8th meeting of the International Argo Steering Team

Paris, France
March 6-9, 2007

Contents

Meeting Summary

The 8th meeting of the international Argo Steering Team was held in Paris on March 7-9 2007, hosted by the Intergovernmental Oceanographic Commission (IOC) of UNESCO.

IAST-8 focused on the maturing nature of the Argo project, identifying a number of issues and opportunities that arise as Argo transitions from its implementation phase of the past few years to its sustained maintenance phase. A discussion of this transition was led by J. Gould (Agenda item 8.1), and most of the meeting agenda was devoted to issues related to the transition. Highlights of these included:

National funding (Agenda item 5). Most Argo national programs continue to be supported by research funding, which poses difficulties for sustaining the observations over decadal timescales. Mechanisms for long-term support are required.

Operational applications (Agenda item 7.1). It is recognized that operational applications will have a major role in justifying a sustained Argo project. In the interest of understanding the present status and data requirements of operational applications, and to encourage more communication between Argo and the operational centers, a mini-symposium was held including presentations/discussion with representatives from most of the operational users of Argo data.

Argo Information Center (Agenda item 8). In addition to providing a mechanism for satisfying IOC Resolution XX-6 on float deployment notification, the AIC's Argo Technical Coordinator has developed many useful tools and applications for float tracking and provides technical support for a range of activities such as recovery of beached instruments. For a mature Argo, the sustained activities of the Technical Coordinator and relationship to other JCOMMOPS functions must be defined, as well as identifying sustained support for the AIC.

Data quality issues (Agenda item 6.1). Recent problems with incorrect pressure binning in Argo/WHOI FSI floats has highlighted the need for Argo to become more proactive in rapidly identifying and correcting data quality problems. Specific steps were discussed and agreed.

Reference data (Agenda items 4.1, 6.2.2). The primary data quality issue for profiling floats is detection and adjustment of salinity drift caused by bio-fouling. For delayed-mode quality control, Argo requires a global database of reference quality CTD data with emphasis on recent data. A separate but parallel issue is to learn the extent to which Argo data from newer floats can be used as a reference for adjustment of data from older instruments.

Extending float lifetimes (Agenda item 6.7, 6.6). For the long-term maintenance of the Argo project, and recognizing the difficulty in deployment of floats in remote ocean regions, it is desirable to extend the lifetime of profiling floats beyond the present capability of ~4 years. Extended lifetimes of 6+ years can be attained with technical improvements.

New sensors on Argo floats (Agenda item 6.4). Argo floats provide potential platforms for accommodating additional sensors that may increase the scientific value of the Argo array. Any additions must be carefully considered and cannot impact the core capabilities of Argo, including float lifetime. A proposal for an oxygen pilot program was presented.

This meeting report includes appendices attached to this document plus other supporting documentation in a separate file.

1. Welcome and introduction

Patricio Bernal, Executive Secretary of the IOC, welcomed the Argo Steering Team to Paris and reflected on his long involvement with profiling floats for research. He invited Argo to continue working together with the IOC to provide high quality ocean data. He stressed international collaboration and the opportunities for Argo to act as a platform for other sensors such as oxygen.

Action item 1: HF to send letter of thanks to IOC/ Bernal, cc to Keith Alverson, Candyce Clark.

2. Action items from AST-7

Actions from AST-7 were either accomplished during the previous year or will be addressed in specific agenda items at the AST-8 meeting.

3. Issues from ADMT-7

S Pouliquen summarized the achievements of the Argo Data Management activities that were discussed at the last ADMT meeting. The complete report can be found at http://www.coriolis.eu.org/cdc/meetings/Argo-DM-report-7th.pdf. The main problems in real-time have been solved and nearly 90% of the floats are distributed on the GTS within 24 hours. A comparative test is under way to compare real-time qc procedures at all DACS and a report will be issued when results from JMA, Meds and KMA are received. From email discussions, as forecasted, the problematic tests are the spike test and the density inversion test which will need some adjustments at DACs.

Another track for improvement is at the GDACS, firstly for improving data checks, especially in delayed mode files and trajectory ones, secondly for strengthening the synchronization process between GDACS.

At the last AST meeting it was recommended to apply the persistence from the last Delayed Mode offset computed from the deep profile as soon as possible. Meds has been applying it since the end of 2006, AOML just started, JMA and Coriolis is planned in April, INCOIS in August and Korea end of 2007. CSIRO plans to apply it this summer as they would like to do perform additional test to verify this correction against CDT correction applied at present in real-time. No plan is known at present for BODC and CSIO.

Concerning the Reference Database needed for Argo we are progressing on the decision taken at last ADMT:

1. Provide visibility on what exists : see http://www.coriolis.eu.org/cdc/dmqc_reference_db.htm
2. Coordinate with NODCs and CCHDO: action at next IODE meeting by Steve Diggs
3. Develop procedures for yearly updates at Coriolis

Argo Regional Centers are progressing at different speeds but all are working on the mandatory functions. An ARC meeting prior to the ADMT will be proposed to ARC managers in order to try to further developments and benefit from other experiences.

The following issues were raised and are addressed later in the agenda:

- Pressure offset correction: what about correction of PRES parameter in RT as DM workshop recommended to do it only in delayed mode

- What about O2 parameter QC?
- Who will study the impact of using Argo floats in the reference DB as DM workshop recommended not to do it and has not planned any action on this issue
- Glider data and Argo: can we provide guidelines for format so that it is easy to use these data together with Argo data.

Moreover it would be interesting to get feedback from the GODAE-QC pilot project coordinated by Jim Cummings, in order to better identify the errors detected by operational users of Argo floats. This point was mentioned later during the Operational User session.

Finally S Pouliquen expressed the worry on manpower allocated to Argo Data management activities. She has the impression that with the increase of the number of active floats, DACs and GDACs are busy guarantying the data provision in real-time and not enough manpower is available for the validation of the Argo data set especially in near real time in order to detect anomalies earlier.

4 Other data management issues

4.1 CTD data for updating the Reference Database

The CLIVAR and Carbon Hydrographic Data Office at SIO (CCHDO) and Argo/Coriolis are building a climatology of WOCE-quality CTD data for the global ocean. This data set, ideally, should consist of CTD profiles from the last 12 months from all oceans and the Mediterranean Sea. These data will not be released to the public, but will only be used in this climatology to estimate salinity drift in Argo sensors. The data will be updated as CTD datasets are fully quality controlled by each scientist.

In the recent past, Argo has approached various organizations in order to secure these CTD profiles in a timely manner. However, we have been able to acquire much of the known data. In retrospect, asking for any data from the last year would be logical, yet these types of requests seem to overwhelm the various national oceanographic data centers (NODCs), whose mission often does not involve the dissemination of recently received data.

A different approach may be to initiate contact and request one recent CTD profile and perhaps a partial data inventory from the last 12 months from a PI or national ODC. In this way, positive responsive contact with an organization may be established and a useful dialog initiated since asking for one profile should not be as intimidating as asking for an entire catalogue of cruises. Once a file is received, Argo/CCHDO can better assess the feasibility of reading in that data center's native format and the man-hours required to convert the file to a useful format, suitable for inclusion in the Argo climatology.

If a data center or PI cannot send at least a single CTD profile quickly, there isn't much hope of receiving an entire cruise of data in a timely manner and we should look for other alternatives in order to gain access to each center's data holdings.

Action Item 2: Each national program will identify or send Steve Diggs data from a recent CTD cruise to track the file through the system from acquisition to delivery to availability from CCHDO. sdiggs@ucsd.edu

4.2 Are organized training sessions needed for DACs?

Some countries regularly express needs for information and "training" on Argo data management and some have contacted other Argo participating institutes directly for such assistance. This information/training has been done on a best effort basis. Coriolis and AOML have both provided training. For example, INCOIS got POGO funding to send a person to Coriolis for three months. Arrangements have usually been made on a bilateral basis and no decision was taken to do it another way in the future.

The question of Delayed Mode training was raised by S Pouliquen. B King explained that some training has been provided at the delayed mode workshops and by emails and it was decided to continue that way or via bilateral agreements between institutes.

Action item 3: All Argo representatives to check the POGO site for fellowship funding opportunities and closing dates for funding. www.ocean-partners.org

4.3 Glider plans; practical issues for inclusion of glider data

The treatment of glider data within the Argo data system was discussed. Although the glider profile data is quite similar to that Argo profiling floats, there are subtle differences than need to be considered. Gliders often take measurements both during their descent and ascent. In contrast to float profiles for which we only know the position at the surface, usually at the end of the profile, the gliders acquire accurate GPS positions just prior to and immediately after each dive. Information about their ascent and descent is also available. Since the gliders are self-propelled and travel horizontally at speeds of order 25 cm/sec, the positions for the top and bottom of a profile can be significantly displaced, by several kilometers for a dive to 1000 m. For gliders in the close vicinity of strong fronts, data assimilation models require that the slant-wise movement of the gliders needs to be taken into account (J. Cummings, personal communication). While the descending and ascending portions of a glider dive can be broken into the equivalent of two float profiles, these equivalent profile data files will have two positions, at the top and bottom of the profile, associated with them.

Thus, there is effectively only one change that needs to be made to the profile data format used in Argo to incorporate glider data. Where the present format has only a single position and time associated with each profile, a glider profile file should include a pair of positions and times to reflect the added information that is available for each profile. The simplest remedy would be to add a second dimension, of length 2, to the position (LATITUDE and LONGITUDE) and time (JULD) NetCDF variables. Alternatively, a set of additional variables, for example LATITUDE_BOTTOM, could be used to store the position and time at the bottom of the profile and a convention established that the existing variables would contain the information for the top of the profiles as is currently the case for floats. Note that this is probably the minimum change that is needed. Gliders are presently being equipped with acoustic doppler velocimeters so that their positions can be estimated throughout their dives and for this case the appropriate solution would be to prescribe a position and time for each measurement in the profile.

The choice between the simplest format change and one that solves the more general case should be finalized at the next ADMT meeting.

Action item 4: B. Owens and S. Pouliquen will work together to update format of glider data, which SP will circulate.

5 Assessments of long-term funding prospects

National funding

National programs submitted reports with funding prospects which are appended to this report. As a reminder, please keep international Argo informed of ways in which Argo can help national programs.

ESFRI funding
P.Y. Le Traon gave a summary of the Euro-Argo initiative. Euro-Argo was labeled as a new research infrastructure for Europe and will receive funding from the European Commission (EC) for a preparatory phase (PP) proposal. The proposal objective is mainly to develop long term plans and agreement (financial, legal and organization) for the European contribution to Argo (250 floats/year, including 50 floats for regional enhancements). The different participating countries will work with their national funding agencies (ministerial level) to sustain Argo on the long term. We will also work with GMES/GEO to prepare a direct EC contribution to the infrastructure. The proposal will also be used to make a better case for Argo and to continue improvements in the data system (GDAC, ARC) and technology. The objective is to be ready to deploy the European infrastructure by 2010 for at least the next 10 years.

AIC funding
The AIC office is experiencing both short term and long term funding difficulties. These issues have come to the front recently because of the rapid ramping up of a reserve fund for termination costs required by UNESCO for any staff member employed longer than six years (the Argo Technical Coordinator, M. Belbéoch, was hired by UNESCO in February 2001). In the short term, there is not enough money to pay the ATC, M. Belbéoch, much past the end of 2007 unless more money is contributed. There is also a large jump in required reserve funds for 2008, after which the annual increase in the reserve fund levels out. Therefore, Argo needs 5 countries contributing $10,000 per year for the next two years to get over this short term money shortage. It would also be possible to contribute travel costs directly for countries who cannot contribute directly to salaries. Countries can also make sure to send their contributions as early as possible.

The long term prospects involve participation in a potential expanded JCOMMOPS that would provide infrastructure support for many observing programs including Argo, DBCP, etc. Input from AST members was requested on a list of specific Argo requirements for such an integrated observing support center; the overall requirements for an expanded JCOMMOPS will be discussed at the upcoming JCOMM Observations Coordination Group (OCG) meeting (23-25 April 2007, Geneva) . The request for proposals for potential hosting institutions will come out in the middle of this year, with the new infrastructure most likely actually starting in 2009. This structure could include both an Argo director and an Argo technical coordinator which could potentially be advantageous for Argo. With the addition of an Argo director, more funding would be needed. J. Gould is working on finalizing the list of requirements for Argo and will participate in the upcoming OCG meeting.

Action item 5: HF to contact countries not currently contributing to the Argo infrastructure

6 Technical issues

6.1 Pressure offset errors in WHOI FSI floats

The errors in pressure for the profile data from WHOI SOLO floats equipped with FSI CTDs were recently announced by the Argo Executive. These errors were first discovered by Josh Willis and John Gilson who compared both the mean difference between float temperatures and

the WOCE climatology and the scatter from profile to profile for a 10° by 10° square in the South Atlantic. The mean error is largest within the thermocline at approximately 400 m depth.

These floats reported bin averaged values for temperature and conductivity. Pressure was not directly reported, but was inferred from the bin number. Requests to the vendor were for the bin averaging to be done from the surface downward. Unfortunately, the averages were done from the bottom pressure upwards. Intended bin intervals were 50 dbars for bins starting below 400 dbar, 20 dbars between 200 and 400 dbars and 5 or 10 dbars for depths above 200 dbars. Because of the decreasing bin size as the data was processed, the number of bins and the breakpoint between bin intervals is very sensitive to starting pressure.

For a fraction of the float profiles (approximately 4000 profiles), the value for the bottom bin pressure was transmitted in the engineering data. For these floats, the profiles can be corrected exactly. For a majority of the float profiles (approximately 8000 profiles), there was an additional error in the code in the float controller and the bottom bin pressure was not correctly reported. At the end of the drift phase, all these floats made a temperature, conductivity, and pressure measurement, and then descended to their maximum depth before profiling to the surface. The time interval between the drift measurement and those made for similar depths during the profile are between 3 and 4 hours. A procedure is being developed to use the drift data to estimate the bin intervals. Preliminary indications are that this will reduce the rms pressure errors below 400 m to about 5 to 10 dbars, but it will not eliminate the error.

These floats have all been placed on the gray list, so that they will not be transmitted on GTS. The corrected files will be submitted to the GDACs as soon as possible.

The discussion following the presentation focused on how to better evaluate the Argo data in an effort to discover this type of systematic problem more quickly in the future. Action items 9 and 10 below are the first steps toward having a better system in place. Action item 9 focuses on doing a better climatology check where PIs can be notified if their floats are providing questionable data. Since the PI is usually an expert in the area of float deployment, they can look more closely at the questionable data and make a decision on whether or not it is acceptable. Action item 10 is aimed at developing additional identification tools to catch systematic problems that a climatology check might miss. These two different lines of defense should help lower the likelihood of this type of incident occurring again.

Action item 6:
The following notice will be posted on the Argo web site and circulated to Argo users following confirmation of greylisting:

Update: Important notice to Argo users (pressure offset errors)

The cause of pressure offset errors in WHOI FSI Argo floats has been identified (incorrect assignment of pressure bins). Most of the affected profiles can be corrected, some more accurately than others. When available, corrected profiles will be provided in the near future. The following is guidance for research and operational users:

Research users are advised not to use WHOI FSI Argo floats (INST_TYPE # 852) for scientific analysis until corrected data and error estimates are provided. A list of WMO ID numbers of these floats is provided on the Argo Steering Team website (http://www-argo.ucsd.edu).

Operational users are advised that all affected floats have been grey-listed, and the data are

excluded from GTS transmission as of 9 March 2007. The data are available from global data assembly centers, but should be regarded as "probably bad" regardless of present quality flags. Corrected data will be provided via the GDACs in the "parameter adjusted fields".

For full documentation of the Argo data system, see http://www.coriolis.eu.org/cdc/argo_rfc.htm
Action item 7: Ask AOML to flag PRES_QC '3' for all WHOI SOLO_FSI floats. (S. Garzoli, C. Schmidt)

Action item 8: Breck Owens to send a list of floats to AOML that can and cannot be corrected in real time with details of correction procedure.

Action item 9: The US DAC will be asked to make a recommendation on improved use of climatology checks for the purpose of identifying systematic problems in Argo data. Such testing is not to be part of the automated real-time quality control process, but rather for referral of questionable data to PIs (or other personnel as appropriate for the National Program) for further examination. (D. Roemmich)

Action item 10: A working group chaired by H. Freeland will investigate the use (or development) of Argo products as tools for identification of systematic problems in Argo data. (H. Freeland)

Action item 11: The following warning should be prominently shown to users acquiring Argo data from GDACs: (S. Pouliquen)

Argo near real-time data is subject to only coarse fully-automated quality control checks.

Argo delayed-mode procedures for checking sensor drifts and offsets in salinity rely on a statistical comparison of the float data with reference data. An adjustment is made when the float PI judges that it will improve the quality of the dataset. Users should include the supplied error estimates in their usage of Argo delayed-mode salinity data.

For both near real-time and delayed mode data, proper and appropriate use is the responsibility of the user.

6.2 Report from DMQC-2

B King summarized some of the key points from DMQC-2, which had been held at WHOI in October 2006. The meeting report is published on the Argo website at http://www.argo.ucsd.edu/FrUG_reports.html.

Between October 2006 and January 2007, the number of different floats with D files at the GDACs went up by 195, so that 1601 floats now have at least some D mode data. In the same period, 291 new floats had been deployed, so the rate of DMQC is not yet matching the rate of acquisition of new profiles (whether counted by either number of platforms or number of total profiles). However, a number of groups expect to make major uploads of D files in the near future. D Roemmich proposed that the co chairs should write to national programs and notify them that AST wanted them to clear their backlog of 'overdue' D files by the end of calendar year 2007. If programs did not expect to be able to achieve this, they should explain what their constraints are (for example, lack of manpower, lack of expertise, lack of adequate reference data). Where there is a lack of expertise, experienced operators/PIs should provide assistance. The initial point of contact for requests for assistance with expertise would be B. King.

Action item 12: DMQC backlogs should be cleared this calendar year. Based on the percentage of 'D' floats by 1 September, 2007, D. Roemmich & H. Freeland will write letters to programs that appear unable to clear back log by end of the year.

6.2.1 DMQC Inter-comparison:

The results of the DMQC inter-comparison were shown. The power point is available on the AST-8 website and as part of the supporting documents file- to the AST-8 report and a full draft written report will be made available on the Argo ST website soon.

Recommendations from the DMQC inter-comparison were discussed, and generally agreed to. Brian King and Susan Wijffels will formulate the recommendations and elicit comments and discussion from the DMQC operators and ADMT.

Recommendations and Supporting Notes:

Most DACs followed Argo data policy of preserving the R/T QC flags on the raw fields and editing the QC flags in the adjusted fields. This practice may be inadequate in the long-term, as future efforts (say by an ARC or scientist) to revisit the drift adjustments will have to disentangle QC changes associated with poor R/T QC screening and QC flags associated with the quality of drift adjustments/thermal lag adjustments. We should consider changing the raw QC flags in DMQC so that this man-power intensive component (despiking, flagging deep hooks, correcting R/T QC errors) is made distinct from the other DMQC adjustments – thermal-lag and drift assessment? This practice could be implemented immediately.

1. When QC flags are re-examined and edited in DMQC, these edits should be made to the RAW QC fields and not the ADJUSTED QC fields. RAW QC flags 1 & 2 should then be propagated to ADJUSTED, 3 and 4 should be set to 4 in ADJUSTED and filled with missing values as per the DMQC manual [check manual]

Currently it is difficult for our users to know which float profiles have been delivered by very good and stable sensors and which have suffered drift errors. There are many studies that would benefit from only analyzing the 'best' Argo data.

2. Alert users of which profiles have been adjusted substantially by adding a column to the Argo index file maintained on the GDACs. The column would contain PSAL_RAW - PSAL_ADJUSTED averaged over the lower 500db of profile [this should be same as for RT].

If recommendation 1 is accepted and put into practice, then PSAL_ADJUSTED_QC is now available to indicate just the quality of salinity adjustments, PSAL_ADJUSTED. We could envision using:
QC = 5 – means adjusted to reference data and to use CALIB_COMMENT to describe the reference data base used.

Action item 14: S. Wijffels & B. King will compose a statement and send it out to argo-dm-dm/argo-dm-rt lists saying:

When QC flags are re-examined and edited in DMQC, these edits should be made to the RAW QC fields and not the ADJUSTED QC fields. RAW QC flags 1 & 2 should then be propagated

to ADJUSTED, 3 and 4 should be set to 4 in ADJUSTED and filled with missing values as per the DMQC manual [check manual].

Action item 15: Add the average difference between the adjusted and raw salinity in the bottom 500m or same procedure as in R/T GDACs to the index file. (S. Pouliquen)

6.2.2 Use of Argo data in the reference database

An informal committee of J. Gilson, G. Johnson, B. King, B. Owens, and A. Wong was set up to discuss the use of Argo float for delayed mode quality control and calibration of the salinity measurements. The results of this discussion were presented to the AST. This issue is of critical importance for regions such as the southern Pacific, southern Indian, Southern Ocean, and regions of deep convection where there is either sparse coverage of historical data or where more timely data is required due to the short time scales evident even at significant depth. While the use of this data seems inescapable, there are concerns that the use of Argo float data in the calibration will be both circular and possibly introduce biases into the data set.

The float conductivity measurements tend to be fresher than they should be due to fouling of the electrodes caused at deployment by TBT contamination and in the longer term by biological fouling. It is believed that the initial TBT contamination usually washes out after 15 cycles. The calibration procedures for conductivity also only make adjustments if the drift is statistically significant compared to the estimated *a priori* errors. As a result, any reference Argo data set will likely be aliased fresh. At present, we expect that this bias is likely to be small, but further work needs to be done to investigate the likely size of this error.

John Gilson formulated a set of rules that should be used to choose the profiles that should be included in a reference Argo data set. There was agreement by the informal committee and at AST-8 that these rules are an excellent set to begin selecting the appropriate profiles. These rules were:

- No real-time data
- No floats that fail in < 1 year
- No cycles within 6 months of end of record
- No cycles which have salinity-drift adjustment (> .001 in bottom data to distinguish from thermal lag adjustment at shallower levels)
- No floats whose deepest level is < 800db.
- No cycles following ones that have significant adjustment
- No cycles with < 90% of values (P,T,S) good.
- No cycles < 18 (first 6 months) to be used (TBT)
- No cycles to be used within 6 months of significant salinity drift.
- No cycles within 1 year, 4 degrees of CTD data. (arbitrarily chosen values)

Prior to using Argo float data for calibration of new data in data sparse regions, it is recommended that these same rules be used to extract an Argo float reference data set in regions with good historical CTD coverage. A statistical comparison of the float data set with the historical data should then be undertaken. Similarly, comparisons of calibrations with and without this additional data set in both data rich and data poor regions should be carried out to investigate the effects of the new data sets. In this way, we hope to be able to investigate the influence of this additional data to the calibration procedures. It was also noted that we expect

that there will be future reanalysis efforts carried out as more reference CTD sections are taken as part of CLIVAR and other programs.

