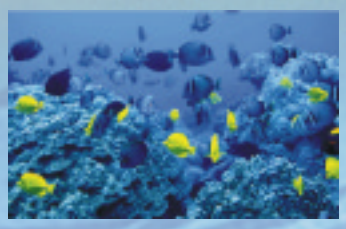
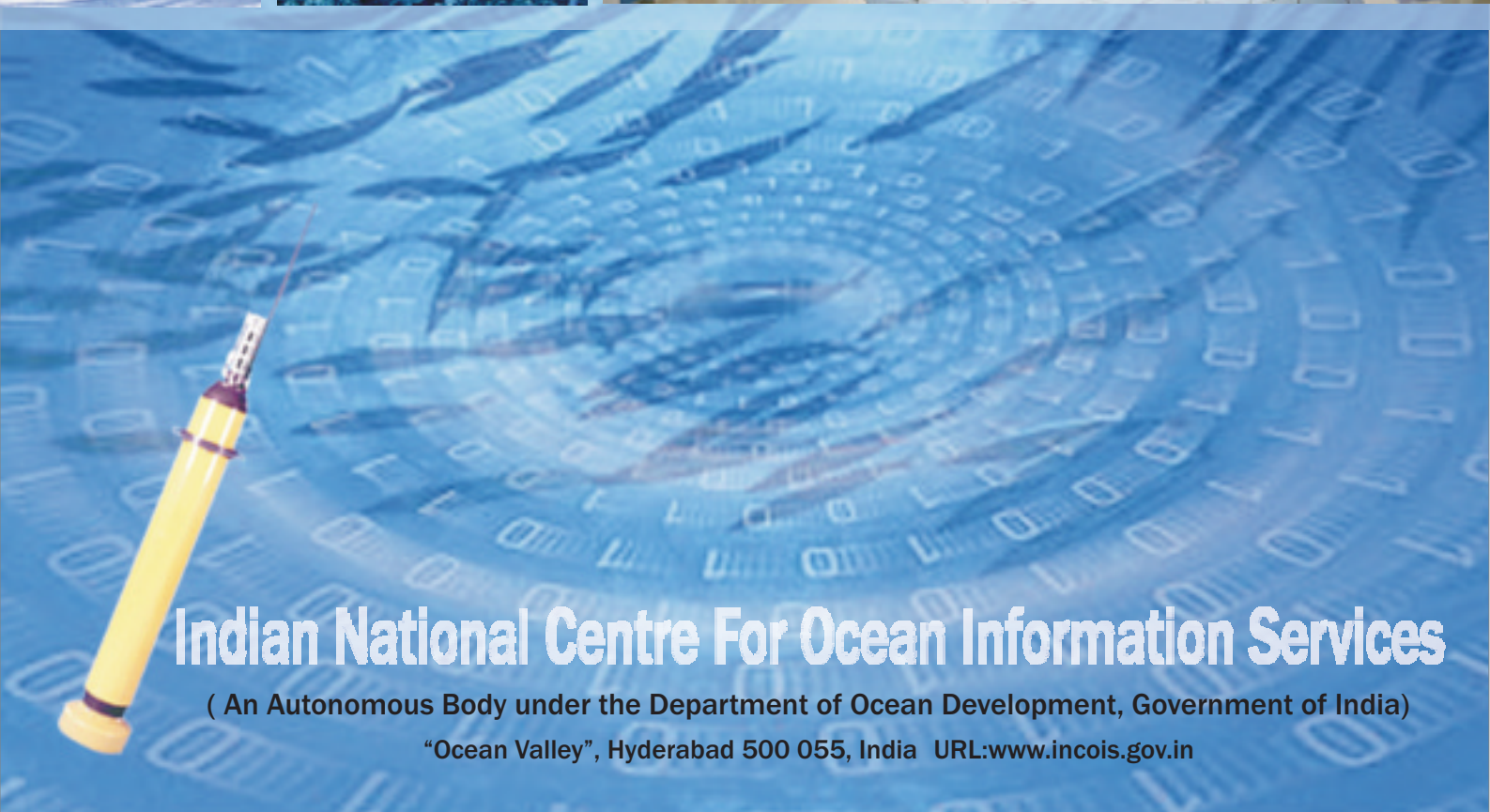
Seventh Annual Report
2004-2005





Indian National Centre For Ocean Information Services

(An Autonomous Body under the Department of Ocean Development, Government of India)

"Ocean Valley", Hyderabad 500 055, India URL:www.incois.gov.in

Contents

Director's Report

The Indian National Centre for Ocean Information Services (INCOIS), an autonomous body set up under the Department of Ocean Development in February 1999, started as a provider of operational data and services and swiftly transformed into a knowledge and information technology enterprise for the oceanic realm.

INCOIS has become: (a) a provider of operational ocean information and advisory services to the entire country using advances in satellite remote sensing, ocean science and information & communication technology (b) an observer of Indian Ocean using cutting edge technology, including the Argo profiling floats (c) prime mover for R&D in frontier area of ocean-atmosphere modelling and (d) most recently as the responsible national organisation for triggering tsunami warnings. The mission of INCOIS is to provide ocean information and advisory services to society, industry, government agencies and scientific community through sustained ocean observations and constant improvement through systematic and focussed research.

INCOIS sustained its key role in the Indian Ocean region as the Secretariat for the Indian Ocean Global Ocean Observing System (IOGOOS), Basin level Coordinator and Regional Data Centre for International Argo project in Indian Ocean. Further, INCOIS was designated as the national Oceanographic Data Centre under the international oceanographic data exchange programme of the Intergovernmental Oceanographic Commission (IOC) of United Nations Educational, Scientific and Cultural Organization (UNESCO).

On August 20, 2004 INCOIS moved into its permanent campus set up at Hyderabad in a 50 acre land with state-of-the-art facilities and the right ambience for a model S&T institution. This campus, named as "Ocean Valley", has been conceived with a vision and realised within a short span of two years.

The highlights of accomplishments during the year 2004-05 are as follows:

- The Potential Fishing Zone Advisory Mission, a matured operational application of satellite remote sensing for providing timely and reliable advisories to fishermen on potential fishing zones, was sustained. This mission became part of the Common Minimum Programme of the Government of India. The delivery chain was further enhanced with several electronic display boards at fishing harbours and information kiosks. This mission is bringing direct economic benefits to the fishing community and it has been reported from the validation surveys that the saving in cost of fuel (through reduction in search time) has been about Rs 1.50 to 3.00 lakhs per vessel per year.
- The experimental forecast of ocean state (wave parameters in Open Ocean and tidal currents in part of west coast) was sustained.
- The Argo Data Centre at INCOIS acquired temperature and salinity profiles (up to 2000 metres) from 61 Argo profiling floats deployed by India in the Indian Ocean since 2002. As the Regional Data Centre for the Indian Ocean, so far 25,000 temperature and salinity profiles acquired from 435 floats deployed in the Indian Ocean have been archived at INCOIS and made available to the scientific community through INCOIS website.

- The INCOIS Web site (www.incois.gov.in) was visited by more than 11,500 visitors and recorded more than 83,000 hits (including down-loading of PFZ advisories, experimental ocean state forecast and Argo data) during the second half of 2004-05.
- A Satellite Data Acquisition and Processing System (SDAPS) was established to acquire in-situ ocean data observing platforms such as Argo profiling floats and Drifting Buoys as well as remote sensing data from NOAA Series, Tera, Aqua and Feng Yun Satellites.
- Significant progress has been achieved in the implementation of Indian Ocean Modelling and Dynamics (INDOMOD) Project and Satellite Coastal and Oceanographic Research (SATCORE) Project including setting up of computational infrastructure and human resources development in the participating institutions.
- IOGOOS sustained its place of pride among the GOOS regional alliances of IOC. One of the significant milestones has been the finalisation of a strategy and implementation plan for an unified Indian Ocean observation system for climate through the Indian Ocean panel of Experts set up by IOGOOS, jointly with IOC and the Climate Variability Research Programme of World Climate Research Programme.

I take this opportunity to express my sincere gratitude to Dr. Harsh K. Gupta, Chairman, Governing Council, all Members of the Governing Council for their visionary direction, able guidance, encouragement and Officials of the Department for their support to shape up this young institution as a model organisation of national significance and international recognition.

(K. Radhakrishnan)

Director

1. The Organisation

The Indian National Centre for Ocean Information Services (INCOIS) is an autonomous body under the Department of Ocean Development (DOD), Government of India, registered as a Society under the Andhra Pradesh (Telangana Area) Public Societies Registration Act 1350 Fasli at Hyderabad on February 3, 1999. The affairs of the Society are managed, administered, directed and controlled, subject to the Bye laws of the Society, by the Governing Council.

INCOIS Society		
1	Secretary, Department of Ocean Development	President
2	Director, National Remote Sensing Agency	Vice-President
3	Joint Secretary, Department of Ocean Development	Member
4	Adviser, Department of Ocean Development	Member
5	Director, National Institute of Oceanography	Member
6	Director, National Institute of Ocean Technology	Member
7	Director, National Centre for Antarctic & Ocean Research	Member
8	Director, INCOIS	General Secretary

INCOIS Governing Council		
1	Secretary, Department of Ocean Development	Chairman
2	Director, National Remote Sensing Agency	Vice-Chairman
3	Financial Adviser, Department of Ocean Development	Member
4	Prof. V.K. Gaur (up to Jun 15, 2004) Dr. George Joseph (from Jun 16, 2004)	Member
5	Prof. B.L. Deekshatulu (up to Jun 15, 2004) Director General, India Meteorological Department (from Jun 16, 2004)	Member
6	Joint Secretary, Department of Ocean Development	Member
7	Adviser, Department of Ocean Development (up to May 13, 2004) Director (Admn.), Department of Ocean Development (from May 14, 2004)	Member
8	Director, National Institute of Oceanography	Member
9	Director, National Institute of Ocean Technology	Member
10	Director, National Centre for Antarctic & Ocean Research	Member
11	Principal Advisor (S&T), Planning Commission	Member
12	Director (Civil-1), Ministry of Surface Transport	Member
13	Director, Space Applications Centre	Member
14	Director, Earth Observation Systems, Indian Space Research Organisation	Member
15	Head, Centre for Mathematical Modelling and Computer Simulations	Member
16	Director, INCOIS	Member-Secretary

The Mission

To provide ocean information and advisory services to society, industry, government agencies and scientific community through sustained ocean observations and constant improvements through systematic and focussed research.

