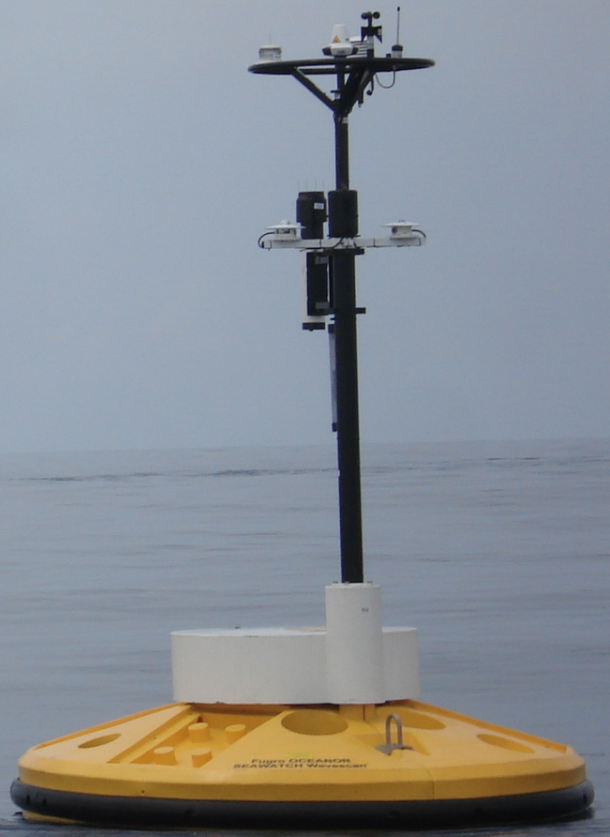
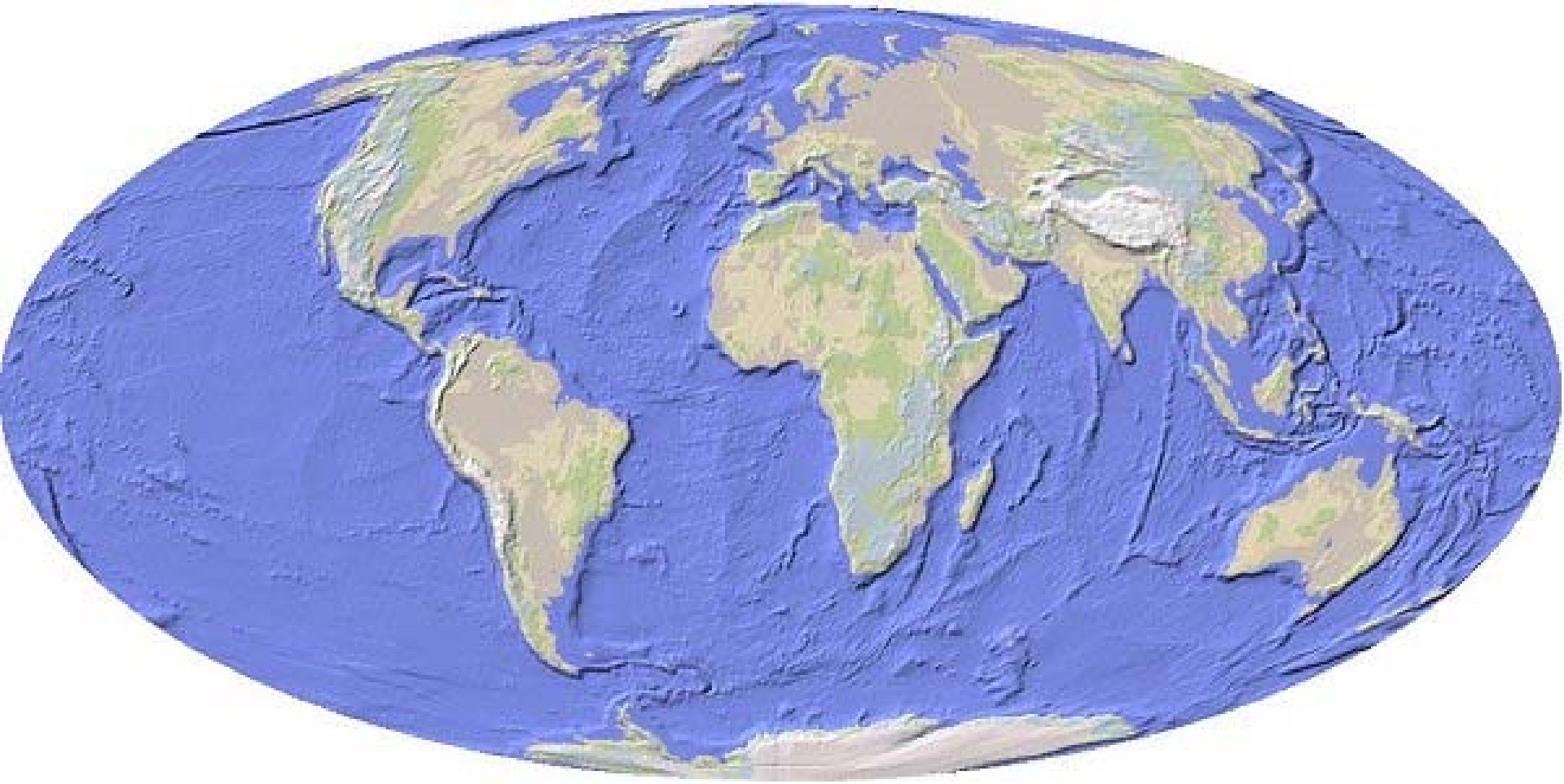
Data Buoy Cooperation Panel DBCP 29



INDIA

R Venkatesan
Ocean Observation Systems
ESSO National Institute of Ocean Technology
Ministry of Earth Sciences
Chennai

SEPTEMBER 2013

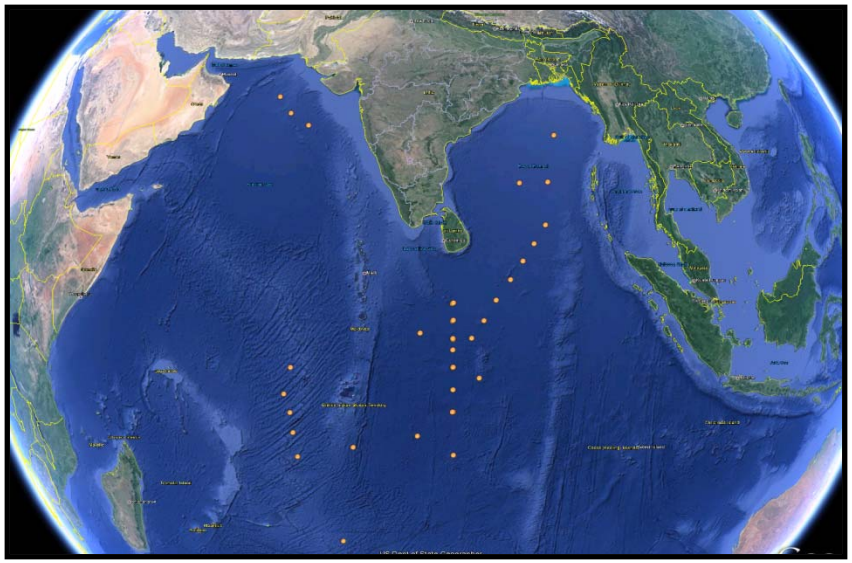


The North Indian Ocean has some very special features:

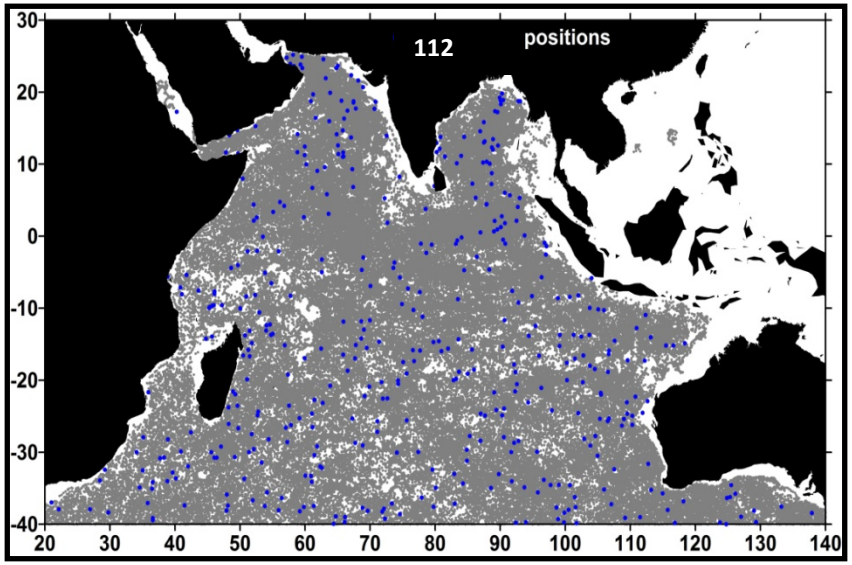
- tropical
- small
- monsoon winds

Argo profiling floats-Current Status

- 43 - Argo floats deployed during July 2012 – July 2013.
- 1-Apex with irridium communication| 33-Arvor | 9-Bio Argo Provor.
- ARVOR and Iridium Apex floats had CTD Sensor
- Bio-Argo: dissolved Oxygen, chlorophyll fluorescence and Optical backscatter and CTD sensor
- The total number of floats deployed by India to 303; of which 112 floats are currently active and providing data in real time.
- At present 705 active floats exist in the Indian Ocean deployed by many countries.



Floats deployed during Jul 2012- July 2013



Active Indian Argos floats positions in the Indian ocean as on July, 2013

Future plan: Deploy 40 Argo float during next one year

20 Standard Argo | 10 Iridium Argo | 10 Bio-Argo

International Argo Programme

Periodic profiles of Temperature and Salinity would enable better understanding of Ocean circulation and enhance Climate predictability

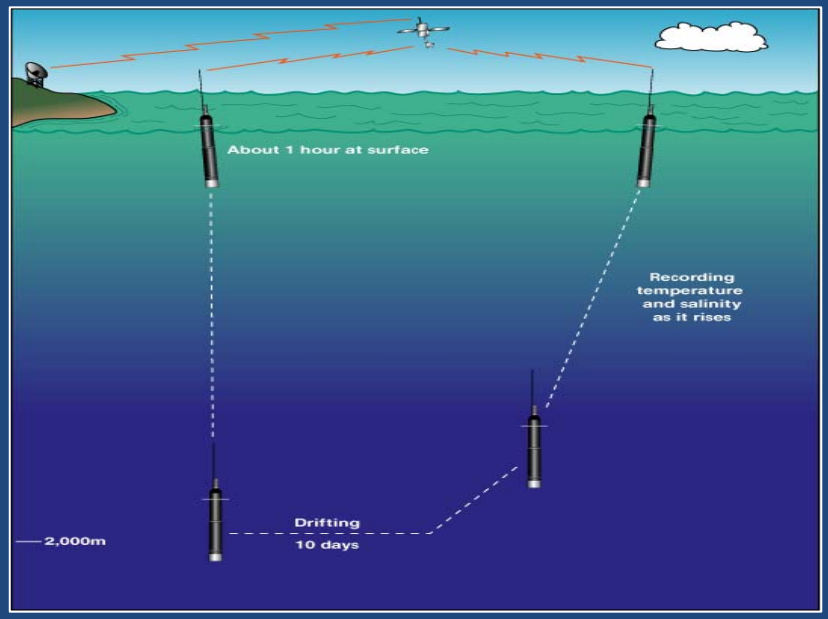
Indian Argo Project

1. Deployment of 150 floats (NIOT)
2. National Data Center
   - Data Reception
   - Processing and Real time QC
3. Data Dissemination
4. Publish Products on WEB
5. Data Analysis
6. Data Assimilation (CAOS)
7. Indigenisation of Floats (NIOT)
8. Capacity Building

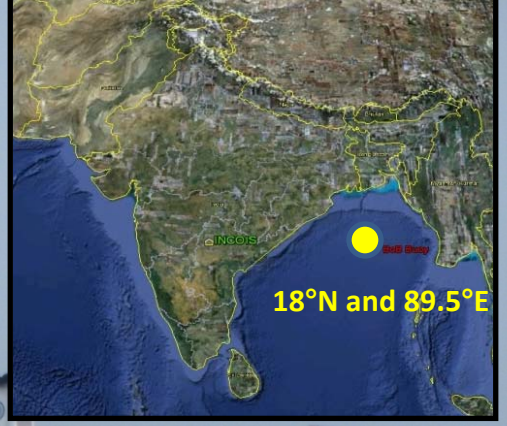
- 3000 Floats in World Ocean by 2004 by 17 Countries
- 450 Floats in Indian Ocean (India: 150 in Indian Ocean)

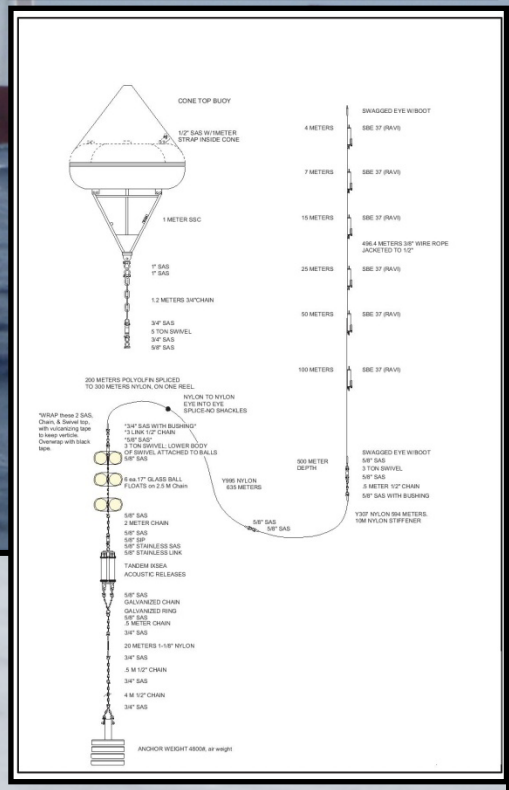
INCOIS role in Indian ocean

1. Regional Co-ordination
2. Regional Data Center
   - Development of North Indian Ocean Hydrology
   - Delayed mode QC



INCOIS- Bay of Bengal Observatory



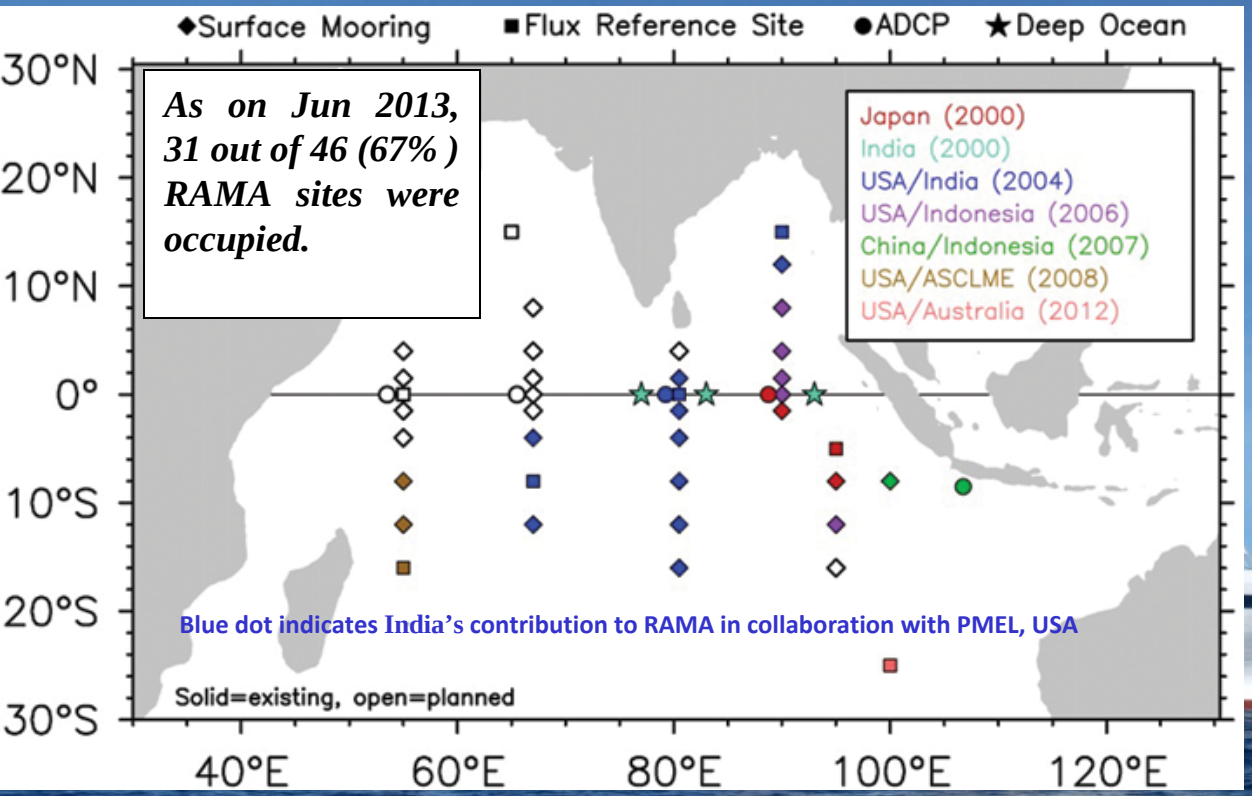


Future plan:

