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DISTRIBUTION OF "PARTICULATE"- AND "VAPOUR"-PHASE POLYCHLOROBIPHENYLS AND POLYCYCLIC AROMATIC HYDROCARBONS IN THE ATMOSPHERE OF THE VENICE LAGOON

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Introduction

Atmospheric transport and subsequent wet and dry deposition are important pathways for the movement of contaminants to terrestrial and aquatic systems where they bioaccumulate and enter the human food chain.

Polycyclic aromatic hydrocarbons (PAHs) and polychlorobiphenyls (PCBs) are priority pollutants and their transport, deposition, and chemical transformations of are extensively controlled by their gas/particle-phase partitioning[1,2].

The lagoon of Venice is a shallow coastal basin located in a highly populated area. In recent years its contamination has aroused considerable concern; several studies[3,4] have addressed pollution sources but knowledge of atmospheric contribution remains very poor.

The aim of this study is to investigate the distribution of "particulate"- and "vapour"-phase PCBs and PAHs in samples of atmospheric aerosols of the Venice lagoon.

Materials and Methods

Details of the sampling protocols and analytical procedures can be found elsewhere[5]. Briefly air samples were collected by high-volume samplers equipped with a quartz filter (QFF) before the sorbent material (polyurethane foam, PUF) on the basis of the speed and the direction of the wind. With "gas" and "particulate" we intend to collect two phases operationally defined by their distribution obtained with QFF and PUF sampling. Sampling was carried out at three sites in the Venice lagoon selected to cover the three main sources (urban and industrial sources, Moranzani site; no direct source, Teolo site; marine sources, P. Sabbioni site). Samples were collected over a 15-day period from spring through winter 2002, providing a total of 18 observations. After sample collection and before their extraction, five carbon-13-labeled PCBs and carbon-13-labeled phenantrene were added to the sampling materials (PUF and QFF) as internal standards. Samples were Soxhlet extracted with n-pentane:dichloromethane (2:1). The extract volumes were reduced by a gentle stream of nitrogen and the solution was cleaned by a florisil-alumina chromatography column. The microcontaminants were eluted with n-hexane (30 ml). The eluate was reduced in volume by nitrogen flow. PCBs and PAHs were analyzed by gaschromatography-mass spectrometry.

For evaluation of the field blanks the QFFs and PUFs were kept in the samplers at the three sampling stations for fifteen days without air flow and analysed as previously described. The concentration values obtained for all blanks are negligible for pollutant determination in Venice lagoon aerosol when a high enough air-volume (> 200 m^3) is sampled.

Results and Discussion

Yearly arithmetical average PCB concentrations (expressed as the sum of 54 congeners) in the "particulate" and "dissolved" phase show the highest value at the Moranzani station; the lowest was obtained at the P. Sabbioni station. For the PAH the yearly arithmetical average concentrations (expressed as the sum of 16 compounds) in the "particulate" and "dissolved" phase showed the highest value at the Teolo station whereas the lowest was obtained at the P. Sabbioni station.

Figure 1 shows the yearly mean "gas"-phase mass percentage distribution of PCB homologs in the sites considered.

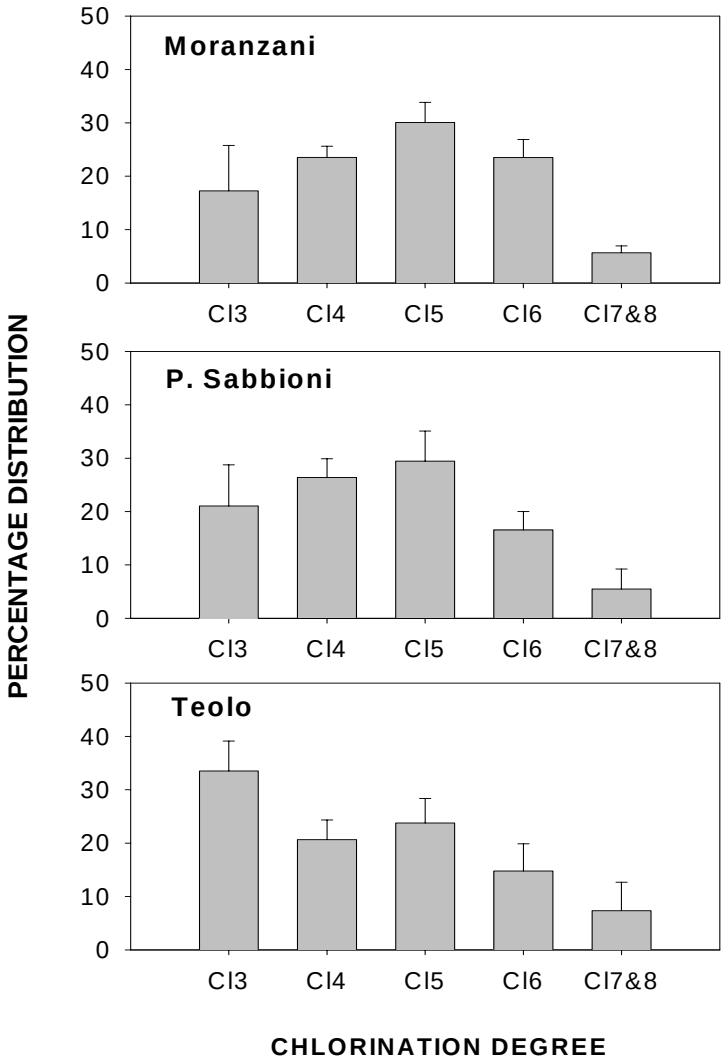

Figure 1: Yearly mean "gas"-phase mass percentage distribution of PCB homologs.

