

MINISTRY OF EARTH SCIENCES**DEMAND NO.29****Ministry of Earth Sciences**

A. The Budget allocations, net of recoveries, are given below:

		<i>(In crores of Rupees)</i>								
		Budget 2009-2010			Revised 2009-2010			Budget 2010-2011		
Major Head		Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total
	Revenue	612.12	307.50	919.62	578.42	338.62	917.04	718.21	299.50	1017.71
	Capital	287.88	2.50	290.38	214.58	2.38	216.96	281.79	2.50	284.29
	Total	900.00	310.00	1210.00	793.00	341.00	1134.00	1000.00	302.00	1302.00
1.	Secretariat - Economic Services	3451	...	19.00	19.00	...	19.25	19.25	...	22.99
2.	<i>Oceanographic Research</i>									
2.1	Oceanographic Survey (ORV and FORV) and Marine Living Resources(MLR)	3403	...	38.25	38.25	...	40.30	40.30	...	39.88
2.2.	Polar Science	3403	94.00	...	94.00	94.00	...	94.00	145.00	...
2.3.	Coastal Research Vessels & Other Research Vessels	3403	5.00	...	5.00	5.00	...	5.00	7.00	...
2.4.	Polymetallic Nodules (PMN) Programme	3403	13.00	...	13.00	12.00	...	12.00	15.00	...
2.5.	<i>Other Programmes</i>									
2.5.1	Information Technology	3403	10.00	...	10.00	10.00	...	10.00	7.00	...
2.5.2	Ocean Observation and Information System (OOIS)	3403	15.00	...	15.00	15.00	...	15.00	23.00	...
2.5.3	Data Buoy Programme / Integrated Sustain Ocean Observation	3403	18.00	...	18.00	18.00	...	18.00	15.00	...
2.5.4	National Institute of Ocean Technology (NIOT)	3403	50.00	...	50.00	50.00	...	50.00	45.00	...
2.5.5	Delineation of Outer Limits of Continental Shelf	3403	1.00	...	1.00	1.00	...	1.00	1.00	...
2.5.6	Comprehensive Topography Survey	3403	6.00	...	6.00	6.00	...	6.00	6.00	...
2.5.7	Gas Hydrates	3403	35.00	...	35.00	35.00	...	35.00	12.00	...
2.5.8	Acquisition of Research Vessels "Sagar Nidhi"	3403	22.00	...	22.00	22.00	...	22.00	20.00	...
2.5.9	Tsunami and Storm Surge Warning System	3403	15.00	...	15.00	12.00	...	12.00	12.00	...
2.5.10	National Center for Antarctic and Ocean Research (NCAOR)	3403	15.00	...	15.00	15.00	...	15.00	15.00	...
2.5.11	Indian National Center for Ocean Information Services (INCOIS)	3403	20.00	...	20.00	20.00	...	20.00	25.00	...
2.5.12	Sea front facilities	3403	0.50	...	0.50	...	...	0.50	...	0.50
2.5.13	Development of manned submersible	3403	5.00	...	5.00	0.50	...	0.50	5.00	...
2.5.14	Multichannel Seismic System onboard ORV Sagar Kanya	3403	0.01	...	0.01	0.01	...	0.01	0.50	...
2.5.15	Expedition to Arctic Region	3403	2.60	...	2.60	2.60	...	2.60	3.00	...
2.5.16	Desalination Plant	3403	5.00	...	5.00	5.00	...	5.00	5.00	...
2.5.17	National Oceanarium	3403	2.00	...	2.00	2.00	...	2.00	1.00	...
2.5.18	Demonstration of Shore Protection Measure	3403	5.00	...	5.00	5.00	...	5.00	5.00	...
2.5.19	Integrated Ocean Drilling Programme & Geotechnic Studies (IODP)	3403	10.00	...	10.00	10.00	...	10.00	6.00	...
2.5.20	Ice Class Research Vessel	3403	0.50	...	0.50	0.50	...	0.50	25.00	...
2.5.21	Head Quarter Building	5403	25.00	...	25.00	25.00	...	25.00	...	25.00

