Solar Spectrum Forcing Due to Soil Particle Concentration

Pantipa Wonglakorn and Surat Bualert

***Abstract*—The Solar spectrum forcing Due to Soil Particle Concentration to study about difference solar energy 3 unit on September 2012 at Petchburi province, Thailand. MS-700, Spectroradiometer was used to determined energy at the wave length 300-1050 nm and short-wave solar radiation. The soil particle was used in the experiment. The result showed that the particulate matter was decrease the shortwave radiation energy. The highest decreasing rate was near infrared range (-0.97%), it showed slightly effect on ultraviolet range (0.11%) and visible light rangeand (0.87%). The soil particle showed significantly effect on the proportion of short wave radiation energy. At the visible light showed percentage is the highest in 450-490 nm (16.0%) the lowest in 380-450 nm (11.0%).**

***Index Terms*—Visible light, solar spectrum, soil particle, proportion of short wave radiation.**

I. Introduction

Solar radiation is the main source of energy that radiate form Electronic wave which cause physical and biological processes on the Earth. The earth receives short-wave radiation from the sun [1]-[4]. At 12.00am is the period which was the lowest light absorption and light scattering due to the lowest distance between earth and sun. As a result, all of the radiation is effective [5]-[11].

The incoming short wave solar radiation is short-wave radiation which can reflect and scatter to the atmosphere. Soil particle in the atmosphere was considered as environmental problem due to increase with economic growth. The 24-hours ambient standard of total suspended particulate (TSP) is 330 μg/m^3. Diameter of soil particle is vary and larger than 500 μm. It can be suspended in the atmosphere for 2-3 minutes before falling to the ground by gravity and wind. The dust suspended in the atmosphere for long. Particulate matter less than 10 μm is usually due to a low speed fall to the ground [12], [13].Which are capable of scattering into the earth's atmosphere. It have colder than normal and absorption of radiation on the earth's surface hotter than normal [14] Therefore, the composition of the atmosphere changes. May affect the balance of the transfer of solar radiation in the atmosphere. This could result in long-term climate conditions.

II. Material and Method

A. Study Area

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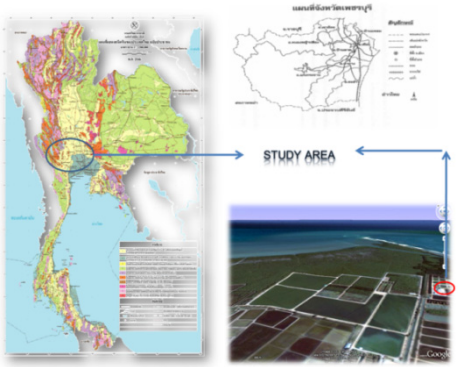

Fig. 1. Study area at Phetchaburi Province, Thailand.

The experiment was conducted at the experimental site of The King's Royally Initiated LeamPhakBia Environmental Research and Developmental Project (the Royal LERD-project) at Phetchaburi Province, Thailand.

B. Field Experimental

Field experiment was set up in September 2012. The measurement was used three Spectroradiometers, MS700 to measure and compared shortwave energy at the difference conditions. The measurement period was between 11am -14am.due to avoid the effect of the sun angle. The experiment contains three units which are:

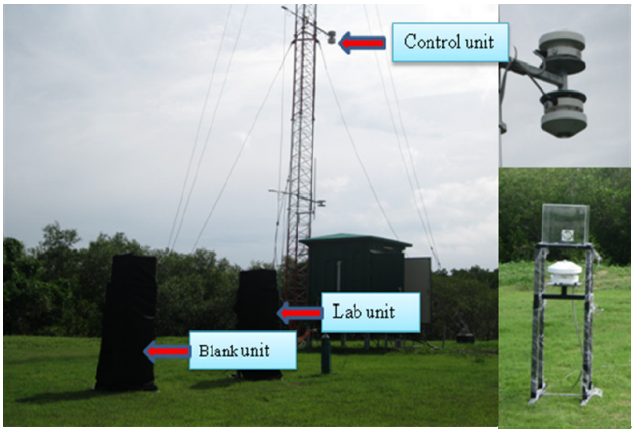

Fig. 2. Field Experimental

1) Control Unit is the unit for measuring the incoming solar radiation which is installed MS-700 at a height of 10 meters. The MS700 is the spectroradiometer for measuring energy of the sun radiation at the continuous wave length or light spectrum (300-1050 nm).

