Argo: Monitoring the state of the oceans with a global array

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How does a profiling float work?

- **Descent to Drifting Depth**: ~1000m
  - ~10 hours at surface
  - ~8-10 days

- **Drifting**
  - ~8-10 days

- **Ascent, Recording Salinity and Temperatures**: ~10 hours

- **Descent to Profiling Depth**: ~2000m

**Total Cycle Time**: ~10 days
The data system turns a profiling float into an Argo float.

We are dominated by requirements set by UNCLOS-3.

For a float to be called an “Argo float” the data must be released in near real-time with an open-access data policy.

More than 90% of data are released within 24 hours on the GTS and within 48 hours on the Global Argo Data Centres.

The data sets served by the Global Argo Data Centres include data presently from 29 nations, with a single universal format and quality control system.
How big is Argo now?

3256 Argo Floats

December 2010

Argentina (10)
Australia (283)
Brazil (15)
Canada (129)
Chile (4)
China (49)
Ecuador (3)
European Union (13)
Finland (2)
France (169)
Gabon (1)
Germany (158)
Greece (1)
India (73)
Ireland (10)
Japan (269)
Kenya (4)
Mexico (1)
Netherlands (32)
New Zealand (9)
Norway (4)
Poland (0)
Russia (2)
Saudi Arabia (1)
South Africa (2)
Spain (11)
United Kingdom (109)
United States (1799)

Fisheries and Oceans
Pêches et Oceans
Profiling float based publications/year

2010 count as of January 6th 2011, probably not complete
Stratification at Ocean Station Bravo
(temperature using Argo floats)
JCOPE Ocean State Prediction

Analysis for 2\textsuperscript{nd} February 2010.

Prediction for 2\textsuperscript{nd} February 2010 initialised on 2\textsuperscript{nd} January 2010.
Improvement in ECMWF seasonal forecasting over the last decade. Where does the improved initialisation come from?

Ocean observations are as important as model improvements.

But this pretty diagram has a dark side to it.
Ocean observations are as important as model improvements.
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Some other sensors have appeared, notably D.O.

155 D.O. floats out of 3255
What is the future of the Argo Program?

• Argo was a product of the OceanObs’99 meeting.
• We have been doing Argo for the last decade.
• In September 2009 we* delivered a 10-year progress report to IOC/UNESCO at OceanObs’09.
• At that meeting we were asked to consider some changes and extensions.
• In fact we received a very large number of suggestions and I am grateful to Lynne Talley from Scripps who said “…it would be very dangerous to dump everything we want onto Argo.” I have to agree with her….

* “We” = The Argo Steering Team.
What is the future of the Argo Program?

The commonest suggestion was that:-

1) *Argo should be sustained and completed.*

This was especially popular among groups with responsibility for operational forecasting. The text above is taken from a white paper by Magdalena Balmaseda.

Can we do this? Right now the prospects look very bright particularly in the USA, European Union and Australia. Between them they account for about 83% of the effort required to sustain Argo.
What is the future of the Argo Program?

2. Recommended that Argo be extended to high latitudes, north and south of the design area (60°S to 60°N) and into marginal seas. This is already under way.
What is the future of the Argo Program?

3. Recommended that Argo increase concentration of floats in boundary current regions. This has been done in the Kuroshio as an add-on to Argo and we will always welcome such projects that enhance Argo in areas that are of specific interest.
What is the future of the Argo Program?

4. Recommended that Argo extend into the abyssal ocean. Not doing this yet, but we are working on it.

North Pacific deep warming – Fukasawa, Freeland et al, 2004

South Atlantic deep warming – Johnson and Doney 2006
What is the future of the Argo Program?

4. Recommended that Argo extend into the abyssal ocean. Not doing this yet, but we are working on it.

This is what a 10% subsample might look like.
What is the future of the Argo Program?

5. Recommended that Argo supply faster vertical sampling to allow computation of Thorpe Scales. This will happen naturally at little cost.
What is the future of the Argo Program?

6. Recommended that Argo floats measure temperature to the surface - currently we stop at 4 metres below the sea surface to avoid contaminating the CTD. This we believe can be done at almost zero cost.

7. Recommended that Argo floats measure salinity to the surface - currently we stop at 4 metres. We see no means of doing this broadly at a cost that will not damage the Argo array – needs a sacrificial CTD. A few of these are being deployed in support of the Aquarius mission.
What is the future of the Argo Program?

8) Finally the hard one – add bio-geochemical sensors. We are not anxious to do this, for several reasons.

a) The cost is high.

b) This will cause us to stress the Law of the Sea too far. (Sampling biology definitely is MSR and is sampling the natural resources of the coastal state.)

c) Not all proponents appear ready to adopt the Argo model of global unfettered access to real-time data.

d) It is not immediately apparent that there are any suitable sensors, other than P, T, S and D.O. ready for use.

e) It is not immediately apparent that quality control methodologies exist for bio-geochemical sensors.
It appears that Argo will be around for a long time to come – the data are yours, please use them,

Thank you for listening....
The last 10 years has been a blast!