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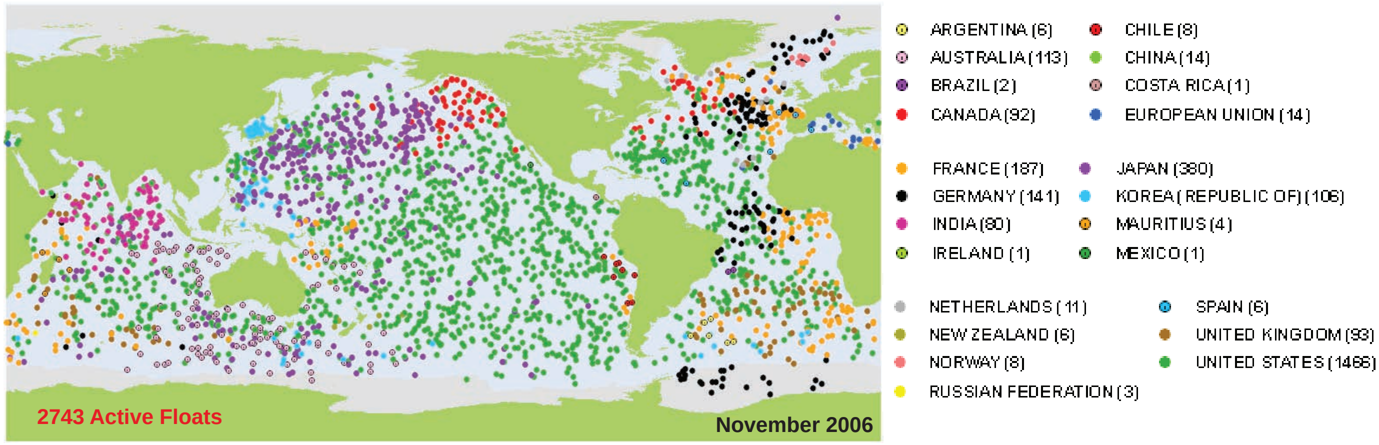
Argonautics

Newsletter of the international Argo project



Editorial

Since the last Newsletter in June 2006, John Gould has stepped down as Argo Director. He continues to keep Argo on his mind and is chairing a session on Argo and GODAE at the upcoming IUGG meeting in July. Look for the invitation to Italy on page 5 of the Newsletter. The Argo program is making some adjustments to losing its director. One of the changes is that I am taking over the responsibility of publishing the Newsletter which we hope to do bi-yearly from now on in June and December.

Since June this year the array has grown from 2483 floats to 2743 floats. Over 300 floats have been deployed in the past months which pushes the yearly deployment to above 720 floats. Perhaps by June next year there will be 3000 floats in the water.

Several Argo meetings have taken place in the last six months including the 2nd Delayed Mode Quality Control Workshop (DMQC-2), the 2nd Argo Trajectory Workshop (ATW-2) and the 7th Argo Data Management Team Meeting (ADMT-7). It had been over a year since the first DMQC meeting where many people were learning how to use the software and how to make the necessary delayed mode quality control decisions. An important part of DMQC-2 was the unveiling of the new OW software tool which improves upon the previous tools. Look for an article on the new OW tool on pages 6-7 and a summary of the meeting on page 9 of the Newsletter.

The ATW-2 was a follow-up to the short first workshop in Venice, Italy earlier this year. The focus of this meeting was on improving the files so they can be used to make velocity calculations. In the Newsletter there is both a summary of ATW-2 (page5) and an article on the velocity product in development (page 10).

An increasingly important part of the Argo program is the Argo Regional Centers (ARCs), formerly called the Regional Data Assembly Centers (RDACs), which are in different stages of spin-up to being fully operational. These centers will help with delayed mode consistency checks, collection and assembly of CTD data and development of Argo products among other tasks. This Newsletter has a summary of where each Argo Regional Center stands and where each hopes to go in the future (pages 2-4). I encourage you to explore their websites.

Mathieu Belbéoch worked hard to create a new AIC website with more functions and statistical tools for the Argo dataset. Read his article on page 8 to learn more about the website and how to take full advantage of the new information available.

For the first time in the Newsletter, the list of Argo-related papers published in the current year, takes up the entire page, leaving the papers in press on another page. This testifies to the increasing number of papers and results based on Argo.

As the Argo program enters 2007, there are many new challenges it faces. In addition to expanding, maintaining and effectively monitoring the array, Argo is working on extending float lifetimes, reducing the backlog of delayed mode files, improving the real time data, and producing higher quality trajectory files. Looking at the amazing achievements Argo has already accomplished, we should feel ready to help Argo enter a new sustained maintenance phase. The AST-8 meeting will be held in March in Paris to help continue steering Argo on a successful and impressive path.

Megan Scanderberg

Argo Regional Center Activities

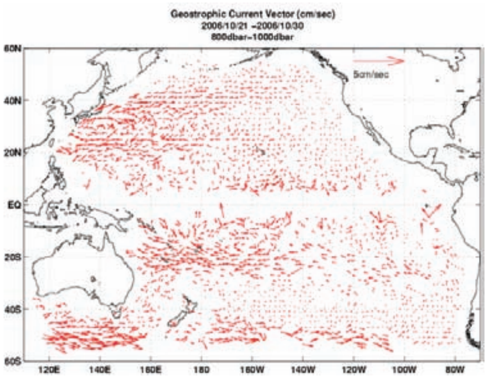
We currently have five Argo Regional Centers (ARCs), the Pacific Argo Regional Center (PARC), the Indian Ocean Argo Regional Center (IARC), the Southern Ocean Argo Regional Center (SOARC), the North Atlantic Argo Regional Center (NA-ARC) and the South Atlantic Argo Regional Center (SA-ARC). Each regional center is charged with ensuring consistency of the delayed-mode dataset across delayed mode operators in their region as well as checking the consistency of the delayed-mode dataset with new shipboard CTD data collected subsequent to delayed-mode processing. Additionally, each data center is asked to work on assembling CTD data in their region and to develop products using Argo data. Some data centers do other optional activities in their region. The following articles are updates from each Argo Regional Center describing the work being done or planned for the future.

Pacific Argo Regional Center (PARC)

http://apdrc.soest.hawaii.edu/argo/

The Pacific Argo Regional Center (PARC) has had four meetings, but really is just entering its second year. The first year was devoted to developing a web page to provide a starting point for PI's and other users with an interest in Pacific Argo floats. The 4th PARC meeting was held in October, 2006, just prior to the ADMT-7 meeting. The meeting was hosted by KORDI in Ansan, Korea. At this meeting plans were discussed for how to make progress on the required and optional tasks prescribed for each ARC.

To date, the PARC has been a loose collaboration between several different international agencies. IPRC provides web-based servers, data that can potentially be used to assist in analysis of Argo data (e.g., realtime CTD casts from FNMOC), and has an interest in developing Argo-based data products. The IPRC does not serve as a DAC. However, several other PARC members (JAMSTEC, KORDI/KMA, and others) also operate as DAC's, and thus have an interest in providing consistency checks and other checks on DMQC'd data; something identified as a critical function of ARC's.



The ARC members have also entered into user outreach efforts, including working with, and providing data products for, nations without floats. IPRC, for example, is working with SOPAC to produce regionally relevant data products for South Pacific Island nations. JAMSTEC is involved in educational outreach, and is continuing a successful collaboration between Argo scientists and lower school education (with local fisheries schools).

