# DBCP 28
# 2012
# National Report
# INDIA

# DBCP National Report India

- Current programme
- Planned programme

# Ocean Observion Network - India

- *Ministry of Earth Sciences Government of India evolved comprehensive work plan for ocean observation network - 2012 to 2016 XII Five Year Plan period allocated 50 million USD*

- **Moored Buoy Network**
- **CALVAL Satellite data validation**
- **Wave rider buoys**
- **Coastal Bio-Optics**
- **ADCP Mooring along the coast**
- **XBT/XCTD**
- **Drifting Buoys**
- **Current meter moorings in the EIO**
- **Tide gauges**
- **Bay of Bengal Observatory**
- **HF Radar**
- **Argo profiling floats**
- **Ship borne observation**
- **COMAPS Coastal ocean monitoring**

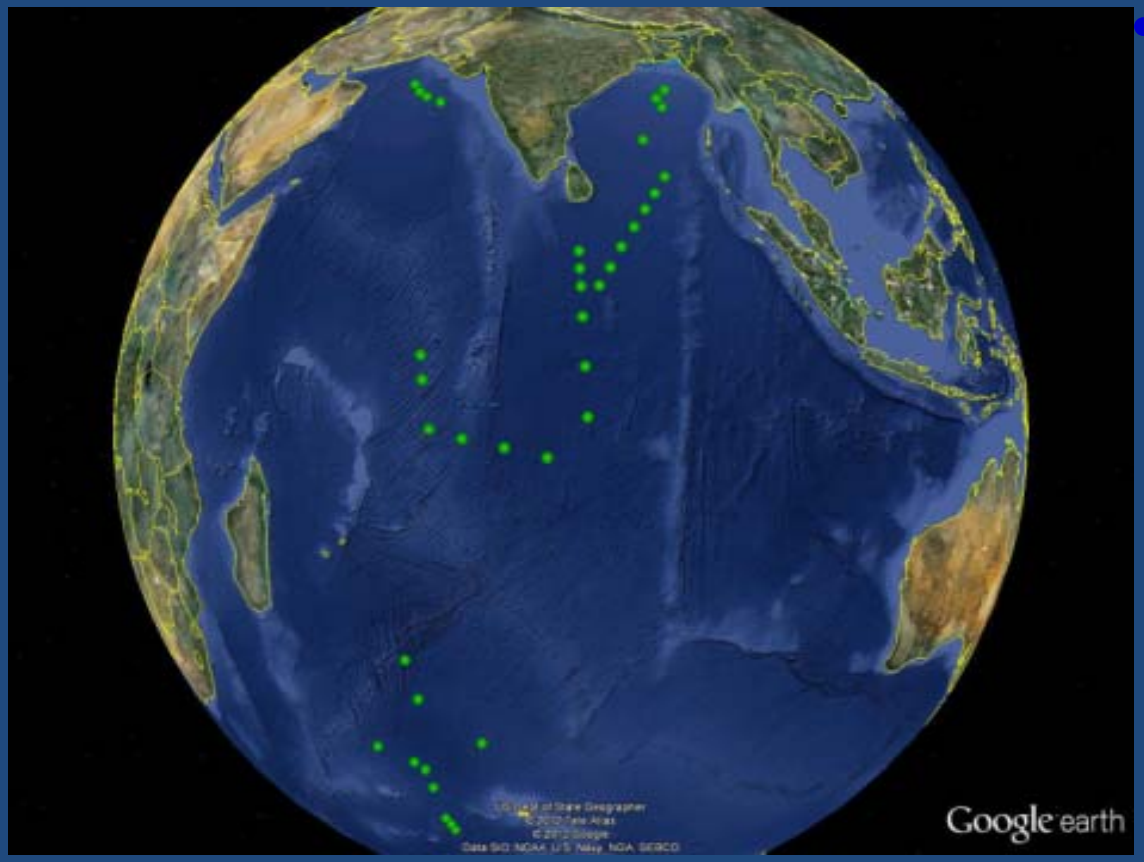
- **IndOOS/RAMA**
- **SIBER**

# Measurements being taken today

The variables measured by the data buoys generally include one or more of the following elements:

- Atmospheric pressure (and tendency),
- Wind speed and direction,
- Air temperature,
- Sea-surface and sub-surface temperature,
- Sea-surface and sub-surface salinity,
- Rainfall
- Wave period and height (and wave spectra)
- Relative Humidity. (Moorings only)
- Down-welling Radiation. (Moorings only)
- Currents from buoys
- Other Biogeochemistry elements ($CO_2$, $O_2$, Fluorescence etc)

# ARGO FLOATS
# Deployment ( Sep 2011 to present)




- 39 floats deployed
  - 21 Provor+ARGOS
  - 2 APEX+Iridium
  - 16 APEX+ARGOS

5 floats of UoW also deployed during our cruise

# Drifting Buoys

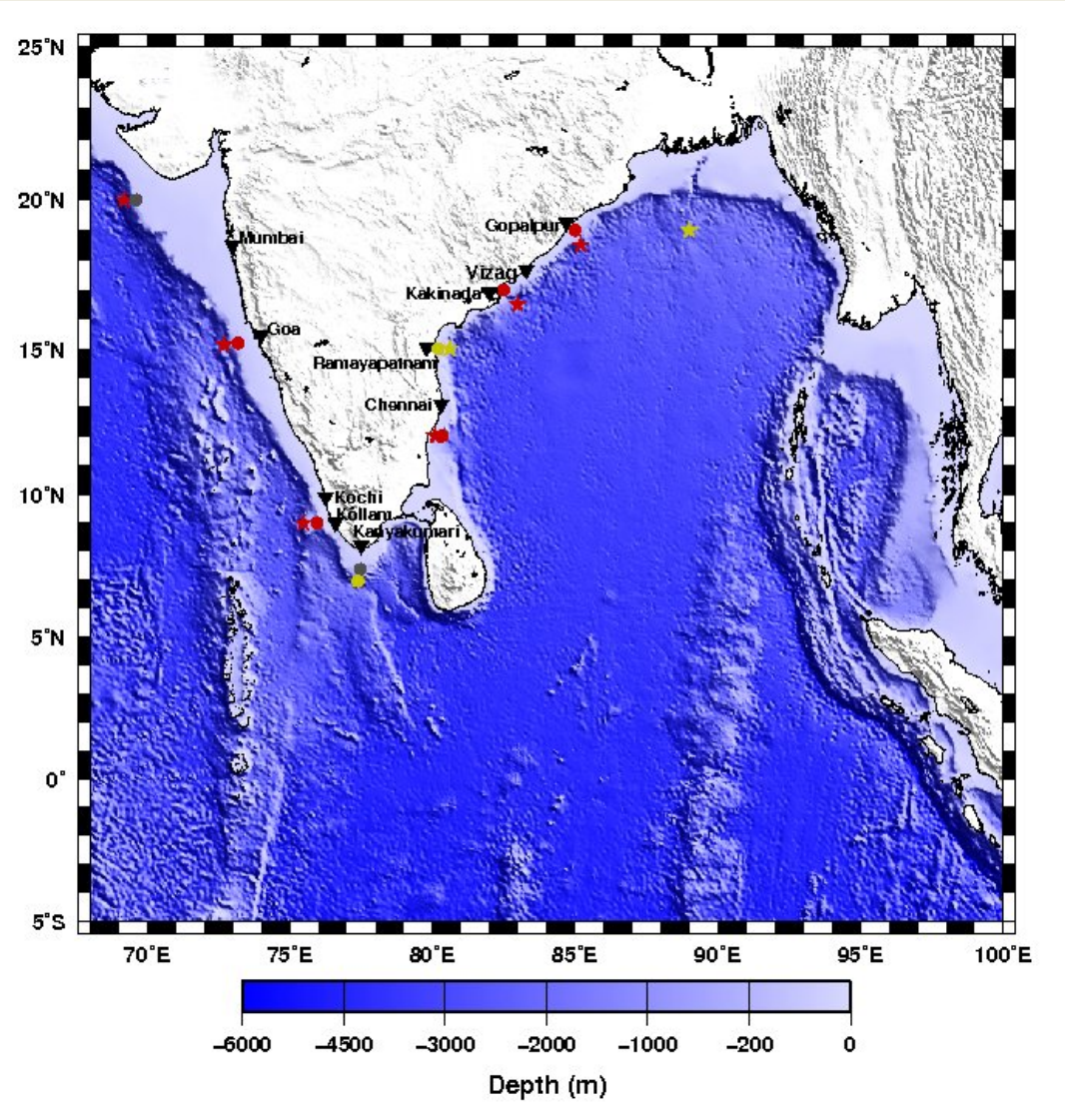
- To collect surface meteorological (atmospheric pressure, wind etc.) and oceanographic (SST, sub-surface temperature, surface velocities) data using the satellite tracked drifting buoys.
- To estimate the surface velocities using the satellite tracked drifting buoys.
- To provide the in situ data on surface velocity and SST for the validation of global circulation models and satellite derived parameters.
- To build an Indian Ocean drifter data archival.

Procurement and deployment – NIO
Data reception and QC - INCOIS

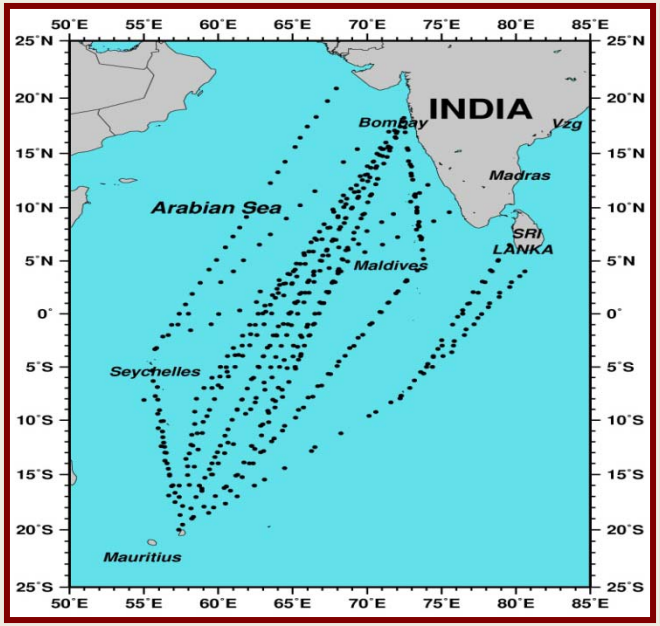
**31 drifters**
**None beached shore**

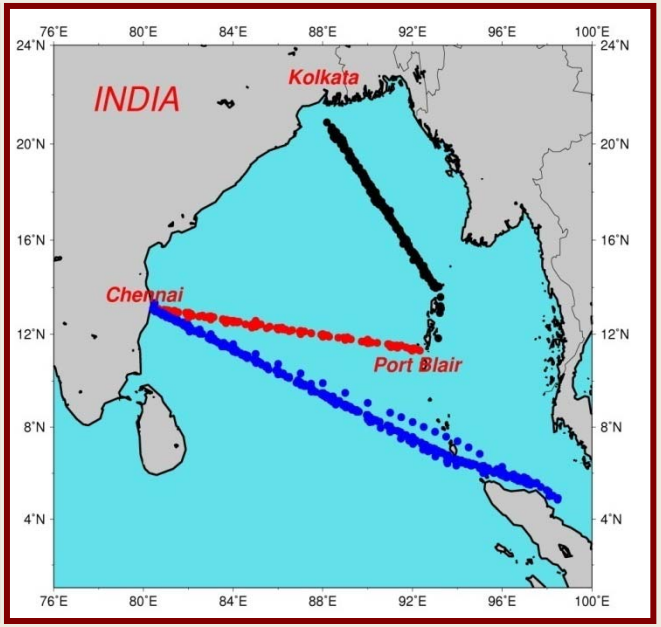
# ADCP moorings along the coast of India

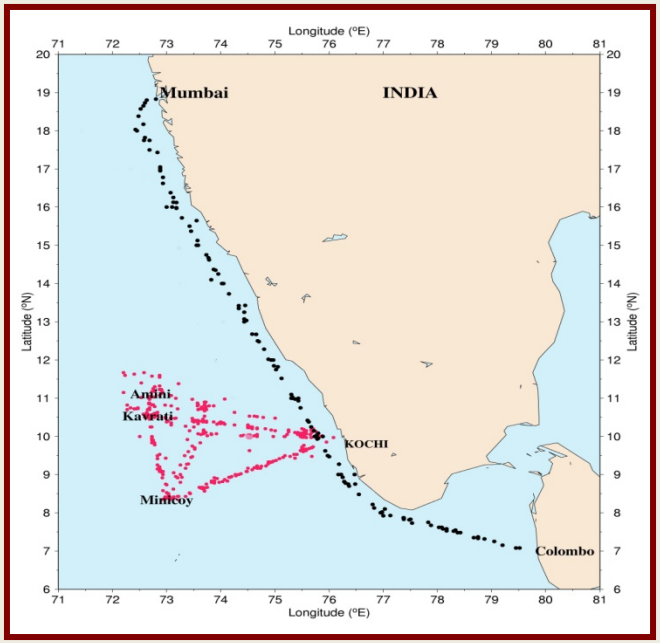
7 ADCPs (3 shallow and 4 deep) were deployed in the Bay of Bengal (4 INCOIS + 3 NIO)



# Indian XBT program

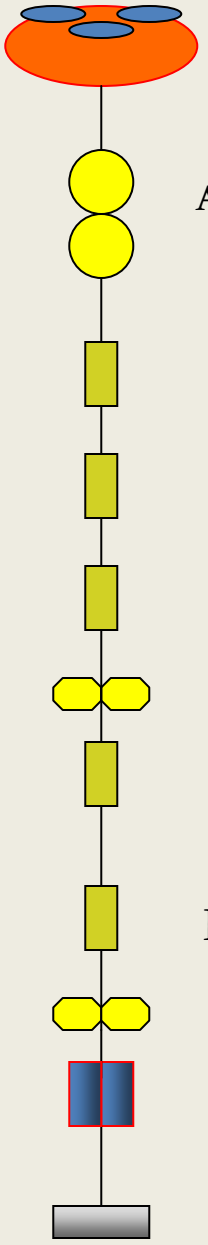


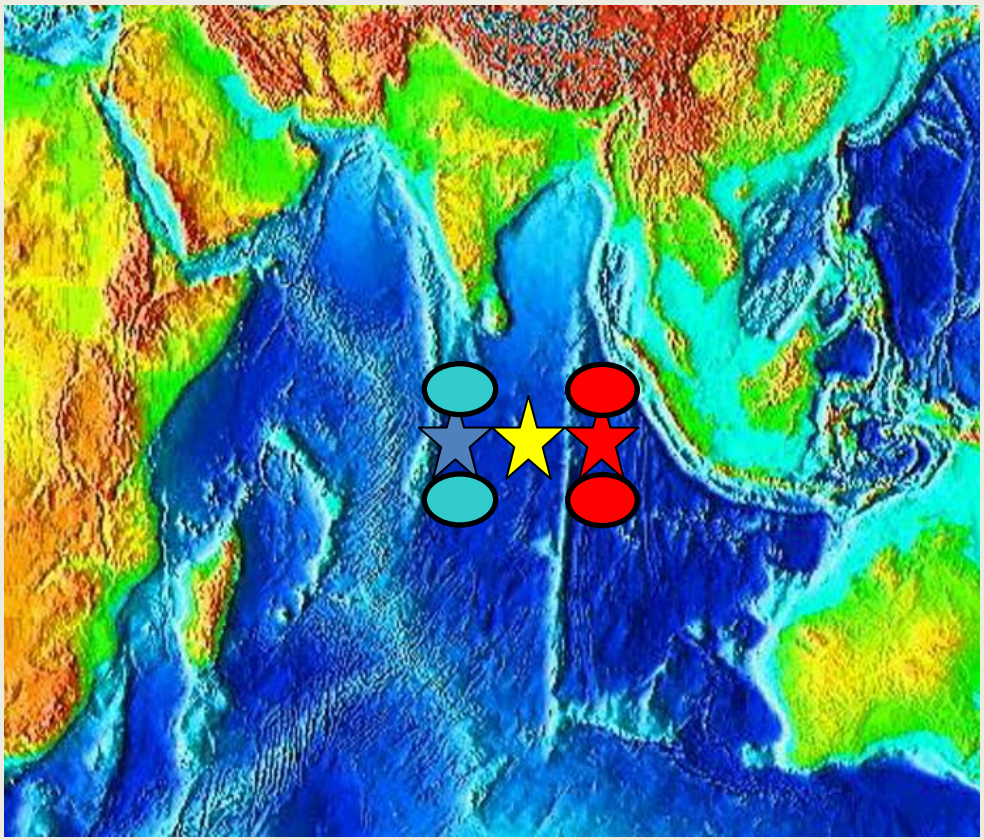




- Mumbai – Mauritius
- Chennai – Port Blair
- Port Blair – Kolkata
- Kochi – Lakshadweep
- Chennai – Singapore
- Mumbai – Colombo

