Data Buoy Cooperation Panel (DBCP)

Training Workshop on Ocean Observations for Operational Services in the Indian Ocean

05 to 07 August 2025

Hyderabad, India

Version 1.0

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NOTES

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International Training Centre for Operational Oceanography
INCOIS


INCOIS

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Data Buoy Cooperation Panel (DBCP)

Training Workshop on Ocean Observations for Operational Services in the Indian Ocean

SUMMARY

The Annual Data Buoy Cooperation Panel (DBCP) Training Workshop was held from August 5 to 7, 2025, at the Indian National Centre for Ocean Information Services (INCOIS) in Hyderabad, India. The workshop was organized by the DBCP Task Team on Capacity Development, in collaboration with the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, and INCOIS. The theme of the workshop was "Advancing Ocean Observations for Operational Services in the Indian Ocean Region."

The event was inaugurated by distinguished speakers, including Dr. M. Mohapatra, Director General of Meteorology at the India Meteorological Department (IMD) and India's Permanent Representative to the WMO; Dr. Balakrishnan Nair, Director of INCOIS; Dr. Nelly Riama, Chair of the DBCP; Dr. Joanna Post from the IOC; and Ms. Champika Gallage from the WMO Secretariat. They emphasized the critical role of ocean observations in improving weather and ocean forecasts, supporting climate monitoring and research, and delivering societal benefits. The speakers highlighted the specific importance of buoy data in validating satellite observations and enhancing numerical weather models—especially during cyclones and other low-pressure systems.

Mr. Fan Jiang, Chair of the DBCP Task Team on Capacity Development (TT-CD), presented the team's ongoing initiatives to support ocean observations in the Indian Ocean region through training, data sharing, and technology deployment. He underscored the need for sustained, high-quality in situ data to support accurate forecasting and climate science. The workshop aimed to identify existing gaps, promote regional coordination, and enhance inclusive and effective capacity development.

Dr. Uday Bhaskar from INCOIS introduced the International Training Centre for Operational Oceanography (ITCOocean), where the workshop was also conducted. Mr. E. Pattabhi Rama Rao, who led the organizing team from INCOIS, provided an overview of operational oceanography and ocean information and advisory services.

The workshop comprised three thematic sessions:

- Ocean Observation, Data Acquisition, and Quality Control
- In-situ Ocean Observations for Forecasting and Services
- Global and Regional Initiatives (GOOS/IO-GOOS)

In addition to lectures, participants engaged in practical, hands-on training through visits to INCOIS's facilities, including the glider operations and testing center, the oceanographic instruments laboratory, the ocean remote sensing ground station, and the ocean observations and prediction systems laboratory. Hands-on sessions on ocean data processing, data management, and data access were particularly well received. Workshop timetable is available in Annex 1

To foster collaboration, group discussions were held to identify national challenges and explore regional coordination strategies. Summary of the group discussions are available in Annex 4. One highlighted success story involved the deployment of wave rider buoys in Seychelles and the Maldives in collaboration with INCOIS. Other participating countries expressed interest in pursuing similar initiatives. From the discussions throughout the three days of the workshop, 15 recommendations were made, and the list of recommendations are provided in Annex 3

The workshop was attended by 41 participants onsite and 24 online, including 35 trainees and 21 speakers from 14 countries. Notably, 34% of the participants were women. A full list of participants is provided in Annex 2. Financial support from DBCP enabled 17 trainees to attend in person, with INCOIS facilitating local logistics, accommodation, and meals.

A post-workshop survey indicated high participant satisfaction with the content, quality, and delivery of the sessions. Areas for improvement include extending the duration of the workshop and allocating more time for hands-on training. A summary of the survey results is provided in Annex 5.

