

## Cruise Summary

### 1. Ship name and Cruise code

R/V MIRAI

MR11-07 Leg-1

### 2. Title of the Cruise (Main Mission)

Cooperative Indian Ocean experiment on intraseasonal variability in the Year 2011 (CINDY2011)

### 3. Chief Scientist

Kunio Yoneyama

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

Research Institute for Global Change (RIGC)

### 4. Research Themes of Sub-missions and Principal Investigators (PIs)

- (1) Observational and modeling analyses of the effects of multi-scale moisture variability on the organization of meso-scale convective systems.  
(PI: Tetsuya Takemi / Kyoto University)
- (2) Validation of daily simulation results using a cloud-resolving model over the tropical Indian Ocean.  
(PI: Taroh Shinoda / Nagoya University)
- (3) On-board continuous air-sea flux measurement.  
(PI: Osamu Tsukamoto / Okayama University)
- (4) Observation study on ozone and water vapor variability in the tropical tropopause layer.  
(PI: Masatomo Fujiwara / Hokkaido University)
- (5) Distribution and configuration of clouds in various Oceans.  
(PI: Toshiaki Takano / Chiba University)
- (6) Lidar observations of optical characteristics and vertical distribution of aerosols and clouds.  
(PI: Nobuo Sugimoto / National Institute for Environmental Studies)
- (7) Maritime aerosol optical properties from measurements of ship-borne sky radiometer.  
(PI: Kazuma Aoki / Toyama University)
- (8) Tropospheric aerosol and gas observations on a research vessel by MAX-DOAS.  
(PI: Hisahiro Takashima / JAMSTEC)
- (9) Water sampling for building water isotopologue map over the Ocean.  
(PI: Naoyuki Kurita / JAMSTEC)
- (10) Study of ocean circulation and heat and freshwater transport and their variability in the Pacific and Indian Oceans, and experimental comprehensive study of physical-chemical-biological processes in the western North Pacific by the deployment of Argo floats and using Argo data.  
(PI: Toshio Suga / JAMSTEC and Tohoku University)
- (11) Distribution and ecology of oceanic Halobates inhabiting tropical area of Indian Ocean and their responding system to several environmental factors.  
(PI: Tetsuo Harada / Kochi University)
- (12) Standardising the marine geophysics data and its application to the ocean floor geodynamics studies.  
(PI: Takeshi Matsumoto / University of the Ryukyus)