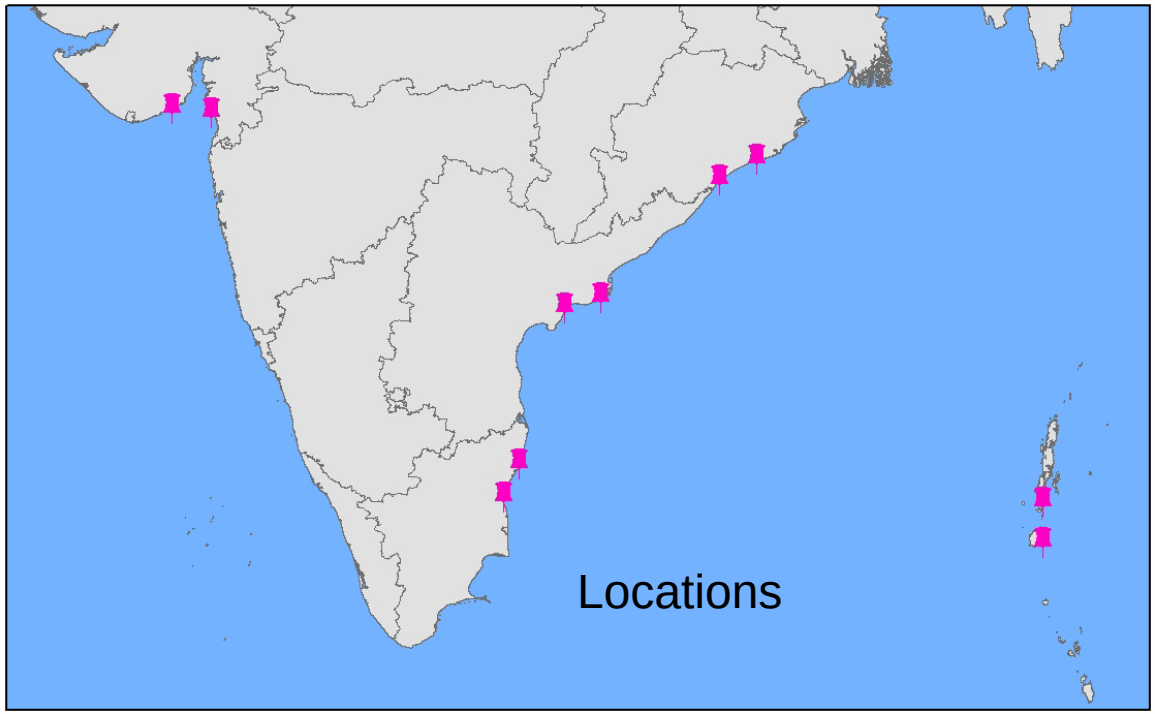
# Current meter moorings



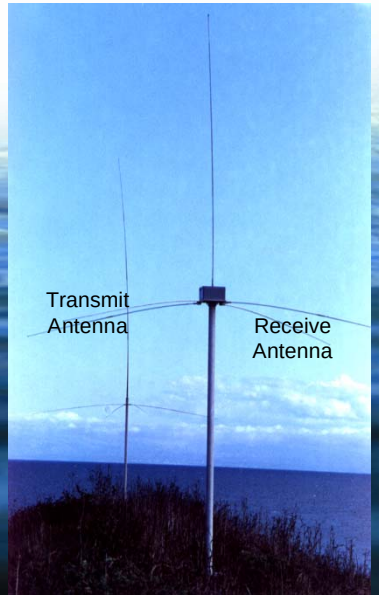



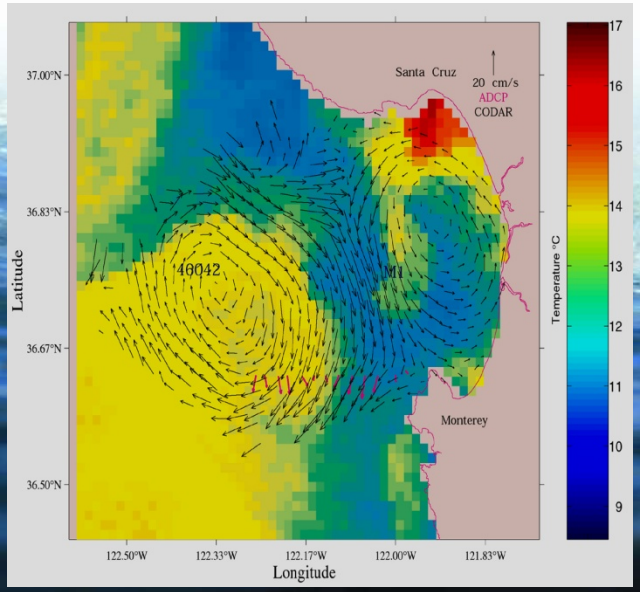
7 Current meter moorings

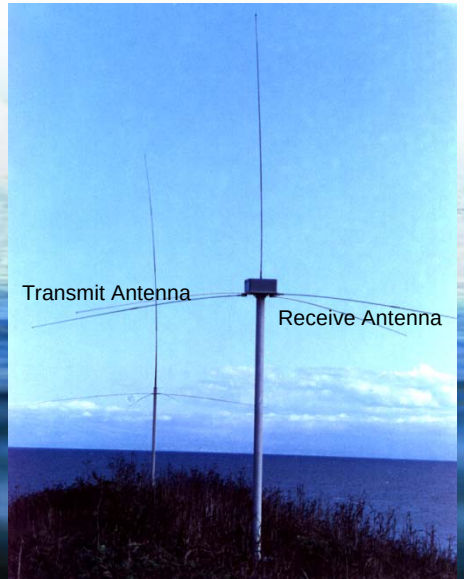
# HF Radar Network



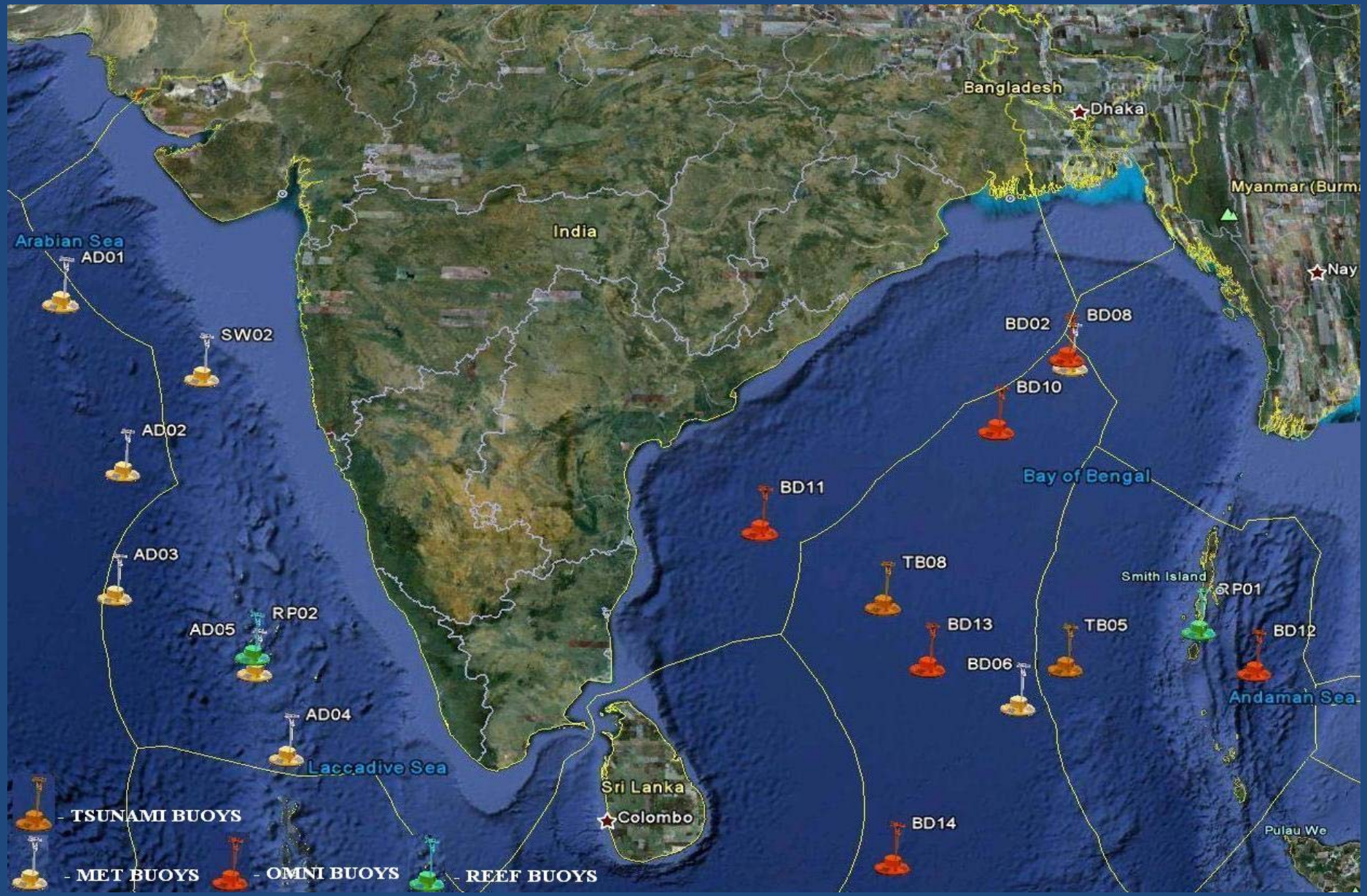

- **5 sets of CODAR are installed at Gujarat, Tamilnadu, Andhra Pradesh, Orissa and Andaman & Nicobar Islands coasts and real time data being received at INCOIS & NIOT**
- **Enables measurement of Waves & Currents to about 100 Kms from the Coast**



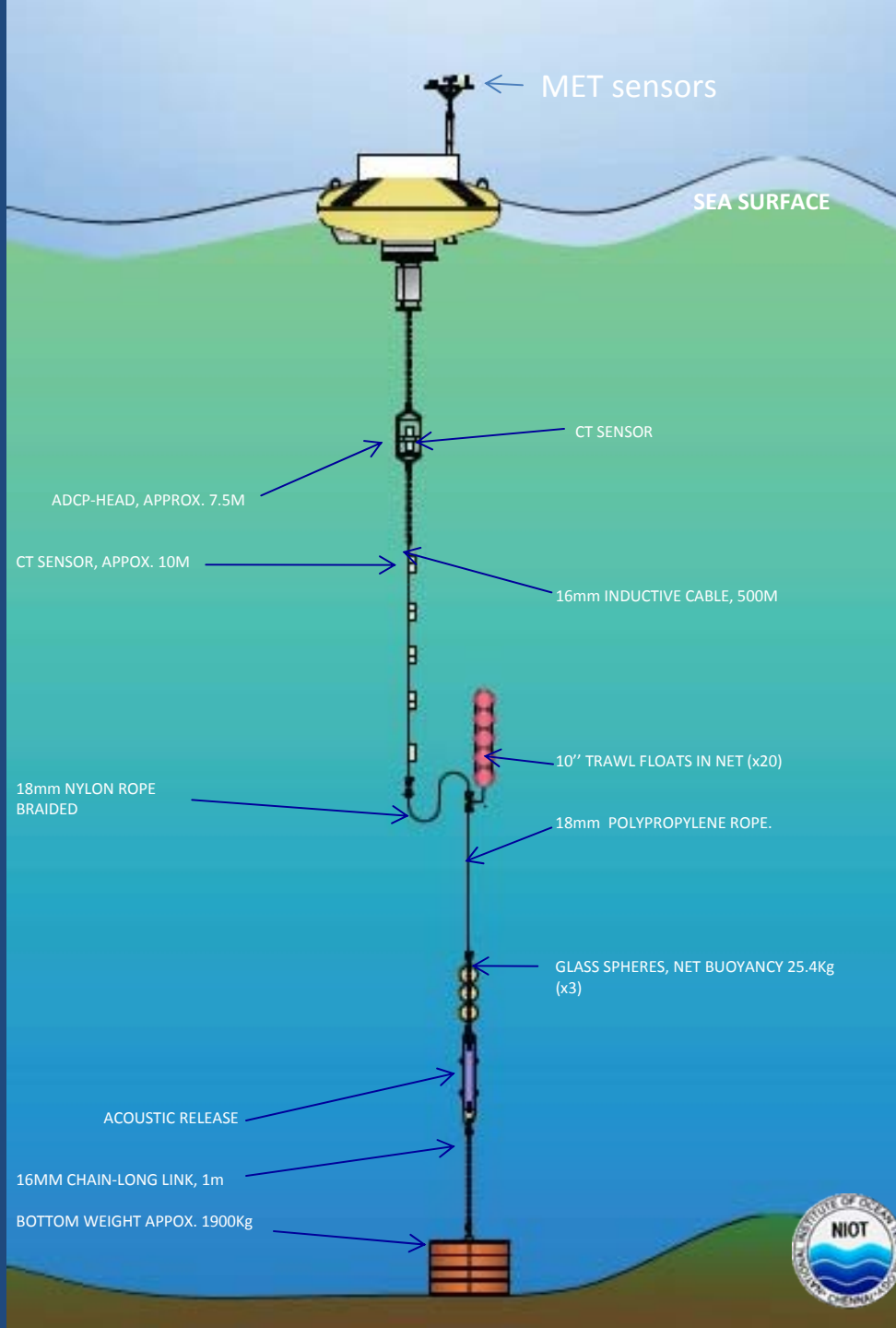



# NIOT
# Moored buoys

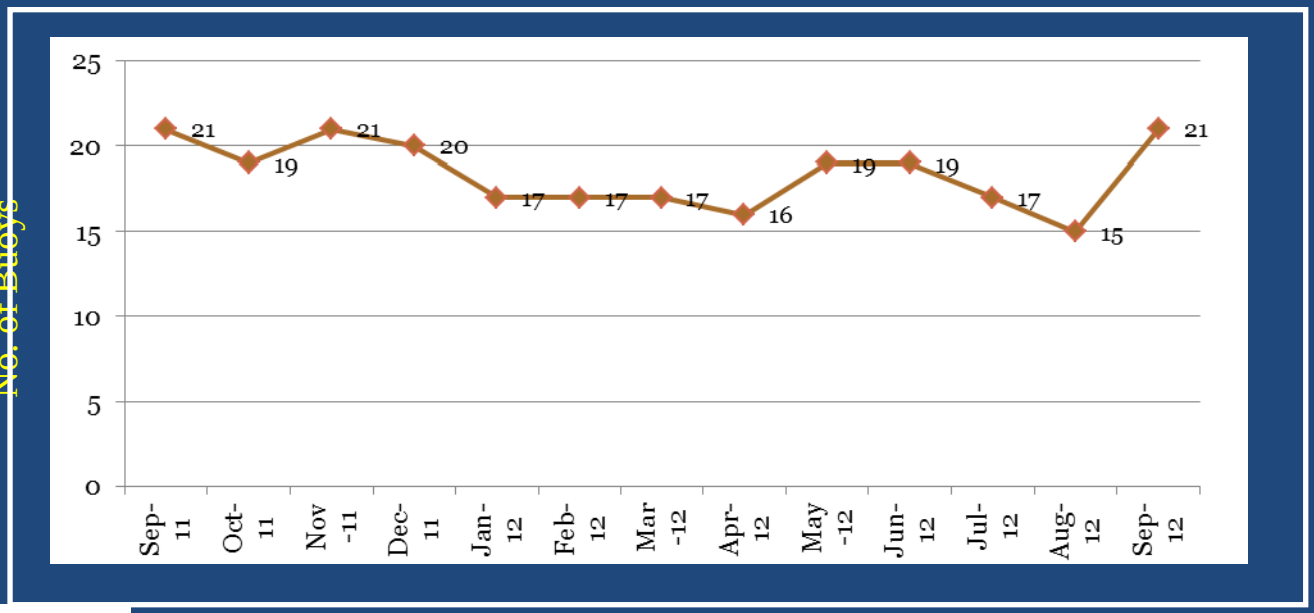


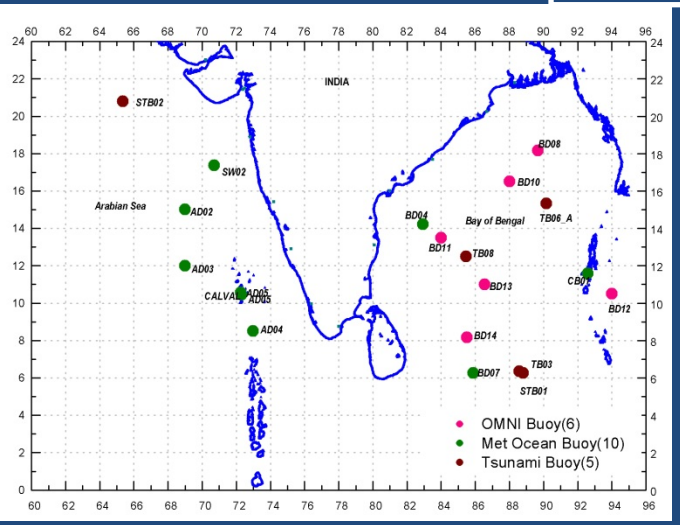
# OMNI BUOY MOORING



# Buoy Operational Status (Sep 11 - Aug 12)

**14** cruises involving **70 o**perations, **2000** man days,
**20000** nm of sailing in Bay of Bengal, Arabian Sea and in Indian Ocean to maintain the buoy network




