INTRODUCTION

Indonesia is an archipelago with a variety of marine biota. Indonesia is dubbed a maritime country because the territorial waters that Indonesia owns are very large. Indonesia's position is located on the equator which causes the climate in Indonesia to be a tropical climate. Natural resources owned by Indonesia are in the form of petroleum, natural gas, coal, gold, nickel, and silver with the division of land consisting of 10% agricultural land, 7% plantations, 62% forested areas, and 45,970 km of irrigated land. Bank, (1994).

Administratively, Lamong Bay is located in the northern area of Surabaya City which is directly adjacent to the Gresik Regency. The waters of Lamong Bay are known as a strategic port on an international scale.

There are rivers along the coast of Lamong Bay which empties into Lamong Bay. The number of rivers that flow and empties into Lamong Bay. These activities can result in an interaction between fresh water and seawater. This interaction affects the salinity value and sea surface temperature in the waters of Lamong Bay. Salinity and sea surface temperature is some of the biggest factors causing corrosion in the sea which will damage the structure of buildings around the sea. It is expected that in this research as information about the waters of Teluk Lamong for data information or database utilization in the field of civil engineering, among others, port maintenance and coastal building planning. Based on this background, research is needed to monitor the spread of salinity values and sea surface temperatures in Lamong Bay using Landsat 8 satellite imagery for the years 2016 and 2020. The result of modeling the algorithm obtained, the model of the algorithm used to process the salinity of the image is the wavelength Band_4 in the Equation Power with the model algorithm \( y = 25.437x - 0.046 \), and the degree of determination value \( R^2 = 0.5825 \). While sea surface temperature in power equation with algorithm model \( y = 302.14x^{0.0029} \) and determination value \( R^2 = 0.4182 \). The results of an analysis of the T-test and validation test can be qualified. The results of the analysis of imagery data showed salinity distribution ranged from 27.33 (ppm) to 29.9 (ppm), while sea surface temperatures ranged from 303.95 Kelvin to 304.39 Kelvin.

Keywords: Landsat 8, Salinity, Sea Surface Temperature
which makes the characteristics or properties of the concrete not following the standard requirements.

Salinity is the amount of salt dissolved in water. The unit of salinity is the permil (ppm), which is the total weight (gr) of materials such as NaCl contained in 1,000 grams of seawater (Nybakken, 1992). Salinity is the physico-chemical part of water, in addition to temperature, Ph, substrate, and others. The salinity level of each water is different, for example, land and sea waters. The distribution of salinity is influenced by several factors, namely evaporation, rainfall, river flows, and ocean currents.

Temperature is a physical quantity that states the heat contained in an object. The distribution of sea surface temperature is influenced by factors of rainfall, evaporation, wind speed, the location of the rising sea level (up-welling), and the intensity of sunlight (Supangat and Susana, 2000).

Salinity and temperature are some of the biggest factors causing corrosion in the sea which can damage building structures around the sea. According to Nurgiantoro and Hamdhana (2019), seawater is a corrosive environment that affects infrastructure materials, especially in seas that have high salinity.

The Landsat 8 satellite is one of the satellites used to observe the earth's surface. Satellites are commonly known as natural resource satellites because their function is to map natural resource potentials and monitor environmental conditions. The mapping of the distribution patterns of salinity and temperature values in this study can be done using satellite imagery data Landsat 8 band 2, band 3, band 4, and band 10.

Observation of salinity levels and sea surface temperature is very important to provide knowledge and understanding of their effects on coastal building materials and is very important for planners engaged in infrastructure both for government agencies or private companies engaged in construction, of course, requires very extra effort in management. Information regarding salinity levels and sea surface temperature. Thus, the development of marine infrastructure in Indonesia must still pay attention to the influence of seawater, especially salinity levels as a physical process that damages the environmental quality and the durability of structures and materials Nurgiantoro & Hamdhana (2019).

The purpose of this research is as basic information or database used for the development of further research on the distribution of sea surface temperature and salinity levels in the waters of Lamong Bay so that it can be needed for the design or planning of port development, bridge construction, and other marine infrastructure development in Indonesia. Therefore, it is necessary to have a study regarding salinity levels and sea surface temperature by utilizing technology from Landsat 8 satellite data and monitoring its distribution patterns.

LITERATURE REVIEW

A. Remote Sensing

Remote Sensing is the art and science of obtaining information about objects, areas, or phenomena through analysis of data obtained using tools without direct contact with the object, area, or phenomenon being studied (Lillesand & Kiefer, 1979).

The instrument referred to in the above definition is a sensing device or sensor. In general, sensors are carried by vehicles in the form of aircraft, hot air balloons, satellites, and other types of vehicles (Sutanto, 1987). The results of the recording by a device carried by a vehicle are hereinafter referred to as remote sensing data.

