Jambura Geoscience Review
Accreditated "4th" grade (SINTA 4) by Directorate General of Higher Education, Research, and Technology (DITJEN DIKTI) of the Republic of Indonesia, Decree No. 79/E/KPT/2023, May 11, 2023
E-ISSN: 2656-0380 | P-ISSN: 2623-0682
Publisher Department of Earth Science and Technology, Universitas Negeri Gorontalo
Journal homepage http://ejurnal.ung.ac.id/index.php/jgeosrev
Journal Contact geosrev@ung.ac.id
Collaborate with

Monitoring Total Suspended Solid Concentration and Shoreline Dynamics Using Sentinel-2 Imagery in 2015-2021

Lia Novianti Ni'amah, Nurhadi Bashit, LM Sabri, Abdi Sukmono, Farouki Dinda Rassarandi

Abstract

Human activities in the Juwana Estuary impact increasing sedimentation, including industry, fish processing, ponds, and settlements. Increased sedimentation every year can lead to the formation of new land. In the long term, sedimentation will impact shoreline changes due to the formation of new land. This study aims to determine changes in Total Suspended Solid (TSS) concentration and shoreline values in the Juwana River Estuary. Increased sedimentation can be indicated based on water turbidity and TSS values—an effective method for observing TSS and coastline using remote sensing. The data for this study uses Sentinel-2 imagery. The TSS processing algorithm uses Laili, Liu, and C2RCC. TSS results using the C2RCC algorithm show the best regression results between image TSS and in situ TSS with an R^2 of 0.721 compared to other algorithms. In 2015-2018 the average TSS value decreased by 2.303 mg/l. Processing results show the largest TSS reduction value of 12.466 mg/l on the Juwana Coast. The TSS value in 2018-2021 shows an average decrease of 4.447 mg/l; the largest decrease, with a value of 19.3 mg/l, is in the Batangan Coast. The coastline is extracted from image data using the Normalized Difference Water Index (NDWI) algorithm. In 2015-2018 changes in the coastline were dominated by abrasion, covering an area of 35.2348 ha with a maximum distance of 143.78 m. In 2018-2021 changes in the coastline were dominated by abrasion, covering an area of 10.28224 ha with a maximum distance of 53.23 m. It can be interpreted that a decrease in TSS indicates a decrease in sedimentation, causing increased abrasion around the coastline.

Keywords

Coastline; Sedimentation; Sentinel-2; Total Suspended Solid

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JAMBURA GEOSCIENCE REVIEW

DEPARTMENT OF EARTH SCIENCE AND TECHNOLOGY, UNIVERSITAS NEGERI GORONTALO

P-ISSN : 26230682 E-ISSN : 26560380

1.44737
Impact Factor

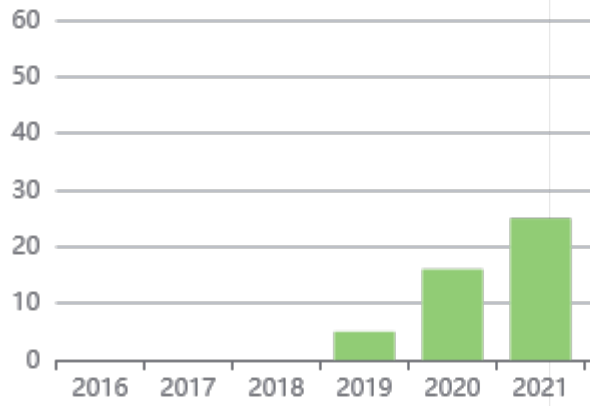
152
Google Citations

Sinta 4
Current Acreditation

Google Scholar Garuda Website Editor URL

History Accreditation

Citation Per Year By Google Scholar



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Jambura Geoscience Review
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Jambura Geoscience Review
Accreditated "4th" grade (SINTA 4) by Directorate General of Higher Education, Research, and Technology (DITJEN DIKTI) of the Republic of Indonesia, Decree No. 79/E/KPT/2023, May 11, 2023
E-ISSN: 2656-0380 | P-ISSN: 2623-0682
Collaborate with
Publisher Department of Earth Science and Technology, Universitas Negeri Gorontalo
Journal homepage http://ejurnal.ung.ac.id/index.php/jgeosrev
Journal Contact geosrev@ung.ac.id