Presently 14 Buoys (4 OMNI + 7 Met Ocean and 3 Tsunami Buoys) are functional

Total Functional Buoys : 14

# Cruises undertaken (Sep 11 - Aug 12)

| SL. No. | CRUISE DETAILS | REGION | | PERIOD | DISTANCE COVERED | OPERATIONS | |
|---|---|---|---|---|---|---|---|
| | | ARABIAN SEA | BAY OF BENGAL | | | DEPLOYMENT | RETRIEVED |
| 1 | ORV SAGAR NIDHI | ✓ | ✓ | 14-11-2011 to 05-12-211 | 2300.6 | AD04,AD05, CALVAL, BD07,BD14,TB10 | BD14,BD07,MB23,AD04,AD05,CALVAL,TB10 (BPR) |
| 2 | WAVE RIDER BUOY RETRIEVAL OFF AGATTI | ✓ | --- | 09-11-2011 to 13-11-2011 | --- | --- | Wave Rider Buoy |
| 3 | ORV SAGAR MANJUSHA | ✓ | --- | 05-12-2011 to 22-12-2011 | 876.54 | RP02 | RP02 |
| 4 | ORV SAGAR NIDHI | ✓ | --- | 05-12-2011 to 22-12-2011 | 1227.32 | AD01, TB12 | --- |
| 5 | ORV SAGAR MANJUSHA | ✓ | --- | 20-02-2012 to 11-03-2012 | 3767 | AD04, AD03, AD02, SW02 | AD04, AD02, AD01, TB12, SW02 |
| 6 | ANDAMAN BUOY DEPLOYMENT | --- | ✓ | 05-03-2012 to 10-03-2012 | --- | CB01 | CB01 |
| 7 | ORV SAGAR MANJUSHA | ✓ | --- | 26-03-2012 to 01-04-2012 | 3452 | CB03 | --- |
| 8 | ORV SAGAR MANJUSHA | --- | ✓ | 06-04-2012 to 05-04-2012 | 1370 | Recover Beached Buoy and BD14OMNI Buoy Components at Srilanka | |
| 9 | ORV SAGAR KANYA | --- | ✓ | 20-04-2012 to 21-05-2012 | 2265 | BD12,TB05,BD13, TB06-A, TB06, BD08,BD02,BD10 | BD14, TB10,BD12, TB05,BD13, TB06,BD08, BD02,BD10 |
| 10 | ORV SAGAR MANJUSHA | --- | --- | 21-06-2012 to 29-06-2012 | 650 | It was planned to retrieve the old Tsunami buoy at TB06 location and deploy the new Tsunami buoy in the given location. In addition to that retrieval of two BPR at TB08 and TB08A locations. But due to high swell and sea state, the operations could not be completed | |
| 11 | ORV SAGAR KANYA | ✓ | --- | 27-06-2012 to 06-07-2012 | 1148 | TB03 | --- |
| 12 | ORV SAGAR PURVI | --- | --- | 12-07-2012 | --- | Survey at coastal buoy location to study the GPRS signal strength at Off Ennore | |

# Satellite data validation
# CAL VAL Phase-II
# SAC & NIOT

## Three activities have been identified namely:

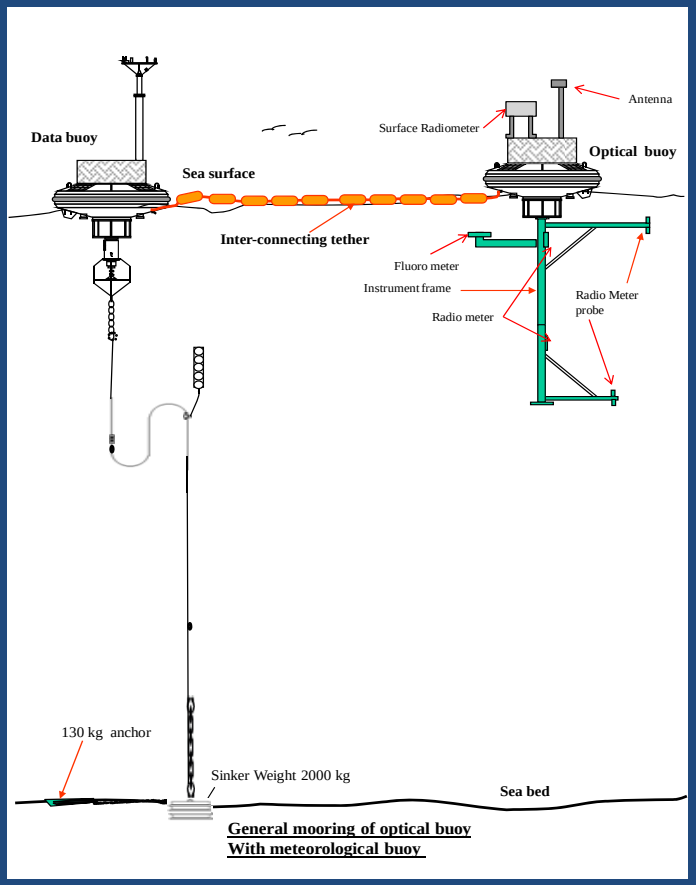
- Deployment of new MET & OPTICAL buoys on Kavaratti site
- Development of a coastal site in Krishna Godavari region for Oceansat-2 CAL/Val and
- Installation of three Bottom pressure recorders for absolute calibration of Saral/AlitKa radar altimeter.

# Material Selection Criteria: Underwater structure

- Should withstand the expected loads
- Able to survive in the corrosive environment
- High strength to weight ratio

Selected Material: SS316

Young's Modulus : 193 x $10^9$ N/$m^2$



**Deployment:**

Deployment of Met – Ocean buoy

Deployment of Optical buoy

# CORAL REEF BUOY
# ANDAMAN & LAKSHADWEEP

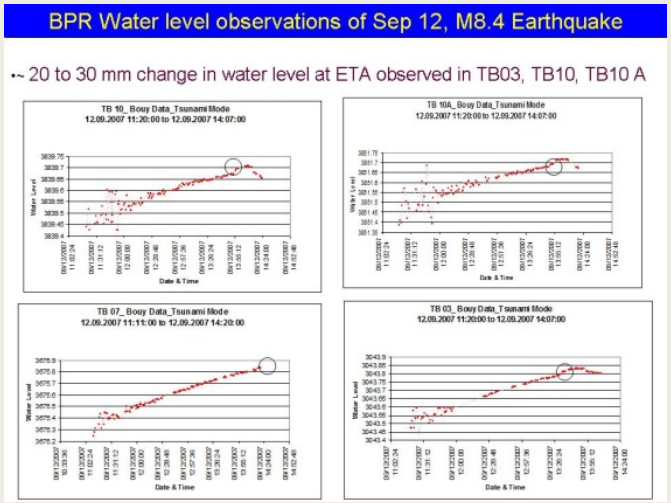
**Buoy Features**

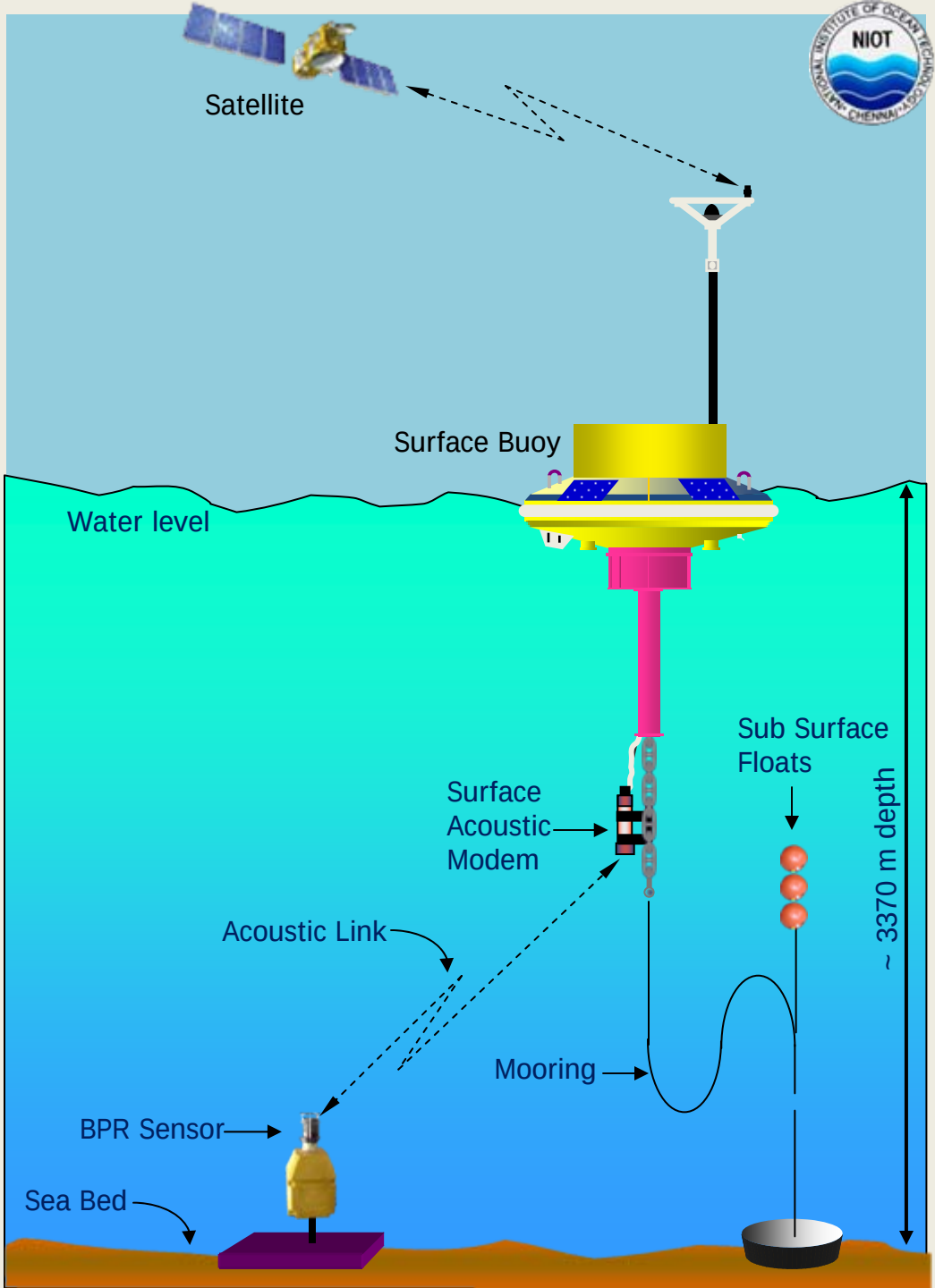
- Measures : Wind Speed & Direction
  Air Temperature
  Air Pressure and Humidity
- Underwater: Dissolved Oxygen,
  Turbidity, Salinity, pH, Conductivity, SST,
  Current Speed & Direction
- Coral Reef Environment Friendly Anchor

PROPOSED
pCO2 sensors
Water quality sensors

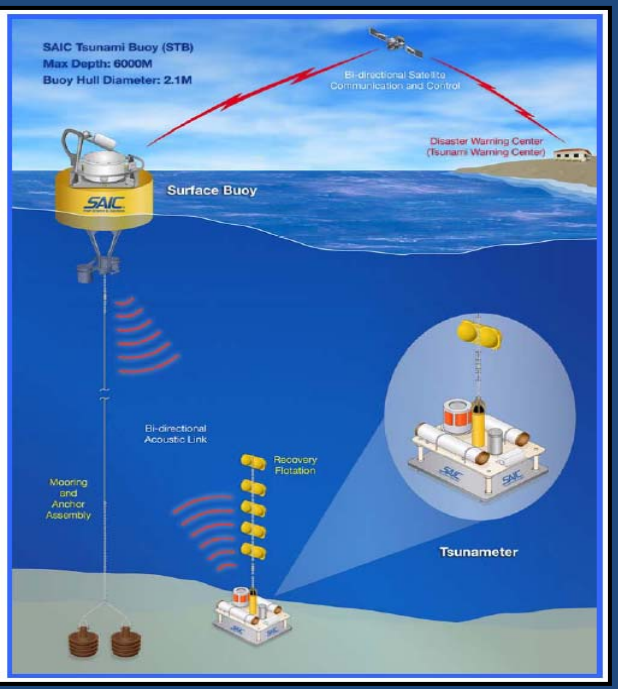
# TSUNAMI BUOY – Indian

**7 Locations**
**2 SAIC**



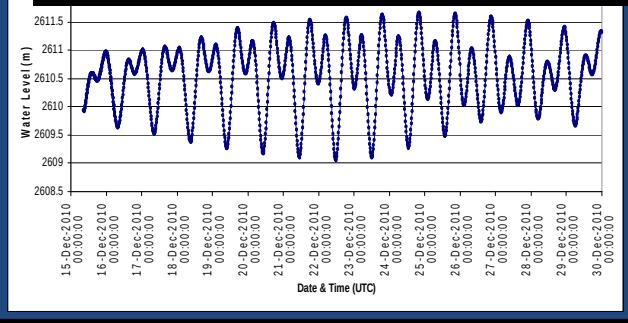



# Tsunami Buoys Deployment INCOIS




**Revised locations of Buoys**

| S. No. | Code | Lat (N) | Long (E) |
|---|---|---|---|
| 1 | STB01 | 06.25 | 88.8 |
| 2 | STB02 | 20.8 | 65.3 |
| 3 | STB03 | 03.8 | 91.7 |
| 4 | TB05 | 11.0 | 89.5 |
| 5 | TB06 | 15.0 | 90.0 |
| 6 | TB08 | 12.5 | 85.5 |
| 7 | TB12 | 21.4 | 64.1 |



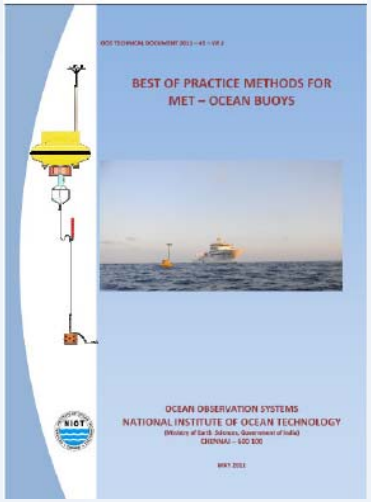

# Best of Practice

A systematic procedure has been evolved and is being followed. This document was vetted by NOAA PMEL and NDBC USA. Following JCOMM standard

✓Individual Sensor Testing
✓Mooring And Mechanical Testing
✓Assembly And Integration Of Buoy
✓Pre-deployment Testing
✓Packing And Transportation
✓On-board Testing
✓Data Monitoring, Quality Check & Dissemination

✓DBCP NIOT Workshop – Asia on
Best practice on instruments

R&D Managers of industry would present
about science behind development of instruments



# Data Reception

- **ADDRESS**

  **Shore station reception system are upgraded with high-end blade servers**

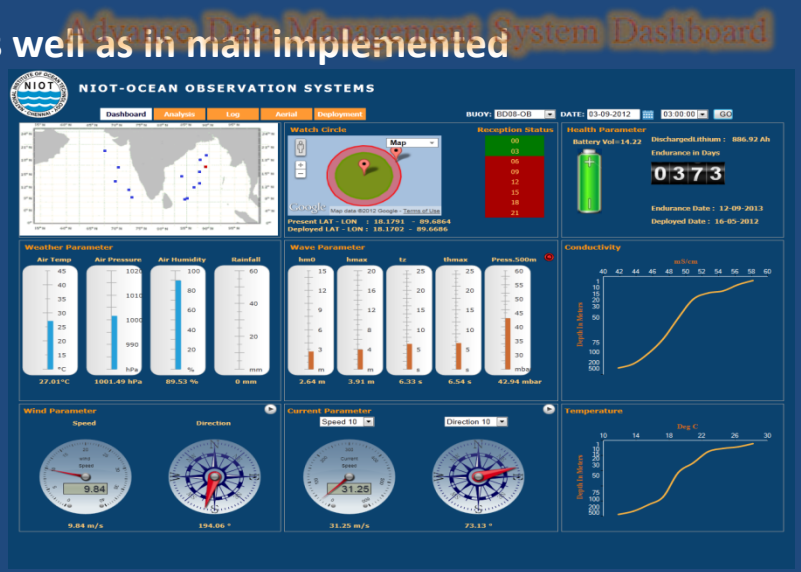
- **To maximise use of IT infrastructure, Virtual desktops implemented on blades**

- **Data Reception latency reduced by segregating buoys to different edge gateway reception nodes**

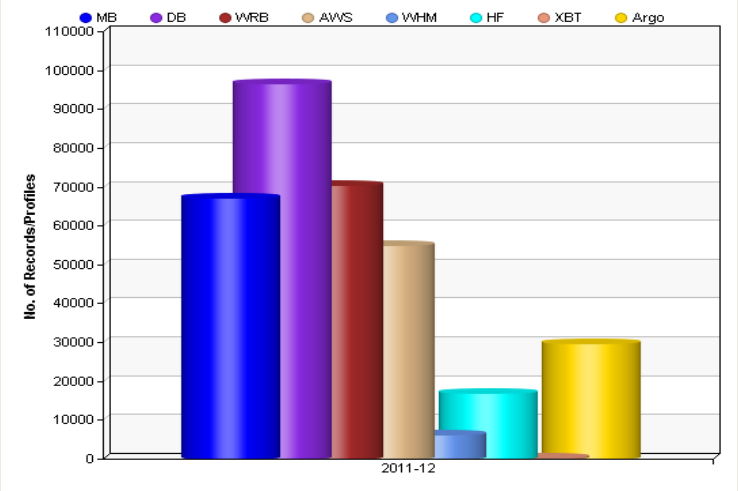
- **High end storage is available for archival and storing voluminous data**

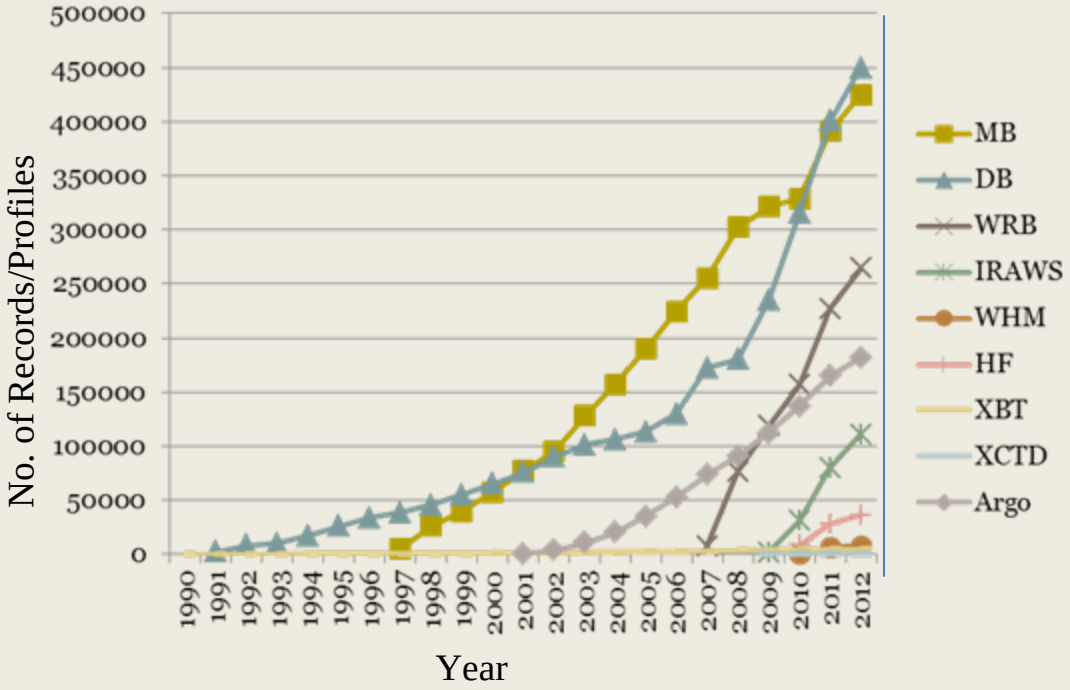
- **Shore station management software developed with high end graphical user interface for RTQC, DMQC, Data Management and Operational Management**

- **Real time earth quake alert system both in audio as well as in mail implemented**

# Data growth during year 2011-2012 Data Centre INCOIS



# Digital Ocean – one stop shop for heterogeneous products of Indian Ocean

**Data Sets:**

Time series data
- CTD, Argo, XBT etc.

