The Argo Project: Global Observations for Understanding and Prediction of Climate Variability

Report on Progress in FY11, October 1, 2010 – September 30, 2011

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LONG-TERM GOALS

The U.S. component of the international Argo Program (http://www.argo.ucsd.edu), a global array of autonomous profiling floats, is implemented through this award. The present report covers Year 4 of the 5-year “sustained phase” of the project, which builds on progress made under previous awards (Phases 1,2 and 3) for pilot float arrays, data system development, and global implementation.

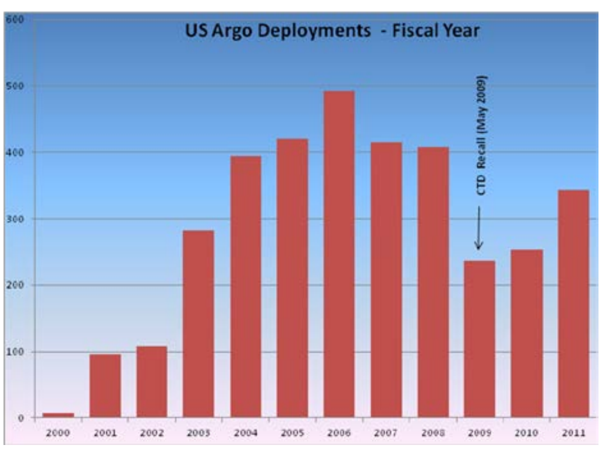
As of November 1, 2007, the international Argo Program, including the US contribution, has met its goal of building a global array of 3000 active profiling CTD floats (Roemmich and Owens, 2000, Roemmich et al, 2001, 2002, Gould et al., 2004), and established a data system to meet the needs of both operational and scientific users for data delivery in real time and delayed mode. In order to maintain the Argo array, it is necessary to replace over 25% (800) of the instruments every year. Argo is a major initiative in oceanography, with research and operational objectives, providing a global dataset for climate science and other applications. It is a pilot project of the Global Ocean Observing System (GOOS).

OBJECTIVES

Phase 1 (9/99 – 9/02) and Phase 2 (7/00 – 6/02) of US Argo provided regional arrays of CTD profiling floats to demonstrate technological capabilities for fabrication and for deployment of float arrays in remote ocean locations (Phase 1) and to demonstrate the capability for manufacture and deployment of large float arrays (Phase 2). Development of the U.S. Argo Data System was carried out to make Argo data publicly available within a day of collection, to apply automated quality control procedures consistent with international Argo practices, and to provide research-quality data in delayed-mode.

Phase 3 of US Argo was a 5-year project (8/01 – 6/06) aimed at full implementation of the US component of Argo. Float deployment rates were increased to more than 400 per year beginning in CY 2004 (Fig 1). Objectives were to achieve 1500 active US Argo floats (50% of the global array), to improve the spatial distribution of floats toward the target of uniform 3^{o} spacing, to increase the mean lifetime of floats to 4 years, to operate the near-real time and delayed-mode data systems consistent with international agreements, and to provide substantial leadership and coordination roles for international Argo.

Phase 4 of US Argo is a follow-on 5-year project (7/06 – 6/11) aimed at improving and sustaining the US component of Argo. Float deployment rates should average around 360 per year (Fig. 1). Objectives are to sustain the array of 1500 active US Argo floats; to further improve the spatial distribution of floats through targeted deployments; to further increase the mean lifetime of floats beyond 4 years; to continue to improve and operate the near-real time and delayed-mode data systems consistent with international agreements; and to provide substantial leadership and coordination roles for international Argo.



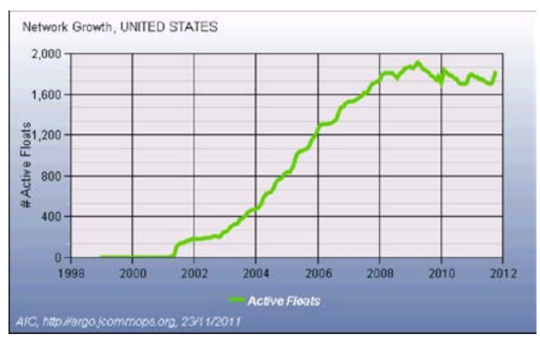


Figure 1: *Yearly deployments of United States Argo Program floats through 30 September 2011, and growth in the number of active US floats (including Argo-equivalent).*

APPROACH AND WORK PLAN

Float production and deployment are accomplished by four facilities – SIO (production and deployment), WHOI (production)/AOML (deployment), UW (assembly and deployment), and PMEL (thorough testing and deployment of commercially manufactured floats). This distributed effort has been designed to safeguard the US contribution to the Argo Program from unforeseen problems at any one of the partner institutions. It also makes Argo success independent of the participation of any individual PI and institution or of any single float design. It allows the large amount of effort to be shared. It encourages individual, technical innovation and enhancement. While the initial focus has been on improving float technical performance, attention of the PIs will increasingly focus on demonstrating the scientific value of Argo.

