DBCP Scientific and Technical Workshop ,Geneva

Significance of met-ocean-subsurface Indian OMNI buoy measurements in Bay of Bengal

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26 September 2011

Bay of Bengal – Region of interest

Bay of Bengal is the largest bay in the world, forms the north-eastern part of the Indian Ocean

Lies between

latitudes 5° and 22° N and longitudes 80° and 90° E

Bordered by Sri Lanka and India to the west, Bangladesh to the north, and Myanmar (Burma) and the northern part of the Malay Peninsula to the east

an area of about 2,173,000 sq km

Bay of Bengal – Regional significance

About1.5 billion People lives in the coastal area (25% world populations) large fishing dependency

The fish catch in the Bay of Bengal was more than 2.4 million tons

Summer and winter monsoon, cyclones, storms, which mostly originate over the Bay of Bengal

Warm pool rise and falls reveal strong monsoon intraseasonal oscillations (ISO)

Major rivers (the Ganges, Brahmaputra, Meghna, Mahanadi, Godavari, Krishna and Salween) introduces large quantities of freshwater and silt into the Bay

Over 200 km^3 of water is discharged from major rivers

2.5 billion tonnes of sediment discharged from Ganges River annually

In deeper waters, high-salinity, low-temperature and low-oxygen waters persist through out the year

MONSOON TO INDIA AND GLOBAL CLIMATE

Monsoon is a complex and chaotic phenomena and it is seasonally varying oceanic and atmospheric circulations

Monsoon weather systems spawn over the bay and deliver heavy rain over the country

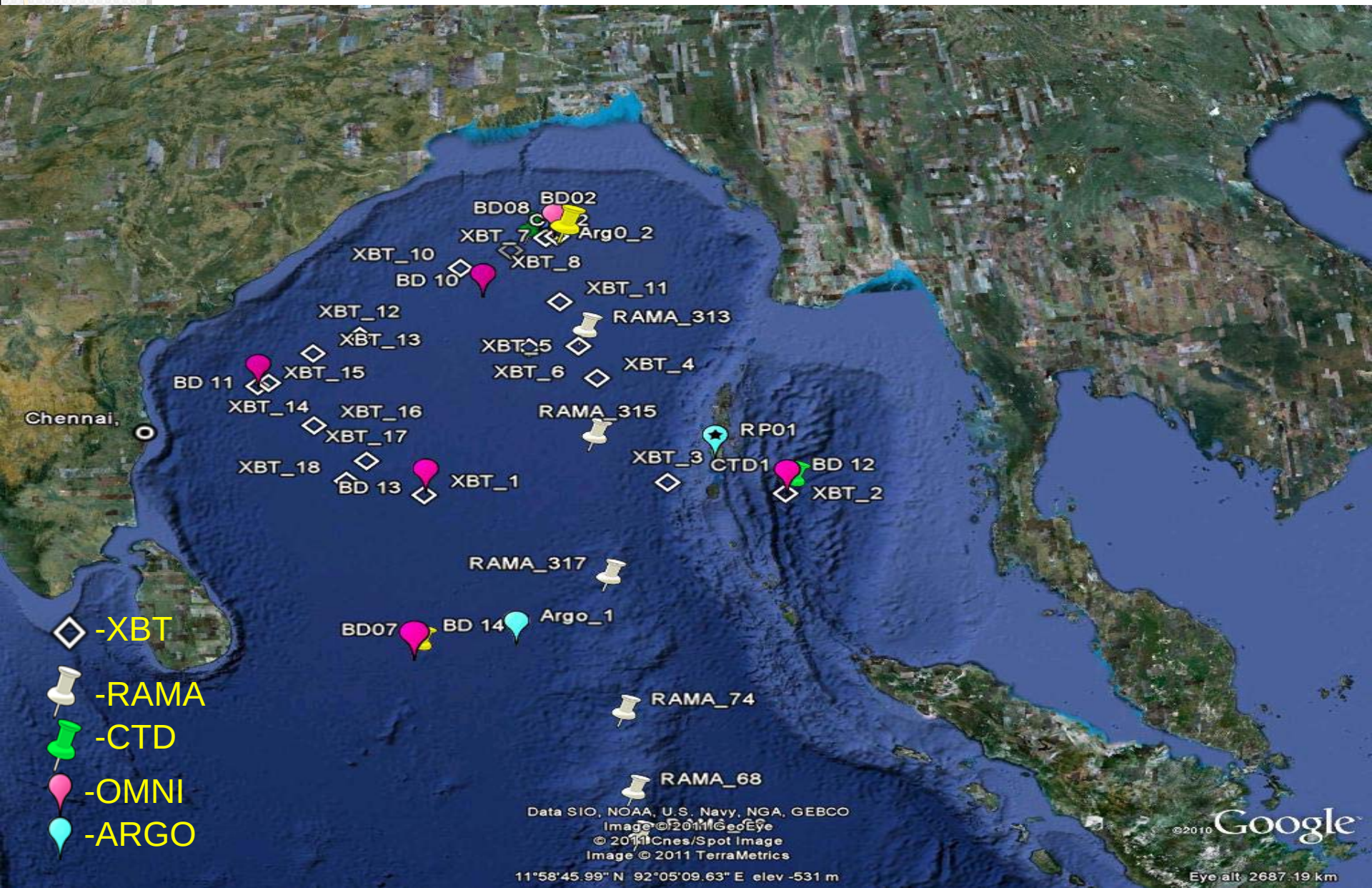
Asia's agriculture productivity mostly depends on monsoon rainfall

Monsoon rains occur each year, supporting agricultural production that provides food for a third of the world's population

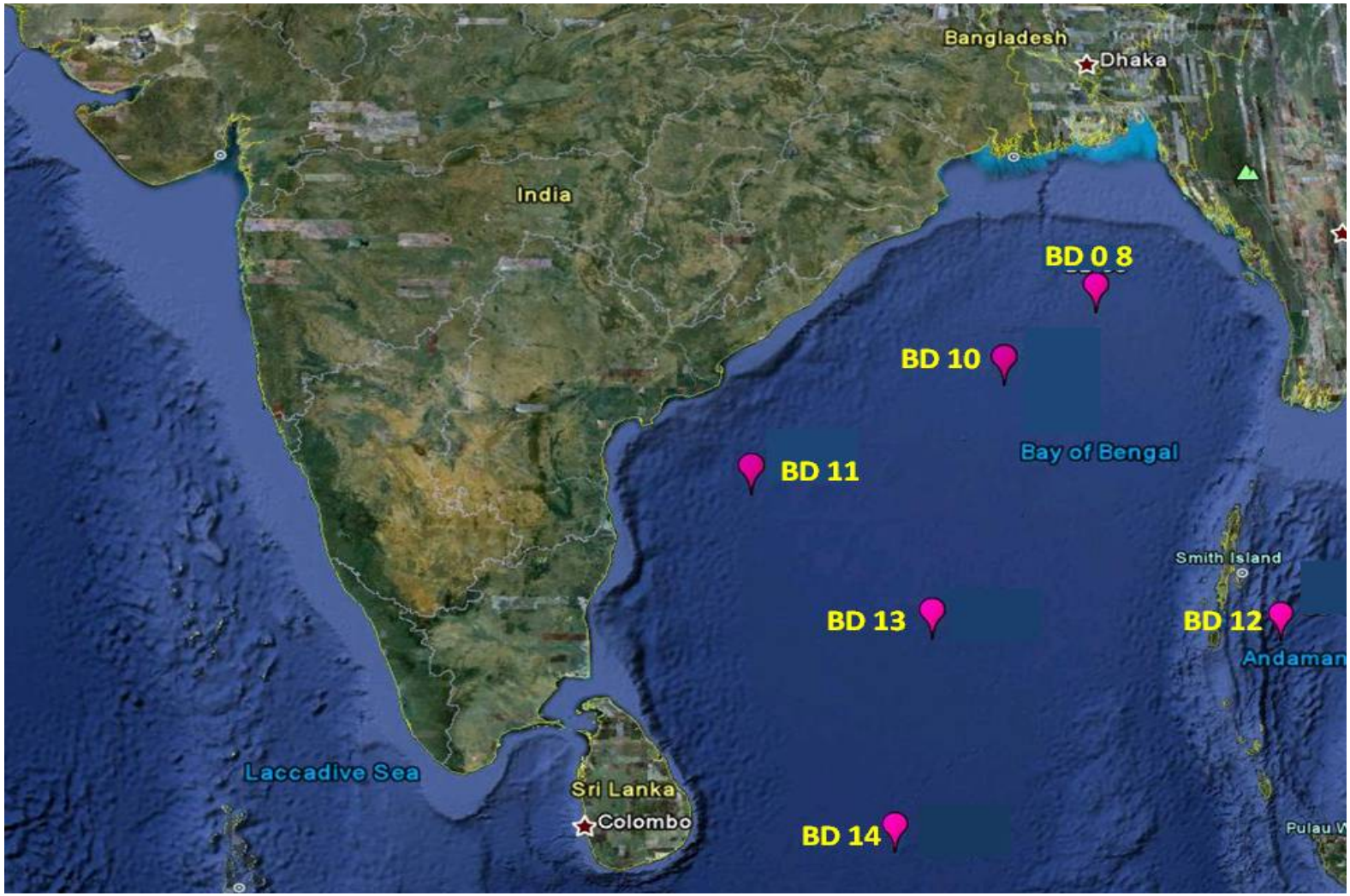
El Niño influence on Indian summer monsoon rainfall

