9th meeting of the
International Argo Steering Team

Exeter, United Kingdom
March 18-20, 2008

Contents

Meeting Summary

The 9th meeting of the international Argo Steering Team was held in Exeter, United Kingdom on March 18-20 2008, hosted by the UK Met Office.

1 Welcome and introduction

Jon Turton welcomed the Argo Steering Team to the UK Met Office. Local arrangements were discussed and a tour of the Met Office was arranged for the following day.

Action item 1: H. Freeland to send letter of thanks to Jon Turton and the UK Met Office.

2 Objectives of the meeting

Howard Freeland opened the meeting with a discussion of the current status of the Argo array and some of the challenges Argo is facing. He emphasized that we have accomplished much of the objectives first set forth by Argo and in fact have made a global array. Given these accomplishments, Argo needs to work on refining and improving some areas that still have difficulties to fully reach Argo's capability. The QC needs improvement – both the real time and the delayed mode in order for users to be able to use the data more reliably. Some parts of the array are over sampled, while others are under sampled, so deployment planning and coordination needs to be improved to keep a well sampled global array over time.

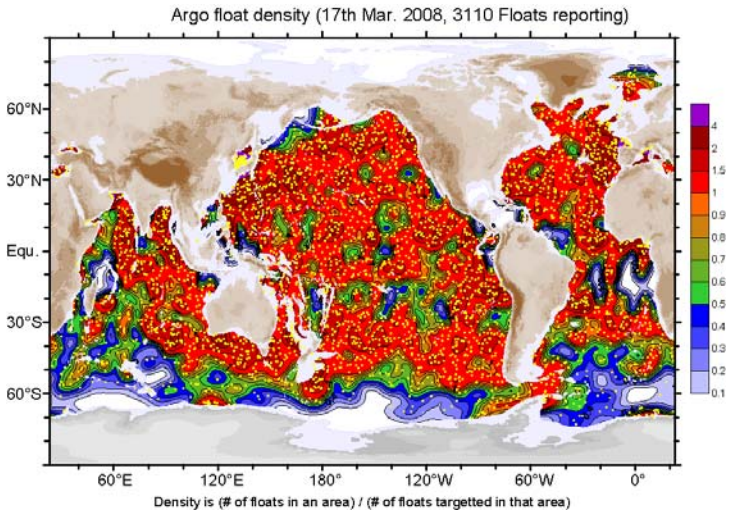

Figure 1: Argo float density

It was fun to celebrate the accomplishment of a 3000-float array in November 2007, and we have achieved a tremendous amount since we started Argo, but a glance at the density map in Figure 1 shows that there are still problems in the distribution of floats. There are large areas in the southern Indian and Atlantic Oceans particularly. The gap in the array in the Gulf of Guinea has opened up during the last few months and there is an area in the western Bering and off the east coast of the Kuril Islands and Kamchatka that is persistently short of floats. How can this be? Why do we have such large gaps when we are well over the targeted number of floats?

One answer lies in the distribution of floats.

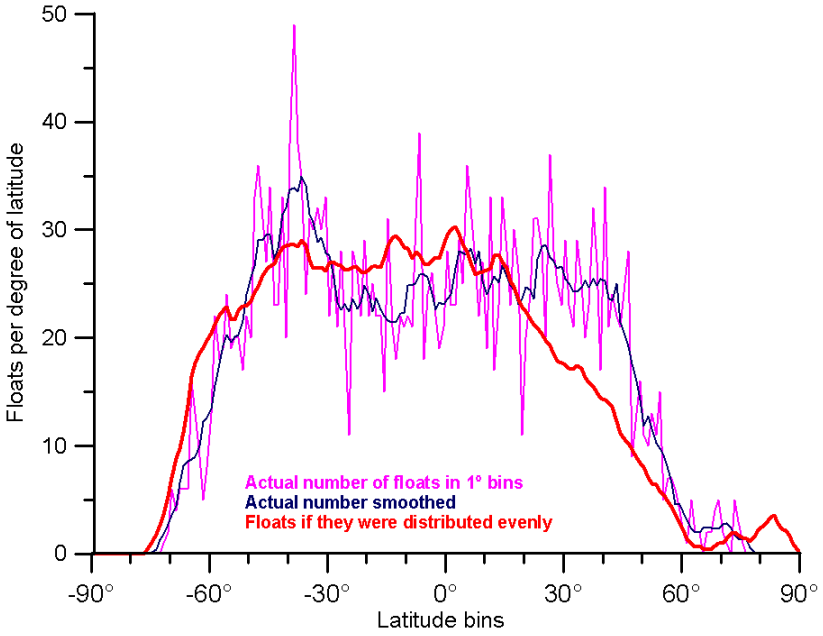

Figure 2: Floats per degree of latitude

In the plot above H. Freeland has examined the number of floats in each 1° latitude bin, the purple line in the background. This is noisy, so a smoothed version is shown by the dark blue line. The positions are taken from M. Belbéoch's file last.txt and include 3110 floats. If we take the number of floats and redistribute them so that all regions of the oceans deeper than 2000 decibars have an equal density of floats, then the red line shows what the distribution of floats should be. Clearly there is a large excess of floats in the latitude range 20°N to 60°N due to the very large float densities in marginal seas. Had this been part of the original Argo design, then we would have needed more than 3000 floats. To achieve the Argo coverage we must deploy fewer floats in the marginal seas and more in the open oceans, particularly in the southern hemisphere.

The other concern is that in fact we have not yet really achieved the 3000-float target, notwithstanding our press releases and celebrations because even though there are 3,110 active floats less than 3,000 are delivering useful data.

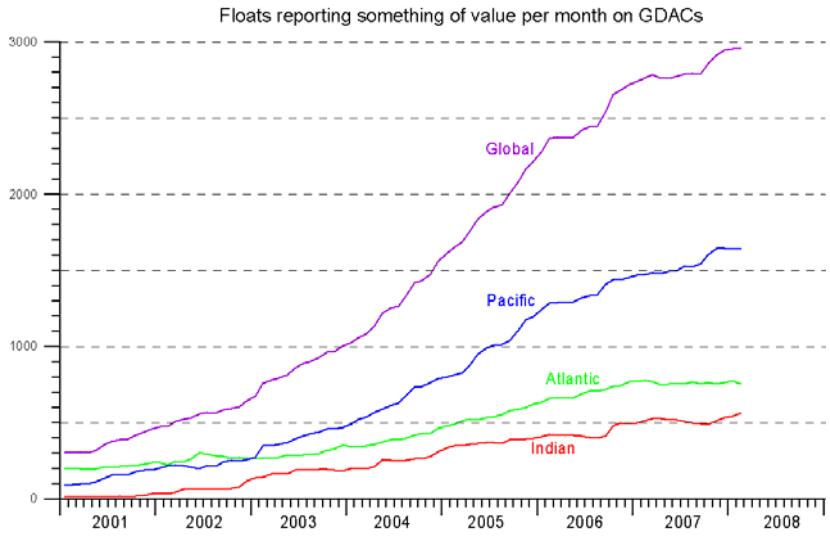

Figure 3: Floats reporting something of value each month on GDACs

The figure above is based on a scan of all CTD profiles presently available on the GDACs. A program simply scans the entire holdings and counts, how many independent WMO-IDs deliver a profile to the GDACs each month, with something, even something very small, of value in the profile submitted. This would have us very close to the 3000-float target but not quite there yet. Perhaps we should be using a different metric to measure our progress towards implementation.

DAC	Total floats>12m old	Total floats>12m old that have been through DMQC	%
AOML	142870	82773	57.9
BODC	13663	4476	32.8
Coriolis	48223	25428	52.7
CSIO	1392	1383	99.4
CSIRO	8720	7039	80.7
INCOIS	11462	8680	75.7
JMA	48467	26870	55.4
KMA	4735	1461	30.9
MEDS	13797	12499	90.6
GTS	23609	0	0
Total	316938	170609	53.8

The table shows a summary of our success to date in reducing the backlog in delayed mode QC. A lot of progress has been achieved but some centres are lagging. During February 2008, new float profiles were being acquired at the rate of 310 profiles/day = 114,000 per year. That yearly rate of acquisition is 67% of the present total number of D-Mode files, which is a worryingly high fraction. Indeed in the last year we have acquired more profiles than we have processed. We do need to start catching up and trying to process files to D-Mode faster than we are acquiring new data.

In summary:

- We have achieved a tremendous amount; we have an array that we can claim is global, but…
- Users need to be able to rely on our QC, and that needs improvement.
- Some areas of the array are actually degrading suggesting long term sustainability of the array is a harder problem than we initially imagined.
- We need to improve deployment planning to reduce the number of floats in over-sampled regions and improve sampling in other areas.
- What are the national prospects for help in maintaining the array?

J. Gould raised concerns about mission creep. He is worried that Argo is beginning to drift from its original mission before successfully completion of some of its first goals. He cited Argo's involvement in ice covered areas, oxygen sensors on floats, and over-sampling in marginal seas as examples of Argo moving onto areas not covered in the mission statement. He suggested creating a new mission statement, in preparation for OceanObs'09 that addresses where Argo hopes to go, while reinforcing its core goals. He also suggested improving the metrics that are currently used to measure Argo's success to better reflect what Argo has accomplished and where it needs to go in order to continue and improve upon a global array that delivers high quality data in real time and delayed mode.

Action item 2: Draft two updated Argo mission statements: one for Argo and one for ABE-LOS purposes. Circulate the statement among AST members for approval. M. Belbéoch to circulate the updated Argo mission statement to ABE-LOS. J. Gould, H. Freeland, M. Belbéoch

3 Action items from AST-8

A selection of action items from AST-8 that were not finished, had little feedback or were relevant to the upcoming meeting were presented. Most items had been completed, and those that were not, are still being worked on by the people responsible.

4 Data management issues

4.1 Feedback from ADMT- 8

S Pouliquen summarized the achievements of the Argo Data Management activities that were discussed at the last ADMT meeting. The complete report can be found at http://www.coriolis.eu.org/cdc/meetings/Argo-DM-report-8th.pdf .

The main problems in real-time have been solved and more than 90% of the floats are distributed on GTS in 24 hours. 2949 floats are reporting data on the GDAC (+216 on grey list). This represents an increase of 10% on active floats compared to last year and an increase of 17% in the number of floats handled at GDAC . The decision to remove the GTS directory from the GDAC (since 15th March) was taken because these data, recovered directly from GTS have poor metadata, unequal quality and are not Argo data per say as they are not processed according to Argo standards. We encourage the PIs who had historical datasets in this directory to work with their DAC to get these data processed and sent to GDAC with required metadata (mainly concerning USA equivalent floats).

Despite constant improvement of the real-time QC procedure, some bad data are still passing through the automatic tests. It will be important to perform real-time consistency test in near-real

time to detect earlier than in delayed mode suspicious floats (PY Le Traon and S Guinehut talks later at the meeting).

Concerning the delayed model processing, more than 50% of the profiles older than 1 year have been processed in delayed mode and we nearly doubled the number of delayed mode profiles in one year. There have been delays because the procedure was not stable until the end of 2007, because DM operators needed training in "difficult" areas such as the Southern Ocean or the North Atlantic because of fronts or high variability of the ocean. There are bad data provided in delayed mode (flags, format, data ,..) and it is important to review the quality of delayed mode data and to organize the delayed mode workshop planned in September to secure the delayed mode processing in a coherent way.

In 2007 all DACs have set up the capability to apply in real-time profile correction with the latest offset provided in delayed-mode.

Both GDACs perform smoothly and the synchronisation process works well and is monitored. The data format checker will be strengthened to stop more format inconsistency and mandatory fields.

No format change plan on profile or trajectory files. Only the Technical file will be impacted when the new nomenclature for technological parameter is finalized.

The constitution of the reference CTD data based is progressing in collaboration between Coriolis, CCHDO and US-NODC and the first version of the Argo reference database will be available by the end of April 2008 as planned at ADMT.

Finally ARC (Regional Argo Centres) are setting up at different speeds with different focuses and there is a need for better coordination and collaboration. This is why there will be, like this past year, an ARC meeting prior to ADMT next October.

The main messages from ADMT to AST can be summarized as follow:

- Real-time processing is automatic and bad data are passing through: important to get tools to detect bad data in the Argo dataset earlier than DMQC
- There are still bad flagging/data in DM files and it's urgent to review the DM dataset. Moreover some training on the method is needed
- Need a leader who can dedicate significant time on trajectory data to steer the work
- Man power is an issue in data management and must be taken into account while setting priorities

Action item 3: A proposal is being drafted by Ann Thresher on new technical parameters to be added to technical files. When the proposal is finished, the AST requests the DACs to review it and make suggestions. When approved by all DACs, the AST requests the DACs adopt it as soon as possible. A. Thresher, DACs

Action item 4: Develop regional data range checks. Need to work on this action item.

Action item 5: DACs and PIs asked to read the monthly AIC float reports and respond to issues relating to their DAC or floats.

4.2.1 Delayed mode QC

An outline of plans for DMQC-3 was presented. The workshop will be hosted by Steve Riser and Annie Wong at the University of Washington, Seattle from 10-12 September 2008, convened by Annie Wong and Brian King. The emphasis of the workshop will be on achieving consistency in DMQC decision making. The following topics will be included for discussion (in no special order of priority):

(1) Centrally-maintained Argo reference database, including Argo data
(2) DMQC tools - OW, SIO GUI, thermal mass inertia correction
(3) SURFACE_PRESSURE correction, especially in APEX
(4) DMQC for TEMP
(5) Review sensor failure modes
(6) Regions of complex/regional oceanography
(7) Assignment of ERROR (from manufacturer, lab calibration, statistical method)
(8) Recording of adjustments in netCDF files
(9) Interaction with RT and regional QC

The workshop does not presently propose to examine DMQC for oxygen. There are a number of PIs working on oxygen QC, and the understanding of how to do QC for oxygen is not yet mature enough to be described to the wider DMQC community. Investigation of oxygen QC should continue among the group of interested experts and PIs.

Pressure: There was discussion of QC of PRES. There are significant issues related to PRES offsets, particularly when negative offsets are truncated in APEX APF8 floats. Further investigation of techniques to assess the identification and impact of lost negative PRES offsets will be undertaken prior to DMQC-3 by a working group led by Susan Wijffels. The intention is to have a firm and revised (relative to DMQC-2) recommendation for DMQC-3 of the circumstances under which PRES should be adjusted to account for surface pressure offset.

The AST encourages each program to send representatives to the upcoming DMQC-3 meeting to improve consistency throughout the Argo delayed mode dataset as this continues to be an issue. To help prepare for the meeting, a folder will be set up on the DACs where delayed mode processors will deposit plots of the suggested OW correction along with plots of the submitted correction and any other documents produced during the delayed mode process that describe thoughts of the processor. This will help identify inconsistencies among processors and can be used as a resource for current and new processors.

It was also suggested that delayed mode processors should test out using Argo in the reference database prior to the DMQC-3 workshop. J. Gilson has created a list of floats for use in an Argo reference database based on criteria he created. He stresses that these criteria need to be examined and perhaps refined based on the results of these tests.

4.2.2 Progress on Argo Reference Database

There has been a fair amount of progress in the effort to increase the number of CTD profiles in the Argo delayed-mode quality control database (DMQC-DB). Last November's ADMT-8 meeting provided an opportunity for the main data centers (CCHDO, Coriolis and US-NODC) to work together and form a tri-agency "virtual data center". As a result of this collaboration, a secure web repository is now available for the submission and transfer of proprietary data, and

a data communications and coordination page is in use by the three agencies. New data have been acquired and ingested in the Coriolis database for use in the Argo DMQC-DB.

Many new CTD profiles are expected within weeks to months from some of the larger hydrographic programs, (US- Repeat Hydrography, DIMES, etc.), however, the CTD group would be more effective at getting recent data if the AST were able to provide clear direction regarding the need for CTD data in particular geographic regions. Focusing on fewer strategically located cruises would be a more optimal approach to increasing the number of CTD profiles in the DMQC-DB where there is the greatest need.

Action item 6: The AST encourages its members and their colleagues to submit CTD cruise data for delayed mode calibration purposes to CCHDO. PIs who take CTD data.

Action item 7: The following request will be added into the call for national reports: Each country will be asked for the number and location of CTD cruise data that has been uploaded by PIs within their country to the CCHDO website in the past year. M. Scanderbeg, AST members

Action item 8: The AST requests from the CCHDO global CTD data for delayed mode quality control purposes only (no public release of data until written permission received from the PI), with a first priority of long repeat lines. CCHDO / S. Diggs

4.2.3 Use of Argo data in a reference database

P.Y. Le Traon presented preliminary results from a study performed by C. Saout in the framework of Coriolis project. The objective of the study was to define new tools to improve quality controls on Argo profiler data in real-time and delayed-mode. This is done by comparing Argo data with Levitus WOD05, a new Argo seasonal climatology (LPO, Ifremer) and objective analysis maps (last 3-month means) produced by the Coriolis Data Center in delayed-mode. Comparison is done globally, per geographical areas and per float types. The calculation of Argo data anomalies in reference of these three sources allows us to detect bad profiles very far from the standard of Levitus climatology or standard of Argo climatology. Argo Climatology (including its standard deviation) seems to provide better results. In the coming months, the method will be applied to the full 2007 year and compared with the results from S. Guinehut on altimetry/Argo comparisons. The objective is then to implement some of these diagnostic tools in the GDAC.

4.3 Report on the first ARC Meeting

No formal presentation was made on the first ARC meeting at AST-9. It was noted that manpower continues to be an issue at some ARCs and that they are all developing at different speeds with different areas of expertise. The Southern Ocean ARC in particular is lacking in manpower and the AST requests JAMSTEC to help the Southern Ocean ARC in doing ARC activities in the South Pacific and its southward extension.

Action item 9: The AST requests JAMSTEC to help the Southern Ocean ARC in doing ARC activities in the South Pacific and its southward extension.

4.4 Status of correction to pressure offset errors in WHOI floats

Significant progress has been on the problem associated with incorrect pressure values from WHOI SOLO floats. The problem can be broken into three categories, (1) floats with SBE CTDs

for which the pressure was misreported, (2) floats with FSI CTDs that reported the pressure values for the top and bottom bins in the engineering data, and (3) FSI equipped floats that only reported pressure for the top bin. For those floats in the first two categories, all the previously submitted raw files have been replaced with corrected files.

The latter category requires considerably more work to correct. After investigating several possible methods, a method was developed that most closely matches the density gradients at the break points between different bin averaging intervals to those computed over large vertical scales. This procedure produces a noisy estimate of the bottom bin pressure that must be manually edited. All of the floats have been processed through this step, but a few problematic floats still have to be uploaded to the GDAC. It was anticipated that these problematic floats could be quickly processed through the DMQC process, but since this no longer appears to be the case, these raw files will be uploaded by the end of March. Uncertainties involved in the pressure estimation procedure have been estimated by applying the procedure to those FSI equipped floats that report bottom bin pressure. There appear to be no significant mean bias and the rms error is approximately 12 dbar. The uploaded files use the ADJUSTED variables to report these adjusted values and the DATA_STATE is set as 'A'.

Delayed Mode QC of all the floats has been accelerated with the addition of Paul Robbins to the WHOI effort. We anticipate that WHOI should be able to treat the backlog of floats within the next six months.

S. Piotrowicz pointed out that the USA deploys most of its floats in the Southern Hemisphere and that both APEX and SOLO floats are deployed in the Indian and Pacific Oceans, but that for the most part only SOLO floats are deployed in the Atlantic Ocean. He suggested this lack of float types in large areas should be addressed by Argo. S. Pouliquen pointed out that some PROVORs are also deployed in the south Atlantic, but that it should be considered when making deployment plans.

Action item 10: Ask that B. Owens supplies the WMO numbers of floats that still have more than 5db pressure errors to be included in document on biases being prepared by the pressure working group. B. Owens

Action item 11: Ask B. Owens to work with J. Willis to qualify this group of floats with large errors and investigate whether this data needs to be flagged as '3'. B. Owens, J. Willis

Action item 12: The AST encourages each basin deployment coordinator to be proactive in acquiring deployment information. Ask Atlantic deployment coordinator to revisit Atlantic (S. Atlantic especially) deployments to fill gaps. Basin deployment coordinator (S. Pouliquen), S. Garzoli, B. Owens, B. King

4.5 Using satellite altimetry data in Argo quality control

Introduction

The main objective of this work is to take advantage of the great consistency that exists between Altimeter Sea Level Anomaly (SLA) measurements and Dynamic Height Anomalies (DHA) computed from T/S Argo profiles. The method compares co-located SLA and DHA time series for each Argo float time series and is able to detect systematic or punctual errors in the Argo data sets.

Data and Method
Altimeter measurements are from the AVISO combined maps. Argo T/S profiles are from the Coriolis-GDAC data base acquired around the 12th of February 2008. Dynamic height is calculated using a reference level at 900-m depth and only profiles with QC at 1 are used. An incremental approach has been used for the mean dynamic height which is an essential parameter to calculate anomalies in dynamic height from Argo T/S profiles. First we have used Levitus annual mean climatology and then a contemporaneous Argo climatology which allows the reduction of errors due to inconsistencies between the means (altimeter and in-situ).

Results
Systematic diagnostics have been done for each float time series and an example is illustrated in Figure 4. It shows the time series of a float deployed in the South East Pacific Ocean in March 2004. Part of the data of this float has been delayed mode quality controlled and shows good correspondences with the altimeter time series. At the end of the time series, when values adjusted in real-time are available, they show a constant offset of about 10 cm with the altimeter data. This offset is due to the salinity offset value of 0.092 applied in real-time which is without any doubt over estimated compared to the 0.015 value applied for the delayed mode.

Results obtained for each time series are summarized on Figure 5. In most areas, rms of the differences between SLA and DHA are lower than 80% of the altimeter signal variance. Anomalous floats with much higher values (red dots on Figure 5) can be detected. Looking at each time series, it appears that these higher values are explained by residual errors in the float time series due to systematic offsets (like for the example on Figure 4), very important punctual errors or the drift of one of the sensors (salinity or/and pressure). Using simple statistical criteria based on the correlation coefficient between the two time series and the rms of the differences allowed us to separate the questionable floats from the others.

Specific results for WHOI floats
A specific study has been carried out for the WHOI floats for which different kinds of errors have been detected in the pressure fields. Results show that the method would have been effective at detecting the SOLO/FSI float problems. For the SOLO/SBE floats, the error on the reported pressure (bottom of bin instead of middle of bin) has an impact of the order of 2 to 3 cm on the dynamic height anomalies. The error on this sub-set of floats is only partially detected with the simple general parameters used here which thus have to be more precisely prescribed. For the SOLO/FSI floats, the comparisons of the uncorrected data sets and the corrected ones with the independent altimeter measurements show improvement for a subset of floats but degradation or no improvement for most of them. Results have thus been provided to the PI and new analyses are ongoing.

Conclusions and perspectives
The main conclusions of this study show that SLA/DHA comparisons are very efficient in detecting gross-error, systematic offset or drift in some Argo float time series. These comparisons can be activated in near real-time (a minimum number of cycles are nevertheless required) in order to detect problems before the full delayed-mode quality controls but also as a verification tool after the delayed-mode control to validate it and to quantify its impact. Future plans include a better definition of the statistical parameters of the method and also its activation on a regular basis and the distribution of the diagnostics to the PI's.

Further recommendations
In addition, we would like to propose a list of recommendations which simply could improve the quality of the real-time and delayed-mode Argo data sets:

- If the float has been delayed-mode quality controlled and if it is not correctable, suggest placing it on the grey list if still active;
- If the float has been delayed-mode quality controlled, to carefully verify that no cycle has been forgotten;
- If the float has been delayed-mode quality controlled or adjusted in real-time, the adjusted values have to be quality controlled;
- In order to improve rapidly the real-time quality control, the global range values of the “Global range test” should be replaced by depth dependant regional values (these ranges can be calculated from the Argo data set but values are already available from the WOD);
- All values for POSITION_QC are ‘0’ for BODC floats, does it means that the position is not checked in real-time but also in delayed-mode ?;
- When DATA_MODE=’A’, the three fields PRES_ADJUSTED, TEMP_ADJUSTED and PSAL_ADJUSTED should be defined together even if only one of these fields has been adjusted (salinity for example);
- When DATA_MODE=’D’ and for example the salinity field has been corrected, I will recommend to put PSAL_QC at ‘3’ or ‘4’, it is very often left with values at ‘1’ even if the delayed-mode operator know for sure that the data are not good.