The data system is also distributed. AOML is the US Argo Data Assembly Center (DAC), responsible for acquiring the float data received by satellite communications, for carrying out real-time quality control, and for distribution of data via the GTS and to the Global Argo Data Assembly Centers. The second step in data management is a semi-automated drift-adjustment of the salinity sensor carried out by each float-providing PI, using nearby high quality CTD data for comparison with float temperature/salinity data (Wong et al, 2003, Owens and Wong, 2009). The final step is individual examination of all profiles by the float-providing PIs, in order to provide high-quality data suitable for research applications.

Approximately 95% of Argo data meet the timeliness target, beingavailable within 24 hours of collectionvia the GTS and/or internet (http://www.usgodae.org/, or http://www.ifremer.fr/coriolis/cdc/argo.htm).

WORK COMPLETED

The goal of 1500 active US Argo floats has been achieved (Fig 2). As of October 2011 there are 1789 active US Argo Program floats, plus 84 US Argo-equivalent instruments that also feed data to the US Argo DAC. Floats are presently being deployed at a rate of ~370 per year. The increase in

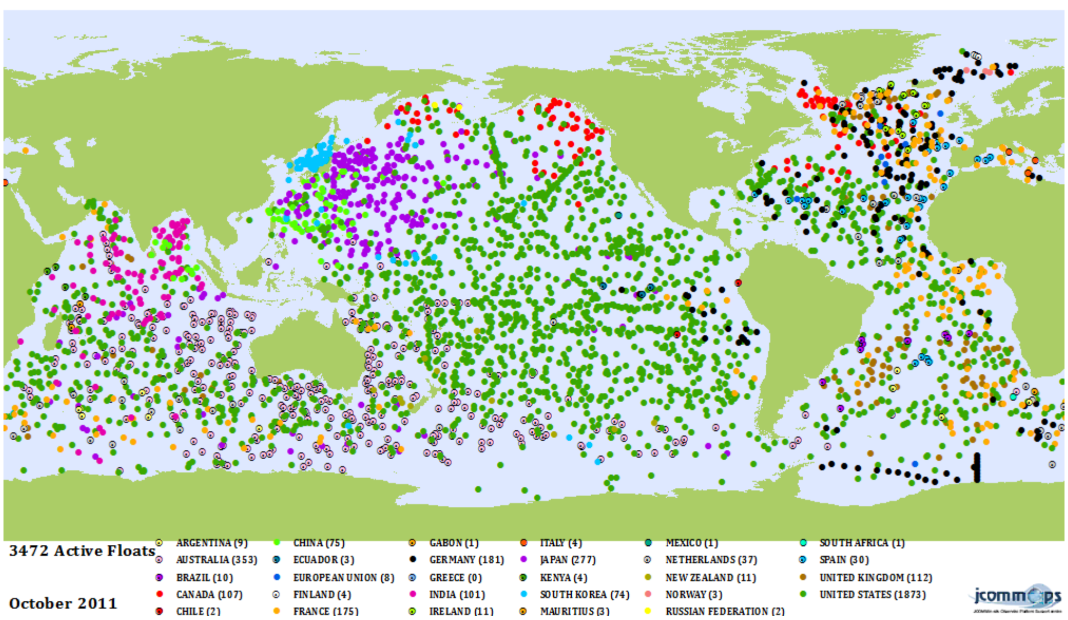


***Figure 2**: The Argo Array as of 31 October 2011. The 1873 active US floats (Green), include 1789 floats funded under the U.S. Argo Program, and 84 other US (Argo-equivalent) floats whose data are released by the PIs via the U.S. Argo Data Assembly Center.*

float deployments that occurred in 2005-2007 was the result of a hiatus in float production in 2001-2003 to address problems leading to high, premature failure rates. Those floats were deployed beginning in 2004. It is not possible to deploy a global array entirely with opportunistic use of research vessels and commercial ships, and so chartered vessels are used to deploy some floats in the South Indian and South Pacific Oceans (description follows). Of the 1764 active US Argo floats, 1142 are in the Southern Hemisphere, reflecting the US commitment to eliminate the northern bias of the international Argo array and achieve uniform global coverage. A notable effort has been the collaboration between US Argo and NIWA (Argo-New Zealand), resulting in more than 980 deployments since 2004 in remote ocean locations by NIWA's R/V Kaharoa.

Good progress has been made in increasing float lifetimes (Fig 3). For floats deployed in 2008, about 75% remain active after 130 cycles. Nearly 90% of 2005 deployments remained active for at least 100 cycles. It is likely that the goal of a 4-year mean lifetime has been met for both APEX and SOLO designs. Floats deployed in 2006-2008 exhibit a higher failure rate due to a problem in CTDs manufactured by Sea-Bird Electronics – see next section. The re-design of the SOLO float (SIO) in order to attain increased lifetime and capabilities has been completed. Prototype SOLO-II floats have been deployed, the first float achieving over 300 cycles in an accelerated testing program. Commercial production of the SOLO-II has begun and the first US purchases of the SOLO-II will occur in 2011. The US is the technology leader in profiling floats and about 90% of floats in the international array are made in the US.

