SUSTAINED OCEAN OBSERVATIONS FOR 30 YEARS USING ARGOS

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ABSTRACT

Since the late 1970's oceanographers, meteorologists and climatologists have used the satellite-based Argos system to report in-situ observations collected by a wide-range of buoys, fixed stations and profiling floats. These data have made significant contributions to our ability to describe, understand and predict global climate and weather on all space and time scales. These global in-situ data collection platforms represent essential core elements of the international Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS). These platforms, reporting their data via Argos, have formed the backbone of international weather and climate programs for almost 30 years and through GCOS and GOOS in particular, will play a substantial role in the implementation of the Global Earth Observing System of Systems (GEOSS). This poster will illustrate the significant role Argos has played in the evolution of ocean observing systems during the last few decades, as well as how the new generations of Argos systems are positioned well to serve the satellite-based data collection needs of GEOSS interdisciplinary science.

1. Introduction

In the late 1970's an international cooperative program called Argos was created among CNES (the French Space Agency), NOAA (the U.S. National Oceanic and Atmospheric Administration) and NASA (the National Aeronautics and Space Administration). Developed by CNES, Argos is a unique satellite-based data collection and location system dedicated to understanding, preserving and protecting the global environment. Created long before the arrival of the personal computer and well before the Internet changed everything, Argos provided a giant leap in global data communications that has remained healthy and effective to this day. In the early years the Argos system enabled the ocean and meteorological scientists to think beyond the limited ship-borne, expensive in-situ measurements to the possibility of large arrays of autonomous platforms covering the world oceans and reporting their data in real-time back to their laboratories. Keeping pace with both the scope of the evolving science and with the volume and sophistication of the required observing platforms is a challenge that Argos has accepted and continues to meet.

2. The Argos Contribution

During the last three decades our global oceanographic-meteorological community has: developed the capability to monitor ENSO and to predict the onset of El Nino events in the tropical Pacific, systematically increased the skill level of our predictions on both weather (3-5 days) and climate (seasonal-to-interannual) time scales, improved hurricane predictability through increased understanding of air-sea mixing associated with the passage of a hurricane, developed the capability for 3-D hindcast – nowcast-forecast of the global ocean, and implemented marine environmental safety services such as "Eddy Watch" in the Gulf of Mexico. A common thread through all of these achievements is the visionary French-U.S. cooperative satellite data collection and location system called Argos and its unparalleled contributions to advancing ocean and atmospheric science. The Argos system is a transatlantic model for 30 years of successful intergovernmental cooperation in support of the environment.

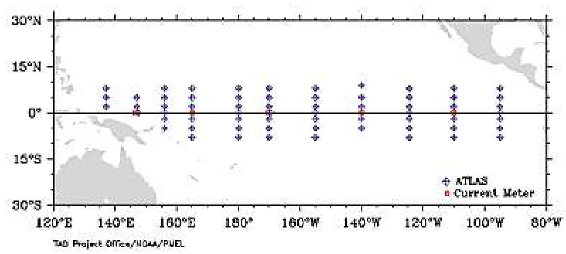
3. The Evolving Observing Systems

In 1964 the Marine Technology Society convened its first symposium which was focused on *"Buoy Technology, An Aspect of Observational Data Acquisition in Oceanography and Meteorology."* In the keynote address for that Symposium, Dr. Athelstan Spilhaus spoke of how the Symposium "…will be discussing of how time series measurements of different variables can contribute to wave measurement, temperatures, currents, chemicals, fisheries, and even the assessment of the biogeography of the sea," and how it "…should lead to buoys that may take meteorological observations as well as oceanographic, ….down into the deep water by sensors which travel up and down below the buoys." He also spoke of "…important special uses for free-floating buoys, but we must discuss how to track and locate them…"

The technology of the early 1960's reflected at this meeting included an 18,000 pound moored buoy requiring 7 kW of 110 volt AC power to operate the buoy and its data recorders, and HF radio link experiments sending PCM/FM/SSB transmissions between San Diego and Hawaii. It would still be another 15 years before satellite-based data retrieval would be a reality.

