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An Integrated System for Real-Time CTD Profiling Float Data on Basin Scales

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LONG-TERM GOALS

This award, together with those at our partner institutions (see below), initiated the U.S. component of the international Argo Project, via the National Ocean Partnership Program (NOPP). By late 2005, Argo will deploy a global array of 3000 profiling CTD floats (Argo Science Team, 1998, Roemmich et al, 2002), plus a data system that will make all Argo data available to both operational users of real-time data and to scientific users of a high-quality data stream. The Argo array will provide unprecedented real-time views of the evolving physical state of the ocean. It will reveal the physical processes that balance the large-scale heat and freshwater budgets of the ocean and will provide a crucial dataset for initialization and assimilation in seasonal-to-decadal forecast models. Argo is a major initiative in oceanography, merging research and operational objectives to provide a uniquely valuable global dataset for climate science and other applications.

OBJECTIVES

Phase I of U.S. Argo (this award) provided 55 profiling floats in the tropical Pacific and Atlantic Oceans. The SIO part of this included 22 floats, most in the tropical Pacific (Fig 1). These floats were to demonstrate technological capabilities for fabrication and deployment of arrays in remote ocean locations. Recent technology developments were also implemented during this deployment. New generation salinity sensors were utilized for improved data quality. Capability for float deployments from fast ships and aircraft were further developed to ensure that the Argo array can be successfully installed globally without dependency on dedicated research vessels. We also participated in the development of the Argo data system, in partnership with NOAA/PMEL and NOAA/AOML, through development of procedures for delayed-mode quality control of profiles from SIO instruments.

RESULTS

Float production and deployment. The 22 SIO/Argo floats were fabricated and deployed as planned, and their trajectories to date are displayed in Fig 1. Performance of these instruments has revealed a failure mode affecting some SOLO floats after about 30-40 cycles (1 year). Extensive redesign of the float pumping system and replacement of the float controller has been carried out, with additional

modifications to increase the ruggedness and reliability of SOLO. These technnology improvements are essential parts of Argo's development in order to meet targets for float lifetime and performance.

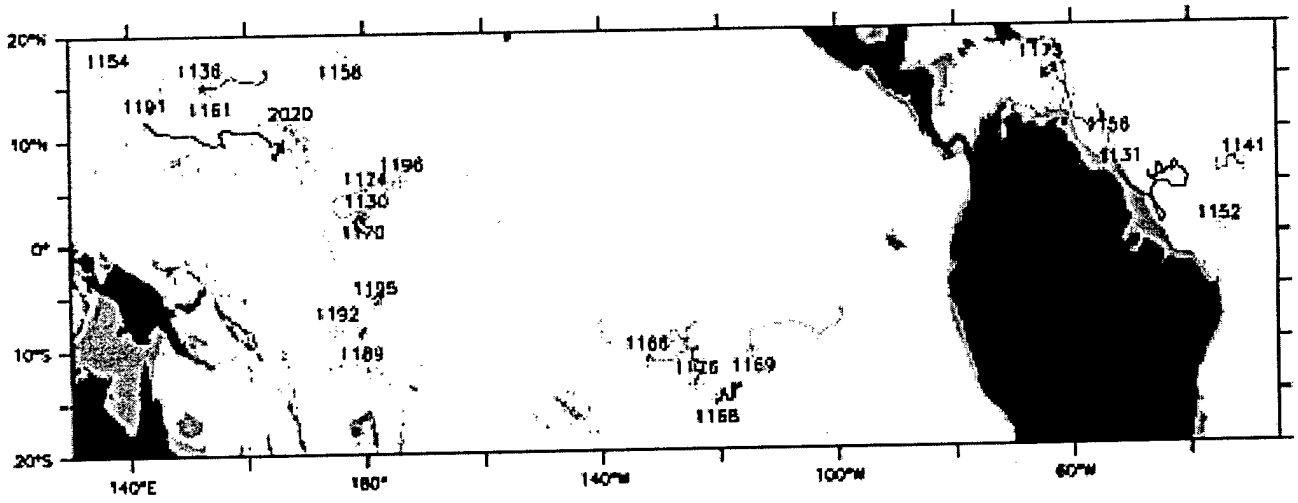

Fig 1. Trajectories of the 22 SIO/Argo floats deployed in Phase 1 of U.S. Argo. Deployment locations were coordinated with other U.S. and international Argo programs. For positions of the present Argo array of 577 active floats see http://argo.jcommops.org.

