AST-21: Status and Future

14th April, 2020

Welcome

- Susan Wijffels chairing today's session
- Guillaume Maze moderating:
  - Please stay muted during presentations. Unmute during discussion periods when you're ready to talk.
  - G. will be monitoring to see who raises their hand or writes a comment or question in chat box to help moderate discussions
  - If you have tech questions about how to use Zoom, private message Howard Freeland through the chat feature
- If something goes wrong with Zoom and the meeting cannot happen, M. Scanderbeg will try sending out instructions on email with new meeting info ASAP

AST #21

Argo Status

JCOMMOPS

mbelbeoch@jcommops.org

Outline

- Exec. Summary
- Key points for discussion

- Feedback (AST#20)
- Design & Targets
- Projections (including COVID impact)
- Implementation status
- Extensions status
- Commitments, Planning

- Instrumentation status

EXEC. SUMMARY - ARGO STATUS - APRIL 2020

- 4050 operational floats !
- Coverage is rather good (and in EEZs as well)
- Float performance has clearly improved (but needs more efforts for APEX)
- Highlights (AST20) are addressed and international cooperation is working well
- Exciting upcoming contributions (China, USA/BGC) and developing potential in Europe

- Numbers have grown up somehow artificially (we are not deploying more floats overall)
- Contributions are not dimensioned to the (new) targets
- Core Global Design is just sustained thanks to extras contributions (and floats performance).
- Extensions are not addressed with some exceptions (Gulf Stream, TPOS)
- 30% of the BGC array is T/S/O only – Deep has doubled its effort.

- The 4000 units array will decay …
- COVID might accelerate the decay, in particular in some basins (SA, SO, IO, NWP)

KEY POINTS FOR DISCUSSION

- How do we address SO and Marginal Seas ?

- How can we improve our international cooperation and planning to optimize deployment strategies.

- Can we build ship time consortium in each basin for routine/accurate deployments
- It might be wised to keep some stock for best opportunities or consortiums participation
- Cross program, cross networks, combos deployment/retrieval has a great saving potential

- What milestones for Argo Global Integrated 2025 ?

FEEDBACK AST20

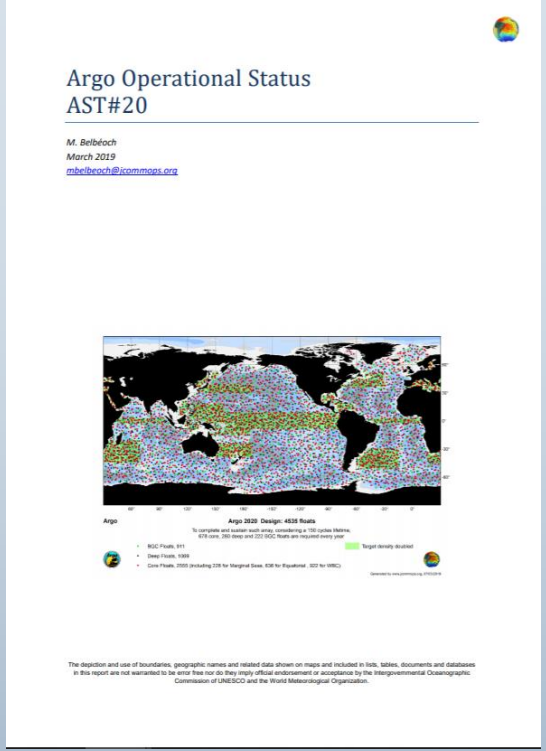
- 2019 Report to AST: still valid and content useful
- http://www.argo.ucsd.edu/AIC_Rep_AST20.pdf

- Key Points:
  - Maximize each float value (space, dataflow, integrated 2025, environment)

  - Address Southern Ocean challenge
  - Relax North Atlantic, address Indian Ocean upcoming gaps
  - Keep improving float reliability
  - Marginal Seas not addressed (new partners, EEZ access, other systems better ?)

  - Keep cooperating, refine planning strategies – basin based teleconferences
  - Prepare the future (national road maps to 2025) … and beyond (new sensors are coming)

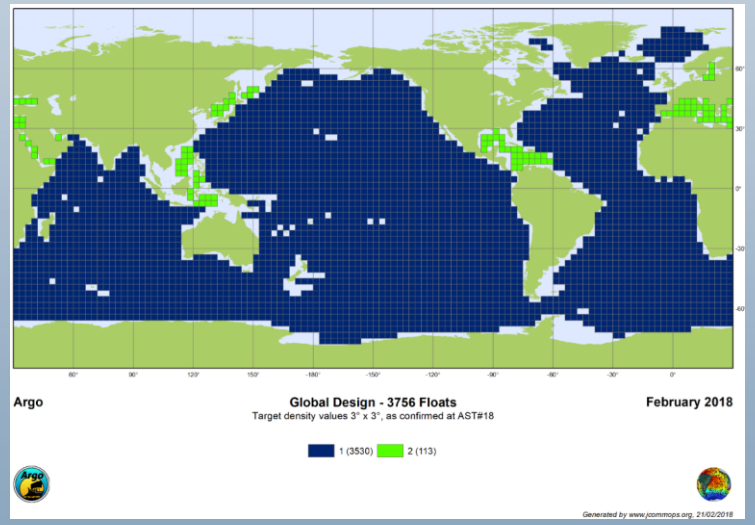
  - Some of the highlights were addressed (Atlantic, Indian), some were not (hots spots not aligned with the design and new extensions)

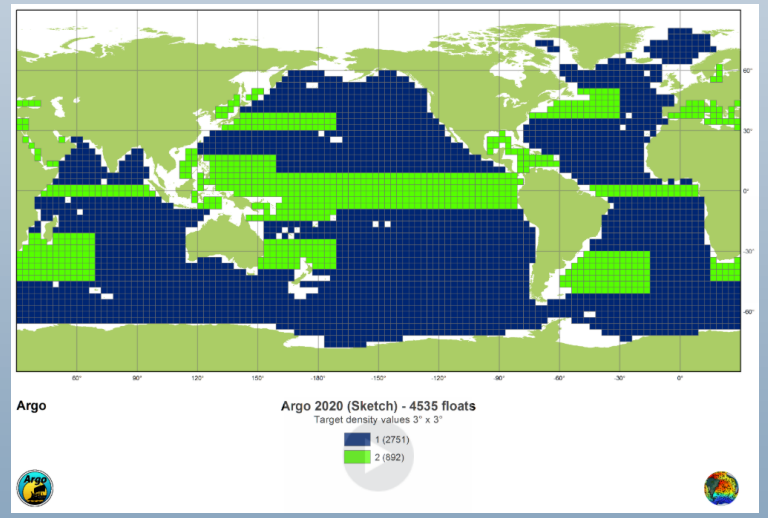

Argo Operational Status
AST#20

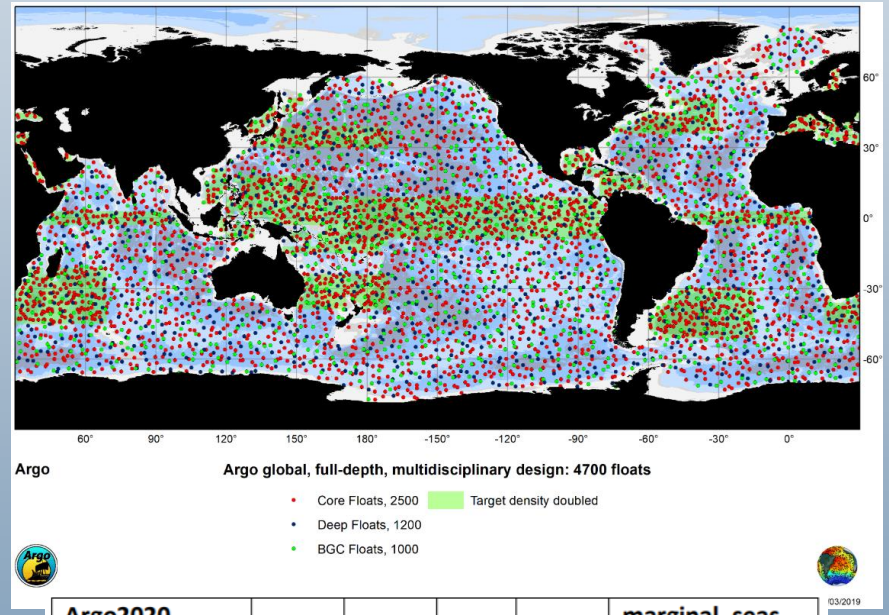
M. Belbéoch
March 2019
mbelbeoch@jcommops.org

DESIGN AND TARGETS

- Global Argo + Global Argo (“2020”) + BGC + Deep = Global Argo Integrated (“2025”)







Argo Global	High Seas	Marginal seas	Total
Total array	3530	226	3756
Intensity (150)	860	110	970
Intensity (175)	736	94	831
Intensity (200)	644	82	727
Intensity (250)	515	66	581
2016-2018 avg	814	70	884

Table 1.: Requirements for Global Argo

Argo 2020	core	Marginal seas	total
Total array	4309	226	4535
Intensity (150)	1050	110	1160
Intensity (175)	899	94	993
Intensity (200)	786	82	869
Intensity (250)	629	66	695
2016-2018 avg	814	70	884

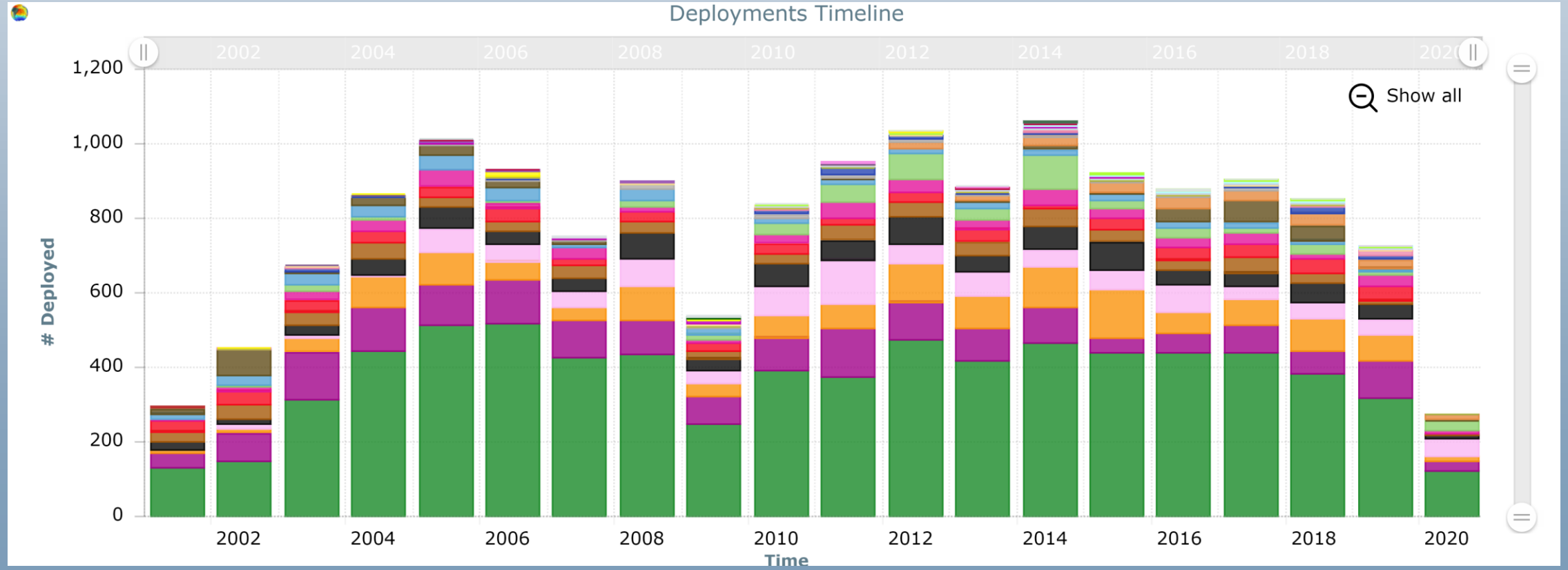
Table 2: Requirements for Argo2020

Argo2020 integrated	total	deep	bio	core	marginal. seas
Total array	4535	1069	911	2329	226
Intensity (150)	1160	260	222	568	110
Intensity (175)	993	223	190	486	94
Intensity (200)	866	195	166	425	82
Intensity (250)	693	156	133	340	66
2016-2018 avg	884	36	131	717	70

Table 3.: Requirements for Argo2020 integrated

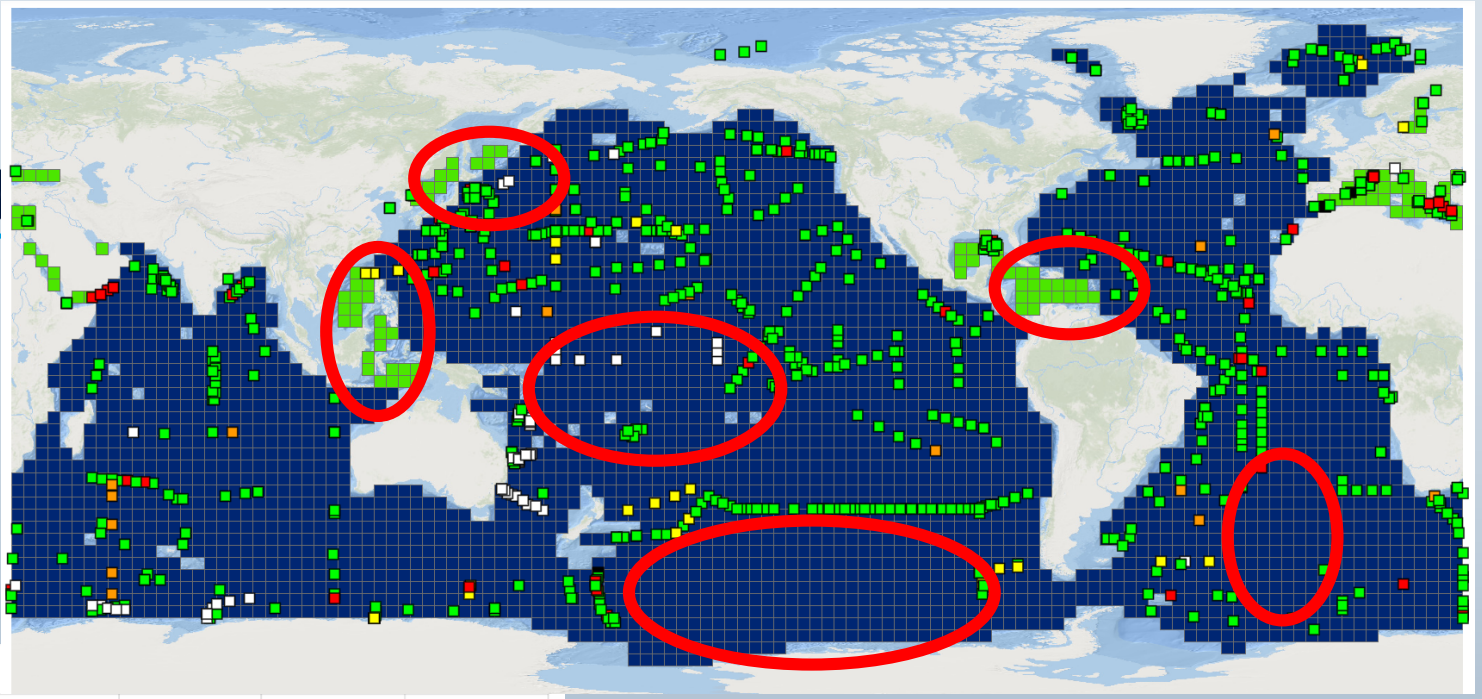
2019 Deployments: 750

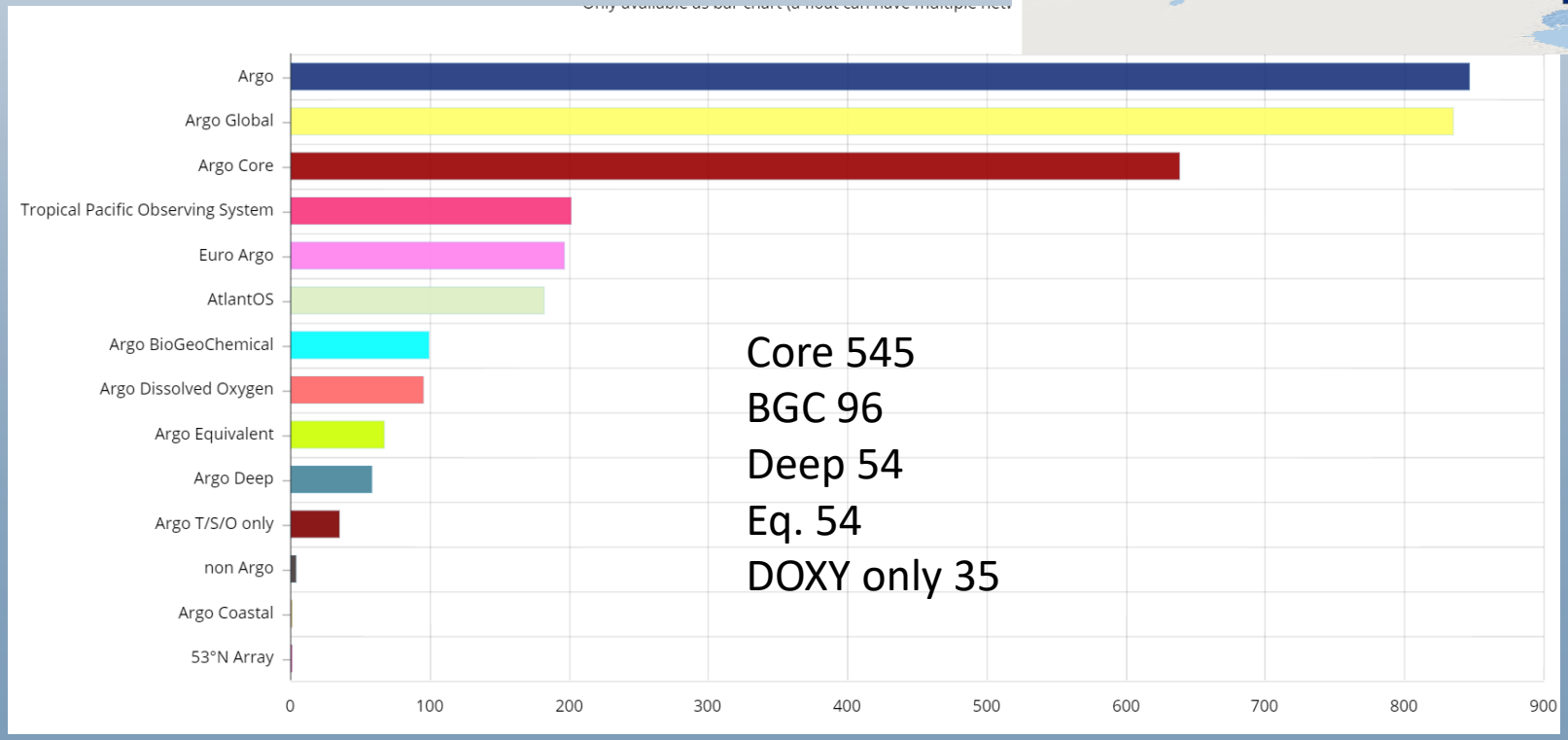
- lowest since 10 years with ~750 floats
- Compaction of national contributions



2019 Deployments: 750

- Logistics' challenges
- Hot/Cold spots
- Marginal Seas issue





Core 545
BGC 96
Deep 54
Eq. 54
DOXY only 35

Argo2020 integrated	total	deep	bio	core	marginal. seas
Total array	**4535**	**1069**	**911**	**2329**	**226**
Intensity (150)	**1160**	**260**	**222**	**568**	**110**
Intensity (175)	993	223	190	486	94
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Table 3.: Requirements for Argo2020

2019 OVERVIEW VS TARGETS 1 2 3

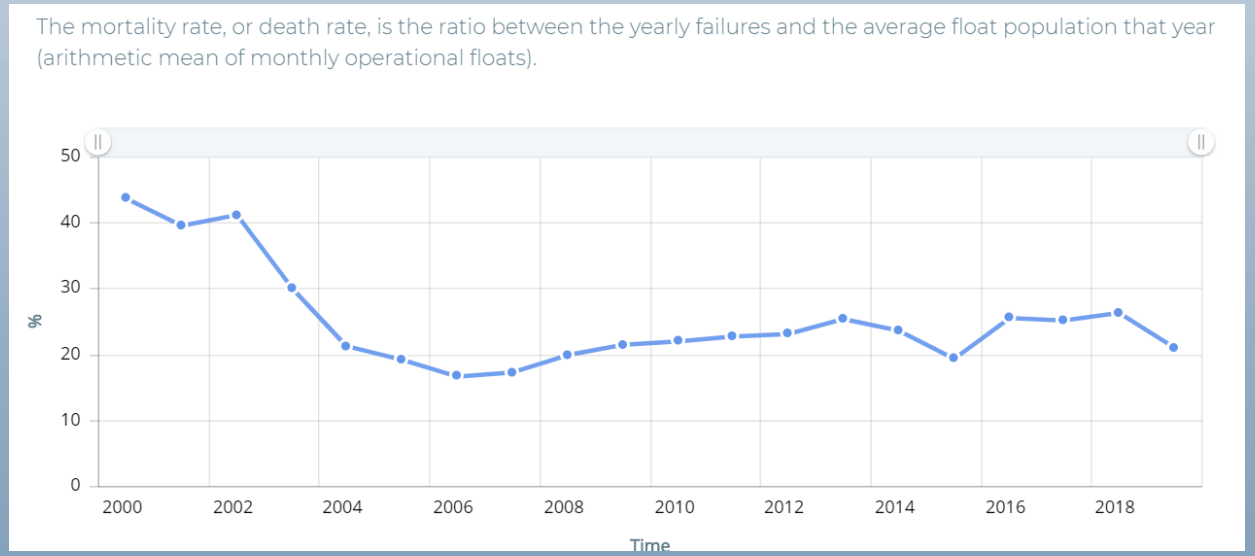
- Main Design can't be sustained without extras contributions
  - Marginal seas not supported beyond Med. Sea, GOM, Baltic
  - No opportunities in Southern Pacific, in central South Atlantic, …
- Global 2020 Design is not really addressed, except TPOS
  - WBC, Eq. expansions (gulf stream ok)
  - TPOS 2020 ok but no new specific contribution to reach a doubled density (in the west ?)
- 2025 Design
  - BGC and Deep contributions are useful, but still at a pilot phase.
  - What is the road map ? Milestones ?
  - If there are regional pilots (in North Atlantic e.g.) they need to be identified, monitored closely.

PROJECTION – COVID IMPACT

- Considering a mortality rate of 21% the stability is around 1000/year without inflation…

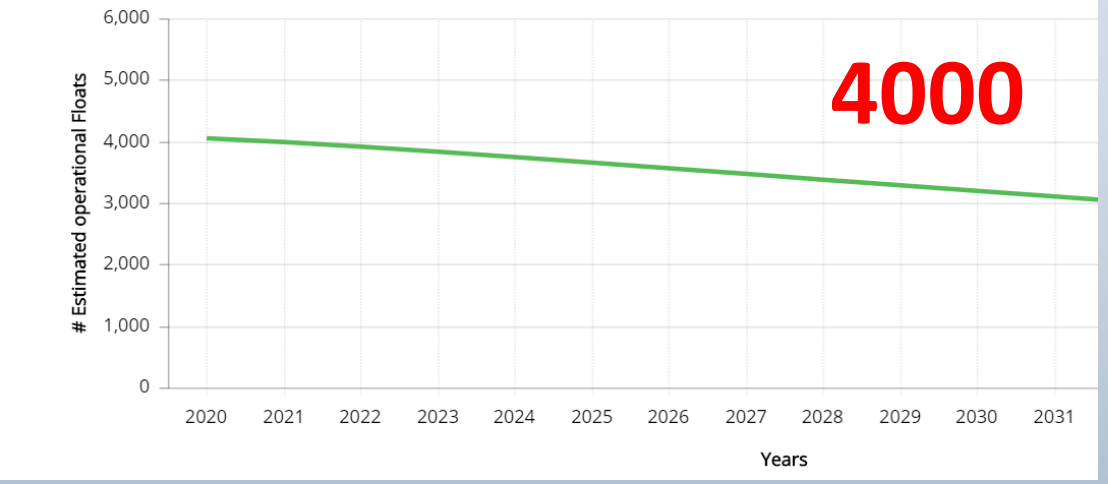
- Reality is around 850 => 3800 in 2021
- 3 months lag => 3700
- 6 months => 3500
- 1 year => 3200

- Economical impact on national budgets?
- Inflation ?
- Opportunities for a new deal ?



