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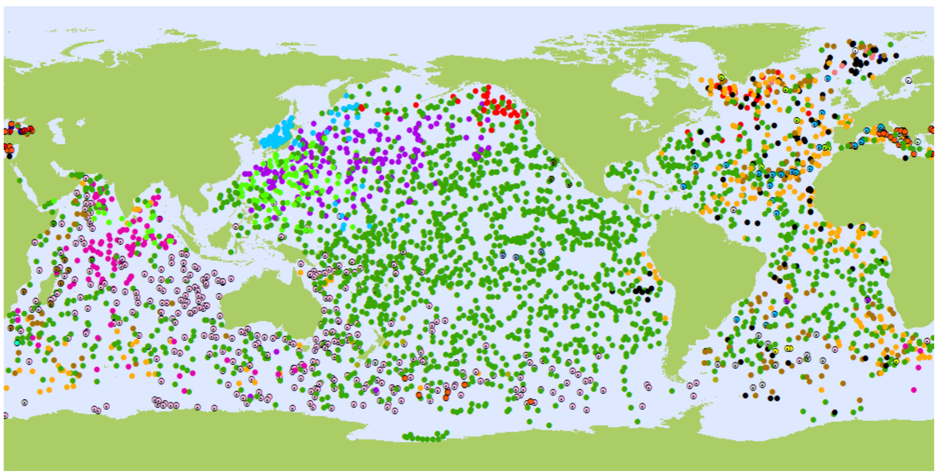
Argonautics

Newsletter of the international Argo project



3752 Active Floats — **November 2014**

ARGENTINA (4)
AUSTRALIA (355)
BRAZIL (2)
BULGARIA (2)
FINLAND (6)
FRANCE (252)
GABON (1)
GERMANY (137)
JAPAN (189)
KENYA (1)
SOUTH KOREA (78)
LEBANON (0)
NORWAY (9)
SOUTH AFRICA (1)
SPAIN (24)
SRI LANKA (0)
CANADA (56)
CHINA (201)
ECUADOR (3)
EUROPEAN UNION (6)
GREECE (4)
INDIA (107)
IRELAND (6)
ITALY (38)
MAURITIUS (7)
MEXICO (3)
NETHERLANDS (14)
NEW ZEALAND (10)
TURKEY (5)
UNITED KINGDOM (151)
UNITED STATES (2080)

Notes from the Editor

It has been over two years since the last newsletter in August 2012. Several important Argo events have occurred in that time including the 4th Argo Science Workshop, the publication of a new brochure, the deployment of Deep Argo prototype floats, the addition of new sensors, the creation and implementation of new file formats, etc. In addition to these special events, the Argo Program has continued to review its current data and how the quality can be improved. Several educational outreach activities have been improved or developed during this time as well. In fact, one can now 'adopt a float' on the Google Earth Argo layer and follow its progress and the data it sends back.

This past spring, the Canadian Argo Program welcomed the Argo Steering Team to Halifax for the fifteenth Argo Steering Team meeting. It was the first meeting where vendors were invited to participate as a one day experiment to improve coordination and communication within the Argo community. The full meeting report is available at: http://www.argo.ucsd.edu/iast15.pdf.

Several Deep Argo float prototypes have been deployed in different locations around the globe. Some of these floats have been equipped with the new SBE61 CTD which is designed to go down to 6000m. See the articles on the Deep Arvor, Deep NINJA, and Deep SOLO in this Newsletter. For more information on the SBE61 CTD, see the cruise report for the *R/V Tangaroa* in this Newsletter.

There are several items related to educational outreach in this Newsletter. One article is about the new teaching modules being introduced in the SEREAD program. Another article is about the 'Mon Ocean et Moi' website developed in France to highlight BGC-Argo floats. During the Deep Solo cruise aboard the *R/V Tangaroa*, the LEARNZ organization tagged along for a field trip and produced some great videos on research vessels, cruises, CTDs, and Argo floats.

The number of Argo-related papers published this year is over 225, bringing the total number of papers published using Argo data since 1998 to over 1700. To help demonstrate the impact of Argo on the education of future scientists, I have added a bibliography comprised of Ph.D. theses using Argo data. If you know of any such theses, or databases containing theses, please send argo@ucsd.edu an e-mail.

A couple of other noteworthy news items occurred since the last newsletter. First, the IPCC AR5 report was released and it highlighted the use of Argo data to reduce uncertainties in ocean heat content estimates. Second, the NY Times declared Argo to be one of the "scientific triumphs of the age".

Additional sensors have been added to floats, causing increased complexity in the Argo data stream due to things like additional variables, additional sampling levels, additional equations, etc. For this reason, it was decided to split the Argo files into core-Argo files and b-Argo files. For more details, see the article in this Newsletter. Accompanying this article is an explanation of the updated file formats.

Finding ways to deploy floats on dedicated ships is becoming more important as the array needs refilling in remote and varied locations. To help with this, there is now a ship coordinator at JCOMMOPS named Martin Kramp. A partnership has been made between Pro Large and JCOMMOPs to offer charter options for float deployment, including the *Lady Amber*, which was upgraded, and other ships. Further work is being done with the sailing community and NGOs to explore deployment opportunities. If you have ideas or questions, please contact Marin Kramp at mkramp@jcommops.org.

A little over one year ago, in August 2013, Howard Freeland was appointed as the Argo Director. He is volunteering at roughly 50% time and is hosted by the Institute of Ocean Sciences, Canada with the Argo Program supporting his travel and operating budget. He agreed to serve for two years from 1st August, 2013 - thanks Howard!

Megan Scanderbeg

Deep Argo Development Voyage

P. Sutton, NIWA, NZ, [Philip.Sutton@niwa.co.nz] *D. Murphy, Sea-Bird Electronics, USA, [dmurphy@seabird.com]*
D. Roemmich, Scripps Institution of Oceanography, USA, [droemmich@ucsd.edu]

A Deep Argo development voyage was completed between 16 and 25 June 2014 on NIWA's (New Zealand's) *R/V Tangaroa*. The principal aims of the voyage were to deploy two Deep SOLO prototypes and undertake full-depth CTD casts for comparisons between SBE-61 CTD pressure, temperature and salinity and the shipboard SBE-911plus data.

Deep SOLO with externally-mounted SBE-61 CTD

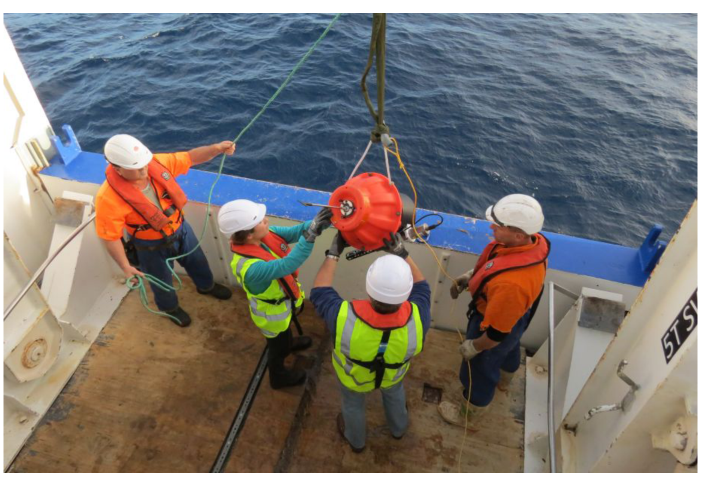
The voyage was collaborative between institutes and nations, with participants from NIWA and the University of Auckland (New Zealand), CSIRO (Australia), SIO, NOAA and Sea-Bird Electronics (USA).

The voyage targeted an area east of New Zealand and the Kermadec Ridge (~177°W, 36°S). The area was chosen to be over an abyssal plain approximately 5500m deep and to have relatively weak flows.

The prototype Deep SOLO floats were built at SIO. They are rated to 6000m, and are based around a 33 cm glass sphere with an externally-mounted SBE-61 CTD. Two prototype Deep SOLOs were deployed; one was supplied by SIO, while the second was co-owned by SIO and NIWA.

An educational outreach organisation (LEARNZ: http://www.learnz.org.nz/) was funded by NOAA to participate in the voyage making a 'virtual fieldtrip' for school uptake. The educational outreach was a success, with 102 classes enrolled, equating to 2399 students from 83 schools. There were over 1200 video viewings from the LEARNZ website. Perhaps of more value are the high quality images and videos freely available for use: http://www.learnz.org.nz/argofloats142/argo-floats-tracking-pulse-world-oceans.

