

# ARGO OPERATIONAL STATUS

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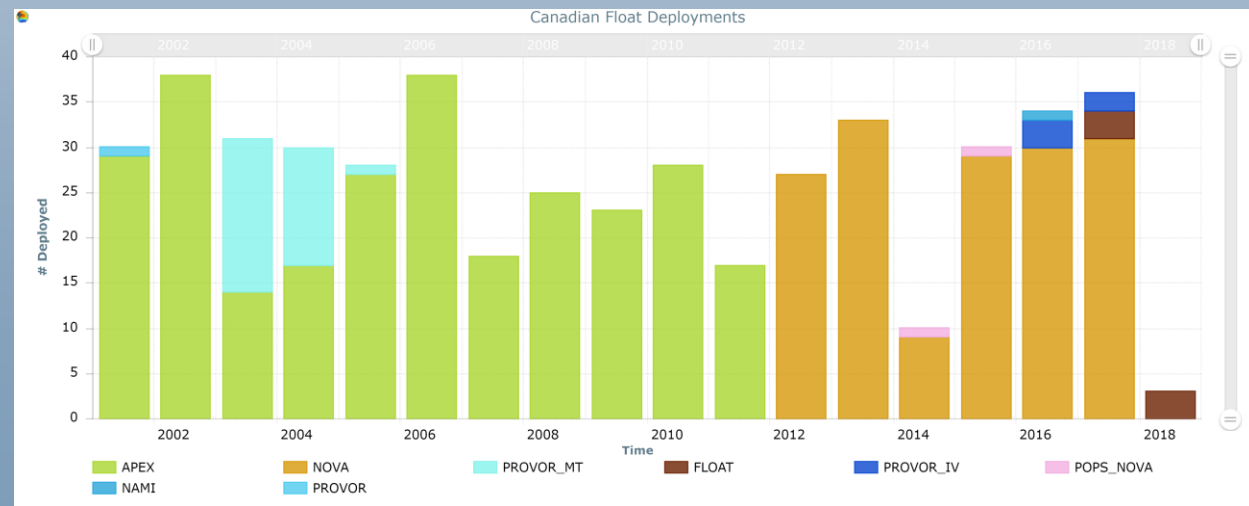
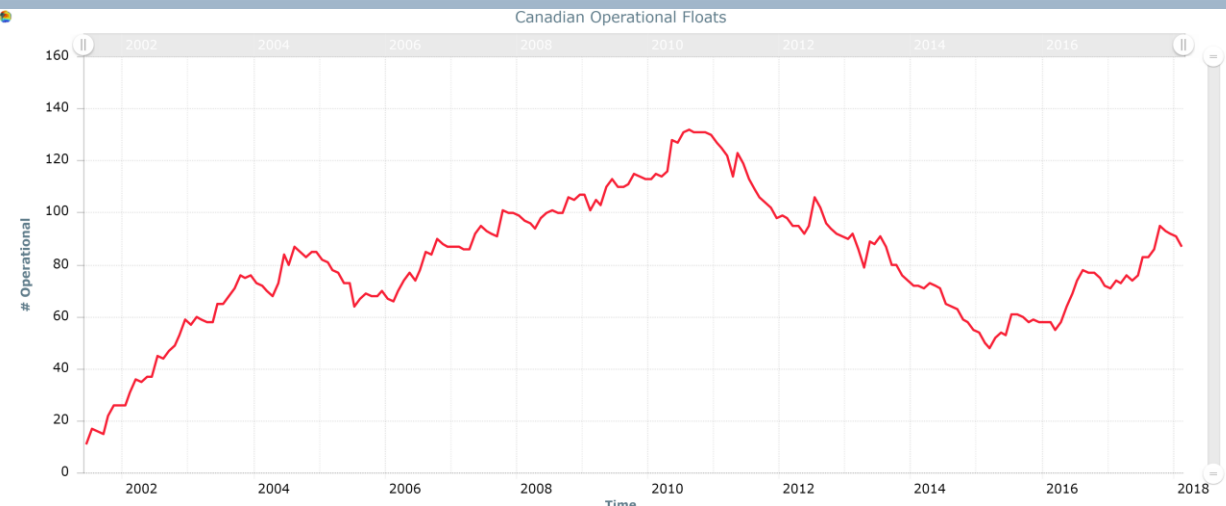
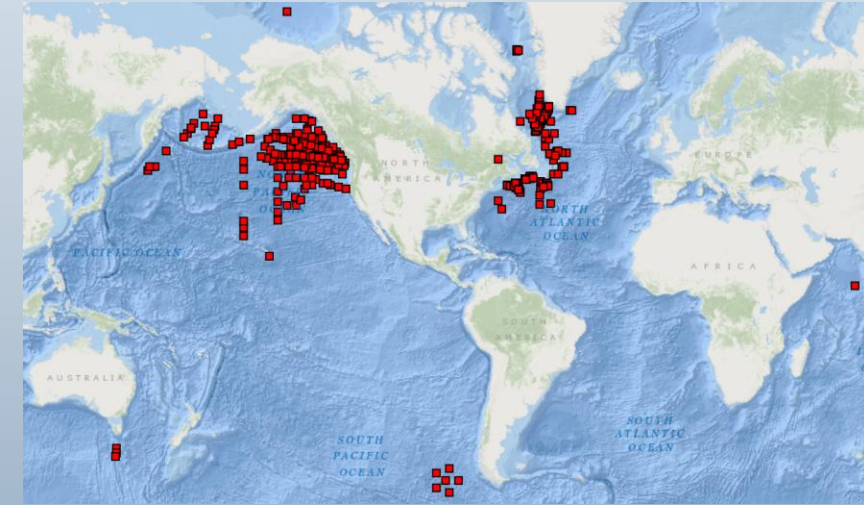
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# ARGO CANADA

- Close to 500 floats deployed (~30 per year)
- Contribution growing: ~100 operational floats
- Strong support and involvement in AST, ADMT
- Contribution to JCOMMOPS/AIC
- Deployments in Aleutian basin important (gap)

## AST#18 Host Highlights

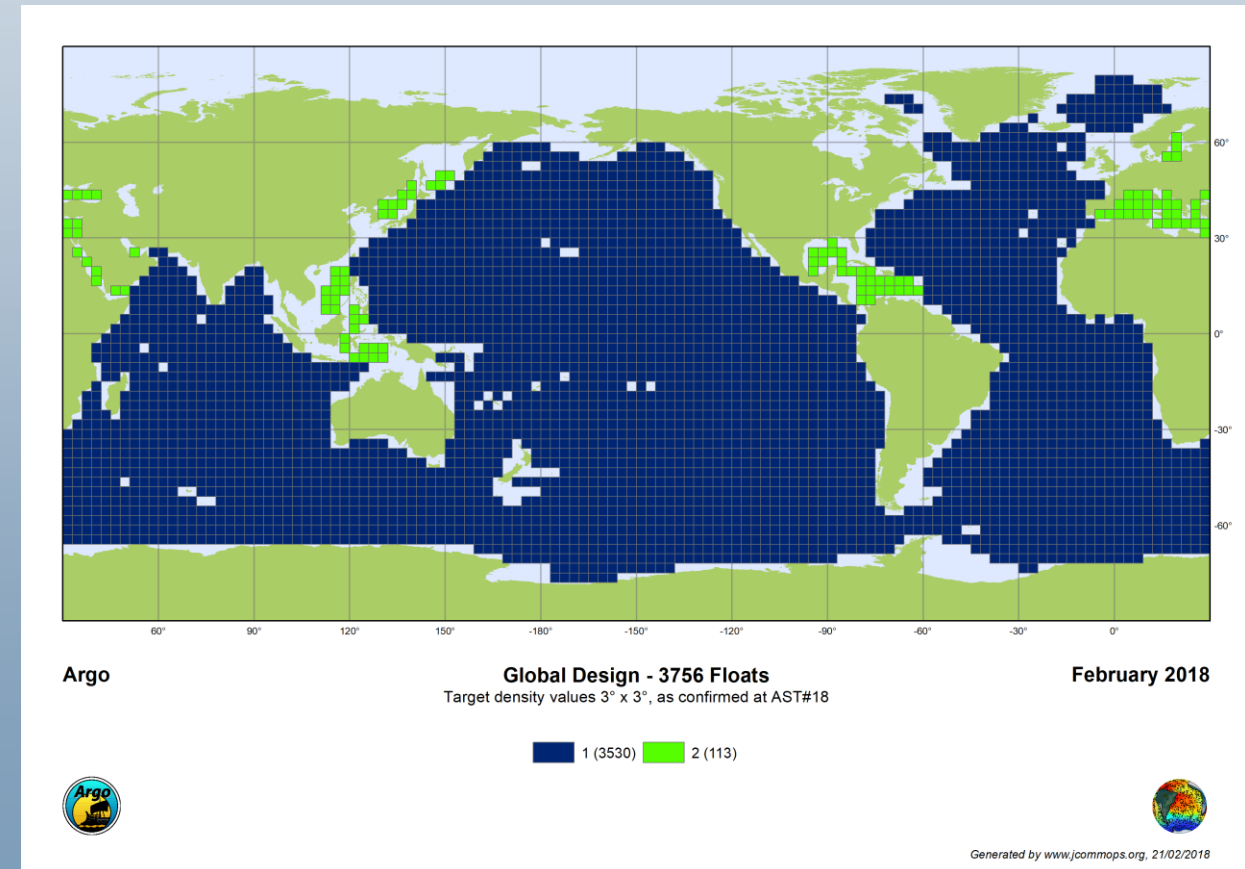


# DESIGN

Global Argo

- [http://www.argo.ucsd.edu/AIC\\_Rep\\_AST18.pdf](http://www.argo.ucsd.edu/AIC_Rep_AST18.pdf) (new one to be posted)

- 3° x 3° design:
  - communication on targets
  - performance indicators calculation
- Changes agreed last year implemented
  - Central Arctic removed
  - Southern Ocean expanded
  - Minor regional updates (practices, smoothing)
- Changes are major technical upgrade



# NETWORKS

## *Definitions*

- Used for commitments, indicators, etc.
- Automatically allocated by the system
  
- 4 (disjointed) networks:
  - Argo Core: float funded under Argo national program (without BGC sensors, not deep).
  - Argo Equivalent: float not funded under Argo (without BGC sensors, not deep).
  - Argo BGC: any float with any BGC sensor
  - Argo Deep: any deep float
  
- $\text{Argo Global} = \text{Argo Core (85\%)} + \text{Argo Equivalent (5\%)} + \text{Argo BGC (8\%)} + \text{Argo Deep}^*$

Do we add criteria on the cycling ?

Is DOXY part of Core or BGC ?

