

ABSTRACT

SOURCE IDENTIFICATION AND ELEMENTAL QUANTIFICATION OF (APM) AIRBORNE PARTICULATE MATTER IN CENTRAL BUSINESS DISTRICT, BAGUIO CITY PHILIPPINES

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The City of Baguio is popularly known as the 'Summer Capital' of the country because of its pleasantly cool climate and its clean pine-scented cool air. The city is frequented by many local and foreign tourists during the Lenten season and the Panagbenga Flower Festival. However, the once 'cleanest and greenest city' has drastically changed due to rapid population growth and unrestrained urban expansion. Adequately characterize the air quality of the city and to correctly identify potential air pollution sources will help aid in formulating strategies towards air pollution abatement for the protection of public health and help in the improvement of the local economy.

The objectives specific to this study are: to investigate mass concentrations and size distributions of inhalable fractions of particles using an optical particle counter; to identify the directionality of the sources of particulate matter pollution using Conditional Probability Function receptor model (CPF) for surface winds and associate the directionality with chemical markers using mineralogical analysis; to conduct a survey of activity related to emissions and recommend solutions for better air quality management.

Real-time sampling of ambient particulate matter was measured using a GRIMM Environmental Dust Monitor (365 E), while PM₁₀ filter samples and surface dust samples were analyzed for key aerosol elements (Na, Mg, Al, Ca, Cr, Mn, Co, Ni, Cu, Zn, As, Sr, Cd, Pb) using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Ninety-six-hour back trajectories ending at 1400 m ASL at Baguio City were also calculated using the HYSPLIT Model 4. Source contributions and wind direction influence were examined using Conditional Probability Function (CPF). Clean Air Score Card v. 3.0 was used to survey activities related to emissions.

The concentration of PM₁₀ (in all study sites combined) ranges from 16 ug/Nm³ to 217 ug/Nm³ with an average value of 110.697±52.353 ug/Nm³ (n=66). The temporal variation of ambient PM₁₀ concentrations generally exceeded the WHO AQG values for PM₁₀ concentration of 50 ug/m³. However, exceedance of PM₁₀ concentration based on the short-term (24-hr) National Air Quality Guideline Values of 150 ug/m³ are evident in several events in all months across the sampling period. ICP-MS results identified Zn and Na with the highest mean concentration at 28.88 ug/Nm³ and 15.61 ug/Nm³ respectively. Pb and Cd with a mean concentration of 0.07 ug/Nm³ and 0.06 ug/Nm³ respectively exceeded the allowable limits set by WHO. The results also showed Kabayanihan site has the highest concentration of Na and Zn followed Baguio City Hall, Veteran's Park, and Pacdal Circle respectively. High levels of Pb and Cd concentrations were also measured in Veteran's Park and Pacdal Circle. Analysis of the PM₁₀ mass concentration, elemental average concentration for both PM₁₀ and surface dust samples as well as the Pb-EF values indicate that both BCPO and UP Baguio

sites are the areas of concern. Measurement obtained from the GRIMM EDM-365 supported the PM₁₀ concentration results. The TSP, PM₁₀, PM_{2.5}, PM₁ concentrations consistently increased in the morning from 2:00 am to 6:00 am, then peaks at 7:00 am after which gradually decreases until 10:00 am. Afterwards a steady increase in the concentration from 11:00 am up to 5:00 pm where it peaks at 6:00 pm. CPF plots for PM₁₀ concentration indicate that the directional pattern of several elements coming from the same possible location which generally points to Southwest and Northeast of Baguio City. The prevailing NE monsoon winds from November to February and SW monsoon winds from July to September may have influenced the directionality of the pollutants during the specific seasons. However, the results of non-correlation of seasonality and PM₁₀ concentration suggests that seasonality may not affect APM concentrations in CBD, Baguio. Most of the air masses are affected by the prevailing winds north east monsoon for the months of November to February and south west monsoon for July to September. Mostly originated from the Pacific Ocean off the coast of Taiwan and from the Java Sea and the Indian Ocean passing Singapore, Malaysia, Cambodia and Borneo during south west monsoon while the majority of the air mass a dry season to a transition season to Habagat. Baguio is classified as an "Emerging" City having majority of key components of clean air management are in place. However, policies and actions to reduce emissions from identified major sources need to be enhanced and sector-based institutions need to upgrade technical and management capacity.