



सत्यमेव जयते

Ministry Of Earth Sciences  
Government of India

# 75 Years of Earth Sciences in India



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Azadi Ka  
Amrit Mahotsav



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2023

# INTRODUCTION

India has made tremendous strides since its independence in the field of Earth System Science, dealing with all the five components of the Earth System, viz., Atmosphere, Hydrosphere, Cryosphere, Lithosphere and Biosphere and their complex interactions.

From providing weather, climate, ocean, coastal state, hydrological and seismological services to forecasting various natural disasters and monitoring tsunamis and earthquakes, India has established itself as a leader in this field. Over the past 75 years, India has developed advanced technologies to better understand the planet we live on.

This coffee table book provides a comprehensive overview of the achievements of the Ministry of Earth Sciences and its contributions to the global scientific community. This book celebrates India's achievements in the field of Earth System Science and showcases the inspiring stories of the organizations behind these remarkable accomplishments.

Through its engaging narratives, this book is a testament to the Ministry of Earth Sciences' commitment to building a sustainable and resilient future for generations to come.



**Shri Kiren Rijiju**



Ministry of Earth Sciences  
Government of India



**Minister**  
**Ministry of Earth Sciences**  
Government of India,  
Prithvi Bhawan, opposite India  
Habitat Centre  
Lodhi Road, New Delhi 110003

### Message

It is with great pleasure that I write the message for this book that celebrates India's achievements in the field of Earth System Science.

Our country is blessed with a diverse landscape, ranging from the mighty Himalayas to the vast expanses of the Indian Ocean. This diversity has inspired generations of scientists and researchers to explore the workings of our planet. This coffee table book showcases some of the most remarkable achievements of India's Earth Science research community and the organisations working to advance the frontiers of knowledge.

I hope this book will inspire young people to pursue careers in this exciting field and contribute to the betterment of our planet.

I would like to congratulate the authors of this book for their excellent work. I am confident that this book will be a valuable addition to the library of anyone interested in Earth System Science.



**Dr. M. Ravichandran**



Ministry of Earth Sciences  
Government of India



**Secretary**  
**Ministry of Earth Sciences**  
Government of India,  
Prithvi Bhawan, opposite India  
Habitat Centre, Lodhi Road,  
New Delhi 110003

### Message

I am delighted to present this coffee table book that celebrates India's remarkable progress in the field of Earth System Science. As the Secretary of the Ministry of Earth Sciences, it is a proud moment to publish this book that looks back at the tireless journey of 75 years.

This book highlights our advances in areas such as weather forecasting, ocean and coastal research, and disaster management, while showcasing some of our innovative programs such as the Deep Ocean Mission.

I would like to take this opportunity to acknowledge the hard work and dedication of our visionary leaders, dedicated scientists, researchers, and all staff who have made these achievements possible.

With this book, we hope to inspire the next generation of scientists to pursue research in this field.

I hope you enjoy reading this book as much as we have enjoyed putting it together. Let us continue to work towards a better understanding of our beloved planet.





## Ministry of Earth Sciences

Government of India

Prithvi Bhawan, opposite India Habitat Centre  
Lodhi Road, New Delhi 110003.



### Institutions of the Ministry of Earth Sciences

- Indian National Centre for Ocean Information Services
- India Meteorological Department
- National Centre for Seismology
- Indian Institute of Tropical Meteorology
- National Centre for Earth Science Studies
- National Institute of Ocean Technology
- National Centre for Medium Range Weather Forecasting
- National Centre for Coastal Research
- National Centre for Polar and Ocean Research
- Centre for Marine Living Resources & Ecology
- The Borehole Geophysics Research Laboratory



### Major Initiatives towards Development of Nation: Impacting Life of Citizens

#### Functions

1. To augment and sustain long-term observations of atmosphere, ocean, cryosphere and solid earth to record the vital signs of Earth System changes.
2. To develop forecasting capacity of atmosphere and oceanic phenomena through dynamical models and assimilation techniques and to build prediction system for weather, climate and hazards.
3. To understand interaction between components of earth systems and human systems at various spatial and temporal scales.
4. To explore polar and high seas regions of the earth towards discovery of new phenomenon and resources.
5. To translate knowledge and insights from Earth systems science into services for societal, environmental and economic benefit.
6. Development of ocean technology for exploration of oceanic resources and societal applications.

It observes, reports and gives timely warning in the changes of

- Weather
- Climate
- Ocean and coastal state
- Hydrology seismology
- Natural hazards
- It explores and connects all the marine resources in a sustainable manner
- Explores the three poles of the earth (Arctic, Antarctic, Himalayas)



#### Atmosphere

- Accurate and timely prediction of tropical cyclones.
- Tropical Cyclone Forecasts to 13 Countries.
- Developed Heat Action Plans to reduce heat-related mortality and morbidity in the country.
- 40 to 50 percent improvement in forecast accuracy of severe weather events in the recent five years.
- The High-Performance Computing (HPC) facility provides world-class weather and climate services.
- A third-party evaluation concluded that India's investment of nearly 1,000 crores through the Monsoon Mission and HPC yielded benefits worth rupees 50,000 crores to ~10.7 million below poverty line (BPL) agricultural households and 0.53 million BPL fisherfolk households over five years.
- Established a High Altitude Cloud Physics Laboratory (HACPL) at Mahabaleshwar for understanding clouds, aerosols and precipitation over the Western Ghats.
- Established a network of lightning detection sensors over India for monitoring and now-casting of lightning occurrences.
- Undertaken Cloud Aerosol Interaction Precipitation Enhancement Experiment (CAIPEEX) to quantify the efficacy of seeding in precipitation enhancement over a suitable location in India.
- Agrometeorological Advisories reach about 43 million farmers.