Remote sensing is a variety of techniques developed for the acquisition and analysis of information about the earth, this information is specified in the form of electromagnetic radiation that is reflected or emitted from the earth's surface (Lindgren, 1985 in Sutanto, 1987). Remote sensing consists of three main components, namely objects that are sensed, sensors to record objects, and electronic waves that are reflected or emitted by the earth's surface.

In general, it can be said that remote sensing can play a role in significantly reducing terrestrial survey activities in the inventory and monitoring of natural resources. The purpose of terrestrial survey activities is to prove a type of object or phenomenon in the field to be adjusted with the results of existing data analysis.

The principle of recording by sensors in data retrieval through remote sensing methods is carried out based on the difference in the reflectance of electromagnetic energy of each object on the earth's surface. The different reflectance power by the sensor will be recorded and defined as different objects that are presented in an image.

Electromagnetic waves reflected by the earth's surface will pass through the atmosphere before being recorded by sensors. Clouds, dust, or other particles in the atmosphere will refract these reflected waves based on the refraction that occurs. Before an image analysis is carried out, radiometric correction activities are required.

B. Citra Landsat 8

According to Iradaf Mandaya (2016), Landsat is an earth image capture program with the Landsat satellite. Landsat has captured millions of satellite images for the whole world, so Landsat is the satellite that has the most complete image collection and is available to the public. The newest satellite is Landsat 8 which was launched in February 2013.
The Landsat satellite is one of the satellites used to observe the earth's surface. Satellites are commonly known as natural resource satellites because their function is to map natural resource potentials and monitor environmental conditions. Landsat satellite instruments have generated millions of images. The imagery is archived in the United States and Landsat receiving stations around the world which have resources for global change research and its applications in agriculture, geology, forestry, regional planning, education, and national security. The TM sensor has a resolution of up to 30 m x 30 m and works to collect data on the earth's surface and a sweeping area of 185 km x 185 km. The use of Landsat imagery for land use mapping has been especially popular in developing countries to speed up the collection of required data or to update old data.

Landsat 8 produces high-quality imagery, for the whole world, every 16 days. This image is provided by the United States Geological Survey (USGS) which is publicly accessible. The Landsat 8 image has a pixel resolution of 28.5 m, with one band higher resolution with a pixel size of 15 m. Once passed, the Landsat 8 satellite captured an image path as wide as 185 km, measured at Earth's orbit. Landsat 8 satellites have sensors.

Onboard Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) with 11 channels. Among these channels, 9 channels (bands 1-9) are on the OLI and 2 others (bands 10 and 11) are on the TIRS.

C. Salinity

According to Nybakken (1992), salinity is the level of salt dissolved in water. The unit of salinity is permil (ppm), which is the total weight of materials such as NaCl contained in 1000 grams of seawater.

Salinity is the concentration of all salt solutions obtained in seawater, where water salinity affects the osmotic pressure of water, the higher the salinity of the meal, the greater the osmotic pressure (Gufran and Baso, 2007 in Widiadmoko, 2013). The distribution of salinity is influenced by several factors, namely evaporation, rainfall, river flow, and ocean currents (Rahman, A., et al, 2017).

D. Sea Surface Temperature

Temperature is a physical quantity related to the heat energy produced. Sea surface temperature is one of the parameters for detecting climate change that occurs in marine waters and coasts. Sea surface temperature is influenced by rainfall, evaporation, air humidity, air temperature, wind speed, and the intensity of solar radiation (Muchlisin Arief et al., 2015).

Temperature also greatly affects the life and growth of aquatic biota, temperature in water bodies is influenced by season, latitude, time of day, air circulation, cloud cover, and water flow and depth. Water temperature plays a role in controlling the condition of the aquatic ecosystem. The increase in temperature causes an increase in the decomposition of organic matter by microbes (Effendi, 2003). Changes in surface temperature can affect physical, chemical, and biological processes in these waters (Kusumaningtyas et al., 2014).

Temperature greatly affects corrosion. An increase in temperature is followed by an increase in the corrosion rate, usually, the corrosion rate increases almost twice every time the temperature rises. The high temperature also affects the O2 concentration which affects the corrosion rate. Surface seawater temperature is determined by warming in the tropics and cooling in high latitudes (Munasir: 2009 in Setiawan, M.E: 2019).
Measurement of sea surface temperature results directly in the field (in-situ), obtained by firing a wide beam of a thermometer gun to the sea surface based on a predetermined station point. In general, the surface temperature of the waters is around 28 °C - 31 °C (Nontji, 2005).