Both prototype Deep SOLOs are operating on a rapid cycling regime and have already completed about 50 profiles, providing valuable engineering data. The floats have drifted slightly east, away from the Deep Western Boundary Current. Data from the floats can be found at:
http://sio-argo.ucsd.edu/5902341c.html
http://sio-argo.ucsd.edu/5902342c.html

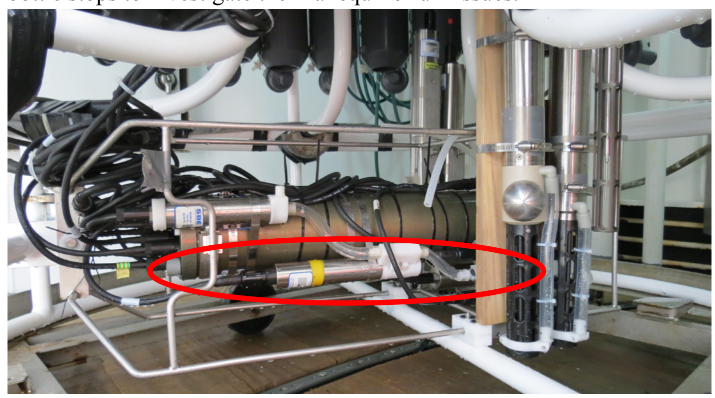


Deep SOLO deployment Photo courtesy of LEARNZ

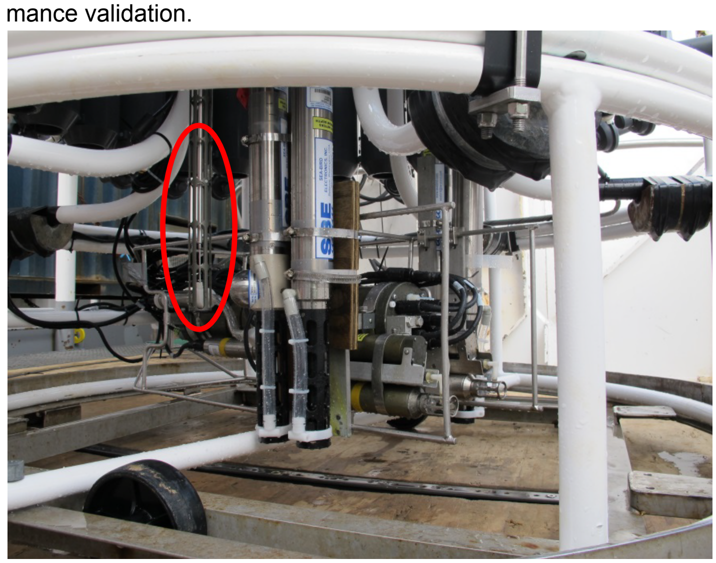
There are salinity offsets for both deep floats. 6003 CTD salinity is 0.005-0.006 saltier than shipboard CTD at pressure > 2000 dbar. 6002 is 0.04 too fresh- the reason for this large offset is currently unknown.

SBE-61 sensor testing and cross-calibration

The eventual target accuracies for the SBE-61 in P, T, S are 3 dbar, 0.001°C, and 0.002, respectively. A key aim of the voyage was to compare SBE-61 data with data from the shipboard CTD (SBE-911plus) and bottle data. Two SBE-61 CTDs were integrated in the shipboard system with an additional SBE-61 internally recording, the shipboard CTD was freshly calibrated and operated dual sensors (SBE-3 temperature, SBE-4 conductivity) and a SBE-35 reference thermometer was also mounted to the frame. 12 full-depth casts with water samples were performed to >5500 m depth at 177°W, 36°S, with different soak times being used at bottle stops to investigate thermal equilibrium issues.



SBE-61 CTD mounted alongside the shipboard CTD for performance validation.



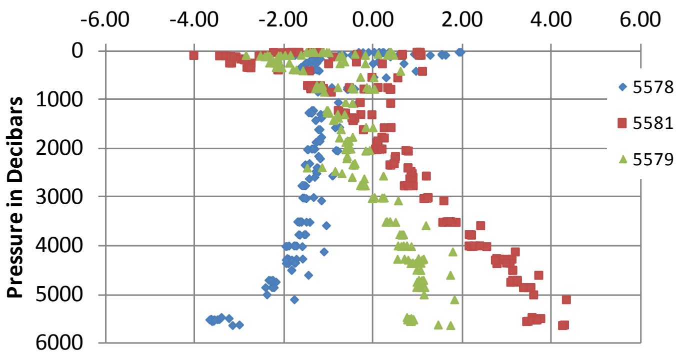
SBE 35 reference thermometer was also mounted.

Provisional results from the intercomparison are:

1) **Pressure:** Difference is ± 4.5 dbar (no offset has been applied to account for the 50 cm vertical spacing difference).

Thermal equilibrium of the strain gauge was found to have a significant impact on the error. This effect was exacerbated by the 1 m/s ascent rate of the shipboard CTD and should be less of an issue for the planned Argo profiling rate of 10-20 cm/s. The long-soak casts showed smaller errors; after 40 minutes the pressure sensor was equilibriated at 2500 dbar, but still coming into equilibrium at 4300 dbar.

Pressure Difference (dbar) SBE 61 - SBE 9



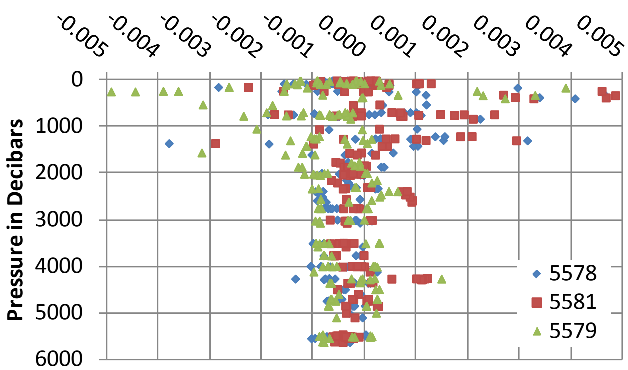
The pressure accuracy may possible be improved with mechanical design changes- but these may change the length and mass of the SBE 61. Mathematical correction may be possible, but would add complexity to the calculation and noise to the results.

2) **Temperature:** Two comparisons were carried out. The first with the primary sensor on the shipboard CTD and the second with an SBE-35 Deep Ocean Standards Thermometer.

   a) The shipboard primary. Agreement below 2000 dbar is ± 0.001 with the exception of 5 points out of 185.

The SBE-61 is cooler than the SBE-9 due to viscous heating of the SBE-3 probe in 30 ml/s pumped flow (the SBE-61 pumps at 8-10 ml/s).

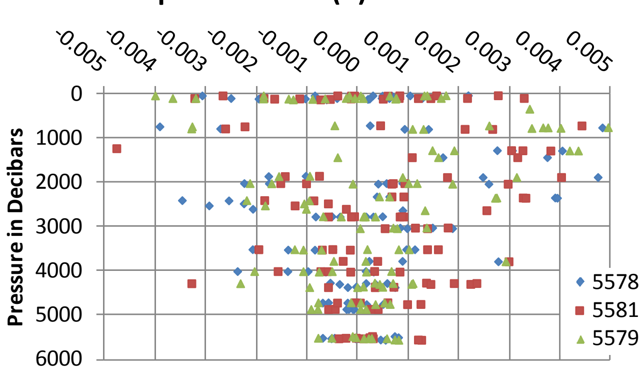
Temperature Difference (C) SBE 61 - SBE 9



   b) The SBE-35 Deep Ocean Standards Thermometer. Agreement below 4500 dbar is ± 0.001 with the exception of 3 points out of 142.

The intercomparison with the SBE-35 is noisier because of the physical location of the probes.

Temperature Diff (C) SBE 61 - SBE 35

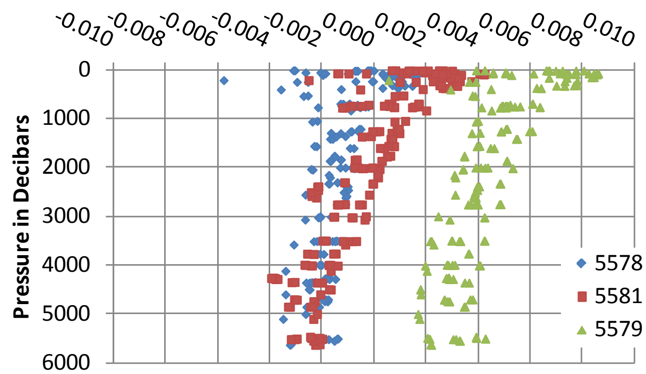


3) **Salinity:** salinity samples were collected for laboratory analysis by 3 labs: NIWA (shipboard), SBE (Seattle) and CSIRO. The average difference between the shipboard primary and SBE discrete was -0.0002 with a standard deviation of 0.0010 (N=123, 2 outliers removed). The average difference between the SBE discrete and the NIWA samples was 0.0009 with a standard deviation of 0.0010 (N=75). Thus the shipboard primary is consistent with the discrete measurements.

There is agreement between the SBE-61 and discrete samples below 2000 dbar. SBE-61s 5578 and 5581 are fresh 0.0 to -0.004 while 5579 is salty to within 0.001 to 0.005. The comparison with the shipboard SBE-9 is offset due to the temperature difference between the SBE-61 and SBE-9.