Projection

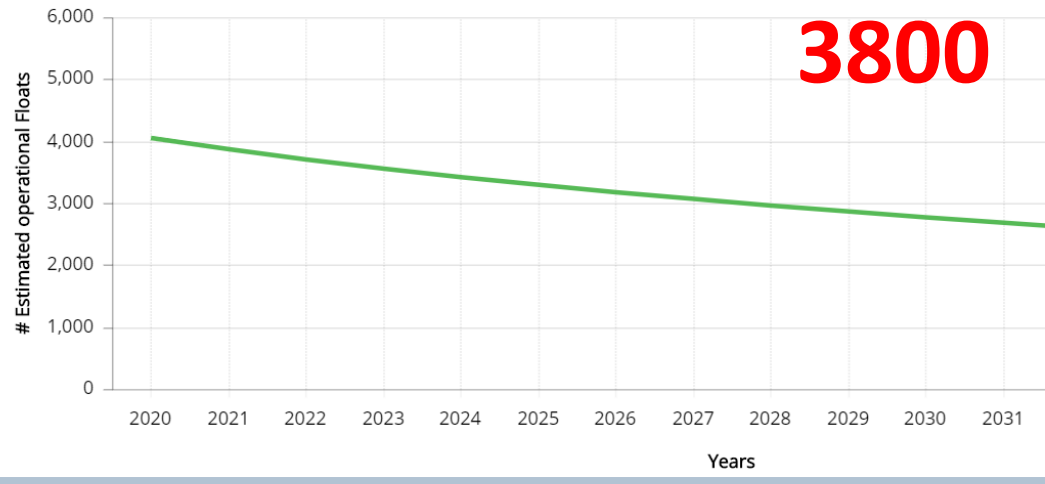
Initial Float Count	Initial Annual Deployments	Failure Rate	Inflation Rate
# Floats: 4061	# Deployments: 1000	0.21	0.03



4000

Projection

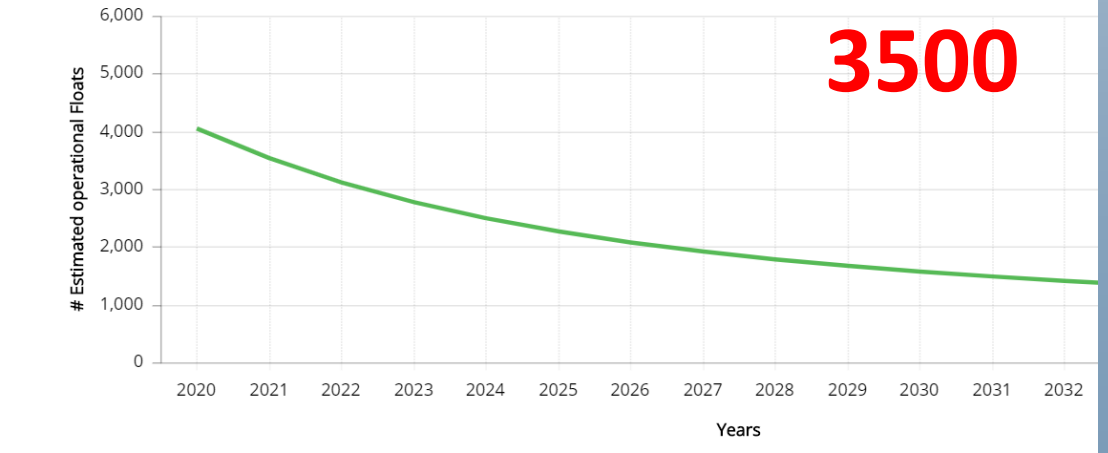
Initial Float Count	Initial Annual Deployments	Failure Rate	Inflation Rate
# Floats: 4061	# Deployments: 850	0.21	0.03



3800

Projection

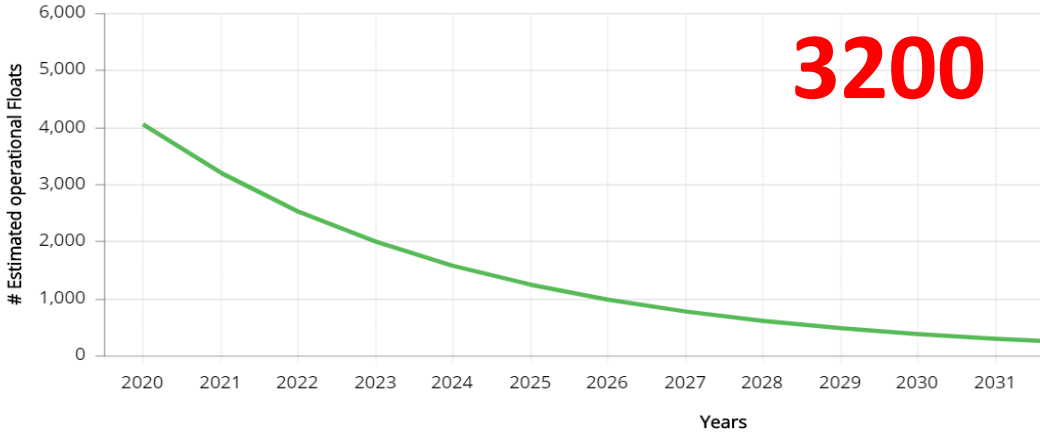
Initial Float Count	Initial Annual Deployments	Failure Rate	Inflation Rate
# Floats: 4061	# Deployments: 425	0.21	0.03



3500

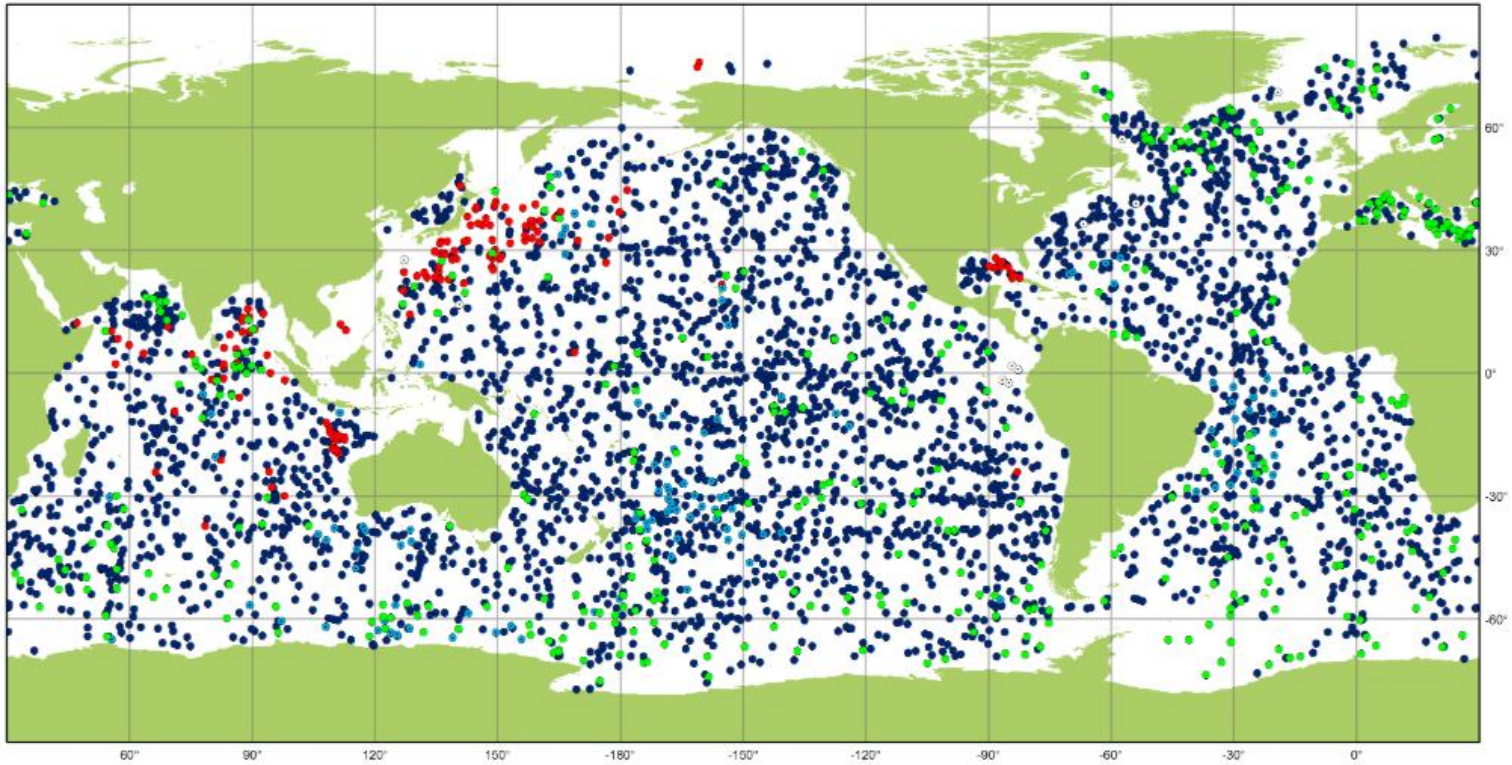
Projection

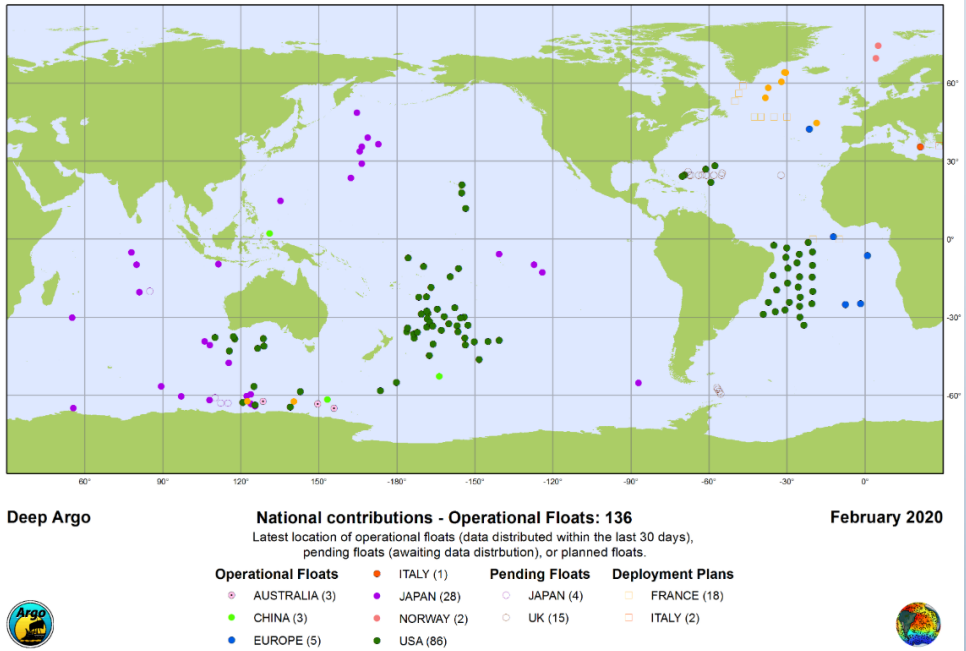
Initial Float Count	Initial Annual Deployments	Failure Rate	Inflation Rate
# Floats: 4061	# Deployments: 0	0.21	0.03

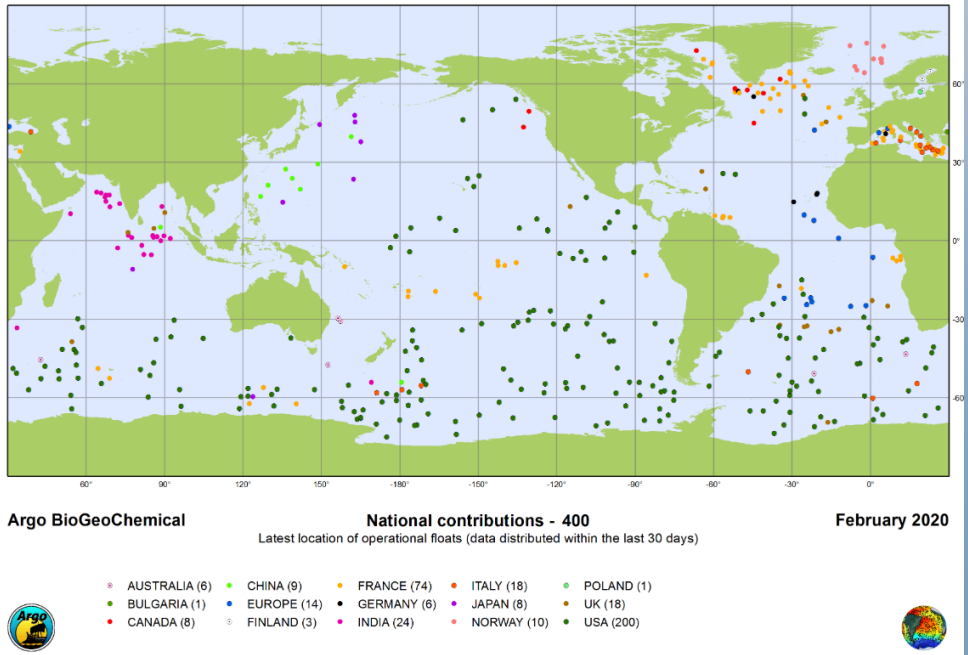


3200

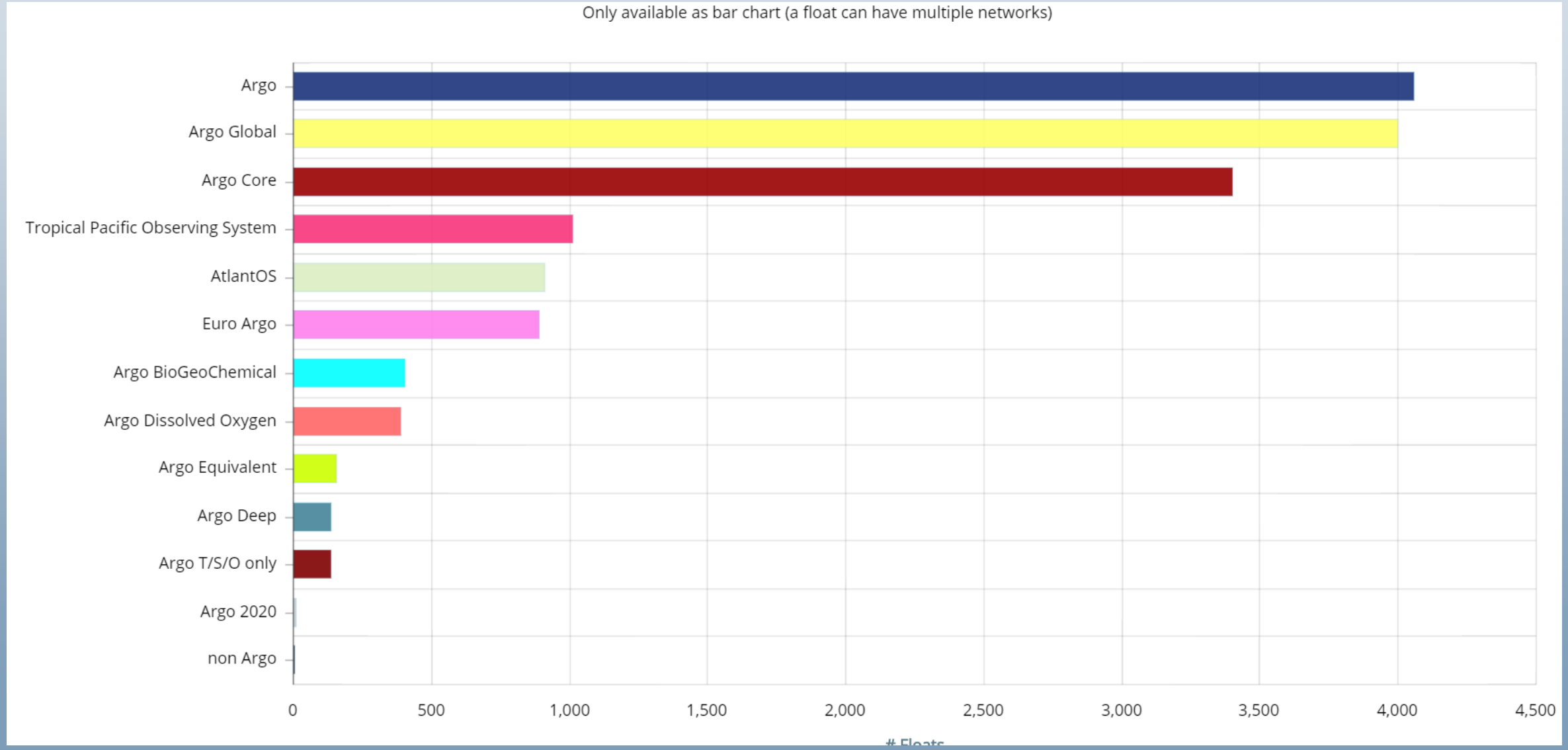
IMPLEMENTATION STATUS







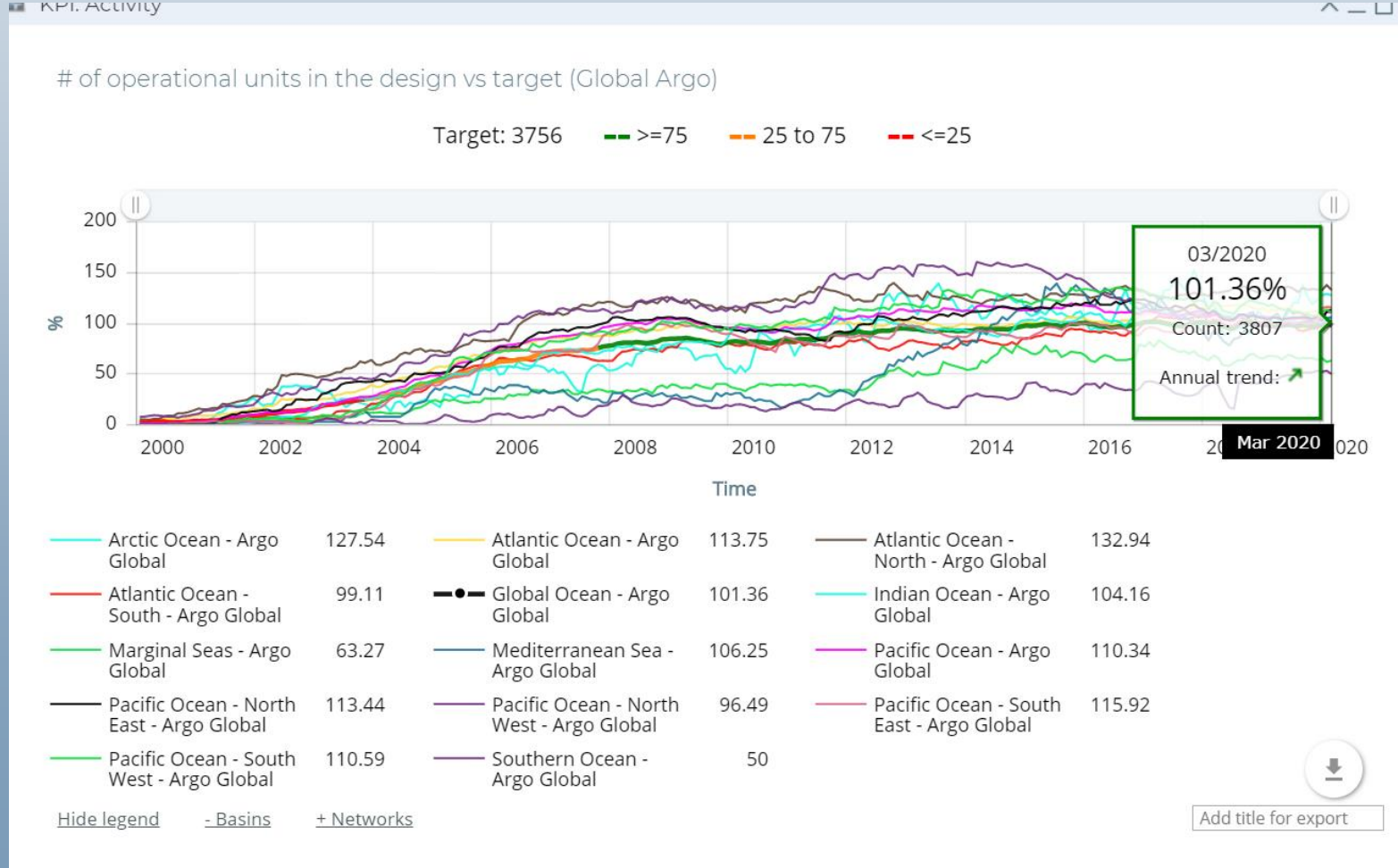
Implementation Status - Activity



IMPLEMENTATION STATUS (ACTIVITY)

- Some basins have some “stock” some other have not (COVIOD impact)

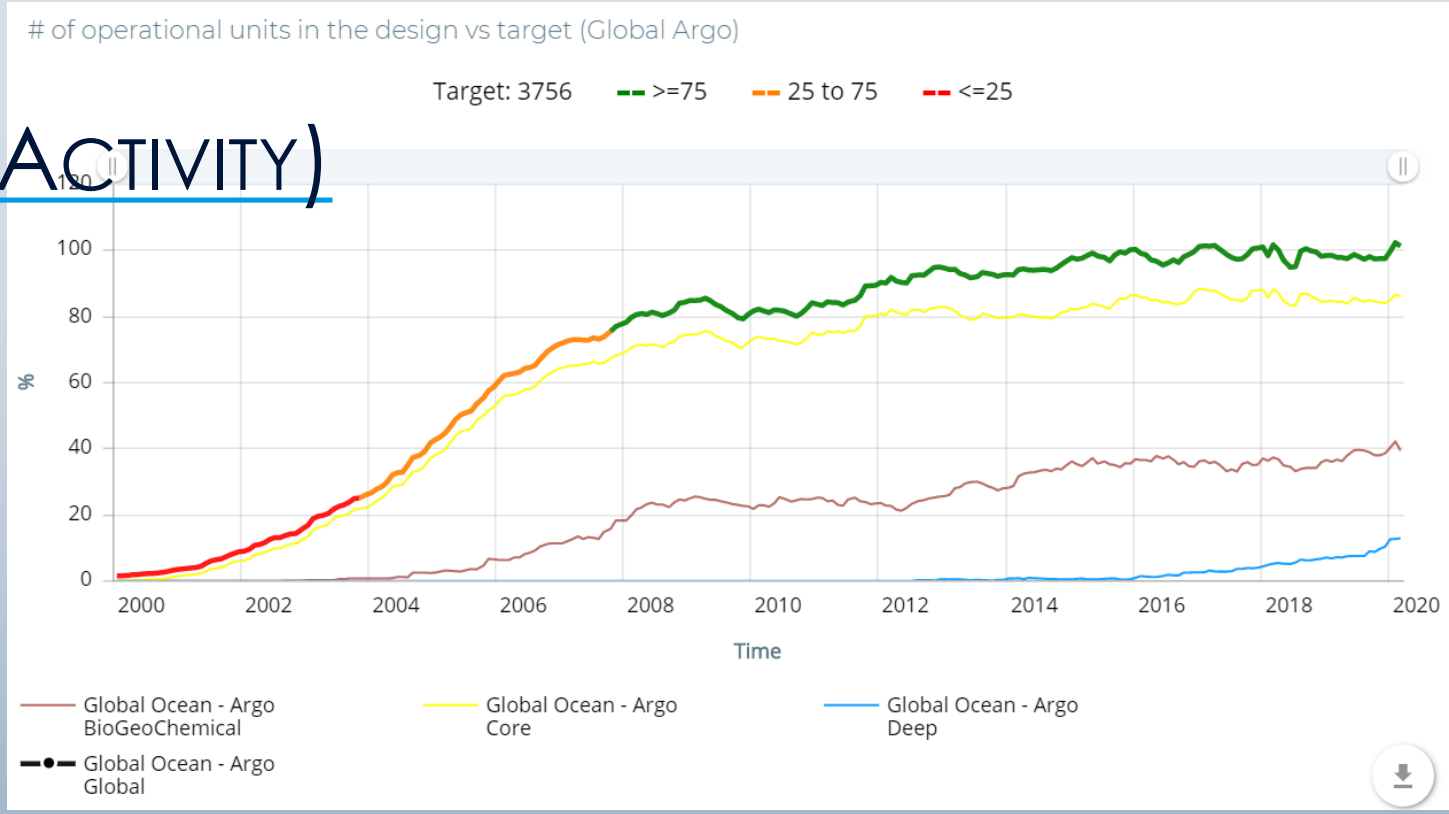
- Southern Ocean
- South Atlantic
- North West Pacific
- Marginal Seas



Implementation Status (Activity)

- light increase for the global +3
- light increase for core +2
- deep doubled +6
- light increase for BGC Argo +3

- Increase is “artificial”…

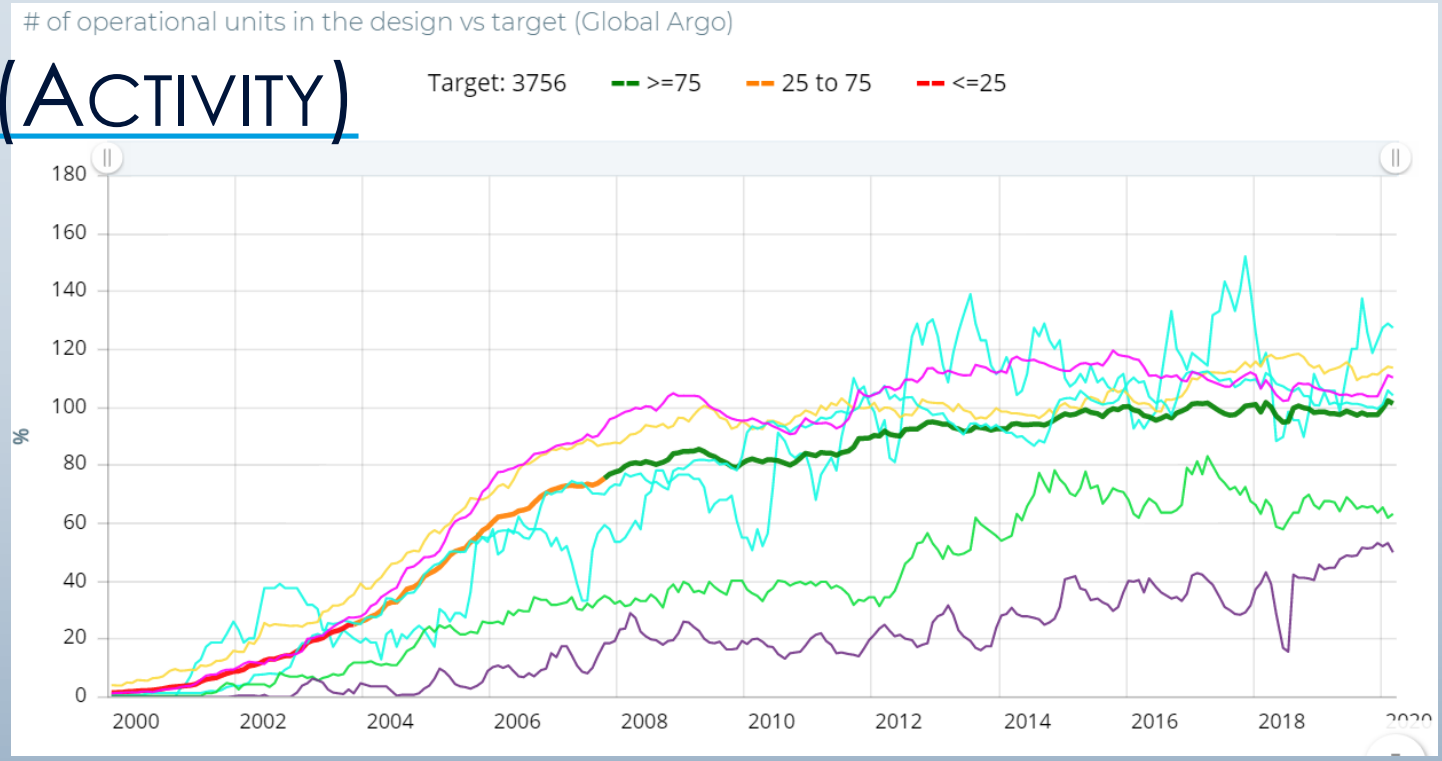


Implementation

Activity Argo Deep	12.91% 3/2020 ↗	138 Raw count	1069 Target	# of operational units in the design vs target (Argo Deep)
Activity Argo BioGeoChemical	39.47% 3/2020 ↗	360 Raw count	912 Target	# of operational units in the design vs target (BGC-Argo)
Activity Argo Core	86.21% 3/2020 ↗	3238 Raw count	3756 Target	# of operational units in the design vs target (Core Argo)
Activity Argo Global	101.36% 3/2020 ↗	3807 Raw count	3756 Target	# of operational units in the design vs target (Global Argo)

Implementation Status (Activity)

- Good increase for the SO
- Decrease for MS
- Indian ocean improving
- Atlantic & Arctic most active
- light decreasing trend for the Pacific and Atlantic

