eISSN: 2721-5717; pISSN: 2747-2124 https://journal.unhas.ac.id/index.php/zonalaut

ZONA LAUT

JOURNAL OF OCEAN SCIENCE AND TECHNOLOGY INNOVATION

The Use Of Remote Sensing In Mapping The Distribution Of Chlorophyl In Belawan Waters

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Abstract

Chlorophyll-a is one of the important water quality parameters in the sea. This research was conducted in April 2022 in the Belawan Waters of North Sumatra Province with the aim of knowing the level of chlorophyll-a concentration in these waters. The method used is survey and extraction of Aqua MODIS satellite image data into ASCII data and image data using the seaDAS application. The value of chlorifyll-a concentration obtained in Belawan waters is 3.35-5.91 mg / m^3 and has an average value of about 4.65 mg / m^3. Belawan waters in April 2022 experienced high chlorophyll-a concentrations.

Keywords: Chlorophyll, Remote Sensing, Aqua MODIS, Belawan

1. INTRODUCTION

Indonesia is the largest archipelagic country in the world because it has a large sea area and a large number of islands. The length of Indonesia's coast reaches 95,181 km2 with a sea area of 5.4 million km2, dominating Indonesia's total territorial area of 7.1 million km2.2. This potential places Indonesia as a country blessed with large marine resources including the greatest wealth of marine biological and non-biological diversity.

Indonesia's public waters, which cover two-thirds of Indonesia's homeland, have large fisheries biological resource potential and cannot yet be fully managed. Indonesian waters are a busy international shipping area and are located on the equator, which has an important role in the process of climate change, both locally and globally. Regional ocean dynamics and sea surface temperature (SST) are important factors that influence regional climate dynamics and global climate [1].

Belawan waters are open waters that are directly connected to the Deli River. The Deli River is one of the rivers that divides the city of Medan to the north of Medan and empties into the Belawan waters. The Belawan area is an international standard port area which is densely packed with industry and residential areas as well as other public facilities [2]. And Belawan waters also have an international shipping port that directly connects Asia with the Middle East, Europe and Africa.

Chlorophyll is the pigment that gives green color to plants, algae and photosynthetic bacteria. This compound plays a role in the photosynthesis process of plants by absorbing and converting light energy into chemical energy. The main function of chlorophyll is to utilize solar energy, trigger the fixation of C02 into carbohydrates and provide the energetic basis for the ecosystem as a whole. And carbohydrates produced by photosynthesis through the anabolism process are converted into proteins, fats, nucleic acids and other organic molecules. For the process of photosynthesis, plants require chlorophyll, so chlorophyll is generally synthesized in leaves to capture sunlight, the amount of which is different for each species depending on environmental and genetic factors [3]. Chlorophyll-a is also a pigment found in phytoplankton which plays an important role in the photosynthesis process. To determine the level of fertility and quality of a body of

water, it can be assessed from the level of chlorophyll-a concentration in the water. Chlorophyll-a is an important photosynthetic pigment for aquatic organisms. This pigment functions to absorb light energy in the photosynthesis process. Chlorophyll-a absorbs the most light at wavelengths of 430 nm and 663 nm. Apart from chlorophyll-a, phytoplankton also contain chlorophyll-b and chlorophyll-c. However, chlorophyll-a is the type of chlorophyll most commonly found in phytoplankton, so phytoplankton concentrations are often measured in the form of chlorophyll-a concentrations. In marine ecosystems, chlorophyll-a in surface water can be used as an indicator of biological productivity and can be linked to fish production. [4].

Chlorophyll-a is an important pigment that phytoplankton need to carry out the process of photosynthesis. Phytoplankton act as primary producers in the chain of life in the sea, so their existence is very important as the basis of life in the sea. The concentration of chlorophyll in a body of water can describe the magnitude of primary productivity in a body of water. The distribution and level of chlorophyll-a concentration is related to the oceanographic conditions of a body of water. The distribution of chlorophyll-a in the sea varies geographically and based on water depth. The intensity of sunlight, nutrients (especially nitrate, phosphate and silicate), and current are physical and chemical parameters that regulate and influence the distribution of chlorophyll-a in waters. The distribution of chlorophyll-a in the water column is highly dependent on nutrient concentrations. Chlorophyll-a content can be used as a measure of the amount of phytoplankton in a particular body of water and can be used as an indicator of water productivity [5,6]

The development of remote sensing technology in the marine sector has made it possible to observe the distribution of chlorophyll-a and various other oceanographic parameters without having to physically hit or touch objects on the sea surface. The existence of sensors capable of monitoring sea surface chlorophyll-a concentrations has helped in studies of primary water productivity, chlorophyll-a interpretation, chlorophyll-a distribution, sea surface temperature variability, determining fishing areas based on oceanographic parameters, and much more.

Remote sensing technology allows scientists and researchers to obtain data quickly, widely and consistently, which in turn can be used to understand and manage marine ecosystems more effectively. Various tracking and continuous monitoring of the distribution of chlorophyll-a and other oceanographic parameters can also help in monitoring and predicting environmental changes in waters. The distribution of chlorophyll-a content in a body of water can be determined based on direct measurements in the field or through remote sensing data. Many remote sensing satellites can be used to detect chlorophyll-a in waters, including MODIS, SeaWIFS, NOAA satellites, and so on. [7]

This research aims to determine the conditions in the environment around the waters, utilizing remote sensing technology through chlorophyll concentrations.a from Aqua MODIS satellite image data and determine the level of chlorophyll concentrationa in Belawan waters.