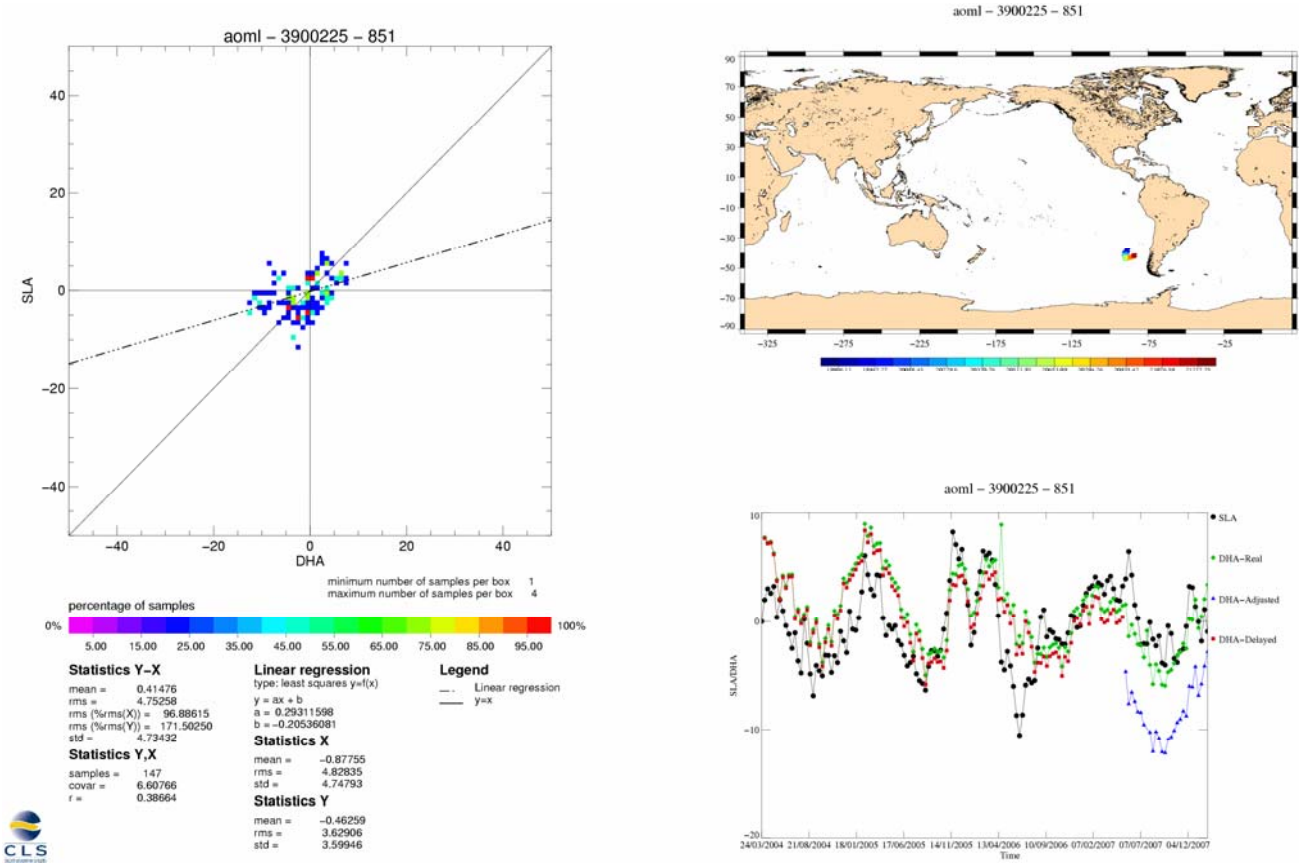

Figure 4 : Geographical position of the 3900225 float. DHA/SLA time series and general associated statistics.

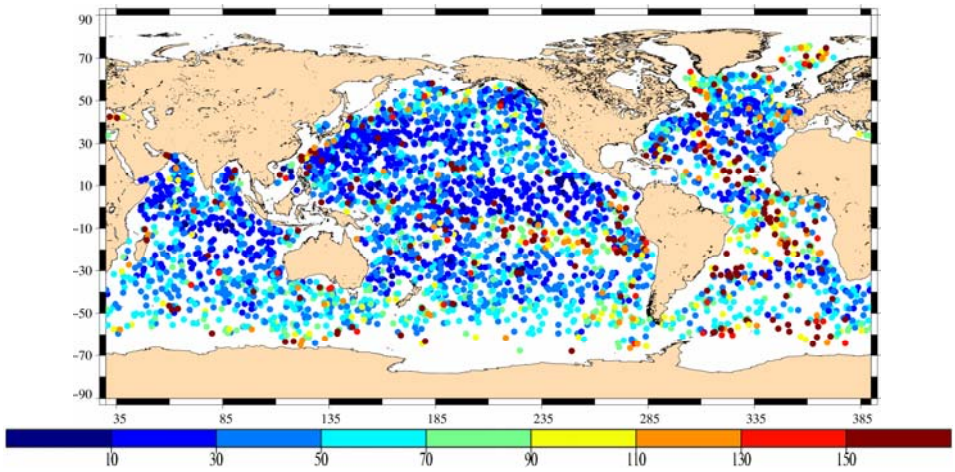

Figure 5 : Each point, at the mean position of each float time series, represents the rms of the difference between the SLA and DHA time series compared to the rms of the SLA signal (in %).

Action item 13: Ask S. Guinehut to work with Coriolis to post the plots she showed of floats with various errors identified using her comparison with altimeter data. Ask M. Belbéoch to identify the PI for each float and ask the PI to look into the issues and report to DMQC3 on results. Additionally, ask Coriolis to work with CLS to routinely generate these plots and to make them available to the Argo community as part of real time consistency checks at GDACs. S. Guinehut, M. Belbéoch, PIs with problematic floats, Coriolis

4.6 Systematic surface pressure error

Shikama

Shikama introduced a paper of Dr. Hiroshi Uchida of JAMSTEC which compared the steric height estimated from CTD, XBT and nearby Argo with the altimetry along the ASUKA line crossing the Kuroshio. The result is telling us that only the Argo data shows a large negative bias of about -10mm compared to the altimeter data. The paper suggests that a systematic pressure error of about -2 dbar can describe such negative bias of steric height. Shikama also introduced another paper of Dr. Uchida which examined the characteristics of Druck pressure sensors for 50 SBE37 CTDs calibrating by the shipboard SBE911 plus CTD systems before and after the long period deep mooring observations. The Druck sensors for SBE37s showed an offset and negatively increasing bias with pressure. Shikama stressed that the pressure tendency of the Druck sensors for Argo should be examined in laboratories or in the field.

Kobayashi

Kobayashi introduced some preliminary estimations on influences of the negative bias of the pressure sensor on the heat and salinity/freshwater contents and the steric height (sea level) in two cases of the offset (-2dbar constant) and the linear (0dbar at surface and -4dbar at 2000dbar). To explain the 10mm difference of the estimations between floats and shipboard CTDs south of Japan, larger negative biases (i.e., -2~3dbar) are required in surface layers. If so, oceanic heat content will be also reduced largely (e.g., 3 * 10^22 J), which may give us the recent “cooling” of global ocean. The ocean cooling and the estrangement of hydrographic steric height from satellite observations started in 2003, which seems consistent with the deployment of the floats with Druck pressure sensors which started in 2002. After 2003, all floats with SBE41 have Druck sensor (the case for JAMSTEC).

N. Shikama's group at JAMSTEC has begun a test to examine the Druck sensor's pressure dependency by simulating real Argo missions. This experiment will take time to carry out, but the results will be useful in helping to understand the Druck sensor issues and how to resolve them.

Willis

A presentation from Josh Willis was shown by S. Wijffels. Using correlations between sea level anomaly measured by satellite altimeters and in situ temperatures on depth surfaces, Josh can generate 'pseudo temperature profiles' from altimetry alone. The correlations are derived based on both Argo data and CTD data. The temperature differences between an observed profile and a pseudo profile can be converted to depth errors using the local temperature gradient, and averaged to look for biases. While the RMS of such errors might typically be 30m, the standard error can be much less than 5db (~1db when averaging 3000 profiles). This method has proved extremely effective in detecting and confirming float cohorts that have significant pressure errors (see Figure 6), as well as detecting fall-rate errors in eXpendable Bathythermographs.

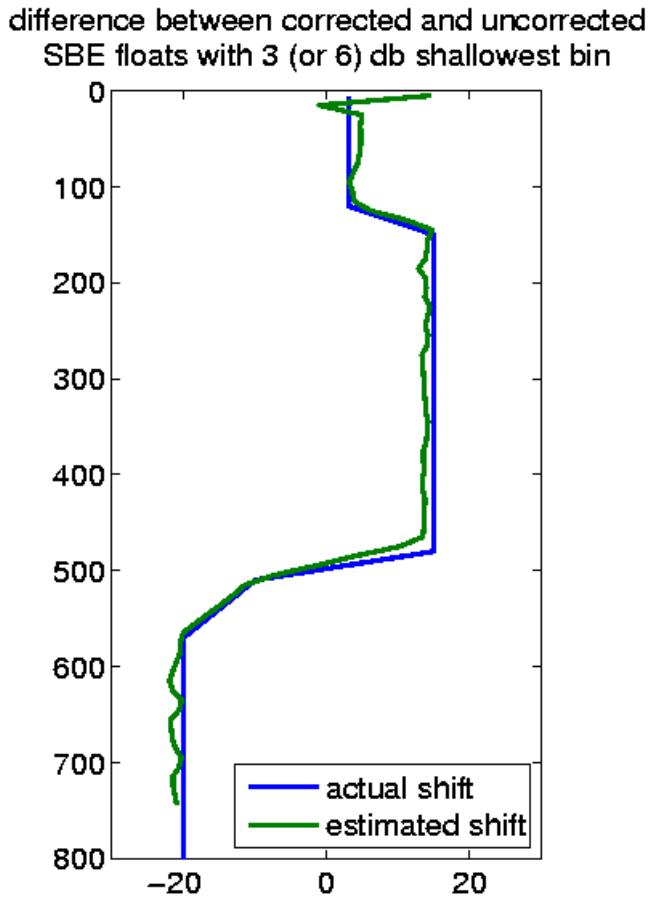

Figure 6 : Depth error in a cohort of SBE WHOI SOLO floats - green, error diagnosed from the pseudo-profile method; blue - actual depth error determined by the PI.

Hence, this method will be useful for detecting Argo pressure biases and can give an estimate of their size as a function of depth. It does, however require substantial averaging - groups of > 200 profiles would need to be averaged in order to reduce the sub-altimetric scale noise in the method. Josh Willis is willing to help Argo in identifying pressure biases using this method.

Barker
S. Wijffels also presented on behalf of Paul Barker and Catia Domingues, who are working on generating the best possible Argo data set for calculating Global Ocean Heat Content. Paul has been correcting Argo pressures from 'raw pressure' using the surface pressures reported in the Argo technical files. He has come across numerous problems – no technical data, a diverse set of names for the same parameter, technical data in the wrong or changing units, mismatched in profile numbers, switches in how the data are stored for one float. Paul has been working with the various DACs over the last year to have the technical files fixed - with mixed success. Some DACs are very responsive and others are not. This underlies the need for the technical names to be standardized and the technical files to be properly populated.

One important aspect from Paul's work is that the surface pressure values reported in the technical files are often noisy – either corrupted by transmission errors or affected by a float 'stuck on the bottom'. DACs are also not consistent in how they treat the 5db added by the APEX APF8 controller board to the reported value.

To deal with the noisy data, a curve-fitting routine is applied to calculate the surface offset rather than using the noisy reported data. Also APEX APF8 floats that report a constant 5db are discarded from the calculation - these floats could have negative drifts that are not assessable/correctable.

In summary, pressure data in Argo floats are not treated consistently by the DACs and this needs urgent attention - accurate global ocean heat content estimates are not possible with the current data on the GDACs since many DACS are not correcting pressure at all. Attempts to do this by a user are being frustrated by technical data inconsistencies or blanks. The truncation in reporting surface pressure by the APF8 controller must be fixed as soon as possible. Also, the controller board on APEX needs to be reported in the meta data files to assist in checks on how pressure data are treated.

Action item 14: Form working group headed by S. Wijffels to look into the various pressure problems and report to DMQC3 or ADMT9. Other working group members: S. Riser, V. Thierry, S. Guinehut, J. Willis, T. Kobayashi. Ask J. Gilson to be involved as well.

Action item 15: Ask the pressure working group to create a historical record of known Argo biases and how they have been fixed. This summary of biases will be posted on the GDACs and AST/AIC websites as a reference for users. Provide clear instructions on how to correct surface offsets in APEX floats and whether this should be done in real time or in delayed mode.

Action item 16: Draft an article for EOS detailing how to use Argo data and known problems with the data. This will expand on the current short users guide previously written by J. Gould. H. Freeland

Action item 17: The AST will write to Webb research requesting a solution to the truncation of negative surface pressure values on the APF8 controller board. Suggest adding an additional measurement of surface pressure. H. Freeland

4.7 Status of trajectory data

Brian King reported on progress towards producing clean and complete files to be used for ocean trajectory calculations.

It was agreed at ADMT-8 that files populated with interpolated and extrapolated positions would be regarded as a 'product' in addition to the traj.nc files submitted by DACs rather than as a substitute for them. The new traj.nc files will have a set of extra variables to include positions, STATUS, QC and ERROR variables associated with the surface position fitting procedure. Brian King presently anticipates having a reasonably complete draft for the entire Argo fleet available to upload to the GDACs by the end of May 2008. The most fundamental information of use to users will be the best estimate of DESCENT_START and ASCENT_END position for each float cycle.

The feasibility of generating this product in real time will need to be reassessed when experience has been gained of producing it in delayed-mode. It may be possible to automate the process for some combinations of float type and mission controller.

Once a robust path has been developed for processing DAC traj.nc files, it will be appropriate to return to DACs to identify and iron out any remaining problems with the filling of _START and _END times, or any other required aspect of traj.nc files, and to define a comprehensive list of format/compliance checks that could be implemented at the GDACs.

Action item 18: B. King is creating a new set of trajectory-like files for the velocity product. When this process is finished, the AST requests that DACs are given clear guidance on how to reprocess old floats to fix the trajectory files. The velocity product should be done in May2008, with help being given to the DACs as soon as possible afterwards. B. King

4.8 Status of oxygen data

Kobayashi
The Oxygen float working group (including all PIs of Oxygen floats and some NDACs) was established by the AST in Oct. 2007 to resolve the inconsistency of Oxygen data between sensor types and T. Kobayashi was called upon to chair the group. Kobayashi suggested the following guidelines to the working group. Unfortunately, there was little discussion among the working group members on this issue before AST-9. The AST encourages further discussion before the oxygen working group reports back to ADMT-9 with results.
SBE Oxygen float: DOXY: raw Oxygen data
Optode Oxygen float: DOXY: raw Oxygen data
DOXY_adjusted: "On shore adjusted" values with the official method prepared by Aanderaa.

- When SBE will prepare a method of "on shore adjustment" for their sensor, the procedure for SEB Oxygen floats will be changed like that for Optode.
- When the method of "on shore adjustment" for Optode will be changed (updated), the above process will follow it.
- It is better that the above procedures are carried out at Real-Time data stream because it is an automatic process (to multiple factors determined by P, S, and T).
- The above procedures are explained in Argo data manuals, and they will be updated as the occasion demands.

Owens
The SeaBird dissolved oxygen sensor has been integrated into the WHOI SOLO float equipped with iridium communications. Three floats, equipped with the latest version of the sensor, have been deployed and one has completed more than 40 cycles. Based on recommendations from

Norge Larson at SBE, we have modeled the drift in the sensor as a multiplicative factor which is similar to that used in the Owens-Wong (OW) calibration procedure for correcting for the drift in the conductivity sensor. The OW software has been adapted to carry out the fit to the oxygen drift and applied to a float launch near Bermuda. The results suggest a 3% constant offset from the initial calibrations which are consistent with a correction that should have been applied to account for the fact that the manufacturer's calibration was carried out in a fresh-water bath. These results are very encouraging and suggest that the SBE sensor performance has significantly improved.

It was noted that more research needs to be done to see if oxygen data can be modeled in a similar fashion to salinity. In other words, work needs to be done to see if there are changes in the vertical direction that need to be addressed as well. A reference database with oxygen data would also need to be developed and maintained in order for this method to work.

4.9 Other potential data streams

There was a discussion regarding including other data types in the Argo data stream. Examples would be oxygen data, fluorometer and other bio-data, glider data, etc. Some of these types of data are already including, while others have not been yet. H. Freeland stated that not only is this an example of mission creep, but that it could be very damaging to Argo if data taken within EEZs that is not in compliance with the law of the seas is being distributed in real time. Argo is hoping to get more guidance following the upcoming ABE-LOS meeting next month concerning the types of data that are considered acceptable for distribution in real time. After the results of this meeting are published, Argo will revisit what types of data should be included in the Argo data stream.

5 Science talks

Dan Lea of the UK Met Office reported on operational uses of Argo data in models such as FOAM. Doug Smith of the UK Met Office reported on using Argo in decadal predictions. Karen Heywood presented on using Argo data to investigate the Julian-Madden Oscillation.

All three PowerPoint presentations can be viewed on the AST-9 meeting site at: http://www.argo.ucsd.edu/FrAST-9_agenda.html

6 Issues arising from National Reports

A variety of issues were raised including concerns about the lack of well coordinated deployment planning, a need for products based on Argo data to help with funding, successful recoveries of beached floats, and funding priorities. Several countries noted that beached floats have been successfully recovered and return has been arranged with the help of the Argo TC, M. Belbéoch. It was also stressed that if countries get back beached floats that are older than one year, they should examine these for calibration purposes rather than immediately redeploying them. Some countries are struggling with the decision to go operational or stay as a research program. Japan was approached with questions regarding what happens to Argo floats when they die which prompted the AST to think about how to address this issue. It was agreed that the Gyroscope environmental statement would be used as a guide for creating one for Argo that could be held in reserve until needed. The issue of buying ship time versus buying more floats was discussed as the USA has decided in the past that ship time will constitute a portion of their budget. Other countries were urged to look at this same issue.

Action item 19: The AST strongly suggests that if given the opportunity to examine a float that has been recovered after being at sea for over one year, this float and its sensors should be studied and not redeployed. PIs who recover beached floats over one year old.

Action item 20: The AST will provide URL for Gyroscope's environmental impact statement and ask AST members us it to craft an environmental statement for Argo that can be held in reserve. H. Freeland to provide URL

7 Regional Activities

7.1 EuroArgo

P.Y. Le Traon gave an overview of the development of the Euro Argo research infrastructure. A preparatory phase (PP) funded by the EC started in January 2008 for a 2.5 year long time period. The PP objective is to develop a long term European contribution to Argo (250 floats/year). This also includes setting up the required coordination and legal structure at the European level. As far as Argo international is concerned, Euro Argo will help to consolidate European contributions to Argo and to attract new European countries. It should also allow us to develop direct long term European Commission funding for floats and coordination (through GMES). EuroArgo, when implemented, will organize the reporting from European countries to Argo international. First phase will already facilitate this reporting. There is also a need to develop a longer term vision on where Argo will go for the next 10-20 years (sensors, sampling) as this obviously will impact the EuroArgo infrastructure definition.

It was requested that EuroArgo deploy floats globally as well as around Europe and that EuroArgo investigate the costs of buying ship time each year. LeTraon agreed that contributing to the global Argo array would be a top priority for EuroArgo and that it would cost out the different ship time options.

Action item 21: The AST encourages the entrainment of more European countries into Argo.

7.2 Argo activities in the Mediterranean Sea

The evolution of the Argo activities in the Mediterranean Sea since 2000 and its status as of early 2008 are reviewed and discussed. A total of 80 floats have been deployed throughout the Mediterranean basin since 2000, providing more than 6000 CTD profiles. Most of these floats have cycles of 5 days, parking depth in 350-650 m, and maximum profiling depth between 600 and 2000 m. The temperature and salinity data provided by the Argo floats are assimilated in near real time into operational numerical forecasting models (as part of the Mediterranean Operational Oceanography Network). Within the EuroArgo program, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) has become the Mediterranean component of the North Atlantic ARC for the coordination of float deployments in the Mediterranean and Black Sea, and the production and distribution of Argo-related products and services. Delayed mode quality control of the Mediterranean and Black Sea Argo data have started in 2008. In addition, demonstration, capacity building and training activities in Mediterranean and Black Sea countries will soon be conducted to increase their awareness about the Argo program and in particular, to enlarge the base of data users and float operators and encourage their contribution to Argo.

8 Technical issues

8.1 Float technology progress

APEX

In the past year there have been several new developments in float technology. Most that will be mentioned are relevant to APEX floats. These include:

(1) As has been noted for several years, APEX floats will perform better and last longer if they are equipped with lithium batteries. Since the float manufacturer will not sell floats with these batteries, it is up to the end-user to purchase and install these batteries on their own. A few Argo groups have successfully made this transition and are now installing their own batteries in APEX floats. Several other groups have expressed an interest in learning how to do this, and to this end an informal workshop on lithium battery installation will be held at UW in Seattle in September of this year (just prior to the DMQC3 Workshop) in order to provide training on lithium battery use.

(2) The APF9 controller that some groups have used in APEX floats will be replaced by the APF10 sometime in the next year or so. This replacement has to do with obsolescence of some components on the APF9, especially on the version used with Iridium communications. The APF10 will be similar to the APF9 in many ways but will have more serial ports and additional memory.

(3) A number of APEX floats have shown air-bladder leaks in the past 12 months, at several different laboratories. These leaks have been traced to a weld that holds the air and oil bladders together. The problem has seemingly been fixed by adding a second weld to the bladder assembly, on the side opposite the first weld. While one or two floats have suffered bladder leaks with the new double-weld bladder, it appears that in general Webb has fixed this problem.

(4) While APEX floats can profile to 2000 m in most places in the world ocean, there are potential problems reaching the sea surface from 2000 m in some cases with floats within about 13 degrees of latitude of the Equator. This has been addressed by adding a canister of N2 gas inside the float which acts as a compressee and provides additional positive buoyancy. The cost of this addition is minimal, approximately US$400 per float. However, the addition of the N2 canister has heretofore made the float unstable at some pressures, specifically near 1000 decibars where most floats are parked. To remedy this, the UW group has experimented with varying the gas pressure in the N2 canister, and this has worked well. It is now possible to park APEX floats equipped with the N2 canister at a pressure of 1000 decibars and to profile from 2000 decibars anywhere in the world ocean without limitation.

(5) Pressure offset errors on some APEX floats. APEX floats equipped with the APF8 controller routinely truncate negative pressure offsets (i.e., the pressure reported when the float is on the surface) to zero. Thus, while there are good statistics concerning positive pressure offsets on APEX, little has been know about the frequency and characteristics of negative offsets. This problem has been known for several years, and at the present time Webb is nearly ready for test deployments of floats with the APF8 controller that remedy this problem. Since the problem does not occur with APF9-equipped floats (there is no truncation of negative offsets), time series of pressure offsets on 270 APEX floats equipped with the APF9 have been examined at UW, and it has been found that the probability distribution of surface pressure errors is nearly Gaussian, with a mean of zero and a standard deviation of about 1 decibar.

Thus, in about 50% of the cases the pressure offset measured by APF8s is being erroneously truncated to zero. The effect of this unknown offset on heat budget calculations and other quantitative estimates is unknown and needs to be examined, since it would appear that perhaps 20% of the Argo array is affected. In addition, the examination of negative offsets on APF9 floats has shown that approximately 5% of the floats have very large negative offsets, perhaps as large as 50 decibars, which are completely unseen and unknown in the APF8 floats because of the truncation. This error is due to an oil leak inside the Druck pressure sensor on SeaBird CTD units. While only a small percentage of floats have this problem, the error is large enough that it might affect ensemble averages of many quantities in potentially important ways.

(6) New sensors on floats. In the past year APEX floats have been deployed with dissolved nitrate sensors (based on the ISUS design previously used on moorings), with more test deployments to come in the next 12 months. So far the results are good and promising. A new suite of sensors supplied by SeaBird capable of measuring high-resolution temperature and salinity all the way to the sea surface has been tested by UW, with the initial results promising. This sensor suite will be useful in validating surface salinity and temperature measurements from satellites, especially in the upcoming Aquarius mission.

Action item 22: The AST recommends testing APEX float air bladders before deployment if possible. S. Riser can provide details on this test process. APEX float deployers.

PROVOR

S Pouliquen presented on behalf of Serge Le RESTE who coordinates the float activities of the Provor technology.

Provor exists in various configurations: Provor-Bio with optical sensors (Transmitto-meter Wetlabs Satlantics Irradiance sensor; deployment March 2008), PROVOR-DO with Oxygen Aanderaa optode (15 operated in Atlantic and south pacific by Chili), PROV-CARBON as contribution to the European project Carboocean (Transmittometer Wetlabs + Optode Aanderaa ; 2 operating) , PROVOR-ULS equipped with an upward looking sounder to measure ice cap thickness and positioned acoustically as a contribution to Damocles European project as a contribution to the International Polar Year (first test at sea in June). Most of these configurations have Iridium transmission.

The Arvor prototype manufactured by Ifremer has worked from December 2006 to December 2007 and has emptied its battery after 186 cycles at 2000m every 2 days with Argos transmission (data on GDAC WMO 6900458). 10 prototypes manufactured by Kannad (formerly Martec) will be deployed by Coriolis in 2008. The Arvor float will be more easily deployable as it weights 19kg instead of 33kg for Provor. The commercialized Arvor will have 24 lithium batteries which will allow

- > 220 cycles, CTD measuring all the time of the ascending profile and 6 hours for Argos transmission
- > 280 cycles, CTD commuted (optional mode) : 10 measurements nearby the pressure point
- > 300 cycles, CTD commuted: one measure at specified pressure point (Apex mode via ARGOS)

If the market exists, an option with alkaline batteries will be studied to reduce the cost but will allow 150 cycles possible in CTD commuted (10 measurements nearby the pressure point).
The coastal version of the Arvor, named Pagode, which cycles from 0 to 200m will be soon available and 4 of them will be deployed in the Bay of Biscay by Ifremer.

SOLO

B. Owens reported on the new SOLO-2 float which is the result of improving the ruggedness and lifetime of the current SOLO float model. The SOLO-2 will be smaller by 38cm in length and more energy efficient than the current model. The air bladder has been removed since it was frequently a source of failure and a pump similar to the Spray Glider's pump has been introduced. The SOLO-2 will be able to profile to 2000m anywhere in the world and will have a 5+ year lifetime. It uses 50% less batteries than the current SOLO and is being built to use Iridium communications. A SOLO-2 prototype deployment is planned for June 2008.

J. Gould raised the issue of how to build floats that profile to deeper depths than are currently available today. This would help with calibrating floats and might be something to think about for OceanObs'09. There is not only the issue of energy consumption to explore, but also sensor capability.

8.2 Tracking technical performance

8.3 Profiling under ice

Owens

A version of the WHOI SOLO Iridium/GPS float has been developed to use a simple algorithm to seek out open water in ice covered regions. The float attempts to surface and checks to see if it can establish a link with the Iridium satellite communications system. If successful, the float acquires a GPS fix, uploads all the profile and engineering data since the last successful satellite communication, obtains a second GPS fix and then submerges to start the next cycle. If unsuccessful, it goes to 50 m depth, waits two hours and returns to the surface and tries again to link with the Iridium system. The float will repeat this for up to 50 times and if still unsuccessful, will go on to the next cycle. Ten of these floats have been deployed near the Bellinghausen Sea off Antarctica. Nine of the floats have successfully returned data. Several floats were unable to find open water after one or more profiles, but have subsequently found open water and transmitted their data. An example from two of the Antarctic floats was presented.

