

Land Accretion and Sedimentation Monitoring on Cirebon-West Java Using Sentinel 2A/B within 2018-2019 Period

Willy GOMARGA, Wiwin.WINDUPRANATA, Anjar Dimara SAKTI, Bambang Edhi LEKSONO, Indonesia

Key words: Marine Remote Sensing, Sedimentation/Land Accretion

SUMMARY

Land accretion and soil abrasion is a crucial problem in Indonesia in addition to the problem of hunger and food problems, because it is related to how people live and how people survive. The land of Accretion that occurs as part of the landscape of Cirebon has high economic prospects and become a controversial issue when the land of accretion which is a vacant land falls into the wrong hands that have no responsibility in the management of this land.

Land accretion is a natural phenomenon that occurs due to coastal erosion activity on coastal morphology due to the dynamic phenomena that occur with marine characteristics and also due to coastal sedimentation activity in the Gulf. The parameters used to measure sedimentation in this area are the use of TSS (Total Suspended Solid) and (Total Suspended Material) which is calculated in Mg/L in the suspension in dimensions and also can be represented in Digital Number value (DN)

To achieve the measurements on the suspended material, there are two observations used in this method the first to use the DELFT 3D model, on this model some earth phenomena such as wind waves, accelerated surge and MetOcean data are used to create sophisticated models of material suspended in coastal areas, especially in the coastal areas of Cirebon. In addition to using the DELFT 3D model, the marine remote sensing is used to create a change detection map using Sentinel-2A/B optical bands, Total suspended and solid Total suspended material which is measured by counting the TSS and TSM using the B4 (red band) on the Sentinel 2A. The purpose of the study was to redefine the boundary between the accretion soil as well as to see the pattern on rainfall modelled with TRMM, the determination of the place of sedimentation by using DSAS (Digital Shoreline Analysis System) and ocean currents and sedimentation modeling using DELFT 3D.

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1. INTRODUCTION

As a city located in the coastal area of the north coast of Java and has a high economic value as a city in the coastal region, Cirebon City and Regency has a uniqueness in addition to its location located in the coastal area, there is a land of accretion or commonly referred to as the arising land which is the result of the erosion that occurs in the area around Indramayu which is a erosion of the coast and the accretion areas arising from the sedimentation and sediment of transport Which is caused by the landscape such as the bay that makes the whirlpool of sea currents. Cirebon City and Regency has an area of 37.54 km² with a space for the land of Accretion about 2,029 km² from 1998-2018 based on data from calculations made by Millary, et. al. 2018 the area of accretion land calculation in Cirebon region experienced a significant change and has a fairly high land economic value.

Regarding the potential of land arising on the coast of Cirebon, based on the provincial regulation of West Java Number 6, 2011 that naturally arising land ruled by the state under the supervision of the Governor who is a derivative of article 33 UUD RI 1945. Further rules regarding land arise are also established by local governments at the city/district level (Noorrahmah., et al., 2014). In addition, the use of land arising in Cirebon can be used as a benefit to the potential of mangrove in Indonesia and also can be used as an area of recreational and tourism attractions that can improve the activities of tourists.

In addition to the many potential that can be utilized to be developed, there are also problems that arise on land arising/accretion of land such as the emergence of unlicensed wild settlements which causes damage to the ecosystem and the overlap of land ownership that causes unclear ownership and is not entitled to be claimed for its development although it is legally controlled by the state.

In the process of supervision for land arising, in practice in Indonesia for the mastery of the land in this case the accretion of land is governed for its ownership under the UU No 5 year 1960 UUPA with reference to article 21 paragraph 2 that by the government stipulated by legal entities that have property rights and terms. As well No 5,1960 UUPA, with reference to article 27 concerning loss of land rights and given to the state if the land was destroyed. In this case, regarding the land arises juridically is a land that is being destroyed and has no ownership or property rights abolished and belongs to the state if it is targeted by government regulations.

