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Detection of the Different Photovoltaic Current before the Raining by using Solar Cell

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ABSTRACT

During the daytime, the variation of electric current (Ipv) generated by solar cell depends on the incidental solar radiation onto the solar cell. In the other point of view, the variation of electric current generated by solar cell could be rational to the variation of daytime daily weather condition. Thus, we might use this variation of electric current generated by solar cell to monitor the daytime daily weather. This serves the way to use solar cell for meteorological purpose in the area that has no any solar instrument except the solar cell. In the period of the experiment from 1st January to 31th December 2012, we successfully converted Ipv to the different Ipv (Ipv_d) which can be used as the weather monitoring tool. The result might significantly shows that the Ipv_d could increase upto 7000 mA around two hours before raining. This result agrees quite well with the satellite image illustrating the cloud covering this area at the same time of the increasing Ipv_d. The two hours duration time before raining could correspond to the minimum duration time of the vertical grow up of the raining cloud such as cumulonimbus.

Key words: Ipv, Solar cell, Weather, cloud

INTRODUCTION

According to the oil price crisis, the uses of the solar cells which are the source of the alternative energy were increasing. Consequently, the numbers of the solar cells in any area were also increased. The increasing of solar cells would also serve the alternative way to use the solar cells such as the use of solar cells in meteorological study [1].The solar radiation that incidents onto the solar cell was varied by the environment in atmosphere such as wind, cloud cover, or rain. In 1960s, the study of the relation between solar radiation and cloud was conducted [2]. The Cloud cover would be the major effect of the variation of the solar radiations in the atmosphere [3-5]. Ehnberg and Bollen [6] successfully used the observed cloud data to simulate the global solar radiation. Moreover, Luo *et al*., [7] estimated the total cloud cover from observed solar radiation data. In this paper, the investigation of using the solar cell to study the solar radiation and cloud cover was conducted. The electricity generated from solar cells directly depends on the intensity of the solar radiation respecting to the daily weather conditions. The time of the rain occurring after the ended raining-cloud formation was investigated together with the time of the variation of the electricity generated by the solar cells. These might be the very useful technique to use solar cell for daytime meteorological purpose in the area that have no any solar radiation devices but solar cells.

Materials and Experimental Setup:

We installed the 1 kW solar cells which consist of 8 solar modules on the top of the faculty of Science and Technology building, Rajamangala University of Technology Thanyaburi as shown in figure 1. It is noted that there are no any shadows effecting to the solar cells. The specification of each solar module is shown in table 1.

The solar cells were monitored by the computer system. All of the information such as Current, Voltage or Power with sampling rate of 24 data per hour were automatically recorded by the software name of Sunny Data control. In the experiment, we set up the recording time of 11 hours a day during 6.00 LT and 17.00 LT. The experimental period was

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from 1st January to 31th December 2012. The photovoltaic current (Ipv) data was selected to investigate in the experiment. In the previous works, Choosakul *et al*.,[1] successfully converted Ipv to the different Ipv (Ipv_d) and the data was used to idenify daytime weather conditions. Thus, Ipv was converted to Ipv_d following with Choosakul *et al*., method. In this study, we focused on the Ipv_d that was in the period of the rainning time. We also used the rain data in order to investigate the evedince of the relationship betweeen the rainy day and Ipv_d. The rian data was recorded by the HOBO U30 weather station every 15 minutes. Around 11 hours a day from 6.00 LT to around 17.00 LT. Thus, 44 rain data per day were collected.

Fig. 1: Solar cell used in the experiment.

Table 1: The specification of solar module.

Solar module	Detail
Name	Sharp Solar Module ND-130T1J
Maximum Power	130.0 W
Open-circuit Voltage (Voc)	22.0 V
Short-circuit Current (Isc)	8.09A
Voltage at point of Maximum power (Vmpp)	17.4V
Current at point of Maximum power (Impp)	7.48A
Maximum system voltage	600 V
Over-current protection	15A

Results and Discussion

Normally, the period of the raining season of Thailand was around May to October [8]. Thus the experiment should directly focus on the 6 months period. Also, it was observed that the high numbers of the rainy day was in the period of May to October 2012. However, the rain may occur even in March or April in Thailand. In the experimental area, for example, we observed that the maximum rain data was recorded on 13th August 2012 which was around 3.6 mm at around 16.10 LT. The rain started around 15.40 LT and ended around 17.30 LT, the total times duration was around 2 hours. The cumulative rain of the day was around 8.5 mm. We compared the raining start time and the Ipv_d variation time in order to investigate the time-scale relationship between them. Figure 2 illustrated the comparison between Ipv_d variation time and the raining time. The Ipv_d reached over the 7,000 mA at around 13.00 LT before raining around 2 hours. Figure 3 showed the satellite image form MSAT-2 IR1 of around 06.00 UT which was corresponded to 13.00 LT. The satellite image indicated that there was the cloud covering the experimental area (in the circle). Thus, it might be possible to serve the evidence that the cloud could affect the Ipv. Consequently, the Ipv_d was increased.

