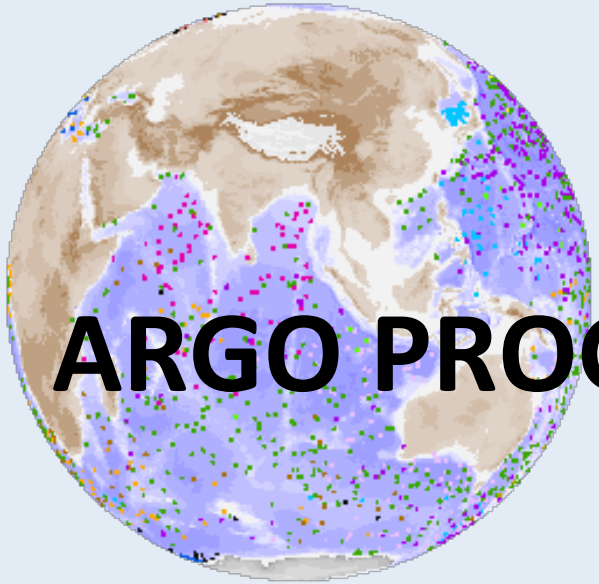


THE ARGO PROGRAM

Susan Wijffels, CSIRO/Centre for Australian Weather and Climate Research, Australia

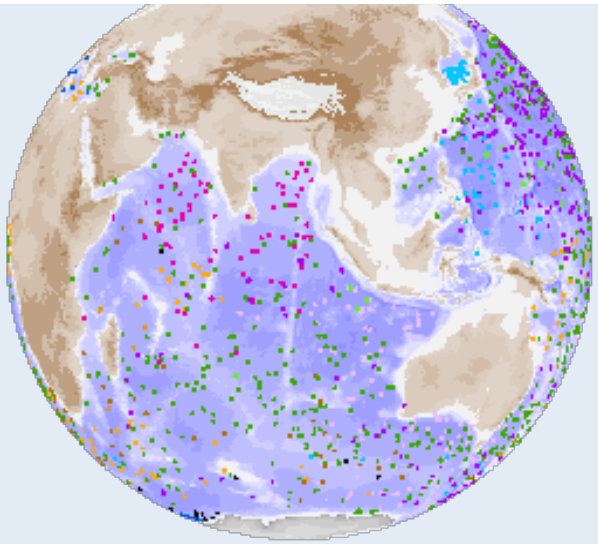
Dean Roemmich, Scripps Institution of Oceanography, USA

for the

The Argo Steering Team

Euro Argo 2014

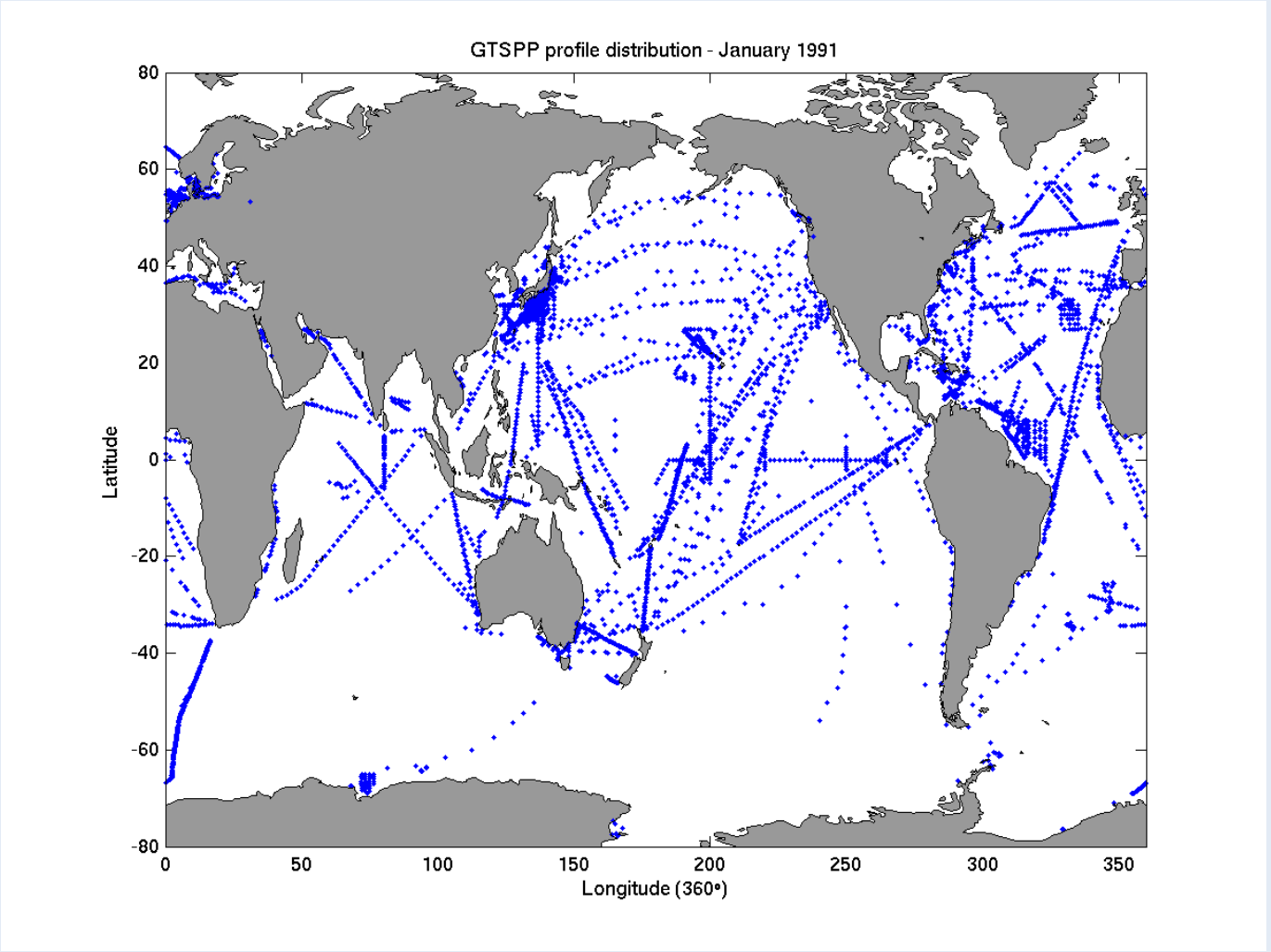
The original mission and design



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:

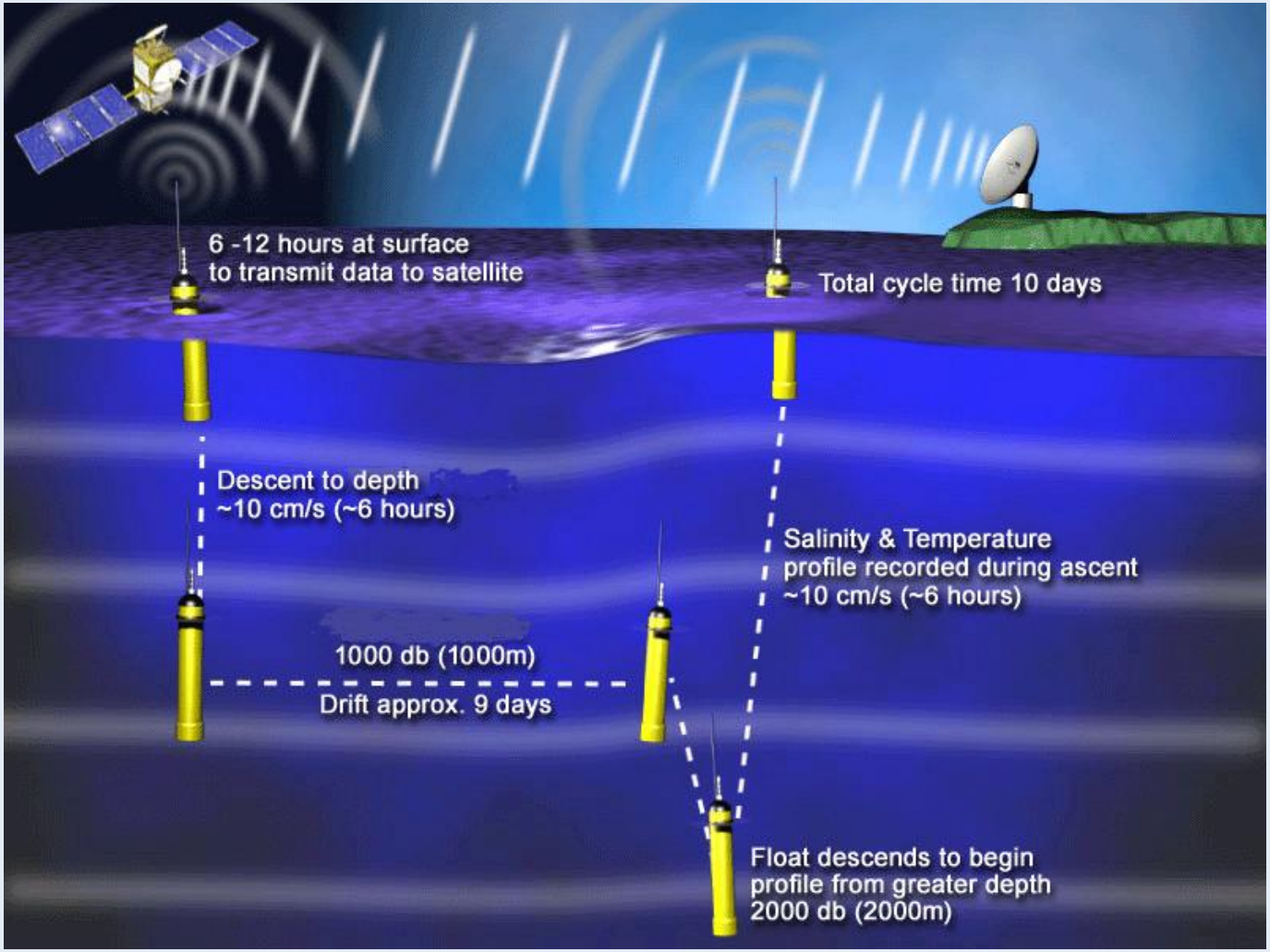
"The most serious defects in present observing networks are the lack of global span in thermal data and the lack of any systematic subsurface salinity data. These are major weaknesses, in effect limiting scientific progress in climate studies."



