6th meeting of the

International Argo Science Team

IFREMER, Brest France

March 9-11 2004

Contents

Appendices

1. Welcome and introduction.

Dr Yves Desaubies welcomed the members and other attendees at the meeting on behalf of the Director of IFREMER. He briefly explained the structure of IFREMER and in particular the Centre de Brest. He detailed the local arrangements for the meeting and thanked Francine Loubrieu for her help in meeting planning.

2. Introduction to IAST-6.

Dean Roemmich, chairman of the IAST welcomed attendees and briefly reviewed the status of Argo. He particularly noted the rapid progress in implementation made over the past year with over 700 floats deployed despite the hiatus caused by the need to withdraw SBE salinity sensors in order to replace the defective Druck pressure sensors. This meant that there was a backlog of floats waiting for deployment and that a rapid increase in numbers would occur in early 2004. By the end of the year the array will be in a sense global following efforts to populate the Southern hemisphere oceans. However he noted that the hemispheric imbalance continued with only 400 floats needed to complete the Northern hemisphere array but 1500 needed for the S Hemisphere.

The challenge for the AST is to adapt to the rapidly maturing float array. Specific issues that would be considered at IAST-6 would be to take the steps needed to:

- Implement effective delayed-mode QC procedures.
- Commit floats to the Southern Hemisphere.
- Create deployment opportunities to increase the array density.
- Demonstrate the value of Argo in operational applications.
- Produce an efficient and stable infrastructure.

In order to reflect those new priorities it should be noted that the Argo Executive group at its meeting the previous day had concluded that the IAST should change its name to the be the Steering Team rather than the Science Team since science would be only part of the group's remit that would include oversight and guidance of implementation and of Argo data use.

1. *With effect from IAST-6 the International Argo Science Team will become the International Argo **Steering** Team to reflect the IAST's wide responsibilities. All Argo participants should take steps to reflect this change in their web sites and literature.*

APO and contributing countries

2.1 Action items from AST-5

John Gould then noted that there were three action items from IAST-5 that had not been completed and about which AST-6 should make a decision.

The first, (Action item 15), concerned collating information on the best float deployment practice. Groups deploying floats had been asked to send details of their deployment instructions to Argo Director together with information on rates of early (1 cycle) failures. It was agreed that reduction of early failures must remain a high priority and that the Argo Director and AIC should hold information on deployment methods for each float type from research and commercial vessels.

2. AD and ATC to collect information on float deployment practice so that new groups will be able to be advised on how to reduce deployment failures.
Action AD/ATC

The second, (Action item 16), concerned the collection of temperature, salinity (and pressure information) during a float's submerged drift phase. The information requested following IAST-5 was presented by Uwe Send under agenda item 5. He concluded that such data collection was possible for APEX and PROVOR float types. Dean Roemmich also confirmed that SOLO floats could also collect such data. The energy penalty is comparatively small (1 sample is approx 1/1000 of a the energy needed for profiling). Both Uwe Send and Yves Desaubies confirmed that pressure data provided a useful diagnostic of float performance. Sylvie Pouliquen confirmed that the Argo data formats were capable of handling the drift data.

In discussion, concerns were expressed that infrequent data would be contaminated by internal wave noise and that collecting and averaging more frequent observations would impose an unacceptable energy penalty. Following discussion it was recommended that floats should collect P, T and S data

3. Float deployers are requested to program new floats to collect pressure, temperature and salinity data during their drift phase.
Action. All float deploying groups.

The final remaining issue concerned the recommendation to adopt 1000db as a standard submerged drift level so as to ensure that velocity data can be compiled to produce velocity fields comparable with those constructed during WOCE. It was noted that the universal availability of a park-and-profile capability now reduced the advantages of choosing deeper drift levels at high latitude in order to reach stable water masses. The standard 1000db recommendation was adopted with the proviso that exceptions were permissible if that level was likely to result in too rapid dispersion of the float array.

4. Argo recommends that unless there are overriding scientific reasons to choose another level, 1000db should be chosen as the drift level for all floats.
Action. All float deploying groups.

3. Status of Implementation.

3.1 EEZ concurrence

Mathieu Belbéoch briefly summarized the status of the global array and reiterated the points made by Dean Roemmich. He showed a map giving the status of EEZ concurrence and noted that few countries have fully concurred but that there had been only one instance of a country expressing interest in the entry of a float to its EEZ (a Canadian float entering Russian waters). It was commented that the map that is available on the AIC web site is not accurate (particularly in showing the UK EEZ compliance). Two action items were agreed

5. ATC to correct errors in the EEZ concurrence map and to ensure that all correspondence associated with concurrences is held by AIC.

Action. ATC

6. *All Argo contributing countries to take steps to implement EEZ concurrence before IAST-7*

Action. APO to approach Argo national contacts.

Mathieu Belbéoch noted that the use of IOC stickers on floats had increased to 50% on floats deployed in 2003 (20% in 2002) and that it will greatly simplify the identification of floats picked up at sea or washed ashore if they have stickers. Dean Roemmich confirmed that SIO had not yet completed trials to identify if stickers can become detached from SOLO floats.

3.3 Float failures

Mathieu Belbéoch went on to highlight that detailed metadata needs to be compiled if we are to be able to document and investigate failures of floats within the global array including failures immediately after launch. Sylvie Pouliquen noted that most of this information was already held by the Coriolis data center, by the AIC or by Steve Riser and needed to be integrated (at Coriolis).

7. *ATC and AD to identify a full set of metadata relating to float shipping and deployment conditions so that potential causes of early failures of float performance may be identified. These should then be incorporated in a standard deployment form.*

Action. AD and ATC.

3.4 Regional implementation

Dean Roemmich showed the basin implementation maps and invited the comments on the plans from the regional co-ordinators. He noted that Southern Ocean deployment planning had not been very active and suggested that in future the Southern Ocean should be included in the Atlantic, Pacific and Indian Oceans using the longitudinal boundaries agreed at AST-5. This was agreed.

8. *Atlantic, Pacific and Indian Ocean deployment co-ordination to include the Southern Ocean region with boundaries set at 20°E, 145°E, 70°W.*

Action. Pacific, Atlantic and Indian Ocean co-ordinators

The deployment plans for the Pacific, Indian and Atlantic Oceans were discussed. It was noted that there were plans for repeated deployments in the Drake Passage by Korea. In the Atlantic it was noted that the map was not complete since the plans for Canada, Germany, Ireland and the Netherlands had not been incorporated. The opportunity presented by the twice-yearly UK- Falklands Atlantic Meridional Transect (AMT) was seen as a valuable means of seeding the S Atlantic. The Atlantic planning web site maintained by Coriolis will soon incorporate links to the national text files as is done on the Pacific site.

Two sites are maintained for the Indian Ocean, at CSIRO and INCOIS. These do not at present show the same information. They will be synchronized by April. It is recommended that the Indian Ocean site(s) should also incorporate text files. Kopillil Radhakrisnan noted that the implementation strategy for the Indian Ocean was in large part driven by IOGOOS and by CLIVAR. He commented also on the excellent contribution that had been made by the *Mirai* during her round the world voyage in deploying floats in the mid-latitude Southern Hemisphere.

Yves Desaubies noted that it was often difficult to identify when a planned deployment had been carried out and that this required a feedback process from the deploying country/lab to the co-ordinator. It was recommended that this should take place and that plans should be updated at least twice per year.

9. APO to send reminders to countries in January and July to update their deployment plans. Float providers are encouraged to submit plans more frequently if appropriate.

Action. APO

Etienne Charpentier commented that the deployment of surface drifters might also present opportunities for float deployments (and *vice-versa*) and suggested that steps should be taken to identify possibilities for ship sharing.

10. ATC/JCOMMOPS co-ordinator to take steps to integrate information on float and drifter deployment opportunities.

Action. ATC

It was also commented that from the viewpoint of planning of the buildup of the Argo array it would be valuable if in the global commitments table compiled by Stan Wilson (Appendix 4), countries could indicate the number of floats that they expected would be deployed south of say 20°S.

11. APO to contact countries and ask how many floats they were committing to regions south of 20°S.

Action. AD

It was noted that Argo depended on the willing co-operation of many research and commercial ships to deploy floats and that this help ought to be recognized.

12. APO to design a certificate to be presented to ships and aircraft that have made exceptional contributions in deployment of Argo floats.

Action. AD

13. Argo float deployment groups to give APO the details of ships whose deployment contributions merit special recognition. (Ship name, call sign, number of floats deployed, dates, contact details).

Action. All float deploying groups

3.5 Sampling strategies

There followed a general discussion of the concerning the desirability for sampling strategies that differed from the standard 10 day profiles to between 1000 and 2000m and 1000m parking depth. Such alternative sampling strategies were driven by regional priorities for the study of particular phenomena. (e.g. in the Mediterranean a 350m cruise depth and 5 day cycle, more frequent sampling and shallower profiling are needed if modes of variability on the low latitude Indian Ocean are to be resolved). It was concluded that such sampling should be done by Argo equivalent floats deployed in addition to the "standard" global array and that a letter to that effect should be sent to CLIVAR.

14. *Letter to be sent to CLIVAR SSG reiterating ARGO's priority to complete the global array with "standard" 10 day cycling floats and to stress that more frequent sampling if needed in the short term must come from additional Argo-equivalent floats.*

Action. AD

3.6 Law of the Sea (ABE-LOS) meeting

Stan Wilson then described the working of the Advisory Body of Experts on the UN Convention on the Law of the Sea (ABE-LOS) that would meet in Greece May 4-7 2004. ABE-LOS was established by the IOC to provide guidance regarding the application of the Law of the Sea to IOC activities. IOC Resolution XXII-12 requested ABE-LOS "*to provide advice on the legal framework within the context of UNCLOS which is applicable for the collection of oceanographic data*". Thus the deliberations of ABE-LOS –IV that will design a framework for the conduct of operational oceanography within EEZs are directly relevant to Argo.

The key issue is whether the deployment and operation of Argo floats is Marine Scientific Research (MSR) and thus requires application 6 months ahead of time to deploy floats in a country's EEZ or whether the operation of Argo floats is more akin to the routine collection of meteorological data that does not require such notification. The exemption of the met data is on the basis of their value for issues relating to safety of life at sea. (The IOC Resolution concerning Argo only addresses advance notification of the deployment of floats on the high seas by one country that might subsequently drift into another country's EEZ. It does not address the deployment *within* another country's EEZ. Even so, an IOC Resolution does not necessarily have the approval of the Foreign Affairs Ministry or Navy of a given country).

We need to make the make an argument on behalf of Argo, based on the potential utility of the resulting data.

15. *AST members are asked to identify who will represent their country at ABE-LOS-IV and explain to that person present and potential new benefits to your country by helping expedite the collection and timely sharing of Argo and other oceanographic data from within your EEZ .*

Action. IAST members.

4. Argo delayed mode quality control workshop

In introducing the workshop Dean Roemmich remarked that much progress on Argo delayed-mode realm had been made in the 12 months since AST-5 in Hangzhou: Argo netcdf Version 2, regional improvements, etc. It was therefore timely for AST-6 to discuss the PI's role in the delayed-mode process. This needed to be done bearing in mind that there should be a delayed-mode procedure for each parameter measured by the floats: pressure, temperature and salinity.

The DM QC workshop was started with a presentation on "Temperature and salinity analysis over the Atlantic in real time - Qualification of measurements" by Emmanuelle Autret and Fabienne Gaillard. They concluded that their operational system producing RT T & S fields over the Atlantic (global ocean by the end of 2004) could be considered a quality control tool by identifying outlying floats. Constant (over depth) salinity offsets can be estimated within 0.01 psu but in the case of time varying offsets one must still decide whether it is due to the analysis (inconsistency with climatology) or to sensor drift. Each case must be looked at individually and compared with other methods - hence reinforcing the role of the PI. In collaboration with L Boehme, E Autret has shown that the estimations of the offset and drift made using this method were coherent with Lars Boehme estimations in Atlantic Ocean.

The initial float calibration is a key element in both real time and delayed mode QC. This calibration may be made in the laboratory prior to dispatch to the deploying vessel or aircraft or it may be in the form of a CTD station worked by the deploying research vessel. A number of presentations (Desaubies, notes from Riser and comments from King), were made demonstrating the value of these two calibration activities. Laboratory calibrations enabled salinity sensors with unusually large offsets to be identified and if necessary replaced. Uncertainties in at sea comparisons with shipboard profiles come from the time delay between deployment and the first profile and by the spatial separation resulting from this delay. This could be reduced if a float were programmed to execute an up profile within 1 day of launch. Yves Desaubies has also shown that these estimations of offsets made both at laboratory and from CTD were compatible with the ones calculated from statistical methods that are agreed for delayed mode QC.

16. *It is recommended that the salinity sensors on all Argo floats should be subjected to a laboratory check of the CTD sensor calibration.*
Action. All float deploying groups.

17. *It is recommended that floats should be programmable to execute a CTD profile within 24 hrs of deployment. APO to consult with manufacturers to see if this can be easily implemented*
Action. All float deploying groups.

The workshop continued with presentations by Lars Boehme on IfM, Kiel's experience with DM QC in the subpolar N Atlantic within the Gyroscope project, by Shinya Minato on JAMSTEC's experience in the N Pacific and by John Gilson on a graphical user interface for the edit of individual profiles and data points.

Annie Wong summarized the current state of the delayed mode QC process by remarking that much progress on the Argo delayed-mode realm had been made in the 12 months since AST-5 in Hangzhou: Argo netcdf Version 2, regional improvements, etc. It was therefore timely for AST-6 to discuss the PI's role in the delayed-mode process. This needed to be done bearing in mind that there should be a delayed-mode procedure for each parameter measured by the floats: pressure, temperature and salinity. This workshop discussed delayed-mode procedure for salinity only. Amongst the instrument errors found in float salinity measurements, this workshop concentrated on sensor-related drifts and offsets. The PI should be aware that there are other instrument errors in float salinity measurements such as anomalous salinity spikes that are associated with areas of sharp thermal gradients.