The challenges to PARC were also discussed at the last meeting. Aside from funding issues, which are not to be understated, the issue of combining all floats in the Pacific in one center, or by one group, may not make sense. Perhaps ARC's focused on dynamical regions (e.g. marginal seas, equatorial currents, etc.) would make more sense. Also, the wide number of countries, DAC's and PI's make coordination difficult. Further problems arise from recent turnovers at various participating agencies, and from different institutes have attended the two PARC meetings, while still others have not been able to attend the meetings.

To overcome these, the PARC has identified collecting links to all the different DAC's and agencies producing products for the Pacific region on the central PARC page (maintained at the IPRC) as a short term action item. It was also noted that as yet no one is doing the consistency checking of DMQC'd data, but JAMSTEC has now agreed to do this. Finally, it was agreed that one important function of PARC will be to produce Argo-based data products (an initial velocity product is shown in this summary). A key will be to identify what products would be useful (and to whom), and then who will produce these. This process should be initiated, at least regionally, by all the PARC members.

Indian Ocean Argo Regional Center (IARC)

http://www.incois.gov.in/Incois/argo1/argo_webGIS_intro.jsp

The Indian National Centre for Ocean Information Services (INCOIS) [http://www.incois.gov.in/Incois/argo1/argo_home.jsp] acts as the Argo Regional Center for the Indian Ocean region. The functions of IARC are as follows:

- Acquisition of Argo data from the GDACs for the Indian Ocean region and availability from the ARC website.
- Acquisition of CTD data from Indian research vessels to update the Indian Ocean reference database
- Comparison of float to float and float to CTD data
- Delayed mode quality control
- Statistics of floats (deployed, active, drifts, percentage of floats in water from deployment, etc)
- Argo value-added products
- Basin level deployment coordination

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

INCOIS started generating and uploading D files to the GDAC in July 2006. So far 59 floats have been subjected to DMQC, but only 357 profiles belonging to 4 floats have been uploaded to GDAC. The remaining floats could not be uploaded due to various issues (handling of PNP profiles, thermal inversions, wrong positions, near shelf cases and missing single & multiple profiles). These issues were raised at DMQC-2 for expert advice and solutions were suggested. Hence D files will be uploaded in near future for all the eligible floats. A separate webpage will be created for posting all D files pertain to Indian Ocean and it will be ready by January 2007.

Efforts are underway to update Indian Ocean reference data sets using high quality CTD data collected on Indian research vessels. Some of the CTD data were submitted to CCHDO through Coriolis Data Center and soon these data will also made available from ARC-Indian Ocean webpage. A separate study has been initiated with National Institute of Oceanography and Indian

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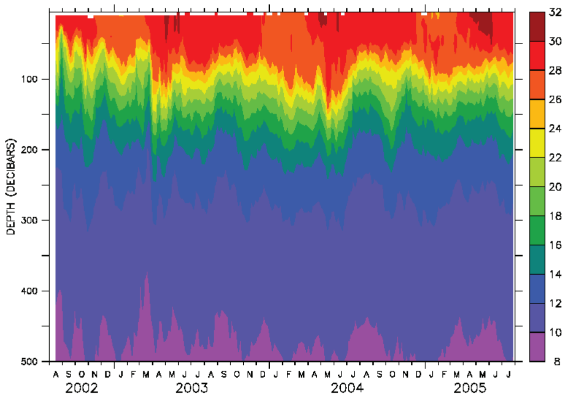
Institute of Technology for making a reference data base for DMQC, Indian Ocean Atlas and validation of profile data (Real-time and Delayed mode) with CTD and recent Argo profiles.

As a part of IARC activities, the following value-added products were generated using all available Indian Ocean Argo floats. These valued added products can be obtained from the following link http://www.incois.gov.in/argo/arc/products.jsp



Temperature - Depth Timeseries product

1. Time series plots of the following parameters:
   - Water fall plots
   - Surface pressure
   - Bottom-most pressure
   - Surface temperature
   - Bottom-most temperature
   - Surface salinity
   - Bottom-most salinity
   - Trajectory of float
   - T/S plots
2. Monthly spatial plots using the objectively analyzed data from all the Argo floats deployed in the Indian Ocean. This includes:
   - Temperature, Salinity and Geostrophic Currents (at 0, 75, 100, 200, 500, 1000 meters)
   - Mixed Layer Depth, Isothermal Layer Depth
   - Heat Content up to 300 m
   - Depth of 20º and 26º isotherms

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

Basin level regional coordination for the Argo float deployment plan for the Indian Ocean is available at http://www.incois.gov.in/argo/arc/future.jsp. The present status of active floats and the intended plan for float deployment location by different countries are available in this WEB-GIS page. This page also contains a present and future status of Argo floats density map for the Indian Ocean region and ships of opportunity.

North Atlantic Argo Regional Center (NA-ARC)

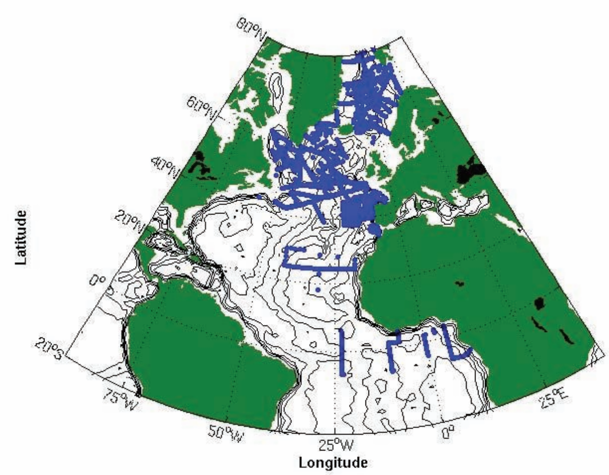
http://www.coriolis.eu.org/cdc/Argo-NA_DAC.htm

The North Atlantic ARC coordinated by Coriolis involves France, Germany, Spain, Netherlands, Canada, UK, USA and Italy, that coordinates Mediterranean Sea activities. It was set up at the end of 2005 and met in plenary only once. The next meeting is planned for early next year. There have been small group meetings in 2006 but most of the activities have been carried out by email.

The NA-ARC has first focused on the compulsory activities: delayed mode QC activities and data consistency over the basin. 2006 has been the year where a lot of exchanges have happened between the teams who had to quality control floats in delayed mode, i.e. mainly Germany (AWI, BSH, IFM-Geomar) , Canada (DFO) and France(IFREMER, CNRS, IRD). These teams have shared their expertise in order to process the data in a coherent way. New CTD data have been collected in the area and shared among the partners (see the plot below). These data will be soon transmitted to CCHDO.

A method to check the consistency of Argo data over the North Atlantic has been developed by Coriolis and was presented at the 2nd Delayed Mode Quality Control workshop in WHOI/USA. It is based on the use of objective mapping to identify suspicious values in float data. Out of 11,500 profiles tested, about 5 anomalous profiles were identified. The anomalies have been pointed out to the corresponding DACs and have been corrected. In addition,

Start of CTD collection on Atlantic for ARC partners France, Germany and Canada



the procedure demonstrates some floats that were not consistent with the reference climatology and/or the floats nearby. Coriolis has plans to transfer the method to pre-operational at the end of 2007 if the remaining scientific studies are successful.