There is also an issue with conductivity cell drift. Experimental cells are exhibiting positive, negative and very small drift. While results are encouraging, they are not entirely satisfying.

Salinity Difference (psu) SBE 61 - SBE 9

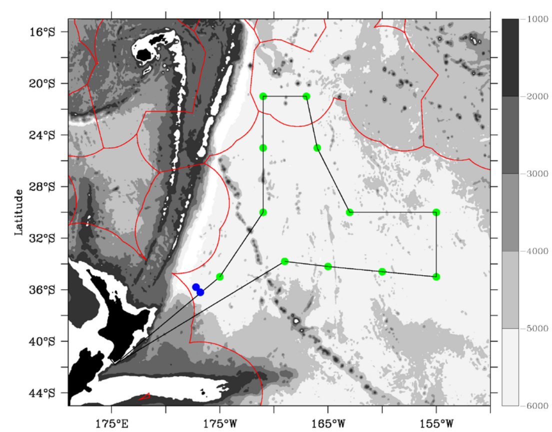


Sensor summary:

- Temperature: meeting the accuracy goals
- Pressure
  - Close to desired accuracy but some room for improvement
  - Improve transient temperature error through mechanical design work
  - Further work on accuracy via calibration process
- Conductivity: continue experiments on cell drift
- Salinity: close to desired accuracy, refinements in pressure and conductivity may yield improvements

Future Plans

There are tentative plans for a Deep Argo float deployment in the SW Pacific Basin in August 2015. It will use the NIWA vessel *R/V Kaharoa* and be a collaboration between US, NZ and Australian Argo. The aim will be to recover the two Deep SOLO floats deployed in 2014 and deploy 12 Deep SOLO and Deep APEX floats.



Changes to the formats and names of Argo data files

The profile, meta and trajectory file formats all changed enough recently that a new version number was assigned - V3. DACs are in various stages of transitioning to the new version 3 and higher formats for all three file types and various formats will be present on the GDACs for some time. For more detailed information on these changes, visit the Data FAQ page at: http://www.argo.ucsd.edu/Data_FAQ.html website. A short synopsis is provided below by file type.

PROFILE FILES

The major change in the version 3 and higher profile files is the ability to accommodate multiple profiles from a single cycle. As floats begin performing increasingly complex missions, it is necessary to be able to differentiate the vertical sampling scheme for the various parameters. For example, some floats collect high resolution near-surface observations. The number of profiles is indicated by the N_PROF dimension where the N_PROF = 1 profile must have the primary sampling profile. Other profiles with different vertical sampling schemes will have N_PROF > 1. A new variable, VERTICAL_SAMPLING_SCHEME, differentiates the various vertical sampling schemes. If you are interested only in the CTD profile, just use the N_PROF = 1 dimension.

TRAJECTORY FILES

The version 3 and higher trajectory files include more information about the events during a cycle and the times associated with these events. There is now a MEASUREMENT_CODE variable that indicates what type of measurement is occurring and when it takes place during the cycle. The codes are explained in Reference Table 15 of the User's Manual. There are a few other new timing variables to fully describe the float's cycle timing information and status.

There is a two-file system now for trajectory files - there will be real time (R) and delayed mode (D) traj files. The real time files will be produced by the DACs and contain only real time data. The delayed mode files will be produced by scientists and will contain both real time and delayed mode data. NOTE: it is possible that a float may have both an R and a D traj file and that both must be looked at to get the entire trajectory information for that float.

META FILES

The version 3 and higher meta files contain two new variables to help document a float's mission and possible change in mission during the float's lifetime. The new variables are CONFIG_MISSION_NUMBER and CONFIG_PARAMETER_VALUE. There is also an added N_SENSOR dimension indicating the number of sensors a float carries as well as other float parameters to help identify which sensor is measuring which parameter.

Core-, B- and M-Argo files

The V3.1 profile and trajectory files are split into core, B- and M-Argo files. The core-Argo profile and trajectory files will look very similar to older file versions on the GDACs. In fact, if the float only has a CTD, there is no difference between the old file and the new core-Argo profile and trajectory files. The names of the files remain the same and the parameters within them remain the same.

B-files will include any Argo parameter except temperature, salinity and, if applicable, conductivity. They will also include any intermediate parameters that are necessary to calculate ocean state parameters.

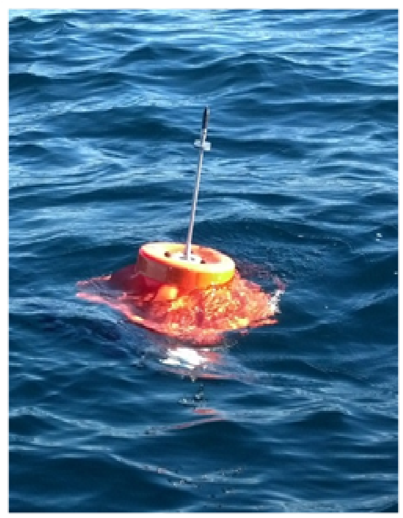
M-files will contain all ocean state variables that a float measures.

Core files will retain the same name. B-files will have a 'B' in front of the old name and M-files will have an 'M' in front.

Deep SOLO

Dean Roemmich, Scripps Institution of Oceanography, USA [droemmich@ucsd.edu]
Nathalie Zilberman, Scripps Institution of Oceanography, USA [nzilberman@ucsd.edu]

The Scripps Float Laboratory has developed[1] a Deep SOLO profiling float, as a contribution to the Deep Argo Program, capable of depths up to 6000 m. Deep SOLO's pressure housing is a 33 cm diameter glass sphere contained in a plastic hardhat, and cabled to the separately-housed SBE-61 CTD[2]. Buoyancy adjustment is by a reciprocating pump similar in design to that used in conventional SOLO-II Argo floats. Deep SOLO has a mass of 25 kg, communicates using the Iridium network, and obtains GPS positions. It uses a passive bottom detection system consisting of a 2-m stainless steel line encased in plastic, hanging below the float. The float's descent stops above the bottom when enough line is resting on the bottom to make the instrument neutrally buoyant.



Deep SOLO 6000 m profiling float.

The first Deep SOLO float was deployed off central California in 4000 m water depth by RV Bell Shimada in January 2013. This engineering prototype completed 100 cycles, including about 60 to 4000 m, until it was recovered by RV New Horizon in September 2013. It carried a preliminary version of the deep float CTD. After recovery it was reconditioned, fitted with a new SBE-61 CTD, and joined in the float lab by a second prototype Deep SOLO.

The two Deep SOLO floats were deployed northeast of New Zealand in 5700 m water depth in June 2014, by RV Tangaroa, as part of the Deep Argo deployment and CTD validation voyage. The Deep SOLO floats and deployments were a collaborative effort by Scripps Institution of Oceanography, with support from NOAA/U.S. Argo, and by New Zealand's National Institute of Water and Atmospheric Research (NIWA). As of mid-September 2014, each Deep SOLO has completed more than 30 cycles, initially to 5500 m and then to the ocean bottom. The floats are profiling continuously in the upper 500 m and then obtaining 500 discrete temperature/salinity/pressure measurements between 500 m and the ocean bottom. Battery capacity is sufficient for about 150 cycles, and the plan is to recover these instruments in mid-2015. At that time they will be replaced by a pilot array of 12 Deep SOLO and Deep APEX floats distributed around the SW Pacific Basin. The SW Pacific Basin is the focus of this first U.S. pilot Deep Argo array because (i) it has a broad, flat abyssal plain, (ii) it shows substantial abyssal warming (Purkey and Johnson, *J. Climate*, 2010), and (iii) the U.S./N.Z. Argo partnership provides good access to this basin.

[1] Contributors to Deep SOLO design include R. Davis, J. Sherman, K. Grindley, M. McClune, and D. Black.
[2] The SBE-61 CTD has been developed for Deep Argo by Sea-Bird Electronics.

Deep Arvor: results of the first industrial prototypes at sea

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V. Dutreuil, X. Andre, V. Thierry, Y. Lenault, Ifremer

The Deep-Arvor float was designed by Ifremer to achieve up to 150 profiles from 4000 meters depth, with continuous pumping of the CTD. The objectives were to keep a high level of measurement quality with an affordable instrument, to limit its weight, and to maintain the self-ballasting feature of the Arvor-Provor family. After the validation of the first two models at sea, the industrialization was entrusted to NKE instrumentation. The first manufactured prototypes of Deep-Arvor were successfully deployed in May 2014 during the Geovide cruise in the North Atlantic Ocean.

