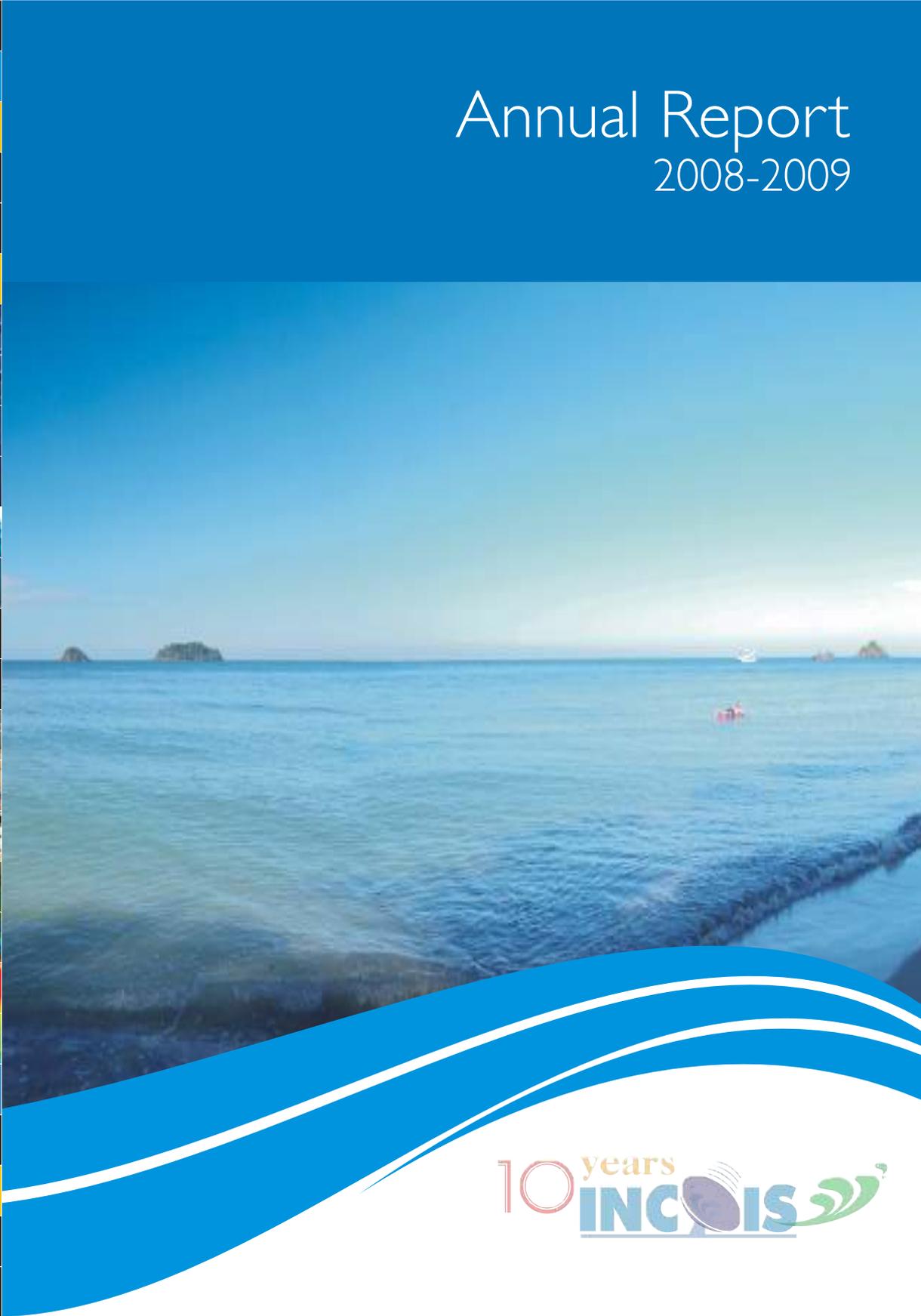


Annual Report 2008-2009



Indian National Centre for Ocean Information Services

(An Autonomous Body under the Ministry of Earth Sciences, Government of India) 'Ocean Valley', Hyderabad 500 055

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Director's Report



It is my privilege to present this report highlighting the contributions of INCOIS to the national endeavour in ocean information and advisory services, after taking the charge as the Director of INCOIS on 30 April 2009.

This year, INCOIS has completed 10 years of its existence. INCOIS is now widely recognized as an institute of national relevance and international significance that transfers benefits of the ocean science to the lowest strata of society by adopting innovative information and communication technology. INCOIS was set up in 1999 as an autonomous institute under the Department of Ocean Development to provide ocean information and advisory services to the society, the Potential Fishing Zone advisories being the flagship programme during its inception. INCOIS now deals with a host of programmes related to tsunami early warning system, ocean state forecast, ocean observing systems, ocean modelling, satellite oceanography, coastal geospatial applications, ocean data and information management and web-based services relevant to societal needs.

Significant contributions during the year 2008-09 are as follows:

- Improved the PFZ advisory service with the addition of two extra parameters chlorophyll and wind. The validations have indicated that the forecast accuracies are close to 85%. The forecast for tuna fishery was initiated on experimental basis. The delivery chain has been enhanced significantly by the adoption of new technologies.
- The Ocean State Forecast has been improved significantly. The forecast at 3 hourly intervals is now available for 6 days at 0.5° x 0.5° resolution. Operational generation and web delivery of high resolution forecast for Arabian Sea, Bay of Bengal and northern and southern Indian Ocean, South China Sea, Red Sea, and Persian Gulf is initiated. Global Wave forecast using Wave Watch III has been operationalised on experimental basis.
- Tsunami Early Warning Center is operational on 24x7 basis and has monitored 186 major earth quakes, issued advisories and initiated the efforts for improving the redundancy in the observing systems. INCOIS is now providing the Level 1 services as Regional Tsunami Watch Provider (RTWP) to Indian Ocean rim countries as part of ICG/IOTWS.
- Ocean modelling activities are being continued and efforts are underway to forecast sea surface temperature and currents using the state of the art ocean models.
- The Ocean Observing System has been sustained and international efforts in the setting up of Indian Ocean Observing System are being sustained.

- New data products and services have been developed and provided to the user community.
- The IT infrastructure has been augmented to meet the user demands and the Real Application Clustering environment has been implemented to speed up data mining.
- INCOIS continues to play the lead role in the Indian Ocean region and has made significant contributions to international initiatives such as Indian Ocean Global Ocean Observing System (IOGOOS), International Argo Programme, Partnership for Observation of Global Ocean (POGO), International Ocean colour coordination Group (IOCCG), International Oceanographic Data Exchange (IODE), Intergovernmental Coordination Group (ICG)/Indian Ocean Tsunami Warning System (IOTWS), International Society for Photogrammetry and Remote Sensing (ISPRS) etc.

In recognition for its services and leveraging innovations in technology, INCOIS has won prestigious national awards viz. Geospatial Solution of the Year 2008, Geospatial Excellence award and the Silver award 2008-09 of National Awards for e-governance for the best government website.

I am grateful to Dr. Shailesh Nayak and Dr. M. Ravichandran who steered INCOIS during the year 2008-09.

I take this opportunity to place on record that I received unstinted support, guidance and encouragement from Dr. Shailesh Nayak, Chairman, Governing Council, the members of the Governing Council, Chairmen and members of the Research Advisory Committee, Finance Committee and the officials of the Ministry of Earth Sciences. I am extremely grateful to all of them.



(S.S.C. Shenoi)

1. The Organisation

The Indian National Centre for Ocean Information Services (INCOIS) is an autonomous body under the Ministry of Earth Sciences (MoES), 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, Ministry of Earth Sciences	President
2	Director, National Remote Sensing Agency	Vice-President
3	Joint Secretary, Ministry of Earth Sciences	Member
4	Advisor, Ministry of Earth Sciences	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, Indian National Centre for Ocean Information Services	General Secretary

INCOIS Governing Council		
1	Secretary, Ministry of Earth Sciences	Chairman
2	Dr. Harsh Gupta, Raja Ramanna Fellow, National Geophysical Research Institute	Vice-Chairman
3	Director, National Remote Sensing Agency	Member
4	Director General, India Meteorological Department	Member
5	Financial Adviser, Ministry of Earth Sciences	Member
6	Shri D.R. Sikka, Former Director, Indian Institute of Tropical Meteorology	Member
7	Joint Secretary, Ministry of Earth Sciences	Member
8	Director, National Centre for Antarctica and Ocean Research	Member
9	Director, National Institute of Oceanography	Member
10	Director, National Institute of Ocean Technology	Member
11	Principal Advisor (S&T), Planning Commission	Member
12	Director, Space Application Centre	Member
13	Director, Indian National Centre for Ocean Information Services	Member-Secretary
14	Programme Officer, Ministry of Earth Sciences	Permanent Invitee

INCOIS Research Advisory Committee

1	Shri D.R. Sikka, Former Director, Indian Institute of Tropical Meteorology	President
2	Prof. B.N. Goswami, Director, Indian Institute of Tropical Meteorology	Vice-President
3	Dr. R. Siva Kumar, Head, Natural Resources Data Management System, Department of Science and Technology	Member
4	Dr. V. S. Hegde, Prog. Director, Disaster Management System, Indian Space Research Organisation	Member
5	Dr. B. K. Saha, Adjunct Professor, School of Oceanographic Studies, Jadavpur University, Kolkata	Member
6	Dr. M. Ravichandran, Head-MOG, Indian National Centre for Ocean Information Services	Member-Secretary

INCOIS Finance Committee

1	Additional Secretary and Financial Adviser, MoES	Chairman
2	Joint Secretary, MoES	Member
3	Director, INCOIS	Member
4	Director/Deputy Secretary (Finance), MoES	Member
5	Programme Officer	Member
6	Senior Scientist, INCOIS	Member-Secretary

The Mission

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

The major objectives of INCOIS are:

- (i) To establish Early Warning System for tsunami and storm surges,
- (ii) To undertake, aid, promote, guide and co-ordinate research in the field of ocean information and services including satellite oceanography.
- (iii) To establish, maintain and manage the systems for data acquisition, analysis, interpretation and archival for Ocean Information and Services.

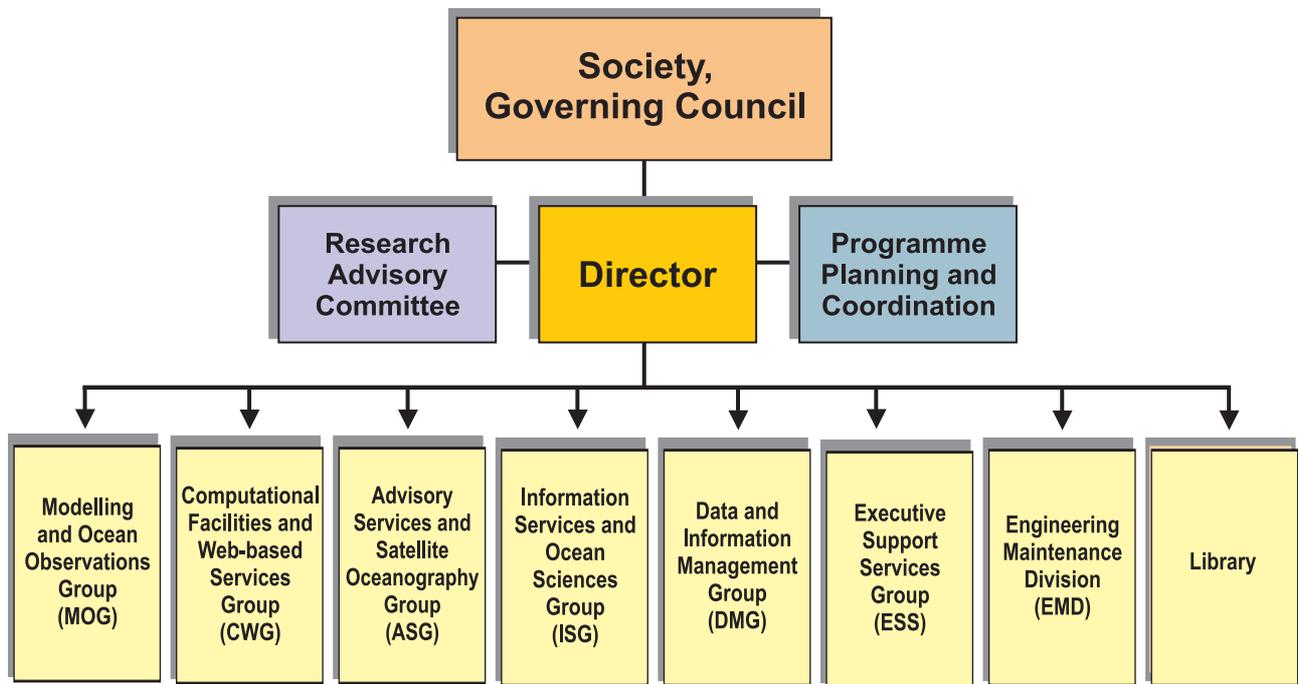
- (iv) To carry out surveys and acquire information using satellite technology, ships, buoys, boats or any other platforms to generate information on fisheries, minerals, oil, biology, hydrology, bathymetry, geology, meteorology, coastal zone management and associated resources.
- (v) To generate and provide data along with value added data products to user communities.
- (vi) To cooperate and collaborate with other national and international institutions in the field of ocean remote sensing, oceanography, atmospheric sciences/meteorology and coastal zone management.
- (vii) To support the research centres to conduct investigations in specified areas related to oceanic parameters, ocean atmospheric interaction, coastal zone information, data synthesis, data analysis and data collection,
- (viii) To organise training, seminars and symposia to advance study and research related to oceanography and technology,
- (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,
- (x) To provide consultancy services in the fields of ocean information and services,
- (xi) To co-ordinate with the space agencies to ensure continuity, consistency and state-of-the-art quality for the ocean data derived from satellite observations.
- (xii) To encourage and support governmental and non-governmental agencies or organizations for furthering ocean and related programmes in the generation of ocean information,
- (xiii) To undertake other lawful activities as may be necessary, incidental or conducive to the attainment and furtherance of all or any of the above objectives of INCOIS.