Ocean temperature profile returns January 1991

Temperature only, to 700m only, low accuracy

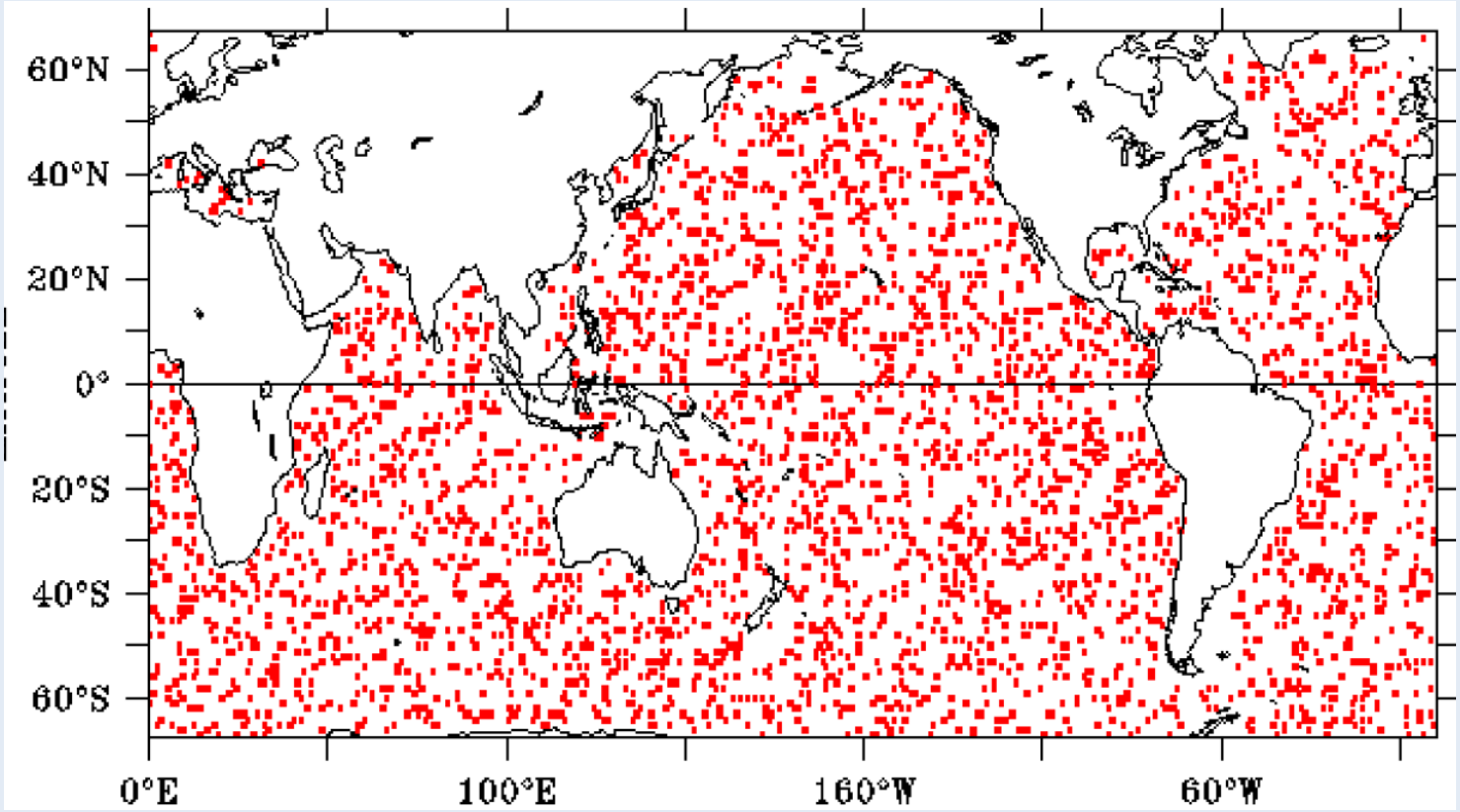
The profiling float: developed during the World Ocean Circulation Experiment (Davis/Webb)



In 1998 a bold idea emerged – to build an array of free-drifting floats profiling globally to 2000m

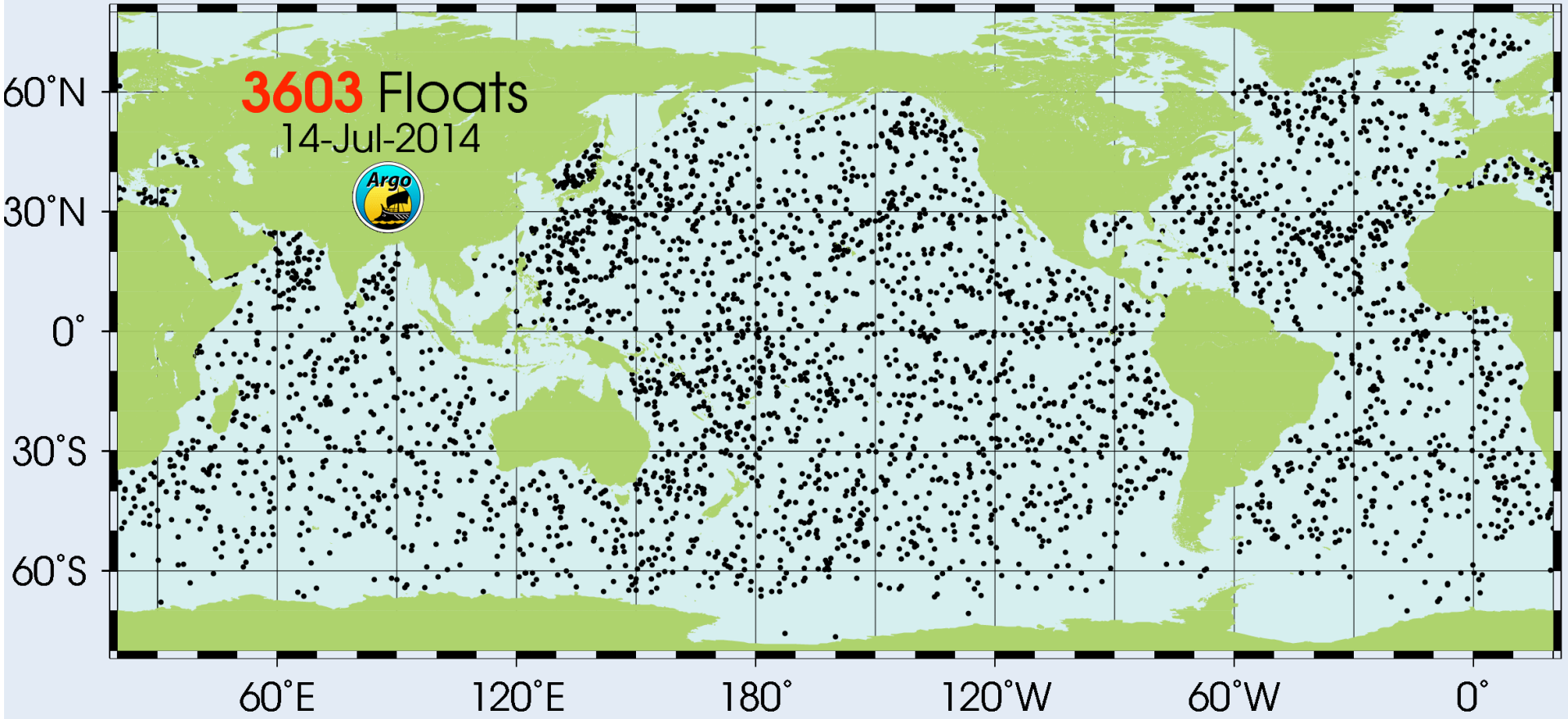
Argo as envisioned in the 1998 Argo Design document:

First Steering Team: Dean Roemmich (chair), **Olaf Boebel**, Howard Freeland, **Brian King, Pierre-Yves LeTraon**, Robert Molinari, W. Brechner Owens, Stephen Riser, **Uwe Send**, Kensuke Takeuchi, Susan Wijffels.

