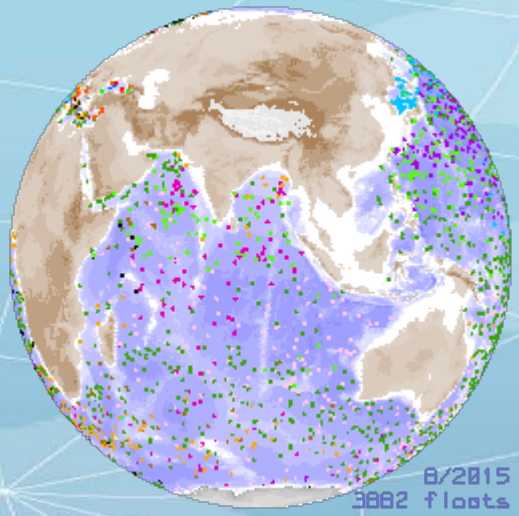
On behalf of Argo project office

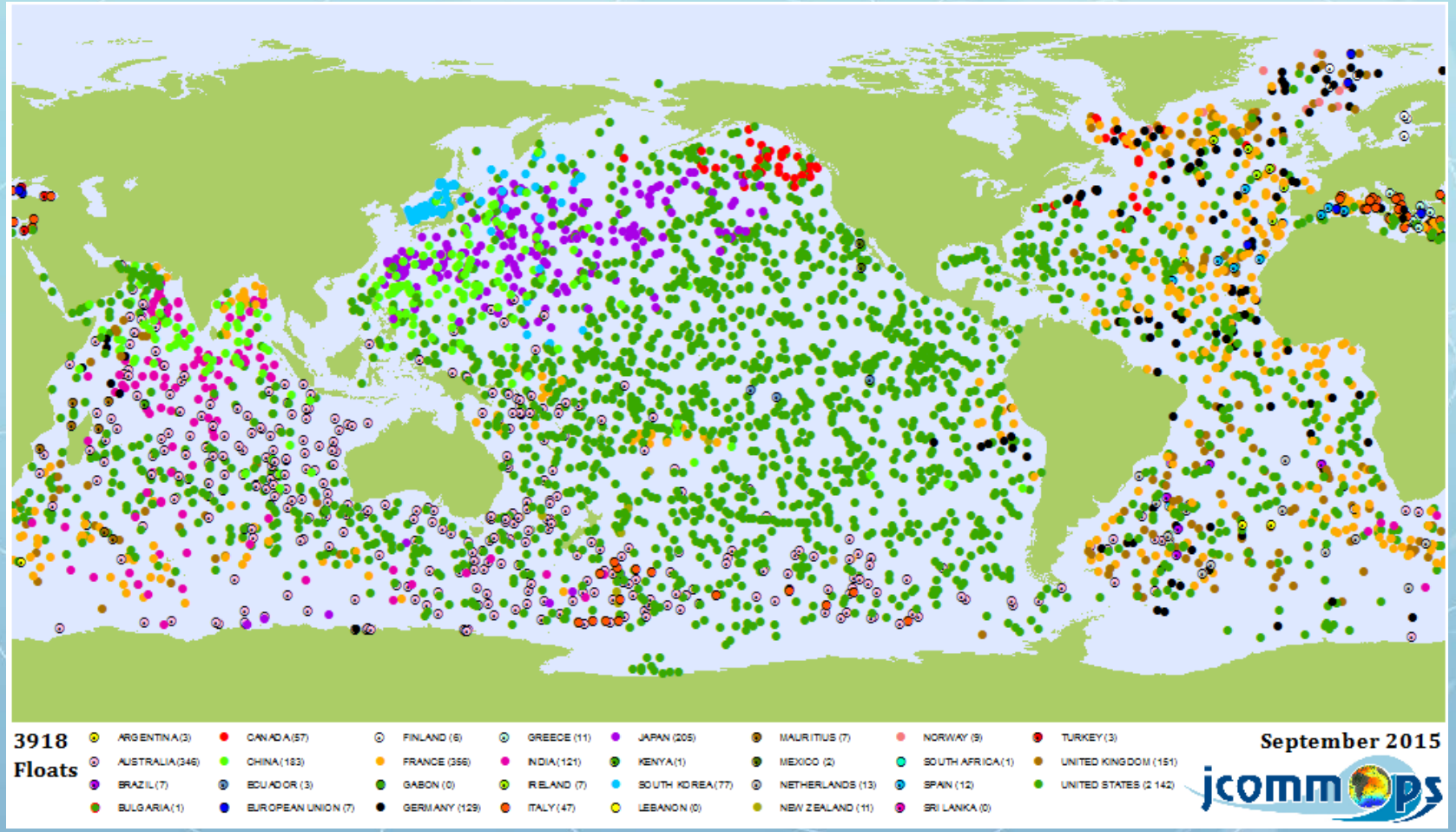
PICES meeting
22 Oct 2015

Progress of global Argo