The major objectives of INCOIS are:

(i) To undertake, aid, promote, guide and co-ordinate research in the field of ocean information and services including Satellite Oceanography,

(ii) To establish, maintain and manage, hire the systems for data acquisition, analysis, interpretation and archival for Ocean Information and Services,

(iii) To carry out surveys and acquire information using satellite technology, ships, buoys, boats, any other platforms and remote sensors, generate information on fisheries, minerals, oil, biological, hydrological, bathymetry, geological oceanography, meteorology, coastal zone management and associated resources and island development, mangroves and associated coastal, forest, soils, wetlands, estuarine mapping, seabed and to undertake studies in marine archaeology, environmental monitoring of India and Antarctica and surrounding oceans and land masses,

(iv) To generate and provide data and value added data products to user communities in coastal and ocean areas using space, aerial and conventional sources,

(v) To establish Ocean data bank, including acquisition of all data obtained from satellite, air-borne sensors, ships, boats, buoys and field surveys, storage, retrieval, dissemination, evaluation, scrutiny, synthesis, analysis, interpretation of information and providing services and consultancy,

(vi) To cooperate and collaborate with other national and international institutions in the field of Ocean Remote Sensing, Oceanography, Atmospheric Sciences/Meteorology and Weather forecasting centres, coastal zone management, usage of satellite data and data acquisition by all technologically possible means in all allied science fields, subject to that prior approval of DOD shall be obtained for collaboration with institutions abroad,

(vii) To provide support to research centres for conducting investigations in specified areas related to Oceanic parameters, Ocean Atmospheric interaction studies, coastal zone information, synthesis, analysis, data collection and undertake developmental work,

(viii) To provide training lectures, seminars and symposia for advanced study and research related to Oceanographic parameters, related sciences and technology and in allied fields related to Ocean Information Services,

(ix) To publish and disseminate information, results of research, data products, maps and digital information through all technologically possible methods like print, voice or electronic media to users for promoting research and to meet societal needs in improving environmental conditions and living standards, provided that dissemination of data is as per guidelines of the Government of India,

(x) To provide consultancy services in the fields of Ocean Information and Services,

(xi) To co-ordinate with all space agencies to ensure continuity, consistency and state-of-the-art quality of ocean data derived from satellite observations,

(xii) Generate data, data products, value added data products and market for coastal and ocean applications,

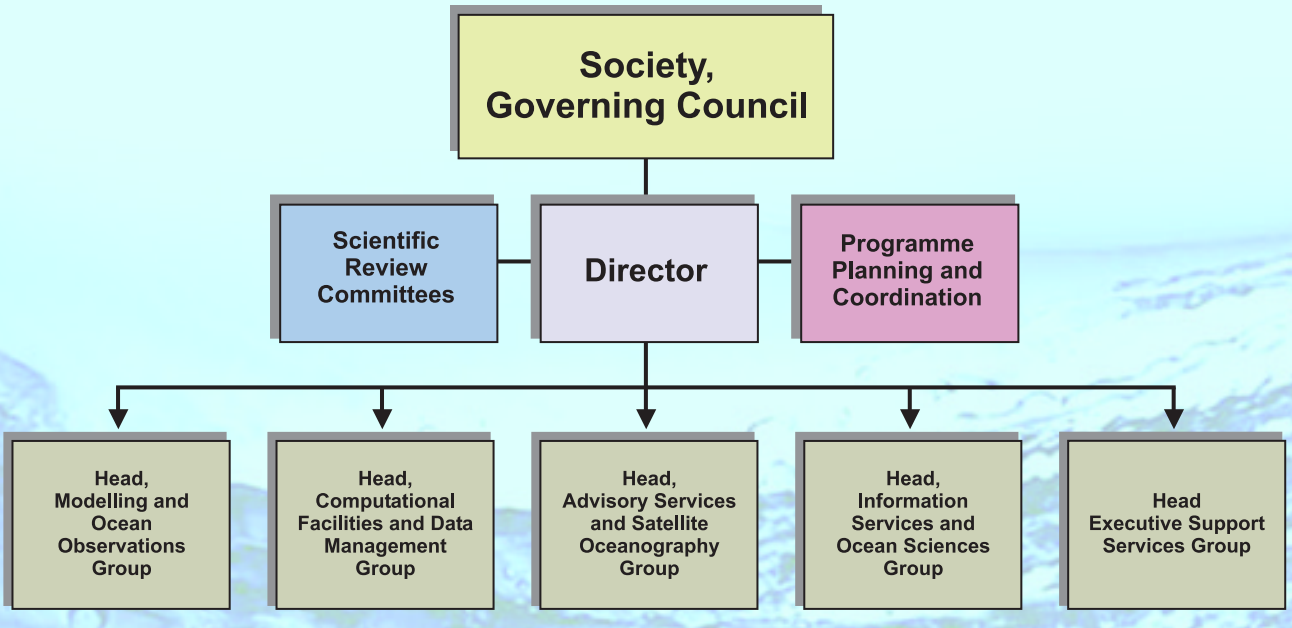
(xiii) To encourage and support Governmental and non-Governmental Agencies or organizations for furthering ocean and related programmes in the generation of ocean information, and

(xiv) To undertake all such other lawful activities as may be necessary, incidental or conducive to the attainment and furtherance of all or any of the above objects of the Society.

INCOIS has been striving to address the national agenda with missionary zeal through (i) Potential Fishing Zone Advisory Services (ii) Experimental Forecast of the Ocean State (iii) Ocean Observation using Argo Profiling Floats and several other in-situ platforms (iv) Satellite Oceanography and (v) Ocean-Atmosphere Modelling efforts. Concomitant with this, INCOIS has been striving to play a significant role in the Indian Ocean region.

INCOIS has a sanctioned strength of 16 regular positions (13 scientific and 3 administrative) supplemented by 13 Project Scientists, 9 Research Fellows and 3 Administrative staff on contract mode. Further, knowledge networking has been established with focussed groups in several premier institutions, especially for implementation of INDOMOD and SATCORE Projects. Outsourcing has been effectively followed for system/software maintenance, operation and maintenance of technical support facilities, house keeping, canteen, transport and security services.

The organisation structure of INCOIS is as given below:



The Organisation Structure

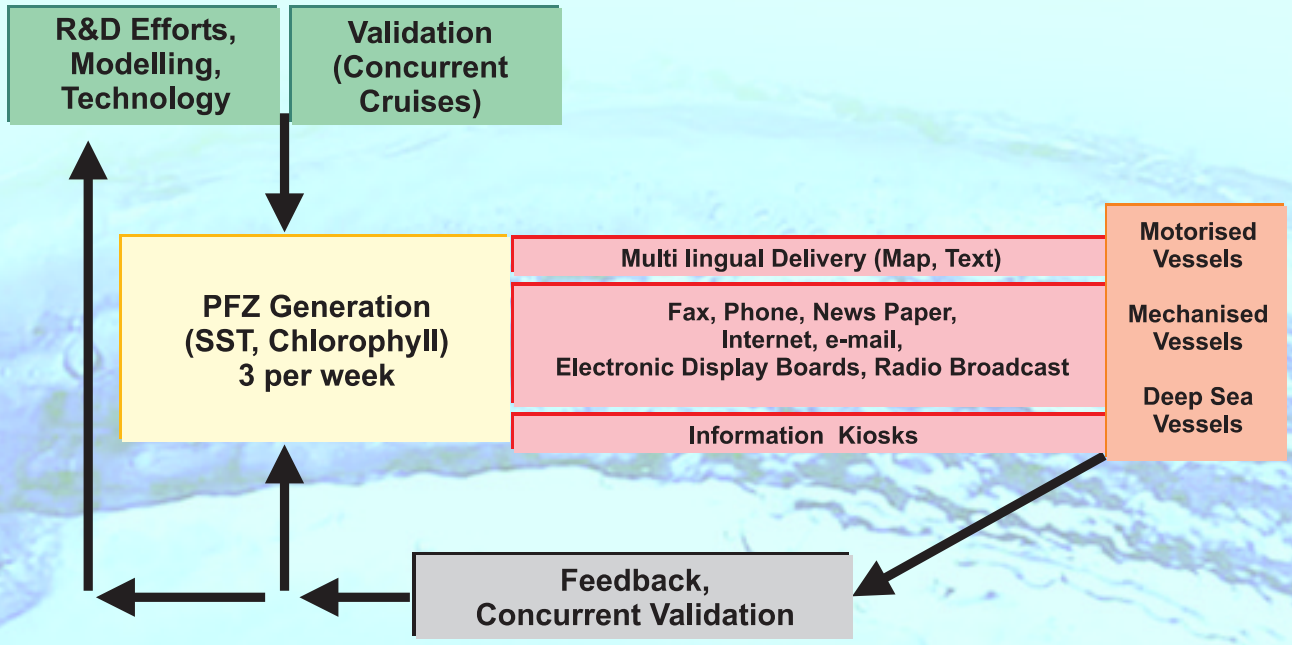
2. Ocean Information and Advisory Services

2.1 Potential Fishing Zone (PFZ) Advisory Service

The concerted efforts of scientists from ocean development, space and fishery science in conjunction with the coastal states have culminated in a unique service to provide reliable and timely potential fishing zone (PFZ) advisories using satellite data to the fishing community of the entire coastline of the country in a Mission mode with active participation of all stakeholders.