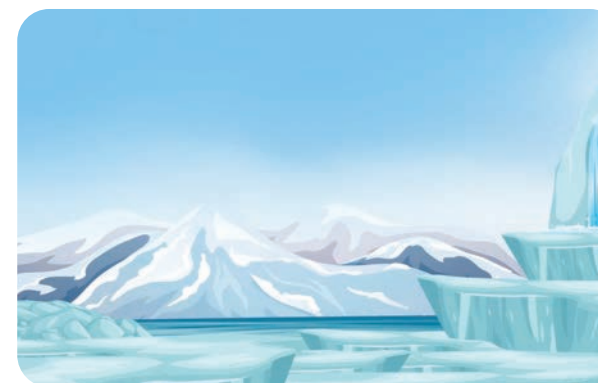






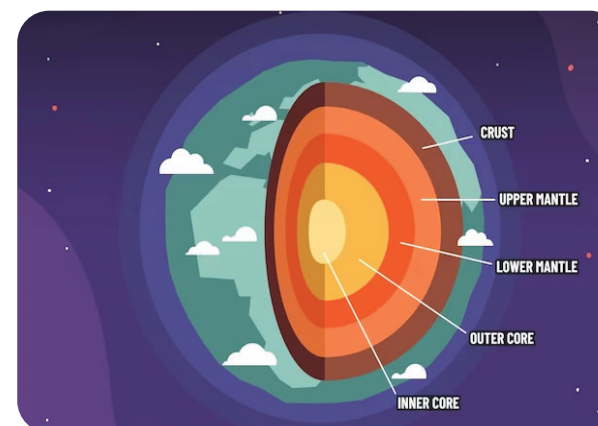
## Hydrosphere

- Potential Fishing Zone advisories to about 7 lakh fisherfolk.
- Forecast on the state of the ocean to about 9.45 lakh stakeholders in India and also to 6 countries in the Indian Ocean.
- Tsunami early warnings for India and to 25 Indian Ocean Rim Countries.
- Ocean services related to coral bleaching, harmful algal blooms, high waves, swell surges, oil spill trajectories, marine search and rescue information, etc.
- Commissioned an environment-friendly Desalination plant in January 2020 at Kalpeni in Lakshadweep Islands to generate potable water.
- Implemented Innovative Coastal Engineering Techniques to restore beaches lost due to erosion in Puducherry, Tamil Nadu, Kerala and Orissa.
- Commissioned two new coastal research vessels--Sagar Tara and Sagar Anveshika.
- A comprehensive web-based coastal change information system has been developed to facilitate coastal managers in the development and shoreline management.
- Marine Pollution is being monitored along Indian Coast and information has been utilised by the Ministry of Statistics and Programme Implementation for the implementation of SDG-14.
- Developed Marine Spatial Plans for Lakshadweep and Pondicherry.
- Created a comprehensive database containing about 1, 20,000 records of more than 6500 marine species with their location, depth, taxonomic classification and hydrographic data.
- Development of Gagan Enabled Mariner's Instrument for Navigation and Information (GEMINI) for effective and seamless dissemination of ocean and weather information to fisherfolk and other maritime users in the open ocean.
- Established the International Training Centre for Oceanography (ITCOOcean) that is recognised as a Category 2 Centre of UNESCO for providing training to countries in the Indo-Pacific region.
- The Deep Ocean Mission, India's ambitious plan to explore and harness deep-oceanic resources was approved and implementation has started.
- First time in the world, locomotion trials of the Deep Sea Mining System were successfully conducted in the Central Indian Ocean at depth of 5270 m. This is the maximum depth at which such a machine was successfully tested anywhere in the world.
- A shallow water Personnel Sphere for human occupancy was successfully tested at a depth of 610 m in the Bay of Bengal.



## Cryosphere

- Established a high-altitude research station in Himalaya called HIMANSH at above 13,500 ft (> 4000 m) at a remote region in Spiti, Himachal Pradesh, to map the Benchmark Glaciers and its discharges.
- Upkeeping two stations in Antarctica and one station in the Arctic facilitating >100 scientists/ year in doing R&D work. Bharati Station in Antarctica facilitates the acquisition of data from the Indian Remote Sensing Satellites.



## Lithosphere

The seismological network was upgraded to 150 stations (from 86) to provide a more accurate estimate of preliminary earthquake parameters, which will enhance the scientific understanding of earthquakes.

- MoES launched several mobile applications such as Meghdoot (Weather+Agriculture), Mausam (weather), Damini (Lightning), SAFAR AIR (air quality), SARAT (oil slick pollution), RISEQ (now Bhookamp), Thoondil (for fisherfolk. (fix this word)), which have helped disseminate real-time information on weather, Ocean, and seismological services.
- Launched The Earth System Science Data Portal (ESSDP) for the Archival and Dissemination of data.
- India's first Earth System Model (ITM-ESM) contributed to global and regional climate change assessments of the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6) and participated in the Coupled Model Intercomparison Project - Phase 6 (CMIP6).
- The National Climate Change Assessment report documenting the regional climate change projections was released to benefit students, researchers, and policymakers.





## Indian National Centre for Ocean Information Services

Ocean Valley, JNTU Road Near ALEAP Industrial Area  
Pragathi Nagar, Nizampet, Hyderabad, Telangana 500090

Total  
Staff  
Strength  
**181**



### Vision

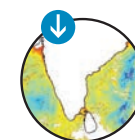
To emerge as a Knowledge and Information Technology Enterprise for the oceanic realm.



### Mission

To provide ocean data, information and advisory services to society, industry, the government and the scientific community through sustained ocean observations and constant improvements through systematic and focused research in information management and ocean modelling.

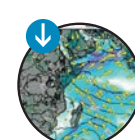
## Important Initiatives



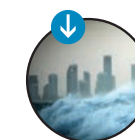
Potential  
Fishing  
Zone (PFZ)  
Advisories



Algal  
Blooms  
Information  
Services



Ocean State  
Forecast  
Services



Tsunami  
Early  
Warning  
System



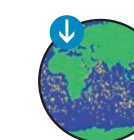
Storm  
Surge  
Warnings



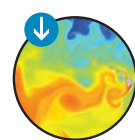
Coral Reef  
Mapping  
and Reef  
Health  
Monitoring