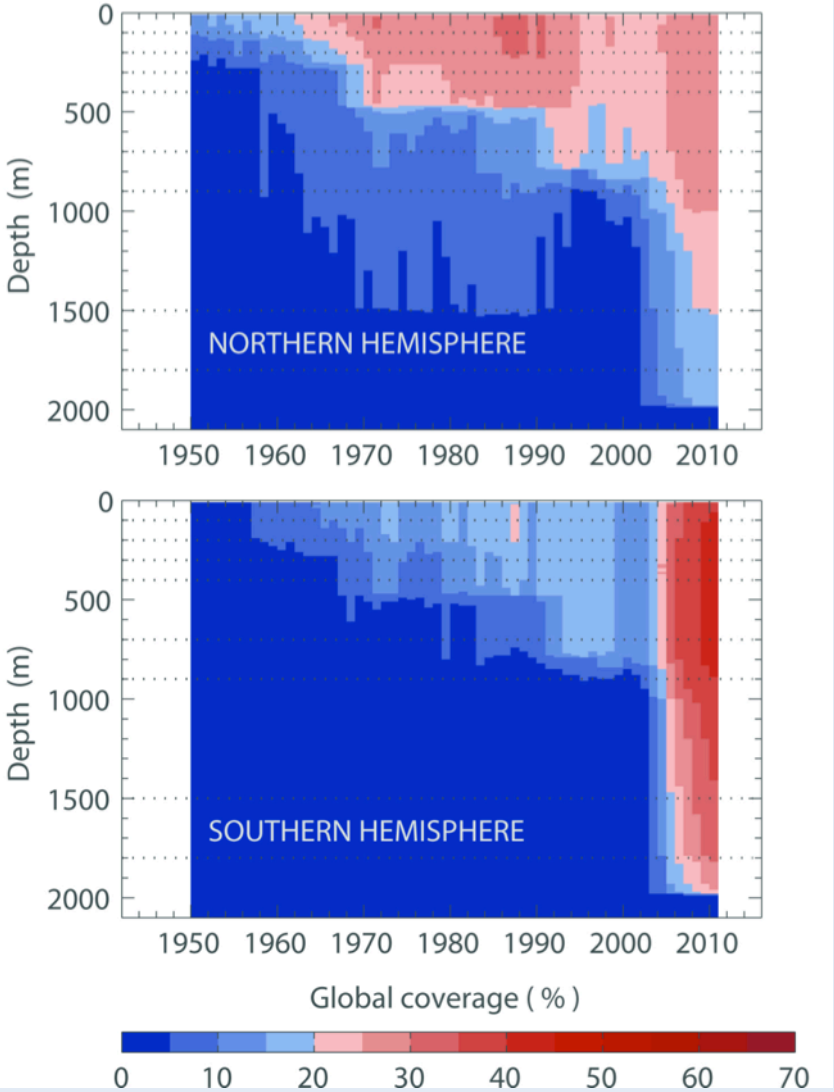


3300 randomly distributed floats at 3º x 3º average spacing.
At the time we did not think we could do ice covered oceans and marginal seas : **3000 float array**

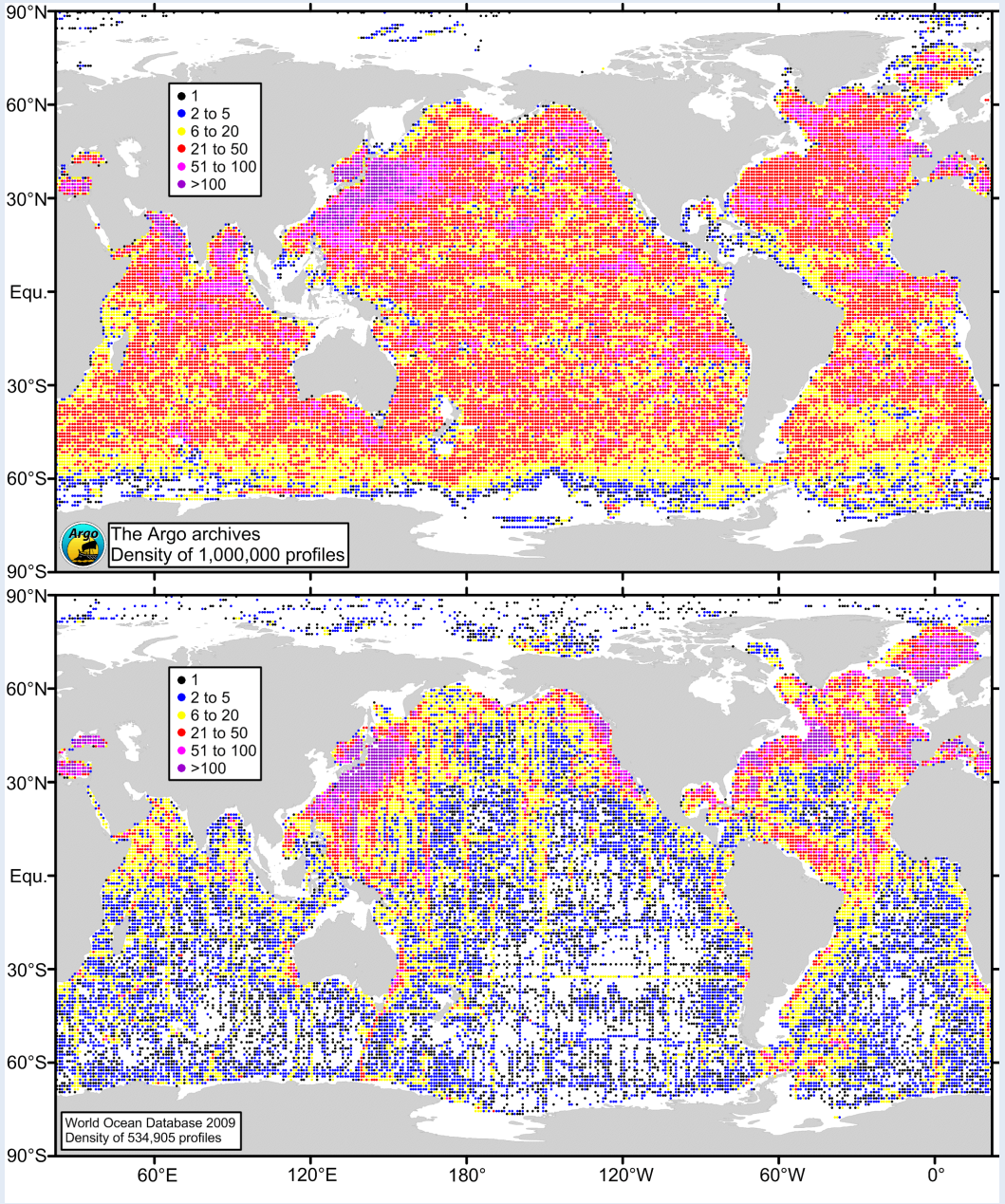
Around 10 years later……
Argo – the real thing