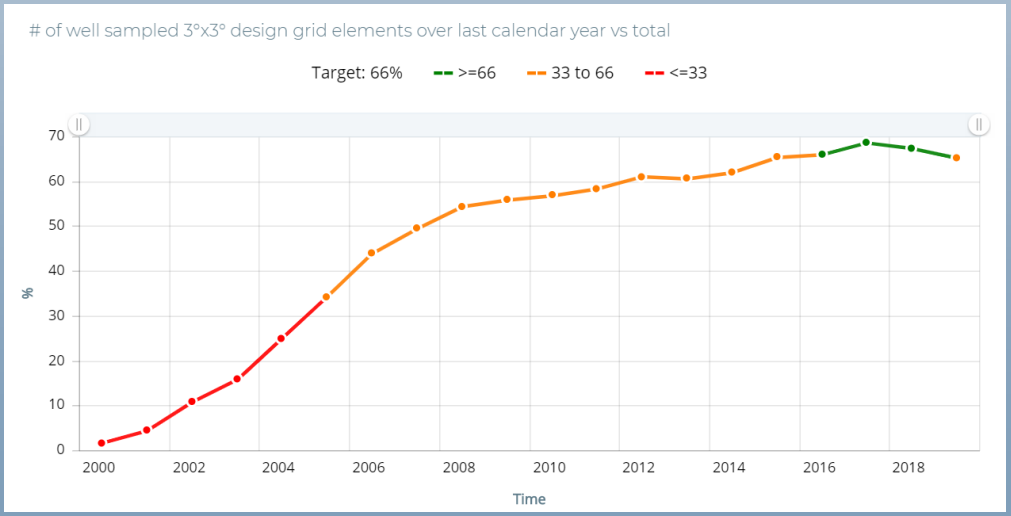


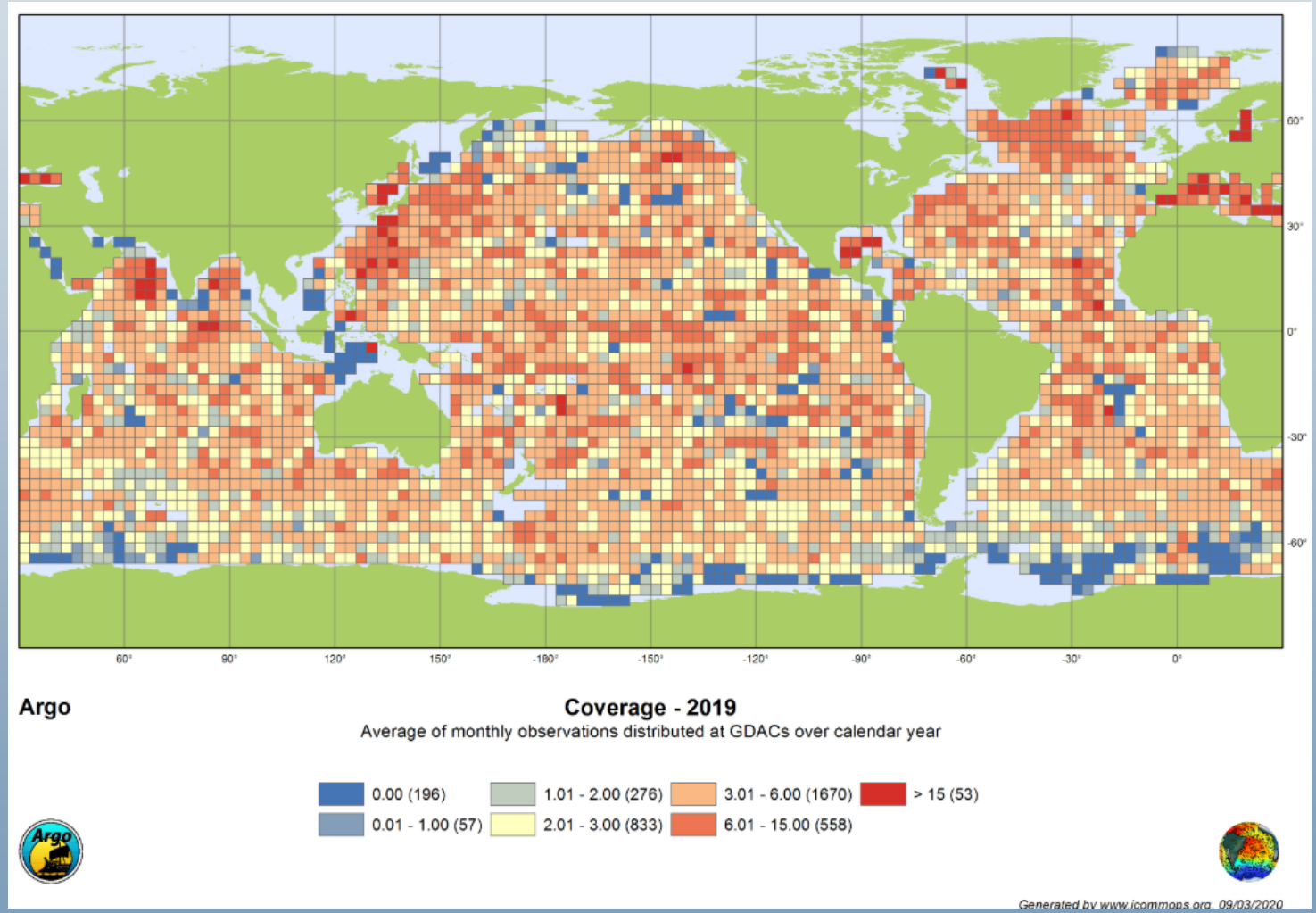
Implementation

Activity Argo Global - Southern Ocean	50% 3/2020 ↗
Activity Argo Global - Marginal Seas	63.27% 3/2020 ↘
Activity Argo Global - Pacific Ocean - North West	96.49% 3/2020 ↗
Activity Argo Global - Atlantic Ocean - South	99.11% 3/2020 ↗
Activity Argo Global	101.36% 3/2020 ↗
Activity Argo Global - Indian Ocean	104.16% 3/2020 ↗
Activity Argo Global - Mediterranean Sea	106.25% 3/2020 →
Activity Argo Global - Pacific Ocean	110.34% 3/2020 ↗
Activity Argo Global - Pacific Ocean - South West	110.59% 3/2020 ↘
Activity Argo Global - Pacific Ocean - North East	113.44% 3/2020 ↗
Activity Argo Global - Atlantic Ocean	113.75% 3/2020 ↗
Activity Argo Global - Pacific Ocean - South East	115.92% 3/2020 ↗
Activity Argo Global - Arctic Ocean	127.54% 3/2020 ↗
Activity Argo Global - Atlantic Ocean - North	132.94% 3/2020 ↘

Implementation Status (Coverage)

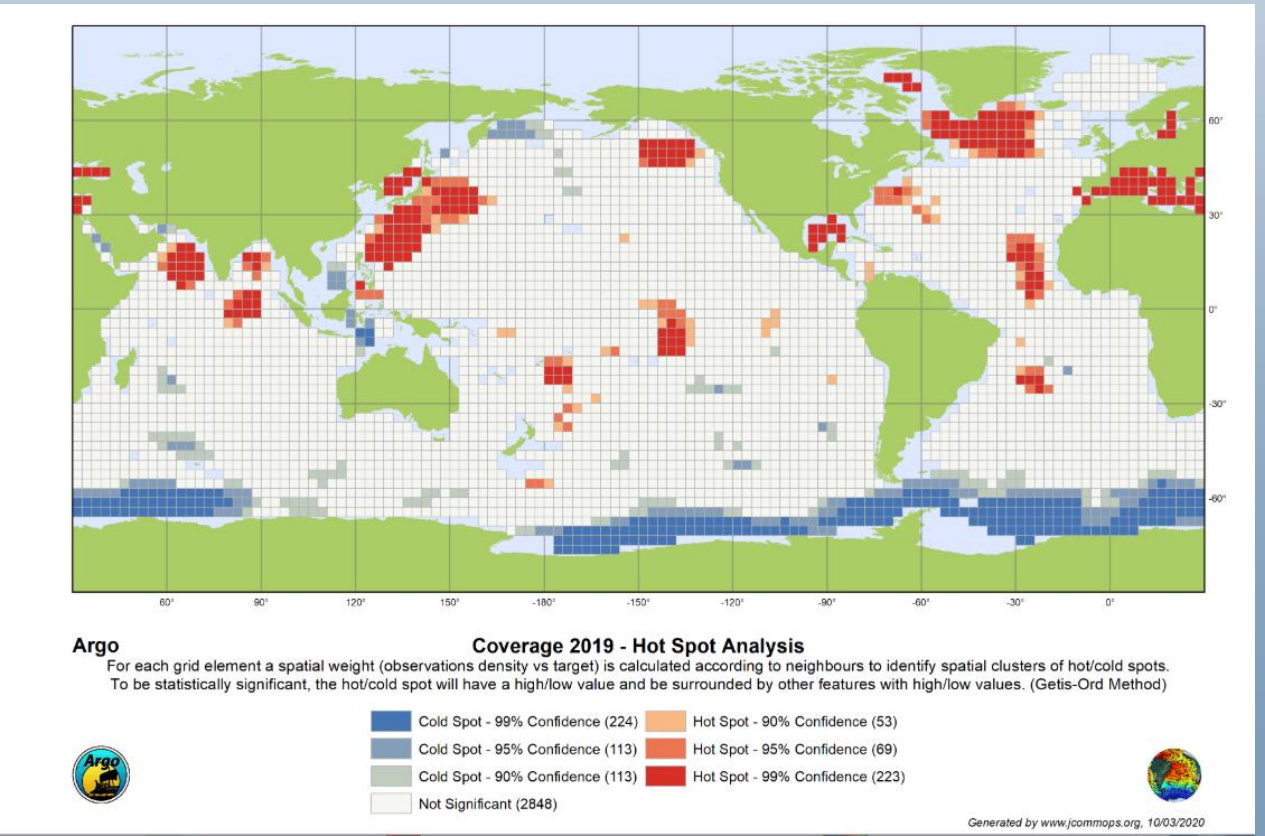
- Coverage is on light decrease

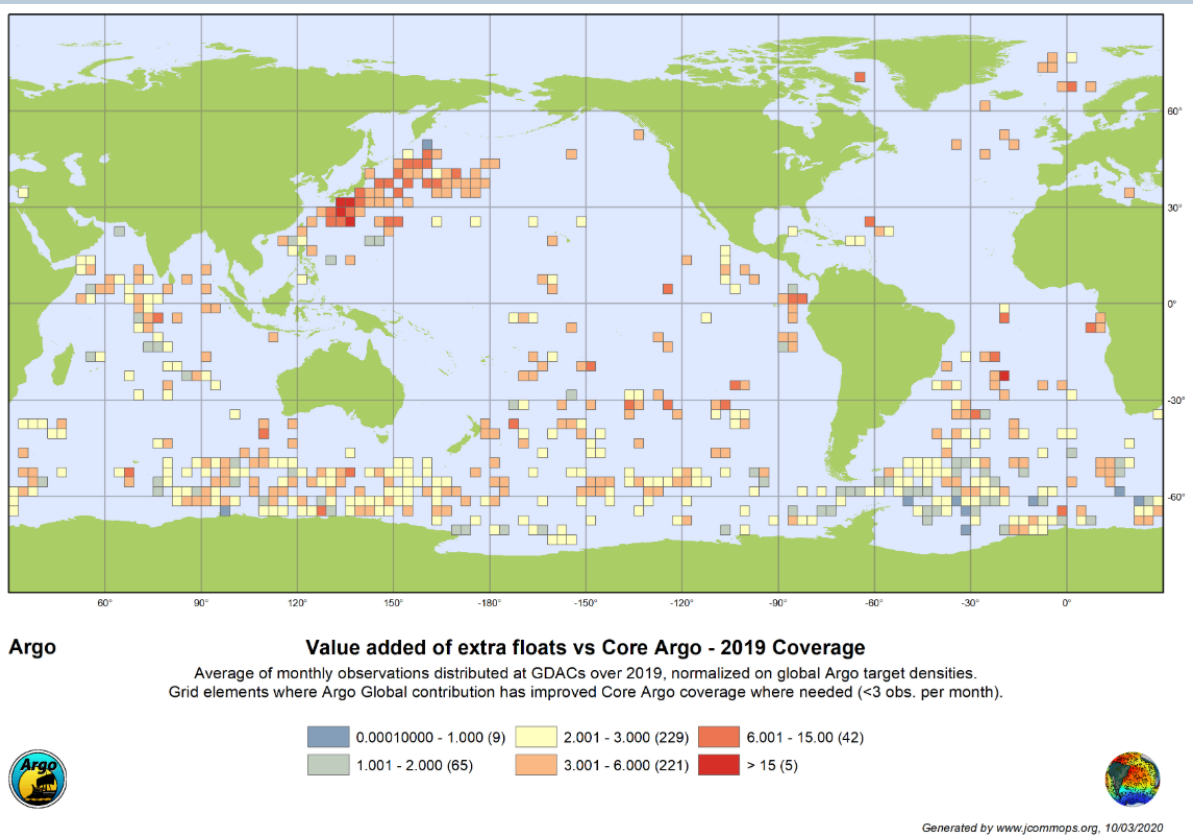




Implementation Status (Coverage)

- Some hot spots: Extensions? Classic R/V spots ?
- GC and deep contributions have a clear positive impact on space/time coverage in particular in the South (thank you SOCCOM).





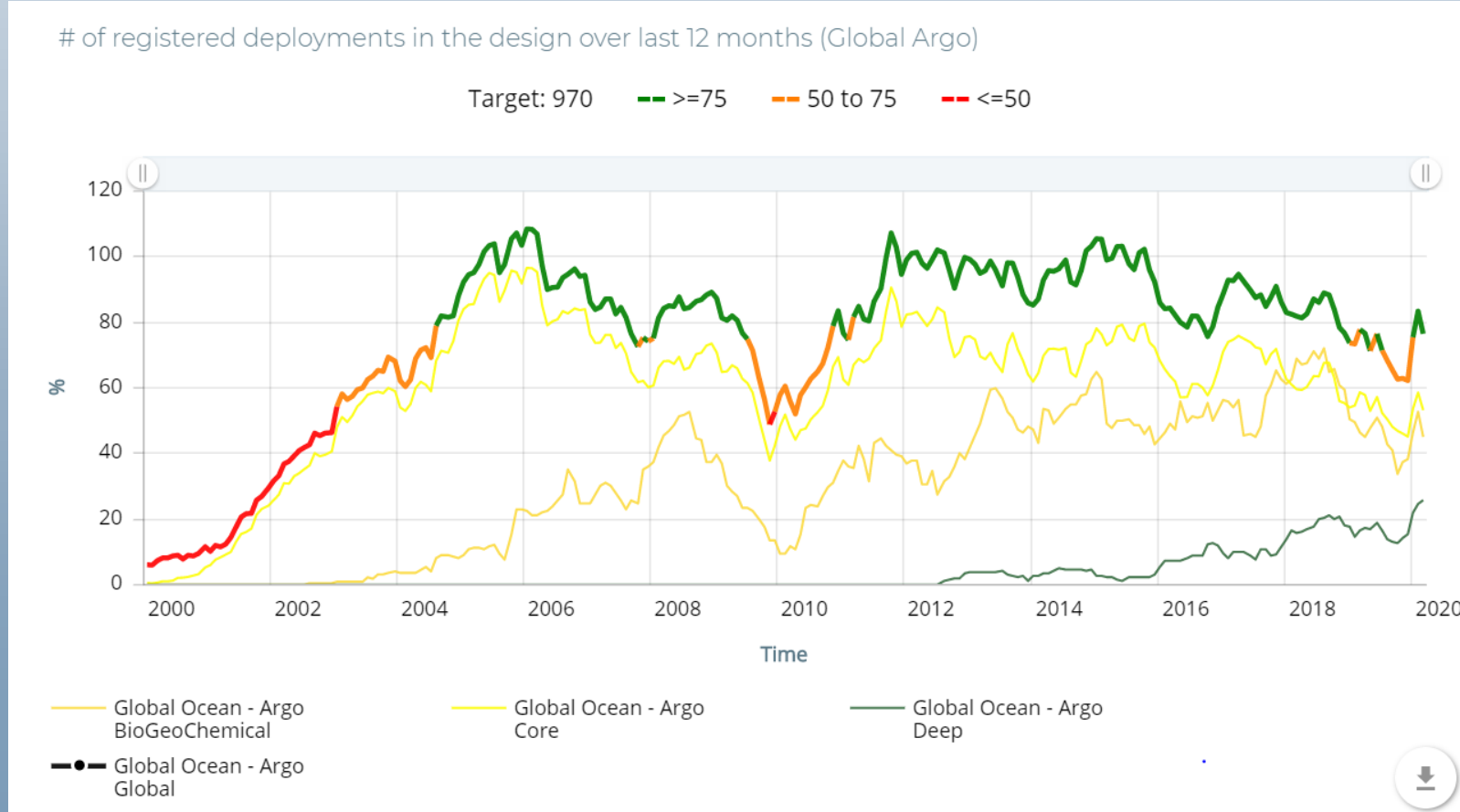
Implementation

Coverage (Yearly) Argo Global - Southern Ocean	28.99% 2019 ↗
Coverage (Yearly) Argo Global - Marginal Seas	41.59% 2019 ↘
Coverage (Yearly) … in EEZ Argo Global	60.25% 2019 ↘
Coverage (Yearly) Argo Global	65.28% 2019 ↘
Coverage (Yearly) Argo Global - Indian Ocean	65.71% 2019 ↘
Coverage (Yearly) Argo Global - Atlantic Ocean - South	66.89% 2019 ↘
Coverage (Yearly) Argo Global - Pacific Ocean - South East	67.71% 2019 ↘
Coverage (Yearly) Argo Global - Mediterranean Sea	68.75% 2019 ↘
Coverage (Yearly) Argo Global - Pacific Ocean - North East	69.7% 2019 ↘
Coverage (Yearly) Argo Global - Atlantic Ocean	71.25% 2019 ↘
Coverage (Yearly) Argo Global - Pacific Ocean	71.29% 2019 ↘
Coverage (Yearly) Argo Global - Pacific Ocean - North West	73.68% 2019 ↗
Coverage (Yearly) Argo Global - Arctic Ocean	73.91% 2019 ↗
Coverage (Yearly) Argo Global - Pacific Ocean - South West	75.06% 2019 ↘
Coverage (Yearly) Argo Global - Atlantic Ocean - North	76.97% 2019 ↘

Implementation Status (Intensity)

- Clear decreasing trend except for deep

Implementation	
Intensity Argo Deep	25.77% 3/2020 ↗
Intensity Argo BioGeoChemical	45.05% 3/2020 ↘
Intensity Argo Core	53.2% 3/2020 ↘
Intensity Argo Global	76.49% 3/2020 ↘



Implementation

Intensity	Argo Global - Pacific Ocean - South West	48.54% 3/2020 ↘
Intensity	Argo Global - Southern Ocean	53.16% 3/2020 ↗
Intensity	Argo Global - Marginal Seas	53.64% 3/2020 ↘
Intensity	Argo Global - Arctic Ocean	70.59% 3/2020 ↗
Intensity	Argo Global - Indian Ocean	72.94% 3/2020 ↗
Intensity	Argo Global	76.49% 3/2020 ↘
Intensity	Argo Global - Pacific Ocean - North East	76.64% 3/2020 ↘
Intensity	Argo Global - Pacific Ocean	79.9% 3/2020 ↘
Intensity	Argo Global - Mediterranean Sea	87.1% 3/2020 ↘
Intensity	Argo Global - Pacific Ocean - South East	88.99% 3/2020 ↗
Intensity	Argo Global - Atlantic Ocean - South	94.55% 3/2020 ↗
Intensity	Argo Global - Atlantic Ocean	95.85% 3/2020 ↘
Intensity	Argo Global - Atlantic Ocean - North	97.59% 3/2020 ↘
Intensity	Argo Global - Pacific Ocean - North West	118.84% 3/2020 ↘

Implementation

Intensity Argo BioGeoChemical - Pacific Ocean - North West	17.65% 3/2020 ↘
Intensity Argo BioGeoChemical - Pacific Ocean - North East	22.22% 3/2020 ↘
Intensity Argo BioGeoChemical - Pacific Ocean - South West	23.08% 3/2020 →
Intensity Argo BioGeoChemical - Pacific Ocean	28.84% 3/2020 ↘
Intensity Argo BioGeoChemical - Indian Ocean	37.79% 3/2020 ↗
Intensity Argo BioGeoChemical - Southern Ocean	39.35% 3/2020 ↘
Intensity Argo BioGeoChemical	45.05% 3/2020 ↘
Intensity Argo BioGeoChemical - Atlantic Ocean	47.74% 3/2020 ↗
Intensity Argo BioGeoChemical - Pacific Ocean - South East	48.15% 3/2020 ↗
Intensity Argo BioGeoChemical - Mediterranean Sea	137.5% 3/2020 ↘
Intensity Argo BioGeoChemical - Arctic Ocean	241.55% 3/2020 ↗

Implementation

Intensity Argo Deep - Southern Ocean	8.39% 3/2020 ↘
Intensity Argo Deep - Pacific Ocean	14.03% 3/2020 ↘
Intensity Argo Deep - Indian Ocean	15.44% 3/2020 ↗
Intensity Argo Deep	25.77% 3/2020 ↗
Intensity Argo Deep - Atlantic Ocean	64.28% 3/2020 ↗

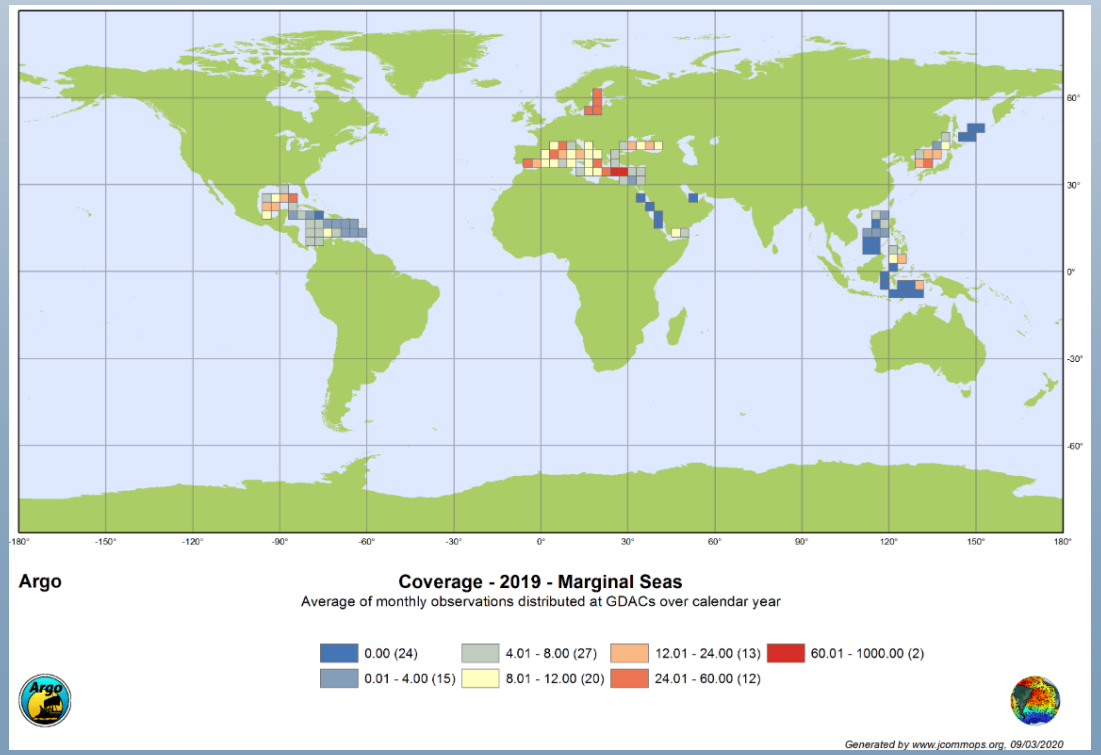
Implementation Status (Extensi

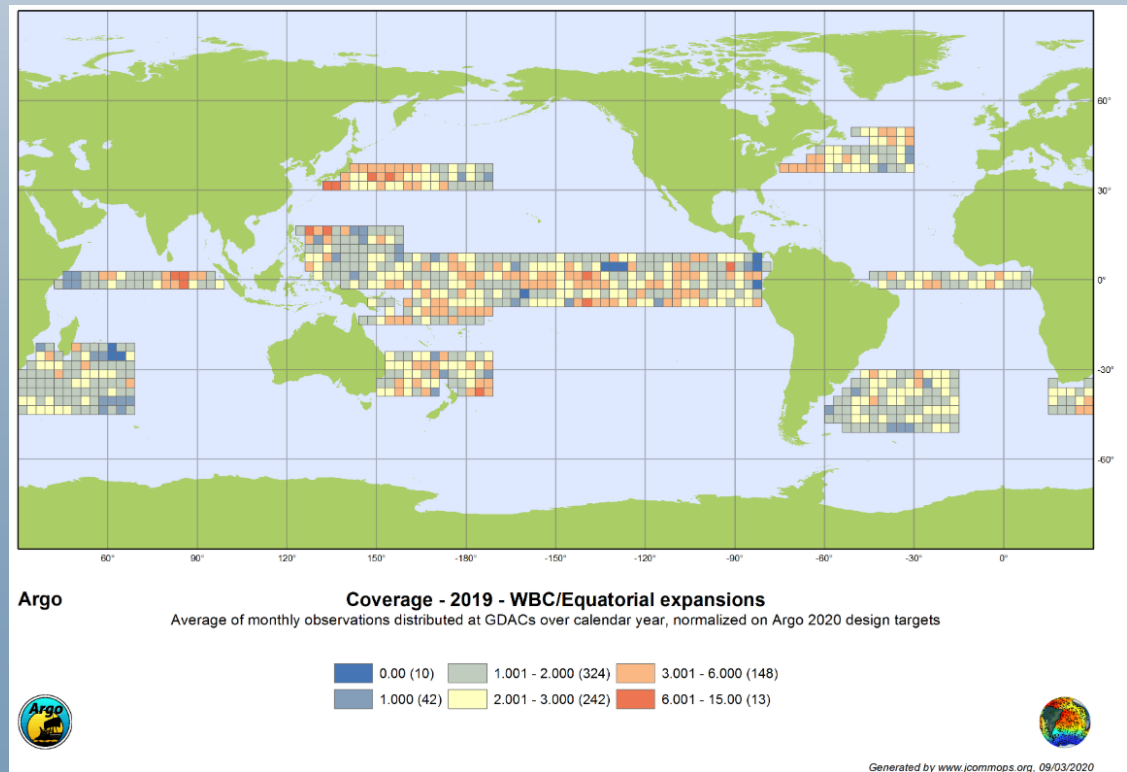
Implementation	
Activity (2020) Argo Global - WBC - Mindanao	39.29% 3/2020 ↘
Activity (2020) Argo Global - WBC - Malvinas/Falklands	48.39% 3/2020 ↘
Activity (2020) Argo Global - WBC - Kuroshio	54.81% 3/2020 ↗
Activity (2020) Argo Global - WBC - Agulhas	55.75% 3/2020 ↗
Activity (2020) Argo Global - WBC - Solomon Sea	56.58% 3/2020 ↘
Activity (2020) Argo Global - WBC	56.62% 3/2020 ↘
Activity (2020) Argo Global - Equatorial - Indian	56.94% 3/2020 ↘
Activity (2020) Argo Global - Equatorial - Atlantic	58.57% 3/2020 ↗
Activity (2020) Argo Global - Equatorial	59.12% 3/2020 ↘
Activity (2020) Argo Global - Equatorial - Pacific	59.51% 3/2020 ↗
Activity (2020) Argo Global - WBC - East Australian	69.49% 3/2020 ↗
Activity (2020) Argo Global - WBC - Gulf Stream	80% 3/2020 →

Activity (2020) Tropical Pacific Observing System - Pacific Ocean	78.55% 3/2020 ↘	989 Raw count	1259 Target
Activity Tropical Pacific Observing System - Pacific Ocean	110.63% 3/2020 ↘	989 Raw count	894 Target

