Improved exploration of fishery resources through the integration of remotely sensed merged Sea level anomaly, Chlorophyll concentration, and Sea surface temperature

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Abstract

The Satellite Altimeter derived Merged Sea Level Anomaly (MSLA) results in the better understanding of ocean variability and meso-scale oceanography and provides good possibility to reveal the zones of high dynamic activity. This study comprised the synergistic analysis of signatures of SEAWIFS derived chlorophyll concentration, National Oceanic and Atmospheric Administration-Advanced Very High Resolution Radiometer(NOAA-AVHRR) derived Sea Surface Temperature and the monthly Merged Sea Level Anomaly data derived from Topex/Poseidon, Jason-1 and ERS-1 Altimeters for the past 7 years during the period from 1998 to 2004. The overlapping Chlorophyll, SST and MSLA were suggested for delineating Potential Fishing Zones (PFZs) and the study used Altimeter derived MSLA as an index for long term variability detection of fish catches along with Chlorophyll and SST images and the maps showing PFZs of the study area were generated. The real time Fishing statistics of the same duration were procured from FSI Mumbai. The Catch Per Unit Effort (CPUE) for each fishing trail was calculated to normalize the fish catch. Based on the statistical analysis the actual CPUEs were classified at each probable MSLA depth zones and plotted on the same images.

Key words: *MSLA, SST, CPUE, PFZ, Altimeter, Chlorophyll.*

Introduction

Remote sensing of Ocean is playing an increasingly important role in fishery research. The sea surface height anomalies (SSHA) is the most derived data product from the RADAR satellite altimetry. Sea Surface Height anomalies (SSHa) are less subject to short period variability. It is expected that positive SSHa is suggestive of deeper thermocline. The study attempted to derive the signatures of chlorophyll, Sea surface temperature and Sea Surface Height(SSH) for the past 7 years(from 1998 to 2004) synergistically in order to understand the co variability in signatures of different variables derived from different region of electromagnetic spectrum.

Data Used

Merged Sea Level Anomaly(MSLa) with monthly composites from the satellites TOPEX/Poseidon (T/P) and Jason-1 satellites were used in this study to derive the sea surface height variations, Chlorophyll data derived from SeaWifS satellite 9km resolution for the period from 1998 to 2004 were used to develop time series monthly data to obtain the chlorophyll variation. The SST data used in this study is the monthly Sea Surface Temperature variation for the period from 1998 to 2004, derived from infrared radiometers of Advanced Very High Resolution Radiometer (AVHRR) onboard the NOAA series satellites and The fishing operations statistics used in this was obtained from Fishery Survey of India which used two fishing vessels namely Matsya Neerikshini and Matsya Mohini

Methodology

MSLAs were used to generate the spatial profile of the track data. The synchronous chlorophyll and SST data were co-registered. These images were used to generate the spatial profile of respective tracks in MSLA. Signatures with its corresponding statistics in three sensor profiles were compared. The images of chlorophyll, SST and MSLA product were compared to understand the patterns of variability in signatures of variables from different sensors.

Results and Discussion

It was observed from the comparative analysis that the spectra of SST and MSLa are co-varying and inversely varying with CC spectras as shown in Figure 1.waters of areas of negative MSLa consists of high CC and relatively low SST. This suggests that negative MSLa consist of dense cooler nutrient rich water and can be used as an indicator of enhanced biological production sites. It was also observed that CC and SST features are found to be

persisted for days to week while MSLa signatures of respective features persisted for longer duration. The high to medium catch contours were found with respect to peak spectra of CC and trough spectras of SST and MSLa. The Vise-a-versa patterns were identified in areas of poor catch contours. The mean CPUEs have been plotted on the MSLa image. Figure 2 shows that comparison of CPUEs in the favourable (PFZ Zones) and non favourable zones (Non PFZ Zones) in the study area.

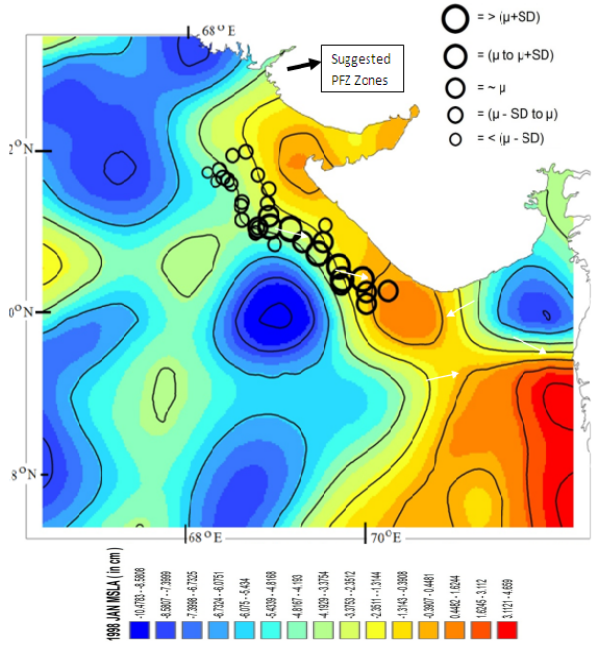

Figure 1: January 1998 fish catch data integrated with MSLa contour overlaid the MSLa color spectras

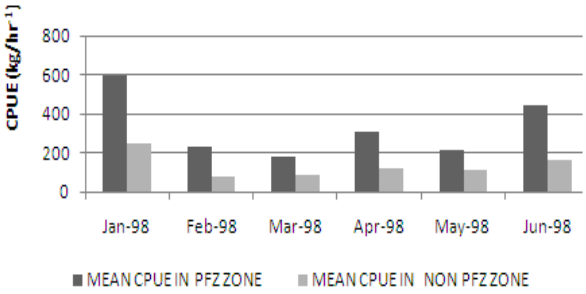

Figure 2: Month wise comparison of mean (μ), CPUE (kg) in PFZs and mean (μ)CPUE in non PFZs

Conclusions

The study takes into account that the biological (CC) and physical parameters(temperature and MSLa) of ocean waters. The synergistic analysis of CC, SST makes the easier location of the regions of fish accumulation. The MSLa features are so stable in time and indicating the high dense cooler nutrient rich Sea surface areas when integrated with spatial spectras of features of CC and SST. The MSLa features are persistent for longer period and can be used as an index for ocean long term variability and increases the probability of identification of the resources sustained for a longer period. The integrated CC,SST and MSLa features are showing the prominent results of Potential Fishing Zones(PFZs) that are validated with fishing observations of field experiments. The study enables the combined use of the satellite sensors operating in the Optical, Thermal and Microwave regions with respective CC,SST and MSLa images indicating the most favourable locations of potential fishig Zones(PFZs) there by producing the enhanced observation of availability of fish resources available in ecosystem.

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