Report on NDBC-NOAA Training "Moored buoys data management and quality control"

18th to 29th Apr 2011

OCEAN OBSERVATION SYSTEMS

NATIONAL INSTITUTE OF OCEAN TECHNOLOGY

(Ministry of Earth Sciences, Government of India)

CHENNAI – 600 100

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ACKNOWLEDGEMENT

We wish to extend our gratitude to the Secretary, MOES for giving us the opportunity to organise the workshop on *"Moored buoys data management and quality control"* in association with NDBC-NOAA, USA.

This is the first time NDBC-NOAA is providing training outside USA, and we take this opportunity to convey our sincere thanks to Mr. Helmut H. Portmann, Director, NDBC and Dr. Bill Burnette, Data Management and Communication Chief, NDBC-NOAA, USA, for extending their valued support by deputing Mr. Walter McCall and Mr. Michael Huguet to train the team of engineers and scientist from NIOT and various other MOES institutes.

We would like to thank Mr. Walter McCall and Mr. Michael Huguet for their diligence, extensive preparation and knowledge sharing.

Finally we express our gratitude to Dr. M.A Atmanand, Director, NIOT, for providing full support, guidance and modalities to make this training happen.

SUMMARY

Background

Considering the importance of Earth Observations, Sciences and to build scientific and technical cooperation among the scientific communities, a MoU was signed between Earth System Sciences Organisation - MoES (on behalf of Govt. of India), and NOAA (on behalf of US Government) on 16th April 2008. The MoU is an enabling mechanism for undertaking joint activities between the two countries to use the combined scientific and technical skills in enhancing the observations of the Earth and use the information most effectively for the benefit of the society.

Under the MoU a training programme on buoys and data management has been identified with NDBC. National Data Buoy Center (NDBC) of NOAA, USA is a pioneer institute gained expertise over years, designs, develops, operates and maintains a network of data buoy and coastal weather stations.

The training was conducted for two weeks (from 18th to 29th April 2011) at NIOT campus by NDBC-NOAA experts. Forty participants including scientist and engineers from NIOT and other MOES institutes attended the training. Fourteen sessions along with buoy assembly and hands on exercise were part of the training schedule.

The training focussed on various aspects starting from buoy assembly to quality data output with the aim to improve the capability and the same has been achieved. As a result a best of practice was evolved for each stage of operation and was validated by NDBC experts too. Scientist and Engineers from NIOT and other MOES institutes were greatly benefitted and towards the end, certificates were issued jointly by NIOT & NDBC.

As a capacity building exercise, Director, NIOT, has expressed his interest to have such expert exchange programme of this kind in future to enhance Indian Ocean observations and to provide quality data to the global community.

NDBC has also agreed to help India to come out with new Indigenous buoy design and to establish a calibration facility for sensors.

INTRODUCTION:

Achievements in Atmospheric Sciences, Climate Research and Weather Forecast have their roots in observations. Time series observations are vital to improve our understanding of ocean dynamics, variability and are used to monitor the marine environment and to improve weather and ocean state forecasts. Systematic real-time meteorological and oceanographic observations are also necessary to improve oceanographic services and predictive capability of short and long-term climatic changes.

Time series information on meteorological variables and surface / sub-surface observations of a specific location at sea are vital and stands as a ground truth for space based observational platforms and establishes a long term environmental records for engineering applications, climate research and air-sea interaction studies.

Ocean Observation Systems (OOS) erstwhile National Data Buoy Programme was established in 1996 by National Institute of Ocean Technology, with the prime objective to operate maintain and develop moored buoy observational network and related telecommunication facilities in Indian seas. Moored data buoys which are fitted with meteorological and oceanographic sensors play an important role by providing in-situ observations.

At present there is no effective coherent data management strategy and quality control and it is hard to integrate these data streams. As a result, there is limited exploitation and use of the observational data across disciplines and spatial and temporal scales. This leads to denial of important benefits that might otherwise be derived from these data, such as improved weather forecasts, climatology and more effective protection of coastal marine ecosystems. These considerations, among others, led NIOT to plan, design, and implement a sustained Observational Data Management System.

To improve upon existing data management strategy and to bring in best of practice in buoy data management and quality control, a training program on ***"Moored buoys data management and quality control"*** was organised by NIOT in association with NOAA-NDBC scientist. The objective behind the training program is to identify and improve on the gaps in process and procedures we follow when compared with NDBC's data management, quality control procedures and techniques. The quality control procedures used by NDBC fall into two categories: completely automated and those that involve a man-machine mix. The completely automated procedures are performed on real-time data which are used for operational forecasts and warnings. The other procedures are performed later on data that is submitted for archival. The real-time automated procedures checks and eliminate gross errors transmission parity error and range limit errors. Time continuity checks, rational checks such as wind gust to wind speed ratio, battery voltage checks are performed to provide quality data to end users. NDBC also uses a man-machine mix of quality checks, such as graphical procedures which relate wind speed and spectral wave energy. Other man-machine procedures involve time series plots, spectral wave curves, and computerized weather maps.

