PAPER

Overview of Monsoon Induced Coastal Erosion Disaster in Peninsular Malaysia Based On Mass-Media Reports

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Overview of Monsoon Induced Coastal Erosion Disaster in Peninsular Malaysia Based On Mass-Media Reports

R Yanalagaran, N I Ramli and P J Ramadhansyah

Faculty of Civil Engineering & Earth Resources, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang Darul Makmur, Malaysia.

Email: noram@ump.edu.my

Abstract. Peninsular Malaysia coastline is undergoing extreme level of erosion causing economic retardation and life threatening situation. National Coastal Erosion Studies 1984 shows that around 52% of Peninsular Malaysia's coastline is undergoing erosion and these value might have increased over the years. Hence, this paper aims to locate the erosion prone area in Peninsular Malaysia in response to monsoon by utilizing documented mass media reports. The review of mass media reports were analysed together with wind speed in representative of monsoon for the five years period to achieve the aim of this paper. The outcome of this study shows that the severity of coastal erosion in Peninsular Malaysia is increasing drastically. In addition, the northeast monsoon shows the highest impact on the erosion disaster especially in the East Coast of Peninsular Malaysia. The result from this empirical studies shows a good correlation between coastal erosion and monsoon in Peninsular Malaysia. Therefore, the coastal erosion is highly catalysed by monsoon (wind) as its prime catalyst.

1. Introduction

Coastal erosion could be defined as the land ward displacement of the shoreline caused by the movement of wind and water [1,2]. In Malaysia, almost 30% of coastline are undergoing erosion (52% for Peninsular Malaysia) based on the National Coastal Erosion Study in 1984 [3]. The severity of this problem had caused the government to classify coastal erosion into different categories such as a) Category 1: Critical, b) Category 2: Significant, and c) Category 3: Acceptable [4]. However, in Malaysia coastal erosion disaster is still underrated till the very few years, the society starts to show their concerns [5]. One of the main cause of coastal erosion in Peninsular Malaysia is due to the wind climate that is dominated by monsoons all over the year [6]. Peninsular Malaysia was already prone to a lot of wind related disasters (thunderstorms, landslides, cyclone and etc.) [7] And now taking its turn towards worsening coastal erosion phenomena [8]. The traditional interpretation of coastal erosion and wind related disaster might not give any relevancy but however, previous research has proven that wind is the main catalyse that cause severe coastal erosion in Peninsular Malaysia [9-11]. The mechanism works as the wind defines the wind waves. The stronger the wind in the coastal zone, the larger is the wave height and therefore the erosive action. Accordingly, the objective of this paper is to identify the erosion prone areas in Peninsular Malaysia based on coastal erosion cases documented by mass media in recent years with response to monsoons in Peninsular Malaysia.

2. Methodology

2.1. Coastal erosion cases

Firstly, an extensive review of online news, news video and online newspaper archives reports documenting coastal erosion in Peninsular Malaysia has been performed using the Public Domain search engines (For instance: www.google.com). Keywords such as "coastal erosion", "coastal erosion damages" or "coastal erosion cases" were used. The search was conducted by setting the time frame to indicate a custom range over a period of time. For instance, the first and last day of each month (January-December) for each considered year that are from year 2013 – year 2017 [12]. Next, collected information was made sure to have reliable publisher, date of occurrence, location of occurrence and other contents that is related to coastal erosion issues as per shown in Figure 1.

Figure 1. Example of online news information layout.

Secondly, all the collected data from year 2013 to year 2017 was tabulated in respective of their year, date, state, news title and publisher using Excel spreadsheet. Several tabulation that emphasizes different data by using "Sort & Filter" option was made based on the collected data to ensure smooth data analysis. The example of data tabulation for this research is shown in Table 1 in reference to Figure 1. These list of data were then processed into several interactive graphs to achieve the aim of this investigation.

Table 1. Example of case tabulation.