		(In crores of Rupees)								
Major Head	Budget 2009-2010			Revised 2009-2010			Budget 2010-2011			
	Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total	
2.5.22 Marine Research and Technology Development (MRTD)	3403	62.00	...	62.00	57.00	...	57.00	69.73	...	69.73
	3601	...	...	...	...	...	...	1.00	...	1.00
	5403	3.00	...	3.00	4.50	...	4.50	7.77	...	7.77
	<i>Total</i>	<i>65.00</i>	<i>...</i>	<i>65.00</i>	<i>61.50</i>	<i>...</i>	<i>61.50</i>	<i>78.50</i>	<i>...</i>	<i>78.50</i>
2.5.23 NIOT extension Centre, West Bengal	3403	0.01	...	0.01	0.01	...	0.01	0.05	...	0.05
2.5.24 R & D in Earth and Atmospheric Sciences	3403	35.00	...	35.00	29.00	...	29.00	45.00	...	45.00
2.5.25 Centre for Climate Change	3403	25.00	...	25.00	25.00	...	25.00	45.00	...	45.00
2.5.26 Multi-hazards Early Warning Support System	3403	10.00	...	10.00	5.50	...	5.50	5.00	...	5.00
Total Other Programmes		397.62	...	397.62	375.62	...	375.62	430.55	...	430.55
Total Oceanographic Research		509.62	38.25	547.87	486.62	40.30	526.92	597.55	39.88	637.43
3. Meteorology										
3.1 Direction & Administration	3455	...	21.00	21.00	...	23.80	23.80	...	22.41	22.41
3.2 Training	3455	...	2.50	2.50	...	2.84	2.84	...	2.71	2.71
3.3 Research & Development Programme	3455	...	21.20	21.20	...	19.20	19.20	...	22.38	22.38
3.4 Satellite Services	3455	...	10.00	10.00	...	12.60	12.60	...	13.23	13.23
3.5 Observatory and Weather Stations	3455	...	117.40	117.40	...	135.60	135.60	...	95.14	95.14
	5455	...	2.00	2.00	...	1.90	1.90	...	2.00	2.00
	<i>Total</i>	<i>...</i>	<i>119.40</i>	<i>119.40</i>	<i>...</i>	<i>137.50</i>	<i>137.50</i>	<i>...</i>	<i>97.14</i>	<i>97.14</i>
3.6 Other Meteorological Services	3455	...	59.50	59.50	...	63.49	63.49	...	57.64	57.64
	5455	...	0.50	0.50	...	0.48	0.48	...	0.50	0.50
	<i>Total</i>	<i>...</i>	<i>60.00</i>	<i>60.00</i>	<i>...</i>	<i>63.97</i>	<i>63.97</i>	<i>...</i>	<i>58.14</i>	<i>58.14</i>
3.7 Other Programmes	3455	...	2.00	2.00	...	2.00	2.00	...	2.00	2.00
3.8 India Meteorological Department (IMD)										
3.8.1 Modernisation of IMD (Communication, Observation, Cyclone Warning, Forecasting, Aviation Services, Instrumentation, Infrastructural Development)	3455	6.00	...	6.00	6.00	...	6.00	16.00	...	16.00
	5455	166.38	...	166.38	130.88	...	130.88	149.00	...	149.00
	<i>Total</i>	<i>172.38</i>	<i>...</i>	<i>172.38</i>	<i>136.88</i>	<i>...</i>	<i>136.88</i>	<i>165.00</i>	<i>...</i>	<i>165.00</i>
3.8.2 Other Schemes in IMD	3455	52.50	...	52.50	45.30	...	45.30	69.98	...	69.98
	5455	85.50	...	85.50	54.20	...	54.20	86.02	...	86.02
	<i>Total</i>	<i>138.00</i>	<i>...</i>	<i>138.00</i>	<i>99.50</i>	<i>...</i>	<i>99.50</i>	<i>156.00</i>	<i>...</i>	<i>156.00</i>
Total IMD		310.38	...	310.38	236.38	...	236.38	321.00	...	321.00
Total Meteorology		310.38	236.10	546.48	236.38	261.91	498.29	321.00	218.01	539.01
4. Other Scientific Research										
4.1 National Centre for Medium Range Weather Forecast (NCMRWF)	3425	12.00	4.65	16.65	10.00	4.54	14.54	11.00	4.12	15.12
	5425	8.00	...	8.00	...	...	...	14.00	...	14.00
	<i>Total</i>	<i>20.00</i>	<i>4.65</i>	<i>24.65</i>	<i>10.00</i>	<i>4.54</i>	<i>14.54</i>	<i>25.00</i>	<i>4.12</i>	<i>29.12</i>
4.2 Indian Institute of Tropical Meteorology, Pune	3425	60.00	12.00	72.00	60.00	15.00	75.00	56.45	17.00	73.45
Total Other Scientific Research		80.00	16.65	96.65	70.00	19.54	89.54	81.45	21.12	102.57
Grand Total		900.00	310.00	1210.00	793.00	341.00	1134.00	1000.00	302.00	1302.00
C. Plan Outlay	Head of Dev	Budget Support	IEBR	Total	Budget Support	IEBR	Total	Budget Support	IEBR	Total
1. Oceanographic Research	13403	509.62	...	509.62	486.62	...	486.62	597.55	...	597.55
2. Meteorology	13455	310.38	...	310.38	236.38	...	236.38	321.00	...	321.00
3. Other Scientific Research	13425	80.00	...	80.00	70.00	...	70.00	81.45	...	81.45
Total		900.00	...	900.00	793.00	...	793.00	1000.00	...	1000.00

