

Australian Contribution to Argo

Report to the 8th Argo Science Team meeting, March 2007

Submitted by Susan Wijffels, CSIRO Marine and Atmospheric Research

1. Status of implementation

Floats deployed and their performance

Australia has currently 121 operating Argo floats. In 2006 45 WRC APEX SBE-41 floats were deployed, most in the subantarctic zone and several in the Coral Sea and Indo-Australian Bight. In addition Australia assisted float deployments by Korea.

APEX performance in the Australian array has been very good – we continue with a near 90% profile returned averaged over all the Australian array, based on an expected 4 year lifetime. The 10% of lost profiles is overwhelmingly due to floats that have grounded or been washed ashore and lost. Of 19 floats deployed in 2002/2003 with mixed lithium/alkaline battery packs, 3 have grounded, 2 ceased to operate and the rest continue to deliver profiles 3-4 years later with healthy voltages (>12V), suggesting APEX powered with lithium batteries can deliver 4+ year lifetimes sampling to 2000db on every profile.

Of the floats deployed in 2004 and 2005, most continue to operate. We have suffered several failures of floats that winter under sea ice despite their being equipped with an ice-detection algorithm. We will be revisiting our strategy for floats that will encounter sea ice.

An APEX float that was taken ashore by a fisherman in Indonesia and recovered with the excellent help of Widodo Pranowo from the Indonesian Ministry of Marine Affairs and Fisheries, was given a technical checkout in Jakarta and redeployed during the INSTANT mooring recovery cruise in December 2007 with a new WMO ID. It is functioning well.

Ann Thresher worked with the Scripps Argo Team to recover a SOLO which had grounded on the shallow shelf of eastern Australia, and had been trawled up by a local fisherman. When tracking the float via its Argos signaled failed, Ann refused to give up and pounded the pavement along local fishing ports until someone recognized the suspect! News paper article attached.

Technical problems encountered and solved

In the past we have replaced some of the alkaline battery packs delivered with the APEX floats with locally sourced lithium packs. As this has worked so well, and since the sensors on our long-lived floats (>4 years) appear to be stable, we will now move to 100% replacement of battery packs with lithium cells in anticipation of achieving +5 year lifetimes.

During technical checkout and before deployment at sea, our team encountered several air-bladder inflation anomalies. Deployments were suspended. On investigation, faulty manufacture of the float bladder was found. WRC was contacted, who also investigated the problem, and all APEX users were notified as well. As a result WRC has revised its factory testing and also its recommendations for pre-deployment inflation tests. Several floats have been returned to WRC to have new bladders installed. We recommend visual inspection of all APEX float bladders before deployment as per the email of Alex Papij to the Argo technical mailing list in late 2006.

As per recommendations from the APEX Users Technical Workshop and AST-7, we also requested two software changes for APEX acquired in fy06/07– profile on deployment and averaging of hourly temperature and pressure measurements during the drift phase in two 5 day bins. Several floats with these new features failed to operate correctly, returning profiles at erratic times. Deployments were suspended until the problem was resolved. On dialogue with WRC, the problem was found by taking careful note of controller board numbers and software versions. However, when these two software features are combined with ice-detection, floats continue to behave erratically. Until this problem is identified, we will revert to previous versions for floats that will encounter ice. These problems were rather tough to trouble-shoot as floats with the new software were also involved in the bladder-inflation failures as well.

2. Status of contributions to Argo data management:

Real time: In late 2006 the Australian realtime processing was switched to a new matlab-based system written by Jeff Dunn at CSIRO and implemented at the Australian Bureau of Meteorology. This upgrade should result in a more stable data stream and the Australian drift files should now be to Argo specifications. Realtime plots and monitoring of float data can be found at:

http://www.marine.csiro.au/~gronell/ArgoRT/select_floats_WMO.html

We continue to correct salinities in real-time where deep values deviate far from high-precision WOCE and WOCE follow-on CTDs. Until our DMQC drift corrections are more routine we will not switch to applying 6 month-old DMQC corrections.

Australia will host the next meeting of the Argo Data Management Team in late 2007. Ann Thresher will be the lead organizer.

Tseviet Tchen and Susan Wijffels have carried out an inter-comparison of delayed-mode data files prepared on a common set of floats by participating national data centers. Their analysis is available in draft form at IAST-8 and will be finalized after comments are received from participants.

2. Status of delayed mode quality control process

About 30% of eligible Australian data are delivered in D-mode. All floats have now passed through initial QC screening using the Gilson software and have been processed for thermal lag error. A large backlog is about to be delivered to the GDACs with delays

caused by problems encountered in the implementation of the thermal-lag correction for SBE-41 sensors on APEX. The change in Argo data format also caused a set back.