The coordination of the deployment over the Atlantic has been pursued and the re-seeding of the North Atlantic has started. AOML and Coriolis plan to work on tools to better refine a re-seeding strategy in future. The deployment plans for 2007 are not yet defined as budgets are under discussion in most of the institutes. In collaboration with European partners of the NA-ARC, a proposal has been submitted and labeled by ESFRI (European strategy Forum on Research Infrastructure). In early 2007, a call will be opened for all new labeled research infrastructures. The EURO-ARGO

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proposal should allow the consolidation of the infrastructure up to 2010/2011 and prepare for the implementation phase. The objective for the implementation phase will be to secure a sustained contribution from the member states as well as from the European Commission. The European contribution is estimated to be about 250 floats per year. This will be achieved through member states and European contributions.

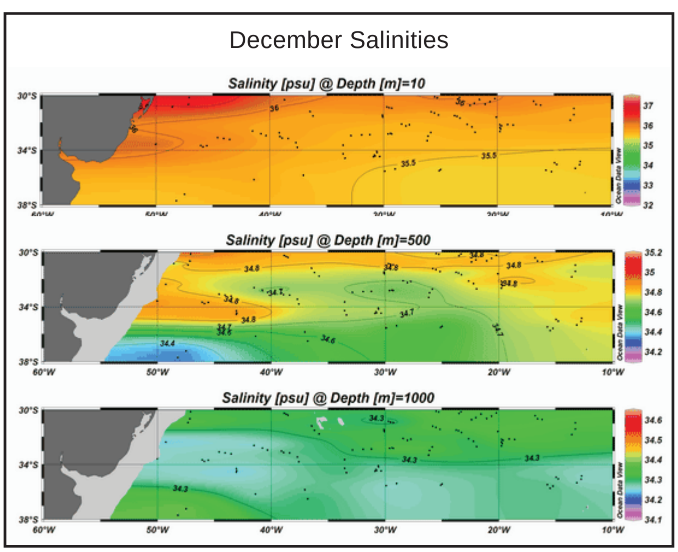
Finally, a new climatology for North Atlantic based on 2000-2005 analysis will soon be made available. It's at present under scientific validation. It should be useful for data quality control, for models as a baseline field in the area and for the research community. The next step will be to derive indicators for the North Atlantic.

The South Atlantic Argo Regional Center

http://www.aoml.noaa.gov/phod/sardac/

The South Atlantic Argo Regional Center (SA-ARC) is working on procedures for the final step of the Argo delayed mode quality control. This step involves comparing the subsurface salinity and temperature (in 400 to 2000 m) with climatology (World Ocean Atlas 2001) and nearby independent observations. Summary plots and tables of the temperature and salinity differences are generated to detect floats with suspicious data. Time series plots are used to investigate if the differences are significant and time dependent. If there are signs of significant sensor drifts or if offsets are detected the principal investigator in charge of the float can be notified. The web page of the South Atlantic ARC provides access to deployment opportunities, meeting agendas and reports, links to data and some products derived from various data sets including Argo floats. See plot below for a snapshot of some salinity products.

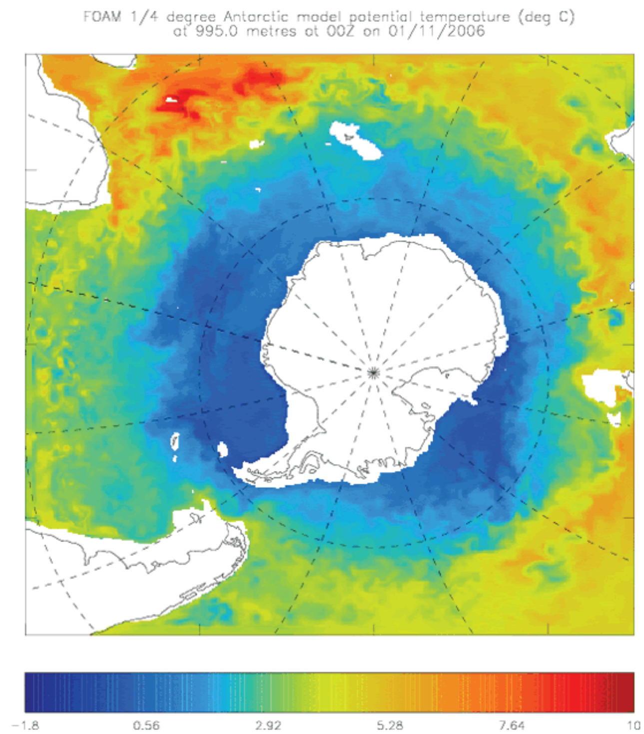
In December 5-7, 2006 a capacity building workshop was held in Ghana. This workshop was organized in a joint effort under the umbrella of the South Atlantic ARC which consists of a consortium of African countries, South American countries and the USA. The objectives of this workshop included an increase in collaboration and data exchange between the involved countries, and the training of participants in the generation and use of high-quality *insitu* observations.



The Southern Ocean Argo Regional Center

www.bodc.ac.uk/projects/international/argo/southern_ocean/

The Southern Ocean Argo Regional Centre (SOARC) is currently a collaborative effort between the British Oceanographic Data Centre (BODC), UK and CSIRO, Australia. CSIRO has responsibility for their sector of the Southern Ocean and BODC for the South Atlantic and Southern Indian Ocean regions. So far progress has been quite slow and until quite recently only a small



number of delayed-mode profiles have been available. However CSIRO have recently appointed a new member of staff to undertake float to float comparisons. BODC have been concentrating their efforts on acquiring recent CTD data - starting with that collected by the UK - to improve the reference data set for the Southern Ocean. BODC will initially concentrate on the South Atlantic sector for float to float comparisons.

The SOARC web-site is hosted by BODC and includes background information and describes the main functions of Argo regional centres. These include ensuring consistency of the delayed-mode dataset across delayed-mode operators and checking the consistency of the of the delayed-mode dataset with new shipboard CTD data collected subsequent to delayed-mode processing. Additionally the web-site has an interactive map giving information on last known positions, deployment positions and direct links to both GDAC ftp sites. Data from all Argo floats are assimilated in to the Forecasting Ocean Assimilation Model (FOAM) run at the UK Met Office. Images of potential temperature, salinity and velocity at 5m and 995.5m for the Southern Ocean are supplied by the Met Office at monthly intervals and included on the web pages. An image of potential temperature at 999.5m produced on 11/1/2006 is shown above.

The SOARC is keen to develop links with Southern Ocean PIs and also with other regional centres, and in particular to develop collaboration in the Pacific sector. For further information contact Lesley Rickards (ljr@bodc.ac.uk) at BODC.

Report on the Second Argo Trajectory Workshop (ATW2)

Brian King and Jong-Jin Park (Co-chairs) [bak@noc.soton.ac.uk, jjbluewater@gmail.com]

Following an informal meeting in Venice, designated as the First Workshop, the Second Argo Trajectory Workshop was held in Seoul, Korea on October 27 and 28, 2006. The workshop was hosted by Kuh Kim and Jong-Jin Park from Seoul National University and scientists from Japan, Korea, the UK and the USA attended. The principal objectives of the workshop were to review the status of the trajectory files, to investigate improving the estimated surface arrival and surface departure timing in the files for velocity calculations, and to compare different position extrapolation programs for estimating the surfacing and departing position of the floats.

Several presentations were given at the meeting describing inconsistencies in the way trajectory variables are filled across DACs. To help reduce the differences, several checks were developed that will be run by the GDACs to inform the DACs of improper filling of variables and flags. Attendees agreed to talk to their DACs about the proper method of filling the files and B. King agreed to talk to DACs without an attendee. Given that some DACs need time to change their trajectory file process, at this point, the GDACs would not reject a trajectory file with some errors.