Action item 15: Compare Argo data sets with high quality CTD data in regions where there is sufficient data. Compile statistics of comparison between the two data sets. (J. Gilson)

Action item 16: Establish prototype database of ref profiles. 2 parts: (1) identify files (2) make mat file to work in dmode file. (J.Gilson, B. Owens, B.King)

Action item 17: To dmode operators: use Argo data to qualify OW salinity adjustments in areas where there is adequate CTD data and use Argo data to estimate salinity adjustment only in areas where there is not sufficient CTD data. (Dmode operators)

6.2.3 Surface pressure offset

One development since DMQC-2 concerned adjustment to surface pressure in APEX floats. B King presented a summary of an investigation by T. Kobayashi and G. Johnson. DMQC-2 had recommended that APEX surface pressure offsets should not be applied for offsets less than 5 dbar. This was because of a lack of knowledge at DMQC-2 about the frequency distribution of positive offsets (reported) and negative offsets (not reported). Kobayashi and Johnson's investigation showed the evidence that (a) For Ametek and Paine sensors, there is a strong bias towards positive offsets in the range 0 to 5 dbar. (b) At latitudes less than 40 degrees, an offset of 5 dbar would have a significant impact (order tenths of a degree C) on average temperature in the upper 300 or 700 meters of ocean. Therefore AST-8 accepted the recommendation by Kobayashi and Johnson that all APEX surface pressure offsets should be applied (i.e. all of Ametek, Paine and Druck).

Concerning the fixing of the negative offset truncation problem in APF-8, Kobayashi and Johnson report: 'Hopefully, in the future, the APF-8 firmware will be updated so that negative pressure drifts can be corrected. The firmware modification has been requested of the manufacturer, and they are bench testing it presently.'

Action item 18: All Paine and Ametek pressure errors need to be adjusted, no matter the size. The AST endorses the pressure report and accepts its recommendation. Ask G. Johnson for advice on whether to correct all Druck pressure errors. (Dmode operators)

6.3 Report from ATW

B King summarized some of the key points from ATW-2, which had been hosted by Korea in October 2006, immediately prior to DMT-7. The meeting report is published on the Argo website at http://www.argo.ucsd.edu/FrUG_reports.html, and there was further discussion in the DMT-7 report.

B King has a Masters student who will work on trajectories between March and October 2007. Since DMT-7, B King has interacted with a number of DACs (Coriolis, CSIRO, MEDS, INCOIS) to start resolving the filling of critical time parameters in traj.nc files. It is hoped the student at NOC will (a) work with DACs to resolve remaining problems with time parameters (b) undertake and report an evaluation of different algorithms for extrapolating surface displacements to ASCENT_END and DESCENT_START times, noting any regional variations in error estimates (c) produce an initial trajectory product with an implementation of the preferred algorithm.

It is not yet clear whether an algorithm could be implemented in real time at a GDAC, but this will be considered.

Action item 19: DACs: ensure that the ascent end time is filled properly for APEX floats.

6.4 Oxygen White Paper

N. Gruber presented the Oxygen White Paper (available in the supporting documents file at http://www.argo.ucsd.edu/FrMeeting_reports.html) to the AST members. He and his group are hoping to obtain funding for a pilot project of oxygen-equipped Argo floats. He presented results of several Argo floats that currently have oxygen sensors and pointed out that while the results have been largely positive, work still needs to be done on the oxygen sensor technology for improved calibration and drift. A summary of the cost of adding oxygen sensors to the floats was presented that took into account different telemetry systems and different oxygen sensor types. The oxygen group plans on finding hopefully two areas to build up oxygen equipped floats for a 2 year pilot phase. For more details of the presentation, see the Oxygen White Paper in the supporting documents file.

Action item 20: AST co-chairs to write letter to Nicolas Gruber stating: AST welcomed the report of Oxygen group and endorses the continued development of the technology and the plans in consultation with the AST.

6.5 QC procedures for oxygen

T. Kobayashi reported on the performance of dissolved oxygen (DO) measurements by Japanese profiling floats deployed in the North Pacific. Compared with the shipboard bottle sampling observations at the deployments, the first DO profiles of floats show negative biases systematically: the biases on isothermal surfaces are about 0-10 μ-mol kg^{-1} in the deep layer and then they increase in the upper layers. The maximum value of the biases exceeds 40 μ-mol kg^{-1} in surface layer. These features are found in all floats and both Optode and SBE43. The negative biases of the sensors are greater than their nominal measurement errors even though a part of them must be caused by ocean variations. The larger biases are found in the layers with strong vertical gradient of DO, which suggests one of the major causes of these biases is slower sensor response. If we assume sensor response time is responsible for all the DO measurement biases, it is estimated at about 100 seconds or longer. The temperature difference between Optode and SBE-CTD is up to 0.03 °C, 0.2 °C, and 0.5 °C in deep layers, main and seasonal thermoclines, respectively. But, these influences on the DO measurements are limited to up to 3 μ-mol kg^{-1} even in the seasonal thermocline.

Performance of the Optode and SBE DO sensors is fairly comparable, but Optode needs "shore-based" adjustment with the CTD measurements to achieve accuracy comparable to SBE43 (the change is up to 8% of raw DO measurements). At present, Optode DO data in netCDF files have no information about the "shore-based" adjustment and both types of data with/without the adjustment are intermingled in GDAC. Effort is required to ensure that a consistent DO dataset is stored at the GDAC.

6.6 Float lifetime prediction

T Kobayashi presented a statistical method for analyzing float survival probability (as a function of cycle number). The method made a best estimate (maximum likelihood unbiased estimate) of

the survival function based on all floats in a study group. This was illustrated by APEXs operated by Japan. The method makes the correct statistical provision for (a) floats still active (b) floats that have died because of faults that have been fixed in hardware and are not expected to recur in floats now being deployed. This allows different operators' study groups to be compared, with correct allowance for loss due to, for example pressure sensor failure, motor backspin, etc.

It was pointed out that if the survival function is used to predict lifetime for 'current generation' floats, there is an implicit assumption that current floats will not have introduced any new failure modes not represented in the reference group. Under this assumption, the expected number of cycles for alkaline-equipped APEX floats deployed by JAMSTEC is 137 profiles.

Kobayashi and King suggested that groups that already have a careful analysis of failure modes should perform a similar analysis, because it is very simple to implement.

6.7 Extending the lifetime and capabilities of Argo floats

6.7.1 Apex Report (S. Riser)

We are all concerned with extending the lifetimes of floats we deploy. This involves the mitigation of the main causes of failure. For APEX floats, a number of failure modes have been eliminated in recent years, and the major failure mode that remains is the premature failure of alkaline batteries in the floats. While in principle these batteries have enough energy to last for slightly more than 4 years, in practice many floats fail before 3 years due to the high loads placed on the batteries when the buoyancy pump is turned on. This problem can be remedied by using lithium batteries in the floats instead. The energy density of lithium batteries is 3-4 times greater than alkaline, and it can be expected that a simple change to 2 lithium battery packs should provide enough energy for APEX floats to last at least 6 years, and for nearly 8 years with 3 packs (although there may be other, unknown failure modes that cause floats to cease operating before this time). Lithium batteries are more expensive than alkaline and, due to the fact that they are classified as hazardous material, require greater care in shipping and handling. This is not a serious problem, however, and experience has shown that most groups can make the change to lithium batteries without major problems. Unfortunately, the manufacturer of APEX floats, Webb Research, has made the decision not to sell floats with lithium batteries. Thus, groups wanting to use these batteries in their floats must purchase the lithium batteries separately, open their floats, and install the batteries themselves. This installation is not difficult but does require a moderate amount of relatively inexpensive equipment and some training by knowledgeable technicians. Several groups have already made the change to lithium batteries in their floats, and these groups have enthusiastically agreed to train other groups in the use of lithium batteries. In order to extend the lifetime of APEX floats, it is hoped that most groups will eventually make the change to lithium batteries.

Several new technological developments are presently occurring with APEX floats. The development of Iridium communications for floats has reached a mature phase, with over 40 Iridium/APEX floats in the water. The results have generally been good. Iridium allows the floats to transmit much more data than ARGOS, in a much shorter time, and permits 2-way communication with the floats, so that missions can be changed at any time after deployment. Using Iridium, high resolution profiles can easily be transmitted. A disadvantage of the use of Iridium is the increased hardware cost compared to ARGOS. This problem is presently under investigation, with an effort underway to change to cheaper electronics and antenna in order to make the cost of Iridium comparable to ARGOS costs. A second technical development is the N_2 float, which has been offered by Webb for the past 2 years. This float uses an internal gas

canister in order to increase the effective displacement of the float from 260 cm^3 to approximately 350 cm^3. This is enough buoyancy to ascend from a depth of 2000 m to the sea surface anywhere in the world, including the tropics, which has previously been impossible. A drawback to this method in some cases is that floats equipped with the N_2 canister are unstable over some portion of the water column, generally 300-1100 meters. This means that they cannot be parked in this range of depths. However, they can be parked outside of this range and can profile to 2000 m anywhere in the world ocean. More than 50 of these floats have been deployed in the world ocean, by several groups. A similar extension of the depth range of APEX floats in the tropics can be gained by the use of composite (i.e., carbon fiber) hulls. Several of these have been tested by the UW group, with good success; 2 of these floats have been in the water for over 2 years without any problems. Webb will soon incorporate these hulls into a new float design, the APEX-2.

As a final technological note, new sensors from both SeaBird and Aanderaa capable of measuring temperature and salinity near the sea surface at high resolution are now being tested by the UW group, with the first prototypes due for deployment in the summer of 2007.

6.7.2 PROVOR

S Pouliquen presented on behalf of Serge Le RESTE who coordinates the float activities of the Provor technology deployments after Gerard Loaec passed away last October. The Provor float equipped with a Seabird sensor has been improved to ameliorate the energy budget (>150 cycles at 2000m) and the hydraulic pump (Provor CTS3). The deployments made in France and in Japan last year shown a high level of reliability. A deployment tool from VOS is now available at Martec.

Provor exists in various configurations: Provor-A equipped of an acoustic receiver, Provor-Bio with optical sensors(Transmitto-meter Wetlabs Satlantics Irradiance sensor) , PROVOR-DO with Oxygen Aanderaa optode, PROV-CARBON as contribution to the European project Carboocean (Transmittometer Wetlabs + Optode Aanderaa) , PROVOR-ULS equipped with an upward looking sounder to measure ice cap thickness and positioned acoustically as a contribution to Damocles European project as a contribution to the International Polar Year. Most of these configurations have Iridium transmission.

The Arvor float is under industrialisation process at Martec and at sea qualification will be performed before the end of 2007. One prototype has been operating in the Bay of Biscay since December 2006. The Arvor float will be more easily deployable as it weights 19kg instead of 33kg for Provor. At present its energy budget allows more than 150 cycles at 2000m.

Finally a coastal version of the Provor, named Pagode will be available in coming months.

SOLO

D. Roemmich reported that the SOLO float engineers are working on developing the next generation SOLO float, with deployment of prototypes planned for later this year (2007).

6.7.3 Technical developments in Japan Argo

N.Shikama (JAMSTEC) reported the recent technical developments in Japan Argo which includes the following topics:

1. JAMSTEC has been developing a new type of float to use at depths beyond 2,000db. This float uses a gear pump with high viscosity silicon oil to control buoyancy. Laboratory tests show the gear pump works well at 3,500db in exhalation mode and at 2,900db in inhalation mode. The first field test in shallow water region was successfully carried out in early March 2007.

2. JAMSTEC has been developing POPS (Polar Ocean Profiling System) in cooperation with METOCEAN. The POPS has a 1000m cable tethered to a weather station set on drifting ice. A PROVOR float moves up and down along this cable to measure the temperature and salinity profile, whose data is transmitted to Iridium satellites by the weather station. The POPS float was deployed near the North Pole in April 2006 and its data was released to the GTS until the POPS terminated its life in January 2007. We can consider that Arctic Argo has just begun.
3. In Japan, using the Iridium system had been prohibited by the Authority until June 2006. After revision of radio wave law, JAMSTEC started preparing to use Iridium APEX with great help from Prof.S. Riser and D.Swift who provided us their software and gave useful advice.
   Five Iridium APEXs were deployed in the MISMO experiment in the Indian Ocean in October 2006. They had been set to surface everyday from 500db measuring a T-S profile at 2db interval. The residence time of Iridium APEXs on the sea surface was 23 min, while Argos APEXs deployed in the same experiment needed 7.5 hours and returned only 30% of data compared to the Iridium APEX. The function of two way communication was successfully tested by changing the profiling depth.
4. Dr. Suga (Tohoku University) deployed an APEX with a chlorophyll-a sensor (Wetlabs FLNTU) in the North Pacific Subtropical Mode Water region in February 2006. This float surfaced from 1,000db every 5 days. The chlorophyll-a sensor worked well for 4 and a half months and afterward showed a malfunction. The cause of malfunction is now being examined at Webb Research. Dr. Watanabe (Fishery Research Agency) deployed an APEX with the same model of chlorophyll-a sensor (Wetlabs FLNTU) to understand the background of fish larva in the Kuroshio region in February 2006. The float drifted at a nominal parking depth of 40db and measured chlorophyll-a profiles from 1,000db at local night-time every 2 days. Three weeks after deployment, the chlorophyll-a sensor showed an unstable tendency and a recovery operation was planned and successfully conducted in April 2006.
5. JAMSTEC deployed 4 APEXs after detaching the anti-foulant device from SBE41 sensor, 2 in the subtropical Pacific in January 2005 and 2 in the sub-arctic Pacific in October 2005. A field experiment during 1.5 to 2 years shows there seems no apparent trend of measured salinity to depart from climatological data. JAMSTEC will continue this experiment until the floats terminate their life.
6. A JAMSTEC float beached on the shore of Maui/Hawaii in the end of January 2007. The float was being kept safely at the US Coast Guard Maui. JAMSTEC sent a technician to Maui who disconnected the battery and shipped it back to Japan. JAMSTEC really appreciates the kindness of the US Coast Guard Maui.

7 Demonstrating Argo's value/ Feedback on user requirements

7.1 Operational applications

7.1.1 UKMO

Read the UKMO report contained in the supporting documents file on the Argo website at http://www.argo.ucsd.edu/FrMeeting_reports.html

7.1.2 JMA

Y. Takatsuki presented a brief description of the operational applications in JMA and the impact on the ocean analysis of the Argo data. JMA operates two systems for ocean analysis and

forecast (global and regional), and will replace the existing assimilation systems with new ones and operate routinely from 2008. Both systems use the Argo data from GTS with their own QC procedure. The results of the comparison experiment between 'with Argo data' and 'without Argo data' on the new global ocean analysis system show large differences especially in the Indian Ocean. The Argo's impact is relatively small in the equatorial Pacific, probably due to the existence of TAO/TRITON buoys. More details can be found in the JMA report in the supporting documents file on the Argo website at http://www.argo.ucsd.edu/FrMeeting_reports.html

7.1.3 Mercator

Read the Mercator report contained in the supporting documents file on the Argo website at http://www.argo.ucsd.edu/FrMeeting_reports.html

7.1.4 ECMWF

Read the ECMWF report contained in the supporting documents file on the Argo website at http://www.argo.ucsd.edu/FrMeeting_reports.html

General discussion after all operational application speakers focused on two main items. The first was operational users wanted a quick and easy way of knowing what changes have been done to a file when it is updated to help them know if they need to download the data again. After some discussion, it became clear that the operational centers are interested in a reanalysis product released yearly with the most up to date profile data. M. Balmaseda and M. Martin are working on drafting a request proposal for the AST for a reanalysis data set.

The second item discussed was the greylist and what floats were put on the greylist and when it was updated. All users requested the list was updated more frequently and that more floats were included on the list, including floats with known systematic problems.

Action item 21: H. Freeland to get list from J. Cummings of rejected floats from various operational centers. Discuss with AST exec.

Action item 22: Update the grey list on a monthly basis. This includes removing groups of floats with substantial systematic errors. (DACs)

Action item 23: Get a summary from M. Balmaseda & M. Martin of their requests for a reanalysis data set

7.2 Argo products

Albert Fischer presented a brief report on the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC) "State of the Ocean" ocean climate indices web site. The goal of the site is to provide a preliminary tool for evaluation of the ocean observing system for climate, through the estimation of uncertainty in key climate indicators with high societal impact, and as a tool for communicating about the abilities of the ocean observing system. The page currently displays the weekly-updated state and trend of a number of ocean climate indices, largely based on sea surface temperature, but with only one subsurface index (the Bermuda-Labrador Basin transport index). Each index can be seen as a two-year or longer time-series plot, or grouped together in an overview, and can be downloaded as a data file. The page describing each index has some scientific background, information on the societal impact, and links to further information. Argo is

mentioned as the main source of data in calculating the subsurface index. The OOPC is working with CLIVAR basin panels and the Global Synthesis and Observations Panel (GSOP) to further develop the indices represented on the site.

Fischer solicited the Argo community for input on further ocean climate indices that could be calculated from subsurface data. Roemmich thought it important to develop Argo-labeled products, including gridded products and climate indices, which could be compared to other products including other types of data, and could be offered to a wider community for use. The Steering Team agreed that Fischer would maintain contact with the co-chairs (Roemmich and Freeland) on ocean climate indices using Argo data.

8 Implementation issues

8.1 Sustaining Argo

John Gould described the phases through which Argo had progressed.

The first was the planning and preparatory phase. The Argo plan grew out of the use of profiling floats during the 1990s and the design of a 3 deg x 3 deg array was presented and endorsed as an integral part of the ocean observing system at the OceanObs'99 conference in Villefranche. An energetic period of international lobbying resulted in commitments from a small number of developed countries and led to the deployment of the first Argo floats by Australia in 1999.

From then to the present day, Argo grew in an implementation phase until it has now almost reached its target. Through this phase there has been substantial progress in

- extending float lifetimes
- implementing an effective data system capable of delivering real-time and delayed mode data
- diagnosing and rectifying problems with floats and their sensors in collaboration with manufacturers
- implementing an efficient oversight structure (AST and ADMT)
- employing an Argo Technical Co-coordinator within JCOMMOPS to ensure compliance with IOC Res XX-6
- developing a widespread user community of both academic researchers and operational agencies
- broadening the number of participating countries

The next phase for Argo is one of sustained maintenance. While many of the challenges from earlier phases continue, new ones now come to the fore. Among these are:

- To further extend float lifetime to achieve and maintain the planned 3000 float array
- To eliminate the continuing Northern Hemisphere bias in float distribution
- To further improve the effectiveness and throughput of delayed-mode quality control

- To learn through scientific analysis how to improve data quality
- To improve the delivery of high quality real-time data to meet the evolving needs of the user community
- To continue and complete initial steps taken to produce high quality subsurface velocity data
- To develop effective means to maintain the integrity of the array when floats reach the end of their operating life

As in the past these primary objectives will need to be supported by activities concerning technology and infrastructure. Argo will need to:

- Continue to monitor array performance and improve it through careful adjustments to the network design and through the deployment and evaluation of appropriate new sensors and communication systems
- Maintain the two global data assembly centers and an appropriate network of national and regional centers
- Evolve and sustain an effective project oversight structure within the existing intergovernmental and international framework

Underlying these tasks will be a need for national programs to convince funders of the need to continue supporting Argo and to derive these funds from appropriate sources.
The sustained maintenance phase will be considered complete when Argo has:

- maintained the array at a level of 3000 ± 250 floats for 5 years
- global coverage with no significant northern hemisphere bias
- reached a point where float technical capabilities and survival rates have stabilized at an adequate level
- carried out an evaluation of the array's design and its benefits to users

In addition Argo will:

- need to maintain an effective dialogue with international and intergovernmental bodies concerned with the promotion and oversight of sustained global observations, (JCOMM, OOPC, GOOS/GCOS, GEOSS) so as to ensure that the central role of Argo is recognized.
- maintain effective national and international outreach activities (web sites, lectures, meetings, publications and educational applications).

In summarizing he remarked that Argo should mark the transition from implementation to sustained maintenance around the middle of 2007, when the 3000 float target has been achieved or is near. The Perugia IUGG meeting in July may be an appropriate time and in addition marks the 50th anniversary of the start of the IGY.

It was suggested that a News and Views article might be prepared for Nature that would describe past achievements, highlight present science results and would explain future challenges.

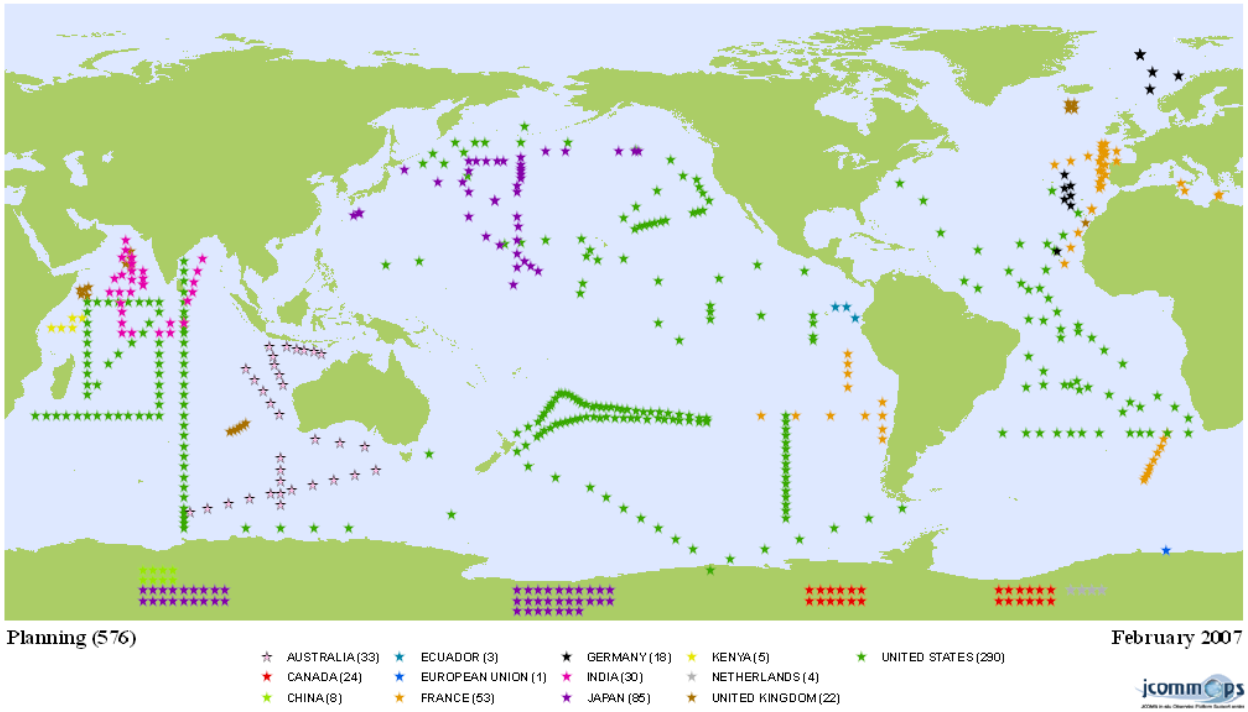
To read the original 'Sustaining Argo' document, please go to the supporting documents file on the Argo website at http://www.argo.ucsd.edu/FrMeeting_reports.html

Action item 24: J. Gould will prepare a synopsis of the News and Views article for approval by the AST prior to submission to the appropriate Nature editor.