PFZ advisories are generated using both the Sea Surface Temperature from NOAA-AVHRR and Chlorophyll from Oceansat-1 based on the features such as oceanic fronts, meandering patterns, eddies, rings, up-welling areas that are proven to be prospective sites for fish accumulation. PFZ advisories prepared in local languages and local measurement units are disseminated thrice a week through innovative and novel initiatives such as Electronic Display Boards and Information Kiosks at the fishing harbours, radio and internet supplementing fax and telephone. This is the only short term forecast available to the fishing community of the country.

Frequent and intense interactions at the fishing harbours between scientists and fishing community are ensuring improved awareness and effective use of these advisories. Concurrent validation and feed back are integral to this mission and the necessary institutional mechanisms are in place. It has been validated that the search time has been reduced by 30 to 70 % due to the usage of these advisories. The recent study conducted in the Kerala coast has brought out that saving on account of using this information is to the extent of Rs 1.50-3.00 lakhs per vessel per year. This is an excellent example of reaching the benefits of science to society.

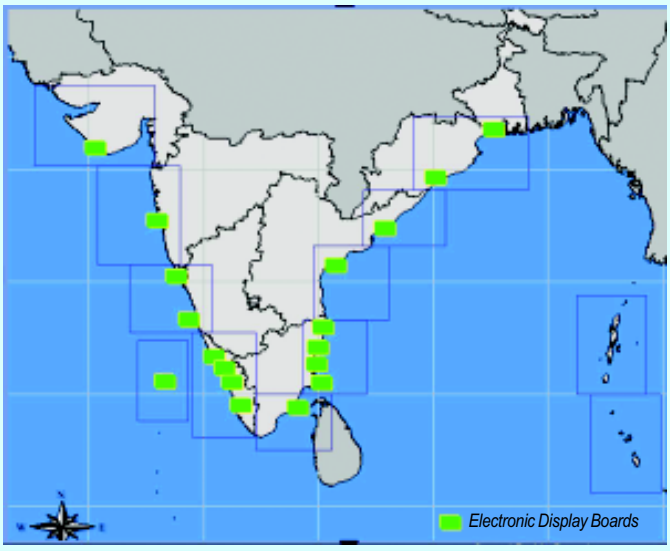


PFZ Mission

The challenge for the near future is to sustain and enrich the PFZ Advisory Mission with (i) additional parameters such as wind, (ii) forecast for commercially important species such as Tuna, (iii) improving the dissemination chain by installation of additional electronic display boards and information kiosks at fishing harbours.

The significant achievements during the year under report are as follows:

- Operational generation of PFZ advisories was sustained and enriched.
- Integrated PFZ multi-lingual advisories (Gujarathi, Hindi, Kannada, Malayalam, Marathi, Tamil, Telugu, Oriya and Bengali) were disseminated by Fax/Telephone to around 225 nodes spreading the entire coast of India under 12 Sectors, viz., Gujarat, Maharashtra, Karnataka & Goa, Kerala, South Tamilnadu, North Tamilnadu, South Andhra Pradesh, North Andhra Pradesh, Orissa & West Bengal, Andaman, Nicobar and Lakshadweep.
- For effective and timely dissemination of PFZ advisories, 17 Electronic Display Boards (EDB) were installed in the fishing harbours at Thengaithattu, Agatti, Neendakara, Beypore and Panjim, Veraval, Ratnagiri, Malpe, Vypeen, Munambam, Veerampattinam, Royapuram, Machilipatnam, Kakinada, Visakhapatnam, Gopalpur and Diamond Harbour. The forecast is being updated thrice a week directly from INCOIS and about 1000-3000 fishermen from each fishing harbour use this information for their fishing activities.



Location of Electronic Display Boards

- A Pilot Information Kiosk was set up at Brahmavar in association with M/s Hindustan Lever Limited (HLL) that provides locale-specific fishery forecasts to about 3,000 Fishermen in the region.
- PFZ advisories along with SST and Chlorophyll images, vector coverage and text information were made available through INCOIS Web-site to the user community.
- PFZ advisories in both map and text forms are e-mailed to about 60 users.
- PFZ advisories for the Andhra Pradesh Coast are being published in a leading Telugu News paper in its coastal district editions. Efforts are underway to publish PFZ advisories in the news papers of the other coastal states in their respective languages.

- PFZ validation projects were carried out along the coasts of Ratnagiri, Mangalore, Kerala, Machilipatnam, Visakhapatnam and Gopalpur.
- Scientists from INCOIS participated in one day user interaction workshops organized by Fishery Survey of India at Pondicherry Fishing Harbour and Thoothoor, Kanya Kumari district.

Electronic Display Board at Thengaithattu, Pondichery Fishing Harbour

User interactions with fishing community at Thengaithattu, Pondichery Fishing Harbour

- PFZ Mission was included in the Common Minimum Programme of the Government in May 2004.

2.2 Experimental Ocean State Forecast

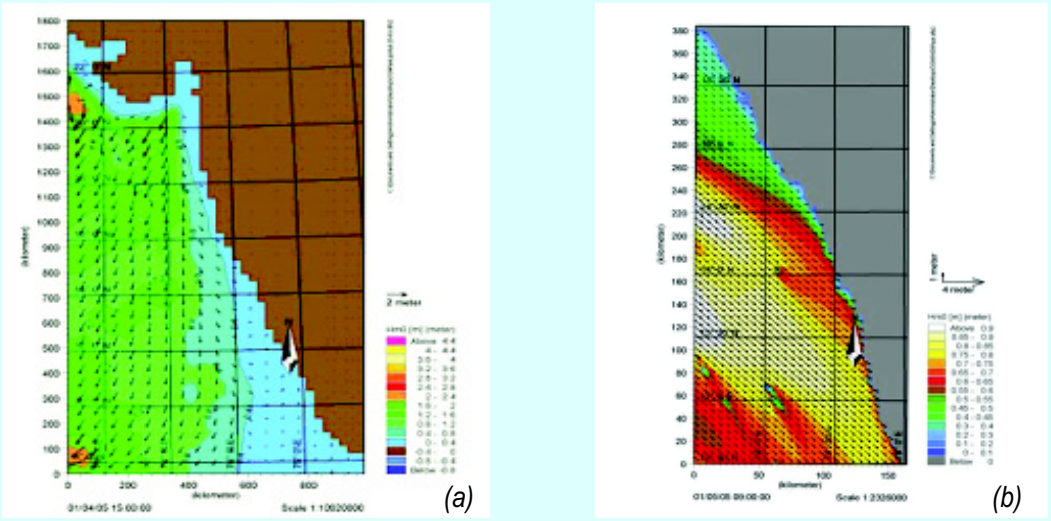
The Experimental Ocean State Forecast (E-OSF) is an excellent example of a multi-institutional endeavour that translated scientific knowledge into a service useful for safe operations at sea. E-OSF is developed out of a joint initiative taken by INCOIS and the Space Applications Centre (SAC). The wind forecast from the National Centre for Medium Range Weather Forecast (NCMRWF), Delhi is the prime input for the E-OSF Forecast. The Centre for Atmospheric Sciences (CAS) of Indian Institute of Technology (IIT), Delhi, the Centre for Atmospheric and Ocean Science (CAOS) of Indian Institute of Science (IISc), Bangalore, the National Institute of Oceanography (NIO), Goa contributed to this multi-institutional endeavour to translate scientific knowledge into a service useful for safe operations in the sea.

The focus has been on forecasting ocean state parameters that meet the operational needs of Navy, Shipping, Oil and Fishing community. Forecast of wave and swell parameters using ocean models for the Indian Ocean, and tidal circulation for Gulf of Kambath have been published on INCOIS web site in GIF format. Numerical values of the forecast for the above parameters are provided through the web to more than 10 organisations. The wind field generated by mesoscale atmospheric models such as Eta and T80 (by NCMRWF) are provided to Wave Model (WAM-3GC) for forecast of wave parameters over the Indian Ocean region. There is a mechanism in place for getting feedback from the users including continuous validation of the forecasts using in-situ and satellite observations.

The progress made during the year 2004-05 is as follows:

- Experimental Ocean State Forecasts are made available through INCOIS website with WEB-GIS capabilities. Forecast of tidal currents from Ratnagiri to Porbandar are operational.

- Latest version of the Simulating WAves Nearshore (SWAN model V 40.31) for the coastal wave forecast has been installed on SGI System and test run was successfully conducted. Pre-processing of SWAN Model with Eta Model output from NCMRWF is underway. SWAN Model was tested with high resolution (0.1° x 0.1°) wind data from NCMRWF. The boundary conditions for the model were considered from JONSWAP Spectra.
- User interaction meetings were held with officials of ONGC and Director General, Shipping at Mumbai.
- Mike model is customised for coastal wave forecast and the calibration studies are underway.



Experimentation with Mike 21 Model: significant wave height and direction from (a) Mike 21 Offshore wave spectral model (OSW) and (b) Mike 21 near shore wave spectral model (NSW)

- Suggestions/feed backs were collected from many users about their requirements in terms of parameters, accuracy, spatial resolution and mode of delivery for the coastal forecast.

2.3 Ocean Information Bank and Web-based Services

Ocean Information Bank

Ocean Information Bank is the back bone for providing information on physical, chemical, biological and geological parameters of ocean and coasts on spatial and temporal domains that is vital for both research and operational oceanography. The Ocean Information Bank is supported by the data retrieved from both the in-situ platforms and satellites. The meta data of the marine data collected by a chain of designated data centres is also a vital element of this Information Bank. The Ocean Information Bank is supported by a national chain of Marine Data Centres and Ocean Observing Systems.

