Optical Properties of Dust and Urban Pollution during CACHE 2005

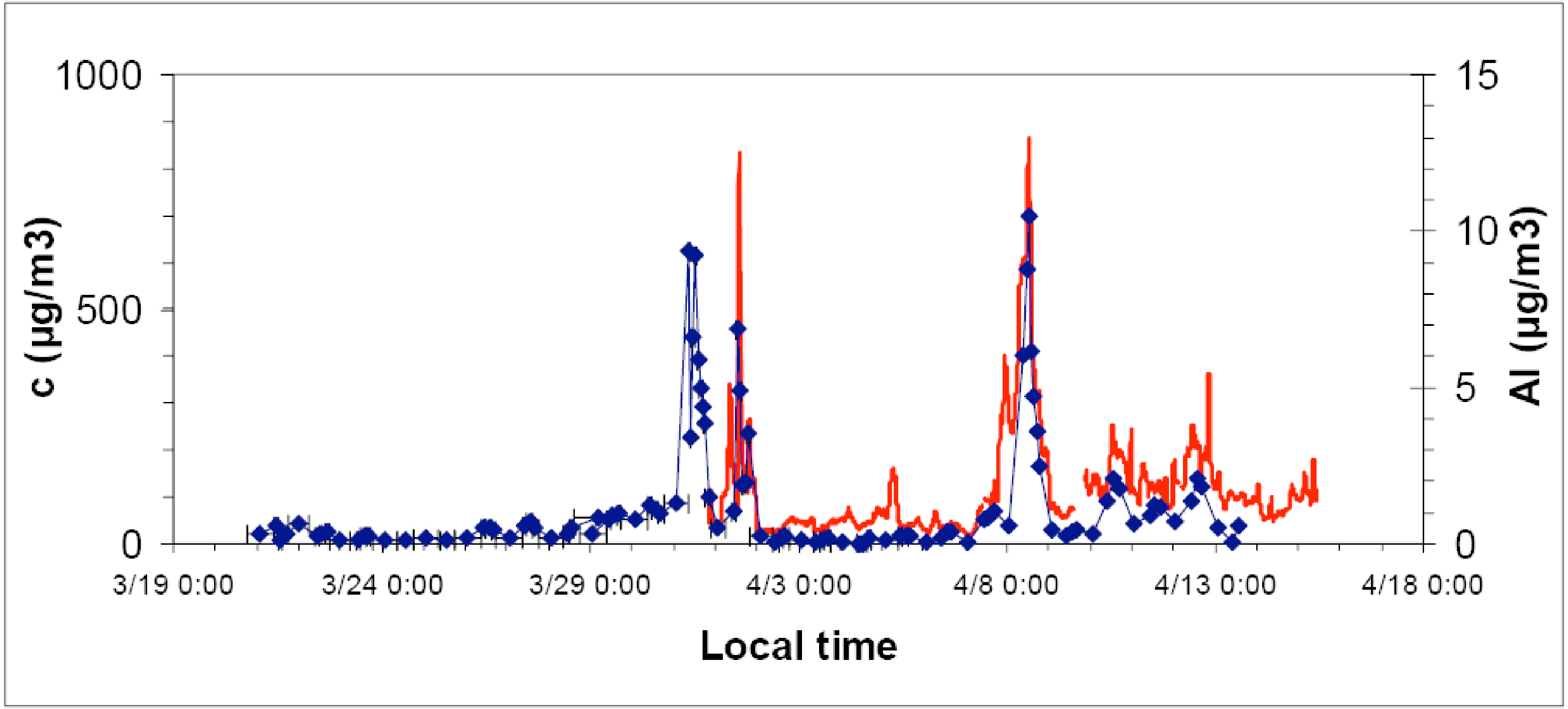


Figure 1: Evolution with time of the PM10 mass concentration (c, solid line) measured in real time by the TEOM microbalance and of the Al mass concentration retrieved by XRF analysis of aerosol samples collected on nuclepore filters (losanges).