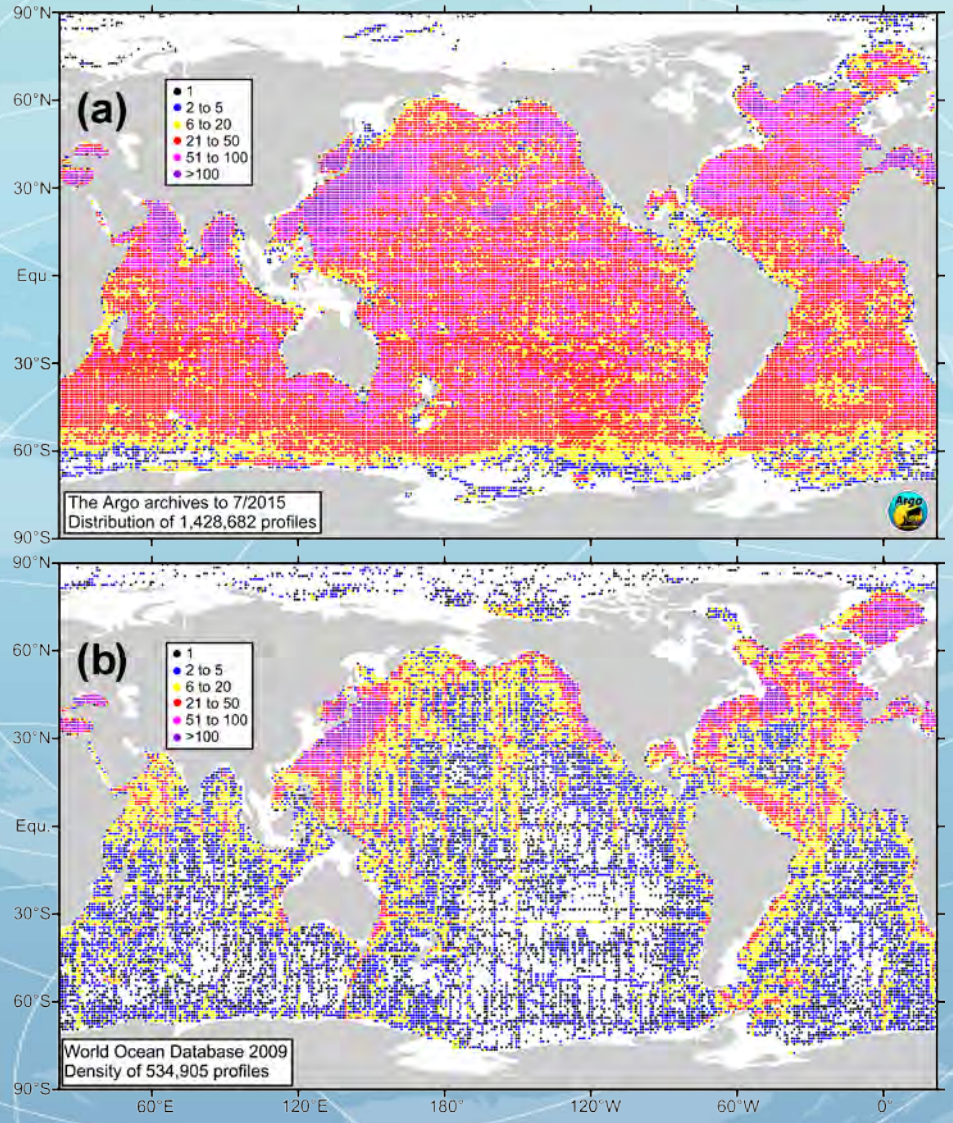
Zenghong Liu, Jianping Xu
China Argo Real-time Data Centre
Second Institute of Oceanography, Hangzhou, P. R. China
Email: liuzenghong@139.com

