Changes in Meteorological Parameters (i.e. UV and Solar Radiation, Air Temperature, Humidity and Wind Condition) during the Partial Solar Eclipse of 9 March 2016

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Abstract. Solar eclipse is a spectacular phenomenon, which occurs when the position of the moon is between the sun and the earth. This phenomenon affects to the meteorological parameters, such as solar radiation, temperature, and humidity. The purpose of this study was to evaluate the impact of partial solar eclipse of 9 March 2016 to the change of several meteorological parameters. In the experimental procedure, we used automatic weather station (AWS) in one of building in Universitas Pendidikan Indonesia in Bandung. Bandung was selected because this place experienced partial (88.89%) solar eclipse on 9 March 2016. The result showed that compared to normal day, meteorological parameters changed during the solar eclipse, such as decreases in the UV and solar radiation, increases in relative humidity, and changes in air temperature and wind condition.

1. Introduction

The event of a solar eclipse has attractively attention for scientists and meteorologists, especially for studying response of earth and atmosphere against this event [1,2]. Although solar eclipse is an astronomical event, it provides unique chances for observing various phenomena in the atmospheric environment [3-12].

In previous literatures, many papers reported the effects of a solar eclipse on the surface ozone concentration [9], the atmospheric boundary layer over a tropical rural station [7], and chemicals on the atmosphere and surface (e.g. O₃, NO, NO₂, NH₃, and CO), the spectral solar and UV radiation [11], wind speed [4; 3] and air temperature [9,15] (see Figure 1). Further, report on the possibility change in the photodecomposition process in the earth has been also reported by Nandiyanto et al. (6,7)

Here, the purpose of this study was to evaluate the impact of partial solar eclipse on 9 March 2016 in Bandung to the change of several meteorological parameters (i.e. UV and solar radiation, air temperature, humidity, and wind condition). In the experimental procedure, we used an automatic weather station (AWS) in one of building in Universitas Pendidikan Indonesia in Bandung. Bandung as the field site was selected because it was thorough the path of the solar eclipse (about 88.76 %). To confirm the effect of solar eclipse on the change in meteorological parameters, we compared the data during solar eclipse day (9 March 2016) with sunny day (10 March 2016). We believe that this data give important information specifically for further meteorological- and environmental-related studies.
Figure 1. Subjects that have been studied based on solar eclipse phenomenon

2. Experimental Method
The experiment was conducted at the experimental field of the Universitas Pendidikan Indonesia (6.86340 SL, 107.59430 EL) in Bandung, Indonesia on 9 March 2016. The field site was selected because it was thorough the path of the solar eclipse (about 88.76%). In short of the experimental procedure, we used an automatic weather station (AWS) that placed in one of buildings in Universitas Pendidikan Indonesia in Bandung, Indonesia. To ensure the results, we compared the data from the change of meteorological parameters during solar eclipse day (9 March 2016) with the two sunny days (8 and 10 March 2016).

3. Results and Discussion
In our previous report [10], we found that the solar eclipse phenomenon in Bandung experienced several phases, in which each phase can be described in the following:
(1) Before solar eclipse phase. This phase happened before 06:21 am.
(2) Phase I, known as The first contact, happen at about 06:21 am. In this phase, the edge of the Moon starts to overlap the edge of the Sun.
(3) Phase II, known as the second contact, happen at 06:21 – 07.22 am. In this phase, almost the entire disc of the Sun is covered by the Moon.
(4) The maximum eclipse phase. This phase happen at 07:22 – 07:24 am. This phase results the completed cover of the Moon to the Sun’s disc. In the case of the partial solar eclipse, the distance between the center of the Moon’s disc and the Sun’s disc is minimum, resulting the appearance of crescent shape sun.
(5) Phase III, known as the third contact. The Moon starts to move away from the Sun’s disc. This phase happen from 07:24 – 08.32 am.
(6) End phase, known as the fourth contact. This phase happen at about 08:32 am. The Moon’s disc stops to overlap the Sun’s disc. The solar eclipse ends.
(7) After 08:32 am, all solar eclipse phases finished, and the sun shines normally.
To confirm the effect of solar eclipse on the solar radiation intensity, we compared the data from 06:00 to 09:00 am. We found that the solar radiation intensity during the solar eclipse was lower than that during the usual day. The rates of increasing solar radiation intensity for the solar eclipse and the usual day were 58,000,000 and 8,000,000 lux/min, respectively. However, after solar eclipse, we found that the intensity was near to normal. This result verified that the solar radiation intensity was affected by the partial solar eclipse [1], in which decreases in the radiation intensity is due to the coverage area of the moon’s disc to the sun [8]. This data was in a good agreement with other reports [4].

Figure 2. Profile of solar radiation on 9 and 10 March 2016. Figures (a) and (b) are the profile at 06:00 – 18:00 am and 06:00 – 09:00 am, respectively.

Figure 3 shows the relative humidity profile during the solar eclipse (9 March 2016) and the usual day (10 March 2016). The relative humidity is fluctuated during the day time (See Figure 3a). The relative humidity in the morning time is between 80 and 90%. Then, the humidity decreased in the afternoon down to 40%. Finally, in the evening, the humidity increased and went to value of near to 90%.
To confirm the relative humidity during the solar eclipse, we investigate the humidity value between 06.00 to 09:00 am (See Figure 3b). We found that the relative humidity in the solar eclipse day was higher than that in the usual day. The main reason of this phenomenon is because the blockage of the moon on the sunlight penetration to the earth make the temperature to be down [3;17]. Indeed, the decrease in temperature causes the increase in the humidity [18;5;9]. This result was in a good correlation with other reports. [2]

![Figure 3. Profile of relative humidity on 9 and 10 March 2016. Figures (a) and (b) are the profile at 06:00 – 18:00 am and 06:00 – 09:00 am, respectively.](image)

**Figure 3.** Profile of relative humidity on 9 and 10 March 2016. Figures (a) and (b) are the profile at 06:00 – 18:00 am and 06:00 – 09:00 am, respectively.

**Figure 4** depicts the temperature, UV radiation, and wind speed during the solar eclipse day (9 March 2016). In the case of UV radiation (see Figure 4a), we found that the similar trend of UV with solar radiation was obtained. UV radiation starts to increase when the partial solar eclipse is near to the end. As shown in Figure 4b, the temperature is relatively lower and reaches to less than 20°C. Then, after passing the maximum solar eclipse phenomenon, the temperature increased gradually. Regarding the
wind speed (see Figure 4c), we found that the wind speed is typically stable in during the initial phase until the maximum solar eclipse. Then, after passing the maximum phase, wind speed increased and starts too fluctuated.

![Figure 4](image.png)

**Figure 4.** Several meteorological parameters during the partial solar eclipse. Figures (a), (b), (c) are UV radiation, Temperature, and Wind speed, respectively.

4. **Conclusion**
Impact of partial solar eclipse on 9 March 2016 in Bandung to the change of several meteorological parameters (i.e. UV and solar radiation, air temperature, humidity, and wind condition) was evaluated. In the experimental procedure, we used an automatic weather station (AWS) in one of building in Universitas Pendidikan Indonesia in Bandung. We found that the solar eclipse phenomena has an impact to the change in meteorological parameters. However, in the case of wind speed, we did not find any change. We believe that this data will give important information specifically for further meteorological- and environmental-related studies.

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