European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

WGs and MC Meeting at Cambridge, 18-20 December 2013

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 2: 1 July 2013 - 30 June 2014 (***Ongoing Action***)

Using lichens to monitor environmental PAHs: how far can we go?

Sofia Augusto, Cristina Máguas, Cristina Branquinho

Invited ESR

University of Lisbon/ Portugal

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Biomonitors complement classic monitoring methods

Biomonitoring - using living organisms to quantify gradients of pollution.

Advantages of using biomonitors:

- High spatial resolution
- Pollutant accumulation over their lifetimes
- Biological response

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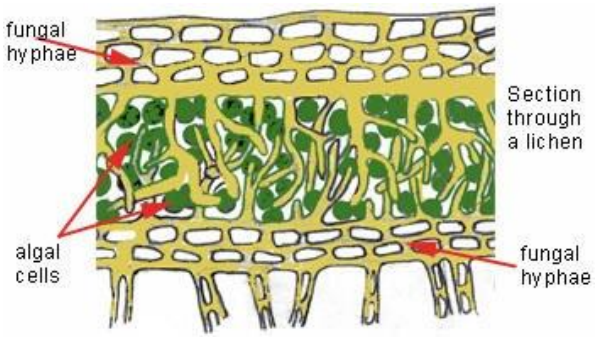


Lichens:

- Symbioses between fungi and algae
- No roots, no cuticle, meaning that they depend on atmosphere for nutrition
- Worldwide distribution

Main areas of research to date related to PAHs

Optimising and inter-calibrating biomonitors, soil and air

Fingerprinting pollution sources using biomonitoring tools

Assessing human health risk based on different monitoring approaches

Environmental Pollution 158 (2010) 483–489

Contents lists available at ScienceDirect

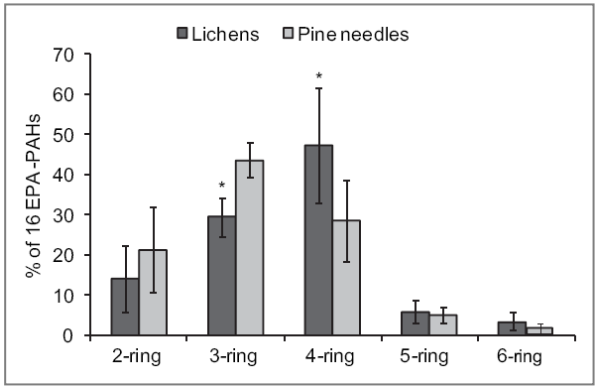
Environmental Pollution

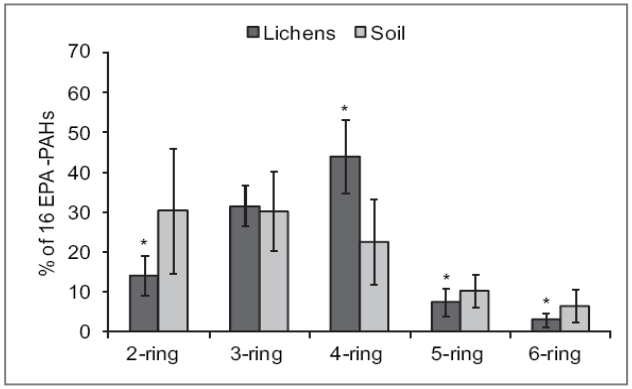
journal homepage: www.elsevier.com/locate/envpol

Optimising and inter-calibrating biomonitors, soil and air

Lichens as an integrating tool for monitoring PAH atmospheric deposition: A comparison with soil, air and pine needles

Sofia Augusto [a], Cristina Máguas [a], João Matos [b], Maria João Pereira [c], Cristina Branquinho [a,*]





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Chemosphere 92 (2013) 626–632

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Chemosphere

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A step towards the use of biomonitors as estimators of atmospheric PAHs for regulatory purposes

