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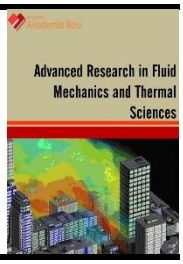

Analysis of Aerosol Optical Depth for Thailand, Malaysia and Singapore from Satellite and Sunphotometer during 2011-2017

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ABSTRACT

Aerosols are particles in the air floating the atmospheric. They can have a huge impact about climate and human health point of view. The impact on the physical environment may be of importance as they are the capable to both scattering and absorbing incident irradiance. In this work, aerosol optical depth (AOD) of 500 nm for Nakhon-pathom, Chiang-mai and Songkhla of Thailand Penang and Sarawak in Malaysia Singapore for Singapore in the case daily average aerosol optical depth. The investigation was based on the solar spectrum of sun-photometers measured at six positions: Chiang Mai meteorological station (18.77°N 98.97°E) Nakhon Pathom(13.82°N 100.04°E) Songkhla meteorological station (7.18°N 100.60°E) Penang (5.36°N 100.04°E) Sarawak (1.49°N 110.35°E) and Singapore (1.30°N 103.78°E).When comparing AOD data from these sites for 7-years.The results show tolerances in case of the root mean square error (RMSE) between the daily retrieval of aerosol optical depth from Aqua satellite and that from the AERONET ground measurement were from the ranged of 5.34% to 18.73%. As the number of aerosol optical depth monitoring station in Thailand, Malaysia and Singapore are still very limited, it is recommended that number of the stations be increased in order to obtain more spatial coverage of information on aerosol optical depth.

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1. Introduction

Aerosols are small particles that float in the air, which naturally occur and cause health problems by causing respiratory problems [1-4]. In addition, the impact on the physical environment may also be important because of its ability to scatter and absorb irradiance [5] and there are also changes in the parameters in the cloud [6-10]. The AOD, which is an indicator of aerosol filling in the vertical column the atmospheric, is the main parameter by which the ability of aerosols to deplete irradiance

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is measured. One important problems are the lack of information on aerosol properties there are still very limited and insufficient to draw conclusions about climate change effects.

The parameter of the aerosol optical can be measured directly using AERONET surface measurements. Evaluating the type of aerosols from the ground on observed surface is often associated with radiative and direct irradiance in the narrow-spectrum [11]. The purpose of this article is to compare AOD-based retrieved using Aqua satellite to that obtained using ground based remote sensing in six sites for Thailand, Malaysia and Singapore.

Due to the importance of column aerosol optical, a number of studies have already been carried out in many parts of the worldwide. In addition, limited works were focused of SEA (Southeast Asia). In the terms with Thailand, Malaysia and Singapore. Information on the aerosol optical types of this tropical country is still very limited and insufficient for atmospheric research and environmental experts. In response to this information requirement, we have established six sun-photometer stations.

2. Measurement

2.1 Ground Based Networks

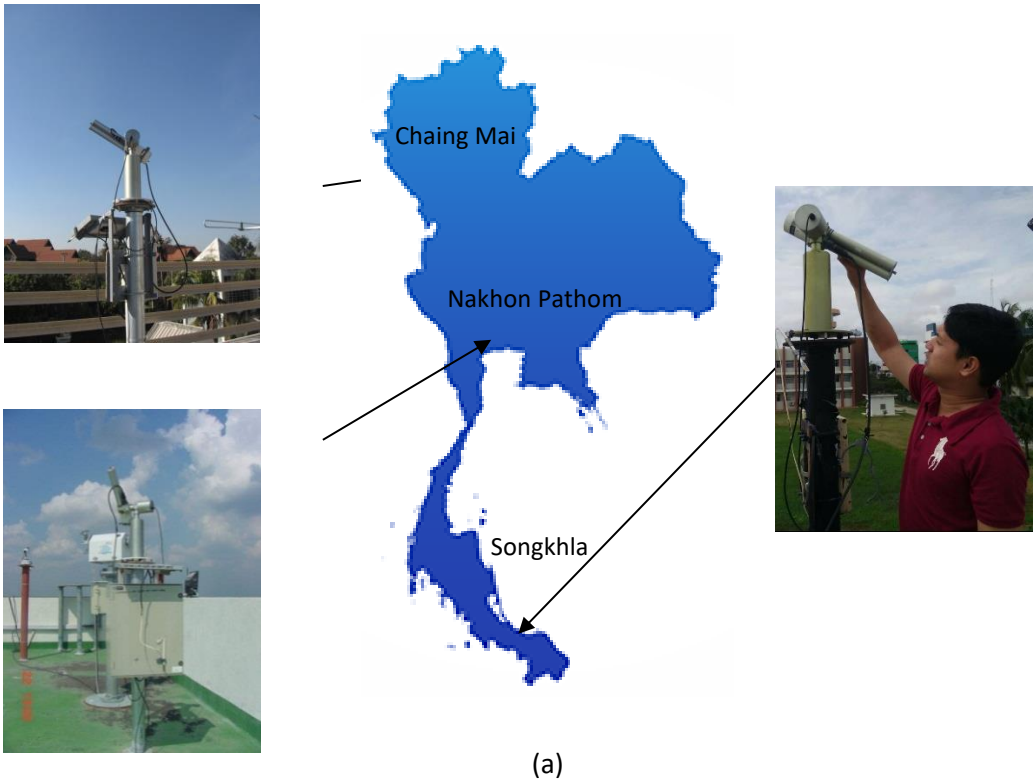
This work present we procured sun-photometers network and installed these stations by our existing irradiance ground based stations every 15 min of Thailand, Malaysia and Singapore. These stations are located of Nakhon Pathom (13.82°N 100.04°E) in the Center, Chiang Mai meteorological station (18.77°N 98.97°E) in the North, Songkhla meteorological station (7.18°N 100.04°E) in the South of Thiland, Penang (5.36°N 100.04°E) in the West, Sarawak (1.49°N 110.35°E) in the East of Malaysia, and Singapore (1.30°N 103.78°E). The sun-photometers at Thailand, Malaysia and Singapore were fabricated in the same CE-318.