2. METHOD

2.1. Research Object

This research is located at the BMKG (Meteorology Climatology Geophysics Agency) maritime Belawan, North Sumatra province.

Figure 1. Location map of BMKG Maritime Belawan, North Sumatra

2.2. Mode of Data Collection

Chlorophyll-a data is available on the official Ocean Color website in Hierarchical Data Format (HDF) format and compressed into bz2 format. And therefore, the SeaDAS application is needed to extract this data so that it can be used in research. Images of the Earth taken from space have high spatial resolution and can be obtained from various objects. Some remote sensing applications require data extraction features to analyze the acquired data. The method used is Aqua MODIS satellite image data extraction of chlorophyll-a concentration. Preprocessing techniques are more concerned with removing error data and unwanted image data elements. Data generated in the preprocessing stage can be used in Geographical Information System (GIS) applications. The distribution of chlorophyll-a concentrations processed from Aqua Modis image data shows the conditions of chlorophyll-a distribution in the field [8]

2.3. Data Processing Method

The tool used in this research is a personal laptop/personal computer (PC) which is equipped with software for processing data. The software used is Microsoft Excel, Google browser, SeaDas, and ArcGis. The data studied was data on the distribution of chlorophyll-a concentrations from the Aqua MODIS satellite. The data used is accumulated data for April 2022. The image data used in this research is 2022 Standard Mapped Image (SMI) level-3 image data. Level-3 data is data that has been refined with the addition of spatial and temporal resampling, Level data -3 is distributed on a global scale and is available in daily, weekly, monthly, seasonal and annual time frames. In the following image, an explanation of the process of carrying out this research is explained.

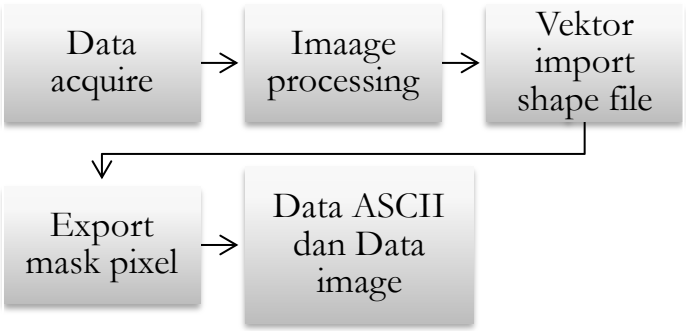

Figure 2. Data extraction using the seadas application

3. RESULT AND DISCUSSION

Field surveys (ground checks) in Belawan waters show that the sea water in the area looks murky and has a brownish color caused by sediment and mud deposits carried from the Deli River to Belawan waters. The results of chlorophyll-a data extraction are displayed in the following table:

Table 1. chlorophyll-a data extraction results

longtitude	latitude	hlorophyll-a concentration (mg/m³)
98.720499	3.833033	5.91
98.760939	3.833033	5.14
98.801379	3.833033	3.29
98.720499	3.7933	5.91
98.760939	3.7933	5.14
98.801379	3.7933	3.35
98.801379	3.753567	3.81
Average		4.65

Based on the results of chlorophyll-a extraction in Belawan waters, the very high chlorophyll-a content in the data collection area is thought to be caused by nutrient input from Belawan port waste and KIM (Medan industrial area) waste into the Deli River which empties into Belwan waters. This shows the important role of river flows in influencing chlorophyll-a concentrations in marine waters. Nutrient input from river flows can increase phytoplankton abundance and chlorophyll-a concentrations, which in turn can affect productivity and marine ecosystems in the area.

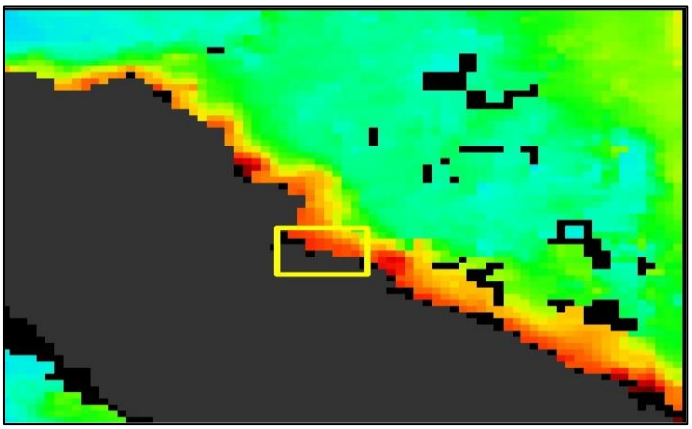

Figure 3. Chlorophyll-a Distribution Map April 2022

The chlorophyll-a concentration value obtained in Belawan waters using the Aqua MODIS satellite which was extracted using the SeaDAS application in April 2022 was 3.35-5.91 mg/m³ and had an average value of around 4.65 mg/m³. Phytoplankton develops well in waters with good water quality, and the level of chlorophyll-a in phytoplankton can indicate the fertility quality of a body of water.

4. CONCLUSION

The research results of the image data taken came from ocean color using Aqua MODIS images and extracted using the seaDAS application to produce ASCII data. It can be concluded that the chlorophyll-a concentration value obtained in Belawan waters was the lowest value 3.35 mg/m³ and the highest value 5.91 mg/m³ and with an average value of 4.65 mg/m³ with this value, Belawan waters in April 2022 experienced high concentrations of chlorophyll-a.
This research still requires field data for data comparisons, so that differences in chlorophyll-a concentration values from Aqua MODIS image data and field data can be obtained accurately.

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