A STUDY ON THE CREATING AND EVALUATION OF ULTRAVIOLET DISTRIBUTION MAP USING SATELLITE IMAGES

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ABSTRACT: Recently, there has been a growing interest in environmental issues in the world. In the case bathed UV more than necessary, there is a need for UV protection in everyday life because skin cancer and cataracts, health damage such as immune suppression is a concern. Therefore, Japan Meteorological Agency is publishing to create a UV forecast distribution map. However, the distribution map can't show clearly the situation of ultraviolet amount at local areas, because this UV distribution map is 20 km square. For all of these reasons, the purpose of this study is to create and evaluation of UV distribution map using satellite images in Akashi city. And the evaluation of UV distribution map created carried out by questionnaire survey. First, this study is grasped differences in UV reflectance for each land cover by result of UV observations for each land cover. By the observing the status of various sky, and proposed ground reaching UV ratio calculation formula superimposed state of land over and cover. Then, this study conducted questionnaire survey for the purpose of evaluation by the subject to UV distribution map and the awareness survey of citizens to UV.

As a result, this study was to clarify the following two points. 1) By taking advantage of the satellite images and digital terrain model, this study proposed a method to create a detailed UV distribution map than UV predictive distribution diagram providing the Japan Meteorological Agency. 2) The results of the questionnaire survey, the answer to utilize the UV information of the Japan Meteorological Agency whereas it is 39%, the person who answered want to use UV distribution map that was created in this study is 58%. And the extensive ultraviolet distribution map is likely to be used many people, in particular, extensive map has been found to be utilized when the route selection until the destination.

1. INTRODUCTION

In the environmental problems that occur on a global scale, to the increase of harmful ultraviolet rays amount have been concerns the impact on such as the increase in skin cancer and cataracts by to reduce of the ozone layer. And Japan Meteorological Agency has started to provide information ultraviolet predictive distribution diagram using UV index indicators from 2005[1]. However, ultraviolet prediction provided by Meteorological Agency is not sufficient accuracy, because the amount of ultraviolet light in other regions uniquely by observations weather and altitude, the ozone layer around the country from the data that has been collected by a fixed observation equipment of three places of Sapporo, Tsukuba Naha for the calculation. Figure 1 shows show the ultraviolet predicted distribution diagram of 20km mesh Meteorological Agency has to offer. Although there is a case study on information provided on the ground reaching amount of ultraviolet rays using 3km mesh satellite images that are available as existing research, this is the distribution on a regional scale[2]. Therefore, in the case attention is paid to the urban space constantly changing by the movement of people, it is not sufficient accuracy in the information provided by the Japan Meteorological Agency and existing previous studies. Now, this study can say efforts on detailed information provided toward the ultraviolet prevention, is one of the important issues and urgent universal.

On the other hand, an actual urban space is made up of buildings and trees, the ground surface is covered with soil and asphalt, or turf, it is considered that a person actually bathed in UV amount depends on the configuration of trees and buildings, reflection also have an impact from the building in addition to the direct UV. Therefore, the purpose of this study is to create and evaluation of UV distribution map using satellite images in Akashi city. And the evaluation of UV distribution map created carried out by questionnaire survey. First, this study is grasped differences in UV reflectance for each land cover by result of UV observations for each land cover. By the observing the status of various sky, and proposed ground reaching UV ratio calculation formula superimposed state of land over and cover. Then, this study conducted questionnaire survey for the purpose of evaluation by the subject to UV distribution map and the awareness survey of citizens to UV.
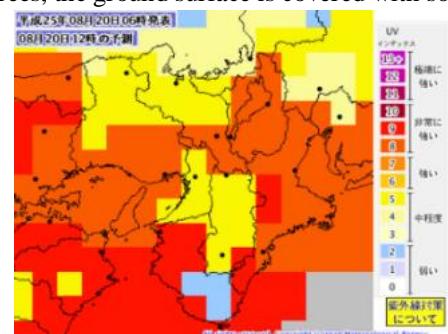

Fig.1. UV forecast distribution map

August 20, 2013 (meteorological institute)

2. Measurement of the UV reflectance of each land cover and over

2.1 UV measurement machinery and the amount of solar radiation measurement

This study used the UV measurement machinery made in United States Ultra Violet Corporation[3]. This sensor name is Radiometer Sensor UVX-36 having wavelength range of interest is 365nm. This wavelength range of interest is UV-A. Then, Figure 2 shows observation method. UV sensor is attached to the upper and lower at a height of about 30cm from the ground surface, because it is desired to determine the amount of reflection from the ground surface and the amount of direct UV. For reflection in land cover, focusing on the correlation of the amount of solar radiation and ultraviolet light, and direct in this study the observation results using the amount of solar radiation.
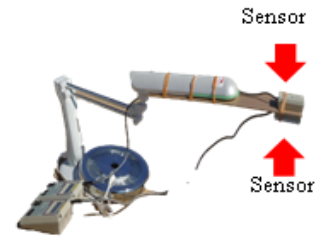

