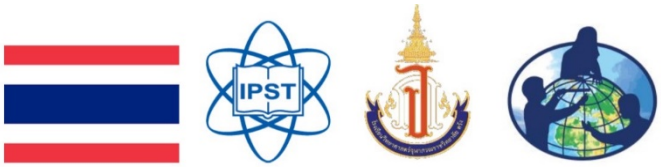

Analysis and Study of Coastal Erosion Trend at Rajamangala Beach

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5th March 2025

Abstract

Rajamangala Beach is a beautiful and well-known tourist attraction in Trang Province. It is also the site of important events such as the 'Underwater Wedding Ceremony,' a famous tradition of Trang. However, the beach has been experiencing continuous coastal erosion, with significant shoreline retreat compared to the past. This study aims to analyze the trends of coastal erosion and determine whether erosion is increasing or decreasing. The data were collected using historical imagery from Google Earth from 2014 to 2021, supplemented by previous research from 2012 to 2014. The length of the eroded shoreline was measured each year to analyze the erosion trend. The findings will be used to raise public awareness and collaborate with local communities and authorities to develop appropriate solutions to mitigate future coastal erosion and preserve the beach's environment.

keywords: Coastal Erosion, Google Earth

Introduction

Rajamangala Beach is a beautiful coastal destination featuring the well-known Wiwa Tai Samad Beach, which hosts underwater wedding ceremonies, a rare activity in Thailand. During our field study in January 2024, we observed that Rajamangala Beach has a rich coastal ecosystem and is a popular tourist destination, attracting approximately 120,000 visitors annually, with numbers increasing each year. One of the key attractions of the beach is the Underwater Wedding Ceremony.

However, during our Land Cover survey conducted using GLOBE Observer, we initially found that the beach was abundant with beach morning glory plants and lined with rows of Casuarina trees along the coastline. After a period of time, we revisited the site toward the end of the year and made a surprising discovery—the beach morning glory plants had disappeared, and many Casuarina trees had fallen or declined in number.

Following our field observations, we conducted further research by comparing satellite images from Google Earth between 2014 and 2021. The analysis revealed a gradual retreat of the shoreline, indicating a consistent trend of coastal erosion over the years. Additionally, we examined news reports regarding erosion in this area. The news content is as follows: Deputy Dean of Rajamangala University of Technology Srivijaya (RMUTSV), Trang Campus, stated that the increasing severity of coastal erosion this year has caused widespread damage to many beaches in Trang province. However, the issue can be addressed scientifically through the construction of breakwaters. The key is to study which design would have the least impact, particularly in terms of the environment, such as sand movement, and social aspects, as there may be both supporters and opponents. This remains a major challenge that all parties should discuss together to find the best solution.

confirming that it has been a persistent issue. This coastal erosion poses a significant threat to tourism and the local environment. Therefore, this project aims to analyze and study coastal erosion patterns at Rajamangala Beach to identify potential solutions for mitigating its impact.

Research Questions

1.What is the current trend of coastal erosion at Rajamangala Beach?
2.How can we help this beach if Rajamangala Beach faces coastal erosion?

Objective

1. To study the trend of coastal erosion at Rajamangala Beach over the next 10 years.
2. To explore possible solutions to mitigate erosion.

Materials

1.camera

2. computer

Methods

1. Study site

1. Conduct a field survey to inspect the current conditions at coordinates E:533977 N:831860 and record any issues or observations found. Then, revisit the site to monitor and document any changes occurring at Rajamangala Beach over time. After that, conduct a Land Cover survey and submit the data entry in GLOBE Observer.As shown in Figure1

2. Establish reference benchmarks and record their coordinates using Google Earth at the specified benchmark locations according to the Rajamangala University of Technology Srivijaya Research Journal 8(1): 60-70 (2016). A total of three reference benchmarks should be set, with an approximate distance of 200 meters between each. Additionally, identify and record the coordinates of one special study point.As shown in Figure2

3. Establish perpendicular transect lines to the shoreline by measuring the distance from the reference benchmarks to the shoreline and record the results. This data will be used to compare shoreline changes over different time periods, as shown in Figure 1. Additionally, collect data on monsoons, storms, and the ENSO phenomenon.