The same phenomenon was found on 18th March, 2012 when the Ipv_d reached around 8,000 mA at around 11.40 LT. Around 2 hours later, the rain started (14.10 LT) as shown in Figure 4. The satellite image of 18th March, 2012 at 04.00 UT (corresponded to 11.00 LT) might confirm that the cloud covered the experimental area (the circle in Figure 5).

In the period of the experiment, there are 39 of rainy days observed in the experimental area. We found that 28 of 39 rainy days had the same phenomena that the Ipv_d increased upto 7,000 mA around 2 hours before the raining. The duration time of around 2 hours could be plausible to the theoretical duration time of the vertical-rain-cloud formation such a cumulonimbus [9]. The formation

of cumulonimbus would be used around 1 hour to more than 6 hours. Thus, the rain after around 2 hours of the Ipv_d increased upto 7,000 mA might be plausibly related at least in the time-scale. In addition, there were 11 of 39 rainy days were observed in the experimental area even the Ipv_d increased in between 6,000 mA and 7,000 mA. However, when we observed the increased Ipv_d, the raining occurred after around 4 hours or occurred in the nighttime. Luo *et al*.,[7] suggested that the cloud cover increased with the decrease in the value of the ratio of the observed solar radiation to clear-sky solar radiation. Thus, this could be plausible to the observed sunny-to-cloudy or the broken-cloud condition when the Ipv_d value was around 2,000 to 6,000 mA. The low Ipv_d was responded to high Ipv. Consequently, the high Ipv was occurred in the sunny or cloudless-sky condition. In this case, the rainy cloud formation needed longer time to grow up until raining.

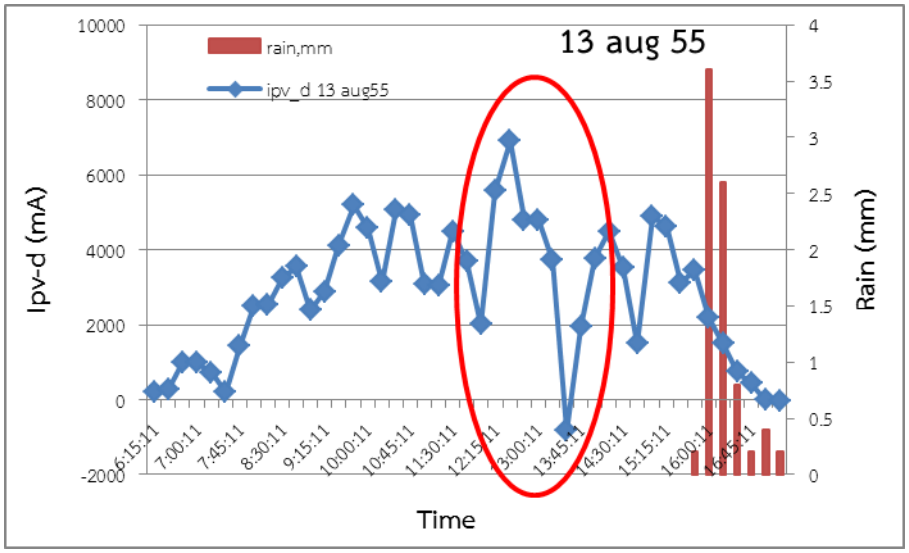

Fig. 2: Comparison between Ipv_d variation time and the raining time of 13th August, 2012 13.00 LT (06.00 UT).

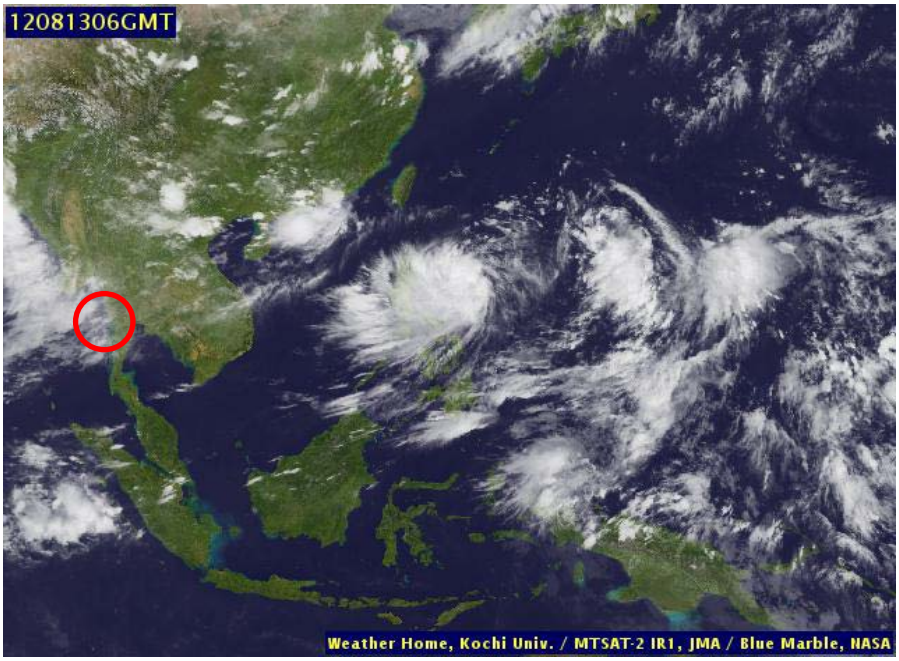

Fig. 3: The Satellite image of 13th August, 2012 06.00 UT.

