Mississippi River/Atchafalaya River Discharge and Nutrients Trends from 2000s and their Drivers/Implications

Abstract

The Mississippi River and the Atchafalaya River are two significant waterways in the North America, whose variations in annual and interannual scales are main drivers for the coastal regions of the Gulf of Mexico. The ecosystem and socioeconomic development in Louisiana are impacted by the Mississippi River and Atchafalaya River system. This research aims to analyze the trends in the discharge and nutrient loadings, which has significant implications for flood management, anthropogenic impacts assessment and aquatic ecosystems. Our hypothesis posits that increased anthropogenic activities have led to significant increments in nutrient loading and water demand, with implications for water quality and ecosystem health. Analysis on discharge trends would help understand temporal variations and predict river flow in future development scenarios. River nutrient transport from agriculture and community could be a good hint for anthropogenic and economic development, with which we can investigate and assess potential impacts of anthropogenic activity emissions on water quality (Cao, et al., 2018; David, et al., 2010). Both river runoff and nutrients play important roles in aquatic environments, including river pathways and coastal regions, even in open ocean. The coastal hypoxia in Gulf of Mexico is associated with annual and interannual variations of nutrient inputs from Mississippi River/Atchafalaya River. Examining discharge and nutrient trends in the Mississippi River and the Atchafalaya River over the last 20 years can provide valuable insights into ecological health, water quality management, and the impacts of human activity. This study's findings will improve environmental policy and practices in the Louisiana region.

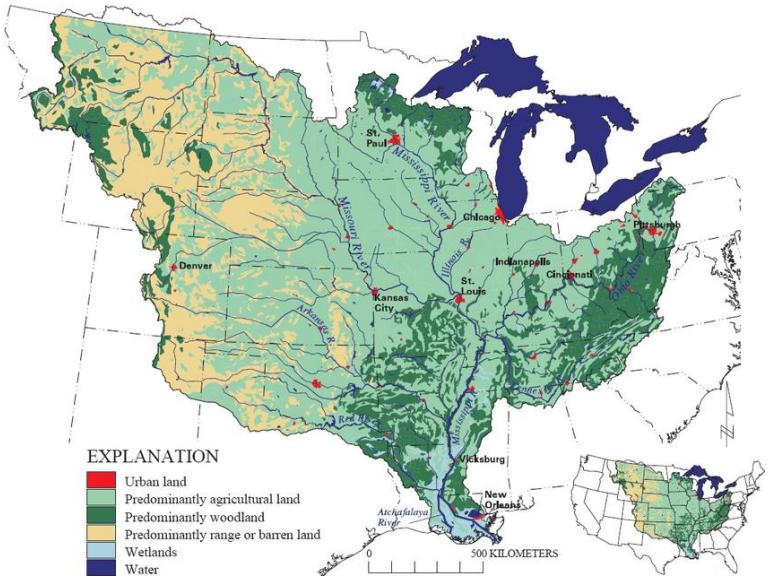

Fig1 Drainage and land use in the Mississippi-Atchafalaya River basin (from Feng, 2009)

Background

The Mississippi River and the Atchafalaya River system is the longest river in North America and creates a drainage basin over 1 million square miles (about the area of India) in size. Over the recent decades, industrialization, urbanization, and agriculture in the river basin have raised concerns about water quality and ecosystem health. (Turner and Rabalais, 2019) and (Turner, 2023) have contributed to in-situ observation in discharge and nutrient loading in Mississippi River for a long time. Observational data indicates changes in river discharge and nutrient levels, so comprehensive studying and quantifying these changes are encouraged. This research will be focused on analyzing trends in quantity and quality of river discharge since the 2000s, based on observational data from USGS and published articles.

Importance of the Research

Comprehensive understanding discharge and nutrient loading trends in the Mississippi River and the Atchafalaya River is crucial for these reasons below:

1. Water Quality: Elevated nutrient levels can lead to eutrophication, harming aquatic life and posing risks to human health.
2. Ecosystem Health: Aquatic biodiversity is under threat from habitat degradation, deoxygenation, and pollution, impacting fisheries and wetland protection in Louisiana.
3. Climate Change Mitigation: Identifying trends can help improve adaptive management and strategies for future climate change scenarios.

Analysis Plan

Data Downloading: Request and download historical discharge and nutrient concentration data from USGS hydrological stations and gather meteorological and agricultural statistics from governmental dataset and/or academic report.

Statistical Analysis: Conduct trend analysis and correlation assessments with Python to evaluate relationships between discharge, nutrient loading, and rainfall, anthropogenic activity. The analysis will include both time series and correlation scattering of discharge,

nutrient loading, precipitation, anthropogenic activity intensity. Furthermore, Attributions analysis is based on quantitative evaluation on different potential factors, like natural activity (precipitation) and anthropogenic activity (agriculture and urbanization). These drivers would be scaled from annual patterns to interannual patterns.

