11th meeting of the International Argo Steering Team

Scripps Institution of Oceanography
La Jolla, CA USA
March 23-25, 2010

Contents

Meeting Summary

The 11th meeting of the international Argo Steering Team was held at Scripps Institution of Oceanography in La Jolla, Ca on March 23-25, 2010. AST-11 focused on Argo reviewing its current status, objectives and future evolution. At OceanObs'09, many white papers proposed additions to Argo either through sensors, location, range, or timing. As Argo contemplates how some of these changes might be incorporated into the core program, there also remains a push for sustained funding and to ensure the highest possible quality data.

Implementation issues

The Argo Technical Coordinator reported that there were several changes at the AIC this year, including a new IT resource, increased time spent on monitoring floats with Iridium and new sensors, the development of new monitoring maps and tools on the website, and the development of the Argo layer in Google Earth. The monthly float reports produced by the TC were well received and were strongly encouraged to continue. The AIC funding was reviewed and it was requested that all countries that contribute to the float array also make contributions to the annual cost of maintaining the Argo Information Centre.

Y. Desaubies reported on the status of JCOMMOPS where he is now working part time as the scientific coordinator. He stated that feedback on the Centre is very positive and users describe it as extremely useful. The way JCOMMOPS is designed, having the technical coordinators of related programs collaborating in the same location, has been found to be very beneficial. A discussion followed about formalizing Argo's relationship with JCOMM, this will continue to be considered.

EuroArgo is reaching the end of its Preparatory Phase which aims to resolve issues necessary to establish a permanent infrastructure. One step towards this goal was achieved when the European Commission recognized EuroArgo as a Research Infrastructure. Work has been done in Europe to consolidate long-term national plans including float development and deployment and data management issues. EuroArgo is also working to entrain new European countries and has had success so far as Bulgaria, Greece, Poland, Portugal and others are becoming involved. EuroArgo plans to contribute one quarter of the global Argo array (200 floats per year) with additional deployments in marginal seas.

A presentation given by B. Owens discussed how gliders might complement the Argo program. Gliders are able to measure boundary currents and choke points better than floats since they are self-propelled and piloted to stay in certain regions. While this type of coverage would be welcomed in the Argo data stream, there are still some specific issues that arise with gliders, including technical ones such as array design, and the issue of gliders operating within Exclusive Economic Zones.

M. Scanderbeg presented the updated Commitments table and it was noted that many countries plan on deploying a large number of floats (pending sensor availability) this year to try and clear the backlog from last year. It will be challenging to deploy so many floats and, thus, it will likely take more than one year to make up for the shortage of deployments in 2009.

Data Management related issues

M. Ignaszewski reported that the GDACs are functioning well and reiterated that the ADMT is currently focusing on improving data consistency, detecting and correcting systematic errors, delayed-mode QC, Argo Regional Centers, and improving the interoperability of the Argo data set. The GDAC file checker is behind schedule, but will be implemented soon. A new version of the Argo Reference Database was released in early 2010 and includes newer data courtesy of the CCHDO and WOD. One big issue facing the ADMT and AST is a possible file format change to allow more flexibility for the inclusion of other data types besides temperature, salinity and pressure. See the appendix for more details on which file format changes have been suggested. The AST is leaning towards adopting option 4.

Several presentations were given on the impact of pressure errors on the Argo dataset. Three different methods were shown to try and detect the pressure bias in the Argo dataset caused by the TPND APEX floats (where the pressure drift is negative but its size is unknown). The first method, done by M. Scanderbeg, compared float profiles to nearby CTD stations and found, globally, that the Argo floats show a small negative pressure bias. When the matches were narrowed down to only TPND APEX – CTD matches, there were not enough to make a conclusion about pressure bias. This points to the need for more, recent CTD data, especially in the Southern Hemisphere.

The second method, done by J. Gilson, compared steric height (0/800db) from SIO SOLO floats, defined by space, time, and climatological steric height, to APEX floats. He found the TPND offset was estimated to be 1dbar (median value) to 2 dbar (modal value). In contrast, the bias was not apparent when SIO SOLO floats were similarly compared to newer APEX floats with the APF9 controller. Identification of individual TPND floats with extreme pressure drift is made difficult by the small percentage of a TPNDs cycles with a nearby SOLO pair.

The third method, done by V. Thierry, used the ISAS (Gaillard et al 2009, von Schuckmann et al 2009) tool to compare individual float profiles to gridded data. A time series of plots for each float is produced which can be studied for a cold bias in a strong thermocline and a saline anomaly at depth. This method does find TPND APEX floats, especially ones with large drifts, but calls for visual inspection of the plots. More work is planned to improve on this method.

S. Diggs presentation on the Argo Reference Database stated that about 1900 CTD stations have been given to Coriolis by the CCHDO in the past two years to be included in the database. Armed with new justifications for using CTD data to calibrate Argo floats, Diggs expects to collect more CTD data this year. He continued to highlight the small amount of recent CTD data in the Southern Hemisphere and asked for help in identifying potential cruises in that region.

A report by M. Ollitrault presented a new product, ANDRO, which contains drift velocities from clean Argo trajectories at the Coriolis, AOML and JMA DACs. Work is currently being carried out at the Indian DAC to add that group of velocities to ANDRO. The AST thanked M. Ollitrault for his work on this and discussed how this might be sustained in the future. Trajectory files are an important part of the Argo data stream and the AST and ADMT will continue to investigate ways of improving the quality of the trajectory files.

Technical issues

E. Boss gave a report on bio-optical and chemical sensors on profiling floats. There are currently about 20 profiling floats deployed and another 150 floats funded that include optical sensors (and about 200 others with oxygen and/or nitrate sensor). He noted that in order to establish a global observatory of profiling floats with biogeochemical sensors, it is imperative that actions be taken soon to standardize sensors, data streams and QC procedures for both near-real-time and delayed mode. The Bio-Argo community is working with Coriolis to find ways to include the new data into the Argo data stream.

Todd Martz presented a brief overview regarding chemical sensors now operating as Argo equivalents within the Argo array. Examples of oxygen data and quality control of oxygen was mentioned, along with data from ISUS nitrate sensors, which have operated on six floats. He also described a newly developed pH sensor based on the Honeywell Durafet(r) which shows remarkable stability in the surface ocean on moorings.

D. Gilbert presented the work done by himself, V. Thierry and T. Kobayashi to try and standardize how the reporting of oxygen from different types of oxygen sensors. A set of standard parameter names related to oxygen are described in the oxygen data management proposal as well as examples of calibration equations describing both the at-sea and the on-

land data processing steps leading to the final DOXY parameter. This oxygen data management proposal will soon be posted on the ADMT website.

Several float technology progress talks were given, including updates on the SOLO-II, ARVOR and Deep NINJA floats. A couple of SOLO-II floats have been deployed and are cycling at an accelerated rate. The SOLO-II is smaller, more energy efficient and uses Iridium. The ARVOR floats previously deployed for testing are still doing well and now Iridium and ARGOS-3 systems are in the process of being implemented. The Deep NINJA has been tested to 3500 dbar, but it is suspected that it could go even deeper as the limit has been reached on the testing chamber without any problems.

G. Johnson reported on improvements in performance of APEX floats by laboratory predeployment testing and use of Lithium batteries, as practiced at NOAA/PMEL. Johnson asserted that for PMEL, the increased performance in floats resulting from laboratory testing and lithium battery use combined was cost effective, easily offsetting the additional labor costs.

Demonstrating Argo's value

Argo's white paper, a group effort at OceanObs'09, was a great success. Additionally, the majority of the other white papers referred to Argo and offered a variety of suggestions around Argo's future. The ideas presented including sustaining the array, including more sensor types, expanding the areas of coverage and changing the sampling schemes. Several individuals or groups have agreed to explore various options including expanding to the seasonal ice-zone, changing the near surface temperature sampling scheme, making floats capable of a deeper range, and establishing a more uniform method of sampling for Iridium floats.

Several advances were made on the Argo layer for Google Earth in the past year. The IT resource at the AIC has worked hard to improve the information featured for each active float. The finished layer will include data for each float, stories on a smaller subset of floats, an animation showing the cycle of an Argo float and property plots overlaid onto the globe showing various properties from Argo data. When the final version is finished, it will be proposed to Google for inclusion into their Google Ocean layer.

1 Welcome and introduction

Dr. Tony Haymet, director of Scripps Institution of Oceanography welcomed the Argo Steering Team to the Scripps Seaside Forum. He commended the AST on the work they have already done and looks forward to learning how the AST will decide to shape Argo's future. Local arrangements were discussed as well as an invitation to the reception dinner the following evening.

Action item 1: S. Wijffels to send a letter of thanks to Dean Roemmich and Scripps Institution of Oceanography for hosting AST-11.

2 Objectives of the meeting

D. Roemmich opened the AST-11 meeting by summarizing the main challenges facing Argo:

(i) How will Argo be sustained and enhanced following the recommendations of OceanObs'09?

(ii) What actions are needed to ensure that the quality of Argo data is sufficient for global change studies?

3 Action items from AST-10

M. Scanderbeg presented the Action items from AST-10. Most items were completed, with several reported on at the meeting. The following action items were not resolved before the meeting and did not have a special place on the agenda, so they were briefly discussed.

Action item 12: Argo co-chairs to speak to China and KORDI AST members to find out time table for DACs to correct technical files. At the meeting, Moon-Sik Suk said that he would check with the KORDI DAC about the technical files and see why the process was taking a longer time than expected. LIU Zenghong said that the technical files should be corrected and placed on the Chinese DAC soon.

Action item 15: Additional check needed at DAC level to ensure cycle number is correct and to prevent repeat profiles in multiprofile files.

Action item 2: AST to ask DACs whether and when they will implement the recent ADMT recommendations on the combined use of CRC and a voting method check on transmitted data blocks.

Action item 20: AST members to designate links to regional activities not on ARC homepages. M. Scanderbeg again called for such links to be sent so that they could be added to the AST webpage.

4 Implementation issues

4.1 AIC Report

The Technical Coordinator reported on the status of the JCOMMOPS office and in particular on the activities of the Argo Information Centre. He acknowledged the financial support provided by Australia, Canada, China, France, Germany, Rep. of Korea, India, the United Kingdom and the United States and mentioned that more members are planning to support the AIC.

Many countries contribute floats to the Argo array and those contributions are greatly appreciated. Argo requests that all such countries make contributions to the annual cost of maintaining the Argo Information Centre. The US would like to scale back their percentage of funding for M. Belbeoch's salary to closer to 50% as more and more money is needed for ship

time to deploy floats. This would take place over time, so there would not be a large change at once.

Some AST members asked for clarifications on the funding provided by SOT and on the conditions of the shared time between Argo and SOT. TC recalled that expanding his activities to SOT permitted, in particular, to hire a new resource at JCOMMOPS, and to provide support to a new programme OceanSITES (via the DBCP TC). The level of financial support from SOT and OceanSITES is under development and must be strengthened. This is being addressed to the concerned panels. It is to be noted that JCOMMOPS is used to provide "free services" while in parallel identifying new funding sources.

2009 was a challenging year for the TC with a conjunction of important meetings, a new resource to manage, the new information system to implement, and growing Argo activities and JCOMMOPS administrative issues.

The TC recalled that no more assistance will be provided to emerging observing systems in order to focus on Argo issues.

Regarding Bio-Argo activities, TC remarked that tracking such exotic platforms was time consuming with the introduction of new issues with meta/data management. TC invited the Bio-Argo group to consider also supporting the Argo infrastructure, including the AIC, to help include their data in the Argo data stream.

TC remarked that it was difficult to produce the "monthly AIC report" every month, and reassured the AST that all will be done to produce at least a report every two months. Some AST members remarked the AIC report was an excellent initiative and provided feedback on some details that would be useful to improve it. The latest monthly report (http://argo.jcommops.org/FTPRoot/Argo/Doc/2010-01-02_AIC.pdf) includes many yearly statistics on the array status.

TC mentioned that the software developer was now fully operational and focusing on the developments for Google Ocean (see section 8.4 of this report for further details).

He mentioned the new Information System was gradually being developed and that most of the efforts made concern the overall architecture and the new database structure.

Database design and synchronization with main data sources (Argos, GTS, GDACs) should be operational by April 2010. All new developments will then be made on this new database with the target to release the first web services early 2011.

TC insisted on the fact that the tracking of Iridium floats is becoming a serious problem. The delivery of Iridium data to Argo customers is decentralized and heterogeneous. Hence the AIC cannot synchronize efficiently its tracking system with Iridium floats. The AIC needs to link with Iridium data before it reaches customers.

> **Action item 3:** ATC to explore ways to obtain direct access to Iridium data for monitoring purposes.

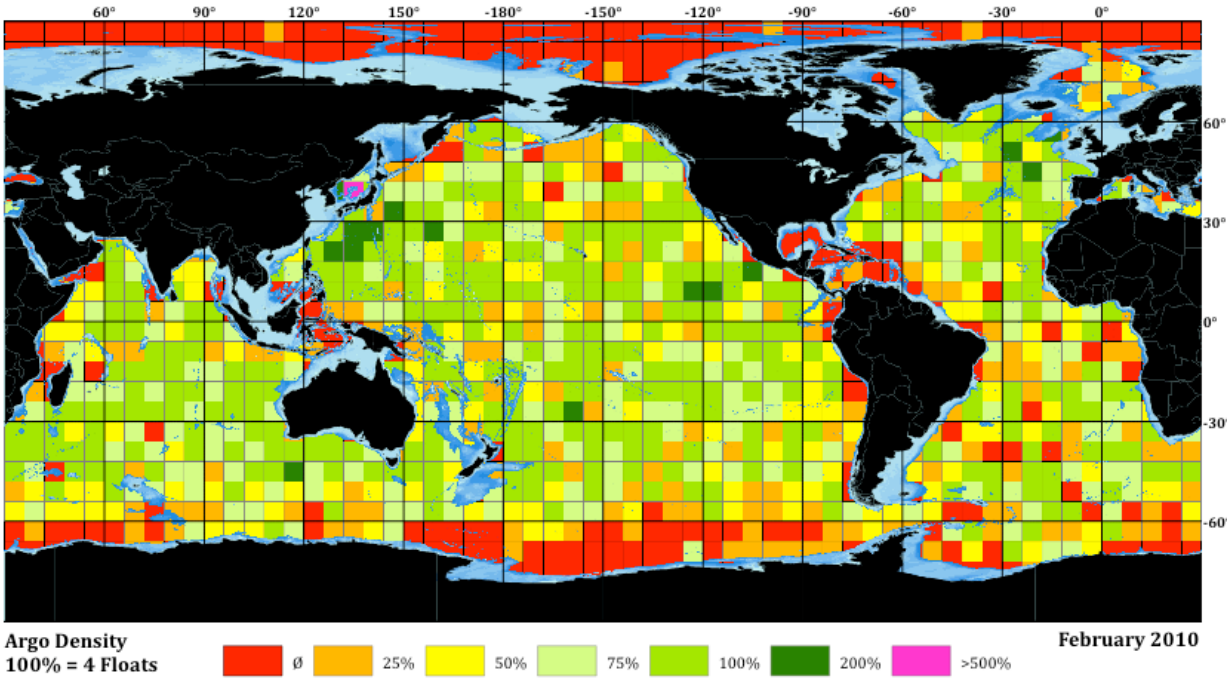
TC presented briefly the new products available for the Network planning and monitoring, including:

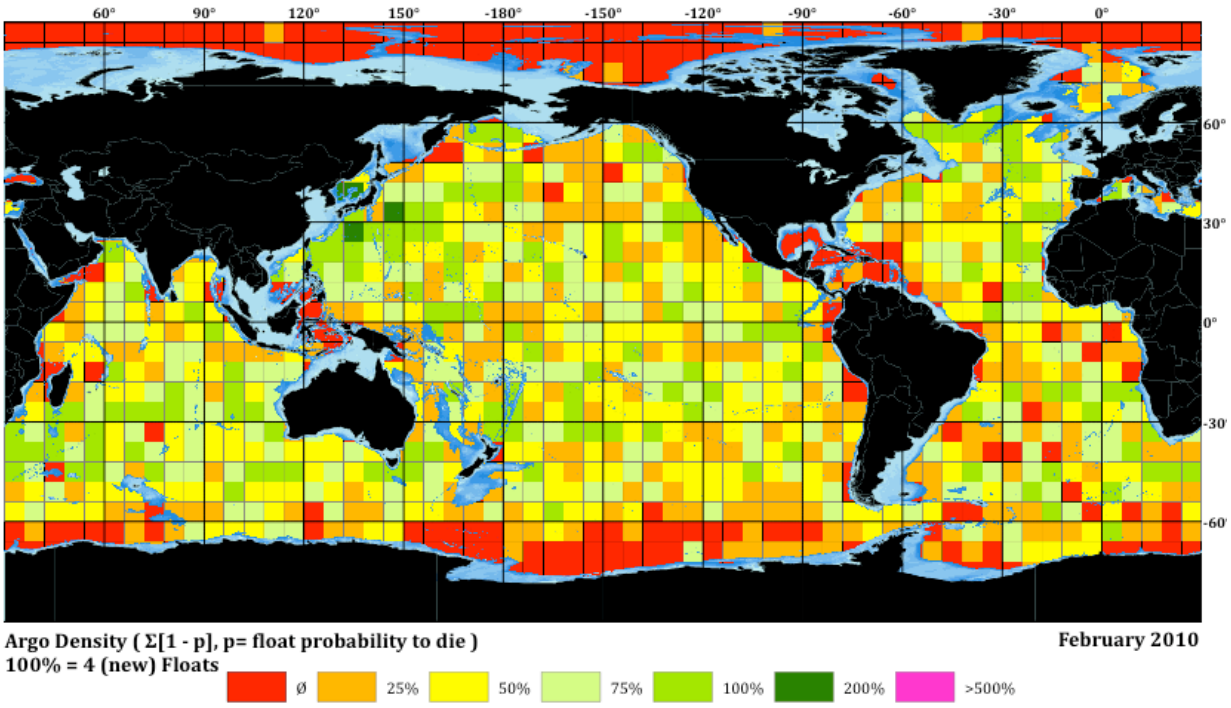
- Deployment plan scoring system developed to prioritize deployments (and float delivery in period of crisis)

- New statistics on float reliability in the float search engine (Cycles per floats, vertical distance profiled)

- New statistics on data distribution delays

- New density maps:

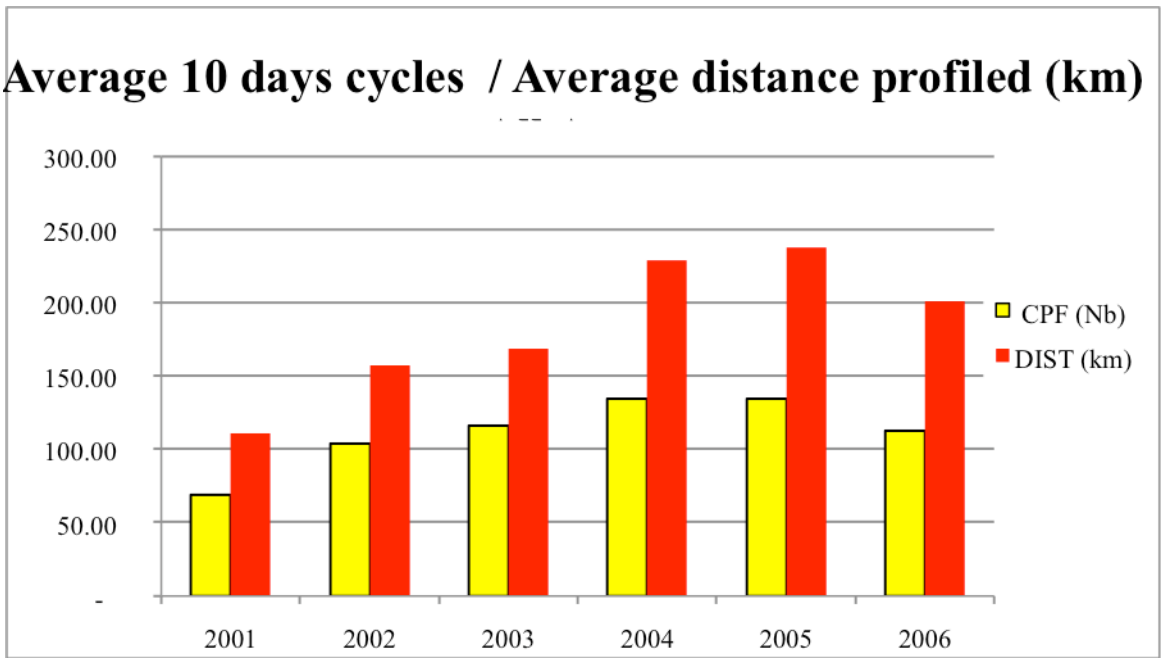


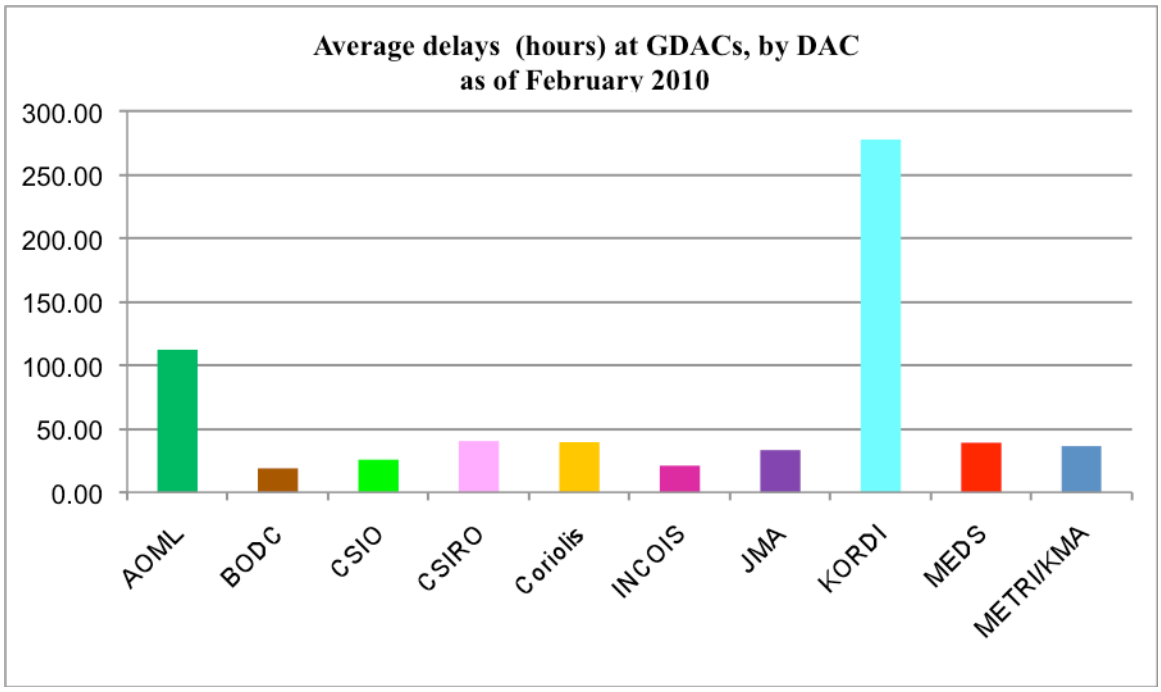


The first figure sums the active floats (not greylisted, not beached) on a 6x6 box, and normalizes the result on the Argo target.

The second sums the (1-p) values, where p is the float probability to die, function of its age. Those maps are also available in Google Earth:

http://argo.jcommops.org/FTPRoot/Argo/Status/ARGO_DENSITY.kmz





Action item 4: ADMT to explore the reason for a delay in data from some DACs in reaching the GDACs.

TC informed the AST that the Argo label was lightly updated, to include a red symbol ”DO NOT OPEN” and that it was decided (with co-chairs) to remove the Argo label on NAVO floats. In addition a special note will be attached to the e-notifications of all equivalent floats:

"The owner of this float has agreed to share data within the Argo data system, and the Argo Information Centre tracks this float for information and can provide some support if needed. However this profiling float was not deployed under the aegis of the international Argo program, and may not comply with Argo best practices."

TC suggested to reclassify the nationality of a beached float when successfully redeployed. Some AST members remarked that it was not always so simple to transfer telecom costs between (CLS-Argos) programmes.

TC reminded the AST of the international co-operations recently developed or under developments. In particular TC recalled the offer of Colombia to promote Argo during the 200th anniversary of its independence by deploying float(s) during special maritime events. Also Argo should be promoted during the 50th birthday of the IOC/UNESCO.

Finally, the TC presented a set of metrics about the Argo status: implementation, data management, float reliability.

For his 10th AST meeting the TC recalled he was glad to assist with the implementation of Argo, day after day.

More information in AIC report for AST#11 (http://www.argo.ucsd.edu/AIC_AST11.pdf).

4.2 JCOMM Observing Program Support Centre

Desaubies presented the JCOMM Observing Programme Support Centre (JCOMMOPS) and summarised recent developments at JCOMMOPS.

JCOMMOPS is a support centre for four of JCOMM observing programmes: DBCP (Data buoy cooperation panel), SOT (Ship observation team), OceanSITES, and Argo. Note that OceanSITES and Argo are considered by JCOMM as "*related*" programmes (and not formally part of the Observation Programme Areas). The role of JCOMMOPS is to provide technical support to the programmes by acting as a clearing house and focal point on all programme aspects (monitor and evaluate the performance of the networks, provide up to date, comprehensive information on status of observing system, assist in data distribution on the Internet and GTS, relay user feedback on data quality to platform operators, provide technical assistance and user support, etc...)

Following a Call for Interest, the Centre has recently been reviewed and renewed by JCOMM. Fifteen responses were received from different Agencies, five were short-listed for closer review, and the proposal from France (CLS & Ifremer) to host the centre was finally selected. JCOMM recognised that the centre was "*extremely useful", "indispensible", "highly regarded"*, and added that there is an *"urgent need for an expansion of its role and scope"*. Therefore there is a strong recommendation that additional resources be sought in order to widen the scope, and to integrate further components of observing systems. (The GoSHIP programme for instance could benefit from JCOMMOPS support if it evolves into sustained operations). Moreover JCOMM recommended that additional scientific guidance be brought to the Centre to "assist in demonstrating scientific value".

The Centre has now two full time persons (H. Viola and M. Belbeoch), one software developer (half time position) and Y. Desaubies (part time scientific support). Funding for JCOMMOPS comes from the programmes it serves and some in kind contributions from the host agencies.

It is beneficial for all programmes to be collocated in one Centre as this provides synergies and scale effectiveness (e.g. sharing of experience and information system developments).

The steering team recognized the valuable and effective support brought to the Argo programme by M. Belbeoch (AIC), but expressed concern that if part of his time is devoted to other programmes, this should be only in proportion to the funding received from each.

> **Action item 5:** H. Freeland will draft a response to the IOC on the ATC funding and budget and send it to the people who received original budget.

There was a brief discussion of the potential benefits or drawbacks to be gained if Argo was to be fully recognized by JCOMM as one of the Observation Programme Areas, rather than as a *related programme.* No clear benefit was identified.

4.3 EuroArgo update

Y.Desaubies presented an update on the Euro Argo project. Euro Argo is recognized by the European Commission as a Research Infrastructure, following the review of the European Strategic Forum on Research Infrastructures.

In this context, Euro Argo is funded (2008-10) as a Preparatory Phase project, in order to resolve all issues necessary to set up a permanent infrastructure: technical, legal, financial, and organizational.

So far the project has developed and consolidated long term national plans for Euro-Argo and attracted new countries; worked on the development of a long term EC funding through GMES (Global Monitoring for Environment and Security initiative) and DG Research; produced several

reports on infrastructure description, costs, float technology, deployment issues, data processing issues and improvements, and impact of Argo data; tested new technical developments and improvements of the Argo data system (Arvor-Iridium, Argos3, Sea Ice and O2 sensors); considered data management upgrades (delayed mode QC, including Chla); developed an educational web site.

Two user workshops have been held and a third and last one will be in Paris on June 17-18, 2010.

The main objective of Euro Argo is to contribute ¼ of the global Argo array with additional enhancements in European regional seas (Nordic, Mediterranean, and Black seas). This will require the deployment of some 250 floats per year (200 for the global array and 50 for marginal seas), including 100 floats to be funded by the EU under the GMES in situ observations programme.

The European Council has recently adopted a new regulation defining a legal status as an international organization for European Research Infrastructure Consortium (ERIC). Euro Argo is preparing to submit a dossier to be recognized and established as an ERIC, thus becoming an operational research infrastructure. Initially, the members will be Bulgaria, France, Germany, Italy, Netherlands, UK, with additional *observers* Greece, Ireland, Norway, Poland, Portugal. Ifremer (France) is proposing to host the ERIC.

The documents are now near final stages and are circulating in the relevant ministries and at the European Commission. It is expected that final approval and signature by all parties would be during 2011.

4.4 Gliders and Argo

Because floats are quickly swept downstream, the Argo float program has had difficulties providing adequate coverage in strong boundary currents. One solution is to augment Argo with a set of ocean glider deployments. While the basic measurements are similar to those from Argo floats, the fact that ocean gliders are self-propelled and piloted, allows them to make transects across boundary currents and remain in the vicinity of these currents. The important issue is whether this effort should be carried out within the existing Argo program or in a closely related program.

Starting from proposed glider regional studies presented in the Testor, *et al*, (2010) White Paper presented at OceanObs09, a subset of these locations can be indentified that address climate change on basin scales and can be considered as closely aligned with Argo. Glider deployments that would address these issues include ones in (1) western boundary currents, (2) choke points, and (3) eastern boundary currents. The western boundary currents and choke points are strong candidates due to their role in determining the meridional and inter-ocean transports of heat and freshwater. While eastern boundary currents have lower meridional transports, upwelling associated with them are critical for primary productivity. Example locations for western boundary currents include the Gulf Stream and Kuroshio in the northern hemisphere, the East Australian Current and the New Guinea Coastal Current and Brazil Current in the southern hemisphere. The Drake Passage is a possible choke point that could be monitored using an ocean glider. Examples of eastern boundary currents include the Peru and California Currents.

While a climate change glider program could share the Argo data system, there are many other ways that such a program is dissimilar to the Argo Program. In particular, there will have to be significantly more involvement between the organizations that run the gliders and the countries whose Exclusive Economic Zone encompasses the boundary currents and choke points. This

suggests that the best model for a glider program would be a federation of regionally based efforts that are coordinated through an international working group. It is proposed that the Argo Steering Team encourage a small number of scientists involved with gliders to set up a working group to formulate a program to support glider deployments in boundary currents and choke points in support of climate change research.

4.5 Commitments table

AST members updated the commitments table and the expected number of float deployments for 2010 is large (~1100) given the small number of deployments last year. While float deployerers have many floats in inventory, it will likely take a couple of years to catch up and find deployment opportunities for all the backlogged floats. It was also noted that for the most part countries do a good job of estimating the number of floats to be deployed in that year based on new statistics compiled by M. Scanderbeg. See Appendix for more details.

4.6 Sustained funding for Argo

A discussion was held on whether Argo should produce and subsequently maintain a brief document that outlines the case for sustaining Argo for a decade and longer. Several AST members noted that such a document would be helpful for seeking long-term funding from their national sources. A draft of the document, prepared in response to a request from GEO, was offered by J. Willis. A small group was formed to review and improve the document.

Action item 6: Howard Freeland, Silvia Garzoli, Steve Riser, Dean Roemmich, Susan Wijffels, Josh Willis will volunteer to read, review and edit a 1-page document that outlines the case for sustaining the Argo Program on a long-term basis.

