14th meeting of the International Argo Steering Team

Wellington, NZ
March 19-21, 2013

Contents

1. Welcome and Introduction

Rob Murdoch, Director of Research, opened the meeting and welcomed everyone on behalf of NIWA. He gave an overview of science done at NIWA as well as an update on the research vessels NIWA owns. He stated that NIWA is committed to the future operation of the RV *Kaharoa* who has deployed more floats than any other vessel. NIWA is also working to further develop environmental forecasting and will support future Argo initiatives including Deep Argo and Bio Argo.

Action item 1: Write letter of thanks to local hosts Rob Murdoch and Phil Sutton. AST co-chairs

2. Objectives of the meeting

The objectives of the meeting were two fold. The first was making the Global Argo Mission more complete and robust. As a follow up to the 4th Argo Science Workshop, one goal of the meeting was to discuss possible Argo extensions into high latitudes, western boundary regions, marginal seas and the equatorial Pacific. The second objective focused on Argo science, education and outreach in the Southwest Pacific. The science talks focused on the SW Pacific and several other speakers gave talks on education and outreach efforts in the SW Pacific.

3. Action items from AST-13

The Action items from AST-13 were reviewed and several of them were carried on to this year's list since they had not been entirely completed. Most actions were completed during the year, but not all. Most of the incomplete ones were endorsed to be done in the coming year. A few that were not finished were modified to be more useful. For example, the action item relating to documenting all problems with the Argo dataset was changed to the creation of a data FAQ web page that can better address these issues. China and Korea stated that they were still having trouble identifying Argo focal points (action item 4). The ATC stated that he was working on this and was coordinating with Albert Fischer to solve this problem. The items relating to B-phase oxygen data (action item15) and trouble with Iridium messages not being sent (action item 18) still need to be investigated as the issues are not yet solved. The item relating to the Argo Wikipedia page (action item 27) was not completed yet, but it was agreed that H. Freeland would take the lead on improving the content on the page and work with M. Scanderbeg to implement the changes. Several other AST members agreed to help translate the page into other languages.

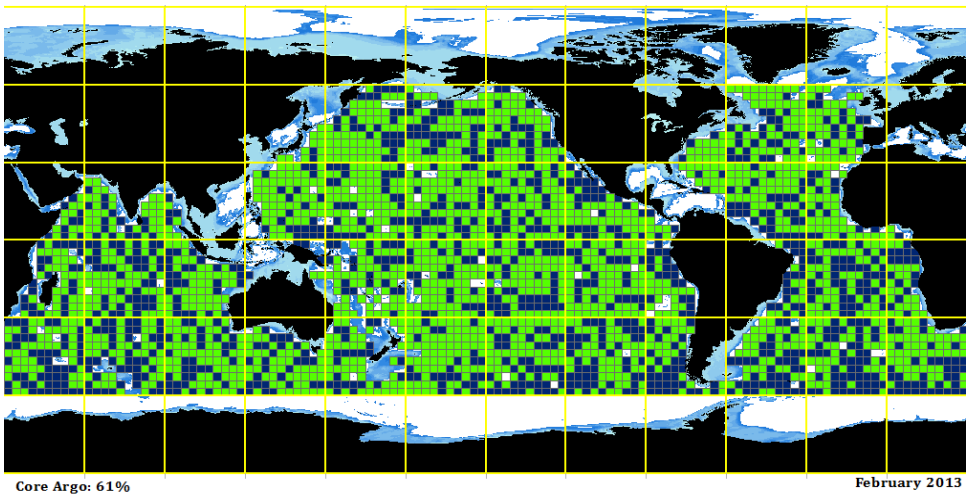
Action item 2: Improve the content on the Argo Wikipedia page. H. Freeland

Action item 3: Translate Argo Wikipedia page into non-English languages after Action item 2 is completed. T. Suga, B. Klein, L. Zenghong, M.-S. Suk, EuroArgo.

4. Implementation issues

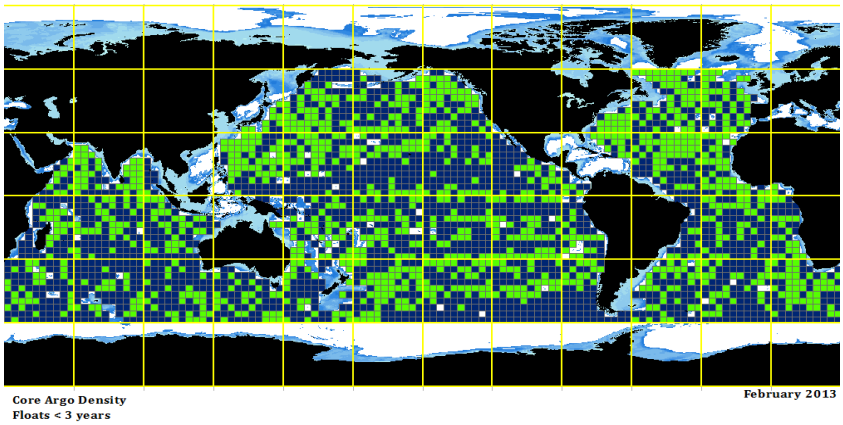
4.1. Status of Argo

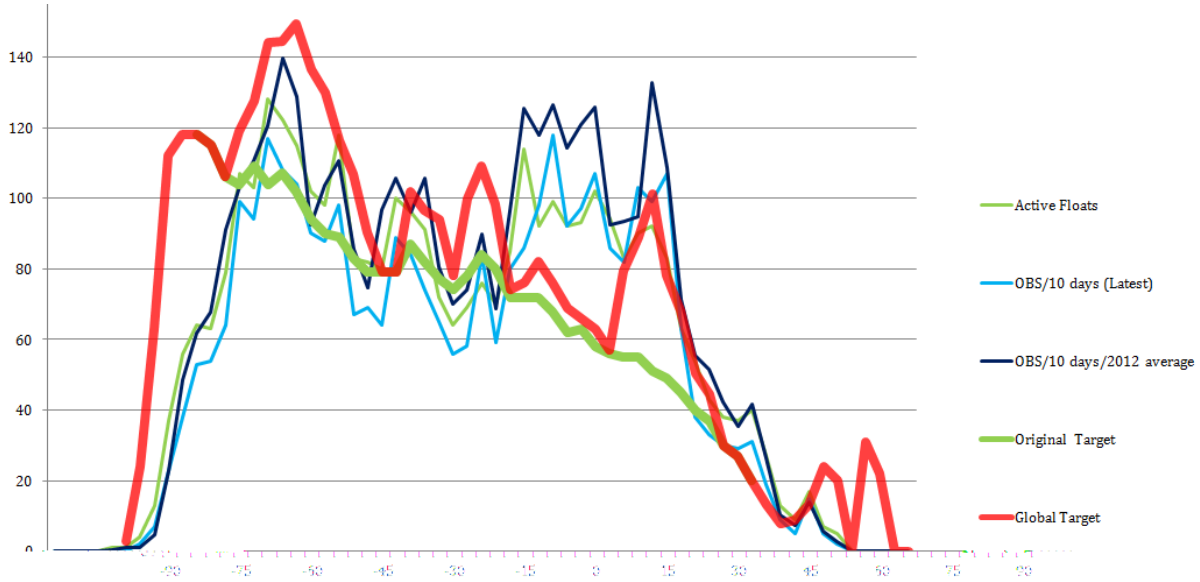
The Argo Coordinator reported on the status of the Argo array and highlighted that we were on the way to “global Argo” with a sustained network of more than 3500 floats. He reminded the meeting that Argo was still vulnerable with 60% maintained by USA. An increase in the European contribution is on its way; Brazil is on board with a sustained contribution (10 floats/year) nearly funded and that could foster the South American effort, which is still too modest. The TC then remarked that the strengthening of the Asian countries' contribution will be required to reach a more complete array and its associated global target.
The evolution from the “original” to the “global” (discussed in 4.4) is a unique opportunity to call for additional support nationally and to seek new partners. Argo should be further promoted in Russia, Mexico, Indonesia, and Turkey (that is already using floats). The Argo Director and the TC should make proper use of their mission budget to that end. Cooperation should be continuously developed, even if it is not always a full success, and some partnerships with manufacturers or sailing communities could help (4.3 and 4.7).
Argo has reached completion of its strict original target (60N/60S, no marginal seas) with 3048 floats. However spatial distribution might be improved as only 60% are operating at the right place (see map).



Overall the float deficit due to the deployment halt in 2009 is solved with regard to yearly deployments (935 floats deployed in 2012). There was a notable small decrease in deployments in the Indian Ocean. Float density numbers by latitude reveal a clear need of floats in the 50/60°S band, a small need at the equator and an excess in the 10/45° band (due to Marginal Seas and classic deployment opportunities) that could be redistributed better in the WBC regions.

TC then highlighted the current and anticipated gaps in the array.





The TC recalled the importance to maintain and share deployment planning information at the AIC from the very early steps to registration. He presented a new strategy to limit float provider work in this task.

The TC then presented a few statistics on float beaching, float models, reliability, telecommunication systems (40% Iridium in 2012). The evolution from an "original" to a "global" array is a unique opportunity develop the right communication to keep Argo on the radar of funding agencies. This evolution will require: more international partners, increased national contributions, improved float lifetime (limited) and deployment practices, accurate target(s) and better metrics to track progress, tools to monitor spatial distribution with time, better planning to optimize use of resources and array distribution and new deployment opportunities.

4.2. Update commitments table

The commitments table was updated at the AST meeting and it was reiterated that the goal is to deploy 800 floats a year. We are currently slightly under this for Argo only (excluding Argo equivalent floats) for 2013. Argo deployed 893 floats last year which was almost exactly what was predicted, so we could be getting better at estimating how

many will be predicted. By now, most programs have deployed their backlog of floats from 2011 - 2012, so there may be less than 800 floats deployed this year.

4.3. Float deployment opportunities

The Argo TC presented the deployment strategies set up by JCOMMOPS. In a difficult economic context where the academic research fleet is shrinking, and with the challenge of a "Global Argo" array to maintain, we will need to exploit existing resources as much as possible, and innovate to create new opportunities. A key step was the establishment of a Ship Coordinator position at JCOMMOPS; Martin Kramp started to work on the team in February 2013. The activities of the Ship Coordinator will be shared between i) technical coordination for the SOT and GO-SHIP initiative, ii) general Ship-time service and cruise information management, and iii) cross-sector JCOMMOPS tasks (cooperation, training, communication). A full report was provided (see annex) on the activities led in 2012, and on the global opportunities proposed by JCOMMOPS.

A new strategy must be to balance scheduled research cruises and recruitment of unexploited opportunity vessels in new organizational frameworks such as the World Ocean Council (maritime industry), specialized sailing associations (NGOs), ocean sailing schools and tour operators, nonprofessional ocean rallies, professional ocean races and delivery cruises and the charter of adequate vessels for substantial deployments.

The Lady Amber continues to support Argo (NOAA/WHOI/AOML) by deploying floats and drifters in the South Atlantic. The NGO Voiles Sans Frontiers deployed successfully a dozen of floats in 2012 and a number of partnerships with sailing races and foundations are being finalized and exploited. In particular, the Barcelona World Race agreed to get all participants to deploy floats in the 2014 race.

JCOMMOPS worked with a specialized maritime consultancy on a strategy for worldwide substantial and cost-effective deployment. Depending on the regional characteristics, adequate charter vessels were identified, to complete the operations of research and opportunity vessels with large scale deployments.

JCOMMOPS has now all the capacities and contacts to handle the overall management of global and substantial deployment missions through turnkey solutions, and to exploit the communication potentials to promote and "humanize" the GOOS and Argo in particular.

Action item 4: Request all programs submit and maintain deployment planning documentation. National Groups/ PIs

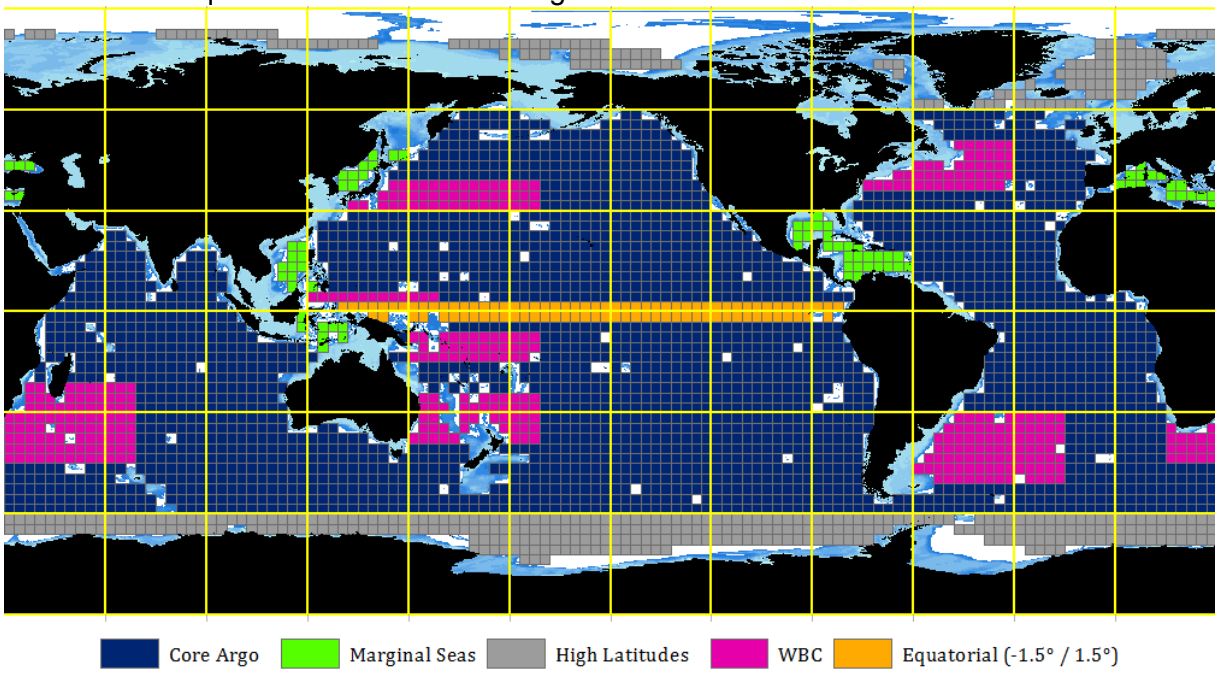
Action item 5: Investigate the question of non-institutional vessels deploying floats within EEZ. Ask Rollie Rogers. J. Turton

4.4. Follow-up to ASW-4 Round table

4.4.0 Prologue - Floats required

The Argo TC introduced the discussions on the evolution of Argo's design. Potential enhancements that were discussed at ASW4 and were followed up by

the TC study (see annex). A number of discussions and early feedback were provided and the AST encouraged the TC to continue the work gradually and release a new version after the meeting. EuroArgo was invited to provide more feedback on requirements for the Arctic region.



4.4.1. High latitudes

It was noted that for the Arctic, Argo may not be the answer. Ice-detecting floats might work, but this needs to be further studied. Ice-tethered profilers might also be an option, but again, additional work is needed to explore this avenue. D. Roemmich suggested that it is not possible to define a sampling target for the Arctic at this time and that pilot studies and other additional work should continue to be carried out to try and understand the best way to sample the Arctic region.

For the Southern Ocean, S. Wijffels noted that, based on pilot studies, it is possible to use Argo floats equipped with ice-detection software in the seasonal ice zone. Even with the extrapolated positions, this is better than delivering no data at all which is the current situation. It is a priority to extend the Argo array into the seasonal ice zones.

Action item 6: Track and highlight the growth of the Southern Ocean array. M. Belbéoch

Action item 7: Query Arctic pilot study groups on Argo float density design. Request Arctic Ocean program design document. Report back to the AST co-chairs. B. Klein, E. Mamaca, D. Gilbert

4.4.2. Western boundary regions

Enhanced sampling over boundary current regions and their instability zones at roughly double normal Argo density (1 float every 2 by 2 degrees and profiling every 10 days).

4.4.3. Marginal seas

The extension of Argo into marginal seas introduces the following issues:
1. Specific requirements of higher concentration of float density for adequate monitoring of T/S and biochemical parameters (smaller scales with respect to the world ocean).
2. Challenges related to floats stranding and being stuck in shallow waters, to floats being recovered and redeployed, to floats being picked up by seafarers (higher mortality).
3. Political challenges around agreements for floats to sample in territorial waters and EEZs.

Two-way satellite communication (Iridium, Argos-3) can help the operational challenges listed in (2). Minimizing surfacing time decreases the probability of theft and drifting ashore. Modifying the cycling and sampling characteristics interactively while floats are drifting allows optimal adaptive sampling and longer operating life.

Solutions to political challenges around float deployments in marginal seas should be pursued through regional partnerships and collaboration, outreach and capacity building. The AIC can provide valuable service in tracking regional requirements and facilitating regional partnerships.

4.4.4. Equatorial Pacific

D. Roemmich suggested that, in addition to the other Argo enhancements endorsed by the OceanObs09 conference and the 4th Argo Science Workshop, Argo also should consider an increase the density of coverage in the equatorial oceans, as recommended in earlier Argo Science Workshops. Observation of the zonal structure and propagation of equatorial intraseasonal-to-interannual anomalies are important for understanding and prediction of tropical variability (e.g. ENSO). He noted that Argo can play important roles in complementing data from the equatorial moored arrays. Argo provides high quality temperature/salinity profiles to greater depth (2000 m) and with much greater vertical resolution than the moored observations. Argo coverage is continuous in time, while moorings have data losses (high in the eastern equatorial Pacific). The present Argo array captures 80-95% of the monthly variance in equatorial eastern Pacific sea surface and subsurface temperature anomaly. Finally, while early Argo floats spent about 10 hours on the sea surface and were carried out of the equatorial band by Ekman divergence, newer Iridium Argo floats spend only 20 minutes on the sea surface and have long residence times (multi-year) on the equator. Roemmich recommended that Argo double its designed coverage within 1.5-degrees of the equator. Further, deployment of long lifetime floats (>300 cycles) would enable cycle times to be reduced to 7 days while still sustaining 6-year float lifetimes. If implemented this would increase the annual number of Argo profiles between 1.5°S and 1.5°N in the Pacific from about 1800 at present to 5000, with proportionately similar increases in the other oceans.

The AST endorsed this recommendation, and noted that good coordination is needed to maximize the value of the integrated ocean observing system.

Action item 8: Approach the Equatorial Ocean Monitoring System Workshop to help with the planning of Argo within the Equatorial latitude band. Suggest additional deployment opportunities if required. AST co-chairs, National Groups who deploy in the equatorial band

4.4.5. Summary of ASW-4 roundtable

Enhancements in Argo coverage described above for high latitudes, western boundary regions, marginal seas and Equatorial oceans are endorsed by the AST. For the time being, the AST did not prioritize among these activities and noted that the highest priority should continue to be sustaining the Argo array consistent with its original design. The following actions will assist the AST in understanding the impacts and importance of enhancements and the requirements for Argo to achieve them.

Action item 9: Approach OceanView GODAE Task Team on Ocean Observing System Design with a strawman of Argo enhancements and find out if they can assist in evlauating their impact on ocean reanalysis and predictions systems. GODAE is meeting in the USA in November 2014. S. Wijffels, D. Gilbert and others

Action item 10: Produce a global map of recommended Argo coverage requirements, including enhancements as noted. For marginal seas, specific plans will be needed from regional partnerships to finalize requirements. M. Belbéoch.

4.5. Deep Argo

To date, a design for how profiling floats might sample the ocean below 2000m does not exist. But AST acknowledges that several of its members are contributing to a GOOS task team who are developing a deep ocean observing system strategy. The design of a global Deep Argo array will be affected by the technical capabilities of deep floats (i.e. cost per profile and data quality). See reports 7.3 and 7.5.

4.6. Bio-Argo/Biogeochemical Argo

The Bio-Argo presentation essentially focused on community coordination, data management and plans for future deployment.
In February 2012, a Bio-Argo-focused session was held at the Ocean Science Meeting in Salt Lake City and included a Town Hall meeting aimed at presenting the observational Bio-Argo float–based projects funded or in preparation. These discussions allowed the identification of key oceanic areas where most of the observational effort should be conducted as an initial step before generalizing global observations through a large Bio-Argo network. These regional “hotspots” are: the Southern Ocean, the North Atlantic sub-polar gyre and the oxygen minimum zones. A

session entitled “Towards a Global Ocean Biogeochemical Observing System Based on Profiling Floats and Gliders" has been submitted for the next Ocean Science meeting (February 2014, Hawaii).

In November 2012, the first two-day Bio-Argo Workshop was organized as part of the ADMT-14 meeting held in Hyderabad. The focus of the workshop was the development of a data management system and quality control procedures, in line with the Argo data management. Several actions were created to continue developing this system. Besides oxygen which is already embedded in the Argo system, three variables are now considered as the primary variable to start with: Chla concentration, (back-) scattering coefficient and nitrate concentration. Other variables, like pH and radiometry, are progressively reaching a sufficient degree of readiness, turning them into possible candidates for the near future.
In 2012 the Bio-Argo community has continued to receive support for float acquisition and deployment. To date, 11 countries are engaged in the development of the Bio-Argo array.
In the discussion following the presentation, it was pointed out again that there are some complications with distributing biological data that was collected within an EEZ. S. Wijffels reiterated that BioArgo needs to follow global protocols around the permission to collect data and that the AIC is not notifying for non- temperature and salinity sensors.

4.7. AIC Funding

Howard Freeland reported on the state of the AIC finances. Superficially the accounts currently look very good, but that hides quite a few concerns which were discussed in the presentation. Among them, it is more complicated now that money is being contributed through three separate agencies and it is not obvious how one works out a comprehensive set of accounts. Countries now are contributing money to the IOC as before with an overhead charge of 10%, to the WMO with an overhead of 7% and to CLS with a zero overhead charge.
A round-table discussion established rough ideas of how much countries would likely contribute during calendar 2013, and it is sufficient, if the contributions materialize. Freeland thanked all countries that do actively support the Argo infrastructure and wishes to encourage other countries to make a contribution. If any country is paying for Argos communications, then you are sending money to CLS. It becomes a very simple operation then to request a small increase in your invoiced amount that CLS should redirect to support of the Argo Information Centre. This is a very effective way of supporting the AIC and requires minimal paperwork.

4.8. JCOMM Observing Program Support Centre

M. Belbéoch reported on the status of the JCOMMOPS centre development and announced that two full time and dedicated staff were just recruited: a software engineer (D. Bourarach), and a ship coordinator (Martin Kramp). To be noted that M. Kramp will take care of SOT and GO-SHIP coordination.

This expansion was made possible thanks to the Argo TC's efforts as the JCOMMOPS leader, at no financial cost for Argo, but at the cost of decreased direct support to Argo. The TC thanked the AST for its patience. The TC recalled that the concept was still

fragile (e.g. the DCBP coordination turnover) and that necessary steps were taken with the host country France to increase the support to the centre.

It is planned to move the center of JCOMMOPS to Brest, building on the existing agreements with JCOMMOPS hosts (CLS and Coriolis), and add support from the local partners (Science Park, Brest city, Brittany region), including in-cash support.

An inauguration of the new JCOMMOPS headquarters in Brest, on the Ifremer campus, is anticipated early 2015.

The TC recalled that he was still looking for resources to set up a float pilot project, a show case including one float of each model. The aim is to work more closely with the float industry, to learn about the experience of buying and setting up a float and to develop more cooperation.

The two first floats donated to UNESCO/IOC (Univ. Maine -E. Boss) unfortunately failed at deployment. The TC recalled that the tax exemption (for UNESCO material) was however successfully experienced.

JCOMMOPS will continue to seek resources and develop partnerships. Some first discussions with float manufacturers were promising.

The TC was glad to announce that the Barcelona World Race just agreed to deploy floats in its next edition (2014-2015) and to ask each racer to fund a float at the next one (2018-2019).

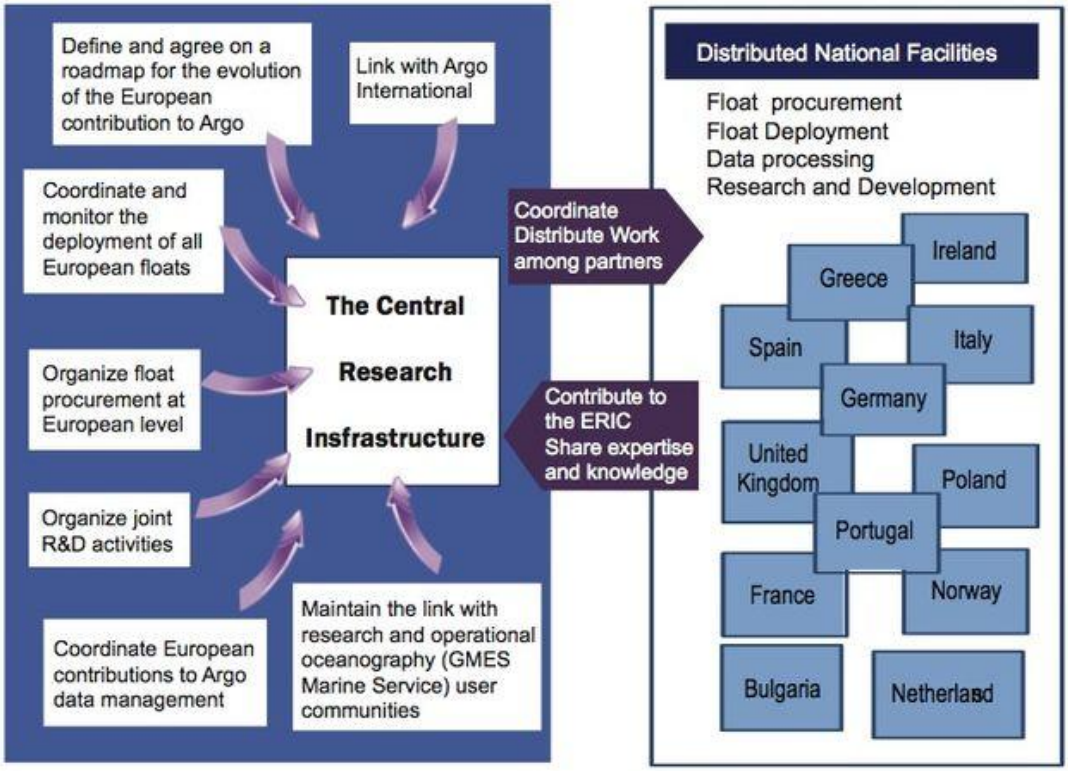
The new JCOMMOPS ship coordinator will also look for sponsoring options.

The TC concluded that with this new team in place, JCOMMOPS was very close to an ideal infrastructure where each program can be properly supported and integrated services can be developed. Argo, through its coordinator, has invested a lot in the JCOMMOPS concept and will now truly benefit from the integrated concept.

4.9. Argo Europe

In 2013, Euro-Argo will set up its new European legal structure (Euro-Argo ERIC: http://www.euro-argo.eu/) that will allow European countries to consolidate and improve their contribution to Argo international.

Agreements are at the ministerial level and this will help to ensure long term sustainability. We are now at the last step for the setting up of the ERIC. The ERIC statute is under signature by different countries at the ministerial level. The French ministry of research will then send the application to the European Commission. The setting up of the ERIC is planned mid 2013.



Euro-Argo started a new project, E-AIMS: Euro-Argo Improvements for the GMES Marine Service: http://www.euro-argo.eu/EU-Projects-Contribution/E-AIMS. This project allows 16 European partners to test new generation Argo floats (e.g. oxygen, biogeochemical, Arctic and deep floats) and analyze their impact for ocean analysis and forecasting centers, climate centers and satellite validation. E-AIMS started in January 2013 and will last for a three year time period. 16 new floats should be procured and tested in 2013/2014.

4.10. Argo India

M. Ravichandran presented the summary of "10 years of Indian Argo program". He discussed the present status of Argo floats deployed by India in the Indian Ocean, utilization of Argo data, capacity building activities, and deployment opportunities in the Indian Ocean.

After the Indian Ocean Implementation planning meeting held at Hyderabad, India during July 2001, the Government of India formally approved the Indian Argo program with a commitment to deploy 30 floats per year during 2002 to 2012 and also to support data management activities and data utilization in terms of science and services. The first float deployed by India was the float provided by Dr. Howard Freeland, Canada. This float provided important information about the buoyancy requirements of float in the North Indian Ocean.

As of March 2013, after 10 years, India has deployed 284 floats in the Indian Ocean and also contributed to Argo data management activities. In terms of new insights, researchers from India have published about 75 publications in referred journals in the areas of Indian Ocean process studies, validation of models, understanding and documenting different phenomena related to Indian ocean dynamics, especially

monsoon, and inter-annual variability of upper ocean heat content, thermocline, generation and termination of Indian Ocean dipole, etc,.
In the operational services, INCOIS has produced a number of value added services specific to the Indian Ocean. In order to initialize the coupled model for the seasonal monsoon forecast and to understand the variability of the Ocean in different time scales, a global ocean analysis is being generated using ocean models and assimilating Argo and other in-situ data. This is a significant achievement in terms of operational utility of Argo data for seasonal prediction of monsoon. He also showed the preliminary results on the impact of Argo in the Indian Ocean in terms of producing ocean analysis by assimilating Argo data and by withholding Argo data.
He also mentioned that by implementing the Argo program in the Indian Ocean, other in-situ observations such as moored buoys, drifters, tide gauges, XBTs ,etc also significantly increased in the Indian Ocean. Additionally, education and outreach activities done by India include organizing user-interaction workshops, producing an "Argo DVD" with data and products pertaining to the India Ocean to target students at University with low band width, etc,. Finally he showed the deployment opportunities available in the Indian Ocean during the year 2013-14.

4.11. Argo China

A presentation was given from the Argo China Team. In the past ten years, under the support from the Ministry of Science and Technology(MOST), the State Oceanic Administration(SOA), and the National Natural Science Foundation of China(NSFC), China Argo has deployed 153 floats in the western Pacific and Indian Ocean, and now there are 84 active floats. In general, China Argo's contribution of float numbers to the global Argo array is limited, due to the Argo funds coming from scientific research projects. But Argo data application is becoming popular in oceanographic and atmospheric areas. Incomplete statistics show that over 150 papers have been published since 1998, of which 50 papers are in the year 2012, and some papers published in distinguished international journals such as Nature-Geoscience. Also Argo data and its assimilation products are widely used in operational ocean and weather forecasting and prediction. Because of this the related authorities are considering incorporating Argo into the operational system, thus China Argo would get sustainable fund support, increasing floats numbers, and it would play an active role in the construction of the Pacific Argo Regional Center(PARC).

Since 2007, some oceanic technical institutions in China have been developing profiling floats using Beidou Satellites Navigation System for location and data transmission (two-way communications), in which the sensors are EXCBLL CTD and SBE41 CTD made by FSI and Sea-Bird. During 2011-2012, several experimental floats had been deployed in the South China Sea, and in the first year of 2013, another two floats will be deployed in the west Pacific. If the experiment succeeds, China Argo would use about 20 floats to construct a real-time ocean observing system in the west Pacific where tropical cyclones (also called typhoons) are generated, and hope the observed data from this system can be shared by the Argo member countries.

4.12. Discussion items from National Reports

S. Wijffels noted that one country stated having issues with data requirements coming out of ADMT. She generalized this to state that Argo is concerned that the data teams are overworked and are dealing with complicated issues including new float types, new

file formats, new data types, etc. She suggested setting priorities for the ADMT to help the current data resources spend their time in the most effective manner. A few AST members noted that new float types and new communication systems are monopolizing data management resources. It was suggested that as more groups deploy the same floats and use the same new communication systems that the original work be shared with newer groups. This should help newer groups come on line faster.

In addition the issue was also raised around non-active Argo Focal Points and their impact on the IOC notification process.

Action item 11: Assistance will be sought from Albert Fischer at the IOC to have the Argo Focal points updated, especially the Indonesian Argo Focal point. M. Belbéoch.

5. Data Management related issues

5.1. Feedback from ADMT-13

ADMT met in Hyderabad India from 14-16 November 2012. We also held a Bio-Argo meeting which is reported separately. Since that time, we have held a phone hookup with most DACs to monitor progress on the Action items arising from that meeting. Several major items were discussed:

All data formats will now be CF compliant and format version numbering will start at 3.0. We will also investigate ACDD conventions to increase data discovery capability and which may be automatically added at Coriolis.

Digital Object Identifiers (DOI) are potentially useful to Argo to track documents and data sets but there are costs in terms of data storage. Do we freeze a snapshot of the data? Use an 'open time series' model that grows until something in the content changes? Mint our own DOIs with Argo in the name? Which organization will be responsible for archiving the snapshots? Justin Buck will pursue this further.

The US GDAC at GODAE lost functionality because it was understaffed and Mark Ignaszewski had no backup. When he was given other duties and then had a personal issue, GODAE could not handle changes to the data delivered by Coriolis (multi-profile files) and synchronization no longer worked – the two GDACs were not delivering the same data to users. A decision was taken to turn off data deliveries to the US GDAC temporarily so their only data would come through one-way synchronization with the Coriolis GDAC. This had mixed success but GODAE has now tasked Michael Frost to help Mark and the GDAC is slowly coming back on line.

The GDACs are handling 11% more data than last year and Coriolis had been doing this more efficiently.

The average delay in delivery of RT files to the GDACs is now 18 hours after a large and unexplained drop in June. In 2011, the delay was 39 hours.

Approximately 89% of the TESACs arrive on the GTS within 24 hours which is similar to last year. BUFR data is more delayed but improving. Only 75% of the profiles are found

on the GTS in BUFR format and of these, 64% of the iridium and 59% of the Argos BUFRs arrive within 24 hours. This needs improvement.

Optimal Analysis, Sea Level / Dynamic Height comparisons continue to be very useful with DACs alerted when files fail these tests.

Note that floats should only be on the Grey List until they are dead and no D files exist.

Currently most profile data issues are minor and have been mostly solved. Surface Pressure Corrections still affect some DACS – with RT files that require pressure correction but have no adjusted fields or an SPO of 0 and have no adjusted fields. It was decided that SPO=0 is still an adjustment and those fields should be filled.

All file formats except the technical files are still changing though many DACs are ready to deliver multi-profile files.

Trajectory files remain the biggest challenge and will require significant effort by the DACS. We will now have two Traj 3.0 files – an R file containing all raw data and a D file containing only profiles that have been through DMQC. These D files will be created from the Andro DEP files through the end of 2009. DACs will be responsible for finding a way to bring their files up to date and may contract to have this done for them.

The data cookbook is continually being updated with new information as it is developed and is a very valuable resource.

A proposal for handling Near Surface Temperature (NST) data is being discussed but has not been finalized. NST data can contain a mix of pumped, unpumped and surface data which all require different QC procedures. The unpumped temperature data will be carried in the secondary profile dimension. The salinity data reported when the pump is turned off should be discarded as it is invalid.