The surface arrival and departure times were considered next. These are not generally transmitted as part of the float data and are not available in 'Real Time'. In some cases they can be inferred from the assembled transmission times over many months of data from a single float; in others, the times can be partly recovered from technical data. The process of assembling the required times has begun, and members of the workshop will work with DACs to complete the time estimation process.

Additionally, the extrapolation methods for surfacing and departing positions were discussed. Several published techniques (Davis et al, 1992, Schmid et al, 2001, Park et al., 2005) are available and will be evaluated using 350 floats spanning the Pacific between 20°N and 60°S. See the Argo Velocity Product article for more information.

In addition to the timing estimates and the position extrapolation, velocity calculations rely on meta data values and it was stressed that the important values like cycle time, surface time, parking pressure and park and profile information be filled in properly.

New variables were proposed for the trajectory netCDF files to store position and uncertainty at the surface arrival and departure times, and to store the interpolated positions corresponding to the times of reported surface transmission. A data mode indicator variable will be introduced to enable users to know when this Delayed-Mode process has been applied. To read about the report in more detail, go to: http://www-argo.ucsd.edu/FrUG_reports.html.

An invitation to Italy

John Gould (wjg@noc.soton.ac.uk)

The International Union of Geodesy and Geophysics (IUGG) will hold its 24th Assembly in the ancient Italian city of Perugia this summer between July 2 & 13th, 2007 (http://www.iugg2007perugia.it/). The theme of the assembly is "Our Changing Planet" and will include a session (PS010) entitled "New Insights into the Ocean and Its Circulation from Argo and GODAE" convened by John Gould and by Pierre-Yves le Traon.

Keynote talks will be given by Pierre-Yves, co-chair of the GODAE Steering Team, and by Dean Roemmich, co-chair of the Argo Steering Team. The exact date(s) of the Argo /GODAE session will not be decided until after the closing date for abstracts.

A small number of grants will be available to support meeting attendance by people who have submitted abstracts. This will be an important opportunity to highlight the remarkable progress made by Argo and GODAE to the wide range of scientists who will be at IUGG.

We encourage you to submit your abstracts as soon as possible so that we can put together an exciting Argo/GODAE session. (Deadline for abstracts is January 31 2007).

The IUGG meetings will be held on the campus of the ancient University of Perugia, the roots of which can be traced back to 1285 (http://www.unipg.it/en/). The meeting also presents a wonderful opportunity to explore Perugia and the many other towns in cities of Unbria.

Photo Source http://www.checifaccioqui.it

Argo educational program in South America

Dr. Luis Pinto (Chile) & Lic. Jorge Mermoz (Argentina)

The Center for Oceanographic Research in the Eastern South Pacific (COPAS, University of Concepcion, CHILE) in collaboration with Center AquaSendas, a non-profit organization, is developing an outreach program with two local public schools using data from the Argo Program to understand basic concepts in oceanography along the Pacific eastern coastal margins. The program entitled "Drifting within the ocean depths" is using data produced by floats WMO ID# 4900512 & 513 deployed by the Chilean Navy Oceanographic Service. Middle-school science teachers Marta Cardenas and Lilian Uriarte are leading their students organized as Team Water and Team Akua in their respective schools. During the last two months they have been downloading statistics about the floats and presenting their results to the rest of the students. Currently, an Argo poster is being translated into Spanish by both teams.

Team Akua

AquaSendas in conjunction with the "La Plata Estuary Project" from Argentina is organizing a Latin American Marine Education network (REdCoL) whose initial regional project will involve the production of Argo teaching material for other Spanish-speaking countries based on our experience and the SEREAD program led by Dr. Julie Hall (NZ) for Pacific Island schools.

The "La Plata Estuary Project" is being assisted by the Hydrographic Office of the Argentine Navy, to train teachers on basic details of the Argo program in order to encourage secondary schools to adopt a float and follow it throughout its active life. Formal activities with students on the Argo Program in Argentina will start in 2007.

AquaSendas temporary website for the Argo educational program in Chile is: www.geocities.com/boyasargo

Team Water

Estimating the drift of the conductivity sensors on Argo floats using a piece-wise linear fit

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Annie P. S. Wong, University of Washington, Seattle, WA [awong@ocean.washington.edu]

A new algorithm has been developed to estimate the drift of conductivity sensors on Argo floats. It is an extension of previous algorithms developed by Wong, et.al. (2003) (WJO) and Böhme and Send (2005) (BS). The structure of the new routines is identical to WJO, allowing easy substitution into existing delayed mode quality control processing. It uses the WJO objective mapping technique to interpolate the historical data to the float locations and assumes in the fitting procedure that the data points are correlated within water masses, depending vertically on the potential temperature differences and horizontally on the separation between profiles.

Following BS, the new procedure uses a reduced number of levels and interpolates the historical data onto the actual float potential temperature values. Whereas WJO uses a sliding fitting window and BS uses a single linear fit, the new procedure uses a piece-wise linear fit to estimate the drift of the conductivity sensor (see Jones and Dey (1995) for a description of the statistical method for this procedure). The number of break points in the fit can be either chosen using standard statistical methods that choose the simplest statistical fit based on the trade-off between increased complexity and significant reduction in the sum of the residual errors or prescribed by the user.

This procedure was presented at the recent 2nd Argo Delayed Mode Quality Control Workshop and was recommended as the preferred algorithm for future estimates of the conductivity drift. A short description of the novel aspects of the algorithm and an example are given below.

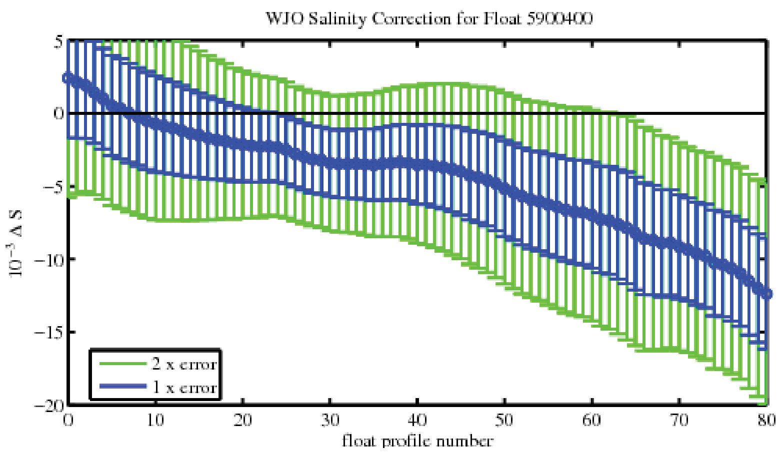
The new algorithm uses the same two-pass objective mapping procedure as WJO to obtain climatological potential conductivities at the float locations. In WJO these values were interpolated onto standard potential temperature levels. Here we follow BS and interpolate the climatological conductivities onto the observed potential temperature values. We then choose 10 differences between the climatological and float potential conductivities for each profile to use in the fitting procedure. These values are chosen as:

1. The values that have a minimum salinity variations on potential temperature, Θ, surface (using the observed value nearest to Θ over the time series.
2. The values that have minimum pressure variation on Θ.
3. Values on 4 pressure levels that have the smallest salinity variations.
4. Values on 4 pressure levels that have the smallest Θ variations.

These criteria effectively choose levels that are within stable water masses and values where there is minimal eddy variability.