INCOIS, in its pursuit for organisational excellence, national relevance and international significance, translates the scientific knowledge into useful products and services through synergy and knowledge networking with centres of excellence in ocean sciences, atmospheric sciences, space applications, information and communication technology.

INCOIS presently has twenty five scientific and three administrative staff, twelve research fellows and forty three project/contract scientists/engineers. Additional human resource is also supported and developed with focused groups in several premier institutions under specific projects like Indian Ocean

Modelling and Dynamics (INDOMOD) and Satellite Coastal and Oceanographic Research (SATCORE). During the year, 13 project/technical/contract mode staff resigned from INCOIS and 31 project/technical/contract mode staff joined INCOIS under various projects. Outsourcing has been effectively done for system/software maintenance, operation and maintenance of technical support facilities, house keeping, canteen, transport and security services.

The organization structure of INCOIS is as given below:



The organisation structure

2. Coastal and Ocean Advisory Services

2.1. Potential Fishing Zone Advisory Service

The Ministry of Earth Sciences, Government of India had formulated a programme to provide the fishing community with credible advisories on Potential Fishing Zones (PFZ). This mission is part of the “Common Minimum Programme (CMP)” of the Government of India. The advisories are generated using data obtained from various satellites.

PFZ advisories are generated based on the locations of oceanic fronts, meandering patterns, eddies, rings, upwelling areas as seen on sea surface temperature (SST) and chlorophyll images. They are further augmented with information on winds obtained from scatterometers. The integrated PFZ advisories prepared in local languages and local measurement units are disseminated thrice a week during non-ban (April 15 –May 31) on the east coast; June 15 – August 10 on the west coast) and cloud-free days, through electronic display boards, information kiosks at the fishing harbours, Doordarshan, print media, emails, INCOIS web site, fax and telephone. This service is unique as this is the only short-term forecast available to the fishing community of the country. These advisories are issued on every Monday, Wednesday and Friday.

It has been observed that the PFZ advisories were more beneficial to artisanal, motorised and small mechanised sector fishermen engaged in pelagic fishing activities such as ring seining, gill netting, etc. thereby reducing the search time which in turn result in saving fuel and human effort. The reduction in search time was found to be 30-70%.

The significant achievements during this year are as follows:

Generation and dissemination

- One hundred and twenty one Integrated PFZ (IPFZ) advisories were generated for the sectors of east and west coast of India on every Monday, Wednesday and Friday during April 2008-March 2009.

Experimental Tuna Fishery Forecasting

- Experimental Tuna Fishery Forecast by providing maps and text information similar to PFZ advisories has been initiated and is available every Tuesday and Thursday. Tuna Fishery Forecast Maps and text information were also sent to the Tuna long liners through emails along with satellite images.

Electronic Display Boards

- Ten modified Electronic Display Boards (EDBs) equipped with voice and siren alert system to disseminate the disaster information in addition to the PFZ information were installed at Paradeep, Penthakothe, Astaranga, Arjipalli, Bahabalpur, Chudamani, Talachuan, Kharanasi of Orissa State and Harne Paj and Deogad, in Maharashtra. These boards are capable of remote updation through GSM / CDMA communication technology and transfer of recorded voice messages and online

broadcast of voice messages. The siren system is capable of providing immediate alert to coastal community (around 1 km radius).



*Inauguration of new generation electronic display board
'Ocean Information System'*

- Thirty two new generation EDBs (Ocean Information System) were installed at Bhadreshwar, Jakhao, Nanalija, Mandvi-kutch, Juna-Bhandar and Diu (Gujarat), Versova (Maharashtra), Vasco (Goa),), Karwar, Batkal, Honnavar and Tadadi (Karnataka), Narayambalam, Mariyanadu and Anchuthengu (Kerala), Parangipettai, Veerampattinam, Panithittu, Samiyarpettai, Mudasalodai, Samiyarpettai, Mudasalodai, Chinnangudi, Akkaraipettai Puthur, Neerody and Kovalam (Tamilnadu), Shankarapur Kakadwip & Namkhana, Frasersgunj, Patuaghat / Jadhavpur University West Bengal (West Bengal) and INCOIS (Hyderabad).
- Installations of five EDBs under the National Institute of Smart Governance (NISG) -UNDP project were completed and the initial testing of the boards is under progress.
- Pre-installation site surveys were completed for the new sites selected in Kerala in collaboration with Ernakulam Welfare Services and five sites identified by the Kutch Nav Nirman Abhiyan (KNNA) organization under the NISG – UNDP sponsored EDB Project.

Validation Projects

- Experiments conducted between Padiyamkara Thekku and Chavara (southern Kerala) employing two identical ringseiners, on Sep 02, 2008, revealed comparatively high Catch Per Unit Effort (CPUE) for Mackerel within PFZ notified areas. Results reported comparatively higher catches of *Rastrelliger kanagurta* and *Euthynnus affinis* within the Potential Fishing Zone.

- A peer review meeting of the PFZ Validation Projects funded by INCOIS (10 Projects) was organized at INCOIS on April 15, 2008 to assess the progress of the existing projects. The review meeting recommended a new project and suggested the mid-course corrections to adopt the uniform methodology for PFZ validation projects.

User interaction workshops

During the year, INCOIS had organised several field awareness campaigns at various fishing harbours with the active participation of fishermen to provide information on PFZ advisory service and explained the benefits of PFZ to the fishing community.

- User interaction workshop and awareness campaigns were organized at Ratnagiri on May 29, 2008 Neelangarai Kuppam, Chennai on July 05, 2008 and September 27, 2008 at Neendakara, south Kerala on July 15, 2008.



PFZ User interaction workshop

- A training programme was conducted for the staff of Kutch Nav Nirman Abhiyan (KNNA) on the interpretation of satellite imageries, PFZ maps and Electronic Display Boards functionalities.

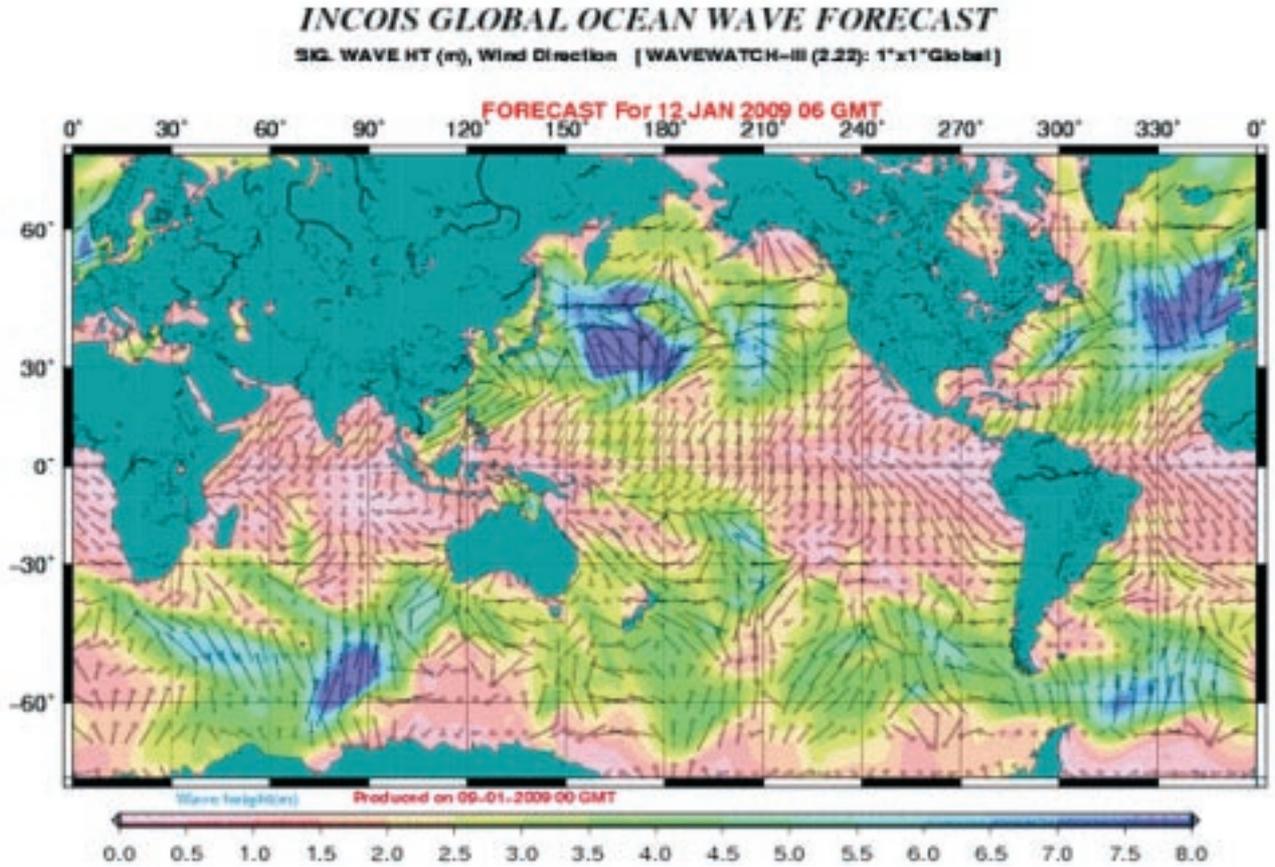
2.2 Ocean State Forecast (OSF)

Reliable forecast of the ocean state is vital for shipping, fishery, offshore industry, ports and harbours as well as for navy and coast guard for safe sailing and operations at sea.

Global Wave Forecast:

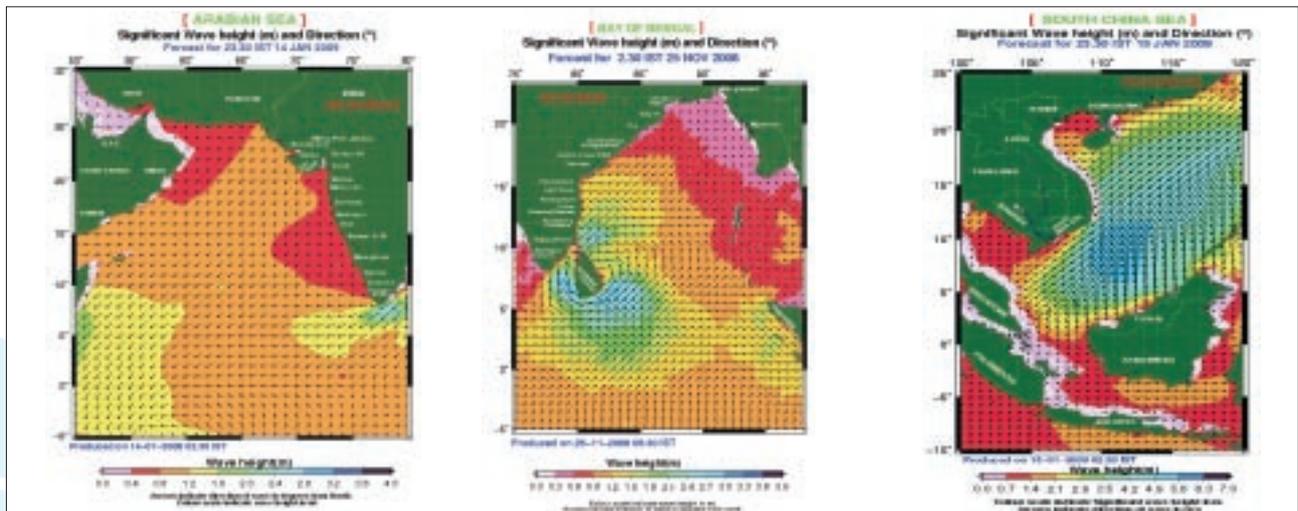
Global wave and swell forecast was provided on 1° x 1° latitude-longitude grids. The 6 hourly forecast was issued for 5 days. The forecast is generated using Wave Watch III (WWIII) model. The model

was forced with forecasted winds from National Centre for Medium Range Weather Forecasting (NCMRWF). The forecast was validated using the observed data from moored buoys and satellite altimeters.

