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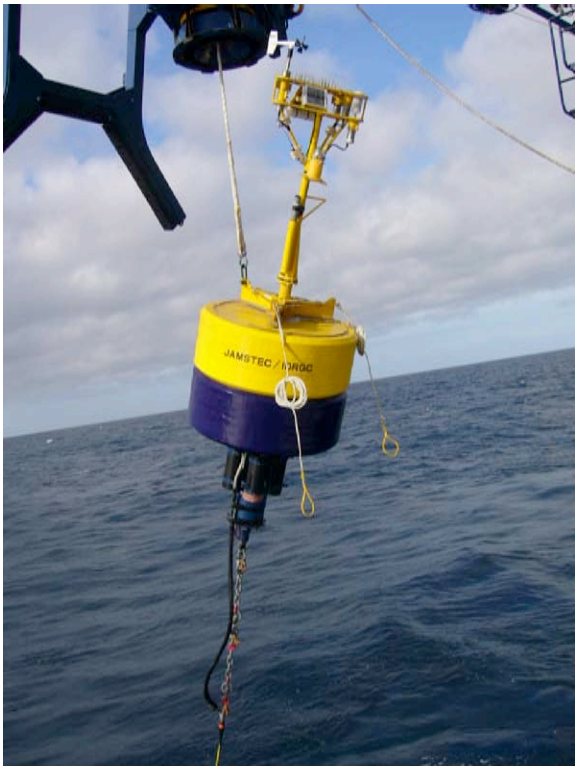
# R/V *MIRAI*

# MR08-E02 Cruise Report

Observational study for the Kuroshio transports and surface flux:
Redeployment of K-TRITON Buoy at the JKEO site

Eastern region of Sanriku, Japan
*11 – 18 November 2008*



Japan Agency for Marine-Earth Science and Technology
(JAMSTEC)

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## 1. Cruise information

1.1 Cruise code

MR08-E02

1.2 Ship

R/V *MIRAI*

1.3 Title of proposal and cruise

Observational study for the Kuroshio transport and surface fluxes: redeployment of K-TRITON buoy

1.4 Research area

Eastern region of Sanriku, Japan

1.5 Cruise period and port call

11 November, 2008 Onahama (departure)

18 November, 2008 Sekinehama (arrival)

1.6 Overview

This cruise was planned to deploy K-TRITON buoy at the JAMSTEC Kuroshio Extension Observatory (JKEO) site. On 11 November 2008, we departed at Onahama toward the JKEO site (nominal location: 38.0˚N, 146.5˚E). The buoy was successfully deployed at 38˚ 4.7146'N, 146˚ 25.1384'E on 12 November. Just after the deployment, we carried out an expendable conductivity-temperature-depth (XCTD) observation to obtain temperature and salinity profiles. Staying within one mile from the site, by use of a portable ARGOS receiver, we continued to perform the data transmission test of the buoy. However, in the morning of 13 November, we found that the buoy data system occasionally malfunctioned. Then, on 15 November 2008, we recovered the top-buoy on deck to do the maintenance of the buoy system, and redeployed it. The buoy system became working well, although we could not identify a clear cause of the trouble of the buoy system. In the evening of 16 November, we left the JKEO site, and arrived at the port of Sekinehama on 18 November.

## 2. Researchers

2.1 Institutions

Japan Agency for Marine-Earth Science and Technology (JAMSTEC):
Institute of Observational Research for Global Change (IORGC)
2-15 Natsushima, Yokosuka, Kanagawa 237-0061, Japan,
and
Mutsu Institute for Oceanography (MIO)
690 Kita-sekine, Sekine, Mutsu, Aomori 035-0022, Japan

2.2 Participants

JAMSTEC/IORGC Researchers:
Akira Nagano*, and Hiroyuki Tomita
*Chief scientist (on-site responsible person),
E-mail: nagano@jamstec.go.jp

Marine Works Japan Co. Ltd. (MWJ):
Hirokatsu Uno, Hiroshi Matsunaga, Tomoyuki Takamori, Tatsuya Tanaka, and Yasuhiro Arii

Global Ocean Development Inc. (GODI):
Shigeru Koura, Wataru Tokunaga, Kazuho Yoshida, and Shinya Okumura

