Solar Erythematous Daily Dose Distributions Maps over Peninsular Malaysia Obtained
By Ozone Monitoring Instrument

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Abstract - Solar erythematous ultraviolet radiation is a small element of the solar ultraviolet spectrum. In Medical terms, erythematous dose is the amount of radiation which, applied to the skin, makes it turn temporarily red. The information on the study of solar erythematous UV incident on earth surface is very significant for the safety of human health. Lots of exposure to UV radiation can cause various cases of skin cancer, cataracts, and impaired immune systems. Excessive UV exposure also can cause damage terrestrial plant life, single-cell organisms, and aquatic ecosystems. Atmospheric ozone plays an important role that affects solar erythematous dose incident to the earth’s surface. This solar erythematous UV radiation data obtained by Ozone Monitoring Instrument (OMI) from AURA spacecraft launch on 14th July 2004. The OMI measurements are used to estimate the ultraviolet (UV) radiation getting to the Earth’s surface. The product contains erythemally weighted daily dose, and erythematous dose rate both at the overpass time and local solar noon. The Version 003 of Aura-OMI Spectral Surface UVB Irradiance and Erythematous Dose Level-2G data product (Daily level-2 data binned into global 0.25 deg Lat/Lon grids) is taken to be studied. Using the correspondence latitude and longitude of Peninsular Malaysia, we can develop the pattern of distribution of erythematous dose rate UV radiation interpolations using Sigma Plot and Adobe Photoshop.

Keywords: Level 2 OMUVB data, AURA spacecraft, Peninsular Malaysia.

I. INTRODUCTION

Solar erythematous ultraviolet radiation is part of the solar ultraviolet spectrum that can cause sunburn to human’s skin. It has some good and bad effects on human health and biological environments. In common, solar erythematous ultraviolet radiation is mainly controlled by the atmospheric ozone (1, 3) Stratospheric ozone absorbs completely UV-C, that extremely hazardous for us and UV-B, but UV-A was not absorbed a lot. Absence of ozone reduction can increase the UV-B radiation on earth, and it can be harmful to us (4). The other factors that effect surface UV erythematous daily dose are cloud cover, solar zenith angle, aerosols, elevation, reflectivity of the earth’s surface and water depth (7).

There, about 90% of atmospheric ozone is contained in the "Ozone layer," which shields us from dangerous ultraviolet radiation from the Sun (6). Stratospheric ozone is believed good for humans and other life forms because it absorbs ultraviolet (UV)-B radiation from the Sun.

Greater exposure to UV radiation can cause many cases of skin cancer, cataracts, and impaired immune systems especially for humans. Excessive UV exposure also can cause the damage on terrestrial plant life and aquatic ecosystems. Other UV radiation, UV-A, which is not absorbed significantly by ozone, will causes premature aging of the skin (5). During the last 30 years, solar erythematous ultraviolet radiation has increased in many parts of the world. The information on the total of solar erythematous ultraviolet radiation incident on the earth surface is very important for the safety of human health and other living things.

Ozone Monitoring Instrument (OMI) is a Dutch/Finnish instrument that attached to the NASA Earth Observing System (EOS) Aura spacecraft (2). OMI can provide maps global distribution and trends in UV-B radiation. FMI is in charge for processing and archiving of the OMI level 2 Surface UV Irradiance Product contains that contains gridded surface UV irradiance and dose quantities. Furthermore it includes metadata for data search.

The short name for this Level-2G OMI Surface UVB product is OMUVBG and the file type of the product is HDF-EOS5. The OMUVBd products are offline products that are mainly intended for long-term observing of the surface UV irradiance. OMI measurements are made once a day about 1:45 pm local time.

OMI offers among other things the surface ultraviolet (UV) irradiance at several wavelengths, clear sky and
overpass erythemal dose rate and the erythemal daily dose. The objective of this study was to investigate the distribution of ultraviolet erythemal daily dose over Peninsular Malaysia that obtained by Ozone Monitoring Instrument.