A step change in coverage

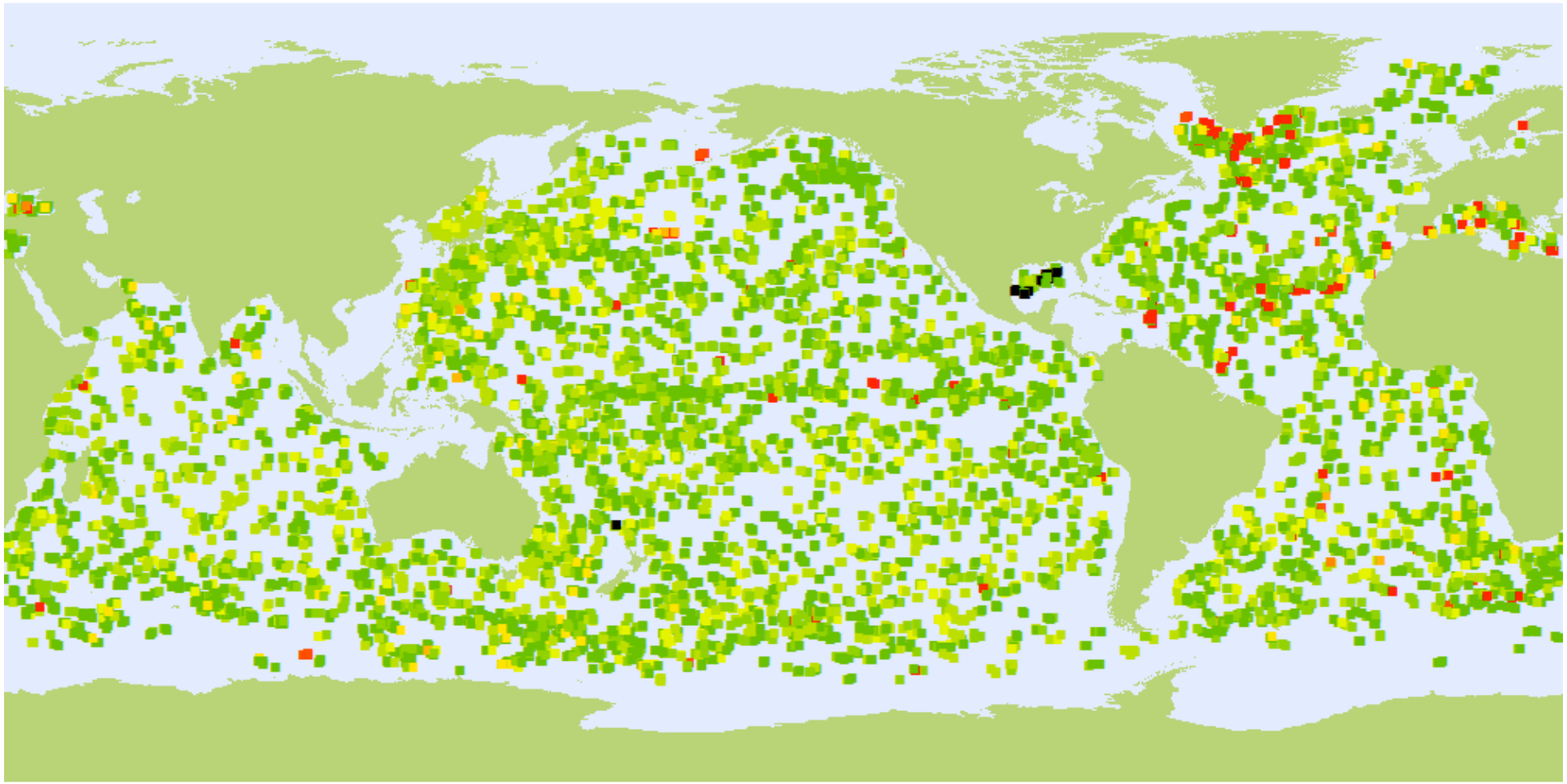


From Catia Domingues



From Howard Freeland

Data delivered within 24 hours



Serving forecasting and research

- Data management: completeness, quality, timeliness.

While the Argo data management system evolved from that of the upper ocean thermal networks, its subsequent development has been groundbreaking and original. Argo data management is now the model emulated by other observing systems.

- Stability and accuracy of salinity

Because of the slow drift of SBE salinity sensors, a large fraction of non-drifting profiles is available for DMQC of those that do drift. Otherwise, there are not enough shipboard CTD profiles to adjust Argo salinity on a global basis.

Salinity stability: > 250,000 profiles (flag=1, > 1000 dbar) through DMQC as of June 2010.

After 100 cycles, nearly 90% have adjustment < 0.01 psu.

