

An Application of the Polynomial Regression Algorithm for Predicting the Effects of Coastal Erosion at Bang Khun Thian



Authors
Dheerin TEMPHUWAPAT, Teerut TANGSIRIPINYO, Nattavee SUNITSAKUL, & Theekhathat WONGSUBSANTATI

Adviser
Kitsada DOUNGJITJAROEN*
kitsada.dou@mail.kmutt.ac.th*



Abstract

The problem of coastal erosion in Bang Khun Thian, Bangkok has resulted in people being forced to retreat or relocate, causing significant impacts on their livelihoods and way of life. To address this issue, a system is aimed to be developed by researchers that can measure and predict the likelihood of coastal erosion patterns in the future using the Polynomial Regression Algorithm based on water flow data, wind speed, and direction measurements. It was found from the experiment that a relatively high accuracy was yielded by the model when compared to the current erosion rates in 2023, and a high level of accuracy is expected to be achieved in predicting erosion for the next 50 years, particularly in the year 2073. With the help of this system, timely prevention and management measures can be taken to reduce the impacts of coastal erosion on the environment, economy, tourism, safety, and people's way of life.

Research Question and Hypothesis

- 1.The mount of sediment in the water in relation to wind speed and direction indicates trends and patterns of future shoreline erosion.
- 2.How wind speed and direction are related to the rate of shoreline erosion.
- 3.How the amount of sediment in the water is related to the rate of shoreline erosion.
- 4.How to create a math model using Polynomial Regression Algorithm to predict accurately.

Research Methods and Materials

The Landsat 9 satellite images of the Bang Khun Thian coastline were used to crop and identify the current coastline using image processing. The sea areas were changed to black, and the pixels before the sea were changed to white, resulting in the identification of the coastline. Polynomial regression algorithm was then used to predict the likelihood of future coastal erosion patterns by inputting 900 white pixels of satellite images taken at band 5 each year for the past 10 years, along with water turbidity, wind speed, and direction measurements. The output values were plotted onto the current satellite images of Bang Khun Thian in 2566 BE. The resulting output values were compared to the previous years, and if the pixel distance exceeded the set value, it was highlighted in yellow to indicate severe erosion, and green was used to indicate mild erosion.

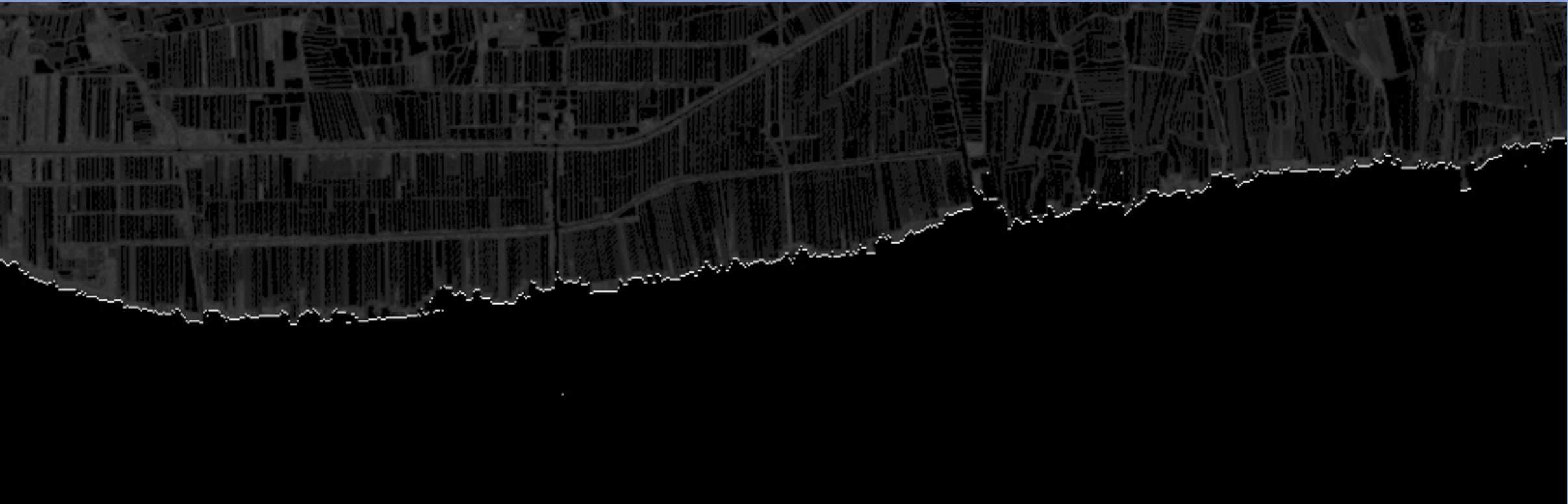


Figure 1: The erosion of the shoreline in Bang Khun Thian area at present (2023)

