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The Role of Indian National Center for Ocean Information Services (INCOIS) in Fishing Industry through Remote Sensing

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Abstract

Finding and catching fish is usually a difficult task, which raises the cost and results in low profitability. With the launch of OCEANSAT in 1999, which offers a real-time satellite image of ocean colour (chlorophyll) and, when combined with SST, allows for the identification of aggregation fish, a new era has begun. One of the most important pre-requisites for profitable fishing is the identification of possible fishing zones, including the kind and amount of fish available. ESSO-Indian National Centre for Ocean Information Services (INCOIS) gives daily advice to fishermen with precise references to 586 fish landing stations throughout the Indian coast, based on remotely sensed data from several satellites. Even if they arrive to the spot after a day, this information aids the fisherman in identifying the PFZ marked on the maps.

Introduction

INCOIS (Indian National Center for Ocean Information Services) is an autonomous government of India entity situated in Pragathi Nagar, Hyderabad, under the Ministry of Earth Sciences. The Earth System Science Organization created ESSO-INCOIS as an autonomous entity within the Ministry of Earth Sciences (MoES) in 1999. *Via* ongoing ocean observations and constant advancements through systematic and targeted research, ESSO- INCOIS is authorised to give the finest possible ocean information and advisory services to society, business, government agencies, and the scientific community (Buttler *et al.*, 1988).

Our oceans are home to almost 2,500 different finfish and shellfish species. Our catch fisheries grew steadily from around 0.6 million t in 1950 to 2.67 million t in 1998, with an average annual growth rate of 6.4 percent. With the launch of OCEANSAT in 1999, scientists were able to get a real-time satellite image of ocean colour (chlorophyll a) and use it in conjunction with SST to identify aggregation fish. One of the most important prerequisites for profitable fishing is the identification of possible fishing zones, including the kind and amount of fish available. For over a decade, the Ministry of Earth Sciences, Department of Space, and several institutions under the Ministry of Agriculture have worked together with the State Governments of the marine states and islands to provide the Indian fishing community with Potential Fishing Zone (PFZ) Advisories generated using Sea Surface Temperature and Chlorophyll. Oceanic fronts, Meandering Patterns, Eddies, Rings, up welling zones, and other features that have been demonstrated to be probable places for fish aggregation have been detected using NOAA-AVHRR Satellite data. In recent years, the availability of Chlorophyll from OCEANSAT and MODIS has supplemented these recommendations (Figure 1).

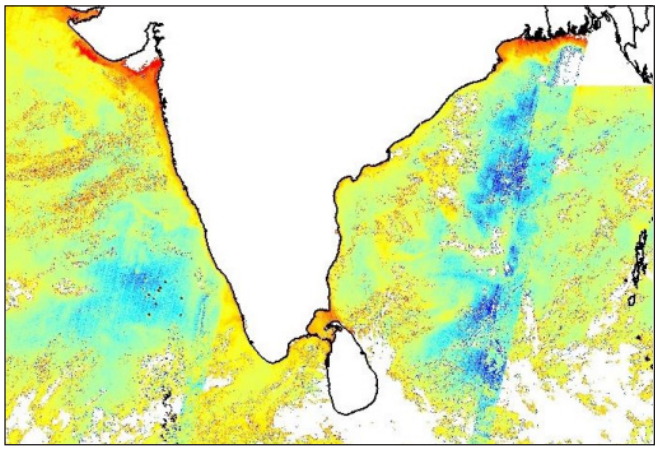

Figure 1: Chlorophyll Image retrieved from Oceansat-2 Satellite Data

History

The Ministry of Earth Sciences, previously the Department of Ocean Development (DOD), launched the "PFZ Mission" in the 1990's and passed it over to the National Remote Sensing Centre (NRSC) in Hyderabad, Andhra Pradesh. Because of Dr. A. Narendra Nath's hard effort, the initiative gradually grew into a full-fledged undertaking. As a result, the project was removed from the NRSC and a new body was established to oversee it. The new institution was given the name Indian National Centre for Ocean Information Services (INCOIS) and was placed under the direction of renowned scientist Dr. A. Narendra Nath, INCOIS's founder director. Since February 1998, when it was founded. Dr. Narendra Nath is the brains behind the PFZ Mission. The principal initiative of the newly created firm was prospective fishing zone (PFZ) advisories. Other services, such as Indian Early Tsunami Warning, Ocean State Forecast, Ocean Modeling, Data and Web Services Management, were launched in addition to PFZ services, and their products are being distributed to various stakeholders in the country on a daily basis. INCOIS was named one of the main International Oceanic Organizations in honour of these efforts. INCOIS provides its services through a web portal and a variety of other devices located around the country.