The Ocean Information Bank was updated regularly with (i) AVHRR data from NOAA Satellite series (of USA) from 1991 and Sea Surface Temperature archives for North Indian Ocean from 1992 to December 2004, including daily, weekly and monthly images and grid data, brightness temperatures (ii) Data from Moored and Drifting Data buoys, Expendable Bathy Thermographs (XBT)s, Current Meter Mooring Array for the period 1997-2004, (iii) Data from the 1700 Argo Floats deployed in the global Ocean (iv) PFZ Maps from 1992 onwards along the Indian coastline and Islands (for non-monsoon months).

Information Bank archived the data available from web pertaining to (i) Altimeter (1990 - 2004) (ii) TMI (1997 -2004) (iii) Simple Oceanographic Data Assimilation products (1955-2001) (iii) temperature profiles from Joint Environmental Data Analysis Centre (1955-2004) (iv) Surface meteorological parameters from National Centre for Environmental Prediction (v) rainfall data from Climate Prediction Center (CPC) Merged Analysis of Precipitation (CMAP) (1979 – 2000) (vi) Quicksat (1998-2004).

During the year, INCOIS was identified as the National Oceanographic Data Centre (NODC) from December 2004 by International Oceanographic Data Exchange (IODE) of IOC and a Scientist from INCOIS has been nominated as the IODE National Coordinator from India.

Marine Data Centres: A network of 14 Marine Data Centres (MDC) was established by DOD in the 90's under the MARSIS Programme, in National Laboratories and Academic Institutions to collect and collate data, undertake quality control exercises and archive in digital data bases. The location of the Marine Data Centres and the type of data held are as given below:

Marine Data Centres and the type of data held by them

1	Geological Survey of India (GSI), Kolkata	Marine Geological Data
2	K.D. Malavia Institute of Petroleum Exploration (KDMIPE), Dehradun	Magnetic, Seismic and Gravity data
3	India Meteorological Department (IMD), Pune	Ocean Surface Meteorological data
4	Survey of India (SOI), Dehradun	Tidal data
5	Naval Hydrographic Office, (NHO) Dehradun	Hydrographic data
6	National Institute of Oceanography (NIO), Goa	Physical, Chemical and Biological Oceanographic data
7	Fishery Survey of India (FSI), Mumbai	Offshore Fisheries
8	Central Marine Fisheries Research Institute (CMFRI), Kochi	Coastal Fisheries
9	Central Drug Research Institute (CDRI), Lucknow	Bio-active substances in the Sea
10	Central Salt and Marine Chemicals Research Institute (CSMCRI), Bhavnagar	Marine Algal Resources
11	Orissa Remote Sensing Applications Centre (ORSAC), Bhubaneswar	Coastal Zone Information System for Orissa and West Bengal
12	Institute for Ocean Management (IOM), Chennai	Coastal Geomorphology, Coastal Zone
13	Regional Centre, National Institute of Oceanography, Mumbai	Marine Pollution
14	National Remote Sensing Agency (NRSA), Hyderabad	Satellite Oceanography

Web-based Services

INCOIS has been providing ocean information and advisory services through Website & Ocean Portal especially in the areas of (i) Potential Fishing Zone Mission, (ii) Indian Ocean Argo Project, (iii) Experimental Ocean State Forecast and (iv) IOGOOS besides facilitating users with Information on various projects and programmes. The web-based multi-lingual on-line information delivery system with Web-GIS capability (www.incois.gov.in) enables all users to query, analyse, visualise and download ocean data, information and advisories for their regions of interest. This has been widely used website among wide spectrum of users.

INCOIS has initiated the development of data warehousing and data mining facility to improve the functionality of the website and maintain a centralised repository of ocean data. A data base was designed using Oracle data warehousing tools for managing in-situ as well as remote sensing data. Also, a GIS based interface for selection and retrieval of data from various observing platforms deployed in the Indian Ocean was developed.

INCOIS web-site has been visited by 11,585 visitors and recorded 83,164 hits over a period of 6 months. PFZ Forecast page, PFZ Multilingual pages, Web-GIS pages of PFZ, E-OSF, Argo and IOGOOS web pages are the prominent pages visited.

Page	Hits	Visitors
INCOIS Home page	42,493	8,364
PFZ Forecast page	9,950	1,100
PFZ-Multilingual pages	3,196	482
PFZ-Web GIS	976	174
SST/Chlorophyll data	318	76
E-OSF Forecast	2,848	391
E-OSF-Web GIS	357	62
Argo array-Web GIS	2,591	328
Argo Data Downloads	18,542	40
Argo Value Added Products	324	30
IOGOOS Home Page	1,569	538

3. Ocean Observation, Satellite Oceanography and Ocean Modelling

3.1 Indian Argo Project

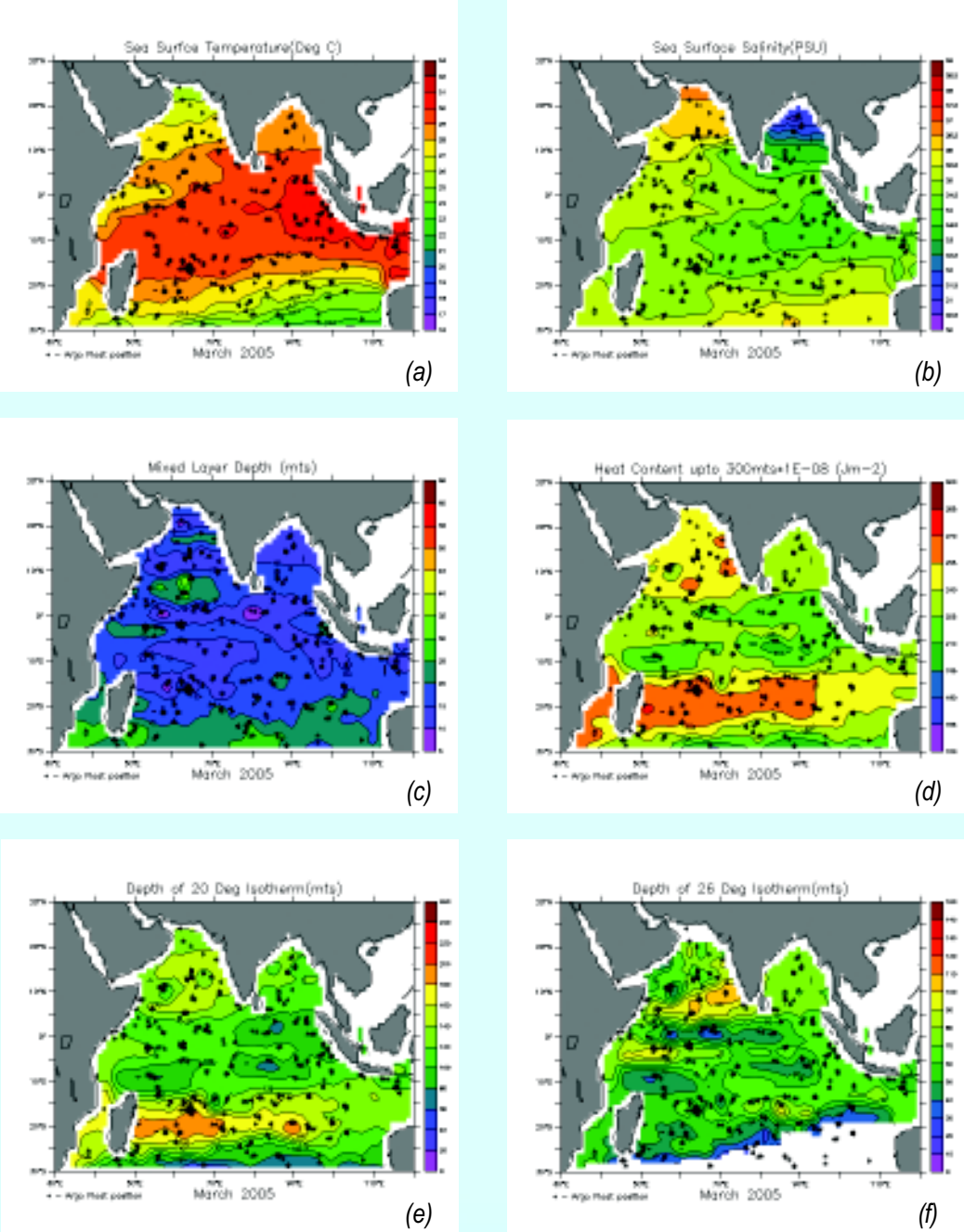
Argo is a revolutionary concept that enhances the real-time capability for measurement of temperature and salinity through the upper 2000 metres of the ocean which contributes to the global description of the seasonal and inter-annual variability of the upper ocean thermohaline circulation. Argo will effectively monitor the pulse of global heat balance and improving our understanding of ocean's role in climate as well as spawn enormous range of valuable ocean applications.

International Argo Project endorsed by World Meteorological Organisation (WMO) and IOC of UNESCO aims to deploy 3000 floats in the global ocean by the year 2006 to establish a global array at a spatial resolution of 3° x 3°. The data from Argo floats are acquired through ARGOS satellite system and processed at designated data centres before disseminating to the world community within 24 hours through internet and Global Telecommunication System (GTS). Free and timely availability of the data is the fundamental tenet of the Project.

The Argo array of the Indian Ocean requires about 450 floats. India is a partner in the International Argo Project by contributing 150 floats for the Indian Ocean. The Indian Argo Project is being implemented by INCOIS jointly with National Institute of Ocean Technology (NIOT) and CAOS/IISc with active participation from a network of other premier institutions. Further, INCOIS has a lead role in the project as (i) the Regional Coordinator for implementation of Argo programme in the Indian Ocean and (ii) the Regional Argo Data Centre for the region.