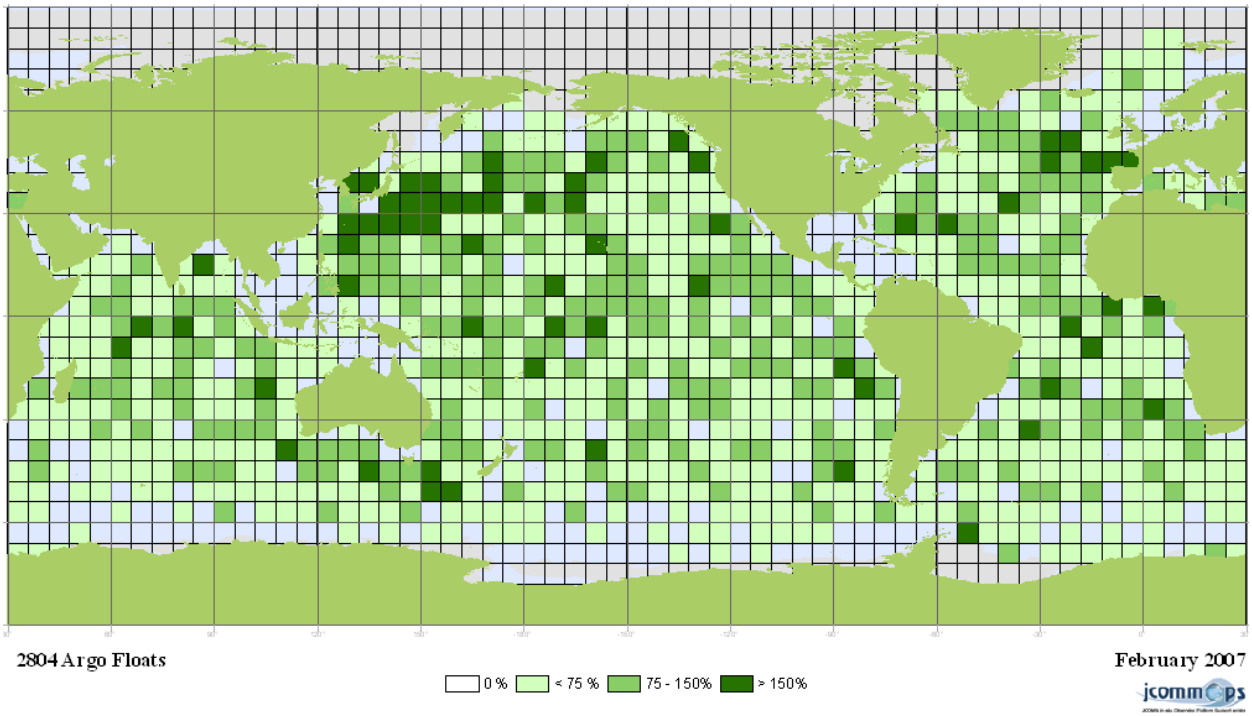
8.2 Coverage/deployment planning

M. Belbéoch, the Argo Technical Coordinator, reported briefly on the Argo status. He noted that the network completion (3000 active floats) should occur by August 2007. He presented the new tools available at the AIC to facilitate and optimize the deployment strategies. He recalled

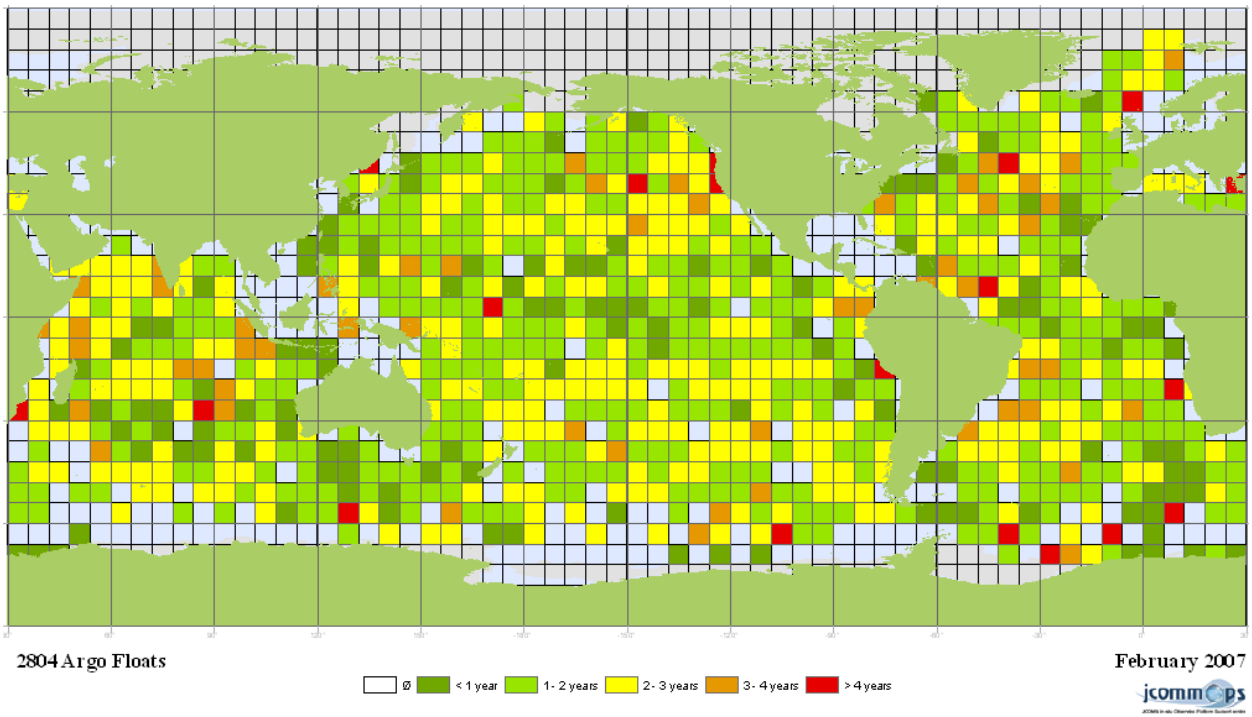
that many efforts have been made and will be continued to promote and adapt the new notification system amongst float operators. For the first time we have a global view of the Argo deployment planning *(see maps below).*



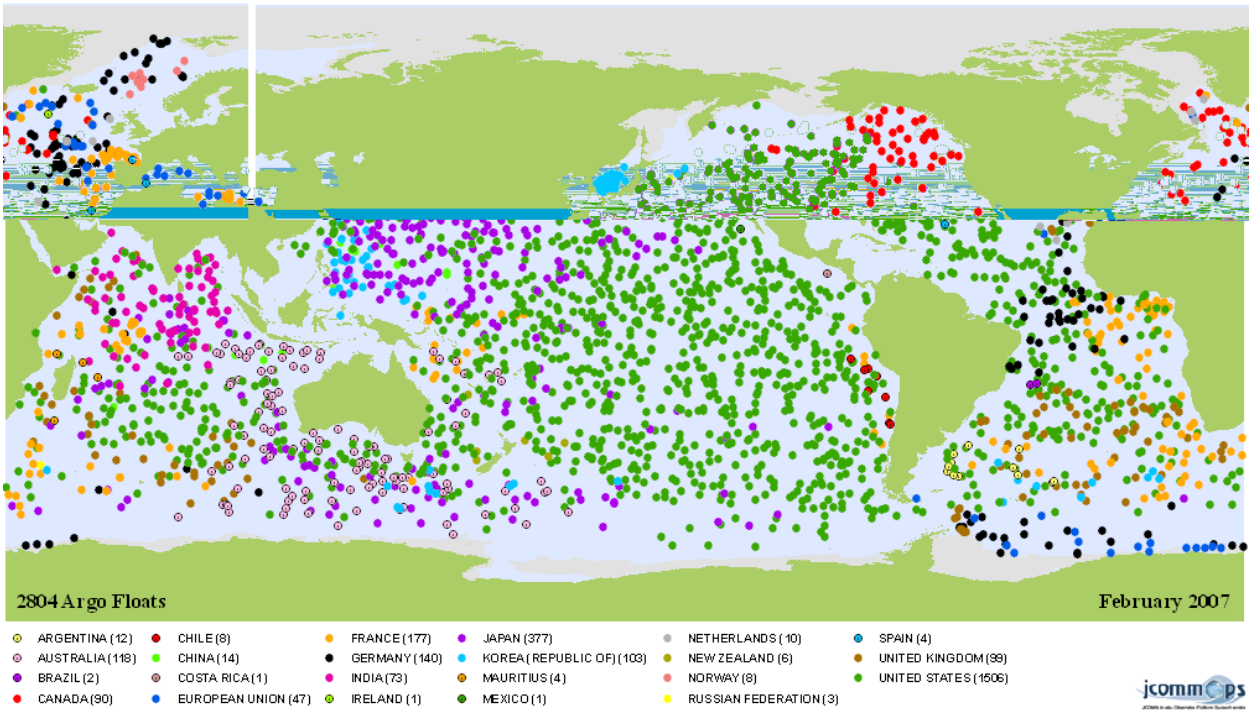
Planned deployments for 2007



Density of float



Age of floats



Current status by country

8.3 Status of recovery of beached instruments

TC reported on the status of beached instruments (tracked through routine reports and on-line), and recalled that this was a PI responsibility. The new label, produced by SIO, was distributed by the AIC to manufacturers and float experts. Some ST members noted that Google Earth files were very useful to track beached floats. TC asked to be informed when floats are recovered.

Action item 25: PI to inform ATC if beached float is secured. (PIs who secure floats)

8.4 AIC report

Argo TC presented the activities of the Argo Information Centre during 2006. He recalled E. Charpentier (TC DBCP/SOT) moved to WMO in Feb. 2006 and was replaced by Hester Viola (BOM, Australia) in July 2006. He noted that some resources regarding the Information System maintenance and development was required at JCOMMOPS, as well as a real secretariat support (to be taken into account in discussions on JCOMMOPS development). In 2006 TC rationalized the float database management, summarizing the Argo status in routine reports, sent to AST and ADMT. The panel noted that this report was particularly useful and encouraged TC to improve it. TC presented his proposal to design a complete and centralized support centre at the AIC to deal with direct support to users and feedback from data users. AST agreed and proposed that Megan will take TC relay as appropriate. He recalled the status of current Argo donor programs (Ecuador, Dominican Rep., Kenya, Morocco, Ivory Coast), potential ones (Caribbean region, Philippines, Columbia, Cape Verde, Sri Lanka) and encouraged the ST members to use this tool to identify new deployment opportunities and extend the international support to Argo. TC presented briefly the new AIC website, released in Sept. 2006, including many new features and statistics, and invited the panel to refer to the report for further details.

See full report at: http://w3.jcommops.org/FTPRoot/Argo/Doc/AIC_2006.pdf
and presentation at: http://w3.jcommops.org/FTPRoot/Argo/Doc/Argo_AIC_2006.ppt

Action item 26: M. Belbéoch to add dmode file statistics for each program in the weekly/monthly report. M. Belbéoch

Action item 27: ATC to implement a user desk. M. Belbéoch

9 Argo outreach activities

9.1a Report on Ghana Workshop

The workshop was a spin-off from the First South Atlantic Argo Regional Center Meeting, Cape Town, South Africa, May 12-14, 2005. It was funded by US Argo, the Global Change SysTem for Analysis, Research, and Training (START) and the Benguela Current Large Marine Ecosystem Programme (BCLME). The workshop took place at the University of Ghana, Department of Oceanography & Fisheries, Accra, Ghana, December 5-7, 2006. The workshop was held to help address issues relating to regional capacity building on Argo data access and applications to monitor, predict and mitigate the adverse impacts of variations in ocean temperatures, salinity and currents on the Atlantic countries of Africa (Morocco to South Africa). It was attended by 44 participants of 11 African countries: Angola, Benin, Cameroon, Cote d'Ivoire, Ghana, Namibia, Republic of Congo, Senegal, South Africa and Togo. During the workshop presentations from experts were made and hands on sessions for training. A complete report of the Workshop can be found at

http://www.aoml.noaa.gov/phod/sardac/meetings/2006Dec05/index.php

9.1b Outreach in Argentina

During the first South Atlantic Argo Regional Center meeting in May 2005, several areas with observational gaps were identified, one of them being the south western Atlantic. In order to cover that gap a set of floats was donated to the Navy Hydrographic Service of Argentina for their deployment. Additionally, the donation helped to further strengthen existing bonds. The opportunity was used by the local partners to train their own technicians in the activation, deployment and use of floats. As a result, Argentina already has a group of trained personnel at the Hydrographic Service (SHN) and both the Icebreaker A.R.A. "Almirante Irizar" and the R/V A.R.A. "Puerto Deseado" constituting an additional asset to the South Atlantic and Southern Oceans observational efforts. Also, by interaction with the Argentine NODC, data products were generated (some of them are available at the SA ARC website) and groups of researchers continue with process studies. A total of twelve floats were donated, the first batch of six was deployed by the R/V Puerto Deseado between February and March 2006 and the second batch of six was deployed by the Almirante Irizar in December 2006. In response to the vigorous mid-depth circulation of the southwestern South Atlantic the Argo floats deployed in the western boundary rapidly spread throughout the basin. These trajectories display striking features of the mid-depth flow, such as the bifurcation suggested near 43ºS in the western Argentine Basin. One branch continues northward associated with the Malvinas Current and the other branch describes an abrupt cyclonic turn and continues eastward. Though similar circulation patterns had been suggested in the upper ocean, this flow at intermediate levels had not been previously documented. In November 2006, within the framework of Argo related activities, the SHN launched a public awareness/capacity building project involving local high schools similar to the "Adopt a Buoy" program. Appropriate contacts were identified in several schools and science teachers were provided with information about Argo, data accessibility and software. The idea is promoting development of projects at each school, including the adoption of the donated floats. For that, both teachers and students efforts are supported by the SHN and the NODC. The initial stage of this program will start this March, including an award to the best project of the year. According to local sources, the idea generated great enthusiasm among those involved and good results are expected.

9.2 SEREAD

D. Roemmich reported on the continuing progress in implementation of the SEREAD program in Pacific island nations (supporting documents file).

9.3 The Scholar Ship

Jon Turton introduced the Scholar Ship (www.TheScholarShip.org) which is operated by the Scholar Ship Research Institute. The mission of the institute is to perform interdisciplinary research in the natural and social sciences; for environmental science this includes oceanography, the coastal environment and climate change. The programme is supported by Royal Caribbean Cruises and is carried out on board the Mona Lisa and during 5-day port stopovers. The programme involves postdocs, graduates and there would be 600 (multi-national) students on board. The institute is keen to involve other centres/institutes in providing specialist instruction/lectures during the voyage or on port stopovers – so there is an opportunity here for Argo outreach and capacity building.

The first cruise is September – December 2007, and involves Atlantic and Pacific crossings. The second is January to April 2008 and covers the Indian and Atlantic Oceans. The institute has expressed interest in deploying floats (and drifters) during these cruises, which are an opportunity that Argo could exploit. The opportunity to deploy floats on the Atlantic crossing at ~30S is of particular interest to the UK. It is hoped that the Scholar Ship will become a regular programme. UK and AOML have already discussed float (and drifter deployments) with institute, the Met Office also hopes to recruit the ship into the UK Voluntary Observing Fleet and NOCS have suggested the possibility of the ship carrying a FerryBox system for underway measurements. If any other countries are interested in the programme then contact Dr Ravinder Bhatia of the Scholar Ship Institute.

Action item 28: S. Wijffels & J. Gould to update Argo brochure**.**

10 Future Meetings

10.1 Argo/GODAE session at IUGG Assembly

The Argo/GODAE session will be held at IUGG in July of this year. Unfortunately, there were not as many Argo abstracts submitted as hoped for. It is unclear as to why the number of submitted abstracts was low, especially for the US. This challenges Argo to think about ways to continue to attract scientists to workshops and meetings to show their work.

10.2 Argo Science Workshop 3

J. Gould was approached by China who requested that the next Argo Science Workshop could be held in China. This option will be considered as well as trying to tie an Argo Science Workshop into another science community workshop as done previously with ASW-2. It was suggested to perhaps try and hold the workshop in collaboration with the Ocean Surface Topography Science Team Meeting and GODAE final symposium which is scheduled for November 2008. D. Roemmich will investigate this option further, but reminded everyone that money and organizational effort are needed to stage a workshop.

10.3 Technical workshops (DMQC, ATW)

Apex users are considering holding another Apex users group workshop sometime in 2008. B. King said DMQC workshops are generally organized when people feel a need to have a meeting again. At this point, no meeting is planned, but B. King guessed the next one might be around 18 months after the previous one which would be in early 2008. B. King thought it was unlikely that another trajectory workshop would be held.

10.4 ARC workshop

S. Pouliquen is proposing to hold an ARC workshop before next ADMT meeting in Hobart in November 2007.

10.5 AST-9

The AST agreed that a meeting should be held in early 2008. J. Turton offered to pursue having the Met Office host the meeting in Exeter next March.

Argo Steering Team Meeting (AST-8)
Paris France, March 7 - 9 2007
Host: Intergovernmental Oceanographic Commission of UNESCO
Location: UNESCO Annexe Building, 1 Rue Miollis

Meeting of Argo Executive,Tuesday afternoon March 6, 1 p.m.. (Roemmich, Freeland, Ravichandran, Wijffels, Shikama, Thierry, Pouliquen, Gould, Scanderbeg, Belbeoch)

Provisional agenda: Begin at 9 a.m. on Wednesday March 7

1. Welcome and local arrangements (Bernal and IOC staff)
2. Action items from AST-7* and Argo Exec (Scanderbeg/Gould/Roemmich/Freeland)
3. Issues from ADMT-7* (Pouliquen/Ignaszewski)
4. Other Data Management Issues
   - 4.1 CTD data for updating the Reference Database* (Diggs)
   - 4.2 Are organized training sessions needed for DACS? (Pouliquen)
   - 4.3 Glider plans; practical issues for inclusion of glider data (Owens)
5. Assessment of long-term funding prospects and new initiatives for national Argo programs (see all National Reports*; Le Traon to report on ESFRI; update of commitments table). Any other issues arising from National Reports?
   - 5.1 Status of AIC Report
6. Technical issues
   - 6.1 Pressure offset errors in WHOI FSI floats
   - 6.2 Report from DMQC-2* (King)
     - 6.2.1 Follow-up DMQC inter-comparison exercise (Wijffels)
     - 6.2.2 Use of Argo data in the reference database (Owens)
     - 6.2.3 Surface pressure offset (G. Johnson paper)
   - 6.3 Report from ATW* (King)
   - 6.4 Oxygen White Paper* (Gruber et al)
   - 6.5 QC procedures for oxygen (Kobayashi)*
   - 6.6 Float lifetime prediction (Kobayashi)
   - 6.7 Extending the lifetime and capabilities of Argo floats (Riser, “Technical developments in Japan Argo” by Shikama, Pouliquen)
7. Demonstrating Argo’s value/ Feedback on user requirements
   - 7.1 Operational applications (This item to be Thursday 8 March pm)
     - 7.1.1 UKMO* (Martin)
     - 7.1.2 JMA* (Takatsuki)
     - 7.1.3 Mercator* (Guinehut)
     - 7.1.4 ECMWF* (Balmaseda)
     - 7.1.5 Bluelink* (Wijffels for Schiller)
     - 7.1.6 US Centers* (Cummings, written rpt only)
   - 7.2 Argo products (Fischer/Roemmich/discussion)

8. Implementation issues
    8.1 “Sustaining Argo”* (Gould)
    8.2 Coverage/deployment planning (Belbeoch)
    8.3 Status of recovery of beached instruments (Belbeoch)
    8.4 AIC report* (Belbeoch)
    8.5 ABELOS status report (Piotrowicz)

9. Argo outreach activities –
    9.1 Report on Ghana Workshop* (Garzoli)
    9.2 Outreach in Argentina (Garzoli)
    9.3 The Scholar Ship (Turton)
    9.4 SEREAD status* (Roemmich)

10. Future meetings
    10.1 Argo/GODAE session at IUGG Assembly (Gould)
    10.2 Argo Science Workshop-3 ?
    10.3 Technical Workshops (DMQC, ATW etc)
    10.4 ARC Workshop (Pouliquen)
    10.4 AST-9

11. Other business

List of Participants for IAST - 8, Paris, France.