All the presentations and documents are available at https://goosocean.org/event/4700

Annex 1
Workshop Agenda

Time (IST) UTC+5.30	Opening Ceremony (Moderator: Ms. Anu Radha)	Lead
0830-0900	**Registration**	
0900-0925	**Opening Remarks** *Director, INCOIS* *DGM, IMD and PR to WMO from India (In person / Remote)* *DBCP Chair, Dr. Nelly Florida Riama* *WMO, Ms. Champika Gallage* *IOC, Dr. Joanna Post (Remote)*	Moderator: E Pattabhi Rama Rao
0925-0935	The objective, expectations and agenda of the workshop	Fan Jiang NCFDRC (Remote/In person)
0935-0950	An Introduction to the International Training Centre for Operational Oceanography (ITCOocean) and Logistics Information	Udaya Bhaskar INCOIS
0950-1030	Welcome words & Operational Oceanography and Ocean Information and Advisory Services	E Pattabhi Rama Rao INCOIS
1030-1045	Group Photo	
1045-1100	**Tea/Coffee Break**	
Session 1: Ocean Observation/Data Acquisition/Quality Control (Moderator: Nelly Florida Riama) Each presentation will be 30 mins and 10 mins for Q&A		
1100-1140	In-situ Ocean Observation Network in the Indian Ocean	Aneesh L INCOIS
1140-1220	Ocean Moored buoys in the Northern Indian Ocean (OMNI) Programme, Data and Applications	Arul Muthaiah NIOT
1220-1300	Indian Argo Programme, Data and Applications	Udaya Bhaskar INCOIS
1300-1400	**Lunch Break**	
1400-1530	Visit to Synoptic Ocean Observations and Prediction System (SynOPS) Laboratory	E Pattabhi Rama Rao INCOIS
1530-1630	**National Reports** (5 minutes per country + 10 minutes discussion): *Bangladesh, Comoros, Indonesia, Kenya, and Malaysia*	Nelly Florida Riama Champika Gallage
1630-1710	Wave Drifters and Their Applications in Research and Operations	Luca Centurioni SIO (Remote)
1710-1750	The RAMA array operations, maintenance and data use	Kenneth J. Connell PMEL (Remote)

Day 2: Wednesday, 6 August 2025

Session 2: In-situ Ocean Observation in Forecasting/Services (Moderator: Pattabhi Rama Rao) Each presentation will be 30 mins and 10 mins for Q&A

0900-0940	Global and Seasonal Ocean Predictions for Tropical Area	Francis INCOIS
0940-1020	Introduction to Wave Ride Buoys and its applications in operational oceanography	Remya INCOIS
1020-1100	Generation and Operational Application of Gridded Data from HF Radar	XU Jiangling NCFDRC of MNR
1100-1115	**Tea/Coffee Break**	
1115-1155	Enhancing Observation Data: A Machine Learning approach to fill gaps in moored buoy data	Siva Srinivas INCOIS
1155-1235	Ocean Data Management activities at the Indian & Hands-on Session	Dr. Udaya Bhaskar INCOIS
1235-1310	Ocean remote sensing data and its applications	Srinivasa Rao INCOIS
1310-1410	**Lunch Break (Moderator : Aneesh Lotliker)**	
1410-1450	Utilizing buoy data for operational storm surge forecasting during tropical cyclones.	Dr. PLN Murty (IMD)
1450-1530	Hands-on Session (Wave Rider buoy data processing)	R Venkat Shesu INCOIS
1530-1615	The role of new autonomous ocean observing technologies in reliable predictions of tropical cyclone	Dr. Scott Glenn Rutgers University (Remote)
1615-1630	**Tea/Coffee Break**	
1630-1730	Visit to National Glider Operations and Test Facility, Oceanographic Instruments and Ocean Remote Sensing Ground Stations	Aneesh Lotliker/Shiva Kumar

