THE FUTURE OF GLOBAL OCEAN OBSERVATIONS IN THE ARGO PROGRAM

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and

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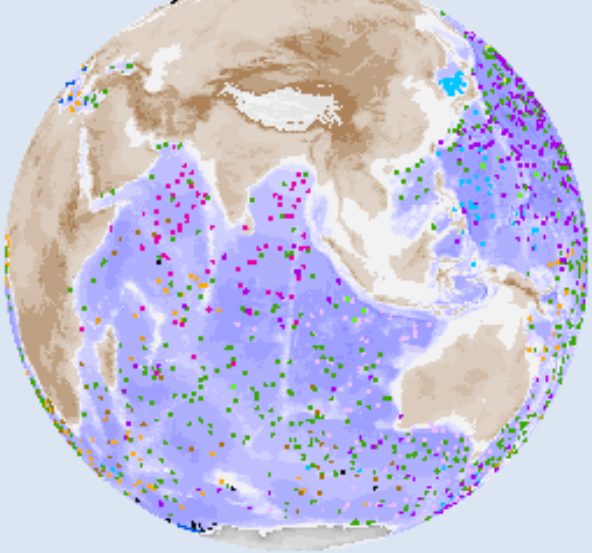
GODAE Ocean View 2013

The original mission and design

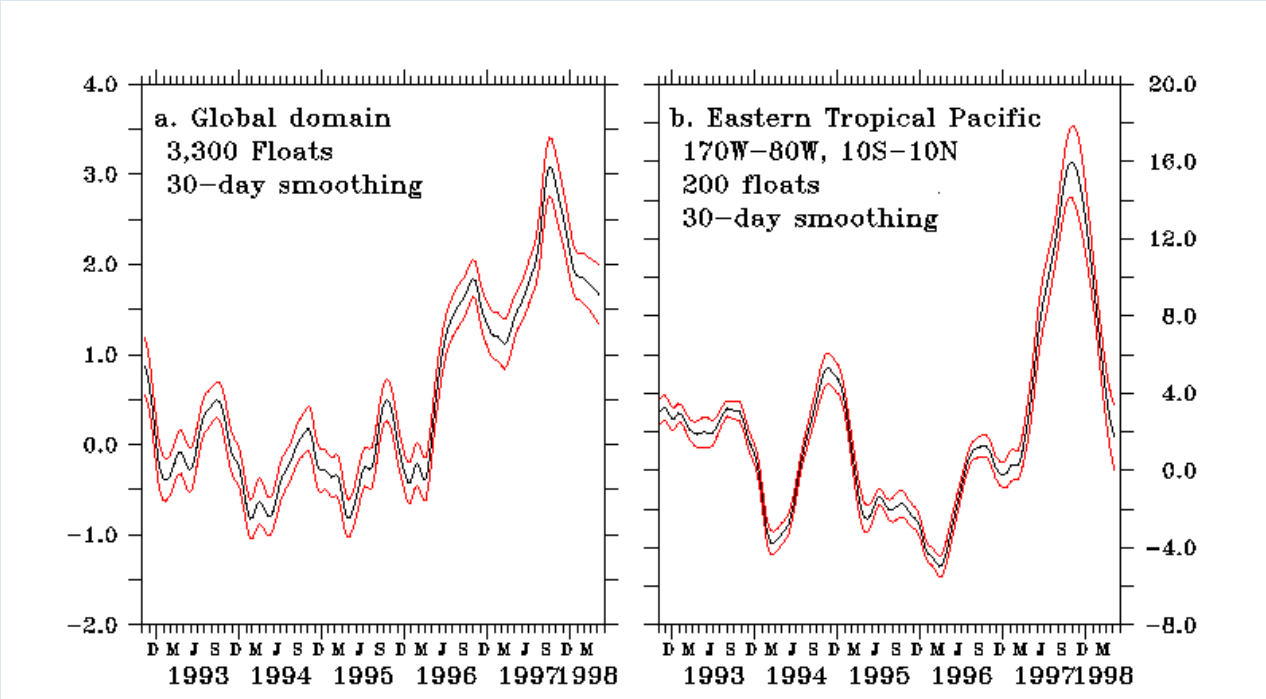


Provide an enhanced real-time capability for measurement of temperature and salinity through the upper 2000 m of the ocean and contribute to a global description of the seasonal cycle and interannual variability of the upper ocean thermohaline structure and circulation.

