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The Distribution of Chlorophyll in West Kalimantan Coastal Using VIIRS-SNPP Satellite Data

M Usman[1], N F Yunita[2], D Merdekawati[3,] R H Nur [4]

[1]*(Informatics Management, State Polytechnic of Sambas, 79462, Sambas, Indonesia)*
[2]*(Marine and Fisheries Agribusiness, State Polytechnic of Sambas, 79462, Sambas, Indonesia)*
[3] *(Marine and Fisheries Agribusiness, State Polytechnic of Sambas, 79462, Sambas, Indonesia)*
[4]*(BPS Sambas Regency- Statistics of Sambas Regency, 79462, Sambas, Indonesia)*

Abstract:
Background:West Kalimantan is one of provinces in Indonesia which has waters which are often exposed to environmental impacts due to human activities. Photosynthesis is produced from phytoplankton organism which have chlorophyll pigment. One of the water parameters is chlorophyll. The concentration of chlorophyll can describe the high primary productivity of a waters because it is related to the abundance of phytoplankton. Phytoplankton act as primary producers.One way to observe the concentration and distribution of chlorophyll is to use remote sensing technology. Remote sensing technology allows the coverage of the observation area to be wider, making it easier to map the distribution of chlorophyll in waters..
Materials and Methods: This study used level-3 chlorophyll image data with the Standard Mapped Image (SMI) type from the Visible and Infrared Imaging Radiometer Suite-Suomi National Polar-Orbiting Partnership (VIIRS-SNPP) sensor which can be accessed on the website https://oceancolor.gsfc.nasa.gov/l3/. The resampling implementation in this study used the Nearest Neighbor Method.
Results: Overall, the chlorophyll concentration in West Kalimantan Province was in the range of 0.45-20 mg/m3. The change of seasons and hydrological conditions of the waters, namely the influence of the river was the cause of the high concentration of chlorophyll in the area.
Conclusion: The concentration of chlorophyll in the coastal areas of Kalimantan showed the highest concentration value. The high concentration was more dominantly influenced by the input from the river which participated in carrying the nutrients needed by organisms.
Key Word:VIIRS-SNPP, Chlorophyll, Distribution, Concentration

I. INTRODUCTION

Coastal areas are very important areas in the provision of goods and services. The coastal area will become a very important area and its condition will be greatly influenced by activities on land[1], such as mining, agriculture, deforestation, and others[2]. Coastal areas are intertidal, subtidal, and are in the exposure area with a depth of 200 m directly with the mainland. The condition of this area is always inundated by sea water. Furthermore,West Kalimantan is one of the provinces in the Indonesia which has waters which are often exposed to environmental impacts due to human activities.

Photosynthesis produced from phytoplankton organisms which have chlorophyll pigment. One of the water parameters is chlorophyll. The concentration of chlorophyll can describe the high primary productivity of waters because it is related to the abundance of phytoplankton. Phytoplankton act as primary producers[3, 4]. In addition, chlorophyll concentration is also one of the most frequently used parameters as an indicator of water fertility [3, 6]. The main focus on changes in chlorophyll over a long period of time is the hydrological and biological characteristics of an aquatic environment, which means that waters are different from one another[7]. In addition, non-seasonal maximum chlorophyll values can also be found in coastal areas which are the result of the association of upwelling in these waters, the availability of nutrients from river run-off and geostrophic circulation[8]. And in coastal areas, the distribution of chlorophyll is very important to understand environmental conditions[9].

One way to observe the concentration and distribution of chlorophyll is to use remote sensing technology. Remote sensing technology allows the coverage of the observation area to be wide, making it easier to map the distribution of chlorophyll in a waters[10].

II. MATERIAL AND METHODS

The purpose of this study is to observe the distribution of chlorophyll concentration on the coast of West Kalimantan for the last 5 years, 2016 – 2020 where the observations were carried out on monthly data and annual data for the province of West Kalimantan.

Study Design: This study used level-3 chlorophyll image data with the Standard Mapped Image (SMI) type from the Visible and Infrared Imaging Radiometer Suite-Suomi National Polar-Orbiting Partnership (VIIRS-SNPP) sensor which can be accessed on the website https://oceancolor.gsfc.nasa.gov/l3/.The data used was data that has been refined with a resolution of 4 km. The time span of the processed data is monthly and yearly.