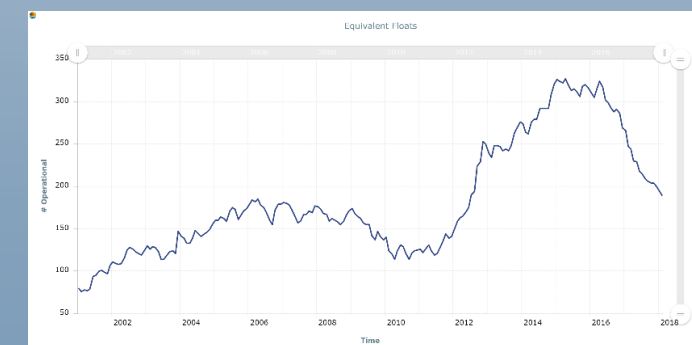
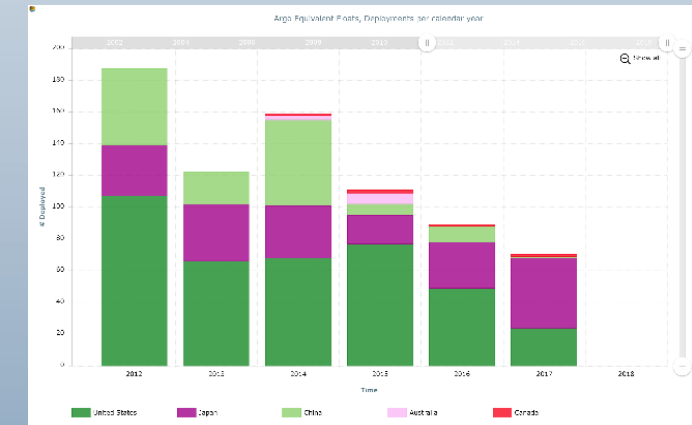
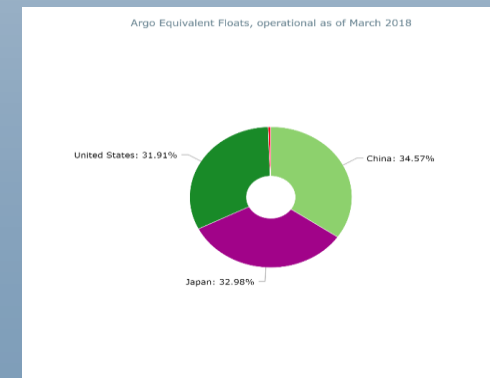
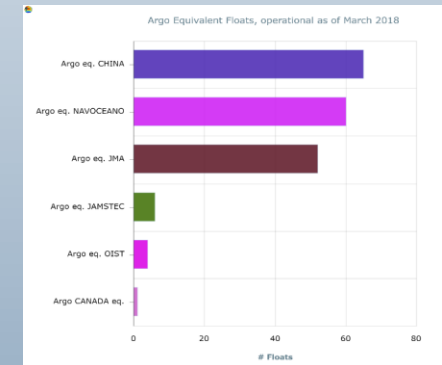
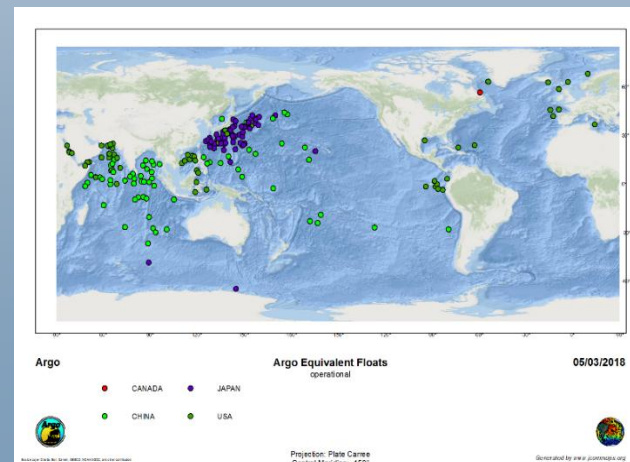
# EQUIVALENT FLOATS

- Ad hoc contributions (research or others) will likely to continue
- Some might go in a new category “Argo extensions” or “Argo 2020”

- Mainly US, Japan, China

- Note yet tagged
  - BSH/Gulf Stream
  - SIO/Eq. Pac
  - UW/TPOS
  - ...

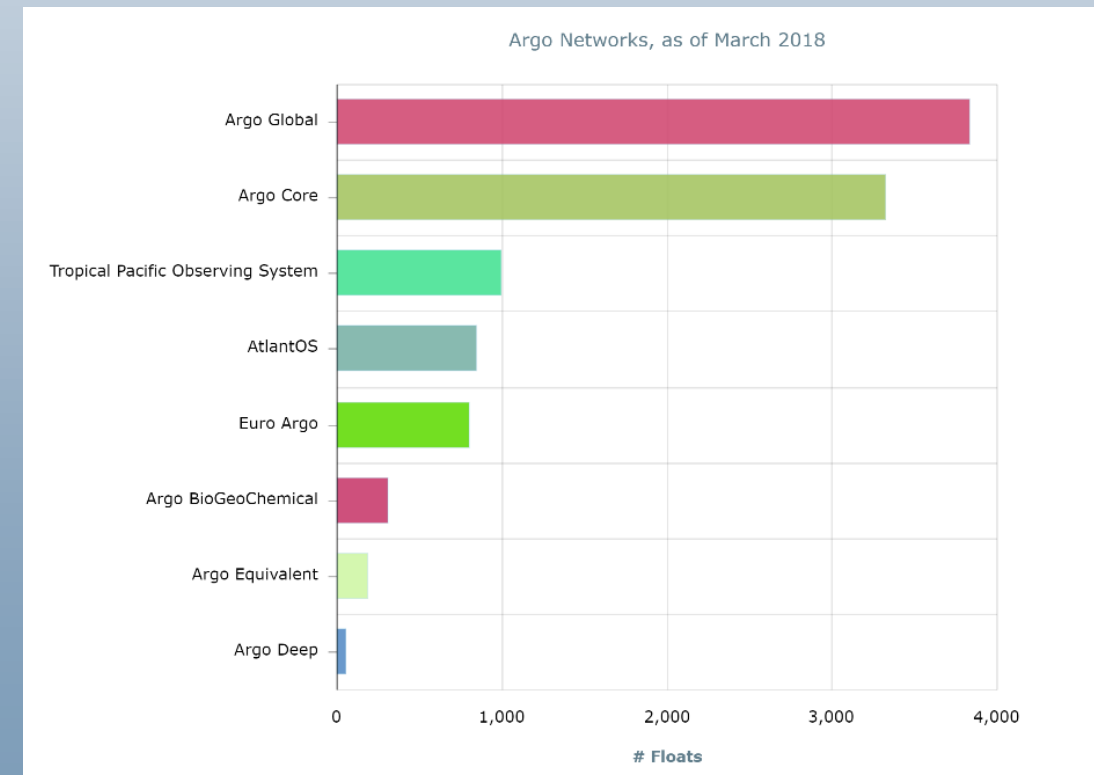
*Action AST #18: reclassify ?*



# NETWORKS

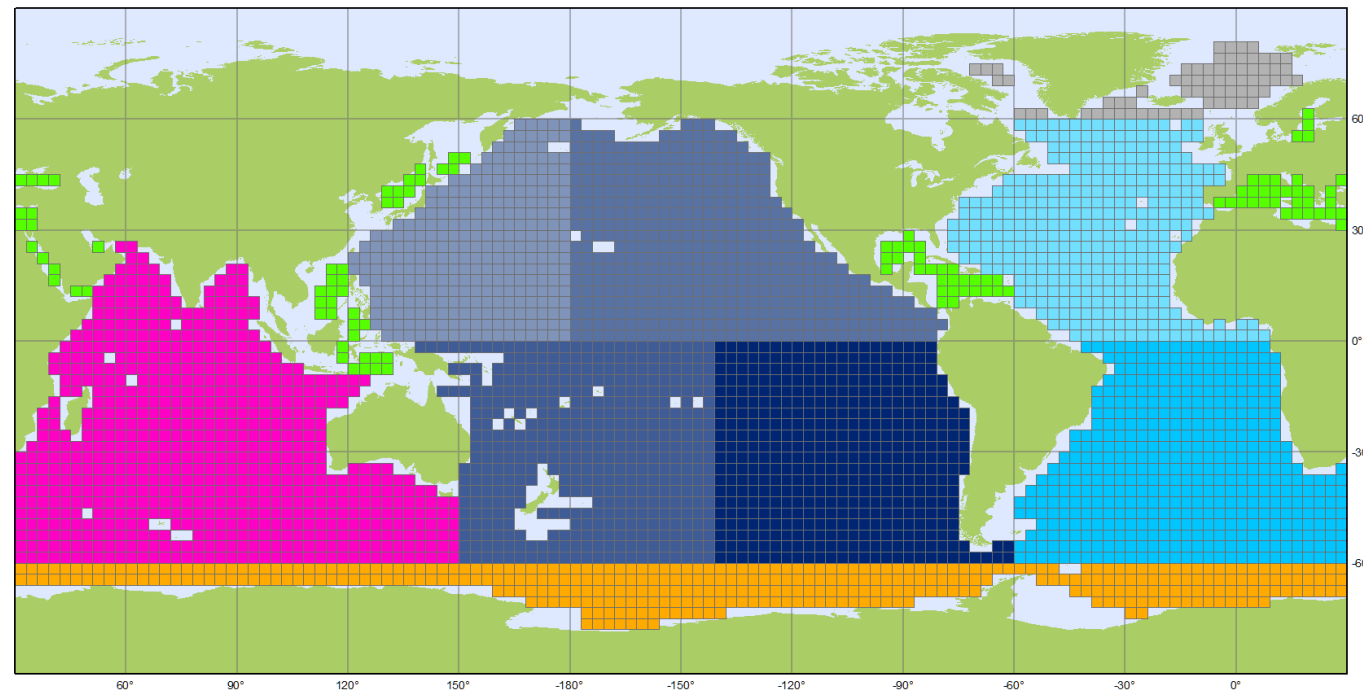
## *Definitions*

- Other networks defined (AtlantOS, TPOS, EuroArgo)
- Flexible way to regroup floats (and JCOMMOPS platforms)
- They can overlap
- Indicators, maps, searches, dashboards
- “Argo Experimental” (see IOC paper)
  - List of sensors



# BASINS

*Definition: Argo Design Basins*



Argo

## Ocean Basins

from Argo Global Design, 3 x 3

Date

Pacific Ocean - NW (285)	Atlantic Ocean - N (343)	Marginal Seas (113)
Pacific Ocean - NE (439)	Atlantic Ocean - S (450)	Arctic Ocean (69)
Pacific Ocean - SW (425)		Indian Ocean (697)
Pacific Ocean - SE (446)		Southern Ocean (376)