In the late 1990's:

"The most serious defects in present observing networks are the lack of global span in thermal data and the lack of any systematic subsurface salinity data. These are major weaknesses, in effect limiting scientific progress in climate studies."

The mission:
Track the 'slowly changing manifold' of the ocean



Along track altimetry and HD XBT lines showed that to resolve **seasonal changes** at **~500-1000km scales**

= 3^ox3^o coverage = 3300 floats

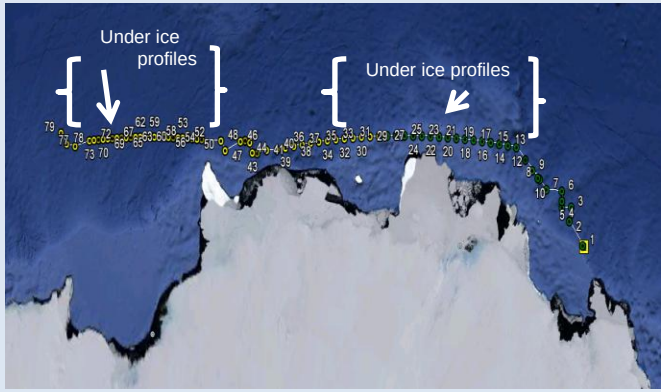
Designed to complement altimetry

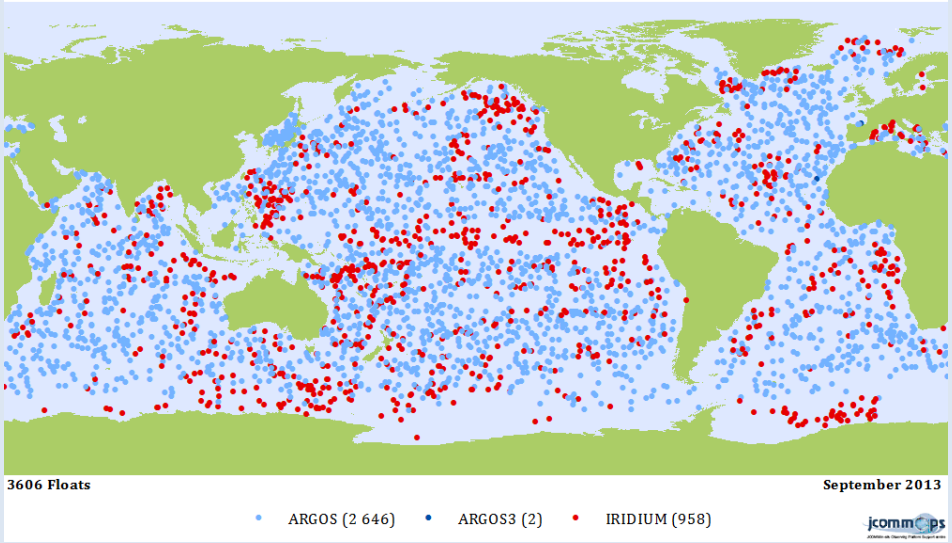
Exclude water < 2000m depth, ice zones and marginal seas

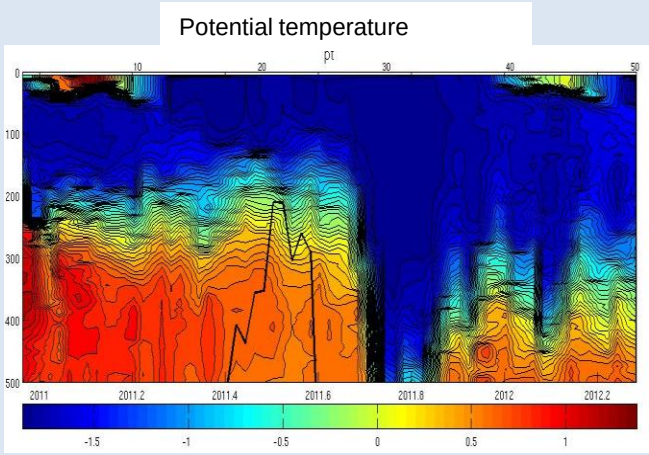
= 3000 floats : **Argo's ORIGINAL DESIGN**

Technology improvements are driving changes

- increased buoyancy control
- more robust hardware designs
- rapid bi-directional satellite communications
- ice-avoidance software