The design focused on the improvement and the extension of the 2000m Arvor model. The SBE41CP CTD, fitted with a reinforced pump housing and a Kistler pressure sensor, was recommended to us by Seabird for an operational depth up to 4000 meters. The hydraulic engine was adapted to address the high pressure constraint and the Iridium-GPS antenna was strengthened. The main evolution was the use of filament winding technology in order to combine the ability to withstand the increased pressure with the desire to minimize the weight of the hull. The heart of Deep-Arvor remains the well proven I535 electronic controller, already used in the Arvor for several years. Additional sensors can easily be added to the top end-cap including an oxygen measurement sensor (Aanderaa 4330 optode). The profile data comprises three separate areas and each one has distinct resolutions, from one meter to several tens of meters, allowing spot sampling or bin averaged data acquisition. The amount of transmitted data can reach 2000 points per profile. To save energy, the user can program the float in order to alternate its profile depth (e.g 1 cycle at 4000 meters every 10 cycles at 2000 meters). A "smart grounding" feature is used to manage operations in regions shallower than 4000 meters. Finally, the features of the Deep-Arvor can be summarized as follow: the capability to realize 150 cycles to 4000 meters (more than 4100 dbars), its weight (26 kg), its various sampling rates, and its flexible programming.

The floats and their sub-assemblies underwent intensive tests: several hydraulic engines passed the equivalent of 150 cycles at operating pressure, the composite housings were first tested at 4580dbar and then withstood the cycles of compression and steady states, which are representative of their life. The effect of swell was assessed and real time missions were done in pressure tanks or in the pool.

The two early Deep-Arvor models, restricted to 3500dbar, have been tested at sea since 2012. The first one disappeared after 60 cycles while the second one is approaching 90 cycles. Many mission configurations have been successfully tested by remotely modifying the period of cycling, the parking and profile depths, the acquisition of oxygen data or not, the resolution of the profile (100 to 1000 CTD+DO samples), etc…

The two industrial 4000m prototypes were deployed in the North Atlantic Ocean during the Geovide cruise (fig1 & fig2). The first one was deployed the 23rd of May 2014. By the middle of September, 25 cycles at 4000m have been performed. Since July, this float has been cycling every 10 days in the Iberian Basin (fig3). The main objective is to monitor the SBE41CP stability in this stable area. The second prototype was deployed the 31st of May 2014 in the west European basin. By the middle of September, 54 cycles at 4000 meters have been done. This float has been cycling every 2 days to facilitate rapid testing.

A complete set of technical information is transmitted to allow accurate monitoring. The first results show a good reproducibility of the behavior of these floats, concerning the displacement and the ability to reach the target pressure, the stability at depth, the grounding behavior and the energy balance.

A first analysis of the data suggests a fresh bias, which is apparently not pressure dependent, of order 0.01-0.02 psu depending on the float, and an underestimation of the oxygen concentration of about 9 micromol/kg for the float deployed in 2014. A larger bias was observed on the oxygen data of the first prototypes because a multi-point calibration was not performed on the optode. A more careful analysis of the data is ongoing; the manufacturers of the sensors will then be contacted.

Today, the Deep-Arvor float is fully operational at sea. The first two models have accumulated 150 cycles at 3500 dbar and the two industrial prototypes are cycling, having successfully reached 80 cycles at 4000 meters depth. This float offers a good performance / cost ratio. In the coming months, several Deep-Arvor floats will be deployed by Ifremer in the North Atlantic Ocean for a pilot experiment and by other European institutes.

This development has been achieved within the NAOS project - Novel Argo Ocean observing System (www.naos-equipex.fr) funded by the French Research National Agency. The Deep-Arvor is now commercialized by NKE instrumentation.

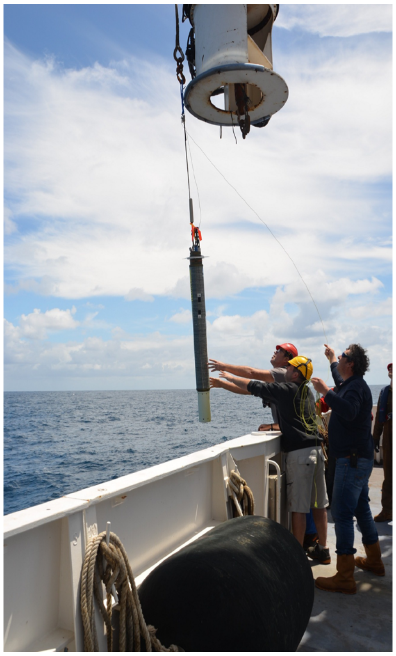
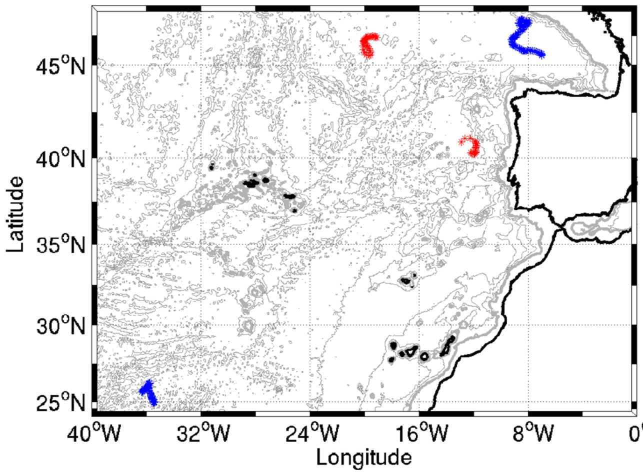


Fig1 (to the left):Deployment of Deep-Arvor during Geovide cruise (May 2014)

Fig2 (below): Position of the 4 Deep-Arvor. The two early Deep-Arvor models are represented by the blue dots. The two floats deployed in 2014 during the GEOVIDE cruise are represented by the red dots.



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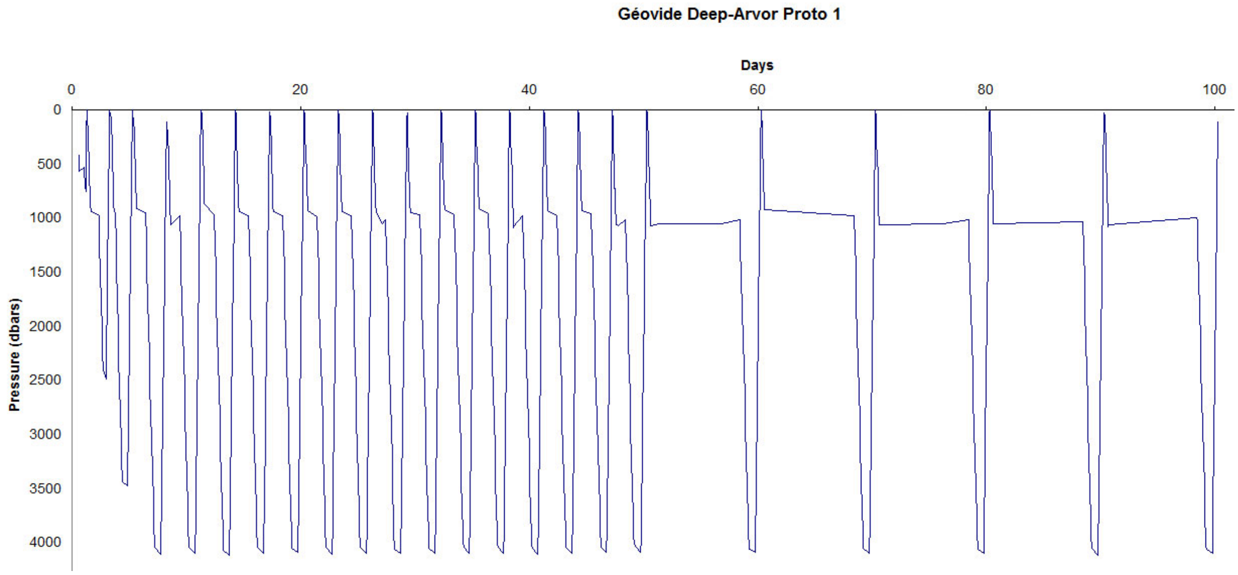