Year	Date	Location	Cases	News
2013	11-Oct	Negeri Sembilan	*Hotel diancam…*	Sinar Online

2.2. Wind speed data

The wind climate in Peninsular Malaysia is dominated by North Eastern Monsoon (November-March), South Western Monsoon (Mid-April-September) and Inter Monsoon (April and October). The

wind speed in Peninsular Malaysia is highly influenced by its monsoonal season [7]. The wind speed for this study was taken for five years period because the variation of average wind speed can be very large for the period of more than five years [13]. The meteorological data of Peninsular Malaysia from year 2013 to year 2017 were obtained from an online metrological database [14] that is also famous among other researcher [15-17]. The database contains observed historical wind data that were classified into Maximum, Average, and Minimum as per shown in Figure 2. In this research, daily Maximum wind speed data was utilised to study the extremity of coastal erosion in Peninsular Malaysia [18]. The wind speed data were then processed to produce average wind speed in peninsular Malaysia (Figure 3), average wind speed in east coast of peninsular Malaysia and average wind speed of west coast of peninsular Malaysia.

2018	Temp. (°C)			Dew Point (°C)			Humidity (%)			Sea Level Press. (hPa)			Visibility (km)			Wind (km/h)			Precip. (mm)	Events
Jan	high	avg	low	high	avg	low	high	avg	low	high	avg	low	high	avg	low	high	avg	high	sum	
1	27	26	25	24	24	23	94	87	79	1010	1008	1007	10	9	6	26	19	-	0	Rain
2	27	26	26	24	24	23	89	83	79	1009	1008	1006	10	10	6	23	19	39	0	Rain
3	29	27	26	25	24	23	89	83	74	1010	1008	1006	10	10	9	19	13	-	0	Rain

Figure 2. Example of case tabulation.

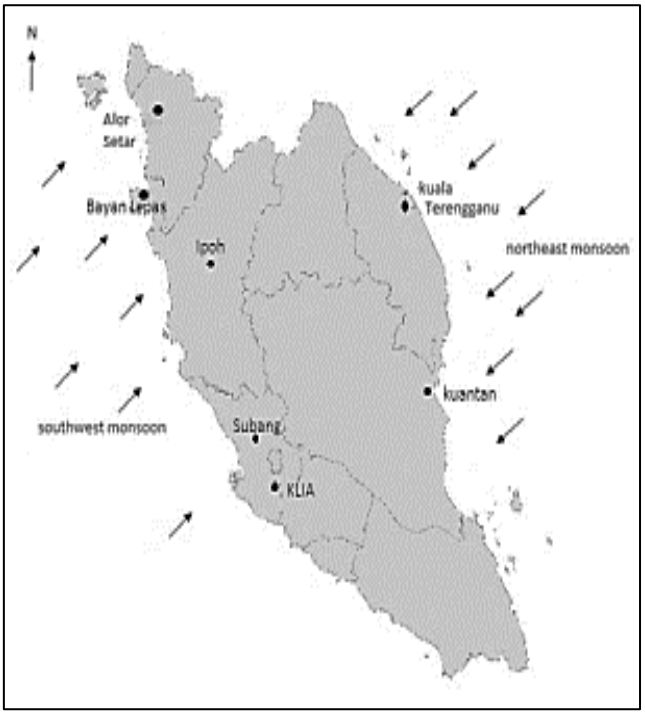

Figure 3. Monsoon flow in Peninsular Malaysia. [20]

3. Results and discussions

3.1. Annual coastal erosion analysis

The analysis of the five years (2013-2017) study period data had given a total of 100 cases inclusive of all news related to erosion such as damages, mitigation and community opinion. Figure 4 shows the trend of coastal erosion cases in Peninsular Malaysia from year 2013 to year 2017, which shows a drastic increment. The increment in coastal erosion cases shows a significant relationship with the increment of wind related disaster as portrayed by the previous researcher, as it grows more rapidly by each year and created awareness among the Malaysian citizens [6].