The Argo data system continues to operate well, with the AOML DAC providing near-real time data to the GDACs in NetCDF format consistent with international specifications. Improvements in procedures continue to be implemented as required by the International Argo Data Management Team. A backlog in processing of research-quality delayed-mode data has been substantially reduced and will be eliminated in the coming year. The pressure offset error detected in some WHOI floats in 2008 has been corrected (http://www-argo.ucsd.edu/Acpres_offset2.html). Procedures are being considered for more effective detection of systematic data errors.

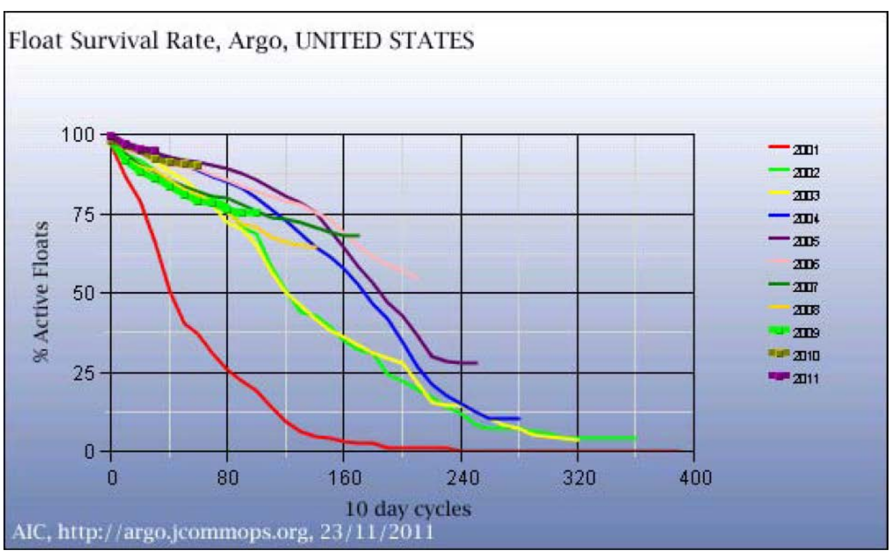


Figure 3: *Float reliability: The average number of cycles for U.S. floats deployed in 2007 is 132, with 72% still active.*

The US Argo consortium plays strong leadership roles in the international Argo project. This includes the international Argo Steering Team Co-Chairman (Dean Roemmich, SIO) and the international Argo Data Management Team Co-Chairman (Mark Ignaszewski, FNMOC) as well as many international panel memberships. US partners provide international leadership in float technology and data management techniques through workshops and training of international colleagues. Argo was the dominant observing system discussed during the OceanObs'09 Conference in Venice in late September of 2009. US partners provide coordination for deployment planning activities in the Pacific, Atlantic, and Southern Oceans. The US is also a leader in utilization of Argo data, organizing international symposia and through sharing of research results and operational capabilities.

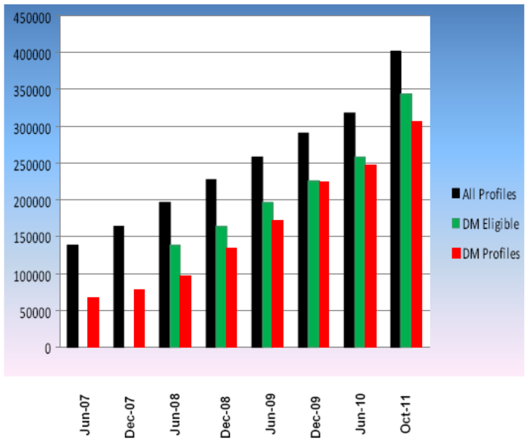
CTD Recall - Update

As was presented in detail in the FY 2009 report, Sea-Bird Electronics issued a recall of all CTDs used on Argo floats worldwide in May 2009. The problem was identified as "micro-leaks" in the pressure transducer, manufactured by Druck Industries as early as 2006, used in the CTDs. Argo float providers have reanalyzed float data for possible indications of this failure that might have been attributed to other causes and these analyses suggest that 30% or more of the CTDs manufactured in 2007-2008 may have this problem. One of the problems in identifying this failure mode is that it may take up to two years to manifest itself. The University of Washington played a critical role in identifying the problem.