Fig3 :First cycles of the Deep-Arvor-#1, deployed in 2014

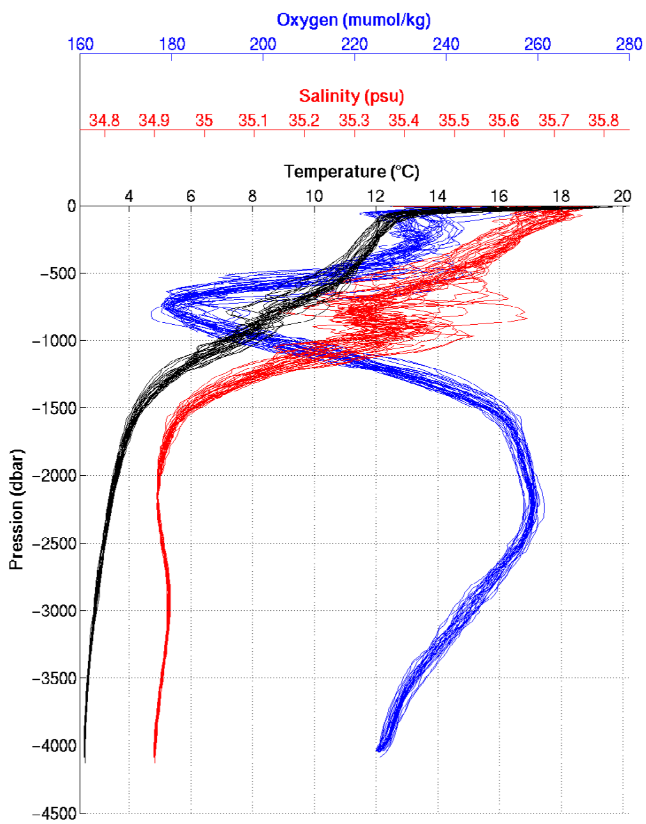

Fig4:Deep-Arvor 2014 - #1 data

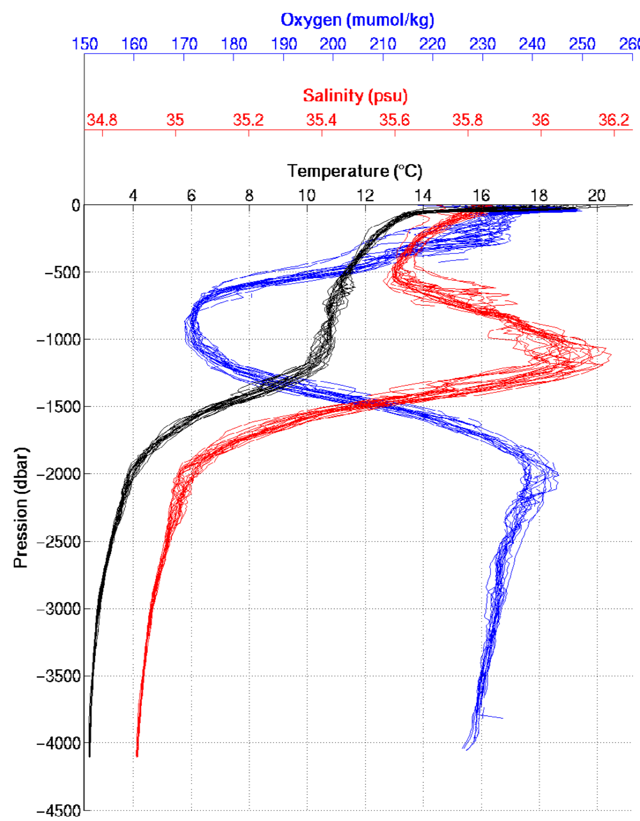

Fig5:Deep-Arvor 2014 - #2 data

Deep NINJA

Taiyo Kobayashi, JAMSTEC, Japan [taiyok@jamstec.go.jp]

We are introducing a new deep float, "Deep NINJA", and the current status of operational observations with it. Its development was started in 2010 and a model has been available to the public since April 2013 from Tsurumi Seiki Co. Ltd. (TSK). Specifications of Deep NINJA are as follows (Figure 1):

- Maximum operation depth: 4000 dbar.
- Height: 210 cm (with antenna).
- Weight: about 50 kg in air.
- Diameter at the maximum: 25 cm at bulge of pressure hull.
- CTD sensor: SBE41CP for deep float model.
- Communication: Short Burst Data Service, Iridium (two-way).
- Positioning: Global Positioning System.
- Lifetime: More than one year powered by Lithium batteries.

JAMSTEC has deployed 14 Deep NINJA floats (including 2 prototypes) mainly in the Southern Ocean in cooperation with TSK as a part of Japan Argo. In general, they are/were operating well, even though some floats ended their lives early. One of the topics on the Deep NINJA observation is its overwintering in the Antarctic. Deep NINJA floats, which were deployed off the Adelie Coast in December 2012, lost contact in June 2013 due to sea ice extension there. One of them resumed data transfer at the end of November 2013, which means Deep NINJA successfully survived an Antarctic winter and observed the deep ocean to more than 2,000m depth in the Antarctic Ocean throughout a year. The float has stayed in almost the same region since then and is now monitoring the deep ocean status there in the second winter (Figure 2). We have a plan to deploy a float off Antarctica at the beginning of 2015.

The details of the observations by JAMSTEC's Deep NINJA fleet are on our website (http://www.jamstec.go.jp/ARGO/deepninja/). Herein, we provide scientifically quality-controlled data of their observations for scientific/educational purposes. For permission to access this data, please contact us after reviewing the Terms and Conditions.

Figure 1: Appearance of Deep NINJA (courtesy of TSK).

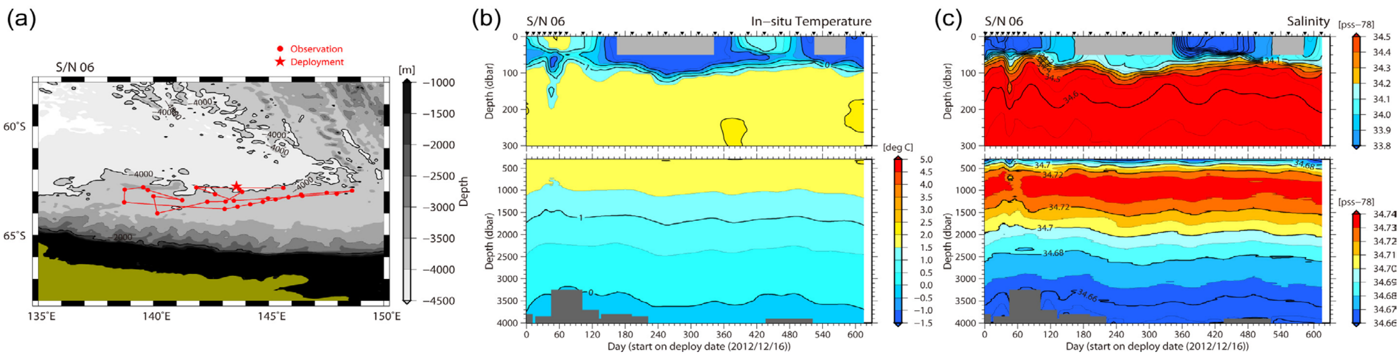

Figure 2: (a) Locations of profiling observations and temporal changes of (b) temperature and (c) salinity observed by Deep NINJA S/N 6 off the Adelie Coast, Antarctica.

Writing a paper using Argo data? Use an Argo DOI to cite the data

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J. Buck, British Oceanographic Data Centre, UK [juck@bodc.ac.uk]

Argo data are freely available without restriction. However, to track uptake and impact, we ask that where Argo data are used in a publication or product, an acknowledgment be given. There are currently two options to acknowledge Argo data:

(1) Cite an Argo DOI: the Argo Data Management Team assigns Digital Object Identifiers (DOIs) to Argo documents and datasets. These can easily be included in publications and keep a direct and permanent link to the Argo document or data set used in that publication (to ensure reproducibility). Right now there are three different categories of Argo DOIs available on the ADMT website (http://www.argodatamgt.org/Access-to-data/Argo-DOI-Digital-Object-Identifier).

- The first category is for Argo documents. Currently there are DOIs for each version of the Argo User's and quality control manuals.
- The second category is for the Argo GDAC. This is a general DOI that includes Argo float data and metadata available from Argo GDACs. There is no time associated with this dataset and the data at a previous point in time is not reproducible.
- The third category is for Argo GDAC monthly snapshots. This includes one DOI for each monthly snapshot taken at the GDACs starting in late 2013. There are a few other monthly snapshots before that time.

Please refer to the ADMT's DOI page to find the correct DOI to include in your publication or product. Also, when thinking about writing a publication or creating a product, please consider downloading the most recent monthly snapshot with a DOI to use as the Argo database in your publication or product.

(2) If you are not able to use one of the DOIs listed on the ADMT page, please use the following acknowledgment:
" These data were collected and made freely available by the International Argo Program and the national programs that contribute to it. (http://www.argo.ucsd.edu, http://argo.jcommops.org). The Argo Program is part of the Global Ocean Observing System."

The citation of dynamic data is an active area of work internationally as part of the Research Data Alliance and there is an on-going effort to simplify the citation of Argo data aiming for a single DOI containing data granules for the Argo data at different points in time.

Argo float rescue and redeployment

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Pierre-Marie Poulain, OGS, Italy [ppoulain@ogs.trieste.it]

A German float (WMO# 6901084) was found in the port of Beirut, Lebanon and was secured by the Lebanese Navy. With the help of MEDARGO, contact was established with the local oceanographers at the Institute of Aquaculture and Aquatic Science (Dept. of Biology) at the American University of Beirut and they retrieved the float from the Navy. Pierre-Marie Poulain visited Beirut in April 2013, tested the float and showed the local oceanographers how to operate it (Fig.1). The float was donated to Lebanon and our Lebanese collaborators redeployed the float (new WMO# 6900895) about 10 nm off southern Lebanon on 27 August 2013. The float made many more cycles before dying due to battery trouble. Its complete trajectory is shown in Fig. 2 with red indicating before re-deployment and with blue indicating after re-deployment.

