NEUTRON ACTIVATION IN ENVIRONMENT, NUTRITION AND EPIDEMIOLOGY

Annual Activity Report 2013

UNIT: Reactors and Nuclear Safety

TEAM

Name	Category	R&D (%)
Marta Almeida	Auxiliary Researcher	100%
Isabel Dionísio	Technical Personnel	100%
Alexandra Silva	FCT Ph.D. student	100%
Carla Ramos	FCT Ph.D. student	100%
Joana Lage	FCT Ph.D. student	100%
Marina Almeida-Silva	FCT Ph.D. student	100%
Nuno Canha	FCT Ph.D. student	100%
Catarina Galinha	FCT Ph.D. student	100%
Tiago Faria	B.Sc. student	30%
Patricia Gonçalves	B.Sc. student	30%
Eva Henriques	B.Sc. student	30%
Maria Ana Miranda	B.Sc. student	30%
Maria do Carmo Freitas	Retired Principal Researcher - collaborator	10%
Ana Cruz	Ph.D student - collaborator	10%
Bruno Vieira	Ph.D student - collaborator	10%
Maria Manuel Farinha	Ph.D student - collaborator	10%
André Shataloff	M.Sc. student- collaborator	10%
H.Th Wolterbeek	TUDelft Sen. Researcher	10%

OBJECTIVES

The research in NANE group is focused on the development of the INAA (Instrumental Neutron Activation Analysis) methodologies and on their application to environment, nutrition and epidemiology studies.

The objectives to 2013 included the following lines:

- Quality assurance and quality control (QA/QC) of the technique INAA by participating in proficiency tests. This work was developed within the IAEA projects "Support Air Quality Management" and "Enhancing the Sustainability of Research Reactors and their Safe Operation through Regional Cooperation, Networking and Coalition";
- Research on air pollution assessment, aerosol characterization, identification of emission sources with receptor models and evaluation of air pollution impacts using dispersion models and biomonitoring techniques. These studies were performed within the FCT projects "Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions" and "Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport" and 3 PhD studies;
- Research on the integration of Indoor Air Quality, Energy Efficiency and Maintenance in Health Buildings. This work was developed within the QREN project EFICARE;
- Research on the exposure of susceptible groups - children, elders and sportsmen – to pollutants and assessment of the associated health impacts. Work developed by 3 PhD students;

- Research on selenium supplementation of bread and durum wheat within the FCT project "Selenium distribution in cereals and Portuguese cultivation soils - Interactions between selenium and iodine uptake by cereals - a case study" and 1 PhD study;
- Research on the development of robotic tools to collect environment samples. This work was developed within the QREN project ROBOSAMPLER;
- Graduation and Post-graduation training (B.Sc., M.Sc, Ph.D.);
- Application for research funding (3 proposals were submitted to FCT and Fundación Mapfre).

MAIN ACHIEVEMENTS

$PM_{fugitive}$ - a FCT project coordinated by CTN/IST in cooperation with ISQ and Sapec Parques Industriais - aimed to improve the understanding of fugitive emissions and the following results were obtained:

1) a methodology to characterize fugitive emissions was developed;
2) a chemical profile of fugitive emissions was created and published;
3) receptor and dispersion models were used to estimate the environmental impact of fugitive emissions. Results showed that in Mitrena average fugitive emissions contribute to 20% of PM_{10}, in summer, and to 4%, in the winter;
4) positive associations between daily levels of particles and admissions for respiratory diseases were found. It was estimated that the percentage of increase in hospital admissions due to an increase of 10 $\mu g.m^{-3}$ of PM_{10} varied from 0.8% to 1.6%.
5) mitigation actions for the reduction of fugitive emissions were identified.

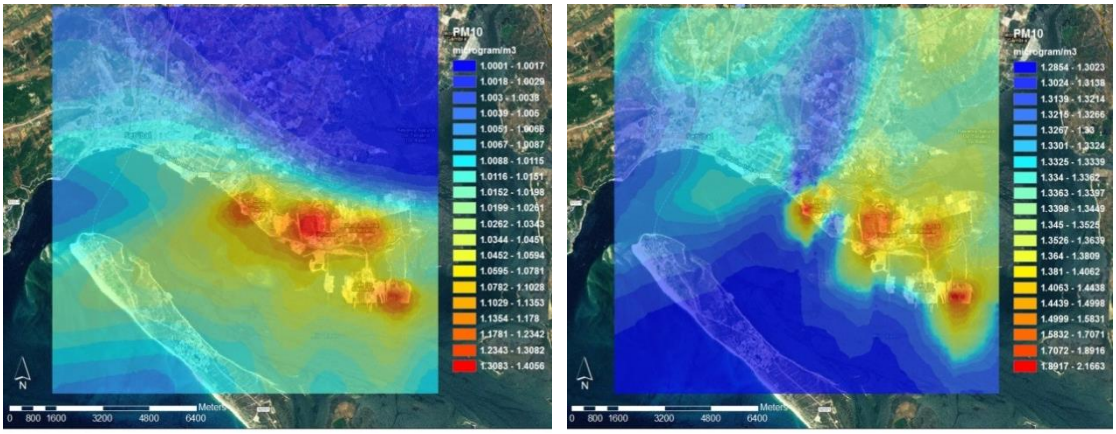

Figure 1: Contribution of fugitive emissions in Mitrena – Setúbal in Winter and Summer.

The main objectives of the **FCT Project CV-Dust** were 1) to characterize the chemical and mineralogical composition of dust transported from Africa by setting up an orchestra of aerosol sampling devices in the strategic archipelago of Cape Verde; 2) to identify the sources of particles in Cape Verde by using receptor models; 3) to elucidate the role Saharan dust may play in the degradation of Cape Verde air quality and 4) to model processes governing dust production, transport, interaction with the radiation field and removal from the atmosphere.

PM_{10} sampled in Cape Verde was chemically characterized and the identification of the main sources and origins of the particles were carried out by integrating complementary tools including Principal Component Analysis, Multilinear Regression Analysis, Positive Matrix Factorization and Cluster Analysis of Air Mass Back trajectories.