S. No	Name	Institution and Address	Nationality
1	Dr. Susan Elizabeth Anne WIJFFELS	CSIRO Marine and Atmospheric Research, Castray Esplanade, GPO 1538, Hobart Tas. 7000.	Australia
2	Dr. Howard John FREELAND	Institute of Ocean Sciences, 9860 West Saanich Road, BC, V8L 4B2.	Canada
3	Dr. XU Jianping	The Second Institute of Oceanography, State Oceanic Administration, People's Republic of China No. 36, Baochubei Road, 310012, Hangzhou, China	China
4	Prof. ZHANG Haisheng	Director, Second Institute of Oceanography, State Oceanic Administration, People's Republic of China No. 36, Baochubei Road, 310012 Hangzhou, China	China
5	Dr. ZHU Yongling	Second Institute of Oceanography, State Oceanic Administration, People's Republic of China No. 36 Baochubei Road, 310012 Hangzhou, China	China
6	Dr. ZHOU Zhigang	Department of Science and Technology, State Oceanic Administration, People's Republic of China No1. Fu Xing Men Wai Avenue, 100860, Beijing, China	China
7	Dr. PENG Yiqi	Department of Basic Research, Ministry of Science and Technology, People's Republic of China No15 B,Fu Xing Road, Beijing, 100862, China	China
8	Dr. Pierre-Yves LE TRAON	Program Director Operational Oceanography Systems, IFREMER Centre de Brest B.P. 70 29280 Plouzané	France
9	Mr. Mathieu BELBÉOCH	JCOMMOPS, 8-10, rue Hermès,Parc technologique du Canal , 1526 Ramonville cedex	France
10	Dr. Sylvie POULIQUEN	Responsable Coriolis / Head of Coriolis, IFREMER, BP70, 29280 Plouzane,	France
11	Dr. Virginie THIERRY	Coriolis, IFREMER, BP70, 29280 Plouzane,	France

12	Dr. Stephanie GUINEHUT	Mercator, Parc Technologique du Canal, 8-10 rue Hermès, 31520 Ramonville St Agne, France	France
13	Dr. Juergen FISCHER	IFM-GEOMAR, Gebäude Westufer, Düsternbrooker Weg 20 24105 Kiel, Germany	Germany
14	Dr. Muthalagu RAVICHANDRAN	Indian National Centre for Ocean Information Services, (INCOIS), "Ocean Valley", P.B No.21,IDA Jeedimetla P.O, Hyderabad - 500 055, India.	India
15	Dr. Yasushi TAKATSUKI	Global Environment and Marine Department Japan Meteorological Agency, Otemachi 1-3-4, Chiyoda-ku, Tokyo100-8122	Japan
17	Dr. Nobuyuki SHIKAMA	2-15, Natsushima, Yokosuka, Kanagawa, 237-0061, Japan, Institute of Observational Research for Global Change (IORGC),Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan
18	Dr. Taiyo KOBAYASHIi	JAMSTEC, currently visiting researcher at National Oceanography Centre, Southampton	Japan
19	Dr. Tomoaki NAKAMURA	2-15, Natsushima, Yokosuka, Kanagawa, 237-0061, Japan, Institute of Observational Research for Global Change (IORGC),Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan
20	Dr. Toshio SUGA	2-15, Natsushima, Yokosuka, Kanagawa, 237-0061, Japan, Institute of Observational Research for Global Change (IORGC),Japan Agency for Marine-Earth Science and Technology (JAMSTEC) & Tohoku University	Japan
23	Dr. Moon-Sik SUK	Korea Ocean Research & Development Institute (KORDI), Ansan, P.O.Box 29, 425-600, Korea	Korea
24	Prof. Nicolas GRUBER	Institute of Biogeochemistry and Pollution Dynamics, D-UWIS, 8092 Zurich, Switzerland	Switzerland
25	Dr William John GOULD	National Oceanography Centre, Southampton, Empress Dock, Southampton, SO14 3ZH.	UK
26	Dr. Brian KING	National Oceanography Centre, Southampton, University of Southampton Waterfront Campus, European Way, Southampton SO14 3ZH, Tel: 00 44 23 8059 6666	UK
27	Dr. Jonathan David TURTON	Laboratory address: Met Office, Fitzroy Rd, Exeter, Devon, UK, EX11 1LR	UK

28	Dr. Matt MARTIN	Met Office, FitzRoy Road, Exeter, Devon, EX1 3PB, United Kingdom	UK
29	Dr. Magdalena Alonso BALMASEDA	ECMWF, Shinfield Park, Reading RG2 9AX, UK	UK
30	Megan Carvel SCANDERBEG	Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla California 92093-0230.	USA
31	Prof. Dean Howard ROEMMICH	Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla California 92093-0230.	USA
32	Dr. Silvia Lucia GARZOLI	AOML, 4301 Rickenbacker Causeway, Miami, FL 33149	USA
33	Prof. Stephen Craig RISER	School of Oceanography, Box 355350, University of Washington, Seattle, Washington 98195.	USA
34	Dr. Stephen R. PIOTROWICZ	NOAA/ Ocean.US, 2300 Clarendon Boulevard, Suite 135, Arlington, Virginia, 22201.	USA
35	Steve DIGGS	CLIVAR Hydrographic Office, Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla California 92093-0230.	USA
36	Dr. Breck OWENS	Woods Hole Oceanographic Institution, Woods Hole, MA 02543-1050	USA
37	Dr. Albert FISCHER	UNESCO, 1 rue Miollis, 75732 Paris cedex 15, FRANCE	UNESCO
38	Candyce Clark	UNESCO, 1 rue Miollis, 75732 Paris cedex 15, FRANCE	UNESCO

	Action	Responsibility	Status
1	Send letter of thanks to IOC/ Bernal, cc to K,. Alverson, C. Clark	H. Freeland	
2	Each national program will identify or send Steve Diggs data from a recent CTD cruise to track the file through the CCHDO system from acquisition to delivery to availability from CCHDO website. sdiggs@ucsd.edu	Each national program	
3	All Argo representatives to check the POGO site for fellowship funding opportunities and closing dates for funding. www.ocean-partners.org	All Argo reps	
4	B. Owens and S. Pouliquen to work together to update format of glider data and SP will circulate.	B. Owens & S. Pouliquen	
5	H. Freeland to contact countries not currently contributing to the Argo infrastructure	H. Freeland	
6	The following notice will be posted on the Argo website and circulated to Argo users following confirmation of greylisting: **Update: Important notice to Argo users (pressure offset errors)** The cause of pressure offset errors in WHOI FSI Argo floats has been identified (incorrect assignment of pressure bins). Most of the affected profiles can be corrected, some more accurately than others. When available, corrected profiles will be provided in the near future. The following is guidance for research and operational users: Research users are advised not to use WHOI FSI Argo floats (INST_TYPE # 852) for scientific analysis until corrected data and error estimates are provided. A list of WMO ID numbers of these floats is provided on the Argo Steering Team website (http://www-argo.ucsd.edu). Operational users are advised that all affected floats have been grey-listed, and the data are excluded from GTS transmission as of dd March 2007. The data are available from global data assembly centers, but should be regarded as "probably bad" regardless of present quality flags. Corrected data will be provided via the GDACs in the "parameter adjusted fields". For full documentation of the Argo data system, see http://www.coriolis.eu.org/cdc/argo_rfc.htm	M. Scanderbeg, D. Roemmich, B. Owens	
7	Ask AOML to flag PRES_QC '3' for all WHOI	S. Garzoli, C.	

	SOLO_FSI floats	Schmidt	
8	B. Owens to send a list of floats to AOML that can and cannot be corrected in real time with details of correction procedure.	B. Owens	
9	The US DAC will be asked to make a recommendation on improved use of climatology checks for the purpose of identifying systematic problems in Argo data. Such testing is not to be part of the automated real-time quality control process, but rather for referral of questionable data to PIs (or other personnel as appropriate for the National Program) for further examination.	D. Roemmich	
10	A working group chaired by H. Freeland & P-Y LeTraon will investigate the use (or development) of Argo products as tolls for identification of systematic problems in Argo data	H. Freeland, P-Y LeTraon	
11	The following warning should be prominently shown to users acquiring Argo data from GDACs: Argo near real-time data is subject to only coarse fully-automated quality control checks. Argo delayed-mode data has been examined and/or adjusted for improved accuracy and consistency with documented reference data, according to agreed protocols. Because most Argo floats are not recovered for recalibration of sensors, absolute accuracy cannot be ensured. Argo delayed-mode procedures for checking sensor drifts and offsets in salinity rely on a statistical comparison of the float data with reference data. An adjustment is made when the float PI judges that it will improve the quality of the dataset. Users should include the supplied error estimates in their usage of Argo delayed-mode salinity data. For both near real-time and delayed mode data, proper and appropriate use is the responsibility of the user	S. Pouliquen	
12	DMQC backlogs should be cleared this calendar year. Based on the percentage of floats dmqc'd by 1 September, 2007, D. Roemmich and H. Freeland will write letters to programs that appear unable to clear the backlog by the end of the year.	D. Roemmich & H. Freeland	
13	S. Wijffels & B. King will compose a statement	S. Wijffels, B.	

	and send it out to argo-dm-dm/argo-dm-rt lists saying: When QC flags are re-examined and edited in DMQC, these edits should be made to the RAW QC fields and not the ADJUSTED QC fields. RAW QC flags 1 & 2 should then be propagated to ADJUSTED, 3 and 4 should be set to 4 in ADJUSTED and filled with missing values as per the DMQC manual [check manual]	King	
14	Add the average difference between the adjusted and raw salinity in the bottom 500m or same procedure as in R/T at the GDACs to the index file.	S. Pouliquen	
15	Compare Argo data sets with high quality CTD data in regions where there is sufficient data. Compile statistics of comparison between the two data sets.	J. Gilson	
16	Establish prototype database of Argo reference profiles. These files need to be identified and then formatted to the correct mat file to work in the new dmode OW procedure.	J. Gilson, B. Owens, B. King	
17	To dmode operators: use Argo data to qualify OW salinity adjustments in areas where there is adequate CTD data and use Argo data to estimate salinity adjustment only in areas where there is not sufficient CTD data.	Dmode operators	
18	All Paine and Ametek pressure errors need to be adjusted, no matter the size. The AST endorses the pressure report from G. Johnson & T. Kobayashi and accepts its recommendation. Ask G. Johnson for advice on whether to correct all Druck pressure errors.	Dmode operators	
19	DACS: get the ascent end time filled in properly for Apex floats	DACs	
20	AST co-chairs to write letter to N. Gruber stating: the AST welcomed the report of the Oxygen group and endorses the continued development of the technology and the plans in consultation with the AST.	AST co-chairs	
21	H. Freeland to get a list from J. Cummings of rejected floats from various operational centers and discuss this with the AST exec.	H. Freeland	
22	Update the grey list on a monthly basis. Remove groups of floats with substantial systematic errors.	DACs	
23	Get a summary from M. Balmaseda & M. Martin of their requests for a reanalysis data set.	M. Balmaseda, M. Martin	
24	J. Gould will prepare a synopsis of the News	J. Gould	

	and Views article for approval by the AST prior to submission to the appropriate Nature editor.		
25	PIs are to inform the ATC if beached floats are secured.	PIs with secured beached floats	
26	M. Belbéoch to add delayed mode file statistics for each program in the weekly/monthly report.	M. Belbéoch	
27	ATC to implement a user desk	M. Belbéoch	
28	S. Wijffels & J. Gould to update the Argo brochure	S. Wijffels, J. Gould	

	2004 Argo deployed	2004 Argo equiv deployed	2005 estimated	2005 Argo deployed*	2005 Argo equiv deployed	2006 Argo deployed	2006 Argo equiv	2007 Argo	2007 Argo equiv	2008 estimated
Argentina						12				
Australia	4		45	64		45		65		
Brazil	0			3						
Canada	30			29		38		25		
Chile	0		2	2**	2		4			
China	8			0		6		50		
Costa Rica	0		2	2***						
Denmark	0		0	0						
European Union	15		4	7		3				
France	85		78	89		65		65		
Germany	27	18	64	56	19	35	1	37		
India	30		51	45		15		50		
Ireland	0			0						
Japan	119		110	98	12	98	18	95	15	
Korea (Republic of)	32			37		33		27		
Mauritius	2•			0		2				
Mexico	0		1	2°						
Netherlands	3		4	4		4		6		
New Zealand	2		2	1		3		2		
Norway	0		0	0		2				
Russia	2			0						
South Africa	0		1	0						
Spain	2		3	4		1				
UK	45		32	28		24		45	2	
USA	396	38	410	455	38	475	21	410		390
Subtotals	800	56		920	71	861	44			
Total	856		809	991		905		877		

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

Notes
50 per year 2008-2012
2005 MERSEA Germany and France
50 floats per year during 2007 to 2012
To 2008 15 equiv beyond 2008
Hoped for level for 2006/7

Australian Contribution to Argo

Report to the 8th Argo Science Team meeting, March 2007
Submitted by Susan Wijffels, CSIRO Marine and Atmospheric Research

1. Status of implementation

Floats deployed and their performance

Australia has currently 121 operating Argo floats. In 2006 45 WRC APEX SBE-41 floats were deployed, most in the subantarctic zone and several in the Coral Sea and Indo-Australian Bight. In addition Australia assisted float deployments by Korea.

APEX performance in the Australian array has been very good – we continue with a near 90% profile returned averaged over all the Australian array, based on an expected 4 year lifetime. The 10% of lost profiles is overwhelmingly due to floats that have grounded or been washed ashore and lost. Of 19 floats deployed in 2002/2003 with mixed lithium/alkaline battery packs, 3 have grounded, 2 ceased to operate and the rest continue to deliver profiles 3-4 years later with healthy voltages (>12V), suggesting APEX powered with lithium batteries can deliver 4+ year lifetimes sampling to 2000db on every profile.

Of the floats deployed in 2004 and 2005, most continue to operate. We have suffered several failures of floats that winter under sea ice despite their being equipped with an ice-detection algorithm. We will be revisiting our strategy for floats that will encounter sea ice.

An APEX float that was taken ashore by a fisherman in Indonesia and recovered with the excellent help of Widodo Pranowo from the Indonesian Ministry of Marine Affairs and Fisheries, was given a technical checkout in Jakarta and redeployed during the INSTANT mooring recovery cruise in December 2007 with a new WMO ID. It is functioning well.

Ann Thresher worked with the Scripps Argo Team to recover a SOLO which had grounded on the shallow shelf of eastern Australia, and had been trawled up by a local fisherman. When tracking the float via its Argos signaled failed, Ann refused to give up and pounded the pavement along local fishing ports until someone recognized the suspect! News paper article attached.

Technical problems encountered and solved

In the past we have replaced some of the alkaline battery packs delivered with the APEX floats with locally sourced lithium packs. As this has worked so well, and since the sensors on our long-lived floats (>4 years) appear to be stable, we will now move to 100% replacement of battery packs with lithium cells in anticipation of achieving +5 year lifetimes.

During technical checkout and before deployment at sea, our team encountered several air-bladder inflation anomalies. Deployments were suspended. On investigation, faulty manufacture of the float bladder was found. WRC was contacted, who also investigated the problem, and all APEX users were notified as well. As a result WRC has revised its factory testing and also its recommendations for pre-deployment inflation tests. Several floats have been returned to WRC to have new bladders installed. We recommend visual inspection of all APEX float bladders before deployment as per the email of Alex Papij to the Argo technical mailing list in late 2006.

As per recommendations from the APEX Users Technical Workshop and AST-7, we also requested two software changes for APEX acquired in fy06/07– profile on deployment and averaging of hourly temperature and pressure measurements during the drift phase in two 5 day bins. Several floats with these new features failed to operate correctly, returning profiles at erratic times. Deployments were suspended until the problem was resolved. On dialogue with WRC, the problem was found by taking careful note of controller board numbers and software versions. However, when these two software features are combined with ice-detection, floats continue to behave erratically. Until this problem is identified, we will revert to previous versions for floats that will encounter ice. These problems were rather tough to trouble-shoot as floats with the new software were also involved in the bladder-inflation failures as well.

2. Status of contributions to Argo data management:

Real time: In late 2006 the Australian realtime processing was switched to a new matlab-based system written by Jeff Dunn at CSIRO and implemented at the Australian Bureau of Meteorology. This upgrade should result in a more stable data stream and the Australian drift files should now be to Argo specifications. Realtime plots and monitoring of float data can be found at:

http://www.marine.csiro.au/~gronell/ArgoRT/select_floats_WMO.html

We continue to correct salinities in real-time where deep values deviate far from high-precision WOCE and WOCE follow-on CTDs. Until our DMQC drift corrections are more routine we will not switch to applying 6 month-old DMQC corrections.

Australia will host the next meeting of the Argo Data Management Team in late 2007. Ann Thresher will be the lead organizer.

Tseviet Tchen and Susan Wijffels have carried out an inter-comparison of delayed-mode data files prepared on a common set of floats by participating national data centers. Their analysis is available in draft form at IAST-8 and will be finalized after comments are received from participants.

2. Status of delayed mode quality control process

About 30% of eligible Australian data are delivered in D-mode. All floats have now passed through initial QC screening using the Gilson software and have been processed for thermal lag error. A large backlog is about to be delivered to the GDACs with delays

caused by problems encountered in the implementation of the thermal-lag correction for SBE-41 sensors on APEX. The change in Argo data format also caused a set back.

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

In 2007 - 2010 Argo Australia will come under the umbrella of a new Australian Government intiative: an Australian Integrated Marine Observing System (IMOS) for research funded under the National Collaborative Research Infrastructure Initiative. The larger IMOS will be based at the University of Tasmania and Gary Meyers is the IMOS Director. The success of the IMOS proposal means that Argo Australia will now be funded at a 50-60 float/year level for 4 years to maintain an array of around 220-240 Argo floats.

Argo Australia will remain a joint program between the CSIRO Marine and Atmospheric Research (CMAR) and the Australian Bureau of Meteorology (BoM), partly funded by the Australian Greenhouse Office, but now substantially expanded via the IMOS funding. CMAR will remain the lead agency.

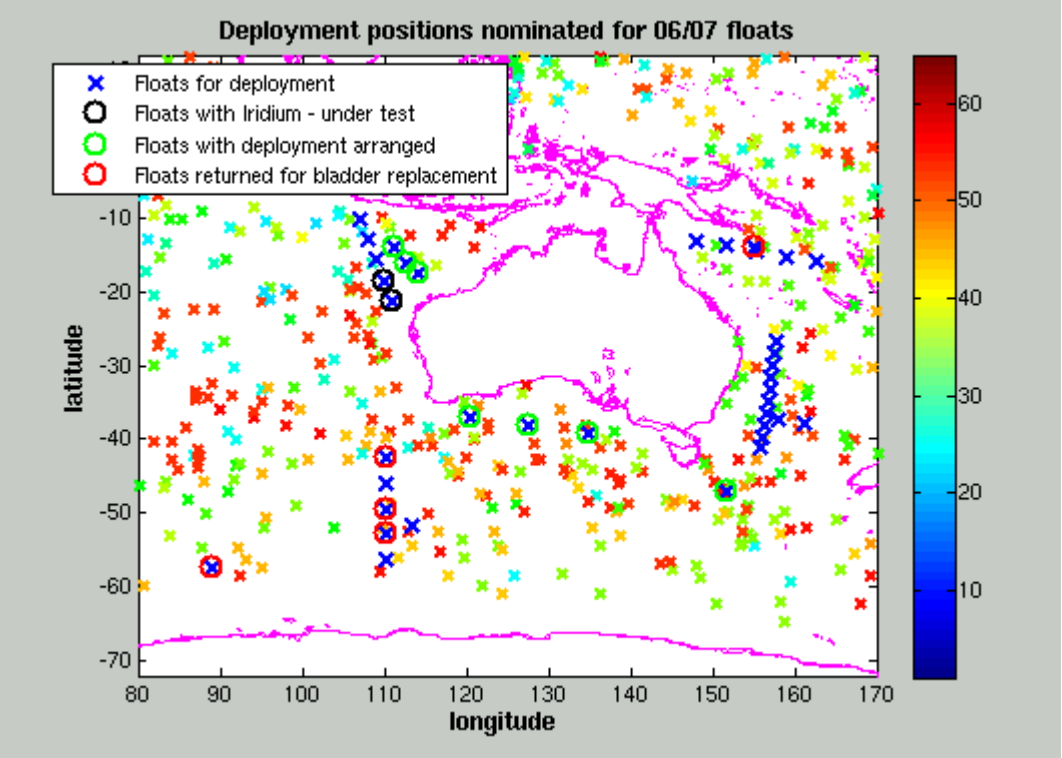
The Cooperative Research Center for Antarctic Ecosystems and Climate (ACE CRC) will acquire its last floats for deployment in the subantarctic zone south of Australia in the upcoming fiscal year. A proposal has been made to CSIRO to continue to acquire 10 floats, the ACE CRC will acquire 14-15 floats and the BoM will acquire 13 floats, with IMOS funding bringing the total to +50 floats deployed next year.

A supplementary proposal has also been submitted to CSIRO to acquire additional floats with oxygen sensors, as well as CTD's to deploy on seals to gain information from the sea-ice zone. It is likely these data will be handled by the Australian Argo data team.

We are currently testing iridium-equipped APEX in our laboratory and hope to deploy these as a pilot in the upcoming 12 months.

Human resources: Australian Argo requires approximately 100% of a engineer and 75% of a technician for float checkout and preparation, test development; 50% of a fulltime operations officer for float shipping coordination and deployment training; delayed – mode data processing requires 150% fulltime data experts but we have been working on a large back-log and hope this level can be reduced as the processing becomes more routine.

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



The above plots show deployment plans for floats in hand (acquired in fy06/07). Future deployments will target gaps in the Indian and SW Pacific, in coordination with other Argo groups operating in the region.

g) Argo data is downloaded to a local mirror once a week. It is then converted to a mat format with an index table to help users find the data they need. The data is being used as part of the BMRC Seasonal outlook and Temperature analysis, Blue Link ocean forecasting models, to study global sealevel rise and long term salinity changes and by numerous students. We are also incorporating it as a high quality background data field for our upper ocean temperature QC programs.

h) Blue Link model outputs and the BMRC Seasonal Outlook and Temperature analysis are two major products from Argo data in Australia. There are too many others to list.

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.

- CSIRO Marine 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. Work on subsurface profile assimilation is underway. PI: Andreas.Schiller@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 (Sloyan), generation of modern era climatologies (Ridgway and Dunn), ocean warming and its role in sea level rise (Church, Domingues, Wijffels), in ocean observing system studies (Oke and Schiller) etc.

Until Argo Australia is up-to-date in our DMQC we will not be actively developing a role in a regional data center. We will reconsider this issue towards the end of 2007.

MEDIA MONITORS
INCISIVE INSIGHT

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MTWTFS-

Probe phones home

Missing sea robot turns up in fisherman's van

Glenis Green

ONLY the sheer determination of a CSIRO scientist has prevented a $30,000 ocean robot from being turned into one of the Sunshine Coast's most unusual and expensive letterboxes.

The robotic profiler, which, back of Mr Wilson's blue work [illegible] monitors ocean temperature and salinity — went missing late last year when it grounded on the sea floor off southeast Queensland and failed to surface as part of its routine cycle.

Scientists had almost given up hope of recovering the expensive device until January 20 when it unexpectedly resumed transmitting.

Heavily barnacled, scraped and filthy, the robot immediately resumed its normal 10-day transmission to the CSIRO and the Bureau of Meteorology.

But by that time it was in the van. Thinking it was just a piece of abandoned flotsam, he had salvaged it for conversion into a nice, new letterbox using his angle-grinder.

That is where the story might have ended — if not for the self-confessed "sheer stubbornness" of Ann Thresher, based at CSIRO's Hobart headquarters.

Knowing only that the probe [illegible] appearance, scientists were even more surprised when they pinpointed the source of the transmission — a fisherman's work van at Mooloolaba.

Mooloolaba prawn fisherman Robert Wilson, 56, had hauled the robot up in the trawl-like nets every 10 days.

Mr Wilson's van and was constantly on the move.

By Tuesday, Dr Thresher said she was getting "a bit frantic" at not being able to home in on her prize.

"I was going to give up, but I just couldn't leave it alone. I couldn't leave unless I turned over every rock," she said.

Postponing her return flight to Hobart, Dr Thresher returned alone to Mooloolaba and decided to foot-slog the wharves and marinas with a photograph in the hope that a sailor or fisherman had seen the machine.

"Before [illegible] the last [illegible] on trawlers at the age [illegible] of [illegible] a 1km radius of Mooloolaba, she joined scientists from Brisbane in the hunt.

