Ministry of Earth Sciences

Brief account of Achievements (2014-23)

- **Enhanced Observing system**: Established state-of-the-art observation, data, modelling and forecasting systems covering Ocean, Coast and Atmospheric domains for provision of operational services to a broad spectrum of blue economy stakeholders ranging from farmers to coastal fishermen.
- **Improved cyclone prediction:** Accurate and timely prediction of tropical cyclones, combined with fieldwork by disaster management agencies, helped save thousands of precious lives. The average track forecast error has reduced from **93 km to 74 km** and from **201 km to 153 km** in 24-hours and 72-hour forecasts respectively during the periods (2013-2017) & (2018-2022) respectively. There has been a **40 to 50 percent improvement in forecast accuracy** of other severe weather events like heavy rainfall, fog, heat/cold waves, thunderstorm in recent five years. High resolution ensemble global/regional models and satellite data assimilation were developed for these applications.
- **A very high-resolution (400 m) operational air quality prediction system** has been developed to forecast air pollution events in Delhi and issue timely warnings to take necessary steps as per the newly designed Graded Response Action Plan (GRAP) of the Government of India.
- **Heat Action Plans** developed in collaboration with NDMA and state governments to reduce heat-related mortality and morbidity in the country.
- The **High-Performance Computing (HPC) facility augmented** to about 10 PFlops to provide world class weather and climate services, by high resolution weather and coupled climate modelling.
- 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.**
- **Twenty new Doppler Weather Radars** have been commissioned in the country during 2014-23 taking the total number to 37, which provide information on severe weather events occurring over the region and support disaster management authorities.

- **A high altitude cloud physics laboratory (HACPL) was established at Mahabaleshwar** for understanding clouds, aerosols and precipitation over the Western Ghats using state-of-the-art measurement facilities.
- **A network of lightning detection sensors** has been established over India for monitoring and now-casting of lightning occurrences.
- **Weather Modification/Management:** Cloud Aerosol Interaction Precipitation Enhancement Experiment (CAIPEEX) undertaken to quantify the efficacy of seeding in precipitation enhancement over a suitable location in India
- **Atmospheric Research Testbed** is an open field observatory spread in 100 acres of land (50 km northwest of Bhopal in Sehore District of Madhya Pradesh) being established for better understanding on the processes governing monsoon convection and land-atmosphere interactions over the core monsoon region using the state-of-the-art observational systems such as Radars, Wind Profilers, UAVs etc. This Atmospheric Research Testbed will be a unique facility in the Tropical region. A Dual-polarimetric C-band Doppler Weather Radar was commissioned in the above facility recently for detailed precipitation process studies in the core monsoon zone.
- **India's first Earth System Model (IITM-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, released to benefit students, researchers, and policymakers.
- **Potential Fishing Zone advisories** to about 7 lakh fishermen, Forecast on state of the ocean to about 9.45 Lakh stake holders in India and also to 6 countries in the Indian Ocean. Tsunami Early Warnings for India and to 25 Indian Ocean Rim Countries
- Provision of **Tsunami Early Warnings for India** and to 25 Indian Ocean Rim Countries and other important ocean services related to coral bleaching, harmful algal blooms, high waves, swell surges, oil spill trajectories, marine search and rescue information, etc.
- A comprehensive web-based coastal change information system has been developed to facilitate coastal managers in the development and shoreline management.
- Integrated **Flood Warning System** (i-flows) was developed for Chennai and Mumbai and put into operation.