Eight QC tests have now been designed for Oxygen data based on the RT QC for other variables. These are documented in the QC manual.

The DM backlog has stalled for the past 2 years – this is an issue of resources and priorities for the data teams.

It is clear that the Data Teams are being stretched by new data types (Bio Argo), new data formats (both from the floats and the version 3.0 files we are designing now) and an increasing array becoming eligible for DMQC. Limited funding and resources mean that we are falling behind. This is something that needs to be urgently addressed and we need guidance from the AST about priorities.

During the discussion, it was noted that the US National Ocean Data Centre (NODC) is only archiving real-time data and not D-mode data. This should be investigated more because if they are not archiving D-mode data, perhaps another archive needs to be made which will include D-mode data.

Action item 12: Develop BUFR templates for real time data distribution on GTS. J. Turton

Action item 13: Develop FAQ of major data/users issues. Continue work on defining important data metrics. To be included in the FAQ is the fluid nature of new and old data requiring frequent refreshes of the entire dataset. Point to NODC for archived 'snapshots'. M. Scanderbeg, S. Wijffels, J. Gilson

Action item 14: Write a letter to NODC clarifying proper use and archiving of Argo data. AST co-chairs

Action item 15: Request assignment of new float WMO code table entries through J. Turton. J. Turton, M. Belbéoch

Action item 16: Clarify what the AST requires for use of a DOI to label Argo data (linked to pre-completed NODC archive snapshot referred to in Action item 14). AST

5.2. Trajectory data, status, and pathway forward

A. Thresher presented for M. Scanderbeg on the status of the trajectory files and how to transition to the new 3.0 trajectory file format. As has been mentioned before at other Argo meetings, the need for a new trajectory file format has stemmed from the need for additional cycle timing variables, more flexibility in reporting data from newer float models and better consistency across DACs. The trajectory 3.0 file format is in its final stages of development and the most recent draft is posted on the ADMT webpage. One new aspect of the trajectory 3.0 files is that there will be two versions - a real time (R) and a delayed mode (D) file. The R files will contain only raw data for the float's trajectory and will be created by DACs based on instructions in the DAC cookbook. R files will exist when there is no delayed mode data available for a float or when there are recent cycles that have not yet been D-moded. The R file will contain all cycles the float has completed, even if a D file exists for part of the float record. The D files will contain both raw and delayed mode data and will be created by PIs/ scientists familiar with the floats. D files will exist when cycles have been D-moded. When a float dies and all cycles have been D-moded, only the D file will exist and the R file will be removed since all the raw data in the R file will be contained in the D file.

It is expected that DACs will begin transitioning to trajectory 3.0 files beginning in June, with the goal to complete the transition by ADMT-14. D trajectory files can be submitted starting in June as well. Michel Ollitrault and Jean-Philippe Rannou will be producing trajectory files based on the DEP files they created to make their ANDRO Atlas and some DACs (Coriolis) will be using these files as a starting point for their D trajectory files. Some work still needs to be done to these files in order to make them D trajectory files, but it provides a good starting place. Other DACs want to learn how to produce D files themselves (BODC, CSIRO, MEDS). Finally, some PIs or D-mod operators want to produce D files themselves (J. Gilson, other US float providers, JAMSTEC for JMA). It is likely that it will take longer for many of these D files to appear. Michel Ollitrault and Jean-Philippe Rannou are looking for funding to continue processing Argo data for the period 2009-2012. If DACs are interested in this, please contact Michel Ollitrault directly. In discussion, some reservations were expressed whether individual DACs had resources to accomplish this transition. The status and timetables for conversion to 3.0 trajectory files should be revisited at ADMT-14.

D. Roemmich suggested that we recommend to float manufacturers that they must report two surface positions. This can be added to the list of recommended measurements/ practices being compiled by S. Wijffels and M. Scanderbeg as a resource for float manufacturers.

B. Owens pointed out that the measurement code tables are open to interpretation as to how they will be applied for each float type. It was agreed that measurement codes should be as consistent as possible for a given float type and that the DAC cookbook is the place to record how these codes will be applied for each float type.

Action item 17: Educate users on changes to trajectory file, including R and D file versions on ADMT, AIC, AST websites by end of April. M. Scanderbeg

Action item 18: DACs/PIs to consider the option of paying for trajectory updates using the ANDRO database. All DACs/PIs

5.3. CCHDO/NODC activity/reference data

Steve Diggs gave updates on the activities related to CCHDO/US-NODC/Coriolis reference data project. This effort combines data discovered by these three data centers to provide continual updates to keep the CTD Reference Data set temporally relevant. These centers are now providing detailed inventories of their data holdings for efficient data discovery and delivery.

The CCHDO added 1712 high-resolution CTD profiles to the Reference data set since AST-13. During the same period, US-NODC contributed 20,721 profiles, not including the CCHDO profiles. JCOMMOPS and the ATC provided valuable information about CTD profiles taken at float deployment locations. In addition, Barney Balch contributed his zonal section profiles from the “Great Southern Coccolithophore Belt” series of cruises. Lisa Beal was added to the reference CTD collection with the Agulhas Current Time Series hydrographic profiles.

Continual feedback from groups performing Argo quality control is needed to identify oceanographic regions such as the Labrador Sea and the Agulhas Current where the reference data are too sparse to perform acceptable quality control.

A tentative agreement was reached with India’s National Institute of Oceanography which will allow the Argo program to include synthetic profiles within India’s Economic Zone, and in situ data in the open ocean.

UNESCO’s IODE has designated the GO-SHIP program as an official associated data unit, which should help with the acquisition of hydrographic profiles from IODE member states,

In spite of these advancements, new profiles are needed to keep the reference data set current.

Looking forward, the Argo program can expect to get CTD profiles from familiar as well as new sources, such as the the US Repeat Hydrographic Program (5 cruises, > 500 profiles) and the GLODAP2 data assimilation project.

5.4. Status of the US GDAC

The US GDAC synchronization process started functioning incorrectly on 8 January 2013 due to an undetected ftp issue following the transition to the new hardware on that date. On 11 March 2013, the issue was resolved and a "large synchronization" of the US GDAC with the French GDAC was successfully performed. As of 11 March 2013, the US GDAC is once again synchronized with the French GDAC. There are a few cases of both R-files and D-files co-existing, etc that are being resolved. Immediate actions that have been taken to maintain a fully-functioning GDAC at the Naval Research Laboratory (NRL) are:

(1) NRL is committed to continued support of the GODAE Server and the GDAC;
(2) NOAA, through, an MOU with NRL is committed to continued support of the GDAC;
(3) NRL has completed a major upgrade of the hardware;
(4) NRL has identified a specific contact for the GDAC and the transition of maintenance duties has begun;
(5) The transition will be completed by October, in the interim the present GDAC manager will remain involved;
(6) Back-up personnel have been identified by NRL;
(7) A Help-ticket system is in place at NRL; this is the only way to ensure prompt response from GDAC users; **all users of the GDAC need to make use of this system**.

Several actions have been taken to enhance communications between the GDACS including semi-annual, exchange visits between the key personnel at each GDACs. There is a need to establish a support structure of oceanographic expertise with the Monterey GDAC to troubleshoot oceanographic data issues and address questions on oceanographic data and/or quality control. The exact scope of this task is being developed but there is a commitment to provide the resources necessary to implement the task.

It was concluded that data management resources are lacking in general and new float providers need to think about giving money to DACs and/or putting aside money for data management resources they will be providing.

6. Regional science, education and outreach

6.1. The SEREAD project

Julie Hall updated the AST members on the progress of the SEREAD project. The goal of the project is to generate substantial knowledge, awareness and discussion among Pacific Island students, teachers and communities of the global ocean observing systems, climate change, sea level rise, global warming and the local impacts of these dynamics. SEREAD has been providing teacher training and resources to help accomplish their goals. The teachers have given feedback about how valuable the training sessions are and there are plans to offer workshops in Kiribati and Vanuatu next.

6.2. Pacific Island GOOS and Argo

P. Wiles is putting together his report on PI-GOOS and Argo.

6.3. Engaging students' interest and enthusiasm for Argo

Carol Brieseman, a Primary Teacher for over 20 years, reported on her work to engage students in the classroom using Argo data. She was lucky enough to win a Primary Teacher Fellowship with the Royal Society and NIWA was her host for six months. Argo was her main project during that time and she created a wiki page (https://waydownsouth.wikispaces.com/home) for teachers and students with information and resources, including science experiments, on Argo floats, the data they send and science related to it. One of the ways she has found to motivate students to learn and write about it has been to build Cartesian Divers to demonstrate how Argo floats work. She suggested allowing students/classrooms to adopt floats to follow for the school year. These floats could be tagged in the Argo Google Earth layer and could include more simplified displays of data that primary students could interpret.

6.4. South African deployment opportunities and feedback on Argo related research and educational initiatives

Deployment opportunities were noted in the South Atlantic, Southern Ocean and South West Indian Oceans in 2013 for Argo floats. A number of collaborative studies are already planned for most of these cruises between South African groups / institutions and international Argo groups (i.e. University of Brest, WHOI, UK Met Office and CSIRO).

The South African Argo team are involved in new Argo related research. For the SOBOM project, Dr. Isabelle Ansorge of UCT will be providing deployment opportunities for roughly 40 Bio-Argo floats in the Southern Ocean. Dr Sandy Thomalla of CSIR is involved in developing carbon flux index floats for Southern Ocean Carbon Research within the Southern Ocean and has deployed two of these thus far. A further South African procurement is that of 10 APEX II floats by the Department of Environmental Affairs (DEA) which will deployed in the Southern Ocean and the west coast of South Africa as soon as they are set-up on an airtime and data management system. Eddy aging research is taking place in the Mozambique Channel with floats donated by WHOI, UK Met Office and CSIRO for profiling within mesoscale eddies on daily profiles.

Lastly, the Argo initiative is being promoted in secondary and tertiary education courses in South Africa. These initiatives include the adopting by secondary schools of Argo floats procured and deployed by SAEON with the help of SAWS, and plotting this data as science projects, the training of young scientists at the Two Oceans research Aquarium and through short courses at a tertiary education level. A publication within the science magazine, Quest, launched at the SciFest Africa in Grahamstown, South Africa, in March 2013 highlights the training currently undertaken at the secondary education level.

6.5. Mon ocean ét moi web site

The twin projects « *mon océan & moi* » and « *adopt a float* » are presently developed by the Laboratoire d'Oceanographie de Villefranche, in particular in the context of Euro-Argo. One of the main goals is outreach for children (K-12) to increase their ocean literacy through the adoption of a Bio-Argo float which they can follow during its scientific journey. The starting point of these projects relies on the facts that (1) Argo

data can also be delivered in near real-time into classes and (2) Bio-Argo data in particular allows a multidisciplinary approach to the ocean. To address these overall objectives, we have developed the *mon océan & moi* web site which delivers a large range of content (Ocean topics), resources (e.g. pictures, graphs, maps, animations) and quizzes and games on specific oceanographic issues (the three main topics we started with are “observation of the Oceans and Seas”, “phytoplankton”, “zooplankton”, and others will follow). Linked to *mon océan & moi* is the project *adopt a float* which started with three classes adopting a float last November. Adopting a float also means that a class has access as an “ocean voyager” to a social network where the students can share and interact with other classes as well as with the scientists. The scientists and PhD students of the lab thus ensure the “hot-line”, whenever needed, and progressively update a FAQ section.

The prospective of these pilot projects is to progressively translate the proposed contents in English, ultimately allowing a co-adoption of floats between classes of different countries. In parallel, the content of *mon océan & moi* will be regularly evaluated and updated. The next two topics concern “ocean acidification” and “seasons in the oceans”.

6.6. AST recognizes deployment of 1140 Argo floats by RV Kaharoa

It was appropriate that the AST took the opportunity to thank NIWA, the Kaharoa crew and in particular, John Hunt (the world's champion float deployer), for their major contribution to the global program through deployment of over 1000 floats into remote regions in the South Pacific and Indian Oceans. Without dedicated ship time and the efforts of the Kaharoa crew, Argo would not have a global array.

RV *Kaharoa* entering the Wellington, NZ harbor
Photo by A. Blacklock

John Hunt moving an Argo float box onto the deck of the RV *Kaharoa* for deployment

7. Technical issues

7.1. Float technology progress

NAVIS

SBE Navis floats have significant advantages, including small size, long life, and large buoyancy change capacity. NOAA/PMEL deployed 42 SBE Navis floats from January 2012 through March 2013, the first of which is still reporting data, on its 41st profile as of this report. While quality control of delivered floats appeared excellent, of the 42 deployed floats ten were not currently reporting data in early March 2013. Of those ten, one never reported a profile, seven stopped reporting after exhibiting symptoms of cavitation in their oil ballasting systems (only those deployed at higher latitudes), one stopped reporting after exhibiting symptoms of an air valve sticking, and one exhibited symptoms of both oil cavitation and stuck air valve systems. SBE is making progress on needed hardware improvements to remedy these early problems. These changes include already implemented changes to the oil pump design, oil viscosity, and internal partial vacuum. They also include implemented air check-valve fixes. SBE is testing a much more gas-impermiable oil bladder. It would also be desirable to improve data transmission efficiency.

NOVA

In 2012, Germany deployed 2 NOVA floats and Canada deployed 27 NOVA floats. Among the Canadian NOVA floats, two failed on deployment and did not return any data. Three other NOVA floats died prematurely after 3, 4 and 7 profiles respectively. The remaining 22 Canadian NOVA floats worked well. With regards to positioning, the two German floats and one Canadian float experienced GPS problems, forcing reliance on much less accurate Iridium positioning. We appreciated the user-friendly nature of the BlueTooth interface provided by MetOcean to perform pre-deployment parameter checks on the floats.

In 2013, Canada bought 29 NOVA floats with a new configuration. These have non-uniform vertical sampling levels, with a 5 db interval between 2000 db and 500 db, a 2.5 db interval between 500 and 100 db, and 1 db interval between 100 db and 2 db. All temperature and salinity measurements will be pumped, and we will stop making measurements at 2db. In the previous version, the shallowest pumped T-S

measurement was done at 5db, and an un-pumped surface measurement close to 0 db was taken. To ease physical manipulation of the floats at sea, we asked MetOcean to install handles near the top and bottom of the float, which they did. We were told by MetOcean that they plan to switch from SBD packets to RUDICS in the next evolution of the float.

SOLO2/S2A

SOLO-2 floats make continuous CTD profiles from 2000 dbar to the surface with 2 dbar bin averages to 20 dbar and 1 dbar bins to 1 dbar. The electrical energy expended for this mission is 9.5 kJ/cycle, where 63% is used for the buoyancy engine, 32% for the CTD and the remaining energy is used for communications, GPS positioning and the controller. Software and hardware changes and improvements for SOLO-2 floats are shared between the Scripps Instrument Development Group and by MRV so that SOLO-2 floats are essentially identical between the two groups and will remain so for the foreseeable future. WHOI is also involved in these developments and in diagnosing problems with the floats. Data from all SOLO-2 floats are presently being processed at both SIO and WHOI. Decoding software to enable users to insert the data from SOLO-2 floats is available from WHOI to the Argo community. A common, web-based interface to alter the mission parameters for the floats is also available to the community. After a high failure rate for first deployment of 15 SOLO-2 due to the tears of the external bladder, modifications were made that has produced a success rate of greater than 95% for the next 180 floats. Further refinements of the software and hardware address probable cause of these premature failures. These improvements include a more effective and durable Iridium/GPS antenna.

Action item 19: Follow up with MRV to confirm delineation of SOLO2 separate from S2A. B. Owens

7.2. Salinity drift in Argo floats

B. Owens delivered a talk prepared by David Murphy from Sea-Bird on drift in SBE CTDs. He showed that Sea-Bird's temperature accuracy has been continuous throughout the history of the Argo program and that the temperature drift is within 0.002 degrees. Next he addressed the pressure stability based on the first 424 floats. Most have a very small offset after 72 profiles.

Since 2009, all Druck pressure sensors are subjected to a rigorous screening process and only those that fall within +/-0.25 db are used in Argo CTDs. Currently, pressure sensitivity to temperature is not adequately corrected. Sea-Bird is investigating reworking the calibration equation.

88% of floats are drifting +/-0.002 PSU compared to climatology through float cycle 72. Sea-Bird is working to understand the cause of the drift in the 12% of floats that are drifting. Nine years of calibrations referenced to the initial calibration done at the time of manufacture show that the CTD is within +/- 0.005 PSU. He points out that different PI groups show different percentages of drift and drift characteristics. To find the source of the salinity error, Sea-Bird is investigating pressure errors, temperature errors and conductivity errors. Both pressure and temperature seem unlikely sources as the errors would have to be very large to produce the salinity error. Therefore, it is likely caused by conductivity sensor errors. He reminded the AST that the conductivity cell could be

damaged or the conductivity sensor circuit could have errors. Fouling of the cell causes negative drift and cell damage can cause positive drift with a large error. Problems with the conductivity sensor circuit could be due to resistor and capacitor difficulties and these could cause both directions of drift. Even knowing these likely mechanisms, it does not explain why some PIs are more impacted than others. Further study shows that positive conductivity drift correlates with low latitude deployments. This could be due to more water vapor inside floats at warmer latitudes or that components on the CTD circuit board are affected by the high humidity. Sea-Bird is conducting humidity experiments to verify the mechanism that causes positive conductivity drift.

Action item 20: National programs to explore working with Sea-Bird and piggy-backing on hydrographic cruises. National programs

Action item 21: Request Sea-Bird report on any potential thermal lag errors in the Kistler pressure sensor. B. Owens

Action item 22: Report on the potential impacts to Argo of temperature dependence of pressure calibration not being linear. B. Owens

7.3. Progress on a CTD for Deep Argo

B. Owens presented a second talk prepared by David Murphy of Sea-Bird on work being done on CTDs for Deep Argo. Currently, Sea-Bird is meeting the Deep Argo temperature requirements. Improvements will be in acquisition and calibration noise, but not in absolute accuracy. For pressure, Sea-Bird is rigorously screening sensors and plans on using 7000 dbar Kistler sensors. They are installing equipment needed to make multi temperature point pressure slope corrections. For conductivity, Sea-Bird is investigating humidity effects with lab experiments and preparing to hermitically enclose the conductivity circuit to conduct field experiments.

7.4. SeaBird warranty announcement

Sea-Bird reminded the AST the warranty on SBE 41 and SBE 41cp Argo CTDs for a period of 5 years after manufacture, subject to a special warranty policy. The warranty period for the last of these products that may have experienced a failure of the glass metal seals within their Druck pressure sensor (the Druck micro-leak problem) will end in on April 1, 2014. To ensure that there is time to evaluate any CTDs that may be exhibiting this failure mode, Sea-Bird requests that the serial numbers of CTDs that may qualify for warranty replacement be forwarded to Sea-Bird by June 30, 2013. See the website for additional information:
http://www.seabird.com/technical_bulletins/ArgoNotice_LastCall.htm

Action item 23: PIs note the last call for claims under the SeaBird warranty regarding the failed Druck sensors. M. Scanderbeg please send notice. All PIs.

7.5. Deep Argo float progress

Deep ARVOR
Ifremer has designed the Deep Arvor which is an extension of the 2000m version of Arvor. The goal is to achieve more than 150 cycles at 3500m depth with the CTD

(continuously pumped) and oxygen measurements. The self-ballasting and the light weight features of Arvor have been maintained in a cost effective solution. Several improvements have been done like transmission of high sampling profiles with Iridium communications, filament winding housing to save weight, new technical parameters for diagnostics to better monitor the float behavior. Sub-assemblies have undergone intensive tests in pressure tanks.

One prototype, cycling every 2 days, has been launched in the mid-Atlantic Ocean from August 2012 to January 2013. It was deployed in an area where the water masses are stable in order to assess the quality and behaviour of the sensors in deep layers. It performed 60 cycles at 3500m depth.

This year, the industrial float will be extended to a 4000m operating depth.

Deep NINJA

Tsurumi Seiki Co. and JAMSTEC have developed a new profiling float for the deep ocean, “Deep NINJA”, which has an ability to measure P/T/S profiles at depths of up to 4000 dbar. After a field test in the Japan Sea with R/V *Natsushima* (JAMSTEC) in May 2012, another field test for deep ocean observation was carried out with 2 prototypes in August - October 2012. Both of them successfully profiled P/T/S from the depth of 4000 dbar. However, communication has been lost with one float since the first ascending, probably due to trouble in its communication module. The other ceased its operation in November. In December 2012, 4 Deep NINJAs were deployed in the Southern Ocean (3 off the Adelie Coast and one in the south of New Zealand) on a R/V *Mirai* cruise to observe variations of Antarctic Bottom Water. All of them have operated well until now. The data measured by Deep NINJAs have not been circulated on the Argo data stream yet, because documents describing its data format are not ready. The data circulation is planned to begin in April 2013. Deep NINJA will be available for the public in 2013.

Deep SOLO

Two prototype Deep SOLO floats have been produced by the Scripps Float Lab, and one of these was deployed at a CalCOFI Station by NOAA’s RV *Bell Shimada* on 24 January 2013. The Deep SOLO uses a modified version (for deep-sea) of the SOLO-II pumping system, housed in a 13-inch glass sphere and hardhat, with a prototype Sea-Bird CTD mounted underneath. Deep SOLO is designed for 6000 m depth, but the initial deployment off central California was in water of just over 4000 m. As of the date of AST-14 the float had completed 20 cycles to 4000 m, returning good CTD profiles (via Iridium SBD) and diagnostic information. Plans are to obtain about 50 cycles during this deployment, then recover the float and redeploy both prototype floats in about 5500 m water depth later in 2013. (Report by D. Roemmich)

Deep APEX

Susan Wijffels showed material from Ernest Petzrick from Teledynne Webb Research on the status of the development of the deep APEX. In 2011, basic mechanical and electrical design was completed, preliminary glass testing was carried out and a decision taken to use glass spheres for a hull. In 2012, cycle testing of spheres was done including over 500 cycles to 10,000 psi, and glass hole pattern and drilled pressure testing was complete. In this year prototypes were built and 4,000 meter test dives completed. A second set of prototypes is being tested.

In 2013 a profile from over 6,000 meters was completed over 26/27 February. Ongoing at present are multiple profiles over 6,000 meters and compressibility tests. Later in the year, both altimeter and turbidity sensor testing will be carried out, as well as lithium battery testing

It is expected that deep APEX will be available for purchase in 2014.

7.6. Status of ARGOS constellation

Y. Bernard sent a presentation on the ARGOS constellation that was presented by M. Belbéoch. Two new Argos satellites were recently successfully launched in the end of 2012 and the beginning of 2013. Currently there are 8 operational Argos satellites - 4 Argos-2 and 4 Argos-3 (only 2 have their downlink on). The sustainability of the Argos satellite system is compatible with long Argo float lifetimes of roughly 10 years. He presented suggestions on how to use Argos for two time categories: until 2016 and after 2016. Until 2016, he suggested using Argos-2 for < 0.5 kbytes of data per profile, Argos-3 low data rate mode for 0.5 kbytes to 2.5 kbytes of data and Argos-3 high data rate mode for > 2.5 kbytes of data. After 2016, Argos-2 and Argos-3 (with three satellites) will still be available. Argos-4 with be available and is designed for high volumes of data. It is planned on being operational until 2028 - 2030.

Next Y. Bernard summarized the possible work that Argos could do reprocessing Argos locations with the Kalman filtering method and to provide error ellipses for the Argo array fro 2008 - 2011. Additionally, CLS could work to create a system that routinely sends error ellipses for all Argo floats. He is creating a proposal for this work that will be sent to the AST for evaluation.

7.7. Standardized sampling for Iridium Argo floats; Bin-averaging/ spot sampling

High bandwidth transmission systems (e.g. Iridium) allow greater volumes of data to be returned by Argo floats. At AST-13, it was suggested that Argo floats be programmed to sample at 2-dbar vertical resolution from 0-2000dbar. Presently many Argo floats using Iridium sample more coarsely deeper than 1000dbar primarily to expend less energy per cycle, extending float lifetimes.

All Argo float data (as of March 10th, 2013) that sampled at 2dbar resolution over the full water column was used to assess the possible temperature bias introduced by reducing vertical sampling resolution. The temperature averaged over 1000-1600dbar from a fully resolved 2dbar profile was compared to that obtained from a sub-sampled profile. In both cases, the averages were computed via linearly interpolating between data points. As expected, an increased bias of computed average temperature is introduced in regions with greater vertical temperature curvature (e. g. the equator) and with decreased resolution.

Other interpolation models (e. g. cubic spline) could reduce the bias, however any vertical model of the ocean will be imperfect and likely to maintain some bias. An Argo float success metric tuned to only float lifetime will likely result in more cycles, but degraded data that may not be optimal for sensitive climate studies.

8. Demonstrating Argo's value

8.1. Argo's First Million Profiles follow-up

There was a brief discussion on what various countries did to celebrate the million profile milestone. Most countries posted the event on websites and some were able to get articles in newspapers. The US held a fruitful one day symposium which was attended by NOAA representatives. The new Argo Brochure was handed out at this symposium. S. Wijffels suggested trying to use the millionth profile as a way to write a high profile article celebrating Argo's contribution to climate science. H. Freeland will begin coordinating this and will happily accept help from others.

8.2. Argo bibliography

J. Gilson presented on behalf of M. Scanderbeg on the Argo bibliography. There are now routinely over 200 papers including Argo data published per year and we reached over 1200 total papers published. In response to an action item from AST-13, a new plot was added to the Argo bibliography page showing the journals publishing the most papers including Argo data. The Journal of Geophysical Research, Geophysical Research Letters and the Journal of Physical Oceanography are the top three journals with a combined total of almost 350 Argo related papers.

M. Scanderbeg has found that searching directly in journal databases, combined with using Google Scholar to catch any articles published in journals not directly searched and direct submissions to the bibliography is the most effective method of compiling the Argo bibliography. In 2012, based on feedback from National Reports, 88% percent of papers were found (98% of papers published in English). The majority of missing papers were not published in English. There continue to be a few papers published which use Argo data in a database and where Argo itself is not mentioned in the article. For these papers to be included in the bibliography, they must be directly submitted to M. Scanderbeg or she will not be able to find them.

Finally, another action item from AST-13 called for the investigation of creating a bibliography of theses published using Argo data. M. Scanderbeg found several databases that covered the US, Canada, Europe and Australia. Occasionally pdfs of the actual thesis are not available, but these databases provide a good starting point for compiling a bibliography of theses. There was an appeal to AST members to inform M. Scanderbeg of any other thesis databases or to provide actual lists of theses published using Argo data within the representative's country. It was concluded that this will be a useful addition to the Argo website and M. Scanderbeg will begin compiling a list of these published using Argo data. It will not be complete, but will be a starting place to show the impact Argo is having on the education system at the graduate level.

8.3. Google Ocean

The latest developments made by the JCOMMOPS team on the G-Earth Argo package were presented. Two new features are available through a "Query page" to display all observations available at GDACs, or any float trajectories from a spatial/temporal query. T/S overlays were updated with the latest Argo Atlas version, and promoted at the root of the layer.

The Argo TC proposed to work with S. Diggs on establishing a working group of developers to create new tools to explore and promote the Argo dataset.

Action item 24: Simplified version of Google Earth balloons associated with floats. Suggest surface/bottom temperature. Adopt a float for school children. M. Belbéoch

Action item 25: Start consultations within the community regarding new design of data serving (Argo API). GDAC, M. Belbéoch, S. Diggs

8.4. Argonautics Newsletter

J. Gilson presented on behalf of M. Scanderbeg on the proposed articles for the 2013 edition of the Argonautics Newsletter. In order to expand on the wonderful education and outreach presented at the AST-14 meeting, M. Scanderbeg would like to include articles on them in the next Argonautics. The first time topics would include work done on the SEREAD program, new developments in PI-GOOS, an introduction to Carol Briesman's Argo blog and the Mon Ocean et Moi web page presented by Herve Claustre. Additionally, there could be a follow up to the work being done in South Africa and the deployment of floats from sailing vessels.

All Deep float providers will be invited to submit articles describing their floats and any testing of prototypes that has occurred. Updates to the AST webpage will be highlighted including the new Argo thesis citation list will be introduced as well as the improved FAQ webpage.

It was suggested to include an article on the revolution of Iridium 2-way communication to the Argo array. Finally, the new format of the trajectory files will be highlighted, with care being taken to explain the two-file system being adopted. Other articles are always welcome. Please submit them to M. Scanderbeg at mscanderbeg@ucsd.edu.

8.5. Upcoming science conferences and workshops

The GODAE OceanView Symposium will take place 4 - 6 November 2013 at NOAA-NCWCP, USA. A letter was sent to AST co-chairs asking that Argo be represented at the meeting.

There will be a EuroArgo Users Workshop at National Oceanography Centre, UK 18 - 20 June 2013.

The PICES meeting will be held 14 - 18 October 2013 in British Columbia, Canada.

China plans to hold a Chinese Argo Science Workshop in November 2013.

The Ocean Sciences Meeting on 23 - 28 February 2014 in Honolulu, HI will include a special session with Bo Qiu. One of the themes is exploring oceanic variability through Argo and satellites.

There will be a Future Marine Monitoring technology meeting at National Oceanography Centre, UK in October 2014.

The 50th Anniversary of the International Indian Ocean Expedition is being planned by the chairs of GOOS/CLIVAR Indian Ocean Panel. If you are interested in being involved, please contact Nick D'Adamo at nick.dadamo@bom.gov.au.

Action item 26: Send 50th anniversary Ocean Expeditions prospectus to the AST. S. Wijffels

8.6. Argo "sidebar" in BAMS State of the Climate in 2012

The BAMS Argo sidebar, written by the AST, is accepted and will be published in August.

8.7. Argo (review of major findings) in Nature Climate Change?

H. Freeland will lead an effort to write a review paper for submission to Nature Climate Change.

Action item 27: Work to put together a review article to submit to Nature Climate Change around the millionth profile. Include a powerful graphic or photo. H. Freeland, S. Wijffels to coordinate

8.8. Other Argo outreach activities

Action item 28: Build exchange of teaching ideas/techniques into Argo web page or something similar. H. Freeland

9. Future meetings

9.1. ADMT-14

ADMT-14 will take place in Liverpool, UK 14-18 October 2013.

Action item 29: DAC data teams to check CSIRO pressure audit to confirm floats are being properly corrected. All DACs

9.2. AST-15

The Canadian Argo Program has offered to host the AST-15 meeting in Halifax, Nova Scotia in March 2014. An organizing committee has already been formed and is beginning preparations for the meeting. The Spanish Argo Program has offered to host the following AST meeting in March 2015.

9.3. DMQC-5

DMQC-5 will take place in conjunction with the ADMT-14 meeting this fall in Liverpool, UK.

Action item 30: Gather the DMQC operators to work on agenda for next workshop. J. Gilson

10. AST membership

Summary of the discussion on the reestablishment of an **Argo Director:**

The offer was presented to the AST whereby Howard Freeland would take on the role of Argo Director (AD). Howard would be hosted by the Institute of Ocean Sciences, Canada with Argo and its contributing countries supporting his travel and operating budget either directly or via the AIC. His time would be volunteered at roughly 50% of full time. The proposal is that he would start in July 2013 and work through for two years before revisiting the situation. The AST gratefully endorsed the proposal and thanked Howard for his generous willingness to support Argo.

The potential duties of the AD were revisited and include:

- On behalf of the AST to work with, and to monitor and direct the activities of the Argo Technical Coordinator functions delivered via the JCOMMOPS centre
- To work with contributing programs and agencies to provide effective publicity for Argo, including producing material and giving presentations to enhance a wider recognition of the progress made and opportunities presented by Argo.
- Help demonstrate the value of Argo to science and the wellbeing of nations. In the near term, to lead a high profile review paper on contributions of Argo to climate science to draw attention to accomplishments and its impacts
- To share with the AST Co-Chairs and the ADMT Co-Chairs the representation of Argo at meetings of relevant bodies and through liaison with related programs.
- To ensure that all users of Argo have easy and timely access to the information they
  require on Argo, particularly by finding or making tools to help make Argo data easier to understand and use e.g. FAQs and Primers, and to reach out to communities outside the physics/climate domains.

11. Other business

There was a discussion on whether or not to begin allowing commercial representatives attend AST meetings. This has not been permitted in the past, but this is now making it very difficult for companies to directly communicate technical information to the AST. It was suggested that the plenary AST meeting could be extended for a half day to allow for technical presentations to be given directly by float, sensor, and communications suppliers. In particular the AST are seeking technical information on platform and sensor performance and development that will affect the data stream or operation of Argo. Thus, the AST might solicit talk abstracts that would be approved to avoid an open and general marketing pitch. Having such a session will involve more planning and, potentially, larger facilities depending on how many companies plan to attend. To help with this, a registration fee may be charged for the next AST meeting. These issues will continue to be discussed among AST members in the course of the year and in preparation for the AST-15 meeting.

The only other item of business was the issue of how the Argo missions will be named. Currently, the definitions are not precise and Argo could benefit from making the definitions more precise. Not all of the people needed in this effort were present at the

meeting, so it was decided to clarify the definitions electronically to allow for larger participation.

Action item 31: The web page announcement of the next AST meeting will include guidelines for commercial entities wishing to make technical presentations. AST co-chairs

Action item 32: Co-chairs and director will make a proposal on new Argo 'mission' descriptions. Within 6 months should have a consensus. All AST should comment on the proposal when it is produced. AIC report has many metrics that may be a strong basis, please comment. Start discussions with GODAE team. AST co-chairs and AST

Argo Steering Team Meeting (AST-14)
Te Wharewaka o Poneke, Wellington, March 18-21, 2012
Host: National Institute of Water and Atmospheric Research, N.Z.

AST Exec meeting: 18 March 1 pm

AST-14: 19 March 9 am – 21 March 1 pm.

1. Welcome (9 am March 19) Rob Murdoch, NIWA

2. Local arrangements (Sutton)

3. Objectives of the meeting/adoption of the agenda

   Making the Global Argo Mission more complete and robust.

   Argo Science, Education, and Outreach in the SW Pacific.

4. Status of action items from AST-13 (Scanderbeg/Gilson)

5. Implementation issues
   - 5.1 AIC Report on Status of Argo (Belbéoch)
   - 5.2 Update commitments table (Scanderbeg/Gilson)
   - 5.3 Float deployment opportunities (Belbéoch)
   - 5.4 Follow-up to ASW-4 Roundtable. Is it time to change the Argo design?
     - 5.4.0 Prologue: Floats required (Belbéoch)
     - 5.4.1 High latitudes (Wijffels)
     - 5.4.2 Western boundary regions (Suga)
     - 5.4.3 Marginal seas (Poulain)
     - 5.4.4 Equatorial Pacific (Roemmich)
   - 5.5 Bio-Argo/Biogeochemical Argo (Claustre)
   - 5.6 AIC Funding (Freeland)
   - 5.7 JCOMM Observing Program Support Centre (Belbéoch)
   - 5.8 Argo Europe (Le Traon, …)
   - 5.9 Argo India (Ravichandran)
   - 5.10 Argo China (Xu)
   - 5.11 Discussion items from National Reports?

