

Sedimentology and geomorphology analysis of coastal area along pantai penarik, terengganu before and during northeast monsoon season

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Abstract. This research is conducted to understand the sedimentology and morphological change before and during the northeast monsoon at the east coast of peninsular Malaysia. The increase in wind speed, wave energy and rainfall during the northeast monsoon are believed to causes the coastal erosion to increase during the season. Rapid development along the east coast area might disrupt the sediments distribution which can increase the coastal erosion rate every year. The understanding on the sediments distribution, erosion and deposition as well as the morphological change can help to figure out if the coastal erosion can affect the infrastructure in the future. The result of the study can show the necessity to perform mitigation or any required action toward the problem that might happen

1. Introduction

Development activities that have been done on the east coast area may have causes the sediment circulation disrupted while the aggressive wave erosion during Northeast monsoon that come from November until March have made the condition worsen [1] [2] [3]. Numerous studies have been done at this coastline, mostly on the coastal erosion at the beach. Among the study that have been done are the Open Sandy Beach Morphology and Morphodynamic as Response to Seasonal Monsoon in Kuala Terengganu, Malaysia, Beach Erosion Variability during a Northeast Monsoon: The Kuala Setiu Coastline, Terengganu, Malaysia and Variation of beach sand in relation to littoral drift direction along the Kuala Terengganu coast.

The local newspaper, The New Strait Times have released an article on February 2016 regarding the bad condition of Terengganu coastline. The article stated that the beach protections made at the coastline are not enough and need to be stretch. One problem arises from recent the monsoon is that the beaches sediments are not fully recovered after the monsoon [4]. Since the issue arises, the understanding about the sediment transport and morphological changes at the Terengganu coastline and the factor affecting it need to be done to find a suitable solution to minimize the erosion effect of Northeast monsoon to the beaches [5] [6].

The objectives of this study are to analyses the sediments distribution and morphological change at the coastal area along Pantai Penarik, Terengganu before and during the Northeast monsoon. The map of study area before and after the Northeast monsoon will be produce to determine the net shore direction.

2. Study area

The study area located at Pantai Penarik at Setiu, Terengganu as shown in Figure 1. It is located about 12 kilometers at Northeast direction of Bandar Permaisuri. Pantai Penarik is one of the famous tourism



area in Terengganu. Along the beaches, there are several restaurants, grocery store, and population nearby the coastline.

The nearest delta located about 8 kilometres at Northwest direction from the study area. At distance from 10 to 30 kilometres from the coastline, there are several islands at the sea which include Pulau Redang and Pulau Perhentian. This study cover 1 kilometre distance of the beaches. There are 11 checkpoints named as point 0 to point 10. Each point has distance of 100 meters apart. Cross section and sediments sampling are collected at each checkpoint.

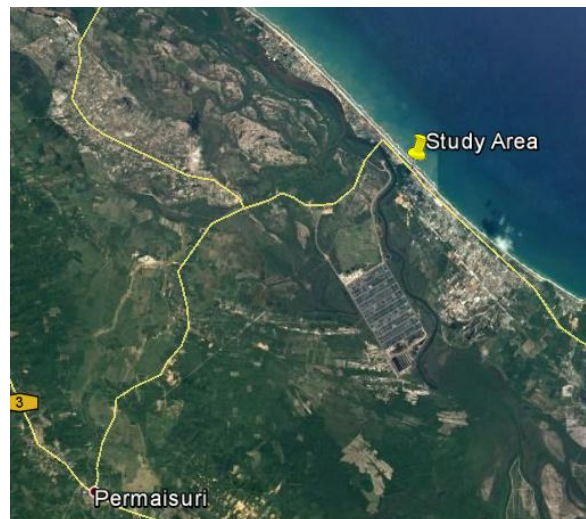


Figure 1: The location of the study area

3. Research methodology

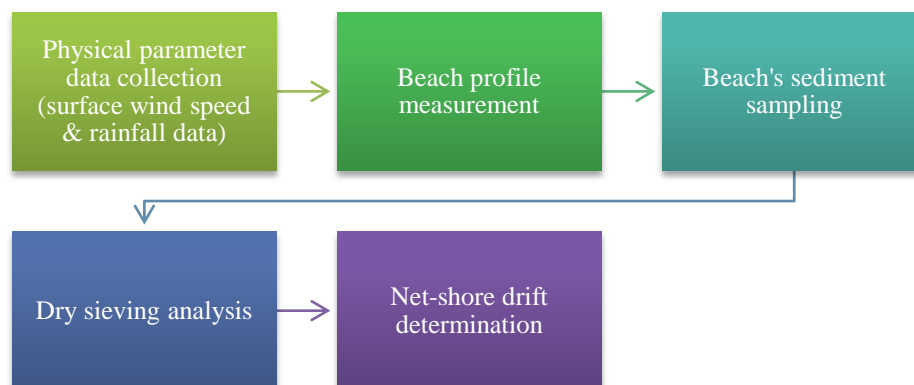


Figure 2: The flowchart of research methodology

4. Result and discussion

4.1. Physical parameter data collection

The monthly rainfall data and wind speed data of 2015 and 2016 were collected from Malaysia Meteorological Department to see the weather change based on each season. The result show that during November, the total rainfall in Terengganu is almost was the highest compared to another month, similar to the past study that have been done [7]. This show that the peak of Northeast monsoon happens in November. The surface wind speed data also show that wind speed on both years are high from December until February. The highest mean surface wind speed recorded was in February 2016 which is still within the northeast monsoon period. In short, the weather during northeast monsoon do become abrupt compared to the transition period and southwest monsoon [4].