Indian monsoon will cause large-scale ocean–atmosphere interactions, mixed-layer dynamics, and ocean circulation

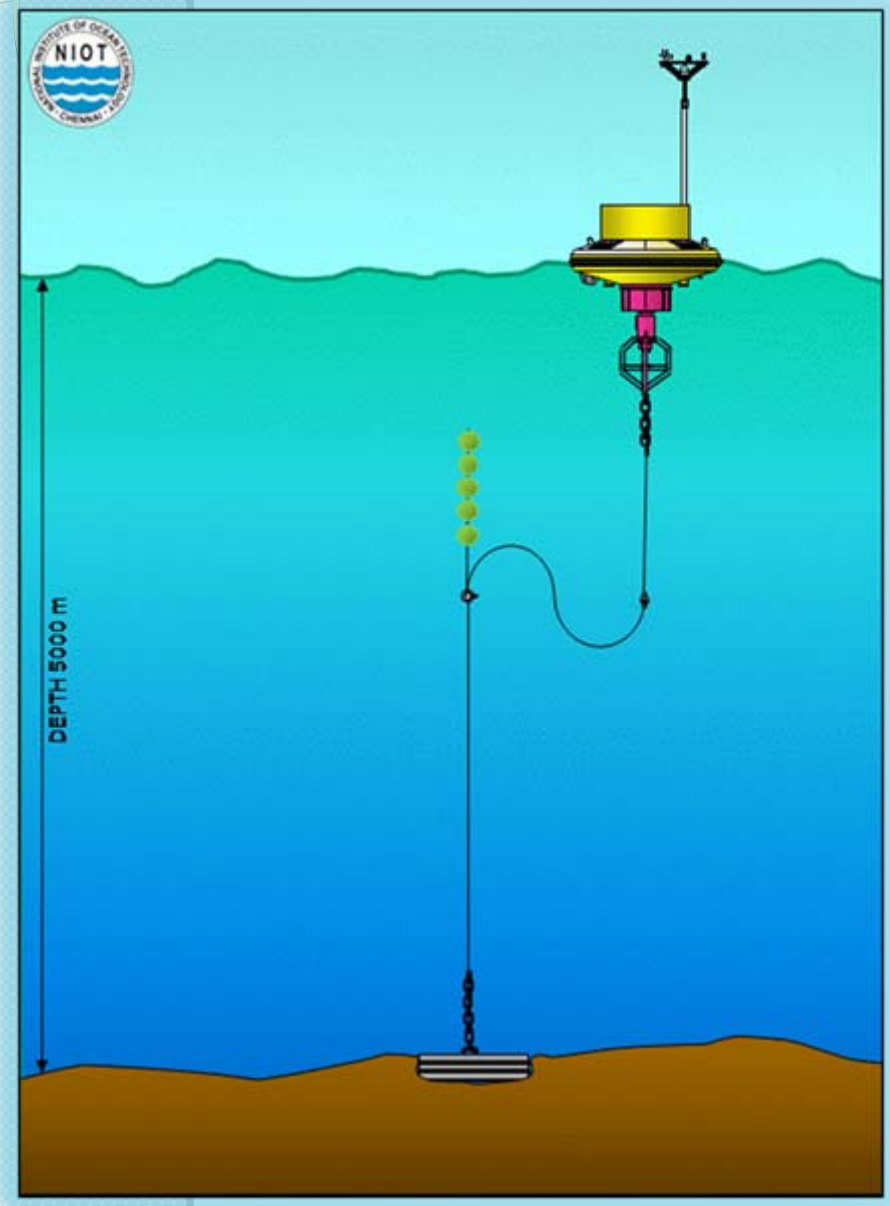
BoB OBSERVATION



OMNI buoys deployed in the Bay of Bengal

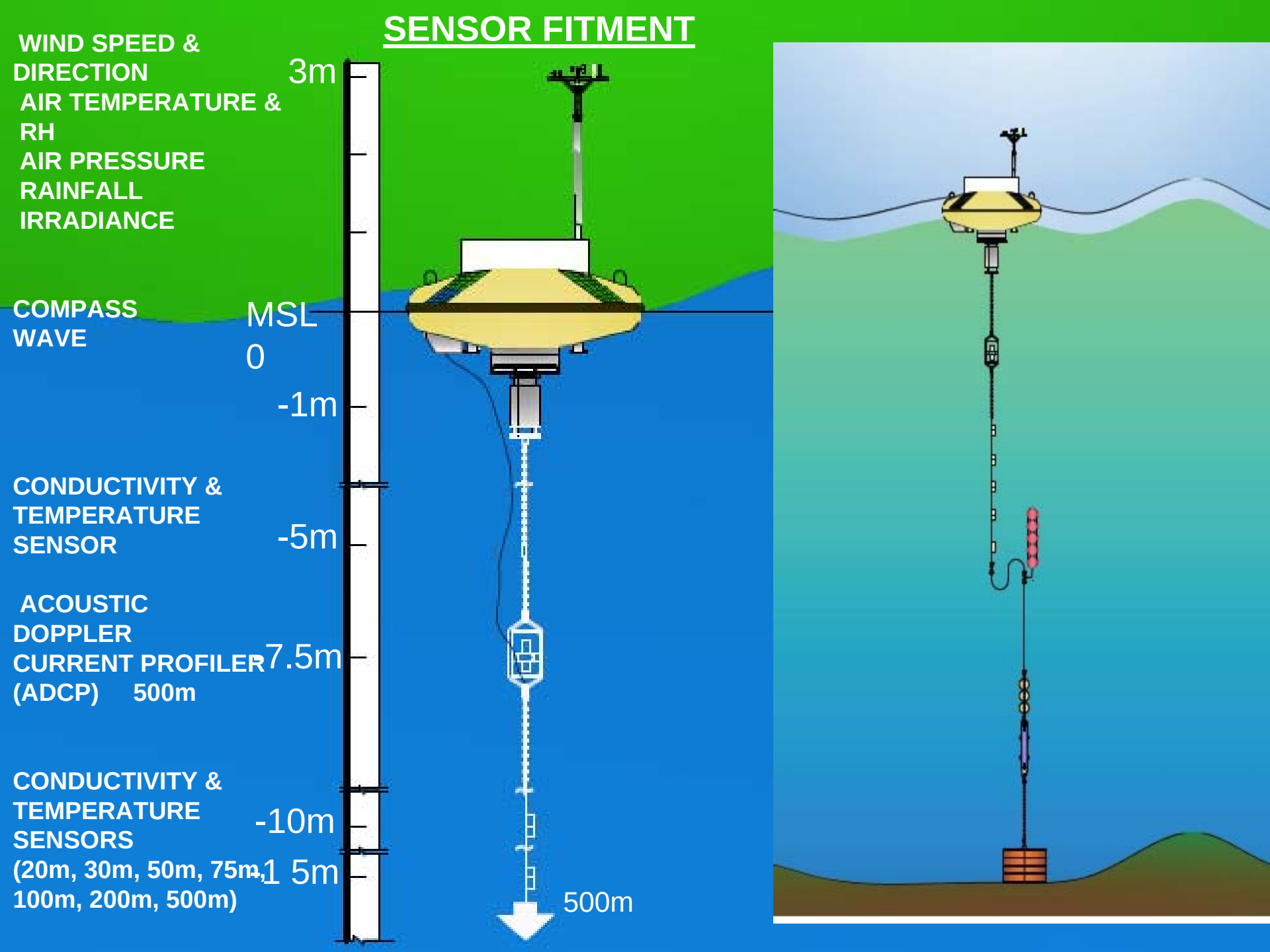


Moored Buoy Network