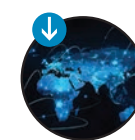
Multi Hazard  
Vulnerability  
Mapping



Ocean  
Data and  
Information  
Services

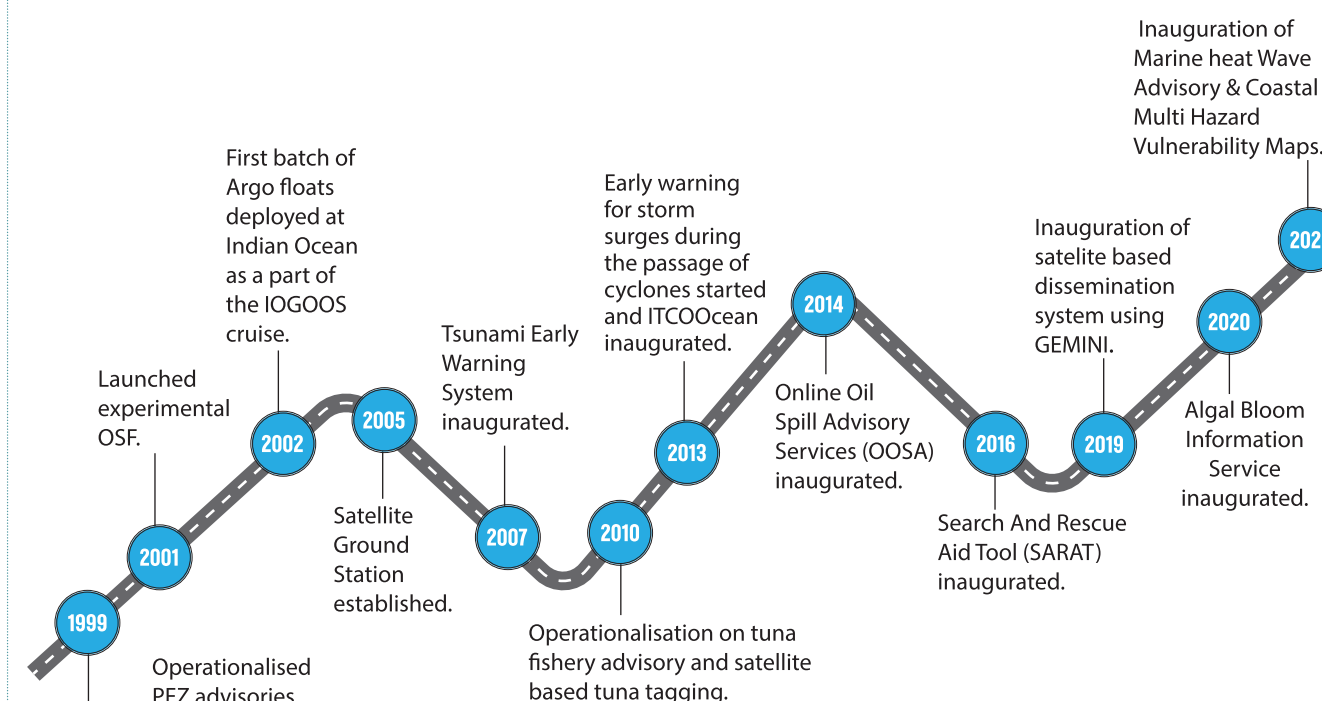


International Training  
Centre for Operational  
Oceanography



Hosts Secretariats of many  
International Frameworks Including  
IGOOS, SIBER, IIOE2 and IOR-DCC.

## Major Milestones







## India Meteorological Department

India Meteorological Department, Mausam Bhawan  
Lodhi Road New Delhi – 110003

Total  
Staff  
Strength  
**3823**



### Vision

- Meteorological observations & forecast for optimum operation of weather sensitive activities.
- No weather hazard to go undetected and unpredicted.

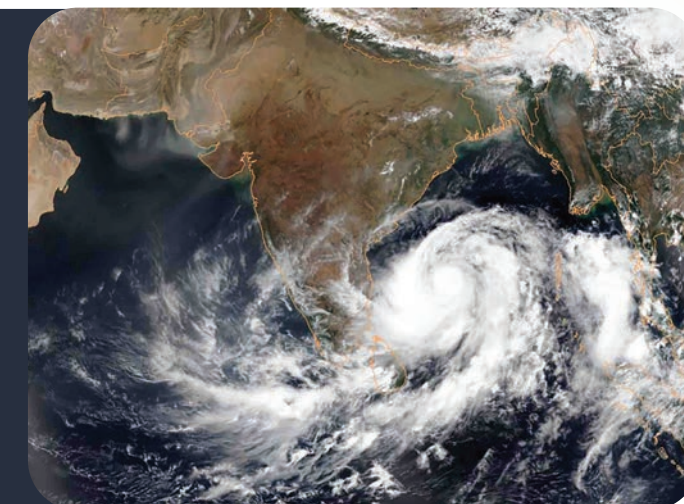


### Mission

- Accurate warnings against hazards with reasonable lead time triggering response from disaster managers and public to save life and property.
- Providing of weather & climate information for optimal use in socio-economic sectors.

## Important Initiatives

- Taking meteorological observations and providing current and forecast meteorological information for optimum operation of weather-sensitive activities.
- Warning against destructive weather phenomena.
- Providing meteorological statistics.
- Conducting and promoting research in meteorology and allied disciplines.



## Major Milestones



In the year 1875, the Government of India established the India Meteorological Department following the infamous Kolkata cyclone in 1864 and subsequent famines in 1866 and 1871.



One of the first few electronic computers introduced in the country was provided to IMD for scientific applications in meteorology. India was the first developing country in the world to have its own geostationary satellite, INSAT, for continuous weather monitoring of this part of the globe and particularly for cyclone warning.



From a modest beginning in 1875, IMD has progressively expanded its infrastructure for meteorological observations, communications, forecasting and weather services and it has achieved a parallel scientific growth by using contemporary technology.



IMD became the first organisation in India to have a message switching computer for supporting its global data exchange.







## National Centre for Seismology

Ministry of Earth Sciences, Government of India  
IMD Complex Mausam Bhavan, Lodhi Road,  
New Delhi - 110003  
Phone : +91-11-43824582



Total  
Staff  
Strength  
**82**



## Important Initiatives

1. Nodal agency of the Government of India for monitoring earthquake activity in and around the country.
2. At present, the National Seismological Network consists of 152 seismological observatories connected with VSAT.
3. The Operational Centre is equipped with state-of-the-art facilities for data collection, processing, and dissemination of earthquake information to user agencies through various modes of communication.
4. Involved in estimating earthquake source processes and related research, and monitoring earthquake swarms and aftershocks.
5. Monthly Seismological Bulletins are prepared and published.
6. Seismic Hazard Risk and Assessment is carried out by developing earthquake risk resilient parameters which serve as vital input for constructing earthquake resilient structures.
7. Seismic Microzonation study has been completed for a number of cities in India.

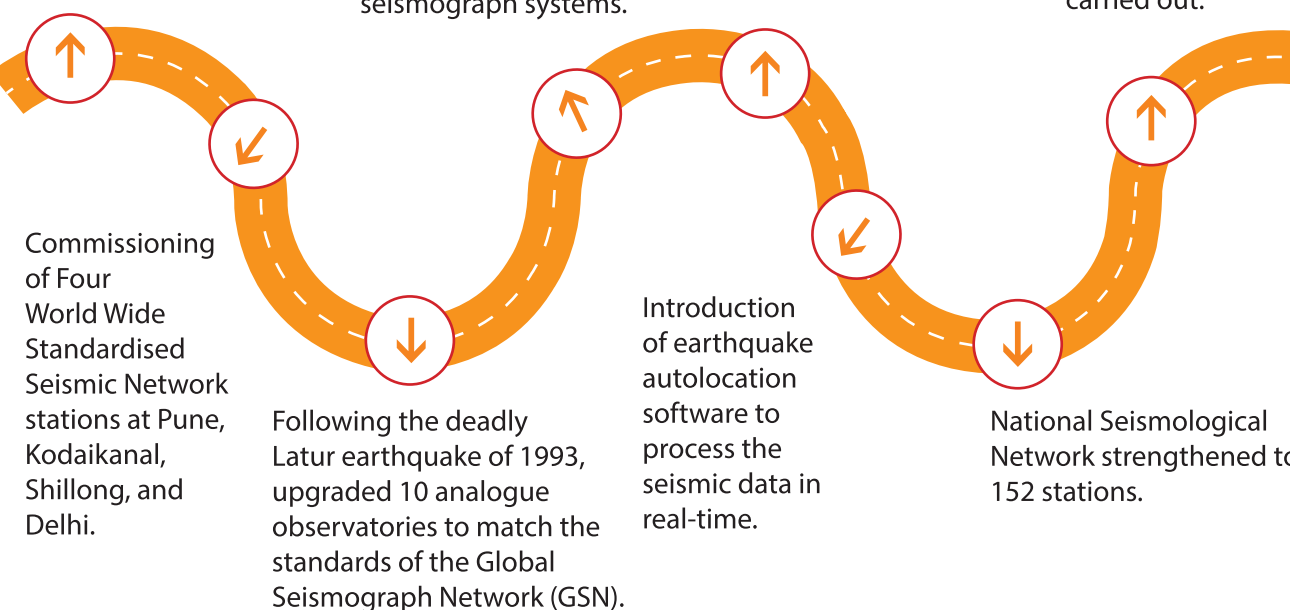
## Major Milestones

The first seismological observatory of the country was established at Alipore (Calcutta) on 1st December 1898.

