Analysis of Wind Speed, Humidity and Temperature: Variability and Trend in 2017

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Abstract In recent years, it has been observed that numerous cases of windstorm event. There are many factors that cause windstorms to occur. The factors of meteorology, urban morphology, the topography need to be studied to find out the cause of windstorms. The work analyzed meteorology factors such as: wind speed, humidity and temperature, occurring in 2017. Meteorological data from the Department of Environment Malaysia (DOE) station, allow determining the wind speed, humidity and temperature data daily in 2017. As well as, the pattern of parameter and their relationship between them being determined. The pattern of wind speed monthly was inconsistent. The highest average wind speed in 2017 was 4.72 m/s and the lowest average was 0.56 m/s. While humidity, the highest average was 83.12 % and the lowest average humidity was 72.33 %.

For temperature, the maximum average for 2017 was 28.43 ℃ and the minimum average was 26.26 ℃. The correlation of wind speed between humidity and temperature was -0.256 and 0.278, which is low correlate. That must be other active factors that influence the wind speed and contribute to the windstorm event. Wind speed, humidity and temperature during the windstorm event on 11 February 2017 was analyzed. During the windstorm event, the wind speed blows up to 15.7 m/s while the humidity reading decrease to 68.4 % and the temperature was 30.9 ℃. When the wind speed reading is high, the temperature reading also increases and the humidity reading will go down and vice versa and has caused the windstorm event to happen.

Keyword: Windstorm, Wind Speed, Humidity and Temperature

1. Introduction

The increase of windstorm events leads to the loss of public and private properties and causes death. Windstorms classified as a tropical cyclone, thunderstorm, tornadoes, monsoon, and gale [1]. Centre for Research on the Epidemiology of Disasters (CRED) in Emergency Events Database (EM-DAT) reported that there is an increase of total damage by storm events in 2017 as compared to the previous
The windstorm event in Klang Valley is not widely discussed in other studies. There are many possibilities that may cause a windstorm event to take place. In Malaysia, total damages by windstorm are more than 50 cases were recorded in 2018 [3]. From that case, the damage includes tree falling, building damage, car damage and death. In another study, 80% of damages to the roofing system in Peninsular Malaysia caused by windstorm events [4]. However, there are many cases of windstorm event happen and not recorded. Even the windstorm impact not too crucial in the Malaysia region, but it is not making it not important to study for future planning. There are many factors play a role in the occurrence of the windstorm. The meteorology factor, topography factors seasonal factors, urban morphology factors and many other related factors need attention to know causes of windstorm occurrence.

The wind is defined as a pressure gradient that provides the impetus for the movement of air [5]. Wind may be a good element or bad element depend on the situation. The role of wind to cool down the Urban Heat Island city and blows the pollution was undeniable [6] [7]. But the bad impact of wind that causes a natural disaster such as cyclone, hurricane and windstorm required high attention since it involves the living things and structure in the earth. The windstorm event usually occurs when the wind speed reaches 10 m/s. The event usually associates with other factors such as meteorology factor, urban morphology factors and other related factors.

Therefore, an early study to know the pattern of windstorm in Malaysia, the meteorology factors was analyzed. The meteorology factors that were selected for this study were wind speed, humidity, and temperature. Malaysia experience four types of monsoon in a year which is Northeast Monsoon (NM) between November to March, Southeast Monsoon (SM) between May to September and Intermonsoon (IM) in April and October [8]. The average wind speed was 7.02 m/s to 9.54 m/s annually and the highest wind speed occur in NM. While average temperature and humidity in Malaysia was 26.43 °C and 84% to 88% approximately [8]. The higher the wind speed more than 12 m/s should be the main factors of windstorm events in any case [9]. But there is study recorded the wind speed of less than 10 m/s has caused many destructions by windstorm events [3].

