Analysis on Oceanographic Dataset

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ABSTRACT

The ocean has vast resources especially on humans, providing food, fishing jobs, shipping goods, tourism and others. Other than that, ocean also provides parameters that can be efficient when used. These ocean parameters such as sea surface temperature, sea surface chlorophyll, salinity, and among others are discovered due to the rise of technological developments, the measurement of physical, chemical, and biological characteristics from the sea surface to the ocean floor has become possible. In this study, we introduce oceanographic data as an essential parameter that can be used in a related environment. The goal of this study is to analyze and find relationships between variables. Here, we utilized EDA and analyzed oceanographic data. EDA primarily focuses on visually examining the given data. Its main goal is to understand the data you have, what potential patterns are there to use, and understand the relationship between them. Results shows that SST, SSC, SLP, AT each has different influence towards Total Catch. Also, we found that SST has a direct effect in AT. In evaluating the oceanographic dataset, it shows that oceanographic dataset is very ideal in dealing with fisheries concerns and could be used an essential indicator especially in finding potential fishing spots

Keywords

Oceanographic data, Oceanographic dataset, Exploratory Data Analysis (EDA).

1. INTRODUCTION

The ocean has vast resources especially on humans, providing food, fishing jobs, shipping goods, tourism and others. Other than that, ocean also provides parameters that can be efficient when used. These ocean parameters such as sea surface temperature, sea surface chlorophyll, salinity, and among others are discovered due to the rise of technological developments, the measurement of physical, chemical, and biological characteristics from the sea surface to the ocean floor has become possible. Along with the rapid technological development, remote sensing method are utilize to obtained oceanographic data. Satellites are the most apparent remote sensing platforms, but some special buoys and even some ships use instruments (e.g. radiometers) to remotely examine the surface of the ocean.

Many operation used the marine environment to acquire its purpose. Last year, according to the study of Fu et al.. The researchers utilized oceanographic parameter in monitoring El Niño phenomenon in Zhoushan Islands. [1] The remote sensing datasets of sea surface salinity (SSS), sea surface temperature (SST), sea surface height (SSH), and chlorophyll concentration (Chl) in the Zhoushan sea area were collected and averaged spatially, temporally, and yearly, in order to analyze the variability monthly and yearly, and during El Niño. The results shows that oceanographic parameters have obvious seasonal variation and spatial distribution. In Hangzhou bay, SSS is high in winter and spring and low in summer and autumn whereas SST is higher in summer and autumn than that in spring and winter. In March–April and July, the minimum value of SSH is seen, while in September and October, the maximum value of SSH is observed. During spring and summer, Chl is significantly higher than in winter.

Another study of Teo and Boustany in 2007, uses oceanographic data to determine the oceanographic breeding grounds of Atlantic Bluefin tuna in the Gulf of Mexico (GOM). [2] The environment parameters used are: bathymetry, bathymetric gradient, SST, SST gradient, surface chlorophyll concentration, surface chlorophyll gradient, sea surface height anomaly, eddy kinetic energy, surface wind speed, and surface current speed. The researchers remarkably convey the breeding areas of Bluefin tuna are significantly associated with these parameters. Among the represented parameters, researchers indicate SST as the most important parameter towards locating breeding grounds of Bluefin tuna in GOM.

In this study, we introduce oceanographic data as an essential parameter that can be used in a related environment. The goal of this research is to analyze the oceanographic data and find relationship between variables. This paper is organized in five sections, Introduction, Review of Related Literature, Methodology, Results and Analysis, and Conclusion.

2. REVIEW OF RELATED LITERATURE

This chapter presents various studies and literature regarding aquatic parameters to be used in our study.