- 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

SENSOR FITMENT

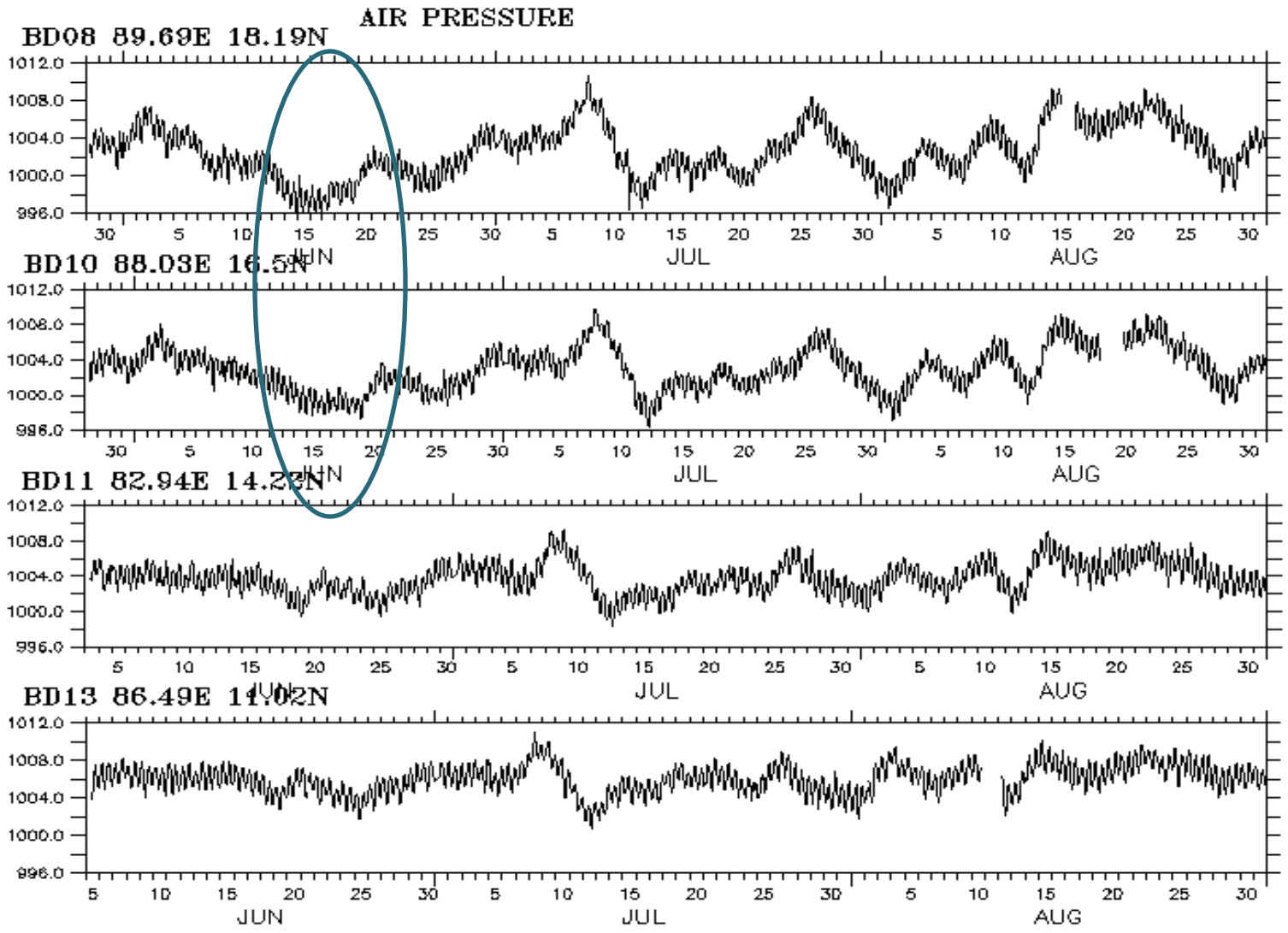


Parameters measured

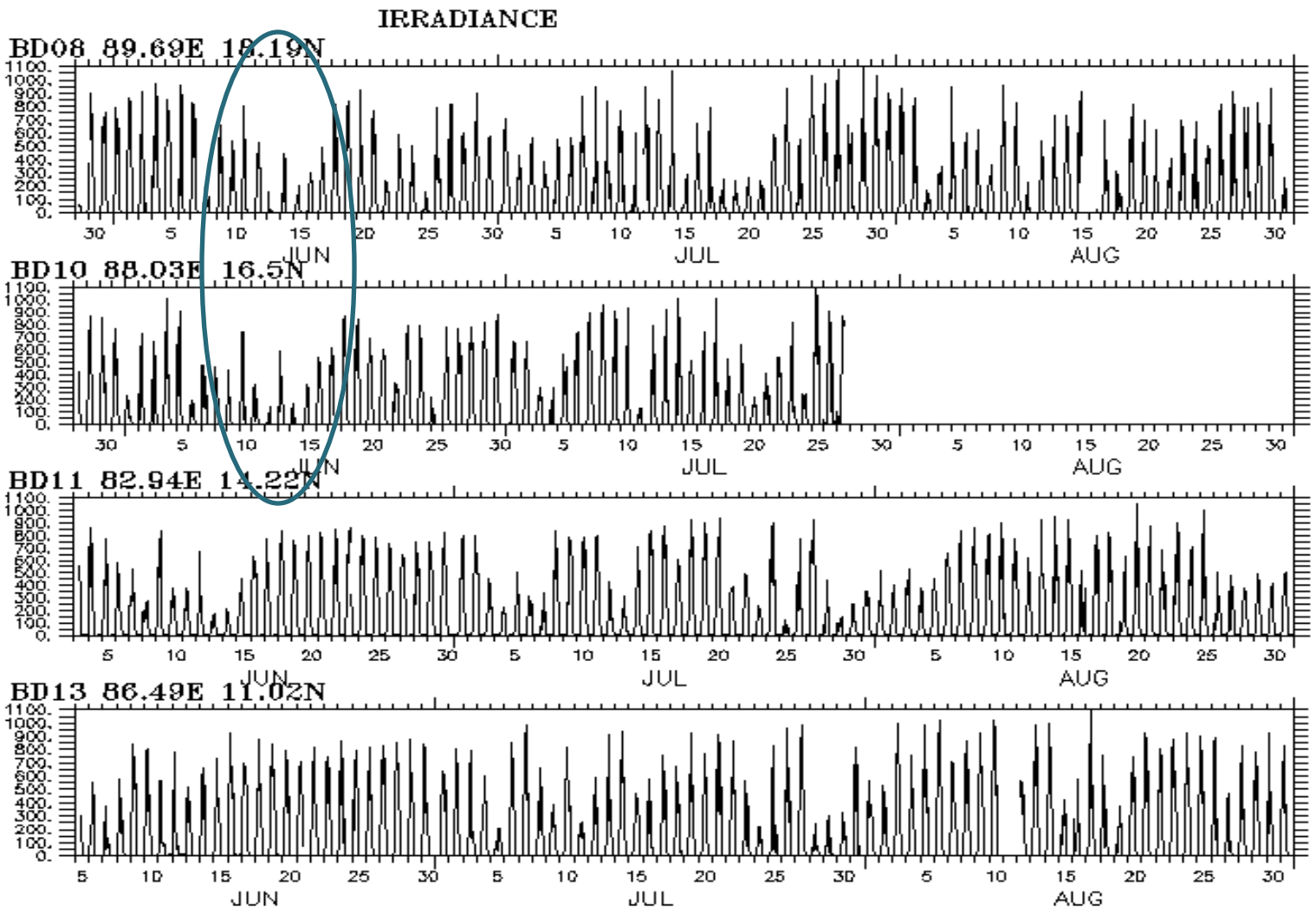
- MET Air humidity, press. & temp.
  Wind Speed, Gust & Direction
  Rainfall Radiation