The selected data are then used to estimate an increasingly complex set of fits to the data, starting with a mean offset, linear trend, and piece-wise linear fits with an increasing number of break points. When N break points are included, there will be 2(N+1) parameters in the fit: the N break points, the initial offset and the N+1 slopes of the continuous lines between the beginning and end of the time series.

In contrast to BS who estimates the fit for each profile and then does a second fit for the temporal variations, the new procedure uses values at all 10 depths and all profiles to least-squares fit the temporally varying conductivity drift. A step-wise F-test is often used to determine the number of parameters to use in a statistical fitting procedure. This test measures the statistical



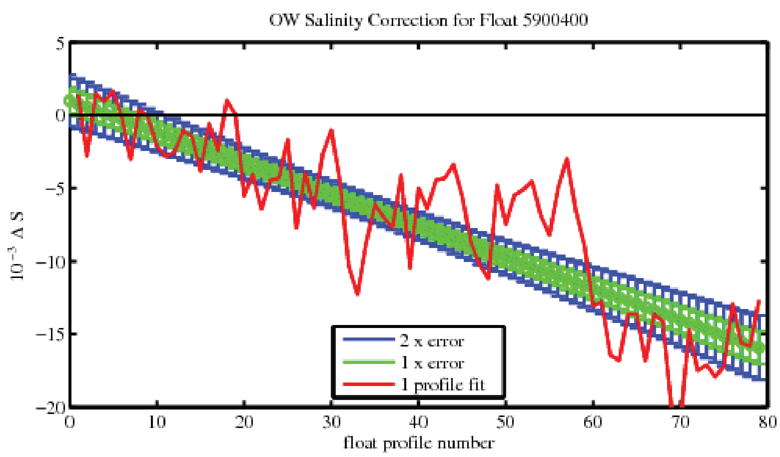


Figure 1. WJO and new algorithm salinity adjustment estimates for float 5900400 from the Pacific. The salinity change is rescaled by 10^{-3}, so that the correction at the end of the time series is approximatly 0.015. In the lower panel, the red curve shows the esitmated correction when the correction is estimated one profile at a time.

significance of the decrease in residual variance with an increase in the degrees of freedom of the fit. When a range of parameters are examined, a better test is the Akaike Information Criterion (AIC) test that examines all the possible choices independently rather than making a step-wise F-test. The default procedure uses the AIC test to choose the statistically simplest model of the conductivity drift. Alternatively, the user can split the time series into segments and/or prescribe the number of break points for either the whole series or the segments.

Since the piece-wise linear fit involves a non-linear statistical estimate, we use a Monte-Carlo scheme to estimate the uncertainty in the fit. Gaussian random errors proportional to the mapping error at each data point are introduced and the resulting

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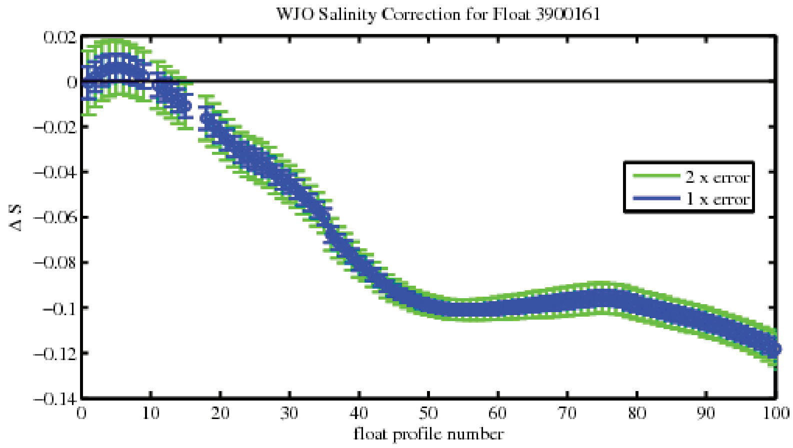

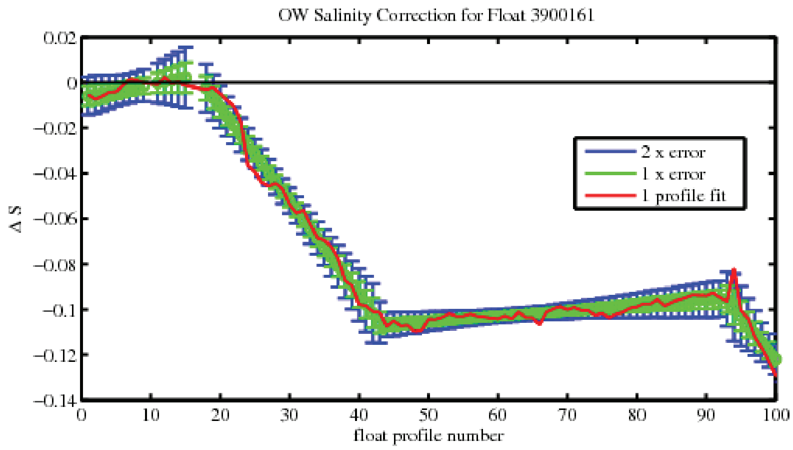

Figure 2. UW float 3900161 from the Pacific. Note that the salinity change is an order of magnitude larger than figure 1.

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RMS variations of the conductivity adjustment at each profile are calculated. This error estimate assumes that each of the data points is statistically independent. Following WJO, the number of degrees of freedom for the fit is adjusted downward using the prescribed correlation functions that depend on the differences in potential temperature and horizontal separation and the error estimates increased to reflect the assumption that these measurements are not independent.

Two comparisons between WJO and the new fitting procedure are shown in Figures 1 and 2 for two floats deployed in the Pacific. The figures include both the estimate and the one and two times standard error bounds. For the new fitting procedure plots, we have also included the estimates using only the data from one profile at a time. The first float, 5900400, was launched by Scripps Institution of Oceanography at approximately 30º S, 135º W and the second, 3900161, was launched by the University of Washington at approximately 5º S, 95º W. Because the new procedure has a much more limited number of parameters for the fit and it uses the entire data set to estimate these parameters, the estimated errors for the new fit are smaller than WJO. These error estimates are larger than would be the case with BS because the correlation between data points has been included in the present error estimate whereas BS assumes that each data point is an independent sample. The number of degrees of freedom used to estimate the drift compared to that used in BS is an order of magnitude smaller, which effectively increases the estimated error by approximately a factor of 3 to 4. A careful examination of the methods used to estimate the errors from the different DACs will be necessary when using the error estimates for the global data set.

The newer fit varies more slowly in time and is less susceptible to errors due to subtle changes in the water masses used to estimate the WJO fit. It also chooses a reasonably reduced set of parameters to fit the observed changes in time. For the first float, the procedure chooses a linear drift that is quite small, with a correction at the end of the time series of approximately 0.015 PSU. Nonetheless, the estimated error for the adjustment indicates that the adjustment is still significantly different from zero. Given the linear fit, there is no ambiguity about when to make the correction and the procedure recommends applying a correction for the whole time series. For the second float, the apparent drift is larger and not such a simple function of time. Note that the actual differences between the two procedures for both floats are not large, suggesting that it will not be necessary to redo previous calibration estimates using WJO.

The advantages of the new algorithm are that it uses a reduced number of levels in the vertical that have less uncertainty than the broader range of potential temperature surfaces used in WJO, it objectively chooses the simplest temporal fit to the conductivity adjustment and uses a larger number of observations to estimate the parameters of the fit compared to WJO that in turn, reduces the estimated errors of the correction, and it uses the expected vertical and horizontal correlations in the error estimation that are excluded in BS. The disadvantage of the new method is that, in principle, the estimates of the correction and the expected errors for the early parts of the time series will require the full time series to estimate. In practice, when there are either relatively constant drifts, such as seen in Figure 1, or if there are breaks in the correction, as in Figure 2, the estimates for the early part of the time series will not change as more data are available.