14 more analogue observatories of the national network were upgraded with similar digital broadband seismograph systems.

16 station Digital Seismic Telemetry in and around NCR Delhi.

Seismic Hazard and Risk Assessment program under which Seismic Microzonation studies in many parts of the country had been finished and in many cities it is being carried out.



### Vision

To work towards creating a seismic resilient society.

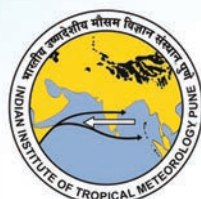


### Mission

Understanding the earthquake source processes and their effects through earthquake monitoring and seismological research to build earthquake-safe society.







## Indian Institute of Tropical Meteorology Pune

Dr. Homi Bhabha Road, Pashan  
Pune 411 008, Maharashtra

 Total  
Staff  
Strength  
**182**



### Vision

To make IITM a global centre of excellence through basic research on all aspects of Tropical Ocean-Atmosphere System required to improve weather and climate forecasts.

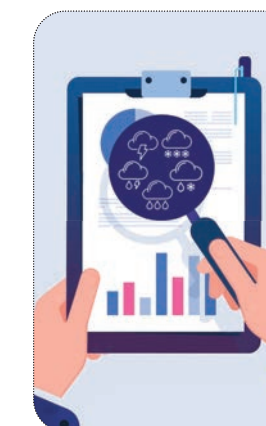


### Mission

- To develop outstanding research talent capable of understanding and exploring enlightened and effective atmospheric sciences.
- To further the advancement of research in ocean atmosphere by undertaking relevant scientific programmes.
- To collaborate with other similar research institutions, in the development and application of climate study.

## Important Initiatives

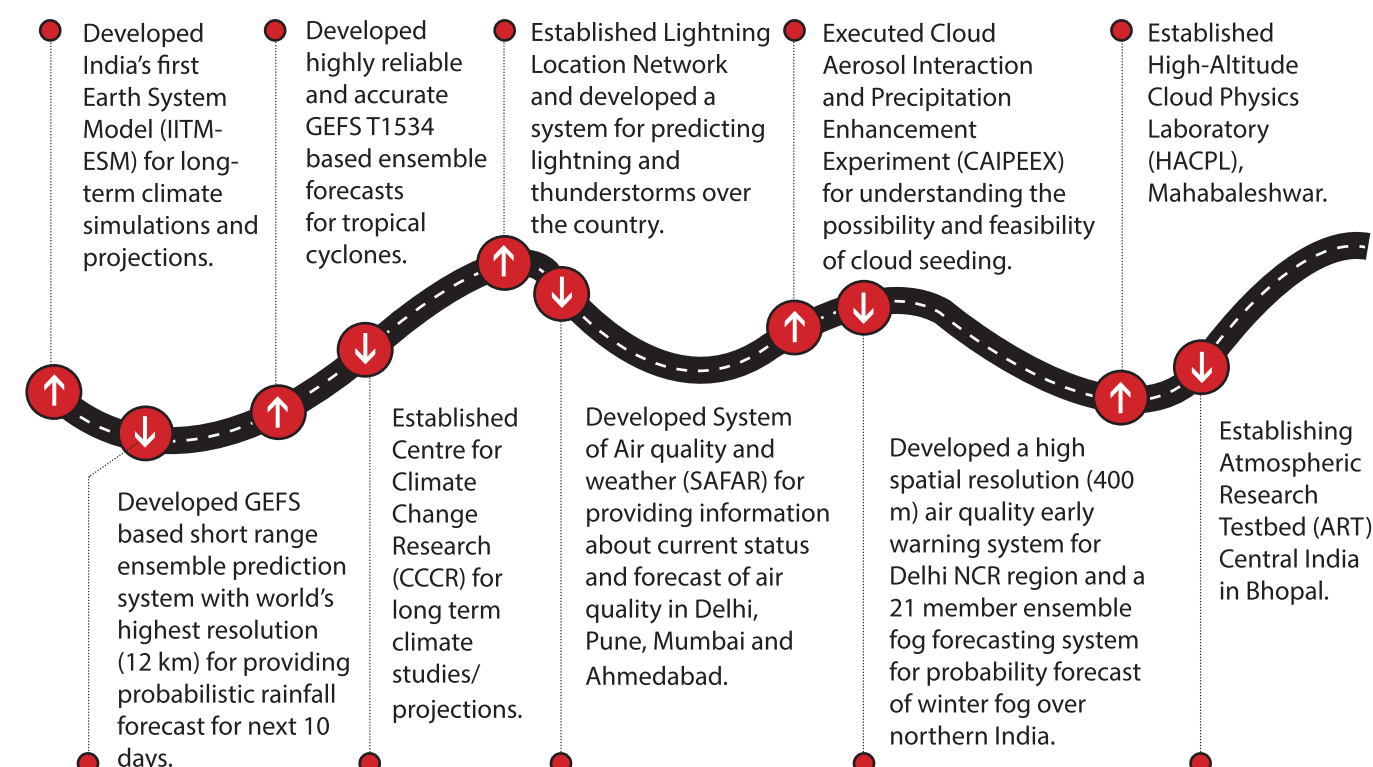
IITM's R&D has helped improve weather and climate forecasts on different spatial and temporal scales over India. Many of the weather and climate prediction products developed by IITM have already been handed over to IMD for operational forecasting. Developed long period rainfall time series for various time scales over the whole country including the most remarkable and classical All India Summer Monsoon Rainfall series (1871-2016). Institute's scientific expertise has potential applications in country's agriculture, economics, health, renewable energy, water resources management, transportation, communications, etc.



IITM is actively contributing in human resource development and capacity building in weather and climate sciences through academic training. Committed in disseminating weather and climate information to stakeholders through websites and mobile apps including Damini – Lightning Alert, SAFAR-Air and Mumbai Weather Live.