For salinity, there are two parts to the Argo delayed-mode process: The first is a semi-automatic procedure for identifying artificial drifts and offsets, where the methods used are repeatable, documented, and have quantified uncertainties. (This is based on WJO, 2003 or Boehme, 2003). In cases where ambiguities still exist, this then needed to be followed by a more subjective procedure for identifying more subtle errors. This involves inspection of individual profiles by PI/expert. The purpose of the workshop is to attempt to introduce some uniformity to the subjective PI/expert part.

The role of the PI in the delayed-mode process is to determine the stability of the float data. This would involve

- Determining that the reference database is adequate for the region sampled by the floats with the help of regional data centres..
- Determining that the statistical method used is appropriate for the region.
- Determining that the statistical uncertainty levels are realistic.
- Determining whether the drifts and offsets identified by the semi-automatic part are
  artificial and not due to ocean events, or determine that the float is stable.
- Determining other instrument errors, other than artificial drifts and offsets.
- Estimating a correction, or concluding that the float measurements are good. In both cases, determining an error bound.

This subjective PI element of the QC process is needed because there is no "absolute reference", and because new instrument errors are still being discovered. This lack of absoluteness is because

• The semi-automatic process cannot distinguish water mass boundaries, fronts, etc., and most importantly, signatures of ocean events such as eddies, interannual variability, and decadal changes.
• Other than artificial drifts and offsets, there are more subtle instrument errors to be identified, e.g. salinity spikes associated with sharp thermal gradients.
• A PI brings in expert information on the float instrument type, local oceanography knowledge of float sampling area, and other recent and close-by data.
• Departure from traditional calibration: float delayed-mode calibration has no "absolute reference". Hence it requires a new kind of thinking: one that synthesizes climatological analysis and climate change analysis.

She hoped that the workshop would provide some basic guidelines for PIs. So far the only agreed guideline is not to correct any drift or offset that is less than 2 x statistical uncertainty or instrument precision, whichever is greater. This means that Argo considers that a float is stable if its measurements deviate from climatology by less than 2 x statistical uncertainty or instrument precision. An issue for the workshop is "Do we want to put a ceiling on the statistical uncertainty?" Also, there are ocean events that can deviate from climatology by more than 2 x statistical uncertainty. If a float samples these events, it doesn't mean that it wasn't stable. What are some examples of these ocean events? How do we identify them? What do we quote as error bars for these events? If the float data are good but the local statistical uncertainty is large and we quote that as the data accuracy, we will turn the signal into noise.

The workshop should also suggest how delayed-mode calibration experiences can be exchanged, for example by establishing an email subscription list or be establishing regular discussions on the topic at AST and ADT meetings?

The best practice needs to be spelled out in the Argo Delayed-Mode QC Manual. She stated that she hoped to have Version 1 on the GDAC sites by end of March. This required agreement on its contents. There were still some unresolved technical issues that need AST input: For instance

- Is the criterion of max [2 x statistical uncertainty, instrument precision] acceptable? Do we want to put a ceiling on the statistical uncertainty? What do we put down for PSAL_ADJUSTED_ERROR when the data are good?
- Should we correct a series (trend) or should we correct individual profiles?
- A sliding window needs to be used when correcting series. What should the length of that window be?
- A set of conventions needs to be established for assigning salinity delayed-mode qc flags PSAL_ADJUSTED_QC = 1, 2, or 3. Do we want to use these to denote quality of dm adjustments, or do we want to use these to flag measurements that have been through real-time qc and delayed-mode qc, but are suspicious according to PI?

The following are the agreed actions for delayed-mode salinity drift correction

18. The basic criterion for delayed-mode qc of float salinities is to not adjust float salinity data that are within max [2 x statistical uncertainty, _ x instrument resolution and precision/reproducibility].

Action. All groups doing DM QC.

19. For drift correction, the parameter PSAL_ADJUSTED_ERROR shall contain the value of max statistical uncertainty, _ x instrument resolution].

Action. All groups doing DM QC.

20. Where float salinity data have been subjected to multiple corrections, e.g. drift correction + spike correction, that the PI shall attempt to propagate errors from all steps, and record the final value in PSAL_ADJUSTED_ERROR.

Action. All groups doing DM QC.

21. Agreed that in the absence of expert intervention, delayed-mode drift correction shall involve the estimation of an offset and slope over a window of twelve months (that is 6 months before and 6 months after the profile, i.e. a new linear fit over 12months is estimated for each profile, which assures the corrections vary smoothly from profile to profile). This means that in general, the timeframe of availability of drift-corrected delayed-mode salinity data is 6 months after a profile is sampled.

Action. All groups doing DM QC.

22. In order to gain experience in delayed-mode processing and to begin reducing the backlog of profiles, it was agreed to process data in order starting with non-controversial data (no drift or drift adjustment accepted), followed by data requiring subjective decisions.

Action. All groups doing DM QC.

23. *Argo shall begin to issue drift-corrected salinity delayed-mode data that have PSAL_ADJUSTED_QC = '1' and '4'. The flags '2' and '3' shall be used to flag features such as spikes and upper ocean anomalies in the adjusted profile.*
Action. All groups doing DM QC.

24. *A delayed-mode email list will be set up by Thierry Carval, with Breck Owens as moderator, for compiling a list of instrument failure modes that warrant using PSAL_ADJUSTED_QC = '2' and '3', and for designing proper codes for recording these failure modes in the HISTORY section of the Argo netcdf files. This email list is also to be used for general discussions related to delayed-mode processes. All PIs are encouraged to subscribe to this email list by contacting Thierry Carval.*
Action. Carval and Owens.

25. *Annie Wong will finalise Version 1 of the Argo Delayed-Mode Manual based on all agreements from this workshop, and put it on the GDAC websites. This manual will be expanded to include additional sections (such as regional specifications, instrument failure mode list, difficult calibration examples, etc) as delayed-mode experience within the community grows.*
Action. Annie Wong.

26. *Agreed to apply estimates of offset and slope to realtime data in cases where this is unambiguous and significant. This should come either from pre-deployment calibrations/deployment CTD casts, or from the most recent delayed-mode salinity corrections. Details remain to be agreed by Breck Owens, Annie Wong , Uwe Send and Yves Desaubies .*
Action. Wong, Send, Owens, Desaubies.

The workshop concluded by noting that Argo is now the primary source of open-ocean profile data. Calibration by reference to a static climatological database will become increasingly inadequate. This is especially true for the Southern Ocean, where the best available measurement will be an Argo profile that has been judged to be stable. Research and development of methods of calibrations by using nearby stable float data in a semi-automatic manner should be stimulated as should be the collection and rapid dissemination of ship-based high quality CTD data that would need to be quickly assimilated into the climatologies used.

5. Argo technical issues

In introducing this agenda item, Dean Roemmich commented that the key issue was to demonstrate that float performance was improving to a level at which we could have some certainty of the date at which the full Argoo array would be completed.

5.1 Float performance and reliability

He started by presenting a report on the SOLO-II floats that have been deployed since late 2002 following design improvements included changes in the pumping system, limit switches, and air bladder and a new CPU. 96 re-designed SIO SOLO floats were deployed in the period October 2002 – November 2003. 60 more have been shipped and/or deployed since November 2003. Of the 96, 91 are still active. 2 failures were due to air bladder (1@8 cycles, 1@10 cycles), one was due to a pressure sensor failure at 30 cycles, and one to grounding at 30 cycles. A further float failed for unknown reasons at 8 cycles.

This means that the cycle completion rate (actual cycles to date/ potential cycles) to date is 98%. Performance figures for SOLO-II floats built by WHOI are similar. Further improvements to the air bladder are planned.

He then showed a presentation prepared by Steve Riser who was unable to attend the meeting. The information was based on the performance of 489 WRC Apex floats in 9 countries that have allowed RT access to Argos messages so that engineering and other data can be monitored and analysed.

The most important problem inherent to Apex that has been fixed in the past year is the *motor backspin problem* that affected floats with a deep parking depth (see table below). This problem was discussed in detail at IAST-5. The problem was corrected by introducing the APF-8C version of the Apex controller. No floats deployed in the past year with the APF-8C have shown the motor backspin problem. This is encouraging, since most of the floats that showed the problem failed within 10 profiles after deployment.

Group	**Sample size**	**Profiles executed**	**Profiles expected**	**Reliability (%)**
Apex 180	20	1234	2033	60.7
Apex 260	468	22672	28659	79.1
APF5	1	17	17	100.0
APF7	58	3292	5997	24.9
APF8	427	20576	24638	83.5
APF8, Park<1400m	*253*	*11854*	*13189*	*89.9*
APF8, Park>1400m	*177*	*8760*	*11506*	*76.1*
APF9	3	38	57	66.7
R1	1	17	17	100.0
Total	489	23923	30709	77.9

Reliability statistics for WRC Apex floats covering the period July 1 1999 to March 9 2004

The statistics for APF-8C controllers are not reflected in the table since until recently statistics were not kept separately. However, UW APF-8C (parking < 1400 m) have had no failures due to the motor backspin. Many of these floats have completed more than 50 profiles. A check of floats parking at deeper levels (i.e. 2000 m) also shows no failures due to backspin after use of the APF-8C controller was initiated.

Early reliability of Apex floats can be seen to be considerably lower than for the present generation. The APF-7 and early versions of the APF-8 controller were only roughly 50% reliable. In practice, this meant that many floats failed during their first year in the water. Present reliability of all 427 floats with APF-8 controllers (including the original version and variants A, B, and C) show 83.5% reliability. With 24638 profiles executed by 427 floats, this yields an average time in the water at present of about 58 profiles, or over 18 months. It seems we are beginning to approach the 90% number that is the stated goal of Argo.

However two new problems have been recognized in the past year. The first manifests itself as a rapid decline in battery voltage after about 100 profiles. This has been traced through the recovery of floats and to long-term pulse discharge tests to poor alkaline battery pack construction. This means that if a single cell fails it will result in the failure of the remaining cells.

There are two possible solutions. The first that has been instituted by WRC is to add protective diodes to each cell. The second more radical solution would be a move to lithium battery packs. This has the double advantage that lithium batteries are more reliable than alkaline cells and that they have greater energy density. (Note there are concerns that as other float failure modes are eliminated it may be clear that the alkaline battery packs in Apex float will be found to have insufficient capacity to complete the required 140 profiles). There are penalties to using lithium batteries. The added cost is about US$500 per float. In addition there are restrictions to shipping lithium batteries that will become more stringent before the end of 2004. Because of this second limitation WRC has opted not to supply floats with lithium batteries. UW intend to eventually change to lithium on all floats. At present they have designed their own lithium battery packs and have now deployed 5 of these floats. UW will use diode-protected alkaline batteries only where shipping restrictions prevent us from using lithiums.

It was noted that SOLO floats use lithium batteries and that there have been no problems encountered with shipping these provided the regulations are closely adhered to.

27. *APO should compile as much information as is available on the shipping of instruments containing lithium batteries in order to engage in informed dialogue with WRC on the subject.*

Action. APO.

The second potential cause for float failure came to light through the recovery of two Apex floats that had run aground. In each of these several tens of grammes (dry weight) of sediment had become trapped in the cowling covering the bladder. This cowling has more holes that are required to allow the bladder to expand and contract freely.

28. *Recommend that float users block all but a single hole in the bottom cowling of Apex floats and that WRC be asked to change the design to eliminate sediment pickup by grounded floats.*

Action. All groups preparing APEX floats and WRC.

Nobie Shikama then presented a report on JAMSTEC's experience with both Apex and Metocean PROVOR floats. They had experienced the same Apex failure modes as reported by Steve Riser. For a sample of 27 Apex floats that had failed 37% showed abrupt battery failure, 37% were attributable to the Druck pressure sensor problem on the SBE salinity sensors, 11% were due to grounding and the remaining 15% had unknown causes. He went on to show how floats had been recovered at sea and pointed out the value of inspection of recovered floats.

He went on to describe a prototype NINJA floats fitted with a chlorophyll sensor and an experiment under the Arctic icecap using an Argo float profiling on a mooring.

Gerard Loaec then reported on the performance of floats used in both the French Argo programme and the European Gyroscope project. He noted that Metocean in Canada were no longer manufacturing PROVOR floats but that they would remain as agents for Martec/SERPE – manufactured floats.

In the Gyroscope project 40 Martec Provors and 44 WRC Apex floats were deployed in mid 2001. Seven of each type had ceased to work in the past year leaving 28 Provors (70%) and 33 Apex (75%) still active. This means that overall each float type has delivered about 85% of the maximum data possible.

Technical improvements during the past year have included the rectification of the fault that caused many Metocean floats deployed by Jamstec to execute an 'emergency ascent' in which the float surfaces without waiting for the end of the cycle if the pressure indicated is higher than the maximum allowed pressure. Most of the floats die between 70 and 90 profiles without the experience of emergency pop-ups. (Japanese National Report) with a parking depth of 2000 dbars. To cure this the software has been updated on all floats to control the float at depth. It also seems that the quality of the valve on the hydraulic engine is not stable and that low leakages inside the hydraulic circuit may happen. All floats have been fitted with a new valve (PSA) since the end of 2003.

A second fault on some Kordi floats is that they don't dive when the surface water temperature is low. This fault has now been rectified.

PROVOR flots have been deployed with both FSI and SBE salinity sensors. The FSI sensors have shown erratic behaviour that has been attributed either to interference by the damping plate with the external field of the salinity sensor or to fouling. The damping plate has been moved further away and some more floats were deployed in the southern ocean (cold water) at the beginning of 2004. Most PROVOR floats are now being deployed with SBE sensors but efforts continue to solve the problems with FSI.

Finally a new float has been designed by IFREMER (it was on display in the meeting room). It is lighter (19kg) than present floats, is designed to do 100 cycles to 2000m in all oceans, it has 800ml variable buoyancy and does not require ballasting.

5.2 Oxygen sensors and other measurements

Finally in this session updates were given by Uwe Send and in a report from Steve Riser on the latest status of oxygen sensor developments. Send showed data from two floats in the Labrador sea that use the Aanderaa optode probe in which the optical properties of a membrane respond to oxygen concenration. The sensor has a fast (30 second ?) response time and is immune from biological fouling. The results seem very promising with good agreement between the two floats when they were close togather and between float and ship data. The values recorded are consistent with expected saturation values in the upper mixed layer.