3. Present level of and future prospects for national funding for Argo

In 2007 - 2010 Argo Australia will come under the umbrella of a new Australian Government initiative: an Australian Integrated Marine Observing System (IMOS) for research funded under the National Collaborative Research Infrastructure Initiative. The larger IMOS will be based at the University of Tasmania and Gary Meyers is the IMOS Director. The success of the IMOS proposal means that Argo Australia will now be funded at a 50-60 float/year level for 4 years to maintain an array of around 220-240 Argo floats.

Argo Australia will remain a joint program between the CSIRO Marine and Atmospheric Research (CMAR) and the Australian Bureau of Meteorology (BoM), partly funded by the Australian Greenhouse Office, but now substantially expanded via the IMOS funding. CMAR will remain the lead agency.

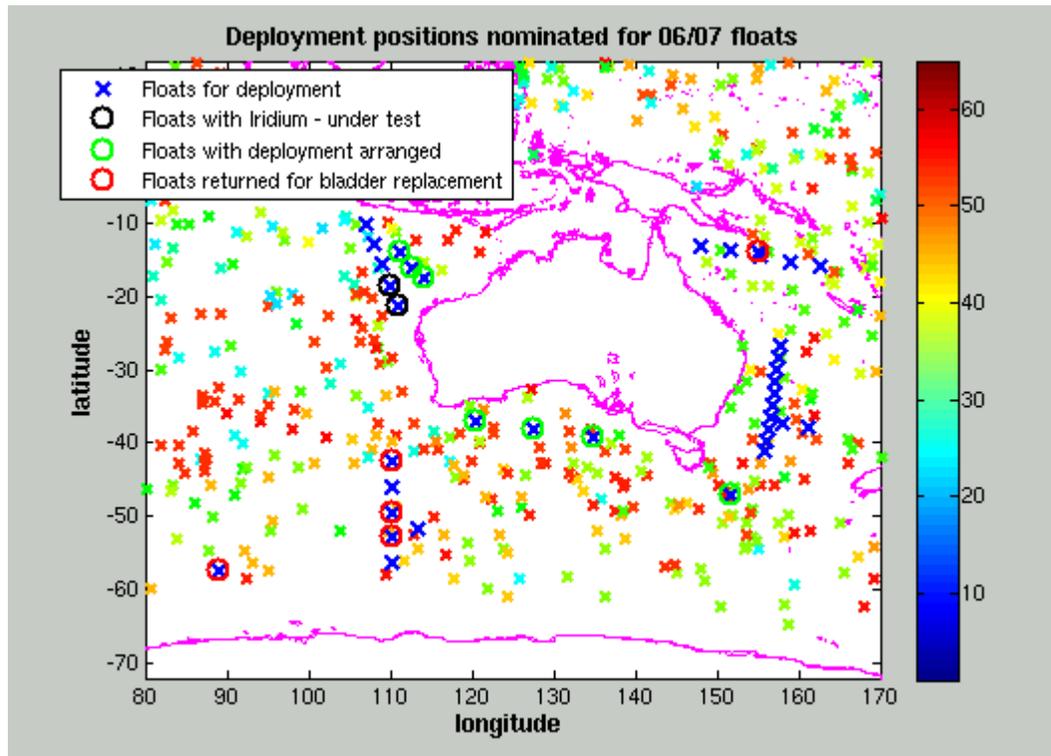
The Cooperative Research Center for Antarctic Ecosystems and Climate (ACE CRC) will acquire its last floats for deployment in the subantarctic zone south of Australia in the upcoming fiscal year. A proposal has been made to CSIRO to continue to acquire 10 floats, the ACE CRC will acquire 14-15 floats and the BoM will acquire 13 floats, with IMOS funding bringing the total to +50 floats deployed next year.

A supplementary proposal has also been submitted to CSIRO to acquire additional floats with oxygen sensors, as well as CTD's to deploy on seals to gain information from the sea-ice zone. It is likely these data will be handled by the Australian Argo data team.

We are currently testing iridium-equipped APEX in our laboratory and hope to deploy these as a pilot in the upcoming 12 months.

Human resources: Australian Argo requires approximately 100% of a engineer and 75% of a technician for float checkout and preparation, test development; 50% of a fulltime operations officer for float shipping coordination and deployment training; delayed – mode data processing requires 150% fulltime data experts but we have been working on a large back-log and hope this level can be reduced as the processing becomes more routine.