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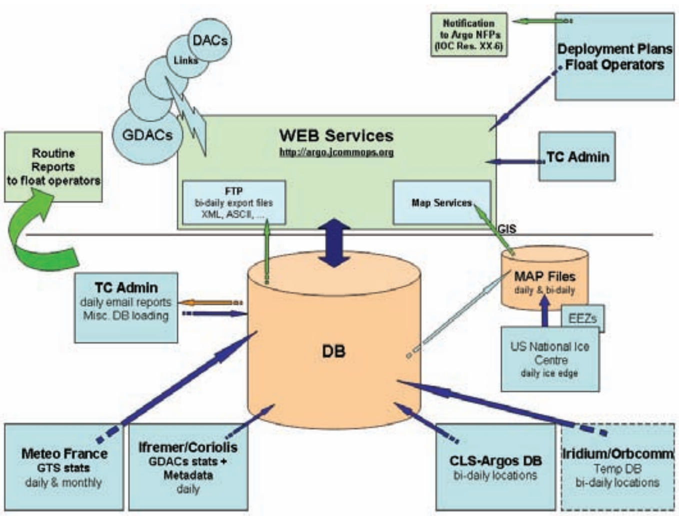
New Argo Information Center (AIC) Website

Mathieu Belbéoch [belbeoch@jcommops.org]

The AIC website is the tip of the AIC Information System iceberg and is used routinely by the Technical Coordinator (TC) to achieve various international coordination tasks which require accurate and up to date information management. The system routinely assimilates information from heterogeneous sources, then checks and re-distributes it in various ways (see information flow diagram below).



The year 2006 marks an important milestone in the AIC development as a new website has been released following 2 years of effort to deploy the system on new hardware and software architectures. The new website was officially released late September. As is expected with any major website upgrade, it will need an additional effort of optimization before reaching a truly stable state.

The dynamic web application previously deployed on a low specification WinNT server has been migrated to a more powerful UNIX/MacOSX server and upgraded with many new components. The JCOMMOPS graphical design (produced by the AIC previously) has finally been applied to the new site. The website is made of 280 dynamic components (content is provided by the database on the fly).

The website includes, in particular, a new deployment notification interface (gathering more metadata), an improved float search engine, an improved float details page linked to national data centre products, more statistics on project development, new statistics on national/regional contributions, new statistics on floats lifetime, a photos/pictures gallery, and much more.

It has two different navigation bars and a shortcut bar:

- Vertical bar for the common JCOMMOPS sections: news, contacts, float search engine, meetings, documents, links, gallery, and help
- Horizontal bar for Argo operations: Implementation, Monitoring, Map Room, Instrumentation, Data issues.
- Shortcut bar for direct access to key pages is at the top.

The website comes with a "Community Toolbar" (Google style) which allows users to:

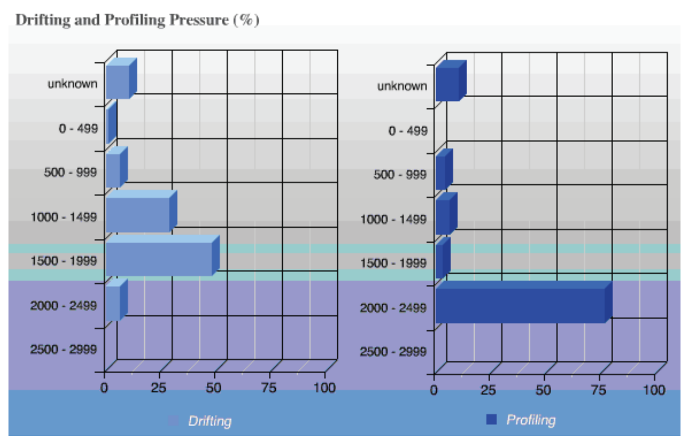
- search from anywhere on the web with Google search engine
- search the AIC database (platforms, contacts, news, documents, glossary)
- gain instant access to key links (Argo project Office, Interactive Map, Notification interface, Latest status map).
- gain access to latest Argo news
- gain instant access to an Argo float by its WMO ID

The website includes an interactive map (web GIS) tracking the network in near-real time (bi-daily update). It includes in particular information on active/inactive floats and their trajectories, achieved deployments, bathymetry, Exclusive Economic Zones, Arctic/Antarctic ice edge, and it provides 4 different views: Pacific, Atlantic and polar N/S.

A new layer was added recently that displays future deployment plans. Float operators are encouraged to notify their deployments in advance to feed this layer and give us a global view of the planning.

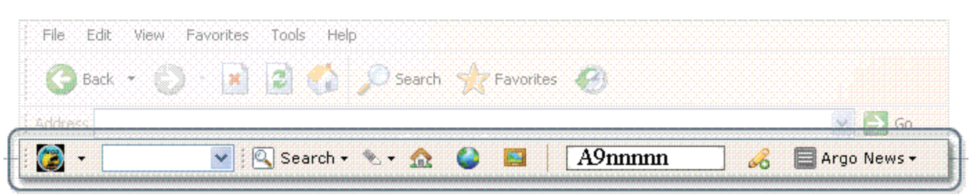
It is to be noted that bi-daily status files, including main Argo metadata, are exported (in ASCII, GIS, Google Earth formats) through FTP, to be used in other monitoring systems. On the other hand, status maps are produced on a monthly basis, stored in the database (png), and available in high resolution via FTP (pdf).

Some sample products provided on-line include: monthly maps, float survival rate charts, yearly deployments, age distribution charts, national contributions, drift/profile pressures. Most products can be generated for any regional/national Argo contribution and any group of floats defined by the search engine.



The AIC services are primary dedicated to the Argo community and not to the public. See News in Brief for a chart showing constant growth in website usage since the AIC was established in 2001. In November 2005 we saw an average of 11,000 sessions per month. This level of user visits has been maintained during 2005-2006. The audience is truly international (180 countries logged) and the main users are from USA (60%), France, Japan, UK, Canada, Germany, China, Korea, Australia, Spain, Netherlands and India (in order of usage level). This growth in usage is seen as a positive result of the Argo project and AIC as it demonstrates that the AIC is used by a larger audience than planned and it demonstrates the excellent visibility of the Argo project.

The Argo TC will continue to address issues with the new website and will focus next year on demonstrating the value of Argo, providing more visibility to the products based on Argo data.



KEY LINKS:
AIC website http://argo.jcommops.org
Interactive Map:
http://w4.jcommops.org/website/Argo
Mailing Lists http://list.jcommops.org
FTP ftp.jcommops.org
Contact: aic@jcommops.org

Report on the Second Delayed Mode Quality Control Workshop

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The Second Delayed Mode Quality Control (DMQC-2) Workshop was held October 4-7, 2006 at Woods Hole Oceanographic Institution. Scientists and delayed mode data analysts attended from all but one of the countries that maintain an Argo Data Assembly Center (DAC). The principal objectives of the workshop were to review progress since the first workshop towards consistently applying DMQC procedures, to discuss implementation of the new software tool created by Breck Owens and Annie Wong, to discuss the management and upkeep of a consistent reference database and to discuss the inclusion of various adjustments in real time.