The Riser report showed data from floats in the North, Central and South Pacific with time series varying in length from 22 to 52 profiles taken at 10 day intervals. For each float the dissolved O_2 profiles were compared to historical data in the WOA2001 archive. All stations in the archive in a 3° box around the trajectory having *T*, *S*, *p*, and O_2 data were averaged onto σ_θ surfaces for comparison with the measured σ_θ – O_2 relation. This comparison is sometimes difficult due to the relatively poor climatology of dissolved O_2.

Results suggest that the SBE-43 oxygen sensor is very promising for measuring dissolved O_2 from profiling floats over times of several years. Historically, the main problem with polarographic Clark-type O_2 sensors has been excessive drift over time. This problem seems to have been greatly reduced with the SBE-43. Several less severe problems remain to be solved with the SBE-43, and it appears that it will eventually be a useful tool for scientific research.

The potential of Argo floats to make other measurements nearer to the ocean surface than is presently possible was discussed. They might be used in the GODAE High Resolution SST Pilot Project and for calibration of satellite salinity sensors. It was clear that there would soon be pressure on Argo floats to make such measurements.

29. *AD to prepare a document outlining the potential for making measurements other that T and S from profiling floats.*

Action. AD

It was suggested that the present method of calculating float reliability as actual profiles measured / maximum possible profiles measured did not fully reflect performance and that other statistical measures that take into account the expected float lifetime should be developed.

It was noted that SBE had moved very quickly to rectify the fault in the salinity sensors and they should be thanked for this effective action.

30. *AD to write to Nordeen Larsen (SBE) to thank him and his company for the speedy action to rectify last year's pressure sensor problem and for their close co-operation with float providers to minimize its impact.*

Action. AD

6. Performance of Argo data system

Sylvie Pouliquen presented a summary of data management activities within the past year. There has been a change in the leadership of data management team: Bob Keeley stepped down from this position last November and M Ignaszewski has accepted to replace him as a co-chair of ADMT.

31. *AD to write to thank Bob Keeley for his work as ADMT chairman*

Action. AD

6.1 Real-time data flow

The real-time data flow is now in a pre-operational stage and 90% of the data are arriving at GDAC through the DACs. The percentage of data arriving solely through GTS has decreased from 30% to 10% in accordance with the goal set by the ADMT. This should be reduced around 5% by the end of 2004, with the setting up of new DACs

(Korea, India), the collaboration between CORIOLIS and CLS-France for the data processed by CLS, AOML and NAVOCEANO for USA. Work is underway to retrieve part of the historical data (starting 2000) received only by GTS.

About 80% of data are now available on the GTS within 24h. since CLS has just decreased the delay before starting GTS processing the data from 25 to 18 hours and we have seen an improvement at French node through the automation of the QC at CORIOLIS.

6.2 Delayed-mode data flow
Completion of the delayed mode data stream is the 2004 challenge for data management. A few DACs are setting up the system and were waiting both for the implementation of Version 2.1 of Argo data (which is able to handle adjusted-parameters) and the guidance from IAST-6 to start (see delayed mode section). Our goal is to have the first delayed mode data available at GDACs in mid 2004.

The setting up of RDACs (regional DACs), is not a priority for 2004 since we first need to have delayed mode data of uniform consistency on a basin-wide scale, and products can then be built from this. BODC mentioned that the RDAC they will establish will deal with data from the Atlantic and Indian sectors of the Southern Ocean but not the Pacific since they have no expertise in that region. A decision needs to be made whether the Pacific sector of the S Ocean should it be included in the responsibilities of the Pacific RDAC?

6.3 Argo data products
In the remit of the ADMT there is an issue (led by Bob Molinari) dealing with two categories of products based on Argo data. The first, concerns the statistics that define the development and performance of the Argo network. For this both AD and IAST should propose examples of statistics that are precise enough to be useful but also clear enough not to be misinterpreted by readers. AD will coordinate these activities.

> *32 AD to suggest statistical parameters (e.g. on float reliability) that can be adopted by all Argo participants to enable the array performance to be examined and publicised*
>
> *Action. AD*

The second concerns products generated from Argo data that could provide good advertising for Argo. AD should propose a set of criteria to define the products that could be than linked from AIC www site.

> *33. AD to establish a set of criteria to be used in assessing whether a product is appropriate to be used to advertise the benefits of Argo*
>
> *Action. AD*

One product that can be produced from Argo data, is the velocity information derived from trajectory files. Kuh Kim will lead the definition of such product for Argo with help from experts for each float type (Kuh Kim for Apex, Yves Desaubies for Provor, Breck Owens for Solo).

Argo's link with operational users has to become much more active of we are to be able to improve the service to them. Each country should organize this link at national level to the DACs and that a summary of the feedback received and the effectiveness of the links will be made at next ADMT meeting. For operational centres directly linked to GTS, this feedback, especially on bad floats, will be returned to GDACs that will make the interface with the DACs.

34. IAST members to take responsibility for establishing a dialogue with operational centres in their country and report to ADMT of any problems with Argo data and its delivery

Action. IAST members

The issue of new real-time QC tests was briefly discussed including the detection of parameter jumps, frozen profiles, and grey lists. It was agreed that the ADMT would pursue these changes and report progress at their next meeting.

The need for a "Cookbook" (or "Quick Start Guide") was discussed and the ADMT has agreed to develop the document in time for review at the ADMT meeting in the fall.

Finally NODC has produced a draft of the Argo CD-ROM ; it was agreed that some IAST members would volunteer to review this new version. (http://argo.nodc.noaa.gov/cd_1 , http://argo.nodc.noaa.gov/cd_2).

35. IAST members to volunteer to test-drive Argo data CD-ROM

Action IAST members

The goal is to finalise the master end of June 2004. The distribution list should be provided by AD to NODC as soon as possible.

36. AD to compile a list of recipients for the first Argo data CD-Rom and pass this to NODC by 1 May 2004

Action AD

The next Argo Data Management Meeting will be in Southampton, UK the 29-30 September, 1st October 2004.

7. Argo data use

John Gould reported that clear evidence of the widespread use of Argo data was given in the presentations from last November's First Argo Science Workshop in Tokyo. The applications ranged from the study of the interactions of tropical cyclones with the upper ocean thermal structure to the study of decadal change in the ocean and the calculation of the global heat storage. These applications by and large were being carried out in research institutions.

Since the real time data stream was at present the most complete we were in a position to review the use of these real time by operational analysis and forecasting centres. He said that he had constructed a table (Table 1) showing which centres were using the data and for what purpose. It was important that Argo maintained an active dialogue with these centres with a view to a) receiving feedback on any problems they encountered with the data delivery and quality and b) Argo being able to cite the use of the data to reinforce the importance of Argo to national funding agencies. Insert RT data use table here

It was decided that the table should be maintained by the APO and enlarged as appropriate. Primary responsibility for maintaining this dialogue should be with the members of the IAST (Action item 33)

8. Argo as an integral part of the Global Ocean and Climate Observing Systems

John Gould introduced this item by stating that while Argo was concentrating on pursuing its own objectives, it was important to recognize that Argo was a key element in the ocean and climate observing systems and that it was now the major source of ocean profile data on which many applications depended. This fact was encapsulated in a table that he had prepared for the meeting of POGO (The Partnership for Observing the Global Ocean). This table had since been used by POGO as evidence to the Global Earth Observations (GEO) system of the importance of ocean observations in defining the state of the earth. GEO was in the midst of a process to define a 10 year implementation strategy for all types of earth observations.

In light of this importance it seemed ironic that Argo was still regarded as only a pilot project but the term "pilot" was indicative of present transient nature of Argo funding. Members of the IAST commented that funding for virtually all elements of the ocean observing system were similarly volatile.

Kopillil Radhakrishnan then gave resume from the perspective of IOC of the importance of ARGO. He noted that GOOS, GCOS and the recent JCOMM are important intergovernmental structures that have a role in shaping the Ocean observation systems as a global design and facilitating its implementation through the Member-States. There are now several active GOOS Regional alliances and a Regional GOOS Council has now been evolved.
There is a Data Exchange Policy of IOC that has been approved by the IOC Assembly in 2003. The IOC Committee on International Oceanographic Data and Information Exchange (IODE) with a chain of 64 Ocean Data Centres is another structure that is important. Ocean Data and Information networking (ODIN) is taking place in three regions. The IODE as well as Data Management aspects of GOOS and JCOMM are moving in synergy. Certainly the Argo Data Management System that is very well developed, has to be formally taken note by JCOMM/IODE.
GOOS is now entering the implementation phase. During 2002 there was a comprehensive review of GOOS structure by a Review Group under Dr Paul Mason as ordered by the IOC Assembly. An inter-sessional Working Group of IOC Assembly recently went through these recommendations. The suggestion regarding GOOS linkage with Pilot Projects such as Argo is as follows:-

"GOOS Pilot Projects that are stimulated by the research community and/or GOOS Community (through one of its Panels) and managed by the wider scientific community through independent steering committees should also become part of the overall plans for GOOS.

GOOS should encourage and support such Pilot Projects with minimal interference but it is important that GOOS is sufficiently well informed of the successes and failures of such

Projects so that it can make sensible decisions about which of them should be taken forward to operational status.

The Steering Committees of such Pilot Projects do not have to be formally represented in the GOOS structure."

9. Assessing Argo science

Kensuke Takeuchi stated that JAMSTEC the Japanese sponsors of the Argo Workshop had been very pleased with the outcome. Both the number of attendees and the breadth and quality of the science had exceeded their expectations. He noted that CD-ROMs of the presentations had been prepared by JAMSTEC and would be distributed. Dean Roemmich and other members of the IAST expressed their pleasure at the success of the workshop.

John Gould said that it was now important to maintain the visibility of Argo science and that this would occur in a number of ways. Firstly there were an increasing number of Argo-based papers in the refereed literature and that this was represented by the Argo bibliography. He asked IAST members to help to keep this list as up to date as possible.

> *37. AD will remind IAST members twice yearly to submit new entries for the Argo bibliography.*
>
> *Action. AD.*

It was also important that papers using Argo data should acknowledge the project. A form of words had been suggested and IAST members were encouraged to ensure that these were used in papers from their country.

> *38. Papers using Argo data should use the following words in the acknowledgement section. " These data were collected and made freely available by the International Argo Project and the national programmes that contribute to it. (www.argo.ucsd.edu, argo.jcommops.org). Argo is a pilot programme of the Global Ocean Observing System".*
>
> *Action. AD and ATC to make these words prominent on the Argo web pages.*

Dean Roemmich suggested that researchers should also, as a courtesy, contact PIs responsible for floats from which they were using data to inform them of the nature of the research being undertaken.

> *38 Researchers should contact PIs responsible for floats from which they are using data to inform them of the nature of the research being undertaken.*
>
> *Action. AD and ATC to make this advice prominent on the Argo web pages.*

The second means of highlighting Argo research was through dedicated workshops such as the one in Tokyo and through sessions at major conferences. An invitation had been extended by Indonesia to host a second Argo workshop in Indonesia. A session in which Argo results from the North Pacific would be presented would be at the PICES-XIII in Hawaii in October. A second opportunity would be an Argo/GODAE session at the IAPSO/IAG conference in Cairns, Australia in August 2005. These meetings were endorsed by the IAST. In discussion it was concluded that the most appropriate time and venue for a 2nd Argo workshop would be in the USA in late 2005/early 2006.

Gaël Forget presented the paper " A 4D-Var analysis of Argo profiles in the North Atlantic" by Gaël Forget, Bruno Ferron and Herle Mercier. The results show that Argo profiles when combined with a low resolution model using 4D VAR assimilation provides a system well suited for climatic analysis of hydrology and circulation.
It allows to interpolate Argo in situ data, reveals the associated circulation from an inverse calculation and describes low frequency/large scale variability, in a dynamically consistent manner.

10. Broadening Argo

John Gould noted that both Ireland and the Netherlands were now Argo float deploying nations and that this was a welcome addition. One of Argo's strengths would be in its diversity and with that in mind Argo should seek ways in which participation could be further broadened. One geographical area that was under-represented was South America. However during and since the workshop South American countries (specifically Brazil, Chile, Costa Rica and Argentina) had expressed interest in becoming active participants in Argo. With this in mind Howard Freeland had started to develop ideas for a workshop in the region. He then described his ideas.

The workshop would probably be held in Chile and would be built around Canada sending two or more floats to Chile. Other countries from across S. America would be invited to attend. The workshop would have speakers explaining how the floats work, including hands-on demonstration of the starting of a float and checking it out prior to launch. There might be an opportunity to discuss the technology in more detail including discussion of the variety of floats available, advantages and disadvantages of different designs etc. Other key elements would be showing examples of the use of Argo for Data Assimilation and for regional environmental assessment and a detailed description of the data system. The workshop should include discussion of international issues surrounding Argo. The workshop might last 2 days.

It could be held in Valparaiso or Concepcion, but since the floats would be shipped to SHOA, Valparaiso seems to be the obvious option. If in Valparaiso it could be either at SHOA or at the Universidad Catolica de Valparaiso.

Members of the Argo Steering Team who attend would be expected to pay their own way. There are indications from the IOC (through Janice Trotte in Brazil) and from the Inter American Institute (IAI) that they may be willing to support the workshop with finding to enable S American participation.

It was pointed out that CLIVAR might wish to be involved and could help with regional organization since they have an active (though not specifically ocean-focussed) program in the region.

Mathieu Belbeoch pointed out that Spain (Gregorio Parrilla) had expressed an interest in donating floats to the region and that they might be able to be deployed by Costa Rica.

39. *Howard Freeland to work with APO to continue planning for an Argo S American workshop and to seek IAST members to make a contribution to the*

workshop.

Action. APO and Freeland

11. Argo infrastructure support

Dean Roemmich, in introducing this topic, noted how Argo had addressed the development of the infrastructure it needed in a rather piecemeal and pragmatic way (this had included the formation of the ADMT, the establishment of the AIC, the development of the data system and most recently the appointment of John Gould as a temporary Argo Director.

