Application of Remote Sensing with R Tool in Validation of Potential Fishing Zone along the Coast of Ratnagiri.

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ABSTRACT - *The Potential Fishing Zone (PFZ) is identified with help of satellite data by calculating different ocean related parameters, by remote processing and image processing technique. Satellite remote sensing in which a satellite filter with sensors is used for varying the ocean due to which it covers large area. Arabian Sea water found predominately productive than the Bay of Bengal water. Many of physical feature in the ocean such as change in temperature, wind speed, upwelling and eddies directly effects the productivity of the ocean. Due to these changes particular area in the ocean is richer in nutrients and phytoplankton. Banse and Macclain (1986) earlier reported that seasonal reversing of winds in Arabian Sea result in large scale change in SST bringing the nutrients to euphoric zone. The satellite derived data obtained from INCOIS Electronic Digital Display Board (EDB) and Wave Rider Buoys (WRB) is processed to get SST and Ocean color in real time mode. The state and central agencies responsible for the conservation of these ecosystems are increasingly adopting remote sensing data for their routine use and to validate the advisories and to improve the remote sensing technology for PFZ locations we have used R language tool for fishermen community.*

Key Words: PFZ, SST, EDB, WRB, NOAA-AVHRR, MODIS, TERRA.

1. INTRODUCTION

India is very rich in coastal and marine environment due to which share in world fishing production is increased to 4.2%. At present fishing activities is concentrated to narrow belt up to 50mts. Fishes are known to congregate in temperature boundaries, therefore surface circulation features like location and evolution of frontal boundaries, upwelling zones, current eddies etc. are important in marine fisheries habitats.

The WRB and EDB which is deployed in Ratnagiri by INCOIS (Indian National Centre for Ocean Information Services) are useful for transmitting data to receiving station. The coast line of Ratnagiri is of 237Kms. an altitude range of about 11mts. The algorithm has been used for retrieval of the chlorophyll concentration. This algorithm captures the inherent sigmoid relationship between R_{rs} (490) /R_{rs} (555) band ratio and chlorophyll concentration where R_{rs} denotes Remote Sensing Reflectance. The algorithm operates with 5 coefficients and has mathematical form

C= $10^{\wedge}$ (0.319-2.336xR+0.879xR^2-0.135xR^3)   -0.071 (0.01mg/m^3≤C≤50mg/m^3)

C- Chlorophyll concentration in mg/m^3 and R=$log10\frac{Rrs(490)}{Rrs(555)}$

where R_{rs} is remote sensing reflectance in corresponding band.

The main objective of the study with help of remote sensing and R tool language is to locate PFZ location by Chlorophyll and SST data. It also includes an effective data handling and storage facility along with graphical facilities for data analysis and display either directly at the computer or hardcopy. R consists of three aspects: A project, a language and a software environment [1]. Most of program written in R are essentially ephemeral, written for single piece of data analysis.

2. LITERATURE SURVEY

The review suggests that as far as ocean parameters of west coast are concerned a total of 38 papers have been published out of 85 research papers. A very few attempts have been made for applied aspects of ocean parameter contents.

Table 1: Status of Statistical study on ocean parameters off western Indian Coast line [2].

Sr. no.	Aspect of Study	Symmetric/ Asymmetric distribution	Correlation and Regression	Simulation Technique	Off Ratnagiri
1	Ocean Waves	4	2	3	4
2	SST	0	0	0	0
3	Wind speed and Direction	0	3	2	1
4	Total	4	5	5	5

Table 2: Comparison of PFZ studies [3]

Approach	Data	Method	Result
GIS application	Fishery data, SST, SSC	Overlay method	Potential fishing ground
Knowledge based expert system with GIS application	SST, SSC and Turbidity	Heuristic rule based on expert knowledge	Potential fishing ground
Simple prediction map	Fishery data SST, SSC	statistical model	Potential fishing ground
Rough Clustering	Coastline direction, Depth to-from.	K mean clustring	Fishing spot identification