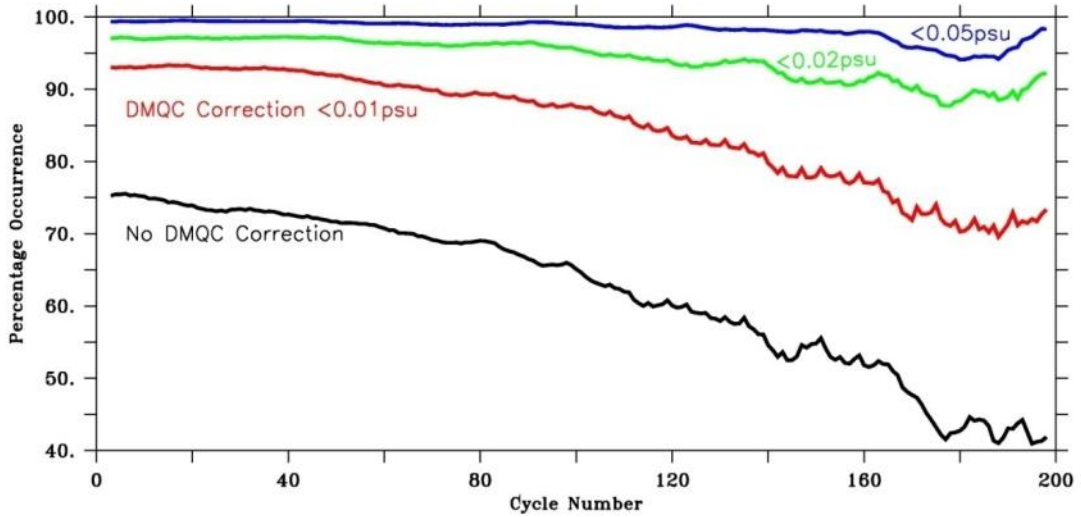


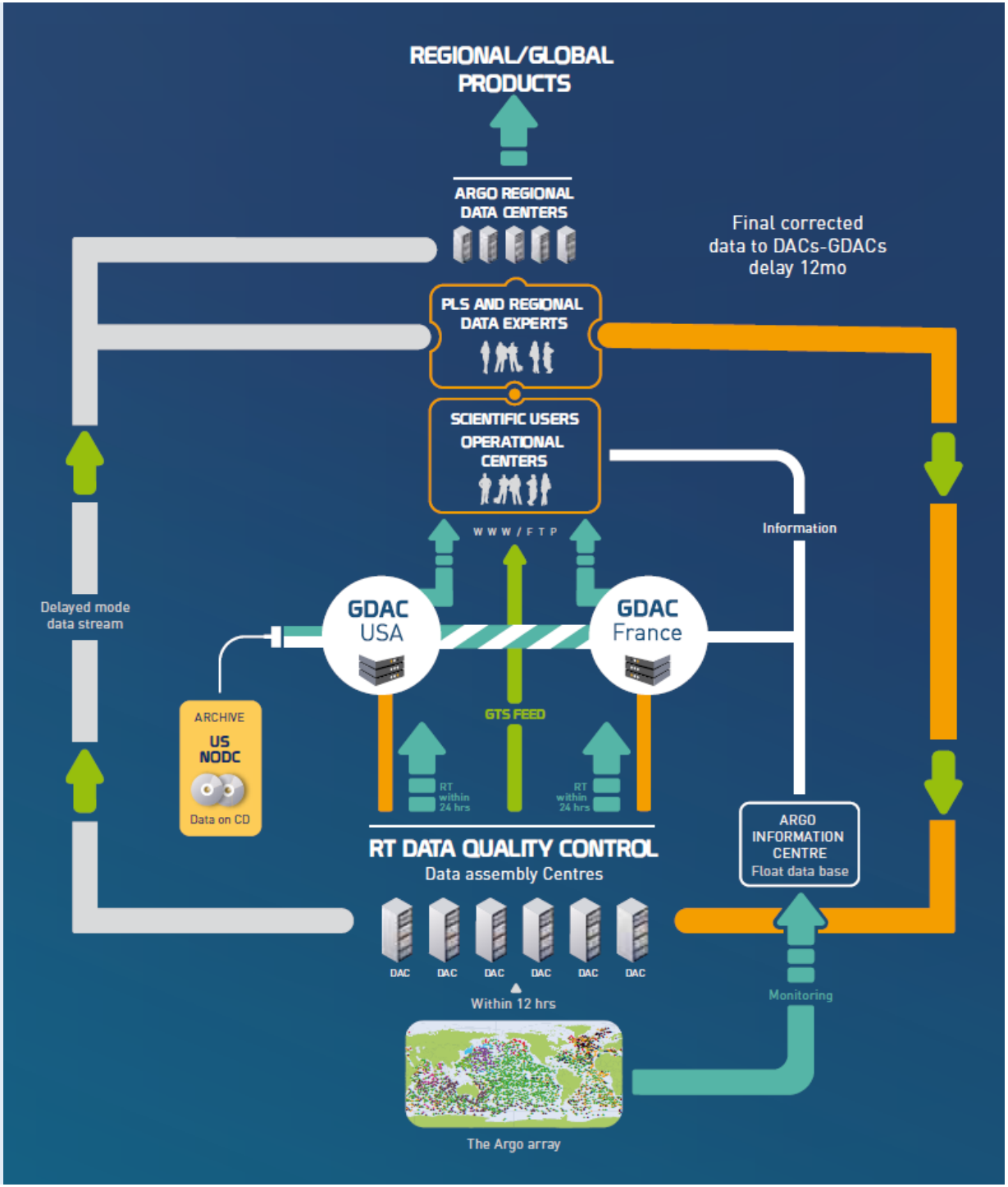
Fig by J. Gilson

Argo data system: delivering to forecasting and research

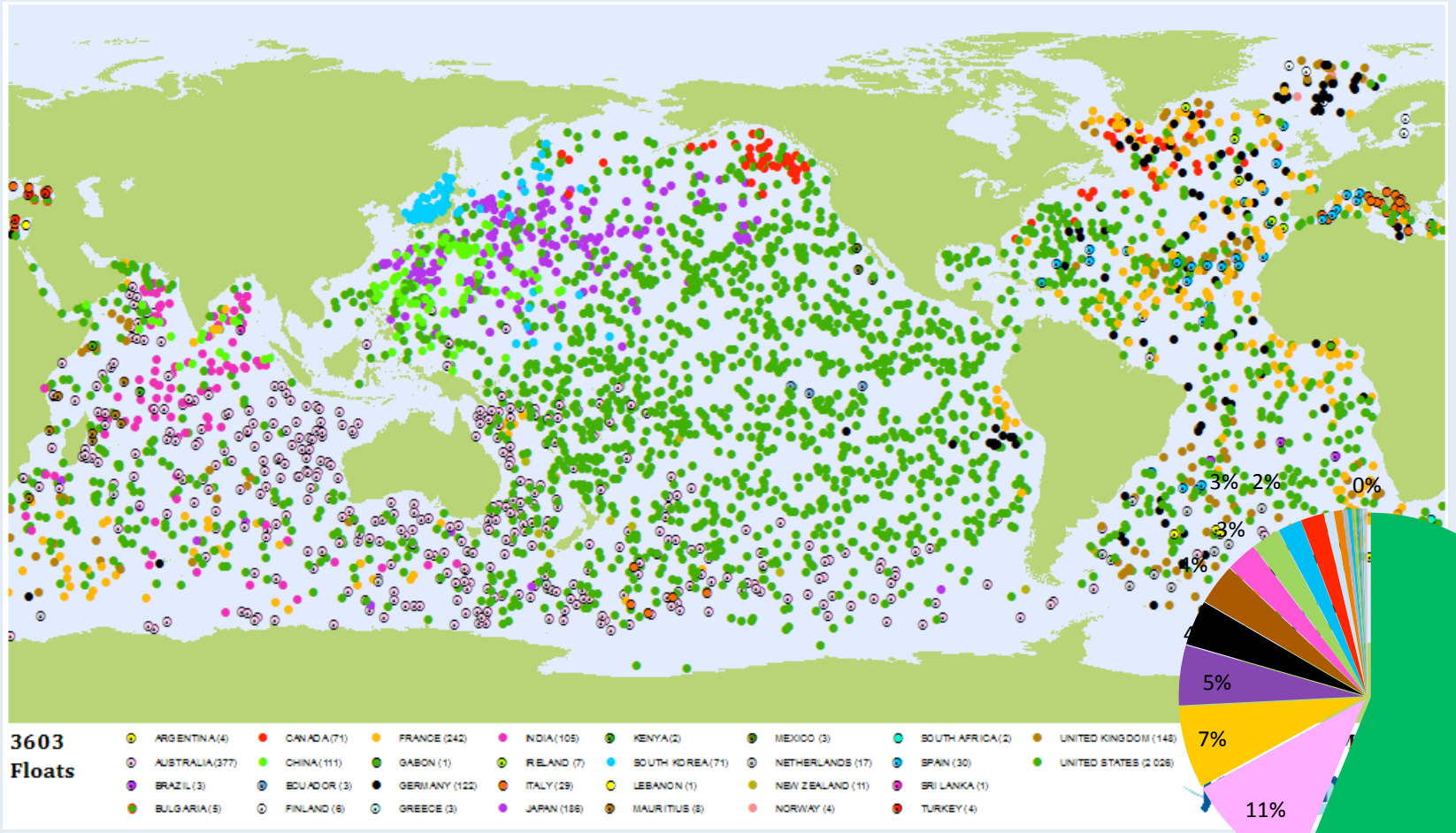
QUANTITY AND SPEED

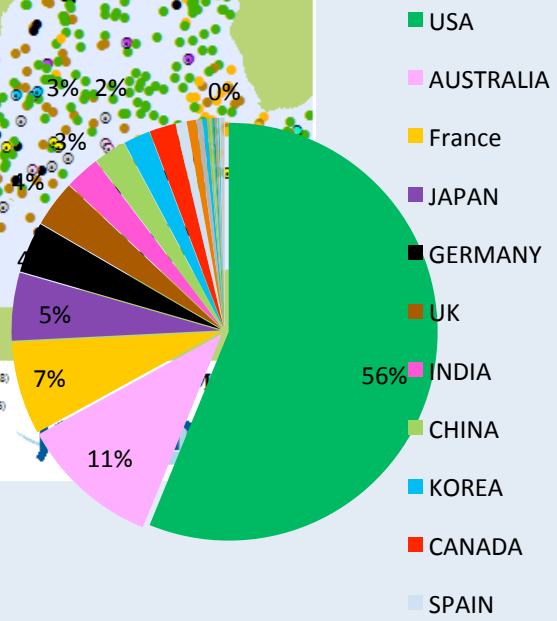
QUALITY AND COMPLETENESS

European partners have been central to the leadership, design and implementation of the Argo data system



Key to Success: strong international co-operation





How will Argo expand for new objectives?

Incremental expansions:

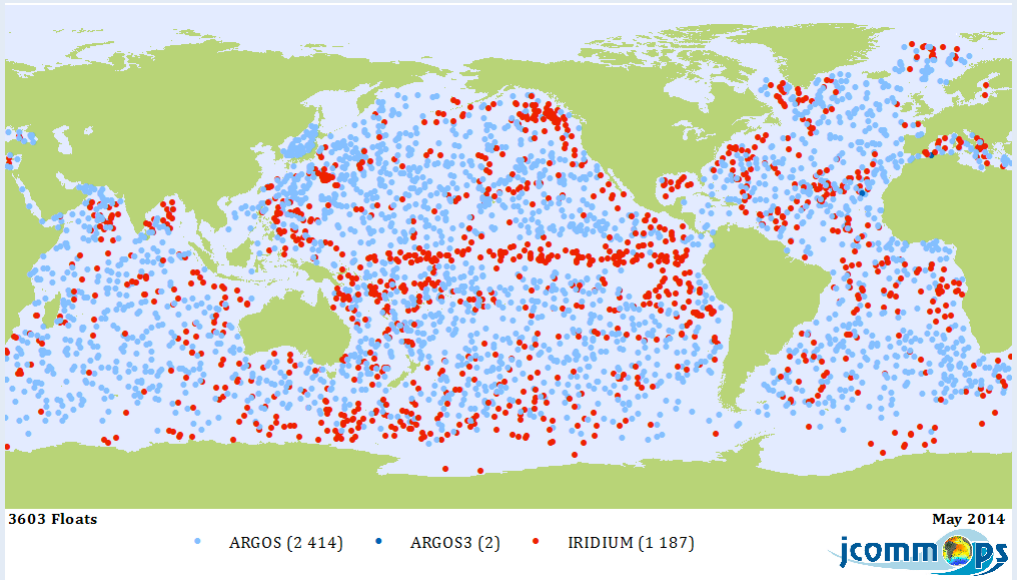
- High latitudes and marginal seas (already begun).
- Improved surface layer sampling.
- Enhanced vertical resolution.
- Active array management.
- Equatorial enhancements

Via 2-way high bandwidth communications

Major expansions:

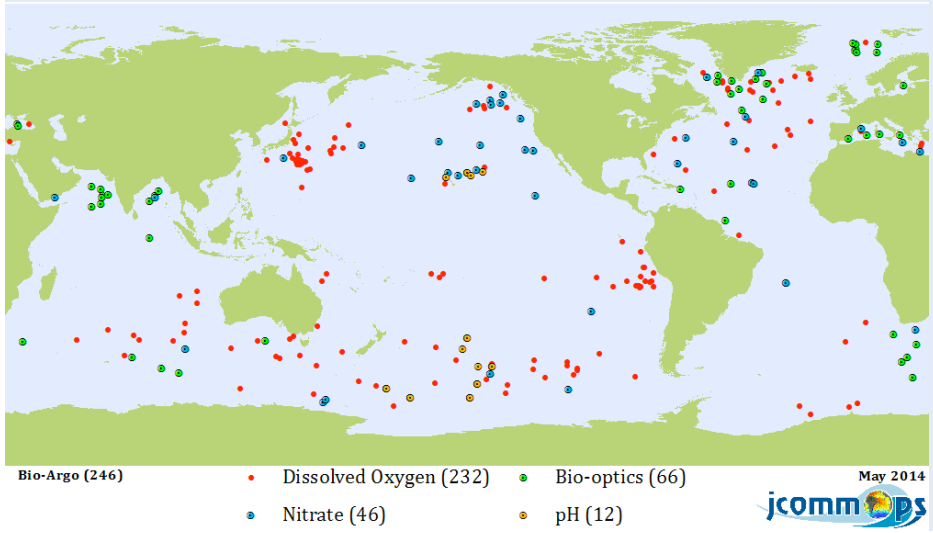
- Deep ocean profiling.
- Multidisciplinary sensors.
- Boundary currents.

