DBCP 2012 SCIENTIFIC AND TECHNICAL WORKSHOP

Fremantle, Australia, 2 October 2012

SALIENT FEATURES OF INDIAN DEEP SEA INSTRUMENTED BUOY NETWORK IN THE BAY OF BENGAL

R. Venkatesan, Arul Muthiah, Simi Mathew and V. R. Shamji

India

Oceans play a significant role in the national development process as

- (a) the driving force for the monsoons,
- (b) a potential source for food, drug and energy,
- (c) a cost-effective medium for transport and
- (d) a strategic space. Disasters such as cyclones originate in oceanic region

BAY OF BENGAL

- **The Bay of Bengal a semi-enclosed sea which plays a foremost role in predicting the monsoon system over the Asian region with its highly stratified waters and the reversal of winds and current with the march of each season.**

- **The high concentration of heat in the surface layer along with favorable atmospheric component always favor development of more than three to four low pressure systems in this region every year**

- **The region is affected by winds and a large freshwater plume, whose extent and coherence affects surface temperature and the interaction of the ocean with the atmosphere.**

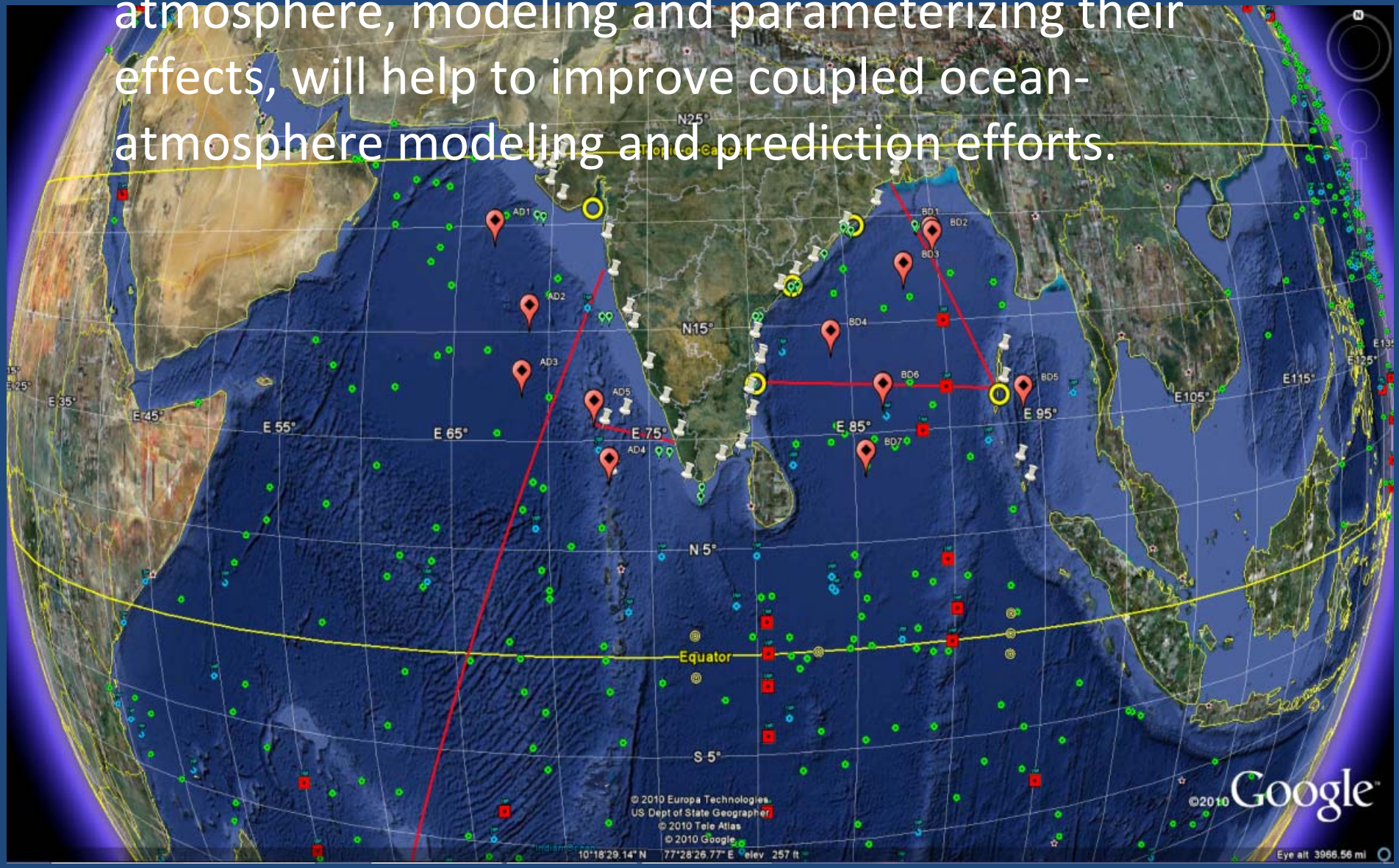
Factors Contributing to Disastrous Surge in the Bay of Bengal

- **Convergence of the Bay**
- **Shallow Water**
  - **Large bottom friction**
  - **Retards return undercurrent**
- **Thickly Populated Low Lying Islands**
  (Ramgati, Sandwip, Hatiya, Bhola & Kutubdia)
- **High Astronomical Tides**
- **Inlets & Estuaries**

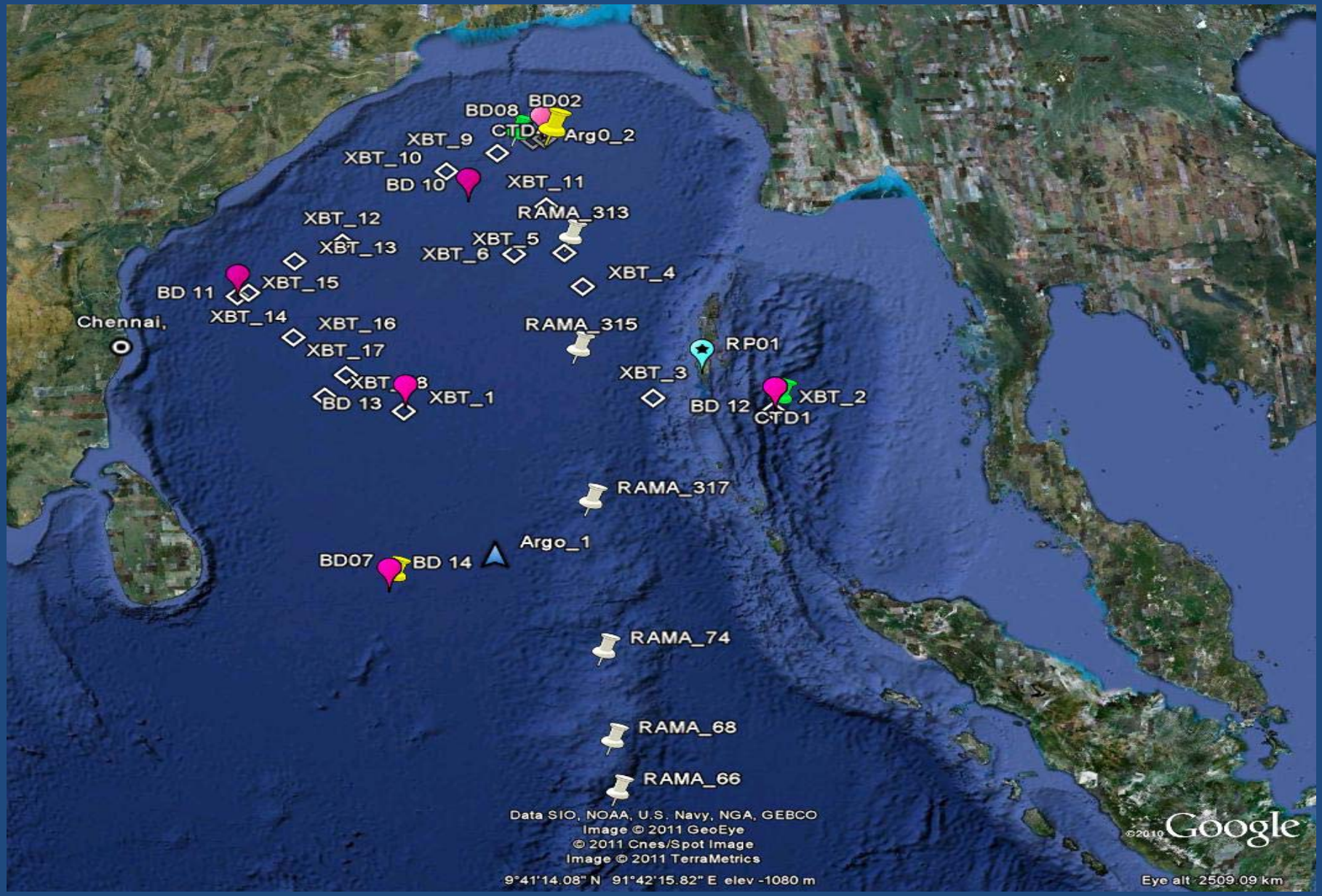
DEATHS IN TROPICAL CYCLONES

YEAR	COUNTRIES	DEATHS
1970	Bangladesh	300,000
1737	India	300,000
1886	China	300,000
1923	Japan	250,000
1876	Bangladesh	200,000
1897	Bangladesh	175,000
1991	Bangladesh	140,000
1833	India	50,000
1864	India	50,000
1822	Bangladesh	40,000
1780	Antilles(West Indies)	22,000
1965	Bangladesh	19,279
1999	India	15,000
1963	Bangladesh	11,520
1961	Bangladesh	11,466
1985	Bangladesh	11,069
1971	India	10,000
1977	India	10,000
1966	Cuba	7,196
1900	USA	6,000
1960	Bangladesh	5,149
1960	Japan	5,000
1972	India	5,000

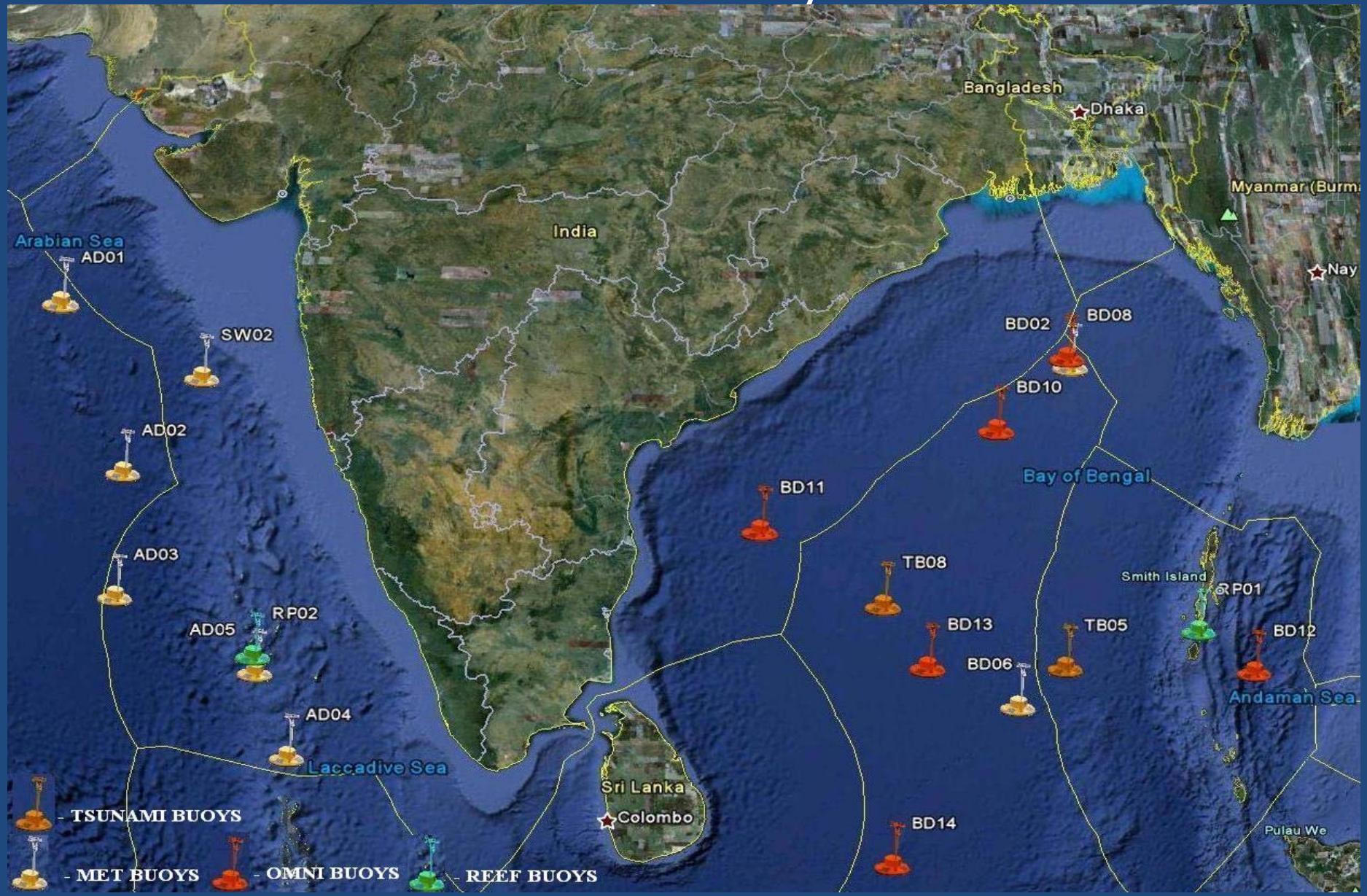
- Observing and quantifying upper ocean processes that affect heat and moisture fluxes to the atmosphere, modeling and parameterizing their effects, will help to improve coupled ocean-atmosphere modeling and prediction efforts.