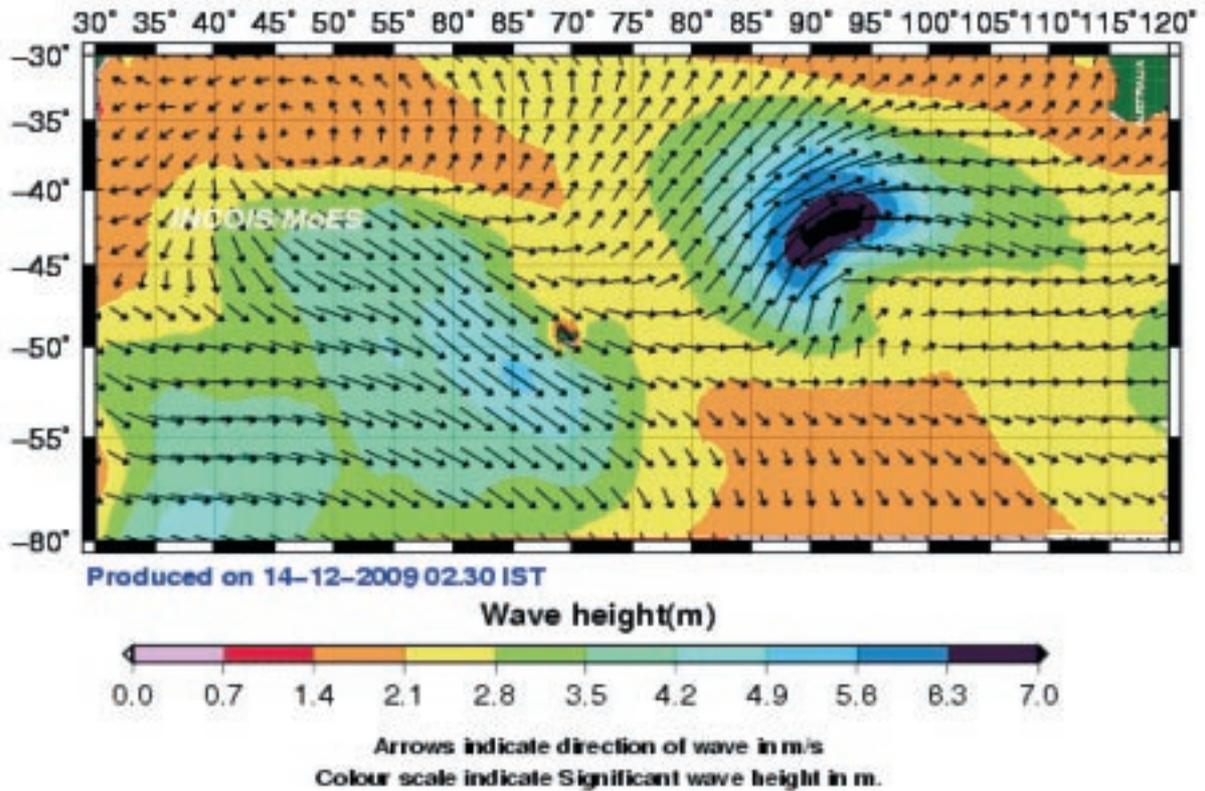


Regional Wave Forecast:

Regional forecast of waves and swells were issued for Arabian Sea, Bay of Bengal, South China Sea, Persian Gulf, Red Sea, and southern Indian Ocean at 0.5° x 0.5° spatial resolutions for 7 days at 3 hourly interval.

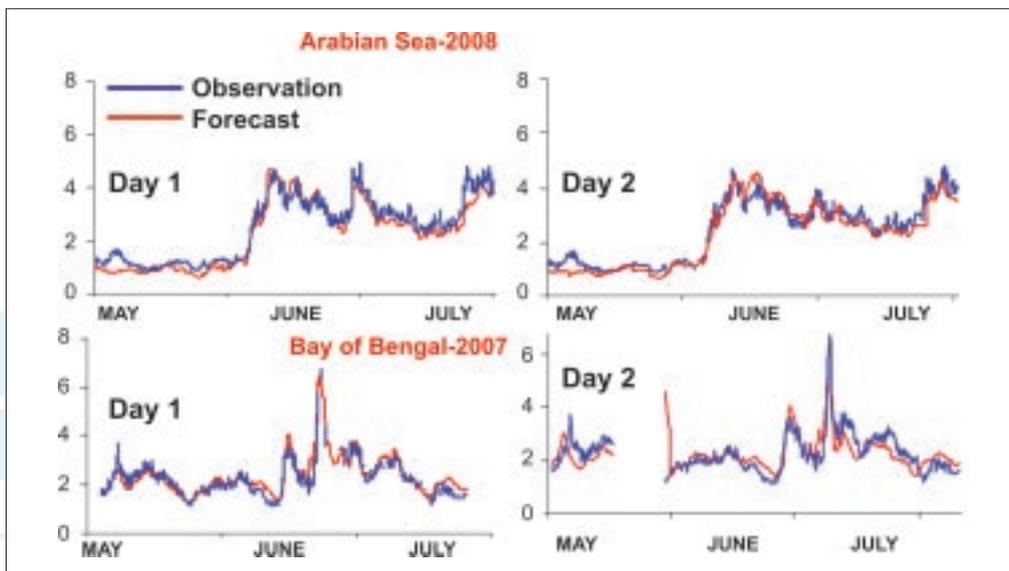


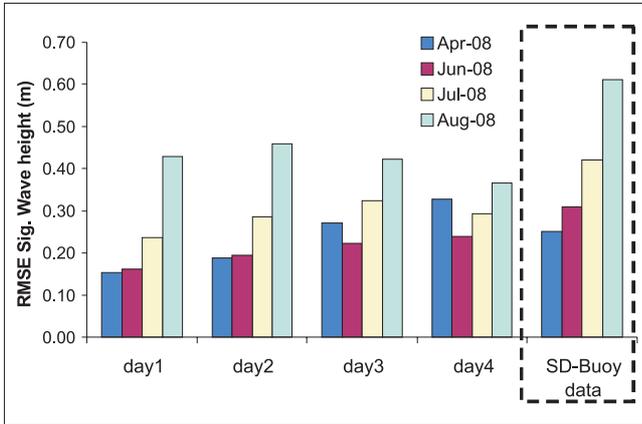
[SOUTHERN INDIAN OCEAN]
Significant Wave height (m) and Direction (°)
 Forecast for 23.30 IST 14 DEC 2009



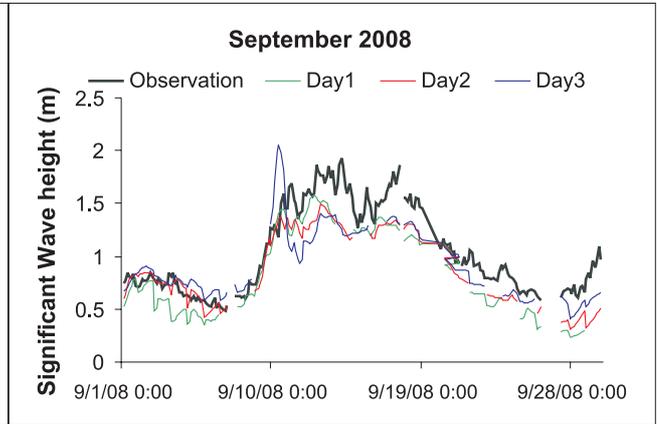
Validation

Validation is a regular exercise that is done before disseminating the products. The validations are done for both input winds as well as for the forecasted waves. The validation of forecasted waves was carried out for extreme event conditions also. A wave rider buoy network has been established to expand the validations at coastal sites.





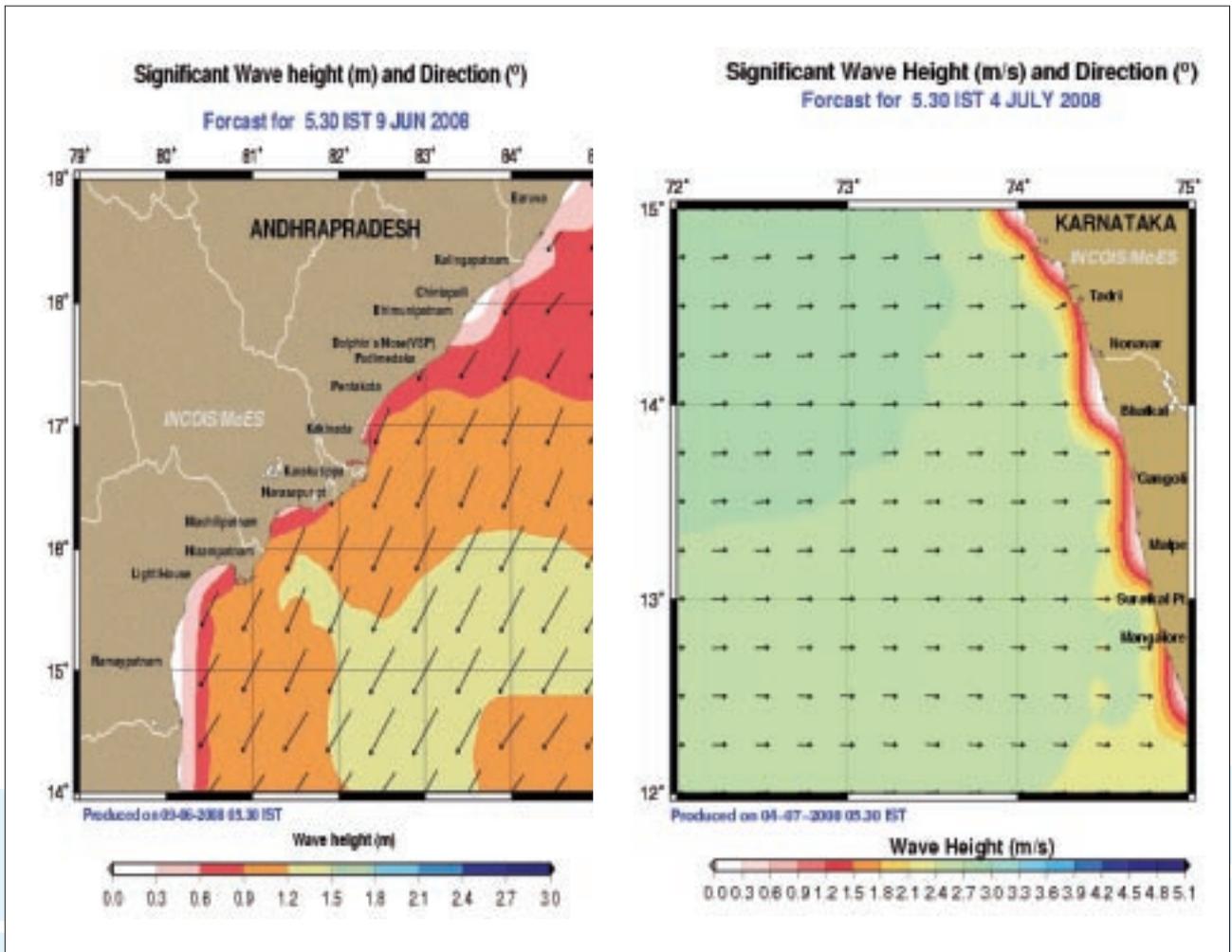
East Coast (Pondicherry)



West Coast (Karwar)

Coastal Ocean Forecast

State-wise forecast of waves and swells was generated and made available for all the coastal states of India, at $0.25^\circ \times 0.25^\circ$ spatial resolution for 7 days at 3 hourly intervals.