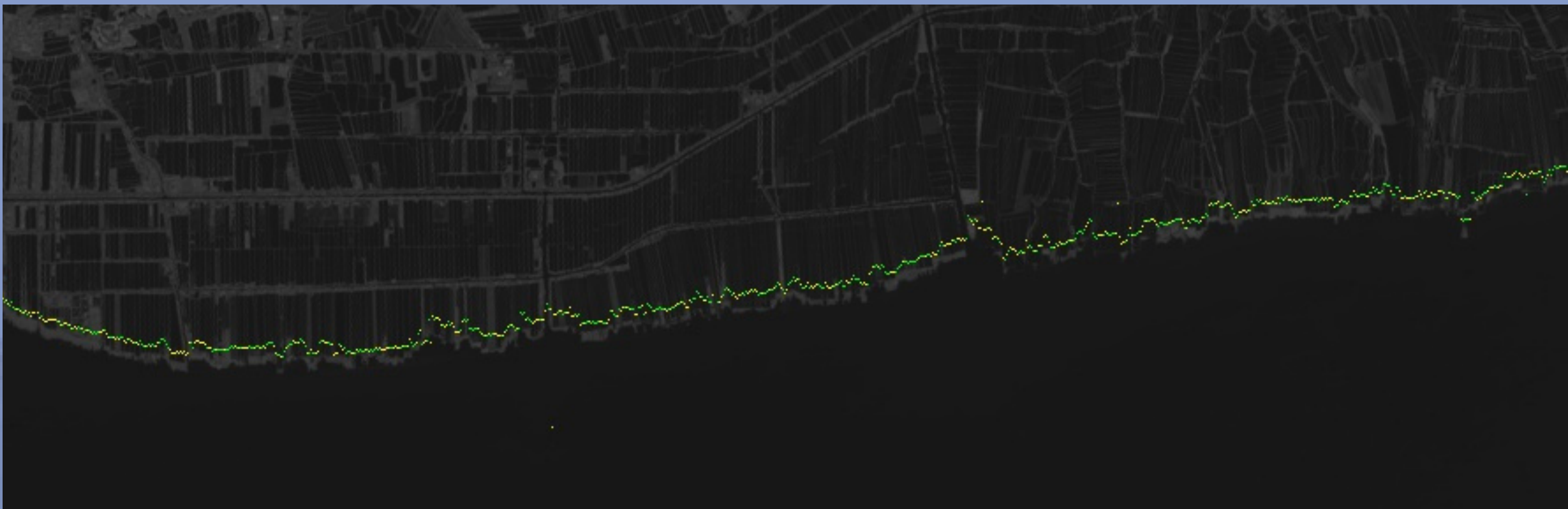


Figure 2 : The erosion in the shoreline of Bang Khun Thian in the year 2073 (Green color: mild erosion, Yellow color: severe erosion).

Results

The Polynomial Regression Model applied with satellite imagery data, underwater turbidity, wind speed, and wind direction retrospectively yielded a relatively high accuracy when compared to the current erosion rates in 2023. This enables us to confidently anticipate a high level of accuracy in the model's predictions for the next 50 years, particularly in the year 2073 .

Discussion

Overall, the proposed system offers a promising approach to tackle the issue of coastal erosion. By providing a more accurate understanding of erosion patterns, policymakers and relevant authorities can take timely and effective measures to mitigate the impacts of coastal erosion. This could include strategies such as beach nourishment, artificial reefs, or other forms of coastal protection. Ultimately, the implementation of this system can help ensure the sustainability and resilience of coastal communities and their environments.

Discussion

Overall, the proposed system offers a promising approach to tackle the issue of coastal erosion. By providing a more accurate understanding of erosion patterns, policymakers and relevant authorities can take timely and effective measures to mitigate the impacts of coastal erosion. This could include strategies such as beach nourishment, artificial reefs, or other forms of coastal protection. Ultimately, the implementation of this system can help ensure the sustainability and resilience of coastal communities and their environments.

Conclusion

The problem of coastal erosion in Bang Khun Thian, Bangkok, which has forced people to retreat or relocate, resulting in significant impacts on their livelihoods and way of life. To address this issue, researchers are developing a system that can measure and predict the likelihood of coastal erosion patterns in the future. The system uses the Polynomial Regression Algorithm based on water flow data, wind speed, and direction measurements to yield a relatively high accuracy in predicting erosion for the next 50 years, particularly in the year 2073. The Landsat 9 satellite images were used to crop and identify the current coastline using image processing. The resulting output values were compared to the previous years, and if the pixel distance exceeded the set value, it was highlighted in yellow to indicate severe erosion, and green was used to indicate mild erosion. By using this system, timely prevention and management measures can be taken to reduce the impacts of coastal erosion on the environment, economy, tourism, safety, and people's way of life.

Bibliography/Citations

- USGS. (n.d.). EarthExplorer. Retrieved January 10, 2023, <https://earthexplorer.usgs.gov/>
- Polynomial regression. (2022, October 3). In Wikipedia. https://en.wikipedia.org/w/index.php?title=Polynomial_regression&oldid=1113806162
- Faiboon A. & Sangmanee W. (2019). Geospatial Monitoring and Forecasts of Coastal Engineering Structures' Shoreline Transformational Impact at Songkhla Lake Mouth. Princess of Naradhiwas University Journal. <https://i01.tci-thaijo.org/index.php/pnujr/article/download/160033/147690/>
- OpenCV. (n.d.). OpenCV. Retrieved November 18, 2022, <https://opencv.org/>
- มหาวิทยาลัยศิลปากร, สถาบันวิจัยและพัฒนา, & สถาบันวิจัยและพัฒนา. (2018). รายงานการวิจัยและพัฒนา : การศึกษาปัญหาและผลกระทบของ. The Journal of Faculty of Applied Arts, Vol. 11, No. 2, Jul. - Dec. 2018.
- กรมอุตุนิยมวิทยา. (n.d.). พยากรณ์อากาศ 7 วันข้างหน้า, สืบค้นเมื่อ 27 พฤศจิกายน 2561. จาก. <https://www3.tmd.go.th/weather/province/bangkok>



I Make an Impact



I am a STEM Storyteller