1. Secretariat Economic Services: The budget provision is for secretariat expenditure of the Ministry of Earth Sciences.

2. Oceanographic Research:

2.1. Oceanographic Survey (ORV & FORV) :- The Oceanographic Research Vessel (ORV) - Sagar Kanya and Fisheries Oceanographic Research Vessel (FORV) - Sagar Sampada have been primary platforms for conducting multi-disciplinary oceanographic research and surveys for the exploration of both non-living and living resources under the Exclusive Economic Zone (EEZ) including Central Indian Ocean Basin and Southern Ocean since 1984. These Vessels equipped with the state-of-the art technology will be used for conducting multi-disciplinary research on the physical, chemical, geological and biological aspects of the Indian Ocean. The vessels will also be utilized in campaigns for validating satellite oceanographic data, assessment of marine (living) resources and for various technology demonstration activities. Recently, these vessels have been refurbished for providing effective services.

Marine Living Resources:- The Marine Living Resources (MLR) programme was initiated during IX Plan towards assessment of the fishery resources and explaining the physical and biological interactions that regulate productivity, tropic structure of Indian continental slope area and international waters, with a view to understand and predict the inter-annual, decadal and long-term fluctuations in the marine fishery. These assessment surveys and monitoring activities under the programme are essential to harvest exploitable resources from the Indian EEZ. The provision of this sub-programme forms part of the programme on Marine Research and Technology Development. And also to the Development technology for commercial scale production of Ornamental fishes in hatchery set-up at Lakshadweep.

2.2. Polar Science (Antarctic Research) :- The Antarctic Research Programme has been designed to take advantage of the unique location and environment of the icy continent for understanding the key global processes which are manifested and controlled by this Polar cap. The Antarctic is a pristine and natural laboratory, which enables scientists to study, detect and monitor global phenomena, such as the atmospheric patterns and ocean circulations. Glaciological and geophysical research provides clue to the geological history and evolution of the earth. The important activities envisaged during the year 2010-11 would be (i) Planning, co-ordination and execution of all scientific and logistics tasks related to the XXX Indian Scientific Expedition to Antarctica, (ii) signing the contract for construction work at Larsemann hills after completion of all the ground work required for construction of 3rd station including shipping of the requisite prefabricated material, (iii) chartering of ice-class vessel to Southern Ocean. With regard to Arctic programme, the existing India's station "HIMADRI" will be equipped with field equipment and processing units and to continue long term scientific projects approved by the expert Group.