It was now recognized that Argo would need a more formal structure with clear lines of communication and responsibility. With this in mind the Argo executive had been working over the past two days to establish an agreed set of Terms of Reference for an Argo Project Office and the duties and interrelationships of the Argo Director, Argo Technical Co-ordinator and JCOMMOPS Co-ordinator. These TORs , when agreed, would form the basis of the new contract for the ATC and for the recruitment of a senior climate and/or ocean scientist to be Argo Director. He noted that while the USA presently provided the major part (80%) of the funding of Argo infrastructure, this would have to be more equitably distributed in future to better reflect that the commitments made by countries to the project as a whole. The total sum required would be of the order of $350k per annum (less than 2% of the total project costs) and might be less depending on the location of the Argo Director.

The IAST agreed that the project needed an effective oversight mechanism to act a the executive arm of the IAST and ADMT. There was some discussion of the location of the AD and its geographical relationship to the AIC and the AST Chair. It was felt that co-location though advantageous was not essential provided there was a willingness on all sides to communicate effectively. It was agreed that the AD would discuss these issues with countries presently supporting Argo infrastructure and seek funding from other sources to provide an effective Argo infrastructure. These discussions would include seeking effective mechanisms to host the Argo Project Office and to administer the funding.

40. Argo Exec to agree TOR for the roles of the APO, AD and AIC and AD to make these available to interested parties (IOC, GOOS/GCOS, JCOMMOPS)

Action. Argo Exec.

41. AD to seek finance and appropriate mechanisms to fund and establish an Argo Project Office.

Action. AD.

In closing this issue the ATC presented a review of his activities during the past year that included the launch of the new AIC web site. AST members expressed some concerns over the difficulty in finding key elements of the old web site in the new one. It was noted that members had been asked to provide comments on the web site before its launch but few had done so. This remains a key issue. (See agenda item 12)

12. Argo communication

John Gould commented that Argo was a large and growing project that needed to have effective internal communication as well as being effective in portraying itself to the larger community of data users, scientist and project managers. A key element in communication was to have effective web sites that could provide both general information and a single gateway to Argo as well as more technical aspects needed by participants in the project such as float notification and the generation of custom-made maps and statistics.

> *42. AD and ATC to urgently improve the Argo web site(s) to meet both the needs of Argo and the general public.*
>
> *Action. AD and ATC.*

There was discussion as to whether Argo should produce a new brochure that was truly international. John Gould pointed out that such documents quickly went out of date particularly when the project was expanding so rapidly. It was agreed that a brochure should be prepared both for printing and for electronic distribution to countries that could add pages with a specific national focus. Kensuke Takeuchi said that JAMSTEC might be able to help with printing costs

> *43. AD to design a new Argo brochure and discuss with JAMSTEC concerning help with printing costs.*
>
> *Action. AD.*

Finally John Gould referred to the proposal that was to be submitted to ICSU for an expansion of the activities of SEREAD. There had been insufficient time to prepare the proposal for submission in February 2004. Instead the proposal would be submitted in early 2005.

13. Future meetings

It was agreed that IAST-7 would be held at INCOIS in Hyderabad by kind invitation of Kopillil Radhakrishnan. The meeting would be in early February 2005 so as to avoid the hottest weather.

> *44. IAST to be polled for suitable dates for IAST-7 in Hyderabad, India in February 2005.*
>
> *Action. AD and Radhakrishnan.*

14. Membership changes

Netherlands will become a member of the IAST.

> *45. AD to write to Andreas Sterl inviting him to join the IAST.*
>
> *Action. AD.*

In light of Uwe Send's impending move to SIO he will step down as the German member of IAST. It is suggested that he be replaced by Juergen Fischer (IfM Kiel) but that Uwe might wish to continue to attend IAST meetings to cover technical issues.

46. AD to write to Juergen Fischer inviting him to join the IAST as a replacement for Uwe Send.

Action. AD.

15. Closure of meeting

In closing the meeting, Dean Roemmich thanked Yves Desaubies, Sylvie Pouliquen and Francine Loubrieu for their hard work in making the meeting run so effectively.

Appendix 1. Meeting agenda

Tuesday March 9th Start 0900

1. Welcome and local arrangements (Desaubies / Senior IFREMER person)
   ** Document Hotel information is at http://www.argo.ucsd.edu*

2. Introduction to AST-6 (Roemmich)
   Review of activities since, and matters arising from AST-5.
   ** Document 2.1 AST-5 action items and status (Gould)*

3. Assessment of Argo implementation status
   - Identification of actions needed to improve implementation
     - National
     - International (Argo)
     - Intergovernmental

* Documents Present status of Argo array (Belbeoch)
National status reports Note these will not be introduced in plenary but any national issues requiring AST or ADT action should be brought to the attention of Dean Roemmich before the meeting.

Science talk

Fabienne Gaillard, IFREMER, "Objective analysis of the Coriolis data set in the North Atlantic; impacts on real time quality control"

Lunch

Tuesday March 9th pm

4. Argo delayed mode data workshop

Argo's delayed-mode quality control process consists of a semi-automated salinity adjustment (WJO or equivalent) followed by examination of all individual profiles by the PI or other salinity expert. The AST has considered the first of these steps in some detail, but not yet the second. In order to ensure the uniform high quality required of Argo delayed-mode data, it is essential that the AST agree on a set of tools and procedures to be applied in a consistent manner to all Argo data. PI-examination is necessarily a subjective process, but we must make it as uniform and consistent as possible. The half day workshop will include :-

Further discussion of WJO and related salinity adjustment procedures.

- 'Validation of WJO salinity adjustment for the floats deployed in the northwest Pacific' (Shinya Minato)
- 'Experience of Quality Control of Profiling Floats in the North Atlantic' (Lars Bohme)
- 'How good is the initial float CTD calibration?' (Steve Riser)
- 'Initial at-sea calibrations' (Yves Desaubies)

Workshop introduction - what is the PI's role and why is it necessary? (Annie Wong)

- PI tools for profile examination
- 'MATLAB-based graphical interface for Argo data' (John Gilson)

Examples and discussion of problematic profiles

Wednesday March 10th (start 0900)

5. Assessment of Argo technical issues
   - can we demonstrate that float performance is improving and is meeting required levels to achieve 3000 floats by 2006?
- Documents/presentations
  - Riser (APEX performance)
  - Roemmich (SOLO-II performance)
  - Loaec (PROVOR performance)
  - Shikama (Performance of APEX, PROVOR, and NINJA)
  - Review of SBE and FSI sensor situation
  - Assessment of status of new technologies
    - New float types (NINJA, etc)
    - Data communications (status of Low Earth Orbit communication trials)
    - Under ice operation
    - New sensors
    - * Update on oxygen sensors (Riser + Send +?)

Science talk after lunch

Gael Forget (IFREMER). "4DVAR analysis of the recently available ARGO profiles for the period June 2002-May 2003".

6. Assessment of Argo data system
   - Real time
   - Delayed mode
   - Identification of actions needed to improve data flow
   -

7. Assessment of Argo data use
   - Who is using it?
   - For what applications?
   - Are users needs being met?
   - * Summary of use by operational centres is being compiled by John Gould

Wednesday evening. No host dinner.

Thursday March 11th (start 0900)

8. Assessment of Argo's position within the wider GOOS and GCOS and links with CLIVAR and GODAE
   - How dependent is Argo on other GOOS/GCOS elements?
   - How dependent are other GOOS/GCOS elements on Argo?
   - Do we need better communications with CLIVAR and GODAE?

* Background document Gould

9. Assessing Argo science
   - Review of 1st workshop
   - Consider other Argo science events
   - Argo bibliography.

10. Broadening Argo

- what steps should we take to broaden participation in Argo?

* Proposal for a workshop in South America (Freeland)

11. Argo infrastructure support

- Contribution of AIC
- Contribution of Argo project office
- How do we optimise that support?

12. Argo communication

- How effective is communication inside Argo? How should it be changed?
- Argo outreach activities? How effective have we been? What more should we do?

(Note this includes the effectiveness of our web sites)

13. Future meetings

14. AST membership changes

Appendix 2 Attendance list

Dean ROEMMICH IAST Chair	Scripps Inst. of Oceanography	9500 Gilman Drive La Jolla 92093-0230 USA	droemmich@ucsd.edu
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Australian Report

Submitted by Susan Wijffels, CSIRO Marine Research

Status of implementation

Floats deployed and their performance

Of the 10 Webb Research Corporation R1-PALACE floats deployed in 1999-2000, one is still operating, though ironically, this float's sensors are malfunctioning. The largest number of good profiles obtained from these floats is 121.

Of the 19 Webb Research Corporation APEX260 floats deployed in 2002/2003, all are still operating. The rate of voltage drop/profile is less than found in the R1-PALACE, consonant with the expected higher efficiency of the APEX engine. Two of the APEX have ceased operations due to grounding on the continental shelf. A single MetOcean PROVOR was also deployed during this period and has delivered 46 profiles.

Australia has formalized a cooperative agreement with KORDI, Korea to assist with float deployments in the Southern Ocean, south of Australia. Over the past year, five KORDI floats were deployed through this cooperation, and we hope to continue in the future.

Technical problems encountered and solved

We have not found any serious technical problems during operations over the past year. Methods to avoid the loss of floats through grounding are being looked at. Along with other float operators, we believe that the bladder cowling on the APEX is capable of picking up sediment during contact with the bottom, which would increase the float's effective weight and prevent surfacing. Methods at minimizing the chances of picking up sediments such as sealing or taping over the holes in the cowling are being considered. We are also exploring the ice avoidance algorithms used in other areas of the subantarctic for upcoming deployments near the latitudes where winter sea ice may occur.

We continue to replace the lithium battery packs delivered with the APEX floats with locally sourced lithium packs. These are all diode protected.

Status of contributions to Argo data management:

Real time: All profiles are real-time QC'd and published on the GTS and sent to the GDACs. In February 2004, 86% of profiles were delivered to the GTS and GDACs within 24 hours. Longer delays largely occurred when anomalous profiles are reported on the weekends.

Delayed mode: Regional historical T/S data sets are being assembled and the Wong and Johnson (2003) method tested on float data from the Australian Argo array. Manpower for this activity is still limited, though proposals to increase it are being considered. Australia still hopes to eventually establish a Regional Delayed Mode QC service.

Contribution to Regional Coordination:

In December 2002, Helen Phillips established a website for the coordination of Argo floats in the Indian Ocean and has been actively coordinating deployments there. India will soon take over this role.

National funding

Float acquisition: Australian Argo is a joint program between the CSIRO Marine Research (CMR) and the Australian Bureau of Meteorology (BoM). The Cooperative Research Center for Antarctic Ecosystems and Climate (ACECRC) will acquire floats for deployment in the subantarctic zone south of Australia.

CMR has committed to acquire10 floats per year, the ACECRC will acquire 14-15 floats per year and the BoM may acquire 6-7 floats per year in future years. Hence the Australian float acquisition will be sustained at about 30 floats/year over the next few years.

Human resources: Australian Argo requires approximately 50% of a fulltime engineer for float checkout and preparation; 20% of a fulltime operations officer for float shipping coordination and deployment training; 30% of a fulltime data expert for real time data monitoring and conversion to netcdf formats etc. Scientific analysis, coordination and oversight are supported by 1.3 fulltime equivalents.

Deployment plans

Australia will continue to maintain a float array between 100°E and its west coast. Plans to greatly expand coverage of the subantarctic zone southwest of Australia have been delayed by up to one year due to the float sensor recalls by Seabird Electronics. In the upcoming Austral summer, we plan to deploy about 35 floats between Australia and Antarctica. Future deployments will see coverage of the Tasman Sea.

National research and operational uses of Argo data:

- Argo data are routinely used in the operational upper ocean analyses of Neville Smith at the Australian Bureau of Meteorology (http://www.bom.gov.au/bmrc/ocean/results/climocan.htm). These analyses are also used to initialize an experimental seasonal rain forecasting system.
- A collaborative analysis of Argo data off Sumatra and Java began in 2003 with a visit by Bagus Hendrajana from the Indonesian Agency for Fisheries and Marine Research. This work was presented at the Argo Science Workshop in November.
- Large scale interannual salinity anomalies captured by Argo in the eastern South Indian Ocean are being investigated by Helen Phillips, a postdoctoral investigator at CSIRO Marine Research. This work was presented at the Argo Science Workshop in November. Helen.Phillips@csiro.au
- CSIRO Marine Research, in collaboration with the Bureau of Meteorology Research Center, is developing an ocean model/data assimilation system for ocean forecasting and hindcasting. Argo data will be the largest *in situ* data source for this system. Work on subsurface profile assimilation is underway. PI: Andreas.Schiller@csiro.au

Canadian National report
(Submitted by Howard Freeland)

1. Status of Float Deployments
Floats deployed since March 2003:
Summary-1: 10 APEX Floats deployed with data return of 99.99%
Summary-2: 17 Metocean PROVOR floats deployed with data return of about 82%.

a) Pacific Deployments:
10 APEX floats were deployed in the Gulf of Alaska, all using the Apf8a controller board, and 9 have returned 100% of the expected number of profiles. The single float supplying less than 100% is missing message #1 from one profile. All data are of high quality.

b) Atlantic Deployments:
17 PROVOR floats have been deployed in the northwest North Atlantic in 2003. All were manufactured by the Metocean Corporation of Dartmouth, Nova Scotia. Of the initial deployment of six floats in July, four suffered pressure parameter problems which are likely attributable to the batch of Druck pressure sensors that are known to be defective. Two of these floats have failed completely, one has been on the surface since 5 January, 2004 broadcasting continuously, and one (4900423) which gave erratic data for its first ten cycles has appeared to have recovered and has delivered eleven successive good cycles. The remaining PROVOR floats were returned to Metocean and the defective SeaBird sensors were replaced. One of the eleven refurbished PROVOR floats failed of unknown causes following its second cycle. As of 18 February, 2004 we have 13 PROVOR floats providing reliable profiles of high data quality.
13 APEX floats were deployed in the northwest North Atlantic in 2002. Two of these floats have failed of unknown causes, one after 25 cycles, the other after 64. The overall data return from these deployments is 94%. 4 APEX floats were deployed in the Slope Water region of the northwest Atlantic in 2001. Three of these floats have failed after 10, 47 and 75 cycles for a current data return of 65%.

