RELATIONSHIP BETWEEN PM2.5 CONCENTRATIONS AND AOT IN NAGASAKI

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1. INTRODUCTION

With rapid economic growth in East Asia areas, the industrial activities produced serious atmospheric pollution. Especially, PM 2.5 flies from the continent to Japan with much health damages. Fine particle matters with the aerodynamic diameter less than 2.5 μm is called $PM_{2.5}$. Because of the effects on visibility, human health and global climate, $PM_{2.5}$ has attracted much scientific and public attention (Yao and Lu 2014; Zhang et al. 2014). In this study, the correlation of PM 2.5 concentrations and AOT (Aerosol Optical Thickness) values was analyzed in Nagasaki. The satellite data was AOT values extracted from the MODIS data and hourly values of PM 2.5 at 14 stations in Nagasaki for a year in 2014 were selected as references. Finally the correlations of these values were obtained monthly. The results showed that the PM2.5 concentrations well correlated with the AOT values. In addition, the PM2.5 concentration contribution of local sources could be reflected by the linear regression parameter.

2. METHOD

The study was carried out in Nagasaki. The PM2.5 concentration data was collected during Jan1 to Dec 31, 2014 from the Air Environment Early Warning System in Nagasaki. Fig. 1 shows the PM2.5 Monitoring stations in Nagasaki. MODIS (Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra (EOS AM) and Aqua (EOS PM) satellites. Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands, or groups of wavelengths. This AOT distribution for Japan was obtained from the MODIS data in 865nm. As shown in Fig. 2, the AOT images extracted from the MODIS data were used to get the AOT values nearest to the PM2.5 monitoring stations in Nagasaki.

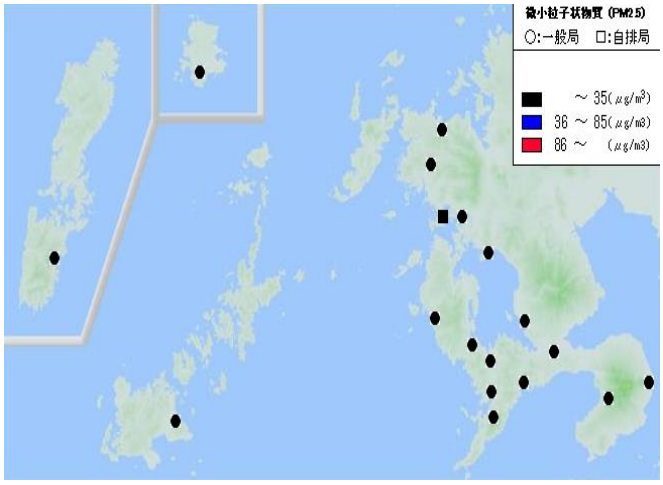

Fig. 1 PM2.5 Monitoring stations in Nagasaki

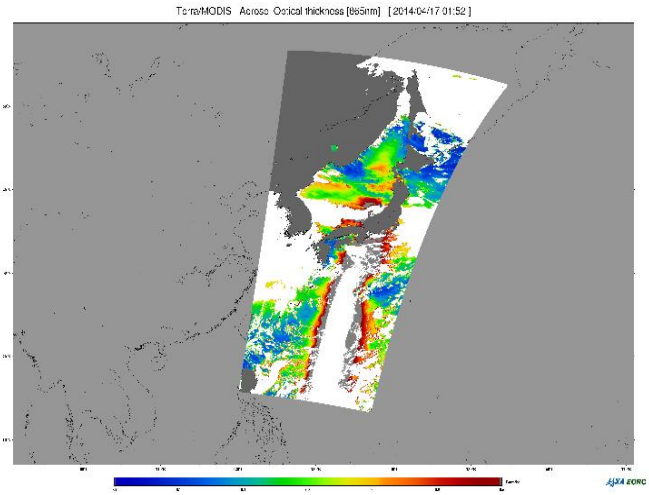

Fig. 2 AOT distribution in Japan

To analyze the relationship between PM2.5 concentrations and AOT, the following linear regression model (1) was used,

$$y = Ax + B \quad (1)$$

where, y represents the PM2.5 concentrations and x represents the AOT values.
After the linear regression, from the parameter B the degree of correlation from R^2 and background PM2.5 concentrations was estimated.

