

ABSTRACT

CARBONACEOUS AEROSOL IN AN URBAN AND A RURAL SITE IN THE PHILIPPINES: METHOD DEVELOPMENT AND CHARACTERIZATION

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Carbonaceous aerosol, broadly classified into organic carbon (OC) and elemental carbon (EC), are atmospheric particulates known to have significant effects to health, climate, and visibility. Concentrations of OC and EC in the $PM_{2.5}$ range were measured for an urban (Valenzuela City, Metro Manila) and a rural (Angat, Bulacan) site in the Philippines from September 2011 to August 2012. The method employed was thermal-optical analysis and the three most widely-recognized protocols, NIOSH, IMPROVE_A, and EUSAAR_2, were first compared to determine an optimal protocol. IMPROVE_A with reflectance correction was ultimately selected for the study for its proper OC and EC fractionation and the wide girth of available data for comparison. However, a modified version of the protocol, having an increased OC4 temperature step of $650^{\circ}C$ from $580^{\circ}C$ (adopted from the EUSAAR_2 protocol) and with transmittance as its correction method, is proposed as optimal for Philippine samples and is predicted to give more accurate results. Measurements show that OC ($8.00 \text{ ug}/\text{m}^3$) and EC ($6.63 \text{ ug}/\text{m}^3$) levels were higher in Valenzuela than in Angat (OC: $4.08 \text{ ug}/\text{m}^3$, EC: $2.29 \text{ ug}/\text{m}^3$), as expected. The total contributions of OC and EC to the $PM_{2.5}$ mass for the urban and rural site were 38.9% and 19.7%, respectively which prove that carbonaceous aerosol constitute a significant part of the fine fraction. Compared to neighboring countries in Asia, the Philippine sites have intermediate OC concentrations (about half of which are from secondary OC formation) but greatly elevated EC levels. These results indicate the dominance of highly inefficient combustion sources and highlight the need for the regulation of such emissions. It was found that Valenzuela was dominated by the OC2, OC3, and EC1 fractions which points to gasoline vehicles, the industrial sector, and residential cooking as the possible main sources. Angat, while generally having lower concentrations and being less EC-dominated, had remarkably higher levels of the EC2 fraction, which suggests a unique EC source in the rural area. Conditional Probability Function (CPF) for Valenzuela shows very similar results mainly pointing towards the 30° , 150° , and 210° direction for OC, EC and secondary black carbon (BC) data. This indicates common sources for these parameters and likely good correlation. BC vs. EC R^2 values however, are low with only 0.349 for Valenzuela and 0.050 for Angat. Cluster analysis shows that the disparity is likely due to varying degrees of light attenuation among the different EC fractions and to the presence of non-EC, light-absorbing particulates, which reflectometry, the method used for determining BC, cannot discriminate.