Figure 1 (above): P-M. Poulain testing an APEX Argo float with Lebanese scientists

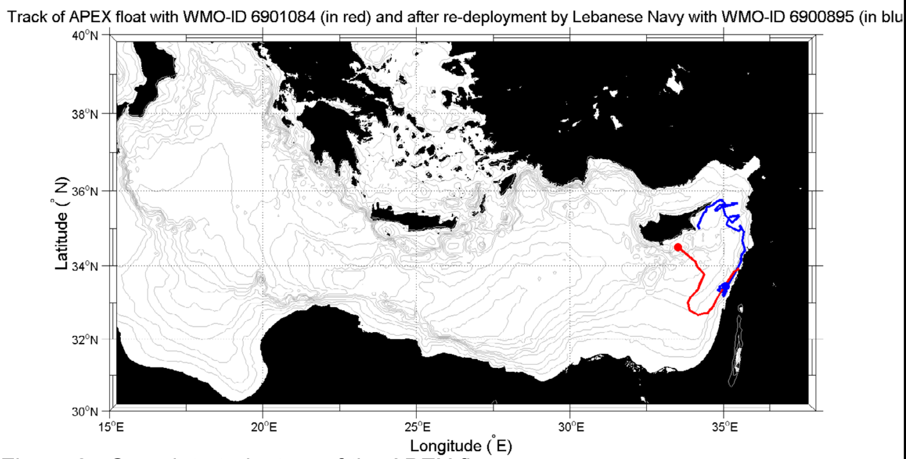


Figure 2: Complete trajectory of the APEX float.

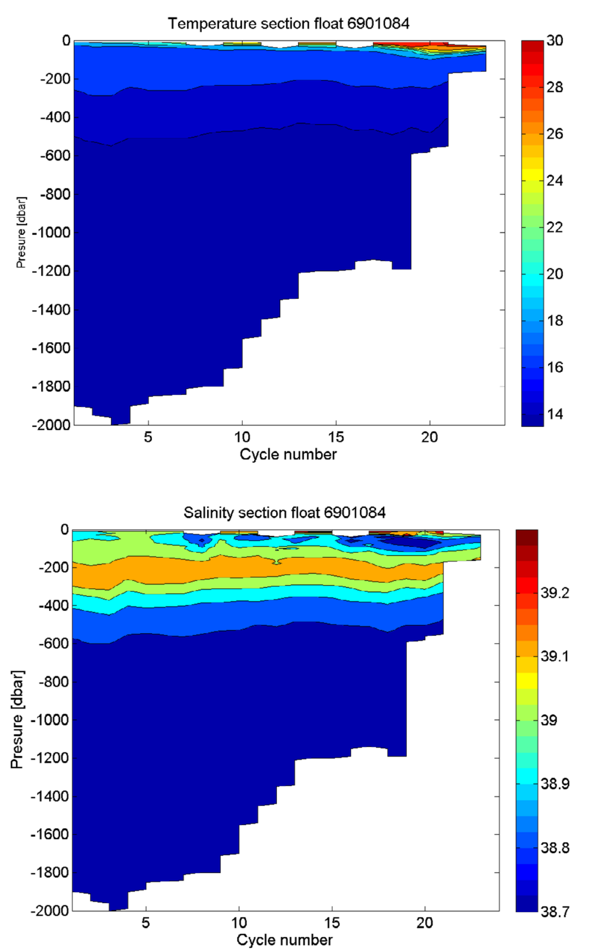
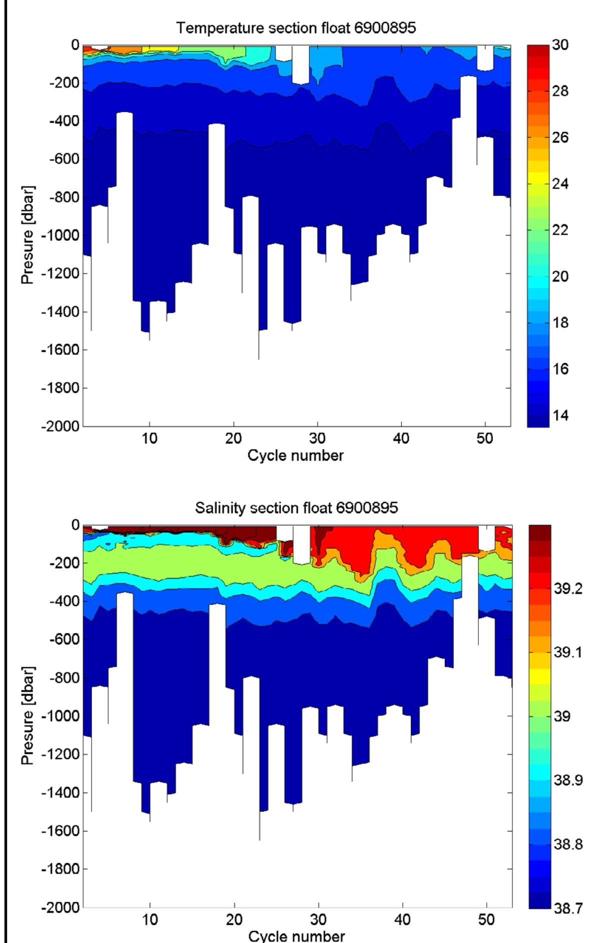


Figure 3 (to the left): Upper plot shows temperature vs. pressure for the float prior to re-deployment. Lower plot shows the salinity vs. pressure plot prior to re-deployment

Figure 4 (to the right): Upper plot shows temperature vs. pressure for the float after re-deployment. Lower plot shows the salinity vs. pressure plot after re-deployment



Argo stop-motion animation

Malou Zuiderma, Australia, [malou.zuidema@gmail.com]
Esmee van Wijk, CSIRO, Australia [Esmee.Vanwijk@csiro.au]

The Argo stop-motion animation aims to inspire children (and adults) to engage with marine science. It is quirky, fun and informative at the same time. The animation explains what an Argo float is, how it operates and how all this data helps us to understand the ocean circulation and climate.

"The Argo animation came about after I saw Malou Zuidema's fantastic 'Forests of the Sea' animation that she did for Lynchpin and the Bookend Trust. I thought communicating science in a fun way would be a great way to get kids more engaged with marine science. I also thought the Argo story would translate well into the medium of stop-motion animation," says Esmee van Wijk, a CSIRO physical oceanographer who works on the Australian Argo program.

"Malou and I worked together to come up with a short story that explains the history of oceanography and ocean measurements and how Argo floats have become a great solution to measuring large parts of the ocean in an autonomous way. Besides explaining to kids how Argo floats work and what they do, we also wanted to showcase how the Argo data is used in real-world applications like climate and seasonal forecasting, scientific research and to help industry to predict ocean currents, temperature and wave height."

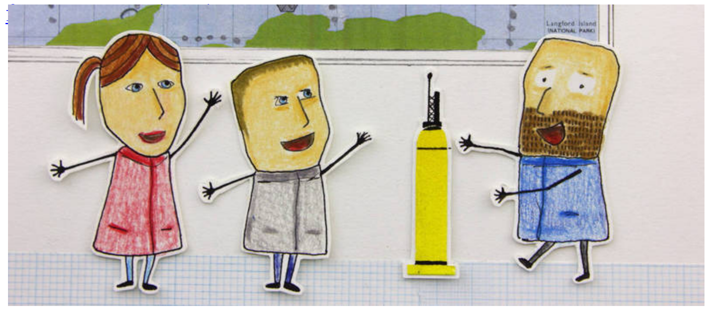
To watch the Argo animation, go to YouTube and enter the search terms "Argo ocean animation" or visit: http://imos.org.au/argoanimation.html.

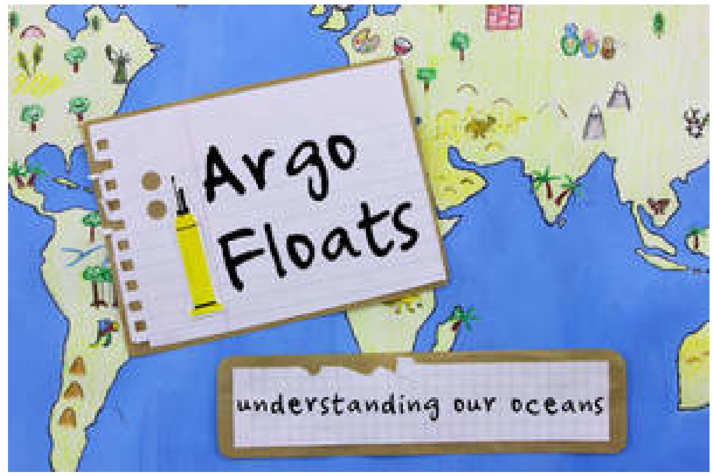
Oceanographers have deployed more than 3500 robotic profiling floats into the global oceans as part of the international Argo program over the past 15 years. Argo floats measure water properties such as temperature, salinity and pressure from the surface to a depth of two kilometers. Floats can change their buoyancy by pumping oil into and out of an external bladder, which allows them to sink, drift with the ocean currents and measure data as they rise to the surface. The floats send their data and location back to processing centers on land via the satellite network. Each float repeats this cycle every 10 days and can drift in the oceans measuring data for as long as 4 to 7 years.

