1st International Conference Eco-Innovation in Science, Engineering, and Technology
Volume 2020
http://dx.doi.org/10.11594/nstp.2020.0519

NST PROCEEDINGS

OPEN ACCESS

Conference Paper

Analysis and Mapping of Changes in Salinity Concentration Influence by Acidity Value in Kwanyar Coastal, Bangkalan Madura District

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ABSTRACT

Kwanyar in Bangkalan Madura district is an area that is not very fertile, the soil contains limestone and the coastal areas of the coast are the result of reclamation for several years. Thus, what used to be water areas turn into land. The purpose of this research is to map and analyze the effect of changes in acidity values on the coast with changes in salinity values that accompany them so that the most suitable mathematical model can be found to describe the coastal conditions of the Kwanyar area. The method developed to map and analyze is the use of remote sensing technology using Terra MODIS satellite imagery with a pixel resolution of 1 kilometer. The results obtained from a series of measurements carried out are that the most suitable wavelength for salinity mapping is 667 nanometers with an exponential mathematical model. This study concludes that the value of acidity in the aquatic environment is statistically sufficient to influence changes in the concentration of salinity in the Kwanyar area, Bangkalan Madura district.

Keywords: Salinity, acidity, remote sensing, terra MODIS, Kwanyar Bangkalan

Introduction

Salinity is one of the parameters that are widely used to measure the health level of an aquatic environment. Where if an environment has low salinity that will disturb the fish living in the water and make them migrate to other places. As in high salinity aquatic environment, in which the water contains a high level of salt, there are no living things that can grow in that kind of waters. Salinity itself has been widely studied by scientists around the world (Baldwin *et al.*, 2019; Souza *et al.*, 2018; Su *et al.*, 2019), where various methods have been developed. Along with the development of information technology and remote sensing, thus global mapping of the distribution of the salinity concentration could be developed and studied in more detail, specifically about their correlation with other parameters and their effects on a wider area.

Several parameters affect the salinity level of waters; one of them is the value of water acidity, where several studies conducted to mention that water acidity value has a close relationship with salinity concentration. The relationship between acidity and salinity is directly proportional, where if acidity concentration is high then the salinity level will also high.

The purpose of this research is to analyze and map the distribution of salinity level and its correlation with the increase in acidity value on the coast of Kwanyar Madura. Many researchers have done a study about the distribution of salinity, as well as study about the acidity value of seawater (Castellanos *et al.*, 2019; Emiyati, Manoppo, & Budhiman, 2017; Wibisana, Zainab, & Dara, 2018), however, there is still limited research which studied the salinity that includes other factors such as sea surface temperature or acidity.

How to cite:
Zainab, S., Handajani, N., & Wibisana, H. (2020). Analysis and mapping of changes in salinity concentration influence by acidity value in Kwanyar coastal, Bangkalan Madura District. *1st International Conference Eco-Innovation in Science, Engineering, and Technology*. NST Proceedings. pages 127-132. doi: 10.11594/ nstp.2020.0519

Research Method

Satellite image data

The satellite image data used in this study is Terra MODIS image data taken from the page of https://oceancolor.glfc.nasa.gov/ with file name T2020239024000.L2_LAC_OC.nc. The data is Level 2 image data, which was downloaded for August 2020 as seen in Figure 1.