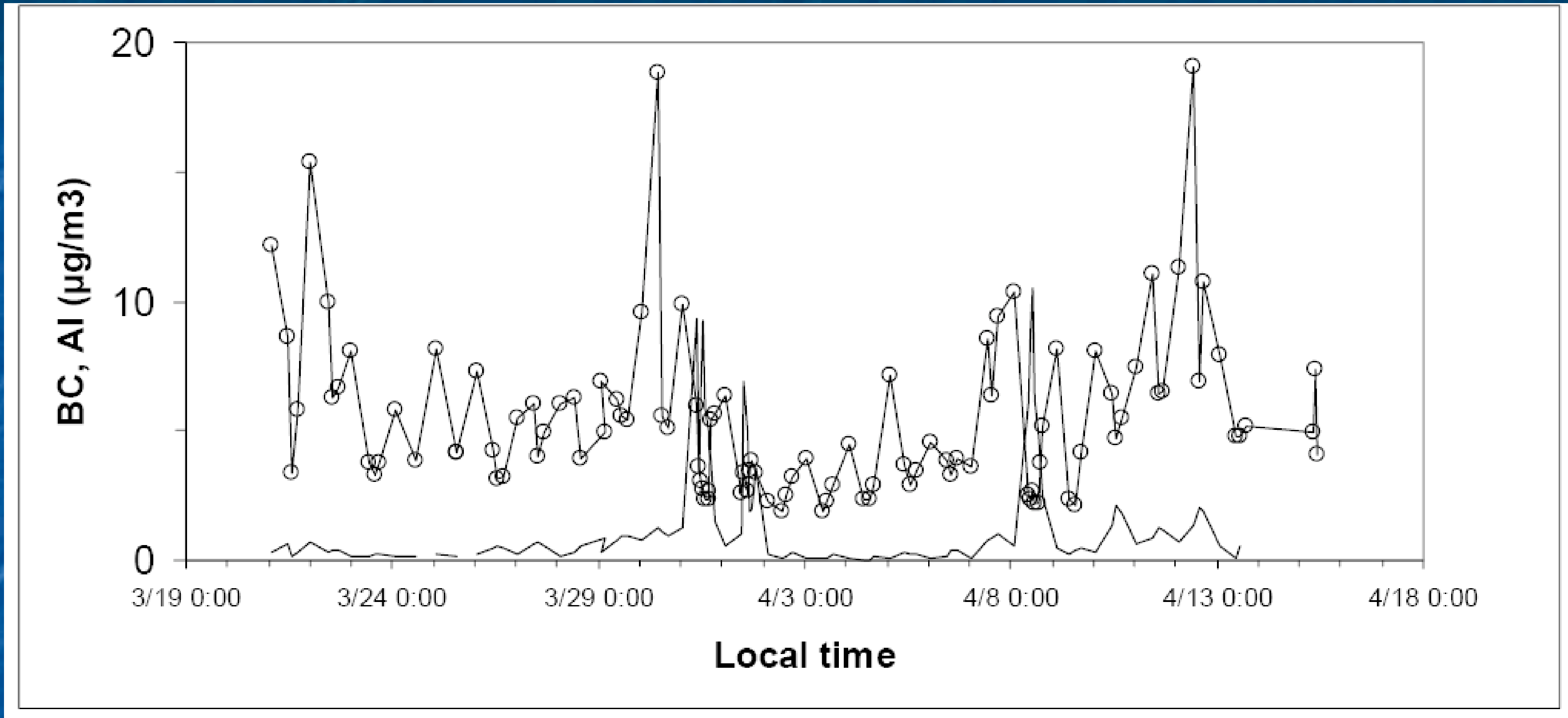


Figure 2: Evolution with time of the black carbon(BC, open circles) and Al (solid line) concentrations measured at the Cairo University sampling site. BC is particularly low when Al is maximal, that is to say during the dust peaks.

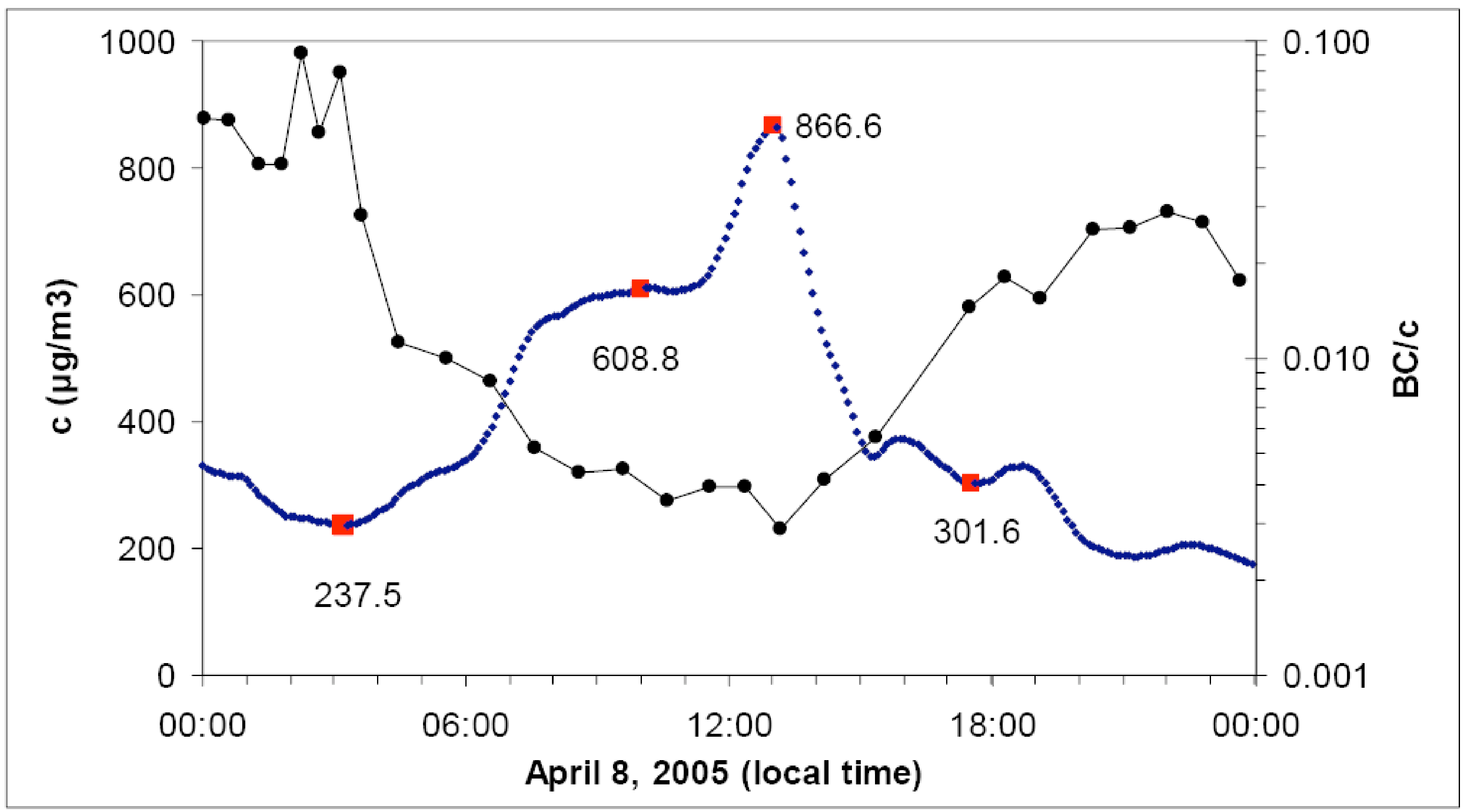


Figure 3: Co-evolutions of the PM10 concentration (c, small losanges) and black carbon mass fraction (BC/c, full circles) during the April 8 dust event. PM10 concentration values are also reported at four particular times of the day: 1) 03.30 AM that corresponds to a pre-dust situation dominated by urban pollution aerosols, 2) 10.10 AM and 01:00 PM that were selected during the dust event, and 3) 05:30 PM that corresponds to the receding phase of the dust event.