2.1 Related Works Regarding Oceanographic Data

Several studies attempt to use oceanographic data as their feature variable. A study of Juan-Jorda et al. in 2009, utilized oceanographic factors in determining oceanographic habitat of ground-fish species. Researchers stated oceanographic data may have an influence in the distribution of ground-fish species. [3] Temperature, salinity, and chlorophyll-a concentrations were the oceanographic parameters selected for study. These parameters have been selected for their importance to ground-fish ecology and their potential as oceanographic habitat descriptors. Results shows that oceanographic data are able to identify and describe oceanographic habitats in the northern California Sea. In contrast, these individual oceanographic factors shows a strong relationship between ground-fish species.

Another study of Zainuddin et. al, in 2013, discussed the remotely sensed oceanographic data, specifically, sea surface temperature and sea surface chlorophyll-a in locating potential fishing zones during southest monsoon in the Bone bay-flores sea.

The data were recorded monthly for the year 2012. Along with simple linear model to predict skipjack tuna abundance, [4] the findings suggested that sea surface temperatures ranging from 28.5˚C to 30.5˚C and chlorophyll-a ranging from 0.10 to 0.20 mg·m−3 characterized the distribution pattern of potential skipjack fishing zones during the southeast monsoon. The researchers proposed that the oceanographic parameters may well correspond to the possible feeding ground for skipjack tuna.

In the study of Roy et. al., stated that oceanographic factors (biological, chemical, and physical) are one of the way in determining potential fishing zones. The researchers proposed a framework in identifying a potential fishing zones in Indian Ocean. Oceanographic data specifically sea surface temperature (SST), and sea surface chlorophyll (SST) were extracted from Copernicus Online Data Access (CODA) and were utilized in this study [5]. Governed by machine learning algorithms, result shows the system is able to identify PFZ's around Indian Ocean. The framework proposed in this study therefore provides a prediction model of the potential fishing area considering spatiotemporal approach and oceanographic features such as SST and SSC.

Weather forecasting is one of the world's most scientifically and technologically complex problems [6]. In relation to weather prediction, this study of Nikam and Meshram proposed a rainfall prediction model. The dataset is collected from Indian Meteorological Department (IDM) and is consists of 7 attributes (Temp, Station level Pressure, Mean Sea level Pressure, Relative Humidity, Vapor Pressure, Wind Speed, and Rainfall) relevant to rainfall prediction. Bayesian model approach were used in this study, and is trained using training data and tested for accuracy on the test data. [6] Result shows a good accuracy and takes moderate compute resources to predict the rainfall. The researchers used the Bayesian approach to illustrate our rainfall prediction model and have found that it works well with good precision.

2.2 Sea Surface Temperature

Sea surface temperature (SST) is a fundamental physical variable for understanding, quantifying and predicting complex interactions between the ocean and the atmosphere. Sea surface temperature can be used as an indicator to determine the existence of a species of fish in waters. Each fish species has a tolerance of a certain temperature range which is favored for its survival so that it influences the presence and spread of fish in the waters [12].

In this recent year, the study of Nugraha et al., stated that water condition can be used in determining fishing ground. [12] Sea surface temperature (SST) is one of the indicators for knowing the condition of a fish species. In this study, SST were used as a parameter to determine the presence of Katsuwonus pelamis. The result shows that the majority of the catches of K. Pelamis can be located in the 29-30°C temperature range. This demonstrates that the temperature for capturing K. Pelamis is 29-30 ° C sufficient in the Banda Sea.

Another study conducted by Apriliani et al. uses sea surface temperature together with sea surface chlorophyll in determining potential fishing spots of hairtail (Trichiurus sp.) in Pangandaran waters, West java, Indonesia. [13] The goal of this study is to improve the effectiveness of catches by identifying potential fishing zones for hairtail fishing. The researchers uses spatial analysis method by gathering data of chlorophyll-a, temperature and production of hairtail fish. The findings have shown that there are 7 areas scattered in Pangandaran waters that may become potential hairtail fishing grounds.

2.3 Sea Surface Chlorophyll

Chlorophyll is regarded as the most significant oceanographic element influencing the marine ecosystem and the fish species' natural habitat [14]. Chlorophyll-a is closely linked to the food chain, where a high chlorophyll content enhances the productivity of zooplankton, producing a food chain that enhances the productivity of fish in water.

