Derived volume size distribution function from 2012 New Year spectrometric measurements in Manila Observatory (14.64N, 121.07E)

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Optical properties of New Year aerosols are characterized by spectrometric measurements performed in Manila Observatory during the 2012 New Year celebration. Data were obtained using an Ocean Optics USB2000 spectrometer from 20:00 (local time) of 31 December 2011 to 05:00 of 01 January 2012. Local time is 8 hours ahead of coordinated universal time (UTC). A xenon lamp was used as light source and was located ~150m from the spectrometer. Sources of these aerosols came from fireworks and burning of firecrackers from residential areas near Manila Observatory. Between 20:00 and 23:30, sporadic fireworks and firecracker burning were observed. The intensity and frequency of firework activities increased as midnight approached. Data were collected every 20s to look at temporal evolution of aerosol optical properties during this time interval. In this study we derive the aerosol volume size distribution function using the parametric inversion method of Kaijser (1983). In this method, we selected 8 wavelengths (387.30, 400.00, 440.00, 470.30, 500.30, 530.00, 550.10, 600.00nm) to derive the volume size distribution functions. Optical depths from these wavelengths were derived using a reference intensity obtained at 20:00 (local time) of 31 December 2011 when the air was considered relatively clean even with the occurrence of sporadic firework activities. A least-square minimization process was implemented between the measured optical depths and computed optical depths using Mie theory and assuming a 33 bimodal log-normal distribution functions with geometric mean radii between 0.003 to 1.2um and standard deviation of 2. The result of the least-square minimization process outputs the coefficients of the log-normal volume size distribution functions. This allowed the log-normal volume size distribution functions of the aerosols to be determined and plotted to indicate changes over time. Fig. 1 shows the temporal development of derived aerosol volume size distribution from 20:00 (local time) of 31 December 2011 to 05:00 of 01 January 2012. From 20:00 to 22:00, the aerosols exhibit a unimodal volume size distribution centered at 0.3um. This can be attributed to background urban aerosols, i.e., without any contamination from aerosols contributed by firecrackers and fireworks. From 22:00 to 00:30, small size aerosols with radius 0.04um started to emerge due to increasing firework activities which intensified until 00:00 creating a bimodal volume size distribution. From 00:00 to 00:30, urban background aerosols have developed into larger aerosols of radius 0.8um due to high relative humidity. From 00:30 to 03:00, the intensities measured by the spectrometer were very low because of low visibility conditions. During this time period, there was an abundance of smoke lingering in the atmosphere as a result of the firework activities and relatively low wind speed conditions. The measured low light intensities from the xenon lamp caused the inversion process to fail for the data set during this time interval. At 03:00 up to 04:30, when the visibility slightly improved, the data obtained by the spectrometer provided sufficiently high light intensities for the inversion process to succeed and yield a relatively constant mean radii for both modes, indicating constant relative humidity. From 04:30 to 05:00 the volume size distribution decreases significantly suggesting a sudden clearing of the atmosphere. With these observations, we have shown the possibility of obtaining the aerosol volume size distribution functions under heavy aerosol loading in the atmosphere. In the future, we intend to improve this method to show aerosol growth under increasing relative humidity conditions.

Reference:

Kaijser, T. (1983). A simple inversion method for determining aerosol size distributions. *J. Comp.*

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