Science Engineering Associates Corporation (SEA):
Teruki Tanaka

2.3 Science party

Table. 2. List of scientists

| Name | Affiliation |
|---|---|
| Hiroshi Ichikawa** | IORGC/JAMSTEC |
| Masanori Konda | IORGC/JAMSTEC |
| Kaoru Ichikawa | IORGC/JAMSTEC |
| Akira Nagano | IORGC/JAMSTEC |
| Hiroyuki Tomita | IORGC/JAMSTEC |
| Katsuhiro Nomura | IORGC/JAMSTEC |
| Yoshiyuki Nakano | MIO/JAMSTEC |

** Representative of science party

## 3. Observation

### 3.1 Objectives

The Kuroshio transports a huge amount of heat to the Kuroshio Extension region, i.e., the eastern region of Japan. The heat is released to the atmosphere there, possibly playing a crucial role in global climate system. Therefore, it is important to estimate the amount of surface heat flux with high accuracy. From February 2008, we started to observe surface heat flux by K-TRITON buoy deployed at the JKEO site.

In KY08-09 cruise (2—18 September 2008) by R/V *Kaiyo*, we had planed to recover the top-buoy on deck, and to replace meteorological sensors installed on it. Unfortunately, an acoustic releaser (Benthos, Model 865A) malfunctioned to be released unintentionally so that we had no choice but to recover the whole mooring system. In MR08-E02 cruise, we aimed to deploy K-TRITON buoy at the JKEO site. The top buoy and the undersea mooring system of K-TRITON are shown in Figs. 1 and 2, respectively.

### 3.2 Cruise track and log

R/V *Mirai* departed at Onahama at 09:00 (JST), 11 November 2008, and arrived at Sekinehama, 09:00 (JST), 18 November 2008 (Table 1; Fig. 3). On 12

and 15 November, buoy deployment and maintenance works were done, respectively. Additionally, during the cruise, we intersected sea surface temperature fronts several times for GODI and SEA engineers to obtain engineering data for ship-mounted acoustic Doppler current profiler (ADCP) maintenance.

Table 1. Cruise log

| Date | Station | Work |
|---|---|---|
| 2008/11/11 | Onahama | Departure (08:00JST) |
| 2008/11/12 | JKEO | K-TRITON deployment, XCTD cast |
| 2008/11/13 | | Checking of the buoy data system |
| 2008/11/14 | — | Checking of ADCP data |
| 2008/11/15 | JKEO | Top-buoy maintenance, XCTD cast |
| 2008/11/16 | | Checking of the buoy data system |
| 2008/11/17 | — | Return to Sekinehama |
| 2008/11/18 | Sekinehama | Arrival (09:00JST) |

