

# Argo Australia Report – 2008 Activities

Report to the Argo Steering Team, 2009

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## 1. Status of implementation

### Floats deployed and their performance

Between January 2008 and March 2009, Australia Argo deployed 81 Argo floats in Australian waters. Two of these had iridium transmitters and the rest had standard Argo transmitters. Australia currently has 229 operating floats though 5 of these are reporting suspect data that is not being distributed to the GTS. We have therefore exceeded the stated plan to have 180 operating floats by the end of 2009 and are well on our way to attaining the ultimate goal of 240 operating floats operated by Argo Australia in the South Indian, Pacific and Southern Oceans. Australian floats in Figure 1, below, are pink circles with a dot in the centre.

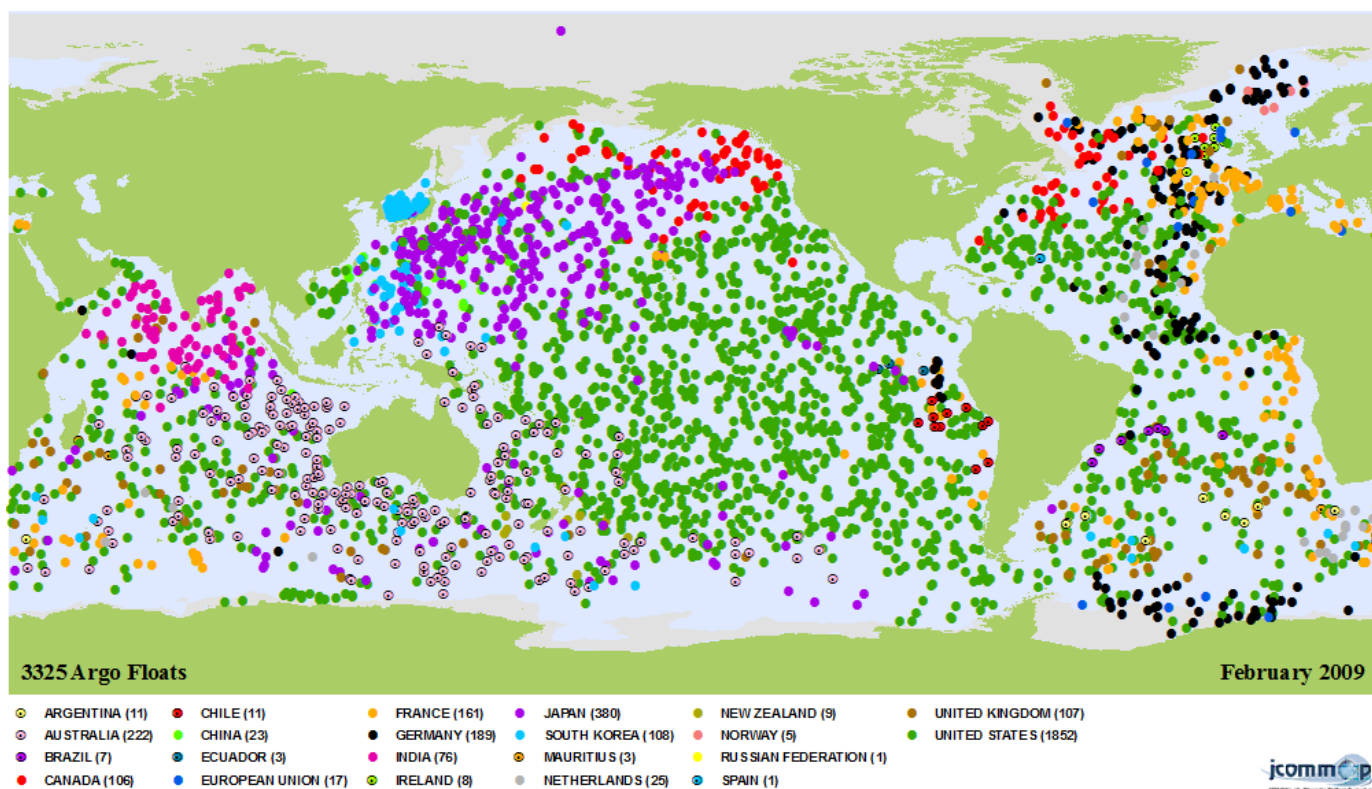


Figure 1. Location of active floats globally, colour-coded by country.