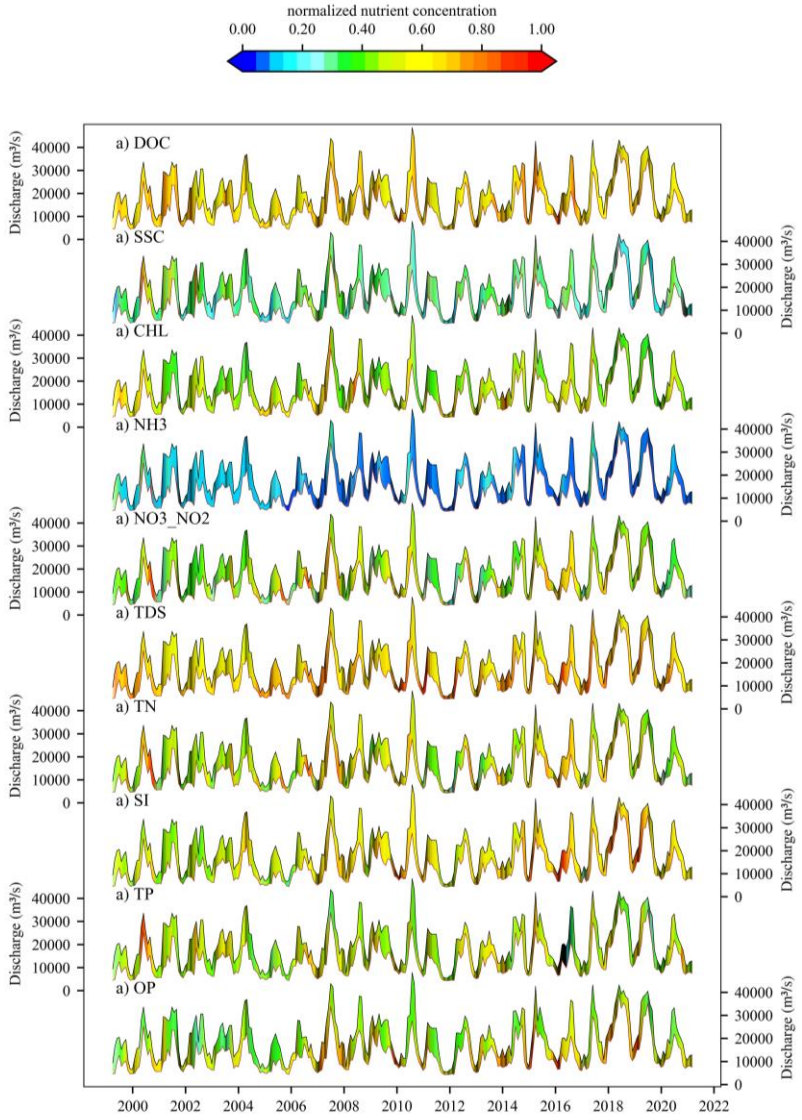

Fig2 Monthly averaged normalized concertation of DOC, SSC, CHL, NH3, NO3_NO2, TDS, TN, SI, TP and OP and monthly maximum and minimum of discharge derived from USGS hydrological station near St. Francisville during 2000 to 2021 (Plotting is done by author.)

Broader Impacts

Policy maker: The LDEQ Water Quality Standards and Assessment Section (WQSAS) (https://waterdata.deq.louisiana.gov/) is distributed and managed by the Louisiana Department of Environmental Quality. The policy maker will apply nutrient concentrations to determine and access water quality of the Mississippi River and Atchafalaya River to better develop environmental policies.

Public mass and community: Residents are interested in water quality in their community. The dataset of historical and future trends of nutrients and water quality will help them raise their awareness of environment protection.

Scientific community: Mississippi River and Atchafalaya River system is one of the largest river systems in the globe. Collaborative research and strategies will promote scientific knowledge on behalf of water quality under future climate change. Especially, the ecological and oceanographical researchers would make use of this dataset to amplify related research areas, including wetlands, coastal regions, and Gulf of Mexico.

Timeline

27/10/2024 to 04/11/2024 Data collection and preprocessing

04/11/2024 to 17/11/2024 Visualization, data validation and data analysis

17/11/2024 to 29/11/2024 Presentation preparation and

Bibliography

Cao, Peiyu, Chaoqun Lu, and Zhen Yu. “Historical Nitrogen Fertilizer Use in Agricultural Ecosystems of the Contiguous United States during 1850–2015: Application Rate, Timing, and Fertilizer Types.” Earth System Science Data 10, no. 2 (June 4, 2018): 969–84. https://doi.org/10.5194/essd-10-969-2018.

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