Status of the Argo array



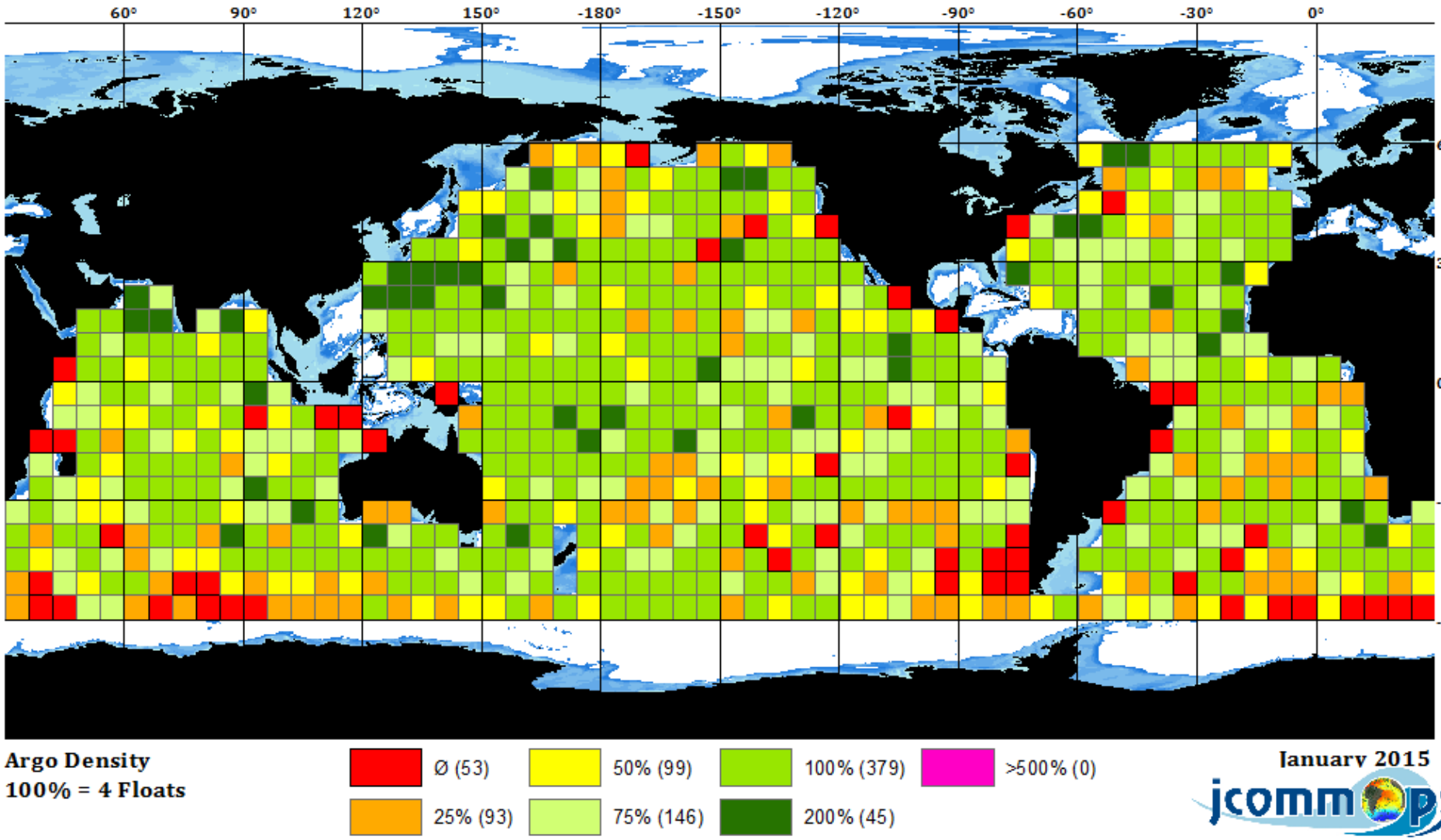
This lists 31 float-deploying nations. This is, of course, not entirely true, some of these are donor programs. However 22 are real procuring and deploying nations. 940 (900) floats were deployed last year, total deployments since 2000 = 10,929 (~9000) of which 1/3 are still reporting >3900 (>3700) floats are now active.

Status of the Argo array



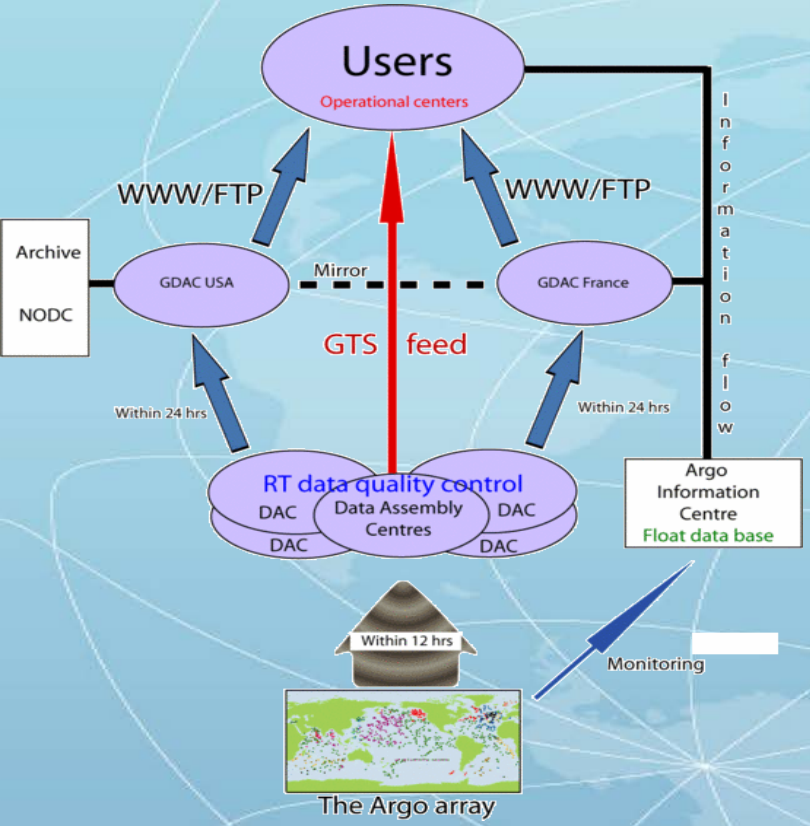
In Nov. 2013 Argo gathered its one millionth profile and is now well on its way towards the second million likely in 2018.