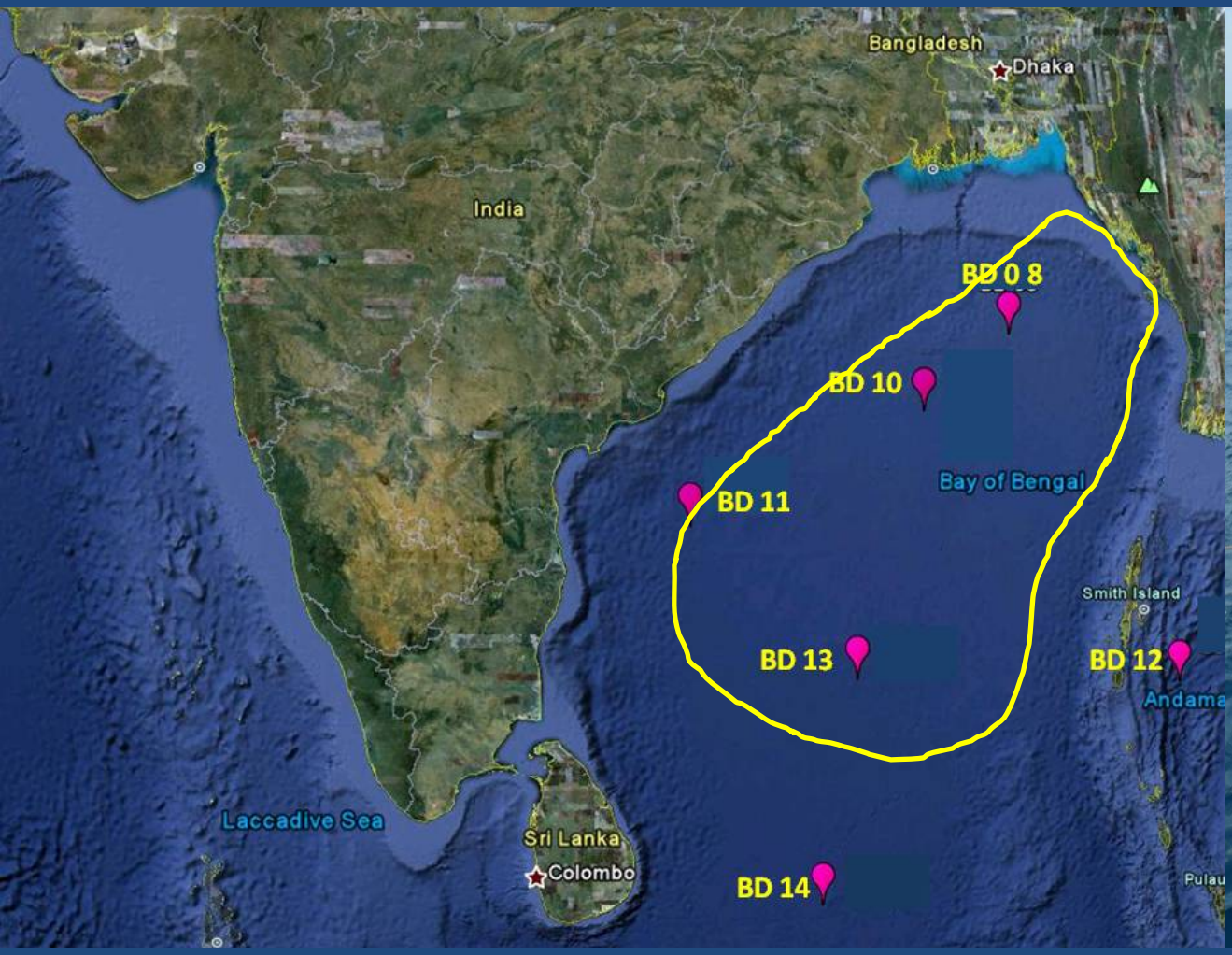
BoB Observation

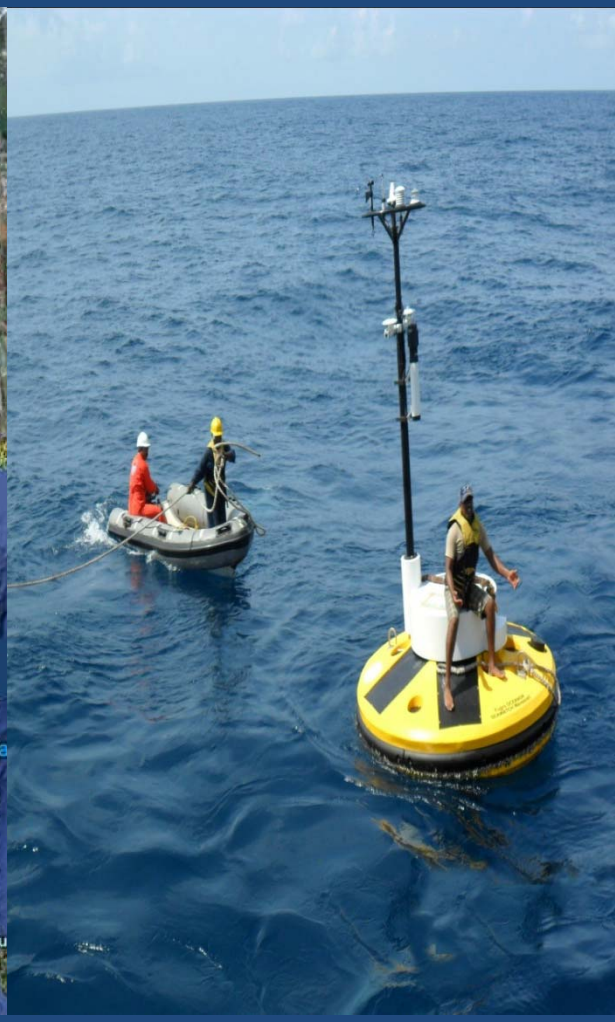


NIOT
Moored buoys

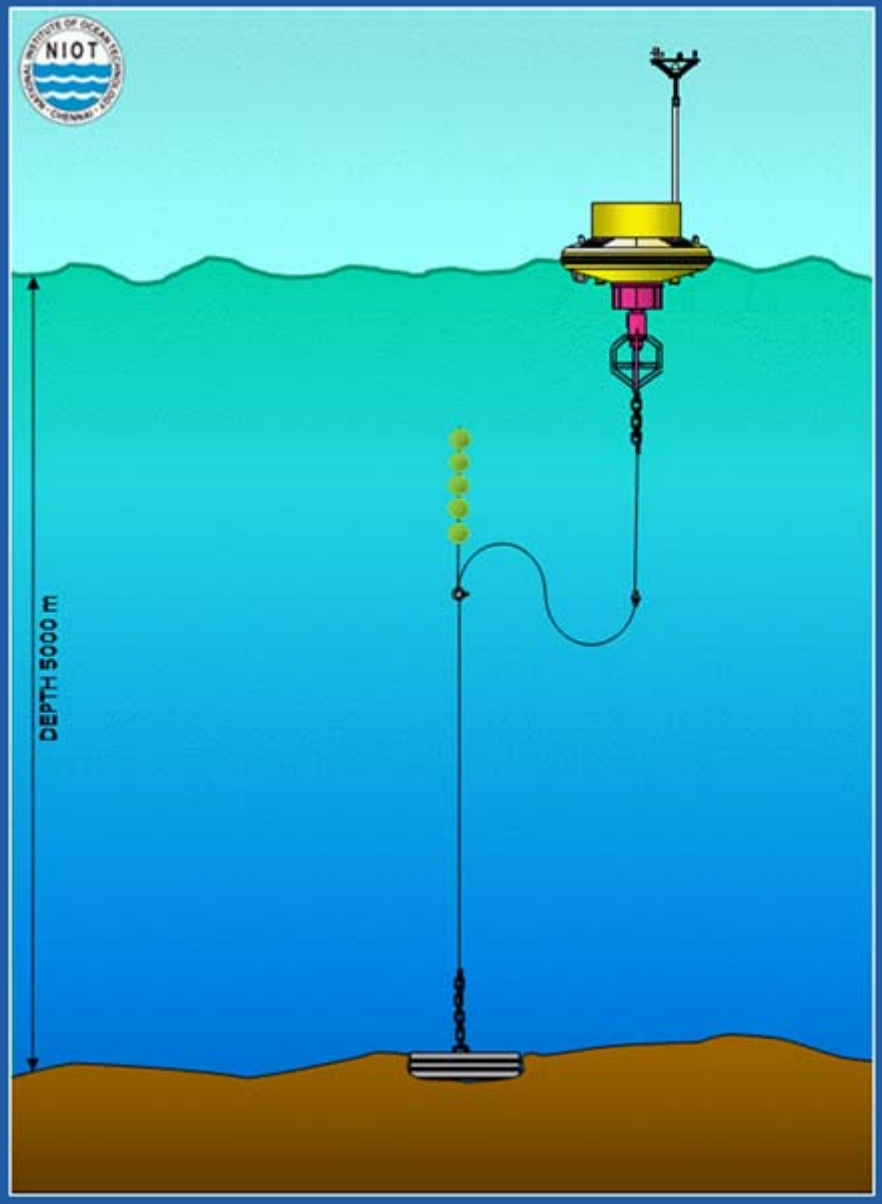


OMNI BUOY LOCATIONS





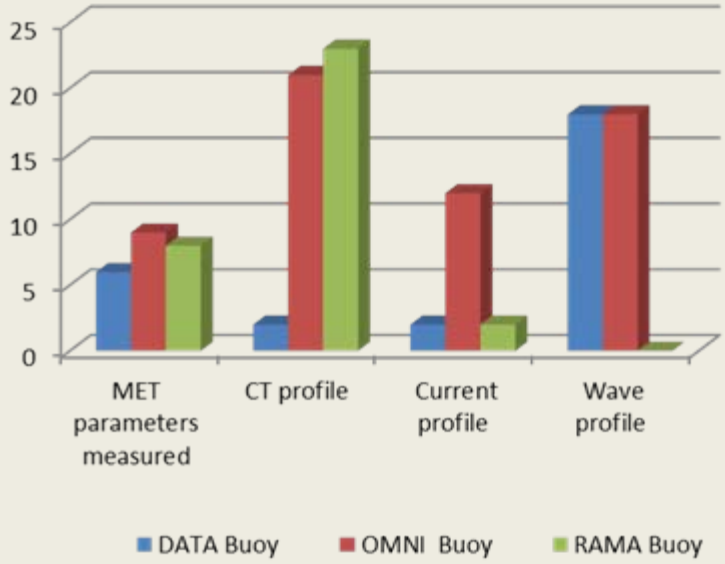
Moored Buoy Network

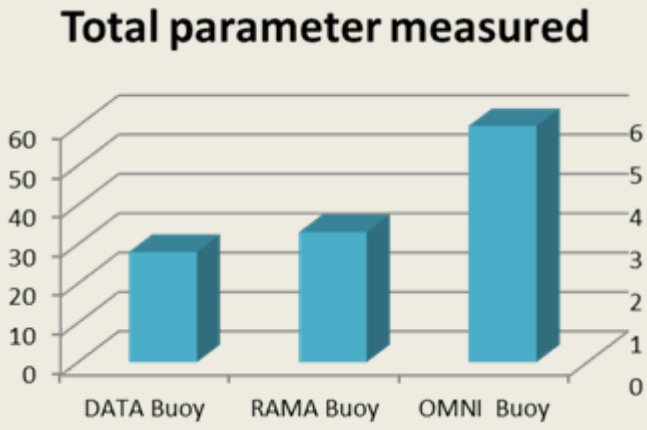


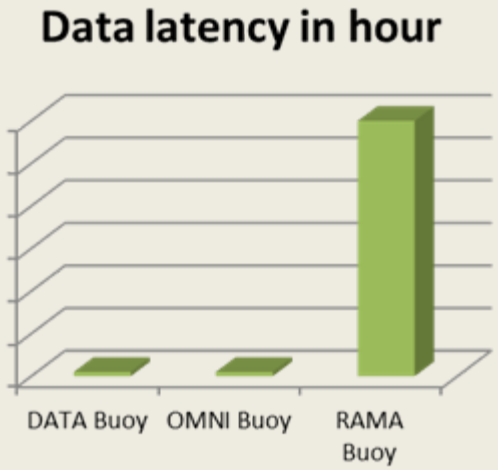
- Surface meteorological
  - Wind speed and direction
  - Air temperature
  - Air pressure
  - Humidity
  - Short wave radiation
  - Incoming long wave radiation
  - Precipitation
- surface Ocean parameters
  - Sea surface temperature
  - Conductivity
  - Wave
  - Current speed and direction
- Sub surface parameters
  - Temperature and salinity at depths starting from 5m, 10m, 15m, 20m 30m, 50 m, 75 m, 100 m, 200m and 500m
  - Currents at depth levels 10m, 20m, 30m, 50m and 100m

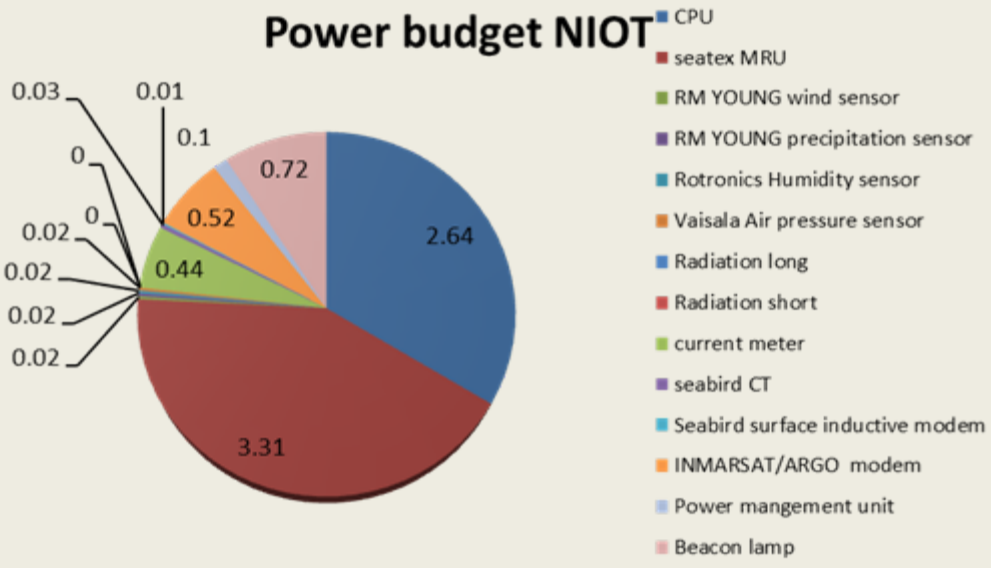
- The time series data with high temporal resolution is the highlight of moored buoy program in the Indian Ocean which is very crucial for the Asian monsoon prediction.
- In order to understand the factor which is more pre-dominant in interfering the data transmission from the buoy system a detailed study of the telemetry data obtained from two buoys each of RAMA and OMNI were studied for a period of 517 days, during November, 2010 to March, 2012.