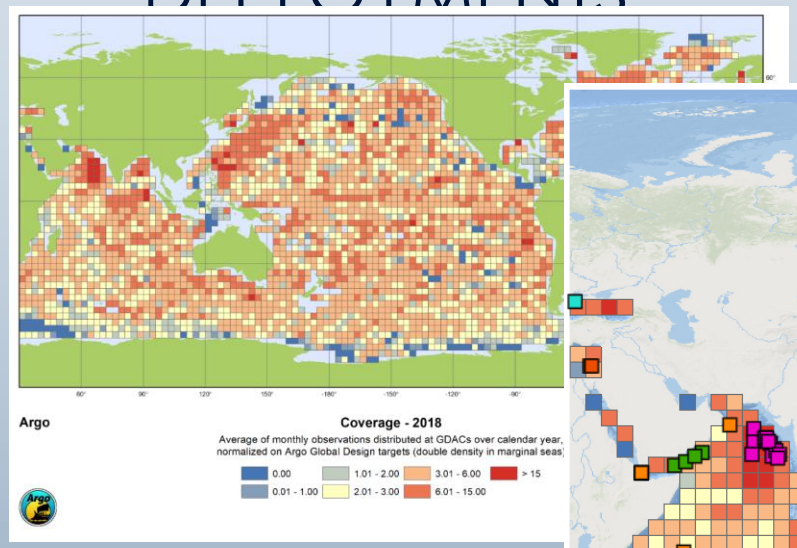
Implementation Status (Extensions)

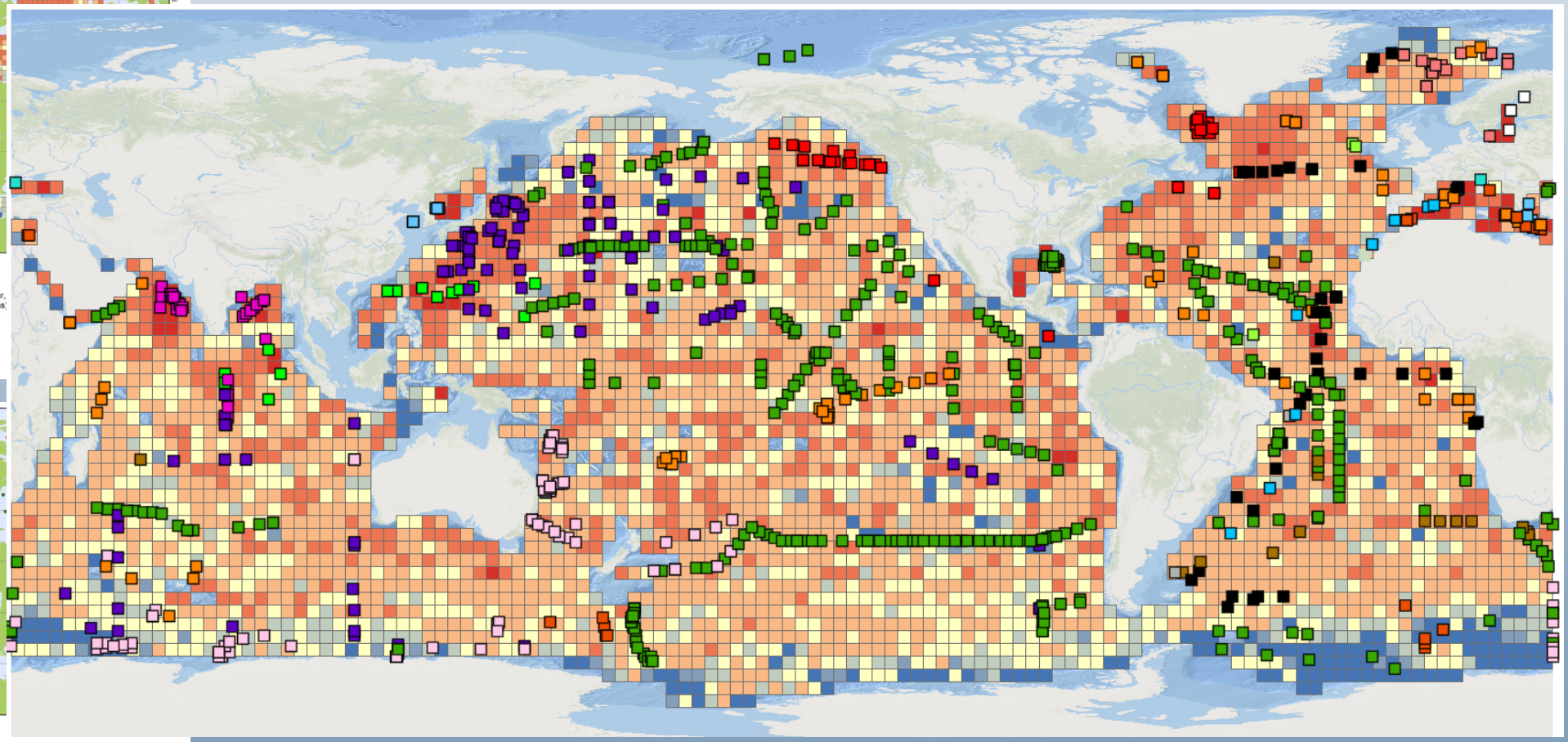
- Marginal Sea, WBC, Eq./TPOS: international issues
- We need more contributions, more partners, EEZ access
- And maybe combine better with other observing networks.

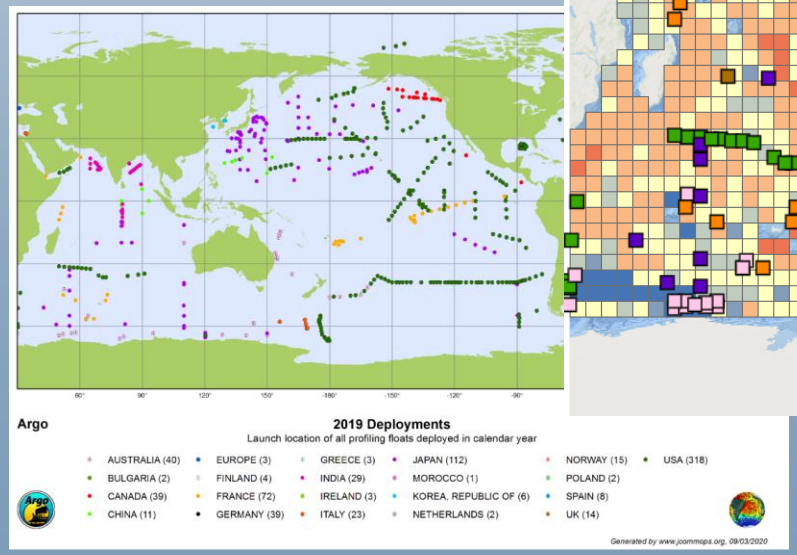




Deployment Planning: 2018 coverage + 2019 deployments





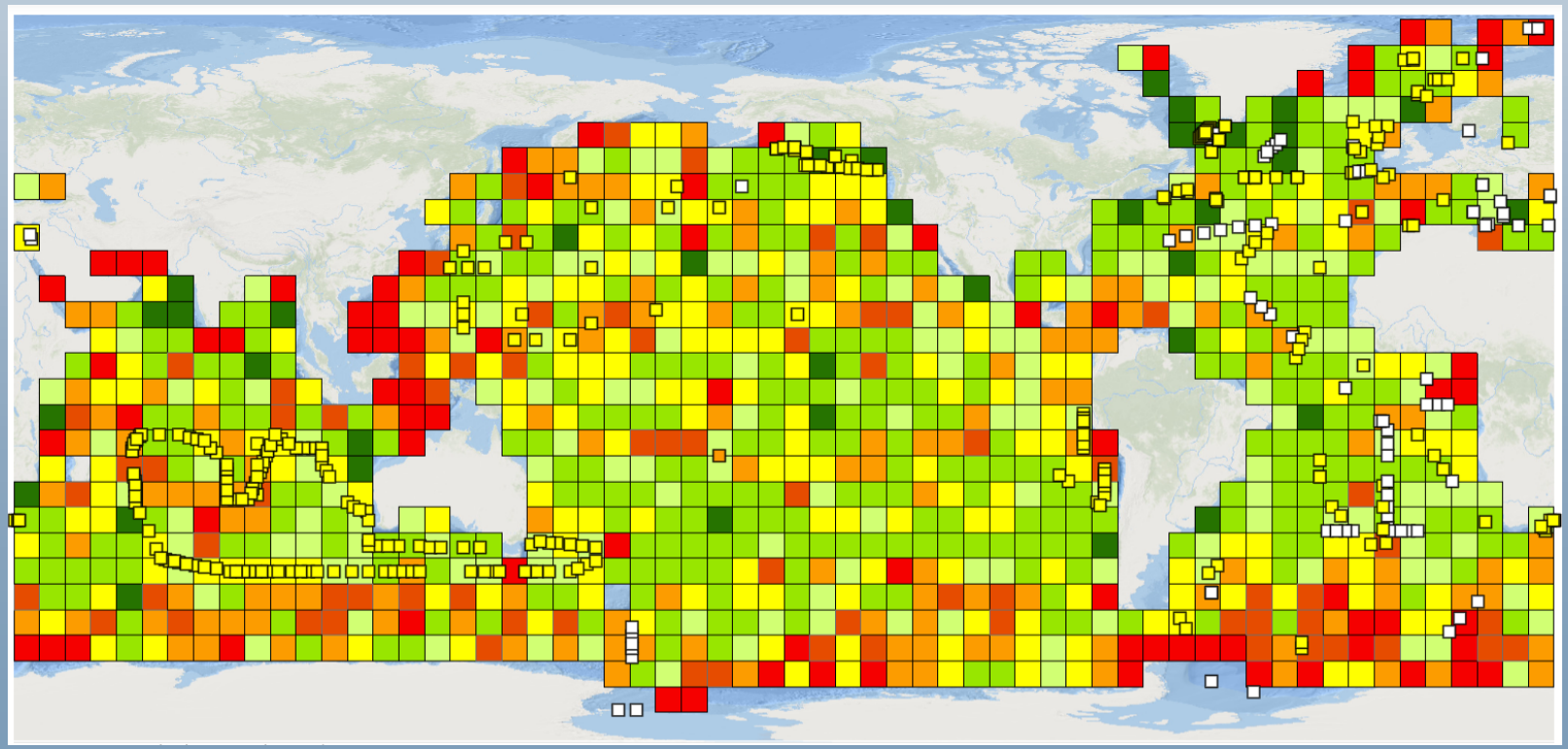


Planning

- Proposal: Basin coordination meeting twice a year
- With other key networks (GOSHIP, OS, gliders)

- Atlantic done once
  - Communication
  - Redraft some plans
  - Match with opportunities
  - Prioritize

- Next ?



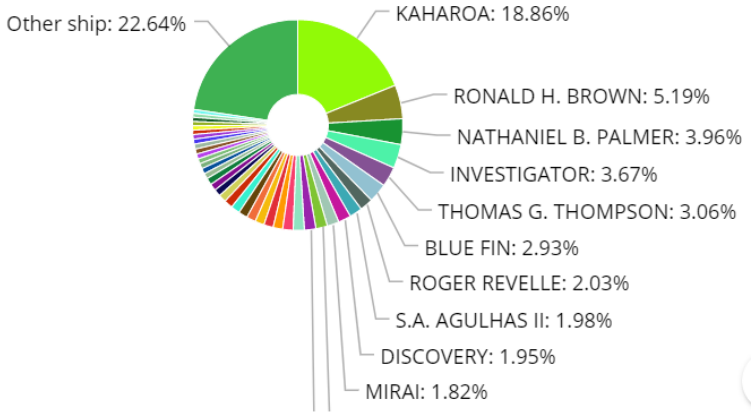
PLANNING

- We need to take the Argo planning to the next level. How far the AST is ready to go?

- Can we have a more collective decision process for priorities?

- Can we work together on charter solution for continuous gaps?
- ~2000$ for a float deployment… +10% of a core (20 profiles) , even less for deep/BGC
- 1 float no contributing to the target is equivalent to 10 free deployments …
- Combine deployment (and retrieval) on large scale

- To optimize the array
- Reduce “fragmentation”, logistics burden
- Improve cost efficiency
- Pilot solution spaces for EEZ access
- Priority to deep and bgc ?



Commitments: https://www.jcommops.org/board/wa/Commitments Module?t=Argo

Commitments

Year: 2020 By Networks

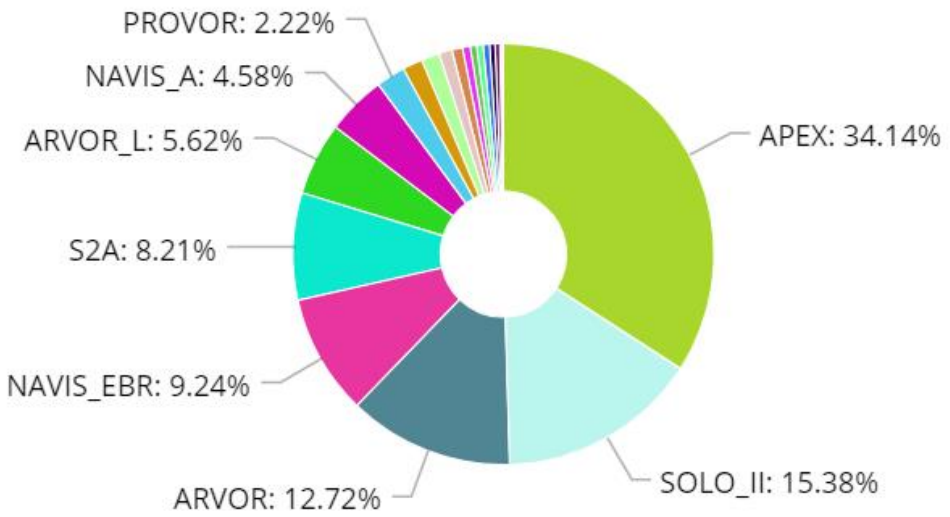
Country	Extend	Total	Argo Core	Argo Equivalent	Argo BioGeoChemical	Argo Deep	Argo 2020	Comments
Argentina	1	0						
Australia	1	0						
Brazil	1	0						
Bulgaria	1	3	1		2			Black Sea
Canada	1	45	35	3	7			3 RBR pilot Atlantic
Chile	1	0						
China	1	175	150		22	3		Pacific Ocean, Indian Ocean and the So...
Costa Rica	1	0						
Denmark	1	0						
Ecuador	1	0						
Total		**848**	**631**	**49**	**124**	**44**	**0**	

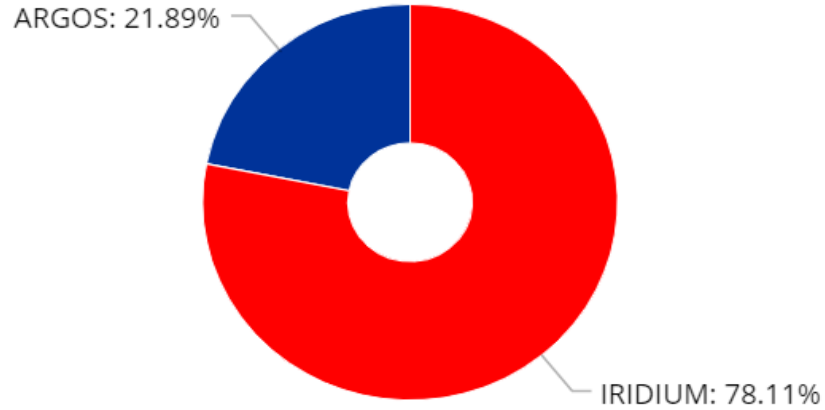
Commitments		848	631	49	124	44		
Deployed		291	180	40	54	27	2	
Target		970	970		222	260		
Commitments - Target		-122	-339	49	-98	-216		
Operational		3745	3190	152	368	135	7	
Projection 2021		3628	3014	158	388	141		

Commitments x

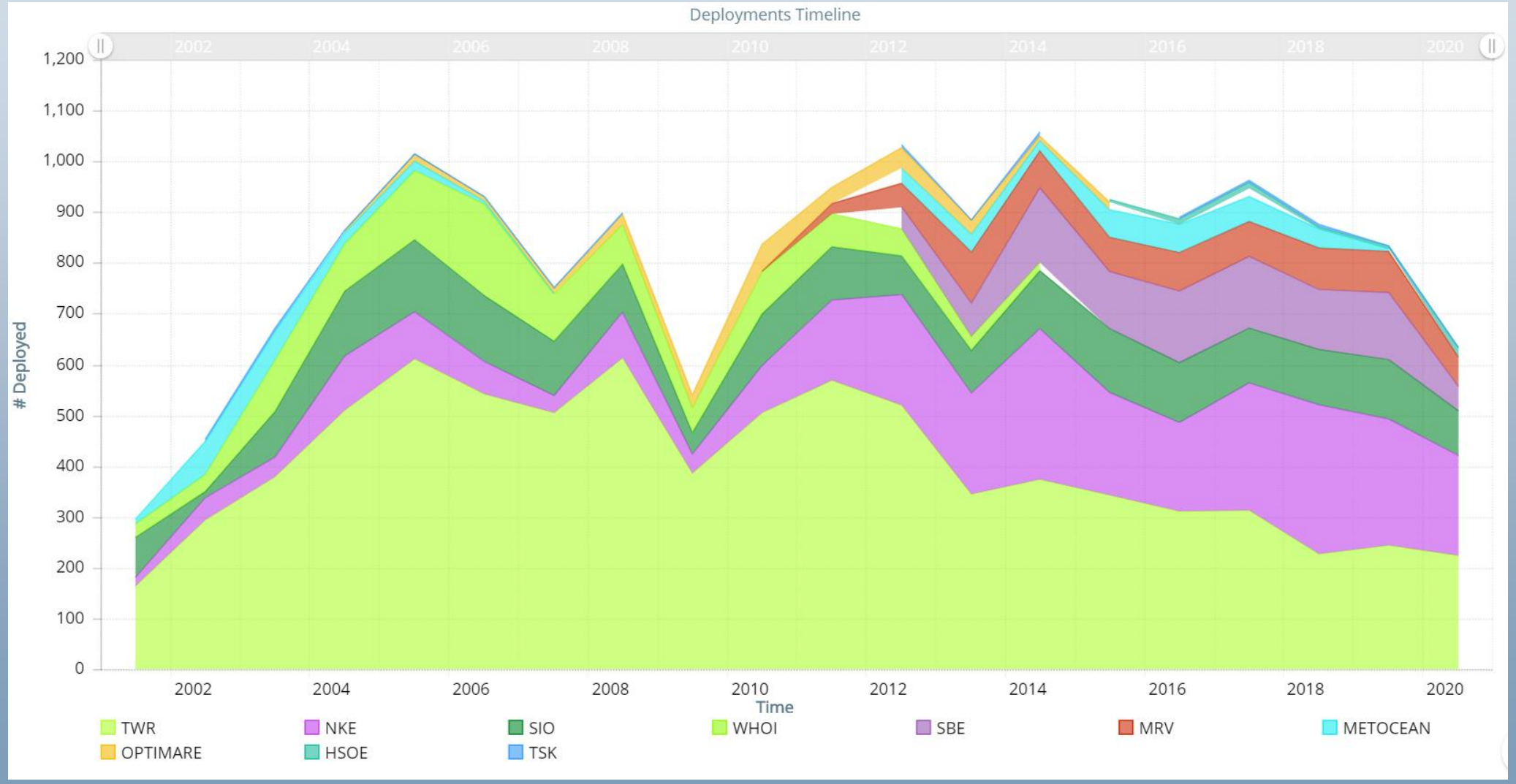
INSTRUMENTATION - DIVERSITY

- Diversity = Resilience
- How do we talk with the industry ?
  - Small companies
  - New target= **250 + cycles to enable BGC and a “smart array”**
  - Sensors cost
  - RBR pilot ? Phased with the industrial time ?
  - Environmental issues ?
  - Data/Metadata



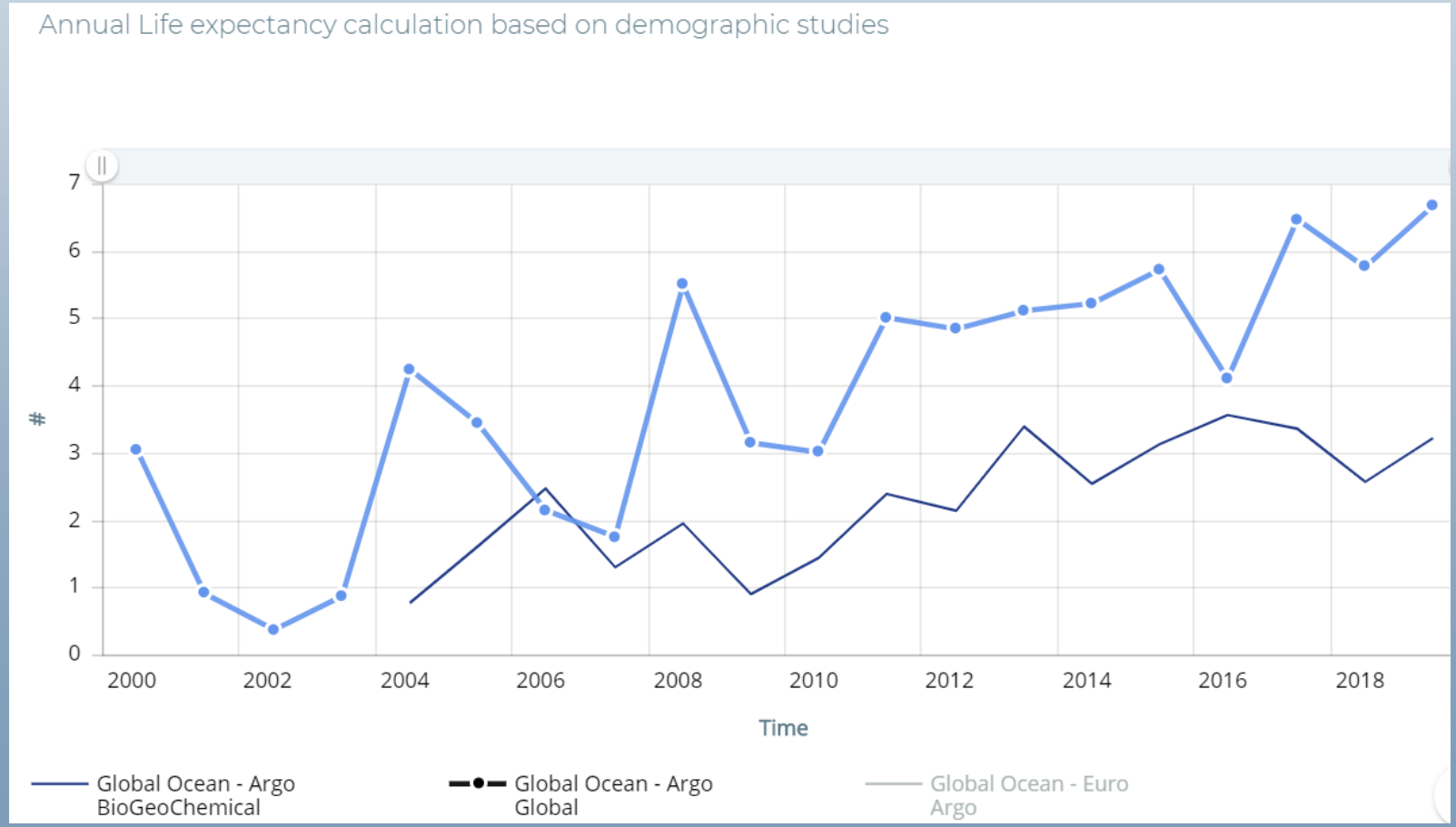


INSTRUMENTATION - MARKET



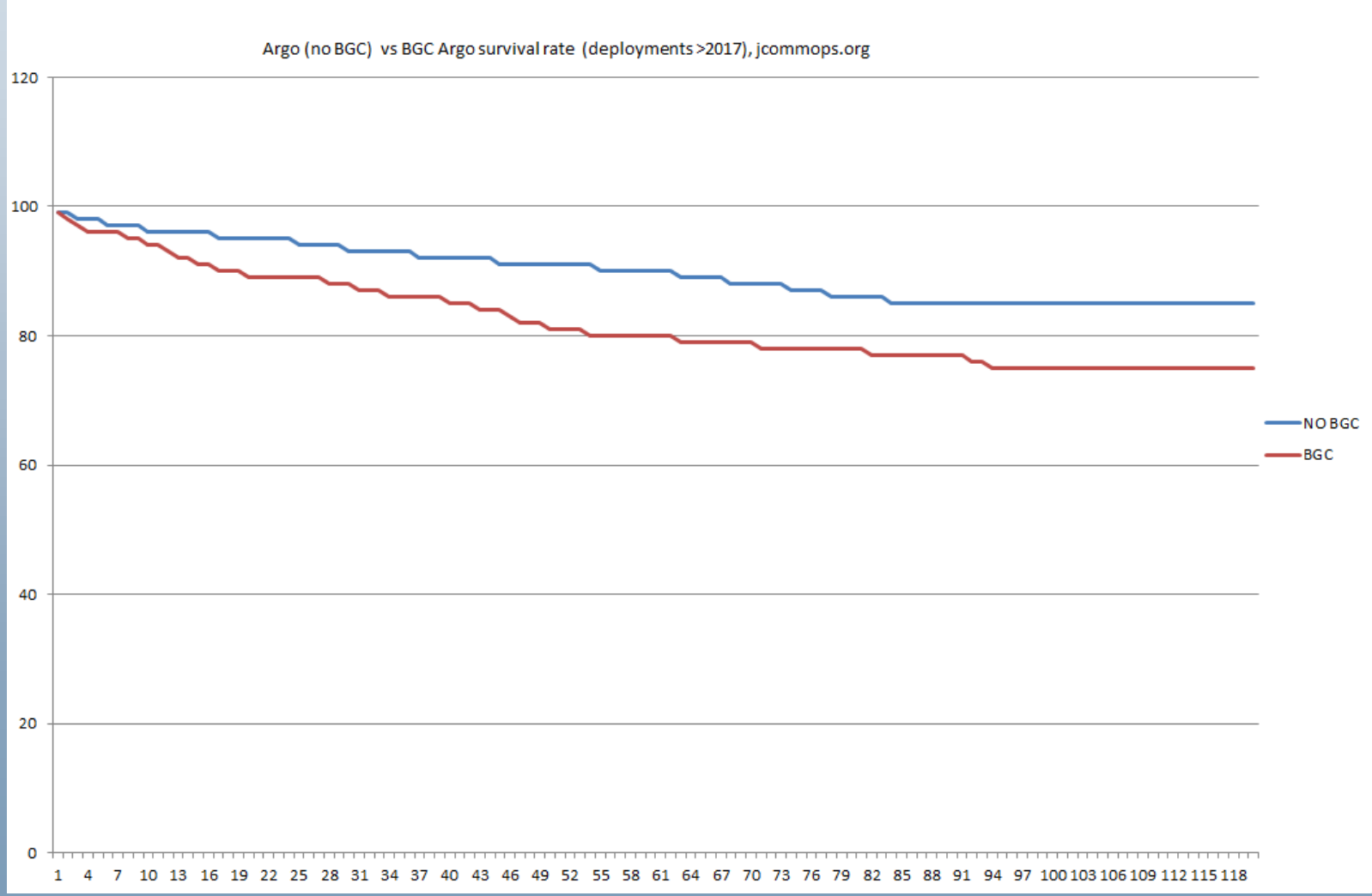
INSTRUMENTATION - PERFORMANCE

- 6.7 years life expectancy at deployment = 244 cycles !!!
- 3.2 for BGC (117 profiles)