E. Global Positioning System (GPS)

Global Positioning System (GPS) is a satellite-based navigation system developed by the US Department of Defense which is supported by a network of 27 satellites. The Global Positioning System (GPS) consists of 3 segments: the space segment, the control or control segment, and the user segment. The space segment consists of 24 satellites operating in 6 orbits at an altitude of 20,200 km and an inclination of 55 degrees with a period of 12 hours (the satellite will return to the same point in 12 hours). The satellite rotates its orbit so that at least 6 satellites can be monitored at any point on earth. These satellites transmit position and time to users around the world.

![Figure 4 GPS Working System (Source: google.com)](image)

Each satellite transmits two signals, namely L1 (1575.42 MHz) and L2 (1227.60 MHz). The L1 signal is modulated with two pseudo-random signals, namely the P-code (Protected) and the C/A code (coarse / acquisition). L2 signals carry only the P-code. Each satellite transmits a unique code so that the receiver (GPS device) can identify the signal from each satellite. When the "Anti-Spoofing" feature is activated, the P-code will be encrypted and hereinafter referred to as the P-code (Y) or Y code.

A civilian Global Positioning System (GPS) device only accepts the C/A code in the L1 signal (although sophisticated GPS devices can utilize the L2 signal to obtain a more precise measurement). GPS devices receive signals transmitted by Global Positioning System (GPS) satellites. In determining position, we need at least 3 satellites for 2-dimensional positioning (latitude and longitude) and 4 satellites for 3-dimensional positioning (latitude, longitude, and altitude). The more satellites obtained, the higher the accuracy of our position.

F. Korelasi Linear

To measure the strength of the relationship between the variable predictor X and the Y response, a correlation analysis was carried out whose results were expressed by a number known as the correlation coefficient. The correlation coefficient indicates the strength of the linear relationship and the direction of the relationship between two random variables. If the correlation coefficient is positive or unidirectional and the first variable is large, the second variable is getting bigger. If the correlation is negative or opposite and the first variable is large, then the second variable is getting smaller (Suyarso, 2019). There are several criteria regarding the interpretation of the strength of the relationship between the two variables as follows:

| Correlation Coefficient | Interpretation of Relationships |
|-------------------------|--------------------------------|
| 0.80 sd 1.0             | Very Strong Positive Correlation |
| 0.60 sd 0.80            | Positive Correlation Strong Enough |
| 0.40 sd 0.60            | Medium Positive Correlation |
| 0.20 sd 0.40            | Fairly Low Positive Correlation |
| 0.00 sd 0.20            | Very Low Positive Correlation |
| 0                        | No Correlation |
| -0.20 sd -0.40          | Very Low Negative Correlation |
| -0.40 sd -0.60          | Fairly Low Negative Correlation |
| -0.60 sd -0.80          | Medium Negative Correlation |
| -0.80 sd -1.0           | Very Strong Negative Correlation |

Source: Usman dan Purnomo, 2000

The linear correlation equation is as follows:

\[
r = \frac{n \sum x_i y_i - (\sum x_i \sum y_i)}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}
\]  

\[
b = \frac{\sum x_i y_i - (\sum x_i \sum y_i)}{\sum x_i^2 - (\sum x_i)^2}
\]  

\[
s_x^2 = \frac{\sum x_i^2 - (\sum x_i)^2}{n(n-1)}
\]  

\[
s_y^2 = \frac{\sum y_i^2 - (\sum y_i)^2}{n(n-1)}
\]
\[ JKG = (n-1) \left( \frac{\sum x^2 - \left( \sum x \right)^2}{n} \right) \] (7)

\[ r^2 = 1 - \frac{\text{JKG}}{(n-1)s_y^2} \] (8)

Since both JKG and Sy2 are never negative, it follows that \( r^2 \) is zero and 1. As a result, \( r \) may take values from -1 to +1. The value of \( r \) still has the original nature of the linear relationship itself, namely a positive or negative relationship. So if you want to express the relationship in percentage form, you can use the value of \( r^2 \).

**G. T Test**

The individual significance test or commonly known as the T statistical test is a partial data analysis process. This T-test will show how much influence the independent variable partially affects the dependent variable. T-test aims to see the extent of the partial influence of the independent variables on the dependent variable. The T-test is more often used for less data, which is less than 30.

The T-test is used if the parameter values are known or determined, and the data is normally distributed. The T-test is divided into 3 types, namely the T-test of 1 sample, 2 paired samples, and free samples. You do this by comparing the \( t \) table with the \( t \) count. Each calculated \( T \) value will be compared with the \( T \) table obtained using the commonly used real level of 0.05. The T-test equation is as follows:

\[ t = \frac{r \sqrt{n - 2}}{\sqrt{1 - r^2}} \]

\[ T = \frac{\beta n}{s \beta n} \]

\( T \) = Significant value \( (t \) count) which will be compared later with \( t \) table.