Results showed that Cape Verde aerosol is affected principally by natural sources: dust coming from Sahara desert contributes on average to 48% of the total PM_{10} mass and sea salt spray contributes on average to 20%. During trajectories from Sahara, dust contribution increases to more than 60% and PM_{10} concentrations reach very high concentrations (10 times higher than the EC limit values and WHO guidelines).

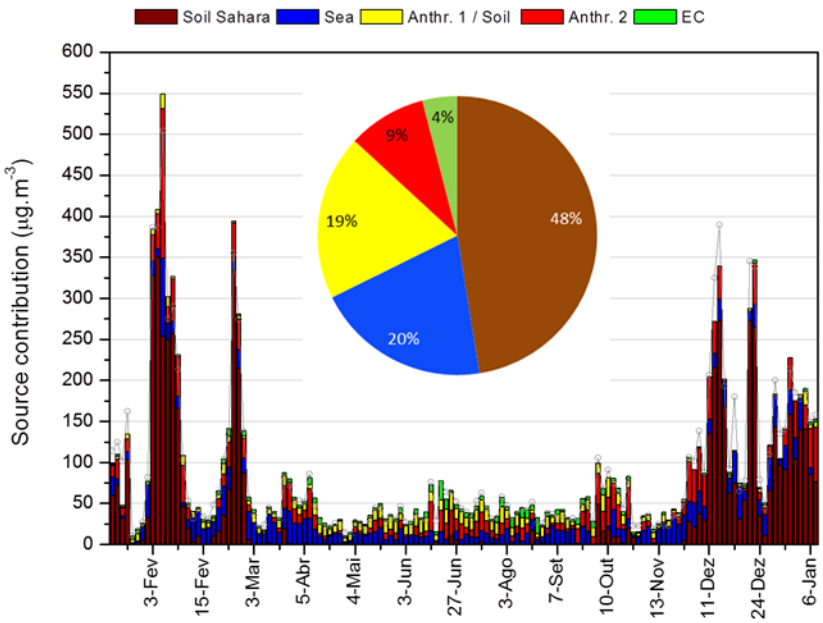

Figure 2: Source contribution for PM_{10} concentrations measured in Cape Verde during 2011.

The objective of the **IAEA TC Project "Support Air Quality Management"** was to establish a network for air monitoring in order to increase the knowledge about the status of atmospheric pollution in the TC Europe Region by broadening access to nuclear analytical techniques. Within this project:

1) Infrastructure for collection of atmospheric particulate matter (APM) and meteorological measurements were established and APM was collected systematically in 14 European countries.
2) Capabilities to apply nuclear analytical techniques for the analysis of APM were regionally improved.
3) Validation of methods was supported by the organization of 2 PT exercises.
4) Source apportionment and trans-boundary movement modellings were applied.

EFICARE is a joint project coordinated by the Portuguese private enterprise Integridade in cooperation with IST, ISQ, Quadrante and Centro Hospitalar de Setúbal. The objective of this project is to integrate and optimize the energy efficiency, the indoor air quality (IAQ) and the management of the maintenance in Health Units.
In 2013, IST/CTN assessed the IAQ in Setúbal Hospital: chemical and comfort parameters were measured; airborne microorganisms were collected; airborne isolates were characterized and identified; the perceived IAQ and the related symptoms were assessed by means of a questionnaire survey among the workers; and an evaluation of the design, performance and maintenance of the ventilation systems was carried out.

ROBOSAMPLER is a joint project coordinated by the Portuguese private enterprise Introsys S.A. in a cooperation with institute Uninova and IST/CTN, with financial support from QREN/IAPMEI/PORLISBOA programme. The aim is to manufacture a robotized system comprised of a terrestrial 4 wheel robot and an autonomous aerial vehicle, devoted to sampling tasks in estuarine mudflats. Operational tests of the accomplished system will be made in the intertidal mudflats of Tejo estuary running from Samouco to Alcochete. Sampling processes will focus on bottom sediments cores, seaweeds and bivalves. During 2013, IST/CTN personnel were devoted to field exercises, aiming to achieve a comprehensive picture of technical and functional requirements.

RELEVANT PAPERS

- N. Canha, S.M. Almeida, M.C. Freitas, M. Täubel, O. Hänninen, Winter Ventilation Rates at Primary Schools: Comparison Between Portugal and Finland, *Journal of Toxicology & Environmental Health Part A* 76 (6), 400 – 408 (2013), doi: 10.1080/15287394.2013.765372.
- M. Almeida-Silva, S.M. Almeida, M.C. Freitas, C.A. Pio, T. Nunes, J. Cardoso, Impact of Sahara Dust transport on Cape Verde atmospheric element particles, *Journal of Toxicology & Environmental Health Part A* 76 (4-5) 240-251 (2013), doi: 10.1080/15287394.2013.757200.
- S.M. Almeida, A.I. Silva, M.C. Freitas, H.M. Dzung, A. Caseiro, C.A. Pio, Impact of Maritime Air Mass Trajectories on the Western European Coast Urban Aerosol, *Journal of Toxicology & Environmental Health* 76 (4-5) 252-262 (2013), doi: 10.1080/15287394.2013.757201.
- P.M. Félix, S.M. Almeida, T. Pinheiro, J. Sousa, C. Franco, H.Th. Wolterbeek, Assessment of exposure to metals in lead processing industries, *International Journal of Hygiene and Environmental Health* 216, 17-24 (2013), doi:org/10.1016/j.ijheh.2012.03.003.
- S.M. Almeida, M.C. Freitas, M. Reis, T. Pinheiro, P.M. Felix, C.A. Pio, Fifteen Years of Nuclear Techniques Application to Suspended Particulate Matter Studies, *The Journal of Radioanalytical and Nuclear Chemistry* 297 (3), 347-356 (2013), doi: org/10.1007/s10967-012-2354-1.