Dissemination of Coastal Forecast

The Coastal Sea State forecast also is disseminated through Electronic Display Boards, All India Radio, television, Village Information Centers and the Internet. The dissemination is also done in collaboration with NGOs over public announcements.

Ocean state forecast is also provided through the Electronic Digital Display Boards setup at fishing harbours.

Location specific Forecast

The location specific forecast and nowcast of parameters such as wave height and direction, wind speed and direction, swell height and direction are being provided daily to 20 coastal villages of Pondichery, Karaikkal, Cuddalore, Thirunelveli and Tuticorin in Tamil Nadu. Such services are being extended to Karwar (Karnataka) and Vishakapatnam (A.P).

Training and User Interaction

Training and user interaction programmes are being conducted at INCOIS and at field locations to make the fishermen aware of ocean information services.

- Ocean State Forecast user interaction workshop was organised for the fishermen and state officials at Karwar during July 11-12, 2008 and for Indian Navy officers at INCOIS on July 11, 2008.



Fisherman Association, Cuddalore

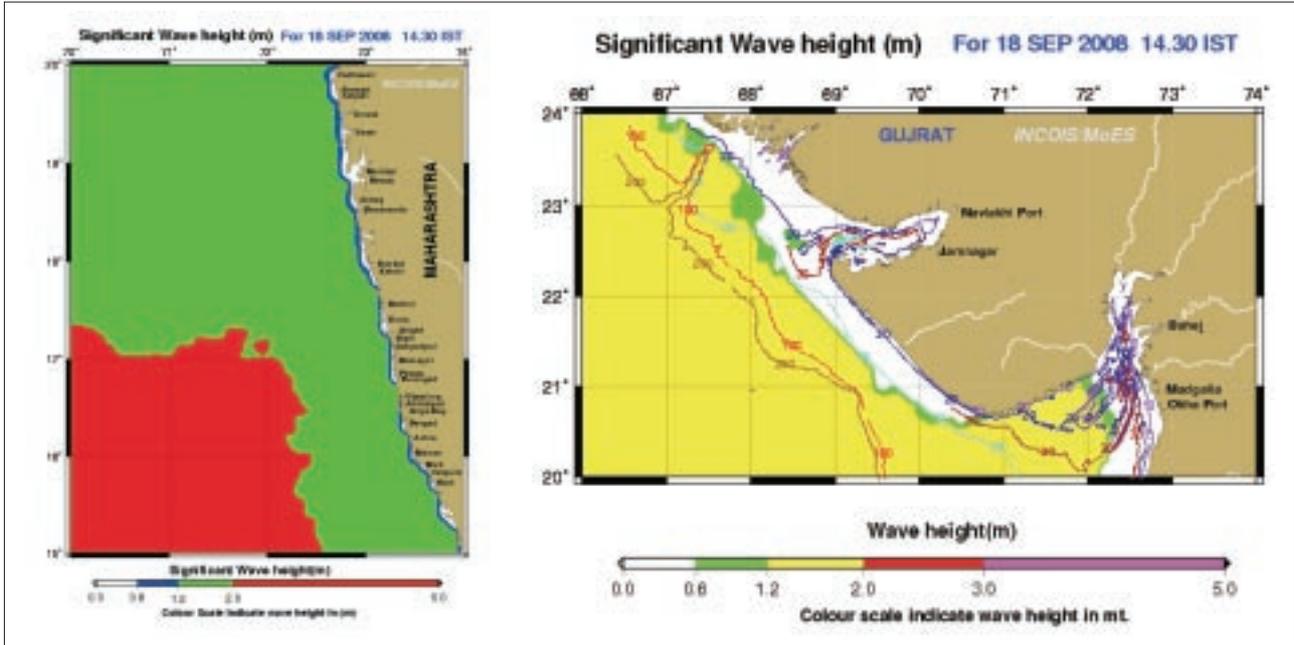


Fisherman Association, Karwar, Karnataka

2.3. Value Added Services

During the year, INCOIS took up the following need based user projects for coastal and offshore applications.

- INCOIS provided 3 hour interval information on wave and swell on a daily basis for individual port locations, to Maharashtra and Gujarat Maritime boards
- Wave simulations were carried out for ten years (1998-2007) to find out the wave conditions for tanker berthing and loading at Bhogat, Gujarat for Cairns Energy Ltd.



Value added services for shipping and energy sectors

- Interpreted the satellite data for:
 - the presence of pipelines prior to 1990 and the dispersal of flux from industry for Tata Chemicals Ltd.
 - generating the landuse maps in Salaya-Vadinar, Gulf of Kutch, Gujarat for Essar Gujarat Ltd.
 - generating the maps of mangrove and coral reef zonation in Salaya-Vadinar, Gulf of Kutch, Gujarat for Essar Gujarat Ltd.
 - Landuse classification for the Paradeep area in Mahanadi deltaic environs, Coastal Orissa for Essar Steel Ltd.
 - The short term changes in the landforms around the Krishnapatnam port area in Nellore district of Andhra Pradesh for Krishnapatnam Port Company Ltd.
 - Shoreline changes along the east coast for Krishnapatnam Port Company Ltd.

3. Early Warning System for Tsunami and Storm Surges

Tsunami Early Warning Centre (TEWC) continued its operation on 24x7 basis at INCOIS. The TEWC monitored 186 major earth quake events during April 2008-March 2009, generated advisories and provided them to Control Room of Ministry of Home Affairs and Secretary, MoES.

In addition to the routine watch operations at the warning centre, significant progress was made in the following activities:

- Real time data from national (17) and international (302) seismic stations were received and processed in Seiscomp software for the real time detection of global earthquakes ($M > 5.0$).
- Configured international (Indian Ocean) and national (IMD & Wadia) seismic stations (138) in Hydra Software. Athena software is then configured to report the earthquakes located by Hydra in near real time with a delay of 5 to 10 minutes depending on the proximity of earthquake locations to seismic network. Dissemination module (Ver. 1.3) is being tested to generate automatic fax bulletins and automatic emails.
- Tsunami Warning Centre received real time data from Tsunami Buoy-03 (TB-03) maintained by National Institute of Ocean Technology (NIOT) through satellite communication at intervals of one hour.
- Sea level data from 15 tide gauges from the Survey of India (SOI) are being received continuously through VSAT communication at 1 minute intervals. Sea level data from 2 tide gauges maintained by NIOT are also being received continuously through VSAT and INMARSAT satellite communication at 5 minutes intervals.
- Generation of historical tsunami scenarios are initiated and their storage into the data base is under progress.
- INCOIS hosted a workshop on “Regional Integrated Multi-Hazard Early Warning System (RIMES) for the Indian Ocean and Southeast Asia Regional Steering Committee Meeting & Integration of Regional Tsunami Watches (RIMES-INCOIS) into National Early Warning Systems” during November 19 - 21, 2008 at INCOIS. Sixteen participants from seven RIMES member countries (Bangladesh, Maldives, Myanmar, Philippines, Sri Lanka, Thailand, and Vietnam) participated in this workshop.



RIMES workshop at INCOIS

- INCOIS in collaboration with IOC organized the “Training programme on Tsunami modeling, Inundation Mapping and Remote Sensing” for Indian Ocean rim countries during 27 October to 7 November 2008 at INCOIS, Hyderabad, India. Sixteen participants from twelve countries of the Indian Ocean region (Bangladesh, Comoros, India, Maldives, Malaysia, Mauritius, Madagascar,

Myanmar, Sri Lanka, Seychelles, Thailand and Tanzania) attended this training programme. INCOIS/ IOGOOS secretariat is working closely with the capacity-development section of Intergovernmental Oceanographic Commission (IOC) in its efforts to enhance operational capability in the Indian Ocean region.



Training programme on tsunami modelling, inundation mapping and remote sensing

- Conducted awareness programme for school children to make them aware of earth sciences and tsunami early warning. Scientists of INCOIS demonstrated the INCOIS activities and Tsunami Early Warning Centre. About 200 school children visited the Tsunami Early Warning Centre on 27th August, 2008.

4. Observation Networks (Argo, Expendable Bathy Thermograph [XBT], drifters, current meter arrays & field campaigns)

4.1 Indian Argo Project

INCOIS acts as Argo Regional Data Center (ARC) for the Indian Ocean region. The Indian Argo Project has been implemented by the INCOIS jointly with the NIOT Chennai, National Centre for Antarctic Ocean Research (NCAOR), Goa and the Centre for Atmospheric and Ocean Sciences (CAOS) of Indian Institute of Science, Bangalore.

Several R&D institutions, operational agencies including the National Institute of Oceanography, Goa, Space Applications Centre, Ahmedabad, National Remote Sensing Agency, Hyderabad, Indian Institute of Tropical Meteorology, Pune, National Centre for Medium range Weather Forecasting, New Delhi, Centre for Mathematical Modelling and Computer Simulation, Bangalore utilised Argo data. Efforts are underway to encourage and enable academic institutions also in this endeavour.

Significant progress made under this programme is as follows:

- Twenty five Argo floats (including 10 floats with oxygen sensors) were deployed in the Indian Ocean.
- Out of 168 floats deployed by INCOIS, 89 are actively providing subsurface temperature and salinity data from the active floats, the data are received directly at INCOIS Satellite Data Acquisition and Processing System. The data is processed and disseminated to user agencies after real time quality control. 566 floats are currently active giving data in the Indian Ocean.
- Float vs Conductivity Temperature and Depth (CTD) comparison was made to ensure the quality of data.
- Successfully implemented real time Argo data processing software in collaboration with CSIRO, Australia. This software is capable of processing APEX-8c and APEX-9a, SBE dissolved oxygen and Aanderra dissolved oxygen floats in real time.
- Delayed mode quality control was applied for 112 Argo floats and these data has been uploaded to Global data Assimilation centre (GDAC).
- Trajectory data from 143 floats has been re-processed and provided to GDAC.
- Updated the value added products viz. float wise (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 (temperature, surface salinity, geostrophic currents at various levels, mixed layer depth, depth of 20°C and 26°C isotherms, isothermal layer depth, heat content up to 300 m, dynamic height) till March 2009 and published them on the INCOIS web site.
- The Argo value added products (thermocline depth, temperature at 50 m, 150 m and 300 m, depth of 26°C, 28°C and 20°C isotherm and mixed layer depth) are being used the experimental Tuna Fishery Forecast.
- First Argo users was organized at INCOIS during July 20-22, 2008 on the utilization of the Argo data. Sixty three scientists from 17 institutions participated in this workshop.

4.2. Other Ocean Observing Systems

- Twenty nine XBT voyages were conducted in the Bay of Bengal and Lakshadweep Sea during 2008 to obtain upper ocean thermal structures. Sea surface salinity samples were also collected along the shipping lines.
- Seventeen drifting buoys were deployed in the Indian Ocean during 2008.
- Equatorial current meter mooring array was retrieved and redeployed after recovering the data.
- Organised a cruise onboard ORV Sagar Kanya during October 10 – November 11 2008 to deploy/retrieve Research Moored Array for African-Asian-Australian Monsoon Analysis (RAMA) Pacific Marine Environmental Laboratory (PMEL) moorings, deploy drifters, and for CTD and radiometer observations in the Bay of Bengal.
- Two cruises were organised for the deployment/retrieval of RAMA moorings by PMEL as part of IndoOOS programme.

