WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

DATA BUOY COOPERATION PANEL

DBCP-XXVII/Doc. 10.1
(12.Sep.2011)

TWENTY-SEVENTH SESSION

ITEM: 10.1

GENEVA, SWITZERLAND
26-30 SEPTEMBER 2011

ENGLISH ONLY

REPORT BY THE ARGO PROGRAMME

(Submitted by D. Roemmich, S. Wijffels, M. Belbeoch, M. Scanderbeg)

Summary and purpose of the document

This document provides for an overview of the current status of the Argo Program and the challenges it faces.

ACTION PROPOSED

The Panel will review the information contained in this report and comment and make decisions or recommendations as appropriate. See part A for the details of recommended actions.

-A- DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

10.1.1 The Technical Coordinator, Mathieu Belbeoch (JCOMMOPS), presented a report on Argo, on behalf of the Argo Steering Team (AST). The panel noted that 3200 floats were operating worldwide with 2900 units that were meeting the requirements of the original Argo design (60N/60S, no marginal seas). If Argo is still short of requirements in the southern hemisphere, the core array has progressed from 85 to 90% since DBCP-26.

10.1.2 The panel noted that the deployment rate was resuming after a challenging year. The challenge for Argo in 2011/2012 will be to address the 2009 deficit in deployments (300 units). Argo is using a scoring system to rate deployments plans according to the array density and the floats age, in order to encourage deployment managers to keep in mind the 3°x3° target.

10.1.3 The panel noted that 90% of Argo profiles reach the GTS within 24 hours of collection and that efforts will have be made to keep the same delay with GDACs data distribution (today ~48h). Progress was made to process the backlog of the profiles in delayed-mode.

10.1.4 The profiling float technology is still improving and new generations of instruments are gradually operating. Use of two-ways telecommunication systems or bio-optical-geochemical sensors are also tested, and plans for “deep floats” are being initiated. Argo had a strong showing at OceanObs’09 where the majority of the other white papers referred to Argo and offered a variety of suggestions around Argo’s future. Analysis continues to be done on the effects of the pressure bias within Argo with the goal of recovering as much data as possible.

10.1.7 The panel noted the work achieved so far on the Google Earth Argo products. Temperature and Salinity overlays (using the Scripps Argo based Atlas) were tested and added to the Google Earth application as well as a quality control feedback system. The Panel noted with appreciation that this service is already developed for the DBCP. The Panel requested the Technical Coordinator to review the content and adapt the product to DBCP needs (***action; TC DBCP; DBCP-28***).

10.1.8 The panel welcomed the idea of developing further the synergies Argo/DBCP regarding Platform donor programmes and ship time sharing.

_____

Appendix: 1

APPENDIX A

ARGO STATUS

(Report submitted by the Argo Steering Team regarding the status of the Argo Program and its plans)

Argo Status

1 Currently, over 3300 Argo floats are operating globally. After a couple of years with fewer float deployments mainly due to pressure sensor problems, over 1000 deployments are scheduled for 2011. So far this year, almost 300 have already been deployed. Special care is being taken to rate float deployments based on various factors like float density or probability to survive (Argo Information Centre tools and services). In addition to planning where to deploy floats, it can be difficult to find ships and coordinate float deployments. The Argo TC has created a mailing list to help circulate cruise information more quickly to scientists who have floats they need to deploy (ships@jcommops.org). The Argo TC has also helped in recruiting the *Lady Amber*, a 20 m sailing vessel, which can be chartered to deploy Argo floats anywhere in the world ocean excluding high piracy zones. The *Lady Amber* has already completed a successful cruise across the Indian Ocean to deploy floats, with another planned for the late fall.

2 Almost 90% of Argo profile data are available to users within 24 hours of a profile being made. In the past year, work was done at the GDACs to reduce delays for data from some of the DACs. The real-time data are subject to similar integrity and quality checks as the real-time XBT data stream. However, some salinity sensors drift with time due to biological fouling and physical deformation. The backlog of data needing these delayed mode corrections has been reduced. Currently, 79% of floats needing to be put through the delayed mode quality control process have been completed. This number is up from last year's 63% and is getting close to being up to date. More work still needs to be done to try and reduce the small backlog of floats left. Many of the floats left are difficult as they are either older and thus lacking detailed information about sensors, or are deployed by countries into areas of the ocean where the scientists do not have as much expertise, making it difficult to quality control the floats. These issues are being addressed by the Argo Data Management Team. As it is important to carefully review files in a timely manner, an additional quality control check that compares sea level anomalies from satellite altimetry to dynamic height anomalies from Argo floats is done by S. Guinehut four times a year. This additional quality control check helps scientists identify potential problematic floats even before delayed mode quality control can be done. Other such methods are under development to help detect large scale problems with the float data.

3 Float technology is an important part of the Argo array and there have been significant developments over the past year to float technology. In 2010, 18% of floats deployed were equipped with Iridium communications. It is expected that this number will continue to grow as more floats switch over to Iridium or other high bandwidth communication systems. Iridium allows for more data to be sent in less time. Both the SOLO and the PROVOR have new generation floats available. The SOLO-II is smaller, more efficient and uses Iridium communications. About 60 SOLO-II floats are expected to be deployed this year. ARVOR floats are also smaller and more efficient than their PROVOR predecesser, but come with ARGOS communications. Currently both Iridium and Argos-3 outfitted ARVOR floats are under development. Additionally, the Deep NINJA float is being developed to profile to at least 3000m. Besides deep profiling, new sensors are being piloted on Argo floats.