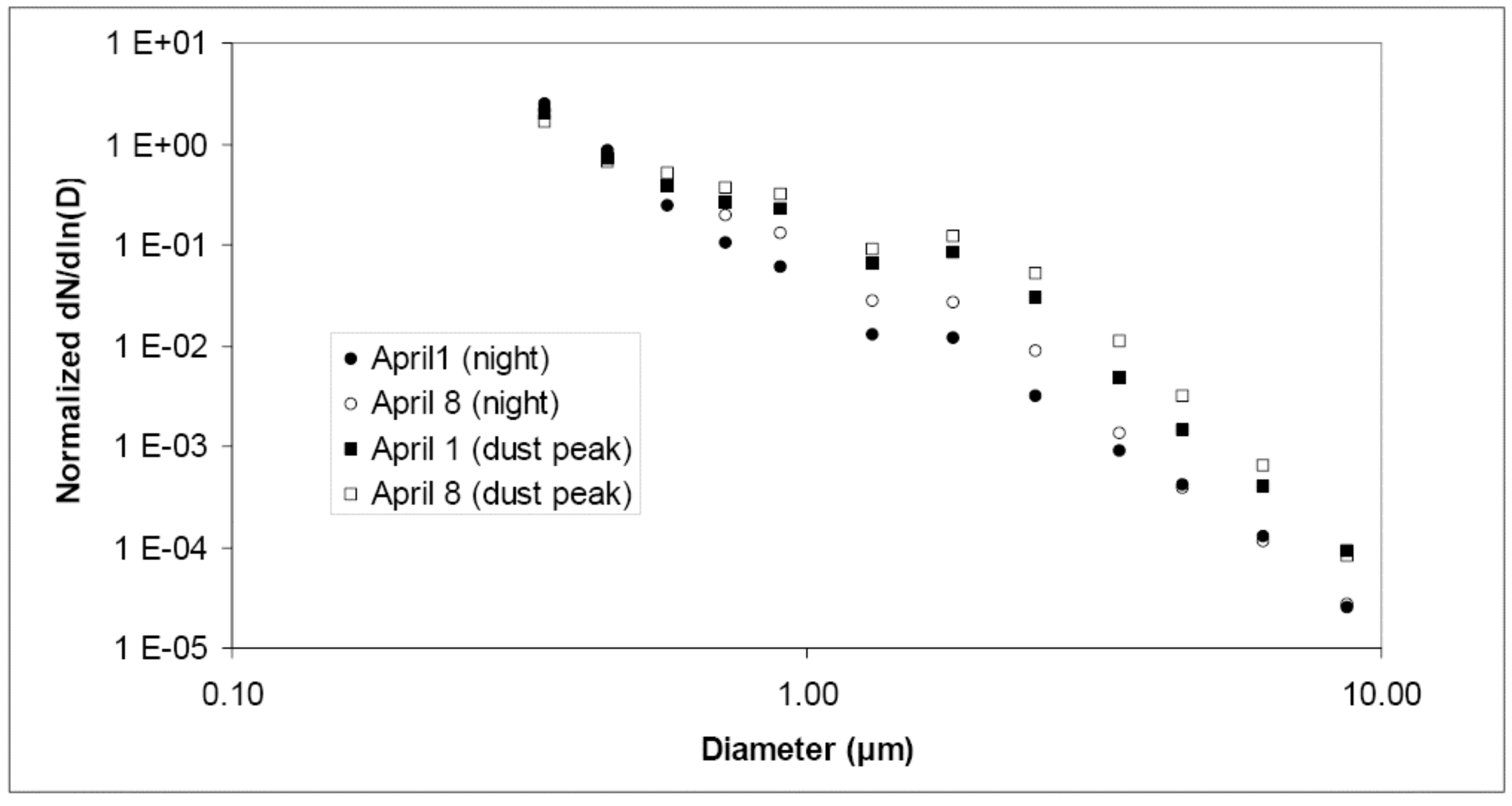


Figure 4: Size distribution of the aerosol mixtures measured by the optical size analyzer in situations dominated by urban pollution (April 1 and 8 nights) and at the peaks of the two dust events. In order to facilitate comparison, values have been normalized to the total particle concentration.

