7th meeting of the

International Argo Science Team

Hyderabad, India
January 16-18, 2006

Contents

1. Welcome and introduction

M. Ravichandran welcomed everyone and thanked Dr. Harsh Gupta, Dr. John Gould, Dr. Dean Roemmich and Dr. Howard Freeland with flowers. The lamp was lit by each of the honorees and the meeting began.

2. Introduction to AST-7

D. Roemmich and H. Freeland thanked the hosts and Dr. Harsh Gupta, and then spoke on how the focus of Argo is changing from initiating and developing Argo into completing and sustaining the array. Harsh Gupta reiterated that India was committed to the Argo program and discussed the question of how we will use the Argo data. India is specifically interested in improving seasonal forecasts. J. Gould ended the introduction speeches by raising the question of societal applications of Argo. He also thanked INCOIS for hosting the meeting.

1. Letter of thanks to M. Ravichandran and to K. Radhakrishnan on behalf of AST
Action AD

The focus of the AST-7 meeting was on how to sustain Argo in the future, and how to continue to improve float technology, international coordination, and data quality. There was discussion of Argo's contribution to other international programs, such as CLIVAR, GODAE and GEO. As Argo matures, new sensors and measurements are becoming more important, and issues surrounding these were discussed. Technology issues included addition of oxygen sensors, improvement of velocity measurements, thermal mass correction in salinity, and collection of high resolution or near-surface temperature and salinity. The technical status of all float types was discussed, and the APEX community requested monitoring of APEX engineering data in order to more quickly identify potential technical problems. The role of the regional data centers was examined and it was decided that a workshop was needed to help standardize their work. The importance of peer-reviewing delayed-mode data was discussed and it was agreed upon that a small selection of floats would be picked for all d-mode operators to review. These results could be compared to define and improve common practices in the d-mode quality control process. The AST agreed that an important issue facing Argo is the recovery, wherever practical, of beached floats. It was suggested that a private contractor might assist in come cases. It was agreed to improve procedures for identifying and locating beached instruments, and for communicating with local authorities.

Argo program infrastructure was discussed, specifically the ongoing needs for an Argo Director and key roles for the Argo Technical Coordinator, in light of J. Gould stepping down in June 2006 and anticipated changes at JCOMMOPS. Finally, the question of Argo's transition from a research program toward an operational program was discussed. Argo is implemented by a coordinated group of national consortia with widely varying degrees of research and operational participation. It was developed largely by research efforts, but it provides a dataset that satisfies the requirements operational users for coverage, sustainability, timeliness and quality.

2.1 Action items from AST-6 (2004) and Argo Exec (2005) meetings

J. Gould noted that a remaining item from the AST-6 concerned reducing early float failure. Early float failure has been greatly reduced by improved float technology and float deployment practices. It was decided that a document concerning best practices of float deployment should

be posted on the website to aid new and current deploying countries deploy floats more effectively. The best practices document can be taken from the APEX Users Workshop Report.

> *2. M. Scanderbeg to work with S. Riser to document best float deployment practices and to post the information on the web*
>
> ***Action M. Scanderbeg***

From the 2005 Argo Executive meeting in February 2005, the first action concerned the coordination of float deployment. J. Gould reported that this was not working as well as it might and may become more difficult as the focus shifts from initial deployments into empty areas to array replacement.

Another action item concerned the development of ocean indices. D. Roemmich reported that D. Stammer and T. Lee, on behalf of CLIVAR, have an initial list of ocean indices for use in comparing ocean reanalysis efforts. It was suggested that Argo start with that list, identify Argo-relevant items, and add to it as needed. It was also stressed that there will be regional indices as well as global ones. The following action item was drafted following the discussion:

> *3. Argo will develop a list of climate-relevant ocean indices to which Argo data make a significant contribution. AD to obtain the draft CLIVAR list from D. Roemmich and invite the AST to make additions by e-mail.*
>
> ***Action: AD and AST members***

The next action item from the Exec concerned raising the profile of Argo through publications in popular science magazines such as Scientific American. S. Riser and H. Freeland have submitted a proposal to Scientific American and are waiting to hear from the editors.

The final action item from the executive meeting concerned national requirements for environmental impact statements. John Gould stated that while we need to be ready for this, national timing and requirements will vary. The AST can provide general support for this activity. Moreover, the AST should identify and encourage environmentally sound practices such as safe and rapid recovery of beached floats. Technical Coordinator M. Belbéoch would report on this topic later in the meeting and action items resulted from that discussion.

3. Issues from ADMT-6

3.1 ADMT-6 Report

S Pouliquen reported on the last ADMT meeting which was held in Tokyo in November 2005. The Complete status is available in the meeting report at
http://www.coriolis.eu.org/cdc/meetings/ARGO-DM-report-6th.pdf

Main achievements in the data system are:

- 80% of the data are transmitted on GTS within 24h from all GTS nodes
- 100% of the Real Time data arrive at GDACs via National DACs. Replacement of the historical GTS data by DAC versions (459 Floats) is underway
- Improvement is needed in the consistency of real time QC for spike/gradient/density inversion tests and actions are underway to do this.
- Delayed mode QC activities progress in a consistent way and important steps forward were made since the first DM workshop at San Diego last April 2005

- 27% of the eligible data have been processed in delayed mode, with this expected to increase quickly in the coming months.
- Salinity adjustment in the real time data stream will be done by applying an offset equal to the last correction validated by the responsible PI
- In collaboration with CLIVAR the reference database necessary for DMQC will be updated
- A format change will be implemented in February to handle parameters other than T & S and to decrease file size that are growing exponentially because of history records in multi-profile files.

The following topics were referred to the AST by the ADMT and the resulting action items are listed below:

- ***AST to provide to ADMT with information on the new capabilities of the next float generation that could have an impact on data processing***: The AST agreed to inform ADMT. First of all AST will provide to ADMT the modification of parameters they plan on using with 2-way communication systems such as Iridium. The ADMT was asked to study the possibility of distributing Glider data at GDACS based of the present European experience within Mersea project

- ***AST to define whether or not thermal inertia lag should be corrected in real time by DACS***: It was agreed that this correction will be first applied in delayed mode and the decision to apply it in real-time will be taken at the 2nd DMQC Workshop (see agenda item 6.3.1 for details)

  4. D-mode operators should apply thermal mass correction to adjusted salinity in order to improve data quality and as a test for RT application. This should be carried out prior to the DMQC workshop. Greg Johnson to supply the subroutines.

  Action D-mode operators

  5. DMQC-2 to provide advice on applying thermal lag correction in RT.

  Action DMQC-2

  6. AST should ask G. Johnson to liaise between SBE and users of 41cp salinity sensors with a view to having the thermal mass correction applied onboard the instrument. (This should be a topic at the DMQC2 workshop).

  Action Brian King

- ***AST to provide guidelines under which "good" Argo profiles would be included in the reference database:*** Initial guidelines were provided (see agenda item 3.2) and will be refined at 2nd DMQC workshop.

- ***AST to organize peer-review of the delayed mode dataset prior to next delayed mode workshop:*** AST agreed that it was an important issue and that each delayed-mode operator should contribute to this activity in collaboration with B King for next DMQC workshop

  7. Action item to be drafted by SW

- ***AST to specify the best means of extracting velocity information from float data***: It was decided that building a uniform and comprehensive velocity data set was an

important issue for Argo and that a workshop would be organized in March 2006 at the Venice Science Workshop and that precise instructions will be then given to ADMT (see point 6.3.3)

8. Velocity is a high priority for Argo, of value to many users, and is endorsed as such by the AST. This should be highlighted in Argo documents and on web pages

Action AST

9. The AST endorsed the action from ADMT-6 on velocity metadata. This will be advertised via Argo-dm mailing list

Action

10. The AST endorse the offer by B. King to hold a velocity workshop in Venice and suggest additional issues for them to consider.

Action AST

11. The AST encouraged studies on the value/quality of velocity data derived from present technologies and using a wide range of mission profiles.

Action AST

- ***AST to encourage the rapid delivery of ship-based CTD data for Delayed mode QC to CCHDO:*** a recommendation will be made by AST

12. *Delivery of data to CCHDO. It is essential that new ship based hydrographic (CTD) data are regularly incorporated in reference data sets . Each nation should determine the quickest and most effective route to pass high quality shipboard CTD data from PIs to CCHDO as soon as practical after cruise completion and to provide ATC with list of PIs and the route adopted.*

***Action All Nat Reps**.*

13. CCHDO to be informed. AIC to hold list of hydrographic PIs for each country and of the route by which data are to be delivered.

Action All Nat Reps

14. ADMT to send CCHDO's format information to national reps.

Action ADMT co-chairs

Reporting data-related problems: It was agreed a consistent method was required to answer problems encountered by Argo data users. A "User desk" email address will be set up for Argo. Emails will be forwarded to ADMT co- chairs and to the AIC. The queries as well as the answers provided will be recorded in a database maintained by AIC and made available to Argo ADMT and AST chairs. The study of the Frequently Asked Questions will help the chairs of the two Argo teams to define priorities for future developments and to improve services provided by Argo.

15. An e-mail address Data-problems@argo.net will be established and messages to it will be distributed to AIC (to collate stats), ADMT co-chairs (to assign to appropriate person for reply) and AST co-chairs.

Action ATC

3.2 Inclusion of Argo profiles in reference database

A presentation by J. Gilson and D. Roemmich highlighted the need to define an Argo-based reference dataset for delayed-mode quality control. There will never be enough shipboard CTD data collected to track interannual to decadal variability in mid-depth T/S. Use of historical ship –based climatologies would result in elimination of significant climate signals such as an observed freshening of intermediate waters in much of the South Pacific in the Argo data set. Thus good Argo data must be incorporated in the reference data sets. A "first iteration" of rules for incorporating Argo data in the reference dataset was presented. The general principle is to rely on initial calibration of float CTDs, where these are consistent with laboratory and field calibration checks carried out by several groups. Suggested "rules" are:
i) No real-time data.
ii) No floats that fail in < 1 year (i.e. available in d-mode but with < 36 cycles).
iii) No cycles within 6 months of end of record (i.e. near end of long d-moded record).
iv) No cycles which have salinity-drift adjustment (> .001 in bottom data, to distinguish from thermal lag adjustment at shallower levels).
v) No floats whose deepest level is < 800db.
vi) No cycles following ones that have significant adjustment.
vii) No cycles with < 90% of values (P,T,S) good**.**

The AST discussed the issue and agreed on the following actions:

16. Initially, D-Mode operators should consider nearby Argo data in their subjective decision making. Tools are available for this purpose.
Action all d-mode operators

17. When sufficient D-Mode data exist, operators should review effectiveness of "Gilson's rules".
Action all d-mode operators

18. The 2nd D-Mode workshop should provide an improved set of rules for use in defining Argo reference data.
Action DMQC-2 workshop

This process highlights the need for RDACs to review the internal consistency of the Argo dataset and, when new shipboard CTD data are available, to identify any systematic salinity errors in the d-mode dataset. This discussion brought up the issue of when the next d-mode workshop would be and the following action item was made:

19. Confirm with BAK that DMQC-2 can be Sept 2006 in Southampton.
Action AD

4 Funding Issues

4.1 National Funding Summary

J. Gould's presentation reiterated that funding sources vary greatly from nation to nation, but that for all countries the coming years are crucial as Argo makes the transition from a pilot program to a more sustained mode of operation. He reported that a questionnaire had been sent to national reps in late September following JCOMM-II at which there was much concern about sustaining funding for Argo. About half the countries polled had replied. He noted that

additional replies can be found in national reports to AST-7. He stressed that as Argo makes this transition some countries will need to apply for operational funding, which comes from quite different sources than the previous research funding. Often this new funding is part of a wider move to provide sustained funding for a range of observational systems. Thus the case cannot be made solely for Argo. He stated that he had provided supporting letters for the Netherlands and Germany and he would be happy to supply them as needed for other countries. He noted that the international aspects of Argo were of great help in making the case for funding in individual nations.

In the discussion that followed, a consensus was reached on two things that can help national funding. One was the publication of more papers showing the application of Argo to key ocean and climate issues and the second was that Argo needs to show how it benefits climate reanalyses and seasonal and longer-term predictions. J. Gould cautioned that it is not always easy to identify the contribution of Argo alone since analyses often include other observational systems, but that it does need to be addressed.

It was noted that for some countries, becoming an operational program could make sustained funding easier to obtain. For other countries, it may make it harder. Many countries stressed that the next couple of years are crucial to funding as Argo develops.

At the POGO-7 meeting immediately following AST-7, it was agreed that POGO would provide letters of support for national programs that request this. An action growing out of the joint AST and POGO meetings is:

> *20. AD to poll national programs on need for a POGO support letter. POGO to provide a sample letter. National programs to provide contact addresses for such letters.*
> ***Action AD***

4.2 European Funding

P.Y. Le Traon gave a summary of EU funding opportunities for Argo. In Europe, sustained funding for operational oceanography will come from GMES. GMES Marine Core Services (i.e. data and modelling/assimilation centers and product distribution and services) will already be funded through a dedicated GMES funding line in the next EC framework program (FP7); the contribution to in-situ observing systems will likely be funded through the regular FP7 R&D program as a contribution to GEO. An EU-Argo group will be set up to draft a proposal outline for the next FP7 and discuss it with the EC and the different national delegates. Argo international could help by making sure that Argo is recognized as a major contribution to GEO.

> *21. P-Y Le Traon to draft action item on preparing European funding bid*
> ***Action P-Y LeTraon***

It was discussed that the transition from pilot to operational is not new and that other programs are going through this same transition. The two ideas of publishing more papers and showing societal benefits due to Argo's contribution were again stressed. The need for ocean indices was reiterated. For Europe, inclusion and ties to GEO is very important, while for other nations, like Australia, it is not yet clear how to approach GEO about funding. Given the need for proving Argo's value, the following action item was proposed.

> *22. Improve Argo applications web page. All reps to view existing page and suggest changes and new material. M. Scanderbeg to e-mail. (Replies by end March)*

Action M. Scanderbeg

The commitments table was also discussed and adjustments were made. It was made clear that the years shown on the table should be calendar years and not fiscal years.

23. M. Belbéoch to reconcile discrepancies between national Argo statements of deployment numbers for 2005 and those in Nat reports and to establish agreed rules.

Action M. Belbéoch

24. M.Belbéoch to circulate statistics of float deployment to each country at the end of the year to confirm float number.

Action M. Belbéoch

5 Argo Achievements

5.1 Argo's Contribution to CLIVAR

J. Gould presented information on how CLIVAR has benefited from Argo and began by stressing Argo's work in the Southern Ocean. He mentioned than in a typical year in the 1990's, about 300 ship based CTD profiles were made to 1500m or more south of 40ºS. Argo presently produces over 1000 in one month. In addition to this impressive contribution, most of the papers for the Argo Science Workshop 2 (ASW 2) are CLIVAR related. He added that Argo can document the present state of the ocean climate system through various methods including climatologies of temperature and salinity for fixed periods, monitoring climate drift, etc. Other CLIVAR-relevant applications of Argo include data assimilation modeling for ocean re-analysis and initialization of seasonal to decadal climate prediction models. A goal for the future should be to improve the degree of communication between Argo and CLIVAR to ensure that CLIVAR user requirements are met and that Argo is aware of where Argo is having an impact.

5.2 Argo's Contribution to GODAE

P.Y. Le Traon gave an overview/status of GODAE and its links with Argo. Overall, there is very good progress in the development of national modelling and assimilation systems that contribute to GODAE. Over the next 2 or 3 years, GODAE will focus its activities on the consolidation of base-line systems, observing system assessment and on demonstrations of impact/utility. A new project will also start to develop further the interfaces with coastal systems. In parallel, GODAE will work with JCOMM on the transition to operational systems.

Links between GODAE and Argo were then discussed. From the GODAE perspective, Argo progress is quite impressive. Argo data are used by all GODAE centers (validation and assimilation) and most of them now assimilate temperature and salinity data. Requirements for global coverage and salinity data are more and more important. GODAE centers also require delayed mode data sets for reanalysis activities and there is a now a strong need for deep velocity data and products. New multivariate assimilation schemes have been developed and this improves very significantly the way Argo data are used. Impact studies have been carried out and results demonstrate the strong impact and contribution of Argo. Argo data are essential (mandatory) data sets to constrain ocean models. Impact studies remain a priority for the next 2 years and this should be done jointly by Argo and GODAE.

During the following discussion, the topic of GRHSST's request for more detailed Argo profiles near the surface was brought up. The feasibility of making these profiles had been discussed

by the UK Argo programme, WRC and GHRSST as well as the increased cost. While GRHSST would like temperature data, other users, notably those planning satellite salinity missions, need sea surface salinity. Temperature might be fairly easily implemented using a supplementary thermistor, but salinity at depths less than 5 m (with profiling floats equipped with SBE CTDs) pose substantial challenges for technology development. It was decided that Argo would investigate and would then inform GRHSST of the implications.

25. P-Y Le Traon will talk to Craig Donelan to revise specs for high resolution in upper ocean temperature (vertical res and horizontal spatial scales).

Action HF to take message to WRC and SBE.

26. Make statement about impact in different oceans of high resolution temperature sampling, depending on number of specially-equipped floats. Make statement with costs included without any decisions being done.

Action P-Y Le Traon

27. Determine user requirements for near-surface salinity. Will 3m be better than present? Input needed from appropriate user groups.

Action AST Co-chairs

28. The AST would benefit from better linkage to the seasonal-to-interannual prediction community. Presentations on seasonal prediction needed at next AST.

Action AST Co-chairs

5.3 Report of South American Workshop

Howard Freeland reported on the CLIVAR Pacific Panel workshop held in Concepcion, Chile, 11-14 October 2005. At that meeting Argo received a lot of attention. A breakout meeting by representatives of Peru, Chile, Ecuador and Colombia put a note on record expressing great interest in Argo and expressing "…the willingness of national oceanographic institutions from the S.E. Pacific to contribute to Argo float deployment and to increase interaction with the Argo project in the region." What this means is that they are keen to deploy floats within their EEZs on behalf of the Argo float-deploying nations.

The meeting specifically requested that SST be added to the standard float mission (see 5.2 above). This was viewed as a minor additional cost with enormous value in some parts of the world where near-surface gradients are large.

A suggestion arose from the modeling community, amplified by an email from Billy Kessler, asking for data gridded in the vertical. This was not received with enthusiasm. The general feeling being that gridding is not hard to do and the user can do it easily.

6 Technical Issues

6.1 Report from APEX users workshop

A workshop was held in Seattle during 19-21 September 2005 for the purpose of bringing together users of APEX profiling floats. This workshop resulted from discussions that took place at the Argo Executive Committee meeting in Perth in February of 2005; these discussions noted that APEX floats accounted for nearly 65% of the Argo array and that, while great progress had

been made in improving float reliability in recent years, it would be very useful to bring together as many users of these floats as possible.

It was noted at the meeting that over 90% of APEX floats deployed in the past 2 years are still operating normally, a substantial improvement over the performance of floats in the early years of Argo. At the present time the most common source of float failure is the so-called *energy flu*, a condition resulting from the premature discharge of alkaline battery packs used in the floats. The cause of this problem has been identified as large current transients induced in the batteries when the buoyancy pump in the floats comes on at the beginning of a deep profile. There are 2 ways to remedy this problem. The surest fix for the problem is to use lithium batteries instead the alkaline batteries supplied by the manufacturer. This will fix the problem entirely, and several APEX groups have already instituted this change. However, lithium batteries are classified as hazardous materials, thus sometime making shipment by air to remote areas difficult. A second remedy for the energy flu problem is to use the park-and-profile feature on APEX floats in a mode where the float is programmed to park at 1000 m and profile to 2000 m only on every 3rd or 4th profile. It was felt that this strategy was a good compromise between the scientific objective of Argo (requiring 2000 m profiles) and the desire for floats to last for 4 or 5 years.

Several new technological issues were discussed, including a new APEX controller, Iridium communications, and new sensors being tested on APEX floats. It was generally felt by all in attendance that the meeting provided valuable information that could be used immediately by many float groups. It was agreed that the group would meet again in 18 months – 2 years.

The workshop had concluded that systematic monitoring of the technical performance of the entire APEX fleet would help with the rapid identification of potential new failure modes and hence their rapid diagnosis and rectification

29. Countries to be asked if they can provide the tech support needed to monitor APEX array.

Action Nat reps using APEX

30. Countries not using Li batteries to consider doing so.

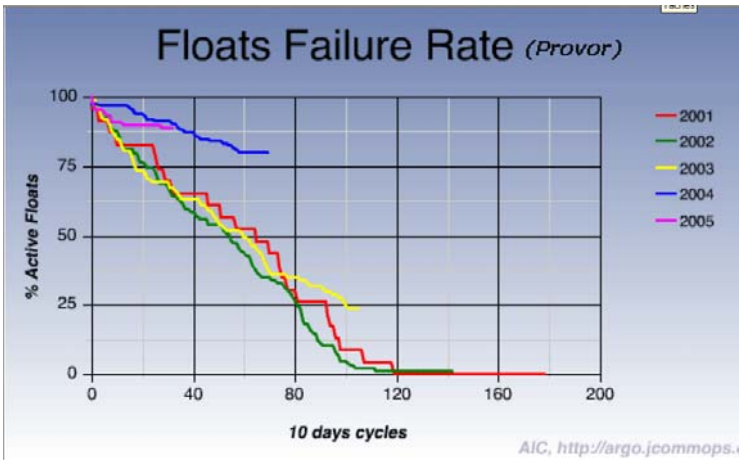
Action Countries not using Li batteries

6.2.1 SOLO performance and technology issues

A technical status report on SOLO was presented by D. Roemmich (see annex &). SOLO has demonstrated dramatic increases in float lifetime over the past 4 years. Plans for the future include Iridium communications, increased buoyancy adjustment capability, elimination of the air bladder, and decreased size.

6.2.2 PROVOR performance and technology issues

S Pouliquen presented on the behalf of G Loaec the engineering developments that have been made on Provor technology. The instrument is now working according to specifications and its reliability has drastically improved since the first prototypes were launched in 2000.



Float deployed in 2004 and 2005 have drastically improved their performance

After some difficulties in transferring the definition to the manufacturer Martec in 2001, and exporting it at Metocean in 2002, the industrial assembly chain is since 2003 located in one place in France that delivers reliable floats to customers. Improvements have been made on Provor to correct problems that had been detected by users (stability at drift, moved to Seabird41CP sensor, reduce energy consumption by redesigning the electronics, price reduction by optimization of processing chain,…). Theoretical maximum number of cycles, with drifting at 1000m and profiling at 2000m, that a Provor float is able to do , if it is encountering no hazards in its life, has increased from 100 in 2000 to 180 cycles in 2006.

It was suggested that AIC builds the kind of statistics shown in the figure above, based on the number of kilometers sampled rather than the number of cycles to take into account that going to 2000m depth needs much more energy than 1000m. This requires that the AIC has access to the mission profile parameters for each float

Technological developments, carried jointly between Ifremer and Martec, are underway and concern two types of products:

- Provor float is now moving to a multi-sensor vehicle able to adapt rapidly to new user needs. The following Provor versions are or will be available mid 2006:
  - Provor-A (= profiling Marvor with acoustic receiver) Rafos
  - Provor-DO (CarboOcean-IFM Kiel+Coriolis) Optode Aanderaa
  - ProvBio Irradiance+ transmissiometer
  - ProvCarbon (CarboOcean - Iridium-SBD) Optode + transmissiometer
- A Profiler New Generation has been developed. It will be smaller, cheaper and more easily deployable via vessel of opportunity. First at sea tests were successful and transfer to industrial is underway

Please refer to the Provor sheet put in annex for more details

6.2.3 Technical development and other issues in JAMSTEC and JMA

N. Shikama reported about a new float which is now under development in JAMSTEC. This float uses a small gear pump to control buoyancy which is expected to make the float much shorter and lighter. A field experiment of this new float is planned in summer 2006. He also introduced the POPS (Polar Ocean Profiling System) developed by JAMSTEC and Metocean and the 3 week experiment in the Arctic Ocean in spring 2005 that met with a good success. N.Shikama also reported about following issues.

Since 2001 JAMSTEC has been recalibrating temperature and conductivity sensors of Sea-Bird 41 and 41CP after shipment using the same calibration system used in Sea-Bird. Among 174 sensors recalibrated, 12 (4 temperature and 8 conductivity) were found below the international Argo criterion. Among these 12 sensors, 3 were sent back to Sea-Bird and other 9 corrected by JAMSTEC with the coefficient. Two APEX floats with TBTO elements detached from the conductivity sensor were deployed by JAMSTEC in the subtropical north Pacific in January 2005 to examine the effect of TBTO. The result 10 month after deployment shows no significant error.

The lifetime of deployed floats calculated using a method in medical statistics was shown. The distribution of JAMSTEC's 94 APEXs deployed in FY2005 and deployment plan in FY2006 were shown. Japan Meteorological Agency (JMA) has just started a new operational analysis program (Marine Diagnosis Report) in which 15 floats are to be deployed every year in the south to east region of the Japanese main island. Seven PROVOR floats deployed by JMA in October and November 2005 are working well.

6.3.1 Thermal Mass

D. Roemmich presented information from Greg Johnson on thermal mass issues in floats and how to apply a correction for this. The basic problem is that temperature and conductivity are mismatched because temperature is measured at the intake of the SBE ducted CTDs and conductivity is measured further downstream of temperature. When sampling through temperature gradients, heat exchanges between the conductivity cell and water transiting the cell. This results in temperature at the thermistor and in the conductivity cell differing, and can induce an error in salinity. Work has been done on this error for the shipboard SBE-9 at several flow rates and for SBE-9 data with a 24-Hz time-series a correction can be accurately determined. For SBE-41 and SBE-41CP data from currently deployed floats the error is larger than that for the SBE-9 which creates a significant fresh bias in strong thermoclines and makes fresh spike at the base of mixed layers above strong thermoclines. This can be corrected, but with an error about as large as the correction. A model of temperature error after transiting a 1 C step is:

$$e^{(t\text{-}to)}/\tau$$

The SBE-41 pumps fast and intermittently, so is small and is large, while the SBE-41CP pumps slowly and continuously, so is large and is small. The salinity error is roughly $\alpha x \tau x dT/dt$ in constant gradients.

CTD	SBE-9	SBE-41	SBE-41CP
α	0.027	0.021	0.164
τ (s)	9	21	5.87
$\tau \times \alpha$ (s)	0.24	0.44	0.96

As can be seen from the table, SBE-41 error is about twice the SBE-9 error and the SBE-41CP error is about quadruple the SBE-9 error. Order 0.1 °C s-1 gradients are occasionally observed by the floats giving (1) an error of about 0.04 in S for the SBE-41 and (2) an error of about 0.1 in S for the SBE-41CP. Thus errors can sometimes exceed Argo specification of 0.01 in salinity.

