The ARGO 21st century in situ ocean observing system

Argo is a new method of collecting information from the upper ocean using a fleet of robotic floats. Argo data complement other in-situ observations (many restricted to shipping routes) and data from earth-observing satellites. The main Argo data uses are in operational ocean and climate forecasting and in oceanographic and climate research.

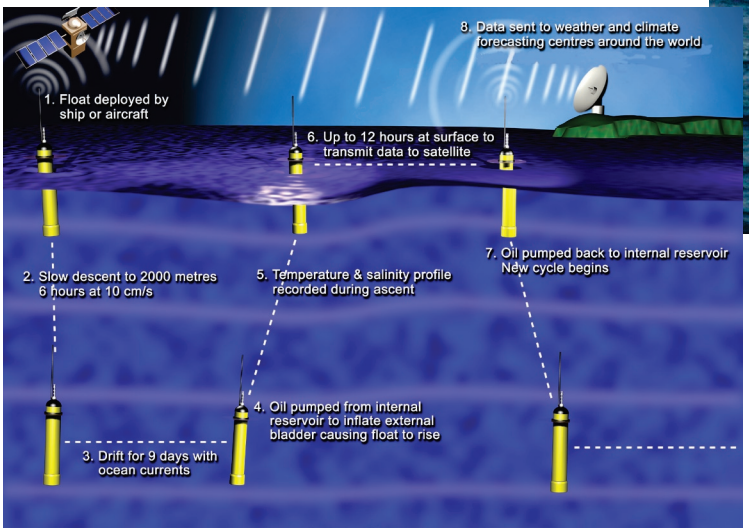
Argo floats drift at depths between 1 and 2km. Every 10 days each float surfaces and measures a profile of temperature and salinity. These data and the float's position are transmitted to satellites and the float then dives to start a new cycle. The 3000 float Argo array (spaced about 300km apart) will deliver 100,000 profiles per year. Over 25% of the array is now operating. Completion is expected by 2006.

Why are Argo data needed?

The oceans have a remarkable capacity to transport and store heat. Three metres of ocean has the same heat capacity as the entire atmosphere. Observations of changes in the distributions of heat and fresh water (through measuring salinity changes) over seasons and longer-periods are essential for understanding the oceans' role in climate and for forecasting climate and ocean conditions due to both natural variability and to human influences. Argo has the unique capacity to provide these measurements throughout the ice-free regions of the deep ocean and especially at high latitudes in winter. The sub-surface drift enables the currents that transport heat and water to be estimated across entire ocean basins.

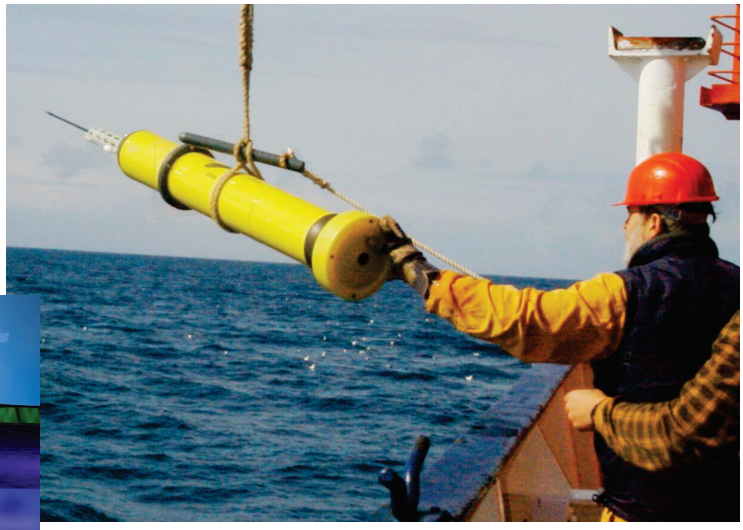
Argo is sponsored by the World Climate Research Programme's Climate Variability and Predictability project (CLIVAR) and by the Global Ocean Data Assimilation Experiment (GODAE). It is a pilot project of the Global Ocean Observing System (GOOS).

How do the floats work?



The operating sequence of an Argo float
(Courtesy of Southampton Oceanography Centre, UK)

The floats stay at depth because their compressibility is less than that of seawater. They rise to the surface by pumping fluid from inside the instrument to an external bladder. When it is time for the float to dive the fluid is drawn back inside the float. The float concept originated in the 1950s and the profiling capability was developed and used widely during the 1990s. Ensuring reliable operation and data quality during the floats' 3-4 year (150-200 cycle) lifetime is a major challenge. Floats can be deployed from research or commercial ships and from aircraft.



Launching a float
(Courtesy of IfM Kiel, Germany)

Argo and Jason

Argo's main partnership in observing the ocean is with satellite altimetry. Radar altimeters reveal the shape of the ocean surface as it is influenced by currents and by heat storage. A succession of such satellites (ERS, Topex - Poseidon and now Jason and ENVISAT) have partnered profiling floats. Jason-2 and the coverage from a new generation of wide swath altimeters is awaited.