SSC was also used as input data to generate potential fishing zones for skipjack in the study of Mukti Zainuddin. The ranges SSC of 0.15-0.40 mg mg-^{3} represent the oceanographic range particularly from May to June. This range can be viewed as an initial indicator of the area most likely to detect skipjack tuna in Bone Bay. Study shows SSC provides a good indicator in detecting potential fishing spots for Skipjack Tuna in Bone Bay.

In a recent study of Syah et al. [15] aims to use remotely sensed data to forecast the Mackerel tuna fishing zone in the Bali Strait. These data including sea surface chlorophyll downloaded from the ocean colour website. With the help of multi regression model in associating oceanographic data, the results showed that in September and October were the highest fishing cathes with SST value of 26 – 28 □C and chl-a value of 0.4 – 2.6 mg/m3.

2.4 Sea Level Pressure

Sea level pressure is the pressure within the atmosphere of Earth. Pressure in the ocean increases about one atmosphere for every 10 meters of water depth. In fisheries, SLP plays a vital role especially in fish activity. In 2018, the study of Zamorov et al., analyzed the influence of sea-level pressure together with water temperature on round roby, from the coastal waters of the Black Sea. Researcher stated that [17] one of the most significant variables influencing fish activity is sea level pressure. Gobies were maintained for several hours a day at temperature intervals of 10-12 ℃, 14-16 ℃, 18-20 ℃, 22-24 ℃, and 26-28 ℃ for 5 days at low pressure. Researchers intended to evaluate the effect of SLP and water temperature on the round goby swimming activity, and results shows that increasing the atmospheric pressure at temperatures of 10-24 ° C affected the round goby activity [17].

Another study of Carassou et al. in 2011, analyzed the impact of climate and environmental factors on interannual variations in juvenile abundances of marine fish in the north-central Gulf of Mexico's river. Sea-level pressure pressure is among the variables that are used in the study. The result demonstrates that during summer and fall, juvenile fringed flounder abundances were positively correlated with sea-level pressure. The juvenile abundance of southern kingfish, another marine fish, was highly associated with sea-level pressure during summer and fall. And lastly, during summer and fall, juvenile hogchoker abundances were strongly correlated with sea-level pressure. In conclusion, this study offers the study of the environmental impacts of a multi-species and multivariable approach on juvenile fish dynamics in the north-central Gulf of Mexico.

2.5 Air Temperature

One of the major effects of solar radiation in the lower Earth atmosphere arising from rational processes of heat transfer, conduction and diffusion is air temperature [7]. Air temperature regulates the growth and development of most living organisms. In fisheries, air temperature has influenced the production of marine protein from fishing and aquaculture. An increase of air temperature will cause ocean temperature to increase as well causing this to affect the growth rate of marine animals.

In the study of Toffolon et. al., in 2014 uses environmental conditions to forecast seasons for decision support primarily in marine fisheries. Researchers stated that variables such as water temperature, rainfall, and air temperature are considered to be useful in season forecasting. Here, seasonal forecasting is being used to minimize volatility and control market risks in marine farming and fishing activities in Australia [7]. Result shows the use of seasonal forecasts to encourage effective marine management can also be a valuable step towards improving decision-making and the sustainability of the industry at longer timescales.

In agriculture, other parameters especially air temperature plays a vital role. The efficiency of farming depends on both the type of soil and other meteorological parameters [8]. In the study of Ahmad and Rasul, uses air temperature as a variable in predicting soil temperature. From germination, root extension, emergence to the reproductive stage, soil temperature plays an important role during the life cycle of the plants. The study shows the essential part of air temperature in determining soil temperature. With just the input of an air temperature and the result will be in the form of soil temperature with sufficient precision to depend on. [8] This will help to select the most appropriate area and species of crops to be produced.