The process of compaction of sediment or land accretion in Cirebon is a compaction phenomenon of soil sediment along with soil suspension from erosion occurring in Indramayu

region, as well as the phenomenon of compaction is a natural phenomenon that occurs in Coastal areas of the city of Cirebon and Indramayu caused by the differences in the coastal.

form with the city of Cirebon with coastal forms that resemble the bay and the city of Indramayu which has a shape resembling the Cape, which is more inclined to occurred from the erosion when compared to the formation of the coastal city of Cirebon that resembles the bay.

In the manufacture and process of knowing how the sediment on coastal areas can undergo sedimentation and erosion, it takes a modeling system with parameters that correspond to the actual environmental conditions for Modeled erosion, one of them using wind and MetOcean modelling to model the flow of sediment flowing from one beach to another for modeling on sedimentation and erosion data used by the software Delft3d To produce models of sedimentation and erosion data and sea currents movements.

In this case, an optical observation in a medium-scale is also needed to find the difference between erosion and sedimentation areas, optical observation in medium scale can also be done by remote sensing method and Photogrammetry, but in this case, the use of image data (remote sensing) using Sentinel 2 as image data due to, data Sentinel 2A/B has a spatial resolution of 10 meters and is relatively capable and quite effective in monitoring the process The occurrence of land accretion in the area that is quite wide in this city of Cirebon with a total land accretion of 2029 Km² and the possibility of observation using photogrammetry is not possible to use. For optical observation in the process of processing is done in the process of observation using the change detection that can be done by looking for differences from changes and also calculations using a formulation of TSS (Total Suspended Solid), as well as observations of the rate of accretion by using DSAS (Digital Shoreline Analysis System) with calculations of these formulations involve calculations by calculating the suspended material using the A red Band of 645 nm on the Sentinel-2 image.

After modelling the process of counting and making the model, from the data of each suspended material obtained from the results of a graphic form model and the model of suspended material used to calculate the size of suspended suspension in a region such as Bay or Promontory, the process of this calculation can be sought by rainfall modeling with TRMM (Tropical Rainfall Measurement Model)/TMPA. Then the result of this output can be used as an explanation of the origin of the land of Accretion in Cirebon and can also be used as a decision making in the cadastral policy for the land arising in the city of Cirebon.

2. METHODS AND DATA

The primary data used in this study was the Sentinel 2A/B level processing 2A image data, then the rainfall data used from the TRMM (Tropical Rainfall Measurement Mission) and wind data from the Cirebon wind and tide station.

The scheme of this research method consists of 4 methods of data processing consisting of: Data processing methods by using GEE (Google Earth Engine) for the search value of the TSS by using the Sentinel 2A/B Level Processing Image:

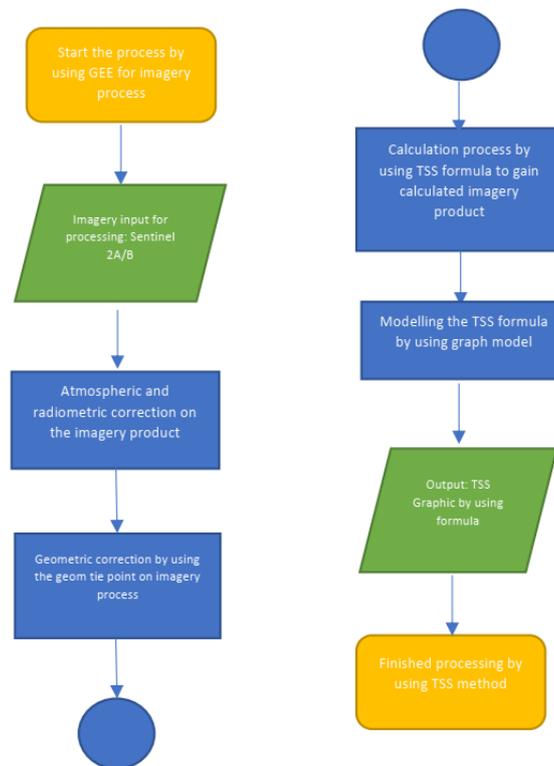


Diagram 1 TSS Workflow by Using Google Earth Engine

Processing methods by using Delft 3D for wind and sea-flow data processing:

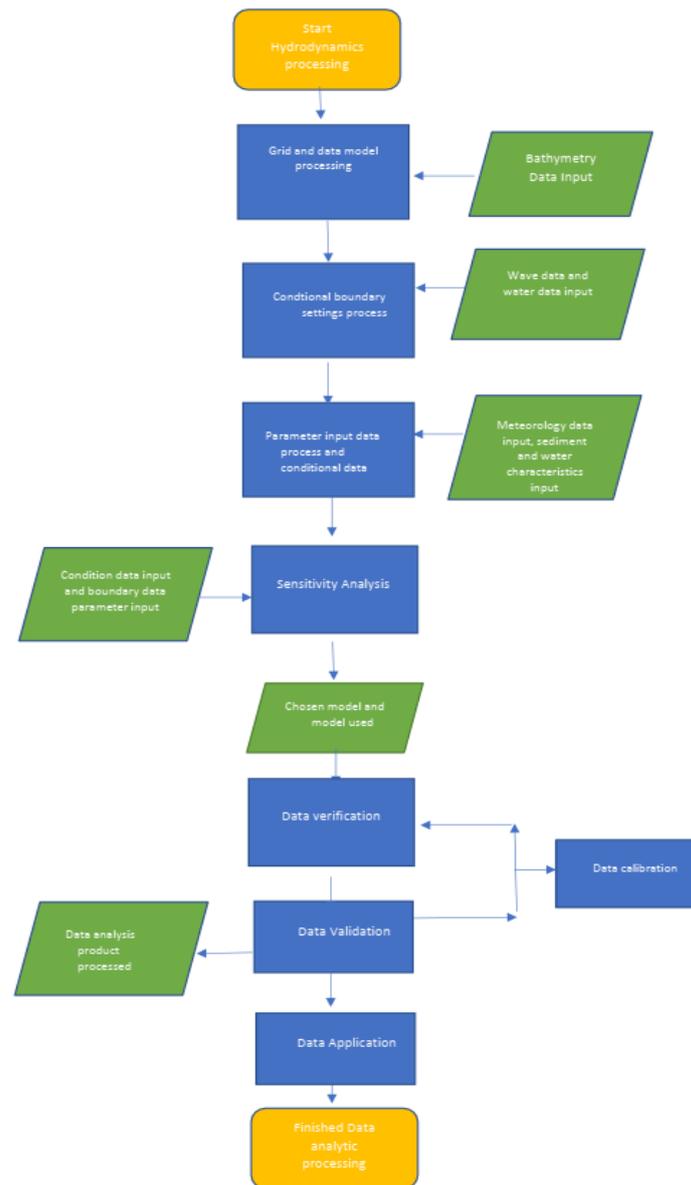


Diagram 2 Delft 3D For Wind and Sea Flow Data Processing

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Processing method using TRMM data (Tropical Rainfall Measurement Mission) to obtain Rainfall plot in Cirebon District.