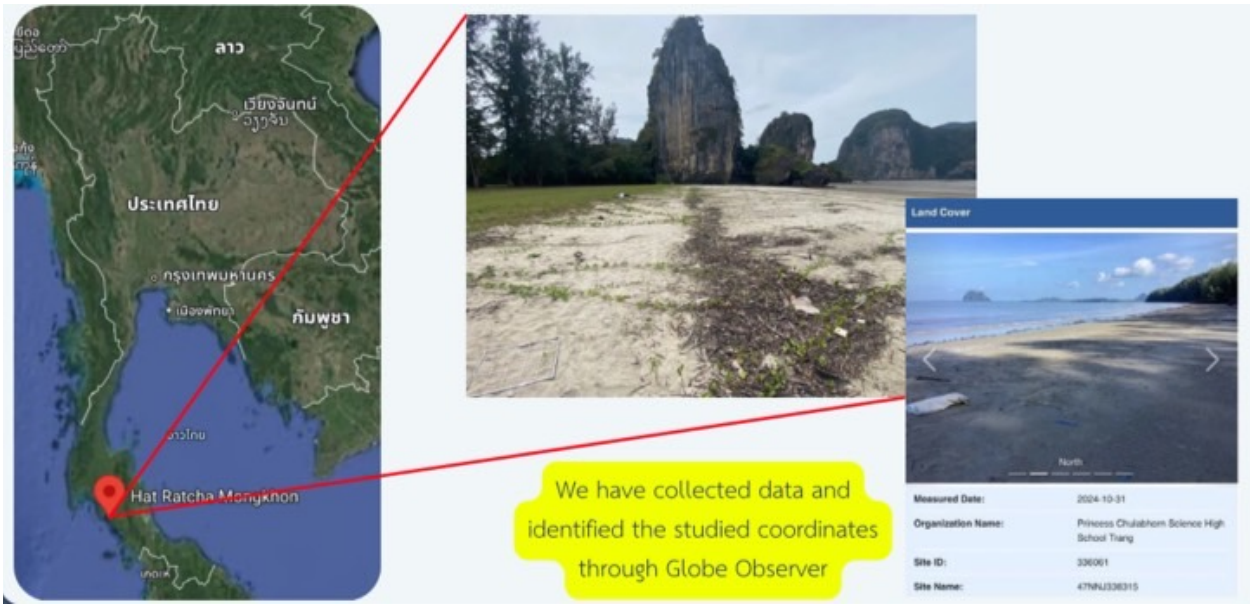

Figure1: The image show the location of Rajamangala Beach

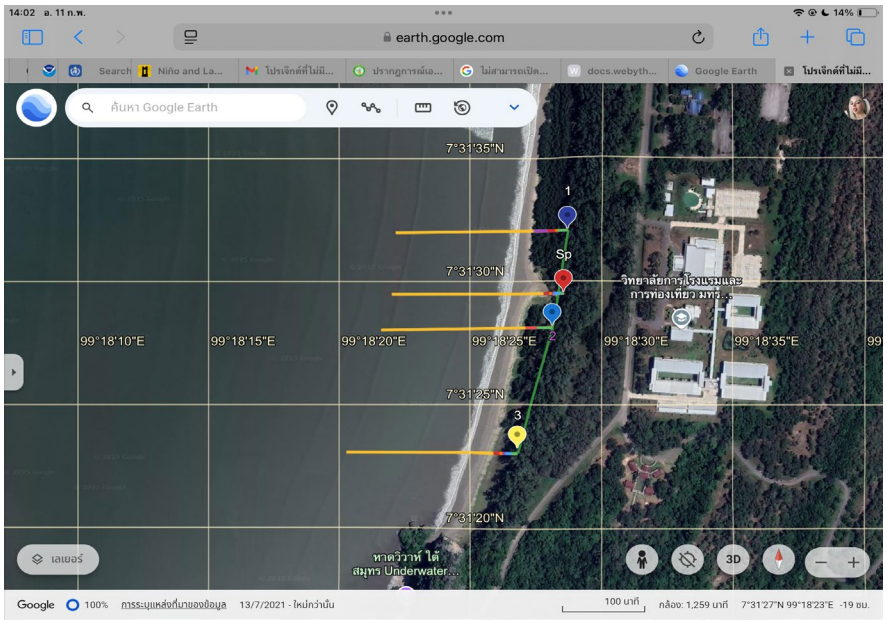

Figure 2: Shoreline Changes Measured by Distance from Reference Benchmarks Using Google Earth (2014–2021)

2. Study and research monsoon information

Research and collect monsoon data from 2014 to 2021 using the meteorological database from the Thai Meteorological Department.