Spatial Data
- Remote sensing

Model outputs
- MOM,ROMS, WWIII etc.

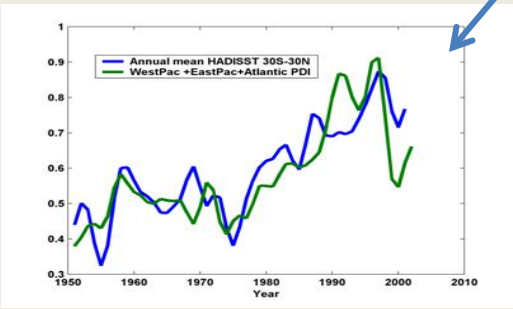
Videos
- Underwater surveillance

**Functionalities:**

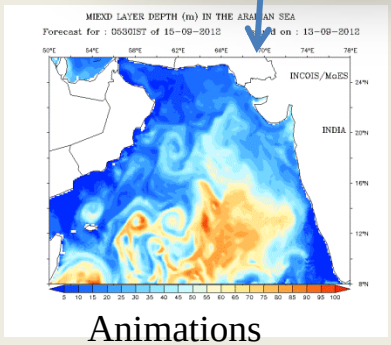
On the fly visualization
Spatial and Temporal sub-setting,
Format conversion,
Draping
Comparison
Online validation,
Downloads

**Data Formats:**

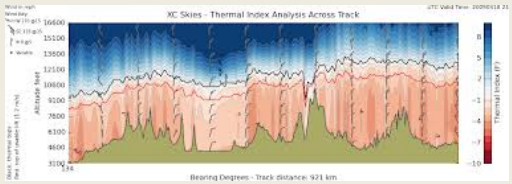
ASCII
NetCDF
HDF
GeoTiff
Binary




Time series




Animations



Cross Sections

Videos

# 3. TECHNICAL DEVELOPMENTS

# Transfer of Technology
# Indigenization of Buoy Data Acquisition System (I-DAS)

I –DAS Met Ocean

I–DAS Wave

I –DAS Tsunami

- I-DAS Met Ocean – Successfully deployed and completed 1 year by July 2010
- I-DAS Wave – Successfully deployed and working from August 2011
- I-DAS Tsunami – Successfully deployed and working from September 2011

I –DAS INSAT

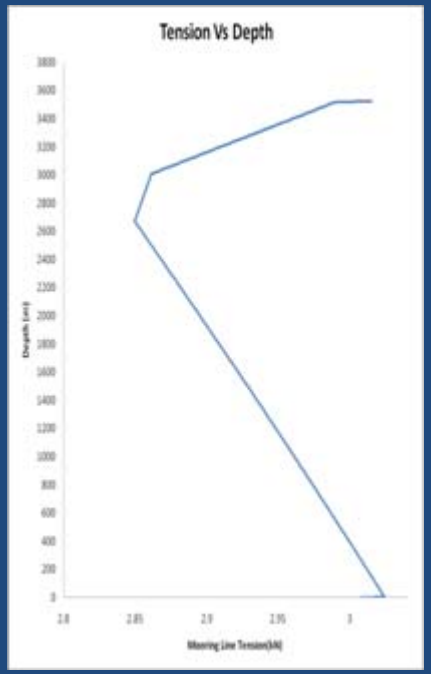
I –DAS OMNI

# MOORING ANALYSIS USING s SOFTWARE "CABLE" and ORCAFLEX

- Problem description
  - -- Surface
  - -- Sub surface
  - -- Towing
- Environmental parameters
  - -- Density
  - -- Gravity
  - -- Depth
  - -- Current profile
  - -- Wind Speed
- Material Description-- Material properties of Mooring hardwares
- System Layout
  - -- Arrangements of Mooring Components

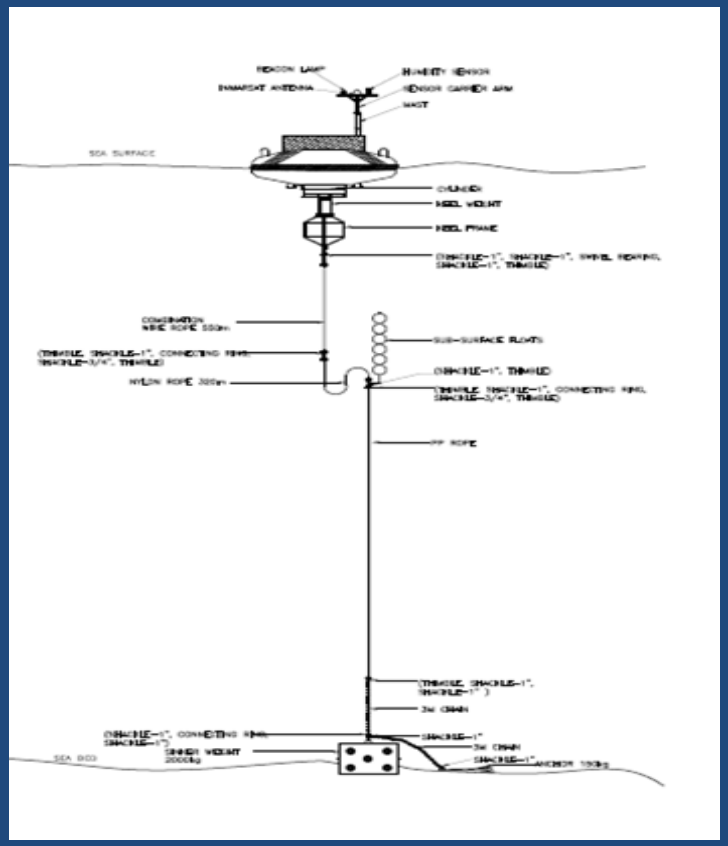
**ENVIRONMENTAL PARAMETERS**

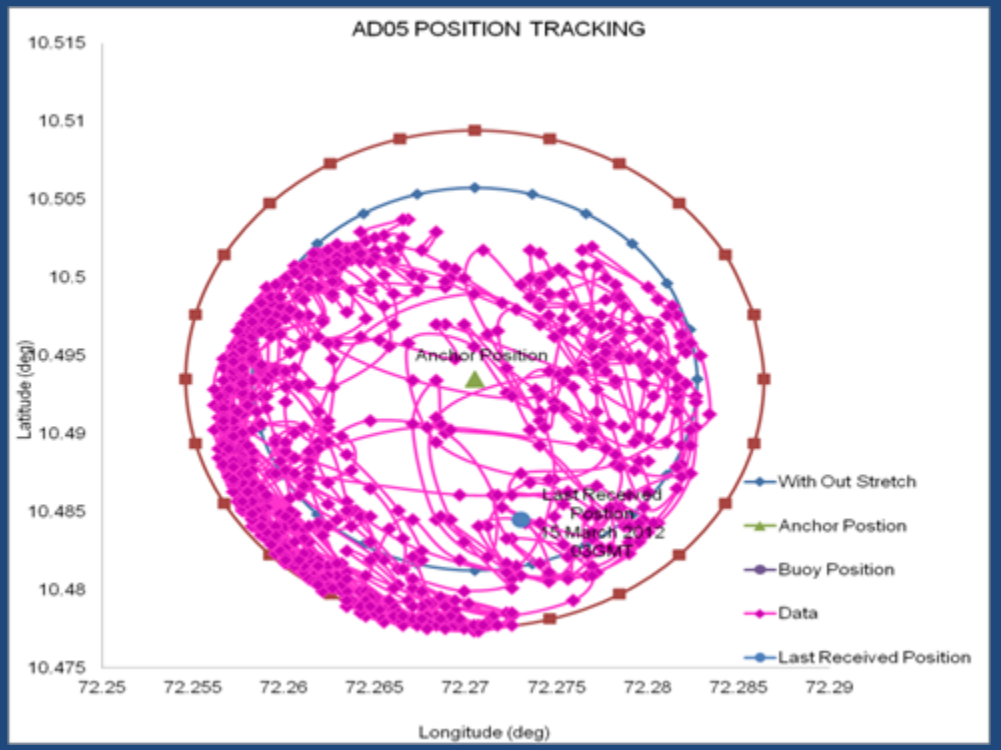
- Wave Parameters
- Wind Speed
- Current Profile
- Depth
- Bottom Conditions



# MOORING DESIGN AND WATCH CIRCLE

Type : Inverse catenary
Scope : 1.2 to 1.4

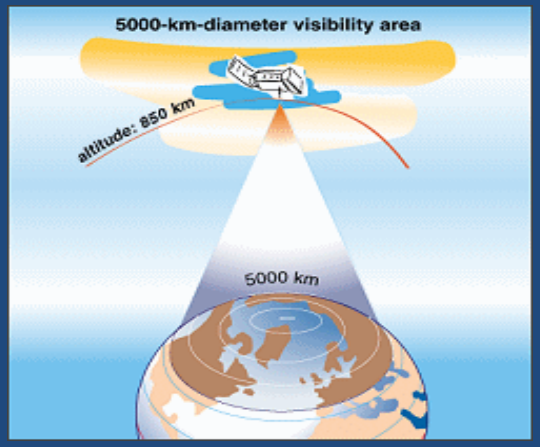




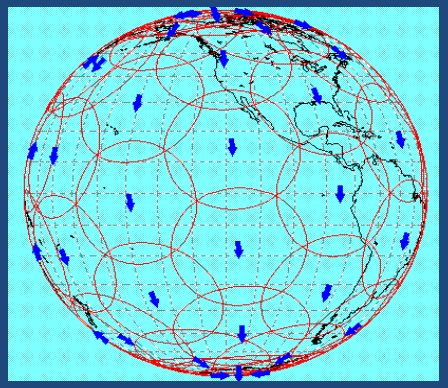

Watch Circle radius : The radius of the circular movement of the buoy about it's anchored position.

Used to take decision about the safe deployment of buoy system, implemented during Feb'12.

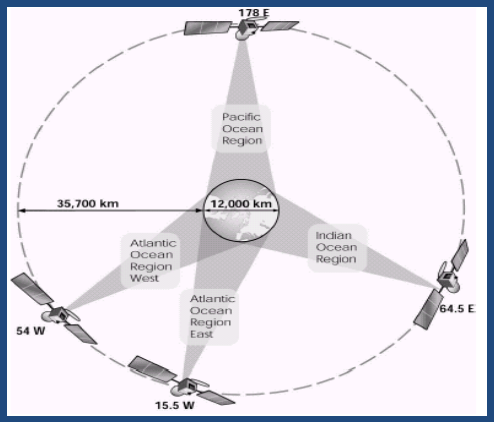
# INMARSAT, IRIDIUM and ARGOS satellite communication




ARGOS - (GEO synchronize)



IRIDIUM – 66 No GEO synchronize




INMARSAT – 4 NO (GEO Stationary)

| | Two way | Acknowledgement | Less delay | Low power | Low altitude |
|---|---|---|---|---|---|
| **ARGOS:** | No | No | No | Yes | Yes |
| INMARSAT | Yes | Yes | Yes | No | No |
| **IRIDIUM** | Yes | Yes | Yes | Yes | Yes |

# INMARSAT, IRIDIUM INSAT and ARGOS satellite communication

**INMARSAT: (OMNI)**

Merit:

- Two way communication with acknowledgement,
- 24 hours latency, 3 minute delay to receive the data after it transmitted from buoy.

Demerits:

- Due to high altitude high power is need to transmit the data.

**INSAT**

**DRT ONE WAY**

**Mss two way**

**ARGOS: (RAMA Buoy)**

Merit:

- Due to low altitude low power is need to transmit the data from buoy

Demerits:

- One way communication
- No acknowledgement
- 1.5 hours latency in equators.
- Data will be received after 4 hours.

**IRIDIUM:**

- Two way communication with acknowledgement,
- 24 hours latency, 13 sec delay to receive the data after it transmitted from Buoy.
- Due to low altitude low power is need to transmit the data from buoy

# Performance of Sensors

Long term performance of

- Precipitation
- Humidity
- Argo transmitter for Moored buoy location
- Li Ion Battery for Buoy System

# ARGOS Transmitter Manufacturer

Make: ARGOS wildCAT PTT  with Alkaline battery 9v-45Ah

Manufacturer: OROLIA SAS

Make: AMR GET

# ARGOS TRANSMITTER – EXPECTED ONE YEAR LIFE

# Humidity Sensor - Effect of probe filter material

**Problem observed:**

- Wire mesh filters are used in the present humidity sensors
- In a high humidity environment liquid water is present on the sensor
- The vapor pressure gradient is insufficient for effective evaporation of liquid water from the sensor surface
- Sensor would stay wet for quite long even though environment is no longer saturated
- This create a prolonged measurement outage

Mesh Filters

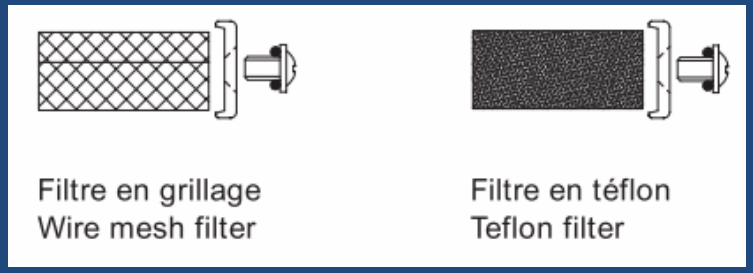
Before deployment

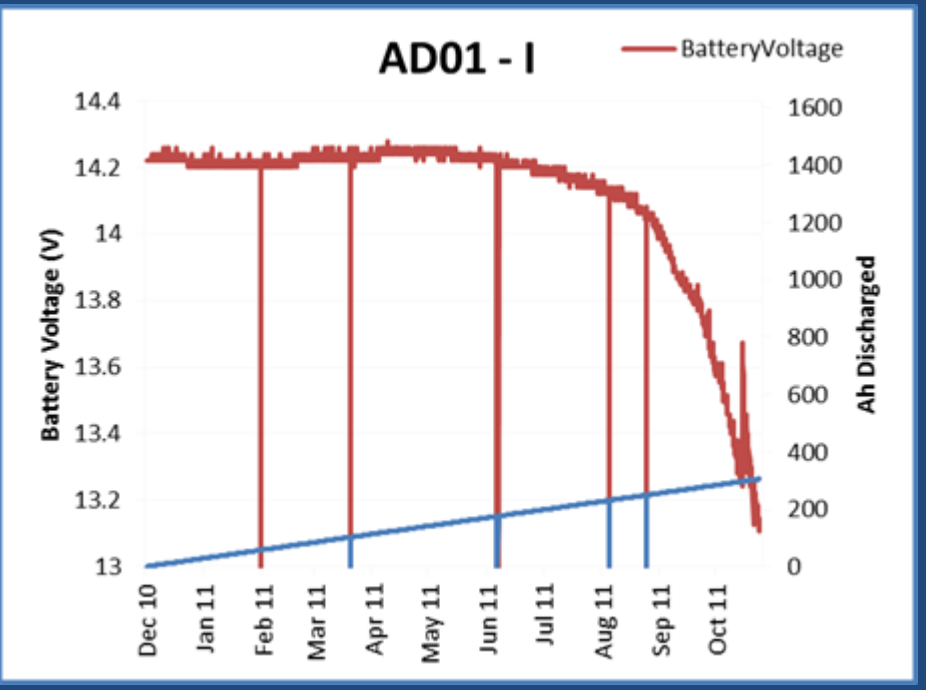
After retrieval
Corrosion in the filter

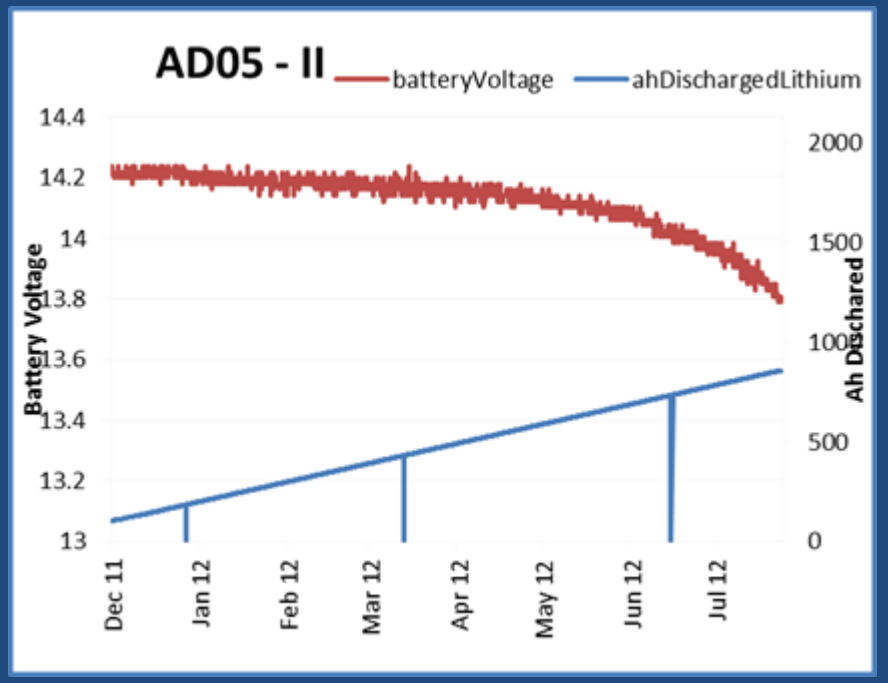
**Action taken:**

- Teflon filter to protect the sensor from salt spray
- Warm probe technology.