6. Data Management related issues
   - 6.1 Feedback from ADMT-13 (Thresher/Pouliquen)
   - 6.2 Trajectory data, status and pathway forward (Ollitrault)
   - 6.3 CCHDO/NODC activity/reference data (Diggs)
   - 6.4 Status of the U.S. GDAC (Piotrowicz)

7. Regional science, education and outreach

7.1 Science presentation: ‘Assessing mean dynamic topography in two boundary currents from *in situ* and satellite data’ by M. Bowen, Auckland University

7.2 Science presentation: ‘Aspects of the water masses and circulation in the southwest Pacific from Argo data’ by K. Ridgway, CSIRO

7.3 Bluelink/Decadal Modes(O’Kane, Wijffels)

7.4 The SEREAD project (J. Hall)

7.5 Pacific Island GOOS and Argo (P. Wiles)

7.6 Engaging students' interest and enthusiasm for Argo (C. Briesman)

7.7 ‘South African deployment opportunities and feed-back on Argo related research and educational initiatives’ (T. Morris)

7.8 “Mon ocean et moi” web site (Claustre)

7.9 AST recognizes deployment of 1140 Argo floats by RV Kaharoa

8. Technical issues

8.1 Float technology progress (several presenters)

8.2 Salinity drift in Argo floats (D. Murphy/presented by B. Owens)

8.3 Progress on a CTD for Deep Argo (D. Murphy, presented by B. Owens)

8.4 SeaBird warranty announcement

8.5 Deep Argo floats progress (Roemmich, Suga, Thierry, Riser)

8.6 Status of ARGOS constellation (Y. Bernard, presented by M. Belbeoch)

8.7 Standardized sampling for Iridium Argo floats; Bin-averaging/spot sampling (Gilson)

9. Demonstrating Argo’s value

9.1 Argo’s First Million Profiles follow-up

9.2 Argo bibliography (Scanderbeg/Gilson)

9.3 Google Ocean (Diggs/Belbeoch)

9.4 Argonautics Newsletter (Scanderbeg/Gilson)

9.5 Upcoming science conferences and workshops

9.6 Argo “sidebar” in BAMS State of the Climate in 2012

9.7 Argo (review of major findings) in Nature Climate Change ?

9.8 Other Argo outreach activities –

10. Future meetings

10.1 ADMT-14 –Liverpool, UK

10.2 AST-15

Should the AST policy of excluding commercial representation be modified? (for purposes of technical reporting or for 1-day open sessions)

10.3 DMQC-5

11. AST Membership

12. Other business

Meeting adjourns Thursday 21 March, 1 p.m.

first name	name	Institution and Address	e-mail address
Mathieu	BELBEOCH	JCOMMOPS, 8-10, rue Hermès,Parc technologique du Canal , Ramonville, France 31526	belbeoch@jcommops.org
Melissa	BOWEN	School of Environment, The University of Auckland, Private Bag 92019, Auckland, NZ	m.bowen@auckland.ac.nz
Carol	BRIESEMAN		carol.brieseman@hamptonhill.school.nz
Zhi	CHEN	State Oceanic Administration People's Republic of China, No. 1 Fuxingmenwai Ave, Beijing, CHINA 100860	chenzhi@nmefc.gov.cn
Young Jean	CHOI	NATIONAL INSTITUTE of METEOROLOGICAL RESEARCH/KMA, 45 Gisangcheong-gil, Dongjak-gu, Seoul, KOREA, 156-720	yjchoikma@korea.kr
Herve	CLAUSTRE	CNRS-UPMC-LOV, Quai de la Darse, Villefranche sur mer, PACA, France 06230	claustre@obs-vlfr.fr
Steve	DIGGS	Scripps Institution of Oceanography, 9500 Gilman Dr., #0214, La Jolla, CA 92093-0214, USA	sdiggs@ucsd.edu
Howard	FREELAND	Fisheries and Oceans Canada, Institute of Ocean Sciences, North Saanich, BC V8L 4B2 CANADA	howard.freeland@dfo-mpo.gc.ca
Denis	GILBERT	Fisheries and Oceans Canada, 850 route de la mer, P.O. Box 1000, Mont-Joli, Quebec, G5H 3Z4 Canada	denis.gilbert@dfo-mpo.gc.ca
John	GILSON	Scripps Institution of Oceanography, 3709 Mississippi St., San Diego, CA 92104, US	jegilson@gmail.com
Julie	HALL	NIWA (National Institute of Water and Atmospheric Research), 301 Evans Bay Parade, Wellington, NZ, 6241	julie.hall@niwa.co.nz
Shigeki	HOSODA	JAMSTEC, 2-15, Natsushima-cho, Yokosuka, Kanagawa, JAPAN 237-0061	hosodas@jamstec.go.jp
Fengying	JI	National Marine Data & Information Service, 93# Liuwei Road, Hedong District, Tianjin, 300171, China	jfywork@yahoo.com.cn
Birgit	KLEIN	Bundesamt fuer Seeschifffahrt und Hydrographie, bernhard-Nocht-str. 78, Hamburg, Germany 20359	Birgit.klein@bsh.de
Byunghwan	LIM	NATIONAL INSTITUTE of METEOROLOGICAL RESEARCH/KMA, 45 Gisangcheong-gil, Dongjak-gu, Seoul, KOREA, 156-720	weatherman@korea.kr
Zenghong	LIU	The Second Institute of Oceanography, SOA, No.36 Baochubei Road, Hangzhou, Zhejiang, CHINA 310012	davids_liu@263.net
Emina	MAMACA	IFREMER, Pointe du diable, Technopole Brest Iroise, Plouzane, France 29280	emina.mamaca@ifremer.fr
Tamaryn	MORRIS	Bayworld Centre for Research and Education, 2nd floor, Foretrust Bldg, Hammerschlag Way, Cape Town, South Africa, 8012	tammy@oceanafrica.com
Rob	MURDOCH	NIWA (National Institute of Water and Atmospheric Research), 301 Evans Bay Parade, Greta Point, Wellington, NZ, 6021	r.murdoch@niwa.co.nz
Arona	NGARI	Cook Islands Meteorological Service, 1 Seawall Road, Nikao, Avarua, Rarotonga, COOK ISLANDS 127	angari@met.gov.ck
Satoshi	OGAWA	Japan Meteorological Agency, 1-3-4 Otemachi, Chiyoda-ku, Tokyo, JAPAN 1008122	s.ogawa@met.kishou.go.jp

Breck	OWENS	Woods Hole Oceanographic Institution, 266 Woods Hole Rd, Woods Hole, MA 02540	bowens@whoi.edu
Steve	PIOTROWICZ	National Oceanic and Atmospheric Administration, 1100 Wayne Ave, Suite 1202, Silver Spring, MD 20910 USA	steve.piotrowicz@noaa.gov
Pierre-Marie	POULAIN	OGS, Borgo Grotta Gigante, 42/c, Sgonico, Trieste, ITALY 34010	ppoulain@inogs.it
Muthalagu	RAVICHANDRAN	Indian National Centre for Ocean Information Services, Ocean Valley, Pragathi Nagar (SO), Nizampet (BO), Hyderabad, Andhra Pradesh, 500090, India	ravi@incois.gov.in
Ken	RIDGWAY	CSIRO, CMAR, Castray Esplanade, Hobart, Tasmania, 7001 Australia	ken.ridgway@csiro.au
Dean	ROEMMICH	Scripps Institution of Oceanography, 9500 Gilman Dr., #0230, La Jolla, CA 92093-0230, USA	droemmich@ucsd.edu
Luis	SANTOS	Brazilian Navy, Rua Barao de Jacequai S/N, Ponta D'Areia, Niteroi, Rio De Janeiro, BRAZIL 24048-900	felipe.santos@chm.mar.mil.br
Toshio	SUGA	JAMSTEC and Tohoku University, Aramaki-Aza-Aoba 6-3, Aoba-Ku, Sendai, Miyagi, 980-8578 Japan	suga@pol.gp.tohoku.ac.jp
Moon-Sik	SUK	Korea Institute of Ocean Science & Technology (KIOST), 787 Haeanro, Seoul, KOREA, 426-744	msuk@kordi.re.kr
Phil	SUTTON	NIWA (National Institute of Water and Atmospheric Research), 301 Evans Bay Parade, Greta Point, Wellington, NZ, 6021	p.sutton@niwa.co.nz
Ann	THRESHER	CSIRO, CMAR, Castray Esplanade, Hobart, Tasmania, 7001 Australia	ann.thresher@csiro.au
Jonathan	TURTON	Met Office, FitzRoy Rd, Exeter, Devon EX1 3PB UK	jon.turton@metoffice.gov.uk
Susan	WIJFFELS	Centre for Australian Weather and Climate Research, CSIRO, Castray Esplanade, Hobart, Tasmania, 7004 Australia	susan.wijffels@csiro.au
Phil	WILES	Pacific Islands Global Ocean Observing System, Secretariat of the Pacific Regional Environment Program, PO Box 240, Apia, Samoa	philipw@sprep.org
Jianping	XU	The Second Institute of Oceanography, SOA, No.36 Baochubei Road, Hangzhou, Zhejiang, CHINA 310012	sioxjp@139.com
Rui	ZHENG	State Oceanic Administration People's Republic of China, No. 1 Fuxingmenwai Ave, Beijing, CHINA 100860	zhengrui047@163.com

	Action	Responsibility	Status
1	Write letter of thanks to local hosts Rob Murdoch and Phil Sutton	AST co-chairs	
2	Improve the content on the Argo Wikipedia page.	H. Freeland	
3	Translate Argo Wikipedia page into non-English languages after Action item 2 is completed.	T. Suga, B. Klein, L. Zenghong, M.-S. Suk, Euro-Argo	
4	Request all programs submit and maintain deployment planning documentation	National Groups/PIs	
5	Investigate the question of non-institutional vessels deploying floats within EEZ. Ask Rollie Rogers.	J. Turton	
6	Track and highlight the growth of the Southern Ocean array	M. Belbéoch	
7	Query Arctic pilot study groups on Argo float density design. Request Arctic Ocean program design document. Report back to the AST co-chairs.	B. Klein, E. Mamaca, D. Gilbert	
8	Approach the Equatorial Ocean Monitoring System Workshop to help with the planning of Argo within the Equatorial latitude band. Suggest additional deployment opportunities if required.	AST co-chairs, National groups who deploy in the equatorial band	
9	Approach OceanView GODAE Task Team on Ocean Observing System Design with a strawman of Argo enhancements and find out if they can assist in evlauating their impact on ocean reanalysis and predictions systems. GODAE is meeting in the USA in November 2014.	S. Wijffels, D. Gilbert, and other	
10	Produce a global map of recommended Argo coverage requirements, including enhancements as noted. For marginal seas, specific plans will be needed from regional partnerships to finalize requirements.	M. Belbéoch	
11	Assistance will be sought from Albert Fischer at the IOC to have the Argo Focal points updated, especially the Indonesian Argo Focal point.	M. Belbéoch	
12	Develop BUFR templates for real time data distribution on the GTS	J. Turton	
13	Develop FAQ of major data/users issues. Continue work on defining important data metrics. Include FAQ on the fluid nature of new as well as old data, thus a frequent refresh of the entire dataset is necessary. Point to NODC for archived 'snapshots'.	M. Scanderbeg, S. Wijffels, J. Gilson	
14	Write a letter to NODC clarifying proper use and archiving of Argo data	AST co-chairs	
15	Request assignment of new float WMO code table entries through J. Turton	J. Turton, M. Belbéoch	
16	Clarify what the AST requires for use of a DOI to label Argo data (linked to pre-completed NODC archive snapshot)	AST	
17	Educate users on changes to trajectory file, including R and D files versions, on ADMT, AIC, AST websites by end of April	M. Scanderbeg	
18	DACs/PIs consider the option of paying for trajectory updates using the ANDRO database	All DACs/PIs	
19	Follow up with MRV to confirm delineation of SOLO2 separate	B. Owens	

	from S2A.		
20	National programs to explore working with Seabird and piggy-backing on hydrographic cruises.	National Programs	
21	Request Seabird report on the any potential thermal lag errors in the Kistler pressure sensor.	B. Owens	
22	Report on the potential impacts to Argo of temperature dependence of pressure calibration not being linear	B. Owens	
23	PIs note the last call for claims under the SeaBird warranty regarding the failed Druck sensors. M. Scanderbeg please send notice.	All PIs	
24	Simplified version of Google Earth balloons associated with floats. Suggest surface/bottom temperature. Adopt a float for school kids.	M. Belbéoch	
25	Start consultations within the community regarding new design of data serving (Argo API)	GDAC, M. Belbéoch, S. Diggs	
26	Send 50th anniversary Ocean Expeditions prospectus to the AST	S. Wijffels	
27	Work to put together a review article to submit to Nature Climate Change around the millionth profile. Include a powerful graphic or photo.	H. Freeland, S. Wijffels to coordinate	
28	Build exchange of teaching ideas/techniques into Argo web page or something similar.	H. Freeland	
29	DAC data teams to check CSIRO pressure audit to confirm floats are being properly corrected	All DACs	
30	Gather the DMQC operators to work on agenda for next workshop	J. Gilson	
31	The web page announcement of the next AST meeting will include guidelines for commercial entities wishing to make technical presentations.	Co-Chairs	
32	Co-chairs and director will make a proposal on new Argo 'mission' descriptions. Within 6 months should have a consensus. All AST should comment on the proposal when it is produced. AIC report has many metrics that may be a strong basis, please comment. Start discussions with GODAE team.	Co-Chairs and AST	

	2005 Argo deployed *	2005 Argo equiv deployed	2006 Argo deployed	2006 Argo equiv	2007 Argo estimated	2007 Argo deployed	2007 Argo equiv	% deployed vs. estimated	2008 estimated	2008 Argo deployed	2008 Argo equiv deployed	% deployed vs. estimated	2009 estimated	2009 Argo deployed	2009 Argo equiv deployed
Argentina			12												
Australia	64		45		65	47	0	72	55	65		118	50	35	
Brazil	3					4								4	
Canada	29		38		25	18		72	22	25		114	28	23	
Chile	2**	2		4							4				
China	0		6		50			0	32	16		50	60	16	
Costa Rica	2***														
Denmark	0														
Ecuador						3									
European Union	7		3			8									
Finland															
France	89		51		65	36		55	68	90		132	65	35	
Gabon														3	
Germany	56	19	35	1	37	22	13	95	50	61	10	142	57	33	
Greece															
India	43		15		50	38		76	40	15		38	40	7	
Ireland	0								4	4		100		4	
Italy															
Japan	98	12	98	18	95	80	15	100	95	76	16	97	101	55	18
Kenya														5	
Korea (Republic c	37		33		27	13		48	29	29		100	18	17	
Mauritius	0		2												
Mexico	2°													1	
Netherlands	4		4		6	4		67	9	13		144	6	4	
New Zealand	1		3		2	2		100		2			2	2	
Norway	0		2												
Poland														2	
Russia	0													2	
Saudi Arabia															
South Africa	0													2	
Spain	4		1						20			0	20		
Sri Lanka															
UK	28		24		45	31	2	73	35	29		83	35	20	
UN (ice tethered profilers)											10				
USA	455	38	475	21	410	381	29	100	360	326	42	102	360	148	61
Subtotals	854	71	847	44		687	59			751	82			418	79
Total	925		891		877	746		92	819	833		112	842	497	

	2005 Argo deployed *	2005 Argo equiv deployed	2006 Argo deployed	2006 Argo equiv	2007 Argo estimated	2007 Argo deployed	2007 Argo equiv	% deployed vs. estimated	2008 estimated	2008 Argo deployed	2008 Argo equiv deployed	% deployed vs. estimated	2009 estimated	2009 Argo deployed	2009 Argo equiv deployed
·Donated by UK	***Donated by Spain			**Donated by Canada											
*Numbers compil	°1 float donated by Spain														

% deployed vs. estimated	2010 estimated	2010 Argo deployed	2010 Argo equiv deployed	% deployed vs. estimated	2011 estimated	2011 Argo deployed	2011 Argo equiv deployed	% deployed vs. estimated	2012 estimated	2012 Argo deployed	2012 Argo equiv deployed	% deployed vs. estimate	2013 estimated	2013 Argo equiv estimated	
					4				4	4		100			Argentina
70	95	72		76	90	112		124	50	47		94	60	2	Australia
					16										Brazil
	2			0	3	3		100	1			0		1	Bulgaria
82	25	28		112	16	17		106	27	27		100	34		Canada
															Chile
27	50	23		46	50	44		88	30	20		67	40		China
															Costa Rica
															Denmark
															Ecuador
													4	21	European Union
		2				2			2	3		150		4	Finland
54	95	55		58	80	53		66	65	82		126	65	15	France
															Gabon
58	110	41		37	48	48		100	66	72		109	38	7	Germany
	1	1		100	3			0	4					3	Greece
18	40	26		65	45	48		107	40	32		80	40		India
	3	3		100	3	3		100	3	2		67	4		Ireland
	2	1		50	30	4		13	24	2	17	79	16	0	Italy
72	116	51	44	82	127	73	40	89	123	54	29	67	70	33	Japan
															Kenya
94	12	12		100	14	14		100	15	15		100	16		Korea (Republic
	2			0	4	4		100	4			0	2		Mauritius
															Mexico
67	8	9		113	7	7		100	7	7		100	7		Netherlands
100	2	2		100	2	2		100	2	2		100	2		New Zealand
	4	4		100	8			0	3			0		3	Norway
	3			0	2			0	2	1		50		1	Poland
															Russia
		1													Saudi Arabia
					2			0					10	3	South Africa
0	12	10		83	5	17		340	13	6		46	3	3	Spain
										1					Sri Lanka
57	40	25		63	40	39		98	36	38		106	38		UK
															UN (ice tethered
58	500	333	28	72	450	311	42	78	360	328	104	120	320		USA
	1122	699	72		1049	801	82		881	743	150		769	96	
59		771		62		883		84		893		101			
% deployed vs. estimated	2010 estimated	2010 Argo deployed	2010 Argo equiv deployed	% deployed vs. estimated	2011 estimated	2011 Argo deployed	2011 Argo equiv deployed	% deployed vs. estimated	2012 estimated	2012 Argo deployed	2012 Argo equiv deployed	% deployed vs. estimate	2013 estimated	2013 Argo equiv estimated	

	Notes
Argentina	
Australia	~18 for 2014
Brazil	16 possible in 2012
Bulgaria	
Canada	
Chile	
China	
Costa Rica	
Denmark	
Ecuador	
European Union	
Finland	
France	Plan for 65 floats/year for 2012 and beyond
Gabon	
Germany	
Greece	
India	40 floats/yr 2012-2017
Ireland	One float from 2012 being deployed in 2013 by Portugal under SIDERI project
Italy	
Japan	
Kenya	
Korea (Republic of)	
Mauritius	floats provided by UK, aim for up to 4 per year
Mexico	
Netherlands	
New Zealand	
Norway	
Poland	
Russia	
Saudi Arabia	
South Africa	
Spain	
Sri Lanka	
UK	
UN (ice tethered profilers)	
USA	

Argo Australia – 2012 Activities

Report to the Argo Steering Team

Susan Wijffels, Ann Thresher, Esmee Van Wijk, Vito Dirita, Jeff Dunn

The Australian Centre for Atmosphere, Weather and Climate Research: a joint partnership between the Australian Bureau of Meteorology and CSIRO

1. Status of implementation

Floats deployed and their performance

Australia currently has 391 active floats distributed across the Indian and South Pacific Oceans (Figure 1)

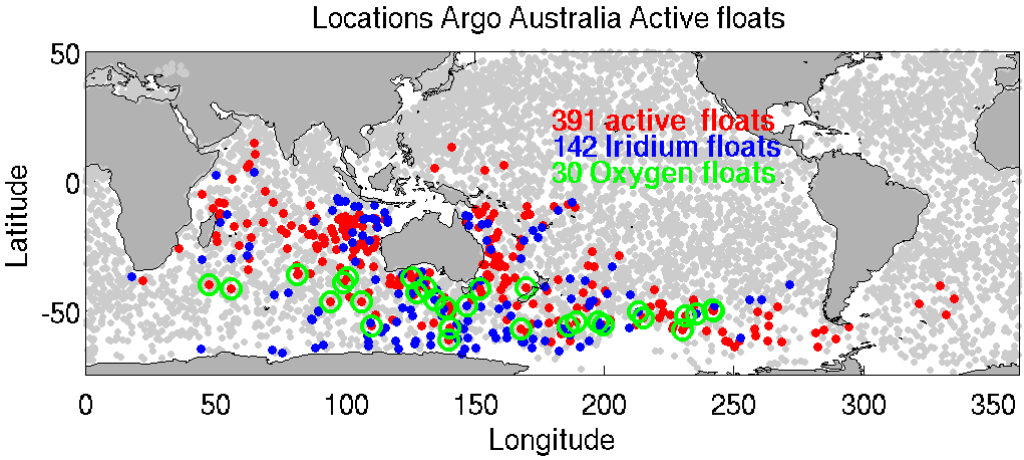
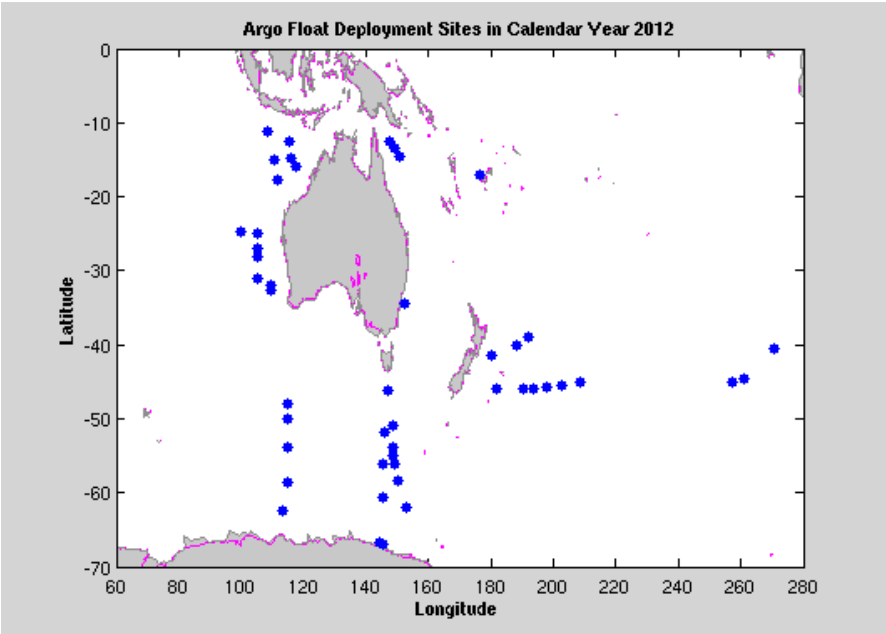


Figure 1. Locations of active Argo Australia floats (colours) as of March 2013 with active international floats in gray. Australian floats using Iridium Communications are in blue and those equipped with oxygen sensors are circled in green.

In the calendar year 2012, the program deployed 48 floats mainly spread throughout the South Pacific and in the Southern Ocean. The sailing vessel *Lady Amber* deployed another 11 floats for Argo Australia bringing her total deployments for us to 65. RV *Kaharoa* also deployed floats for Argo Australia, continuing her successful contribution to the program.

For the first time, we have deployed MRV and Seabird manufactured floats as part of a 'Proof of Concept' trial and analysis of new float technologies. We also have 4 Teledyne Webb APF11 floats which will be deployed shortly.



Technical problems encountered and solved

We have switched almost our entire Iridium fleet to RUDICS communications which has decreased our costs significantly, making the program more sustainable into the future. Technical problems have been very few this year. The biggest challenge has been running the tender process for float purchases (a new requirement with the availability of new float models) and then preparing the floats we purchased as a result of our Proof of Concept trial. We have had to deal with new data formats and different preparation methods, as well as new communications methods (Z modem instead of X modem). Hopefully now that these problems are all solved, we can go forward more easily.

Float Failure Mode Analysis

As of the 15^{h} of March 2013, the Australian Argo program had deployed 558 floats. From the total number of floats deployed; 156 are dead. Of the remaining 402 operational floats, more than 90% are returning good data, 18 floats are producing suspect or bad data and are under review including 4 floats that are confirmed as suffering from the Druck microleak issue. Of the dead floats, 34% ceased to operate due to normal end of life when they ran down their battery packs. A further 12% died of unknown causes and 6% were dead on deployment. The remainder of floats died mainly due to environmental reasons such as grounding (19%), leakage (10%) or were lost in the ice (6%). Other contributing factors are summarized in the table below.

Float failure mode for dead floats	**Number of floats** (156)	**% of dead floats**
End of life	53	34
Grounded	29	19
Unknown	19	12
Leak	16	10
Died on Deployment	10	6

Lost under ice	9	6
Firmware issues	5	3
Turned on too early/went too deep	5	3
Software issues	4	3
CTD failure/damage	2	1
Communications failure	2	1
Druck snowflake	1	1
Redeployed	1	1

Summary of Technical Issues

As for last year, we have had problems with faulty solenoids on some of our floats. These faults mean that the air pump doesn't close, and so the air bladder doesn't inflate. This loss of buoyancy at the surface potentially leads to problem with the satellite communications, particularly for our Iridium floats. We have killed one iridium float with a faulty solenoid because it was incurring excessive communications costs and another two might be suffering from this. One Argos float with a faulty solenoid is still communicating reliably however.

To control telecommunications costs, we have reduced the size of the log file sent by Iridium floats from 60K to 5K. In most cases we still receive sufficient diagnostic information and can increase the log file size when necessary to diagnose failure modes.

Many faults are detected before we deploy the floats during our extensive lab testing. These include faulty transmitters, unreliable solenoid connections which required soldering by our technicians, calibration issues and erroneous metadata programmed into the floats. Some are more serious than others. We have the ability to reprogram the floats in-house which simplifies correction of most metadata errors (wrong serial numbers or iridium dial-up strings – a relatively common problem). Other problems have required return of the float or sensors to the manufacturer.

Status of contributions to Argo data management

Ann Thresher is now co-chairing the Argo Data Management Team.

Collaboration with Argo India: The program has continued to work with the Indian Argo program, helping them code for new data formats and install DMQC processes. Esmee van Wijk worked with Uday at INCOIS in the DMQC procedures and he is now working through their backlog. They have now begun encoding BUFR messages as well.

Collaboration with KORDI: We have completed installation of both the Australian ArgoRT system and DMQC software at KORDI. They are now using ArgoRT operationally and beginning the process of DMQC, after Esmee van Wijk trained Moon-Sik during his visit at CSIRO.

Pressure Bias Audit: Jeff Dunn continues to check compliance with ADMT recommendations around the treatment of Truncating Negative Drifting Pressure (TNDP) floats and pressure corrections. This audit has been carried out roughly 6 monthly. Most DACs are now compliant through a few small remaining issues are being chased up.

Metadata Standardisation: Esmee van Wijk, Ann Thresher and Matthieu Belbeoch (with the help of the broader Argo community and manufacturers) have been working on making the content of the global metadata files consistent. A table of fixed configuration parameter names exists on the ADMT website so that file content is standardised. Any new names required for new floats etc. must be added to this table and vetted for consistency before being used in the files. Work on unifying the labelling of data formats is continuing. The manufacturers have been asked to provide a unique data format label with all new floats and manuals. The task to identify old float formats is ongoing but will take some time.

Status of delayed mode quality control process

Australian DM Statistics (as at 15/03/2013)	
D files submitted to GDAC	35796
Total R files	35586
R files eligible for DMQC	20150
Total eligible files for DMQC	55946
Total files at GDAC	71382

Table 1. Delayed Mode processing statistics for the Australian array.

The Australian Argo array continues to grow rapidly with a 30% increase in the total number of profiles delivered to the GDAC compared to the previous year. A total of 558 floats have been deployed to date since the beginning of the Argo program and 402 floats are still operational. As at 15/03/2013, 64% of eligible profiles (those that are greater than 12 months old) have been processed through delayed mode quality control.

The next 12 months will focus on the incorporation of new float types, data formats and metadata variables, multi-profile files, trajectory files, oxygen data and delivery of Argo products. We have 2 new float types (the Solo S2A and Navis floats) that will require tweaks to the RT and DM software to deal with the new formats.

In total 435 floats have been assessed through the DMQC process for drift of the salinity sensor, many of these are now assessed in routine maintenance mode. Of these, 10 floats (2 %) returned no data from deployment and 8 floats (2 %) returned bad data for most of the record due to pressure sensor issues, cracked conductivity cells or other hardware problems. Of the remaining 417 assessable floats, 375 (90%) show no salinity drift for the life of the float. A further 34 (or 10%) of floats show a positive salinity drift. Eight floats (2 %) are affected by a fresh offset or biofouling. Most floats with either a salty or fresh drift were able to be corrected using the OW software. A further 16 floats (4 %) suffered from TBTO fouling at the start of the record, generally only the first or second profiles but in some cases up to 7 profiles.

Detailed descriptions of the quality control process, including the data and plots for each float are available at the following CSIRO website:
http://www.cmar.csiro.au/argo/dmqc/index.html

For those working with trajectory data or whom are interested in float data formats, electronic copies of the CSIRO APEX float manuals are now available online: http://www.cmar.csiro.au/argo/dmqc/html/Australian_float_manuals.html

2. Present level of and future prospects for national funding for Argo

Argo Australia has been part of Australian Government initiative: an Australian Integrated Marine Observing System (IMOS; www.imos.org.au) for research infrastructure funded under the Education Infrastructure Fund (EIF). Argo Australia also gets direct funding from CSIRO's Division of Marine Research, the Australian Climate Change Science Program, in kind assistance from the Bureau of Meteorology and also logistical assistance from the Royal Australian Navy who will deploy floats for us again this year.

EIF funding for Argo Australia ends in June 2013 and while the Australian government has provided bridging funds for July 2013-Dec 2014 under the CRIS program, these funds are very limited - essentially aimed at 'keeping the lights on' - and comprise a 70% cut for most facilities. As a result, many parts of the IMOS network are seeing large quantities of equipment recovered and warehoused. Due to the recognized high value of the program, cuts to Argo were not as severe as initially thought. However, there will be the loss of our full time engineer and a limited float purchase of 20 floats (10 not yet confirmed), less than half of our normal target deployment of 50 floats for the core array per year. In addition, we expect to see delays in DMQC processing as the cuts have meant we cannot grow our data processing team as planned. We are hoping a follow-on program for the IMOS will be forthcoming but to date no announcement has been made.

Despite impact of purchasing fewer floats, due to longer float life times and floats already purchased and prepared for deployment we believe we can maintain an array of around 350 active floats over this period. Due to the lag imposed by our lab-testing processes, the impacts of next years' lower acquisition will only be felt in the out years.

3. Summary of deployment plans (level of commitment, areas of float deployment)

We have just over 60 floats the lab with identified deployment opportunities for most of these in 2012/13, most in the Indian and Southern Oceans, and some in the Western Pacific Ocean (Figure 3). The RAN will deploy floats along IX12 in the Indian Ocean.

In the Pacific, floats will be deployed from ships of opportunity but also the RV *Kaharoa,* in partnership with US Argo and New Zealand's NIWA.

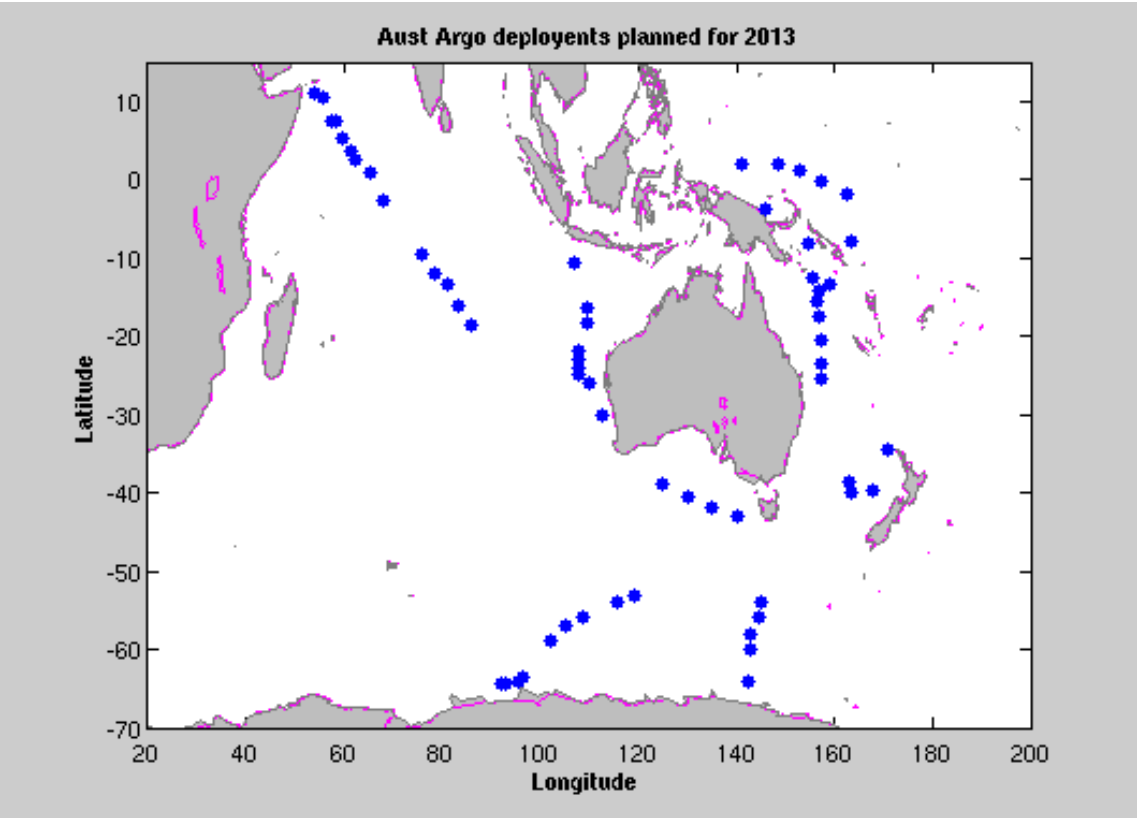


Figure 3. Proposed Locations of planned float deployments over the next year

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centres.