3. Data analysis

Analyze shoreline changes by examining the positional changes of reference benchmark coordinates to determine whether the area is experiencing erosion or accretion. Then, calculate the annual shoreline change rate and project future erosion trends using the shoreline change rate formula.As shown Figure3

$$\text{rate of coastal erosion (m/year)} = \frac{\text{perpendicular distance from the actual coast area(m)}}{\text{year ranges}}$$

Figure 3: Formula for Calculating Shoreline Erosion Rate

Results

1.Study of Shoreline Changes Using Reference Benchmarks for Monitoring the Changes of Rajamangala Beach Shoreline

A total of three reference benchmarks were established, with a distance of approximately 200 meters between them. Additionally, one special study point (Sp) was selected. Data was recorded from September 2012 to July 2021, spanning 8 years and 10 months. The results revealed that during this study period, all reference benchmark points showed changes in the shoreline. For Reference Benchmarks 2 and 3 and the special study point (Sp), shoreline changes were characterized by erosion, with distances of 9.05 meters, 21.62 meters, and 19.38 meters, respectively. The annual erosion rates were 1.02 meters, 2.45 meters, and 2.19 meters per year, respectively. It is projected that in the next 10 years, the shoreline erosion will be 10.2 meters, 24.5 meters, and 21.9 meters, respectively. For Reference Benchmark 1, the shoreline changed differently compared to other areas, with an increase of 14.81 meters, and the annual shoreline change rate was 1.68 meters per year, as shown in Table 1.

Table 1: Shows the data on the distance of shoreline changes (meters) and the rate of change (meters/year)

location/period (Specify month and year)	2012-2016	2016-2018	2018-2021	Beginning of the year 2021- end of year 2021	Overall rate of change over 8 years and 10 months
location1	-8.29	-3.07	27.56	-1.39	1.68
location2	-13	-2.1	9.66	-3.61	-1.02
location3	-7.45	-2.89	-3.57	-7.71	-2.45
Location Sp	-6.05	-2.75	-2.67	-7.91	-2.19

Discussion

The study of shoreline changes at Rajamangala Beach, Trang Province, using reference benchmarks, GPS application for transect walking, and field surveys revealed that Rajamangala Beach has undergone shoreline changes at locations 1, 2, 3, and the special point (SP). At Location 1, the shoreline has increased compared to other points, due to mangrove planting activities conducted by Rajamangala University of Technology Srivijaya, Trang Campus, in 2021. At Location 3, it was found to have the highest average erosion rate, followed by the SP and Location 2, respectively. The periods of highest erosion at each reference point often coincided with significant events, such as the El Niño-La Niña phenomenon and tropical cyclones. Therefore, it can be concluded that the main cause of shoreline erosion is these factors. A follow-up visit to the site was conducted to consult with Rajamangala University of Technology Srivijaya, Trang Campus, where plans were made to educate the local community and promote mangrove planting as a means to reduce the future rate of shoreline erosion.

Conclusion

Based on the retrospective survey and analysis of the data, it was found that coastal erosion is occurring, mainly caused by tropical storms and the El Niño-La Niña phenomenon, which significantly affect the rate of shoreline erosion. If these issues are not addressed, it is predicted that the coastline will erode by approximately 19 meters, which will have a severe impact on the local wildlife and environment. Field observations revealed that even before a full year had passed, the coastal area had already shrunk, as evidenced by the death of seagrass due to saltwater intrusion. The situation prompted consultations with Rajamangala University of Technology Srivijaya, Trang Campus, where plans were made to educate the local community and promote mangrove planting to reduce the rate of coastal erosion.

Acknowledgments

This project was successfully completed with the kind support of our advisor, Ms. Nuengruethai Chaimanee, who provided valuable guidance and feedback throughout the study. We would like to express our deep gratitude for her invaluable assistance.

We would also like to thank our parents for their continuous support and encouragement. Additionally, we appreciate our friends and seniors who provided useful suggestions regarding the project.