Advisory on Potential Fishing Zones

An accurate and timely advice on possible fish aggregation zones would assist the fishing community by reducing the time and effort spent searching for shoals of fish, hence increasing profitability and thereby boosting socioeconomic position. In June 1990, the Ministry of Earth Sciences (MoES), formerly known as the Department of Ocean Development (DOD), launched the Marine Satellite Information Services (MARSIS) programme to develop methods for using oceanographic data, particularly satellite data, to address issues related to the use of oceanic resources. One of MARSIS' goals was to develop techniques for using satellite data to collect food from the sea, as well as to employ remote sensing data and its applications for the management of coastal waters. At this point, experts from the fields of marine sciences, remote sensing, and fisheries research cooperated to create a method for detecting fish aggregation using remotely observed sea surface temperature (SST). The successful demonstration of the application of satellite derived data for the demarcation of Potential Fishing Zone (PFZ) as a proxy to potential shoals of fish aggregation in Indian waters was made possible by the concerted collaborative efforts of scientists from Earth Sciences, Space Science, and Fisheries Science.

ESSO-Indian National Centre for Ocean Information Services (INCOIS) uses remotely sensed data from several satellites to deliver these recommendations to fishermen on a daily basis, with particular references to 586 fish landing locations throughout the Indian coast. ESSO-INCOIS provides this operational service all year except during periods of Government of India-imposed marine fishing bans and adverse sea state conditions such as cyclones, high waves, and tsunamis. For the identification of Potential Fishing Zones (PFZ) along the Indian coastline, data on Sea Surface Temperature (SST) and Chlorophyll retrieved regularly from thermal-infrared channels of NOAA-AVHRR (USA) (Figure 2)

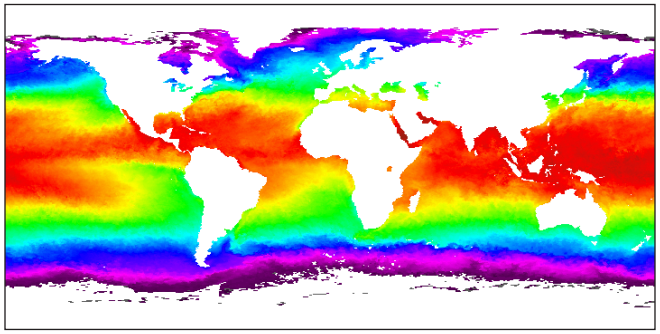

Figure 2: Sea Surface Temperature (SST) Image retrieved from AVHRR

and Eumetsat (ESA) Met-Op series satellites, as well as optical bands of Oceansat-II (India) and MODIS Aqua (USA) satellites, are used (Gower, 1972). The PFZ advisories are generated for each sector in the form of PFZ Maps and text, and are divided into 14 sectors: Gujarat, Maharashtra, Goa, Karnataka, Kerala, South Tamil Nadu, North Tamil Nadu, South Andhra Pradesh, North Andhra Pradesh, Orissa, West Bengal, Lakshadweep Islands, Andaman Islands, and Nicobar Islands (Somvanshi, 2002). The PFZ Maps include information on main landing zones, bathymetry, and PFZ locations (latitude and longitude information). Because of the fluid nature of the water, the fishing zones depicted on the maps may vary from their original location. As a result, the wind speed and direction information is included on the PFZ maps to help fisherman

anticipate any adjustments in the PFZ. Even if they arrive to the spot after a day, this information aids the fisherman in identifying the PFZ marked on the maps.

