Modern Applied Science; Vol. 9, No. 1; 2015
ISSN 1913-1844 E-ISSN 1913-1852
Published by Canadian Center of Science and Education

Influence of Concentrations Dried Sea Salt Aerosols to Decrease Solar Radiation

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Received: August 29, 2014 Accepted: September 8, 2014 Online Published: December 29, 2014

doi:10.5539/mas.v9n1p189 URL: http://dx.doi.org/10.5539/mas.v9n1p189

Abstract

The study was aimed to study influent concentration of total dried sea salt aerosol to decrease solar radiation located in Phetchaburi province by measuring wave-length between 300-1050 nm using spectroradiometer and model MS-700.Spearman,s correlation was used to determine the relationship between the different concentration of sea salt and the measurement of solar radiation. The result showed that decreasing percentage of solar radiation was decreased causing the reflection of radiation from the sun. Moreover high concentration of solar radiation from spectrum between 390-400 nm by small sea salt aerosol and soil particle. Radiation from the sun with wave-length (visible-light 400-700 nm) was increased due to size of soil particle and sea salt aerosol were smaller than the size of the wave-length. Radiation from the sun with wave-length (infrared 700-1040 nm) was increased in both sea salt aerosol and soil particle because the size of sea salt and soil particle were smaller than wave-length .The higher concentration of the sun concentration was in the wave-length between 910-930 nm and wave-length between 955-961 nm both in sea salt aerosol and soil particle. In additionally there should be a reduction of solar radiation in the wave-length between 955-961 nm. Which occurred only in sea salt aerosol due to radiation blocking (Chunkao, 1979) by sea salt particle. Radiation from the sun with wave-length between 1090-1120 nm was decreased the wave-length called atmospheric windrow, the sun radiation can be increased and decreased .Additionally the result showed correlations significant in wave-length 300-311,751-781,911-971 nm and significant high particular in wave-length 1070-1131 nm .respectively.

Keywords: sea salt, aerosols, Phetchaburi, Thailand

1. Introduction

1.1 Introduce the Problem

The ocean is a source of primary particles of sea salt (Sea salt particles sea spray) from the disintegration of the bubble waves are along the coast and in low tides and waves, particles, sea salt will have life and substance stick with organic contaminants. They are divided into three statuses, including solids, liquids and gases and elements of sea salt (Kishchaa et al., 2010), seawater have a salinity of approximately 3.5% (35ppt) (in 1 liter of sea salt dissolved in 35 g each section large as NaCl or 0.6 M NaCl), the density of sea water is between 1020 to 1030 kg / m ^{3} and the pH is between 7.5 to 8.4 (Blanchard & Woodcock, 1957), and important minerals in seawater constituents in seawater more than 70 elements, but the elements are only 6 species, only the elements more than 99 %, including 4 elements : Na, Cl, SO_4^{2-} and Mg are the elements represented in the determination of salinity by various methods (hydrometer, refractometer, conductivity). The other elements left to make the salinity changes only 0.6 ppt. (Blanchard, 1995)

1.2 Explore Importance of the Problem

Otherwise, sea salt aerosols also affect solar radiation from the sun (Iqbal, 1983; Lutgens & Tarbuck, 1979) both directly and indirectly (Haywood, Ramaswamy & Soden, 1999; Takemura et al., 2002; and Yue & Liao, 2012). By the way there is the phenomenon of reflection, light distribution (Dowd et al., 1999), which will be in place solid (sea salt aerosols size Particle size from 0.1-10 nm). (Woodcock, 1972; Lewis & Schwartz, 2004) due to the

physical characteristics of the quartz crystal is mostly indirect liquid. High humidity (properties hydroscopic) together with clouds of smoke and so on (Mulcahy et. al., 2008; Clarke,Owens & Zhou, 2006).

1.3 Describe Relevant Scholarship

From the above study the influence of concentration of dry sea salt to decreasing solar radiation this time we have demonstrated atmospheric environment using the trial chamber size 300 × 300 × 300 mm., Which has taken control of the concentrations of dry sea salt and the demonstrations of three units consist of Control Unit measures, Blank Unit measure Laboratory Unit measures, (the power of the sun. Is w/m^3) through measuring the radiation from the sun equal concentrations of concentration of dry sea salt. During the month of November 2012 time 11.00-14.00 experiment was tested three times, then average the reduction of radiation from the sun three times to statistical analysis.