Webb Research Corporation has been sold to Teledyne and is now operating as Teledyne Webb Research. Operations continue as before and personnel have not changed. This stability is reassuring.

APEX performance in the Australian array has been excellent – we now have 14 floats that have operated for more than 6 years profiling to 2000db. These floats all have mixed alkaline/lithium battery packs encouraging us to hope that floats with full lithium packs will last even longer. Only 4 floats of that cohort have failed.

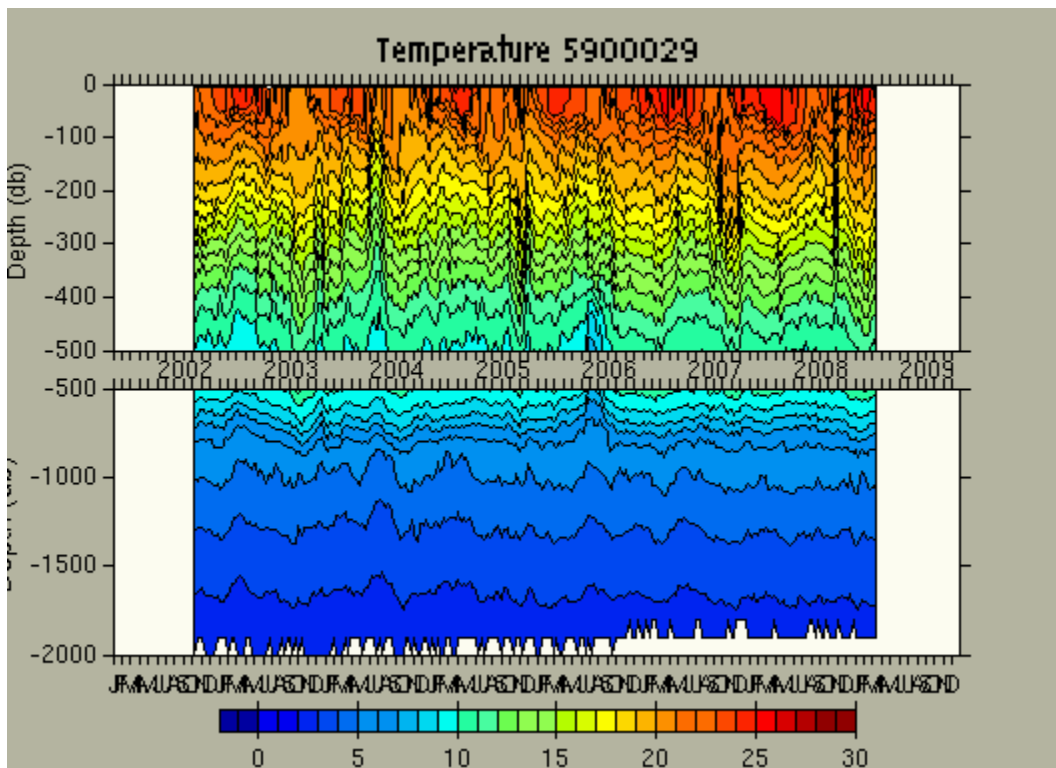


Figure 2: Temperature profiles from one of our first cohort of APEX installed with mixed alkaline-lithium battery packs, demonstrating continuous profiling to 2000db at low latitudes for over 6 years.

Following on from our experience with a bad batch of floats last year, all of that group have now failed to report after extremely rapid battery drain caused by a programming error. We have received 2 floats in compensation from the manufacturer.

Both iridium floats deployed are operating well – it is too early to assess any reliability or longevity difference between these and the Service Argos Floats.