Study Location: The coastal areas arein West Kalimantan Province.

Study Duration: The time span of the processed data is monthly and yearly. The period of data processed is 5 years, namely 2016 – 2020

Procedure methodology

After downloading the data, it was then processed using the SEADAS application to display visualizations related to the distribution of chlorophyll. Where, in the process, data was combined with the aim of getting the average chlorophyll for the last 5 years, both monthly and yearly. After that, the image was cut with the aim which the visualization results were only in the observed area, namely the West Kalimantan area. In the process, a resampling or image transformation process was also carried out by providing a corrected image pixel value.

Statistical analysis

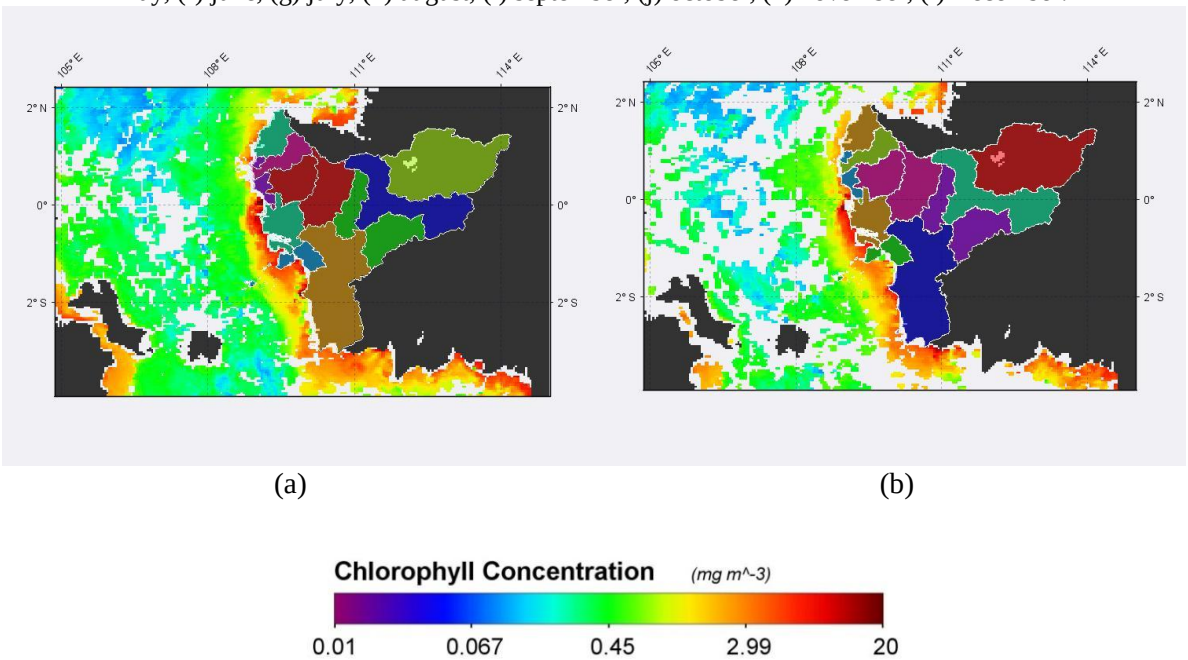
The resampling implementation in this study used the Nearest Neighbor Method. This method is an interpolation algorithm in which the interpolated value given at a point is the same as the input sample point value closest to the interpolated point. The advantage of this method is that the calculation process is quite simple and avoids changing the pixel value.