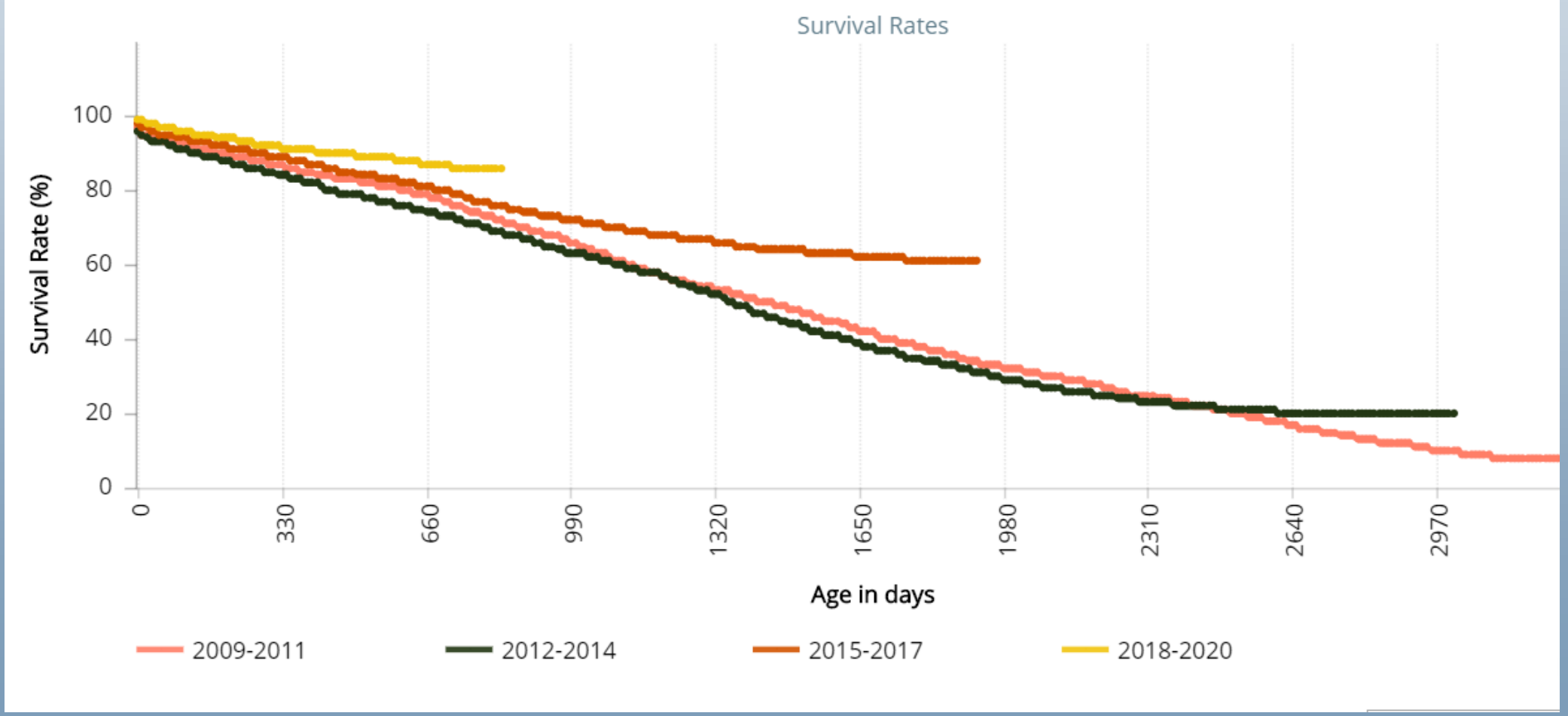
INSTRUMENTATION - PERFORMANCE

- Survival rate 3-year



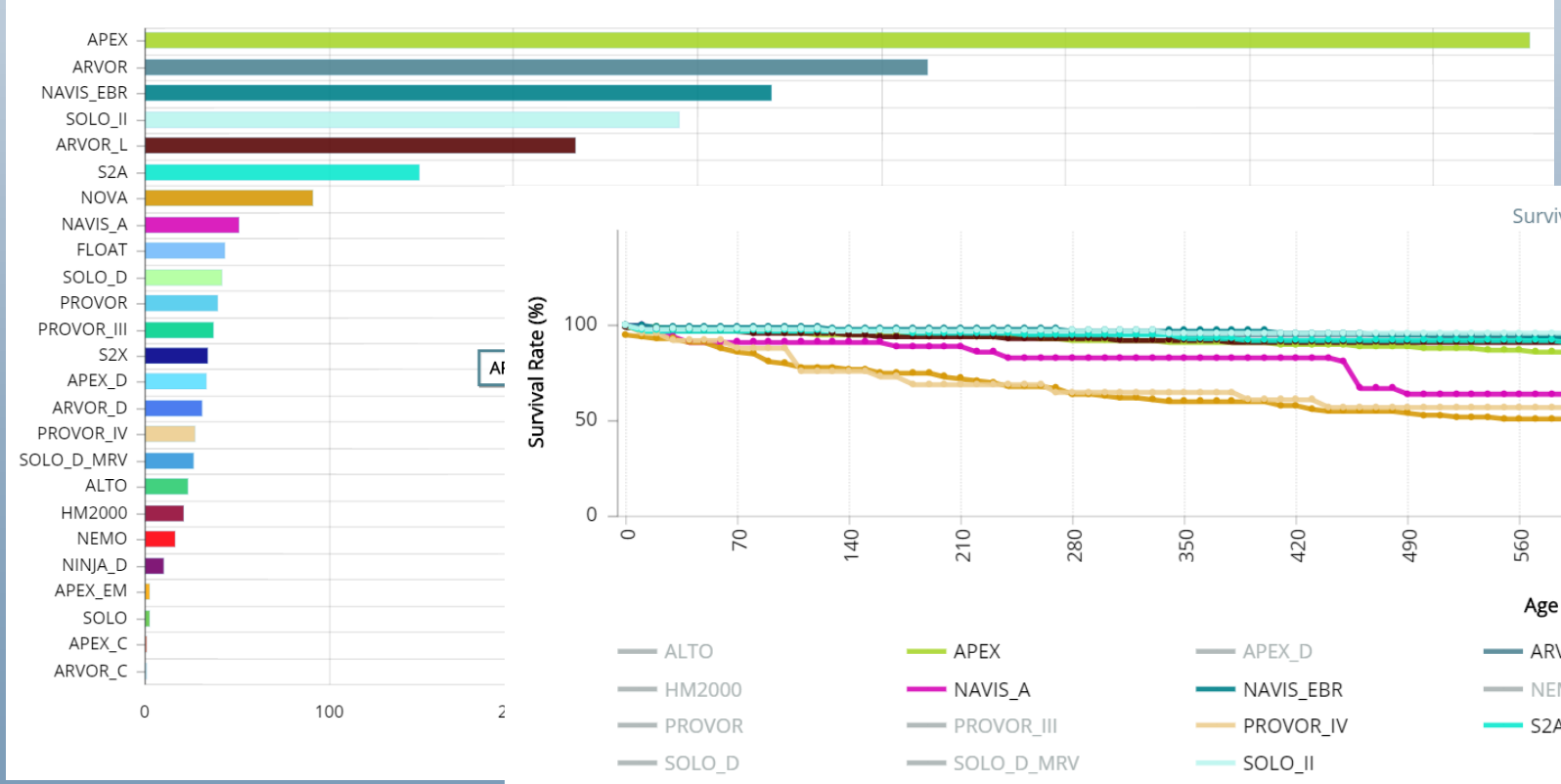
INSTRUMENTATION - PERFORMANCE

- Survival rate 3-year generations



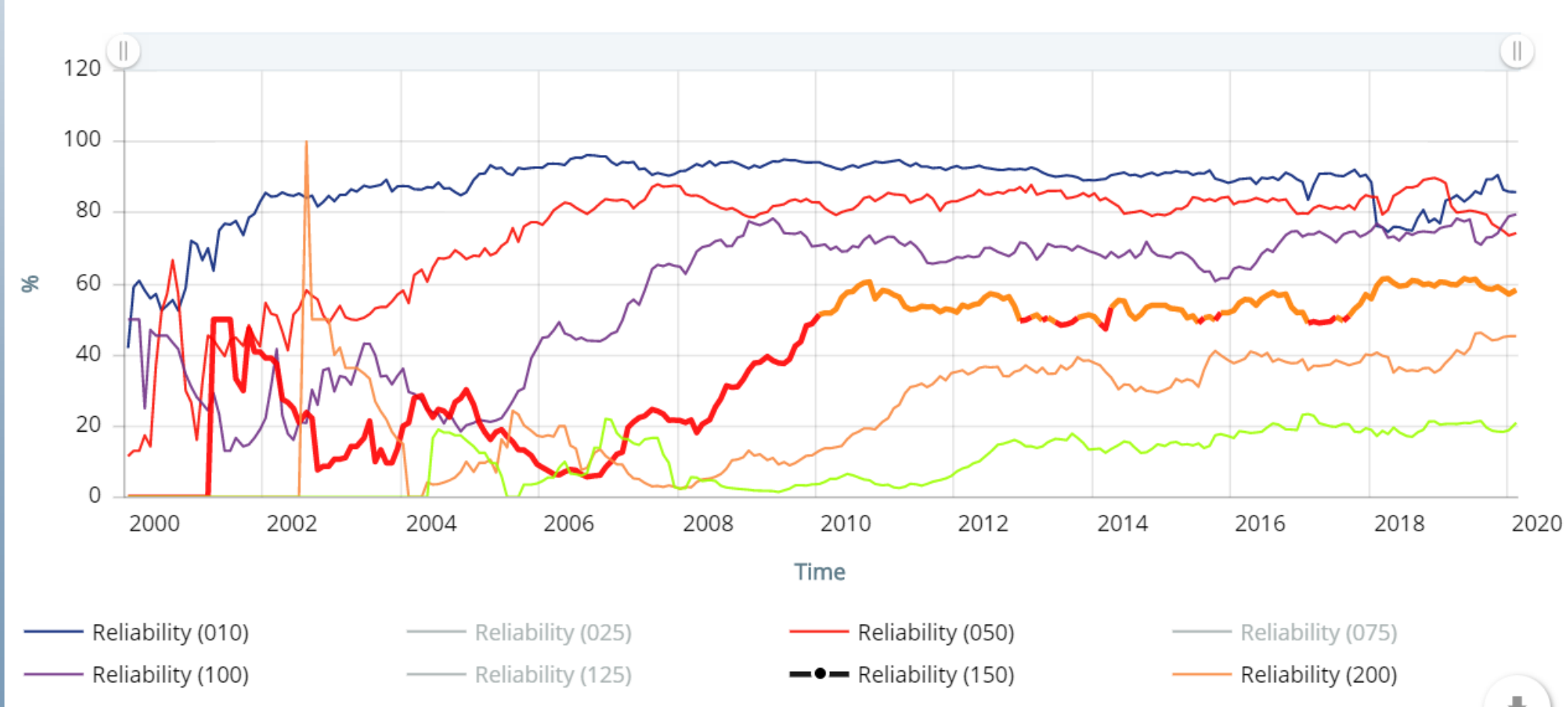
INSTRUMENTATION - PERFORMANCE

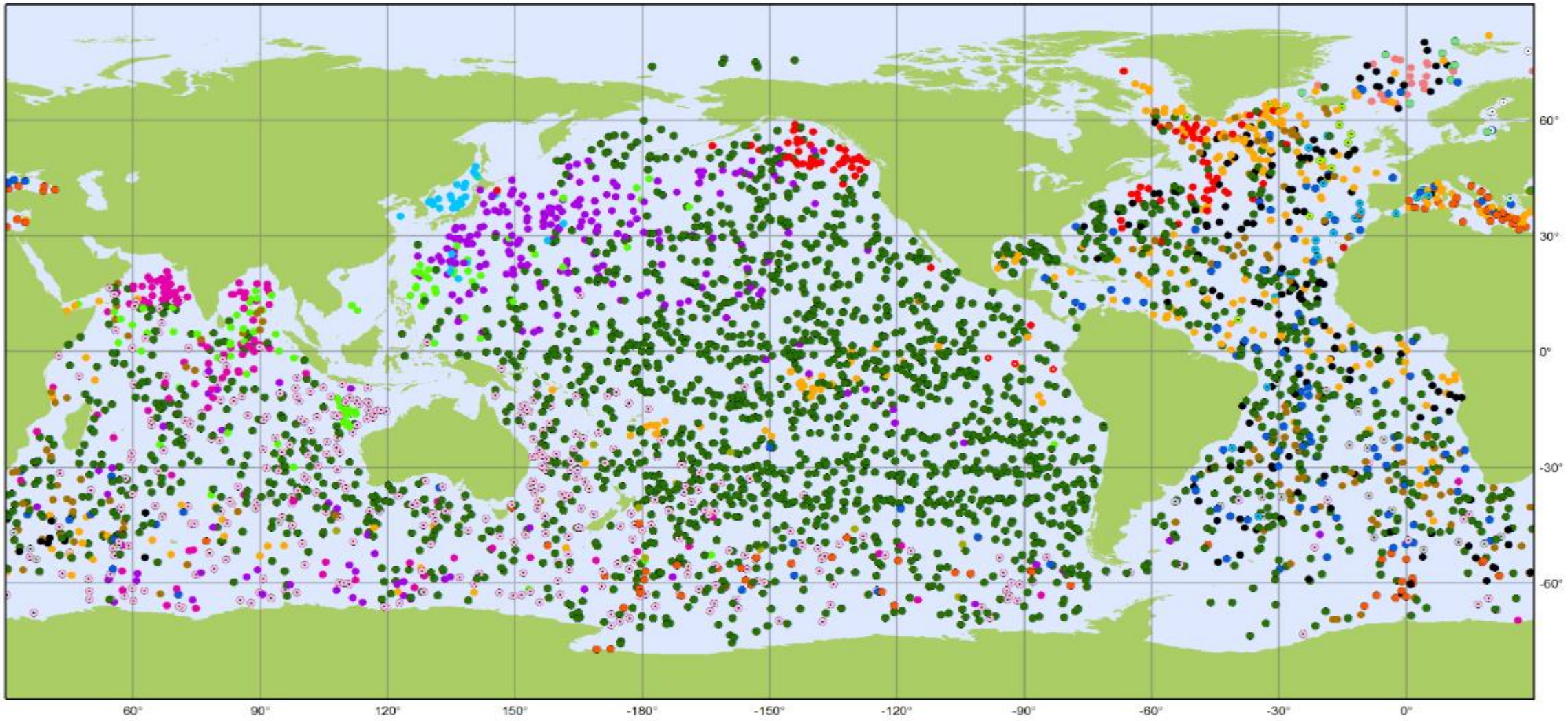
- Survival rate >= 2017
- 3 groups (SOLOII, S2A, NAVIS_EBR, ARVOR) …. (SOLO_D, ARVOR_L, APEX) …. (NAVIS_A, NOVA)



INSTRUMENTATION - PERFORMANCE

- Reliability evolution at different targets cycles





Argo

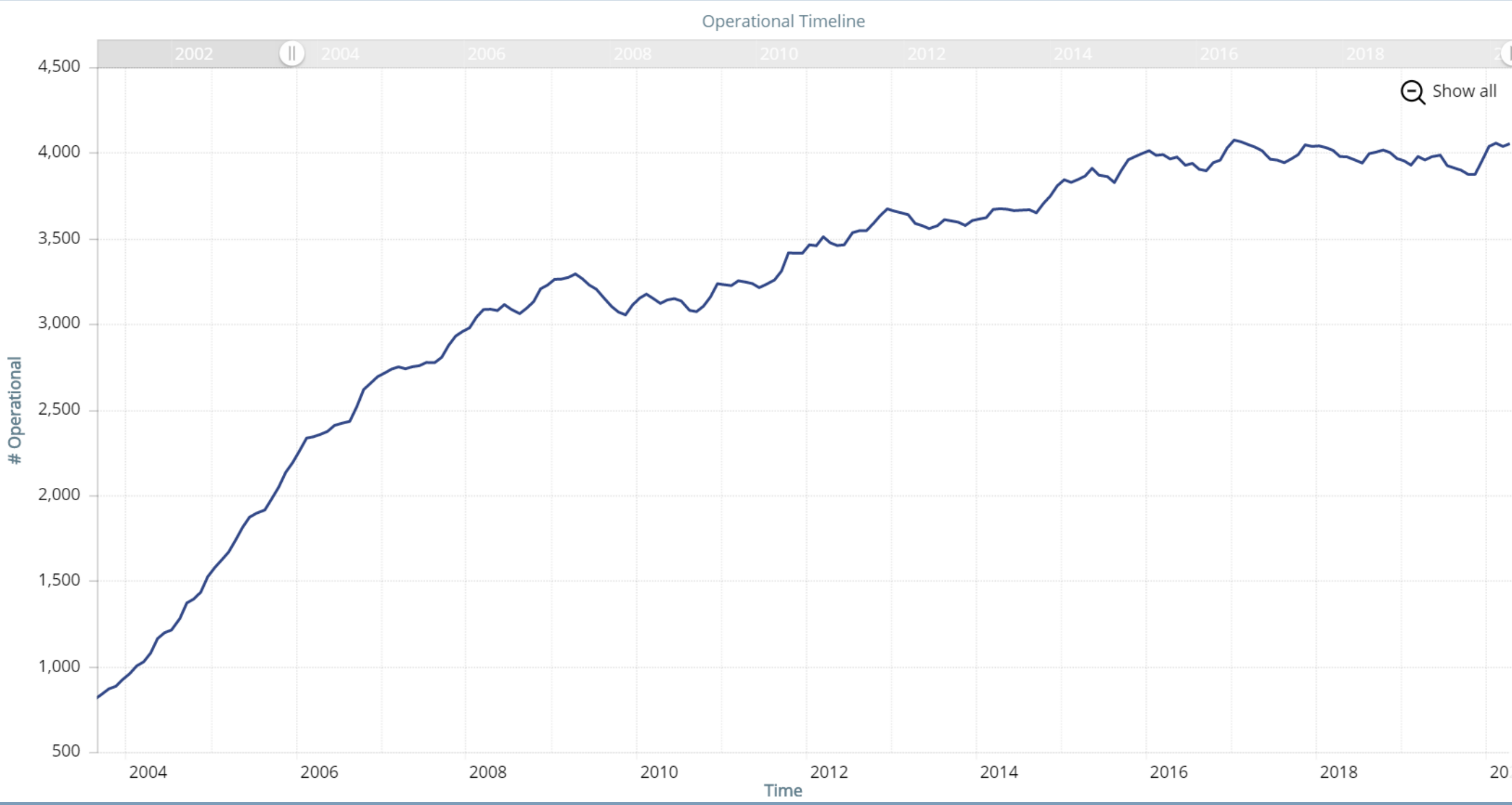
National contributions - 4072 Operational Floats

February 2020

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

- AUSTRALIA (365)
- BULGARIA (2)
- CANADA (96)
- CHINA (97)
- EUROPE (121)
- FINLAND (5)
- FRANCE (269)
- GERMANY (164)
- GREECE (1)
- INDIA (119)
- IRELAND (13)
- ITALY (82)
- JAPAN (238)
- MEXICO (1)
- MOROCCO (1)
- NETHERLANDS (25)
- NEW ZEALAND (12)
- NORWAY (21)
- PERU (3)
- POLAND (9)
- KOREA, REPUBLIC OF (35)
- SPAIN (24)
- UK (150)
- USA (2219)

Extras Slides - Stats


Operational Timeline
2002
2004
2006
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2010
2012
2014
2016
2018
Show all
4,500
4,000
3,500
3,000
2,500
2,000
1,500
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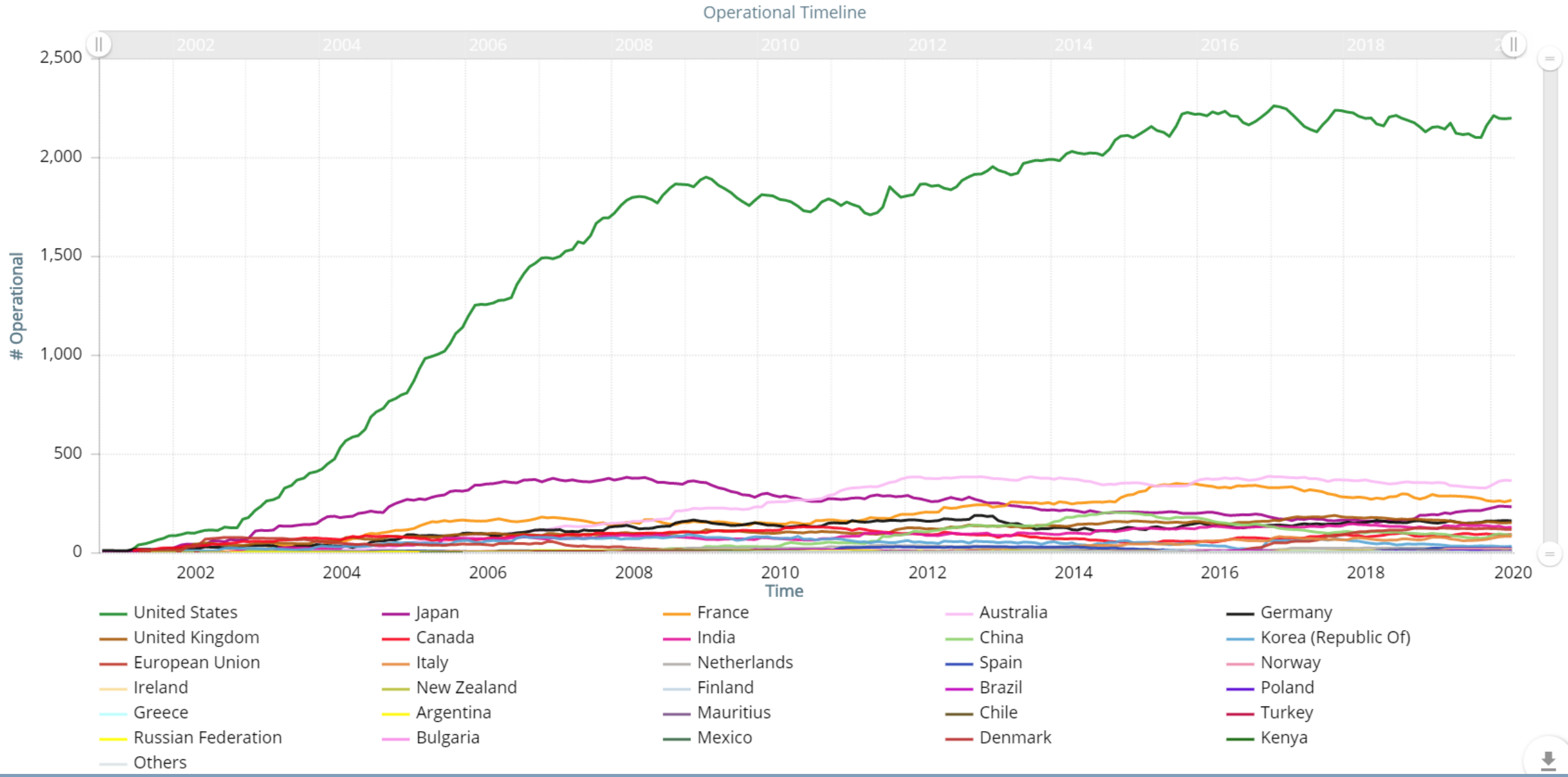
500
Operational
2004
2006
2008
2010
2012
2014
2016
2018
Time


Operational Timeline
2002
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2,500
2,000
1,500
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Operational
2002
2004
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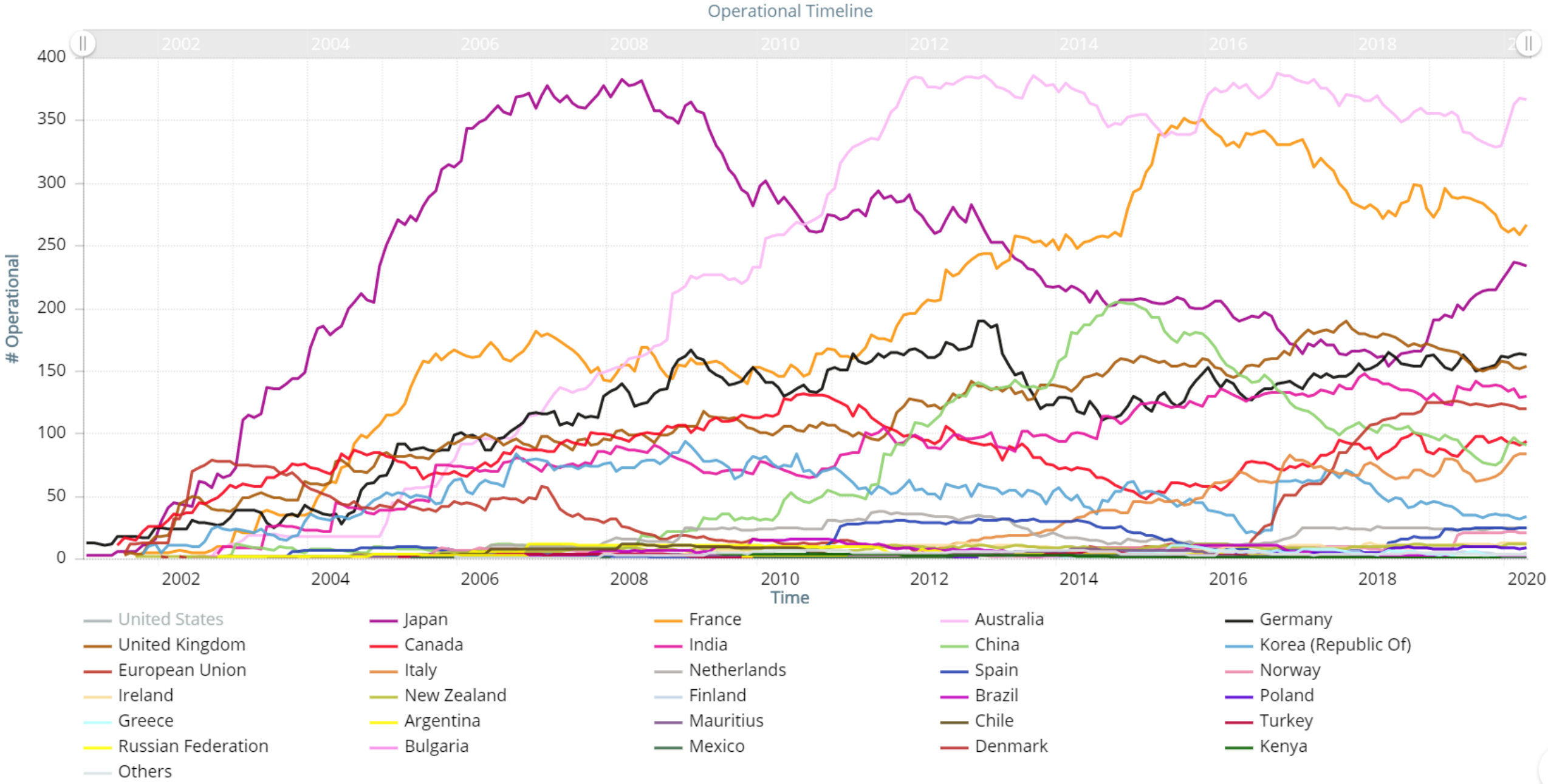
2012
2014
2016
2018
2020
Time
United States
Japan
France
Australia
Germany
United Kingdom
Canada
India
China
Korea (Republic Of)
European Union
Italy
Netherlands
Spain
Norway
Ireland
New Zealand
Finland
Brazil
Poland
Greece
Argentina
Mauritius
Chile
Turkey
Russian Federation
Bulgaria
Mexico
Denmark
Kenya
Others