- **Marine Pollution** is being monitored along Indian Coast and information has been utilised by Ministry of Statistics and Programme Implementation for implementation of SDG-14
- Marine Spatial Plans are being developed for Lakshadweep and Pondicherry under Blue Economy imitative of Indo- Norway collaboration
- A comprehensive database containing about 1, 20,000 records of more than 6500 marine species have been created with complete details of location, depth, taxonomic classification and hydrographic data.
- **Three environment friendly Desalination plants** have been commissioned in Lakshadweep Islands to generate potable water. Three more desalination plants are being set up in the Lakshadweep islands.
- Innovative Coastal Engineering Techniques implemented to **restore beaches lost due to erosion** in Puducherry, Tamil Nadu, Kerala and Orissa.
- **Two new coastal research vessels—Sagar Tara and Sagar Anveshika commissioned**, in partnership with India's private sector, boosting the vision of 'Make in India', to monitor coastal Ocean and its related research.
- **The Deep Ocean Mission**, India's ambitious plan to explore and harness deep-oceanic resources was approved and started implementation.
- **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 successful tested anywhere in the world
- **Established the International Training Centre for Oceanography (ITCOOcean)** that is recognised as a Category 2 Centre of the UNESCO for providing training to countries in the Indo-pacific region.
- **A high-altitude research station in Himalaya called HIMANSH was established, situated 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 Arctic facilitating >100 scientists / year in doing R&D work. Bharati Station in Antarctica facilitates acquisition of data from the Indian Remote Sensing Satellites.
- **The Antarctic Bill** was passed by the Parliament on August 01, 2022. The bill was enacted as the Indian Antarctic Act on August 06, 2022. It aims at having India's own

national measures for protecting the Antarctic environment and dependent and associated ecosystem.

- On March 17, 2022, India released its **Arctic Policy** entitled 'India and the Arctic: Building a partnership for sustainable development'. It is aimed to prepare the country for a future where the biggest challenges facing humankind, such as climate change, can be successfully addressed only through collective will and effort.
- Seismological network was upgraded to 152 stations (from 86) to provide a more accurate estimate of preliminary earthquake parameters, which will enhance the scientific understanding of earthquakes.
- The seismic **microzonation work of four cities**, Bhubaneswar, Chennai, Coimbatore and Mangalore, is at advanced stage of completion and work related to eight more cities (Patna, Meerut, Amritsar, Agra, Varanasi, Lucknow, Kanpur and Dhanbad) has been started and various Geophysical & Geotechnical surveys are in progress.
- Borehole Geophysics Research Laboratory (BGRL), Karad has undertaken scientific deep drilling and associated investigations in the Koyna seismic zone, Maharashtra. **A pilot hole of 3 km depth has been drilled.** Detailed geophysical measurements carried out in the borehole provided critical new information regarding the subsurface geology, temperature, physical and mechanical properties and the state of stress to 3 km depth in the seismogenic zone.

- **An Earth System Science Data Portal** (ESSDP) of MoES (https://incois.gov.in/essdp) was launched on 27 July 2021. The ESSDP hosts about 1050 metadata records of data collected and maintained under different programs implemented by MoES over the years and link them to the respective data centres. It facilitates ease of search and discovery of various data-sets by different search criteria. ESSDP serve the increasing data-discovery needs of a wide range of users including research institutions, operational agencies, strategic users, academic community, industry, policy makers and the public.

- MoES launched **several mobile applications** such as Meghdoot (Weather+Agriculture), Mausam (weather), Damini (Lightning), SAFAR AIR (air quality), SARAT (oil sleek pollution), RISEQ (now Bhookamp), Thoondil (for fishermen), which have helped disseminate real-time information on weather, Ocean, and seismological services.

- Development of Gagan Enabled Mariner's Instrument for Navigation and Information (GEMINI) for effective and seamless dissemination of ocean and weather information to fishermen and other maritime users in the open ocean.
- **Swachh Sagar Surakshit Sagar Campaign:** India has over 7,500 kilometres of coastline and about 30% of the country's population lives on the coast and derives their livelihoods from the oceans. Litter especially in the form of plastics in the marine environment are a major concern and growing international problem and a number of studies have shown their harmful impact on marine biodiversity, ecosystems, fisheries, human health and economy. As a part of the "Azadi Ka Amrit Mahotsav", the Ministry of Earth Sciences along with other Ministries/Departments of Government of India, Voluntary Organizations, and the local society ran a 75-day long "Swachh Sagar, Surakshit Sagar" cleanliness campaign at 75 beaches along India's entire coastline. The campaign which was launched on 05th July 2022 and culminated on "International Coastal Cleanup Day" on 17th September 2022 was intended to bring a mass behavioural change among the masses by raising awareness about how plastic usage is destroying our marine life. About 1500 tonnes of marine litter and Scientific data and information on Marine Litter in various matrices, such as coastal waters, sediments, biota, and beaches were collected.