Around ~33% of the array is now returning high resolution profiles using high-band-width satellite communications



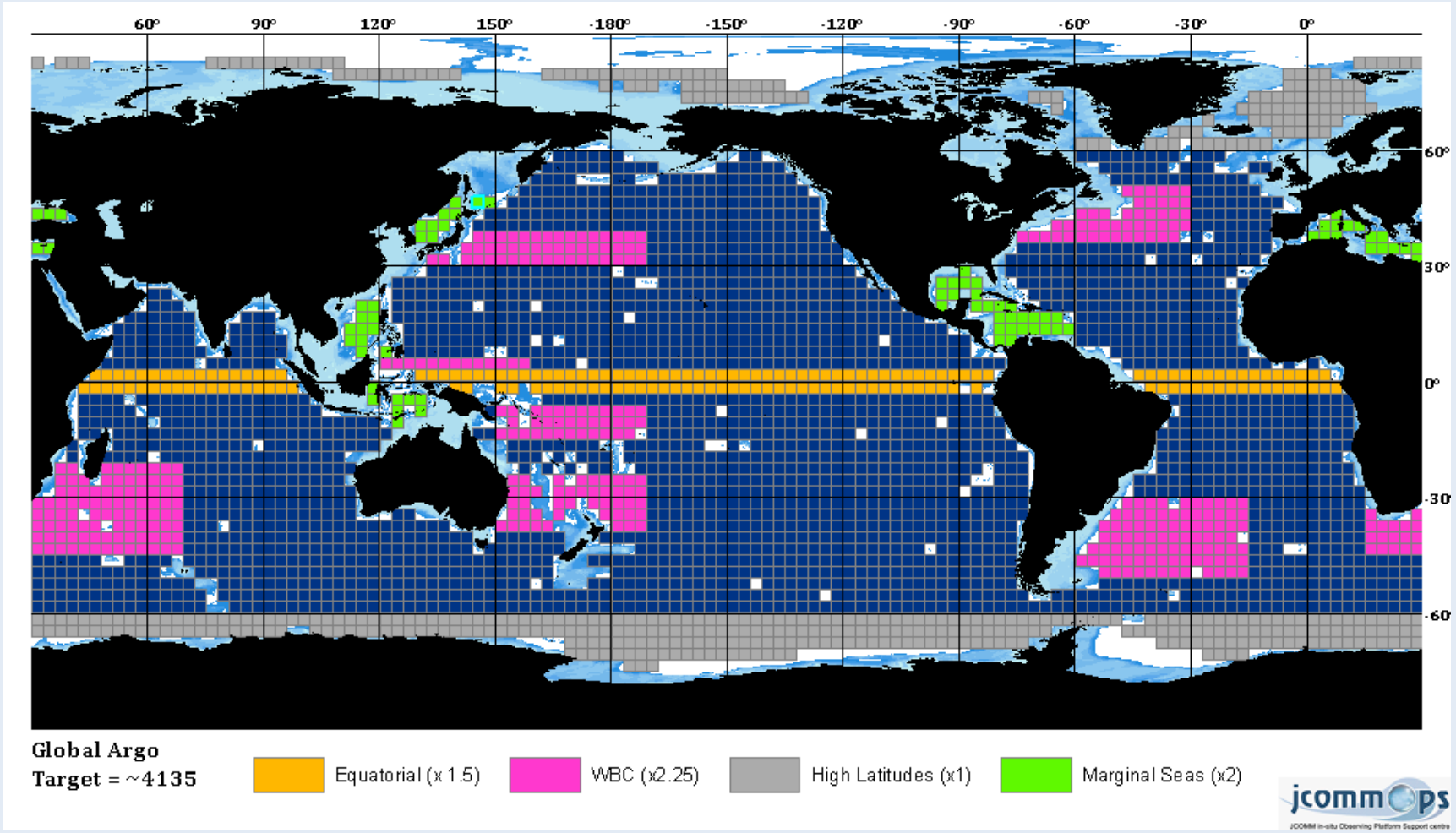
Issues for expanding Argo:

- Expansions should not go forward without proportional new resources (*in manpower, including data management,* and *floats*).
- Argo's evolution must maximize the value of the integrated ocean/climate observing system. How can this best proceed i.e. for Argo and gliders, Deep Argo and repeat hydrography, etc?
- Additional sensors beyond T,S increase Exclusive Economic Zone sensitivities and reduce chances for international consensus on global deployment.
- Deep Argo and Multi-sensor Argo both present challenging technology development problems.
  - ➢ Deep Argo may be resource-limited (cost per profile?).
  - ➢ Multi-sensor Argo may be manpower limited (complex data challenge).