3. PROPOSED SYSTEM

The proposed system to calculate Chlorophyll and Sea Surface Temperature with help of R tool language consists of Global, Server and User Interface. The Global file coding is used to calculate the chlorophyll and Sea Surface Temperature value. The data which is provided by INCOIS with X and Y coordinates determines the latitude and longitude values of whole Indian Coast line. By selecting the latitudinal and longitudinal position of the Ratnagiri we can get the required region and this is obtained by Raster to point value conversion to get all four coordinates. The chlorophyll value is obtained by using MODIS sensor and TERRA satellite. The Geotiff image of Chlorophyll is processed with formulae: pixel value*1 and Sea Surface Temperature value are calculated using the reflectance value, the formulae: SST*0.15 is used to get the temperature Geotiff image. The AVHRR sensor along with NOAA-18 satellite is used to obtain the Geotiff image [4]. TERRA satellite carries a payload of five remote sensors designed to monitor the state of earth environment and ongoing changes in its climate system, its mission type in climate research. NOAA-18 hosts the AMSU-A (The Advanced Microwave Sounding Unit), MHS (Microwave humidity sounder), AVHRR, Space Environment Monitor SEM/2 instrument and High Resolution Infrared Radiation Sounder (HIRS) instruments as well as the SBUV/2 (Solar Backscatter Ultraviolet Radiometer) ozone monitoring instrument,[5] its mission type is weather satellite. The Automatic Picture Transmission (APT) transmission frequency is 137.9125 MHz [6]. The satellite data Acquisition and Processing System was set to receive remote sensing data in real time from NOAA (17 and 18), Terra and Aqua satellites to meet the operational data requirements of PFZ advisory services. The data received from various observing systems in real time at different communication system are assembled and standardized [7].

Table 3: Sensor and Parameters used

Satellite/Sensor	Parameters
AVHRR-NOAA-18	SST
MODIS - TERRA	CHL

The User Interface coding consists of templates, display of the output model for user to operate. The user enters commands at the prompt and each command is executed one at a time. Construction of Graphical User Interface divides into two parts: The Individual Widget and Logical Aspects of the Interface. To facilitate the user selecting different actions the menu bar and tool bar are widgets design each of which represents an operation in the application [8]. After calculating the value of Chlorophyll and Sea Surface Temperature we have to combine the values which are in X and Y coordinates. By performing this operation the PFZ location can be obtain of Ratnagiri location.

R package adds graphical element and layers to the map widget, it adds a raster image as a layer. Histogram of Chlorophyll and SST is also obtained with server coding.

The main objective of the project is to locate the PFZ region near Ratnagiri. This will also help to study the histogram in graphical format of both Chlorophyll and Sea Surface Temperature.

Figure 1 and 2 determines the Input data which denotes Color of Circle and Size of Circle. The chlorophyll ranges from 0.1mg/l to 0.3 mg/l and Temperature ranges from 20ºC to 25ºC; these values are favorable for Potential Fishing Zone. For understanding purpose we have given color for different group of ranges. The map shows the possible catch near Ratnagiri.
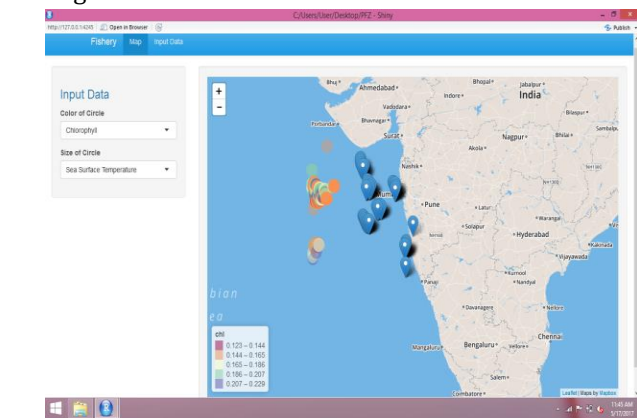

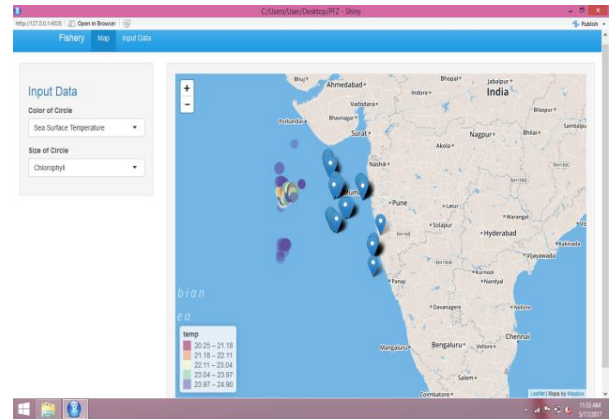Fig - 1: Input data and Location along with Chlorophyll Concentration.

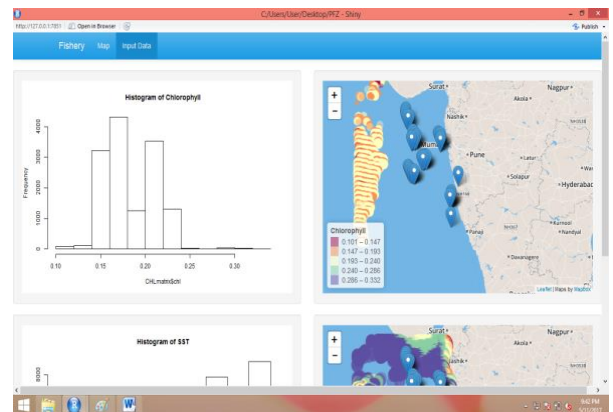Fig - 2: Input data and Location along with Temperature.