Argo's Plans

4 Following direction from OceanObs'09, Argo is exploring how to expand to new sensor types and to new areas of float coverage, both on the surface and below. With the addition of two-way communications, Argo is also analyzing changing sampling schemes after deployment. Several individuals or groups within or associated with Argo have agreed to explore various options including expanding to the seasonal ice-zone, changing the near surface temperature

sampling scheme, making floats capable of a deeper range, and establishing a more uniform method of sampling for Iridium floats. Even with the increased number of delayed mode profiles available, Argo still continues to focus on improving the quality and timeliness of both real-time and delayed-mode data. Analysis continues to be done on the effects of the pressure bias within Argo with the goal of recovering as much data as possible.

5 Demonstrating the value of Argo data remains a high priority of the Argo program. With a global array in place since 2004, researchers are able to use Argo data to investigate global and regional phenomena, with over 100 papers published using Argo data in 2011 already. The broad range of research topics includes water mass properties and formation, air-sea interaction, ocean circulation, mesoscale eddies, ocean dynamics, and intra-seasonal to multi-decadal variability. Secondly, Argo is the core subsurface dataset for ocean data assimilation modeling, used by modeling centers around the world in ocean reanalyses and for initializing seasonal-to-decadal prediction. (See http://www-argo.ucsd.edu for links to all operational centers known to be using Argo data). Already, operational centers including NCEP, ECMWF, and the U.K. Met Office are reporting improvement in their products due to the impact of Argo data. Additionally, Argo recently developed a Google Ocean layer which includes data for each float, stories on a smaller subset of floats, an animation showing the cycle of an Argo float and property plots overlaid onto the globe showing various properties from Argo data. The use of Argo in secondary and tertiary education is growing rapidly, as students anywhere in the world can now explore the global oceans from their desktop.

Argo Information Centre

6 The AIC is funded on a yearly basis via voluntary contributions from Australia, Canada, China, France, Germany, India, the United Kingdom and the United States. To be noted that Japan (via JAMSTEC) started provide funds for the AIC in 2011.

7. 2010-2011 was a challenging period for the TC with growing Argo activities and growing JCOMMOPS administrative and management issues. In addition its main collaborator position (TC DBCP) was empty for a year. Nevertheless, the I.T team was strengthened by the arrival of an intern at JCOMMOPS in November 2010 (for two years).

8. Argo Steering Team members strongly requested the TC to ensure a regular maintenance of the float database (as every single float is checked by the TC), crucial for implementation planning.

9. The AST requested the TC make the necessary developments to finalize the “EEZ warning system” so that implementers have a minimum of work to notify bilaterally the Member States that requested it. Application is now operational and 10 Member States receive pdf report by email each time their floats approach one of the 10 coastal states concerned.
see ftp.jcommops.org/Argo/eez

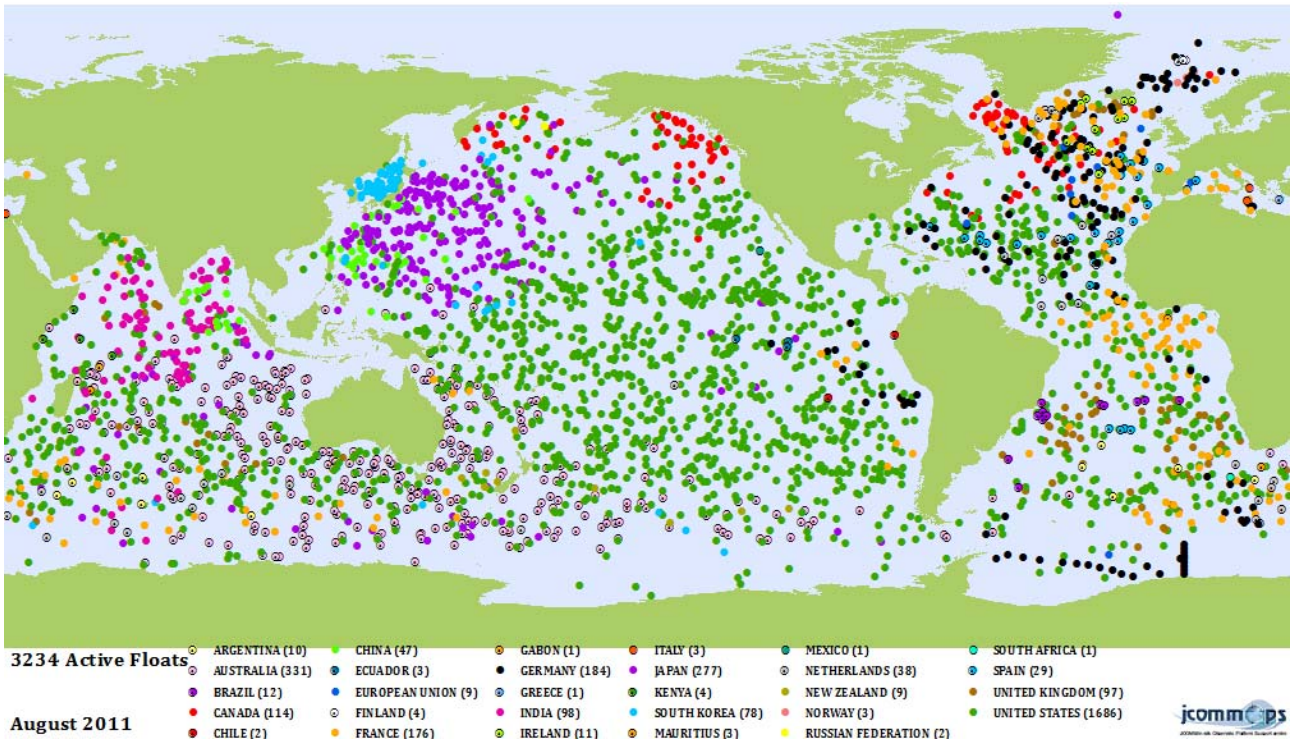
10. The AST encouraged the TC to finalize the float donation contracts with the IOC to properly transfer float responsibility between two Member States or to UNESCO.