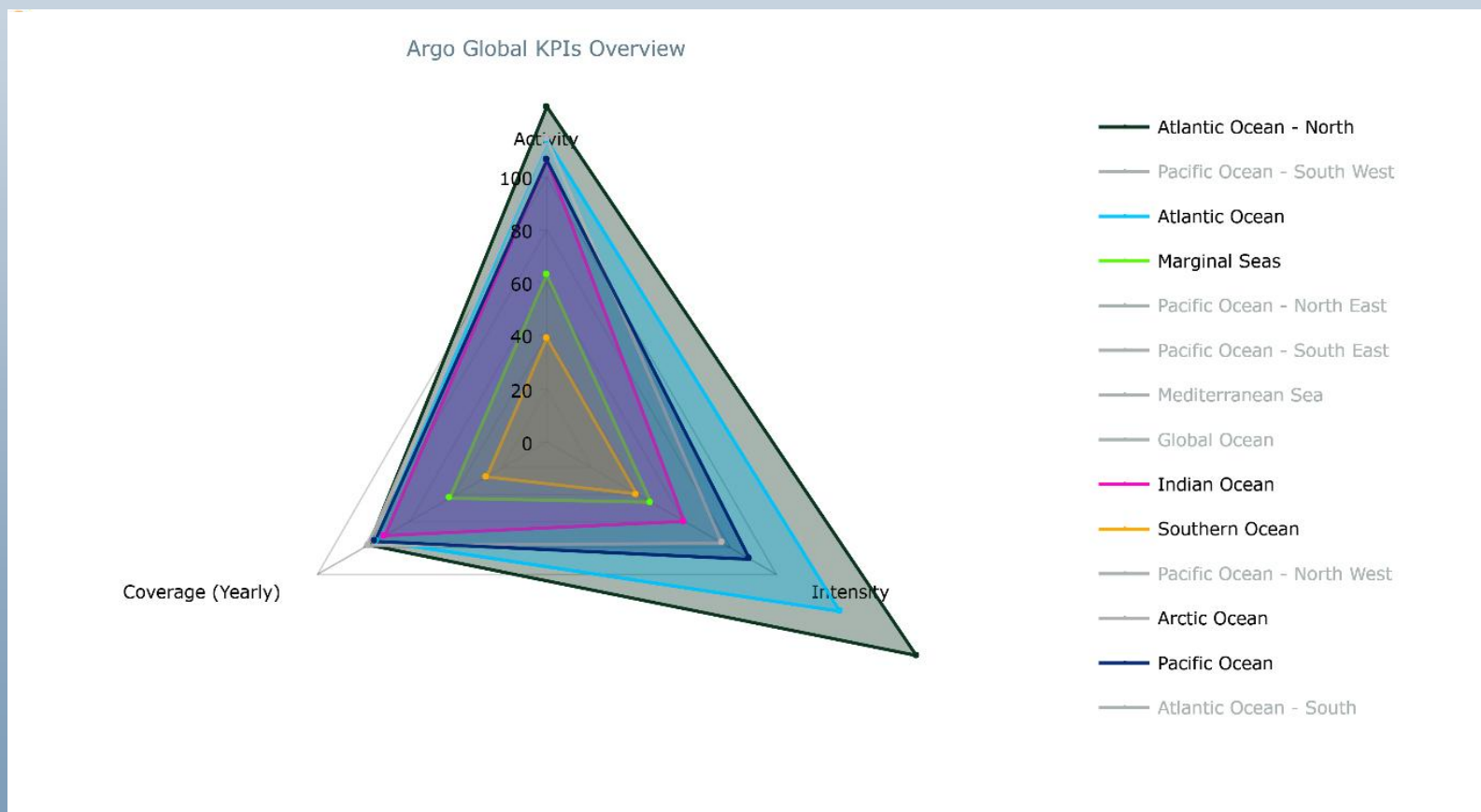
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# PERFORMANCE INDICATORS

- Big machinery (250)
- All precalculated
- Routinely updated monthly, or yearly.

- Activity
- Intensity
- Coverage

*KPIs*





# TARGETS

- Considering the float expected lifetime L, in theory, 150 cycles:  
 $L = 150 \times 10 \text{ days} = 4.109 \text{ years}$   
 $L = 150 \times 5 \text{ days} = 2.05 \text{ years}$  (expected lifetime in Marginal Seas)
- Then

$$\text{Intensity} = \text{Activity} / L$$

- Intensity target not appropriate in SO.
- Arctic ? Cycling strategy ?
- Reviewed in Marginal seas

Action: SO floats reliability & ice avoidance metadata)

## Definition

Instrumentation		
Mortality Rate	25.23%	
Argo Global	2017	↘
Mortality Rate	22.52%	
Argo Global - Southern Ocean	2017	↘
Mortality Rate	18.84%	
Argo Global - Indian Ocean	2017	↘
Mortality Rate	24.03%	
Argo Global - Pacific Ocean	2017	↘
Mortality Rate	27.24%	
Argo Global - Atlantic Ocean	2017	↗
Mortality Rate	58.66%	
Argo Global - Mediterranean Sea	2017	↗
Mortality Rate	37.77%	
Argo Global - Arctic Ocean	2017	↗
Mortality Rate	25.19%	
Argo Global - Marginal Seas	2017	↗

Instrumentation		
Life Expectancy	2.42	
Argo BioGeoChemical	2017	↘
Life Expectancy	6.66	
Argo Global - Indian Ocean	2017	↗
Life Expectancy	6.74	
Argo Global - Pacific Ocean	2017	↗
Life Expectancy	5.25	
Argo Global - Atlantic Ocean	2017	↗
Life Expectancy	2.51	
Argo Global - Mediterranean Sea	2017	↗
Life Expectancy	2.67	
Argo Global - Southern Ocean	2017	↘
Life Expectancy	5.52	
Argo Global	2017	↗
Life Expectancy	3.98	
Euro Argo	2017	↘

# TARGETS

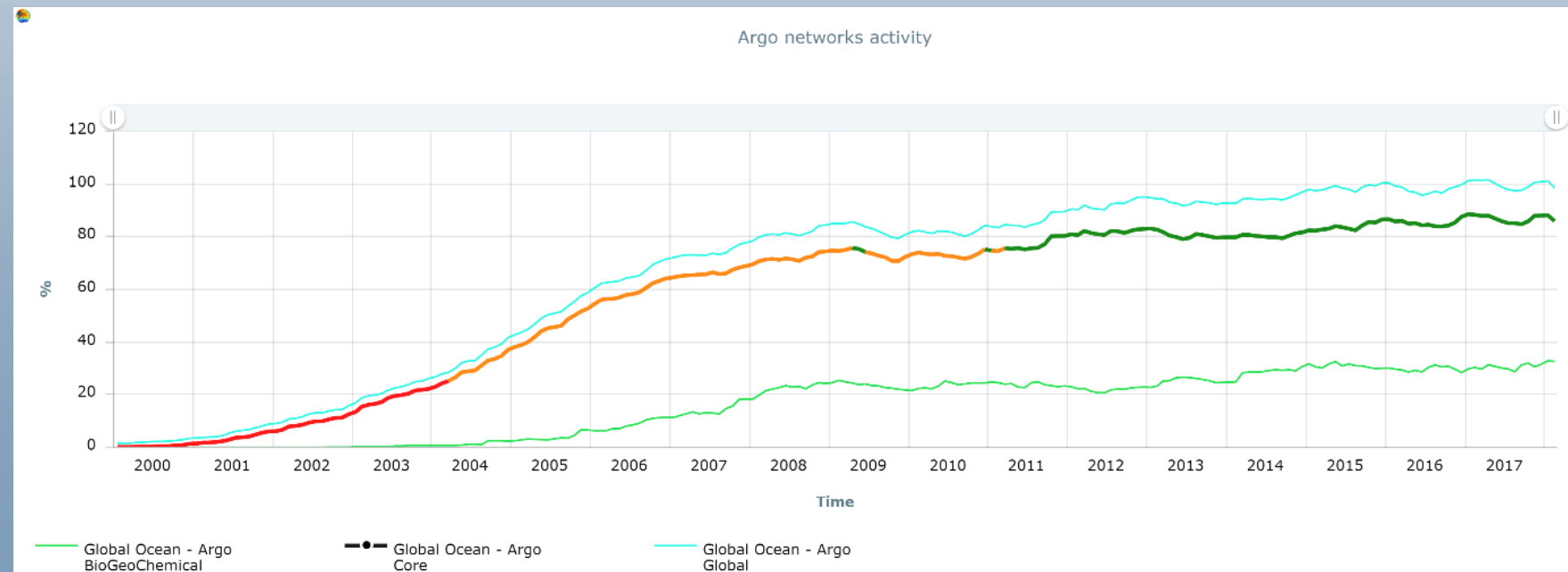
Basin	Argo Global Design	
	Activity	Intensity
Atlantic	793	193
Indian	697	170
Pacific	1595	388
Southern	376	92
Arctic	69	17
Marginal Seas	226 (113 x 2)	110
Global Argo	<b>3756</b>	<b>970</b>
TPOS [-30°;30°]	894	218
Mediterranean Sea	64 (32x 2)	31
North Atlantic	343	83
South Atlantic	450	110
North West Pacific	285	69
North East Pacific	439	107
South West Pacific	425	103
South East Pacific	446	109