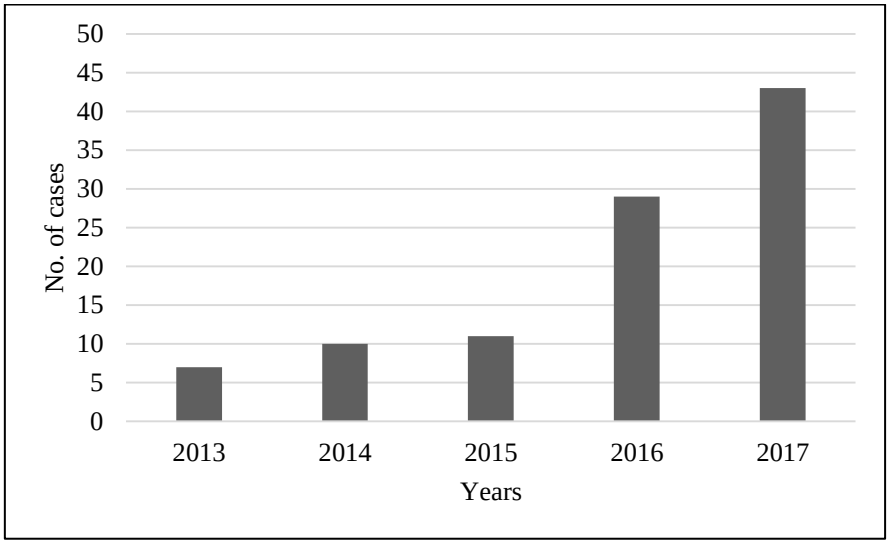

Figure 4. Total coastal erosion cases in Peninsular Malaysia (2013 – 2017).

3.2. Annual coastal erosion and wind speed analysis

In regards to the increment coastal erosion cases and wind related disaster as signified by the previous researches, an analysis of coastal erosion cases and average wind speed in Peninsular Malaysia was done. The analysis was done from the year 2013 to year 2017 as shown in Figure 5 in monthly separation perspective. Figure 4 exhibits some distinguish result that shows the relevancy of wind speed (monthly average) along with the number of coastal erosion cases. The analysed wind speed data in this study agrees well with previous researchers data in Peninsular Malaysia [19]. The highest of both coastal erosion cases documented and average wind speed are noted on February and December. The lowest of coastal erosion documented cases are on March and Jun in which Jun has the least average wind speed too. The rest of the months exhibits significant amount of cases along with the wind speed in Peninsular Malaysia.

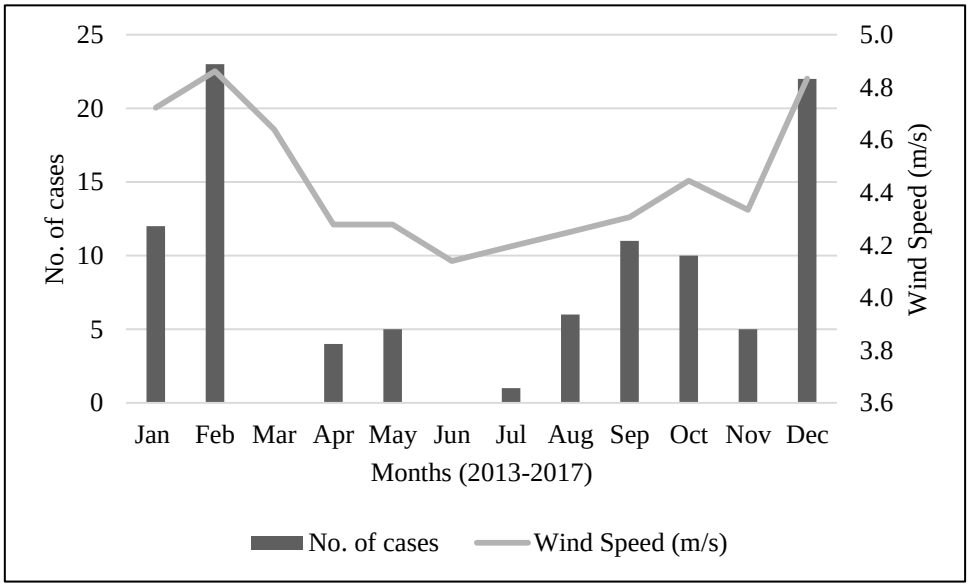

Figure 5. Coastal erosion cases and average wind speed in Peninsular Malaysia (2013 – 2017).

The justification of this result could be related to the wind flow of Peninsular Malaysia that are dominated by monsoons [6,20]. Firstly, the highest cases of coastal erosion are documented along with

the highest average wind speed in the month of February and December which falls into the duration of Northeast monsoon flow (November to March). The least amount of cases are documented during the Southwest monsoon (May to September). In this period zero cases were achieved in March and Jun along with the lowest average wind speed. The inter monsoon season on April shows a dim increment in the number of erosion cases and low wind speed as it approaches Southwest monsoon. In contrast to inter monsoon on October that shows a high increment in the number of cases and wind speed as it approaches Northeast monsoon. In brief, this analysis shows that Northeast Monsoon has a bigger impact on the coastal erosion in Peninsular Malaysia compared to Southwest monsoon [10,21].