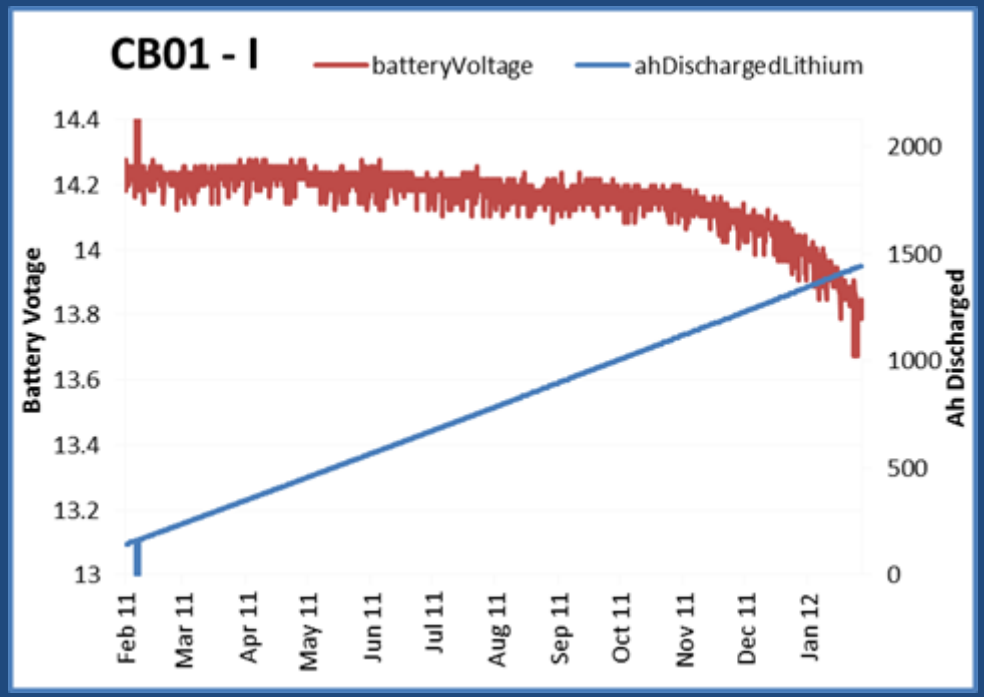
Teflon Filter

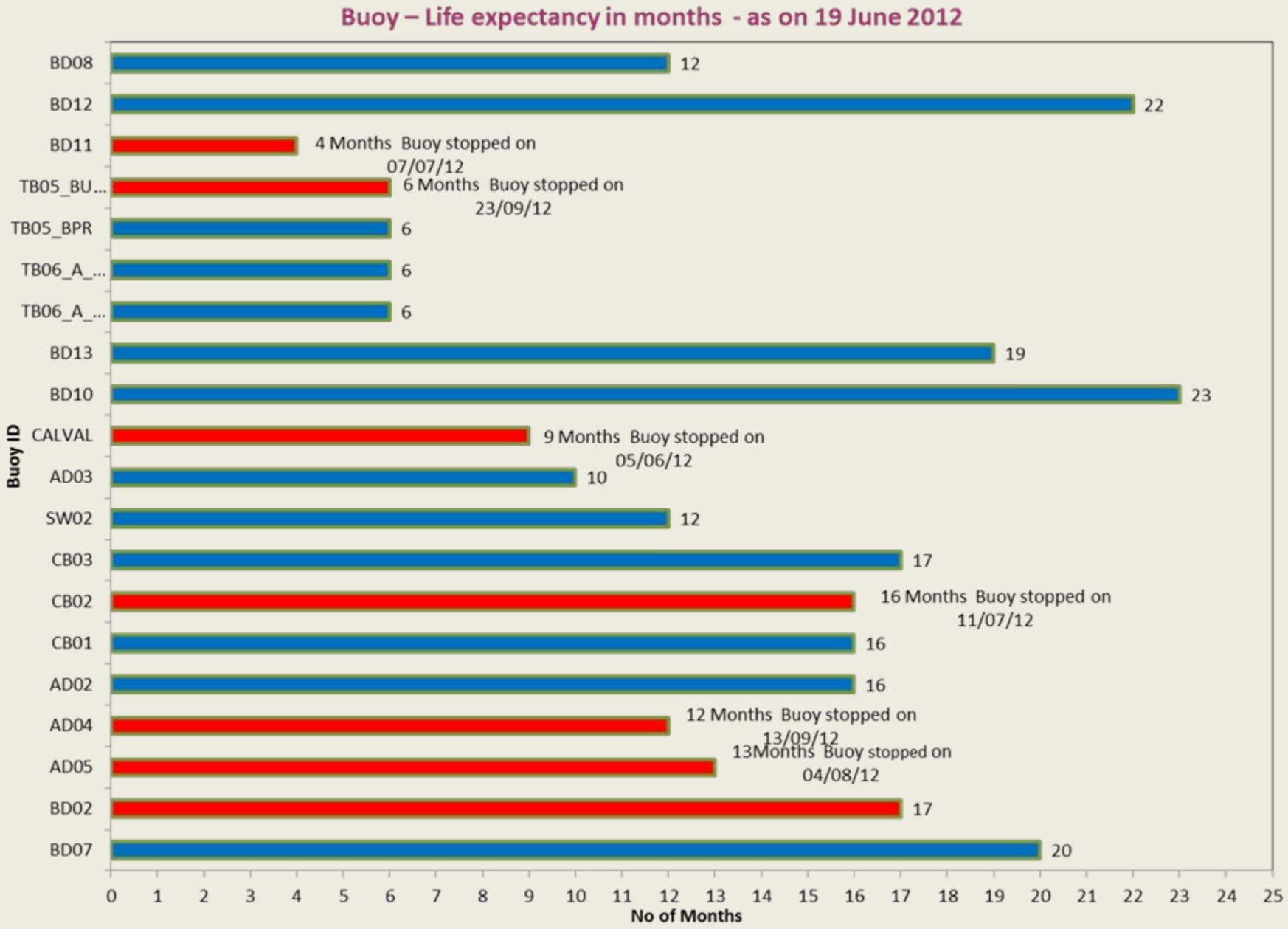




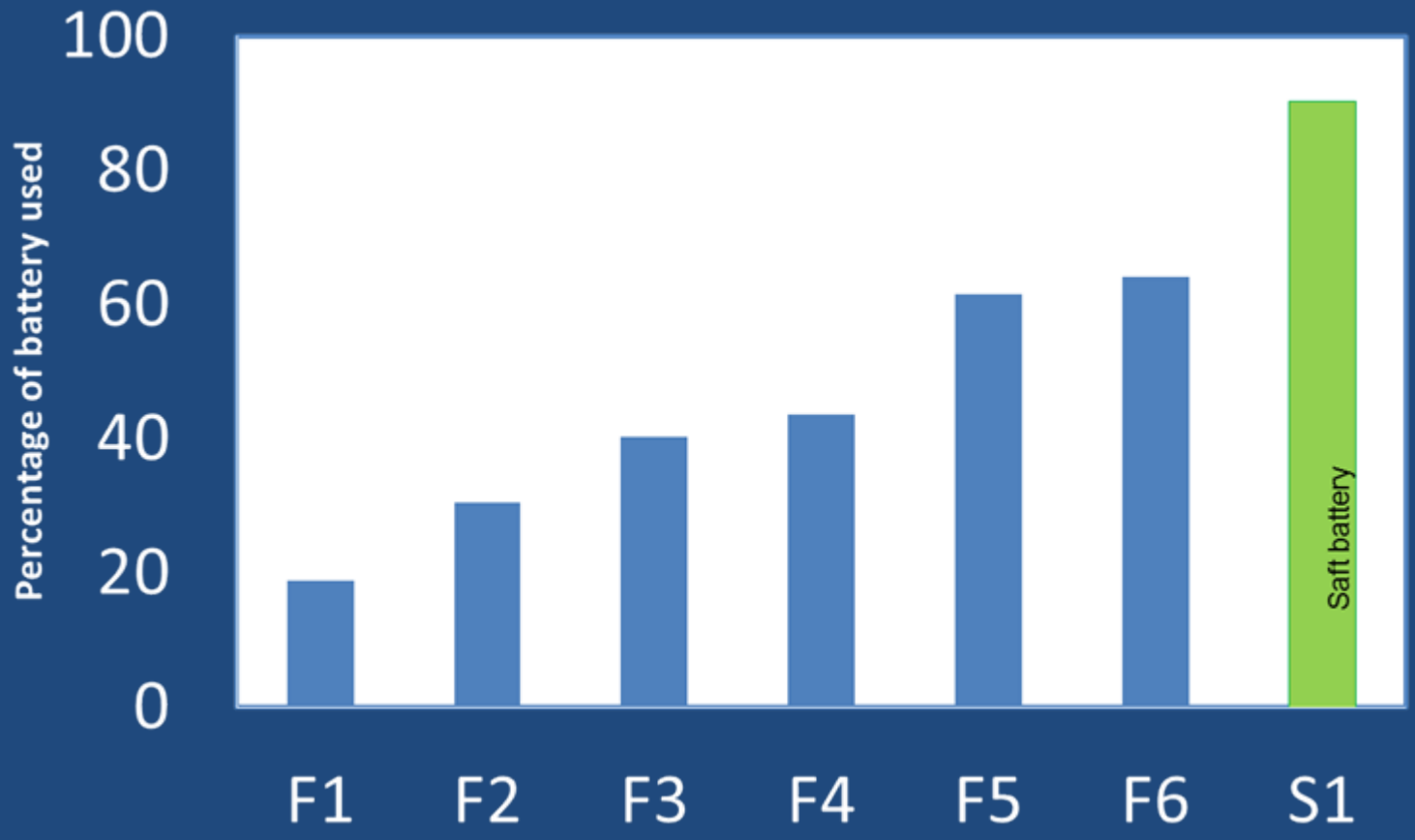




**Lithium thionyl Chloride battery:**




Buoy – Life expectancy in months - as on 19 June 2012
BD08
BD12
BD11
TB05_BU...
TB05_BPR
TB06_A_...
TB06_A_...
BD13
BD10
CALVAL
AD03
SW02
CB03
CB02
CB01
AD02
AD04
AD05
BD02
BD07
12
22
4 Months Buoy stopped on 07/07/12
6 Months Buoy stopped on 23/09/12
6
6
6
19
23
9 Months Buoy stopped on 05/06/12
10
12
17
16 Months Buoy stopped on 11/07/12
16
16
12 Months Buoy stopped on 13/09/12
13Months Buoy stopped on 04/08/12
17
20
Buoy ID
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
No of Months

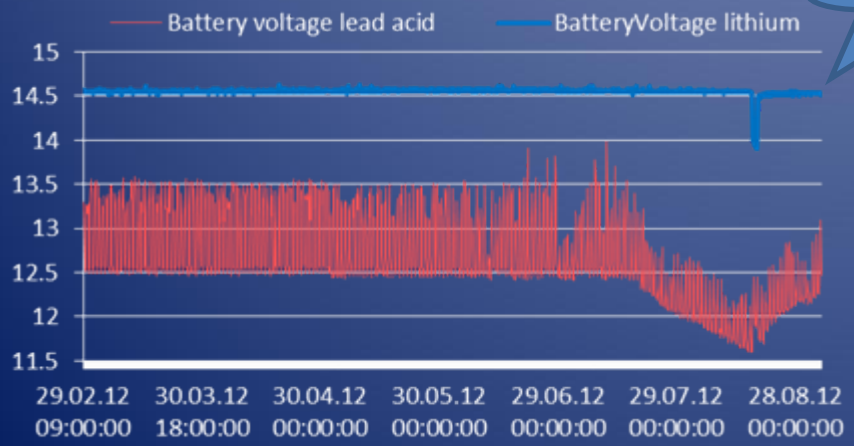
# Performance of Forte and Saft battery(Utilization)

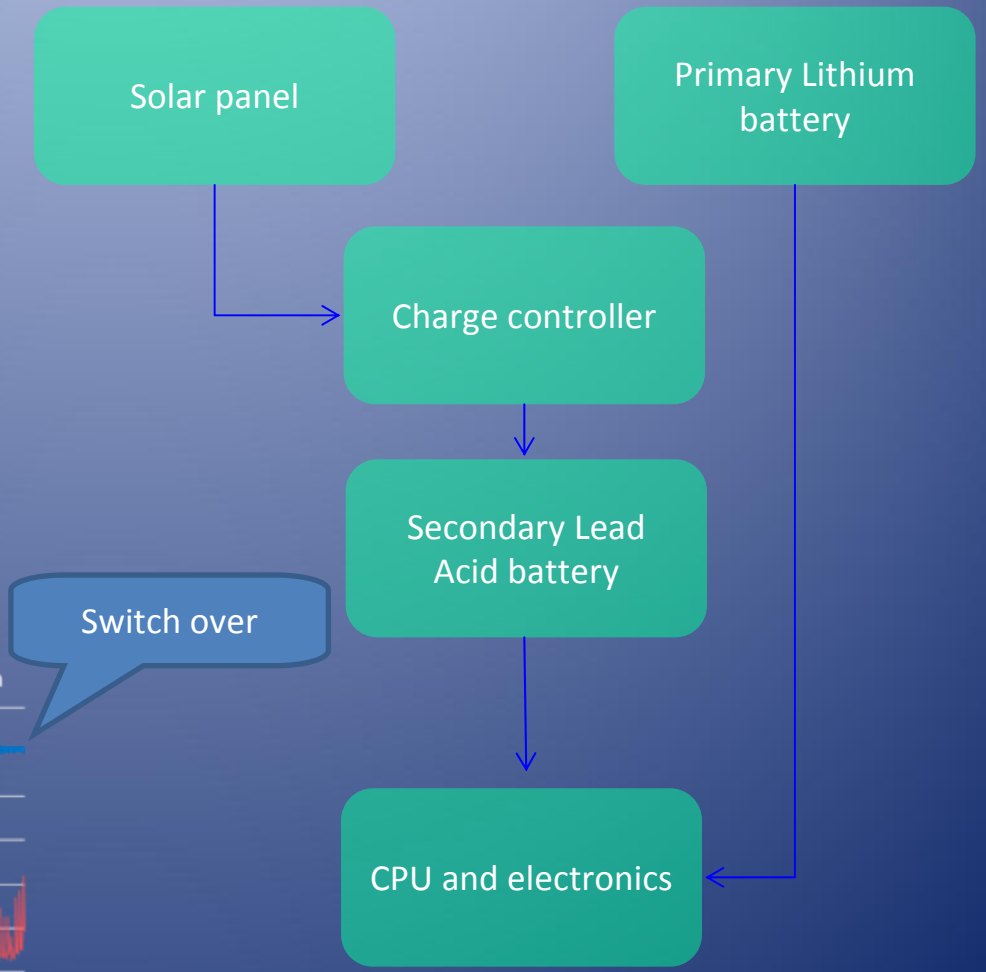


# Dual Power module
# Buoy power system with primary Lithium batteries

Advantages :
- Uninterrupted power supply to buoy
- High energy density
- Less weight
- Combined effect of both battery increases buoy life

Constraints :
- High initial cost
- Depends on reliability of Lithium thionyl Chloride battery for prolonged operation