*Summary*

# IMPLEMENTATION

*Activity: 100%*

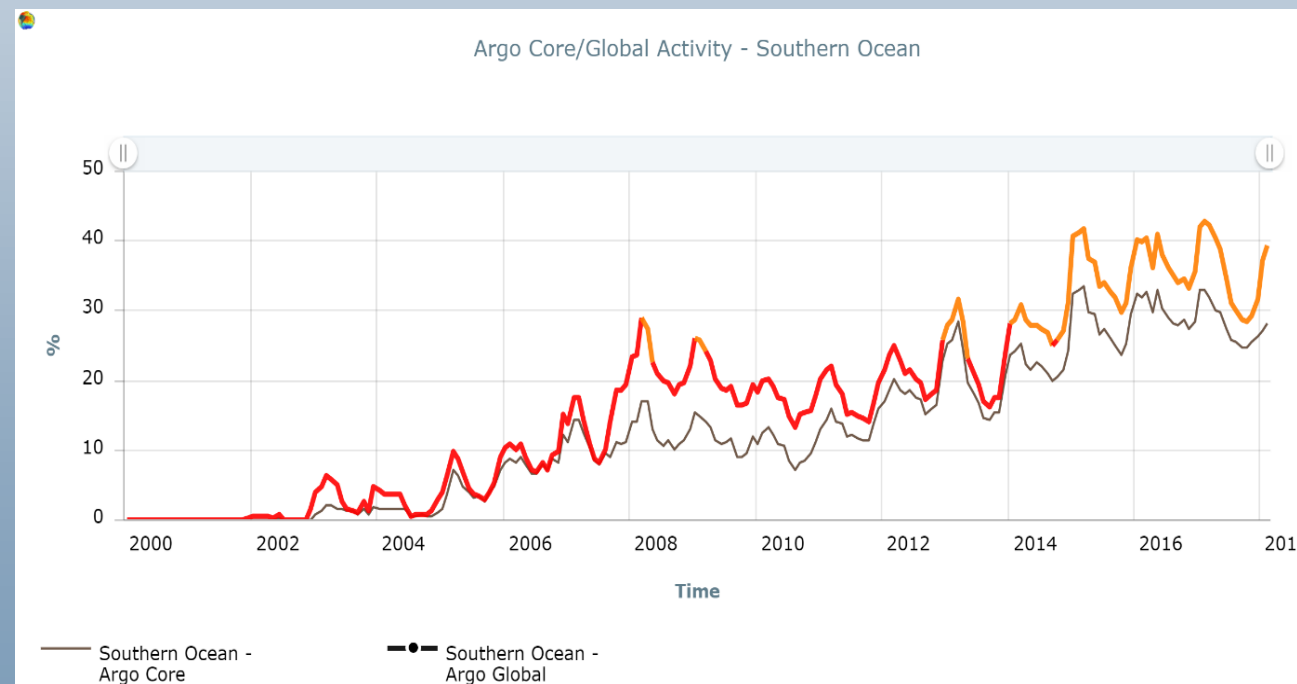
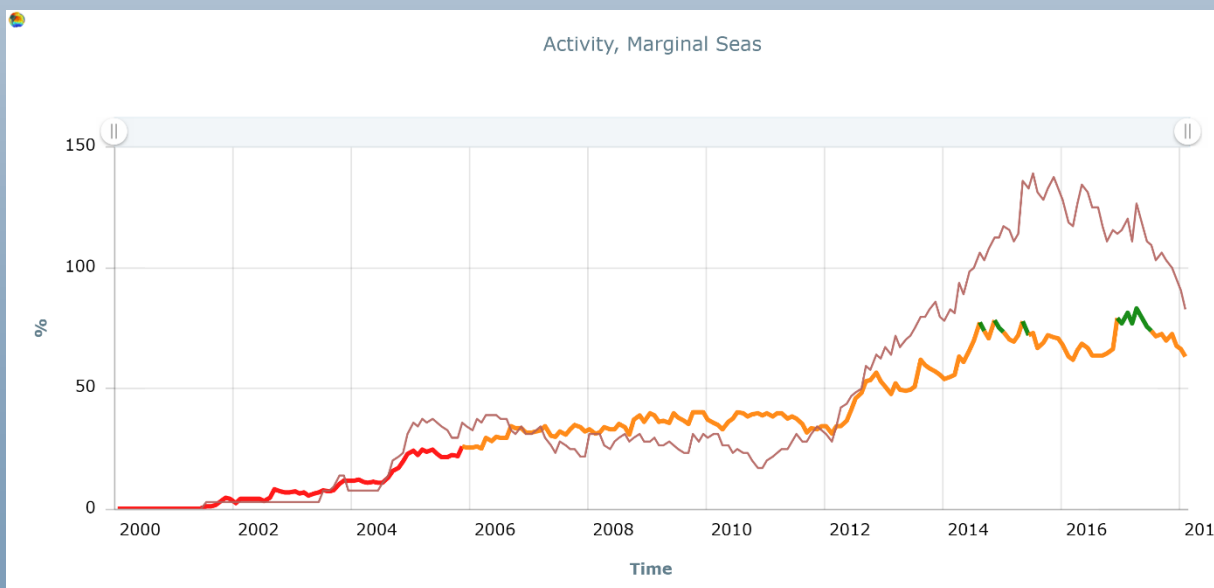
- Core Argo short by 15%
- Extras contributions are essential to meet the global target
- Plateau reached for all networks
- Argo oscillates between 3800/3900 operational floats



# IMPLEMENTATION

*Activity*

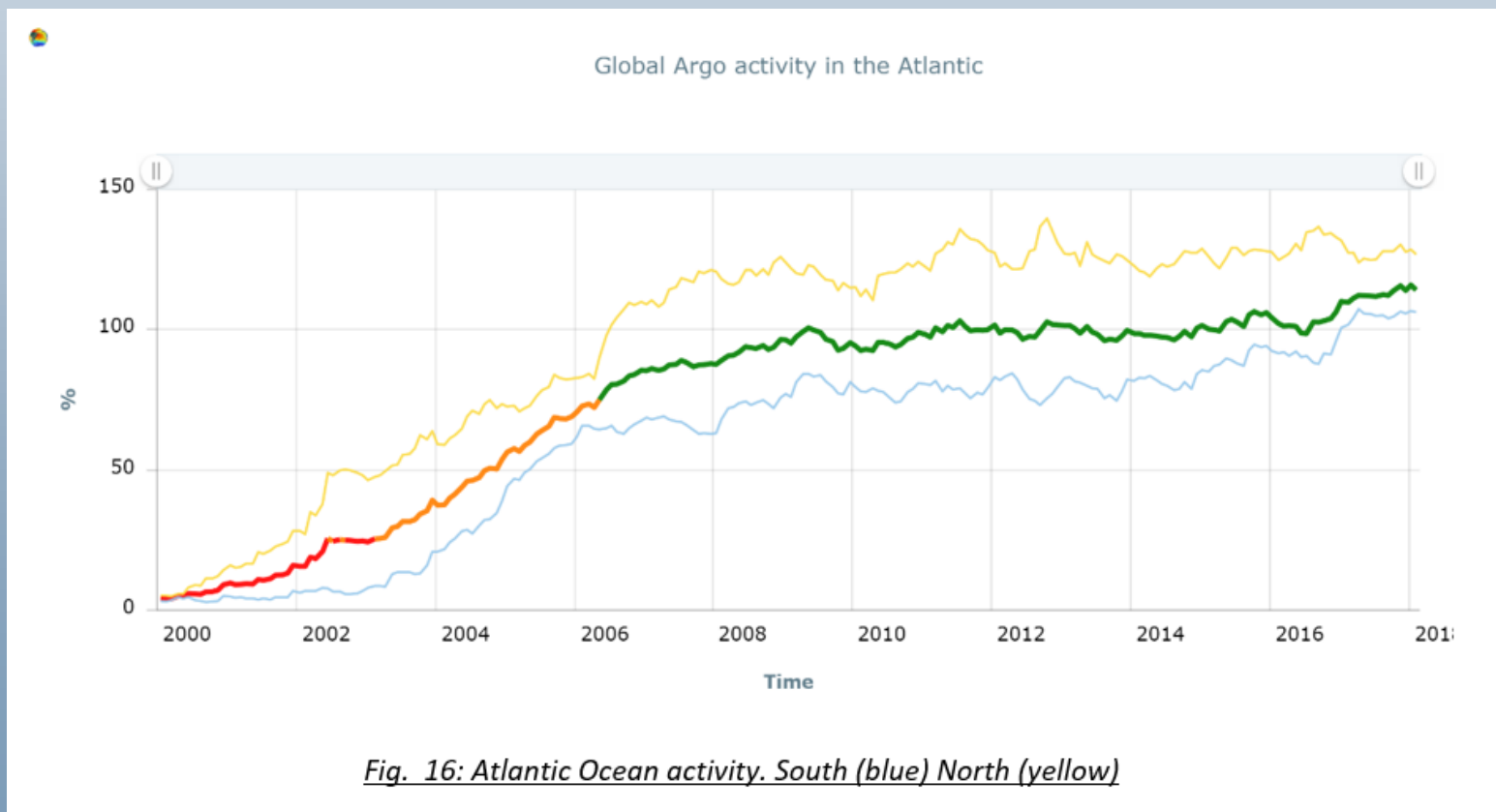
- All indicators are optimal except in Marginal Seas (65%) and Southern Ocean (39%)
- The contribution of BGC Argo in the SO is increasing and visible
- Med. Sea dropping



## IMPLEMENTATION

Activity, A0

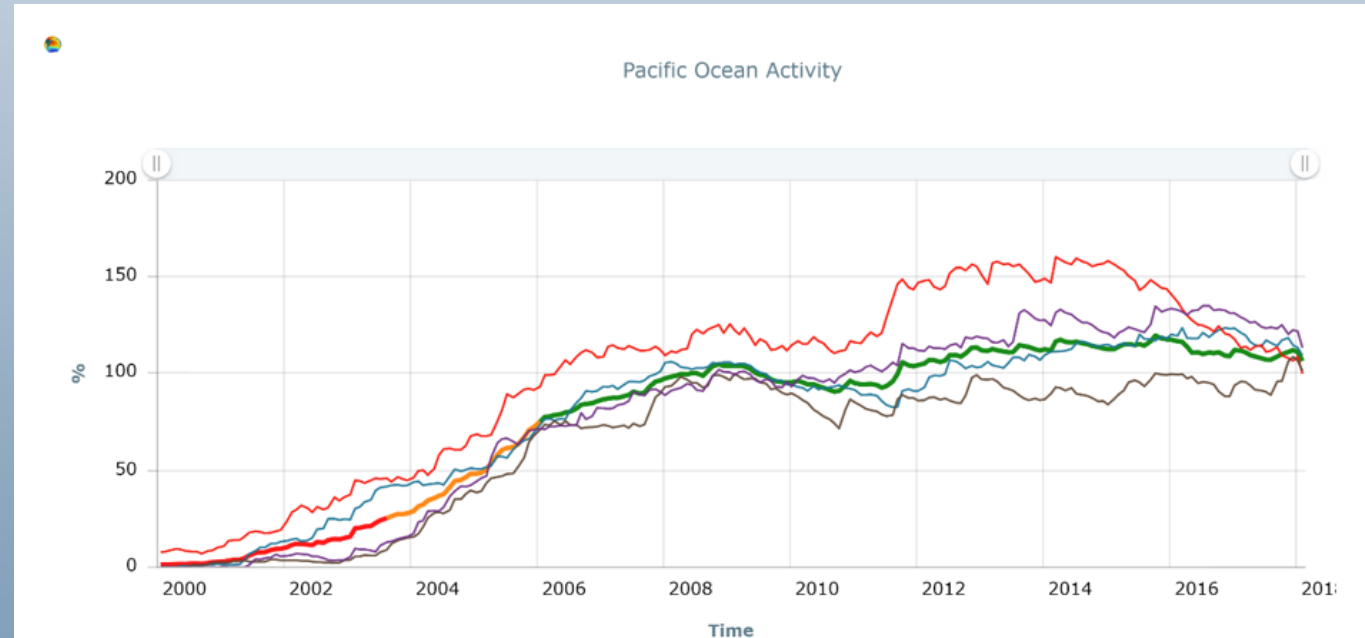
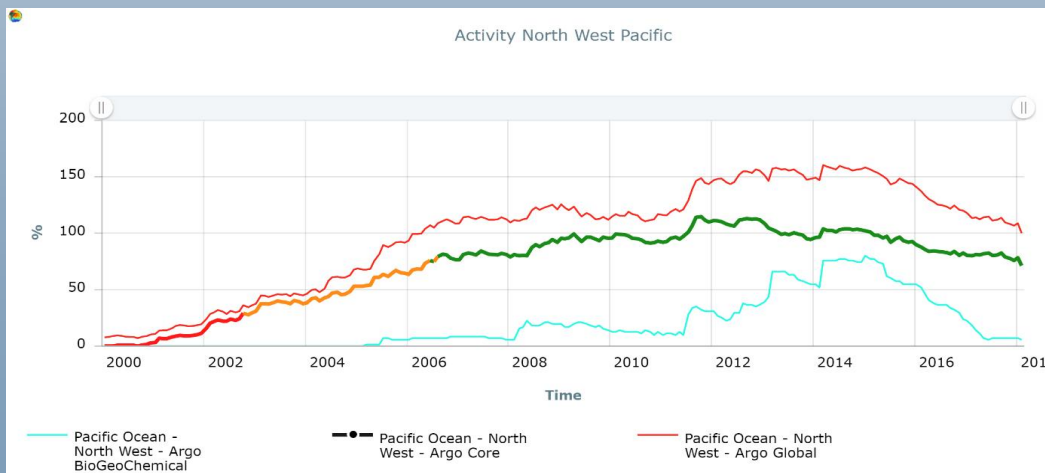
- Highest activity in Atlantic Ocean (122%) and « reserve » of ~100 units
- Rebalancing between North and South is progressing