- Argo data are routinely used in the operational upper ocean analyses Australian Bureau of Meteorology (http://www.bom.gov.au/bmrc/ocean/results/climocan.htm).
- The dynamical seasonal forecasting system POAMA heavily uses Argo data for forecast initialization, including assimilating salinity which great improves the analysis – Oscar Alves, Australian Bureau of Meteorology
- CSIRO Marine and Atmospheric Research, in collaboration with the Bureau of Meteorology Research Center, has developed an ocean model/data assimilation system for ocean forecasting and hindcasting. Argo data is the largest *in situ* data source for this system. The ocean reanalysis products can be found here: http://www.cmar.csiro.au/staff/oke/BRAN.htm. The Ocean forecasts are now routinely published and are available via the Bureau of Meteorology website.
- Many students in the CSIRO/University of Tasmania graduate program and University of New South Wales are utilizing Argo data in their thesis studies.
- Jeff Dunn is refining a global ocean climatology based on Argo data - http://www.marine.csiro.au/~dunn/cars2009/

Argo Australia's web site is: http://imos.org.au/argo.html

Real Time data documentation :
http://www.marine.csiro.au/~gronell/ArgoRT/http://www.marine.csiro.au/~gronell/ArgoRT/

Delayed Mode data documentation: http://www.cmar.csiro.au/argo/dmqc/index.html

5. Issues to be raised with the Argo Steering Team

Definition of "core Argo" versus "Bio Argo" Ice Argo" etc. Do we want to create categories of extensions to the argo array in the metadata or will this cause more problems than it's worth? The idea was to create a simple way of searching through the global database so that floats could easily be grouped into different categories. There was however vigorous debate at ADMT as to whether a float can belong to multiple categories, i.e. core Argo and Bio Argo and the wording of these definitions.

7. Argo Publications by Australian Authors 2012

Rintoul, S, Meredith, MP, Schofield, O, Newman, L 2012, The Southern Ocean Observing System, Oceanography, vol. 25, no. 3, pp. 68-69, doi:10.5670/oceanog.2012.76

Durack, P, Wijffels, S, Matear, R 2012, Ocean Salinities Reveal Strong Global Water Cycle Intensification During 1950 to 2000, Science, vol. 336, no. 6080, pp. 455-458, doi:10.1126/science.1212222

Wu, L, Cai, W, Zhang, L, Nakamura, H, Timmermann, A, Joyce, T, McPhaden, M, Alexander, MA, Qiu, B, Visbeck, M, Chang, P, Giese, B 2012, Enhanced warming over the global subtropical western boundary currents, Nature Climate Change, no. 2,pp. 161-166, doi:DOI: 10.1038/NCLIMATE1353

Rousseaux, C, Lowe, R, Feng, M, Waite, A, Thompson, P 2012, The role of the Leeuwin Current and mixed layer depth on the autumn phytoplankton bloom off Ningaloo Reef, Western Australia, Continental Shelf Research, vol. 32, no. 1, pp. 22- 35, doi:10.1016/j.csr.2011.10.010

Zavala-Garay, J, Wilkin, JL, Arango, HG 2012, Predictability of mesoscale variability in the East Australian Current given strong-constraint data assimilation, Journal of Physical Oceanography, doi:10.1175/JPO-D-11-0668.1

Rayson, MD, Jones, N, Ivey, GN 2012, Temporal variability of the standing internal tide in the Browse Basin, Western Australia, Journal of Geophysical Research - Oceans, vol. 117, doi:10.1029/2011JC007523

Sallee, J-B, Matear, R, Rintoul, S, Lenton, A 2012, Localized subduction of anthropogenic carbon dioxide in the Southern Hemisphere oceans, Nature Geoscience, vol. 5, pp. 579-584, doi:10.1038/ngeo1523

Qiu, Y, Cai, W, Li, L, Guo, X 2012, Argo profiles variability of barrier layer in the tropical Indian Ocean and its relationship with the Indian Ocean Dipole, Geophysical Research Letters, vol. 39, doi:10.1029/2012GL051441

Holte, J, Talley, LD, Chereskin, TK, Sloyan, B 2012, The role of air-sea fluxes in Subantarctic Mode Water formation, Journal of Geophysical Research - Oceans, vol. 117, doi:10.1029/2011JC007798

Durack, P, Wijffels, S, Matear, R 2012, Ocean Salinities Confirm an Intensifying Hydrological Cycle, Science, vol. 336, no.6080, pp. 455-458, doi:10.1126/science.1212222

Drushka, K, Sprintall, J, Gille, ST, Wijffels, S 2012, In Situ Observations of madden-Julian Oscillation Mixed Layer Dynamics in the Ondian and Western Pacific Oceans, Journal of Climate, vol. 25, pp. 2306-2328, doi:10.1175/JCLI-D-11-00203.1

Baird, ME, Ridgway, K 2012, The southward transport of sub-mesoscale lenses of Bass Strait Water in the centre of anticyclonic mesoscale eddies, Geophysical Research Letters, vol. 39, doi:10.1029/2011GL050643

Oke, P.R, P. Sakov, M. L. Cahill, J.D. Dunn, R. F. Feidler, D.A. Griffin, J. V. Mansbridge, K. R. Ridgway and A. Schiller, 2013: Towards a dynamically balanced eddy-resolving ocean reanalysis: BRAN3. Ocean Modelling, in review.

Feng, M., M. J. McPhaden, S-P. Xie3, J. Hafner, 2013: La Niña forces unprecedented Leeuwin Current warming in 2011. Nature Scientific Reports, 3, (1277) doi:10.1038/srep01277

BRIEF REPORT ON THE STATUS OF BRAZILIAN ARGO PROGRAM

1. The status of implementation

Brazil, in order to promote the appropriate use of existing resources and installed capacity, beyond the defense of political-strategic interests of Brazil at sea, both nationally and internationally, has a government plan called Sector Plan for the Resources of the Sea (PSRM). In the scope of this Plan, one of the actions is the monitoring and observation of the oceans and climate, conducted by the Brazilian Ocean Observing and Climate (GOOS-Brazil). This system aims to improve scientific knowledge, provide the collected data and support studies, forecasts and actions, helping to reduce risks and vulnerabilities arising from extreme events, climate variability and climate change affecting Brazil.

Currently, the GOOS-Brazil comprises four networks and a research project. In term of this Plan, these networks will be expanded and new networks and projects can be created. The data collected by networks and design are public domain and are available in the website http://goosbrasil.org.

The Program GOOS-Brazil, aims to implement, expand and consolidate an operational oceanographic information, climatological and meteorological, aiming to generate data and produce knowledge and products that support oceanographic and meteorological forecasts in the sea area of national interest.

The implementation of the ARGO program in Brazil is being held in the scope of GOOS-Brazil, with the main objective of improving the regional oceanographic model through data assimilation. This year is being assembled an international bidding for the acquisition of the first 10 floats of the program, which will be managed by the Brazilian Navy.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

The program will be funded by GOOS-Brazil with an initial budget of approximately $ 150,000.00 per year.

As described above, the program will be managed by the Brazilian Navy through the Oceanographic Division of the Navy Hydrographic Center, which currently has seven people that will support this management. However, other national research institutions will participate in the program.

3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

An initial strategy has been studied and will cover the areas of the Brazilian coast with larger deficit of information. Some details still need to be defined, such as the resolution of the profiles, and we count on the support of the ARGO Program to improve this initial strategy.

Presently we do not have a structure of qualified personnel and in an appropriate amount to perform the data management and the intention is to use the structure already established in the ARGO Program.

Our initial plan is to deploy 10 floats per year.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

The Project REMO is a specific Brazilian effort on operational short-range Ocean Forecasting started in 2008 under the Oceanographic Modeling and Observation Network (REMO). The general goals of REMO are to do research in physical oceanography and to develop operational ocean forecasting systems over the tropical Atlantic and the South Atlantic Ocean for a broad range of users of oceanographic information, including the off-shore petroleum industry.

These modeling products are useful for SOLAS, military purposes and the Oil and Gas industry.

The partnership between REMO members was established to connect academia, industry and government efforts to deliver ocean forecasts to the Brazilian community. The industry provides funding to the University to develop models, and to the Navy to make these models operacional, then the whole society benefits from its ocean forecast.

The results are disseminated in the Navy´s internet website (https://www.mar.mil.br/dhn/chm/meteo/prev/modnum/hycom/novohycom/index.html) and also transmitted to PETROBRAS where oil spill models are run with boundary conditions from basin scale model. These results may be used to mitigate ocean natural disasters and to support ocean operations.

The operational modeling system in Brazil, running at the Brazilian Navy Hydrographic Center (CHM) today is based only on HYCOM. Three different domains are employed using a nesting strategy: (i) a large-scale configuration with 1/4º of horizontal resolution and 21 vertical layers that covers almost the whole Atlantic Ocean, from Antarctica to 50º N and from 100º W to 20º E, except the Pacific; (ii) an eddy resolving configuration with 1/12º of horizontal resolution and 21 vertical layers for the METAREA V; and (iii) a meso-scale configuration with 1/24º of horizontal resolution and 21 vertical layers for the region off the Brazilian southeast coast, from the continent to 35º W, and from 35º S to 12º S. Constant barotropic mass fluxes and relaxation of temperature and salinity for climatology are imposed as lateral boundary conditions for the large-scale grid.

The large-scale domain is forced by the NOAA/NCEP Global Forecast System (GFS) 0.5º atmospheric fields each 3 h. The other domains are forced by the Deutscher Wetterdienst (DWD) atmospheric model HRM with 0.1º of horizontal resolution that runs in an operational daily basis in CHM.

The model HYCOM-CHM is an regional application used to daily forecast in METAREA V. Simulations are leaving every 6 hours, for a period of 90 hours. In order to improve the quality of simulations, data Height and Surface Temperature Sea are obtained from the HYCOM-NCODA global and satellite sensors, used to correct the results by method of interpolation based statistical methodologies developed by Ezer & Mellor (1995), and Cooper & Haines (1996).

The current effort is in the qualification for the ARGO data assimilation, with the prospect of being able at the end of 2014.

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report.

As a new program, there are a number of concerns regarding its implementation, such as:

1) the technical specifications of the floats;
2) the proper configuration;
3) the transmission, qualification and management of data;
4) the launch strategy;
5) the opportunities for exchanges and training; and
6) the possibilities for donations.

Thus, it would be very valuable if we could have a guidance by AST regarding these issues.

LUÍS FELIPE SILVA SANTOS
Lieutenant Commander
Brazilian Navy
(felipe.santos@chm.mar.mil.br)

Status of Argo Bulgaria, 1st March 2013

The Bulgarian Argo activities are framed by the BulArgo "Development of national research infrastructure as a component of Argo network" project, funded by the Bulgarian National Science Fund. It comprises a consortium of three research organizations: the Institute of Oceanology in Varna, Sofia University "St. Kliment Ohridski" and the National Institute of Meteorology and Hydrology in Sofia. The focus of the ongoing research program is the monitoring of the Black Sea.

1. The status of implementation

Bulgaria was first involved in the Argo activities in December 2009, when one French PROVOR float (#5902291) was deployed in the deep part of the Black Sea by the R/V Akademik operated by the Institute of Oceanology in Varna. Latter, in March 2011, three APEX floats (#6900803, #6900804 and #6900805) were deployed in the Black Sea by the same vessel. The floats were purchased by the BulArgo project; one of the floats was equipped by an oxygen sensor. Currently, the data are available at the Institute of Oceanology website (http://www.gisserver.io-bas.bg/Web_argo).

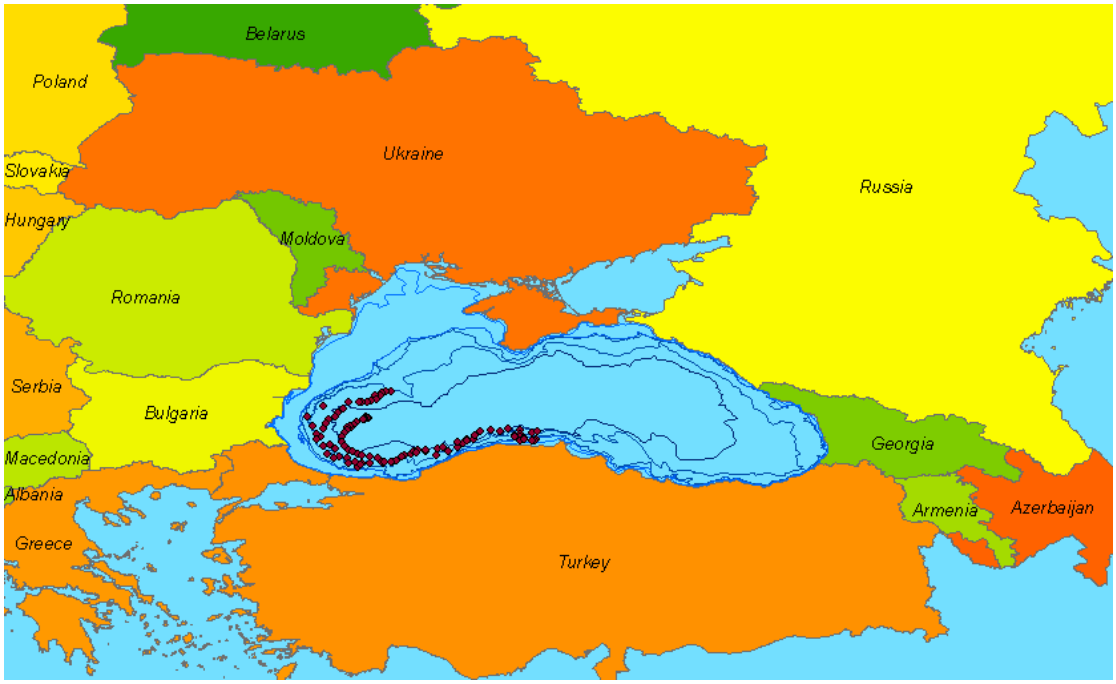


Figure. Locations of surfacing of the 3 BulArgo floats since 18 March 2011.

Four Italian floats (WMO 6901959, 6901960, 6901961 and 6901962) were deployed in 2012 in the Western Black Sea from the board of R/V Akademik by the Institute of Oceanology, Varna. These floats were Arvor-L instruments manufactured by NKE in France. They were programmed to perform sampling between the surface and 700/1500 dbar once every 5 days, as well as to collect observations at the parking depth of 200 dbar. The floats measure temperature and salinity at each ascent. They transmit data by the standard Argos satellite system when being at sea surface. One of the floats (WMO 6901960) stranded on the Southern Bulgarian coast (near the city of

Primorsko) after 26 cycles of operation. It was successfully recovered, refurbished and repaired and is now ready to be re-deployed. The other floats are still collecting data as of the end of February 2013.

Delayed mode

At present the standard procedures for real time and delayed mode data processing and quality control are performed at the French Argo Data Centre Coriolis. However, the procedures are being revised by the competent staff to account for the Black Sea regional characteristics. A M.Sc. thesis on the quality control procedures is under preparation. The QC includes specific range of the values control; comparison with climatological profiles, comparison with other Argo floats data, temperature and salinity gradients check, check of stability of the vertical stratification. The standard QC flags are assigned to each profile. The data coming from the float with the oxygen sensor are still under validation.

2. Present level of and future prospects for national funding for Argo

BulArgo project which covers the period 2010-2013 is financed by the Bulgarian National Science Fund initially with 200 kEuro. Unfortunately due to the financial crisis the overall sum was decreased by 40% for the second half of the project. Thus four floats in total will be deployed in the Black Sea in the frame of this activity. The logistics will be provided by the Institute of Oceanology in Varna. The BulArgo project comprises a consortium of three research organizations: Institute of Oceanology in Varna, Sofia University (SU) “St. Kliment Ohridski” and National Institute of Meteorology and Hydrology in Sofia.

Extensive collaboration with the Bulgarian Ministry of Education, Youth and Science during the Euro-Argo preparation phase project has lead to an agreement at ministerial level that Bulgaria joins the Euro-Argo ERIC as a full member, thus a support for the membership fee and the deployment of 3 floats per year in the Black Sea has been ensured. Additionally to the Bulgarian national funding, IO-BAS and SU were funded in the frame of the EC FP7 PERSEUS, SIDERI and E-AIMS

projects, for multiple activities (technical, administrative, capacity building, training and education, establishment of user community) related to Argo.

3. Summary of deployment plans

Bulgarian activities focus on the Black Sea. Float deployment in 2013 will follow the national plans in the frame of BulArgo (one float). Additional deployments are foreseen of one float with T/S sensor and IRIDIUM communication and 2 floats with biogeochemical sensors provided by FP7 PERSEUS and E-AIMS projects respectively. The stranded Italian float which was retrieved in 2012 will be re-deployed. Bulgarian scientists are in contact with the Turkish scientists, who also plan float deployment in 2013.

4. Data management

The data from the floats deployed under the BulArgo project are available at the Institute of Oceanology website (http://www.gisserver.io-bas.bg/Web_argo). The standard procedures for real time data processing and quality control are performed at the French Argo Data Centre (www.coriolis.eu.org). Collaboration with the scientists at MedArgo data center is ongoing to allow for processing data also in MedArgo. At the moment the data quality procedures are being revised by experts to account for the Black Sea regional characteristics.

5. Summary of national research and operational uses of Argo data

The key objectives to use the Argo data in the Black Sea involve:

- Development of adequate data quality control procedures taking into account the Black Sea peculiarities
- Study of the temperature and salinity changes near the sea surface and in the deep layers
- Assimilation of the Argo data in a Black Sea circulation model
- Evaluation of chemical properties
- Validation of satellite- derived SST products
- Quantification of the steric effects in the Black Sea
- Getting new insight about the deep circulation of the Black Sea
- Strengthening of the users' community and use of data for educational purposes at university level.

6. Issues we wish to be considered and resolved

The influence of the aggressive compounds on the float functioning.
How to prevent the capture of the float in the coastal eddies, which could lead to the standing on the beech?

7. Bulgarian contribution to Argo bibliography in 2012

Palazov, A., V. Slabakova, E. Peneva**,** V. Marinova, A. Stefanov, M. Milanova, G. Korchev, 2012, BulArgo activities in the Black Sea, Proceedings of Third International Scientific Congress of TU-Varna, 4-6 October 2012, Varna, Bulgaria

2012 Argo Canada report of activities

(submitted by Denis Gilbert)

14th meeting of the Argo Steering Team (AST-14)
Wellington, New Zealand
March 18-21, 2013

1. Status of implementation (major achievements and problems in 2012)

- floats deployed and their performance

In 2012, Argo Canada deployed 27 NOVA floats (16 in the northeast Pacific, 11 in the northwest Atlantic). Of these 27 floats, 2 did not report any data, and 3 floats died prematurely after 3, 4 and 7 profiles respectively. The 22 remaining floats are still active and functioning properly.

- technical problems encountered and solved

On some NOVA floats, the GPS unit intermittently failed to report valid positioning data. This forced us to use lower quality positioning data from the Iridium system. We would like to discuss this more broadly with others (see section 5).

- Status of contributions to Argo data management (including status of pressure corrections, technical files, etc)

ISDM (formerly MEDS) continues to acquire data from 110 active Argo floats. Of which 27 floats seemed to be in trouble and have not reported data for at least 6 months. Data are issued to the GTS and GDACs every 6 hours in TESAC, BUFR and netCDF format. We increase the frequency of data acquisition from the Argos server to hourly if we fail to access the system at a specific 6 hour interval. In 2012, Canada deployed 27 Nova floats from MetOcean. The data of all Canadian floats together with some graphics are posted on a website and updated daily:
http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/index-eng.html.

On average 69% of data from January 2012 to February 2013 data were issued to the GTS within 24 hours of the float reporting. The percentage of data transmitted on the GTS within 24 hours decreased compared to last year due to the following factors:

- Delays in the developing of new decoder for Nova floats
- The instability of services provided by Joubeh on making data transmitted by floats on the FTP site available for MEDS to download
- The reliability of the program for batching jobs on our server
- Migration of ISDM servers from Windows platform to Linux platform

Since AST 13, we completed the following tasks:

- Developed decoders to handle data reported by NOVA floats and fixes when NOVA floats only reported Iridium positions.
- Fixed format error detected by format checkers for technical netCDF files.
- Developed Oracle database and programs to transfer current data in ISAM format to Oracle. This process is required to handle data that had been quality controlled by Michel Ollitrault's method and any new data reported by floats. This will ease the transition of current netCDF trajectory to netCDF trajectory version 3.0 once the format is approved by ADMT.
- Acquired BUFR data set received at JAMSTEC daily, Japan to ensure that all of the Argo BUFR messages transmitted on the GTS are counted in the statistic.
- ISDM provides ADMT quarterly reports on the performance of Argo data on the GTS in TESAC and BUFR formats.

- Status of delayed mode quality control process

As of March 2013, 17% of all eligible floats, active and inactive, had their profiles QCed visually and adjusted for pressure and salinity according to latest delayed-mode procedures. The salinity component of DMQC had been performed on 63% of all eligible cycles at least once. Updated delayed mode data have been processed and uploaded to the GDACs.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

Financial resources

Unlike some other countries participating to Argo, Canada does not have multi-year commitments of money devoted to Argo. New paperwork and lobbying is necessary on an annual basis to renew the funding required to purchase new floats and for satellite telemetry of data. Year 2012 was excellent in that we were able to purchase 27 NOVA floats. We expect 2013 to be even better, with the purchasing of 34 NOVA floats. Though the crystal ball for Argo Canada funding in 2014 and beyond is opaque, we see more reasons for being optimistic than pessimistic. This cautious optimism has to do with the development of closer links between the Argo program and both the operational meteorology and operational oceanography R&D activities at the Canadian Meteorological Centre (Dorval, Québec). Denis Gilbert took the early initiatives of making contacts in this regard two years ago, and we are now starting to see some tangible benefits in terms of inter-departmental (Environment Canada, Department of National Defence, Fisheries and Oceans) cooperation and flow of money under the umbrella of the CONCEPTS (Canadian Operation Network of Coupled Environmental PredicTion Systems) memorandum of understanding.

Human resources

Five persons from the Department of Fisheries and Oceans perform the bulk of the work related to running the Argo Canada program. But all five have other work commitments in addition to Argo. In FTE (Full-Time Equivalent) units, these five persons are:

Anh Tran (ISDM, Ottawa, 0.8 FTE)
Mathieu Ouellet (ISDM, Ottawa, 0.2 FTE)
Igor Yashayaev (BIO, Halifax, 0.5 FTE)
Howard Freeland (IOS, Sidney, 0.7 FTE)
Denis Gilbert (IML, Mont-Joli, 0.7 FTE)

In addition to the above persons, we benefit from the technical support of sea-going staff (Marie Robert and Svein Vagle at IOS, Rick Boyce, Adam Hartling and Bob Ryan at BIO) that follow established pre-deployment protocols and perform the float deployments. Administrative support from Helen Joseph and Carolyn Campbell (Ottawa) is gratefully acknowledged.

With Howard Freeland's imminent retirement from DFO, we are continuing to explore options for continuing some of his tasks. While Denis Gilbert replaced Howard as national director of the Argo Canada program, we will need someone to look after the logistics of float deployments in the northeast Pacific. Doug Yelland (IOS) volunteered to fill this particular gap. As of now, we have not yet identified someone who would commit to maintaining some of the data products developed by Howard, such as surface circulation maps of the Gulf of Alaska, Argo data interpolated to station Papa and projected onto Line P. Fisheries and Oceans Canada is facing tough budget restrictions, and one implication is that not all retirees are being replaced. We will need to continue to defend the value of Argo and its derived products in order to ensure the continuation of some of the data products developed by Howard over the years.

3. Summary of deployment plans (level of commitment, areas of float deployment, low or high resolution profiles) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

In 2013, we plan to deploy 34 NOVA floats, 15 in the Pacific (Gulf of Alaska), and 19 in the Atlantic (Labrador Sea and Gulf Stream northern recirculation gyre, aka Slope Water). Anh Tran plans to continue to provide ADMT with quarterly reports on the performance of Argo data on the GTS in TESAC and BUFR formats.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

Environment Canada scientists Greg Smith and Mateusz Reszka from the Canadian Meteorological Centre (Dorval, Québec) began assimilating real-time Argo temperature

and salinity data into a pre-operational, coupled atmosphere-ocean-ice model in October 2012. Early results indicate better prediction skill than in the operational model that is currently being run by Environment Canada for issuing weather forecasts. Increased skill is mainly seen at forecast times of 48 hours and longer. Environment Canada plans to upgrade its operational model with the coupled model following more detailed testing in 2013-14. From then on, Argo data will thus be part of the data assimilation schemes that are used in the production of weather forecasts in Canada.

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the coordination of activities at an international level and the performance of the Argo data system.

With Iridium telemetry floats, we have sometimes experienced problems with the failure to acquire GPS position data. This forced us to use lower quality Iridium positioning data. We know this problem is not exclusive to NOVA floats as other PI's using Iridium have also faced the lack of GPS data. Should we collectively agree on which CEPradius values should be considered "garbage" and which ones could be retained in the calculation of Iridium positions? Should we calculate an average position from all received SBD packets with a CEPradius value less than the agreed upon threshold value? Or else should we retain the single best quality Iridium position, i.e. the one(s) with the lowest value of CEPradius?

6. To continue improving the number of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include the number and location of CTD cruise data uploaded by PIs within your country to the CCHDO website in the past year. These cruises could be used for Argo calibration purposes only or could be cruises that are open to the public as well.

Most of the recently collected Canadian CTD data are transferred from ISDM to NODC and then to CCHDO. In addition, when Steve Diggs finds that recent data from particular monitoring surveys are missing, he gets in touch with data management staff working at individual laboratories from the Department of Fisheries of Oceans. In 2012, Steve contacted BIO personnel to get data from the AR7W line in the Labrador Sea.

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Argo Chinese National Report 2012

(Jianping Xu & Zenghong Liu, The Second Institute of Oceanography, SOA)

1. The status of implementation (major achievements and problems in 2012)

- floats deployed and their performance

In 2012 China deployed 20 floats in the northwestern Pacific Ocean through two cruises during June-September and December, respectively (Figure1). All of them were deployed by the Second Institute of Oceanography, SOA (CSIO), in which 9 floats were iridium APEX floats, and the remaining 11 were standard APEX floats. All the floats worked normally except one float (WMO number: 2901489) reported bad salinity data. Of them, 12 floats were installed lithium battery packs by the technicians from CSIO. China Argo has deployed 153 Argo floats since 2002, and 83 floats were still active as of 29 Jan, 2013.

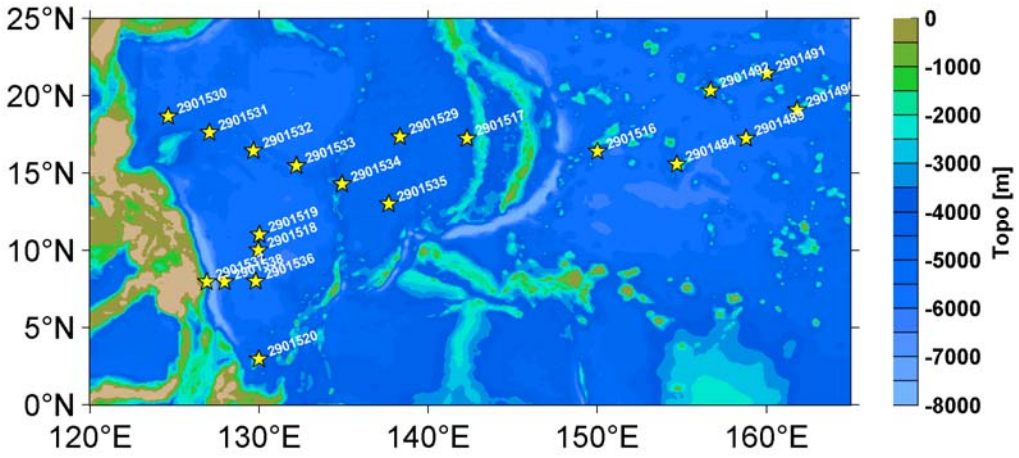

Fig.1 Launch positions of Chinese Argo floats in 2012.

In August 2012, AIC technical coordinator – Mr. Belbeoch Mathieu informed that two floats (WMO number: 2901515 and 2901617) were redeployed near Galle, Sri Lanka by National Aquatic Resources Research and Development Agency (NARA) after they were captured by local fisherman of Sri Lanka. The float 2901515 belongs to CSIO and was recovered by local fisherman at the end of December 2011, whereas the float 2901617 belongs to the East China Sea Branch, SOA. After redeployment, the float 2901515 was allocated a new WMO number (2902365) and reported good data, while the another float didn't survive the redeployment. AIC then changed the ownership of this active float and put Sri Lanka in the list of Argo supporting countries. We are gratified that a new member state was added into International Argo. However, AIC should have notified its owner before changed the ownership of the float. We thank Dr. K. Arulanthan and Dr. R.M.R.M. Jayathilaka from NARA for their sincere help.

In September 2012, another Chinese float (ARVOR) which was deployed in the northwestern Pacific was notified drifting into the coastal waters of Hainan Island. CSIO immediately entrusted local fishery management agency to find this float in home of a fisherman. CSIO has recovered the float and notified the manufactory – NKE Instrumentation through the sales representative in China. NKE is willing to recall it and analyze the technical malfunction

(noted that this float always drifted at sea surface after deployment).

- technical problems encountered and solved

Currently two APF9a floats equipped with SBE41 CTD sensor (WMO number: 22901512 and 2901489) reported bad salinity measurements since their first profiles (Table 1 and 2). We have contacted with TWC for this issue, but they answered that Sea-Bird Electronics has finally looked through their internal test and calibration records and could not find any anomalies. So we can't find out what led to this technical problem.

Table 1. Comparison of salinity data between float 2901515 and nearby float

Cycle	Pressure (dbar)	Salinity	Nearby Salinity
1	1500.2	2.474	34.964
2	1500.4	11.538	34.983
48(LATEST)	1498.3	17.910	34.981

Table 2. Comparison of salinity data between float 2901489 and nearby float

Cycle	Pressure（dbar）	Salinity	Nearby Salinity
1	1999.7	14.085	34.603
2	1999.9	28.528	34.600
18(LATEST)	1900.1	29.710	34.600

-status of contributions to Argo data management (including status of pressure corrections, technical files, etc)

In 2012, China Argo submitted 3126 TS profiles (including 182 O2 profiles) to GDAC. Coriolis still helped us decode Argos messages from 8 active ARVOR floats. All data were distributed on GTS by CLS. We would thank Mr. Bernard from CLS for his selfless help.

Due to the lack of manpower, some actions of the ADMT haven't been done until now (e.g. resubmission of O2 profiles, update of a few technical files from PROVOR floats). It's a challenge for us to implement all the actions in a short time. We expect China Argo will be brought into national operational system in the near future, and change the situation of China Argo funded by research programs.

- status of delayed mode quality control process

CSIO submitted a total of 6888 D-files to GDAC in February and December 2012, respectively. We implemented surface pressure, CTM and OW salinity correction in DMQC. Until now, CSIO has submitted 7412 D-files which account for about 81% of the profiles. The main difficulties we encountered during DMQC are lack of historical CTD casts and difficult to carry out efficient DMQC in the Western Boundary Current region (Kuroshio) where exists larger salinity variations.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

China Argo is mainly funded by research programs mostly from Ministry of Science and Technology (MOST), State Oceanic Administration (SOA) and National Natural Science Foundation of China (NSFC). In 2012, China Argo was funded by a special project of Science and Technology basic work from MOST, through which 35 floats will be deployed in the western Pacific in the following 5 years. Until now, China Argo hasn't been brought into operational ocean system, so the number of yearly deployment is unstable. At CSIO (Hangzhou), there is a group (about 5 persons) in charge of float deployment, Argo data processing (RT/DMQC), data exchange and Argo related products development. There are 3 persons in charge of Argo data processing, products development, and global Argo data collection and archives at NMDIS (Tianjin). SOA is considering bringing China Argo's operation into ocean observing and prediction system, and providing 50 floats every year.

3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

In 2013 we estimate that China Argo will deploy about 40 floats, in which 20 are stocked. Because we haven't got any funding for float deployment cruise, so we have to look for appropriate cruises or opportunities to deploy these floats. Only one cruise has been confirmed until now, that is the South China Sea Institute of Oceanology, Chinese Academy of Sciences (SCSIO) will deploy two floats in Indian Ocean during March.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

Argo data has been operationally used in ocean and atmosphere prediction and forecasting models in China. The agencies affiliated to SOA and Chinese Academy of Sciences developed some Argo products in order to prompt the application of Argo data. The products include:

CORA: a 23-year regional reanalysis product of temperature, salinity and currents for the China coastal waters and adjacent seas developed by NMDIS (www.argo.gov.cn).

BOA_Argo: a monthly ($1^{o} \times 1^{o}$) gridded temperature and salinity fields of global oceans based on Argo profiles from 2004 to 2011 which was developed by CSIO (www.argo.org.cn).

Surface Current: a dataset (Version 2) of global ocean surface currents for 1999-2010 derived from Argo float trajectories developed by Institute of Atmospheric Physics (IAP), Academy of Sciences (www.argo.org.cn).

The Argo data and its derived products are widely used in scientific areas of ocean and atmosphere basic research. According to incomplete statistics, 48 Argo related papers have been published on domestic and overseas journals (see the section of 'Keeping the Argo bibliography') in 2012. In 2003, CSIO and IAP once launched the first workshop of Chinese ocean data assimilation. From then on, seven workshops have been held. At least 1/3 conference papers were related to Argo in each meeting. During the 7th workshop of Chinese ocean data assimilation in 2012, 47 papers were submitted and 36 papers were related to Argo, which accounts for 76% of all the papers. Besides, CSIO once held the first Argo Science

Workshop at Hangzhou in 2006, under the support of MOST and SOA. There were 75 participants from 20 agencies attended the meeting, and 25 papers were submitted. One book named 'The collection of Argo Application papers' was published by Chinese Ocean press after the workshop. To further prompt the application of Argo data in the scientific area of ocean and atmosphere, CSIO plans to hold the 8th Chinese ocean data assimilation & the 2nd Argo Science workshop at Zhoushan, Zhejiang in the early of November 2013.

China Argo always concerns about the activities of Pacific Argo Regional Center (PARC), it will take up the activities of PARC and contribute more to international Argo with other countries around the Pacific, once China Argo gains the long-term operational funding. China Argo will contribute to the funding of the AIC as before.

There are two websites constructed by China, one is maintained by NMDIS (www.argo.gov.cn) at Tianjin (China Argo data center), and another is maintained by CSIO (www.argo.org.cn) at Hangzhou (China Argo Real-time data center). Through them, the implement status of China Argo, real-time data display including T/S/O2 profiles, float trajectory, profile data, the derived products and status of global Argo are presented. Meanwhile, GDACs, related international organizations and member's Argo websites can be accessed through these two websites.

5. To continue improving the number of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include the number and location of CTD cruise data uploaded by PIs within your country to the CCHDO website in the past year.

In the past year, we submitted 64 CTD casts to Coriolis. All CTD data were obtained from the cruise conducted by the Institute of Oceanology, Chinese Academy of Sciences from November to December 2012 in the northwestern Pacific. The contribution from the principal scientist of this cruise – Dr. Dongliang Yuan is appreciated. We will continue to collect and distribute recent CTD casts for Argo DMQC reference dataset.