3.3. Annual erosion and wind speed analysis (Sections of Peninsular Malaysia)
Further analysis of coastal erosion and wind speed was done to identify the locations of erosion in Peninsular Malaysia. Based on this extensive review, it shows that nine states in Peninsular Malaysia is undergoing coastal erosion that are Johor, Kelantan, Melaka, Negeri Sembilan, Pahang, Pulau Pinang, Perak, Selangor, Terengganu. Geographically, these states could be merged into sections such as East Coast of Peninsular Malaysia (Kelantan, Pahang, and Terengganu) and the West Coast of Peninsular Malaysia (Melaka, Negeri Sembilan, Pulau Pinang, Perak, Selangor, and Johor).

3.3.1. West coast region.
The similar analysis of coastal erosion cases and wind speed analysis was done for the west coast region as shown in Figure 6. The analysis done for the west coast region shows that west coast had very little amount of erosion cases over the period of five years with some of months had absolute zero cases documented. The highest wind speed recorded around March shows the end of northeast monsoon and transitioning to southwest monsoon which lasted until September with the highest case of coastal erosion documented over the period with no significant wind speed related. Hence, based on the review it shows that west coast of Peninsular Malaysia is less likely to be majorly damaged by the coastal erosion without denying the fact erosions are happening but in a very low rate.

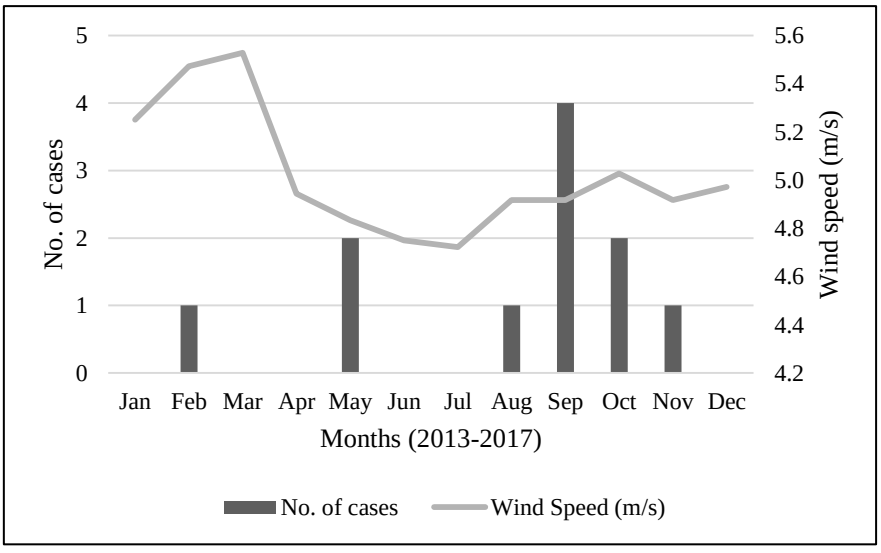

Figure 6. Coastal erosion cases and average wind speed in West Coast of Peninsular Malaysia (2013 – 2017).

3.3.2. East coast region. The similar analysis of coastal erosion cases and wind speed analysis was done for the east coast region as shown in Figure 7. The analysis done for the east coast region shows that east coast had extreme amount of erosion cases over the period of five years. The highest wind speed recorded around December shows the beginning of northeast monsoon that lasted till March with the highest case of coastal erosion documented over the period with significant wind speed

related. Hence, based on the review it shows that east coast of Peninsular Malaysia is more likely to be majorly damaged by the coastal erosion with alarmingly high rate of cases.