# IMPLEMENTATION

Activity, PO

- Status overall maintained (float reliability)
- SE recent deployments balance decrease elsewhere
- Recent drop (100 TPOS floats died?)
- NW dropping
- Extras contributions vital

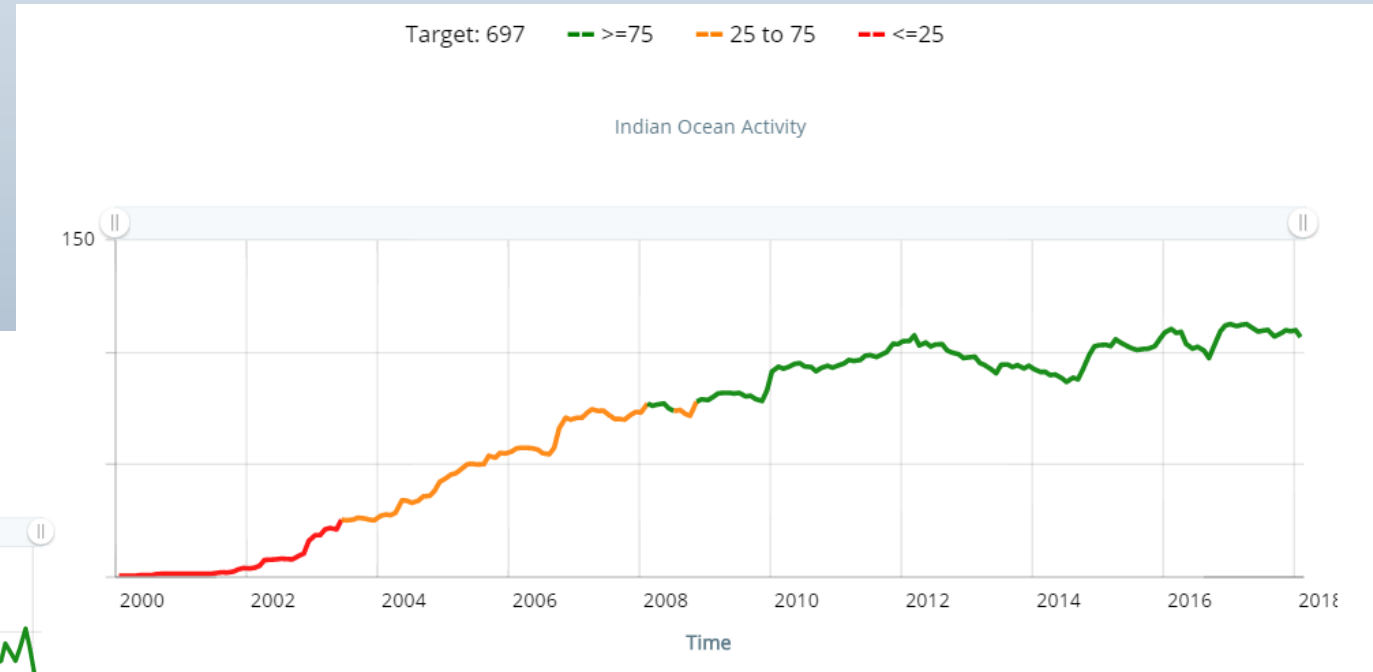


*Fig. 17: Argo operational floats the Pacific Ocean*  
*Bold (all), red (NW), purple (SW), Brown (SE), Blue (NE)*

# IMPLEMENTATION

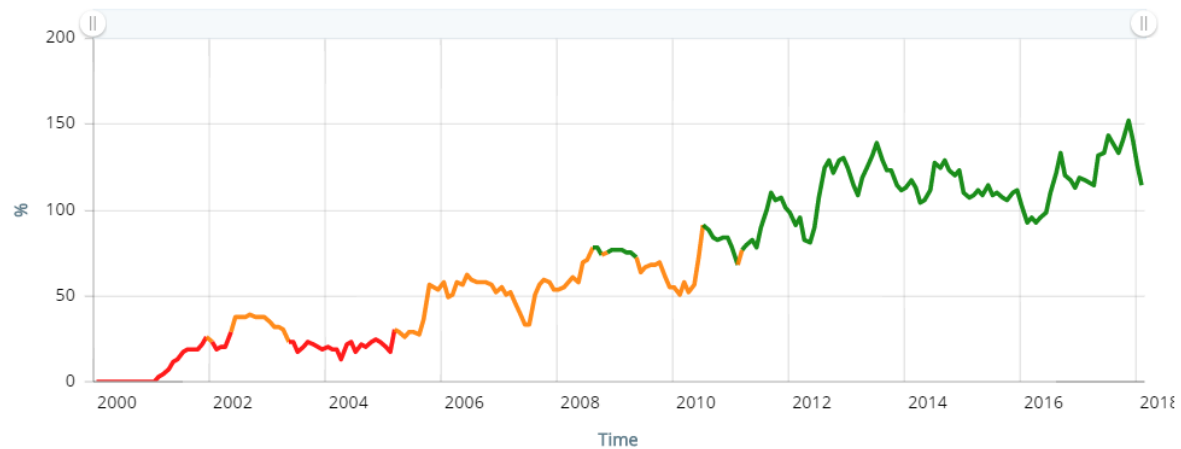
- Indian Ocean fine.
- Arctic Ocean fine.

*Activity, IO*



# of operational units in the design vs target (Global Argo) - Arctic

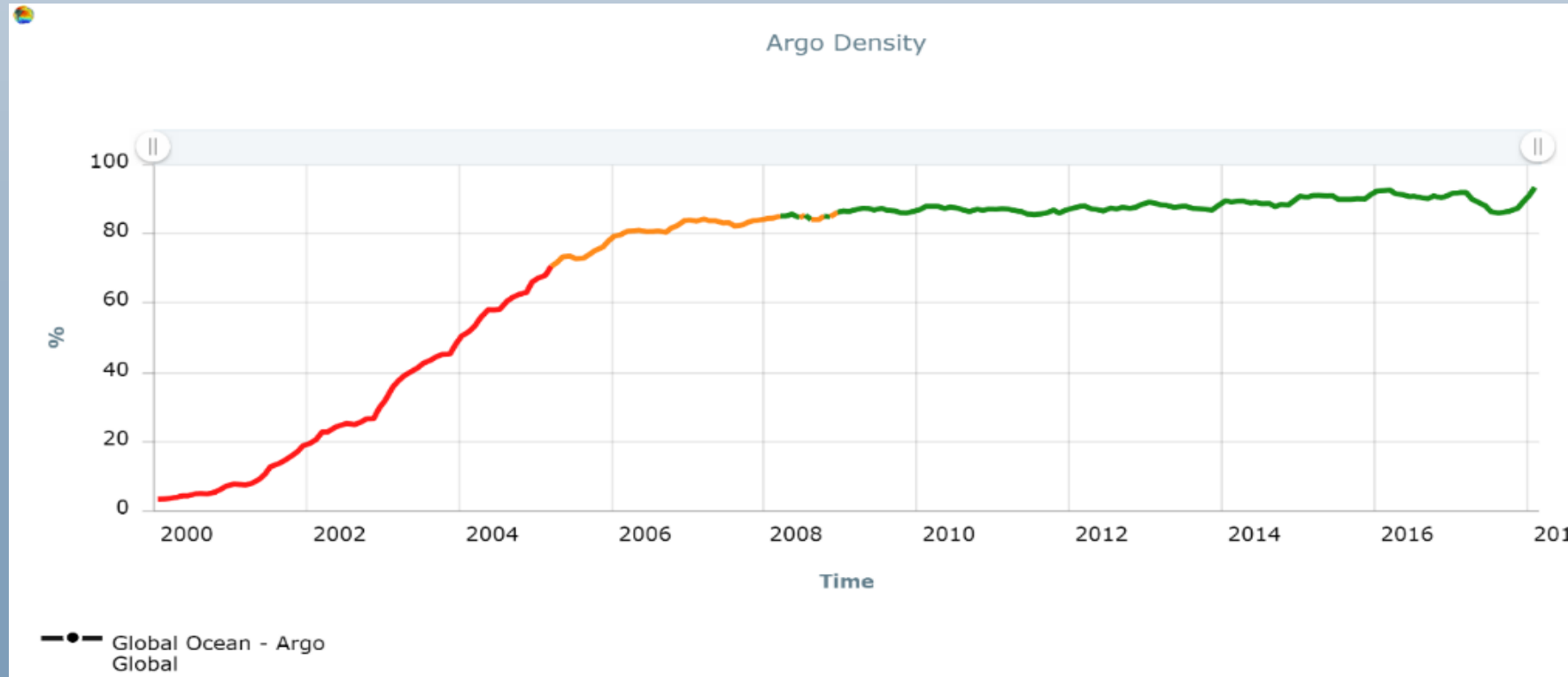
Target: 69    —  $\geq 75$     — 25 to 75    —  $\leq 25$



## IMPLEMENTATION

*Spatial (yearly) Coverage: 69%*

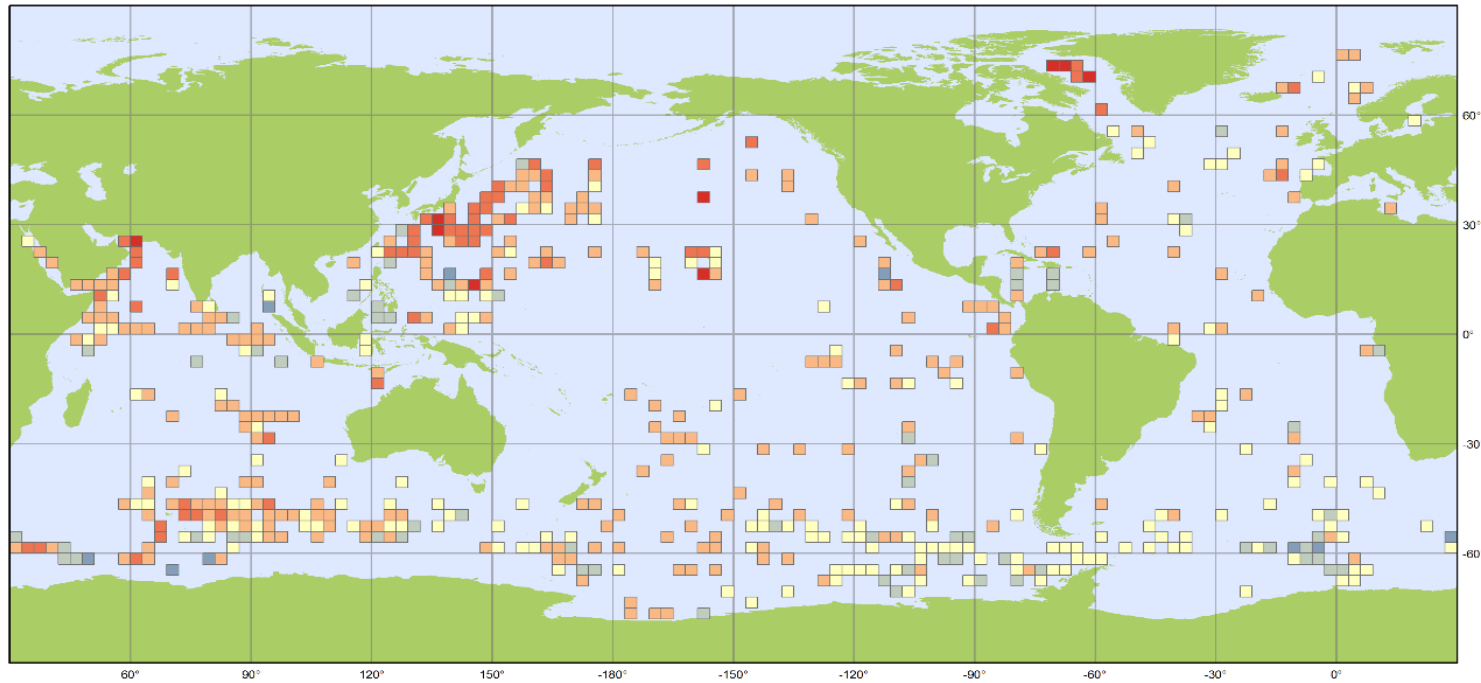
- slowly but continuously improving (+4%)
- Extras contribution participate more than expected to this improvement
- There is still margin for improvement everywhere.