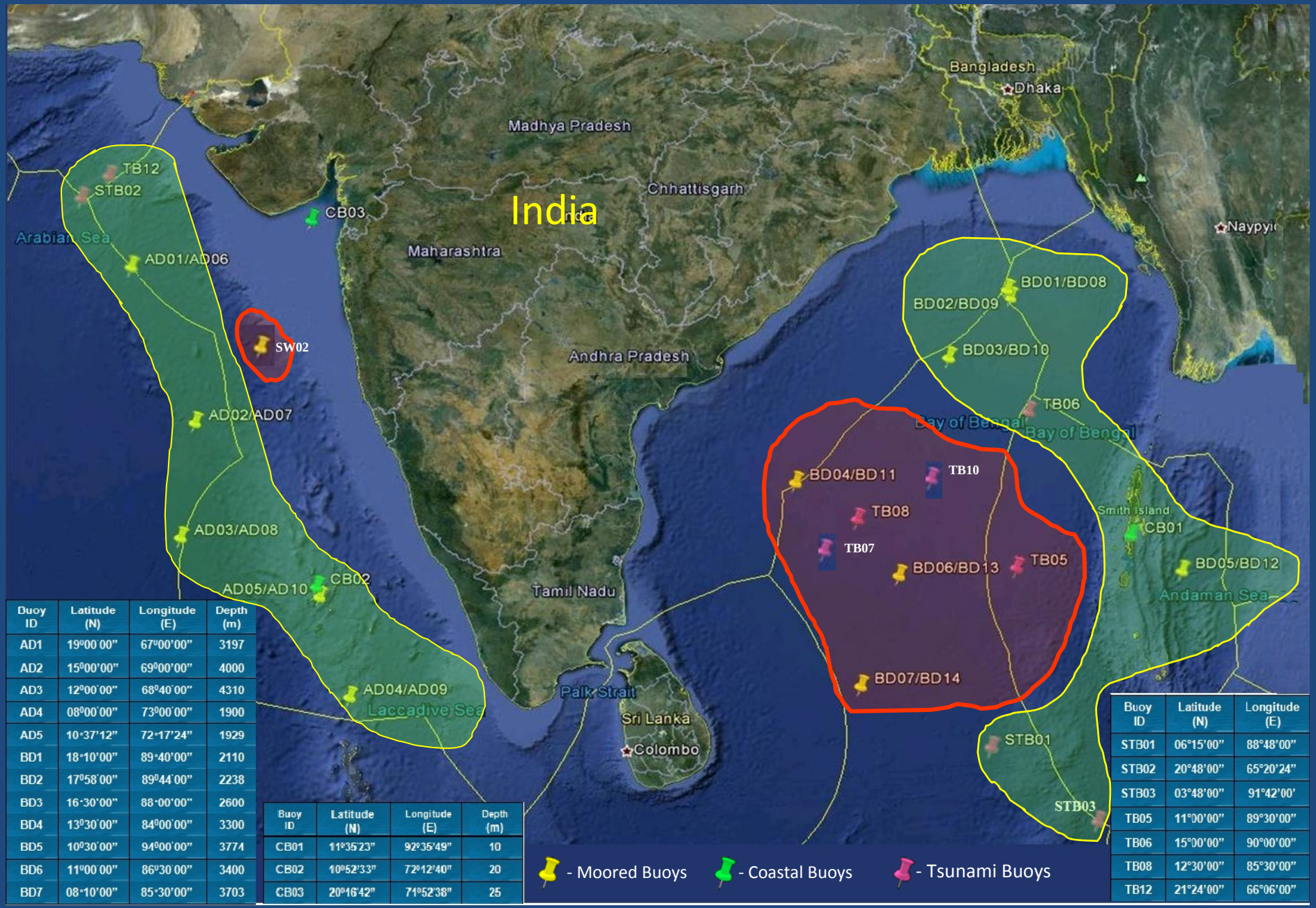


- Quality of Buoy data — QC as per guidelines
- Communications — INMARSAT, INSAT
- Buoy Life Times — 8 to 12 months

- New buoy is being designed for longer life

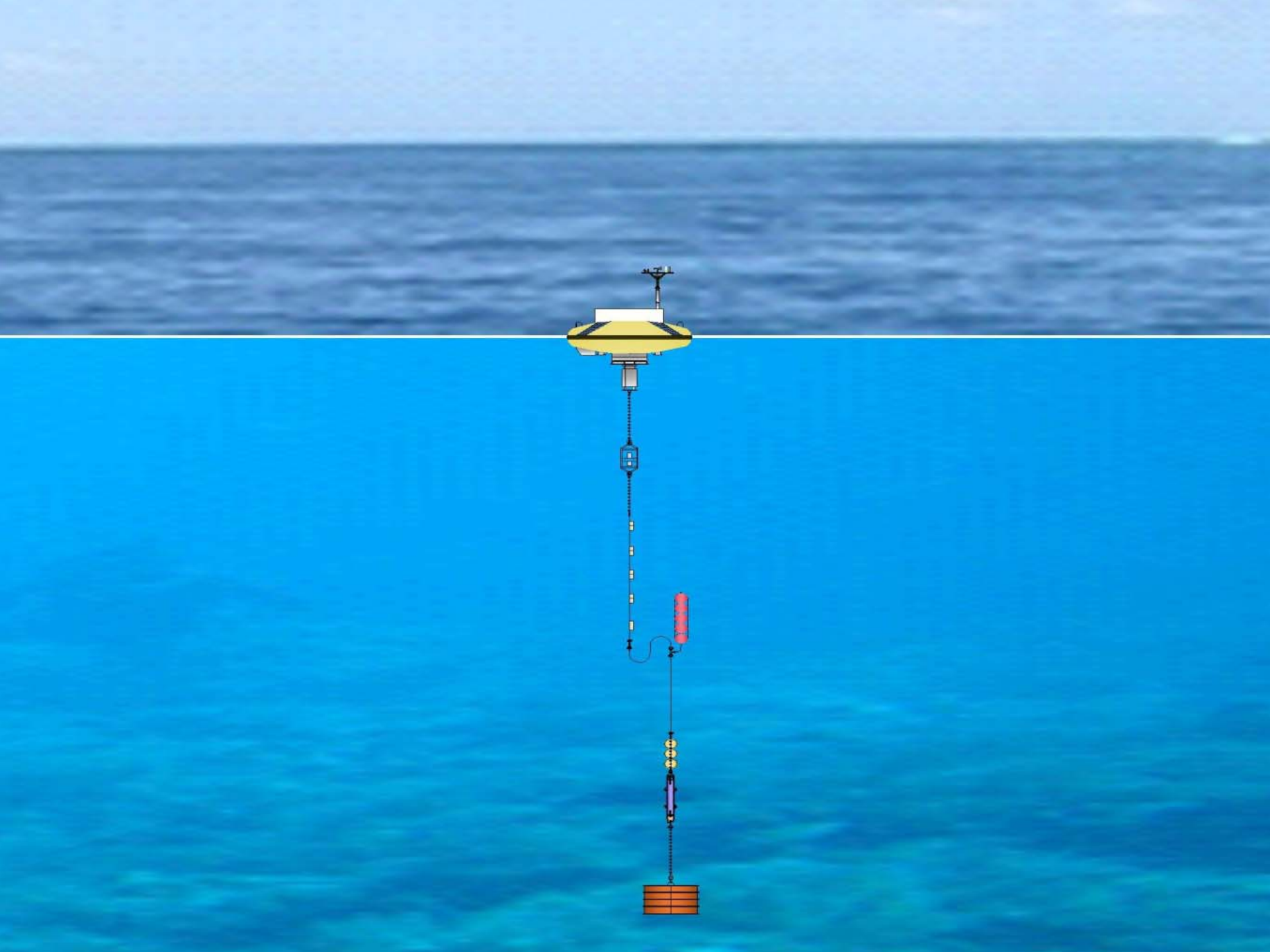
# VANDALISM ON BUOYS IN BAY OF BENGAL & ARABIAN SEA

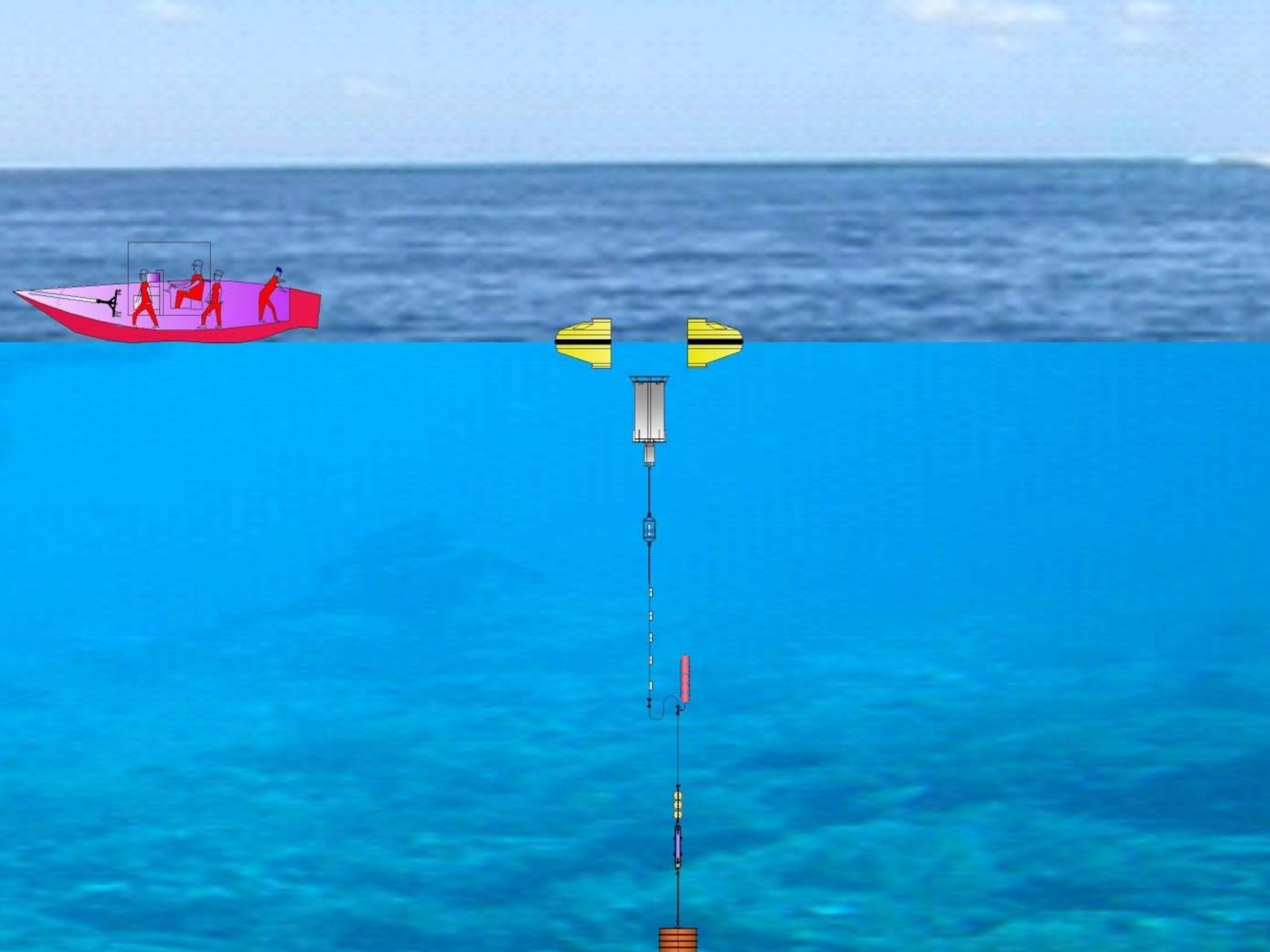


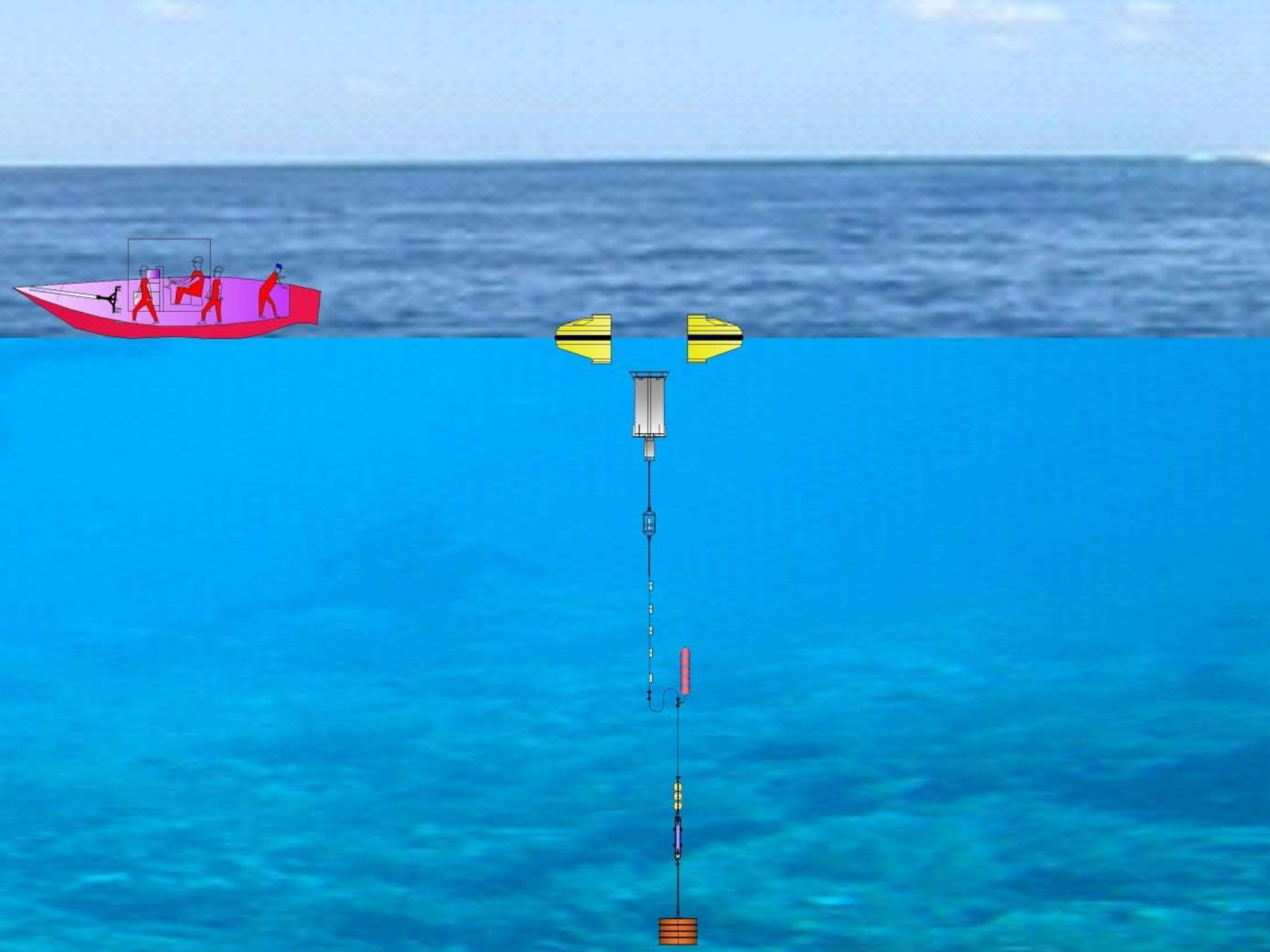

| Buoy ID | Latitude (N) | Longitude (E) | Depth (m) |
|---|---|---|---|
| AD1 | 19°00'00" | 67°00'00" | 3197 |
| AD2 | 15°00'00" | 69°00'00" | 4000 |
| AD3 | 12°00'00" | 68°40'00" | 4310 |
| AD4 | 08°00'00" | 73°00'00" | 1900 |
| AD5 | 10°37'12" | 72°17'24" | 1929 |
| BD1 | 18°10'00" | 89°40'00" | 2110 |
| BD2 | 17°58'00" | 89°44'00" | 2238 |
| BD3 | 16°30'00" | 88°00'00" | 2600 |
| BD4 | 13°30'00" | 84°00'00" | 3300 |
| BD5 | 10°30'00" | 94°00'00" | 3774 |
| BD6 | 11°00'00" | 86°30'00" | 3400 |
| BD7 | 08°10'00" | 85°30'00" | 3703 |

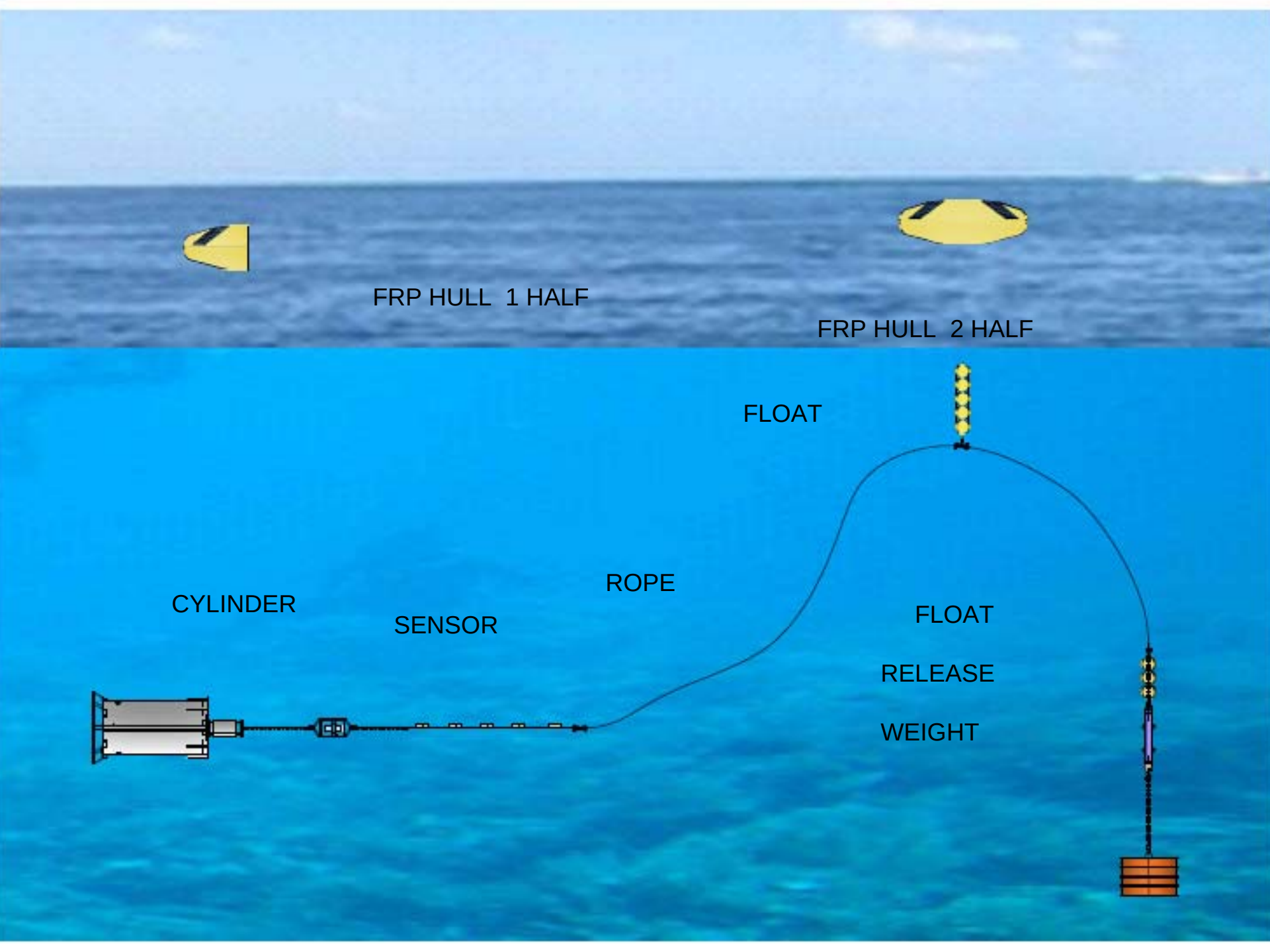
| Buoy ID | Latitude (N) | Longitude (E) | Depth (m) |
|---|---|---|---|
| CB01 | 11°35'23" | 92°35'49" | 10 |
| CB02 | 10°52'33" | 72°12'40" | 20 |
| CB03 | 20°16'42" | 71°52'38" | 25 |