- **Retrieval Phase-III (October 2013)**
- **Deployment of Phase-IV (October 2013)**
  With existing specification

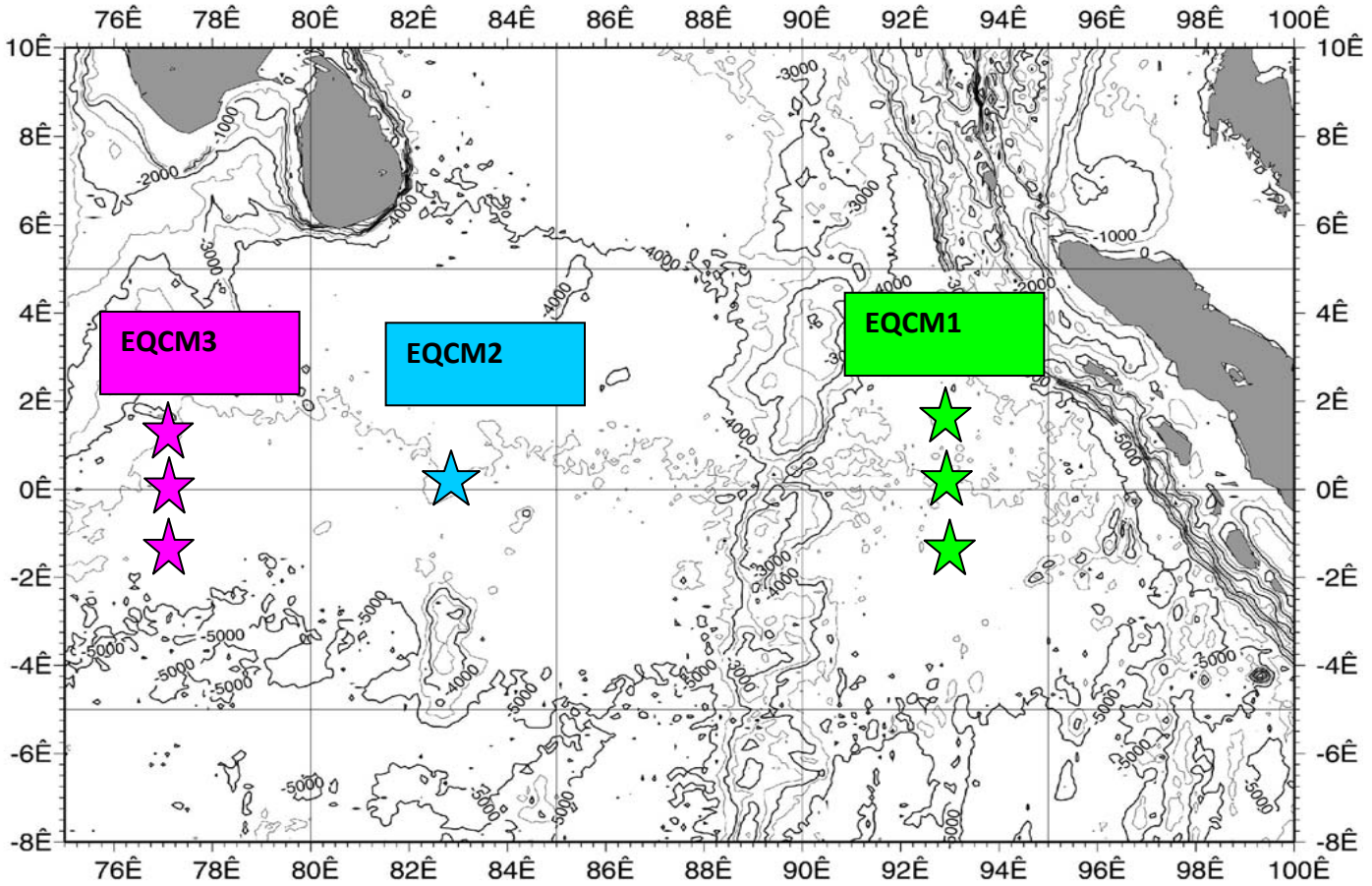
- The primary objective of this mooring is to understand the complex near surface thermohaline structure in the northern Bay of Bengal.

RAMA: Present Status



•During last year 61 operations at 18 RAMA sites were carried out, which includes deployments, recovery and repair of ATLAS, CONE type and ADCP moorings.

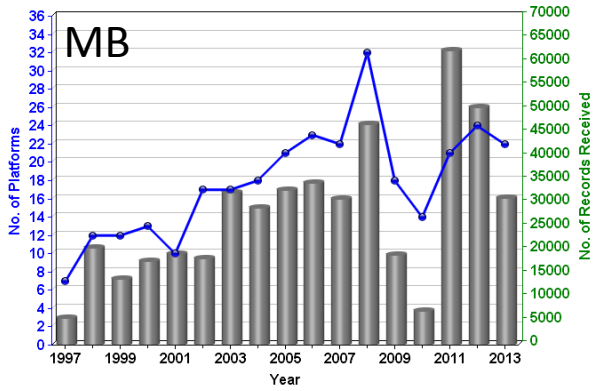
Equatorial Indian Ocean Observational Array since 2000

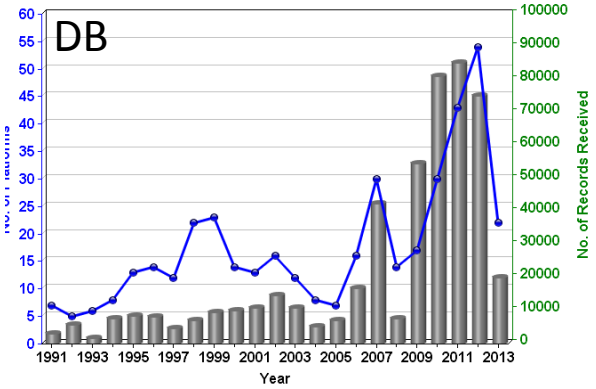


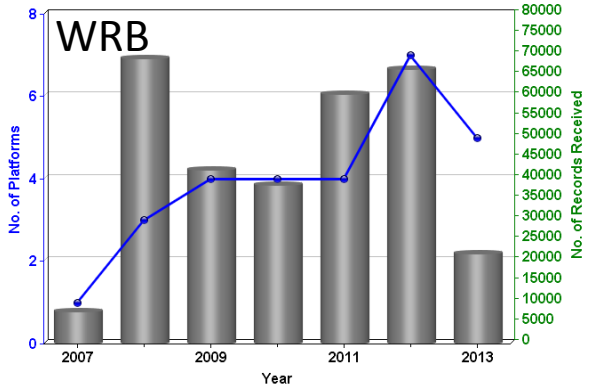
The current meter moorings project is being executed since February 2000. Servicing of the moorings is being done regularly onboard *ORV Sagar Kanya and occasionally onboard Sagar Nidhi. The program is Extended till 2017.*

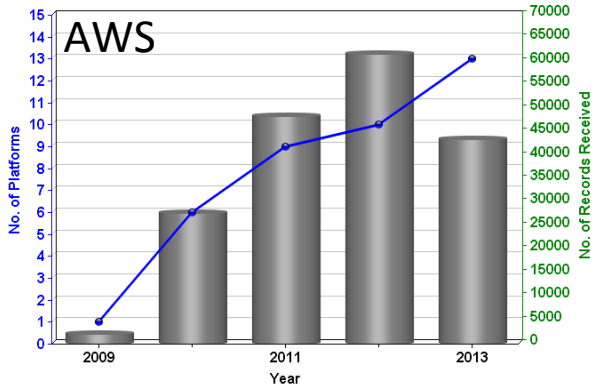
Data Received in Real-time
(April 2012 – July 2013)

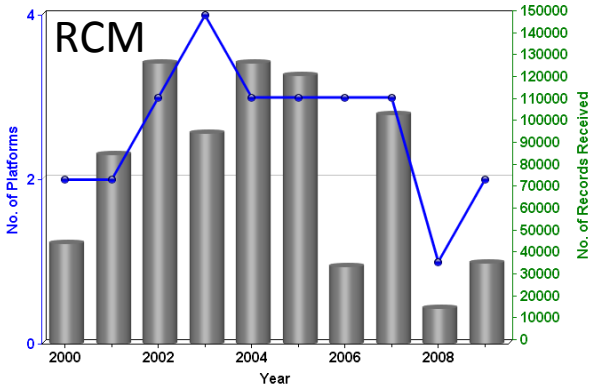
Programme (Institute)	Parameters	No. of Platforms / Stations Reported
Argo Floats	T & S Profiles	39356 profiles
Moored buoys	Surface met-ocean parameters	26 buoys
Drifting buoys	Surface met-ocean parameters	51 buoys
Ship-mounted AWS	Met parameters	15 ships
Wave rider buoys	Wave parameters	11 stations
Wave Height Meter onboard Ship	Wave Parameters	1 ship
HF RADAR	Currents	5 pairs of stations
RAMA buoys (PMEL)	Surface met-ocean parameters	21 buoys