1.4 State Hypotheses and Their Correspondence to Research Design

Thus the purpose of this study is Influence of concentrations dried sea salt aerosols to decrease solar radiation which have important .in order to new knowledge and understanding about cropping plant and planning along Coastal area in Thailand.

2. Method

2.1 Location

The located of demonstration was carried out at area The King's Royally Initiated Leam Phak Bia Environmental Research and Developmental Project (the Royal LERD-project) at Phetchaburi Province, Thailand November 2012 Figure 1. Location of demonstration.

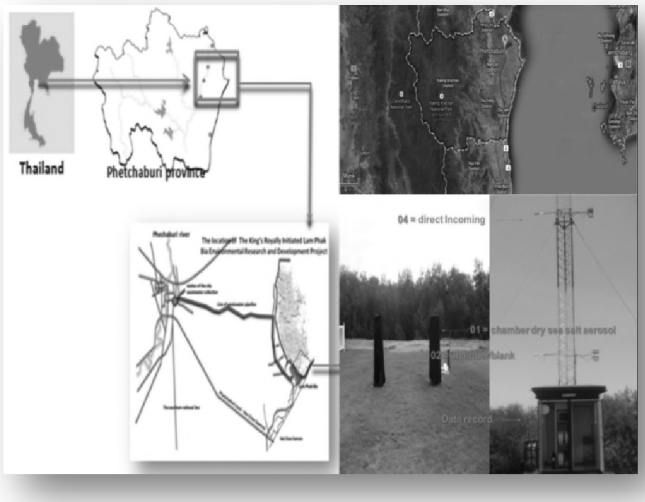

Figure 1. Location of demonstration

2.2 Sampling Procedures

2.2.1 Research Design

Sampling Procedures was carried out on November 2012. The demonstrations method used Spectroradiometers meter and Model MS-700 determination and analogy. The spectra energy in variedness of environments. The demonstration was range 11am-14 am. The demonstration consist of three units as follows figure 1.) control units gauged incoming solar radiation by, ms-700 (spectroradiometer) at heights of 10 meter and continuous to demonstrated energy from the sun radiation wave - length (380-1050 nm) 2.blank unit gauge influence of trial chamber.it made from acrylic size 300 × 300 × 300 mm .Below the chamber, ms-700 (spectroradiometer) was set up to gauged the energy of solar radiation transmittance to the blank chamber 3. Laboratory Unit the gauged influence of sea salt aerosols internal trial chamber was spray sea salt aerosols at different concentrations. It start from 0.48, 0.85, 1.22, 1.59, 1.96 and 2.33 g/ m^3,spectroradiometer (MS-700) was set up to gauged the energy of solar radiation that transmittance the chamber packing sea salt aerosols. The demonstration was carried out by

three spectroradiometers, (MS-700) that same time at duration 12.00 to **12:45** am (in Fig 1.) Influence of Concentrations dried Sea Salt Aerosols to decrease solar radiation determine by variedness of incoming solar energy, the extinction of energy caused by sea salt aerosols and chamber. Incoming solar energy was gauged by the control unit. The energy was extinct by chamber sea salt aerosols was gauged by blank unit and lab unit respectively .Influence of sea salt aerosol = (Control - Blank) – (Control - Lab) (Meesang, W., Bualert, S., & Wonglakorn, P., 2013).

2.2.2 Statistical Analysis

Spearman's correlation was used to determine the relationship and method allows testing the significant difference of the means between the different concentrations total dried sea salt and the measurements in the incident solar radiations (i.e. wavelength, nm).Because many of the atmospheric aerosol measurements considered in this paper exhibit data distributions with deviations from normal, we used a non-parametric test to examine if the differences in absorbing and scattering the solar radiations within the bands of wavelength was statistically meaningful. In particular, the significance of differences in distributions of sea salt among the band of wavelength intervals was evaluated using the Kruskal - Wallis analysis of variance test. The descriptive analysis and the non–parametric statistical tests were carried out using the Stata software package, version 12 (Stata Corp, College Station, TX)

3. Results

3.1 Sampling Procedures

Mensuration in the energy between spectrum of radiation detector the MS-700 spectroradiometer was measured every 1 nm between 380-1050 nm continuously for 24 hour, which was carried out on 18 November 2012 as the demonstrate every 3 minutes along with water heaters measurements. And the end results is Fig. 2.

