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Surface UV Irradiance Obtained by Ozone Monitoring Instrument (OMI) Over Peninsular Malaysia

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ABSTRACT

Ultraviolet radiation is at shorter wavelengths than the visible spectrum (400 to 700 nm) and is divided into three components: UV-A (315 to 400 nm), UV-B (280 to 315 nm), and UV-C (less than 280 nm). Global increases in UV-B fluxes from decreasing stratospheric ozone amounts caused by anthropogenic chlorine releasing gases (mostly chlorofluorocarbons) have been a matter of public concern for the past 20 years. This surface UV irradiance data retrieved from Ozone Monitoring Instrument (OMI) from AURA spacecraft with the filename OMUVB. OMUVB contains surface UV irradiance data along with supplementary information generated using the OMI global mode measurements. In this mode each file contains the sunlit portion of a single orbit from pole-to-pole, with an approximately 2600 km wide swath composed of 60 ground pixels. The OMI measurements are used to estimate the ultraviolet (UV) radiation reaching the Earth's surface. The product contains spectral irradiances at 305.1, 310.1, 324.1, and 380.1 nm corresponding to both the overpass time and the local solar noon. Using the correspondence latitude and longitude of Peninsular Malaysia, we can develop the pattern of distribution of UV irradiance interpolations using Sigma Plot and Adobe Photoshop.

Keywords: Surface UV irradiance, Ozone Monitoring Instrument (OMI), AURA spacecraft, Peninsular Malaysia

INTRODUCTION

The sun radiates energy in a wide range of wavelengths, most of which are invisible to human eyes. The shorter the wavelength, the more energetic the radiation, and the greater the potential for harm. Ultraviolet (UV) radiation that reaches the Earth's surface is in wavelengths between 290 and 400 nm (nanometers, or billionths of a meter). This is shorter than wavelengths of visible light, which are 400 to 700 nm. The solar UV radiation has positive and negative effects to human life, animals and plants. For human, solar UV enables the synthesis of vitamin D in skin whereas skin cancer or eye diseases when expose to excessive doses of UV radiation (WMO 2007). Surface UV radiation has several factors that affect it, but the main factor is existence of atmospheric ozone. Stratospheric ozone absorbs completely UV-C, that extremely dangerous for us and UV-B, but UV-A was not absorbed significantly. Absence of ozone depletion can increase the UV-B radiation on earth, and it can be harmful to us. The other factors that effect surface UV irradiance are cloud cover, solar zenith angle, aerosols, elevation, reflectivity of the earth's surface, and water depth.

OMI is a Dutch/Finnish instrument onboard the NASA Earth Observing System (EOS) Aura spacecraft (Levelt *et al*., 2006a). OMI is a nadir-viewing UV/Visible spectrometer with a spectral resolution about 0.63 nm for the visible channel (349-504 nm) and about 0.42 nm for the UV channel (307-383 nm). It measures the solar light scattered by the atmosphere in the 270-5—nm

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wavelength range with a spatial resolution at nadir of 13 km x 24 km. The sun-synchronous orbit of Aura and the wide viewing angle of OMI enable daily global coverage of the sunlit portion of the Earth. Omi is the successor of TOMS instruments and contributes to monitoring of the atmospheric ozone, trace gases, aerosols and surface UV radiation (Levelt *et al*.,2006b)

STUDY AREA AND METHODOLOGY

The study area for this paper is peninsular Malaysia area starting from (1˚N, 99˚E) until (9˚N, 106˚E) is taken (*Fig. 1*). The date taken for the study are on 9, 16, 25, and 30th August 2005 and 9, 15, 25, and 29th August 2008, based on the date that Aura satellite is passed. The data of surface UV irradiance is downloaded from website Mirador Earth Science Data Search Tool, and the area of Surface UV irradiance data over study area was viewed using HDF Explorer software.

Daily Level 3 global gridded data products (Ozone, Aerosol, Effective Cloud Fraction, Surface UV-B Spectral Irradiance and Erythemal Daily Dose at 0.25x0.25 deg and 1x1 deg global grids and the wavelength 305.1 nm was used to investigate the distribution of satellite observed from (OMI) and surface UV irradiance distribution over peninsular Malaysia. By using Adobe Photoshop 7.0 and Sigma Plot 11.0 software, map was generated for surface UV irradiance over peninsular Malaysia.