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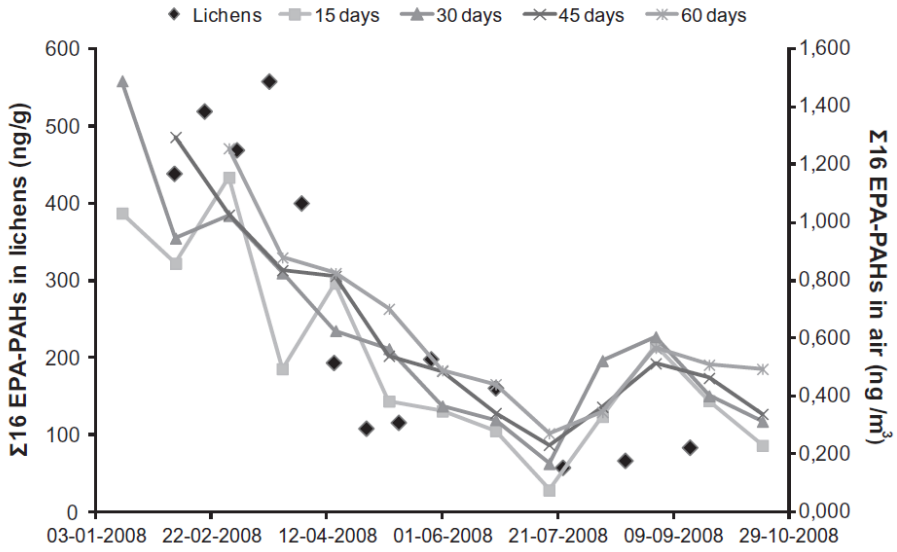

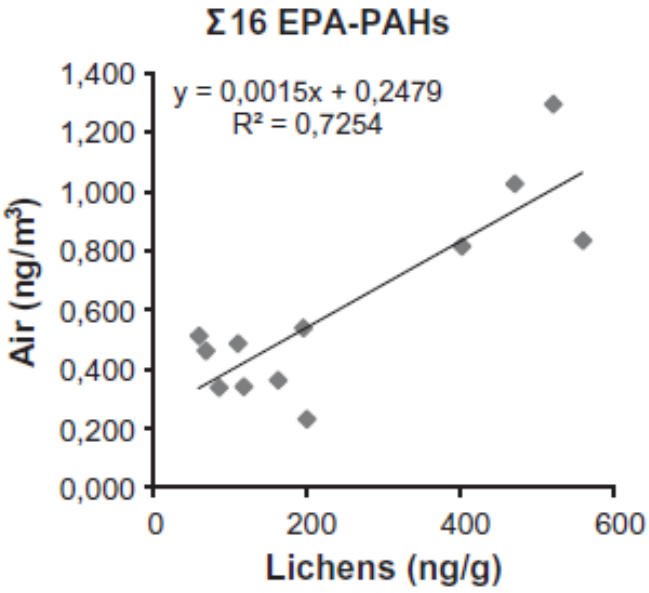

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Fingerprinting pollution sources using biomonitoring tools

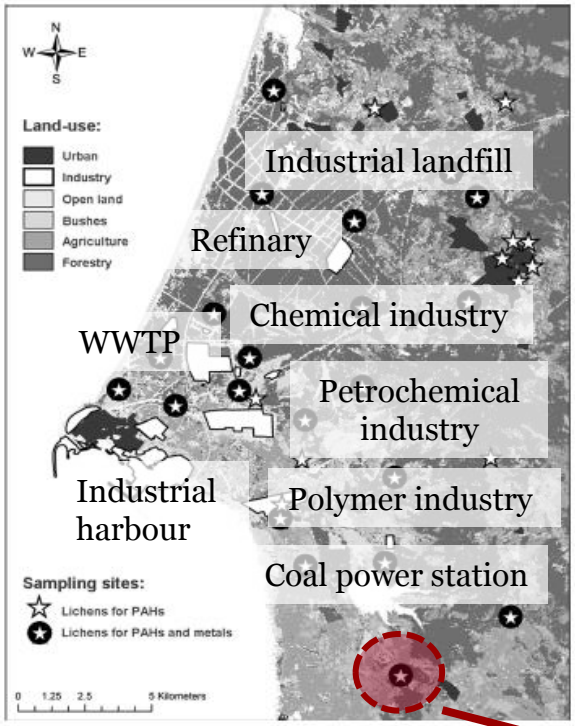
Environ. Sci. Technol. 2009, 43, 7762–7769