The meeting began by reviewing the progress made so far by the program as a whole towards creating a D mode file for each of the R mode profiles now held at the GDACs. Since November 2005, an additional 41,000 D mode profiles have been added to the GDACs, bringing the total number of D mode profiles to 70,000. See the table for details. Additionally, many national efforts are ready to submit large batches of D files in the near future.

DAC name at GDAC	Total profiles at GDAC	Recent profiles not yet available for DMQC	Profiles available for DMQC	D profiles at GDAC	Percent available files that have been dmoded
AOML	118089	47504	70585	34711	49
BODC	12105	3453	8652	396	5
Coriolis	41661	12664	28997	13121	45
CSIO	1202	306	896	338	38
CSIRO	6894	3090	3804	1251	33
INCOIS	9072	3561	5511	340	6
JMA	40970	12927	28043	11187	40
KMA	3442	878	2564	0	0
MEDS	11532	2574	8958	8884	99
Total of above DACS	244967	86957	158010	70228	44
gts	26454	427	26027	0	0

Owens and Wong described the new statistical tool, named OW, they have developed in response to discussion at DMQC-1 which updates WJO to include some features from the Boehme-Send method. Please refer to the article about OW in the Newsletter on pages 6 and 7 for more details.

It was agreed that maintaining carefully-prepared reference datasets for Argo DMQC is a critical activity. At ADMT-6 Coriolis agreed to host and update reference datasets, using CCHDO as the route for acquiring new reference data. The baseline of this dataset will include reference datasets prepared by JAMSTEC for the Pacific (SeHYD) and Indian (IOHB) Oceans. For the Atlantic Ocean, Hydrobase will need to be translated into the correct format by WHOI. The Southern Ocean is included in SeHYD and IOHB, but not the Atlantic Hydrobase, so that must be addressed. One solution is using the database from Orsi et al's WOCE Southern Ocean Atlas.

Besides using ship-based CTD data, the workshop considered using Argo float data in the reference dataset. J. Gilson has created 7 criteria which a float profile should satisfy if it is to be considered useful. See meeting report at http://www-argo.ucsd.edu/FrUG_reports.html for the list. Everyone agreed the criteria were reasonable, but some present were worried about Argo having an unidentified residual bias error that might accumulate through successive use of Argo profiles as reference and result in a biased Argo dataset. Therefore, DMQC-2 agreed that profiles satisfying "Gilson's rules" could be used to clarify the probability that a float required adjustment, but did not recommend at this time that Argo data should be a routine part of DMQC reference data.

Simulations and studies are being done by different groups as to the effect of including float data in the reference dataset. As more work of this type is done, the inclusion of float data into the reference dataset will be considered again.

Three possible adjustments in real time were discussed at DMQC-2: salinity, pressure and thermal mass correction. As for the salinity adjustment, it has already been agreed upon that real time adjustment should take place at the DACs, but the exact method of that adjustment was discussed at this workshop. DACs are to calculate the profile offset in the most recent D file available at the GDAC and apply this assuming persistence. The workshop also required that further experiments should be undertaken to investigate whether the proportion of times when the assumption of persistence of offset provides a real time estimate closer to the final delayed mode estimate than the unadjusted real time value.

The real time adjustment of pressure was discussed and it was recommended that for APEX floats, corrections for surface pressure adjustments are not appropriate for real time. Brian King agreed to formally request Webb Research to address the problem of truncating negative surface pressure offsets and to suggest the use of a median of surface pressure determinations over a typical wave period rather than a single value.

The real time adjustment for thermal mass correction was considered and it was decided to apply this correction in delayed mode since the real time uncertainty is larger than the thermal mass correction. It was requested that sensor type, pumping mode and ascent rate algorithm are included in the Argo data system to allow easier calculation of thermal mass correction. Finally, DMQC-2 encouraged an experiment to be performed to help better determine the coefficients needed for the fit so this problem can be corrected onboard the Seabird sensor.

Taiyo Kobayashi presented results of oxygen measurement studies done on 9 Japanese floats with both SBE43 and Anderaa Optode sensors. Kobayashi found both sensor bias and sensor drift present, but at this time, there is not enough information available to develop delayed mode statistics. It was also requested that oxygen sensor users fill in the DO sensor type in the meta-data file so others can know the sensor type being used.

Argo Velocity Product

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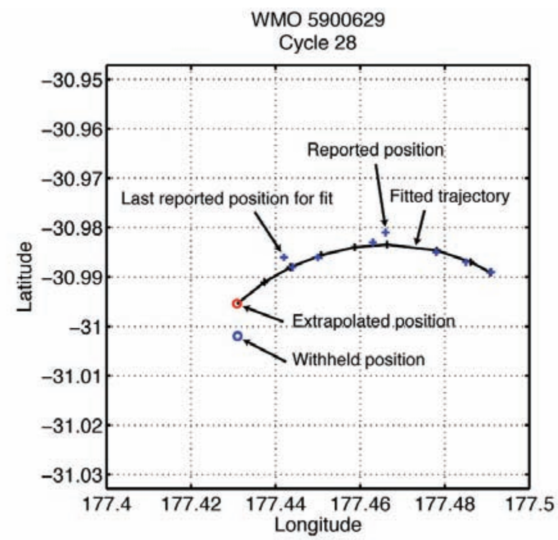
Given the Argo user interest in calculating velocity from float trajectory files, Argo is working to improve the consistency and quality of its trajectory files and to develop a velocity product. The overwhelming majority of the present Argo fleet uses Argos satellites for data telemetry and position fixing, which means that several hours can elapse between a float reaching the surface and the first position being calculated. During this time the float can be carried up to several kilometers by the surface current. A corresponding unmeasured displacement can occur at the end of the float's surface time.

An initial set of ocean velocity data, 'YoMaHa'05', calculated from float surface positions has been released by Hiroshi Yoshinari and colleagues at IPRC, as mentioned in the Argonautics 7 News in Brief section. YoMaHa'05 uses the earliest and latest positions reported during the surface part of a float cycle to define the submerged ocean velocity, so it does not account for the unmeasured displacements.

If the surface arrival and departure times are known, a higher level product could be generated by extrapolating the surface trajectory from the end reported positions to estimated surfacing and diving positions. While there are plans to update YoMaHa to include new 2006 data using the same methodology developed for the 2005 product, the recent Argo Trajectory Workshop - 2 was concerned with establishing procedures to undertake this extrapolation of surface times and positions to improve the velocity product.



The first task is to assemble a complete set of surface arrival and departure times. These times are usually not part of the float data delivered in real time, but depending on the float type, different procedures can be done to either recover or predict these times. Much work was done at the Argo Trajectory Workshop – 1 on understanding the timing cycle for each float type in order to develop the best methods possible for determining the surface and arrival times.

For Apex floats, to get an accurate surface arrival time, the DACs need to calculate this from the time of the Argos telemetry messages which are not available to users. While some DACs are currently doing this, the remaining DACs are being asked to start this process to accurately fill the Apex surface arrivals in real time and the process should be completed within a year. The departure time for Apex floats can then be calculated using an envelope method which looks at many months of data from one float.

For SIO SOLO floats, an envelope method can be used to predict the surface arrival and departure times using many data cycles. This method is robust, but must be done in a delayed mode process by the responsible PI. The process has already begun for some floats and will expand to remaining floats in the future.

For other float models, like the Provor, estimating or properly recording the timing is being investigated by their deployers and will be included in the files as soon as effective methods are found. Since Apex and SIO SOLO floats comprise a large percentage of the array, the longer timeline for improving the other models' timing is not significantly affecting float coverage for velocity calculations.