6. Keeping the Argo bibliography

In 2012, China Argo published a special issue named 'Argo-China' in Atmoshpere-Ocean (Volume 50, Guest Editor: Dake Chen). 10 papers related to Argo were published in this special issue. There are 48 papers related to Argo published in domestic and overseas journals this year.

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ARGO National Report 2013 – The Netherlands

1) Status of implementation

The Dutch Argo program, run by the Royal Netherlands Meteorological Institute (KNMI), started with three deployed floats in 2004. Since then 55 floats have been purchased and deployed, 33 of which are still working correctly.

KNMI is involved in EuroArgo and has decided to join a European Argo consortium that will probably be founded in 2013.

2) **Present level of (and future prospects for) national funding for Argo including summary of human resources devoted to Argo**.

In their observation strategy adopted in 2006 KNMI has expressed the intention to deploy about 7 floats per year, a level that has approximately been reached during the past years. A semi-permanent fixed budget is available.

One person (Andreas Sterl) is working on ARGO. He does so besides his other duties.

3) **Summary of deployment plans** (level of commitment, areas of float deployment) and for other commitments to Argo for the coming year (and beyond where possible).

About 7 floats will be purchased. Deployment is not yet planned, but preferably in the Atlantic Ocean.

4) Summary of national research and operational uses of Argo data

In the framework of CMIP5 KNMI performed decadal prediction runs with their EC-Earth climate model. The ocean initialization is taken from an ECMWF product (NEMOvar) that heavily relies on Argo data.

Building on these decadal prediction runs KNMI will, within the EU-funded E-AIMS project, perform sensitivity experiments to find ocean regions where initialization is particularly important for decadal predictions.

5) Issues that your country wishes to be considered (and resolved) by AST regarding the international operation of Argo

Nothing.

6) CTD data uploaded to CCHDO

Yes.

7) Bibliography

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French National report on Argo – 2012
Present status and future plans

March 2013
V. Thierry, S. Pouliquen, E. Mamaca, C. Coatanoan, S. Le Reste, C. Cabanes

LPO-Report N° 13/02

1. Background, organization and funding of the French Argo activities

Argo France gathers all the French activities related to Argo and its extension toward biogeochemical measurements. Argo France is the French contribution to the Euro-Argo European research infrastructure that organizes and federates European contribution to Argo. The European Commission has validated the Euro-Argo ERIC application and a final iteration was performed between the French ministry and the other ministries. The signature process started and the ERIC set-up is likely to happen in 2013. Together with its European partners, Ifremer also works with the European commission to set up a long term direct EC funding for Argo. France will host the Euro-Argo ERIC legal structure. Euro-Argo and its French component (Argo France) is part of the Ministry of Research national roadmap on large research infrastructures (TGIR).

1.1. Organization and funding

At national level, the Argo France activities are undertaken by Coriolis (CNES, Ifremer, INSU, IPEV, IRD, Météo-France et SHOM) as well as by two laboratories: the Laboratoire de Physique des Océans (LPO, Brest, France) and the Laboratoire d'Océanographie de Villefranche (LOV, Villefranche, France). Argo France has been recognized in January 2011 as a long-term observing service. The agreement is valid for 10 years.

Argo France is funded by the ministry of Research and by local administrations (Britanny region, Finistère department, city of Brest) mostly through Ifremer but also through other French institutes involved in oceanography (CNES, IRD, INSU, Météo-France) and in a lesser proportion by the ministry of Defense through SHOM. Until now, the French contribution to the Argo global array was at the level of about 65 floats per year with funding from Ifremer (about 50 floats/year) and SHOM (about 15 floats/year).

Since 2000, more than 640 French floats have been deployed in a number of different geographic areas. Deployments have been focused on meeting specific French requirements while also contributing to the global array.

To complement Argo France and Euro-Argo ERIC, the NAOS project has been recently funded by the Ministry of Research to consolidate and improve the French contribution to Argo and to prepare the next scientific challenges for Argo**.** The project provides an additional funding of 15 floats per year from 2012 to 2019, which allows Ifremer to increase its long-term contribution to Argo from 50 to 65 floats/year. A European Research Council (ERC) advanced grant has also been recently obtained by LOV to work on the development of a biogeochemical component for Argo**.** Overall, as part of the NAOS and REMOCEAN project, 150 floats should be deployed over the next 8 years in three pilot areas: Mediterranean Sea, Arctic and North Atlantic.

Overall the level of support, additional to float purchase, is as indicated in Tableau 1 (man power for coordination activities, float preparation, deployment and data management activities).

Year	Funding	Man/Year	French floats	Co-funded EU floats	Total
2000	300k€		11		11
2001	633k€	3	12		12
2002	980k€	6	7	4	11
2003	900k€	9	34	20	54
2004	1400k€	15	85	18	103
2005	450k€	15	89	11	100
2006	900k€	12	51	14	65
2007	900k€	12	36		36
2008	1200k€	12	90		90
2009	1200k€	12	35	8	43
2010	1400k€	12	55		55
2011	1400k€		53		53
2012	1400k€	12	82		82
Total (2000-2012)			***640***		**715**
2013	**1400k€**	**12**	**65**		

Tableau 1: (*Man/year* column) Man power dedicated to Argo for coordination activities, float preparation, deployment and data management activities (GDAC,DAC, NAARC, DMQC) within Argo-France. (*French floats* column) French floats contributing to Argo deployed by year. (*Co-funded EU floats* column) EU floats are the additional floats co-funded by European Union within the Gyroscope, Mersea and MFSTEP projects. Estimated value is given for 2012.

1.2. Float development

Based on Ifremer expertise in acoustically tracked Lagrangian floats named "Marvor", Ifremer has developed the PROVOR profiling float in the late 90s and in collaboration with the NKE manufacturer has managed to provide to the Argo community a reliable instrument meeting the Argo requirements. PROVOR has now moved towards a « multi-sensors » utilization. The instrumental base has been modified in order to make the integration of new sensors easier. For example, Provor is fitted with an Aanderaa optode (Provor-DO). ProvBio (CTD and optical sensors) and ProCarbon (CTD, dissolved Oxygen, Particular Organic Carbon) have been developed and use Iridium system to transmit more data, to reduce time at surface and to modify some mission parameters by remote control. Developments are under way to provide an ARGOS3 version of these floats.

Ifremer, in partnership with NKE manufacturer, has developed the ARVOR float that aims to complete the float offer. When PROVOR leads toward a "multi-sensors" utilization, ARVOR tends to agree with the following criteria: performances improvement, easy deployment (lighter weight < 20kg) and costs reduction. Since 2010, ARVOR floats can be fitted with Iridium transmission capability.

Since 2011, Ifremer together with NKE and CNRS is working on PROVOR/ARVOR floats improvement within the NAOS project in order to develop, validate and deploy the next generation of French Argo profiling floats. The new float capabilities include: longer life-time, more efficient design

of the vehicle, improved transmission rates, integration of biogeochemical sensors, deeper measurements and under ice operations in the polar seas. In 2012, several prototypes have been completed.

Ifremer teams have been deeply involved in Argos-3 satellite transmission. The main objective is to transmit a complete profile on a single satellite pass and to remotely control the float. Two transmission types have been explored, the low and the high-rate. The interactive low-rate uses the same channel flow rates and power transmission as Argos-2. An Arvor-A3 has been successfully deployed in October in the Bay of Biscay. The float is able to transmit 150 points data per profile (about 1.5 times a typical Argo profile) in a single Argos-3 satellite pass (less than fifteen minutes) including margins. The high-rate transmission uses GMSK modulation on a dedicated channel, with increased power and at a theoretical speed of 4 800 bits/s. The transmission test results suffer from high variability. The best passages satellites can transmit more than 1 000 points, for the best cases to much less for the worst ones. This point is still under investigation.

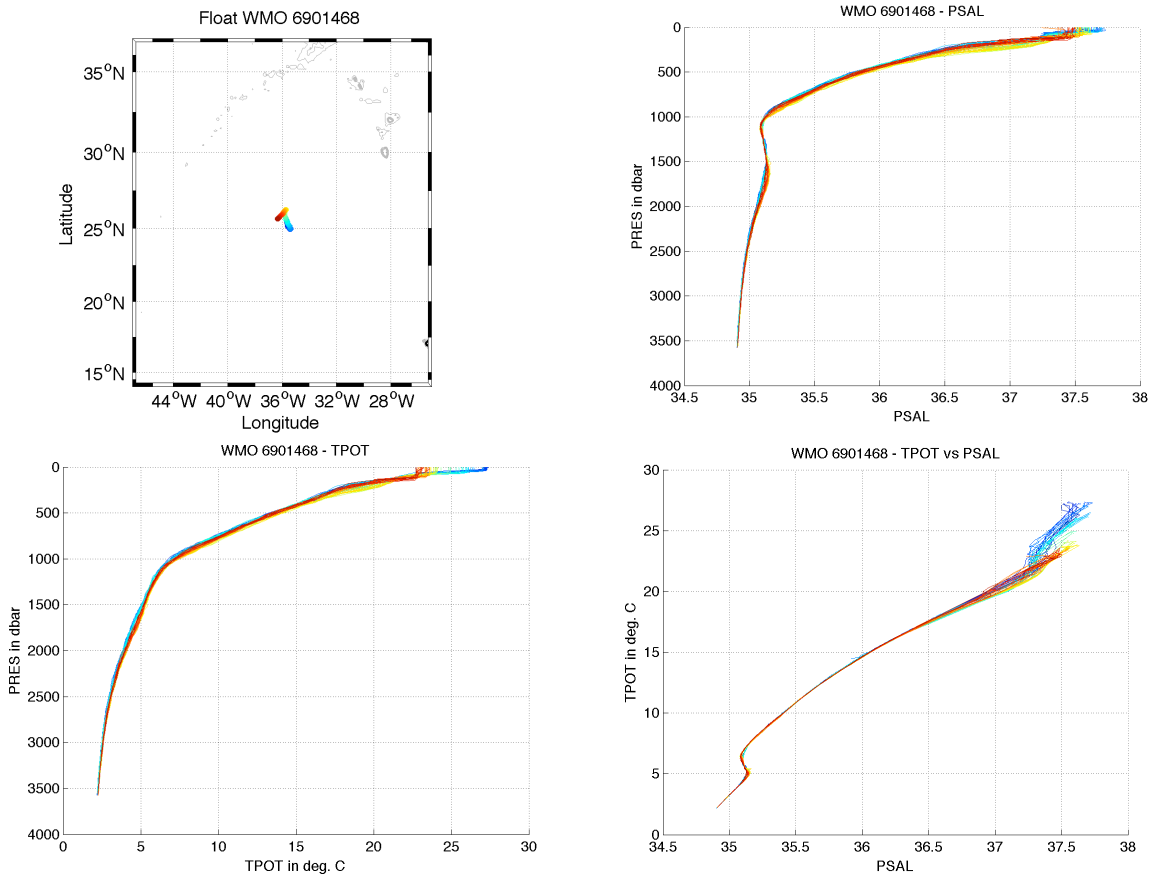


Figure 1: Position, salinity and temperature profiles and θ/S diagram for the deep Arvor float (WMO 6901468). The color of each profile varies from blue (first profile) to red (last profile).

The deep Arvor model was successfully deployed during the Strasse campaign in August 2012 in the middle of the Atlantic Ocean (Figure 1). This was the last step of a work started in 2009 by Ifremer. This extension to Argo capabilities is needed to monitor deep water masses that play a key role in climate change studies. The targeted "depth" was achieved thanks to the use of composite materials that have the advantages of being light and cheap, the adaptation of engine technology and the

evolution of the CTD sensor. This deep-Arvor float is also equipped with an optode sensor and an Iridium satellite transmission in “sbd” mode. The on-board energy package is dimensioned to realize 150 cycles CTD02. Since its launch, the deep-Arvor reached sixty cycles at 3500 m depth (Figure 1) and transmitted both standard Argo sampling profiles and high-resolution profiles (1000 points). The float remained in the same area which allowed us to verify the good stability of the sensors over the first 6-month period. The achievement and maintaining a cycling Argo float at 3500 m depth is a performance. We are currently investigating the possibility to reach 4000 m depth.

2. The status of implementation (major achievements and problems in 2012)

- floats deployed and their performance

82 floats have been deployed in 2012. The deployment areas are chosen to meet French requirements in terms of research and operational activities (Atlantic, Indian and Southern Oceans) but also to contribute to establishing the global array (especially in the Southern Ocean).

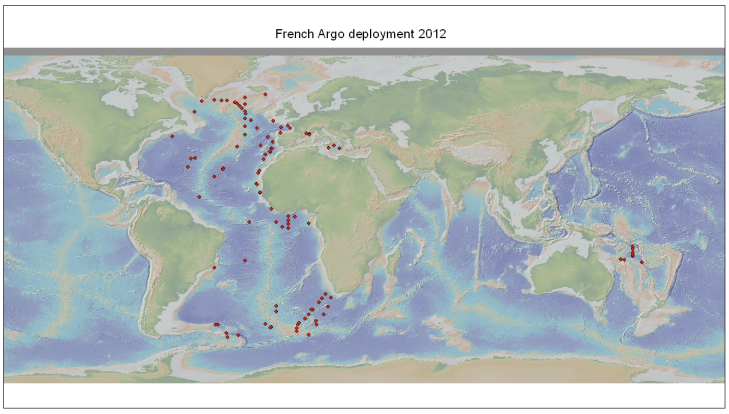


Figure 2: Deployment position of the 82 French floats deployed in 2012.

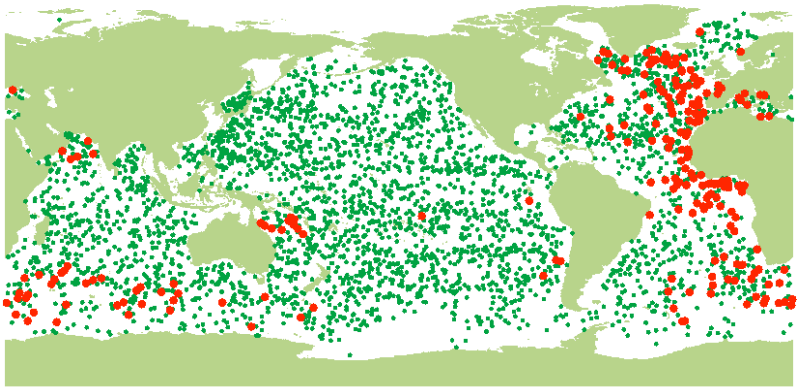


Figure 3: (Lower panel) Actual position of the French active floats.

- technical problems encountered and solved

No major technical problems were encountered in 2012.

- **status of contributions to Argo data management**

Within Argo-France, Coriolis plays three roles in the Argo data management organization: Argo Data Assembly Centre, Global Data Centre, and leader of the North Atlantic Argo Regional Centre. Coriolis is located within Ifremer-Brest and is operated by Ifremer with support of Shom.

As Argo Data Assembly Center, Coriolis processes in Real Time and Delayed Mode float data deployed by France, by 7 European countries (Germany, Spain, Netherlands, Norway, Italy, Greece, Bulgaria) Coriolis data center processes data coming from 1431 floats including 466 active floats in February 2013. Data are processed and distributed according to Argo recommendations.

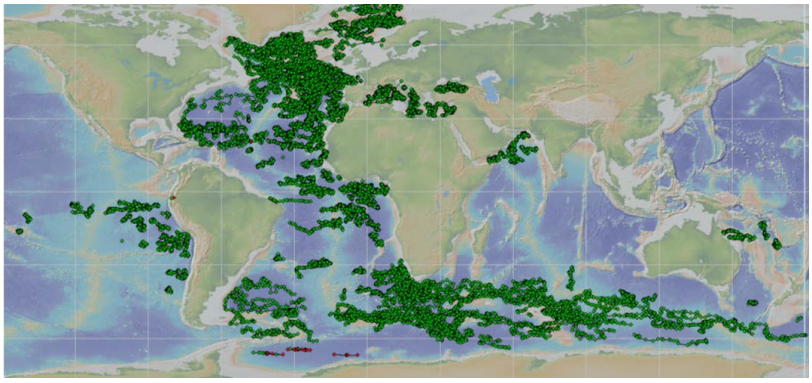


Figure 4: Maps of the 18 841 profiles from the 1431 floats managed by Coriolis DAC this current year.

As Argo Global Argo Data Centre, Coriolis hosts one of the two global data assembly centres (GDAC) for Argo that contains the whole official Argo dataset. The Argo GDAC ftp server is actively monitored by a Nagios agent (see http://en.wikipedia.org/wiki/Nagios). Every 5 minutes, a download test is performed. The success/failure of the test and the response time are recorded. From January to November 2012 the ftp server was available for 99,98% of the time. The 0.02% of failure represents 1 hour 52 minutes and 54 seconds of interruption (compared to 1 day 5 hours and 45 minutes last year). The main problems problem occurred on May 1st 2012. The ftp server failed down, but was automatically reactivated on another node of the cluster). Compared to last year, the new ftp server dramatically increased the files transfer time from 100ms to 4 ms: the files are downloaded up to 25 times faster.

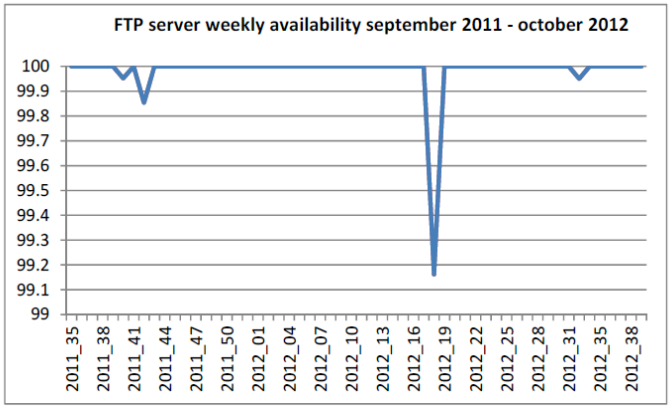


Figure 5 : Nagios monitoring: between September 2011 and October 2012.

North Atlantic Argo Regional Centre (NA-ARC) : France has taken the lead in establishing the NA-ARC, which is a collaborative effort between Germany (IFM-HH, BSH), Spain (IEO), Italy (OGS), Netherlands (KNMI), UK (NOCS, UKHO), Ireland (IMR), Norway (IMR), Canada (DFO), and USA (AOML), Greece (HCMR) and Bulgaria (IOBAS). Coriolis coordinates the North-Atlantic ARC activities and in particular the float deployment in Atlantic.

The NA-ARC WWW site, http://www.ifremer.fr/lpo/naarc/ (also available through the Argo Data Mangement Web site: **http://www.argodatamgt.org/Argo-regional-Centers/North-Atlantic-ARC** under "More on NA-ARC floats".) provides useful information about float data and status in the North-Atlantic Ocean. For instance, it can be used to monitor the number of floats in the North-Atlantic as well as the number of floats equipped with an oxygen sensor (**Figure 6**).

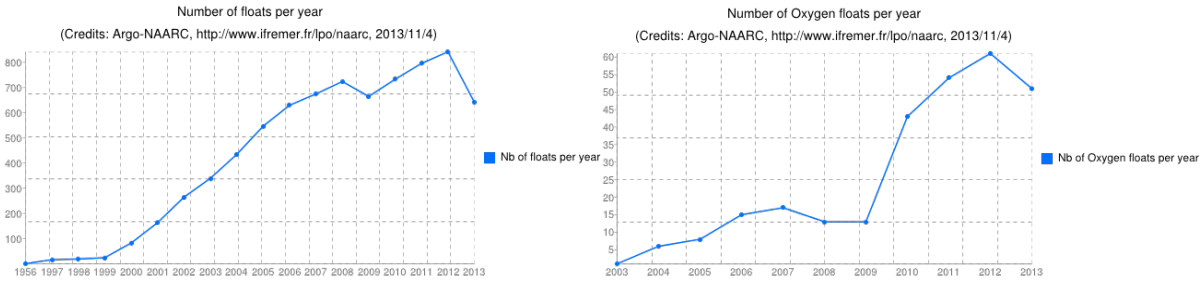


Figure 6 Examples of viewing service available at http://www.argodatamgt.org/Argo-regional-Centers/North-Atlantic-ARC under "More on NA-ARC floats". The figures display the number of floats in the NA-ARC area (Atlantic ocean North of 20°S) and the number of floats equipped with .

See also Section 4.

- **status of delayed mode quality control process**

In 2012, 10327 new delayed mode profiles where produced and validated by PIs. A total of 93299 delayed mode profiles where produced and validated since 2005. In February 2013, 72% of the floats and 73.3% of the profiles processed by the Coriolis DAC are in delayed mode.

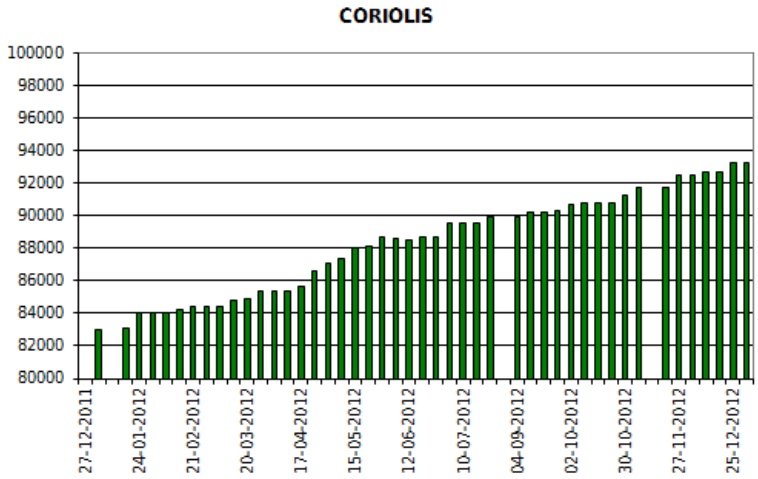


Figure 7: Evolution of the DM profiles' submission versus dates

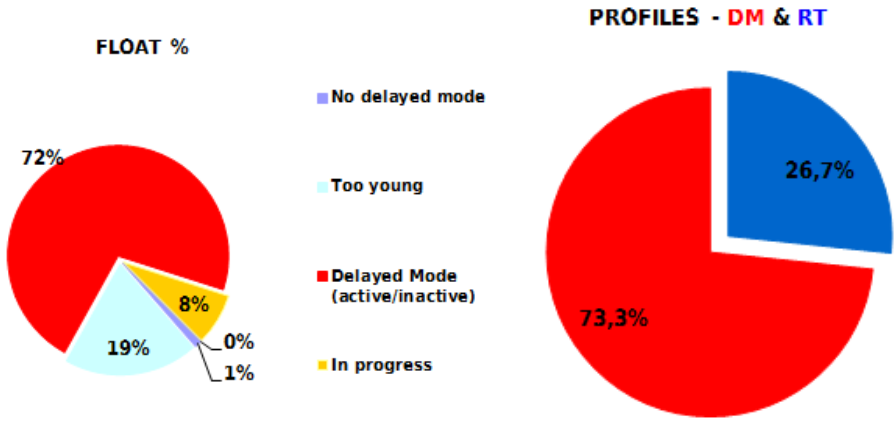


Figure 8 Status of the floats processed by Coriolis DAC. Left: in terms of float percent and right: in terms of profile percent (DM : delayed mode – RT : real time).

Status of pressure corrections, technical files : For APEX floats, the real-time pressure correction has been implemented at the Coriolis data center and it is operational. The implementation of the pressure correction of NEMO floats is still on-going

3. Summary of deployment plans (level of commitment, areas of float deployment) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

According to the current deployment plan, 65 floats will be deployed in 2013. They will be deployed in 2013 in the Mediterranean Sea, in the North and the South Atlantic Oceans, in the Southern Ocean and in the Indian Ocean (Figure 5).

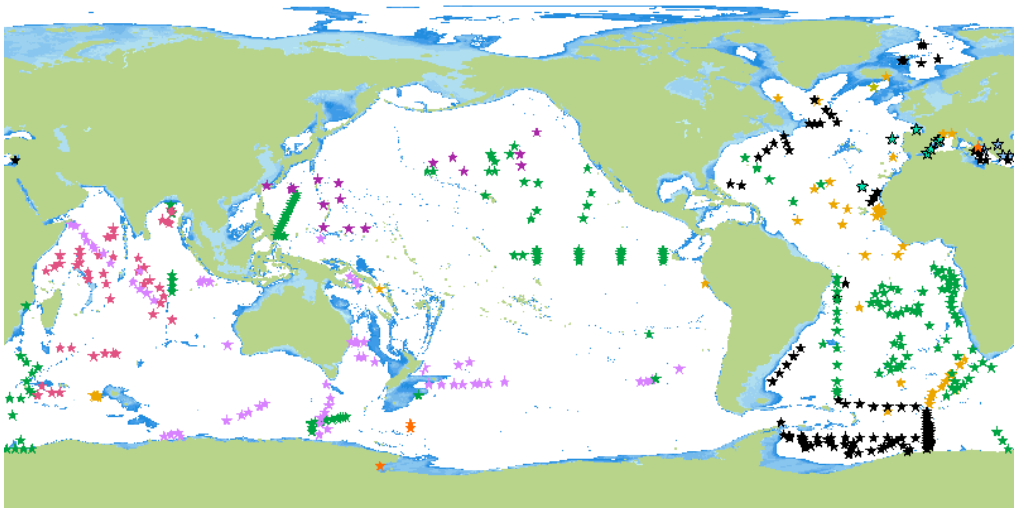


Figure 5: Deployment plan. The orange stars represent the French deployment plan for 2013.

Coriolis will continue to run the Coriolis DAC and the European GDAC as well as coordinating the North Atlantic ARC activities. Within the Euro-Argo project development will be carried out to

improve anomalies detection at GDAC both in RT and DM, to monitor in real time the behavior of the European fleet and to improve data consistency check within NA-ARC.

France also contributes to the funding of the AIC.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers

Operational ocean forecasting. All Argo data (alongside with other in-situ and remotely sensed ocean data) are routinely assimilated into the MERCATOR operational ocean forecasting system run by the MERCATOR-Ocean structure.

Support to the Mercator and Coriolis scientific activities: Coriolis has developed together with MERCATOR (The French operational oceanography forecast center) a strong connection with the French research community via the Mercator-Coriolis Mission Group (GMMC). It consists of about one hundred researchers (with some turnover each year) following a scientific announcement of opportunities and call for tender. Its task is to support the Mercator and Coriolis scientific activities and to participate in product validation.

Ocean science. Argo data are being used by many researchers in France to improve the understanding of ocean properties (e.g. circulation, heat storage and budget, and mixing), climate monitoring and on how they are applied in ocean models (e.g. improved salinity assimilation, …). List of scientific publications is available trough the Argo web site: http://www-argo.ucsd.edu/FrBibliography.html and through the French Argo web site: http://wwz.ifremer.fr/lpo/SO-Argo-France/Publications. About 125 peer-reviewed papers using Argo-data have a leading author based in a French laboratory.

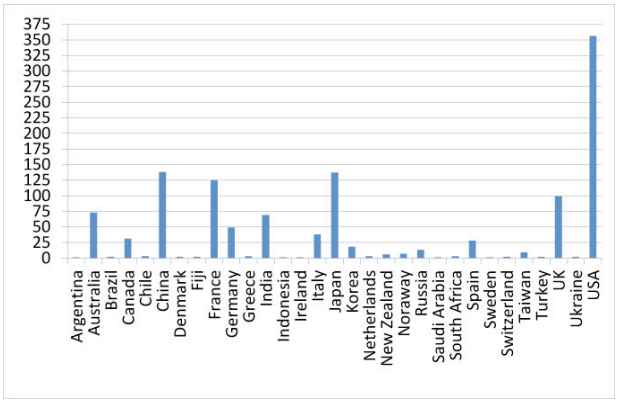


Figure 9: Number of paper using Argo data as function of the country of the lead author.

French-Argo meeting: The French Argo Users' Group provides a forum for engagement between these scientists and the French Argo program. The last meeting of the user group was scheduled the 20-21 June 2012 in Brest. In 2013, French Argo Users will meet as part of the 4th Euro-Argo Science Meeting that will be held in Southampton 18-20 June 2013.

Argo-Regional center: We are currently investigating the performance of the OW method in the North-Atlantic. Our objective is to propose a kind of cookbook on how to use OW to detect and correct salinity sensor bias or drift in the North-Atlantic. We have first selected all floats in the Subpolar gyre region that have been processed in delayed mode and for which no correction for

salinity bias or drift was necessary according to the PI's decision. We have then used this subset of "unbiased" floats to test the OW method in the Subpolar gyre region.
Figure 10A shows the correction proposed by the OW method for this subset of floats when the CTD reference database is used for calibration. One would expect that the corrections proposed by OW would be distributed around zero. However this is not the case, particularly along the Reykjanes Ridge and the topography in the Labrador sea were negative corrections are systematically proposed (-0.02 to -0.03PSU).

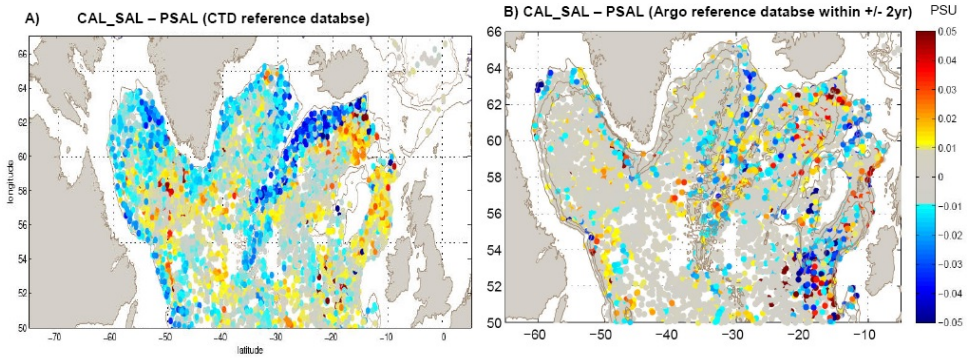


Figure 10: Corrections proposed by the OW method for all floats for which no salinity correction was judged necessary by the PIs. A) CTD reference database is used for calibration. B) Argo reference database is used for calibration and reference profiles are selected within +/- 2 years of the analysed Argo profile.

We have checked that these results were not strongly related to the choice of configuration parameters and θ levels. Instead, the systematically negative corrections proposed along the topography in the Labarador and Irminger seas are mainly explained by a large decadal variability that is not well captured in the CTD reference database. In consequence, salinity corrections estimated with OW and using the more recent Argo reference database seem to be more reliable. It is even necessary to select reference data within +/-2yr of the date of the profile in the Labrador Sea region because of large interannual variability (>0.01 PSU) (see Figure 10B).

Finally, we have checked the corrections made on Argo profiles on the GDAC. Figure 11 shows the delayed mode salinity corrections actually applied to all the floats in the North Atlantic region. Some floats in the subpolar gyre have been corrected for positive salinity biases (negative corrections) that are comparable to the values shown Figure 10A. Therefore, we counted 8 floats in this region that may have been over-corrected and that should be checked again (on-going work).

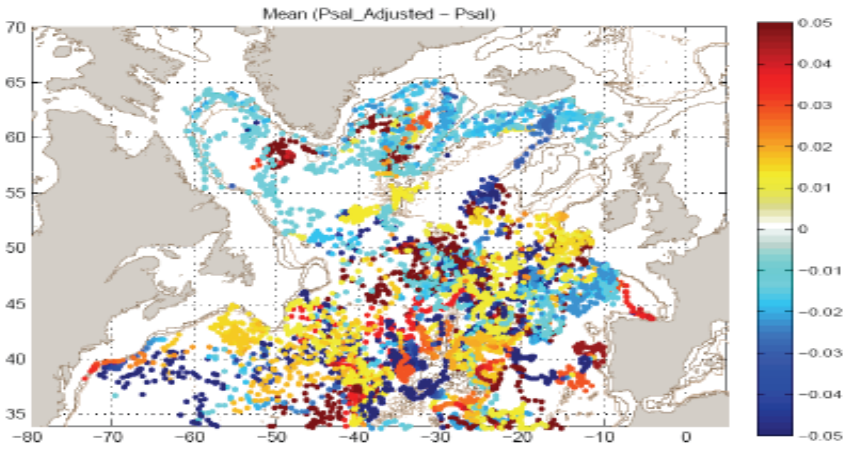


Figure 11: Salinity corrections made on Argo profiles

Owens, W. B. and Wong, A. P. S.: An improved calibration method for the drift of the conductivity sensor on autonomous CTD profiling floats by 2-S climatology, Deep-Sea Res.-Pt. I, 56, 450–457, 2009.

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report

None.

6. To continue improving the number of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include the number and location of CTD cruise data uploaded by PIs within your country to the CCHDO website in the past year. These cruises could be used for Argo calibration purposes only or could be cruises that are open to the public as well

The number of CTD cruise data uploaded by PIs within France in 2012 to the CCHDO website is not known.

The Coriolis reference database has been updated with new NODC data acquired since the release of the WOD 2009 and until October 2012, as well as ICES CTD data. Some CTD from CCHDO have been also integrated in this version provided in November 2012. An updated version of the reference database will be provided to the Argo community mid-March 2013.

7. List of publications in which a scientist from a french laboratory is involved

This list is available on the following web site: http://wwz.ifremer.fr/lpo/SO-Argo-France/Publications. The missing publications on the Argo Bibliography page web have been reported to Megan Scandeberg.

Argo Germany National Report 2012

February 2013

Marek Stawarz, BSH

1. Status

Data acquired from floats

Most of the floats deployed by Germany are operated by BSH but additional funding has been acquired by various research institutes. From November 2011 to October 2012, BSH deployed 38 floats, additional 49 floats have been deployed in the Atlantic Sector of the Southern Ocean and in the Weddell Sea during Polarstern cruise ANT-XXIX/2 between December 2012 and January 2013: 47 by AWI and 2 by BSH (Fig.1). The deployments in the Southern Ocean have started in 2010 and are still continuing. Currently (February 1st, 2013) 214 German floats are active (Fig.2). The total number of German floats deployed within the Argo program increased to 562 and the total number of received profiles is 39726. Most of the German floats are APEX floats purchased from Webb Research, but a smaller amount of floats are manufactured by the German company Optimare. Optimare has been working in close collaboration with the AWI and has developed a float type suitable for partially ice covered seas. These floats are equipped with an ice sensing algorithm which prevents the float from ascending to the surface under ice conditions and prevents it from being crushed. Float profiles are stored internally until they can be transmitted during ice free conditions. Most of the German floats are equipped with the standard Seabird CTD but occasionally additional sensors as Aanderaa optodes and Rafos acoustic receivers are installed.
In 2012 BSH deployed also two NOVA (New generation Oceanographic Variable-buoyancy Autonomous) profiling floats from MetOcean in Canada. The floats have been deployed in the western part of the North Atlantic in July 2012. The NOVA floats are equipped with Iridium satellite telemetry, which allows for quicker, bi-directional, and more cost effective data transmissions. Both floats work reliable and have provided up to now 21 high quality profiles.