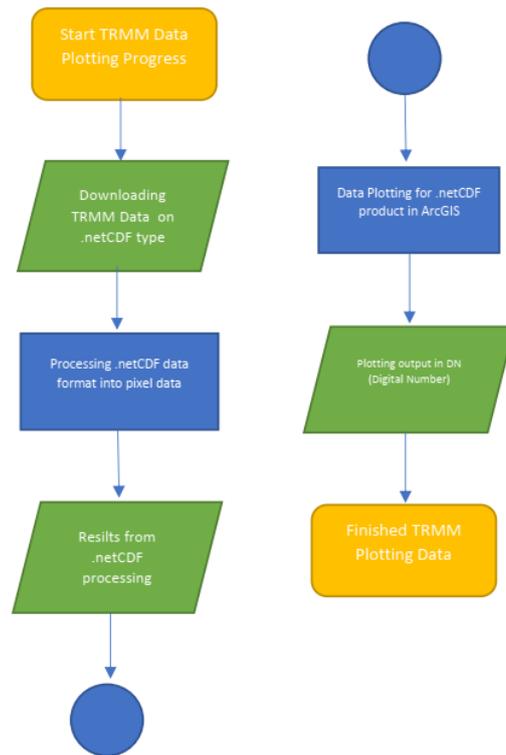
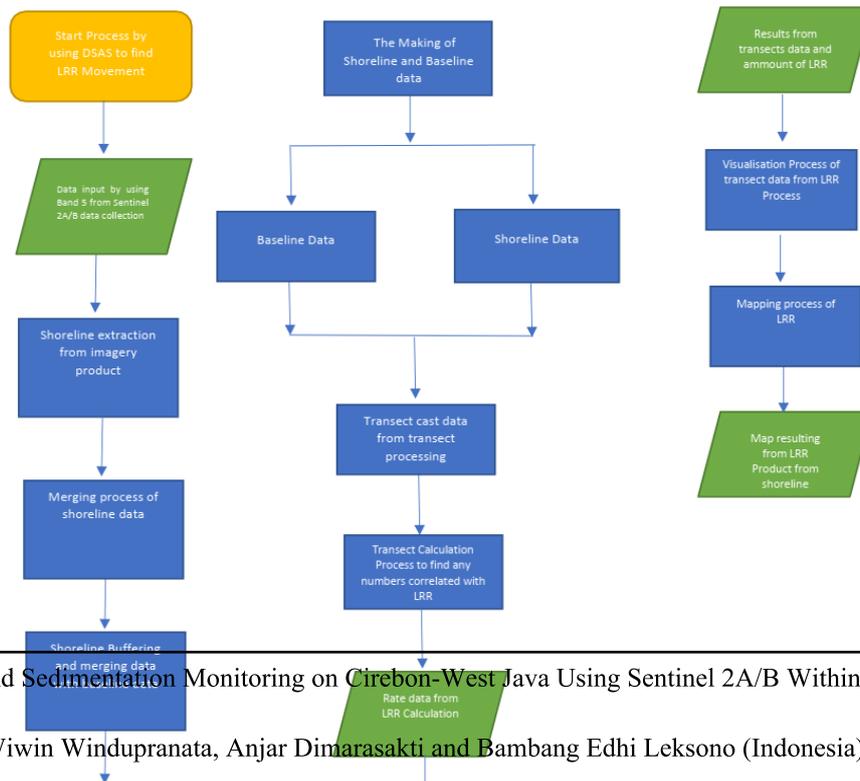


Diagram 3 TRMM (Tropical Rainfall Measurement Mission) to Obtain rainfall plot in Cirebon District.

To obtain the shoreline change feature, DSAS was conducted on this method to find LRR (Linear Regression Rate), the following figure:



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Diagram 4 DSAS Figure to obtain Shoreline LRR Movement.

Selected Algorithms for TSS (Total Suspended Solid) and The Research Scope

The area covered in this research object covers the object relating to the territorial and spatial problems. The physical descriptions of the research areas in question include the geographical realm of the area of Cirebon which is a coastal region and is a promontory area or estuary area which is an area that allows for the occurrence of abrasion or erosion that causes land arising in this form of land accretion. For areas of research are depicted in the following picture:



Figure 1 Scope Of The Area

For Sentinel 2 image used to describe the region of the location of Cirebon city displayed as follows:



Figure 2 Sentinel 2 image used to describe the region of the location of Cirebon city

3. RESULTS AND DISCUSSION

3.1 RESULTS

From the results obtained from each method, there are 4 results are processed with each different way according to the final goal of this final task, as for the results include the source code of Google Earth Engine along with the graph of results Multitemporal calculations, result of processing with TRMM (Tropical Rain Measuring Mission), processing results from DSAS (Digital Shoreline Analysis System), as well as processing results using DELFT 3D for hydrographic modeling in coastal areas Cirebon District.