Riser

Approximately 90 UW floats have been deployed in the seasonal ice zone of the Antarctic in the past 12 months, in conjunction with the International Polar Year. These floats have been deployed in the Indian, Pacific, and Atlantic sectors of the Southern Ocean by various icebreakers. The floats all have an ice-avoidance algorithm based on the median temperature in the water column between 80 and 30 meters depth. If this median temperature on any profile is below a set threshold (usually set to be around -1.8 deg C, the approximate freezing point of seawater), then the float stops its ascent, retracts its bladder, and descends back to the parking depth. Usually in this case floats will get to within 10 m of the sea surface before stopping.
Most of the ice-floats are equipped with Iridium communications, so that if they detect ice they will store their CTD profile before descending and will transmit it at a later time when no ice is detected. These floats can store up to 64 high resolution CTD profiles. Argos floats with the ice algorithm do not store their profiles. We have begun equipping all floats deployed south of 50 deg. S with ice-detection software. After one winter, 90% of the floats are still operating normally. Many transmitted 10 or more profiles collected under the ice during Austral winter.

The idea that was raised that ice floats could be another example of Argo straying from its core mission. S. Riser felt this was not true and noted that there is a large possibility of floats that

are deployed south of 50S eventually being stuck under ice. For him, it is standard practice to include the ice-detecting software on floats deployed south of 50S.

8.4 Near surface profiling

Jon Turton reported on a sampling modification to Apex floats that had been developed by Webb to give more frequent sampling of temperature in the upper 10m using the current sensors. Being a software modification, this will not increase the float cost. Between 10-5db, 5 temperature samples will be taken at 1db intervals. First will be a non-pumped sample immediately followed by a pumped sample to compare. From 5db to the surface, every 6 seconds, non-pumped temperature samples will be taken. By looking at the data it should be possible to determine if this can give useful data. The plan was to deploy several prototypes later in 2008. It was pointed out that currently there is no place in the netcdf files for this additional data.

The idea of sampling to 2db was discussed, but the AST felt this was too risky as the sensor could be out of the water in some areas and given the surface pressure errors this did not seem much more helpful than samples taken at 5db.

Steve Riser is testing out a near surface CTD that will work above 5db and is funded by the Aquarius program. This new sensor is deployed together with the current sensor to allow calibration on each profile.

8.5 Update on Oxygen White Paper

There are now more than 100 Argo floats equipped with dissolved oxygen sensors; this number is growing rapidly (it has doubled in the past year). Problems with both of the 2 types of oxygen sensors used on floats remain. SeaBird continues to work to improve the long-term drift of its SBE-IDO sensor, and some progress with this problem is apparent. Many of the sensors show no drift at all over times of a few years, but a significant number continue to exhibit drift larger than the stated specifications of the instrument. Some of the causes of this drift have been identified and fixed. The Aanderaa Optode sensor is generally quite stable over time but suffers from slow response and poor initial calibration. Aanderaa is working on both of these problems, with suggested remedies being tried.

Scientists from the European Union have proposed a large experiment in the eastern equatorial Atlantic, off the coast of Africa, which would use 50-100 profiling floats equipped with O2 sensors, gliders, and atmospheric sampling to map the low-O2 tongue in the region and to assess the interactions between deep-sea O2 and the distribution of O2 on the local continental shelf. This experiment has been called OXYWATCH (see section 8.6 below for more information) and is now under review.

With all of the O2 data being produced by profiling floats, some work is necessary on applying uniform quality control procedures to the data. Several preliminary attempts to do this are now being carried out and should be finished by the 2009 AST meeting.

8.6 Report on OXYWATCH

The OXYWATCH (Towards Global Observatories for Oxygen Depletion) project is a response to the following work program from the European call (FP7): “Monitoring and observing oxygen depletion throughout the different Earth system components.” The coordinating person is Arne

Kortzinger from IM-Geomar and 15 partners are involved (6 European countries, Senegal and Cabo Verde). If the project is funded, it will last 4 years from 2009 to 2012.

Its objective is to develop a blueprint for a global oxygen observatory of the ocean-atmosphere system on the basis of (i) a float based open ocean system, (ii) a glider-based coastal ocean system, and (iii) an atmospheric monitoring station-based system. This blueprint is based on a pilot-project that focuses on the eastern tropical North Atlantic, a region that is characterized by very low oxygen concentrations that are prone to becoming further depleted. The observations will be integrated and synthesized using sophisticated data analysis and modelling techniques in order to better understand the causes and impact of past and future oxygen changes on marine ecosystems, from lower trophic levels up the trophic ladder to top-predators, such as tuna.

The pilot project for *a float based open ocean system* is the pilot phase proposed by The Friends of Oxygen White Paper and corresponds to the first step toward the implementation of an "Argo-oxygen program". Recommendations for the implementation of such program will be provided to the Argo Steering Team at the end of the project. This will include recommendations on energy consumption, costs estimates, accuracy and precision, sensors evaluations (see the Friends of Oxygen White Paper). Three types of floats will be used: PROVOR CTS3, APEX and NEMO. All floats will be equipped with Seabird CTD and AADI oxygen optode. Some PROVOR floats will be used to test AADI air pressure sensor and some APEX floats will be equipped with both an AADI oxygen optode sensor and a Seabird IDO oxygen sensor.

Action item 23: Argo officially welcomes the two oxygen pilot programs (Friends of Oxygen and OXYWATCH) and hopes they will continue developing.

9 Demonstrating Argo's value

9.1 Report on GEO Ministerial

In November 2007, the GEO Ministerial meeting took place in Cape Town, SA. Argo attended as part of the "Oceans United" grouping, coordination being supplied by Chris Reid, the Executive Director of POGO at the time. Conrad Lautenbacher was very gracious in his opening speech, noting the spectacular success that Argo has supplied. H. Freeland met with Lautenbacher afterwards and thanked him.

Argo contributed several things to the meeting including people (H. Freeland, S. Piotrowicz and M. Belbéoch), an "Oceans United" exhibit, and a couple articles for different volumes ("The First 100 Steps to GEOSS" and "The Full Picture" which was distributed to all delegates). Unfortunately the articles did not turn out as well as could be hoped.

The Oceans United exhibit was extremely well done and very impressive. The Argo poster was coupled with the Jason poster to create a message of "partners in ocean exploration".

The posters were about 2 meters high and used graphics to draw the eye immediately to the links between the two systems. We also had two plasma screens with movies running on continuous loops and reinforcing the message of "Partners in Ocean Exploration". And nearby was a "Magic Globe" running a variety of ocean displays.

The financial investment was quite large and the resulting display is now in storage in Plymouth. These are all available for rental and were in fact used the week before AST-9 at the Oceanology International exhibit in London.

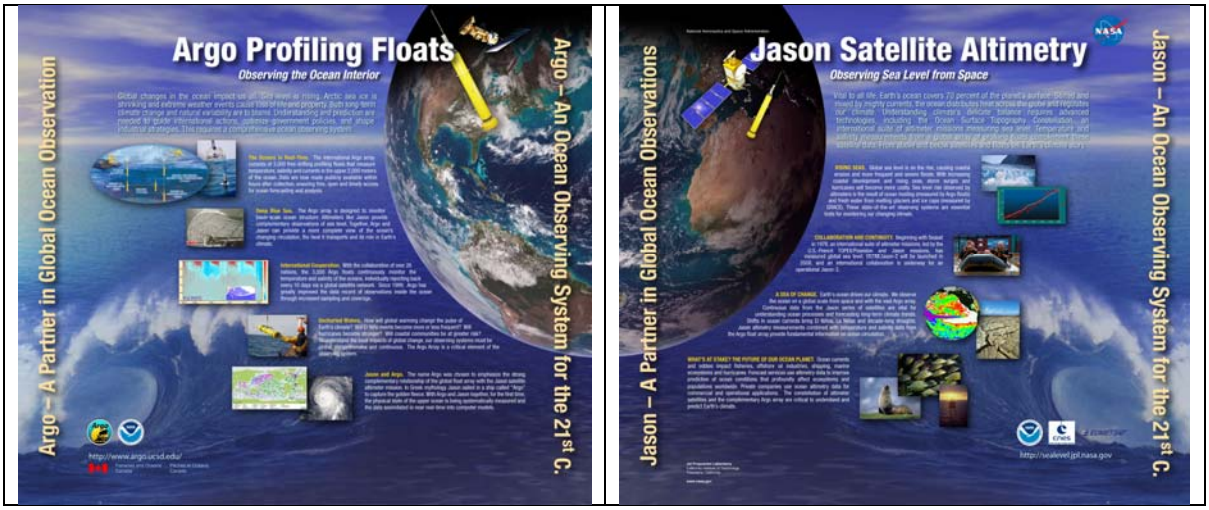

Figure 7: Argo and Jason posters for GEO Meeting

Despite the excellent planning for the Argo/Jason exhibits and the Oceans United exhibit overall, the display unfortunately was a failure because of a lack of visitors. Though the VIP enclosure was within 5 meters of the Argo/Jason exhibit, we counted one Minister only taking the time to visit, the environment minister from Nepal. The highlight of the event was the open day when students came in large numbers, they were all wonderful.

Action item 24: The AST wants to advertise the availability of the Argo/JASON display made for Cape Town for display by any AST member. Contact Chris Reid if interested.

9.2 Upcoming science meetings

9.2.1 GODAE Final Symposium

An outline of the GODAE final symposium was given by P.Y. Le Traon. The symposium will be held from November 12 to November 15 in Nice just after the Ocean Surface Topography meeting (altimetry) meeting. A science committee (SC) and organizing committee were set up in October 2007. Funding is now almost secured. Argo is represented in the SC (D. Roemmich). The program is now finalized with a series of invited multi-author papers (includes an Argo paper and several papers related to Argo). There is an evening round table on Argo and GODAE the second day which needs to be organized. Call for abstracts for posters will be issued in April. Invited papers will be published in proceedings at the meeting after internal review by the science committee. A subset of papers will be reviewed/published in Oceanography Magazine (Spring/Summer 2009). Contribution of Argo community in several key invited multi author papers is expected and needed (e.g. Argo, data processing systems, OSE/OSSEs, future of GODAE – requirements for the global ocean observing system). We also expect strong participation from the Argo community in posters for the different sessions. Abstracts and list of co-authors for invited papers will be reviewed by Symposium Steering Committee in April. Inputs/suggestions from AST are welcome/needed (through D. Roemmich and P.Y. Le Traon).

Action item 25: D. Roemmich will circulate the draft abstract for GODAE symposium among AST members and invite comments and coauthorship.

9.2.2 OceanObs'09

The upcoming OceanObs'09 meeting was discussed and Argo will begin preparing for this meeting using the 3rd Argo Science workshop. This meeting will be an important opportunity for Argo to restate its mission for the next decade since the last OceanObs meeting.

9.2.3 The 3rd Argo Science Workshop

We plan on holding the Third Argo Science Workshop in early 2009 in Hangzhou, China, and link this with the annual AST meeting. The critical item to note is OceanObs'09 in Venice, 21-24 Sept 2009. Argo is expected to prepare a progress report, detailing what we have achieved since OceanObs'99 and outlining Argo's vision of the future.

H. Freeland proposes that we invite papers on the use of Argo and ask speakers to address various aspects of the sufficiency or adequacy of the Argo array. We would welcome comments on to what extent a deep Argo might be needed, on the effectiveness of the spatial coverage, on the cycle timing, etc. What is learned during ASW-3 will inform a group designated to draft a paper for OceanObs'09.

Freeland offered a two-week long option (Option 1) and a one-week option (Option 2). Quickly Options 3, 4 and 5 were suggested.

The final versions came from Sylvie Pouliquen:
Sunday April 12th – Argo Steering Team arrives, possibly with a brief Argo exec meeting.
Monday April 13th – AST meeting day 1
Tuesday April 14th – AST meeting day 2
Wednesday April 15th – ASW-3
Thursday April 16th – ASW-3
Friday April 17th – ASW-3
Saturday April 18th – drafting team meets

and John Gould:

Sunday April 12th – AST meeting day 1
Monday April 13th – AST meeting day 2
Tuesday April 14th – break to regroup or meet in smaller groups
Wednesday April 15th – ASW-3
Thursday April 16th – ASW-3
Friday April 17th – ASW-3
Saturday April 18th – drafting team meets

The meeting will take place at the beautiful hotel used previously for AST-5 on the West Lake of Hang Zhou.

New options are still welcome.

Action item 26: AST members are asked to email H. Freeland with ideas and votes on how to plans the ASW-3 and AST-10. Emails are requested by April 1.

9.2.4 Operational Oceanography session at IAPSO/IAMAS Montreal

Argo was asked to contribute a session to this meeting and H. Freeland has agreed to be a convener. Other conveners for this session are Toshio Suga and Temel Oguz.

We developed a description of a session that is oriented toward "operational oceanography" rather than exclusively Argo.

This full-day session will focus on the opportunities being offered by the new real-time data systems that permit research on the evolution of the oceans on a large scale, as well as the observation and assessment of ocean state for the generation of products which carry distinct social benefits.

We invite papers that address the following topics:

- academic exploration of the ocean environment using Argo
- the use of Argo to supply useful products, and
- all other fields of operational oceanography.

http://iamas-iapso-iacs-2009-montreal.ca

9.3 Argo products

9.3.1 The Pacific and Global Marine Atlas

M. Scanderbeg presented on the Pacific and Global Marine Atlases under development that will provide a way for users to view gridded Argo data. The target audience is classrooms, government officials and scientists and the Atlases could be used for a variety of purposes including learning about local, regional and global water properties, helping to give funding agencies a visual on what Argo is providing, etc. The gridded Argo file created by D. Roemmich and J. Gilson that forms the basis of the Atlas is a 4-D file with 1 degree latitude by 1 degree longitude resolution, 58 depth levels of vertical resolution and monthly time values for the period of 2004 - 2007. The Atlas allows users to create map plots, vertical sections, time series and a variety of line plots. Options are available to plot temperature, salinity and density, along with their anomalies and station locations. Currently, the Atlases are made for use on PCs and use the graphing program Ferret to create the plots. A goal for the Atlas is to keep it flexible and one way to do this is to allow users to substitute in their own gridded netcdf file and to contribute Ferret journal files that create different plots. When the Atlases are complete, they will be freely distributed via the Argo websites for anyone to use with updates to the gridded Argo file supplied regularly. The Atlas could provide a valuable tool to compare different data sets. For more information or to test out the Atlases, please contact D. Roemmich or M. Scanderbeg.

9.3.2 Bibliography

M. Scanderbeg presented some of the reasons for the Argo bibliographies as well as how they are maintained. Three separate bibliographies are kept on the AST website: a research in press bibliography, an Argo and profiling float bibliography and a general float bibliography. These documents are maintained in hopes of providing a resource for Argo scientists to use in obtaining funding and doing research and to provide feedback to the AST as to how users are

actually using the Argo data. It was noted that M. Scanderbeg relies solely on author submissions for updating the research in press bibliography as no other method of searching for these papers is available. For the other two bibliographies, M. Scanderbeg also takes author submissions as well as searching through various online databases for articles related to oceanography. Currently submissions are requested through advertisements in the Argo newsletter and the call for national reports. Additional requests for submissions can be added to the website where the bibliographies are posted.

Action item 27: Publishing PIs are asked to send article citations to M. Scanderbeg for Argo bibliographies, remembering this includes articles in press as well as published articles. H. Freeland will explore subscription services to provide lists of articles relating to Argo. M. Ravichandran will look into generating a list of Argo articles using his resources.

10 Implementation issues

10.1 Review/discuss commitments table

The commitments table was reviewed and properly updated for the coming year. It is estimated that almost 800 floats will be deployed in 2008. See the updated commitments table in the supporting documents of the report for more details.

10.2 AIC Report

The TC reported first on the status of the Argo array. In agreement with the panel, he proposed to review and refine all metrics used to monitor the Argo array growth and efficiency.

Regarding deployment planning, the TC noted that progress was made in 2007 but that the effort should be continued to record plans in advance in the AIC web based system. At this time 70% of the 2008 planning was already on-line:

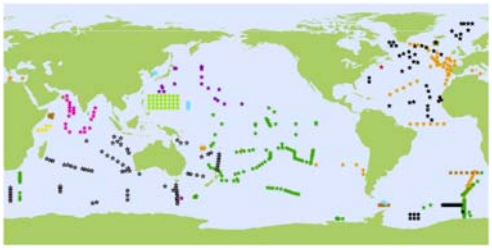

Figure 8 : Deployment plans for 2008

The TC restated that he would be pleased to help achieve this task in any way necessary. He recalled that potential problems (wrong WMO / Argo Ids) can be detected if notifications are done **before** the data distribution via the DACs. He highlighted that the deployments in the Atlantic Ocean were divided in half in 2007.

He presented some new products to highlight priorities in the Argo implementation as the following map combining network density and age:

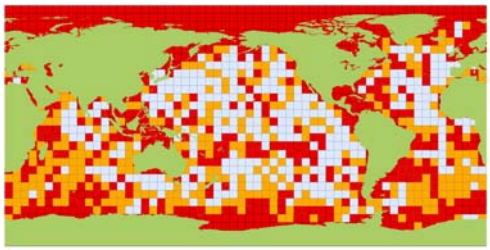

Figure 9: Map combining Argo density and age

The panel recalled that the TC monthly report was extremely useful and should be sent outside the AST/ADMT if some Argonauts request it.

The TC presented then the AIC/JCOMMOPS activities during 2007 and the progress made on:

- Argo implementation monitoring and planning
- Argo Data distribution monitoring
- Support to Argo users
- Reporting to PIs/Programmes Managers, float operators and data managers
- Upgrade of the JCOMMOPS information System
- Finalisation of the new AIC website
- International issues

The JCOMMOPS web services are now monitored 24/7 by CLS operational team. The TC informed the panel that the remaining weakness of the Information System was the dependency on TC expertise. To that end a full user guide will be prepared in 2008 to ensure continuity of AIC services.

He presented the first results of the audience tracking system set up for the AIC and Project Office websites.

He presented as well the first results of the Argo support centre and recalled that all its actions items from ADMT8 were completed.

The TC informed the AST of the problem that some floats equipped with the Argo label (beached and retrieved) were not tracked by the AIC and data were never distributed. Float manufacturers should be contacted to take care to apply the Argo label appropriately (only if the customers are involved with Argo and the AIC) and eventually design another safety label for non-Argo floats.

The TC informed the AST that the notification mechanism set up by the AIC could be formally recognized through a new IOC Resolution, and that the IOC/ABE-LOS group was progressing and could agree this year on a procedure for float deployments.

The TC informed the AST of the contacts established with potential participating countries and recalled that the donation contract was approved by UNESCO legal affairs.

He presented his priorities for 2008:

- Continue to encourage/assist float operators to notify deployment plans
- Continue to address any issues with the new website

- Improve JCOMMOPS Information System operational status
- Review AIC/JCOMMOPS Information System documentation
- Improve the AIC Monthly Report
- Improve the Support Centre
- Work on metadata: cycle and Argos/Iridium data formats
- Improve data distribution monitoring (GTS/GDACs)
- Finalize bi-daily files generation (GIS, text, Google Earth)
- Continue to issue reports on EEZ status to IOC Member States
- Improve the Argo websites (work with Megan)
- Review all mailing lists subscribers
- Update Argo communication material: presentation, poster
- Continue to assist in the float retrieval activities
- Continue to foster participation by new countries through donor programs
- Improve (modestly) Argo media coverage via direct contacts or educational initiatives
- Assist Bio-Argo and other "equivalent" initiatives
- work on deployment opportunities

Action item 28: Add a table to the Argo mission statement listing the marginal seas and the number of floats that should be in each one according to the Argo density guidelines. H. Freeland, J. Gould, M. Belbéoch. Additionally, state the number of floats required in the various parts of the global ocean, reflecting sub-basin regions (to be suggested by J. Turton) and H. Freeland will calculate the expected number of floats in each sub-region.

Action item 29: Argo co-chairs and M. Belbéoch will discuss Argo floats vs. Argo equivalent floats in regards to the issue of floats masquerading as Argo floats when they are not part of the Argo program.

Action item 30: Argo co-chairs to note that if resources are available it would be best to have a professional web interface created for exploring Argo websites.

Action item 31: M. Belbéoch asked to automate update of float map on Wikipedia commons.

Action item 32: Argo co-chairs to look at and update M. Belbéoch's terms of reference by end of June.

Action item 33: M. Belbéoch to develop a new set of metrics, in coordination with the AST, that reflect the delivery of data, and not just an active float in the water, to measure Argo's progress, and to better reflect the numbers of floats required in each ocean sub-basin and marginal seas. This includes providing density maps that exclude grey-listed floats.

10.3 Deployment in remote ocean regions

The need for improved deployment planning was stressed again as well as the need for dedicated ship time to deploy floats in more remote areas. It was suggested that a reasonably priced ship could be found in South Africa to help repopulate the southwest Indian Ocean.

10.4 Update on DBCP, SOOP and JCOMM Observing Program Support Centre

DBCP, SOOP

In the context of Argo's relationship to other observing systems, Hester Viola, the Technical Coordinator of the Data Buoy Cooperation Panel and Ship Observations Team (VOS & SOOP) reported on the status of the DBCP and the SOOP program. She described the DBCP and its aims, as well as its major achievements to-date, in that it completed its initial array of 1250 Drifting Buoys in 2005, had increased the amount of Air Pressure data being collected, particularly in higher latitudes, and considered buoy data quality to be very good. She noted that the Buoy community had begun disseminating data in BUFR formats and were looking at increasing the amount of platform metadata available in real-time, plus that the DBCP would like to have barometers on all buoys in future.

The distribution of buoys was discussed and deployment opportunities were raised as a major issue for DBCP. She commented that the Argo Deployment planning maps had been very useful in investigating opportunities, but that DBCP and Argo could work more closely on this issue together in future, as many of the issues are common to both programs. She discussed the challenges faced by the DBCP in real time quality control and in trying to reduce delays in disseminating data onto the GTS. A pilot project has begun to test the use of Iridium, which it is hoped will allow a decrease in delays experienced from drifting buoys in remote areas.

She explained the scope of the Ship Observations Team and highlighted the work being done each year with the Ship Of Opportunity Program, collecting XBT temperature profiles and how she compiles a report of the sampling success of the SOOP program, each year. She noted that this report can give valuable information about ship cruises and deployment opportunities for drifting buoys and floats.

Several AST members commented that combining deployment opportunities and planning for drifters and Argo floats would be productive. The AST encouraged buoy and float operators to pursue the effort in sharing deployment planning and opportunities and encouraged the TCs to make this information available across both programs.

M. Belbéoch volunteered to help to identify locations of CTD cruise data that could be collected for the Argo reference database and asked the AST for a specific action item on this issue as it could be time consuming.

JCOMM

The Argo TC recalled that JCOMMOPS was a component of the international coordination mechanism which aims, on behalf of JCOMM, to:

- develop synergies between observing systems (Argo, DBCP, SOT)
- assist in the planning, implementation and operations of the observing systems
- monitor and evaluate the performance of the networks
- encourage cooperation between communities and member states
- encourage data sharing
- assist in data distribution on Internet and GTS
- relay users feedback on data quality to platforms operators
- provide technical assistance and user worldwide support
- act as a clearing house and focal point on all programs aspects

JCOMMOPS faces the challenge of strengthening its infrastructure and extending its operations to new observing systems. Informal discussions (with secretariat and panel chairs) took place in 2007 to start OceanSITES coordination within JCOMMOPS.

Hence, JCOMMOPS would provide support for Argo, DBCP, SOT and OceanSITES:

- the DBCP TC would spend 70% of time on DBCP matters and 30% of time on OceanSITES
- the Argo TC would spend 70% of time on Argo and 30% on the Ship Observations Team (to be discussed)
- JCOMMOPS will gain an additional half-time employee dedicated to I.T. support

The AST endorses the proposed split of tasks performed by the ATC and DBCP-TC to accommodate OceanSITES.

The TC remarked that his mission budget was not sufficient to cover all Argo needs and that I.T. support was required in JCOMMOPS to alleviate his workload.

The AST was invited to provide feedback on this suggestion and to review and agree on new TC Terms of Reference including SOT coordination.

In parallel, following a joint WMO/IOC circular letter, 15 institutions offered to host the future JCOMM-OPSC.

The AST was invited to provide feedback to JCOMM about moving the relationship Argo-JCOMM to a more formal level in the context of a “systems” approach to the long term ocean observations.

TC DBCP, Hester Viola reported on the status of the DBCP and SOT programs. The panel noted the potential benefits of a good cooperation between the two program regarding deployment planning and encouraged JCOMMOPS to continue the effort of integration of services.

11 Argo outreach activities

Argo outreach activities were separated into three different categories: working with Argo data users, interfacing and reaching out to the general public, and education activities. Each country reported on the outreach activities within their country in the past year or so and many had interactions with the media surrounding the Argo 3000 milestone. Several countries also have held Argo user workshops for Argo users within their country and have found these to be very helpful in educating scientists on how to use Argo data as well as getting feedback on how Argo data is being used. Everyone agreed that in terms of education and Argo this is an area where an Argo director could really make a meaningful impact. J. Gould suggested the need for an educational website as well as for keeping the current websites as up to date as possible.

12 Future meetings

12.1 ADMT-9

ADMT-9 will take place in Hawaii on October 29-31, 2008. An ARC meeting will take place on October 28, 2008.

12.2 DMQC-3

DMQC-3 will take place at the University of Washington on September 10-12, 2008.