A matlab correction subroutine can be applied and requires profile data in order of collection, estimates of elapsed time (in seconds) since profile start at each pressure, and an estimate of α & τ. Contact gregory.c.johnson@noaa.gov for the subroutine.

While not perfect, this correction is still very useful because it ameliorates unstable density spikes at the mixed layer base and because it removes a fresh bias in strong thermoclines. It is possible that this correction can be made onboard the SBE-41CP if it is pursued.

It was decided that national programs need to work on putting sensor type, rise rates, and pumping rates into meta data files to apply this correction. Additionally, putting Iridium floats in water would help find the constants. SeaBird has stated that they are interested in this and would be willing to help.

Concern was expressed that by applying this correction, 2 separate salinity adjustments would be done (salinity drift, thermal mass correction) that could not necessarily be undone. The first one is constant with depth, but the thermal lag correction is not. After weighing the usefulness of the correction, it was decided to begin applying it and the following actions resulted:

> *31. D-mode operators should apply the thermal mass correction to adjusted salinity in order to improve data quality and as a test for RT application prior to the DMQC-2 workshop. Get subroutines from G. Johnson.*
>
> ***Action d-mode operators***

> *32. DMQC-2 to provide advice on applying thermal lag correction in RT.*
>
> ***Action DMQC -2***

6.3.2 Oxygen sensors

There is a growing interest in adding dissolved oxygen sensors to floats. Two types of sensors are known to exist, the SBE43/IDO from SeaBird Electronics and the Aanderaa Optode. The SBE43 uses an electrochemical polarographic sensor similar to that used on shipboard CTD systems. This technology has been greatly improved by SBE in recent years. The Optode senses dissolved oxygen by optical methods. Several papers have appeared that show the stability and precision of Optode sensors on floats for periods of up to a year. The University of Washington float group has had some SBE43 sensors that showed little drift over periods of nearly 3 years. In order to assess the relative merits of these sensors, the UW group has deployed several floats with both sensors. The results show that the two sensor types agree remarkably well, although there appear to be some systematic differences. The SBE43 appears generally to have a better initial calibration than the Optode, but over times of a year or so the Optode is generally more stable. Testing of both sensors will continue. There is a general recognition that data from either sensor would be a useful addition to the Argo data stream if it can be shown that the addition of these sensors does not adversely affect the central Argo mission, compromise the CTD data in any way, or add substantial cost to Argo beyond the cost of the sensors themselves. It remains to be shown that these conditions can be met.

> *33. The AST reiterated US and international Argo policy on new sensor adoption. (On web site) i.e. that no new sensor should be included unless it brought with it resources for the additional floats needed to make up for the decrease in float life through decreases in reliability and increases in energy consumption*
>
> ***Action All Nat. reps***

34. S. Riser to suggest protocols for thermal mass correction of Optode data using CTD temperature and initiate discussion on Argo-tech

Action Steve Riser

6.3.3 Trajectory data

Kuh Kim presented information on trajectory data used to calculate mean ocean velocities. He pointed out the inconsistencies in the ASCENT_END, DESCENT_START and surface time between APEX floats and the inaccuracies of these values that are provided in the meta data. This is important because in order to estimate the sub-surface displacement during a float cycle, and hence make an estimate of mean ocean velocity during the submerged phase, we must estimate the start and end positions of the submerged phase. Strictly, the position of ASCENT_START and DESCENT_END must be estimated. This requires an extrapolation of discrete surface positions acquired during the surface period.

It is suggested that the estimates required should be produced in a standard Argo manner, according to agreed and documented methods, and with a documented uncertainty. Users who do not wish to adopt the Argo product can apply their own preferred methods of estimating submerged drift velocities. If Argo does not provide a product, all users will be forced to make their own drift calculations. Many users will simply use the difference in positions assigned to successive Argo profiles, which will be a significantly inferior product to any that Argo may offer.

There is clearly a high demand for a standardized Argo velocity product, so it is imperative that Argo take a lead in delivering this. If we do not, someone else will do so, and may produce a product that we do not like very much. Users will use whatever product is (a) available (b) easy to use and (c) kept up to date. Therefore, it has been proposed and offered to convene a working group with an initial meeting at the ASW-2 in Venice.

After discussing the velocity issue, it was decided that workshop would be very valuable since many users are trying to use the trajectory data. The following actions emerged:

35. AST endorses the importance of velocity and states that it is a high priority.

Action AST

36. Endorse action from ADMT-7 on velocity metadata. Advertise via Argo-dm mail list.

Action S Pouliquen

37. AST endorses trajectory workshop in Venice.

Action AST

38. AST encourages studies on the quality/errors of velocity data derived from present technologies and mission profiles. Are present floats capable of producing high quality trajectory data?

Action Nat reps

6.3.4 Gliders

The idea of including deep ocean gliders to measure boundary currents was discussed. The Argo array does not resolve boundary currents and the addition of a glider component for systematic boundary current measurement is attractive. Some deep ocean glider sampling is

already underway. Should Argo try to incorporate this in data management stream? The eventual capabilities and limitations of gliders are not yet known, so caution in this initiative is needed.

39. AST recognizes that float sampling in interior and glider sampling in boundary currents are highly complementary. AST should investigate possibility of merging deep ocean glider sampling into Argo project when capabilities are better known. The addition of glider sampling should not detract resources from the core Argo (large-scale) program. ADMT should investigate adding glider data to Argo data stream in near future. S. Pouliquen to circulate MERSEA guidelines

Action AST, ADMT, S. Pouliquen

7 Implementation issues

7.1 Coverage/deployment planning

After discussing coverage and deployment planning, there were no specific problems noted by any country. It was recognized that float coverage and deployment planning will become harder as the array matures and holes develop. Of course repopulating the array will depend on the variability in float lifetime. If the variability is high (>1 yr), it should be fairly easy to redeploy floats since holes will develop gradually. If it is low, then a higher priority must be attached to predicting holes in the array. It was noted that the timeline to getting floats in the water is about a year. It was agreed that models need to be developed to predict where holes will appear. Additionally, predictive models could be used to plan float deployments and oversupply the array in sparse areas where holes may appear. Generally, it was thought to be a good idea to develop a working group to meet with countries to develop tools for prediction of array holes.

In addition to predicting array holes, current deployment plans must be updated regularly. The deployment planning websites are much more effective if updated more regularly than 6-9 months, but it can be difficult to get the needed information from national contacts.

40. The AST is concerned that deployment plans are not regularly updated. Plans should be sent to regional co-coordinators whenever a change is made.

Pacific	*J. Gilson*
Atlantic	*V. Thierry/S. Pouliquen*
Indian	*M. Ravichandran*

Action All PIs

7.2 Depth, mission definitions

It was agreed that 1000m is the recommended parking depth for Argo floats. In addition, deep (2000 m) profiles should be obtained as often as possible. Reasons for deep profiles include Argo's scientific objectives and to obtain deep samples in stable T/S layers for delayed-mode quality control. Floats should profile from full ballasted depth on every cycle if permitted by battery/energy constraints (i.e. by using lithium batteries). The AST should develop improved tools to monitor parking depth and profile depth.

41. M. Belbéoch to maintain statistics on Argo array parking depths and profile depths.

Action M. Belbéoch

42. Graphics of float lifetime need a version that takes into account the total number of km's water profiled.

Action M. Belbéoch

7.3 Recovery of beached instruments

The Argo TC described the past achievements concerning retrieval of beached instruments. Only a small percentage of floats end up ashore (<2%). The AST agreed that recovery of those beached instruments is a high priority. PIs have the responsibility to retrieve their instruments whenever they are beached if it is feasible to do so. The TC described available tools to track the floats (Interactive map, Google earth) that PIs can use and proposed some improvements.

SIO is designing a new label, with an appropriate mass (to not impact the ballasting if it becomes detached during float mission). As for the previous label, manufacturers will sell floats directly equipped with this label. AIC and APO are finalizing a safety guide on handling of beached instruments and will circulate it as appropriate. TC recalled that he awaits PIs concurrence before establishing the first contact (using IOC, WMO, PMO, NFP) with officials in regions with a beached float. TC will produce a report twice a year to track beached floats and the different retrieval initiatives.

43. New Argo float label design to be evaluated and any improvements suggested to D. Roemmich. (Agree to design by end Feb.)

Action AST

D. Roemmich suggested using Google earth files to decide if a float was beached or not. If the final surface trajectory from an inactive float is far from the beach, then in most cases the float likely died from causes other than beaching (i.e. grounding on the sea bottom). It was noted that float trajectories could be color coded according to distance from shore to make monitoring of nearshore floats easier. All PIs need to be monitoring their floats to see if they are beached and then go about retrieval accordingly. Floats need to be recovered as soon as practical.

The recovery of floats is complicated by the fact that lithium batteries must be removed before shipping. Argo PIs decide if a regional contact can provide the technical expertise for safe battery removal or if the PI needs to send a technician out to remove battery. To help with this difficulty, D. Roemmich will try and identify a private contractor who can recover beached floats. This would allow small national programs to act through the contractor and requires battery removal instructions for all float types. MARTEC has done this and SOLO will soon. APEX is asked to provide instructions.

44. Gould to supply M. Belbéoch with CIESM contact list.

Action MB & JG

45. AST reiterates that recovery of beached floats remain the responsibility of the float owner who should take steps to ensure each float's safe recovery.

Action AST & PIs

46. AST expressed interest in the use of contactors to assist in float recovery and encouraged further development of this approach.

Action DR + AST

8 Argo infrastructure

8.1 RDAC mandatory responsibilities

RDAC activities were originally defined at the 5th ADMT. The AST refined the list as follows:

- Mandatory Activities:
    1. Perform regional analysis of all the Argo data in the area to assess its internal consistency as well as its consistency with recent shipboard CTD data.
    2. Provide feedback to PIs via National DACs
    3. Provide documentation of their procedures.
- Optional activities
    4. Develop climatologies in concert with other regional centers. It is expected that Regional Centers will need to improve the climatologies they are working with and make them available to the rest of Argo community
    5. Prepare and distribute Argo data products and services on a regular schedule.
    6. Provide scientific QC as a service to national programs without such capabilities.
    7. Coordinate Argo float deployment plans for the region.
    8. Develop new quality control tests for real-time or delayed mode if appropriate for the particular region.
    9. Compare Argo data with model output and with assimilated fields to understand why specific data are rejected by assimilations (e.g. model inconsistencies, systematic data errors).

The need for data consistency in the mandatory activities was underlined and an RDAC workshop may be important to organize when RDACs will have acquired enough of expertise on the topic.

It was agreed that an RDAC was not aiming to be a data assembly center but more an expert advisory group for Argo and therefore it would be safer to change the name to something like Argo Regional Advisory Team or Argo Regional Center.

8.2 South Atlantic RDAC

Silvia Garzoli reported that the main objectives of the SARDAC are to achieve the final calibration of the Argo data, and to obtain the collaboration and participation of South Atlantic countries to generate the adequate climatology and to achieve the required data coverage. A meeting was held in Cape Town, South Africa, May 2005 whose main objective was the implementation of the South Atlantic ARGO Data Assembly Center (SARDAC) between countries with interest in the Atlantic from 20N to 40S. Countries participating in SARDAC are: Angola, Argentina, Brazil, Namibia, Nigeria, South Africa, Uruguay and the US. Up to date, the main accomplishments are: the creation of a web site that provides information on the activities, the creation of a coordination group that collects and distributes information on available platforms for deployment of Argo floats in the Atlantic Ocean, the availability to the program of local vessels for float deployments, and the beginning of an activity for quality control of Argo data. The later consists of two parts. The first one is to determine the robustness of the climatology used for the calibration, and the second is an inter-comparison between the performance of an individual floats with data collected from those floats in the vicinity plus other available CTD data. This activity will evaluate and compare the qc procedures for different floats and is directed to establish criteria for operator review of the performance of individual floats. Additional activities consist on the creation and distribution of products based on Argo data, and training activities to address issues relating to regional capacity to use newly available

Argo float technology. A workshop was requested of all RDACs to evaluate and normalize these procedures.

8.3 North Atlantic RDAC

The North Atlantic RDAC started in late October 2005. 8 countries agreed to contribute (Canada, France, Germany, Italy, Netherlands, Spain, UK and USA) coordinated by Coriolis team. Italy agreed to coordinate the RDAC activities for the Mediterranean Sea.

There is a lot of overlap between North and South Atlantic RDAC and therefore we have decided to share our efforts on some activities. The main NAARDAC objectives are:

- Common with SAARDAC, Close link with SORDAC
  - Atlantic contribution to the global Argo reference data base for quality control
  - Logistics for deployment (deployment opportunity , deployment plans)
- Specific to NAARDAC
  - Consistency of the Argo data from the North Atlantic
  - Sharing expertise
  - Products delivery

The consistency of the network will be processed by AOML and Coriolis with their in-house statistical method and comparison of the results will be done in 2006. NAARDAC contributors recommend that RDAC perform this activity in a consistent way within ARGO. The following products will be made available.

- T & S weekly analysis perform with Argo data combined with other networks
- Regional climatology/mean sea state for the North Atlantic before end of 2005
- Velocity products are planned.
- Links to national products will be made.

One important benefit is the group expertise on networking activities and the sharing of expertise of instrumentation, deployment methodology, data processing, improvement of RT and delayed mode QC procedure in the North Atlantic and Med Sea. These improvements will be reported to the Argo Delayed Mode group. It was requested to have only 3 maps of float density: Atlantic, Pacific and Indian Ocean.

8.4 Pacific Argo Regional Center (PARC)

S. Minato presented on the PARC and informed the AST that CSIRO, IPRC and JAMSTEC have had three meetings up to now. At the last meeting, held just after the last ADMT meeting in Tokyo, Korean and Chinese people joined in it.

At the 1st meeting, we discussed promoting regional center jobs in the Pacific and made several decisions:
1) The RDAC's name should be PARC (Pacific ARGO Regional Center).
2) As a joint cooperation, we should start making a web page to show all our activities.

A first version of page has been made and can be found at www. www.jamstec.go.jp/ARGORC. It has much to be updated but it shows our ideas to implement the RC functions defined.

It was noted that data must be given to CCHDO and not just offered on the website and after seeing three different websites, the question was raised as to whether all the RDAC websites should have the same format. No agreement was reached.

8.5 Southern Ocean RDAC

J. Turton presented information from British Oceanographic Data Centre (BODC) on this RDAC and noted that the S. Ocean RDAC was a collaboration between BODC and CSIRO. The center was setting out to perform the various RDAC tasks as recommended by the ADMT, but there is a need to accelerate this work. Both groups (BODC and CSIRO) will analyze the data and overlap regions will be compared to exchange ideas and software. The S. Ocean RDAC also anticipates a role in providing feedback to PIs, developing a regional historical data set, and being custodians of regional historical data set for S. Ocean region. Some regional products are currently available via the S. Ocean RDAC website http://www.bodc.ac.uk/projects/international/argo/southern_ocean/, including regional FOAM (Forecasting Ocean Assimilation Model) products, current status images, and profile maps on a monthly basis. However, the center aims to make their website more dynamic and active vs. static. It is expected that the centre will concentrate initially on the Drake Passage region. It was mentioned that the Japanese have cleaned up historical data in Indian Ocean which can, and should, be used for d-mode QC.

8.6 Indian Ocean RDAC

M. Ravichandran reported that the Indian Ocean RDAC is doing d-mode qc on all floats in Indian ocean, even if India didn't deploy them. So, since other PIs with floats in the Indian Ocean, like S. Riser are already doing their own d-mode which goes to GDAC, the first steps to peer review are already happening. Next the Indian Ocean RDAC needs to actually compare their data with other PI d-mode qc data.

8.7 Discussion on RDACs

Since RDACs are not actually assembling data, it was suggested that their names be changed to Argo Regional Centers, in line with the Pacific Argo Regional Center. There was some disagreement over this suggestion since some people felt that naming it center implies having data is available. The idea of including "expert" in the name was also suggested.

> *47. Test ARGO REGIONAL CENTER name with RDACS*
>
> ***Action AD***

> *48. The primary function of regional centers needs to be restated and implemented. Mandatory functions are:*
> *a) Ensuring consistency of the delayed-mode dataset across d-m operators*
> *b) Checking consistency of the d-m dataset with new shipboard CTD data collected subsequent to d-m processing.*
>
> ***Action Regional Centers***

> *49. Regional centers to meet alongside DMQC2 to agree on best practices for implementing mandatory functions.*
>
> ***Action Regional Centers***

It was noted that there are gaps in coverage of RDACs north of the Southern Ocean RDAC. S. Wijffels said that starting this year Australia will hopefully fill in the gaps in the Indian Ocean and the S. Pacific. It was also noted that some donated floats are incorrectly labeled on RDAC

maps. M. Belbéoch stated the need to have metadata files provided by countries donating floats to reflect the correct status.

50. M. Belbéoch to check files for all donated floats to ensure that the countries are appropriately recognized.

Action MB

It was agreed to pursue the peer review of d-mode QC, as suggested by B. King for the DMQC-2 workshop.

51. Tseviet Tchen and Susan Wijffels from CSIRO will coordinate a peer review of each group's DMQC work. A common list of floats will be compiled based on input from each group, some requiring large adjustment and other marginal adjustments. Each DMQC group will perform DMQC on all of these floats and send the resulting Dmode files to CSIRO for intercomparison and analysis. The goal is to have the full analysis ready for the 2nd DMQC workshop in late 2006. Members of AST will be asked to encourage participation of their national DAC.

Action S. Wijffels, T. Chen, B. King

8. 8 Argo Information Center

The Argo TC introduced then the core mission of the AIC and recalled that TC DBCP is planning on hiring a new technical coordinator at a lower level than the outgoing one so that more of the responsibilities in the JCOMMOPS office will likely fall on Argo TC as the experienced and senior member of the office. TC noted that he will ensure the minimum tasks (production of monthly DBCP/SOOP maps) in the transitional period. TC recalled the fundamental support provided by IOC to JCOMMOPS concerning administration and international issues.

He presented then the 2005 AIC activities highlighting the decrease in the working time dedicated to developments (10%) as planned in its ToR. TC insisted on the necessity to rationalize some tasks performed at the AIC. This will be done by producing regular reports to AST, ADMT and Argo community. The acceleration of Argo implementation (1000 floats deployed in 2005) and the growing Argo community have naturally pushed the TC to limit the developments. Hence the new website release was delayed to early 2006.

TC presented the status of the AIC information system showing that an average of 11,000 visits (or sessions) per month (or 360/day) was observed on the AIC website. He presented the developments achieved in 2005;e.g. new notification system, new web GIS with 3 projections, daily ice edge layer, Google earth daily files, and float lifetime statistics. He presented the various collaborations initiated by the AIC through float donor programs explaining how legal aspects are being fixed (thanks to IOC/UNESCO assistance) with some donation contracts. He finally presented the priorities planned for 2006: deploy the final website with all problems fixed and highlight the Argo project good health on the website, rationalize the update of float database, rationalize the reporting, finalize the float retrieval procedure, finalize the donor program, establish new contacts (e.g. POGO research cruise database) to provide better information on deployment opportunities, improve (modestly) Argo media coverage via e.g. educational initiatives.

52. ATC to ensure that monthly maps appear within first week of new month.

Action M. Belbéoch

8.9 Argo Director

John Gould reported on the meetings he has attended this year as well as the funding he has sought, the publications done, the outreach and the interactions with other global systems. Of

course organizing the ASW-2 in Venice has taken up a large part of his time, but this has been very successful. Before the meeting, he plans on publishing a new Argo brochure which will be done in English first and translated to other languages as possible. After running the ASW-2, he will complete action items from this meeting before stepping down in June.

> *53. Complete brochure in time for review and printing to circulate at ASW-2. Offers of assistance welcome. CSIRO will help with layout. Printing costs are yet to be determined.*
>
> ***Action J. Gould***

DR stated that funding is chief obstacle to replacing the Argo Director. Currently, 50% of the salary is from US Argo, but no other salary support has been forthcoming. In addition to funding, we need to identify appropriate candidates and location for the position. The implications of not having a director need to be considered.

J Gould noted that money had been offered by Japan but that this could not be used for salary support

9 Future Meetings

9.1 ASW -2 Venice

John Gould reported that he hoped to have funding to support a small number of scientists from developing countries and help them get to Venice. Printing costs for the brochure need to be found from somewhere since the brochure should be finished and available at the workshop (this has now been offered by Japan). National programs should consider if any funding agency people should attend the meeting.

9.2 ASW – 3

It was agreed to wait until later to begin planning the next ASW, but it was suggested to allow more lead time before the workshop.

9.3 AST - 8

Argo has been invited by IOC to hold AST-8 in Paris.

> *54. AST co-chairs to consult with IOC on format and timing of AST-8 to ensure that meeting has maximum beneficial impact.*
>
> ***Action AST co-chairs***

9.4 IAPSO (2007) Meeting

J. Gould noted that he has agreed to co-organize (with P-Y leT) an Argo/GODAE session at the IAPSO meeting in Perugia Italy in 2007.

9.5 Trajectory workshop

A preliminary trajectory workshop will be held on Tuesday and Thursday during ASW-2 in Venice, with a view toward organizing a more formal workshop later in the year.

10. Educational Outreach

A workshop proposal has been written for June 2006 to bring a small group of experts to Ghana to train and educate scientists on how to use Argo data. The date seems unrealistically close, and it was agreed to try this in late 2006 or early 2007.

55. National programs should increase efforts to exploit educational outreach potential of Argo.

Action Nat. reps

11. Other Business

S. Wijffels suggested sending a letter to Seabird about thermal lag to solicit help in fixing the problem onboard the instrument.

56. S. Wijffels will draft letter to Seabird

Action S. Wijffels

The question of when Argo would cease to be a "pilot" program was discussed. GODAE calls Argo a pilot, but GODAE will end in 2008. The merits and drawbacks of being a "pilot" were enumerated. Some national programs find it difficult to obtain sustained funding for a "pilot" program. No decision was reached.

D. Roemmich gave a brief description of the evolving situation at JCOMMOPS regarding the two Technical Coordinators. The DBCP/SOOP TC is leaving and a replacement is being recruited now for a temporary position. This change is an opportunity to think carefully about overall structure of TC positions.

A brief meeting was held with J. Gould, D. Roemmich, H. Freeland, S. Piotrowicz and DBCP chair D. Meldrum to discuss integration of functions. Argo has vital need for the ATC's services, especially for carrying out IOC Resolution XX-6 (Notification). Both DBCP and Argo see advantage to having a more overlapping environment. There was agreement with DBCP to review the functions carried out by the Coordinators. Which ones are essential, which are most effectively carried out by the TCs and which might be better elsewhere? Where should the TCs be located for best communications, oversight, and efficiency? Argo, DBCP, and SOOP will start thinking of JCOMMOPS as a more cohesive unit instead of two independent TCs. A report will be produced on outcomes of the Argo/DBCP meeting and national representatives are requested to provide their thoughts on TC functions.

Joint session between Argo and POGO

A joint session between Argo and POGO was held at INCOIS and was followed by a tour of the new facilities.

The joint session consisted of a presentation on Argo by the AD followed a question and answer session.

Appendix 1: Agenda

Argo Steering Team Meeting (AST-7)
Hyderabad India, January 16-18 2006

Host: Indian National Center for Ocean Information Services (INCOIS)
Venue: Hotel Fortune Katriya, Hyderabad

Annotated agenda

Meeting of Argo Executive* (Sunday evening January 15th)
(* Roemmich, Freeland, Ravichandran, Wijffels, Shikama, Le Traon, Pouliquen, Gould, Scanderbeg, Belbéoch)

Begin 08:30

1. Welcome and local arrangements. Welcome by Harsh K. Gupta.
Former Secretary DoD. Complete by 10:15
2. Action items from AST-6 and Argo Exec (Jan 2005)
   Lead - ***Gould***
3. Issues from ADMT-6 (Lead – ***Pouliquen)***
   Including Argo profiles in reference database ***(***Lead -***Roemmich)***
4. Assessment of future funding prospects for national Argo programs.
   (Lead – ***Gould***) – national reps to comment
   European funding FP-8 (Lead - ***Le Traon.)***
5. Review of Argo achievements
   5.1 Argo's contribution to CLIVAR
   (Lead - ***Gould based on input from Cattle)***
   5.2 Argo's contribution to GODAE
   (Lead – ***LeTraon)***
   Discussion of representation of user community on AST (Action from Exec)
   5.3 Report of S America workshop (Lead – ***Freeland)***

********** End of Day 1**********

6. Technical issues
   6.1 Report from APEX users workshop
   (Lead - **Riser)**
   6.2 PROVOR and SOLO performance and technology issues
   SOLO (Lead - Roemmich)
   PROVOR (Lead - Pouliquen)
   Technical development and other issues in JAMSTEC (Lead - Shikama)
   6.3 Other Argo float and sensor technology issues
   Thermal Mass (Lead - Roemmich)
   Oxygen sensors – performance – issues relating to wider deployment (Lead – Riser)
7. Implementation issues
   7.1 Coverage/deployment planning
   Are deployment planning activities adequate? How to improve?
   Are there coverage problems not being addressed?
   7.2 Depth, mission definitions
   Are new floats following the 1000-m recommendation?
   Should floats go to their ballasted depth on every dive? How many are not?
   7.3 Recovery of beached instruments
   (Lead - Belbéoch
8. Argo infrastructure

Should floats go to their ballasted depth on every dive? How many are not?

7.3 Recovery of beached instruments

(Lead - Belbéoch

8. Argo infrastructure

8.1 Data system, including future priorities for the ADMT.

RDAC activities.

Mandatory responsibilities (Lead – **Pouliquen)**

South Atlantic RDAC (Lead – Garzoli)

N Atlantic RDAC (Lead – Pouliquen)

Pacific RDAC (Lead - Minato)

S Ocean RDAC (Lead – Turton)

Indian Ocean RDAC(Lead – Ravichandran)

********** *End of Day 2* **********

8.2 Argo Information Centre

(Lead –Belbéoch)

8.3 Argo Director

(Lead –***Gould)***

9. Future meetings

9.1 Argo Science Workshop – 2 (Lead – Gould)

9.2 ASW-3 (Where/when?)

9.3 AST- 8, offered to be hosted by IOC, when?

9.4 Argo/GODAE session at IUGG Assembly (Perugia, Italy, August 2007)

9.5 DMQC-2

9.6 Trajectory workshop

9.7 Oxygen QC workshop

10. Argo outreach activities

West Africa Argo workshop (Lead – Freeland).