3.1.1 Results From GEE and TSS Calculation

For the result of processing by using GEE, the Sentinel 2A image with the image that has been done geometric correction and radiometric correction of the image data. The metadata of

the files that were convinced was done radiometric correction and geometric correction from the handbook of Sentinel 2A data that has been done correction on the image as a finished product. As for the resulting display is shown in the following image:

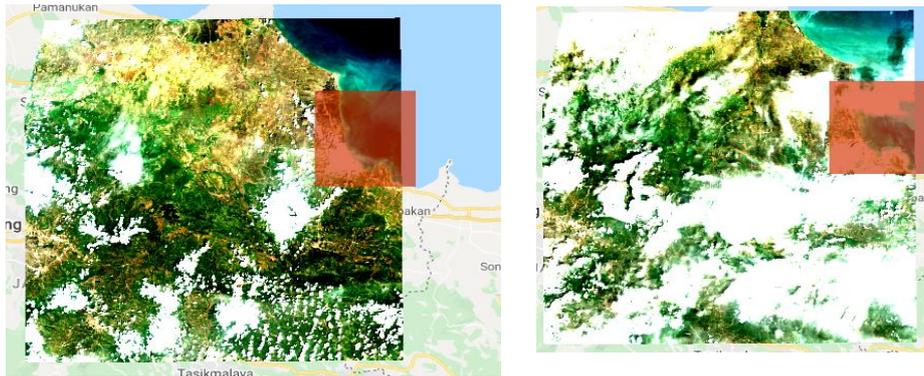


Figure 3 Display for Sentinel image 2A Postprocessing Year 2019 (left) and Right for 2018

Otherwise to display the result of this Sentinel 2A image was used in the illustration using imagery with Band 4, Band 3 and Band 2 with a spatial resolution of 10 meters in 2018 and 2019, on using TSS calculation there are three algorithms used in this methods and the resulting from this calculation there are three graphics shown below in radiance band value:

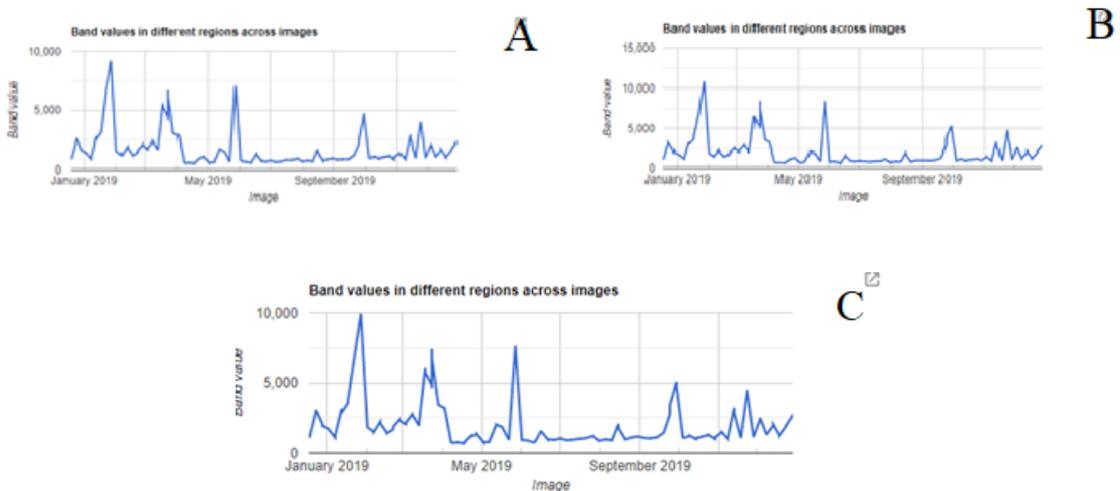


Figure 4 TSS Calculation Graphic From (A) Dorjji et.al, (B) Hendrawan Asai (C) Hasyim et.al

3.1.2 Result From TRMM Processing

Rainfall plotting result is performed multitemporally by downloading the netCDF format data that is converted into values from the digital number. In images or maps that are processed as a result of the processing of rainfall is generated in West Java coverage, and the plot graphic shown:

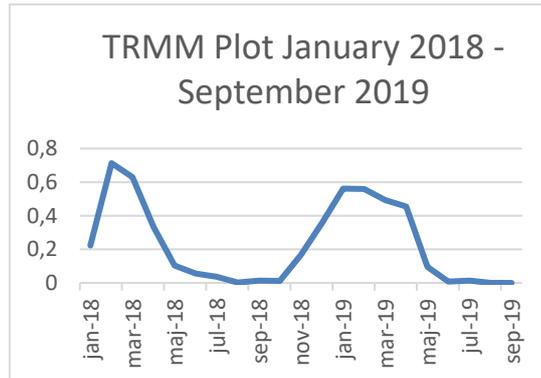


Figure 5 TRMM Graphic Plot

3.1.3 Result From DSAS Processing

For processing using DSAS (Digital Shoreline Analysis System) conducted by digitizing and depictions of coastline, as for the data used at the rate of 3 coastline in 2017-2019, for the results of the depiction By using DSAS generated in the form of plot maps of coastal movements based on sedimentation and erosion levels:

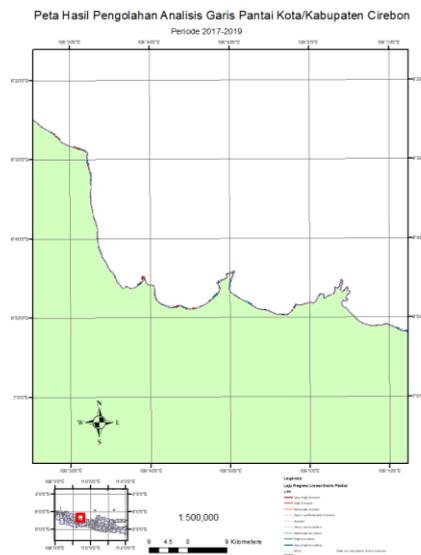


Figure 6 Results From DSAS (Digital Shoreline Analysis) Map

3.1.4 Result From Delft 3D Processing

Processing by using DELFT 3D for models of hydrodynamics used in the form of data flows displayed with QuickPlot menu of Delft 3D-Matlab with results:

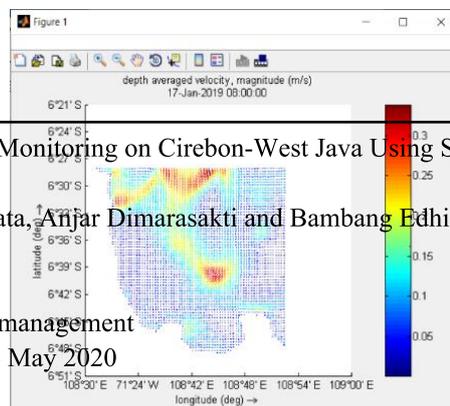


Figure 7 Processing results using DELFT 3D

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3.2 DISCUSSION

For the result of the rate of accretion resulting from the calculation of DSAS using Sentinel 2 in the year 2017-2019 visible in the red section of the map with the attachment as an area with a high erosion result marked with red markings and If viewed from modeling using DELFT 3D This occurs in January to April and seems volatile due to the months of January and April when viewed from rainfall plotted through TRMM data, rainfall Which affects the movement of the rain clouds and sedimentary movements of the TSS value calculated by using the GEE with data from the Sentinel 2A it appears that from January to April it has fluctuation of sediment that has increased due to the high rainfall which is certainly also influenced by the hydrodynamics factors. In addition to the blue portion of the coastal part of the DSAS map in 2017-2019, it was seen that there was an accretion or sedimentation due to the flow of wind and rain that brought sediment to settle and for the air was known as 1 to 6 m/A (meter/annum) in the blue, and as is known from the literature which was adapted by Millary et, al, the territory of the accretion or sedimentation in Cirebon is known to be on the territory given the circle in the image following:

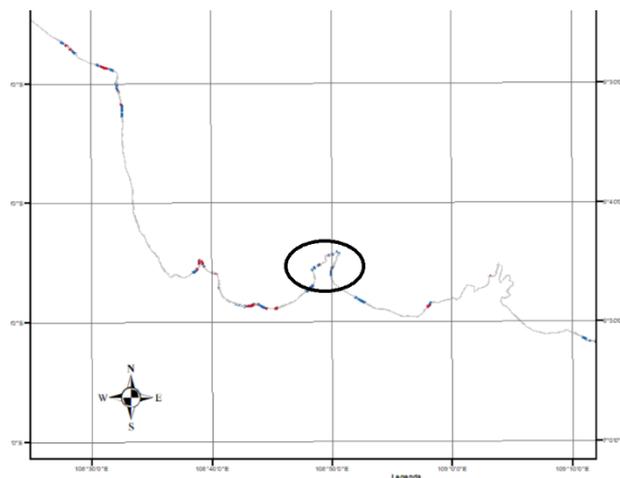


Figure 8 Accretion Area in Cirebon District

For the erosion area of Cirebon in the region with a red line with a black circle, which indicates that the occurrence of erosion caused by a erosion due to the pattern of movement of currents in the coastal areas of Cirebon In Figure 4.9. Then if it is associated with rainfall

patterns and TSS (Total Suspended Solid), for movement of the current and sediment seen in the TSS chart patterns, the most visible suspension is in June to September was flat in this period or not Fluctuating with an overview of the three TSS algorithms used in the Sentinel 2A image:

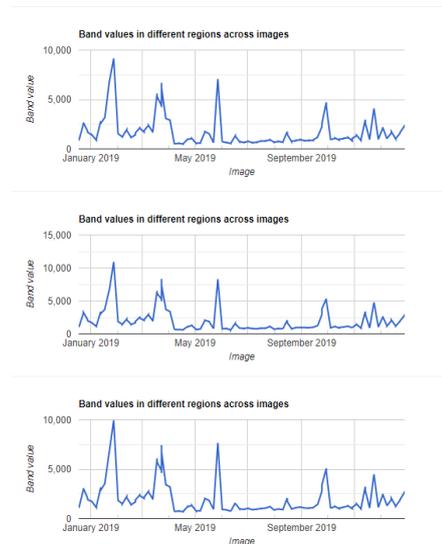


Figure 9 TSS Calculation Graph

Thus it can be known from the calculation results and modeling with TSS (Total Suspended Solid) on GEE (Google Earth Engine) has interconnected but not very striking correlation between the results of modeling by using DSAS (Digital Shoreline Analysis System) with current modeling with Delft 3D.

4. CONCLUSION

The process of sedimentation erosion in the coastal areas of the city of Cirebon is influenced by the rainfall and ocean currents occurring around the northern coast of Java, and also influenced by the movement of the wind and also monsoon when viewed of pattern and rainfall from TRMM (Tropical Rainfall Measurement Mission) data.

Then the analysis on the chart of TSS (Total Suspended Sediment) is seen that the pattern has a high tendency of TSS and rainfall is seen in December to Febuari and visible observation of sediment occurred high fluctuations but in the month In May 2019 experienced different anomalies of the rainfall pattern by using the Sentinel 2 image with the process level 2.

For processing of the coastline data used DSAS (Digital Shoreline Analysis System) which is an extension in GIS software used to view the range of the progress or deterioration of the coastline in the observation of accretion in coastal areas ranging-3 meters/annum up to 3 meters/annum.

With the use of Delft 3D, data from ocean currents and wind can be modeled to see the regional distribution of the city/district of Cirebon that has been sedimentation or erosion, which is caused by the movement of currents and winds.

for the process of modeling DSAS, Delft 3D, TSS with Sentinel 2A and processing with TRMM, it can be seen that with the resolution of the imagery data and other observation data can be generated observation results have a correlation between the data and the model could be Generated

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BIOGRAPHICAL NOTES

Willy Gomarga is the student who is still studying at Bandung Institute of Technology, as the senior student majoring in geodesy and geomatics, He concerns his research in remote sensing technology and photogrammetry especially in rapid mapping technology for risk disaster management, The writer has won some achievements in National Innovation of Geospatial Competition which held in Universitas Gadjah Mada and also won National Paper Contest in Geodesy and Geomatics held by IMG I (Ikatan Mahasiswa Geodesi Indonesia).

CONTACTS

Willy Gomarga
Hydrographic Group ITB
Labtek IX-C 4rd floor,
Jl Ganesha 10, Bandung- 40132 INDONESIA
Tel. +62.22.2530701
Fax. +62.22.2530702
Email:willygomarga@students.itb.ac.id

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