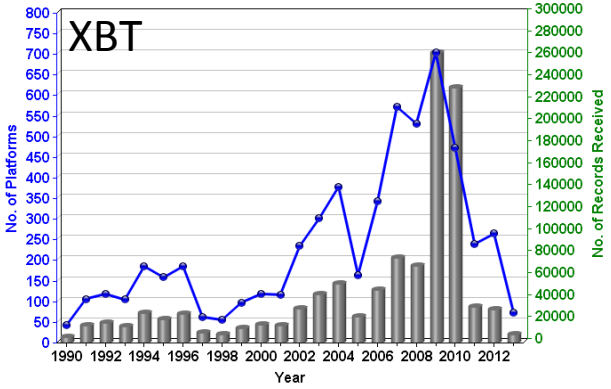


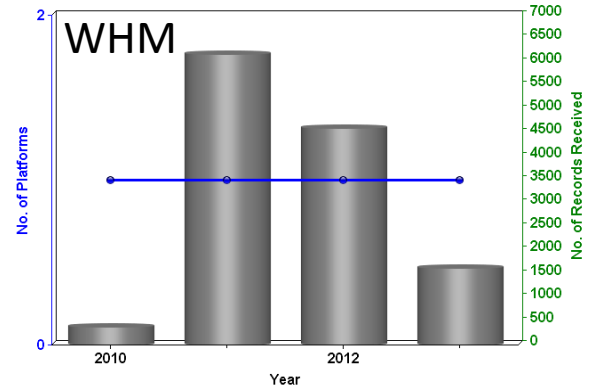


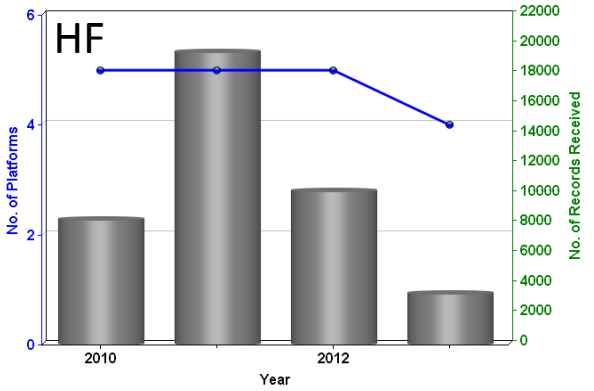


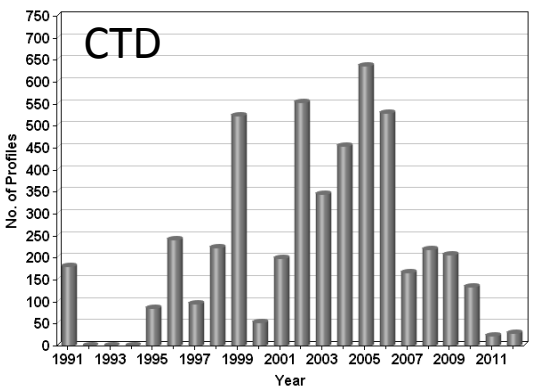








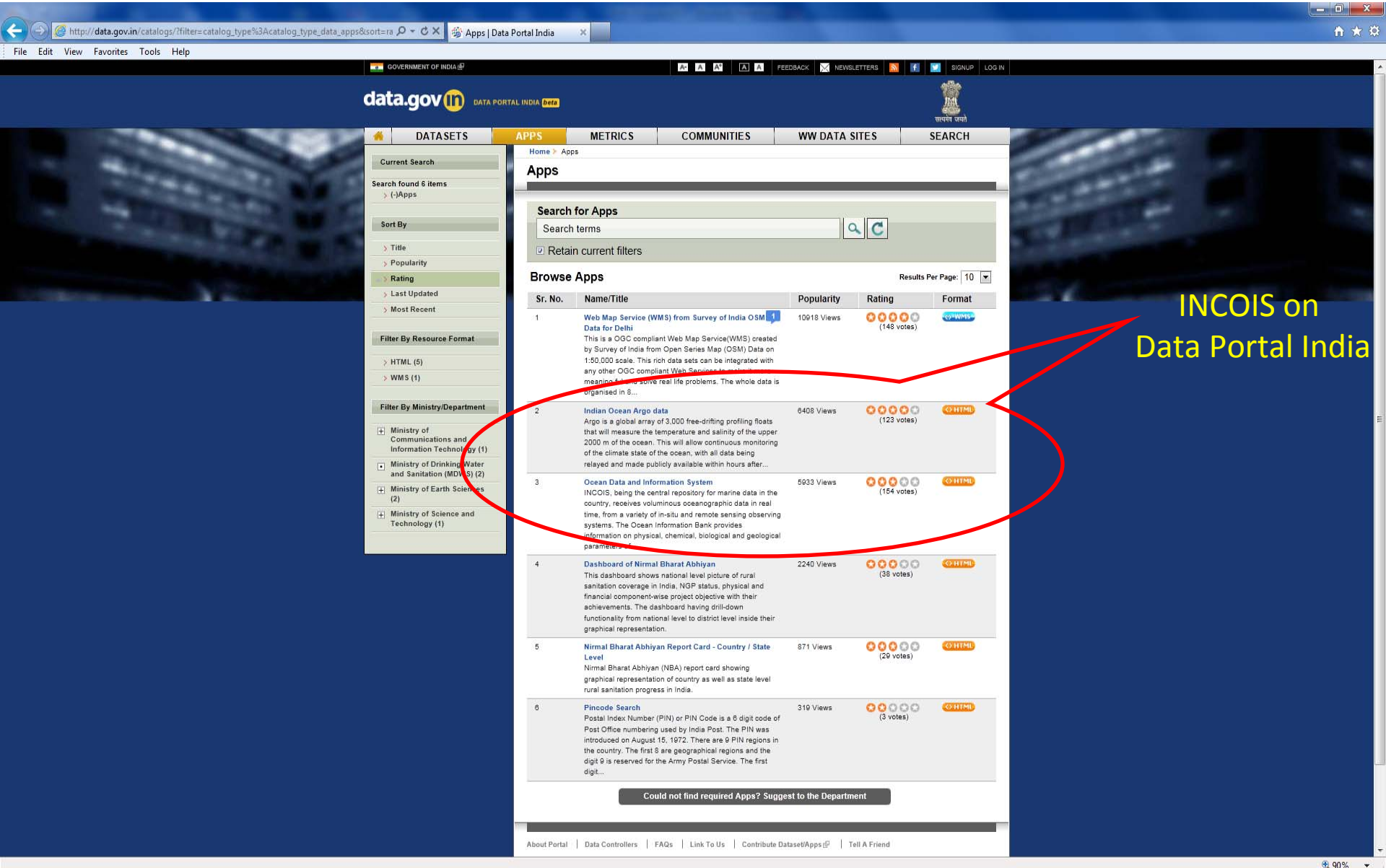




Data Growth from Different Platforms

Data Portal India

INCOIS Data Services were prominently listed on the Data Portal India



Digital Ocean – One stop shop for heterogeneous products of Indian Ocean

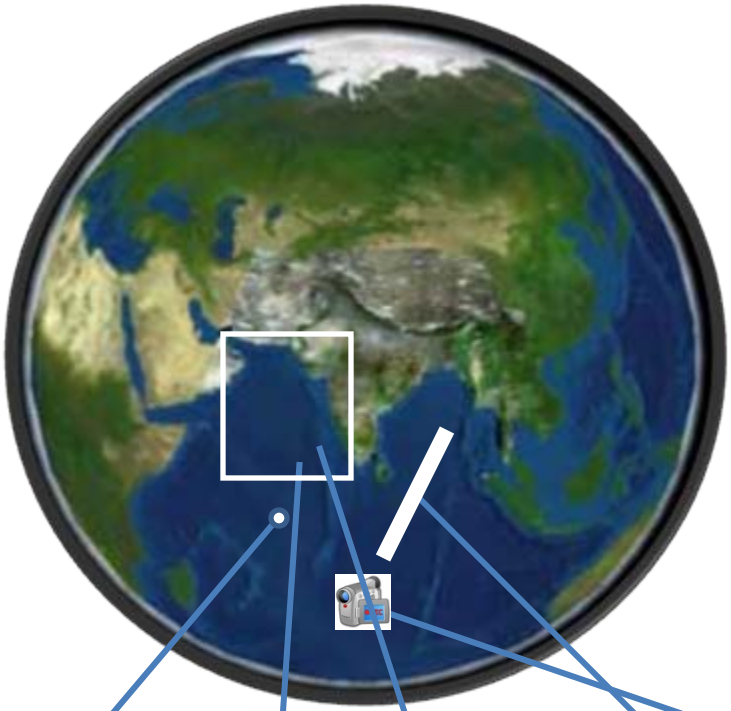
Data Sets:

Time series data
- CTD, Argo, XBT etc.

Spatial Data
- Remote sensing

Model outputs
- MOM,ROMS, WWIII etc.

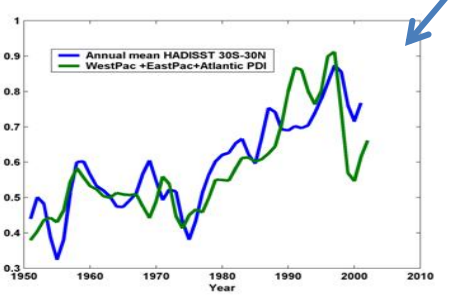
Videos
- Underwater surveillance



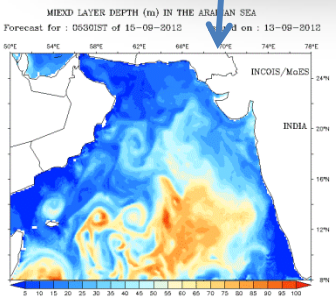
Functionalities:
On the fly visualization (3D/4D)
Spatial and Temporal sub-setting,
Format conversion,
Draping
Comparison
Online validation,
Downloads
Data Formats: ASCII, NetCDF HDF, GeoTiff, Binary

EoI is being finalised

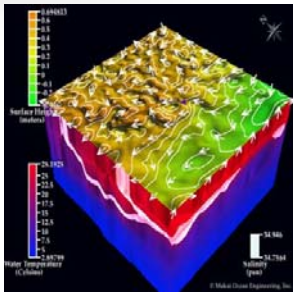
Videos



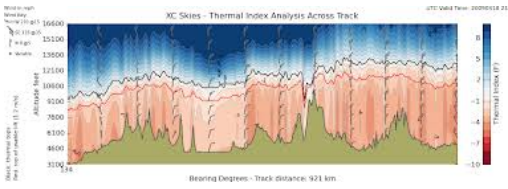
Time series



Animations

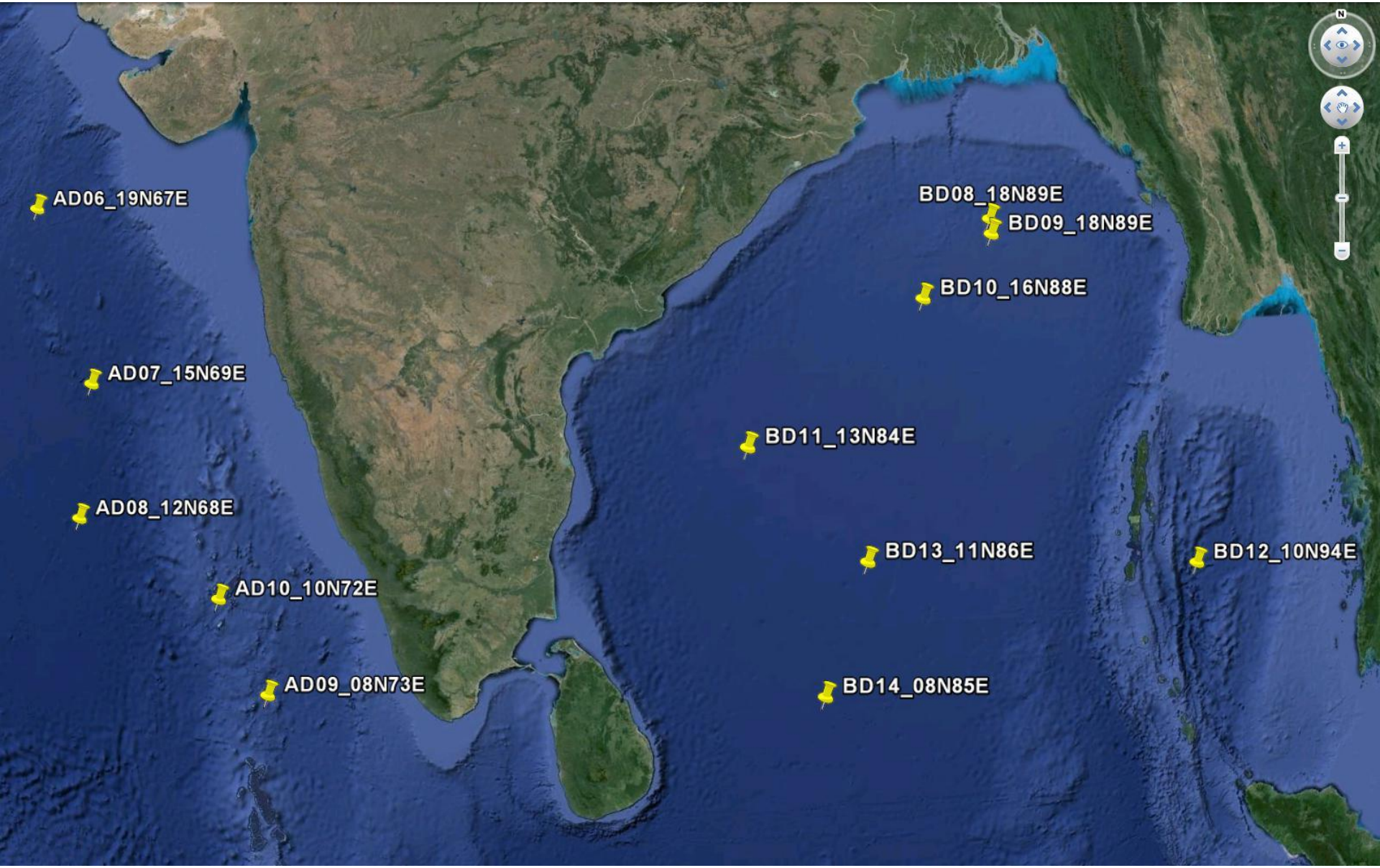


3D/4D Visualisation

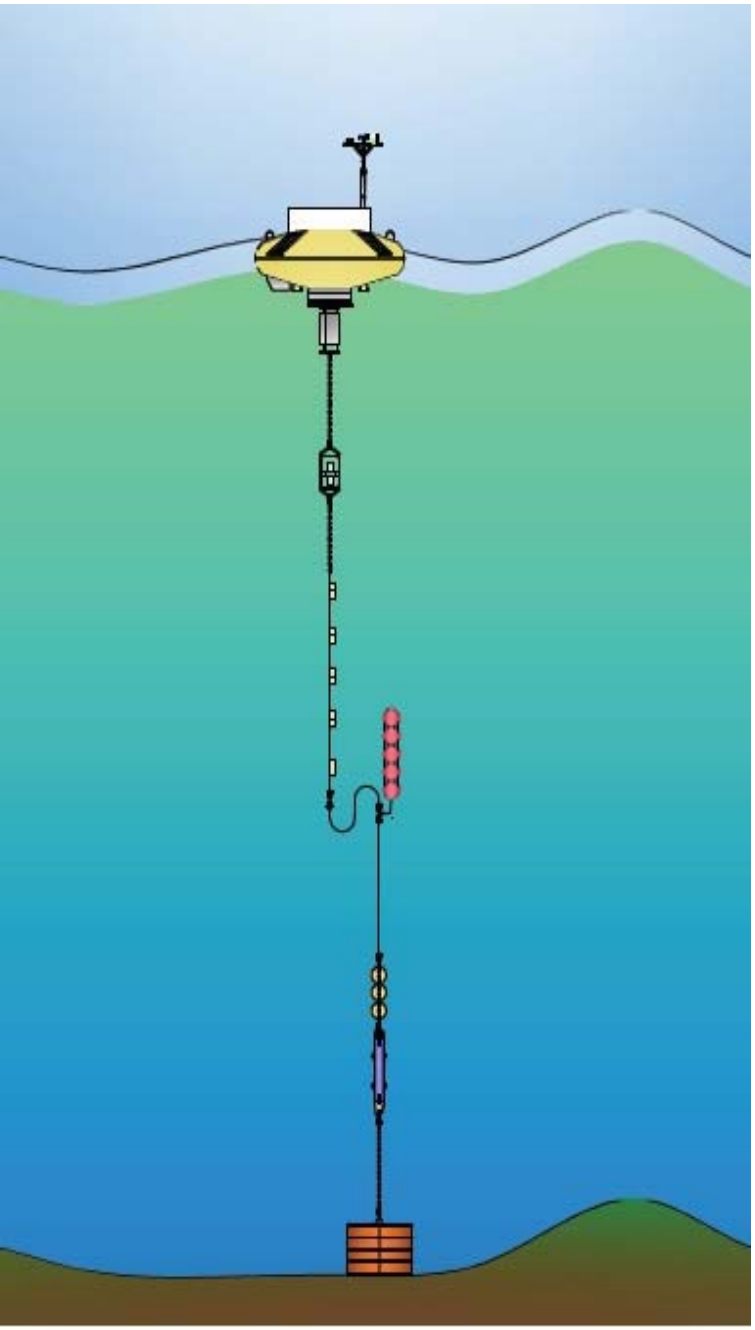


Cross Sections

Moored Buoy Network


AD06_19N67E
BD08_18N89E
BD09_18N89E
BD10_16N88E
AD07_15N69E
BD11_13N84E
AD08_12N68E
BD13_11N86E
BD12_10N94E
AD10_10N72E
AD09_08N73E
BD14_08N85E

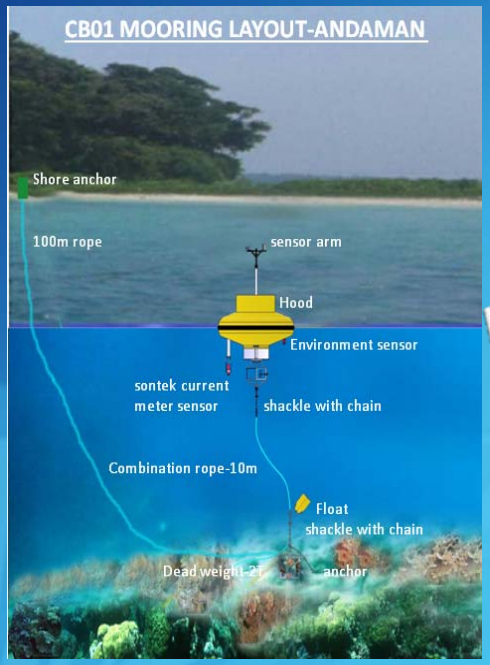
National Expert committee on moored Buoys