\( R \) = correlation coefficient

\( N \) = Number of samples

\( s \beta n \) = standard error for each variable

\( \beta n \) = The regression coefficient for each variable.

**RESEARCH METHOD**

**A. Data and Equipment**

**Data:**
The data used in this study are as follows:
1. Landsat 8 Satellite Image Data in the waters of Lamong Bay.
2. Water sample data in the waters of Lamong Bay.

**Equipment:**
The equipment used in this research is as follows:
1. Hardware (hardware)
   - Laptop
   - Global Positioning System (GPS)
   - Thermometer
   - Digital salinometer
   - Stationery
   - Digital Camera
   - Boat
2. Software (software)
   - Microsoft Office 2016
   - Landsat 8
   - Google Earth Pro
   - SeaDAS

**B. Flowchart of Research**

**C. Flowchart of Landsat Image Processing**

**RESULT AND DISCUSSION**

**A. Data Landsat 8**
Satellite image data used in this study is Landsat 8 satellite imagery taken from the page www.earthexplorer.usgs.gov with time. Map of Landsat 8 satellite imagery taken from the old
Exponential, Linear, Logarithmic, and Power, the reflectance values have been obtained which have been converted into reflectance values at the wavelength of Landsat 8 imagery for Band 2, Band 3, and Band 4, the formula equations, namely Exponential, Linear, Logarithmic, and Power to find the value of the largest degree of determination R².

B. Processing of Salinity Levels of Landsat Image

Landsat 8 satellite image data processing is calculated using algorithmic modeling. Where to get the reflectance value, you must choose electromagnetic waves for further processing. The selected waves are band 2 (blue), band 3 (green), and band 4 (red). The reflectance value is obtained by entering the pin manager and selecting the pixel data filter, after that select band 2, band 3, and band 4 then the Digital Number value will appear.

The Digital Number value is then converted into a Reflective Value by entering the formula from the Metadata (MTL) file with the file name LC08_L2SP_118065_20201120_20201210_02_T1 MTL. Next, look for the values in REFLECTANCE_MULTI_BAND_2 and REFLECTANCE_ADD_BAND_2 to insert formulas into calculations in Microsoft Excel.

Example of a calculation to change a Digital Number to a Reflective Value:

Formula = Digital Number*Reflectance_Multi_Band_2 – Reflectance_Add_Band_2
= 6995*2.0000E – 05 – 0.1
= 0.03990 (Reflectance Value)

From all the Digital Number values that have been converted into reflectance values at the wavelength of Landsat 8 imagery for Band 2, Band 3, and Band 4, the reflectance values have been obtained which have been summarized in table 1 below:

| Titik | Band_2 | Band_3 | Band_4 |
|-------|--------|--------|--------|
| 1     | 0.03990| 0.07498| 0.06286|
| 2     | 0.05788| 0.09206| 0.07824|
| 3     | 0.01930| 0.07060| 0.05184|
| 4     | 0.02604| 0.06062| 0.04140|
| 5     | 0.01734| 0.07678| 0.06414|
| 6     | 0.01164| 0.09070| 0.08114|
| 7     | 0.02730| 0.09694| 0.08998|
| 8     | 0.04252| 0.10178| 0.09316|
| 9     | 0.03920| 0.10094| 0.09162|

| Titik | Band_2 | Band_3 | Band_4 |
|-------|--------|--------|--------|
| 10    | 0.04374| 0.10596| 0.09608|
| 11    | 0.21106| 0.24950| 0.24080|
| 12    | 0.05674| 0.19568| 0.16502|
| 13    | 0.00268| 0.10614| 0.09626|
| 14    | 0.01060| 0.09112| 0.09340|
| 15    | 0.20366| 0.25200| 0.23826|
| 16    | 0.02028| 0.13974| 0.12208|
| 17    | 0.13004| 0.14756| 0.15724|
| 18    | 0.12618| 0.17412| 0.17028|
| 19    | 0.21002| 0.16404| 0.17636|
| 20    | 0.41020| 0.40770| 0.39834|