## Major Milestones

Developed country's first coupled forecast model Monsoon Mission Climate Forecast System (based on NCEP CFS) for making high resolution predictions about the Indian Monsoon on different space and time scales, with one of the best skills for monsoon forecasts in the world.







## National Centre for Earth Science Studies

Post Box. No. 7250, Akkulam  
Thiruvananthapuram-695011, Kerala, India



Total  
Staff  
Strength  
**157**



### Vision

To excel in Solid Earth Research and its applications.



### Mission

To foster multi-disciplinary research in emerging areas of Solid Earth Science and provide services by utilizing the knowledge for Earth Science applications and generate leadership capabilities in selected areas of geosciences.

## Important Initiatives

NCESS is an authorized institution of Govt. of India for HTL/LTL demarcation, and Govt. of Kerala for River Sand Mining Certification (while functioning under KSCSTE). NCESS is also a Coastal Ocean Monitoring Unit of MoES. The earthquake data from Peechi station contribute to national seismological network. As part of major research projects, the scientists of NCESS estimated a series of palaeomagnetic poles to trace geodynamics of Indian Ocean region; carried out petrological studies on nature of mantle sources, their development and partial melting; brought out causative factors for the landslide incidences and land subsidence in parts of the Western Ghats region and prepared district level hazard maps for risk assessment and management; applied fluid inclusion and laser Raman spectroscopy technique to assess the quality of oil inclusions in terms of API gravity in the Cenozoic sedimentary strata off the west coast; prepared CZMP Maps in 1:25K and 1:4000 scales as per standard specification of CRZ Notification 2011 for Kerala state and two districts of Maharashtra state; coordinated the Submarine Groundwater Discharge determination along east and west coasts of India. The projects of NCESS like CRZ mapping, groundwater recharging using rainwater harvesting and subsurface dykes, watershed management planning, beach protection, de-siltation of dams, etc., and the research on landslides, soil piping, earthquake, coastal hazards, lightning, flooding, climate change, and other natural hazards have direct social impact. NCESS assisted the government in formulating National Water Policy 2012 and its subsequent revisions till 2018 and in formulating mitigation policies of natural disasters. NCESS bagged prestigious awards viz. Bhatnagar prize, INSA Award, National Mineral Award, M. S. Krishnan memorial award, National Geoscience Award, Outstanding Geologist award, etc..

## Major Milestones

Centre for Earth Science Studies (CESS) was established as an autonomous institute to carry out multidisciplinary studies in Earth Sciences (1978).

CESS was brought under Kerala State Council for Science, Technology and Environment (KSCSTE) within the S&T Department of Govt. of Kerala (2003).

NCESS became an autonomous R&D centre of the MoES, GoI with key research objectives on understanding and addressing the geological evolution of peninsular India, complexities of the coastal processes and for evaluation of natural hazards (2014).

NCESS shall merge into a single autonomous body of MoES under Earth Science System Council (ESSC) along with four other autonomous institutes of the Ministry (2022).

Developed a reliable methodology to use video imaging for monitoring of beach-surf zone morphodynamics and nearshore waves including breaker wave-surf zone processes (2016).

Developed an Android application software "Geoscience Mapping APP (GeoMAPP)", a multi-function data collection application (2018).

Established a lightning monitoring system over southwest India (in collaboration with IITM, Pune). This real time lightning data/information is available to common people via the Android app 'Damini: Lightning Alert' developed by MoES (2018).

Establishment of National Geosciences data portal, a Data Repository with the capability to store and share all kinds of geospatial data viz., satellite, aerial, thermal images, geophysical and field monitoring data (2022).





## National Institute of Ocean Technology

NIOT Campus, Velachery-Tambaram Main Road  
Pallikaranai, Chennai, Tamil Nadu 600100



Total Staff Strength  
**197**



### Vision

To develop reliable indigenous technologies for ocean related research and to solve various engineering problems associated with harvesting of living and non-living resources in the Exclusive Economic Zone



### Mission

- To develop world class technologies and their applications for sustainable utilisation of ocean resources.
- To provide competitive, value added technical services and solutions to organisations working in the oceans.
- To develop a knowledge base and institutional capabilities in India for management of ocean resources and environment.

## Important Initiatives

- Providing safe drinking water to the remote islands of Lakshadweep using NIOT's Low Temperature Thermal Desalination (LTTD) technology.
- Development of steel personnel sphere for manned submersible which can carry three human beings to 500 meters water depths.
- Deployment of In-situ soil tester for seabed soil assessment and testing.
- Development and deployment of remotely operated submersible ROSUB 6000 in the Bay of Bengal for locating aircraft debris and search operations.
- Renewable Energy from Oceans - Ocean Thermal Energy Conversion (OTEC), Wave powered buoys etc.
- Demonstration of technology for re-creation of lost beaches in open coasts using innovative methods and materials at Puducherry and Kadalur fishing villages, Tamilnadu.
- Developed and successfully demonstrated Open sea cage culture in Rameswaram.
- Moored buoy systems of NIOT captures signals of cyclones in the Bay of Bengal and the Arabian Sea. The buoys constantly observe changes in the deep oceans for early detection of Tsunami for early warning.
- Development and deployment of Indigenous passive acoustic monitoring systems to aid climate change studies and autonomous Ambient Noise Measurement System (ANMS) for deep water applications.
- Development of acoustic sub bottom profiler for shallow water applications.
- Several innovations and products in Ocean Electronics demonstrated and transferred to industries.
- Highly dedicated state of the art vessels for marine deployments and deep water data collection studies.

### Collaboration with other companies and countries

MoUs and partnership with several world class universities and countries for mutual collaboration in Ocean Science and technology research and for joint development of machines and associated technologies for deep sea mining and testing of materials, structural elements, and a ready-made habitable capsule for the piloted submersible. Scientific studies and DPR for state government bodies and industries.

## Major Milestones

- First plant installed at Kavaratti island, UT Lakshadweep to provide safe drinking water using NIOT LTTD Technology (2005).
- First tsunami detecting open ocean buoys deployed by NIOT to strengthen nation's tsunami warning systems (2006).
- Soil assessment tests at CIOB at 5418 m depths using In-situ Soil Tester (2019).
- Seabed locomotion trials at 3420 m depths in BoB using mining machine (2020).
- Human acclimatisation endurance test with the shallow water sphere for proposed Samudrayaan.
- IMD Certificates of Merit for NIOT vessels.
- National Geoscience Award 2010.
- National Meritorious Invention Award 2018.
- CII Best Innovative Practices Award 2020.
- Top 24 rating in Agri India Hackathon 2020.





## National Centre for Medium Range Weather Forecasting

Ministry of Earth Sciences, A-50, Sector-62,  
NOIDA, UP, Pin: 201 301

Total  
Staff  
Strength  
**40**



### Vision

To develop advanced Numerical Weather Prediction System with increased reliability and accuracy.



