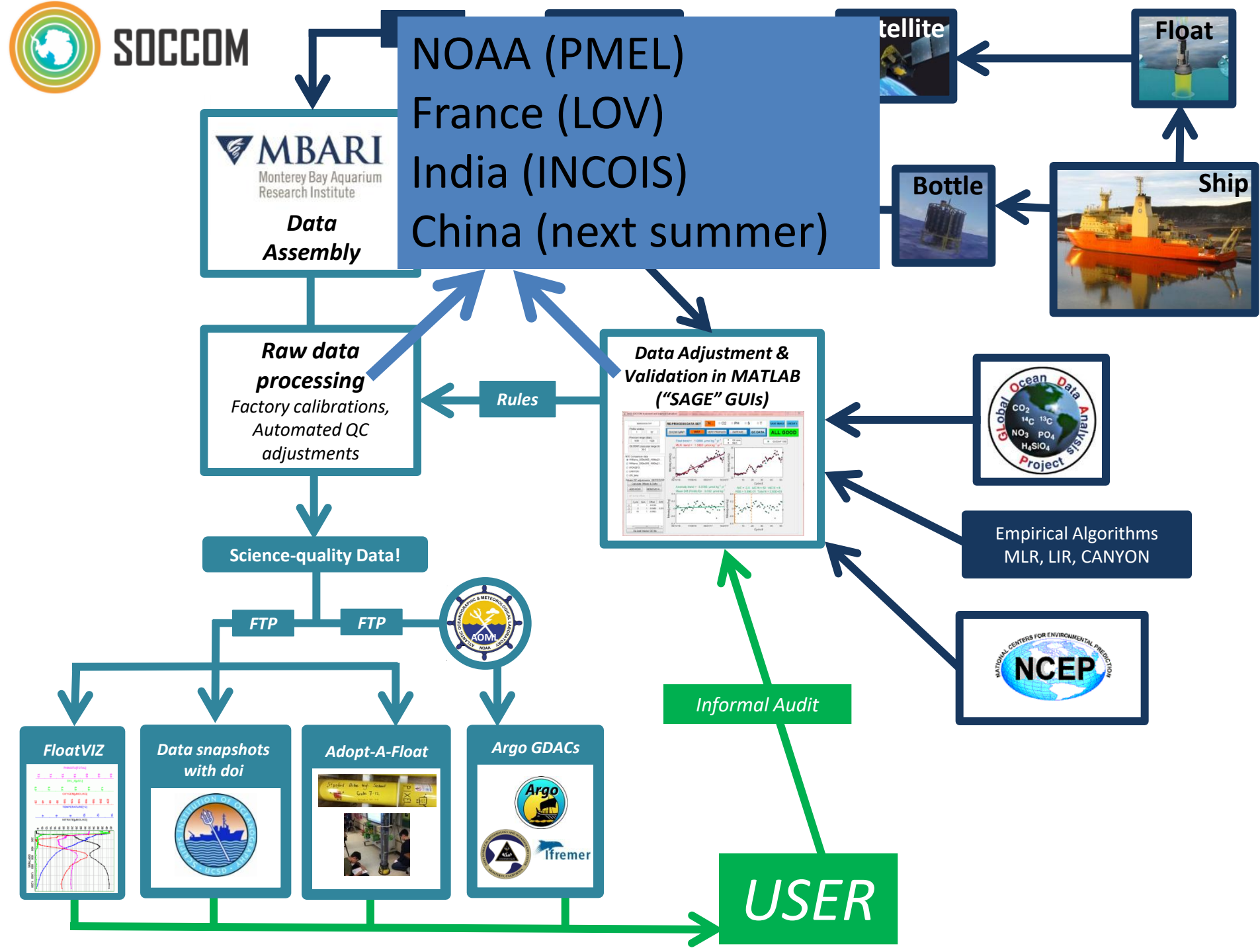
Bottle samples are not used to calibrate sensors, they are an independent assessment of accuracy.