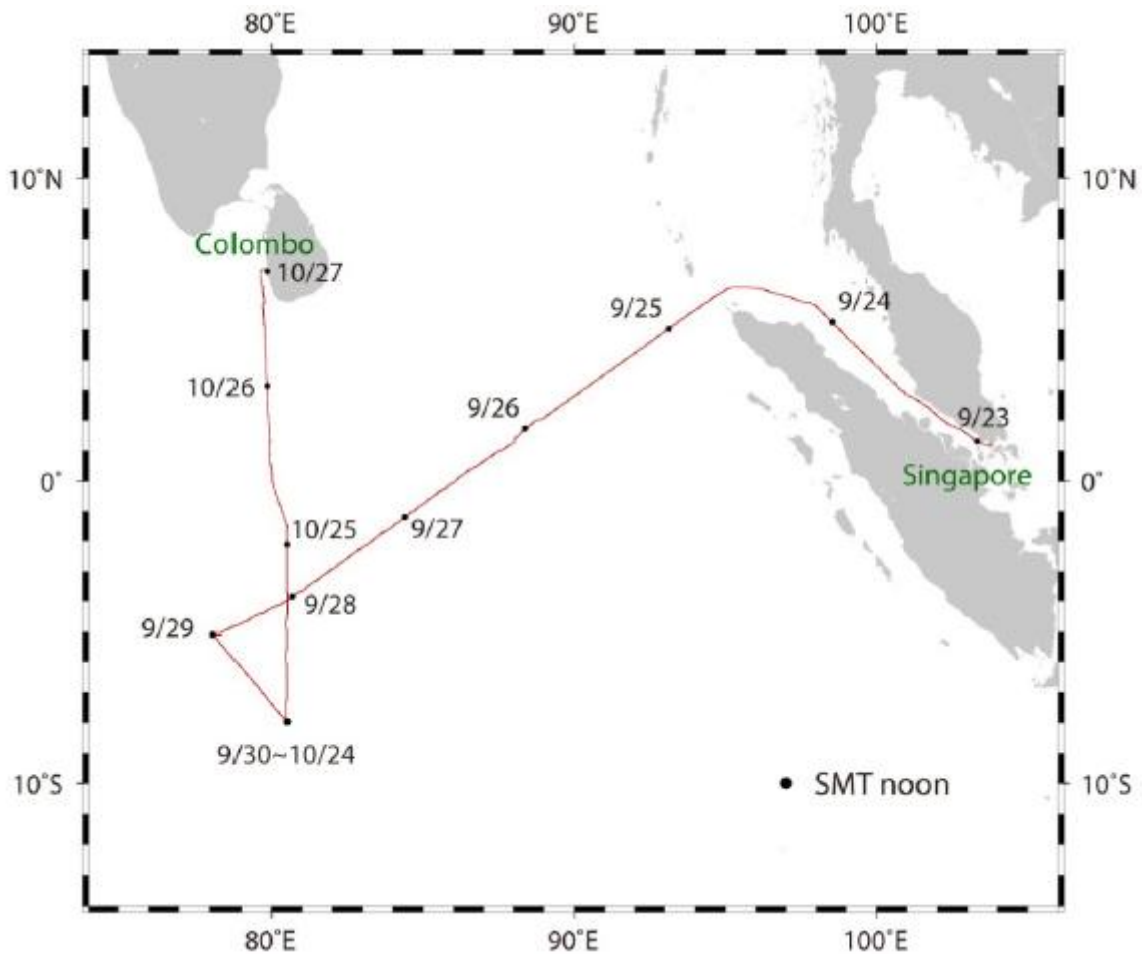
## 5. Period and Ports of call

2011 Sept 23 departed Singapore  
Oct 27 called at Colombo, Sri Lanka

## 6. Research Area

Tropical Central Indian Ocean

Stationary observation at fixed site at 8S, 80.5E from Sept 30 through Oct 24, 2011.



## 7. Purpose

The aim of the cruise is to collect in-situ atmospheric and oceanic data to advance our knowledge on the initiation mechanism of the Madden-Julian Oscillation (MJO), which is the dominant intraseasonal mode in the tropics. The MJO is an eastward propagating disturbance, occurring primarily over the central equatorial Indian Ocean, and is known as a phenomenon, which has a great impact onto the climate of not only the tropics but also higher latitudes through the interaction with El Niño, monsoon, tropical cyclone, and so on. Although previous studies have revealed the various aspects of the MJO, so far there is no definitive explanation on the onset of the MJO convection over the Indian Ocean and associated upper-ocean variability. This cruise is designed to improve our knowledge on the initiation processes by providing in-situ data.

This cruise was conducted as a part of an international field experiment “Cooperative Indian Ocean experiment on intraseasonal variability in the Year 2011 (CINDY2011)”. CINDY2011 and its US component “Dynamics of the MJO (DYNAMO)” project are officially endorsed by the World Climate Research Programme (WCRP) / Climate Variability and Predictability Project (CLIVAR).

## 8. Overview of Observations

During the first two weeks of the stationary observation, active convection appeared with 3-4 days period, while it was mostly convectively suppressed for the last two weeks. Easterly prevailed in the lower troposphere during the entire period. Based on the satellite data analyses, MJO-convections developed over the west of intensive observation array and passed over the array. However, dry condition continued over the Mirai while such an event occurred over the array. Total precipitable water vapor shows large variation from 25 mm to 60 mm, by reflecting the fact that our observation site was located between the convectively active MJO phase in the equatorial region and the south-easterly monsoonal wind region in the subtropics.

During the cruise, the following observations were intensively conducted.