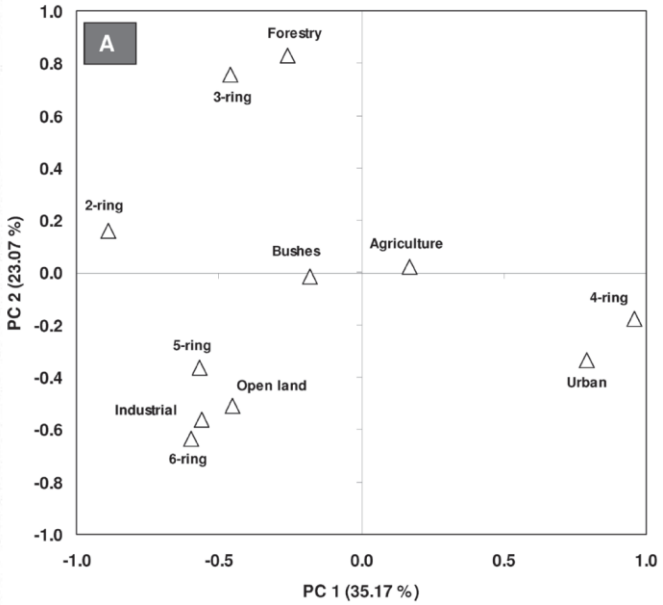
Spatial Modeling of PAHs in Lichens for Fingerprinting of Multisource Atmospheric Pollution

SOFIA AUGUSTO,† CRISTINA MÁGUAS,† JOAO MATOS,† MARIA JOAO PEREIRA,‡ AMÍLCAR SOARES,‡ AND CRISTINA BRANQUINHO*,†

ecosystem level and in the human food-chain; for that, not only must the sources be identified but also the sites where PAHs are being deposited.

Chemical analyses of air, soil, and plant and animal bioindicators have been used to monitor atmospheric deposition from different sources (5– 7). While measurements in air (in the vapor- and particulate-phases) reflect a short-term indicator that varies considerably in space and time, soils are sinks for organic compounds and therefore reflect a typical profile of long-term atmospheric pollution deposi-





Relative cover of each land-use class in circular buffers (1 Km radius) centered at each sampling site.

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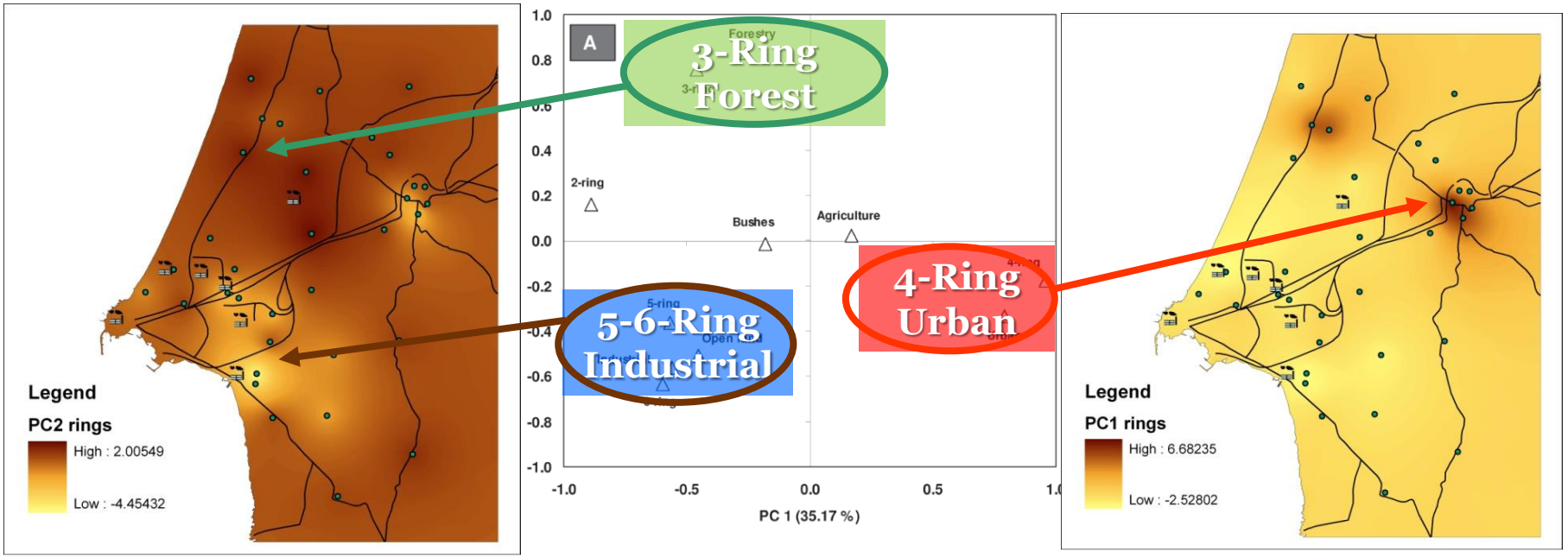