Summary of Biogeochemical-Argo Meta Data and Profile Data Availability for all DACs*

as of March 07, 2018

compiled by Henry Bittig, LOV, Villefranche-sur-Mer





Commitments

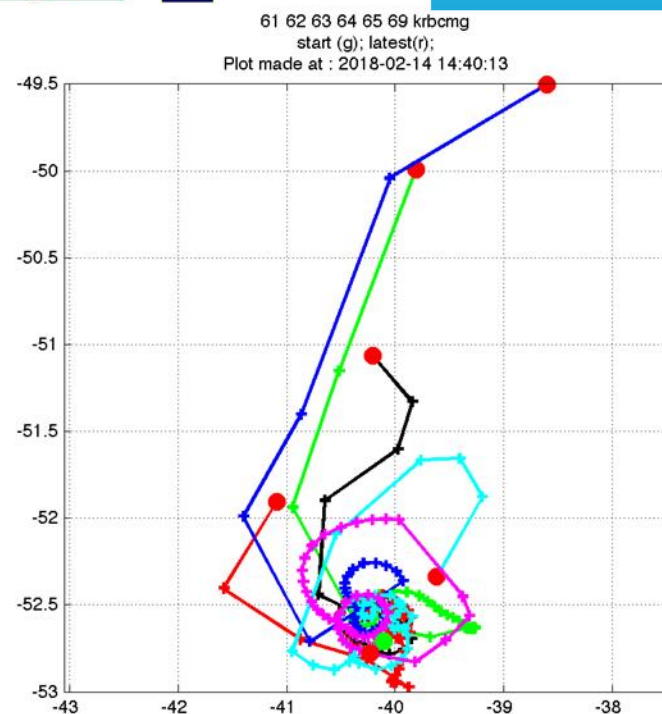
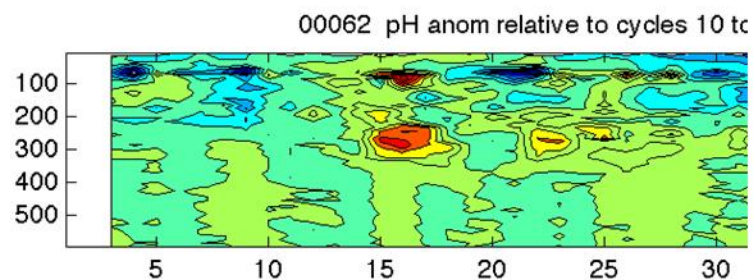
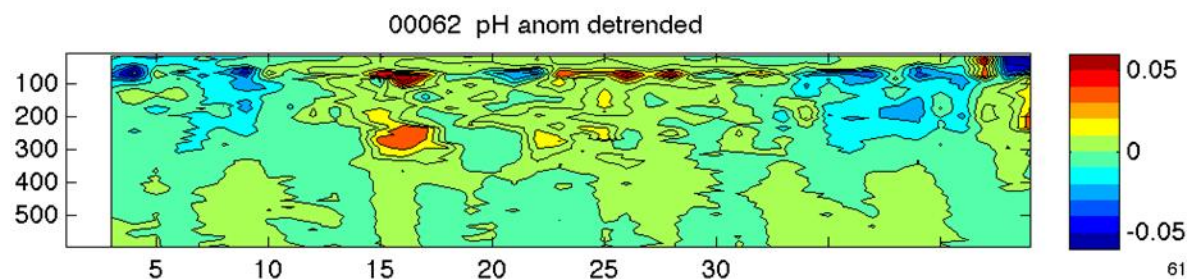
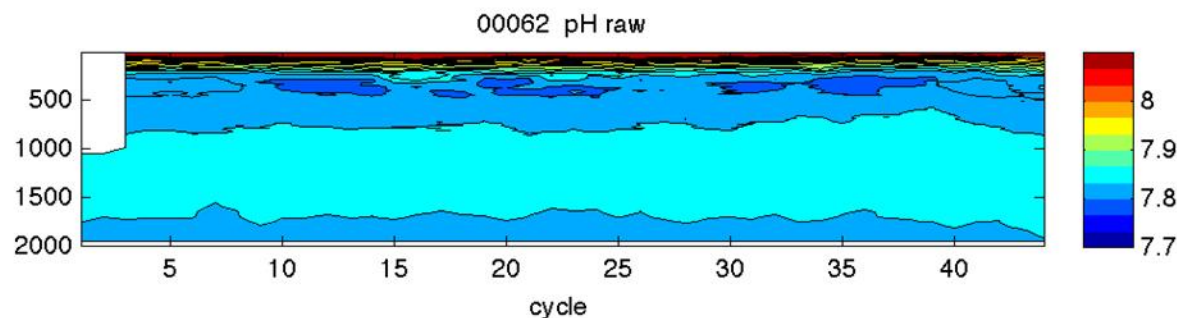
Year:

Country ▲	Extend	Total	Argo Core	Argo Equivalent	Argo BioGeoChemical	Argo Deep
Netherlands	1	4	4			
New Zealand	1	2	2			
Norway	1	14	6		5	3
Peru	1	0				
Poland	1	3	2		1	
Romania	1	0				
Russian Federation	1	0				
Saudi Arabia	1	0				
South Africa	1	0				
Spain	1	7	5			2
Sri Lanka	1	0				
Turkey	1	0				
United Kingdom	1	38	28	0	6	4
United Nations	1	0				
United States	1	424	357	30	37	
Total		971	739	64	123	45

Commitments		971	739	64	123	45
Deployed		168	108	20	30	15
Target		970	970		222	
Commitments - Tar...		1	-231	64	-99	45
Operational		3796	3307	194	299	45
Projection 2019		3575	3025	192	315	67

UK (B King)

6 pH/O₂ floats
in So. Atlantic



BGC-Argo Deployment Plan (2018/19) by China

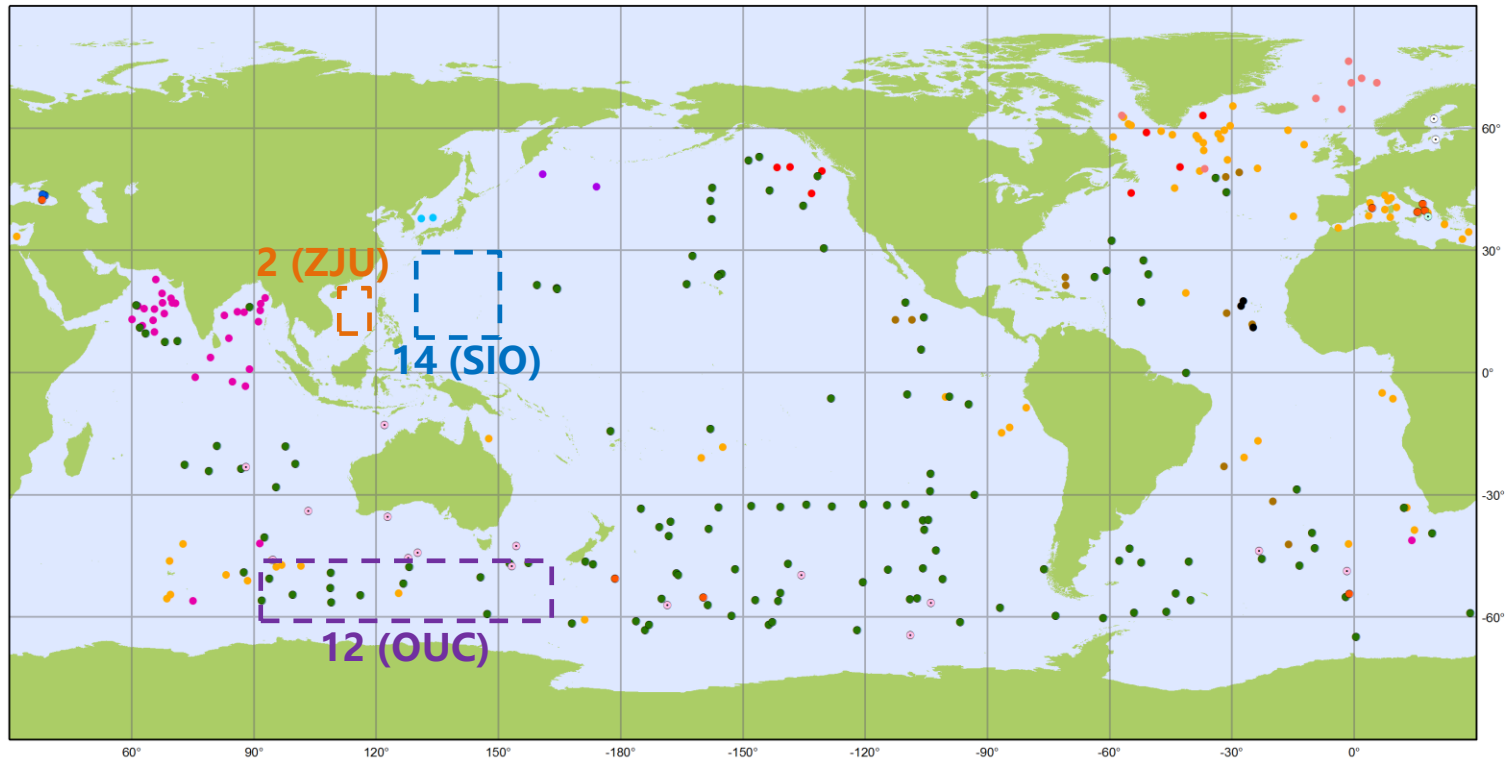
Institution	Num	Model	DO	ECO	OCR	NO ₃	pH	Area
SIO	4	Provor	✓	✓	✓	✓		Northwestern Pacific
SIO	2	Provor	✓	✓	✓	✓	✓	Northwestern Pacific
SIO	4	Provor		✓				Northwestern Pacific
SIO	2	Provor	✓					Northwestern Pacific
SIO	2	Navis-Trec	✓	✓	✓	✓	✓	Northwestern Pacific
ZJU	2	Navis	✓	✓		✓		South China Sea
OUC	12	Provor	✓					Southern Ocean