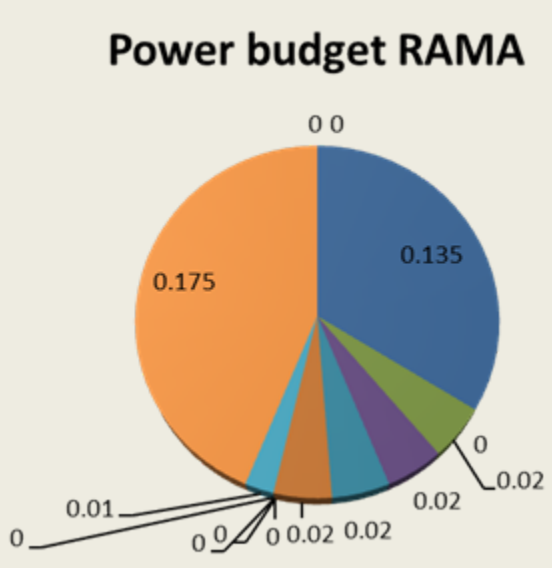
DATA,OMNI&RAMA Buoy system



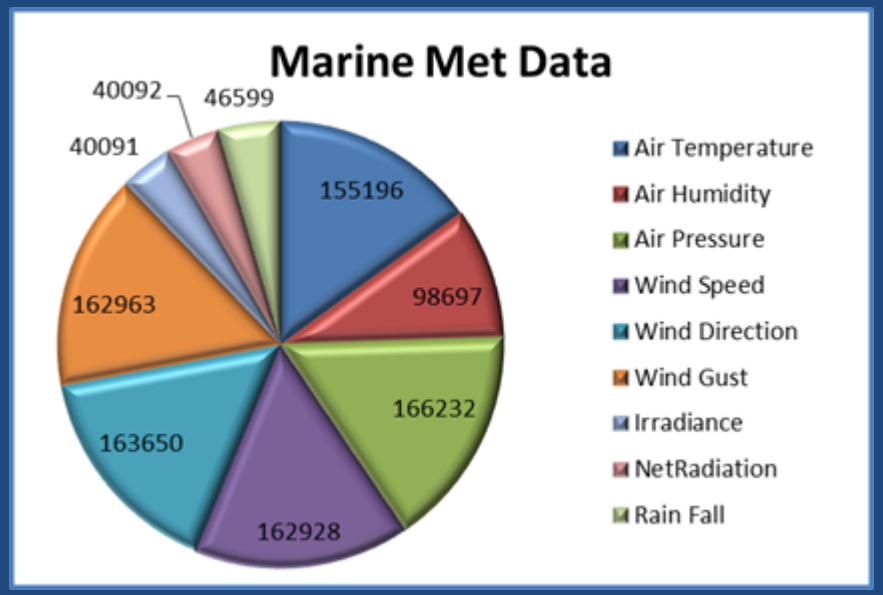


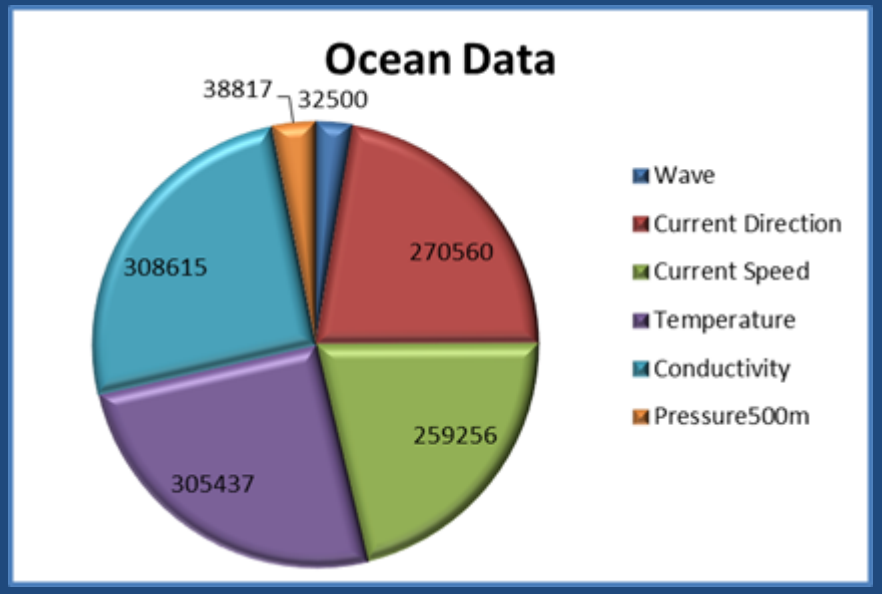


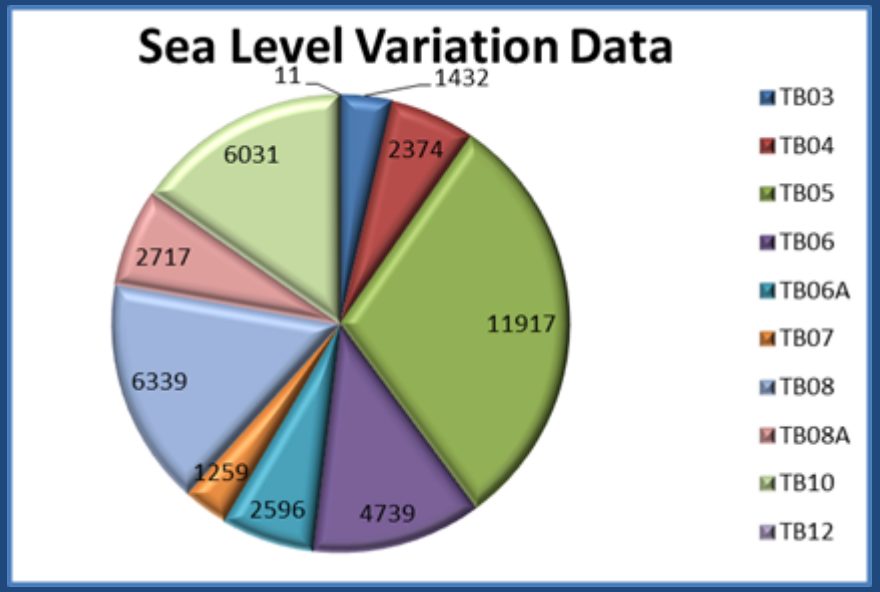




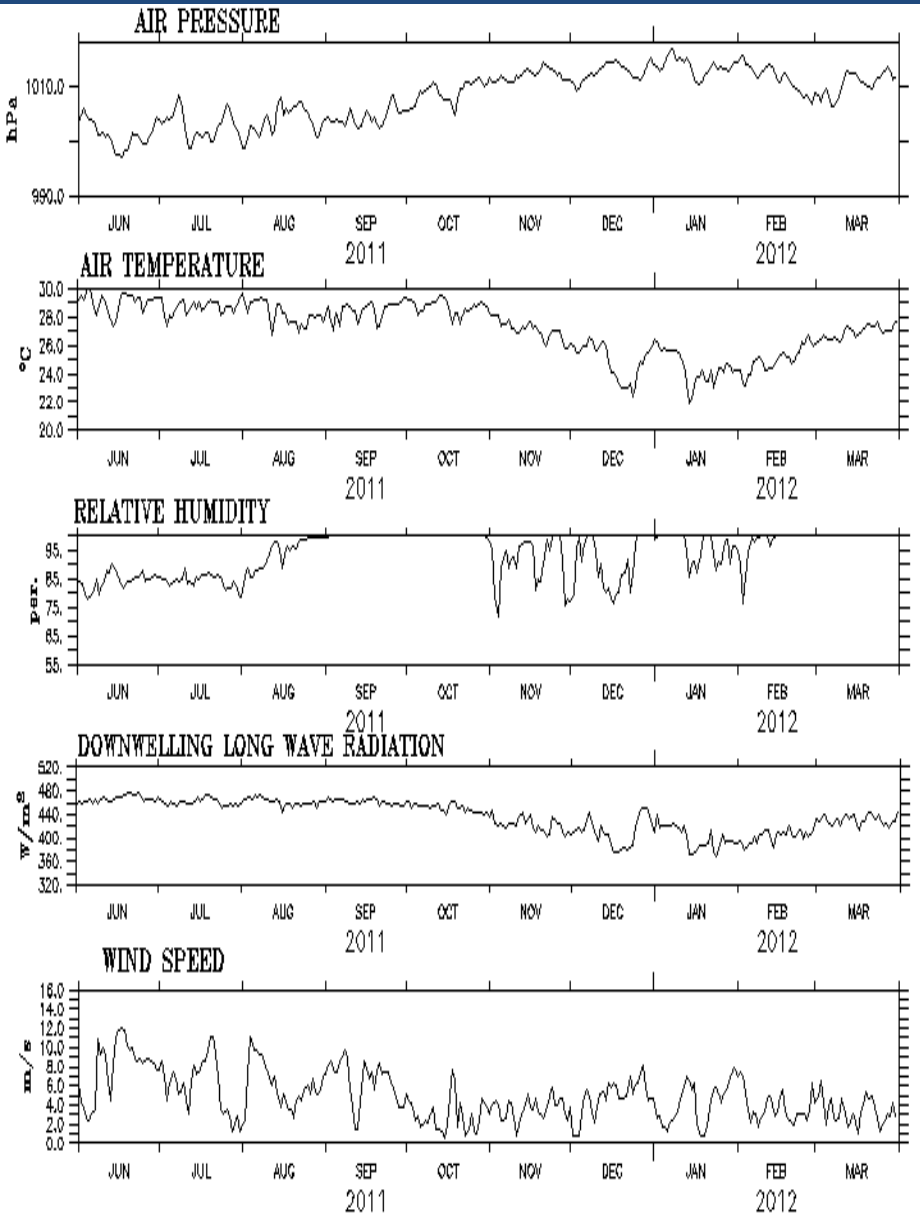
DATA AVAILABILITY FROM JUNE 2010 TO AUGUST 2012