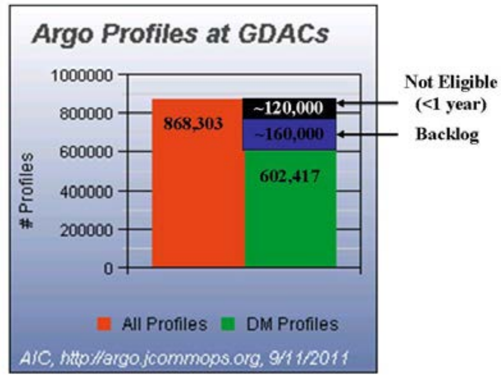
This recall resulted in a hiatus in the shipment of CTDs and, thus, the provision of profiling floats by the instrument manufacturers. The CTD recall significantly impacted on the deployment of floats in 2009 and 2010 (Fig. 1). The recall of CTDs purchased in 2008 and 2009 is complete and floats are being manufactured with new sensors. There is a backlog in new CTDs, however, the U.S. was able to procure sufficient instruments to meet its annual deployment target in 2011. New pressure sensors using a different manufacturing process are being provided by Druck Industries to the CTD manufacturer, who is testing each sensor in-house. There remains the possibility that the new process may introduce new defects so the testing process is proceeding very deliberately.

RESULTS

A sparse global Argo array was achieved in 2004, and so there are now nearly 8 years of continuous global coverage. Today Argo is providing over 110,000 high quality profiles of temperature and salinity annually, most to 2,000 meters, homogeneously distributed over the global ocean, without seasonal bias. Beginning in 2007, more than 100,000 profiles a year are being received with 91% being distributed on the GTS within 24 hours of collection (U.S. – 96% within 24 hours), and approximate 96% available within 72 hours via the GTS and Internet. Figure 4(a) shows the growth of U.S. Argo Program profiles available at the GDACs since June 2007 and the status of the Delayed-Mode Quality Control processing as of October 2011.



(a) U.S. Argo Program profiles at the GDACs from June 2007 through October 2011.



(b) Status of Global Argo Delayed-Mode Quality Control (DMQC) processing as of September 2011..

Figure 4: *Argo Profiles at the Global Data Assembly Centers (GDACs)*

Because of the need to obtain extended data records to assess instrument drift, profiles are considered "eligible for DMQC when a one-year record has been obtained from the instrument. As of this report, approximately 80% of the total number of profiles eligible for DMQC processing have been processed. The U.S. Argo Program has processed approximately 89% of its eligible profiles. DMQC processing is a labor intensive process. Three different software routines have been published and been used to process profiles in an automated mode, however, a large fraction (20% or so) have to be manually inspected to determine if a signal represents sensor drift or represents changing water masses. Assessing water mass changes requires inspection of the T-S profiles, an understanding of the dynamics of the region, and often access to other datasets such as high-quality, shipboard CTDs. Figure 4(b) presents the status of DMQC processing for the global Argo Program.

One major impact of Argo has been in the amount of data now being received from the Southern Hemisphere, which constitutes about 60% of the global ocean. A number of factors, many related to the geographic isolation of the Southern Ocean and lack of population in the southern hemisphere contribute to the lack of data from the Southern Hemisphere. Opportunities for the collection of routine observations are limited to a very few, major shipping routes in the tropics and subtropics. Observations in high latitudes are generally limited to research programs occurring at irregular frequencies and Antarctic research and supply vessels which transit specific routes. Very few observations are taken during the Austral winter, with those that are, taken north of 30º S.

Table 1 presents all temperature profile data, including Argo and non-Argo, received by the Coriolis Operational Oceanography Center Data Service in Brest, France which is also one of the Argo GDACs (the other being at the Fleet Numerical Meteorology and Oceanography Center in Monterey, California). The data are from December (Austral summer) and July (Austral winter) 2010, months with an equal number of days. The number of Argo profiles delivered is over 4,700 in both periods, relatively uniformly distributed except south of 60º S, the region subject to seasonal ice cover (Argo floats can operate under ice, storing profiles for later transmission). There are very few non-Argo profiles south of 30º S in the Austral winter. This means that all operational ocean models would lack any *in situ* temperature profile data from a vast portion of the ocean during the Austral winter if not for Argo data. Even in the Austral summer, there would only be around 30 temperatures profiles a day, on average, from the Southern Ocean if not for Argo.

Temperature Profile Data Received at the Coriolis (France) Data Center

(2010 Total: Argo – 110,777; XBT + CTD – 36,508)

Location/Month (2010)	XBT plus CTD Profiles	Argo Profiles
Global/July	2,883	8,835
Global/December	1.969	9,899
Southern Hemisphere/July (Austral Winter)	600	4,779
Southern Hemisphere/December (Austral Summer)	848*	5,370
Including and South of 30º S (July)	145	2,642**
Including and South of 30º S (December)	368*	2,989

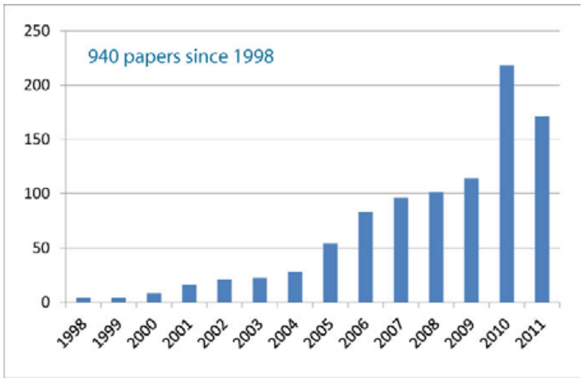
* - CTD profiles are primarily obtained by research vessels and there is a time delay in their receipt by Data Centers.