Operational Timeline
2002
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150
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Operational
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2004
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2018
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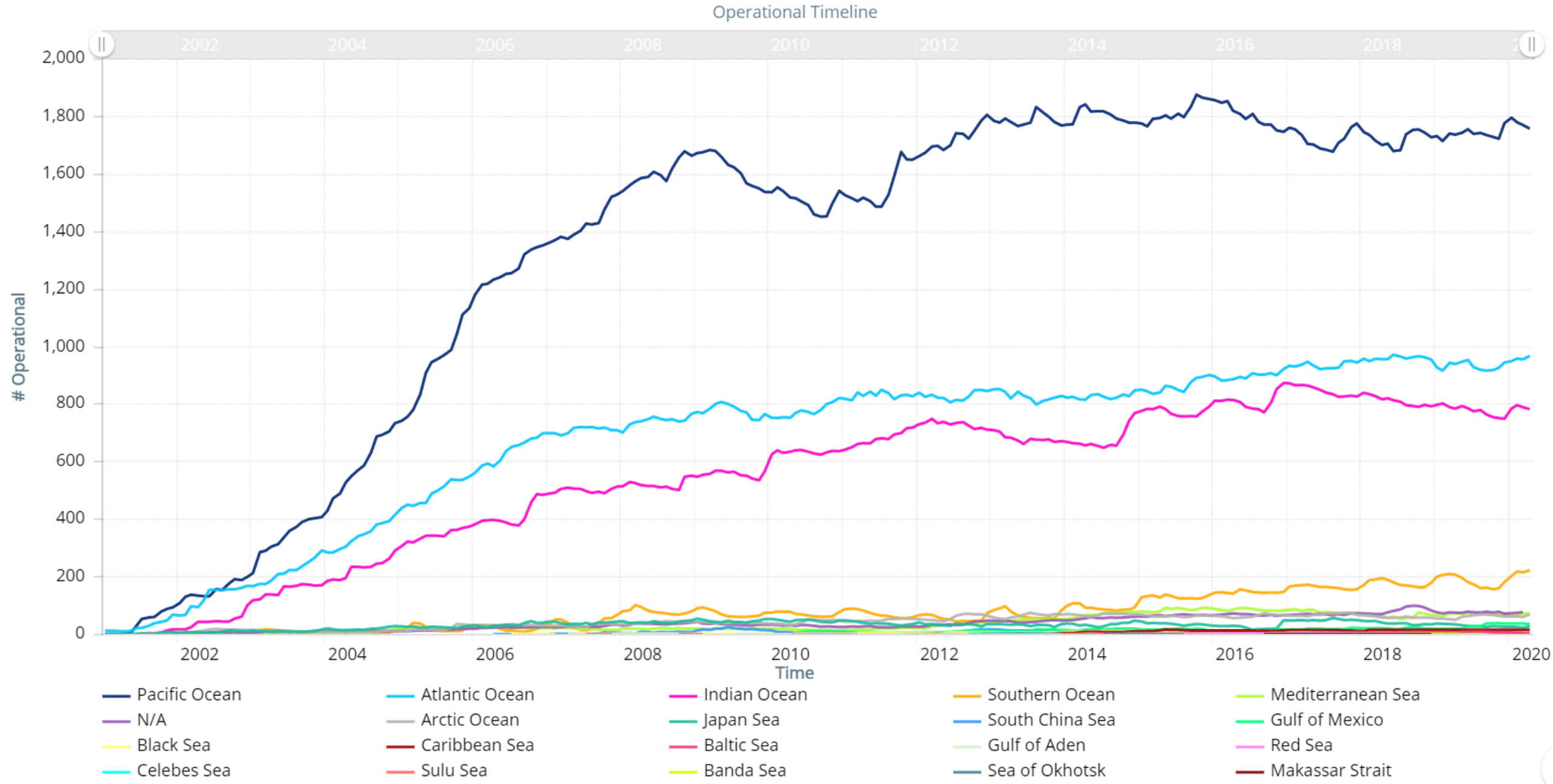
Time
United States
Japan
France
Australia
Germany
United Kingdom
Canada
India
China
Korea (Republic Of)
European Union
Italy
Netherlands
Spain
Norway
Ireland
New Zealand
Finland
Brazil
Poland
Greece
Argentina
Mauritius
Chile
Turkey
Russian Federation
Bulgaria
Mexico
Denmark
Kenya
Others


Operational Timeline
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1,400
1,200
1,000
800
600
400
200
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Operational
2002
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2010
2012
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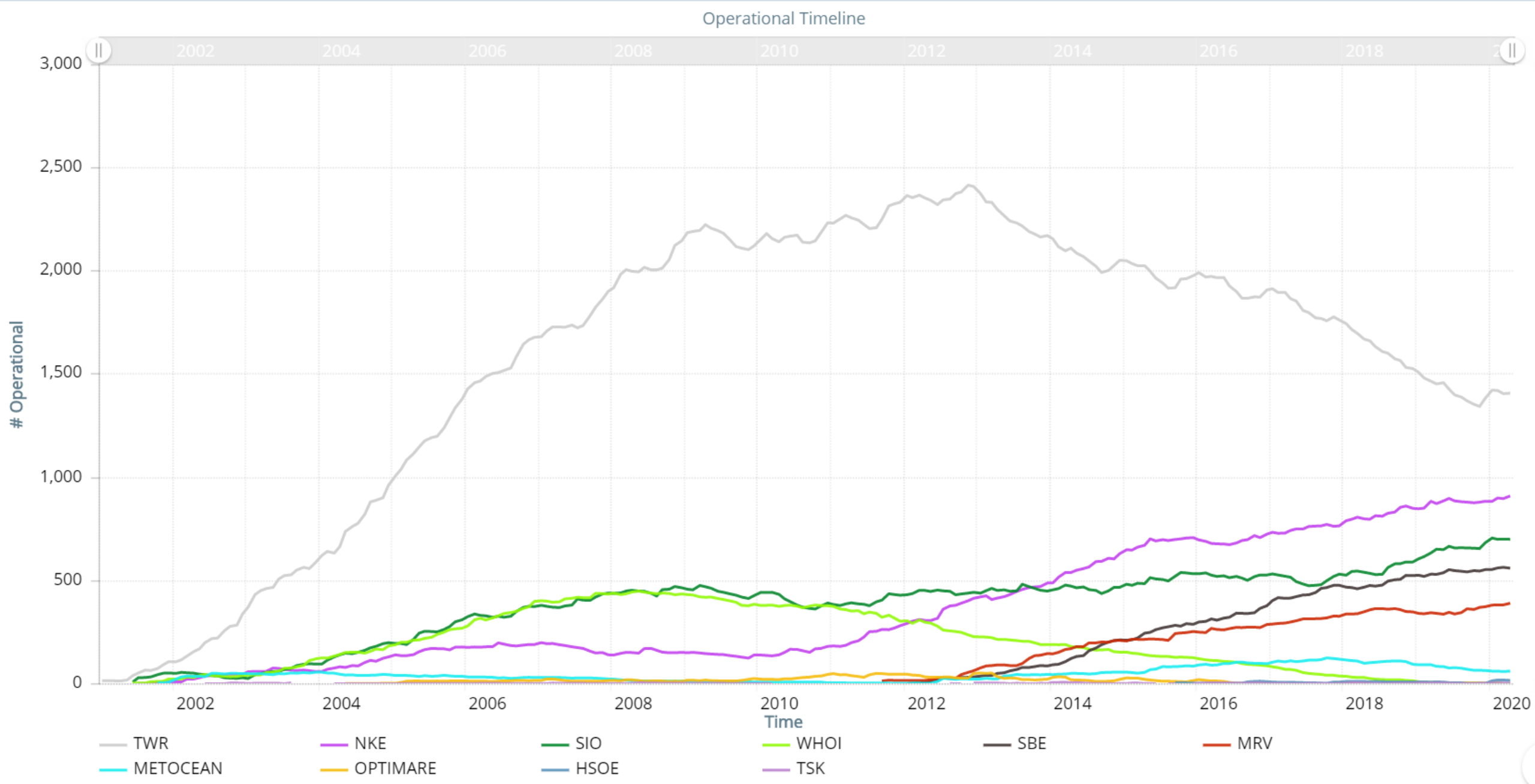
2016
2018
2020
Time
Pacific Ocean
Atlantic Ocean
Indian Ocean
Southern Ocean
Mediterranean Sea
N/A
Arctic Ocean
Japan Sea
South China Sea
Gulf of Mexico
Black Sea
Caribbean Sea
Baltic Sea
Gulf of Aden
Red Sea
Celebes Sea
Sulu Sea
Banda Sea
Sea of Okhotsk
Makassar Strait


Operational Timeline
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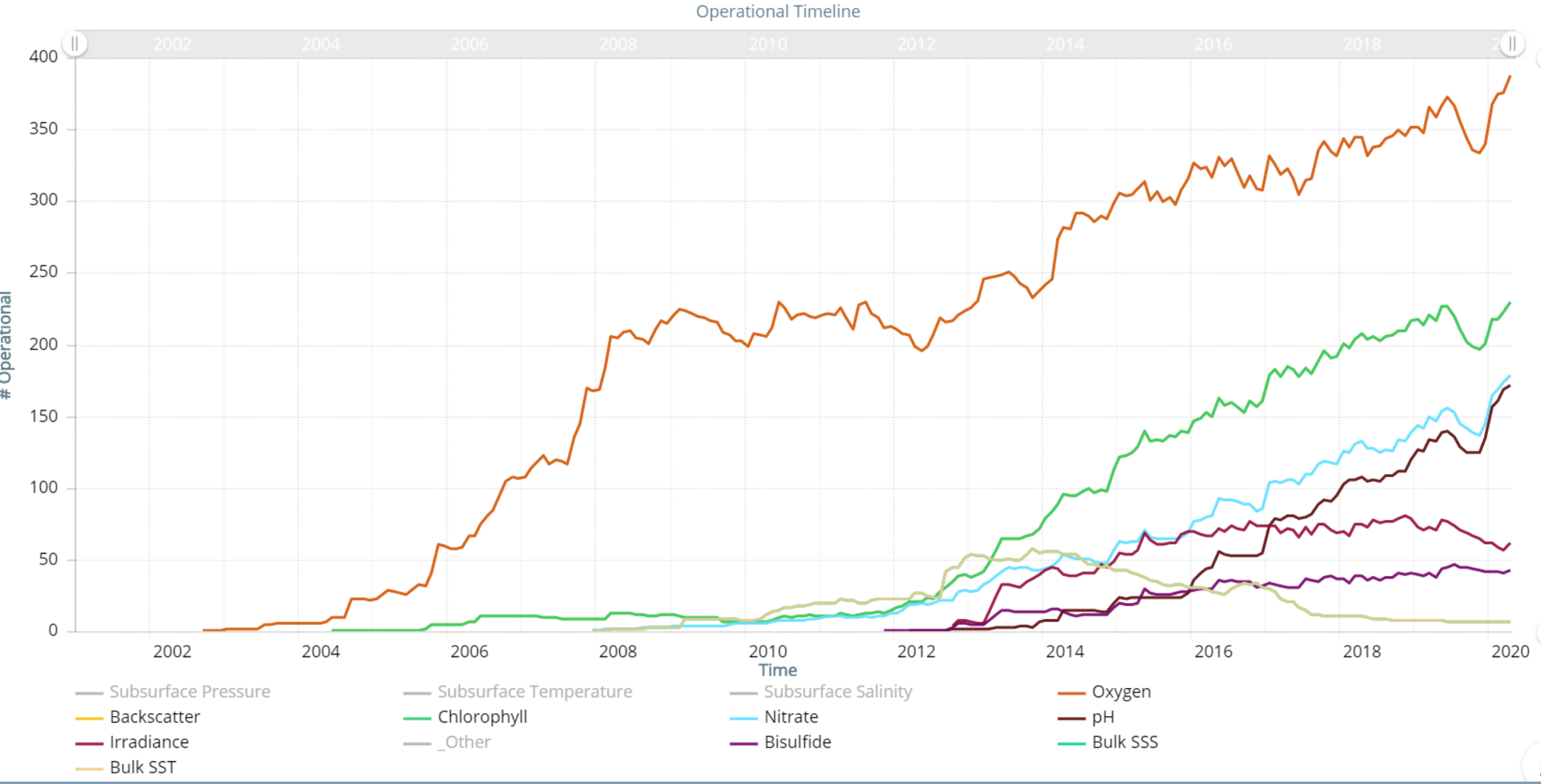
METOCEAN
OPTIMARE
HSOE
TSK


Operational Timeline
2002
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0
Operational
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Time
Subsurface Pressure
Subsurface Temperature
Subsurface Salinity
Oxygen
Backscatter
Chlorophyll
Nitrate
pH
Irradiance
_Other
Bisulfide
Bulk SSS
Bulk SST

An Argo Environmental Impact Statement

Stephen C. Riser
University of Washington

Argo Steering Team Meeting 21
13 April 2020

Background:

In the past 20 years Argo has often been asked about the environmental impact of maintaining an array of over 3000 floats, with roughly 400-800 new floats being deployed every year.

In 2019 the question of Argo's environmental impact was repeatedly raised at the Ocean Obs '19 meeting.

During and after that meeting it was determined that it was time to produce an environmental assessment of the effect of Argo's operations in order to answer the repeated queries about the program's impact.

The result is a document that has been circulated to the AST for comments.

Text from the draft of an Argo Environmental Assessment Statement

Environmental Issues and the Argo Array

Stephen C. Riser, University of Washington
Susan Wijffels, Woods Hole Oceanographic Institution
and the Argo Steering Team

Introduction

The Argo array provides a vital operational and research data stream that underpins important nowcast and forecast services, science, and policy assessments. The array contributes to saving lives, avoiding property...

[etc...12 pages long]

Issues addressed in the document:

(1) Sources of pollution and environmental contamination by Argo floats in the operational and end-of-life phases of float activity

(2) Environmental impacts of alternative methodologies for obtaining results similar to Argo

(3) The possibility of recovering large numbers of floats in order to lessen pollution

(1) Economic and environmental constraints of potential mitigation strategies

Contaminants from a typical Argo float

TABLE 1.

Material	Amount per float (kg)	Argo flux for 900 floats (kg/yr)	Total Flux into the ocean (kg/yr)	Float fraction of the total flux
Copper	0.1	90	1.7×10^{9} (2)	5.3×10^{-8}
Zinc	0.05	45	7.7×10^{8} (3)	5.8×10^{-8}
Plastic	2	1800	8×10^{9} (4)	2.3×10^{-7}
Lithium	0.2	180	2×10^{6} (5)	9×10^{-5}
Lead	0.8	180	1.5×10^{10} (6)	1.2×10^{-8}
TBTO	0.01	9	3×10^{3} (7)	3×10^{-3}
Aluminum	18	1.7×10^{4}	2.7×10^{11} (8)	6.3×10^{-8}

Note: **plastic and TBTO are anthropogenic values; others are natural fluxes**

- Discussion: 5 min

BGC-Argo Status, challenges and pathway paper

Ken Johnson, Hervé Claustre

& BGC-Argo mission Team

Two remote BGC-Argo Mission Team meetings

- **Sub meeting #1 : April 10** (22 participants)

1. National BGC-Argo reports.
2. Plan for the future deployments, long-term implementation of the global array, coordination.
3. Project office, communication and web
4. Reorganization of BGC-Argo “governance”

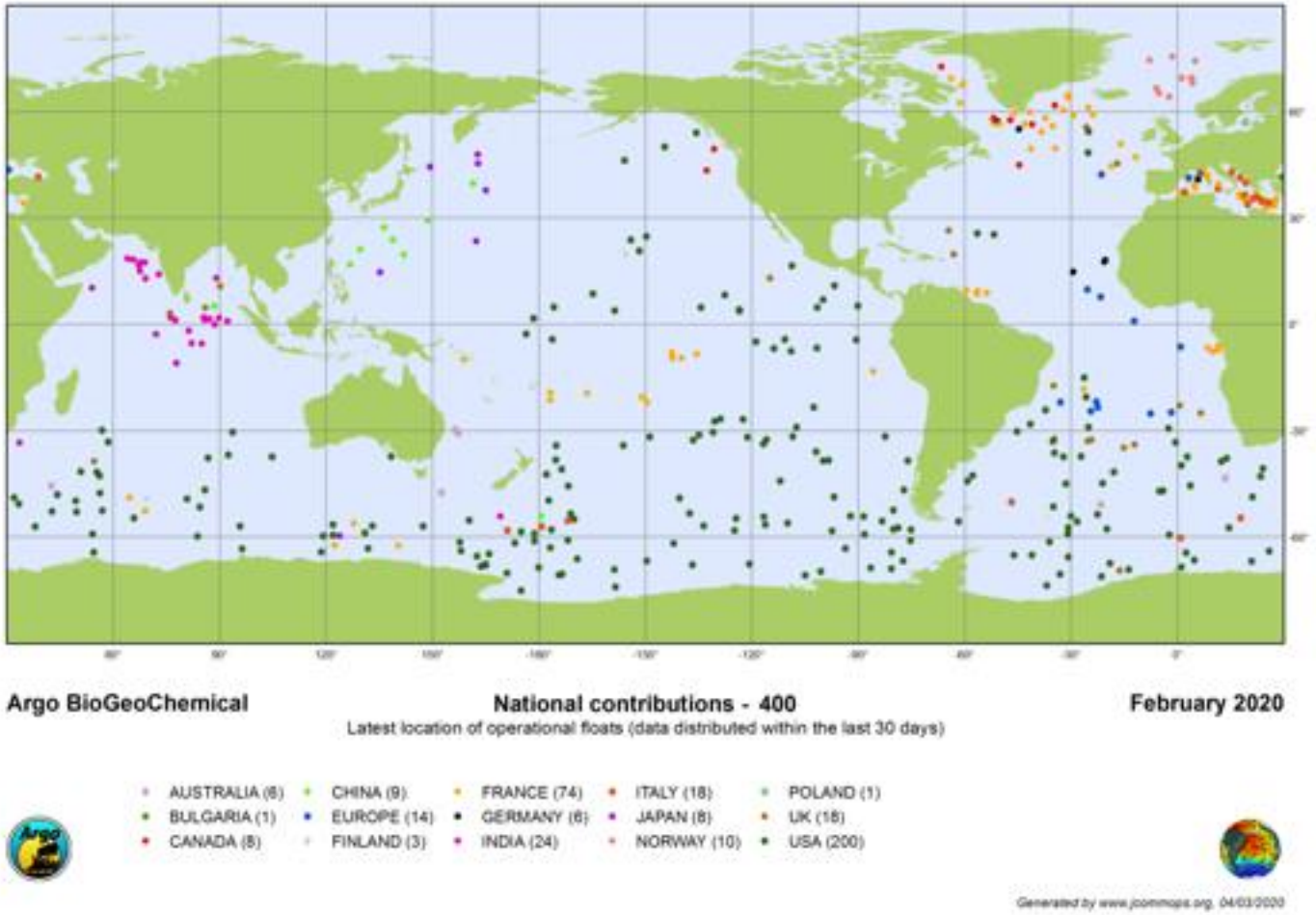
- **Sub meeting #2 : April 20**

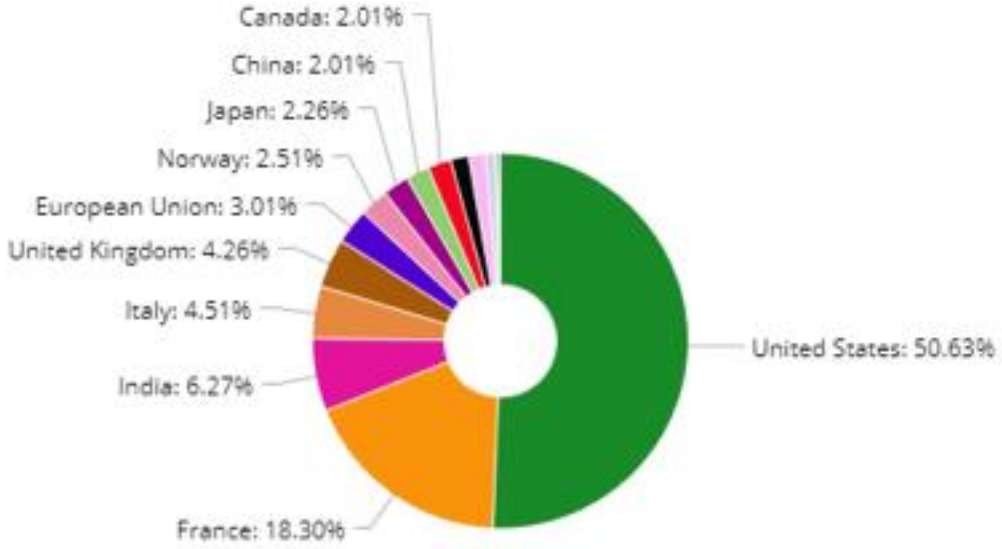
1. ADMT report
2. Current status of flagging and QC at various DACs
3. Generation and hosting of derivative products of interest to modelers
4. Float and sensor performance update – lifetimes

National Reports

- Tremendous amount of enthusiasm from current programs:
  - Australia
  - Canada
  - China
  - EU
  - France
  - Germany
  - India
  - Japan
  - South Africa
  - UK
  - USA

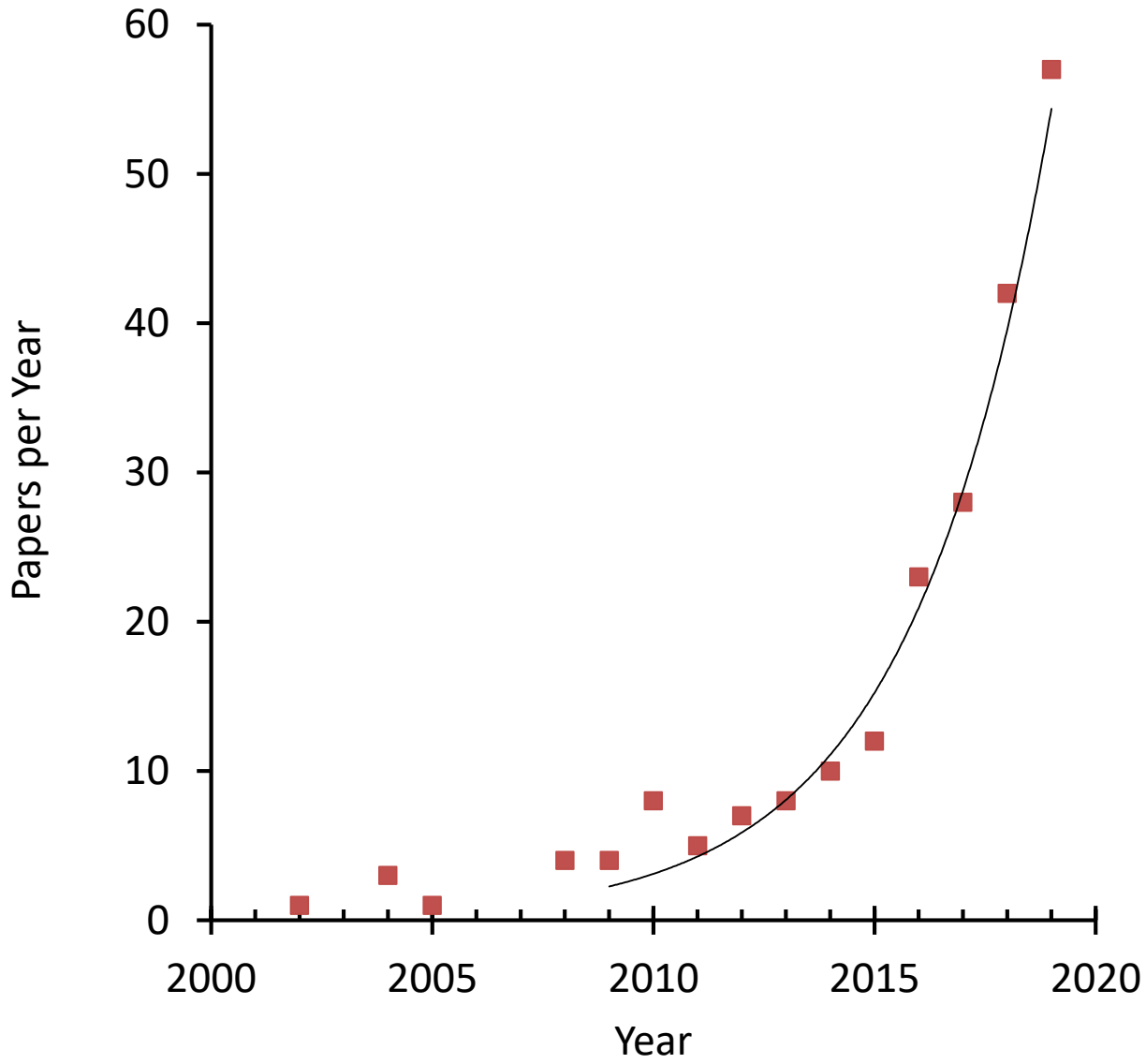
15 nations with operating floats, more coming.





Science productivity high and growing.