"I took a radio direction [illegible] and got in touch with [illegible] Robert who brought it around," she said.

Dr Thresher said while data [illegible] Scripps [illegible] opportunity to recover the probe [illegible] 40m deep on January 20.

filers because they are mostly drifting with the remote currents in the ocean basin anywhere between the Arctic and Antarctica," she said.

Usually about 2800 of the [illegible] robots are [illegible] time around the world.

As for Mr Wilson [illegible] philosophical about [illegible] potential letterbox.

"I didn't know what [illegible] one seemed to know."

But unusual as it [illegible] Wilson said he had [illegible] interesting objects haul[illegible] the nets since he began [illegible] frustrated by [illegible] planes, [illegible] things," [illegible] Dr De[illegible]

ve, fisherman Robert Wilson who snared the device in his nets, *right*. Pictures: Glenn Barnes/Graeme Parkes

GONE fishing ... Brian Logan from CSIRO with the robotic profiler, abo

Canadian National Report on Argo-2006

1. Status of implementation (Major achievements and problems encountered in 2006)

1.1 Floats deployed and their performance
During 2006, Canada deployed 38 floats: all were APEX floats. Of these APEX floats 11 carried Aanderaa Optode sensors. As of writing in February 2007 one float only has failed, all of the rest are supplying good data. We are grateful to Dick Feeley (University of Washington) for allowing us to deploy 8 floats from the Thomas Thompson, and we are grateful to the Canadian navy for deployment of 5 floats. Deployment plans for 2007 have remained uncertain as our inventory of floats declined almost to zero. By the end of March 2007 we will have 24 floats in inventory and are now developing a deployment plan. We welcome deployment opportunities of Canadian floats from other nations.

Although reliability issues with the PROVOR floats have led us to focus on the use of APEX floats for the time being, it is important for that there be multiple sources of floats to allow a necessary healthy competition for this market. We are pleased about a recent offer from Martec/Metocean to replace two aged PROVOR floats in our inventory with 2 of the PNG (PROVOR New Generation) floats. We are anxious to test these in the field.

1.2 Status of contributions to Argo data management
MEDS continues to acquire data from 96 active Argo floats and issues data to the GTS and GDACs every 6 hours. On average 80% the data were distributed to the GTS within 24 hours. Our website is updated daily automatically. The website displays float tracks, temperature, salinity and oxygen contour plots and technical information for each float. The website is located at www.meds-sdmm.dfo-mpo.gc.ca. We also monitor the timeliness of Argo data from different data centers on the GTS. We are working with Service Argos to solve the duplications of the Argo messages on the GTS.

We implemented additional quality control tests and changes to the NetCDF file format at GDACs resulting from the 5th Argo Data Management Meeting. As a result of the last DMQC workshop, we reprocessed and sent all of the delayed mode data from Canada to the GDACs. We also adjusted the salinity in real-time based on delayed mode QC feedback.

For the upcoming year, we will modify our software to adapt to the file format change at GDACs. We are working with Denis Gilbert on quality control tests for oxygen data. We have completed software to both encode and decode Argo data into and from BUFR. We have carried out testing with Japan to verify the encoding works.

Ron Perkin, our delayed mode data quality specialist has retired. We will be moving this operation to be carried out by Mathieu Ouellet, a physical oceanographer at MEDS, in the near future. Ron has been working with Mathieu to ensure as smooth a transition as possible.

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 2006 Canada experienced some difficulties in the continuation of funding, though not as severe as they were in 2005. It is always our hope that funding may eventually be moved to a more routine or operational basis but at the moment we cannot see a route to that objective. The funding in 2006 was adequate to our needs.

Capital funding did become available late in the fiscal year that is allowing us to purchase floats for future launch and an order for 21 units is in place at the time of writing. The financial resources arrived too late in the fiscal year to allow us to order floats with sensors for dissolved oxygen.

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).

Following the delivery of floats from the current order Canada will have 24 floats available for launch during 2007 and early 2008. This includes one APEX-Optode and 2 PROVOR floats left in the inventory from previous years plus the 21 new APEX floats currently on order. Of these 24 floats, 12 will be available for Atlantic launches and 11 for Pacific launches.

Deployment plans are in the early stages of preparation as we did not know until a couple of weeks ago whether or not instruments would be available for deployment. Nevertheless, it does appear that launches in 2007 will be less than the number of Canadian launches in 2006.

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

a) Pacific Ocean

We have developed systems to enable us to monitor the changing conditions in the N.E. Pacific Ocean. The information gathered is now an essential component of formal annual reporting on the state of the ocean. The information used in this formal report is subsequently used for fisheries management etc. Information is also used extensively by the Canadian military. Research is being conducted to develop Ocean data Assimilation modelling capabilities in the Pacific. This research is being funded by the CFCAS (Canadian Foundation for Climate and Atmospheric Science). Many scientists at the Institute of Ocean Sciences and nearby Universities are learning about Argo and developing research activities.

b) Atlantic Ocean

Lack of resources remains an obstacle for the systematic exploitation of Argo temperature and salinity data from the northwest Atlantic but we hope to improve on this. Denis Gilbert (IML) continues to explore the use of the Aanderaa Optode oxygen sensor.

c) Global
Personnel at ISDM (formerly MEDS in Ottawa) have implemented an objective analysis module to generate near real-time 3D fields of temperature and salinity. The fields consist mostly of Argo temperature and salinity data and will be provided to the Canadian Ice Service to assist in the operation of a coupled ocean-ice model. The fields will also be used by COMDA (DFO's virtual Centre for Ocean Model Development and Application).

5. Issues that your country wishes to be considered and resolved by AST regarding the international operation of Argo. Examples include tasks performed by the AIC, the means of co-ordination of activities at an international level and the performance of the Argo data system. If you have specific comments relating to the agenda items please include them in your national report.

We are concerned about the lag in most countries in the delivery of Argo data that has passed through the delayed-mode quality control process. We believe that this should be done more promptly than currently appears to be happening.

We are very keen to see a permanent Argo program office established and wish to encourage the Argo Executive and IAST to make this happen. We believe that a single program office should be established that will co-locate the ATC and AD positions. This would best be done at a location with other international program offices.
A significant part of the present North Atlantic float coverage came about from time-limited research programs that have now ended. We are concerned about the long-term sustained coverage of the North Atlantic. There needs to be a discussion about mechanisms for ensuring the re-seeding that will be required to sustain the North Atlantic float array.

Appendix – summary of Canadian float launches during calendar 2006.

	Launch Date	WMO-ID	Oxygen sensors?	Ocean Basin	Launching Vessel	Still Operating?
1	16-Feb	4900739		p	CCGS Tully	Yes
2	17-Feb	4900740		p	CCGS Tully	Yes
3	17-Mar	4900733		p	Thompson	Yes
4	18-Mar	4900734		p	Thompson	Yes
5	19-Mar	4900741		p	Thompson	Yes
6	21-Mar	4900742		p	Thompson	Yes
7	23-Mar	4900737		p	Thompson	Yes
8	24-Mar	4900738		p	Thompson	Yes
9	26-Mar	4900736		p	Thompson	Yes
10	28-Mar	4900735		p	Thompson	Yes
11	19-May	4900635		a	Hudson	Yes
12	21-May	4900677		a	Hudson	Yes
13	21-May	4900678		a	Hudson	Yes
14	21-May	4900679		a	Hudson	Yes
15	27-May	4900682		a	Hudson	Yes
16	29-May	4900876		a	Hudson	Yes
17	30-May	4900880	Yes	a	Hudson	Yes
18	31-May	4900879	Yes	a	Hudson	Yes
19	29-May	4900876		a	Hudson	Yes
20	01-Jun	4900683		a	Hudson	Yes
21	05-Jul	4900869	Yes	p	Hudson	Yes
22	07-Jul	4900522		p	Laurier	Yes
23	18-Jul	4900871	Yes	p	Tully	Yes
24	19-Jul	4900872	Yes	p	Tully	Yes
25	28-Jul	4900877		a	Templeman	Yes
26	29-Jul	4900628		a	Templeman	Yes
27	03-Aug	4900496		p	HMCS Vancouver	Yes
28	03-Aug	4900503		a	Templeman	Yes
29	04-Aug	4900873	Yes	p	HMCS Vancouver	Yes
30	04-Aug	4900865		p	HMCS Vancouver	No
31	04-Aug	4900866		p	HMCS Vancouver	Yes
32	05-Aug	4900874	Yes	p	HMCS Vancouver	Yes
33	03-Oct	4900868		p	Tully	Yes
34	04-Oct	4900870	Yes	p	Tully	Yes
35	08-Oct	4900878		a	Hudson	Yes
36	11-Oct	4900881	Yes	a	Hudson	Yes
37	14-Oct	4900882	Yes	a	Hudson	Yes
38	27-Nov	4900883	Yes	a	Hudson	Yes

China National Argo Report for AST−8 Meeting

Submitted by Prof. Xu Jianping
The Second Institute of Oceanography, SOA, China
February 12, 2007.

The status of China Argo Program

The implementation of China Argo Program has been supporting by the Ministry of Science and Technology, the State Oceanic Administration, and the National Natural Science Foundation of China. However, up to now the fund support is just in form of research projects, and the support ability of fund is limited. For which, scientists from the State Oceanic Administration, China Meteorological Administration and Chinese Academy Sciences, are appealing the government to set a special program giving long-term support.

1. Floats deployed

Since 2002, China has deployed 35 Argo floats in the northwestern Pacific and eastern Indian Oceans (Fig.1), in which there were 6 floats deployed in 2006. Among these floats, 20 are APEX floats and 15 are PROVOR floats. Presently there are 12 floats normally operating in oceans. The statistics of the floats survival ratio is shown as the Fig.2. The APEX float has the mean lifespan of 52 cycles, and the PROVOR float has only 25 cycles.

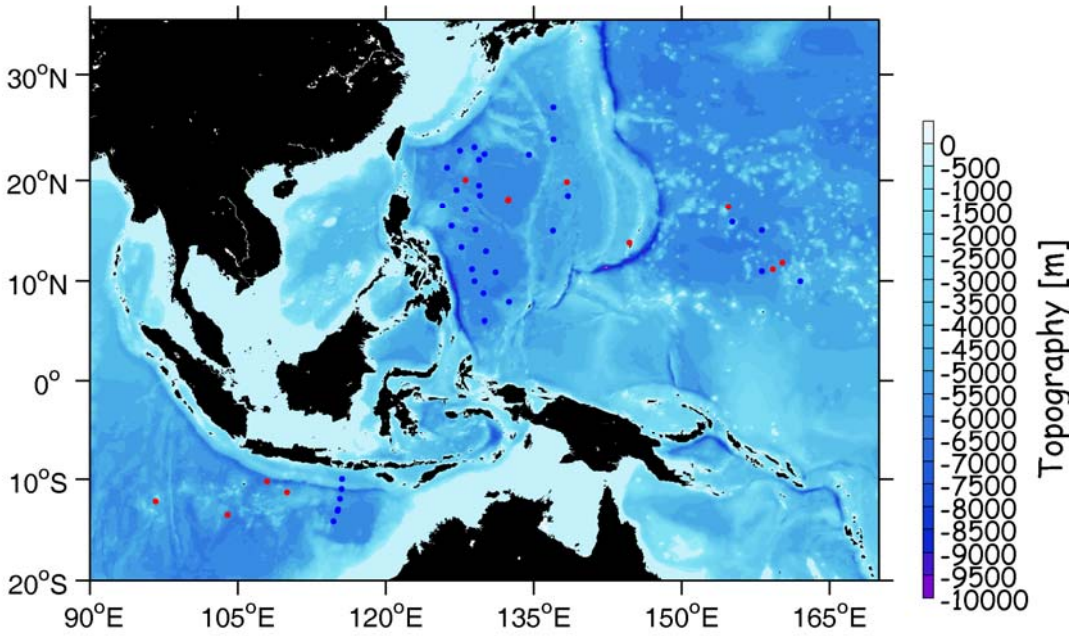

Fig.1 Locations of deployed (blue dots) and currently operating (red dots) Argo floats.

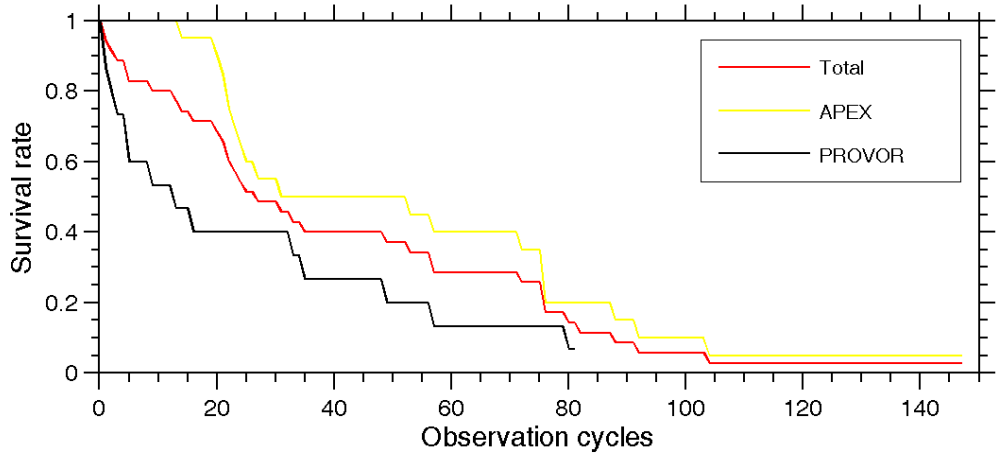

Fig.2 Survival rate estimated from all Argo floats (red), APEX (yellow) and PROVOR (black) as of 19 January 2007.

2. Technical problems encountered

There are three kinds of technical problems with the floats deployed by China Argo Program:

1) Energy flu

Among the 20 APEX floats, 2 floats encountered energy flu problem with the observed cycles of 56 and 91, respectively.

2) Druck pressure transducer problem

Among the 20 APEX floats, there are 2 floats existing Druck pressure transducer problem.

3) Other problems unknown reasons

As of the 15 PROVOR floats, 6 floats suddenly lost signals after observing several profiles, but the reason is unknown.

All these floats have the actual average operating period of 1-2 years, but the designed lifespan is 4-5 years. Obviously there exists a large difference between the actual lifetime and the designed, which once influenced the administration's confidence to the Argo Program.

The China developed profiling float — COPEX has almost finalized the design and tested in the sea, but it still needs long-time examination of reliability and stableness.

3. Status of Argo data management

1) Real-time data management

China Argo Real-time Data Center is responsible for receiving the data from all the floats deployed by China. All the data files are sent to GDACs as NetCDF format through a real-time QC, and profiles are inserted into the GTS under the help of CLS.

As of January 2007, the data center has sent 1338 profiles to GDACs.

2) Delayed-mode quality control (DMQC)

China Argo Real-time Data Center applies the WJO method to calibrate the salinity measurements. Up to now, 388 profiles after DMQC have been updated to GDACs. The work of thermal mass correction and surface pressure correction is in the stage of trying application. The profiles of all floats through DMQC are expected to upload into GDACs in 2007.

3) Argo floats information and data products

The global Argo data and related products are issued on the websites of China Argo Data Center (http://www.argo-cndc.org/) and China Argo Real-time Data Center (http://www.argo.org.cn/), including floats trajectories, T-S diagrams, T/S vertical profiles, and T/S horizontal distributions.

4. The operational application of Argo data

At present, Argo data has been widely used by research organizations under the jurisdiction of State Oceanic Administration, China Meteorological Administration, and Chinese Academy Sciences. Research results are involved in ocean circulation, water masses, mesoscale eddy, middle-layer circulation and thermocline distribution. The Chinese Academy of Meteorological Sciences has added the Argo profiles into the NCC-GODAS System, and this greatly improved the assimilating results, which has been released at the website of IRI/LDEO, Columbia University (http://iridl.ldeo.columbia.edu/SOURCES/.CMA/.BCC/.GODAS/). In addition, other research institutions are using Argo data in ocean data assimilation experiments, and reconstructing the T/S fields of the Pacific Ocean.

In June 2006, The Second Institute of Oceanography and the China Argo Real-time Data Center hosted the First China Argo Science Workshop in Hangzhou. There were about 50 scientists attended the meeting. The representatives discussed issues of the Argo data application, quality control, and floats technology development. The proceedings were published by China Ocean Press with the title of “Collection of Argo Application Papers”, which includes over 20 papers.

The China Argo Data Center hosted the 7th Argo Data Management Meeting (ADMT-7) during November 1-3, 2006, in Tianjin, China. 36 scientists participated in the meeting from 9 countries.

Floats Deployment plans and future funding

1. Year Plan of 2007

2007 is the key year for the Global Argo Project to complete the construction real-time ocean observing network. The Ministry of Science and Technology and the State Oceanic Administration are planning to fund 10 million RMB, to deploy about

50 floats in the region of Western Pacific and Eastern Indian Ocean. And there is a plan to use the GTS node at China Meteorological Administration, to promote the China Argo data to be shared by all the global Argo member countries.

The Ministry of Science and Technology also plans to fund 5 million RMB for the COPEX float's reliability and stableness test in the sea, trying for forming the ability of small scale producing within 2 years.

2. 5 years plan

The Ministry of Science and Technology, and the State Oceanic Administration are positively looking for channel of national special program to support Argo project. The plan is, in the coming 5 years, to fund 10 million RMB each year to deploy 50 floats in the region mentioned above, i.e. in the period of 2008-2012 the total deployed floats reaches 250-300.

The Chinese polar research vessel "Xue Long" sails for Antarctic each year through November to March of the next year, to undertake the polar scientific investigation, and provide the logistics for Chinese Antarctic Scientific Stations of "Great Wall" and "Zhong Shan". Another research vessel "Da Yang 1", after finishing the global ocean voyage in 2006, it began the half year's Pacific—Indian ocean exploration from January 2007 (Fig.3). The floats of China Argo Program were deployed mostly by these two research vessels. We also with pleasure provide opportunities for the other Argo member countries to deploy the floats in regions of Pacific Ocean, Indian Ocean, and the Southern Ocean.

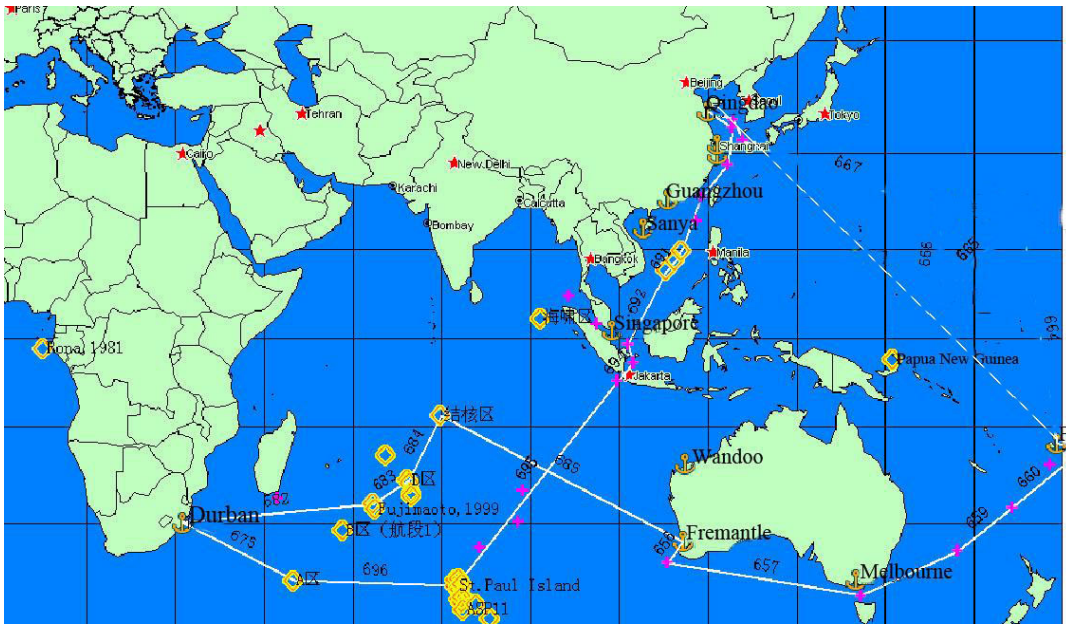

Fig.3 Cruise track of RV "Da Yang 1" during January-August, 2007.

China Argo Real-time Data Center, the State Key Laboratory of Satellite Ocean Environment Dynamics, and the Second Institute of Oceanography, State Oceanic Administration, hope to host the 3rd International Argo Science Workshop in Hangzhou, China, to make the contribution of promoting Argo data to be used more widely and the Argo Project sustainable development.

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ARGO National Report 2007 – The Netherlands

1) Status of implementation
The Dutch Argo program, run by the Royal Netherlands Meteorological Institute (KNMI), started in 2004 when three floats were deployed between Spain and Ireland. In 2005 four floats were deployed in the Irminger Sea, and in 2006 four in the Canary Basin. All deployments were done by the Dutch research vessel *Pelagia*, which is operated by the Netherlands Institute for Sea Research (NIOZ).

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. However, funding for float procurement has to compete with investments in other observational programs. As a consequence only six floats can be purchased in 2007.

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).
Six floats will be purchased and deployed in 2007. Deployment positions will probably be in the central North Atlantic Ocean, a region in which the current array is sparse.

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.

ARGO France
Report for the ARGO Steering Team meeting
February 2007
V. Thierry, S. Pouliquen, L. Gourmelen,
T. Carval L. Petit de la Villéon, C. Coatanoan

1. The status of implementation (major achievements and problems in 2006)

- floats deployed and their performance:

77 floats were deployed in 2006 early 2007, 2 Provor beached in the Mediterranean Sea, and one Apex failed after one cycle. The performance of the present Provor-CTS3 is very good and no failure occurred in 2006 both during the acceptance tests and at sea.

In yellow the position of the floats deployed by France in 2006

- technical problems encountered and solved:

No technical problems were encountered in 2006. Special study, in collaboration with CLS-ARGOS, has been conducted to adjust time at the surface because transmissions are not easy in Mediterranean Sea. In most of the cases 100% of the data are transmitted at shore for the Provor floats.