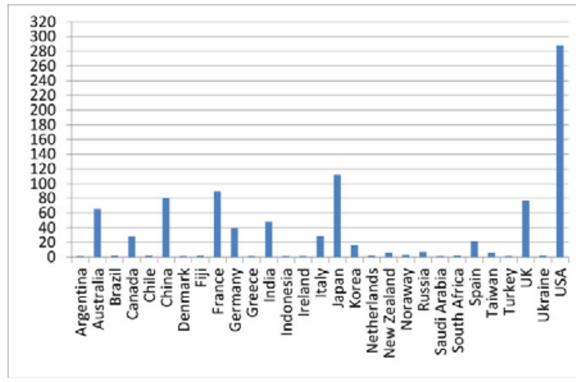
**- Floats in regions subject to ice cover are equipped with ice sensing algorithms.

Table 1: *Profiles received at the Coriolis Data Service*

Globally Argo provides approximately three times as many temperature profiles in a year as XBTs plus CTDs received at Coriolis. The major portion of the XBT profiles are to 750 meters while CTD data often goes to 2,000 meters and deeper and includes salinity data. With only 6 years of near-global and global coverage, as of 31 December 2010, Argo data provide ~21% of all the temperature profiles from the Southern Hemisphere in the World Ocean Database, ~40% of all the salinity profiles and ~57% of all the salinity profiles below 500 meters in the Southern Hemisphere.

At least 13 operational centers around the world are using Argo data on a routine basis (http://www.argo.ucsd.edu/Use_by_Operational.html). Operational applications include ocean state estimation, short-term ocean forecasting, atmosphere/ocean seasonal-to-interannual prediction, and coupled climate modeling. Ocean state estimation has an increasing number of valuable uses including climate monitoring, forecast initialization, fisheries and ecosystem modeling, provision of boundary conditions for regional and coastal modeling, and others. Operational centers have noted that the use of Argo data has had positive impacts in all the above applications.





(a) (b)

Figure 5: *Research publications on Argo floats and/or using Argo data.*

Figure 5 shows (a) the number of research publications per year and (b) the national origin of the lead authors of papers. Approximately 940 research publications from 29 countries have resulted so far from Argo data, including 171 in 2011 (through October) alone. The growth in publications is dramatic since reasonable, global coverage was attained in the 2004-2006 period. These publications span a wide variety of research topics from small spatial-scale/short time-scale phenomena such tropical cyclone intensification, to studies of mesoscale eddies, to large-scale phenomena such as water mass variability and basin-scale ocean circulation. Argo is among the most heavily used resources in modern oceanography, comparable for example in terms of publications per year to satellite altimetry.

The Argo array is providing unprecedented views of the evolving physical state of the ocean. It reveals the physical processes that balance the large-scale heat and freshwater budgets of the ocean and provides a crucial dataset for initialization of and assimilation in seasonal-to-decadal forecast models. The 6-year global dataset provides a baseline of the present climate-state of the oceans against which future variability can be observed by a sustained Argo array. With 6-years of data we have, for the first time, a stable estimate of the mean of the global ocean over a fixed period of time.

With all of the papers using Argo data being published, highlighting any research result is challenging. The 2010 NOPP Report highlighted a paper illustrating the usefulness of a truly global array in revealing the physical processes that balance the large-scale heat and freshwater budgets of the ocean, thus providing a crucial dataset for initialization of and assimilation in seasonal-to-decadal forecast models. The following work suggests that observations from profiling floats that collect CTD data throughout the annual cycle, when the polar oceans are ice covered and when they are not, can be an important tool in understanding the interactions of the ocean, atmosphere, and sea ice in the high-latitude regions.

Wong, A. P. S. and S. C. Riser, 2011: Profiling Float Observations of the Upper Ocean Under Sea Ice off the Wilkes Land Coast of Antarctica. *Journal of Physical Oceanography*, **41,** 1102-1115, http://dx.doi.org/10.1175/2011JPO4516.1

The advent of profiling float technology has enabled unprecedented year-round observation of the upper 2000 m of the global ocean. However, float observations from regions covered by sea ice have been sparse. Early attempts to observe the ice-covered ocean by profiling floats showed high instrument mortality rate, either because of crushing between ice floes while at the sea surface or hitting the bottom of the ice during ascent. Temperature criteria were subsequently explored as a means to detect the presence of sea ice and to instruct the float to abort its ascent to the sea surface. Such an ice-sensing algorithm was first used on profiling floats in the Weddell Sea in 2002, with instrument survival rate reported to be about 80% through the first winter in the ocean, more than a twofold increase from cases without the ice-sensing algorithm.

