Atmospheric Elemental Dispersion

Maria do Carmo Freitas

The research is focused on studies of atmospheric environment, nutrition and health. The investigation appeared as a natural application of the potentialities of k_0-INAA (instrumental neutron activation analysis using the k_0-method). The unit activities include six main lines:

Monitoring, Biomonitoring, Quality Control, and Data Handling aiming at characterising areas of Portugal using lichen transplants, air particulate matter collection, and (wet+dry) deposition. The data are analysed for factors aiming at identifying emission sources and the spread of elements through the atmosphere, both locally and by long-range transport. Data analysis methods and their development are very important due to the multielement nature of the analytical technique used. To assure the quality of the data, accuracy and precision studies are being performed, both in biomonitoring and monitoring fields, aiming at better understanding differences found in the results for the same element and sample. Air particulate matter obtained by different air samplers is compared. So-called conventional analytical techniques are applied to complement the research unit's results. Within this activity line, the following are being done: services to industry (monitoring), FCT funded project research (both biomonitoring and aerosol monitoring) and training (one post-doctorate on monitoring and two current PhD theses on biomonitoring).

Epidemiological studies include health related problems. The objective is to link biomonitoring and monitoring to epidemiological studies, at local, regional and European scale. Currently, one PhD and one post-doctorate are dedicated to this subject.

Element Uptake Processes. The group also enters the plant physiology looking for effects on plants due to atmospheric chemical components. The underlying questions are related to the extent in which lichens may reflect the element contents of particulate matter, which may possibly be dominated by its soluble element concentration fractions. This is the subject of one PhD thesis.

Training. The research unit has a strong component in post graduation training.

Services. Analytical services are also provided under request (private companies).

Research Team

Researchers

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Students

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I.R. KHAN, FCT project fellowship

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Study of relationships between fine particles and respiratory problems in children of Lisbon basic schools

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Objectives

37 basic schools of Lisbon city, Portugal followed a questionnaire. The questionnaire contained questions to identify children with respiratory diseases (wheeze, asthma and rhinitis) as well as their nutrition habits, ingested medication, environmental aspects, among others. The questioned children were 5 to 10 years old, and the answers are from June to December 2006. The results are from 1125 children inquired who have shown 26.1% with wheezing symptoms, 9 % with asthma, and 27.5% with rhinitis.[1]

It is attempted to correlate complains of children from four selected schools among the questioned ones children with mass concentration and its chemical composition available in their neighbourhood. The complains concern rhinitis and/or asthmatic symptoms daily reported by the children and their parents; studied particles are of aerodynamic diameter below 2.5 micrometers ($PM_{2.5}$), collected in teflon filters using a Partisol sampler, located at IST/Tech. Univ.

Results

Tables 1 and 2 report: 1) the number of questioned children in the four basic schools, 2) the average number of children of the four schools who answered the daily questionnaires, and 3) the percentage of children who reported rhinitis or asthma. The number of children to report was very scarce, demonstrating the difficulties in getting answer to questionnaires, although the questionnaires went individually to each child home. Comparing the percentage of cases of rhinitis and asthma reported in the selected schools with the whole amount of questioned schools, the values are of the same order of magnitude. More intense symptoms are observed in Spring, also previously observed for the whole set of questioned children.

Fig. 1 shows the daily mass concentrations collected by Partisol, obtained by gravimetric methods. Mass concentrations were often above the regulated value of 20 microgram/cm^3. Two huge amounts of $PM_{2.5}$ were observed in April and May, as well as in January.

The filters were analysed by neutron activation analysis using thermal and epithermal neutron, in normal and Compton modes, short and long irradiations. The chemical elements which could be accessed are: As, Al, Ba, Br, Ca, Ce, Cl, Co, Cr, Cs, Cu, Eu, Fe, K, Mg, Mn, Mo, Na, Ni, Rb, Sb, Sc, Se, Si, Sr, Th, Ti, V, I, In, Mo, Sb, Si, Sr, W, and Zn.

Table 1. Average month percentage of children who declared rhinitis episodes in four selected schools

Month	Nr. inquired children	Nr. Children who answered	Positive rhinitis
April	279	29.5	16.9%
May	279	42.5	27.5%
June	279	45.6	20.7%
July	279	4	4%
August	279	4	11.3%

Table 2. Average month percentage of children who declared asthma episodes in four selected schools

Month	Nr. Inquired children	Nr. children who answered	Positive asthma
April	279	28.5	4.4%
May	279	40.9	4.2%
June	279	43.5	5.2%
July	279	4	0%
August	279	4	0%

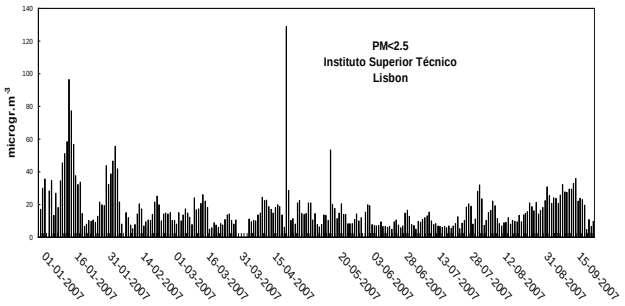

Fig. 1. Mass concentration of $PM_{2.5}$, collected 24 h daily in Teflon filters using a Partisol sampler. Data from January to September 2007. The sampling site is at IST/Tech. Univ. Lisbon.