2.6 Total Catch

Fishery resources must depend on a variety of important factors to assess the status of fisheries. Total catch data for target species are amongst these variables. It is possible to collect these data in a number of ways, including log books, shore side tracking, and many others. Total catch data allows fishermen to determine the current status of the fishery, other than that, these data can also be used in historical trends in fishery where it can be used in estimating population abundance of certain fish species.

The study of Zainuddin et. al in 2006, uses oceanographic features specifically total catch data to determine fishing spots of albacore (Thunnus alalunga) in northwestern North Pacific [9]. Remotely sensed data from multi-sensor satellite images of TRMM/TMI sea-surface temperature (SST), SeaWiFS chlorophyll-a concentration and photosynthetically active radiation (PAR) and AVISO mean sea-level anomaly (MSLA) were connected to fish catch data from 1998 to 2003 to better understand and describe oceanic hot spots for albacore (Thunnus alalunga). These results indicate that the ocean hot spots for albacore are correlated with hydrographic characteristics that affect the pattern of distribution and the formation of tuna abundance. In addition, the study offers an example of how remote sensing through multi-sensor satellite can help identify albacore hot spots.

Another study of Nurdin et. al. in 2017, [10] uses oceanographic data in detecting potential fishing grounds of Rastrelliger kanagurta in the waters of Spermonde, Indonesia. The goal of the study was to establish the relationship between the distribution of chl-a and SST fish in order to identify potential fishing grounds. In exploring fishing resources, it is important to understand the relationship between the distribution of fish and environmental factors. This research used fishing-catch data of Rastrelliger kanagurta and satellite data of chlorphyll-a (Chl-a), and sea surface temperature (SST) from MODIS-Aqua. [10] The Rastrelliger kanagurta distribution was significantly correlated with the preferred range of chl-a at 0.30–0.40 mg/m3 and SST at 30.00–31.00 ℃ ($p < 0.0001$). The results of this study suggested the applicability of remote sensing in the long-term management of Rastrelliger kanagurta resources.

3. METHODOLOGY

This chapter present the methods of collection, preparation, analysis and evaluation of the data.

3.1 Dataset Collection

The data used in this research was found on Kaggle website. The data contains the following: Date, Sea Surface Temperature, Sea Surface Chlorophyll, Sea Level Pressure, Air Temperature, and lastly Total Catch. The data collected was from year 2007 up to 2017, and was recorded by month.

3.2 Dataset Preparation

In preparing the data, we utilized Jupyter Notebook to access these data. First, we check all the columns to see if we have all the necessary columns to evaluate. We then apply shape function on our dataset to determine the number of rows and columns and our dataset is consist of 132 rows and 6 columns. Next, we check the dataset to see if there are any missing values. Fortunately, the dataset doesn't contain any missing values. Now the dataset is ready to be analyze.

3.3 Dataset Analysis

In analyzing the data, we utilized Exploratory Data Analysis (EDA) approach in this study. EDA primarily focuses on visually examining the given data. Its main goal is to understand the data you have, what potential patterns are there to use, and understand the relationship between them. In our case we utilize this approach in finding relationship between variables.

3.4 Dataset Evaluation

The oceanographic data analyze in this study are one of the many oceanographic data available, this study mainly focuses on finding the relations between SST, SSC, SLP and AT towards the total catch. This data could be useful towards finding potential fishing zones that the fishermen needed, this data in this study provides the fishermen indications which area to fish and what temperature and weather to consider when fishing.

4. Results and Analysis

The goal of this study is to analyze and find relationships between variables. Here, we utilized EDA and analyzed oceanographic data. Results shows that SST, SSC, SLP, AT each has different influence towards Total Catch. Also, we found that SST has a direct effect in AT.

Figure 1 shows the relationship between sea surface temperature and total catch. As you can see, temperature around 27º to 31º shows numerous catches recorded in that temperature. This

explains that temperature from 27º to 31º is appropriate for fishing.