- status of contributions to Argo data management:

French Coriolis data center process data coming from 680 floats including 351 active floats in October 2006 (half Provor , half Apex) , deployed by 13 countries (Chile, Costa Rica, Denmark, France, Germany, Italy, Mexico, Netherland, Norway, Russia, Spain), Operated by 35 scientific projects (Good-Hope, Mersea, MFSTEP, Tropat, Weccon…) The detail can be found in the 7th ADMT report. Data are processed and distributed according to Argo recommendations

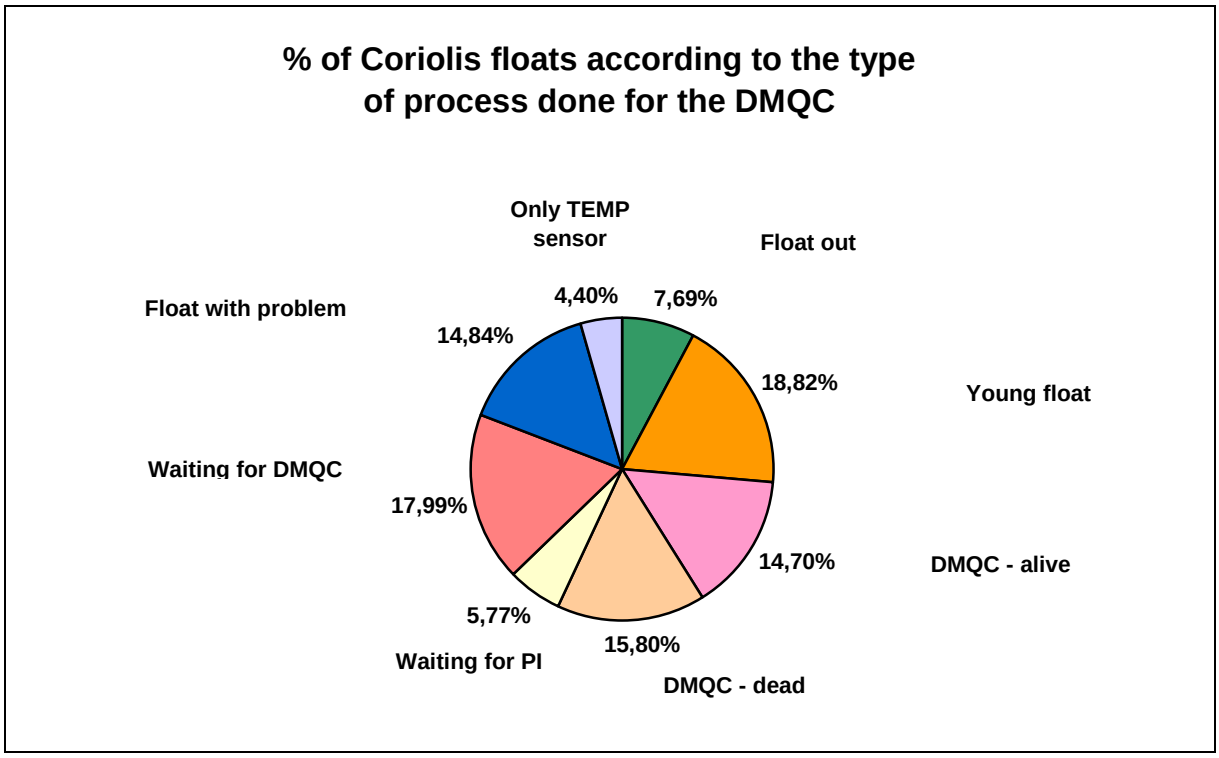
France also operates the European GDAC in collaboration with its USA counterpart FNMOC.

France also coordinates the activities of the North Atlantic ARC. The main activities are related to the reference data base as well as for data consistency in North Atlantic.

2. Status of delayed mode quality control process

- **fraction of accumulated profiles processed:**

The figure presents the status of the Coriolis floats. About 1/3 of the floats have been processed, while 1/3 of the floats cannot be processed for various reasons (only temperature sensor, float too young, etc..). Among the remaining floats that must be controlled in delayed mode, the Coriolis data center is waiting for the response of the PI for 15% of them, 47% of the floats have not been considered yet and 38% of the floats are problematic and must be considered carefully.



- **prospects for getting process up-to-date:**

Each profiling floats deployed as part of the French Argo program has a PI in charge of the delayed mode processing. PIs are strongly encouraged by the Coriolis datacenter to validate the data as soon as possible. Coriolis provides a support to the PI to help use the recommended method (BS in 2006 and now OW).

- **problems being encountered with DMQC:**

One problem encountered with the DMQC process is that the statistical method used to identify and correct salinity drift and bias is not yet stabilized. Following the recommendation of the 1st DMQC workshop, we have done some adaptation to the Boehme and Send (2005) method and now we are testing and shifting to the new merged method (Owens and Wong).Also, the method needed some adaptation in some regions due to the presence of fronts or because of the lack of reference data (eastern Tropical Atlantic or Antarctic for instance). In addition, different scientific teams are in charge of the DMQC. So, the observed delay is partly due to the PI because they commit to validate the data but not necessarily to do it within 1 year after the measurements.

3. 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, more than 300 French floats have been deployed in a number of different geographic areas, where deployments have focused on meeting specific French requirements, while also contributing to the global array. The French contribution is comparable to that from other developed countries and has provided a significant contribution to the growing Argo array.

Year	*French floats*
2000	*11*
2001	*12*
2002	*7(+4)*
2003	*34(+20)*
2004	*85 (+18)*
2005	*89(+11)*
2006	*65(+15)*
2007	*65*

Table 1. Numbers of French floats contributing to Argo deployed by year, figures in brackets are the additional floats co-funded by EU within the Gyroscope, MFSTEP and Mersea projects. Estimated figures are given for 2007.

The interests of France are global but with special interests in the Atlantic, Indian and Southern Oceans. We first started in the North Atlantic and gradually moved to the south while the network was dense enough in this area. French Argo has also deployed floats in sparsely populated regions (e.g. South Indian Ocean, South Atlantic and Southern Ocean),

The French Argo Project has been funded by the ministry of Research (mostly through Ifremer) and in a lesser proportion by the ministry of Defense (through SHOM). Overall the level of support, additional to float purchase, has been as indicated in the table below (man power for float preparation and data processing).

Year	Man/Year
2001	3
2002	6
2003	9
2004	15
2005	15
2006	12

2007	12

Table 2. Man power dedicated to Argo for Float preparation and Data management activities within French Argo.

France plans to contribute to the Argo global array at the level of about 80 floats per year with funding from Ifremer (about 50 floats/year) and SHOM (about 10 floats/year) and some direct EC funding. The expectation is that about 30% of the French contribution could come on the longer run from direct European funding. As part of the Euro-Argo preparatory phase, Ifremer will work with its funding ministry (mainly research ministry) to agree on a long-term funding level and commitment. Together with its European partners, Ifremer will also work with the European commission to set up a long term EC funding to Argo.

4. 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 2007 we will deploy floats in the Southern Ocean (between Africa and Antarctic) , in the Drake passage, in Mediterranean Sea, in Pacific near Chile, in Tropical Atlantic near Canary Islands and also planned some opportunity deployment in North Atlantic to reseed it if necessary.

Coriolis will continue to run the Coriolis Dac and the European GDAC as well as coordinating the North Atlantic Arc activities.

5. 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 programme is to develop the capabilities to fully exploit all 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.

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

As part of the scientific announcement of opportunities mentioned previously (GMMC), PIs can be selected to deploy floats within their scientific experiments. Here is the list of the experiments during which floats were deployed. Most of those projects rely strongly on Argo data.

- **OVIDE and North Atlantic variability** (H. Mercier, V. Thierry, T. Huck, P. Lherminier, B. Ferron)**:** This project focuses on the variability of the thermohaline circulation (THC) on seasonal and interannual time scales, on water mass analysis and census and on heat balance estimates. It includes a 4-D VAR inversion to reconstruct optimum circulation. The project includes a high resolution CTD section from Iberia to Greenland every two years, useful for delayed mode QC.
- **EGEE** (B. Bourles)**:** This project focuses on the variability in the Gulf of Guinea and Eastern tropical Atlantic. It is an ocean (and large scale air sea interaction) contribution to the AMMA program (African Monsoon Multidisciplinary Analysis).
- **Flostral** (R.Morrow)**:** This project focuses on the mode water (SAMW and AAIW) in the SW Indian and Austral Ocean, on the thermocline and on its role in setting up the deeper T-S variations.
- **GoodHope** (S. Speich, M. Arhan)**:** This project studies transfers between Indian and Atlantic oceans (water masses, heat, fresh water), relationship to global THC and regional air-sea interactions.
- **Cirene** (J. Vialard)**:** This project focuses on seasonal to inter-annual variability of the thermohaline circulation in the Tropical Indian Ocean.
- **Frontalis** (T. Delcroix)**:** This work studies the warm pool and salt barrier variability and their relationship with ENSO.
- **EGYPT-MC** (I. Taupier-Letage)**:** This project focuses on the general circulation and small-scale turbulence in the eastern Mediterranean Sea.
- **CONGAS** (A. Serpette): This project aims at studying ocean dynamics along the continental slope in the Bay of Biscay.
- **FLOPS** (G. Eldin, A. Chaigneau)**:** This project aims at studying the vertical water mass structure in the eastern Pacific, the oxygen subsurface minimum observed near the Peru-Chile coastline and the meso-scale structures observed in the current along this coastline. Floats deployed as part of this program are equipped with oxygen sensors.
- **CANOA-ARGO** (J. L. Pelegrì)**:** This study focuses on the spatial and temporal distribution of water masses in the Canary Basin. The project includes hydrographic cruises, moorings and surface drifters.
- **PROBIO** (H. Claustre): This project is consists in implementing optical sensors in profiling floats and to test them various area of the world ocean.
- **DRAKE** (C. Provost)**:** This project aims at studying the cold route of the thermohaline circulation and its variability. It focuses on three main objectives: investigate the variability of the Malvinas current transport, the transformation of the intermediate water masses in the Argentinean basin and the variability of the Antarctic Circumpolar Current at the Drake Passage.

In addition to those projects, some scientists have included Argo data for their research (without deploying any floats). Those works concern for instance an estimate of the mean circulation at 1000m depth in the equatorial Atlantic Ocean (M. Ollitrault) or the use of optimal interpolation of temperature and salinity to describe and quantify seasonal and interannual variability of the ocean (mean state, heat and salt content, etc).

6. 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.

The problem encountered recently with the SOLO FSI floats raises the following problem: who is the person to contact to notify suspicious data that have a QC flag set to 1 or 2. Is it the PI of the float, the corresponding ARC, the DAC in charge of the float, or someone else? It is important that someone is in charge of collecting information on anomalous data detected by users, to at least forward the information to the appropriate persons, or better to synthesize the information and to be available to detect, as early as possible, generic problems on some types of floats.

As more and more floats are equipped with oxygen sensors, it is important to perform tests in real time to discard erroneous data. What are the tests (at least the basic ones: O2 greater than 0, ..) that can be implemented in the data center ? What about delayed mode quality control ?

Argo National Data Management report for Germany (2006)

1. Status

Four German groups have deployed floats which contribute to ARGO: AWI (Alfred-Wegner Institut, Bremerhaven), BSH (Bundesamt für Seeschifffahrt und Hydrographie, Hamburg), the IFM-GEOMAR (Leibnitz Institut für Meereswissenschaften, Kiel) and the ZMAW (Zentrum für Marine und Atmosphärische Wissenschaften, Hamburg). The real-time data acquisition for all German groups is performed by Coriolis, which issues the data to GTS and performs the real-time QC. The real-time data from the four projects are sent for delayed QC back to the four groups. Each of the four groups is responsible for their "own" data, performs the delayed mode QC and then sends data back to the GDAC (Coriolis).

Basic Web pages exist for all 4 projects.
http://www.awi-bremerhaven.de/Research/IntCoop/Oce/weccon.html

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

http://www.ifm-geomar.de/index.php?id=argo

http://www.mersea.eu.org/Insitu-Obs/1-Insitu-Floats.html

Among the four German groups, about 7 PI's are working on ARGO data for scientific applications. ARGO data are not assimilated in operational models, but are used for assimilation in a global ocean model (ECCO at the ZMAW). While so far no standard products are generated from ARGO data, products are evaluated for a number of scientific purposes.

2. Delayed mode QC

Each of the four groups handles their own data for delayed mode QC and is responsible for providing these data to the GDACs. Delayed mode QC is generally done on a half-yearly basis. Within the joint German-ARGO project (AWI, BSH, IfM-Geomar) extensive collaboration exists and several meetings have dealt with the issue of delayed mode QC.

AWI presently operates floats in the partly ice covered Southern Ocean / Weddel Sea. These floats (mainly NEMO) have an ice sensing algorithm incorporated that prevents surfacing under ice. Profile data are archived in the float and sent when an ice-free surface is encountered. For positioning under ice the floats are tracked acoustically by a RAFOS sound source array. Delayed mode procedures have been set-up at the AWI and controlled data have been sent to Coriolis since the beginning of 2006. Due to the lack of data in the winter season, it would be preferable to perform the delayed mode QC on yearly intervals to get a better view of the salinity trends. The historical data base is poor in the southern Ocean and fronts in the ACC are also an issue.

BSH presently operates 49 active floats. Delayed mode procedures have been set-up at the BSH on a half-yearly basis and controlled data have been sent to Coriolis twice

since the beginning of 2006. About half (26) of the floats needed no salinity drift correction, some floats showed a small drift that was corrected and some of the older floats deployed around year 2000 showed stronger drifts and even jumps in salinity. The data base from the central Atlantic is in general good and no major problems have been encountered. The project is considered to be pre-operational.

The IFM-GEOMAR presently operates Argo floats in the tropical Atlantic. Delayed mode procedures have been set-up at the IFM-GEOMAR on a half-yearly basis and controlled data from the Atlantic have been sent to Coriolis since the beginning of 2006. There is a delay in processing 4 floats in the Indian Ocean (Argo equivalent), but they will be processed soon. Besides of problems with format changes and software modifications the system is considered to be pre-operational.

The ZMAW presently operates most of the Argo fleet in the Nordic Seas, and there will be a close cooperation with the Norwegian efforts regarding the QC of the floats in that area. The programs for delayed mode QC have been implemented and DMQC will be performed on a half-yearly basis.

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

The German Argo component has been funded from research funding agencies and the Ministry of Research (BMBF) until 2006. This funding included float deployments and personnel at each of the groups involved. It has been made clear, that there will be no continuation of this kind of funding from the BMBF. However, there is still the possibility for funding of scientific programs including an Argo component (Argo equivalent floats), but this is strictly PI driven research. Secondly, for a transition period of one year (2007) there is some funding of personnel (3 positions), travel and the like (but no additional floats) for the transition of German Argo from research oriented to more operational. Thirdly, the good news is that the Ministry of Traffic (responsible for the German Weather Service and the BSH) agrees to launch an operational Argo component with funding of the order of 35 to 50 floats per year; this is planned to begin in 2008 and presently there are negotiations for year 2008 financing.

4. **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.**

Altogether Germany will deploy 37 Argo floats in 2007, with some of the activities already taking place. These floats will be put into the Nordic Seas (11), the North Atlantic (14), the tropical Atlantic (2) and the Southern Ocean (10). These are all funded. Beyond 2007 the situation is somewhat unclear, but we are confident that we will have sustained (annual) deployments through national funding of the order of 35 to 50 floats per year (personnel is less clear). Regionally, the efforts will be focussed on the Atlantic, presumably in the areas of primary German / European interest (North Atlantic, Nordic Seas).

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

As the German Argo component (past to present) is linked to research programs like CLIVAR, Argo data will be used for climate related studies. Assimiliation efforts are ongoing for research purposes. Increased interest by German PIs in Argo data usage is anticipated from the Euro-Argo initiative.

Argo Steering Team Meeting (AST-8)

National Report – India

(Submitted by M. Ravichandran)

1. 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 (lead) jointly with the National Institute of Ocean Technology (NIOT) of MoES, Chennai, and the Center for Atmospheric and Ocean Sciences (CAOS) of Indian Institute of Science at Bangalore.

b) The Indian Argo Project envisages (a) Deployment of 150 Argo floats in the Tropical Indian Ocean, (b) Setting up and operation of Argo Data Reception and Processing System at National level, (c) Setting up and operation of Regional Argo Data Centre, (d) Regional Coordination for Deployment in the Indian Ocean, (e) Development of Ocean Data Assimilation System, (f) Analysis and utilization of Argo data and (g) Capacity Building at National level.

c) Several R&D Institutions including the National Institute of Oceanography at Goa, Space Applications Centre at Ahmedabad, National Remote Sensing Agency at Hyderabad, Indian Institute of Tropical Meteorology at Pune, National Centre for Medium range Weather Forecasting (NCMRWF) at New Delhi, Centre for Mathematical Modelling and Computer Simulation (C-MMACS) at Bangalore participate in the utilization of Argo data. Efforts are underway to encourage and enable academic institutions in this endeavour.

2. Floats deployed and their performance

a. Float deployment

Deployment of Argo floats is the major part of the program and the total commitment of India's contribution is 150 floats for the period 2002-2007. To fulfill the commitment, 122 floats have been deployed so far. Remaining 28 floats have already procured and will be deployed within 2 or 3 months depending upon the availability of ship time. The year-wise break-up of float deployment is given here.

Financial Year	Floats deployed
2002-03	10
2003-04	21
2004-05	33
2005-06	43
2006-07	15 (2 Oxygen Sensor)
TOTAL	122 (28 to be deployed)

During the year 2006-07, six floats were procured with Oxygen sensors and two floats of this type were already deployed in Bay of Bengal

b. Performance Analysis of the Floats deployed so far

Out of 122 floats deployed by India so far, 76 floats are active, 4 floats are providing only near surface information and 42 floats are inactive. Out of 42 inactive floats, 4 floats were beached (2 in Maldives, 1 in Somali coast and other one in Oman coast), 28 floats were failed due to (i) pressure sensor problem, (ii) energy flu and/or (iii) completion of its life cycle. The reasons for the remaining failed floats are not known, but they are Provor type floats.

One Argo float beached in Maldives was retrieved by Maldivian fishermen was handed over to Indian High commission and was brought by Indian Navy to India. There was no damage in this float and it is in working condition. Highest appreciation to Maldivian fishermen, Argo Information Center, Indian High Commission (Maldives), and Indian Navy for their help in retrieving the float.

3. Status of contributions to Argo data management

a. Real time data stream:

One Scientist from INCOIS was trained by Coriolis Data Centre, France for Automatic Quality control procedure, development of Visual QC and generation of Data products. A hand on experience of Coriolis Visual Quality Control (CVQC) was used to correct all INCOIS profiles by eliminating error flags. The profiles with wrong position are changed to the correct position using the surface trajectory information. Three level Quality Control is implemented at INCOIS for generating data with correct quality flags. The three levels include 1. Automatic Quality Control , 2. Visual Quality Control and 3. Using Objective Analysis for Quality Control.

The Automatic Quality Control passes the data to 19 prescribed quality control checks and subsequently the profiles generated are used in Objective Analysis and those profiles which are rejected by the Objective Analysis are checked with Visual QC for further correction of flags.

With the above three tier architecture all the old data starting from October 2002 were reprocessed and NetCDF files are generated and uploaded on to GDAC.

b. Delayed Mode QC:

Out of 122 floats deployed by India, 96 profiles are eligible for DMQC (13 floats were failed before 1 year time frame and another 13 are less than one

year old). Out of 96 eligible floats, DMQC are made only 10 floats and uploaded to GDAC. Remaining floats will be done in 2 to 3 months. The delay is due to some problem in R files, which was corrected recently.

Lack of CTD profiles from North Indian Ocean is still a critical problem when decision is to be taken for a complicated case. It was advised on DMQC-2 to switch off the bottle data for better calibration. It is found that in some cases this strategy is very useful for making meaning full guess about the float sensor behavior but data gaps will be worse in these cases.

c. Trajectory data:

The Argo trajectory files for floats deployed after 2004 are re-processed from raw ADS format. A total of 67 trajectory netcdf files are uploaded to the GDAC. The trajectory files for the rest of the floats are under processing.

d. Argo Regional Data Center and Basin level co-ordination (Indian Ocean)

Indian National Centre for Ocean Information Services (INCOIS), India acts as Argo Regional Data center (ARC) for the Indian Ocean region. The functions of ARC-Indian Ocean are as follows:

- Acquisition of Argo data from GDAC for Indian Ocean region and made available from ARC web.
- Acquiring CTD data from Indian Research Vessel for Updating Indian ocean reference data base
- Comparison of float to float and float to CTD data
- Delayed mode Quality control
- Statistics of floats (deployed, active, drifts, percentage of floats in water from deployment, etc)
- Argo Value added products
- Basin level Deployment Co-ordination

Data from Indian Ocean Argo floats are made available at ARC- Indian Ocean WEB-GIS site http://www.incois.gov.in/argo/arc/present.jsp. Wherein, users can quarry with desired time, depth and parameters and, download the required data in ASCII format for a single float or group of floats. All the active and inactive floats data are made available in this site.

Efforts are underway in updating Indian Ocean reference data sets using high quality CTD data collected using Indian Research Vessels. Some of the CTD data were submitted to CCHDO through Coriolis Data Center and soon these data will also made available from ARC-Indian Ocean webpage. A separate study has been initiated with National Institute of Oceanography and Indian Institute of Technology for making Reference data base for DMQC, Indian Ocean

Atlas and validation of profile data (Real-time and Delayed mode) with CTD and recent Argo profiles.

Value-added Products

As a part of ARC activities, products such as Waterfall plot of temperature, salinity and density (to show consistency of the data), sea surface temperature, sea surface salinity, T-S plots, time-series of surface pressure & maximum profile pressure by float type are generated and published in INCOIS web. This information is available from INCOIS website for all the Indian Ocean floats from the date of deployment to present. Also, objectively analyzed monthly products such as spatial variation of Sea surface temperature, sea surface salinity, mixed layer depth, heat content up to 300 m depth, upto thermocline depth and upto 26 deg isotherms, Geostrophic currents, dynamic height, etc are generated. http://www.incois.gov.in/argo/arc/products.jsp

Data from the Indian Ocean regions are gridded into 3x3 box for monthly and 10 day intervals. These gridded data sets are made available through Live Access Server (LAS). (http://www.incois.gov.in/argo/arc/las.jsp) Users can view and download data/images in their desired format.

Basin level Regional Co-ordination for Argo floats deployment plan for Indian Ocean is made available from http://www.incois.gov.in/website/futureextended/viewer.htm

3. 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 2002 to March 2007 fully funded by MoES, Govt. of India. During this period, India committed to deploy 150 floats. However, we could deploy only 122 floats as of now and the remaining 28 floats will be deployed within two months.

For the next five year plan (2007 to 2012), Ministry of Earth Sciences has approved funding for deploying 50 floats per year (250 floats for 5 year term) with few floats will have additional sensors.

5 Permanent and 3 temporary scientific/technical personal are working under Indian Argo project, which include personal for deployment of Argo floats, Data system, Analysis of Data, etc. in three different institutions.

4. Summary of deployment plans and other commitments to Argo 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.

INCOIS, India will continue to serve data management activities including Regional Data center and deployment co-ordination.

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

Presently, Argo data are used by India Meteorological Department for their operational use. During the last one year many scientific users from different Organization (INCOIS, NIO, SAC, C-MMACS, NRSA, IITM, NCMRWF, IISc, etc) have started analyzing data for different applications. Efforts are underway in assimilating argo data in OGCM.