2. Status of Contributions to Argo Data Management.

URL: www.meds-sdmm.dfo-mpo.gc.ca follow links to the Argo program.

Operations at MEDS are fairly routine now since the last deployment of floats. Our automatic processing runs every 6 hours to acquire data from Canadian floats, build profiles, automatic QC and issuing data to the GTS, GDACs and to PIs. Our website is updated automatically on the same schedule. We have tracking files to alert us when things go wrong so that corrective action can be taken.

We regularly find small problems with float data as they arrive which causes delays in issuing data to the GTS. In most cases, this is caused by suspect data in the profile or short profiles. With special handling, usually we recover the missing portions and these data find their way to the GDACs.

We have been busy in the conversion of data to the new data format and replacing all historical records at the GDACs with the new form. This is complete.

We are finding that we are experiencing slowdowns in unloading data to both GDACs at 1200 Eastern Standard Time. We are not sure if this is due to increased traffic on the Internet, or a bottleneck coming out of MEDS.

The standardization of delayed mode QC at the last data management meeting in November, 2003, required some changes to our processing. This is underway and delayed mode data from Canada should be found on the GDACs by the time of the AST meeting.

Work will be required to add new data processing software to handle the floats with Optode sensors. We will be discussing what to do with these data in the global data system at the upcoming data management meeting.

3. National Funding for Argo Operations (not including use of Argo)

The Canadian Argo program is relatively small but is spread across three institutions. The central management of the Canadian strategy for Argo is based at the Institute of Ocean Sciences (IOS) in Sidney, British Columbia. Deployments for the Atlantic are based out of the Bedford Institute of Oceanography (BIO), Halifax, Nova Scotia, and data management centred at the Marine Environmental Data Service (MEDS) in Ottawa.

Human resources dedicated to Argo operations add to 5. PYs

Purchase of floats is conducted on an ad hoc basis but is typically C$600k/year = US$390k/year.

Operations are funded through a single grant issued specifically to support Argo operations and amounting to about C$360k (US$235/year). This supports shipping, data management, travel, computing requirements and three technical support salaries.

4. Deployment Plans

Our deployment plans are rather ad hoc as we are rarely able to predict from one year to the next how many floats we will have to deploy or indeed if we will have any floats to deploy. As of writing we have 51 floats on order. Two of the N. Atlantic floats and two of the Pacific floats will carry Aanderaa Optode sensors. We also have several floats remaining on inventory from 2003 and 2 of these will be deployed with the assistance of SHOA/Chile in September 2004.

The North Atlantic deployments present a particular challenge because of the strong boundary currents along the western boundaries of the sub polar and sub tropical gyres. We are attempting to maintain the Argo array in the north-western North Atlantic north of 35°N and west of 40°W. Many of the floats deployed in this region eventually get captured by the western boundary currents and the North Atlantic Current and get carried to the south and east. This would be okay if there was a steady supply of floats to the regions upstream of our region to fill the gaps. There are presently few active floats in the Irminger Sea to replace the Labrador Sea floats that are being swept south to Flemish Cap and the North Atlantic Current.

Because of the late release of funds to purchase floats in the first quarter of 2004, we have not yet developed a deployment plan for this large inventory of floats. We will use our presently scheduled oceanographic cruises in the North Pacific and North Atlantic to fill gaps in the Argo float array in the Gulf of Alaska, along the Canadian Atlantic continental margin and in the Labrador Sea. This can be done in both the spring and the fall. We have not requested specific Canadian ship time to deploy floats over a larger region of either the North Pacific or Atlantic nor have we yet explored deployment opportunities from Canadian naval vessels or foreign research vessels. It seems likely that a large part of this inventory will remain to be deployed in 2005 at which time we expect that many of the Gulf of Alaska Floats deployed in 2001 will need replacement.

5. National Research and Operational Uses of Argo Data

During August 2002 a meeting was held in Halifax, Nova Scotia, to discuss the development of ocean data assimilation and similar strategies within Canada and the use of the new real-time ocean data sets. The meeting was hosted by CMEP (Canadian Centre for Marine Environmental Prediction) which is a new agency funded partially by academic funding agencies and partially by the federal government. CMEP is based at Dalhousie University in Halifax. At that meeting a decision was announced by the Director of the Meteorological Service of Canada to develop a global coupled atmosphere/ocean data assimilation model. The following projects are ones that I am aware of within Canada that use Argo data.

1) Atlantic Ocean data assimilation - A project funded by the CFCAS (Canadian Foundation for Climate and Atmospheric Science) to develop data assimilation and hindcast tools for the N. Atlantic. The Principal Investigators are Keith Thompson (Dalhousie University) and Dan Wright (Bedford Institute).
2) Pacific Ocean data assimilation - A project funded by the CFCAS (Canadian Foundation for Climate and Atmospheric Science) to develop data assimilation and hindcast tools for the Gulf of Alaska. The Principal Investigators are Mike Stacey (Royal Military College), Mike Foreman and others at IOS.
3) Pacific Ocean data assimilation - A project funded by the Department of Fisheries and Oceans “Strategic Science Fund” to parallel and assist project 2).
4) Mixed layer mapping in the Gulf of Alaska: This project is funded at the University of Alberta (PI = Paul Myers) to study the evolution of mixed layer depths in the Gulf of Alaska focussing on the data from Argo, funds derive from the Dept of Fisheries and Oceans “Science Subvention Fund”.
5) Antarctic Intermediate Water formation: This project is funded through the CFCAS, the PIs are Richard Karsten (Acadia University, Nova Scotia) and Howard Freeland (IOS) and will study the floats recently deployed in the formation area for Antarctic Intermediate water. A Post-Doctoral Fellow has been hired and will be presenting a paper at the spring AGU meeting in Montréal.
6) Gulf of Alaska cold pool: This project is funded through the DFO Science Subvention Fund. The PI is William Hsieh at the University of British Columbia, Vancouver. The object is to study with a combination of modelling and analysis of Argo data an unusual invasion of sub-arctic water that occurred during 2002.
7) Pacific – State of the Ocean: Howard Freeland as part of his job at IOS monitors the state of the environment in the Gulf of Alaska. Conditions have been extremely unusual during the last 2 years and upper-ocean stratification has never been as high as has recently been seen. This threatens to reduce the supply of nutrients to the productive zone with impacts on the ecosystem seen in 2003 and further likely during 2004.
8) Atlantic – State of the Ocean: Profile data from the Argo floats deployed over the Continental Slope in Atlantic Canada are being examined as part of the regions annual assessment of the state of the ocean environment. This document is

produced for the Fisheries Oceanography Committee of the Canadian Regional Assessment process. These documents are also presented at the annual meetings of the North Atlantic Fisheries Organization (NAFO) and the International Council for the Exploration of the Seas (ICES). Movement of cold Slope Water equatorward along the Continental Slope is an infrequent occurrence that has significant impact on the shelf fisheries from the Eastern Scotian shelf to the mid Atlantic Bight.

Chinese National report
(Submitted by Jianping Xu)

1. Status of implementation

1.1) Floats deployed and their performances

Under the support from MOST (Ministry Of Science and Technology) and SOA (State Oceanic Administration), China Argo project in the 2003 F-Y deployed 3 APEX floats in the sea area of northwest Pacific Ocean. Since the first float was launched in the eastern Indian Ocean in March 2003, China has totally deployed 24 floats, of which 2 in the Indian Ocean and 22 in the Pacific Ocean.

Those floats were differently provided, 13 PROVOR floats by MetOcean Company in Canada, and 11 APEX floats by Webb Research Corporation. At present, there are 11 floats operation in waters, and 2 floats have been taken to Philippines coast bays.

The 24 floats were all deployed from R/V (Xue Long and XiangYang Hong 14). At the same time, ship-based CTD and Laboratory Salinometer (Guild Line Auto Sal 8400B) are used to make synchronous observations of T/S. Water samples are taken in order to get the standard salinity value near the Argo floats deployed, for the purpose of understanding the CTD's performance and correcting the in-situ data provided by the Argo floats. In 2003, National Ocean Technology Center (NOTC) deployed 2 experimental COPEX floats in the northwest Pacific.

1.2) Technical problems encountered and solved

In the past year, there mainly were two technical problems encountered: One problem was probably caused by floats' communication obstacle. That is, some floats had no signal when tested in laboratory by uplink receiver; some float, even if passed the Lab test, could just provide 1-2 profiles and then fail. The problems mostly come from the PROVOR floats. The second problem was caused by the float's pressure sensor. After float normally worked several profiles, the following profiles became shallower and shallower with pressure abnormal, until float remained on the surface. This problem mainly occurred on a batch of the APEX floats. But recently this situation also happened to the PROVOR floats.

According to the float manufacturer's analysis, it was the sensor producer provided the unqualified pressure sensors that caused the trouble. Now the reason has been found and the problem has been resolved. And from now on this problem will never happen. We hope the float quality be surely further improved. According to the deployed-float statistics of 2003, there exist only 50% floats that could routinely run over a whole year.

The 2 experimental COPEX floats (developed by NOTC) separately configured the FSI-CTD sensor and Sea-Bird CTD sensor. Though the 2 floats got some profiles, there is a great difference between the designed observing depth and the actual observed depth. And it remains to be improved.

1.3) Status of Contributions to the Argo data management

The China Argo Data Center (Chinese Language Web Server) began to work in 2002, which are used to distribute Argo data and its products, and related information. Its data comes from the Global Argo Data Centers via the international website. Using the Argo Real-time and Delayed Mode Quality Control Models recommended by International Argo Data Management Group, China Argo Data Center produces Argo data disk and provides for the home users.

The China Argo Real-time Data Center, under the China Argo Data Center, is responsible for the Argo floats deploying, real-time data receiving /processing and distributing. Assisted by the School of Oceanography (University of Washington, USA), an Auto-online Argo Real-time data/products exhibiting system was set up in the China Argo Real-time Data Center. Also according to the Argo Real-time and Delayed Mode Quality Control Models recommended by International Argo Data Management Group, Argo data are received and corrected and distributed by Web-net, and Argo data disks are periodically produced and provided for the home users.

In July 2003, National Marine Environment Forecasting Center (under SOA) received the Global Argo floats profiles on the GTS, which were transmitted by China GTS 's Receiving Station-China Meteorological Administration.

2. National funding

Presently, the fund for the China Argo floats deployment is mostly coming from the MOST, and SOA gives the support of R/V for the floats deploying. The Argo data application research is mainly supported by the NNSF (National Natural Science Foundation of China) and the SOA. The Chinese scientists are now looking for a national specific fund for the implement of China Argo project.

3. Deployment Plans

In the 2004 F-Y, China will deploy 16-20 floats in the areas of North Pacific (10), West Equatorial Pacific (4-6) and Eastern Indian Ocean (2-4). In addition, another 2 experimental COPEX floats will be deployed in the North Pacific.

4. **Research Applications of the Argo data**

In the past year, the Argo project become gradually known by public (via the media, Argo Webs and scientific conferences). The data has been more widely applied by universities and institutions in China. The Chinese Academy of Meteorological Sciences, Second Institute of Oceanography, Ocean University of China, First Institute of Oceanography, National Marine Environment Forecasting Center etc., all has research group for the application research of Argo data in the oceanic and atmospheric fields. And a sum of successful research results have presented, such as " Application of a 4DVAR data assimilation system to the Argo data", " Research on the circulation and water mass in the West Pacific with the Argo data", and " The decreasing of sea surface salinity by the typhoon in the northwestern Pacific warm pool area". The China National Climate Center has being tried to apply the Argo data to the operational forecasting of " Global Sea-Atmosphere Coupled Model (CGCM)". As the global Argo data increasing, it will definitely be more and more used in the fields of oceanography and atmosphere.

5. Issues for the AST-6

5.1) Up to now, there are over1000 floats running in the oceans. It is suggested that AIC produces a disk for the delayed-mode controlled Argo data set, and distributes to the countries and regions, especially to those who are presently has no GTS receiving stations and Internets, which would expand the influence of the Argo Project and the use of the Argo data worldwide, and attract more countries and regions to join the Argo Team or get their support.

5.2) As the Argo floats increasing in the seas, there is an increasing probability of the floats being encountered by coast people or fisherman. For this issue, some International Organizations as WMO etc should make effort to recover those floats. That has at least two advantages. Firstly, those floats could be reused and thus reduce the cost of floats and their deployment. Secondly, those floats can provide manufacturers more information about the float's performances and trouble reasons, and enable them to improve float's working period. At present, about 50% floats can't effectively work for a year, which disappoints the float users.

5.3) Presently, there is no GTS interface at the China Argo Real-time Data Center, and we could not insert the Data onto the GTS. Instead, we have authorized CLS to issue to GTS. But much data has not been sent to GTS; and some profiles are not completely sent to GTS. So we appeal the DADCs could improve this situation, ensure that the China Argo data be shared by all the Argo member countries.

French (Coriolis project) and European (Gyroscope) reports

(Submitted by Yves Desaubies and Sylvie Pouliquen)

CORIOLIS: http://www.coriolis.eu.org
Gyroscope: http://www.ifremer.fr/lpo/gyroscope

Organisation at French level

The French Argo Project is handled through a multi agency project named CORIOLIS and supported by 7 agencies: CNES, CNRS, IFREMER, IRD, INSU, IPEV, Meteo-France and SHOM. It started in 1999 with the Pomme experiment for which the first prototypes of Provor floats equipped with FSI sensors were deployed. Float deployment is handled by IFREMER, SHOM and INSU. Data processing is operated by IFREMER.

Status of Implementation

Cruise name	Period	Number of Floats Deployed/active	Ocean	Vessel
Flostral	January 2003	15/12	Indian	Marion Dufresne 2
PIRATA	February 2003	5 /2	Atlantic Guinea Gulf. Support to UK-Argo	Suroît
ETO	May 2003	19/17	South Atlantic + Indian	BHO Beautemps-Beaupré
MFSTEP	October 2003	2/2	Mediterranean sea	
Flostral 2a	January 2004	10/10	Indian	Marion Dufresne 2
Total		51/43	5 funded by UK-Argo	

During 2003, some deployments on opportunity cruises were cancelled at the end of the year because of the lack of available floats due to an unplanned change in the FSI sensor definition.