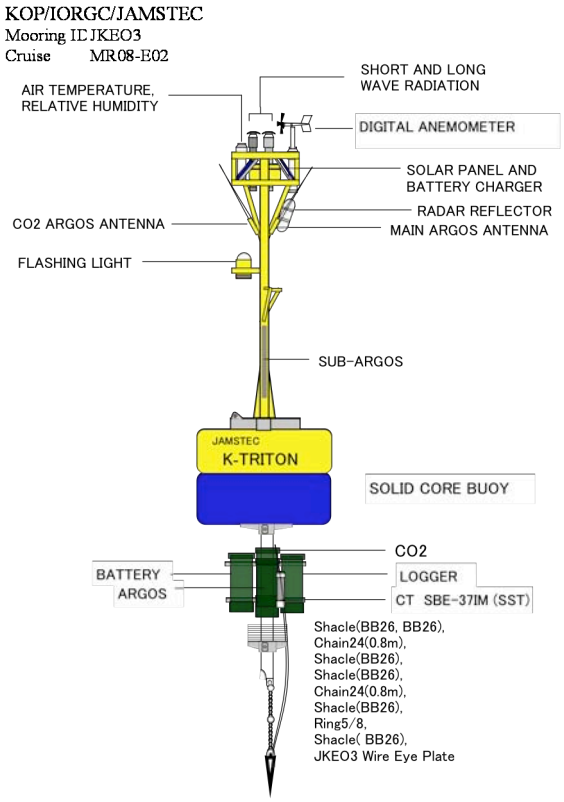
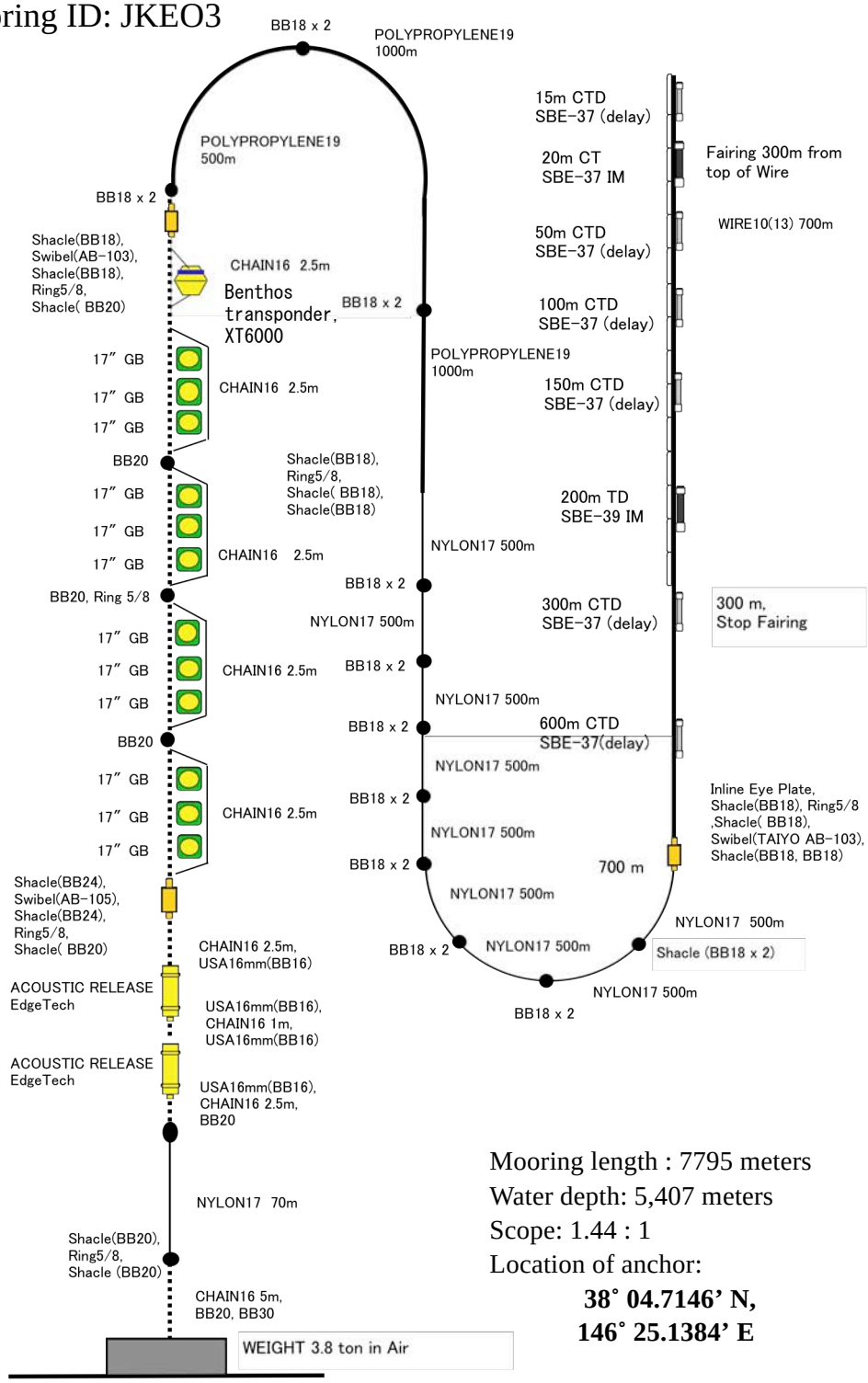



Figure 1. Top-buoy of K-TRITON and the configuration of meteorological sensors

**IORGC/JAMSTEC**
Mooring ID: JKEO3




Mooring length : 7795 meters
Water depth: 5,407 meters
Scope: 1.44 : 1
Location of anchor:
**38˚ 04.7146' N,**
**146˚ 25.1384' E**

Figure 2. Mooring system of K-TRITON beneath the top buoy in Fig. 1.