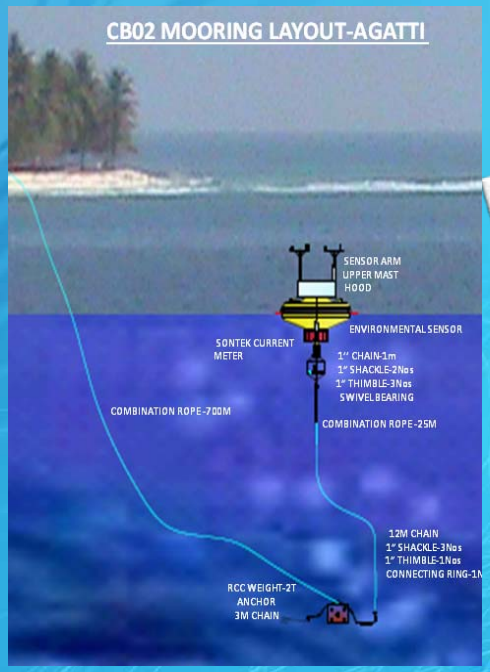


OMNI Moored BUOY

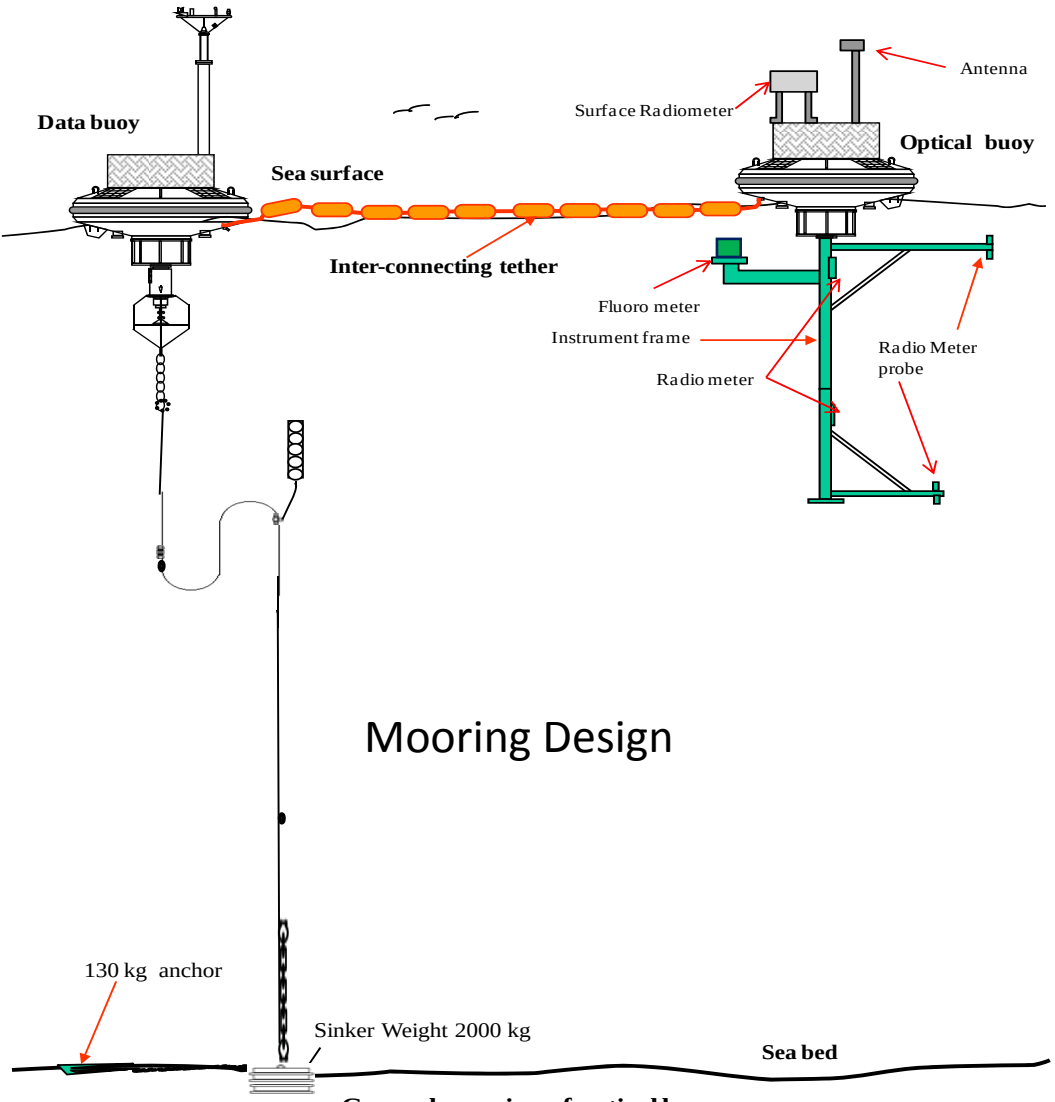
- **Surface meteorological**
  - Wind speed and direction
  - Air temperature
  - Air pressure
  - Humidity
  - Short wave radiation
  - Incoming long wave radiation
  - Precipitation
- **surface Ocean parameters**
  - Sea surface temperature
  - Conductivity
  - Wave
  - Current speed and direction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

Coastal B


CB01 MOORING LAYOUT-ANDAMAN
Shore anchor
100m rope
sensor arm
Hood
Environment sensor
sontek current
meter sensor
shackle with chain
Combination rope-10m
Float
shackle with chain
Dead weight-2T
anchor


CB02 MOORING LAYOUT-AGATTI
SENSOR ARM
UPPER MAST
HOOD
ENVIRONMENTAL SENSOR
SONTEK CURRENT
METER
1" CHAIN-1m
1" SHACKLE-2Nos
1" THIMBLE-3Nos
SWIVEL BEARING
COMBINATION ROPE-700M
COMBINATION ROPE-25M
12M CHAIN
1" SHACKLE-3Nos
1" THIMBLE-1Nos
CONNECTING RING-1N
RCC WEIGHT-2T
ANCHOR
3M CHAIN

Calval Buoy



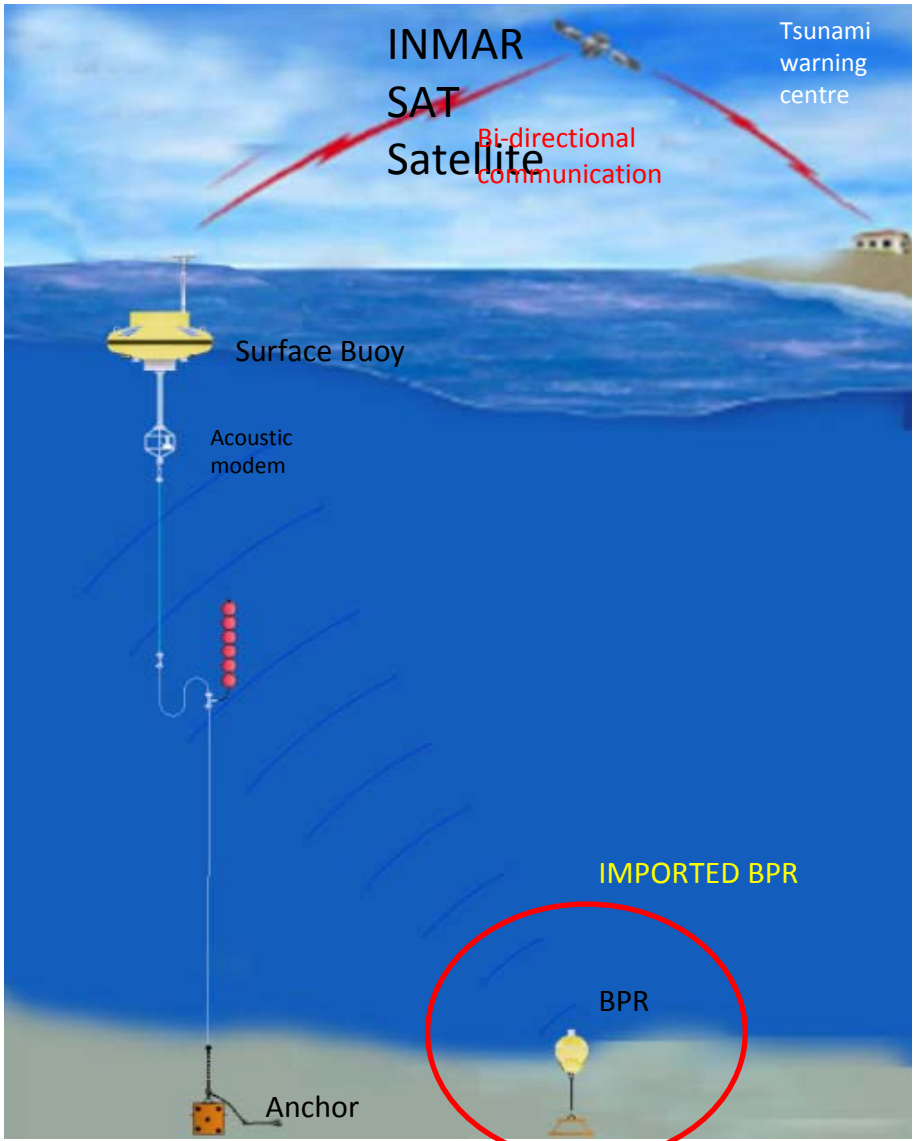
Mooring Design

General mooring of optical buoy With meteorological buoy

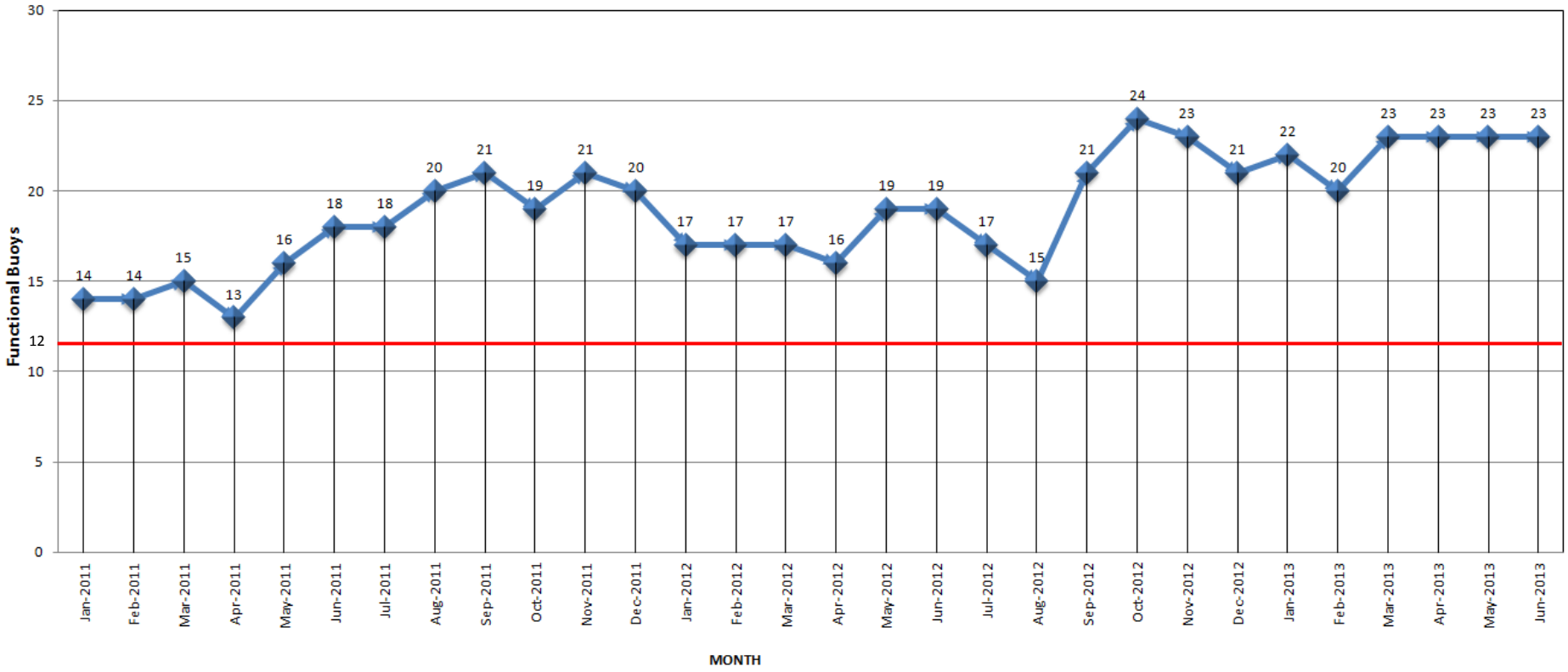
- Inverse catenary mooring for Met – Ocean buoy.
- Tether to connect Optical buoy

Tsunami Buoy

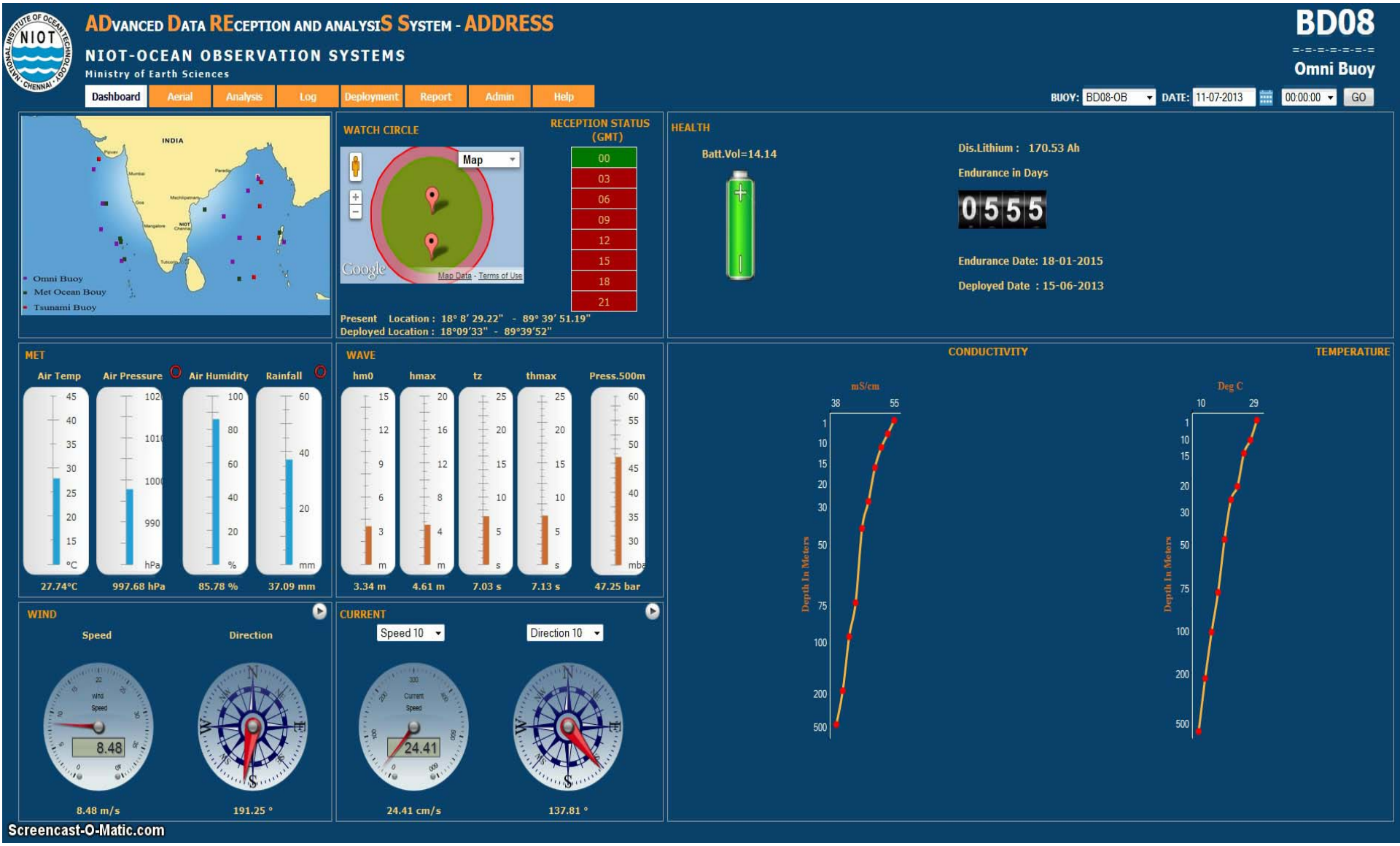
- Ocean Observation System, NIOT. took up the tsunami project based on the experience of establishment of Data Buoy Systems with deep sea mooring and satellite communication link to shore station after 2004 tsunami.
- Experience of working with diversified Bottom Pressure Recorder (BPR)
  - ✓ Sonardyne UK,
  - ✓ Envirtech Italy,
  - ✓ Fugro Oceanor Norway
  - ✓ DART System of SAIC USA.
- Experience nearly 80 operations since 2006
- Many issue faced in imported BPR nearly 10 firmware updations.
- 5 buoys are working