III. RESULT

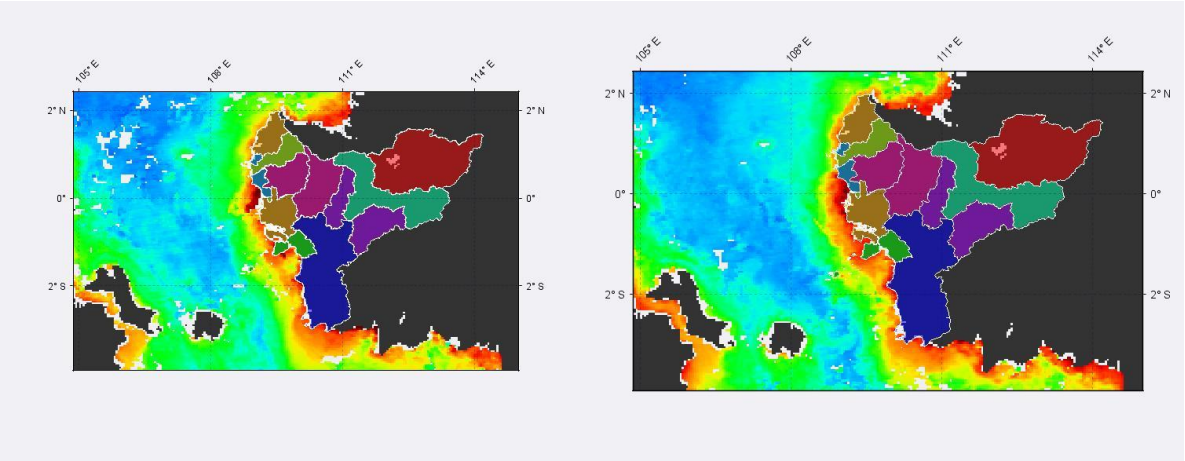
3.1 Distribution of Monthly Average Chlorophyll Concentration for 5 Years

Based on the results of *VIIRS-SNPP* monthly data visualization, the distribution of chlorophyll in West Kalimantan can be seen in Figure 1 below.

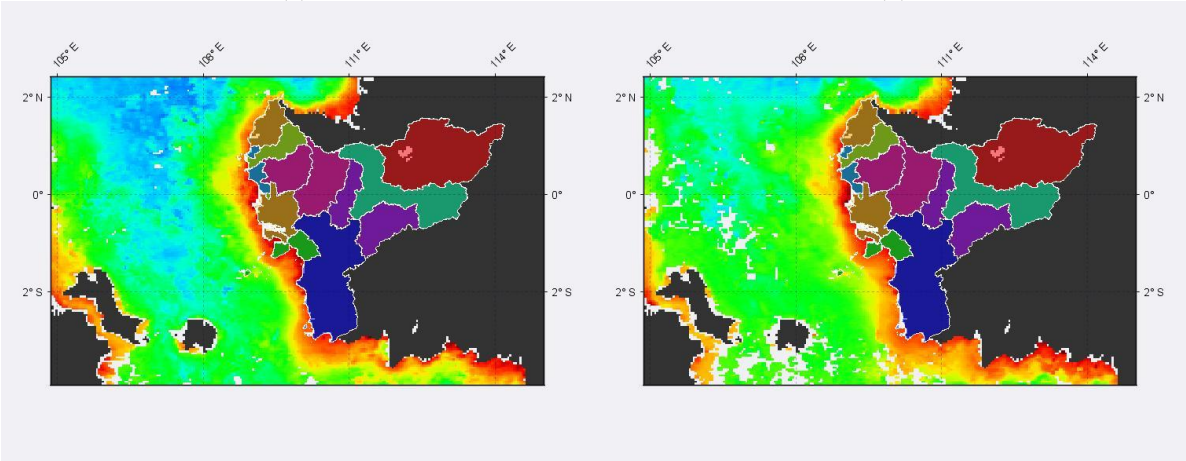
Figure no 1: Monthly chlorophyll distribution 2016–2020 (a) january, (b) february, (c) march, (d) april, (e) may, (f) june, (g) july, (h) august, (i) september, (j) october, (k) november, (l) December.



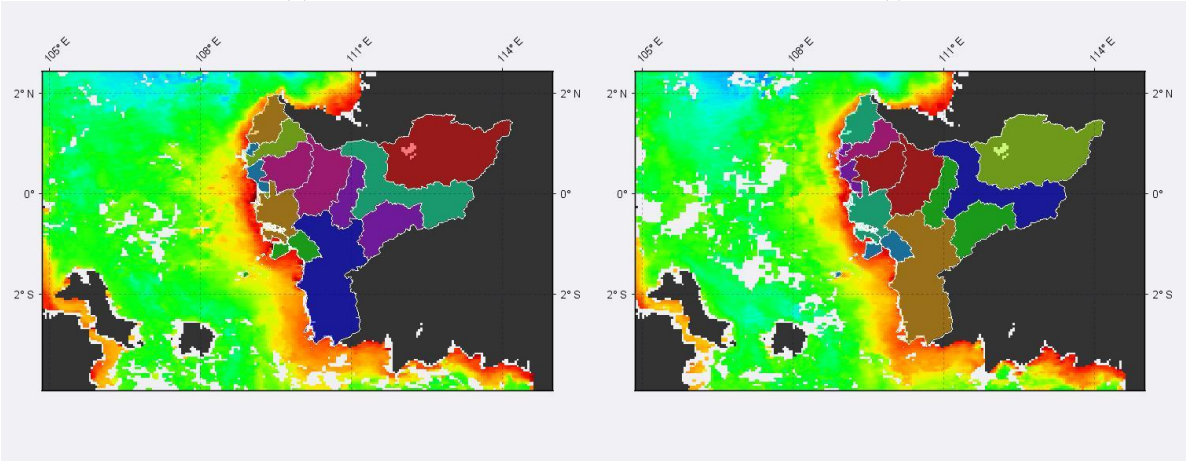
(a) (b)