- OCEAN Temperature, Salinity & Current
- WAVE

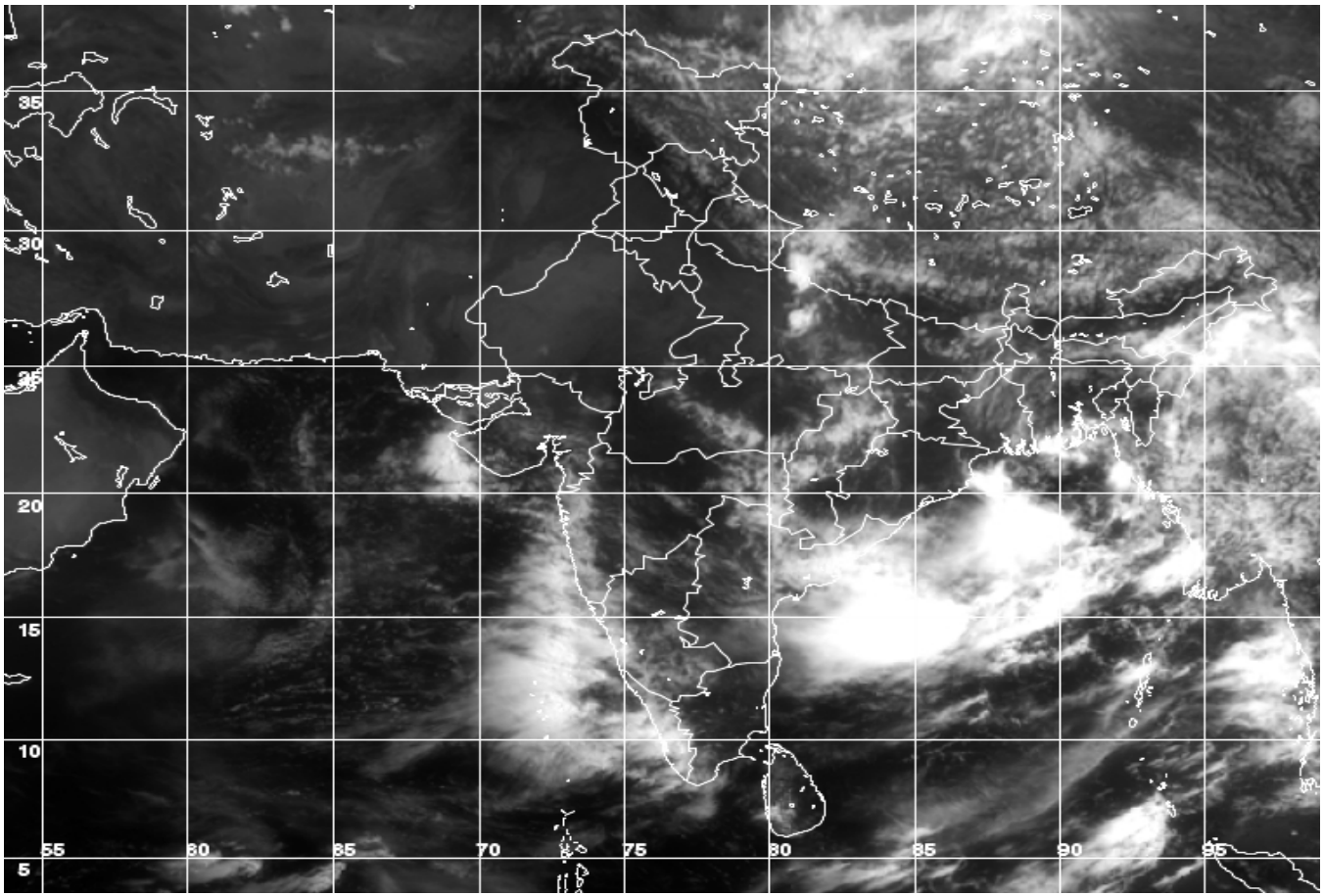
LOW PRESSURE SYSTEMS FORMING OVER BAY OF BENGAL DURING THE SOUTHWEST MONSOON



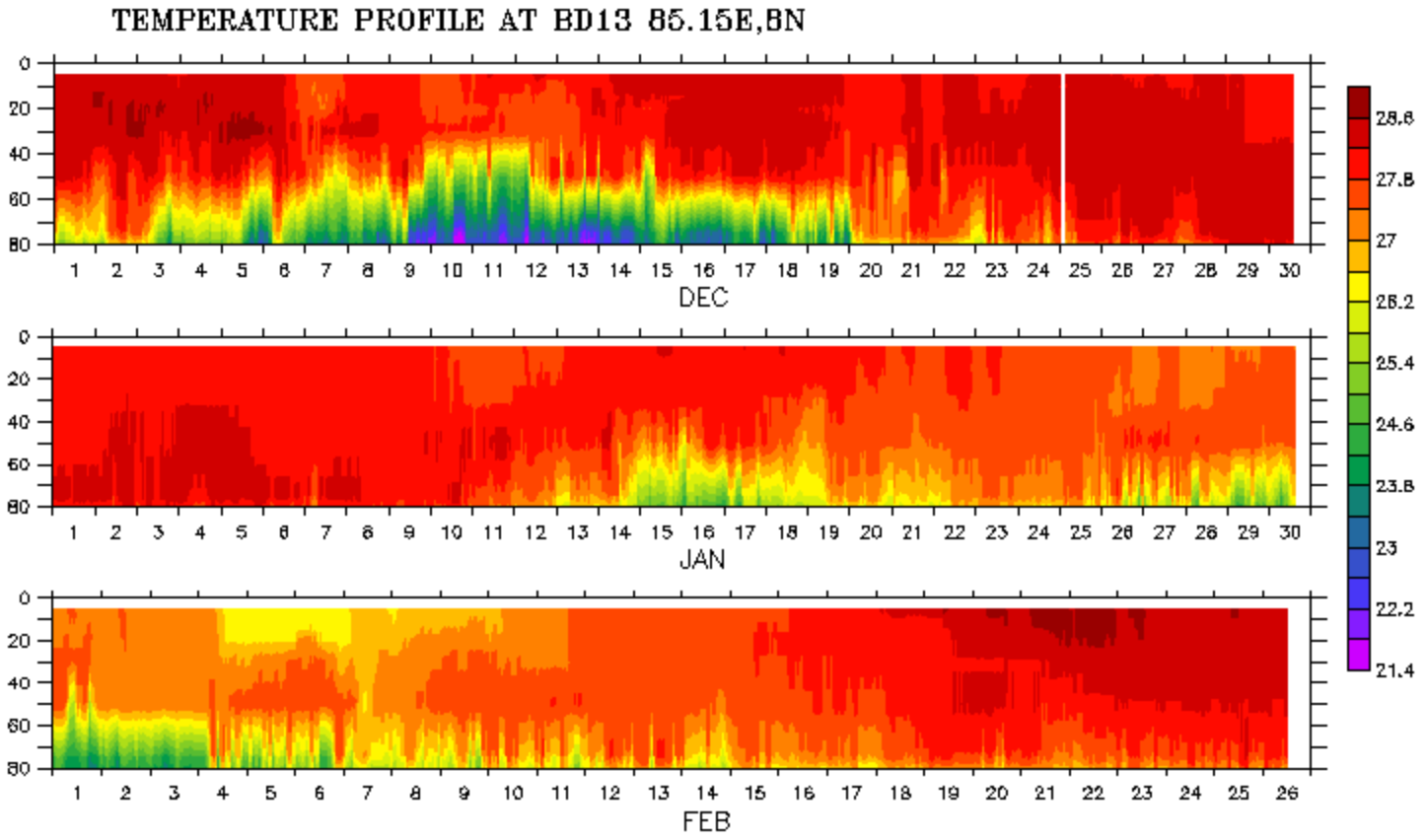
IRRADIANCE


IRRADIANCE
BD08 89.69E 18.19N
BD10 88.03E 16.5N