2. Methodology

The study area selected was in the Klang Valley area which is Selangor and Kuala Lumpur. The present study was using data wind speed, humidity and temperature from the Department of Environment Malaysia (DOE) station in the year 2017. The date was selected due to availability data. Table 1 shows the station of DOE used for this study.

| Station                              | Latitude | Longitude |
|--------------------------------------|----------|-----------|
| SK Batu Muda, KL                     | 3.2124   | 101.6822  |
| SMK Seri Permaisuri, Cheras          | 3.1062   | 101.7179  |
| SK TTDI, Shah Alam                   | 3.1047   | 101.5562  |
| SM (P) Raja Zarina Klang             | 3.0100   | 101.4084  |
| Kolej MARA, Banting                  | 2.8170   | 101.6231  |
| SM Sains Kuala Selangor              | 3.3265   | 101.2589  |
| SR Sri Petaling, Petaling Jaya       | 3.1095   | 101.6388  |
| SK Bandar Utama, Petaling Jaya       | 3.1315   | 101.6084  |

The data was averaged monthly for one year (2017). The average monthly being analyzed using the descriptive analysis to see the pattern of wind speed, humidity and temperature. The correlation analysis
between parameters was analyzed. Data on 11 February 2017 was selected to be analyzed in 24 hours because there was an occurrence of a windstorm event on that date.

3. Result and analysis

3.1 Wind Speed Monthly Pattern in 2017

Figure 1 shows the average wind speed monthly graph in 2017 in Klang Valley station. The highest average of wind speed recorded was 4.72 m/s in February which is in NM. The lowest average was 0.56 m/s during Inter-monsoon in April. The reading for SM was average from 0.79 m/s to 0.90 m/s which is intermediate from NM and IM. It is similar to study by [3] the highest wind speed was in NM due to winter monsoon blows from land to sea. The lowest wind speed occurs in inter-monsoon caused by interchange monsoon between NM and SM.

![Figure 1. Monthly wind speed average in 2017](image)

3.2 Humidity Pattern Monthly in 2017

Figure 2 shows the average of humidity monthly in 2017 in Klang Valley station. The highest reading was 83.12 % in February which is in NM. The lowest reading was 72.33 % in SM. While in IM season the humidity average was 75.50 % in October and 82.50 % in April. Humidity is the presence of water vapor in the atmosphere. The more water evaporates in each area, the more water vapor rises into the air, and the higher the humidity of that area is. Hot places tend to be more humid than cool places because heat causes water to evaporate faster [10]. Klang Valley was affected by Urban Heat Island (UHI) and cause the area to tend to be hot and high humidity [11].
3.3 Temperature Pattern Monthly in 2017

Figure 3 shows the average temperature monthly in 2017 in Klang Valley station. The highest reading was 28.43°C in July, SM while the lowest average reading was 26.26°C in November, NM. The temperature between IM was 27.45 °C and 27.77 °C respectively. The high temperature may cause by natural or industrial. The Klang Valley was in the industrial area and may cause increases in temperature all year.

3.4 Correlation analysis between wind speed, humidity, and temperature.

The correlation analysis between wind speed, humidity and temperature were conducted. From table 2, the relationship between wind speed and humidity was 0.278. It shows the low significant between both parameters. While the relationship between wind speed and the temperature was -0.256. It shows the negative low relationship between wind speed and humidity. From the result, it shows that wind speed does not really depend on humidity and temperature parameter. There must be other factors that influence wind speed. But for Humidity and temperature, the correlation is 0.908 which is high.
3.5 Data Analysis 24 hours between wind speed, humidity, and temperature in Station SMK Bandar Utama, Petaling Jaya on 11 February 2017.

The 24-hour data of wind speed, humidity, and temperature were analyzed on 2 November 2017 as shown in Table 3. The Station SMK Bandar Utama, Petaling Jaya (coordinate) was selected. On this date, the highest wind speed was recorded was 15.7 m/s at 4.00 pm. The windstorm event and destruction has occurred at the nearby area between 12.00 pm to 8.00 pm on this date.