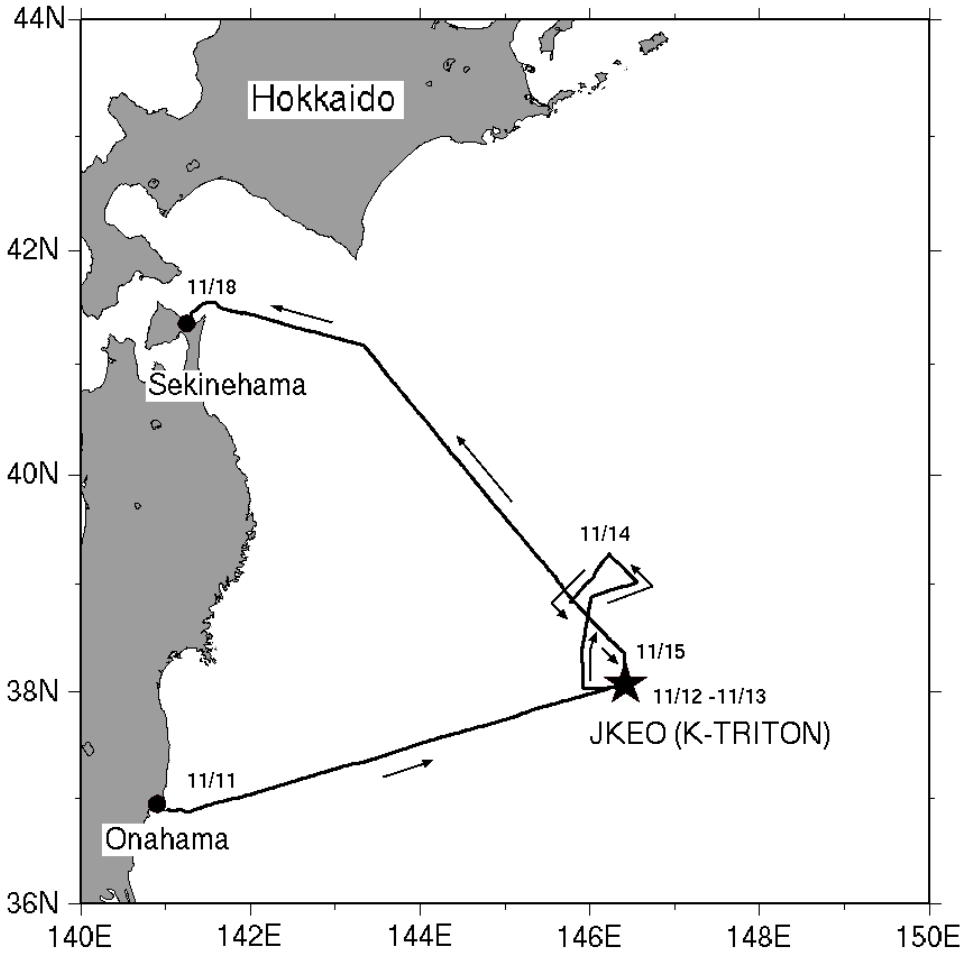



Figure 3. Ship track of R/V *Mirai*

### 3.3 K-TRITON buoy deployment

At 07:30(JST) 12 November 2008, we started to deploy K-TRIOTN buoy at the JKEO site. We let go the anchor at 12:08; totally it took up 4 hours and 38 minutes.

By using Super Short Base Line (SSBL) positioning system, the final position of the anchor (more precisely, Benthos acoustic transponder, XT6000) was determined to **38˚ 04.7146'N, 146˚ 25.1384'E** (Fig. 4). The water depth at this position is 5407 m.

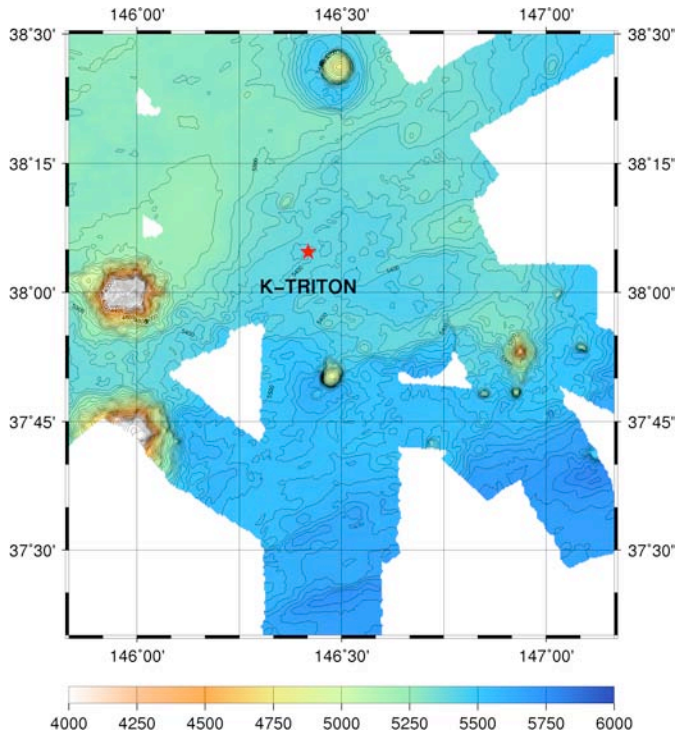



Figure 4. Bottom topography around the JKEO site. A red star indicates the location of the anchor of K-TRITON buoy.