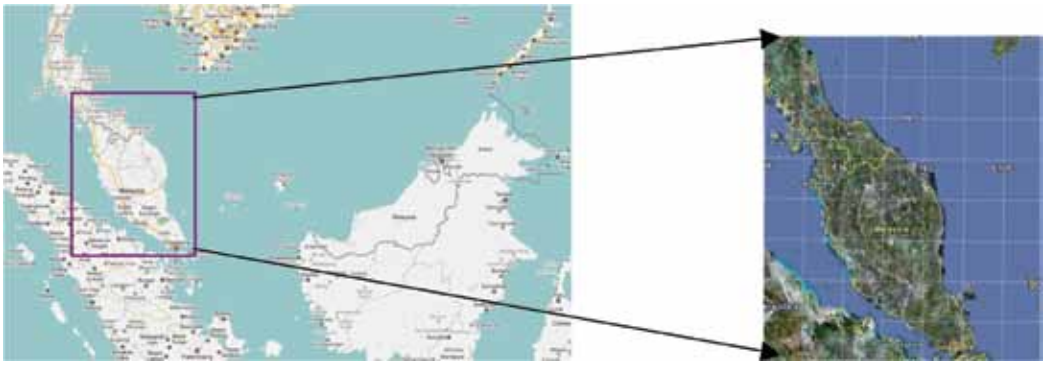
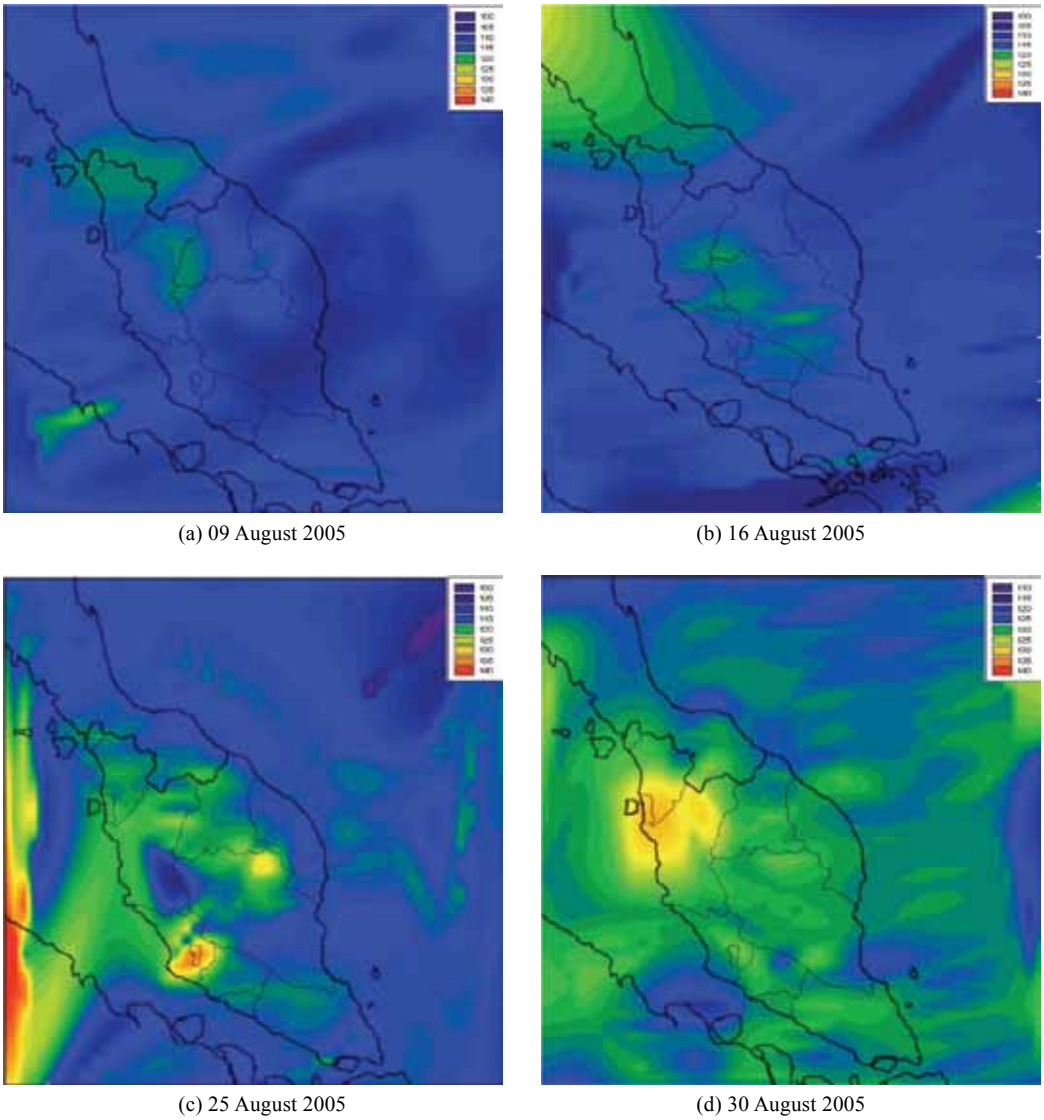


