SURAT PENCATATAN

CIPTAAN

Dalam rangka pelindungan ciptaan di bidang ilmu pengetahuan, seni dan sastra berdasarkan Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta, dengan ini menerangkan:

Nomor dan tanggal permohonan	:	EC00202247125, 23 Juli 2022
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Jenis Ciptaan	:	**Karya Tulis Lainnya**
Judul Ciptaan	:	**Analysis Of Shoreline Change In Coastal Area Of Subang West Java Indonesia From 2010 To 2019 Through Satellite Imagery**
Tanggal dan tempat diumumkan untuk pertama kali di wilayah Indonesia atau di luar wilayah Indonesia	:	1 September 2020, di Bandung
Jangka waktu pelindungan	:	Berlaku selama hidup Pencipta dan terus berlangsung selama 70 (tujuh puluh) tahun setelah Pencipta meninggal dunia, terhitung mulai tanggal 1 Januari tahun berikutnya.
Nomor pencatatan	:	000362854

adalah benar berdasarkan keterangan yang diberikan oleh Pemohon.
Surat Pencatatan Hak Cipta atau produk Hak terkait ini sesuai dengan Pasal 72 Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta.

a.n Menteri Hukum dan Hak Asasi Manusia
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Analysis of shoreline changes in the coastal area of Subang Regency West Java Indonesia through satellite imagery

Abstract

The condition of beaches in Indonesia is currently quite concerning. Indonesia's mangroves and coastal sand are in danger of being damaged. Commitment from all parties is needed to overcome coastal damage. If not, the negative impact will be dangerous for the existence of coastal communities. Damage to coastal is a serious threat to the surrounding ecosystem, even tends to harm humans. Not only waste carried by the flow into the sea, but also garbage disposed of around the coastal areas of the sea and poor land management are clearly some actions that can reduce the carrying capacity of the environment. This carriage a serious threat to the environment. The beach in Subang district, West Java has quite severe coastal damage. Analysis of shoreline changes is needed to overcome the damage to the coast. The method used to analyze shoreline changes is through satellite mapping using Google Earth Pro. The results obtained from 10 years of coastline satellite mapping in Subang district are changes in coastline and area that occur due to erosion and/or accretion. These results will help to challenge erosion and/or accretion. The next step can be made a coastal protection in the form of mangrove plants or coastal protection structures.

Introduction

The conditions around the coastal areas in Indonesia are one of the natural phenomena that have an important role and are closely related to nature and human activities. Natural processes, such as wind, waves, earthquakes and tsunamis occur in Indonesia. This natural process can cause damage to coastal areas, such as rising sea levels due to an increase in the volume of sea water which is seen periodically or continuously seen from the phenomenon of tides. The continuous sea level rise identified by global warming can cause the reduction or retreat of the coastline, accelerating the occurrence of coastal erosion, flooding in coastal areas, and damage to infrastructure in coastal areas such as piers and other coastal structures [1]. The second phenomenon is human activity itself which causes coastal erosion, such as clearing new land by cutting down mangrove forests for the benefit of settlements and infrastructure development [2]. One of the mangrove forests around the coast is a natural protection for the coast. This natural phenomenon and human activities indicate that changes in the coastline have a very significant impact on life and ecosystems and other conditions on the coast [3].

Coast is a geographical form consisting of sand and is found in coastal areas of the sea. The coastal area is the boundary between land and sea waters. The coast occurs because of the waves that hit the edge of the land without stopping. The length of this coastline is measured around the entire coast. According to [4], the coastline is the boundary of sea and land water which is always changing very dynamically and interacting with each other, temporary changes such as tides and changes in abrasion with accretion over a long period of time so that the zone produces a unique environment and is vulnerable to change. Certain shoreline changes will occur because the coast is dynamic [5, 6, 7]. One of the consequences of shoreline changes is erosion which causes damage to beach and disrupts activities around the coast. On the other hand, the sea line can change due to abrasion, namely the erosion of the coast by the impact of sea waves which causes a reduction in the land area [8].

The investigated of coastline is in coastal area of Subang Regency, West Java, which borders the Java Sea to the north. The Subang coastline is 48.20 km and has an area of 13,380.27 ha. Therefore, economic activity in the region is centered on fisheries and trade and has environmental impacts and pressures on its surroundings [9]. Based on the phenomenon that occurs, it is necessary to analyze changes in the coastline in the Subang Regency, West Java (Fig. 1). Satellite mapping from Google Earth [10, 11] and using AutoCAD [12] as a support tool for this research.