2.3. Coastal Research Vessels (CRV):- The three indigenously built coastal vessels "Sagar Purvi", "Sagar Paschimi" and "Sagar Manjusha" of the Ministry of Earth Sciences (MoES) would be utilized for continuous monitoring of pollution levels in the coastal areas to assess the health of the coastal waters of India. These vessels are equipped with appropriate and modern technological equipment. During 2010-11, these vessels would undertake cruises for this purpose. National Institute of Ocean Technology (NIOT) has been operating these vessels.

2.4. Polymetallic Nodules (PMN) Programme:- The work of survey and exploration is mainly directed towards assessing relative concentration and quality characteristics of nodules as well as seabed topography. Demarcation of grade of nodule deposits in the Central India Ocean Basin is one of the main objectives. Design and development of mining system has been reoriented so that the intermediate applications of the technology could be achieved before developing the ultimate system for a depth of 6,000 m. A crawler, in-situ samples, and ROSUB have been developed and tested at 410 m, 5200 m and 205 m respectively. A continuous demonstration pilot plant of 500 kg/day capacity of extraction of copper, nickel and cobalt from nodules was set up at Hindustan Zinc Limited, Udaipur and campaigns are continuing. EIA monitoring studies in the pioneer area for assessing the impact of the simulated mining at deep seabed is continuing at the site of nodules occurrence. During 2010-11, the Sea trials of integrated mining system with collector and crusher developed, ROSUB, Insitu Soil tester demonstration at 6000 m depth, Deployment of the Submersible with Gas Sensors at Gas Hydrate Site in KG basin and in Mahanadi basin, Deep Water testing of ACS in Indian waters and ACS & Deployment at Gas Hydrate Site will be conducted. Surveys of EEZ with multibeam system survey of CIOB nodule areas in the first generation mine site with a chartered a vessel will be conducted.

2.5. Other Programmes:-

2.5.1. Information Technology:- The budget provision for expenditure is made to strengthen the Information Technology, computerization as a part of e-governance activities of the Ministry and centres of Ministry of Earth Sciences. IT related communication facilities at Headquarters and other autonomous bodies have been strengthened and office automation software is under implementation.

2.5.2. Ocean Observation and Information System (OOIS):- The OOIS is designed to acquire time-series data and develop a wide range of ocean atmospheric models. The data acquired through Argo floats, Drifters, Current Meter Arrays from the sea around India are being used for various operational and research purposes including forecasting of cyclones and understanding the climate variability.

2.5.3. Data Buoy Programme/ Integrated Sustain Ocean Observation:- The programme is designed for strengthening the Data buoy network in the Indian Ocean to acquire real-time data on surface meteorological and upper ocean parameters for various operational purposes viz., weather forecast, improve monsoon prediction capability, coastal and offshore developmental activities. The programme is restructured to deploy 12 moored buoys in selected locations in the seas around India for continuous reception of the time-series data. Under the programme, the buoys would be produced indigenously by NIOT with possible private partnership. The work includes deployment; operation and maintenance of buoy network including dissemination of data in near real time to the potential users.

2.5.4 National Institute of Ocean Technology (NIOT):- The NIOT was established in November, 1993 with a view to develop technology in ocean sector. In addition to the four core mission activities of Ocean Energy, Deep Sea Mining, Coastal and Environmental Engineering and Marine Instrumentation, NIOT would also continue to undertake consultancy service in ocean related activities, Ocean Science & Technology and enhancement of marine living resources.