4. Summary of deployment plans (level of commitment, areas of float deployment)



The above plots show deployment plans for floats in hand (acquired in fy06/07). Future deployments will target gaps in the Indian and SW Pacific, in coordination with other Argo groups operating in the region.

g) Argo data is downloaded to a local mirror once a week. It is then converted to a mat format with an index table to help users find the data they need. The data is being used as part of the BMRC Seasonal outlook and Temperature analysis, Blue Link ocean forecasting models, to study global sealevel rise and long term salinity changes and by numerous students. We are also incorporating it as a high quality background data field for our upper ocean temperature QC programs.

h) Blue Link model outputs and the BMRC Seasonal Outlook and Temperature analysis are two major products from Argo data in Australia. There are too many others to list.

5. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.

- Argo data are routinely used in the operational upper ocean analyses of Neville Smith at the Australian Bureau of Meteorology (<http://www.bom.gov.au/bmrc/ocean/results/climocan.htm>). These analyses are also used to initialize an experimental seasonal rain forecasting system.

- CSIRO Marine Research, in collaboration with the Bureau of Meteorology Research Center, has developed an ocean model/data assimilation system for ocean forecasting and hindcasting. Argo data is the largest *in situ* data source for this system. Work on subsurface profile assimilation is underway. PI: Andreas.Schiller@csiro.au
- Many students in the CSIRO/University of Tasmania graduate program are utilizing Argo data in their thesis studies. It's use is becoming widespread for studies of subduction in the Southern Ocean (Sloyan), generation of modern era climatologies (Ridgway and Dunn), ocean warming and its role in sea level rise (Church, Domingues, Wijffels), in ocean observing system studies (Oke and Schiller) etc.

Until Argo Australia is up-to-date in our DMQC we will not be actively developing a role in a regional data center. We will reconsider this issue towards the end of 2007.



Probe phones home

Missing sea robot turns up in fisherman's van

Glenis Green

ONLY the sheer determination of a CSIRO scientist has prevented a \$30,000 ocean robot from being turned into one of the Sunshine Coast's most unusual and expensive letterboxes.

The robotic profiler — which monitors ocean temperature and salinity — went missing late last year when it grounded on the sea floor off southeast Queensland and failed to surface as part of its routine cycle.

Scientists had almost given up hope of recovering the expensive device until January 20 when it unexpectedly resumed transmitting.

Surprised at the probe's reappearance, scientists were even more surprised when they pinpointed the source of the transmission — a fisherman's work van at Mooloolaba.

Mooloolaba prawn fisherman Robert Wilson, 45, had hauled the robot up in the turtle excluder in his nets from about 40m deep on January 20.

Heavily barnacled, scraped and filthy, the robot immediately resumed its normal 10-day transmission to the CSIRO and the Bureau of Meteorology.

But by that time it was in the back of Mr Wilson's blue work van. Thinking it was just a piece of abandoned flotsam, he had salvaged it for conversion into a nice, new letterbox using his angle-grinder.

That is where the story might have ended — if not for the self-confessed "sheer stubbornness" of Ann Thresher, based at CSIRO's Hobart headquarters.

Knowing only that the probe had suddenly popped up within a 1km radius of Mooloolaba, she joined scientists from Brisbane in the hunt.

"I took a radio direction finder and when it gets close you can hear it," she said. "The trouble is it only transmits for five hours every 10-day cycle."

Dr Thresher's search was frustrated by the fact the probe

was still in Mr Wilson's van and was constantly on the move.

By Tuesday, Dr Thresher said she was getting "a bit frantic" at not being able to home in on her prize.

"I was going to give up on it, but I just couldn't leave it alone. I couldn't leave unless I turned over every rock," she said.

Postponing her return flight to Hobart, Dr Thresher returned alone to Mooloolaba and decided to foot-slog the wharves and marinas with a photograph in the hope that a sailor or fisherman had seen the machine.

"Believe it or not, on the last vessel I got to, the crew recognised it and got in touch with Robert who brought it around," she said.

Dr Thresher said while data gathered in the past 18 months had been transmitted, finding the float meant its condition could be evaluated by CSIRO engineers.

"Rarely do we have the opportunity to recover the pro-

filers because they are mostly drifting with the remote currents in the ocean basin anywhere between the Arctic and Antarctica," she said.

Usually about 2800 of the robots are floating at any one time around the world.

As for Mr Wilson — he's philosophical about losing his potential letterbox.

"I didn't know what it was, no one seemed to know."

But unusual as it was, Mr Wilson said he had seen more interesting objects hauled up in the nets since he began working on trawlers at the age of 16.

"I've had pieces of aeroplanes, torpedoes, all sorts of things," he said.

Dr Dean Reemmich, from Scripps Institute of Oceanography, said the east coast of Australia was a place that the floats would occasionally travel thousands of kilometres to visit.



GONE fishing ... Brian Logan from CSIRO with the robotic profiler, above, fisherman Robert Wilson who snared the device in his nets, right.

Pictures: Glenn Barnes/Graeme Parkes