Day 3: Thursday, 7 August 2025

Session 3: Global and Regional Initiatives (GOOS/IO-GOOS) (Moderator: Uday Bhaskar) Each presentation will be 30 min and 10 min for Q&A		
0900-0940	GBON for ocean and WIS 2.0	Champika Gallage WMO
0940-1020	OceanOPS and DBCP Metadata	Martin Kramp OceanOPS (Record)
1020-1100	Indian Ocean Global Ocean Observing System	Nagaraj Kumar IOGOOS
1100-1115	**Tea/Coffee Break**	
1115-1155	**National Reports** (5 minutes per country + 10 minutes discussion): *Mauritius, Seychelles, South Africa, Sri Lanka, Thailand, Tanzania, India*	
1155-1235	Group Discussion (Part 1) *Q1: What are the key challenges you face in accessing and maintaining the quality and continuity of in-situ ocean observations in your country?*	Nelly Florida Riama Aneesh L
1235-1345	**Lunch Break**	
1345-1445	Group Discussion (Part 2) *Q2: What steps can be taken to strengthen coordination between countries operating observation platforms in the Indian Ocean?* *Q3: What are the skills gaps that still need to be addressed in your country through capacity building?*	Nelly Florida Riama Aneesh L

1445-1530	Summary and Recommendation	Nelly Florida Riama Champika Gallage
1530-1610	Closing Ceremony (Award of the Certificates)	Nelly Florida Riama Champika Gallage
1610-1630	**High Tea**	

Acronyms

DBCP	Data Buoy Cooperation Panel
INCOIS	ESSO-Indian National Center for Ocean Information Services,India
IMD	India Meteorological Department
IOC	Intergovernmental Oceanographic Commission of UNESCO, France
IOGOOS	Indian Ocean Global Ocean Observing System
IITM	Indian Institute of Tropical Meteorology
MNR	Ministry of Natural Resources, China
NCFDRC	North China Sea Forecast and Disaster Reduction Center, MNR
NIOT	National Institute of Ocean Technology, India
NSMFC	North China Sea Marine Forecasting Center of MNR
SIO	Scripps Institution of Oceanography
PEML	NOAA Pacific Marine Environmental Laboratory

Annex 2
List of Participants

In-person

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Annex 3
Recommendations arising from the workshop

RECOMMENDATIONS

1. **Technology Transfer and International Accessibility**
   The Indian Ministry of Earth Sciences, through partnerships with industry, commercializes technologies developed by its scientists. It is recommended that INCOIS extend international access to these innovations by publishing them on the Ocean Best Practices System (OBPS) or the DBCP web portal.

2. **Capacity Development and Resource Sharing**
   INCOIS has developed several educational resources (e.g., [insert titles]) as part of its capacity-building efforts. It is encouraged to make these resources available to workshop participants to enhance learning outcomes.

3. **Utilization of Regional Resources**
   INCOIS, as a leading provider of ocean observation and services—particularly in the Indian Ocean region—offers a wealth of information and products free of charge. Countries in the region are encouraged to utilize these resources to enhance their national and regional services. INCOIS remains available to provide assistance where needed.

4. **Wave Buoy Network: Expansion and Knowledge Sharing**
   INCOIS operates a coastal wave buoy network that provides critical data for marine services and shows strong return on investment. A forthcoming technical paper—"*Wave Monitoring Along Nearshore (WAMAN) Buoy Network: Best Practices and Applications in Sea State Monitoring and Forecasting for the Indian Ocean" (Balakrishnan et al., 2025, BAMS)*—will be shared with workshop participants upon publication.

   Additionally, INCOIS has shown willingness to expand this network beyond India's EEZ. With wave buoys already deployed in Mauritius and Seychelles under bilateral agreements, other interested countries are encouraged to initiate similar collaborations. DBCP and WMO/IOC are ready to support such initiatives.

5. **Strengthening Inter-Agency Coordination at the national level**
   Countries are encouraged to enhance coordination between ocean observation agencies and National Meteorological and Hydrological Services (NMHSs), especially where responsibilities are divided across institutions. Improved communication will foster data sharing, break down institutional silos, and ensure ocean data is fully integrated into weather, marine, and climate services, including early warning systems.

6. **Raising Awareness on the Value of Ocean Data**
   Participating countries in the Indian Ocean region are encouraged to raise awareness about the critical importance of ocean observations for services such as tropical cyclone forecasting and coastal inundation. They are also urged to actively promote and enhance the sharing of observational data through the Global Telecommunication System (GTS) and the WMO Information System (WIS), to improve the accuracy and effectiveness of forecast models in this data-sparse region.