Citations

Nikom Onsri, Aneak Sawain, Surin Kanchana, Narit Klompong. (2015.) A Study of Shoreline Change along the Andaman Sea Coast in Sikao District, Trang Province. Rajamangala University of Technology form:https://www.repository.rmutsv.ac.th/bitstream/handle/123456789/1187/FullText.pdf?sequence=1rom 2012 to 2014

The Climate Center, Meteorological Development Division. (2023.) Thai Meteorological Department Environmental Journal, Year 15, Issue 1, January - March 2011, Pages 7-11. Environmental Research Institute. Chulalongkorn University from: https://www.tmd.go.th/

GLOBE Data Entry

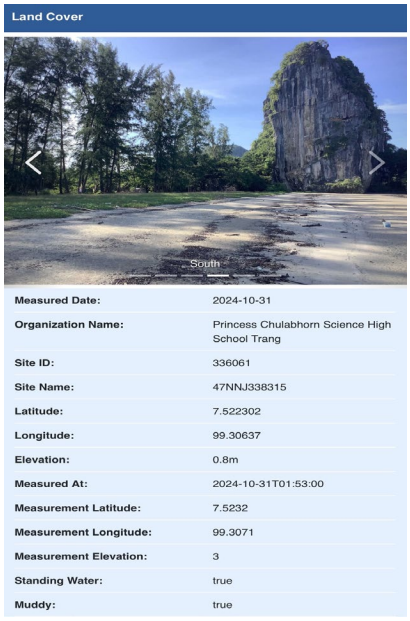

Figure4: Land cover Data

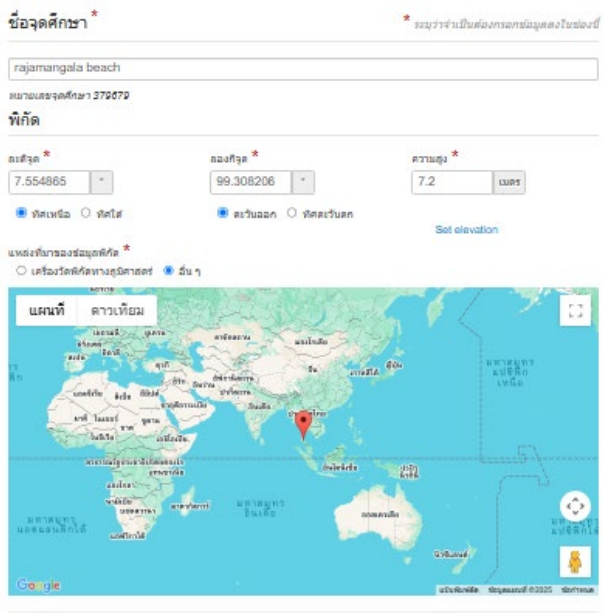

Figure5: Study Site Data

Optional Badge

1. I AM A DATA SCIENTIST

In this research, the author conducted field surveys at Hat Rajamangala during early 2024 and again at the end of the year. The surveys revealed noticeable changes in the coastal line, prompting the researcher to collect historical data from Google Earth to observe the coastal erosion trends at Hat Rajamangala, Trang, from 2014 to 2021. Additionally, the researcher studied coastal erosion data from 2011 to 2014, published in the journal of Rajamangala University of Technology Srivijaya, to further understand the shoreline changes. The study analyzed the transformation of the coastline at Hat Rajamangala from 2011 to 2021 and found a consistent decrease in shoreline area, influenced by various factors such as tropical storms and El Niño-La Niña events. The rate of shoreline reduction each year primarily depends on the prevailing weather conditions. To assess future trends, the researcher calculated the annual average erosion rates at key observation points, allowing for a more comprehensive understanding of the situation. This data-driven approach aims to help predict future erosion patterns and, in collaboration with the local community, find sustainable solutions to mitigate and address the erosion issues effectively.

2. I MAKE AN IMPACT

This research provides the opportunity for the local community at Hat Rajamangala to collaborate with the researchers in developing solutions to prevent and address coastal erosion near their settlements. Through the study and analysis of coastal erosion trends at Hat Rajamangala, the findings contribute to the development and promotion of tourism at Hat Wiwah, a key attraction of Hat Rajamangala. The community will be able to enhance its resilience against erosion while also promoting tourism, which is expected to boost the local economy and generate greater income opportunities for the residents of Hat Rajamangala in the future.

3. I AM A PROBLEM SOLVER

This research can help address issues related to tourism and contribute to the economic development of the province. It can also encourage people to engage in unique activities, which are a highlight of Hat Wiwah, a part of Hat Rajamangala, Trang. This study aims to analyze future trends in coastal erosion at Hat Rajamangala, Trang, an area that has the potential to support tourism. Additionally, it explores solutions in collaboration with the local community at Hat Rajamangala to play a role in the economic development of tourism in the province and surrounding communities.