5 Data Management Issues

5.1 Feedback from ADMT-10

The data system is operating stably. The real-time data continues to provide 90% of the data on GTS within 24 hours with no major distribution issues at this time. Coriolis is providing two additional QC checks on the real-time data to improve detection:

1) A daily objective analysis is performed to detect anomalies and
2) A quarterly comparison of the Argo data with satellite altimetry data

These allow the detection and correction of major problems much earlier than waiting for delayed-mode.

The ADMT is currently focusing on improving data consistency, detecting and correcting systematic errors, delayed-mode QC, Argo Regional Centers, and improving the interoperability of the Argo data set. Activities related to correction of the pressure drift problem, delayed-mode QC, ARCs, and trajectory data are covered by separate presentations.

It was noted that the Argo Reference Database was updated by Coriolis in February 2010 and that the Argo Profile Reference Dataset was updated by John Gilson.

Developments at the GDAC were briefed including detailed index files, MD5 signatures, automated DAC file removal, and the new layout of the latest_data files. It was also noted that the enhanced format checker has missed its deadlines but that it has been operating internally at the US GDAC for almost a month. The US GDAC (Mark Ignaszewski) will be contacting the DACs regarding their results immediately after this meeting.

ADMT efforts to provide the NAVO bounce profiles on the GDACs and achieve CF compliance were discussed.

Four new format proposals (see Appendix) for accommodating "exotic" sensor data (near-surface temperature, dissolved oxygen, etc) and data on different pressure axes were discussed at length. The AST considered keeping the current file format with only T, S, and P in the files and then creating separate files for any other type of parameter measured which would make it clear to outside communities that extra work and funding was needed before the variables they desired could be included into the file structure. In the end, the option the AST is leaning towards adopting as a file format change is option 4. This would add dimensions into the current format for each new type of parameter that might be included in the file. It was also noted that the ADMT should investigate whether these different options are CF compliant and whether operational centers will be able to use these files without major changes to their systems. In the end, the AST did not decide definitively which option was best, but requested further investigation into the impact of option 4 on users, metadata, technical and multi-profile files. The AST wishes to minimize the impact on users while keeping the data format as flexible as possible for future parameter inclusion and for long term solutions.

> **Action item 7:** The AST is tending towards adoption option 4 for a file format change. Ask ADMT to make example files, including meta and tech files, following option 4 that users and operational centers, where appropriate, can test in their code. It is important that the ADMT also investigate the impact on metadata, technical and multi-profile files if option 4 is adopted.

5.2 Impact of pressure errors on Argo dataset

5.2.1 Status of APEX surface pressure correction

The Argo program strongly recommends not deploying floats with APF-8 controller boards unless they are non-truncating. APEX ROMS are specified by created date (MMDDYY) and according to G. Johnson at PMEL, it is best to use the number of 122707 as a guideline for selecting APF-8 ROMS. PMEL ROMS for non-truncating APF-8's include pressure activation, fast first profile and a logarithmic depth sampling table, but lack ice-avoidance software. If a user would like to purchase an APEX float with an APF-8 that is non-truncating, it is suggested to ask for a new ROMS if the PMEL ROMS does not satisfy the user requirements for the float.

> **Action item 8:** Post updated pressure statement from S. Wijffels onto Argo websites to keep users informed on the surface pressure correction status.

> **Action item 9:** All DACs need to update and/or correct technical files and pressure corrections on APEX floats as needed by the end of 2010.

5.2.2 Identifying pressure bias in the Argo dataset

Scanderbeg
Argo profiles were matched within 10 days and 100km to CTD stations in the reference database in the time period of 2004-2009. Of the 16,930 possible CTD stations, there were 2,819 matches with Argo profiles. For each matched pair, the Argo profile was shifted up and down relative to the CTD profile to find the pressure offset that minimized the sum of the squares of the temperature difference at each pressure level. The overall pressure offset was

0.11 dbar with a standard error of 0.27 dbar, meaning Argo floats would have to be shifted 0.11 dbar deeper than CTD profiles which is consistent with a negative pressure offset. Matches were plotted by launch year and by match year. A positive offset is consistent with a negative pressure drift in APEX floats. The subset of TPND APEX floats based on the list provided by CSIRO within the 2,819 matches were pulled out and graphed separately. This only yielded 624 matches, with 456 in the NW Pacific region and only 100 matches were in the Southern hemisphere. Based on this comparison, more recent CTD data is needed to expand the possible matches. It was also noted that the pressure offset should perhaps be graphed by the age of the float to see if there are more positive offsets (consistent with a negative pressure offset) as the floats age.

Gilson

A feature of some past versions of APEX floats in the Argo program is that they truncate reported surface pressure if the value is less than -5.0 dbar. Thus a subset of APEX floats, dubbed Truncated Pressure Negative Drift (TPND), have no recorded correction for known negative drift. An inter- comparison between SIO SOLO floats, which report and have been corrected for pressure drift, and the TPND floats was presented. Comparing steric height (0/800db) from nearby floats, defined by space, time, and climatological steric height, the TPND offset was estimated to be 1dbar (median value) to 2 dbar (modal value). In contrast, the bias was not apparent when SIO SOLO floats were similarly compared to newer APEX floats with the APF9 controller. Identification of individual TPND floats with extreme pressure drift is made difficult by the small percentage of a TPNDs cycles with a nearby SOLO pair. SIO SOLO floats are primarily in the southern hemisphere, especially the southern Pacific basin. Thus this local comparison might differ slightly from a global analysis.

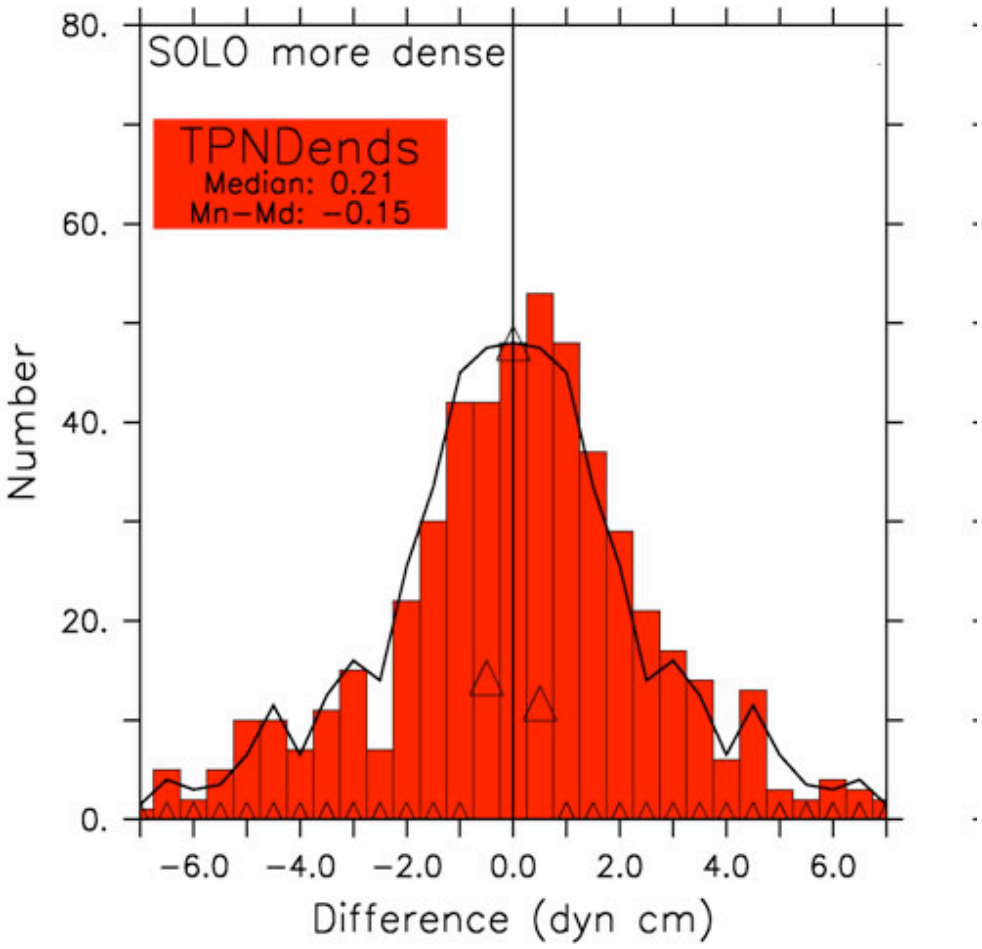


Figure 1: Histogram of differenced steric height derived from SOLO profiles nearby a subset of APEX TPND profiles which reported offscale surface pressure (-5 db) and continued to report offset surface pressure to the end of the TPND float record. The pairing of profiles assigned euqal weight to 111km distance, 5 days in time and 1 dyn-cm of climatological steric height. Bins on the right side of the center line are consistent with negative APEX pressure drift.

Thierry

Compared to a reference field, a negative pressure bias in float data induces a cold bias in a strong thermocline and a saline anomaly at depth. Some Druck pressure sensors experience a microleak that induces a negative pressure bias. Unfortunately, this drift is not assessable for TNPD APEX floats. V. Thierry presented a study based on the ISAS tool to detect TPND APEX floats concerned by the Druck microleak defect.

ISAS is a tool based on an optimal interpolation method that is used to interpolate in situ data (mainly ARGO data) on ½°x ½° global grid (Gaillard et al 2009 in JAOT, von Schuckmann et al 2009 in JGR). The float data (TEMP, PSAL and PRES) are compared to the gridded data interpolated at the float location and a time series of the difference is provided for each suspicious float. The difference is calculated as the float data minus the gridded data.

For each potential TNPD microleakers, the time series of the differences is plotted to look for evidence of the Druck microleak (cold bias in strong thermocline, saline anomaly at depth and negative anomaly for the pressure).

The method is clearly able to detect APEX TNPD microleakers. Large drifts are obvious. Complementary diagnostics are required to detect smaller drifts. Using ADJUSTED data and excluding suspicious floats from the analysis should help refine the detection of the TNPD microleakers.

> **Action item 10:** Ask CSIRO to redo their comparisons to look at buddy pairs by launch year to help identify possible errors in pressure by year for a correction or error to add into files.

5.2.3 Progress on Argo Reference Database

S Diggs was unable to attend the AST-11 meeting, so the status report on the current state of the acquisition and dissemination of Ship-Based CTD data was presented by M Scanderbeg. After briefly reviewing the original need for these data and the tri-agency structure of the CTD data acquisition team, recent work by J Gilson, M Scanderbeg and S Diggs was shown. The most recent CTD database (CTD_for_DMQC_2010V1) and the "Argo Float" database (Argo_for_DMQC_2009V4) were used within the Owens and Wong (OW) salinity calibration tool to 'map' the climatology of the South Pacific and Southern Oceans. This analysis attempts to quantify those regions where new CTD data are most necessary to improve the Argo DMQC reference database (CTD) and simultaneously to confirm ocean state changes measured by the Argo float database.

In addition, the presentation included a Google Earth animation highlighting the lack of publicly available CTD profiles in the Southern Ocean in the last ten years. However, the CCHDO's involvement in the US Repeat Hydrography Program as well as the new GO-SHIP project will give the Argo data team rapid access to a significant number of high-quality CTD data from research cruises scheduled in the coming months and years. Unfortunately, identifying temporally relevant CTD observations data from the Southern Indian Ocean continues to be a challenge. Further direction and feedback from the Steering Team would help the Data Team continue to refine its objectives and insure success with this project.

5.2.4 Other reports and open discussion on pressure issues

S Wijffels reported on an analysis by CSIRO of pressure adjustments in the Argo APEX data set downloaded from the GDACs in December 2008. This analysis is currently in review, and is focused on producing a version of the Argo data set appropriate for studying changes in global ocean heat content (GOHC). It was noted that as the pressure sensors deployed in Argo has changed over time, the bias in the DAC data set has changed. Early float sensors (Ametek and Paine) typically drifted positive while Druck sensors typically have little drift or strong negative drift (when afflicted by a micro-leak) – figure X.

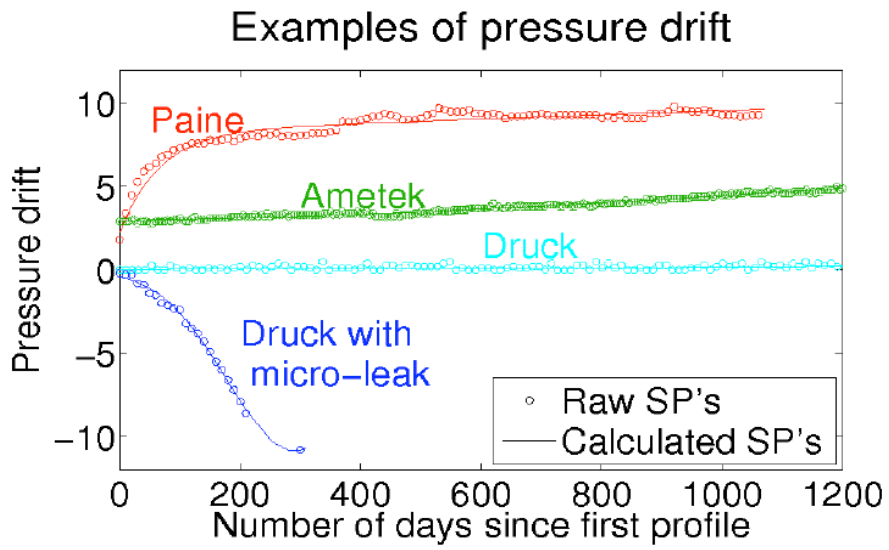


Figure 2: typical drift behavior of the different pressure sensor types deployed in the Argo array.

In the December 2008 version of the Argo data set, it was found that about 34% of total profiles are not able to be pressure corrected and thus cannot be reliably used for this study, either due to missing information (~15%) or due to the fact that they derive from APEX floats which reported a truncated negative drifting surface pressure (TNDP). If Argo DACs properly populate their technical and meta data files, then much of the former can be corrected, and we can expect that the TNDP data (with unknown pressure bias) will remain a small part of the global data set (~15%). The Argo DMQC teams are now labeling TNDP float data so that users sensitive to these small pressure errors can identify them.

Once a corrected version of the Argo data set was produced, an analysis of GOHC was performed to compare the December 2008 GDAC version with the corrected versions. The good news is that in global integral the GDAC analysis is very similar to the pressure-corrected version. Thus the warm bias associated with uncorrected positive pressure drifts appear to cancel the cold bias associated with the unknown TNDP negative pressure drifts. However, regionally, errors are significant – likely reflecting cohorts of biased or uncorrected floats deployed near each other by various Argo programs.

5.3 DMQC-4

A one-day delayed-mode workshop (DMQC-4) was held in September 2009 in conjunction with ADMT-10. The major purpose of DMQC-4 was to update all delayed-mode groups of the increased likelihood of SBE CTDs being affected by the Druck oil microleak problem, and to ensure that the associated negative pressure errors be treated in delayed-mode.

Particular attention was paid to the APEX uncorrectables, which were the APEX floats with Apf-5, Apf-7, Apf-8 controllers and which did not report any positive surface pressure values in a large portion of their time series. These floats have unknown negative pressure errors, with T/S anomaly being observable only when pressure error became severe (e.g. negative 20 dbar pressure error will result in positive 0.01 salinity error). It was agreed at DMQC-4 that for APEX

uncorrectables whose float data did not show observable T/S anomaly, that their adjusted Argo variables be flagged with the qc flag of '2'. That is, PRES_ADJUSTED_QC = '2', TEMP_ADJUSTED_QC = '2', and PSAL_ADJUSTED_QC = '2'. In addition, APEX uncorrectables that used Druck pressure sensors with serial numbers greater than 2324175 and which did not report any positive surface pressure values from some point onwards in their time series should be suspected as microleakers after that point. Post-workshop discussions agreed to quoting the upper bound of 20 dbar as the uncertainty for this group of pressure data. Other instrument types in Argo were determined to be able to handle negative pressure errors, as they were designed to either automatically reset pressure offsets at the sea surface, or telemeter un-truncated surface pressure values for delayed-mode pressure adjustment.

Other matters such as delayed-mode data format and quality consistency were also discussed. It was agreed that future delayed-mode workshops would be convened when requirement for one was expressed. Moreover, it would be advantageous to hold future workshops in conjunction with ADMT events.

5.4 ARCs

Developments at the SAARC

Results of the analysis for the consistency check of Argo profiles are online at http://www.aoml.noaa.gov/phod/sardac/index.php. As defined in the International Argo Data Management Team, this is done, after the delayed mode qc. The analysis currently performs comparisons with nearby profiles and climatologies. The mean statistics as well as time-dependence of the differences are analyzed, and diagnostic graphics and tables are generated, which are published on the Internet. What needs to be added is the generation of reports to the float PIs.

As of March 2010, there were 590 floats with D files in the SAARC region. For 444 (75%) of them, the results are available online. An additional 4 have delayed-mode files that are less than 6 months old and will be processed next.

SAARC developed software to generate maps of float locations color coded by number of profiles and data quality (for temperature and salinity) to help with deployment planning.

Regarding the action items from 3rd ARC Workshop (September 2009):

The report is available at the AIC, the ADMT and at http://www.argo.ucsd.edu/ARC3_report.pdf

One topic of interest for the AST was how to define what we mean by Argo data products. For example, would model output that does data assimilation of in situ be considered to be an Argo product. Maybe the AST is the best group to discuss this.

Another challenge is to keep track of the various products that are produced (complete listing of product descriptors and qualifiers that is easy to maintain). A table was updated at the ARC workshop, but it needs more work. Maybe such a listing could be hosted at SIO, which already has a "gridded Argo products page"?

5.5 Status of trajectory data

Since 2000, data from ~ 6000 Argo floats have been collected, worldwide, generating ~ 400,000 profiles in the ocean main thermocline. With their cycling periods of 10 days (generally), Argo floats subsurface displacements can also be used as a direct and absolute measure of the ocean mesoscale motions, at their drifting depths, but reliable estimates of Argo deep displacements are required. The simplest estimates use the first Argos fix from the present cycle and the last Argos fix from the previous cycle. Reliable estimates of Argo deep displacements also require exact values of the park pressures, but those values might be wrong in the existing NetCDF files. Additional errors (decoding) have also been found in the existing netcdf files.

Michel Ollitrault and Jean-Philippe Rannou have, over the last three years, almost fully corrected the AOML, Coriolis and JMA DAC data to provide the displacement/velocity ANDRO ascii file. This was possible because they had access to the original raw Argos messages received. In January 2010, the ANDRO atlas, updated to the end of 2008, contains 75% of the whole Argo data set. Work is presently beginning to extend their procedure to the whole Argo data set, i.e. for all the other DACs, beginning with INCOIS. All the errors detected and most corrections have been communicated, on a regular basis, to AOML Coriolis and JMA, so that they can progressively update the NetCDF files, as appropriate.

The main difference with the Yomaha'09 atlas is that grounded cycles are excluded and the parking pressure for each cycle is a measured value. It is given as:

- Mean of pressure measurements at drifting depth, if they are available,
- Otherwise, the one parking pressure measured
- Or, the parking pressure found in the meta file (only 29 floats are concerned)

ANDRO extended worldwide, i.e. to all the Argo DACs, should be completed by the end of 2010 (with data until 1 January 2009).

Susan Wijffels thanked Michel Ollitrault and Jean-Philippe Rannou for their work on the trajectory files. All agreed this time consuming, but important work needs to continue and the suggested it is time for the data management team to begin addressing the delayed mode quality control of trajectory files. It appears there are two methods to quality control the trajectory files: continue with a small group of people fixing files or work at the DAC level to qc the trajectory data. Sustained funding would be needed for a small group to fix the files.

> **Action item 11:** DACs need to update and correct their decoding of trajectory data both in real time and in older data where errors are being found. Progress to be reported at ADMT-11.
>
> **Action item 12:** Brian King, Michel Ollitrault, and Virginie Thierry to work together to present a pathway for Dmoded trajectory data to the ADMT.

6 Technical issues

6.1 Surface layer timing issues

A number of specific applications require that we know exactly when Argo floats reach the surface. For example, in order to determine velocity trajectory information, precise start and stop times are critical. Validation efforts that require matching multiple independent

measurements depend on knowing the precise timing of the Argo measurements, and this is particularly true in the upper ocean, where temperature evolve rapidly. In addition science questions focused on understanding rapidly evolving aspects of the ocean, such as the upper ocean diurnal cycle, depend on knowing the precise timing of the Argo measurements. At present, different manufacturers have adopted different conventions for defining the time when Argo floats rise to the surface. Depending on the float type the best estimate of surfacing time might come from the variable JULD, or the variable JULD_ASCENT_END, or an adjustment to one of these assuming some knowledge of clock drift or time at surface. Brian King reports that further information is available in raw transmission files that are not available to most Argo float users.

Sarah Gille's recommendations are to set standards for future Argo data reporting to make surface arrival times easier to detect. This could include the following:

(1) Establish standard usage for the JULD and JULD_ASCENT_END variables for all data centers.

(2) Have floats report their internal clock times when they (a) arrive at the surface, (b) begin transmitting, and (c) at the moment of transmission, or else equivalent information that would make it possible to have redundant information to determine profiling times.

(3) Include profile times in profile files (not just in trajectory files), with information indicating whether estimated or exact (or with uncertainties.) If it is not possible to do this, then establish consistent cycle numbering schemes for trajectory and profile files to allow cross-comparison of data.

6.2 Status of Bio-Argo

Bio-optical and chemical sensors on profiling floats have been used for more than a decade. They have matured a lot in terms of ease of integration and robustness with papers describing them being published in high impact scientific journals. There are currently about 20 profiling floats deployed and another 150 floats funded that include optical sensors (and about 200 others with oxygen and/or nitrate sensor). The International Ocean Color Coordinating Group (IOCCG) has established a committee to provide recommendation on the best practices for the use of optical sensors on profiling floats (Chair: H. Claustre). A white paper has been written that will be shared with the greater community as soon as it is finalized later this year. In addition much interest in these technologies has been generated in the OceanObs meeting in Venice in 2009 and several manuscripts describing the promising future of these assets are in press.

In order to establish a global observatory of profiling floats with biogeochemical sensors it is imperative that actions be taken soon to standardize sensors, data streams and QC procedures for both near-real-time and delayed mode. The IOCCG committee has tackled some of these issues and more work is planed soon. Synergies with Argo are obvious and would benefit both communities (increasing funding and user base). In order for this synergy to work, Argo will need to be supplemented with additional personnel (to handle increased data complexity and volume). Indeed, in France, efforts have been made to find additional funding for the Coriolis data center to deal with the added work that will be caused from QC and dissemination of biogeochemical data.

6.3 pH sensor development

Todd Martz presented a brief overview regarding chemical sensors now operating as Argo equivalents within the Argo array. Examples and uses of oxygen data were given and quality control of oxygen was mentioned. Next, a few slides were presented showing new data from ISUS nitrate sensors, which have operated on six floats. The remainder of the presentation focused on a newly developed pH sensor based on the Honeywell Durafet(r). Several figures were presented demonstrating that the pH sensor operates with remarkable stability in the surface ocean on moorings. In conclusion, it was also shown that recent modifications to the Durafet now allow high pressure operation, and it was mentioned plans are being made to deploy the first float with a pH sensor in 2011.

6.4 Status of oxygen measurement and QC

As of February 2010, 5% of all active Argo floats were equipped with oxygen sensors. In action item 14 of the AST-10 meeting (Hangzhou, China, March 2009), Denis Gilbert, Virginie Thierry and Taiyo Kobayashi were asked to ensure that DACs are processing oxygen data according to a common set of recommendations. This has lead to the production of a proposal that was first presented at the ADMT-10 meeting (Toulouse, France, October 2009). Comments and feedback received from ADMT-10 participants have lead to a revised version of the oxygen data management proposal whose main elements were the object of Denis Gilbert's presentation. Between 2002 and 2009, only two oxygen sensors have been used on Argo floats: Seabird's SBE-IDO and Aanderaa's optode. However, despite this apparent simplicity, the conversion of raw data transmitted from the floats to the satellites for land processing has been performed in several different manners by PI's who deployed these Argo oxygen floats. The steps taken for transforming raw data from the floats to oxygen concentrations in units of micromoles/kg are presently poorly documented, so that it becomes difficult for a researcher to use the entire Argo oxygen dataset with confidence for quantitative analyses. To address this caveat, a set of standard parameter names related to oxygen are described in the oxygen data management proposal. Examples of calibration equations describing both the at-sea and the on-land data processing steps leading to the final DOXY parameter are also given in the oxygen data management proposal.

Action item 13: AST and ADMT members should provide comments on version 0.9 of the oxygen data management proposal by April 30, 2010.

Action item 14: Version 1.0 of the oxygen data management proposal (Thierry, Gilbert and Kobayashi 2010) should be posted on the Argo data management website by May 15, 2010.

6.5 Float technology progress

PROVOR/ARVOR

In 2009, the following improvements on PROVOR/ARVOR floats have been done:

- The surface pressure value is now transmitted with a 1 cbar resolution (instead of 1 dbar) to better follow the pressure sensor behaviour.
- PROVOR and ARVOR floats can now transmit a near surface P, T and S triplet acquired in spot sampling mode before the CTD pump is turned off. The depth at which this last measurement is done is defined by the user (it can be 5 or 2 dbar for instance). This modification has been implemented on the two Arvor-iridium floats recently deployed.

- Until now, it was possible to define two zones with different vertical sampling resolution: a deep zone and a shallow zone. The transition depth (500 dbar for instance) and the bin size (25 dbar in the deep zone below 500 dbar and 10 dbar above) are defined by the user. It is now possible to define a third zone near the surface with high-resolution sampling (1 dbar bin average for instance). This will be implemented on 14 Arvor floats.

Three Arvor prototypes have been deployed in 2009 and have successfully achieved their missions. Two are still active and should have completed 200 cycles by end of March. A commercialisation licence should be established in 2010. The overall objectives of the ARVOR floats are: 250 cycles at 2000m, continuous pumping for the CTD, 110 points transmitted by cycle.

The Iridium transmission has been implemented on 2 Arvor floats. The first float (WMO 6900794) has been deployed in the Med Sea from the TARA (collab. with OGS) at the end of 2009. 99 cycles have already been done (1 cycle/day). The float transmits 2 dbar bin-averaged data and 1 spot sampled triplet at 2 dbar. The downlink communication has been successfully tested as well as the grounding procedure. The second float (WMO 1900848) has been deployed in the Adriatic in Feb 2010. 5 cycles have already been done (1cycle every 5 days). The float also transmits 2 dbar bin-averaged data and 1 spot sampled triplet at 2 dbar.

Two ARVOR floats with ARGOS 3 transmission are in construction by NKE. The floats should be deployed in 2010 in the Med Sea (contribution to EuroArgo). They will surface according to the predicted passage of A3 and they will send 1Koctet of data over 1 pass. A testing platform has been developed to help define the transmission strategy. Good results have been obtained in the lab.

We are currently investigating the feasibility of developing high-pressure profiling floats. We should be able to conclude in 2010. Finally, we also investigate the feasibility of measuring nitrates from PROVOR floats.

Deep NINJA

Tsurumi Seiki Co. Ltd. (TSK), in cooperation with JAMSTEC, is developing a new profiling float for a depth greater than 2000 dbar: Deep NINJA. It has a new buoyancy engine, which is a hybrid system of single-stroke piston engine and hydraulic pump engine. The prototype hardware of Deep NINJA will be finished to be assembled probably in summer 2010 and the field tests will be done within a year. While the buoyancy engine of the prototype of Deep NINJA was originally designed for the maximum operation depth of 3000-dbar, its laboratory test indicated that the engine functioned very well even at 3500 dbar, which is the safety limit of the pressure tank. It is likely that the engine works at a greater pressure level. JAMSTEC hopes that TSK improves it to be good for the depth of up to 4000 dbar.

SOLO-II

Dean Roemmich reported that there are now two SOLO-II prototype floats in the ocean operating at accelerated cycling intervals, and the first production run of about 30 S-II floats is planned for later this year. Attributes of the S-II include its small size (40 cm shorter than SOLO), light weight (19 kg), low energy consumption for long life (> 200 cycles), 2000 m depth capability anywhere in the world, Iridium communications, and no air bladder. While the basic S-II is small, the instrument is scalable for additional batteries, sensors, and other features.

APEX float lifetimes

Gregory Johnson reported on improvements in performance of APEX floats by laboratory testing and use of Lithium batteries, as practiced at NOAA/PMEL. To do this he presented a comparison of float decay statistics from Argo TC Mathieu Belbeoch. For this analysis NOAA/PMEL float decay statistics for each deployment year class from 2004 through 2009 were compared with "fantail ready" APEX groups. Since JAMSTEC, UW, CSIRO, and PMEL all do some additional testing, those groups were excluded from the "fantail ready" floats for the analysis. All "beached" floats were also excluded from the analysis. The analysis showed that early failure rates are much lower for APEX floats laboratory tested at PMEL than for "fantail ready" APEX floats, and also indicated that later on in the float life cycle lithium batteries improved performance. Johnson asserted that for PMEL, the increased performance in floats resulting from laboratory testing and lithium battery use combined was cost effective, easily offsetting labor costs.

7 Demonstrating Argo's value

7.1 Report on OceanObs'09

In 2009 the Argo Steering Team was required to produce a report with "community input" to be submitted as a White Paper to OceanObs'09. At AST-10 in Hangzhou we identified writers with assignments to complete a first draft of each of 6 chapters. Each chapter was to be informed by what the writers heard at ASW-3 and to represent that meeting. This was done, and a few weeks after ASW-3 had been completed Dean Roemmich and Howard Freeland met at Scripps to assemble the white paper which was submitted to OceanObs'09.

The meeting went very well. The Argo white paper was cited by almost every speaker throughout the week. My feeling (HJF) is that we received significant credit for taking seriously the instruction to get community input. There were many suggestions for improvements to Argo and even more suggestions for additions to Argo. I am grateful to Lynne Talley who warned the audience that "it would be dangerous to dump everything we want onto Argo" and I have to agree with her. The most common recommendation was to complete and sustain Argo. Other recommendations included adding a biological component, sampling SST, sampling SSS, sampling the abyssal ocean, supplying observations suitable for estimating Thorpe Scales, sampling boundary current regions better and extending Argo to high latitudes. Some suggestions will be hard to implement, some are easy, and some are sufficiently obvious that they are already being implemented.

Thanks to all who assisted creation of the Argo White Paper, it was a successful and influential document. Also thank you especially to our Chinese colleagues who worked so hard to make the ASW-3 meeting successful. Without ASW-3 we would never have been able to construct the white paper with such attention to instructions.

7.1.1 Seasonal ice-zone sampling

S. Wijffels noted that there are still large gaps in the seasonal-ice zones and that more needs to be done to examine the survival rate of floats in that region. According to a calculation done by E. Van Wijk, it would take an additional 650-700 floats to cover the seasonal-ice zones. Given this large addition to the number of floats needed and the likely lower float lifetime, this could potentially be a large increase in funding needed for Argo if seasonal-ice regions were included as part of the core array. B. Owens suggested that perhaps ice-tethered profilers could provide a solution in the ice regions. The AST agreed that further work was needed to evaluate platform lifetime and costs to determine what the best method of covering seasonal ice-zones might be.

Action item 15: Ask E. Van Wijk to work with others (B. Owens, S. Riser, O. Klatt) to evaluate the platform lifetime and costs in seasonal-ice zones, including floats and tethered floats. Report results back to ADMT and AST.

7.1.2 Near surface temperature sampling

With the implementation of 2-way communication in Argo (Iridium, ARGOS-3) and increased bandwidth, Argo floats will routinely transmit profile data with greater vertical resolution. At the same time, improved pressure-sensor stability will enable (pumped temperature and salinity) sampling closer to the sea surface than the present 5-dbar cutoff. Further evaluation is needed of the accuracy of unpumped temperature data in the top few meters. The AST noted that minimal requirements provided by the GHRSST Science Team were for vertical resolution of 1 m in the upper 10 m and 0.5 m in the upper 3 m.