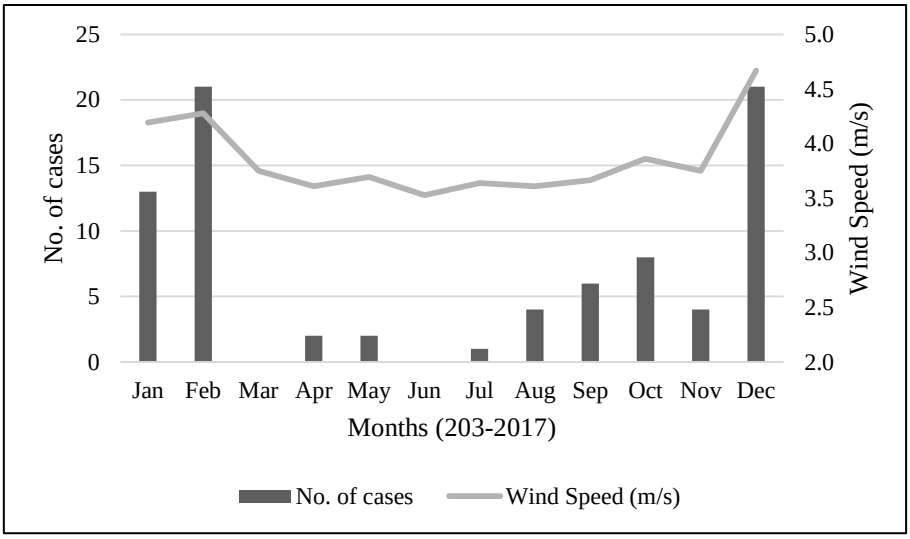

Figure 7. Coastal erosion cases and average wind speed in East Coast of Peninsular Malaysia (2013 – 2017).

3.4. Coastal erosion and monsoon correlation

Subsequently, in this study the evaluation of coastal erosion and monsoon correlation was done solely using the collected wind speed data and number of cases documented. Based on these information the graph of wind speed (representing monsoon) against number of coastal erosion cases was plotted as shown in Figure 8. In fact, the correlation between wind speed that represents monsoon and number of coastal erosion cases shows a good correlation with the regression analysis of $R^2 = 0.6$. The twelve plotted points represents all the twelve months representing the number of coastal erosion cases and wind speed for each months as portrayed in Figure 4. It as well as exhibits similar data content as shown in Figure 4 except that Figure 7 shows clearer absence and extremity of coastal erosion and wind speed relationship.

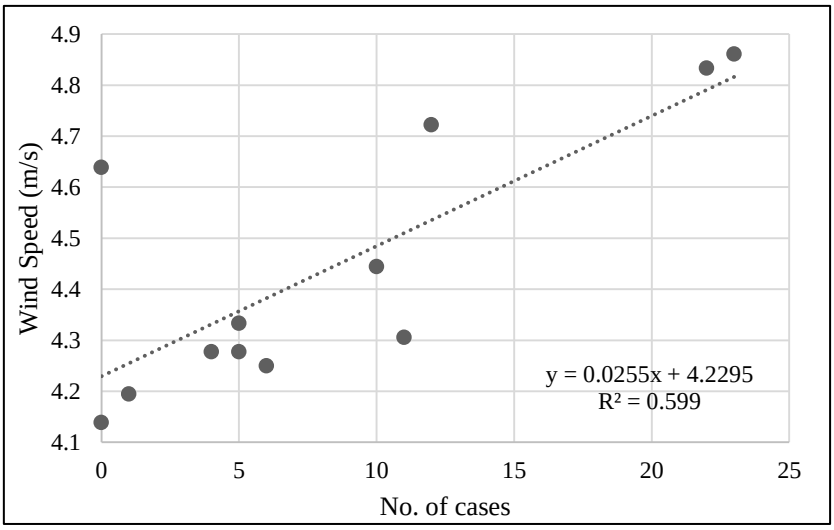

Figure 8. Wind speed against number of cases.

3.5. Monsoon induced coastal erosion

It has been shown that coastal erosion reciprocate well with the monsoonal phenomena in Peninsular Malaysia. The drastic increment of coastal erosion based on the mass media reports review portrays the disaster's severity and community's agitation over the disaster [6,22]. The above analysis also shows that the northeast monsoon tends to have higher impact on coastal erosion phenomena especially in the East Coast of Peninsular Malaysia compared to the southwest monsoon that hits the West Coast of Peninsular Malaysia as shown in Figure 8 [10,21]. This arduous damages on the East Coast of Peninsular Malaysia could again be justified as the amount of coastal erosion cases increases during the transition southwest monsoon to northeast monsoon. The geographical location of East and West Coast of Peninsular Malaysia might be the reason of such difference in the erosion extremity. The vast South China Sea that faces East Coast of Peninsular Malaysia without any obstacles could be the reasons that influences high erosion cases compared to the West Coast of Peninsular Malaysia that is facing Sumatran Island [3]. The severity of coastline erosion and damages caused in the East Coast of Peninsular Malaysia are highly intolerable especially in Terengganu state, which has the highest amount of cases documented from this study. The damages caused by coastal erosion are inclusive of structural damages, infrastructural damages, economical retardation and some life threatening situation [23]-[26].