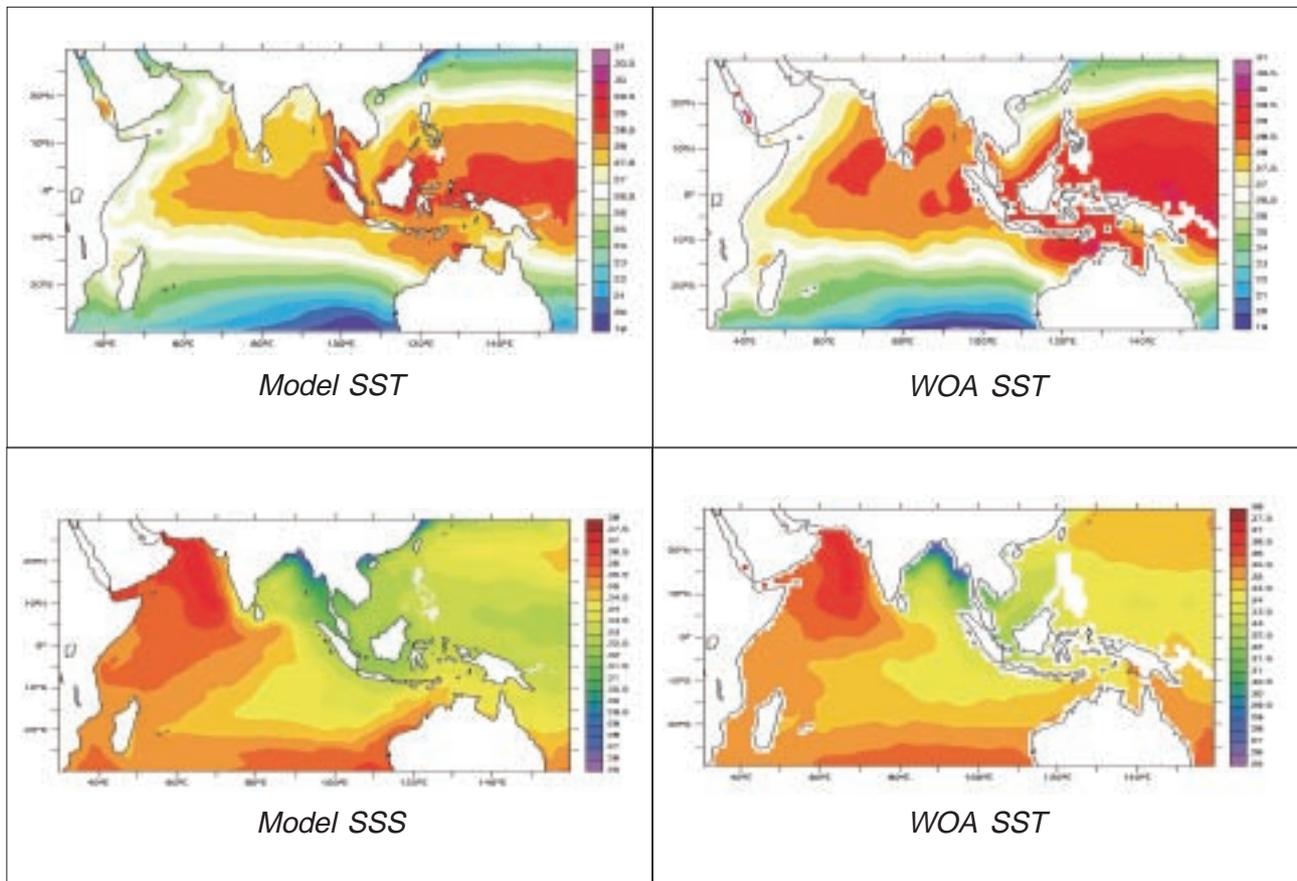
5. Research and Modelling (ocean modelling, INDOMOD, SATCORE, R&D Projects)

5.1 Ocean Modelling

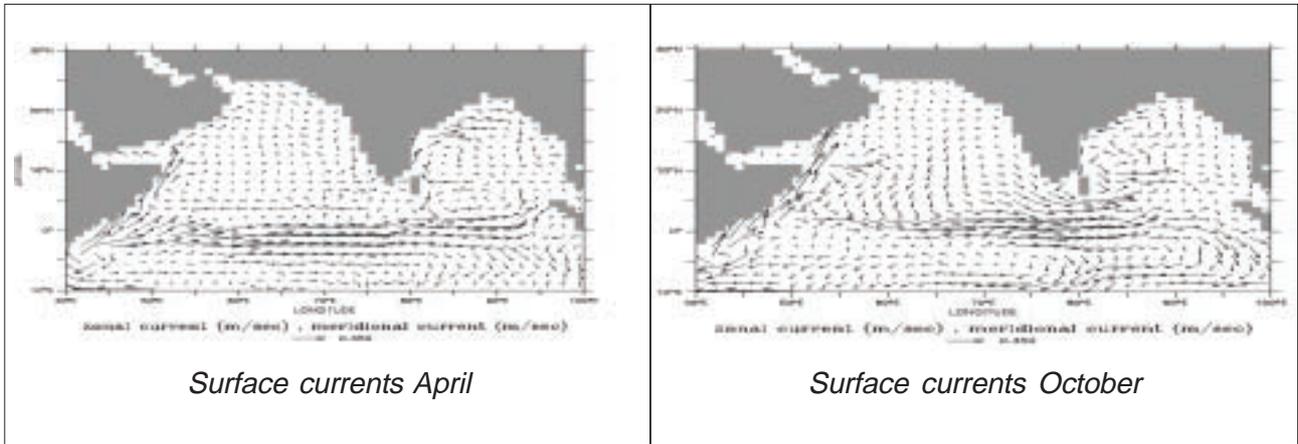
INCOIS continued ocean modelling activities using the forcing functions from atmospheric models, to study the variability of ocean and marine environment and conducted simulation experiments to optimize the observation system.

The progress made at INCOIS during the year is as follows:

- High resolution MOM4p1 for the Indo-Pacific basin with open boundary conditions and climatological CORE forcing fields is being set up in SGI Altix machine.

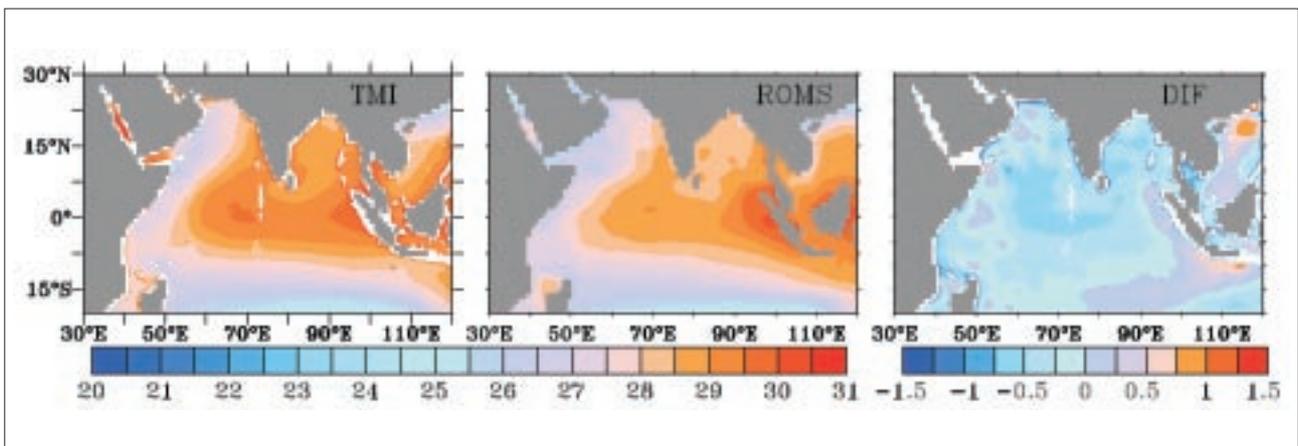


Comparison of MOM SST& SSS annual mean climatology with WOA

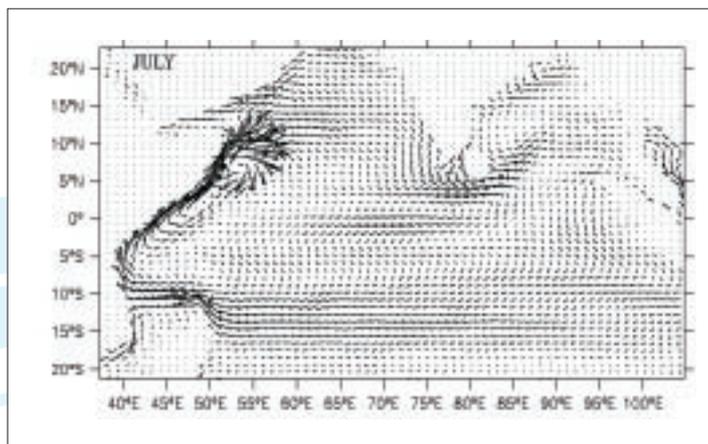


Model simulated monthly mean surface currents for April and October

- Ten year (1998-2007) simulations with interannually varying forcing fields were carried out using Regional Ocean Modeling System (ROMS). The model could simulate the major features such as Indian Ocean Dipole events in 2003 and 2006

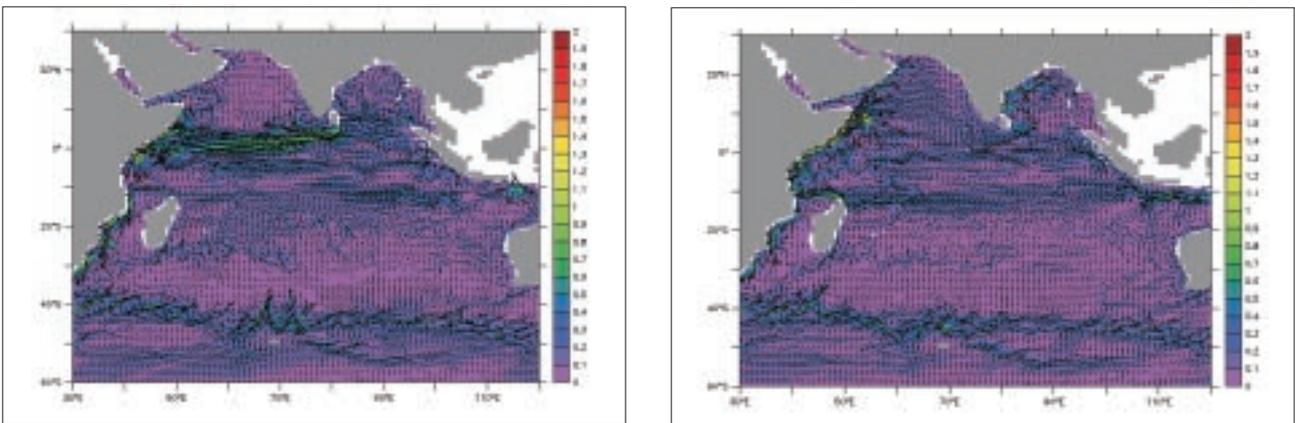


Comparison of ROMS SST with annual mean climatology of TMI SST



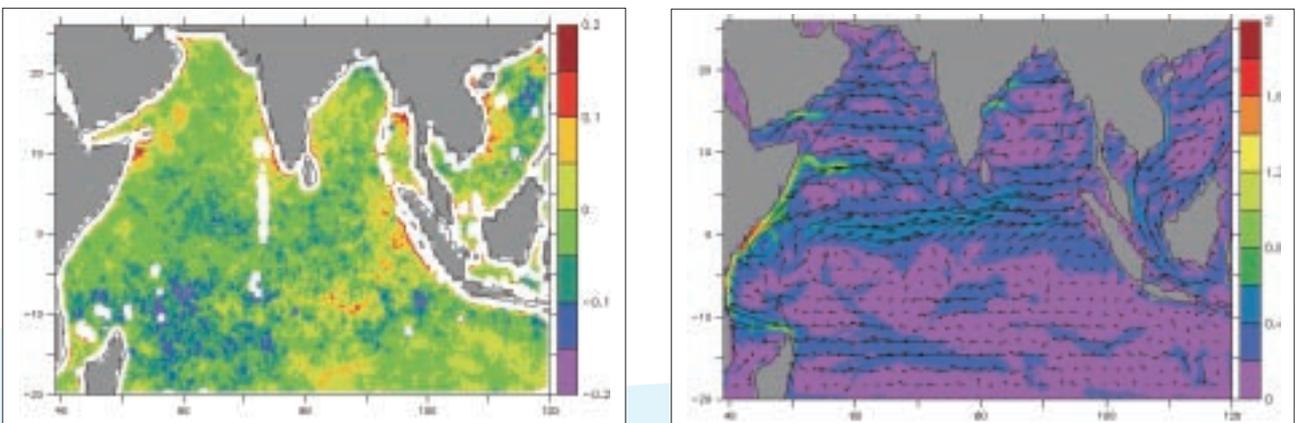
ROMS simulation of July mean currents in the Indian Ocean

- Topaz model based on HYCOM has been ported on SGI Altix machine at INCOIS and was spun up for 10 years using Gdem temperature salinity climatology and ERA40 atmospheric forcings. The model is grid configured using conformal mapping and hence having varying spatial grid resolution. The model is set up at resolution of 14-42 km, sufficient to resolve the larger meso-scale features. The model has 30 hybrid layers. The GEBCO (1 minute) bathymetry was interpolated to the model grid. Tools for nesting the larger domain model to a smaller domain are being ported on the SGI machine together with ensemble Optimal Interpolation (ENOI) based assimilation scheme. The model runs for the period 1992 to 1997 without data assimilation has been carried out and is being compared with observations.