Significant achievements under the programme during 2004-05 are as follows:

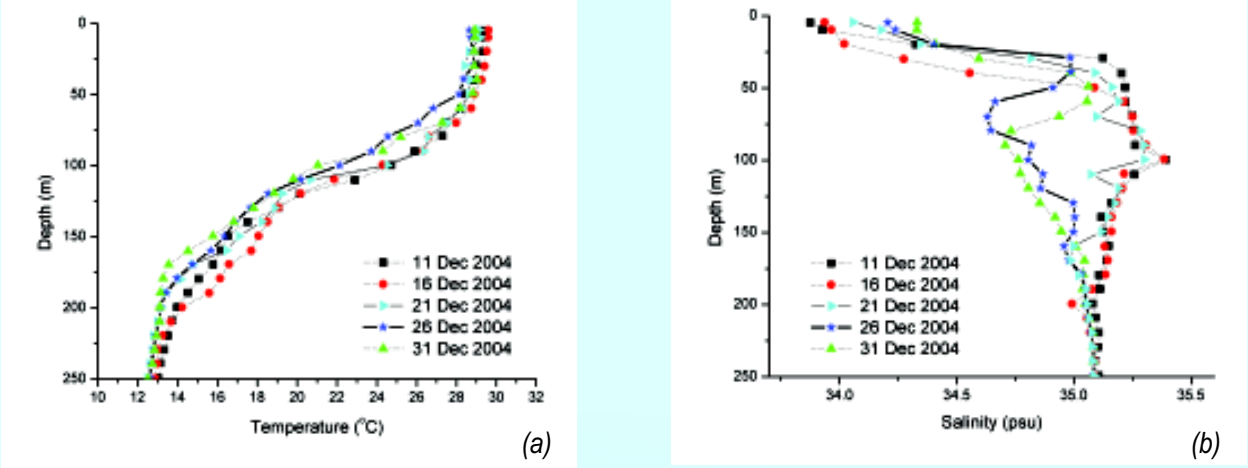
- Argo Data Centre at INCOIS acquired data from 61 floats deployed by India and processed them at INCOIS and disseminated to different users after real time quality control.
- Value added data products derived from Argo float data are made available on INCOIS website (www.incois.gov.in). The data products available on INCOIS website includes float-wise data products (waterfall plots for Temperature and Salinity, time series plots for Temperature, Salinity, surface pressure and bottom pressure, temperature vs salinity, float trajectories) and objectively analysed monthly data products (Sea Surface Temperature, Sea Surface Salinity, Mixed Layer Depth, Heat Content up to 300m, depth of 20°C isotherm and 26°C isotherm).
- As a Regional Coordinator for the Indian Ocean, INCOIS co-ordinated the deployment of about 435 floats by 8 countries and the Regional Data Centre at INCOIS so far acquired and archived 25,000 Temperature/Salinity profiles from all the floats deployed in the Indian Ocean and made available to the scientific community through INCOIS website.



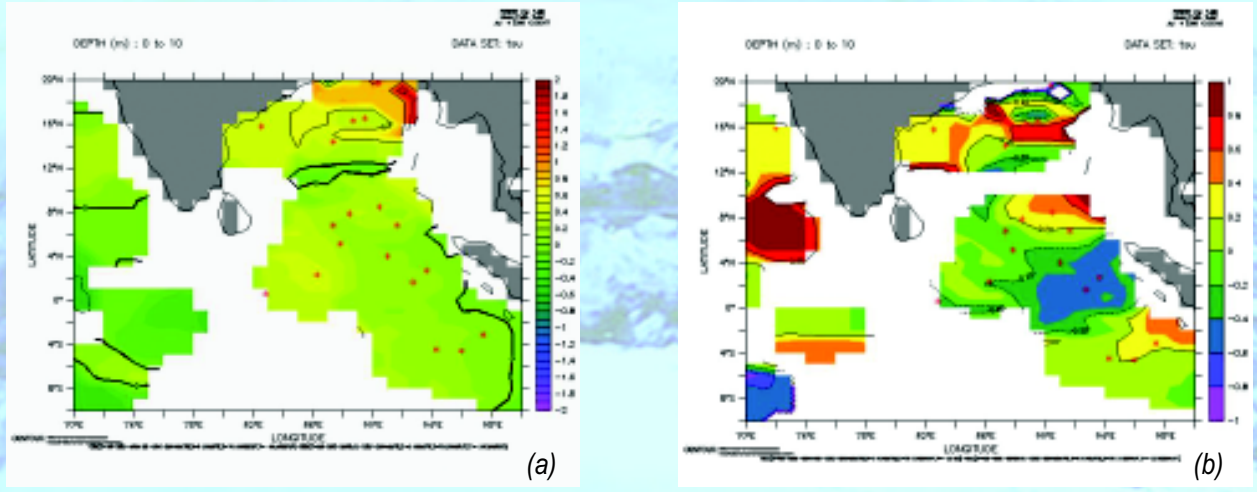
Argo value added data products (objectively analysed) of (a) Sea Surface Temperature (b) Sea Surface Salinity (c) Mixed Layer Depth (d) Heat Content (e) Depth of 20°C Isotherm and (f) Depth of 26°C Isotherm

- An automatic data processing system that enables the user to get data within 12 hours of data collection from the Indian floats has been developed to send the data.
- A software module has been developed to convert Argo GTS data to ASCII data and installed at IMD, New Delhi for their operational use.
- New format for distribution of Argo float data evolved during recent Data Management meeting was implemented at INCOIS.
- Thermohaline structure in the Bay of Bengal was studied using Argo Data and other collateral data.

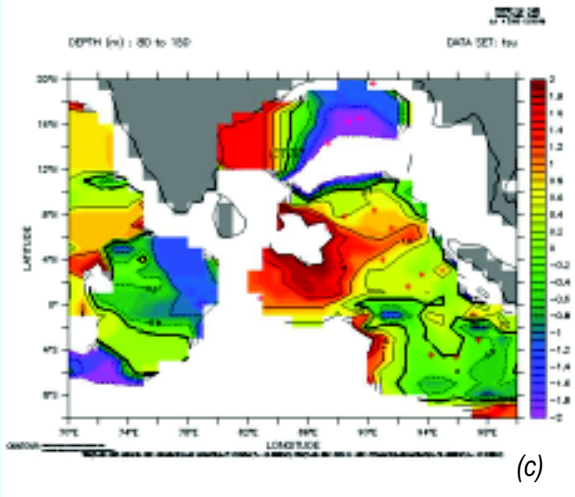
- A comparative and quantitative study of the upper ocean response and the role of air-sea interaction processes in the Bay of Bengal and Arabian Sea during the southwest and northeast monsoon was studied using the data from Argo floats, Comprehensive Ocean-Atmosphere Data Set (COADS) and European Centre for Medium Range Weather Forecasting (ECMRWF).
- Spatial and temporal variations of Mixed Layer Depth in the Arabian Sea and Bay of Bengal were computed using Argo float data.
- The upper ocean variations of heat content at different depths (50m, 26°C isotherm and 20°C isotherm) and surface salinity observed by Argo floats during three consecutive monsoon periods (2002-04) was studied and the relation between heat content in the Arabian Sea and all India Monsoon rainfall was examined.
- Argo float observations during the pre and post Tsunami event in the Indian Ocean were analysed to study the thermohaline changes in the southern Bay of Bengal. Drop of 0.5°C in temperature and reduction of 0.2 psu in salinity observation were noticed in the upper 50m layer. Further, a thermal inversion was also observed in some of the locations in this region. Studies are underway to explain changes in the thermohaline structure in the Bay of Bengal after the Tsunami event.

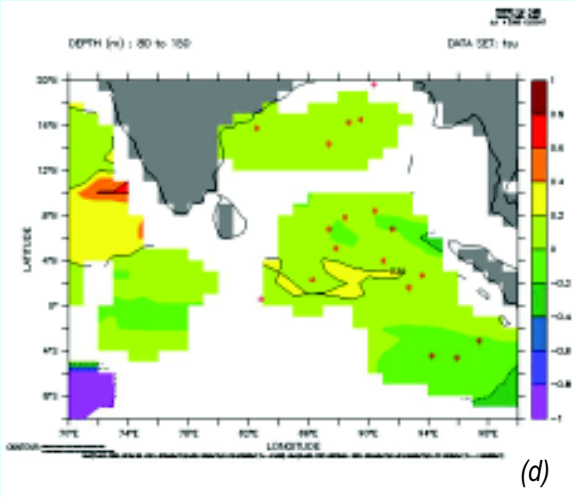


Argo float observations: Changes in the vertical distribution of (a) Temperature and (b) Salinity before and after the Tsunami event in the Indian Ocean



Argo float observations: Changes in the (a) Sea Surface Temperature and (b) Sea Surface Salinity before and after the Tsunami event in the Indian Ocean





Argo float observations: Changes in the (c) sub-surface Temperature (100 m depth) and (d) sub-surface Salinity (100 m depth) before and after the Tsunami event in the Indian Ocean

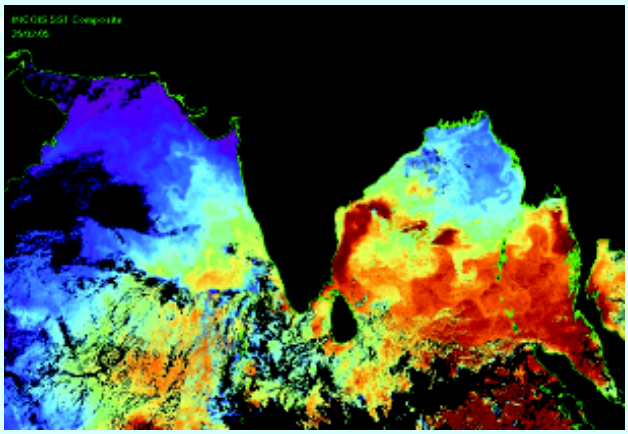
3.2 Satellite Data Acquisition and Processing System (SDAPS)

A state-of-the-art Satellite Data Acquisition and Processing System (SDAPS) was established at INCOIS premises to receive data from the in-situ platforms (Argo floats and drifting buoys) and remote sensing satellites [NOAA Series, Feng Yun, Aqua and Tera (MODIS)] in real time. SDAPS is an integrated system of hardware and software for automated scheduling, capturing and processing the met-ocean data from in-situ platforms as well as the remote sensing satellites.