The University of Washington (UW) deployed 19 profiling floats programmed with an ice-avoidance algorithm along the East Antarctic coast between 80º and 130ºE, an area historically referred to as the Wilkes Land coast (Fig. 6). These 19 profiling floats were deployed during cruises in February 2007 and September–October. As of April 2010, after having been in the ocean for three austral winters, 14 of these floats remained active, yielding a survival rate of 74% after 2.5 years. This work describes the data collected by the 19 profiling floats along the Wilkes Land coast from the time of their deployment through April of 2010. These data represent the first direct measurements of the annual cycle of the upper ocean under a sea ice cover in this region of the East Antarctic.

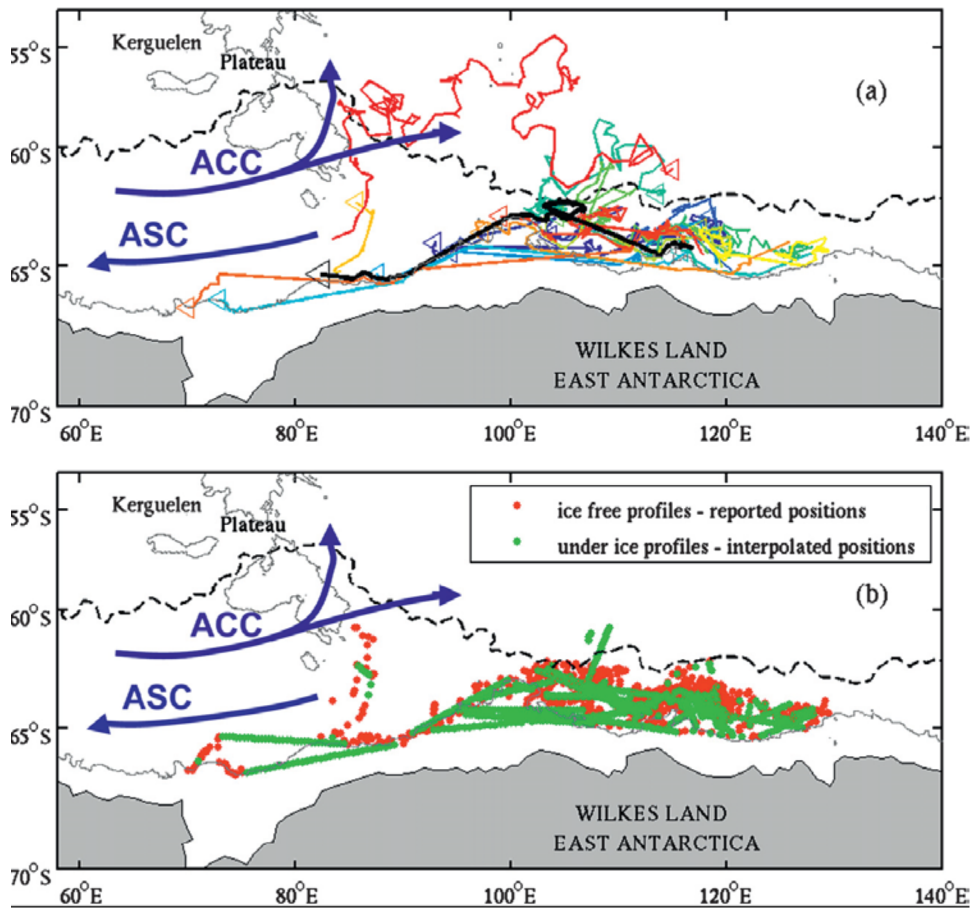


Figure 6: *(a) Estimated trajectories of the 19 profiling floats used in this study. Triangles mark last position in each trajectory as of April 2010. The path of one float (WMO ID 2900126) is highlighted in black. (b) Positions of the 1964 CTD profiles used in this study, collected between February 2007 and April 2010. The gray contour line marks the 2000-m isobath. The black dashed line marks the approximate position of the maximum winter sea ice edge. Schematic flow of ACC and ASC are also shown.*

Summer in Antarctica is short lived. The percentage of under-ice profiles over the course of a year indicates that, in this region, summer lasts only 3 months, from January to March. Most sea ice growth occurs in autumn during the months from April to June, with the ice cover remaining above 90% from July to October. Sea ice begins to retreat in November, with most of the spring thaw occurring in December. Thus, in this region, the rate of sea ice decay (occurring over 2 months) is greater than the rate of sea ice growth (which lasts 7 months). The seasonal evolution of the mixed layer in the Antarctic zone is naturally related to the seasonal cycle of sea ice growth and decay. Figure 7 presents the time series of measurements from float WMO ID 2900126 (Fig. 6) and illustrates typical temporal evolution of the mixed layer under sea ice.