During 2003 Provor float equipped with FSI sensors have been deployed in tropical Atlantic and have experienced salinity jumps probably due to bio-fouling on the conductivity cell. Some of these jumps will be corrected during the delayed mode QC process, others jumps and unstable drifts are unrecoverable. We have decided to stop deploying FSI sensors in these areas.

In October 2003, the first Provor floats, equipped with SBE sensors and developed by Martec /France have been successfully deployed during the test phase of the EU project MFStep. They have been recovered after one month at sea and have provided results compatible with the Apex that were deployed in the same area. These floats will be redeployed next summer during the operational phase of MFSTEP.

Gyroscope Project

The year 2003 was the final one for the GyroScope project (2001-2003), which was partially funded by the Commission of the European Community under its 5th Framework Programme. As a cost-shared action, over half of the funding came from participating institutions. Thus, GyroScope must not be seen as an exclusively European Community contribution to ARGO, but also of the agencies listed.

GyroScope was coordinated by IFREMER, with the following partners :

France : Centre National de la Recherche Scientifique (CNRS), Service Hydrographique et Océanographique de la Marine (SHOM), and Collecte Localisation Satellites (CLS)

Germany : Institut für Meereskunde (IFM/Kiel) presently Leibnitz Institute

United Kingdom : Met Office and Southampton Oceanography Centre

Spain : Instituto Español de Oceanografia, Institut de Ciències del Mar, and Universidad de Las Palmas de Gran Canaria (ULPGC).

The project has been very effective in increasing visibility and awareness of ARGO within Europe; it has enabled participation of several scientists and agencies in the full range of activities from instrument procurement, operations at sea for deployment, data validation, data analysis and scientific investigation of the North Atlantic. The Coriolis Data Centre, which was one of the Ifremer partners, played a central role in the data management.

A total of 84 floats (APEX and Provor) were deployed, during 10 cruises. At the end of the project, 61 floats are still active, with excellent data return. The experiment was the first opportunity for large scale deployment of the newly designed Provor float and for demonstration of its operational capability.

A significant role has been played by the project (LPO end IFM) in pursuing delayed mode quality control procedures. A workshop was organised in October in Brest to review and assess various methods, leading to the demonstration of improved performance of the Boehme and Send method in regions of rough bathymetry, boundary currents, complex water masses and high inter-annual variability, such as the sub-polar gyre.

Various scientific results of the project were reported during the ARGO Science Workshop in Tokyo, as listed below.

Several of the GyroScope participants have been very active in promoting ARGO in diverse programmes and agencies : GOOS, GODAE, CLIVAR, the European Community, the GMES (Global Monitoring for Environment and Security) initiative of the ESA, and EC, as well as within their own countries.

Complete information on the project can be found on :

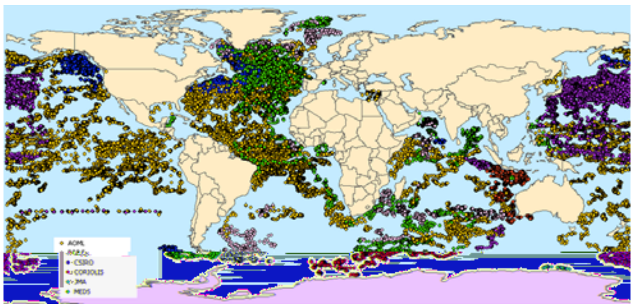
http://www.ifremer.fr/lpo/gyroscope

Data Management activities

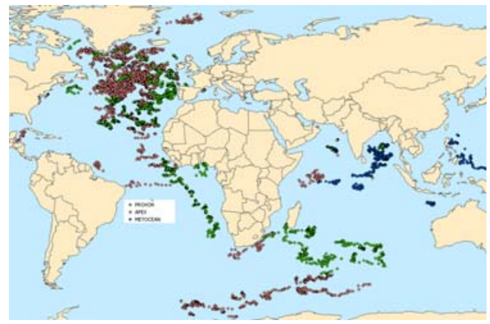
CORIOLIS acts as a DAC and a GDAC for Argo program and is setting up a RDAC for North Atlantic ocean.

- DAC : data assembly center Coriolis process 176 actives floats (282 deployed) for 7 countries and 11 scientific programs. Coriolis process threes types of floats (Provor, Metocean, Apex) ie 15 different versions . Data are qualified in real-time and good data are distributed with 24h both on GTS and Gdac. Based on expertise gained within the Gyroscope project we are setting up the delayed mode processing chain developed by Ifm/Kiel.
- GDAC : global data center. Together with the US-GODAE server in Monterey, Coriolis is a global data center for Argo and is fed daily by 6 DACs

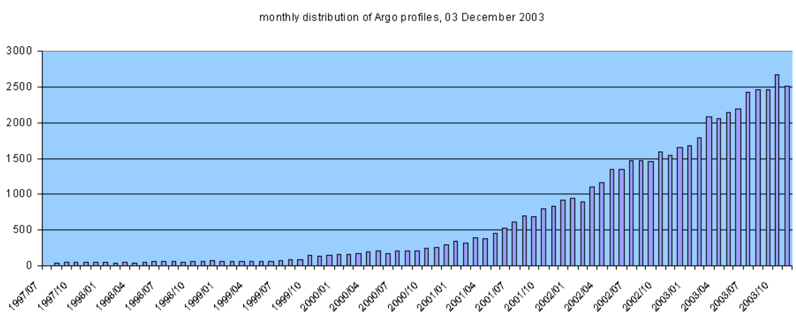
:AOML (USA), MEDS (Canada), JMA (Japan), Coriolis (France), BODC (UK), CSIRO (Australia) GDACs handle data from more than 1400 floats Argo (more than 50 000 cycles). The two GDAC are synchronized daily since September 2003. The 11th February 2004, all data at GDACs have been regenerated in 2.1 version format which allows to handle properly the delayed mode data processed by the DACs.



Global GDAC coverage, December 2003
1400 floats, 50 000 cycles



Coriolis Dac coverage for 2003,
176 active floats, 7 countries,
11 scientific programs.



Number of new cycles available each month at Coriolis GDAC since 1997

CORIOLIS team is deeply involved in data format and Argo network definition and co-chair the Argo data management committee.

National Funding

IFREMER and SHOM are planning to purchase floats in the coming years. Up to now IFREMER committed to buy about 70 floats in 2004, and probably between 30 and 50 in 2005; SHOM will buy 15 floats per year for three years.

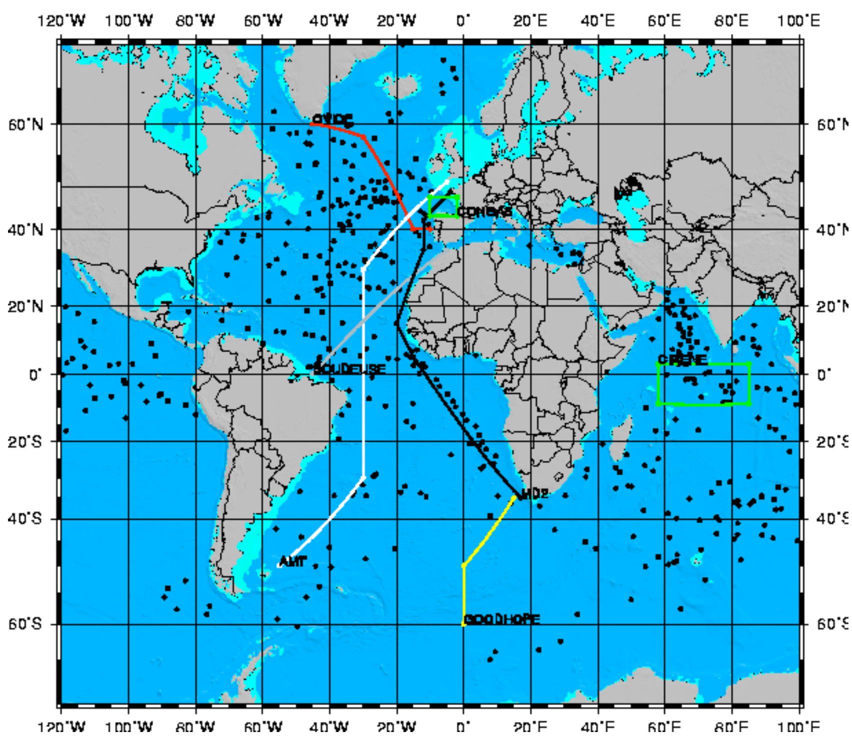
France will continue to contribute to Argo through the CORIOLIS data centre acting as a National centre for France and other European countries, as a GDAC for the Argo program, and will set up a Regional Dac for the North Atlantic. CORIOLIS will also continue to help some countries in their float data processing while they set up their own facility.

In the course of the MERSEA project (see below) 40 additional floats will be purchased and deployed in 2004 (or 2005), with funding from the European Community.

Deployment plans

Cruise Name	Period	Number of Float	Ocean	Vessel	Remark
Good Hope	February 2004	16	Antarctic	S.A. Agulhas	Approved
CIRENE	October 2004	20	Indian	Marion Dufresne 2	Approved
CONGAS	May than November 2004	11	Atlantic Bay of Biscay	BSHM	Opportunity
LAPLACE	April 2004	5	North Atlantic Guinea gulf	BH2 Laplace	Opportunity
OVIDE	June 2004	10	North Atlantic	Thalassa	Opportunity
BOUDEUSE	June 2004	5	Inter-Tropical Atlantic	La Boudeuse	Opportunity
MD2	August 2004	To be defined	North and South Atlantic	Marion Dufresne 2	Opportunity
AMT	September 2004	5	North and South Atlantic	James Clark	Opportunity
BBP	Setpember 2004	To be defined	Mediterranean sea	Beautemps-Beaupré	Opportunity

A lot of uncertainty still needs to be addressed before a fixed plan is made for 2004. This will be finalized soon according to the float availability, gaps in oceans along the vessels transects.
Up to now the planned map is the following:



National research and operational use of Argo data

Operational use

<u>Product development</u> : (PI : F.Gaillard)
In support of the Coriolis data centre, data syntheses by objective mapping have been developed and implemented operationally. Maps –and the associated data files –are available on a weekly basis. The method uses temperature and salinity profiles from profiling floats, XBTs, XCTDs or CTDs, drifting and moored buoys.

In order to both qualify the data and provide temperature and salinity analysed fields, an objective analysis method has been developed for the Atlantic: 60°S - 70°N, 98°W - 20°E.

Using the temperature and salinity profiles from the CORIOLIS data base, real time analyses are performed by the CORIOLIS data centre once a week. The analysed fields are constructed on a grid with one third of degree resolution in latitude and longitude at 59 levels from 5 down to 2000 meters depth.

<u>MERCATOR</u>
Coriolis and the French ARGO contribution are closely associated with the MERCATOR operational system.
The MERCATOR mission was defined in 1996 by six partner organizations -CNES, CNRS/INSU, Ifremer, IRD, Météo France, and SHOM The project is pursuing three goals:

1) Develop an operational oceanography system that is:
- ready for operational use,
- based on a high-resolution primitive-equation model,
- capable of assimilating satellite and in-situ ocean observation data.

2) Develop downstream oceanography applications

Mercator must:
- support public service, civil protection and military applications, as well as commercial oceanography applications, by providing a real-time description of sea-state conditions and predicting flows of water masses;
- provide a research tool that will help the scientific community to interpret the results of experimental research programs and measurement campaigns;
- contribute to the development of seasonal climate foecasting by providing ocean initial conditions for ocean-atmophere coupled models.

3) Contribute to the international GODAE project, alongside the Jason satellite altimetry and CORIOLIS programme of in-situ measurement, Mercator is France's contribution to the Global Ocean Data Assimilation Experiment (GODAE).

MERCATOR presently produces global, low-resolution (2°) analyses and forecasts, and high resolution (1/15°) for the North Atlantic and Mediterranean, assimilating altimeter, SST, and in situ (including ARGO) data.

The Mersea project

MERSEA[1] is a new 4 –year project (2004 –2008), with significant funding from the CEC[2] under its 6th Framework Programme of R&D. The key objective of MERSEA to develop a European ocean monitoring and forecasting system in support of the Ocean and Marine Applications of GMES[3]. The project, co-ordinated by IFREMER, includes 40 participating Agencies, Research Centres or Companies in 13 EC countries. The major global operational systems (FOAM in the UK, Mercator in France, MFS in Italy, and TOPAZ in Norway) are key participants. They all assimilate routinely ARGO data. MERSEA will coordinate the EC contribution to GODAE. These activities will give high visibility to the ARGO programme, as well as demonstrate its utility for operational oceanography.

Research programmes

Calls for proposals have been issued within France to encourage wide participation of French scientists in scientific projects that can benefit from ARGO. Several of those projects are in collaboration with international programmes.

OVIDE : (PI : H.Mercier). An observatory of inter-annual variability of the thermohaline circulation in the North Atlantic. [http://www.ifremer.fr/lpo/ovide.].
The Ovide project aims at repeating a trans-oceanic hydrographic section from Greenland to Portugal every other year. The project also includes the ARGO data set to interpolate on a seasonal scale the ocean circulation. The goal is to contribute to the monitoring of the inter-annual variability of the water masses as well as the variability of the mass, heat, and tracer transports in the northern North Atlantic Ocean. This is a contribution to CLIVAR. The OVIDE line will be reoccupied in 2004, and 2006, with float deployments and moorings to monitor the variability of the East Greenland Current .

EGEE : (PI : B.Bourlès). Oceanic circulation and its variability in the Gulf of Guinea Atlantic. Programme coordinated with the African Monsoon project AMMA.
The main objectives of the project are to study the oceanic circulation and its variability in the upper layers of the eastern Tropical Atlantic, mainly in the Gulf of Guinea (GG) and the linkages with the climate of the neighbouring regions. The intensity of the Western African Monsoon intensity depends upon the meridional energy gradients between the GG and the continental regions (West Africa). One of the prior scientific questions lies in the comprehension of the oceanic processes that control the energy exchanges at the ocean-atmosphere interface in the GG, and particularly the sea surface temperature (SST) and its variability, from seasonal to interannual time-scales.