11. JCOMMOPS has also started to sell some services, to cover some functioning expenses and develop some activities. In that line, the AST agreed to have the official Argo sticker (small or large size) sold to manufacturers for a symbolical amount of 3€/unit. It is a way as well to officially label a platform and make sure JCOMMOPS is in touch with the operator. A charter should be provided along with the sticker so that operator is aware of services provided by JCOMMOPS and duties of participating in the programme.

12. Temperature and Salinity overlays (using the Scripps Argo based Atlas) were tested and added to the Google Earth application as well as a quality control feedback system. It is recalled

that this service is already developed for the DBCP but the content will have to be reviewed and adapted in details by the new DBCP TC.

13. The AIC is preparing an audit on Argo metadata to harmonize metadata files content (Argo GDACs, JCOMMOPS, GTS Codes), and add crucial metadata not yet handled by the Argo netCDF format.



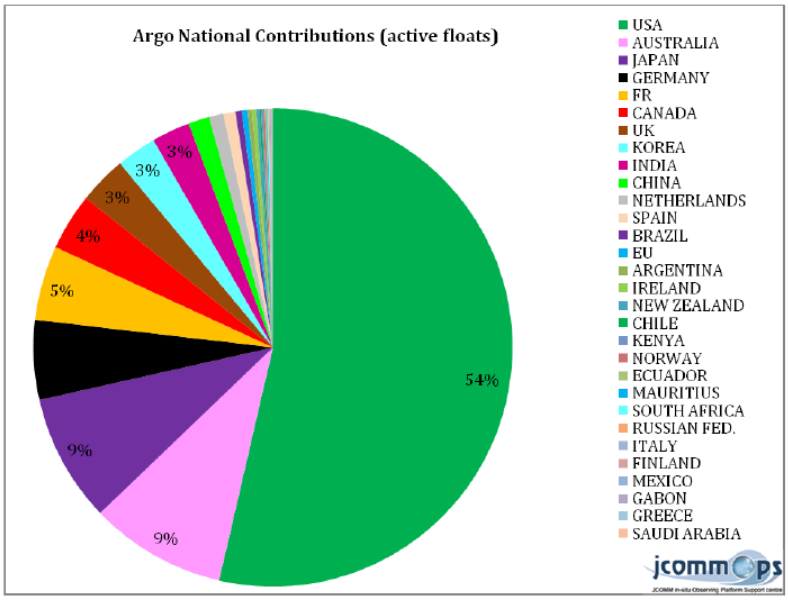


Figure 1, 2: Argo is the result of 28 national contributions, including ~80 different programmes.
54% of the array is maintained by USA (reaching a limit)
EuroArgo is fruitful with many new comers.
To be noted the substantial Australian contribution (1st in number of float/habitants.)

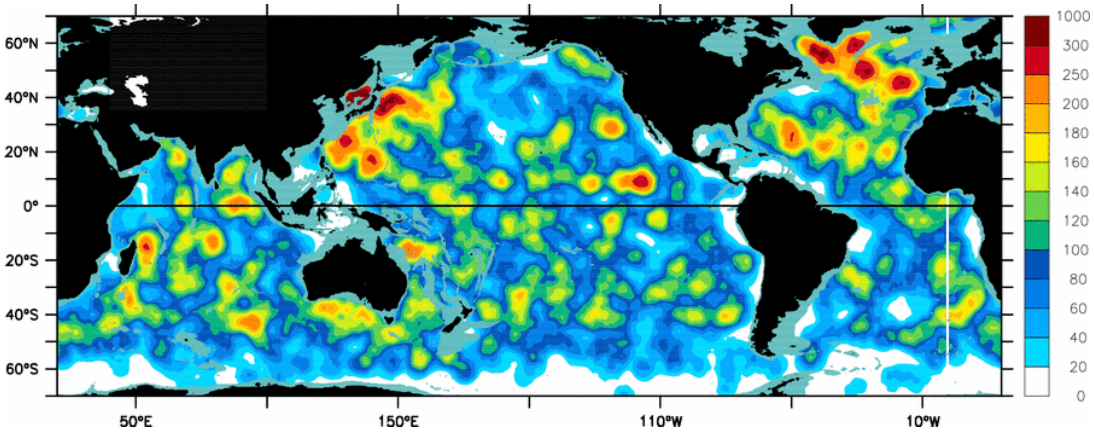


Figure 3: Float density as of Sept. 2011 (source: SIO)