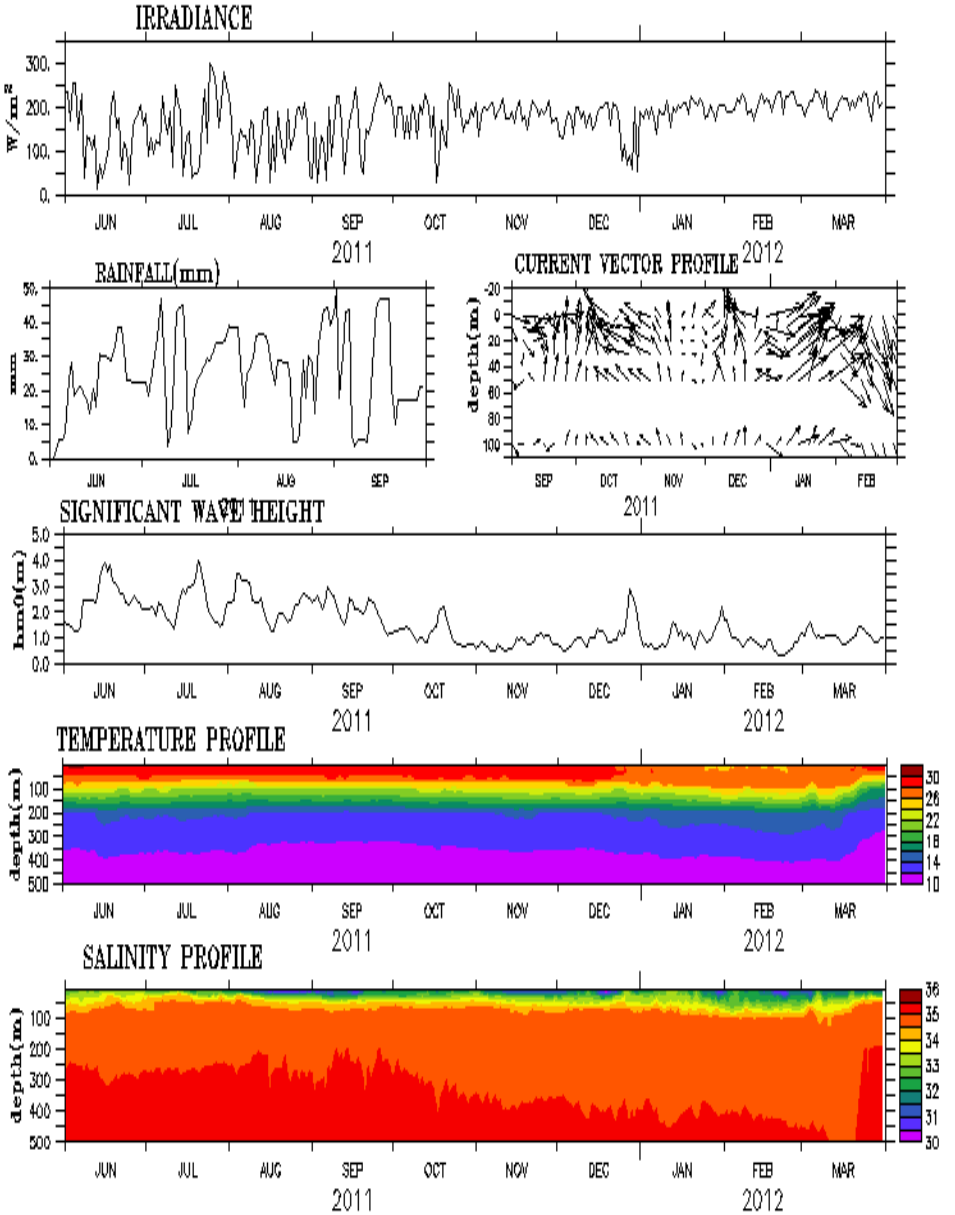




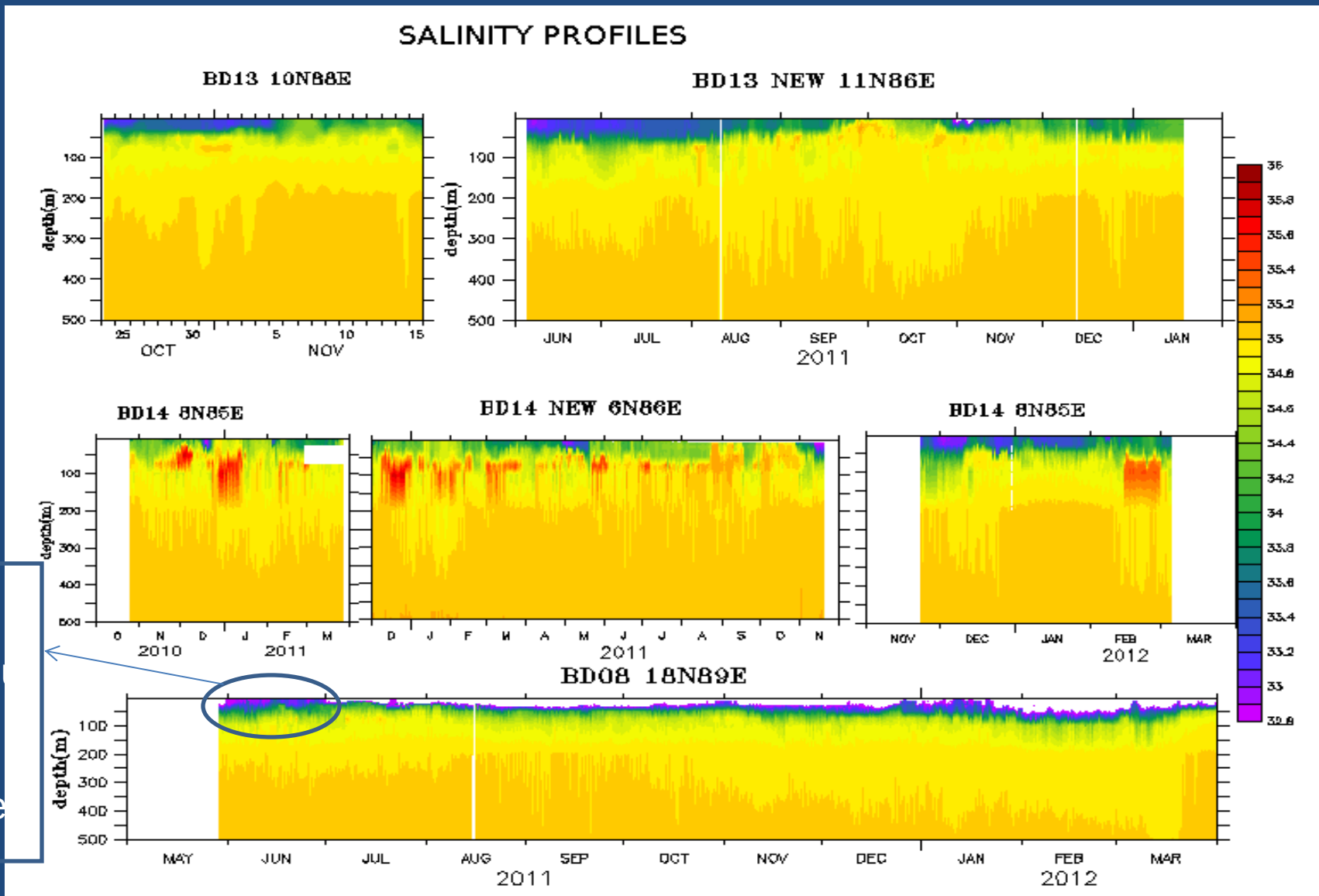


MAJOR INFORMATION OBTAINED FROM THE OMNI BUOYS





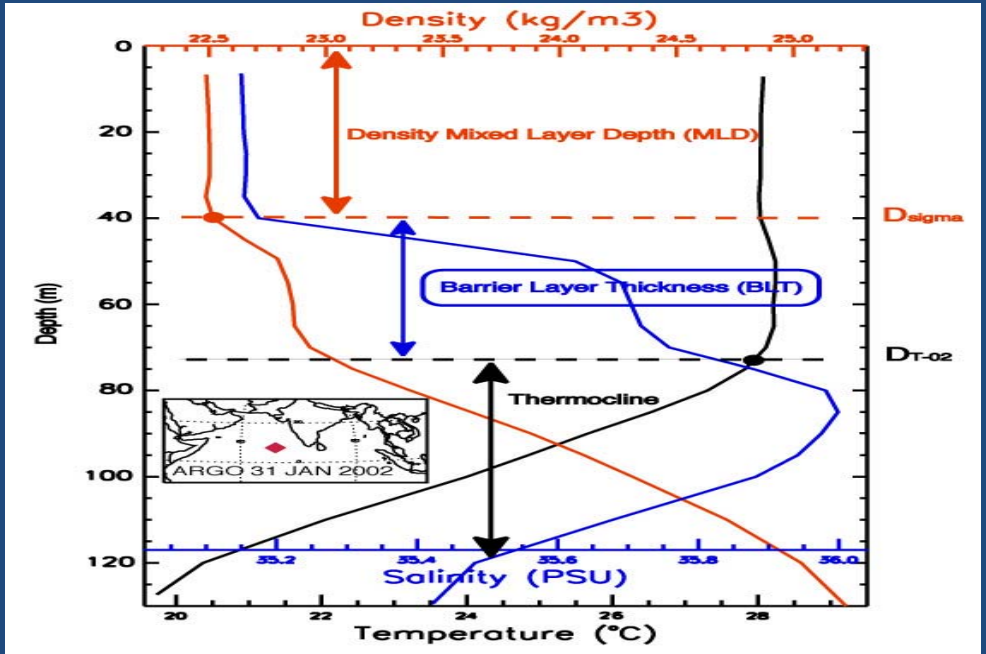
SUBSURFACE SALINITY



Lowering surface salinity d to heavy river discharge

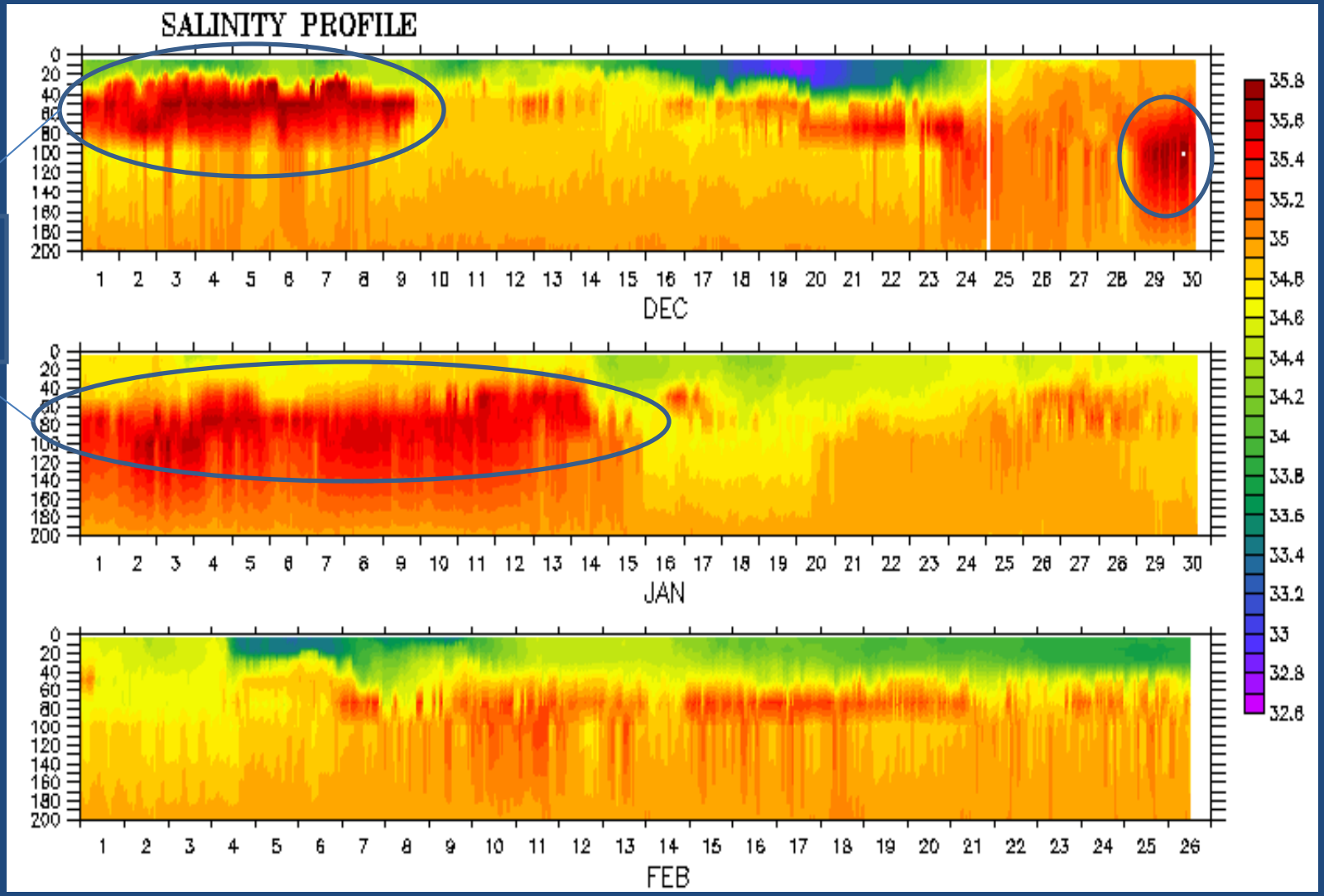
Significance of barrier layer

- Barrier layer insulates the upper mixed layer from mixing with water below.
- Ocean-atmosphere interaction is restricted to thinner mixed layer.
- SST is determined by these upper ocean processes
- Low saline water with high SST favours the formation of monsoon depressions



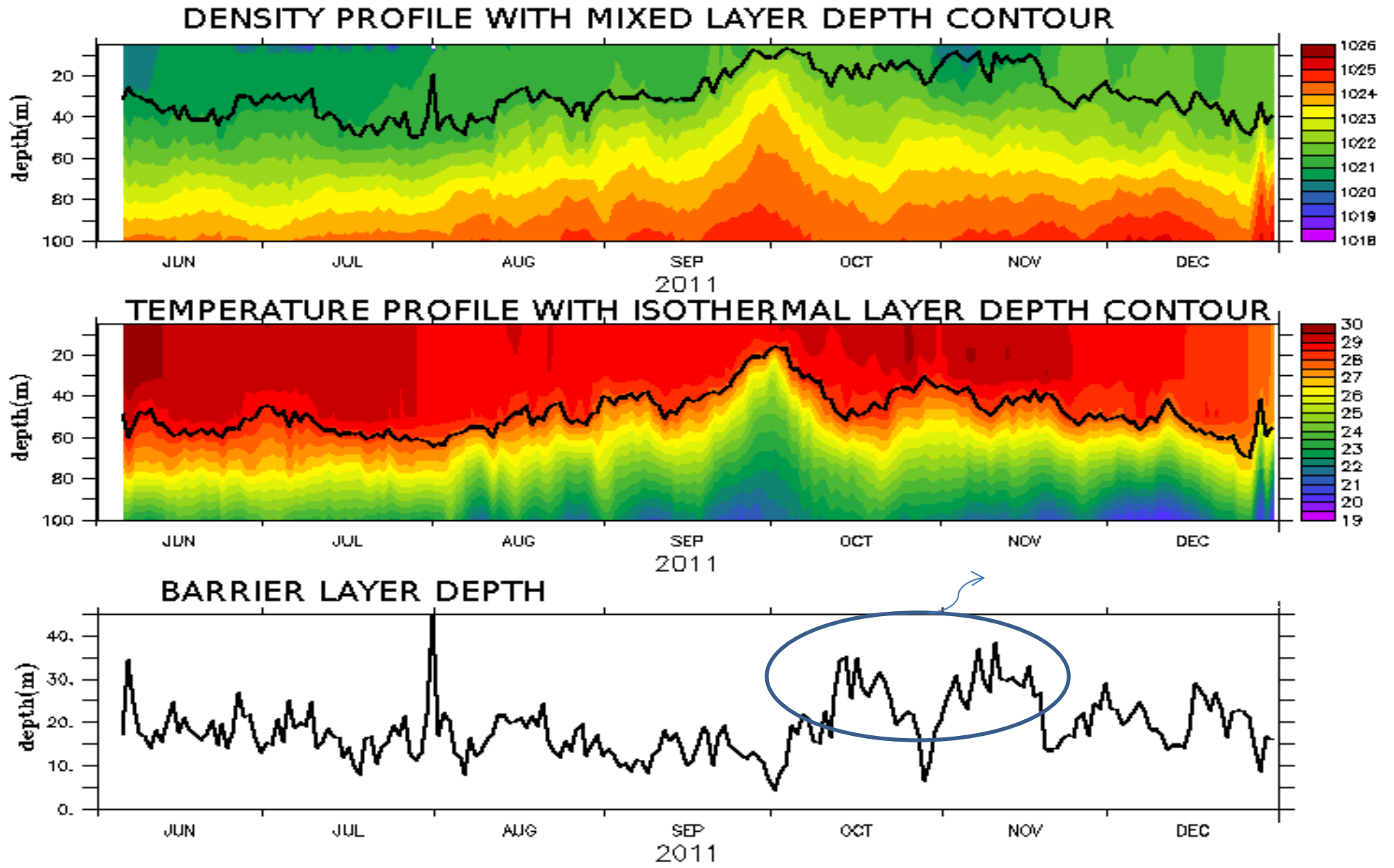
SALINITY PROFLIE AT BD13[85.15E & 8N]

High subsurface salinity

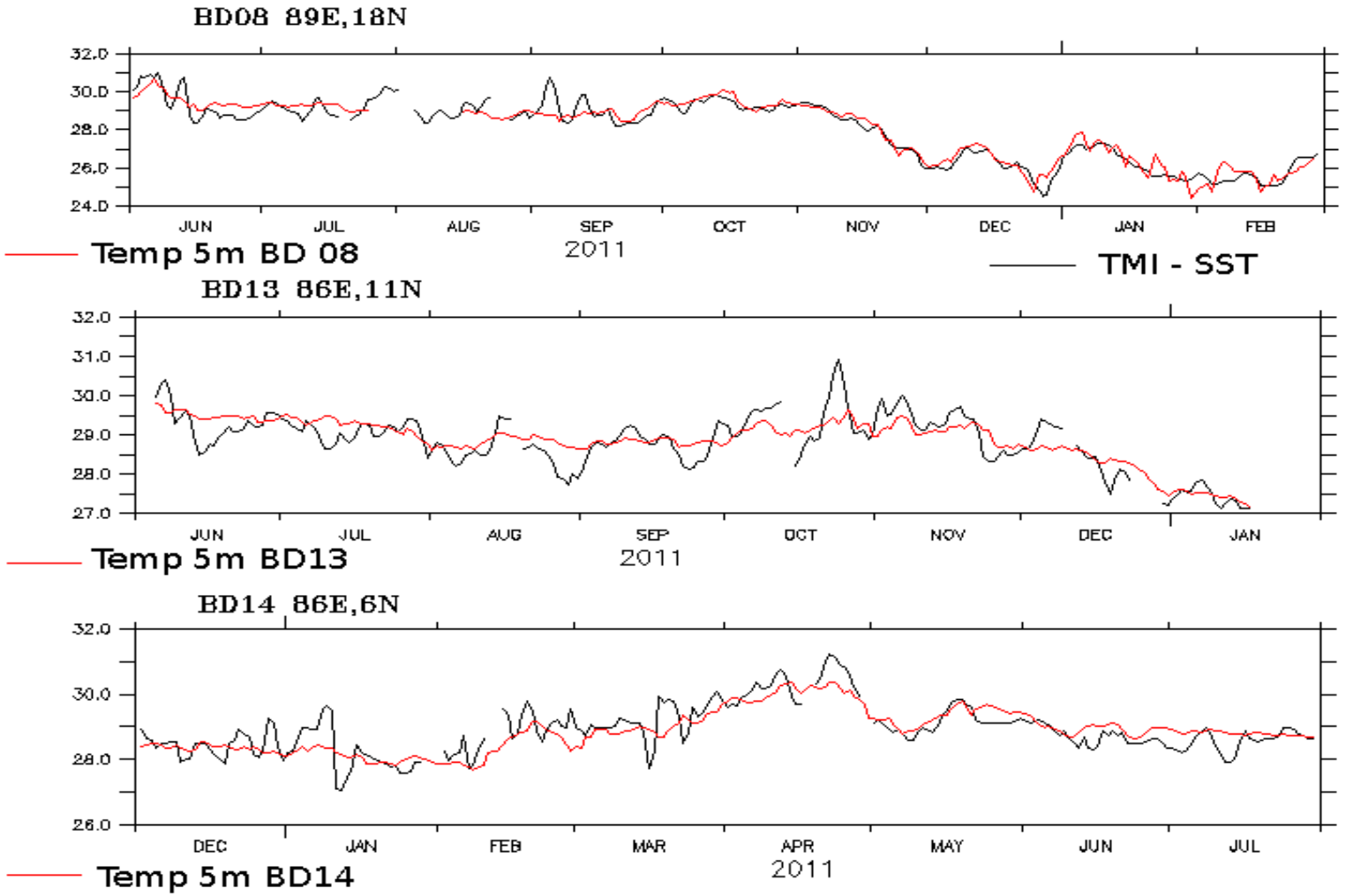


High Subsurface salinity at this location favours barrier layer formation during the northeast monsoon period – presented a paper in the OSICON 2011