4. Conclusion

In conclusion, an in depth review of coastal erosion cases in relation to wind speed at Peninsular Malaysia has been performed for a period of five years (2013-2017). Utilizing the methodology of this study a conclusion was drawn to show that the coastal erosion cases in Peninsular Malaysia is increasing drastically mainly due to the northeast monsoon (November – March) which high impact to the East Coast of Peninsular Malaysia, especially Terengganu. These series of incident also causes high loses in economic value and some life threatening situation. This conclusion is drawn solely drawn from the outcome of the erosion cases documented and the wind speed of Peninsular Malaysia without considering other external parameters. More importantly, this study represents an empirical investigation of coastal erosion in response to monsoons that incorporates quantitative coastal erosion cases that happened in Peninsular Malaysia. Similar, approach was previously used by Ileana to investigate thunderstorm in Romania and Noram to estimate roughness length with semi-empirical method [27], [12]. Hence, the analysis of this research shows good agreement to the aim of this paper that is to identify the erosion prone areas in Peninsular Malaysia based on coastal erosion cases documented by mass media in recent years with response to monsoon in Peninsular Malaysia

References

[1] Alex Jackson 2014, https://geographyas.info/
[2] Prasad D H and Kumar N D 2014 *Int. J. Geoscience, 2014* 5 341–5
[3] Ann O C 1996 *Proc.13th Annual Seminar of the Malaysian Society of Marine Sciences* (Malaysia) p 1-11
[4] Department of Drainage and Irrigation 2015, https://www.water.gov.my/
[5] Rajendra E 2016 http://www.thestar.com.my/
[6] Ramli N I, Majid T A, Wan Chik F A, Muhammad M K A and Deraman S A C 2014 *J. Civil Engineering Research* 4 135–137
[7] Mohamed Shaluf I and Ahmadun F 2006 *Disaster Prevention and Management: An International Journal* 15(2) 286–298
[8] Mail R 2017 http://www.theborneopost.com/
[9] Hashim R, Roy C, Shamshirband S, Motamedi S, Fitri A, Petkovic D, and Song K I 2016 *Water Resour Manage*, 30 2391–2404
[10] Husain M L, Yaakob R and Saad S 1995 *Pertanika J. Sci. & Tech 3*(2) 337–348
[11] Jaafar S N, Yusoff M M and Ghaffar F A 2016 *Malaysia J. Society Space*, 10(10) 145–58
[12] Calotescu I 2018 *Int. Workshop on Wind-Related Disasters and Mitigation* (Tohuko

University, Sendai, Japan) p 10
[13] Nor K M, Shaaban M and Abdul Rahman H 2014 *Renewable Energy* 62 147–54
[14] Weather Underground Inc. 1995 https://www.wunderground.com/
[15] Grolinger K, ElYamany H F, Higashino W A, Capretz M A M, and Seewald L 2018 *Energy Efficiency*, chapter 11(2) 521–538
[16] Leo Samuel D G, Nagendra S M S and Maiya M P 2017 *Indoor and Built Environment*, 26(5) 680–93.
[17] Wisse J A and Stigter K 2007 *J. Wind Engineering and Industrial Aerodynamics*, 95 908–27.
[18] Deraman S N C, Wan Chik F A, Muhammad M K A, Ramli N I., Majid T A, and Ahamad M S S 2014 *J. Civil Engineering Research* 4(3A) 145–8.
[19] Muzathik A M, Nik W B W, Ibrahim M Z, and Samo K B 2009 *Wind Engineering* 33(4) 389–402
[20] Satari S Z, Zubairi Y Z, Hussin A G and Hassan S F 2015 *Sains Malaysiana* 44(10) 1521–30.
[21] Ariffin E H, Sedrati M, Akhir M F, Yaacob R. and Husain M L 2016 *J. Coastal Research* 75 1032–36.
[22] Majid T A, Ramli N I, Ali M I and Saad M S H 2012 *7th Workshop on Regional Harmonization of Wind Loading and Wind Environmental Specifications in Asia-Pacific Economies* (Hanoi, Vietnam)
[23] Bernama 2014, https://www.mynewshub.cc
[24] Jusoh E Y 2017 http://www.sinarharian.com.my/
[25] Wartawan Sinar Harian 2017 www.sinarharian.com.my/
[26] Zulkifli A R 2017 https://www.hmetro.com.my/
[27] Ramli N I, Ali M I, Saad M S H and Majid T A 2009 *7th Asia-Pacific Conf. on Wind Engineering* (Taipei, Taiwan) pp 10–3.