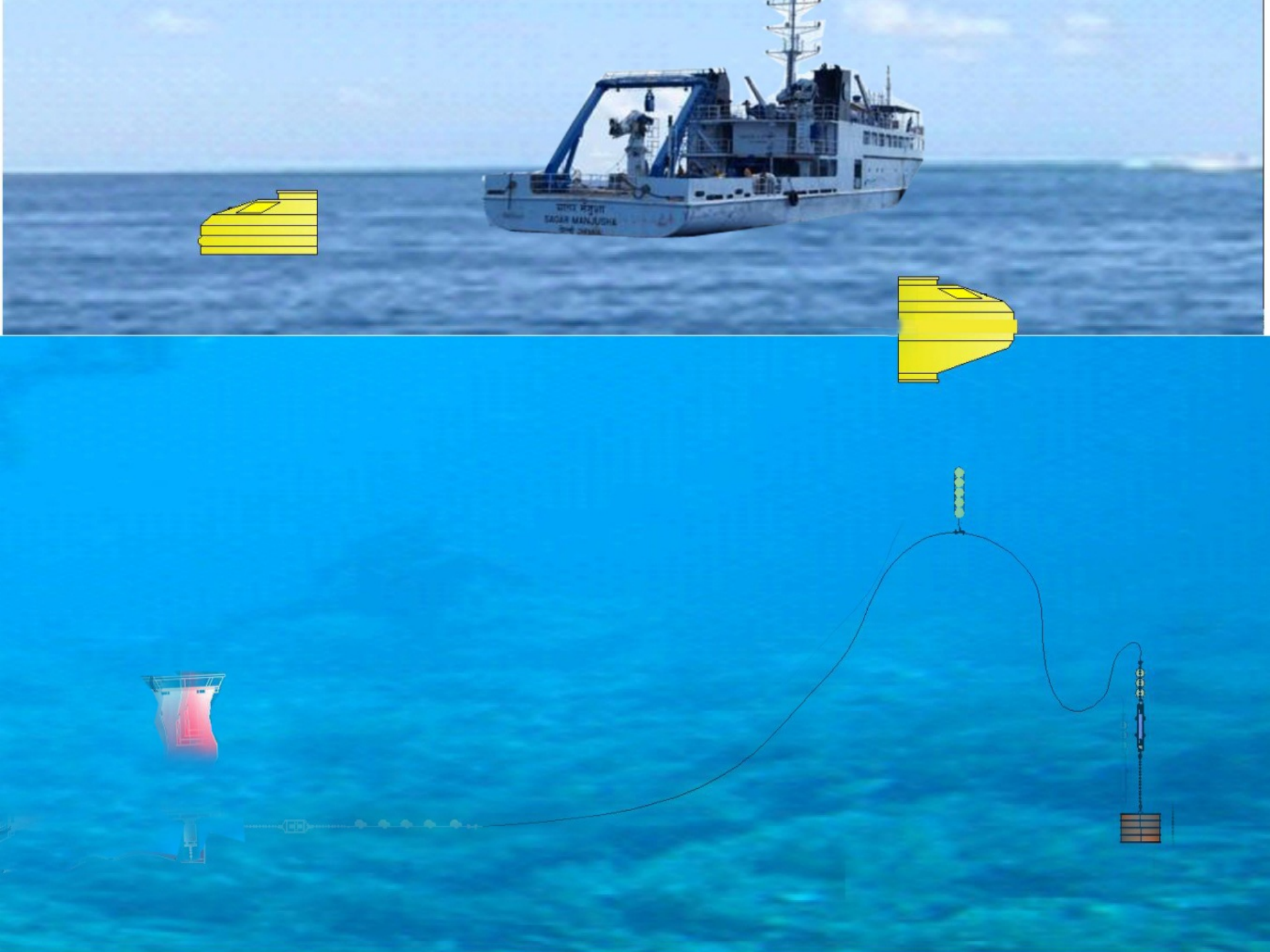
| Buoy ID | Latitude (N) | Longitude (E) |
|---|---|---|
| STB01 | 06°15'00" | 88°48'00" |
| STB02 | 20°48'00" | 65°20'24" |
| STB03 | 03°48'00" | 91°42'00' |
| TB05 | 11°00'00" | 89°30'00" |
| TB06 | 15°00'00" | 90°00'00" |
| TB08 | 12°30'00" | 85°30'00" |
| TB12 | 21°24'00" | 66°06'00" |