Functional Buoys Status from Jan 2011 – Jul 2013

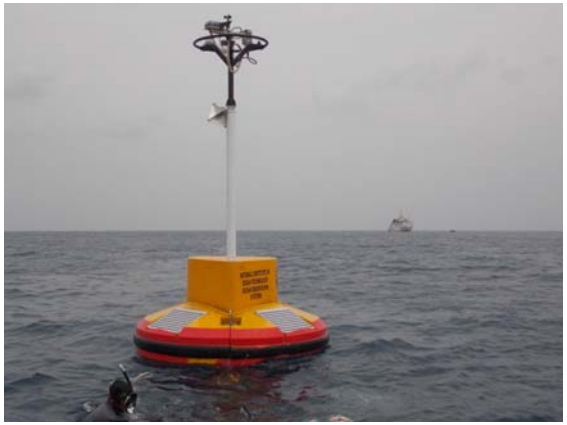


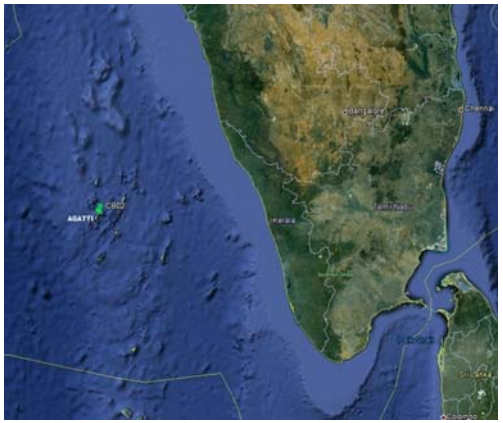
Data Monitoring and Management Tool for Data Buoys

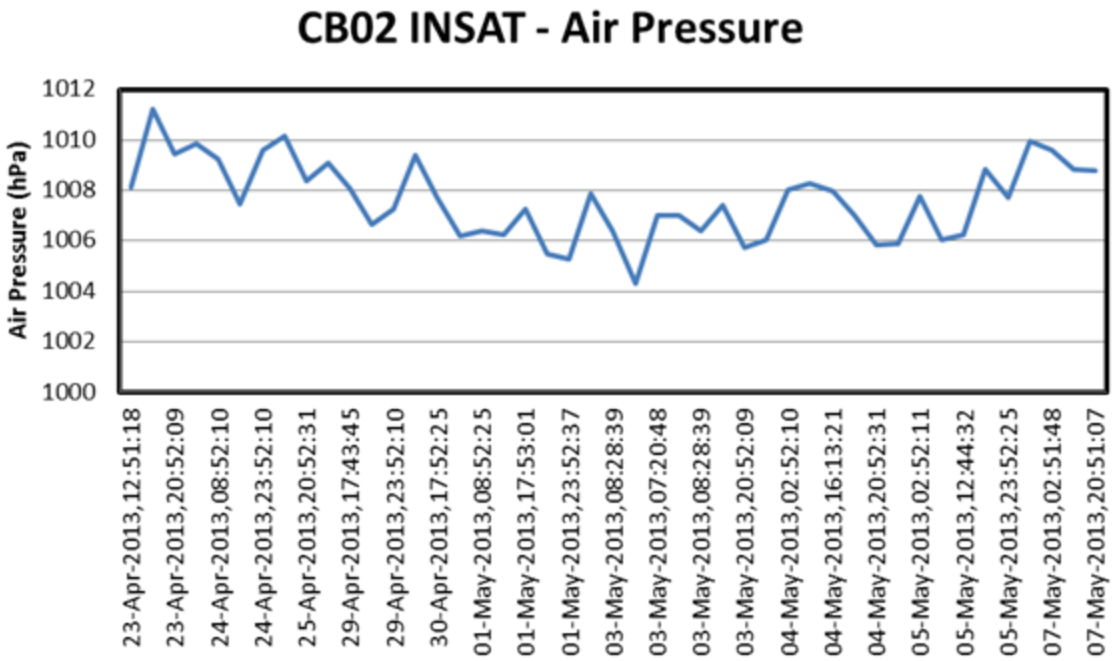


INDIAN SATELLITTE
IDAS INSAT

- IDAS Met Ocean buoy interfaced with INSAT communication
- Buoy deployed in ocean and working satisfactorily.







Indigenenous Buoy Data Acquisition System (I-DAS)

I –DAS Met Ocean

I–DAS Wave

I –DAS OMNI & I-DAS INSAT being developed

I –DAS Tsunami

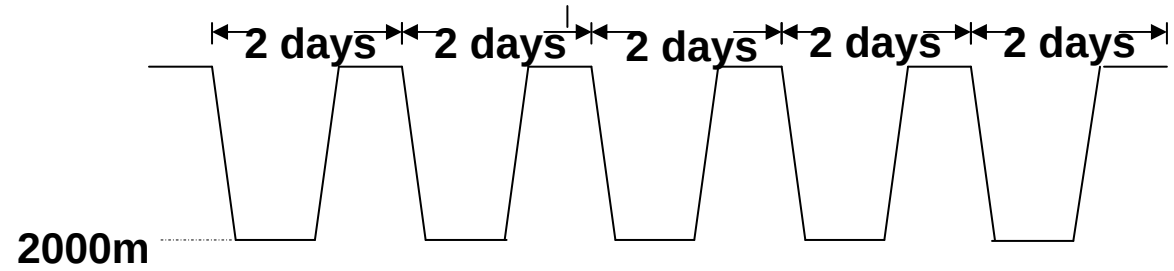
- The I-DAS system had successfully worked more than 3 years
- I-Das Wave buoy successfully deployed completed six months in deep sea at Bay of Bengal and in operational
- I-Das wave algorithm project is in progress
- I-DAS Tsunami deployed August 2011 successfully and in operational

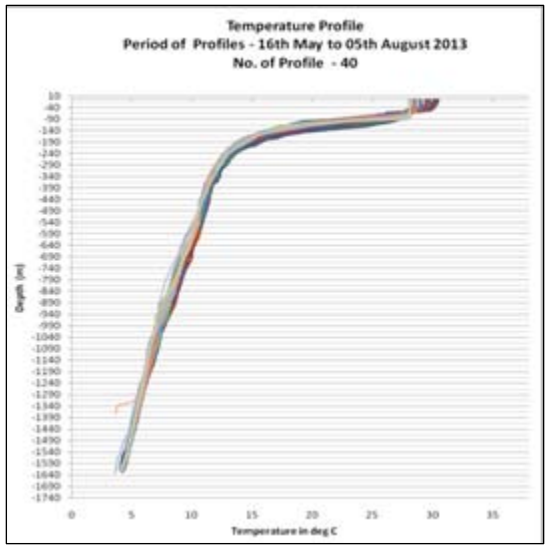
Indian float and Drifter buoy

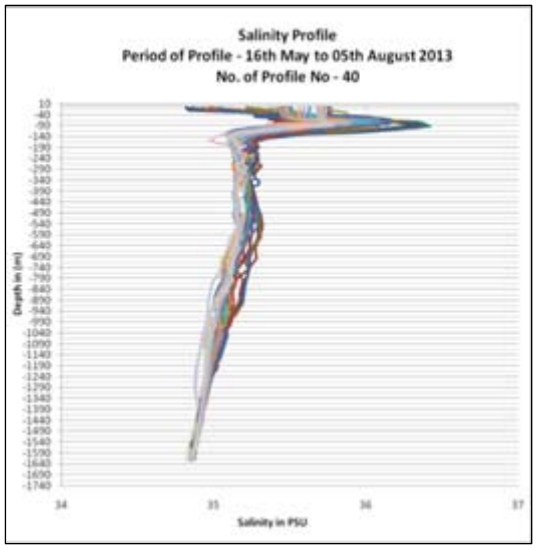
Trial Production of Autonomous under water profiling drifter (AUPD)

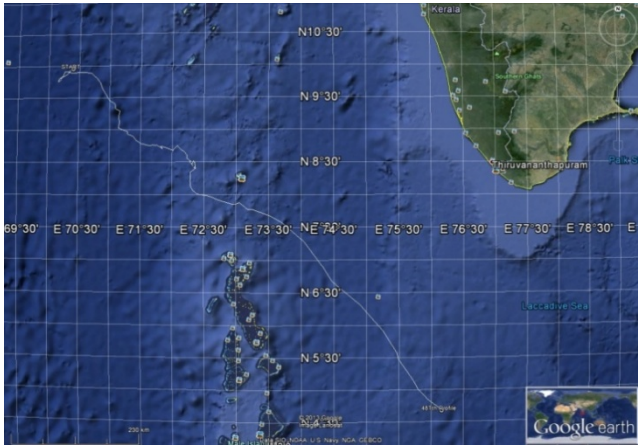
- The first Industry developed system was deployed on 12.5.13 and it has been functioning satisfactorily.
- The profile depth is about 1620 m and profile interval is 48 hours.

Completed more than 100 days of sea trials







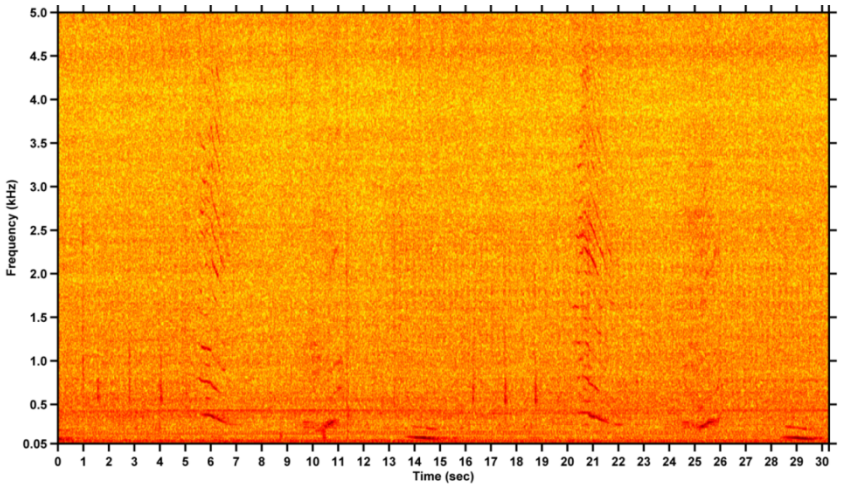


Ambient Noise buoy and research findings

An autonomous system for time series measurement of ocean ambient noise has been developed , deployed and successfully operated for 4 months in the sea. The system withstood severe cyclonic events .

•Noise made by various species of mammals and fishes have been identified. Noise made by Humpback whale is shown here.

Audio

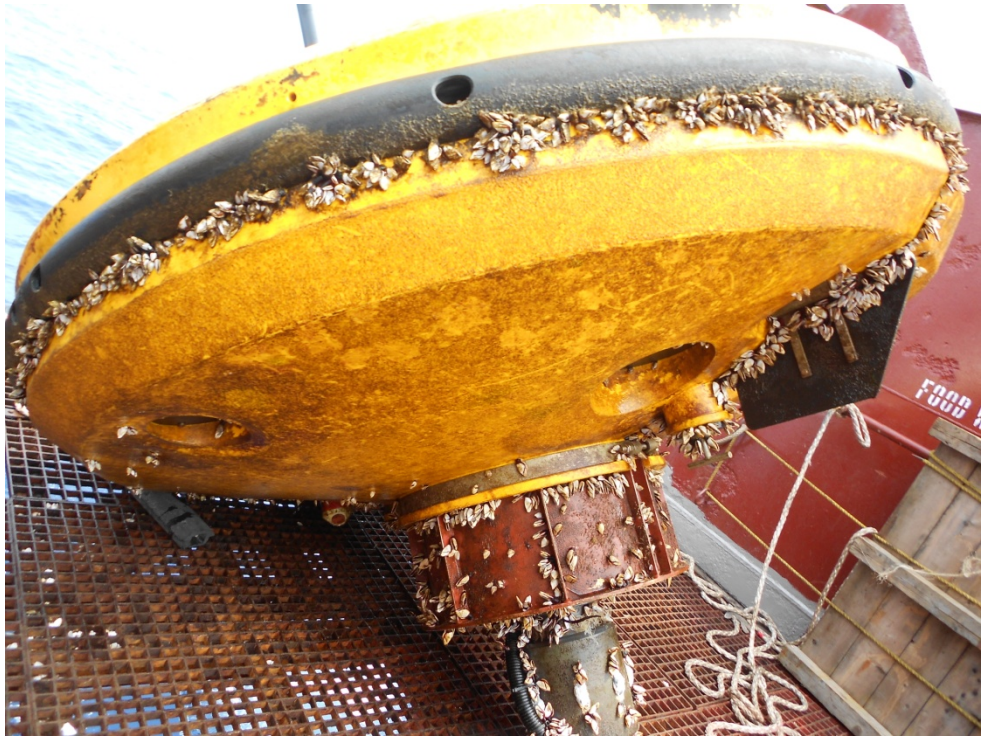


Time/frequency spectrogram of Humpback whale

Challenges

- Vandalism
- Piracy
- Biofouling
- Inventory
- INMARSAT
  - Expensive
  - high power consumption
  - SATCOM

MARINE GROWTH

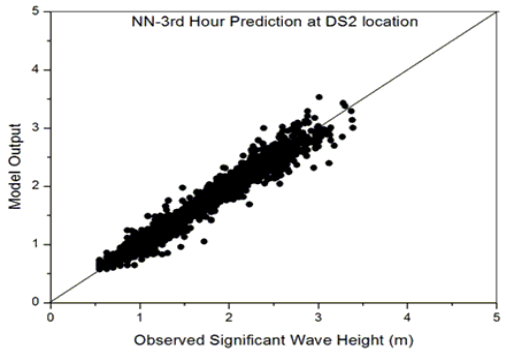


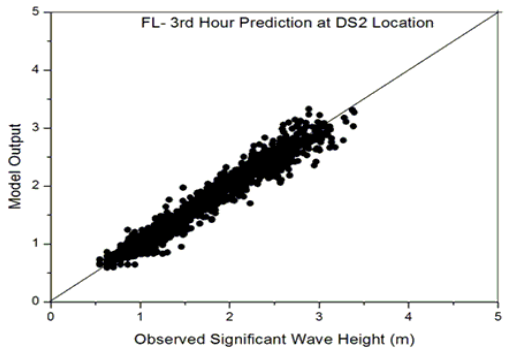
Marine Growth on ADCP

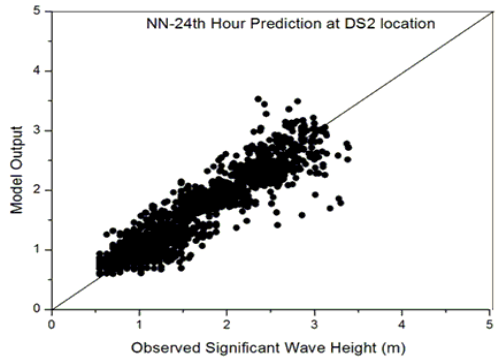
Buoy ID : BD 08

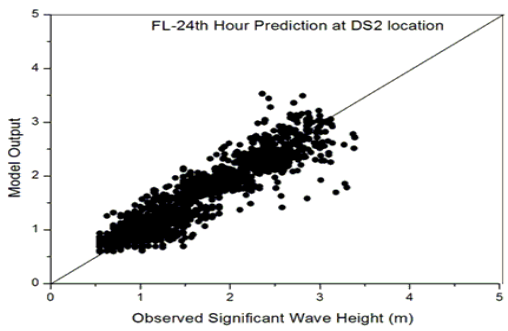
- Observed SST variability in the Eastern Arabian Sea and Bay of Bengal
- Wave Forecasting using Artificial Neural Network
- Wave forecasting in Arabian sea using Adaptive Network Fuzzy Inference System
- Wave Hind casting using Artificial Neural Network with varying Input Parameters