7. **Glider Data Dissemination**
   Glider operators in the region are encouraged to share their data through the GTS and WIS. The U.S. Integrated Ocean Observing System (IOOS) operates a Glider Data

Assembly Center (DAC), which can assist countries in facilitating data delivery. Operators should contact the IOOS DAC (glider.dac.support@noaa.gov) for support.

8. WIS 2.0 Integration by Oceanographic Institutions

National oceanographic institutions that operate outside of National Meteorological and Hydrological Services (NMHSs) are willing to establish WIS 2.0 nodes for the real-time distribution of ocean data. However, there is a need for targeted guidance. WMO is encouraged to develop and disseminate clear guidelines, technical documentation, and onboarding procedures tailored to non-NMHS entities. Broader participation will enhance data diversity and support global forecasting efforts.

9. Assessment of the trainees on the contents of DBCP training

To promote active participation and accountability, it is recommended to conduct a multiple-choice exam based on workshop content. Presenters can contribute questions alongside their materials. Announcing the exam on the first day will help maintain trainee focus and encourage deeper engagement.

10. Aligning Challenges with the SDGs and ODC Framework

It is recommended that inputs and issues raised during group discussions be mapped to relevant Sustainable Development Goals (SDGs) and Ocean Decade Challenges (ODCs). Doing so will enable targeted follow-up by connecting the appropriate SDG and ODC focal points with the representatives who raised specific challenges, facilitating problem-solving through globally aligned frameworks.

11. Sharing user cases with the community

To enhance knowledge exchange and promote the practical impact of ocean observing systems, it is recommended that workshop participants actively contribute user case summaries to the Data Buoy Cooperation Panel (DBCP) for inclusion in its quarterly newsletter. These user cases serve as valuable examples of how buoy data supports operational, scientific, and societal applications — such as maritime safety, climate monitoring, disaster risk reduction, and ecosystem management. Countries are encouraged to submit concise, one-page summaries detailing specific use cases, including the context, outcomes, and benefits derived from buoy data. These contributions should be sent to DBCP at mkhotimah@wmo.int.

12. Improving Recovery of Beached Ocean Platforms

Timely recovery of beached ocean platforms is crucial for sensor calibration, performance analysis, and possible redeployment. However, current recovery efforts often face delays due to limited coordination. It is recommended that the DBCP strengthen collaboration mechanisms and establish clearer protocols with relevant national and regional stakeholders to ensure efficient and timely recovery of beached platforms.

13. Enhancing the Role of National Focal Points for Improved Coordination

To foster stronger national-level coordination, the DBCP Chair is encouraged to maintain and regularly update the list of National Focal Points. The Chair should also engage directly with these focal points to encourage active involvement in facilitating coordination between national oceanographic and meteorological communities. This will support sustained national engagement and strengthen DBCP's impact across member countries.

14. Linking Group Discussion Outcomes to SDGs and Ocean Decade Challenges

It is recommended that inputs and issues raised during group discussions be mapped to relevant Sustainable Development Goals (SDGs) and Ocean Decade Challenges

(ODCs). Doing so will enable targeted follow-up by connecting the appropriate SDG and ODC focal points with the representatives who raised specific challenges, facilitating problem-solving through globally aligned frameworks.

15. **Centralized Compilation of Workshop Resources**
Given the wealth of information shared during the workshop—including numerous references and external links—it is recommended to compile a centralized document that consolidates all key resources, presentation materials, and relevant website links. This will serve as a valuable reference for participants and support continued learning and application of workshop content.

