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ISSN: 2155-9546
Journal of Aquaculture Research & Development

Perspective

Effects of River and Ocean Particle Matter on the Magdalena River Estuary

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DESCRIPTION

The Caribbean Sea receives the majority of its freshwater and sediment from the Magdalena River. At high and low flows, the Magdalena River contributes 10,287 and 4068 gallons of water, respectively. One of the greatest sediment deliveries in the world comes from the Magdalena River, which also carries suspended particles. In order to map the extent of the turbidity plume using its morphometric properties and assess the spatial and temporal variability of suspended sediment concentration at the mouth of the Magdalena River, we used Moderate Resolution Imaging Spectroradiometer (MODIS) images. We also identified the key fluvial and oceanographic factors associated with plume variability. Data on the average monthly concentration of suspended silt for the years 2003 to 2017 were evaluated. Using on-site measurements of suspended sediment concentrations in the study area's surface waters, MODIS pictures were calibrated. The turbidity thresholds and regions of the plume were defined using a finite mixing model. The Magdalena River mouth has high suspended sediment concentrations, levels that are on par with those of the measured and Amazon River mouths in terms of magnitude. The Magdalena River plume appears to have a small area based on calculated diffuse, solid, and mixed plume areas as well as their morphologies, which are related to factors including wind direction and speed, streamflow, and sediment movement. Calculated shapes and regions show the potential to produce a close-range region, which denotes the presence of a distinct convergence front. The information highlights how crucial it is for sediment to be transported from the Magdalena River to the Caribbean Sea. Such fluvial transport is crucial to the biogeochemistry of estuarine systems, particularly in turbid estuaries where the distribution of sediment in surface waters varies noticeably.

Many factors, such as mixing, horizontal advection, streamflow patterns, ocean currents, wind fields, tidal regimes, and water residence duration, affect the plume development at a river mouth. By adding fresh water, dissolved nutrients, pollutants, and suspended sediments to coastal zones, river plumes have an impact on the physical, chemical, and ecological dynamics of those areas. As a result, fluctuations in the physical and chemical conditions of coastal zones are reflected in changes to the properties of river plumes over time and space. These variations in turn have an impact on processes involved in global biogeochemical cycles. To assess the effects of riverine sediment transport on marine and coastal environments and to ascertain these environments' ability to respond to environmental perturbations brought on by climate change and/or anthropogenic activity, an analysis of sediment concentrations at river mouths is essential. Due to changes in sediment characteristics, uneven dispersion of suspended material, and temporal unpredictability in the hydrological regime, high-discharge rivers with heavy sediment loads can have complicated effects on biogeochemical processes in receiving estuaries. Under these circumstances, the turbidity plume has a significant impact on the distribution of nutrients and pollutants, light penetration, and regional morph dynamics, all of which have an impact on the productivity and health of the estuarine environment. Such material can be monitored by field sampling, laboratory analysis, or *in situ* monitoring to better understand the impact of suspended sediment concentrations on the coastal ecosystem. However, due to the remoteness of river mouths, these methods are costly, time-consuming, and in some cases difficult. Because to this, high geographical and temporal resolution monitoring of alterations in suspended sediment is constrained. Furthermore, it is difficult to measure *in situ* the shape and size of turbidity plumes due to horizontal advection. The study of water quality in coastal habitats has increasingly turned to remote sensing techniques. Estimating the concentration of suspended silt in estuarine ecosystems' surface waters is one of these applications. Observations of suspended sediment concentration and empirical models based on remotely sensed data have enhanced understanding of the dynamics, composition, occurrence, and morphology of turbidity plumes globally.

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Received: 27-Jan-2023, Manuscript No. JARD-23-20047; **Editor assigned:** 30-Jan-2023, Pre QC No. JARD-23-20047 (PQ); **Reviewed:** 17-Feb-2022, QC No JARD-23-20047; **Revised:** 24-Feb-2023, Manuscript No. JARD-23-20047(R); **Published:** 02-Mar-2023, DOI:10.35248/2155-9546.23.14.730

Citation: Barthez A (2023) Effects of River and Ocean Particle Matter on the Magdalena River Estuary. J Aquac Res Dev.14:730.

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