4.2. Beach profile measurement

The beach profile measurement for data before northeast monsoon was completed by using the total station equipment. The data consist of profile for 1 kilometre long beach with 11. Each checkpoint has 100 meter from each other. Based on the data collected, the beach width and maximum slope angle of each checkpoints are collected.

Two process either erosion or deposition of sediments happened along the beach. The erosion is identified when there is a decrease in profile from July compared to October and deposition is vice versa. The summary of the result are tabulated in Table 1.

Table 1: Summary of profiling result

Distance (m)	Beach width (meter)		Maximum Slope angle (°)		Activities
	July	October	July	October	
0	23.22	22.72	9.85	22.05	Erosion
100	36.12	43.24	10.55	9.05	Erosion
200	29.64	31.40	12.11	9.69	Erosion
300	33.92	30.67	9.63	17.95	Erosion
400	27.03	39.51	13.11	10.46	Deposition
500	25.74	30.00	15.60	14.74	Erosion
600	35.28	31.25	11.02	9.45	Deposition
700	29.86	32.65	13.53	9.89	Erosion
800	27.87	32.71	9.71	13.92	Deposition
900	25.04	28.10	10.47	8.59	Deposition
1000	27.18	28.98	9.47	7.76	Deposition

4.3. Sieve analysis

The results of mean size analysis and sediment sorting calculate using GRADISTAT method [6] from samples taken on July and October are used to generate a static model. The map from July data are shown in Figure 3(a) and 5(b). The sediments collected during July show that most of the sample in low tide area are coarse sand. In the middle tide area, the grain size are either fine sand or medium sand. The high tide area during July all has medium sand grains. The results of sorting show that the sediments at the low tide area on July are either poorly sorted or moderately sorted. At the middle tide area, the sorting are mostly either moderately well sorted or moderately sorted. In the high tide zone, most of the sediments are moderately sorted. The low tide area that has coarse sand and poorly sorted show the inconsistency in the wave energy. That area probably only experience low wave energy hence only transport the light fine grain.

During October, the low tide area has changed from coarse sand to medium sand in some area. Some area still has coarse sand. The middle tide area still has the medium or fine sand and the high tide area all show medium sand grains. During October, the sediments in the low tide zone are poorly sorted. Only three checkpoints are moderately sorted. The middle tide zone are all moderately sorted and the high tide zone mostly are moderately sorted. Except for point 0 where it is moderately well sorted. This show the consistency in the wave energy which probably quite strong and capable of transport coarse sand throughout the process.

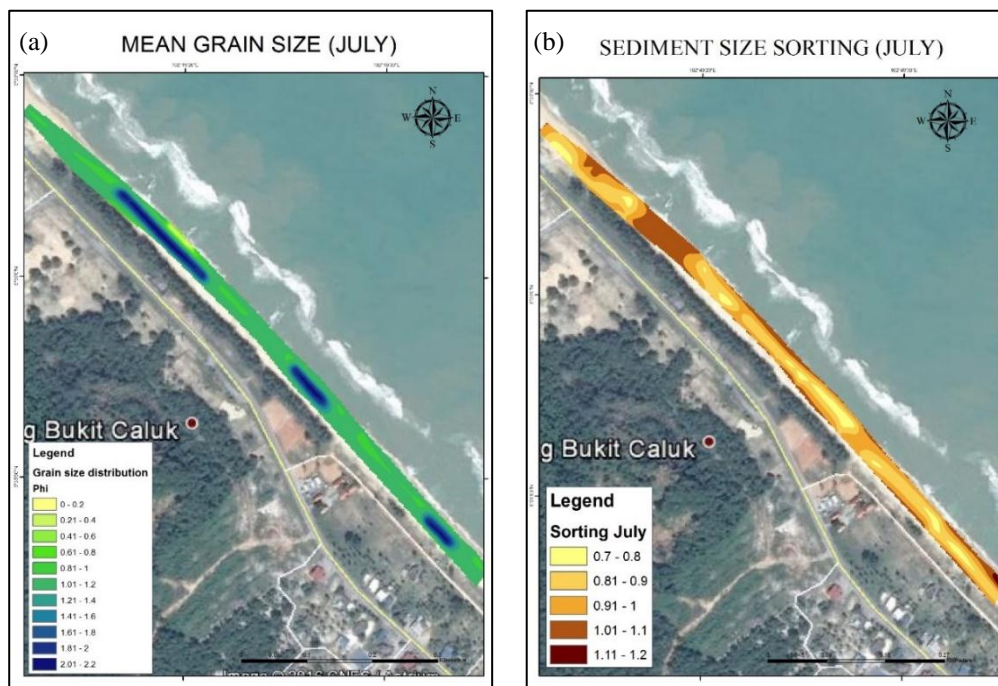


Figure 3(a) the sediment size distribution created based on the July data result and 5(b) the sediment sorting map of July data