105° E
108° E
111° E
114° E
2° N
0°
2° S

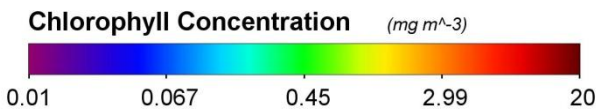
(c) (d)


105° E
108° E
111° E
114° E
2° N
0°
2° S

(e) (f)


105° E
108° E
111° E
114° E
2° N
0°
2° S

(g) (h)


Chlorophyll Concentration
(mg m^-3)
0.01
0.067
0.45
2.99
20

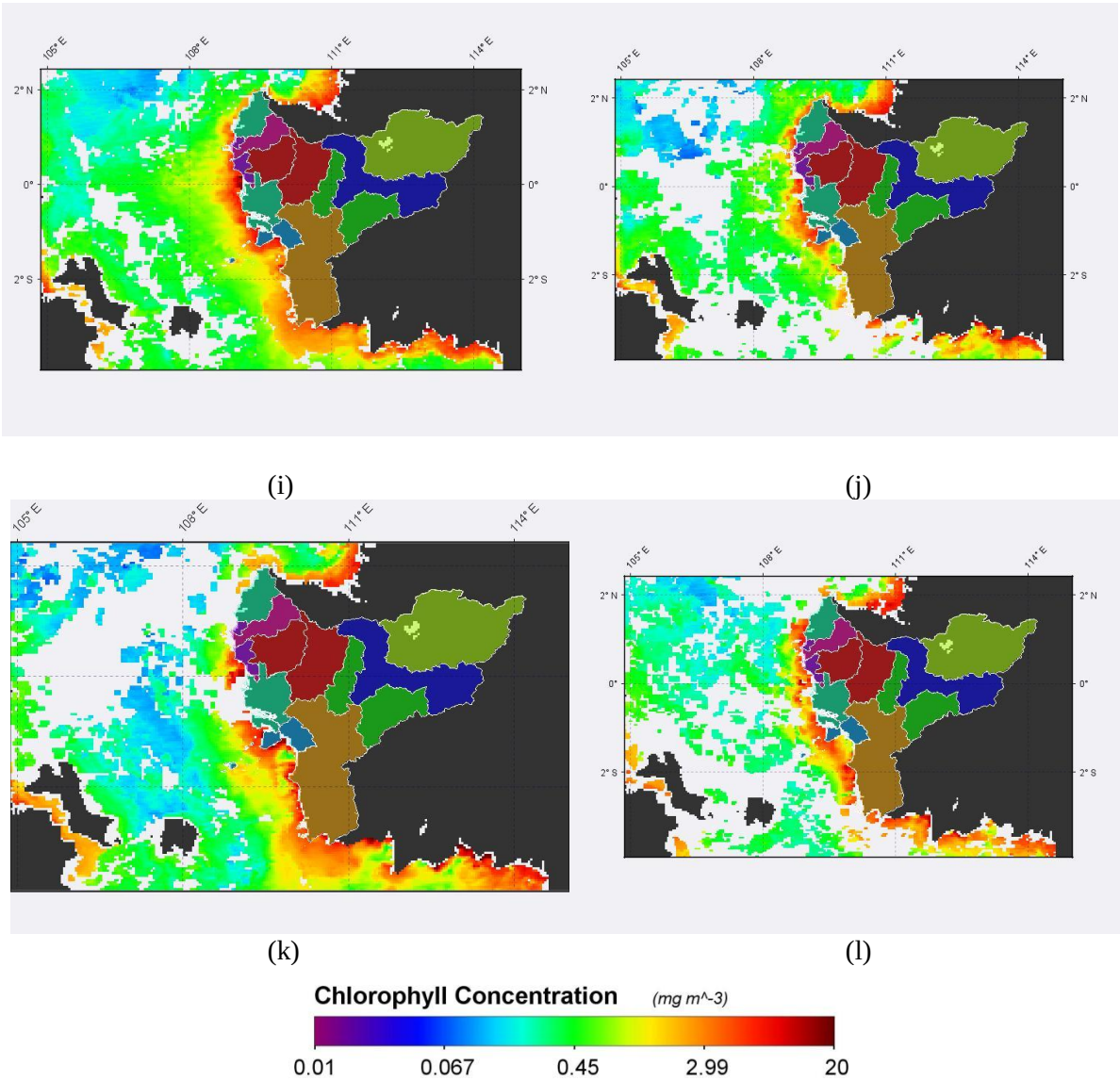


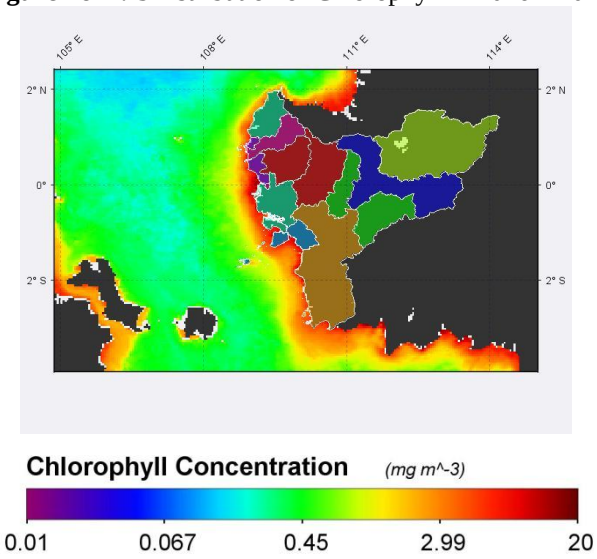
Figure1 shows the distribution and concentration of chlorophyll in the Province of West Kalimantan, and those were different. Overall, the chlorophyll concentration in West Kalimantan Province was in the range of 0.45-20 mg/m3. The change of seasons and hydrological conditions of the waters, namely the influence of the river was the cause of the high concentration of chlorophyll in the area[3, 6, 7, 11, 12]. However, the location factor controlled in determining the distribution pattern of chlorophyll concentration and its distribution area. The chlorophyll concentration showeda high value for each month because it was in the equatorial region (Fig. 1a-11). May to September were months which had a wider concentration of chlorophyll than January, February, March, April, October, November, and December. This happens because the sun irradiation waslonger and the intensity of rain was rare [12, 13]. Furthermore, in the area of West Kalimantan Province which is located from 1° south latitude, the chlorophyll concentration ranges from 0.45 – 20 mg/m3. A high concentration of chlorophyll had a wide distribution area. Changes in the distribution area of chlorophyll were only slight. On the other hand, in the area of West Kalimantan Province which is located at 1° North latitude, the chlorophyll concentration was lower than in the area from 1° South Latitude. was 0.45-7 mg/m3. Current conditions in the waters and the large number of watershedsin this area were the cause of the low chlorophyll membrane in this region.

IV. DISCUSSION

Distribution of Average Chlorophyll Concentration Over 5 Years 2016 – 2020

The average chlorophyll distribution for 5 years is shown in Figure 2 below.

Figure no 2 : SDistribution of Chlorophyll in 2016 – 2020



The figure shows that the average chlorophyll concentration for 5 years ranged from 0.45 – 20 mg/m3. The coastal area had the highest concentration value for all coastal areas in each existing regency. But it was different for each regency depending on the location and the characteristics of the waters[7,14].In West Kalimantan Province, the distribution pattern of chlorophyll in areas which had location coordinates in northern latitudes tends to show a lower concentration distribution than in areaswith southern latitude coordinates.

V. CONCLUSION

The concentration of chlorophyll in the coastal areas of Kalimantan showed the highest concentration value. The high concentration was more dominantly influenced by the input from the river which participates in carrying the nutrients needed by organisms. Regencies which had many watersheds tended to have higher chlorophyll concentrations and higher chlorophyll distribution.

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