Hycom surface velocities overlaid with directional vectors (5-Jan-1995)

- The Colorado University Princeton Ocean Model (CUPOM) was set up for the Indian Ocean region at 1/4 deg resolution and 38 vertical sigma levels. The model was forced with NCEP winds and nudged with observed TMI- SST and merged SSHA from satellite altimeter. Correlations of simulated SST with TMI observed SST and RAMA mooring SST was 1.0 and 0.88 respectively. The match between simulated surface currents with drifter climatological surface currents are encouraging.



CUPOM model minus TMI - annual average for 2005

CUPOM model simulated surface currents for June 2005

- The INDO-Norwegian workshop on operational modeling of the Indian Ocean was jointly organised by INCOIS, NERSC and NERCI at INCOIS during March 11-12, 2009. The workshop has the background of the existing MoU signed between INCOIS and NERSC in 2008 and also explores possibility of cooperation in different aspects of operational oceanography and remote sensing. The two day workshop discussed about the present status and future plans on various topics viz. modeling and validation, marine ecosystem monitoring and modeling, regional ocean modeling and data assimilation. The workshop identified major areas for future cooperation.

5.2. Indian Ocean Modelling and Dynamics (INDOMOD) Project

INDOMOD project focuses towards the end goal of achieving ocean predictability and understanding the role of ocean on climate predictability. The project envisages participation of several institutions, with a mission to enhance the basic understanding of oceanic and atmospheric processes and catastrophic weather events.

Twenty five proposals from Indian Institute of Science (IISc), Bangalore, Indian Institute of Technology (IIT-D), Delhi, Indian Institute of Technology (IIT-Kgp), Kharagpur, National Institute of Oceanography (NIO), Goa, Centre for Mathematical Modelling and Computer Simulation (C-MMACS), Bangalore, Andhra University (AU), Visakhapatnam, Hyderabad University, Hyderabad, Cochin University of Science and Technology (CUSAT), Kochi, Annamalai University, Chennai, Jadavpur University, Jadavpur, Allahabad University, Allahabad were selected for funding on the recommendations of a selection committee categorised under the following modules

- Ocean and climate (8)
- Coastal oceanography (6)
- Bio-geo-chemistry (3)
- Ocean observation (5)
- Hazardous weather events, atlas and computational oceanography(3)

Significant progress made under the programme during the year is as follows:

- Basin scale model has been set up for the region between 30° S - 30° N and 30° -120° E.
- Two fine resolution coastal models using POM were also set up for the east and west coast of India.
- A mesoscale model (Weather Research and Forecasting) version 2.2 has been set up and the numerical experiments are in progress.
- Deployed three sets of ADCP moorings off the central west coast of India (one each on the shelf and slope region).
- Deployed two wave rider buoys off Dwarka (at 15 and 30m water depths) and two wave rider buoys off Ratnagiri (at 15 and 30m water depths).
- Twenty one research papers were published.
- An oceanographic atlas for the Indian Ocean using remote sensing data was released.

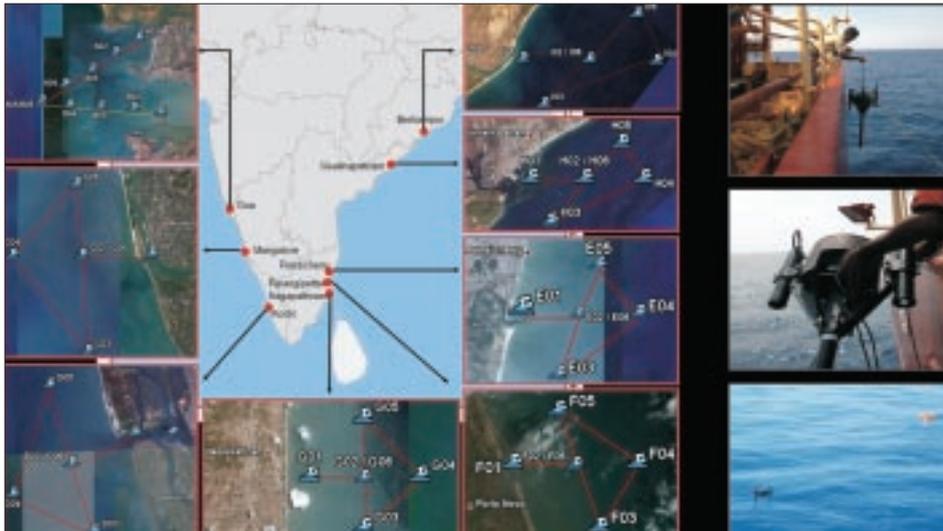
5.3. Satellite Coastal and Oceanographic Research (SATCORE)

INCOIS is the key coordinator for the SATCORE programme during the XI five year plan. The programme is internationally linked to the global initiatives through ChloroGIN and Indian Ocean GOOS. ChloroGIN identified as IOGOOS contributions to the coastal ocean aims at the networking and distribution of chlorophyll and SST maps along the coast lines of Indian Ocean rim countries.

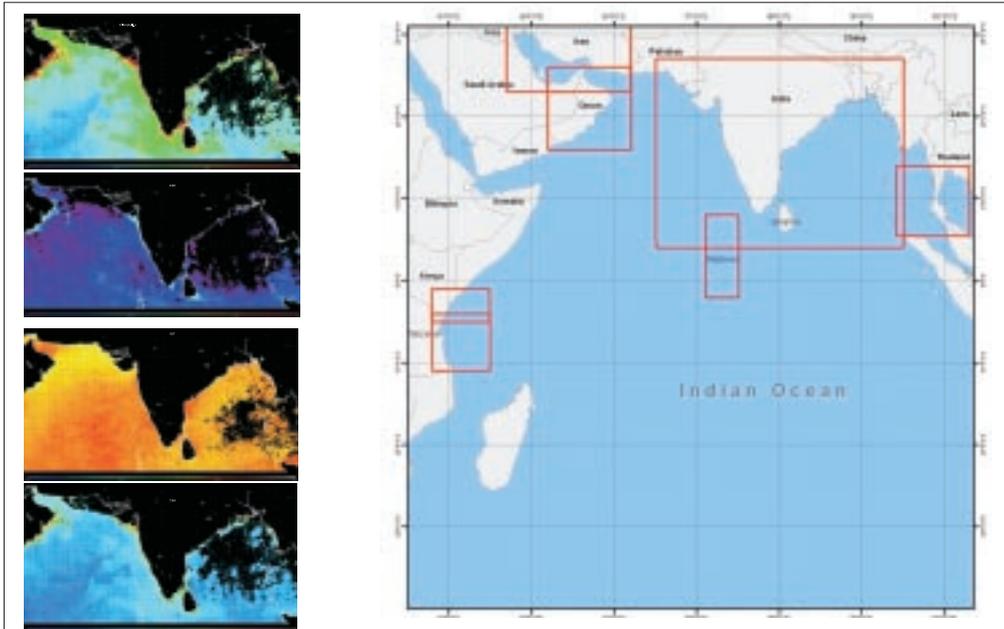
INCOIS joined this programme to provide Chlorophyll, SST maps and time-series measurements. The scope of the work includes (i) processing of satellite data in real time to support operational users and generation and web-dissemination of near-real time satellite data products such as Chlorophyll, SST, K490 and TSM, and (ii) establishment of time-series stations off Goa, Mangalore, Kochi, Pondichery, Parangipettai, Nagapattinam, Machlipatnam, Visakhapatnam coasts for the measurement of key physical and bio-geo-chemical parameters in the Indian coastal waters by involving the universities and research institutes. By complementing and supplementing the *in situ* observations with remote sensing databases, the project envisages the validation of satellite derived products.

Significant achievements during the year under report are listed below:

- Established 8 time-series stations for *in situ* measurement of optical properties of coastal waters, chlorophyll, CDOM, SST, etc.



- Automated the data processing chain to generate ocean colour products using MODIS – Aqua data on real time.
- Daily, weekly and monthly composite images of chlorophyll_a, SST, K_490 and TSM were generated for eight Indian Ocean rim countries (India, Sri Lanka, Maldives, Iran, Kenya, Oman, Tanzania and Thailand) and published on INCOIS web-site.
- Three and seven days binned ocean colour data products, were generated for Tuna forecasting.
- Initiated the efforts to use the high-resolution MODIS-Aqua data for oil spill monitoring and to generate red tide index for the identification of harmful algal blooms.



Data products Chlorophyll, SST, K490 and TSM for Indian Ocean rim countries

- The red tide index (RTI) algorithm was incorporated in SeaDAS and is currently being evaluated and is undergoing further tests.
- Organized a training programme on “*In-situ* techniques for validation of satellite derived ocean colour data products” in collaboration with CAS in Marine Biology at Annamalai University.

Eco-morphological zonation and coral reef health monitoring

A project was sanctioned by the Ministry of Environment and Forests (MoEF), Govt. of India, to study the coastal zone management aspects of the Indian coast using satellite data. Space Applications Centre (ISRO), Ahmedabad, is the nodal agency and INCOIS is a partner of this project. The project proposes the study of coral reefs of India and the zonation of the coral reefs based on eco-morphology and the assessment of the health of reefs. The responsibilities of INCOIS under the project are (i) monitoring reef health (RH) indicators using satellite data (ii) finalization of RH criteria (ii) generation of composite maps (iii) validation of RH model (iv) health bulletins and (v) documentation.

During the year, coral reef zonation mapping for Andaman & Nicobar island was completed.

6. Computational Facility (High Performance Computing System, Ocean Portal) and Ocean Information Bank

6.1. Computational and Communication Facilities

The computational facilities of INCOIS comprise of high end uni-processors to multiprocessor systems, enterprise storage servers and a 3-tier storage.

Campus wide networking using ethernet technology (gigabit ethernet technology) with optical fiber cable as backbone and UTP cabling has been upgraded. The network uses load balancers, link load balancers, firewalls, switches, routers, etc.

Other major achievements during the year are:

- Enhanced the internet bandwidth from 2 Mbps to 8 Mbps (4x2 Mbps) to meet the operational requirements of Tsunami Warning Centre in addition to other operational projects of INCOIS. The bandwidth was taken from two different ISPs- BSNL and Tata Communication to avoid single point failure.
- Upgraded the website hardware, successfully implemented the Oracle Real Application Clustering and migrated the website and ocean portal.
- Installed and configured IVRS for the dissemination of earth quake information,
- The Refreshed Technology of existing IBM hardware with state of the art IBM technology,
- Initiated the implementation of High Performance Computing System

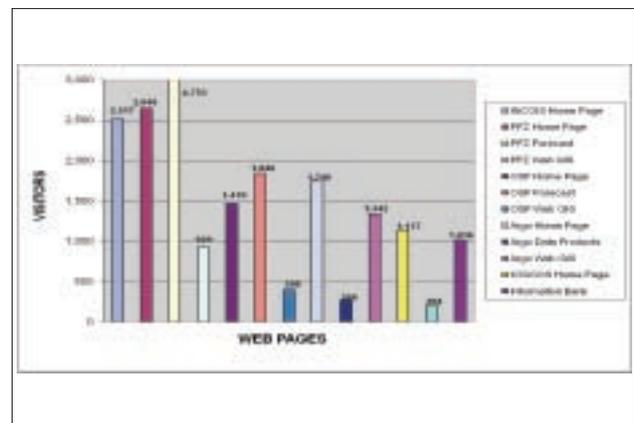
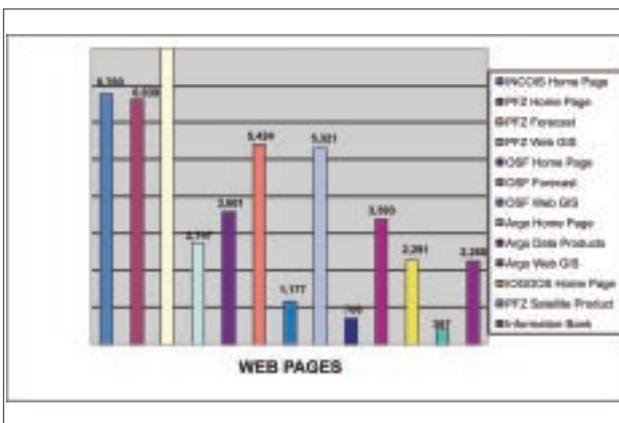
The software packages installed and maintained at INCOIS includes ERDAS, ENVI and E-Cognition (for image analysis), Arc/Info, Arc SDE and Arc IMS (for GIS), Oracle 10g (RDBMS), MATLAB (for data processing and analysis), Websphere (for web server), MS Exchange.