Year	Science/ Nature family
2020	3
2019	4
2018	1

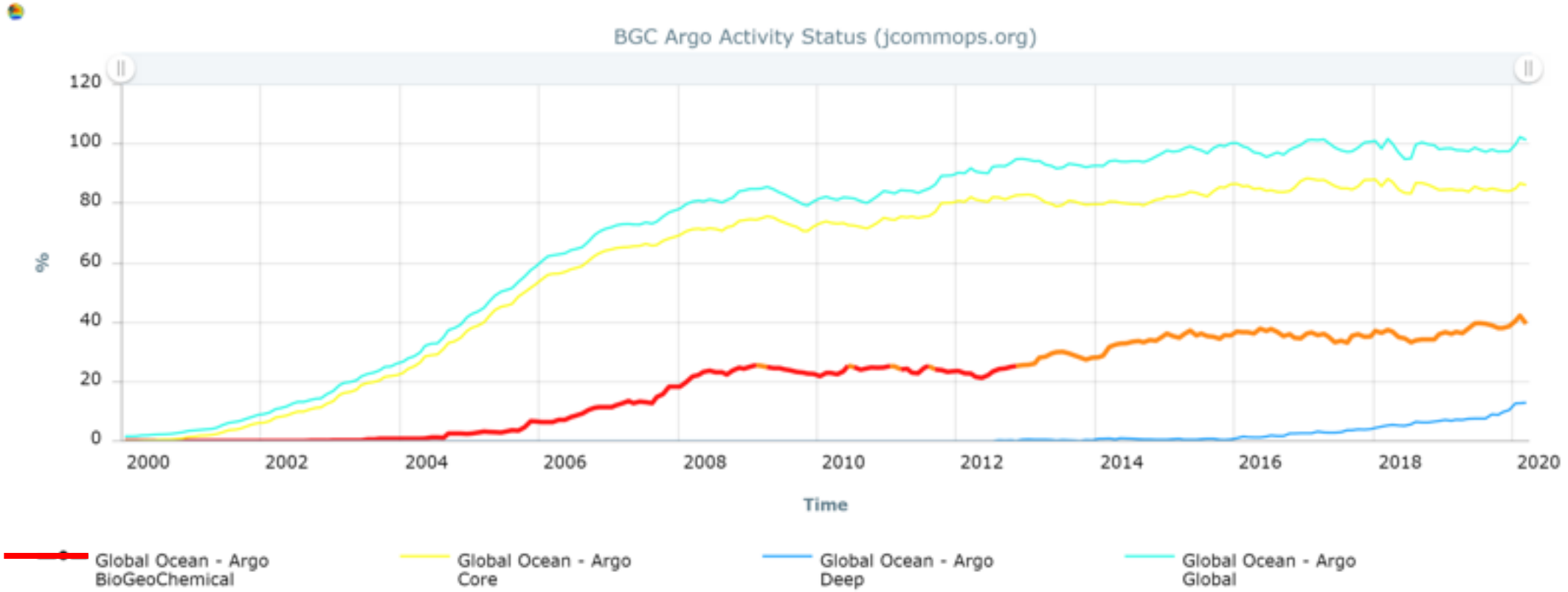


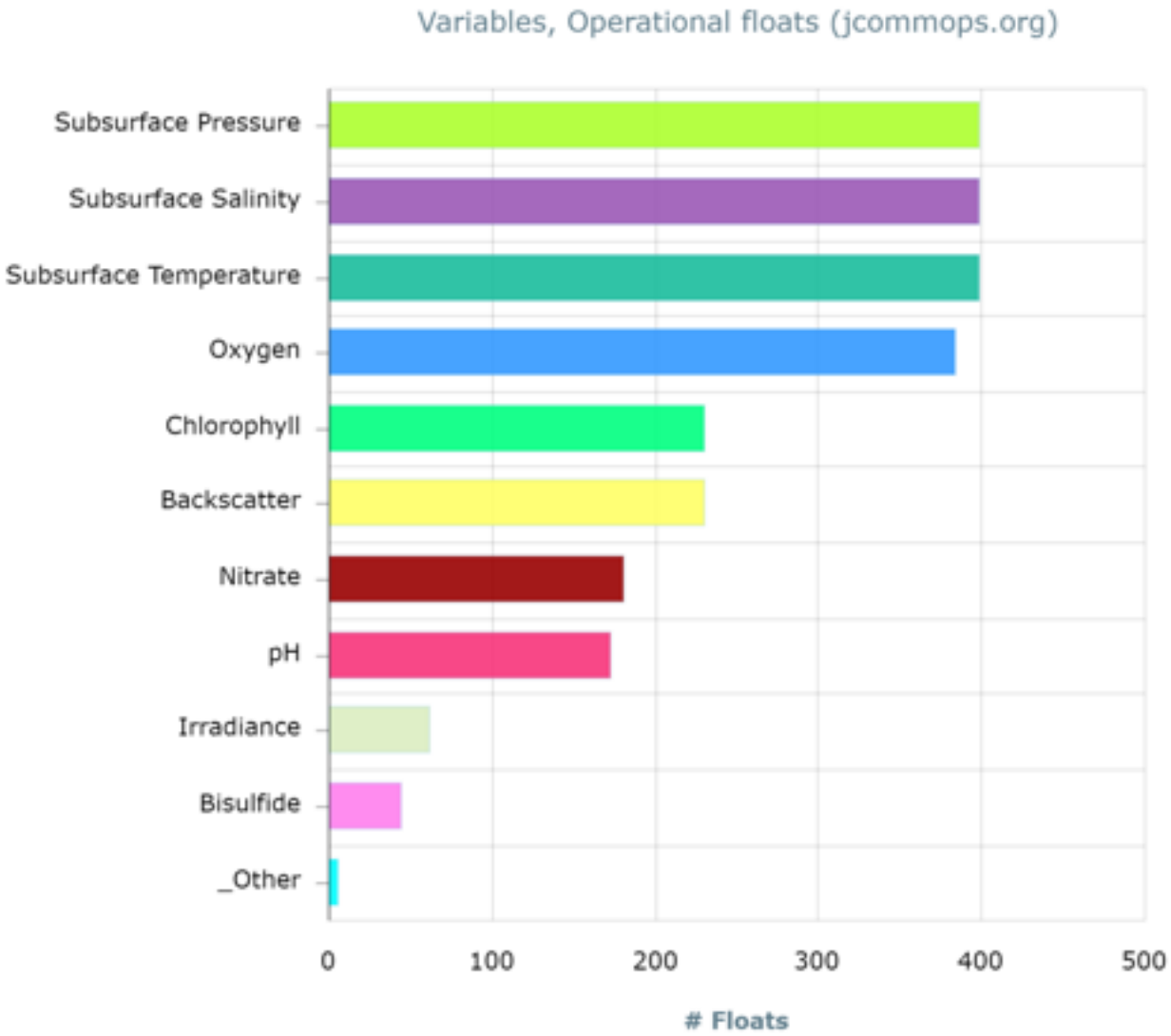
https://biogeochemical-argo.org/peer-review-articles.php

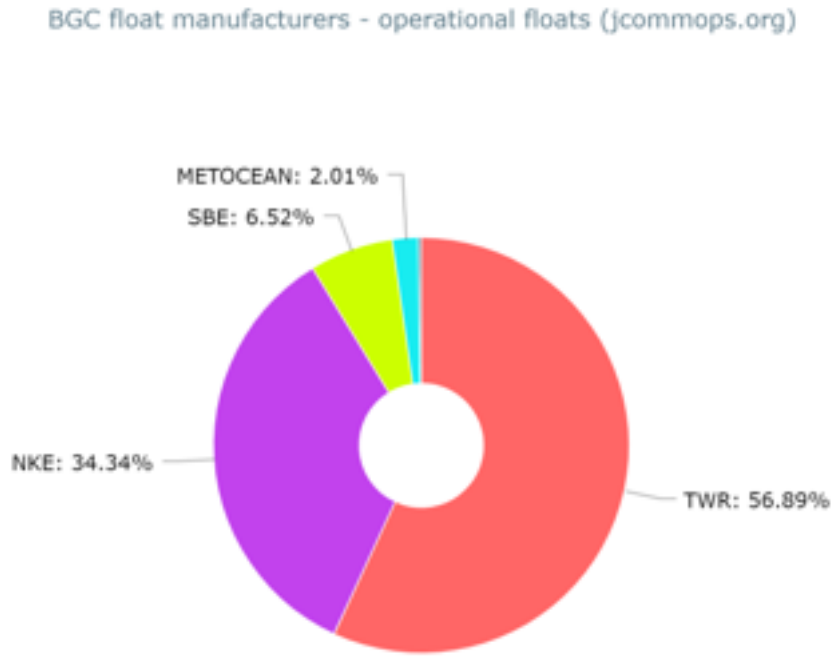
Extension of BGC-Argo participating countries

- New countries are more active in BGC-Argo with specific focus on Marginal Seas :
  - Norway = > Nordic Seas
  - Mexico = > Gulf of Mexico
  - Saudi Arabia = > Red Sea
  - Finland = > Baltic Sea

Present assessments of BGC-Argo array leave the impression that we are better in reaching our 1000 floats target than we actually are.




Variables, Operational floats (jcommops.org)
Subsurface Pressure
Subsurface Salinity
Subsurface Temperature
Oxygen
Chlorophyll
Backscatter
Nitrate
pH
Irradiance
Bisulfide
_Other
0
100
200
300
400
500
Floats


BGC float manufacturers - operational floats (jcommops.org)
METOCEAN: 2.01%
SBE: 6.52%
NKE: 34.34%
TWR: 56.89%

What is a BGC-Argo float ?

- BGC-Argo Science and Implementation Plan targets 1000 floats with O_2, NO_3, pH, Chl. Fluor., BB, Ed.
- Few floats now carry the complete sensor set.
- Revising Science and implementation Plan to reflect role of floats with 4/5 sensors in the transitioning phase towards 6 variable floats.
- Many programs deploying O2 only floats (Euro-Argo is targeting 50% with O_2).
- Discuss within Argo (e.g. with Deep mission) the objective of having an O_2-only mission.
- Work with JCOMMOPS to develop the appropriate monitoring tools and display with respect to objective / target for the network.

The future of BGC-Argo

- Many countries would like to be more engaged but recent prices are prohibitive:
  - *“More cost-effective at the scale of a country to buy gliders than contributing to an array with 1 / 2 float”*
  - *Euro-Argo develops ways to order BGC-Argo for EU countries and get more competitive prices*
  - *Some countries could support sensors for other who have uncomplete floats…*
- *Costs high as many manufacturers treat each float as a development project:*
  - *Need to move to more standardized suites*
  - *Need to increase number of purchases with more regularity*

Adjust BGC-Argo organisation in the Argo2020 context

- Extend the present BGC-Argo mission team to new countries (presently Mexico, Norway, Saudi Arabia, Finland)
- Establish an executive committee with a reduced board to prepare meetings and follow actions
- Establish a BGC-Argo technological Task team (forum?) in the same way we have establish a data management one?
- Develop a BGC-Argo user committee?

- **Develop an Implementation Roadmap for BGC-Argo guiding the transition from pilot phase towards global sustained array**

A future BGC-Argo project office

- Funded by “Exploration de Monaco” and China, managed by JCOMMOPS at LOV-Sorbonne University
- Develop / strengthen the awareness of BGC-Argo
  - Help in the coordination of the network, support for meeting organization…
  - Newsletters, website, social media, bibliography, organization of events…
- Organization of the interaction within the Argo community
  - Project Office in Scripps, JCOMMOPS
  - AST meetings, ADMT meeting, Argo science meeting
- Strengthening collaboration / interactions outside the Argo community
  - with other GOOS BGC-communities (Ocean gliders, OceanSite, Go-SHIP):
  - with modeling community: GODAE / OceanPredict, MERCATOR Ocean
  - with satellite (ocean color) community : IOCCG, NASA, ESA, EUMESAT….
- Bridging Monaco with the Ocean observation community
  - Capacity building
  - Specific case of Small Island Developing States (SIDS) (resources)
- JCOMMOPS: Enable new data streams and better connect with regional partners (Med. Sea).

DATA MANAGEMENT TASK TEAM

Home / About us / Data Management Task Team

The **BGC-ADMT task team** has been established under the mandate to drive and enhance the development of BGC data management procedures following the scientific guidance of the BGC-Argo Steering Team, stimulate communication, engagement and operational consistency among regional **BGC Data Assembly Centers (DACs)**, and support the general advancement of the Argo program.

TERMS OF REFERENCE

Tanya Maurer
USA

Catherine Schmechtig
FRANCE

Josh Plant
USA

Annie Wong
USA

Violetta Paba
UK

Matt Donnelly
UK

Thierry Carval
FRANCE

Henry Bittig
GERMANY

Liu Zenghong
CHINA

Xiaogang Xing
CHINA

Christina Schallenberg
AUSTRALIA

Udaya Bhaskar
INDIA

Satya Prakash
INDIA

Kensaku Kobayashi
JAPAN

Anh Tran
CANADA

https://biogeochemical-argo.org/data-management-task-team.php

Deep Argo status, challenges, and pathway paper

AST-21, April 2020

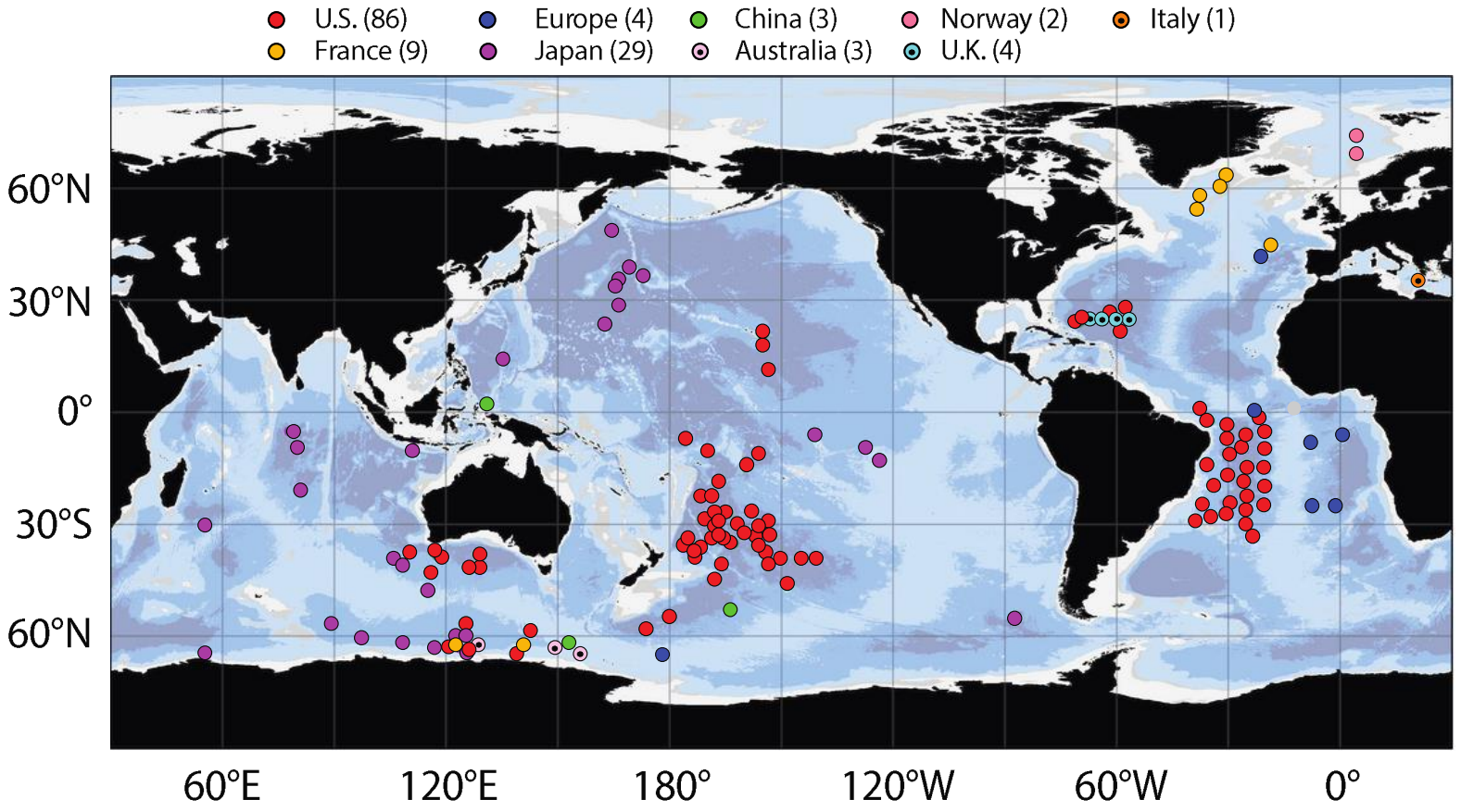
N. Zilberman, B. King, S. Purkey, V. Thierry,
T. Kobayashi, D. Roemmich

Contribution from National Programs

141 active Deep Argo floats deployed from 9 National Programs

Regional Deep Argo pilot arrays were implemented in all ocean basins

- North Atlantic Basin (19)
- South Atlantic Basin (30)
- Mediterranean Sea (1)
- North Pacific Basin (12)
- South Pacific Basin (43)
- South Australian Basin (10)
- Australian Antarctic Basin (20)
- Indian Ocean (6)

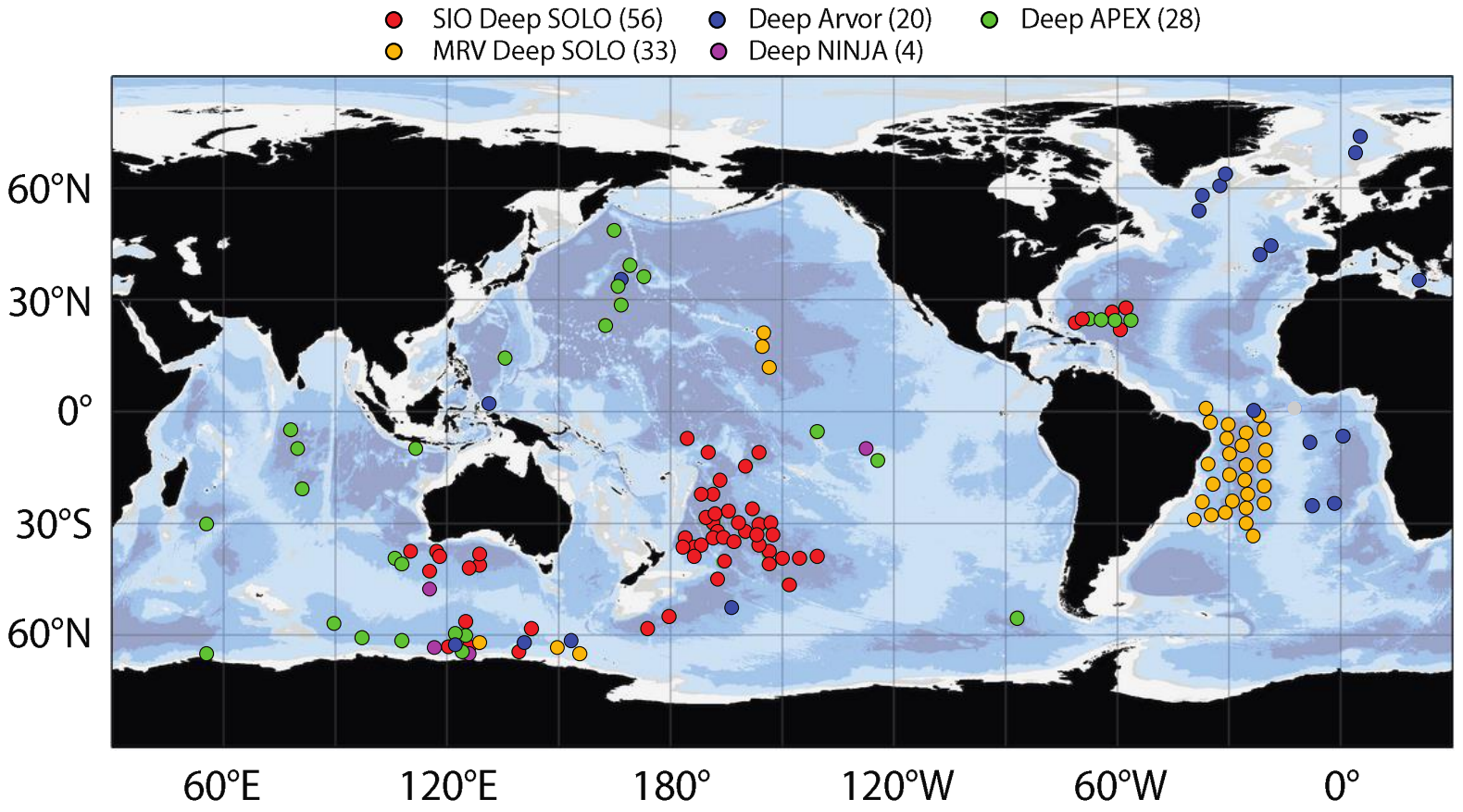


Deep Argo float models currently active

4 Deep Argo float models are in use

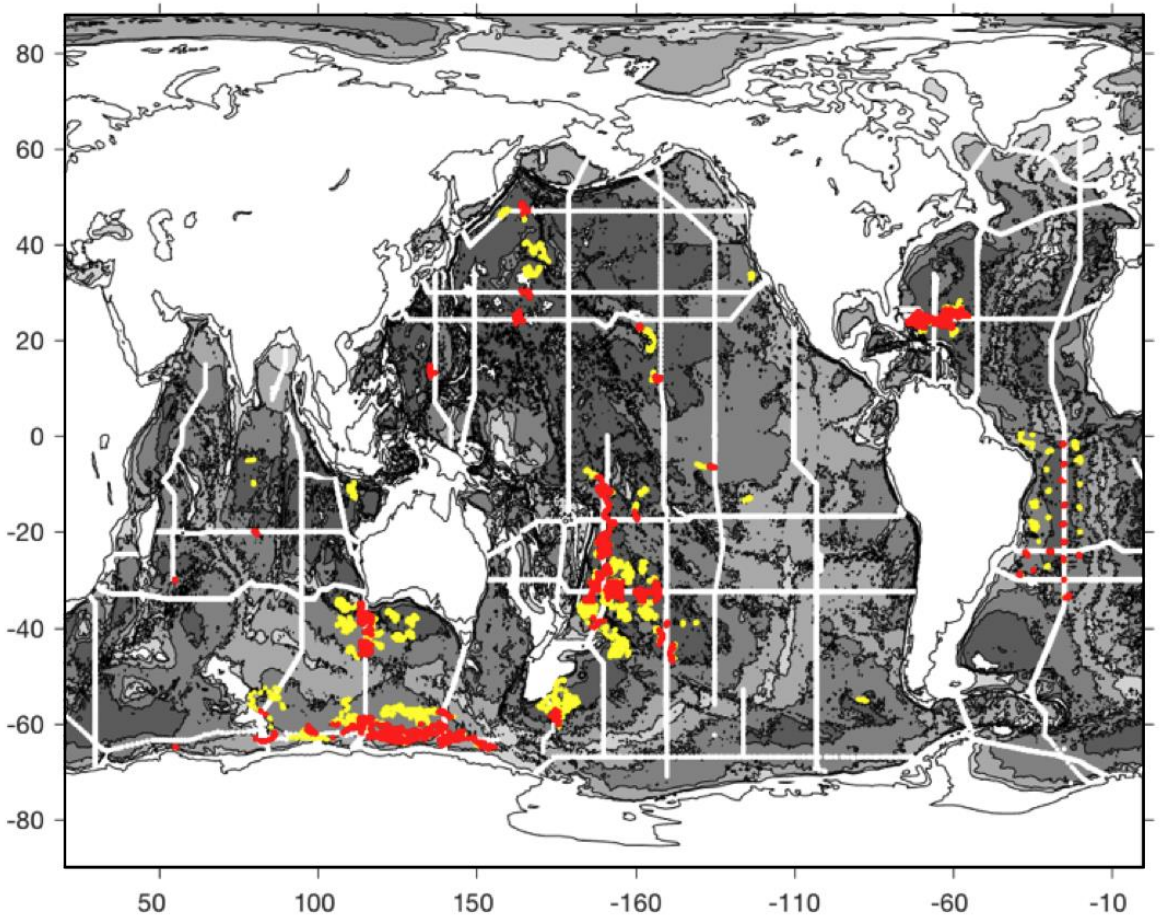
- Deep NINJA and Deep Arvor are equipped with the extended-depth SBE-41 CTD
- Deep SOLO and Deep APEX are equipped with SBE-61 CTD

3-headed Deep Arvor float deployed to compare and test performances of Sea-Bird and RBR CTDs



CTD accuracy, stability, and QC

- Initial accuracies of temperature, salinity, and pressure defined using CTD synchronized with shipboard system and bottle samples
- Sensor stability assessed using
  - High-quality reference data including GO-SHIP repeat hydrography (clean product on CCHDO), Core Argo floats, and Deep Argo floats
  - Deep Argo CTD synchronized with shipboard system
  - Additional high-quality CTD and sensors mounted on Deep Argo floats



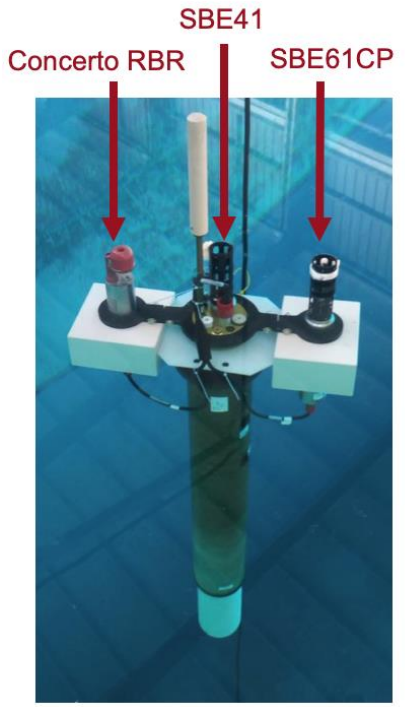
Status of the Deep Argo CTDs

Results from *in situ* data

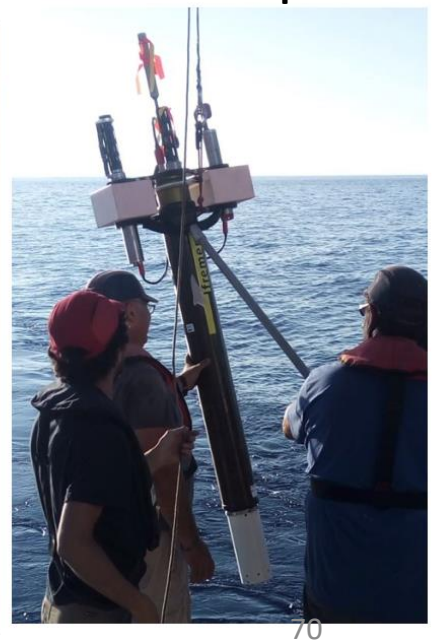
- **SBE-61 CTD**
  - TSP accuracies of ±0.001°C, ±0.005 PSS-78, ±4.5 dbar
  - 15% show catastrophic salty drift after 60-70 cycles
  - 13% experience slow salty drift after 40-100 cycles
  - CPcor adjustment decreases salinity bias
  - NOPP project will assess pressure drift and reduce salinity drift
- **4000-m SBE-41 CTD**
  - Fresh salinity offset of 0.005 PSS-78
  - 14% show salty drift
  - CPcor adjustment consistent with SBE-61 CTD
- **6000-m RBR CTD**
  - Preliminary results at 0-2000 m are encouraging
  - CTD casts collected along the RAPID line 2020
  - 3-headed Deep Arvor float deployment is scheduled Fall 2020 off the Canary Islands

Manufacturer's specifications

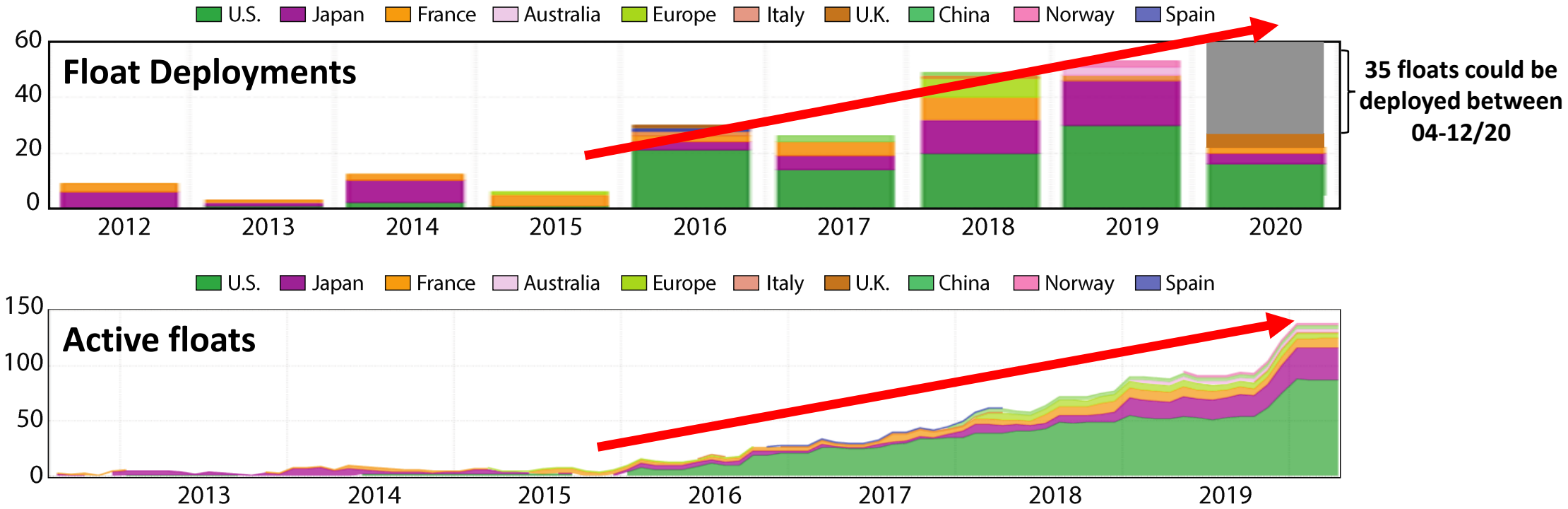
	Temperature	Conductivity	Pressure
SBE-61 initial accuracy	±.001 °C	±.0002 S/m	±4.5 dbar/7000 m
SBE-61 stability	.0002 °C/year	.002 S/m over 10 yrs	0.8 dbar/year
4000 m SBE-41 initial accuracy	±.002 °C	±.0003 S/m	±4 dbar/4000 m
4000 m SBE-41 stability	.0002 °C/year	.003 S/m over 10 yrs	0.8 dbar/year
RBRargo CTDdeep6k accuracy	.002°C	±0.03mS/cm	± .05% FS
RBRargo CTDdeep6k stability	.002°C/year	0.010mS/cm per year	.05% FS