Scatter plot of Observed Hs and model predicted Hs at DS2 Locations









Error Statistics

Buoy ID	Statistics	03rdhr		06thhr		12thhr		24thhr	
		ANFIS	ANN	ANFIS	ANN	ANFIS	ANN	ANFIS	ANN
DS2	Correlation Coefficient	0.99	0.99	0.98	0.98	0.97	0.97	0.95	0.95
	RMSE (m)	0.011	0.009	0.016	0.016	0.026	0.000	0.041	0.038
	MAE (m)	0.000	0.001	0.001	0.002	0.001	0.000	0.005	0.002

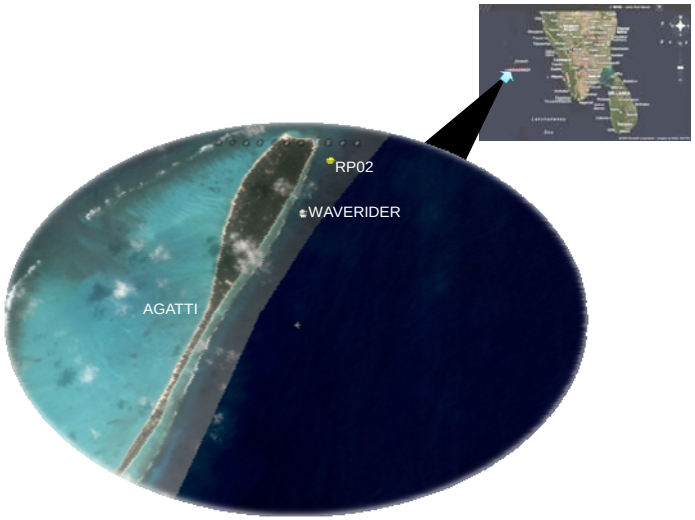
Inter-comparison of buoys

•An Inter comparison of wave parameters between NIOT Wave Buoy (Kongsberg MRU 4) and Datawell wave rider buoys has been carried out.

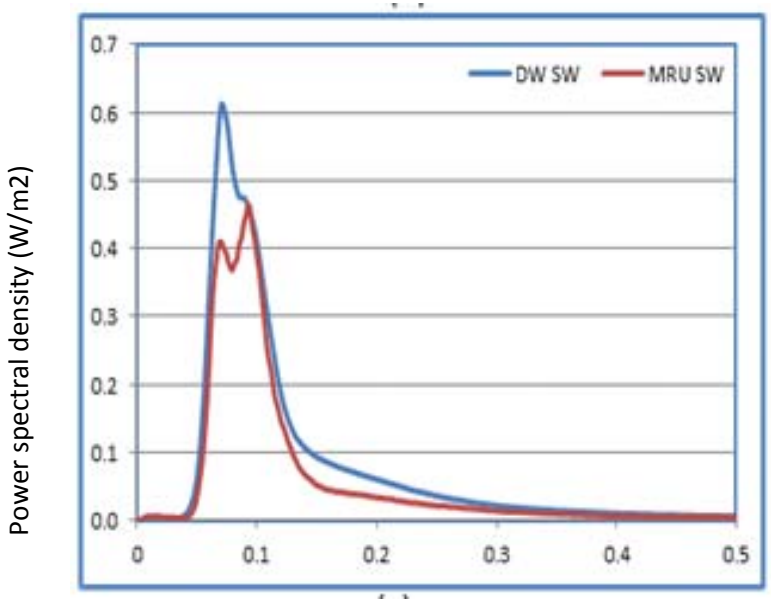
Buoys deployed

•Data buoy with Kongsberg make MRU 4

•Wave rider buoy Datawell – Accelerometer based



NIOT Buoy : Lat: 10° 87.836′ N. Lon: 72° 21.582′ E
Datawell Buoy : Lat: 10° 51.792′ N. Lon: 72° 12.253′ E
Depth : 20 m



Capacity Building Exercises at Ocean Observation Systems,NIOT

Regional Workshop on Best Practices for instruments and Methods of Ocean Observation from 19th – 21st November 2012.

National Training for Data Collection in the Ocean by Seabird Electronics and WET Labs from 22nd – 27th November 2012.

Pacific Marine Environmental Laboratory. Under MoU between MOES – NOAA

•On-board training for OOS Staff(July-August 2011)

•Training at Pacific Marine Environmental Laboratory,USAmfrom 3r to 10 October 2011

•Proposed Training at PMEL USA 5 to 14 August 2013)

Training on Buoy assembly maintenance at Fugro Oceanor , Norway from 11th 13th July 2012.
Discussion with JAMSTEC Japan on Buoy maintenance

Regional Workshop on Best Practices for instruments and Methods of Ocean Observation

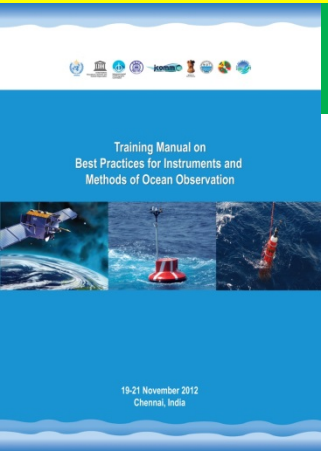
Objective: Capacity building of scientists, researchers, engineers and managers on best of practices on calibration and testing instruments for ocean observation systems

Date : 19th– 21st November 2012

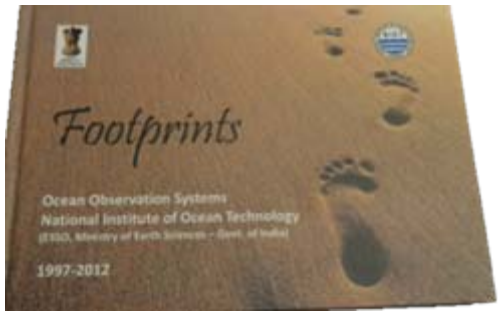
Participant Countries: 19, Number of Industries: 26, Number of presentations : 33

Hands on Demo - 9 stalls

Number of attendees: 120



Release of Training manual and Foot Print



National Training for Data Collection in the Ocean by Seabird Electronics, WET Labs USA

Objective: To provide knowledge on the advanced observational techniques with sensors and use different standards and protocols for collecting, archiving, and assimilating high quality data and thus monitoring and processing the collected data of the global oceans

Date: 22nd - 27th November 2012

Total number of participants: 47

Release of E-Training material

Number of lectures: 40

Number of modules covered: 18

S.No	Participated Organisations
1	NCAOR
2	INCOIS
3	ICMAM
4	NIO,Goa
5	NPOL
6	Annamalai University
7	Hach India
8	Norinco (p) ltd.
9	Eurotech Systems
10	OOS,OA,OE,CEE, MBT,ROSUB of NIOT

Lecture by Science Director, Seabird electronics Inc.

Visit of OOS staffs at National Oceanic and Atmospheric Administration-Pacific Marine Environmental Laboratory(NOAA-PMEL) and National Data Buoy Center (NOAA-NDBC) from 5th August 2013 to 14th August 2013

Objective: Familiarization of instruments used in the array of RAMA,DART,TAO buoy programme

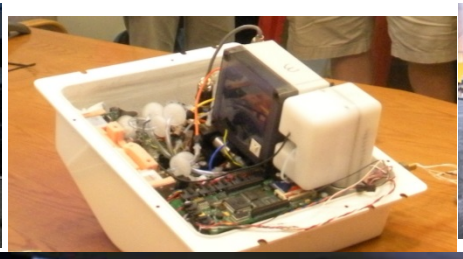
Number of Participants: 3

Topics discussed at PMEL

- pCo_2 Sensors
- Wave Glider
- New methods of Tsunami Detection
- Development/modification in electronics and sensors
- Data comparison exercise

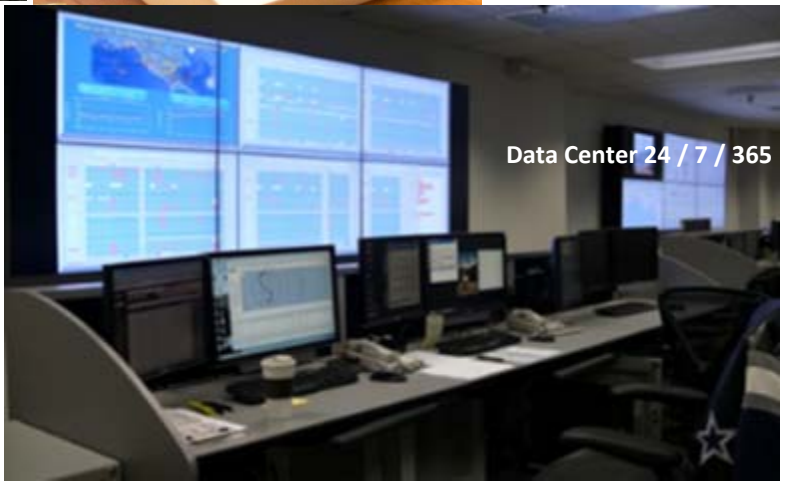
Topics discussed at NDBC

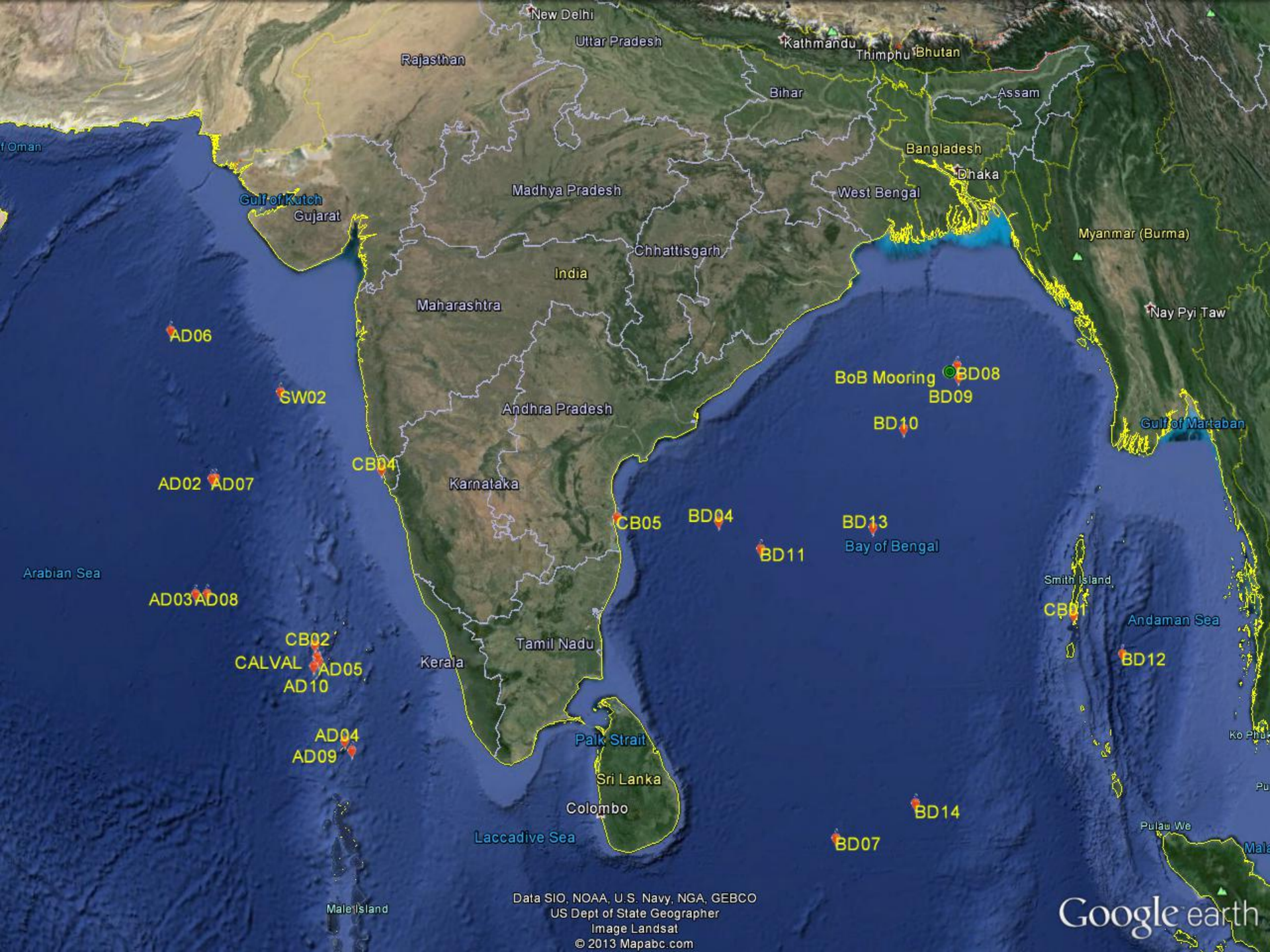
- Camera buoy system of NDBC and NIOT
- Gliders
- Anti-Vandalism efforts & Experience
- Buoy deployment operation
- Mooring Systems



Visit to Seabird Electronics

Visit to Paroscientific Inc.