Table 2. Correlation relationship between wind speed, humidity and temperature.

| Wind Speed | Humidity | Temperature |
|------------|----------|-------------|
| Wind Speed | 1.000    |             |
| Humidity   | -0.256   | 1.000       |
| Temperature| 0.278    | 0.908       | 1.000       |

Table 3. Wind speed, humidity and temperature data from the station SMK Bandar Utama, Petaling Jaya on 11 February 2017.

| Date      | Time (h:mm) | Wind Speed (m/s) | Humidity (%) | Temperature °C |
|-----------|-------------|------------------|--------------|----------------|
| 2/11/2017 | 1:00:00     | 1.5              | 96.4         | 26.3           |
| 2/11/2017 | 2:00:00     | 2.5              | 93.9         | 26.8           |
| 2/11/2017 | 3:00:00     | 2.6              | 94.8         | 26.2           |
| 2/11/2017 | 4:00:00     | 3.4              | 93.6         | 26             |
| 2/11/2017 | 5:00:00     | 3.1              | 95.9         | 25.4           |
| 2/11/2017 | 6:00:00     | 1.6              | 99           | 24.6           |
| 2/11/2017 | 7:00:00     | 1.5              | 99.7         | 24.4           |
| 2/11/2017 | 8:00:00     | 1.3              | 99.8         | 24.1           |
| 2/11/2017 | 9:00:00     | 6.5              | 89.6         | 26.6           |
| 2/11/2017 | 10:00:00    | 11.4             | 78.6         | 28.6           |
| 2/11/2017 | 11:00:00    | 11               | 73.7         | 30.1           |
| 2/11/2017 | 12:00:00    | 14.5             | 70.3         | 30.9           |
| 2/11/2017 | 13:00:00    | 15               | 69.3         | 31.4           |
| 2/11/2017 | 14:00:00    | 14.8             | 65.9         | 32             |
| 2/11/2017 | 15:00:00    | 14.2             | 64.8         | 32             |
| 2/11/2017 | 16:00:00    | 15.7             | 68.4         | 30.9           |
| 2/11/2017 | 17:00:00    | 11.8             | 68.4         | 31.1           |
| 2/11/2017 | 18:00:00    | 11               | 64.3         | 31.4           |
| 2/11/2017 | 19:00:00    | 10.3             | 69.1         | 30.6           |
| 2/11/2017 | 20:00:00    | 13.3             | 73.1         | 28.8           |
| 2/11/2017 | 21:00:00    | 10.6             | 75           | 28.2           |
| 2/11/2017 | 22:00:00    | 8.9              | 79.2         | 27.5           |
| 2/11/2017 | 23:00:00    | 10.6             | 77.8         | 27.4           |
| 2/11/2017 | 24:00:00    | 7.4              | 76.7         | 27.2           |

Figure 4 shows the graph of 24-hour data between wind speed, humidity, and temperature. At 4.00 pm, when the wind speed reading reaches to 15.7 m/s, the humidity and temperature reading was 68.4 % and 30.9 °C respectively. The high reading of wind speed does not cause the temperature to go down but, the wind will blow strongly when the temperature was high. When the wind speed blow at 1.5 m/s, the humidity and temperature was 96.4 % and 26.3 °C. On this date, the windstorm event was reported has caused tree falling and impact the car and causes damage. Even so, there is no official report produce by Malaysia Government due to this event. The early hypothesis was made, when the wind speed reading is high, the humidity reading will go down and vice versa. While another hypothesis, when the wind speed reading is high, the temperature reading also will go up.
4. Conclusion

In this study, the pattern of wind speed, humidity and temperature were investigated. It shows a low relationship between wind speed and humidity, wind speed and temperature. The wind speed pattern is dynamic and cannot predict all over the year. From the 24-hours analysis of these three parameters, it shows that there is a little relationship during the event. The other factors must be investigated for further study of wind speed and windstorm events. Further investigation proposed to study the urban morphology of the wind event.

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