The Third Argo Science Workshop: *"The Future of Argo"*

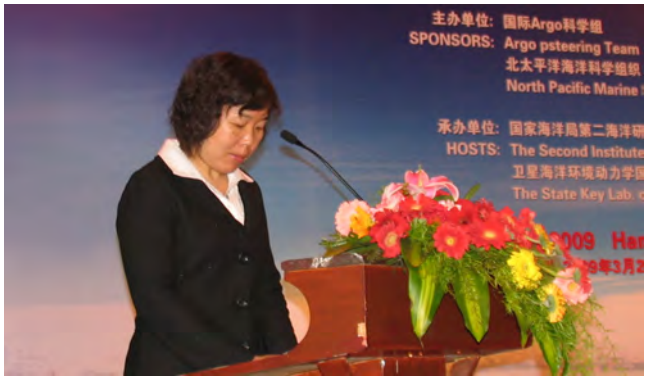
by Howard Freeland

The first Argo Science Workshop took place in Tokyo in November 2003, with the second being in Venice in March 2006. It was then with great pleasure that the Argo Steering Team accepted the generous offer from China-Argo to host the Third Argo Science Workshop (ASW-3) on March 25–27, 2009, at the Zhejiang Hotel in the beautiful city of Hangzhou. The Argo Steering Team thanks all of our Chinese hosts for the smooth and efficient organization of this meeting, and especially for arranging the deployment of a very large Chinese Argo float in the West Lake during the meeting. That must have been very hard to arrange.

A view across the West Lake showing an Argo float about to make its first dive with the deploying vessel shown to the left.

The focus of ASW-3 was the OceanObs'09 Conference to be held in the autumn of 2009 in Venice. To prepare for OceanObs'09 we needed to consult with our user community, find out what worked in the design of Argo and what needed improvement, and so develop a community sense of what changes one might consider making to the general design of Argo. Scientists were invited to present talks on any aspect of ocean science provided that substantial use was made of Argo data. Speakers and poster presenters were also asked at some point to address the sufficiency of Argo from the point of view of their own research. Specifically, we wanted to know if Argo was perfect for the project reported or if some changes in design might have made Argo work better in some way. We anticipated that there might be a call for more rapid sampling in some areas of the ocean, or perhaps a perceived need for more floats, or a sub-sample of floats sampling abyssal waters, *etc*. Suffice it to say, our instructions to the authors were addressed, and we did receive the input we requested. We have now material that will be used in the Community White Paper on Argo to be presented to, and discussed at, OceanObs'09.

The workshop was co-sponsored by several Chinese organizations: the Ministry of Science and Technology, the State Oceanic Administration (SOA), the Second Institute of Oceanography and the State Key Laboratory of Satellite Ocean Dynamics. The North Pacific Marine Science Organization (PICES) served as the international sponsor and provided assistance by assembling the abstracts and program volume and giving considerable advice on how to run a meeting like this. The workshop was also supported with contributions towards an evening banquet event from the following industrial exhibitors: Aanderaa Data Instruments (Norway), JFE Alec Co. Ltd. (Japan), Laurel Scientific, NKE Instrumentation (France), Rockland Scientific International (Canada), Sea Corp. (Japan), Teledyne Webb Research (U.S.A.), Optimare (Germany) and Yichang Institute of Testing Technology (China). We would like to thank them all for their generosity and support.



Madam Yue Chen, Deputy Director-General of the Department of International Cooperation of SOA, welcomes delegates to ASW-3.

Following the opening ceremony and speeches from our sponsors, we began the science program with reviews of the current state of Argo (Dean Roemmich) and the current state of the data system (Sylvie Pouliquen). These were necessary to ensure that everyone attending understood the current status of the program. The remaining talks were roughly divided into five general themes:

1. Heat and salt budgets on global to regional scales;
2. Estimation of circulation fields on global to regional scales;
3. The role of Argo in constraining ocean data assimilation models;
4. Seasonal to interannual variability as seen by Argo;
5. New technology.

Talks were fitted only loosely into these themes as we wanted to hear from as many speakers and poster exhibitors as we could and so decided against strict adherence to categories.

Participants of the Third Argo Science Workshop (March 25–27, 2009, Hangzhou, People's Republic of China). There are 108 people shown in this photo, which includes most of the attendees.

Eleven Argo nations were represented in oral and poster presentations (among them were five PICES nations) and several more were represented in the audience; this was a good cross–section of the international Argo community.

An innovation was a decision to conscript two wise people, Stan Wilson and Kimio Hanawa, to lead a guided discussion at the end of each day. The concept here was that these are two people who are knowledgeable about Argo but have not (at least not for many years) been central elements of the Argo Steering Team. They were, therefore, qualified to offer opinions as informed outsiders. The task set to them was to highlight important items that they had heard each day and to comment on conclusions achieved. The intention was to create a medium for discussion and debate at the end of each day.

I was pleased with the level of discussion and debate that took place, and this was a relief to everyone who knew that they had contributions to a Community White Paper to write. Also, as one of the organizers of this event, I was surprised firstly by the level of interest in the meeting. I was frequently in touch with the ASW-3 local organizers, Jianping Xu and Renqing Liu, and there was a palpable sense of panic developing in the weeks immediately prior to the workshop that just perhaps the meeting might be too popular and we might have more people interested in attending than we could easily accommodate in the meeting hall. It is easier to deal with that problem than the opposite problem. I always knew that there would be some people who agreed to present talks and then would be unable to attend. But in fact, after the program was assembled, there were only two people who dropped out. For a meeting of this size, it is a surprisingly small number. We were very grateful to Denis Gilbert and Mathieu Belbéoch who graciously agree to step in at the last moment with well-prepared talks.