"We had a lot of fun creating the animation and thinking about how to illustrate and communicate the different parts of the Argo story. We hope people enjoy watching it as much as we enjoyed making it."

Article reprinted from the IMOS website: http://imos.org.au/newsitem.html?&no_cache=1&tx_ttnews%5btt_news%5d=445&cHash=017513d-

IMOS
Integrated **Marine**
Observing System





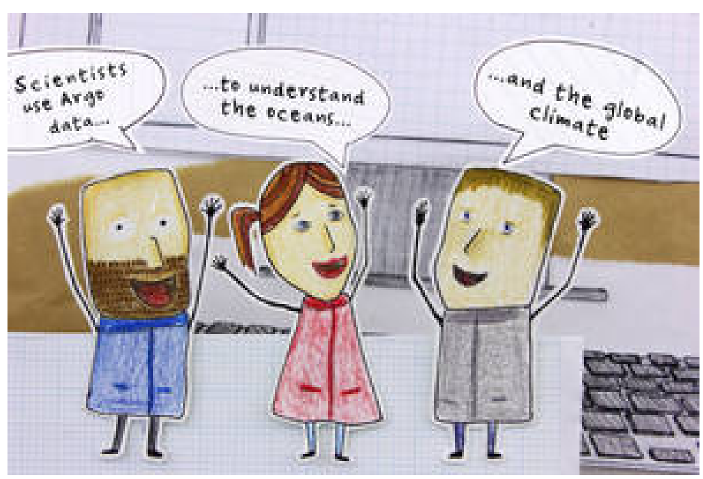


Figure 1 to the right: Still images from the stop-motion animation. Credit: Malou Zuidema

NOTE: The Argo movie web page (http://www.argo.ucsd.edu/Argo_movies.html) has been updated recently to include this stop-motion animation as well as other animations, float deployment videos and educational videos.

Seread - 10 years on and still strong

Carol Young, Seread, New Zealand [carolmyoung@xtra.co.nz]

Imagine a conference room packed full with 12 round tables, each seating two teachers and seven to eight students. Each student, and most teachers are clutching a device – laptop, netbook, tablet, iPad, iPhone or smartphone. Each of them gazing at the screen to find out how to trace the trajectories of Argo floats.

Photo 1 (above): Attendees at the Seread conference. Photo courtesy of Carol Young

This was the scene in Mauritius in July of this year. After opening speeches by the Minister of Education and the Director, it was over to Captain Peter Flanagan and myself to talk them through the process. The result of over 100 devices going onto Google Earth at the same time was predictable – only a handful were successful. We had expected this, despite assurances to the contrary, so Plan B went into action and they accessed information on different floats from the WHOI site. It was fascinating to see the interest and enthusiasm on these senior secondary school students' faces. They also enjoyed Captain Pete's videos of float deployment on *The Lady Amber*.

The Seread programme has been operating in the Pacific for 10 years. This was the first foray into the Indian Ocean and was due to Captain Peter Flanagan of *The Lady Amber* forging a very positive relationship with the Minister of Education, the Honourable Dr Bunwaree. Captain Pete had visited Mauritius on a trip to deploy Argo floats and excited the interest of the Minister of Education, teachers and students. A number of schools organised to adopt floats through him. The Minister is now promoting the inclusion of Argo into all secondary schools in Mauritius. The Ministry looked after Captain Pete and myself very well during our week long visit. We had meetings with the Secretary of Education and all senior Ministry officials. The Minister arranged a dinner with us signaling that the trip was given high importance. We had two hour seminars with teachers and ministry officials from each of the four districts. Two of these were held in schools in different regions before the two one-day workshops. I introduced the Seread learning activity, Shrinking Islands, on the second day and this was very popular with the students.

The workshops led me to the realisation that more support was needed. I had emails for almost 100 teachers in Mauritius, so after discussion with my Seread colleagues, I asked the Mauritius teachers if they would be interested in a series of online modules to help them understand Argo data and use it with their students. More than half agreed so we set up a series of eight modules on Blendspace – an online learning programme. This allowed us to upload or link to videos and PowerPoints as well as to type in information. Each module contains information for the teacher linking Argo data and climate change, activities for the teachers to do for themselves and activities to do with their students. We revamped our Wikispace – SereadSouthPacific (http://sereadsouthpacific.wikispaces.com) – and teachers are using this to upload the resources they have created. The modules cover tracking and adopting floats, interpreting salinity and temperature data, ocean acidification and currents and the finale will link all these together.

We are keeping the modules private at the moment since this is a new venture for us and we are keen for feedback from the teachers to improve the process. The intention is to make them public once we are confident they are useful. We hope to make a student version as well. There will be follow-up workshops in Mauritius in January which will also include Seread activities.

Many teachers in the Pacific will be keen to use this resource in conjunction with Seread material so we are excited about our foray into modern learning technologies and will be including them in our work in Tonga and Kiribati in 2015. The Seread books are being updated into one book – What is Weather, What is Climate, and Oceans Rising will be Water, Weather and Climate Change by December. The Teaching and Learning Strategies will stay a separate book. These will go on the Wikispace and the Argo education site once completed.

Photo 2 (to the left): Captain Peter Flanagan, The Hon, Dr V. K. Bunwaree , Carol Young
Photo by Ashan Purmessur

mon océan & moi: share research with oceanographers & discover our oceans

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Hervé Claustre, Laboratoire d'Océanographie de Villefranche, France (claustre@obs-vlfr.fr)
Julia Uitz, Laboratoire d'Océanographie de Villefranche, France (julia.uitz@obs-vlfr.fr)

The program « mon océan & moi » focuses on the dissemination of ocean sciences to a non-specialist audience and especially young people. Its main objectives are to:

1) contribute to a better understanding of marine environments and communicate about scientific approaches,
2) facilitate exchanges in and between the academic and non-academic "worlds"

Teamwork is one of the bases of the program. Its participatory approach favours a close collaboration between scientific colleagues and science communicators, web-designers, teachers and students. Another pillar is the multiple supports including the local school authority, the general council (Alpes-Martitimes) and the outreach components of scientific projects, namely the ERC funded remOcean ("remotely-sensed biogeochemical cycles in the Ocean") project as well as other EU-projects.

From left to right and from top to bottom: Teaching float principles to students with hands-on activities. Adopting a profiling float in Villefranche-sur-Mer: Students sticking a tag to their float. Tag designed by the students for their float. Students and their teacher ready for this adventure – Photo credit: C. Scheurle and J.-J. Pangrazi.

While its concept is mostly oriented towards online dissemination, the team is conscious of the importance of keeping in direct contact with key audiences. The web-based interface includes science-based information, educational tools, quizzes and games as well as a social network (blog and twitter) and an interactive map (cf. web links below). Its modularity facilitates the development of new content, educational resources, and multidisciplinary approaches.

The program is still young and, therefore, its appraisal centers at present mostly focus on qualitative evaluation methods. The feedback received confirms however that the initial orientations were well targeted and undeniably encourages pursuing the effort. The "mon océan & moi" program is also enriched by a large group of PhD students. As part of their curricula in Villefranche, the program asks them to take part in dissemination activities and allows training in teaching science.

This specifically is the case within the context of the "adopt a float" initiative. This outreach initiative is closely linked to the "mon océan & moi" program, and invites middle and high school students to adopt a Bio-Argo profiling float, follow its journey, and share experiences with scientists and other groups of students. The students "access" an oceanic zone and, in real-time, may make observations and learn about associated science. The web-platform and the interactive map (cf. web links below) provide teachers and students with learning material necessary to better understand and interpret the data from their float(s).

Web links

« mon océan & moi »	http://www.monoceanetmoi.com
"adopt a float"	http://www.monoceanetmoi.com/web/index.php/en/adopt-a-float-home
interactive map	http://www.oao.obs-vlfr.fr/mapsf/en/?projectid=10
twitter	@monoceanetmoi

Timetable of Argo meetings		
2014-2015		
March 16 - 21, 2015	Brest, France	EuroArgo Workshop, the 16th Argo Steering Team Meeting, and an Educational workshop
September 14 - 18, 2015	Galway, Ireland	"Sustained ocean observing for the next decade" A GOSHIP/Argo/IOCCP Conference

Sustained ocean observing the next decade

A combined GO-SHIP/ARGO/IOCCP conference on physical and biogeochemical measurements of the water column

14 - 18, September 2015
Galway, Ireland

This conference will be the 5th international Argo Science Workshop. More information will be coming out shortly about the conference. Visit http://www.gaic2015.org/ for more information and to sign up for updates.