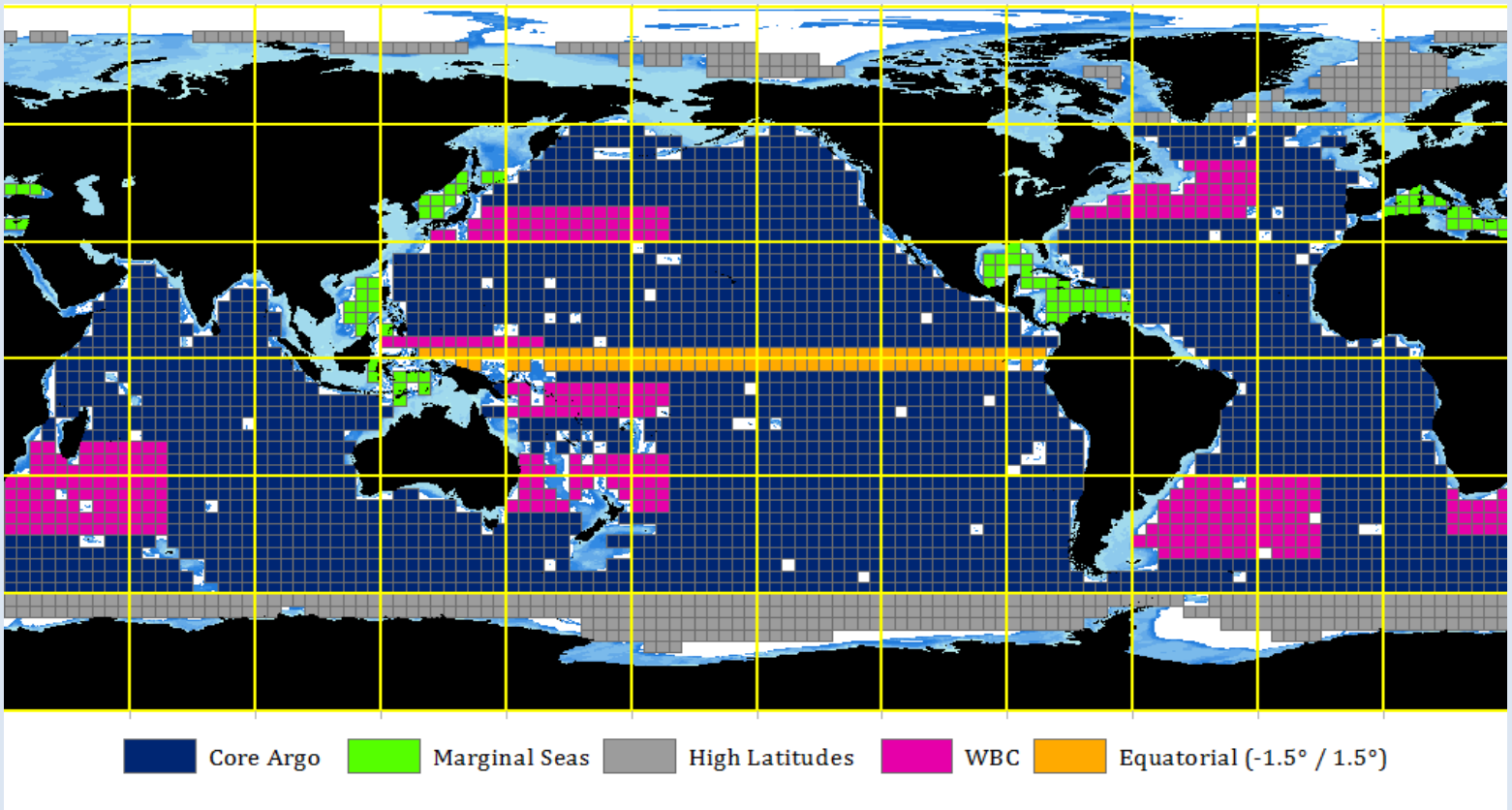




This allows us to contemplate completing the original mission

– expand the array to **nearly global coverage** and **drive up signal-to-noise ratio**

A Design for Global Argo?