Table 3 Results of the Salinity Level Reflectance Value Extract 2016 Landsat 8 imagery

| Salinity Level Reflectance Value Data in 2016 | Titik | Band_2 | Band_3 | Band_4 |
|----------------------------------------------|-------|--------|--------|--------|
| 1                                             | 0.13014| 0.15602| 0.13754|
| 2                                             | 0.12854| 0.15390| 0.13564|
| 3                                             | 0.12690| 0.15188| 0.13368|
| 4                                             | 0.12280| 0.14846| 0.12954|
| 5                                             | 0.11838| 0.14644| 0.12806|
| 6                                             | 0.10288| 0.14154| 0.12128|
| 7                                             | 0.03668| 0.08320| 0.07316|
| 8                                             | 0.03758| 0.08120| 0.07480|
| 9                                             | 0.03792| 0.08148| 0.07478|
| 10                                            | 0.10384| 0.13658| 0.13012|
| 11                                            | 0.07202| 0.10644| 0.10064|
| 12                                            | 0.21024| 0.23466| 0.23092|
| 13                                            | 0.07926| 0.11810| 0.11154|
| 14                                            | 0.04368| 0.08760| 0.08190|
| 15                                            | 0.03176| 0.07586| 0.07074|
| 16                                            | 0.04886| 0.12374| 0.10074|
| 17                                            | 0.12366| 0.15244| 0.13424|
| 18                                            | 0.12598| 0.15170| 0.13368|
| 19                                            | 0.12630| 0.15016| 0.13328|
| 20                                            | 0.13028| 0.15416| 0.13768|

Source: Data Processing Using Software Microsoft Excel

After getting the reflectance value of each of the satellite image waves, namely band 2 (blue), band 3 (green), and band 4 (red) then analyzed the data using Microsoft Excel software. The data used for data analysis are 15 data (point 1 to point 15) and the last 5 data (points 16 to 20) are used for data validation. The reflectance value is the parameter for the X-axis and the in situ salinity value for the Y-axis. The next step is to determine the four algorithm equations, namely Exponential, Linear, Logarithmic, and Power to find the value of the largest degree of determination R².

C. Calculation of Salinity Levels of Satellite Imagery in 2016

From all the equations that have been carried out on the reflectance value of the Landsat 8 image wavelength for Band 2, Band 3, and Band 4 with 4 scatter equations, namely Exponential, Linear, Logarithmic, and Power, the...
The value of the degree of determination $R^2$ has been summarized in Table 3. The following:

Table 4 Recapitulation of Processing Results of Salinity Levels

| Band   | Type       | Model Algoritma                                      | Determination |
|--------|------------|-----------------------------------------------------|---------------|
| Band_2 | Logarithmic| $y = 0.6095\ln(x) + 29.901$                          | $R^2 = 0.1881$|
| Band_2 | Linear     | $y = 5.6073x + 27.836$                              | $R^2 = 0.1117$|
| Band_2 | Exponential| $y = 27.836e^{0.1955x}$                            | $R^2 = 0.1096$|
| Band_2 | Power      | $y = 29.917x^{0.0213}$                              | $R^2 = 0.1856$|
| Band_3 | Logarithmic| $y = 0.986\ln(x) + 30.439$                         | $R^2 = 0.1489$|
| Band_3 | Linear     | $y = 5.6754x + 27.633$                              | $R^2 = 0.0831$|
| Band_3 | Exponential| $y = 27.639e^{0.1977x}$                            | $R^2 = 0.0815$|
| Band_3 | Power      | $y = 30.484x^{0.0345}$                              | $R^2 = 0.1469$|
| Band_4 | Logarithmic| $y = 0.7477\ln(x) + 30.006$                         | $R^2 = 0.0855$|
| Band_4 | Linear     | $y = 3.4967x + 27.949$                              | $R^2 = 0.029$ |
| Band_4 | Exponential| $y = 27.948e^{0.1208x}$                            | $R^2 = 0.028$ |
| Band_4 | Power      | $y = 30.02x^{0.026}$                                | $R^2 = 0.0838$|

Source: Data Processing Using Software Microsoft Excel

The thematic map of Salinity Levels in 2016 is dominated by blue, which indicates that the Salinity Level value in that year is quite low. The distribution of salinity is influenced by several factors, namely evaporation, rainfall, river flows, and ocean currents.

In the 2016 salinity level mapping, the lowest salinity value was 27.33 ppm while the highest salinity level was 29.81 ppm. These parameters are obtained from the results of data processing from Landsat 8 satellite imagery with the algorithm equation value $y = 25.437x - 0.046$ and the determination value $R^2 = 0.5825$. The mapping of salinity levels is expected to provide information about salinity levels in Lamong Bay, Surabaya for marine utilization, port maintenance, and coastal building planning.