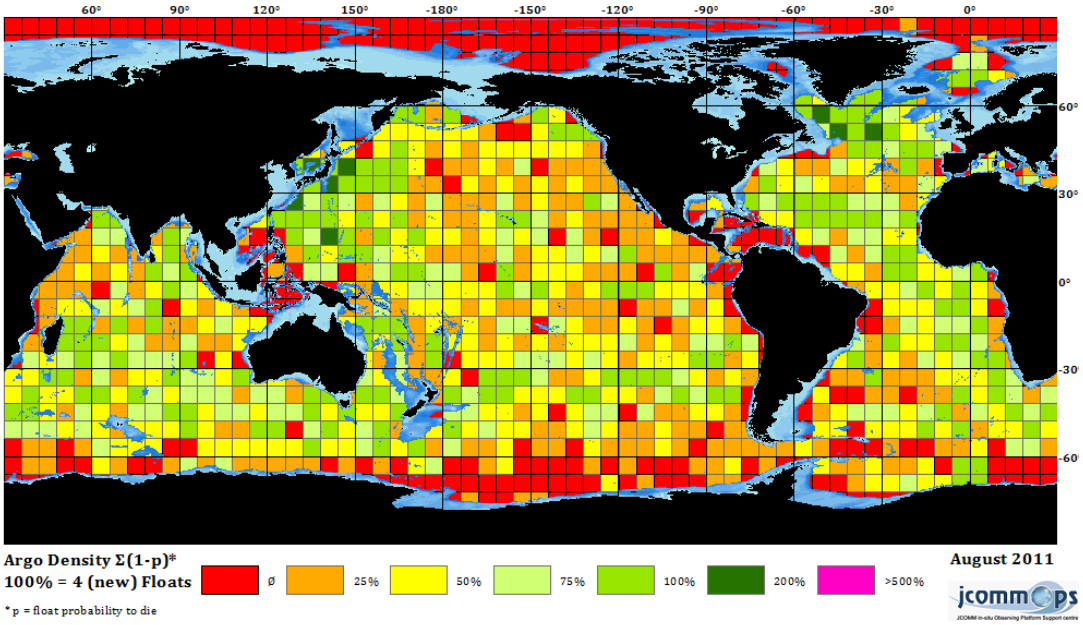


Figure 4: Float density taking into account their probability to die.

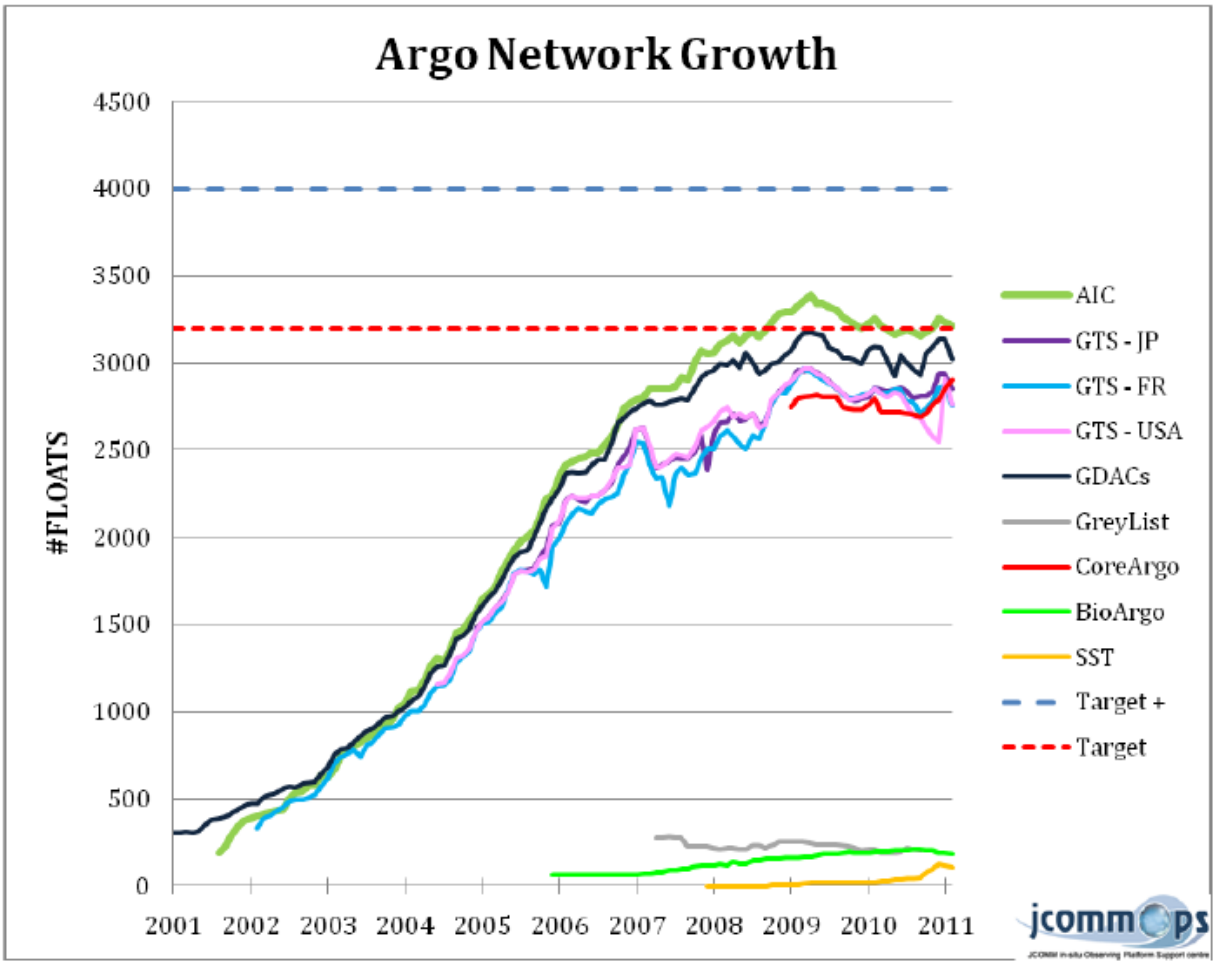


Figure 5: Different metrics are used to monitor the Argo array growth and optimize the real-time data distribution. Can the target of 4000 units for an expanded Argo (high latitudes, marginal seas) be reasonably reached?