Science in action (top) and science inaction (bottom) at ASW-3.

During the workshop we received suggestions for extending the Argo array poleward from its original design criteria of 60°S to 60°N. In fact, there are now floats reporting from ice-infested regions in both the northern and southern hemispheres. There was considerable discussion following several suggestions that Argo should switch from 10-day sampling to 5-day sampling in the equatorial Indian Ocean. The issue here is that more frequent realizations of the state of the tropical Indian Ocean are needed to support coupled assimilation modelling and especially monsoon forecasting in the Indian basin. An alternative view was that changing the sampling frequency of individual floats from 10 days to 5 days is not cost effective, as their expected lifetime will

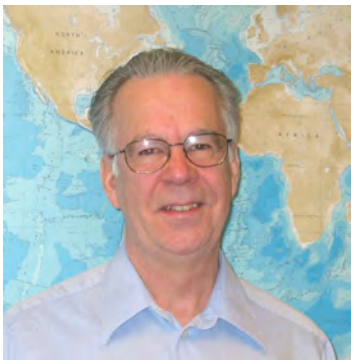
drop from 5 years to 2½ years, so requiring earlier replacement. Thus, it was suggested that it might be more cost effective (factoring in ship costs) to double the number of floats reporting in the critical areas.

There were also repeated requests that Argo floats sample ocean conditions all the way to the ocean surface. This is a message we have received, and Argo is almost ready now to supply temperature all the way to the surface. However, salinity is a larger problem. The issue here is that the CTD on board an Argo float is a pumped system. At the moment we turn off the pump, and so stop measuring salinity at a depth of 4 metres. This is done to protect the salinity measurements from contamination by surface bio-chemical films. Experience dictates that we should not pump surface contaminants through the CTD system. In fact, an alternative system has been proposed that would allow the measurement of surface salinity, but the cost is high and requires careful evaluation.

Argo has existed now for 10 years and is engaged in a process that will affirm the direction that it has taken or lead to changes in the design of Argo. As the title of the workshop suggested, ASW-3 was designed to be an important step along the way to the next 10 years, the *Future of Argo*, and the Argo Steering Team had high expectations from the workshop. ASW-3 met and surpassed those expectations.

Following the completion of ASW-3, contributions to the Community White Paper were received and assembled into a coherent document titled "*Argo-A Decade of Progress*" by Freeland *et al*. This is now available on the OceanObs'09 website (http://www.oceanobs09.net/), and a mechanism now exists that allows community input to the document. Comments are solicited until some time in July 2009 when the papers will be revised, taking the comments into account, but they are still not final. Following round-table discussions at OceanObs'09, the papers will be subjected to further modification. From this process we expect to receive guidance from the entire oceanographic community that will help us plan the next 10 years of Argo.

In conclusion, I cannot possibly list everyone who was important to making this meeting a success. I assume you all know who you are. Thank you to all.



Dr. Howard Freeland (Howard.Freeland@dfo-mpo.gc.ca) is a physical oceanographer conducting research on the circulation and dynamics of the N.E. Pacific and works for Fisheries and Oceans Canada at the Institute of Ocean Sciences. He was launching profiling floats before the Argo concept emerged. Since then Howard has been involved in every meeting of the International Argo Steering Team and Executive Committee and presently he co-chairs the International Argo Steering Team. Howard received his B.A. at the University of Essex (England) and his Ph.D. at Dalhousie University, in Halifax, Nova Scotia.

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The existing CPR surveys have extensive spatial coverage, but there is still a vast amount of the global ocean not sampled. For instance, there is no sampling in the tropics, in the south Pacific, in the Mediterranean, or in upwelling regions. Emphasising the value of CPR data to resource and policy decision-making processes may help find a local champion who can work with the CPR commonwealth to set up a new survey in some of these key areas. Expansion into these regions would additionally help compile data for the next report of the Intergovernmental Panel on Climate Change (IPCC). The workshop felt that momentum was gaining on the role of CPR data in contributing to the biological observations needed by ocean observing systems. A white paper that is being prepared for the upcoming OceanObs'09 conference (September 21–25, 2009, Venice, Italy) will incorporate the discussion from the workshop, in addition to contributions by the wider community, to maintain this momentum.

The *Journal of Plankton Research* had expressed an interest in publishing papers from the workshop, and about 5–6 articles are likely to form a themed section in the journal (deadline for submission was agreed as the end of 2009).

We concluded that with the very positive views expressed in working more closely together, scientists from the CPR surveys need to meet more often and communicate more frequently and that we should utilise many different fora to make this happen. We intend to take advantage of future international symposia to convene workshops (including annual taxonomic workshops that are to be hosted by SAHFOS), produce a newsletter and initiate an internet-based CPR list-serve where updates and ideas can be posted. The benefits of meeting in person were felt by everyone and it has not happened frequently enough in the past. The workshop agreed that a more holistic global approach is now warranted.