E. Calculation of Image Salinity Levels in 2020

From all the equations that have been carried out on the reflectance value of the Landsat 8 image wavelength for Band 2, Band 3, and Band 4 with 4 scatter equations, namely Exponential, Linear, Logarithmic, and Power, the value of the degree of determination $R^2$ has been summarized in Table 4. The following:

Table 5 Recapitulation of Processing Results of Salinity Levels in 2020

| Band   | Type       | Model Algoritma                                      | Determination |
|--------|------------|-----------------------------------------------------|---------------|
| Band_2 | Logarithmic| $y = -0.115\ln(x) + 27.957$                         | $R^2 = 0.0225$|
| Band_2 | Linear     | $y = -5.8038x + 28.667$                             | $R^2 = 0.1965$|
| Band_2 | Exponential| $y = 28.659e^{-0.206x}$                            | $R^2 = 0.2004$|
| Band_2 | Power      | $y = 27.945x^{-0.004}$                               | $R^2 = 0.0231$|
| Band_3 | Logarithmic| $y = -1.4ln(x) + 25.218$                            | $R^2 = 0.5193$|
| Band_3 | Linear     | $y = -9.2415x + 29.441$                             | $R^2 = 0.4614$|
| Band_3 | Exponential| $y = 29.455e^{-0.327x}$                             | $R^2 = 0.4677$|
The results of the data recapitulation in table 4.6 show that the wavelength that has the largest value of determination $R^2$ is the Band_4 wavelength (red color) with the Power algorithm model equation obtained by the algorithm model $y = 25.437x - 0.046$ with the value of the degree of determination $R^2 = 0.5825$.

| Band | Power | $y = 25.366x^{-0.05}$ | $R^2 = 0.5253$ |
|------|-------|------------------------|----------------|
| Band_4 | Logarithmic | $y = -1.289\ln(x) + 25.293$ | $R^2 = 0.5774$ |
| Band_4 | Linear | $y = -9.7664x + 29.385$ | $R^2 = 0.5004$ |
| Band_4 | Exponential | $y = 29.395e^{-0.346x}$ | $R^2 = 0.5063$ |
| Band_4 | Power | $y = 25.437x - 0.046$ | $R^2 = 0.5825$ |

Source: Data Processing Using Software Microsoft Excel

The T-test test uses one left side, which is presented in table 4.9 the data shows that $T$ is smaller than $T$ critical with a value of $-0.17768 < -1.76131$ so that $H_0$ is accepted, meaning that there is no difference between the Salinity Level (ppm) in situ and the Salinity Level (ppm) satellite imagery.

G. Thematic map of salinity levels in 2020

![Thematic map of Salinity Levels in 2016](Source: SeaDAS)

The thematic map of 2020 Salinity Levels is predominantly blue, which indicates that the Salinity Level value in that year is quite low. The conclusion from the mapping image above is that the redder the color on the map, the higher the salinity level value, and the blue the map color, the lower the salinity level value. The distribution of salinity is influenced by several factors, namely evaporation, rainfall, river flows, and ocean currents. The mapping of Salinity Levels in 2020 is covered in clouds, meaning that the Salinity Level values listed here have been refracted due to cloud factors, humidity, absorption so they cannot be reflected.

In the 2020 salinity level mapping, the lowest salinity value was 27.4 ppm while the highest temperature was 29.9 ppm. These parameters are obtained from the results of data processing from Landsat 8 satellite imagery with the algorithm equation value $y = 25.437x - 0.046$ and the determination value $R^2 = 0.5825$. The mapping of salinity levels is expected to provide information about salinity levels in Lamong Bay, Surabaya for marine utilization, port maintenance, and coastal building planning.

H. Processing of Sea Surface Temperature (SPL) Image Landsat 8 in 2016

Landsat 8 satellite image data processing is calculated using algorithmic modeling. Where to get the radian value, you have to choose electromagnetic waves for further processing. The selected wave is band 10 (Thermal). The data is then processed to form a scatter graph which will show the determination value of each equation. The following is the able radian value in Band_10 and the Insitu Sea Surface Temperature.
Table 7 Radian Value and Sea Surface Temperature in Years 2016

| Point | Digital Number | Radian | SPL (Kelvin) |
|-------|----------------|--------|--------------|
| 1     | 35154          | 11.85  | 304.50       |
| 2     | 35166          | 11.85  | 304.60       |
| 3     | 35312          | 11.90  | 304.60       |
| 4     | 35103          | 11.83  | 304.40       |
| 5     | 35127          | 11.84  | 304.10       |
| 6     | 35151          | 11.85  | 304.20       |
| 7     | 34849          | 11.75  | 304.20       |
| 8     | 34692          | 11.69  | 304.20       |
| 9     | 34574          | 11.65  | 304.20       |
| 10    | 33957          | 11.45  | 304.30       |
| 11    | 34413          | 11.60  | 304.20       |
| 12    | 33962          | 11.45  | 304.00       |
| 13    | 34211          | 11.53  | 303.90       |
| 14    | 34553          | 11.65  | 303.70       |
| 15    | 35073          | 11.82  | 303.80       |
| 16    | 35267          | 11.89  | 304.00       |
| 17    | 35546          | 11.98  | 303.80       |
| 18    | 35707          | 12.03  | 303.90       |
| 19    | 35779          | 12.06  | 303.70       |
| 20    | 35606          | 12.00  | 303.80       |

Source: Data Processing Using Software Microsoft Excel

The equality data of Radian values and Sea Surface Temperature imagery in 2016 are then processed to form a scatter graph which will later show the determination value of each equation. The parameter on the Y-axis is the Insitu Sea Surface Temperature and the X-axis is the radiant value data.