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ISSN: 1528-7394 print / 1087-2620 online
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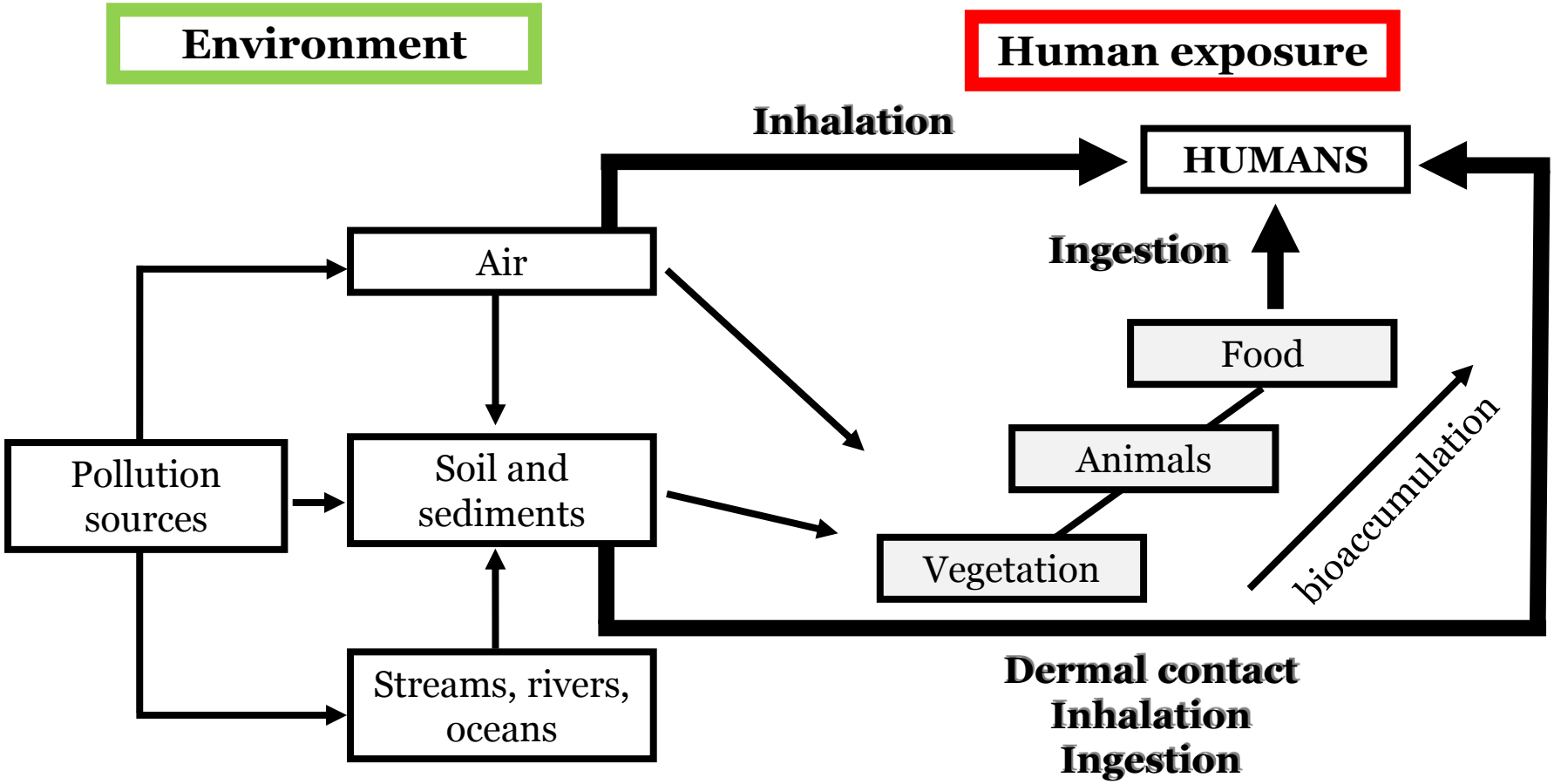