Action item 16: Ask J. Turton to look at the quality of the unpumped temperature data and based on that evidence, work with the near surface community to come up with a sampling scheme for use on Iridium floats and report back to AST.

7.1.3 Deep Argo

D. Roemmich stated that the US may begin development of a deep Argo float in 2011. Everything from the required number, cycling frequency, and spatial distribution to the maximum depth of the float and its cost needs to be investigated. Another question is whether deep floats will need to be recovered for CTD recalibration. He noted that it would take more than one country investing money in deep floats to make them feasible to include in the Argo array. Japan reiterated they are developing the deep NINJA float which can go to 3500db and perhaps deeper. France is also looking into making a float that can go to 3500db. Greg Johnson and Silvia Garzoli noted that to truly cover the ocean that some floats will need to be at least 5km deep and hopefully 6km.

7.1.4 Iridium

As the technical coordinator pointed out earlier in the meeting, more and more floats are being deployed with Iridium communications.

Action item 17: Ask B. Owens to compile what sampling schemes are currently in use with Iridium floats. Interact with mixing paper authors to see which sampling schemes would be beneficial for them and report the results at the ADMT meeting.

7.1.5 Open discussion on sustaining and evolving Argo

As Argo evolves, additional sensors and data will want to be added to the Argo data stream. In order for this to happen, it is important that individuals from these different communities (like Bio-Argo) work with the AST and/or the ADMT to find ways to include the new data types in the data stream. This includes establishing naming conventions, metadata and technical information for the new variables as well as a quality control pathway.

Action item 18: Encourage Bio-Argo to work with Coriolis to develop naming conventions, metadata and technical file information for the new data types to be included in the Argo data stream.

Action item 19: Ask ADMT co-chairs to invite a representative from Bio-Argo to attend the ADMT meeting as an observer.

7.2 Upcoming science meetings

7.2.1 IUGG

The IUGG meeting will be held next year in Melbourne, Australia (28 June – 7 July 2011) and there will be a session that will focus on Argo and other ocean observing systems. The AST encourages scientists to submit abstracts to this meeting to help represent Argo and to look for methods of sustained funding.

7.2.2 EuroArgo

There is an upcoming EuroArgo meeting this 17 – 18 June in Paris for all EuroArgo scientists.

7.3 Argo bibliography

M. Scanderbeg presented work done in the last year on the bibliography pages on the AST website. The definition of an "Argo" citation was tightened to include only papers which use Argo data or Argo equivalent data. This is a change from papers that were previously included which contained data from profiling floats in general. Additionally, it was decided that the type of citations included will be peer-reviewed papers, book chapters, and theses. These changes reduced the number of papers in the recent years, but the total in 2009 was still above 100 papers. It was suggested to provide links to other pages on regional or national websites that contain references to other types of non-peer reviewed documents like technical reports, newsletters, etc.

M. Scanderbeg now also maintains graphs showing the number of papers published per year and the numbers of papers published per country as designated by the country of the first author on the paper. There are a large number of papers published in the US and part of this may be that the search for such papers is done in the US. Therefore, all AST members were again encouraged to continue sending any citations of Argo papers to argo@ucsd.edu. M. Scanderbeg noted that she now searches directly as the source of several journals and uses Google Scholar which has increased the number of non-physical oceanographic references as the search engines used in the past were heavily weighted towards physical sciences.

M. Scanderbeg also proposed ending the updating of the complete float bibliography which is supposed to contain citations from all types of floats. This is a large, time-consuming task which does not offer a large benefit to the Argo program and where it is likely that many papers are missing. Other AST members and attendees agreed and so the complete bibliography will only go through 2009.

7.4 Google Ocean

TC recalled the aim of this initiative, to be presented to Google when ready, for a potential addition in Google Ocean:

The offer will include two main elements:

– Part I) Argo network status (the floats…)

– Part II) Ocean state as seen by Argo (the products …)

And these will be regrouped in a package and presented via a tour.

Oceanographers will be encouraged to tell stories on floats, ocean, climate, etc in order to "humanize" the Argo observing system and promote it as a pillar of the climate warning system.

TC then did a live demonstration of the layer.

Presentation with details on the layer:
(http://w3.jcommops.org/FTPRoot/Argo/Doc/Meetings/AST/11/AIC-AST11_Google.ppt)
Download the layer itself:
(http://www.jcommops.org/jcommops-kml/WebObjects/jcommops-kml.woa/wa/initKml?prog=argo)

Megan Scanderbeg presented overlay images of temperature at the surface that have been produced based on the gridded Argo product produced at Scripps Institution of Oceanography. The goal of these products is to be able to cover the globe with temperature, salinity, anomalies, etc and let users drill down into the ocean and go both forwards and backwards in time to see how the properties change. These global images will be available monthly and nicely complement the individual, real time, data status seen in the balloons compiled by the ATC.

> **Action item 20:** The AST strongly encourages continuing work on the development of layers for Google Ocean to continue to make the Argo layer more efficient and user friendly. AST members to provide feedback on the design and content of the balloons created by the ATC for each float. Send comments directly to ATC.
>
> **Action item 21:** AST members to provide feedback on which properties should be overlaid onto the Google Earth globe. Send feedback to M. Scanderbeg on which properties to include and any text that might be displayed with the images on Google Earth.

7.5 Next Argonautics Newsletter

M. Scanderbeg presented ideas for the next Argonautics Newsletter which will likely be published by the fall. The main focus will probably be on educational uses of Argo data as EuroArgo has made strides in this department. M. Belbeoch has also worked on new layers for Google Ocean that showcase Argo data and stories about different floats. Additional articles might include information on new floats such as the SOLO-II and an update on the ARVOR. There will possibly be an article describing the work M. Ollitrault has done on the trajectory files.

8 Argo outreach activities

> **Action item 22:** M. Scanderbeg to add links to educational/training tools (e.g. work done at the Gabon meeting, EuroArgo's new education website, work done in Chile, etc) to the AST website.

9 Future meetings

9.1 ADMT-11

ADMT-11 will be hosted by Birgit Klein in Germany 19 – 22 October 2010.

9.2 AST-12

AST-12 will be hosted by Argo Argentina, with the date and location to be announced later.

Argo Steering Team Meeting (AST-11)
Scripps Seaside Forum, Edward W. Scripps II Room, March 23-25 2010
Host: Scripps Institution of Oceanography UCSD, La Jolla California USA

Agenda: Tuesday March 23; begin at 9 a.m., finish by noon March 25

1. Welcome by Dr. Tony Haymet, Director of Scripps Institution of Oceanography
2. Objectives of the meeting/adoption of the agenda
   How will Argo be sustained and enhanced following OceanObs'09?
   What actions are needed to ensure that the quality of Argo data is sufficient for global change studies?
3. New AST co-chair
4. Local arrangements (Scanderbeg)
5. Status of action items from AST-10 (Scanderbeg)
6. Implementation issues
   - 6.1 AIC Report (Belbéoch)
   - 6.2 AIC funding (Freeland)
   - 6.3 JCOMM Observing Program Support Centre (Desaubies, Belbeoch).
   - 6.4 EuroArgo update (LeTraon/Desaubies)
   - 6.5 Gliders and Argo (Owens)
   - 6.6 Update commitments table (Scanderbeg)
     Will the missed 2009 deployments be made up in 2010?
   - 6.7 Sustained funding for Argo (Willis/Roemmich draft for GEO)

If time permits prior to afternoon coffee break, begin item 8.

7. Science talks: A series of three 30-minute science presentations will be made by California researchers on Argo-related topics. 3:30 p.m. on Tues March 23.

"Diurnal Variations in Upper Ocean Temperature from Argo: Implications for the Ocean Mixed Layer" – Sarah Gille, 3:30 p.m.

"Capturing the Conveyer Belt: Detecting Changes in Atlantic Overturning with Argo Floats and Satellite Altimeters" – Josh Willis, 4:00 p.m.

"Boundary current observations using the underwater glider Spray" – Dan Rudnick, 4:30 p.m.

Wednesday March 24; begin at 8:30 a.m.

8. Data Management related issues
   - 8.1 Feedback from ADMT-10 (Ignaszewski)
   - 8.2 Impact of pressure errors on the Argo dataset
     - 8.2.1 Status of APEX surface pressure correction (Wijffels, Wong)
     - 8.2.2 Identifying pressure bias in the Argo dataset (Gilson/Scanderbeg, Thierry, Willis)
     - 8.2.3 Progress on Argo Reference Database (Diggs)
     - 8.2.4 Other reports (?) and open discussion on pressure issues
   - 8.3 DMQC-4 (Wong)
   - 8.4 ARCs (Schmid)
   - 8.5 Status of trajectory data (Thierry/Ollitrault)
9. Technical issues
   - 9.1 Surface layer timing issues (Gille)
   - 9.2 Status of Bio-Argo (Claustre/Boss)
   - 9.3 pH sensor development (Martz)
   - 9.4 Status of oxygen measurement and QC (Riser, Gilbert/Kobayashi)
   - 9.5 Float technology progress (Riser, Thierry, Suga, Roemmich, Johnson)

(Optional) tour of the Scripps float and glider lab and walking tour of the Scripps campus (begins 3:30 on Weds March 24) followed by AST-11 Dinner at the Martin Johnson House

Thursday March 25; begin at 8:30 a.m., finish by noon

10. Demonstrating Argo's value/evolving for Argo's future
    - 10.1 Report on OceanObs'09 (Freeland)
        - 10.1.1 Seasonal ice-zone sampling (?)
        - 10.1.2 Near surface temperature sampling (?)
        - 10.1.3 Deep Argo (Roemmich)
        - 10.1.4 Iridium (?)
        - 10.1.5 Open discussion on sustaining and evolving Argo
    - 10.2 Upcoming science meetings
        - 10.2.1 IUGG (28 June – 7 July 2011)
        - 10.2.2 EuroArgo (17-18 June 2010)
    - 10.3 Argo bibliography (Scanderbeg)
    - 10.4 Google Ocean (Belbeoch, Diggs)
    - 10.5 Next Argonautics Newsletter (Scanderbeg)
11. Argo outreach activities - discussion
12. Future meetings
    - 12.1 ADMT-11 (19-22 October 2010)
    - 12.2 AST-12
13. AST Membership
14. Other business

List of Participants for AST-11, Scripps Institution of Oceanography

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Option 1: Integrate variables

PRES	TEMP	PSAL
0.	4.075	fill_value
0.2	4.075	fill_value
0.2	4.074	fill_value
0.6	4.083	fill_value
1.0	4.072	fill_value
1.5	4.075	fill_value
2.1	4.072	fill_value
2.6	4.072	fill_value
3.2	4.072	fill_value
4.7	4.069	33.863
5.1	4.069	fill_value
9.4	4.069	33.864
10.0	4.068	fill_value
14.6	4.067	33.863
15.2	4.066	fill_value
19.7	4.050	33.864

Option 1: Integrate variables

- Advantages
  - Simple
- Disadvantages
  - Mixes the different vertical sampling schemes and the related parameter data
    - No way to distinguish the “near surface” sampling from the standard sampling

Option 3a: New variables Independent Pressure Axis

PRES	TEMP	PSAL	PRES_NST	TEMP_NST
4.7	4.069	33.863	0.	4.075
0.2	4.069	33.864	0.2	4.075
14.6	4.067	33.863	0.2	4.074
19.7	4.050	33.864	0.6	4.083
…	…	…	1.0	4.072
…	…	…	1.5	4.075
…	…	…	2.1	4.072
…	…	…	2.6	4.072
…	…	…	3.2	4.072
…	…	…	5.1	4.069
…	…	…	10.0	4.068
…	…	…	15.2	4.066

Option 3a: New variables Independent Pressure Axis

- Advantages
  - Straightforward. We are currently doing this.
  - Maintains distinction between sampling schemes
- Disadvantages
  - "Name propogation"
    - Users have to know what names to look for
    - Consider a dissolved oxygen float:
      - PRES, TEMP, PSAL, DOXY
      - PRES_DOXY (on all?), DOXY
      - Some have TEMP_DOXY, not all
      - Now include PRES_NST and TEMP_NST
  - Multiple pressure axes

Option 3b: New Variables Distributed Pressure Axis

PRES	TEMP	PSAL	PRES_NST	TEMP_NST
fill_value	fill_value	fill_value	0.	4.075
fill_value	fill_value	fill_value	0.2	4.075
fill_value	fill_value	fill_value	0.2	4.074
fill_value	fill_value	fill_value	0.6	4.083
fill_value	fill_value	fill_value	1.0	4.072
fill_value	fill_value	fill_value	1.5	4.075
fill_value	fill_value	fill_value	2.1	4.072
fill_value	fill_value	fill_value	2.6	4.072
fill_value	fill_value	fill_value	3.2	4.072
4.7	4.069	33.863	fill_value	fill_value
fill_value	fill_value	fill_value	5.1	4.069
9.4	4.069	33.864	fill_value	fill_value
fill_value	fill_value	fill_value	10.0	4.068
14.6	4.067	33.863	fill_value	fill_value
fill_value	fill_value	fill_value	15.2	4.066
19.7	4.050	33.864	fill_value	fill_value

Option 3b: New Variables Distributed Pressure Axis

- Advantages
  - Maintains sampling order across parameters
- Disadvantages
  - Many fill_values embedded through data
  - Impacts on QC systems?

Option 3c: New Variables Single Pressure Axis

PRES	TEMP	PSAL	TEMP_NST
0.	fill_value	fill_value	4.075
0.2	fill_value	fill_value	4.075
0.2	fill_value	fill_value	4.074
0.6	fill_value	fill_value	4.083
1.0	fill_value	fill_value	4.072
1.5	fill_value	fill_value	4.075
2.1	fill_value	fill_value	4.072
2.6	fill_value	fill_value	4.072
3.2	fill_value	fill_value	4.072
4.7	4.069	33.863	fill_value
5.1	fill_value	fill_value	4.069
9.4	4.069	33.864	fill_value
10.0	fill_value	fill_value	4.068
14.6	4.067	33.863	fill_value
15.2	fill_value	fill_value	4.066
19.7	4.050	33.864	fill_value

Option 3c: New Variables Single Pressure Axis

- Advantages
  - Maintains pressure axis order
- Disadvantages
  - Mixes the different vertical sampling schemes
    - (New variable to indicate sample type?)
  - Many fill_values embedded through data
  - Impacts on QC systems?

Option 4: Multiple Profiles Within Single Cycle Files

NPROF = 1		
PRES	TEMP	PSAL
4.7	4.069	33.863
0.2	4.069	33.864
14.6	4.067	33.863
19.7	4.050	33.864
…	…	…
…	…	…
…	…	…
…	…	…
…	…	…
…	…	…
…	…	…
…	…	…

NPROF = 2	
PRES	TEMP
0.	4.075
0.2	4.075
0.2	4.074
0.6	4.083
1.0	4.072
1.5	4.075
2.1	4.072
2.6	4.072
3.2	4.072
5.1	4.069
10.0	4.068
15.2	4.066

Option 4: Multiple Profiles Within Single Cycle Files

- Advantages
  - Reduces “name propogation” (a temperature variable is always TEMP)
  - Clearly separates vertical sampling schemes
- Disadvantages
  - Code changes required by users

Option 5: Multiple Files For a Single Cycle

- Advantages
  - Primary files stay focused on core mission
  - Reduces “name propogation” (a temperature variable is always TEMP)
  - Clearly separates vertical sampling schemes
- Disadvantages
  - Users wanting all of the data need to “discover” and download multiple files

Additional Considerations

- Multi-profile files (for a float, geo, latest_data)
  - Only include core variables?

- Stress to the Argo community: Please inform the data management community as early as possible when changes are expected.

	Action	Responsibility	Status
1	S. Wijffels to send a letter of thanks to Dean Roemmich and Scripps Institution of Oceanography for hosting AST-11	S. Wijffels	
2	AST to ask DACs whether and when they will implement the recent ADMT recommendations on the combined use of CRC and a voting method check on transmitted data blocks.	S. Wijffels, ADMT co-chairs	
3	ATC to explore ways to obtain direct access to Iridium data for monitoring purposes	M. Belbeoch	
4	ADMT to explore the reason for a delay in data from some DACs in reaching the GDACs	S. Pouliquen, M. Ignaszewski	
5	H. Freeland will draft a response to the IOC on the ATC funding and budget and send it to the people who received original budget	H. Freeland	
6	Small subcommittee volunteers to read, review and edit the document on sustained funding for Argo as requested by GEO.	H. Freeland, S. Garzoli, S. Riser, D. Roemmich, S. Wijffels, J. Willis	
7	The AST is tending towards adoption option 4 for a file format change. Ask ADMT to make example files, including meta and tech files, following option 4 that users and operational centers, where appropriate, can test in their code. It is important that the ADMT also investigate the impact on metadata, technical and multi-profile files if option 4 is adopted	ADMT and operational users of netCDF files	
8	Post updated pressure statement from S. Wijffels onto Argo websites to keep users informed on the surface pressure correction status.	Argo website managers	Posted on ADMT, AIC, AST sites
9	All DACs need to update and/or correct technical files and pressure corrections on APEX floats as needed by the end of 2010.	DACs	
10	Ask CSIRO to redo their comparisons to look at buddy pairs by launch year to help identify	CSIRO	

	possible errors in pressure by year for a correction or error to add into files.		
11	DACs need to update and correct their decoding of trajectory data both in real time and in older data where errors are being found. Progress to be reported at ADMT-11.	DACs	
12	Brian King, Michel Ollitrault, and Virginie Thierry to work together to present a pathway for Dmoded trajectory data to the ADMT.	B. King, M. Ollitrault, V. Thierry	
13	AST and ADMT members should provide comments on version 0.9 of the oxygen data management proposal by April 30, 2010.	AST, ADMT members	
14	Version 1.0 of the oxygen data management proposal (Thierry, Gilbert and Kobayashi 2010) should be posted on the Argo data management website by May 15, 2010.	V. Thierry, D. Gilbert, T. Kobayashi, ADMT website manager	
15	Ask E. VanWijk to work with others (B. Owens, S. Riser, O. Klatt) to evaluate the platform lifetime and costs in seasonal-ice zones, including floats and tethered floats. Report results back to ADMT and AST	E. VanWijk, B. Owens, S. Riser, O. Klatt	
16	Ask J. Turton to look at the quality of the unpumped temperature data and based on that evidence, work with the near surface community to come up with a sampling scheme for use on Iridium floats and report back to AST.	J. Turton	
17	Ask B. Owens to compile what sampling schemes are currently in use with Iridium floats. Interact with mixing paper authors to see which sampling schemes would be beneficial for them and report the results at the ADMT meeting.	B. Owens	
18	Encourage Bio-Argo to work with Coriolis to develop naming conventions, metadata and	H. Claustre, E. Boss, Coriolis	

	technical file information for the new data types to be included in the Argo data stream.		
19	Ask ADMT co-chairs to invite a representative from Bio-Argo to attend the ADMT meeting as an observer.	S. Pouliquen, M. Ignaszewski	
20	The AST strongly encourages continuing work on the development of layers for Google Ocean to continue to make the Argo layer more efficient and user friendly. AST members to provide feedback on the design and content of the balloons created by the ATC for each float. Send comments directly to ATC	AST members, M. Belbeoch	
21	AST members to provide feedback on which properties should be overlaid onto the Google Earth globe. Send feedback to M. Scanderbeg on which properties to include and any text that might be displayed with the images on Google Earth.	AST members, M. Scanderbeg	
22	M. Scanderbeg to add links to educational/training tools (e.g. work done at the Gabon meeting, EuroArgo's new education website, work done in Chile, etc) to the AST website.	M. Scanderbeg	

	2004 Argo deployed	2004 Argo equiv deployed	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
Argentina					12								
Australia	4		64		45		65	47	0	72	55	65	
Brazil	0		3					4					
Canada	30		29		38		25	18		72	22	25	
Chile	0		2**	2		4							4
China	8		0		6		50			0	32	16	
Costa Rica	0		2***										
Denmark	0		0										
Ecuador								3					
European Union	15		7		3			8					
France	85		89		51		65	36		55	68	90	
Gabon													
Germany	27	18	56	19	35	1	37	22	13	95	50	61	10
Greece													
Italy													
India	33		43		15		50	38		76	40	15	
Ireland	0		0								4	4	
Japan	119		98	12	98	18	95	80	15	100	95	76	16
Kenya													
Korea (Republic of)	32		37		33		27	13		48	29	29	
Mauritius	2•		0		2								
Mexico	0		2°										
Netherlands	3		4		4		6	4		67	9	13	
New Zealand	2		1		3		2	2		100		2	
Norway	0		0		2								
Poland													
Russia	2		0										
South Africa	0		0										
Spain	2		4		1						20		
UK	45		28		24		45	31	2	73	35	29	
													10
USA	396	38	455	38	475	21	410	381	29	100	360	326	42
Subtotals	803	56	854	71	847	44		687	59			751	82
Total	859		925		891		877	746		92	819	833	

·Donated by UK
*Numbers compiled from AIC website
**Donated by Canada
***Donated by Spain
°1 float donated by Spain

% deployed vs. estimated	2009 estimated	2009 Argo deployed	2009 Argo equiv deployed	% deployed vs. estimated	2010 estimated		Notes
						Argentina	
118	50	35		70	95	Australia	at least 50/year until 2011
		4				Brazil	
					2	Bulgaria	
114	28	23		82	25	Canada	
						Chile	
50	60	16		27	50	China	50 per year 2008-2012
						Costa Rica	
						Denmark	
						Ecuador	
						European Union	
132	65	35		54	95	France	65 floats/year for 2009 & beyond
		3				Gabon	
142	57	33		58	110	Germany	50 floats per year during 2007 to 2012
					1	Greece	
					2	Italy	
38	40	7		18	40	India	40 floats per year during 2008-2012
100		4			3	Ireland	
97	101	55	18	72	116	Japan	
		5				Kenya	
100	18	17		94	12	Korea (Republic of)	
					2	Mauritius	
		1				Mexico	
144	6	4		67	8	Netherlands	
	2	2		100	2	New Zealand	
					4	Norway	
		2			3	Poland	
		2				Russia	
		2				South Africa	
0	20			0	12	Spain	
83	35	20		57	40	UK	40 floats per year during 2011
						UN (ice tethered profilers)	
102	360	148	61	58	500	USA	
		418	79		1122		
112	842	497		59			

Argo Information Centre

TC Report – AST11

Feb. 2010 M. Belbeoch

AIC, *http://argo.jcommops.org*
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1. Background

The international Argo Information Centre (AIC) is participating in the activities of the Argo Project Office and of the JCOMM Observing Program Support centre (JCOMMOPS).
The AIC is funded on a yearly basis via voluntary contributions from Australia, Canada, China, France, Germany, Rep. of Korea, India, the United Kingdom and the United States.

JCOMMOPS (and its AIC component) faces the challenge of strengthening its infrastructure, integrating the existing services better, developing a new generation of web services, and eventually extending its operations to new observing systems.
In the context of the development of JCOMMOPS, it has been proposed to extend the Argo TC activities to the Ship Observation Team (VOS, SOOP), as of Feb. 2009.

⇨ See the Argo/SOT TC Terms of Reference in annex

In return, this permits to:
- Stabilize Argo/SOT TC position (with a funding under pressure)
- Hire a new I.T expert to work (half-time) for JCOMMOPS, as of September 2008.
- Develop further synergies with SOT (and SOOP in particular)
- Make available some mission budget Argo/SOT TC on the WMO side.

JCOMMOPS was formally expanded into a JCOMM Observing Program Support Centre at the JCOMM III session, and France was selected as the hosting country for the centre, through a partnership Ifremer/CLS.
Following up on this result, the partnership CLS/Ifremer is being strengthening its support to the centre:
- Y. Desaubies has started to work within JCOMMOPS (1/4 time) as Scientific Coordinator
- The software developer half-time position will be made full time (details being discussed with host)

The contract between IOC/UNESCO and CLS will be reviewed in order to make of the centre a true IOC/UNESCO Programme Office and strengthen the legal and logistical aspects.

On the other hand JCOMMOPS will seek new funding sources with the hosting country, with Europe (the EuroArgo initiative may help), and will develop synergies with other JCOMM/GOOS programmes (e.g: BioArgo, IOCCP/GOSHIP, MEOP, Gliders, GHRSST) as given in its new mandate. Also its role of international coordination will be completed by “Project Office” activities which remain to be adequately defined and funded.

⇨ See the new JCOMMOPS Terms of Reference in annex

2. AIC

TC Activities

The TC supports the Argo community on a wide range of issues that could be summarized in three keywords: **Assistance**, **Monitoring**, and **Cooperation**.
Many of these issues became routine activities:

- Network status monitoring
- Data management status monitoring
- Monthly Reporting
- Assistance to deployment planning, float retrieval, data distribution
- Assistance on EEZ issues, IOC Res. XX-6 & XLI-4 implementation
- Assistance to national programmes and PIs (ad hoc stats, maps, …)
- Support Centre (user desk, QC feedback relay)
- Information System technical maintenance and development
- Information System content management (float metadata, contacts, documents, news, …)
- International Cooperation, Donor Programmes
- JCOMMOPS Administration, development
- Links with SOT, DBCP, OceanSITES, IOC, WMO, JCOMM
- Media needs (photos, articles)
- *Assistance to new programmes (Marine Mammals, ITP, Bio-Argo, ...)*

As expected at AST10, 2009 was a challenging year for the TC:

- growing Argo activities
- management of the software developer
- design of the new Information System
- new responsibilities on the SOT programme
- growing JCOMMOPS administrative issues
- number of missions / meetings

The assistance provided to new programmes (basic tracking, GTS data distribution issues, etc) will not be sustained in order to focus on Argo issues.
The question remains open for new "BioArgo" floats, including oxygen floats.
The TC established the contact with these PIs, set up a basic (sometime manual) tracking system, and provide basic products.
There are some issues to solve regarding data distribution and metadata: e.g.
N floats where declared at AIC with oxygen data, P floats have the oxygen declared in the meta files and Q floats provide oxygen profiles.
Should the TC spend some time fixing this?

TC 2009 Missions

JCOMM OCG, Paris (March)
AST10, ASW3 Hangzhou (March)
Libreville, Gabon (April)
Scripps, Argo Project Office /Google workshop) (April)
Geneva, SOT V (May)
~~Euro-Argo, Italy (June)~~
Germany: Argo agencies, float manufacturer (September)
OceanObs09, Italy (September)
ADMT10 (hosted by AIC with CLS, October)
JCOMM III, Morocco (November)
Brest, Ifremer (Gabon meeting, JCOMMOPS/Y. Desaubies) (December)

TC 2010 Missions
IOC/UNESCO, Paris. Meeting with new IOC Executive Secretary, W. Watson Wright (March)
AST11, San Diego, (March)
GTSPP (Ostende) (May)
Brest, Ifremer (May)
Euro Argo, Paris (June)
IOC 50th anniversary/ Ex. Council (June)
India, Rep. of Korea when possible.
Visit AOML/SOOP chair
Morocco donor programe
Gabon Training Workshop

Monthly Report
The "monthly" report continues to be enhanced and improved each month with new products. TC starts to work on the report by the end of each month, and release it as soon as possible, after a set of checks and communications with float operators. This takes generally between one and two weeks.

6 Reports were made in 2009 (10 in 2008).
Report could be done more regularly if some time could be found to make appropriate developments. For now too much time is spent on formatting and fixing technical details.
Also when the TC is away for missions or vacations nobody can backup.

Anyway, the best will be done to ensure the production of a report every two months and target a routine monthly reporting.

The latest monthly report includes many yearly statistics on the array status:
http://argo.jcommops.org/FTPRoot/Argo/Doc/2010-01-02_AIC.pdf

Information System
The development of the new system has been slow down for a number of issues (see above) and you can't make miracles with a half-time I.T. person. But the substantial time spent in training and familiarizing the developer on JCOMMOPS services will definitely payback in 2010.

A new (Oracle) database server was set up and its design is being optimized to handle various platform concepts (e.g.: buoys/floats, ships, sites) and a large volume of observations statistics.
The 10 years experience in handling similar information will permit to simplify dramatically the design and allow more flexibility and more efficiency in the development of products.
The improvement of the Oracle technology in the last decade will definitely boost the performances.
Database design and synchronisation with main data sources (Argos, GTS, GDACs) should be operational by April 2010.
All new developments will then be made on this new database with the target to release the first web services early 2011.

On the other hand a new GIS server is being set up to evaluate most recent GIS technologies.
Our challenge here is to allow the generation on the fly of map services resulting of GIS analyses (density, intersection with EEZ, etc).

The core web services will be developed around the following toolbox:

- define groups of platform via complex queries
- map the results (GIS, Google Earth, etc)

- produce statistics and allow comparisons between different groups
- edit multiple platforms metadata from planning to end

- define a group of observations (does not exist today via the web)
- map/stats on the results

- save users/profile favourite monitoring products ("my JCOMMOPS")

Iridium

The delivery of Iridium data to Argo customers is decentralized and heterogeneous. Hence the AIC can't synchronize efficiently its tracking system with Iridium floats.
This starts to be a serious issue.
In addition the tracking system is not "independent" and the transparency of the Argo array is no more ensured. Many services of the AIC won't work (how to remind a PI to process a float, how track a beached float, how track a float back on-line, how track floats within EEZ, etc).

⇨ **The AIC needs to link with Iridium data before data reach customers …**

Network Planning & Monitoring

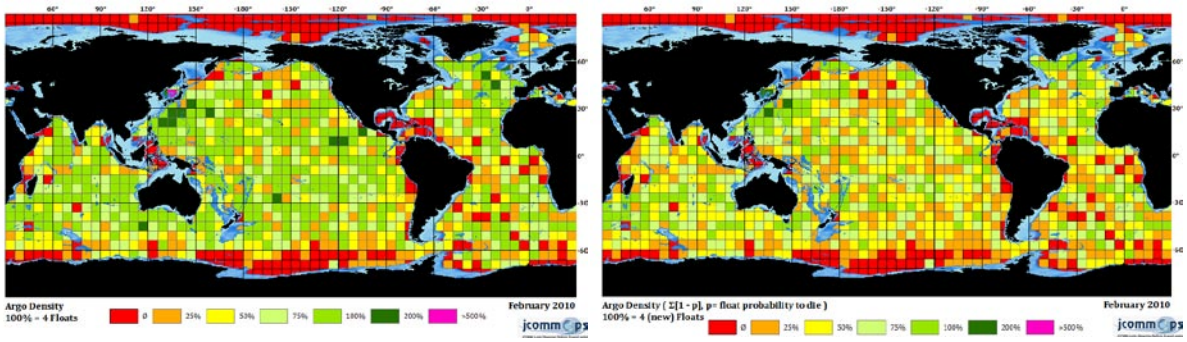
Under the guidance of the AST co-chairs, and in cooperation with some AST members, the TC designed a scoring system for the deployment plans.
This scoring system is encouraging float operators to deploy their floats where it is needed for the global array maintenance.
It can be also used by manufacturers to prioritize their float delivery in period of crisis as we had this year with the SBE sensor issue.

This information is updated twice a day and available on line in the planning interface, in the web GIS, and Google Earth. A summary by cruise is provided in the monthly report.

⇨ This tool makes sense only if float operators enter their deployment plans on-line

Method is detailed in the following report:
http://argo.jcommops.org/FTPRoot/Argo/2009-04-05-AIC.pdf

Two density maps are available via the web to assist operators to optimize their deployment plans:



The first one sum the active floats (not greylisted, not beached) on a 6x6 box, and normalizes the result on the Argo target.
The second sum the (1-p) values, where p is the float probability to die, function of its age.