12.3 AST-10

AST-10 will take place in Hangzhou, China in connection with the 3rd Argo Science Workshop next April.

13 Membership

Argo Steering Team membership was discussed and it was agreed that the Argo terms of reference will be updated by J. Gould to reflect the description of AST members. It was requested that each country review these terms of reference and then nominate someone from their country to be the AST member. This does not exclude others from attending AST meetings, but rather lets the chairs know who to contact for each country so that information can be distributed quickly and effectively to all Argo users. A few other people are invited to be on the AST including ADMT chairs, a GODAE representative and perhaps a CLIVAR representative.

Action item 34: J. Gould will construct terms of reference for the Argo Steering Team and then, from that, co-chairs will ask each country to nominate an AST member.

Argo Steering Team Meeting (AST-9)
Exeter U.K., March 18-20 2008
Host: U.K. Met Office, Location:

Meeting of Argo Steering Team Executive, Monday afternoon March 17, 1 p.m.
(Roemmich, Freeland, Ravichandran, Wijffels, Shikama, Thierry, Pouliquen, Ignaszewsky, Scanderbeg, Belbéoch, Turton, Xu, Gould)

Agenda: Begin at 9 a.m. on Tuesday March 18

1. Welcome and local arrangements (Turton)

2. Objectives of the meeting

Present state of the Argo Program and its relationship to other observing system elements. (Lead – Freeland and Discussion)

Objectives:

1) "Completing" the Argo array in the sense of float technology (lifetime and capabilities), array deployment and coverage, data quality and QC procedures. Following the "Argo 3000" achievement, which generated a lot of positive attention and goodwill, we have a "grace" period of a year or two to fix the remaining problems. The AST should map out the pathway toward an Argo that meets all of its targets.

2) Promoting broader use of the Argo dataset and greater awareness both in the ocean/climate community and the public.

3. Action items from AST-8 and Argo Exec (Scanderbeg)

4. Data Management related Issues
    - 4.1 Feedback from ADMT8 (Pouliquen/Ignaszewski)
    - 4.2 Delayed Mode QC
        - 4.2.1 Status on Delayed mode QC and DMQC-3 plans (King)
        - 4.2.2 Progress on Argo Reference Database (Diggs)
        - 4.2.3 Use of Argo data in a reference database (LeTraon)
    - 4.3 Report on the first ARC Meeting (Shikama)
    - 4.4 Status of correction to pressure offset errors in WHOI floats (Owens)
    - 4.5 Using satellite altimetry data in Argo quality control (Guinehut)
    - 4.6 Systematic surface pressure error (Shikama, Kobayashi, J. Willis, P. Barker)
    - 4.7 Status of trajectory data (King)
    - 4.8 Status of oxygen data (Kobayashi, Owens)
    - 4.9 Other potential data streams (e.g. bio data)

5. Science Talks
    - 5.1 Dan Lea – UK Met Office operational uses
    - 5.2 Doug Smith – Using Argo in Decadal Predictions
    - 5.3 Karen Heywood – Invited Science Presentation

6. Issues arising from National Reports.

7. Regional Activities
   7.1 EuroArgo (P-Y LeTraon)
   7.2 Argo activities in the Mediterranean Sea (P-M Poulain)

8. Technical issues
   8.1 Float technology progress (Riser, Pouliquen, Roemmich)
   8.2 Tracking technical performance (Belbéoch to describe present procedure)
   8.3 Profiling under ice (Owens, Riser, + discussion)
   8.4 Near surface profiling (Turton)
   8.5 Update on Oxygen White Paper (Riser)

9. Demonstrating Argo's value
   9.1 Report on GEO Ministerial (Freeland, Belbéoch)
   9.2 Upcoming science meetings
      9.2.1 GODAE Final Symposium (Le Traon, Roemmich)
      9.2.2 OceanObs''09
      9.2.3 3rd Argo Science Workshop (Xu, Freeland) (+AST-10?)
      9.2.4 Operational Oceanography session at IAPSO/IAMAS Montreal (Freeland)
   9.3 Argo products
      9.3.1 The Pacific and Global Marine Atlas (Scanderbeg).
      9.3.2 Bibliography (Scanderbeg)

10. Implementation issues
   10.1 Review/discuss commitments table
   10.2 AIC Report (Belbéoch) (+ discussion on beached floats, deployment planning)
   10.3 Deployment in remote ocean regions.
   10.4 Update on DBCP, SOOP, and JCOMM Observing Program Support Centre (Viola, Belbéoch)
11. Argo outreach activities

12. Future meetings
   12.1 ADMT-9
   12.2 DMQC-3
   12.3 AST-10

13. Membership

14. Other business

15. Review of Action Items and Close

List of Participants for IAST - 9, Exeter, United Kingdom.

S. No	Name	Institution and Address	Nationality
1	Dr. Susan Elizabeth Anne WIJFFELS	CSIRO Marine and Atmospheric Research, Castray Esplanade, GPO 1538, Hobart Tas. 7000.	Australia
2	Dr. Pierre-Marie POULAIN	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Borgo Grotta Gigante, 42/c, 34010 Sgnoico (Trieste), Italy	Belgium
3	Dr. Howard John FREELAND	Institute of Ocean Sciences, 9860 West Saanich Road, BC, V8L 4B2.	Canada
4	Dr. XU Jianping	The Second Institute of Oceanography, State Oceanic Administration, People's Republic of China No. 36, Baochubei Road, 310012, Hangzhou, China	China
5	Mr. LIU Renqing	The Second Institute of Oceanography, State Oceanic Administration, People's Republic of China No. 36, Baochubei Road, 310012, Hangzhou, China	China
6	Dr. Sylvie POULIQUEN	Responsable Coriolis / Head of Coriolis, IFREMER, BP70, 29280 Plouzané Cédex, France	France
7	Mr. Mathieu BELBÉOCH	JCOMMOPS, 8-10, rue Hermès,Parc technologique du Canal , 1526 Ramonville Cédex	France
8	Hester VIOLA	JCOMMOPS, 8-10, rue Hermès,Parc technologique du Canal , 1526 Ramonville Cédex	UK
9	Dr. Pierre-Yves LE TRAON	Program Director Operational Oceanography Systems, IFREMER Centre de Brest B.P. 70 29280 Plouzané Cédex	France
10	Dr. Virginie THIERRY	Laboratoire de Physique des Océans, IFREMER, BP70, 29280 Plouzane Cédex	France
11	Dr. Stephanie GUINEHUT	Mercator, Parc Technologique du Canal, 8-10 rue Hermès, 31520 Ramonville St Agne, France	France
12	Dr. Muthalagu RAVICHANDRAN	Indian National Centre for Ocean Information Services, (INCOIS), "Ocean Valley", P.B No.21,IDA Jeedimetla P.O, Hyderabad - 500 055, India.	India
13	Dr. Nobuyuki SHIKAMA	2-15, Natsushima, Yokosuka, Kanagawa, 237-0061, Japan, Institute of Observational Research for Global Change (IORGC),Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan
14	Dr. Taiyo KOBAYASHIi	2-15, Natsushima, Yokosuka, Kanagawa, 237-0061, Japan, Institute of Observational Research for Global Change (IORGC),Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan
15	Dr. Tomoaki NAKAMURA	2-15, Natsushima, Yokosuka, Kanagawa, 237-0061, Japan, Institute of Observational Research for Global Change (IORGC),Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan

16	Dr. Kazuhiko HAYASHI	Marine Division 1-3-4 Ote-machi, Chiyoda-ku Tokyo 100-8122 JAPAN	Japan
17	Dr. Toshio SUGA	2-15, Natsushima, Yokosuka, Kanagawa, 237-0061, Japan, Institute of Observational Research for Global Change (IORGC),Japan Agency for Marine-Earth Science and Technology (JAMSTEC) & Tohoku University	Japan
18	Dr. Jangwon SEO	National Institute of Meteorological Research (METRI) Korea Meteorological Administration (KMA) 45 Gisangcheong-gil, Dongjak-gu, Seoul 156-720 KOREA	Korea
19	Dr. Pil-Hun CHANG	National Institute of Meteorological Research (METRI) Korea Meteorological Administration (KMA) 45 Gisangcheong-gil, Dongjak-gu, Seoul 156-720 KOREA	Korea
20	Dr. Moon-Sik SUK	Korea Ocean Research & Development Institute (KORDI), Ansan, P.O.Box 29, 425-600, Korea	Korea
21	Dr William John GOULD	National Oceanography Centre, Southampton, Empress Dock, Southampton, SO14 3ZH.	UK
22	Dr. Karen HEYWOOD	University of East Anglia, Norwich, NR4 7TJ UK Telephone: (+44) (0) 1603 456161	UK
23	Dr. Brian KING	National Oceanography Centre, Southampton, University of Southampton Waterfront Campus, European Way, Southampton SO14 3ZH, Tel: 00 44 23 8059 6666	UK
24	Dr. Dan LEA	Met Office, FitzRoy Road, Exeter, Devon, EX1 3PB, United Kingdom	UK
25	Dr. Doug SMITH	Met Office, FitzRoy Road, Exeter, Devon, EX1 3PB, United Kingdom	UK
26	Dr. Jonathan David TURTON	Laboratory address: Met Office, Fitzroy Rd, Exeter, Devon, UK, EX11 1LR	UK
27	Megan Carvel SCANDERBEG	Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive, La Jolla California 92093-0230.	USA
28	Dr. Breck OWENS	Woods Hole Oceanographic Institution, Woods Hole, MA 02543-1050	USA
29	Dr. Stephen R. PIOTROWICZ	NOAA/ Ocean.US, 2300 Clarendon Boulevard, Suite 135, Arlington, Virginia, 22201.	USA
30	Prof. Stephen Craig RISER	School of Oceanography, Box 355350, University of Washington, Seattle, Washington 98195.	USA

	Action	Responsibility	Status
1	H. Freeland to send letter of thanks to UK Met Office, Jon Turton	H. Freeland	
2	Draft two updated Argo mission statements: one for Argo and one for ABE-LOS purposes. Circulate the statement among AST members for approval. M. Belbéoch to circulate the updated Argo mission statement to ABE-LOS.	J. Gould, H. Freeland, M. Belbéoch	
3	A proposal is being drafted by Ann Thresher on new technical parameters to be added to technical files. When the proposal is finished, the AST requests the DACs to review it and make suggestions. When approved by all DACs, the AST requests the DACs adopt it as soon as possible.	A. Thresher, DACs	
4	Develop regional data range checks.		
5	DACs and PIs asked to read the monthly AIC float reports and respond to issues relating to their DAC.	DACs & PIs	
6	The AST encourages its members and their colleagues to submit CTD cruise data for delayed mode calibration purposes to CCHDO.	AST members, PIs who take CTD data.	
7	The following request will be added into the call for national reports: Each country will be asked for the number and location of CTD cruise data that has been uploaded by PIs within their country to the CCHDO website in the past year.	M. Scanderbeg, AST members	
8	The AST requests from the CCHDO global CTD data for delayed mode quality control purposes only (no public release of data until written permission received from the PI), with a first priority of long repeat lines.	CCHDO/Diggs	
9	The AST requests JAMSTEC to help the Southern Ocean ARC in doing ARC activities in the South Pacific and its southward extension.		
10	Ask that B. Owens supplies the WMO numbers of floats that still have more than 5db pressure errors to be included in document on biases being prepared by the pressure working group.	B. Owens	
11	Ask B. Owens to work with J. Willis to qualify this group of floats with large errors and investigate whether this data needs to be flagged as '3'.	B. Owens, J. Willis	
12	The AST encourages each basin deployment coordinator to be proactive in acquiring deployment information. Ask Atlantic	Basin deployment coordinator (S.	

	deployment coordinator to revisit Atlantic (S. Atlantic especially) deployments to fill gaps.	Pouliquen), S. Garzoli, B. Owens, B. King	
13	Ask S. Guinehut to work with Coriolis to post the plots she showed of floats with various errors identified using her comparison with altimeter data. Ask M. Belbéoch to identify the PI for each float and ask the PI to look into the issues and report to DMQC3 on results. Additionally, ask Coriolis to work with CLS to routinely generate these plots and to make them available to the Argo community as part of real time consistency checks at GDACs.	S. Guinehut, M. Belbéoch, PIs with problematic floats, Coriolis	
14	Form working group headed by S. Wijffels to look into the various pressure problems and report to DMQC3 or ADMT9. Other working group members: S. Riser, V. Thierry, S. Guinehut, J. Willis, T. Kobayashi. Ask J. Gilson to be involved as well.	S. Wijffels and working group	
15	Ask the pressure working group to create a historical record of known Argo biases and how they have been fixed. This summary of biases will be posted on the GDACs and AST/AIC websites as a reference for users. Provide clear instructions on how to correct surface offsets in APEX floats and whether this should be done in real time or in delayed mode.	S. Wijffels and pressure working group	
16	Draft an article for EOS detailing how to use Argo data and known problems with the data. This will expand on the current short users guide previously written by J. Gould.	H. Freeland	
17	The AST will write to Webb research requesting a solution to the truncation of negative surface pressure values on the APF8 controller board. Suggest adding an additional measurement of surface pressure.	H. Freeland	
18	B. King is creating a new set of trajectory-like files for the velocity product. When this process is finished, the AST requests that DACs are given clear guidance on how to reprocess old floats to fix the trajectory files. The velocity product should be done in May2008, with help being given to the DACs as soon as possible afterwards.	B. King	
19	The AST strongly suggests that if given the opportunity to examine a float that has been recovered after being at sea for over one year, this float and its sensors should be studied and not redeployed.	PIs who recover floats older than one year	

20	The AST will provide URL for Gyroscope's environmental impact statement and ask AST members us it to craft an environmental statement for Argo that can be held in reserve.	H. Freeland	
21	The AST encourages the entrainment of more European countries into Argo.		
22	The AST recommends testing APEX float air bladders before deployment if possible. S. Riser can provide details on this test process.	APEX float deployers	
23	Argo officially welcomes the two oxygen pilot programs (Friends of Oxygen and OXYWATCH) and hopes they will continue developing.		
24	The AST wants to advertise the availability of the Argo/JASON display made for Cape Town for display by any AST member. Contact Chris Reid if interested.	All AST members	
25	D. Roemmich will circulate the draft abstract for GODAE symposium among AST members and invite comments and coauthorship.	D. Roemmich	
26	AST members are asked to email H. Freeland with ideas and votes on how to plans the ASW-3 and AST-10. Emails are requested by April 1.	AST members	
27	Publishing PIs are asked to send article citations to M. Scanderbeg for Argo bibliographies, remembering this includes articles in press as well as published articles. H. Freeland will explore subscription services to provide lists of articles relating to Argo. M. Ravichandran will look into generating a list of Argo articles using his resources.	PIs who write articles using Argo data, H. Freeland, M. Ravichandran	
28	Add a table to the Argo mission statement listing the marginal seas and the number of floats that should be in each one according to the Argo density specs. Additionally, state the number of floats required in the various parts of the global ocean, reflecting sub-basin regions (to be suggested by J. Turton) and H. Freeland will calculate the expected number of floats in each sub-region.	H. Freeland, J. Gould, M. Belbéoch	
29	Argo co-chairs and M. Belbéoch will discuss Argo floats vs. Argo equivalent floats in regards to the issue of floats masquerading as Argo floats when they are not part of the Argo program.	H. Freeland, D. Roemmich, M. Belbéoch	
30	Co-chairs to note that if resources are available it would be best to have a professional web interface created for exploring Argo websites.	H. Freeland, D. Roemmich	

31	M. Belbéoch asked to automate update of float map on Wikipedia commons.	M. Belbéoch	
32	Co-chairs to look at and update M. Belbéoch's terms of reference by the end of June.	Co-chairs	
33	M. Belbéoch to develop a new set of metrics, in coordination with the AST, that reflect the delivery of data, and not just an active float in the water, to measure Argo's progress, and to better reflect the numbers of floats required in each ocean sub-basin and marginal seas. This includes providing density maps that exclude grey-listed floats.	AST, M. Belbéoch, J. Turton, H. Freeland	
34	J. Gould will construct terms of reference for the Argo Steering Team and then, from that, co-chairs will ask each country to nominate an AST member.	J. Gould, co-chairs	

	2004 Argo deployed	2004 Argo equiv deployed	2005 Argo deployed*	2005 Argo equiv deployed	2006 Argo deployed	2006 Argo equiv	2007 Argo estimated	2007 Argo deployed	2007 Argo equiv	2008 estimated	2009 estimated
Argentina					12						
Australia	4		64		45		65	43			
Brazil	0		3					4			
Canada	30		29		38		25	18			
Chile	0		2**	2		4					
China	8		0		6		50				
Costa Rica	0		2***								
Denmark	0		0								
Ecuador								3			
European Union	15		7		3			8			
France	85		89		65		65	32		68	
Germany	27	18	56	19	35	1	37	22	13		
India	33		43		15		50	38		30	
Ireland	0		0								
Japan	119		98	12	98	18	95	80	15	95	
Korea (Republic of)	32		37		33		27	13		29	
Mauritius	2•		0		2						
Mexico	0		2°								
Netherlands	3		4		4		6	4		9	
New Zealand	2		1		3		2	2			
Norway	0		0		2						
Russia	2		0								
South Africa	0		0								
Spain	2		4		1						
UK	45		28		24		45	31	2		
USA	396	38	455	38	475	21	410	381	29	390	
Subtotals	803	56	918	71	861	44		679	59		
Total	859		989		905		877	738		621	

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

	Notes
Argentina	
Australia	
Brazil	
Canada	
Chile	
China	50 per year 2008-2012
Costa Rica	
Denmark	
Ecuador	
European Union	2005 MERSEA Germany and France
France	15 floats/year for 2009 & beyond
Germany	50 floats per year during 2007 to 2012
India	40 floats per year during 2008-2012
Ireland	
Japan	To 2008 15 equiv beyond 2008
Korea (Republic of)	
Mauritius	
Mexico	
Netherlands	
New Zealand	
Norway	
Russia	
South Africa	
Spain	
UK	
USA	

Australian Contribution to Argo

Report to the 9th Argo Science Team meeting, March 2008
Submitted by Susan Wijffels, CSIRO Marine and Atmospheric Research and the Australian Center for Atmosphere, Weather and Climate Research.

1. Status of implementation

Floats deployed and their performance

In 2007 45 WRC APEX SBE-41 floats were deployed and Australia has currently 158 operating Argo floats in the South Indian, Pacific and Southern Oceans. Australia has also deployed more floats with oxygen sensors.

APEX performance in the Australian array has generally been good – of APEX floats deployed in 2002 with mixed battery lithium/alkaline battery packs, 14 continue to operate past 5 years, with many achieving > 200 profiles to 2000db in the tropics and subtropics.

Of the 45 floats deployed in 2007, most continue to operate. Several floats were affected by software errors which were diagnosed with the help of the manufacturer and fixed. Some floats were replaced by the manufacturer.

Technical problems encountered and solved

Operational Changes: All floats are now fitted with a full complement of lithium batteries, rather than mixed lithium/alkaline battery packs. The switch was made to:
1) avoid any premature float failures associated with alkaline cell reliability; and
2) to extend the life of the floats.

Argo Australia, among others, has proved that APEX floats can profile usefully to 2000db (including the tropics) for 5 years +.

Problems solved in the last year:
1) the manufacturer discovered a programming bug in the oxygen-equipped float software. Deployments were delayed until the bug fix is tested and sent to us. However 4 floats were deployed with the bug.
2) we observed erratic reports by some recently deployed floats – deployments were halted, the manufacturer was alerted and subsequently identified a software bug. The remaining floats were reprogrammed and we have received replacements for the deployed floats from the manufacturer.
3) lab. tests found faults in buoyancy bladder manufacture that required some floats to be returned to the manufacturer for repair. The manufacturer has changed their QA/QC procedures.
4) lab. testing found faulty batteries from one of our suppliers and this, along with observed unexpected early voltage drops in a particular float batch halted deployments

while all batteries were re-tested. This has now been completed and we are satisfied our installed packs are all good. Deployments will recommence. Further lab tests will be carried out to identify the reason for the fast discharge of some floats in the field. All battery packs will now be load-tested before future installations. We continue to dialogue with the battery manufacturers on the causes of these failures. The cause of rapid voltage drop in some floats remains a mystery and we have not been able to diagnose its cause clearly in the laboratory yet.

Status of contributions to Argo data management:

Ann Thresher and the Argo Australia team hosted the International Argo Data Management Team (ADMT) in Hobart in November, 2007. The meeting was very successful and worked through many issues around improvements to the Argo data stream. Surrounding the meeting was good media coverage of the Argo 3000 float milestone and the awarding of the Sverdrup Medal to Dean Roemmich, who has provided excellent international leadership for Argo since its inception.

Real time: Last year's upgrade of our real-time processing software has resulted in a more stable and timely data stream. Real-time plots and monitoring of float data can be found at:

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

Status of delayed mode quality control process

About 70% of eligible Australian data are delivered in D-mode and we continue to make progress. We aim to begin including 'good' Argo data profiles in our drift assessments soon, as adjustments in certain data sparse regions remain difficult to judge.

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

Argo Australia is now part of the Australian Government initiative: an Australian Integrated Marine Observing System (IMOS) for research infrastructure funded under the National Collaborative Research Infrastructure Initiative. Through IMOS, and if levels of support from our participating partners remains steady, Argo Australia will be funded at a 50-60 float/year level for 4 years to maintain an array of around 220-240 Argo floats. The ongoing support through the Australian Climate Change program, however, may be in doubt as this program ends in July 2009, and its replacement is not yet scoped out.

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

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

Argo Australia has ~83 floats prepared for deployment. The map below shows where deployment plans have been made for some of these. We are seeking assistance in filling the gaps opening up in the SW Indian Ocean and South Pacific Oceans.

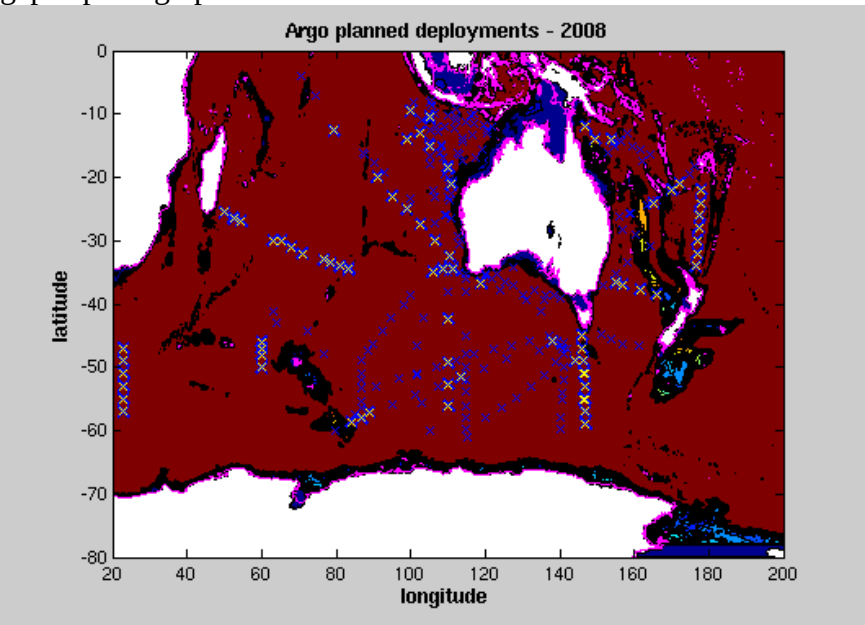

Figure caption: Yellow-white 'x' - planned deployment locations of fy 07/08 floats either on ships, in the laboratory or shortly to be delivered; blue 'x' – past deployments. Most Southern Ocean deployments can only be done in the Austral summer. Most deployments north of 40°S will take place in the next 3 months.

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

- Argo data are routinely used in the operational upper ocean analyses of Neville Smith at the Australian Bureau of Meteorology (http://www.bom.gov.au/bmrc/ocean/results/climocan.htm). These analyses are also used to initialize an experimental seasonal rain forecasting system.
- The dynamical seasonal forecasting system POAMMA heavily uses Argo data – Oscar Alves, Australian Bureau of Meteorology
- CSIRO Marine Research, in collaboration with the Bureau of Meteorology Research Center, has developed an ocean model/data assimilation system for ocean forecasting and hindcasting. Argo data is the largest *in situ* data source for this system. Work on subsurface profile assimilation is underway. PI: Andreas.Schiller@csiro.au
- Many students in the CSIRO/University of Tasmania graduate program are utilizing Argo data in their thesis studies. It's use is becoming widespread for studies of subduction in the Southern Ocean (Sloyan, Rintoul), generation of modern era climatologies (Ridgway and Dunn), ocean warming and its role in

sea level rise (Church, Domingues, Wijffels), in ocean observing system studies (Oke and Schiller), Ocean salinity changes (Durack/Wijffels)

- Developing model-based gridding techniques to produce an Argo-gridded data set (Dunn, Oke, Tchen, Wijffels)

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team

Gaps opening up in the Southern Hemisphere: While Argo has made tremendous progress internationally, the array density remains biased towards the Northern Hemisphere - coverage in the SW Indian and central Pacific is inadequate. We would like to see basin coordinators target these regions.

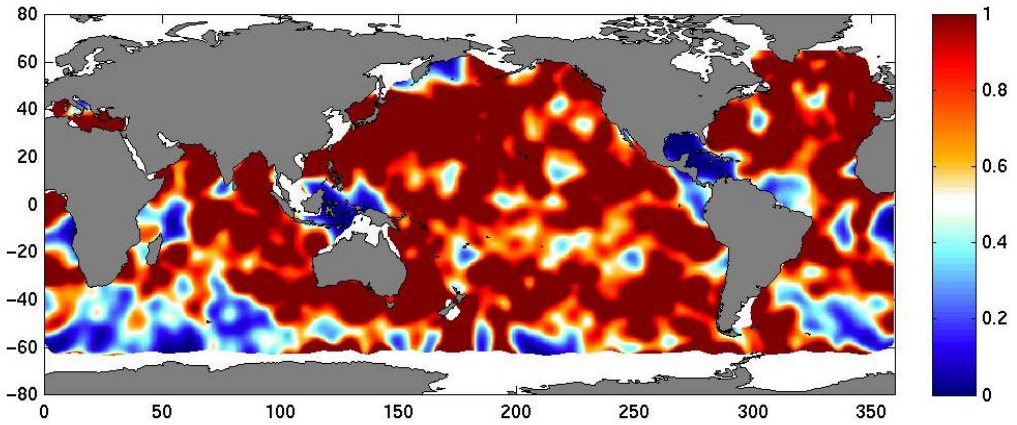

Figure caption: Argo density as a fraction of optimal design coverage in January 2008. Blue regions indicate where coverage is half or less of optimal.