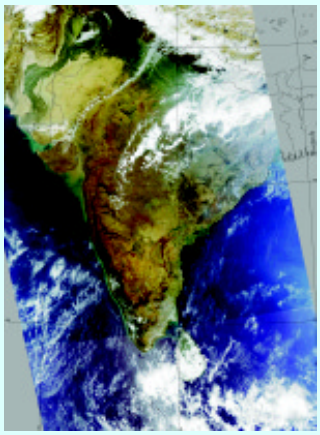
The system hardware comprises of 2.4 meter diameter antenna (covered with 3.2 meter radome) with L and X Band feeds, GPS, acquisition system with antenna control unit, L and X Band receivers, acquisition & processing computers and tape drive for data archival. The antenna covers an area of about 5000Km diameter from INCOIS. The software consisting of a set of functions, daemons and reference data, orchestrates the entire scheduling, capturing and processing of the data in real time. In built software tools are available for data processing, visualisation, generation and distribution of data products.

2.4 m L/X Band Antenna covered with Radome

Satellite Data Acquisiton and Processing System



Daily Composite Image of Sea Surface Temperature derived from NOAA-AVHRR



RGB Image of MODIS Aqua

SDAPS is operationally receiving data from Argo floats and drifting buoys within the coverage area through ARGOS Data Collection and Location System onboard NOAA series of satellites and remote sensing data from NOAA 17, Feng Yun and Aqua & Tera (MODIS) satellites. The system is compatible to receive data from NOAA 18 and Meteorological Operational (METOP) Satellites, in future, with a minor software/hardware upgrade.

The data received from the Argo floats in the Indian Ocean is delivered in real time to the Argo Data Centre at INCOIS for further processing and web publishing. Sea Surface Temperature is generated from the AVHRR of NOAA-17 and being delivered for the Potential Fishing Zone Mission. Generation of met-ocean data products from NOAA-18, Aqua and Tera (MODIS) is underway.

3.3 Satellite Coastal and Oceanographic Research (SATCORE) Project

INCOIS, jointly with the Department of Space played a catalytic and facilitating role in building national capability for application of satellite remote sensing for oceans and coasts. SATCORE Project envisages development of various algorithms and models for retrieval of met-ocean parameters (e.g. sea surface temperature, winds, wave parameters, bathymetry, suspended matter, mixed layer depth, chlorophyll, aerosol, water vapour, clouds, currents and sea level) from the data from Indian and foreign satellite sensors including Oceansat-1 (IRS P4). Besides, this Project would also carryout diagnostic studies and generation of forecast models, customisation of algorithms and development of related software packages. The SATCORE project is executed primarily through SAC and NRSA.

During the year under report, significant progress was made in these projects. A sub-committee of the Project Management Council of INDOMOD/ SATCORE Projects reviewed the progress of SATCORE Projects.

Sl. No	Project	Institution
1	Advanced Ocean State Forecast, Ocean Processes (Convection), Geophysical Parameter Retrieval and Validation	SAC
2	Ocean Colour Applications, Ocean Biology, Coastal processes, Ocean Lithosphere, Coral reef Studies	SAC
3	Improvement of Mixed Layer Depth Predictions	NRSA
4	Development of Integrated Fishery Forecast Model	NRSA
5	Observation platforms in Islands	SAC

A core Group on Advanced Ocean State Forecast (A-OSF) was setup with members from SAC, INCOIS, NCMRWF, NRSA, CAS/IIT, NIO, NIOT, Directorate of Naval Oceanography and Meteorology (DNOM), Integrated Coastal and Marine Area Management (ICMAM). The group is aiming to provide A-OSF in the coastal region for up to 48 hrs and in the open ocean up to 5 to 7 days in advance. The operational system is expected to be in place by end of 2005. Projects on Ocean Color, Biology and Fishery forecast (using wind) made good progress.

3.4 Indian Ocean Dynamics and Modelling (INDOMOD) Project

INDOMOD Project during the IX Plan made a significant initiative towards realising a national capability in Ocean Atmosphere modelling. During the X Plan, a new phase of modelling efforts was initiated under INDOMOD project, focussing towards the end goal of achieving ocean predictability and enabling climate predictability in a mission-mode with concomitant efforts in Modelling, Data Assimilation and Validation.

Building a national team with a network of institutions viz. CAOS/IISc, CAS/IIT-D, Centre for Mathematical Modelling and Computer Simulation (C-MMACS), Indian Institute of Tropical Meteorology (IITM), IMD, INCOIS, NIO, NCMRWF, Naval Physical Oceanographic Laboratory (NPOL), NRSA, SAC and SOI is the key to realise this mission. Significant progress has been achieved in setting up of computational infrastructure and human resources development in several centres of excellence for implementation of Indian Ocean Modelling and Dynamics (INDOMOD) Project.

Fifteen separate sub-projects are in progress under the INDOMOD Project addressing a specific activity pertaining to development of ocean-atmospheric modelling in 5 modules viz. (i) Ocean and Climate (ii) Coastal Ocean (iii) Hazardous Weather events (iv) Ocean Data Assimilation and Information Bank and (v) Validation of observations using concurrent observations.

Sl. No	Project	Institution
	Module-1: Ocean and Climate	
1.1	Large Scale Air-Sea interactions in Asian Monsoon Region	CAOS/IISc
1.2	Intra-seasonal to Inter-annual variability of the Indian Ocean	CAOS/IISc
1.3	Common computing facility for CAOS	CAOS/IISc
1.4	Modelling Ocean-Atmosphere-Land Interactions in the North Indian Ocean	NIO
1.5	Air-Sea Interactions in the Indian Ocean region. The focus is on coupling global models	IITM
1.6	Development of Indian Ocean Community Model	C-MMACS
	Module-2: Coastal Ocean	
2.1	Numerical Modelling of Circulation, Salinity Intrusion and Sediment transport in Gulf and Estuaries	CAS/IIT-D
2.2	Operational Integrated Indian Ocean State Forecasting System including wave, current and storm surges.	CAS/IIT-D
	Module-3: Hazardous Weather Events	
3.1	Validation of Storm Surge Model including Tide gauges	INCOIS and SOI
3.2	Modelling of Air-Sea Interactions processes to study Genesis, Intensification and Dissipation of Cyclonic Vortices over Indian Seas	CAS/IIT-D and NRSA
	Module-4: Ocean Data Assimilation and Information Bank	
4.1	A Data Assimilative Sigma-Coordinate Numerical Model for the North Indian Ocean	IITM and NCMRWF
4.2	Digital Atlas, Information Bank	INCOIS and NPOL
4.3	Assimiliation of In-situ and Satellite Altimeter data in to an OGCM	C-MMACS
	Module-5: Observations for validation of models	
5.1	Long term measurements of currents in the equatorial Indian Ocean through Current meter moorings along the equator	NIO
5.2	XBT observations for long term monitoring of upper ocean thermal fields in the seas around India	NIO
5.3	Measurements of surface velocity and met-ocean parameters using satellite tracked drifting buoys in the Indian Ocean	NIO

Significant achievements under the programme during 2004-05 are as follows:

- INCOIS sponsored an Intensive Course-cum-workshop on Large Scale Ocean Modelling organised by CMMACS, Bangalore during October 4-14, 2004 that was attended by 25 Scientists chosen from different institutions including 5 Scientists from INCOIS. The faculty for this workshop was drawn from Geophysical Fluid Dynamics Laboratory (GFDL)/Princeton University, USA.
- Computational facilities have been established at CAOS/IISc, IITM and CAS.
- Experiments were conducted with the hybrid coupled model to study of role of air-sea interaction on the Elnio and Southern Oscillation (ENSO)-monsoon relationship. An intermediate model of the ENSO-monsoon system was developed.
- A regional model of the Indian Ocean [(Modular Ocean Model (MOM4)] has been designed on a high resolution grid of 0.25 latitude and 0.25 longitude and 40 vertical levels and a seven year run of the model has been carried out using climatological forcing.
- Hydrological model of the western ghats was tested with data for the Mandovi River in Goa.
- Heat budget of the upper ocean in the Arabian Sea and Bay of Bengal was studied and a climatology constructed from the results of Simple Ocean Data Assimilation (SODA) model.
- The link between ocean dynamics and SST in the north Indian Ocean was investigated.
- Detailed analysis of results of Ocean General Circulation Model (OGCM) experiments have been carried out. The global OGCM experiments were carried out with monthly surface forcing.
- A detailed study was carried out on the role of the Southwest monsoon forcing in affecting the mixed-layer and thermocline interactions in the Northern Indian Ocean.
- The nested SWAN model was coupled with IIT Delhi storm surge model and validation of the model was carried out. New air-sea coupling theory was implemented to WAM and SWAN model.
- A depth-averaged model for suspended sediment transport was developed for gulf of Khambhat.
- The three dimensional model POM (Princeton Ocean Model) for the North Indian Ocean (NIO) was Simulated using daily forcing to find the dynamical response of ocean to the atmospheric forcing and the scale to which these two massively coupled systems control the monsoon phenomena over the Indian subcontinent.
- Preparation of Digital Oceanographic Atlas and Digital Animation Atlas for the tropical Indian Ocean is underway.
- Deployed 8 drifting buoys, retrieved and redeployed 3 current meter moorings and carried out 13 XBT cruises.
- The first meeting of Project Management Counsel was held at INCOIS.