A float that was picked up (unbeknown to us) in 2004 has been returned to CSIRO after spending the intervening years in a shed. This float also appeared to have a severe fault – it had failed to report after deployment and apparently drifted at the surface until washing up on King Island in Bass Strait, where it was found. When examined, it was clear that

the batteries were completely drained and the memory had been cleared. We are taking an in-depth look at this float and will eventually return the board to Webb Research for their input. It appears there was a catastrophic failure between the first profile and the test messages (which all were normal). Not even the Argos ID survived in memory so the float couldn't report. This was one of another batch of questionable floats. One other float from this group also disappeared immediately after deployment and we suspect a similar failure. Though this software/hardware version is no longer in production, it might well tell us something about failure modes and how to prevent it in future.

### **Status of contributions to Argo data management:**

The technical file naming scheme designed by Vito Dirita and presented at ADMT-9 by Ann Thresher has been approved subject to the GDACs implementing file format checkers that can handle the new format files. The Argo community has been extensively consulted about names and a final set has been defined. The software already generates the new format files and they are ready to be delivered.

*Real time processing:* This year, the big challenge for RT development was to adapt and deliver the Australian ArgoRT software to our Indian counterparts at INCOIS. Their software currently doesn't provide enough metadata in the right format to allow proper processing. Many of their files were incomplete or in error. By implementing ArgoRT, they will become compliant and can generate all the required files. This has been a long job but a successful one – currently 85% of their floats are being processed using ArgoRT. The remaining 15% are either Provor floats which can not yet be decoded by the software or a few floats with some problems that will be sorted out as soon as possible.

*An Analysis of Pressure Errors in APEX floats in the global array:* An analysis of the APEX fleet data was carried out (by Paul Barker) to identify profiles at the GDAC which were not corrected for reported drifts of surface pressure and also to identify those APEX floats which may have a negative drifting pressure sensor (but are uncorrectable due to truncation of surface reports). Diagnostic plots, float cohort lists and suggested actions were made available for DACs via ADMT-9 and the web. Currently DACs are working toward correcting these biases in floats with positive drifting sensors, which is an urgent issue. DACs need to also identify floats with possibly negative drifting sensors so that a list can be maintained at the GDACs for exclusion in certain global calculations (such as ocean heat content). A pressure-corrected December 2008 version of the Argo data set will soon be made available by CSIRO, once documentation of the problem is completed.

### **Status of delayed mode quality control process**

There are 20086 CSIRO profiles in total at the GDAC. Of these, 11467 are real time R files of which 3444 are eligible for processing (Figure 3).

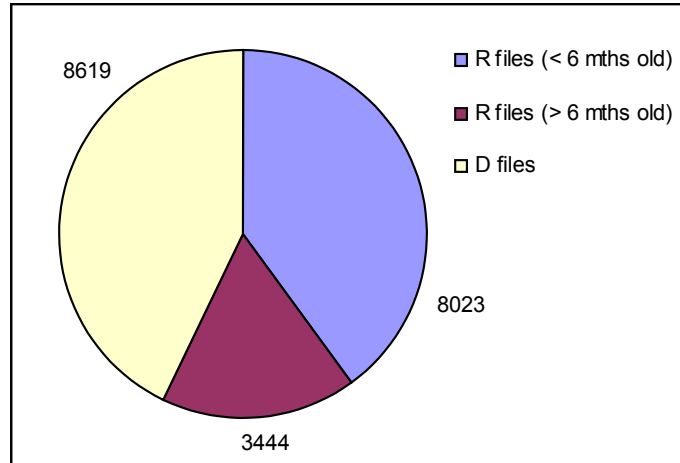


Figure 2. R files are real-time files, D files are delayed mode versions

CSIRO have currently processed 71% (8619) delayed mode files from a total of 12063 eligible files (i.e. those greater than 6 months old) (Figure 4).