I. Calculation of Image Sea Surface Temperature in Year 2016

All the equations that have been carried out on the reflectance value of the Landsat 8 image wavelength on band_10 with the scatter equation namely Exponential, Linear, Logarithmic, and Power, then the value of the degree of determination R² has been summarized in table 7 below:

Table 8 Recapitulation of sea surface temperature data

| No. | Type       | Model Algoritma | Determinasi |
|-----|------------|-----------------|-------------|
| 1   | Exponential| $y = 295.27e^{0.0025x}$ | $R^2 = 0.1932$ |
| 2   | Linear     | $y = 0.7734x + 295.13$ | $R^2 = 0.1933$ |
| 3   | Logarithmic| $y = 8.9857ln(x) + 282.08$ | $R^2 = 0.1915$ |
| 4   | Power      | $y = 282.87x^{0.0295}$ | $R^2 = 0.1914$ |

Source: Data Processing Using Software Microsoft Excel

The results of the data recapitulation in table 7 note that the wavelength that has the largest value of determination R² is the wavelength with the type of Linear equation obtained is SPL = 0.7734x + 295.13 with a value of $R^2 = 0.1933$. The largest comparison of the Determination value between 2016 and 2020 is in 2020 with the value of $R^2 = 0.4182$ in the Power equation, so what is used to calculate the value of the Image Sea Surface Temperature in 2016 is using the determination value in 2020.

J. Thematic map of sea surface temperature in 2016

Figure 9 Thematic map of sea surface temperature 2016 (Source: SeaDAS)

The thematic map of Sea Surface Temperature in 2016 is dominated by red and yellow, which indicates that the sea surface temperature in that year is normal. The conclusion from the mapping image above is that the redder the color on the map, the higher the sea surface temperature, and the blue the map color, the lower the sea surface temperature. Air and sea conditions have a very close interaction, any change in weather will affect sea conditions.

In the 2016 Sea Surface Temperature mapping, the lowest temperature was 304.26 Kelvin, while the highest temperature was 304.30 Kelvin. These parameters are obtained from the results of data processing from Landsat 8 satellite imagery on the Power equation type with the SPL algorithm equation value = 302.14x0.0029 and the determination value $R^2 = 0.4182$. This sea surface temperature mapping is expected to provide information about sea surface temperature in Lamong Bay, Surabaya for use in the marine sector and coastal buildings.

K. Processing of Sea Surface Temperature (SPL) Image Landsat 8 in 2020

Table 9 Data Sea Surface Temperature in 2016

| Point | Point | Point | Point |
|-------|-------|-------|-------|
| 1     | 31480 | 10.62 | 304.50 |
| 2     | 39807 | 13.40 | 304.60 |
| 3     | 36990 | 12.46 | 304.60 |
| 4     | 33918 | 11.44 | 304.40 |
| 5     | 36694 | 12.36 | 304.10 |
The equality data for the Radian value and Insitu Sea Surface Temperature in 2020 are then processed to form a scatter graph which will later show the determination value of each equation. The parameter on the Y-axis is the Insitu Sea Surface Temperature and the X-axis is the radian value data.

L. Calculation of Image Sea Surface Temperature in Year 2020

All the equations that have been carried out on the reflectance value of the Landsat 8 wavelength on band_10 with the scatter equation, namely Exponential, Linear, Logarithmic, and Power, the value of the degree of determination R² has been obtained which is summarized in table 9 below:

Table 10 Recapitulation of sea surface temperature data

| No. | Type    | Model Algorithm                      | Determinasi |
|-----|---------|--------------------------------------|-------------|
| 1   | Exponential | y = 303.31e^{0.0003x} | R² = 0.4029 |
| 2   | Linear   | y = 0.0827x + 303.3 | R² = 0.4028 |
| 3   | Logarithmic | y = 0.873ln(x) + 302.14 | R² = 0.4181 |
| 4   | Power    | y = 302.14x^{0.0029} | R² = 0.4182 |

Source: Data Processing Using Software Microsoft Excel

The results of the data recapitulation in table 9 can be seen that the wavelength that has the largest value of determination R² is the wavelength with the equation of the Power algorithm model obtained by the algorithm model y = 302.14x^{0.0029} with the value of the degree of determination R² = 0.4182.