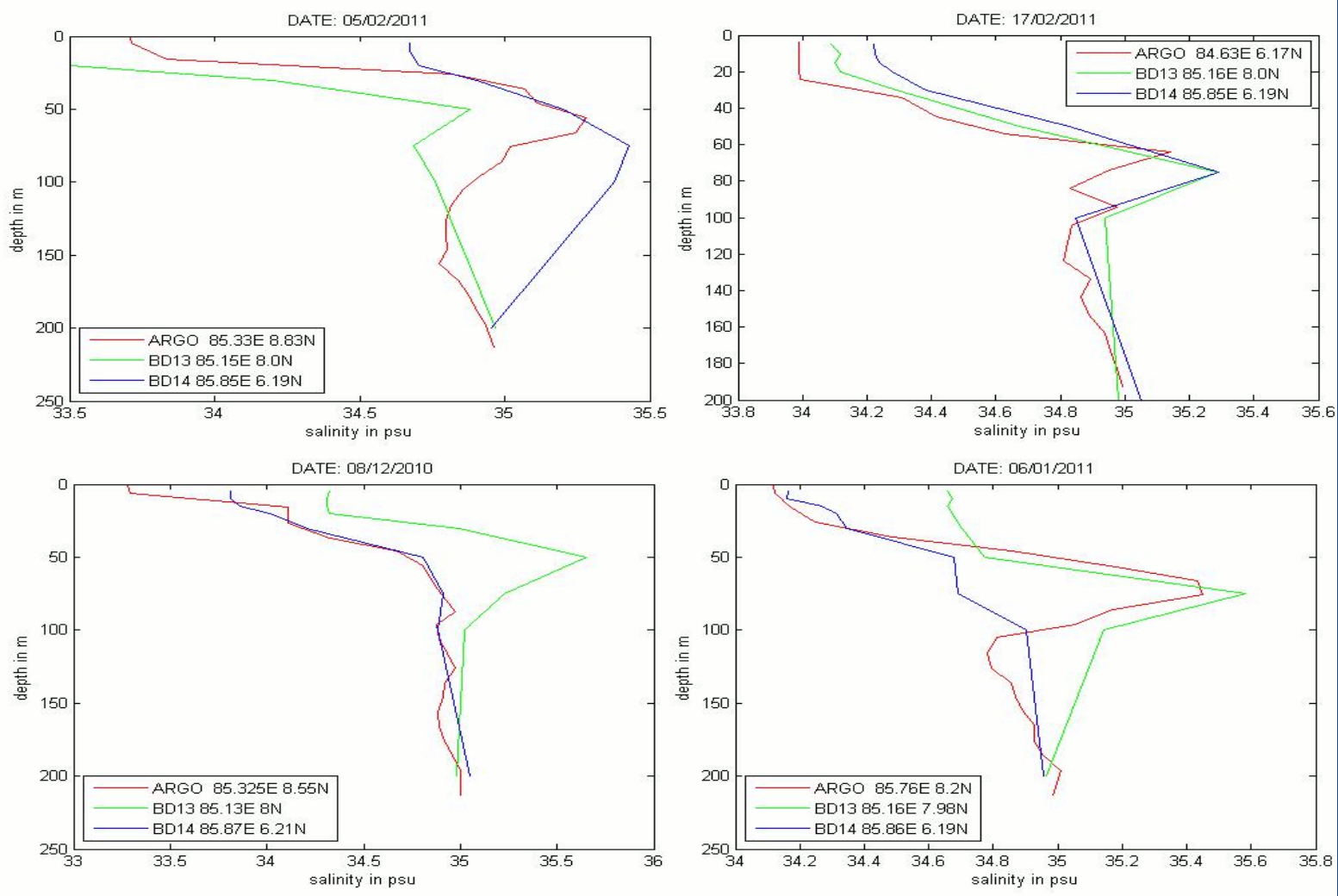
SUBSURFACE CT SENSOR DATA A POWERFULL TOOL FOR STUDYING THE UNDERWATER DYNAMICS



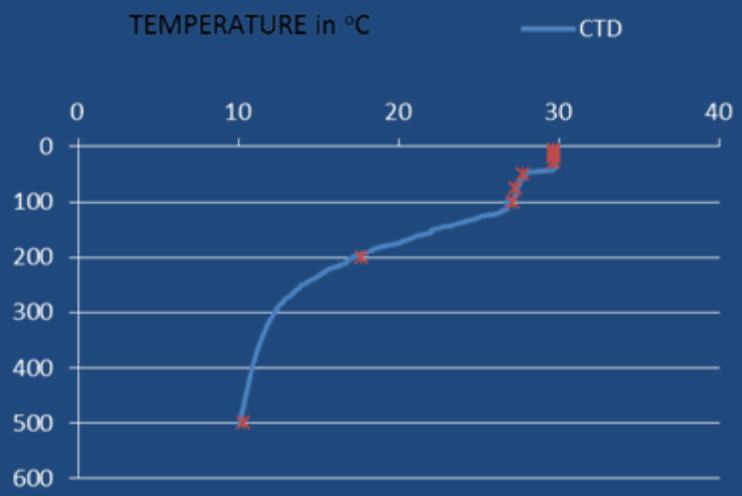
TMI-SST DATA COMPARISON WITH BUOY SURFACE WATER TEMPERATURE



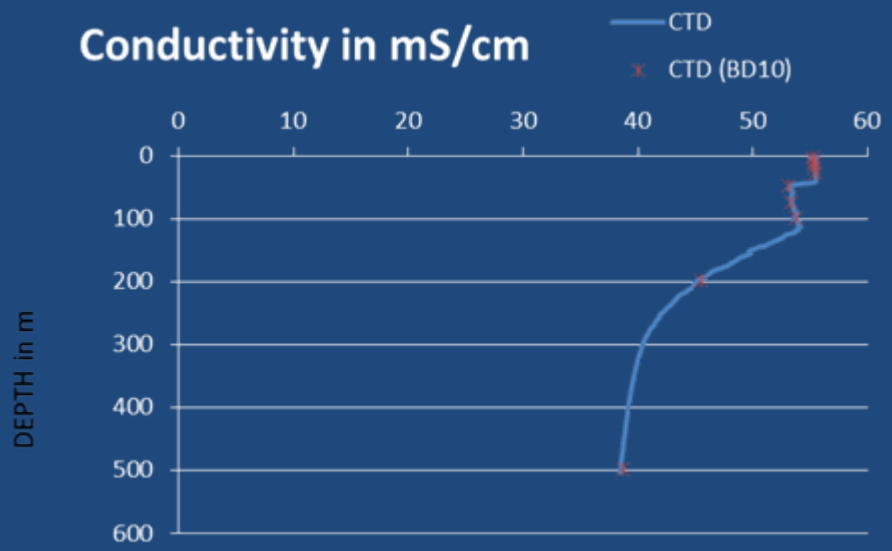
COMPARISON WITH ARGO PROFILES



INTERCOMPARISON BETWEEN CTD AND OMNI BUOY OBSERVATIONS

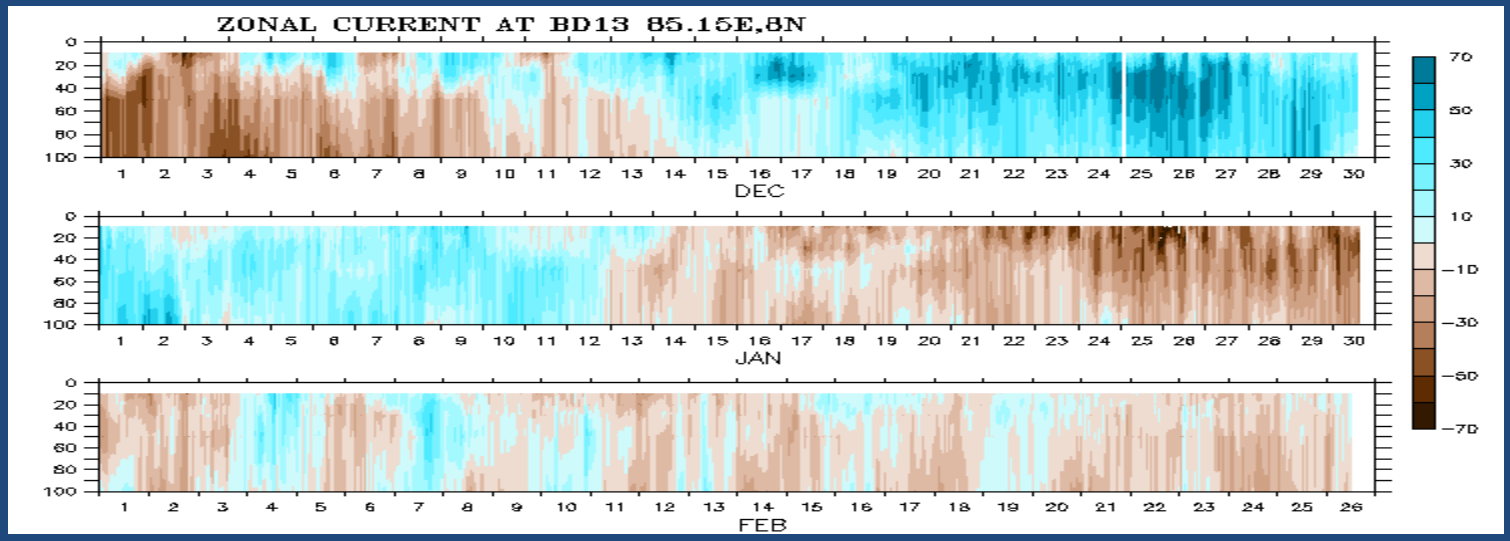


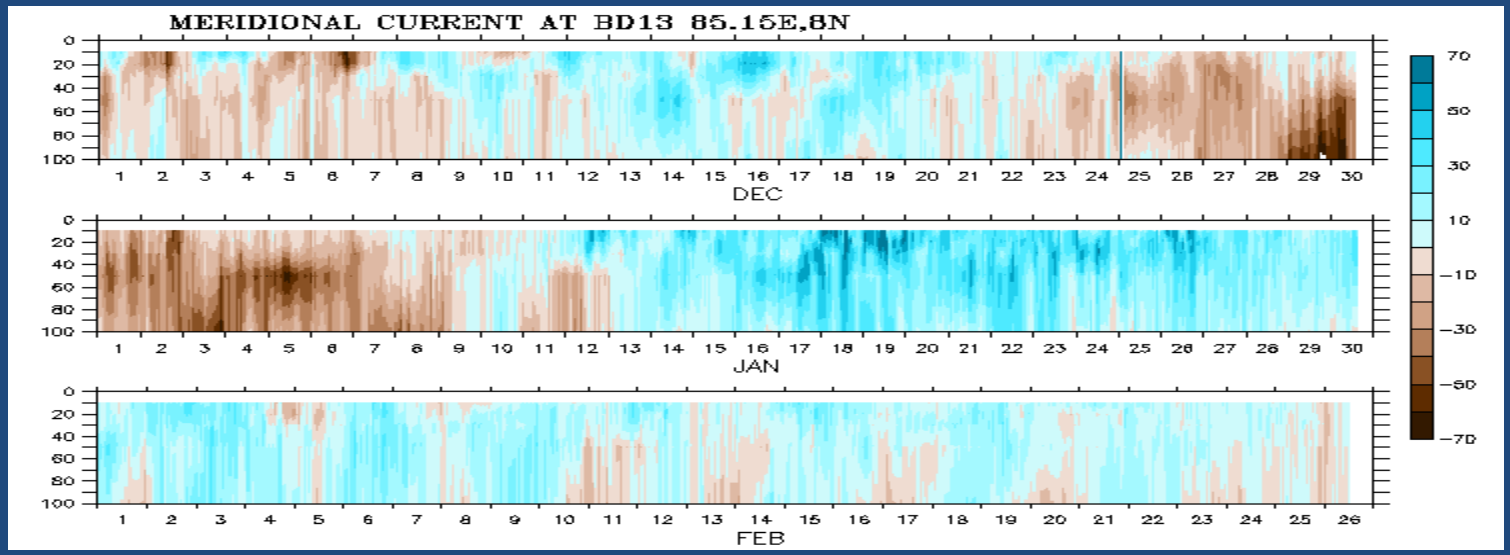
CTD- SEABIRD SBE9
OMNIBUOY-SEABIRD SBE37



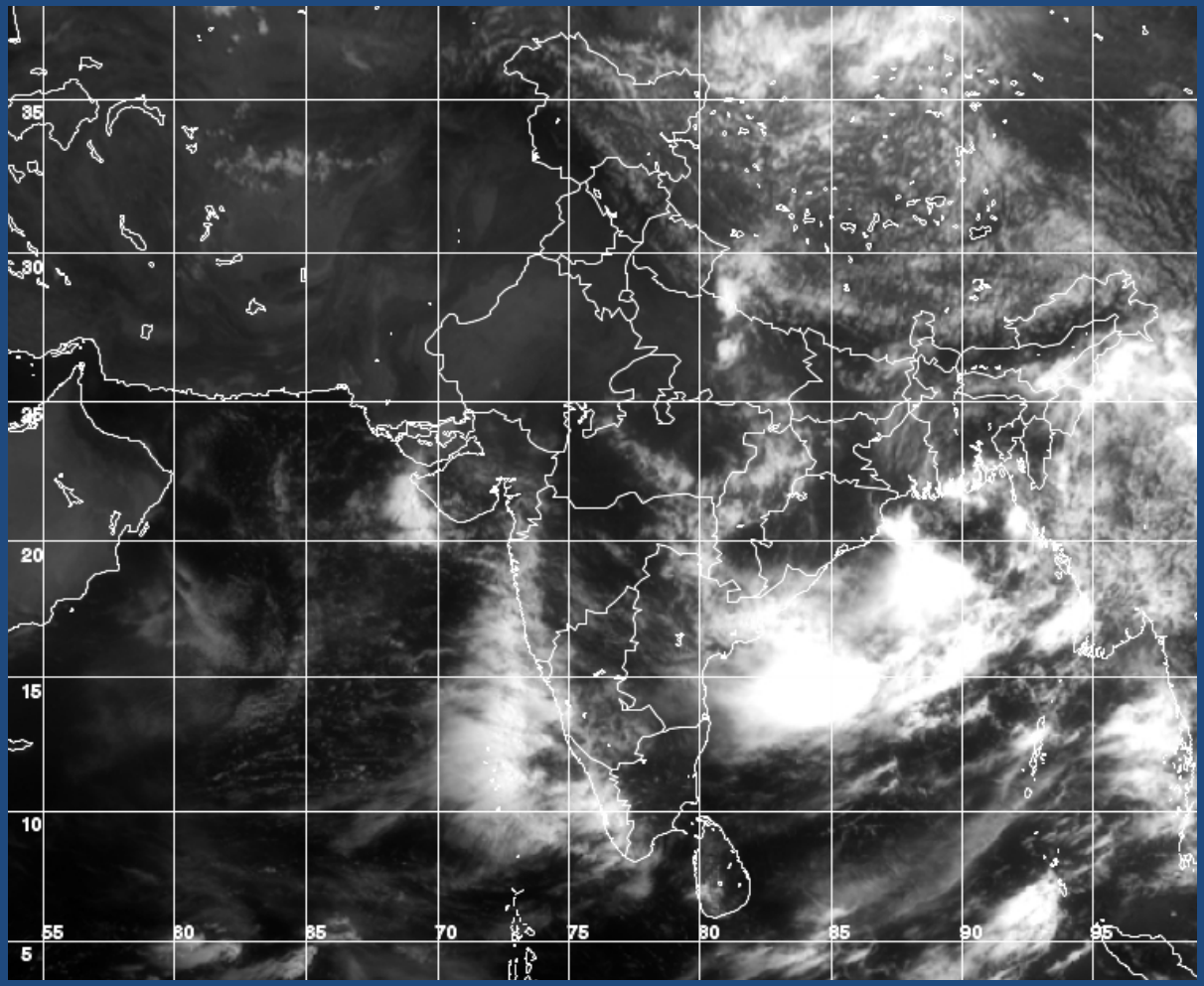
Currents upto 100m depth

The current measurements will give a clear idea on the role of advection In carrying water masses to different locations