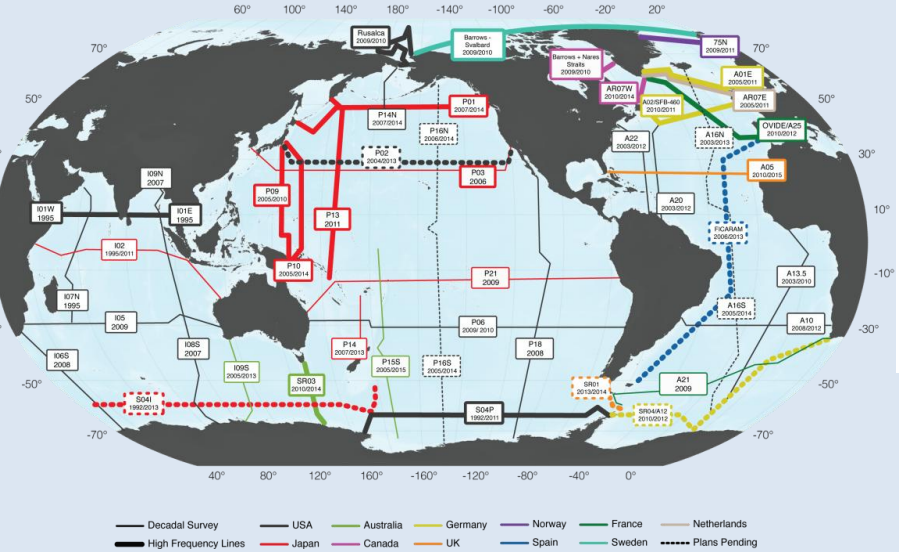
- Same mission – tracking the slow manifold - more spatially complete and better signal to noise
- Double sampling in WBCs and equatorial regions
- Marginal Seas: enhanced sampling - determined by regional partnerships
- Seasonal Ice zone: normal sampling [Fast ice zone requires different technology]

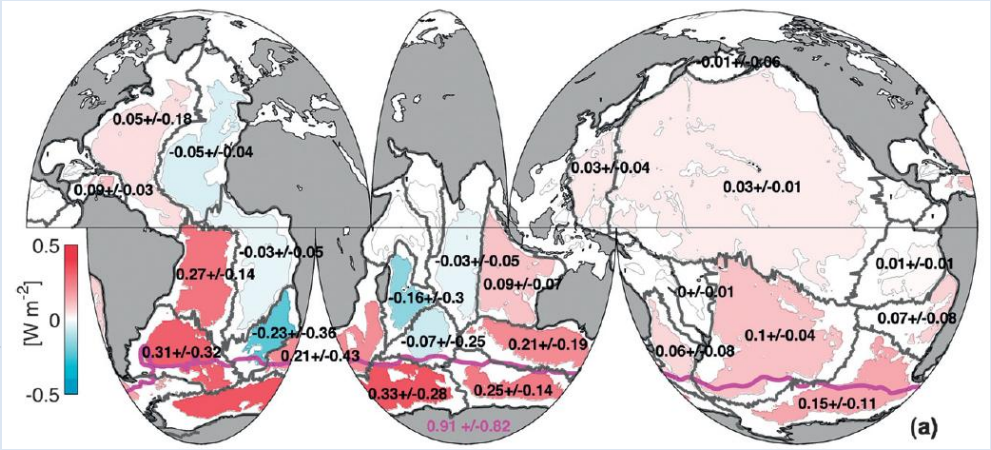
~4200 float array

New Missions ?
Deep Argo

Requirements?

- closure of the sea level, ocean mass, and energy budgets on regional and global scales
- provide new information on ocean circulation and water mass formation and properties
- mitigate the lack of observations below 2000 m for ocean data assimilation modeling





Bottom Water warming from 1990's to 2000's

Purkey and Johnson (2010)

Deep Argo

Readiness?

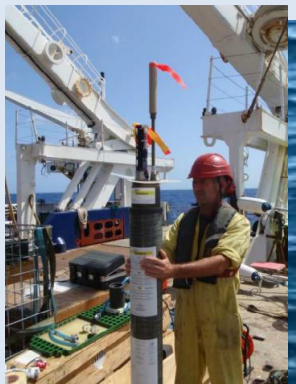
Deep floats are being developed and tested by several groups

A new CTD is under parallel development with improved sensor stability is needed for abyssal measurement