BD11 82.94E 14.22N
BD13 86.49E 11.02N
JUN
JUL
AUG

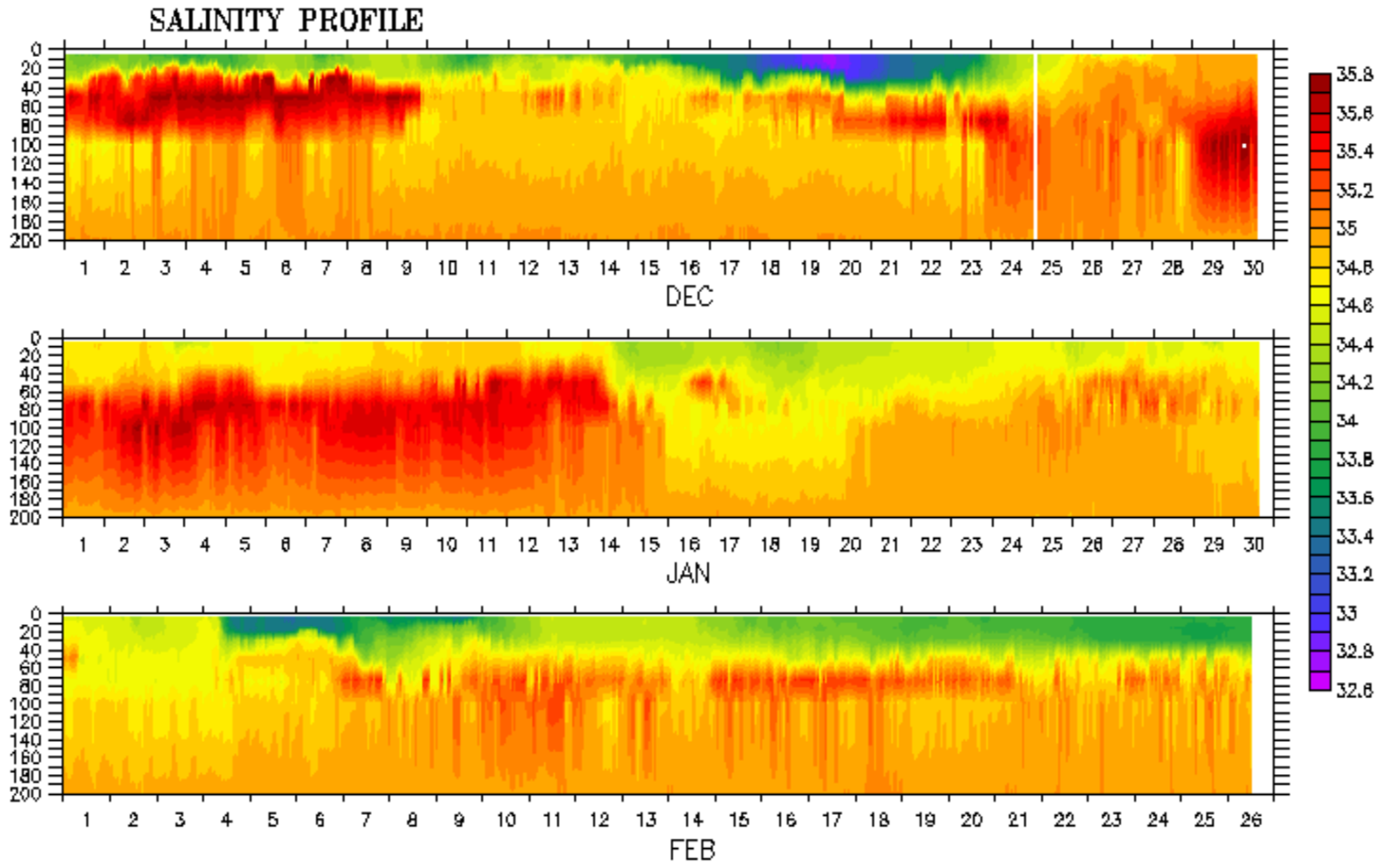
LOW PRESSURE SYSTEM OVER NORTHERN BAY OF BENGAL ON 14 TH JUNE, 2011



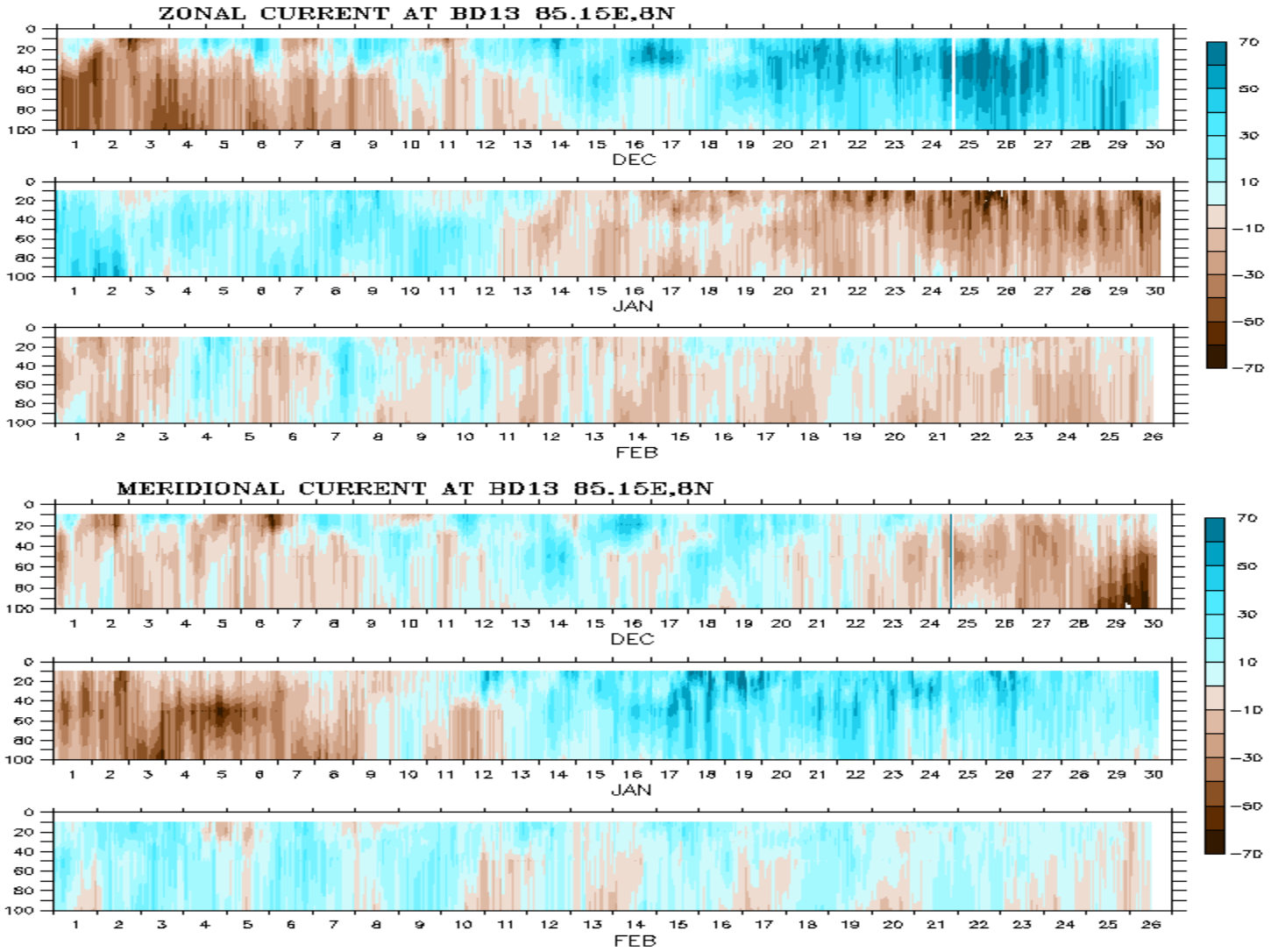
OMNI buoys – Source for continuous subsurface information