3.5 Capacity building at INCOIS for Ocean Modelling

A core team was developed at INCOIS for Ocean Modelling as part of capacity building. Regional Ocean Model (ROMS) developed by Rutgers University, USA and MOM-4 model developed by GFDL,

customized for Indian Ocean region was installed at INCOIS for modelling studies on Ocean and Climate. Further, coastal ocean modelling studies were carried out using WAM 3GC and SWAN models. Highlights of the progress are given below:

- Indian Ocean Model (IOM) was configured on SGI System and different experiments conducted with this model. The model consistency was checked by comparing the model output with observational datasets. IOM is forced with National Centre for Environmental Prediction (NCEP) winds for the years 1990 to 1995, the model output such as temperature, salinity, MLD, sea level and currents were produced on monthly basis and the results are being compared with the available data sets to see the model performance.
- Modular Ocean Model (MOM 4.0) has been customized for the Indian Ocean (Indian Ocean Model) at INCOIS. Test runs for Indian Ocean were performed and the outputs were compared with Levitus and SODA data sets. IOM was experimented with different vertical mixing schemes, viscosity, with and without tidal forcing etc. The results are being analysed with observed data sets.
- Regional Ocean Model (ROM) of Rutgers University has been configured to study the coastal circulation. The model is forced with only tidal components and results are being analysed with tidal observations.
- A Tidal calculation Model developed at Oregon State University was installed and configured for the Indian Ocean region for forcing the Terrain following Numerical Ocean model. The tidal constitutes are determined using this model in the open boundary conditions. These parameters will be used to force the POM model.
- The upper ocean thermohaline structures are studied in the equatorial Indian Ocean for the past 40 years using Simple Ocean Data Assimilation (SODA) data sets to understand the upper ocean changes during bad and good monsoon years.

4 Early Warning System for Mitigation of Oceanographic Disasters: Tsunami and Storm Surges

Recognising the imperative to put in place an Early Warning System for mitigation of these Oceanogenic Disasters that cause severe threat to nearly 400 million of our population that live in the coastal belt with devastation of life and property, and further driven by the national calamities due to the Indian Ocean Tsunami of December 26, 2004, the Department of Ocean Development (DOD) formulated the project on ‘Early Warning System for Oceanographic Disasters: Tsunami and Storm Surges’ Project, in consultation with Department of Science and Technology (DST), Department of Space (DOS) and the Council of Scientific and Industrial Research (CSIR). INCOIS contributed to the formulation of this Project proposal.

5 Infrastructure Development

5.1 Campus Development

INCOIS has developed a permanent campus in Hyderabad in a 50 acre land with state-of-the-art facilities and the right ambience for an S&T institution. This campus, named as “Ocean Valley”, has been conceived with a vision and realized within a short span of two years. The construction of the building with state-of-the-art technical support facilities commenced in March 2003 with an 18 months-schedule for its commissioning i.e. August 2004. The Civil Engineering Division of the Department of Space (CED/DOS) carried out the project management of the construction activity. INCOIS started functioning from its permanent campus at Ocean Valley, Gajularamaram, Hyderabad from August 19, 2004.

The total plinth area of the building is about 7600 Sq. m covering the Main Building, Amenity Building, Sub-Station, Car Parking, Covered Pathway, Amphi-theatre, Security Building, Sump and Pump House, Over Head Tank and Sewage Treatment Plant.

INCOIS Campus at ‘Ocean Valley’, Gajularamaram, Hyderabad (a) Main Building (b) Amenities Block (c) Technical Facilities Building (d) Scientists work place and (e) Information block

The Main Building houses Information Block, Director and Administration Block, Library and Ocean Sciences Block, Conference Block, Auditorium Block. The Amenity Building houses Canteen, Multipurpose Hall, Bank and First Aid and Guest Rooms.

Technical services comprises High Tension Power Supply, Transformers with High Voltage/Low Voltage Switchgears, Diesel Generator Sets, Uninterruptible Power Supply, Air Conditioning, Water Supply, Sewage Treatment and Recycling Plant, etc. which included advanced and high end specification for the facilities to be created in near future.

State-of-the-art Access Control System, Building Management System and Fire Safety System and Public Address System are the important technical features of the Building. The Fire Safety System, Air Conditioning System, Access Control System and Public Addressing System are connected to the Building Management System.

Extensive floor trunking network to avoid open wiring was provided in all areas of the Main Building for Local Area Network (LAN), Telephone System, Electrical System, etc. The Main Building is equipped with the lightning arrestor system and lightening interceptors were installed on Over Head Tank and Sub-Station for protection from the lightening.

5.2 Computational Infrastructure

Installation and configuration of IT infrastructure comprising of high end servers, workstations, storage solutions, back-up systems, etc., was completed in the new campus and all the systems were made operational. The Campus wide networking based on Ethernet technology with Fiber backbone along with state of art technology network components was completed in the INCOIS new campus. The internet bandwidth has been upgraded from 1 Mbps to 2 Mbps and made operation at INCOIS new campus with a dedicated Fiber based leased line from BSNL. A 256 Kbps ISDN connectivity for transfer of satellite data has been re-established at INCOIS new campus.

The computational facilities of INCOIS comprising high end UNIX Servers, UNIX Workstations, Windows 2000 Servers, Windows 2000 Workstations, Enterprise Storage Server (0.5 Terrabyte), Pentium IV Desk Top Systems and peripherals connected using both fibre and Gigabit Ethernet network were fully utilised and in some cases round-the clock.

Computational Facilties

INCOIS utilised for its operational and developmental studies a wide range of software packages including:

a) Standard packages such as ERDAS, ENVI and E-Cognition (for image analysis), Arc/Info, Arc SDE and Arc IMS (for GIS), Oracle 9i (for RDBMS), MATLAB (for data processing and analysis), Websphere (for web server), MS Exchange etc.

b) Customised packages from SAC/RRSSC for OCM data processing and analysis and SST processing software.

c) Customised packages from SAC/IIT-D for WAM3GC Model, Price 1D Model and SST forecast.

d) Tidal Circulation model developed by NIO for Gulf of Khambat.

e) Freeware for Ocean General Circulation Modelling (POM and MOM-4).

6 INCOIS in the International Scene

6.1 Intergovernmental Oceanographic Commission (IOC)

India is the founder member of IOC and also a Member of the Executive Council. Director, INCOIS continued as the Vice-Chairman of IOC, with the responsibility to replace the Chairman whenever he is unable to serve.

6.2 Global Ocean Observing System (GOOS)

GOOS is an internationally organised system for the gathering, coordination, quality control and distribution of many types of marine and oceanographic data and derived products of common worldwide importance and utility, as defined by the requirements of the broadest possible spectrum of user groups. Dr. K. Radhakrishnan, Director, INCOIS played a pivotal role in restructuring the Global Ocean Observing System (GOOS), the largest and most complex of its scientific and technical programmes.

6.3 International Argo Project

International planning for Argo programme is coordinated by the International Argo Steering Team (IAST). Director, INCOIS is the Member of IAST and also the Regional Coordinator for the International Argo Programme in Indian Ocean. INCOIS has been identified as the Regional Argo Data Centre for the Indian Ocean region. Regional Argo Data Centre has been set up at INCOIS and Basin-level Coordination is being implemented by INCOIS.

6.4 Regional Alliance in Indian Ocean for GOOS (IOGOOS)

INCOIS, as the Secretariat for IOGOOS till 2008, has been effectively leading IOGOOS that has taken a place of pride among the nine such GOOS Regional Alliances. Since its formal launch at the First Indian Ocean Conference held at Mauritius on November 05, 2002, IOGOOS membership has grown from 19 to 21 institutions from 13 countries. Some of the major initiatives of IOGOOS are (i) the setting up of Indian Ocean Panel working towards a strategy and implementation plan for Indian Ocean Observations for Climate, (ii) Data & Information management, (iii) Remote Sensing Capacity Building

Strategy, (iv) Prawn Pilot Project, (v) Keystone Ecosystems Project, (vi) Shoreline change monitoring project, etc. IOGOOS members have played a key role in Argo deployments and enhancing the tropical moored buoy array. Major accomplishments of IOGOOS during the year under report are as follows:

- IOGOOS Secretariat coordinated and arranged the IOGOOS Workshop & Second Annual Meeting at Colombo Sri Lanka. INCOIS has been identified as the Regional Data Centre and Clearing House Ocean Data & Information in the Indian Ocean Region. Director, INCOIS was re-elected as the Chairman, IOGOOS for the second term for the period Nov 2004 – Nov 2006.
- The Indian Ocean Panel (IOP) in the 2nd meeting held at Australia during Mar 30 – Apr 02, 2005, prepared an implementation plan for Integrated Observing System in the Indian Ocean.
- A survey on GOOS Regional Alliances Networking Development (GRAND) has been taken up among IOGOOS members and potential members and a consolidated report has been submitted.
- E-Group and Discussion Forum for Data and Information Management has been developed on IOGOOS/INCOIS website.

6.5 Partnership for Observation of Global Oceans (POGO)

Partnership for Observation of Global Oceans (POGO) is an international network of major oceanographic institutions in the world and established to promote and enhance the implementation and integration of global oceanographic activities. As of now, POGO has 26 institutional members from 16 countries. During the year, INCOIS has become the Member of POGO. Director INCOIS participated in the Sixth annual meeting of the Partnership for Observation of the Global Oceans (POGO) at Brest, France.