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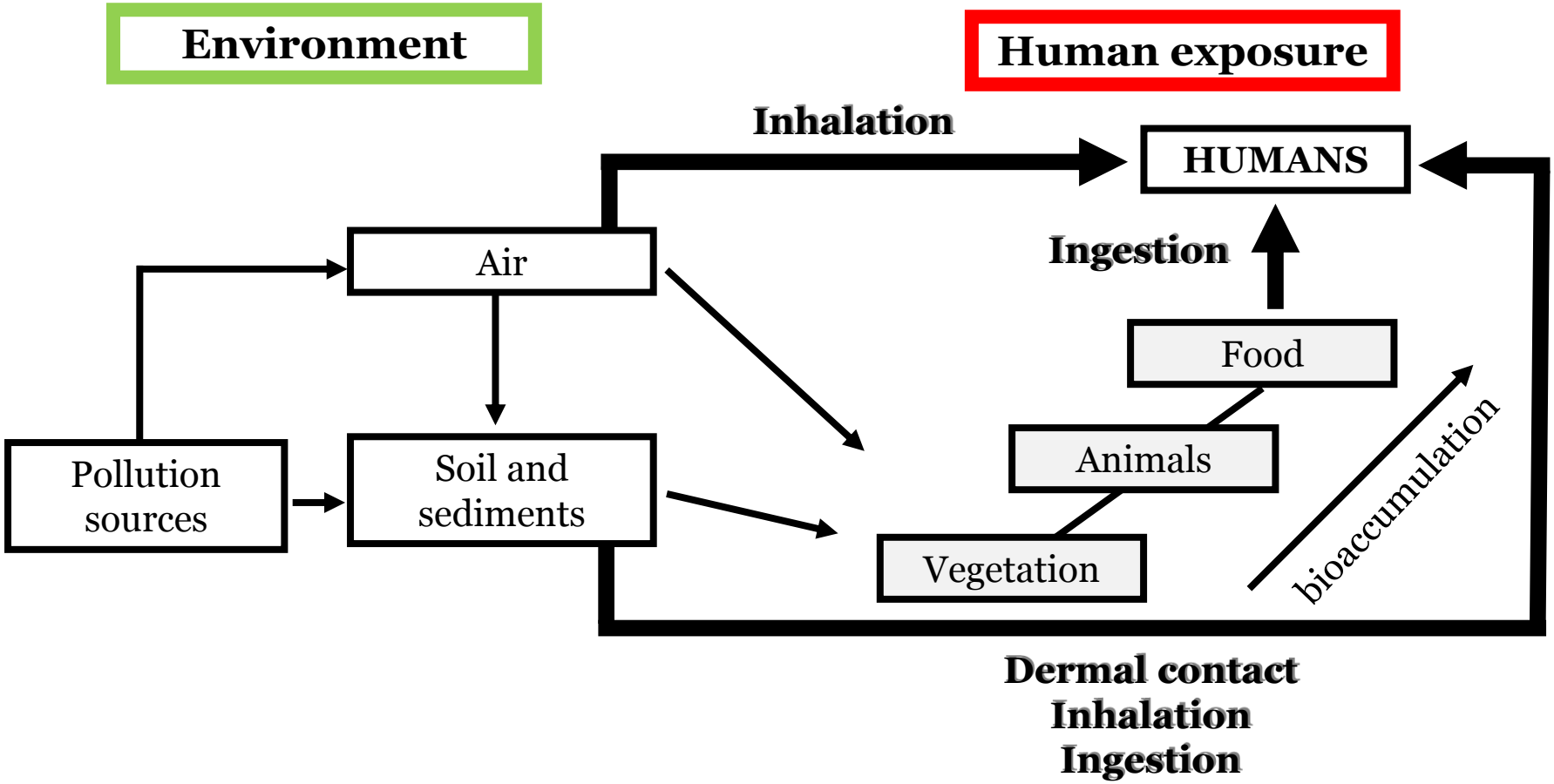