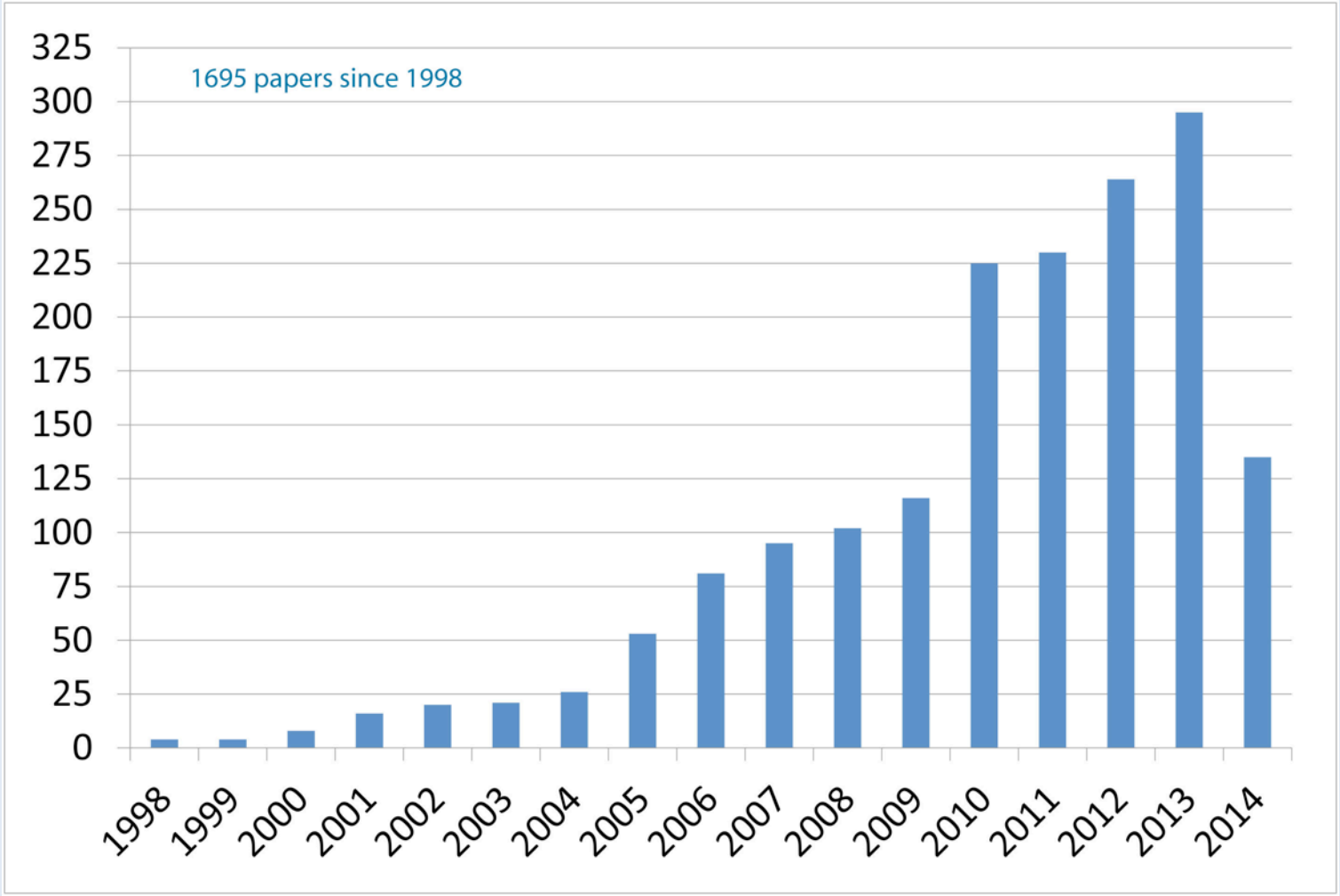


Argo floats with oxygen, bio-optical,pH and nitrate sensors

A new design for ‘global’ Argo is being developed



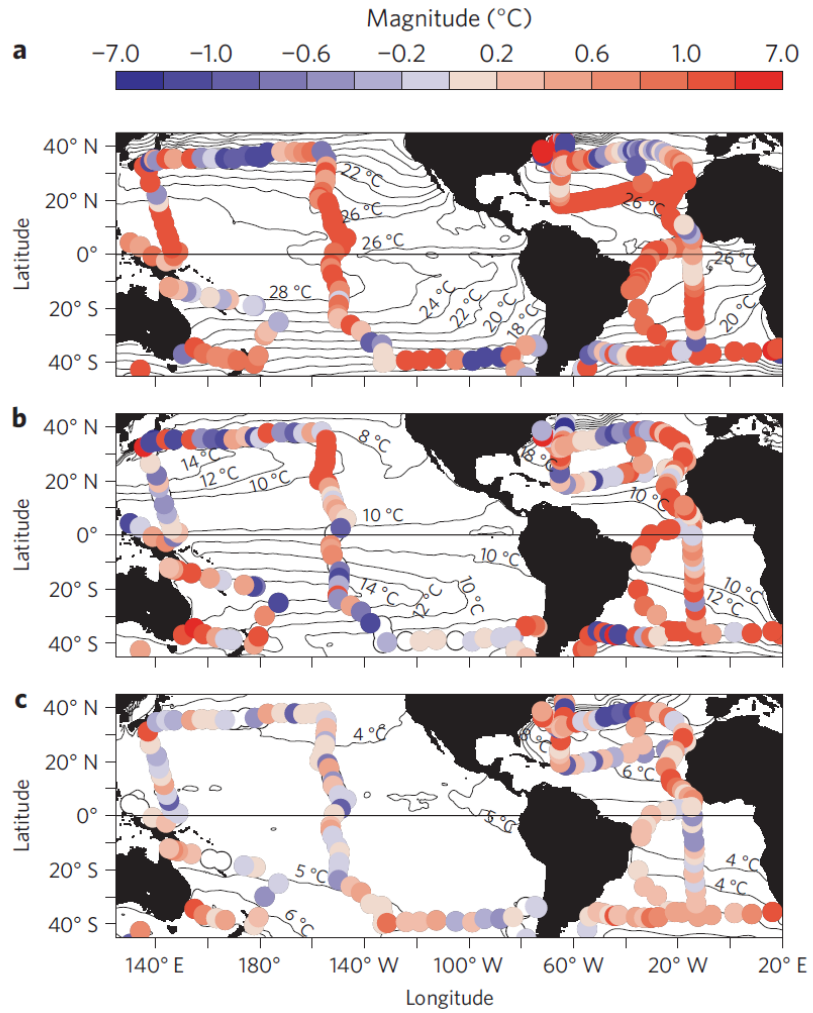
Research Community uptake is now strong

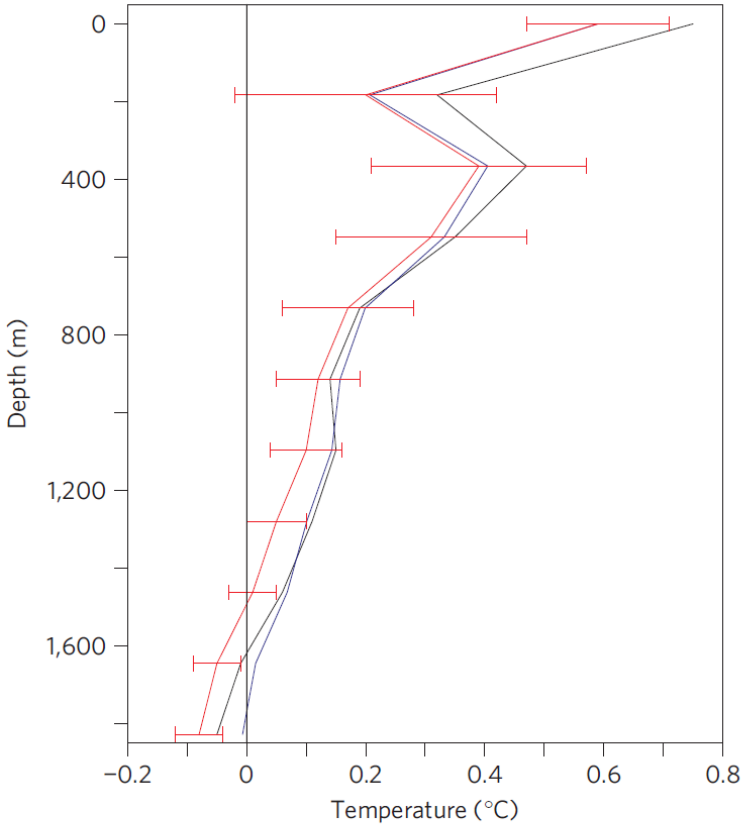


http://www.argo.ucsd.edu/Bibliography.html

Argo(2004-2010)-HMS Challenger (1872-76)