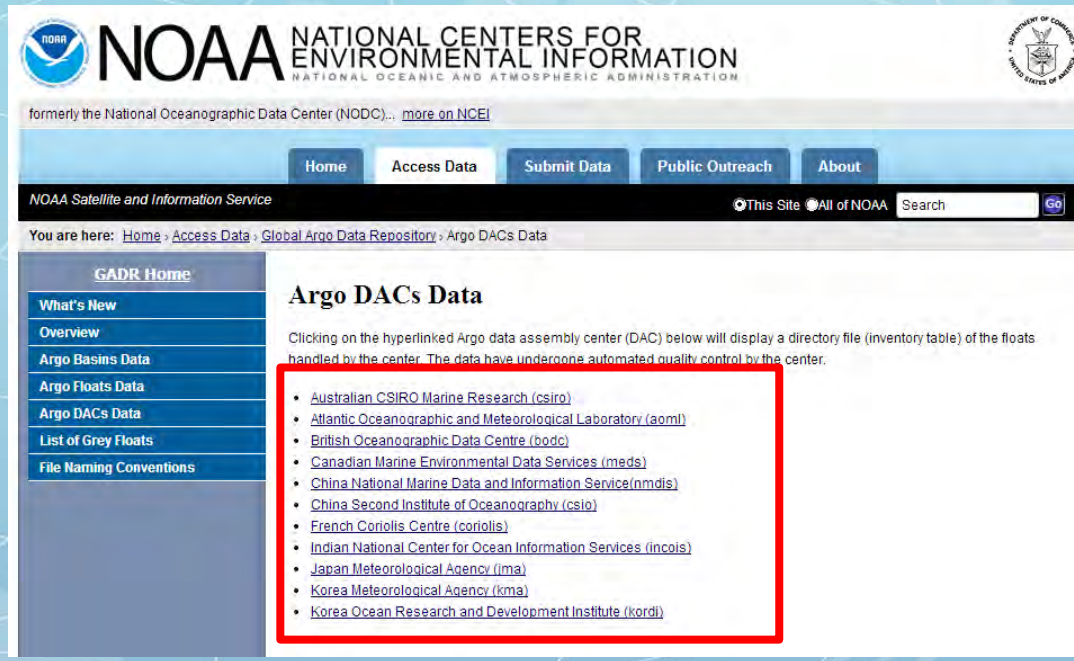
Status of the Argo array



The density of floats in the original mission, some gaps do persist and probably always will persist, but we are doing better than in 2013 (OCG-5).

Argo real-time data streams





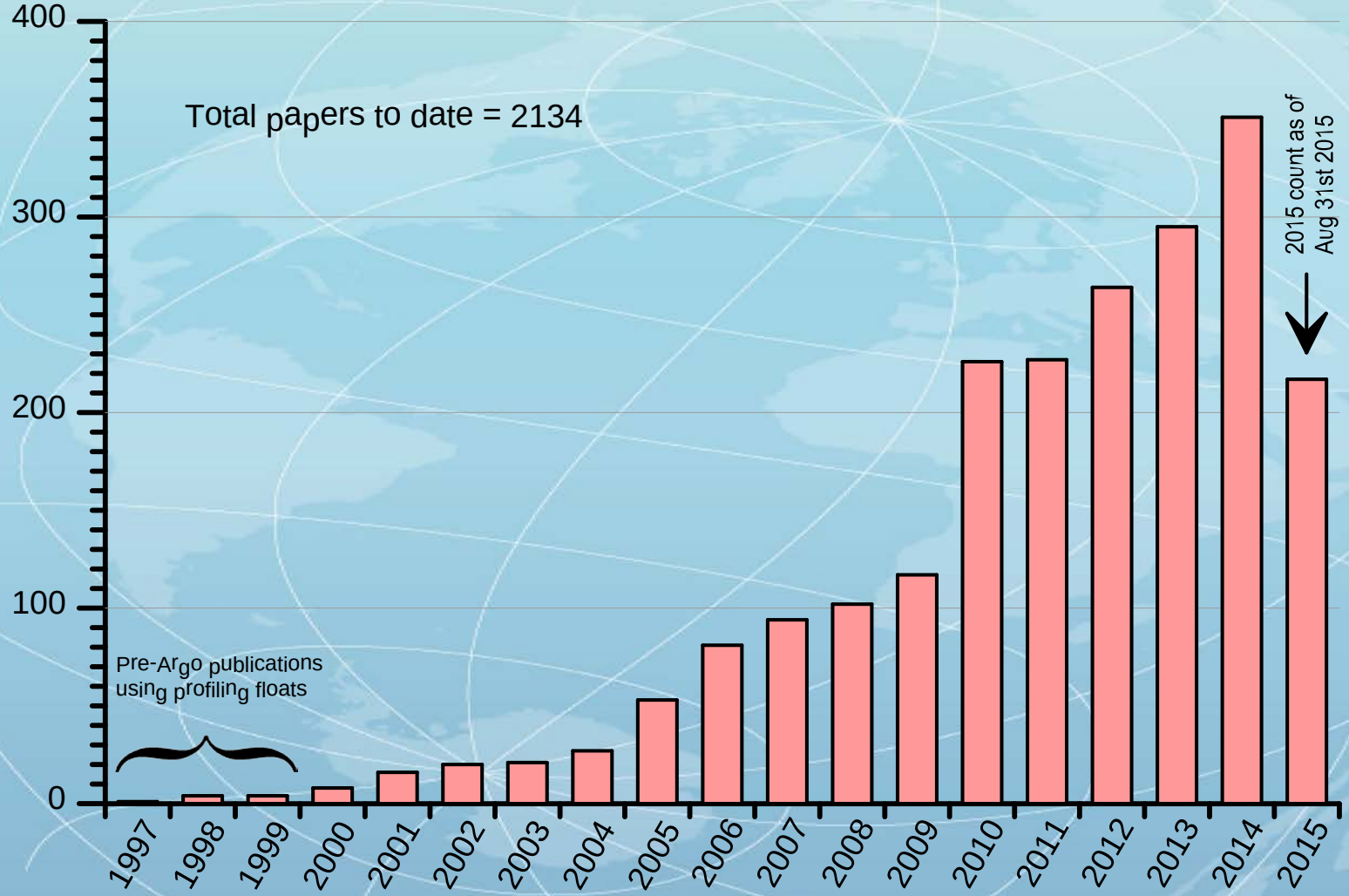
11 DACs

Argo has setup an efficient real-time data stream including one Argo information centre, 11 data assembly centres and 2 global data assembly centres. Users are able to get data either from WWW/FTP or GTS.