11. AOB

Joint session with POGO. (Afternoon, Wednesday 18th)

13:30 Bus leaves for INCOIS

Venue: INCOIS

14:30 – 14:45 Welcome and Introduction to INCOIS: Director, INCOIS

14:45 – 15:05 Update on Argo (Gould/Roemmich/Freeland) Given by Gould

15:05 – 15:30 Q and A session on Argo with opportunities to explore

- Funding issues (Argo and its infrastructure)
- Argo's need for ship based data
- Argo applications and their societal benefits, particularly in GEO areas (Climate, Weather, Water, Health, etc)
- Expanding Argo with new sensors and communication.
- Educational outreach potential.

15:30 – 15:45 Break

15:45 – 17:00 Visit INCOIS

19:30 – Dinner and entertainment

Dinner talk: Ocean acidification (Nick Owens)

Appendix 2: Attendance List

Participants list (IAST-7), Hyderabad, INDIA

S. No	Name	Address
1	Sylvie POULIQUEN	Responsable Coriolis / Head of Coriolis, IFREMER, BP70, 29280 Plouzane,
2	Pierre-Yves Le Traon	Program Director Operational Oceanography Systems, IFREMER Centre de Brest B.P. 70 29280 Plouzané
3	Susan Wijffels	CSIRO Marine and Atmospheric Research, Castray Esplanade, GPO 1538, Hobart Tas. 7000.
4	Keisuke Mizuno	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)
5	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)
6	Shinya Minato	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)
7	Howard John Freeland	Institute of Ocean Sciences, 9860 West Saanich Road, BC, V8L 4B2.
8	Mathiue BELBEOCH	JCOMMOPS, 8-10, rue Hermès,Parc technologique du Canal , 1526 Ramonville cedex

9	William John Gould,	National Oceanography Centre, Southampton, Empress Dock, Southampton, SO14 3ZH.
10	Megan Carvel Scanderbeg,	Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla California 92093-0230.
11	Dean Howard Roemmich	Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla California 92093-0230.
12	Stephen R. Piotrowicz	NOAA/ Ocean.US, 2300 Clarendon Boulevard, Suite 135, Arlington, Virginia, 22201.
13	Stan Wilson	Office of the Chief Scientist National Oceanic and Atmospheric Administration (NOAA) HCHB Room 5224 14th St. & Constitution Ave., NW Washington DC 20230-0001, USA stan.wilson@noaa.gov;
14	Suk Moon Sik	Korea Ocean Research & Development Institute (KORDI), Ansan P.O.Box 29 425-600, Korea
15	Silvia Lucia Garzoli	4301 Rickenbacker Causeway, Miami, FL 33149
16	Yasushi TAKATSUKI	Global Environment and Marine Department Japan Meteorological Agency, Otemachi 1-3-4, Chiyoda-ku, Tokyo100-8122
17	Andreas Karl Anton Sterl	Laboratory address: KNMI, P.O.Box201, 3730 AE De Bilt,

18	Stephen Craig Riser	School of Oceanography, Box 355350, University of Washington, Seattle, Washington 98195.
19	Kuh KIM	School of Earth & Environmental Sciences, Seoul National University School of Earth & Environmental Sciences, Seoul National University, San 56-1, Sillim-dong, Kwanak-gu, Seoul 151-742,
20	Shapovalov, Sergei	Head, Center for Coordination of Ocean Sciences P.P. Shirshov Institute of Oceanology Russian Academy of Sciences Nakhimovsky prospect 36 Moscow 117851, RUSSIA smshap@sio.rssi.ru;
21	Golubeva, Natalia	golubeva@mmbi.info.ru;
22	Jonathan David Turton	Laboratory address: Met Office, Fitzroy Rd, Exeter, Devon, UK, EX11 1LR
23	M. Ravichandran	Indian National Center for Ocean Information Services (INCOIS) Post Bag. No. 21, IDA Jeedimetla, Hyderabad – 500 055.
24	M. A. Shajahan	National Institute of Ocean Technology (NIOT), Velachery-Tambaram Main Road, Pallikarnai, Chennai, India
25	Sudheer Joseph	Indian National Center for Ocean Information Services (INCOIS) Post Bag. No. 21, IDA Jeedimetla, Hyderabad, India – 500 055.
26	Uday Bhaskar	Indian National Center for Ocean Information Services (INCOIS) Post Bag. No. 21, IDA Jeedimetla, Hyderabad, India – 500 055.

Appendix 3: SOLO technical status report

Report on SOLO float technology

Improvements made to SOLO

The SOLO float is based on a WOCE design that used a 140 cc single-stroke pump and had a good reliability record. The Argo version employs a 220 cc pump to extend operating depth range. Early in the project we experienced an unacceptable failure rate after 20-40 cycles. This precipitated a thorough redesign in which problems with the switches that limit piston movement were solved, an improved brake for the pump motor and a stronger motor/gearbox were introduced, the Argos antenna was improved, and the stability disk attachment was strengthened. These improvements led to substantial increase in achieved float lifetime (Fig 1).

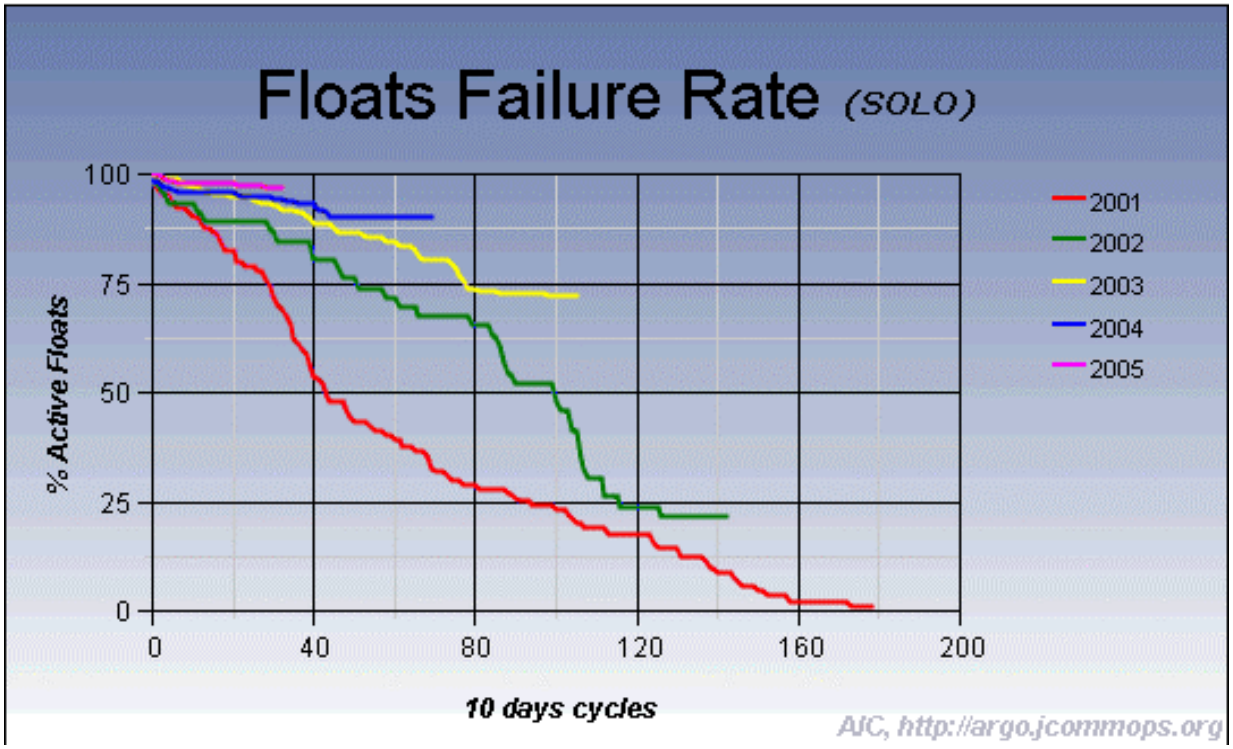


Fig 1: Failure rate for SOLO floats (source: AIC), which make up 26% of the total Argo array. The correction of problems in early Argo/SOLOs has led to a dramatic increase in float lifetime. Of the 270 SIO-SOLOs deployed in 2004-2005, 256 (95%) are active.

Concern for safety led to redesign of the mechanism that holds the float end cap on so that this will vent if the internal pressure exceeds atmospheric by a small amount. Efficiency, economy and performance were increased with an improved pneumatic system, switching to a more capable 6800HC12 microprocessor and improved electronics, having fully machined pressure cases for uniformity, and modifying numerous mechanical components.

Air-launch and underway VOS capabilities were developed to provide flexibility in deployment. Shipping was switched to biodegradable shipping boxes. Pre-cruise checkout was dramatically simplified to eliminate human errors. Programming a float to automatically wake up and surface after deployment when it sinks simplifies deployment and eliminates the need for manual records of deployment time and position. Simultaneously, procedures and documents were

streamlined and improved, making it possible for Woods Hole to successfully manufacture floats with little technical support from SIO.

Plans for continuing SOLO improvement

GPS navigation and two-way Iridium communication will be added to SOLO, allowing mission-parameter changes, limiting time on the surface, increasing the amount of data that can be relayed, and decreasing the energy for communication. Some SOLO floats have already been deployed with GPS and ORBCOMM two-way satellite communication but it is clear that Iridium offers better performance and longevity. Three prototype Iridium floats were deployed in the Artic where they profiled many times before finding a lead in which to surface and send all un-transmitted data. A new Iridium modem and anticipated improvements in GPS hardware and software suggest the following plan: 1) after a careful engineering review, the prototype Iridium/GPS antenna(s) should be transitioned to a commercial manufacturer; 2) improvements in Iridium modem and GPS receiver technology should be incorporated as these systems become smaller and more nimble; 3) long-term tests of a few floats equipped with new antennas and communication systems should verify that long term immersion and pressure cycling do not affect the resonance characteristics of the antenna and to get statistics on the reliability of the communications channel.

The present float cannot profile to 2 km in tropical oceans where warm surface water provide inadequate buoyancy. Three changes will achieve a 2-km capability in all oceans: 1) Float compressibility will be increased by thinning the pressure case and adding strengthening ribs. 2) The total pumped volume change will be increased by using the original 140 cc pump and having it pump 2, or even 3, times as needed. This will require adding a small valve and internal oil reservoir. 3) Float volume and mass will be reduced. The thinner pressure case and smaller pump make this possible. In addition to an operating depth increase, these three changes will also decrease the energy needed for pumping and thus increase operating life.

A third technical avenue will be continued incremental evolution of the instrument as sources of failure or inadequate performance are identified. Now the highest priority is to replace the external air sleeve bladder, which appears susceptible to fish-bite. Additional changes are anticipated in later years. This evolutionary approach, rather than committing to a static design, is critical to maximize accuracy and lifetime while keeping costs low.

Appendix 6: Provor technical report

PROVOR profiling floats performances and improvements

Contribution to Argo IAST 7(January 2006)

Introduction

Provor is the name of the free-drifting profiling subsurface float developed by Ifremer through an industrial partnership with MARTEC company. It executes identical programmed cycles (typically 10 days) of descent, drift at depth at a given pressure for a few days, descent to the start of profile depth, ascent, and Argos data transmission. T (Temperature or C/ST (Conductivity/Salinity, Temperature) measurements are carried out during the descent (optional), drift (optional) and ascent phases. The profiler is located at the surface during the ARGOS data transmission phase. Most of floats are set to profile between surface and 2000 m on all cycles. They can however be configured to profile to 2000 m only every a given number of cycles.
Since the first operational deployments, some modifications have occurred in order to improve performances and life time.

1-Provor performances

The first important deployments (significant quantities) started at the beginning of 2002, so that is the starting date of this analysis. 2 batches of floats are defined:

- first one : floats fitted with Hydac hydraulic valve
- second one: floats fitted with PSA hydraulic valve

The first six months revealed that some floats of this first set were quite unstable while drifting at depth. The consequence was unwanted corrective actions, to maintain the float at the given depth. Therefore this led to consume more energy than planned and lifetime to be reduced.
It seems that the quality of the Hydac valve of the hydraulic engine was not stable and that low leakages inside the hydraulic circuit might happen. That was corrected by using a new valve (PSA), and qualified on 2 prototypes from September 2002 until first months of 2003. All floats have been fitted with this new valve since the end of 2003 and first deployments were made at the beginning of 2004. No float has been lost since then because of a hydraulic defect. Others defects that have been detected and solved are reported in Iast-5 and Iast-6 meeting reports, but the most frequent cause of failure was this imperfect hydraulic component.

To take into account the increase of the viscosity of oil in very cold water, the hydraulic circuit has been modified to get a higher flow and reduce the time that is spent to dive when the float is at the surface, after data transmission.

2-Expected Lifetime

All Provor floats are fitted with lithium batteries. Despite the problems of transportation, using lithium technology is the only way to ensure expected lifetime as lithium cells are more reliable than most of alkaline batteries. Fig 1 shows how power is consumed on the different types of floats:

- CTF2 : Provor fitted with FSI sensors and deployed before 2005 (129 cycles, including a 2000 m profile every 10 days, about 100 CTD samples and 8 hours Argos data transmission).
- CTS2 : Provor fitted with SeaBird sensors end deployed before 2005 (105 cycles, including a 2000 m profile every 10 days, about 100 CTD samples and 8 hours Argos data transmission). The SBE pump is running during the full ascent.
- CTS3 : Provor fitted with Seabird sensors and deployed from 2005 (182 cycles, including a 2000 m profile every 10 days, about 100 CTD samples and 8 hours Argos data transmission). The SBE pump is running during the full ascent. To increase the lifetime, a new hydraulic engine has been developed, using the same hydraulic technology (reciprocating pump), and a bigger lithium battery pack is used.

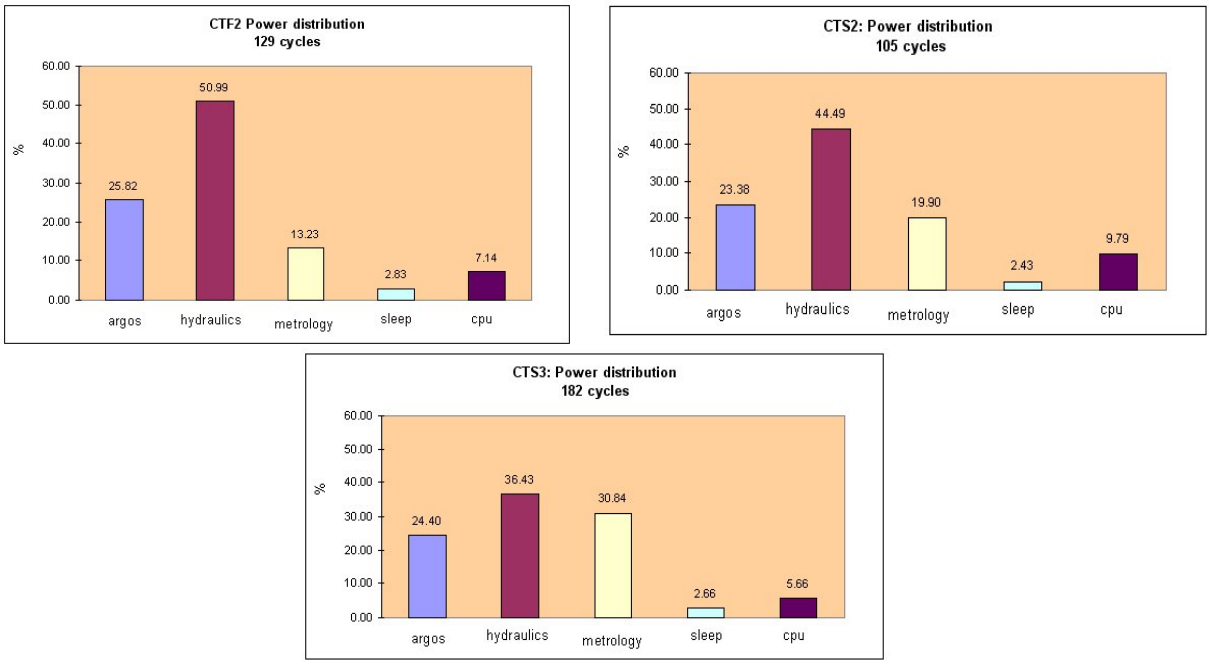


Fig 1 – Energy consumption

3-Other improvements

A new electronic board was developed to replace the first one, which components are obsolete, and the embedded software has been upgraded. This new board, built around an Atmel processor, is more integrated and make easier the set-up of the user-defined parameters and starting of the mission before deployment. All Provor-CTS3 are using this new electronic board and the new hydraulic reciprocating pump. More than 100 Provor-CTS3 have been produced by Martec in 2005. 15 of them were delivered to JMA in 2005 and 9 were deployed profiling to 2000 dbars on every cycle.

4-New floats

Some other profiling floats, based on Provor technology, are being developed:

- Provor-A : Provor-CTS3 + acoustic Sofar receiver, to get locations at depth when the float is moving in an array of acoustic sources. The lower endcap has been modified to be able to add a new sensor or a connector (see fig2. showing the hydrophone of the Provor-A).
- Provor-DO : Provor-CTS3 + Aanderaa Oxygen sensor

- ProvBio : In addition to the Sea Bird CTD, ProvBio (see Fig3) is fitted with optical sensors provided by Satlantic and Wet Labs(a 3 wavelength irradiance sensor and a transmissiometer). As the volume of transmitted data increases, the Iridium Satellite System is used, on the basis of Short Burst Messages that will be send through Iridium gateway to Coriolis Data Center, decoded and made available to end-users. The typical cycle of this float is modified so that the ascent is made around local noon, taking into account the time and the location provided by the Gps receiver..
- ProCarbon : Provor-CTS3 + Oxygen sensor + transmissiometer + Iridium. This float is developed within the framework of CarboOcean project, funded by the European Communauty.

Fig 2 – Detail of lower endcap of Provor-A

Fig 3 - ProvBio

Appendix 5: Commitments Table

Commitments Table

	2004 Argo deployed	2004 Argo equiv deployed	2005 estimated	2005 Argo deployed*	2005 Argo equiv deployed	2006 Argo	2006 Argo equiv	2007 Argo	2007 Argo equiv	Notes
Australia	4		45	63		25		25		2007 number may increase with CRC funding
Brazil	0			3						
Canada	30			29		25		25		
Chile	0		2	2**	2		28			
China	8			0						
Costa Rica	0		2	2***						
Denmark	0		0	0						
EU	15		4	7		38				
France	85		78	88	1	76		65		
Germany	27	18	64	56	19	15	1			
India	30		51	45		30		13		
Ireland	0			0						
Japan	119		110	98	12	95	15	95	15	until 2008, Argo Eq: 15 after 2008
Korea (Republic of)	37			33		30				
Mauritius	2•			0		2				
Mexico	0		1	2°						
Netherlands	3		4	4		3		3		
New Zealand	2		2	1		2		2		Hoped for level for 2006/7
Norway	0		0	0		2				
Russia	2			0						
South Africa	0		1	0						
Spain	2		3	4		1				
UK	47		32	28		50	2			
USA	396	38	410	458	38	410		410		
Subtotals	807	56		917	72					
Total	863		809	989		804		638		

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

Appendix 6: National Reports

Australian Contribution to Argo

Report to the 7th Argo Science Team meeting, January 2006
Submitted by Susan Wijffels, CSIRO Marine and Atmospheric Research

Status of implementation

Floats deployed and their performance

In 2005 56 floats were deployed, most in the subantarctic zone and several in the Coral Sea and Indo-Australian Bight. This constituted about two years of float acquisition due to hold ups caused by the Druck pressure sensor recall. In addition Australia assisted float deployments by Korea and the USA. Japan and Indonesia assisted in several deployments in the Indo-Australian Bight and south of Australia.

Australia has predominantly deployed Webb Research Corporations' APEX floats.
APEX performance has been very good with 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. Battery voltages remain high on floats with over 100 profiles and their prospects of achieving a 4 year lifespan looks promising. One float was taken ashore by a fisherman in Indonesia and has been recovered with the excellent help of Widodo Pranowo from the Indonesian Ministry of Marine Affairs and Fisheries.

Technical problems encountered and solved

We continue to replace some of the alkaline battery packs delivered with the APEX floats with locally sourced lithium packs. These are all diode protected. We believe this strategy has allowed us to avoid early float failure due to alkaline energy flu. We are beginning to build a salinity checking apparatus, and are experimenting with the APEX APF-9 controller board. We have deployed several floats with an ice-detection algorithm and these appear to be working well with floats surviving periods under the ice.

During the delayed-mode QC process we have seen small, but anomalous values at the bottom of profile measurement in APEX, whereby the temperature measurement appears low. We have not discovered the reason for this small error.

Status of contributions to Argo data management:

Real time: All profiles are real-time QC'd and published on the GTS and sent to the GDACs by the Australian Bureau of Meteorology.

Delayed mode: We are beginning to submit delayed-mode data for Argo. We expect to be up to date in submissions to GDACs in early 2006.

National funding for Argo

Float acquisition: For 2006, Australian Argo 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. The Cooperative Research Center for Antarctic Ecosystems and Climate (ACE CRC) will also continue acquire floats for deployment in the subantarctic zone south of Australia, and is also purchasing multisensor floats.

CMAR has committed to acquire 8-10 floats per year, the ACE CRC will acquire 14-15 floats per year and the BoM may acquire 3-5 floats per year in future years. Hence the Australian float acquisition will be sustained at about 25-30 floats/year over the next few years.

Prospects for more sustained funding for Argo and other elements of the ocean observing system under a new national research infrastructure framework look promising, and will be explored in 2006.

Human resources: Australian Argo requires approximately 100% of a fulltime engineer for float checkout and preparation, test development; 50% of a fulltime operations officer for float shipping coordination and deployment training; 20% of a fulltime data expert for real time data monitoring and conversion to netcdf formats etc, delayed –mode data processing requires 100% fulltime data expert. Scientific analysis, coordination and oversight are supported by 0.8 fulltime equivalents, but use of Argo data in other areas increases.

Deployment plans

During 2005 we have greatly expanded coverage of the subantarctic zone south and west of Australia. We will target future deployments on the Great Australian Bight, the Coral and Tasman Seas and filling gaps in the Indian Ocean.

National research and operational uses of Argo data:

- 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.
- Float data off northwest Australia are being examined for the signatures of internal waves.
- Large scale interannual salinity anomalies captured by Argo in the eastern South Indian Ocean are being further investigated by Helen Phillips, University of Tasmania. Seasonal climatologies are also being developed.
- Argo data are being used to map out ocean climate change signatures in the Indian Ocean (Susan Wijffels, CMAR).
- Steve Rintoul and students are examining the Argo data in the subanarctic zone.
- CSIRO Marine Research, in collaboration with the Bureau of Meteorology Research Center, is developing an ocean model/data assimilation system for ocean forecasting and hindcasting. Argo data will be the largest *in situ* data source for this system. Work on subsurface profile assimilation is underway. PI: Andreas.Schiller@csiro.au

Canadian National Report on Argo-2005

Submitted by Howard Freeland

1. Status of implementation (Major achievements and problems encountered in 2005)

1.1 Floats deployed and their performance
During 2005, Canada deployed 29 floats: 27 APEX floats and 2 PROVOR floats. Of the APEX floats, 2 carried Aanderaa Optode sensors.
a) APEX – At the end of 2005, 14 of the 17 APEX floats (82%) deployed by Canada in 2004 were still reporting. Data return so far has been 100% from 26 of the 27 floats deployed in 2005. One float only experienced data loss, that single float (an oxygen float) achieving only 97% data return. So far we are greatly impressed with the integration of the Aanderaa Optode sensors and have 11 of these on order for deployment in 2006.
b) PROVOR – At the end of 2005, 8 of the 12 PROVOR floats (67%) deployed by Canada in 2004 were still reporting. Of the two deployed during calendar 2005, one is behaving perfectly, and one failed to deliver a single profile. One of the PROVOR floats deployed in 2004 also failed to deliver a single profile. We presently have few left PROVOR floats in stock.

1.2 Status of contributions to Argo data management
MEDS continues to acquire data from 83 active Argo floats and issues data to the GTS and GDACs every 6 hours. Five out of the 83 active floats have the Aanderaa Optode sensor. On average 80% the data were distributed to the GTS within 24 hours. Our website is updated daily automatically. The website displayed 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 feedbacks. 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 are planning software for encoding Argo data into the BUFR format.

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 2005 Canada experienced a funding crisis and early in the year we had to abandon all plans to deploy floats. Following some useful foreign intervention we were able to resume float deployments. At the time of writing (Dec. 20th 2005) I do not know where funding for Argo will come from in our fiscal year April 2006 to March 2007.
However, a significant option has been created and I am guardedly optimistic that the Canadian program will emerge in April 2006 with stable funding. The present level of funding is not reported as I believe this to be an unusual year.
At the present time I estimate the HR resources devoted to running Argo to be about 2.7 person-years and a contractor at 1.0 PY for a total of 3.7 PY.

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).

Canadian deployment plans are not well developed; this is largely because of the uncertainties about funding. We had deployment plans a year ago that were abandoned because we needed to save money wherever possible. We do have deployment plans for float deployments over the next few months, but may have insufficient personnel to execute these plans.
We will have floats available for launch during 2006, but the development of a rational plan will have to wait for clear news about funding. We are willing to deploy floats in any ocean basin to help complete the global Argo array.

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 has led to a lag in the exploitation of Argo temperature and salinity data from the northwest Atlantic. Preliminary results suggest that Argo data from the Labrador Sea can be useful for monitoring winter convection. Denis Gilbert (IML) has begun studying the performance of the Aanderaa Optode oxygen sensor.
c) Southern Ocean Richard Karsten at Acadia University is funded by the Canadian Foundation for Climate and Atmospheric Sciences to explore ocean dynamics in the southern ocean.

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

In Canada we are pleased with the recent decision to feed back results from DMQC to the real-time data system. This will make Argo considerably more robust. 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. Although apparent 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.

Costa Rica ARGO National Report 2005

Submitted by Daniel Ballestero

1. Status of implementation

Two floats were deployed in December 8 and 9, 2005 in the Eastern Tropical Pacific at positions (10 N, 87 W) and (9 N, 90 W). Both floats are delivering positions and profiles.

The Instituto Español de Oceanografía donated the floats (1900378 and 1900379). The vessel *Pancha Carrasco*, from the Costa Rica Servicio Nacional de Guardacostas, was used for the deployments. Support for the fuel was provided by ARGO-USA (mainly), and by the Instituto Meteorológico Nacional and the Universidad Nacional from Costa Rica.

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

Two members of the Laboratorio de Oceanografía y Manejo Costero (Universidad Nacional) will devote 10 hours weekly to ARGO in 2006.