(1)	5.3-GHz Doppler radar	continuously
(2)	GPS Radiosonde	232 times
(3)	Ceilometer	continuously
(4)	Surface Meteorology	continuously
(5)	GPS Meteorology	continuously
(6)	Infrared SST Autonomous Radiometer (ISAR)	continuously
(7)	CTD	195 times
(8)	Water sampling	97 times
(9)	Lowered ADCP	193 times
(10)	Ocean turbulent measurement (TurboMAP)	419 times
(11)	Shipboard ADCP	continuously
(12)	Sea surface water monitoring	continuously
(13)	Mie-scattering LIDAR	continuously
(14)	95-GHz cloud profiling radar	continuously
(15)	CFH radiosonde	3 times
(16)	Rain and water vapor sampling	continuously
(17)	Turbulent flux	continuously
(18)	Aerosol measurement (MAX-DOAS)	continuously
(19)	Atmospheric gas measurement	continuously
(20)	Aerosol measurement (Sky radiometer)	continuously
(21)	Gravity/Magnetic force	continuously
(22)	Topography	continuously
(23)	Sea skater sampling	17 times
(24)	Argo float deployment	1 time at 5S, 78.1E
(25)	Sub-Surface ADCP mooring deployment	1 time at 5S, 78.1E

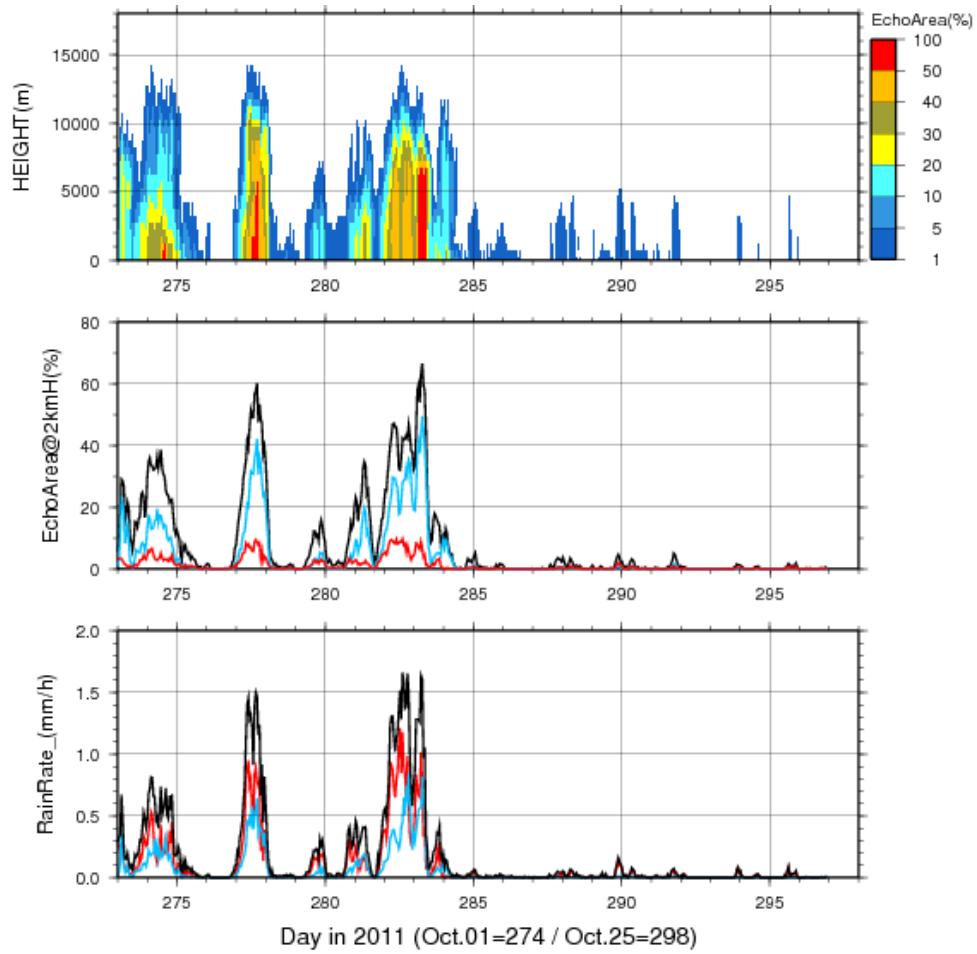


Figure. (top) Echo area coverage as a function of time and height. (middle) Time series of echo area based on the classification into convective (red) and stratiform (blue) regions. Black indicates total. (bottom) Time series of rainfall rate produced by convective (red) and stratiform (blue) type rain.