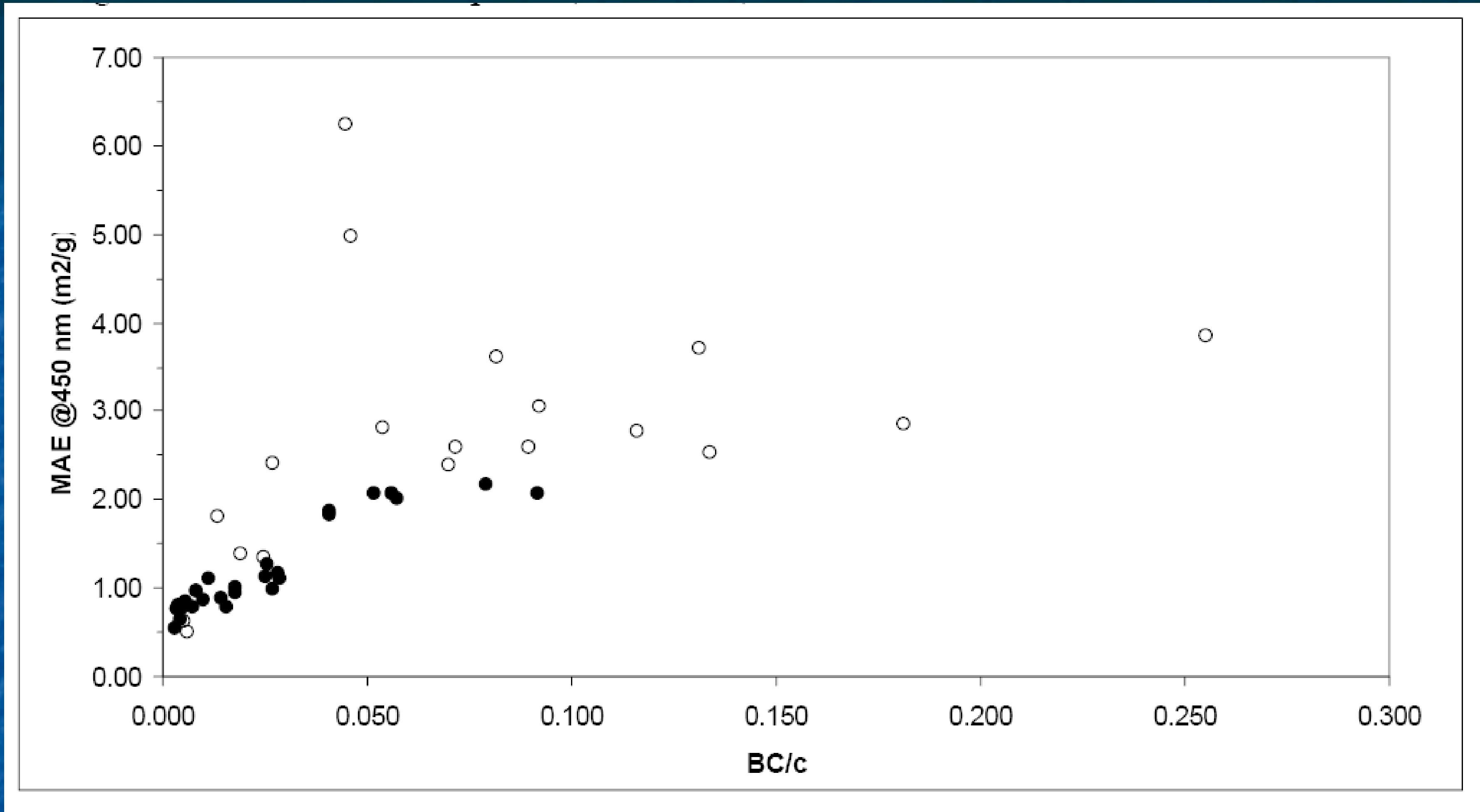


Figure 5: Influence of the proportions of the urban pollution/mineral dust mixture on the aerosol mass scattering efficiency at 450 nm. Results for April 1 (open circles) have been distinguished from those of April 8 (full circles).

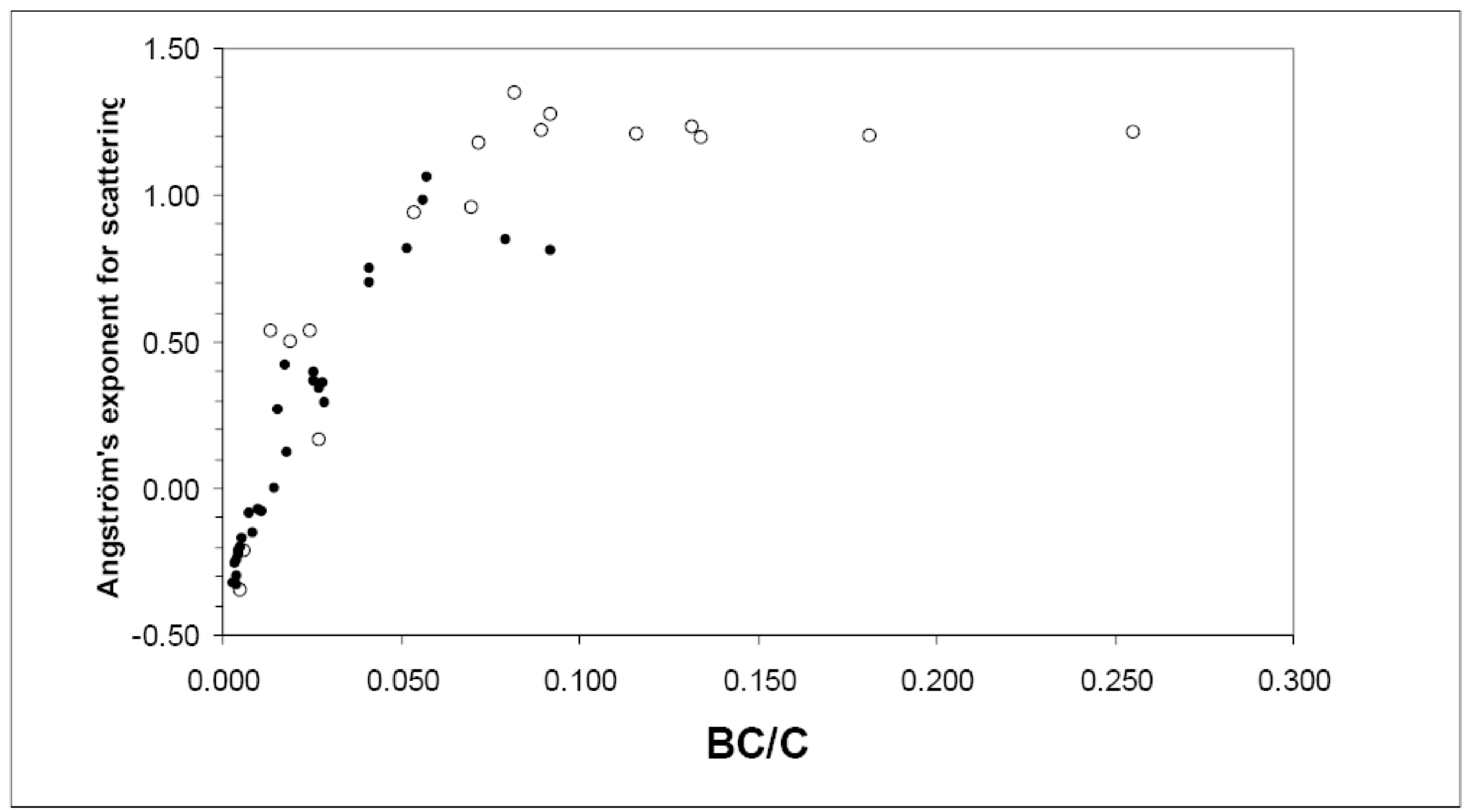


Figure 6: Influence of the proportions of the urban pollution/mineral dust mixture on the spectral dependence of scattering by UP/MD mixtures. Results for April 1 (open circles) have been distinguished from those of April 8 (full circles).