The “gas”-phase distribution of PCB homologs is different at the three stations, with the tri-CB homolog more abundant in the Teolo aerosol and the penta-CB homolog more abundant in the Moranzani and P. Sabbioni aerosols. This may be due to different contaminant sources.
Figure 2 shows the yearly mean “gas”-phase mass percentage distribution of PAH compounds in the sites considered.

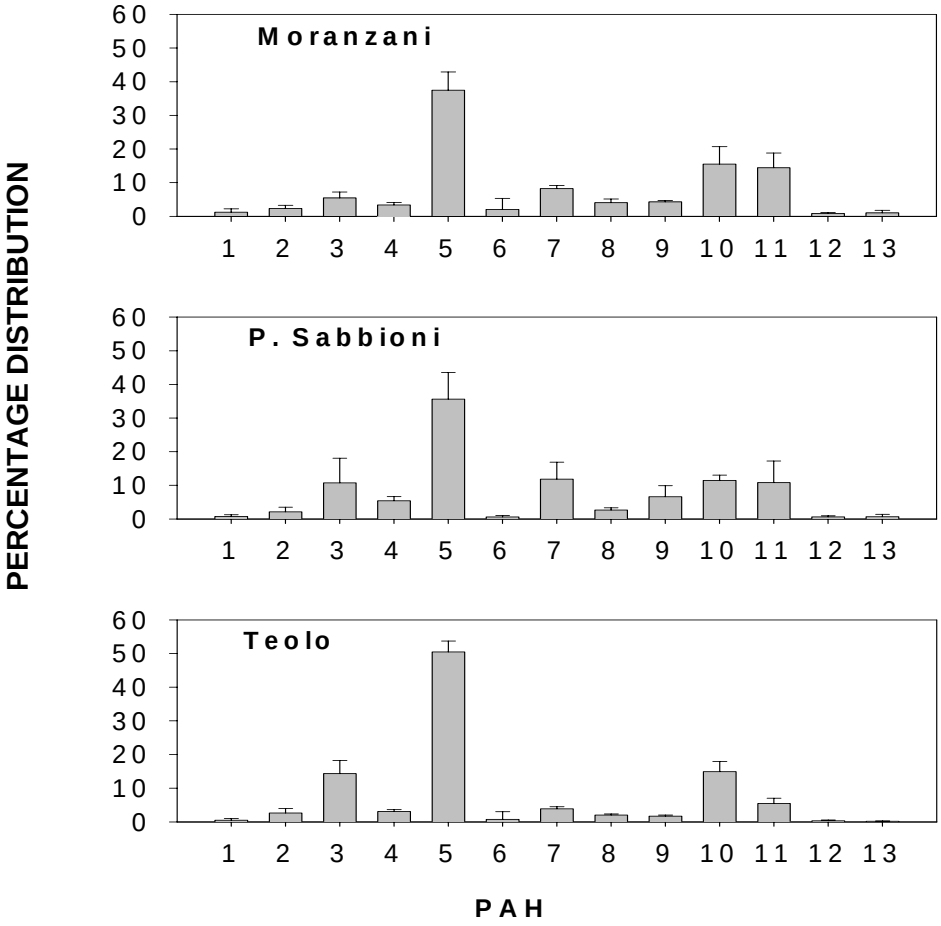

Figure 2: Yearly mean “gas”-phase mass percentage distribution of PAH compound: 1) acenaphthylene, 2) acenaphthene, 3) fluorene, 4) dibenzothiophene, 5) phenanthrene, 6) anthracene, 7) 2-methylphenanthrene, 8) 4H-cyclopenta(d,e,f)phenanthrene, 9) 1-methylphenanthrene, 10) fluoranthene, 11) pyrene, 12) benzo(g,h,i)fluoranthene+benzo(c)phenanthrene, 13) benzo(a)antracene+ triphenylene+ crysene.

The PAH “gas”-phase pattern is similar for all sites. The predominant PAH for total concentration was phenantrene.
The PCB and PAH concentrations in the “dissolved” phase were about 20 times higher than in the “particulate” phase at all sites.
“Gas”-phase concentrations of PCBs and PAHs exhibit different seasonal trends. PCBs show lower concentrations in the autumn and higher concentrations in the summer at all sites. Otherwise at the Moranzani and P. Sabbioni stations, PAHs show higher concentrations in the autumn months whereas at the Teolo station the higher values were obtained in summer.

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References
1. Odabasi, M., Vardar, N., Sofuoglu, A., Tasdemir, Y., Holsen, T.M.; (1999), The Science of the Total Environment, 227, 57.
2. Lee, R.G.M., Jones, K.C. ; (1999), Environ. Sci. Technol., 33, 705.
3. Moret, I., Piazza, R., Benedetti, M., Gambaro, A., Barbante, C., Cescon, P.; (2001), Chemophere, 43, 559.
4. Moret, I., Piazza, R., Gambaro, A., Benedetti, M. and Cescon, P.; (1999), Organohalogen Comp., 40, 223.
5. Gambaro, A., Piazza, R., Manodori, L., Ferrari, S., Moret, I., Cescon, P.; (2002), Organohalogen compounds, 57, 269.