Argo data management

- 18 real-time quality control tests (24 hrs).
- delayed-mode quality control including pressure correction, thermal lag correction and salinity correction using historical CTD dataset (for floats older than 6 months).
- uniform NetCDF format for submission.

Argo Data Utilization



Argo continues to be used in a broad range of basic research spanning time scales of days to a century. More than 2000 papers have been published using Argo data from its begininng.

Argo Data Utilization

Argo products

Global fields

Institution	Documentation	Gridded field description	Data Source	Spatial resolution	Vertical resolution	Temporal coverage	Temporal resolution	Access
Coriolis		Global gridded NetCDF dataset produced by optimal interpolation in near real time (ISAS)	Argo plus others	1/2 degree global	250 levels to 2000 m	Since 2010-01-01	weekly	data access website
Coriolis		Global gridded NetCDF dataset produced by optimal interpolation yearly (CORA3)	Argo plus others	1/2 degree global	250 levels to 2000 m	1950 - 2013	monthly	data access website
CSIRO		Global gridded netCDF dataset produced by LOES filter from all profile data including Argo but excluding bathythermograph. Also seasonal dynamic height and MLD. "CARS2009"	Argo plus others	0.5 degree global	79 levels to 5500 m	1930 to May 2009	Mean and seasonal sinusoids	Instructions via "Access" section of website
CSIRO		Global gridded netCDF dataset produced by LOES filter from all Argo. Also seasonal dynamic height and MLD. "CARS2009"	Argo only	0.5 degree global	66 levels to 2000 m	All Argo, updated ~3 monthly	Mean and seasonal sinusoids	Instructions via "Access" section of website
IFREMER/LPO		ISAS13: Global gridded NetCDF monthly fields and profile data base. Climatology 2004-2012.	Argo plus others	1/2 degree Merc	151 levels to 2000 m	2002 - 2012	monthly	website email for data access: fabienne.gaillard@ifremer.fr
IPRC		Global gridded ASCII and NetCDF dataset produced by variational interpolation from Argo only profiles (Aviso altimetry for Absolute Dynamic Topography fields was used)	Argo plus Aviso altimetry	1 degree global	27 levels to 2000 m	Since 2005-01-01	monthly	website access
JAMSTEC		Global gridded NetCDF dataset produced by optimal interpolation from all available data including Argo. MOAA GPV (Grid Point Value of the Monthly Objective Analysis using Argo data)	Argo plus others	1 degree global	25 levels to 2000 dbars	Since 2001-01-01	monthly	website access
JAMSTEC		Global gridded ASCII and NetCDF of YoMaHa'07 (http://apdrc.soest.hawaii.edu/projects/yomaha/index.php), QC'ed Argo drift trajectories	Argo	1 degree global	1000 dbars	Average since 2001-01-01	Average only	website access

Global Argo Marine Atlas (SCRIPPS)

Extension of Argo

Hence, it is recommended that, as the required technical modifications mature, the core Argo mission should be expanded to include the high latitude oceans, marginal seas, and the deep ocean, with sampling characteristics and additional sensors to further broaden Argo applications including surface layer sampling, ocean mixing, and biogeochemical impacts of climate variability and change.

In Nov. 2009, Argo project office submitted a white paper to OceanObs'09 .

In AST-13 meeting (Nov. 2012), the extension of Core Argo mission to "global Argo" was proposed.

OceanObs'09

Ocean information for society: sustaining the benefits, realizing the potential

21-25 September 2009, Venice, Italy

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COMMUNITY WHITE PAPER 10.5270/OceanObs09.cwp.32

Argo - A Decade of Progress

Howard J. Freeland[1], Dean Roemmich[2], Silvia L. Garzoli[3], Pierre-Yves LeTraon[4], Muthalagu Ravichandran[5], Stephen Riser[6], Virginie Thierry[7], Susan Wijffels[8], Mathieu Belb♦och[9], John Gould[10], Fiona Grant[11], Mark Ignazewski[12], Brian King[13], Birgit Klein[14], Kjell Arne Mork[15], Breck Owens[16], Sylvie Pouliquen[17], Andreas Sterl[18], Toshio Suga[19], Moon-Sik Suk[20], Philip Sutton[21], Ariel Troisi[22], Pedro Joaquin V♦lez-Belchi [23], Jianping Xu[24]