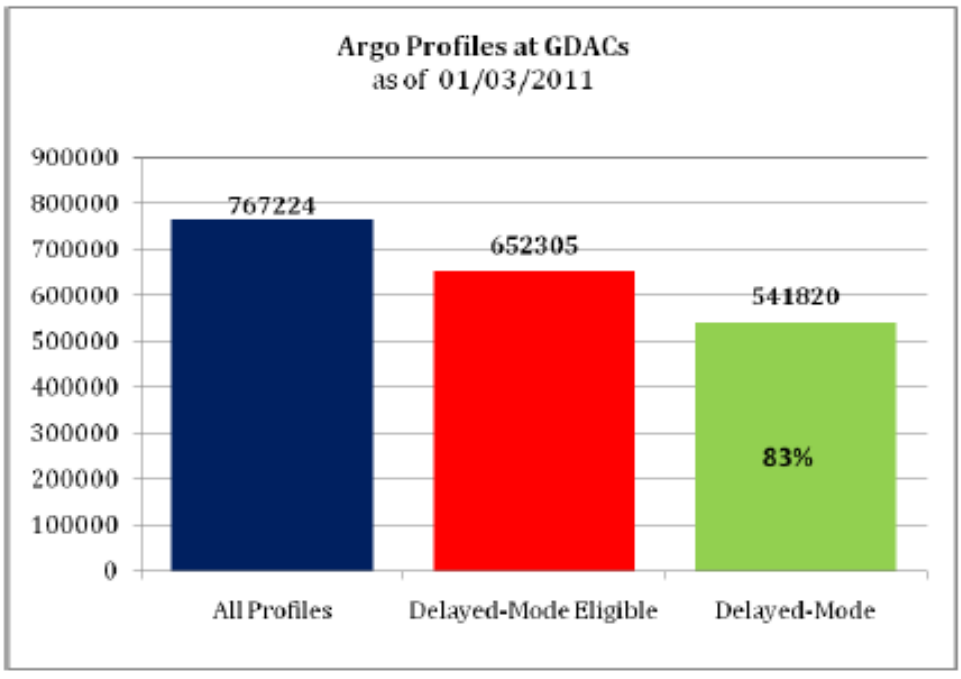


Figure 6: ~835 000 Float profiles are available at the GDACS as of Sept. 2011.

~80% of the (eligible profiles) have been reviewed in delayed-mode.

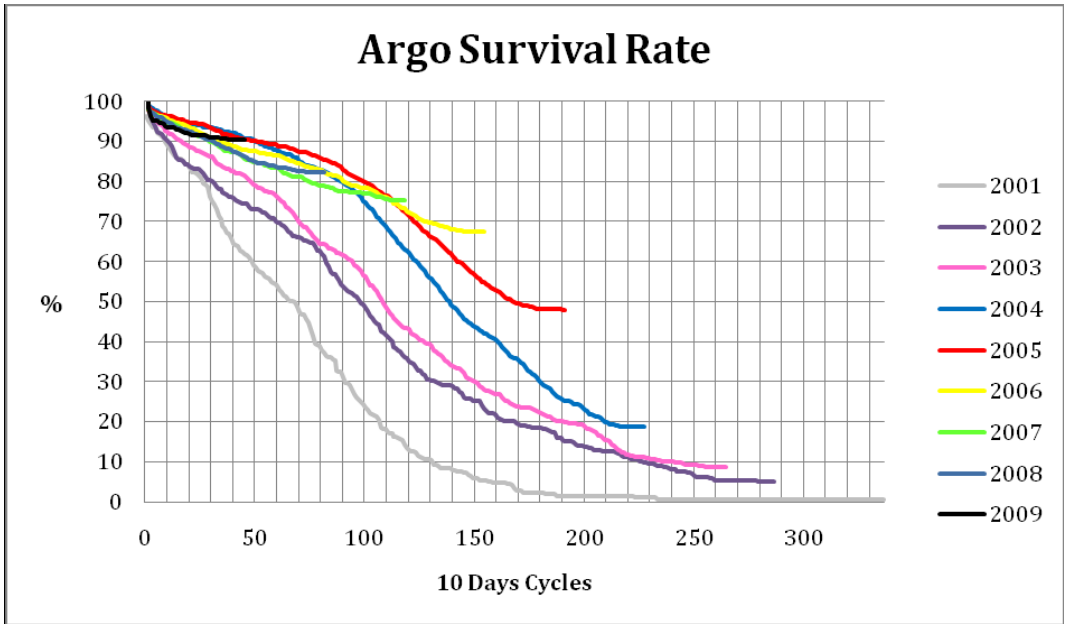
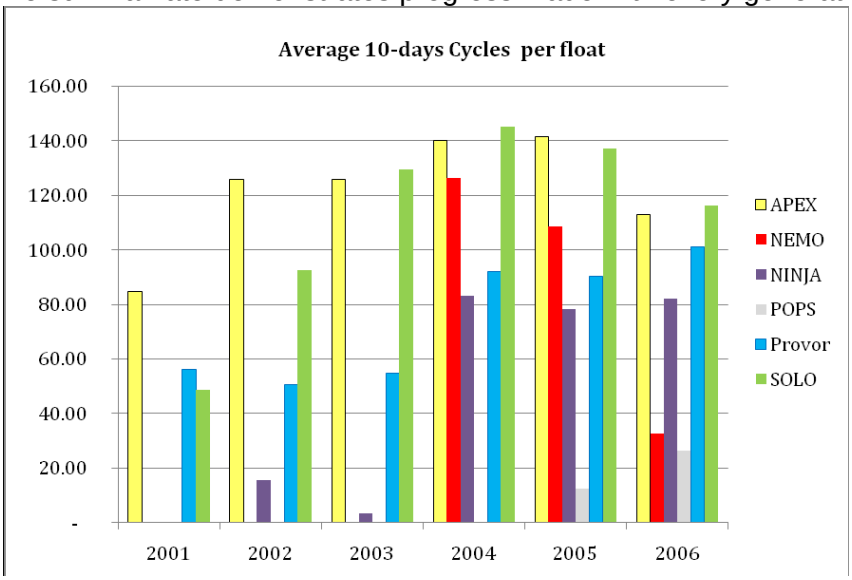


Figure 9: The survival rate demonstrates progress made with every generation of float.



