

ATMOSPHERIC AEROSOLS IN HIGH ALPINE GLACIER SITES

M.G. PERRONE¹, E. BOLZACCHINI¹, V. GIANELLE², S. BORGHINI³, V. MAGGI¹

¹Department of Environmental Science, University of Milano-Bicocca, Piazza della Scienza 1, 20126 Milano, Italy

²ARPA Lombardia – Milano Città, Via Juvara 22, 20129 Milano, Italy

³Osservatorio Meteorologico Duomo (OMD), Milano, Italy

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INTRODUCTION

Glaciers are cold ecosystems which represent condensation and accumulation sites for atmospheric pollutants, carried in the gas or particulate phase.

Several studies have shown that a large number of semivolatile organic compounds, including the toxic polycyclic aromatic hydrocarbons (PAHs) which are tracers of combustion activities, are distributed worldwide, posing at risk both human health and ecosystem stability. In remote areas as arctic glaciers, PAHs concentrations in the late 20th century result 50 times more abundant than 18th century according to the historical record of the world petroleum production (Kawamura K. et al., 1994).

Remote mountain areas, far from any pollution source, are interesting environments for the assessment of atmospheric pollution load over continental areas: thus, alpine glaciers are unique historical archives to study temporal trends of atmospheric pollution of central and west Europe. Atmospheric aerosols have an important role in the understanding of long range transport mechanisms for semivolatile organic compounds as PAHs.

METHODS

Atmospheric aerosols have been sampled in two different high-quote alpine sites during summer campaigns:

- Cevedale glacier (m. 3264), Regione Lombardia, Italy, July 2002 (July 20-30th, 2002)

- Lys glacier (m. 3647), Regione Piemonte, Italy, July 2003 (July 4-10th, 2003)

During the two campaigns high volume gravimetric samplers were used:

- Cevedale Glacier: a PM10 high volume sampler (STAPLEX, 1,2 m³/min, glass fiber filters)

- Lys Glacier: the PM10 high volume sampler (STAPLEX, 1,2 m³/min, glass fiber filters) and a second high volume sampler with a six stage cascade impactor (ZAMBELLI, 0,6 m³/min, high purity aluminium foils as impaction substrates).

CONCLUSIONS

PM10 mean concentration measured at Cevedale and Lys glaciers were respectively of 13 (\pm 4) and 10 (\pm 4) μ g/m³. For remote high-quote sites they are quite high concentrations: other authors reported such values and higher in other remote alpine sites during summer period, but for lower altitudes (Fernandez P, 2002).

Meteorological conditions during Lys glacier campaign were analysed (observations made at the radio sounding station of Milano-Linate): during those days weather was characterized by no inversion in the vertical temperature profiles so that transport of air pollution from the boundary layer could occur till high altitudes.

A day/night trend on aerosol concentrations couldn't be appreciated (figure 1a).

Size distribution of atmospheric aerosol sampled on the Lys glacier with the six stage cascade impactor show a bimodal distribution (figure 2b). The finest fraction (< 0,7 μ m) is about 68% of total aerosol, and the coarse fraction show a relative maximum for the size range 4,2-10,2 μ m.

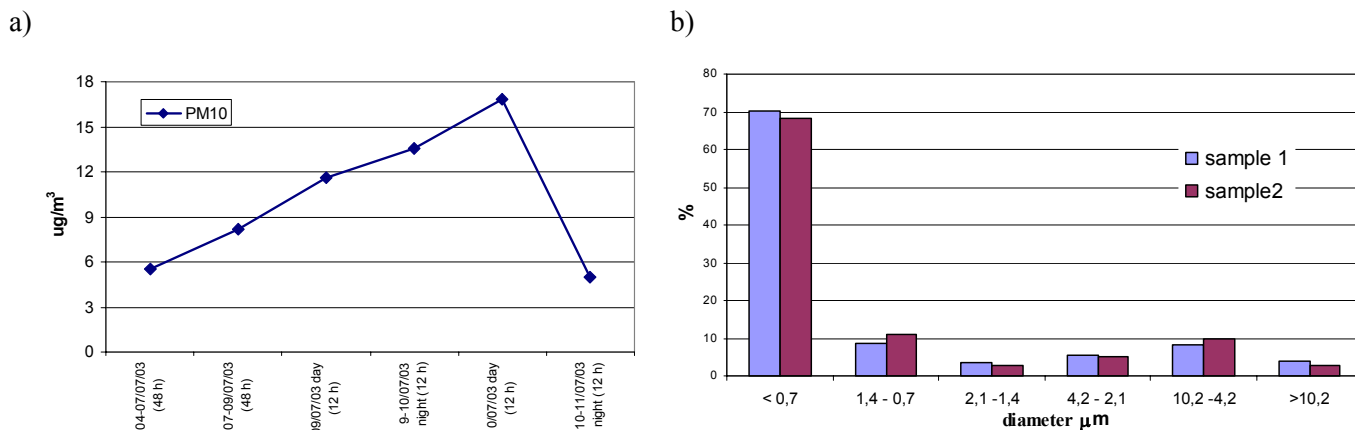


Figure 1. a) PM10 concentrations measured at the Lys glacier (m. 3264), Italy, July 4-10th 2003. b) Size distribution of atmospheric aerosol on the Lys glacier.

Atmospheric aerosol sampled on Cevedale glacier has been analysed for PAHs (ultrasonic extraction and quantification by HPLC- RF), and mean PAHs concentrations have been compared to PAHs concentrations measured in a typical high polluted site (Milan urban area). The aerosol sampled in the high quote alpine site is characterized by a similar PAHs content than the aerosol sampled in Milan (about 200 km far away) in the same period, confirming as such pollutants can be easily transported on atmospheric aerosol till high quote remote areas, were eventually they deposit and accumulate. Snow samples were collected and PAHs concentration levels were on the order of ng/l as it was detected on other European high mountain areas (Carrera, 2001).

Cevedale glacier	PY	B[a]A	Cr	B[e]P	B[b]F	B[k]F	B[a]P	B[ghi]P + dB[ah]A
ng/mg PM10	2,22	0,87	2,04	1,79	2,90	0,74	0,97	1,33
Milan	PY	B[a]A	Cr	B[e]P	B[b]F	B[k]F	B[a]P	B[ghi]P + dB[ah]A
ng/mg PM10	2,64	1,16	1,61	2,02	2,96	1,05	2,03	1,43

Figura 2. Mean PAHs concentrations in PM10 (ng/mg) sampled at the Cevedale glacier and in the urban area of Milan, July 2002.

During summer campaign 2003 at the Lys glacier an ice core to a depth of 106 m was drilled: PAHs concentration has to be analysed to study historical trends of atmospheric pollution in that region.

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