SPATIAL AND TEMPORAL VARIABILITY OF ATMOSPHERIC FLUXES OF METALS AND PHOSPHORUS OVER THE WHOLE MEDITERRANEAN: RESULTS FROM A ONE-YEAR MONITORING EXPERIMENT

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Abstract
During the ADIOS program, the bulk atmospheric deposition of metals (Al, Fe, Zn, Pb, Cd) and phosphorus was collected montly during one year at 9 sampling sites around the Mediterranean.The temporal variation was high for elements of crustal origin (Fe, Al) in relation with Saharan fallout events and lower for mainly anthropogenic ones (Zn, Pb, Cd, P). Examining the annual fluxes for each site, complex spatial trends are evidenced.
Keywords : Atmospheric Input, Phosphorus, Metals, Eastern Mediterranean, Western Mediterranean.

During the ADIOS EU funded program, the bulk atmospheric deposition of Al, Fe, Zn, Pb, Cd and P was collected monthly during one year (June 1, 2001 to May 31, 2002) at 9 sites all over the Mediterranean Sea (fig. 1). Sampling was made according to the same protocol [1] and the same schedule, and the analysis of samples (described in [2]) was centralized in order to avoid any bias in assessing spatial and temporal trends.

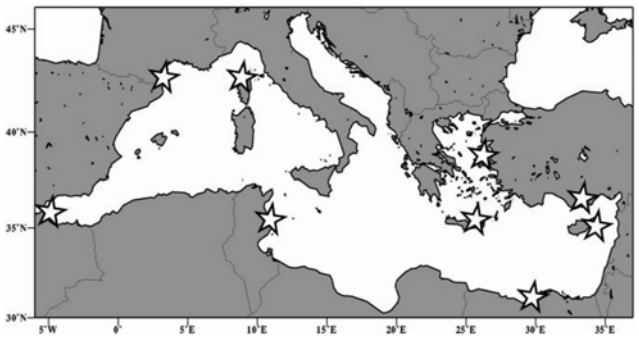

Fig. 1. Location of the ADIOS atmospheric sampling sites.

The annual mean fluxes for Al, Fe, P, Zn, Pb, Cd were 808, 525, 41, 10, 1.3 and 0.035 kg $\cdot km^{-2} \cdot y^{-1}$ respectively.
When considering the whole data set, the variation coefficients are good indicators of the temporal and spatial variability of the fluxes over the whole Mediterranean Sea. These coefficients were high for the elements of crustal origin, around 250 % for Al and Fe and lower for mainly anthropogenic elements (150 % for P, 130 % for Zn, 100 % for Pb and Cd). Examining the annual fluxes for each site, complex spatial trends are evidenced. For example fluxes of crustal elements, ie originating mainly from north-African arid areas, decrease from south to north in the Eastern basin while the opposite pattern is observed in the Western one.

We used the typical ratios of Fe, Pb, P, Cd and Zn to Al [3,4] in Saharan aerosols to quantify their fraction of non Saharan origin. Only 12 % of the total atmospheric deposition of iron was non Saharan; Al/Fe ratios were very close for eastern and western Mediterranean sites. Phosphorus was mainly anthropogenic (75%), like lead (80%); 20% of lead was found to be of Saharan origin for both basins at the annual scale. 95% of Cd and 88 % of Zn were anthropogenic.
The comparison of our data with the bulk deposition ones available for the Mediterranean coastal stations [2,7,8,9] confirms the general decrease of lead atmospheric fluxes over the past decades. Although quite a few data are available for phosphorus [5,6], no change in fluxes were evidenced over the past decades for this element.

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