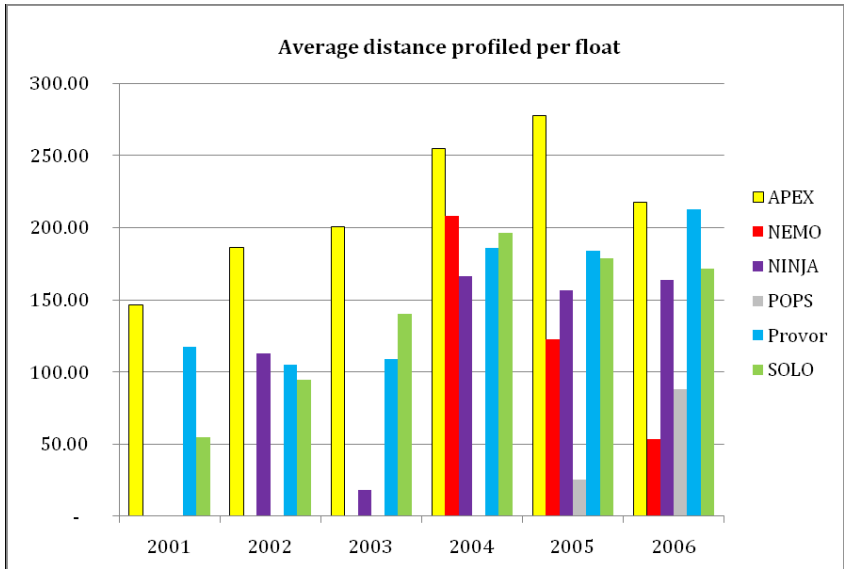


Figure 10,11: Float reliability can be evaluated looking at the average number of 10-day cycles performed by each float model (or at the distance profiled).
Floats are almost all reaching the theoretical lifetime of ~4 years (or ~150 cycles).