Argo Floats - tracking the pulse of the world oceans

This LEARNZ field trip took place 16 - 25 June 2014 and was supported by the New Zealand Ministry of Education, NIWA and NOAA. Several floats were deployed on the field trip including two Deep SOLO prototypes like the one shown in the picture below with Phil Sutton, Nathalie Zilberman and Norge Larson. Part of the cruise included daily audioconferences with schools as shown in the photo to the right where Phil has the "Ambassadors" from the different schools on his lap and Shelly, the LEARNZ teacher, is on an audioconference. To learn more, go to: http://www.learnz.org.nz/argofloats142/argo-floats-tracking-pulse-world-oceans

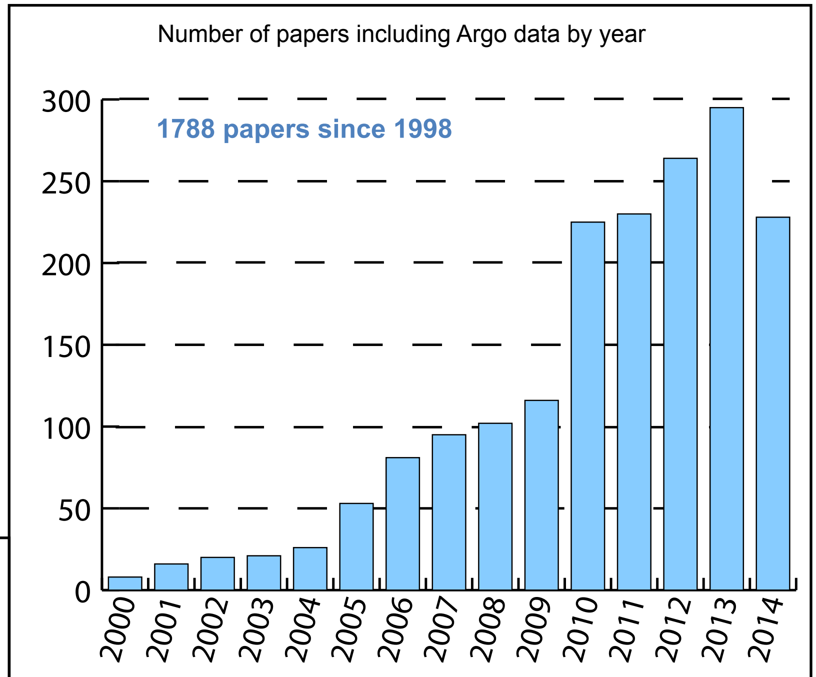
Both images are from LEARNZ

Bibliography & Thesis Citation List

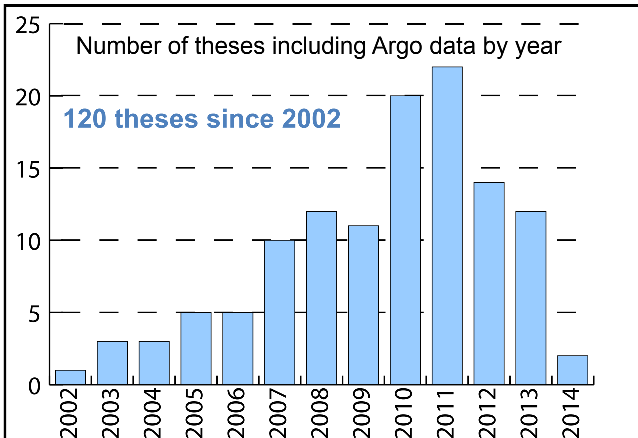
The number of papers published using Argo data this year is over 225 which brings the total number of papers published using Argo data since 1998 to over 1700. The complete list is available online at http://www.argo.ucsd.edu/bibliography.html. The last couple of years has seen an increase in papers using gridded Argo data, in papers comparing Argo data and salinity data from satellites, and in papers using bio-geochemical Argo data. There is also a list of papers in press at http://www.argo.ucsd.edu/Argo_research_in_press.html.

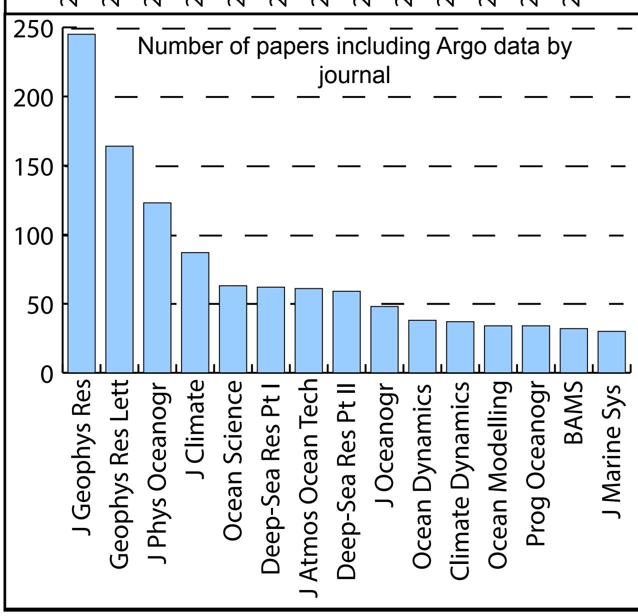
To help demonstrate Argo's influence on education, I have compiled a list of doctoral theses that have been published using Argo data. The list is based on thesis databases and individual submissions. Due to the limited availability of theses online, this is most certainly an underestimate of the total number of theses published using Argo data. Right now there are a total of 120 theses in the database.

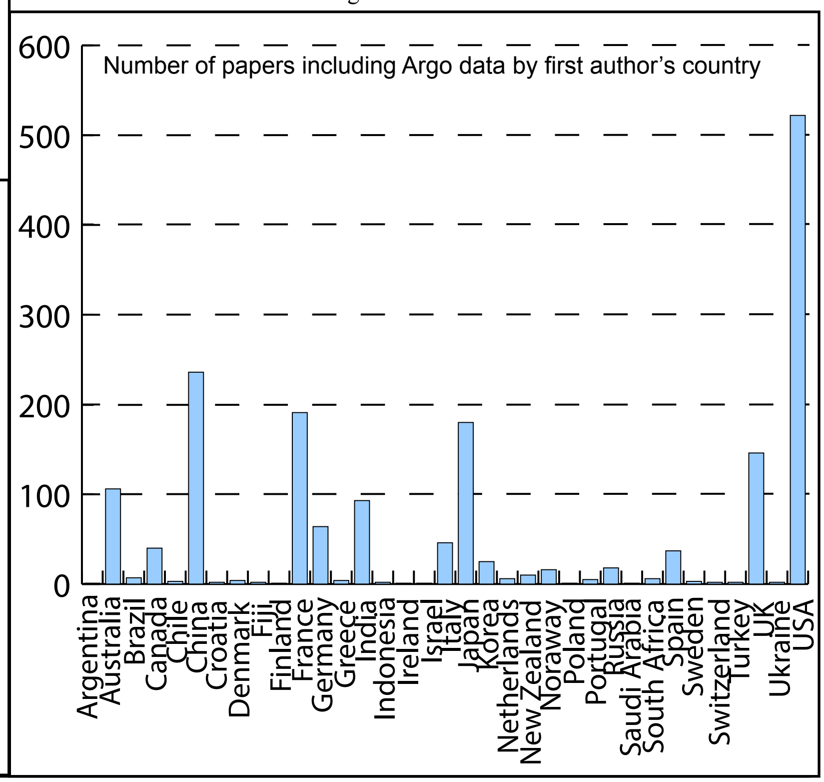
As usual, if you have any citations or theses to add to a list, please send argo@ucsd.edu an e-mail. I am always happy to provide a subset of citations upon request.



The Argo bibliographies continue to showcase the strength of the Argo program and its freely available data policy. DOIs are now available to cite Argo documents and data. Refer to the Argo web page, ADMT web page and page 7 in this newsletter for more information on the Argo DOIs.







Argonautics is the Newsletter of the International Argo Project
Please send articles for *Argonautics* to argo@ucsd.edu or to Mathieu Belbéoch, Argo Technical Coordinator (belbeoch@jcommops.org)
Permission to quote an article from *Argonautics* should be obtained from the author.

Information about Argo can be found at www.argo.ucsd.edu and from the Argo Information Centre at argo.jcommops.org. The AIC site includes information about the present and past distribution of Argo floats. Argo data may be downloaded from the Global Data Centers www.usgodae.org/argo/argo.html and www.ifremer.fr/coriolis/cdc/argo.htm