Published work

I.R. Khan, M.C. Freitas, A.M.G. Pacheco, Particulate matter levels in Portugal (mainland and islands). A preliminary study for outdoor/indoor environment in basic schools, Proceedings, REHVA World Congress Clima 2007 WellBeing Indoors, 10–14 June 2007 Helsinki, Finland, Olli Seppänen & Jorma Säteri (Eds).

M.C. Freitas, H.Th. Wolterbeek, T. Verburg, S.M. Almeida, Effect of Particulate Matter, Atmospheric Gases, Temperature and Humidity on Respiratory and Circulatory Diseases in Lisbon, Proceedings, 100th Annual Conference and Exhibition, A&WMA (Air and Pollution Management), 26-29 June 2007, Pittsburgh, Pennsylvania, USA.

[1] CERENA/IST/Tech. Univ. Lisbon; [2] DAO/Univ. Aveiro

(Bio) Assessment of elemental burden from selected atmospheric particulate matter's (PM's) size classes

R.M. Godinho, M.C. Freitas, H.Th. Wolterbeek[1], T.G. Verburg[1]

The issue of this program is to relate lichen elemental occurrences to elemental occurrences in selected atmospheric size PM. This year work intent to better understand how the lichen constitution may affect element uptake and release, thus influencing the lichen´s memory length, thereby aiming to increase possibilities to improve biomonitoring results, interpretation and comparability. Lichen response to specific element, element toxicity and biomonitor remembrance time can be related with elemental internal spatial distribution. Because of that the elemental microdistributions of thin sections of peripheral and central parts of the foliose lichen F*lavoparmelia caperata* were studied under proton microprobe at ITN. In order to access the potential cation-exchange capacity of the lichen, experiments of pH and metal titration were performed at IRI-TU Delft.

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Biomonitoring of trace element air pollution: links to emission sources and to human health

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The aim of the actual project is to investigate whether and which components and sources of air pollution may contribute to differences in cause-specific mortality in the Portuguese population. This year work focused on the impact of atmospheric aerosol in human health. In this scope data handling has been performed to study the influence of temporal fluctuations both of hospital admissions data and risk factors data on the regression studies.

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Chemical elements in airborne particulates over Angra do Heroísmo, Terceira island, and Pico summit, Pico island, both at Azores (Portugal)

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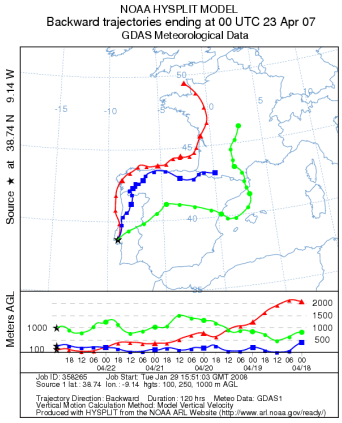

This study deals with aerosol collections from Angra do Heroísmo (sampling height: 74 m), a UNESCO-designated (1983), World Heritage city in Terceira island, Azores. Glass fiber filters with PM10 mass concentrations, sampled by IM from 6 July 2005 to 30 June 2006, were put through instrumental neutron activation analysis for elemental evaluation. Blank contents were taken into account. The urban results from Angra were compared with data obtained near the summit of Pico mountain (sampling height: 2225 m), Pico island, Azores. In Pico, the results show higher medians for most of the chemical element, sodium being an exception (10 times higher in Angra). This may indicate that the atmospheric chemistry of Angra is primarily governed by inputs from marine sources, as expected in an oceanic environment, while influence of long-range transport of anthropogenic elements cannot be ruled out for PM10 composition from remote, high-altitude site.

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The calibration of gamma-ray spectrometers coupled to Compton suppression and fast pneumatic systems for k_0-NAA at the RPI/ITN

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A new Compton suppression system for the gamma-ray spectrometer used for neutron activation analysis (NAA) has been set up at the RPI/ITN. The fast pneumatic transfer system, SIPRA, used for short-lived nuclides has recently been changed: its control system upgraded and the linear electronics for the gamma-ray spectrometer replaced by a new Ortec DSPEC module. The calibration of the Compton suppression and SIPRA systems including the characteristics of energy, peak shape and efficiency has been carried out. In addition, the peak-to-total ratios have been calculated for the correction of true-coincidence effect of the gamma-ray spectrometers. In order to check the accuracy of the calibration parameters obtained in this work, some certified reference materials (CRMs) have been analyzed using the k_0-IAEA software and the result has been evaluated and shown.