# IMPLEMENTATION

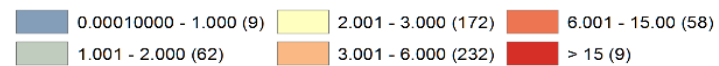
Coverage



Argo

## Value added of extra floats vs Core Argo - 2017 Coverage

Average of monthly observations distributed at GDACs over 2017, normalized on global Argo target densities.  
Grid elements where Argo Global contribution has improved Core Argo coverage where needed (<3 obs. per month).



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# IMPLEMENTATION

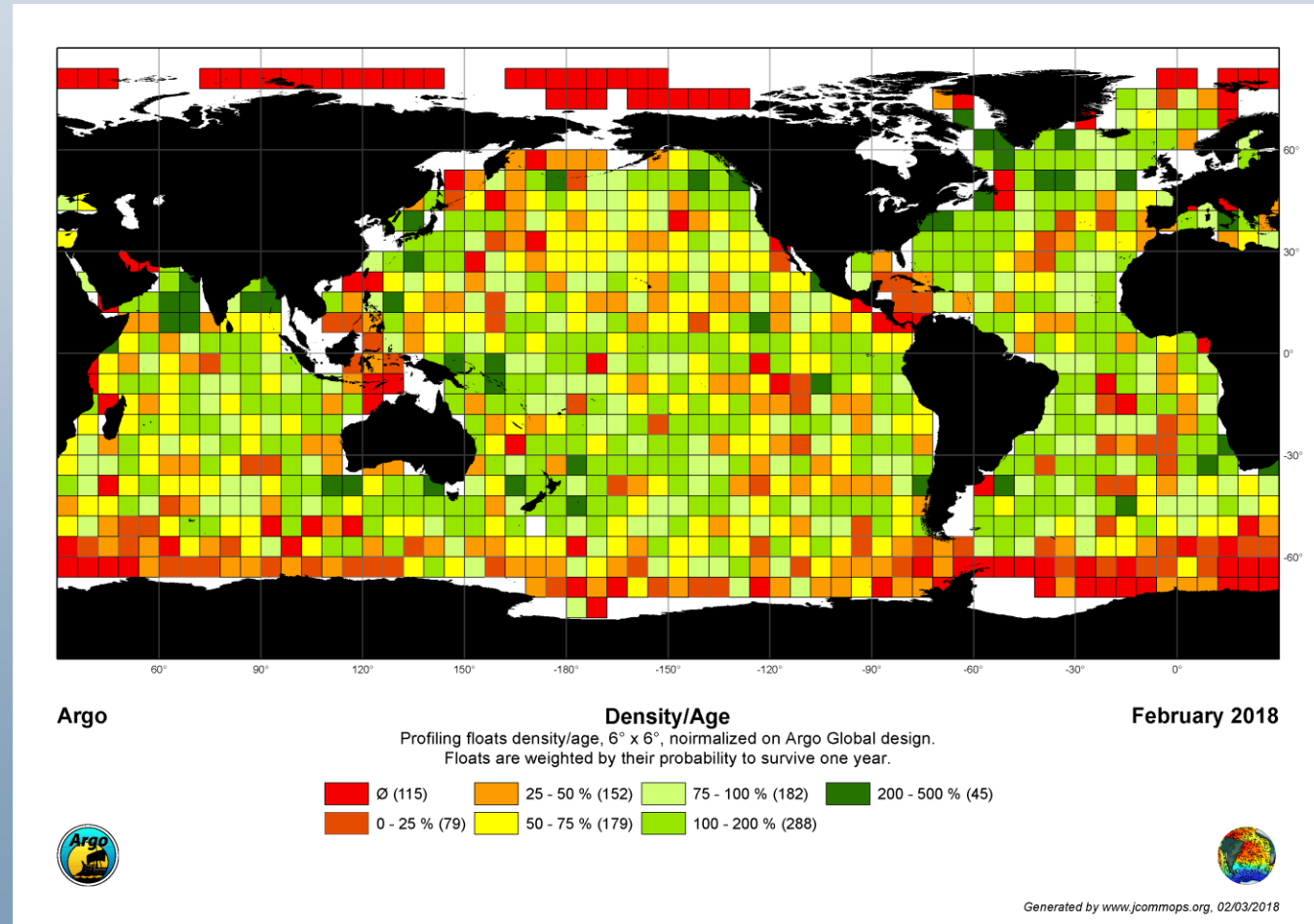
*Coverage, summary*

Implementation			
Coverage (Yearly)	68.65%	Coverage (Yearly)	79.3%
Argo Global	2017 ↗	Argo Global - Pacific Ocean - North West	2017 ↘
Coverage (Yearly)	75.17%	Coverage (Yearly)	71.3%
Argo Global - Pacific Ocean	2017 ↗	Argo Global - Pacific Ocean - North East	2017 ↘
Coverage (Yearly)	74.65%	Coverage (Yearly)	82.35%
Argo Global - Atlantic Ocean	2017 ↗	Argo Global - Pacific Ocean - South West	2017 ↗
Coverage (Yearly)	70.73%	Coverage (Yearly)	69.51%
Argo Global - Indian Ocean	2017 ↘	Argo Global - Pacific Ocean - South East	2017 ↗
Coverage (Yearly)	26.33%	Coverage (Yearly)	77.84%
Argo Global - Southern Ocean	2017 ↘	Argo Global - Atlantic Ocean - North	2017 ↘
Coverage (Yearly)	78.13%	Coverage (Yearly)	72.22%
Argo Global - Mediterranean Sea	2017 ↘	Argo Global - Atlantic Ocean - South	2017 ↗
Coverage (Yearly)	78.26%		
Argo Global - Arctic Ocean	2017 ↗		
Coverage (Yearly)	42.48%		
Argo Global - Marginal Seas	2017 ↗		

***Fig. 27: Yearly coverage indicator values for 2017***

# IMPLEMENTATION

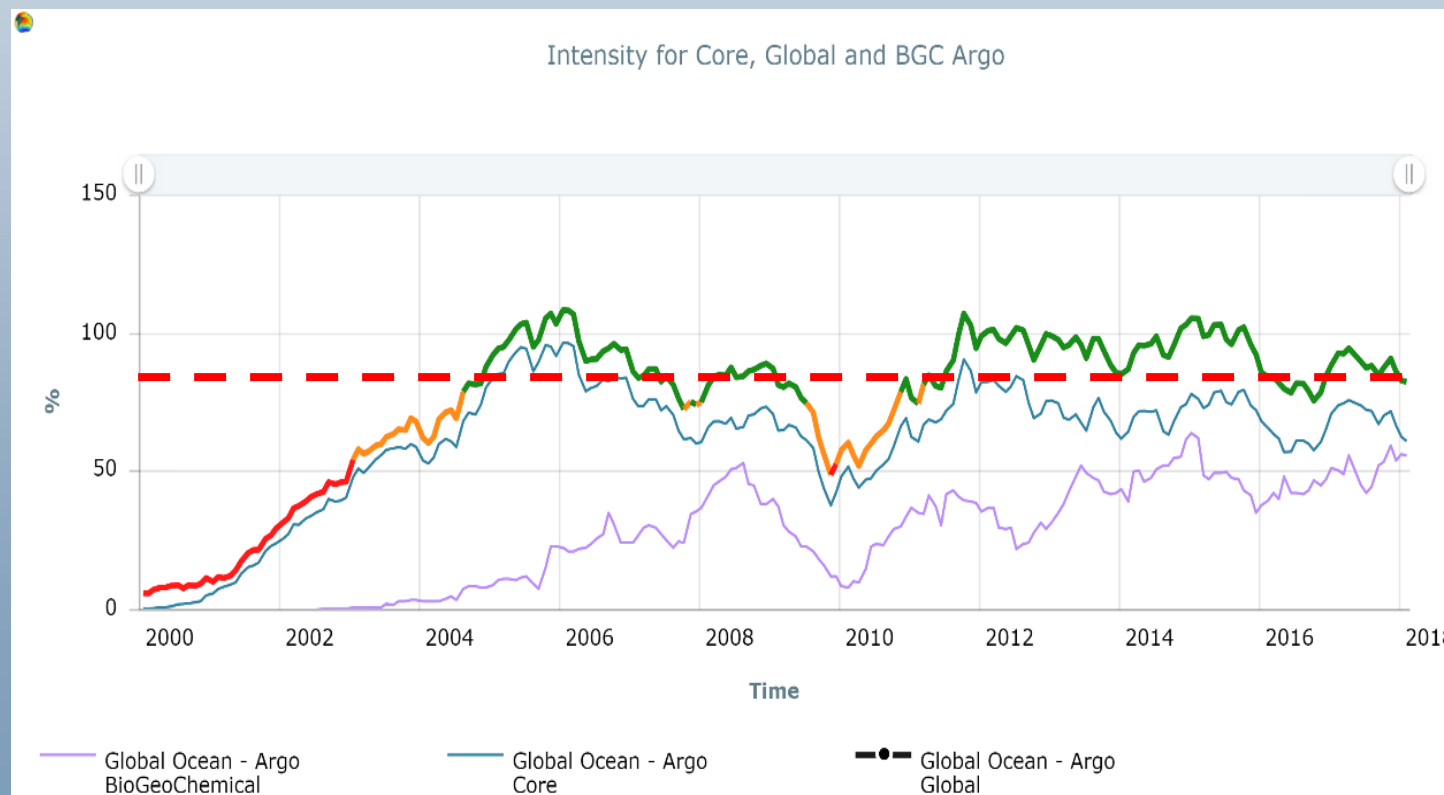
*Density*



# IMPLEMENTATION

*Intensity*

- slow decreasing trend in the intensity of deployments for Argo Global and Core while BGC is stabilized (50%).
- Expansion not followed by agencies
- No new commitments
- Flat funding slowly impacts
- Extras can't compensate it



# IMPLEMENTATION

*Intensity: overview*

- Indian Ocean warning (70 floats deficit).
- Southern Ocean: considerable challenge (intensity might be optimistic given lifetime)
- Med. Sea trend need to be inverted

■ Arctic: little effort

■ Warning South West Pac.