Annex 4
Group work summary

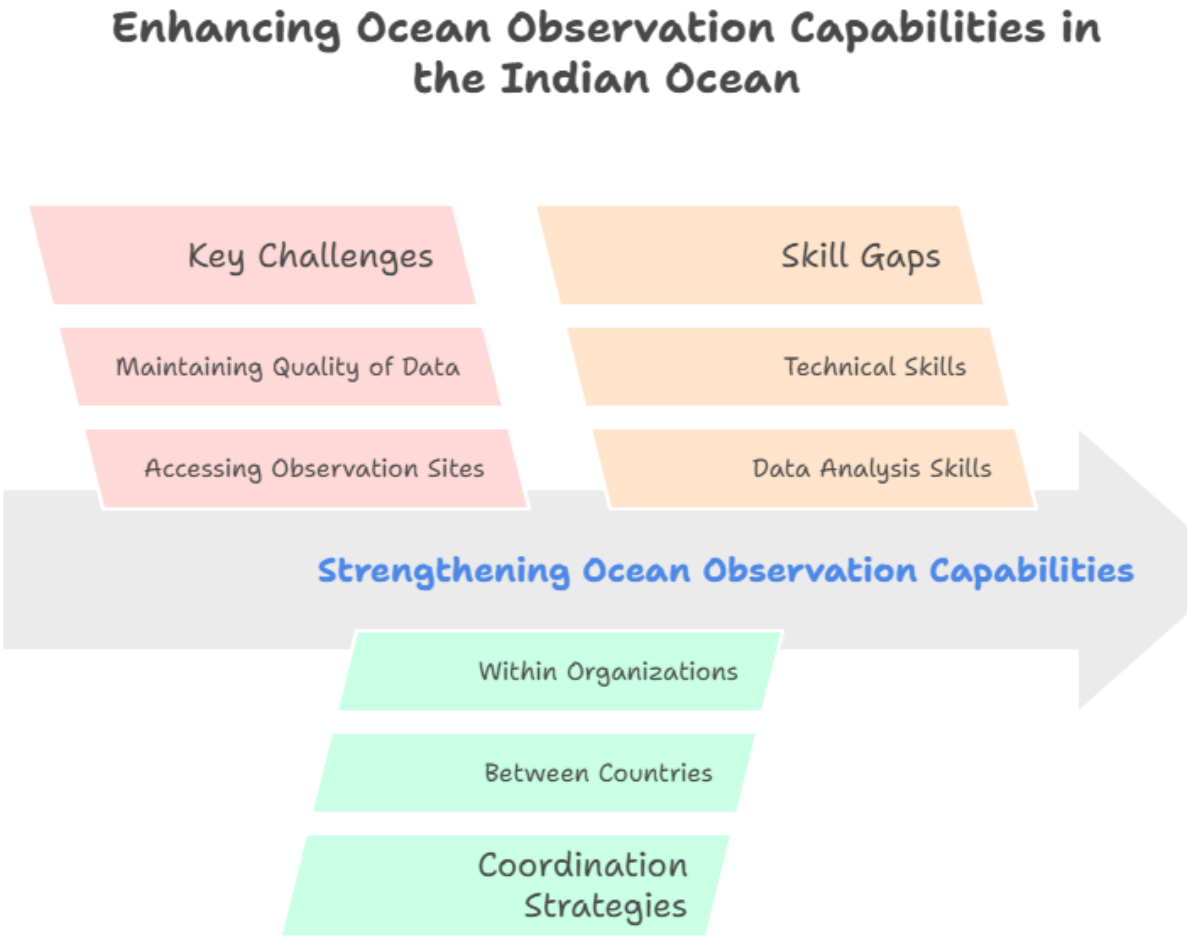
Group – 1

Q1	**What are the key challenges you face in accessing maintaining the quality and continuity of in-situ ocean observations in your country?**
Ans	- Funding – equipment, communication etc, long term funding - Deployment & Maintenance – lack of expertise, logistics - Training & Capacity building - Quality control - Filling data gaps - Common platform for data sharing - Lack of infrastructure - Communication/collaboration between departments improving instrumentation (startups) - Utilization of available technology in the market - Simplify administrative protocols, quick establishment of observations network, vandalism, bio-fouling
Q2	**What steps can be taken to strengthen coordination between countries operating observation platforms in the Indian Ocean?**
Ans	- Knowledge sharing about technology / donating / friendship between countries - Countries can establish share data protocols - Simplify administrative protocols – quick establishment of observation network - Joint training – multilateral training program - Establish regional frameworks and agreements - Dissemination of real time data between countries during a extreme weather events - Joint marine cruises & collaboration with all countries - Establishment of regional coordination
Q3	**What are the skills gaps that still need to be addressed in your country through capacity building?**
Ans	- Coordination between different agencies within the country - Technical expertise towards operations, maintenance, calibration of ocean observations systems - Technical skill for GIS & Remote Sensing - Overcoming linguistic barriers - Awareness with the local community - Investment in Research & Development ventures (modelling AI-ML etc) - Cross training between departments / countries