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).

An oceanographic vessel will sail from USA to Central America in February 2006 as part of the Eastern Tropical Pacific Seascape project (Costa Rica-Panamá-Ecuador-Colombia). A proposal was put forward to deploy ARGO floats as part of the initiative. Still waiting for the outcome.

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

ARGO data will be used for the study of the Costa Rica dome and the anticyclonic eddies generated by gap-winds in Central America.

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

None

ARGO National Report 2006 – The Netherlands

Submitted by Andreas Sterl

1) Status of implementation

The Dutch Argo programme, run by the Royal Netherlands Meteorological Institute (KNMI), started in 2004. Three floats were deployed that year between Spain and Ireland. In 2005 four floats were deployed in the Irminger Sea. The deployment s 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 .

Approved funding for 2006 will again allow for the purchase of three or four more floats and to cover the costs of deployment and telecommunication. One person (Andreas Sterl) is working on ARGO. He does so besides his other duties.
At present, funding is decided on a year - to- year basis as part of the regular KNMI budget. KNMI is now in the process of overhauling their complete observation strategy, part of which is Argo. In this strategy the (funding) level of each component in the observation system that KNMI contributes to will be fixed. Argo has to compete with, e.g., surface drifters, VOS ships, radiosondes, satellites, to mention only a few. Decisions will probably be made in 2006.
For Argo a funding level sufficient to sustain a fleet of approx. 30 floats is sought. Given a lifetime of about 4 years for a float this means purchase of about eight floats per year, plus communication. There will be no money for dedicated cruises to launch the floats. Opportunities will be sought on (research) vessels that sail into “interesting" regions.
If approved the program would be fully operational.

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

Depending on exchanges rates, three or four floats will be purchased and deployed in 2006, preferably in the Atlantic Ocean. For the years after 2006 see point 2.

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
December 12th 2006

V. Thierry, S. Pouliquen, L. Gourmelen,
T. Carval L. Petit de la Villéon

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

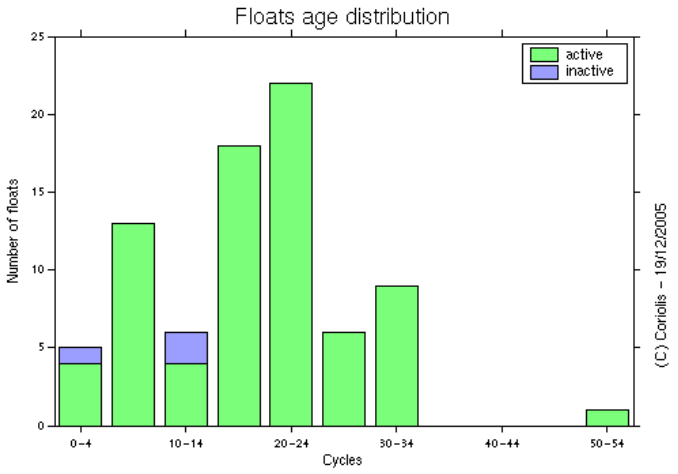
- ***Floats deployed and their performance:***

Deployment activities: A national program has been set up to engage PIs to deploy floats within the context of scientific experiments. Several proposals have been selected, for deployment of 87 floats in 6 projects in the Atlantic, the Mediterranean and the Pacific.

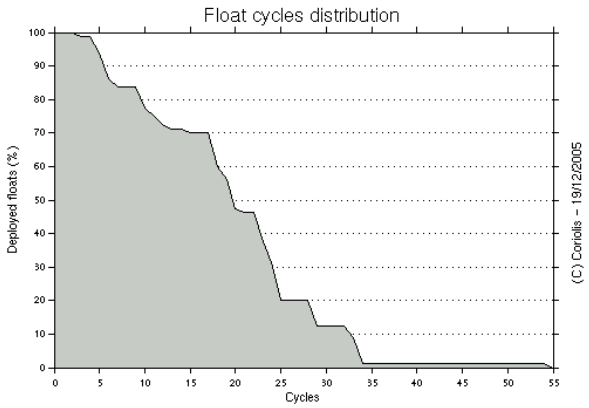
Name	PI	Date	Number of float and type	Ocean	Vessel
GoodHope 3	S. Speich	February 2005	12CTS	Antarctic	Polarstern
CONGAS	A. Serpette	June 2005	15 APEX	North East Atlantic	BSAD ALCYON,
DRAKE	C. Provost	April 2005	12 CTS	South West Atlantic	IRIZAR
GoodHope 4	S. Speich	September 2005	5 CTS	Antarctic	SA Agulhas
Frontalis_3	T. Delcroix	April 2005	20 CTS	Pacific	Alis
EGEE	B. Bourles	June 2005 September 2005	20 CTS	Tropical Atlantic	NH Suroît
EGYPT_MC	I. Taupier Le Page	November 2005	3 CTS	Mediterranean	Explora

Table 2: ARGO Deployments in 2005 by CORIOLIS.

You will find hereafter statistic on the 80 Provor float performances that have been deployed by Coriolis project in 2005. These statistics are updated regularly on Coriolis WWW site.



Repartition by age



Most of the floats have been deployed after April

All Floats			Active		Inactive		
Deployed	Active (%)	Number of performed profiles	Maximum number of performed cycles	Average number of cycles	Maximum number of performed cycles	Less than 5 cycles performed (%)	Average number of cycles
80	96.25	1612	54	19.35	14	33.33	9

Among the 80 floats deployed, most of them are active. 3 tdied, one before 5 cycles and the other two before 14 cycles.

Three different version of Provor floats were deployed in 2005. The anomalies that have been detected for these floats are mainly transmission problems via Argos in Mediterranean Sea and in Pacific. The impact on the data is small but exists in the Mediterranean Sea. No location and sensor anomalies were detected on these floats. Some floats present occasional shorter profiles (100 to 400 db less from normal profile starting depth). This problem is under investigation.

Anomaly	No location (%)	Incomplete received data (%)	Sensor anomaly (%)			Early ascent (%)	Sub-surface drift out of range +/- 100 dBar (%)	Short profiles (%)	Number of performed cycles	Number of deployed floats
			Pressure	Salinity	Temperature					
PROVOR 4.1	0	7.64	0	0	0	0	1.04	5.14	1440	77
PROVOR 4.11	0	3.7	0	0	0	0	0	14.81	54	1
PROVOR 4.21	0	4.35	0	0	0	0	0	4.35	23	2
All floats	0	7.45	0	0	0	0	0.99	5.47	1517	80

- *Technical problems encountered and solved:*

The Provor Floats, version CTS2, are working well. Unfortunately, due to the obsolescence of some components, the controller boards have been redesigned and therefore a new version CTS3 is now available from Martec Company. This new equipment has been qualified in the laboratory and has been deployed this summer. The equipment is working according to specification. The first batch of CTS3 floats has now been delivered to Ifremer and the acceptance tests are underway. First operational deployment will happen in 2006.

- *Status of contributions to Argo data management* See Data management reports by T Carval and L Petit de la Villéon

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

France is strongly committed to continuing participation and support for ARGO, in the broader context of other activities leading to the development of Operational Oceanography in France and in Europe. Several programmes are developed : CORIOLIS, for in situ data provision; MERCATOR for operational ocean monitoring and forecasting; and the MERSEA Integrated Project, coordinated by IFREMER, with involvement of some forty European laboratories or agency, including major French partners (MERCATOR , CLS, CNRS, Météo-France).

- *Deployment:* In 2005, 87 floats have been purchased by IFREMER and 15 floats by SHOM. Plans for 2006-2007 are (per year): 50 floats by IFREMER , and 15 by SHOM ; however, funding is on a yearly basis and no firm commitments can be made for the future. The man power involved is one technician full time and one engineer part time.

- *Data management:* The plan is to sustain the Coriolis Data Center after 2006 in order to provide a sustained *in situ* portal for operational oceanography. In this context Coriolis will continue to serve as a DAC and GDAC for ARGO and expect to set up a RDAC in 2006. The man power involved in the ARGO data management activity is 5 persons full time.

- *MERSEA*: The aim of MERSEA is the development of a European system for operational monitoring and forecasting of the ocean physics, biogeochemistry and ecosystems, on global regional scales. It is a 4-year EU funded research and development project, where a contribution to ARGO has been identified. As a cost-share action, the participating institutions bear half the cost. A total of 45 floats is funded under the project, to be purchased and deployed by IFREMER[1] (North Atlantic), IfM-Hamburg (North / Polar Atlantic), and AWI (Southern Ocean). 19 among the 45 floats were deployed in 2005 and the rest will be deployed in 2006. CORIOLIS is the in situ data portal for MERSEA, and processes the floats for the project.

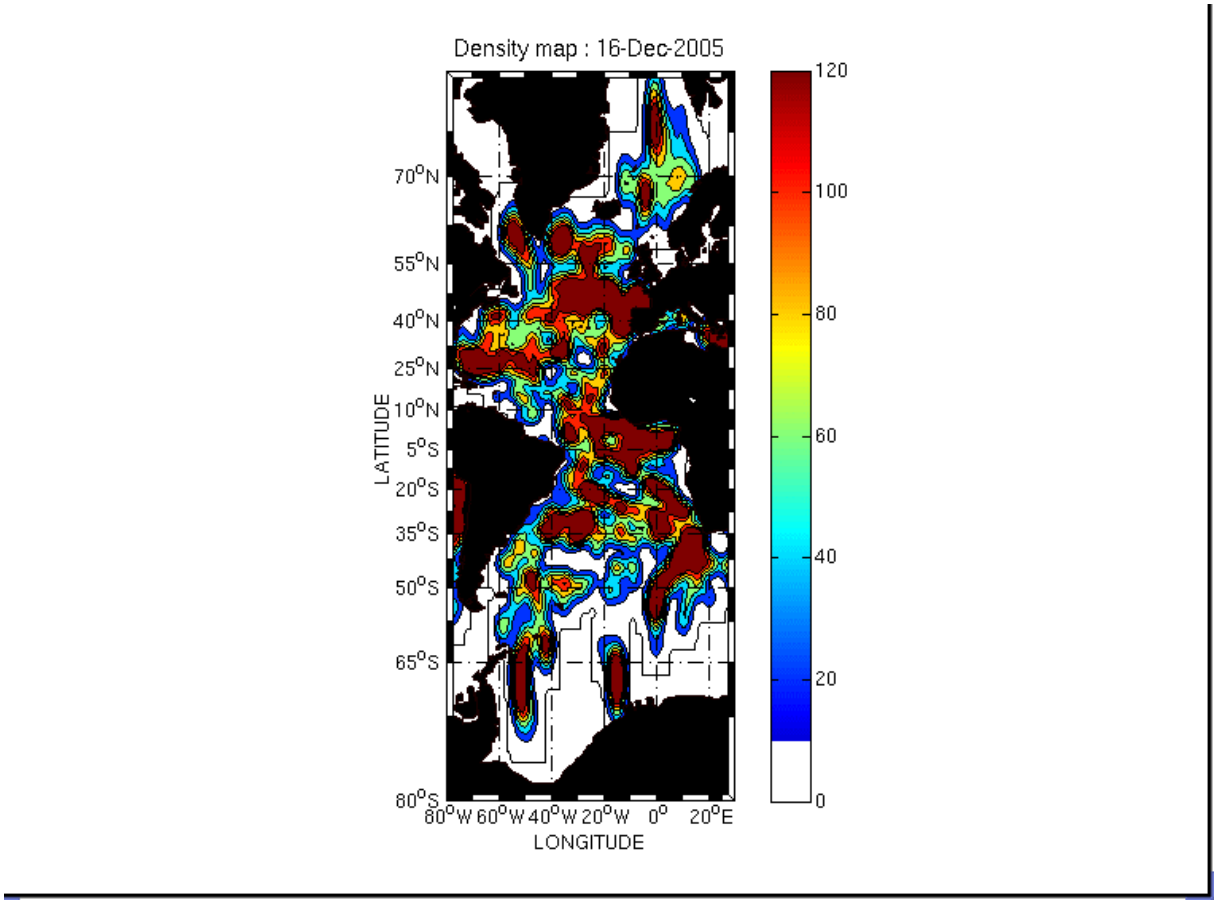
3) Summary of deployment plans (level of commitment, areas of float deployment) and for other commitments to Argo (data management) for the coming year (and beyond where possible).

- *Deployment plans:* A national program has been set up to engage PIs to deploy floats within the context of scientific experiments. Several proposals have been selected, for deployment of 91 floats in 9 projects in the Atlantic, the Mediterranean and the Pacific.

PI	Date	Number of floats	Ocean
Taupier-Letage EgyptMC-2	January	2	Mediterranean Sea
Eldin Flops-1	April	10	South Pacific

[1] The MERSEA - funded floats at IFREMER are included in the number of floats quoted above for French deployments (16 floats).

S. Speich Goodhope-5	May	11	Antarctic
Thierry Ovide	June	16	Atlantic (contribution to Mersea)
Bourles Egée-2	Summer	10	Tropical Atlantic
Serpette Congas-2	Summer	12	North East Atlantic
Peligri Canary	Summer	7	Tropical Atlantic
Taupier-Letage EgyptMC-3	Summer	6	Mediterranean Sea
Claustre PRO-Bio	Autumn	4 + Bio sensors	Mediterranean sea and Atlantic
Vialard Cirene-2	Autumn	10	Indian Ocean
Eldin Flops-2	Winter	10	Pacific Ocean



Density map of ARGO profiling floats in the Atlantic Ocean on the 16 December 2005. after France, USA, Germany deployments in 2006 .

- *Other commitments to ARGO, data management:* France will contribute the South Atlantic RDAC and has started to work on North Atlantic RDAC at the end of 2005. S. Pouliquen will continue to chair the Argo Data Management team in 2006.

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

ARGO data are used in support of operational programs and for scientific research. The inter-agency MERCATOR project produces routine (weekly) global ocean analysis and forecasts by assimilating Sea Level Anomaly and in situ profile data. This activity is part of the development of operational oceanography activities in France and in Europe. European cooperation is strong in this domain: CORIOLIS processes float data for the MFSTEP EU project (development of Mediterranean Forecasting System). In the context of MERSEA, the partners will also assimilate the ARGO floats in their models.

The ARGO data are incorporated in the Objective Mapping products, posted weekly for the Atlantic ocean. Those data-synthesis are used in turn as part of the real-time and delayed mode quality control for the ARGO data. Plans for 2005 are to extend the products to global coverage. They will lead to updated climatologies used also for model validation, and scientific research (determination of principal modes of variability, F. Gaillard).

The PIs selected, as indicated above, are engaged in several projects relying strongly on ARGO data. To name a few, that specifically include float deployments:

- **OVIDE and North Atlantic variability** (H. Mercier, V. Thierry, T. Huck, P. Lherminier, B. Ferron, C. Grit, G. Forget)**:** 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.
- **Western Tropical Pacific** (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-Chili coastline and the meso-scale structures observed in the current along this coastline.
- **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.

In addition to those projects, some scientists have included ARGO data for their research (without deploying any floats). Those works concern for instance estimate of the mean circulation at 1000m depth in the equatorial Atlantic Ocean (M. Ollitrault) or estimate of the heat budget in the POMME area (in the north-east Atlantic) (H. Mercier, C. Grit, V. Thierry).

5) Issues that your country wishes to be considered (and resolved) by ARGO Exec regarding the international operation of ARGO.

- Collecting information for coordination of Atlantic deployments is improving with the setting up of the Atlantic RDACs. Nonetheless we would like to highlight the fact that it's more collection of information than real coordination and the Atlantic coordinator had no mandate to tell one country to put his floats somewhere else. This can be critical when ocean is pretty well covered…Moreover the question of reseeding the north hemisphere should be addressed and strategy defined at ARGO level. The need for OSSE (observing system simulation experiment)that were expressed last year by Y Desaubies and V Thierry is still not fulfilled and the question in becoming more and more important when we are struggling for sustained funds.
- Float performance -particularly life-time - remains an important factor in the cost of the system. Did the technical teams worked on this in past year and significantly improved energy budget…
- Improve link between ARGO Data Management Activities and ARGO Steering Team ones:
    - ARGO data management team need to know what are the novelties that the AST is testing and have good chance to be put in operational mode (i.e. study the impact of two-way communication capabilities on float data management, new parameters to be included, development of new regional/global climatologies…) in order to prepare the ARGO Data management system to these new features.
    - On the other hand ARGO Data Management team needs AST to progress on some topics to be able to progress (how to calculate Trajectories from float data, how to introduce Argo profiles in the reference database used for DMQC, how to improve correction in real-time,..)
- National programs need more visibility on the results obtained from the global ARGO array. To sustain funding, ARGO needs to provide a number of "success stories" and striking results to illustrate the utility of the array. This is necessary to convince politician that the ARGO array is indispensable and has to be sustained. The Project Office had started to provide information on AST www site but probably need to be improved for non-scientists readers…
- How to improve user feedback and knowledge of ARGO users?
- How to handle new parameters collected by ARGO network and in particular their quality control?
- ARGO and JCOMM what do we want /plan to do ?

6) Specific comments relating to the agenda items :

argo data management

Argo data management
October 30th, 2005
Ref : cordo/dti-rap/05-146
Thierry Carval

ARGO DATA MANAGEMENT REPORT
FRENCH GDAC


ARGO
part of the integrated global observation strategy

Introduction

This document is the annual report of the French Argo Global Data Assembly Centre (GDAC) for 2005.

Argo GDAC Functions

National centres reporting to you

Currently, 9 national DACs submit regularly data to the French GDAC.

In February 2005, the CSIO DAC (China) started to send data and meta-data.

The additional GTS DAC contains all the vertical profiles from floats that are not handled by a national DAC. These data come from GTS and GTSPP projects. The GTS profiles are quality controlled by the French DAC (Coriolis).

On October 30th, the following files were available from the GDAC FTP site :

- AOML, USA
  - File types: meta-data, trajectory, technical and profile
  - 1456 meta-data files accepted
  - 76053 profile files accepted including 20764 delayed mode profiles
  - 1407 trajectory files accepted
  - 1406 technical data files accepted
- BODC, United Kingdom
  - File types: meta-data, trajectory and profile
  - 170 meta-data files accepted
  - 9175 profile files accepted, including 396 delayed mode profiles
  - 159 trajectory files accepted
  - 0 technical data files accepted
- CSIO, China (HZ)
  - File types: meta-data, trajectory, technical and profile
  - 24 meta-data files accepted
  - 961 profile files accepted, including 340 delayed mode profiles
  - 24 trajectory files accepted
  - 24 technical data files accepted
- Coriolis : Denmark, France, Germany, Italy, Netherland, Norway, Spain
  - File types: meta-data, trajectory, profile and technical
  - 558 meta-data files accepted
  - 28395 profile files accepted, including 5407 delayed mode profiles
  - 532 trajectory files accepted
  - 532 technical data files accepted
- CSIRO, Australia
  - File types: meta-data, trajectory, profile and technical
  - 83 meta-data files accepted
  - 4085 profile files accepted, including 0 delayed mode profile
  - 31 trajectory files accepted
  - 80 technical data files accepted
- INCOIS, India
  - File types: meta-data, trajectory and profile
  - 107 meta-data files accepted
  - 4412 profile files accepted, including 0 delayed mode profile
  - 105 trajectory files accepted

    - 0 technical data files accepted
- JMA, Japan
    - File types: meta-data, trajectory, profile and technical
    - 490 meta-data files accepted
    - 29525 profile files accepted, including 751 delayed mode profiles
    - 489 trajectory files accepted
    - 490 technical data files accepted
- KMA, Korea
    - File types: meta-data, trajectory, profile and technical
    - 59 meta-data files accepted
    - 2750 profile files accepted, including 0 delayed mode profile
    - 53 trajectory files accepted
    - 53 technical data files accepted
- MEDS, Canada
    - File types: meta-data, trajectory, technical and profile
    - 152 meta-data files accepted
    - 9392 profile files accepted, including 6971 delayed mode profiles
    - 149 trajectory files accepted
    - 149 technical data files accepted
- GTS (data collected by GTSPP)
    - File type : meta-data, profile
    - 406 meta-data files accepted
    - 28354 profile files accepted, 0 delayed mode profile

Operations of the ftp server

- Meta-data, profile, trajectory and technical data files are automatically collected from the national DACs ;
- Index files of meta-data, profile and trajectory are daily updated ;
- GDAC ftp address: ftp://ftp.ifremer.fr/ifremer/argo
- **New feature** : OpenDAP data access for Argo data
  Using OpenDAP, Argo data appears to you as a local file, like a network file system over the web.
  http://www.coriolis.eu.org/cdc/opendap-dods_distribution.htm
  http://www.ifremer.fr/cgi-bin/nph-dods/data/in-situ/argo

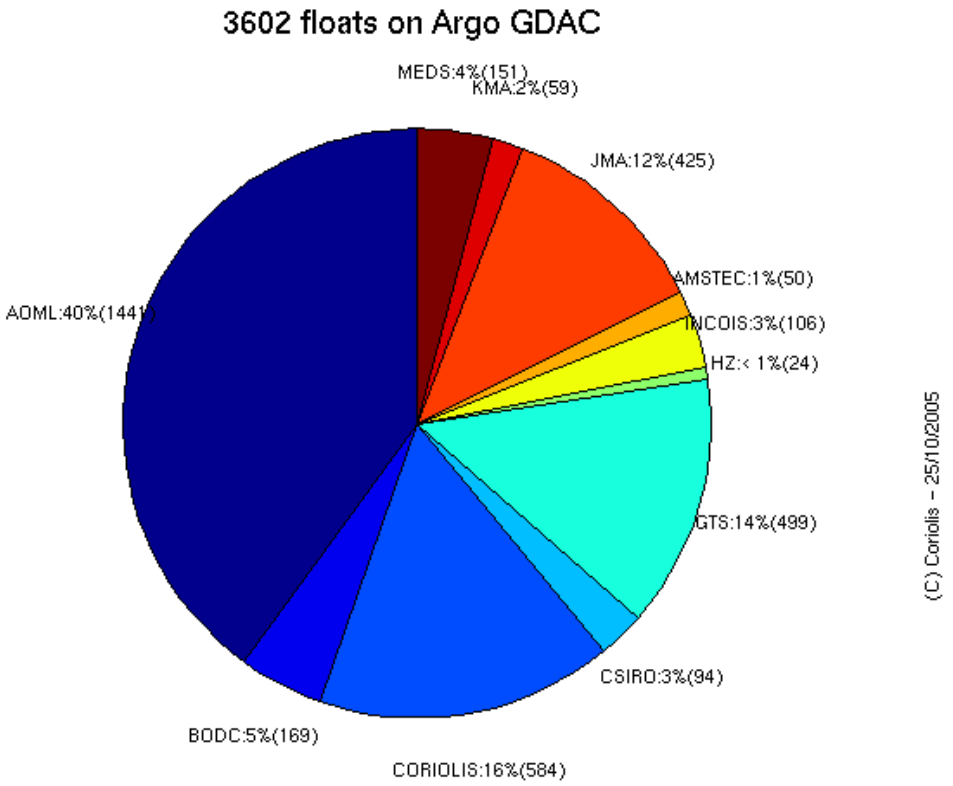
Operations of the www server

Ifremer maintains a web site with real-time and delayed mode data or meta-data collected by GDAC. The following features are available :

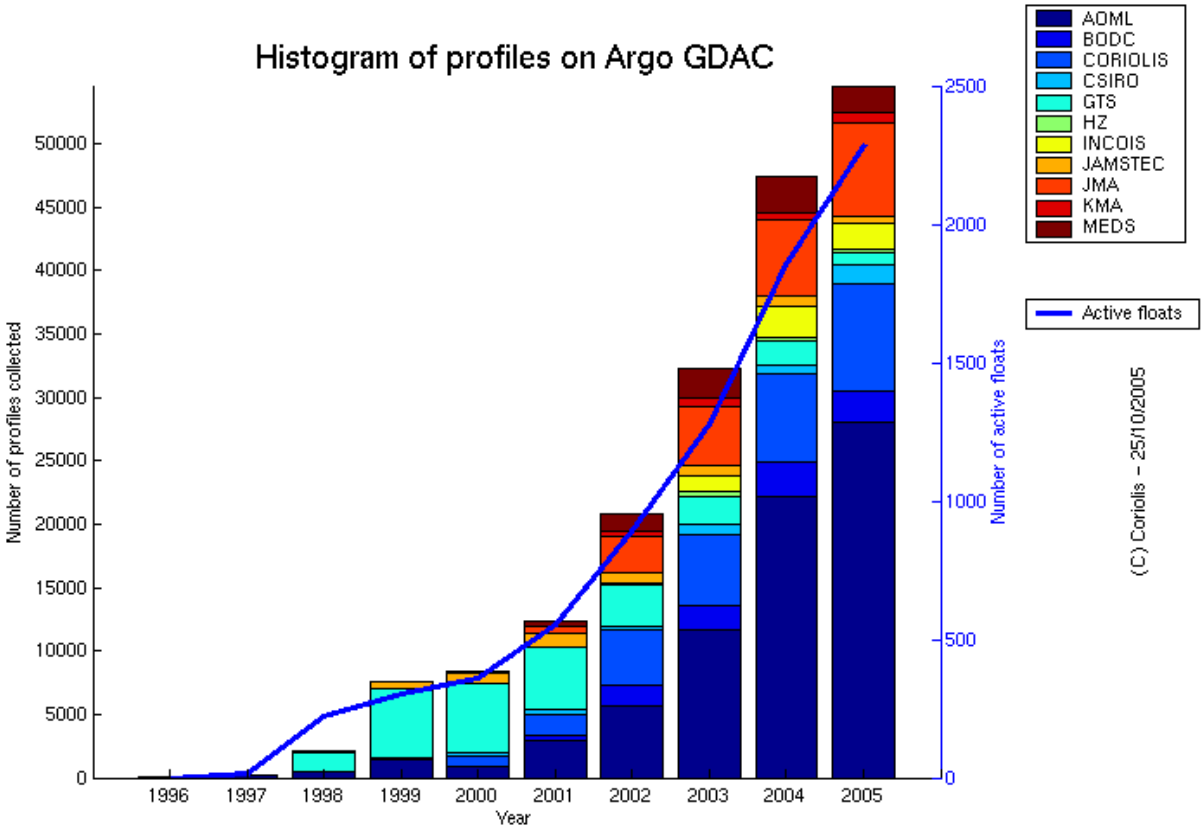
- Display of Argo profiling floats
  - http://www.coriolis.eu.org/cdc/floats/cdcFloats.asp
  - Display all active/old floats per ocean
  - Display technical informations and graphics for floats and measurements
  - Distribute data in Argo NetCdf format or medatlas Ascii format.
- Web data selection interface :
  http://www.coriolis.eu.org/cdc/dataSelection/cdcDataSelections.asp
  - Select data by date, location and meta-data informations
  - Select Argo data and additional profiles from GTSPP program (XBT, CTD, buoys)
  - Distribute data in Argo NetCdf format or medatlas Ascii format.
- Display GDAC monitoring statistics
  http://www.coriolis.eu.org/cdc/argo_gdac_monitoring.htm
- **New feature** : meta-data files monitoring
  Once a week, a global monitoring of Argo meta-data files is performed.
  - A list of 24 highly desirable meta-data parameters is defined.
  - For each float of each DAC, each missing or incorrect highly desirable parameter is pointed out
  - http://www.coriolis.eu.org/cdc/argo_gdac_monitoring.htm
- **New feature** : Argo data area selection
  The user enters the boundaries of an area. For each float that crossed this area, all profile data are delivered to user.