Programme Schedule:

Programme & Training Schedule	
Time	**18th April 2011**
10:30 to 10:40	Welcome Address
10:40 to 10:50	Guest Introductory Address
10:50 to 11:00	Participant Introduction
11:00 to 11:30	Break
11:30 to 13:00	Start of Session 1. Buoy to Ground 2. Ground to GTS 3. Ground to Web
13:00 to 14:00	Break
14:00 to 16:00	Wave Processing, Ocean Currents, Salinity & Water Temperature Processing
16:00 to 16:15	Break
16:15 to 17:15	Derived Measurements
17:15 to 17:30	Q&A and summing up of the session
Time	**19th April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	Tsunami, Wind, Temperature, Pressure Processing
11:30 to 11:45	Break
11:45 to 13:00	Manual Quality Control Methods & Techniques
13:00 to 14:00	Break
14:00 to 16:00	Data Assembly Centre (DAC) Responsibilities of DAC Physical Scientist vs Engineer and their responsibilities
16:00 to 16:15	Break
16:15 to 17:15	Engineering Monitoring
17:75 to 17:30	Q&A and summing up of the session & Participants Photo session
Time	**20th April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	Manual Quality Control Tools
11:30 to 11:45	Break
11:45 to 13:00	Manual QC Software Installation and setup
13:00 to 14:00	Break
14:00 to 16:00	Spatial Graphs Satellites Near-by Stations
16:00 to 16:15	Break
16:15 to 17:15	Station Profilers
17:75 to 17:30	Q&A and summing up of the session

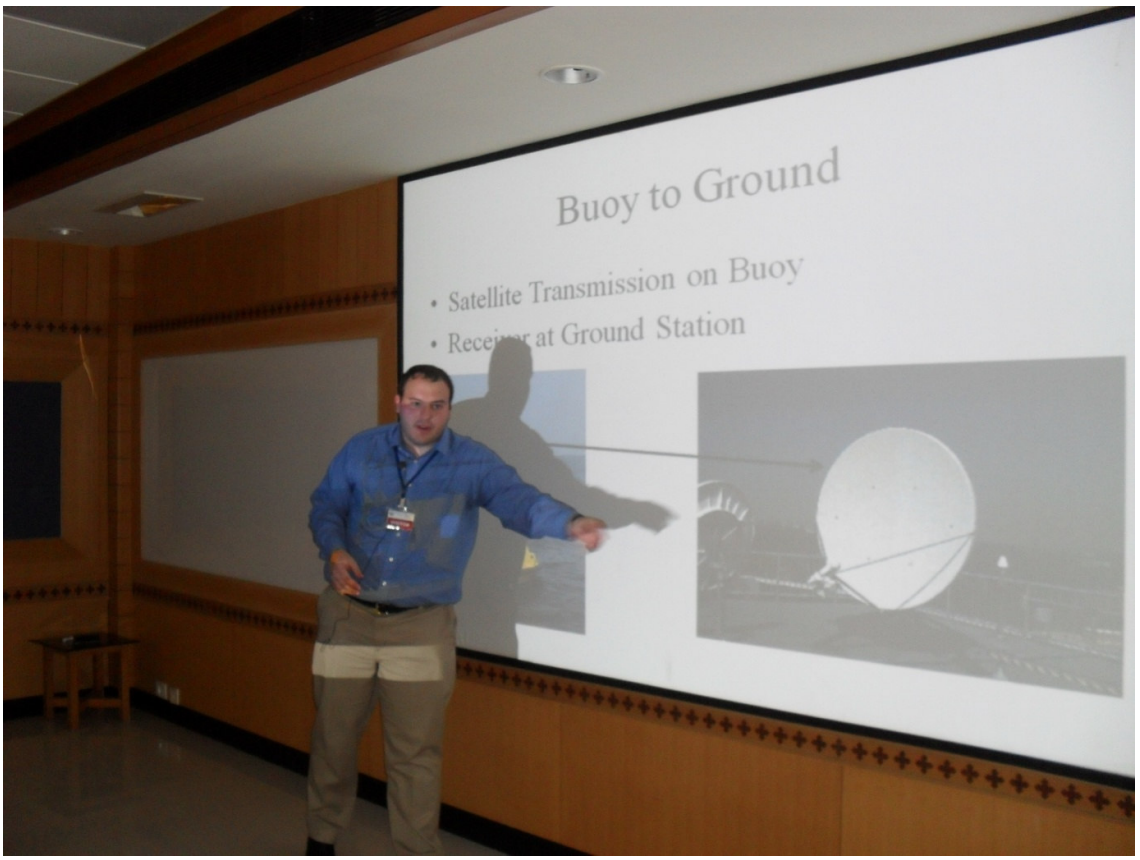
Programme & Training Schedule	
Time	**21st April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	Models Introduction to Automated Quality Control (AQC)
11:30 to 11:45	Break
11:45 to 13:00	Automated Quality Control QC Software installation and setup
13:00 to 14:00	Break
14:00 to 16:00	QC Software Training
16:00 to 16:15	Break
16:15 to 17:15	Hands on work for AQC systems
17:15 to 17:30	Q&A and summing up of the session
Time	**25th April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	Buoy Assembly & Testing
11:30 to 11:45	Break
11:45 to 13:00	Buoy Assembly & Testing
13:00 to 14:00	Break
14:00 to 15:00	Burn in Procedures
15:00 to 16:00	Buoy data quality control during Integration and Testing
16:00 to 16:15	Break
16:15 to 17:15	Importance of Engineering QC & Sensor Testing
17:75 to 17:30	Q&A and summing up of the session
Time	**26th April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	Environmental Testing
11:30 to 11:45	Break
11:45 to 13:00	Future Quality Control Routines
13:00 to 14:00	Break
14:00 to 16:00	Future Quality Control Routines
16:00 to 16:15	Break
16:15 to 17:15	Data Distribution Discussion
17:75 to 17:30	Q&A and summing up of the session