SIO: Second Institute of Oceanography, SOA (Hangzhou)

ZJU: Zhejiang University (Hangzhou & Zhoushan)

OUC: Ocean University of China (Qingdao)

BGC-Argo Deployment Plan (2018/19) by China



Argo BioGeoChemical

National contributions - 286

September 2017

Latest location of operational floats (data distributed within the last 30 days)

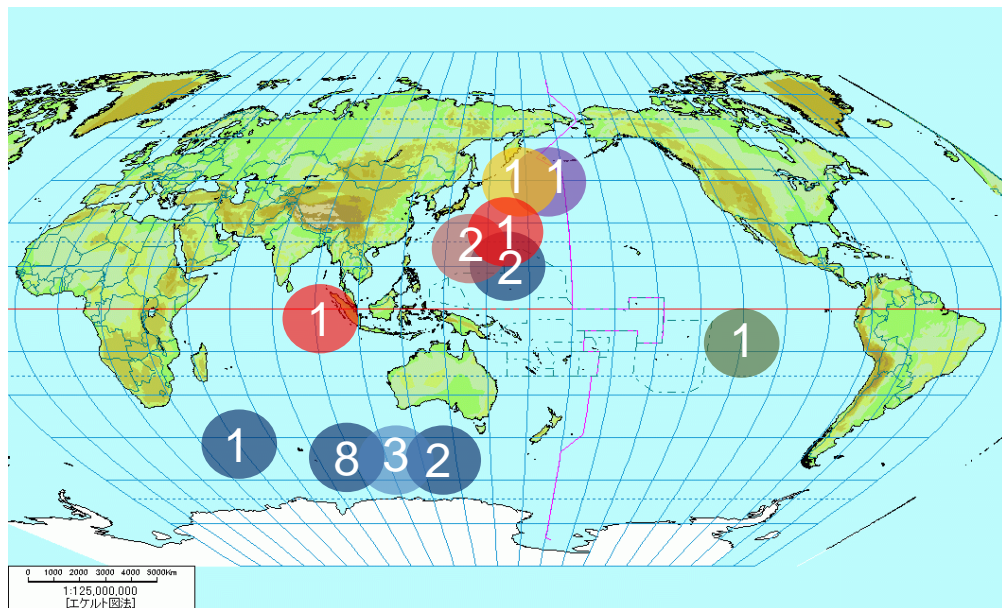
- | | | | | |
|------------------|---------------|--------------|--------------------------|-------------|
| ○ AUSTRALIA (15) | ○ FINLAND (2) | ○ GREECE (1) | ● JAPAN (2) | ● UK (11) |
| ● CANADA (8) | ● FRANCE (63) | ● INDIA (30) | ● KOREA, REPUBLIC OF (2) | ● USA (131) |
| ● EUROPE (2) | ● GERMANY (3) | ● ITALY (8) | ● NORWAY (8) | |