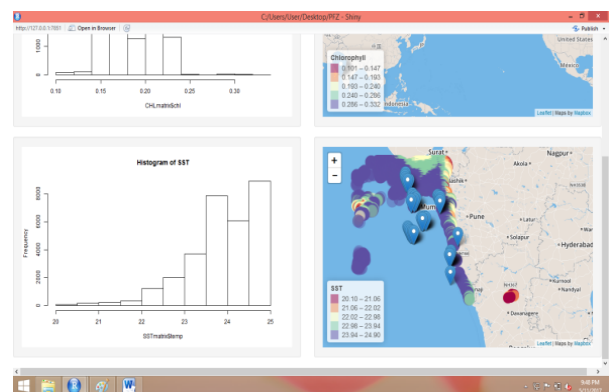Fig - 3: Histogram of Chlorophyll.

Fig - 4: Histogram of SST.

Figure 3 and 4 determines the Histogram of Chlorophyll and SST. The X axis shows the CHL matrix and SST matrix and Y axis shows frequency. It's helpful to think of a Histogram as being like a snapshot.

According to the proposed flow chart, it starts with the R tool. The reading of SST and Chlorophyll are required which obtained from INCOIS, these values are in excel form which has to be converted to matrix form for use. After modifying the data separate matrix is developed of SST and Chlorophyll of whole west coast. For finding the PFZ, standards are made for detecting the location. For SST temperature ranges from 20-25ºC is potential fishing ground and for Chlorophyll ranges from 0.1 to 0.22mg/m^3.
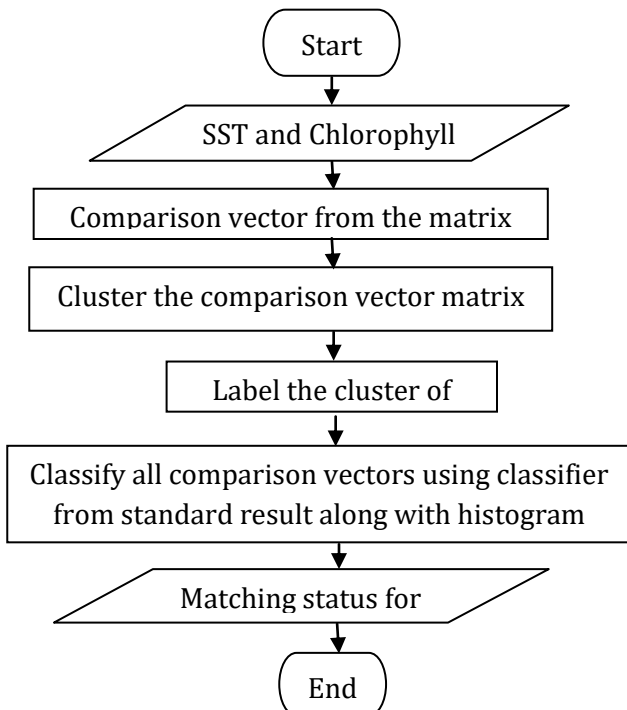

Fig. 5 - Proposed flow chart

After matching SST and Chlorophyll matrix and joining it together the PFZ region is obtained. Figure 5 shows the Visualization of the spatio-temporal clustering results for the largest number of fish catches of every month. The graph determines month, latitude and longitude position along all three axes of year 2001 to 2004.

The graph states that in year 2001 and 2002 the fish catch was more as compared to 2003 and 2004. In year 2002, the fish catch was good from August to October. In 2004, the fish catch was less and in year 2003 the catch was moderate. The Latitude and Longitude position on graph determines quantity of fish of particular month.

4. PERFORMANCE ANALYSIS

With help of R tool the values are from Raster to Point, the values are from -1 up to 50000, from which the required location is determined by latitudinal and longitudinal position and remaining other values are filtered in matrix format. The X coordinates is longitudinal value and Y coordinates are latitudinal values. By performing this operation the Chlorophyll values are obtained. Same operation is performed to obtain the SST from 0 to 255 values. By combining the values with X and Y coordinates with Chlorophyll and SST data the PFZ location is obtained. Other methods are also useful to find the PFZ location such as Arc GIS, ENVI, ERDAS etc. these methods are complicated, cannot run without license software and also require more memory to run as compared to R tool.

The Arc GIS includes a set of comprehensive tool for working with the geographic data. The Geodatabase view, Geovisualiation view and Geoprocessing view are GIS view to represent in ArcGIS. It consists of geographical representation, collection of vector based features (set of points, lines and polygon) which are for land navigation, terrains and other surfaces. Due to this it is difficult to work on finding potential fishing zone with help of ArcGIS.