Fig. 1 Subang Coastal Area

Methodology

Several beaches in the territory of Indonesia have undergone many shorelines changes due to abrasion and accretion. Currently, the coast in the coastal area of Subang Regency is used in various land use activities to support local community income. Several factors that exist in the coastal area of Subang Regency, West Java can cause warning sign of changes in coastlines [9]. Changes that occur in the coastline can be monitored using a technology. Where the technology used in monitoring shoreline changes is using satellite imagery. Remote sensing is the science that is done by a person or group in examining objects or objects to obtain the desired information [13, 14, 15, 16, 17, 18]. For the purposes of planning and management of coastal areas in Subang

Regency, West Java, research is needed on the study of shoreline changes using a remote sensing approach in the coastal areas of Subang Regency.

This study aims to determine and map changes in coastline in the coastal area of Subang Regency by using satellite imagery comparisons. The results of this study are expected to provide information to the government, the community and various parties about changes in the coastline that occur along the coast of the coastal area of Subang Regency and can be used as a reference in the development and management of coastal areas. In this study, data coastline from 2009 to 2019 were used which were obtained from mapping satellite images sourced from the software/via the Google Earth Pro application (Fig. 2).
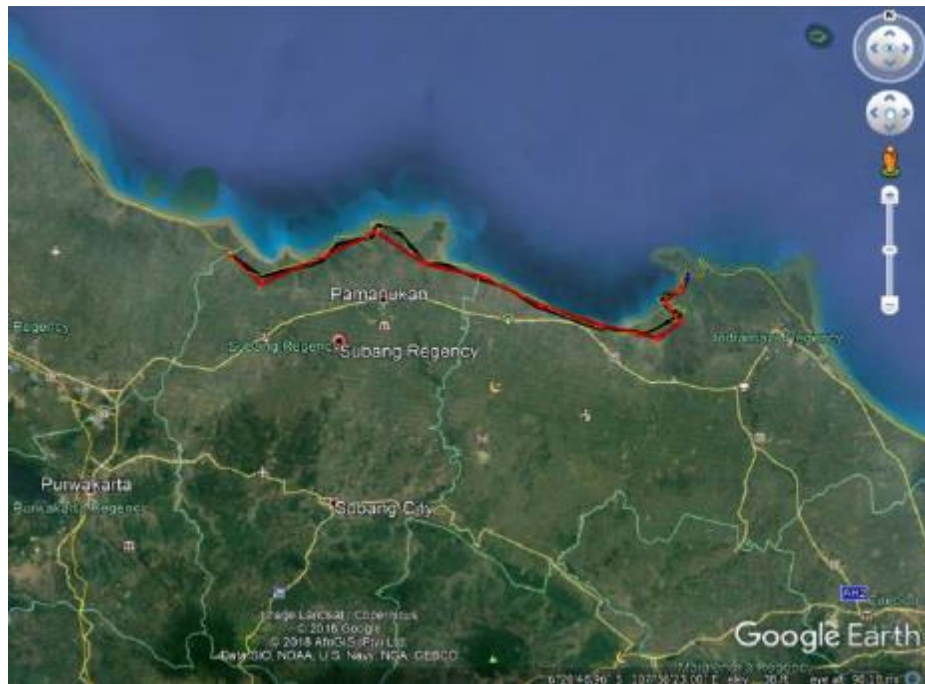