### 3.4 K-TRITON buoy maintenance

At 07:45(JST) 15 November 2008, we started maintenance work of K-TRITON buoy. The buoy data system was recovered on deck at 09:41. From 10:03 to 13:34, we checked electrical and mechanical connections etc. Although we could not identify a clear cause of the trouble of the buoy system, we confirmed that the system works well and we redeployed the top buoy on the sea

surface. The deck work was finished at 14:36. Finally, the hanging rope attached to the buoy was removed by a person on a working-boat approached to the buoy from R/V *Mirai*. All works on deck was finished at 14:36.

### 3.5 General observations

3.5.1 XCTD observations

Just after the deployment (12 November, 2008) and maintenance (15 November, 2008) of K-TRITON buoy, we obtained temperature and salinity profiles by using XCTD probes. These two sets of XCTD profiles are shown in Fig. 5 together with their T-S diagrams.

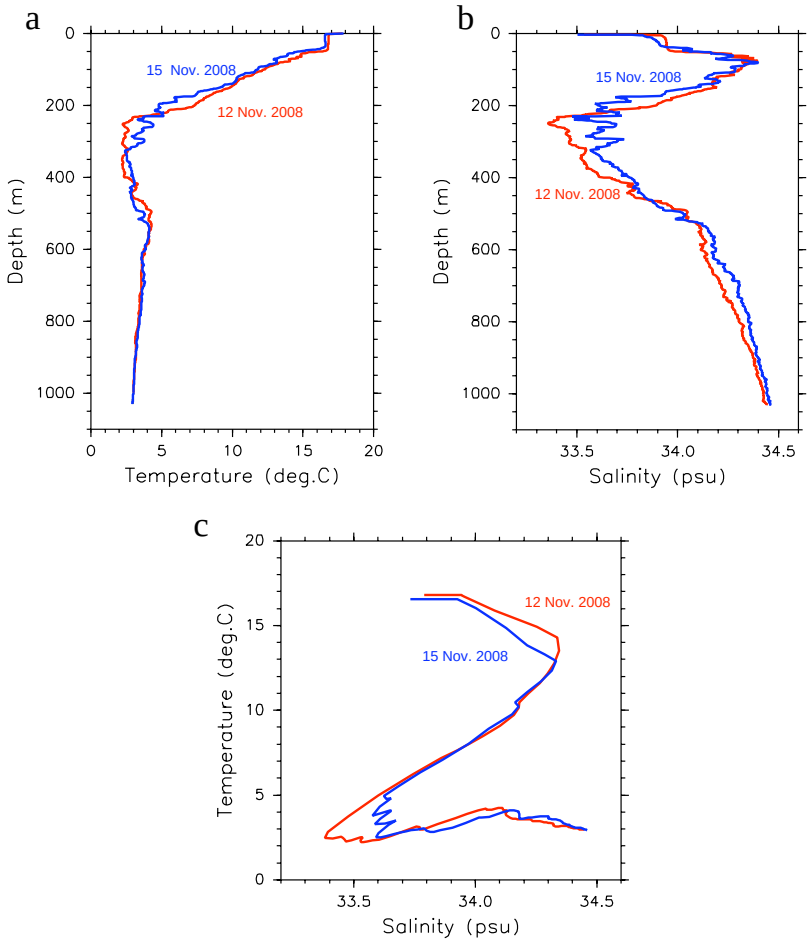



Figure 5. (a) Temperature and (b) salinity profiles at JKEO site just after the deployment (red curves) and maintenance (blue curves) of K-TRITON buoy.

3.5.2 Surface oceanographic observations

By using continuous sea surface water monitoring system (Nippon Kaiyo Co. Ltd.), we obtained sea surface temperature (SST), salinity (SSS), dissolved oxygen, and fluorescence data along the cruise track during 11—13 November 2008. In addition, we obtained $pCO_2$ data along the track.