Fig.2. Main body and Radiometer Sensor UVX-36

2.2 Selection of observation points and survey results

UV reflectance of each land cover is necessary in order to create a UV distribution map. And therefore this study was determined by the land cover UV reflectance using ultraviolet measuring device at multiple points. Observation points is sandy beach, grass, asphalt, concrete, wood deck and soil was surveyed during the day ultraviolet observation. Table 1 shows the result of UV reflectance of each land cover.

<Project summary>
・Observation date: October 7, 2012 and December 6, 2014
・Weather: fair weather
・Survey Time: 10:00-16:30
・Maximum temperature 25.5℃／minimum temperature 16.2℃
・Measure once every 30 minutes per one location
・Measure five times at one measurement time, it's average value is representative value

Table 1 Result of UV reflectance of each land cover

land cover	UV reflectance ratio（%）
Grass	2.2
Asphalt	7.2
Soil	9.9
Sand	12.1
Concrete	17.0

3. Creating UV distribution map using satellite images

3.1 Study area and used data

This study with a satellite image is intended to create a distribution diagram of UV high definition. Therefore, it is necessary to select a high accuracy satellite image used. In this study, the region where Akashi, Hyogo Prefecture, to use satellite images of high resolution, the GeoEye-1. Table 2 shows the brief information of satellite images used. The institution of center of the figure 6 is Akashi National College of Technology.

Table 2. Image brief of the used satellite image

Location	Akashi city (in Japan)
Date	March 2010
Image type	GeoEye-1
Spatial resolution	0.41m pan-sharpened images
File format	GeoTIFF (11bit/pixel/band)

Fig.3. Geoeye-1 image of study area

3.2 Land cover classification using satellite images and Ultraviolet reflection map

In order to create a distribution diagram ultraviolet, this study followed by land-cover classification in urban space using satellite images. Land cover classification is a supervised classification using training data. The training data is a land cover obtained ultraviolet reflectance of each land cover. Figure 4 shows result of Land cover classification using satellite images. Land cover is understood from Table 1, UV reflectance of each land cover has been grasped from Figure 4. By using these values, Figure 7 is shown distribution diagram of the ultraviolet reflectance of each land cover.

Fig.4. Result of Land cover classification

and Creating UV distribution map

3.3 Extraction of leafy shade using the digital terrain model

The UV distribution map shown in Fig. 4 is a problem that rice field and trees are classified as the same vegetation. Therefore, this study use the digital terrain model (DTM). DTM is DSM (Digital Surface Model) and DEM (Digital Elevation Model). DEM is Digital elevation data. DSM is a digital surface model trees and building shape is accurately grasp rather than the elevation values. For the fields and trees distinction performs raster operation to take a difference of digital surface model and digital elevation model, it is possible to consider the shadow caused by trees. Figure 5 show the difference of DSM and DEM. In this study, DSM-DEM > 3m is determined as the trees in vegetation area. Because definition of high tree is more than 3m. And Figure 6 show Extraction result of shade by high tree using DSM and DEM