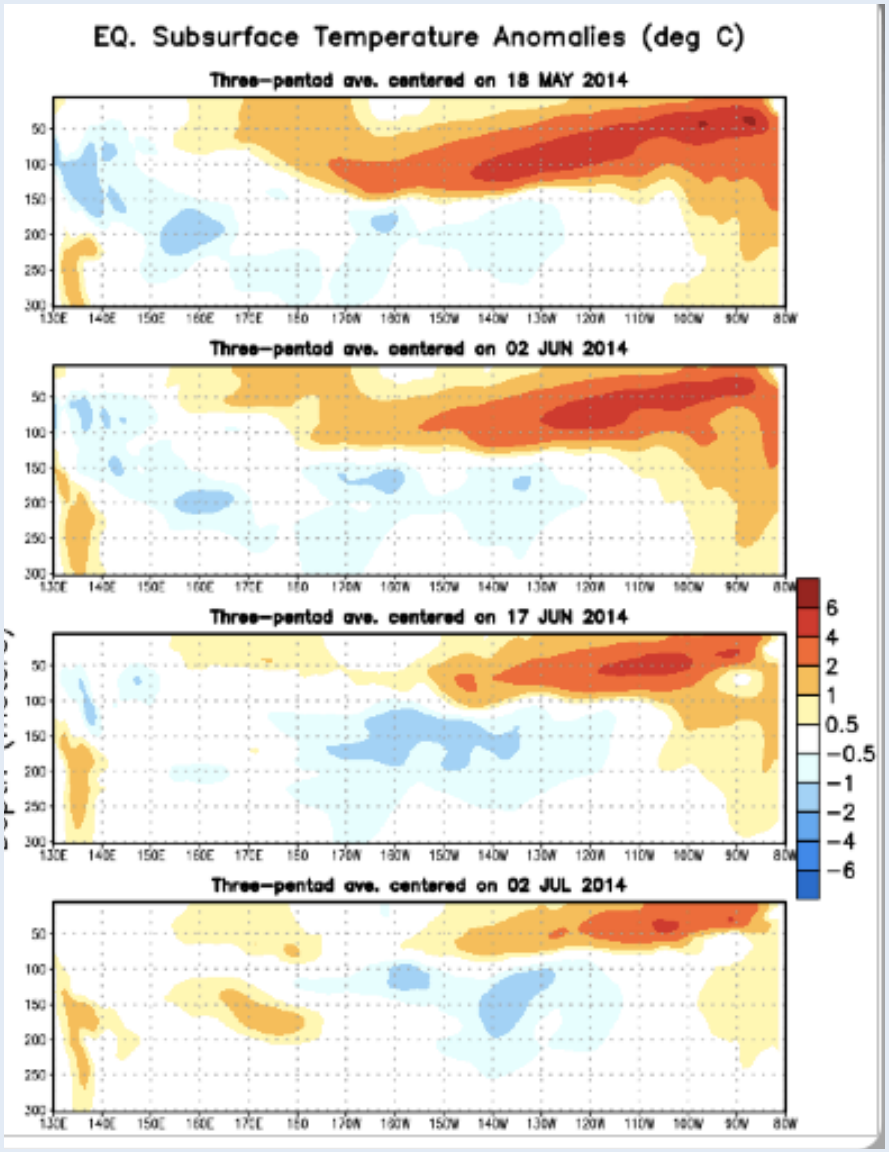
135 years of warming

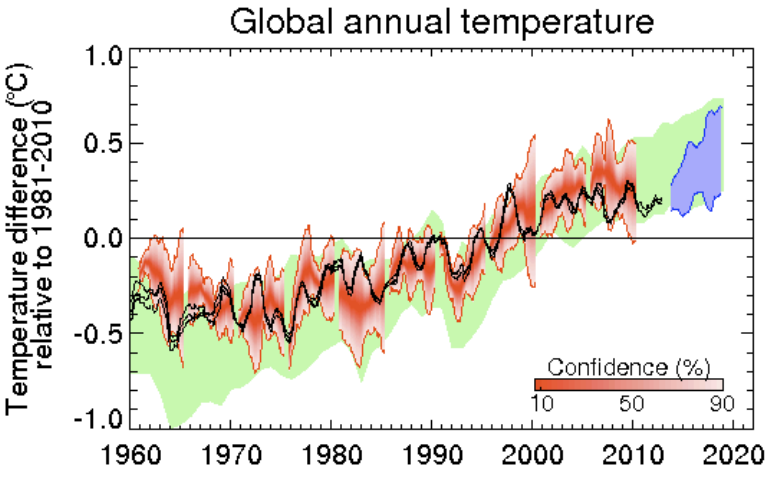


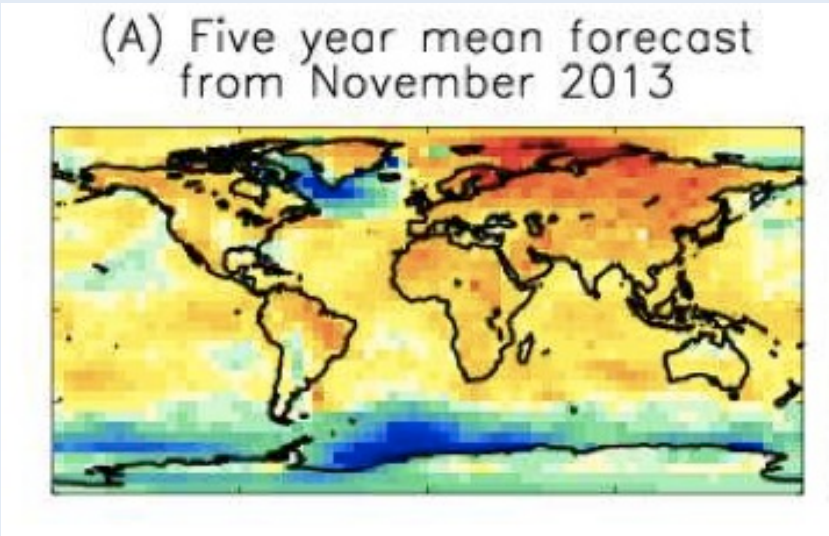


Roemmich, Gould and Gilson, NCC, 2012

Argo underpins operational climate forecasting

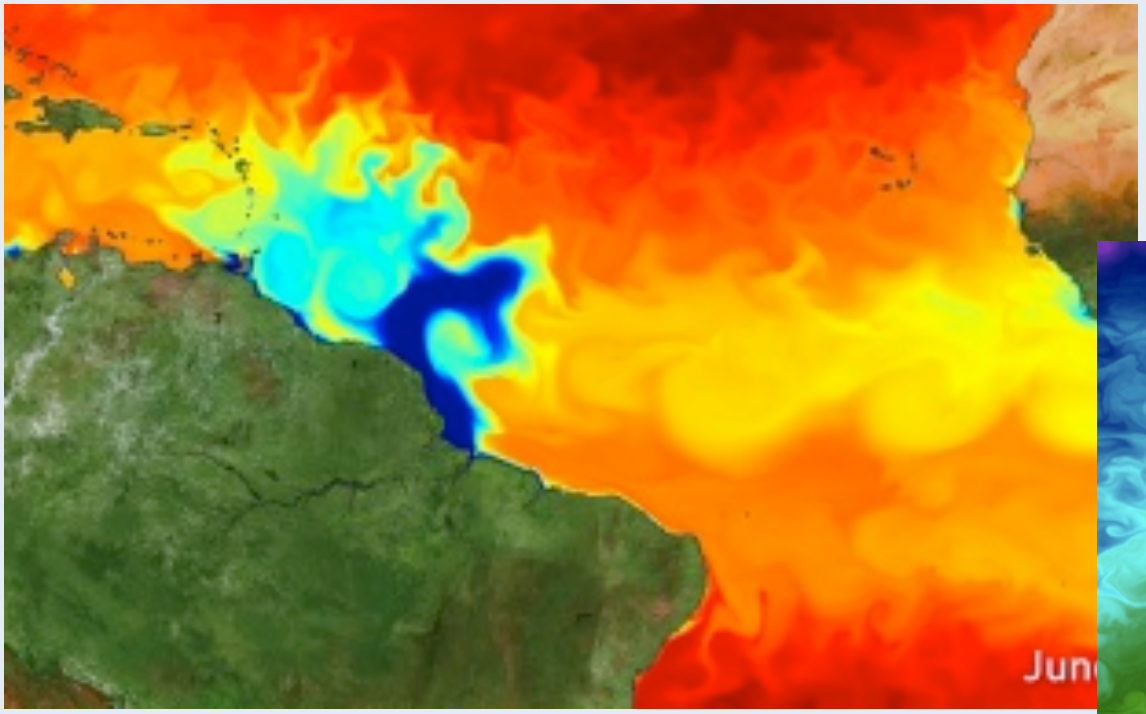




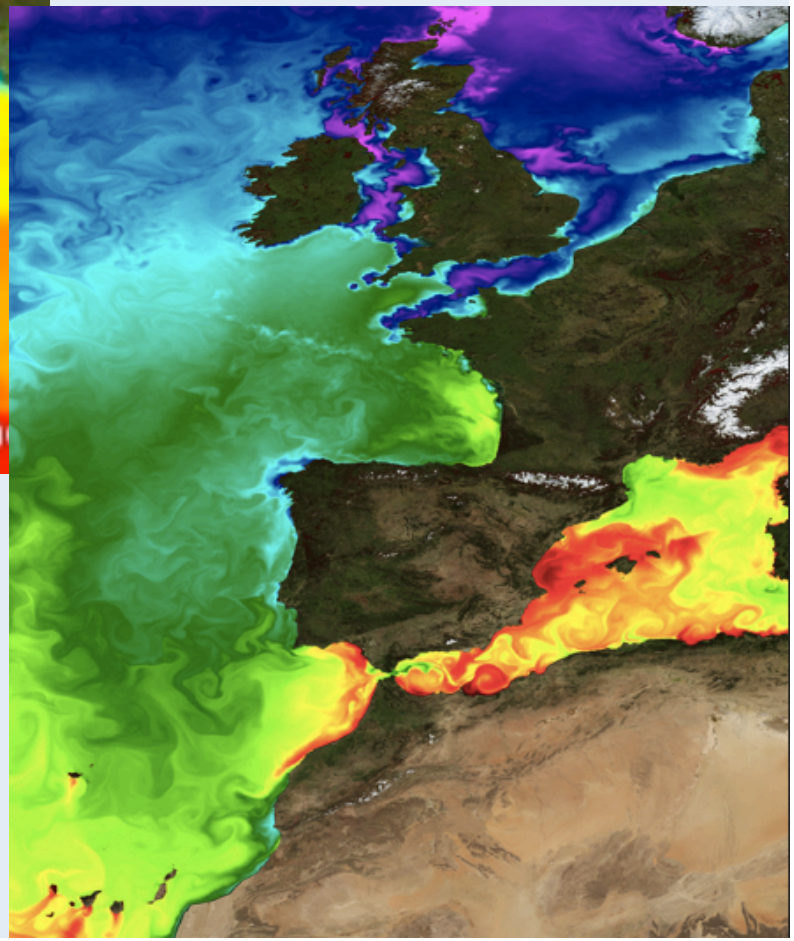


www.metoffice.gov.uk

European uptake of Argo for ocean forecasting is strong



From myocean.eu



From mercator

Summary

Europe has encompasssed foundation partners of the Argo project - designing and implementing todays system.

Argo has achieved or surpassed its original objectives

It is enabling a new view of the ocean, its change and variability and its role in climate, allowing us to quantify and explore processes that have been poorly known to date

It is underpinning new ocean and climate forecasting services

Future:

A stronger base –great diversity in national contributions. EuroArgo is an essential part of making core Argo more robust and secure

Evolution to a trully 'global' design

Extending into new BGC parameters and application areas

Extending into the deep ocean

Thank you

Acknowledgements

- The Argo Steering Team, Argo Data Management Team, past co-chairs (Howard Freeland), past Director (John Gould)
- The many, many agencies and nations that contribute to Argo in ways both small and large.

www.argo.net