2.5.5. *Delineation of Outer limits of Continental Shelf*:- In accordance with provisions of the Convention on the Law of the Sea, India is entitled to delineate the outer limits of the continental shelf beyond (200 nautical miles) Exclusive Economic Zone (EEZ). The necessary geophysical data (over 33,000 line km) required for submission of claim has been acquired successfully. The delineation of the Continental margin in case of India is likely to give a large continental margin extending beyond EEZ.

2.5.6 *Comprehensive Topography Survey* : This programme entails scientific mapping of Exclusive Economic Zone (over 2 million sq. km.) area to have an inventory of potential resources and to identify the causes of hazards. The bathymetric survey beyond 500 mts. depth would be undertaken with chartered vessel.

2.5.7 *Gas Hydrates*:- Gas hydrates have the potential of providing total energy security to our nation. The programme consists of both scientific & technology development for gas hydrates. The Ministry, in association with CSIR and other laboratories, would focus on scientific research with special emphasis on resource extent evaluation and environmental impacts and development of technology for detection and qualification of gas hydrates in sediments. Development and integration of automatic coring system for conducting sea trials would be taken up. At Gas Hydrate Site in KG basin and in Mahanadi basin, Deep Water testing of ACS in Indian waters and ACS & Deployment at Gas Hydrate Site will be conducted.

2.5.8 *Acquisition of Research Vessels "Sagar Nidhi"*:- The Ministry's focus in the next 5 years will be to develop sustainable technology for the exploitation of various non-living resources. Suitable platform is required to replace the vessels and crafts chartered by the MoES at present for technology services and demonstration.

2.5.9 *Tsunami and Storm Surge Warning System*:- The objective of the project is to establish a warning system for the Oceanogenic disasters caused by Tsunami and storm surges. The project is being carried out with participation of other concerned departments such as Science and Technology (DST), Scientific and Industrial Research, Space over a period of 30 months. The project is expected to strengthen the 7 seismic observation station of DST, establishment of 8 -10 DART Observation Network, Installation of real time tide gauge monitoring stations, 24 hours monitoring of the systems for generation of timely warning, etc. A full-fledged Tsunami warning centre had been set up at INCOIS Hyderabad with deployment of 18 tide gauges and 6 bottom pressure recorders for providing warning on 24X7 basis. This centre has been recognized as Regional Tsunami Warning System for the Indian ocean.

2.5.10 *National Center for Antarctic and Ocean Research (NCAOR)*:- NCAOR is an autonomous society of the Ministry which coordinates the Indian Antarctic Research programme. Following the commissioning of a state of the art ice core archival and analytical facility at NCAOR, the Centre has embarked on a major programme on analytical studies of ice-cores retrieved from Antarctica. Carbon and pigment analyses of sediments samples collected from lakes of Antarctica are being done. This was earlier included in the Polar Science Programme. Special studies will be conducted in the southern ocean by strengthening the facilities at NCAOR. A dedicated expedition has been launched to the southern ocean for conducting multidisciplinary research.

2.5.11 *Indian National Center for Ocean Information Services (INCOIS)*:- The objective of INCOIS is to generate and disseminate user-oriented ocean data/data products on an operational basis. Data products in the form of Sea Surface Temperature maps, Potential Fishing Zone maps, Ocean State Forecast, wind vector maps, mixed layer depth maps, at least on heat-budget are being made available on operational basis. INCOIS is also responsible for implementation of Projects like Early Tsunami Warning System. A suite of ocean related data and data products are being made available through its web site. This was earlier included in the Ocean Observation and Information Services. Over 55 integrated Coastal Ocean Information kiosks have been established in the various locations along the coast for dissemination of Information. A High Performance Computing Facility has been installed to improve the services.

2.5.12 *Sea Front Facilities*:- The Ministry is implementing various oceanography research related programmes (both scientific and technology development). The technology development work being mainly carried out by NIOT, Chennai needs various sea-front facilities for creation of integration bay, test ponds, test bed for tow vehicles, Mari-culture and research labs, etc. Accordingly, NIOT is proposed to create a sea front facility to meet the research requirements of various programmes. This was earlier included in National Institute of Ocean Technology Programme.