The data are being used for:

- To study the structure and variability of the Indian ocean
- To study the response of the North Indian Ocean to the summer monsoon
- Heat content variability of Indian Ocean
- Barrier layer studies in Bay of Bengal and Arabian Sea
- To study short-term variability of Sound Velocity
- Assimilation of Argo float data in OGCMs
- Validation of Ocean models

One of the main Objectives for the forthcoming year is to assimilate Argo and other satellite data in OGCM and deliver operational nowcast/ forecasts on the seasonal time scale for the Indian Ocean region.

Japan National Report

(Submitted by Nobie Shikama)

1. Status of implementation (major achievements and problems in 2006)

1.1 Floats deployed and their performance

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 86 floats (84 APEXs, 2 NINJA) in FY 2006 from April 2006 to March 2007.

JAMSTEC introduced five APEXs using the Iridium Satellite System into Japan for the first time and deployed them in the MISMO cruise in the Indian Ocean in October 2006. These Iridium-APEXs are working well to send temperature-salinity profiles from 500db everyday. JAMSTEC really appreciates the assistance of Dr. S. Riser and D. Swift of University of Washington who provided their software to treat Iridium APEXs and gave a lot of useful advice in this introduction.

The Arctic research group of JAMSTEC deployed a POPS (Polar Ocean Profiling System) near the North Pole in the Arctic Sea in April 2006. 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) had been sent to the GTS until mid-January 2007 when it terminated its transmission probably due to its drift into a non-ice zone and submergence. We can really say “Arctic Argo has begun! ”.

An APEX of JAMSTEC beached on the shore of Maui/Hawaii and was kept by US Coast Guard in the end of January 2007. A technician of JAMSTEC will visit US Coast Guard of Maui to examine and ship it back to Japan safely in mid-March 2007. JAMSTEC really thanks both US Coast Guard for keeping the float safely and D. Swift of University of Washington for giving the first information about the beached float.

Among the 528 floats (447 APEXs, 72 PROVORs, 9 NINJAs) which JAMSTEC deployed in the Pacific, Indian and Southern Oceans, from 1999 to the end of January 2007, 308 (305 APEXs, 1 PROVOR, 2 NINJA) floats are now in normal operation, 213 floats (138 APEXs, 69 PROVORs, 6 NINJAs) terminated their mission and 7 floats (4 APEXs, 2 PROVORs, 1 NINJA) were recovered.

The Japan Meteorological Agency (JMA) deployed 16 floats (7 PROVORs, 9 APEXs) from January 2006 to December 2006 in the seas around Japan for operational ocean analysis and forecast as Argo equivalent floats. Among 23 floats (14 PROVORs, 9 APEXs) which JMA deployed from 2005 to 2006, 19 floats (10 PROVORs, 9 APEXs) are operating at the end of December 2006, while 4 PROVORs terminated the transmission in 2006.

National Research Institute of Fisheries Science, Fishery Research Agency deployed 1 APEX with a Wetlab chlorophyll sensor in the Kuroshio region in February 2006. As the chlorophyll data began to show unstable tendency 3 weeks after launch, the float was recovered in April 2006 by the same institute.

Tohoku University deployed 1 APEX with both a Sea-Bird oxygen sensor and a Wetlab chlorophyll sensor in February 2006. Reliable chlorophyll data was obtained during about 140 days after launch. Tohoku University also deployed 1 isopycnal APEX with an Aanderaa Oxygen Optode in July 2006.

1.2 Technical problems encountered and solved

Chlorophyll sensor (Wetlab FLNTU) loaded on an APEX which was deployed by Tohoku University began to show unreliable data 140 days after launch. The cause of malfunction is now being examined at Webb. We heard that a similar malfunction was also experienced in Chilean float deployment.

In JMA's deployment, three in four floats ceased their operation in shallow waters before expiration of their expected lifetime. One PROVOR deployed in February 2006 did not submerge after launch but kept floating on the sea surface and sending a message "end of life mode". The reason of malfunction is unclear. Among 15 APEXs purchased in 2006, 3 APEXs failed the automated bladder function test and were sent back to the import agent.

1.3 Status of contributions to Argo data management

Real time data management.

The Japan DAC, JMA has operationally processed data from all the Japanese Argo and Argo-equivalent floats including 351 active floats as of February 5, 2007. Nine Japanese PIs have agreed to provide data to the international Argo data management. All profiles from those floats are transmitted to GDACs in netCDF format and issued to GTS using TESAC code after real-time QC on an operational basis.

Delayed mode data management

JAMSTEC has modified the original algorithm of automated position QC by request of the participants of the Trajectory Workshop held in Korea in October 2006, and is ready to release the source code of new procedure to other DACs. JAMSTEC plans to revise the present reference data bases (SeHyD and IOHB) to accommodate them to the new DMQC tool (OW) after summer 2007.

2. Status of delayed mode quality control process

2.1 Fraction of accumulated profiles processed

JAMSTEC had submitted the data of 11,353 profiles to GDACs as of September 2006, and processed about 3,000 profiles for DMQC afterwards. These additional data are being submitted to GDACs.

2.2 Prospects for getting process up-to-date

JAMSTEC is now preparing introduction of the new DMQC tool (OW). JAMSTEC is applying the cell thermal mass correction for SBE41 sensors of APEXs in the operational processing. Regarding the measured surface pressure of APEXs, JAMSTEC has been correcting it for the values between 0 and 20 db and flagging it over 20 db since 2003. If an integrated value like heat content is calculated by using uncorrected pressure data, a significant error might be produced.

3. 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: JAMSTEC), the Ministry of Land, Infrastructure and Transport, JMA and Japan Coast Guard.

After the Millennium Project terminates in March 2005, JAMSTEC is to continue the operation until FY2008 nearly in the same scale (about 90 floats to be deployed every year) and JMA will continue to deploy 15 floats around Japan every year for operational ocean analysis and forecast.

4. 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 FY2007, JAMSTEC will deploy 80 to 90 floats in total in the Pacific, Indian, and Southern Oceans. JMA will continue to deploy 15 floats around Japan every year 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.

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

Many groups in JAMSTEC, JMA and Japanese universities are using Argo data for oceanographic researches on water mass production and transport in the North pacific, the mid-depth circulation, the mixed layer variation, the barrier layer variation and so on.

The global Argo TESAC messages are used for operational ocean analyses and forecasts by JMA. Various oceanographic charts in the sea adjacent to Japan based on the output of the Ocean Comprehensive Analysis System are operationally distributed through the JMA web site (in Japanese) for national use. Numerical outputs of the system are available from the NEAR-GOOS Regional Real Time Data Base (http://goos.kishou.go.jp/) and the Japan GODAE server (http://godae.kishou.go.jp/) operated by JMA. Outputs of the Ocean Data Assimilation System and the El Nino Prediction System (an ocean- atmosphere coupled model) for monitoring and prediction of El Nino-Southern Oscillation are also distributed from the Tokyo Climate Center (http://okdk.kishou.go.jp/).

JAMSTEC is providing a variety of products related to DMQC for the Pacific Argo Regional Center (PARC) web site as a main contributor. Some information about consistency of the float data will be added to the web site in near future.

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Argo Steering Team Meeting (AST-8)

Paris, France, March 7-9, 2007

Korean National Report on Argo-2006[1]

Deployment in 2006 and Future Prospect

Korea Argo has kept its steady course, deploying 33 floats; 10 floats in the North Pacific, 5 floats in the Southern Ocean and 18 floats in the East/Japan Sea. Korea Ocean Research and Development Institute (KORDI) and Korea Meteorological Administration/Meteorological Research Institute (KMA/METRI) deployed 18 and 15 floats respectively, which are working properly at present.

In 2007 total of 27 floats are planned for deployment; 10 in the North Pacific, 3 in the Southern Ocean and 14 in the East/Japan Sea. However, there is a slight possibility that adjustment of funding due to restructuring of METRI may result in less number of float deployment. Korean Argo community is working hard with KORDI and METRI to secure the present level of funding and float deployment, but the future beyond 2007 is uncertain.

Argo RTQC

KORDI has some difficulties in decoding the PROVOR float data, hence its RTQC was delayed initially for a couple of months. Within 24 hours of data collection, all data of KORDI Argo floats are issued to GTS by CLS in France. KORDI started to send RTQC data to US GDAC from November 2006 onwards as a DAC role.

KMA RTQC system produces profile data, meta data, technical data, and trajectory data with TESAC and NetCDF format from raw data with 32byte Hexa format in real time. Those 4 types of data are transmitted into GTS network and GDAC. Now, the RTQC system is being upgraded by following the “Argo quality control manual ver. 2.2” and “user’s manual ver. 2.2”.

Delayed mode quality control

Korea Oceanographic Data Centre (KODC) is in charge of delayed QC and working on the DMQC for Korean floats in the East/Japan Sea and the North Pacific Ocean. Preliminary DMQC results were obtained in 2006 and will be sent to some experts on the East/Japan Sea and the North Pacific region for quality examination. Moreover, additional hydrographic data

[1] Prepared by Kuh Kim in collaboration with Moon-Sik Suk (KORDI) and Yong-Hoon Youn (KMA/METRI).

for the East/Japan Sea will be collected and processed for improvement of the reference dataset. However, KODC and KORDI cannot perform the DMQC for the Argo floats deployed in the Southern Ocean. It would be appreciated deeply if any other DAC is willing to do this work for the Southern Ocean floats.

Human Resources

Korea is short of human resources to take care of Argo program in general. Lack of technical personnel at KORDI and rotation of position at METRI have been major source of problems. As Argo is considered as a research project in Korea and an operational application of Argo data is still at a primitive stage, it is an uphill battle to justify long-term benefits of Argo.

Research and operational uses of Argo data

KORDI uses Argo data for scientific research and modeling for the East Sea region and its webpage (http://argo.kordi.re.kr) serves as a data distribution centre since 2004.

KMA has been developing the data assimilation system and has a long-term plan to work on the operational ocean climate forecast around the Korean peninsula as well as the global ocean. Argo float data and their management system in KMA also go well in gear with their operational climate forecasting system. METRI distributes global Argo data on its webpage (http://argo.metri.re.kr).

Researches on inertial currents in the surface mixed layer, data assimilation, typhoon passage and deep circulation in the East Sea are actively carried out at Seoul National University, Chunnam National University and Pusan National University as well

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5 February, 2007

REPORT ON THE ARGO MEXICAN FLOATS PROGRAM

Dr. José Luis Ochoa de la Torre
Departamento de Oceanografía Física/ CICESE
Ensenada, Baja California, México

The participation of México in the ARGO program started in 2005, and continues to this date, with a single float (WMO 1900377) donated by the Instituto Español de Oceanografía via Dr. Gregorio Parrilla.

1. Status of implementation. One Float (WMO 1900377), from its deployment, May 4, 2005, until today has produced 65 profiles of which 18, from the 20th to 33rd and from the 41 to 44, 'touched' bottom, all the rest profiled the 2000 db as programmed.

2. Funding level and human resources. There is no commitment for funding in 2007 and at present, there are only two researchers directly involved in the ARGO program: Dr. Armando Trasviña in a USA_Colombia_Mexican joint venture and myself.

3. No future deployment plans exist.

4. There is interest in the use of the ARGO data by researchers of the program 'Investigaciones Mexicanas de la Corriente de California' (IMECOCAL, http://imecocal.cicese.mx).

New Zealand National Report January 2007

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. Two further floats will be purchased before July 2007. 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 ten floats to date and is committed to purchasing two further floats before July 2007. 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) and 2585 (5901271) 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. These voyages, dating back to 2004 have deployed nearly 450 floats, primarily in the South Pacific but also in the eastern Tropical Pacific and Indian oceans. NIWA's larger research vessel, R/V Tangaroa deployed 45 floats between 45°S and 55°S during 2005 in the western Pacific as part of the same collaboration.

Two additional R/V Kaharoa deployment voyages are in planning stages. The first of these planned deployments are included in the Pacific Planned deployments figure on the Argo webpage: (http://www.argo.ucsd.edu/FrDeploy.html).

ARGO Norway

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.

ARGO Norway focuses on both research topics and marine climate monitoring of the Nordic Seas. Approximately 4 scientists in 3 projects are directly involved in ARGO Norway but several other people contribute regarding technical expertise, data management, ship time for deployments, and processing and analysing the data. There is also an increased interest in the Argo data at other Norwegian institutes.

At present we have in total deployed eleven Argo floats where five floats are still active. Three floats were deployed in 2002, while six were deployed in 2003. Two more floats that include oxygen and fluorescence sensors were deployed in April 2006. These additional sensors have so far performed well.

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 two Argo floats.

The funding has so far been self-financed (i.e. funded by our institute). There are not devoted any funding for scientific analysis, but a person is partly working with the Argo floats regarding collecting data and for presentation on the web. The scientific analysis is done in other financed projects.

At present we have no plans for further deployment of Argo floats due to lack of financial support. However, Argo Norway will continue to apply for more funding on a national level.

Regarding the “Delayed mode” we have in the past not done anything special with that. However, we have an agreement with IFREMER where they will do the quality check for us. IFREMER will then, afterwards, make the high-quality data and the meta-data available on the internet.

ARGO National Report – Spain – 2006

The year 2006 was the last one of the funded (Spanish Department of Science and Technology, REN2001-4022-E) ARGO-Spain contribution. It ended in September with the deployment of the last float in the Canary Basin area.

In order to divulgate the actives of the Spanish Argo contribution, with especial interest in the use of the data by the Spanish-speaking community; the argo-España web page has been released:

argo.oceanografia.es

1. The status of implementation

- The last profiler was deployed in the Canary basin in September 2006.
- The status of the 11+3 (donated to Costa Rica and Mexico) floats is summarized as follows:

Estado	ID	proyect	First Profile	Last profile	Age	type
Active	4900557	ARGO_SPAIN	Sep.13,2004	Feb.21,2007	2.44	PROVOR Ps
Active	6900506	ARGO_SPAIN	Sep.24,2006	Feb.21,2007	0.41	APEX Pros
Active	1900278	ARGO_SPAIN	Sep.29,2003	Mar.01,2007	3.42	APEX Pros
Active	1900377	ARGO_MEXICO	May.04,2005	Feb.25,2007	1.81	PROVOR Ps
Active	1900379	ARGO_CR	Dec.07,2005	Feb.23,2007	1.21	PROVOR Ps
Inactive	4900556	MFSTEP	Mar.23,2005	Feb.04,2007	1.87	PROVOR Ps
Inactive	4900558	ARGO_SPAIN	Sep.10,2004	Dec.31,2006	2.31	PROVOR Ps
Inactive	6900230	ARGO_SPAIN	Sep.23,2003	Sep.12,2005	1.97	APEX Pros
Inactive	6900231	ARGO_SPAIN	Dec.28,2003	Nov.07,2005	1.86	APEX Pros
Inactive	1900275	ARGO_SPAIN	Oct.11,2003	Oct.15,2006	3.01	APEX Pros
Inactive	1900276	ARGO_SPAIN	Oct.02,2003	Jun.12,2005	1.70	APEX Pros
Inactive	1900277	ARGO_SPAIN	Oct.04,2003	Jan.15,2007	3.29	APEX Pros
Inactive	1900279	ARGO_SPAIN	Oct.07,2003	Dec.25,2005	2.22	APEX Pros
Inactive	1900378	ARGO_CR	Dec.07,2005	Dec.31,2005	0.07	PROVOR Ps

- The data is send directly to the Coriolis (Ifremer) center, who is doing all the near real time processing, including near-real time QC, issue to GTS and public web page maintenance.
- Actually there is not national center for ARGO (DAC) is Spain, neither plan to begin it at the Instituto Español de Oceanografía in the near future.

2. Status of delayed mode quality control process

- The DM control of the ARGO-Spain floats will be carried out during 2007.

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

- Spain, through IEO and the CSIC, will participate in the preparatory phase of the European ARGO contribution.
- During 2007, a renewal of the Spanish contribution will be applied to the national funding agency. The implication in the Euro-ARGO initiative will help in obtained the appropriate funds.

4. 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.

- The floats funded by the Spanish ARGo contributions will be devoted to fill in the gaps (from the theoretical 3ºx3º implementation), in the following areas:
  - Iberian basin
  - Canary basin
  - Central eastern mid Atlantic
  - Western Mediterranean.
- However, the deployments won´t be possible until mid-2008.

UK ARGO PROGRAMME

REPORT FOR ARGO STEERING TEAM 8TH MEETING, MARCH 2007

Background and present status

The UK Argo programme is undertaken by a partnership which was developed following discussions between the NOAA Administrator and the Chief Scientific Advisor (CSA) in 1999. It has been funded by UK government through the Department for Environment, Food and Rural Affairs (Defra) (www.defra.gov.uk), the Ministry of Defence (MoD) (www.mod.uk) and the Natural Environment Research Council (NERC) (www.nerc.ac.uk) and is carried out in collaboration 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 UK programme was initiated in 2000, with our first Argo floats being deployed in January 2001, and is presently in the process of transitioning to a sustained (or operational) basis.

Floats deployed

Since 2001, over 200 UK floats (including 5 donated to Mauritius) have been deployed in a number of different geographic areas, where deployments have focused on meeting specific UK requirements, while also contributing to the global array.

Year	*UK Argo floats*	*Argo equivalent floats*
2001	*27*	*2*
2002	*34*	*4*
2003	*22 (1)*	*15*
2004	*45 (2)*	*0*
2005	*28*	*0*
2006	*24 (2)*	*0*
2007	*45*	*2*

Table 1. Numbers of UK floats contributing to Argo deployed by year, figures in brackets are floats donated to and deployed by Mauritius. Estimated figures are given for 2007 (for which 12 floats have been deployed so far).

The interests of the UK are global but with special interests in the Atlantic and Southern Ocean. However, because other countries have committed a sufficient number of floats to the North Atlantic, UK Argo has only deployed a relatively small number of floats in that region. In particular UK Argo has taken a lead in deploying floats in other regions (e.g. North west Indian Ocean, South Indian Ocean, South Atlantic and Southern Ocean), as shown in Fig. 1, to help in establishing the global array. This has involved developing partnerships with other countries to assist in deploying UK floats, including South Africa, Mauritius, Norway, Mozambique, Iceland as well as US and France

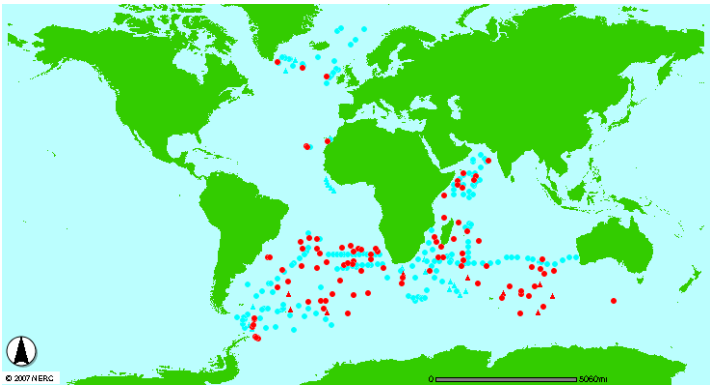

Figure 1. Locations of UK floats (•) when deployed and (•) those currently operating.

Float survivability

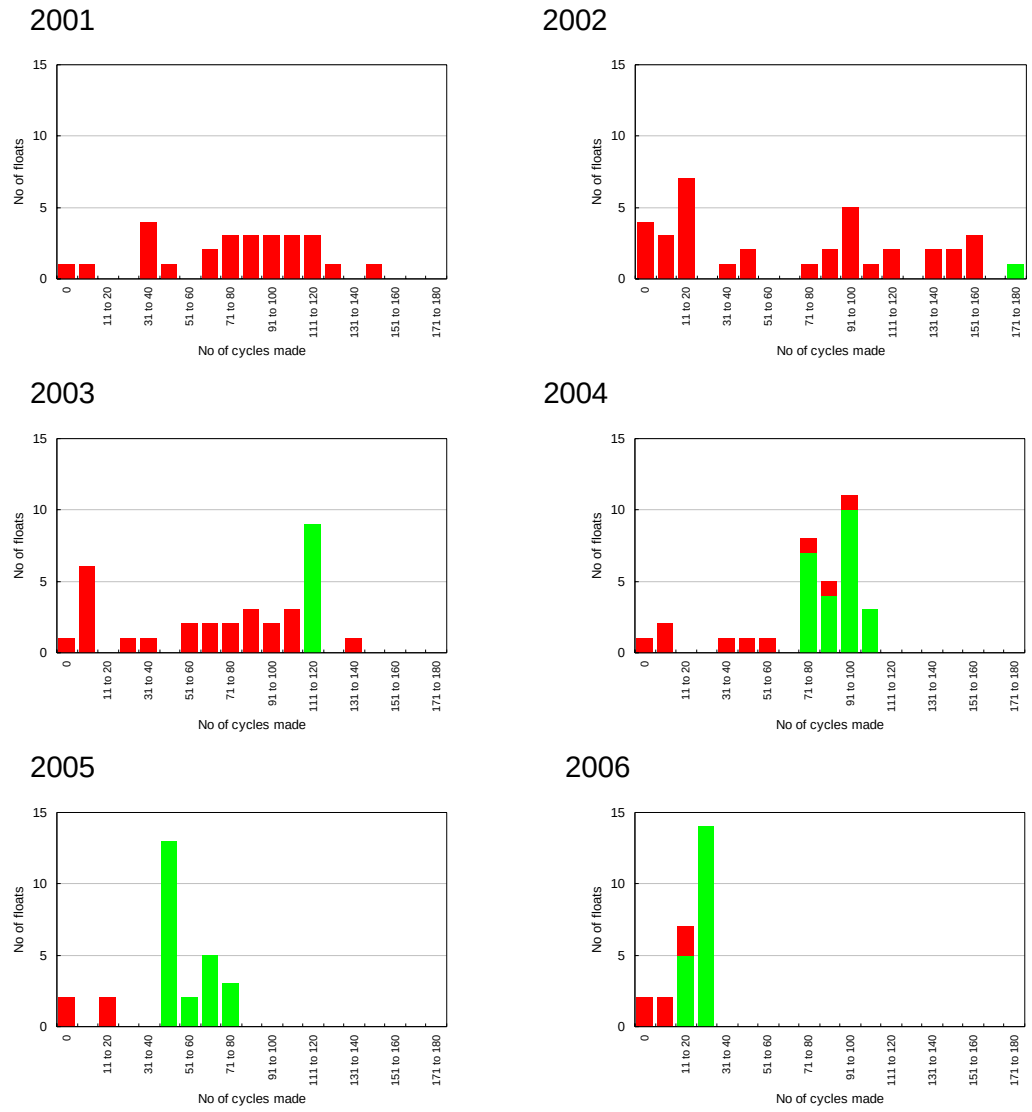

Figure 2. Showing the numbers of full-depth profiles completed for active (green) and dead (red) Apex floats grouped against year of deployment. Figures exclude floats where deployment failure has been confirmed. The number of cycles is adjusted for those floats that have shallower profiles or only profile deep intermittently.