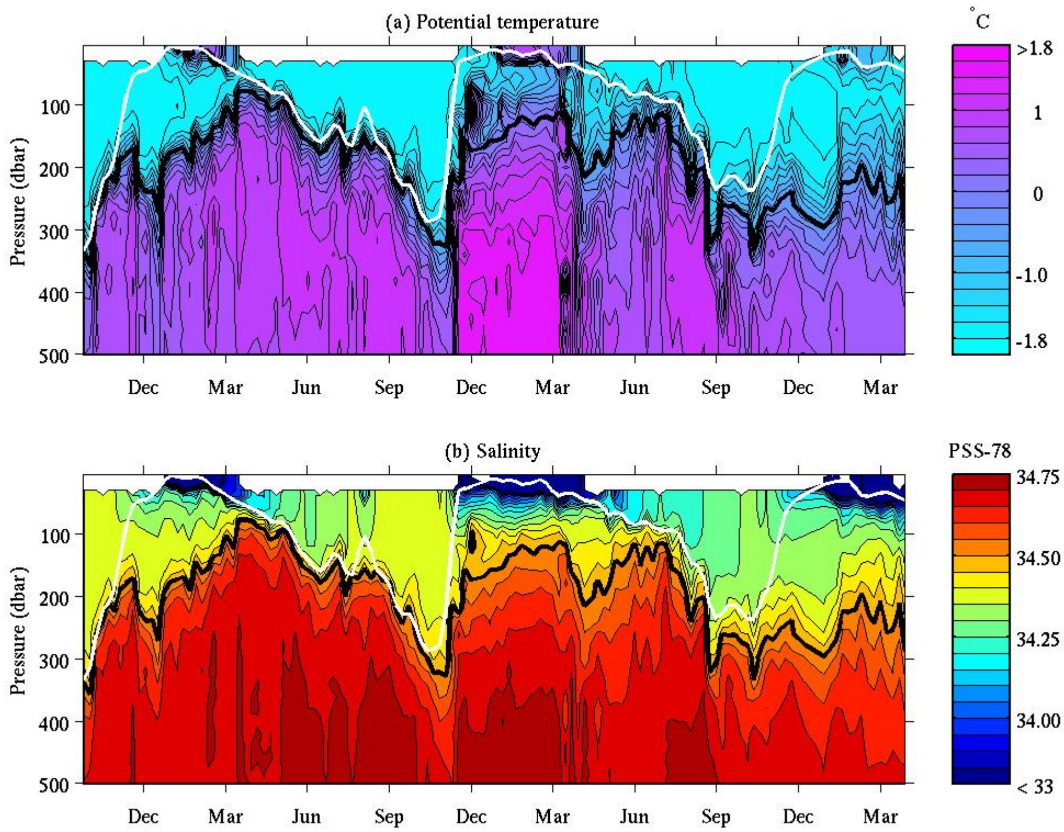


Figure 7: *Time series of measurements from the top 500 dbar from the float with WMO ID 2900126 (track in Fig. 1). Measurements were taken from October 2007 to April 2010. Missing data in the top 30 dbar indicate periods under sea ice. The white solid line marks approximate position of the mixed layer base. The black solid line is the 34.5 isohaline, which marks the approximate top of the permanent pycnocline.*

This work demonstrates that a quantitative winter mixed layer model can provide a means to use in situ hydrographic data to estimate flux terms such as the winter ocean heat loss to the atmosphere in the sea ice zone. These air–sea flux variables are traditionally difficult to estimate, especially in challenging environments such as the seasonal ice zone around Antarctica. Any basic advances in improving such estimates will help to improve the representations of these quantities in global climate models.

The Wilkes Land coast, an open ocean region where the presence of Circumpolar Deep Water results in a warm and salty permanent pycnocline, may be representative of the sea ice zone in many locations around Antarctica. These are environments where entrainment can introduce heat and salt into the winter mixed layer. Entrainment heat flux drives a negative feedback: large entrainment that will erode the pycnocline, allowing open ocean convection via brine rejection, whereas the upward heat flux associated with such convection can melt the sea ice cover, leading to polynya formation. Similar studies around Antarctica can provide insights into potential likely spots for the formation of these sensible heat polynyas and therefore deep water ventilation.

This dataset confirmed several other observations regarding differences between the Arctic and the Antarctic. Sea ice decay is faster than sea ice growth around Antarctica, whereas the opposite is generally true in the Arctic. This contrast suggests fundamental differences in the temperature and salinity characteristics in the two polar oceans. The permanent pycnocline in the Southern Ocean is generally weaker than that in the Arctic Ocean, because of the relatively low freshwater input (and thus relatively high salinity) of surface water around Antarctica. Other work has noted that the rapid sea ice decay around Antarctica could partly be explained by the relatively weak pycnocline, which allows easier vertical heat flux from pycnocline water into the surface water through Ekman pumping and cross-pycnocline mixing. The oceanic heat budget in the Arctic is presumably quite different from the winter model presented in this study.