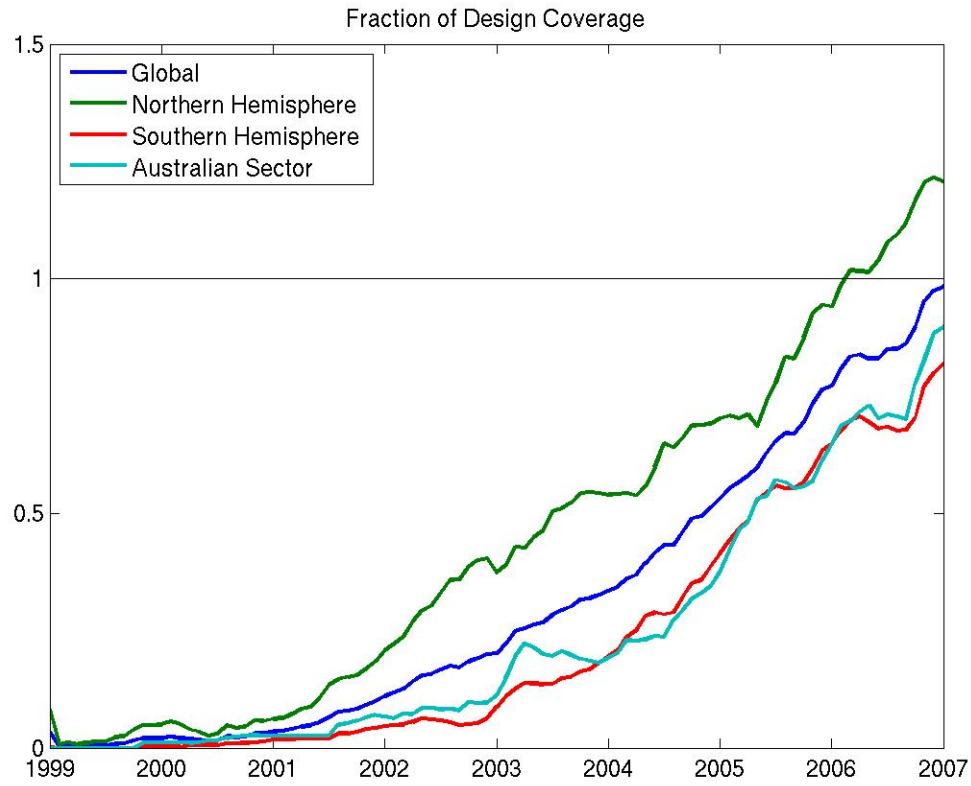

Figure caption: Time history of the fraction of design density reached by Argo averaged over various areas. A fraction of 1 means design density has been achieved. Globally averaged, Argo achieved design coverage at the end of 2007. Note, however, that the northern hemisphere is over-sampled and the southern hemisphere is under-sampled.

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INCISIVE INSIGHT

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Probe phones home

Missing sea robot turns up in fisherman's van

Glenis Green

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

The robotic profiler — which monitors ocean temperature and salinity — went missing late last year when it grounded on the sea floor off southeast Queensland and failed to surface as part of its routine cycle.

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

Surprised at the probe's reappearance, scientists were even more surprised when they pinpointed the source of the transmission — a fisherman's work van at Mooloolaba.

Mooloolaba prawn fisherman Robert Wilson, 45, had hauled the robot up in the turtle excluder in his nets from about 40m deep on January 20.

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

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

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

Knowing only that the probe had suddenly popped up within a 1km radius of Mooloolaba, she joined scientists from Brisbane in the hunt.

"I took a radio direction finder and when it gets close you can hear it," she said. "The trouble is it only transmits for five hours every 10-day cycle."

Dr Thresher's search was frustrated by the fact the probe was still in Mr Wilson's van and was constantly on the move.

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

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

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

"Believe it or not, on the last vessel I got to, the crew recognised it and got in touch with Robert who brought it around," she said.

Dr Thresher said while data gathered in the past 18 months had been transmitted, finding the float meant its condition could be evaluated by CSIRO engineers.

"Rarely do we have the opportunity to recover the profilers because they are mostly drifting with the remote currents in the ocean basin anywhere between the Arctic and Antarctica," she said.

Usually about 2800 of the robots are floating at any one time around the world.

As for Mr Wilson — he's philosophical about losing his potential letterbox.

"I didn't know what it was, no one seemed to know."

But unusual as it was, Mr Wilson said he had seen more interesting objects hauled up in the nets since he began working on trawlers at the age of 16.

"I've had pieces of aeroplanes, torpedoes, all sorts of things," he said.

Dr Dean Roemmich, from Scripps Institute of Oceanography, said the east coast of Australia was a place that the floats would occasionally travel thousands of kilometres to visit.

GONE fishing ... Brian Logan from CSIRO with the robotic profiler, *above*, fisherman Robert Wilson who snared the device in his nets, *right*. Pictures: Glenn Barnes/Graeme Parkes

Canadian National Report on Argo-2007

1. Status of implementation (Major achievements and problems encountered in 2007)

1.1 Floats deployed and their performance

During 2007, Canada deployed 18 floats: all were APEX floats and of these 10 were deployed in the Atlantic and 8 in the Pacific. As of writing in February 2008 only one float has failed with the rest continuing to supply good data. The Atlantic effort focussed on the Slope Water and Labrador Sea. The Pacific effort included deployments in the Gulf of Alaska and the Bering Sea. We are grateful to JAMSTEC for allowing us to deploy 5 floats from the R/V Mirai. Deployment plans for 2008 have remained uncertain as our inventory of floats declined almost to zero. By the beginning of March 2008 we will have 1 float in inventory and 12 floats on order, but may be able to order floats shortly. When we know what resources are available we will develop a deployment plan. We welcome deployment opportunities of Canadian floats from other nations.

A year ago we were pleased about an offer from METOCEAN Data Systems, Dartmouth, NS to replace two aged PROVOR floats in our inventory with 2 of the PNG (PROVOR New Generation) floats. We are anxious to test these in the field but progress on this exchange does not appear to be taking place. All of our remaining operating PROVOR floats are showing rapid declines in voltage (as expected of lithium cells after a long period of steady voltage) and we expect none to be operating by the March 2008 AST meeting.

1.2 Status of contributions to Argo data management

ISDM (formerly MEDS) continues to acquire data from 107 active Argo floats (100 APEX including 11 equipped with Aanderaa oxygen optode sensors, 7 Provor of which 8 floats appear likely to fail soon. Data are issued to the GTS and GDACs every 6 hours. We increased the frequency of acquiring data from the Argos server to hourly if we failed to access the system at every 6 hour interval. On average 75% of data are issued to the GTS within 24 hours of the float reporting for year 2007. We have sent approximately 3870 delayed mode quality control profiles to GDACs at the end of October 2007. We have roughly 4 month's worth of profiles ready for delayed mode quality control at this time. Our website is updated daily automatically. The website displays float tracks, temperature, salinity and oxygen contour plots and technical information for each float. The website is located at:-
http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Prog_Int/Argo/ArgoHome_e.html

For this year, we will continue to monitor Argo data on the GTS and report back any problems we see. We will update the technical and trajectory NetCDF format according to guidelines. We will need to set up the process to transmit and receive Argo data in BUFR format. Furthermore, we will need to rewrite and test some of our programs that

create NetCDF files in Java for the new server, because our UNIX server will be retired within 6 months.

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 2007 the Canadian Argo program was primarily funded as a research program. It has been our early intention to move funding to a more routine or operational basis but that has not yet occurred. We are continuing to pursue this. The funding in 2007 was adequate to maintain and slightly enhance the Canadian contribution to the international effort.

Funding appears to be becoming available late in our fiscal year (April 1st to March 31st) that would allow us to purchase floats for future launch and an order for 21 units has recently been placed with a possibility of being able to lodge an order for a few more units. The financial resources arrived too late in the fiscal year to allow us to order floats with sensors for dissolved oxygen and the lateness and uncertainty of financial resources does not permit forward planning of deployments.

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

Detailed deployment plans cannot be known until we know how many floats we can purchase. However, it is expected that the floats on hand will be deployed roughly 50% in the Atlantic and the Pacific. Atlantic deployments are likely to be biased towards the Labrador Sea and Pacific deployments biased towards the far northern regions of the Pacific, including the Bering Sea.

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

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

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 the ATC and AD positions should be co-located. We note that JCOMM is working to provide an Observing Programme Support Centre. This may be a suitable location as operations will be run in concert with other ocean observation programs.

As noted above, our current funding is still without long-term stability. We feel that it may be useful to us to hold an Argo Steering Team meeting some time in the foreseeable future in Canada, preferably in Ottawa.

Appendix – summary of Canadian float launches during calendar 2007.

	Launch Date	WMO-ID	Oxygen sensors?	Ocean Basin	Launching Vessel	Still Operating?
1	06/05/2007	4900875	N	A	Hudson	Yes
2	26/10/2007	4901066	N	P	Mirai	Yes
3	27/10/2007	4901067	N	P	Mirai	Yes
4	25/06/2007	4901068	N	P	Tully	No
5	22/06/2007	4901069	N	P	Tully	Yes
6	24/10/2007	4901070	N	P	Mirai	Yes
7	25/10/2007	4901071	N	P	Mirai	Yes
8	12/06/2007	4901073	N	P	Tully	Yes
9	24/10/2007	4901074	N	P	Mirai	Yes
10	14/05/2007	4901075	N	A	Hudson	Yes
11	15/05/2007	4901076	N	A	Hudson	Yes
12	17/05/2007	4901077	N	A	Hudson	Yes
13	25/05/2007	4901079	N	A	Hudson	Yes
14	25/05/2007	4901080	N	A	Hudson	Yes
15	08/10/2007	4901081	N	A	Hudson	Yes
16	12/10/2007	4901082	N	A	Hudson	Yes
17	14/10/2007	4901083	N	A	Hudson	Yes
18	07/10/2007	4901084	N	A	Hudson	Yes

China National Report

Submitted by Prof. Xu Jianping

Present Status of China Argo

China Argo gets financial supports from the Ministry of Science and Technology, the State Oceanic Administration (SOA) and the National Natural Science Foundation. So far it has been funded through R & D projects and the amount of fund is limited.

1. Floats deployed and recovered

No floats were deployed in 2007 by China Argo. There are 10 floats still active, in which Float 5900019 has been working in the Northwest Pacific for more than 5 years and observed about 180 profiles.

In July 2007, China Argo Real-time Data Center bought 2 APEX floats with lithium batteries from Webb, but they have not been deployed yet. In November the same year, the National Marine Environmental Forecasting Center (NMEFC), SOA entered into a contract with Webb for purchasing 10 APEX floats.

In March 2007 the fishermen from China Hainan Province got a float in the fishing net to the east of Hainan Island. The float has a number of 3063. It entered into our EEZ but no organizations or countries informed us about it. In August 2007 the fishermen from Zhejiang Province happened to get another float, an ALACE float numbered 168 in the fishing net. During the visit of Mr. Mathieu Belbeoch to China Argo Real-time Data Center, the owners of the floats were informed about the float, but we have gotten no responses up until now. The two floats are still kept in China Argo Real-time Data Center waiting for retrieval by their owners.

In July 2007, China Argo Real-time Data Center was informed by AIC that an Argo float (Argos Platform Number 21302, WMO Number 5900225) deployed by China Argo in January 2003 to the east of Philippines was taken by Philippines fishermen to Davao Gulf, Mindanao Island and was kept by the Philippines Coast Guard until now. As early as 2004 to 2007, China Argo Real-time Data Center contacted the scientists of the Marine Science Institute (MSI) of University of the Philippines for many times and asked them to help us to get the float back to China, but no result for some reason or other. In July 2004, MSI helped us successfully in retrieving another float taken by the fishermen to Bislig Bay, Mindanao Island. China Argo Real-time Data Center and MSI have built up close links in exchange of Argo data and recovery of Argo floats. Both sides have very happy cooperation. At present we have got in touch

with the Philippines Coast Guard through AIC and scientists of MSI are entrusted to help us to transport the float to China.

For effective retrieval of Argo floats, China Argo Real-time Data Center has designed and printed 50,000 copies of an advertising poster, which were distributed among the fishermen and other people working on the sea before the end of 2007, with an aim of timely retrieval of beached Argo floats or floats drifting near shore.

The International Argo Technical Coordinator, Mr. Mathieu Belbeoch made a special trip to visit China in September 25-29, 2007. Officials dealing with marine affairs from the Department of International Cooperation, State Oceanic Administration talked to him on the issue concerned by us about the foreign Argo floats entering our EEZs for many times, and made it clear to him about our position on this issue. We hope that the Argo TC will report the information to Argo co-chairmen or the whole member of the Argo Steering Team and urge relevant countries to act on the aim of the International Argo Program. Any float deployed in the name of Argo should be for the purpose of scientific research and operational application, not for grabbing marine environmental information of the territorial seas or EEZs of other countries and thus, harm the marine rights of the countries. We also hope that the TC will inform the coastal countries about the information of the Argo floats that are going to enter or have entered the EEZs or territorial seas according to IOC Assembly Resolution XX-6 and ask for their opinion if they allow the float continue the observation, thus to make it possible for them to take necessary measures and to avoid any infringement of their marine rights.

2. Technical problems encountered

All the active floats are APEX floats at present. No energy flu or Druck pressure transducer problems are found on these floats.

3. Status of Argo data management

3.1 Real-time data management

China Argo Real-time Data Center at SIO/SOA is responsible for receiving the data from all active floats deployed by China. All the R-files through real-time QC are sent to GDACs in NetCDF format and profiles are inserted into GTS at CLS. 382 profiles were sent to GDACs in 2007.

3.2 DMQC

China Argo Real-time Data Center has made big progress in DMQC in 2007. Thermal mass correction has been applied on all APEX floats. A total amount of 1611 D-files have been transmitted to GDACs and more than 90% profiles have been applied DMQC. In 2008 trial utilization of OW method will be carried out in the center.

3.3 Products of Argo floats and data

The estimated monthly mean mid-depth currents in Pacific Ocean are available at China Argo Data Center's website (http://argo-cndc.org). At the National Marine Environmental Forecasting Center, Argo data is being used with other data from GTS in their ocean assimilation system, and the reanalysis products are available at http://dell1500sc.nmefc.gov.cn/argo-sz/argo11n.asp. The Chinese Academy of Meteorological Sciences has added the Argo profiles into the BCC-GODAS System and the data is released at the website of IRI/LDEO, Columbia University (http://iridl.ldeo.columbia.edu/SOURCES/.CMA/.BCC/.GODAS/).

4. Operational use of the Argo data

China National Climate Center and NMEFC have assimilated Argo data into ocean and climate forecasting models and entered into a stage of operational trial application. The Ministry of Science and Technology and State Oceanic Administration approved 2 projects of basic research based on the global Argo real-time observation program to support Argo data assimilation and re-analysis of multi-resources data for the study of formation and variation of the upper layer structure of the subtropical Pacific Ocean, the heat and salt exchange between the Pacific Western Boundary Current and the coastal seas of China, and the seasonal to interannual variation of the upper layers of the subtropical Pacific and Indian Oceans, so as to provide theoretical basis for the study of forecastability of the marine environment of the Northwestern Pacific Ocean and short term tropical climate and to allow wider application of Argo data in operational forecast of weather, climate and ocean features.

Deployment plans

1. Deployment plan in 2008

China plans to deploy 32 floats including 2 APEX floats with oxygen sensor (SeaBird IDO) and 2 iridium APEX floats. These floats are all going to be deployed in the Northwestern Pacific Ocean.

2. Available deployment opportunities

China's polar *R/V SNOW DRAGON* goes to Antarctic from November to March every year to carry out scientific expedition and provide logistic supply for the Great Wall and Zhongshan Antarctic stations. Another *R/V OCEAN No. 1* had a round-the-world trip in 2006 and fulfilled a scientific survey in Pacific and Indian Oceans in January 2007. In May 2008 it will carry out another Pacific-Indian Ocean survey. China Argo floats are deployed mainly by these two vessels. We are willing to help other Argo members to deploy Argo floats in the Southern Ocean and Indian Ocean through the two vessels.

China Argo Real-time Data Center, the Second Institute of Oceanography, SOA and the state key laboratory of Satellite Ocean Environmental Dynamics hope to host the

3rd Argo Science Workshop in Hangzhou. We wish to make more contributions for the wider application of Argo data as well as sustained development of Argo project.

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ARGO National Report 2008 – The Netherlands

1) **Status of implementation**

   The Dutch Argo program, run by the Royal Netherlands Meteorological Institute (KNMI), started in 2004 when three floats were deployed between Spain and Ireland. Scince then 17 more floats have been purchased and deployed, bringing the total to 20, two of which have stopped working.

   KNMI is invloved in EuroArgo.

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

   In their observation strategy adopted in 2006 KNMI has expressed the intention to sustain a fleet of approx. 30 floats. Given a lifetime of about 4 years for a float this means purchase of about eight floats per year, plus communication. However, funding for float procurement has to compete with investments in other observational programs. At the moment (31 Jan.) it is still open whether extra floats can be purchased in 2008.

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

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

   At least four floats (see above) will be deployed in the North Atlantic.

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 9th ARGO Steering Team meeting
February 2008
V. Thierry, S. Pouliquen, C. Coatanoan

1. The status of implementation (major achievements and problems in 2007)

- floats deployed and their performance:

32 floats were deployed in 2008. It is less than planned as a number of cruises have been delayed. This explains the increase in the plans for 2008.

A prototype of the new generation of PROVOR profiling float, the ARVOR float, was deployed in December 2006 in the Bay of Biscay. He died after 186 cycles due to the lack of power after a remarkable mission. He was programmed to cycle every 2 days down to 2000m with a parking depth of 1000m with continuous pumping during the ascent and a 6-hour Argos transmission. He was equipped with 18 batteries.

- technical problems encountered and solved:

ARVOR industrialization: Due to various problems (lack of man power, technical problems), the industrialization phase of the ARVOR floats, which began in 2006, was delayed in 2007. It is now terminated and in February 2008, the first of the ten floats ordered has been tested in a tank and the weight budget is being improved. The soft is coded and a complete float cycle has been simulated in laboratory. Qualifications tests are pursued and a deployment at sea with float recovery will be done soon from a cruise of opportunity.

Provor float equipped with Dissolved Oxygen sensors (PROVOR-DO): 2 prototypes have been provided by Ifremer to IFM Geomar (as part of CARBOCEAN) to replace PROVCABON floats that were not available at that time. Deployed in February 2007, only one is still active. The other one never transmitted anything.

Tests realized on 8 other PROVOR-DO floats show large mismatches in the O2 measurements. Complementary tests realized on 2 floats showed systematic underestimation of the O2 measurements that is greater than the Aandera specification. The underestimation of the O2 concentration is problematic for those floats that were deployed in minimum oxygen zone (off the Chile coast) as value of 0 μM/l has been reached. We thus conclude that it is mandatory to recalibrate the O2 sensor before deployment.

In 2008, we will work on the improvement of the PROVOR-DO float. In particular, we are going to move the DO sensor from the bottom to the top cap of the float. It is worth mentioning that within the Oxywatch project, which has been recently submitted to Europe (FP7) and in which Ifremer is partner, improvement in oxygen measurement will be done.

Irridium transmission: Irridium antennas were tested on PROVOR floats equipped with optical and biological sensors. Due to many problems encountered with existing antennas from Trident sensors, Ifremer successfully developed its own antenna. The first PROVCARBON float has been successfully deployed in February 2008 by IFM Geomar.

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

Coriolis continue to process French floats in RT and DM. French Coriolis data center processes data coming from 775 floats including 333 active floats in November 2007 (about half Provor , half Apex) , deployed by 11 countries (Chile, China, Costa Rica, France, Germany, Korea, Mexico, Netherlands, Norway, Russia, Spain and the European Union), Operated by more than 35 scientific projects (Good-Hope, Mersea, MFSTEP, Tropat, Weccon…) The detail can be found in the 8th ADMT report. Data are processed and distributed according to Argo recommendations
Coriolis operates one of the GDAC in close collaboration with FNMOC/ISA. Coriolis also coordinates the ARC activities and in particular the float deployment in Atlantic

2. Status of delayed mode quality control process

Statistics on all delayed mode data loaded in the Coriolis database for end of February are presented on Figure 1. 25052 delayed mode profiles are present in the Coriolis DAC that represents about 46% of the total number of profiles available at the Coriolis DAC. This number did not increase since the last ADMT in November because some cycles have been re-decoded to correct trajectory data and metadata. Because of the re-decoding of the floats, the delayed mode data have been removed from the database. Few of them have been re-submitted and updated in our database but others are still waiting for this update. This problems concern only Coriolis floats because the work on the trajectory data was initiated on Coriolis float (Provor CTS2 and CTS3 - APEX version 4 and 11).

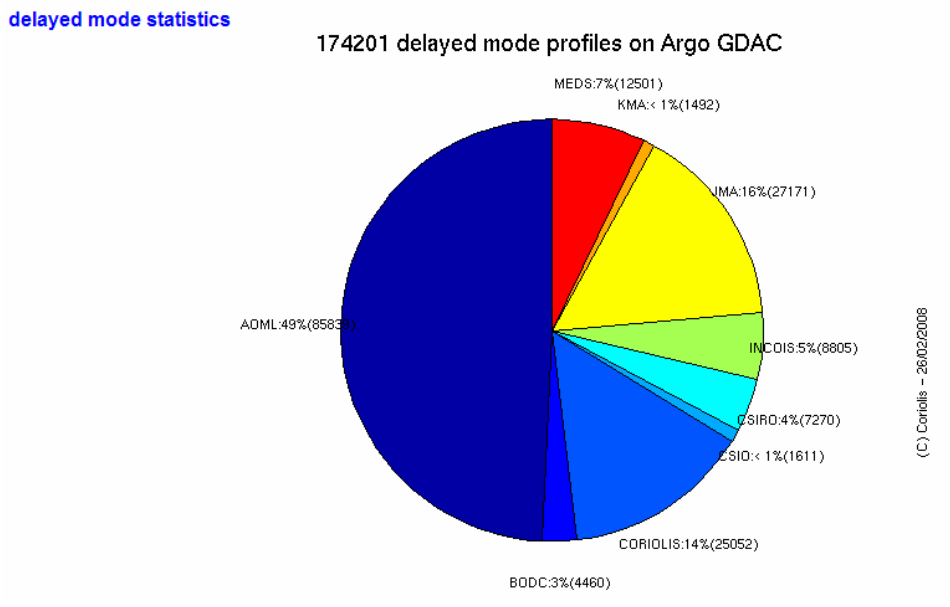


Figure 1: Delayed mode statistics.

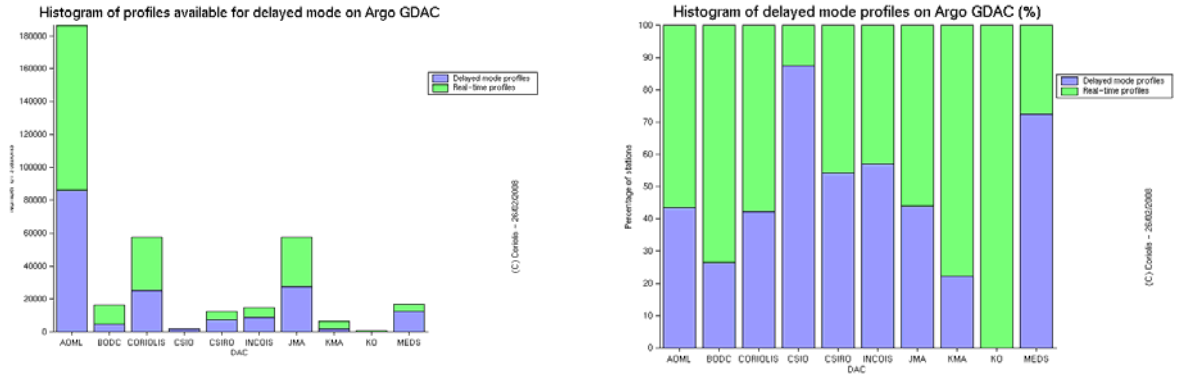


Figure 2: Histogram of profiles available for delayed-mode on Argo GDAC. (Left) Number of pofiles; (Right) percentage.

The Figure 3 presents the status of the Coriolis floats. 46% of the floats have been processed, while 18% of the floats cannot be processed for various reasons (only temperature sensor, float too young, etc..). Among the remaining floats that must be controlled in delayed mode, 29% of the floats are currently under consideration by the PIs and 10% of the floats are problematic and must be considered carefully.