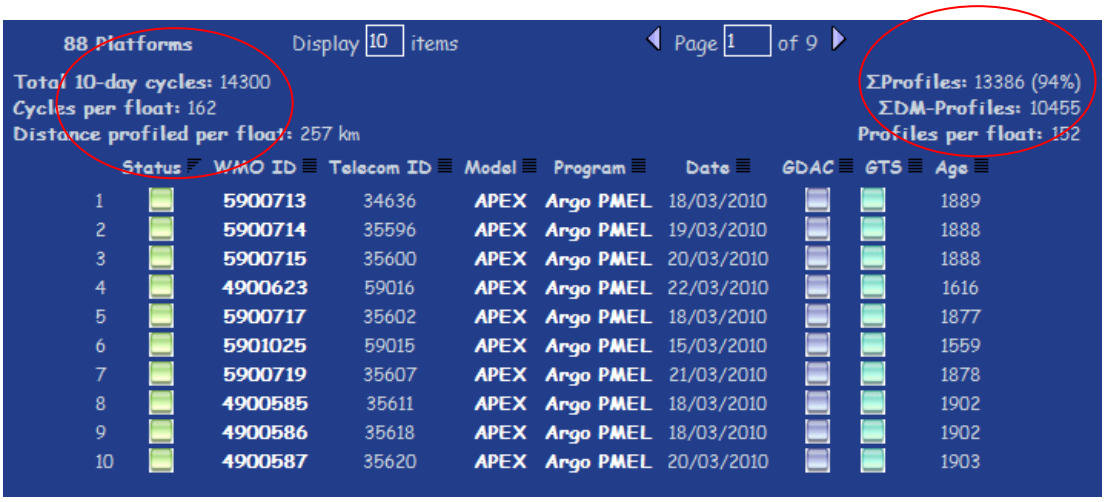
Those maps are also available in Google Earth:
http://argo.jcommops.org/FTPRoot/Argo/Status/ARGO_DENSITY.kmz

Planned improvements:

- Design a density map with values on a 1°x1° grid
- Make the scoring system real-time

New stats

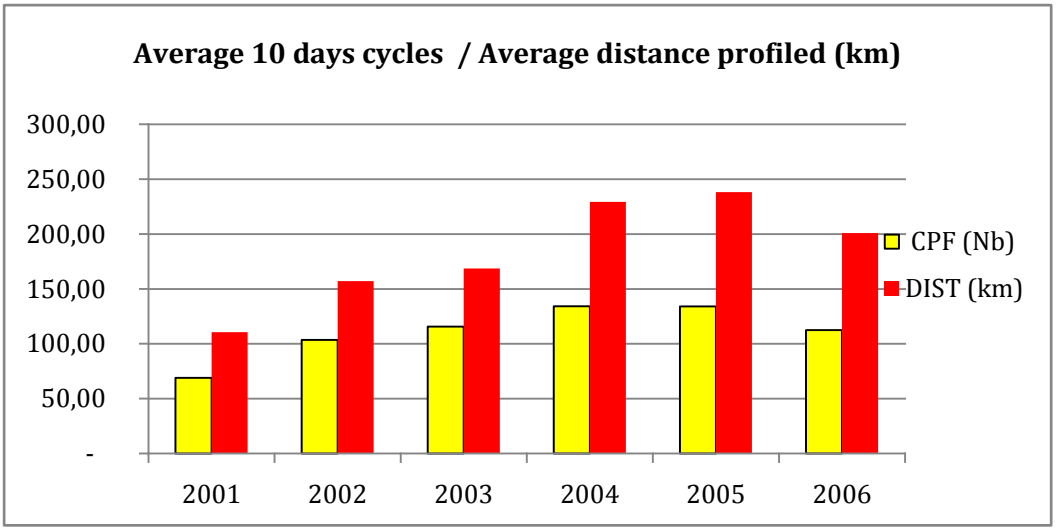
Some simple statistics were added to the float search engine following suggestion by AST co-chairs:



	Status	WMO ID	Telecom ID	Model	Program	Date	GDAC	GTS	Age
1		5900713	34636	APEX	Argo PMEL	18/03/2010			1889
2		5900714	35596	APEX	Argo PMEL	19/03/2010			1888
3		5900715	35600	APEX	Argo PMEL	20/03/2010			1888
4		4900623	59016	APEX	Argo PMEL	22/03/2010			1616
5		5900717	35602	APEX	Argo PMEL	18/03/2010			1877
6		5901025	59015	APEX	Argo PMEL	15/03/2010			1559
7		5900719	35607	APEX	Argo PMEL	21/03/2010			1878
8		4900585	35611	APEX	Argo PMEL	18/03/2010			1902
9		4900586	35618	APEX	Argo PMEL	18/03/2010			1902
10		4900587	35620	APEX	Argo PMEL	20/03/2010			1903

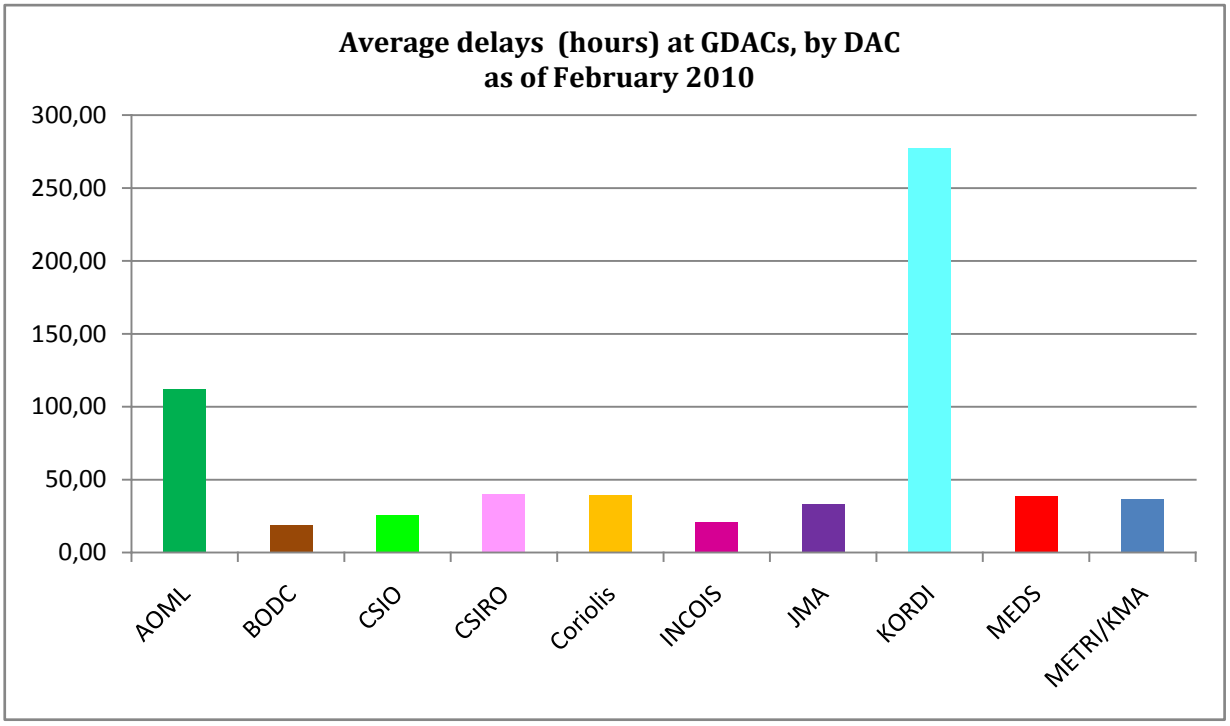
e.g: 2005 PMEL floats have made in average 162 cycles, have profiled 257 km, produced 152 profiles per float ...

Such statistics will be exploited further, as shown in the monthly report:



To be noted that the values of the "distance profiled" have to be taken with caution as many operators declared a default profiling depth of 2000m while the float is not going so deep in average. So values may be a bit optimistic.
This is being fixed gradually.

Coriolis GDAC has improved its detailed index file so that delays can be measured properly:
ftp://ftp.ifremer.fr/ifremer/argo/etc/argo_profile_detailled_index.txt.gz



To be noted by the way that the average delay for an observation to reach the GDACs (the users) was 81 hours in February. This delay is 20 hours for GTS distribution.

Argo & Google Ocean

The Google earth Argo layer is still under development.
The software developer at JCOMMOPS is focusing on this application.

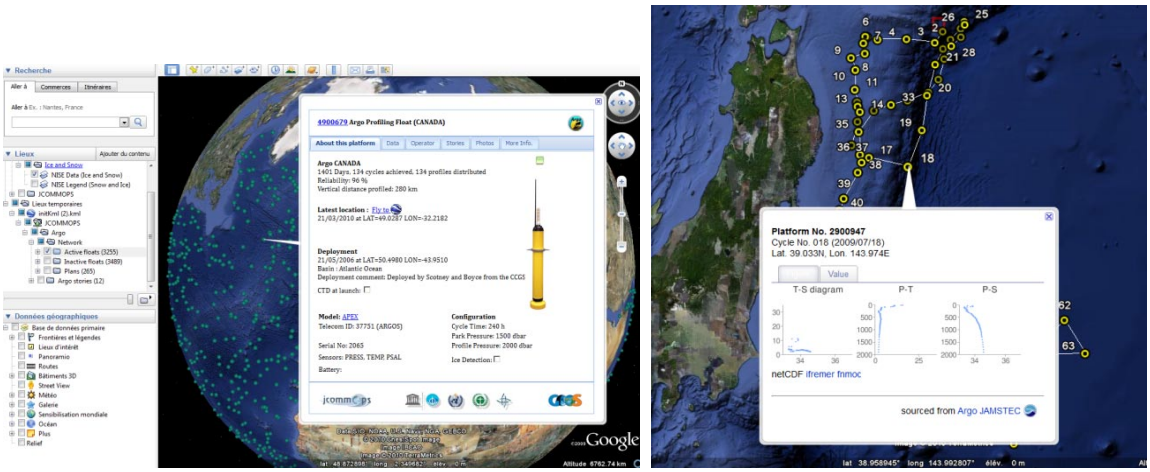
The original plan was to:

1) Provide general information on Argo via a "tour"
2) Improve the existing Argo balloon for the 3000 floats
3) Include T/S/Anomalies monthly (Argo only) products at key levels
4) Tell stories on ocean state, oriented on climate issues

The general KML is generated on the fly and includes:
Active Floats/Inactive Floats/Deployment Plans/Float Stories
http://www.jcommops.org/jcommops-kml/WebObjects/jcommops-kml.woa/wa/initKml?prog=argo

The Argo balloon is displayed when user click on a float or directly using the following link, or the Argo toolbar:
http://www.jcommops.org/jcommops-ptf/WebObjects/jcommops-ptf.woa/wa/wmoKml?code=4900587&prog=Argo

Content is also generated on the fly.



The first tab **"About this platform"** contains general information about the float, its status and provides access to the trajectory (generated by JAMSTEC web services) which allows a quick view on individual profiles distributed at GDACs, and use of text data.
Latest profile plot is provided by JMA.
The link to the Argos trajectory data (with ellipses of errors) will be added soon here:

The second tab **"Data"** aims to include GDACS and DACs products about the float data, and also global diagnostic tool such as the Altimetry QC stats from CLS/Coriolis or Surface pressure plots from CSIRO. Whenever the diagnostic page is an image, it is included directly in the balloon, otherwise the link is displayed.

The third tab **"Operator"** aims to give visibility to the float operator initiative, agencies and people involved, and offer another set of diagnostic plots and links.

E.g.: A float operated by SIO has data products at GDACs, DAC (AOML), SIO, and in misc. websites. This balloon gives a single point of access for all this information.

The fourth tab **"Stories"** includes the float of the month stories maintained by the Project Office.

The fifth tab **"Photos"** includes a slideshow for deployment photos if any. These photos are stored in the http://picasaweb.google.com/JCOMMOPS/Argo# Argo album. Just add a proper "tag" with the WMO id.
Try with http://www.jcommops.org/jcommops-ptf/WebObjects/jcommops-ptf.woa/wa/wmoKml?code=7900233&prog=Argo

The last tab **"More Info."** provides additional info, legend for pictures, acknowledgements, copyrights, etc.

The Argonauts are invited to comment and make suggestions on the beta version.

The AIC has made a tour of all Argo websites to gather the links that permit to include the diagnostic plots in the balloon.
Please keep the AIC aware of your developments and changes.
All these links can be found here:
http://wo.jcommops.org/cgi-bin/WebObjects/Argo.woa/wo/Weblink_List.wo
select "Platform Diagnostic Pages" on the popup menu.

AIC website audience

The website audience has dropped by 15% in 2009 compared to 2008.
It is interesting to note that this audience has decreased with users from Americas (-15%) or Europe (-30%) or Asia (-9%) but it has increased in Oceania (+8%) and Africa (+32%).
To be noted that the "float of the month" audience has decreased by 30% so it is needed to promote it more widely. An email to the Argo general mailing list would be good each time a float story is added.

ADMT#10Meeting Action List:

1) Calculate time delay for getting RT/DM files onto the GDACS. Investigate files slowly arriving
- ⇨ RT Done. See charts and maps in monthly report
- ⇨ RT Done also for GTS data
- ⇨ Detailed stats on DM profiles processing included in monthly report

2) Study how to keep information on sensor failures (Greylist)
- ⇨ To be discussed with T. Carval.

3) Investigate on the content of the existing netCDf metadata files and make suggestions for improvements.
- ⇨ Target ADMT11
- ⇨ Right timing as the AIC meta-database is being redesigned

3. International Issues

e-Notification

For all equivalent floats an additional note will be attached to the electronic notification:

"The owner of this float has agreed to share data within the Argo data system, and the Argo Information Centre tracks this float for information and can provide some support if needed. However this profiling float was not deployed under the aegis of the international Argo program, and may not comply with Argo best practices."

Bilateral Notification

The AIC set up a routine system for assisting USA to notify floats that might drift into Argentinean, Peruvian and Turkish EEZs.
See: http://argo.jcommops.org/FTPRoot/Argo/EEZ/

Every day, any group of floats entering into a predefined area (EEZ + 100 nm) is listed with key metadata. The list can be attached to a template notification letter to be sent bilaterally.

⇨ Such system can be adapted for any country and any maritime zone.

But it appears to not be practical on the long run (ask feedback from US Argo).

Beached Floats
The design of the "large Argo label" has been slightly reviewed to show the red symbol "DO NOT OPEN".
Manufacturers were invited to order directly labels to the printing company.
Scripps will send a new pack of "small Argo label" to the AIC.

It was decided to restrict the use of the Argo label for some equivalent floats.
An appropriate written note will be sent to the manufacturers.
In particular all future NAVOCEANO floats won't be equipped with the Argo label.

Official Argo program PIs are invited to seriously feedback on pending issues.
The AIC has the role to inform PIs on the status of their beached floats, provide instruction to secure the floats to local people, and thank them for their assistance.
In any case the retrieval procedure as to be driven by the PI unless specific instructions are provided to the AIC.

Note that NOAA has provided the AIC with a stock of "Atlas of the Ocean" to be sent in return of the help received to secure the floats.
We could improve this package with some more material.
Any suggestion and offer from an AST member country will be welcome.

We have seen a number of redeployment of beached floats by local individuals or local oceanographers.
When the redeployment is successful we have to have a new float record in term of tracking and data distribution (with a new WMO Id).
Why not then reclassify the float under the nation that helped to secure and redeploy the float**.**

This would permit to:
- Thank the nation that helped Argo
- Extend the international support to Argo
- Humanize the observing system by telling the related stories
- Transfer the responsibility in case of new beaching
- Keep statistics clean at the AIC. Such new deployment would increase artificially the number of float funded for a given program/country.

⇨ **The AST is invited to feedback on this suggestion.**

Donor Programmes

Kenya: The 5 floats have been successfully deployed by US Navy. End of the story.

Gabon: One of the most successful cooperation so far, thank to US Argo.
- 3 floats shipped in Gabon
- Workshop set up to explain how to deploy floats and raise a national Argo program
- 3 floats successfully deployed by Navy

- Donation celebrated at Foreign Affairs Minister in presence of high profile people with full media coverage.
- 2010 Training Workshop (in French) for west African countries being prepared with US Argo, US Navy and Argo France.

⇨ Main difficulty for the future: lack of physical oceanography cursus at University.

Morocco:
- Float donation by France celebrated at JCOMM III.
- Contact established with Met Services and deployment planning being set up;

Colombia will celebrate this year the 200th anniversary of its independence and a number of events will be celebrated. In particular it was proposed by the Colombian Commission for Oceanography to deploy some floats as part of maritime events. Colombia is a strategic place within South America with an access both on the Pacific and Caribbean regions.

Peru, Ivory Coast, Indonesia, Cape Verde, Sri Lanka, Togo, and Rep. Dominican are waiting for a donor programme.

Contacts have been established with **Seychelles** authorities to facilitate float deployments within its EEZ (by Australia) and evaluate the potential deployment opportunities.

4. Planning

Beyond AIC routine activities, and AST/ADMT suggestions and action items, planning for 2010 can be summarized as follow:

- Continue to produce/improve the AIC Monthly Report
- Ensure at least a report every two months
- Continue to encourage/assist float operators to notify of deployment plans.

- Finalize the Google Ocean Argo Layer
- Finalize the design of the new database
- Set up synchronisation with main data sources (Argos, GTS, GDACs)
- Fix the issue of Iridium float tracking
- Set up a new GIS server
- Start developments of new web services

- Exploit further detailed index files to develop appropriate monitoring tools

- Work (with AST and JCOMM) on new monitoring products demonstrating how Argo is meeting its requirements.
- Work with Y. Desaubies on Argo issues

- Continue to assist in the float retrieval activities
- Continue to foster participation by new countries through donor programmes

- Work with Y. Desaubies on JCOMMOPS issues
- Work with IOC to renew the MoU with host
- Investigate possibilities to strengthen JCOMMOPS resources with (ship coordinator) via discussions with GOSHIP, CCHDO.

Argo Australia – 2009 Activities

Report to the Argo Steering Team

Susan Wijffels, Ann Thresher
The Australian Center for Atmosphere, Weather and Climate Research: a joint partnership between the Australian Bureau of Meteorology and CSIRO

Esmee Van Wijk
Antarctic Climate and Ecosystems Co-operative Research Centre, University of Tasmania

1. Status of implementation

Floats deployed and their performance

Australia currently has 249 active floats distributed across the Indian and South Pacific Oceans (Figure 1)

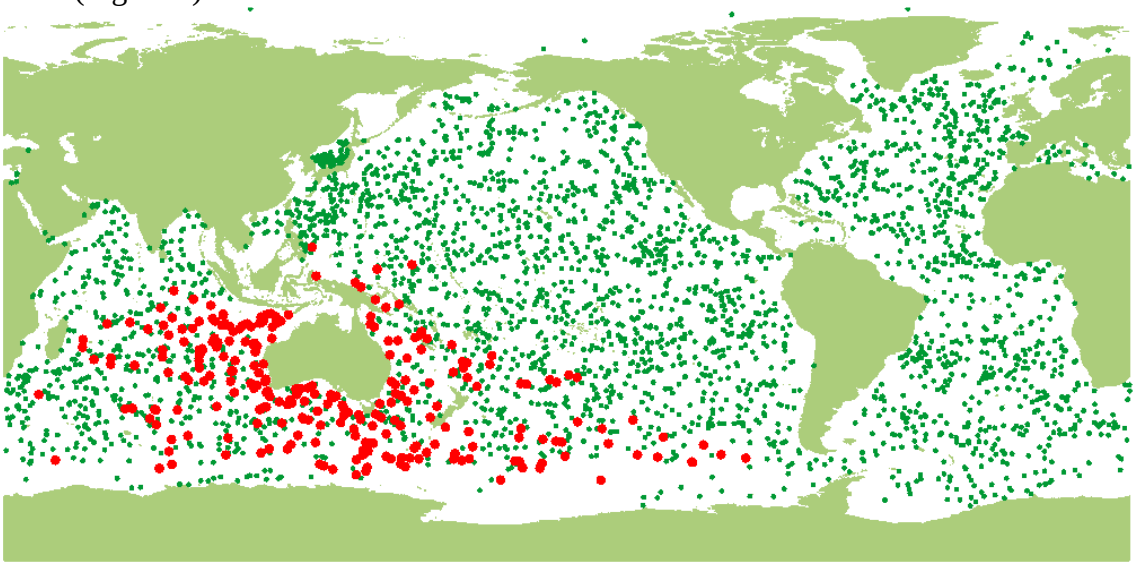


Figure 1: Locations of active Argo Australia floats (red) with active international floats in green (Argo Information Centre, March 2010).

Due to the deployment suspension associated with the Druck pressure sensor microleaks, Argo Australia deployed only 35 floats in 2009 (down from 81 the previous year). However, as floats became available again near the end of 2009, deployments are rapidly catching up, with 33 already deployed since January 2010.

Of the 35 deployed in 2009, 16 are equipped with Iridium transmitters and the rest had standard Argos transmitters, reflecting a move towards the increased use of Iridium communications to about 50% of new acquisitions. Ice-avoidance algorithms are active on 9 of these, with 4 deployed in the seasonal ice zone as a result of a one-off expansion in funding. Nine of this 2009 cohort are equipped with oxygen sensors (Optodes). Due to the lack of vetted Druck pressure sensors, we also took the opportunity to pilot the use of Kistler pressure sensors, deploying 7 floats off the repeat CLIVAR line along 32°S. So far, this cohort appears to be returning sensible data with little sign of surface pressure drift.

Argo Australia uses APEX floats manufactured by Teledyne Webb Research Corporation. When re-equipped with lithium batteries and carefully tested and inspected before deployment, APEX appear to be able to deliver well beyond the anticipated 3.5 years of useful life.

Securing deployment opportunities into array gaps in our region is becoming a key focus of the program. This year we partnered with the US and New Zealand programs to secure deployments of both US and Australian floats into the South Indian and Great Australian Bight (over 50 floats were deployed last month). We also took advantage of US repeat hydrographic activity in the South Pacific to deploy floats out of Brisbane with high-quality CTD data taken on deployment. These floats are equipped with a new pressure sensor (Kistler) which will be assessed for stability and accuracy, informing the global program in the face of difficulties with the current sensor (Druck).

Float Failure Analysis

As of the end of January 2010, Argo Australia had deployed a total of 293 floats. Of these, 49 are dead, 6 are suspect and 3 are returning bad data. Of these dead floats, only 9 ceased to operate due to 'natural causes' – that is, they ran down their battery packs. Most floats have died prematurely due to various environmental factors or failure modes.

Based on the sensor and technical data from the dead floats, we find that environmental factors are the biggest cause of float failures, including loss in the ice zone and groundings (see table below). We anticipate that as ice-avoidance algorithms are refined and with the broader adoption of Iridium communications reducing surface times drastically, the frequency of these failures will go down.

Summary of float failure mode (excluding those caused by natural causes i.e. end of battery life)	**Number of floats***	**% of dead floats***	**% of total floats***
Environmental factors (grounding/ice)	18	44	6
Hardware faults	7	17	2
Software issues	7	17	2
Human interference/error	4	10	1
Unknown	5	12	2
Total	41	100	14

*** only floats in the Australian array are included in this analysis**

Environmental category includes loss due to grounding and ice.
Hardware faults includes: motor backspin, leaking air bladder, failed potentiometer, transmissometer leak.
Software issues include: firmware bugs.
Human interference/error includes: floats turned on too early, picked up by fishermen.

Technical problems encountered and solved

The program was greatly impacted by the recall of the Druck pressure sensors. We also thank Dana Swift (University of Washington) for diagnosing this serious problem. We appreciated the prompt action of both the sensor and float manufacturers in alerting the community to this problem, working through its solution in a transparent manner. A pilot deployment of 7 floats with Kistler pressure sensors by Argo Australia in the South Pacific may help in assessing this alternative to the Druck sensor.

As our use of Iridium APEX floats is set to rise sharply we are closely tracking their performance. Of 36 deployed, 1 is leaking and 3 show incomplete or corrupt data.

2. Status of contributions to Argo data management

The program has been working with the Indian Argo program around adoption of the Australian realtime data processing software (http://www.marine.csiro.au/~gronell/ArgoRT/). This year, the Argo Australia delayed-mode system will also be tested and possibly implemented by India.

An analysis and correction of pressure drift errors in the global data set as available at the end of 2008 has been completed and submitted to the Journal of Atmospheric and Ocean Technology. This 'bias free' data set will be made available to the community once the paper has passed through peer-review (second-half of 2010).

3. Status of delayed mode quality control process

Comprehensive documentation of float data and quality control is available at:
http://www.cmar.csiro.au/argo/dmqc/index.html

Of the eligible files, Australia has processed and submitted about 80% in delayed-mode. Full implementation of the global Argo reference data set and the Owens and Wong drift correction software is needed to complete the DMQC processing for the cohort of floats that display salinity drift.

Processing software was adapted to properly treat the Truncated Negative Drifting Pressure floats (APF8's are categorised into 3 types depending on the serial number and anomalous data checks). All Australian floats have been corrected for pressure drift (where possible), except the small number requiring salinity drift correction (these will be corrected over the coming months).

Of the 260 Argo floats assessed in DMQC, we find impressive salinity sensor performance – see Figure 2. Most float sensors do not show salinity drift (78% - Figure 2, top panel), 11% show drift after several years of profiles (Figure 2-middle) and 11% show drift from deployment onwards.

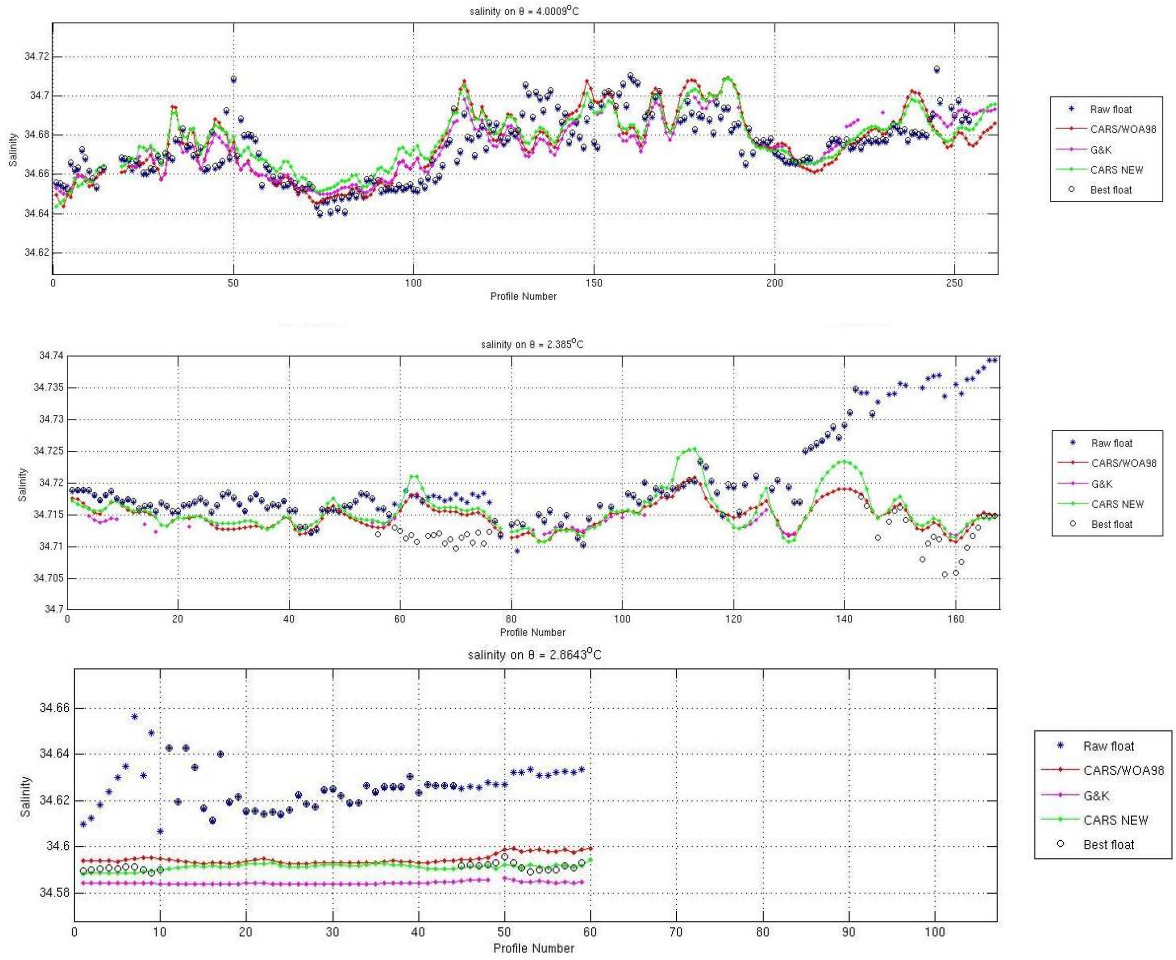


Figure 2: Salinity on a deep potential isotherm in 3 representative floats. Top – example of a float that does not drift after over 6 years of operation; Middle – typical example where drift arises after 100 profiles or so; Bottom – example where drift exists from deployment.

4. 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 National Collaborative Research Infrastructure Initiative (NCRIS). Through IMOS, and if levels of support from our participating partners remains steady, Argo Australia will sustain deployments of 50-60 floats pre year and maintain an array of around 220-240 active floats. The NCRIS phase of IMOS was funded through June 2011. In early 2009, the Australian government announced an extension and slight expansion of IMOS via a new funding scheme, the Education Infrastructure Fund (EIF). This funding began in July 2009, and thus IMOS received a rapid injection of funds. Argo Australia was thus awarded funds to acquire and deploy an extra 40-50 floats in addition to its normal acquisition of ~50 floats before June 2010. Combined with the halt in float shipments due to the Druck pressure sensor recall, this presented a great challenge to the program. However, working with international partners and the manufacturers it appears the program will have acquired and deployed most of EIF-funding enhancement floats before June 2010 as required. EIF funding for Argo Australia is now secured through June 2013, and providing partner contributions remain

steady (CSIRO, Australian Bureau of Meteorology, Department of Climate Change), the program will remain funded at the level of 50-60 float deployments per year.

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

Argo Australia currently has over 95 floats either in the lab or on order. A further order for another 50 will go in shortly, completing our purchasing for 2009/10 and most of 2011. This map shows where deployments are planned for these floats.

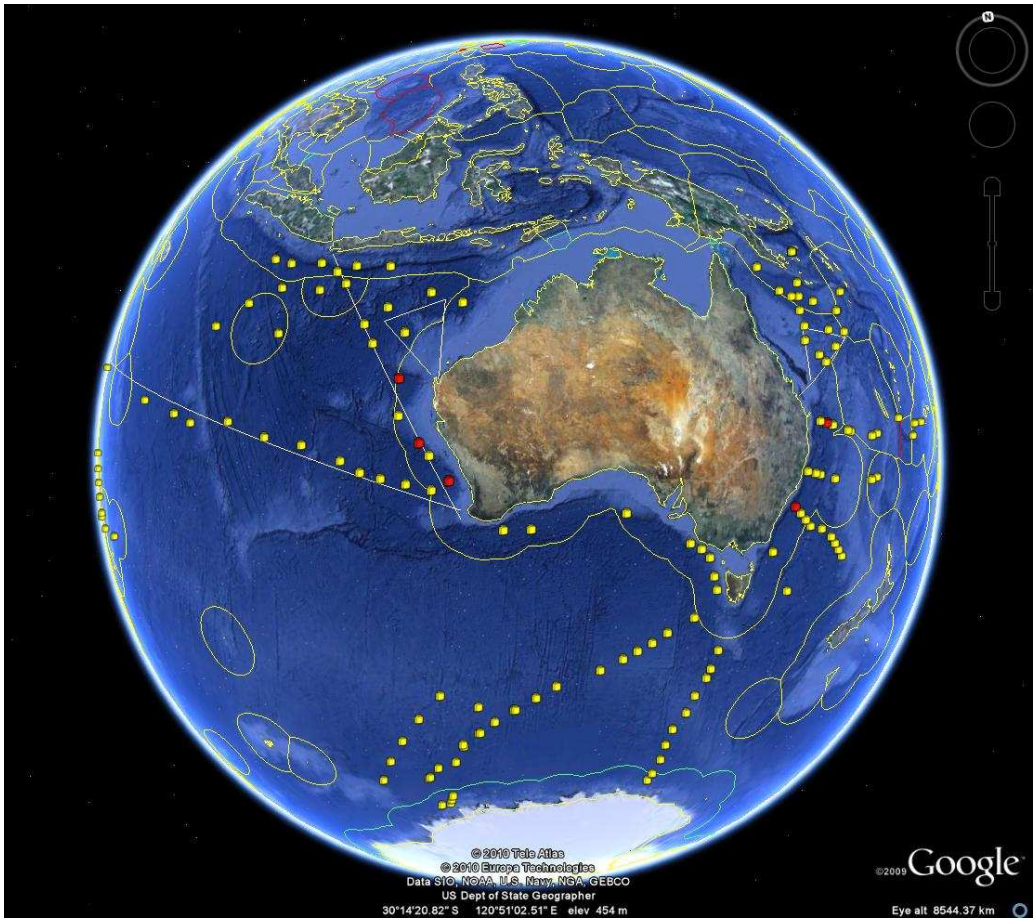


Figure 3. Locations of planned float deployments over the next year – red dots are IMOS2 oxygen floats still on order.