3-headed Deep Arvor



History of deployments and active floats since 2012

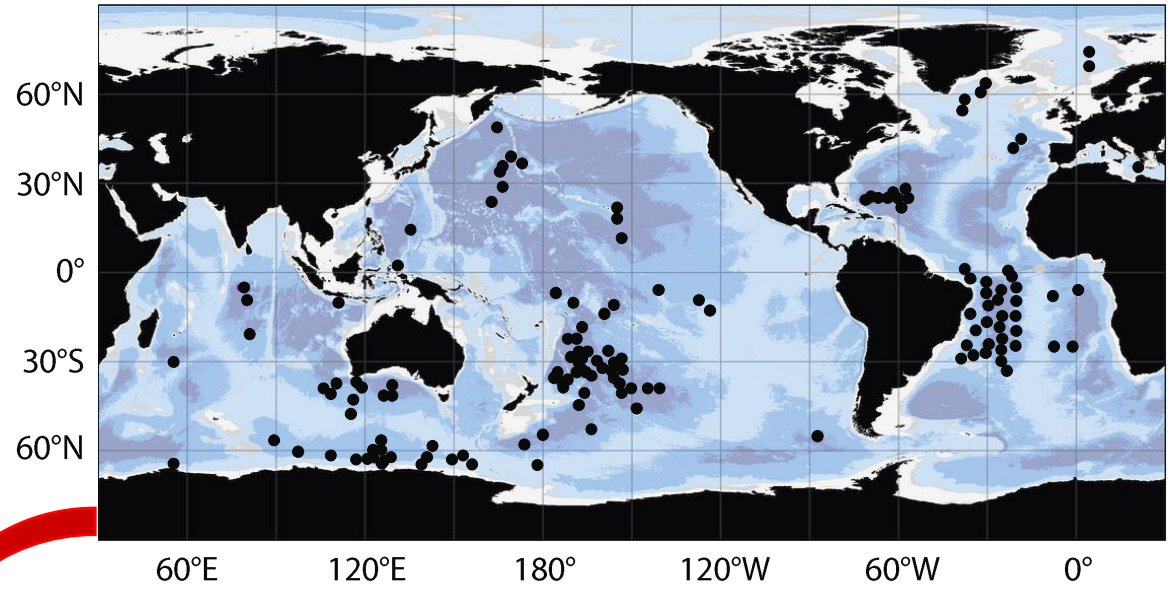


- Averaged number of Deep Argo float deployments between 2018-2020 is ~50 floats per year
- Tentative Deep Argo float deployment between April-December 2020 include 3 Deep Arvor (Norway, May), 1 Deep Arvor (Italy, June), 5 Deep SOLO (U.S., July), 8 Deep Arvor (France, July), 8 Deep Arvor (France, Sep), 1 Deep Arvor (Italy, September), 6 Deep SOLO (U.S., Oct), and 3 Deep floats (Japan)
- Number of active Deep Argo float floats in regional pilot arrays has increased since 2016

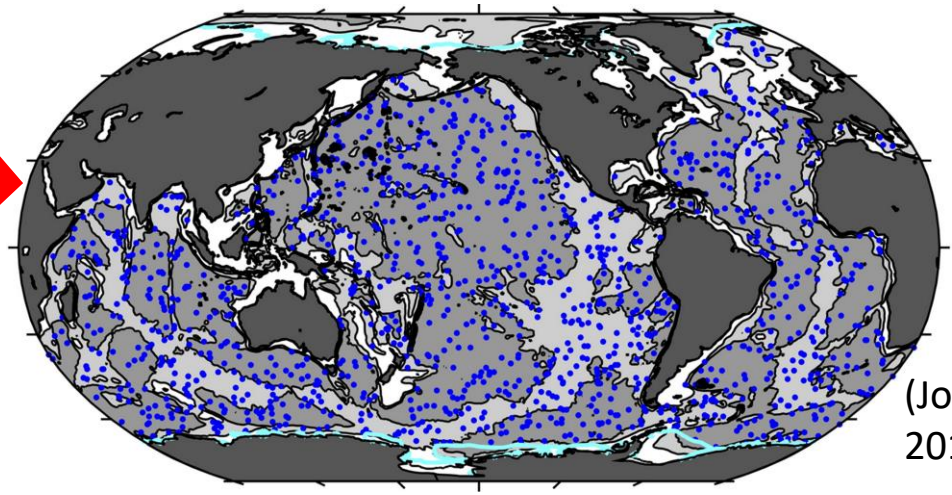
Transition to global implementation

- Accuracy and stability of CTD measurements that approach aspirational targets
- Mature procedures for RT and DMQC
- Resources of National Programs sufficient to build and sustain Deep Argo
- Gradual and sustainable increase in deployment/year
- Deployment strategy for integration of 4000-m and 6000-m float models
- Plans for expansion from regional to global deployment
- Core, Deep, and BGC Argo integration

Regional pilot arrays — 141 active Deep Argo floats



Global Deep Argo float array of 1,200 Deep Argo floats

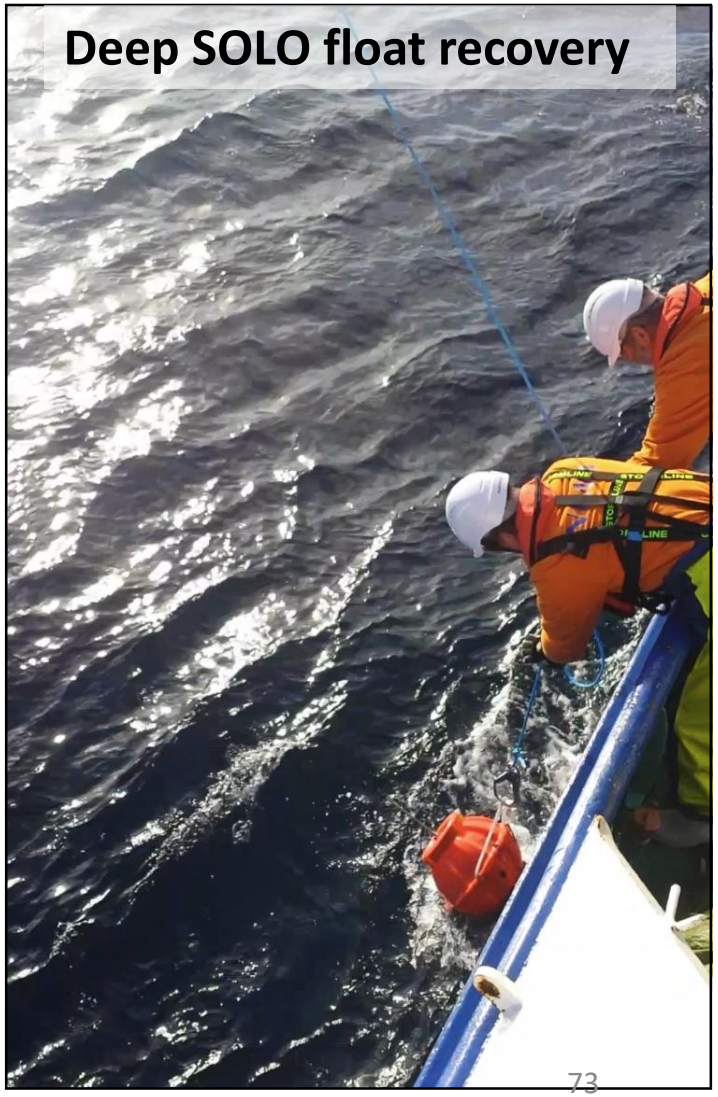


(Johnson et al., 2015)

Float standard mission and potential recovery

- **Deep Argo mission parameters compatible with Core Argo**
  - 10-day cycle
  - Parking at 1000-m depth
  - Floats deployed at high-latitude equipped with sea-ice avoidance software
  - Aspirational float lifetime > 4 years
  - Profile from the sea surface to 4000-6000-m or near the sea floor

- **Potential float recovery**
  - Dedicated ship time is required
  - Loss of >10% battery life
  - Valuable for sensor recycling and recalibration
  - Float recycling value is limited (wear and tear during cycling, and breakage upon recovery)



National Program bullet points

- EuroArgo is working with Member states and European Commission is extend its contribution to 1/4 of the new Argo global, full depth and multidisciplinary design. Considering that this new design is implemented through pilot expriments, it's important to increase coordination at basin scale level to take into account the development of deep and BGC pilot array and adjust CORE+DEEP+BGC deployment to fill gaps.
- EuroArgo presently is evaluating the impact in terms of data lost due to SBE high salty drift failure. It would be interesting to also assess the situation at Argo international level and envisage to jointly ask for a compensation from SBE
- Argo Germany has established a BGC Argo group in 2019 (ICBM, IOW, Geomar). We have held an interministerial meeting with funding ministries in February 2020 and are continuing discussions about a funding increase in 2022 to start implementation. For 2021 additional funding for BGC floats will be provided by the Science ministry (still in progress)
- Argo-France sees an impact of the Seabird batch of drifting CTDs on Argo RT and DM datasets as well as related products. Argo-France DMQC activities are focusing on containing and evaluating impact of this key issue for the program and the Argo dataset quality.
- Argo Norway started in 2019 to deploy deep and BGC Argo floats in the Nordic Seas, and further deployments are planned the next years. 3 BGC and 2 Deep floats were deployed in 2019.

- **The funding for the first phase of China Argo infrastructure construction has been secured.**
- ==========
- Float: 400 HM2000, with Deidou Navigation Satellite System (BDS).
- Region: Within BDS-1 covered region in the Western Pacific ocean, the South China Sea and Indian ocean. Could be expanded as the BDS-3 being adopted by the end of 2020.
- Challenge: CTD delivery (COVID-19), deployment opportunity, optimized deployment (risk of drifting outside the BDS-1 coverage)

- South Africa remains committed to assisting with Argo float deployments and is exploring one proposal to procure floats for deployment particularly in the Southern Ocean. South Africa locked down early and we remain optimistic. The majority of our cruises are planned from September onwards (Gough, SAMBA, SANAE and potentially a Marion Island take-over), with only SEAmester planned for July. We are hoping to be cleared to undertake these cruises successfully by then.
- Argo Australia plan to deploy about 72 core floats and 6 BGC floats in the next year. The next tranche of core floats will include 18 from MRV with RBR sensors. All of these floats will be deployed with buddy floats that have SBE sensors in different regions – hoping to provide a good test for the RBR sensors. Other interesting activities includes the development of a Pre-deployment Application for mobile devices – hoping to simplify pre-deployment testing.
- Argo Canada is making an effort to increase data management capacity to be better prepared for the additional workload associated with BGC and Deep Argo.
- Japan Argo purchased 50 Core, 25 Deep and 10 BGC floats to contribute to Argo enhancement and started to deploy them towards Argo 2020 design in 2018. Japan Argo initiated assessment of possible logistical impact from transition to One Argo. Japanese ocean science community's large research project proposal, which includes a global Deep/BGC Argo array, has been selected as one of key research projects： 10% chance of getting funded.

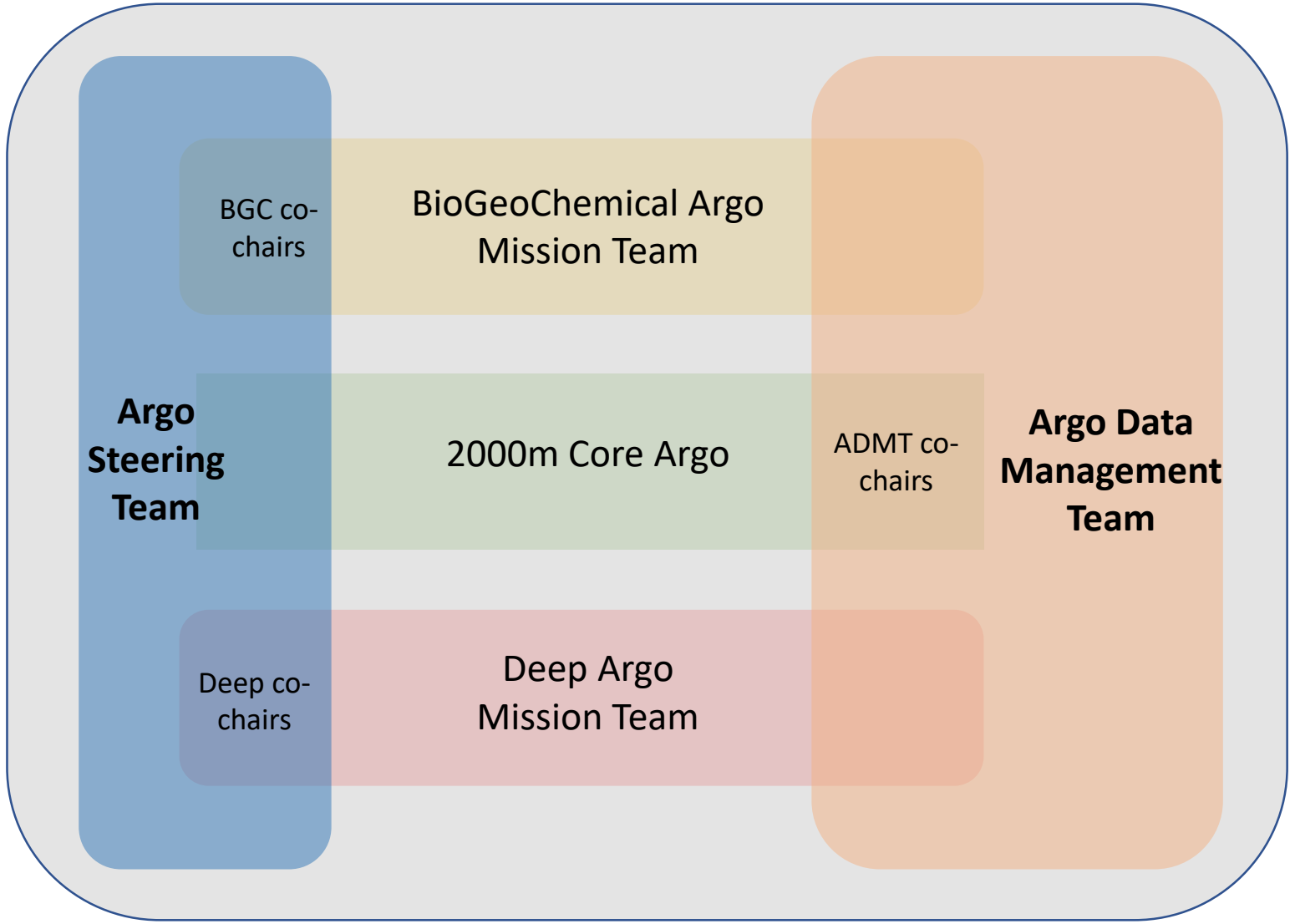
- USA:
  - AOML: The AOML data assembly center data pipeline remains active through remote telework. AOML-led GO-SHIP cruise A13.5 continues to transit to a US port. A total of 6 BGC-Argo (from UW), 10 core Argo (from WHOI), 34 SVP drifters and 5 SVP-Barometer drifters will have been deployed before the ships return April 17th to Norfolk. Other AOML activities that helped to deploy floats in the Atlantic have been suspended. Deployment opportunities continue to be essentially on hold and will likely result in data gaps in the future.
  - PMEL Argo float testing and deployment activities have been slowed by production slowdowns or shutdowns by our commercial partners, as well as reductions of hours spent in the lab to maintain social distance. Some PMEL floats have been deployed in late March through early April, and there may be a few even into June. However, we anticipate a hiatus in deployments of unknown duration thereafter. Data management activities are proceeding through telework.
  - SIO Argo float production and development continue at a reduced pace, while data management activities are sustained by working remotely. Planned US/NZ/AUS collaborative cruises on RV Kaharoa and RV Tangaroa for float deployment and CTD improvement are subject to possible delay or reduced programs.
  - The float lab at UW is closed, and no operations have been conducted since early March. We have received the components for many floats, and fabrication was underway when we were forced to close. We have 26 floats prepared and ready to ship for this summer's Kaharoa cruise, with 16 more nearly ready, although it is possible that the cruise will be delayed with a revised ship track. A number of BGC-Argo floats are also partially completed, with scheduled cruises in the fall that might be in jeopardy.
  - Due to the impact of COVID19 on ship operations, float deployments have largely been halted, and some floats are being returned to WHOI. Ballasting, checkout and deployment preparation is ongoing at WHOI, at a reduced pace and we expect to build an inventory of 'ready to deploy floats' during the COVID-impacted months. Deliveries from our supplier (MRV) are tailing off due to a lack of available CTDs from SeaBird. Data management has largely continued via remote work.

COVID-19 impact

- When the COVID-19 period is behind us and both Seabird productions restart and research vessels plan become clearer, it will be important to collaborate to plan with Seabird sensor deliveries taking into account cruise plan/projects milestones, network gaps or other logistical issues to smooth the process for the benefit of most countries

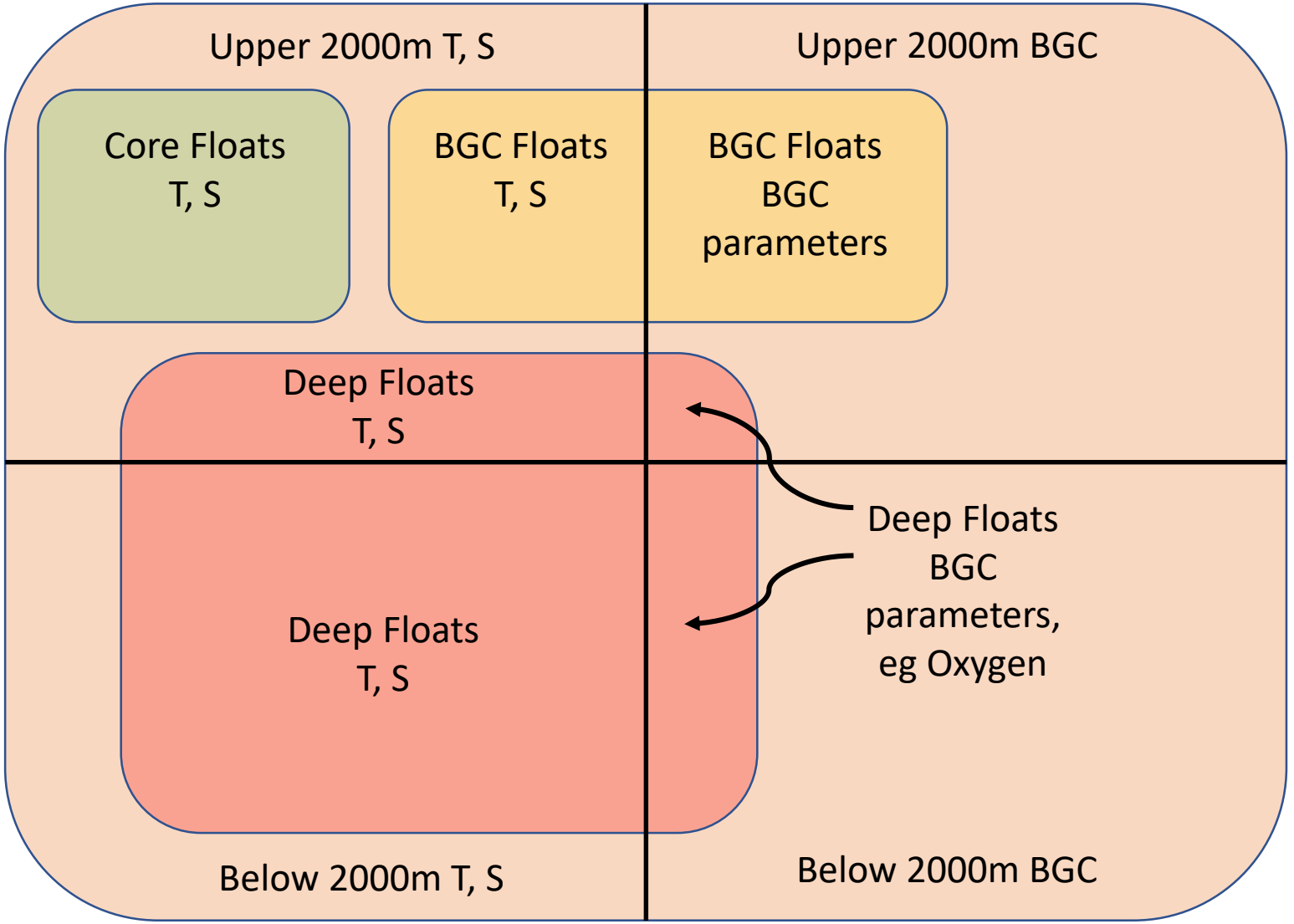
- Discussion: 15 min

Argo leadership beyond 2020



Notes (1) The Argo Steering Team is responsible for the 2000m Core Argo array, which includes data contributions from the BGC and Deep missions
(2) The BGC and Deep Argo Mission Teams report to the Argo Steering Team and engage with the Argo Data Management Team; the BGC, Deep and ADMT co-chairs are part of AST.

Contributions to the single Argo dataset from the Argo missions and float types:
Upper 2000m and below 2000m, Core parameters (T,S) and BGC parameters



Notes: (1) In the single Argo dataset, BGC and Deep floats contribute core parameters Temperature and Salinity to the Upper 2000m core array.
(2) Some Deep floats measure oxygen, which contribute to the BGC dataset in the upper 2000m.

- Discussion: 5 min

JCOMMOPS Strategy Meeting UNCLOS/IOC Meeting

Breck Owens

slides modified from Emma Heslop (IOC) presentation to OCG
Presentation February 2020

JCOMMOPS 5-YEAR STRATEGIC PLAN MEETING

- 1.5 day facilitated workshop (January 15-16, 2020) at WMO HQ, Geneva
- Including global networks, OCG, IOC (GOOS, IODE), WMO, ECMWF (users)
- Reviewed JCOMMOPS Vision, Mission, organizational values
- Revised and defined goals and mission
- Several 'challenges' identified
- Participants made commitments to work to support the development of JCOMMOPS
- 5-Year Strategic Plan – in draft now

JCOMMOPS VISION & MISSION

VISION

To be the international hub and center of excellence that provides vital services in monitoring, coordinating, and integrating data and metadata across an expanding network of global oceanographic and marine meteorological observing communities.

MISSION

To monitor and report on the status of the global ocean observing system and networks, to ensure the transmission and timely exchange of high quality metadata, and to use its central role to support efficient observing system operations and free and unrestricted data delivery to users across operational services, climate and ocean health.

JCOMMOPS ORGANISATIONAL VALUES

1. **Responsiveness** to the needs of the observing community, large and small is critical.
2. **Collaboration** is essential to reduce fragmentation and encouraging integration.
3. **Transparency** is critical to engender trust, confidence, and engagement with our users and Coastal states. Rigorous monitoring of programs is critical.
4. **Accountability** requires quantifiable and results-oriented activities and the delivery of user requested products and services.

GOALS FOR THE NEXT 5 YEARS

1. **Provide Information** for the Monitoring and Improvement of Observing System Performance
2. **Lead metadata standardization and integration** across the global ocean observing networks
3. **Support and Enhance** Operations of the Global Observing System
4. **Enable** new data streams & networks
5. **Shape** JCOMMOPS infrastructure for the future

CHALLENGES IDENTIFIED

1. **Governance**: Need to clarify and develop JCOMMOPS' relationship to OCG, IOC, WMO, GOOS. This needs to be understood by all stakeholders.
2. **Boundaries**: Need articulate priorities and manage requests between current core and emerging programs.
3. **Funding**: Need to clarify management and 'system vs. network' tasks and develop more direct from OCG, IOC, WMO, GOOS to resolve long standing issues
4. **Communications**: Increase community recognition JCOMMOPS an important player in the ocean observing system.

Next Steps

1. Draft of the JCOMMOPS 5-Year Strategic Plan to be made available in April 2020 - networks strongly encouraged to review and provide comments
2. Strategic Plan discussed and finalized at OCG-11

Ocean Observations in Areas under National Jurisdiction

February 2020

- 2 day Experts Workshop (February 12-13) at IOC HQ, Paris
- Global networks, international law of the sea experts (academic and DUALOS), IOC, GOOS, WMO (experts there in their personal capacity)
- Discussed
  - the value of GOOS observations to coastal states
  - the concerns of coastal states
  - the different issues for global networks to make observations in EEZs
- Several potential solution spaces identified
- Workshop Report - in Draft now
- Issues will be raised at the IOC Executive Council in July 2020
  - Executive Secretaries Report to include the report as background
  - A side-event on ocean observations in EEZs to highlight the report and seek input from member states
  - Next steps depend in part on feedback from the Executive Council

SOLUTION SPACES FOR EEZ DEPLOYMENTS

From Draft 5-Year Strategic Plan (not yet final)

1. Argo notification process viewed as standard for other programs
2. UNCLOS Article 247 (IOC procedure)

- An intergovernmental body (e.g. IOC) can approve a network and give notice of intent to observe in a states EEZ, if no objection is received the work could go ahead.
- BUT this has never been used, would require formal adoption by IOC Assembly (all member states
- States can request application for Marine Scientific Research (MSR) clearance anyway.
- Potentially a 'universal' solution, but significant potential obstacles and many years to accomplish.
- Proposal to have law of the sea experts review this with support from IOC Excecutive

SOLUTION SPACES FOR EEZ DEPLOYMENTS

From Draft 5-Year Strategic Plan (not yet final)

3. Update DUALOS published guide

- DOALOS publish a "Guide to the Implementation of the Relevant Provisions of the United Nations Convention on the Law of the Sea." This could be updated to address issues such as time to gain clearance.
- This has potential however it would take time and resources.

4. Raising awareness activities

- Need to raise awareness in coastal states of the value of the observations in EEZ and the need for a truly integrated GOOS.
- Capacity development important. GOOS, but also DUALOS, WMO and other partners could all have a role to play here.
- States do not realize the value to them of the observations or the issues faced by observers.

SOLUTION SPACES

From Draft 5-Year Strategic Plan (not yet final)

4. WMO Recommendations

- Strengthen past WMO past resolutions for atmospheric/earth system analyses and observations for safety of life at sea resolution.
- There is a strong difference between ("shall" vs "urges").
- Additional resolutions supporting variables/platforms important for WMO service delivery will take time to develop.

5. Regional / country arrangements

- Need to develop a regional or pan-country arrangements to facilitate observations in EEZs, some examples already exist.

6. Article 258 of UNCLOS

- Article 258 of UNCLOS clarifies the status of ocean observing platforms versus research vessels. Platforms are no different from research vessels.

NEXT STEPS

- Draft of the Experts Workshop Report - available in April after review
- Most solutions would require action by IOC and WMO
- No one solution solves everything, likely a ‘patchwork’ of actions can be undertaken
- Will be raised at the IOC Executive Council in July 2020,
  - In the Executive Secretaries Report (report as background document)
  - A side-event on ocean observations in areas under national jurisdiction is proposed to highlight the report and listen to the ideas and thoughts from member states
  - Next steps by IOC depend in part on feedback from the Executive Council

- Discussion: 5 min