FUNDS

Project/Service	Reference	Timeframe	2013
Project: PMfugitive - Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions, Fundação para a Ciência e Tecnologia	PTDC/AAC-AMB/098825/2008	1 Jan 2012 – 31 Dec 2012	9.741,31 €
Project: CV-Dust: Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport, Fundação para a Ciência e Tecnologia,	PTDC/AAC-CLI/100331/2008	1 Jan 2012 – 31 Dec 2012	6.127,64 €
Project: Support Air Quality Management, International Atomic Energy Agency	TC project RER/1/008	1 Jan 2012 – 31 Dec 2012	(meetings, reference materials, filters)
Project: EFICARE: Modelo de Monitorização da Eficiência Funcional de Infraestruturas de Unidades de Saúde,	QREN, Projeto de I&DT Empresas em Co-Promoção, n.º 30399	1 Apr 2013 – 31 Mar 2015	0,00 €
Project: Robosampler: Desenvolvimento de um sistema robótico terrestre para monitorização radiológica e de metais pesados em ambientes estuarinos, QREN - Quadro de Referência Estratégica Nacional	ROBOSAMPLER LISBOA-01-0202-FEDER-024961	1 Jan 2013 – 31 Dec 2014	8.003,00 €

INTERNATIONALIZATION

- Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Madrid, Spain, Application of RCF analysis to locate potential source regions for particles.
- Participation in the COST ACTION FA 0905 “Mineral Improved Crop Production for Healthy Food and Feed”.
- Delft University of Technology, Netherlands, co-supervision of 8 Ph.D. students.
- Environmental Research Laboratory, Institute of Nuclear Technology - Radiation Protection, NCSR "DEMOKRITOS", Athens, Greece, collaboration in the analysis of aerosol filters.
- National Centre of Nuclear Energy, Sciences and Techniques, Rabat, Morocco, collaboration under the IAEA’s technical cooperation programme.

- Scientific and Technical Centre for Building (CSTB), MarneLaVallée, France, Scientific visit of the PhD student Nuno Canha: October 2013 – December 2013.

Annex

TRAINING

- Nuno Canha – Course "Lichens as a tool for interpretation of environmental changes and management" (post- graduated, 6 ECTS), CBA-FC-UL, 28 January to 1 February 2013.
- Joana Lage – Course "Lichens as a tool for interpretation of environmental changes and management" (post- graduated, 6 ECTS), CBA-FC-UL, 28 January to 1 February 2013.
- Joana Lage – RER/1/008/002 - Regional Training Course on Methods and Tools to Identify Trans-boundary Movements and Sources of Atmospheric Particulate Matter (APM) in Vilnius, Lithuania, 8-12 July 2013.
- Marina Almeida-Silva – Summer Course: Toxicological and Environmental Health in Institute for Risk Assessment Sciences, Utrecht University, The Netherlands, 19-30 August 2013.
- Carla Ramos – RER/1/008 - Group Fellowship 2 2013 on Atmospheric Aerosol Measurement and Characterization by Nuclear Techniques, Athens, Greece, 16 September-4 October 2013.

OTHER PUBLICATIONS

- H.M. Anawar, N. Canha, I. Santa-Regina, M. C. Freitas, Adaptation, tolerance, and evolution of plant species in a pyrite mine in response to contamination level and properties of mine tailings: sustainable rehabilitation, *Journal of Soils and Sediments* 13, 730–741 (2013), doi: 10.1007/s11368-012-0641-7
- N. Canha, M.C. Freitas, A.M.G. Pacheco, Response of air-pollution biomonitors under three different meteorological conditions, *Journal of Radioanalytical and Nuclear Chemistry* 295(1), 489-496 (2013), doi: 10.1007/s10967-012-1918-4
- S. Viegas, V. Mateus, M. Almeida-Silva, E. Carolino, C. Viegas, Occupational exposure to particulate matter and respiratory symptoms in Portuguese swine barn workers, *Journal of Toxicology and Environmental Health, Part A: Current Issues* 76(17): 1007-1014 (2013), doi: 10.1080/15287394.2013.831720.
- C. Galinha, M.C. Freitas, A.M.G. Pacheco, Elemental characterization of bread and durum wheat by instrumental neutron activation analysis, *Journal of Radioanalytical and Nuclear Chemistry* 297 (2), 221-226 (2012), doi: 10.1007/s10967-012-2368-8.
- C. Galinha, M.C. Freitas, A.M.G. Pacheco, J. Coutinho, B. Maçãs, A.S. Almeida, Selenium supplementation of Portuguese wheat cultivars through foliar treatment in actual field conditions, *Journal of Radioanalytical and Nuclear Chemistry* 297 (2) 227-231 (2012), doi: 10.1007/s10967-012-2372-z.

COMMUNICATIONS

- *OFFICAIR WP4: IAQ in modern office buildings in Europe*, C. Mandin, N. Canha, M. Ouattara, G. Wyart, *OFFICAIR Final Workshop*, Brussels, Belgium, 22nd October (2013). Oral.