The figures above, for Webb Apex floats, clearly show the relatively high number of early failures for floats deployed in 2002 (motor backspin) and 2003 (pressure transducer), with a

reduction in early failures for floats deployed from 2004. The oldest surviving float (from 2002) has now made 177 cycles (nearly 5 years of operation).

Of the 26 floats (all Apex) deployed in 2006, 3 failed very early (2 failed to report any profiles and 1 stopped after 2 profiles) – initial transmissions were received from these 3 floats and the failures may be due to failed air bladders (problem identified during January 2007).

The figures below shows similar statistics for the MARTEC Provor floats. As fewer of these have been deployed the figures are grouped for floats deployed in 2001 to 2003 and 2004/2005. The more recent (2004/05) Provors have demonstrated greater reliability than the earlier Provors.

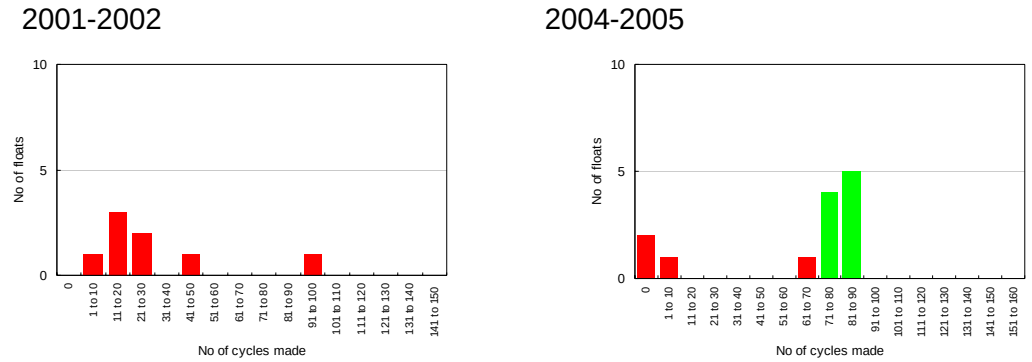

Figure 3. Showing the numbers of full-depth profiles completed for active (green) and dead (red) Provor floats grouped against years of deployment. Figures exclude floats where deployment failure has been confirmed.

Apex float monitoring

In addition we have established a partnership with Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) to monitor the performance of deployed UK (and Australian) Apex floats where an engineering web-site for UK and Australian Apex floats has been established (see http://www.cmar.csiro.au/argo/tech/). This work helps to identify areas where further improvements to the float technology can be made.

Deployment plans

As at end February 2007, we have deployed 12 floats in 2007 and have another 39 floats available for deployment, as shown in Table 2 (over).

Data management

The UK Argo Data Centre, which is established at BODC, processes all our float data. New floats are added into the system as they are deployed and metadata compiled; a metadata netCDF file is generated for each float and forwarded to the 2 Argo Global Data Assembly Centres (GDACS) in France (Coriolis) and the US (USGODAE).

Real-time data processing

An automatic real-time processing system has been developed and is operational. This downloads, twice daily, the raw (hexadecimal) data from CLS, decodes the data stream, carries out an agreed suite of automatic quality control tests (adding quality flags to the data as necessary), and generates profile and trajectory data files in the internationally agreed

12 floats deployed so far in 2007	
South-east Indian Ocean	*4 Apex floats with lithium batteries deployed from MSC Didem in January.*
Weddell Sea	*4 Apex floats to be deployed by UEA from RRS James Clark Ross in February – with ice avoidance capability - includes 2 NERC-funded Argo-equivalent floats*
Southern Ocean	*4 Apex floats (with lithium batteries) deployed from RRS James Clark Ross in February*
Floats for which deployments are scheduled (4 floats)	
South-east Atlantic (40S)	*4 Apex floats to be deployed from SA Agulhas in September*
Floats for which deployments have not yet been scheduled (35 floats)	
South Indian Ocean	*6 Apex floats*
North-east Atlantic (Iceland Basin)	*5 Apex floats (NOCS to deploy)*
North-east Atlantic (26N)	*2 Apex floats (NOCS to deploy)*
Southern Ocean	*7 Apex floats*
Arabian Sea	*5 Apex floats (VOS)*
Somali Basin	*5 Apex floats (VOS)*
tbd	*5 refurbished Provor floats*

Table 2. Floats deployed and available for deployment in 2007.

formats. The UK Argo Data Centre web-site is automatically updated daily with UK float status information, a map of current float positions and temperature and salinity profile plots.

The automatic real-time system generates the float data in both WMO TESAC and Argo netcdf formats. The TESAC messages are automatically emailed to the Met Office where they are then disseminated on the GTS via Exeter (EGGR) – this system was tested during summer 2006 and implemented operationally from September (from when TESAC messages for our floats were no longer issued through Toulouse). GTS (and in the future the WMO Weather Information System) will remain the primary mechanism for receipt by National Meteorological Services of real-time data (float, buoys and ship data etc.) needed for meteorological and ocean forecasting.

The data in netcdf format are also provided (by FTP) to the two GDACs, generally within 24 hours of receipt, and are also available from the UK Argo Data Centre web-site via an interactive map interface.

Delayed-mode data processing

This is carried out by BODC with support from the UKHO. In the last year a substantial number of floats have been processed. While the adjustments to the float data have been agreed, modifications are needed to the software used to generate the delayed-mode netcdf file. These should be completed shortly and the data submitted to the GDACs. The delayed-mode processing has focused on floats from the South Indian Ocean and South Atlantic with a few from the North Atlantic and Southern Ocean. A new member of staff will join BODC in March to work on the delayed-mode QC and it is anticipated that the backlog in data needing to be processed will be significantly reduced during 2007.

Southern Ocean Argo Regional Centre (SOARC)

As noted earlier, the UK has particular interest in the Southern Ocean and has taken the lead in establishing the SOARC, which is a collaborative effort between BODC and CSIRO. BODC has primary responsibility for the South Atlantic and western Indian Ocean sectors of the Southern Ocean, while CSIRO have responsibility for the eastern Indian Ocean sector and the region around Australasia. Work has concentrated on acquiring recent CTD data to improve the reference data set for the Southern Ocean needed for scientific QC of the float data. New web pages for the Southern Ocean Argo regional Centre have been launched with an interactive map which provides links to the GDACs for retrieving float data.

Operational and scientific use of Argo data

A key aspect of the UK Argo programme is to develop the capabilities to fully exploit all Argo data for operational forecasting and research applications, as summarized below. Further details are given in the UK report for Agenda Item 7.

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). Assessments have clearly demonstrated the positive impact of Argo data on ocean predictions, with a significant improvement in the accuracy of temperature and salinity predictions through the top 1,000m of the ocean. Argo data have also been used to improve and validate the mixed layer model used in FOAM. Within NCOF research work continues to improve the assimilation methods used.

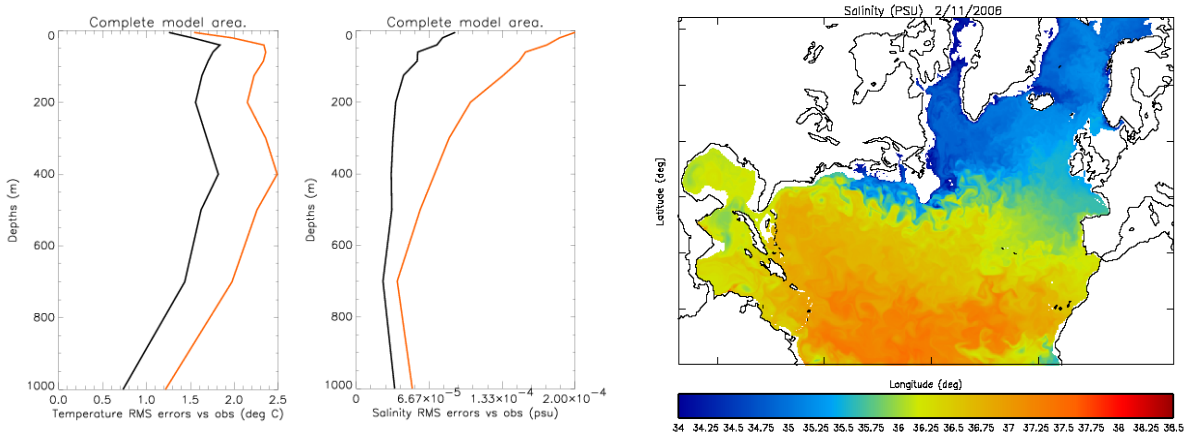

Figure 4. Left, RMS errors in temperature and salinity analyses compared to in situ profile observations, the orange curve is when Argo data are withheld. Right, example of FOAM output for the North Atlantic.

Seasonal forecasting

The Met Office produces a forecast out to six-months ahead once a month using a coupled atmosphere-ocean general circulation model. Data-withholding experiments have shown the benefits of using Argo data in being better able to define the initial ocean state. Argo data from the North Atlantic are now also used to monitor ocean temperature anomaly patterns in the summer, as these can be used to predict the probability of winter conditions (related to the North Atlantic Oscillation) over western Europe.

In particular Argo data were used in examining temperature anomalies for the North Atlantic during 2005 and provided observational evidence for the basis of the forecast issued in October 2005 of a two in three chance of a colder-than-average (and drier-than-average) winter for much of Europe. This forecast attracted considerable government and media attention in the UK[1] – and four out of five predicted events actually happened.

WINTER REVIEW		
	Prediction	**Outcome**
Mean temperature across Europe	Most likely colder than average	Colder than average for many areas
UK mean temperature	Most likely colder than average	Warmer than average
Southern UK mean temperature	Most likely colder than average	Colder than average
UK precipitation	Most likely drier than average	Drier than average
North Atlantic Oscillation (NAO) for the winter season	Negative	Negative

Table 3. Verification of winter forecast for 2005/06.

Since then the Met Office has been designated a Long-Range Forecasting Centre by WMO. Although other centres received this designation, the Met Office is the only centre to meet all the criteria.

Climate monitoring and prediction

Argo data are also used for ocean climate monitoring (e.g. ocean heat content) and will be used by the Hadley Centre with climate models to make decadal climate predictions. By measuring changes in ocean temperature and salinity using Argo data it is possible to observe the integrated effect of surface climate changes over the ocean. The increased spatial and temporal resolution of temperature and salinity data from Argo are already helping to understand better the variability of the climate system, as demonstrated by results from UK floats deployed in the South Indian Ocean – where the data and recent climate model simulations suggest changes between the 1960s and 2002 (previously thought to be a freshening trend) are best explained by internal variability of the climate system. Argo data will continue to be used by the Hadley Centre and NOCS to further our understanding of, and ability to predict, climate change.

The Hadley Centre are developing the HadGOA dataset (see http://hadobs.metoffice.com/hadgoa), a new ocean analysis of historical temperature and salinity suitable for climate model validation, evaluation of historical ocean heat content variability and more general climate monitoring, based on observed data (now mainly Argo). HadGOA will provide an important addition to the key global climate datasets maintained by the Hadley Centre for the climate research community.

Ocean science

Argo data are being used by many researchers in UK on improving understanding of ocean properties (e.g. circulation, heat storage and budget, and mixing) and on how they are applied in ocean models (e.g. improved salinity assimilation, mixed layer forecasting and seasonal forecasting). This includes many scientists from outside of the UK Argo community. The UK Argo Users' Group provides a forum for engagement between these scientists and the UK Argo programme.

[1] Weather, December 2006, Vol 61, No. 12. Special issue on 2005/06 winter forecasting – methodology and accuracy.

Funding

As noted earlier the UK Argo Project has been funded by Defra and MoD (through the Met Office) and by NERC (through NOCS and BODC), in addition MoD also funds UKHO support for Argo data processing.

The need for longer-term funding for UK Argo has been recognised by two important cross-government committees, the Inter Agency Committee on Marine Science and Technology (IACMST) (http://www.marine.gov.uk) and the Global Environment Change Committee (GECC) (http://www.ukgecc.org), as Argo is recognised as being a key component of the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS)[2] to which the UK has made commitments. Argo is specifically mentioned in the GEOSS Implementation Plan to which the UK made a high profile ministerial commitment (Defra minister Lord Whitty) in February 2005.

UK government has stated that climate change is the greatest environmental challenge facing the world today. Marine issues have also been identified as one of the top 10 issues for Defra for the next three to five years as identified in the Defra Strategy Refresh initiative led by David Miliband, the Defra Secretary of State. Under the lead of Defra, a UK Marine Monitoring and Assessment Strategy (UKMMAS) is being developed, which recognises the requirement to meet the UK's marine/ocean commitments to international programmes.

The UKMMAS remit includes monitoring activities in both UK waters and the open oceans and covers ocean monitoring carried out in support of internationally agreed programmes, such as from Argo, that are commitments to the GOOS, GCOS and the GEOSS. At present there is a shortfall in UK funding for marine monitoring (as required to meet EC directives and international commitments) and through the UKMMAS a bid for additional funding is being prepared and is expected to be submitted as part of the UK Government's 2007 Comprehensive Spending Review (CSR).

The planned CSR bid includes longer-term funding for UK Argo at £850k per annum. It is expected that, if successful, the bid will provide funding for 10 years from April 2008. For 2007/08 funding from Defra, MoD and NERC has been allocated, although the level of funding cannot be confirmed as yet. Defra and MoD have indicated that they will continue to try to provide some funding for UK Argo in the event that the CSR bid is delayed or unsuccessful. Longer-term NERC funding, at the present level, has been agreed for the next 2 years with future allocations being dependent on the outcome of the CSR.

UK aspirations for Argo

Our priority is to see the complete global 3,000 float array established and maintained long enough for its full value to be demonstrated. For climate purposes (i.e. determining ocean heat content) a coarser array would not be sufficient. For climate research the full value of Argo will only be realised when multi-year or decadal time-series are available and it is recognised that this could take at least as long as 10 years. Therefore, it will be critical to maintain international support for Argo for at least this length of time, and the UK will advocate its continuation as long as there is the wider international support for Argo.

An ongoing contribution of 50 floats per year would represent ~6% of the array, which we believe is not too large a contribution for UK to make given our strong international and

[2] UK GOOS Strategic Plan Summary Report. Report of the GOOS Action Group of the Inter-Agency Committee on Marine Science and Technology. July 2006.

maritime interests, and is consistent with the initial commitment by the Governments Chief Scientific Advisor (Sir Robert May) CSA in 1999 that the UK would contribute to Argo, to at least a GNP level (presently 4.94%) of contribution at full deployment, with the expectation that Argo would be sustained in the longer term.

Although the baseline Argo array should be focused on well-established technology, there remains an important role for the research community in improvement of the technology, development of new sensors and implementation of higher resolution regional arrays for scientific research. This is an area in which NOCS would take the lead for UK.

The advantages of the free and unrestricted data policy for Argo have already been seen in that Argo data are being used by scientific researchers outside of the 'Argo community'. Wider use of the data for scientific and educational purposes will continue to be encouraged by UK Argo.

Euro-Argo

The UK Argo programme intends to engage fully with the Euro-Argo proposal, and has suggested the following contributions.

(1) Procurement, preparation and deployment of additional floats in key regions of importance for European climate. UK would procure and deploy around 30% of any EC-funded floats alongside UK funded (approx 45 per year) floats. The deployments for the EC-funded floats would be coordinated with the international Argo programme, but focused on the South Atlantic, other Atlantic regions and the Southern Ocean. Plus monitoring of all European Apex floats (building on the CSIRO collaboration).

(2) Data processing. With EC-funding we would increase resources at BODC on the existing UK Argo Data Centre and Southern Ocean Argo Regional Centre functions, focusing on the South Atlantic and Southern Ocean regions, in order to remove backlogs in the data flow and bring these centres fully up to the level of capability required.

(3) Research. Continue work on exploitation of the Argo data (for ocean forecasting, seasonal forecasting, decadal climate prediction and ocean climate monitoring), development of new Argo data products etc.

Through Euro-Argo it is advocated that Europe (through the EC and national programmes) will sustain ¼ of the global 3,000 float array, and provide additional floats to provide enhanced coverage in the European regional and marginal seas.

USA Report to AST-8, Paris France, March 2007
(Submitted by D. Roemmich)

Organization:

The U.S. Argo Project is supported through the multi-agency National Ocean Partnership Program (NOPP). The project is presently being carried out by a U.S. Float Consortium that includes principal investigators from six institutions (SIO, WHOI, UW, NOAA/AOML, NOAA/PMEL, 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 ONR and NOAA (FY99, FY00), and a 5-year (FY01-05) full implementation phase under NOPP, the Argo project is now in the first 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 NDBC.

The present continuation of U.S. Argo 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 315 floats funded in FY02, 344 in FY03, 410 in FY04, 410 in FY05, and 390 in FY06. A reduction to approximately 360 instruments may occur in FY07.

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 and outreach activities.

Status:

As of February 20, 2007 there are 1511 active U.S. floats (Argo Information Center and see Fig 1), including 1423 from U.S. Argo float providers (SIO, UW, WHOI, PMEL) plus 88 Argo-equivalent floats provided by partnering programs. During 2006 there were 505 floats deployed by U.S. Argo and U.S. partners. The high deployment rate is partly to clear a backlog of instruments funded but not deployed earlier.

The major focus of the U.S. effort in 2006 has been to help achieve Argo's objective of a global array by increasing float density in sparsely sampled regions. The majority (266 out of 505) of U.S. float deployments this year were in the Southern Hemisphere. A major deployment cruise consisted of 100 floats, mostly in the southern Indian Ocean, deployed from a collaborative U.S./N.Z. cruise on R/V Kaharoa.

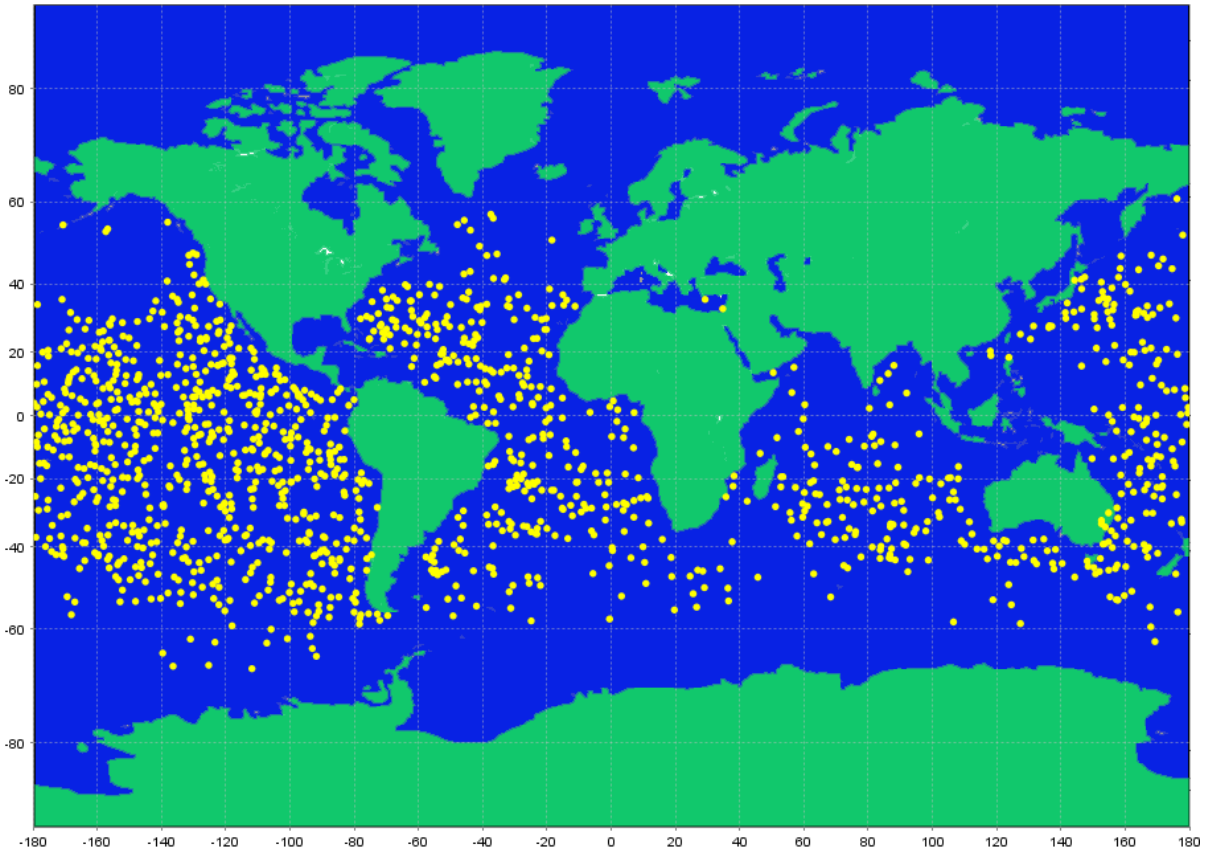

Fig 1. Positions of U.S. Argo profiles during a 12-day period, February 2007 (AOML).

Out of 1456 Argo floats presently active in the Southern Hemisphere, 62% (903 floats) 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 Float Consortium and representatives of Argo data user groups. The highest priority is deployment of a global Argo array. Specific plans for 2007 float deployments are posted on the AST web site's deployment planning links.

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 the past year. There are now 41 US Argo floats equipped with Iridium communications.

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 computers housed at Service ARGOS (U.S.) and operating round-the-clock, running software developed at AOML to implement internationally-agreed upon 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. A second technical workshop on delayed-mode quality control was hosted by U.S. Argo in Woods Hole in October 2006. As of February 20, 52% of the floats at AOML that are ready to be delayed-mode quality controlled have been done. That is, 45,253 profiles out of 86,785 have been delayed-

mode quality controlled. The backlog of U.S. delayed-mode files is expected to be cleared in early 2006.

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.

Uses of Argo data

The impressive breadth of Argo applications, both research and operational, in the U.S. is well illustrated by the publications list and operational centers referenced at www-argo.ucsd.edu, as well as in posters and presentations at the Second Argo Science Workshop held in 2006. The structure of the U.S. Argo Science and Implementation Panel is intended to increase communications between Argo and the user community, and to stimulate the use of Argo data.

A significant structural issue in U.S. Argo continues to be the lack of funding targeted specifically at Argo research (or even more broadly at research based on the sustained ocean observing system). We believe that an essential characteristic of a successful ocean observing system is that "those with the greatest need for high quality data should have responsibility for collecting it". The fact that the US Argo PIs are not funded to do research with Argo data was certainly a contributing factor to the slow identification of pressure offset errors in FSI-equipped US Argo floats. It is not healthy to establish a system in which Argo data are collected by a group of float experts while the bulk of research is carried out by scientists who are unfamiliar with technical details of the floats and the array.