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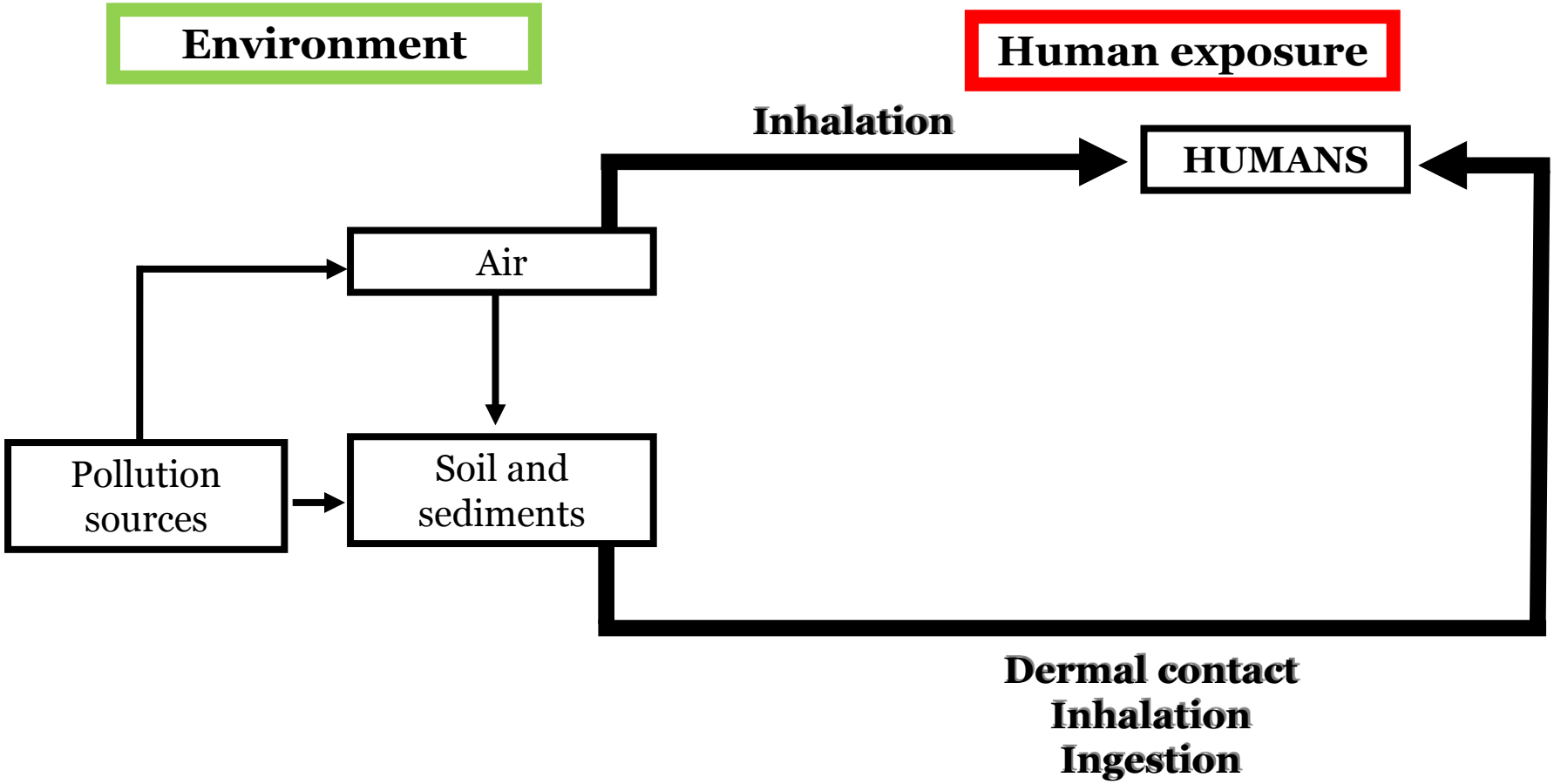