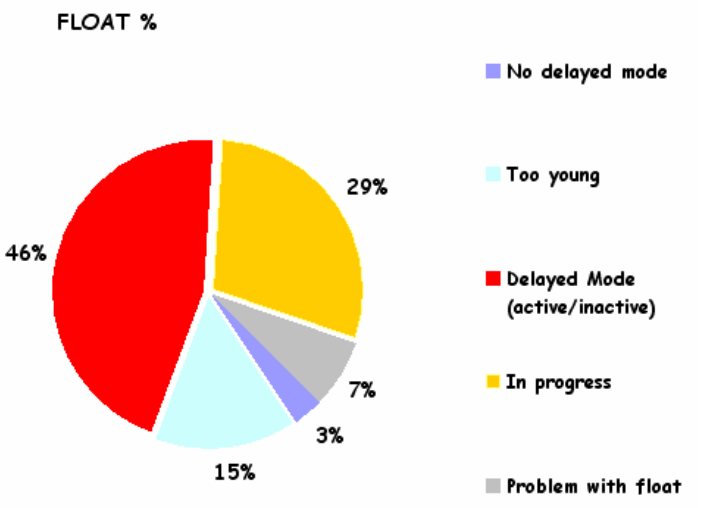


Figure 3 : Status of the delayed mode process at the Coriolis DAC.

In terms of project, some of them are well updated and others need complementary studies to provide delayed mode data, especially those that deployed floats in the southern ocean (Goodhope and Drake projects). With the new version of the OW's method taken into account polar front, we hope that delayed mode data for those projects will be provided very soon. The delayed mode profiles from some floats should have been available since December 2007 but the matlab files sent to Coriolis by the PI where erroneous and because of the unavailability of the PI, those data should be available soon. In another project (Ovide project), the PI provides a report for each float containing a complete overview of the behaviour of the float, of the changes on real-time flags, as well as information about the correction applied to the data. Those reports are available on the following Web page: http://www.ifremer.fr/lpo/ovide/data/argo_profiling_floats.htm. It takes some time to write them, which explains part of the delay in the availability of the delayed-mode profiles, but we believe it is worth doing it. We encourage each PI to do the same kind of report for each calibration on floats. To conclude, the delayed-mode quality control of the Coriolis DAC floats is progressing but we are still in the development stage which explains that the number of delayed mode profile does not increase that much.

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

Since 2000, more than 335 French floats and 68 floats co-funded by European Union have been deployed in different geographic areas. The deployments meet specific French requirements but they also contribute to the global array. The French contribution is comparable to that from other developed countries and has provided a significant contribution to the growing Argo array.

Year	*French floats*

2000	*11*
2001	*12*
2002	*7(+4)*
2003	*34(+20)*
2004	*85 (+18)*
2005	*89(+11)*
2006	*65(+15)*
2007	*32*
2008	*68*

Tableau 1: Numbers of French floats contributing to Argo deployed by year, figures in brackets are the additional floats co-funded by EU within the Gyroscope, MFSTEP and Mersea projects. Estimated figures are given for 2008.

The French Argo Project is funded by the ministry of Research (mostly through Ifremer) and in a lesser proportion by the ministry of Defense (through SHOM). Ifremer plans to buy 50 floats in 2008 while no float will be buy by SHOM this year. It plans to buy 15 floats/year in 2009 and beyond. As part of the Euro-Argo preparatory phase, Ifremer works with its funding ministry (mainly research ministry) to agree on a long-term funding level and commitment. Together with its European partners, Ifremer also works with the European commission to set up a long term EC funding to Argo.
Overall the level of support, additional to float purchase, is as indicated in the table below (man power for float preparation and data processing).

Year	Man/Year
2001	3
2002	6
2003	9
2004	15
2005	15
2006	12
2007	12
2008	12

Tableau 2: Man power dedicated to Argo for float preparation and data management activities within French Argo.

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

According to the current deployment plan, 68 floats will be deployed in the Mediterranean Sea, in the North and South Atlantic Oceans, in the Southern Ocean and in the Pacific Ocean (Figure 4).

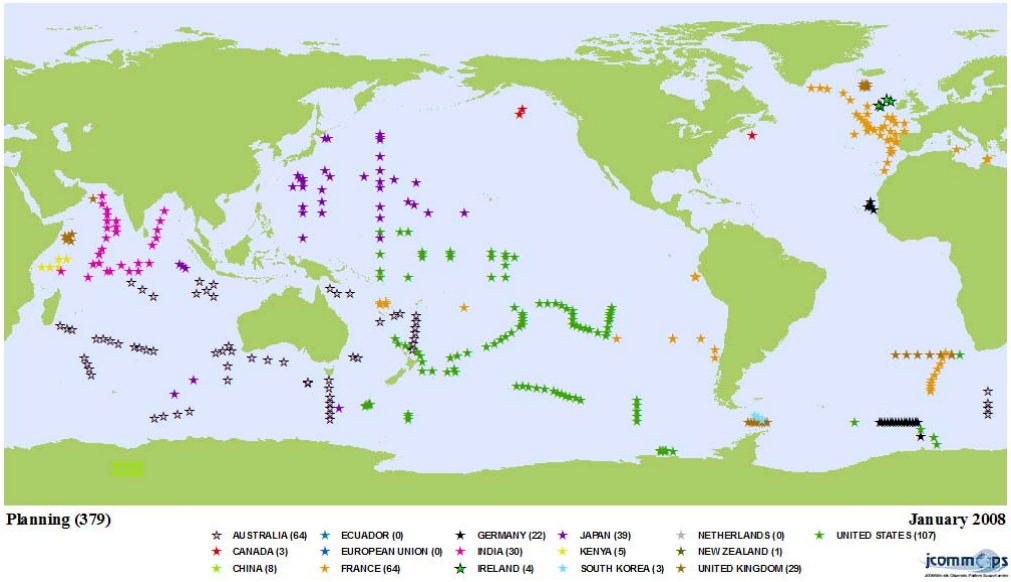


Figure 4: Deployment plan. The orange stars represent the french deployment plan for 2008.

Coriolis will continue to run the Coriolis Dac and the European GDAC as well as coordinating the North Atlantic Arc activities. Within the Euro-Argo project development will be carried out to improve anomalies detection at GDAC both in RT and DM, to monitor at sea behavior of the European fleet and to improve data consistency check within NA-ARC.

Franc also contributes to the funding of the AIC. Coriolis is also willing and interested to host a future extended JCOMMOPS center.

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

A key aspect of the French Argo program is to develop the capabilities to fully exploit all Argo data for operational forecasting as well as research applications. Therefore Coriolis has developed together with MERCATOR (The French operational oceanography forecast centre) a strong connection with the French research community via the Mercator-Coriolis Mission Group (GMMC). It consists of about one hundred researchers (with some turnover each year) following a scientific announcement of opportunities and call for tender. Its task is to support the Mercator and Coriolis scientific activities and to participate in product validation.

Operational ocean forecasting. All Argo data (alongside with other in-situ and remotely sensed ocean data) are routinely assimilated into the MERCATOR operational ocean forecasting system run by the MERCATOR-Ocean structure. Assessments have clearly demonstrated the positive impact of Argo data on ocean analyses and predictions

Ocean science. Argo data are being used by many researchers in France to improve the understanding of ocean properties (e.g. circulation, heat storage and budget, and mixing), climate monitoring and on how they are applied in ocean models (e.g. improved salinity assimilation, …). The French Argo Users' Group provides a forum for engagement between these scientists and the French Argo programme.

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

- **OVIDE and North Atlantic variability** (H. Mercier, V. Thierry, T. Huck, P. Lherminier, B. Ferron)**:** This project focuses on the variability of the thermohaline circulation (THC) on

seasonal and interannual time scales, on water mass analysis and census and on heat balance estimates. It includes a 4-D VAR inversion to reconstruct optimum circulation. The project includes a high resolution CTD section from Iberia to Greenland every two years, useful for delayed mode QC.

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

Additional projects are also funded by Coriolis and Euro-Argo for data analysis:

- **PABIM (Euro-Argo)** (F. d'Ortenzio): This project aims at defining the best way to measure and process biogeochemical data from autonomous platforms (profiling float, glider, seal). The focus will be on oxygen and chlorophl.
- **ARGO-ALTI (Euro-Argo)** (G. Larnicol): Using Argo and altimetry data, this project aims at investigating the impact of the Argo data on the understanding of sea level variations mechanisms at global and regional scales.
- **TOCAD (Euro-Argo)** (F. Gaillard, T. Huck, B. Ferron): The TOCAD objectives are : (1) to monitor ocean properties during the ARGO period (2002-2007) and contrast them to the 1980-2000 period; (2) to study the variation of the large scale ocean circulation using robust-diagnostic and inverse models; (3) to perform 4D-var assimilation of ARGO profiles and altimetry
- **PROSAT** (L Prieur) : This project aims at developing a method for joint analysis of time series of in situ profiles (CTD, ARGO) and time series of satellite data (SST, SChla) in order to get time series of heat, salt and biomass content.

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 the use of optimal interpolation of temperature and salinity to describe and quantify seasonal and interannual variability of the ocean (mean state, heat and salt content, etc).

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

GERMAN ARGO PROGRAMME

PRESENT STATUS AND FUTURE PLANS

B. Klein, BSH
February 07, 2008

1. Background and organization of German Argo activities

The German Argo programme has been initialised as a partnership between three oceanographic institutions (AWI, BSH, IfM-Geomar) in Germany. German Argo began in 2004 and was funded by the Ministry of Research until the end of 2007. German Argo is considered to be an operational programme since the beginning of 2008 and the Ministry of Transportation is providing long-term funding for German Argo. BSH will manage the German contribution to the international programme.

Deployment of profiling floats started as early as 1998 within several research projects. All pre-Argo floats were declared Argo-equivalent floats and the respective data sets have been submitted to the GDACs through Coriolis. Floats deployed by IfM-Hamburg in the context of the Mersea and WEN projects have also been made available for the Argo programme.

The BSH and KDM (a consortium of German research institutes) are participants in the Euro-Argo project. Euro-Argo will aim at promoting a European contribution to Argo and will establish a European structure from the various national programmes (to be defined in the Euro-Argo PP) after 2011.

1.1 Deployed floats

Since 1998, more than 250 floats have been deployed by Germany in a number of different geographic areas and programmes (ARGO_AWI, ARGO_Greenland, BSH, Clivar Marine German Programme, IFM2, IFM_GEOMAR, SFB460, TROPAT, WECCON, WEN). Deployments have focused on meeting specific German research requirements, but contributed also to the global array. The German contribution is comparable to that from other developed countries and has provided a significant contribution to the growing Argo array.

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

Year	Deployed floats
2007	30+11 (WEN)
2008	~50

Floats deployed by Germany as a contribution to Argo in 2007 and 2008

1.2 Float Development

Most of the floats deployed by Germany are APEX floats purchased from Webb Research, but a minority of floats are manufactured by the German company Optimare. Optimare has been working in close connection with the AWI and has developed a float type suitable for partially ice covered seas. These floats are equipped with an ice sensing algorithm which prevents the float from ascending to the surface under ice conditions and prevents it from being crushed. Float profiles are stored internally until they can be transmitted during ice free conditions.

Most of the German floats are equipped with the standard Seabird CTD but occasionally additional sensors as Aanderaa optodes and Rafos acoustic receivers are installed.

1.3 Data management

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

Delayed-mode data processing. The delayed mode processing is distributed between the various German institutions contributing to Argo, depending on their area of expertise. AWI is responsible for the southern Ocean, IFM-Hamburg is processing the German floats in the Nordic Sea, IfM-Geomar is covering the tropical and subtropical Atlantic and BSH is responsible for subpolar Atlantic. The sharing of delayed-mode data processing will be continued in the coming years, but BSH will cover all the German floats which have not been assigned a PI. All institutions have been working in close collaboration with Coriolis and delayed mode data have been provided on a 6 monthly basis. Delays in delayed-mode data processing have occurred occasionally due to changes in personal and delay in data transmission in the Southern Ocean due to ice coverage. Delayed-mode data processing follows the rules set up by the Data Management Team.

North Atlantic Argo Regional Centre (NA-ARC). Germany has contributed to the activities of the NA-ARC. Work has concentrated on acquiring recent CTD data to improve the reference data set for the North Atlantic Ocean needed for scientific QC of the float data and setting up the delayed mode processing in the different institutes.

1.4. Operational and scientific use of Argo data

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

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

2. Funding

2.1 Existing funding for German Argo

As noted above the German Argo Project has been funded by the Ministry of Research from 2004-2007 and will be funded by the Ministry of Transportation from 2008 onwards. Funding in 2007 was meant to ensure a smooth transition into the operational phase and covered only personnel costs. Overall the level of support is indicated in the table below. Funding from the Ministry of Transportation covers only costs related to float procurement and transmission costs, personnel will be provided by BSH. This will consist of 1 scientist and 1 technician.

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

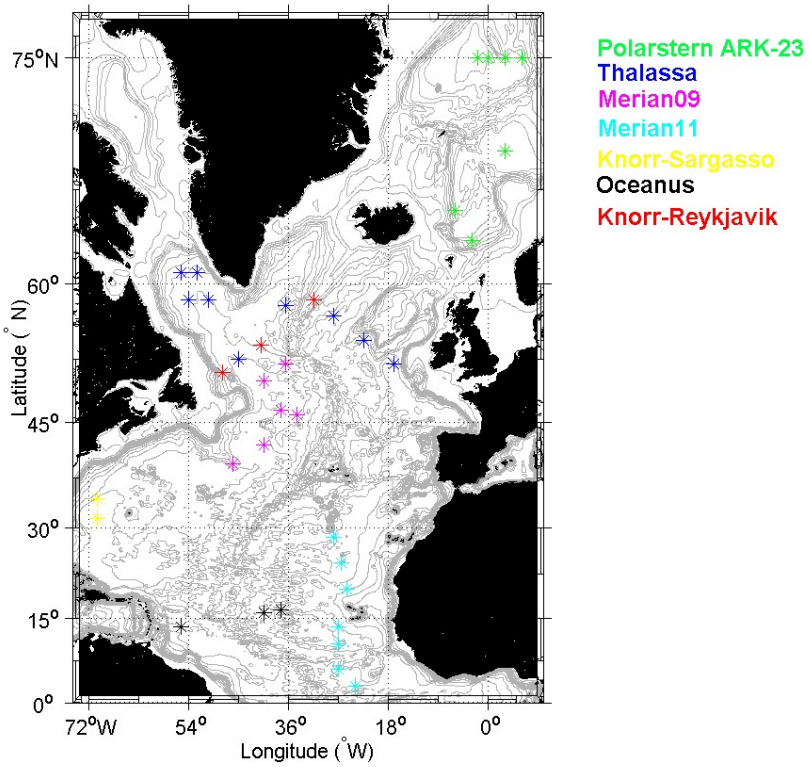
Table 3. Previous and future funding for German Argo.

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

Germany will to contribute to the Argo global array at the level of about 50 floats per year. Requests for financial contribution have been included in the budgets for 2009-2013, but budget negotiations will be carried out on an annual basis. As part of the Euro-Argo preparatory phase, BSH will work with its funding ministry to agree on a long-term European structure.

3. Summary of deployment plans for 2008

Float deployment in 2008 will be performed in co-operation with the German research institutes. A preliminary map of the planned deployment positions in the North Atlantic is given below. Six additional floats will be deployed in the Weddell Sea, deployment positions will be assigned later this year.



Preliminary plan for deployment of German floats in 2008. Deployments will start in mid June 2008 earliest. Deployment opportunities from Knorr and Oceanus have yet to be confirmed. Six more floats will be deployed in the Weddell Sea at the end of 2008.

Argo Steering Team Meeting (AST-9)

National Report – India

(Submitted by M. Ravichandran)

A. Organization of Indian Argo Project

a) The Indian Argo Project, fully funded by the Ministry of Earth Sciences (MoES), Government of India is implemented by the Indian National Center for Ocean Information Services (INCOIS) of MoES at Hyderabad. From this year, National Centre for Antarctic and Ocean Research (NCAOR) is taken up the responsibility of deployment of Argo floats.
b) The Indian Argo Project for the year 2007-2012 envisages (a) Deployment of 200 Argo floats in the Tropical Indian Ocean, (b) Argo Data Management Activities, (c) Regional Coordination for Deployment in the Indian Ocean, (e) Development of Ocean Data Assimilation System, (f) Analysis and utilization of Argo data and (g) Capacity Building at National level.
c) Several R&D Institutions including the National Institute of Oceanography at Goa, NCAOR, 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. National level Argo utilization meeting is planned in July 21-23, 2008.

1. Floats deployed and their performance

a. Float deployment

During the year 2007-08, 38 floats have been deployed with 10 floats with Oxygen sensors. Another 30 floats are planned to deploy in North Indian Ocean during October-Dec 2008.

Financial Year	Floats deployed
2002-03	10
2003-04	21
2004-05	33
2005-06	43
2006-07	15 (4 Oxygen Sensor)
2007-08	38 (12 Oxygen sensor)
TOTAL	160

During the year 2007-08, 10 floats were deployed with Oxygen sensors in Bay of Bengal and two floats were deployed in Western equatorial Indian Ocean.

b. Performance Analysis of the Floats deployed so far

Out of 160 floats deployed by India so far, 89 floats are active. Out of 89 active floats, 70 floats are less than two year old.

One Argo float beached in Srilanka was retrieved by Srilankan fishermen with NARA. Presently this float is with NARA. There was no damage in this float and it is in working condition. Highest appreciation to Srilankan fishermen, Argo Information Center and NARA their help in retrieving this float.

c. Status of contributions to Argo data management

- **Data acquired from floats**
  India had deployed 160 floats so far. Out of these 89 floats are active. All the active floats data are processed and sent to GDAC.

- **Data issued to GTS**
  Presently we do not have GTS access and hence we are not able to send Indian floats data to GTS. Up on our request CLS ARGOS is still continuing to send Indian floats data in TESAC format to GTS.

- **Data issued to GDACs after real-time QC**
  All the active floats (89) data are subject to real time quality control and are being sent to GDAC.

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

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

Page	Hits	Visitors
Argo Web-GIS	3842	603
Data download	7367	244
Live Access Server	310	57
Argo products	510	52

- **Delayed Mode QC:**
  INCOIS started generating and uploading D files to GDAC form July 2006, as of today 93 eligible floats(as of July 2007) were subjected to DMQC and only 81 of them were uploaded. More than 70% of the eligible Indian Floats are DMQCied and are available on GDAC.

  Major bottle necks identified for DMQC are

  - Lack of CTD profiles from North Indian Ocean is still a critical problem when decision is to be taken for the complicated cases. As per the suggestion following the previous DMQC meeting, if the data other than CTD is omitted from the reference database, the number of profiles for DMQC reduces significantly in many regions.
  - The second major issue is the Manpower.

- **Trajectory data:**

  - A total of **140 trajectory** netcdf files were processed and uploaded to the GDAC. The process of generation of trajectory netcdf files undergoes quality checks like position, time, cycle number, etc., and corresponding quality status is assigned to each parameter. Finally a visual check is performed to verify that there are no missing cycles without cycle numbers and to check the surface time intervals.
  - For 8 new floats deployed in 2007, trajectory files are also processed for surface time and uploaded to GDAC.

  The proposals of ATW-2and status of implementations is given in the following tables.

Trajectory - Format checks		**Status**
1	Introduce missing cycles and CYCLE_NUMBERs with CYCLE_NUMBER starting from zero.	Done
2	Julian day (JULD) to be made monotonic.	Done
3	Position_QC and JULD_QC to be made consistent with Table2 ofATW-2.	Done
4	Increment in JULD to be consistent with CYCLE_NUMBER	Done

Trajectory - Scientific challenges		Status
5	Estimation of times at end of ascent and start of descent	Done for Floats deployed in 2007
6	Estimation of position at those times by extrapolation of reported surface positions	Code for the module is under process

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

Indian Argo Project is a 5 year Program from April 2002 to March 2007 fully funded by MoES, Govt. of India. For the next five year plan (2007 to 2012), Ministry of Earth Sciences has approved funding for deploying 40 floats per year (200 floats for 5 year term) with few floats will have additional sensors. Funding is secured upto 2012 for deployment of 200 Argo floats, Data management activities, Data analysis, etc.

2 Permanent and 1 temporary scientific/technical personal are working under Indian Argo project, which include personal for deployment of Argo floats, Data system, Analysis of Data, etc. in three different institutions. Efforts are underway to get more manpower.

3. Summary of deployment plans and other commitments to Argo for the upcoming year and beyond where possible.

India committed to deploy floats in North Indian Ocean wherever gap exists. Also plans to deploy few tens of floats in the Southern Indian Ocean.

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

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

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

The data are being used for:

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

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

National Level Argo user meet workshop is planned during July 21-23, 2008, mainly to take stoke of the research going on in National level using Argo data.

Regional Centre Functions

- Acquisition of Argo data from GDAC corresponding to floats other than deployed by India and made them available on INCOIS web site.
- Delayed Mode Quality Control
  (Refer 2.0 above)
- Data from the Indian Ocean regions are gridded into 3x3 box for monthly and 10 day intervals. These gridded data sets are made available through Live Access Server (LAS). Users can view and download data/images in their desired format.
- Additionally SST from TMI and Wind from Quickscat are made available on daily and monthly basis. SSHA merged product is provided on ten day basis on INCOIS Live Access Server.
- Data Sets (CTD, XBT) have been provided to CORIOLIS, IFREMER for integration into the Reference Data Sets, used for Delayed Mode Quality Control.
- Value added products:
  Two types of products are currently being made available to various user from INCOIS web site. They are:

  1. Time series plots corresponding to each float (only for Indian floats). This include the following plots:
     - Water fall plots
     - Surface pressure
     - Bottom most pressure
     - Surface temperature
     - Bottom most temperature
     - Surface salinity
     - Bottom most salinity
     - Trajectory of float

- T/S plots.

2. Spatial plots using the objectively analysed from all the Argo floats data deployed in the Indian Ocean. This includes:
   - Temperature (at 0, 75, 100, 200, 500, 1000 meters)
   - Salinity (at 0, 75, 100, 200, 500, 1000 meters)
   - Geostrophic Currents (at 0, 75, 100, 200, 500, 1000 meters)
   - Mixed Layer Depth, Isothermal Layer Depth
   - Heat Content up to 300 mts
   - Depth of 20 deg and 26 deg isotherms

These valued added products can be obtained from the following link http://www.incois.gov.in/Incois/argo/products/argo_frames.html

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

TVS Udaya Bhaskar, D. Swain and M. Ravichandran (2007), Mixed layer variability in Northern Arabian Sea as detected by an Argo float, *Ocean Science Journal*, Vol. 42, No. 4, Dec, 2007.

Anitha, G., M. Ravichandran, and R. Sayanna, (2008), Surface buoyancy flux in Bay of Bengal and Arabian Sea, *Annales Geophysicae*., in press

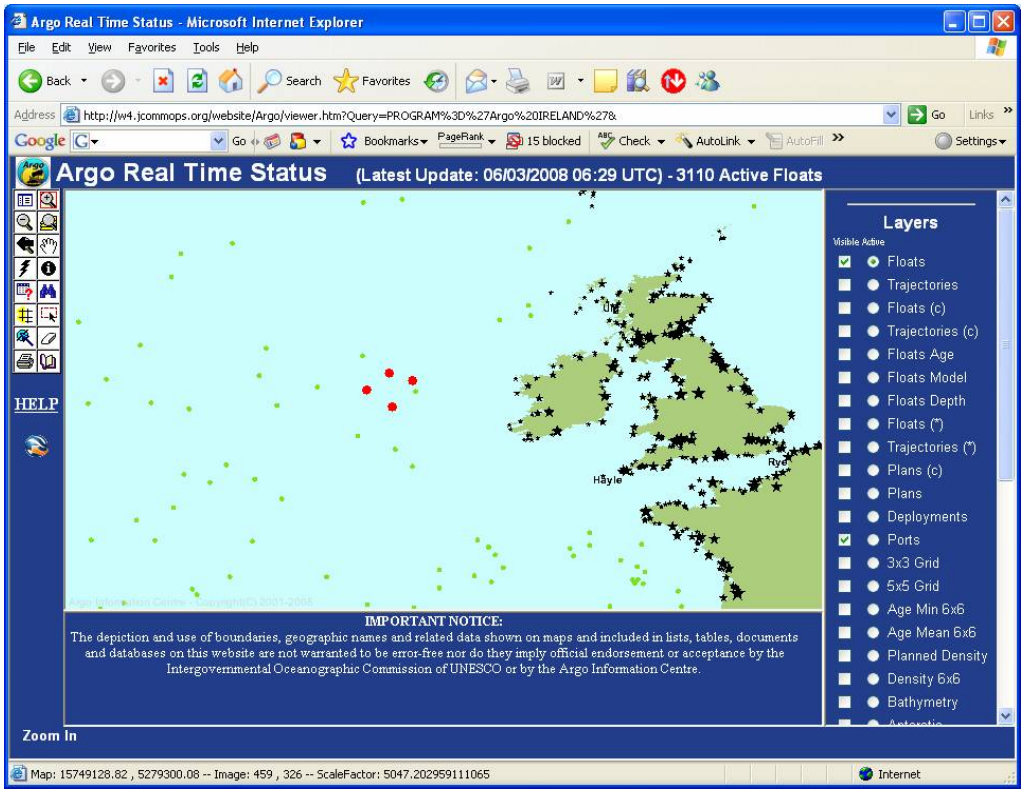
Argo Steering Team – Ireland Argo Activities 2007-2008

1) Status of implementation

2007 was the first year in which Ireland became a member of the Argo programme and a partner in the Euro Argo PP. Twelve floats were procured through a European Regional Development Fund (ERDF) grant, four of which were deployed in March of 2008 from the RV Thalassa.

4 Platforms

	Status	WMO ID	Telecom ID	Model	Program	Date	Data	Age
1		6900648	79622	APEX	Argo IRELAND	03/03/2008		0
2		6900650	79615	APEX	Argo IRELAND	12/03/2008		11
3		6900647	79621	APEX	Argo IRELAND	03/03/2008		0
4		6900649	79616	APEX	Argo IRELAND	10/03/2008		10



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

At present, there is no official operational budget for the Argo programme. As mentioned previously, the Argo floats were purchased using an ERDF grant. Four floats were deployed in the Rockall Trough during a research cruise on the RV Thalassa. Additional costs which may be incurred during subsequent deployment phase will be absorbed by the MI. The MI have secured agreement from the BODC to facilitate the delivery of 'real-time' Argo data and validate the 'delayed-mode' data from the Irish floats. The cost of the data delivery and processing is currently being shouldered by the Marine Climate Change programme in the MI. This programme is in place for a period of two years, with the possibility of extension for another five

year period. Costs incurred in the storage and testing facilities for the Argo floats are being carried by the MI annual budget.