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

- Argo data are routinely used in the operational upper ocean analyses of Neville Smith at the Australian Bureau of Meteorology (http://www.bom.gov.au/bmrc/ocean/results/climocan.htm). These analyses are also used to initialize an experimental seasonal rain forecasting system.
- The dynamical seasonal forecasting system POAMMA heavily uses Argo data – 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. Ocean forecasts and reanalysis products are now routinely published and are available via the Bureau of Meteorology website or the PI (www.marine.csiro.au\~griffin): David.Griffin@csiro.au

- Many students in the CSIRO/University of Tasmania graduate program are utilizing Argo data in their thesis studies. It's use is becoming widespread for studies of subduction in the Southern Ocean (Sallee, Sloyan, Rintoul), generation of modern era climatologies (Ridgway and Dunn), ocean warming and its role in sea level rise (Church, Domingues, Wijffels, Barker), in ocean observing system studies (Oke and Schiller), Ocean salinity changes (Durack/Wijffels)
- Developing model-based gridding techniques to produce an Argo-gridded data set (Dunn, Oke, Wijffels) and a new global Argo climatology

6. Issues to be raised with the Argo Steering Team

Pressure Bias Corrections: We congratulate the DACs in making progress in removing the pressure errors in float data where possible and report floats with unknown pressure errors to the GDACs so that a list of these are available to users. We urge them to complete this task as soon as possible so that Argo may be confidently be used to track the evolution of the global ocean heat content.

Canadian National Report on Argo-2009

1. Status of implementation (Major achievements and problems encountered in 2009)

1.1 Floats deployed and their performance

During 2009, Canada deployed 25 floats: all were APEX floats and of these 14 were deployed in the Atlantic and 11 in the Pacific. Significant financial support from the Canadian Ice Service, Environment Canada permitted enhanced coverage of the northern Labrador Sea and the Bering Sea. We are also grateful to the Russian Argo Program and the Rusalca Program for the opportunity to deploy floats in the Bering Sea from a vessel known variously as the Professor Khromov and the Spirit of Enderby and assistance from the Canadian Department of National Defence for deployments from HMCS Protecteur. As of writing in February 2009 three floats seem to have failed with the rest continuing to supply good data. The three failures appear to be associated with catastrophic failures in the pressure sensors. These were all floats that were NOT returned to the manufacturers following the recall in 2009. The risks involved were known and a calculated risk was taken. Similarly the three floats deployed from HMCS Protecteur were also deployed without using the recall of floats. These now have completed 23 or 24 profiles, about the same number as completed by the three Atlantic floats prior to their catastrophic failures.

The Atlantic effort focussed on the Slope Water and Labrador Sea. The Pacific effort included deployments in the Gulf of Alaska and the Bering Sea. The assistance from Russia, and especially help from Dr. Slava Lobanov at the Pacific Oceanological Institute is greatly appreciated.

1.2 Status of contributions to Argo data management

ISDM (formerly MEDS) continues to acquire data from 120 active Argo floats. Data are issued to the GTS and GDACs every 6 hours. We increase the frequency of acquiring data from the Argos server to hourly if we fail to access the system at a specific 6 hour interval. On average 83% of 2009 data were issued to the GTS within 24 hours of the float reporting. ISDM has been transmitting Argo data in BUFR format under header IOPX02 since January 19, 2009. We regularly receive Argo BUFR from others data centers. During 2009, we set up the decode software for Argo floats with APF9 controller and floats with Aanderra Optode Oxygen sensor. The software to generate technical NetCDF was changed to the current format approved by ADMT. We also modified our system to be able to handle 6 digits Argos number.

Our website, http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/index-eng.html, is updated daily automatically. The website is currently in the process of moving to CLF2.0 to be compliance with Treasury Board requirements.

Routines for delayed mode quality control of pressure were written at the end of 2009. The whole delayed mode quality control system was redesigned to allow re-flagging of raw data in delayed-mode and implement the pressure adjustments prior to control of salinity.

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

During 2009 the Canadian Argo program was primarily funded as a research effort. It has been our early intention to move funding to a more routine or operational basis but that has not yet occurred. We are continuing to pursue this. The funding in 2009 including the much appreciated contribution from the Canadian Ice Service was adequate to maintain and slightly enhance the Canadian contribution to the international effort.

Funds to purchase floats typically appear very late in our fiscal year and at the moment we know we will have 28 floats available for launch starting March 31st, 2010.

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

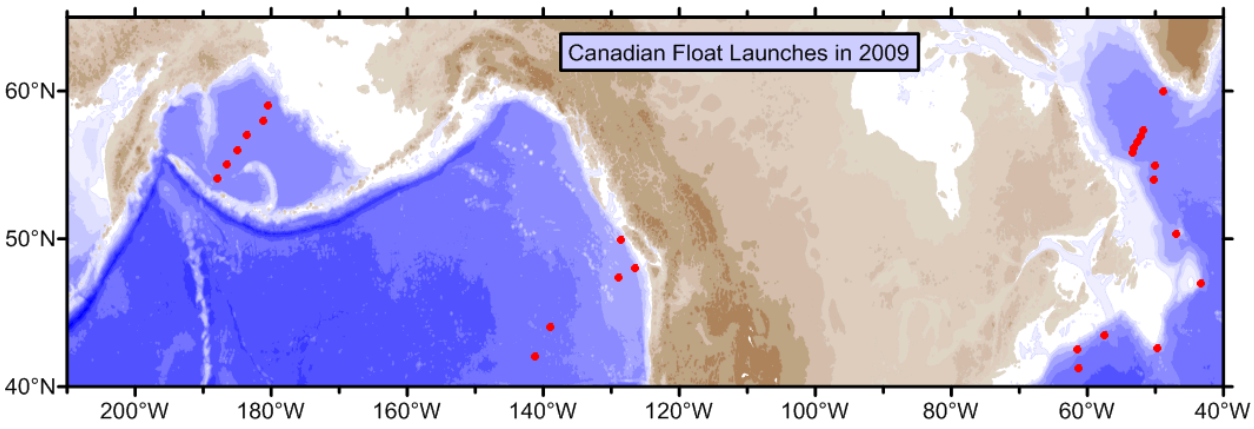
Detailed deployment plans are not yet known as it was only very recently that it became known how many floats we would have on hand. We expect to deploy 14 floats in each of the Atlantic and Pacific sectors with deployments biased towards the far northern regions of both oceans, with most going into the Bering and Labrador Seas.

4. Issues that Canada wishes to be considered and resolved by AST regarding the international operation of Argo.

The delivery of delayed mode, quality controlled Argo data to GDACs has improved significantly in the past 12 months. Despite this, we believe that there is still some room for improvement in the timely delivery of delayed mode data.

Appendix – summary of Canadian float launches during calendar 2009.

	Launch Date	WMO-ID	Comms	Ocean Basin	Launching Vessel	Still Operating?
1	13/04/2009	4901109	Argos	A	Hudson	Yes
2	28/04/2009	4901110	Argos	A	Hudson	No Catastrophic P error on 30th profile.
3	16/05/2009	4901128	Argos	A	Hudson	Yes
4	20/05/2009	4901130	Argos	A	Hudson	Yes
5	19/05/2009	4901131	Argos	A	Hudson	Yes
6	21/05/2009	4901111	Argos	A	Hudson	Yes
7	22/05/2009	4901133	Argos	A	Hudson	Yes
8	24/05/2009	4901127	Argos	A	Hudson	Yes
9	24/05/2009	4901126	Argos	A	Hudson	Yes
10	25/05/2009	4901125	Argos	A	Hudson	Yes
11	25/05/2009	4901124	Argos	A	Hudson	No Catastrophic P error on 27th profile.
12	25/05/2009	4901123	Argos	A	Hudson	Yes
13	31/05/2009	4901129	Argos	A	Hudson	Yes
14	27/06/2009	4901106	Argos	P	Protecteur	Yes
15	29/06/2009	4901107	Argos	P	Protecteur	Yes
16	29/06/2009	4901108	Argos	P	Protecteur	Yes
17	14/07/2009	4901132	Argos	A	Teleost	No Catastrophic P error on 22nd profile.
18	21/09/2009	4901121	Argos	P	Tully	Yes
19	22/09/2009	4901122	Argos	P	Tully	Yes
20	03/10/2009	4901113	Argos	P	Spirit of Enderby	Yes
21	04/10/2009	4901115	Argos	P	Prof. Khromov	Yes
22	04/10/2009	4901114	Argos	P	Prof. Khromov	Yes
23	05/10/2009	4901116	Argos	P	Spirit of Enderby	Yes
24	05/10/2009	4901119	Argos	P	Spirit of Enderby	Yes
25	05/10/2009	4901120	Argos	P	Spirit of Enderby	Yes



The 11th Argo Steering Team Meeting, Scripps, March 23-25, 2010

China National Report for the AST-11

(Submitted by Jianping Xu)

The Second Institute of Oceanography, SOA

1. The Status of implementation (major achievements and problems in 2009)

1.1 Floats deployed and their performance

China Argo deployed 15 Apex profilers through 2 cruises in April and July 2009 respectively in which 6 were APF-8C and 9 APF-9A. All the floats were deployed in the western Pacific Ocean near the Luzon Strait. Two of them are equipped with Aanderra Optode. By the end of 2009, China has deployed 66 Argo floats, and 31 are still in normal operation.

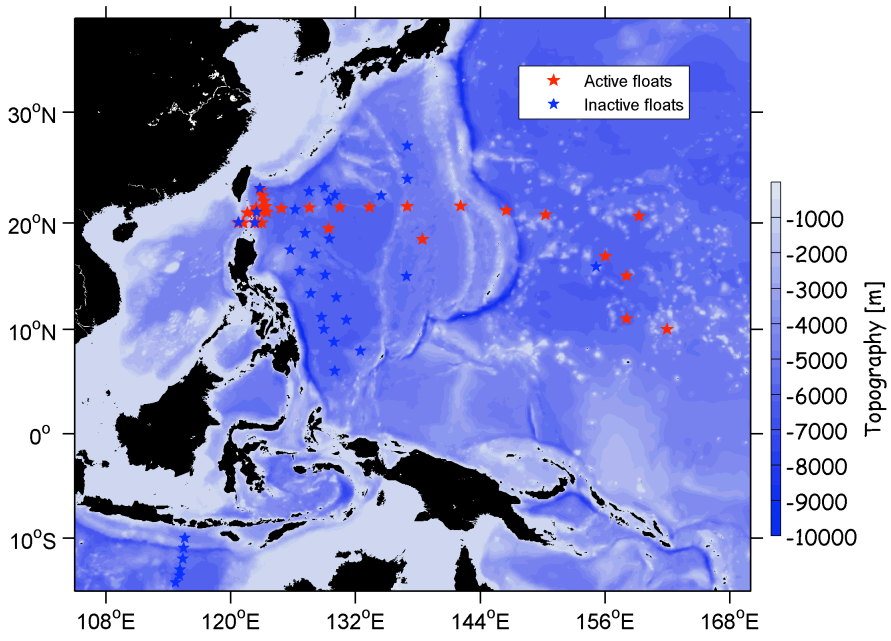


Fig.1 The launch positions of profiling floats during 2002-2009.

A float (WMO ID: 2901153) was retrieved by chance by a Philippine fisherman in the vicinity of 20.30ºN, 121.50ºE near the Batanes Island on June 29, 2009. After replacing the damaged fitting that connects the conductivity sensor and the outside tube with a new one provided by TELEDYNE Webb Research, the float was redeployed by Philippine fishermen.

1.2 Technical problems encountered and solved

Most of the APF-8C profilers deployed in last 2 years encountered TNPD problem, but their T/S measurements didn't show significant anomalies. Due to the Druck microleak problem, we sent back 40 Apex profilers for transducer replacement after Sea-Bird announced a recall of SBE41 and SBE41 CP CTDs on Argo floats.
The technicians from the China Argo Real-time Data center installed lithium battery packs in 2 Apex floats this year, and both of them have sent back observations.

1.3 Status of contributions to Argo data management

The China Argo Real-time Data Center processed over 1,154 profiles from 38 floats this year. All the data were submitted to GDACs within 24 hours after collection through RTQC, and were inserted into GTS at CLS.

1.4 Status of delayed mode quality control process

A total number of 2,357 D-files which accounts for 68% of all the profiles have been submitted to GDACs. OW tool is used to correct salinity drift. The difficulty in DM salinity correction lies in the fact that some of our floats are drifting along the western boundary current (the Kuroshio) resulting in variable salinities. Sea Surface Pressure correction hasn't been implemented yet.

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

China Argo deployment is mainly funded by the Ministry of Science and Technology (MOST) and the State Oceanic Administration (SOA). About 100 Argo floats for the next 2-3 years have been funded, in which 50 floats are from the Second Institute of Oceanography, and another 50 floats (purchased at the end of 2008, and to be deployed in the first half of 2010) from the East China Sea Branch, SOA. However, the present support to float deployment is still from some research programs.

3. Summary of deployment plans

Due to Druck microleak problem, 40 floats were returned and another 10 floats' delivery was delayed in 2009, so there will be more floats to be deployed in 2010. We are designing a special cruise for Argo deployment, and more than 40 Argo floats (including 12 iridium floats) will be deployed in the Western Pacific warm pool (see Fig.1). The lack of deployment opportunities in the open oceans is one of the difficulties we encountered in recent years.

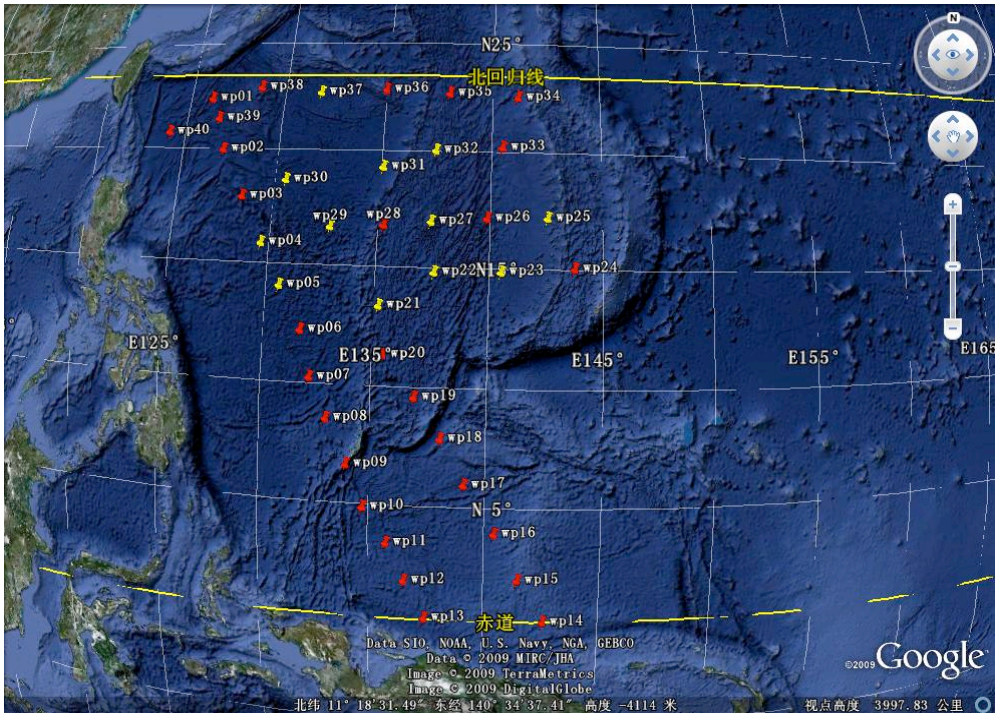


Fig.1 The designed launch positions of Argo floats. The red pins are floats using Argos satellites, and yellow pins are iridium floats.

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

National Marine Data & Information Service (NMDIS) has developed a 23-year regional reanalysis product of temperature, salinity and currents for the China coastal waters and their adjacent seas named the China Ocean Reanalysis (CORA) using Argo, CTD, BT, SSHA and SST data. This release of reanalysis covers a period from

January 1986 to December 2008, with a time span of 23 years and the model area is set from 99°E to 148°E and from 10°S to 52°N, which covers the Bohai Bay, the Yellow Sea, the East China Sea, the South China Sea and their adjacent waters. The products are monthly mean fields with a spatial grid resolution set to 0.5° and 25 vertical levels.

The National Marine Environmental Forecasting Center developed a monthly product which has a horizontal resolution of $2^{\circ}\times1^{\circ}$ in the tropical Pacific Ocean. Argo data are also used in their ocean data assimilation system (http://www.nmefc.gov.cn/NewsShow.aspx?FID=20081113125648859113&CID=20081222114941699974).

The China Argo Real-time Data Center continues collecting global Argo data monthly, and implementing visual QC before releasing on the ftp server. The data are available on ftp.argo.org.cn/pub/ARGO/global/.

Report from the Data Buoy Cooperation Panel and OceanSITES project office.

Hester VIOLA, viola@jcommops.org

Data Buoy Cooperation Panel

Network Status and distribution

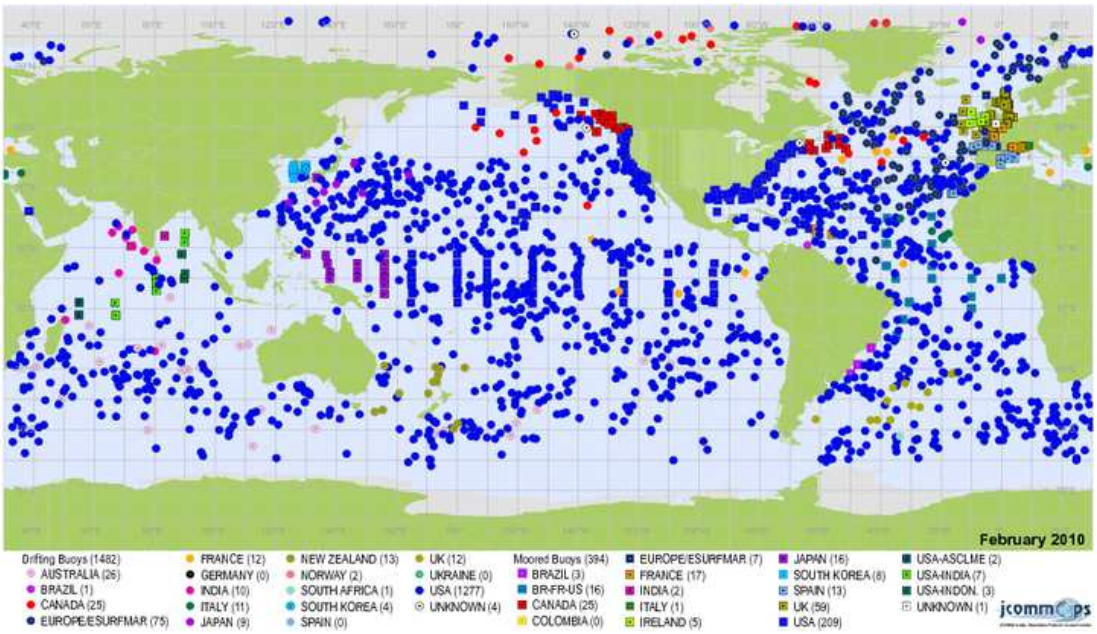
http://www.jcommops.org/dbcp/network/status

The total number of buoys globally was stable in the last year. The spread across the globe has been even apart from a recent sparseness in the eastern Pacific Ocean. For the Drifting Buoy network, the Southern Ocean and Arctic Ocean were identified as areas where deployment opportunities are needed, as well as the central and far north Pacific, surrounding New Zealand and to the west of the African continent.

Note that there are new moorings from Colombia and Brazil.

Very good coverage overall, and particular improvements in the Southern Indian and Pacific Oceans. The far Southern Ocean is still quite sparse though.

The coverage in the Arctic looks good here but the gaps in the Russian sector of the Arctic and the North west Pacific are clearly visible.



DBCP monthly status by country for February 2010. (Data Buoys reporting on the GTS via Météo-France

All Maps are visible on http://www.jcommops.org/dbcp/network/maps.html for the current month or on http://www.jcommops.org/dbcp/network/dbcpmaps.html for older maps

Use of pdf layer features for high resolution maps:

A note about the PDF versions of maps: All of the maps produced each month at JCOMMOPS are in both PNG and PDF file formats. Within the PDF files there are Layers which can be toggled on and off, for example to view certain GTS platform message types only. Some instructions on how to use this Layer function in Adobe Acrobat are available at: http://www.jcommops.org/FTPRoot/JCOMMOPSmaps-AdobeReader.doc

Interactive('Live') Maps

Links available there to Google Earth (Daily and Monthly) and Google Maps (Monthly)

- New and improved Google Earth files layers (daily and monthly updates), http://www.jcommops.org/FTPRoot/DBCP/status/dbcp_daily.kmz (daily) and http://www.jcommops.org/FTPRoot/DBCP/status/dbcp.kml (monthly)

Monthly:

- Maintained monthly dynamic map: http://w4.jcommops.org/WebSite/DBCP
- Google Earth Monthly DBCP Map http://www.jcommops.org/FTPRoot/DBCP/status/DBCP.KMZ
- JCOMMOPS Maintains a dynamic map of all JCOMM observing systems http://w4.jcommops.org/WebSite/JCOMM
- *Google Earth for JCOMM* : http://www.jcommops.org/FTPRoot/JCOMM/Status/jcommops.kmz

Daily:

- Maintained daily dynamic map (drifter trajectories for 14 days): http://w4.jcommops.org/WebSite/DBCP_RT
- Google Earth Daily DBCP MAP http://www.jcommops.org/FTPRoot/DBCP/status/dbcp_daily.kmz

Global Observations

The JCOMM Observations Coordination Group's phased-in implementation plan, is to eventually equip at least 700 drifting buoys with barometers outside of the tropics, this goal was not quite achieved this year. This July the number in the higher latitudes (above 30 degrees N/S) was ~470, compared with 485 last July. There are peaks for these regions during the summer months, due to more opportunities to deploy and a lack of ice, but this does not allow for a sustainable growth in the buoy network.
The Global Drifter Center, supported by NOAA, continues to offer the Barometer upgrade opportunity for standard SVP drifters for ~$1000 per unit (see the following URL for details: http://www.jcommops.org/dbcp/svpb_upgrade.html) to encourage buoy operators to equip drifters with a barometer.

The measurement of Mean Sea Level Air Pressure is a very important part of the observations taken from the buoy network. There was a steady growth in the number of buoys reporting Air Pressure in the last year, but a proportional decrease in percentage terms in the last few months.

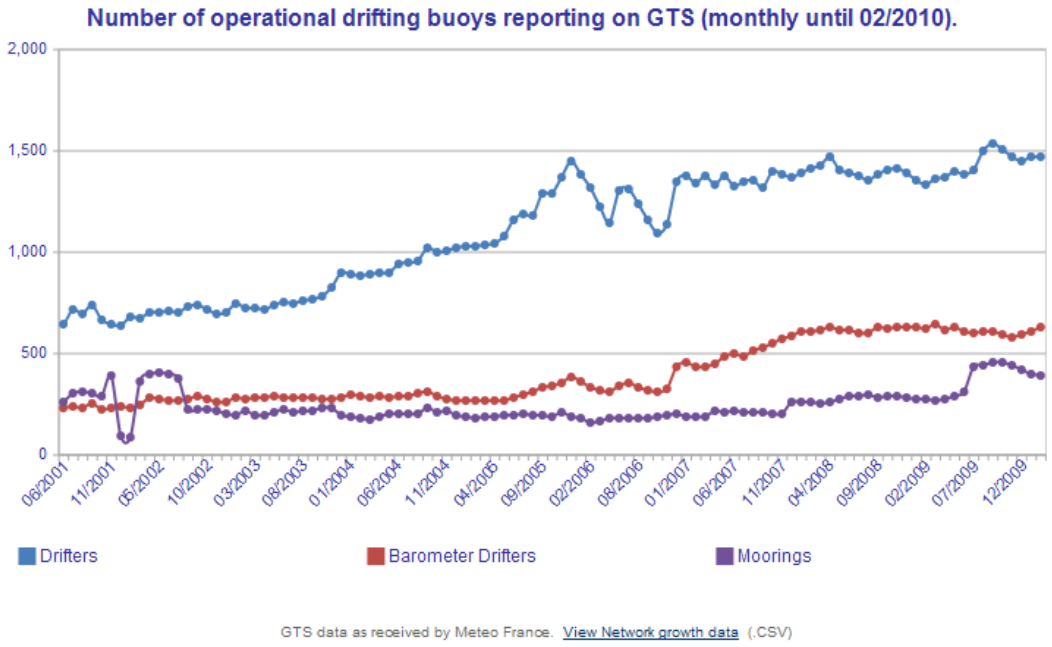
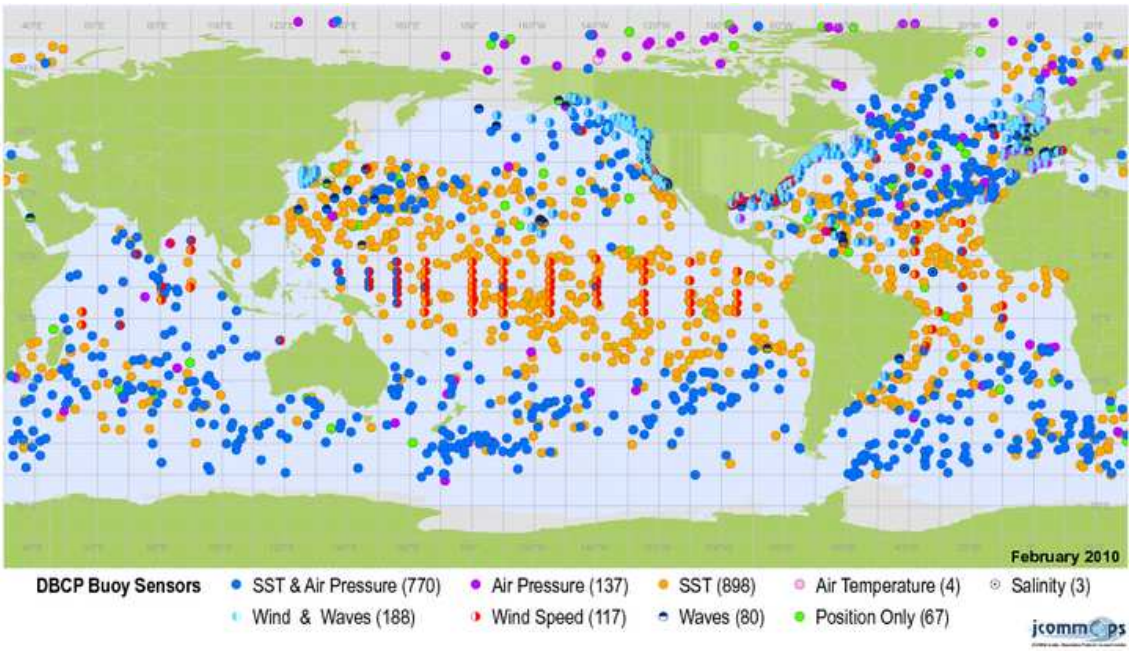


Chart of growth in the buoy network (Drifters, Moorings and Barometers on Drifters)
http://www.jcommops.org/dbcp/network/status.html



Map of the main observations on the GTS from Drifting and Moored Buoys for February 2010.

JCOMM Maps of platforms and observation types

PDF and PNG Files are accessible directly from http://www.jcommops.org/FTPRoot/JCOMM/Maps/

All in situ marine observations:
http://wo.jcommops.org/cgi-bin/WebObjects/JCOMMOPS.woa/wa/map?type=GTSM_FMT
Sub-surface salinity and temperature profiles (now included in a single map):
http://wo.jcommops.org/cgi-bin/WebObjects/JCOMMOPS.woa/wa/map?type=GTSM_SZ
All Floats, Drifting and Moored Buoys:
http://wo.jcommops.org/cgi-bin/WebObjects/JCOMMOPS.woa/wa/map?type=BUOYS
All Floats, Drifting and Moored Buoys - Polar areas:
http://wo.jcommops.org/cgi-bin/WebObjects/JCOMMOPS.woa/wa/map?type=BUOYS_POLES

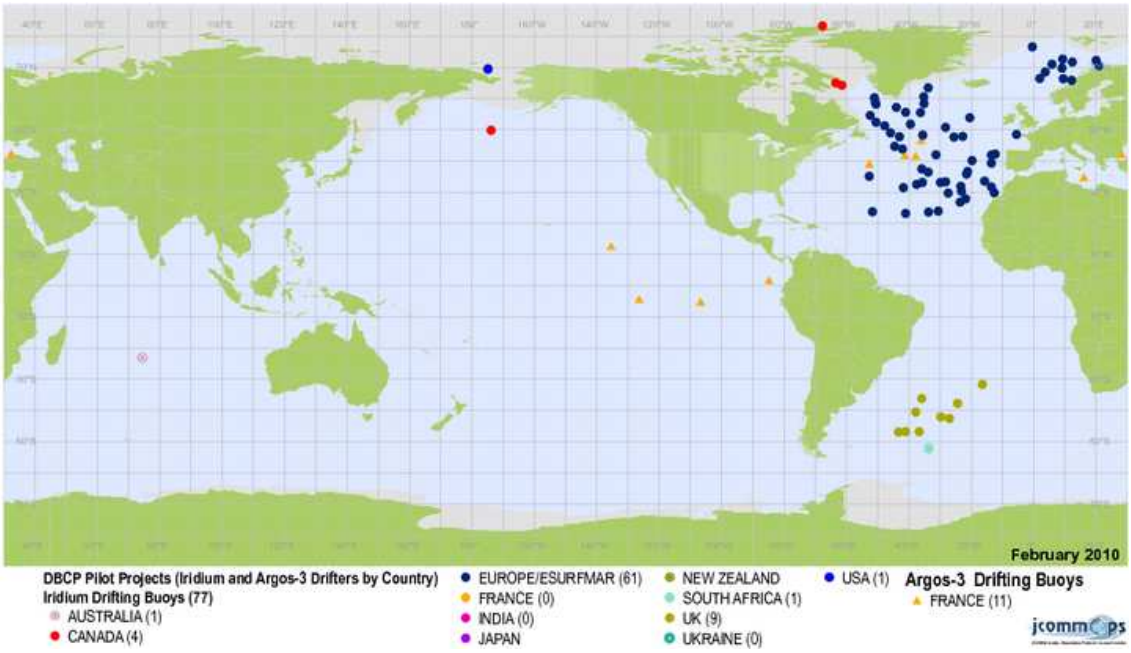
GTS Delays

- In general, the delay between observation time and GTS dissemination has decreased this year for all Argos Buoys
  - Problem areas: Central/Southern Atlantic, Southern Pacific and Mediterranean.
  - The arctic is still generally good
- Iridium Delays are insignificant – often just several minutes. The DBCP is encouraging buoy operators to use Iridium in the the Problem areas.