The CimelElectronique sun-photometers take irradiance observations, The instrument measures direct sunlight observations at eight bands centered for 1020, 940, 870, 675, 500, 440, 380 and 340 nm and diffuse sky solar radiation for 1020nm, 870nm, 675nm and 440nm, with broadband in the Ultra violet [12].

All Cimel sun-photometers were incorporated into the atmospheric AERONET (AErosolROboticNETwork) data program is a federation in NASA. It should also be noted that only level 1.5 (cloud screened), Version 3 aerosol optical depth data were utilized in this study. Figure 1 Provide additional details, including locations.

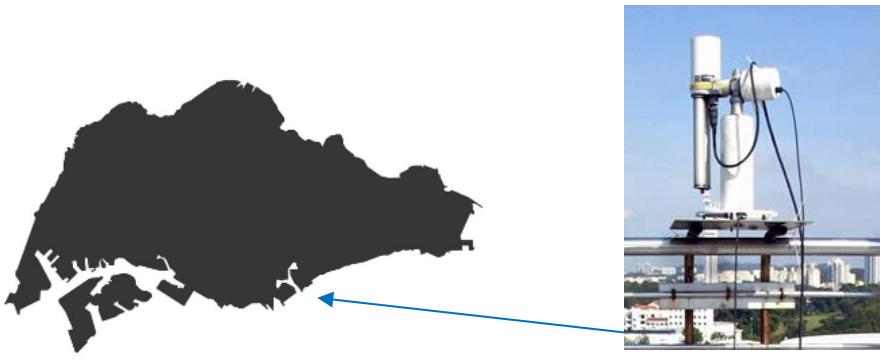
2.2 AOD-Satellite Data

The MODIS is a measurement of the NASA Aqua platform at 470, 550, 650 and 860. Moderate resolution Imaging spectroradiometer (MODIS) measurement collects spectral solar radiation data in 36 spectral channels ranging of 0.40 to 14.39 μm using VIS to near IR wavelengths. In this study, we have used data from Aqua satellite aerosol optical depth for the period of 2011 - 2017. Which corresponds to the based instrument. Information is received by a daily format at spatial resolution 1°x1° grid in National Aeronautics and Space Administration (NASA). The aerosol optical depth data using moderate resolution Imaging spectroradiometer tropospheric (Deep Blue) were sectorized by the locations in Chiang-mai region (18.77°N 98.97°E) Nakhon-pathom (13.82°N 100.04°E) Songkhla (7.18°N 100.04°E) Penang (5.36°N 100.04°E) Sarawak (1.49°N 110.35°E) and Singapore (1.30°N 103.78°E).



(a)

(b)



(c)

Fig. 1. Measurement and local aerosol of the ground based sites. (a) Thailand (b) Malaysia (c) Singapore