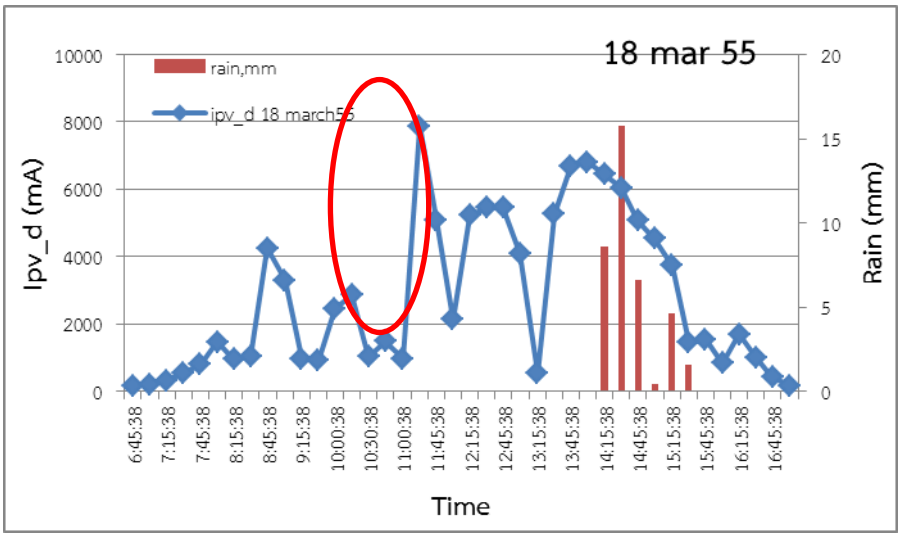

Fig. 4: Comparison between Ipv_d variation time and the raining time of 18th March, 2012 11.40 LT (04.40 UT).

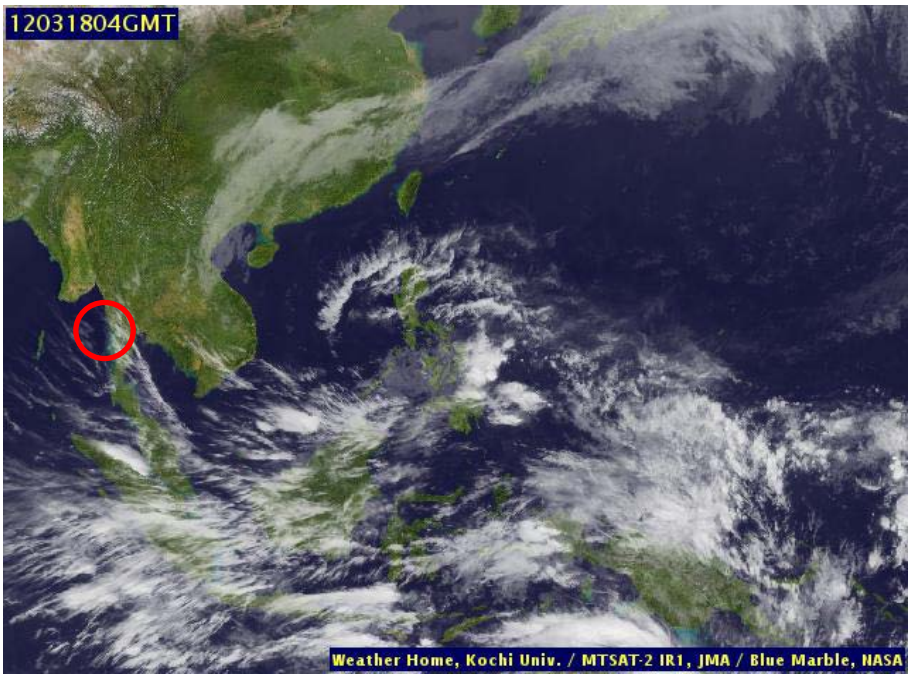

Fig. 5: The Satellite image of 18th March, 2012 04.00 UT.

Conclusion:

The variation of the current that obtained from the solar cells could be found under the daytime weather conditions. The plausible relationship between the variation of the current and the raining at least in time-scale was discovered. In the experiment, there might be found some phenomenon or patterns that firstly, the Ipv_d variation upto 7,000 mA, then around 2 hours later, the rain would start. The duration time of around 2 hours might be plausible to the duration time of the rainy-cloud formation especially the vertical-rainy cloud such a cumulonimbus. Thus, it would be possible to use solar cells in applicant of meteorological study or the daytime weather monitoring system, but it is still needed more future investigations and developments.

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