In terms of human resources devoted to the Argo project, Fiona Grant has been appointed as project manager for the Euro Argo PP and Sheena Fennell is in charge of operational issues (deployment, data delivery and the MI website). One to two other research personnel in the MI will use Argo data to validate the ROMS model. Data may also be used by staff in the Marine Climate Change programme which is headed up by Glenn Nolan.

3) Summary of deployment plans (level of commitment, areas of float deployment) and for other commitments to Argo for the coming year (and beyond where possible).
See paragraph above in relation to Argo deployment plans. Four floats per year will be deployed from 2008-2010 (lifetime of Euro Argo PP). The MI are WP leaders for Implementation Strategies in the ESONET NoE project and are WP leaders for the Business Plan and Legal Work in the EMSO PP. It is envisaged that mechanisms to leverage additional funding for large scale infrastructures may be identified in these projects which may also benefit the case for Euro Argo.

4) Summary of national research and operational uses of Argo data
The MI runs the Rutgers Ocean Model (ROMS) on an operational basis. Argo profiles are used to provide a near real time check on model output profiles of temperature and salinity within the model domain.
http://www.marine.ie/home/services/operational/oceanography/OceanModelSimulation.htm

Martin White in the National University of Ireland, Galway has also deployed Argo floats (one of which is still operational). Both he and research students have used the data in their research activities.

We envisage that operational uses of Argo data will become more relevant when we receive the first profiles from the floats.

5) Issues that your country wishes to be considered (and resolved) by AST regarding the international operation of Argo
As discussed at the Euro Argo kick off meeting in Brest in January, if there is a cost benefit to Ireland in procuring floats centrally, then this could be considered by the AST. It has been beneficial to the MI to use the BODC data delivery and processing facility as it would not be feasible to set up a similar process here given the small number of floats involved.

The 9th Argo Steering Team Meeting, Exeter, March 18-20, 2008

Japan National Report

(Submitted by Nobie Shikama)

1. The Status of implementation (major achievements and problems in 2007)

1.1 Floats deployed and their performance

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 80 floats (all APEXs) with the aid of R/Vs of 11 domestic organizations in 2007. Two APEXs among these 80 floats have a Sea-Bird oxygen sensor and a Wetlab chlorophyll sensor. The R/V Mirai of JAMSTEC deployed 5 APEXs belonging to IOS/Canada in the Bering Sea in October 2007, which became the commemorative 3000th float in the international Argo network. Five Iridium-APEXs deployed by JAMSTEC in the MISMO experiment in the Indian Ocean in October 2006 finished their initial mission (1day cycle, 500db profiling) and were modified to observe in the normal Argo mission (10day cycle, 1525db profiling) via the two-way communication in April 2007. Among these 5 Iridium-APEXs, 4 are still working.

After the success of the first POPS deployed near the North Pole in the Arctic Sea in April 2006 (see Argonautics No.7 and the Japan national report to AST-8), the Arctic research group of JAMSTEC tried to deploy the second POPS in the same area in September 2007, however, postponed deployment because some electric leakage was found with the 1,000m cable on the spot. Two or three POPS are being prepared to deploy in the Arctic Sea in summer 2008. POPS (Polar Ocean Profiling System) is an ice-based drifting buoy with a PROVOR float moving up and down along a 1000m cable. The observed data (temperature-salinity profiles of every 3 days, 3-hourly GPS position, atmospheric temperature and pressure) is transmitted to Iridium Satellites and distributed to GTS via JMA.

Among JAMSTEC's 613 floats (530 APEXs, 72 PROVORs, 11 NINJAs) deployed in the Pacific, Indian and Southern Oceans, from 1999 to the end of January 2008, 320 (318 APEXs, 2 NINJA) floats are now in normal operation, 249 floats (171 APEXs, 70 PROVORs, 8 NINJAs) terminated their mission, 4 floats (all APEXs) are transmitting on the beaches after stranding and 8 floats (5 APEXs, 2 PROVORs, 1 NINJA) were recovered.

The Japan Meteorological Agency (JMA) deployed 15 APEXs as Argo equivalent floats in the seas around Japan from January 2007 to December 2007, whose data have been used for operational ocean analysis and forecast. Among 38 floats (14 PROVORs, 24 APEXs) which JMA deployed from 2005 to 2007, 31 floats (9 PROVORs, 22 APEXs) are operating at the end of December 2007, while 3 floats (1 PROVOR, 2APEXs) terminated the transmission in 2007.

The Fisheries Research Agency introduced a Slocum Glider manufactured by Webb Research and used it in the Kuroshio-Oyashio region in September 2007. This is the first experience of the Slocum Glider in the Japanese Argo community.

There reported three cases of recovered floats, two from a Japanese island, Amami-oshima (28.3N, 129.5E) and another from Negros Island, the Philippines.

1) JMA was informed by a local resident who recovered a float on the beach of Amami-oshima in November 2007, which was confirmed to be a PROVOR (WMO No. 2900581) deployed by JMA in February 2006. This float was sent back to JMA.
2) Japan Coast Guard recovered a float in the harbor of Amami-oshima in November 2007, which was confirmed by JAMSTEC to be an APEX of NAVOCEANO (WMO No. 2900382). JAMSTEC communicated with AIC and NAVOCEANO and then this float was redeployed by JCG in the Kuroshio a week after its recovery. Unfortunately, there has been no transmission from the redeployed float.
3) JAMSTEC was informed by AIC in February 2008 that the Philippine Coast Guard in Dumaguete City, Negros Island safely kept an Argo float which had been caught in a local fisherman's nets in 2006. This float was deployed by JAMSTEC in March 2003 and still transmitting. JAMSTEC plans to send a technician to Philippine to take off the batteries and send it back to Japan safely.

1.2 Technical problems encountered and solved

Among 40 APEXs delivered to JAMSTEC in October 2007, 9 ARGOS transmitters manufactured by Seimac showed a lower output power and less stable frequency than usual. These 9 transmitters were sent back to the maker and replaced by normal ones.

JMA's three floats terminated the transmission in 2007, of which two ceased their operation in shallow waters. JMA postponed the deployment of 3 APEXs due to the failure in the bladder function test as informed in the previous report. These floats were repaired and deployed by August 2007, which are working without problems.

An APEX (WMO No. 2900667) showed a series of profiles with lower salinity by 0.09psu compared with that of CTD measurement at deployment location and showing a gradual approach to a normal profile in the 9th cycle (Fig. 1). We were thinking that this sort of problem had been solved several years ago.

Abnormal observation with pressure was reported from an APEX (WMO No. 2900666). There was no observation in shallow layers from 16th to 30th profile (Fig. 2). After the 17th profile any observed pressure values differed from those of the designated depth table. Similar case was ever reported by H. Freeland with IOS's APEX (WMO No. 4900633).

1.3 Status of contributions to Argo data management

The Japan DAC, JMA has operationally processed data from all the Japanese Argo and Argo-equivalent floats including 380 active floats as of January 24, 2008. Nine Japanese PIs agree to provide data to the international Argo. All profiles from those floats are transmitted to GDACs in netCDF format and issued to GTS using TESAC and BUFR code after real-time QC on an operational basis. Argo BUFR messages have been put on GTS since May 2007.

JAMSTEC released the OW version of SeHyD, which is the baseline data to be used in the delayed- mode QC in the Pacific Ocean. JAMSTEC is also working with INCOIS to integrate the Indian Ocean historical data to IOHB, which should be the baseline data in the delayed-mode QC in the Indian Ocean.

1.4 Status of delayed mode quality control process

JAMSTEC has submitted the delayed-mode QCed data of 27,171 profiles to

GDACs as of January 2008. Among these data, the ones of about 16,000 profiles were provided within a year. JAMSTEC has also started the operation of delayed-mode QC for the floats of Japanese PIs other than JAMSTEC. The remaining backlog of about 12,000 profiles will be cleared by this operation.

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

Japan Argo had been conducted in a 5-year program from FY1999 to FY2004, as a part of Millennium Project implemented under cooperation among the Ministry of Education, Culture, Sports, Science and Technology (operation: by JAMSTEC), the Ministry of Land, Infrastructure and Transport, JMA and Japan Coast Guard.

After the Millennium Project terminates in March 2005, JAMSTEC is to continue the operation until FY2008 nearly in the same scale (about 80 floats to be deployed every year) and JMA will continue to deploy 15 floats around Japan every year for operational ocean analysis and forecast.

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

In FY2008, JAMSTEC will deploy about 80 floats in total in the Pacific, Indian, and Southern Oceans. JMA will continue to deploy 15 floats around Japan every year for operational ocean analysis and forecast.

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

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

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

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

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

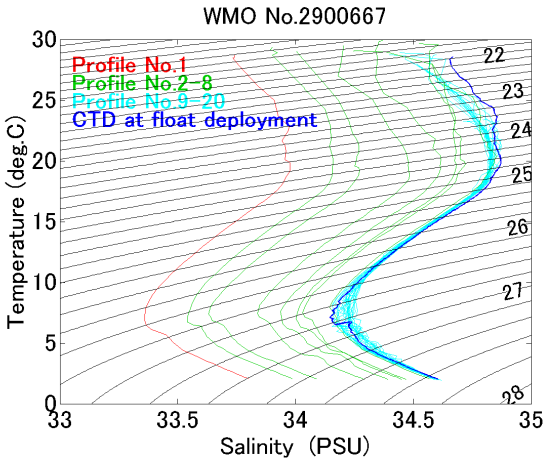


Fig. 1 Gradual approach of WMO No. 2900667 observations to the CTD cast at deployment location.

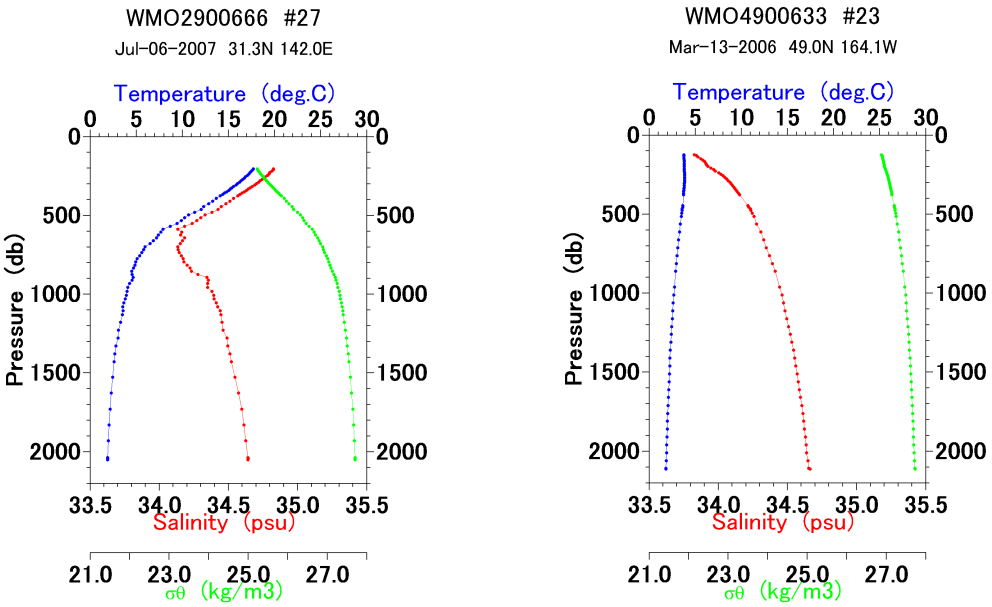


Fig. 2 Lack of observations in shallow layers; (left) WMO No. 2900666, (right) WMO No. 4900633.

Korean National Report on Argo-2007

Deployment in 2007 and Future Prospect

National Institute of Meteorological Research of Korea Meteorological Administration (METRI/KMA) and Korea Ocean Research and Development Institute (KORDI) are involved in International Argo Program. In 2007, KORDI deployed 9 floats in East/Japan Sea. Since 1998, Korea Argo has kept its steady course, deploying 193 floats until 2007. At present, 96 floats are active.

In 2008 total of 29 floats are planned for the deployment; 16 floats in the East/Japan Sea , 10 floats in the Pacific Ocean, and 3 floats in the Drake Passage. In addition, KMA/METRI is going to purchase 15 floats for the deployment in 2009 during this year. It is expected that METRI is able to secure funding to maintain the current level of float launch for the next several years.

Status of Argo data management

METRI's RTQC Argo data with TESAC and NetCDF format are transmitted into GTS network and GDAC respectively. In 2007, however, there was a problem in transmitting into GTS during several months due to the change on KMA's system. Currently the problem was solved. Submission of KORDI's RTQC Argo data to GDAC is now normally working with NetCDF format since February 2008. We had noticed that there was no separate directory for KORDI in the outgoing section of GDAC.

Korea Oceanographic Data Center (KODC) is in charge of delayed mode QC (DMQC) and has worked on the DMQC for Korean Argo data in the North Pacific, the East/Japan Sea and the Antarctic Ocean. As of December 2007, KODC sent 1493 delayed mode profiles, 50% of total 3011 profiles in the North Pacific, to the GDACs. KODC also made a reference database for the East/Japan Sea which is a marginal sea in the Northwest Pacific. It was named as ESHB (East Sea HydroBase). Delayed mode file in the East/Japan

Sea is going to be submitted to GDACs. In relation to DMQC in the Antarctic Ocean, KODC asked ADMT group for assistance.

In 2007 METRI upgraded Argo web site (http://argo.metri.re.kr) for the distribution of DMQC data, but the data are limited to Korean floats in the North western Pacific. METRI has a plan of additional upgrade for DMQC DB in 2008.

Research and operational uses of Argo data

METRI has a long-term plan to develop the operational ocean forecasting system around the Korean Peninsula as well as the global ocean. For the purpose, METRI has been developing the (Argo) data assimilation for their model system. Also, KORDI uses Argo data for scientific research and a data assimilating-model to understand circulation in East/Japan Sea. In addition, researches on the variability of heat content in the mixed layer, data assimilation and other application for ocean modeling are actively carried out by several universities in Korea.

Real time ARGO observations are being used in KOPS model for the East Sea region. Following figure (Fig.1) shows the current location of the each ARGO float deployed in the East Sea (only live floats are shown in the figure). Profiles are being updated every 2 days and used for data assimilation purpose. For any given day of model run, observations available in recent 10 days prior to the model date are used.

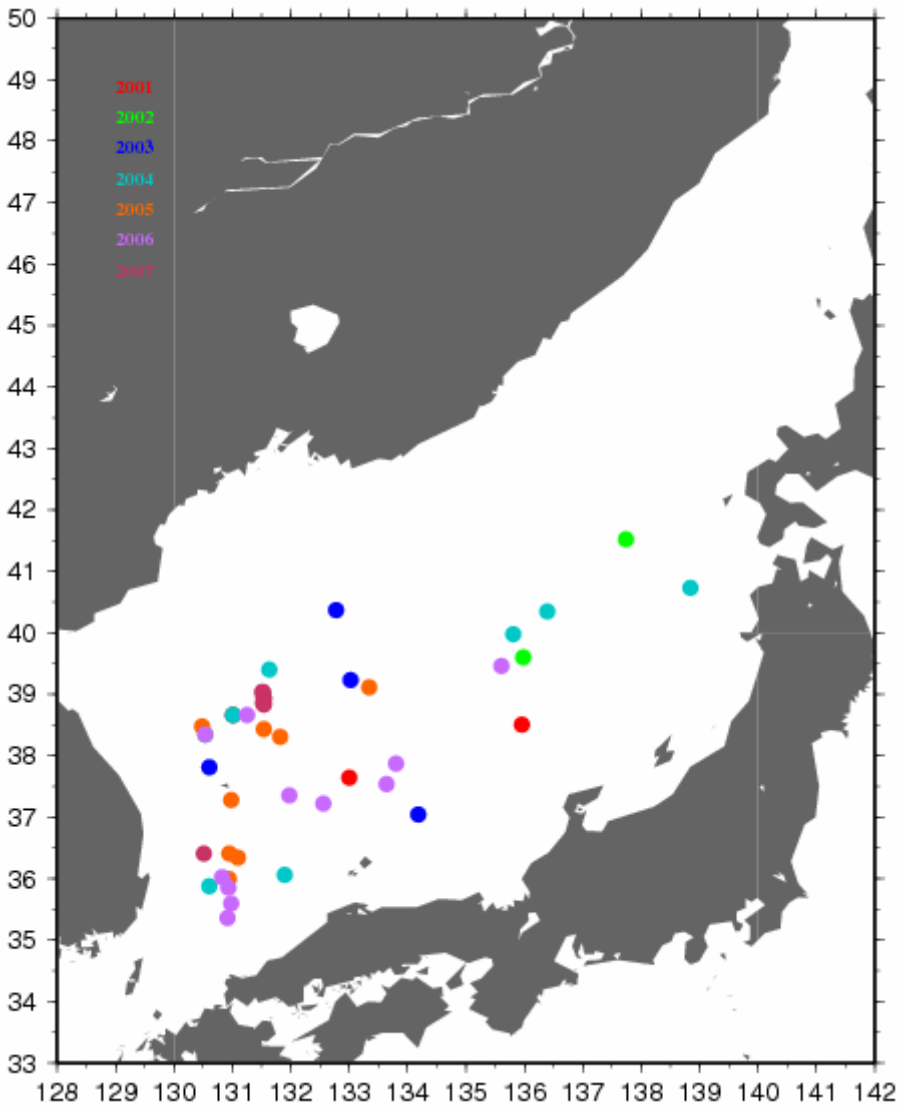


Fig.1: Current locations of ARGO floats in the East Sea

Some observations have errors and some have missing values for some depths in between, these observations are removed from the data assimilation by using quality control checks.

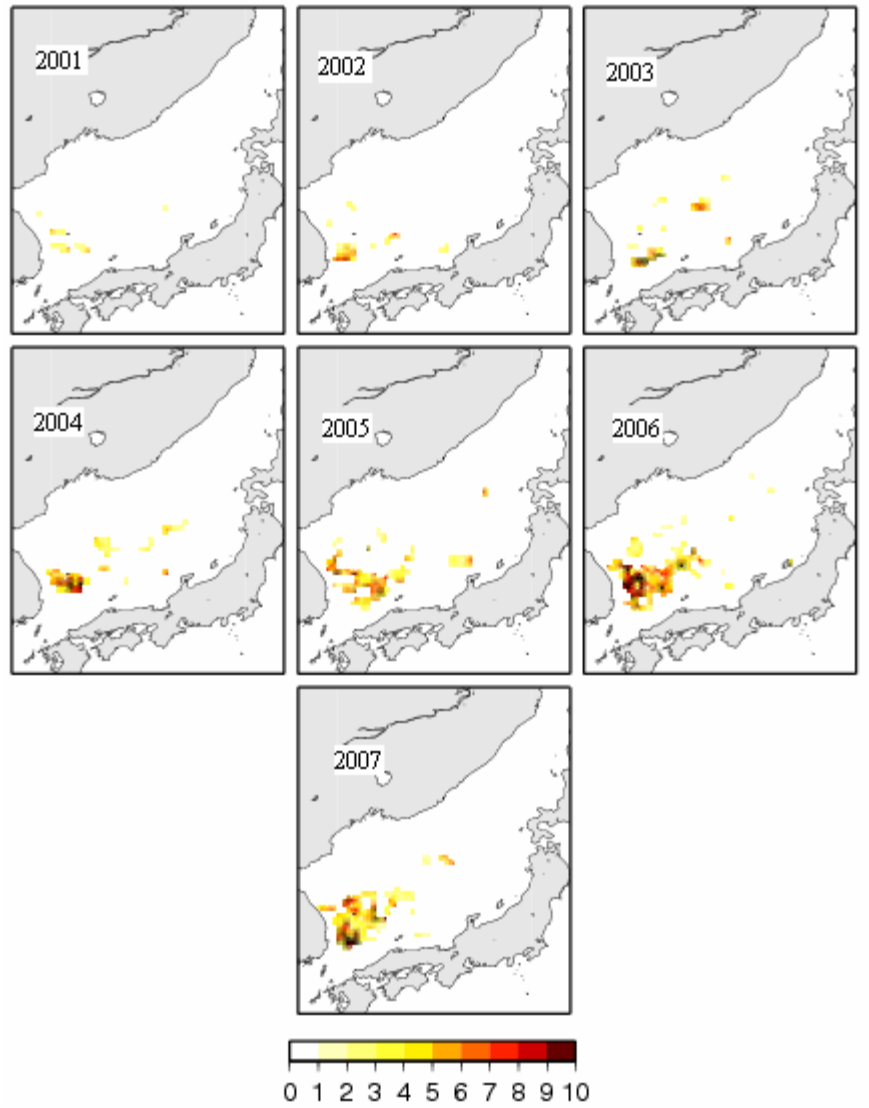


Fig. 2: No. of observations per grid (.25 X 0.25) in the East Sea are shown for each year from 2001 to 2007.

The distribution of ARGO observations were very sparse during 2001 (since this is the beginning of the program) and increased year by year. The available observations are shown per each 0.25 X 0.25 Deg. grids are shown in the above figure (Fig. 2). The ARGO observations are relatively dense in the southwestern part of the East and very few observations are available in the northern part of the East Sea.

New Zealand National Report February 2008

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

New Zealand's floats

NIWA has purchased fourteen floats and deployed 13 floats to date. The fourteenth float will be deployed in March 2008. Purchases and deployments are likely to continue at the 2 floats/year level.

Information on the New Zealand floats, designated (WMO#) 2039 (5900106), 2042 (5900109), 2137 (5900205), 2138 (5900206), 2331 (5900631), 2332 (5900632), 2463 (5901028), 2547 (5901227), 2555 (5901239), 2585 (5901271), 2693 (5901763), 2659 (5901804) and 2739 (5901843) can be found at: http://sio-argo.ucsd.edu/weqpac_web.html.

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

Providing deployment opportunities

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

In an ongoing collaboration, NIWA is funding 15% of the vessel costs of R/V Kaharoa deploying floats for University of Washington and Scripps Institution of Oceanography. NIWA's larger research vessel, R/V Tangaroa has also deployed floats in the southern ocean as part of the same collaboration. These voyages, dating back to 2004 have deployed nearly 530 floats, primarily in the South Pacific but also in the eastern Tropical Pacific and Indian oceans.

Additional R/V Kaharoa deployment voyages are in planning stages and at least 15 floats (2 NZ and 13 US) will be deployed from Tangaroa during research voyages in 2008.

Status of Argo Norway, Feb-2008

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

1. The status of implementation

At present we have in total deployed eleven Argo floats where seven floats are still active. Three floats were deployed in 2002, while six were deployed in 2003. Two more floats that include oxygen and fluorescence sensors were deployed in April 2006. These additional sensors have so far performed well.
Regarding the "Delayed mode" we have in the past not done anything special with that. However, we have an agreement with IFREMER where they will do the quality check for us. IFREMER will then, afterwards, make the high-quality data and the meta-data available on the internet.

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

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

IMR has running contact with the Norwegian Research Council that supports the EU-funded ESFRI-project "Euro Argo", which IMR is a partner in, and will in collaboration with IMR work to get a long-term commitment from the Ministry of Education and Research.

3. Summary of deployment plans

At present we have no plans for further deployment of Argo floats due to lack of financial support.

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

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

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

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

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

We have fluormeter/turbidity sensor (WETLABS) on two Argo floats (Webb-floats). However this parameter is not included in the netcdf-file on the FTP-catalogue at IFREMER/Coriolis (ftp.ifremer.fr/ifremer/argo/dac/coriolis). We wish that all parameters are available on the ftp-catalogue.

ARGO SPANISH ACTIVITIES REPORT
SECOND SEMESTER 2007

1. Background and organization of Spanish ARGO activities.

There is not a dedicated Argo Spanish project *per se*, and the framework for the Argo Spanish activities is obtained under different national calls. Mainly calls for activities complementary to research projects, nationals or europeans. Since the first funding for Argo activities received in 2003, 11 floats have been deployed, seven in 2003, two in 2004, one in 2005, and the last one in September 2006. Additionally two floats have been donated to Mexico and one to Costa Rica.

The last financial support was obtained at the end of 2007 as complement to the Euro-Argo proposal, in a call devoted to infrastructures within the ESFRI roadmap. This financial support will be used to deploy 12 Argo floats, and set up a framework, to support the deployment (transmission costs, paperwork,..) of floats purchased and funded under other Spanish research projects.

The Spanish Argo activities are coordinated by the Spanish Oceanographic Institute (Instituto Español de Oceanografía).

1.1. Deployed floats

During the period covered by this report no floats were deployed. The last deployed float was carried out in September 2006.

1.2. Float Development.

No float development has been done.

1.3. Data management

The data management of the Spanish Argo floats is currently been done by Coriolis. Nerveless, the DM for those floats will be carried out shortly.

1.4. 1.4. Operational and scientific use of Argo data.

The Argo data in Spain is mainly being used for scientific purposes. And therefore one of the main objectives of the IEO within euro-Argo is to broad the utility of the Argo data for operational activities at national level.
Two papers are under submission:

- Vélez-Belchí, P., A. Hernandez-Guerra and E. Fraile-Nuez. (2008). Changes in the temperature tendencies in the upper levels of the subtropical North Atlantic ocean.
- A. Hernández-Guerra, T. M. Joyce, E. Fraile-Nuez and P. Vélez-Belchí. (2008).Using Argo data to investigate the North Atlantic Conveyor Belt

2. Funding

2.1. Existing Spanish funding for Argo

Actually, the funding for Argo activities in Spain amounts to 172.000€. However, two different Spanish research projects have been additionally funded to purchase 4 Argo floats each one, to be deployed in the Mediterranean. This set of 20 Argo Spanish floats (12+4+4) will be deployed during the second half of 2008.