Being an operational agency, it is necessary for INCOIS to maintain state of the art communication devices for real time reception and dissemination of data, information and warnings. At present INCOIS maintains INSAT communication hub (MSS and DRT) for real-time reception of tsunami buoy data, satellite data acquisition and processing system for receiving real-time data from NOAA series of satellites and Argo floats (Aqua & Terra (MODIS)), VSAT based seismic data reception to receive real-time seismic data from 17 broad band seismic stations through INSAT 3E and VSAT for real-time reception of tide gauges and BPRs maintained by NIOT and Survey of India.

6.2. Web-based Services

INCOIS website (www.incois.gov.in) has matured as a prime vehicle for the delivery of ocean data, information and advisory services especially in the areas of Potential Fishing Zone, Indian Ocean Argo Project, Ocean State Forecast and IOGOOS. The web-based, multi-lingual and on-line information delivery system with Web-GIS capability enables the users to query, analyse, visualise and download ocean data, information and advisories for their regions of interest.

The content updation of INCOIS website was carried out and several new web pages were developed. 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 data. A GIS-based interface for selection and retrieval of data from various observing platforms in the Indian Ocean has been developed.



INCOIS web-site usage during the period April 2008 – March 2009

6.3. Ocean Information Bank

Ocean Information Bank is the one stop shop 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 in-situ platforms and satellites as well as by a chain of Marine Data Centres.

- Data from moored buoys, drifting buoys, XBTs, current meter mooring arrays are acquired, processed, quality checked and disseminated to different user agencies in real-time and delayed mode.
- Remote sensing data from AVHRR (NOAA-17,18) and MODIS (Aqua and Terra) are being received in real time. Data products viz. SST, chlorophyll, aerosol optical depth, clouds etc. are being generated in real time and published on INCOIS website. MODIS atmospheric profiles and NOAA SST are regularly supplied to IMD and NCMRWF in near-real time for their operational use.
- The ocean information bank was updated with the new data sets received from the COMAPS programmes.
- Developed applications for automated real time quality control of moored buoy data and for the extraction of moored buoy data through INSAT communication.

- Automated the entire process of acquisition, processing, quality checking, and web publishing of the data from moored buoys.
- INCOIS started operational dissemination of the moored buoy data to the users [Indian Meteorological Department (Delhi and Chennai), Directorate of Naval Oceanology and Meteorology (Mumbai, Port Blair, Vizag, Goa, Kochi), and Coast Guard (Chennai)] by email in real time.
- The Argo value added products (thermocline depth, temperature at 50 m, 150 m and 300 m, depth of 26°C, 28°C and 20°C isotherm and mixed layer depth) were provided for use in experimental Tuna Fishery Forecast.
- INCOIS has become the Data Assembly Centre (DAC) of the 'Oceansites' programme on global network of time-series stations.
- Developed GML Scheme for providing metadata to National Spatial Data Infrastructure developed by the NRDMS/DST.
- A DVD on Argo Data and Data Products for the Indian Ocean (*Version 1.0, Feb'2009*) was released for the use of scientific community. This DVD contains about one lakh temperature and salinity profiles obtained from about 1000 Argo floats deployed in the Indian Ocean by various countries.
- Generation of MLD atlas for the Indian Ocean using the Argo data is under progress.
- Initiated the studies on outlier analysis of moored buoy data for delayed mode QC and spatio-temporal density based algorithms for clustering physical oceanographic data.
- Initiated the process to set up of ground station to receive the Oceansat-2 data in real time at INCOIS.

INCOIS plans to strengthen the ocean information bank with the data generated from the chain of marine data centres, MoES institutions and academia by networking of these centres.

Apart from serving as a national repository of marine data, the INCOIS as the National Oceanographic Data Centre of India, also acts as national contact point for the International Oceanographic Data and Information Exchange (IODE), and Global Ocean Observing System (GOOS)-programmes of Intergovernmental Oceanographic Commission (IOC).

7. INCOIS-Infrastructure development; Operations and Maintenance

INCOIS is functioning from its permanent campus developed at Hyderabad in a 50 acre land with state-of-the-art facilities and the right ambience for an S&T institution. As part of the campus expansion

programme the acquisition of adjacent land (10 acres) is under progress. Also initiated the planning and tendering process for the extension of INCOIS building, residential quarters, guest house and hostel accommodation.

8. INCOIS in the International Scene

Intergovernmental Oceanographic Commission (IOC): India is a founder member of IOC and also a member of the executive council. Director, INCOIS participated in the 41st session of executive council of the International Oceanographic Commission (IOC) in Paris, France.

Regional Alliance in Indian Ocean for GOOS (IOGOOS): INCOIS, being the Secretariat for IOGOOS till 2008, has been effectively leading IOGOOS that has taken a place of pride among Regional GOOS Alliances. Since its formal launch at the first Indian Ocean conference held in Mauritius on 5 November, 2002, IOGOOS membership has grown from 19 to 25 institutions from 15 countries. Some of the major initiatives of IOGOOS are) the setting up of Indian Ocean Panel (IOP) working towards the strategy and implementation plan for Indian Ocean Observations for Climate, Data & Information management, remote sensing data in the use of capacity building, prawn pilot project, keystone ecosystems project and shoreline change monitoring project. IOGOOS members have played a key role in Argo floats deployments and enhancing the tropical moored buoy array.

Major accomplishments of IOGOOS during the year are as follows:

- IOGOOS Workshop and 6th Annual Meeting was organised by IOGOOS Secretariat, in Hyderabad during December 03-05, 2008.



- The functioning of IOGOOS Secretariat at INCOIS was extended for another term of 6 years.

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 the 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.

Partnership for Observation of Global Ocean (POGO):

Partnership for Observation of Global Ocean (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. INCOIS is a Member of POGO since 2004 and Director, INCOIS is a member of Executive Committee of POGO since 2006.

9. General Information

Promotion of Hindi

INCOIS is constantly promoting and propagating the Official Language, Hindi. The Hindi Committee was constituted at INCOIS with Shri. K.K.V. Chary, Senior Administrative Officer, INCOIS as the Chairman. Meetings of official language implementation committee were held regularly.

During 2008-09, efforts were made to promote the progressive use of Hindi in the institute. INCOIS Annual Report 2007-08, News Letters, and other letters were prepared in Hindi. The potential fishing zone advisories were also issued in Hindi along with the local languages.

Hindi Pakhwara celebrations were organised at INCOIS by the Hindi Committee, on September 15, 2008. Essay writing competition in Hindi was held among INCOIS Staff. A seminar on official language was held at INCOIS on February 2, 2009. Dr. D. D. Ozha, Scientist, Indian Society of Health, Environment, Education and Research (ISHEER), Jodhpur delivered a lecture in Hindi. Dr Shailesh Nayak, Secretary, MoES and Chairman, INCOIS-GC was felicitated by the ISHEER during this occasion.



Dr. Shailesh Nayak, Secretary, MoES felicitated by ISHEER, Jodhpur at INCOIS on 2 Feb, 2009

Vigilance activities

Dr. Ravichandran, Scientist 'F' and Head, MOG has been functioning as the Vigilance Officer at INCOIS. The Vigilance Awareness Week was observed from 3-7 November 2008 at INCOIS. The pledge related to the Vigilance Awareness was administered to the officers and staff of INCOIS on 3 November, 2008 at 11.00 A.M. During the year 2008 -2009, no complaints related to vigilance were received.

Reservations

Government of India's reservation policy for the recruitment of posts is being implemented at INCOIS.

Right to Information Act

Right to Information Act, 2005 is being administered at INCOIS. Dr. Shailesh Nayak, Director, INCOIS and Shri. E. Pattabhi Rama Rao, Scientist 'D' and Head, DMG functioned as the Public Information Officer and Assistant Public Information Officer respectively. Information about the activities of the INCOIS and staff were published on the website in the prescribed format under Right to Information Act 2005 pages. Annual return form for the year 2007-08 prepared as per the guidelines of the Central Information Commission is also published on INCOIS website. During the year 2008-2009, nine requests under the Right to Information Act 2005 were received and were replied.

Meetings

- The 12th meeting of INCOIS Finance Committee (FC-12) was held on 14 August, 2008 at INCOIS.
- The 3rd meeting of the Research Advisory Committee (RAC-3) of INCOIS was held on 19 September, 2008 at INCOIS, Hyderabad.

Workshops/Training Programmes by INCOIS

INCOIS organized the IOC/UNESCO First Advance Leadership Workshop for the Directors of Marine Institutes in the Indian Ocean region during May 10-14, 2008. Twenty five participants from 11 countries of the Indian Ocean region (Bangladesh, India, Malaysia, Maldives, Mauritius, Oman, Seychelles, Sri Lanka, Thailand, United Arab Emirates, South Africa and UNESCO officials from France) attended. Most of them were directors or senior executives. Specializations and expertise of the participants included operational marine meteorology, physical oceanography, marine hazards, hydrography, biological oceanography, fisheries, remote sensing, modelling and data management.



IOC/UNESCO First Advanced Leadership Workshop

INCOIS in collaboration with Centre for Studies on Bay of Bengal, Andhra University organised a training programme on Fundamentals of Ocean Sciences during September 22 to October 03, 2008 for the recently joined scientific staff.

INCOIS organised a lecture series on 'Geophysical Fluid Dynamics' (14 lectures) during January – March 2009, for the scientific staff, by Dr. D. B. Rao, Consultant Scientist, INCOIS and former Chief, Modelling and Analysis Wing, National Centre for Environmental Prediction, NOAA, Camp Springs, MD.

Lectures and Colloquium at INCOIS

Scientist and Affiliation	Lecture	Date
Dr. Matthew J. Harrison, Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA	Observing and Modeling the Indian Ocean Climate System	12-12-2008
Dr. Vijay Tallapragada, Environmental Modeling Center, National Centers for Environmental Prediction (NCEP), USA	The Hurricane WRF (HWRF) - Addressing the next generation hurricane prediction problems at NCEP's Environmental Modeling Center	02-07-2008
Dr. Andreas Schiller, CSIRO, Australia	The BLUElink Project	11-06-2008
Dr. Tim Boyer, NODC, USA	Estimating global ocean heat and freshwater change from insitu data'	30-01-2009

Training programmes attended by INCOIS staff

Name	Training Programme	Period	Host / Organiser
R.S. Mahendra Scientist B	Workshop cum training programme on Coastal Sediment Cell	26 - 27 May, 2008	Institute of Environmental Studies & Wetland Management (IESWM), Kolkata
Mr. N. Kumar Project Assistant	Access & Management of E-Resources: Consortia Approach	30 June, 2008 04 July, 2008	National Institute of Science Communication and Information Resources (NISCAIR), New Delhi
Dr. Anish Lotliker Scientist B R.S. Mahendra Scientist B	Acoustic Techniques for Fish finding and Plankton Biomass Estimations"	22 - 27 September, 2008	CMLRE, Kochi

Mr. B. Sambasivarao, Project Scientist B Mr. S.P. Vighneswar, Project Scientist B	Geo-spatial Interoperability and Spatial Data Infrastructure (SDI)	29 September, 2008 1 October, 2008	Department of Science and Technology held at IIT-Kharagpur
Mr. M. Nagaraja Kumar, Scientist C Mr. R. Venkata Shesu, Scientist B Ms. K.G. Sandhya, Scientist B Mr. N. Kiran Kumar, Project Scientist B Mr. A. Murali Krishna, Project Scientist B Ms. Sridevi Tiwari, SRF Ms. P. Sirisha, SRF Mr. P. C. Mohanty, SRF Ms. Neethu C., SRF Ms. M. V. Sunanda, JRF Mr. R.P. Raju, JRF M. C. Neelima, JRF Ms. U. Jemima, JRF Ms. Lalitha Kumari, JRF Ms. Nagaswetha, Sc. Asst-B Mr. A.K. Mishra, Sc. Asst-B Mr. T.V. Rajesh, Sc. Asst-B Mr. R. Misra, Sc. Asst-B	Fundamentals of Ocean Sciences	22 September, 2008 04 October, 2008	Funded by INCOIS and organised by Centre for Bay of Bengal Studies, Andhra University, Visakhapatnam
Dr. Sudheer Joseph Scientist-D	HYCOM (TOPAZ) model implementation for Indian Ocean at Nansen Environmental and Remote Sensing Centre	25 October, 2008 20 December, 2008	Nansen Environmental and Remote sensing Center(NERSC), Bergen, Norway

Visit of foreign delegation to INCOIS

A delegation of officials from Thailand led by Dr. Smith Dharmasaroja, chairman of Thailand's National Disaster Warning Administration visited INCOIS during 19-20 June, 2008 to discuss about the collaboration in Tsunami early warning system.