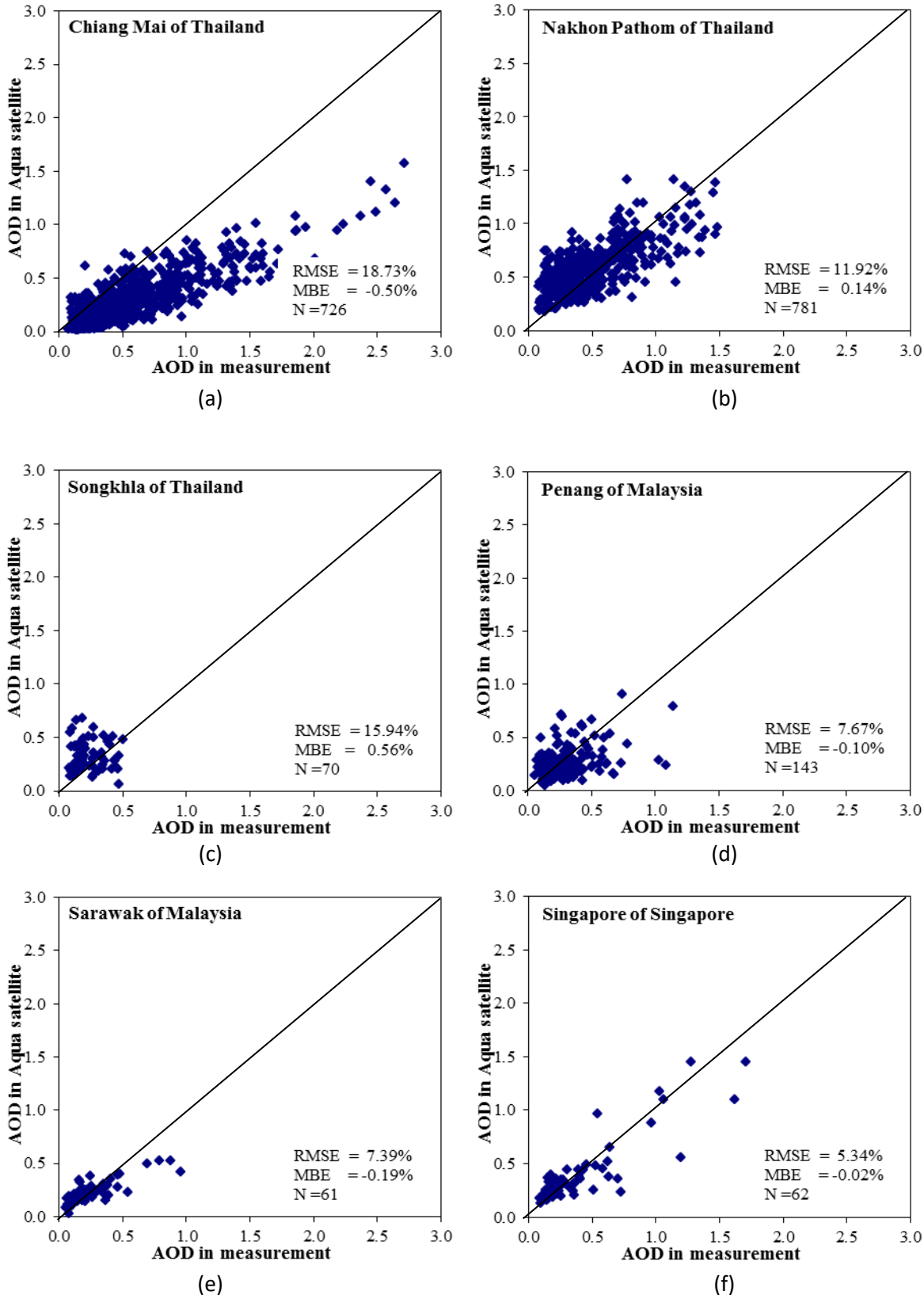


Fig. 2. Comparison of the daily average aerosol optical depth between Aqua satellite with that observation at six stations namely: (a) Chiang-mai (b) Nakhon-pathom (c) Songkhla (d) Penang (e) Sarawak and (f) Singapore

3. Results and Discussions

The aerosol optical depth data from Aqua satellites of 6 sites were compared with the measurements over Thailand, Malaysia and Singapore. This check is made by comparing the value of a wavelength at 550 nm to the ground on value measured by sun photometer in the same area of a wavelength at 500 nm.

Figure 2 (a)-(f) show the comparison of the aerosol optical depth measured on Nakhon-pathom region, Chiang-mai region, Songkhla, Penang, Sarawak and Singapore using AOD derived from Aqua satellite for this region based on the daily data. Overall, the root mean squared error (RMSE) for Nakhon-pathom region, Chiang-mai region, Songkhla, Penang, Sarawak and Singapore are in the range for 5.34% to 18.73%. The highest RMSE values (18.73% for daily) was observed for Chiang-mai. It shows that the aerosol model used for the inversion of the Aqua satellite irradiance measurements might be rather well adapted to the locally produced aerosols but it is not to the term of the seasonal biomass burning aerosols in Chiang-mai. In unfavorable conditions, the optical depth of aerosols taken from the Aque satellite will be overestimated for a clean environment and underestimated for turbidity from the ground on the surface observetions [13-15]. This may be due to the termination of agricultural cleaning activities, which results in the reduction of particulate matter in Chiang-mai textile metabolism.

4. Conclusions

The main objective of this article present is to compare the AOD data from Aqua satellite with those from ground on based observations in six sites for Thailand, Malaysia and Singapore. Aqua satellite aerosol optical depth compares better with those from AERONET observations at the Nakhon-pathom region, Chiang-mai region, Songkhla region, Penang, Sarawak and Singapore. There is also a lower relationship at Chiang Mai Station, which has a large biomass burn. The root mean squared error (RMSE) between aerosol optical depth values retrieved using Aqua satellite and ground on based observations was in the ranged from 5.34%-18.73% and mean bias error in the ranged of -0.50 to 0.56%.

Since the number of aerosol optical depth monitoring station in Thailand, Malaysia and Singapore are still very limited, it is suggested that number of the stations be increased in order to obtain more spatial coverage of information on aerosol optical depth.

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