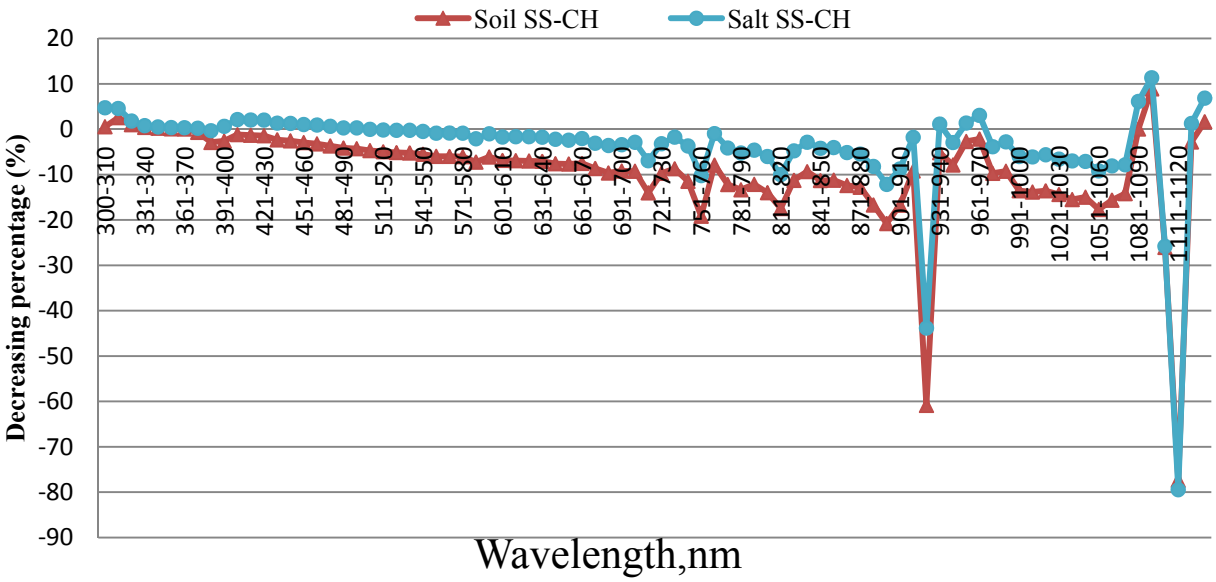

Figure 2. Average experiment of three units decrease % of solar radiation dried sea salt aerosols

3.2 Statistical Analysis

The result of the correlation analysis revealed a negative relationship between dried sea salt concentrations and radiative forcing in the atmosphere. In particular, an increase in the sea salt concentrations correlated significantly with less scattering or absorbing aerosol in the ambient atmosphere, as the majority of coefficient were close to -1 showed that in table 1.

Table 1. Summary statistics for the incident solar radiation (over all the 84 bands of wavelengths ranging from 300 to 1140 nm), according to dried sea salt concentrations (g/m^3)

Dried sea salt concentrations (g/m^3)	Range		Percentiles			Mean (Standard Deviation)
	Minimum	Maximum	25th Percentile	Median	75th Percentile	
0.0013	-11.44	76.96	-1.42	0.07	3.60	2.25 (10.43)
0.0033	-14.13	75.81	-1.58	-0.30	2.55	1.70 (10.19)
0.013	-14.61	76.87	-1.91	-0.48	1.92	1.19 (10.32)
0.023	-13.28	73.51	-2.41	-0.85	1.63	0.83 (9.90)
0.033	-12.73	74.49	-2.95	-0.97	1.42	0.62 (10.16)
0.043	-16.24	73.25	-3.37	-1.28	1.31	0.35 (10.13)
0.053	-16.15	74.10	-3.38	-1.44	0.83	0.11 (10.10)
0.063	-15.47	73.86	-3.39	-1.42	0.82	0.06 (10.10)
0.083	-14.18	73.11	-3.41	-1.45	1.05	1.15 (10.03)
0.1	-13.66	72.61	-3.17	-1.29	1.06	0.31 (9.97)

Fig. 3, 4 shows the magnitude of the absorption and scattering of solar radiation for: (a) short- wave spectrum (300 nm to 750 nm), and (b) long-wave spectrum (751 nm to 1140 nm). These box plot graphs show remarkable variations among measurements of incident solar radiations according bands of wavelengths. The Kruskal–Wallis non-parametric analysis indicated that significant statistical differences (p-value<0.05) exist among these measurements. In particular, we found a predominant absorbing behavior at short-wavelengths (although with different intensity according bands) and a diverging absorbing/scattering behavior at long-wavelengths. As an example, we found very high levels of solar radiation at the bands 921-930 nm, 1,101-1,110 nm and 1,111-1,120 nm. respectively.