In ENVI, environment studies aims to increase user understanding environmental issues facing by the world and helps how these issues can be tackled. These issues are climate change, globalization and consumerism. There are many papers related to environmental studies which have typical codes such as ENVI522- Environmental and Planning law, ENVI528-Climate change issues, ENVI529- Sustainable energy [9].Due to this it is difficult to work on finding potential fishing zone with help of ENVI.

In ERDAS IMAGINE, bands of data are occasionally referred to as layers. Once a band is imported into a GIS, it becomes a layer of information which can be processed in various ways [10]. The products of ERDAS add-ons are licensed separately and the cost of the licensed software is too expensive which makes it difficult to buy and to work smoothly. Therefore the R tool is used because it has special libraries which are easy to handle for the required work and the data which is provided by INCOIS is need to modify in the required format to obtain the output of particular Ratnagiri location.

Following graph shows the Visualization of the spatio-temporal clustering results for the largest number of fish catches in (a) 2001; (b) 2002; (c) 2003; and (d) 2004.

Table 4: Comparison of PFZ and Non-PFZ

Details	PFZ Region	Non-PFZ Region
No. of Hauls and Hrs.	2	1
Total catch in Kg	12193	4000
Major species caught	Coastal Tuna	Pomfrats
Coast of total catch(Approx.)	120000	600000
Total expenditure in fishing	36000	26500
Profit	1164000	573950

Fig - 5: Visualization of fish catches in 2001-2004 PFZ forecast on SST/Chlorophyll image of 6/7/2006 in tabular format to understand comparison between PFZ and Non-PFZ location: Area: Goa Sector [11]

4.1 RESULT AND VALIDATION MODEL

To compare the performance of our frame work we compared prediction model with the heuristic rules defining the fishing ground.

Table 5: Condition for SST and Chlorophyll

Condition	Consequence
If SST range 20ºC to 25ºC	Potential Fishing ground
If SST <20ºC and >25ºC	Non- Potential Fishing ground
If CHL range 0.12 mg/m^3 to 0.22 mg/m^3	Potential Fishing ground
If CHL <0.12 mg/m^3 and >0.22 mg/m^3	Non- Potential Fishing ground

We utilize heuristic rule as the classification method for defining Potential and Non-Potential Fishing Zone. The average accuracy for this method was 89% for finding PFZ location.

Table 6: Accuracy chart

Method	Data	Accuracy
R Tool Approach	Fishery forecast data, SST and Chlorophyll data	89%
Heuristic Approach	SST,SSC and Turbidity	84%

5. CONCLUSIONS

This study showed that the proposed framework identified areas that have high PFZs based on daily fish catch data. With the help of R tool language the user can find the PFZ location for gaining good catch. The ocean data and information system, an end to end system was designed for data acquisition processing, quality control and data base generation for providing web based ocean data information and advisory services. The model also demonstrated that it
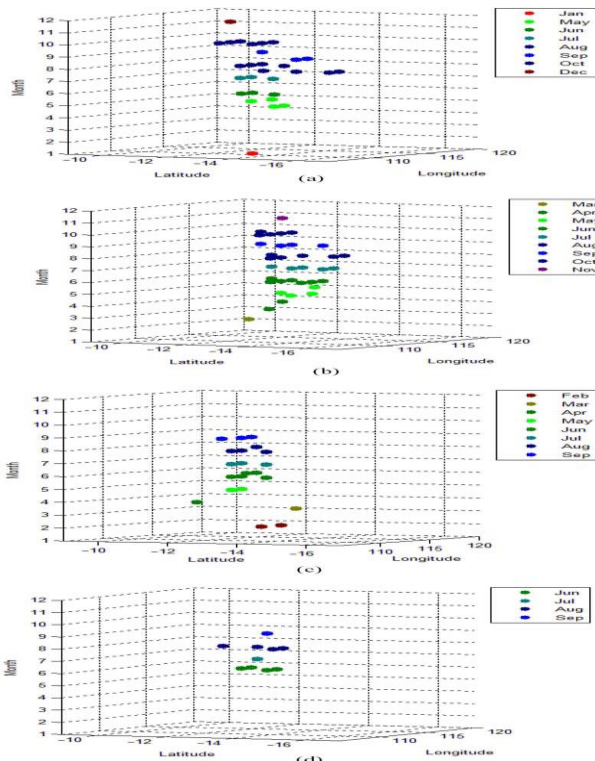
reached 89% average accuracy within the predicted area. The results showed that the proposed data-mining framework outperformed the heuristic rules model. A state of art data base driven user friendly dynamic website with multilingual capability, providing ocean information and advisory services such as potential fishing zone was designed. INCOIS website www.incois.gov.in has been a prime component for delivering of ocean data. We have initiated the development of data warehousing and data mining concept with help of R tool to work with the functionality of website. Future prospective of R tool will be data virtualization, wide use in Statically and Graphical uses.

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