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Anthropogenic Influence on Secondary Aerosol Formation and Total Water-Soluble Carbon on Atmospheric Particles

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On a global scale, the atmosphere is an important source of nutrients, as well as pollutants, because of its interfaces with soil and water. Important compounds in the gaseous phase are in both organic and inorganic forms, such as organic acids, nitrogen, sulfur and chloride. In spite of the species in gas form, a huge number of process, anthropogenic and natural, are able to form aerosols, which may be transported over long distances. Sulfates e nitrates are responsible for rain acidity; they may also increase the solubility of organic compounds and metals making them more bioavailable, and also can act as cloud condensation nuclei (CCN). Aerosol samples (PM2.5) were collected in a rural and industrial area in Rio de Janeiro, Brazil, in order to quantify chemical species and evaluate anthropogenic influences in secondary aerosol formation and organic compounds. Samples were collected during 24 h every six days using a high-volume sampler from August 2010 to July 2011. The aerosol mass was determined by Gravimetry. The water-soluble ionic composition (WSIC) was obtained by Ion Chromatography in order to determine the major anions (NO_3-, SO4= and Cl-); total water-soluble carbon (TWSC) was determined by a TOC analyzer. The average aerosol (PM2.5) concentrations ranged from 1 to 43 ug/m3 in the industrial site and from 4 to 35 ug/m3 in the rural area. Regarding anions, the highest concentrations were measured for SO42- (10.6 μg/m3–12.6 μg/m3); where the lowest value was found in the rural site and the highest in the industrial. The concentrations for NO_3- and Cl- ranged from 4.2 μg/m3 to 9.3 μg/m3 and 3.1 μg/m3 to 6.4 μg /m3, respectively. Sulfate was the major species and, like nitrate, it is related to photooxidation in the atmosphere. Interestingly sulfate concentrations were higher during the dry period and could be related to photochemistry activity. The correlations between nitrate and non-sea-salt sulfate were weak, suggesting different sources for these species. The secondary aerosol represented an important fraction of total compounds in PM2.5 ranged from 16 to 18% for (NH4)2SO4 and 6 to 8% for $NH4NO_3$. The values for TWSC ranged from 0.28 to 6.35 μg/m3 in the industrial area and 0.12 to 7.49 μg/m3 for rural area. The similarity between the areas regarding secondary aerosols formation and water-soluble carbon compounds is probably due to the particle size.