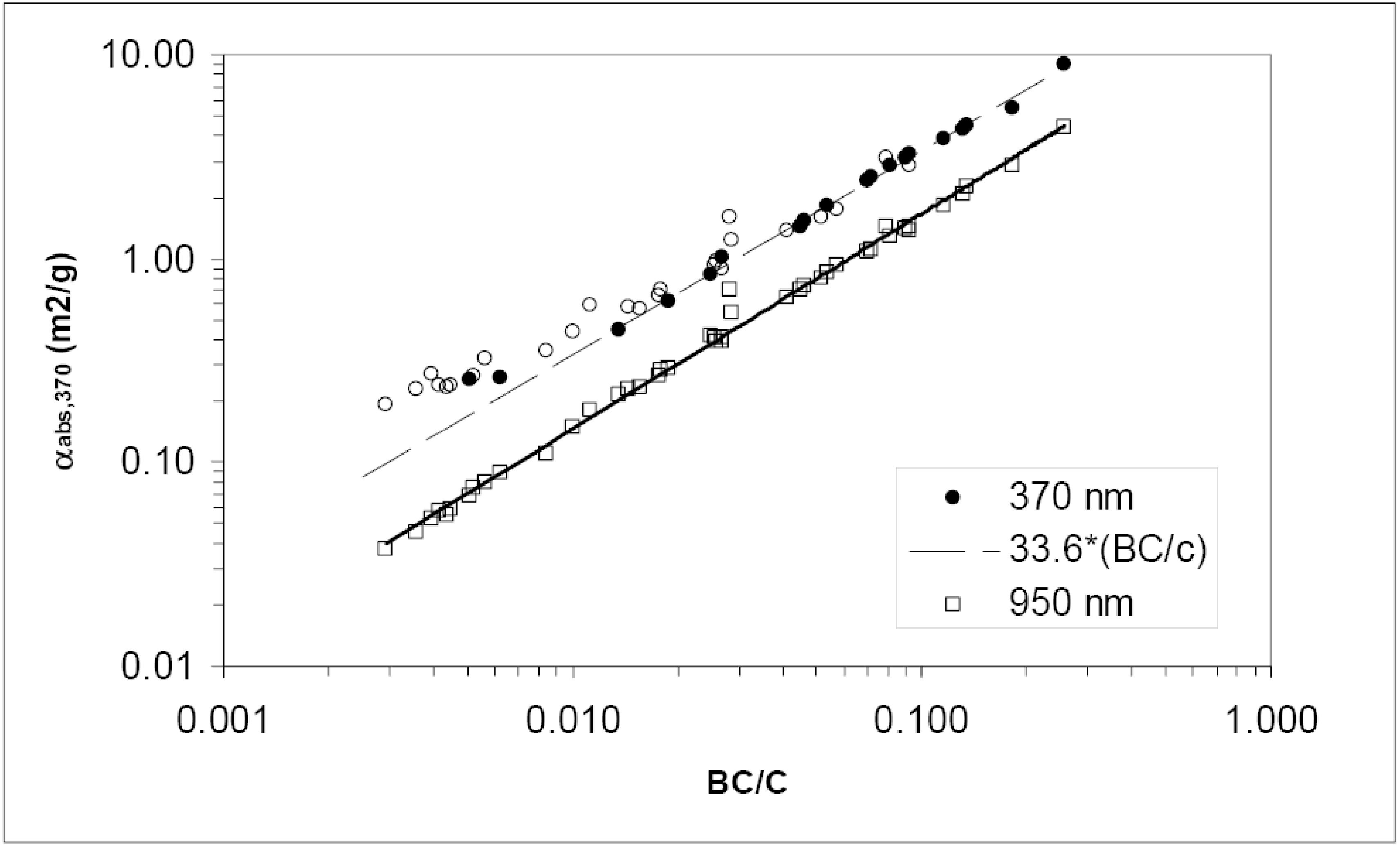


Figure 7: Evolution of the aerosol mass absorption efficiencies at 950 (circles) and 370 (open squares) nm with the proportion of the UP/MD mixtures. At 370 nm, results obtained during the April 1 dust event (full circles) have been distinguished from those of April 8 (see text for details).

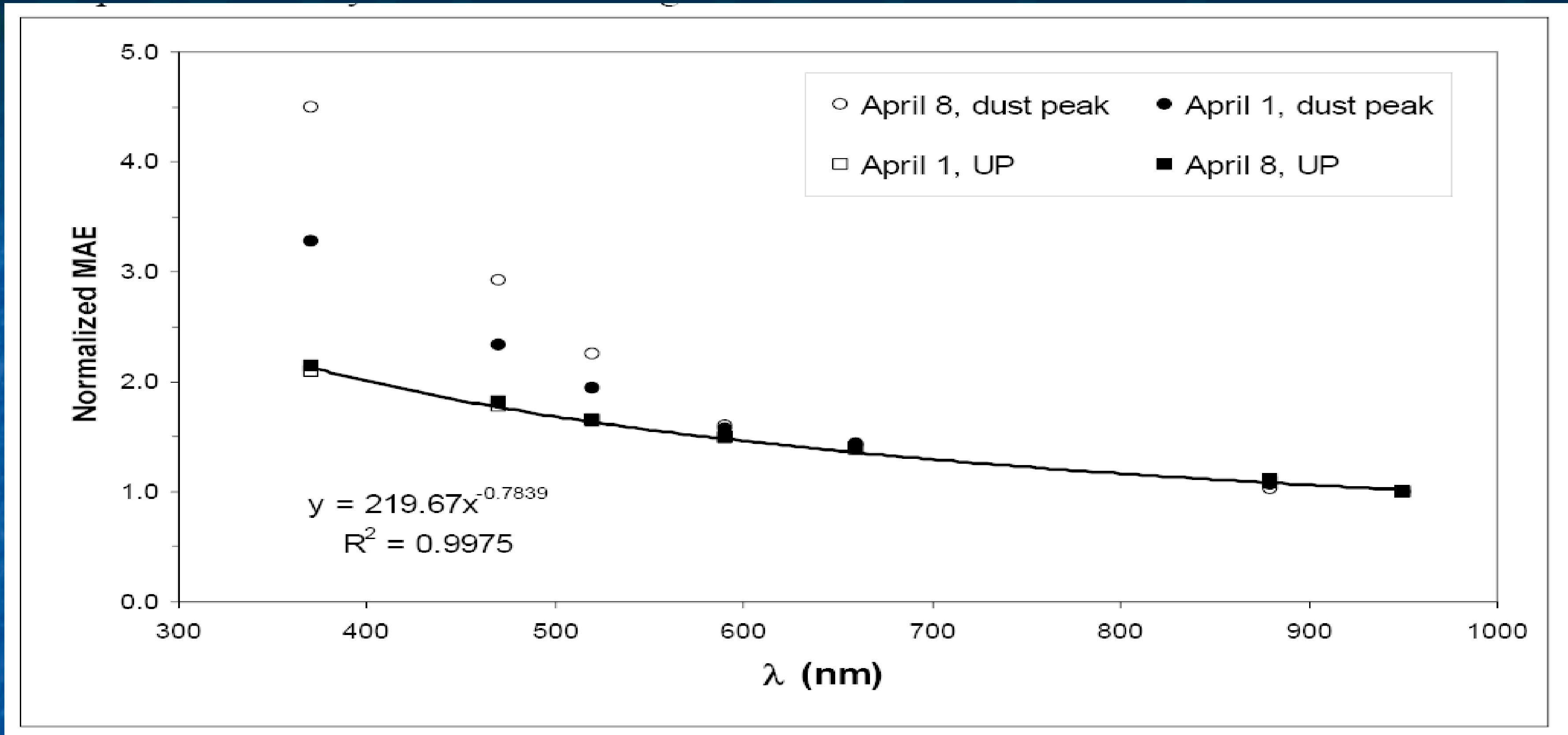


Figure 8: Normalized mass absorption efficiencies at the seven aethalometer wavelengths. Two different types of conditions have been selected: nocturnal pre-dust situations dominated by urban pollution (UP), and peaks of dust events. The spectral dependence of absorption is the same for all conditions at wavelengths larger than 660 nm, but mineral dust enhances absorption selectively at lower wavelengths.

