Argo - A global array of profiling floats for climate research and part of the legacy of WOCE.

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International and national planning continues to advance toward deployment of a global array of temperature/salinity profiling floats, known as Argo, beginning in 2000. Conceptually, the Argo array is a descendent of WOCE hydrographic, float and expendable bathythermograph (XBT) sampling networks. Profiling float technology was developed as part of WOCE, first to observe the reference velocity field at mid-depth (Davis, 1998), and later to include vertical profiling of temperature and salinity. Large-scale float deployments in the Pacific, Indian and Atlantic Ocean were integral to the WOCE sampling strategy. The Argo network is a major part of WOCE's legacy in an integrated ocean observing system for climate.

Argo is designed (Argo Science Team, 1998) to evolve from the upper-ocean thermal networks sustained by WOCE and TOGA in a way that preserves and greatly expands their value. The present networks have provided a wealth of information on the ocean's role in climate variability through heat storage and heat transport, and have proven valuable in initialization of successful seasonal to interannual forecasts in coupled models. However, serious limitations to further advances include poor spatial and temporal coverage over much of the globe, insufficient depth range and accuracy of XBT data, and a lack of systematically repeating salinity measurements. These limitations are removed by the new float technology.

Argo will provide over 80,000 T/S profiles per year from about 3000 floats distributed over the global oceans (Fig 1) cycling to 2000 m depth every 10-14 days. In addition to profile information, the float trajectories will determine the absolute flow field at a reference depth. The new generation of floats can have a profile depth that is different from the parking depth, and both can be variable from profile to profile. At its meeting in March, 1999, the international Argo Science Team discussed these and other practical issues such as deployment techniques and strategies, communications, salinity accuracy and stability, power budgets, costs, and data system development (Argo Science Team, 1999). All Argo data will be publicly available in near real-time via the GTS. A scientifically quality-controlled data stream will be available from the data centers with a delay of a few months.

The Argo measurements of temperature, salinity, pressure and reference velocity, together with sea surface height from satellite altimetric data, form a dynamically complete description of the upper ocean. The high degree of synergy between float and altimetric data gives rise to the name Argo, chosen to stress the complementary relationship of the float array with the next generation Jason altimeter. Floats provide the subsurface vertical structure of temperature, salinity and velocity fields that is needed for successful interpretation of sea level variability. In turn, the excellent spatial and temporal sampling characteristics of the altimeter allow this description of the physical state of the ocean to be extended to short spatial and temporal scales that are beyond the capability of an in situ observing system.

A broad-scale global array will require about 4 years to implement from the time of the initial deployments in 2000. Global coverage should be achieved during the Global Ocean Data Assimilation Experiment (GODAE), which together with CLIVAR and GCOS/GOOS, provide the major scientific and operational impetus for Argo.

Once it is implemented, the Argo array should be maintained for at least 10 years provided that regular ongoing assessments of its impacts on ocean observation, assimilation and forecast systems are positive. Over a 10-year period, the principal accomplishments of the array are expected to be the following:

(1) Produce an accurate global climatology, with error bars and statistics of variability and valid for the specific period of the array, of monthly mean temperature and salinity as a function of depth.
(2) Produce accurate time-series of heat and freshwater storage (globally) and of the temperature/salinity structure and volume of the world's intermediate and thermocline water masses.
(3) Provide large-scale constraints for atmospheric model-derived surface heat and freshwater fluxes.
(4) Complete the global description of the mean and variability of large-scale ocean circulation, including interior ocean mass, heat and freshwater transport - the equivalent for large-scale ocean circulation of a real-time synoptic upper ocean WOCE.
(5) Determine the dominant patterns and evolution of interannual variability in temperature and salinity, e.g. for analysis of coupled modes of air/sea interaction. Discover other ENSO-like phenomena in the global oceans and their impact on improvement of seasonal-to-interannual atmospheric forecasts.
(6) Provide global maps of the absolute height of the sea surface, with accuracy of about 2 cm on periods of a year and longer - allowing Jason(altimeter)/Argo combinations to examine a broad range of space- and time-scales.
(7) Enable the interpretation of (altimetric) sea surface height by determining the statistical relationship between sea surface height and subsurface temperature and salinity variability.
(8) Directly interpret sea surface height anomalies - for example due to global sea level change, El Nino, etc. - by separating them into contributions due to the effects of (i) E-P, (ii) differential heating and cooling, (iii) advection of heat and freshwater, and (iv) wind-driven redistribution of mass.
(9) Obtain an unprecedented dataset for model initialization, data assimilation and dynamical consistency testing of the next generation of global ocean and coupled models.
(10) Enable realistic operational real-time global ocean forecasting for the first time.

The Argo array will evolve over time as better knowledge of sampling requirements is obtained from data analysis and assimilation and as technology progresses. Instrumentation developments in the near future may include floats with selfpositioning ability (gliders) for time-series or transect measurements and new sensors such as bio-optical ones. The array must be adaptable to value-adding developments while maintaining continuity in its basic broad-scale physical sampling.

International planning for Argo, including global sampling issues as well as technical planning, is coordinated by the Argo Science Team. Nations having national Argo plans that include float procurement or production and deployment include Australia, Canada, France, Japan, U.K., and U.S.A., plus a European Union proposal. Combined deployments from these nations are expected to exceed 700 floats per year by 2002. Broad participation by many nations is anticipated and encouraged either through float procurement or through logistical support for float deployment and through analysis and assimilation of Argo data.

For more information: a web site for Argo is planned, and interim information is circulated to any interested parties through an email subscription list. To subscribe, send mail to listserv@sio.ucsd.edu with the body of the message including:
subscribe (my_address) argo_info
where (my_address) is replaced by email address to be subscribed.

References

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