These multilingual PFZ alerts are distributed to universities and partner NGOs by numerous modalities, including telephone, fax, email, website, Doordarshan, radio, news media, mobile services/ mobile applications, and underfunded initiatives (Figure 3). Advances in information and communication technology have been utilised to increase coverage and penetration. In the first phase, a few pilot locations were equipped with basic LED boards that could only display text information. INCOIS built and implemented next generation Electronic Display Boards (EDB) in major fishing harbours using state-of-the-art technology, which has had a significant impact on the supply chain. These second-generation EDBs include an LCD monitor, which allows them to show colourful maps. INCOIS is working on 3rd-Generation EDBs with many additional features in partnership with the industry.

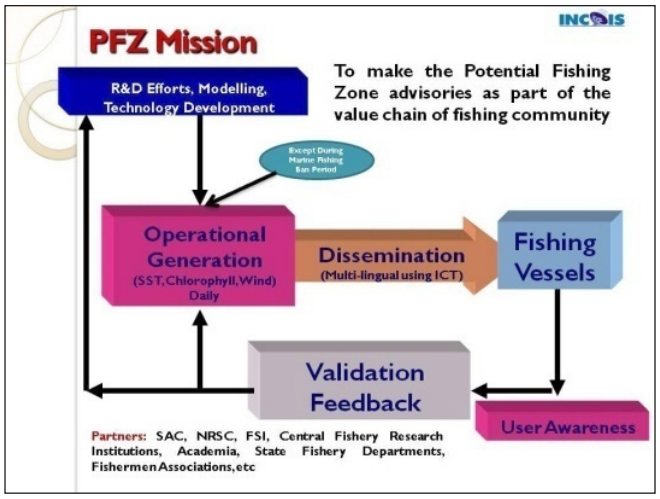

Figure 3: Mission of PFZ service and flow diagram of its operational process

Tuna Fishery Advisory

In India, the oceanic tuna fishery is still in its early stages. The number of landings has remained low. The oceanic tuna fisheries resource potential in the Indian EEZ is projected to be 2,13,000 tonnes, with yellowfin accounting for 54%, skipjack 40%, and Big-eye 6%. Since the industry has shown a strong interest in converting vessels to long liners in recent years, the industry and MPEDA have asked INCOIS to build an advice system comparable to the PFZ Advisory Services. Based on geo-referenced tuna catch information and remote sensing data products, ESSO-INCOIS has undertaken a few hindcast exercises. The operational creation of tuna fishing warnings has been expedited by ESSO-INCOIS utilising satellite-derived metrics such as Sea Surface Temperature, Chlorophyll, and Kd490 (Water Clarity). The tuna long ships are receiving the alerts via the website (WebGIS) and emails.

Ocean State Forecast

The majority of significant ports are situated near major coastal cities. One crucial aspect for the proper functioning of these ports is information on nearby sea state characteristics, such as locally created wind waves, remotely generated swell waves, currents, winds, and tides. These characteristics regulate the entry and exit of boats to the port, whether a tiny fishing boat or a massive oil tanker, and advance awareness of these parameters will substantially aid port operations. Marine operations in the waters surrounding India are diverse, ranging from traditional fishing to high-tech oil, natural gas, and mineral discoveries; cargo transit, marine research, and defence activities. During cyclones and other extreme events, notifications are provided to the general public as well as the administrators of the coastline stretch under peril, based on prediction information, so that the people under threat can be moved to safer areas. Forecasting oceanographic characteristics (both surface and subsurface) at various time scales is thus critical for a wide range of customers, including fishermen and offshore companies. With this in mind, the Earth System Science Organisation - Indian National Centre for Ocean Information Services (ESSO-INCOIS) developed the integrated INDian Ocean Forecasting System (INDOFOS), which can forecast the surface and subsurface properties of the Indian Ocean pretty well in advance (5 to 7 days presently).

INCOIS now offers predictions for

- Height, direction, and timeframe (of both wind waves and swell waves).
- Surface currents in the sea.
- The temperature of the sea.
- Depth of mixed layers (the well mixed upper layer of the sea).
- Isotherm depth at 20 degrees (a measure of the depth of the thermocline).
- Tides astronomical.
- Wind direction and speed.
- Oil spill pathway.