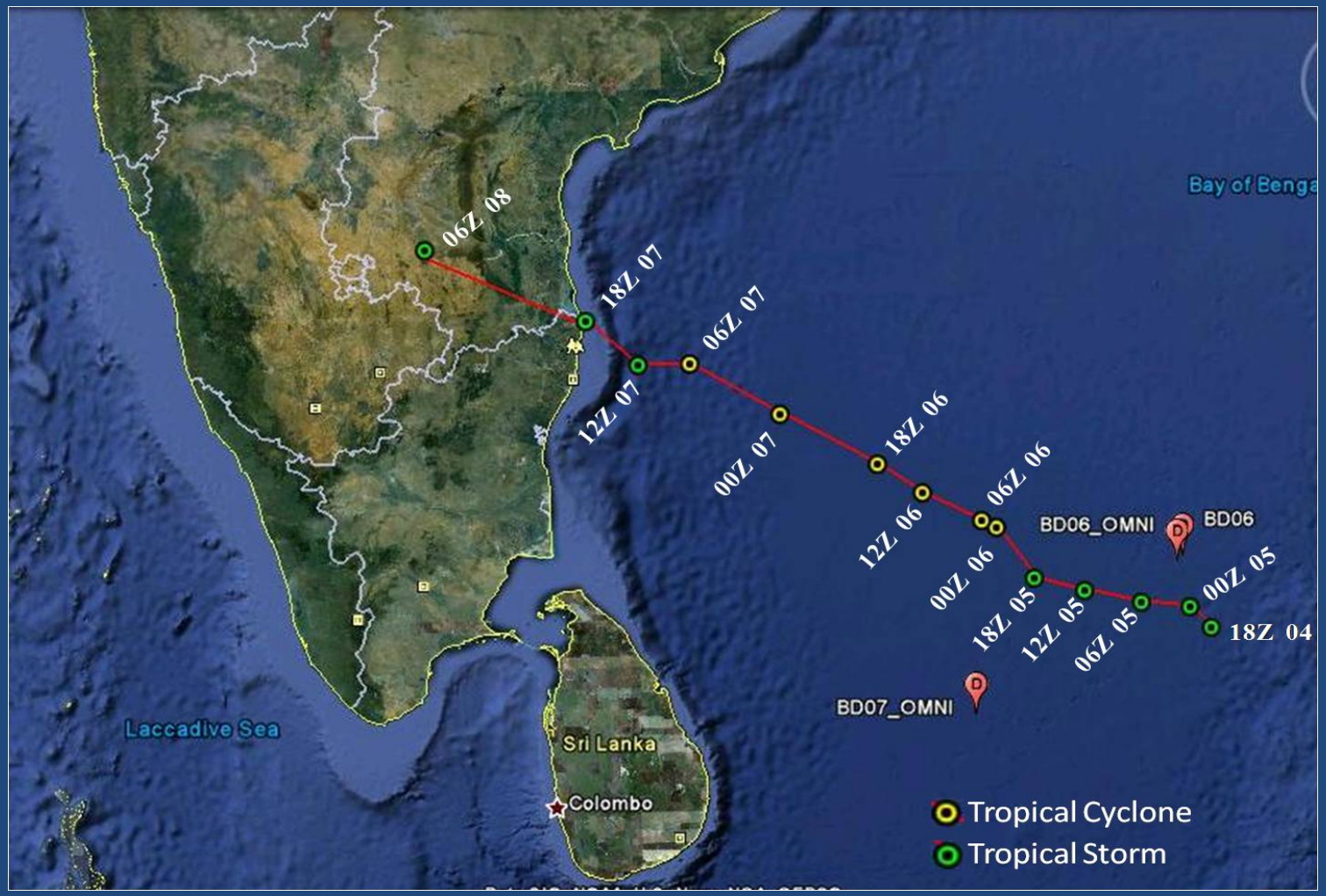




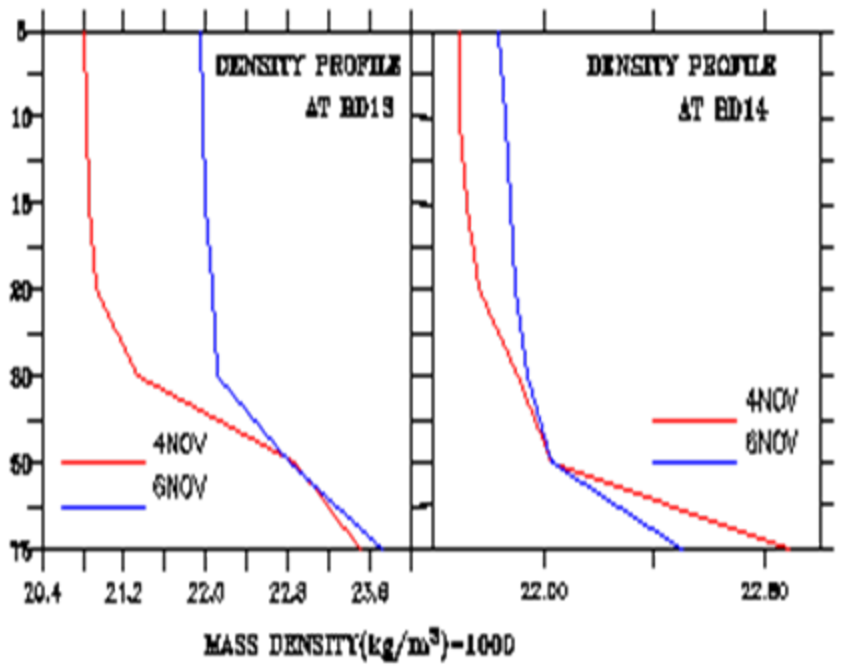
LOW PRESSURE SYSTEM OVER NORTHERN BAY OF BENGAL ON 14 TH JUNE, 2011

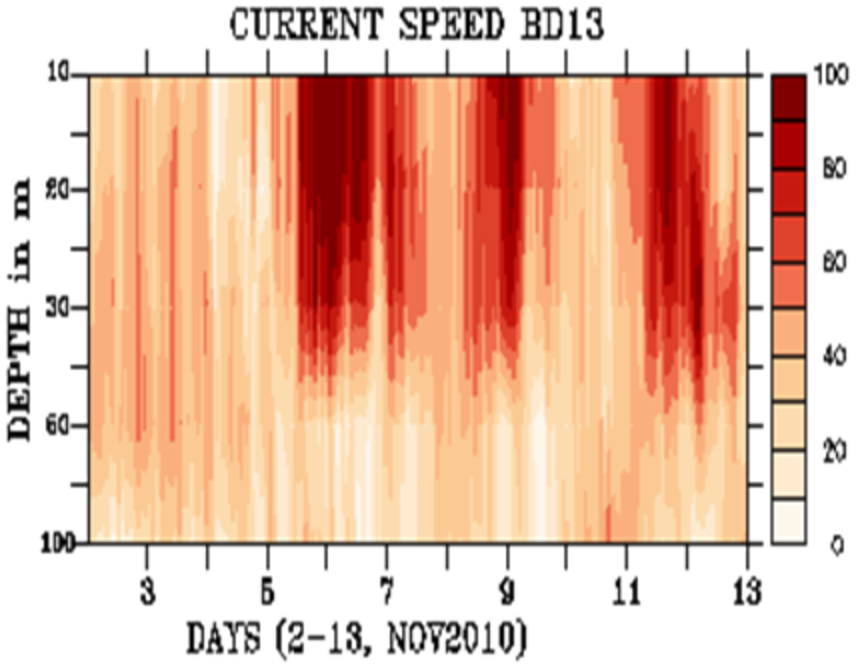


JAL CYCLONE


06Z 08
18Z 07
06Z 07
12Z 07
00Z 07
18Z 06
06Z 06
12Z 06
00Z 06
BD06_OMNI
BD06
18Z 05
12Z 05
06Z 05
00Z 05
18Z 04
BD07_OMNI
Bay of Benga
Laccadive Sea
Sri Lanka
Colombo
Tropical Cyclone
Tropical Storm

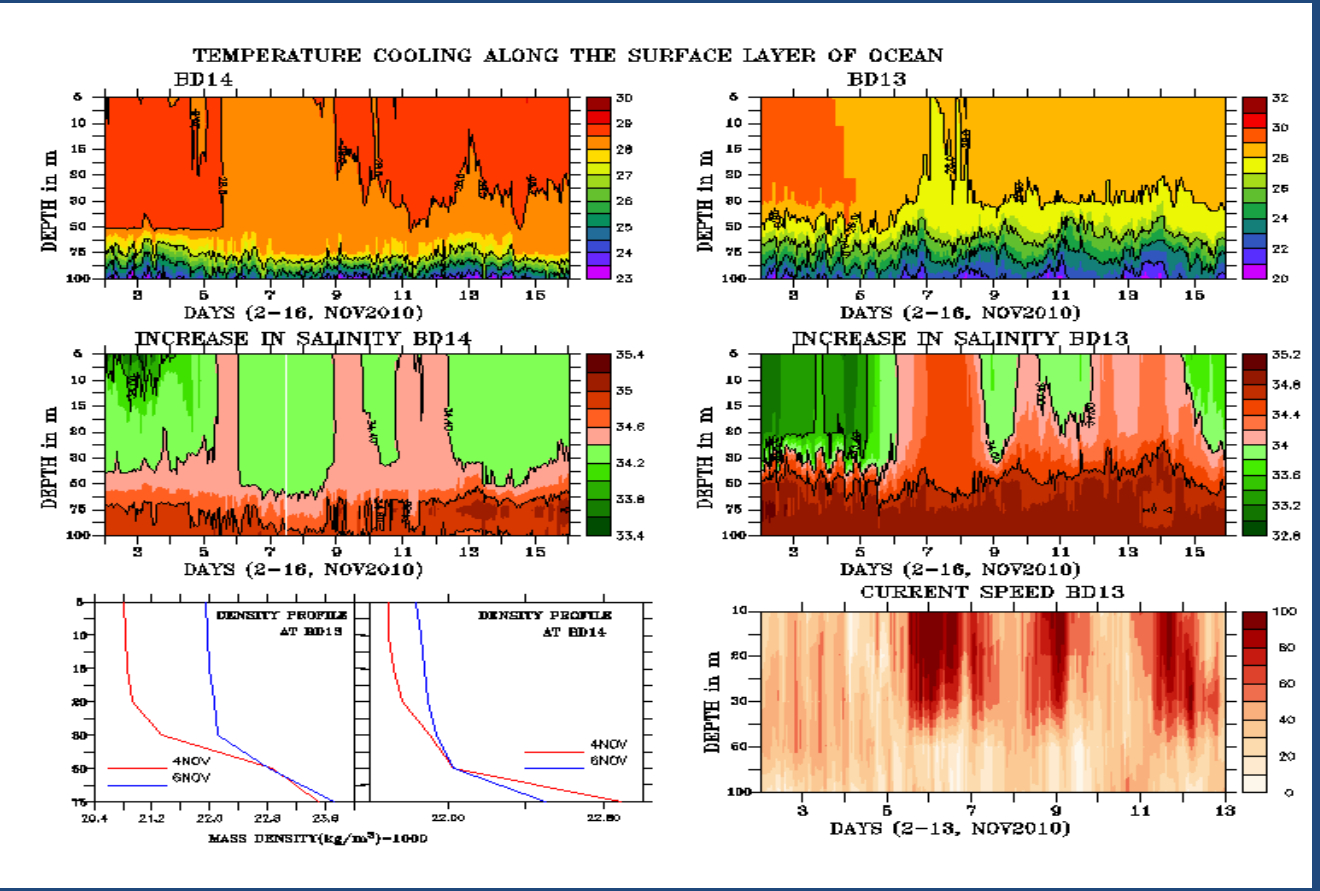
JAL Cyclone during 4-8 Nov, 2010 originated near 92E and 8N





- **Increase in surface density and increase in mixed layer depth**
- **Increase in surface current speed upto a depth of 40m**