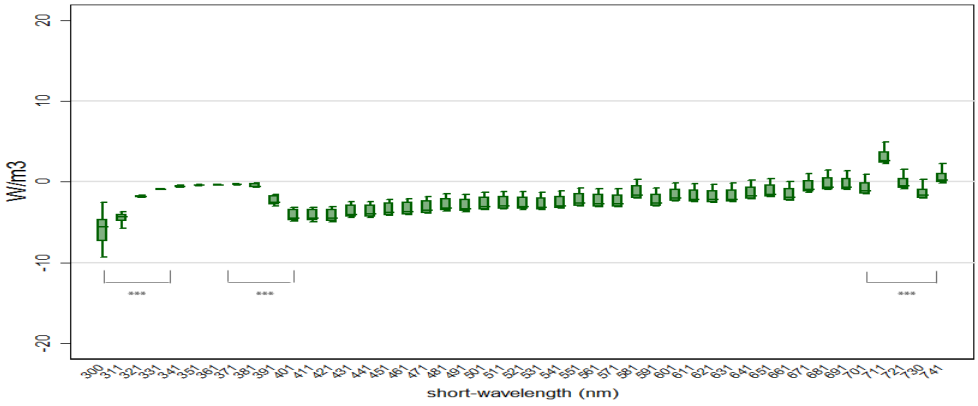

Figure 3. Box plots of the measurements of incident solar radiations at (a) short- wavelengths (300 nm to 750 nm)

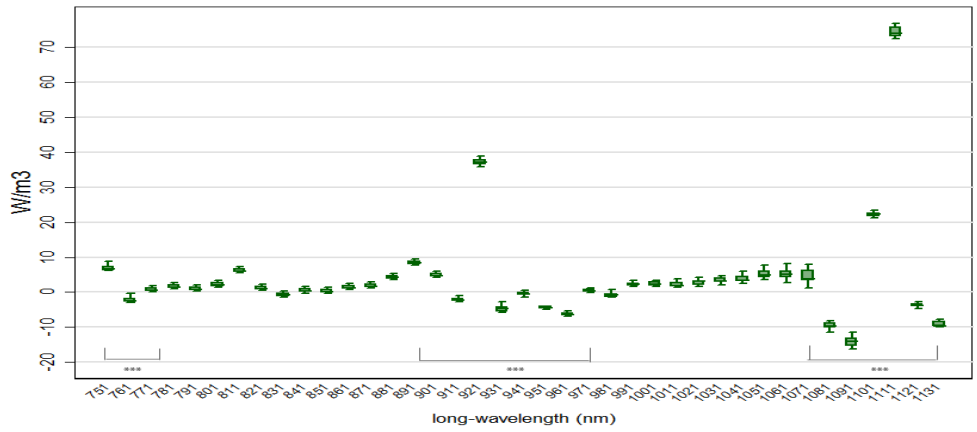

Figure 4. Box plots of the measurements of incident solar radiations (b) long- wavelengths (751 nm to 1140 nm). The graphs underline several results from the Kruskal-Wallis test: * p-value < 0.05, ** p-value <0.01

4. Discussion

In this concentration of dried sea salt significantly influent the reduction of solar radiation the same result as shown in (Moteith , 1973) indicated that sun radiation was decreased into 3 ranges of wave-length including short-wave visible-light infrared. Figure 2 showed that solar radiation wave-length between 310-320 nm both soil particle and sea salt aerosol due to high heat in short-wave the sun radiation with wave-length between 390-400 nm was decreased because solar radiation is smaller than sea salt aerosol and soil particle. Moreover solar radiation with spectrum (visible-light between 400-700 nm) was increased because the smaller size of sea salt aerosol and soil particle absorb solar radiation. Radiation from sun with wave-length between 700-1040 nm was increased in both sea salt aerosol and soil particle are smaller than solar radiation wave-length. Radiation from the sun with wave-length between 1090-1120 nm was decreased the wave-length called atmospheric windrow , the sun radiation can be increased and decreased .Additionally the result showed correlations significant in wave-length 300-311,751-781,911-971 nm and significant high particular in wave-length 1070-1131 nm .respectively