FLOSTRAL : (PI : R.Morrow). The main objective of the FLOSTRAL project is to further understand the mechanisms that govern the circulation of SAMW / STMW, and how their water mass characteristics are modified during that circulation. With this aim, an essential element of the FLOSTRAL project is to establish a network of PROVOR profiling drifters in the southern Indian Ocean in 2003-2004. 15 floats have already been launched. Another 15 will be launched in 2004.

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[1] Marine Environment and Security for the European Area
[2] Commission of the European Community
[3] Global Monitoring for Environment and Security

GOODHOPE : (PI : S.Speich) aims to establish a programme of regular and appropriate observations (XBT, CTD, floats etc.) along the SR2 between South Africa and Antarctica. The objectives are to gain a better understanding of the Indian-Atlantic interocean exchanges (including their effect on the climate of the African continent); to monitor the variability of the Southern Ocean frontal systems; and to study the local air-sea heat exchanges and their role in the global heat budget.

CIRENE : (PI : J. Vialard). The main scientific objective of the CIRENE proposal is to investigate the ocean-atmosphere variability in the Indian Ocean sector (58°E-85°E, 9°S-3°N) from intraseasonal to interannual time-scales. A particular emphasis is put on understanding the physical processes at the origin of the intraseasonal variability. A more general question concerns the scale interaction between the interannual variation of the thermal structure of the Indian Ocean and different characteristics of the Intra-seasonal Oscillations (amplitude, propagation, associated dynamical perturbation, link with the Pacific Ocean,…).

Product development : (PI : F.Gaillard)
This is an extension and scientific use of the objective mappings presently available on the Coriolis site. Initially, the study focuses on the North Atlantic; it will then be extended to the global ocean.
Reanalyses of the Coriolis in situ data base will be performed from 2001 to 2003 (and onwards); with extraction of the dominant modes of variability and consideration of water mass properties, mixed layer characteristics and climatic indicators. Priority is given to temperature and salinity. These data-based syntheses will be used to validate the outputs of operational models that assimilate all available data.

A 4DVAR analysis of ARGO profiles in the North Atlantic (Thesis in progress by G. Forget, supervised by B.Ferron)

A 4DVAR analysis of the recently available ARGO profiles for the period June 2002-May 2003. The estimation problem consists of determining TS initial conditions of a North Atlantic configuration of the MIT model (1 degree resolution). Data assimilation clearly improves the model water mass properties and partly modifies the associated oceanic circulation. TS anomalies compared to climatological values are evidenced. Some focus is additionally put on the estimated seasonality. Consistency checks, comparison with twin experiments and elements of model validation are provided to investigate the quality of our estimates. Finally, the work illustrates the information that ARGO profiles would provide to more complete assimilation systems.

Issues to be considered by AST

Data management Issues raised by Data Management committee:

- **Delay Mode QC:**
  - **The question of QC on sliding window was not solved at ADMT meeting. If we do a sliding window QC what is the size of the window?**
  - **Feedback to real time of correction made in delayed mode?**

- **How to organize feedback from users?**
- **How to improve trajectories data?**
- **Ask AST to stamp Scientific products that should be advertised through AIC**

9. Presentations at the ARGO Science Workshop in Tokyo for France and Gyroscope project

Autret E, F Gaillard : Analysis of Temperature and Salinity in the N Atlantic. Poster.

Carval T., L. Petit de la Villéon, C. Coatanoan : CORIOLIS data centre: In situ data for operational oceanography. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Desaubies Y., L. Boehme, and U. Send : Experience of delayed mode quality control for the Atlantic. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Oral.

Desaubies and Gyroscope partners, The GyroScope project : objectives, overview, and preliminary results. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Grit C. and Herlé Mercier : Determination of North Atlantic circulation by inversion of profiling float data. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Guinehut S., Pierre-Yves Le Traon and Gilles Larnicol, Comparing and combining Argo data with altimeter data. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

King B. The detection of subsurface theta-S changes. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Oral.

King B. and Louise M Duncan. Comparison of float profiles with an assimilating model (FOAM) in the North Atlantic. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Le Grand P. and Jean.-Pierre Mazé : Near real time velocity estimates using float profiles. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Le Traon P-Y. : Argo and GODAE. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Oral.
Wood R., H.T. Banks, M. Vellinga, S. Stark, M. Palmer, Potential of Argo data for detection and attribution of oceanic climate change. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Oral.

Mercier H. and T. Hascoet : Characteristics and variability of Subpolar mode water in the North Atlantic, as observed from Argo floats. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Pouliquen S., Thierry Carval, Yves Desaubies, Loic Petit de la Villéon, Gérard Loaec. Operational oceanography in France: the CORIOLIS project. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Ruiz S., D. Gomis, and Jordi Font. 3D, EOF-based spatial analysis of Gyroscope observations in the North Atlantic Ocean. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

Send U. Argo and other observing systems – issues and challenges. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Oral.

Zenk W., Matthias Lankhorst, Bernard le Cann. Cross-crest pathways of Iceland Scotland Overflow Water in the North Atlantic Ocean. Int. ARGO Science Workshop. Tokyo. Nov. 2003. Poster.

National German ARGO Report,
Submitted by Uwe Send

1) Status of Implementation

Germany now has a national ARGO program funded for the next three years. This program has three components: subpolar North Atlantic (BSH), tropical Atlantic (IFM-Geomar) and Southern Ocean (AWI). Each of the programs has about 30 floats spread over the next 2-3 years. In addition there are floats in a number of ocean regions via research projects or from small contributions of institutional funding. Germany also is an ongoing partner in the European efforts to contribute to ARGO. Activities and plans under/for European projects are reported separately, therefore here only the national deployments are outlined.

Subpolar Atlantic/Labrador Sea:
In September 2003 there were 7 floats deployed in the New Foundland basin (of which one failed). These floats drift at 1500 m depth and profile 2000m to surface. In addition there were 3 Floats with oxygen sensors deployed in the Labrador Sea, of which one is still operating. The data are processed at Coriolis and are available for ARGO.

North Atlantic:
BSH has funding from the German ARGO program for 15 floats to be deployed this year (FY04) along approximately the former WOCE line A2. Looking for deployment opportunities. The currently operating floats from the previous typical 5 per year deployments are shown in figure 1. All floats are processed by Coriolis.

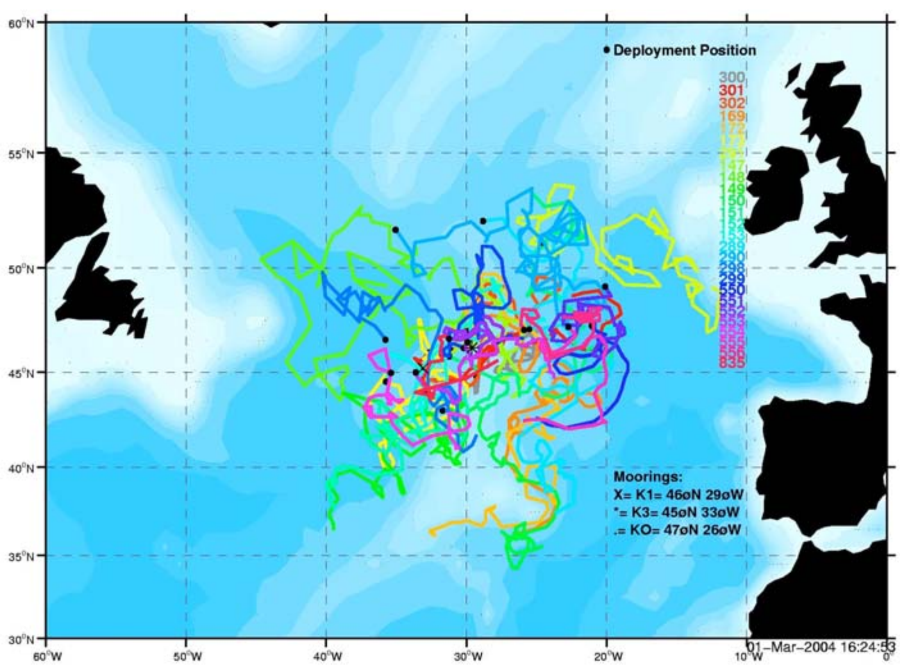

***Figure 1:** BSH floats operating in the 48N corridor as of 1 March 2004.*

Tropical Atlantic:
Some floats were deployed formerly (10 in March/April 2000, 5 in Nov/Dec 2000) by IfM-Geomar, all at shallow levels (200/400m). Several of these beached on the South American coast, a few are still active. The data are are now being processed and made available by Coriolis; some of the older data are not reprocessed yet.
August 2004 will see 15 floats of the German ARGO component TROPAT being deployed in the western tropical Atlantic (presumably on shallow park levels, but profiling deep). Some of these (5) will be equipped with RAFOS sensors (some probably also with oxygen).

Indian Ocean:
Initially 15 floats (ARGO equivalent) were funded to be deployed in the south western Indian Ocean. Due to a failure during the deployment only 4 floats are operational now.

Weddell Sea:
Since 1999 a total of 49 floats has been deployed by AWI Bremerhaven, of these 13 are active at the time of writing. All floats performed well. In the last austral winter (mid 2002), 13 floats had been covered by ice, all of which are equipped with the ice sensing algorithm (ISA, if median 50m-20m temperature is below –1.79 degC, the ascent is abandoned). 11 of these floats survived the ice-cover (one for 25 weeks, i.e. 25 attempts to surface), while two did not re-appear.
The data are available through Coriolis but processed and QC´d separately at AWI.

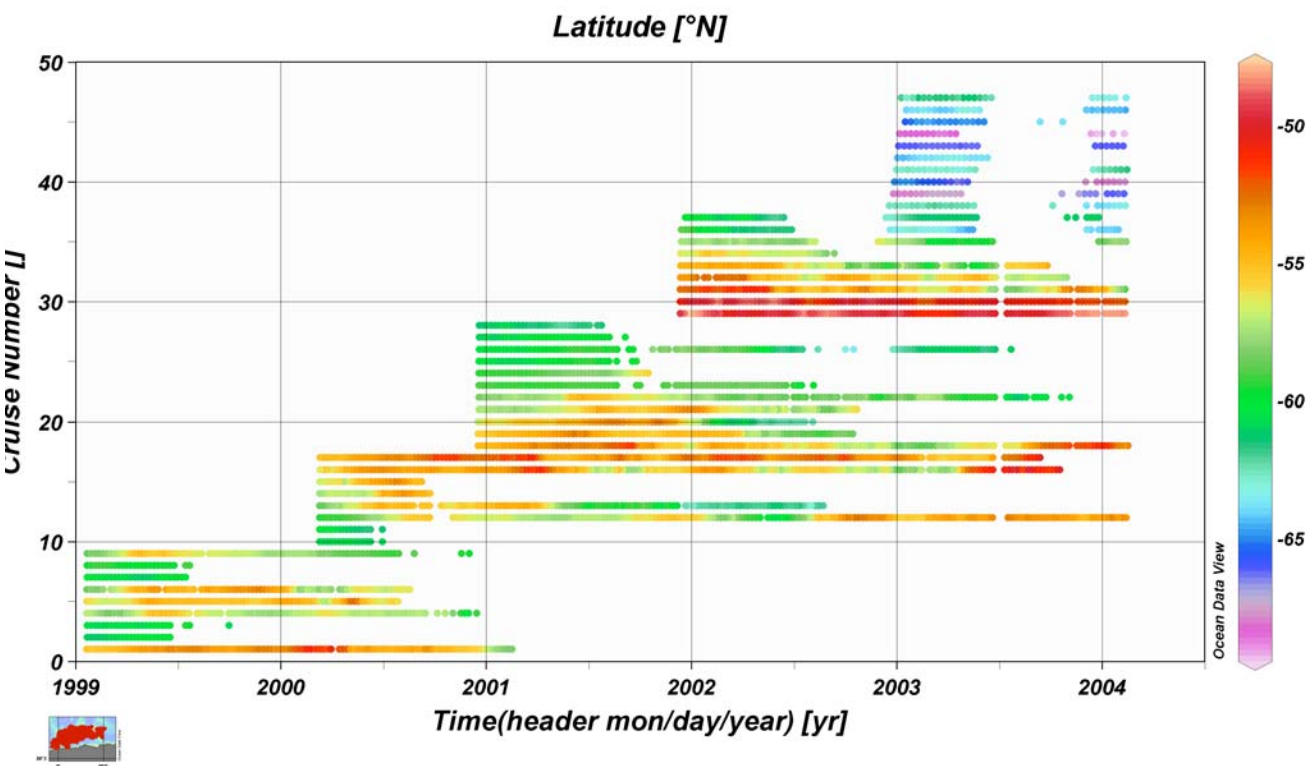

Figure 2: *Results from the Weddell Sea showing the efficiency of the new Ice Sensing Algorithm added from 2002 onwards to AWI floats. The figure plots latitude (colour dots) of a transmitted float profile. X axis is the cycle number, y axis is the float number. The*

plot shows that in 2002 3 out of 3 floats reappeared after one winter, and in 2003 3+8 out of 3+10 floats reappeared. Of these, 9 are currently active, with unknown causes for the 2 failures after reappearance.

2) Level of funding and deployment plans

Next 3 years:
A joint proposal of three research groups at the AWI, BSH and IFM-GEOMAR for a German ARGO component is now funded for a three year period beginning Jan. 1. 2004.
This program has three components, each with approximately 30 floats each in the Southern Ocean Atlantic Sector (AWI), in the western tropical Atlantic (IFM-Geomar) and in the subpolar North Atlantic (BSH).
In addition, there will be several floats deployed within research projects (ARGO equivalent).

The totals are:
AWI: 30 floats from German ARGO, 16 float equivalents from AWI funding
IFM-GEOMAR: 30 floats from German ARGO, 7 float equivalents from other projects
BSH: 30 floats from German ARGO
IfM–Hamburg: 10 float equivalents from other national projects.