Fig. 2 Satellite image of coastline in Subang Regency

Shoreline change modeling to determine the characteristics of changes in each line in each year by modeling the distance between the changes. The modeling is divided into 2 parts, namely the distance in every 10 km (Fig. 3) and in every 3 km (Fig. 4) from the starting point coordinates to the end point coordinates.
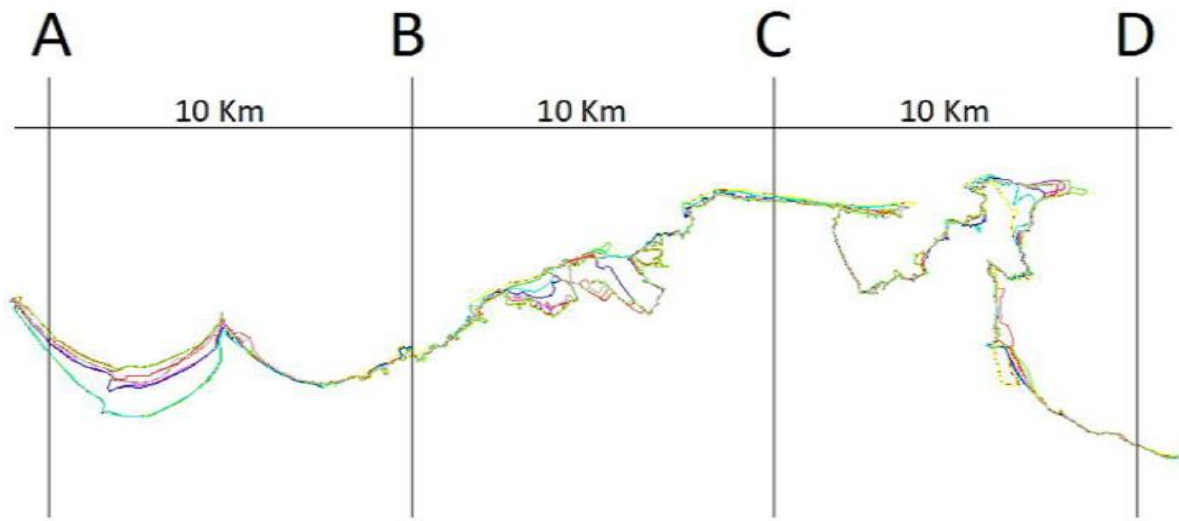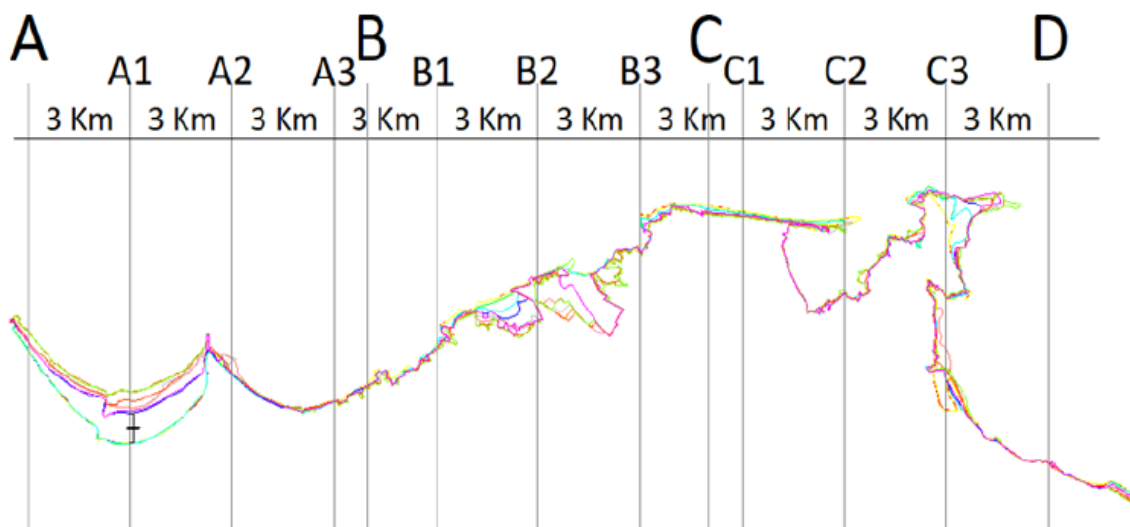
Fig. 3 Analysis Map Modeling in every 10 Km