Appendix with raw data

El Niño and La Niña Years and Intensities

Based on Oceanic Niño Index (ONI)

Jan Null, CCM

Updated thru November-December 2024 - january 2025

The Oceanic Niño Index (ONI) has become the de-facto standard that NOAA uses for classifying El Niño (warm) and La Niña (cool) events in the eastern tropical Pacific. It is the running 3-month mean SST anomaly for the Niño 3.4 region (i.e., 5°N-5°S, 120°-170°W). Events are defined as 5 consecutive overlapping 3-month periods at or above the +0.5° anomaly for warm (El Niño) events and at or below the -0.5 anomaly for cool (La Niña) events. The threshold is further broken down into Weak (with a 0.5 to 0.9 SST anomaly), Moderate (1.0 to 1.4), Strong (1.5 to 1.9) and Very Strong (≥ 2.0) events. For the purpose of this report for an event to be categorized as weak, moderate, strong or very strong it must have equaled or exceeded the threshold of the highest category for at least 3 consecutive overlapping 3-month periods.

El Niño - 27				La Niña - 25		
Weak - 11	Moderate - 7	Strong - 6	Very Strong - 3	Weak - 12	Moderate - 6	Strong - 7
1952-53	1951-52	1957-58	1982-83	1954-55	1955-56	1973-74
1953-54	1963-64	1965-66	1997-98	1964-65	1970-71	1975-76
1958-59	1968-69	1972-73	2015-16	1971-72	1995-96	1988-89
1969-70	1986-87	1987-88		1974-75	2011-12	1998-99
1976-77	1994-95	1991-92		1983-84	2020-21	1999-00
1977-78	2002-03	2023-24		1984-85	2021-22	2007-08
1979-80	2009-10			2000-01		2010-11
2004-05				2005-06		
2006-07				2008-09		
2014-15				2016-17		
2018-19				2017-18		
				2022-23		

Figure5: The El nino and La nina Data

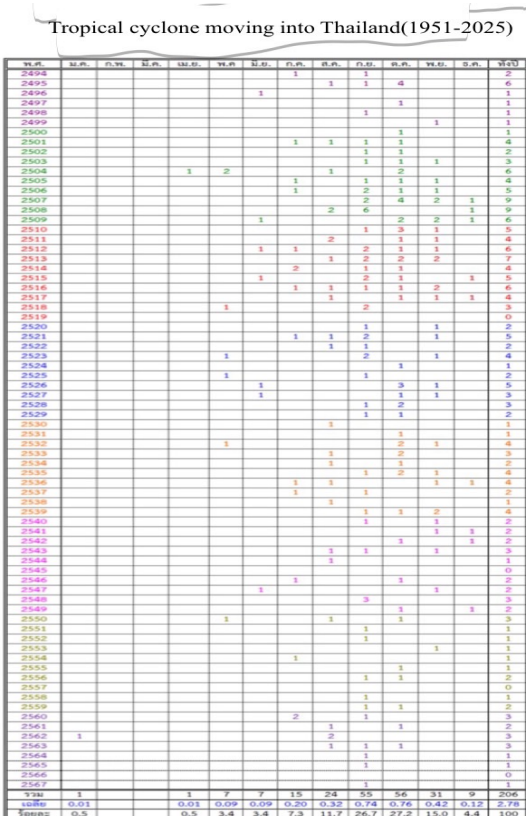

Figure6: Tropical cyclone moving into Thailand (1951-2025)

Table showing the changes in the coastline of Rajamangala Beach from 2014 to 2021.

	#07 2021	#01 2021 -07 2021	#2018 -2021	#2016 -2018	#2014 -2016	Rate of change (meters per year)	**2020-2023 Triple Lanina
1	0.00	-1.39	27.56	-3.07	-8.29	1.68	2023-2024 El Niño
2	0.00	-3.61	-2.10	9.66	-13.00	-1.02	
3	0.00	-7.71	-3.57	-2.89	-7.45	-2.45	
Sp	0.00	-7.91	-2.67	-2.75	-6.05	-2.19	
	La Niña	La Niña	La Niña	La Niña	Severe El Niño		
		Typhoon Sinlaku	Typhoon Son-Tinh	Northeast monsoon	Monsoon trough		
		Typhoon Noul	Southwest monsoon	Southwest monsoon	outhwest monsoon		
		Monsoon trough	Monsoon trough	Typhoon Tokage	lortheast monsoon		
		Northeast monsoon	Northeast monsoon	Pressure trough	Typhoon Hagupt		
			Typhoon Plabuk				

Figure7: Distance data of coastline changes over different periods