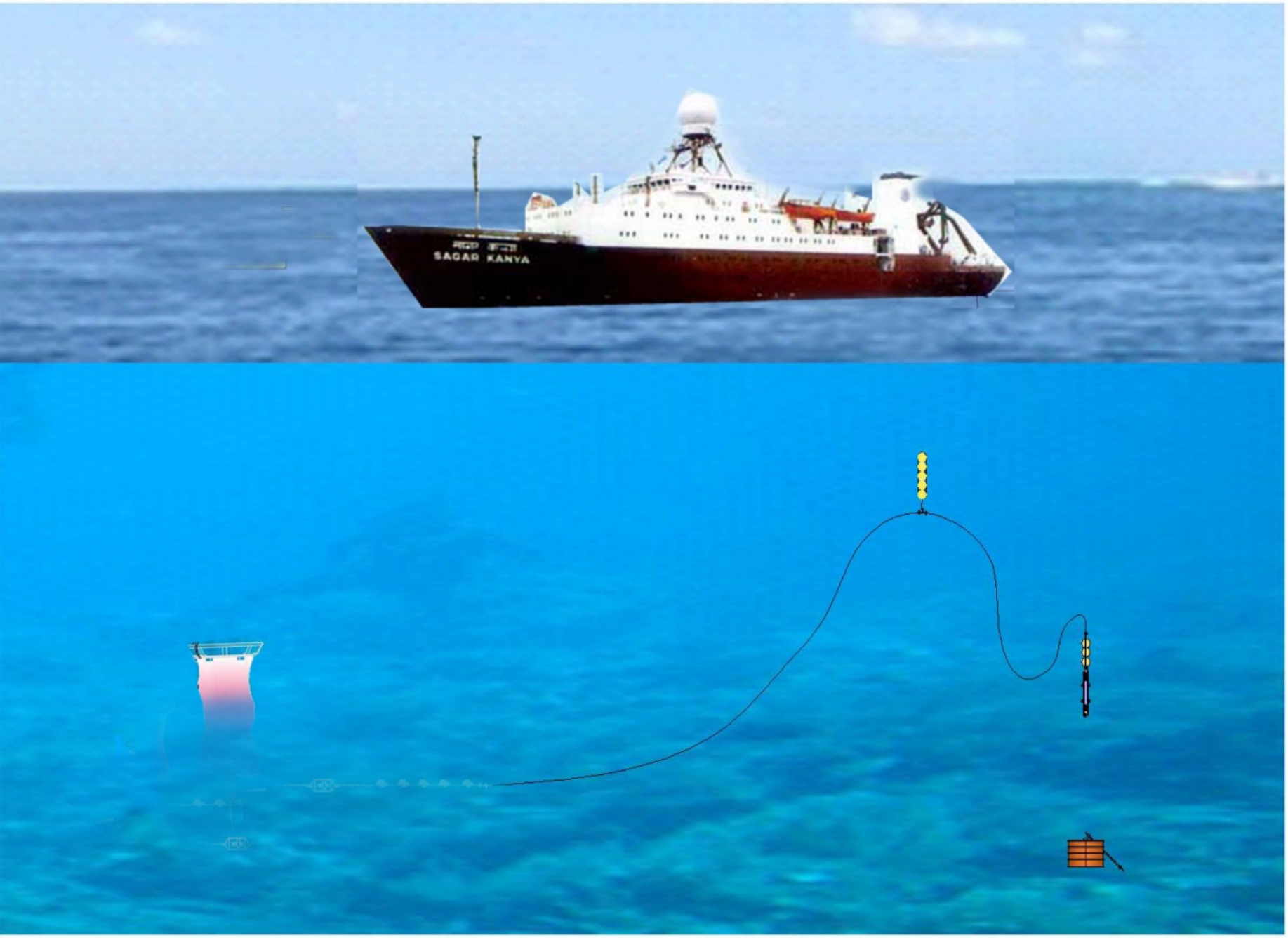


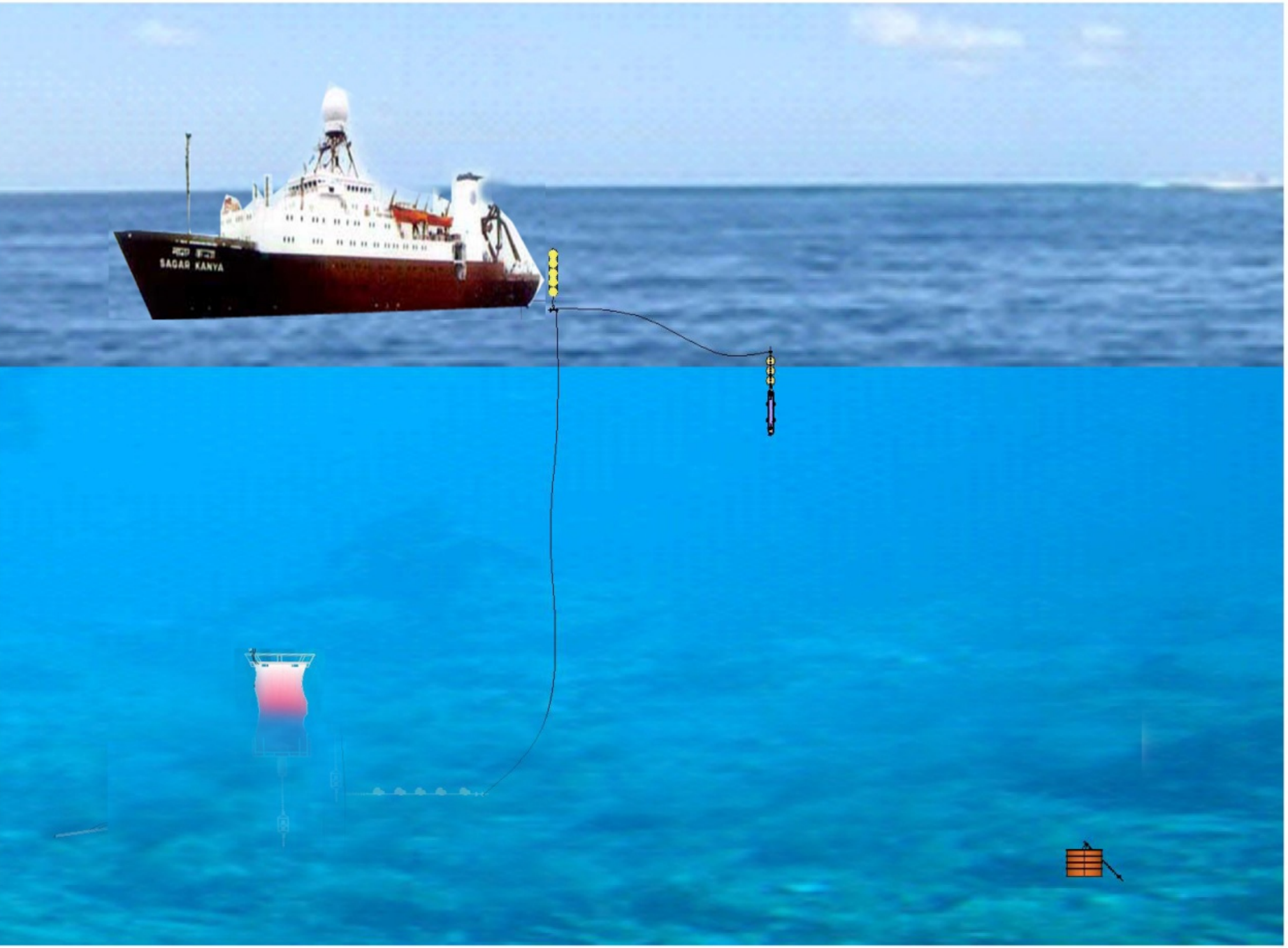


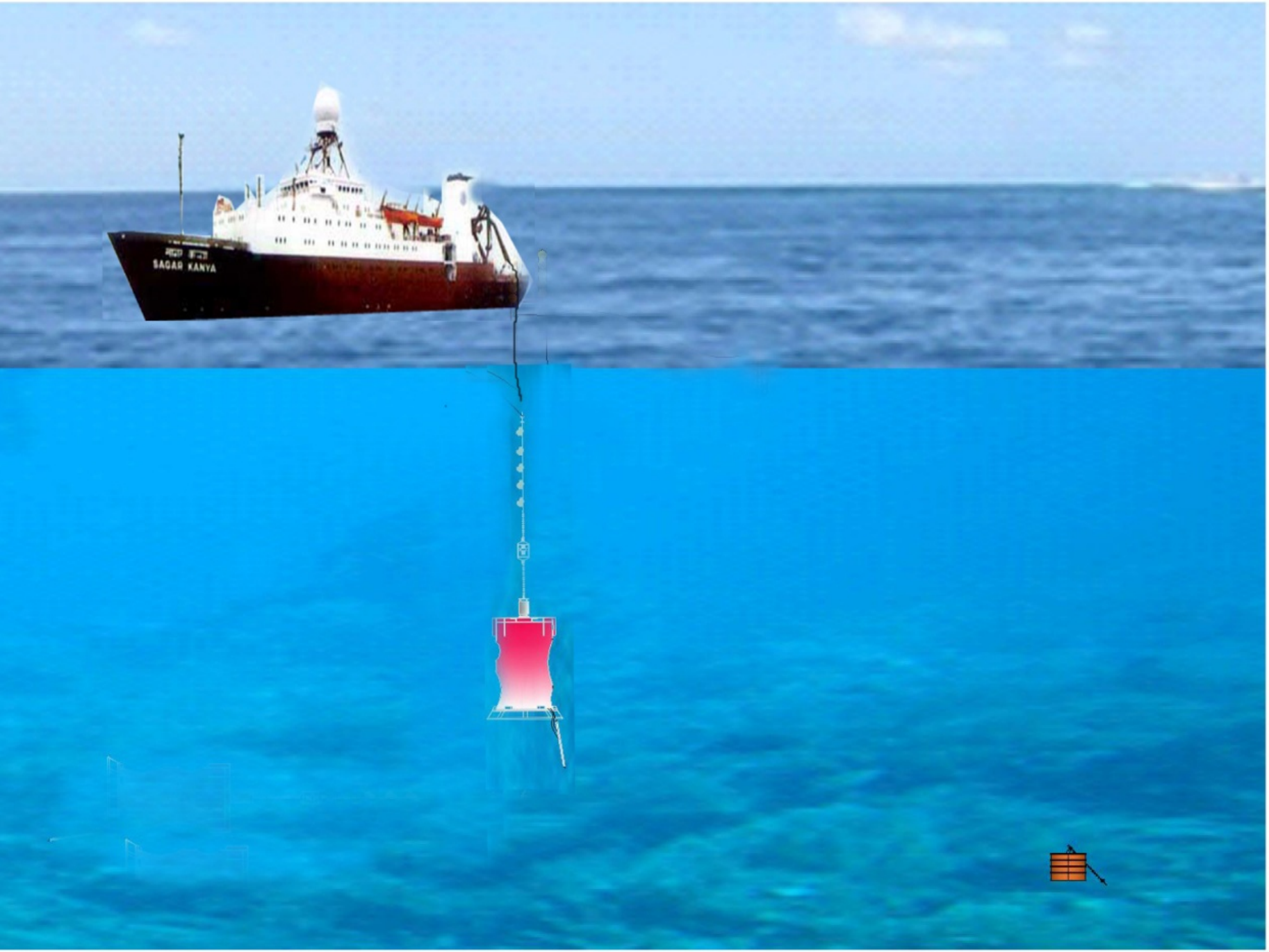


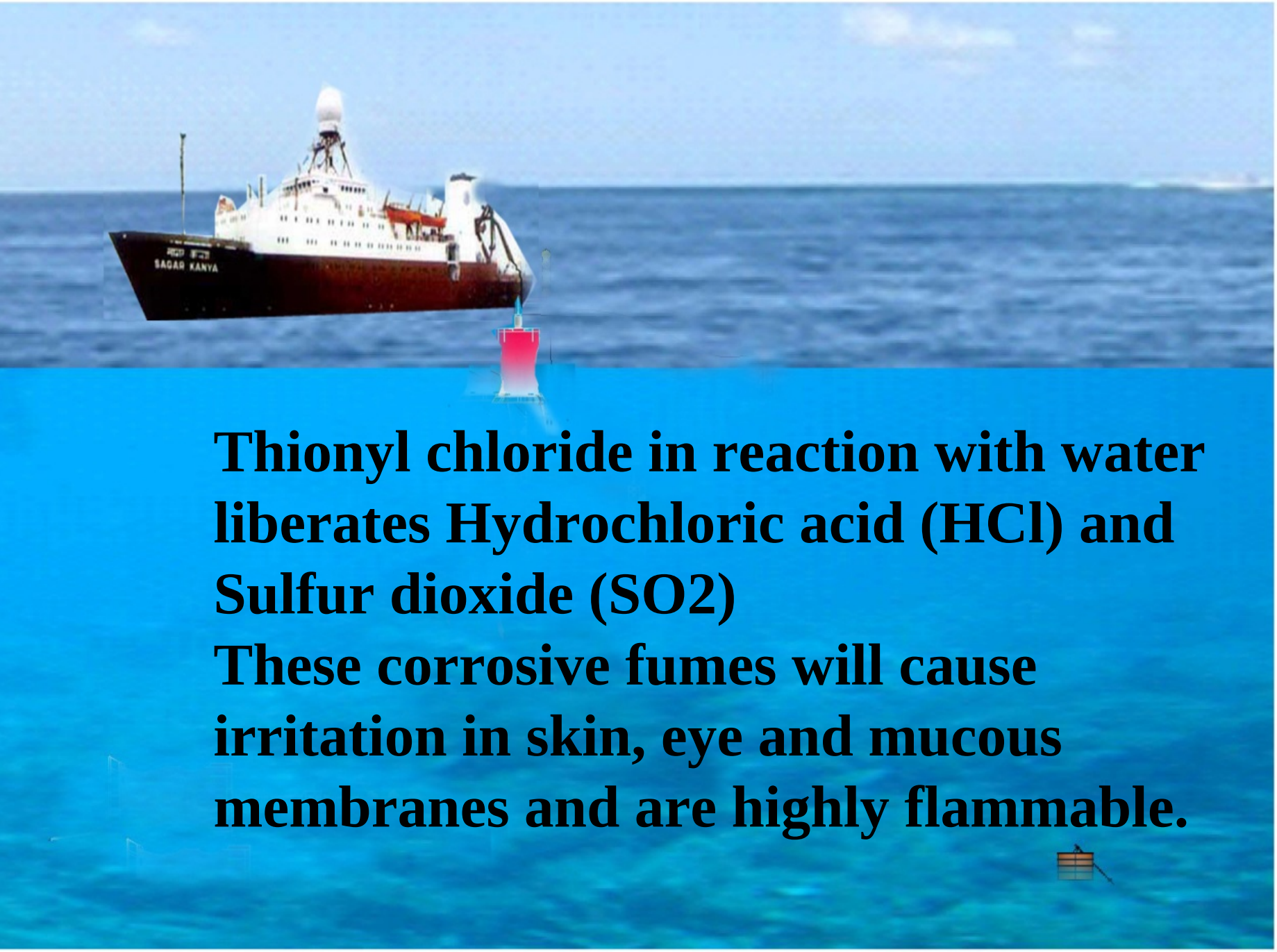

FRP HULL 1 HALF
FRP HULL 2 HALF
FLOAT
CYLINDER
SENSOR
ROPE
FLOAT
RELEASE
WEIGHT


SAGAR MANJUSHA


SAGAR KANYA

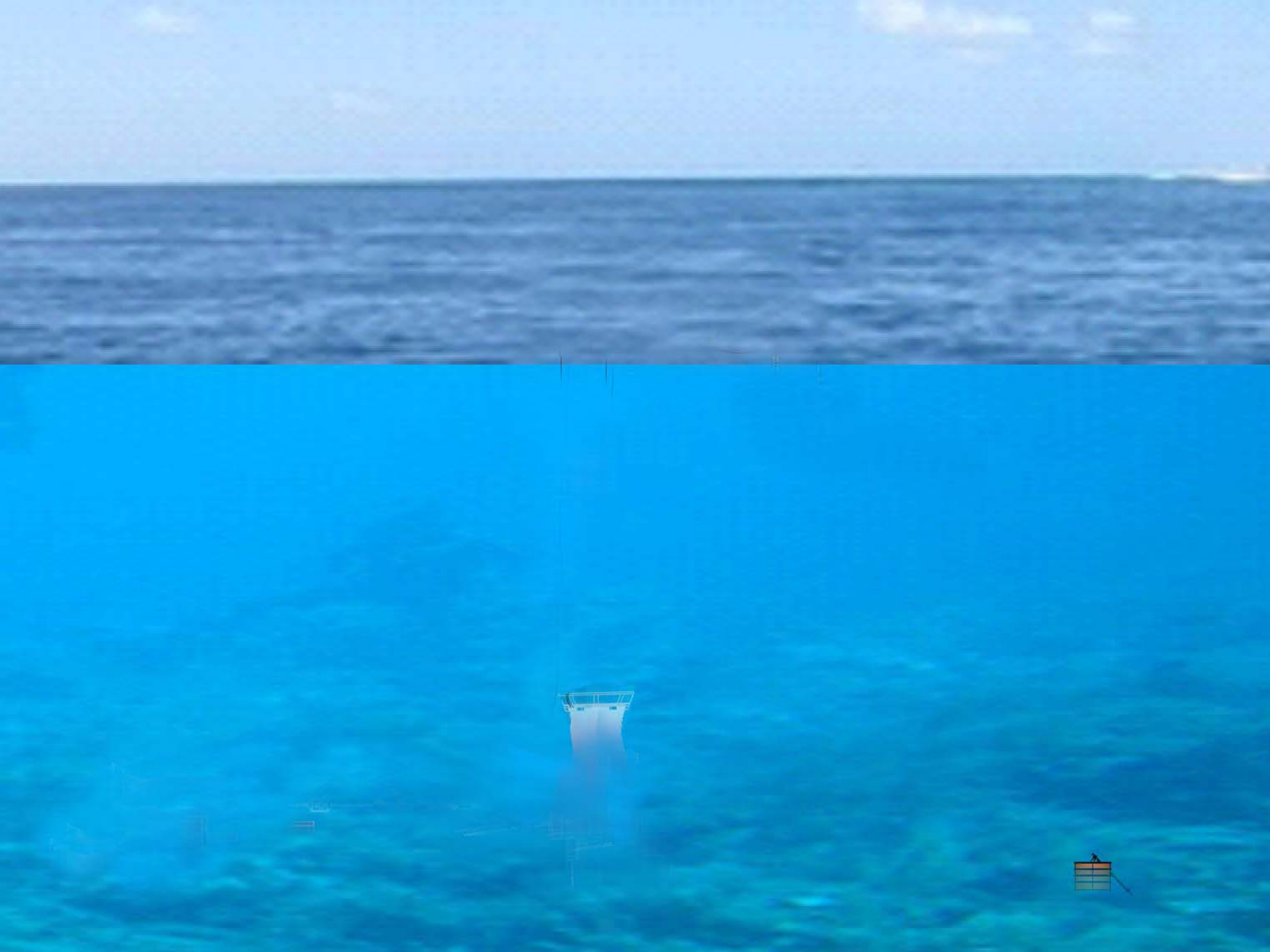

SAGAR KANYA


SAGAR KANYA

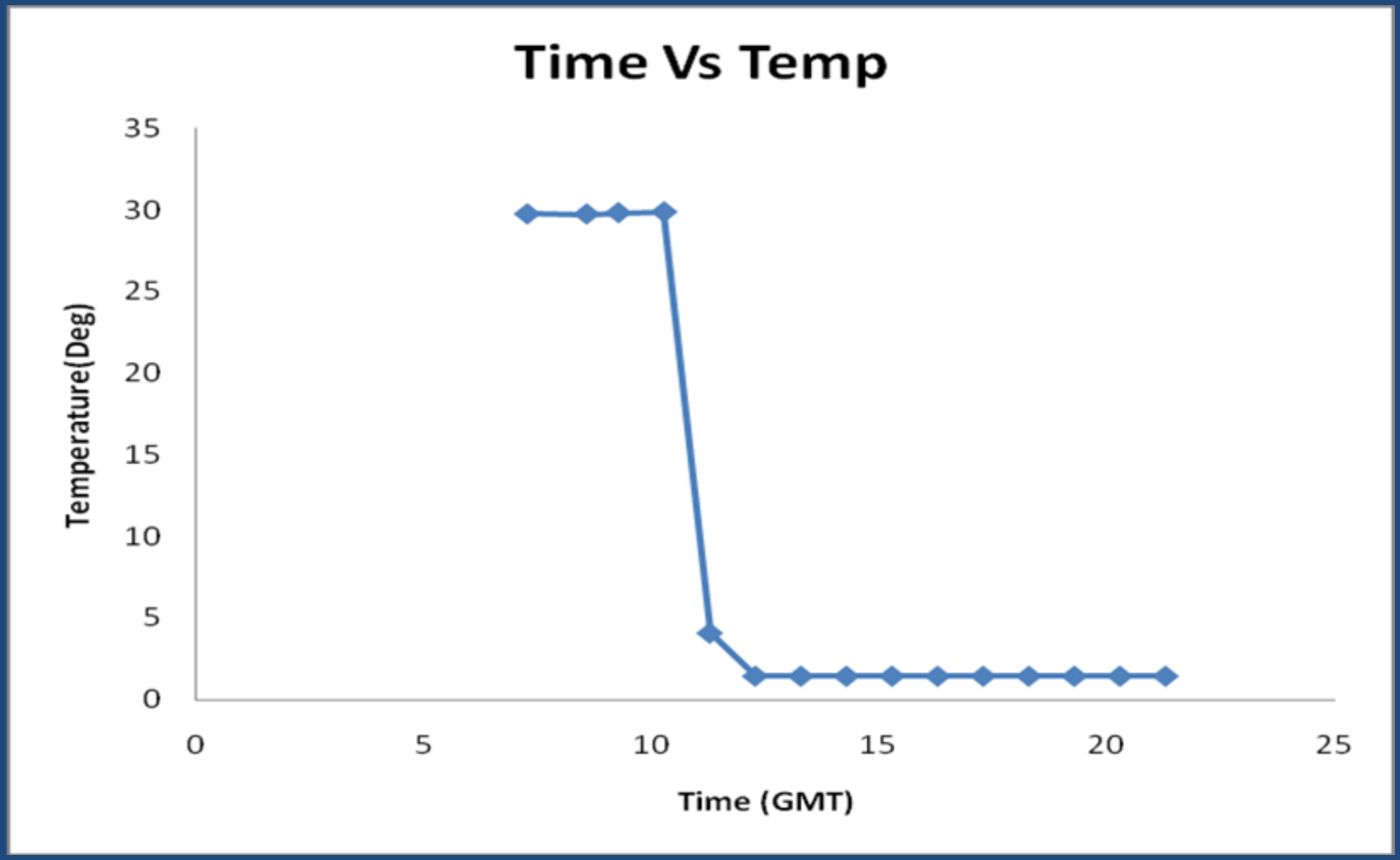



**Thionyl chloride in reaction with water liberates Hydrochloric acid (HCl) and Sulfur dioxide (SO2)**

**These corrosive fumes will cause irritation in skin, eye and mucous membranes and are highly flammable.**



# CT sensor fall as recorded by the TEMPERATURE DATA
# Sea bed 4000m



CT sensor data at 10 m depth.

Observations

Cylinder started descending after 10.28 GMT (ie) Sea Surface Temperature is 29.87° C and settled at 12.28 GMT on seabed. Based on the change in temperature we calculated the speed of descending and listed in the following table.

| Date and Time (GMT) | CONDUCTIVITY | TEMPERATUE (° C) |
|---|---|---|
| 31-03-2012 07:28 | 55.92563 | 29.7502 |
| 31-03-2012 08:28 | 55.91767 | 29.7426 |
| 31-03-2012 09:28 | 56.04985 | 29.8285 |
| 31-03-2012 10:28 | 56.07724 | 29.8719 |
| 31-03-2012 11:28 | 33.15013 | 4.0674 |
| 31-03-2012 12:28 | 31.60266 | 1.4407 |
| 31-03-2012 13:28 | 31.59206 | 1.4362 |
| 31-03-2012 14:28 | 31.5895 | 1.4335 |
| 31-03-2012 15:28 | 31.58882 | 1.4341 |
| 31-03-2012 16:28 | 31.58776 | 1.4324 |
| 31-03-2012 17:28 | 31.58782 | 1.4325 |
| 31-03-2012 18:28 | 31.58776 | 1.4324 |
| 31-03-2012 19:28 | 31.58433 | 1.4325 |
| 31-03-2012 20:28 | 31.57934 | 1.433 |
| 31-03-2012 21:28 | 31.58483 | 1.4331 |

# Fishermen Awareness Programme on Vandalism of Buoys in Kanyakumari & Chennai

*20th anniversary existence of the Association of Deep Sea Going Artisanal Fishermen (ADSGAF) at the Thuthoor village, Kanyakumari from 16th to 20th July 2012.*

The objective was to promote the awareness on Met Ocean buoy and Tsunami buoy against vandalism and the safety measures in dealing with the buoy systems at sea and to promote awareness about the fisherman welfare and technology in fish catching, developing the improvements of fish catching & preservations, Need for Protection of Buoys at sea.

Hon' ble MLA urged fishers to safe guard buoy systems at sea

NIOT participated and presented the importance of buoys and as a response to this, Association of Deep Sea Going Artisanal Fishermen agreed to propagate the awareness among their fellow fishermen in other areas *and protect the buoys against vandalism.*

# 4. PUBLICATIONS

- Journals 6
- Conferences / Seminars 4
- Patent 1

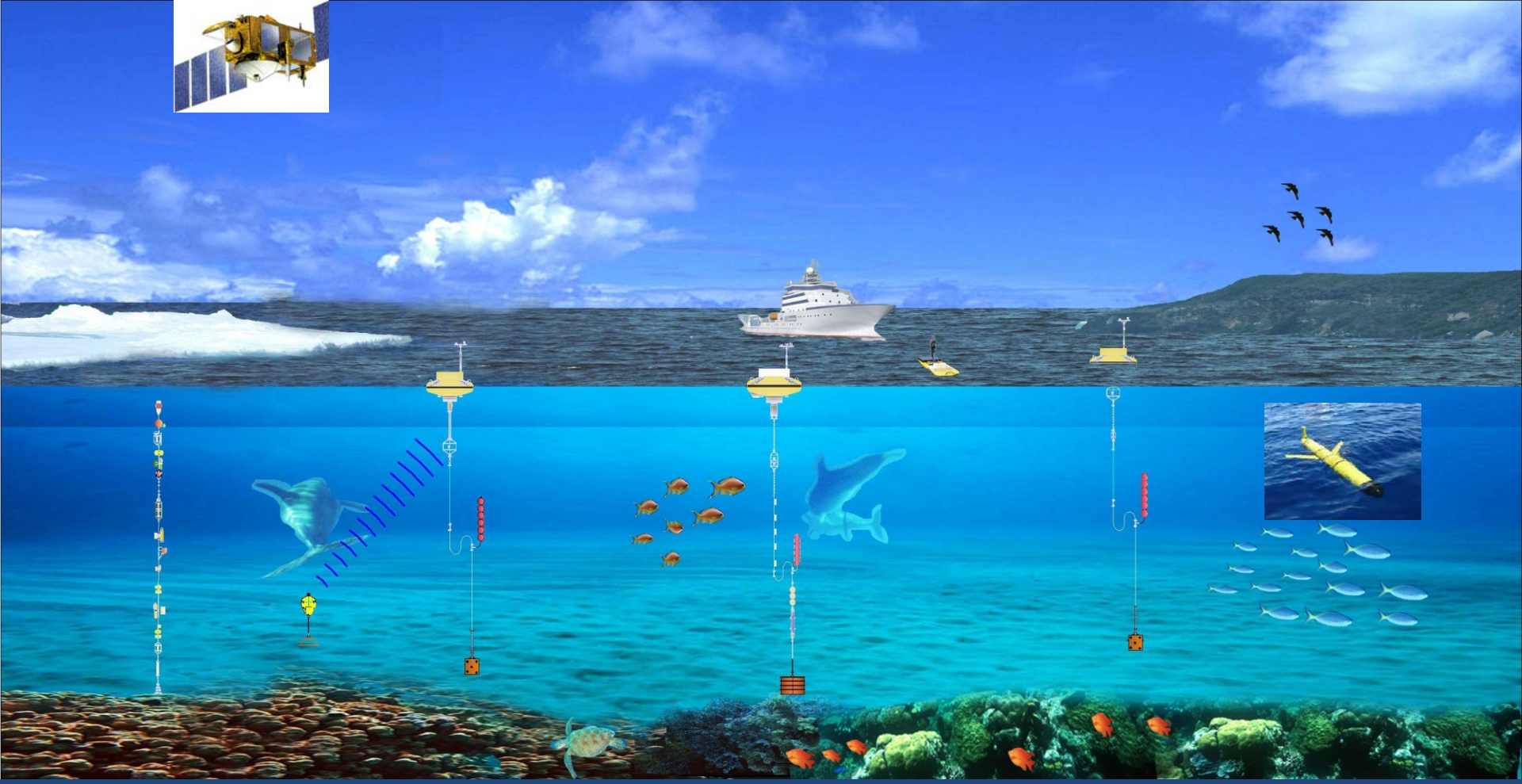
# Future Plans

1. Gliders
2. Indian Arctic Buoy System
3. Coastal BPR - CAL VAL Altimeter data validation
4. Underwater observatory system

# Conclusions

DBCP may note these points

1.Data transmission issues INMARSAT
2.Performance of sensors on moored buoys Humidity, Precipitation, ADCP, DVS
3.CAL VAL Buoy data for Satellite data validation - established CAL VAL for Ocean Color – 4 years
India is launching SARAL Altika - JCOMM-
4.Piracy in Arabian 3 cruises have been undertaken with Armed Guards on board India is supportive to RAMA
5.Vandalism of buoys- Awareness  campaign, Technological solutions
6.Ship time availability – sustainability of observation network
7.Marine Fouling of Sensors - Bio Chemical



Thank you for your attention

dr.r.venkatesan@gmail.com