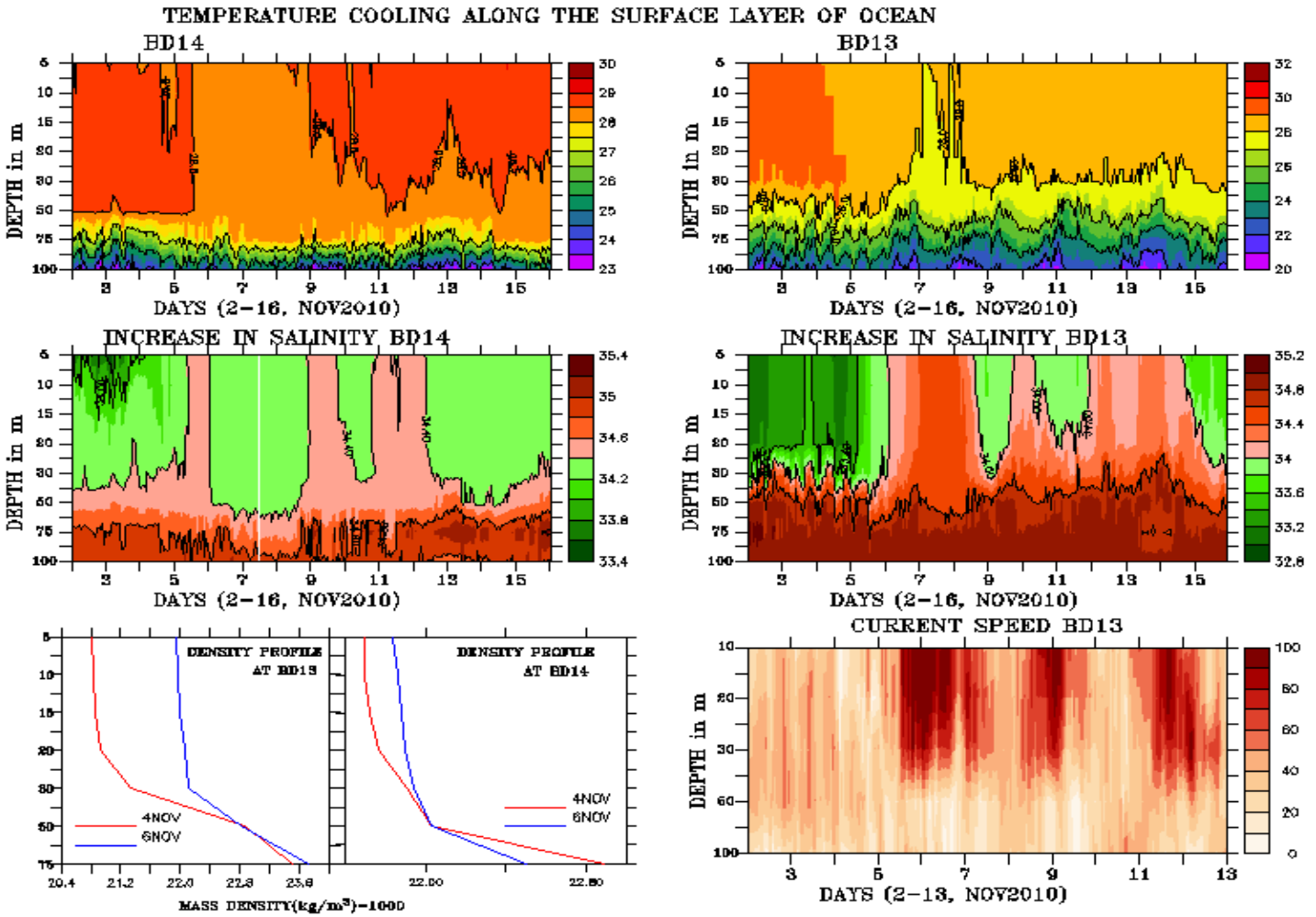
Information on salinity structure of the ocean – BARRIER LAYER



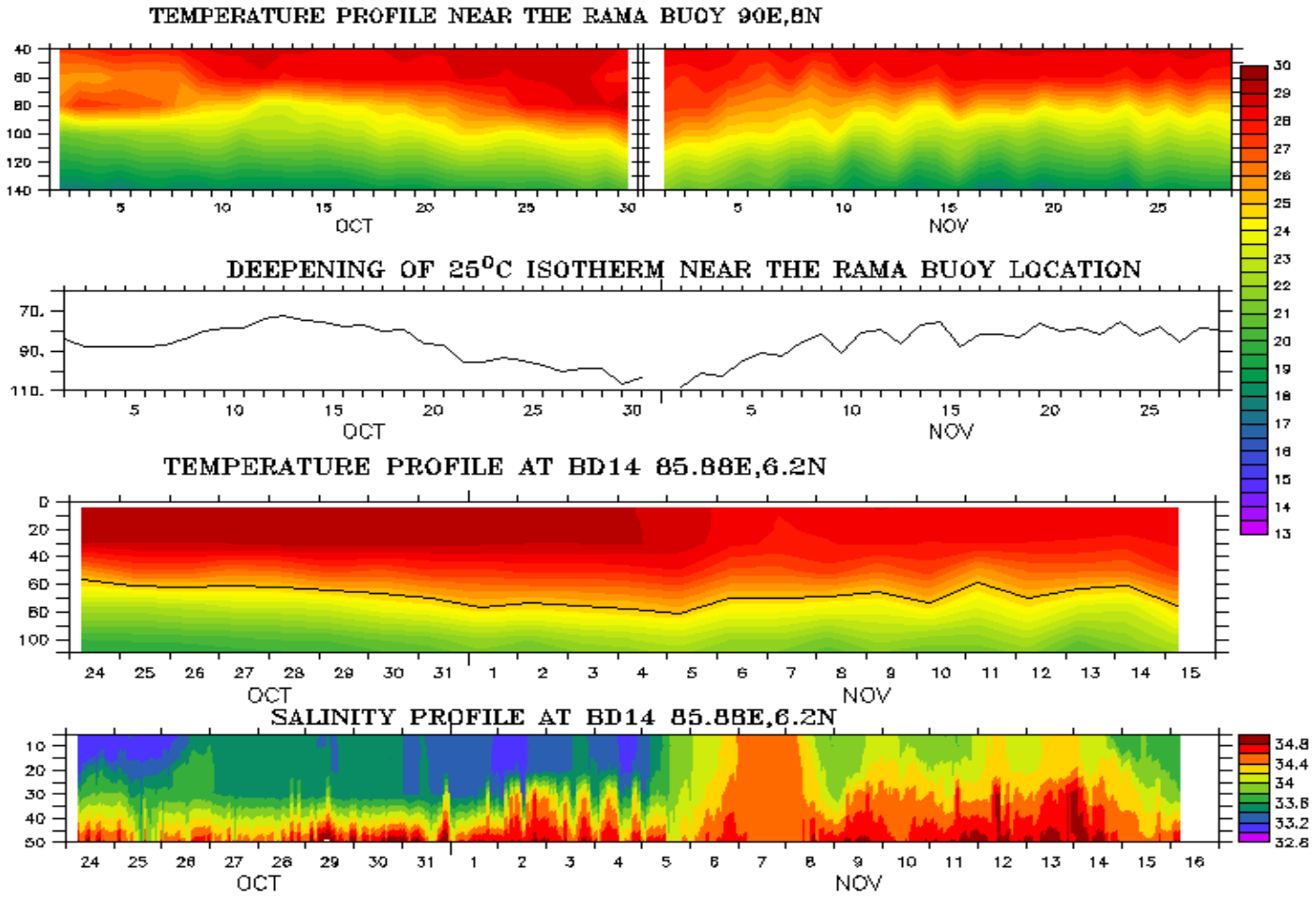
Currents upto 100m depth



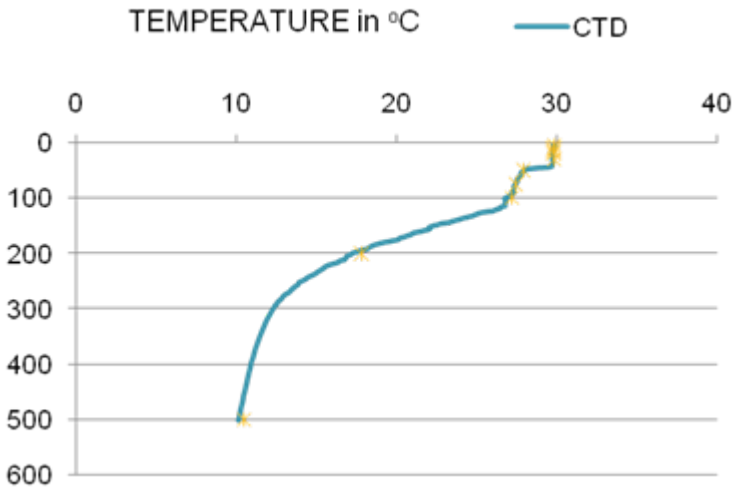
JAL Cyclone


TEMPERATURE COOLING ALONG THE SURFACE LAYER OF OCEAN
BD14
DEPTH in m
DAYS (2-16, NOV2010)
BD13
DEPTH in m
DAYS (2-16, NOV2010)
INCREASE IN SALINITY BD14
DEPTH in m
DAYS (2-16, NOV2010)
INCREASE IN SALINITY BD13
DEPTH in m
DAYS (2-16, NOV2010)
DENSITY PROFILE AT BD13
4NOV
6NOV
DENSITY PROFILE AT BD14
4NOV
6NOV
MASS DENSITY(kg/m³)-1000
CURRENT SPEED BD13
DEPTH in m
DAYS (2-13, NOV2010)