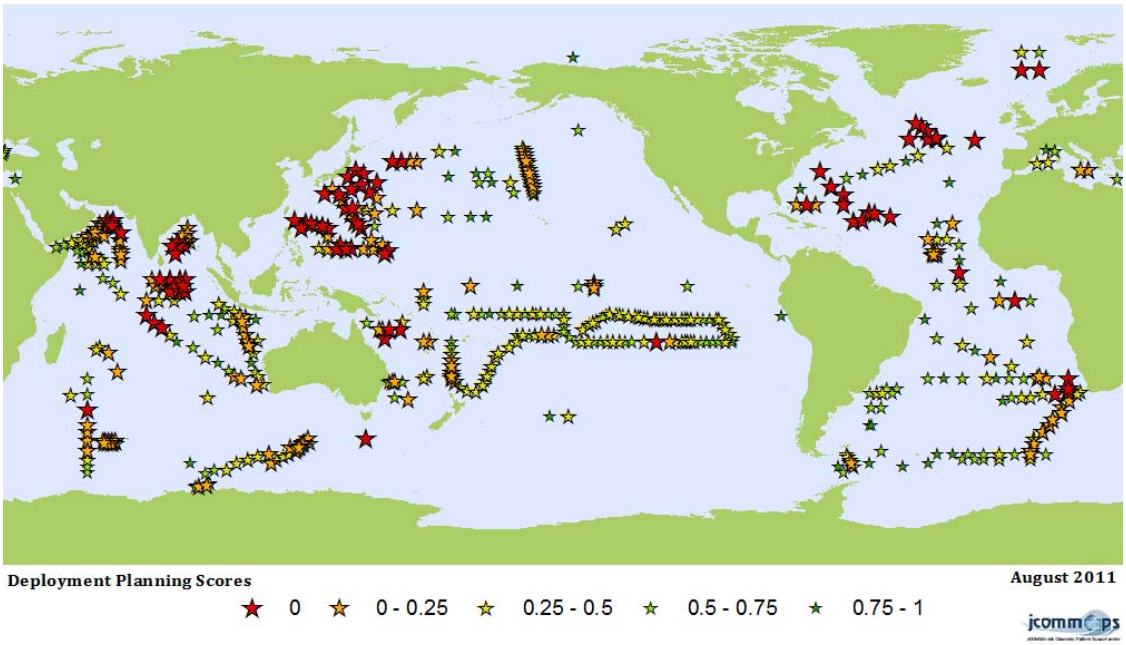
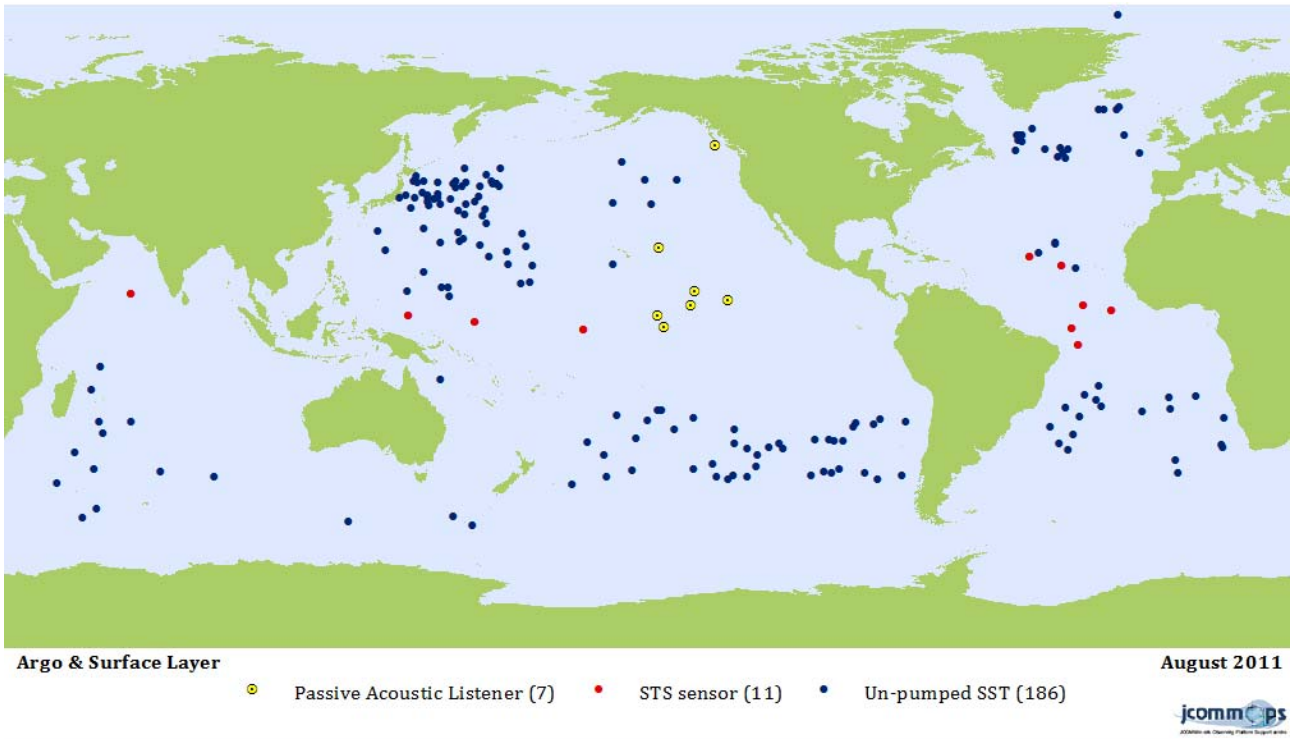
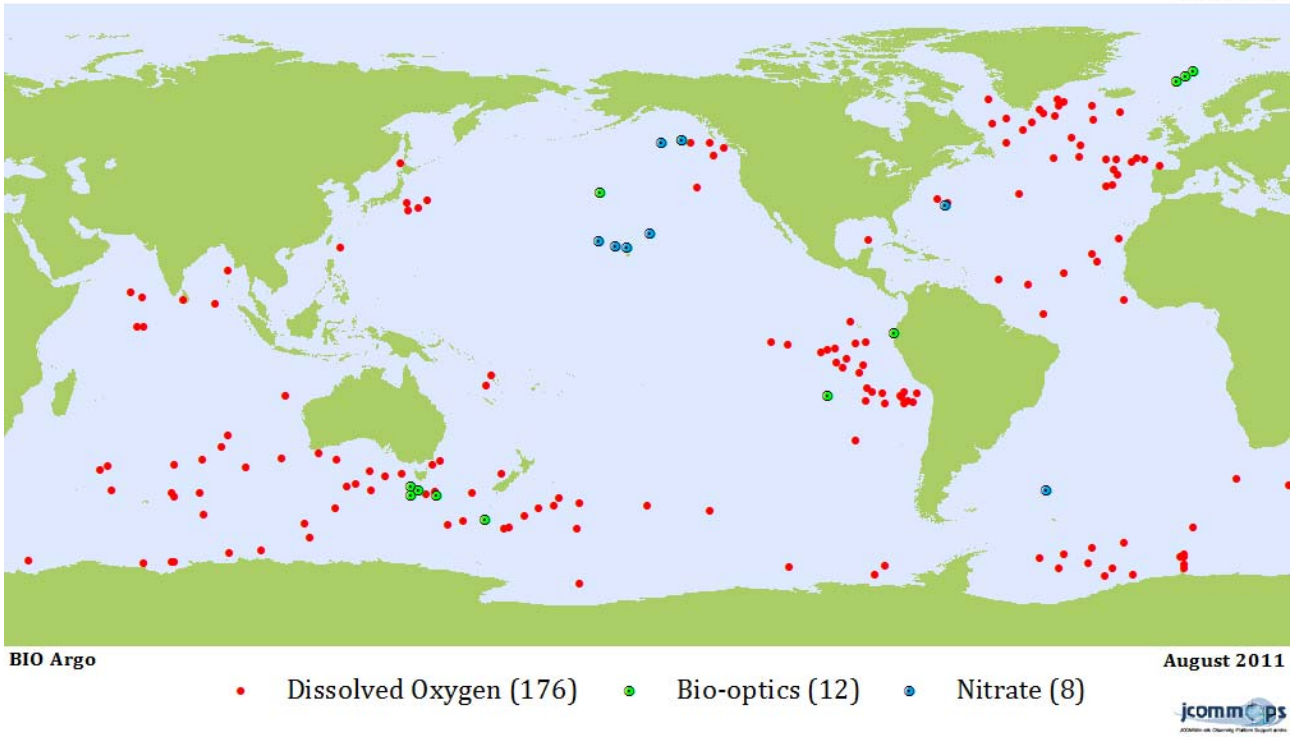
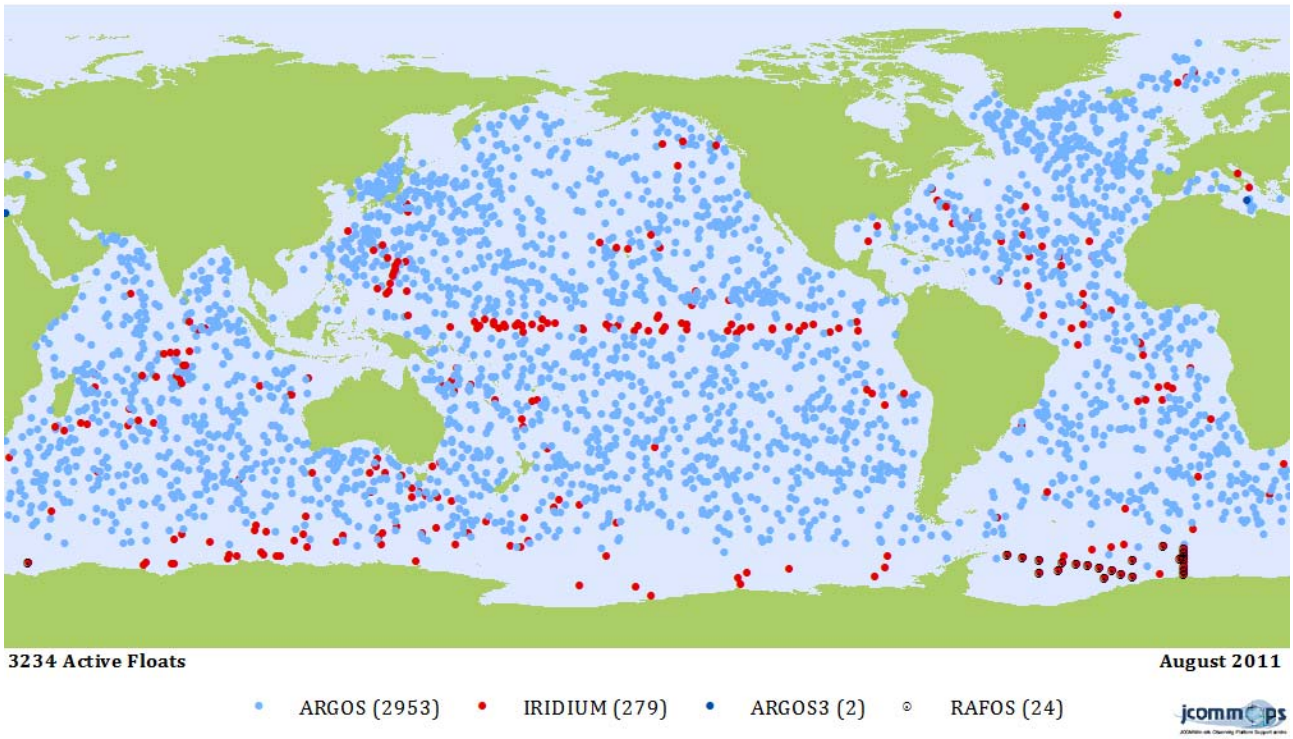