2) Blank Unit is the unit for measuring the effect of Trial Chamber. It made from Acrylic box at the packing cube shaped particle size 300 × 300 × 300 mm. Under the chamber, MS-700 was installed to measure the energy of solar radiation which passed through the blank chamber.

3) Laboratory Unit is the unit for measuring the effect of soil particle inside the Trial Chamber. The chamber was

filled with soil particle at difference concentrations. MS-700 was installed to measure the energy of solar radiation which pass through the chamber contained soil particle.

The experiments were conducted using three MS-700 Spectroradiometers, which were measured at the same time between 11:00 to 14:00 am (Fig. 1).

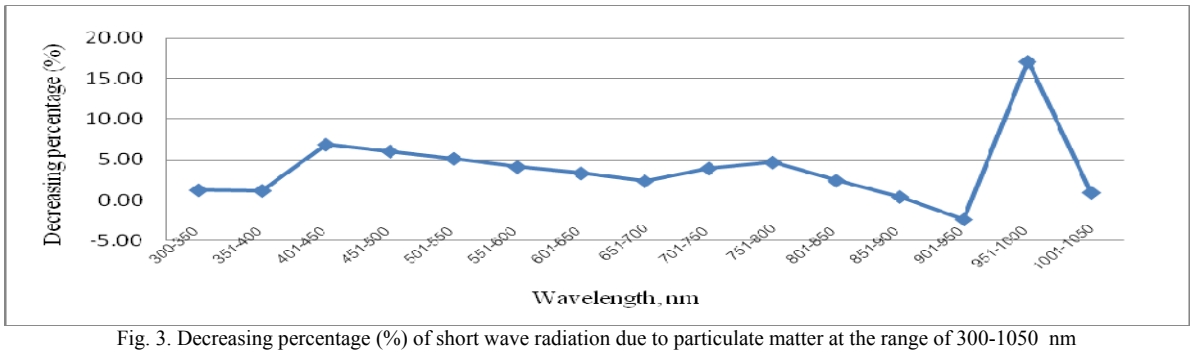

Fig. 3. Decreasing percentage (%) of short wave radiation due to particulate matter at the range of 300-1050 nm

TABLE I: PROPORTION AND PERCENTAGE OF SOLAR ENERGY IN ULTRAVIOLET, VISIBLE LIGHT AND NEAR INFRARED WAVE LENGTH

Experiment units	Percentage of solar energy (%)		
	300-380 nm	380-750 nm	750-1050 nm
Control unit	16.73	54.50	28.77
Blank unit	1.13	59.72	39.16
Lab unit	1.02	58.85	40.13

TABLE II: PROPORTION AND PERCENTAGE OF VISIBLE LIGHT ENERGY

Experiment units	Percentage of visible light energy (%)						
	380-450 nm	450-475 nm	475-495 nm	495-570 nm	570-590 nm	590-620 nm	620-750 nm
Control unit	11.0	16.0	16.0	15.6	14.8	14.5	12.1
Blank unit	9.5	15.6	15.8	15.7	15.3	15.3	12.9
Lab unit	10.1	15.1	15.4	15.5	15.4	15.1	13.5

Equation (1) is the effect of soil particle on the short-wave solar radiation defined as the difference of incoming solar energy and the energy that was loosed by the soil particle and the chamber. The incoming solar energy was measured by the control unit. The energy that was loosed by chamber and soil particle was measured by blank unit and lab unit respectively.

$$\text{Effect of soil particle} = (\text{Control - Blank}) - (\text{Control-Lab}) \quad (1)$$

III. RESULT

The experiment was conducted on September 2012. The measurements showed difference solar energy in each experimental unit. The result showed that there were impacts on shortwave radiation in term of quantity and quality of shortwave radiation as follow:

A. Decreasing of Shortwave Radiation Due to Particulate Matter

Concentrations of soil particle were slightly effects on ultraviolet wave length (300-380 nm) by decreasing the solar energy in the wave length around 1.96%.

At visible light (380-750 nm), the decreasing rate was showed the significantly decreasing rate at 380-450nm but it was slightly decreasing rate at 450-700 nm. At 900-950nm, the decreasing rate was negative because of the effect of the chamber. At near infrared (750-1050 nm), the highest decreasing rate was 17.1% at 950-1000nm (Fig. 3).