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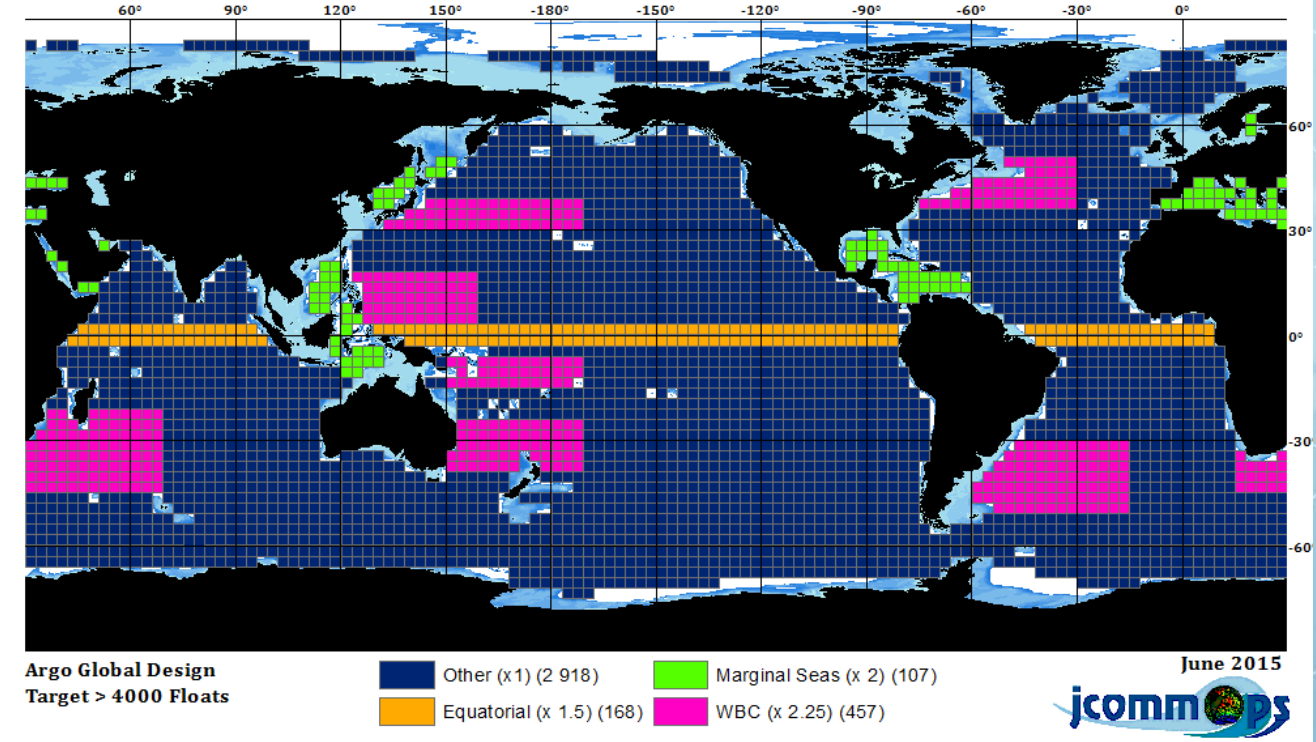
The primary goal of Argo, as enunciated in the original prospectus ([1], page 5), was to create a global network of instruments integrated with other elements of the climate observing system: -? to detect climate variability on seasonal to decadal time-scales. The targeted variability includes changes in the large-scale distribution of temperature and salinity and in the transport of these properties by large-scale ocean circulation. -? to deliver information needed for calibration of satellite measurements, and -? to provide data for initialization and constraint of climate models. To accomplish this it was proposed to deploy a large array of profiling floats measuring temperature and salinity to 2000 metres and reporting in real-time every 10 days. The proposal suggested a global spacing of 3♦ ? 3♦ which was based on (i) previous design studies from the global XBT networks, (ii) spatial statistics from satellite altimetry, and (iii) sampling experiments using WOCE hydrographic sections. The 3♦ ? 3♦ network would yield a formal error of estimation for near surface temperature of less than 0.5♦C, which was equivalent to an error in bimonthly surface heat fluxes of 15 W/m2. Such spacing required an array of 3300 instruments between 60♦S and 60♦N. The instruments were planned to sample every 10 days, a choice informed by a need for many independent samples on seasonal and longer time-scales, knowledge of ocean variability and the existence of a satellite altimeter already sampling at 10-day intervals. A decade later, how well have these initial objectives been met?