Data synchronization

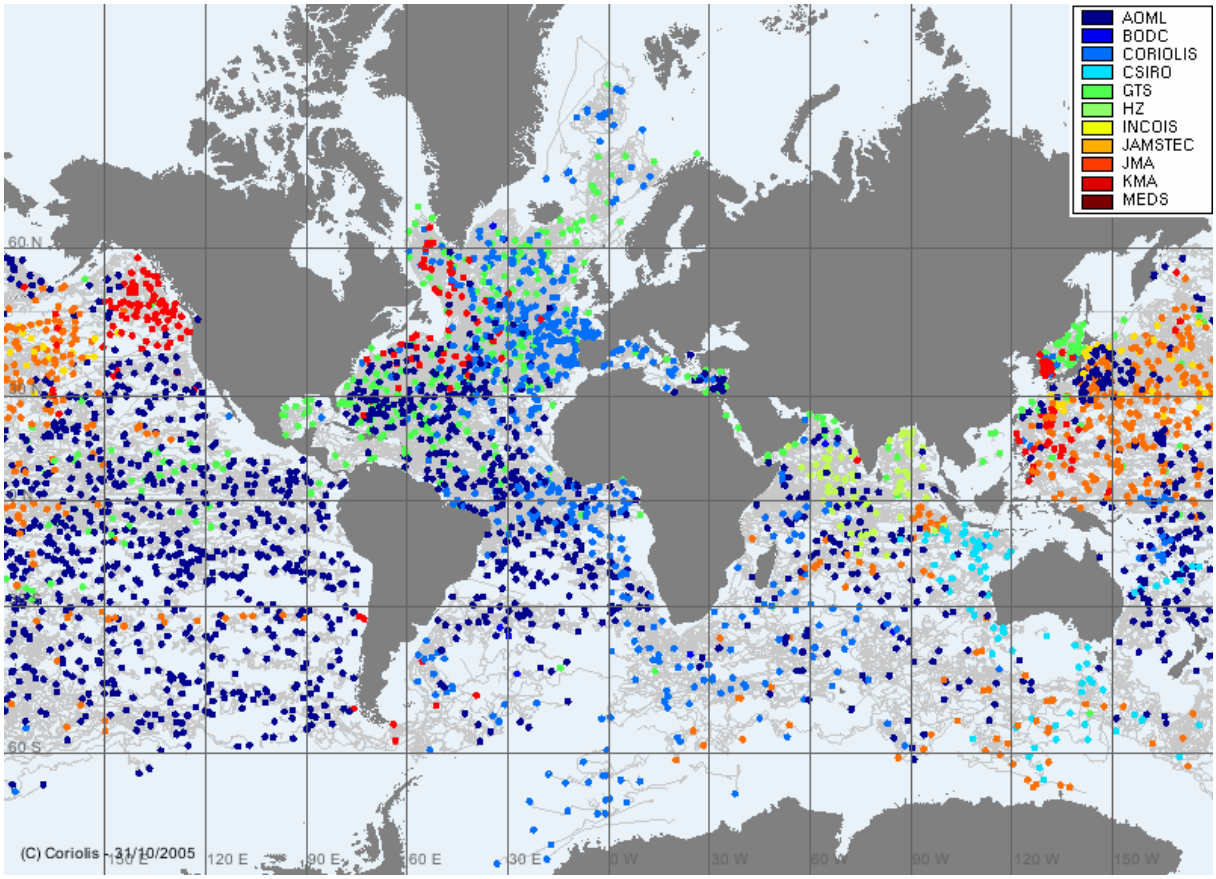
- Implemented on 20/02/2003, the synchronization with US-GDAC is performed once a day.



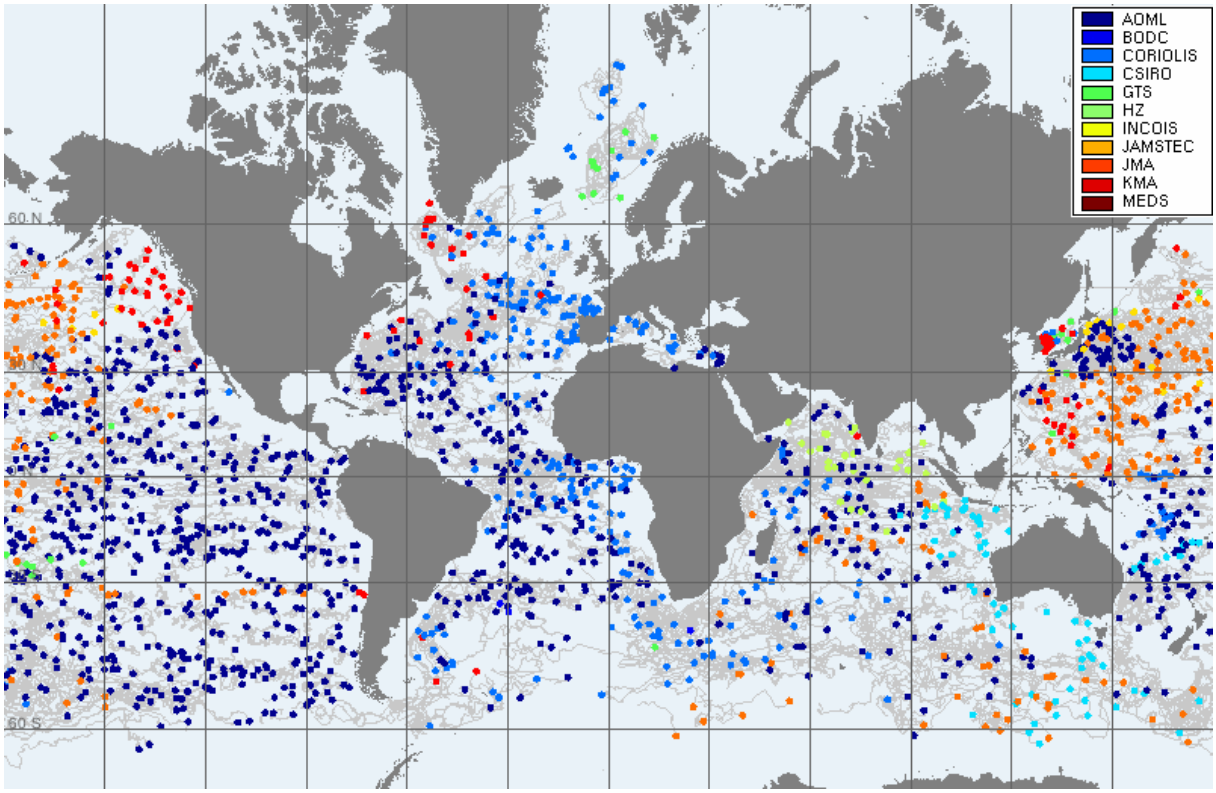
Argo GDAC : floats distribution per DAC in October 2005



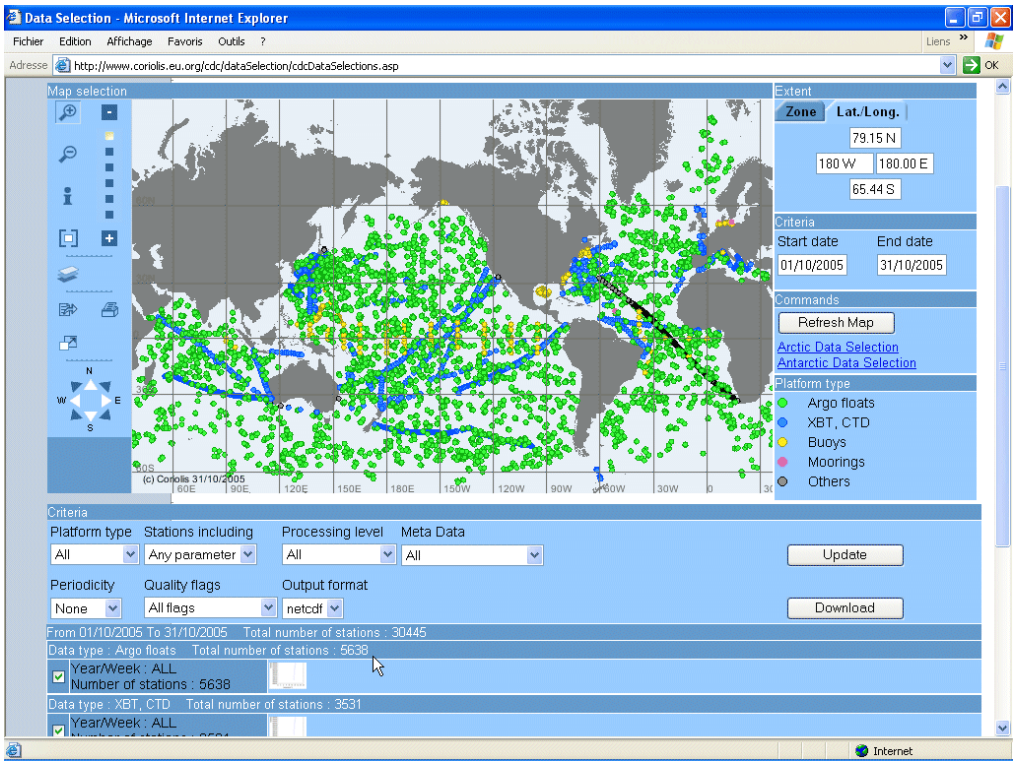
Argo GDAC : profiles distribution per DAC in October 2005



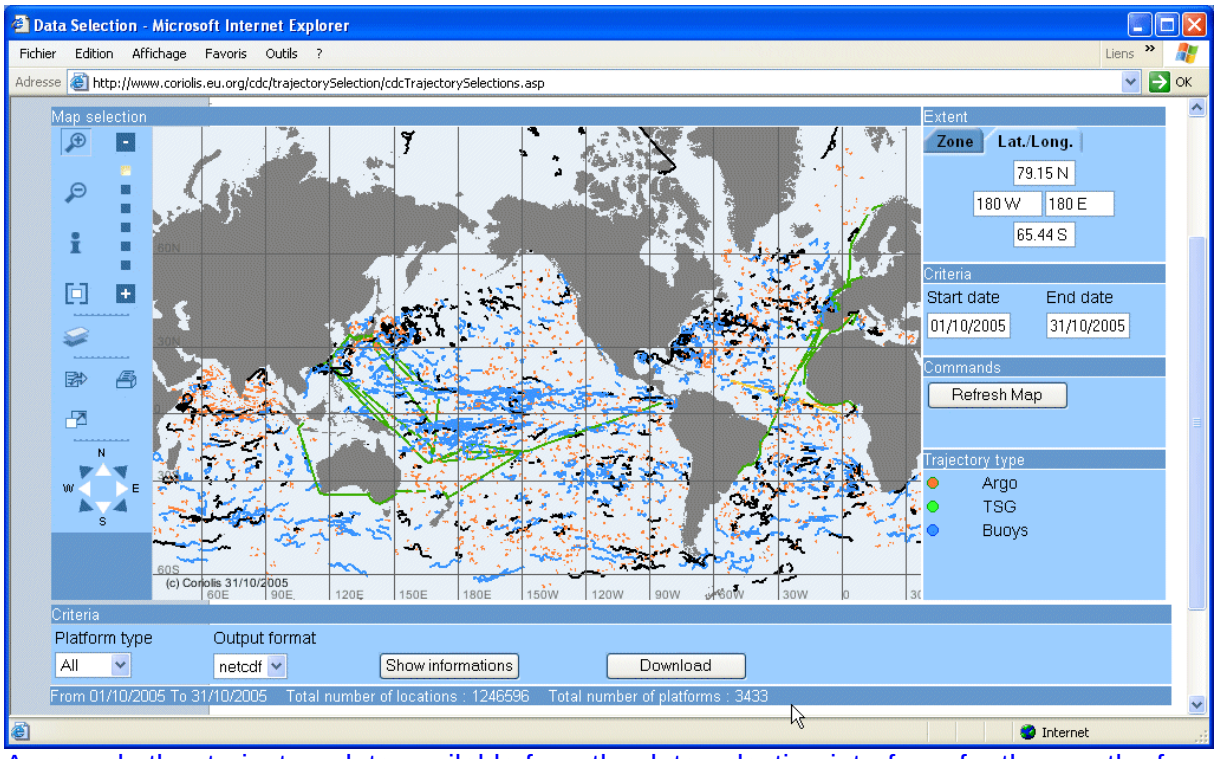
Argo profiling floats availables from GDAC in October 2005
(This map includes active and old floats)



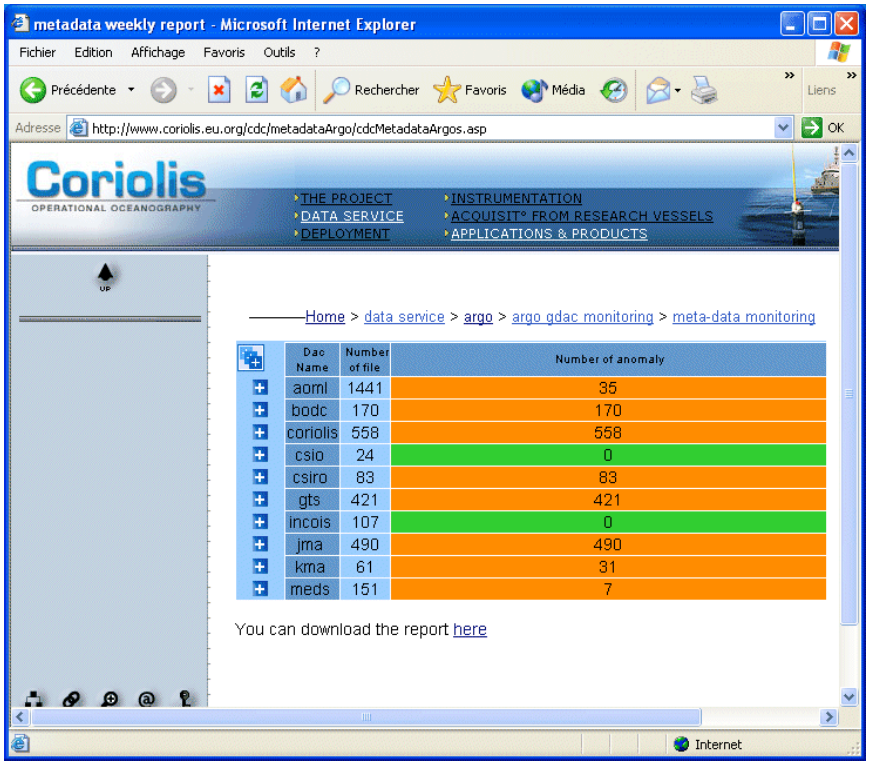
Active Argo profiling floats availables from GDAC in October 2005



Argo and other GTSPP profile data available from the data selection interface, for the month of October 2005
(green dots : Argo profiles, blue dots : GTSPP XBT profiles, yellow dots : GTSPP buoys)



Argo and other trajectory data available from the data selection interface, for the month of October 2005
(Orange lines : Argo trajectories, blue lines : DBCP buoy trajectories, green lines : Gosud thermosalinographs)



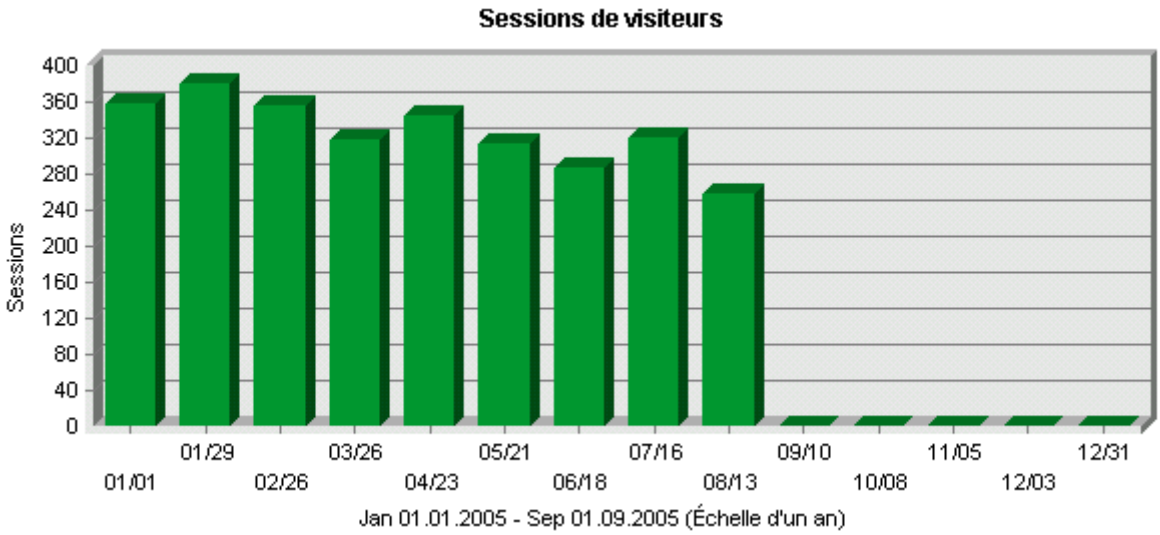
New feature : meta-data files monitoring

A list of 24 highly desirable meta-data parameters is defined. For each float of each DAC, each missing or incorrect highly desirable parameter is pointed out

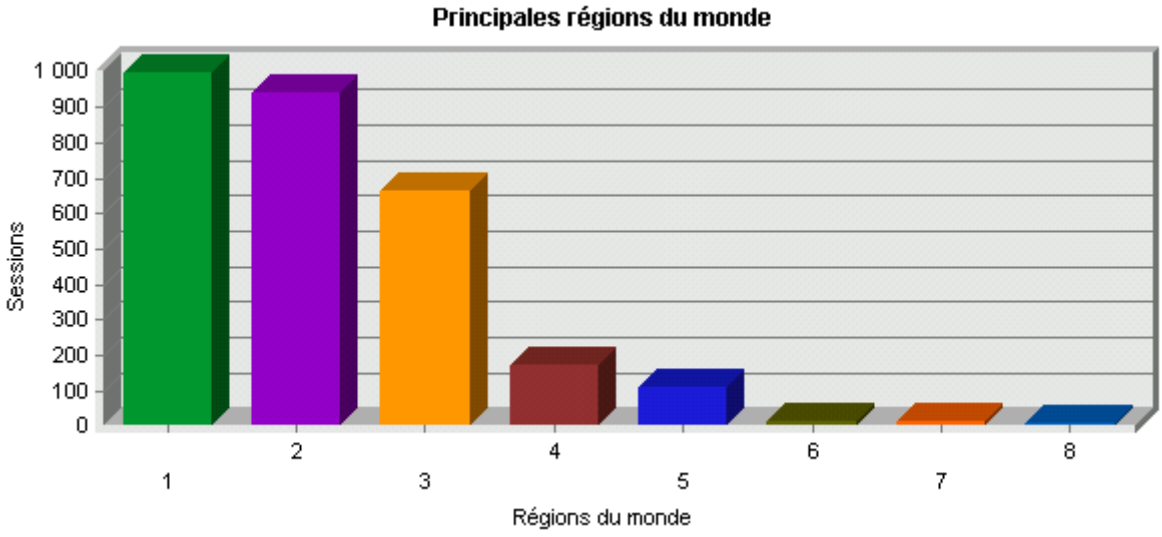
Use statistics from GDAC FTP site

From January to September 2005, the GDAC FTP server recorded

- 2 942 sessions
- 353 different visitors
- 2 908 061 file transfers.
- 11 918 daily file transfers (average)

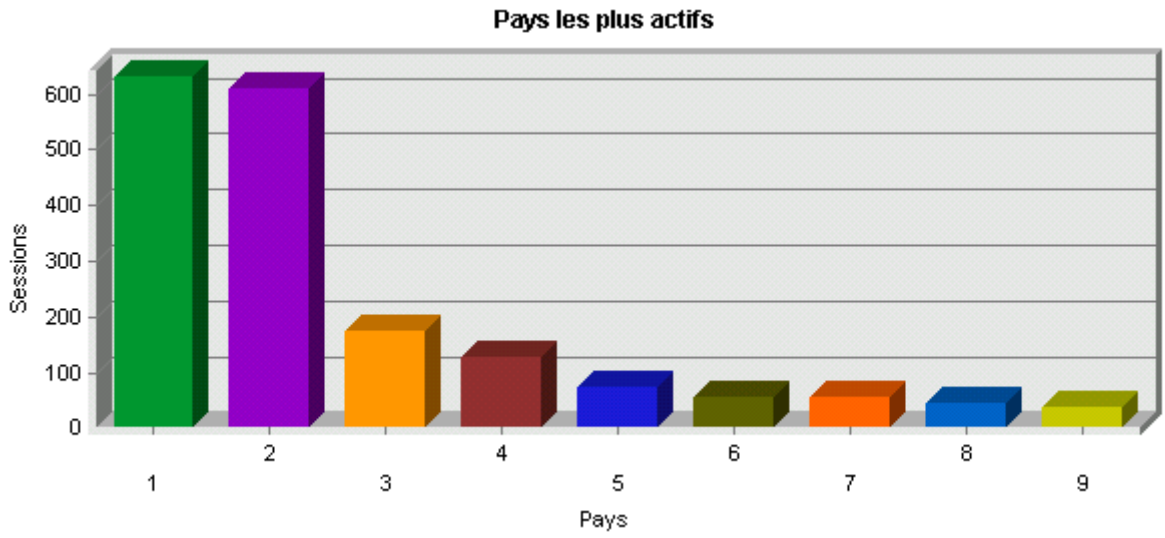


Number of FTP sessions on GDAC, from January to September 2005



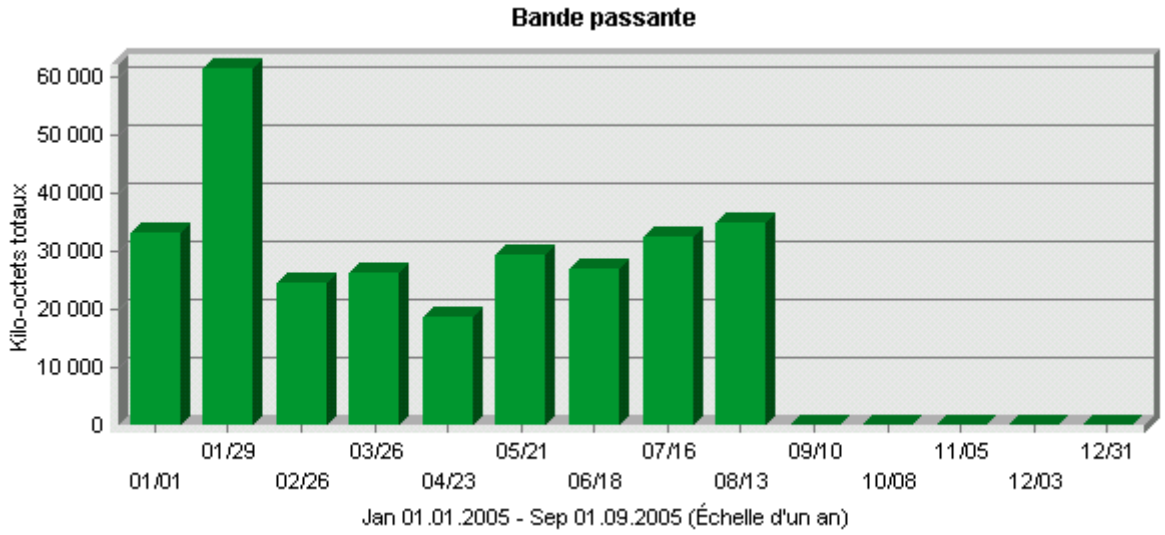
Origin of FTP sessions, main areas, from January to September 2005

1 : unspecified origin, 2 : Occidental Europe, 3 : North America, 4 : Northern Europe, 5 : Asia, 7 : Australia, 8 : Southern America

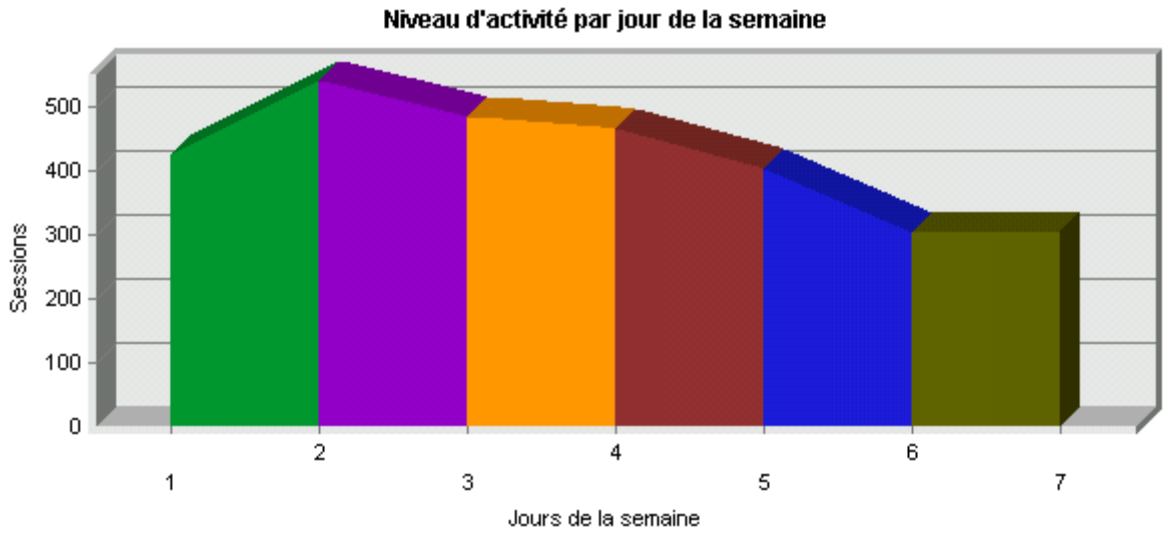


Origin of FTP sessions, main countries, from January to September 2005

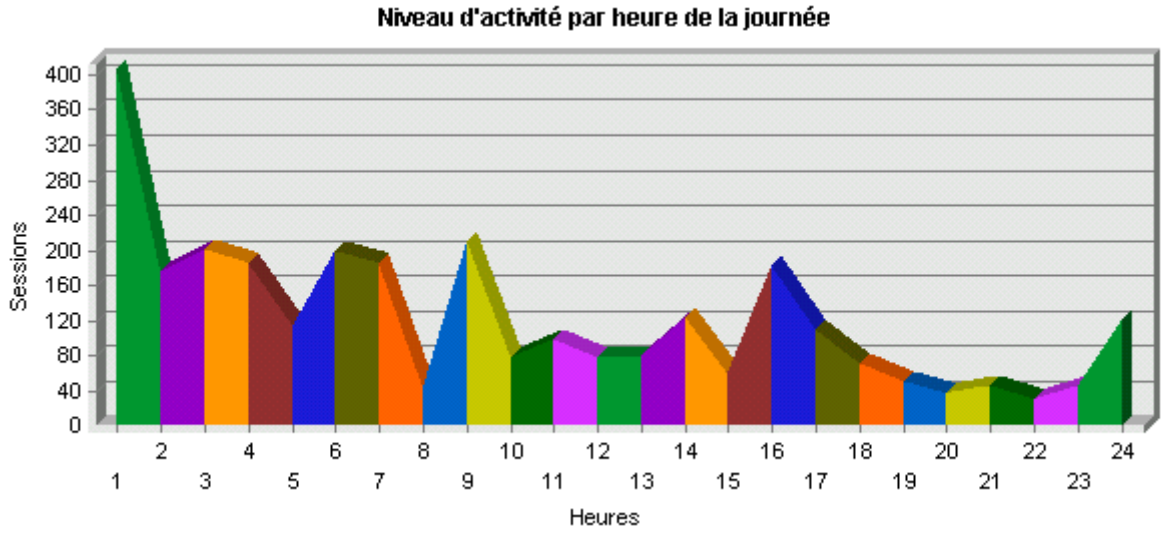
1 : France, 2 : USA, 3 : Norway, 4 : Germany, 5 : Japan, 6 : Netherlands, 7 : Canada, 8 : Spain, 9 : United Kingdom



FTP monthly bandwidth, from January to September 2005



FTP activity level per day of the week, from January to September 2005
(1 : Monday – 7 : Sunday)



FTP activity level per hour of the day, from January to September 2005

argo data management

Argo data management
November 2nd, 2005
Ref : cordo/dti-rap/05-145
Version 1.1

ARGO DATA MANAGEMENT REPORT FRENCH DAC

Argo National Data Management Report of France

November 2005

Introduction

This document is the annual report of the French Argo Data Assembly Centre (DAC) for 2005.