Fig. 1: Location map of the study area

DATA AND ANALYSIS

Fig. 2 shown the distribution of surface UV irradiance at 305 nm over peninsular Malaysia observed by Aura satellite. The highest irradiance on 9th August is 118.278 W/m²/nm. On 16th August, the highest surface irradiance recorded is 118.894 W/m²/nm. This value is not really high and considered as normal distribution for lower latitude region because peninsular Malaysia is near the equator and the skies over Malaysia was covered with cloud, so the surface UV irradiance distribution is almost unchanged for this study area. On 25 August, several places were record a high distribution of UV irradiance such as at Sumatera and Kuala Lumpur's area. There are a number of causes can effect the UV irradiance like presence of cloud and aerosols' effect. On mid-August 2005, Indonesia forest fires was badly affected and caused air pollution and this presence of aerosols can affect the surface UV irradiance. All particles on air tend to reduce the UV irradiance (defined as the radiation incident on a horizontal surface). However, scattering by non-absorbing aerosols can actually increase the UV exposure on non-horizontal surfaces due to the additional radiation incident from low angles (Blumthaler *et al*. 1997; Dickerson *et al*., 1997; Loxsom & Kunkel, 1997). The highest point on 30th August was at Penang and Perak.

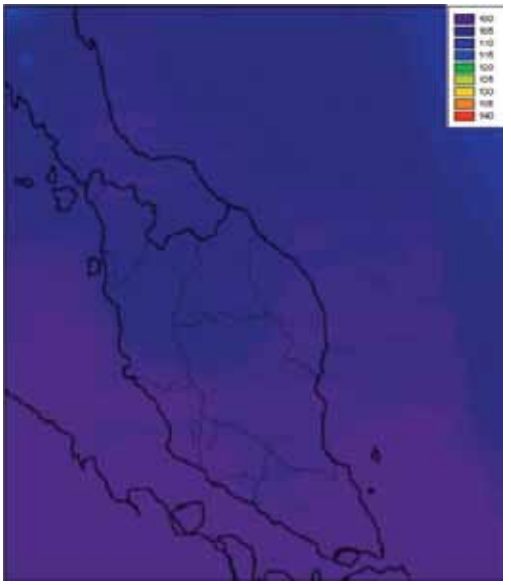


(a) 09 August 2005 (b) 16 August 2005

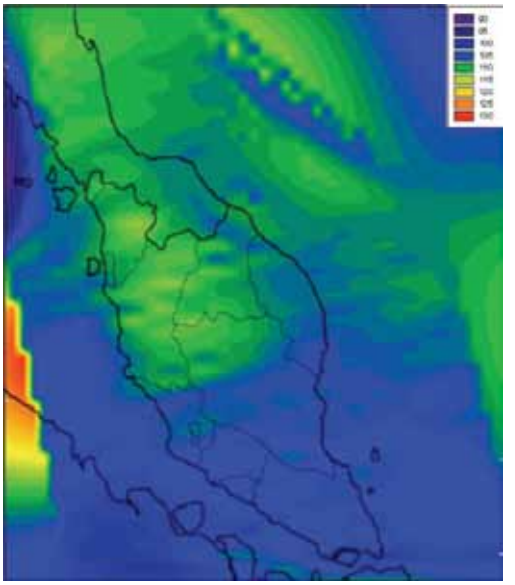
(c) 25 August 2005 (d) 30 August 2005

Fig. 2: OMI surface UV irradiance at 305 nm over peninsular Malaysia on August 2005 for various days