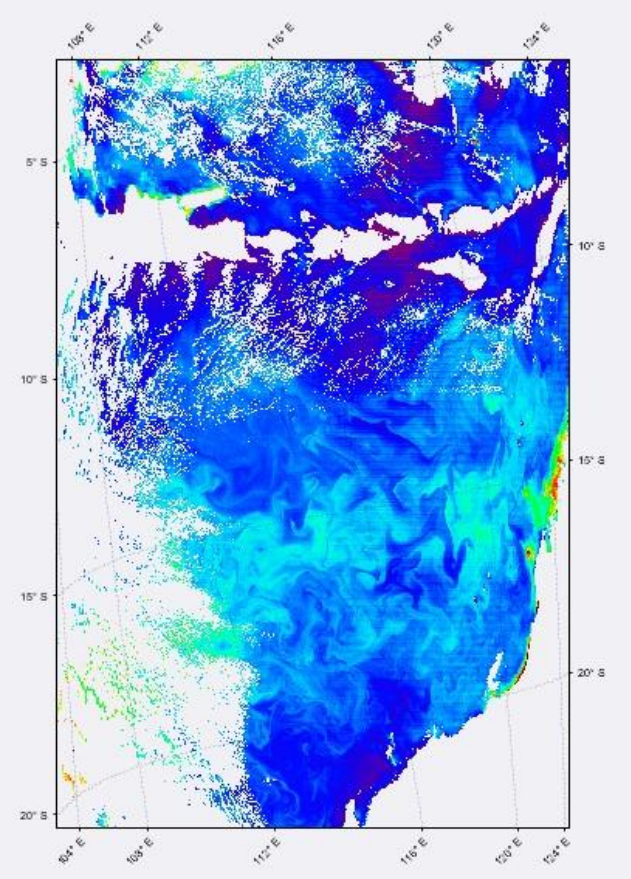

Figure 1. Scene of Terra MODIS Satellite Images, August 2020

Salinity calculation

To obtain salinity data, the data collection was carried out directly in the field, using a fisherman boat. A plastic bottle with a volume of approximately 1 liter was prepared. In the field, the seawater from the depth of 20-3- cm from sea level was taken. Then the water was tested for the existing salinity levels. The calculation was made at the predetermined coordinates with the help of GPS navigation from an existing application device and stored on the mobile phone. The salinity data obtained from the field was recorded for later calculation of algorithm with a selected mathematical model that is linear, exponential, logarithmic, and power.

Acidity measurement (pH)

To obtain the acidity value, thus the seawater that has been taken from the field was measured directly by dipping a digital pH meter device with an accuracy of 0.1 to the seawater and the reading of the numbers could be done directly at that time. The recording result of salinity value and pH is given in Table 1 below, including the corresponding coordinates records.

Table 1. Salinity and pH data with field coordinate

Point	Lon	Lat	Salinity (o/oo)	pH
1	112.9003	-7.2396	30.9	6.4
2	112.9120	-7.2396	32.6	6.6
3	112.9237	-7.2395	34.1	6.4
4	112.9354	-7.2511	32.3	6.2
5	112.9471	-7.2511	34.2	6.4
6	112.9589	-7.2627	33.7	6.5
7	112.9706	-7.2743	28.7	6.8
8	112.9823	-7.2743	26.9	7.2
9	112.9940	-7.2859	25.3	6.6
10	113.0174	-7.2741	26.6	7.1
11	113.0174	-7.2858	25.7	7
12	113.0058	-7.2975	24.5	7.1
13	112.9824	-7.2976	25.1	7.2
14	112.9707	-7.2977	27.3	7.1
15	112.9590	-7.2861	28.2	6.9
16	112.9473	-7.2861	28.5	7.3
17	112.9355	-7.2745	30.6	7
18	112.9238	-7.2629	28.8	7.1
19	112.9121	-7.2629	29.4	7.1
20	112.8887	-7.2630	33.7	6.8

Source: taken from field measurement

Results and Discussion

The data obtained in Table 1 is then processed into the calculation of the remote sensing algorithm. The calculation is involving linear, exponential, and logarithmic, and power mathematical models. For the results of data processing with a Scatter diagram at a wavelength of 412 nanometers, it is obtained that the value which has the highest correlation is in the exponential model with an R^2 value of 0,8464 as seen in Table 2.