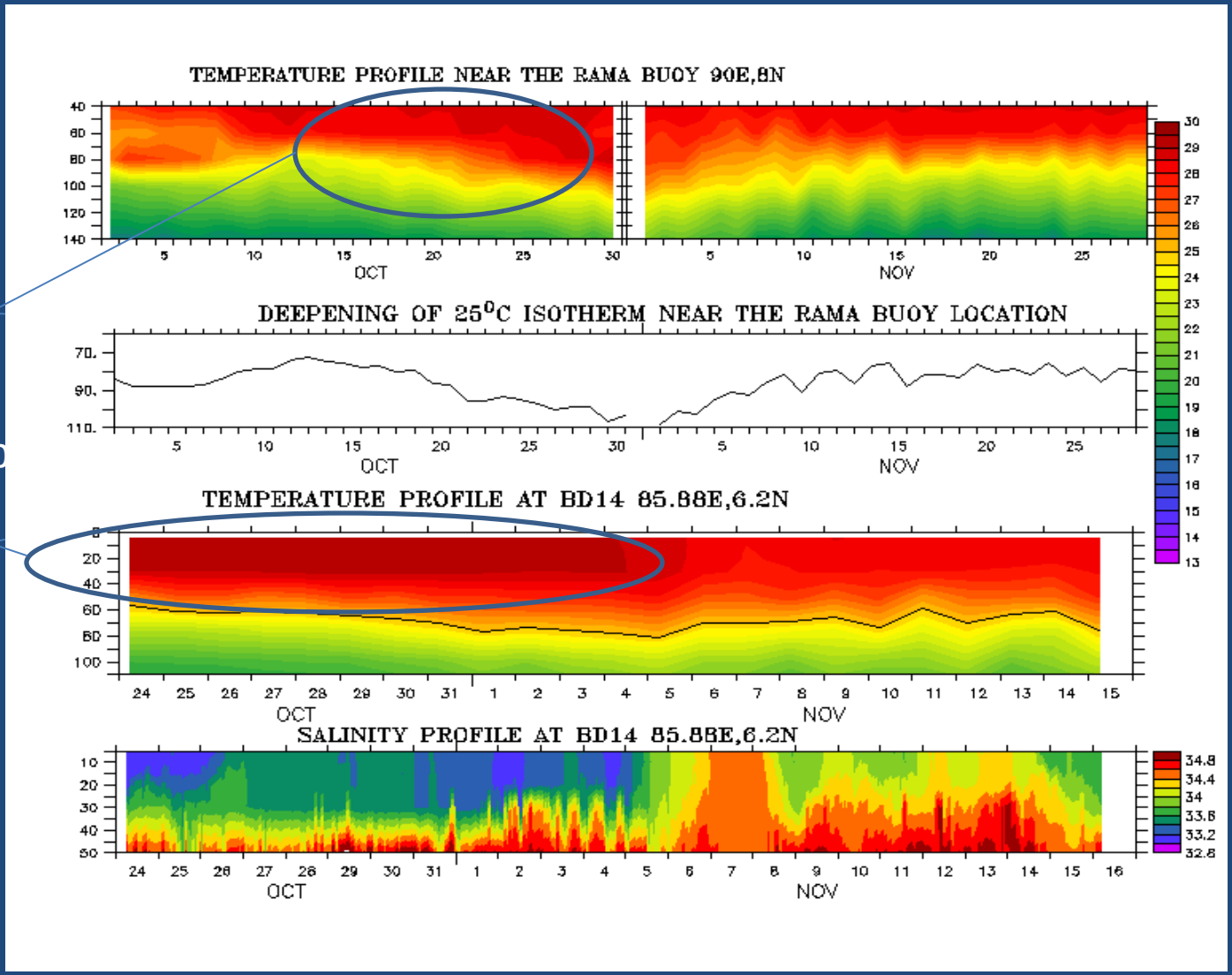
JAL Cyclone during 4-8 Nov, 2010 originated near 92E and 8N

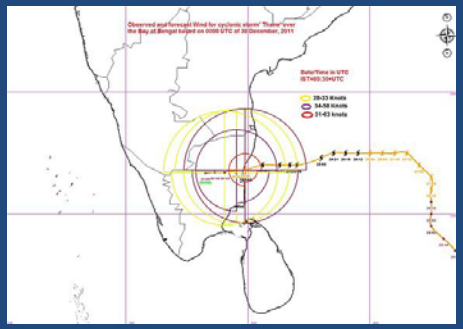


- **Subsurface cooling**
- **Entrainment of high saline waters**
- **Increase in surface density and increase in mixed layer depth**
- **Increase in surface current speed upto a depth of 40m**

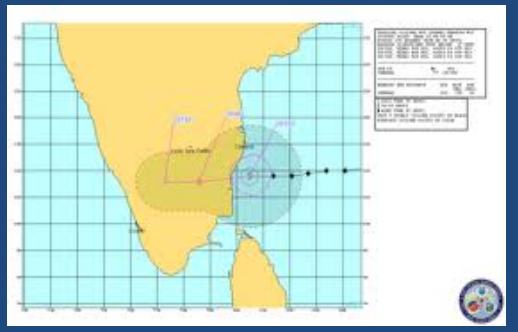
Downwelling ROSSBY WAVE SIGNALS as observed by RAMA [90E,8N] and BD14[86E,6.2N]

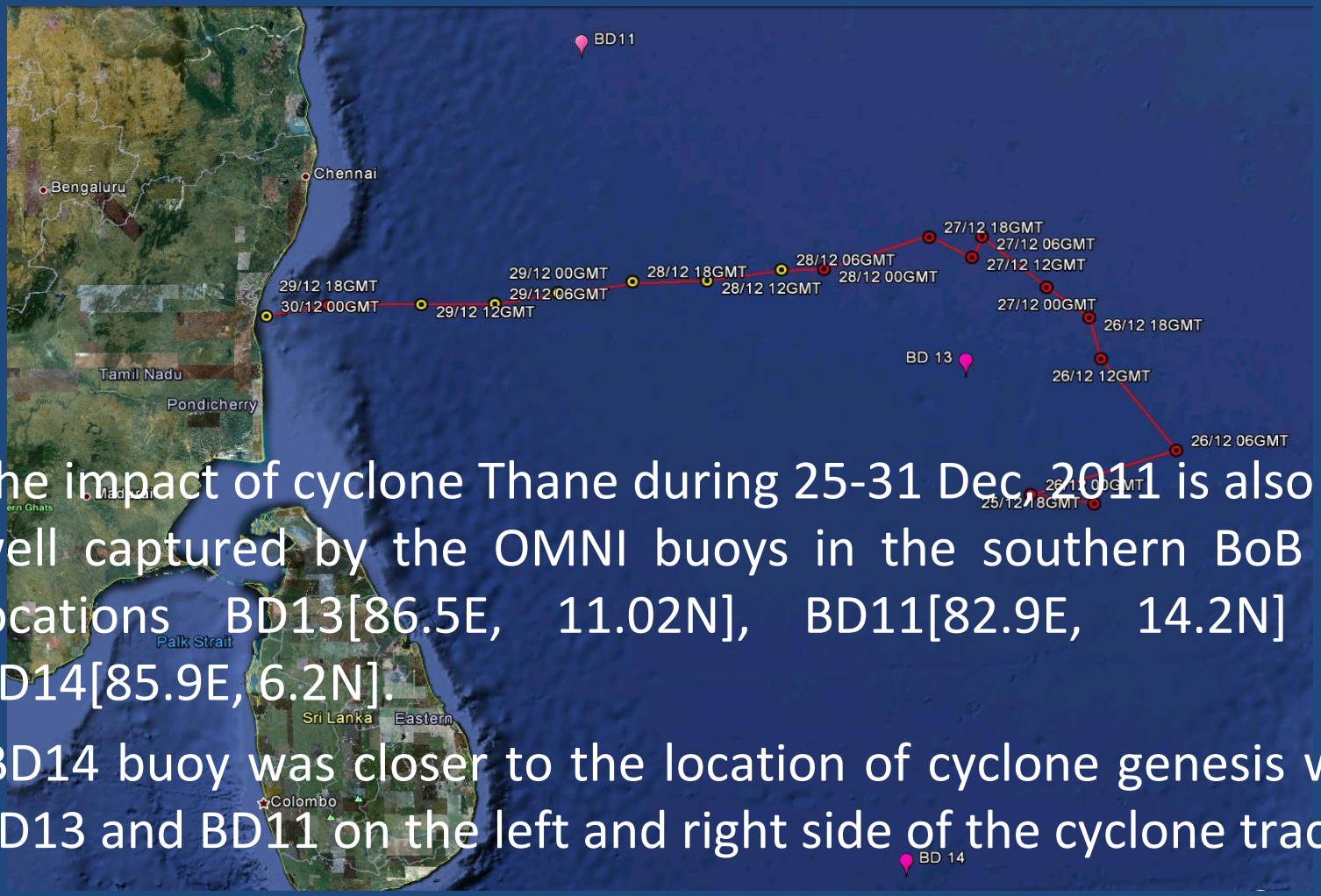
Intensive warming
In the presence of
downwelling Rossb
wave prior to the
JAL Cyclone





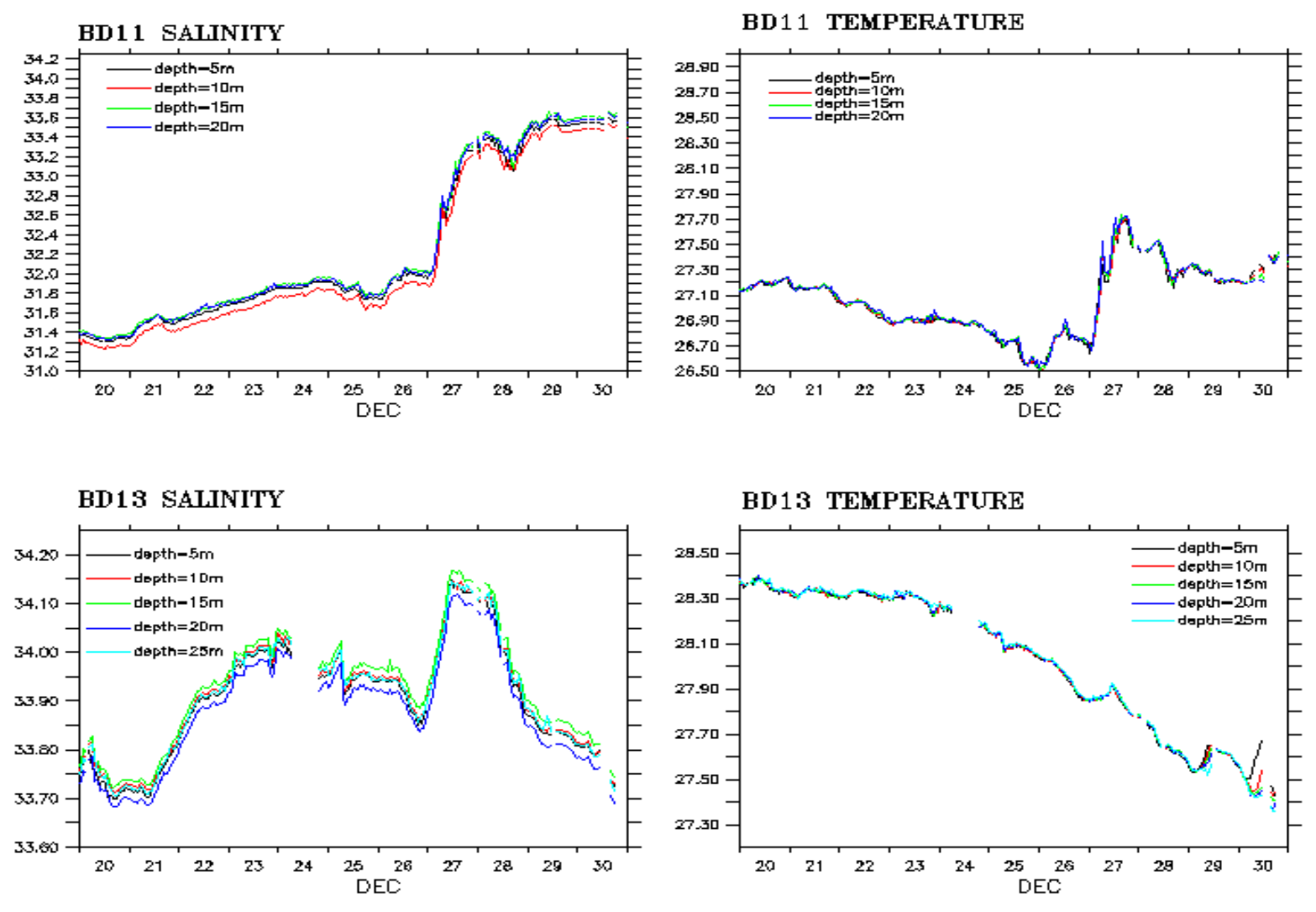
THANE CYCLONE TRACK





- The impact of cyclone Thane during 25-31 Dec, 2011 is also very well captured by the OMNI buoys in the southern BoB at 3 locations BD13[86.5E, 11.02N], BD11[82.9E, 14.2N] and BD14[85.9E, 6.2N].
- BD14 buoy was closer to the location of cyclone genesis while BD13 and BD11 on the left and right side of the cyclone track.

RESPONSE OF THANE CYCLONE

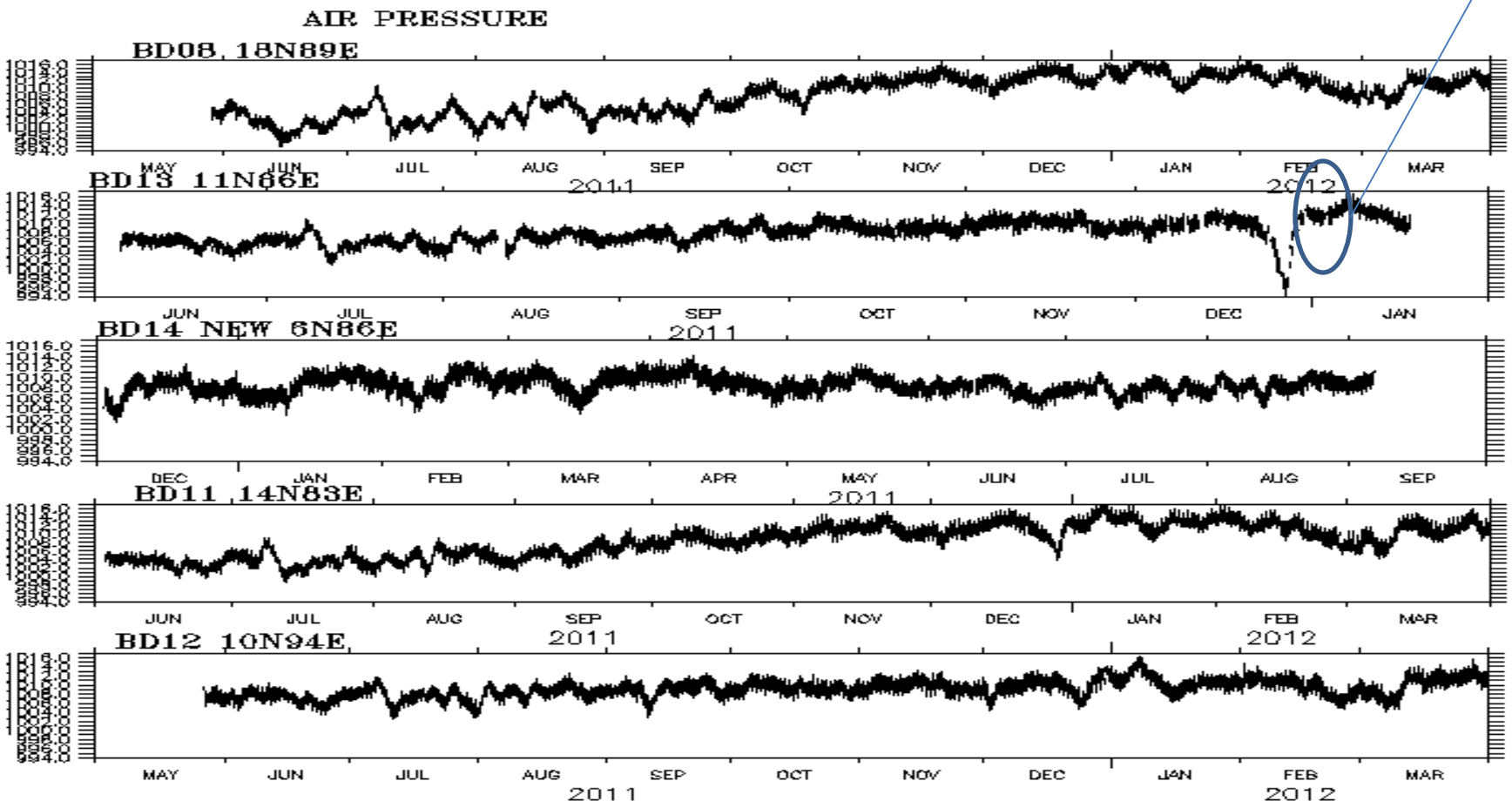


Since BD13 was closer to the cyclone track, it has showed an increase of surface salinity and a decrease of surface temperature during the passage of cyclone.