2.5.13 *Development of manned submersible*:-The project is envisaged to develop a tool which will put India at par with developed nations having under water intervention capabilities.

2.5.14 *Multichannel Seismic System on board ORV Sagar Kanya*:- The requirement of multi-channel seismic facility has been felt on board over any research vessels due to growing demand of seismic survey for major programmes like Gas-Hydrate Studies, inter ridge Programme, limits of continental shelf programme, etc.

2.5.15 *Expedition to Arctic region* :- The understanding of climatic changes in the Arctic region and their consequences on global climate changes has relevance to Indian subcontinent as well. It is therefore proposed that during the ensuing XI Five Year Plan concrete efforts need to be made to launch the First Indian Scientific Expedition to the Arctic. Future emphasis would be laid on bi-hemispheric approach in understanding the vital issues related to environment/climatic changes. Accordingly efforts will also be made to initiate scientific programmes in the Arctic realm in consonance with the international endeavors in the Arctic being mounted under the Svalbard Treaty, SCAR, etc.

2.5.16 *Desalination Plant* : - NIOT has developed, and demonstrated commercial scale Low Temperature Thermal Desalination plant. During the XI plan, NIOT would take up a scheme to design, develop, and demonstrate the large scale desalination plants. The ultimate goal of the endeavour will be to establish such desalination plants along the coast and island territories of India to alleviate drinking water problem of coastal region. A set of 3 more plants one each in the islands of Lakshadweep islands are being set up.

2.5.17. *National Oceanarium*:- The main objective of this programme is to make learning about the oceans a family experience by means of promoting science tourism so that young children are motivated to opt for an ocean career later on as adults. The government would provide seed capital and the expertise to the interested parties under this scheme.

2.5.18 *Demonstration of Shore Protection measures* :- During X plan, the projects on Shoreline Management and Management of Tidal Inlets to understand the cause of erosion and siltation were initiated at inlets along the Indian coast. The project will be implemented through pilot project at selected sites along the Indian Coast and its performance is monitored.

2.5.19 *Integrated Ocean Drilling Programme & Geotechnical Studies (IODP)*:- The objective is to develop a science plan and initiation of deepdrilling through the IODP, in at least three scientifically significant sites, one each in the Arabian Sea, the Bay of Bengal and in the western Andamans.

2.5.20 *Ice Class Research Vessel*: With the proposed plans for undertaking multidisciplinary scientific programmes in the Southern Ocean, initiation of activities during establishment of a new permanent Indian base in the Larsemann hills and plans to expand Indian scientific endeavors to the Arctic region/northern hemisphere, it is felt that it is time for India to have her own Ice class research vessel which will (a) serve as a medium for transportation of men and material to Antarctica; (b) serve as a platform for the Indian scientists to undertake oceanographic studies in the sub Arctic and sub Antarctic regions and (c) serve the needs of the Indian scientific community year-round in the tropical waters as well as in the sea-ice conditions of the polar regions. The complete technical specification and design would be taken up after obtaining the approval of the Government. The Vessel will be acquired by NCAOR, Goa.

2.5.21 *Headquarter Building*: The present requirement is of full-fledged Building with a campus in Central Delhi of about 15000 sq. m. The necessary approval of construction of the building has been obtained. More than 50% work on construction has been completed. The building is likely to be commissioned during the year (July 2010).

2.5.22 *Marine Research and Technology Development (MRTD)* :- This scheme consists of well defined programmes addressing specifically various R & D aspects of marine science and technology. Besides Marine Living Resources, the Scheme covers programmes like Assistance for Research Projects, Coastal Ocean Monitoring and Prediction System (COMAPS), Exhibition & Fairs, Seminar & Symposia, Manpower Training, Marine Non-Living Resource Programme and Integrated Coastal and Marine Area Management (ICMAM). The details are given below:

(i) *Assistance for Research Projects*:- The objectives of this programme are to strengthen the infrastructure facilities in selected universities/ institutions to carry out basic research in marine science to create centre for excellence on Ocean, Atmospheric Science & Technology. Nine Ocean Science and Technology Centres (OSTC) were set up in universities/IIT.