Fig. 4 Analysis Map Modeling in every 3 Km

Shoreline changes in route analysis is to make route boxes with a size of 1000 m x 1000 m. The route boxes are connected in an orderly manner to cover all coastlines to be studied. The process of determining the area to be calculated is by means of a visual way where it can be seen areas with very extreme potential for abrasion/accretion, based on shoreline data. The data of the coastline has been previously formed by digitizing using Google Earth and has been converted into AutoCAD. By making polygon/line to calculate distance and area of shoreline change in a

period using the properties feature in the AutoCAD. Figure 5 shows the route analysis map modeling.
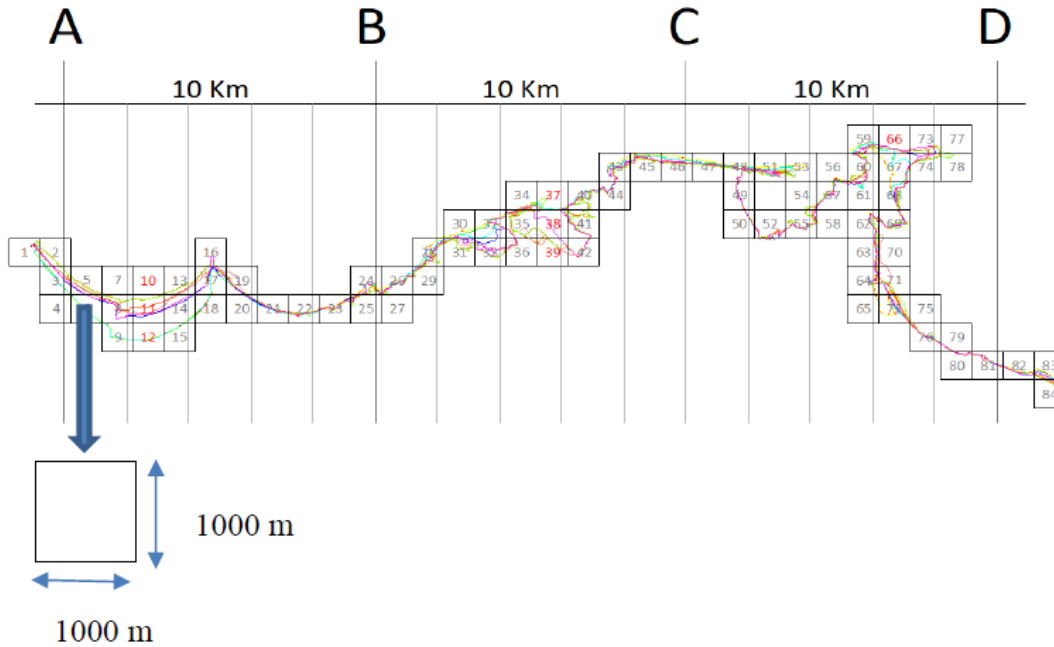

Fig. 5 Modeling Route Analysis

Results and Discussions

The first modeling with a distance in every 10 km from the starting point of the coordinates to the end point of the coordinates from the mapping results of Google Earth in the year 2009 to the year 2019. In modeling from the digitization results of Google Earth satellite imagery converted to AutoCAD, it can be obtained the distance in every location point studied in accordance with the year shown in Table 1.

Table 1 Changes in coastline from 2009 to 2019 in every 10 km

Year	A (m)	B (m)	C (m)	D (m)
2009-2010	-3,66	+39,83	+1,24	+1,79
2010-2011	+0.56	-154,78	+1,12	+1,12
2011-2012	-1,60	-2,85	+1,69	+1,69
2012-2013	+278,67	+11,14	+4,49	+4,49

2013-2014	+32,32	0	-2,02	-2,02
2014-2015	+153,70	-111,47	+2,43	+2,43
2015-2016	-29,75	+16,72	-3,76	-3,76
2016-2017	+3,09	+2,89	+8,05	+8,05
2017-2018	+201,83	-66,10	-0,55	-0,55
2018-2019	-8,20	+83,45	-0,27	-0,27

(-) Abrasion and (+) Accretion

Changes in the shoreline at point A have a maximum accretion in 2012-2013 along 278.67 m, at point B there is a maximum abrasion of -154.78 m in 2010-2011, in 2012-2013 at point C there is a maximum abrasion of -76.85 m, and at point D the maximum accretion is -8.05 m which occurred in 2016-2017.

Interpretation data between Google Earth satellite imagery and superimpose by converting via AutoCAD results from the data obtained from the segmentation in every 10 km which tends to be more tenuous and too large. The second modeling with three km from the starting point of the coordinates and the end point of the coordinates obtained from the mapping results of Google Earth Pro 2009 to 2019. The segmentation in every 3 km is denser and more precise than the accuracy of the data, making it easier for further analysis to determine which parts are included in the abrasion and accretion. Table 2 shows the changes of the coastline in every 3 km for the year 2009 to the year 2019.