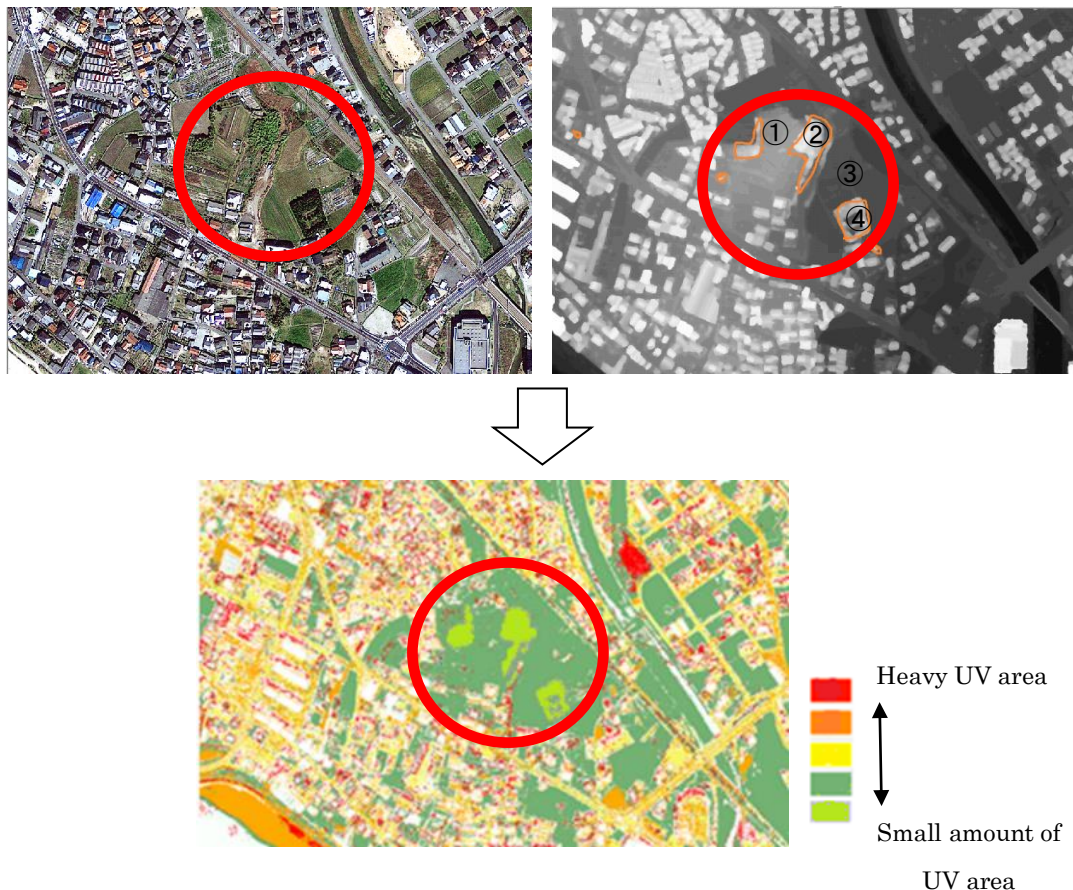Fig.5 The extraction method of high tree using DSM and DEM

Fig.6 Extraction result of shade by high tree using DSM and DEM

4. Evaluation of UV distribution map according to questionnaire survey

This study conducted for the purpose of evaluation by the subject to UV distribution map and the awareness survey of citizens toward UV using a questionnaire survey. The questionnaire survey item are three points as of the test subject's attributes, interest toward UV, the evaluation of UV distribution map. The questionnaire survey conducted to 16 o'clock from 10 o'clock by October 23 days and 24 days in 2015. Total number of subjects are 101 subjects.

Figure 7 show the result of interest toward UV. Figure 8 show the result for everyday UV protection.
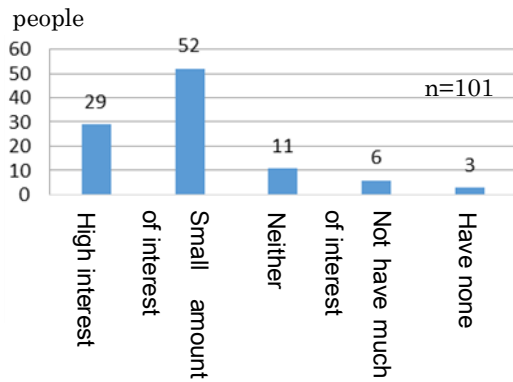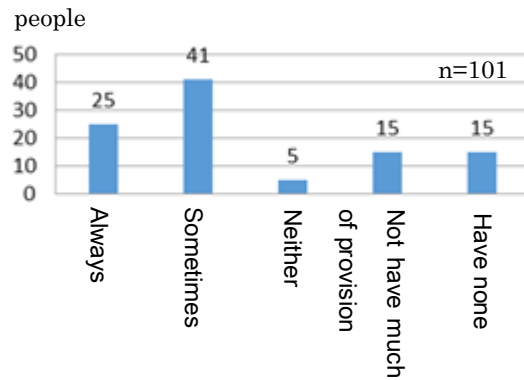
Fig.7 Result of interest toward UV

Fig.8 Result for everyday UV protection

5. Conclusion

As a result, this study was to clarify the following two points. 1) By taking advantage of the satellite images and digital terrain model, this study proposed a method to create a detailed UV distribution map than UV predictive distribution diagram providing the Japan Meteorological Agency. 2) The results of the questionnaire survey, the answer to utilize the UV information of the Japan Meteorological Agency whereas it is 39%, the person who answered want to use UV distribution map that was created in this study is 58%. And the extensive ultraviolet distribution map is likely to be used many people, in particular, extensive map has been found to be utilized when the route selection until the destination.

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