Table 2. The model mathematic calculation at 412-nanometer wavelength

No	Algorithm	Mathematical model	R^2
1	Linear	Sal = 896.31x + 13.719	0.8315
2	**Exponent**	**Sal = 17,022e^{30,848x}**	**0.8464**
3	Logarithmic	Sal = 13.939ln(x) + 86.078	0.7843
4	Power	Sal = 206.35x$^{0.4809}$	0.8021

Source: algorithm calculation

Table 3. The model mathematic calculation at 667-nanometer wavelength

No	Algorithm	Mathematical model	R^2
1	Linear	pH = -72.779(Rrs_667) + 8.0134	0.5919
2	**Exponent**	**pH = 8.1338e$^{-10,81(Rrs_667)}$**	**0.5928**
3	Logarithmic	pH = -1.122ln(RRs_667) + 2.1796	0.5483
4	Power	pH = 3.4192(Rrs_667)$^{-0.167}$	0.549

Source: algorithm calculation

For the measurement of the acidity value or pH, it can be seen that the highest correlation value is obtained in the exponential mathematical model, as can be seen in Table 3, where this model has an R^2 value of 0,5928. It means that there is data conformity with the model; the suitability of the data with the model is 59,28%, while the measurement of Salinity and its correlation with pH are shown in Table 4. In this table, it can be seen that the linear mathematical model has a better correlation among other models, thus later this linear model will be used to create a thematic map of the Salinity distribution (with the influence of pH / influenced by pH) on the Kwanyar Madura coastal area.

Table 4. The model mathematic calculation at 667-nanometer wavelength

No	Algorithm	Mathematical model	R^2
1	Linear	Sal = -8.3265(pH) + 85.283	0.6823
2	Exponent	Sal = $195.78e^{-0.283(pH)}$	0.678
3	Logarithmic	Sal = -56.14ln(pH) + 136.22	0.6816
4	Power	Sal = $1108.2(pH)^{-1,911}$	0.6791

Source: algorithm calculation

The thematic map for salinity to the best reflectance value is shown in Figure 4, which is at a wavelength of 667 nanometers, while the thematic map for acidity (pH) to the best reflectance value is shown in Figure 5, which is also at a wavelength of 667 nanometers.

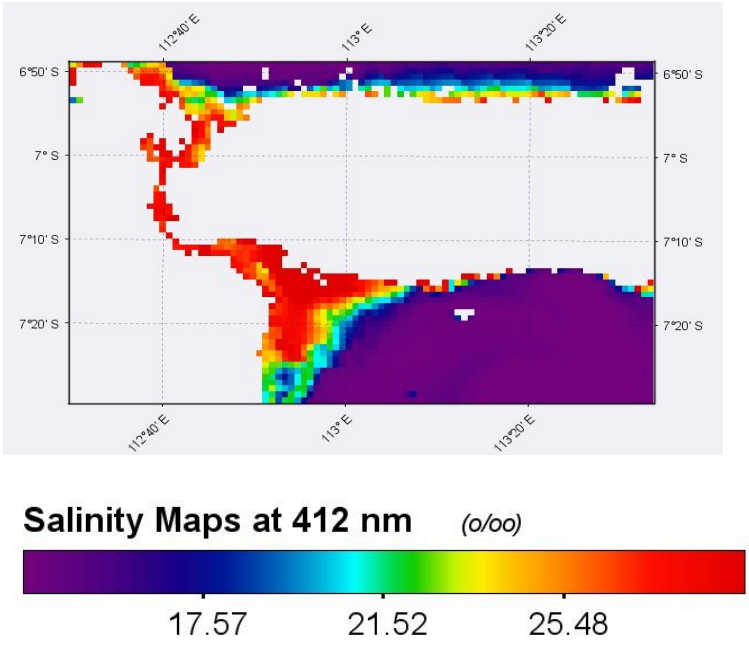

Figure 2. Salinity map of Kwanyar area with exponent algorithm on 412 nm wavelength