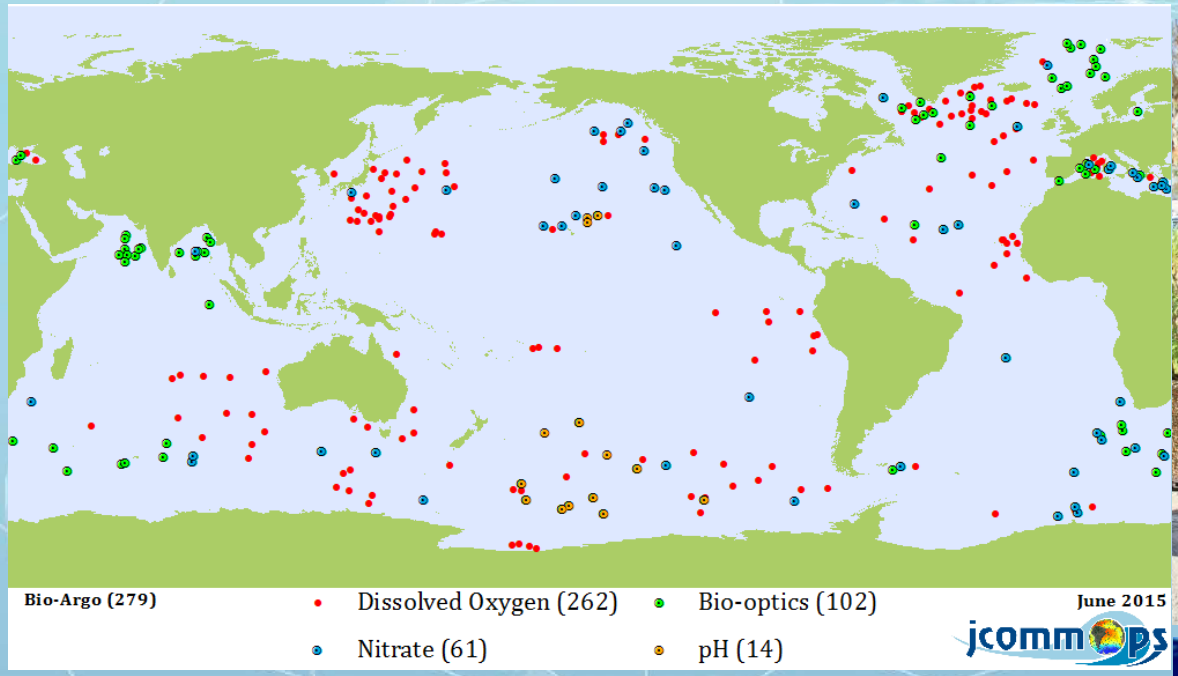
[1]Fisheries and Oceans Canada, Institute of Ocean Sciences, 9860 West Saanich Road, PO Box 6000, Sidney V8L 4B2, B.C., Canada
[2]Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, San Diego, La Jolla, CA 92093-0225, USA
[3]NOAA/AOML (National Oceanic and Atmospheric Administration/Atlantic Oceanographic Marine

Extension of Argo



Global Argo design >4000 floats.
Extension to high latitudes, enhanced observing in marginal seas, equatorial, and western boundary currents.

Extension of Argo

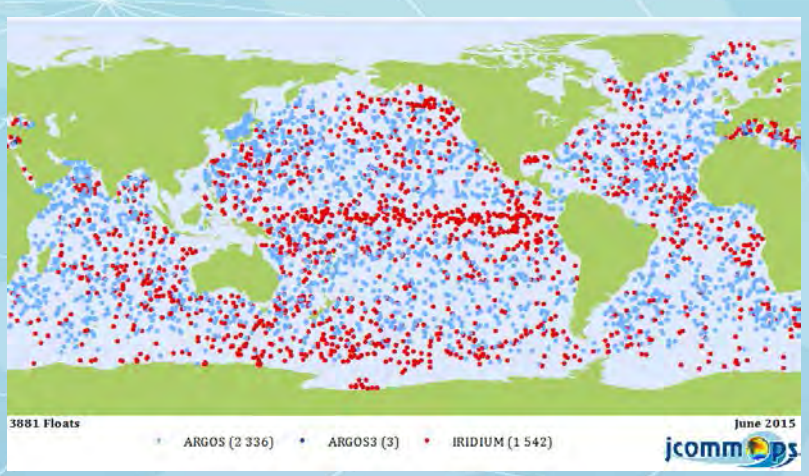


Expand Argo to deep ocean (>2000 m), biogeochemical

Extension of Argo

Argos-3

Iridium



Satellite technology

Currently 1545 floats = 1542 Iridium and 3 Argos-3, or 39.8% of the Argo array is now delivering profiles with high bandwidth, this permits:-

1) High vertical resolution, 1000 levels compared with 76.
2) Short surface residence time, less fouling, beaching and divergence.
3) It is the high bandwidth that makes possible the sensors that Bio-Argo needs

Float technology

APEX
USA

SOLO
USA

PROVOR
France

ARVOR
France

NINJA
Japan

NAVIS
USA

NOVA
Canada

NEMO
Germany

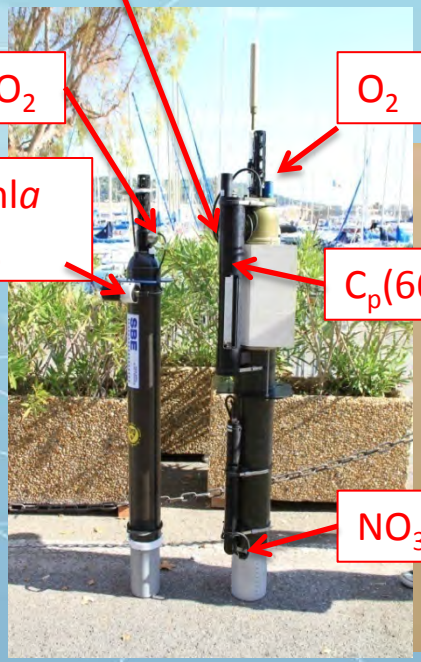
HM2000
China

Float technology

Bio-Argo

CDOM
Chl*a*
b_{bp} (700)

Eds (λ)
PAR



O_2

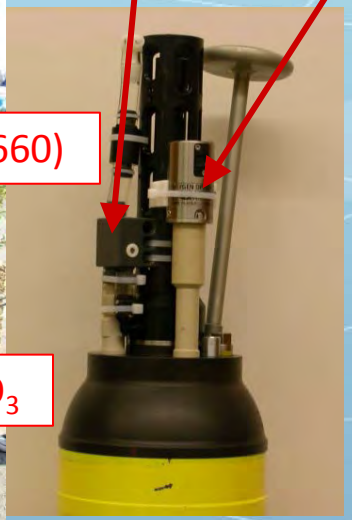
O_2

Chl*a*
b_p

C_p(660)

NO_3

ISUS (embedded in CTD outflow)



Optode O_2 sensor

FLBB sensor

pH sensor and reference electrode

Float technology

Deep Argo (>2000 m)

Deep APEX

Deep NINJA

Deep ARVOR

Deep SOLO

SBE61 CTD for deep Argo

Float technology

- There are 4 floats existing that are able to sample deeper than the 2000 decibar standard global Argo mission calls for, all are still in their testing phases.

