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Aerosol Chemical Composition in Urban Sites: A Comparative Study of Lima and Medellin

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Abstract : South American large cities often present serious air pollution problems and their atmosphere composition is influenced by a variety of emissions sources. The South American Emissions Megacities, and Climate project (SAEMC) has focused on the study of emissions and its influence on climate in the South American largest cities and it also included Lima (Peru) and Medellin (Colombia), sites where few studies of the genre were done. Lima is a coastal city with more than 8 million inhabitants and the second largest city in South America. Medellin is a 2.5 million inhabitants city and second largest city in Colombia; it is situated in a valley. The samples were collected in quartz fiber filters in high volume samplers (Hi-Vol), in 24 hours of sampling. The samples were collected in intensive campaigns in both sites, in July, 2010. Several species were determined in the aerosol samples of Lima and Medellin. Organic and elemental carbon (OC and EC) in thermal-optical analysis; biomass burning tracers (levoglucosan - Lev, mannosan - Man and galactosan - Gal) in high-performance anion exchange ion chromatography with mass spectrometer detection; water soluble ions in ion chromatography. The average particulate matter was similar for both campaigns, the PM10 concentrations were above the recommended by World Health Organization (50 µg m^{-3} – daily limit) in 40% of the samples in Medellin, while in Lima it was above that value in 15% of the samples. The average total ions concentration was higher in Lima (17450 ng m^{-3} in Lima and 3816 ng m^{-3} in Medellin) and the average concentrations of sodium and chloride were higher in this site, these species also had better correlations (Pearson's coefficient = 0,63); suggesting a higher influence of marine aerosol in the site due its location in the coast. Sulphate concentrations were also much higher at Lima site; which may be explained by a higher influence of marine originated sulphate. However, the OC, EC and monosaccharides average concentrations were higher at Medellin site; this may be due to the lower dispersion of pollutants due to the site's location and a larger influence of biomass burning sources. The levoglucosan average concentration was 95 ng m^{-3} for Medellin and 16 ng m^{-3} and OC was well correlated with levoglucosan (Pearson's coefficient = 0,86) in Medellin; suggesting a higher influence of biomass burning over the organic aerosol in this site. The Lev/Man ratio is often related to the type of biomass burned and was close to 18, similar to the observed in previous studies done at biomass burning impacted sites in the Amazon region; backward trajectories also suggested the transport of aerosol from that region. Biomass burning appears to have a larger influence on the air quality in Medellin, in addition the vehicular emissions; while Lima showed a larger influence of marine aerosol during the study period.

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