Field tests of handfuls of floats are planned

A **regional pilot** deployment is required to

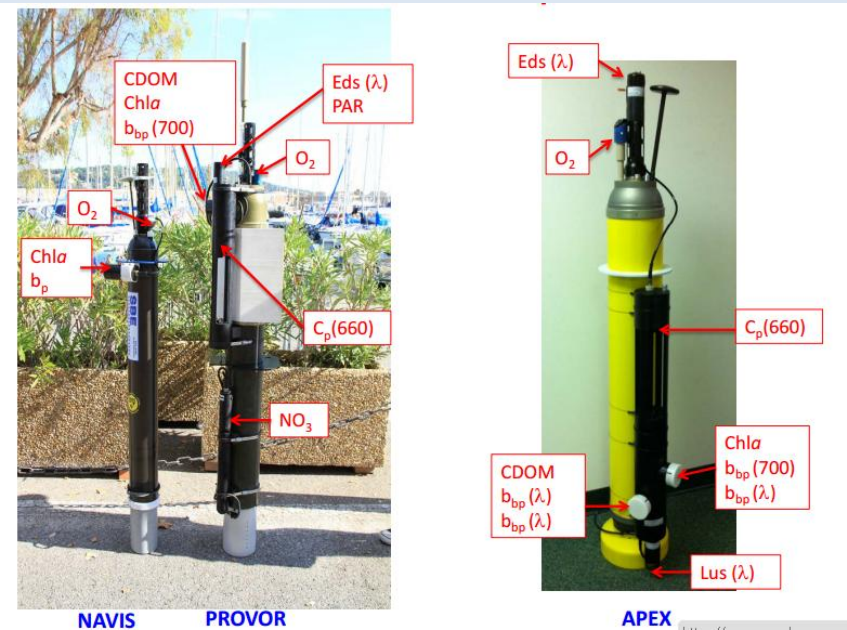
1. Prove technology and refine the cost basis
2. Inform a global array design, as part of a whole of GOOS strategy for the deep ocean



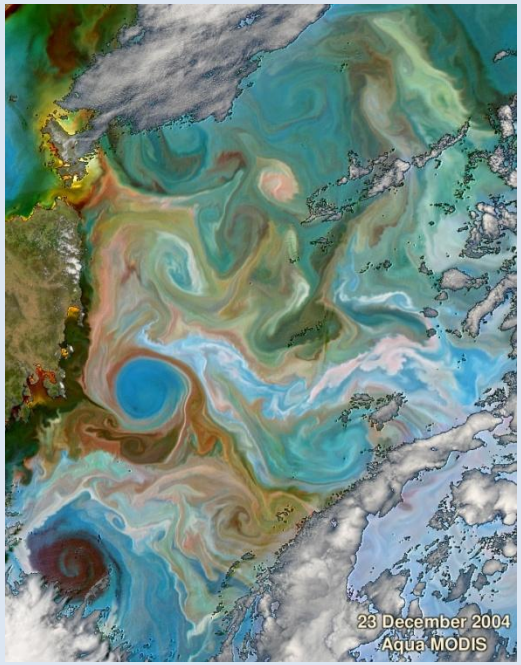
New Missions?
Bio-Argo

Requirements?

- Exploration; filling the gap in unexplored spatio-temporal domains / scales
- Regional BGC budgets established with less uncertainties
- Extraction of long term properties (climatic trends)
- coupled GCM biogeochemistry models fed with “sufficient” data => assimilation of biogeochemical data