The French DAC is supported by the Coriolis project , a joint project for operational oceanography.

1. Status of the DAC

- Data collected from floats
  - 540 floats including 311 active instruments
  - 28395 profile files, including 5407 delayed mode profiles
  - 532 trajectory files
  - 532 technical data files

- Description of the 540 floats :
  - 311 active floats in October 2005
  - Provor (264), Apex (254), Metocean (12), Nemo (10)
  - 33 versions of floats : 13 versions of Provor, 17 versions of Apex, 2 versions of Nemo, 1 version of Metocean
  - Deployed by 8 countries (Denmark, France, Germany, Italy, Netherland, Norway, Russia, Spain)
  - Operated by 22 scientific projects (Good-Hope, Mersea, MFSTEP, Tropat, Weccon…)

During the past year, in coordination with CLS Argos we have processed Apex 28 bits format floats which are not hosted by a national DAC.
We also quality control the data circulating on GTS from floats with no national DAC.

- Data issued to GTS

All data processed by Coriolis are distributed on the GTS by way of Meteo-France. This operation is now automatically performed. After applying the automatic Argo QC procedure, the Argo profiles are inserted on the GTS every 2 hours. So, Argo profiles are now inserted on the GTS 365 days per year, 24 hours a day.

- Data issued to GDACs after real-time QC

All meta-data, profiles and trajectory data are sent to Coriolis and US-Godae GDACs. This distribution is automated.

Technical data are regularly issued to the GDACs

- Data issued for delayed QC

All profile files are sent to PIs for delayed QC. Most of the Atlantic data handled by Coriolis are checked by the European project Mersea.

- Delayed data sent to GDACs

Annie Wong et al method has been adapted to North Atlantic environment to produce the delayed mode data for Gyroscope project (Lars Boehm). This year, the method has evolved with Christine Coatanoan and Virginie Thierry . A total of 5407 delayed modes profiles was sent to the GDAC.

- Web pages

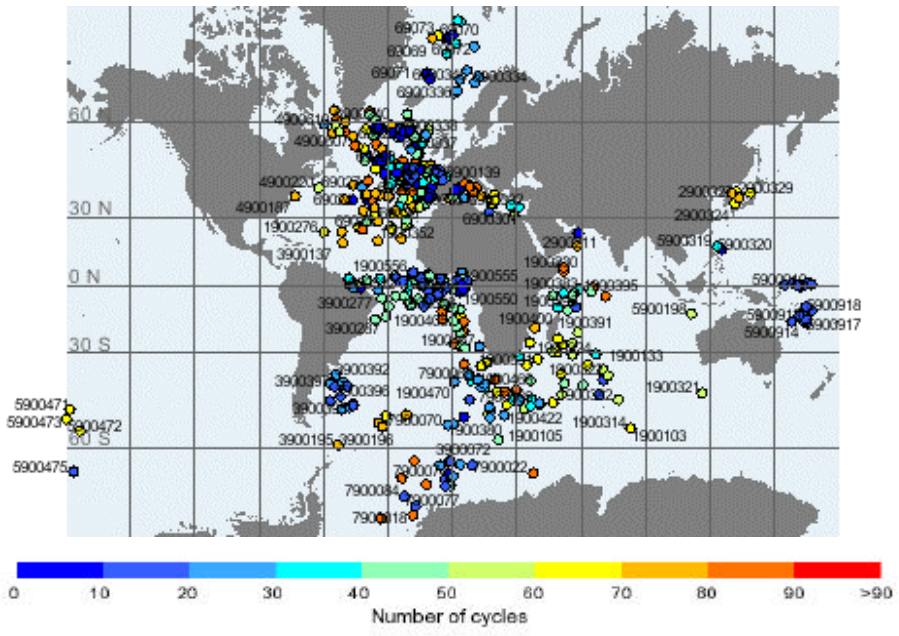
The web site of the French DAC is available at : http://www.coriolis.eu.org/cdc/

It provides :

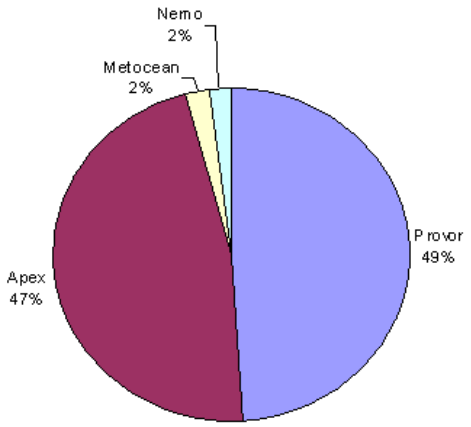
- Individual float description and status (meta-data, geographic map, graphics : section, overlayed, waterfall, t/s charts)
- Individual float data (profiles, trajectories)
- FTP access ;
- Data selection tool ;
- Global geographic maps ;
- Weekly North Atlantic analyses (combines Argo data and other measurements from xbt, ctd, moorings, buoys) ;
- Some animations.

Since last report, new functionalities have been implemented on the Coriolis web site:

- Floats monitoring statistics: http://www.coriolis.eu.org/cdc/coriolis_floats_monitoring.htm



Coriolis DAC : geographical distribution of floats in October 2005



Coriolis DAC : type of floats in October 2005

2. Delayed Mode QC

At the Coriolis data center, the data proceed through the Böhme and Send's software. Some changes in a few programs has been done to implement the decisions of the April 2005 Argo Delayed Mode Workshop in San Diego. The main modification concerns the 12-month sliding window. We now split the data series in various segments as shown in Figure 1. The characteristics of the correction applied on each segment are saved for different purposes (creation of the "D" files, statistics, re-processing of the DMQC, etc).

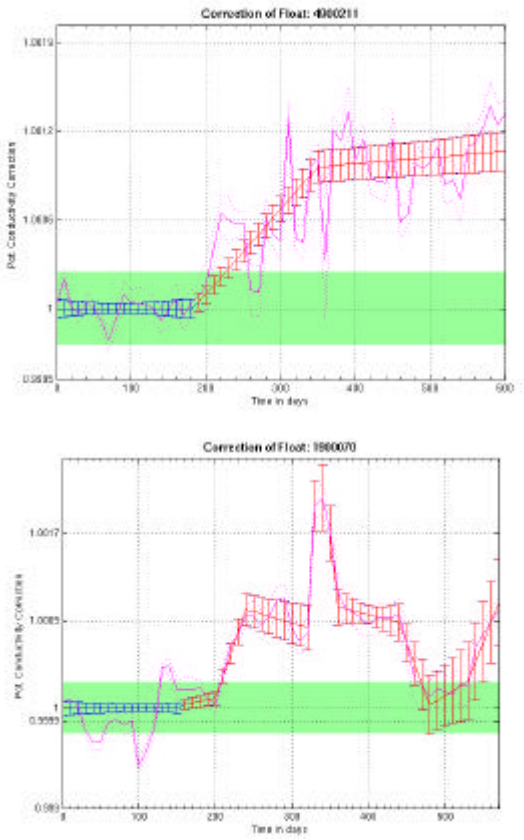


Figure. 1.

Complementary diagnostic plots have been developed to compare DMQC results with temperature and salinity fields of the weekly analysis performed at Coriolis..

The residual values (difference between float data and analysis) allow to follow for some levels possible drifts or offsets (Figure 2). The method of the differences is used to make comparison between measurement points and objective analysis fields : using the temporal closer objective analysis, getting grid points around the float, making horizontal and vertical interpolations and difference with the measurement point. Plots for some levels (Figure 2) present differences for all measurements points and mean cycle by cycle.

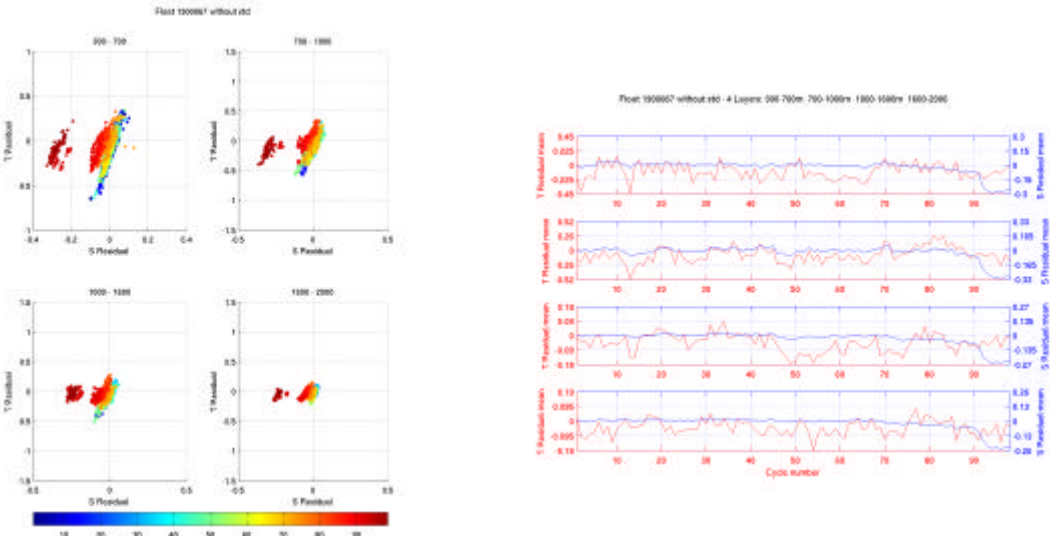


Figure 2. a) Residual values (temperature versus salinity) for some levels. b) Residual values averaged over different range depths versus float cycles.

As shown Figure 3, the float salinity is also compared to a mean salinity field.

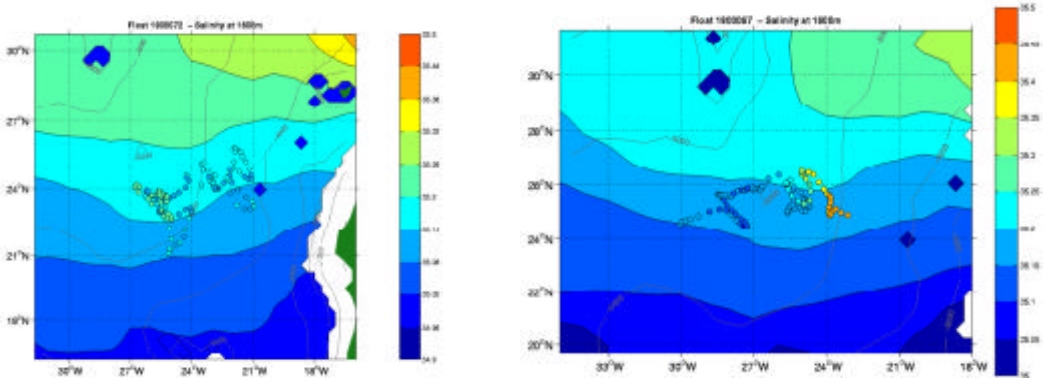


Figure 3.

Discussions with the PI have allowed to assess actions to be done on the floats even if for specific cases, more studies must be developed because the correction to be applied is not very clear.

At this time, we have focused the delayed mode on the North Atlantic Ocean (Figure 4). For the floats deployed in the South Oceans, we have problems to process all the float data in delayed mode QC because of the lack of data in the reference database.

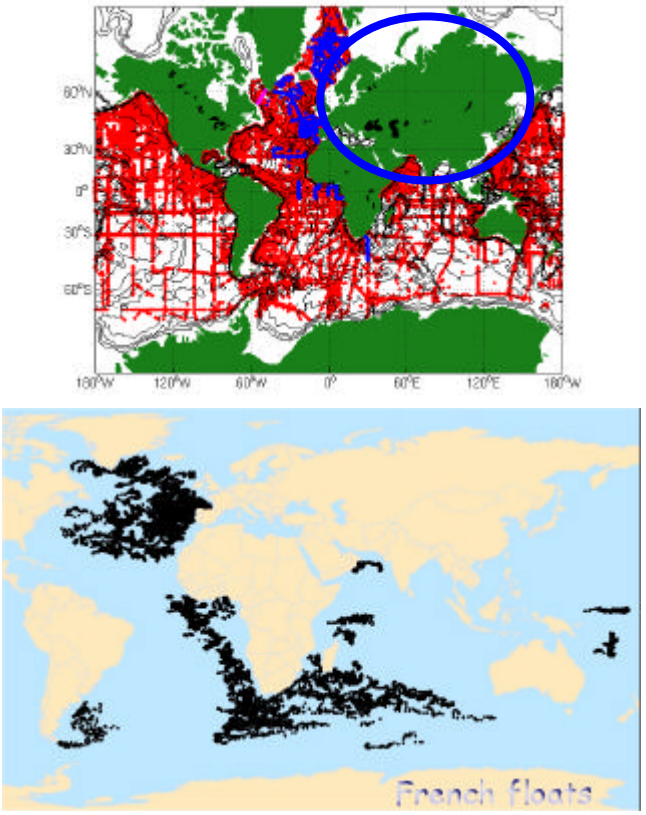


Figure 4. a) WOD01 Reference database (red) and recent CTD data (blue and magenta). b) French floats which have to be processed in DMQC.

For the German floats, the delayed mode QC is carried out by the BSH centre, like some contacts have took place, between the Coriolis and BSH centers, on the use of the Böhme and Send's software. Some exchanges are also in progress to share recent CTD data and to provide them in the framework of the RDAC.

For the North Atlantic Ocean, the French floats have been reviewed using the results of the April 2005 Argo Delayed Mode Workshop. The "D" files are under construction and will be send to the GDACs in the next weeks.

3. GDAC functions

The French GDAC is supported by the Coriolis project, a joint project for operational oceanography.

See French GDAC report ref. CORDO/DTI-RAP/05-146.

4. Regional centre functions

Partners involved in Argo Activities in the North Atlantic (80N to 20S) have decided to collaborate with each other and the South Atlantic Argo Regional DAC (SAARDAC) to establish the North Atlantic Argo RDAC (NAARDAC)."

They have decided to work together in six main directions

- Ensure consistency of the Argo data from the North Atlantic, independent of float provider, using statistical tools to detect potential outliers and provide feedback to DACs and PIs
- Facilitate development of a Reference Data Base for delayed mode quality control by establishing a low resolution CTD database that includes the most recently collected data (i.e., those not yet available through Clivar or NODC).
- Logistics for deployment : inform on vessel opportunities and of compile float deployment plans in collaboration with South Atlantic RDAC
- Capacity building in Mediterranean Sea and Tropical area to train interested countries on float deployment and/or data processing
- Product delivery: The main product of the RDAC will be a consistent Argo delayed mode dataset for the North Atlantic. However some scientific products such as temperature and salinity weekly analysis, improved mean sea state of the ocean for Argo period, currents calculated from floats , ... will be made available thought NARDAC with clear documentation.
- Coordination with other RDACs

The countries involved are at present :

- Canada
- France
- Germany
- Italy
- Netherlands
- Spain
- United-Kingdom
- USA

North Atlantic Regional Data Centre meeting :
http://www.coriolis.eu.org/cdc/argo/NARDACMeetingReport-October2005-V1.0.pdf

Argo Steering Team meeting at Hyderabad, India, January 16-18, 2006

National Report – India

(Submitted by M. Ravichandran)

1. Organization of Indian Argo Project

a) The Indian Argo Project, fully funded by the Department of Ocean Development (DOD), Government of India is implemented by the Indian National Center for Ocean Information Services (INCOIS) of DOD at Hyderabad (lead) jointly with the National Institute of Ocean Technology (NIOT) of DOD, 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.

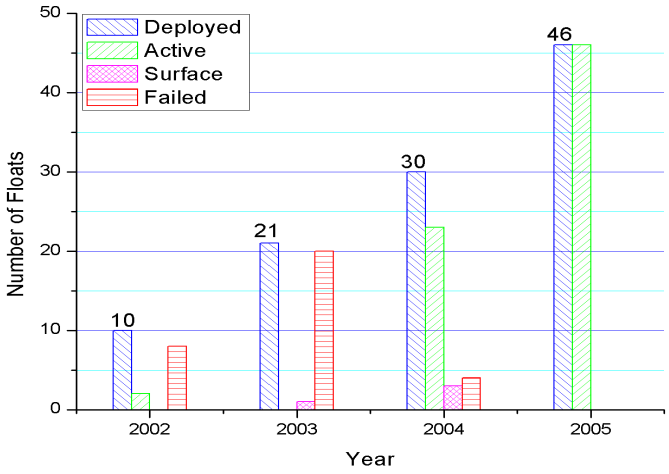
c) Several R&D Institutions, Operational Agencies including the National Institute of Oceanography at Goa, Space Applications Centre at Ahmedabad, National Remote Sensing Agency at Hyderabad, Indian Institute of Tropical Meteorology at Pune, National Centre for Medium range Weather Forecasting (NCMRWF) 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

- 10 floats were deployed during Oct-Nov 2002
- 21 floats were deployed during May-June 2003
- 30 floats were deployed during 2004.
- 46 floats have been deployed during 2005

a. Performance Analysis of the Floats deployed so far

Out of 107 floats deployed so far by India, 71 floats are active, 4 floats are providing only near surface information and 32 floats are inactive. In the year 2005, there were 46 floats have been deployed and all the floats are active.



The location of the floats deployed and the present location of the floats are shown in Fig. 1 a and 1 b.

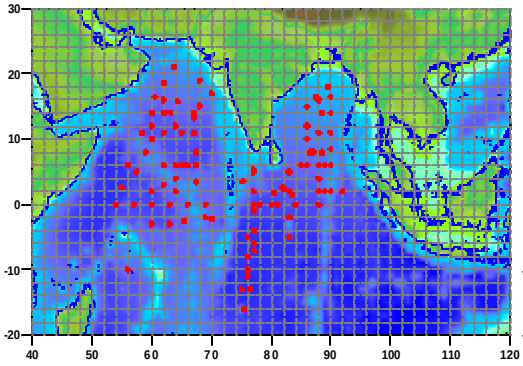


Figure 1 a

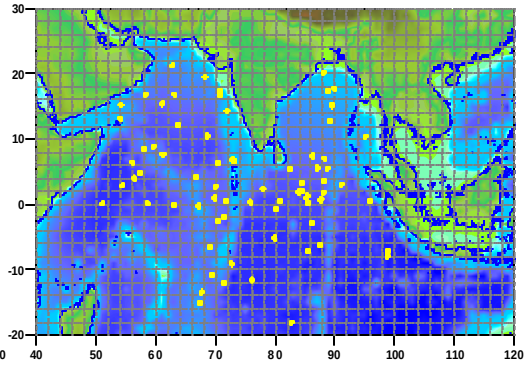


Figure 1 b

b. **Technical problems encountered and solved:** Nil

c. Status of contributions to Argo data management

(i) Real-time QC

India has been receiving data pertaining to Indian floats from CLS-ARGOS via FTP. INCOIS is processing the data and sent it to GDAC in real time. Also, these data are made available through INCOIS website www.incois.gov.in/argo.html in ASCII format. Presently we do not have GTS access and hence we could not send Indian floats data to GTS. However, we have requested ARGOS CLS to send Indian floats data to GTS. In doing so, ARGOS-CLS are processing data before receiving complete profile and they are sending only limited data instead of complete profile. Hence, ADMT is observed that GDAC receive GTS files earlier than DAC files (time delay).

(ii) Delayed mode QC

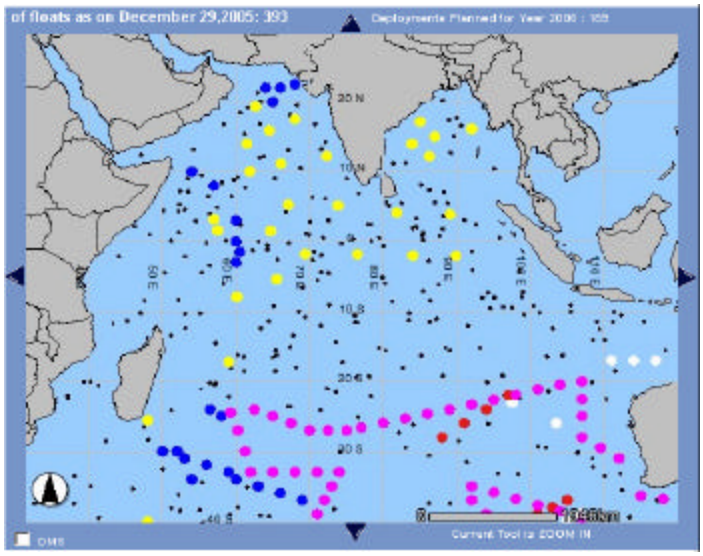
We are still testing a suitable procedures to enable the calibration of floats since the floats in the North Indian Ocean was hindered by non-convergent TS relationship and lack of good quality of historical salinity data sets. The problems faced in carrying out delayed mode quality control of Argo data from this basin was already mentioned in ADMT-6 meeting (please refer ADMT-6 meeting report for more detail). However, non-problematic floats data will be sent to GDAC before Feb 2006.

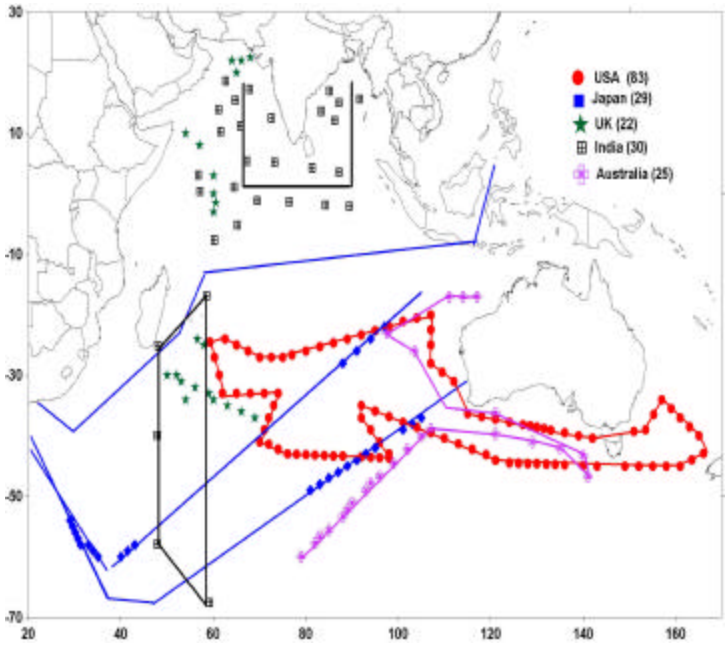
(iii) **Regional Centre Functions**

a. Acquisition of Argo data from GDAC other than Indian floats and made available at INCOIS web based services
b. Acquiring CTD profiles from Research vessels for improving Indian ocean hydrology
c. Value added products

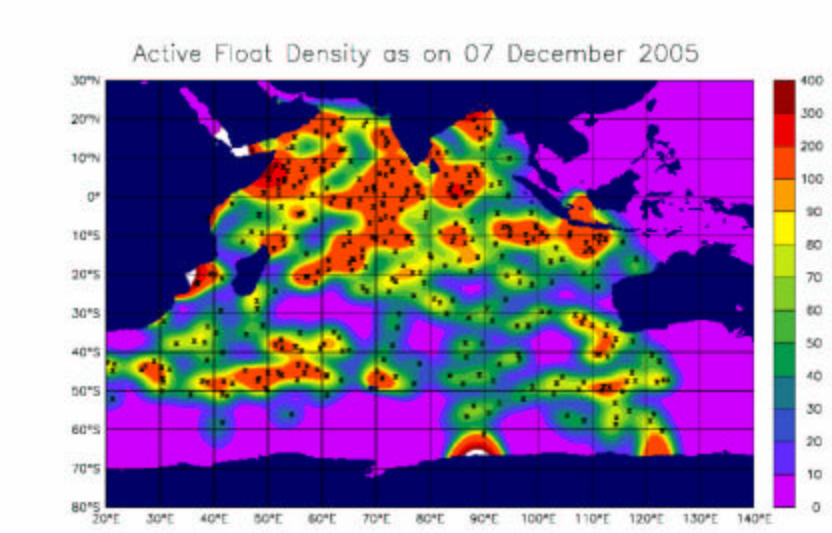
   Two products Viz. (i) time series plots for a specific float (water fall, time series of temperature and salinity, TS plot, trajectory etc) and (ii) spatial plot using objective analysis for different parameters (Heat content upto different depths, Mixed layer depth, depth of 20 and 26 deg isotherm, SST, SSS, etc) are being prepared for the Indian Ocean region and made available via WEB.
d. Regional co-ordination for Argo floats deployment plan for Indian Ocean.