JAPAN BGC/Deep Deployment

2018-2019 plan (JAMSTEC)

FY2018: DO-DeepApex (T,S,P,DO)	1
Rinko-DeepNINJA (T,S,P,DO)	3
BGC (T,S,P,DO,NO ₃ ,Chl,BS)	2
BGC (T,S,P,DO,Chl,BS)	1
BGC (T,S,P,DO,pH,Chl,BS)	2
DeepNINJA (T,S,P)	1
DeepApex (T,S,P)	13
FY2019: DO-DeepApex (T,S,P,DO)	1
Rinko-DeepNINJA (T,S,P,DO)	3
BGC (T,S,P,DO,NO ₃ ,Chl,BS)	2
BGC (T,S,P,DO,Chl,BS)	0
BGC (T,S,P,DO,pH,Chl,BS)	3
DeepNINJA (T,S,P)	1
DeepApex (T,S,P)	6
	+α



Based on JAMSTEC Deep/BGC-float science plan, we will deploy about 23 floats in total. (Apr 2018 – Mar 2019). Next FY, 16 floats and more are planned at present.

G7, AST, ADMT recommendations were really effective to enable to deploy the largest number of BGC/Deep floats by JAMSTEC. Thanks a lot!



Deep-Apex series



BGCs



DeepNINJA series

Germany

- 3 Apex with O₂/pH in May 2018 as a pilot project,
- Proposed extension of German Argo to include 5 O₂/pH floats each year in subpolar N. Atlantic near ICOS VOS lines.

France contribution to « BGC-Argo »