There are currently no major technical problems

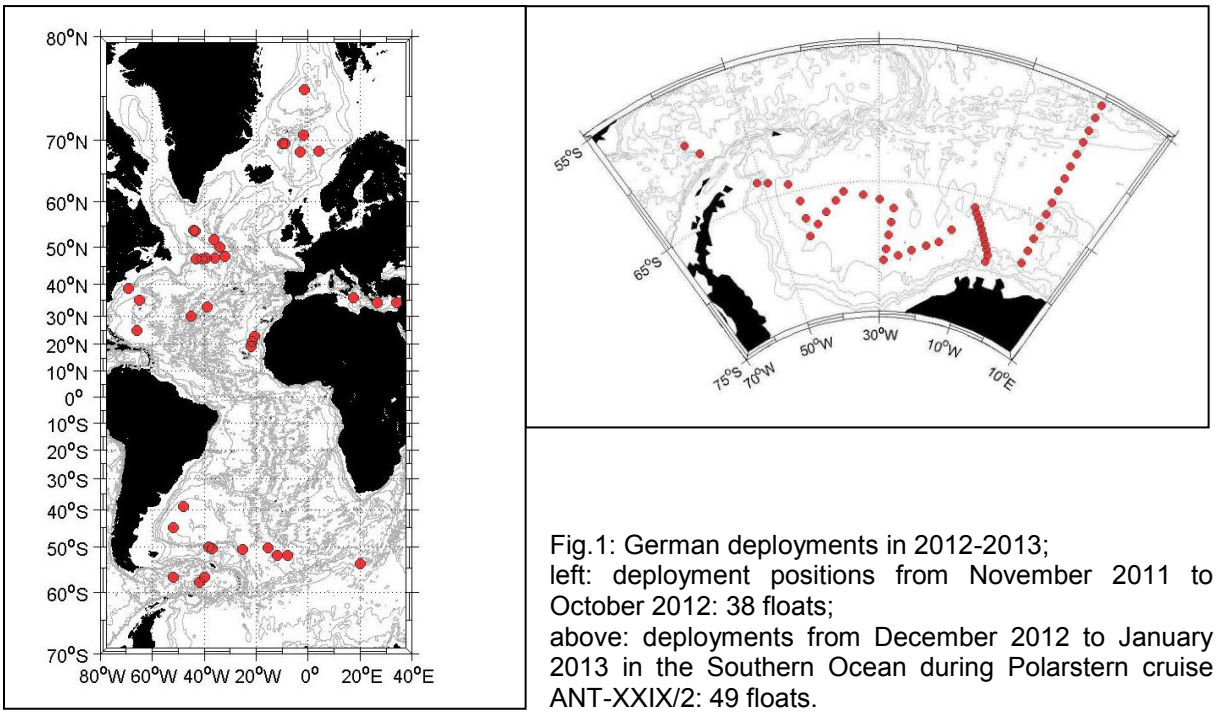


Fig.1: German deployments in 2012-2013;
left: deployment positions from November 2011 to October 2012: 38 floats;
above: deployments from December 2012 to January 2013 in the Southern Ocean during Polarstern cruise ANT-XXIX/2: 49 floats.

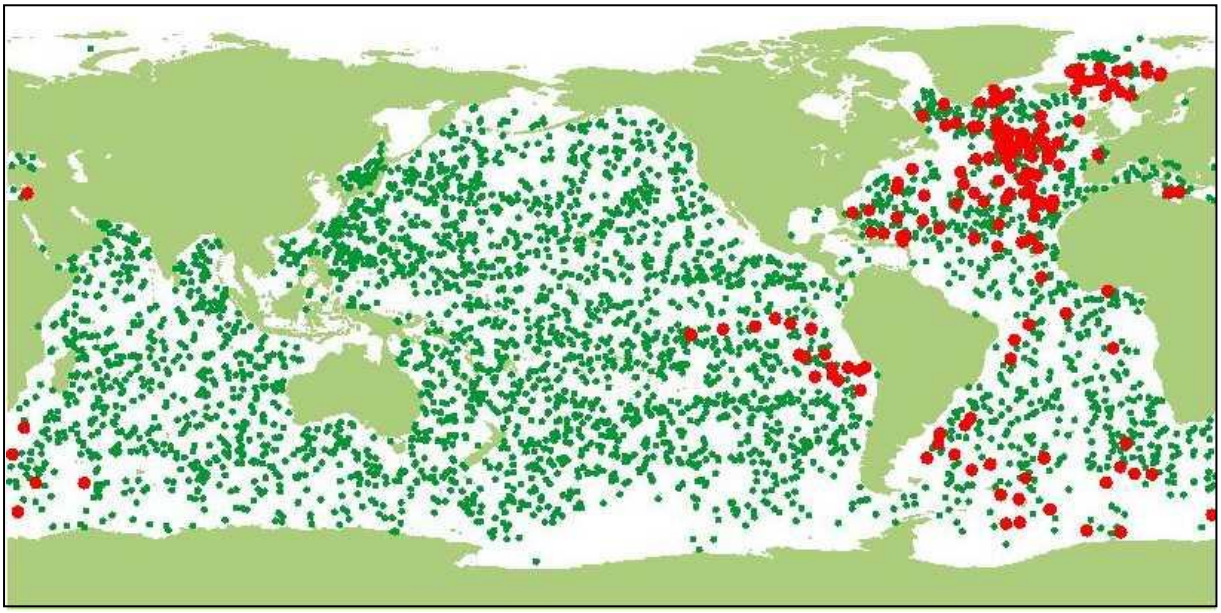


Fig. 2: Locations of active German floats (red) with active international floats (green) (Argo Information Centre, February 2013).

Two floats deployed in the Mediterranean were lost early in their mission: one with WMO-ID 6901083, deployed in April 2012 was found beached in Crete, Greece. The beaching was detected with the help of the AIC and the float was recovered by the Greek colleagues and send back to Germany and it will be re-deploy after requiring service. The second float has beached or it was picked up in shallow water close to Beirut.

Deployment plan for 2013

The deployment plans for 2013 will comprise 36 floats from BSH in the Atlantic and the Nordic Seas, 8 floats from GEOMAR in the eastern subtropical Pacific and an unknown number of floats from AWI, which will be deployed in the Southern Ocean and in the Weddell Sea in the Antarctic summer season 2013/2014. The deployment will be performed in co-operation with the German research institutes. Germany owns deployment capabilities for all oceans including the ice covered areas but foreign research cruises will be used as well to cover all intended deployment areas.

The main goal is to support the global array in the Atlantic Ocean and will focus on data sparse regions, specifically in the Southern Ocean, the western North Atlantic, the Nordic Seas and the Mediterranean. The exactly deployment positions have not been determined yet.

Data issued to GTS

The profiles for all German floats are processed by Coriolis and are distributed on the GTS by way of Meteo-France.

Data issued to GDACs after real-time QC

The real-time data processing for all German floats is performed at the Coriolis Center in France. Data processing follows the procedures set up by the Argo Data Management Team.

Data issued for delayed QC

The delayed mode processing is distributed between the various German institutions contributing to Argo, depending on their area of expertise. AWI is responsible for the Southern Ocean, IfM-Hamburg together with BSH is processing the German floats in the Nordic Sea, and BSH is covering the tropical, subtropical Atlantic and subpolar Atlantic. The sharing of delayed-mode data processing will be continued in the coming years, but BSH will cover all the German floats which have not been assigned a PI. BSH also has adopted some European floats which did not have a DMQC operator assigned to them, such as national Argo programs from the Netherlands, Denmark, Norway, Finland and Poland. All German institutions have been working in close collaboration with Coriolis and delayed mode data have been provided on a 6 monthly basis. Delays in delayed-mode data processing have occurred occasionally due to changes in personal and delay in data transmission in the Southern Ocean due to ice coverage. Delayed-mode data processing follows the rules set up by the Data Management Team. The DMQC process is well underway and no major delays have been encountered.

Delayed data send to GDACs

All delayed mode profiles have been sent to GDACs. The total number of received profiles is 39726 (February 1st, 2013), the number of DM profiles is 35539. The percentage of DM profiles with respect to the total number of profiles is about 90%.

Web pages

BSH is maintaining the Argo Germany Web site. The URL for the Argo Germany is:

http://www.german-argo.de/

It provides information about the international Argo Program, German contribution to Argo, Argo array status, data access and deployment plans. It also provides links to the original sources of information.

Statistics of Argo data usage

Currently no statistics of Argo data usage are available.

Products generated from Argo data

A key aspect of the German Argo program is to develop a data base for climate analysis from Argo data, to provide operational products for interpretation of local changes and to provide data for research applications.

Argo data are being used by many researchers in Germany to improve the understanding of ocean variability (e.g. circulation, heat storage and budget, and convection), climate monitoring and application in ocean models.

Germany contributes to the NARC and contributes recent CTD data to the Argo climatology

GREEK ARGO PROGRAMME

PRESENT STATUS AND FUTURE PLANS

G. Korres and D. Kassis
HCMR
February, 2013

1. Background and organization of GREEK ARGO activities

Greece has established national contribution to the ARGO project.

1.1 Deployed floats

During 2010, HCMR procured (using internal funds) and deployed a PROVOR-CTS3 float initiating the Greek Argo programme. The float was deployed in the Cretan Sea, south of Santorini Island on the 26th of June 2010 using R/V AEGAEO. The float has been integrated in the MedArgo project. Taking into account the proposed sampling strategy for the Mediterranean Sea and the bathymetry of the deployment site and the adjacent areas, the mission parameters of the float were set as follows: The parking depth of the float was set to 350m, its profiling depth to 1000m and the cycle period to 5 days. The raw data of the Greek float are delivered at the Coriolis data Centre where the real time quality control takes place while the delayed mode quality control of the data will be processed by the MedArgo Centre at OGS.
In August 2011, the float stopped operating, found by fishermen and was delivered back to HCMR premises by the porting authorities of Kassos island (southeastern Aegean). The float was sent back to NKE Electronics for the necessary maintenance (changing batteries, replacing bladder housing) and in November 2011 was successfully re-launched in the Cretan Sea by HCMR stuff. The float was lost in March 2012 somewhere in the Western Cretan Strait (Antikithira Island) after completing more than 80 valid profiles.

1.2 Float Development

HCMR has finished the design and will start to construct an Argo float's detection system in order to test it during the Mediterranean Argo workshop during September 2013. This activity is under the task of proposing and testing simple methods of tracking and recovery Argo floats in short time and range scales in the framework of SIDERI project.

1.3 Data management

HCMR has run an extended network of buoys within the Aegean and Ionian Seas including the multi-parametric M3A observatory of the Cretan Sea and a deep sea (2000m) bottom platform deployed in the Ionian Sea (POSEIDON & POSEIDON-II monitoring, forecasting and information systems). HCMR also operates the Hellenic National Oceanographic Data Centre (HNODC) established in 1986, as part of the National Centre for Marine Research (NCMR). HNODC operates as a National Agency and is responsible for processing, archiving and distributing marine data. HNODC is also developing techniques for oceanographic data processing and data base maintenance. Furthermore it promotes the International Exchange of Data in the frame of its cooperation with the "Intergovernmental

Oceanographic Commission IOC) of UNESCO as it is responsible for the coordination of International Data Exchange (IODE) in Greece. The HNODC manages a variety of oceanographic data and information collected by several Hellenic Marine Research Laboratories and in particular from the Institute of Oceanography of the Hellenic Centre for Marine Research-HCMR as well as from HNODC's participation in international projects (MTP-II MATER, MEDAR/MEDATLAS II, HUMBOLDT, SEADATANET). Moreover within the My Ocean project (GMES MCS) HCMR will consolidate and improve its in-situ data services for the Eastern Mediterranean region building on the capacity developed under POSEIDON, MFSTEP (coordination of M3A time-series network, analysis and provision of basin scale data), and MERSEA projects (coordination of Mediterranean in situ observations).

Delayed-mode data processing. HCMR has not developed yet a delayed-mode quality control capability for the Greek Argo data. The delayed mode quality control of the data delivered from the Greek Argo float will be processed by the MedArgo data centre. HCMR considers the possibility of developing delayed-mode data processing for ARGO profiles collected within the Eastern Mediterranean region. HCMR may also contribute to the improvement of the delayed mode quality control processing conceding CTD data collected through several HCMR research cruises. HCMR operates the Med Sea data portal that was set up for the needs of MyOcean project. Within this framework HCMR is in charge of validating biochemical data from Argo floats that are operating in the Mediterranean.

1.4. Operational and scientific use of Argo data

A very important activity, in the frame of the Greek Euro-Argo programme (which will demonstrate the Argo value) is the development of the capabilities in order to exploit Argo data for operational forecasting as well as for research applications. Along this direction, HCMR established a network of relevant Greek scientific groups mainly from Universities and Research Institutes which constitute the Greek Argo Users group/network. These different groups are already using or will be using ARGO data in ocean/atmospheric forecasting, climate studies and for educational purposes. It is expected that the Greek Argo Users Group will further grow and expand its activities concerning the scientific exploitation of Argo data and the cooperation among Greek scientists. Additionally, it is foreseen that the establishment of the E-A ERIC will increase the interaction of the Greek Argo Users Group with the European and international ARGO scientific community in the near future.

Operational ocean forecasting:

Med-Argo data have been already used as independent data in order to assess the impact of remote sensed and Ferrybox SSS data assimilation into the Aegean Sea hydrodynamical model component of the POSEIDON system running operationally at HCMR within the framework of POSEIDON-I system.

Med-Argo data are routinely assimilated (using localized Singular Evolutive Extended Kalman filtering techniques) on a weekly basis in one of the operational forecasting systems that are currently operating at HCMR involving the Mediterranean basin at $1/10^{o}$ resolution (POSEIDON-II system) and the Aegean Sea at $1/30^{o}$ resolution.

The results of the works described above are included in the following scientific publications:

[1] Korres, G., K. Nittis, I. Hoteit, and G. Triantafyllou, 2009: **A high resolution data assimilation system for the Aegean Sea hydrodynamics.** *Journal of Marine Systems,* **77,** 325-340.

[2] Korres, G., K. Nittis, L. Perivoliotis, K. Tsiaras, A. Papadopoulos, I. Hoteit and G. Triantafyllou, 2010. **Forecasting the Aegean Sea hydrodynamics within the POSEIDON-II operational system**. *Journal of Operational Oceanography*, Vol. 3, nu. 1, 37-49,

[3] Korres, G., I. Hoteit, G. Triantafyllou, K. Nittis and K. Tsiaras. **An operational data assimilation system for the Mediterranean Sea hydrodynamics** (in preparation).

as well as in a poster presentation for the 2nd EURO ARGO users meeting (OGS, Trieste - Italy)*:*
G. Korres, K. Nittis, L. Perivoliotis, G. Triantafyllou and M. Chatzinaki, 2009. **The Aegean Sea –Poseidon model.** Hellenic Centre For Marine Research, Greece.

Ocean science

Med-Argo data are currently used by a small group of researchers in Greece for studies of water mass characteristics of the different deep basins of the Mediterranean Sea and as a continuous record of T/S characteristics providing insight in the seasonal and inter-annual variability of the Mediterranean Sea and its sub-basins. Additionally, Argo data are used for educational purposes in some Greek University Departments. Due to HCMR initiatives within Euro Argo, Greek Argo and SIDERI programmes, collaboration with other scientists has been launched. Greek Argo team has contacted potentially interested Greek and other scientists from the eastern Mediterranean region and informed them about the benefits of Argo programme. An increasing demand for Argo data along the Aegean and Ionian Sea for both scientific and educational purposes has been registered.

2. Funding

2.1 Existing funding for Greek Argo

The procurement, deployment and operation costs of the first Greek float launched in 2010/2011 were covered by HCMR internal funds. Last year, Greece established national funding to the Greek Argo programme through the General Secretariat of Research and Technology (GSRT), Ministry of Education, Lifelong Learning and Religious Affairs (funding agency). A major achievement is that Greece will meet the standards to participate to the future European infrastructure E-A ERIC as a full member. A tender regarding the procurement of 25 new floats during the next 4 years period is underway.

2.2 On the future funding and organization for Greek Argo – links with Euro Argo

The previous years, as part of the Euro-Argo preparatory phase, HCMR has undertaken all necessary efforts and managed to establish long term national funding for the E-A ERIC infrastructure and to meet the standards of a full member.
Greece has deployment capabilities for the Aegean, the Ionian Sea and the central Levantine basin. Float deployment in 2013 will be performed according to the plans of the Greek-Argo research infrastructure and two EU projects (PERSEUS and IONIO) that have started last year. The main goal within 2013 is to initiate the development of the Greek-Argo infrastructure array in accordance with MEDARGO and the EuroArgo infrastructure. It is

planned to start deployments in spring 2013 and deploy 6 floats in total in the Ionian (2 floats), in the Aegean Sea (3 floats) and South of Crete (1 float). One of these floats has been already purchased with PERSEUS funds, two will be purchased with IONIO (Interreg-III) allocated funds while National Greek Argo programme will contribute with three additional floats.

3. Dissemination activities of the Euro-Argo infrastructure

The Euro-Argo infrastructure is demonstrated on the POSEIDON updated web page, http://www.poseidon.hcmr.gr/article_view.php?id=57&cid=28&bc=28. The POSEIDON system is the operational monitoring and forecasting system for the Greek Seas and many of its forecasting components use T/S Argo profiles for data assimilation purposes. The POSEIDON web page is also hosting the links to the EuroArgo educational web site as well as to the floats from each European country. The above links along with other informative material (Euro Argo leaflet, focused questionnaire) were forwarded directly to all active and potential users of Argo data in Greece. Many research groups filled and sent back the questionnaire providing valuable feedback to HCMR team. Furthermore, the EuroArgo poster and leaflet translated in Greek and they are hosted in the POSEIDON website. A press release was sent after the deployment of the Greek float. The press release is permanently hosted in the HCMR's Greek webpage, http://www.hcmr.gr/listview4_el.php?id=1110.
Additionally HCMR Argo team is planning to set up a web portal presenting all Greek Argo activities, news and data from Greek Argo floats as well as outreach and promoting activities.

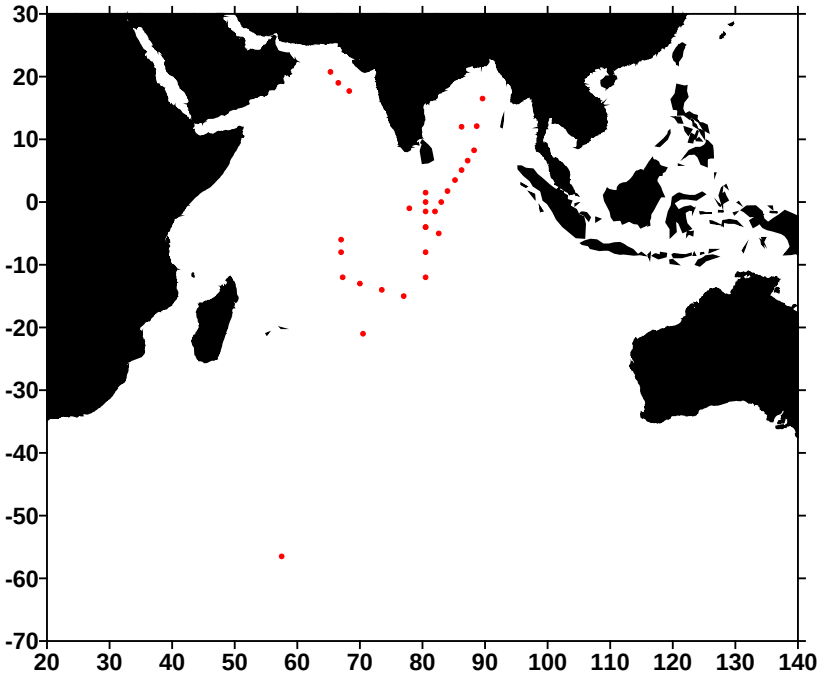
Argo Steering Team Meeting (AST-14)

National Report – India
(Submitted by M Ravichandran)

1. The status of implementation

1.1a Floats deployment

During the year 2012–13, 30 floats were deployed in the Indian Ocean taking the total to 284. The new deployment includes 8 Bio-Argo floats with additional sensors like Doxy, FLBB, Chl-a. The deployment locations are given below.



1.1b performance Analysis of Floats deployed

Out of the 284 floats deployed, 114 floats are active. Out of these 114 active floats, 87 floats are less than 3 years old.

1.2 Technical problems encountered and solved

None

1.3 Status of contributions to Argo data management

- **Thirteenth Argo data management team meeting and Bio-Argo workshop was hosted by INCOIS, Hyderabad during 12-16, November 2012.**

- **Data acquired from floats**
  All the active floats data are processed and sent to GDAC.

- **Data issued to GTS**

  From June 2011, India started uploading TESAC format messages to GTS via New Delhi RTH. There is slight issue with respect to the GTS messages not appearing in METEO France and once this is resolved, INCOIS would soon start transmitting the BUFR messages onto GTS.
- **Data issued to GDACs after real-time QC**

  All the active floats (114) data are subject to real time quality control and are being sent to GDAC.
- **Web pages**

  INCOIS is maintaining Web-GIS based site for Indian Argo Program. It contains entire Indian Ocean floats data along with trajectories. Further details can be obtained by following the link:
  http://www.incois.gov.in/incois/argo/argo_home.jsp.
- **Statistics of Argo data usage**

  Argo data is widely put to use by various Organisations/ Universities/Departments. INCOIS Argo web page statistics (for the past one year) are as shown below

Page	Views	Visitor
Argo Web-Gis	871	679
Data downloads	1029	1101
Live Access Server	2,13,727	99,137
Argo products	1301	722

In addition to this, the Argo data is provided in the form of a DVD for users with low bandwidth, particularly, university students. Web-GIS features on the INCOIS web site are all incorporated into this DVD. This DVD serves all the Argo data and data products pertaining to the Indian Ocean. As many as 200 copies are supplied to the users.

- User interactions meeting were conducted to bring about awareness about the Argo data among the researchers and students from various organizations and universities in India.
- INCOIS is also conducting University outreach program where in scientist visit various universities to bring about the awareness about the data with

INCOIS. Students are encouraged to use Argo data for their MS thesis dissertations, thereby giving wide publicity to the Argo program. Many publications and dissertations are coming out using Argo data.

1.4 Status of Delayed Mode Quality Control process

DMQC is done on all eligible floats on a routine basis.

- Around 187 floats were passed through the DMQC s/w and the following problems were tackled
  - Pressure Sensor offsets.
  - Salinity drift.
  - Salinity Hooks.
  - TBTO problems.
  - TNPD problems. etc
- Around 66 % of FLOATS are DMQCied for INCOIS DAC.
  - Lack of CTD profiles in some of the region in North Indian Ocean (coastal areas and in EEZ) is still a critical problem when decision is to be taken for the complicated cases.

1.5 Trajectory files status:

A total of 276 trajectory netcdf files were processed and uploaded to the GDAC. The process of generation of trajectory netcdf files undergoes quality checks like position, time, cycle number, etc., and corresponding quality status is assigned to each parameter.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

Indian Argo Project is a 5 year Program from April 2012 to March 2017 fully funded by Ministry of Earth Sciences, (MoES), Govt. of India. Funding is secured for deployment of 200 Argo floats (40 floats per year including 10 Bio-argo floats), Data management activities, Data analysis, etc.

3 Permanent and 2 temporary scientific/technical personnel are working under Indian Argo project, which include personal for deployment of Argo floats, Data system, Analysis of Data, etc.

3. Summary of deployment plans (level of commitment, areas of float deployment) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

India is committed to deploy floats in the Indian Ocean wherever gap exists. India has committed 40 floats per year for the next five year (10 floats in the Southern Ocean, 10 floats in the Bay of Bengal, 10 floats in the equatorial Indian Ocean and remaining 10 in the Arabian Sea). After ascertaining the gap region and cruise plan of MoES research vessels, these floats will be deployed. The existing data management resources will continue for the next 5 year term.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.

Operational: All Argo data are being routinely assimilated in Ocean Model for providing Global ocean analysis. This analysis is being used by MET department for initialization of coupled ocean-atmosphere forecast of Monsoon. From the year 2011, India could provide seasonal forecast of monsoon using dynamical model wherein Ocean analysis (with assimilation of Argo) is an important contribution. The analysis products are being made available at INCOIS live access server (las.incois.gov.in)

Research: Argo data are being widely used for many applications to understand the Indian Ocean dynamics, cyclone and monsoon system in relation to heat content, thermosteric component of sea level and validation of OGCM.

INCOIS is hosting Indian Ocean ARC, wherein all floats data from the Indian Ocean region are archived and distributed apart from many products

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report.

None

6. As part of an action item from AST-9 aimed to improve CTD cruise data being added to the reference database by Argo PIs, it is requested that you include the number and location of CTD cruise data uploaded by PIs within your country to the CCHDO website in the past year. These cruises could be used for Argo calibration purposes only or could be cruises that are open to the public as well.

None

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Sharma, R., B. Mankad, N. Agarwal, R. Kumar, and S. Basu, 2012: An assessment of two different satellite-derived precipitation products in relation to simulation of sea surface salinity in the tropical Indian Ocean. *J. Geophys. Res.*, **117,** C07001.

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Report on the Italian Argo Program for 2012

1. The status of implementation (major achievements and problems in 2012).

- floats deployed and their performance:

In total, 19 Italian floats were deployed in 2012 (see Tables 1 to 3 for details). These floats were Arvor designs manufactured by NKE (France), some with Iridium (Arvor-I) and others with Argos telemetry (Arvor-L). In the Mediterranean, 13 units were deployed (Table 1) but unfortunately two of them (WMO 6901039 and 6901820) never transmitted data after deployment, despite normal and positive test and deployment procedures. Except for these 2 floats, all the other instruments are still operating at the end of February 2013. They have a parking depth at 350 dbars and profiling depths alternating at 700 and 2000 dbars. They all have cycles of 5 days, except WMO 6901044 which is cycling at daily intervals in the Malta Channel. Most floats were deployed from research vessels of opportunity (R/V Nase More, Pourquoi Pas, Urania, Explora) with the help of colleagues from Croatian, France, Italian, Cyprus and Malta.

Model	WMO	Deploy Date	Lat	Lon	Cycles	Last Date	Lat	Lon	Status
Arvor-L	6901039	18-Feb-2012 12:00	42.25	17.75	0	18-Feb-2012 00:00	0	0	D
Arvor-L	6900979	10-Mar-2012 20:18	38.98	18.31	71	25-Feb-2013 12:29	38.23	18.57	A
Arvor-L	6900980	13-Mar-2012 18:17	40	12.66	70	26-Feb-2013 07:46	38.79	10.39	A
Arvor-L	6900978	16-Mar-2012 11:41	39.4	14.01	73	26-Feb-2013 07:45	39.39	11.68	A
Arvor-L	6900981	17-Mar-2012 03:09	40.76	10.9	69	22-Feb-2013 13:02	39.15	16.01	A
Arvor-L	6901040	29-Mar-2012 15:51	42.22	17.72	66	24-Feb-2013 12:54	42.18	16.97	A
Arvor I - 2	6901041	03-Aug-2012 02:30	41.17	11.75	41	26-Feb-2013 00:16	42.02	10.52	A
Arvor I - 2	6901042	04-Aug-2012 01:25	43.02	9.08	39	22-Feb-2013 00:19	43.96	8.57	A
Arvor I - 2	6901043	18-Sep-2012 15:29	33.58	31.98	31	22-Feb-2013 00:28	32.58	33.79	A
Arvor I - 2	6901817	11-Nov-2012 13:23	34.96	22.64	23	26-Feb-2013 00:09	34.61	21.52	A
Arvor I - 2	6901820	14-Nov-2012 11:22	38.65	17.25	0	14-Nov-2012 11:32	36.36	14.3	D
Arvor I - 2	6901818	19-Nov-2012 05:34	35.9	22.91	19	24-Feb-2013 00:11	34.94	21.87	A
Arvor I - 2	6901044	14-Dec-2012 16:40	36.29	14.3	70	26-Feb-2013 00:13	0	0	A

Table 1. Status information for the 13 Italian floats deployed in the Mediterranean Sea during 2012.

Four Italian floats were deployed in the Black Sea in 2012 (Table 2) with the help of Bulgarian colleagues. They were released in the southwestern Black Sea from R/V Akademik. One of them (WMO 6901960) stranded on the Bulgarian coast after 26 cycles. It was recovered, refurbished and is now ready to be re-deployed. The other floats are still collecting data as of the end of February 2013. All floats have a parking depth at 200 dbars and execute alternating CTD profiles from 700 and 1500 dbars. The cycling period is 5 days.

Model	WMO	Deploy Date	Lat	Lon	Cycles	Last Date	Lat	Lon	Status
Arvor-L	6901959	08-Jun-2012 09:36	43.47	30.09	53	25-Feb-2013 12:28	43.31	33.44	A
Arvor-L	6901960	09-Jun-2012 08:03	43.17	29.66	26	22-Oct-2012 19:37	42.3	27.79	D
Arvor-L	6901962	17-Aug-2012 01:50	43.42	30.17	39	25-Feb-2013 12:29	41.34	38.15	A
Arvor-L	6901961	06-Nov-2012 18:07	43.15	30.77	22	21-Feb-2013 13:14	41.59	31.14	A

Table 2. Status information for the 4 Italian floats deployed in the Black Sea during 2012.

Two Italian floats were deployed in the northeastern tropical Atlantic Ocean off Senegal in 2012 (Table 3) with the help of French and Senegalese colleagues onboard R/V Le Suroit. Unfortunately, float WMO 6900983 was incorrectly turned on and was deployed in “end of mission” mode. It stayed at surface and was eventually lost. The other float (WMO 6900982) executed successfully 6 cycles before stranding and being picked up on the Senegalese coast. The float was recovered and shipped back to NKE for repair and refurbishing. These floats were programmed as follows: 10-day cycles, parking at 1000 dbars and maximal profiling depth of 1500 dbars.

Model	WMO	Deploy Date	Lat	Lon	Cycles	Last Date	Lat	Lon	Status
Arvor-L	6900982	08-Mar-2012 01:04	14.86	-17.62	6	19-Apr-2012 14:17	14.68	342.53	D
Arvor-L	6900983	11-Mar-2012 08:30	14.34	-17.66	0	11-Mar-2012 08:30	0	0	D

Table 3. Status information for the 2 Italian floats deployed off West Africa during 2012.

- technical problems encountered and solved

As stated above, two floats failed upon deployment in the Mediterranean despite the fact that the pre-deployment tests were positive and deployment procedures were standard and normal. The reasons for theses failures are still unknown. They will be investigated in collaboration with the manufacturer NKE.

- status of contributions to Argo data management (including status of pressure corrections, technical files, etc)

The data management for the Italian float was done by the Coriolis GDAC. Metadata and data are available through the Coriolis web site in near real-time.

- status of delayed mode quality control process

Delayed mode quality control (DMQC) of the data provided by the Italian floats has not been done yet. OGS will perform this activity in 2013 as part of the EC FP7 Sideri and MyOcean-2 projects. Note that OGS is responsible for the DMQC of all the floats operated in the Mediterranean and Black seas. The temperature and salinity data of 87 floats (over a total of 175 floats) have been quality controlled following the standard Argo procedure, covering the period 2000-2012.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

The Italian Ministry of Research has provided funding to buy about 50 floats in 2013, including about 10 instruments with biogeochemical sensors. In addition, the Italian human resources devoted to Argo-Italy per year amounts to about 50 man-months for technical, administrative and scientific personnel involved in the project in 2013. It is expected that the same level will maintained in 2014. The Italian Ministry of Research is committed to provide funding in order to sustain the Italian contribution to Argo beyond 2013 as member of the Euro-Argo Research Infrastructure Consortium. In addition to the Italian national funding, OGS has funding from the EC FP7 PERSEUS, SIDERI and E-AIMS projects, for multiple activities (technical development, data management, capacity building and training, EuroArgo strategy, etc.) related to Argo.

3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

The Italian deployment plans are detailed in Table 4. The main areas of interest are the Mediterranean and Black seas and the Southern Ocean.

Year	Floats with T/S		Floats with biogeochemical sensors		Total
	Quantity	Area	Quantity	Area	
2013	10 1 3	Mediterranean Black Sea Southern Ocean	2	Mediterranean	**16**
2014	10 2 5	Mediterranean Black Sea Southern Ocean	3	Mediterranean	**20**
2015	10 3 5	Mediterranean Black Sea Southern Ocean	2	Mediterranean	**20**

Table 4. Italian deployment plans for 2013-2015.

OGS is committed to carry out DMQC on all the Argo floats of the Mediterranean and Black seas as part of the SIDERI, E-AIMS and MyOcean-2 projects over the next two years.

The website for the Italian contribution to Argo (Argo-Italy) was developed (http://argoitaly.ogs.trieste.it/). The link to the Mediterranean & Black Sea Argo Centre (MedArgo) is http://nettuno.ogs.trieste.it/sire/medargo/ .

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.

Operational ocean forecasting.

All Argo temperature and salinity data in the Mediterranean (alongside with other in-situ and remotely sensed data) are routinely assimilated into the Mediterranean Forecasting System (MFS)

operational forecasting system run by the Italian Gruppo Nazionale di Oceanografia Operativa (GNOO). Assessments have clearly demonstrated the positive impact of Argo data on ocean analyses and predictions. In particular, studies on the optimization of float sampling and cycling characteristics for the Mediterranean have been performed, as well as the development of methodology for the assimilation of Argo float sub-surface velocities into numerical models.

Ocean science.

Argo data are being used by several researchers in Italy to improve the understanding of marine properties (e.g. circulation, heat storage and budget, and mixing), climate monitoring and on how they are applied in ocean models, with particular focus to the Mediterranean Sea.

5. Issues that your country wishes to be considered and resolved by the AST.

N/A

6. Number of CTD cruise data added to the Argo reference database by Italian PIs in 2012.

N/A

7. Italian contribution to Argo bibliography in 2012.

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Japan National Report

(Submitted by Toshio Suga)

1. The Status of implementation (major achievements and problems in 2012)

1.1 Floats deployed and their performance

The current positions of all the active Japanese Argo floats are shown in Fig.1.

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 58 Argo and Argo equivalent floats from January to December 2012: 5 APEXs, 14 PROVORs, 38 ARVORs and1 NEMO. All the floats were deployed with the aid of R/Vs of 10 domestic organizations.