TEAM RESEARCHERS

NAME: Susana Marta Lopes Almeida
CATEGORY: Auxiliary Researcher
IST-ID: 5472

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Project: $PM_{fugitive}$ - Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions, Fundação para a Ciência e Tecnologia, PTDC/AAC-AMB/098825/2008	30
2	Project: CV-Dust - Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport, Fundação para a Ciência e Tecnologia, PTDC/AAC-CLI/100331/2008	10
3	Project: Support Air Quality Management, International Atomic Energy Agency, TC project RER/1/008	5
4	Project: Enhancing the Sustainability of Research Reactors and their Safe Operation through Regional Cooperation, Networking and Coalition, International Atomic Energy Agency, TC project RER/4/032	5
5	Project: EFICARE: Modelo de Monitorização da Eficiência Funcional de Infraestruturas de Unidades de Saúde, QREN - Quadro de Referência Estratégica Nacional, Projeto de I&DT Empresas em Co-Promoção, n.º 30399	20
6	Project: Robosampler: Desenvolvimento de um sistema robótico terrestre para monitorização radiológica e de metais pesados em ambientes estuarinos, QREN - Quadro de Referência Estratégica Nacional	5
7	Students supervision	10
8	Management of the k_0-INAA research group	15
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	Significant amount of atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream. **$PM_{fugitive}$ -** a FCT project coordinated by CTN/IST in cooperation with ISQ and Sapec Parques Industriais - aimed to improve the understanding of fugitive emissions and the following results were obtained: • a methodology to characterize fugitive emissions was developed; • a chemical profile of fugitive emissions was created and published; • receptor and dispersion models were used to estimate the environmental impact of fugitive emissions. Results showed that in Mitrena, fugitive emissions represented an increase in the PM_{10} concentration which highly depended on the season. It was found that on average fugitive emissions contribute to 20% of PM_{10}, in summer, and to 4%, in the winter; • the impacts of the particles in the human health were estimated. Positive associations between daily levels of particles and admissions for respiratory diseases were found. It was estimated that the percentage of increase in hospital admissions due to an increase of 10 $\mu g.m^{-3}$ of PM_{10} varied from 0.8% (for ages above 64 years) to 1.6% (for ages below 14 years). • mitigation actions for the reduction of fugitive emissions were identified.
2	The main objectives of the **FCT Project CV-Dust** were 1) to characterize the chemical

	and mineralogical composition of dust transported from Africa by setting up an orchestra of aerosol sampling devices in the strategic archipelago of Cape Verde; 2) to identify the sources of particles in Cape Verde by using receptor models; 3) to elucidate the role Saharan dust may play in the degradation of Cape Verde air quality and 4) to model processes governing dust production, transport, interaction with the radiation field and removal from the atmosphere. PM_{10} sampled in Cape Verde was chemically characterized (elements, water soluble ions and carbonaceous aerosols) and the identification of the main sources and origins of the particles were carried out by integrating complementary tools including Principal Component Analysis, Multilinear Regression Analysis, Positive Matrix Factorization and Cluster Analysis of Air Mass Back trajectories. Results showed that Cape Verde aerosol is affected principally by natural sources: dust coming from Sahara desert contributes on average to 48% of the total PM_{10} mass and sea salt spray contributes on average to 20%. During trajectories from Sahara, dust contribution increases to more than 60% and PM_{10} concentrations reach very high concentrations (10 times higher than the EC limit values and WHO guidelines).
3	The objective of the **IAEA TC Project "Support Air Quality Management"** was to establish a network for air monitoring in order to increase the knowledge about the status of atmospheric pollution in the TC Europe Region by broadening access to nuclear analytical techniques. Within this project: • Infrastructure for collection of APM and meteorological measurements were established and APM was collected systematically in 14 European countries. • Capabilities to apply nuclear analytical techniques for the analysis of APM were regionally improved. • Validation of methods was supported by the organization of 2 PT exercises. • Source apportionment and trans-boundary movement modellings were applied.
4	Laboratories under the IAEA Technical Cooperation (TC) projects RAF4022, RAS1018, **RER4032**/RER1007 and RLA0037 participated in inter-laboratory comparison rounds organized by the IAEA in conjunction with the Wageningen Evaluating Programs for Analytical Laboratories (WEPAL) to assess their analytical performances (the majority using Neutron Activation Analysis). The IAEA evaluated the test results in organized feedback workshops. These workshops provided a platform of discussion for issues such as potential sources of error, technical and organizational issues following a case-by-case approach. Recommendations to the laboratories were given and plans for improvement were drafted and accepted.
5	**EFICARE** is a joint project coordinated by the Portuguese private enterprise Integridade in cooperation with IST, ISQ, Quadrante and Centro Hospitalar de Setúbal. The objective of this project is to integrate and optimize the energy efficiency, the indoor air quality (IAQ) and the management of the maintenance in Health Units. In 2013, IST/CTN assessed the IAQ in Setúbal Hospital: chemical and comfort parameters were measured; airborne microorganisms were collected; airborne isolates were characterized and identified; the perceived IAQ and the related symptoms were assessed by means of a questionnaire survey among the workers; and an evaluation of the design, performance and maintenance of the ventilation systems was carried out. Results showed that particle concentrations were higher in the emergency services due to the large circulation of people that promotes the re-suspension of dust. PM_{10} levels exceeded the limit values established by the WHO. VOC concentrations presented higher values in the operating theatres, increasing at the beginning of the surgery during the disinfection of the patient. In the emergency service and in the infirmary, CO_2 concentrations exceeded the limit values established by national and international standards due to the poor ventilation. Fungal concentrations presented very high values in the emergency service, whereas bacteria presented higher concentrations in the emergency service and in the infirmary.
6	**ROBOSAMPLER** is a joint project coordinated by the Portuguese private enterprise Introsys S.A. in a cooperation with institute Uninova and IST/CTN, with financial support from QREN/IAPMEI/PORLISBOA programme. The aim is to manufacture a robotized

	system comprised of a terrestrial 4 wheel robot and an autonomous aerial vehicle, devoted to sampling tasks in estuarine mudflats. Operational tests of the accomplished system will be made in the intertidal mudflats of Tejo estuary running from Samouco to Alcochete. Sampling processes will focus on bottom sediments cores, seaweeds and bivalves. During the first year of the project, IST/CTN personnel were devoted to field exercises with engineers from Introsys and Uninova, aiming to achieve a comprehensive picture of technical and functional requirements. First semester delivered documents comprised technical reports on Requirements and Sensor Module. Second semester was dedicated to field exercises with a terrestrial robotized vehicle prototype - Introbot™ - developed by Introsys and with a build from scratch sediment core collector, hand operated, used as an intermediate tool to gather information on the required force for collecting sediment samples, and also to refine the appropriated design of the device to be applied in the ROBOSAMPLER itself. It is expected that the robotized system will be supplied by the end of March 2014. Field tests and monitoring campaigns will extend to late summer. IST/CTN will process all sampled material by gamma spectrometry analysis and neutron activation analysis.
7	Supervision of 5 PhD, 4 MSc, 4 BSc.
8	Scientific, technical and financial management of the group NANE: 1) Preparation and submission of projects; 2) Management of the k0-INAA Laboratory; 3) Management of the group team.