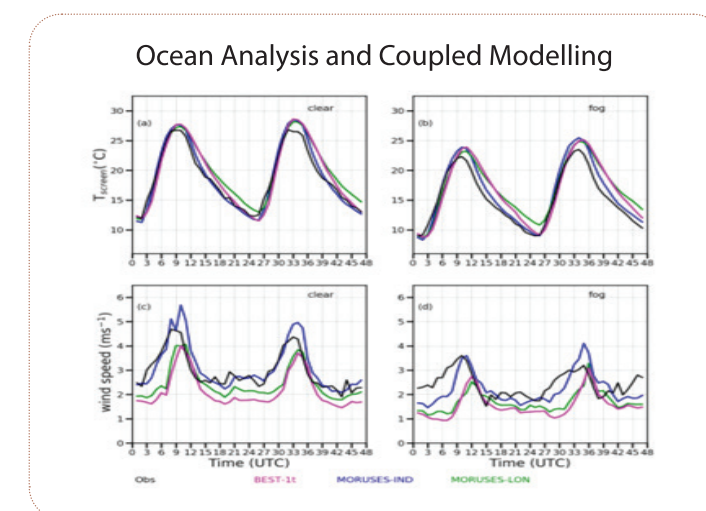
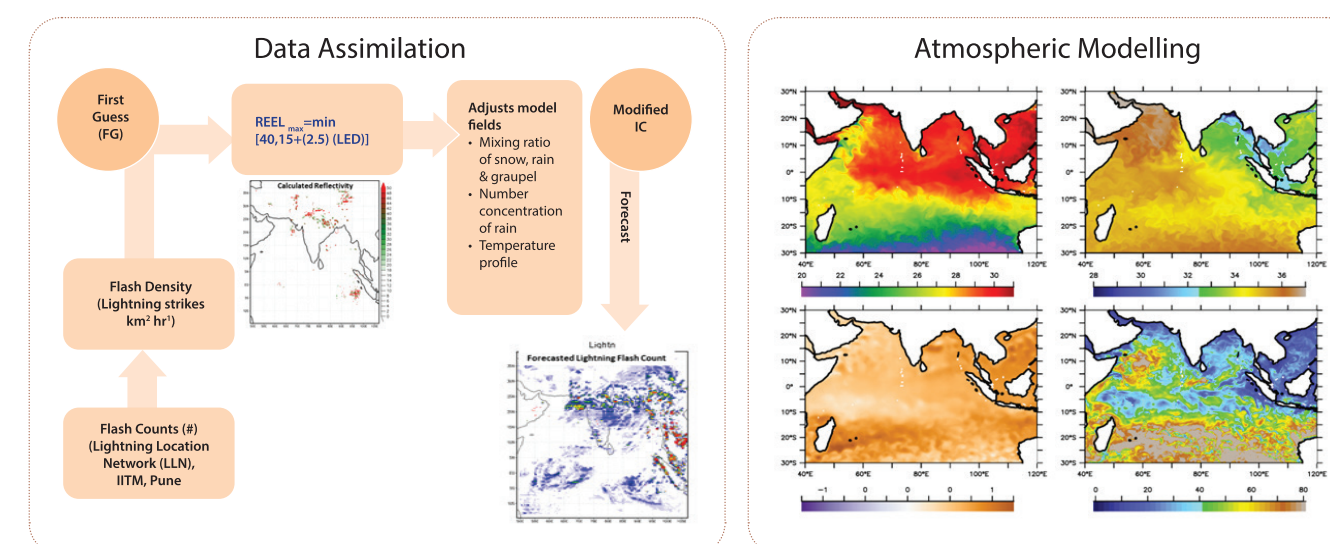
### Mission

To continuously develop next generation of numerical weather forecasts, in terms of reliability and accuracy over India and neighboring regions through research, development and demonstration of new and novel applications, maintaining highest level of knowledge, skills and technical bases.

## Important Initiatives

1. Improvement of weather and climate prediction system.
2. Develop global/regional coupled model across scales.
3. Develop the GFS/WRF Data Assimilation systems.
4. Development of novel applications based on dynamical model outputs for various sectors (viz. defence, energy, water resource, transport, geo-hazards etc.).
5. Establishment, maintenance and enhancement of physical, computational and associated infrastructure for carrying out research and development activities.
6. Continue and reinforce the activities of BIMSTEC Centre for Weather and Climate at NCMRWF (BCWC).

## Major Milestones



### NCMRWF Plans (2021-26)

1. Development of NWP Applications for Defense Sector
2. Developing next generation numerical weather forecast systems
3. Enhance the R&D efforts in data assimilation
4. Development of seamless deterministic and probabilistic prediction system along with their diagnostic and verifications
5. Enhance the utilisation of satellite data and model products for societal and important sectoral applications