Pilot Projects

- While surface current, SST and Air pressure remain the core measurements for the buoy network, observations of Waves and Wind have been monitored more closely added to this map to show the lack of coverage of Wave measurements.
- There are two DBCP Wave Pilot Projects established to investigate how best to improve this situation. One using drifters with GPS to model wave motion and one to intercompare moored buoy technologies to recommend the most reliable and efficient systems for measuring spectral waves. Details at http://www.jcomm.info/wet and http://www.jcomm.info/wmd
- The panel is considering a pilot project of 'High resolution' Temperature measurements from drifting buoys in support of satellite validation and the Group for High Resolution Sea Surface Temperature (GHRSST) Science Team – Validation and Diurnal Variability WG . This will involve an initial fleet of 50 buoys with individually calibrated thermistors and GPS and a trial through the European E-SURFMAR program.
- A Pilot Project of Argos-3 buoys is underway.

Iridium Pilot Project



http://www.jcommops.org/FTPRoot/DBCP/Maps/DB_IRIDIUM.png

Seeks to evaluate the feasibility of Iridium technology for *real-time telecommunication* of drifter data

- under *various conditions* e.g. in wide temperature ranges, remote ocean areas and in rough seas, where the buoy will be frequently submerged

DBCP funds used to upgrade 50 Argos buoys to Iridium ($500 each) to be deployed worldwide

Since its inception in early 2007, the DBCP Iridium Pilot Project has seen more than 200 Iridium-equipped SVPB drifters deployed, of which approximately 80 are still active and reporting hourly data on the GTS. In order to stimulate the roll-out of the project, the Panel has from the beginning offered to cover the nominal costs (USD 500) of upgrading a traditional Argos-equipped buoy to Iridium + GPS. Overall the Panel is very satisfied with the progress of the project, both in terms of the number of platforms deployed, and the progress that is being demonstrated in reducing satellite usage costs and greatly improving data timeliness and quantity. For further information about the project, including interactive maps, refer to http://www.jcommops.org/dbcp/iridium-pp/'
The project has demonstrated that drifters can successfully use Iridium for telecommunications, though the impacts of the GPS on battery life is still to be improved and the real costs of using Iridium assessed. Low-cost telecommunications have been offered to project participants, but in future it still remains to be seen exactly how much an iridium buoy will cost. This is to be assessed in 2010 during analysis of the project results.

There are now operationally supported Iridium processing services are offered by :

CLS via the Argos System (including full real-time QC and GTS dissemination)

JouBeh (including full real-time QC and GTS dissemintion via the Canadian met service)

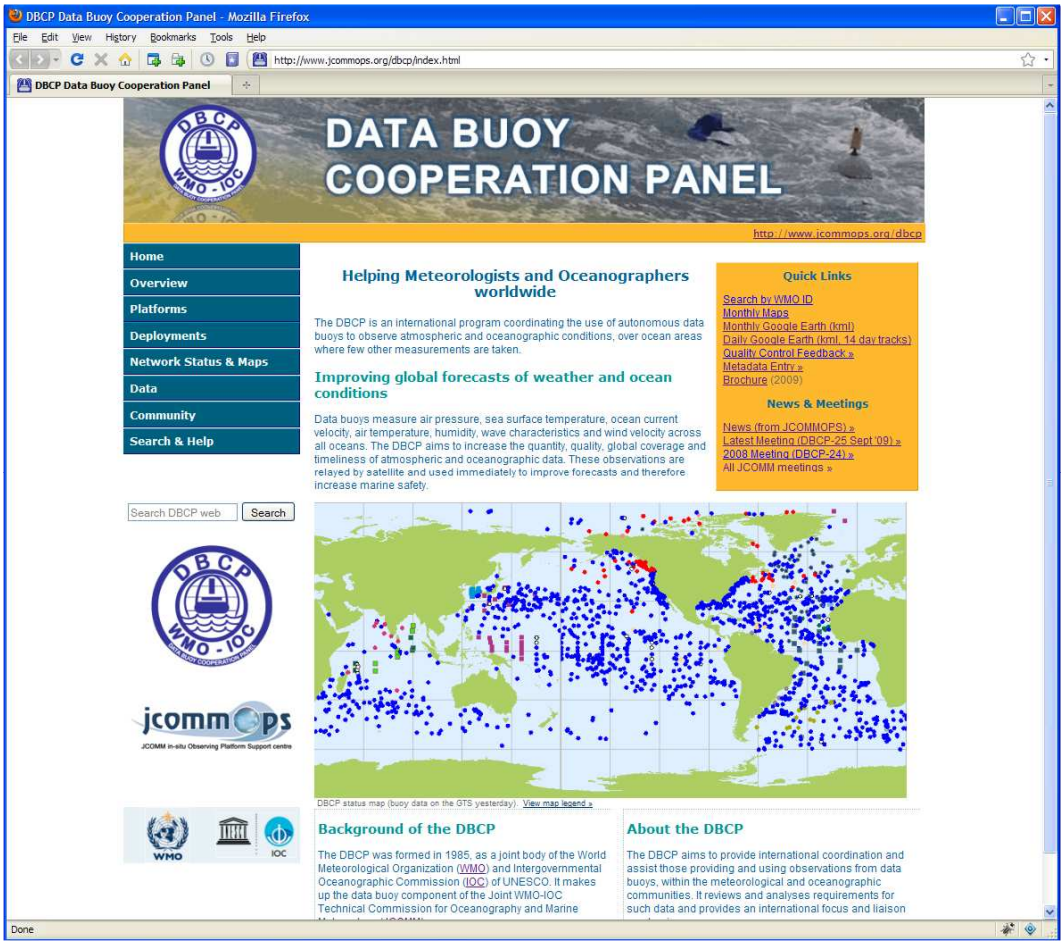
As well as many other government agencies. The costs for using the Argos System with Iridium include the GTS dissemination of data, but need to be negotiated with CLS or CLS America.

Information Exchange

New Publications of interest

- Draft report on tests to be undertaken by a data processing center putting data on the GTS (especially for Iridium Processing centres)
- The British Antarctic Survey published a “Satellite buyers Guide”, which was placed on the DBCP website.
- Best Practices page on
- The DBCP brochure was updated to a two page document, useful for taking to ships of opportunity to encourage them to deploy drifters. http://www.jcommops.org/dbcp/doc/DBCP_BROCHURE_2009.pdf

New DBCP web page



DBCP website front page. http://dbcp.jcommops.org

Some information about the DBCP was entered onto the JCOMM website. http://www.jcomm.info under the Observations Program Area – e.g. Content added for the OPA and the DBCP, Groups for OceanSITES (under DBCP Action Groups in People and Teams)

A photo album for the DBCP was uploaded onto http://picasaweb.google.com/JCOMMOPS/DBCP# for general use.

Deployment opportunities

New-ish opportunities:

- Navoceano Air Deployments recommenced
- Cruises of German research vessels (IFM-GEOMAR) POLARSTERN, METEOR & MERIAN, SONNE & POSEIDON
- KNMI, Netherlands will make VOS ships available for deployments.
- The DART Tsunami buoy deployment and maintenance cruises will provide an ongoing opportunity in the Pacific and Central Atlantic oceans. Cruise planning is completed each year by NDBC.
- The POGO Research Cruise database contained information which could be of use to panel members. Panel members can also enter information about cruises for others to use http://www.pogo-oceancruises.org/cruises/
- The **Australian Antarctic Division** has its cruise schedules from 2010-11 online at: http://its-db.aad.gov.au/proms/public/schedules/voyage.cfm?season=1011. There are upcoming cruises from Hobart to Macquarie Island in both May-June and October 2010. Then plans for voyages to Antarctica from November 2010.
- The **GO-SHIP** program lists all planned cruises on its new website: http://www.go-ship.org/CruisePlans.html. A map of the cruises which are regularly undertaken is here: http://www.go-ship.org/RefSecs/Map_RefSecs1.1.pdf. **e.g. The US Repeat Hydrography** program will complete the **Southern Ocean S04P** section in 2011. This will extend from McMurdo to Punta Arenas along 67° S with southward (Pacific) extensions along P14, P15, P16, P18.
- The Research project GEOTRACES has some planned cruises in the North Pacific and Atlantic:
  - in June-July of 2010 departing from Tokyo
  - see http://www.jodc.go.jp/geotraces/plan.htm for proposed cruises in 2011 and 2012 from Japan
  - and http://www.bodc.ac.uk/geotraces/cruises/programme/ for global plans (including 2 planned cruises in the Sub-Tropical and Southern Atlantic)
- The Korean Polar Research Institute (KOPRI) will launch its new research icebreaker the *Araon* in early 2010 with open sea and ice trials between Christchurch and Cape Burks Antarctica. The Araon ("ara"=sea; "on"=all) has been designed to carry out multidisciplinary research in the Arctic and Antarctic regions and to provide logistics support for Antarctic research stations. Further information on http://www.go-ship.org/CruisePlans.html.

- Information is available at http://www.jcommops.org/depl_opport/depl_opport.html.
- Updates are also sent each month via email to the DBCP community.
- For the Drifting Buoy (and Argo) network, the Southern Ocean and Arctic Ocean are areas where deployment opportunities are needed most, as well as the central and far north Pacific, surrounding New Zealand and to the west of the African continent.
- JCOMMOPS overlaid active SOOP lines with these areas of interest to obtain a list of lines to consider.

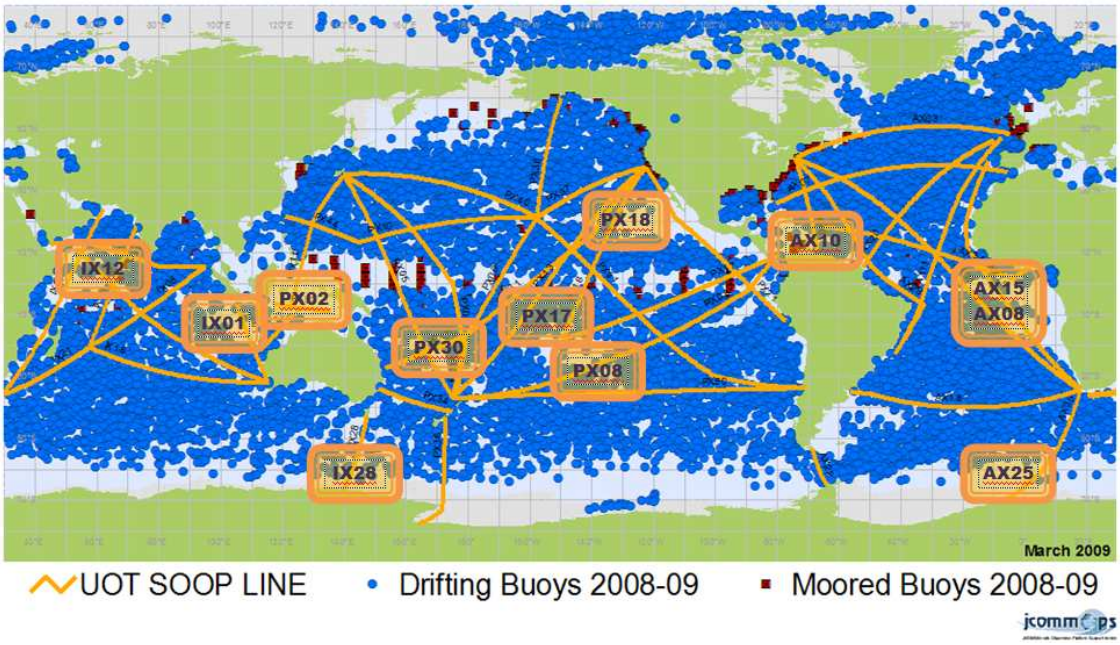


Figure 3 – showing the SOOP lines overlaid on the drifting buoy locations in 2008-09, showing (orange boxes) which lines could be used more to deploy drifters to fill gaps in the DBCP network.

- SOOP Lines which could be used to deploy drifting buoys in areas or to deploy buoys more regularly in the areas required are:

INDIAN	PACIFIC	ATLANTIC
IX01 (BOM)	PX02 (BOM)	AX08 (AOML)
IX12 (BOM)	PX08 (AOML/SIO)	AX10 (AOML)
IX28 (CSIRO)	PX17 (IRD)	AX15 (IRD)
	PX18 (AOML/SIO)	AX25 (AOML)
	PX30 (CSIRO)	

Lines which have been active in the SOOPIP, which go through areas that have been consistently without drifting buoys. In brackets are the agencies nominally responsible for the lines.

Oceansites

JCOMMOPS provides support for the OceanSITES (30% of Hester Viola's time). The priority tasks in the previous year, were:

- Updating documentation to get a clearer Network status
- Creating new map products to view network status
- Updating websites
- Updating contact details and user groups
- Supporting the Data Management Team in getting data (and metadata) onto GDACs
- Maintaining Site Catalog, monitoring data flows and GDAC structure
- Seeking Sustained funding for the Project Office Support

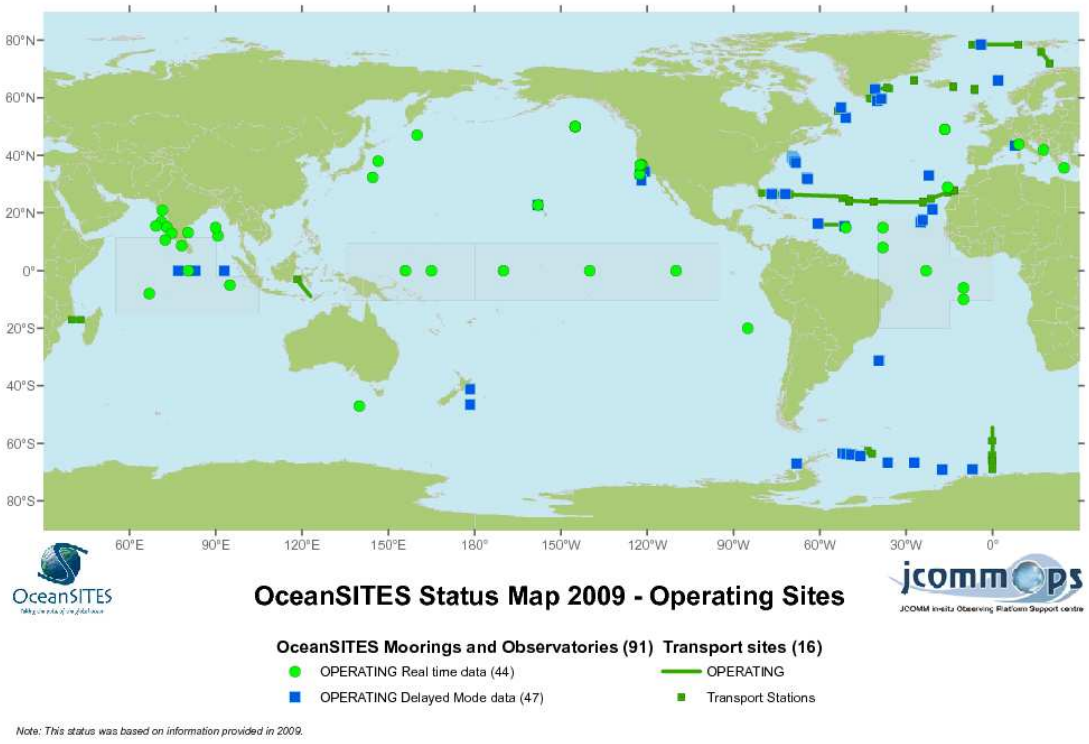
The website at www.oceansites.org had been updated with new scientific descriptions of sites, a new summary spreadsheet listing all sites and new Current Status maps and Vision maps (2009) and a Google Earth file as a new interactive map. A new Monthly map now available showing sites sharing data on the GTS of WMO.

PDF and PNG Files are also accessible directly from http://www.jcommops.org/FTPRoot/OceanSITES/maps/

All active and current sites: http://www.jcommops.org/FTPRoot/OceanSITES/maps/200908_CURRENT.pdf

Google Earth File: http://www.jcommops.org/FTPRoot/OceanSITES/status/200908_oceansites_locations.kmz

All planned and discontinued sites: http://www.jcommops.org/FTPRoot/OceanSITES/maps/200908_VISION.pdf



Current OceanSITES Status

The GDACs are now up and running:

- ftp://data.ndbc.noaa.gov/data/oceansites/
- ftp://ftp.ifremer.fr/ifremer/oceansites/

Organisational issues

- The DBCP agreed to pursue the creation of an action group for the International Tsunameter Partnership (ITP)
- In 2008 the DBCP established an executive board to oversee and plan for administrative and financial matters on behalf of the Panel.
- The DBCP also established a series of Task Teams to globally address specific areas of its goals:
    - DBCP Task Team on Data Management
    - DBCP Task Team on Instrument Best Practices and Drifter Technology Development

    - DBCP Task Team on Moored Buoys
    - DBCP Task Team on Capacity Building
- David Meldrum stood down as Chair of the DBCP in 2009 and has been replaced by Al Wallace from Environment Canada. The Vice Chairs are Dr Rajendran from NIOT India, Ken Jarrott from BOM, Australia and Jean Rolland from Meteo France.

Future Priorities for DBCP Technical Coordinator

- Integration of OceanSITES data/metadata into JCOMMOPS database
- Adding extra metadata fields to GTS Data Flows (BUFR templates) and assessing success in adoption of BUFR
    - Look also at managmenet of Moored Buoy metadata across all JCOMM programs
- Improve documentation of common ("Best") practices
- Looking at Delays across the network and support for testing alternative telecommunications systems such as Iridium.
- Management of OceanSITES metadata and assisting in data flow. Creation of a full database and online query tools for OceanSITES network status and platform metadata.
- Working in JCOMMOPS on improved managmenet of deployment opportunity informaotin along with CCHDO and SeaDataNet.

ARGO National Report 2010 – 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 33 floats have been purchased and deployed, 23 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 2011.

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 sustain a fleet of approx. 30 floats. Given a lifetime of about 4 years for a float this means purchase of about eight floats per year, plus communication. Although this level of funding has in principle been agreed upon, it has to be negotiated each year again. It is not yet clear how large the budget for 2010 will be.

   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).

   4-8 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**

   Nothing done yet.

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**

   Unknown.

7) **Bibliography**

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French National report on Argo – 2009
11th Argo Steering Team meeting
March 2010

1. The status of implementation (major achievements and problems in 2009)

- **floats deployed and their performance**

27 floats and 8 additional floats co-funded by the MFSTEP project have been deployed in 2009.
The current position of the French active floats and the French float survival rate are displayed Figure 1 and Figure 2.

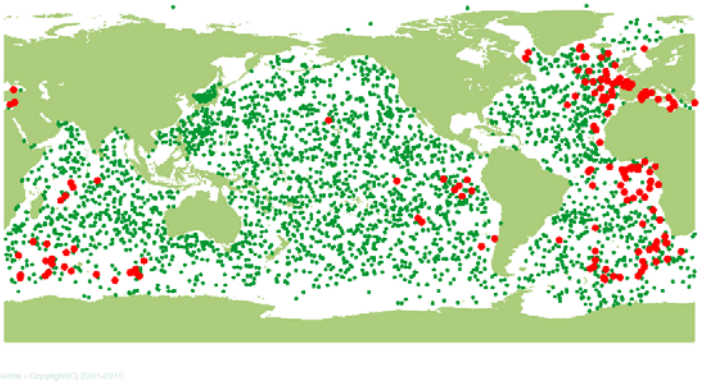


Figure 1: The large red dots represent the French active floats.

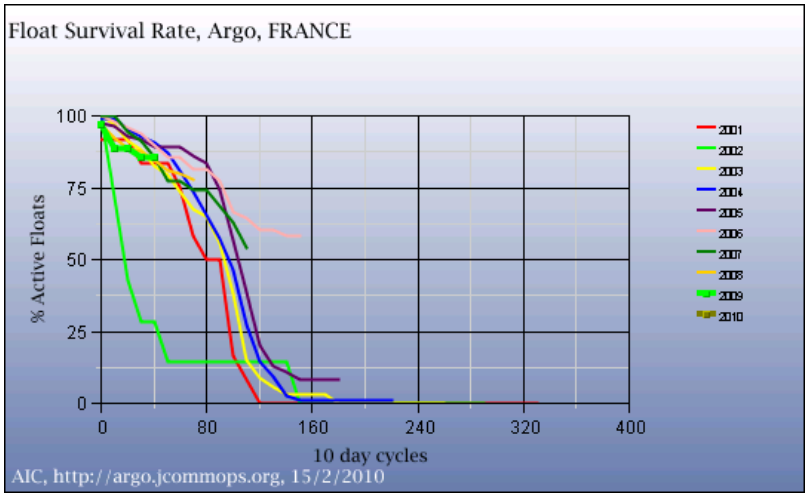


Figure 2: Float survival rate of the French floats

- **technical problems encountered and solved**

- **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.

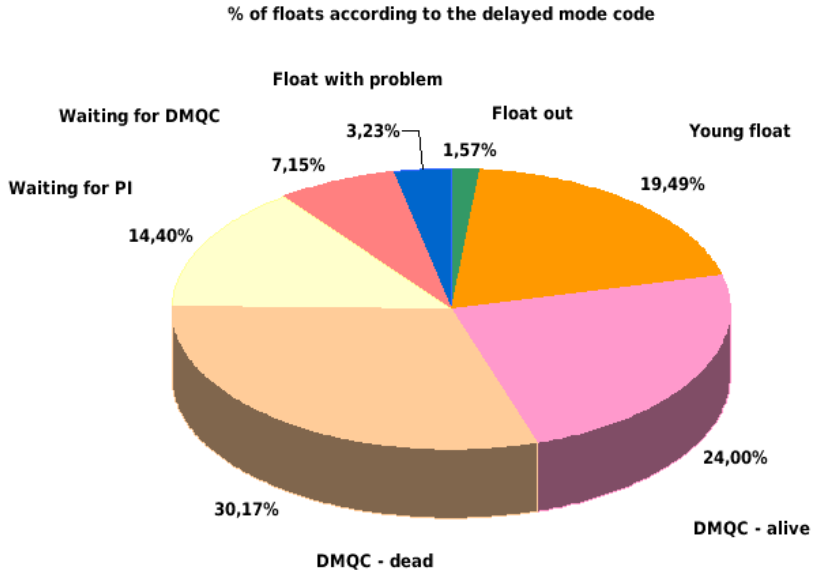
As Argo Data Assembly Center, Coriolis processes in Real Time and Delayed Mode float data deployed by France, by 5 European countries (Germany, Spain, Netherlands, Norway, Italy) and by 4

non European countries (Chili, Costa Rica, Mexico, Russia). Coriolis data center processes data coming from 1066 floats (506 Provor, 479 Apex, 80 Nemo and 1 Metocean floats) including 340 active floats in February 2010 (135 Provor, 184 Apex and 21 Nemo floats). Data are processed and distributed according to Argo recommendations. Some floats are deployed as part of scientific projects. The detail can be found on the Coriolis web site:
http://www.coriolis.eu.org/cdc/scientific_projects.htm

Coriolis operates one of the GDAC in close collaboration of FNMOC/USA. Coriolis also coordinates the North-Atlantic ARC activities and in particular the float deployment in Atlantic.

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

As of today, about 50% of the French floats have been controlled in delayed mode and about 22% of the floats are waiting for DMQC.
Last year, a second delayed mode control has been done to the old GYROSCOPE floats to take into account recent knowledge of the DMQC process (pressure correction, OW method). The delayed mode data of those floats are better but this led to a delay in the DMQC of more recent 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

Since 2000, France has provided a significant contribution to the growing Argo array. 455 French floats and 68 floats co-funded by European Union have been deployed in different geographic areas. The deployments meet specific French requirements but they also contribute to the global array.

Year	Man/Year	French floats	Co-funded EU floats	Total
2000		11		11
2001	3	12		12
2002	6	7	4	11
2003	9	34	20	54
2004	15	85	18	103
2005	15	89	11	100
2006	12	51	14	65
2007	12	36		36
2008	12	90		90
2009	12,6	35		35
Total(2000-2009)		***450***	***63***	**517**
2010	**12,6**	**95**		

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 2010.

The French Argo Project 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. Ifremer and SHOM plan to buy between about 50 and 15 floats respectively in 2009 and beyond. As part of the Euro-Argo preparatory phase, Ifremer (for the Argo-France project) works with its funding ministry (mainly research ministry) to agree on a long-term funding level and commitment. Together with its European partners, Ifremer also works with the European commission to set up a long term EC funding to Argo.
In parallel to the Euro-Argo initiatives and to sustain the commitments of France in Argo, a proposal has been submitted to the French agencies to identify Argo-France project as a research observatory. When obtained, the agreement is valid for 10 years.
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).

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, 95 floats will be deployed in 2010. Deployements plans of 35 floats are already known and shown Figure 3.

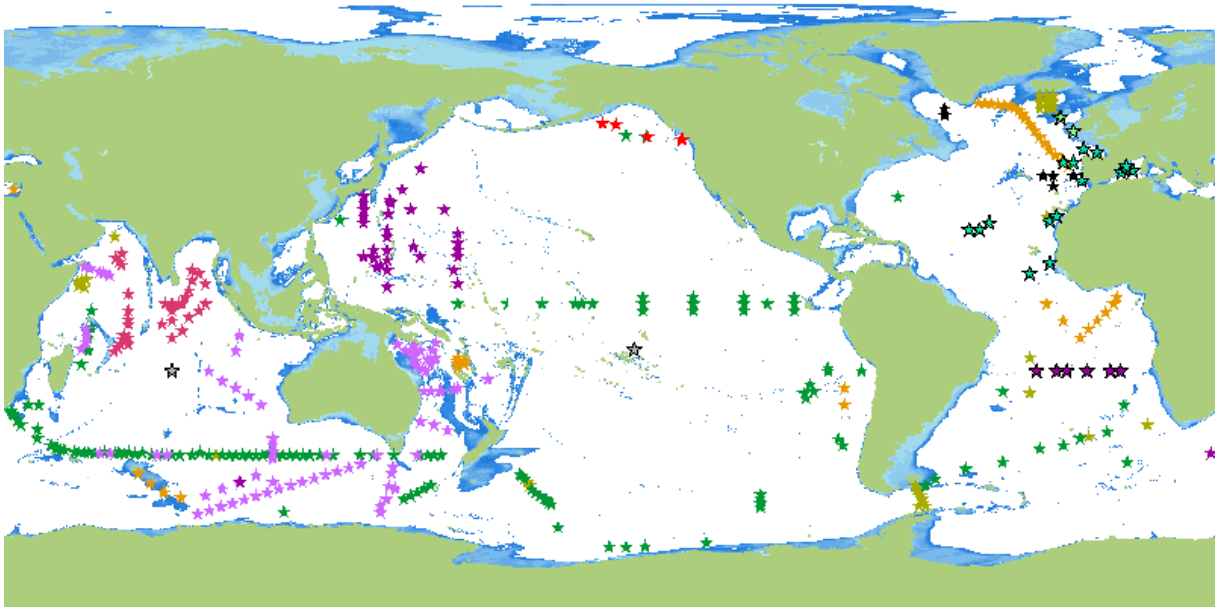


Figure 3: Deployment plan. The orange stars represent the French deployment plan for 2010.

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 behaviour 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

A key aspect of the French Argo program is to develop the capabilities to fully exploit Argo data for operational forecasting as well as research applications. Therefore Coriolis has developed together with MERCATOR (The French operational oceanography forecast centre) 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. As part of the scientific announcement of opportunities mentioned previously (GMMC), PIs can be selected to deploy floats within their scientific experiments. The list of experiments during which floats were deployed are available through the Coriolis web site (http://www.coriolis.eu.org/cdc/scientific_projects.htm). Additional projects including Argo data in their analysis are also funded by other institutes (CNES, IFREMER, INSU, SHOM, Météo-France).

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. Assessments have clearly demonstrated the positive impact of Argo data on ocean analyses and predictions.

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) The French Argo Users' Group provides a forum for engagement between these scientists and the French Argo program.

Argo France coordinates the North-Atlantic Argo Regional Center. Besides coordinating deployment in the North-Atlantic, Argo France is working on method to improve data consistency check in the North-Atlantic and to detect TNPD Apex floats with large negative pressure sensor drift.

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

Ten years after the beginning of the Argo program, information concerning the functioning of some floats is already lost. The value of the Argo data is increasing with years and in 20 years from now, Argo data will be even more valuable than today. We have to ensure that our current knowledge is saved to avoid problems such as those concerning XBT and their fall rate for instance.

Argo data are supposed to be used for the monitoring of climate change signal. Climate change is a very sensible topic. Can we guarantee that the current DM Argo data can be used for climate change studies? Do we provide enough information relative to those data? Can a user outside the Argo community find all necessary information to use the data as he should do?

The Argo format has been designed according to the nominal float cycle. New capabilities are now available and the range of possibility is growing very fast:

- New sensors
- Measurements on different vertical axis for a given platform
- Near surface data
- Iridium transmission
- Two way communications that allow changes in the float mission
- Etc…

The Argo format has not been designed to manage all those configurations. In addition, one might expect that in the future even new data or configurations will show up. Can we keep adding new data or keep fitting new configuration in the existing Argo format? I have no clear answer to this question.

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

Since 2000, data from 4 French cruises have been uploaded to the CCHDO website.

Line	**Cruise name**	**Ship**	**Cruises dates yyyy/mm/dd** From	to	**Chief scientist**	**Country**
AR15	EQUALANT	THALASSA	2000/07/24	2000/08/21	Yves Gouriou	FRA
IR06E		MARION DUFRESNE	2000/09/09	2000/10/03	Michèle Fieux	FRA
A025	OVIDE02	THALASSA	2002/06/11	2002/07/11	Herlé Mercier	FRA

A025	OVIDE04	THALASSA	2004/06/05	2004/07/06	Thierry Huck	FRA

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GERMAN ARGO PROGRAMME

PRESENT STATUS AND FUTURE PLANS

B. Klein, BSH
February 19, 2010

1. The status of implementation (major achievements and problems in 2009)

1.1 Floats deployed and their performance

Since 1998, more than 350 floats have been deployed by Germany in a number of different geographic areas and programmes. Deployments have focused on meeting specific German research requirements, but contributed also to the global array. The German contribution is comparable to that from other developed countries and has provided a significant contribution to the growing Argo array.

The main interest of Germany will remain in the Atlantic, but to maintain the global array floats could also be deployed in the other oceans if necessary. Recent deployments reflect the specific research interests and range from the Nordic Seas, the subpolar North Atlantic, the tropical Atlantic to the Atlantic sector of the southern Ocean.

Overall, Germany plans to contribute to the Argo global array at the level of about 60-70 floats per year with funding from BSH/BMVBS (about 50 floats/year) and individual science programs (BMBF, DFG and national budgets at about 20 floats/year). The majority of the Argo-equivalent floats will be used for regional enhancements in the polar areas. In 2010 the agreed funding will amount (44/6) floats funded by BMVBS and (2/20) floats funded by science programmes. The numbers in parenthesis indicate core Argo/additional deployments.

Year	Deployed floats
2000	27
2001	21
2002	14
2003	27
2004	45
2005	65
2006	36
2007	39
2008	72
2009	35
2010 plans	72 + 19 remaining from 2009
2011 plans	75

Floats deployed by Germany as a contribution to Argo since 2000

1.2 Technical problems encountered and solved

The repair of the faulty pressure sensors on the Seabird CTDs has only been finished recently. Unfortunately the CTD units for the floats purchased in 2009 had already

been bought before the microleak problem was discovered which halted the release of all floats for 2009. A significant amount of floats deployed in 2008 shows pressure drift from the microleaks, some already show severe malfunctions. All these floats will need especial attention during the delayed-mode QC.