Deployment technique. A system was developed and tested for underway deployment of SOLO floats from Volunteer Observing Ships at speeds of 20+ knots. Six of the SIO/Argo floats were successfully deployed from M/V Nacre (15 knots) and S/S CSX Enterprise (22 knots). Floats are lowered in bio-degradable padded cardboard boxes that are automatically released from a harness on contact with the water.

An air deployment system for SOLO floats has also been developed and successfully tested. This is awaiting a final live instrument test and certification by NAVOCEANO.

Data throughput and quality. All of the data from these floats has been subjected to real-time quality control procedures established by the Argo Data Management team, then formatted in TESAC messages and sent over the GTS. With most profiles, this has been done within 24 hours of data collection. The near real-time data are forwarded in NETCDF format from the U.S. Argo Data Center at NOAA/AOML to the two global Argo Data Centers at IFREMER (France) and FNMOC (Monterey).

The new generation salinity sensors tested and deployed during Phase 1 have proven to have high stability in long-term deployments. As an example, SOLO float S/N 1166 - one of the first Argo instruments deployed - has completed 87 cycles and is still active. Its SBE salinity sensor has slowly drifted by 0.06 psu (fresher) over 28 months (Fig 2). An automated system for correction of slow

salinity drift has been developed by U.S. Argo partners at NOAA/PMEL (Wong et al, 2002). Salinity performance from SOLO Float 1166 is typical, and the small drift is correctable using stable deep T/S.

All Argo data are publicly available from either of the two global data centers. See http://www.ifremer.fr/coriolis or http://www.usgodae.org