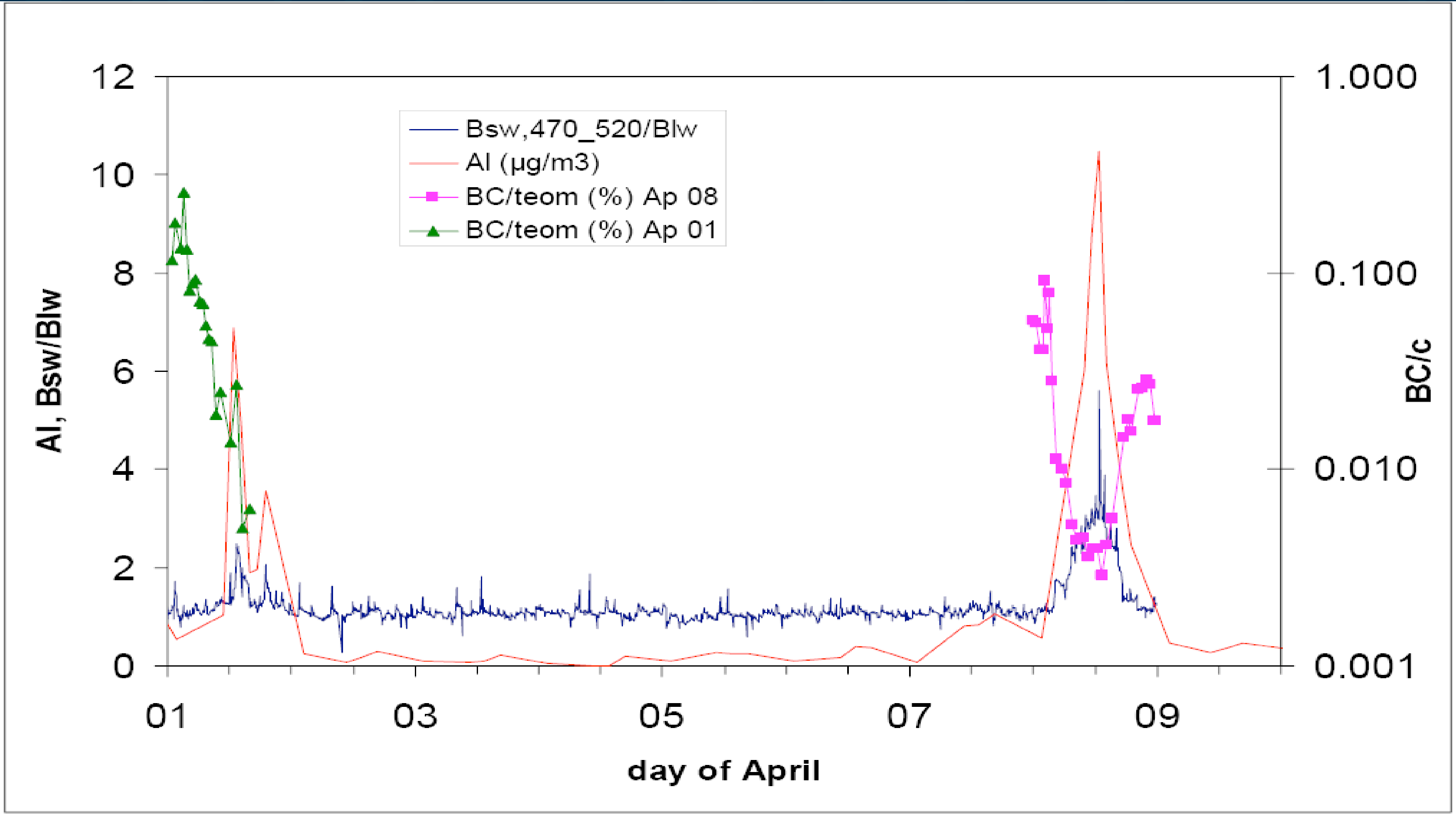


Figure 9: Ratio of Angström's exponents for absorption at short wavelengths (BSW computed between 470 and 520 nm) and at long wavelengths (BLW). This ratio is sensitive to the presence of dust in the mixture (indicated by large Al concentration, and negatively correlated to BC/c.