One NEMO float was deployed near the northwest coast of Papua New Guinea in order to make quasi stationary observation of New Ireland Coastal Undercurrent (NICU) in August 2012, as part of the JAMSTEC contribution to CLIVAR/SPICE. The float used the Iridium transmitter, measuring temperature and salinity, and was supposed to stay in the NICU for a long time by controlling parking depth in the NICU and the opposite flow just below it. Unfortunately, the float observed two profiles and then stopped communication due to technical failures.

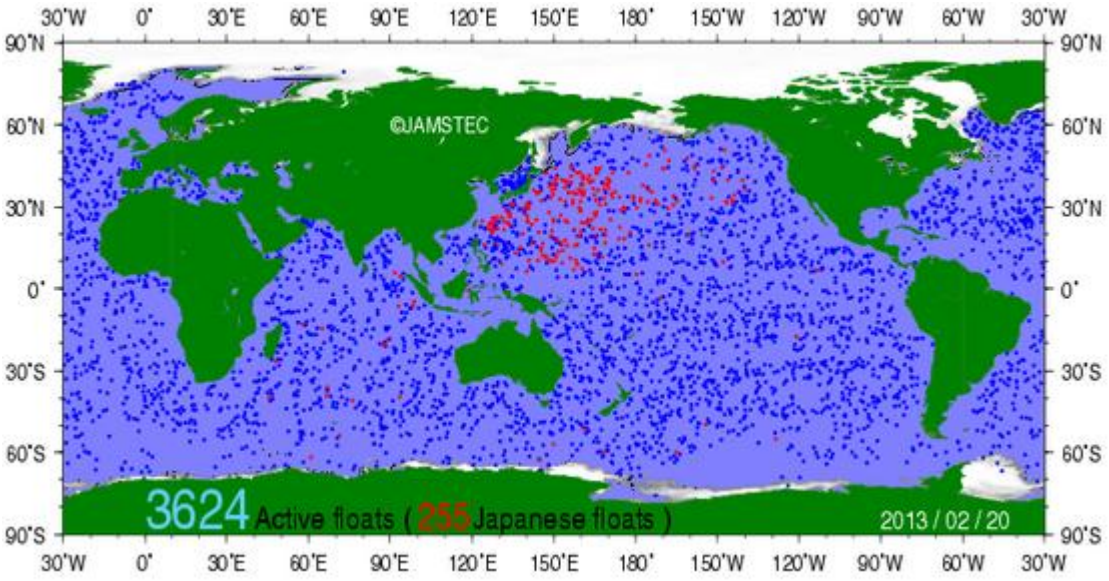

Figure 1: The distribution of active Argo floats. The red dots represent active Japanese floats.

Four floats were deployed voluntarily from cargo ships owned by a Japanese merchant ship company (NYK Line) in 2012. In order to increase float deployment opportunity, JAMSTEC has developed cooperative relationship with NYK Line, which has a lot of cargo shipping routes covering the global ocean from 2011. This wide coverage is very useful to deploy Argo floats in the area of sparse float density. This deployment opportunity contributes to not only maintain the global Argo array, but also environment conservation efforts of merchant ship companies through optimal routing owing to improvement of ocean current prediction.

Among JAMSTEC's 990 Argo and Argo equivalent floats (756 APEXs, 143 PROVORs, 38

ARVORs, 36 NEMOs, 11 NINJAs, and 6 POPSs) deployed in the Pacific, Indian and Southern Oceans, from 1999 to the end of January 2013, 198 floats (112 APEXs, 43 PROVORs, 37 ARVORs, and6 NEMOs) are now in normal operation. The other 792 floats (644 APEXs, 100 PROVORs, 1 ARVOR, 30 NEMO, 11 NINJAs, and 6 POPSs) terminated their missions, including 15 floats transmitting on the beaches after stranding or being captured by ships, 12 floats drifting at the sea surface and 16 floats recovered.

The Japan Meteorological Agency (JMA) deployed 27 Argo equivalent floats (27APEXs) in the seas around Japan from January to December 2012. All the floats get 2,000 dbar T/S profiles every 5 days for operational ocean analysis and forecast.

Among 141 floats (16 PROVORs, 98 APEXs and 27 ARVORs) which JMA has deployed from 2005 to 2012, 52 floats (31 APEXs and 21 ARVORs) are active as of the end of December 2012, while 17 floats (15 APEXs and 2 ARVORs) terminated the transmission in 2012. JMA deployed 3 APEXs in January 2013.

All of 9 floats deployed by the Fisheries Research Agency (FRA) in 2005 and 2008 terminated their missions by mid 2011. FRA conducted research survey using a Slocum glider (1-km model; manufactured by Webb Research) and a Sea Glider (manufacturerd by i-Robot inc.) in the Kuroshio-Oyashio mixed water region in the North Pacific in 2012. The Sea glider was successfully operated for about two months, and measured detailed vertical structures of temperature and salinity above1000 m.

1.1.1 Floats deployed as part of INBOX

Besides 58 floats deployed in 2012 as reported above, JAMSTEC deployed 13APEX floats and one NEMO float equipped with dissolved-oxygen sensors (Aanderaa Optode4330) byl December 2012. The deployment was done as part of Western North Pacific **IN**tegrated Physical-**B**iogeochemical Ocean **O**bservation E**x**periment (INBOX); its purpose is to investigate physical-biogeochemical processes associated with mesoscale variability by constructing an integrated physical and biogeochemical ocean observation system in collaboration with ship, satellites and/or mooring observations. The floats measure temperature, salinity and dissolved oxygen from surface to 2000 dbar, telecommunicating by iridium transmitter. Two target areas are set: one is around the biogeochemical observation mooring site S1 (30N, 145E) maintained by JAMSTEC where 25 oxygen floats were deployed in 2011 in a square area of 150 km x 150 km with 30 km of horizontal resolution, synchronizing every 2 days; another is warm core mesoscale eddies in Kuroshio-Oyashio mixed water region (Left panel of Fig. 2).

Around S1, two floats (APEX) were sequentially deployed to extend time series data around S1 with high temporal and vertical density. The obtained data were analyzed with mooring, ship and satellite data to clarify the relationship between mesoscale physical process and bio-geochemical process.

In the warm core eddies, 12 (11 APEXs and one NEMO) floats were deployed in two cruises (Right panel of Fig. 2). First deployment for the eddy observation was done around the eastern warm core eddy off southeastward of Hokkaido (42 N, 147 E); 8 floats were deployed in June 2012. Second was around the western warm core eddy off south of Hokkaido (41 N, 144 E); 4 floats were deployed in September 2012. In each of the two observations, some surface drifters were also deployed, and high-quality ship observation for temperature, salinity and dissolved oxygen (CTDO) were carried out.

JAMSTEC conducted pre-deployment calibration of the Optode4330 sensors in the laboratory. With the pre-deployment calibration along with the comparison with shipboard CTDO observation, the accuracy of dissolved oxygen data will be greatly improved. Data from the INBOX floats will be opened with delayed-mode calibration after completion of dissolved oxygen calibration within 2 years from the deployment.

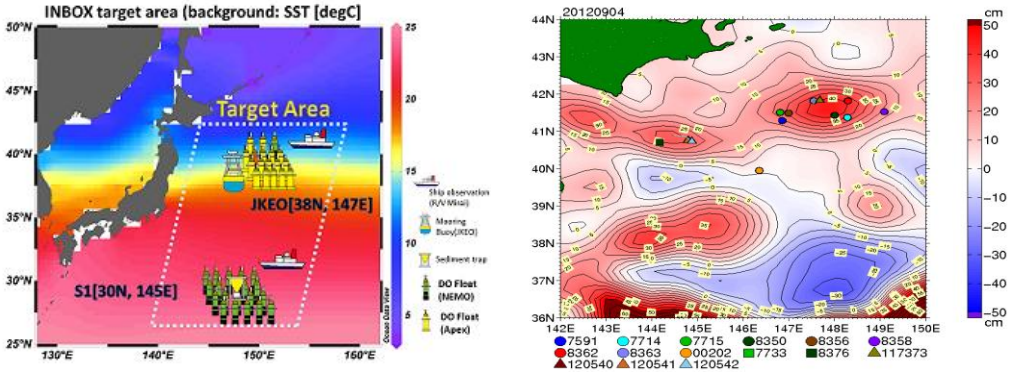

Figure 2. (Left panel) Study area of INBOX. In 2011 and 2012, 25 floats with Optode3830 and 2 floats with Optode4330 were deployed respectively around the S1 mooring site (30N, 145E) in the Kuroshio recirculation gyre. In 2012, 14 floats with Optode4330 were deployed in the Kuroshio-Oyashio mixed water region to study physical-biogeochemical processes associated with mesoscale eddy. (Right panel) Locations of the floats on September 4, 2012. Background colors and contours show the sea surface height anomaly based on the merged altimeter satellite product distributed by AVISO (http://www.aviso.oceanobs.com).

1.2 Technical problems encountered and solved

A lot of APEX floats equipped with alkaline batteries, purchased by JAMSTEC in 2010 and 2011 and by JMA in 2008, terminated their missions within 70 cycles. The life time as Argo floats were clearly shorter than the specification (150 cycles). The manufacturer, Webb research inc., reported that the trouble is probably caused by energy flu. That is, the battery voltage of those floats rapidly decreased because some of the battery cells were gradually broken. While they recommended us to use lithium batteries to avoid energy flu, JAMSTEC requires further investigation for this problem.

Among the 73 APEX floats with APF9 controllers deployed by Japan before the SBE41 and 41cp recall due to micro-leak problem, 8 floats have the negative surface pressure drift larger than -2.4 dbar. Among these floats, 4 floats have the extreme negative surface pressure drift, exceeding -10 dbar. The floats recalled or those purchased after the problem was fixed have either a Kistler pressure or a Druck pressure sensor. Both pressure sensors show little drift.

Tsurumi Seiki Co. and JAMSTEC have developed a new profiling float for deep ocean, “Deep NINJA”, which has an ability to measure PTS profiles at the depth of up to 4000 dbar. After a field test in the Japan Sea with R/V Natsushima in May 2012, the field test for deep ocean observation was carried out with 2 prototypes in August-October 2012. Both of them made a success of PTS profiling from the depth of 4000 dbar. However, communication has been lost with one float since the first ascending, probably due to a trouble of its communication module. The other ceased its operation in November. In December 2012, 4 Deep NINJAs were deployed in the Southern Ocean (3 off the Adelie Coast and one in the south of New Zealand) at R/V Mirai cruise to observe variations of Antarctic Bottom Water. All of them have operated well until now. The data measured by Deep NINJAs have not been circulated on the Argo data stream yet, because documents describing its data format is not ready. The data circulation is planned to begin in April 2013. Deep NINJA will be available for public in 2013.

JAMSTEC and JMA suffered again severe experiences of Iridium telecommunication trouble of floats in 2012. The troubles occurred in both dial up type service for APEX. As to the trouble of the dial up type service, telecommunication was stopped several times in one year. Although all the observed data during the troubles could be finally obtained owing to the data logging in the floats, mission commands could not be sent to the floats during the troubles. The trouble during our

INBOX eddy observation caused floats diverging from the eddy to the outside due to long surface-drifting time. JAMSTEC and JMA have been asking for examination of the troubles to Japanese agent of Iridium telecommunication system.

As reported in 2011, EEZ clearance procedure for Argo float deployed by Japanese PIs was changed following IOC Resolution XLI-4, and now in operation in 2012. This change reduced our time and effort for the process of EEZ clearance. However, the EEZ clearance still needs in some key countries because Argo national focal points (NFPs) of those countries are not listed in AIC. Since the procedure in Japan is applied to only the coastal nations whose Argo NFP is registered (listed in AIC) . Japan Argo community has a strong desire for more countries, especially in/around the Pacific Ocean, to register their NFPs.

1.3 Status of contributions to Argo data management

The Japan DAC, JMA has operationally processed data from all the Japanese Argo and Argo-equivalent floats including 255 active floats as of February 6, 2013. Ten Japanese PIs agree to provide data to the international Argo. All the profiles from those floats are transmitted to GDACs in the netCDF format and are also issued to GTS using the TESAC and BUFR codes after real-time QC on an operational basis excluding NOVA float of OIST, which has not been determined WMO instrument code yet. Argo BUFR messages have been put on GTS since May 2007.

1.4 Status of delayed mode quality control process

JAMSTEC has submitted the delayed-mode QCed data of 83,652 profiles to GDACs as of December 2012. Among these data, 6,803 profiles were provided within a year.

As of December 2012, according to the new definition of APEX Truncated Negative Pressure Drift decided at the 12th Argo Data Management Team Meeting, JAMSTEC is still re-creating D files for some APEX floats.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

Japan Argo had been conducted in a 5-year program from FY1999 to FY2004, as a part of Millennium Project implemented under cooperation among the Ministry of Education, Culture, Sports, Science and Technology (operation: by JAMSTEC), the Ministry of Land, Infrastructure and Transport, JMA and Japan Coast Guard. After the Millennium Project terminated in March 2005, JAMSTEC continued the operation until FY2008 nearly in the same scale (about 80 floats to be deployed every year) under its mid-term program. While new mid-term program for FY2009-2013 started in April 2009, JAMSTEC has been trying to continue the operation nearly in the same scale as part of its research activity. JMA allocates operational budget for 27 floats every fiscal year.

3. Summary of deployment plans (level of commitment, areas of float deployment) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

In FY2013, it has been proposed that JAMSTEC will deploy about 70 floats in total in the Pacific Ocean for the Argo core mission. Three EM-APEX will be deployed near the Kuroshio Extension as part of INBOX. Some Deep-NINJA, which JAMSTEC and Tsurumi-Seiki Co. Ltd. are planned to be deployed in the Southern Ocean in 2013. Two POPSs are planned to be deployed as an Argo equivalent float near the North Pole in April 2013. These POPSs are equipped with NOVA. Three NEMO-Iridium float is planned to be deployed as Argo equivalent float. It will be deployed in the western tropical Pacific Ocean to investigate surface ocean variations associated with atmosphere-ocean interaction. JMA plans to deploy 27 Argo equivalent floats around Japan in FY2013 and in the coming years. All the JMA floats are identical with the core Argo floats except

that they are operated in a 5-day cycle, synchronized with JMA's real-time ocean data assimilation and forecast system. University of Tokyo will deploy two Chl-a/DO APEXs in the Kuroshio-Oyashio mixed water region to investigate physical-biogeochemical processes in blooming period, collaborating with JAMSTEC.

JMA continues serving as the Japan DAC. JAMSTEC continues running the Pacific Argo Regional Center for the upcoming year.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.

Many groups in JAMSTEC, JMA, FRA and Japanese universities are using Argo data for oceanographic researches on water mass formation and transport in the Pacific Ocean, the mid-depth circulation, the mixed layer variation, the barrier layer variation, and tropical atmosphere-ocean interaction in the Pacific and Indian Ocean and so on. Japanese fisheries research community is conducting their biogeochemical studies using Argo floats equipped with chlorophyll and/or oxygen sensors.

The global Argo TESAC messages are used for operational ocean analysis and forecast by JMA. Daily and monthly products of subsurface temperatures and currents for the seas around Japan and western North Pacific, based on the output of the real-time ocean data assimilation system (MOVE/MRI.COM-WNP), are distributed through the JMA web site (in Japanese). Numerical outputs of the system are available from the NEAR-GOOS Regional Real Time Data Base (http://goos.kishou.go.jp/) operated by JMA. Monthly diagnosis and outlook of El Nino-Southern Oscillation based on the outputs of the Ocean Data Assimilation System and the El Nino Prediction System (an ocean-atmosphere coupled model) are also operationally distributed through the JMA web site (in Japanese) and the Tokyo Climate Center (TCC) web site (http://ds.data.jma.go.jp/tcc/tcc/products/elnino/). JMA has introduced the ocean-atmosphere coupled model, which is the same as that for El Nino prediction, into seasonal forecast of climate in Japan since February 2010. The model products for seasonal forecast are available from the TCC web site (http://ds.data.jma.go.jp/tcc/tcc/products/model/).

JAMSTEC is providing a variety of products including objectively mapped temperature and salinity field data (Grid Point Value of the Monthly Objective Analysis using Argo float data: MOAA-GPV: http://www.jamstec.go.jp/ARGO/argo_web/MapQ/Mapdataset_e.html), objectively mapped velocity field data based on YoMaHa'07 (version September 2010) (http://www.jamstec.go.jp/ARGO/argo_web/G-YoMaHa/index_e.html), and gridded mixed layer depth with its related parameters (Mixed Layer data set of Argo, Grid Point Value: MILA-GPV http://www.jamstec.go.jp/ARGO/argo_web/MILAGPV/index_e.html).

JAMSTEC is also providing information about consistency check of float data related to delayed-mode QC for the Pacific Argo Regional Center (PARC) web site as a main contributor. JAMSTEC will support the activities of the Southern Ocean ARC (SOARC) in the Pacific sector.

JCOPE2 (Japan Coastal Ocean Predictability Experiment 2) is the model for prediction of the oceanic variation around Japan which is operated by Research Institute for Global Change of JAMSTEC. JCOPE2 is the second version of JCOPE1, developed with enhanced model and data assimilation schemes. The Argo data is used by way of GTSPP. The reanalysis data 20 years back and the forecast data 2 months ahead are disclosed on the following web site: http://www.jamstec.go.jp/frcgc/jcope/. More information are shown in http://www.jamstec.go.jp/frcgc/jcope/htdocs/jcope_system_description.html.

FRA-ROMS is the nowcast and forecast system for the Western North Pacific Ocean developed by Fisheries Research Agency (FRA) based on the Regional Ocean Modeling System (ROMS). Instead of FRA-JCOPE, which was the previous system of providing the hydrographic forecast information around Japan, FRA started the FRA-ROMS operation in May 2012. Argo has

been one of important sources of in-situ data for the FRA-ROMS data assimilation system. The forecast oceanographic fields are provided every week on the website http://fm.dc.affrc.go.jp/fra-roms/index.html/.

5. Summary of the number and location of CTD cruise data to the CCHDO website.

Data of 935 CTD casts conducted by JMA in the western North Pacific from January to December 2012 were uploaded to the CCHDO website.

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National Report on Argo-2012

by Republic of Korea

Deployment in 2012 and Future Plan

Korea Meteorological Administration (KMA) and Korea Institute of Ocean Science & Technology (KIOST[i]) are involved in the International Argo Program since 2001. In 2012, KMA deployed additional 15 floats in the East Sea (10 floats) and southwestern region of Kamchatka peninsula (5 floats).

KMA has a plan to deploy 16 floats in the Northwestern Pacific Ocean (5 floats) and the East Sea (11 floats) in August 2013. One float equipped with DO sensor will be deployed in the East Sea. It is expected that KMA is able to increase float deployment.

KIOST's strategy regarding the Argo program is under revised in terms of contribution toward the global ocean observation.

Status of Argo data management

During Jan. - Dec. 2012, 2,617 R-files of KMA were sent to GDAC.

National Fisheries Research and Development Institute (NFRDI)/Korea Oceanographic Data Center (KODC) is responsible for DMQC. NFRDI/KODC executed DMQC for 9,982 profiles (~73.7% of total profiles).

Research and operational uses of Argo data

KMA is developing an operational ocean forecasting system for the global ocean, co-working with UKMO. Last year, KMA successfully introduced NEMO/NEMOVAR system with a resolution of ORCA025L75. In 2013, KMA will develop pre-processing system for the ocean observation including Argo. After preparation of operating system, KMA will assess an effect of Argo data on its data assimilation system.

Using Regionally Adapted Quality Control and the OI method, KMA generated gridded monthly temperature and salinity fields for the North Pacific Ocean (-30ºS ~ 60ºN) from Jan. 2004 to Dec. 2011. Currently, the verification of gridded fields is being carried out by comparison with

WOA01, OI-SST, and CTD observations. Simultaneously, KMA works on global gridded T-S fields based on Argo data.

Web pages

KMA is maintaining the Argo Korea Web site. The URL is:

http://argo.metri.re.kr/

[i] From the First of July 2012, KORDI has changed its name to KIOST and takes the new step towards to be the world class ocean research institution by achieving the qualified outcomes from the research and education.

New Zealand National Report March 2013

NIWA is the New Zealand participant in Argo. NIWA has purchased 2 floats per year since 2001, with no floats being purchased in 2003 because of float availability. We have also deployed floats for other providers and are collaborating on large deployments by contributing towards vessel costs.

New Zealand's floats

NIWA has purchased and deployed 22 floats to date. Purchases and deployments are likely to continue at the 2 floats/year level.

Information on the New Zealand floats, designated (WMO#) 2039 (5900106), 2042 (5900109), 2137 (5900205), 2138 (5900206), 2331 (5900631), 2332 (5900632), 2463 (5901028), 2547 (5901227), 2555 (5901239), 2585 (5901271), 2693 (5901763), 2659 (5901804), 2739 (5901843), 2750 (5901853), 2859 (5902224), 2860 (5902225), 2872 (5903332), 2873 (5903333), 8035 (5903756), 8064 (5903777), 8097 (5904062) and 8116 (5904076) can be found at: http://sio-argo.ucsd.edu/weqpac_web.html.

The data from the NZ floats are administered by Scripps Institution of Oceanography and are available on the Argo Global Data Assembly Centers (GDACS).

Providing deployment opportunities

NIWA has provided deployment opportunities for other nation's floats in the southwest Pacific and Southern Ocean. This is a very important contribution to Argo, given that these regions had poor float coverage and limited deployment opportunities from commercial vessels.

In an ongoing collaboration, NIWA is funding 15% of the vessel costs of R/V Kaharoa deploying floats for University of Washington (USA), Scripps Institution of Oceanography (USA) and CSIRO (Australia) has now joined this collaboration.

NIWA's larger research vessel, R/V Tangaroa has also deployed floats in the southern ocean, both as part of the same collaboration and opportunistically when other research takes place in the southern ocean. The latest deployments were of SIO and UW floats in March 2013.

These voyages, dating back to 2004 have deployed around 1140 floats, primarily in the South Pacific but also in the eastern Tropical Pacific and Indian oceans.

Additional R/V Kaharoa deployment voyages are in planning stages.

Finally, NIWA is also available to facilitate float deployments being mobilized out of New Zealand ports.

Report on the status of the Polish Argo Program

Waldemar Walczowski, Ilona Goszczko
IOPAS, Sopot, Poland
March 2013

1. The status of implementation

The Argo float (WMO 6901902) deployed by IOPAS from the board of Oceania on 2 July 2012 took 56 profiles from 6 July to 17 December 2012. Since then no more information has been received. Probably, the float was stuck under the sea-ice. The last three profiles were done only to 300 dbar. The parking and profiling depths were adapted (via Iridium by OPTIMARE) to the shallower bathymetry in case of easternward floating (with the North Spitsbergen Current). However, the float could follow the slope and flow northward under the compact sea-ice and is lost at the time.

There is no national Polish DAC. Floats operated by Optimare received the binary data output in files of hexadecimal format. Datasets were decoded into physical units by data operator, written into ASCII files and shared via ftp server or disseminated via email to: float owner (IOPAS) and to the GDAC (Coriolis) which acts as a RDAC.

Figure 1. Locations of all Argo deployments from Argo Poland and CTD stations performed during IOPAS summer cruises in the area of interest.

Real-time quality control (RTQC) was performed by Coriolis. The netcdf files were created from the incoming data and real-time QC procedures were applied. For now DMQC was performed by IOPAS. It is planned in the nearest future.

2. Present level of and future prospects for national funding for Argo

The decision applying to the Poland's participation in the European Research Infrastructure Consortium (ERIC) is being considered at the Department of Strategy, Polish Ministry of Science and Higher Education at present. It should cover Polish commitments: observer status and deployment of 2 Argo floats per year.

Polish Roadmap for Research Infrastructures was developed by the Ministry of Science and Higher Education in 2011. The Polish input into the Euro-Argo was included among other 33 Projects on Roadmap list (in the subgroup 8: Assurance the sustainable development of the natural and human environment). Moreover, there is an additional possibility for developing proposals for strategic research infrastructure investment projects this year (deadline until 15 March 2013). IOPAS is going to submit an application which would allow to develop Polish resources devoted to Argo to a certain

degree (floats testing and deployments, developing specifications and algorithms for sea ice detection and positioning under the ice, telecommunication usage, QC implementation, advancement of Argo data assimilation techniques in OGCMs, and so on).

The project proposal concerning SIDERI has been prepared and sent to the Polish Ministry of Science and Higher Education. The project agreement (W95/7.PR/2012) was signed. Additional national founds in the amount of 17 518 PLN for the project implementation was allocated for years 2012-2013.

3. Summary of deployment plans

For 2013 IOPAS is planning to continue floats deployment in subpolar regions. At least one float (guaranteed by E-AIMS) will be deployed in the West Spitsbergen Current area (high latitudes) to trace the Atlantic water flowing into the Arctic Ocean. DMQC will be implemented in the upcoming year.

The proposal submitted to the BONUS (Science for a better future of the Baltic Sea region) call 2012 "Viable ecosystem" takes into account one additional Argo float which will be deployed in the Southern Baltic Sea.

4. Summary of national research and operational uses of Argo data

No funding for scientific analysis is allocated, but some persons are partly working with the Argo floats as regards data collection and management (according to the SIDERI, E-AIMS and Euro-Argo Projects). The scientific analysis is done in other externally financed projects (pre-doctoral grant from The National Science Centre (NCN) and perhaps Polish-Norwegian Research Programme grant).

The main aims of IOPAS Argo deployments are: investigation of the West Spitsbergen Current structure and velocity in its various branches; field tests of various data transmission technologies (ARGOS vs. Iridium); feasibility tests of RAFOS technology for float tracking in the Fram Strait.

Data received from the IOPAS floats and other Argo devices floating in the Norwegian and Greenland Seas are used to develop mean hydrographic fields in the West Spitsbergen Current (WSC) for a comparison with the WSC structure obtained from the ship-borne hydrographic measurements (Fig. 1). Floats data are also used for validation and evaluation of output from the high resolution (2 km) numerical model of the circulation in the Nordic Seas and the Arctic Ocean (RACM and RASM models).

Polish Argo Program website has been developed and is regularly updated:
http://www.iopan.gda.pl/hydrodynamics/po/Argo/argo.html

5. Issues wished to be considered

The complete tutorial concerning DMQC will be useful for the Argo data beginners. Information collected on the Argo website as well as in the AIC FAQs are not easy for searching. Also the order and responsibility for the data submission to DAC is not quite clear.

There were some troubles with loading information concerning deployment plans into the AIC website – after short time of inactivity, the plan vanished. This forced longer time devoted for that.

6. Location of CTD cruise data uploaded to the CCHDO website in the past year.

Datasets from the IOPAS cruises may be soon submitted to the CCHDO website. We were not aware that this is required.

7. Keeping the Argo bibliography

The poster entitled “Properties and pathways of the Atlantic Water in the Greenland Sea observed with Argo floats” by Goszczko I., Walczowski W. and Cisek M. was presented at the 4th Argo Science Workshop, 27-29 September 2012, Venice, Italy. IOPAS prepared the input to the position paper “Roadmap for the evolution of Argo in Europe”, part 5: Monitoring High Latitudes.

8. The commitments table of deployed and planned floats

Information about the Polish Argo deployments and plans was updated in the commitments table via an e-mail.

Argo National Report – South Africa

Report to Argo Steering Team Meeting: March 2013

Tamaryn Morris[1], Isabelle Ansorge[2], Katherine Hutchinson[2], Gerda du Plessis[2], Sandy Thomalla[3], Sebastiaan Swart[3], Thomas Mtontsi[4], Tommy Bornman[4,5], Juliet Hermes[4] and Mthuthuzeli Gulekana[6]

The South African Argo Program presently is one of deployment opportunities and educational outreach as opposed procuring of floats and seeding the global Argo array. However, we are striving to develop projects and funding opportunities in that direction. Given South Africa's unique position geographically of bordering three oceans – The Atlantic, Indian and Southern Oceans – we are able to provide numerous deployment opportunities for Argo floats to the global array. We are also working on dynamic research programs and experiments using Argo floats to a) study physical forcing dynamics and b) contribute to the development of biogeochemical floats particularly in the Southern Ocean. The research groups currently involved in the South African Argo program are: The South African Weather Services (SAWS), University of Cape Town (UCT)[2], The South African Environmental Observation Network (SAEON)[4], Bayworld Centre for Research and Education (BCRE)[1], The Council for Scientific and Industrial Research (CSIR)[3], The Department of Environmental Affairs (DEA)[6] and the Agulhas Somali Current Large Marine Ecosystem program (ASCLME)[5].

1. Status of implementation / Deployments undertaken in 2012:

Southern Ocean:

Gough Island Cruise – September 2012

3 floats: University of Brest with UCT (#'s: 5816, 5817, 5818)

4 floats: UK Met Office with UCT (#'s: 6262, 6256, 6257, 6263)

SANAE Cruise – December 2012-January 2013

15 floats: University of Brest with UCT (WMO #'s: 6901422, 6901423, 6901424, 6901425, 6901426, 6901427, 6901428, 6901429, 6901444, 6901431, 6901432, 6901433, 6901434, 6901435, 6901436)

Indian Ocean:

ASCLME Alliance Cruise – January-March 2012

4 floats: NOAA with ASCLME (#'s: 1901604, 1901605, 1901606, 1901607)

Atlantic Ocean:

None

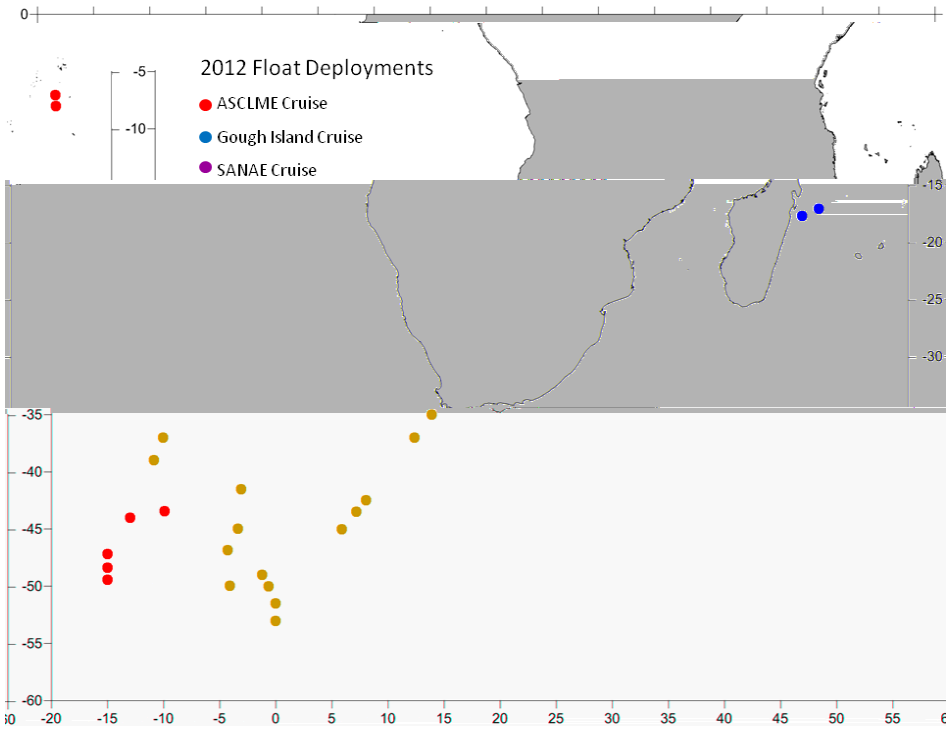

Figure 1: 2012 deployment positions of Argo floats.

Technical issues encountered and resolved:

Two floats on the Gough Island Cruise (#'s 5817 and 6263) were not deployed as the floats could not be switched on magnetically.

2. Present level of (and future prospects for) national funding for Argo including summary of human resources devoted to Argo:

Dedicated Argo funding to procure new floats to seed the global array is not currently available in South Africa, but it is a goal for the South African Argo group to work towards. Individuals from organisations (listed above) work on different projects involving Argo floats and have come together under the auspices of the South African Argo program to share knowledge, resources, cruise time where applicable and information regarding Argo.

3. Summary of deployment plans for 2013:

Southern Ocean:

Marion Island Cruise – April/May 2013

7 floats: DEA (if ready for deployment)

Gough Island Cruise – September 2013

8 floats: UK Met Office with UCT

SANAE Cruise – December / January 2013

18 floats: University of Brest with UCT

SOSCEx Cruise – To be confirmed

2 floats: CSIR. Carbon flux biogeochemical floats developed in conjunction with Provor (France). Details of experiment below.

<u>Indian Ocean:</u>

ASCLME Cruise – April/May 2013

5 floats: WHOI with BCRE

~ 4 floats: NOAA with ASCLME

ACEP Cruise – July 2013

2 (4) floats: UK Met Office with BCRE

Meteor Cruise – December 2013

5 floats: CSIRO with BCRE

<u>Atlantic Ocean:</u>

SAMBA Mooring Array – July or October 2013

4 floats: NOAA or University of Brest with UCT/BCRE

West Coast South Africa – to be confirmed

3 floats: DEA (if ready for deployment)

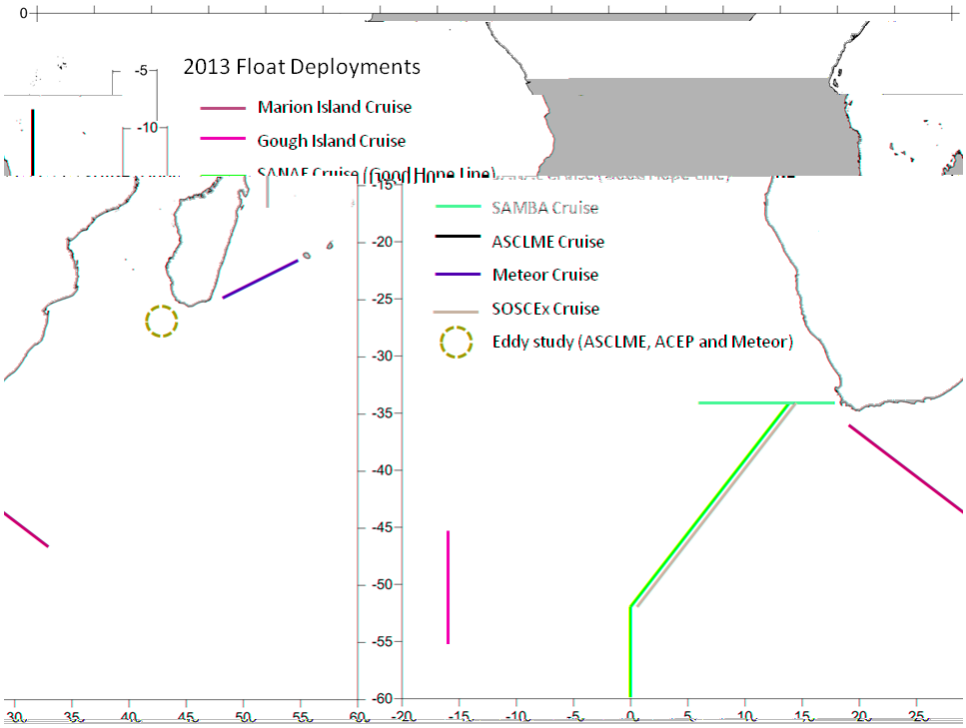

Figure 2: Proposed deployment positions / cruises for 2013.

