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Relation between aerosol particles and their optical properties: a case study for São Paulo-Brazil

Regina Miranda (1) and Maria de Fatima Andrade (2)

(1) EACH - University of São Paulo, São Paulo, Brazil (remaura@usp.br), (2) IAG - University of São Paulo, São Paulo, Brazil (mftandra@model.iag.usp.br)

Brazil has a territory of 8.5 million km2 and a population of more than 160 million inhabitants, distributed throughout 26 states. Brazillian capital-cities with millions inhabitants and vehicles have several problems concerning air pollution. São Paulo, capital of São Paulo State, with more than 19 million inhabitants, 7 million vehicles, as well as the major industrial and technological park of the country, has high concentrations of air pollutants, especially in the winter. Air pollution, high building density, and a lack of green areas, combined with the proliferation of asphalt and concrete surfaces, have resulted in a greater number of urban heat island effects, fewer drizzle events, and rainfall events of greater intensity. São Paulo has an extensive air quality monitoring network, which has shown that ozone levels often exceed the NAAQS limit during spring and summer, and that concentrations of inhalable particles exceed the NAAQS limit mainly during the winter, from June to August. Aerosols are produced by a variety of processes, creating differences in their physicochemical properties and hence in their ability to scatter and absorb solar radiation. For most urban areas in Brazil, vehicles are considered the principal source of particles emitted to the atmosphere. Particles have been monitored in the winter of 2012 in São Paulo using a MOUDI (Micro Orifice Uniform Deposit Impactor), in order to have the mass distribution of the aerosol. The concentrations of coarse particles can still be larger than those of fine particles, although the difference between both has become smaller than in the past. The samples collected were analyzed by gravimetry for mass concentration, optical reflectance for Black Carbon concentration and X-ray Fluorescence for elementar characterization. Optical properties were obtained from Aeronet (Aerosol Robotic Network, http://aeronet.gsfc.nasa.gov/) for São Paulo city. It was found that a high fraction of elements was derived from mineral dust (Al, Si, Ca, Fe), anthropogenic particles and the burning of diesel (S), as well as from industries and residual oil combustion. Considering the trace element values obtained through EDXRF analysis, Angstron coefficients and Aerosol Optical Thickness (AOT 500 nm) were correlated (Pearson Correlation) to particulate and chemical elements. Soil elements have a positive correlation, fine particles are strong correlated to AOT. Elements like Fe, Si and Ca are usually related to larger particles and lower Angstron coefficients.