

Characterization and Source Apportionment of Airborne Particles in Eastern Botswana

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Abstract

The aims of this work are to characterize aerosol particles in Botswana, to find sources and source regions as well as transport patterns of aerosol particles in Botswana, and to develop methods for simultaneous study of black carbon and elemental contents of aerosol particles.

Airborne particles have been collected at five locations in eastern Botswana. The equipment used to collect the particles are a dichotomous virtual impactor, a Batelle cascade impactor and a laboratory-made black carbon sampler. The dichotomous impactor was used for all the measurements while the cascade impactor and the black carbon sampler were used for only one measurement period at one of the locations. Characterization involved elemental concentrations and mass concentrations of the fine and coarse particles, mass concentration of black carbon in airborne particles, and elemental size distributions of airborne particles. For elemental analysis, the energy-dispersive X-ray fluorescence and total reflection X-ray fluorescence techniques were used. The mass concentrations of the fine and coarse particles were determined by gravimetry. To obtain the black carbon concentrations, a reflectometer was used.

The measured concentration levels are discussed and a number of methods, among which are principal component analysis, linear regression analysis and enrichment factors of airborne particles with respect to soil, are used to determine possible sources of airborne particles in Botswana. High levels of soil derived elements and those of lead and bromine have been measured in Botswana. The elemental size distributions are dominated by particles $> 2\mu\text{m}$ and the mass concentration is dominated by coarse particles (2.5 –10 μm). Soil is the major source of airborne particles in Botswana. Other sources of importance include traffic, biomass burning and some industrial activities. From the results of the reflectometer measurements of samples collected concurrently by the black carbon sampler and the fine particle channel of the dichotomous impactor, it appears possible to use samples from either of the two instruments for both elemental and black carbon concentration measurements

Keywords: Aerosol particles, fine particles, coarse particles, EDXRF, TXRF, size distribution, mass concentration, elemental concentration, black carbon.