(ii) *Coastal Ocean Monitoring and Prediction System (COMAPS)*:- The COMAPS programme has been in operation at 76 locations for collection and analysis of 25 parameters relating to physical, chemical and biological characteristics of water and sediments. Based on the data collected through this project, the areas of concern have been identified and steps are being taken to prevent and control the causes of pollution by supplying the information to the State Pollution Control Boards. The need for strengthening this long term programme arises in wake of the expanding areas of work relating to environmental concern. The data collected under the programme has been put in data base for presentation.

(iii) *Exhibition and Fairs*:- Provision has been made for promoting awareness in general public towards oceans around India and to highlight India's effort in the endeavor to explore

and exploit these resources for sustainable growth. Besides, the work would also be participation in a number of national and international workshops showcasing the activities of the Ministry.

(iv) *Assistance for Research Seminar & Symposia*:- The Ministry would continue to provide funds for organizing seminars, conferences, workshops, etc. for creating public awareness on oceans and atmospheric sciences.

(v) *Manpower Training*:- Provisions have been made to meet the objectives of the programme relating to the manpower training in Ocean and Atmospheric Sciences. Ministry would continue to support fellowships to develop specialized manpower.

(vi) *Marine Non-Living Resource Programme*:- Palaeo-oceanographic studies are being carried out in the Bay of Bengal Fan (BENFAN). A cruise is to be undertaken and investigations of cobalt rich seamount crust deep-sea mineral exploration are to be carried out.

(vii) *Integrated Coastal and Marine Area Management (ICMAM)*:- The programme has two components, namely (i) Capacity building and ii) Development of Infrastructure for R&D, Survey and Training for ICMAM. The component has four activities, namely, i) Development of GIS based information system for 11 critical habitats in the coastal and Marine Areas in India, ii) Determination of Waste Assimilation Capacity at selected estuaries along coastal areas of India iii) Development of Guidelines for Environmental Impact Assessment, iv) Preparation of Model Integrated Coastal and Marine Area Management Plans. Under the component on infrastructure, training, laboratory and other facilities have been established in the NIOT Campus, Chennai. Ecotoxicological studies and ecosystem modeling at selected locations will be carried out in addition to the above.

(viii) *Drugs from Sea*:- The programme is an ongoing project for supporting research in different participating R&D laboratories and inducting new institutions for exploratory and product development phases. After successful completion of clinical trial, the systematic collection, extraction and biological evaluation of sea weeds, sea grasses, mangroves, anemones, sponges, corals starfish, seahorses, poisonous fin-fish and associated organisms, etc., would be carried out to identify novel molecule(s) for developing potential drugs.

2.5.23 *NIOT Extension Centre, West Bengal*: The Centre in the eastern region will develop science, technologies and resources management specific to the regions of West Bengal and Orissa.

2.5.24 *R & D in Earth and Atmospheric Sciences*: In order to strengthen the basic research in the field of Atmospheric Earth Science, Seismicity and Earth Precursor programmes the Ministry proposes to take up a separate activity by leveraging the expertise available at various Universities and Research Organizations. This will be done through signing a separate MoU with the participating agencies to achieve the proposed targets.

2.5.25 *Centre for Climate Change*: The Program has three main components, namely, the Program Office, the Centre for Climate Change Research at IITM, Pune and the network of national research institutions that are already working on different aspects of climate change. In addition to this there are a number of departments, ministries and international agencies that require to be linked to both support the program and to get research inputs.

2.5.26 *Multi-hazards Early Warning Support System* : The objective of the programme is to develop disaster specific

adaptable management frameworks by integrating local scale lead-time impact assessment based on early warning, hazard mapping and risk management decision support systems (DSSs) with customized emergency preparedness mechanisms and to develop critical and fail-safe communication and customized systems of protocols [by integrating technologies for evolving emergency response strategies linked to improved multi-hazard early warning.