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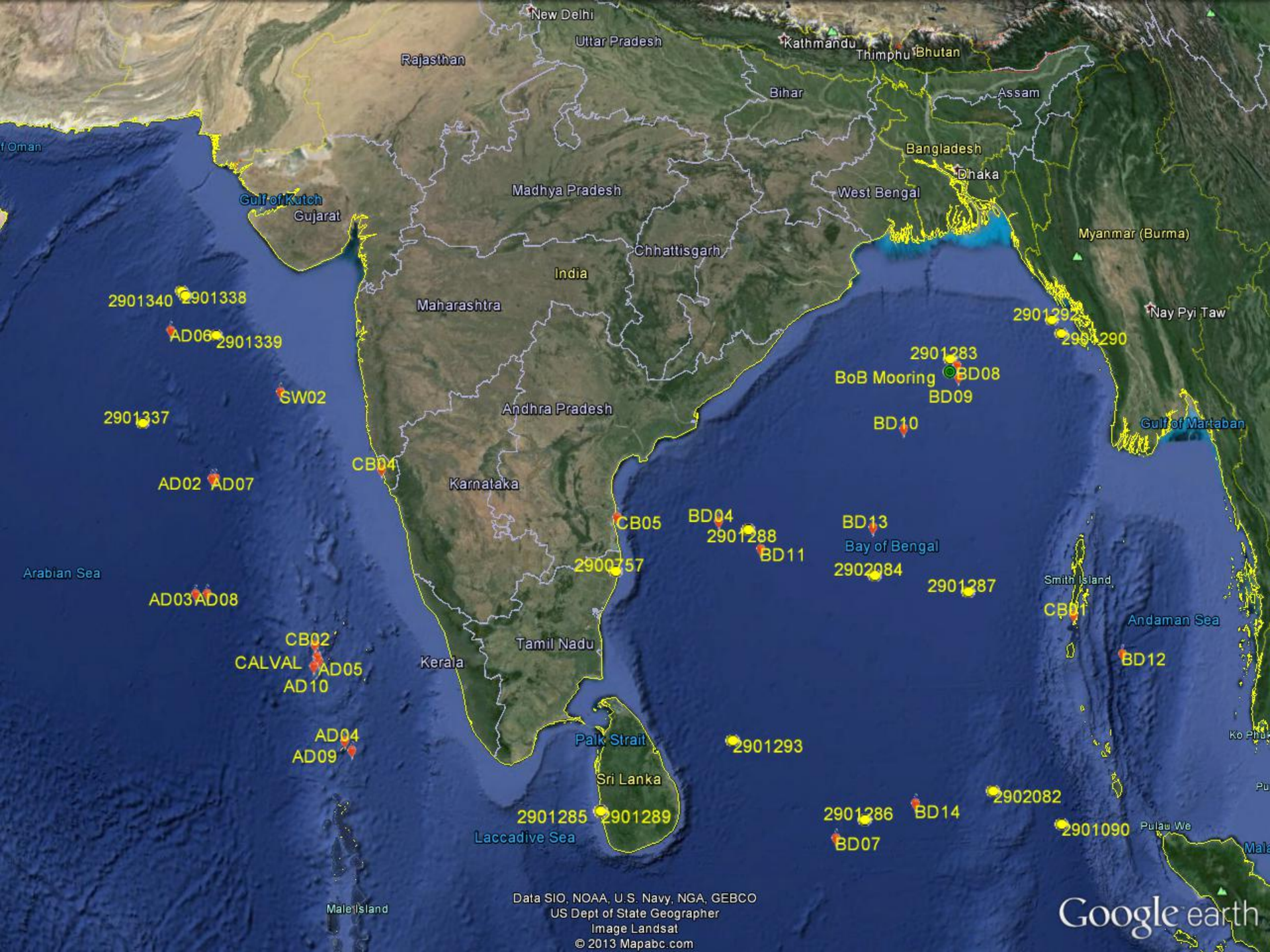
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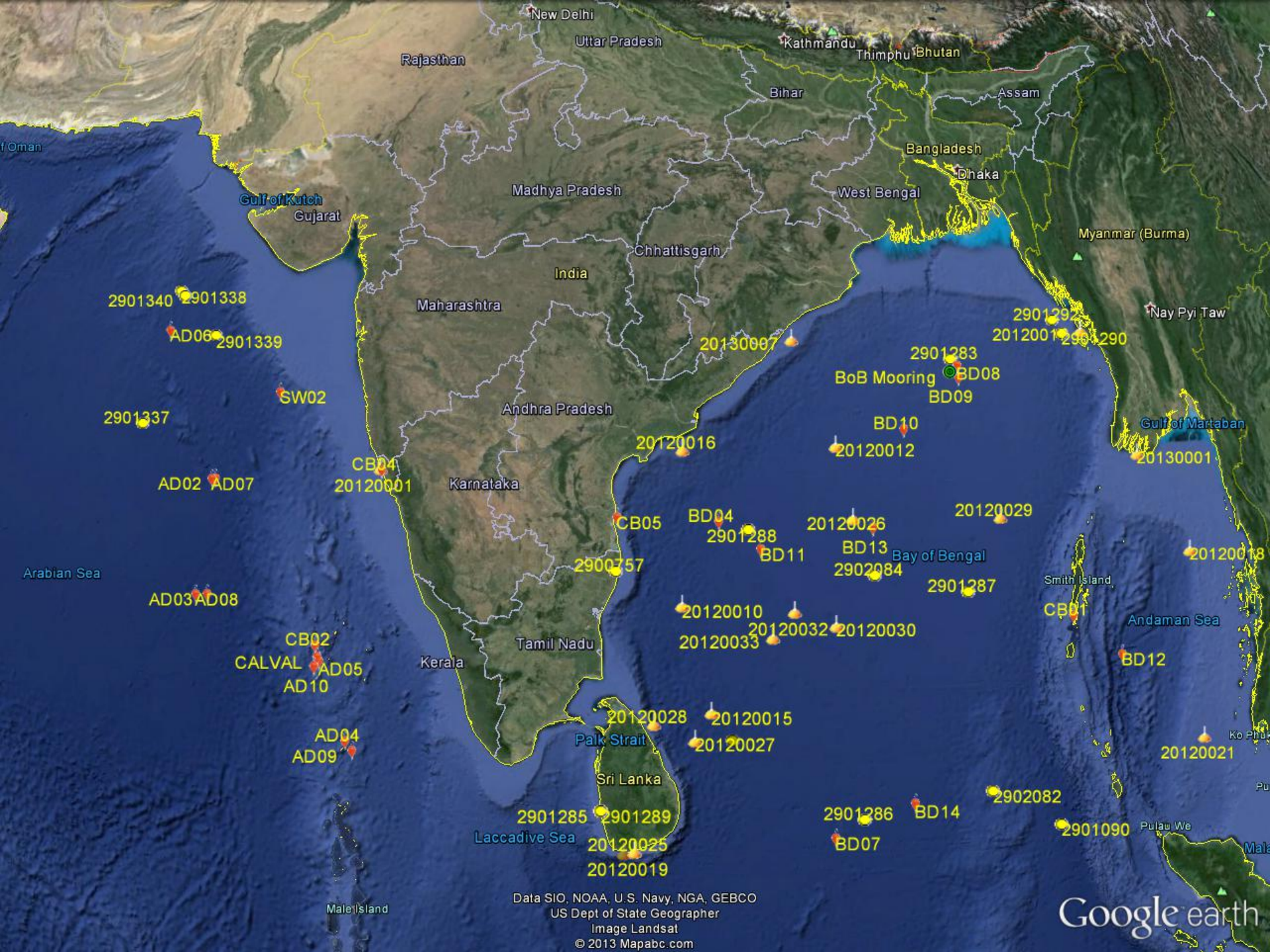
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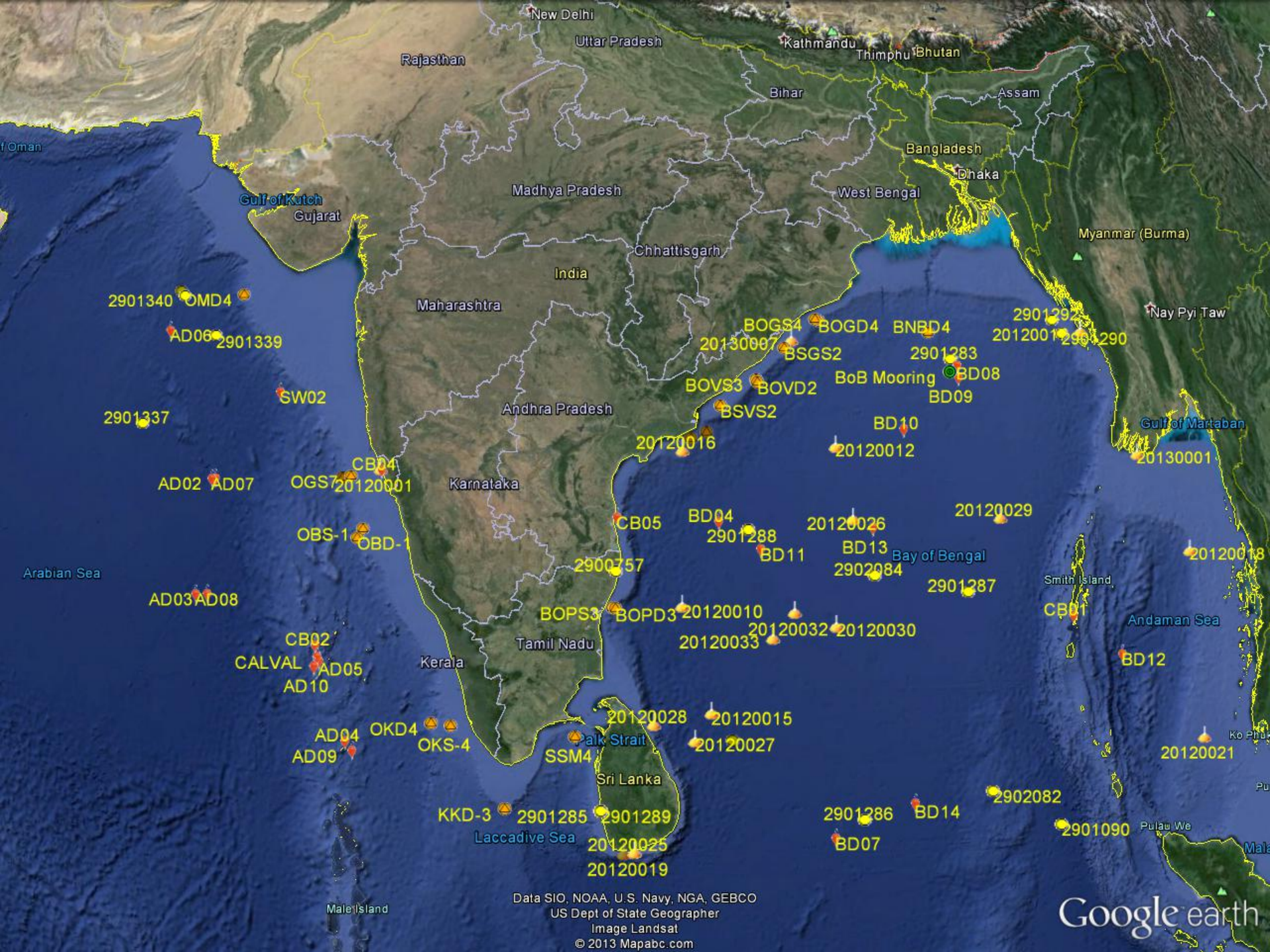
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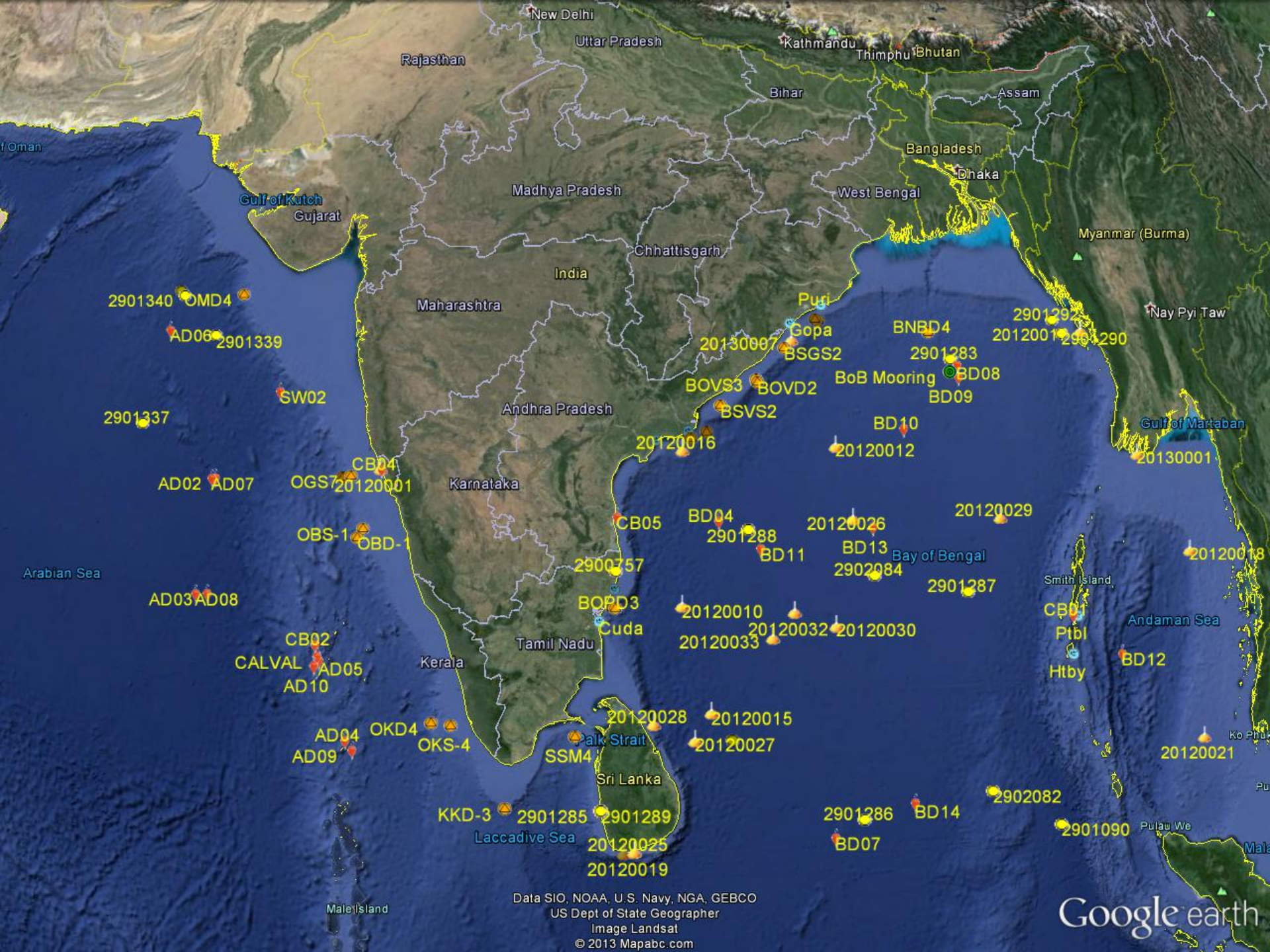
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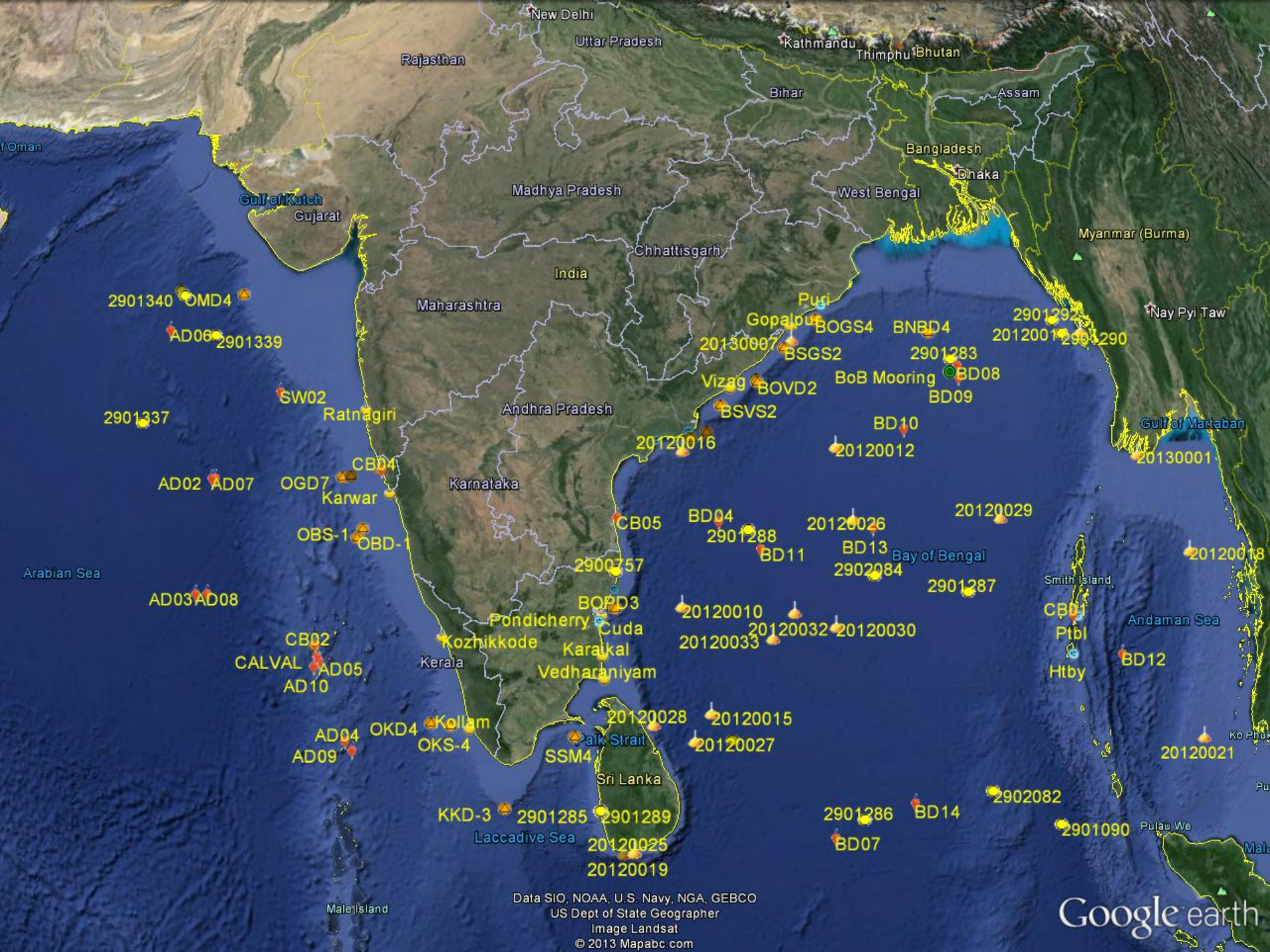
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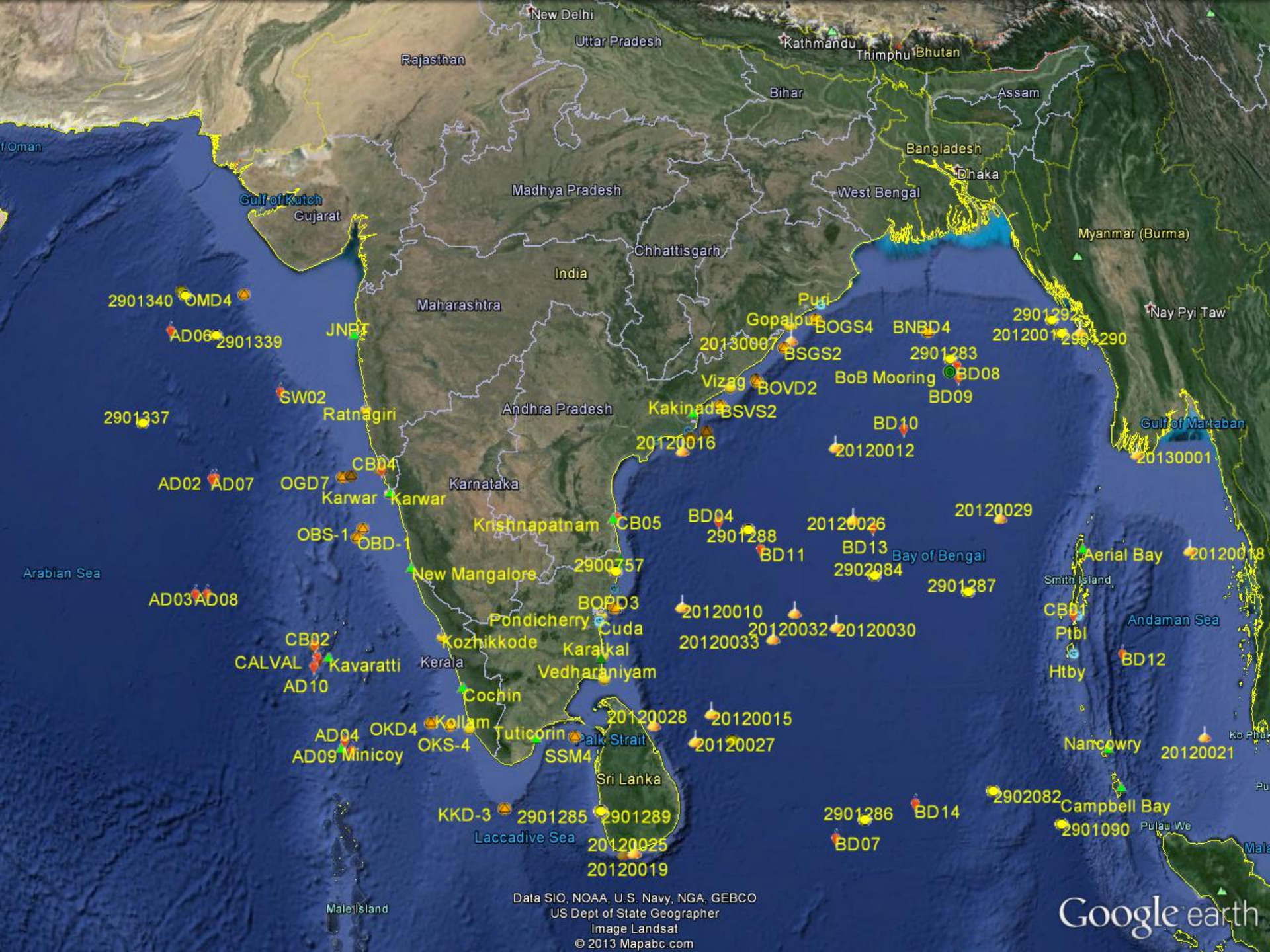