B. Proportion of Shortwave Radiation

1) Proportion between ultraviolet, visible light and near infrared

The shortwave solar radiation (300-1050nm) was divided into three ranges, ultraviolet (300-380nm), visible light (380-750nm) and near infrared (750-1050 nm). The ratio of them was 1.0: 3.5: 1.7. The largest proportion was the visible light energy (54.5%). The near infrared and ultraviolet were 28.77% and 16.73% respectively (see Table I).

The proportion of shortwave radiations measured by control unit, blank unit and laboratory units were used to compare the effect of particle on the proportions of shortwave radiation energy. The result showed the proportion of shortwave radiation was changed by decreasing the energy 300-380nm and increased the energy 380-750 nm (see Table I).

The different between the proportions (laboratory and blank unit) was the effects of particulate matter in the chamber on proportion of short wave radiation. The highest different was in the range 620-750 nm. It can conclude that the particulate matter was reduced visible light energy the short wave radiation energy by difference proportion. As the increasing proportion at 380-750 nm (visible light) and decreasing proportion at 300-380 nm (ultraviolet).

The result shows a good agreement to the recommends in Kuwate and Colorado. It reported that solar irradiation at Kuwate using SKr-1850 measured at different (347.5, 450, 550, 650, 700 and 800 nm).Show Ultraviolet region was

weak (315-380nm). But in near infra-red region (700-800 nm) was high irradiation intensity [15]. Frequent new particle (NPF) in Colorado. An Ultraviolet Multifilter Radiometer (UV-MFRSR) measured solar irradiance 7 narrowband (300, 305, 311, 317, 325, 332and 368 nm). Result NPF events are strongly correlated with the UV irradiance [16].

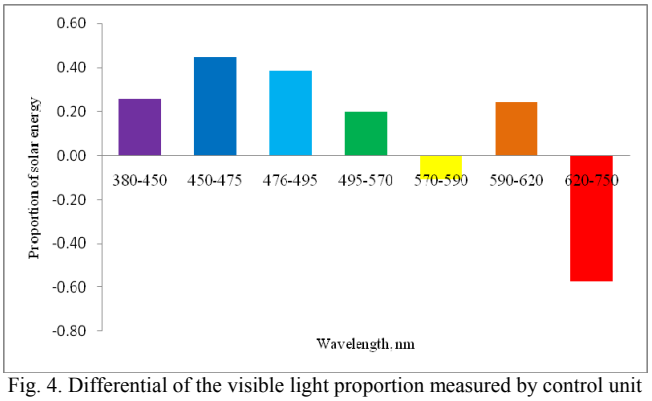

Fig. 4. Differential of the visible light proportion measured by control unit and laboratory unit

2) Proportion of visible light

The visible light energy was divided into 7 ranges, 380-450, 450-475, 475-495, 495-570, 570-590, 590-620, and 620-750 nm. The result showed that the ratio of visible light energy measured by control unit was 11: 16: 16: 15: 14: 14: 12. Table II is showed that the largest proportion (16.0%) was the range of 450-495 nm (indigo and blue) and the lowest was 380-450 nm (Purple). The highest proportion measured by blank unit and laboratory unit was 15.75% and 15.37% respectively at 475-495 nm. The lowest proportion was measured by blank unit and laboratory unit were 9.47% and 10.06% respectively at 380-450 nm. Compared the proportion measured by control unit to the proportion measured by blank unit and laboratory unit, the proportion was decreased at 380-495 nm but it was increased in the range of 495-750 nm (see Table II and Fig. 4).

IV. Conclusion

Shortwave radiation was forced to reduce the energy due to particle by 1.96% especially on near infra red energy (950-1000 nm). The energy decreasing was affected on the proportion of energy in difference wavelength. Ultraviolet was decreased by 0.11 %. Visible light was decreased by 0.87% and near infra-red was increased by -0.97%. Comparing to the non-particulate matter in the chamber in the natural condition (or control unit), the percentage of ultraviolet, visible light and near infra-red were 16.73, 54.5 and 28.77% respectively. The percentage of visible light (350-450 nm (purple), 450-475 nm (indigo), 475-495 nm (blue), 495-570 nm (green), 570-590 (yellow), 590-620 nm (orange), 620-750 nm (red) in the natural condition were 11.0, 16.0, 16.0,15.6, 14.8, 14.5 and 12.1% respectively.

Acknowledgment

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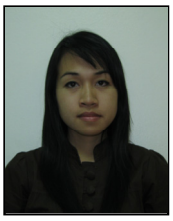

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