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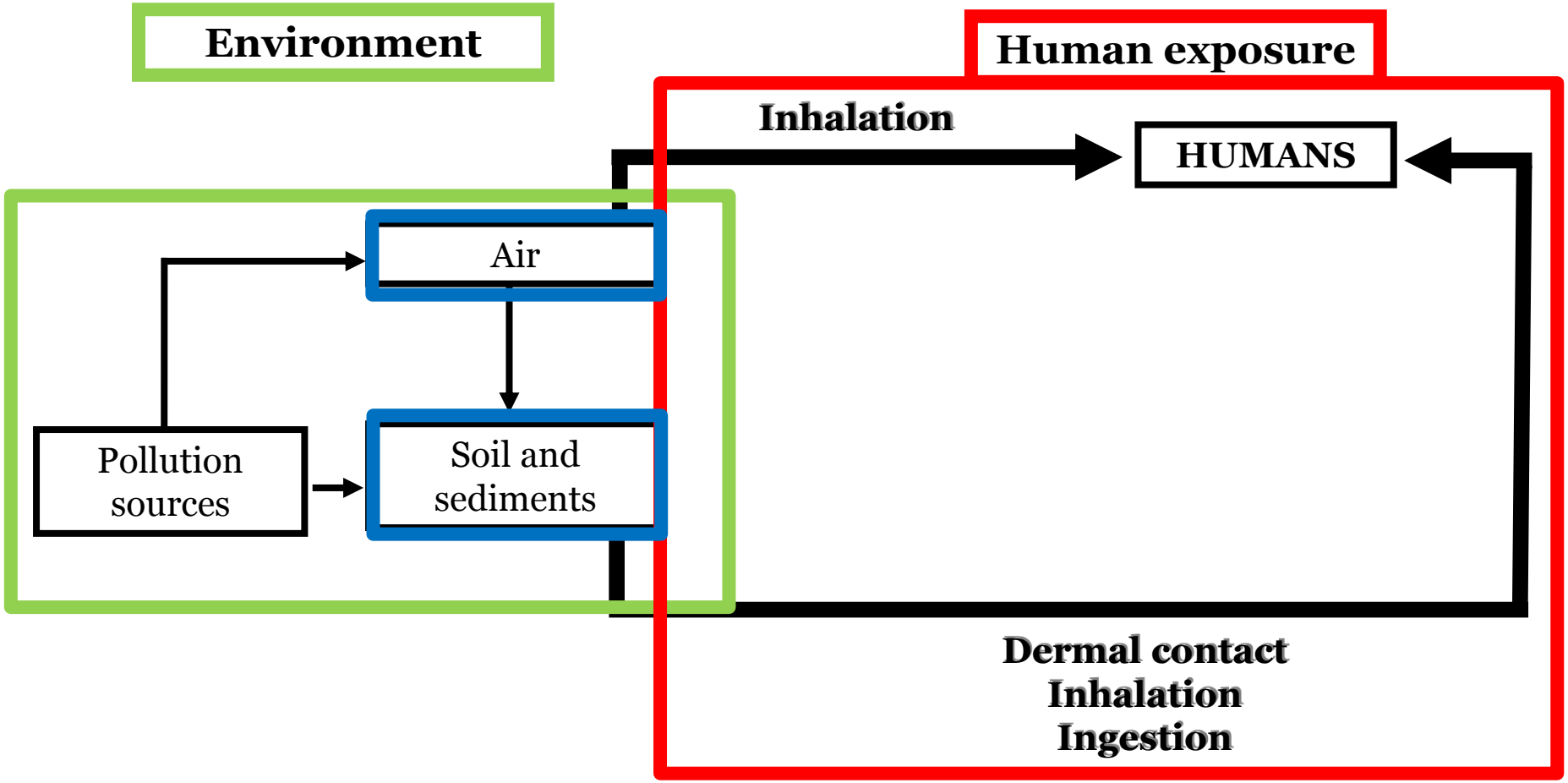

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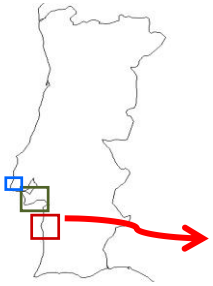
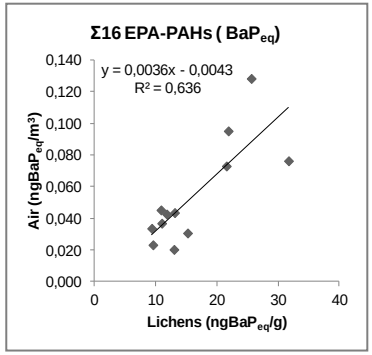
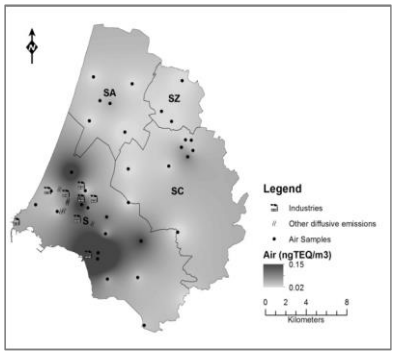
PAH toxic concentrations



Inhalation

Air (estimated using lichens)



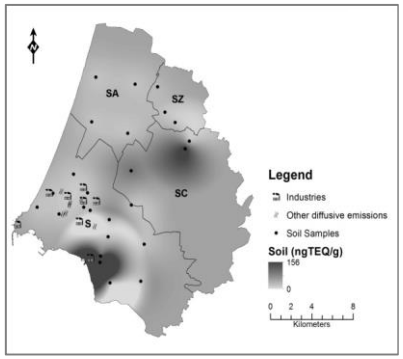


Ingestion

Inhalation

Dermal Contact

Soil



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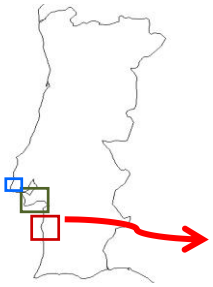