The German share of possible EU funded float projects are explained in the European report.

Human resources:
Within the German ARGO program each of the partners has a three year postdoc position allocated to their subprogram . AWI has devoted 80% of a scientist to ARGO, and is funding a half-time position at a company for float data processing.

ARGO data processing at IfM Hamburg is done within running Arctic projects.

3) Research and operational uses of ARGO

There are no operational uses of ARGO data, but they are used and important in various research projects, like German CLIVAR, the special research initiative SFB460 in Kiel, and smaller individual projects. An important aspect to emphasize is that the intention stated in research proposals to make maximum use of existing ARGO data seems to have helped review success and leveraged better funding prospects.

Ireland National Report

Submitted by Jenny Ullgren

1. Status of implementation

We deployed two floats in October, one just north and one southwest of Porcupine Bank, off the west coast of Ireland. The parking depth, and the usual profiling depth is 1000 dB but every third profile is a 'deep' one to 2000 dB. The two floats have been reporting successfully to date.

Our floats are handled within the UK Argo programme. The data access is through the BODC. We have only done preliminary checks on the quality to date but we are working on setting up a system for our delayed mode/manual QC. The data so far has been generally good, with some spurious data.

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

3) Summary of deployment plans

We are currently negotiating with the Marine Institute, Ireland's national agency for marine research and development, for more floats in the year(s) to come.

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

We want to use Argo data for a study of the intermediate circulation and water mass structure in the Rockall Trough, more specifically the effect of the winter convection on the currents entering the area from the south and west. Our two floats were deployed as a part of this project, which also involves two moorings in the southern entrance to the Trough and hydrographic work during cruises in the area.

Netherlands national report

Submitted by Andreas Sterl

1) Status of implementation

The Netherlands, through the Royal Netherlands Meteorological Institute (KNMI), have only recently decided to take part in the ARGO programme. While KNMI will cover the organizational as wel as the scientific part of the project, the deployment of the floats will be done by the Dutch research vessel *Pelagia*, operated by the Netherlands Institute for Sea Research (NIOZ). First deployments are planned for the summer of this year (2004).

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

Approved funding for 2004 will allow to purchase three or four floats and to cover the costs of deployment and telecommunication.
At present, funding is decided on a year-to-year basis as part of the regular KNMI budget. Prolongation will depend on the success of the ARGO programmes as well as on the money available for KNMI. The aim is to make the contribution to the ARGO programme a structural part of the budget of either KNMI or another Dutch organization.
One person (Andreas Sterl) is working on ARGO. He does so besides is other duties.

3) Summary of deployment plans

Depending on exchanges rates, three or four floats will be purchased and deployed in the Northwest Atlantic during cruises of the Dutch research vessel Pelagia.

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.

Spanish National report
(Submitted by Gregorio Parrilla)

Spain has begun in 2003 her direct contribution to Argo. It started in September this year with the deployment of one profiler in the Bay of Biscay and five ones in the area between the Canary and Cape Verde islands. A last profiler was deployed in December SW of the Gulf of Cadiz. The floats, all of them APEX; were deployed from Spanish research vessels.

A further deployment of six floats, all of them PROVOR; is planned for year 2004. A main area of interest is the Mediterranean outflow area and the W. Mediterranean Sea, although the mayor part of these floats will be offered to the Argo international community to be deployed according to the Argo requirements in some other part of the globe. There has been already talks with the Technical Coordinator of AIC, Mathieu Belbeoch, to initiate conversations with some Latin American countries to establish an agreement for that purpose.

The Spanish Argo contribution has been funded by the *Ministerio de Ciencia y Tecnología* and it is led by the Instituto Español de Oceanografía: other partners are Instituto de Ciencias del Mar, Puertos del Estado, I. Hidrográfico de la Marina, I. Nacional de Meteorología, Universities from Málaga, Castilla-La Mancha, Cádiz y Las Palmas de G. C. and AICO-InterOCEAN.

We continue disseminating, through IEO web page and talks, information about the Argo project, its data and products and ways to obtain them.

We are planning to submit, through the same channels than the previous one, another proposal to acquire more profiles.

The following papers have made use of the Argo data:

Parrilla-Barrera, G., M. Vargas-Yáñez, P. Vélez-Belchi, A. Lavín, C. González–Pola, E. Fraile, A. Hernández-Guerra, E. Tel & D. Vega. 2003. A comparison with the Argo observing system - Gyroscope 0302 cruise. In “Building the European Capacity in Operational Oceanography”. Proceedings of the Third International Conference on EuroGOOS. Edited by H.. Dahlin, N.C. Flemming, K. Nittis, and S.E. Petersson. Elsevier Oceanography Series, 69. 356-360

Vargas-Yáñez, M., Gregorio Parrilla, Alicia Lavín, Pedro Vélez, César González-Pola, Alonso Hernández-Guerra. 2003. Eddy-induced variability in a transatlantic section: Argo Observing system-Gyroscope 0302 cruise comparison. (Submitted to Journal of Atmospheric and Oceanic Technology-O)

Vargas-Yáñez, M., Gregorio Parrilla, Alicia Lavín, Pedro Vélez-Belchí, César González-Pola. 2003. Temperature and salinity Increase in the Eastern North Atlantic along the 24.5ºN during the last ten years. (Submitted to Geophy. Res. Letters).

Appendix 4.

International Commitments for Argo floats- March 2004

Compiled by Stan Wilson stan.wilson@noaa.gov

This table and the accompanying annotation were reviewed and approved by the International Argo Science Team at its meeting in Brest, France 9-11 March 2004.

No. of Floats by Country	Argo Funded	Float Equiv's	Argo Funded	Float Equiv's	Argo Funded	Float Equiv's	Argo Funded	Float Equiv's	Argo Funded	Float Equiv's	Argo Funded	Float Equiv's	Proposed over next	Prop Float Equiv's
Draft 3 Mar 04	FY99	FY99	FY00	FY00	FY01	FY01	FY02	FY02	FY03	FY03	FY04	FY04	3 years	over 3 yrs
Australia	10				19		7		25		30		90	
Canada	10		42		20		25		30		50		90	
China					10		8		6		16		50	
Denmark						5								
Eur. Comm.			10		70						40	10		10
France		8	3		50		80		29		44		160	
Germany				18		22		27		40	32	18	70	4
India							10		21		50		69	
Ireland										2				
Japan			24	4	76	8	110	3	100	15	95	7	270	7
Mauritius									1		2		3	
Netherlands											3		9	
New Zealand			2		2				2		2		6	
Norway							3		6				30	
Rep. Korea					19		25		30		30		90	
Russia		1		2		2	2	1	2				10	
Spain									13				10	
U.K.			13		50	6	54	10	24	5	38		117	14
U.S.A.	55		131	51	174	43	315	39	344	17	412	16	1236	60
Totals	75	9	225	75	490	86	639	80	633	79	844	51	2310	95
Totals by Yr.	FY99 =	84	FY00 =	300	FY01 =	576	FY02 =	719	FY03 =	712	FY04 =	895	Ave/Yr =	801.6667

A "Float Equivalent" is defined as a float—while not funded under the Argo Program—whose data are available consistent with the Argo Data Policy and provides the information equivalent to one Argo float.

Australia – FY03 starts Jul 1, 03 – For FY03, 10 floats funded by Commonwealth Scientific and Industrial Research Organization - Marine Research (CMR), 1 by Bureau of Meteorology (BoM), and 14 by Antarctic Climate and Ecosystem Cooperative Research Centre (ACECRC); CMR and ACECRC acquisitions expected to remain steady, while BoM may increase to 6 per year <susan.wijffels@csiro.au>

Canada – FY starts Apr 1 – funded by Dept. of Fisheries & Oceans with potential funding from Dept. of National Defense, Environment Canada, and others <freelandhj@dfo-mpo.gc.ca>

China - FY starts Jan 1 - funded by Ministry of Science & Technology (MOST); implemented by State Oceanic Administration (SOA) in collaboration with other organizations; 16 are proposed for FY04 and about 50 for FY05/06/07 <sioxu@zgb.com.cn>

Denmark – Niels Bohr Institute for Astronomy, Physics and Geophysics deployed 5 floats in the Greenland Sea <quadfase@ifm.zmaw.de>

European Commission – Gyroscope proposal—submitted by France, Germany, Spain, and U.K.—has funded 80 floats in FY00 and 01, with 40 for Institute für Meerskunde-Kiel and 40 for Institut Francais de Recherche pour l' Exploitation de la Mer (IFREMER) <yves.desaubies@ifremer.fr>; Marine Environment and Security for the European Area (MERSEA) proposal will fund 40 floats in FY04 to be implemented by Institut für Lehrerfortbildung, Alfred-Wegener-Institut für Polar- und Meeresforschung, and IFREMER <sylvie.pouliquen@ifremer.fr>; and Mediterranean Forecasting System: Toward Environmental Predictions (MFSTEP) will fund 20 float-equivalents in FY04/05, to be implemented as MedArgo by the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale with 5-day profiling to 700m <ppoulain@ogs.trieste.it>

France – FY starts Jan 1 – Overall coordination under the national Coriolis Project; most funding from Institut Francais de Recherche pour l' Exploitation de la Mer, with smaller contributions from Centre National de la Recherche Scientifique (20 in FY02) and Service Hydrographique de la Marine (3 funded in FY00; 15 per year have been included in the overall number proposed for FY04/05/06); an additional 8 floats were funded in FY99 as part of POMME <sylvie.pouliquen@ifremer.fr>

Germany – FY starts Jan 1 – German Argo funded by the Ministry for Research & Technology (BMBF); implemented by Leibniz Institute of Marine Sciences at Kiel University (IFM-GEOMAR), Alfred Wegener Institute for Polar and Marine Research (AWI), and Bundesamt für Seeschiffahrt und Hydrographie (BSH). Argo float-equivalents: BSH has funded 18, 5, 7 & 5 floats in FY00, 01, 02 & 03 for North Atlantic; AWI has funded 10, 20 & 10 floats in FY01, 02 & 03 for Southern Ocean; Deutsche Forschungs Gemeinschaft (DFG) has funded IFM-GEOMAR for 7 floats in FY01 for Lab. Sea, 10 floats in FY03 for North Atlantic, and 15 floats in FY03 for Indian Ocean <jfischer@ifm-geomar.de>

India – FY starts Apr 1 – funded by Dept. of Ocean Development; implemented by National Center for Ocean Information Services (lead), National Institute of Ocean Technology, Center for Atmospheric and Ocean Sciences along with National Institute of Oceanography and 6 other academic/R&D/operational institutions <radhakr@incois.gov.in>

Ireland – funded by the Ireland Higher Education Authority and implemented by the National University of Ireland <martin.white@nuigalway.ie>

Japan – FY starts Apr 1 – funded by Ministry of Education, Culture, Sports, Science & Technology (MEXT) and Ministry of Land, Infrastructure & Transport under the Millennium project (FY00-04); MEXT is expected to fund 80-100 per year for FY05-09; implemented by JAMSTEC. Argo float-equivalents: National Institute for Polar Research is being funded to deploy 3-5 floats per year in the Southern Ocean; Tohoku University was funded for 2 floats in FY03 and is bidding for another 2 in FY04; Fisheries Agency was funded for 5 floats in FY03 and 2-4 in FY04 <takeuchik@jamstec.go.jp>

Mauritius – implemented by the Mauritius Meteorological Service in collaboration with U.K. Argo <mbbohn@adafrica.net>

Netherlands – FY starts Jan 1 – funded and implemented by the Royal Netherlands Meteorological Institute and Netherlands Institute for Sea Research <andreas.sterl@knmi.nl>

New Zealand – FY02 starts Jul 1, 02 – funded and implemented by National Institute of Water & Atmospheric Research <p.sutton@niwa.co.nz>

Norway – FY starts Jan 1 – funded and implemented by the Institute of Marine Research <einar.svendsen@imr.no>

Republic of Korea – FY starts Jan 1 – funded by Ministry of Science & Technology/Korean Meteorological Administration and Ministry of Marine Affairs & Fisheries; implemented by Meteorological Research Institute (METRI) and Korea Ocean Research & Development Institute (KORDI) under supervision of Korea Argo Subcommittee of the Korea Oceanographic Committee <kuhkim@yahoo.com>

Russia – FY starts Jan 1 – funded by Hydromet; implemented by Far Eastern Regional Hydrometeorological Research Institute (FERHRI) <danchenk@vladivostok.ru>

Spain – support dependent on funding from Programa Nacional de Investigacion for the Instituto Espanol de Oceanografia, Universidad de Las Palmas de GC, Instituto de Ciencias del Mar de Barcelona-CSIC and several other Spanish research institutions <gregorio.parrilla@md.ieo.es>

U.K. - FY starts Apr 1 - U.K. Argo funded by Dept. for Environment, Food & Rural Affairs, Ministry of Defence, and Natural Environment Research Council; managed and implemented by U.K. Met. Office in collaboration with Southampton Oceanography Centre (SOC), British Oceanographic Data Centre, and U.K. Hydrographic Office; funding for U.K. Argo to March 06 has been agreed, but longer-term funding from April 06 has no been assured; additional Argo float-equivalents dependent on successful bids by SOC for research funding and includes 1 float (FY01) funded by Scott Polar Research Institute <jdturton@meto.gov.uk>

U.S.A. – FY04 starts Oct 1, 03 – funded by NOAA and Office of Naval Research via National Oceanographic Partnership Program; beginning in FY04, NOAA to provide _ of the global array (412 floats per year) <steve.piotrowicz@noaa.gov>. Argo float-equivalents: Naval Oceanographic Office (Navoceano) – 16, 20, 30, 17 & 16 in FY00, 01, 02, 03 & 04); NOAA via Consortium for Ocean Research & Climate – 35 in FY00, 20 in FY01; the 60 proposed by Navoceano are dependent on availability of funding <hortone@navo.navy.mil>; NOAA/OAR/Arctic Program Office – 3 for deployment in Bering Sea in FY01 and 9 in Bering Sea and subpolar N Pacific in FY02 <gregory.c.johnson@noaa.gov>