IMPACT, APPLICATIONS, and TRANSITIONS

National Security

The US Navy has a strong interest in accurate estimates and forecasts of the physical state of the ocean and the coupled air-sea system, because of the obvious impacts of wind, waves, currents, and temperature on virtually all aspects of naval operations. The Navy has experimental ocean state estimation and forecasting efforts, using both regional and global models, for which Argo provides a central contribution for ocean data assimilation. The Navy interest is further expressed by the hosting of one of the two Global Argo Data Centers (at the Naval Research Laboratory, Monterey), by NAVOCEANO participation in International Argo through the use of the Argo Data Management System for processing and distribution of data thereby making the data available to users worldwide, and by deploying floats from Naval vessels, most recently, the deployment of U.K. and Australian floats in the NW Indian Ocean.. Phase 1 of US Argo was supported by ONR.

Economic Development

GODAE OceanView: GODAE OceanView follows on from an experiment (Global Ocean Data Assimilation Experiment – GODAE) towards a long-term International Programme for Ocean Analysis and Forecasting. Argo plays a special role in GODAE OceanView because it is the only globally repeating subsurface ocean dataset, and is strongly complementary to its satellite counterparts. GODAE OceanView will provide coordination and leadership in: “(1) consolidating and improving global and regional analysis and forecasting systems (physics); (2) the progressive development and scientific testing of the next generation of systems covering biogeochemical and ecosystems and extending from the open ocean into the shelf sea and coastal waters; (3) the exploitation of this capability in other applications (weather forecasting, seasonal and decadal prediction, climate change detection and its coastal impacts, etc); and (4) assessing the contribution of the various components of the observing system and scientific guidance for improved design and implementation of the ocean observing system” (http://www.godae.org/oceanview.html) .

Quality of Life

Argo is central to an unprecedented capability for global assessment of the evolving climate state of the ocean. The thermal structure of the upper ocean controls the temperature of the lower atmosphere, and is the primary variable defining the physical environment of ocean ecosystems. Over 80% of the increased heat content due to global warming of the air/sea/ice climate system in the past 50 years occurred in the oceans (Levitus *et al.*, 2001). Climate stresses on ocean ecosystems have serious consequences, and sometimes dramatic ones, such as coral reef bleaching. Conversely the ocean can impact the atmosphere even on short time-scales such as through intensification of tropical cyclones. In the future, the impacts of a varying climate on the health of the seas and coastal ecosystems will become an increasingly important aspect of resource management. The unique niche of the Argo array is to provide global broadscale observations of the upper ocean. Science Education

Although the Argo project is still very new, it is proving to be an attractive educational asset for secondary, tertiary, and post-graduate levels. For secondary education, the web-based and real-time nature of the Argo data system, as well as Argo's strong climate-relevance, have been keys to engaging student interest in the oceans. Our consortium participates in a Pacific Island GOOS-sponsored initiative called SEREAD, (http://www.argo.ucsd.edu/FrEducational_use.html) that uses Argo data in existing secondary science curricula in Pacific Island countries. In post-graduate education, Argo is already providing primary data for dissertation research of graduate students in the U.S. and other countries. Central to all educational uses of Argo data is easy access and display of the data in gridded formats. US Argo has developed a PC-based Global Marine Atlas (http://www.argo.ucsd.edu/Marine_Atlas.html) allowing users to produce graphical displays of Argo data, including maps, vertical sections, and time-series plots.

Between the Real-Time and Delayed-Mode Quality Control Centers and the two Global Data Assembly Centers are the Argo Regional Data Assembly Centers (RDACs). These centers focus on (1) providing local expertise to the analysis of Argo data and (2) integrating Argo data with other data to produce integrative products for regional applications. These centers tend to be organized around ocean basins. The South Atlantic RDAC (SARDAC) is operated by U.S. Argo Program through the Atlantic Oceanographic and Meteorological Laboratory. Beginning in 2005, SARDAC has implemented a number of data analysis workshops (Cape Town, South Africa 2005; Accra, Ghana 2006; Lagos, Nigeria 2009) and one technical workshop (Accra, Ghana 2008) in Africa. Since 2008, these projects have been implemented in conjunction with the U.S. Navy, Africa Partnership Station Program.

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PUBLICATIONS

See http://www.argo.ucsd.edu/Bibliography.html.

Over 940 research publications have resulted so far from Argo data (see above link), including 220 in 2010 alone. These publications span a wide variety of research topics from small spatial-scale/short time-scale phenomena such tropical cyclone intensification, to studies of mesoscale eddies, to large-scale phenomena such as water mass variability, basin-scale ocean circulation, and climate change. Almost none of this work would have been possible without the contributions of US Argo to building, sustaining, and utilizing the global Argo array.

US Argo Consortium relevant web sites:

Argo Steering Team home page http://www.argo.ucsd.edu
Argo Information Center http://argo.jcommops.org
Scripps Institution of Oceanography http://sio-argo.ucsd.edu
Woods Hole Oceanographic Institution http://ursa.whoi.edu/~argo/
University of Washington http://flux.ocean.washington.edu/argo/
NOAA PMEL http://floats.pmel.noaa.gov
NOAA AOML(US DAC and South Atlantic Argo Regional Center)
http://www.aoml.noaa.gov/phod/argo/index.php

US GDAC http://www.usgodae.org