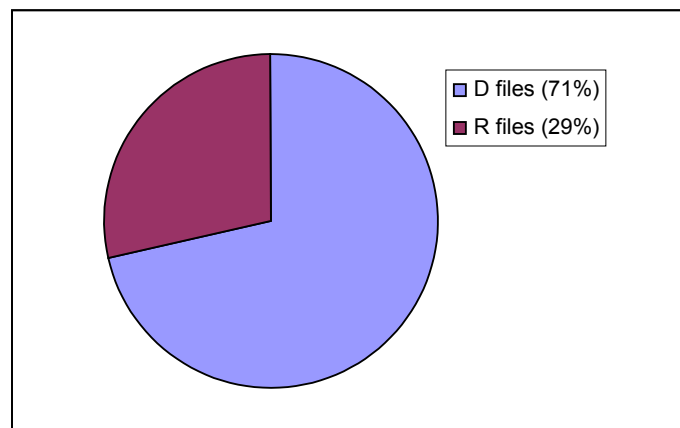


Figure 3. D and R are defined as for figure 2.

### Reference Data

We have developed an in-house software tool which uses nearby Argo data to help assess salinity drift in the delayed mode assessment. This tool is extremely useful in making decisions on salinity drift in historically data sparse regions such as the Coral Sea and the Southern Ocean and is now used routinely to assess drift for all Australian floats.

During 2009 we will implement OW and replace WJO in the delayed mode data processing stream. The intent is to include the new Argo CTD reference data set and the Argo profile reference data set when we make this transition.

### Resource/manpower

We currently have 1.5 people dedicated to DMQC. In the past year we have had a change of personnel in our Argo programming position and therefore, during the transition there

has been a delay in processing the backlog of profiles. Jeff Dunn was brought on board in late 2008 as the new DMQC programmer in order to streamline the delayed mode quality control process. His role involves rewriting and cleaning up existing code, writing and testing new software, website development, documentation and developing gridded Argo products. We expect that by July we will have our new DMQC processing system set-up and our backlog of profiles dealt with.

### **Documentation**

A considerable effort has gone into creating html documentation for each float. This is one third complete and these documents will be made available online to the Argo community as soon as the entire dataset is complete (most likely by June). An html template has been created which produces a single html file for each float containing all the relevant DMQC plots and including basic float specifications and a summary of overall data quality.

### **Outreach activities**

We are also creating and hosting a website to promote Argo to data users, the scientific community and the general public. There will be examples of Argo data, a "latest news" section with recent deployments and features including the new Iridium floats etc.

## ***2. Present level of and future prospects for national funding for Argo***

Over the past two years, Argo Australia has been part of the the Australian Government initiative: an Australian Integrated Marine Observing System (IMOS) for research infrastructure funded under the National Collaborative Research Infrastructure Initiative. Through IMOS, and if levels of support from our participating partners remains steady, Argo Australia will be funded at a 50-60 float/year level for 4 years to maintain an array of around 220-240 Argo floats. However, substantial resources are contributed by CSIRO and the Australian Department of Climate Change via the Australian Climate Change Science Program (ACCSP), which has an uncertain future.

*Human resources:* Australian Argo requires approximately 100% of an engineer and 75% of a technician for float checkout and preparation, test development; 50% of a full-time 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.

## ***3. Summary of deployment plans (level of commitment, areas of float deployment)***

Argo Australia currently has 66 floats either in the lab or on order. It is likely that we will order a further 40-50 before the end of the year, funded by IMOS and CSIRO. The map below (Figure 5) shows where deployment plans have been made for some of these, though 20 are still unallocated spatially and we will examine gaps before deciding where to put them.