2.2. On the future Spanish funding and organization for Argo

The future funding for the Argo activities in Spain will be negotiated during this year, since there is not an Argo-España *per se* project, it is necessary to apply each year for funding. The objective of this negotiation is to obtain a long-term agreement.

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UK ARGO PROGRAMME

REPORT FOR ARGO STEERING TEAM 9TH MEETING, MARCH 2008

Background and present status

The UK Argo programme is undertaken by a partnership which was developed following discussions between the NOAA Administrator and the Chief Scientific Advisor (CSA) in 1999. It has been funded by UK government through the Department for Environment, Food and Rural Affairs (Defra), the Ministry of Defence (MoD) and the Natural Environment Research Council (NERC) and is carried out in collaboration between the Met Office (who manage the programme), the National Oceanography Centre Southampton (NOCS), the British Oceanographic Data Centre (BODC) and the UK Hydrographic Office (UKHO). The UK programme was initiated in 2000, with our first Argo floats being deployed in January 2001. UK Argo has also been active within the international Argo Steering Team and the Argo Data Management Team.

Floats deployed and their performance

Since 2001, nearly 250 UK floats (including 5 donated to Mauritius) have been deployed in a number of different geographic areas, where deployments have focused on meeting specific UK requirements, while also contributing to the global array.

Year	*Floats deployed*	*Operating*
2001	*29*	*0*
2002	*38*	*0*
2003	*37 (1)*	*4*
2004	*45 (2)*	*21*
2005	*28*	*22*
2006	*24 (2)*	*20*
2007	*33*	*28*
2008	*35*	

Table 1. Numbers of UK floats contributing to Argo deployed by year, figures in brackets are floats donated to and deployed by Mauritius. An estimated figure is given for 2008, for which 10 floats have been deployed too date.

The interests of the UK are global but with particular interests in the Atlantic and Southern Ocean. However, because other countries have committed a sufficient number of floats to the North Atlantic, UK has only deployed a relatively small number of floats in that region. In particular UK Argo has taken a lead in deploying floats in sparsely populated regions (e.g. Arabian Sea, South Indian Ocean, South Atlantic and Southern Ocean) in support of establishing the global array.

Float survivability

1. Apex floats

There has been a distinct improvement in the survival of our floats deployed from 2004 to those deployed in earlier years. Only 30 to 40% of floats deployed before 2004 made more than 100 profiles, although our longest-living float (from 2002) reached 185 profiles before expiring. However for floats deployed in 2004 nearly 70% reached the 100 profile mark.

The reduction in early failures is also seen in floats deployed in 2005. For the 2006 floats we believe that 3 of the early failures (plus 2 in 2007) may have been ice-related.

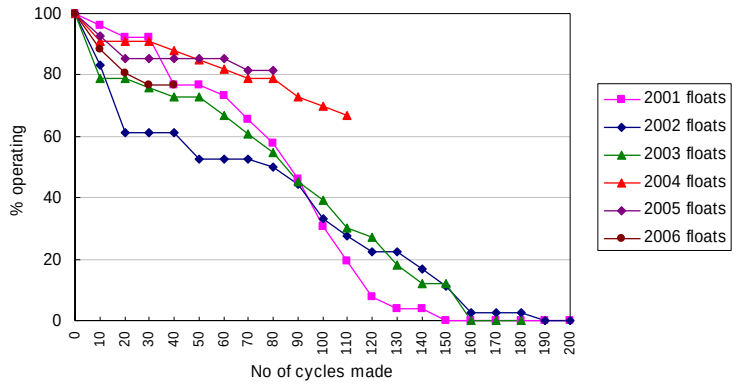

Figure 1. Showing the % numbers of Apex floats, deployed by year, operating. Statistics exclude floats where deployment failure has been confirmed and the number of cycles is adjusted for those floats that have shallower profiles or only profile deep intermittently.

2. Provor floats

Similarly the survivability of our Provor floats deployed in 2004 and 2005 (13 floats) shows a distinct improvement over those deployed in 2001 and 2002 (8 floats). However, a number of these later floats expired after making 100 profiles, leaving just 2 operating (>116 cycles). Of the 4 Provors (all upgraded by Martec) deployed in 2007, one failed after 4 cycles the others are approaching 20 cycles).

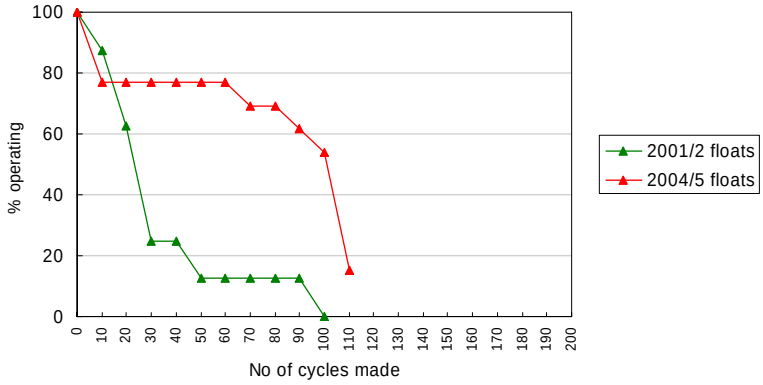

Figure 2. Showing the % numbers of Provor floats, deployed by period, operating. There were no deployment failures with all floats cycling to 2,000m depth.

Apex float monitoring

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

Deployment plans for 2008

As at mid-February 2008, we have deployed 10 floats in 2008 and anticipate at least another 25 float deployments during the year, as shown in Table 2 (over).

10 floats deployed so far in 2007	
South-east Indian Ocean	*6 Apex floats with lithium batteries deployed from CMA/GGM Lavender in January (IX-15 line)*
Arabian Sea	*4 Apex floats deployed in the Arabian Sea from RV Sagarkanya end January*

Floats available for deployment (8)
1 Apex for north-east Atlantic (Iceland Basin/Rockall Trough)
1 Apex for Arabian Sea
4 Apex for Somali Basin
1 Apex for Southern Ocean
1 Provor, region to be decided

Floats to be delivered March/April (30)
6 Apex for south-east Atlantic (plan to deploy from Agulhas in September)
8 Apex for Southern Ocean (will have lithium batteries), 4 with ice-avoidance
6 Apex for north-east Atlantic (Iceland Basin/Rockall Trough)
4 Apex for south-east Indian Ocean
6 Apex regions to be specified

Table 2. Floats deployed and available for deployment from 2008.

Data management

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

Real-time data processing. An automatic real-time processing system has been developed and is operational. This downloads, twice daily the raw (hexadecimal) data from CLS, decodes the data stream, carries out an agreed suite of automatic quality control tests (adding quality flags to the data as necessary), and generates profile and trajectory data files in the internationally agreed formats. The UK Argo Data Centre web-site is automatically updated daily with UK float status information, a map of current float positions and temperature and salinity profile plots.

The automatic real-time system generates the float data in both WMO TESAC and Argo netCDF formats. The TESAC messages are automatically emailed to the Met Office where they are then disseminated on the GTS via Exeter (EGGR). GTS (and in the future the WMO Weather Information System) will remain the primary mechanism for receipt by the Met Office (and other National Meteorological Services) of real-time data (floats, buoys and ship data etc.) needed for meteorological and ocean forecasting.

The data in netCDF format are provided (by FTP) to the two GDACs, generally within 24 hours of receipt, and are also available from the UK Argo Data Centre web-site via an interactive map interface. In addition the technical files are updated once a week and these files are used by CSIRO Marine to populate the technical web-site.

Delayed-mode data processing. This is carried out by BODC with support from the UKHO. A total of 4,492 delayed-mode profiles have been submitted, this is about 40% of all floats

available for delayed mode processing (i.e. excluding floats that have been operating for less than 18 months).

Southern Ocean Argo Regional Centre (SOARC). As noted earlier, the UK has particular scientific interests in the Southern Ocean and has taken the lead in establishing the SOARC. This has been a collaborative effort between BODC and CSIRO with BODC having primary responsibility for the South Atlantic sector of the Southern Ocean and CSIRO responsibility for the eastern Indian Ocean sector and the region around Australasia. Recently the University of Washington, USA, has agreed to take responsibility for the Indian Ocean sector and JAMSTEC, Japan, for the Pacific Ocean sector. Work undertaken by BODC has concentrated on acquiring recent CTD data to improve the reference data set for the Southern Ocean needed for scientific QC of the float data.

Operational and scientific use of Argo data

A key aspect of the UK Argo programme is to develop the capabilities to fully exploit all Argo data for operational forecasting and research applications.

Operational ocean forecasting. All Argo data (alongside other in-situ and remotely sensed ocean data) are routinely assimilated into the FOAM operational ocean forecasting system run by the National Centre for Ocean Forecasting (NCOF). The FOAM predictions are used by the Royal Navy and also provide forcing to high resolution models of the north-west European shelf-seas that provide outputs with potential applications such as prediction of the transport and dispersion of oil-spills, ecosystem parameters, harmful algal blooms and for fisheries. Experiments have shown that Argo data has a significant positive impact; without Argo data temperature errors are up to 40% larger and salinity errors near the surface are over twice as large, even when all other in situ data sources are assimilated. Argo data have also been used to improve and validate the mixed layer model used in FOAM. Within NCOF research work continues to improve the assimilation methods used.

Seasonal forecasting. Seasonal forecasts provide long-range warning of weather conditions, both for the UK and for developing countries (e.g. forecasts for drought conditions in the Sahel, East African rainfall). They are largely determined by statistical methods in which the forecast is based on precursor sea surface temperature patterns as these change slowly and influence patterns in the weather. An example of where Argo data had a direct impact on the UK forecast was in the North Atlantic in summer 2005 where monitoring of sub-surface temperature anomalies provided clear observational support for the statistical forecast of the forthcoming 2005/06 cold winter.

Numerical models are also run to make seasonal forecasts. Although initialising numerical seasonal forecasting models with Argo data improves the accuracy of their predictions of surface temperature, the models are not presently any more accurate than the statistical techniques as they are still experimental and not yet capable of exploiting the full benefits from the Argo data; this is an area of continuing research and development.

Climate monitoring and prediction. Modelling studies at the Met Office Hadley Centre have shown that the traditional approach of occasional (and generally haphazard) observation of the sub-surface ocean through research cruises does not produce sufficiently close sampling of the ocean (in space or time) to allow rapid detection of the effects of climate change. Argo is the only observing system that provides the global coverage and frequency of sampling required. Climate model simulations by the Met Office Hadley Centre have indicated that 3,000 floats is probably near optimal. The results suggested that with $3^{\circ} \times 3^{\circ}$ spacing Argo should capture the variability and signal in ocean heat content, as the

temperature variability (noise) in the model decreased most rapidly when sampling up to 3° resolution, but the decrease was less (diminishing return) when sampled at higher resolution.

The Hadley Centre have developed the HadGOA dataset, a new ocean analysis of historical temperature and salinity suitable for climate model validation, evaluation of historical ocean heat content variability and more general climate monitoring, based on observed data (mainly Argo). HadGOA will provide an important addition to the key global climate datasets maintained by the Hadley Centre for the climate research community.

It has been demonstrated that initialisation of ocean heat content is a key element adding skill to decadal predictions of regional climate; use of Argo data significantly influences predictions of the Atlantic thermohaline circulation (THC) which is responsible for the relatively mild climate of western Europe (and expected to weaken as a result of global warming).

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

Funding

As noted earlier the UK Argo Project has been funded by Defra and MoD (through the Met Office, but provided from departmental research lines) and by NERC (through NOCS and BODC). Presently part of the funding support is agreed to 2011 with other parts being agreed on an annual basis. In addition MoD also funds UKHO support for data processing.

Our aspiration for UK Argo is to contribute to the global programme to at least a GNP level based share (~5%), i.e. to deploy 40 – 50 floats each year. However, present funding levels are insufficient to deliver that level of contribution. We are currently working through the UK government's Marine Monitoring and Assessment Strategy (UKMMAS) with the aim to secure agreements on longer-term funding for UK ocean observations, with Argo as a pressing example for action. (The UKMMAS remit includes monitoring activities in both UK waters and the open oceans and covers ocean monitoring, such as Argo, carried out in support of internationally agreed programmes that are commitments to the GOOS, GCOS and the GEOSS.) This is proving to be very difficult as there is presently no mechanism within UK Government to transition systems from research funding to operational funding lines. Hence it is likely that funding for Argo for the next few years will continue to be requested from existing research budgets.

Euro-Argo

Euro-Argo is a 30-month programme (which started January 2008) to develop and recommend a European infrastructure to enhance the collective ability of the European nations to contribute to Argo, and by working together to be able to do so more efficiently in the future. For the UK the organisations involved are NERC (through the National Oceanography Centre, Southampton and the British Oceanographic Data Centre) and the Met Office. The aim is to develop the infrastructure to the level where the European partners have the capacity to procure and deploy ~250 floats per year, the ability to monitor these floats, ensure all float data can be processed (both in real-time and delayed-mode) and to

clear the present backlogs in the data processing system. With a mean float lifetime of 3¾ years such a European contribution would support approximately 1/4 of the global array and provide an additional 50 floats per year for enhanced coverage in the European and marginal seas.

By entraining more European countries into Argo, and seeking EU GMES funding for floats, it is expected that the European-wide contribution to Argo will be increased and put onto a more secure basis. This will help secure the longer-term operation of the Argo 3,000 float array, and its continued ability to deliver valuable data to operational and research users. Securing a long-term UK funding commitment to Argo and the Euro-Argo infrastructure is critical to both Euro-Argo and to the international Argo array.

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(Submitted by D. Roemmich)

Organization:

U.S. Argo is supported through the multi-agency National Ocean Partnership Program (NOPP). The project is presently being carried out by a U.S. Float Consortium that includes principal investigators from six institutions (SIO, WHOI, UW, NOAA/AOML, NOAA/PMEL, FNMOC). Float production, deployment, and data system functions are distributed among these institutions on a collaborative basis. Following two years of pilot activity supported by ONR and NOAA (FY99, FY00), and a 5-year (FY01-05) full implementation phase under NOPP, the Argo project is now in the second year of a five-year continuation, supported by NOAA and (for FNMOC participation) the Navy.

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

The present continuation of U.S. Argo will end in mid-2011.

Support level:

The support level for U.S. Argo is aimed at providing half of the global Argo array. The target level is 1500 active floats, based on a deployment rate of about 410 floats per year. There were 315 floats funded in FY02, 344 in FY03, 410 in FY04, 410 in FY05, and 390 in FY06, and about 370 in FY07. With level funding, further incremental reductions in float numbers are likely.

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

Status:

As of March 3, 2008 there are 1746 active U.S. floats (Argo Information Center, see Fig 1), including 1662 from U.S. Argo float providers (SIO, UW, WHOI, PMEL) plus 84 Argo-equivalent floats provided by partnering programs. During 2007 there were 367 floats deployed by U.S. Argo (Fig 2) and U.S. partners. The large number of active US Argo floats (1746) relative to the target number of 1500 reflects the high deployment rate in 2005-2006, to clear a backlog of instruments funded but not deployed earlier. A concern for the international array is that the number of US floats is likely to decrease toward the 1500 float target number.

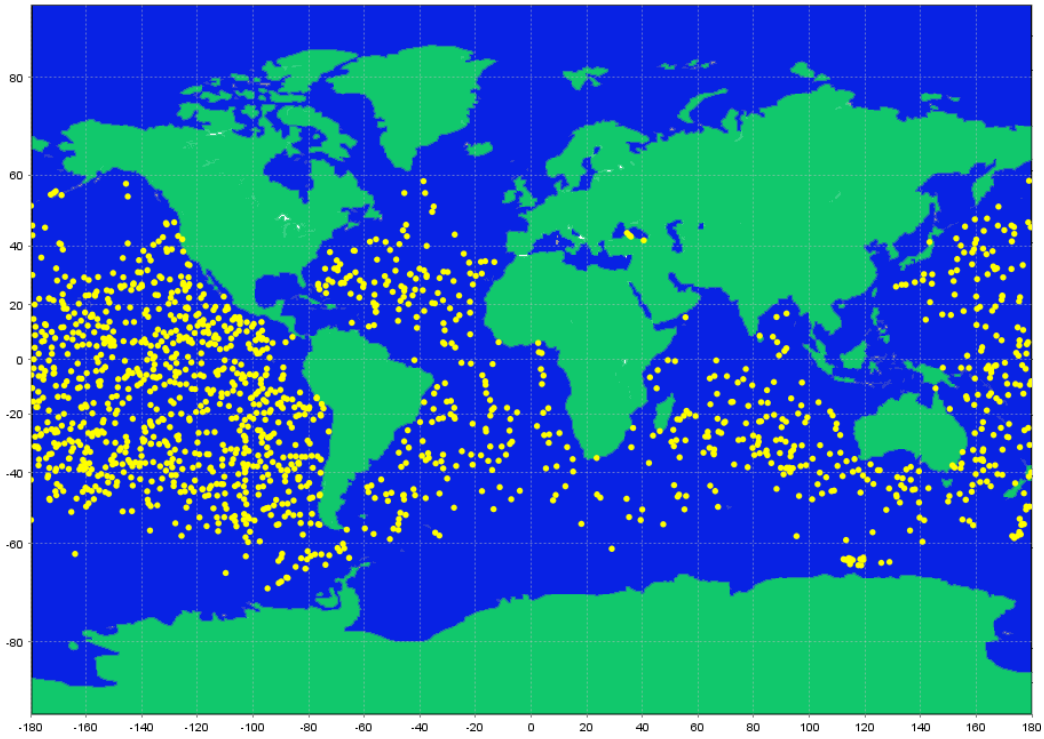

Fig 1. Positions of U.S. Argo profiles during a 12-day period, March 2008 source: (AOML).

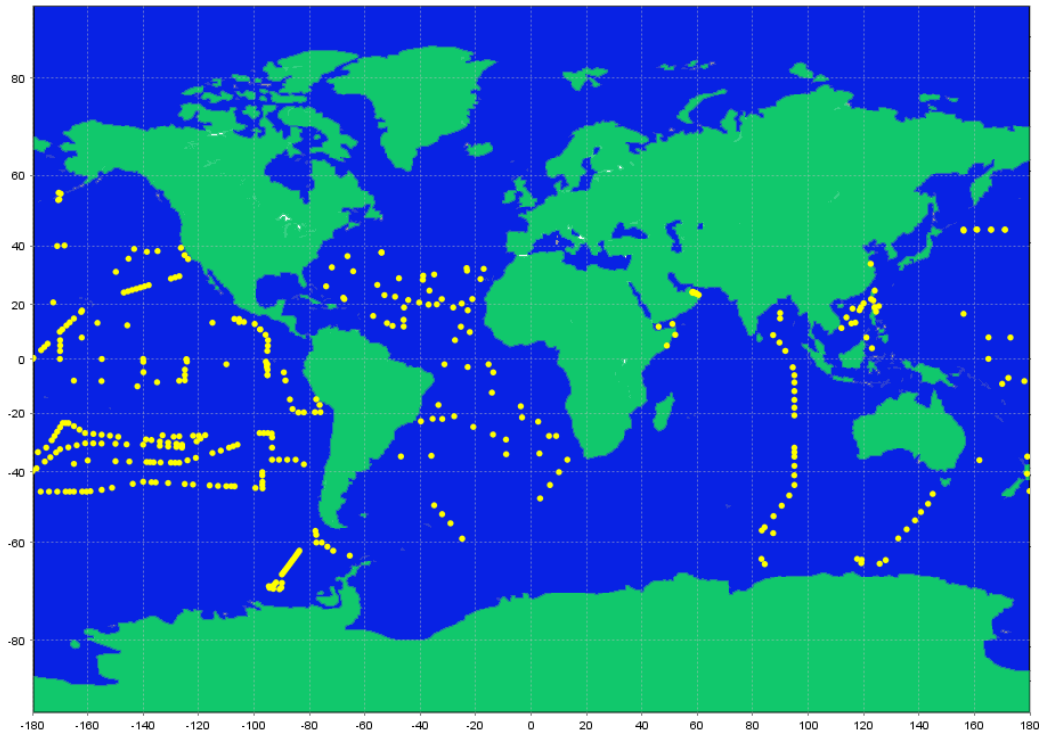

Fig 2. Positions of U.S. Argo deployments during 2007 (source: AOML).

The major focus of the U.S. effort in 2007 was to help achieve Argo's objective of a global array by increasing float density in sparsely sampled regions. The majority (246 out of 367) of U.S. float deployments during the year were in the Southern Hemisphere (Fig 2). This included two major cruises in the South Pacific, jointly staged with New Zealand Argo on R/V Kaharoa, and a substantial float deployment in the South Indian Ocean during a repeat hydrography cruise on R/V Revelle.

Out of 1654 Argo floats presently active in the Southern Hemisphere, 66% (1088 floats) have been provided by the U.S. Priorities for float deployments are established by the U.S. Argo Science Panel, comprised of members of the Float Consortium and representatives of Argo data user groups. The highest priority is deployment of a global Argo array. Specific plans for 2008 float deployments are posted on the AST web site's deployment planning links.

A continuing effort in U.S. Argo is aimed at technology improvement: for increased float lifetime, and improved performance. Ongoing improvements in reliability have been demonstrated in recent years. Over 2/3 of floats deployed in 2004 are achieving lifetimes of 4 years (Fig 3), and 2005 deployments appear to be even better. A goal of U.S. Argo is to extend average float lifetimes beyond 4 years.

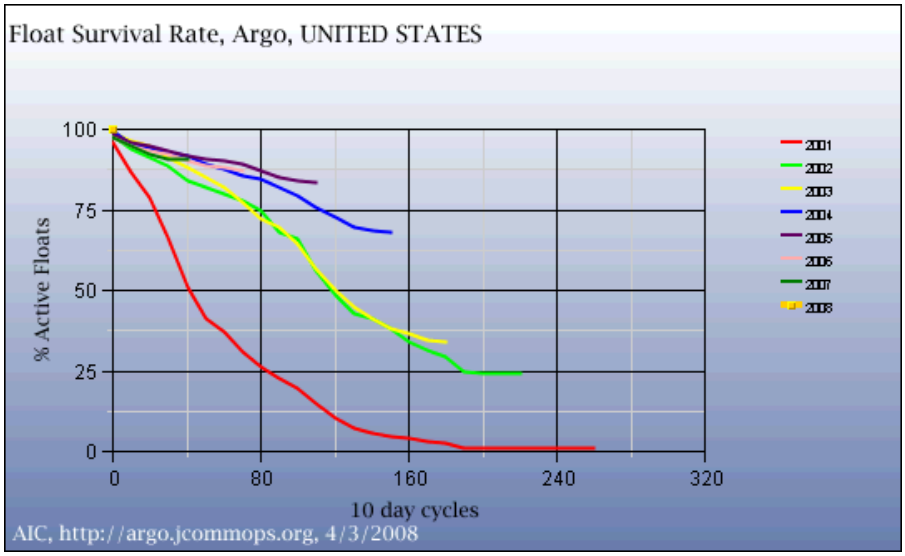

Fig 3. Survival rate for U.S. floats, by year of deployment (source: AIC).

The U.S. Argo Data Center is based at NOAA/AOML. Real-time data from all U.S. Argo floats are transmitted via the GTS. GTS transmission uses 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. During 2008, U.S. goals in data management include development of improved methods for real-time quality control, and elimination of the backlog in delayed-mode quality control (Fig 4).

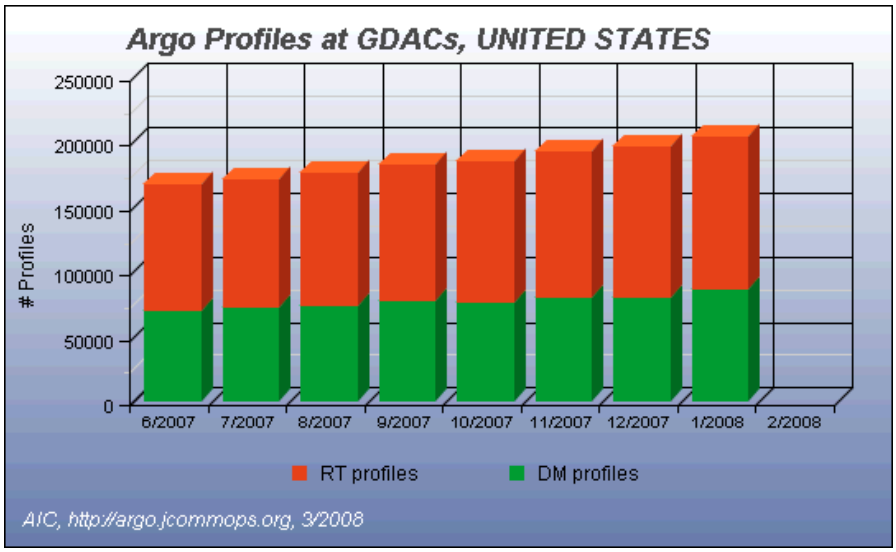

Fig 4. Number of profiles held at GDACs for U.S. floats (source: AIC), including those with delayed-mode and real-time levels of quality control. Roughly 60,000 of the RT profiles are less than one year old and not yet eligible for DM processing.

In addition to the national DAC, a Global Data Assembly Center (GDAC) is run as part of the GODAE server, located at FNMOC/Monterey. The two GDACS at FNMOC/Monterey and IFREMER/Brest are mirror images in their assemblies of Argo data from all international partners, and are responsible for dissemination of the data.

Several U.S. institutions participate in Argo Regional Center activities, including AOML's role as focus for the South Atlantic ARC.

Uses of Argo data

The impressive breadth of Argo applications, both research and operational, in the U.S. is well illustrated by the publications list and operational centers referenced at www-argo.ucsd.edu. A significant structural issue in U.S. Argo continues to be the lack of funding targeted specifically at Argo research (or even more broadly at research based on the sustained ocean observing system).