## National Centre for Coastal Research

NIOT Campus, Velachery-Tambaram Road  
Pallikaranai, CHENNAI - 600100

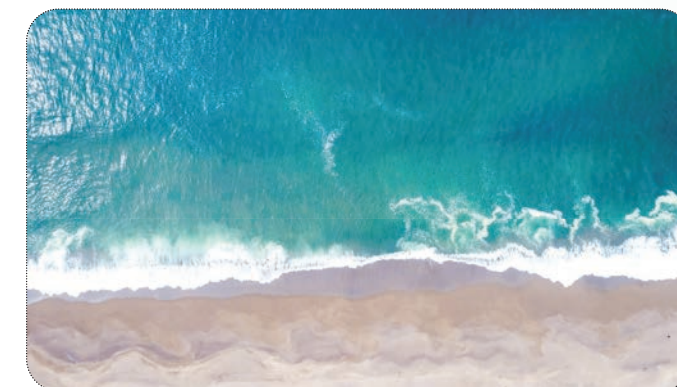


Total Staff Strength  
**133**

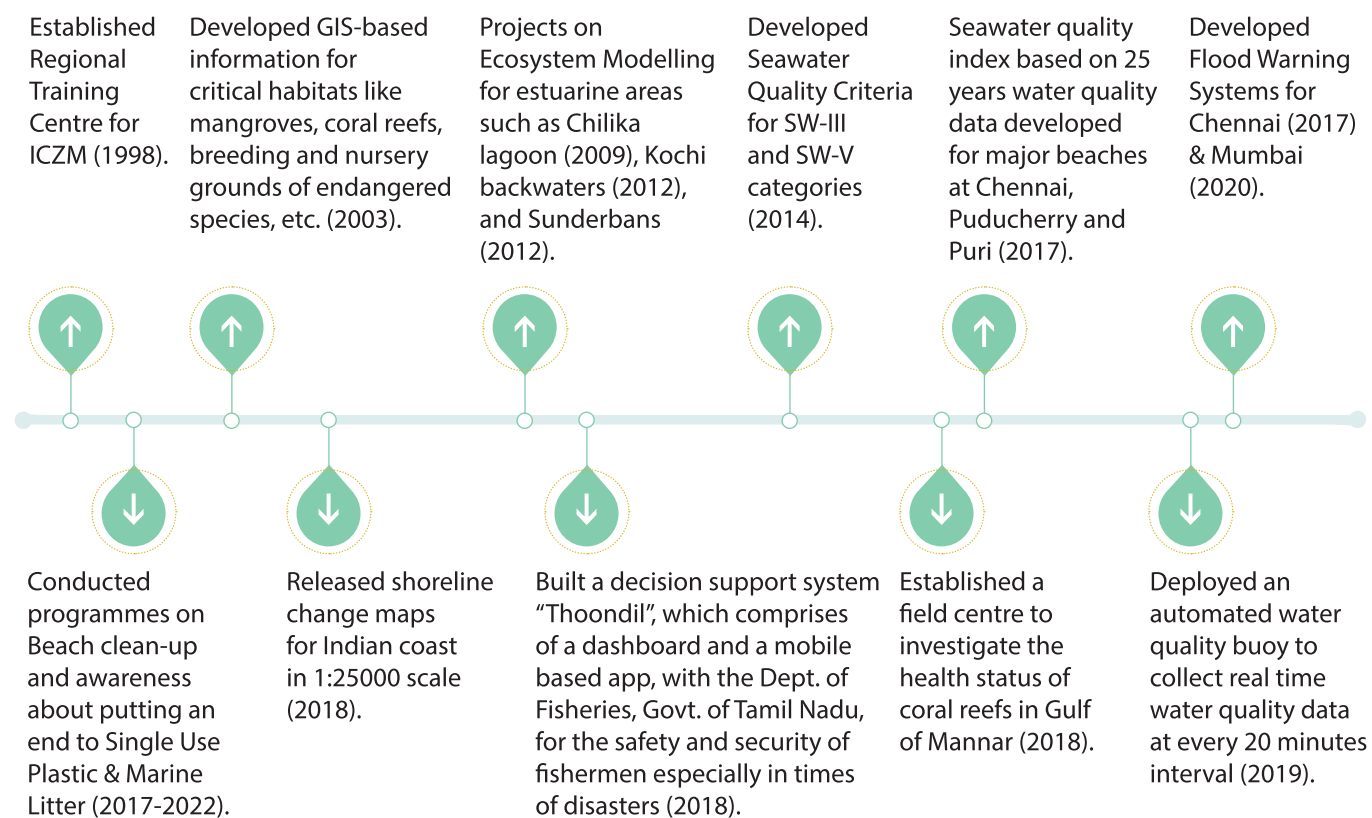


## Important Initiatives

- To provide best possible technological and scientific services / support for sustainable management of coastal areas by developing and improving capabilities related to coastal water quality, coastal processes, shoreline management, coastal hazards- vulnerability and coastal ecosystems through multi-disciplinary and integrated research programmes.
- To provide scientific and technical support to coastal states and stakeholders for effective management of coastal areas and resources.



## Major Milestones



### Vision



To be a centre of excellence for coastal research and offer scientific, advisory and outreach services to the coastal states and stakeholders for sustainable management of the coastal areas.

### Mission



To carry out multi-disciplinary research related to coastal water quality, coastal process, shoreline management, coastal hazards-vulnerability and coastal ecosystems for the benefit of society and environment.







## National Centre for Polar and Ocean Research

Ministry of Earth Sciences, Government of India  
Headland Sada, Vasco-da-Gama, Goa 403 804, India

Total  
Staff  
Strength  
**295**



### Vision

Plan, coordinate, and execute polar science and logistics activities to maintain India's presence in the polar regions, uphold our strategic interests, and be recognized globally.



### Mission

To ensure a perceptible and influential presence of India in polar and surrounding oceans through scientific expeditions, knowledge sharing and research publication.

## Important Initiatives

### Functions at a glance

1. The only polar centre that enabled a coordinated and centralised study of Antarctica, Arctic, and Southern Ocean.
2. Undertakes major projects on long-term climate studies.
3. Conducts strategically important surveys like, mapping of the entire Exclusive Economic Zone of India, legal continental shelf, and exploration of hydrothermal sulphide mineral deposits in the deep ocean.

### Major Missions

- Execution of Indian Polar Programs to Antarctica, Arctic, Southern Ocean and Himalaya and geoscientific studies.
- Operations and Management of Polar Stations (Maitri and Bharati in Antarctica; Himadri in Arctic and Himansh in Himalaya) and Research vessel- Sagar Kanya.
- These programs help to understand the impacts of climate change on the pristine polar environments.
- Also, how the consequences of climate change will impact the Indian climate system, including the monsoon.

### Thrust projects

- Indian Antarctic Program
- Indian Arctic Program
- Southern Ocean Studies
- Past Climate and Oceanic Variability
- Polar Remote Sensing
- Polar Biology
- Polar Environment
- Polar Atmosphere
- Geosciences (Integrated Ocean Drilling Programme (IODP)), (Commission on the Limits of the Continental Shelf (CLCS)), (Indian Ocean Geoid Low (IOGL)); (Exclusive Economic Zone (EEZ)) Hydrothermal.

## Major Milestones

- Represents India at several international forums dedicated to polar and ocean research.
- Establishment of research basis in Antarctica, Arctic, and Himalaya.
- For the first time, identified many new morphological features in the Indian EEZ region which had significant implications for mineral exploration and scientific research.
- Discovered two new hydrothermal vent mineralisation sites in the Central Indian Ridge.
- Ice-core laboratory established at NCPOR for the first time in India.
- Deployment of IndARC, an indigenous technology under Indian Arctic programme.





## Centre for Marine Living Resources and Ecology

LNG Rd, Puthuvype, Kochi, Kerala 682508



Total Staff Strength  
**28**



### Vision

Marine Living Resources and Ecology and ecology (CMLRE) under the Ministry of Earth Sciences is a national facility to undertake R & D activities related to the marine living resources of Indian EEZ through ecosystem monitoring and modelling studies, to enable the policy makers and managers to derive strategies for the optimum and effective utilization of marine living resources through ecosystem management.



### Mission

The Marine Living Resources Programme envisages survey, assessment and harnessing of the marine living resources and studies on their response to changes in the physical environment with the objectives of developing an ecosystem model for the management of the living resources in the Indian EEZ.

## Important Initiatives

Scientists in CMLRE has been taking a lead role in correlating living marine resources to the physical and biogeochemical environment and developing an ecosystem approach to the management of these resources. Extensive ship-based field observations have been carried out during the last two decades to understand the influence of physical processes on the biogeochemical and biological implications. The findings are significant to elucidate the Greenhouse Gases fluxes, anthropogenic effects, fishery oceanography and marine food-chain. Information related to the biodiversity including marine mammals of the northern Indian ocean is collated in a single platform (Indobis) accessible for making comprehensive biodiversity assessment and its applications to deep-sea oceanographic and fishery-related issues. Efforts were developed for continuous assessment of the abundance and distribution of fish egg and larvae of the economically important small pelagic fishes in the coastal waters of Indian EEZ by ship based "Continuous underwater Fish Egg sampler". Numerous taxonomic catalogues on various deep-sea organisms were published for scientific outreach activities.