7 General Information

7.1 Publications

- Ocean Observation Systems - The Emerging Indian Scenario, K. Radhakrishnan, *Oceanology*, Edited by Harsh K Gupta, 39-40, 2005.
- Argo Profiling Floats bring new era of In-situ Ocean Observations. Gould.J, Roemmich. D, Wiffels.S, Freeland. H, Ignaszewski.M, Jianping.X, Pouliquen. S, Desaubies.Y, Send.U, Radhakrishnan. K, Takeuchi.K, Kim.K, Danchenkov.M, Sutton. P, King.B, Owens.B and Riser.S. *EOS*, Vol 85, No. 19, May 11, 2004.
- Sustainable Development of Oceans and Coasts, Keynote address delivered by K. Radhakrishnan at the 3rd Environmental Congress held at Thiruvananthapuram, December 2004.
- Salinity variability in the Arabian Sea. Sudheer Joseph and Howard J. Freeland, Geophysical Research Letters, Vol. 32, L09607,doi: 10.1029/2005GL022972., 2005.
- Anant Parekh, Abhijit Sarkar, and M. Ravichandran, Surface winds in the Arabian Sea from MSMR – an empirical approach, *Journal of the Indian Society of Remote sensing,* Vo. 33, No.1, pp 2005.

- Signature of active and break phases of ISM in subsurface argo data. Anita, G, M. Ravichandran and R. Sayanna, *Journal of Environmental Geochemistry*, Vol.8, pp 237-243, 2005.
- Thermo-haline changes in the Arabian Sea during three consecutive monsoons revealed from Argo floats. M. Ravichandran, Indian Ocean Marine Environmental Conference (IOMEC), The University of Western Australia in Perth, Australia during February 14-18, 2005.
- Indian Ocean Argo Data Centre. M. Ravichandran, Uday Bhaskar and K. Radhakrishnan, Indian Ocean Marine Environmental Conference (IOMEC), The University of Western Australia in Perth, Australia during February 14-18, 2005.
- Circulation, wind speed, and rainfall measured from Argo floats in the Bay of Bengal. Steve Riser, M. Ravichandran, and M. Shajahan, IOMEC, Perth, Australia during February 14-18, 2005.
- Storm surge simulations for Orissa'99 – Super Cyclone using Finite Element Model. G. Latha and E. Pattabhi Rama Rao, 10th International Symposium on Natural and Human Induced Harzards (Hazards-2004), Hyderabad during December 2-4, 2004.

7.2 Ocean Awareness

- Scientists from INCOIS participated and setup DOD stall in the Indo-US Conference and Exhibition on Space Science, Applications and Commerce at Bangalore during June 21-25, 2004.
- Scientists from DOD and INCOIS participated in the 51st Damascus International Fair, Damascus, Syria during Sep 03-12, 2004 and setup the DOD stall to showcase DOD Activities.

INCOIS/DOD Stall at INDO-US Conference and Exhibition on Space Science, Applications

7.3 Training

Officials	Training Programme	Duration
Dr. M. Ravichandran, Shri. T.V.S. Uday Bhaskar, Dr. S. Phani Kumar, Shri. D. Bala Subrahamanyam, Ms. K. Vani	'Intensive Course cum Workshop on Large Scale Ocean Modelling' sponsored by INCOIS and organised by CMMACS, Bangalore	Oct 4-14, 2004
Shri. T. Srinivasa Kumar	'Calculation of Regional-Scale Primary Production for Indian Waters and Application to Ecosystem Dynamics' under the Joint Nippon Foundation (NF) and Partnership for Observation of Global Oceans (POGO) Visiting Professorship Programme at NIO-RC, Kochi	Dec 06, 2004 – Jan 05 2005
Shri. T. Srinivasa Kumar Dr. T.M. Balakrishnan Nair Shri. M. Nagaraja Kumar	MIKE Modelling Software by DHI Water and Environment, Denmark	Aug 9 – Sep 4, 2004
Dr. Sudheer Joseph	'Collaborative training in Delayed mode quality control of Argo data' under the POGO-IOC-SCOR Fellowship Programme at Institute of Ocean Sciences, Sidney, British Columbia, Canada	Oct 02 – Dec 18, 2004.
Shri. T.V.S. Uday Bhaskar, Dr. S. Phani Kumar	Short Course on Fluid Dynamics, Remote Sensing and Atmosphere Ocean Modelling organised by the Hyderabad Central University, Hyderabad	Feb 7-12, 2005

7.4 Deputations abroad

Official	Meeting/Conference/Training	Period
Dr. K. Radhakrishnan Director, INCOIS	IOGOOS Workshop and Second Annual Meeting (IOGOOS II) in Colombo, Sri Lanka	Apr 26-29, 2004
	37th Session of the IOC Executive Council and IOC Officers meeting at Paris, France	Jun 21-29, 2004

	Sixth annual meeting of the Partnership for Observation of the Global Oceans (POGO) at Brest, France	Nov 29 – Dec 1, 2004.
	World Conference on Disaster Reduction at Kobe, Japan.	Jan 18-22, 2005.
	Ministerial meeting on Regional Cooperation in Tsunami Early Warning System at Phuket, Thailand.	Jan 27-29, 2005
	Dialogue for High Level Administrative Policy Makers on Establishing a Tsunami Early Warning Mechanism in the Indian Ocean at Tokyo, Japan	Feb 22-24, 2005
	International Co-ordination meeting for the development of Tsunami warning and mitigation system for the Indian Ocean with in a Global Framework, at UNESCO HQ, Paris, France	Mar 03-08, 2005
Dr. M. Ravichandran	5th Argo Data Management Meeting at Southampton Oceanography Centre, Southampton, UK	Sep 29 – Oct 1, 2004
	Indian Ocean Marine Environmental conference (IOMEC), Perth, Australia	Feb 14-18, 2005
	2nd Indian Ocean Panel meeting at Hobart, Australia	Mar 30 – Apr 02, 2005
Shri. T. Srinivasa Kumar	Second Annual Meeting (IOGOOS II) in Colombo, Sri Lanka	April 26-29, 2004
	GRAND meeting held at London	Sep 06 – 10, 2004
Dr. Sudheer Joseph	5th Argo Data Management Meeting at Southampton Oceanography Centre, Southampton, UK	Sep 29 – Oct 1, 2004
Shri. E. Pattabhi Rama Rao	51st Damascus International Fair, Damascus, Syria	Sep 03-12, 2004
	First planning meeting of the Ocean Data and Information Networking for the Central Indian Ocean (ODINCINDIO) organised by IOC/UNESCO at Tehran, Iran	Oct 02-05, 2004

7.5 Awards

- Director, INCOS was conferred with 'Vignan Bhushan' award for the year 2004, instituted by Indian Society of Health Environment Education and Research (ISHEER), Jodhpur for his exemplary performance in R&D pertaining to Ocean Sciences and enlightening INCOIS at national and international levels.

7.6 Promotion of Official Language

- Hindi Workshop on 'Operational Oceanography' was organised at INCOIS on January 05, 2005.
- A Scientist from INCOIS participated in one day National Hindi Workshop organised by DOD on November 05, 2004.

7.7 Other Information

- The meetings of 7th Finance Committee and 9th Governing Council were held on May 13, 2004 and May 14, 2004 respectively.

7.8 Membership in Governing Bodies/National Committees

Dr. K. Radhakrishnan

International

- Vice-Chairman, Intergovernmental Oceanographic Commission (IOC).
- Chairman, Global Ocean Observing System for the Indian Ocean (IOGOOS).
- Chairman, Inter-sessional Working Group on GOOS Restructuring.
- Member, International Argo Steering Team and Argo Executive.

National

- Member, NNRMS Standing Committee on Ocean Resources.
- Member, NNRMS Standing Committee on Meteorology.
- Member-Convenor, SATCORE/INDOMOD Steering Committee.
- Member-Secretary, INCOIS Governing Council.
- Member, Advisory Committee, Centre for Mathematical Modelling and Computer Simulations, Bangalore.

8 Finance

The Report of the Auditors and Audited Accounts of INCOIS for the year 2004-05 are placed as Appendix-1 to this Report.

7th Annual Report
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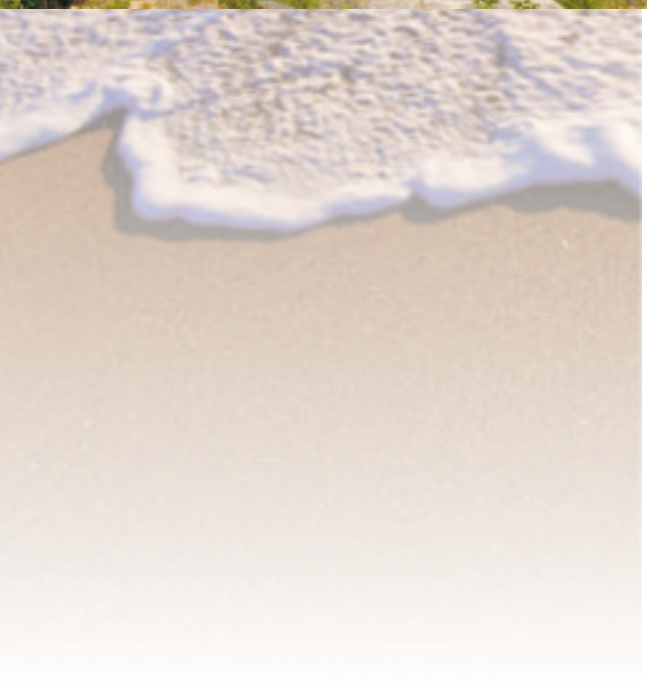

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