Vol 5, No 2 (2023): Jambura Geoscience Review (JGEOSREV)

DOI: https://doi.org/10.34312/jgeosrev.v5i2

Jambura Geoscience Review (JGEOSREV) Volume 5 Number 2 July 2023 has been officially published, and its full-texts are open access. This issue contains 6 articles from 8 affiliations and 22 authors. The published articles discuss Geophysics (1), Remote Sensing (3), and Geology (2).

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E-mail: geosrev@ung.ac.id

doi: 10.34312/jgeosrev.v5i2.19613 ejurnal.ung.ac.id/index.php/jgeosrev

Vol. 5, No. 2, July 2023: 86-97

Jambura Geoscience Review

p-ISSN 2623-0682 | e-ISSN 2656-0380

Department of Earth Science and Technology, Universitas Negeri Gorontalo

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ARTICLE INFO

Article history:
Received: 7 May 2023
Accepted: 16 July 2023
Published: 25 July 2023

Keywords:
Coastline; Sedimentation; Sentinel-2; Total Suspended Solid

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ABSTRACT

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Human activities in the Juwana Estuary impact increasing sedimentation, including industry, fish processing, ponds, and settlements. Increased sedimentation every year can lead to the formation of new land. In the long term, sedimentation will impact shoreline changes due to the formation of new land. This study aims to determine changes in Total Suspended Solid (TSS) concentration and shoreline values in the Juwana River Estuary. Increased sedimentation can be indicated based on water turbidity and TSS values—an effective method for observing TSS and coastline using remote sensing. The data for this study uses Sentinel-2 imagery. The TSS processing algorithm uses Laili, Liu, and C2RCC. TSS results using the C2RCC algorithm show the best regression results between image TSS and in situ TSS with an R^2 of 0.721 compared to other algorithms. In 2015-2018 the average TSS value decreased by 2.303 mg/l. Processing results show the largest TSS reduction value of 12.466 mg/l on the Juwana Coast. The TSS value in 2018-2021 shows an average decrease of 4.447 mg/l; the largest decrease, with a value of 19.3 mg/l, is in the Batangan Coast. The coastline is extracted from image data using the Normalized Difference Water Index (NDWI) algorithm. In 2015-2018 changes in the coastline were dominated by abrasion, covering an area of 35.2348 ha with a maximum distance of 143.78 m. In 2018-2021 changes in the coastline were dominated by abrasion, covering an area of 10.28224 ha with a maximum distance of 53.23 m. It can be interpreted that a decrease in TSS indicates a decrease in sedimentation, causing increased abrasion around the coastline.

How to cite: Ni'amah, L. N., Bashit, N., Sabri, L. M., Sukmono, A., & Rassarandi, F. D. (2023). Monitoring Total Suspended Solid Concentration and Shoreline Dynamics Using Sentinel-2 Imagery in 2015-2021. *Jambura Geoscience Review, 5*(2), 86-97. doi:https://doi.org/10.34312/jgeosrev.v5i2.19613

1. INTRODUCTION

River estuaries have an important role as shipping lanes connecting rivers and seas which are areas of water bodies where seawater and river water merge (Purnawan et al., 2012). The accumulation of natural processes and human activities causes the sedimentation process to change the coastline (Paena, 2008). The estuary of the Juwana River is one of the river mouths where there are various human activities. The Juwana River estuary is used by residents through ponds, settlements, fish processing industries, shipping lanes, and fishing activities (Indriananingrum et al., 2016). This land use has high economic value but affects the aquatic environment because of the area's high activity. Periodic observations are important for observing environmental problems in the waters of the Juwana Estuary.