

1. Introduction

This report presents an overview of the TRITON project development by JAMSTEC (Japan Marine Science and Technology Center). The early version was presented at the International Workshop for Review of the Tropical Moored Buoy Network at PMEL (Pacific Marine Environmental Laboratory) in Seattle during September 10-12, 2001.

1.1 Development of the TRITON project

Due to the recent increase in concerns regarding global environmental changes such as global warming, it is necessary to predict the changes and to take some measures to minimize their impact on human society. The measures should be planned on the basis of scientific results. However, we do not yet have an adequate understanding of many of the characteristics of the global environment itself. The operational network of meteorological observatories on land placed all over the world have enabled us to monitor the change of the global atmosphere. At the same time, we have less observational platforms covering the world oceans and less understanding of oceanic environmental changes. Through the TOGA (Tropical Ocean and Global Atmosphere) decade, basin wide observing networks of mooring arrays, surface drifters, XBT lines, and tide gage stations have been developed to monitor and study ENSO (El Nino/Southern Oscillation). In particular, the TAO (Tropical Atmosphere Ocean) array successfully monitored the 1991-93 El Nino (McPhaden, 1993; McPhaden et al., 1998) and the 1997-98 El Nino (Kitamura et al, 1998; McPhaden et al., 1999), and contributed greatly to the improvement of ENSO prediction models. By this success, the oceanography and meteorology communities in Japan recognized the importance and effectiveness of such a mooring array. The promotion of mooring arrays as one of the fundamental projects was stated in the 4th Report of the Council for Ocean Development of the Japanese Government.

The standard TAO-ATLAS buoy measures wind vector, air temperature, relative humidity and subsurface temperature. The array enabled us to detect the basin-scale thermocline displacement and surface wind forcing, and helped us to understand ENSO physics. However, each El Nino indicated different features such as the onset process, strength, and duration, and these differences have not yet been well understood theoretically nor well predicted by models. For a better understanding of ENSO the community has considered the necessity of development of a new buoy, which could measure surface heat and fresh water flux and also subsurface salinity changes in order to elucidate the heating processes in the western Pacific Ocean.

The Committee on Ocean Heat Circulation Study (Chaired by Prof. T. Matsuno) sponsored by JAMSTEC defined the scientific purpose and buoy functions during FY1994 to FY1996 that resulted in the present sensors. The scientific review and recommendations by this Committee were published in 1996. In the report the major themes recommended to be carried out by the Japanese ocean and atmosphere research communities were: (1) ENSO in the tropical Pacific Ocean, (2) Asian monsoon in the western Pacific and Indian Oceans, and (3) decadal variations in the northern Pacific Ocean. The TRIANGLE program at JAMSTEC was named after the three themes and geographical regions, as was the TRITON (TRIangle Trans-Ocean buoy Network).

JAMSTEC hosted the International Workshop on Ocean Climate Variations from Seasons to Decades with Special Emphasis on the Pacific Ocean Buoy Network, at Mutsu City, Japan in 1996. During the workshop, the TRITON plan was reviewed in terms of cooperation with the TAO project and international programs such as CLIVAR (Climate Variability and Predictability) and GOOS (Global Ocean Observing System).

The technological development began with feasibility studies, conceptual buoy design, and simulation of buoy motion during 1992-1994. The prototype buoy was built in 1995. Since 1995, the open sea tests were carried out at 4000 m depth near Ogasawara Islands and technological improvements were made. The *R/V Mirai* specially designed for buoy operations, was launched in 1997, and four TRITON buoys were deployed in 1998 along 156E in the western tropical Pacific Ocean. TAO buoys west of 156E were replaced with TRITON buoys, and the TAO/TRITON array officially began in January 2000. At present, summer 2001, eleven TRITON buoys are working and are monitoring ENSO jointly with the TAO array.

1.2 Introduction of the TOCS program

The research activities in the tropical oceans at JAMSTEC have developed as follows. During the 1986/87 ENSO event, JAMSTEC dispatched the *R/V Natsushima* during January and February 1987 for the Japanese El Nino Experiment-1987 (JENEX 87), supported by the Science and Technology Agency (STA) to study oceanic and atmospheric conditions in the central and western Pacific in cooperation with several other institutions. Following the JENEX cruise, the Japanese Pacific Climate Study (JAPACS) program was launched by STA to study the impact of ENSO on the climate in and around the Pacific. In this program, six cruises were carried out in the central and western Pacific from 1987 to 1993. These cruises were conducted through international cooperation within the context of the Tropical Ocean Global Atmosphere (TOGA) and TOGA COARE programs. The cruises for the JENEX and JAPACS programs were very successful and yielded beneficial scientific results.

In order to maintain the momentum and to continually develop important studies in the western tropical Pacific with emphasis on field observations, JAMSTEC launched a new research program named the Tropical Ocean Climate Study (TOCS) in 1993 as its own project funded by STA. The purpose of the TOCS program is to observe physical oceanic conditions in the western tropical Pacific for better understanding of ocean-atmosphere interaction with emphasis on ENSO phenomena. The TOCS program has been successfully continued since 1993. As part of the TOCS program, the TRITON project has been funded by STA (and by the Ministry of Education, Culture, Sports, Science and Technology, as of the Year 2001).