Software modifications have been installed to ensure that the Nemo floats report surface pressure without truncation.

1.3 Status of delayed mode quality control process

BSH has taken the lead in the delayed mode processing for Germany, but various German institutions contributing to Argo, are sharing the work 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. 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. There is no major backlog in delayed-mode profiles.

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

The level of support is indicated in the table below. Approximately 50 floats per year will be contributed to the global array by Germany through funding from the Ministry of Transportation. It covers only costs related to float procurement and transmission costs, personnel will be provided by BSH. This will consist of 1 scientist and 1 technician.

Year	Float related costs	Manmonth/Year
2007	0k€	36
2008	550k€	24
2009	600k€	24
2010	600k€	24
2011	600k€	24
2012	600k€	24
2013	650k€	24

Table 3. Previous and future funding for German Argo.

Germany will to contribute to the Argo global array at the level of about 50 floats per year. Requests for financial contribution have been included in the national budgets for 2009-2013, but final budget allocations will be carried out on an annual basis. As

part of the Euro-Argo preparatory phase, BSH will work with its funding ministry to agree on a long-term European structure. The research community has also secured funding for floats in the order of 20 floats per year for the next 3 years which will mostly be used for regional enhancements in the polar areas.

3. Summary of deployment plans

Float deployment in 2010 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. The intended deployment areas cover particularly data sparse regions in the Atlantic, the Nordic Seas and the Mediterranean. Additional floats will be deployed in the Weddell Sea. The repair of faulty pressure sensors in the SBE CTDs is nearly finished but additional software problems with the Nemo floats have to be solved first before the remaining floats purchased in 2009 can be deployed. It is planned to start deployments in summer with 8 floats in the Nordic Seas.

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

A key aspect of the German Argo programme is to develop a database for climate analysis from Argo data, to provide operational products (time series, climate indices) for interpretation of local changes and to provide data for research applications. German Argo is planning to host an annual user workshop where research applications can be presented and requests for operational products can be specified.

Ocean science: 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 (assimilations, boundary conditions,…).

5. Issues to be resolved by Steering Team

Nothing

6. Contributions to Reference data base

German cruise data in the Nordic Seas have been contributed to the reference data base as part of the work in the North Atlantic ARC. A link to the ICES database has been established.

7. Updates to the Argo bibliography

Indian National Report (AST-11)

(Submitted by M Ravichandran)

Organization of Indian Argo Project

a) The Indian Argo Project, fully funded by the Ministry of Earth Sciences (MoES), Government of India is implemented by the Indian National Center for Ocean Information Services (INCOIS) of MoES at Hyderabad.
b) The Indian Argo Project for the year 2007-2012 envisages (a) Deployment of 200 Argo floats in the Indian Ocean, (b) Argo Data Management Activities, (c) Development of Ocean Data Assimilation System, (d) Analysis and utilization of Argo data and (e) Capacity Building at National level.
c) Several R&D Institutions including the National Institute of Oceanography at Goa, NCAOR, Goa, Space Applications Centre, Ahmedabad, National Remote Sensing Centre, Hyderabad, Indian Institute of Tropical Meteorology, Pune, National Centre for Medium range Weather Forecasting (NCMRWF), New Delhi, Centre for Mathematical Modelling and Computer Simulation (C-MMACS), Bangalore participate in the utilization of Argo data. Efforts are underway to encourage and enable academic institutions in this endeavour.

1. The status of implementation

1.1a Floats deployment

16 floats have been deployed during the year 2009.

1.1b performance Analysis of Floats deployed

Out of 184 floats deployed so far, 79 floats are active. Out of these 79 active floats 48 floats are less than 3 years old.

1.1c Software support of CSIRO is continuing

CSIRO is extending full support with regards to the Real Time data processing software. We take this opportunity to thanks the CSIRO team for sharing the software and continuing the support.

1.2 Technical problems encountered and solved

None

1.3 Status of contributions to Argo data management

- **Data acquired from floats**

  India had deployed 184 floats so far. Out of these 79 floats are active. All the active floats data are processed and sent to GDAC.

- **Data issued to GTS**
  Presently we do not have GTS access and hence we are not able to send Indian floats data to GTS. Upon our request CLS ARGOS is continuing to send Indian floats data in TESAC format to GTS.
- **Data issued to GDACs after real-time QC**
  All the active floats (79) data are subjected 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	Hits	Visitor
Argo Web-Gis	3210	1291
Data downloads	7487	421
Live Access Server	582	117
Argo products	811	267

1.4 Status of Delayed Mode Quality Control process

- INCOIS started generating and uploading D files to GDAC form July 2006, and as of today, profiles belonging to all eligible floats have been subjected to DMQC. John Gilson's GUI is extensively used at different stages of DMQC. It is appreciated that he extended whole hearted support in setting up the GUI and slight modifications required due to platform change.
- Number of Real time profiles from INCOIS DAC : 22,763.
- Number of Delayed Mode profiles from INCOIS DAC: 12159.
- 53 % of FLOATS are DMQCied.

Major hurdles for DMQC are

- Lack of CTD profiles from North Indian Ocean is still a critical problem when decision is to be taken for the complicated cases.

1.5 Trajectory files status:

A total of **180 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. Finally a visual check is performed to verify that there are no missing cycles without cycle numbers and to check the surface time intervals.

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 2007 to March 2012 fully funded by MoES, Govt. of India. Funding is secured upto 2012 for deployment of 200 Argo floats (40 floats per year), Data management activities, Data analysis, 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 committed to deploy floats in North Indian Ocean wherever gap exists. Also plans to deploy few tens of floats in the Southern Indian Ocean. Received 15 floats with Iridium communication with standard CTD and these floats will be deployed in the equatorial Indian Ocean during July 2010. Another 30 floats are planned to procure and deploy where the gap exists in Indian Ocean (10 floats in Southern Ocean). After ascertaining the gap region and cruise plan of MoES research vessels, these floats will be deployed.

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

- Argo data has been widely utilized to understand the Indian Ocean dynamics, especially Dipole event, understanding the monsoon system in relation to heat content, buoyancy flux of the Indian Ocean and for validation of OGCM.
- Efforts are underway to assimilate argo data in OGCM to realize operational forecast of ocean variables Indian Ocean region.
- INCOIS is hosting Indian Ocean ARC, wherein all floats data from 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.

Nil

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

Nil

Publications:

1. Sindu Raj Parampil, Anitha Gera, M. Ravichandran, and Debasis Sengupta, (2010), Intraseasonal response of mixed layer temperature and salinity in the Bay of Bengal to heat and freshwater flux, *Journal of Geophys. Research*, in Press.

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Irish National Report

1. The status of implementation (major achievements and problems in 2009)

- floats deployed and their performance

Four floats were deployed during 2009 on the R.V. Celtic Explorer and carried out a combined total of 133 profiles. Their distribution can be seen on the maps below.

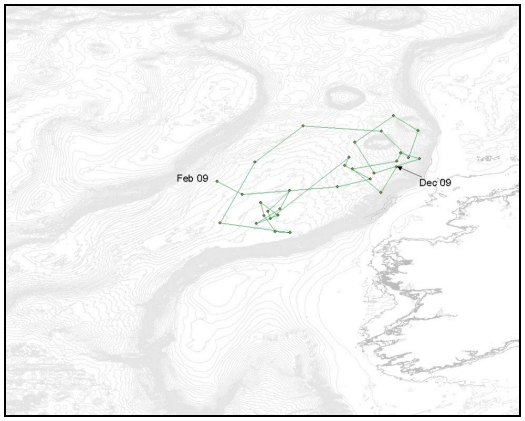


Figure 1: WMO 6900651

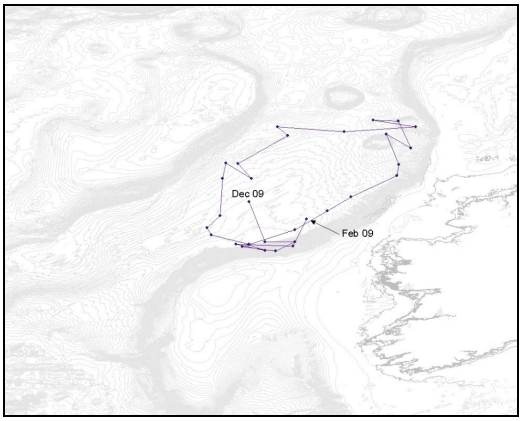


Figure 2: WMO 6900652

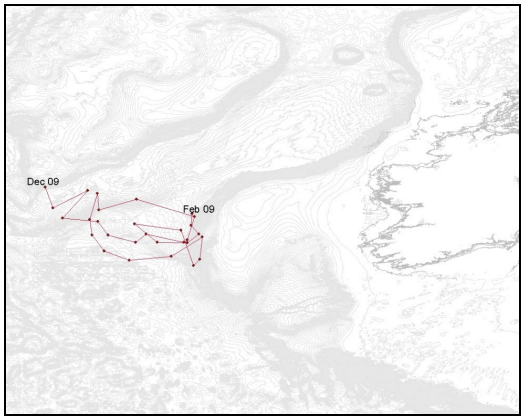


Figure 3: WMO 6900653

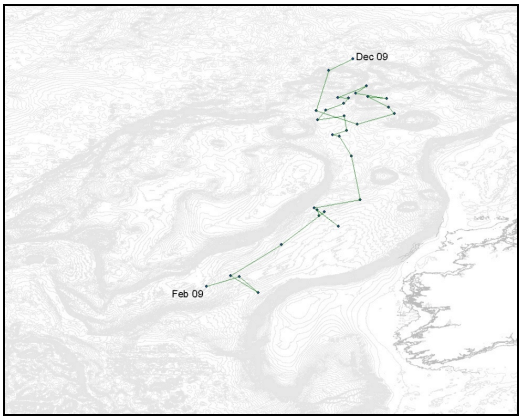


Figure 4: WMO 6900654

- technical problems encountered and solved

The four remaining floats awaiting deployment were returned to Webb Research for replacement of pressure sensor.

- status of contributions to Argo data management

BODC is currently carrying out the delayed mode data management for Irish floats although when last checked, had not had an opportunity to deal with Irish float data due to backlogs.

- status of delayed mode quality control process

BODC are currently carrying out the delayed mode quality control process for the Irish floats (see note above).

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 funding for Euro-Argo floats beyond the lifetime of the PP project has not yet been agreed. Ireland is interested in becoming an observer member of the Euro-Argo ERIC. The MI have been in discussions with the Irish national ESFRI delegates regarding the procedure to sign up to the legal form. We remain committed to the Euro-Argo project.

One section manager (Glenn Nolan), one team leader (Fiona Grant) and two Science and Technical Officers (Kieran Lyons and Sheena Fennell) are responsible for the delivery of the Euro Argo programme in Ireland. The programme is overseen by the Director of Ocean Science Services, Michael Gillooly.

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.

During February 2010 two more Argo floats were deployed during the standard section ICES cruise on the R.V. Celtic Explorer in the Rockall Trough. The JCOMMMOps float density map was consulted prior to choosing the deployment locations. In the latter part of February during the IWDG (Irish Whale and Dolphin Group) survey a third float was deployed in the Porcupine Sea Bight.

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

In 2010, the MI are consulting with oceanographic researchers in NUIG to develop a research project using Argo data. Further information will be supplied when available.

As part of WP5, a project was developed to routinely compare Argo profiles with the Marine Institute North East Atlantic ROMS Model. On a weekly basis, the ARGO temperature and salinity profiles are compared with model temperature and salinity profiles from the same location and closest timestamp. Profile plots and validation metrics are created (bias, skewness and RMS of difference; correlation coefficient). These are all available on http://www.marine.ie/home/services/operational/oceanography/ModelValidation.htm

Some analysis was recently conducted on Argo floats in the southern entrance to Rockall Trough to discern water mass variability at this location. Float 6900653 has traversed from Porcupine Bank to Rockall Bank over the past 12 months. The data below show the gradual transition from intermediate water masses dominated by Mediterranean Outflow Water to Sub Arctic Intermediate water over that period. Further analysis will be conducted in 2010 to examine Mixed Layer Depth in this region from Argo float profiles.

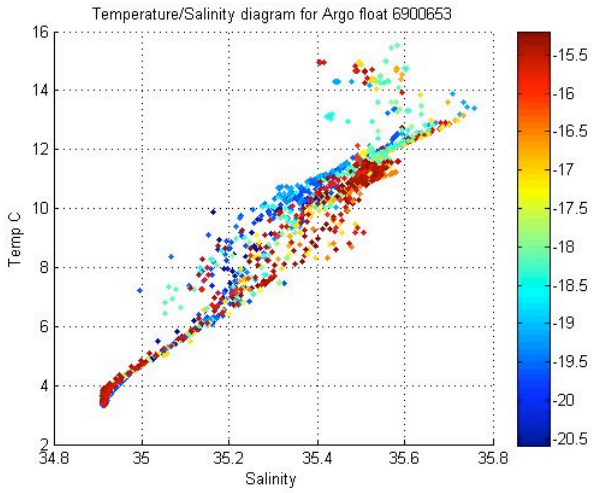
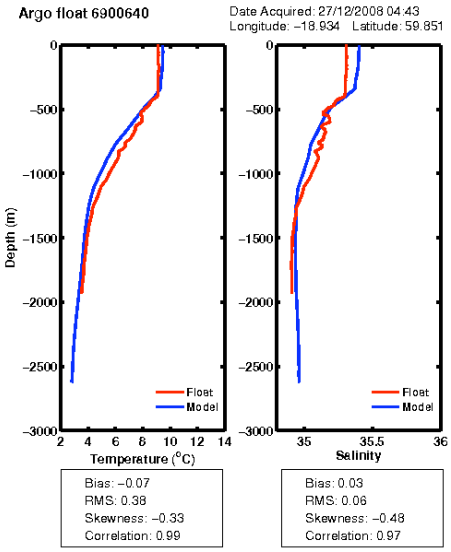


Figure 5. Argo derived Temperature and salinity diagram as a function of longitude showing transition from MOW influenced waters in the eastern Rockall Trough (red and orange) and SAIW influenced waters in the western Rockall Trough during 2009.



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.

All issues currently being raised through Euro-Argo PP.

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 MI, through the work of Kieran Lyons, submitted all available CTD cruise data to Christine Coatanoan in April 2009. The archive of CTD data (to end of year 2008) was processed and quality controlled using Seabird processing software. It was binned to 1 metre and then imported

to a SQL Server database where it goes through some final quality control checks (e.g. density inversion) before being written to a final database.

The data sent had 2 files:

- CTD_Header.csv: this contains a unique identifier for each cast, and the date and location of the cast
- CTD_Data.csv: this contains a unique identifier to link each record with a cast, and the depth, temperature and salinity for each record.

7. Keeping the Argo bibliography (http://www.argo.ucsd.edu/FrBibliography.html) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. Please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.
Not aware of any publications nationally using Argo data.

8. An action item from AST-10 asked for more statistics on the commitments table, focusing especially on how well countries are predicting their deployments for the year. I am also attaching a spreadsheet of the commitments table which I updated on January 6, 2010 using the AIC website. I understand the statistics this year will be skewed given the break in float deployments due to pressure leaks. However, I have included the statistics for 2007-2009. Please correct any errors on float totals in the past year and send me an estimate of the expected number of deployments for 2010.
Excel sheet attached for information.

Japan National Report

(Submitted by Toshio Suga)

1. The Status of implementation (major achievements and problems in 2009)

1.1 Floats deployed and their performance

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 57 floats from January 2009 to December 2009: 56 APEXs and 1 POPS (Polar Ocean Profiling System). All the APEXs were deployed with the aid of R/Vs of 10 domestic organizations. POPS is an ice-based drifting buoy with a PROVOR float moving up and down along a 1000m cable. The observed data (temperature-salinity profiles of every 3 days, 3-hourly GPS position, atmospheric temperature and pressure) are transmitted to Iridium Satellites and distributed to GTS via JMA. The Arctic Ocean Climate System Research Team of JAMSTEC deployed a POPS in the Arctic Sea in April 2009. Unfortunately, this POPS was terminated in October 2009. Another POPS is planned to be deployed near the North Pole in April 2010.

Two APEXs equipped with two different oxygen sensors (Optode3830 and SBE43) were deployed in the Yamato Basin, Japan Sea late January 2009. The main purpose of this deployment was to evaluate sensor biases, drifts, etc. The layer below 300-500 m in this basin is occupied by Japan Sea Proper Water, which is vertically and horizontally homogeneous deep water with small temporal variability. The region is thus ideal for the evaluation of oxygen sensors. A preliminary comparison of the two types of sensor will be briefly mentioned in Section 1.2. While we hoped that the two floats would stay in the Yamato Basin, they were drifted away from the basin. One of them was drifted into Toyama Bay along the central part of Honshu (the main island of Japan) and recovered on October 6, with the aid of Ishikawa Prefecture Fisheries Research Center. The two sensors on this float have been sent back to the manufacturers for calibration.

Among JAMSTEC's 757 floats (670 APEXs, 76 PROVORs, 11 NINJAs) deployed in the Pacific, Indian and Southern Oceans, from 1999 to the end of January 2010, 254 floats (all of them are APEXs) are now in normal operation. The other 503 floats (415 APEXs, 76 PROVORs, 11 NINJAs) terminated their mission, including 5 floats (all of them are APEXs) transmitting on the beaches after stranding, one APEX drifting at the sea surface and 11 floats (8 APEXs, 2 PROVORs, 1 NINJA) recovered.

The Japan Meteorological Agency (JMA) deployed 17 APEXs as Argo equivalent floats in the seas around Japan from January 2009 to December 2009, whose data have been used for operational ocean analysis and forecast. Among 59 floats (14 PROVORs, 45 APEXs) which JMA deployed from 2005 to 2009, 23 floats (all of them are APEXs) are active at the end of December 2009, while 20 floats (6 PROVOR, 14 APEXs) terminated the transmission in 2009. JMA deployed 10 APEXs in January 2010.

The Fisheries Research Agency (FRA) recovered one float in June 2009 because it was drifted too close to the coast of Hokkaido, Japan. The float was one of the 4 isopycnal-APEXs with AANDERAA Oxygen sensor, which were deployed in the Kuroshio-Oyashio region of the Northwestern Pacific as Argo equivalent floats aiming to trace source waters of the North Pacific Intermediate Water in 2008. The recovered float was redeployed in the same region in September 2009. Three floats out of the four are still active. FRA is developing lithium buttery of a Slocum glider (manufactured by Webb Research) to extend the observational life time until 3 months. They conducted several field observation tests during 2009. However, it is still under a developing stage.

Among Tohoku University's 8 floats deployed during 2008 as Argo equivalent floats (3

NINJJAs having a WET Labs chlorophyll sensor and an anti-biofouling shutter with the parking depth of 40 dbar and 5-day cycle, 4 APEXs having a Sea-Bird oxygen sensor and a WET Labs chlorophyll sensor with 3-day cycle, and an APEX with an AANDERAA oxygen sensor with 3-day cycle), 4 floats (2 NINJA and 2 APEX) are active at the end of December 2009. While one NINJA float is in normal operation, the WET Labs sensor of the other has not functioned since its 7th profile. While one APEX with an AANDERAA oxygen sensor is in normal operation, the WET Labs sensor of the other has not functioned since its 25th profile. One NINJA terminated the transmission in 2009. Two APEXs recovered in 2008 have been in the process of repair and will be ready for redeployment in 2010.

1.2 Technical problems encountered and solved

Because of the micro-leak problem in the Druck sensor, JAMSTEC cancelled most of the APEXs' deployment from May to September 2010 and sent 38 sensors to the manufacturer for repairs. All of them have been sent back to JAMSTEC by the end of January 2010. The twenty four of the repaired sensors were the products of the Kistler and the others were those of the Druck.

For the same reason, JMA cancelled four APEXs' deployment and sent them to the manufacturer for repairs in May 2009. They were sent back to Tokyo in November 2009 and immediately deployed by JMA's research vessels in the sea south of Japan. The three of the repaired sensors were the products of the Kistler and the other was a screening tested Druck. Besides, JMA ordered 14 APEXs in April 2009. The delivery of the floats was delayed about two months for the same reason and made in December 2009. The sensors of them were all the Kistlers.

Among the APEX floats with APF9 controller in Japan, 5 floats have the negative surface pressure drift larger than -2.4 dbar. Among these floats, 2 floats have the extreme negative surface pressure drift, exceeding -10 dbar.

Most of the six WET Labs chlorophyll sensors (ECO-FLNTU) on APEXs deployed by Tohoku University and JAMSTCE during 2008 went wrong after 3-26 profiles. It has been unofficially reported that the manufacturer identified and fixed the causes of this short life after inspection of two sensors on the Tohoku University's APEXs that had been recovered from the sea. The manufacturer is trying to send two floats with repaired sensors back to Tohoku University by the end of March 2010.

The two sets of a pair of different oxygen sensors (Optode3830 and SBE43) experimentally deployed in the Japan Sea showed that the oxygen profiles from the two sensors were systematically different. A comparison with Winkler Oxygen made by JMA R/V Seifu-Maru at the float deployment clarified that there were negative biases of 5-10% of oxygen values for SBE43 and 10-15% for Optode. Causes of the difference between the two types have not been identified. One set of the two was recovered from the sea and sent back to the manufacturers as mentioned above.

Tsurumi Seiki Co., in corporation with JAMSTEC, began to develop a new profiling float for a depth greater than 2000 dbar, which adopts a new buoyancy engine working at up to 3500 dbar. The prototype is capable of descending down to 3000 dbar and we hope to improve it to be capable of descending down to 4000 dbar.

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 292 active floats as of February 10, 2010. Nine Japanese PIs agree to provide data to the international Argo. All profiles from those floats are transmitted to GDACs in netCDF format and issued to GTS using TESAC and BUFR code after real-time QC on an operational basis. 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 92,761 profiles to GDACs as of January 2010. Among these data, some 16,000 profiles were provided within a year. JAMSTEC has continued the operation of delayed-mode QC for the floats of Japanese PIs other than JAMSTEC. The remaining backlog of about 21,000 profiles will be cleared by this operation.

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 has started in April 2009, JAMSTEC has been trying to continue the operation nearly in the same scale. JMA plans to increase deploying floats to 27 around Japan every year for operational ocean analysis and forecast.

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 FY2010, it has been proposed that JAMSTEC will deploy about 80 floats in total in the Pacific, Indian, and Southern Oceans. JMA will deploy 27 floats around Japan every year from FY2010 for operational ocean analysis and forecast.

JMA continues serving as the Japan DAC for the upcoming year. 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 production 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 analyses and forecasts by JMA. Daily and monthly products of subsurface temperatures and currents for the seas around Japan and northwestern Pacific Ocean, 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 web site (http://ds.data.jma.go.jp/tcc/tcc/products/elnino/). JMA has expanded the ocean monitoring and prediction area for climate to the tropical Indian Ocean since July 2009.

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) and objectively mapped velocity field data based on YoMaHa’07. 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 of the SOARC.

Based upon the accomplishment of the JAMSTEC research project “Japan Coastal Ocean Predictability Experiment (JCOPE)”, Forecast Ocean Plus, INC (FOP) was established as a JAMSTEC venture in March 2009. FOP provides the ocean current forecast information over the global ocean based on the state of the art ocean models, including real time forecasts for the shipping companies, offshore industries, coastal engineering works, and the weather information company. Argo is one of important sources of in-situ data for the FOP data assimilation system.

Following the accomplishment of the FRA-JAMSTEC joint research project “A new operational ocean prediction system with hydrographic data of coastal repeated observation lines and its linkage for ecosystem problems”, FRA has been operating the ocean prediction system FRA-JCOPE since 2007. FRA-JCOPE provides the hydrographic forecast information around Japan both to the fisheries research/management community and the general public. Argo is one of important sources of in-situ data for the FRA-JCOPE data assimilation system.

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

Data of 1321 CTD casts conducted by JMA in the western North Pacific from autumn 2008 to summer 2009 were uploaded to the CCHDO website.

6. Argo bibliography

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Argo Steering Team Meeting (AST-11), Scripps Institute Oceanography, March 23-25, 2010

Korean National Report on Argo-2009

Deployment in 2009 and Future Prospect

National Institute of Meteorological Research of Korea Meteorological Administration (METRI/KMA) and Korea Ocean Research and Development Institute (KORDI) are involved in the International Argo Program since 2001. In 2009, METRI/KMA deployed 6 floats in tropical northwest Pacific Ocean and 6 floats in the East/Japan Sea, and KORDI deployed 5 floats in the East/Japan Sea. Since 2001, Korea Argo has kept its steady course, deploying 235 floats until 2009. At present, 97 floats (48 of KMA and 49 of KORDI) are active.

In 2010 total of 12 floats are planned for the deployment; 4 floats in the Pacific Ocean and 8 floats in the East/Japan Sea. In addition, METRI/KMA has a plan to deploy 14 floats in 2011. It is expected that METRI is able to secure funding to maintain the current level of float launch for the next several years. KORDI's strategy regarding the Argo program is under revised in terms of contribution toward the global ocean observation.

Status of Argo data management

METRI's RTQC Argo data with TESAC and NetCDF format are transmitted into GTS network and GDAC respectively. In addition, METRI/KMA has tried to generate Bufr message. However, it is needed to change edition in the encode software.

Korea Oceanographic Data Center (KODC) is in charge of delayed mode QC (DMQC) and has worked on the DMQC for Korean Argo data in the North Pacific, the East/Japan Sea and the Antarctic Ocean. As of December 2007, KODC sent 2040 delayed mode profiles, 53.8% of total 4393 profiles in the North Pacific and 1578 delayed mode profiles, 52.4% of total 3352 profiles in the East/Japan Sea, to

the GDACs. KODC also made a reference database for the East/Japan Sea, which was named as EJSHB (East/Japan Sea Hydrobase), and added 278 CTD profile data to EJSHB in 2008. Delayed mode file in the East/Japan Sea is going to be submitted to GDACs. In relation to DMQC in the Antarctic Ocean, KODC asked ADMT group for assistance.

Research and operational uses of Argo data

METRI/KMA has a long-term plan to develop the operational ocean forecasting system for Pacific Asian Marginal Seas. For the purpose, METRI/KMA has been developing the data assimilation for the system. In 2009, ARGO data were assimilated to the Regional Ocean Model (ROMS) using Ensemble Kalman Filter. In addition, we start developing modeling system for the construction of reanalysis fields in the East/Japan Sea.

Also, KORDI uses Argo data for scientific research and a data assimilating-model to understand circulation in East/Japan Sea. In addition, researches on the variability of heat content in the mixed layer, data assimilation and other application for ocean modeling are actively carried out by several universities in Korea.

New Zealand National Report February 2010

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 18 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) and 2873 (5903333) 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 and Scripps Institution of Oceanography. The most recent Kaharoa voyage included Argo Australia as a collaborator and 8 Australian Floats were deployed in the Indian Ocean.

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.

These voyages, dating back to 2004 have deployed around 675 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- an example being acting as the shipping contact and storage facility for floats loaded on the Australian vessel "Southern Surveyor" in January 2009.

Status of Argo Norway, Feb-2010

The Institute of Marine Research (IMR) is involved in the international Argo programme with contribution of Argo floats, ship time for deployment and user of the data. At present, IMR is the only institution in the Argo Norway.

1. The status of implementation

At present we have in total deployed eleven Argo floats. Three floats were deployed in 2002, while six were deployed in 2003. Two more floats that included oxygen and fluorescence sensors were deployed in April 2006. These additional sensors performed well until the floats stopped sending data late 2009.

Regarding the "Delayed mode" the Argo German do delayed mode quality control for all floats in the Nordic Seas including our floats.

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

The funding has so far been self-financed (i.e. funded by our institute). The total float purchase has cost about 160kEURO. There are not devoted any funding for scientific analysis, but a person is partly working with the Argo floats regarding data collection. The scientific analysis is done in other external financed projects.

IMR has running contact with the Norwegian Research Council (NRC) that supports the EU-funded ESFRI-project "Euro Argo", which IMR is a partner in. In collaboration with IMR NRC will work to get a long-term commitment from the Ministry of Education and Research. We recently received funding from the IMR's annual budget for purchasing four (4) floats which also will include oxygen and fluorescence sensors.

3. Summary of deployment plans

In spring 2010 we will deploy four (4) Argo floats in the Nordic Seas, primarily in the Norwegian Sea. All floats include oxygen and fluorescence sensors, and will use Iridium communication.

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

ARGO Norway focuses on both research topics and marine climate monitoring of the Nordic Seas. Approximately 3 scientists in 3 projects are directly involved in Argo Norway but also other people contribute with technical expertise, data management, ship time for deployments, and processing and analysing the data. There is an increasing interest in using Argo data in Norway. Several institutes are involved in the EU-project MyOcean where Argo data are central, and within this project two climate centres are now using the data operationally in climate models.

The present scientific topics are mainly within the Nordic Seas (Norwegian, Iceland and Greenland Seas) and include:

- Studies of the deep ocean circulation in the Nordic Seas. These studies have so far brought new insights in the circulation of the Nordic Seas.
- Water mass changes and also in relation with biological activities. This topic is also one of the reasons that we have included both oxygen and fluorescence sensors on our Argo floats.

5. Issues we wish to be considered and resolved

There is confusion about the oxygen unit. At two different Argo data bases I found two different units, and when looking at the specification for the oxygen optode from Aanderaa there is a third unit.

UK ARGO PROGRAMME

REPORT FOR ARGO STEERING TEAM 11TH MEETING, MARCH 2010

The UK Argo programme is undertaken by a partnership between the Met Office (who manage the programme), the National Oceanography Centre Southampton (NOCS), the British Oceanographic Data Centre (BODC) and the UK Hydrographic Office (UKHO).

The most important issue for the UK programme is in securing continuing and ongoing funding for UK Argo and ensuring the long-term delivery of data from the global 3,000 float Argo array.

Floats deployed and their performance

Floats deployed. Since 2001, 288 UK floats have been deployed (including 5 floats donated to Mauritius) in support of the Argo array, as shown in Table 1 and Figure 1 below. (Argo equivalent floats are those that have been procured using research grants rather than from designated UK Argo funding.) Fewer deployments were made in 2009 due to the Druck 'microleak' problem and need to replace the sensors.

Year	UK Argo floats			Argo equivalent floats
	Apex	Provor	Mauritius	
2001	25	2		2
2002	33	1		4
2003	17	5	1	15
2004	33	12	2	
2005	27	1		
2006	24		2	
2007	27	4		2
2008	28	1		
2009	20			

Table 1. Numbers of UK floats contributing to Argo deployed by year (including floats donated to and deployed by Mauritius).

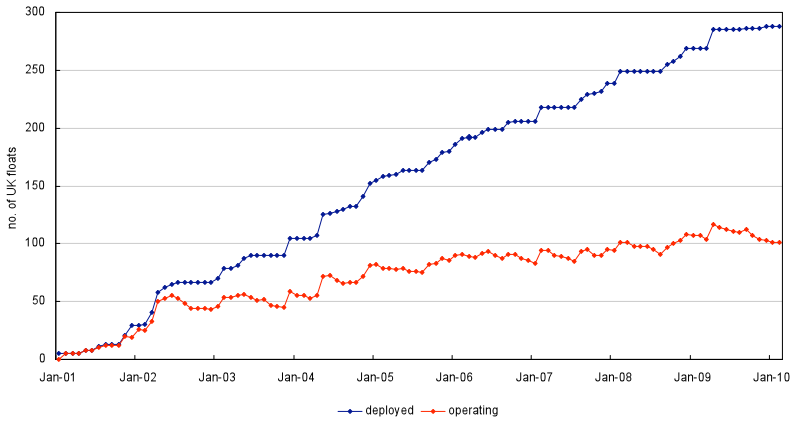


Figure 1. Number of UK floats deployed that contribute to Argo and the number operating by month.