II. STUDY AREA AND METHODOLOGY

Figure 1 below shows the study area for this paper, that is peninsular Malaysia area starting from (1°N, 99°E) until (9°N, 106°E) is taken. The distribution map that generated here is average daily dose in early year of 2009. Since the data at study area was not available everyday, so it’s better to take the monthly average value of erythemal daily dose for this study.

The data of ultraviolet erythemal daily dose is downloaded from website Mirador Earth Science Data Search Tool, on the filename ‘Aura-OMI Spectral Surface UVB Irradiance and Erythemal Dose Level-2G data product (Daily level-2 data binned into global 0.25 deg Lat/Lon grids (OMUVBG)). OMUVBG files are available in EOS Hierarchical Data Format (HDF5-EOS). Each file contains daily data from the day lit portion of the globe.

The take on L2 grid is a 0.25-degree by 0.25-degree grid in longitude and latitude. The dimensions of the grid are 1440 by 720. The center of the first grid cell is located at longitude -179.5 and latitude -89.5. The center of the final grid cell is positioned at longitude 179.5 and latitude 89.5. The file size for the OMUVBG data product is about 128 Mbytes and the area of Solar Erythemal Daily Dose data over study area was viewed using HDF Explorer software. By using Adobe Photoshop 7.0 and Sigma Plot 11.0, Daily distribution map of solar erythemal dose rate can be generated.

III. DATA AND ANALYSIS

Figure 2 until Figure 5 show the distribution of Ultraviolet erythemal daily dose over peninsular Malaysia observed by Aura satellite. The highest erythemal dose on 13th November 2009 is 7103.83 J/m² and the average is 4752.55 J/m². Meanwhile on 22nd November, the highest erythemal dose recorded is 7344.37 J/m² and the average dose is 3335.23 J/m². 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 1st February 2010, the highest erythemal dose recorded is 8230.75 J/m² at South China Sea and the average dose is 6329.71 J/m². The highest erythemal dose on 17th February 2010 is 8180.80 J/m² and the average dose is 6002.61 J/m². As the result, the average dose value on both days for February is increase about 52.5 % compared to November’s day.

The value for February is higher than November may cause from the final phase of Northeast Monsoon that happened in February. Plus, the position of the sun which is relatively almost vertical in the equator line of February caused the increasing value of erythemal daily dose value. Besides, El-Nino phenomena that happen in the middle of Pacific Ocean since last June causing the lack of raindrops and clouds at Peninsular Malaysia. Because of these, many parts of Malaysia experience overheats that happen in January until March 2010[10]. As in November, early phase of Northeast Monsoon bringing heavy rain at east Peninsular Malaysia and this will decrease the erythemal daily dose reaching surface due to presence of the thick clouds.

IV. CONCLUSION

Satellite measurements are able to evaluate the increase of erythemal UV daily dose distribution over different regions of Peninsular Malaysia, from OMI data; we expect UV erythemal daily dose maps will guide to a more understanding of the UV irradiance resources. This data can be used to inform the public on the risks of overexposure to solar ultraviolet radiation, this data can be taken to publish in daily weather information website or other broadcast media. Further study will be extended to include analysis the inspection and measurement of the satellite (AURA) to the effects to other factors such as aerosols appearance, cloud affect and surface albedo.

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REFERENCES


13th November 2009

![Figure 2: OMI average erythemal Ultraviolet daily dose distribution map over peninsular Malaysia for 13th November 2010](image)

![Figure 3: OMI average erythemal Ultraviolet daily dose distribution map over peninsular Malaysia for 22th November 2009](image)
Figure 4: OMI average erythemal Ultraviolet daily dose distribution map over peninsular Malaysia for 1st February 2010

Figure 5: OMI erythemal dose rate of UV irradiance map over peninsular Malaysia on (a) 1st February 2009, and (b) 17th February 2009