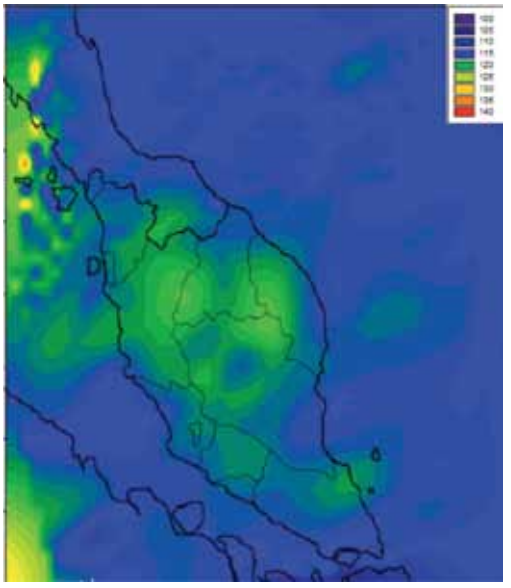
Fig. 3 shows the distribution of surface UV irradiance over peninsular Malaysia on August 2008. All study days show that the distribution of surface UV irradiance was quite normal for all area, except at middle peninsular Malaysia, where the surface UV irradiance is higher than other area. This is because middle peninsular Malaysia was consists of hills and mountains and high altitudes reflect back higher irradiance than lower altitudes.



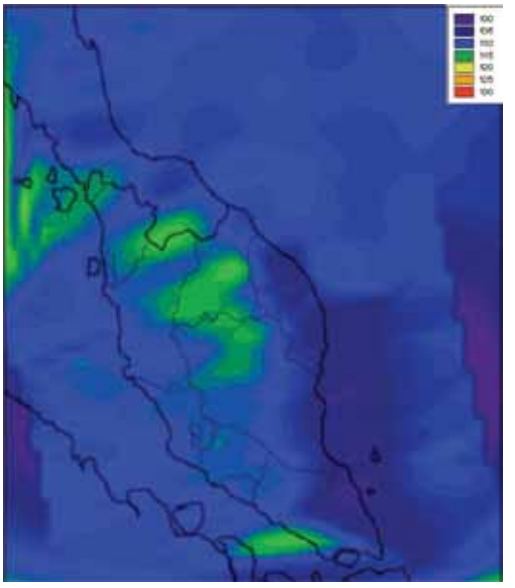
(a) 09 August 2008



(b) 16 August 2008



(a) 25 August 2008



(b) 29 August 2008

Fig. 3: OMI surface UV irradiance at 305 nm over peninsular Malaysia on August 2008

CONCLUSION

As expressed here, OMI has been designed to provide daily global coverage of clouds, aerosols, and surface UV irradiance with a spatial resolution of 13 × 24 km² (OMI ATBD Vol. I) and the result is shown in this study. UV distribution on August 2005 is higher than August 2008 due to forest fire at Indonesia on mid-August.

For further study, this data have to compared with the ground-based measurement over the study area in order to validate the data. Most validation comes from high latitude countries such as French, Italy, Finland and etc. because ozone depletion is greater at higher latitudes (toward the North and South poles). Even though ozone depletion is negligible at lower latitudes, the concern of the harmful of UV effects is still considerable. So this OMI data can helps the study on UV distribution over peninsular Malaysia.

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