For example, SST and SSS are shown in Figs. 6 and 7. Approaching to the Kuroshio front from the south (Fig. 3), they largely increased. Their maximum values were 24.1˚C and 34.36 at 13:50 and 15:45 (UTC), 11 November, respectively. When R/V *Mirai* passed over the Kuroshio front at about 19:00, the SST and SSS values fall right down to 16.4˚C and 33.96.

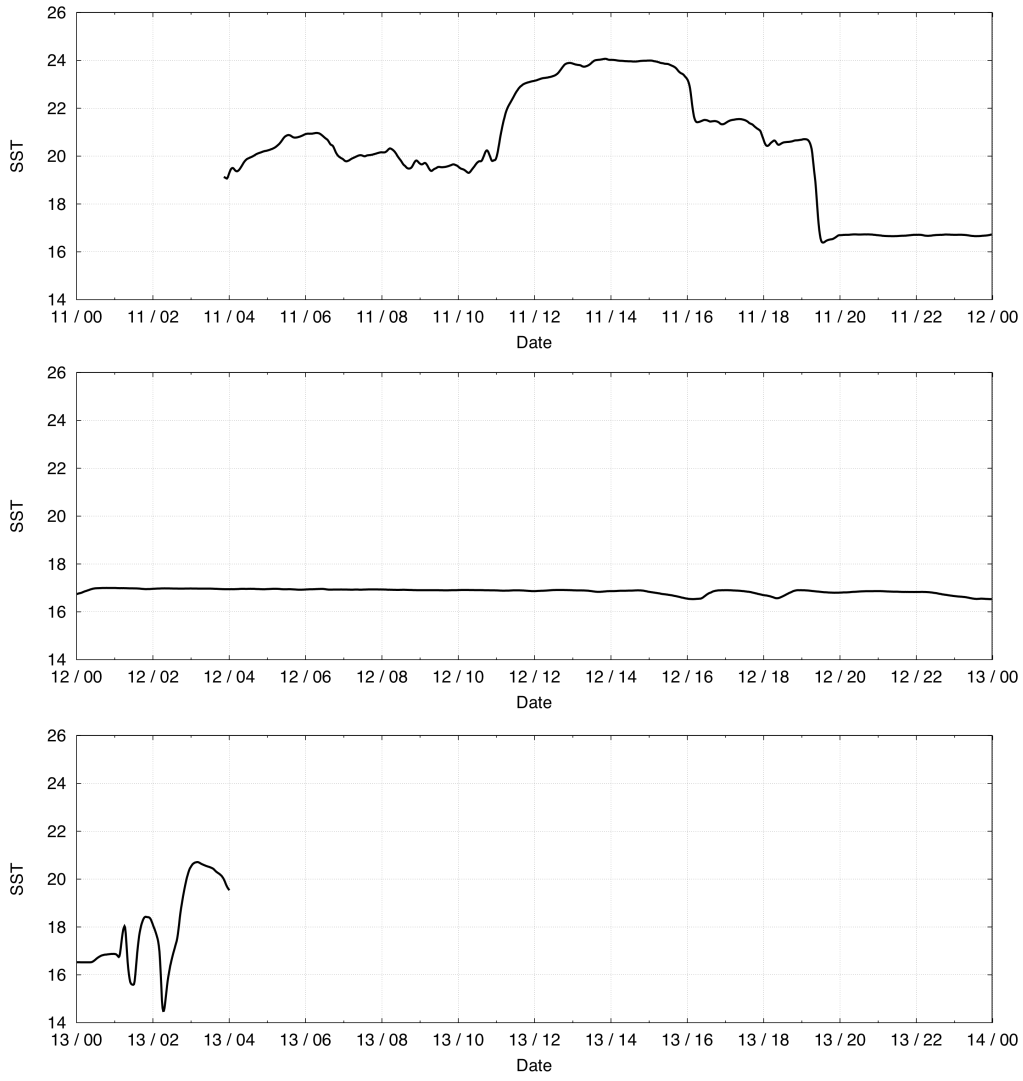



Figure 6. Sea surface temperature (˚C) along the cruise track during 11—13 November 2008.