3. Meteorology

3.1 Direction & Administration: It provides expenditure for administration of India Meteorological Department (IMD).

3.2. Training: The training sections at Pune, New Delhi and Calcutta impart training in meteorology and in operation, maintenance and servicing of radio meteorological instruments and telecommunications.

3.3. Research and Development Programme: The Research and Development activities of the department cover experimental work and research on basic and applied meteorology and seismology including design and development of the instruments.

3.4. Satellite Services (Space Meteorology): IMD participated in space programme since the launching of the first Indian National Geo-stationary Satellite IA by ISRO in 1982. Valuable data & cloud imageries are being received since then. With the deployment of second generation INSAT II A in August 1992 there has been much improvement in the quality of data and cloud imageries. Secondary data utilization center have been established to receive and process satellite cloud imageries directly at the other main forecasting offices from Main Data Utilization Centre, New Delhi.

3.5. Observatories and Weather Stations: The activities consist of recording of observatories and equipping ships, maintenance of inland and overseas meteorological telecommunication network for quick exchange of weather information reception of satellite weather.

3.6. Other Meteorological Services :-The activities consist of manufacture, supply and maintenance of meteorological instruments and production of hydrogen gas at Departmental Workshops and supply of these to the upper air observatories. Provision also includes expenditure for agro meteorological units and facilities.

3.7. Other Programmes :- These include payments of India's annual contribution to World Meteorological Organization and the International Seismological Center.

3.8 India Meteorological Department (IMD)

3.8.1 Modernization of IMD (Communication, Observation Cyclone Warning, Forecasting, Aviation Services,

Instrumentation, Infrastructural Development):- The objective is improvement of weather forecast and climate prediction including the Indian monsoon. It is proposed to break the project of Modernization of IMD into various sub projects such as Doppler Weather Radars, Automatic Rain Gauge Network, Automatic Weather System, MFI, etc.

3.8.2 Other Schemes in IMD:- This includes Seismic hazard and Risk evaluation and Common Wealth Games & Dedicated Weather Channel. The IMD will work in collaboration with several other government operational and research agencies such as National Centre for Medium Range Weather Forecasting (NCMRWF), Indian Air Force, Indian Navy, Indian Institute of Tropical Meteorology (IITM), Pune, Department of Science & Technology, Department of Space and Centre for Atmospheric Sciences, Indian Institute of Technology (IIT), Delhi, Indian Institute of Technology, Kharagpur and Centre for Atmospheric and Ocean Sciences, Indian Institute of Sciences, Bengaluru to plan and implement the project. The project envisages of private entrepreneurs working on high-end computing, meteorological instrumentation, audio-visual equipments, GIS and GPS systems, etc. will be taken as done by NWS and UKMO in the past for other sport events. The coordinating organizations will have to work in tandem with the Organizing Committee of the CWG-2010 so that the system being proposed can be implemented along with IT components being planned by them.

4. Other Scientific Research:

4.1 National Centre for Medium Range Weather Forecasting (NCMRWF): The aim of the programme is to develop global circulation model for preparing weather forecasts upto three days in advance. Towards this objective a National Centre for Medium Range Weather Forecasting with super-computing facilities has been established. This institute will work on various atmospheric modeling aspects such as Global Modeling and Data Assimilation System, Mesoscale Prediction System, Extended- Range/Seasonal Prediction System, Computer/Network Infrastructure and Services, Satellite Radiance Data Assimilation System, Climate Modeling System, Environmental Prediction System and Computer/Network Infrastructure Upgradation.

4.2. Indian Institute of Tropical Meteorology, Pune: This institute will carry out primarily the research in atmospheric sciences including long range prediction of seasonal mean monsoon and extended range prediction of active/break spells, regional climate model, quantification of uncertainty in estimation of monsoon climate under climate change scenarios and study of sensitivity of the estimate of monsoon climate under climate change.