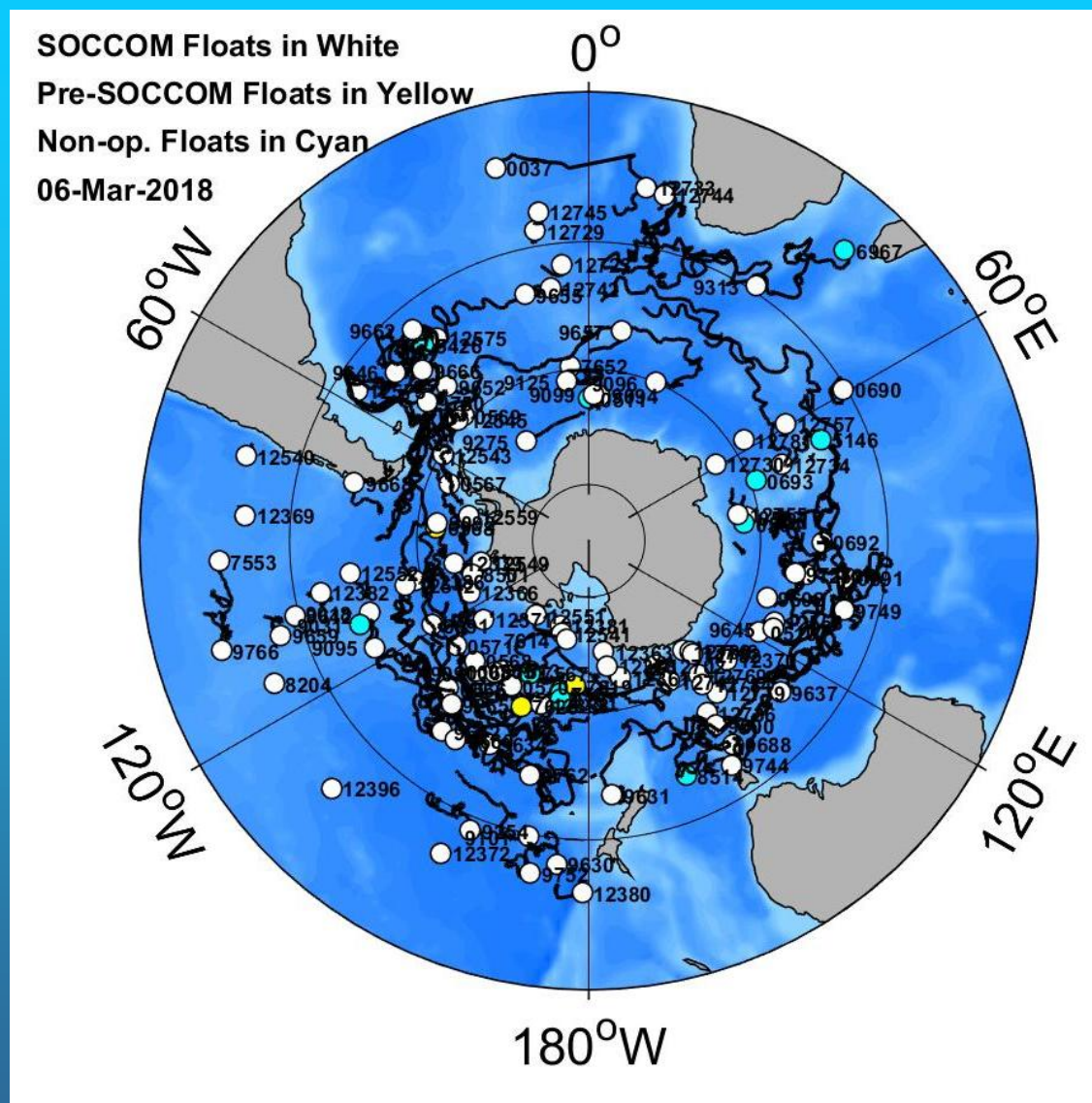
- 32 floats over 2018-2019
 - Med Sea (East and West): 11
 - Southern Ocean (Kerguelen) : 4
 - South Pacific gyre (Tahiti, Marquesas): 4
 - North Atlantic (Labrador): 2
 - Arctic (Baffin bay): 5
 - Equatorial pacific (to be confirmed): 2
 - TB: 3
- 10 published BGC-Argo papers in 2017 (4 in 2018).
- R & D Cooperation with Seabird and NKE to integrate the Seabird pH sensor on NKE float (float now measuring the 6 BGC core variables).
- Integration in ADMT (Schmechtig, Poteau, Bittig).
- Administration of the BGC-Argo Web Site.
- Management of the BGC-Argo newsletter
- BGC-Argo twitter
- Outreach / “adopt a float”, in collaboration with US-SOCCOM.