PUBLICATIONS

Journals

- O.K. Owoade, O.G. Fawole, F.S. Olise, L.T. Ogundele, H.B. Olaniyi, S.M. Almeida, M.D. Ho, P.K. Hopke, Characterization and Source Identification of Airborne Particulate Loadings at Receptor Site-classes of Lagos Mega-City, Nigeria, *Journal of the Air & Waste Management Association* 63 (9), 1026-1035 (2013), doi:10.1080/10962247.2013.793627
- A. Vicente, C. Alves, A.I. Calvo, A.P. Fernades, T. Nunes, C. Monteiro, S.M. Almeida, C. Pio, Emission factors and detailed chemical composition of smoke particles from the 2010 wildfire season, *Atmospheric Environment* 71, 295-303 (2013), doi: j.atmosenv.2013.01.062.
- N. Canha, S.M. Almeida, M.C. Freitas, M. Täubel, O. Hänninen, Winter Ventilation Rates at Primary Schools: Comparision Between Portugal and Finland, *Journal of Toxicology & Environmental Health Part A* 76 (6), 400 – 408 (2013), doi: 10.1080/15287394.2013.765372.
- S.M. Garcia, G. Domingues, C. Gomes, A.V. Silva, S.M. Almeida, Impact of Road Traffic Emissions on Ambient Air Quality in an Industrialized Area, *Journal of Toxicology & Environmental Health Part A* 76 (7), 429-439 (2013), doi: 10.1080/15287394.2013.771763.
- M. Almeida-Silva, S.M. Almeida, M.C. Freitas, C.A. Pio, T. Nunes, J. Cardoso, Impact of Sahara Dust transport on Cape Verde atmospheric element particles, *Journal of Toxicology & Environmental Health Part A* 76 (4-5) 240-251 (2013), doi:10.1080/15287394.2013.757200.
- S.M. Almeida, A.I. Silva, M.C. Freitas, H.M. Dzung, A. Caseiro, C.A. Pio, Impact of Maritime Air Mass Trajectories on the Western European Coast Urban Aerosol, Journal of Toxicology & Environmental Health 76 (4-5) 252-262 (2013), doi:10.1080/15287394.2013.757201.
- P.M. Félix, C. Franco, M.A. Barreiros, B. Batista, S. Bernardes, S.M. Garcia, A.B. Almeida, S.M. Almeida, H.Th. Wolterbeek, T. Pinheiro, Biomarkers of exposure to metal dust in exhaled breath condensate: methodology optimization, *Archives of Environmental and Occupational Health* 68 (2), 72-79 (2013), doi:org/10.1080/19338244.2011.638951.
- P.M. Félix, S.M. Almeida, T. Pinheiro, J. Sousa, C. Franco, H.Th. Wolterbeek, Assessment of exposure to metals in lead processing industries, *International Journal of Hygiene and Environmental Health* 216, 17-24 (2013), doi:org/10.1016/j.ijheh.2012.03.003.
- S.M. Almeida, M.C. Freitas, M. Reis, T. Pinheiro, P.M. Felix, C.A. Pio, Fifteen Years of Nuclear Techniques Application to Suspended Particulate Matter Studies, *The Journal of Radioanalytical and Nuclear Chemistry* 297 (3), 347-356 (2013), doi:org/10.1007/s10967-012-2354-1.
- M.A. Barreiros, T. Pinheiro, P.M. Félix, C. Franco, M. Santos, F. Araújo, M.C. Freitas, S.M. Almeida, Exhaled Breath Condensate as a biomonitor for metal exposure: A new analytical

challenge, *The Journal of Radioanalytical and Nuclear Chemistry* 297, 377-382 (2013), doi:10.1007/s10967-012-2354-1.

Book of Proceedings

- S.M. Almeida, A.V. Silva, S. Garcia, E. Henriques, M.A. Miranda, Contribuição do tráfego automóvel na zona industrial da Mitrena. 10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013), ISBN: 978-989-98673-0-7.
- J. Lage, S.M. Almeida, M.A. Reis, P.C. Chaves, M.C. Freitas, T. Ribeiro, S. Garcia, J.P. Faria, B.G. Fernández, H.Th. Wolterbeek, Avaliação do impacte da actividade industrial na qualidade do ar atmosférico, através das técnicas de biomonitorização e amostragem instrumental de partículas, 10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013), ISBN: 978-989-98673-0-7.
- N. Canha, S.M. Almeida, M.C. Freitas, H.T. Wolterbeek, Qualidade do Ar Interior – abordagem integrada para a sua avaliação em contexto escolar. 10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013), ISBN: 978-989-98673-0-7.
- C.A. Ramos, S.M. Almeida, H.T. Wolterbeek, Exercício físico e poluição em espaços interiores.10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013), ISBN: 978-989-98673-0-7.
- J. Lage, S.M. Almeida, M.A. Reis, P.C. Chaves, M.C. Freitas, T. Ribeiro, S. Garcia, J.P. Faria, B.G. Fernández, H.Th. Wolterbeek, Assessment of emission sources in an industrial area using instrumental and biomonitoring techniques. European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).
- C.A. Belis, F. Karagulian, F. Amato, M. Almeida, G. Argyropoulos, P. Artaxo, M.C. Bove, D. Cesari, D. Contini, E. Diapouli, K. Eleftheriadis, I. El Haddad, R.M. Harrison, S. Hellebust, E. Jang, H. Jorquera, D. Mooibroek, S.Nava, J. K. Nøjgaard, M. Pandolfi, M.G. Perrone, A. Pietrodangelo, G. Pirovano, P. Pokorná, P.Prati, C. Samara, D. Saraga, A. Sfetsos, G. Valli, R. Vecchi, M. Vestenius, E. Yubero, P.K. Hopke, European Intercomparison for Receptor Models Using a Synthetic Database. European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).
- M. Almeida-Silva, S.M. Almeida, H.T. Wolterbeek, Exposure assessment to air pollutants in elderly care centers. European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).
- S.M. Almeida, M. Almeida-Silva, C.A. Pio, T. Nunes, J. Cardoso, M. Cerqueira, M.A. Reis, P.C. Chaves, A. Taborda, Saharan dust contribution to PM_{10} levels and composition in Cape Verde. European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).
- S.M. Almeida, A.V. Silva, S.M Garcia, A.I. Miranda, Contribution of Fugitive Emissions in an Industrial Area of Portugal. European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).
- C.A. Ramos, S. M. Almeida, H.T. Wolterbeek, Exposure to indoor air pollutants during physical activity in gymnasiums. European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).
- C. Pio, J. Cardoso, T. Nunes, C. Alves, M. Cerqueira, S.M. Almeida, M. Almeida-Silva, M.C. Freitas, Application and recalibration of a GRIMM spectrometer in the monitoring of Sahara dust, European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).
- N. Canha, S.M. Almeida, M.C. Freitas, H.T. Wolterbeek, Indoor particles collected passively in urban and rural primary schools of Portugal. European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).