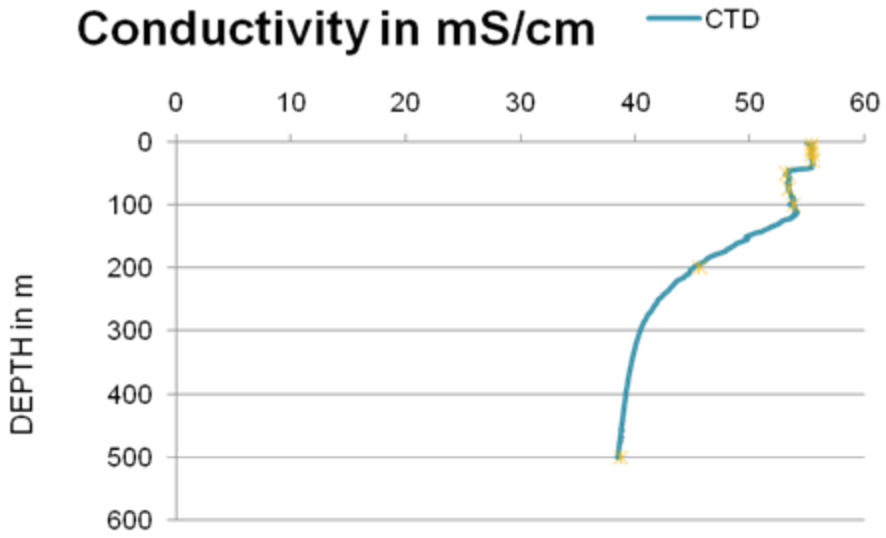
ROSSBY WAVE SIGNALS



INTERCOMPARISON BETWEEN CTD AND OMNI BUOY OBSERVATIONS



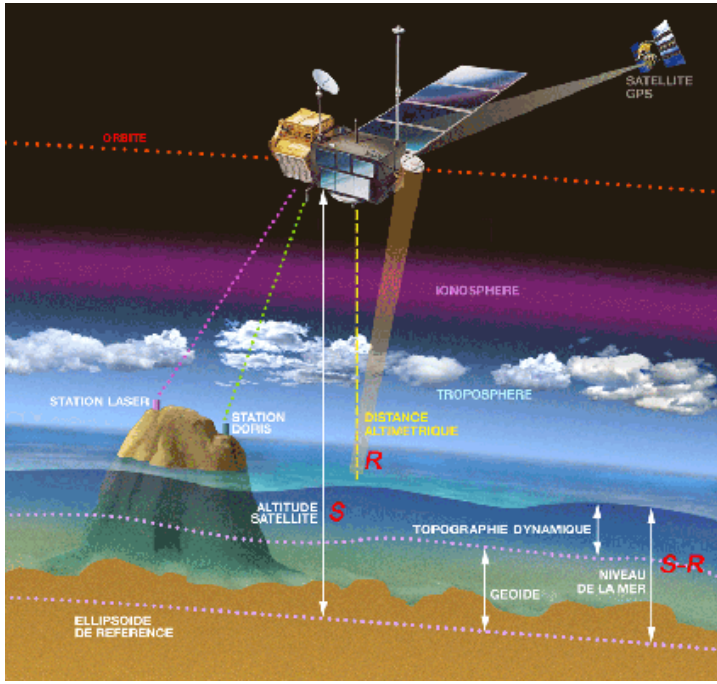
CTD- SEABIRD SBE9
OMNIBUOY-SEABIRD SBE37



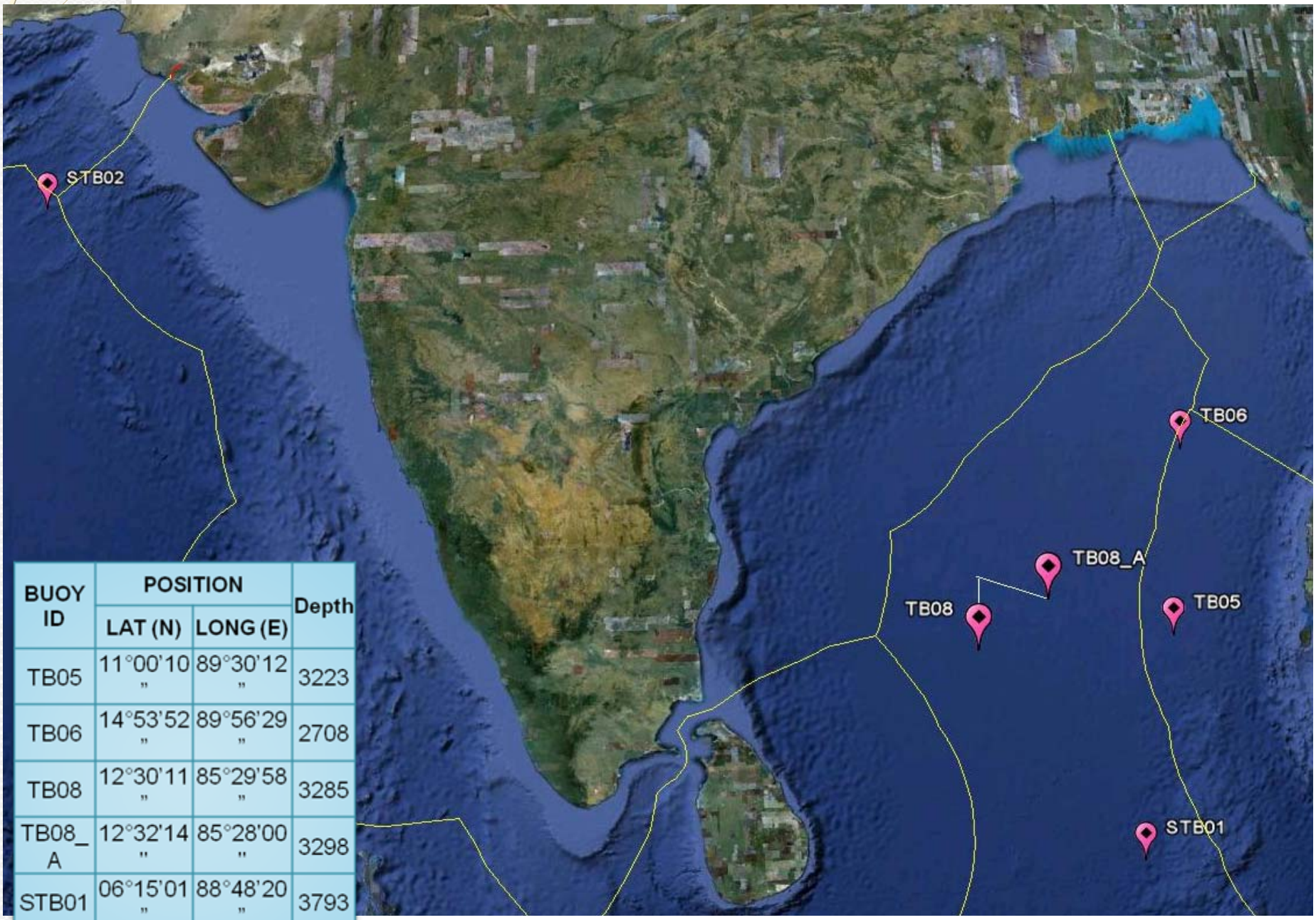
- The availability of time series data on surface met-ocean parameters and near surface thermohaline structure provides unlimited opportunities for research scientists to describe and explain the variability on different time scale across the basin.
- Studies related to warm and cool pools and fresh water pool are being carried out to explain their genesis, evolution and decay in certain regions of the Arabian sea and the Bay of Bengal. The Bay of Bengal is a region of intense haline stratification in near-surface layer primarily due to heavy discharge of fresh water from major rivers.
- In the northern Bay of Bengal large number of monsoon lows and depressions originates and then propagate along the monsoon trough to provide copious amount of rainfall over Indo-Gangetic plains. These buoy net-work provide very valuable sea truth data to validate the satellite measurements and model prediction. It is proposed to include pCO2 sensor to few of these buoy systems to evaluate the potential for direct covariance gas flux measurements. This will also augment RAMA moorings in Bay of Bengal.
- Tropical oceans are the main source of CO2 from the ocean to the atmosphere because of tropical upwelling. These upwelling systems are also an important factor in regulating strong biological activity in the tropical oceans. These long time series measurements can reveal significant correlation between CO2 outgassing and tropical circulation change on decadal or longer time scales.