M. T - Test

After obtaining image data in 2020, then the T-test is carried out to test how the influence of the independent variable, namely the Sea Surface Salinity (Kelvin) based on Landsat 8 satellite imagery. T-Test analysis for 2020:

Table 11 Analysis of T – Test

| TKelvin | SPL INSITU |
|---------|------------|
| Mean    | 307.1406   | 304.193333 |
| Variance| 190.8786428 | 0.072095238 |
| Observations | 15 | 15 |
| Pearson Correlation | 0.641630323 |
| Hypothesized Mean Difference | 0 |
| df | 14 |
| t Stat | 0.836539659 |
| P(T<=t) one-tail | 0.208451054 |
| t Critical one-tail | 1.761310136 |
| P(T<=t) two-tail | 0.416902109 |
| t Critical two-tail | 2.144786688 |

Source: Data Processing Using Software Microsoft Excel

The results of the T-Test analysis in Table 10 show that there are two criteria for the results, namely the first is that H0 is accepted if T is <Tritical, which means that there is no significant difference between the two data. H1 is accepted if T count > T critical, which means that there is a difference between the two data.

The data shows that the T count is smaller than the T critical with a value of 0.836539659 < 1.761310136 so that H0 is accepted, meaning that there is no difference between the sea surface temperature (SPL) in situ and the sea surface temperature (SPL) of satellite imagery.

N. Thematic map of sea surface temperature in 2016

The thematic map of the 2020 Sea Surface Temperature is predominantly solid red which indicates...
that the sea surface temperature in that year is quite high. The conclusion from the mapping image above is that the redder the color on the map the higher the Sea Surface Temperature value and the blue the map color the lower the Sea Surface Temperature value. The distribution of sea surface temperature values can be influenced by factors of rainfall, evaporation, wind speed, the location of the rise in seawater mass (up-welling), and the intensity of sunlight. Sea Surface Temperature in 2020 is partially covered by clouds, meaning that the Sea Surface Temperature values listed here have experienced refraction due to cloud factors, humidity, absorption so that they cannot be reflected.

In the mapping of Sea Surface Temperature in 2020, the lowest temperature is 303.95 Kelvin while the highest temperature is 304.39 Kelvin. These parameters are obtained from the results of data processing from Landsat 8 satellite imagery on the Power equation type with the SPL algorithm equation value \(= 302.14x^{0.0029}\) and the determination value \(R^2 = 0.4182\).

The empirical algorithmic modeling of sea surface temperature, in 2020 has the best value in the band_10 type equation of the Power algorithm model obtained by the algorithm model \(y = 302.14x^{0.0029}\) with a value of the degree of determination \(R^2 = 0.5825\). The empirical algorithmic modeling of sea surface temperature in 2016 has the best value at wavelength band_2 (blue) with the logarithmic algorithm model equation obtained \(y = 0.6095\ln(x) + 29.901\) with a value of \(R^2 = 0.1881\), while for 2020 it has a value the best at the Band_4 wavelength (red color) with the Power algorithm model equation obtained by the algorithm model \(y = 25.437x - 0.046\) with a value of the degree of determination \(R^2 = 0.1933\).

1. The salinity level empirical algorithm modeling, in 2016 has the best value at wavelength band_2 (blue) with the Logarithmic algorithm model equation obtained \(y = 0.6095\ln(x) + 29.901\) with a value of \(R^2 = 0.1881\), while for 2020 it has the best at the Band_4 wavelength (red color) with the Power algorithm model equation obtained by the algorithm model \(y = 25.437x - 0.046\) with a value of the degree of determination \(R^2 = 0.5825\).

CONCLUSION

3. The thematic maps of salinity levels and sea surface temperature in Lamong Bay are presented in Chapter IV along with an explanation of the images. The thematic map of salinity levels in 2016 is dominated by red, which indicates that the distribution of salinity values in the same month is quite high, while the 2020 thematic map has red, blue, and green gradations which indicate that the distribution of salinity values in that year has decreased. So that the special action or research is needed to find the cause of the decrease in salinity value in 2020. It can be concluded that the redder the mapping color, the higher the salinity value.

The thematic map of sea surface temperature in 2016 is dominated by red, which means that that year the sea surface temperature is hot, while in 2020 the sea surface temperature is dominated by dark blue. It can be concluded that the sea surface temperature from 2016 to 2020 has decreased significantly. One of the factors in the decline in sea surface temperature is that the rainfall in 2020 is quite high compared to 2016.

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