Group – 2

Q1	**What are the key challenges you face in accessing maintaining the quality and continuity of in-situ ocean observations in your country?**
Ans	Funds. Vandalism, Infrastructure (Research Vessel, Communication, Hardware, Human Resource), Technology (H/W, Human Skills), Bio-fouling.
Q2	**What steps can be taken to strengthen coordination between countries operating observation platforms in the Indian Ocean?**
Ans	Exchange programs (Workshop, Seminars), Data Sharing, (MoU including Bilateral and Multilateral), Collaborative studies (Students programs), Resource sharing between countries, Awareness program to regional communities, Stake holder engagements, Standardization of data format across the globe.

Q3	**What are the skills gaps that still need to be addressed in your country through capacity building?**
Ans	Training in Observations, Modelling, Forecasting, Data processing & dissemination, Help in installation of maintenance of observations instruments, Capacity Building, Infrastructure, Training Centers



Annex 5
Post-workshop survey results summary
(link to survey: https://forms.office.com/e/K4Y1cisHr4)

1. Executive Summary

The DBCP-INCOIS Training Workshop was held in Hyderabad, 5 – 8 August 2025 for participants in Indian Ocean. Conducted in hybrid mode, this training workshop aimed to enhance technical capacity in ocean observations, data management, and operational services, while fostering regional collaboration.

This report presents the post-event impact evaluation of the DBCP–INCOIS Training Workshop 2025, conducted using Kirkpatrick Levels 1 (Reaction) and 2 (Learning).

Based on survey result the event engaged 22 participants from multiple countries across the Indian Ocean region, with 86% attending in person and 14% online. India (6) and Sri Lanka (3) had the largest groups, while most other countries sent 1–2 delegates, ensuring broad regional representation. The majority were first-time attendees (91%), bringing fresh perspectives to the program. Participants were highly qualified, with most holding postgraduate degrees, and came from multidisciplinary backgrounds including marine science, physics, climatology, meteorology, and engineering. Professionally, the group balanced researchers, meteorologists, and marine/technical specialists, enabling the workshop's outcomes to support both scientific advancement and operational ocean–climate services.

Findings show exceptionally high participant satisfaction (mean scores above 5.6-5.9 out of 6 and 3.6-3.9 out of 4) and strong self-reported learning gains (mean score 3.8 out of 4). Data also shows that 100% of respondents rated both satisfaction and learning as positive (Agree/Strongly Agree or Very Good/Excellent), indicating that the training met or exceeded participant expectations.

Qualitative feedback confirms significant improvements in understanding, technical skills, and exposure to new technologies and appreciation of regional collaboration.

2. Methodology

- Evaluation Framework: Kirkpatrick Model Levels 1 & 2
- Data Source: Participant feedback survey (n=22) elaborated with Participant's application form
- Data Collection: Immediately post-event
- Analysis: Quantitative scoring (%positive, mean scores), frequency distributions, and thematic analysis of open-ended responses

3. Profile of Participant

The countries representation shows that while India (6) and Sri Lanka (3) formed the largest groups, the majority of countries contributed 1–2 participants each, ensuring strong regional representation and inclusivity. This balance reinforces DBCP's goal of promoting regional collaboration, though future workshops could scale representation per country to maximize impact.

The gender distribution shows that while men are the majority (68%), women made up a substantial minority (32%), which is relatively strong for a technical capacity-building

workshop in this domain. Continued emphasis on inclusive participation strategies can help move closer to gender balance in future events.