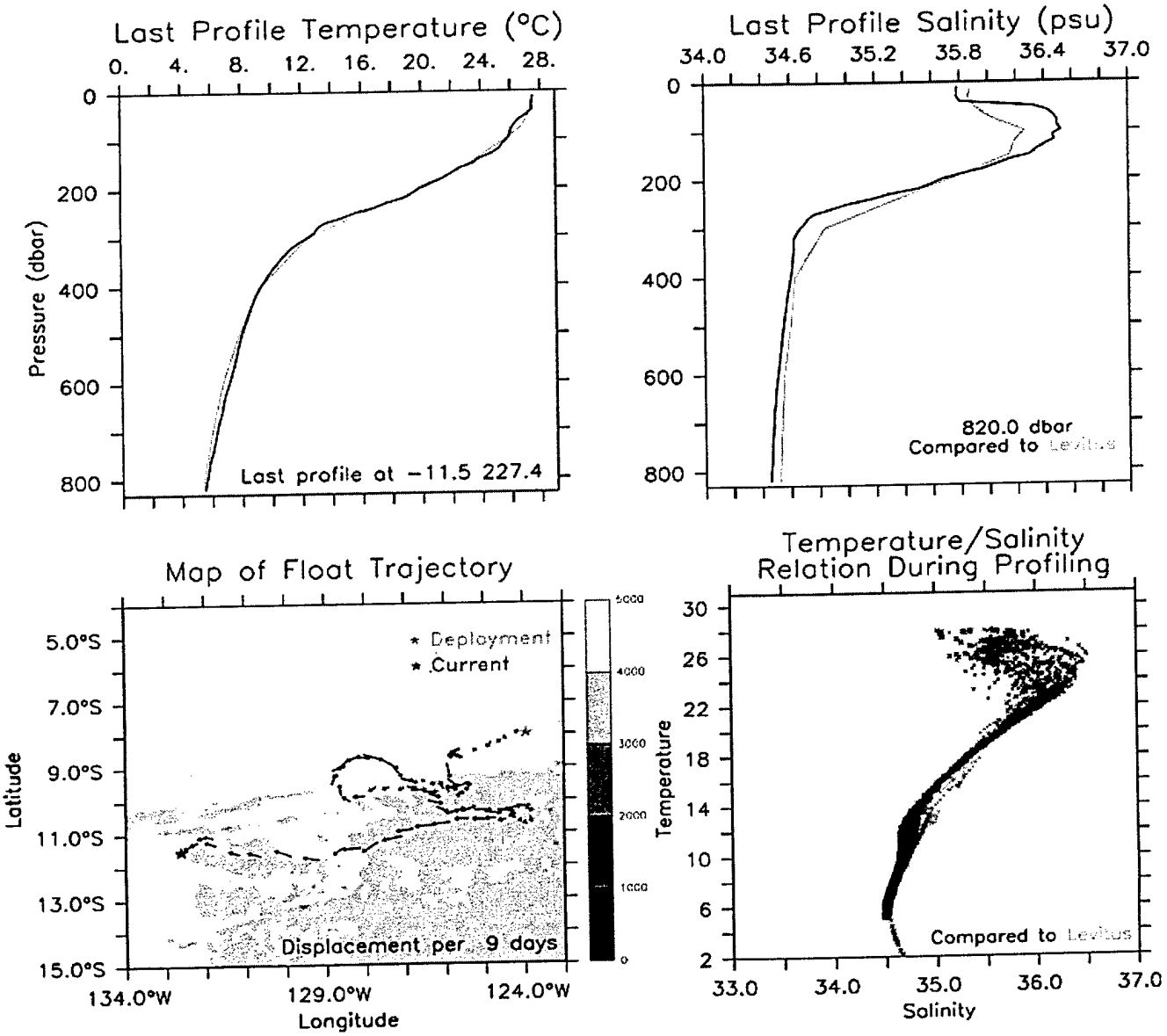

Fig 2. Raw data from SIO/Argo float 1166 (see http://sio-argo.ucsd.edu), showing the most recent profile (upper panels), trajectory (lower left) and T/S data from all 87 profiles. Slow drift of the salinity sensor, by 0.06 psu over 28 months, is correctable using procedures described by Wong et al (2002).

National and international collaborations. During Phase 1 of Argo we built the national and international partnerships that are essential for deployment and maintenance of the global Argo array in the coming years. The U.S. Argo partnership is poised to deploy 500 floats during calendar 2003,

taking advantage of improved technical designs and an Argo Data Management system that is nearly complete. The international Argo Science Team (chaired by D. Roemmich) coordinates the activities of 15 float-providing nations, and international Argo is on target for full implementation of the array by the end of 2005. As of November 2002 there are 577 active Argo floats (http://argo.jcommops.org).

IMPACT/APPLICATION

Demonstration of the ability to deploy and maintain large-scale profiling float arrays in Phase I and II of U.S. Argo, as well as the public distribution of real-time datasets has confirmed the practicality and feasibility of the global Argo float program. Utilization of the Argo profiles in regional-to-global data assimilation systems will confirm its value. Argo partners are presently focused on early results showing the value of Argo data in regional arrays.

The rationale for the global float array, and its impacts are described in Roemmich and Owens (2000) and Roemmich et al (2001). The present status of the array and plans for implementation and data utilization are discussed in Roemmich et al (2002).

RELATED PROJECTS

1 – Other float-providing principal investigators in the NOPP U.S. Argo project are B. Owens of Woods Hole Oceanographic Institution and S. Riser of University of Washington.

2 – Lead principal investigators responsible for building the U.S. Argo Data System are R. Molinari of NOAA/AOML (Argo Data Center, real-time data stream) and G. Johnson of NOAA/PMEL (delayed mode quality control).

3 – A variety of data assimilation projects are dependent on successful deployment of the Argo array, including assimilation research activities under NOPP as well as operational modeling in the Navy and NOAA and modeling progams in partner countries as part of the Global Ocean Data Assimilation experiment.

4 – Argo float-providing partner countries in addition to the U.S. include Australia, Canada, China, Denmark, European Union, France, Germany, India, Japan, Korea, New Zealand, Norway, Russia and the U.K. (http://argo.jcommops.org).

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