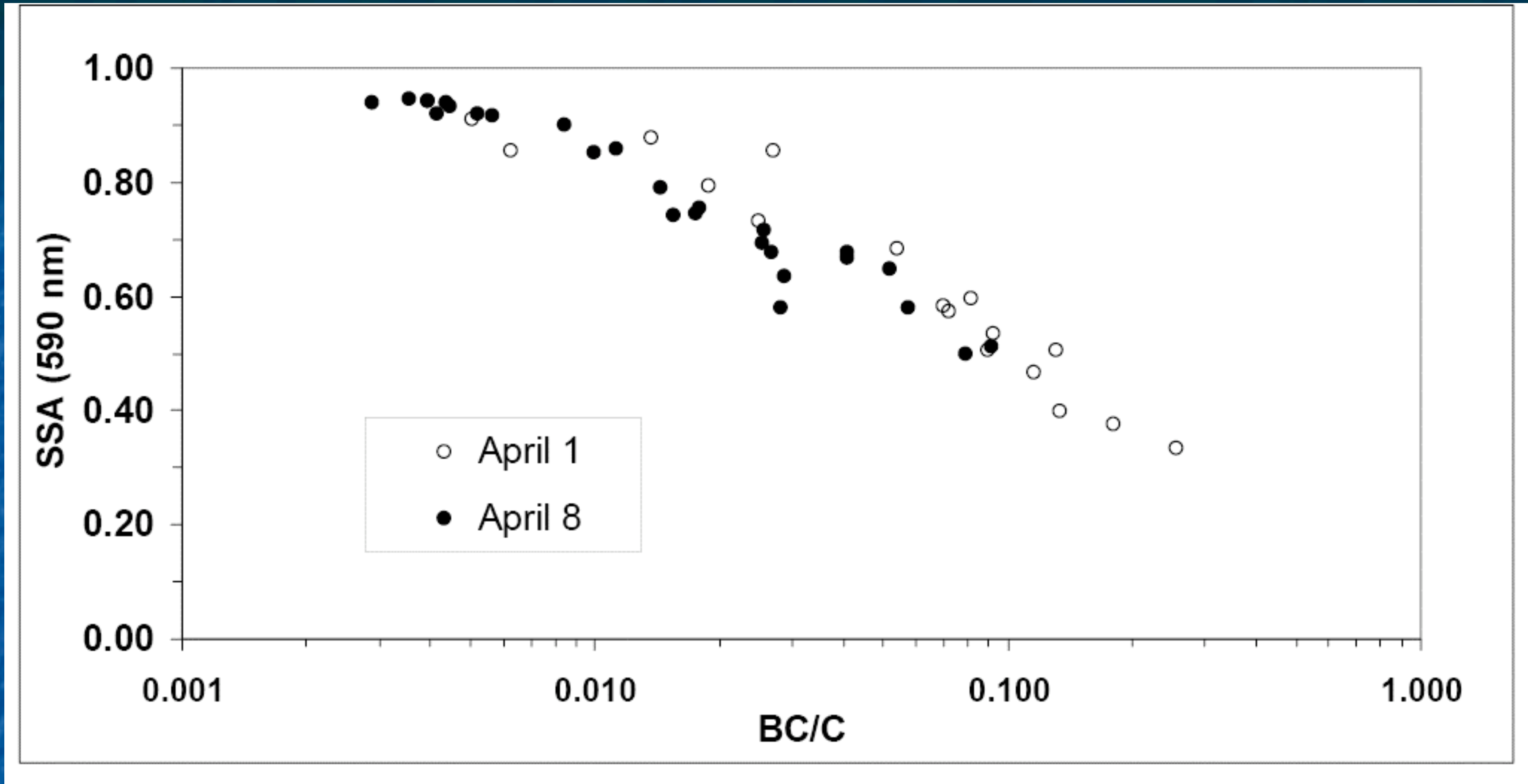
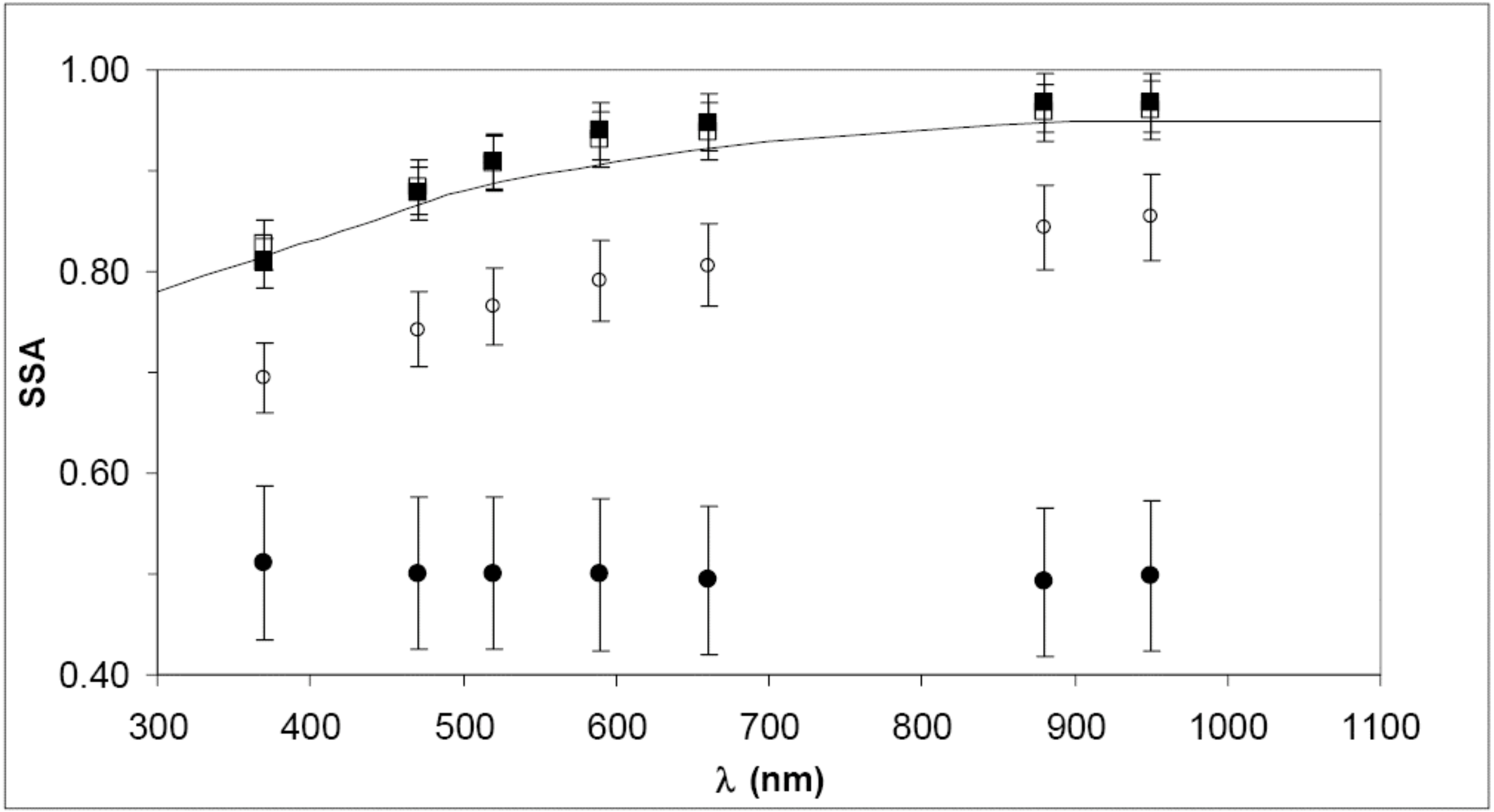


Figure 10: Sensitivity of the single scattering albedo at 590 nm to the proportion of the UP/MD mixture. Uncertainties on values corresponding to UP-dominated situations (larger values of BC/c) are ca. 15% whereas uncertainties corresponding to situations with a strong mineral dust component (lowest values of BC/c) are ca. 3%.