Acknowledgments

The first author would like to express sincere gratitude for Faculty of Environment,Kasetsart University, Bangkok, Thailand Udon Thani Rajabhat University , Udon Thani , Thailand and Environmental Research Group King's College London.London,UK

References

Blanchard, D, C., & Woodcock, A. H. (1957). Bubble Formation as a function in the sea and its meteorological significance. *Tellus, 9*, 145-158.

Blanchard, D. C. (1995). The oceanic production of atmospheric sea salt. *Journal of Geophysical Research, 90*(1), 961– 963.

Chunkao, K. (1979). *Near surface meteorology*. Department of Conservation, Faculty of Forestry, Kasetsart University, Bangkok, Thailand.

Clarke A. D., Owens, S. R., & Zhou, J. (2006). An ultrafine sea-salt flux from breaking waves: implications for cloud condensation nuclei in the remote marine atmosphere. *Journal of Geophysical Research*, *111*, D06202. http://dx.doi.org/10.1029/2005JD006565

Dowd, O. C., McFiggins, G., Creasey, D. J., Pirjola, L., Hoell, C., Smith, M. H., … Kulmala, M. (1999). On the photochemicalproduction of new particles in the coastal boundary layer, *Geophys. Res. Lett., 26*, 1707–5171.

Haywood, J. M., Ramaswamy, V., & Soden, B. J. (1999). Tropospheric aerosol climate forcing in clear-sky satellite observations over the ocean. *Science, 283*, 1299–1303. http://dx.doi.org/10.1126/science.283.5406.1299

Iqbal, M. (1983). Prediction of hourly diffuse solar radiation from measured hourly global radiation on a horizontal surface. *Solar energy, 24*, 491-503.

Irsha, R. D., Grainger, R. G., Peters, D. M., McPheat, R. A., Smith, K. M., & Thomas, G. (2009). Laboratory measurements of the optical properties of sea salt aerosol. *Atmos Chem Phys, 9*(1), 221–230.

Kishcha, P. S., Nickovic, B. B., Starobinets, A., di Sarrac, R., Udisti, D. S., Becagli, D., … Alpert, A. (2010). Sea-salt aerosol forecasts compared with daily measurements at the Island of Lampedusa (Central Mediterranean). *Atmosphilic Research, 100*(1), 28-35. http://dx.doi.org/10.101/j.atmosres.201.12.021

Lutgens, F. K., & Tarbuck, E. J. (1979). *The Atmosphere: An introduction to meteorology*. New Jersey: PRETICE-HALL.

Meesang, W., Bualert, S., & Wonglakorn, P. (2013). Sea Salt Aerosols: Shortwave Radiative forcing. *International Journal of Environmental Science and Development, 4*(2), 104-106. http://dx.doi.org/10.7763/IJESD.2013V4.314

Monteith, J. L. (1973). *Principles of Environmental Physics*. University of Nottingham of Agriculture. Edward Arnold Ltd. London.

Mulcahy, J. P., O'Dowd, C. D., Jennings, S. G., & Ceburnis, D. (2008). Significant enhancement of aerosol optical depth in marine air under high wind conditions, *Geophysical Research Letter, 35*(16), L16810. http://dx.doi.org/10.1029/2008GL034303

Takemura, T., Nakajima, T. Dubovik, O., Holben, B. N., & Kinne S. (2002). Single-scattering albedo and radiative forcing of various aerosol species with a global three-dimensional model, *J. Climate, 15*, 333-352.

Woodcock, A. H. (1972). Smaller salt particles in oceanic air and bubble behaviour in the sea. *Journal of Geophysical Research, 77*, 362-371.

Yue, X., & Liao, H. (2012). Climatic responses to the shortwave and long-wave direct radiative effects of sea salt aerosol in present day and the last glacial maximum. *Climate Dynamics.* http://dx.doi.org/10.1007/500382-012-1312-5