The educational level shows a well-qualified and diverse participant pool, combining advanced academic expertise (M.Sc, PhD) with operational-level staff (B.Sc, technicians). This balance is valuable for capacity development, ensuring both conceptual understanding and practical application are strengthened

The educational background profile reveals that participants were largely drawn from physical and marine sciences, with additional representation from climate, meteorology, and technical fields. This multidisciplinary foundation supports the workshop's objectives of enhancing capacity in ocean observations and related applications.

The professional specialization profile highlights a research–operations–technical balance among participants. This mix ensures that knowledge from the workshop can be applied both in scientific development and operational ocean/climate services, though better data capture is needed to eliminate gaps.

4. Level 1 – Reaction

4.1 Trainer Quality

- Mean Score: 5.68/6 (trainers), 5.64/6 (effectiveness)
- % Positive (Excellent/Very Good): 96–100%
  Interpretation: Trainers were consistently rated as highly effective and professional, with unanimous positive ratings.

4.2 Variety of Methods

- Mean Score: 3.64/4
- % Positive (Agree/Strongly Agree): 100%
  Interpretation: Participants valued the diverse instructional methods, though fewer "strongly agreed" compared to other dimensions — indicating room to further diversify approaches.

4.3 Hands-on Usefulness

- Mean Score: 3.68/4
- % Positive: 100%
  Interpretation: Practical sessions were highly valued, with most strongly agreeing on their usefulness.

4.4 National Report Usefulness

- Mean Score: 3.68/4
- % Positive: 100%
  Interpretation: The national report component was considered a valuable element for sharing experiences and fostering collaboration.

4.5 Overall Satisfaction & Logistics

- Overall Workshop Rating: 5.86/6 (96% Excellent/Very Good)
- Organization & Communication: Above 5.7/6 across indicators Interpretation: The workshop was very well-organized, with smooth logistics and communication.

5. Level 2 – Learning

5.1. Understanding & Skills

- Score 5 (Strongly Improved): 9 participants (40.9%)
- Score 4 (Improved): 13 participants (59.1%)
- Mean Score: 4.41
- % Positive (≥4): 100%

Interpretation: All participants reported improvement in understanding and skills, though more than half rated it as "Improved" rather than "Strongly Improved", indicating potential to enhance depth of learning for more participants.

5.2. Qualitative Learning Themes

1. Improved Understanding of Ocean Observation Importance
    - "Yes, it focused on making us understand the importance of ocean observation."
    - "I now understand the importance of data sharing for the Ocean Network."
2. Enhanced Technical Knowledge & Methods
    - "Enhanced my understanding… particularly in data collection methods, quality control…"
    - "Deep understanding… Applicability of buoys, determination of water contamination, real-time monitoring of vessel movement."
3. Skills in Data Management & Quality Control
    - "...skills in ocean observation, particularly in data collection methods, quality control…"
4. Awareness of New Technologies
    - "I was fully aware about new technologies which have to be taken into consideration back home."
5. Collaboration & Networking Benefits
    - "Importance of data sharing for the Ocean Network."
    - "...importance of regional collaboration."

6. Key Findings

- High satisfaction with trainers, delivery methods, and practical sessions.
- Strong reported learning outcomes, especially in technical knowledge, data management, and applications to forecasting.
- 100% positive ratings for both reaction and learning.
- Qualitative data reinforce quantitative results, emphasizing knowledge gains, technology awareness, and regional collaboration.

7. Recommendations

- Continue the strong emphasis on practical, hands-on components.
- Allocate more time for interactive sessions (labs, exercises, site visits).
- Expand coverage of new technologies and modelling applications (storm surge, tsunamis).
- Provide recordings and materials for continued reference and for online participants.
- Maintain the high quality of trainers and logistical support.

8. Conclusion

The DBCP–INCOIS Training Workshop 2025 achieved **outstanding outcomes** at Kirkpatrick Levels 1 and 2. Participants were highly satisfied with the training content,

delivery, and relevance, and reported significant learning gains that align closely with the workshop’s objectives.

9. Complete Evaluation