Subsurface partner of ocean colour satellite data



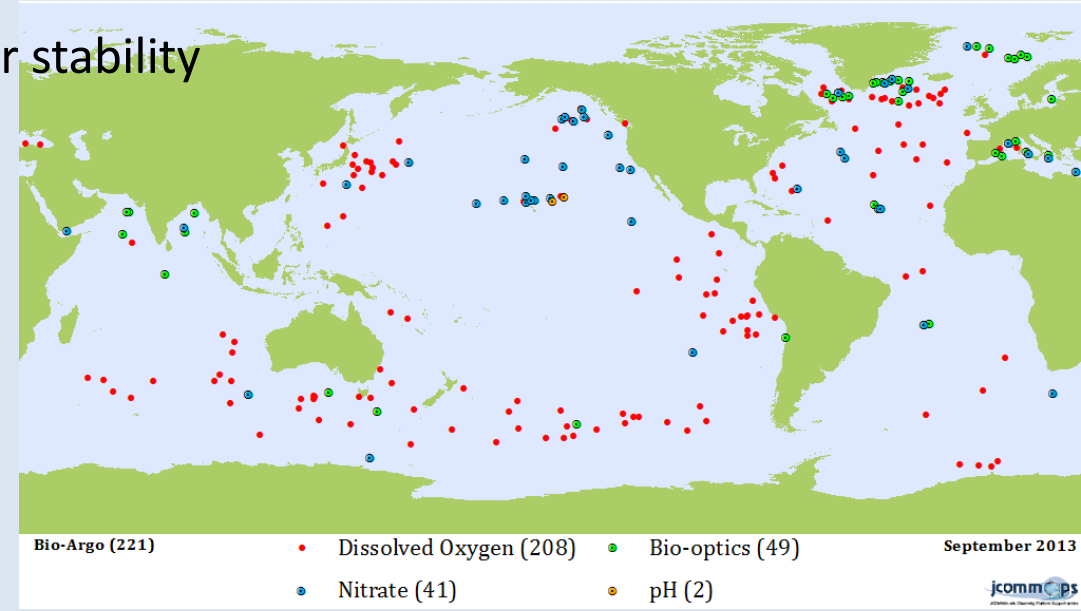
Bio-Argo

Readiness?

- > 200 floats already carry oxygen – QC and sensor stability is still a work in progress
- nitrate, pH, and bio-optical sensors are being developed and proposed on a subset of Argo floats (regional pilot)

Challenges

- ongoing improvement in sensor stability
- resourcing and development of data management protocols, especially for delayed-mode quality control.
- EEZ sensitivities are very high with many nations



Other New Missions ?

- Near surface profiles – via additional dual sensors or sampling T-only – calibration of satellite data
- Frequent shallow profiles for coupled near term forecasting
- Shallow frequent profiles on the shelves

These are possible but are likely to delivery **lower accuracy data**

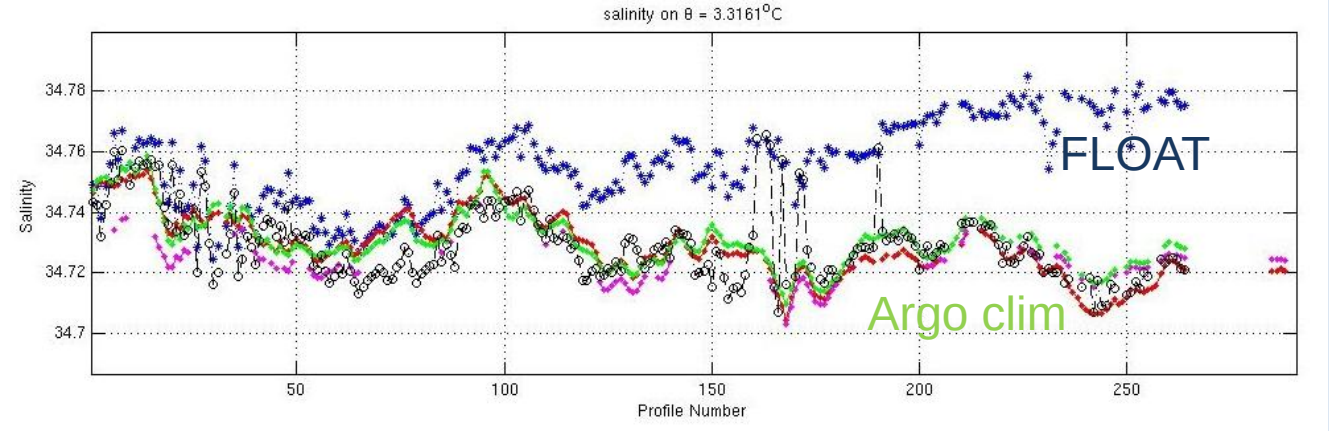
Should different Argo missions have different data quality targets?

Moving Forward

Argo's top priority is to **sustain its original mission** and to keep **improving its high data quality**

Expansion and new missions must come with **adequate resources** otherwise they will weaken delivery

The highest **stress** is currently on **Argo's data system**: distributing ever more complex parameters while maintaining quality in core profile and trajectory data is not working – new resources are needed



Largest Challenges

- to **sustain** these essential and valuable observations across scientific generations and despite shrinking national resources
- to achieve **international consensus** on deployment of Argo floats **inside EEZs**

OV GODAE is a key partner for Argo – for support and advocacy, demonstration of value/impact and to help Argo evolve its design and utility

Thank you

Acknowledgements

- Argo Data Management Team, Argo's Director- Howard Freeland
- The many, many agencies and nations that contribute to Argo in ways both small and large.

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