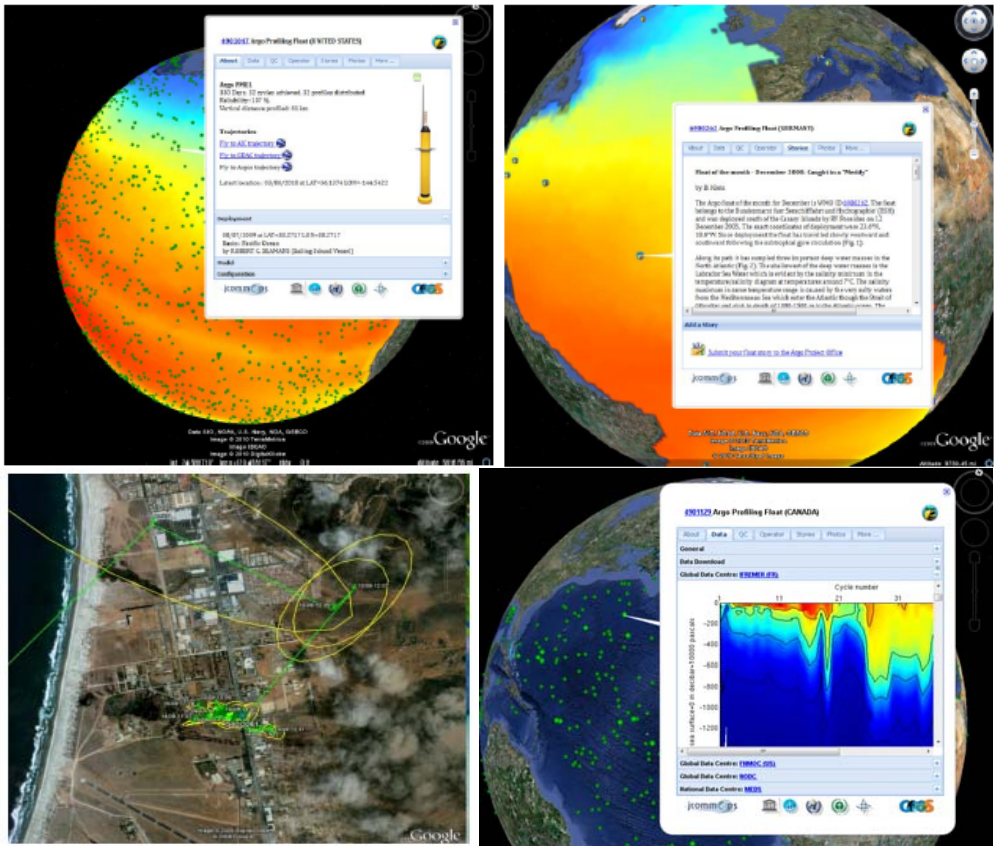
Figure 12: Argo deployment planning is regularly updated through the AIC central interface to optimize implementation strategies and allow cooperation within and outside Argo.
Red stars flag floats that might be deployed more wisely according to array target.


Argo & Surface Layer
August 2011
Passive Acoustic Listener (7)
STS sensor (11)
Un-pumped SST (186)
jcommops


BIO Argo
August 2011
Dissolved Oxygen (176)
Bio-optics (12)
Nitrate (8)
jcommops



Figures 13,14,15: New sensors and telecommunications systems are gradually used on floats



Figures 16,17,18,19: http://argo.jcommops.org/argo.kml
A new Google Earth toolbox for Argo has been developed by the AIC

Key URLs

General Argo Information	http://www.argo.ucsd.edu
Argo Information Center	http://argo.jcommops.org
Argo Portal	http://www.argo.net