Oman Delegation

A delegation from Oman headed by Dr. Ahmed H.M. Al Harthy, Director Operations and Technical Services, Ministry of Transport and Communication visited INCOIS on 20 October, 2008.

NOAA Delegation



A delegation from National Oceanic and Atmospheric Administration (NOAA), USA headed by Dr. Chet Koblenky, Director of NOAA Climate Program Office, visited INCOIS on 08 September, 2008 as part of the ongoing MoES-NOAA Memorandum of Understanding.

Distinguished Visitors



Dr. Madhavan Nair, Secretary, Department of Space, visited INCOIS on 01 September, 2008. Dr. K. Radhakrishnan, Director, Vikram Sarabhai Space Centre, Trivendrum and Dr. V. Jayaraman, Director, National Remote Sensing Centre, Hyderabad were also present during the visit of Dr. Madhavan Nair.

Prof. Ian Dowman, the First Vice President of the International Society for Photogrammetry and Remote Sensing (ISPRS) visited INCOIS on 12 February, 2009.



Deputations abroad

Name	Meeting/Conference/Training	Country and Period
Dr. Shailesh Nayak, Director, INCOIS	5 th Session of the IOC Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System.	Kuala Lumpur, Malaysia April 8 October, 2008.
	41 st Session of Executive Council of the International	Paris, France 24 - 28 June, 2008

	Oceanographic Commission (IOC).	
	21 st Congress of the International Society for photogrammetry and Remote Sensing (ISPRS)	Beijing, China 2 - 15 July, 2008
Dr. M. Ravichandran Head, MOG	5 th Indian Ocean Panel (IOP) meeting of IOGOOS	Bali, Indonesia. 12 - 14 May, 2008
	2 nd Coastal altimetry workshop	Pisa, Italy 6 - 7 November, 2008.
	Symposium on Observing and forecasting the Ocean processes – Ocean surface topography science team meeting and GODAE final symposium.	Nice, France 10 -15 November, 2008
	Argo Steering Team Meeting (AST-10) and 3 rd Argo Science Workshop	Hangzhou, China 22 - 27 March, 2009
Dr. T. Srinivasa Kumar Head, ASG	5 th Session of the IOC Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System	Kuala Lumpur, Malaysia 8 - 10 April, 2008.
	Second International Round-table dialogue on Earth quake and Tsunami hazards in South China sea and Western Pacific marginal seas.	Kota Kinbalu, Malaysia 6 - 8 October, 2008
	International Conference on Tsunami Warning towards Safer Coastal Communities and the Inter Sessional Meetings of the ICG/ IOTWS working groups.	Bali, Indonesia 12 -15 November, 2008
	Establishment of a system of Interoperable Advisory and	Melbourne, Australia 25 - 26 February, 2009

	Warning Centres for the Indian Ocean Tsunami Warning System	
	Global Meeting of the Intergovernmental Coordination Groups for Tsunami Warning Systems (GLOBAL TWS)	Paris, France 24 - 27 March, 2009
Dr. T.M. Balakrishnan Nair Head, ISG	Global Operational Oceanographic System	Perth, Western Australia 23 - 24 February, 2009
Shri. E.Pattabhi Rama Rao Head, DMG	OceanSITES meeting	Vienna, Austria 10 -12 April, 2008
	21 st Congress of the International Society for photogrammetry and Remote Sensing (ISPRS).	Beijing, China 3 - 11 July, 2008
Dr. P.A. Francis Scientist-C	2009 ROMS/TOMS Asia-Pacific Workshop	Sydney Institute of Marine Sciences, Sydney, New South Wales, Australia 31 March, 2009 - 3 April, 2009
Shri.Ch. Patanjali Kumar Scientist B	Intensive Training Workshop on “Strengthening Tsunami Warning and Emergency Responses: Training Workshop on the Development of Standard Operating Procedures for Indian Ocean and Southeast Asian Countries.	Bangkok, Thailand 12 - 16 May, 2008
Dr. Sudheer Joseph Scientist-D	The 3 rd Argo Delayed-Mode Quality control Workshop	Seattle, USA 10 - 12 September, 2008
	Training on HYCOM (TOPAZ) model implementation for Indian Ocean at Nansen Environmental and Remote Sensing Centre,	Bergen, Norway, 25 October, 2008 - 20 December, 2008
Mr. T.V.S. Uday Bhaskar Scientist-D	Argo Data Management Team and Argo Regional Data Centre meeting	Hawaii, USA 27 - 31 October, 2008

Shri. Aneesh Lotliker Scientist-B	International Symposium, Asia Pacific Remote Sensing.	Noumea, New - Caledonia 17 - 21 November, 2008
Shri. M.Nagaraja Kumar Scientist-C	International Capacity Development Program : Seminar and Proposal Writing Workshop for Marine related institutions	Sabah, Malaysia 10 - 14 December, 2008
Shri. R.S. Mahendra Scientist-B		
Shri. S.M. Raghavendra, Project Scientist-C		
Smt. E. Umadevi Project Scientist-C	International Workshop on Tsunami Vulnerability Assessment.	Dhaka, Bangladesh 21 - 22 January, 2009

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- **T.V.S. Udaya Bhaskar**, D. Swain, and **M. Ravichandran**, 2008. Seasonal Variability of Sonic Layer Depth in the Central Arabian Sea. Ocean Science Journal, 43, 147-152.
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- P. Reddy, P. S. Salvekar, and **S. Nayak**. 2008. Super Cyclone Induces a Mesoscale Phytoplankton Bloom in the Bay of Bengal. IEEE Geoscience and Remote Sensing Letters, 5, 588-592, DOI: 10.1109/LGRS.2008.2000650.
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- Rao, A.D., M. Joshi, and **M. Ravichandran**, 2008: Oceanic upwelling and downwelling processes in waters off the west coast of India. Ocean Dynamics, 58, 213-226.
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anomalous upwelling in the Lakshadweep Sea during the summer monsoon season of 2005, *Journal of Geophysical Research (Ocean)* 113, C05001, doi:10.1029/2007JC004240.

- A. Bahuguna, **S. Nayak**, and D. Roy, 2008. Impact of the tsunami and earthquake of 26th December 2004 on the vital coastal ecosystems of the Andaman and Nicobar Islands assessed using RESOURCESAT AWiFS data, *International Journal of Applied Earth Observation and Geoinformation*, 10, 229-237.

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- **Pattabhi Rama Rao. E.**, B.V.Satyanarayana and Shailesh Nayak, 2008. Ocean Data and Information System (ODIS) and Web-based Services. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B4. Beijing 2008*, pp. 697-702.
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- S Siva Reddy, **S H Rahman, M Ravichandran** and KV Subba Rao, Sea level and dynamic height variations over Indian Ocean as inferred from satellite Altimeter and Argo ISRS National Symposium on “Advances in Remote Sensing Technology and Applications with Special Emphasis on Microwave Remote Sensing”, Ahmedabad, December 18-20, 2008.
- **R. S Mahendra, Hrusikesh Bisoyi, Prakash C. Mohanty, Sumisha Velloth, T. Srinivasa Kumar, Anjali Bahuguna, and Shailesh Nayak**, Spatio-temporal Variations in the Coral Environs of North Reef Island, Andaman: A Remote Sensing and GIS approach, ISRS National Symposium on “Advances in Remote Sensing Technology and Applications with Special Emphasis on Microwave Remote Sensing” Ahmedabad 18-20 December 2008.

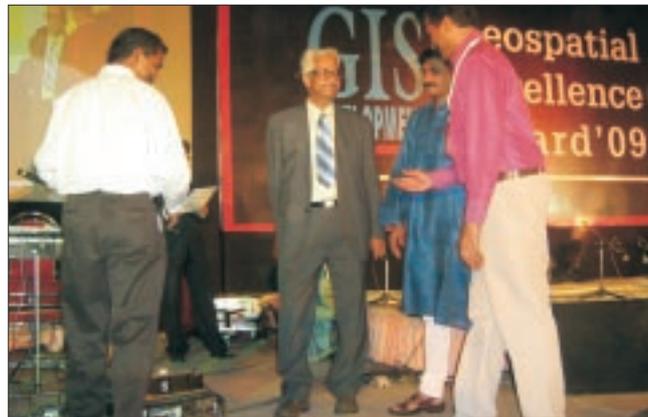
Other publications

- **Shailesh Nayak, T. Srinivasakumar, and M. Nagarajakumar**, 2008. Satellite-based Fishery Service in India, The Full Picture. Group on Earth Observation, ISBN 978-92-990047-0-8, Geneva, Switzerland.

Awards



Geospatial Solution of the Year 2008 was awarded to the Tsunami Early Warning Centre at INCOIS on April 25, 2008 in a ceremony held at New Delhi. Dr. Shailesh Nayak, Director, INCOIS received the award from Shri. Kapil Sibal, Hon. Minister for Science & Technology and Earth Sciences.



INCOIS won the “Geospatial Excellence Award 2008” in recognition of the “Tsunami Warning Centre” for “Use of Geospatial technology for Disaster Management”. This award was received at Map World Forum organised by GIS Development during 10-13 February 2009 at Hyderabad International Convention Centre under the patronage of Ministry of Science and Technology, Government of India.



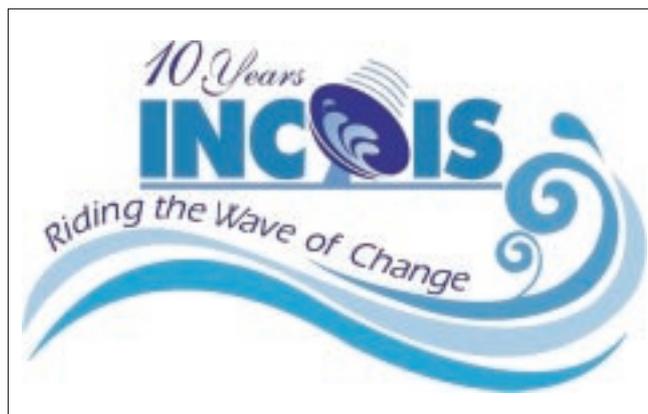
INCOIS website won the Silver Award 2008-09 under the best Government website category of National Awards for e-governance, DARPG & Ministry of Information Technology. The award was received by Shri. B.V. Satyanarayana, Head CWG during a function held in Goa.



Shri B V Satyanarayana, Head - CWG of INCOIS received the Certificate of merit award from Hon'ble Chief Minister of Delhi, Smt. Sheela Dikshit for his distinguished contribution in the field of Ocean & Atmospheric Sciences during the foundation day function of Ministry of Earth Sciences held at Vigyan Bhavan, New Delhi on July 27, 2008.

Dr. T. Srinivasakumar, Head, ASG, INCOIS was conferred with the "Indian National Geospatial Award - 2008" by the Indian Society of Remote Sensing during their annual convention held at Ahmedabad on December 18, 2008.

INCOIS Decadal Celebrations



INCOIS completed 10 years of its existence on 3 February, 2009. In commemoration of INCOIS services to the society, decadal celebrations were held on 3 February, 2009.

Dr. Shailesh Nayak, Secretary, MoES and Chairman, INCOIS-GC delivered the inaugural address of decadal celebrations. Dr. Harsha K. Gupta, Raja Ramanna Fellow, Former Secretary, DOD and Vice-Chairman of INCOIS-GC and Dr. K. Radhakrishnan, Director, VSSC (Founder Director of INCOIS) were the Guests of Honor also delivered lectures on this occasion.

INCOIS honoured the guests present during the function, for their significant contributions in the achievements of INCOIS during the decade. An atlas (4 Volumes) on various oceanographic parameters derived from the satellite data, Handbook on Tsunami Early Warning System, Operations and

Procedures and a DVD on Argo Data and Data Products for the Indian Ocean were released during this occasion.

Various sports events were organised as part of the decadal celebrations and prizes were given to the winners of the events.



Decadal celebrations

10. Finance

The Report of the auditors and audited accounts of INCOIS for the year 2008-09 are placed in Appendix-1 to this report.



Indian National Centre for Ocean Information Services

(An Autonomous Body under the Ministry of Earth Sciences, Government of India)

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