Table 2 Changes in the coastline in every 3 km for the year 2009 to the year 2019

Point (m)	Year									
	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
A	-3.66	0.56	-1.60	+278.67	+32.32	+153.70	-29.75	+3.09	+201.83	-8.20
A1	-1.11	+2.86	-5.29	+838.10	+57.64	+76.86	-7.43	+212.04	+252.71	-4.83
A2	-0.90	-8.16	+0.22	+0.22	+7.33	+47.64	-37.85	-357.96	-18.64	-7.61
A3	-0,57	-31.44	-20.67	+8.69	+12.72	+2.79	+1.27	-3.96	-21.98	+1.86
B	+39.83	-154.78	-2.85	+11.14	0	-111.47	-16.72	+2.89	-66.10	+83.45
B1	-0.72	-0.28	+6.25	-91.45	0	-13.07	-2.62	-17.25	-37.58	-0.67
B2	-0.35	-1.37	+3.77	+1.55	0	+62.89	-67.49	-23.23	+34.98	-39.39
B3	+3.32	+8.96	+23.19	-38.26	0	-1.92	+10.89	-12.21	-0.18	-4.29
C	+1.24	+1.12	+1.69	+4.49	-2.02	+2.43	-3.76	+8.05	-0.55	-0.27
C1	+0.21	-90.61	+3.34	-50.39	0	-12.40	-7.31	+4.62	-13.21	+0.90
C2	-2.95	+0.16	-12.18	-0.77	0	+5.64	-5.69	+0.18	+29.80	+21.37
C3	-12.59	+896.36	-10.21	+164.61	0	+267.19	+597.21	-624.98	-22.69	+67.89
D	+1.79	+1.12	+1.69	+4.49	-2.02	+2.43	-3.76	+8.05	-0.55	-0.27

(-) Abrasion and (+) Accretion

Changes in the shoreline occur at the maximum accretion point: A1 of +838.10 m in the years 2012-2013, B2 of +62.89 m in 2014-2015, C2 of +29.80 m, in the years 2012-2013, C3 of +896.36 m in the years 2010-2011. There is maximum abrasion at the point: A2 of -357.96 m in 2016-2017, A3 of -31.44 m in the years 2010-2011, B1 of -91.45 m in the years 2012-2013, B3 of -38.26 m in the years 2012-2013, and C1 of -90.6 m in 2010-2011.

After obtaining the results of modeling changes in the coastline of each point in each year, the next analysis uses a zone or route analysis system. Shoreline change modeling with this route system, coastline data from 2009 to 2019 from Google Earth is plotted manually per box with a length times width adjusted to the overall scale. Shoreline change modeling with this route system is made with a box model consisting of 84 boxes. This shoreline change analysis is focused on the change in maximum distance and maximum area that occurs. The maximum distance and maximum area of change in the shoreline also indicates the occurrence of abrasion and/or accretion. The shoreline change modeling with this route system focuses on routes between points A1-A2; routes between points B2-B3 and; as well as routes between points C3 and C4. Table 3 shows the distance and are to change of coastline with route system.

Table 3 Distance and Area to Change of Coastline with Route System

Route	Year	Distance (m)	Area (m^2)
A1-A2	2011-2019	-1434	-1,419,5332
B2-B3	2010-2019	+1284	+1,114,501
C3-C4	2009-2019	-1982	-1,052,3231

(-) Abrasion and (+) Accretion

Conclusions

Analysis of shoreline changes in Subang Regency, West Java using the satellite mapping method. The analysis of shoreline changes is focused on changes in distance and area according to satellite mapping data from 2009 to 2019. The results of changes in distance and area of changes in coastline determine the occurrence of abrasion and/or accretion. Modeling using routes is easier to see results that are more specific and easier to use. The superimpose result of changes in the coastline of the route between points A1-A2 experienced abrasion along -1434 m with an area of 1,419,532 m^2; route between points B2-B3 experiences accretion along +1284 m with an area of 1,114,501 m^2; as well as the route between points C3-C4 experiencing accretion along +1982 m with an area of 1,052,321 m^2. Changes in the coastline of Subang Regency, West Java, experience abrasion and accretion which can reduce coastal functions and affect coastal buildings and need

special attention in maintaining the sustainability of the ecosystem around the coast in Subang Regency, West Java

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