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Observations for climate: Global ocean temperature, salinity and circulation measured by the Argo Program

Dean Roemmich[†]; Silvia Garzoli; Gregory Johnson; W Owens; Stephen Riser
[†] University of California San Diego, USA
Leading author: droemmich@ucsd.edu

The Argo Program is transforming large-scale oceanography by implementing and sustaining systematic global ocean observations. Global coverage with Argo profiling floats was achieved in 2004 and the target of 3,000 active floats has been maintained continuously since 2007. Argo provides free and unrestricted access to its 100,000 temperature/salinity profiles every year through an innovative data management system, delivering near real-time data in less than 24 hours and high-quality data for climate research in delayed-mode. Argo has observed the mean state of the ocean with unprecedented accuracy, while providing the first global views of time variability in the subsurface ocean. The Argo array is a subsurface counterpart and a complement for satellite missions observing sea surface height, ocean wind-forcing, ocean mass, and sea surface temperature and salinity. Its global coverage enables integration of the ocean observing system - repeat hydrographic and XBT transects, moorings and time-series stations, surface drifters, and air-sea flux measurements - together with the satellite measurements of the sea surface, for a dynamically complete description of the physical state of the oceans. Argo is implemented by a multi-national partnership, with over 30 nations contributing floats, logistics, and data management in oceanography's most internationally collaborative effort ever. U.S. Argo plays major roles in the partnership, ensuring global coverage, developing advanced float and sensor technologies, and sharing leadership roles with international partners in data management and program coordination. In the coming years, Argo will expand its sampling capabilities for better coverage in the high latitudes, marginal seas, and boundary current regions, and to include the deep ocean below 2000 m. Additional sensors, for dissolved oxygen, nutrients, pH, and bio-optical measurements will enable observations of the biogeochemical impacts of climate variability and change in the oceans. The Argo Program contributes to climate research through several areas of application. Basic research using Argo data has grown rapidly to over 200 publications in 2010 alone, on topics including water mass properties and formation, air-sea interaction, ocean circulation, mesoscale eddies, ocean dynamics, and intra-seasonal to multi-decadal ocean variability. Second, Argo is the core subsurface dataset for ocean data assimilation modeling, used by modeling centers around the world in ocean reanalyses and for initializing seasonal-to-decadal prediction. Finally, the use of Argo in secondary and tertiary education is growing rapidly, as students anywhere in the world can now explore the global oceans from their desktop.