SOCCOM

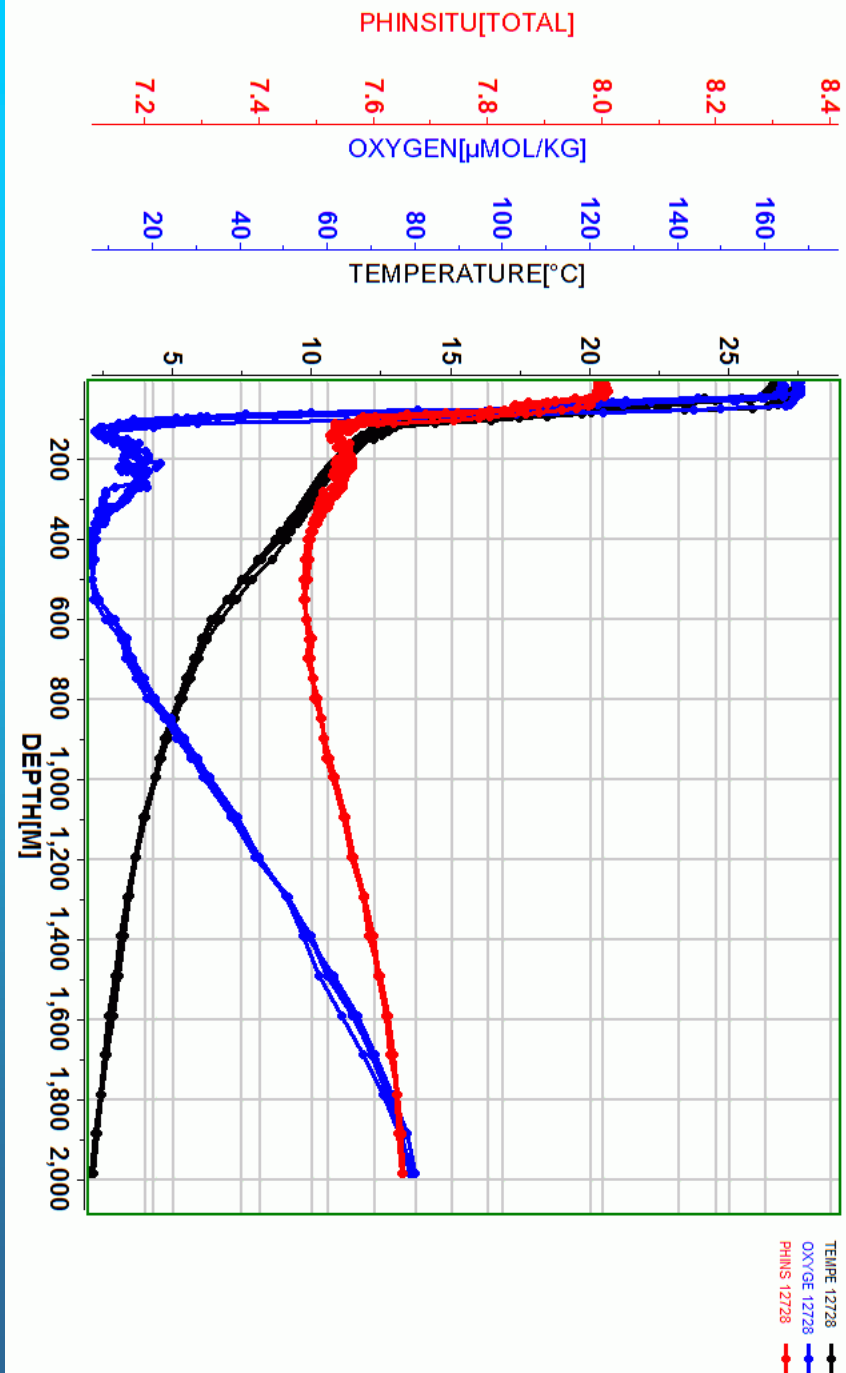
- 106 Active Floats,
- 3 more years with 30 to 35 floats/year,
- All data goes to GDAC,
- QC/adjustments to produce climate quality data stream,
- Discussing program extension.

O_2 , NO_3 , pH, Chl, Backscatter



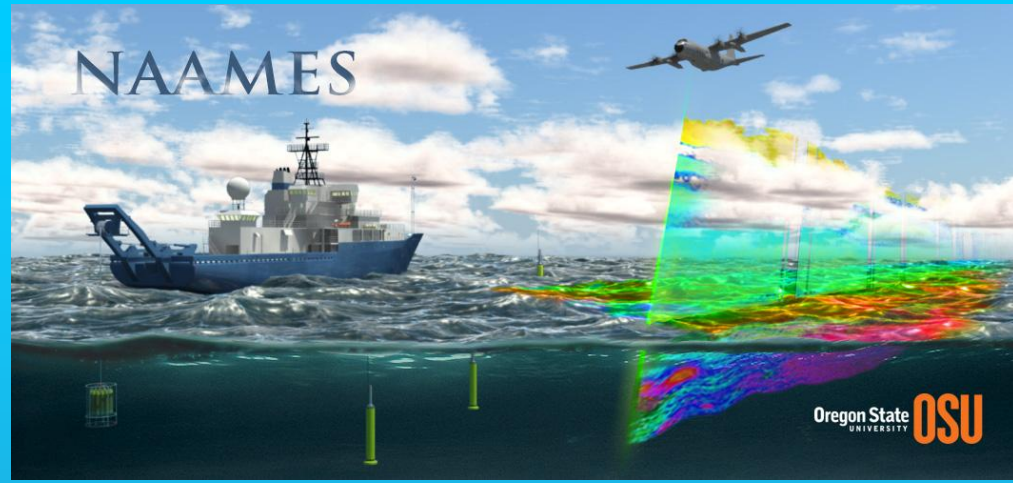
US Tropical Pacific Obs. Sys.