COMMUNICATIONS

Invited Oral

- *The role of neutron activation analysis in environment and health studies (experiment performed at TUD),* S.M. Almeida, *1st NMI3-II/FP7 General Assembly, Berlin, June 20 – 21 (2013),* Invited Talk.

Oral Talks

- *Portuguese Achievements on Interpretation of Data from Atmospheric Particulate Matter (APM) Transboundary Movements,* S.M. Almeida, *Regional Workshop on Interpretation of Data from Atmospheric Particulate Matter (APM) Transboundary Movements and Review of Project Achievements, IAEA Technical Cooperation Project RER/1/008, Vienna, Austria,11th-15th November (2013).*
- *Avaliação do impacte da atividade industrial na qualidade do ar atmosférico através das técnicas de biomonitorização e amostragem instrumental de partículas,* J. Lage, S.M. Almeida, M.A. Reis, P.C. Chaves, M.C. Freitas, T. Ribeiro, S. Garcia, J.P. Faria, B.G. Fernández, H.Th. Wolterbeek, *10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013).*
- *Contribuição do tráfego automóvel na zona industrial da Mitrena,* S.M. Almeida, A.V. Silva, S. Garcia, E. Henriques, M.A. Miranda, *10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013).*
- *Qualidade do Ar Interior – abordagem integrada para a sua avaliação em contexto escolar,* N. Canha, S.M. Almeida, M.C. Freitas, H.Th. Wolterbeek, *10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013).*
- *Assessment of the Portuguese k_0-INAA Laboratory Performance by Evaluating Internal Quality Control Data,* S.M. Almeida, M. Almeida-Silva, C. Galinha, C. Ramos, J. Lage, N. Canha, A.V. Silva, I. Dionisio, P. Bode, *k_0-Users' Workshop, Budapest, Hungry, 22nd – 27th September (2013).*
- *Integrating k_0-INAA, PIXE and Nuclear Microscopy to Characterize Fugitive Emissions,* S.M. Almeida, A.V. Silva, S.M. Garcia, T. Pinheiro, *k_0-Users' Workshop, Budapest, Hungry, 22nd – 27th September (2013).*
- *k_0-INAA and PIXE combined to characterize the aeolian aerossol from Cape Verde,* M. Almeida-Silva, S.M. Almeida, J. Cardoso, T. Nunes, M.A. Reis, P.C. Chaves, A. Taborda, C.A., *k_0-Users' Workshop, Budapest, Hungry, 22nd – 27th September (2013).*
- *Multi-Elemental Characterization of the Indoor Aerosols in Elderly Care Centers,* M. Almeida-Silva, S.M. Almeida, H.Th. Wolterbeek, *k_0-Users' Workshop, Budapest, Hungry, 22nd – 27th September (2013).*
- *Integrated approach to assess exposure to aerosol toxic elements in an industrial area,* J. Lage, S.M. Almeida, M.A. Reis, P.C. Chaves, M.C. Freitas, T. Ribeiro, S. Garcia, J.P. Faria, B.G. Fernández, H.Th. Wolterbeek, *2nd International Conference on Occupational & Environmental Toxicology, Porto, Portugal, 16th-17th September (2013).*
- *Biomonitoring study in indoor and outdoor environments of primary schools,* N. Canha, S.M. Almeida, M.C. Freitas, H.T. Wolterbeek, *2nd International Conference on Occupational & Environmental Toxicology, Porto, Portugal, 16th-17th September (2013).*
- *European Intercomparison for Receptor Models Using a Synthetic Database,* C.A. Belis, F. Karagulian, F. Amato, M. Almeida, G. Argyropoulos, P. Artaxo, M.C. Bove, D. Cesari, D. Contini, E. Diapouli, K. Eleftheriadis, I. El Haddad, R.M. Harrison, S. Hellebust, E. Jang, H. Jorquera, D. Mooibroek, S.Nava, J. K. Nøjgaard, M. Pandolfi, M.G. Perrone, A. Pietrodangelo, G. Pirovano, P. Pokorná, P.Prati, C. Samara, D. Saraga, A. Sfetsos, G. Valli, R. Vecchi, M. Vestenius, E. Yubero, P.K. Hopke, *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*
- *Exposure assessment to air pollutants in elderly care centers*, M. Almeida-Silva, S.M. Almeida, H.T. Wolterbeek, *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*
- *Assessment of emission sources in an industrial area using instrumental and biomonitoring techniques,* J. Lage, S.M. Almeida, M.A. Reis, P.C. Chaves, M.C. Freitas, T. Ribeiro, S. Garcia,