There were 101 UK floats operating at end February 2010. There has been a distinct improvement in the survival of our Apex floats deployed since 2004 to those deployed in the earlier years in terms of cycles completed (normalised to 2,000m for floats that make

shallower profiles or only profile to 2,000m intermittently, with invalid cycles due to pressure transducer failure discounted and deployment failures omitted), as shown in Figures 2 and 3.

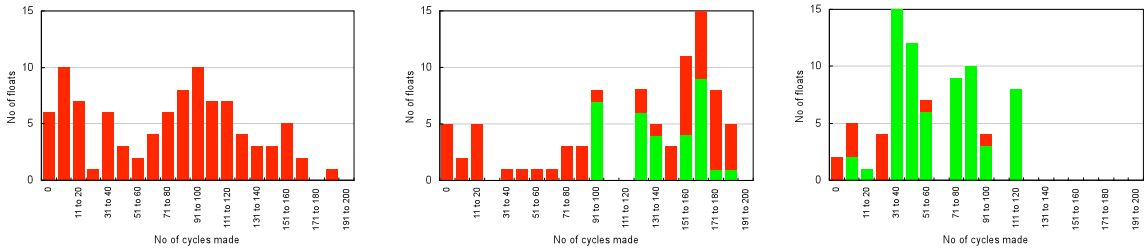


Figure 2. Number of (normalised) cycles made by UK Apex floats deployed in 2001-2003 (left), 2004-2006 (centre) and 2007-2009 (right). Operating floats are shown in green, with dead/failed floats in red.

Only 30-40% of floats deployed before 2004 made more than 100 cycles. However, for floats deployed in 2004 and 2005 around 70% and 75% exceeded the 120 cycle mark. For floats deployed in 2006 and 2007, around 75% have exceeded 80 cycles.

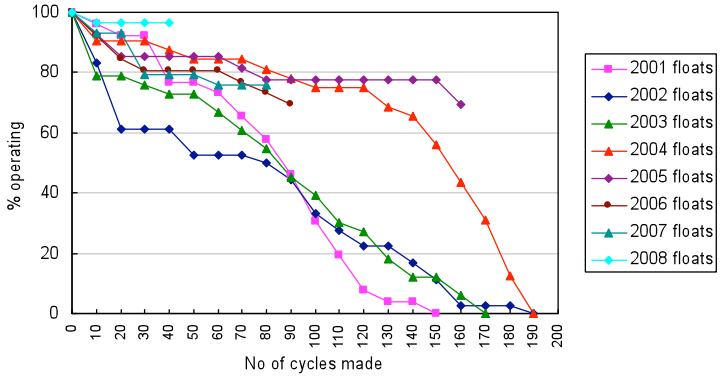


Figure 3. Float lifetime (in terms of number of normalised cycles completed) distributions for UK Apex floats deployed from 2001 to 2008.

Float enhancements. In 2007 we deployed our first Apex floats with lithium batteries and have now deployed 30 floats with such batteries. 5 of these have failed early: 1 on deployment, 1 after 3 profiles and 1 after 29 cycles (suspected due to a slow water leak). The other 2 early failures were after 21 cycles and most likely due to damage from Antarctic ice. All Southern Ocean floats considered at risk of ice are now specified with ice-avoidance capability. So far 8 floats with ice-avoidance have been deployed (in 2007 and 2008) and all except 1 (which survived for 3 years) are presently operating.

In 2008 our first 2 Apex floats with near surface temperature measurement capability (unpumped measurements) were deployed and another 4 were deployed in 2009. All are working normally at present. All new floats (apart from those with ice-avoidance) will now have this capability as standard.

Technical/engineering web-site. We have established a partnership with CSIRO, Australia to develop an engineering web-site for UK and Australian Apex floats (see http://www.cmar.csiro.au/argo/) enabling the performance of deployed UK (and Australian) Apex floats to be monitored and assisting failure cause diagnosis.

Deployment plans for 2010 and 2011

At the end of 2009 we had 26 Apex floats available for deployment, with 58 new Apex floats scheduled to be delivered by end March 2010. This will give us a stock of 84 floats for deployment in 2010 and 2011, although the actual deployments have still to be arranged. It is planned on making up to 40 float deployments in both 2010 and 2011. The floats are ballasted for the areas as shown in Table 2.

Atlantic Ocean
9 Apex for north-east Atlantic (Iceland Basin/Rockall Trough)
14 Apex for north-east Atlantic (~26N)
12 Apex for South Atlantic(~15S)
10 Apex for south-east Atlantic (~36S)
Southern Ocean
14 Apex for Atlantic sector (50-60S)
Indian Ocean
9 Apex for Arabian Sea
8 Apex for Somali Basin
4 Apex for South Indian Ocean (~30S)
4 Apex for Mauritius

Table 2. Floats available for deployment in 2010 and 2011.

Data management

The UK Argo Data Centre, established at BODC, processes all our float data (including the floats donated to Mauritius and 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 used by CSIRO Marine to populate the technical web-site.

Delayed-mode. Delayed-mode processing is carried out by BODC with support from the UKHO. Much of the work in 2009 has been working on identifying pressure sensor issues with our floats and correcting the data. A total of 4,492 delayed-mode profiles have now been submitted, this is about 22% of all our profiles eligible for delayed mode QC (i.e. excluding floats that have been operating for less than 18 months). The UKHO are now taking the lead on processing the Arabian Sea floats (~2,000 profiles). It is expected that the backlog of data needing to be submitted will be reduced during 2010 as the vacant real-time processing post at BODC has been filled.

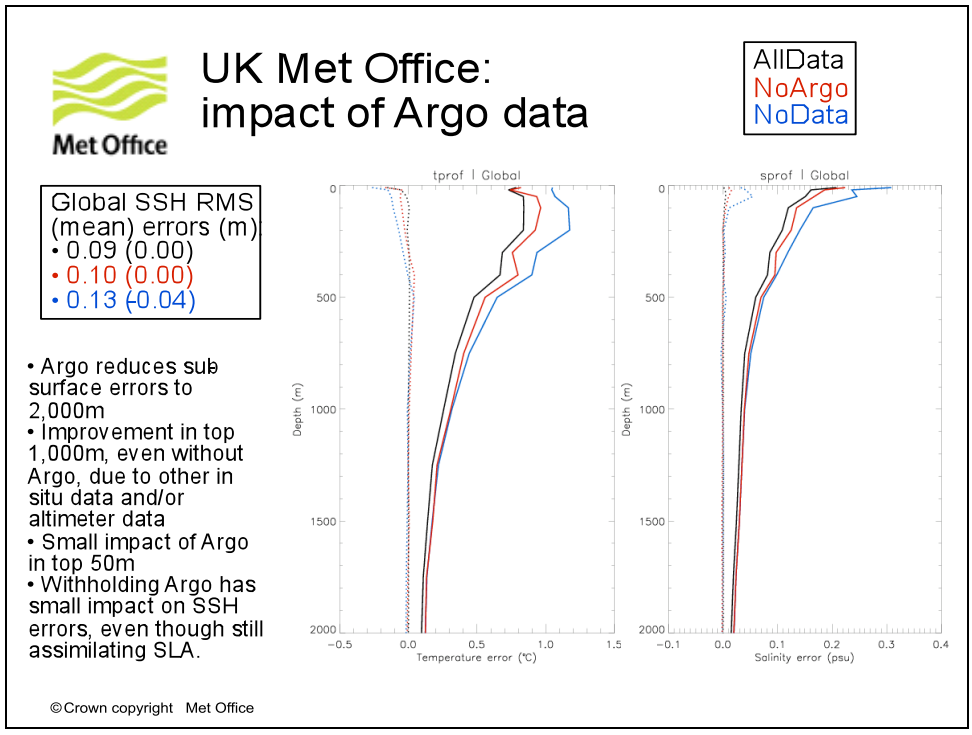
Southern Ocean. We work with 3 other organizations to operate a Southern Ocean Argo Regional Centre (SOARC) and to cover the entire Southern Ocean - BODC (Atlantic Ocean Sector), CSIRO ('Australian' sector), JAMSTEC (Pacific Ocean Sector) and the University of Washington (Indian Ocean Sector). BODC hosts the main SOARC data and information web pages. These pages contain an animation of the Met Office Forecast Ocean Assimilation Model (FOAM) outputs (potential temperature, salinity and velocity at 5m and

around 1,000m depth) and an interactive map giving information on last known positions, deployment positions and direct links to both GDACs ftp sites. Due to resource problems little progress has been made on the Regional Centre activities during the last year.

Under the EC-funded MyOcean project the level of SOARC activities at BODC should increase. Initial plans include the working up and submission of relevant CTD profiles to the NODC which will then filter through to the Argo delayed-mode QC reference data. Collaborative work with the Environmental Systems Science Centre (ESSC) at Reading is beginning that will compare the results of Argo QC to several Met Office operational assimilation QC tests. It is hoped to identify potential improvements for both the Argo QC and operational data assimilation QC systems.

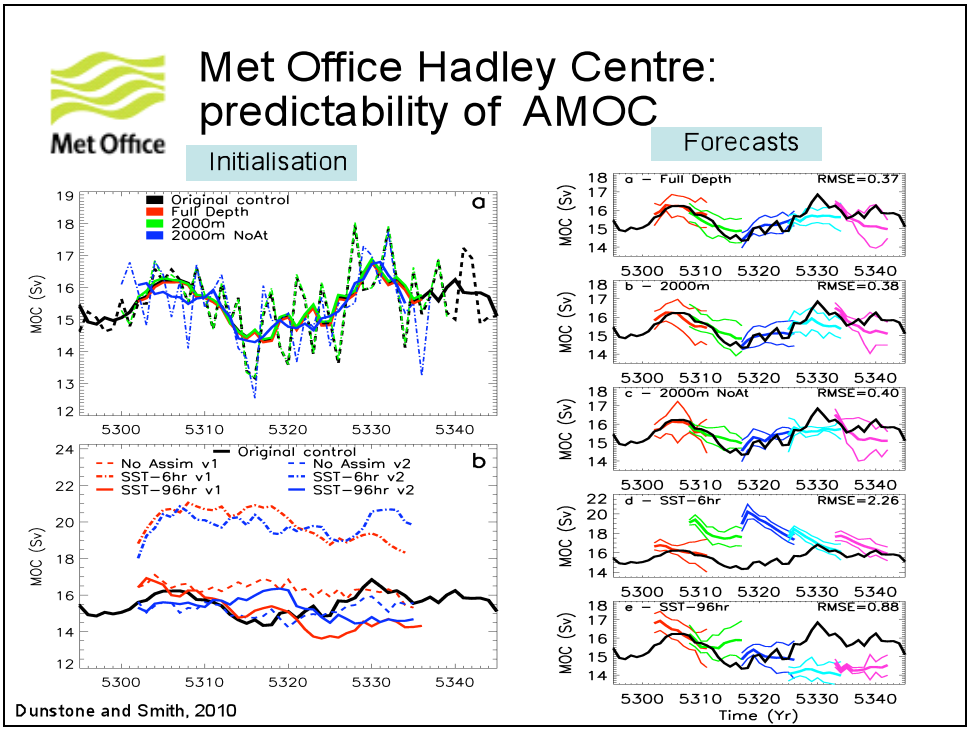
Operational and scientific use of Argo data at the Met Office

Operational ocean forecasting. All Argo data (alongside other in-situ and remotely sensed ocean data) are routinely assimilated into the FOAM operational ocean forecasting system run by the National Centre for Ocean Forecasting (NCOF). A new series of experiments were carried out using the 1/4 degree resolution global FOAM-NEMO system, forced by 6-hourly surface fluxes produced by the Met Office's NWP system, with results (observation minus background statistics) as shown below.



Seasonal to decadal prediction. Argo data are also assimilated by the GloSea (Global Seasonal) coupled model run to make seasonal forecasts for several months ahead. These are more reliable for tropical regions than for temperate climates. Seasonal forecasting is still an area in which the science is being developed and it has been decided that the UK seasonal forecasts will not be made publicly available. On longer timescales the Hadley Centre DePreSys (Decadal Prediction System) is being developed for climate predictions on decadal timescales. The impact of Argo data on decadal climate forecasts has been assessed in idealised experiments (Dunstone and Smith, 2010). These studies attempt to predict the evolution of a control integration of a coupled climate model using pseudo-

observations taken from the model integration. Results show that decadal variability of the Atlantic Meridional Overturning Circulation (AMOC) is potentially predictable given the information that would be available from Argo floats. However, assimilating only sea surface temperatures does not initialise the AMOC correctly, resulting in much less skilful forecasts. Skill is slightly improved, especially in the Southern Ocean, with observations below 2000m. Including atmospheric observations does not significantly improve the skill apart from during the first year.



Climate monitoring and prediction. The Hadley Centre maintain the HadGOA (sub-surface global analysis) dataset of historical temperature and salinity. Variables are on a 2-degree grid and computed on number of fixed isotherms and fixed depths at monthly resolution. 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.

Research using Argo data at NOC

Argo data are also used extensively in a wide range of research projects in UK Universities and research laboratories and are a central component of several PhD and MSc projects. A survey carried about John Gould has indicated there are almost 50 projects/researchers (excluding the Met Office) that are using Argo data. The UK Argo Users' Group has provided a forum for engagement between these scientists and the UK Argo programme. Although this activity has to some extent been taken forward in the context of a European Argo Users Group under the Euro-Argo project, there remains a need to improve the interaction with UK users of Argo data and a Users Workshop was held at Exeter on 16th March 2010.

Research using Argo data at NOC is carried forward mainly, though not exclusively, through graduate students. Current projects include:

Alex Brearley is reconstructing circulation at 36N in the Atlantic using Argo profiles and trajectories. The western boundary is being handled with the addition of repeat ship-based measurements, including shipboard and lowered ADCP, at Line W. The drivers of variability

are being studied, for example the extent to which variation in the basin-scale circulation is a response to changes in the wind-driven Sverdrup transport.

Sally Close is studying seasonal to decadal variations in water mass properties (SAMW, AAIW, NADW, UCDW) in the SE Pacific/Drake Passage/Atlantic sector of the Southern Ocean. All available data are being used, including repeat hydrography, Argo profiles and animal-borne sensors.

Gerard McCarthy is studying decadal changes in intermediate and thermocline water properties in the subtropical South Atlantic, from CLIVAR/GO-SHIP repeat hydrography lines. Argo profile data are being used in support of this study to determine the magnitude of interannual variability and hence to clarify the timescale of observed changes.

Lorna McLean is studying decorrelation scales (from Argo data) in the Pacific and Atlantic basins, their geographic (mainly latitude) and depth variations. Originally motivated for use in data assimilation, the final conclusions will be applicable to the Argo DMQC task.

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.

UK Argo Science Report

During 2009 a report was prepared for the UK Argo funders detailing the latest results from the application and scientific use of Argo data. The report stresses that Argo is an essential element of our climate observation system and that data from Argo has already led to improvements in understanding climate-relevant ocean processes and for predictive models. It concluded that '*the long-term funding of the Argo array of profiling floats is of highest priority for UK climate science and to ensure that the best climate science is used to inform government policies on climate change mitigation and adaptation*'. The report is available at www.metoffice.gov.uk/weather/marine/observations/gathering_data/Science_case_for_Argo.pdf.

Funding

It was initially agreed that MoD and DETR (then Defra, Dept of Environment, Fisheries and Rural Affairs and now DECC, Dept of Energy and Climate Change) would provide matching funding (through the Met Office) for UK Argo, and that NERC would also provide funding and support through NOCS and BODC. However, the funding from MoD has declined since 2005 and funding from DECC (ex Defra) has also reduced and with large year-to-year variations as it has often included year-end underspend monies. From April 2010 all MoD funding will cease as the MoD has decided to withdraw its support for climate research. At the time of writing it is expected that MoD support for data processing at the UKHO will continue. NERC funding has also been relatively variable due to funding for floats relying largely on bids to thematic programmes, although funding for support activities (e.g. data processing, science leadership) has been relatively stable. NERC funding for these support activities has been allocated to March 2012 through the Oceans2025 settlement, with the expectation it will continue after the 5 year Oceans2025 period.

Securing adequate regular funding for UK Argo continues to be a problem, particularly with the cessation of MoD funding. However, the additional 'underspend' funding committed by DECC and NERC in early 2010 has enabled additional floats to be purchased so that UK Argo will be able to deploy around 40 floats in each of 2010 and 2011. Regular funding for personnel (programme management, technical support and data management) remains at a minimum level.

Considerable time and effort has been (and continues to be) expended in trying to secure longer-term funding for UK ocean observations that have been committed to international programmes such as the GOOS, GCOS and the GEOSS; with Argo as a pressing example for the need for a solution. This has so far been unsuccessful as there is currently no mechanism within UK Government to transition funding from research to operational funding lines. However long-term (9 years) funding for Jason-3 has now been agreed, after the issue was elevated to senior ministers.

During 2009, as a response to the 'Investigating the Oceans' report a new high-level cross departmental Marine Science Coordination Committee (MSCC) has been established, reporting to a Ministerial Marine Science Group. The initial task of the Committee was to develop a UK Marine Science Strategy, this has now been signed off by the Ministerial Marine Science Group, where a priority task is to "*develop a transparent prioritisation tool to help inform decisions on the funding of observation systems (for both starting and stopping observation systems*" and to "*also develop practical proposals to provide cross-cutting, longer-term funding for priority long term monitoring systems*". Hence sustained funding for long-term observations, such as Argo, will be one of the strategic issues the committee will be addressing in 2010.

Euro-Argo

Both the Met Office and NERC are involved in the Euro-Argo project (January 2008 to December 2010) to develop and recommend a European infrastructure to enhance the collective ability of the European nations to contribute to Argo, to the level where 'Europe' has the capacity to deploy ~250 floats per year, and to process the resulting data. Such a European contribution would support approximately 25% of the global array and provide an additional 50 floats per year for enhanced coverage in the European and marginal seas. This will require long-term funding commitments from the European partners and from the EU (via GMES). The Met Office and NERC are leading on several Euro-Argo work packages (WP3. Financial Work and WP6. Strengthening the User Community respectively) and the Met Office also lead on the WP5.3 Impact Studies and Demonstration Cases task. One outcome of WP6 is an educational outreach site focussed on Argo (see http://www.noc.soton.ac.uk/o4s/euroargo/).

DECC have advised that UK should go for full membership of the Euro-Argo ERIC (European Research Infrastructure Consortium) and sign off is expected to be via a DECC minister), but at present their longer-term commitment is only at a minimum level (and well below the level at which the UK ought to contribute). However, NERC have 'earmarked' longer-term funding for Euro-Argo but this is not, as yet, a commitment. In parallel with the work through the cross-government MSCC this should ensure the issue of UK Argo funding is raised to the Ministerial Marine Science Group for a decision on longer-term funding.

USA Report to AST-11, La Jolla California USA, March 2010
(Submitted by Dean Roemmich)

Organization:

U.S. Argo is supported through the multi-agency National Ocean Partnership Program (NOPP). It is implemented by a U.S. Float Consortium that includes principal investigators from six institutions: Scrips 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 production, deployment and data system functions are distributed among these institutions on a collaborative basis. Following two years of pilot activity supported by the Office of Naval Research (ONR) and the National Oceanic and Atmospheric Administration (NOAA) (FY99, FY00), and a 5-year (FY01-05) full implementation phase under NOPP, the Argo project is now in the fourth year of a five-year continuation, supported by NOAA and (for FNMOC participation) the Navy.

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

The present 5-year cycle of U.S. Argo implementation will end in mid-2011.

Support level:

The support level for U.S. Argo is aimed at providing half of the global Argo array. The target level is 1500 active floats, based on a deployment rate of about 410 floats per year. There were 316 floats funded in FY02, 344 in FY03, 410 in FY04, 410, in FY05, 390 in FY06, 368 in FY07 and about 360 in FY08. Due to level funding, further incremental reductions in float numbers are likely.

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.

Status:

As of March, 2010, there are 1770 active U.S. Floats that have provided at least one profile in the past 12 days. Of these, 88 are Argo-equivalent floats provided by partnering programs, and the rest are provided by U.S. Argo. From January 2009 to March 2010, 271 floats were deployed by U.S. Argo (Fig 2), plus 63 Argo-equivalent floats by U.S. partners. The large number of active U.S. Argo floats relative to the target number of 1500 reflects the high deployment rate in 2005-2006, to clear a backlog of instruments funded but not deployed earlier. A concern for the international array is that the number of U.S. floats is likely to decrease in the future below the 1500 float target number.

U.S. float deployments in 2009 were reduced due to the CTD pressure-sensor microleak problem, with deployments restarting in late 2009 following a hiatus of several months. A substantial backlog of 2009 instruments remains to be deployed. The majority of U.S. Argo float deployments during the year were in the Southern Hemisphere. This included a major cruise deploying 99 U.S. floats in the South Indian Ocean, jointly staged with Australian Argo and New Zealand Argo on R/V Kaharoa.

Out of 1886 Argo floats presently active in the Southern Hemisphere, about two-thirds have been provided by the U.S. Priorities for float deployments are established by the U.S. Argo Science and Implementation Panel, comprised of members of the U.S. Float Consortium and representatives of Argo data user groups. The highest priority is deployment of a global Argo array. Specific plans for 2010 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 is planned in late 2010 on R/V Kaharoa.

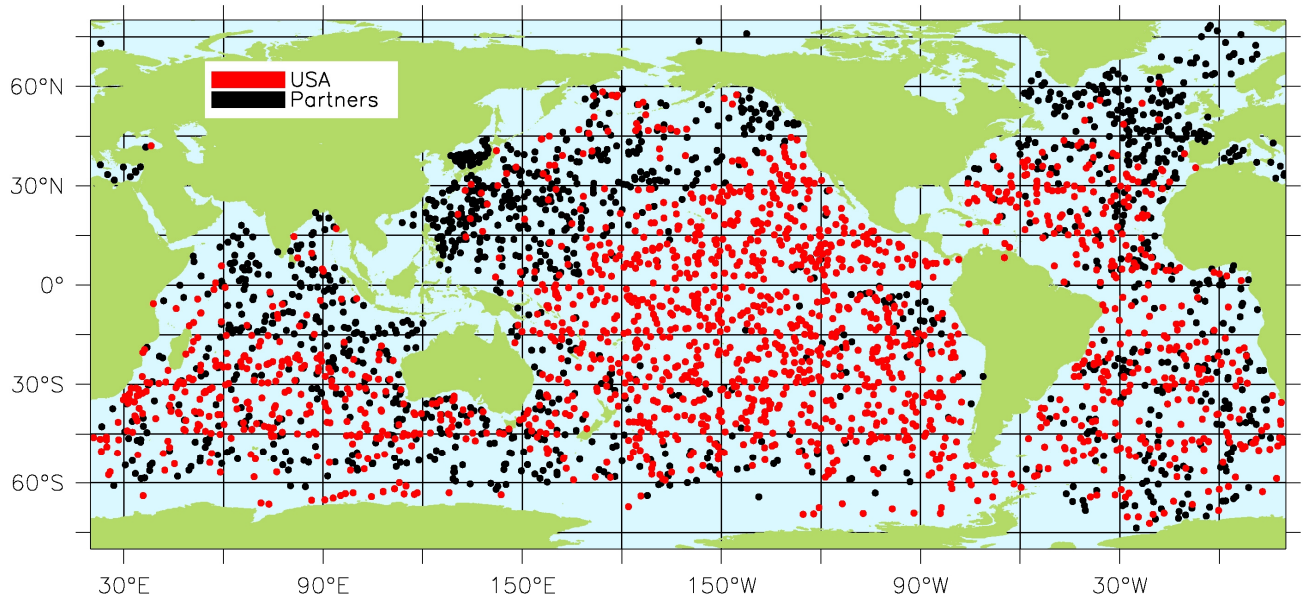


Fig 1. Positions of all active Argo floats in black, with positions of active U.S. Argo floats in red, March 2010.

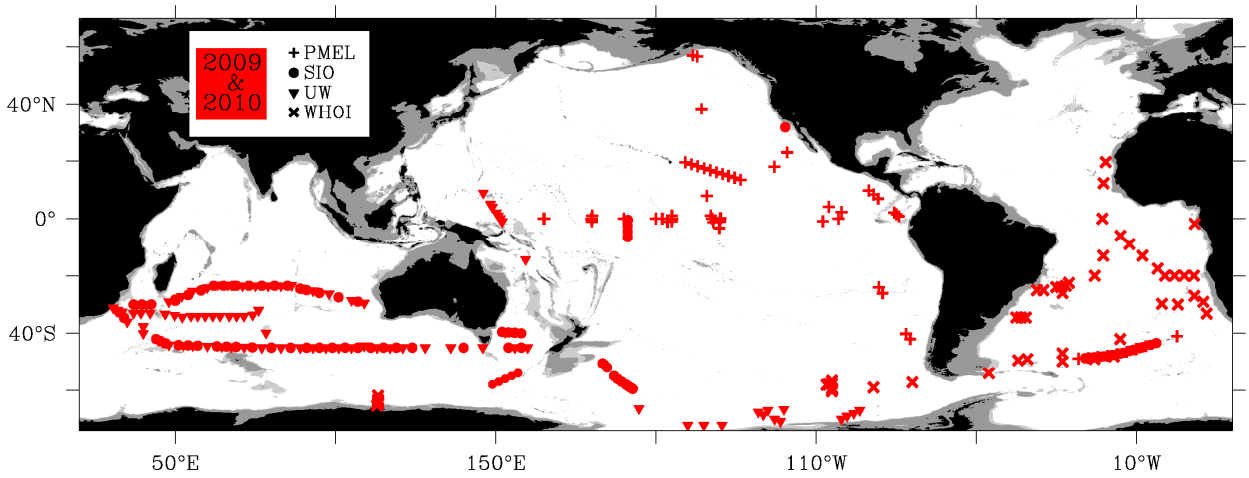


Fig 2. Positions of U.S. Argo deployments during 2009 and early 2010.

A continuing effort in U.S. Argo is aimed at technology improvement: for increased float lifetime and improved performance. Ongoing improvements in reliability have been demonstrated in recent years. Out of 430 U.S. Argo (PMEL, SIO, UW, WHOI) floats deployed in 2004, 114 remain active as of March 2010. The floats deployed in 2004 have, while they were active, completed an average of 155 10-day cycles. The objective of a 4-year mean lifetime (i.e. 146 cycles) has been achieved with these floats. Floats deployed in 2005 and 2006 appear to be doing even better. A goal of U.S. Argo is to extend average float lifetimes beyond 4 years.

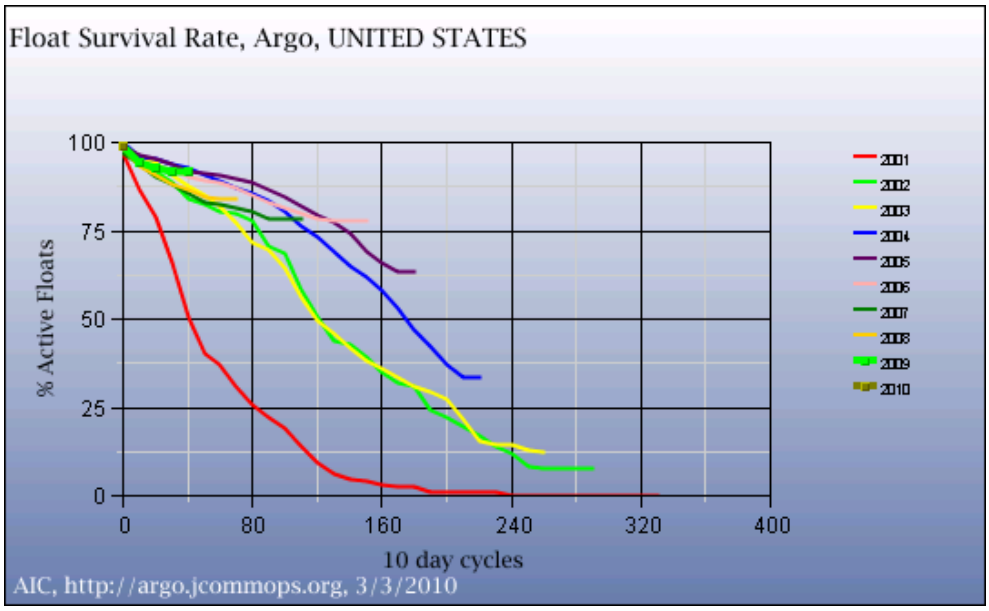


Fig 3. Survival rate for U.S. floats, including Argo-equivalent, by year of deployment (source: AIC).

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) and operating around-the-clock, running software developed at AOML to implement 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 2009, the U.S. backlog in delayed-mode quality control was substantially reduced (Fig 4).

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.

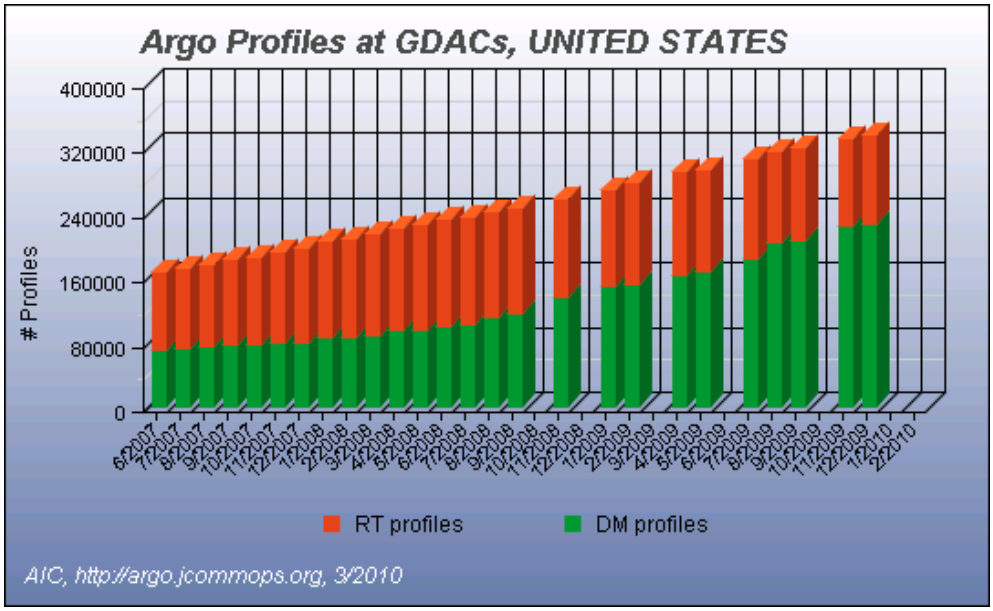


Fig 4. Number of profiles held at GDACs for U.S. floats (source: AIC), including those with delayed-mode and real-time levels of quality control. Roughly 65,000 of the RT profiles are less than one year old and not yet eligible for DM processing.

Uses of Argo data – OceanObs'09

U.S. Argo participated extensively in the OceanObs'09 process and conference (http://www.oceanobs.net) through Argo-related Community White Papers and plenary presentations. OceanObs'09 demonstrated the high societal value and broad uses of Argo data.

With regard to basic research, there are now more than 160 peer-reviewed papers using Argo data and having a U.S.-based lead author (http://www.argo.ucsd.edu/Bibliography.html) .

Issues

The U.S. Argo Science and Implementation Panel held its annual meeting in Dec 2009 at the University of Hawaii. Some issues discussed there included:

- Ongoing impacts on operations and data quality of the pressure-sensor microleak problem.
- Requirements for dedicated ship time for deployment in remote regions.
- Sparse coverage of Argo floats south of 45^{o}S.
- Need for increased effort on identifying and correcting systematic errors in Argo data.
- Continuing improvements in float technology – lifetime and capabilities.