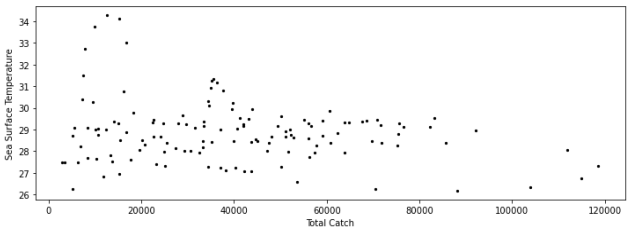

Figure 1. Relationship between SST and Total catch data.

In Figure 2, this also shows the relation between SSC and Total catch. In the figure shown below, around 0.10 to 0.25 amount of chlorophyll shows several total catch data recorded in that area. This explains that around 0.10 to 0.25 are ideal for determining fishing spots.

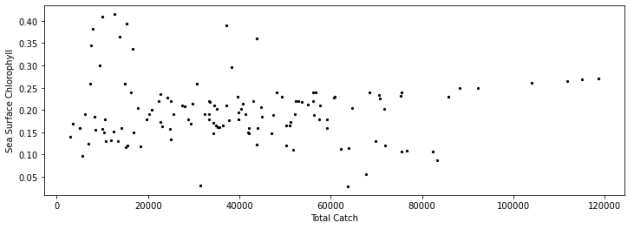

Figure 2. Relationship between SSC and Total catch data.

In Figure 3 shows the correlation between SLP and Total catch. Figure below explain that around 1006 to 1014 shows various total catch data gathered which results to SLP as an important variable in finding fishing spots.

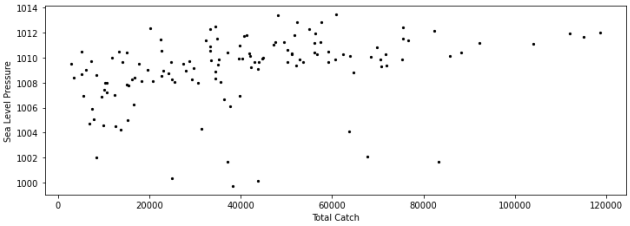

Figure 3. Relationship between SLP and Total catch data.

Lastly, figure 4 shows the relation between AT and Total catch. Below explain that around 27º to 31º temperature shows several of data gathered in that temperature. This shows that AT could be a feature in finding potential fishing spots

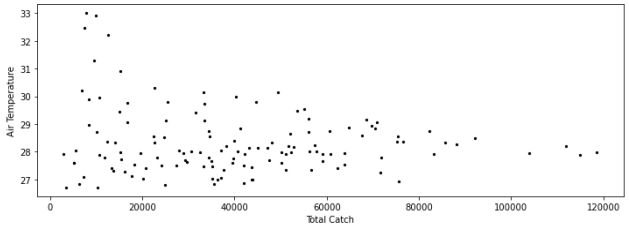

Figure 4. Relationship between AT and Total catch data.

As you notice, the temperature of AT and SST are quite the same, it's because SST has a direct influence in AT. Figure below shows the visual representation of SST and AT. Here, we notice that as SST increase the AT also increases and as SST decreases the AT somehow decreases.

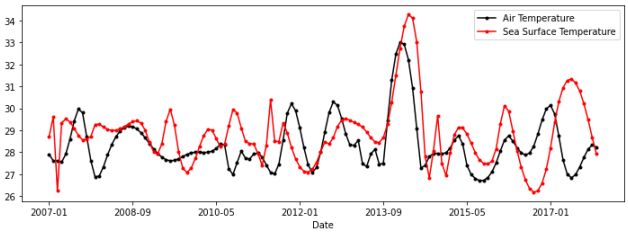

Figure 5. Relationship between SST and AT.

5. Conclusion

In this paper, we describe oceanographic data as an important information that can be employ in marine issue. In evaluating the oceanographic dataset, it shows that oceanographic dataset is very ideal in dealing with fisheries concerns and could be used an essential indicator especially in finding potential fishing spots.

We hope that this work will allow new efforts to evaluate various matter. This data is highly beneficial since it can be extended to several issues like climate change, pollution, and many others. In future we can try to add necessary features to improve results.

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