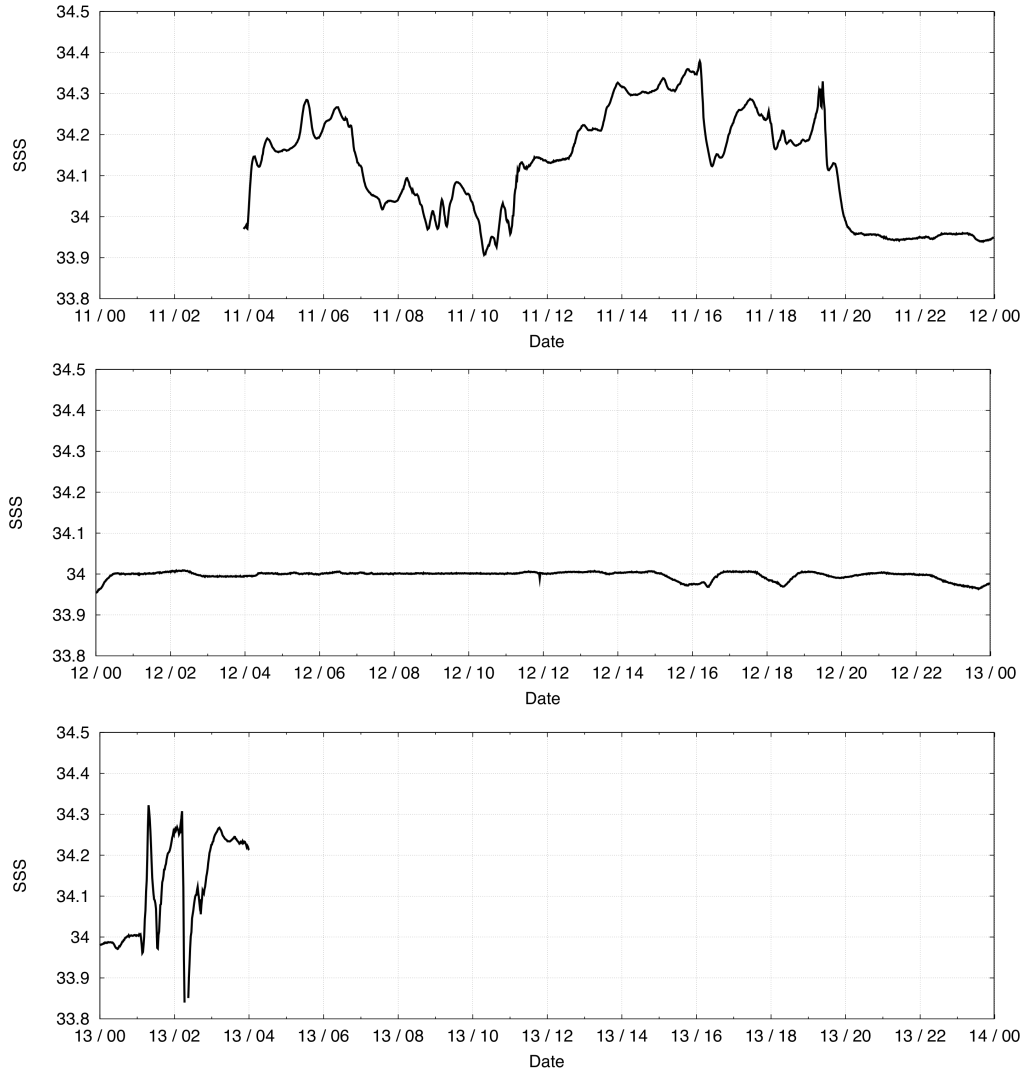



Figure 7. Same as Fig. 6 but for sea surface salinity.

Sensor information:

a) Temperature and salinity sensor
SEACAT THERMOSALINOGRAPH
Model: SBE-21, SEA-BIRD ELECTRONICS, INC.
Measurement range: Temperature –5 to +35˚C, Salinity 0 to 6.5 S $m^{-1}$
Accuracy: Temperature ±0.01˚C 6 $month^{-1}$, Salinity ±0.001S $m^{-1}$ $month^{-1}$
Resolution: Temperature 0.001˚C, Salinity 0.0001 S $m^{-1}$

b) Temperature sensor installed on the water suction pump
Model: SBE 3S, SEA-BIRD ELECTRONICS, INC.
Measurement range: Temperature –5 to +35˚C
Resolution: Temperature 0.001˚C
Stability: 0.002˚C $month^{-1}$

c) Dissolved oxygen sensor
Model: 2127A, HACH ULTRA ANALYTICS JAPAN, INC.
Measurement range: 0 to 14 ppm
Accuracy: ±1 at 5˚C
Stability: 5% $month^{-1}$

d) Fluorometer
Model: 10-AU-005, TURNER DESIGNS
Detection limit: 5 ppt or less for chlorophyll a
Stability: 0.5% $month^{-1}$ of full scale

e) Flow meter
Model: EMARG2W, Aichi Watch Electronics LTD.
Measurement range: 0 to 30 $min^{-1}$
Accuracy: ±1%
Stability: ±1% $day^{-1}$

The observation period (UTC) in the cruise was as follows:
Start: 2008/11/11 03:20:00, Stop: 2008/11/13 04:00:01.