4. Summary of national research and operational uses of Argo data:

Three research and one outreach project are noted below:

a) SOBOM:

The Centre for Southern Ocean Biogeochemical Observations and Modeling (SOBOM) are a focused group developing a new ocean observing system for carbon, nutrients and oxygen that will complement the already established observing system for heat and freshwater. To this end, 150-200 profiling floats equipped with biogeochemical sensors will be deployed throughout the Southern Ocean and the cruises run by UCT (Dr. Ansorge) in this region (i.e. SANAE and Gough Island) will be used as a platform for deployments in 2014. For more information:

http://sobom.princeton.edu/content/deployment-opportunities

b) SOSCEx:

The Southern Ocean Carbon-Climate Observatory (SOCCO) group of the CSIR have developed a program to study carbon flux dynamics in the Southern Ocean through the SOSCEx experiment. Three carbon-flux biogeochemical floats were developed by Provor specifically for the CSIR and two will be deployed on the Good Hope Line for this project in 2013. For more information:

www.csir.co.za/nre/coasts_and_oceans/osc.html

Figure 3: Complete SOSCEx experiment configuration.

c) Eddy Aging Dynamics:

Mesoscale eddy dynamics in the Mozambique Channel have been investigated over a number of years. However, the understanding of how these eddies age over time and space, and how this affects the upper-trophic levels, has yet to be determined. This project will use floats deployed off the Madagascan coast on a daily profile basis to sample the water column within an eddy to monitor its "collapse" as it progresses across the Mozambique Channel mouth. Three experiments are planned for 2013 and will look at both cyclones and anti-cyclones if possible.

Float data from the daily profiles collected on these eddy experiments will also be used by the educational outreach program (detailed below) for training of secondary school children on Argo and the oceans.

d) Educational Outreach – The Argo Floats Program by SAEON Egagasini:

Five secondary schools have been identified in the Western Cape region to track changes at sea from data collected on floats 1901469 and 1901470 purchased by SAEON/SANAP with support from SAWS and deployed in 2009.

In 2012 school monitoring teams were encouraged to do schools science projects on:

1. The Identification of deep water masses and their direction using temperature
2. Relationships between salinity and depth
3. Relations of temperature, pressure and salinity

The overall focus of the SAEON Egagasini education programme is to:

- primarily encourage awareness of science skills to learners
- to create a platform where Marine Science Research can be integrated into School Sciences curriculum by encouraging interactions between learners, educators and scientists
- to promote an understanding of, create awareness and generate an interest about our oceans

An article will be published this year (2013) on the Argo Floats Educational Program in a popular scientific magazine in South Africa:

Mtsonti, T. and Ansorge, I. 2013. Robots in the Ocean. *Quest* 9(1). 50-53.

Copies can be made available to anyone who is interested.

A request to the Argo community is for any old, used or damaged floats or float models for the outreach program for educational display purposes. Only one is available in South Africa and is used for both educational and science displays, hence heavily in demand.

5. Issues that your country wishes to be considered (and resolved) by the Argo Steering Team regarding the international operation of Argo:

None at this stage.

6. CTD data to be added for data quality comparisons:

All CTD, certainly from the eddy experiments and areas where CTD data is particularly rare, will be sent for uploading to the data quality centres.

7. Bibliography:

None for 2012.

UK ARGO PROGRAMME

REPORT FOR ARGO STEERING TEAM 14TH MEETING, MARCH 2013

The UK Argo programme is undertaken by a partnership between the Met Office, the National Oceanography Centre Southampton (NOCS) and the British Oceanographic Data Centre (BODC). The Met Office are responsible for programme management and coordination, organizing float deployments, preparation of floats for deployment, telecommunications (costs) and international contributions. NOCS and BODC have responsibility for Argo science and data management.

The most pressing issue for the UK programme remains on securing continuing and ongoing funding for UK Argo after March 2015, and internationally on ensuring the long-term delivery of data from the global Argo float array and agreeing the future shape of the array given the need to include high latitudes, marginal seas, bio-geochemistry and deeper profiling in Argo.

Floats deployed and their performance

Floats deployed. Since 2001, over 390 UK floats have been deployed (including 5 floats donated to Mauritius) in support of the Argo array. As can be seen from Figure 1 below, the number of floats purchased each year is very variable, as float procurement is largely reliant on the release of end-of-year under-spend funding. As a result, the number of deployments each year has also been variable, with an increase in 2011 and 2012 where 43 floats and 38 floats were deployed. At the present time (February 2013) there are 139 active floats (including 3 that were provided to and deployed by Mauritius in 2011) contributing to the global Argo array, see Figure 2.

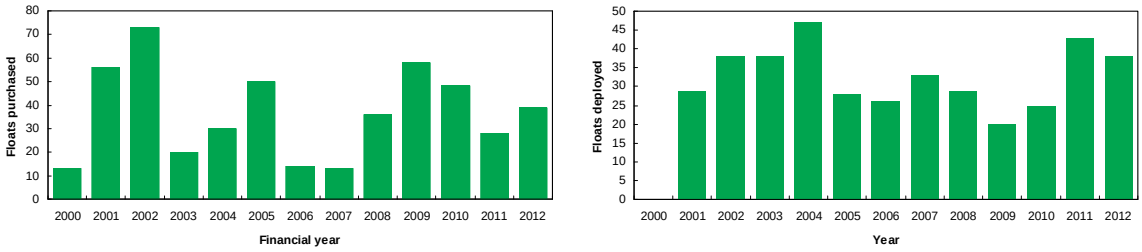

Figure 1. Showing (left) the number of floats procured each financial year (Apr-Mar) and (right) deployed in each calendar year.

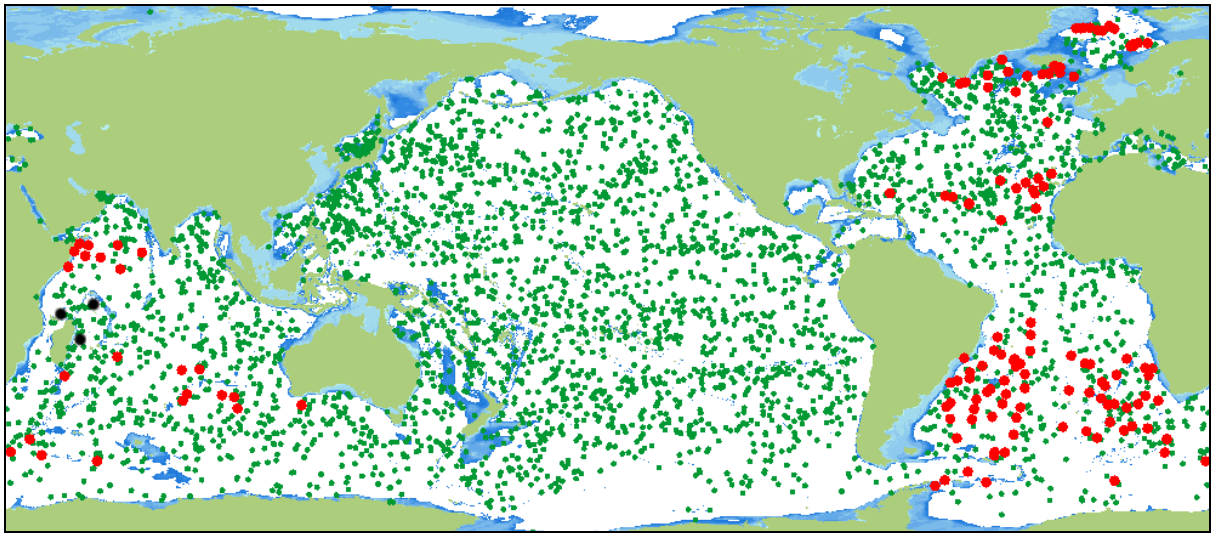

Figure 2. Showing the locations of operating UK floats (in red) and the three active Mauritian floats (in black) in mid-February 2013.

With the increase in the number of floats deployed in the last 2 years the number of UK floats contributing to Argo has increased to around 140, as shown in Figure 3.

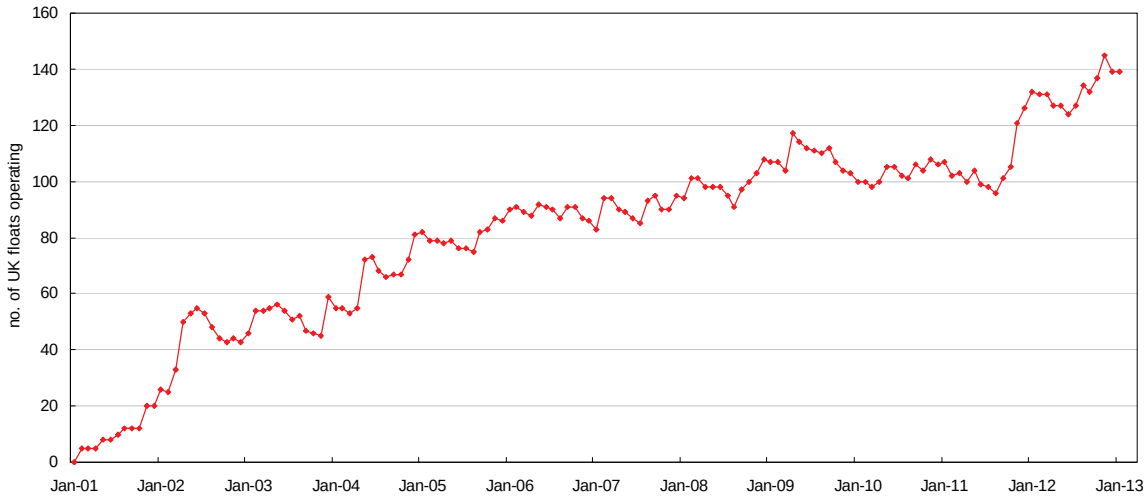

Figure 3. Number of active UK (including Mauritius) floats contributing to Argo by month.

Float performance. There has been a steady improvement in the reliability (survival) of our Apex floats deployed since 2004 in terms of cycles completed, as shown in Figure 4. (Where the number of cycles has been normalised to 2,000m for floats that make shallower profiles, or only make intermittent deep profiles to 2,000m, where invalid profiles due to pressure transducer failure on pre-2004 floats have been discounted and deployment failures omitted.)

For floats deployed from 2007 to 2009 over 80% of floats have exceeded 110 profiles (>3 years lifetime) with around more than 70% expected to achieve 4 years (or longer). For floats deployed in 2010 and 2011, 93% have reached the 1 year mark.

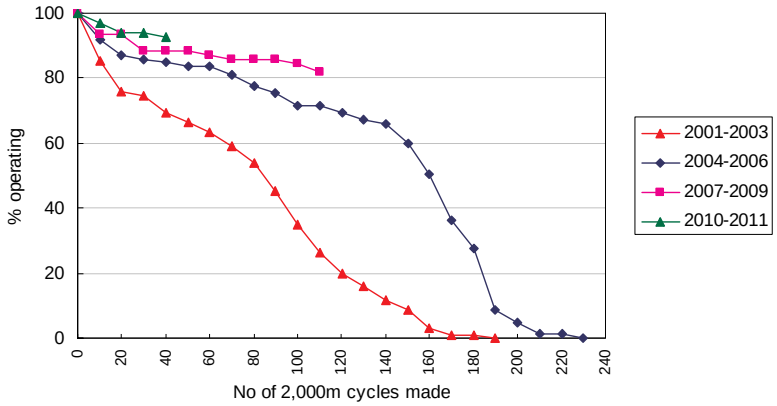

Figure 4. Number of (normalised) cycles made by UK Apex floats deployed in 2001-2003, 2004-2006, 2007-2009and 2010&2011.

Following some early float losses to ice damage in 2007, since 2008 all new Southern Ocean floats considered at risk of ice have been specified with ice-avoidance capability. So far 19 floats with ice-avoidance have been deployed in the Southern Ocean and 13 in the Nordic Seas (one of which has recently gone under ice). In 2007 we deployed our first Apex floats with lithium batteries and have since deployed over 80 floats with lithiums. Figure 5 shows lifetime figures from AIC for our floats deployed since 2007. This suggests with lithium batteries there have been fewer mid-life failures.

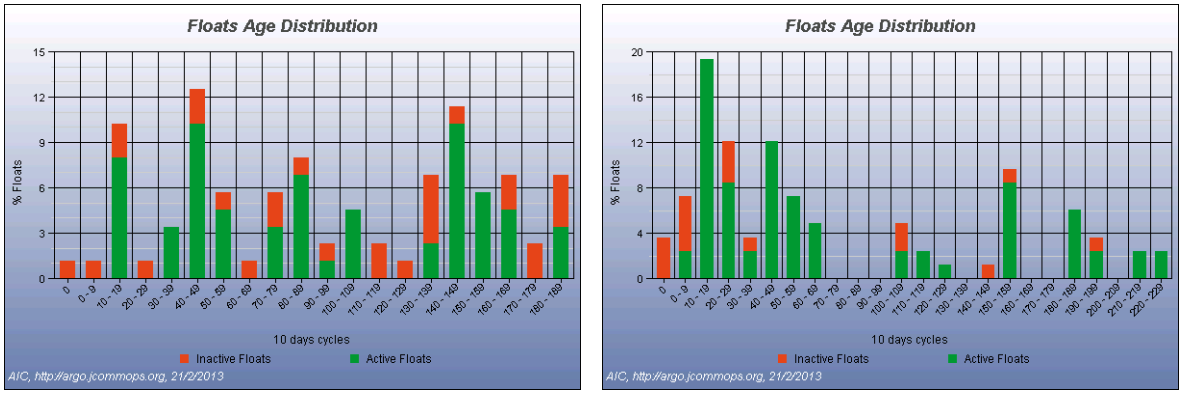

Figure 5. Number of cycles made by UK Apex floats deployed since 2007 with (left) alkaline and (right) lithium batteries.

In 2008 our first 2 Apex floats with near surface temperature measurement capability (un-pumped measurements) were deployed, with 74 SST-capable floats having now been deployed.

In 2012 we deployed 13 floats with Iridium communications in the Nordic Seas, 4 of these also carried sensors for dissolved oxygen and chlorophyll fluorescence.

Deployment plans for 2012

At the end of Feb 2013 we have around 45 Apex floats available for deployment, with a further 39 floats expected to be delivered by end March 2012. This includes 27 Apex floats (16 Argos, 11 Iridium) and 12 SeaBird Navis floats.

Anticipated deployments in 2013 include:

8 floats Southern Ocean/Drake Passage (March)
4 floats Rockall Trough/Iceland basin (Extended Ellett Line, May)
4 floats Western Indian Ocean (ACEP cruise, July)
2-4 floats Nordic Seas
4 floats SE Atlantic (SA Agulhas, Sept)
6-10 floats S Atlantic (AMT cruise, autumn)
2-4 floats for Mauritius

The expectation is to deploy around 40 floats during the year, including floats provided to Mauritius

Data management

The UK Argo Data Centre, established at BODC, processes all our float data (including the floats donated to Mauritius and also floats for the Irish Argo programme).

Real-time

An automatic system processes the data in real-time and generates the profile data in WMO TESAC and BUFR and Argo netCDF formats. The TESAC/BUFR messages are relayed to GTS via the Met Office (EGRR). Almost 100% of GTS messages are available within 24h. Occasional disruptions happen due to email server failures and server problems. Data in netCDF format are also sent (by FTP) to the two GDACs. The real-time processing system operates every 12 hours and delivers data twice daily. The data are also available from the UK Argo Data Centre web-site via an interactive map interface. In addition the technical files are updated once a week and these files are provided to CSIRO Marine to populate the technical web-site.

Delayed-mode

Delayed-mode processing is carried out by BODC using the OW software and the most recent CTD climatology and Argo climatology reference datasets. These are updated when new versions are made available. However, the additional time needed to train new staff combined with setting up real-time systems for biogeochemical floats meant delayed-mode processing at BODC was paused in 2012 and will resume in summer 2013. Clare Davis is to be trained as a delayed-mode operator in addition to her real-time operator duties. This will mean BODC have 2 delayed-mode operators which is important with the additional load caused by bio-geochemical sensors and trajectory file improvements.

As of March 2013 the percentage of eligible (greater than one year old) profiles on the GDACs in delayed mode is 89%.

Southern Ocean

BODC works with three other organizations to operate the Southern Ocean Argo Regional Centre (SOARC) covering the entire Southern Ocean. Responsibilities are: BODC - Atlantic Ocean Sector, CSIRO - 'Australian' sector, JAMSTEC - Pacific Ocean Sector and the University of Washington - Indian Ocean Sector. BODC hosts the main SOARC data and information web pages (http://www.bodc.ac.uk/projects/international/argo/southern_ocean/).

On-going development activity

In addition to maintaining progress of previous years on-going development at BODC is focusing on the following:

- Improving the quality of trajectory data distributed by BODC. This is based on the actions decided by the ADMT and output from the ANDRO Atlas.

- Development of real-time quality control procedures for un-pumped near surface temperature data from Apex.
- Real time processing and distribution of data from floats with bio-geochemical sensors.
- Investigation into how persistent identifiers can be assigned to Argo data.

Reference CTD data

At the Argo Data Management Team meeting in 2012 the link between BODC and CCHDO was restored. This included an initial submission of ~3,500 CTD profiles in BODC holdings for use in the Argo delayed mode reference climatology. The aim is an eventual move towards automated submission of data to CCDHO (plus NODC and ICES) when data are banked at BODC.

The delayed mode cookbook information produced by BODC in previous years has also been supplied to Steve Diggs who is using this information to identify areas where the current reference data/climatology is in need of enhancement so these areas can be prioritised when seeking new data for inclusion in the climatology. This approach has already been fruitful in the Northwest Atlantic. Under Euro-Argo SIDERI the cookbook is to become part of the documentation available on the Argo data management pages and will consist of short summaries of ocean regions where complex oceanography can impact on delayed mode results. The summaries will primarily be produced by Euro-Argo partners.

Scientific and operational use of Argo data

At the Met Office Argo data are assimilated into FOAM (Forecasting Ocean Assimilation Model), see http://www.metoffice.gov.uk/research/weather/ocean-forecasting, which is the Met Office deep ocean forecasting system. It comprises a global ¼ degree model (ORCA025) and nested $^{1}/_{12}$ degree North Atlantic, Mediterranean and Indian Ocean limited area models. The system is run operationally at around 0500 UTC every day.

Argo data are also used in the GloSea (Global Seasonal) coupled model run by the Met Office to make seasonal forecasts for several months ahead. Seasonal forecasting is still an area in which the science is being developed. On longer timescales the Hadley Centre DePreSys (Decadal Prediction System) is being developed for climate predictions on decadal timescales, where the impact of Argo data on decadal climate forecasts has been demonstrated through idealised experiments. See http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal.

The Hadley Centre also maintains the HadGOA (sub-surface global analysis) dataset of historical temperature and salinity. The dataset includes available Argo data and will include near real-time updates using Argo data. The dataset is used for global ocean heat content analyses. For further information see http://www.metoffice.gov.uk/research/climate/climate-monitoring/oceans-and-sea-ice.

Research results

Work has continued on examining the near-surface temperature measurements from Argo floats, in particular to detect near surface stratification (diurnal warming) which is of interest to the GHRSST (Group for High Resolution Sea Surface Temperature) community. A detailed analysis of data (15,916 profiles) from 329 near-surface capable floats was carried out and results presented at the 4th Argo Science Workshop (Venice, September 2012). 345

profiles showed significant temperature gradients in the upper 10 m, many of which would have been missed by normal Argo floats. These profiles were compared to the Met Office OSTIA (Operational Sea Surface Temperature and Sea Ice Analysis) 'foundation' SST and the results suggest an 'equivalence depth' between Argo near-surface temperature and OSTIA foundation SST of approximately 4 dbar, which supports the use of the normal (pumped) Argo temperature data from approximately 4 m depth to verify GHRSST foundation SST products. *Near-surface temperature profiles from pumped and un-pumped Argo measurements. Poster for Argo Science Workshop, Venice, Sept 2012. Fiona Carse, Justin Buck and Jon Turton.*

As part of the ERA-CLIM project, a high quality subset of Sea Surface Temperature (SST) observations from drifting buoys and ships (1996-2010) was produced through assessment against the Met Office OSTIA. QC procedures were developed to flag commonly observed gross errors in drifting buoy observations and to blacklist ships whose observations were deemed unreliable. The QC outcomes were partly validated using Argo observations, which are not assimilated by OSTIA and provide a useful independent validation of the results. *Assessing the quality of sea surface temperature observations from drifting buoys and ships on a platform-by-platform basis. C.P.Atkinson, N.A.Rayner, J.Roberts-Jones, R.O.Smith. Submitted to JGR-Oceans.*

GODAE OceanView have been developing methods of assessing the impact of observations on ocean data assimilation systems. The Met Office have performed a series of experiments to assess the impact of different observing systems on its FOAM forecasting system. This included testing the impact of excluding all Argo temperature and salinity data for 1 month (July 2011). One method to assess the model is the fit to observations before they are assimilated, where the fit to both temperature and salinity profiles is 5% worse without Argo. It should be noted that one month may not be long enough to see the full impact of removing Argo data as experience in FOAM suggests the subsurface can take a year or more to spin-up (or spin-down). The results were presented at the Venice workshop and being prepared for submission in the literature. *Lea, D.J., Martin, M.J. Demonstrating complementarity of observations in an operational ocean forecasting system. In preparation for submission to Q. J. R. Meteorol. Soc.*

Research using Argo data at NOC is carried forward mainly, though not exclusively, through graduate students. Projects include: upper ocean circulation and variability in the North Atlantic, ocean correlation scales in the Pacific and Atlantic oceans, seasonal to decadal variations in water mass properties in the SE Pacific/Drake Passage/Atlantic sector of the Southern Ocean, decadal changes in intermediate and thermocline water properties in the subtropical South Atlantic. Also, the NOC satellite oceanography group is involved in ground truth for SMOS and is evaluating ways in which Argo near-surface data can be used for SMOS evaluation.

The data are used extensively in a wide range of research projects in UK Universities and research laboratories and is a central component of several PhD and MSc projects covering a broad range of topics including water mass properties and formation, air-sea interaction, ocean circulation, mesoscale eddies, ocean dynamics and seasonal-to-decadal variability.

Funding

It was initially agreed in 1999 that MoD and DETR (then Defra and now DECC) would provide matching funding (through the Met Office) for UK Argo, and that NERC would also provide regular funding for support activities (e.g. data processing, science leadership) with additional capital funding for floats being provided on an opportunistic basis (e.g. via open calls for proposals). The matched funding agreement collapsed after MoD withdrew its

funding in April 2010. Regular annual funding from DECC (ex Defra) to the Met Office has also reduced, although it has been supplemented in most years with year-end funding for floats. NERC has maintained regular, stable funding for support activities at NOCS and BODC, whilst funding for floats has remained variable relying largely on bids for NERC capital funds and year-end funds. Hence, the funding profile for UK Argo has exhibited large year-to-year variations.

For the period Apr 2012 to Mar 2015 the Met Office (Public Weather Service Programme) has agreed to co-fund UK Argo with DECC and a MoU has been signed off. NERC will continue to fund its Argo support activities at NOCS and BODC. However the committed funding will only be sufficient to pay for support activities and does not include any provision for procuring floats, hence maintaining an annual contribution of 30 to 50 floats beyond 2013 will be dependent on the continued availability of additional funding (e.g. from year-end under-spends).

Consideration will be given to a new funding model, including an option to transfer funding, at a level to be agreed, from DECC to BIS (as the Met Office is now a BIS Agency) after the end of the 3 year DECC/Met Office agreement. While the current agreement provides some stability for the 3 years, there is still a risk that by April 2015 we are no further ahead.

Euro-Argo

During the period, the Euro-Argo ERIC statutes were modified following review by the EC and circulated for final review among prospective members. It has been agreed with BIS that John Hirst (Met Office CE) will sign the statutes on behalf of BIS; however, signature and setting up of the ERIC is not expected until summer/autumn 2013.

Work for the Euro-Argo FP7 SIDERI project started in the following areas: legal and policy (e.g. UNCLOS, EEZ) issues, how Argo should relate to (or interface with) the emerging WIGOS (WMO Integrated Global Observing System) and on near-surface measurements from floats (as noted above). Also the Euro-Argo E-AIMS FP7 project started in January 2013. This will provide (50%) funding for 2 floats with bio-geochemical sensors and 2 floats with new (Iridium) communications, developing the data processing capability at BODC for these floats and evaluation of the data. E-AIMS will also support work on assessing the impact of Argo data on short-range forecasts using a coupled ocean-atmosphere model and on validation of satellite SST products and diurnal skin SST analyses.

The Euro-Argo FP7 projects have also supplemented NERC funding at BODC to bring the resources to a level where real progress can be made, as noted earlier, and new developments are possible.

USA Report to AST-13, March 2012. (Submitted by D. Roemmich)

Organization of U.S. Argo:

The U.S. Argo Program is supported with major funding provided by the National Oceanic and Atmospheric Administration (NOAA), and additional participation of the U.S. Navy. It is implemented by a U.S. Float Consortium that includes principal investigators from six institutions: Scripps Institution of Oceanography (SIO), Woods Hole Oceanographic Institution (WHOI), the University of Washington (UW), the Atlantic Oceanographic and Meteorological Laboratory (AOML), the Pacific Marine Environmental Laboratory (PMEL), and the Fleet Numerical Meteorology and Oceanography Center (FNMOC). Float technology development, production, deployment, array monitoring, and data system functions are distributed among these institutions on a collaborative basis.

In addition to U.S. Argo floats, Argo-equivalent floats have been provided from a number of U.S. float groups and programs, including the University of Hawaii, PMEL, AOML, NAVOCEANO, and Florida State University.

The present 4-year cycle of U.S. Argo implementation began in mid-2011, and extends to mid-2015.

Objectives:

Primary objectives identified in the present Work Plan (2011-2015) for U.S. Argo are:

i. In float technology, an evolution of the Argo array toward bi-directional communications (Iridium, ARGOS-3) will provide energy savings, reduction of surface time and hazards, greater data throughput and enhanced profile resolution, and new applications.

ii. Float lifetime will continue to be extended beyond 4 years[1] by deployment of next generation floats (SOLO-II), through improvements to existing (APEX) float models, and by evaluating new commercial floats (Navis). The technology improvements will also result in a greater fraction of active float cycles providing high quality profile data.

iii. Working together with international Argo partners, overall data quality will be improved by insuring (through repeated audits of the data system, and by automated checking at global data centers) the completeness and consistency of metadata, technical, profile, and trajectory files.

iv. U.S. Argo will respond to community consensus recommendations regarding enhancements in float coverage and new sampling protocols to meet user requirements. Recommendations are made through recognized community forums such as OceanObs'09, or by the major Argo user groups including CLIVAR, GODAE OceanView, and the operational centers. OceanObs'09 recommendations for temperature/salinity profile measurements from Argo include extension of coverage to include the seasonally ice-covered oceans, increased density of observations in western boundary regions, enhanced vertical resolution of profiles, profiling to the ocean floor (as deep as 6000 m) with a subset of floats, and taking measurements nearer to the sea

[1] The 519 U.S. floats deployed in 2006 have completed an average of 165 cycles (= 4.5 years mean lifetime), with 267 floats (51%) still active as of 02/2012. Source: Argo Information Center

surface. Enhancements will only be undertaken if they do not compromise the present core Argo sampling of 3° resolution every 10 days between 60°N and 60°S

Support level:

The support level for U.S. Argo is aimed at providing half of the global Argo array. The target level is 1600 active floats, based on a deployment rate of about 410 floats per year. Due to level funding, the number of floats has decreased to about 360 per year. However, with increases in the mean lifetime of floats, the target number of active floats has been maintained.

The U.S. Argo effort includes float production and deployment, technology improvement, communications, data system development and implementation for real-time and delayed-mode data streams, and participation in international Argo coordination, Regional Centers and outreach activities.

Beginning in 2011, U.S. Argo is funded for development and testing of Deep Argo floats. It is planned these instruments will profile from pressures as great as 6000 dbar, and be capable of 100+ cycles. Deployment of initial prototypes could occur by late 2012. Prototype deployments will be followed by a pilot program, whose goal will be to instrument two deep ocean basins.

Status:

As of March, 2012, there are 1847 active U.S. Floats (source AIC) and these have completed an average of 124 cycles. Of the active floats (Fig 1), 1765 are provided by U.S. Argo and 82 by partnering programs. The number of US float deployments decreased slightly from 387 in 2010 to 363 in 2011 (Fig 2).

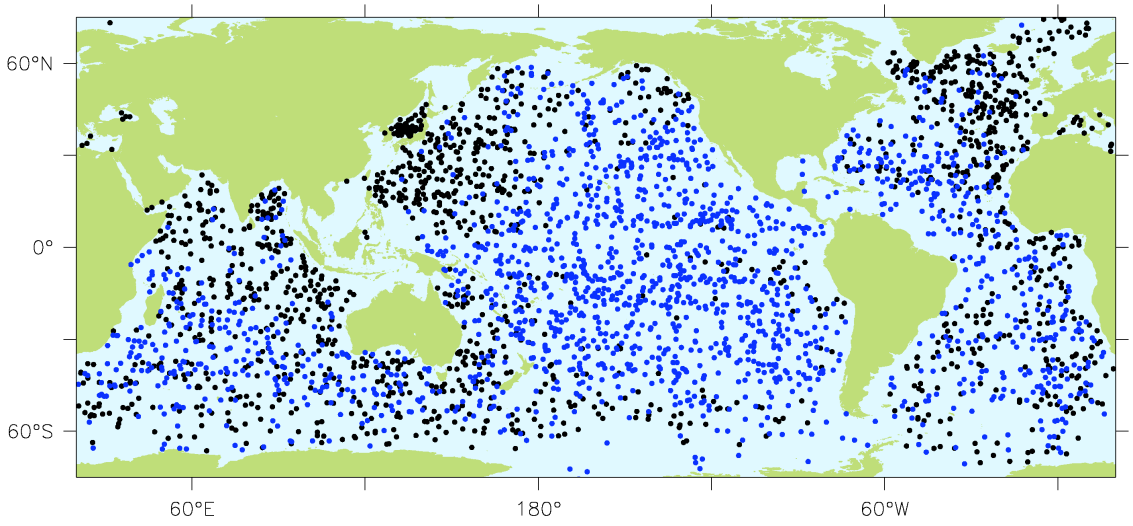

Fig 1 Positions of 1847 active U.S. floats (blue dots) as of March 2012.

The highest priority for U.S. Argo is to sustain the core global Argo array. Specific plans for 2012 float deployments, as they evolve, are posted on the AIC deployment planning links. A major U.S./New Zealand/Australia deployment cruise in the South Pacific Ocean was carried out in late 2011 on R/V Kaharoa, and another is planned beginning in January 2013. RV Kaharoa has deployed 985 Argo floats since 2004.

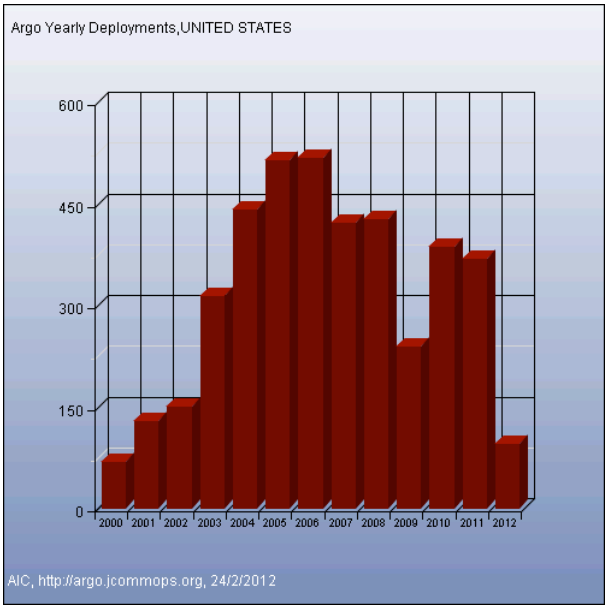

Fig 2. Yearly deployment of U.S. floats. (Source: AIC)

The U.S. Argo Data Center is based at NOAA/AOML. Real-time data from all U.S. Argo floats are transmitted via the GTS. GTS transmission uses parallel systems developed at AOML and housed at AOML and at Collect Localisation Satellites (CLS), implementing internationally-agreed quality control tests. The AOML data center serves as the national focus for data management and is the conduit for delayed-mode data to pass between the PIs and the GDACs. During 2011 further progress was made in delayed-mode quality control (Fig 3).

In addition to the national DAC, a Global Data Assembly Center (GDAC) is run as part of the GODAE server, located at FNMOC/Monterey. The two GDACs at FNMOC/Monterey and IFREMER/Brest are mirror images in their assemblies of Argo data from all international partners, and are responsible for dissemination of the data. Several U.S. institutions participate in Argo Regional Center activities, including AOML's role as focus for the South Atlantic ARC.

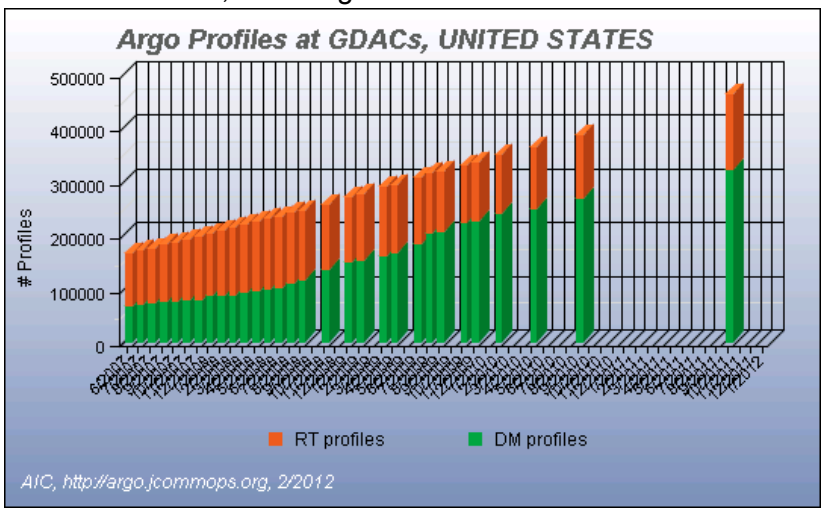

Fig 3. Number of profiles held at GDACs for U.S. floats (source: AIC), including those with delayed-mode and real-time levels of quality control. Roughly 65,000 of the RT profiles are less than one year old and not yet eligible for DM processing.