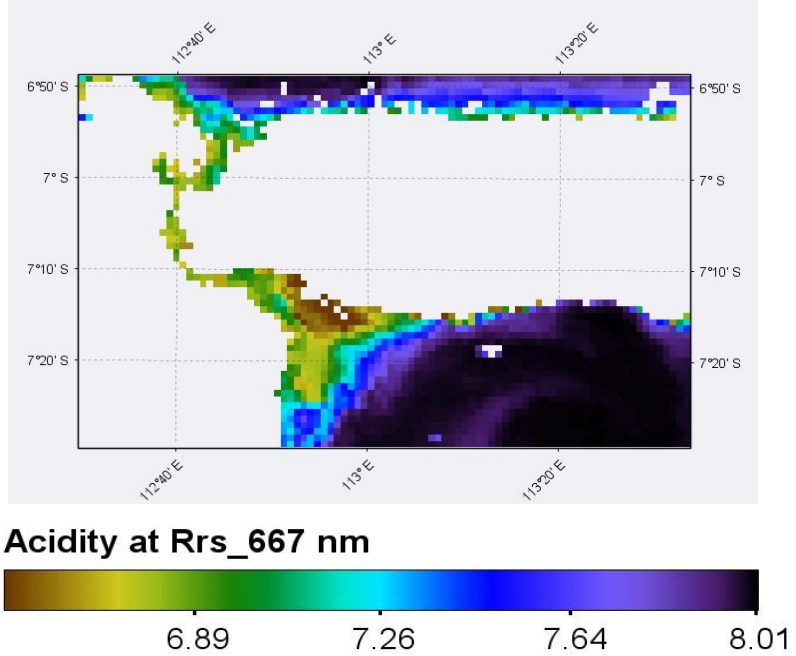

Figure 3. Acidity map of Kwanyar area with exponent algorithm on 667 nm wavelength

Figure 4 shows a thematic map for the best Salinity to Acidity / PH with the linear algorithm Sal = -8.3265 (pH) + 85.283 with R2 = 0.6823.

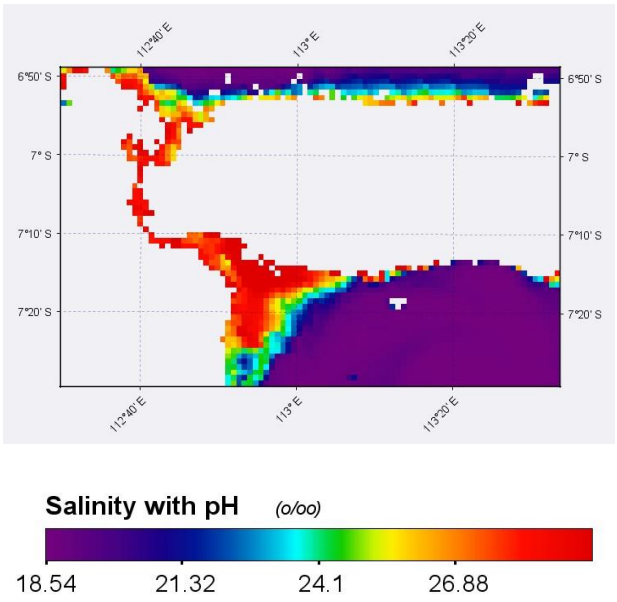

Figure 4. Salinity with Acidity /PH map of Kwanyar area with a linear algorithm

Conclusion

Terra MODIS satellite imagery can be used to analyze the salinity and acidity of coastal areas, even though it has a very wide coverage, yet it still can provide a good reflectance to the study area. Besides that, the distribution of salinity that occurs has an inverse relationship with acidity. This is shown by that the best mathematical model is linear Sal = -8,3265 (pH) + 85,283 with R^2

= 0,6823, where the value of the parameter coefficient is negative, so that the greater the pH value, the smaller the salinity value.

Acknowledgment

We would like to thank the LPPM UPN Veteran Jawa Timur who have to provide founding through skim advanced basic research, Batch SK Rector Number: SKEP/103/LPPM/2020 so that this research can be completed properly and contribute useful results, also we would like to thank the students who help the team as surveyors in the field.

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