■ Excess in N. Atl. (by 50)

■ Pac. below requirements

Living on float performance

Virtual deficit of 150, 200

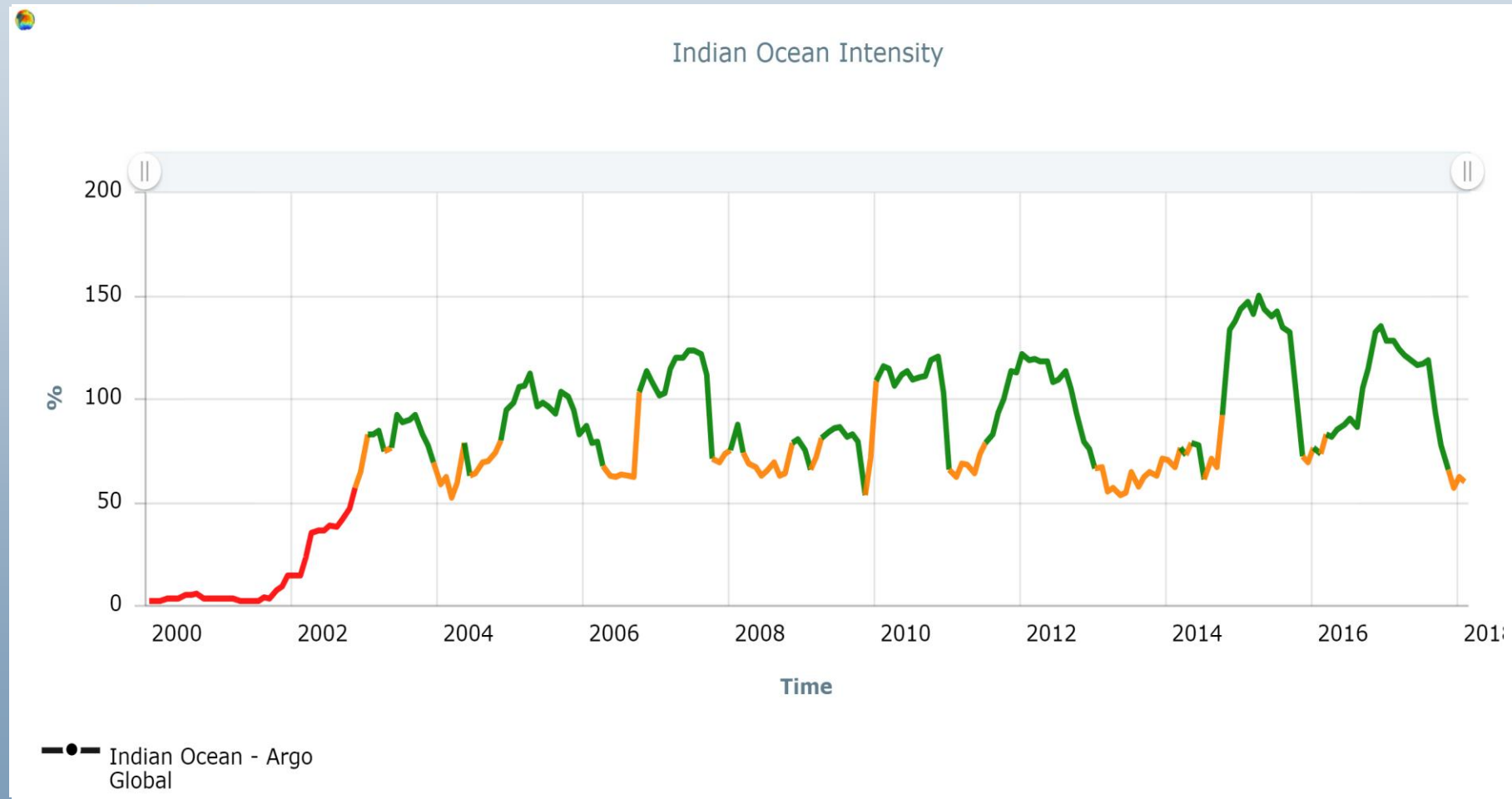
Implementation			
Intensity Argo Global	82.47% 2/2018 📉	800 Raw count	970 Target
Intensity Argo Global - Atlantic Ocean	127.98% 2/2018 📈	247 Raw count	193 Target
Intensity Argo Global - Pacific Ocean	88.66% 2/2018 📈	344 Raw count	388 Target
Intensity Argo Global - Indian Ocean	60% 2/2018 📉	102 Raw count	170 Target
Intensity Argo Global - Southern Ocean	39.24% 2/2018 📉	31 Raw count	79 Target
Intensity Argo Global - Mediterranean Sea	61.29% 2/2018 📉	19 Raw count	31 Target
Intensity Argo Global - Arctic Ocean	76.47% 2/2018 📈	26 Raw count	34 Target
Intensity Argo Global - Marginal Seas	45.45% 2/2018 📉	50 Raw count	110 Target

Intensity Argo Global - Pacific Ocean - North West	107.25% 2/2018 📈	74 Raw count	69 Target
Intensity Argo Global - Pacific Ocean - North East	75.7% 2/2018 📉	81 Raw count	107 Target
Intensity Argo Global - Pacific Ocean - South West	63.11% 2/2018 📉	65 Raw count	103 Target
Intensity Argo Global - Pacific Ocean - South East	113.76% 2/2018 📈	124 Raw count	109 Target
Intensity Argo Global - Atlantic Ocean - North	161.45% 2/2018 📈	134 Raw count	83 Target
Intensity Argo Global - Atlantic Ocean - South	104.55% 2/2018 📉	115 Raw count	110 Target

*Fig 34: Intensity status as of February 2017*

# IMPLEMENTATION

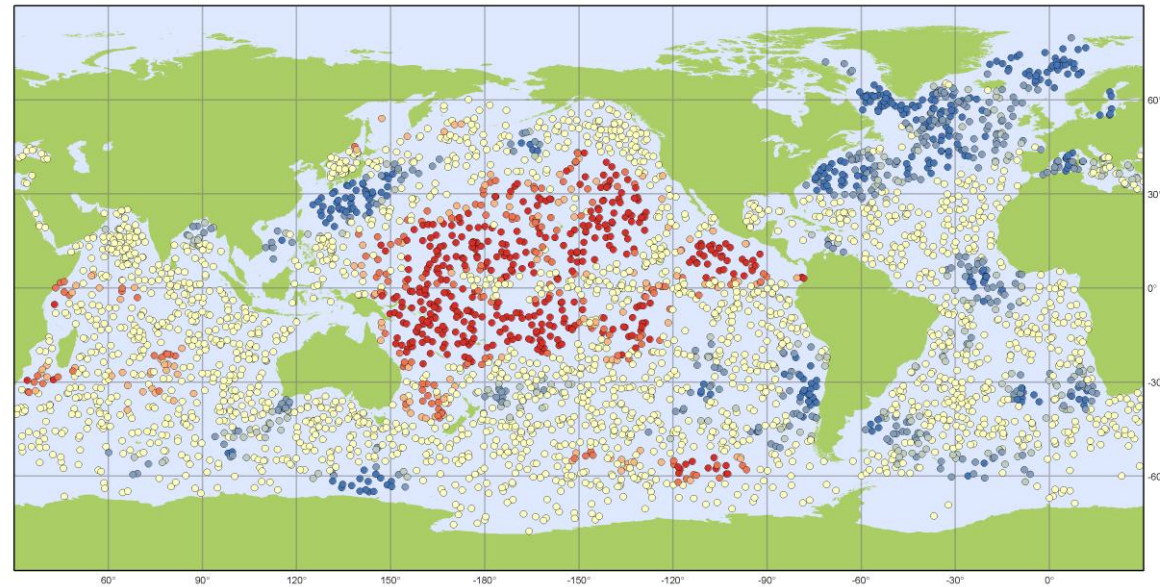
*Intensity*



# IMPLEMENTATION

- 225 floats > 7 years in PO.

Age



## Argo Age - Hot Spot Analysis February 2018

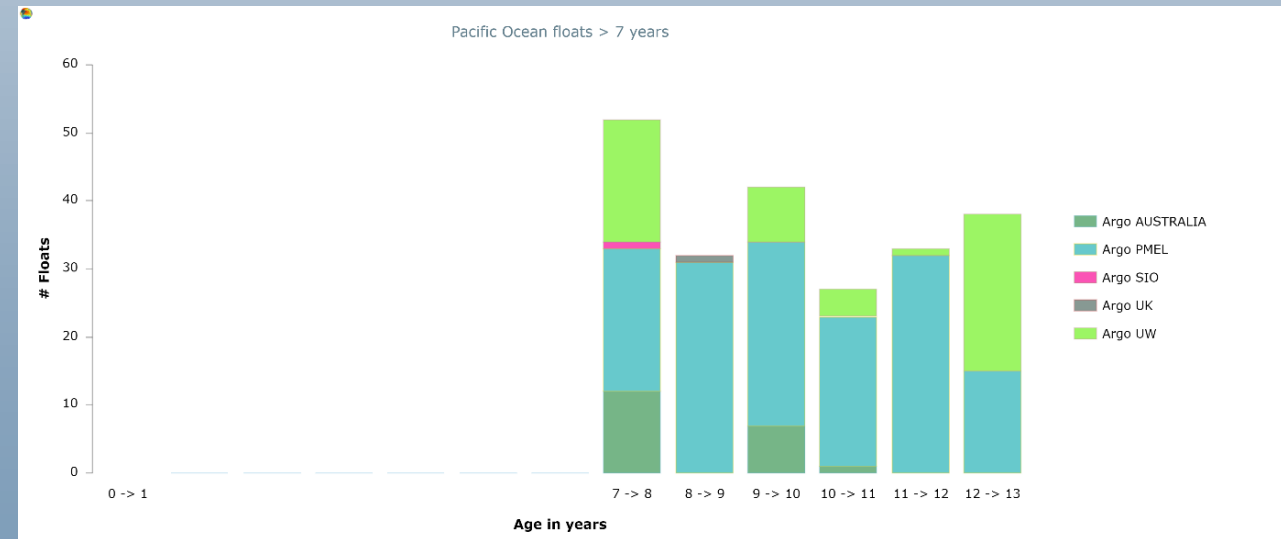
For each float a spatial weight on age is calculated according to neighbours to identify spatial clusters of hot/cold spots. To be statistically significant, the hot/cold spot will have a high/low value and be surrounded by other features with high/low values. (Getis-Ord Method)



- Cold Spot - 99% Confidence
- Cold Spot - 90% Confidence
- Cold Spot - 95% Confidence
- Not Significant
- Hot Spot - 90% Confidence
- Hot Spot - 95% Confidence
- Hot Spot - 99% Confidence