CONTINUOUS DATA AT SPECIFIC LOCATIONS

Air Pressure information used for monitoring low depression formed over the oce
To study the pressure gradients which drive the geostrophic winds

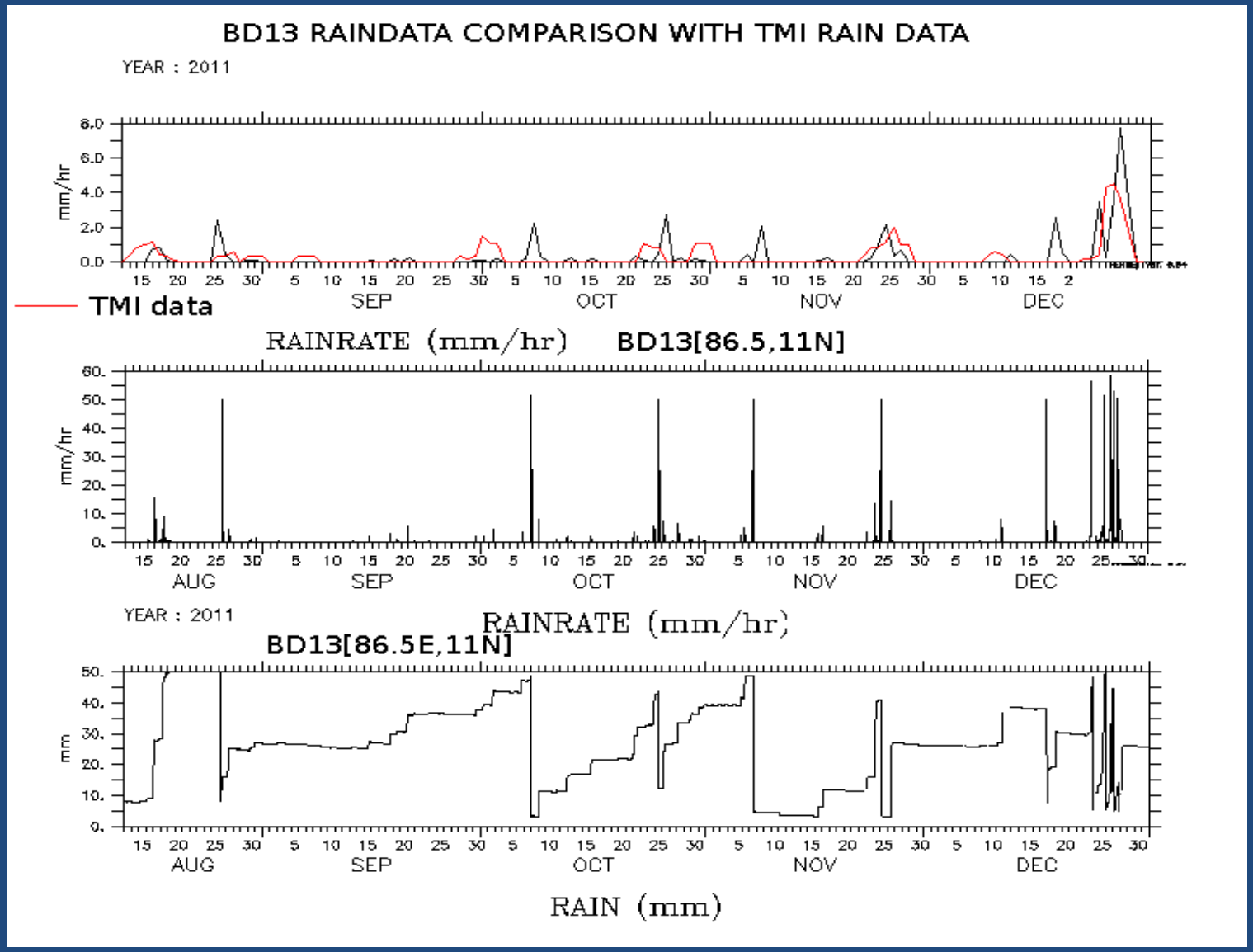
Thane cyclone



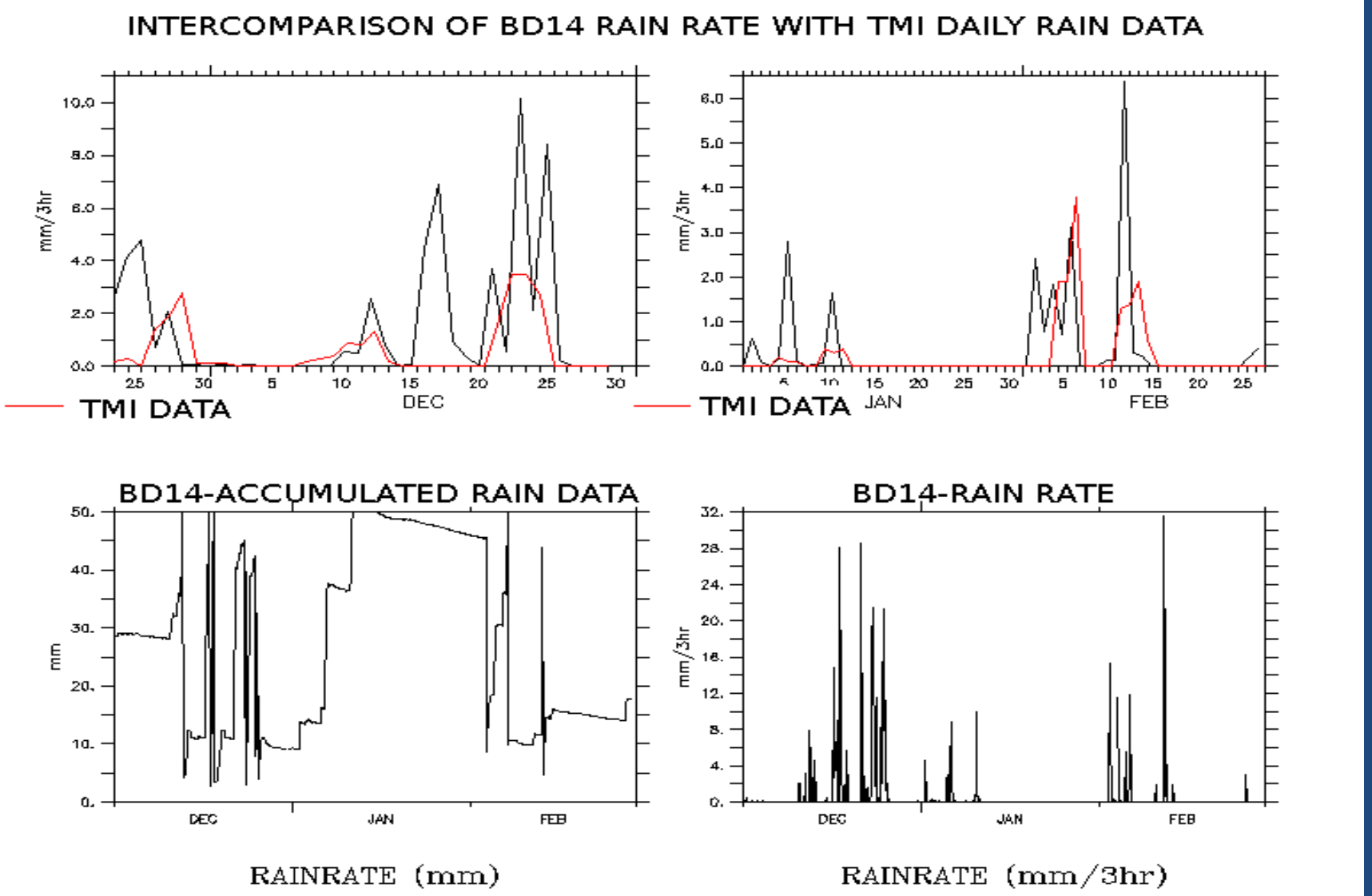
Rain data analysis

RAINDATA ANALYSIS AND COMPARISON WITH TMI RAIN DATA

ACCUMULATED RAIN DATA HAS BEEN CONVERTED TO RAIN DATA



RAIN DATA AT BD14[85.5E & 8.18N]



On-going Research Activities

- To study the warm and cool events.
- Studying the cyclone genesis and ocean responses.
- Freshening by river discharges - Barrier layer
- The freshwater discharge and the temperature inversion in the northern bay
- The cyclone forming in the BoB and AS and its impact on the subsurface ocean dynamics.
- Signals of Rossby wave signals
- Validating satellite data and model outputs
- Intra-seasonal and annual variations of SST

Coastal BUOY-ANDAMAN

Coral Reef Buoy deployed on 23rd February 2011 in Mahatma Gandhi Marine National Park, Wandoor, **Andaman & Nicobar** Island on the request of Department of Environment & Forests.

Press Release

The Daily Telegrams

The Largest Circulated Daily of A&N Islands

CENSUS QUIZ

Q 24. In which of the following Census, the reference date was 1st April.
a) 1941 b) 1961 c) 1971
d) None

Coral Reef Buoy...

Coral Reef Buoy set up near Grub Island

Port Blair, Mar 4

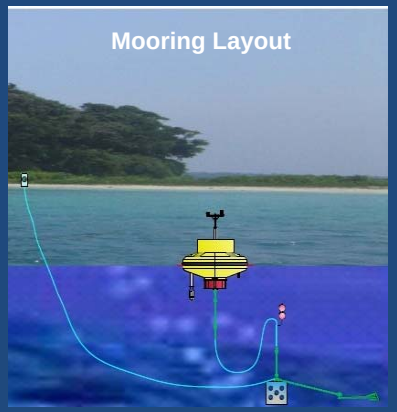
A Coral Reef Data Buoy (CRB) has come up near Grub Island in the Mahatma Gandhi Marine National Park, Wandoor. Such a dedicated Coral Reef Buoy is a first time initiative in the nation and shall provide host of ocean and weather related parameters of Andaman Sea. The Coral Reef Buoy has been set up by the Department of Environment & Forests in collaboration with National Institute of Ocean Technology, Chennai and Department of Science & Technology, A&N Administration, Port Blair.

The data buoy has sensors for measuring wind speed, direction, air temperature, air pressure and humidity. It also has under water sensors for measuring dissolved oxygen, turbidity, salinity, PH, conductivity and sea

Buoy Features

- Measures : Wind Speed & Direction
  Air Temperature
  Air Pressure and Humidity
- Underwater: Dissolved Oxygen,
  Turbidity, Salinity, pH,
  Conductivity, SST,
  Current Speed & Direction
- Coral Reef Environment Friendly Anchor

Deployment Operation

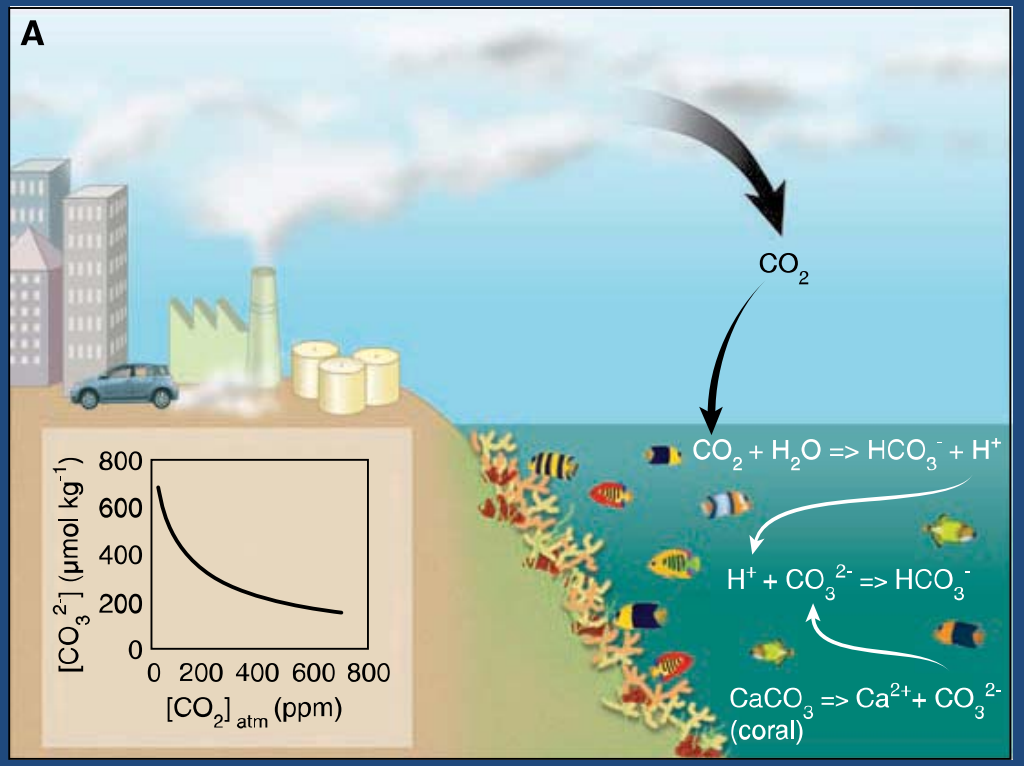


Mooring Layout

The other CO_2 problem

- Ocean acidification
- 30% of excess CO_2 absorbed by the ocean
- Ocean becomes more acidic and changes carbonate chemistry

pCO2, carbonic acid, bicarbonate, H^+



Hoegh-Guldburg et al. 2007

carbonate, pH (-logH^+)

Linking Observations to Benefits

- Better observations will allow us to forecast with more accuracy allowing us to get our coastal communities more effective warnings
  - More than half the world's population lives within 60 km of the shoreline, & this could rise to 3/4 by the year 2020
  - Coastal storms account for major disaster losses annually
  - 25% of Earth's biological productivity & an estimated 80-90% of global commercial fish catch is concentrated in coastal zones
  - Worldwide agricultural benefits of better El Niño forecasts are conservatively estimated at $450-$550M/year
  - State of scientific understanding on the role of upper ocean processes in the Bay of Bengal on the Indian Monsoon.
  - We aim to identify key processes and variables in the Bay of Bengal, whose measurement and quantification could lead to an improvement in understanding and prediction of the Indian monsoon.

Thank you for your attention

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