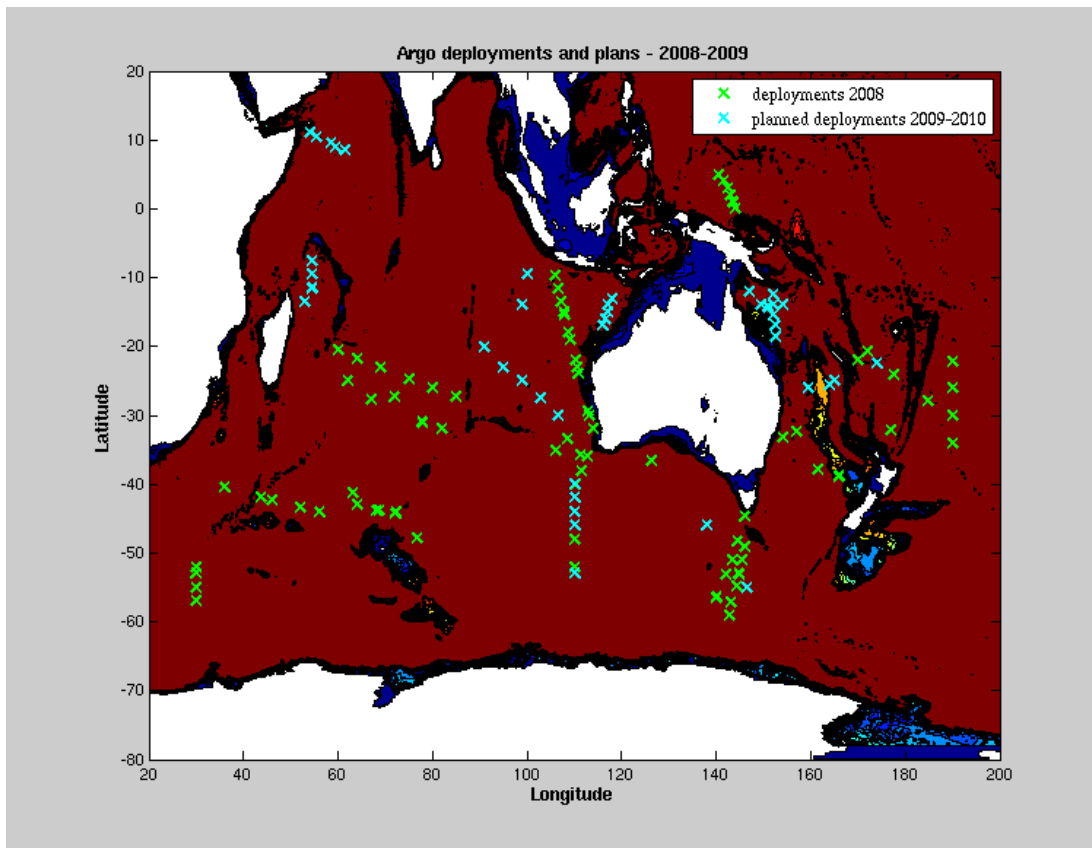


Figure 5. Locations of float deployments over the last year - green 'x'. Planned deployment locations of fiscal floats-on-hand or ordered- cyan 'x'.

#### **4. 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.
- The dynamical seasonal forecasting system POAMMA heavily uses Argo data – Oscar Alves, Australian Bureau of Meteorology
- CSIRO Marine and Atmospheric 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. Ocean forecasts and reanalysis products are now routinely published and are available via the Bureau of Meteorology website or the PI ( [www.marine.csiro.au/~griffin](http://www.marine.csiro.au/~griffin) ) : [David.Griffin@csiro.au](mailto:David.Griffin@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, Rintoul), generation of modern era climatologies (Ridgway and Dunn), ocean warming and its role in

- sea level rise (Church, Domingues, Wijffels, Barker), in ocean observing system studies (Oke and Schiller), Ocean salinity changes (Durack/Wijffels)
- Developing model-based gridding techniques to produce an Argo-gridded data set (Dunn, Oke, Tchen, Wijffels) and a new global Argo climatology

## ***5. Issues to be raised with the Argo Steering Team***

**Southern Hemisphere coverage:** While Argo has made tremendous progress internationally, the array density remains biased towards the Northern Hemisphere - coverage in the SW Indian and South Atlantic. We would like to see basin coordinators target these regions. Australia will endeavour to assist with deployment in these regions.

**Pressure Bias Corrections:** We urge DACs to urgently correct the pressure errors floats where possible and report floats with unknown pressure errors to the GDACs so that a list of these are available to users. Argo must be seen as a reliable means to track the global ocean heat content IN REAL TIME.