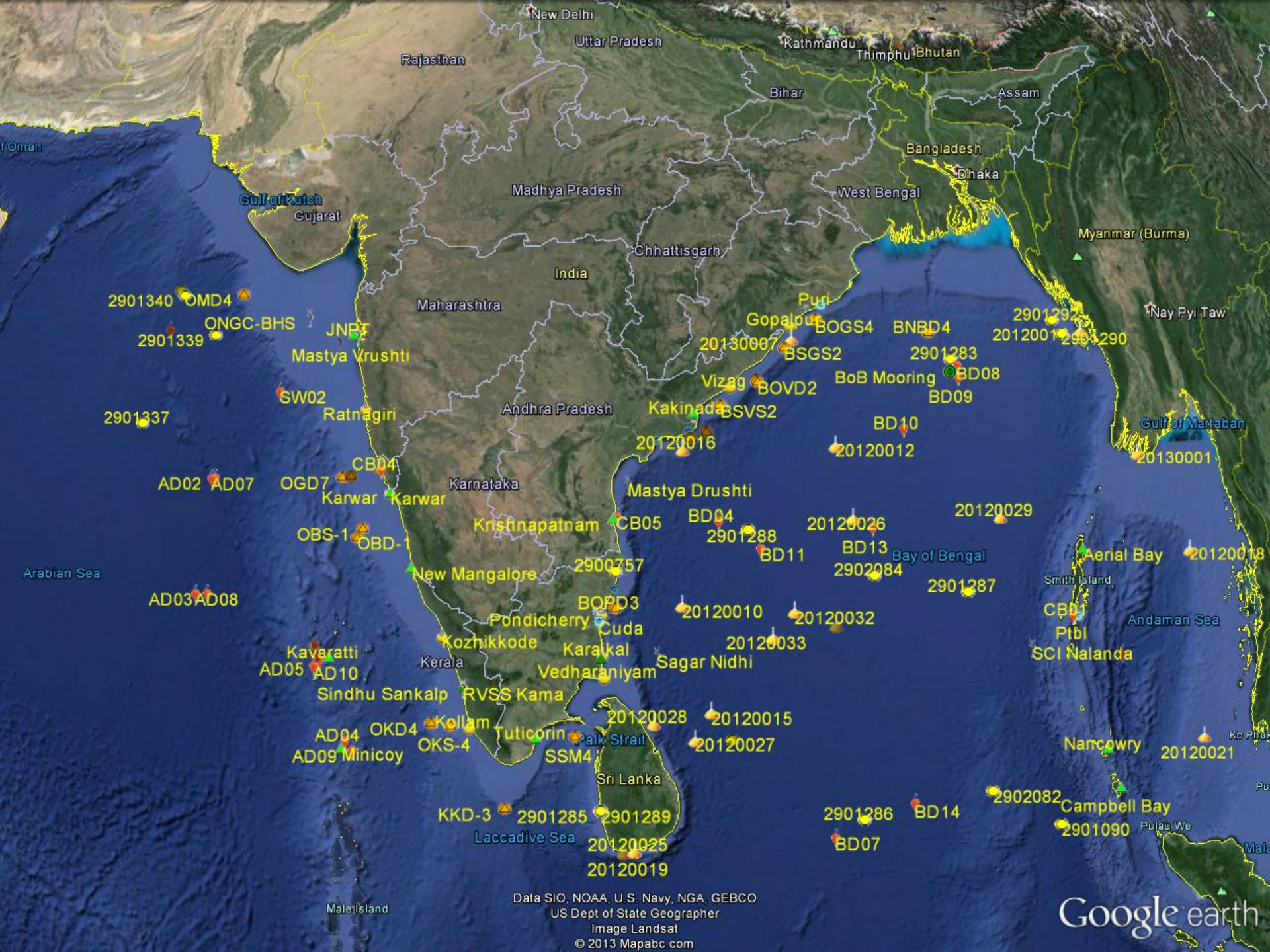
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Future Plan

INDO US Programme

National Proposal to NMM "Ocean Mixing and Monsoons (OMM)"

Goal:

- To understand the Coupled Physical Processes in the Bay of Bengal and Monsoon Air-Sea Interaction
- Parameterize upper ocean physics, surface fluxes, atmospheric mixed-layer physics
- Capacity development

Proposal:

A five-year (2013-2017) programme

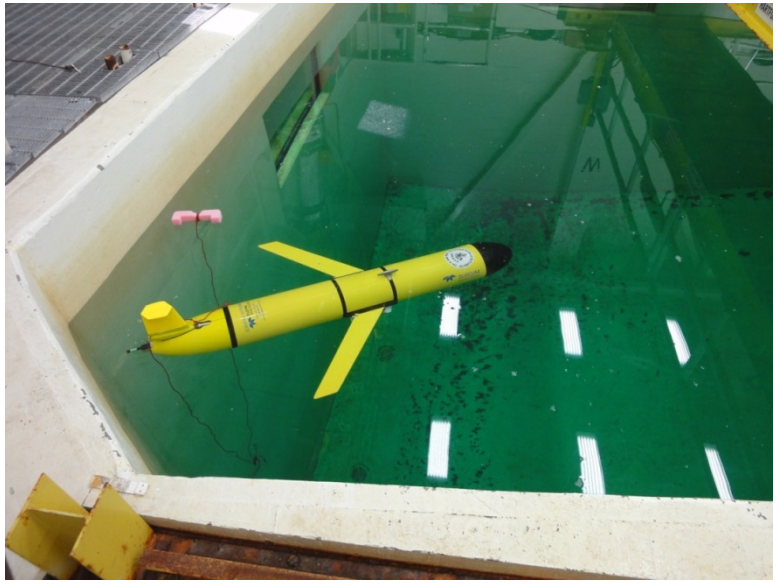
(A) Observations of ocean and atmospheric boundary layers;
(B) Fine-scale modelling;
(C) Regional ocean/coupled modelling, and
(D) OGCM experiments.

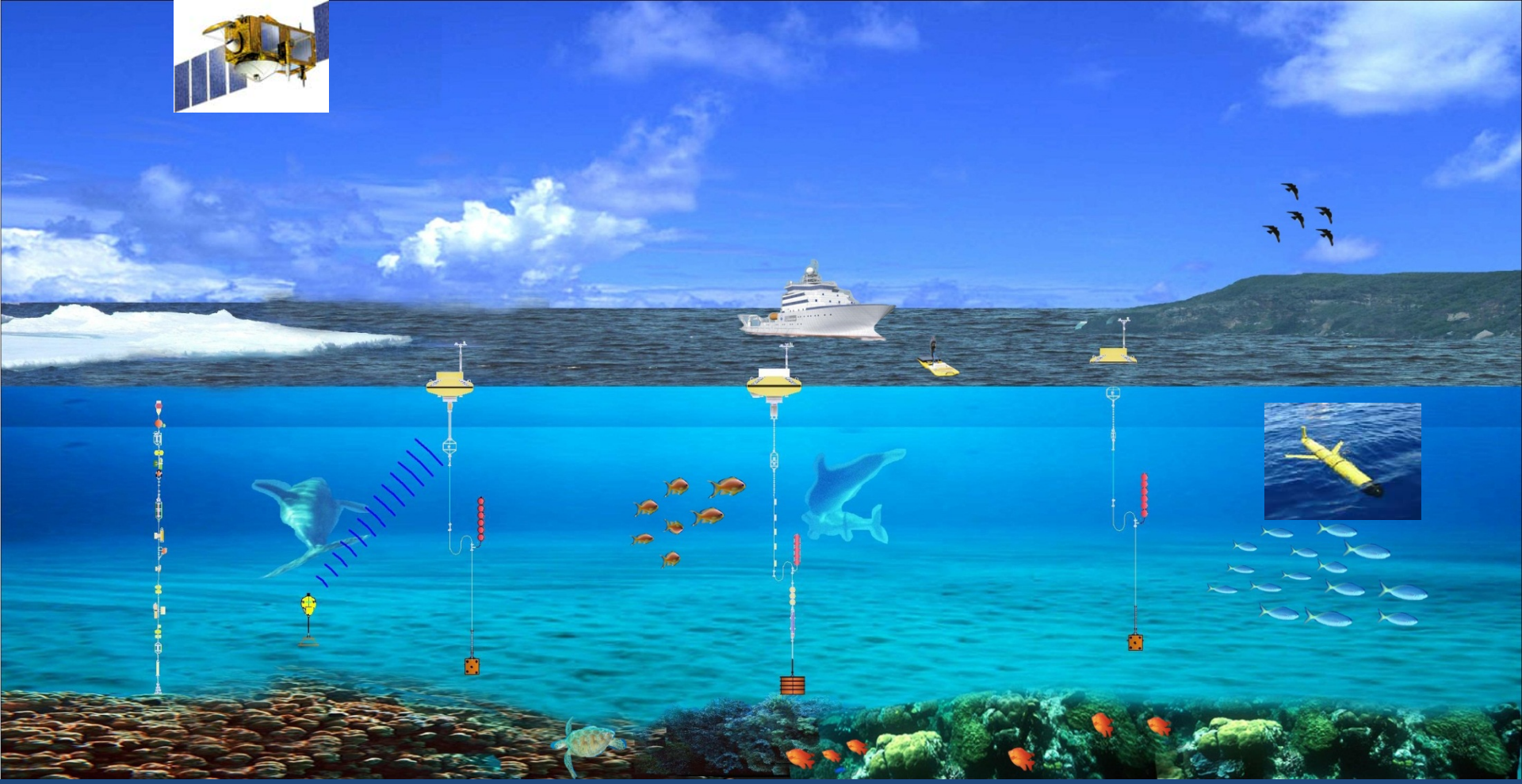
Plan

- **6-week pilot experiment:** November-December 2013
- **18-24 month IOP:** October/November 2014-October 2016

Future Plans

1. Gliders
2. Indian Arctic Buoy System June 2014 Norwegian vessel
3. Southern Ocean mooring





Thank you for your attention

dr.r.venkatesan@gmail.com