   About 189 floats are planned to deploy in Indian Ocean during the year 2006. The proposed deployment location, some of the cruise plan and present status of floats in Indian ocean are shown in the following figure. The regional co-ordination website is at http://www.incois.gov.in/website/futureextended/viewer.htm





Proposed cruises by different countries for deployment of Argo floats in Indian Ocean region



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

Indian Argo Project is a 5 year Program from April 2002 to March 2007 fully funded by Department of Ocean Development. During this period, India committed to deploy 150 floats. Since India has already deployed 107 floats, the remaining 43 floats will be deployed before March 2007.

For the next five year plan (2007 to 2012), Department of Ocean Development committed to fund for the deployment 250 floats, approximately 50 floats (few floats will have additional sensors) per year in the Indian Ocean region. Proposal for the same has been submitted to Government of India for

final approval, the exact amount for the financial support from Government will be known by end of 2006.

12 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 for other commitments to Argo for the coming year

In the year 2006, India plans to deploy 30 floats in Indian Ocean. Most of the floats will be deployed in the North Indian Ocean region where the floats density is not meeting Argo design. Before March 2007, another 13 floats will be deployed.

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

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

a. Scientists from several Institutions in India are utilizing Argo data for many applications including:

- To study the structure and variability of the Indian ocean
- To study the response of the North Indian Ocean to the summer monsoon
- To study the upper ocean response and to improve the predictive capability of the intensity and track of the cyclone
- To study Arabian sea water mass
- To study short-term variability of Sound Velocity

b. Operational uses

Efforts are underway to assimilate the Argo data in the Ocean General circulation models for operational forecast of sea state in the Indian Ocean. However, we are not successful in realizing the same.

6. Issues that your country wishes to be considered by Argo Exec regarding the international operation of Argo

Though Argo floats in the Indian Ocean have grown tremendously and a wonderful data base is growing, the application and utility of these Argo floats is not encouraging, especially operational utility. In this regard, some training is required for Indian Scientists from participating countries for assimilation of in-situ data, especially Argo data. This will elucidate sustaining and enhancing the National funding for Argo Program.

National report of Japan

(Submitted by Nobuyuki Shikama)

1. Status of implementation

1.1 Floats deployed and their performance

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is scheduled to deploy 94 floats (93 APEXs, 1 NINJA) in FY 2005 from April 2005 to March 2006.

Japan Meteorological Agency (JMA) deployed 7 PROVORs from October to November 2005 and will deploy 7 PROVORs from January to February 2006 in the seas around Japan for operational ocean analysis. All the deployed PROVORs are operating properly.

Hokkaido National Fisheries Research Institute, Fishery Research Agency deployed 5 isopycnal APEXs in July 2005, which are working well. National Research Institute of Fisheries Science, Fishery Research Agency will deploy 1 APEX with a Wetlab chlorophyl sensor in February 2006.

Tohoku University will deploy 1 APEX with a Sea-Bird oxygen sensor and a Wetlab chlorophyl sensor in February 2006.

Among the 431 floats (351 APEXs, 72 PROVORs, 8 NINJAs) which JAMSTEC deployed in the Pacific, Indian and Southern Oceans, from 1999 to the end of December 2005, 302 (299 APEXs, 1 PROVOR, 2 NINJA) floats are still operating, 122 floats (48APEXs, 69PROVORs, 5NINJAs) terminated the transmission and 7 floats (4 APEXs, 2 PROVORs, 1 NINJA) were recovered.

An average survival rate calculated by a medical statistics is given in Fig.1 for 317 APEXs and 78 PROVORs whose data are managed by JAMSTEC.

1.2 Technical problems encountered and solved

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Regarding energy flu problem of APEX with control board APF8, 6 among 150 APEXs which were fixed for all possible defects such as motor back spin, alkaline energy flu and others showed the similar energy flu symptom. And so, we cannot say that the energy flu problem has fully solved.

Regarding Druck pressure transducer problem, 28 of 50 APEXs with unfixed Druck pressure transducers died showing abnormal pressure data over several cycles. Three among 33 APEXs whose Druck pressure transducers had been fixed only concerning the snow flake problem showed abnormal pressure data and died. This malfunction seems due to the electrostatic discharge to pressure transducer that was later found as another cause of Druck pressure transducer problem. Only one among 211 APEXs whose Druck pressure transducers had been fixed concerning both snow flake and electrostatic discharge problem showed such an abnormal pressure data as

3,000db, lost its buoyancy control and died. We can consider that the Druck pressure transducer problem has fully solved.

JAMSTEC has recalibrated a lot of Sea-Bird CTD sensors after we received them from Sea-Bird using the same system as the one Sea-Bird uses. Since 2001, JAMSTEC has recalibrated 174 CTD sensors and found 12 sensors among them to have some trouble. Even the temperature sensor showed abnormal data in two cases. Other ten cases were involved with the conductivity sensor.

1.3 Status of contributions to Argo data management

Real time data management.

The Japan DAC, Japan Meteorological Agency (JMA), is presently acquiring ARGOS messages from 324 active floats operated by nine Japanese organizations, as of November 30, 2005. All profiles are issued to the GTS and GDACs in accordance with the Argo data management standard. Historical data from 501 floats including those from the active floats have been sent to GDACs.

Data acquired from floats.

JAMSTEC has got 9019 profiles (more than 90% of Japanese floats) from about 302 active floats operated by JAMSTEC, National Institute of Polar Research and Tohoku University in 2005.

Data issued for delayed QC.

JAMSTEC made Delayed Mode QC on routine basis to about 7246 profiles obtained in 2005. Results (figures and ASCII data files) are accessible on JAMSTEC's Web page.

Delayed data sent to GDACs.

JAMSTEC sent about 3240 profiles to GDACS in 2005.

Products about Argo floats and data.

JAMSTEC's web pages show the followings in addition to float coverage map, float trajectory map and individual float data.

(1) network informations (only in Japanese):
Number of access, Number of profiles obtained and processed

(2) float informations:
Statistics of JAMSTEC's floats, Survival rate, Battery voltage, Surface pressure

(3) scientific products:
Distribution of T/S/Geostrophic Current on isobaric or isopycnal surface, distribution of Mixed Layer Properties for the Pacific and/or Indian Ocean.

2. Present level of and future prospects for national funding for 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 100 floats to be deployed every year) and JMA is to continue to deploy 15 floats around Japan every year for operational ocean analysis.

3. Summary of deployment plans and for other commitments to Argo for the coming year.

In FY 2006 JAMSTEC will deploy 90 to 100 floats in total. Detailed plan of many cruises for FY2006 are not yet decided but those for the first half are shown in Fig.2 and Fig.3. JMA is planning to deploy 15 floats around Japan every year for operational ocean analysis.

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

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 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/).

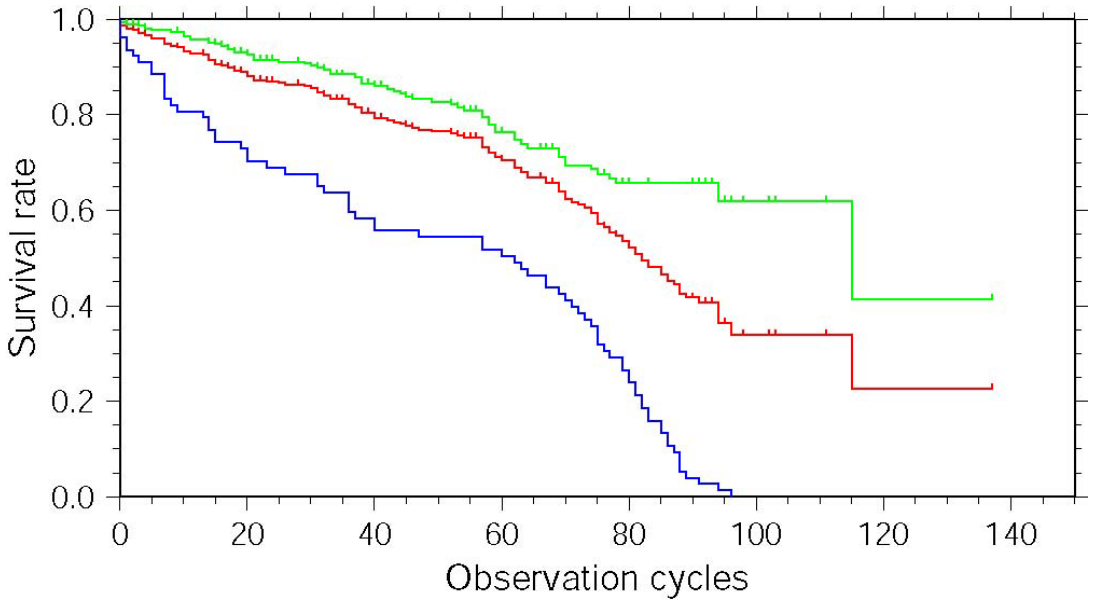


Fig.1 Survival functions estimated from all Argo floats (red, total number was 395), Apex (green, 317), and Provor (blue, 78) managed by JAMSTEC as of 8 August 2005. The floats not sending "normal" profiles are considered "dead". The average lifespan of Argo floats of JAMSTEC is over 82 cycles, and over 99 cycles for APEX and 50 cycles for PROVOR, respectively.

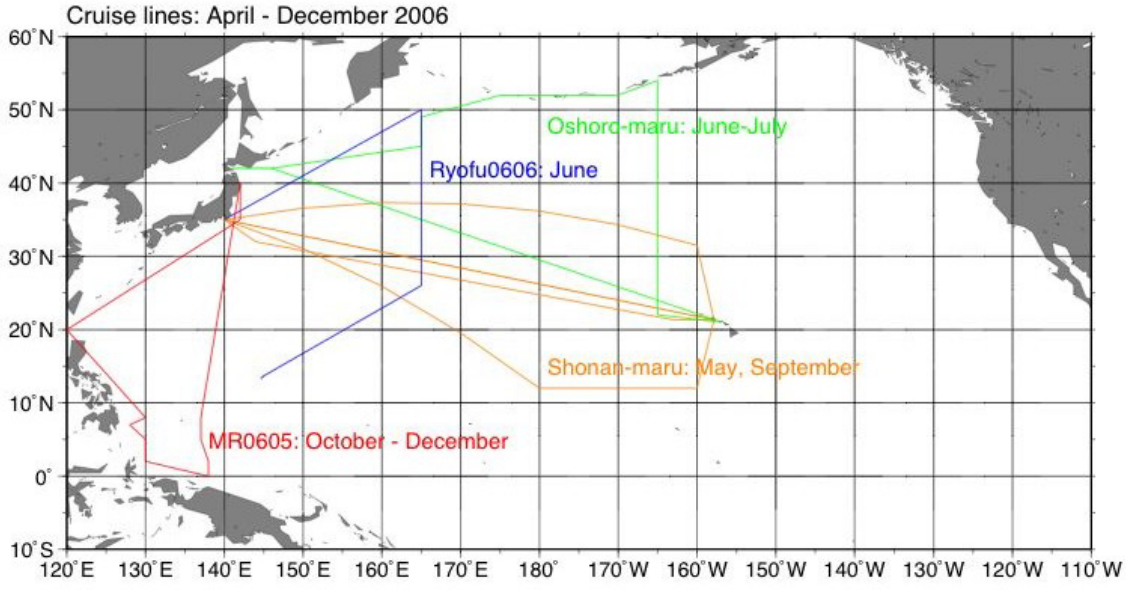


Fig.2 Launch plan for the first half of FY2006.

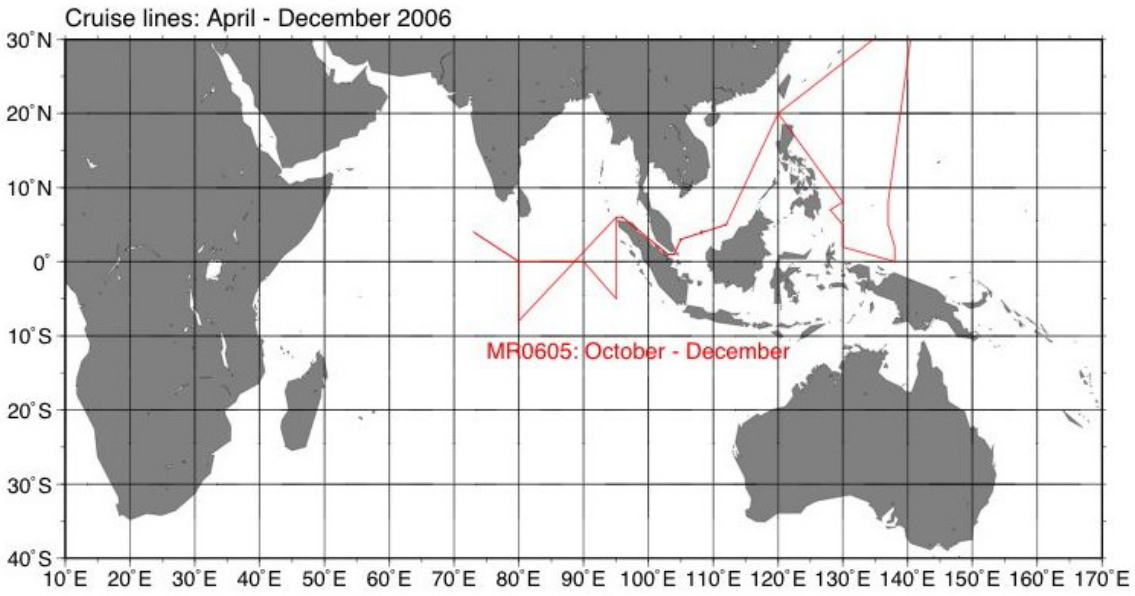


Fig.3 Launch plan for the first half of FY2006.

Korean National Report on Argo-2005

Submitted by Kuh Kim

Organization:

Korean Argo Subcommittee under Korea Oceanographic Commission coordinates Argo projects in Korea, which are carried out by Korea Ocean Research and Development Institute (KORDI) and Korean Meteorological Administration (KMA).

Status of implementation:

1.1. Floats deployed and their performance

- KORDI deployed 18 floats (13 APEXs, 5 PROVORs) in November and December, 2005. All floats are stable, 3 in the Drake Passage, 5 south of Australia, 10 in the East/Japan Sea.
- KMA deployed 15 APEX floats in September and October, 2005: 5 in the East/Japan Sea and 10 in the North Western Pacific. All floats are working properly at present.

1.2. Argo data management

Data issued to GTS

- Within 24 hours of data collection KMA float date are issued to GTS by KMA.
- Within 24 hours of data collection KORDI float data are issued to GTS by CLS in France by an arrangement between KORDI and CLS, but some delays are reported.

Data issued to GDACs after real-time QC

- RTQC system at KORDI is flexible enough to handle data from different type of profilers. Prior to communicating the ARGO datasets to GDAC, the KORDI ARGO dataset is processed by CLS, France for dissemination to GDAC.
- 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 suggestion in the 6th ADM and Argo quality control manual ver. 2.1, and user's manual ver. 2.1.

Data issued for delayed QC

- The KODC is working for delayed QC, following the Wong's method. KORDI has been developing delayed mode QC schemes and salinity calibration methods for data obtained in the East/Japan Sea. Data with delayed mode QC will be distributed next year.

Funding and deployment plan:

-The METRI/KMA has secured the fund for the year of 2006 with a plan to deploy 5 floats in the East/Japan Sea and 10 floats in the North Western Pacific in 2006. KMA has a plan to continue the current project until 2011, but funding is subject to annual evaluation. KMA Argo project is under a strong pressure to show that Argo data are useful to improve the weather service in Korea.

- KORDI will deploy about 15 floats in 2006. Since the first target of Argo program is to deploy 3,000 floats in the world oceans for 2001-2006, KORDI has a fund for same period of 2001-2006. An action at the international level is strongly required to continue funding beyond 2006.

Research and operational uses of Argo data:

- Argo data has been used for data assimilation in the East/Japan Sea, North Pacific and global oceans. Researches on statistics of inertial motions, upper ocean response to tropical storms and fisheries are supported by the Argo projects. KMA has a strong interest in Argo program with a long-term goal of developing an operational ocean forecast system.
- Korea Ocean Data Center (KODC) plays a pivotal role in maintaining the ARGO DMDB.

REPORT ON THE ARGO MEXICAN FLOATS PROGRAM

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

The incursion by México in the ARGO program is, at this time, practically symbolical. Thanks to a donation (float WMO 1900377) by the Instituto Español de Oceanografía via Dr. Gregorio Parrilla, there is one float attached to the Mexican national program. This float was shipped to Mexico and deployed within the Mexican EEZ with CICESE's funding. In addition, there is a separate Mexican participation in a joint USA_Colombia_Mexico program, although such float did not work after deployment.

1. Status of implementation. One Float (WMO 1900377), from its deployment, May 4, 2005, until today has produced 25 profiles of which the last 6 are 'touching' bottom. In fact, the last 4 profiles are for depths shallower than the parking depth of 1000 db (971, 424, 458 and 261 m). There is no near future (4 months) recovery/redeployment possibility.

2. Funding level and human resources. There is no commitment for funding in 2006 and at present, there are only two researchers directly involved in the ARGO program: Dr. Armando Trasviña in the USA_Colombia_Mexican joint venture and myself.

3. No future deployment plans exist.

4. There have been no specific uses of the ARGO data.

5. A group of Mexican marine researchers (about 30 in the mailing list) is making progress towards unifying ideas and finding ways to participate in GOOS related issues, including the ARGO program.

New Zealand National Report 2005

NIWA is the New Zealand participant in Argo. NIWA has purchased roughly 2 floats per year, and will purchase 2 further floats before June 2006. It is expected that we will continue to purchase and deploy 2 floats per year.

We have also deployed floats for other providers and are collaborating on large deployments in the Pacific (with University of Washington and Scripps Institution of Oceanography) by contributing towards vessel costs.

New Zealand's floats

NIWA has purchased 8 floats and deployed seven to date. The remaining float will be deployed in March 2006.

NIWA's floats are administered by Scripps Institution of Oceanography and information about them can be found at: http://sio-argo.ucsd.edu/.

Float summary (as of 3/11/2005):

SIO id	WMO id	# profiles	deploy date	lat	lon	last prof date	lat	lon	status
2463	5901028		23 Oct 2005	41.62 S	179.28 E				tst
2332	5900632	47	08 Aug 2004	30.86 S	167.74 E	29 Oct 2005	31.22 S	166.73 E	act
2331	5900631	47	05 Aug 2004	32.53 S	171.82 E	27 Oct 2005	36.10 S	174.08 W	act
2138	5900206	109	02 Dec 2002	34.24 S	165.13 E	26 Oct 2005	33.39 S	173.12 E	act
2137	5900205	109	01 Dec 2002	34.34 S	169.44 E	26 Oct 2005	32.36 S	174.16 E	act
2042	5900109	32	17 Sep 2001	31.45 S	171.01 E	02 Aug 2002	28.17 S	169.09 E	ndg
2039	5900106	130	16 Sep 2001	32.35 S	170.00 E	09 Apr 2005	36.80 S	177.31 W	npr

Status (float)*
act: currently active
tst: test complete
ndg: No Diagnostics reported from this float
npr: Float has not returned profile data in atleast one cycle

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 have poor float coverage and limited deployment opportunities from commercial vessels. In February 2003, eight Scripps Institution of Oceanography Argo floats were deployed southeast of New Zealand during a Japanese charter of R/V Tangaroa. Four floats were deployed during a R/V Tangaroa transit to Antarctica for NOAA/PMEL in February 2004.

Collaboration in deployments
NIWA has funded 15% of the vessel costs of R/V Kaharoa deploying floats for University of Washington and Scripps Institution of Oceanography. A summary of the voyages is as follows:

NIWA/UW/SIO Argo `deployment voyages

1. **Wellington-Valparaiso.** R/V Kaharoa. Feb 2004. 61 floats deployed (35 SIO, 26 UW).

2. **Wellington-Tahiti.** R/V Kaharoa. July 2004. 80 floats deployed (40 SIO, 40 UW)

3. **Wellington-Wellington (southern ocean).** R/V Tangaroa. March 2005. 45 floats deployed (25 SIO, 20 UW)

4. **Wellington-Hawaii.** R/V Kaharoa. April 2005. 60 floats deployed (40 SIO, 20 UW).

5. **Wellington-Valparaiso-San Diego.** R/V Kaharoa. October 2005. (Currently underway) 134 floats to deploy (67 SIO, 67 UW).

6. **Wellington-Freemantle-Mauritius.** R/V Kaharoa. Planned for 2006. ~100 floats to deploy.

Argo Norway

Institute of Marine Research (IMR) in Norway is so far, as we know, the only institute in Norway that have deployed Argo floats. We have deployed nine Argo floats (Apex type) in the Norwegian Sea. Three floats were deployed in June 2002 and six floats in August 2003. All floats are drifting at 1500 m depth, in deep water masses. The parking depth at 1500 m depth was chosen due to the bottom topography for the area. The CTD-profiling is performed from the parking depth at 1500 m depth to the surface every ten days. There are no other sensors than pressure, temperature and conductivity on the floats. Except for one float that was deployed in 2002, the floats are still operative. All floats have worked well giving good data and new insight of the current patterns. The nine floats were all funded by our institute. However, 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 will be done in other financed projects.

Regarding the "Delayed mode" we have in the past not done anything special with that. However, just recently we made 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. Unfortunately we do not have any high-resolution data in the vertical.

At present, we have ordered two new Argo floats (APEX), that were funded by our institute, that will be deployed in the Norwegian Sea next year, probably in March. Both these floats will also, in addition, include fluorescence and oxygen sensors. At present we have only written popular science articles and no peer-review publications.

Positions of IMRs nine Argo floats, updated 4 Nov 2005

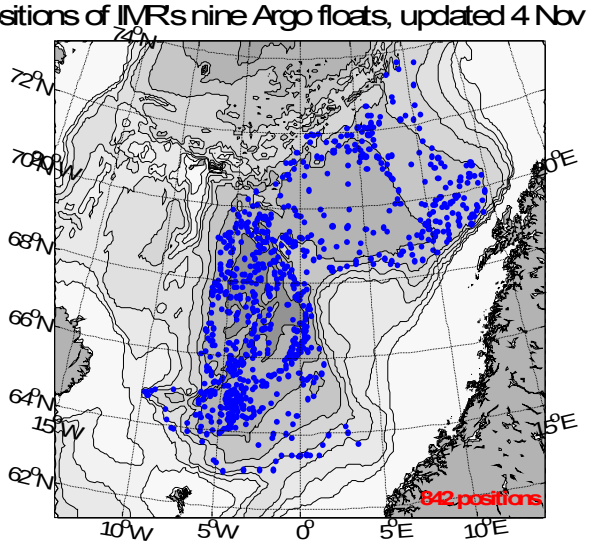
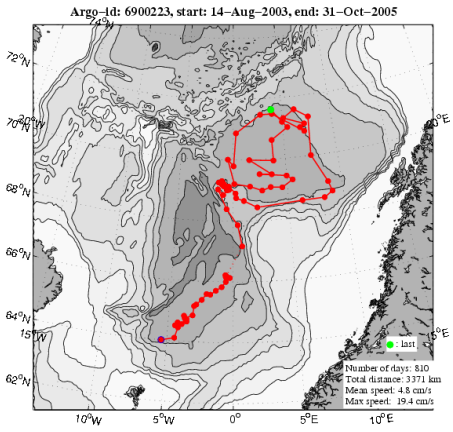
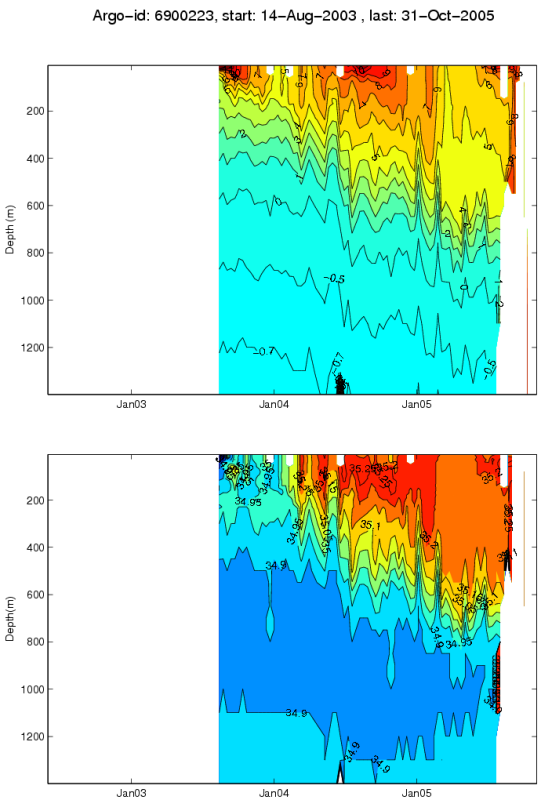


Figure: Example of drift, temperature and salinity for one of the IMR's Argo floats.





Spanish ARGO National Report for AST7 meeting

Submitted by Gregorio Parrilla-Barrera

The PROVOR profiler (WMO-ID 1900377), transferred to Mexico, it was deployed by J.L. Ochoa (CICESE; México), last May, in the eastern subtropical North Pacific. Another one (490556) has been deployed in W. Mediterranean last March. The two ones transferred to Costa Rica (1900378 and 1900379) has been deployed in December.

The status of those deployed in 2003 and 2004 is as it follows:

APEX profilers WMO ID 1900275 through 19200279 only transmit position not T/S records. The rest are working properly.

One Apex profiler has been acquired to be deployed next year in the eastern subtropical North Atlantic.

We have submitted to the IEO Direction a plan to deploy at least 2 profilers per year.

Institut de Ciencies del Mar-CMIMA-CSIC is leadering a project ((CANOA, PI: José L. Pelegrí, (pelegri@cmima.csic.es)) to which Coriolis has financed 7 PROVOR floats to be deployed from Gibraltar to Cabo Verde Island in 2007.

Both, IEO and CMIMA (involved in MedARGO) dedicate atound 2 manmonths/year to ARGO

We have still problems atracting a wider community to become Argo data users.