3. RESULTS AND ANALYSIS

Fig. 3 shows the relationship between PM2.5 concentrations and the AOT values in April, Nagasaki. From the results, the R^2 value is 0.6082, which means that the linear regression model well described the correlation between PM2.5 concentrations and the AOT values. As shown in Fig. 3, when the AOT values is 0, the PM2.5 concentrations is 5.1397μg/m^3, which shows the background concentrations.
Table 1 shows the parameters (A, B, R^2 and R) of the monthly linear regression. As shown in the results, the R^2 values are basically around 0.6 with the highest value is 0.8339 and the lowest value 0.2874, which shows a good linear.

Keywords: PM2.5, Correlation, AOT, MODIS, Linear Regression
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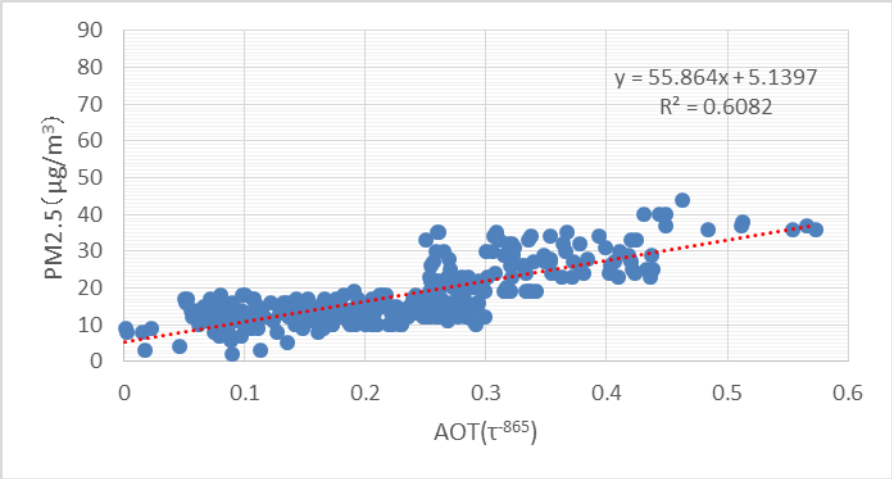

Fig. 3 Correlation between PM2.5 concentrations and AOT values

correlation between PM2.5 concentrations and AOT values. The values of the parameter, B, is in the range of -2.3395 to 5.1397. For most of the months, B values were positive, which means there is the background of PM2.5 concentrations from local sources. While in some months, like June, the B values is -2.3395, which means the PM2.5 concentration is 0 when the AOT value is 0.04187 (B/A=2.3395/55.864). An aerosol is a colloid of fine solid particles or liquid droplets, in air or another gas. Aerosols can be natural or not. Examples of artificial aerosols are haze, dust, particulate air pollutants and smoke. PM2.5 is only a part of aerosols.

Table 1 Monthly linear regression results in 2014, Nagasaki

	A	B	R^2	R
Jan	59.813	4.0841	0.5996	0.774338
Feb	66.816	0.7113	0.6139	0.783518
March	56.853	4.5532	0.6903	0.830843
April	55.864	5.1397	0.6082	0.779872
May	74.654	4.0038	0.6866	0.828613
June	75.866	-2.3395	0.6222	0.788797
July	39.636	2.2019	0.3016	0.549181
Aug	28.81	3.837	0.2874	0.536097
Sep	67.522	0.9468	0.658	0.811172
Oct	61.899	2.9521	0.6505	0.806536
Nov	52.473	3.8258	0.642	0.801249
Dec	86.205	-1.2308	0.8339	0.913181

4. CONCLUSIONS

Using the linear regression model, the correlation of PM 2.5 concentrations and AOT values was analyzed in Nagasaki, 2014. Finally the correlations of these values were obtained monthly. The results showed strong positive correlation between PM 2.5 concentrations and AOT values. From the model parameter B, the background of PM2.5 concentrations could be estimated.

REFERENCES

Yao, Ling, and Ning Lu., 2014. Particulate matter pollution and population exposure assessment over mainland china in 2010 with remote sensing. International journal of environmental research and public health, 11(5), pp. 5241–50.
Zhang, F., Cheng, H.R., Wang, Z.U., Lv, X.P., Zhu, Z.M., Zhang, G., Wang, X.M., 2014. Fine particles (pm2.5) at a cawnet background site in central china: chemical compositions, seasonal variations and regional pollution events. Atmospheric Environment, 86, pp. 193–202.
http://kuroshio.eorc.jaxa.jp/ADEOS/mod_nrt_new/index.html
http://gissv02.pref.nagasaki.jp/TaikiWeb/MainController
http://en.wikipedia.org/wiki/Aerosol
http://nagasaki-taiki.aa0.netvolante.jp/