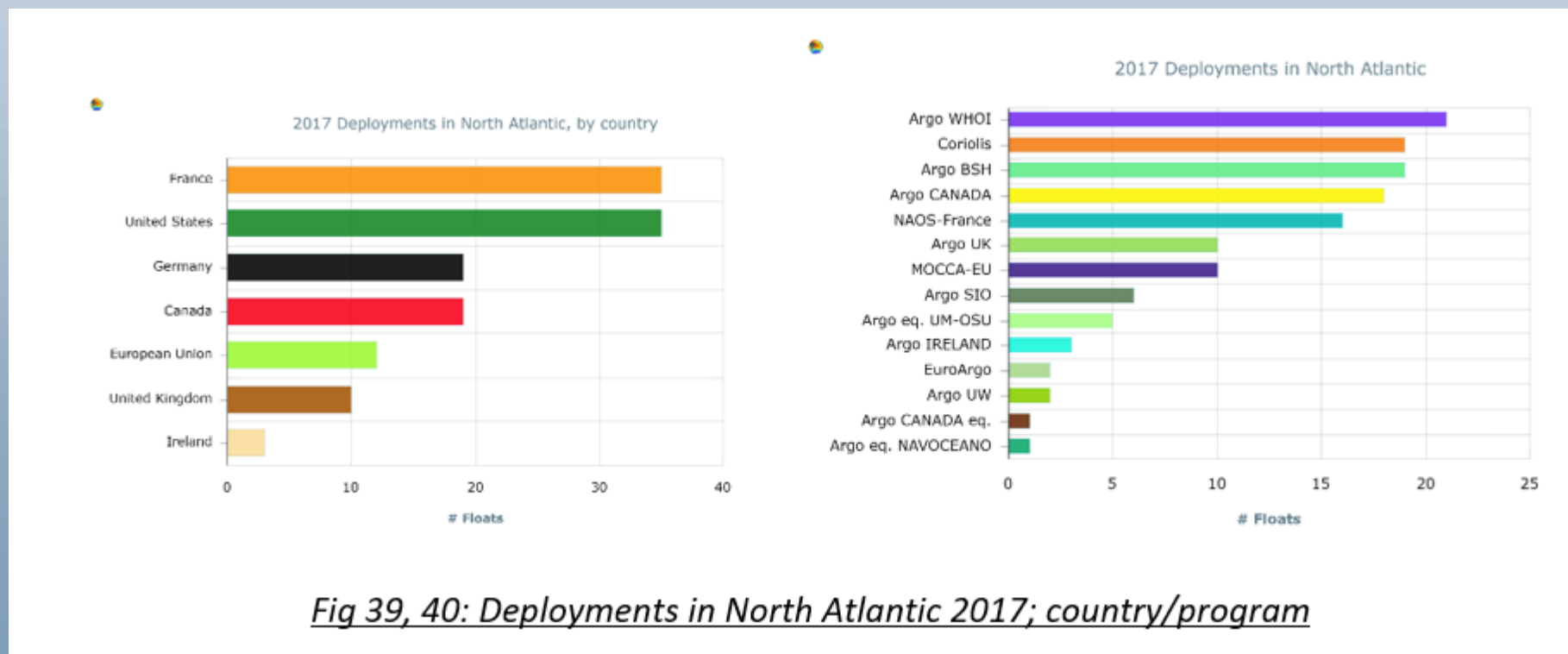
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## RECOMMENDATION

*Cooperation*

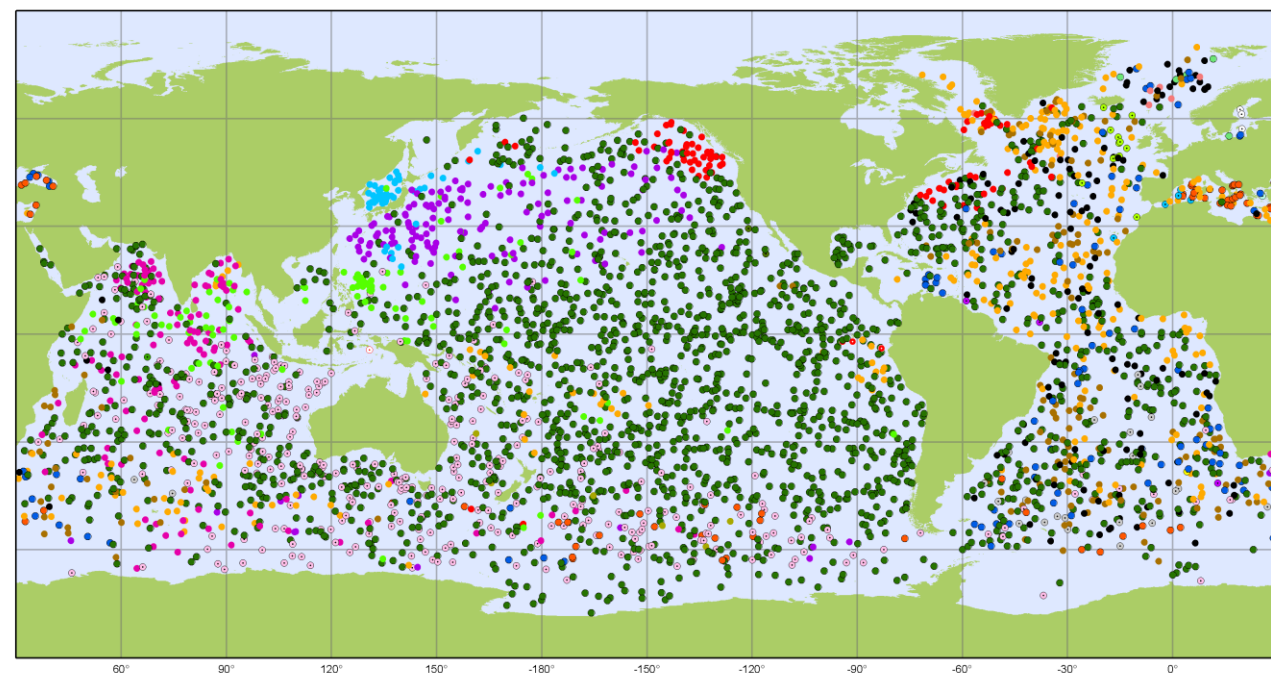
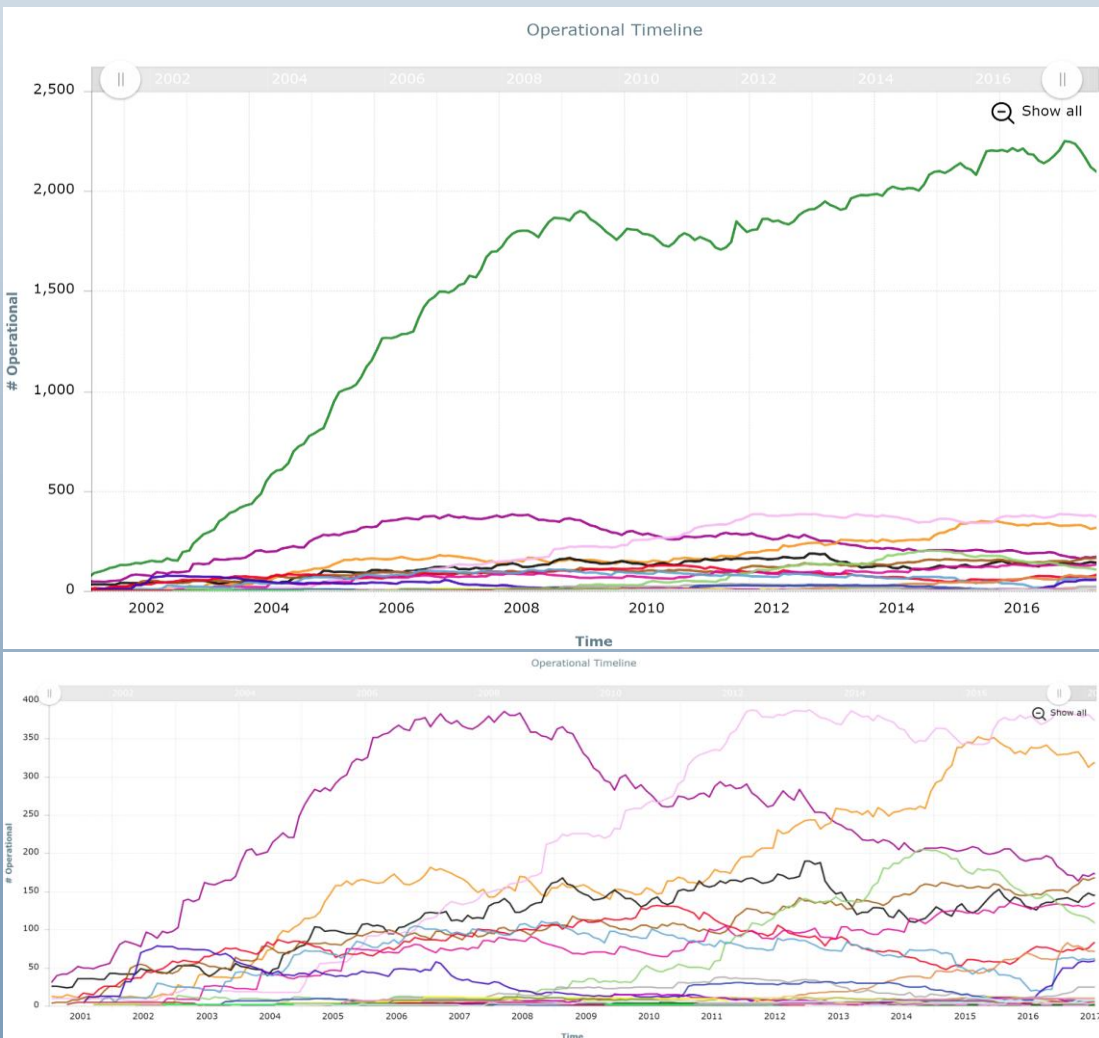
- North Atlantic deployments should be redirected in the Southern Ocean, by 50 units per year; Europe, USA (WHOI) and Canada to discuss.





# IMPLEMENTATION

## International Partners



Argo

National contributions - 3881 Operational Floats

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

February 2018

- |                 |               |               |                  |                         |            |
|-----------------|---------------|---------------|------------------|-------------------------|------------|
| ARGENTINA (1)   | EUROPE (94)   | INDIA (124)   | KENYA (1)        | PERU (3)                | USA (2179) |
| AUSTRALIA (361) | FINLAND (3)   | INDONESIA (1) | MEXICO (2)       | POLAND (5)              |            |
| BRAZIL (3)      | FRANCE (277)  | IRELAND (12)  | NETHERLANDS (24) | KOREA, REPUBLIC OF (53) |            |
| CANADA (87)     | GERMANY (142) | ITALY (65)    | NEW ZEALAND (6)  | SPAIN (5)               |            |
| CHINA (105)     | GREECE (2)    | JAPAN (156)   | NORWAY (7)       | UK (163)                |            |



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## CONCLUSION

*Take away messages*

- Argo is doing remarkably well with less means and could do even better
- Southern Ocean challenge is considerable and calls for a major cooperative effort
- Improving float reliability is actually our only margin of security ...
- Indian ocean deficit to be monitored
- Equivalent contribution in NW Pacific si vital
- North Atlantic partners are challenged for next year !