3.5.3 Meteorological observations

Surface meteorological data were collected as “JamMet” by Shipboard Oceanographic and Atmospheric Radiation System (SOAR) composed of an anemometer (Model 05106, R.M. Young), a thermometer/humidity sensor (HMP45A, Vaisala), a barometer (61202V, R.M. Young), a rain gauge (50202, R.M. Young), an optical rain gauge (ORG-815DA, Osi), and radiometers (PSP/PIR, Eppley labs.). These sensors were installed on the foremast 30 m from the base line. In addition, similar meteorological data were obtained as “SMet”. The height of cloud bases was observed by a ceilometer (CT25-K Ver. 2.0, Vaisala). Their observation period is from 23:00(UTC) 10 to 00:00 18 November 2008.

Atmospheric temperature, relative humidity, northward and eastward wind velocity are shown in Fig. 8. Atmospheric temperature and relative humidity are sometimes inversely correlated each other such as between 13 and 15 November 2008, during which the direction of wind is quite variable.

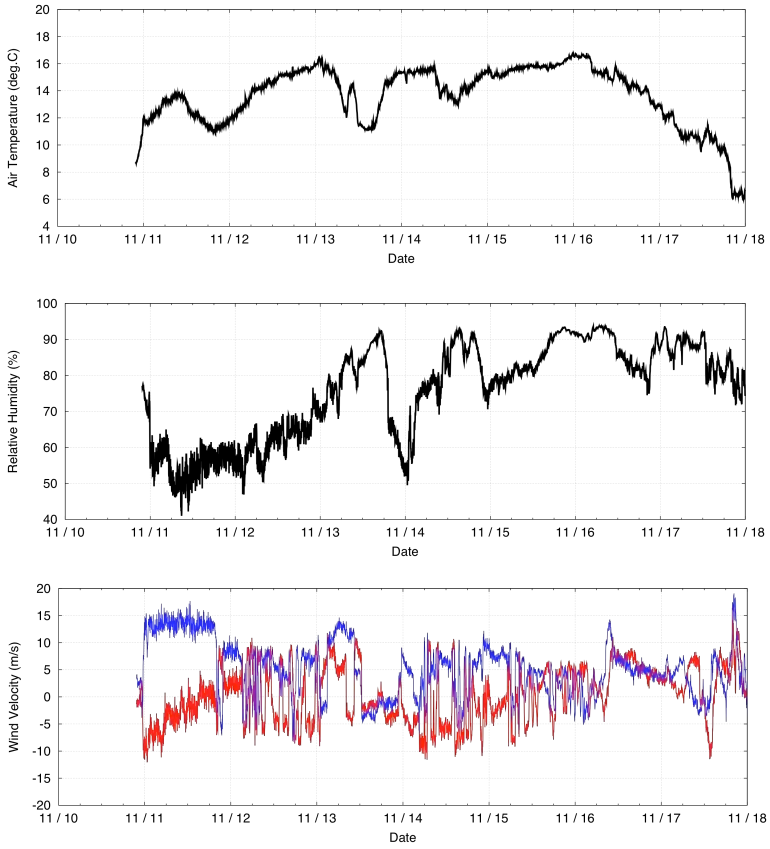



Figure 8. Atmospheric temperature (upper panel), relative humidity (middle panel), and wind velocity (lower panel): Eastward and northward wind velocity components are indicated by red and blue curves, respectively.

**Acknowledgements**

We would like to thank Capt. Masaharu Akamine, crew, and technicians for all efforts to deploy the buoy, and do the buoy maintenance and other observations.

**Notice on using:**

This cruise report is a preliminary documentation as of the end of the cruise. It may not be corrected even changes on content (i.e. taxonomic classifications) are found after publication. It may also be changed without notice. Data on the cruise report may be raw or not processed. Please ask the Chief Scientist for the latest information before using.

Users of data or results of this cruise are requested to submit their results to Data Integration and Analysis Group (DIAG), JAMSTEC.