What happens to the data from the floats?

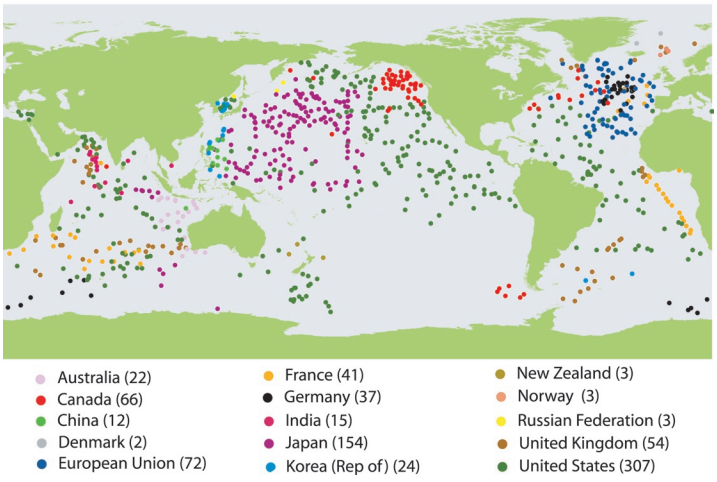
Some users (for example operational forecast centers) need information within 2 days. They receive Argo data via the meteorological Global Telecommunication System (GTS). Others retrieve data from two global data centers at Monterey in the USA and at Brest in France. For some climate and oceanographic applications a delay of several months is acceptable and during this time scientists and regional data centers carry out detailed quality control of the salinity data. Unrestricted access to data is a fundamental principle of Argo.

Who makes the floats, how much do they cost?

Most Argo floats are made by commercial companies in North America and Europe but some are manufactured by research institutions. Two prototype designs are being evaluated in Japan and China. Each float costs around US$15,000 and communication, deployment and calibrations costs approximately double the through-life cost of each float. Thus each profile costs approx $200.

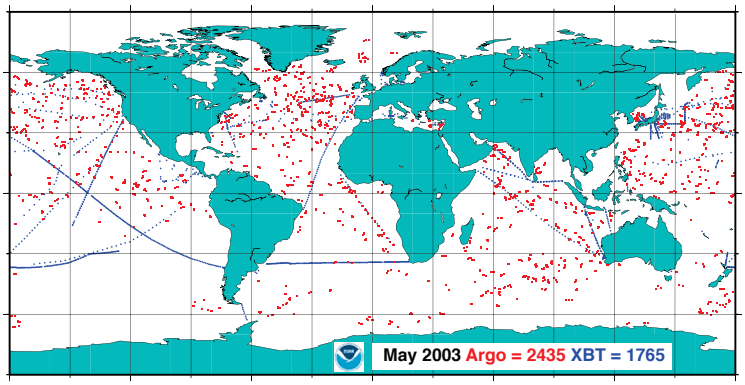
How is the Argo project operated and funded ?

Although Argo is planned internationally, it is funded through national programmes. The present float array is contributed by 14 countries and the European Union.



National contributions to Argo June 2003 (815 floats)
(Courtesy of the Argo Information Centre)

Project planning is the responsibility of the Argo Science Team (AST) whose members representat the contributing countries and other experts. An Argo data team addresses issues of data management. Each country has its own regional priorities and organisational structure but all are committed to building the global array. An Argo Information Centre monitors the development of the array in particular on issues relating the floats operating in Exclusive Economic Zones.



Global distributions of Argo and high-density XBT data in May 2003. XBT data are temperature only profiles from ships and typically reach only 750m. All observations shown here were available to users within 48hours.
(Courtesy NOAA - AOML, USA)

Next steps

Argo is new and innovative. Scientific, technical and operational evaluation of the programme will provide improvements to the project and to the accessibility, quality and usefulness of Argo data. Outside the Argo project. profiling floats are being used to collect a range of additional physical, chemical and biological measurements. New communication methods are being evaluated to provide faster data transfer, more detailed profiles and two-way communication.

Argo is growing rapidly and will soon become the central element of the Global Ocean Observing System and the major source of ocean profile data. Argo requires countries to commit to sustained funding so that the array can be completed and then maintained beyond 2006. Present estimates of float life imply that 825 float deployments/year will be needed to maintain the array – a total cost of the order of $20-25m per annum.

Argo information sources

- Argo Science Team — www.argo.ucsd.edu
- Argo Information Centre — argo.jcommops.org
- Commercial float manufactures — www.webbresearch.com, www.metocean.com, www.martec.fr
- Satellite altimetry — sealevel.jpl.nasa.gov, wwww.aviso.oceanobs.com
- Argo data sources — www.ifremer.fr/coriolis/cdc/, www.usgodae.fnmoc.navy.mil/argo/argo.html
- CLIVAR — www.clivar.org
- GODAE — www.bom.gov.au/bmrc/ocean/GODAE
- GOOS — ioc.unesco.org/goos/
- History of float development — www.soc.soton.ac.uk/JRD/HYDRO/argo/history.php

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