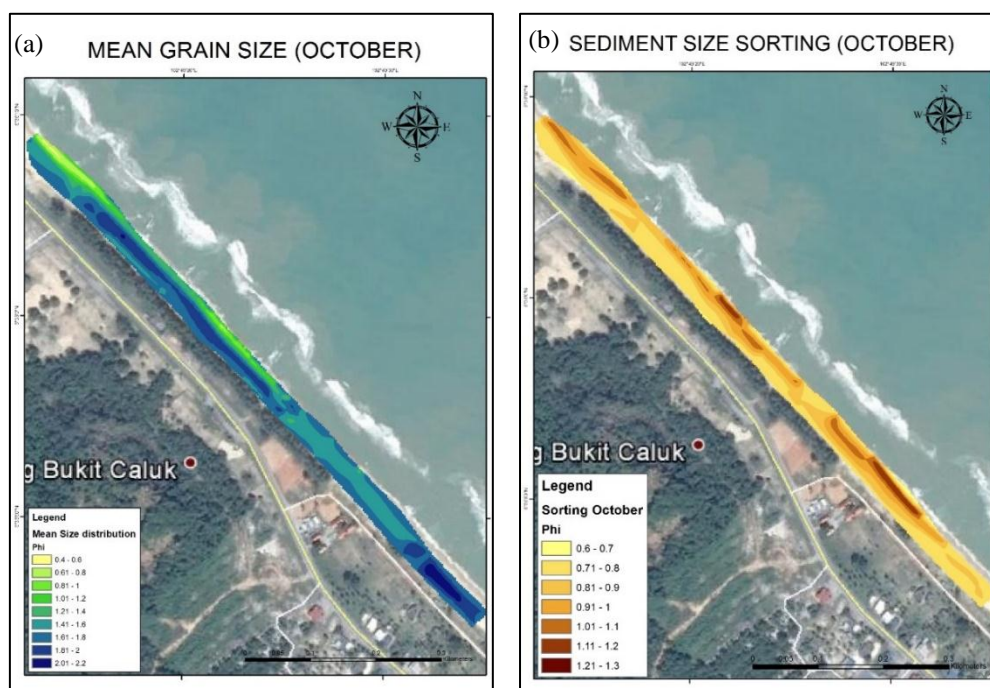


Figure 4(a) the sediment size distribution created based on the October data result and 6(b) the sediment sorting map of October data

4.4. Net-shore drift

Based on the profiling result and the sieve analysis result, the net shore drift can be determine based on the observation of the data. Based on profiling result in Table 1, morphological change show that the erosion happen in the northwest direction of the study area and the deposition happen in the

southeast direction of the study area. This show that the sediments that eroded from the northwest area are transported and deposited at the southeast area.

The static model of the mean size distribution from July data (Figure 3) show coarser sediments accumulated at the northwest area. Although most of the sediments especially in the low tide areas are coarse sand, there is still more distribution of coarser sediment at the northwest area. This can be interpreted as the finer sediment have been transported toward southeast direction.

The mean size distribution map from October data (Figure 4) shown that there is change of distribution compared to July data. During this period, the sediments accumulated at the northwest area are mostly coarse sediments while the moderate sand sediments accumulated at the southeast area. This has strengthen the interpretation made from July data which stated that the fine sediments have been transported in southeast direction.

4.5. Economic value

Pantai Penarik is an attractive tourism spot in Terengganu. Generally, this area is a moderately populated area. On top of that, there are several shop and restaurant located along the road which located only 50 meters from the shoreline. The wave and coastal erosion can effect or destroy the houses and shops that located near the shoreline. During the second visit, a minor destruction on a small infrastructure was observed. This show that the wave have the capability to hit and destroy other infrastructure along the coastline. Other than that, the change could also causes the human activities to be affected which include the fisherman activities and tourism [8] [9].

5. Conclusion and recommendation

Based on the past studies such as Open Sandy Beach Morphology and Morphodynamic as Response to Seasonal Monsoon in Kuala Terengganu and Beach Erosion Variability during a Northeast Monsoon: The Kuala Setiu Coastline which stated about the sediment deposition disruption and possible coastal erosion due to the effect of Northeast monsoon, the conclusion that can be made is that more study need to be done not only in Terengganu, but also other location in East Coast. The study can be focusing on monitoring the beach change due to the wave action and effect caused by human activities. Other than that the reason the effect of the Northeast monsoon worsen also need to be study to understand the causes and learn the possible prevention action.

In term of this study, the comparison between the July data and end of October data show the difference especially in sediments analysis. The physical parameter data show that the month of October wind speed and rainfall data is high, but still in the average value. The maximum amount of wind speed and rainfall is on November. Because of this, the data is best collected during November so the major effect of Northeast monsoon can be study.

Other than that, the rules regarding the development, especially on the coastal line area need to be revise. The geological factors need to be emphasized in the regulations so the future development will have no effect to the environment or the effect can be controlled.

6. References

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