J.P. Faria, B.G. Fernández, H.Th. Wolterbeek, *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*

- *Results from the Portuguese k_0-INAA laboratory PT tests.* S.M. Almeida, *Workshop on Inter-comparison feedback of Proficiency Tests performed in 2012 and 2013 for NAA and other Analytical Techniques,Vienna, Austria, 27th-31st May (2013)*
- *Traffic-Related Air Pollution in an Industrial Area*, S.M. Almeida, A.V. Silva, S. Garcia, E. Henriques, M.A. Miranda, *Air Pollution 2013, Siena, Italy, 3rd-5th May (2013).*
- *Chemical characterization of ambient suspended particles in an urban area affected by industrial activities*, A.V. Silva, S.M. Almeida, C.M. Oliveira, A.M. Miranda, *Air Pollution 2013, Siena, Italy, 3rd-5th May (2013).*
- *Seasonal variability of atmospheric aerosol composition in Cape Verde Islands under the influence of Sahara dust intrusions: results of the CVdust campaign*, C.A. Pio, J. Cardoso, T.Nunes, M. Cerqueira, O. Tchepel, F. Rocha, P. Fialho, C.Alves, C. Gonçalves, C. Gama, J. Ferreira, S.M. Almeida, M. Almeida-Silva, M. Reis, M.C. Freitas, J. Baldasano, *1st Iberian Meeting on Aerosol Science and Technology, Évora, Portugal, 1st-3rd July (2013).*

Poster

- *Exercício físico e poluição em espaços interiores*, C.A. Ramos, S.M. Almeida, H.T. Wolterbeek, *10ª Conferência Nacional de Ambiente, Aveiro, Portugal, 6th-8th November (2013).*
- *Gymnasiums: a place to improve our health or the personal exposure to pollutants?*, C.A. Ramos, S.M. Almeida, N. Canha, H.T. Wolterbeek, *2nd International Conference on Occupational & Environmental Toxicology, Porto, Portugal, 16th-17th September (2013)*.
- *Indoor air quality assessment in different hospital areas*, S.M. Almeida, S. Cabo Verde, C.A. Ramos, C. Viegas, S. Viegas, *2nd International Conference on Occupational & Environmental Toxicology, Porto, Portugal, 16th-17th September (2013).*
- *Elderly exposure assessment to indoor air pollutants*, M. Almeida-Silva, S.M. Almeida, H.T. Wolterbeek, *2nd International Conference on Occupational & Environmental Toxicology, Porto, Portugal, 16th-17th September (2013).*
- *Seasonality of air pollutants in Santiago Island, Cape Verde: the influence of Sahara dust intrusions*, M. Almeida-Silva, S.M. Almeida, J. Cardoso, T. Nunes, M.A. Reis, P.C. Chaves, A. Taborda, C. A. Pio, *2nd International Conference on Occupational & Environmental Toxicology, Porto, Portugal, 16th-17th September (2013).*
- *Saharan dust contribution to PM_{10} levels and composition in Cape Verde*, S.M. Almeida, M. Almeida-Silva, C.A. Pio, T. Nunes, J. Cardoso, M. Cerqueira, M.A. Reis, P.C. Chaves, A. Taborda *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*
- *Contribution of Fugitive Emissions in an Industrial Area of Portugal*, S.M. Almeida, A.V. Silva, S.M Garcia, A.I. Miranda, *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*
- *Exposure to indoor air pollutants during physical activity in gymnasiums*, C.A. Ramos, S. M. Almeida, H.T. Wolterbeek, *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*
- *Application and recalibration of a GRIMM spectrometer in the monitoring of Sahara dust*, C. Pio, J. Cardoso, T. Nunes, C. Alves, M. Cerqueira, S.M. Almeida, M. Almeida-Silva, M.C. Freitas, *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*
- *Indoor particles collected passively in urban and rural primary schools of Portugal*, N. Canha, S.M. Almeida, M.C. Freitas, H.T. Wolterbeek, *European Aerosol Conference 2013, Prague, Czech Republic, 1st-6th September (2013).*
- *Radionucleidos en sedimentos y biota de la orilla sur del estuario y del tramo final del Rio Tejo*, J. Corisco, L. Portugal, S.M. Almeida, *Third Joint Congress of the Spanish Health Physics and Radiological Protection Societies, Cáceres, Spain, 18th-21st June (2013).*
- *Contribution of Fugitive Emissions for PM_{10} Concentrations in an Industrial Area of Portugal*, S.M. Almeida, A.V. Silva, M.A. Miranda, E. Henriques, S.M. Garcia, E. Sá, S. Rafael, A.I. Miranda, *European Geosciences Union 2013, Viena, Áustria, 7th-12th April (2013).*

- *Source apportionment of particulate matter sampled in Cape Verde*, S.M. Almeida, M. Almeida-Silva, C.A. Pio, T. Nunes, J. Cardoso, P.C. Chaves, A. Taborda, M.A. Reis, *European Geosciences Union 2013, Viena, Áustria, 7th-12th April (2013).*
- *Temporal evolution of mineralogical associations of atmospheric dust*, F. Rocha, A. Quintelo, D. Terroso, C. Costa, J. Vidinha, J. Cardoso, T. Nuns, C. Pio, S.M. Almeida, *European Geosciences Union 2013, Viena, Áustria, 7th-12th April (2013).*
- *Elemental characterization of Aeolian aerossol from Cape Verde by INAA and PIXE*, M. Almeida-Silva, S.M. Almeida, C.A. Pio, T. Nunes, J. Cardoso, P.C. Chaves, A. Taborda, M.A. Reis, *European Geosciences Union 2013, Viena, Áustria, 7th-12th April (2013).*
- *Microbiological Contamination Assessment in Elderly Care Centers*, C. Viegas, M. Almeida-Silva, A.Q. Gomes, S. Cabo Verde, S. Viegas, H.T. Wolterbeek, S.M. Almeida, *2nd Ibero-American Meeting on Toxicology and Environmental Health, Ribeirão Preto, Brazil, 17th-19th June (2013).*
- *Determination of elemental atmospheric concentrations by PIXE in highly loaded samples from Cape Verde*, M. Almeida-Silva, S.M. Almeida, C.A. Pio, T. Nunes, J. Cardoso, P.C. Chaves, A. Taborda, M.A. Reis, *13th International Conference on Particle-Induced X-Ray Emission, Gramado, Brazil, 3rd-8th March (2013).*

SEMINARS

- Qualidade do Ar Exterior, S.M. Almeida, Course "Seminários em Saúde Ambiental", Degree in Environmental Health, Escola Superior de Tecnologia da Saúde de Lisboa, 29th November (2013).