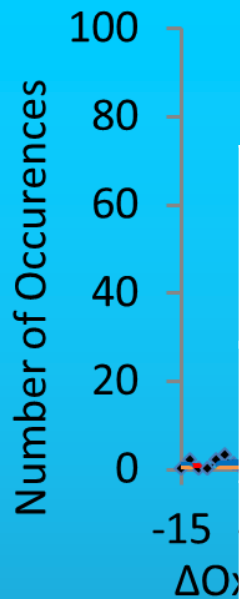
- Riser et al. (NOAA),
 - 15 floats/4 years with pH/O₂/PAL/FLBB
- Emerson et al. (NSF, X-Prize),
 - 6 floats/2 years with O₂/NO₃/pH
 - 6 floats/2 years with O₂



US NAAMES & EXPORTS

- Boss (NASA NAAMES),
 - 5 floats with O₂/Bio-optics in North Atlantic (deployed)
- Fassbender (NSF & NASA EXPORTS),
 - 2 floats in 2018 with O₂/NO₃/pH/Bio-optics at Ocean Stn. Papa, No. Pacific

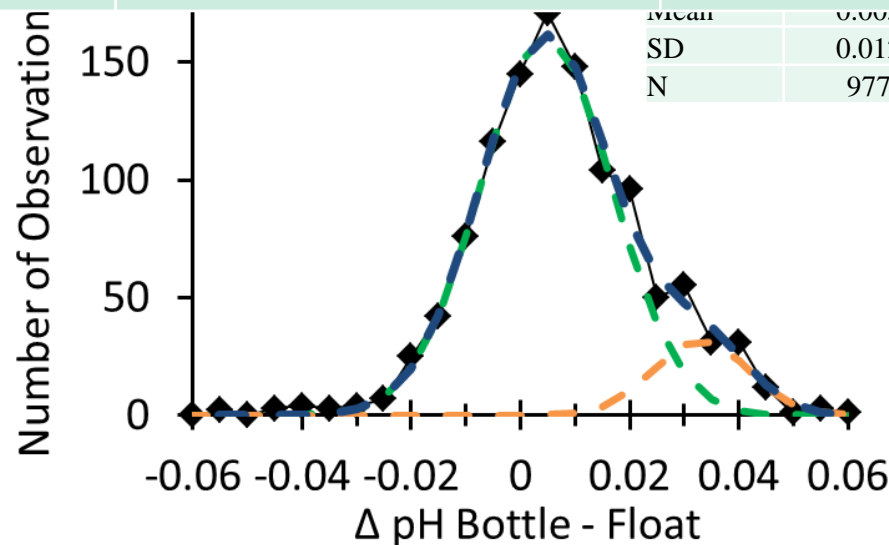
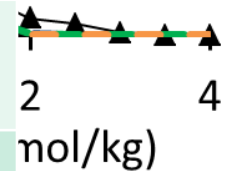




Mean	1	9	5
SD	3	2	11
N			
Samples	1088	216	235

Mean	0.1	-1.5
SD	0.6	0.5
N	1152	186

	Fleet average accuracy	Fleet average precision (SD)
O ₂	1 $\mu\text{mol/kg}$	2 $\mu\text{mol/kg}$
NO ₃	0.1 $\mu\text{mol/kg}$	0.4 $\mu\text{mol/kg}$
pH	0.005	0.008



Mean	0.005	0.005
SD	0.012	0.009
N	977	138