MR06-05 Leg2 Cruise Summary

1. Introduction

The Madden-Julian oscillation (MJO), that is a dominant eastward propagating intraseasonal oscillation in the Tropics, is a key issue to be solved, as it influences not only the tropical atmospheric and oceanic variations but also the global climate. Since the MJO is a phenomenon coupled with deep cumulus convections, it is manifested over the warm pool region from the eastern Indian Ocean through the western Pacific Ocean. However, past major field experiments conducted in the Indian Ocean were devoted to study the summer monsoon, and there are few data especially in the boreal fall-winter season.

On the one hand, recent studies using reanalysis and satellite data revealed various aspects of the large-scale MJO structure. However, current general circulation models still fail to simulate the "slow" eastward propagation and underestimate the strength of the intraseasonal variability. It is believed that this deficiency is mainly due to the insufficient cumulus parameterization. Therefore, it requires that fine-scale observation data is invaluable to promote our knowledge on the mechanism of the MJO.

Based on the fact mentioned above, we at JAMSTEC have planned to conduct the intensive observation using the R/V Mirai to capture the detailed features from the ocean surface to the entire troposphere in the period from late October through November when the onset of convection in the MJO is often observed. We have named this project as MISMO (Mirai Indian Ocean cruise for the Study of the MJO-convection Onset).

During the Leg-2 of MISMO cruise, surface meteorological measurement, atmospheric sounding by radiosonde, CTD casting, and ADCP current measurement as well as Doppler radar observation were carried out as a main mission. In addition, deployment of TRITON/m-TRITON buoys, turbulent flux measurement, Mie-scattering LIDAR, vertical-pointing cloud radar, and other many observations were conducted.

We would like to introduce the web site for MISMO project. On the web site at "http://www.jamstec.go.jp/iorgc/mismo/", details on not only the Mirai cruise but also the relevant observations conducted as part of the MISMO project can be found.

2. Overview

2.1. Ship

R/V MIRAI
Captain Masaharu Akamine

2.2. Cruise code

MR06-05 Leg 2

2.3. Project name

Tropical Ocean Climate Study

2.4. Undertaking institution

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
2-15, Natsushima-cho, Yokosuka 237-0061, Japan

2.5. Chief Scientist

Yoshifumi Kuroda (JAMSTEC)

2.6. Period

November 28th, 2006 (Male, Maldives) - December 13th, 2006 (Singapore)

2.7. Research Participants

Total 29 scientists and technical staffs participated from 6 different institutions and companies.

3. Observation summary

TRITON buoy deployment:	2 sites
TRITON buoy recovery:	2 sites
m-TRITON buoy deployment:	1 site
ADCP buoy deployment:	1 site
ADCP buoy recovery:	3 site
CTD including water sampling:	7 casts
XCTD:	2 launches
Radio sonde:	52 launches
Surface meteorology:	continuous
Shipboard ADCP measurement:	continuous
Surface temperature and salinity measurements by intake method:	continuous

*** Other specially designed observations have been carried out.

4. Observed oceanic and atmospheric conditions

A zonal Dipole Mode phenomenon in the tropical Indian Ocean has developed since the end of July 2006 and was in the mature phase in November 2006. Associated with this event, easterly winds prevailed until mid November. The data from two m-TRITON buoys (0,79E and 0,82E) in the MISMO mooring array indicated that the thermocline was shallower than climatology, and it deepened toward west reversed to the climatology. It may indicate warm water migration from east to west. The temperature in the surface layer was warmer than climatology. The shipboard ADCP data during Leg 1 indicated that the westward currents dominated in the surface layer, but reversed eastward currents intensified subsurface layer. In mid November, a MJO system reached to the MISMO region, then the easterly winds was weakened and convective clouds developed. During Leg 2, westerly winds observed, and the convective system moved also eastward as R/V Mirai moved. On the ship, the cloud convective system highly developed on December 4. When the ship steamed from 1.5S90E to 5S95E, we

observed strong boreal winter monsoon winds about 15m/s. Then, the convective system seemed to be calmed down, and it was calm weather continued since December 8th. The ship board ADCP data during Leg 2 indicated that the eastward currents were well developed along the equator without strong westerly winds along the equator. Thus, we infer that the east ward currents was induced by ocean interior dynamics rather than surface winds forcing. At the 5S, 95E TRITON buoy site, the sea surface temperature was lower than climatology, and it may be due to that the cooled pole of Dipole Mode well developed and there was large excursion of upwelling water from Sumatra coast. The eastward currents along the equator may contribute some part to the termination of this Dipole Mode event.

Thus, during Leg 1, we observed from the preconditioning stage to the onset of one MJO under the mature phase of the Dipole Mode event. During Leg 2, we observed from developing stage to termination stage of the MJO. The obtained data shall enable us to analyze the ocean and atmosphere changes associated with the MJO and Dipole Mode event, and its hidden interaction processes between them.