Altitude and Sea-Surface Height

- Since the altimeter only measures the range from the satellite to the sea surface, called *R*, we have to calculate the sea-surface height with respect to a terrestrial reference (*see diagram*).
  To do this, we must first define an arbitrary reference surface.
- Since the sea depth is not known accurately everywhere, we use a regular, imaginary surface that is a raw approximation of the shape of the Earth, which is a sphere flattened at the poles. This surface is called the *reference ellipsoid*, which allows us to calibrate data precisely and uniformly.
- The satellite's altitude with respect to the reference ellipsoid, called *S*, is calculated with an accuracy of 3 cm using the satellite's orbital parameters and precise positioning instruments.



WORKING TSUNAMI BUOY NETWORK

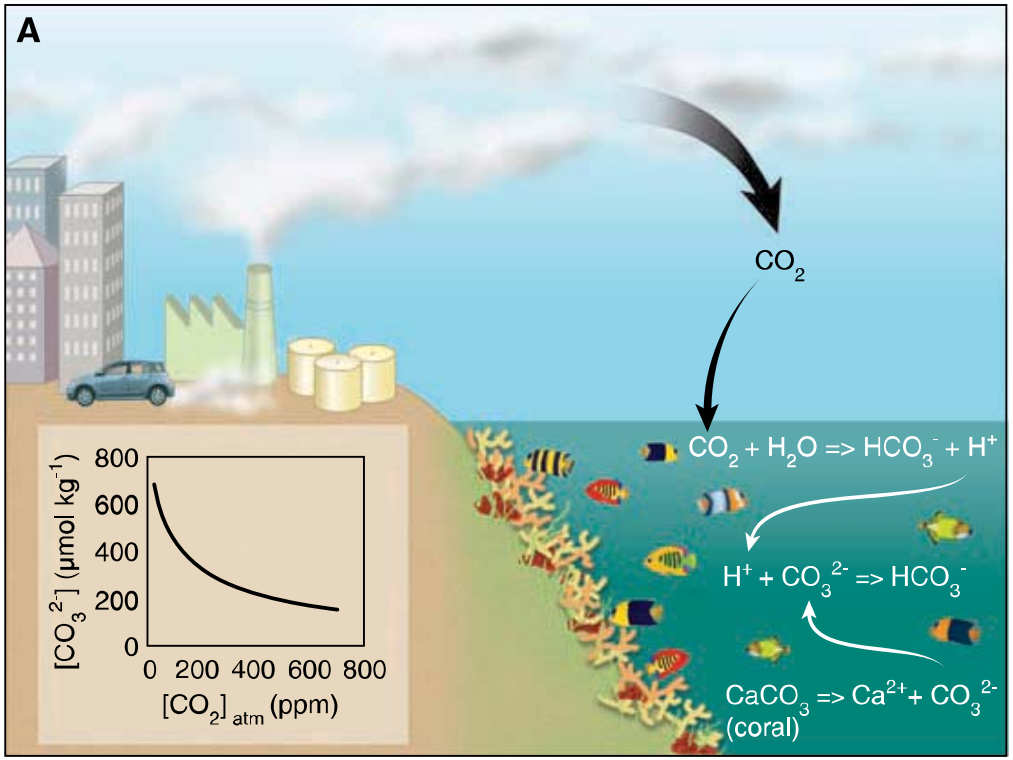


BUOY ID	POSITION		Depth
	LAT (N)	LONG (E)	
TB05	11°00'10"	89°30'12"	3223
TB06	14°53'52"	89°56'29"	2708
TB08	12°30'11"	85°29'58"	3285
TB08_A	12°32'14"	85°28'00"	3298
STB01	06°15'01"	88°48'20"	3793

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^+

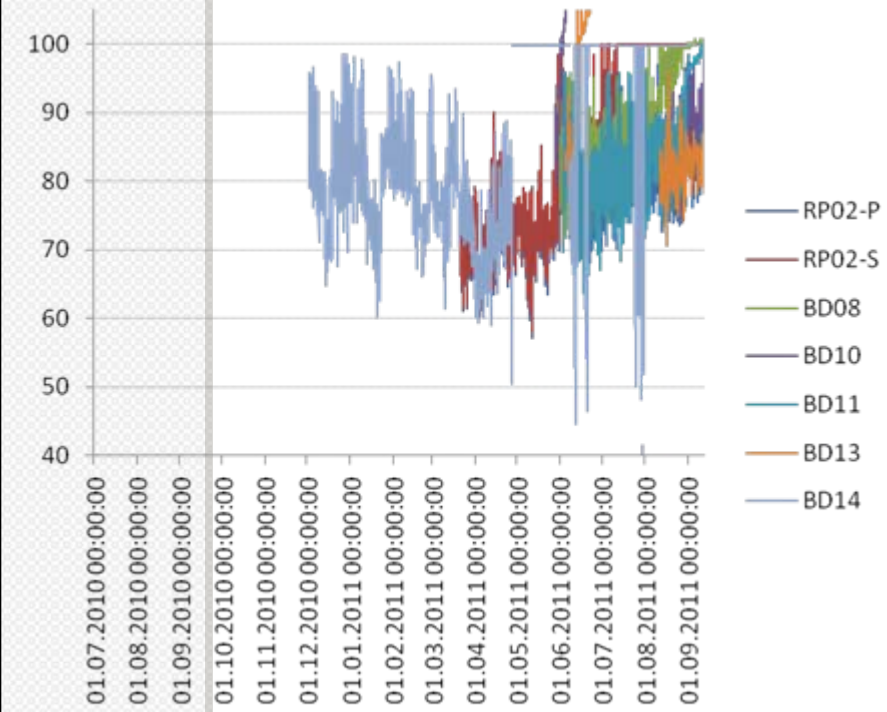


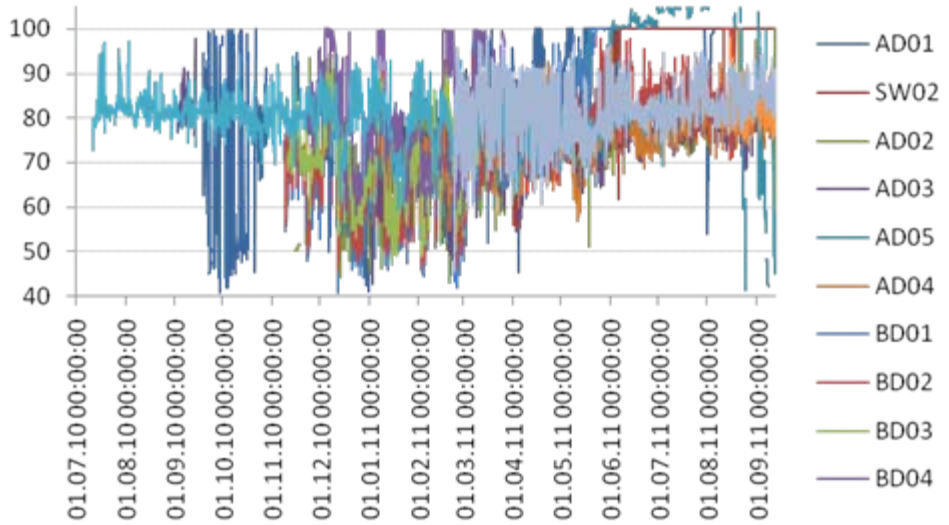
Hoegh-Guldburg et al. 2007

carbonate, pH (-logH^+)

Air Humidity data

Performance of sensor is a concern
DBCP can work on standardisation of sensor suitable for moored buoy





SUMMARY

- Useful to understand the warm and cool events.
- Freshening by river discharges - Barrier layer
- Can give valid input for the monsoon depressions forming over Bay of Bengal.
- Signals of Rossby wave signals
- Validating satellite data and model outputs.

Thank you for your attention

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