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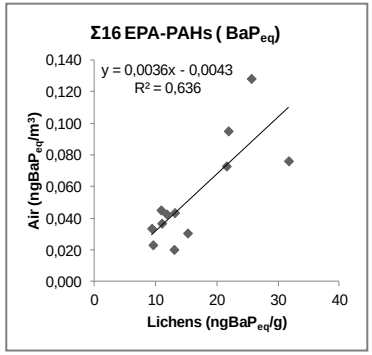

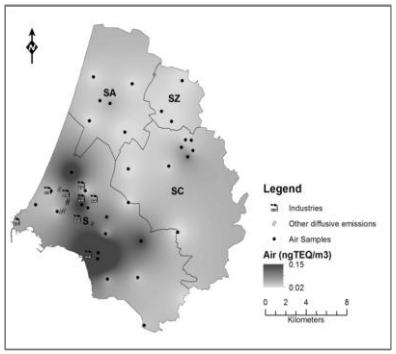

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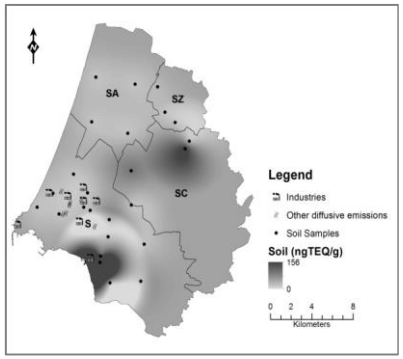

Exposure (adult)	SZ	SC	SA	S
Inhalation Air	76	100	88	166
Ingestion Soil	99	198	99	168
Inhalation Soil	4200	8426	4208	7134
Dermal	0,06	0,12	0,06	0,10
Individual exposure (ngBaPeq/day)	4375	8723	4395	7468

Human Exposure

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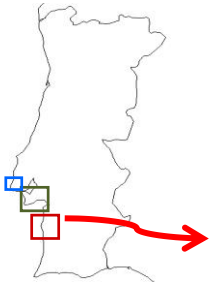

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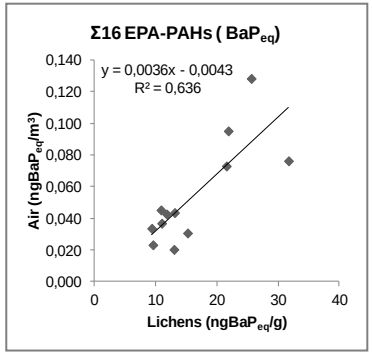

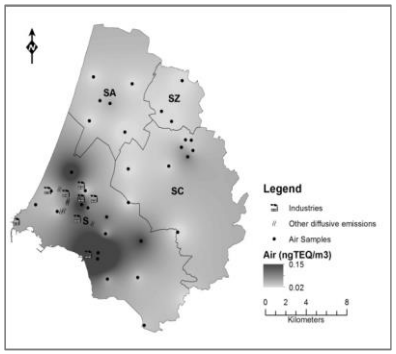

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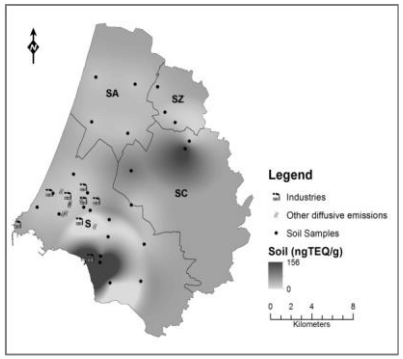

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Human Exposure

Carcinogenic risk

Incremental lifetime cancer risk (ILCR)	SZ	SC	SA	S
ILCR	$2,7x10^{-4}$	$5,5x10^{-4}$	$2,7x10^{-4}$	$4,7x10^{-4}$
Subjects developing cancer in their lifetime	**0,1**	**3,2**	**2,3**	**4,5**

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Final remarks

- Lichens have shown to be useful biomonitors, accumulating PAHs **over detection limits**, complementing conventional monitoring methods and allowing **tracking different pollution sources**.

- The **high spatial resolution** maps obtained using biomonitors allow getting a real picture of dispersion and deposition of atmospheric PAHs, enabling to identify control and exposed populations for further **human health studies**.

- **Translating PAH concentrations in lichens into the equivalent ones for air**, allows integrating biomonitors into human exposure and human health risk assessments.

Future research: How far can we go?

Optimising and inter-calibrating biomonitors, soil and air

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Lichens – questions yet to be answered:

- Accumulation mechanisms?
- Critical level of PAHs?
- Particulate- and gas-phase of air?

Development of European guidelines and standard methods

Networking/know-how exchange:

- contribute to the development of new technologies based on our knowledge on ecological indicators, in particularly lichens