Programme & Training Schedule	
Time	**27th April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	New Sensor Technologies
11:30 to 11:45	Break
11:45 to 13:00	Discussion on Wave Testing Equipment
13:00 to 14:00	Break
14:00 to 16:00	Hands on QC Practice
16:00 to 16:15	Break
16:15 to 17:15	Hands on QC Practice
17:15 to 17:30	Q&A and summing up of the session
Time	**28th April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	Case studies & Hands on practice on Data Quality Control
11:30 to 11:45	Break
11:45 to 13:00	Case studies & Hands on practice on Data Quality Control
13:00 to 14:00	Break
14:00 to 16:00	Flagging erroneous data & flagging methods
16:00 to 16:15	Break
16:15 to 17:15	Queries on spikes & other generic items
17:75 to 17:30	Q&A and summing up of the session
Time	**29th April 2011**
10:00 to 10:15	Q & A if any from previous session
10:15 to 11:30	Buoy Assembly and Testing – Results & Discussion
11:30 to 11:45	Break
11:45 to 13:00	Vandalism and Anti Vandalism efforts by NDBC
13:00 to 14:00	Break
14:00 to 16:00	Experience Sharing (NDBC & NIOT)
16:00 to 16:15	Break
16:15 to 17:15	Conclusion discussion & Vote of Thanks
17:75 to 17:30	Photo Session and End of Training

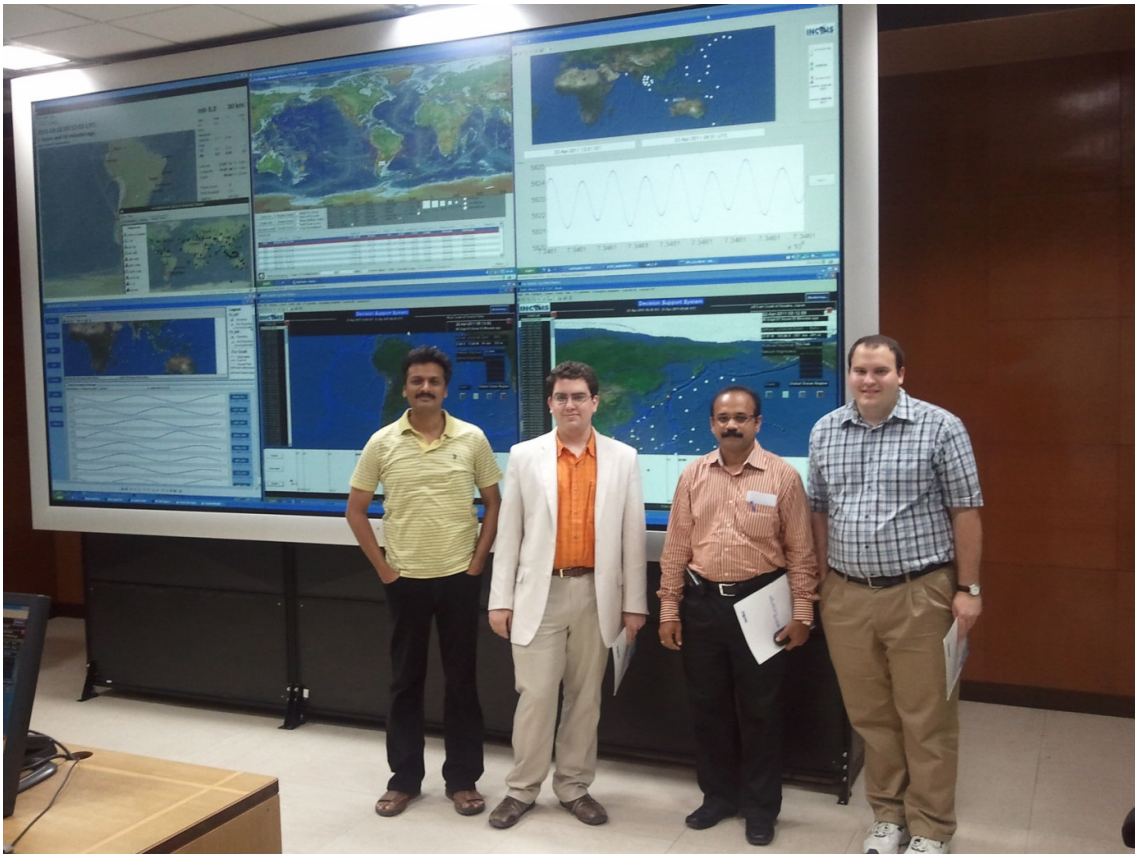
Participant Details:

The training was structured in such a way that the first two days were common and caters to a variety of audience. Participants from Indian National Centre for Ocean Information Services (INCOIS), Hyderbad, Indian Institute of Tropical Meteorology (IITM), Pune and various groups of NIOT participated. Later from the third day onwards the training was more specific to Ocean Observation System Group and its contractors (Electronik Lab & Eurotech). The trainers also visited Indian National Centre for Ocean Information Services INCOIS, Hyderabad.

Photos taken during the session:


Buoy to Ground
• Satellite Transmission on Buoy
• Receiver at Ground Station


Summary
Freeze
• It's a lot easier to fix buoy problems on land than at sea
• Careful engineering monitoring streamlines buoy deployments
• Give as much weight to health readings as to the meteorological data
Battery – What to look for



Key points discussed & Recommendations from NDBC Team:

Issue to resolve; states the problems that exist right now. The suggestion and goals section is what is envisioned as a timely solution.

Issues to resolve

1. Develop a standard data format with fixed naming conventions (ATMP or Air Temperature or Air Temp and do not use all three in your files).
2. Keep columns the same in all the data log files (eg: column 4 is always Air pressure)
3. All messages from the buoy should report missing data as ///// or 99999 regardless of the sensor.
4. All measurements should have a required samples met in order to transmit (NDBC uses 80% of samples must be good in order to compute the average)
5. Automate the QC Graphs (already partially completed)
6. Develop accuracy and calibration testing
7. Right now there are multiple functionality tests. We need 1-2 function tests and then an accuracy test for all sensors. Some of this will require a facility (wind tunnel, ocean cal lab) but some can be done without that.
8. Compass test to be conducted
9. Wind tunnel need to be built
10. An Air Temperature / Humidity Oven to be built
11. Need an Ocean Sensor Test room (5 baths at fixed temperature)
12. To start migration from cup anemometers to Ultrasonic anemometers or a propeller type

Suggestion for Compass Testing:

A mark on a board referencing the compass can be made and move the compass over it to see whether it gives the same reading.

GOALS

Immediate:

1. Use of RF transmitter instead of Satellite during testing which saves cost
2. Standardise data format

3. Fix bad data reporting on payloads (99999 and percent samples)
4. Automate Data Graphs
5. Implement Automated Quality Control
6. Develop test plan for Ultrasonic or Propeller Anemometers
7. Built a Wave calibration setup
8. SST calibration facility

2-5 Year Goals:

1. Build calibration facility at NIOT
2. Implement INDIA Payload with all corrections and necessary modifications
3. Implement Ultrasonic or Propeller anemometers
4. Design and start preliminary test of India Buoy
5. Get on India Satellite to reduce transmit costs
6. Hire a senior data analyst full time to provide training and environmental studies
7. Publish scientific papers using NIOT data which in turn increases the awareness of buoy systems among scientific community
8. Develop User guide to NIOT data

Apart from the above discussions,

Director NIOT emphasised that such trainings and expert exchange programme need to continue under the MOU signed between NOAA USA and Ministry of Earth Sciences India.

In addition NDBC experts also expressed their interest in guiding INDIA with the technical know how of an improved buoy design.

With that the two week training programme was successfully completed and certificates were issued to the participants.

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