1.00
0.80
0.60
0.40
SSA
300
400
500
600
700
800
900
1000
1100
λ (nm)

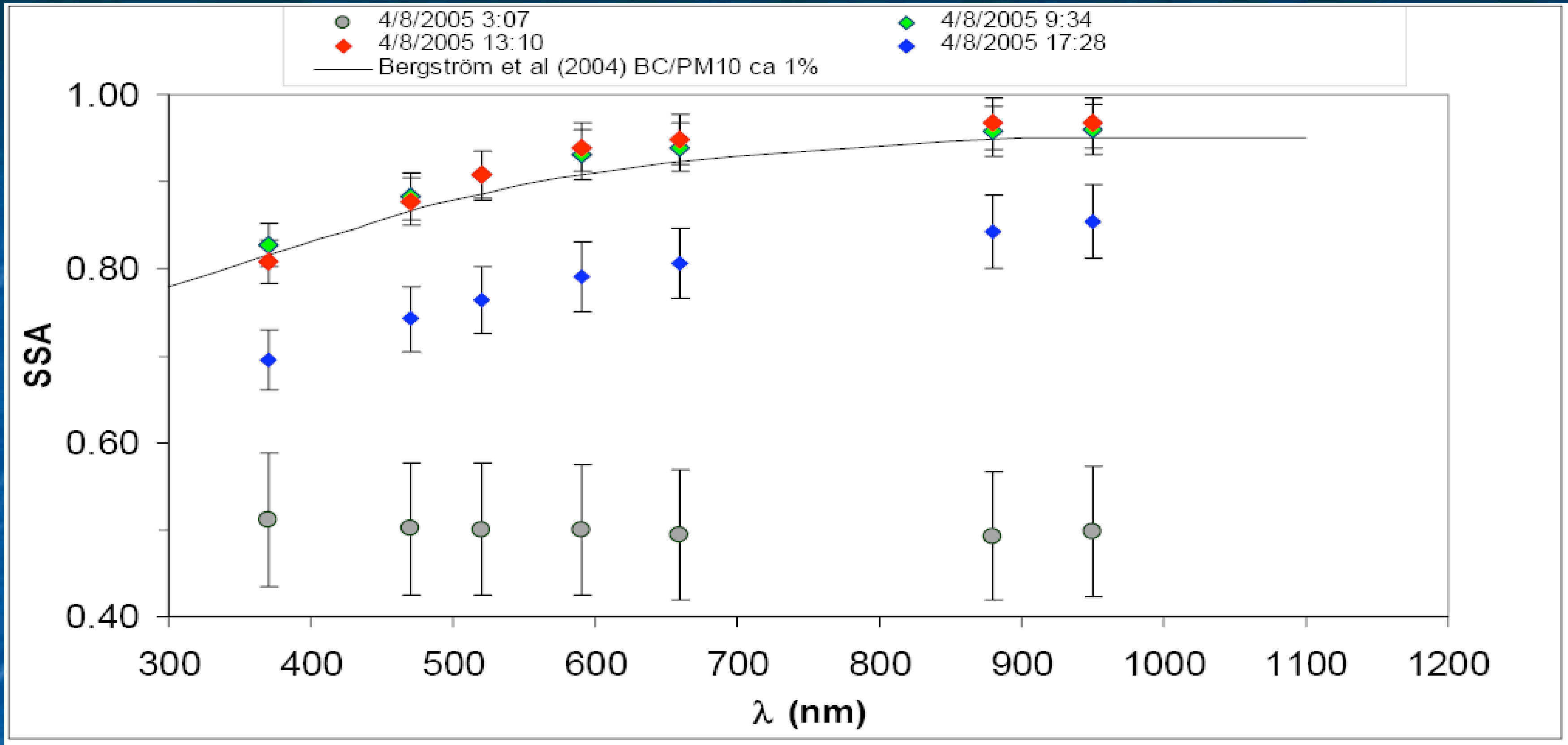


Figure 11: Spectral dependence of the scattering albedo in the four April 8 conditions reported on fig. 3: Nocturnal urban-pollution dominated (BC/c = 0.10) situation (full circles), dust dominated situations with BC/c values of 0.004 and 0.003 (full and empty squares, respectively), and an intermediate (BC/c = 0.018) situation (open circles). For the sake of comparison, single scattering albedo obtained by inverting airborne radiative measurements performed over the Korean Strait during a strong dust event [Bergstrom et al.; 2004] are also
reported.

Instrument	Start/stop date	Time step	Analysis/correction	Final product
Online filtration	03/20-04/14	1 to 12 h	XRF	Elemental composition
Microbalance (TEOM)	03/31-04/11	6'	-	PM10 concentration
Optical Size Analyzer (Grimm)	03/20-04/14	1'	-	Size distribution
Spectral nephelometer (3λ)	03/31-04/08	5'	Truncation error	Scattering coefficients and their spectral dependence
Spectral aethalometer (7λ)	03/20-04/14	3'	Filter effect	BC concentration Absorption coefficients and their spectral dependence

Table 1: Summary of the instruments and methods used for determining the aerosol composition and optical properties during the mineral dust/urban pollution mixing events of CACHE's spring intensive observation period.

Crustal element (X)	April 1, 2005	April 8,2005
Si	3.69 (0.21)	3.61 (0.17)
Ca	2.15 (0.52)	2.15 (0.26)
S	2.15 (0.52)	2.15 (0.26)
Fe	0.65 (0.06)	0.57 (0.01)
Mg	0.25 (0.04)	0.30 (0.06)
K	0.22 (0.02)	0.24 (0.01)
P	0.06 (0.01)	0.06 (0.01)
Ti	0.15 (0.01)	0.14 (0.01)

Table 2 : Elemental ratios (X/Al) of major crustal elements during the April 1 and April 8 (2005) dust events.

Thank you