Aerosol characterization in Buenos Aires and relationships with transport patterns in South America

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Abstract

The present study aims to characterize the different contributions to the aerosol load in the atmosphere of Buenos Aires and the role of the atmospheric flow in Southeastern South America as a transport mechanism. The analysis is based on measurements of the columnar aerosol content and derived quantities obtained with ground-based remote sensors. The results provided evidence of the relative importance of the regional transport and the local contribution, as well as elements related with the particulate size distribution and their links with the possible aerosol sources.

1. Introduction

The characterization of the pollution related with particulate matter is of utmost importance due to the several effects that produces, which range from the short to the global scale. In South America, the airborne particulate matter can be broadly associated with that originated at the great urban conglomerates, which is pollution rather local in nature, and the regional pollution due to biomass burning. In the central region of South America, biomass burning takes place mainly in the dry season (August to October (ASO)). On the other hand, previous studies showed the role of the South American Low Level Jet (SALLJ) as an agent to disperse water vapor and biogeochemical substances (Freitas et al 2005, Vera et al 2006, Ulke et al 2007). A subset of the SALLJ, known as Chaco Jet (CJ), has a main role in the transport from tropics to mid-latitudes. This current is normally oriented NW-SE and extends from low latitudes farther 30°S. Its exit region to the Atlantic Ocean occurs generally near the Rio de la Plata were Buenos Aires is located. The CJ events have a baroclinic environment associated with the approach of a cold front from southern Argentina. The front displacement to the northeast inhibits the advance of the regional pollution plumes to higher latitudes.

2. Data and methodology

For a five year period (2000-2005), the SALLJ events were diagnosed applying modified Bonner's (1968) criterion to the analyses of the Global Data Assimilation System from the National Centers for Environmental Prediction. The dates of occurrence of CJ in which Buenos Aires had a pre-frontal location were selected. For the same period, the daily measurements of aerosol optical thickness at 500 nm (AOT) from the AERONET site (AErosol RObotic NETwork) from NASA (National Atmospheric and Science Administration) (http://aeronet.gsfc.nasa.gov), at CEILAP-BA (34.5º S, 58º O) were used. In addition to the AOT, the Ångström coefficient (in the range 440-870 nm) and the particulate size distributions were analyzed. The dates of occurrence of CJ were used to split the measurements and derived quantities in different samples and explore the signature of the regional transport and help characterize the possible sources and impacts of the aerosol load.

3. Results and discussion

The SALLJ occurred 30% of the time in the considered period, from which the CJ had a 35% frequency. Table 1 presents the statistics for AOT and Ångström coefficient for the samples CJ or no CJ. The overall climatological values for the site are: 0.12 for AOT and 1.12 for the Ångström coefficient. It is observed an increase in AOT during the CJ events, in accordance with the presence of a greater aerosol load. The higher Ångström coefficient obtained during CJ indicates a relationship with biomass burning aerosols, typically in the fine fraction, which agrees with the literature (Kambezidis and Kaskautis, 2007).

Table 1. Statistics for AOT and Ångström coefficient.

	AOT		**Ångström**	
	CJ	No CJ	CJ	No CJ
Mean	0.23	0.088	1.40	1.33
Std Dev.	0.22	0.096	0.36	0.38
Maximum	1.12	1.00	2.17	2.56
Minimum	0.03	0.016	0.28	0.21
N	138	868	138	868

The CJ events were further split in two sub-samples. the events that occurred during the burning season (ASO) and the rest of the months. The first one ensures the existence of an increased amount of active fires. Table 2 shows the statistics of these sub-samples. The sub-sample CJ during the burning season (CJ_BB) has an important raise in AOT and Ångström coefficients.

Table 2. Statistics for AOT and Ångström coefficient.

	AOT		**Ångström**	
	CJ_BB	CJ_NBB	CJ_BB	CJ_NBB
Mean	0.35	0.13	1.47	1.35
Standard deviation	0.27	0.082	0.34	0.37
Maximum	1.12	0.55	2.07	2.17
Minimum	0.03	0.03	0.68	0.28
N	63	75	63	75

Figure 1 depicts the mean particle size distributions obtained for the CJ_BB events and those for the CJ events in the rest of the year (CJ_NBB). The results show a clear impact on the particle size distribution with a remarkable increase in the concentration and, particularly, in the fine fraction of the distribution for the CJ_BB events. On the other hand, there is only a slight difference between the peaks associated to the fine and coarse fractions for the CJ_NBB events.

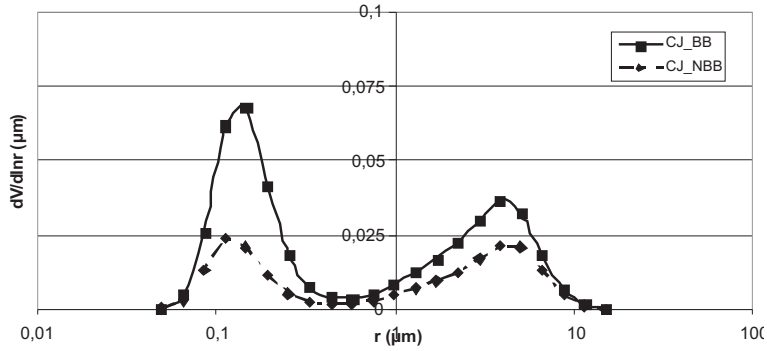

Figure 1. Particle size distributions during the CJ events.

4. Conclusions

Buenos Aires aerosol load and derived quantities had episodic contributions from biomass burning in central South America. The CJ appears as the main regional transport mechanism. The CJ events during the burning season showed a remarkable increase in aerosol concentrations, Ångström coefficient and a major impact in the accumulation mode of the particle size distribution.

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