A surface trajectory will be derived as a weighted fit to the set of reported positions, and used to extrapolate to surface arrival and departure times. Several published techniques (Davis et al, 1992, Schmid et al, 2001, Park et al., 2005) are being evaluated using a set of 350 floats spanning the Pacific between 20°N and 60°S. Withheld data will be used to determine which method produces the smallest errors in extrapolated position, and whether there is any regional variation in the choice of best method. This will also enable us to characterize the dependence of extrapolated position error on time and distance of extrapolation, and on goodness of fit of the trajectory to the known positions.

The figure illustrates an extrapolation for cycle 28 for float WMO# 5900629 in which the reported positions are blue plusses. The fitted trajectory is the solid black line with plusses to mark the interpolated position at transmission times; the extrapolated position is a red circle. The withheld data is a blue circle, which was a best quality Argos position fix.

Once the complete set of surface arrival times, departure times and their corresponding extrapolated positions has been compiled, the information will be stored in new variables in the trajectory netCDF files. The new variables will include all the times, extrapolated and interpolated positions as well as uncertainties where appropriate. See the ATW-2 Meeting Report Annexe for a complete list of proposed variables. [http://www-argo.ucsd.edu/FrUG_reports.html] This complete set of delayed mode trajectory files can be used by individuals to calculate velocities in different regions of interest or by some organization like an Argo Regional Center to create an ocean velocity product. Look on the website http://www.argo.ucsd.edu and in the next newsletter for updates on the trajectory file process.

Report on the Argo Data Management Team

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The 7th annual Argo Data Management Team (ADMT-7) meeting was hosted by the National Marine Data and Information Service (NMDIS) in Tianjin, China from 1 – 3 November 2006 with 39 participants, from 9 countries, in attendance. A primary concern of the ADMT continues to be the consistency of the Argo dataset and this will be a primary focus for the coming year. The main items discussed at the ADMT-7 were:

- Most of the problems in the GTS data have been resolved and the main problem that remains (pressure being reported instead of depth for CLS floats) should be resolved very soon. During the past year, the BUFR template was approved by the WMO and test BUFR transmissions were performed. Parallel distribution of BUFR data will begin during the coming year. Increased monitoring and reporting of the GTS data will be provided by the AIC with the assistance of MEDS.
- The consistency of the real-time QC performed at the national centers continues to be a concern of the ADMT. A set of standardized tests will be applied at all national centers by early 2007 to ensure consistent data flagging in real-time.
- The second delayed-mode QC workshop (DMQC-2) was held in October 2006. Most DM operators made great progress in processing their files during the past year. A peer review of the delayed-mode dataset found very good consistency in the data. The objective analysis technique continues to be improved, leading to even better consistency in the dataset. Additionally, improved format consistency checks will be implemented at the GDACs during the coming year. The main goal for 2007 is to reduce the backlog of profiles to be processed in delayed mode.
- The DMQC-2 recommended the real-time application of a salinity drift correction based on the persistence of the last delayed-mode drift correction. The national centers will implement this before mid 2007.
- The development of a reference dataset for Argo continues to be a priority and challenge for the ADMT. The ADMT will continue to coordinate with the NODCs, CCHDO, and the developers of other regional datasets to produce a single, consistent dataset for use by the DMQC operators
- The Second trajectory workshop was held in October 2006. Many problems were identified in the existing trajectory dataset. These will be addressed with the national centers and improved format consistency checks will be implemented at the GDACs during the coming year.

- The Argo Regional Centers (ARCs; formerly referred to as RDACs) are developing at very different rates due to manpower issues. The benefits of the ARCs in the areas of basin-wide deployment coordination, delayed-mode QC consistency, and reference dataset development are starting to be realized. The ARCs are also performing significant outreach activities including an Argo workshop for African nations, producing products for the South Pacific islands, and educational outreach activities in Japan.

The full report of ADMT-7 is under final review and will be available soon at http://www.coriolis.eu.org/cdc/meetings/ARGO-DM-report-7th.pdf.

Remembering Gerard Loaec

IFREMER Colleagues

G. Loaec passed away on the 23rd of October. He was 47 years old. He had been a key actor in France in marine technology, electronics and autonomous instruments. Designer of Marvor and Provor, he was managing at IFREMER the lagrangian and profiling float programs. He was also promoting autonomous instrument technology and enjoyed exchanging with the Argo community.

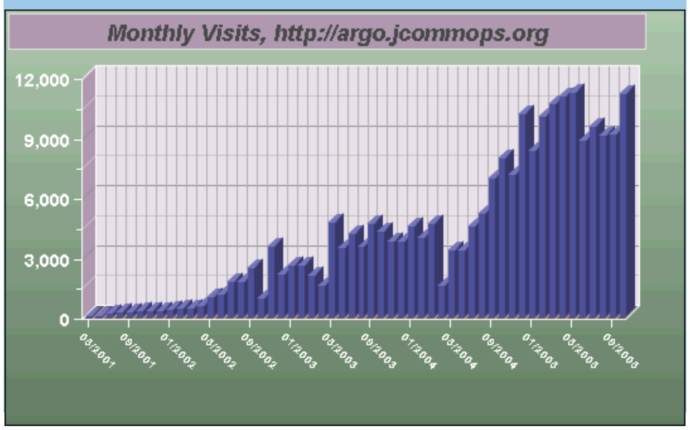
NEWS IN BRIEF

New Argo Logo

Continuing with efforts to transition from ARGO to Argo, there is a new Argo logo available. Please use this new logo on websites, publications, etc. that advertise Argo. You'll find the new logo at:

http://www.argo.ucsd.edu/Frpictures.html

AIC website traffic



Kaharoa deploys 400th float

The Kaharoa, a 28 meter New Zealand research vessel, has deployed over 400 Argo floats in the past three years. The Kaharoa has been vital to helping Argo attain global coverage, especially in less-traveled areas of the ocean like the mid-South Pacific. The funding for these trips are co-sponsored by US Argo and the National Institute of Water and Atmosphere (NIWA) in New Zealand and so represents an important international collaboration that is so important to Argo. To learn more, go to:

http://www.csiro.au/csiro/content/standard/ps2gb,,.html

Contribute to the next newsletter

If you are doing research on Argo floats that you think others would like to read about, let us know. We are always looking for news article submissions for Argonauts. The research can be on float technology, data assimilation, data analysis methods, or other aspects of Argo data. The next newsletter will be published in June, so please sumbit your article idea to argo@ucsd.edu by March 2007. We will let you know by April if your article idea has been accepted for the upcoming newsletter.

Argo in press bibliography

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How to Acknowledge Argo Data

The Argo Steering Team encourages the use of a standard acknowledgement in publications that use Argo data: "*These data were collected and made freely available by the International Argo Project and the national programs that contribute to it. (www.argo.ucsd.edu, argo.jcommops.org). Argo is a pilot program of the Global Ocean Observing System*". People using Argo float data should, as a courtesy, contact the person responsible for the floats used and outline the type of research or analysis that they intend to carry out.

Timetable of Argo-relevant meetings

2007			
January 17 - 19	Qingdao, China	POGO - 8	http://www.ocean-partners.org/meetings.htm
March 7 - 9	Paris, France	AST - 8	http://www-argo.ucsd.edu/FrAST-8.html
July 2 - 13	Perugia, Italy	Argo/GODAE session at IUGG Ocean Sciences	http://www.iugg.org/assemblies/2007/perugia/

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