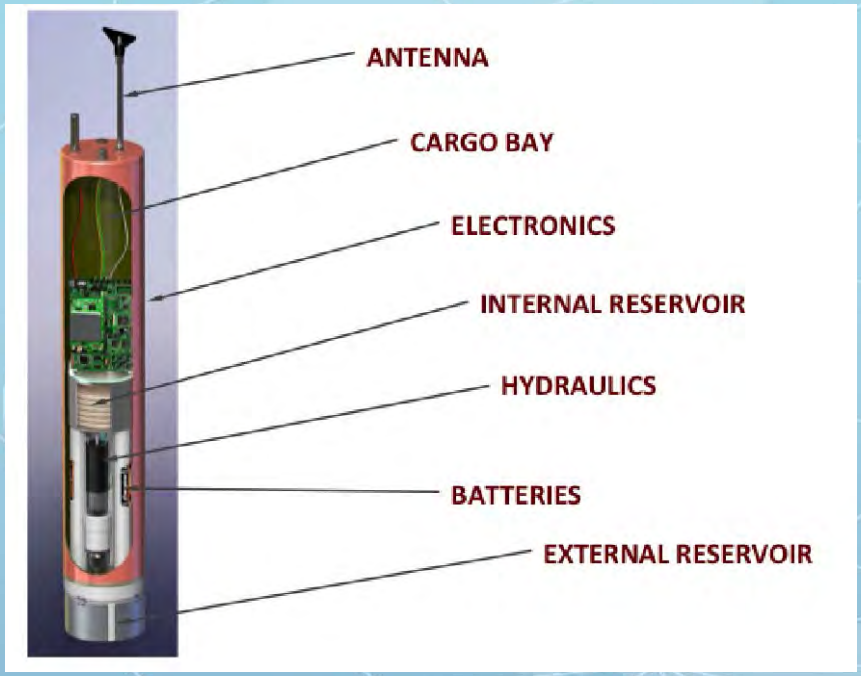
1) Deep-Ninja is functioning and operates to 4000 decibars.
2) Deep-PROVOR is also functioning to 4000 decibars.
3) A few deep-SOLO floats exist and can function to 6000 decibars.
4) A few deep-APEX floats exist, but so far none have been launched. They are designed for 6000 decibars.

- The 6000 decibar floats use the new SeaBird-61, which is still being tested.

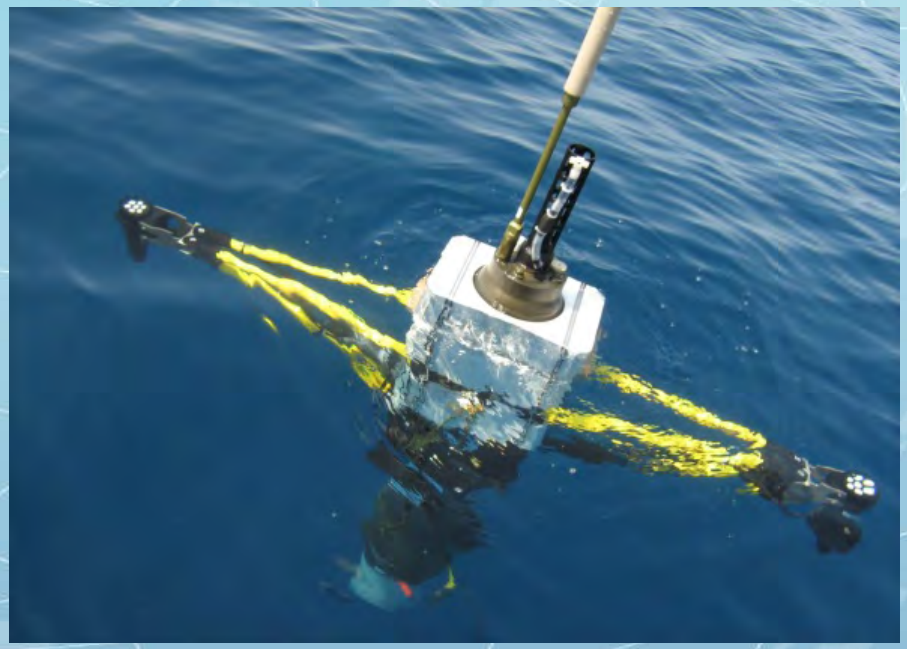
- Further work must continue on prototype floats before we can consider designing a deployment plan.

Float technology

ALAMO air-deployed profiling floats



PROVOR ProVal float



The ProVal float is specifically designed to provide daily high accuracy radiometric data for satellite Ocean Color validation exercises.

Final Comments

Argo is now expending to “global mission”, deep water and biogeochemical. Argo does not stand alone. We must all be mindful that the object of global ocean sampling is understanding what is happening in the ocean climate system. Argo will continue to work closely with other programs and not just in the JCOMMOPS office.


Thanks for your attention