In the 1970's, large scale met-ocean experiments like GARP, GATE, and FGGE provided the motivation to improve in-situ observing capabilities. The observation of ocean currents by following surface buoys in the open ocean captured the imagination of oceanographers. An important result of the planning and implementation of experiments like GARP was that the problems of atmospheric physics and of the physics of the ocean, applied mathematics and computer engineering, and the technical problems of observation systems, began to be addressed in a coordinated way. Argos was there to provide a global, low-cost, simple, low-power satellite-based telemetry link to satisfy the needs of these new observing methods for the ocean and the atmosphere.

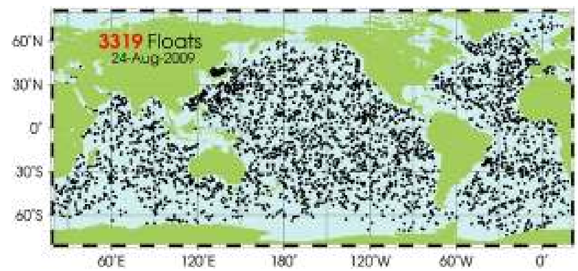
The TOGA (Tropical Ocean Global Atmosphere) Program and the World Ocean Circulation Experiment (WOCE) in the 1980's, motivated scientists to develop a moored buoy array in the Tropical Pacific to



TAO Array, ***Argos Newsletter #53, August 1998***

monitor ENSO signals and to develop a global array of lightweight, low-cost drifters to obtain an accurate instrumental record of the ocean circulation. Many hundreds of drifting and moored buoys were equipped with Argos transmitters that allowed the buoys to be located on the ocean as well as routinely transmit the much needed ocean and atmospheric parameters back to shore.

In 1974 the U.S. National Academy of Sciences recommended the establishment of a network of automatic data buoys to monitor synoptic-scale fields of sea level pressure, surface air temperature, and ice motion throughout the Arctic Ocean. Based on the Academy's recommendation, the Arctic Ocean Buoy Program was established by the Polar Science Center (PSC), Applied Physics Laboratory-University of Washington, in 1978 to support the Global Weather Experiment. From this evolved the IABP (International Arctic Buoy Program) which today is composed of 20 different research and operational institutions from 9 different countries. Because Argos flies on polar orbiting satellites it has excellent coverage of the poles and has been the data communications system of choice by the IABP members for nearly two decades.



Argo Float Positions on August 24, 2009

Observational oceanography took a major step forward when the Argo Program was conceived. The idea of autonomous platforms "patrolling" the global ocean had been proposed multiple times over the years by forward thinking oceanographers. The idea became tangible in 1999 with the implementation of Argo. Today there are more than 3,300 Argo profiling floats sampling the upper 2,000 meters over the world's oceans and nearly all of these floats communicate their data via the Argos system.

4. International Planning and Coordination

The global in-situ data collection platforms outlined above represent essential core elements of the international Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS). These platforms, reporting their data via Argos, have formed the backbone of international weather and climate programs for almost 30 years and now, through GCOS and GOOS in particular, will play a substantial role in the implementation of the Global Earth Observing System of Systems (GEOSS).

5. The Argos technology and the Future

Beginning with the TIROS-N satellite in 1978, and most recently NOAA-19 in February 2009, eighteen Argos systems have been successfully launched. Six of these are currently in operation. Starting with very simple, low bit-rate, one-way random access transmission protocols, Argos is now in its third generation with high data rate (4,800 bits per sec.) capability, two-way communications, error-free message acknowledgement by the satellite, plus platform-based satellite pass prediction capability to enable satellite-platform rendezvous and thus minimize power consumption.

Responding to continually expanding user requirements, CNES is now developing the fourth generation Argos system. Argos-4 has two main objectives: **I.** To ensure the location and data collection mission continuity on meteorological polar satellites over the period 2014-2022 , and **II.** To improve the Service offered to the users and to fulfil their needs at least until 2022. Specifically, the Argos-4 developments are aimed at providing continuity of the Argos-3 modes and services, increasing overall system capacity, increasing the volume of data that can be transmitted each day, increasing the receiver sensitivity onboard the satellite, and improving location accuracy.

6. Summary

Argos is proud to have contributed to providing sustained observations for the global ocean-meteorological community for the last 30 years. New Argos technology developments and a strong multi-national partnership ensures a continuing and responsive commitment for satellite-based data communication well into the future.