## Major Milestones

- Multidisciplinary and multi-institutional R&D programmes on marine living resources covering the entire Indian EEZ onboard FORV Sagar Sampada have brought out benchmark information on the physical, chemical and biological processes, impact of short-long term environmental changes on the community/species, the dynamics of ecosystems and its biodiversity.
- The Referral Centre, aptly christened "Bhavasagara" or "the ocean of worldly life," has been established for the safe storage of deep sea organisms collected during FORV Sagar Sampada cruises. The facility holds approximately 3,200 voucher specimens collected from the Indian EEZ and Areas Beyond National Jurisdiction (ABNJ) which includes 24 new species and 67 new geographical records of deep-sea marine organisms.
- The centre represents the country in the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR) which was established for management of the Southern Ocean resources particularly the krill- single species with largest total biomass.
- CMLRE, recognized as the regional node of the Ocean Biodiversity Information System (OBIS) for the northern Indian Ocean functions as a national data archival centre for marine biodiversity information documenting the diversity, distribution and abundance of marine life. Currently, 1,10,000 occurrence records of marine biota, collated from primary and secondary sources, have been contributed to the OBIS database.
- The centre has initiated the process of acquiring status of a Designated Repository for safe deposit of holotypes/isotypes/paratypes of new marine taxa discovered in Indian seas and beyond including the islands.
- The centre deals with the new global implementing agreement namely "Biodiversity beyond national jurisdiction-BBNJ" under the United Nations Law of the sea.
- For the first time, upwelling over the south-eastern Arabian Sea, an important physical mechanism driving the entire ecosystem dynamics, its associated biogeochemistry has been tracked completely from its onset to offset.
- Major hotspots regions of harmful algal blooms within the Indian exclusive economic zone were identified. A species- specific satellite algorithm to Noctiluca, diatom and mixed bloom were developed.



BGRL

## Borehole Geophysics Research Laboratory

C/O National Centre for Seismology, Govt. of India,  
Ministry of Earth Sciences, Hazarmachi, Karad-Vita Road  
Karad 415 105, Dist. Satara, Maharashtra



Total  
Staff  
Strength  
**30**



### Vision

To emerge as an institution of international repute housing highly specialized geophysical, geological, seismological and geotechnical expertise and facilities dedicated to earthquake research.



### Mission

- To understand the genesis of reservoir-triggered earthquakes by establishing a fault zone observatory at depth through scientific deep drilling.
- Integration of real-time borehole datasets with surface-based observations and laboratory experimentation to address fundamental problems of earthquake physics.

## Important Initiatives

1. Artificial water reservoirs generate hydropower besides contributing to irrigation and flood control, but they can cause anthropogenic seismic activities under geologically favourable conditions.
2. BGRL conducts deep drilling investigations to understand earthquake genesis, which may lead to improvement in the predictive capability of earthquakes and realistic assessment of seismic hazards.

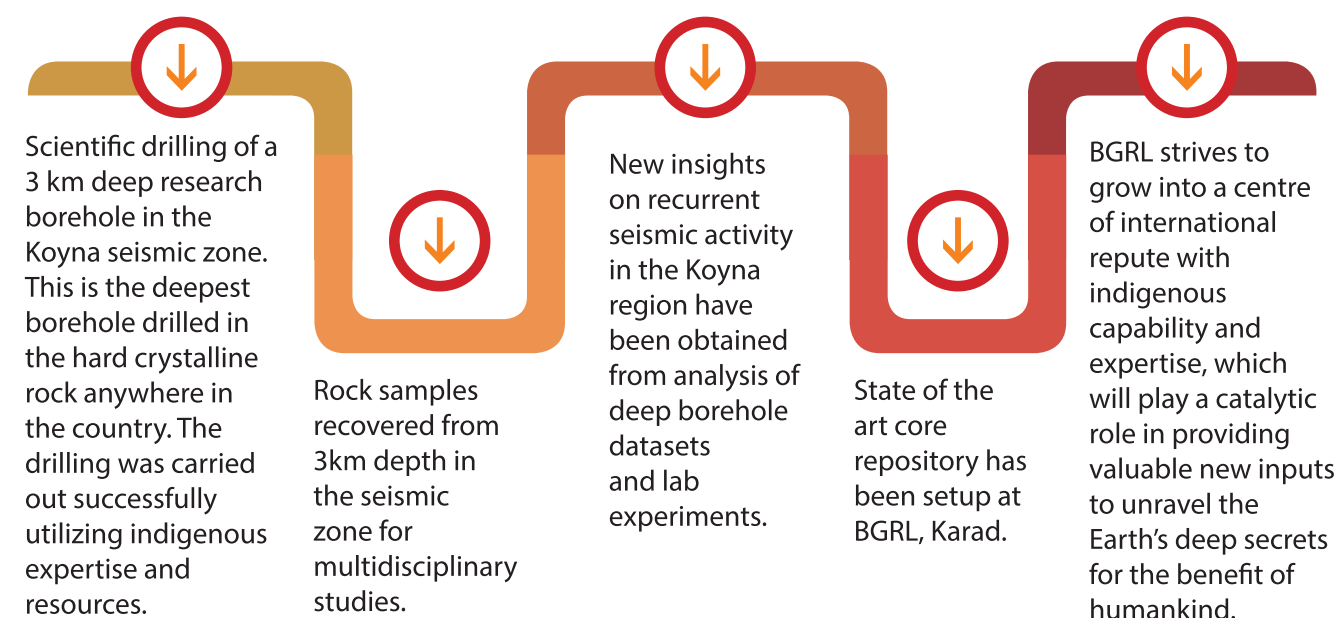
### Functions at a glance

1. Scientific deep drilling into active seismic faults
2. Deep borehole measurements and monitoring
3. Core curation
4. Education and outreach
5. Provides scientists a variety of samples from depths of up to three kilometers (km) below the earth's surface
6. Its upcoming labs will offer immense potential for young researchers to carry out innovative and socially-relevant projects.

### Forming the organisation

1. Borehole Geophysics Research Laboratory (BGRL) established at Karad by the Ministry of Earth Sciences, Government of India to implement its flagship program "Scientific Deep Drilling in the Koyna Intraplate Seismic Zone, Maharashtra"
2. Started functioning as a project office since October 07, 2014: Initiated scientific activities as well as development of R&D infrastructure simultaneously
3. R&D infrastructure ready by 75th year Independence
4. The first of its kind research centre in India to address the multi-disciplinary areas of Earthquake Science - earthquake geology, borehole geophysics, seismology, rock mechanics/rock physics and modelling.

## Major Milestones







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# Ministry of Earth Sciences

Government of India



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