ESSO-INCOIS not only offers ocean state information to fishermen, the Indian Navy, the Indian Coast Guard, merchant and passenger shipping companies, offshore oil and gas exploration agencies, and research organisations, but also to other coastal communities. The forecasts for the Arabian Sea, Bay of Bengal, Northern Indian Ocean, Southern Indian Ocean, Red Sea, Persian Gulf, and South China Sea are provided individually. It also includes more particular prediction information for specific places like as fish landing centres, local fishing harbours, commercial ports, and the coastal seas of India's marine states, union territories, and island regions.

Tsunami Early Warning

The Indian Ocean Tsunami (December 26, 2004) was one of the strongest in the world and by a factor of ten the deadliest of all time. As a result of this national tragedy, the Indian government decided to implement an Early Warning System to help mitigate such oceanogenic calamities. Hyderabad's Indian National Center for Ocean Information Services (INCOIS) was tasked with coordinating the project and making it operational. The Indian Tsunami Early Warning System consists of a real-time network of seismic stations, bottom pressure recorders (BPR), tide gauges, and a 24-hour-a-day, seven-day-a-week operational tsunami warning centre to detect tsunamigenic earthquakes, monitor tsunamis, and provide timely advisories to vulnerable communities using the most up-to-date communication methods, with back-end support from a scenario database, vulnerability modelling, and Decision Support System.

The components of the Early Warning System are as follows:

• A specialised Tsunami Warning Centre that operates 24 hours a day, 7 days a week to generate timely advisories.

• A network of land-based seismic stations for earthquake detection and focal parameter calculation in the two known tsunamigenic zones, with near-real-time communication to the Early Warning Centre.

• A network of 12 bottom pressure recorders (each capable of detecting and measuring a 1 cm change in water level at depths up to 6 km) to detect and monitor tsunami surrounding these two tsunamigenic zones.

• A real-time monitoring network for Upper Ocean and surface met-ocean characteristics, particularly in the regions of cyclogenesis and coastal seas, to improve storm surge forecasting.

• A network of 50 real-time tide gauges, radar-based coastal monitoring stations, and current metre moorings to track tsunami and storm surge progression.

• Creation of a high-resolution bathymetry, coastal topography, and coastal land use database (for coastal areas within 1-3 km in general and for 10-25 km at selected areas near coastal water bodies).

• Coastal vulnerability modelling and inundation mapping.

• Capacity building, training, and education for all stakeholders on how to use the maps, warnings, and watches.

The Dissemination

Even while the INCOIS website is the major way of distribution, it also delivers these services to all stakeholders *via* email, mobile phones, television, radio, and electronic display boards. Information and communication technology technologies have been fully utilised to provide consumers with in-time quality forecasts. For further distribution, there is substantial partnership with NGOs, coastal research centres, and universities. Manual Display Boards (*e.g*., Sundrabans region) and Black Boards at other fish landing stations are used in places where there is no electricity or where there are major power difficulties.

The Users

Fishermen and coastal communities, Maritime Boards, the Indian Navy, the Indian Coast Guard, the shipping industry, the energy sector, the oil and offshore exploration sectors, and port authorities are among our users. Boards for Pollution Control, NGOs, disaster management agencies, and other research groups.

Feedback

For the purpose of refining the distribution system, users' input is collected on a regular basis by mail, telephone, and user interaction meetings at coastal places as well as at INCOIS. Workshops on user awareness and engagement are held around the coastal belt to assist fishermen and enhance the system's quality while taking their demands into account.

Conclusion

INCOIS' primary mission is to measure and monitor the temperature and salinity of the ocean's upper 2000 metres. The major goal of this company is to use satellite data and remote sensing to offer information on fish aggregation in the sea. These data can assist fishermen in locating optimal fishing locations in order to capture a greater number of fish without wasting a lot of fuel and time searching for fish. Fishermen may also acquire PFZ information on their smartphones. As a result, using these INCOIS data would assist fisherman in catching more fish and increasing India's fish production with less CPUE.

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