WE suggest to the appropiate Argo office to be attentive to the development and outcomes of the next ABE LOS meeting , to be held next April in Málaga (Spain), since they are dealing with “Practical guidelines for (i) the deployment of floats in high seas which may drift into Exclusive Economic Zones; (ii) the deployment of floats and surface drifting buoys into Exclusive Economic Zones; (iii) the deployment of XBTs (Expandable Bathy Thermograph) by ships of opportunity into Exclusive Economic Zones”

The following publication has made use of the Argo data:

Vargas-Yáñez, M., Gregorio Parrilla, Alicia Lavín, Pedro Vélez, César González-Pola, Alonso Hernández-Guerra. 2005. Eddy-induced variability in a transatlantic section: Argo Observing system-Gyroscope 0302 cruise comparison. Journal of Atmospheric and Oceanic Technology. Vol. 22, Nº 7, 1066-1076)

UNITED KINGDOM ARGO PROJECT

REPORT FOR ARGO SCIENCE TEAM 7TH MEETING, JANUARY 2006

UK Argo Project

The UK's contribution to Argo has been funded by the Department of the Environment, Food and Rural Affairs (Defra), the Ministry of Defence (MoD) and the Natural Environment Research Council (NERC), and undertaken by a partnership involving the Met Office (who also manage the project), the National Oceanography Centre Southampton (NOCS), the British Oceanographic Data Centre (BODC) and the UK Hydrographic Office (UKHO).

The UK Argo Project was initiated in 2000 and the programme is in the final year of its project phase, during which time funds have come from the R&D budgets of its sponsors. Both Defra and MoD have indicated that if the UK contribution to Argo is to continue then different funding streams will be required.

Floats deployed

Over the last 6 years UK has deployed some 180 (Argo and Argo-equivalent) floats as shown in the table below.

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

Table 1. Numbers of UK floats contributing to Argo deployed by year, figures in brackets are floats donated to Mauritius.

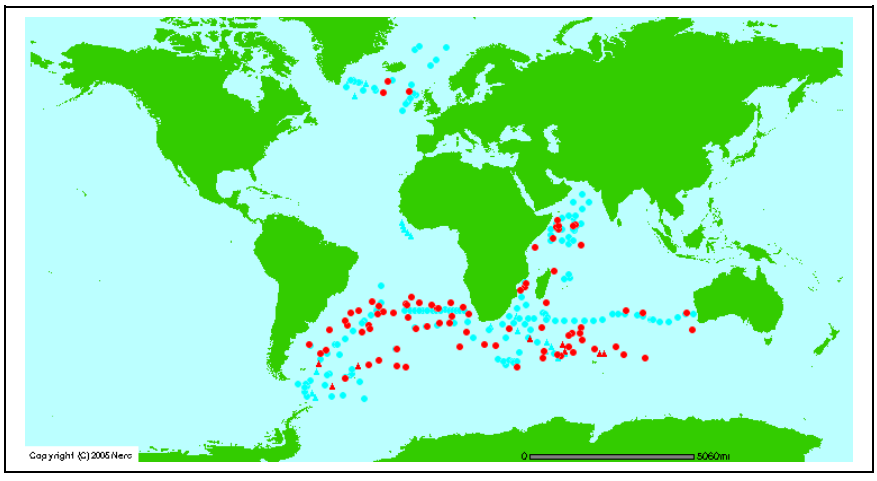


Figure 1. (Left) present distribution of operating Argo floats and (right) locations of deployed (●) and currently operating (●) UK floats.

As can be seen from Figure 1 the majority of UK floats have been deployed in the Southern Hemisphere with the aim of supporting building the global array. Of the floats deployed 20 floats have been MARTEC PROVORs while the rest have been Webb Apex.

Float performance/technical problems

In 2002 and 2003 a number of our Apex floats failed early due to the motor backspin (2002) and the pressure transducer (2003) problems. Both these problems have been rectified with a subsequent reduction in early failures. Our MARTEC PROVOR floats were all fitted with FSI salinity sensors. The early PROVORs (2001, 2002) suffered from a problem in which the salinity exhibited a major jump and offset. Explanations were possible movement of the flotation collar and problems due to contamination by the antifouling coating. Our PROVORS deployed in late 2004/early 2005 had the coating removed and 9 of 12 of these floats are presently operating satisfactorily. See Appendix A for figures on UK float performance.

Following the float failures in 2002 and 2003, UK Argo increased its technical support at the Met Office and in 2004 a technical collaboration with CSIRO Marine was initiated. All Apex floats received in the UK are now bench-tested before deployment. In collaboration with CSIRO an engineering web-site (http://www.cmar.csiro.au/argo/tech/) for UK and Australian floats has been established to help monitor the performance of deployed UK (and Australian) floats.

Deployment plans

As at end December 2005, we have in our inventory 23 floats (18 Apex and 5 PROVORs). In addition we expect a further 44 Apex floats to be delivered in early 2006. Deployment plans are as shown in Table 2.

Floats for which deployments are arranged	
Southern Ocean	*6 Apex floats to be deployed from SA Agulhas*
South Indian Ocean	*6 Apex floats to be deployed from RV Boris Petrov*
Somali Basin	*2 Apex floats to be deployed (VOS)*
Mauritius	*2 floats*
Floats for which deployments have not yet been arranged	
South Indian Ocean	*4 Apex floats*
North-east Atlantic (Iceland Basin)	*4 Apex floats*
North-east Atlantic (26N)	*4 Apex floats*
South-east Atlantic	*4 Apex floats*
Southern Ocean	*6 Apex floats*
Weddell Sea	*4 Apex floats*
Arabian Sea	*5 Apex floats (VOS)*
Somali Basin	*4 Apex floats (VOS)*
tbd	*5 Provor floats*
tbd	*11 Apex floats*

Table 2. Floats available for 2006 and outline deployment plans.

Data management

Real-time data (GTS). Data from all working UK floats are issued to GTS in WMO TESAC format by CLS/Meteo-France for our older 20-bit Apex floats and for our newer (28-bit) Apex and PROVOR floats by Coriolis/Meteo-France on receipt of the netcdf files from BODC. All

float data received over GTS are assimilated into the operational ocean prediction system FOAM (Forecasting Ocean Assimilation Model) run by the National Centre for Ocean Forecasting (NCOF) and also used in the GLOSEA (Global Seasonal) coupled ocean-atmosphere general circulation model for seasonal forecasting run at the Met Office. GTS remains the primary mechanism for receipt of real-time data (float data, ship date etc) used in ocean forecasting.

Comparing the number of UK floats reporting on GTS with the number on the GDACs (processed by BODC) it looks as though the number tends to vary between 90 and 95%. And in not all cases are all 3 profiles received each month from each float, so the actual data return is lower. There are also a number of partial profiles issued to GTS by CLS (through Meteo-France), where the full profiles exist on the GDACs. There are also delays in issuing the data for the Provors and the newer 28-bit Apexes, since the TESACs are generated by Coriolis from the netcdf received from BODC, then sent to Meteo-France for GTS insertion; and some appear to be missed. Therefore, consideration is being given to the development of a system to issue UK float data to GTS (in TESAC format and migrating to BUFR) through the Regional Telecommunications Hub (RTH) at Exeter (EGRR).

UK Argo Data Centre.

(i) Real-time. The UK Argo Data Centre, established at BODC, (see http://www.bodc.ac.uk/projects/international/argo/), processes all our full-resolution float data. An automatic processing system is in place to download the raw (hexadecimal) data, generate the netcdf in real-time and send to the GDACs. The data are also available over the web via an interactive map interface.

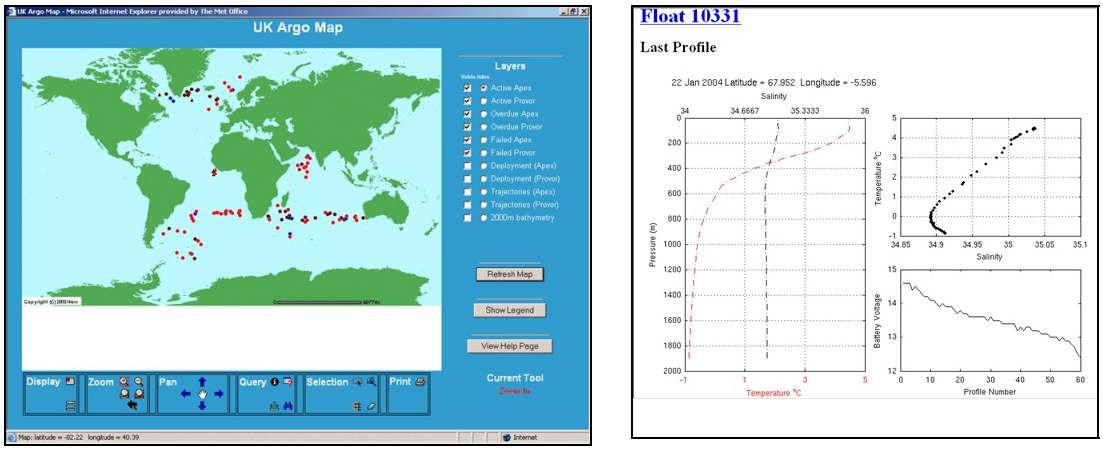


Figure 2. Example of web interface for UK float data on the UK Argo Data centre web-site.

(ii) Delayed-mode. The WJO software has been installed at BODC and is being used in the delayed-mode QC process. At present only a small amount of delayed-mode data (10 floats, 395 profiles) have been submitted to the GDACs although all 22 South Indian Ocean floats, deployed in 2002, that have produced valid profiles have been processed and should be submitted early in 2006.

(iii) Southern Ocean Regional Data Centre (SORDAC). The SORDAC is a collaborative effort between BODC and CSIRO, and during 2005 an improved SORDAC web-site was introduced (http://www.bodc.ac.uk/projects/international/argo/southern_ocean/) which includes monthly Southern Ocean FOAM products from NCOF (see example below). Work continues to compile CTD data to improve the reference climatological data for the region.

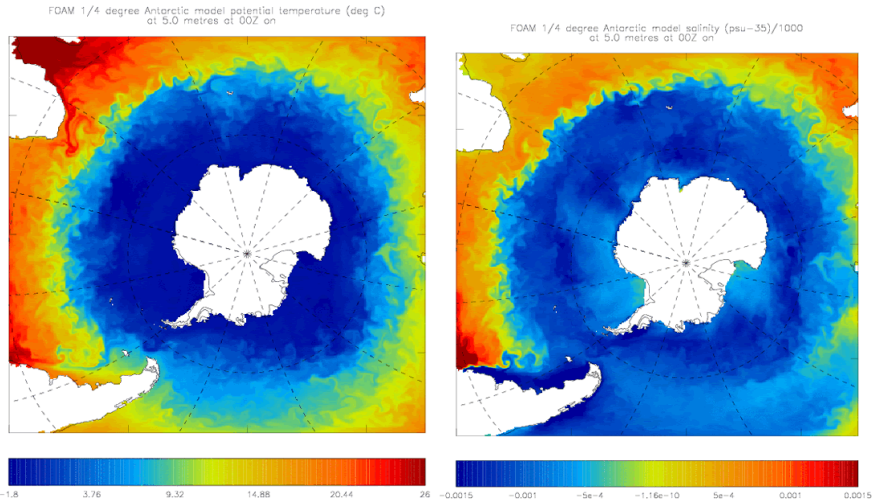


Figure 3. Examples of Southern Ocean FOAM products (5m temperature (left) and salinity (right)) available on SORDAC web-site.

Operational and scientific use of Argo data

Operational ocean forecasting. As noted earlier all Argo data (alongside other in-situ and remotely sensed ocean data) are assimilated into the FOAM operational ocean forecasting system (see http://www.ncof.gov.uk/products.html) run by the NCOF. Assessments have demonstrated the impact of Argo data on FOAM predictions, giving a significant improvement in the accuracy of the analysis for the top 1,000m of the ocean. In particular the assimilation of collocated temperature and salinity significantly improves the salinity analysis. Argo data also enables the model to validated (especially for salinity). Also Argo data have been used to improve and validate the mixed layer model used in FOAM.

Seasonal forecasting. The Met Office's seasonal forecast system produces a forecast out to six-months ahead once a month using a coupled atmosphere-ocean general circulation model. Initial conditions are provided by an ocean analysis. Data-withholding experiments have been carried out for the period 2000-2004 and show the benefits of the Argo data on the system. Although the 5 year retrospective period is short in terms of accounting for the variability in forecast skill, a more general assessment of predictability of ocean heat content shows a positive benefit for all lead times and forecast seasons from forecasts initialised using Argo data. In particular the global coverage of Argo data acts to remove biases in the analysis resulting from XBT data and the ocean model /atmospheric forcing.

Argo data were also used in examining temperature anomalies for the North Atlantic during 2005 and provided further support for a negative North Atlantic Oscillation mode during the 2005/06 winter, and for the forecast issued in October of a two in three chance of a colder-than-average (and drier-than-average) winter for much of Europe. This forecast has attracted considerable national and media attention in the UK.

Climate monitoring and prediction. Argo data are also being used for ocean climate monitoring (e.g. ocean heat content) and will be used 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.

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). Work will be presented at the 2nd Argo Science Symposium in March 2006 – 12 abstracts from UK scientists have been submitted.

Resources and future funding

As noted earlier the UK Argo Project has been funded by Defra and MoD (through the Met Office) and by NERC (NOCS, BODC), in addition MoD also funds support from UKHO. Overall the level of support is as shown in the table below (includes an additional £105K Defra funding confirmed mid-December 2005). As indicated in the table Defra and MoD funding for 2006/07 cannot yet be confirmed.

	2003/04	*2004/05*	*2005/06*	*2006/07*
Defra	*£300k*	*£300k*	*£405k*	*tbc*
MoD	*£300k*	*£300k*	*£250k*	*tbc +£50k**
NERC	*£346k*	*£269k*	*£353k*	*£256k*
UKHO (MoD)	*£18k+*	*£18k+*	*£18k+*	*tbc*
Total	*£964k*	*£887k*	*£1026k*	

* deferred from 2005/06
\+ 0.3 m-y for data processing (estimated at £60k /m-y)

Table 3. UK Argo funding 2003/04 to 2006/07.

The breakdown of funding for 2005/06 is as shown below.

Met Office

Programme management and technical support	£118k*
Application research (Hadley Centre)	£54k
Floats	£511k
Communications (Argos)	£36k
Data processing (BODC)	£43k
Technical support (CSIRO)	£32k

*includes support for the JCOMMOPS Argo Information Centre
Note figures do not match Table 3 as unspent funds in earlier years have been carried forward

NERC

Scientific support (NOCS)	£50k
Data processing (BODC)	£116k
Floats (AFI – Argo equivalent)	£20k
Science research (RAPID, COAPEC, AFI)	£200k
In-kind support for the Argo Project Director	

Issues

The biggest issue facing the UK (and many other Argo countries) is in securing longer-term funding to sustain the Argo array, even though we have already demonstrated benefits from Argo and anticipate further significant benefits from a full array. Despite the fact that Argo has been remarkably successful in growing from a small number of floats at the end of 2000 to around 2,250 (75% of target density) by the end of 2005, it is proving difficult to secure ongoing funds to sustain a UK contribution to the array. This is a problem in the UK

because there is no mechanism for the transition of a system from its research phase when funding is relatively short term and justified on research grounds, to a sustained (or operational) status when longer-term funding commitments are required.

The issue of longer-term funding for UK Argo (at around £1M per year) has been recognised by both the Inter Agency Committee on Marine Science and Technology (IACMST) and the Global Environment Change Committee (GECC), as Argo is recognised as being a key component of the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS) and is specifically mentioned in the GEOSS Implementation Plan to which the UK has made a high profile commitment (Defra minister Lord Whitty in February 2005). Efforts continue to secure continued funding to sustain the UK programme, however at this time the level of funding for FY06/07 and beyond cannot be confirmed.

Appendix A: Reliability for UK floats deployed between 2001 and 2005

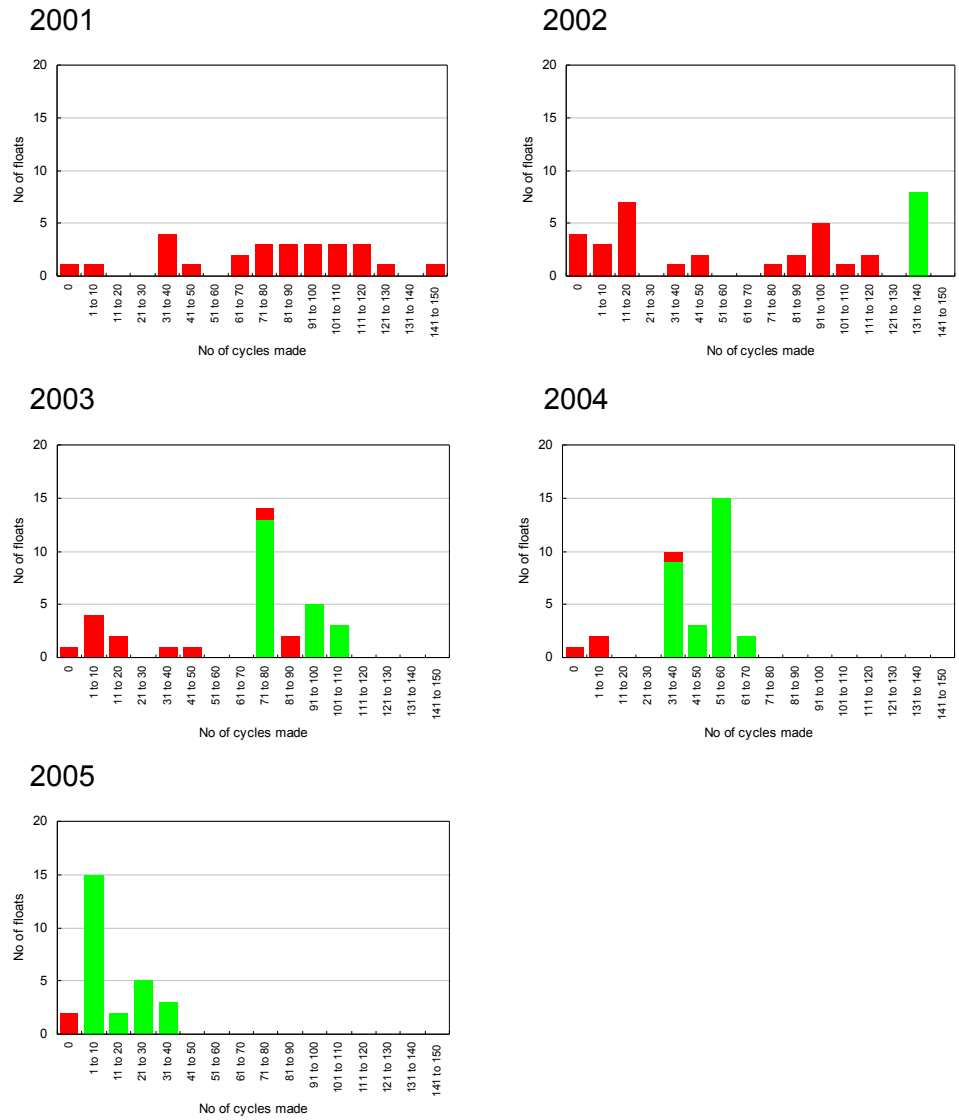


Figure 2. Showing the numbers of cycles completed by active (green) and dead (red) Apex floats grouped against year of deployment. Figures exclude floats where deployment failure has been confirmed.

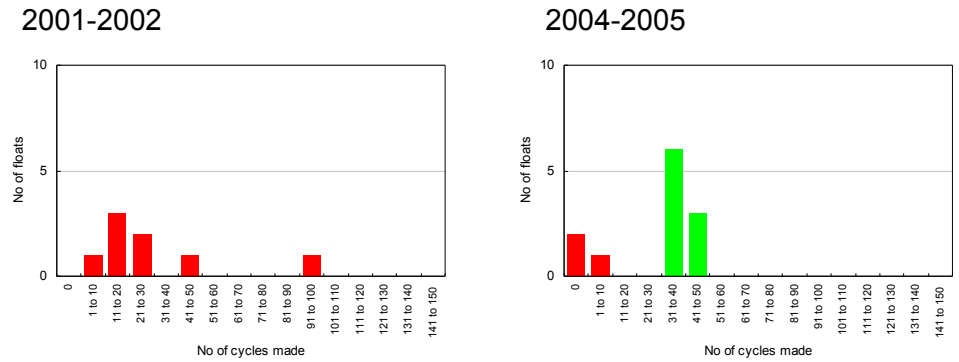


Figure 3. Showing the numbers of cycles completed by active (green) and dead (red) Provor floats grouped against years of deployment. Figures exclude floats where deployment failure has been confirmed.

USA Report to AST-7, Hyderabad India, January 2006
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), the NOPP/Argo project is now in the final year of a five-year full implementation phase 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 five-year full implementation phase of U.S. Argo will end in mid-2006. A request for proposals was published for the next five years of U.S. Argo implementation (see http://www.grants.gov). The outcome of the competitive solicitation, including the selection of P.I.s and institutions to carry out the next phase of U.S. Argo, will be determined in early 2006.

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, and 410 in FY05. A similar number is anticipated for FY06.

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 December 20, 2005 there are 1171 active U.S. floats (Fig 1), including 1079 from U.S. Argo float providers (SIO, UW, WHOI, PMEL) plus 92 Argo-equivalent floats provided by partnering programs. During 2005 there were 488 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.

A major focus of the U.S. effort in 2005 has been to help fill remaining gaps in global Argo coverage, and to increase float density in the tropics and sparsely sampled regions. The majority (308 out of 488) of U.S. Argo float deployments this year were in the Southern Hemisphere. Many were deployed by New Zealand research vessels

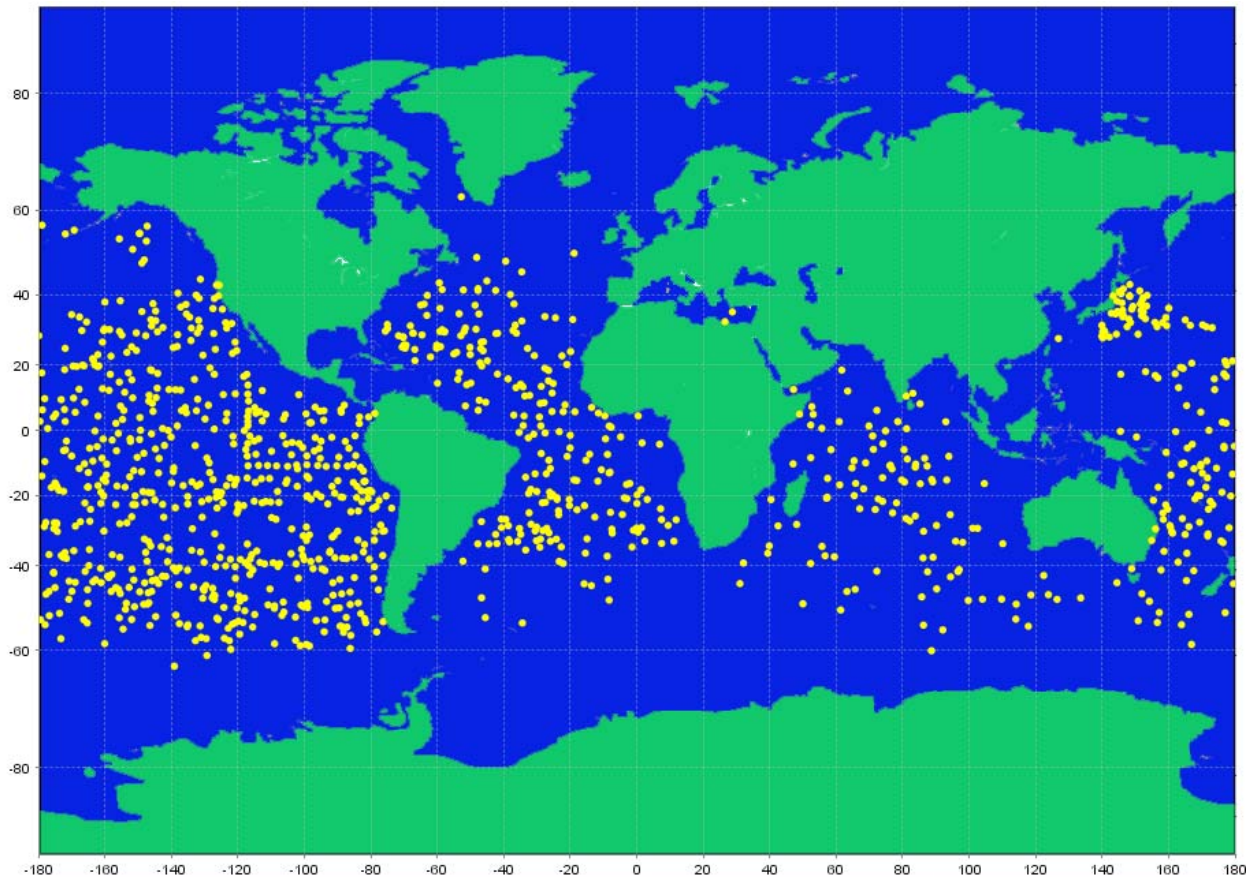


Fig 1. Positions of U.S. Argo profiles during a 12-day period, December 2005 (AOML).

through a joint agreement between the U.S. and N.Z. Argo programs (see N.Z. National Report). Out of 1173 Argo floats presently active in the Southern Hemisphere, 62% (728 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, with high priority regions including tropical and western subtropical oceans and the Southern Ocean. Specific plans for 2006 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 ruggedness and reliability, and improved performance. Ongoing improvements in reliability have been demonstrated in the past year. A technical workshop for APEX users was hosted by U.S. Argo in Seattle in September 2005. During 2006 a substantial number of deployments are planned using 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 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 technical workshop on delayed-mode quality control was hosted by U.S.

Argo in San Diego in April 2005. Following the recent agreement on protocols for delayed-mode quality control, 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 Regional Data Assembly Center (RDAC) activities, including AOML's role as focus for the South Atlantic RDAC (http://www.aoml.noaa.gov/phod/sardac/).

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 the abstracts submitted to the Second Science Workshop. 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.

However, a significant structural issue in U.S. Argo is the lack of funding targeted specifically at Argo research (or even more broadly at research based on the sustained ocean observing system). The lack of targeted funding is possibly seen in the fact that less than 25% (30 out of 138) of abstracts submitted to the Second Science Workshop are from U.S. authors – a substantial response but not an overwhelming one. For the next five-year phase of U.S. Argo, a strong focus should be on increasing the size of the Argo user community.