EDUCATION

Theses Supervision

- Supervisor, MSc Thesis, Indoor Air Quality in Gymnasiums: the importance of the environmental control for physical exercise, by Carla Ramos, Instituto Superior de Educação e Ciências, 22nd July 2013.
- Supervisor, MSc Thesis, Human exposure to air pollutants in the urban area of Setúbal, by André Shataloff, Instituto Superior de Educação e Ciências, 22nd July 2013.
- Supervisor, MSc Thesis, Biomonitoring of atmospheric deposition of chemical elements in the industrial area of Gijón, Spain, by Joana Lage, Universidade Lusófona de Humanidades e Tecnologias de Lisboa, 21st May 2013.
- Supervisor, BSc Thesis, PM_{10} contamination in Elderly Care Centers and outdoor emission sources, by Tiago Faria, Escola Superior de Tecnologia da Saúde de Lisboa, December 2013.
- Supervisor, BSc Thesis, Determination of the Personal Cloud in the city of Lisbon, by Patricia Gonçalves, Escola Superior de Tecnologia da Saúde de Lisboa, December 2013.
- Supervisor, BSc Thesis, Relation among traffic road and pollutants levels in an industrial area, by Eva Henriques, Escola Superior de Tecnologia da Saúde de Lisboa, June 2013.
- Supervisor, BSc Thesis, Meteorological effects on pollutants in an industrial area, Mitrena, Portugal, by Maria Ana Miranda, Escola Superior de Tecnologia da Saúde de Lisboa, June 2013.

Lectures

- "Indoor Air Quality", Post graduation in Energy Efficiency in Buildings, S.M. Almeida, ISQ, Lisbon, February/March (2013).
- "Indoor Air Quality Audits", Course on Energy Management in Service Buildings, S.M. Almeida, Agência para a Energia, Lisbon, 28th February (2013).
- "Indoor Air Quality Audits", Course on Energy Management in Service Buildings, S.M. Almeida, Agência para a Energia, Oporto, 26th March (2013).

JURY MEMBERSHIP

- Fátima Mirante (2013), Size distribution of the atmospheric aerosol in the Iberian Peninsula, PhD thesis, Universidade de Aveiro, 13 December.
- Andreia Lopes (2013), Populational exposure to atmospheric pollutants in Estarreja region, MSc thesis, Universidade de Aveiro, 13 December.
- Ana Clara (2013), Analysis of air quality in Central Region - Validation of Policies, MSc thesis, Universidade de Aveiro, 13 December.
- André Shataloff (2013), Human exposure to air pollutants in the urban area of Setúbal, MSc thesis, Instituto Superior de Educação e Ciências, 22 July.
- Carla Ramos (2013), Indoor Air Quality in Gymnasiums: the importance of the environmental control for physical exercise, MSc thesis, Instituto Superior de Educação e Ciências, 22 July.
- Joana Lage (2013), Mapping of heavy metals in industrial area through the use of biomonitors, MSc thesis, Universidade Lusófona de Humanidades e Tecnologias de Lisboa, 21 May.

PROJECTS

Running

- *Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions ($PM_{fugitive}$)*, Fundação para a Ciência e Tecnologia, PTDC/AAC-AMB/098825/2008, Leading Institution: IST/CTN, IST/CTN Coordinator: S.M. Almeida (30%)
- *Atmospheric aerosol in Cape Verde region: seasonal evaluation of composition, sources and transport (CV-Dust)*, Fundação para a Ciência e Tecnologia, PTDC/AAC-CLI/100331/2008, Leading Institution: Universidade de Aveiro, IST/CTN Coordinator: S.M. Almeida (10%)
- *Support Air Quality Management*, International Atomic Energy Agency, TC project RER/1/008 Leading Institution: IAEA, IST/CTN Coordinator: S.M. Almeida (5%)
- *EFICARE: Modelo de Monitorização da Eficiência Funcional de Infraestruturas de Unidades de Saúde*, QREN - National Strategic Reference Framework, R&D Project for companies in co-promotion n.º 30399, Leading Institution: Integridade; IST/CTN Coordinator: S.M. Almeida (20%).

Submitted

- *Reducing exposure to air pollutants during active commuting: development of a methodology*, Fundação para a Ciência e Tecnologia, EXPL/AAG-MAA/1653/2013. Leading Institution: IST-ID. IST/CTN Coordinator: S.M. Almeida (refused).
- *Prevenção da Exposição a Poluentes Atmosféricos na Potenciação dos Benefícios do Exercício Físico (DEPort)*, Fundación Mapfre, BIL/13/PR/177. Leading Institution: IST. IST/CTN Coordinator: S.M. Almeida (refused).
- *Integrated human exposure to particles: characterization, identification of sources and health effects*, Fundação para a Ciência e Tecnologia, 2013 FCT Investigator Grant, IF/01078/2013. Host institution: C^2TN, Funded researcher: S.M. Almeida (recommended for funding).

COLLABORATIONS

- M. Bounakhla, National Centre of Nuclear Energy, Sciences and Techniques, Rabat, Morocco, 18^{th}-29^{th} November 2013, Scientific Visit under IAEA's technical cooperation programme.
- P. Bode, Delft University, Delft, Netherlands, 5^{th} -11^{th} May 2013, Scientific Visit under the FCT project $PM_{fugitive}$.