Karlsruher Institut für Technologie

Polycyclic aromatic compounds (PAHs, OPAHs, azaarenes) in soil: Occurrence – Transformations – Availability

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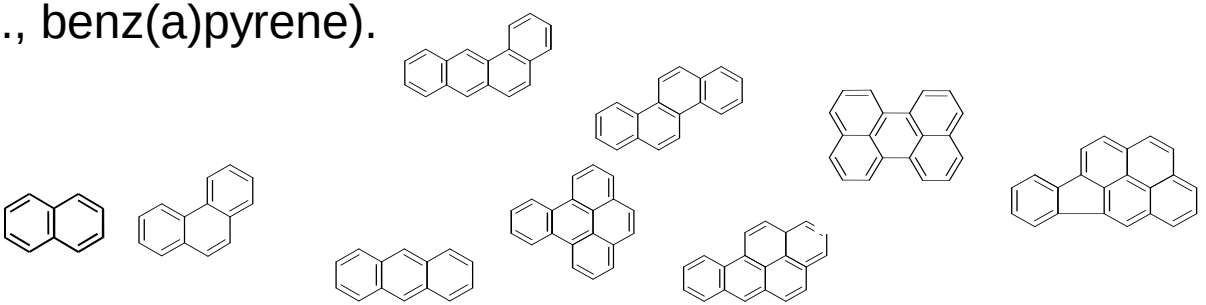
Polycyclic aromatic compounds

Introduction

PAHs are a group of several 100 compounds consisting of at least two condensed aromatic rings. Some representatives are carcinogenic and mutagenic (e.g., benz(a)pyrene).



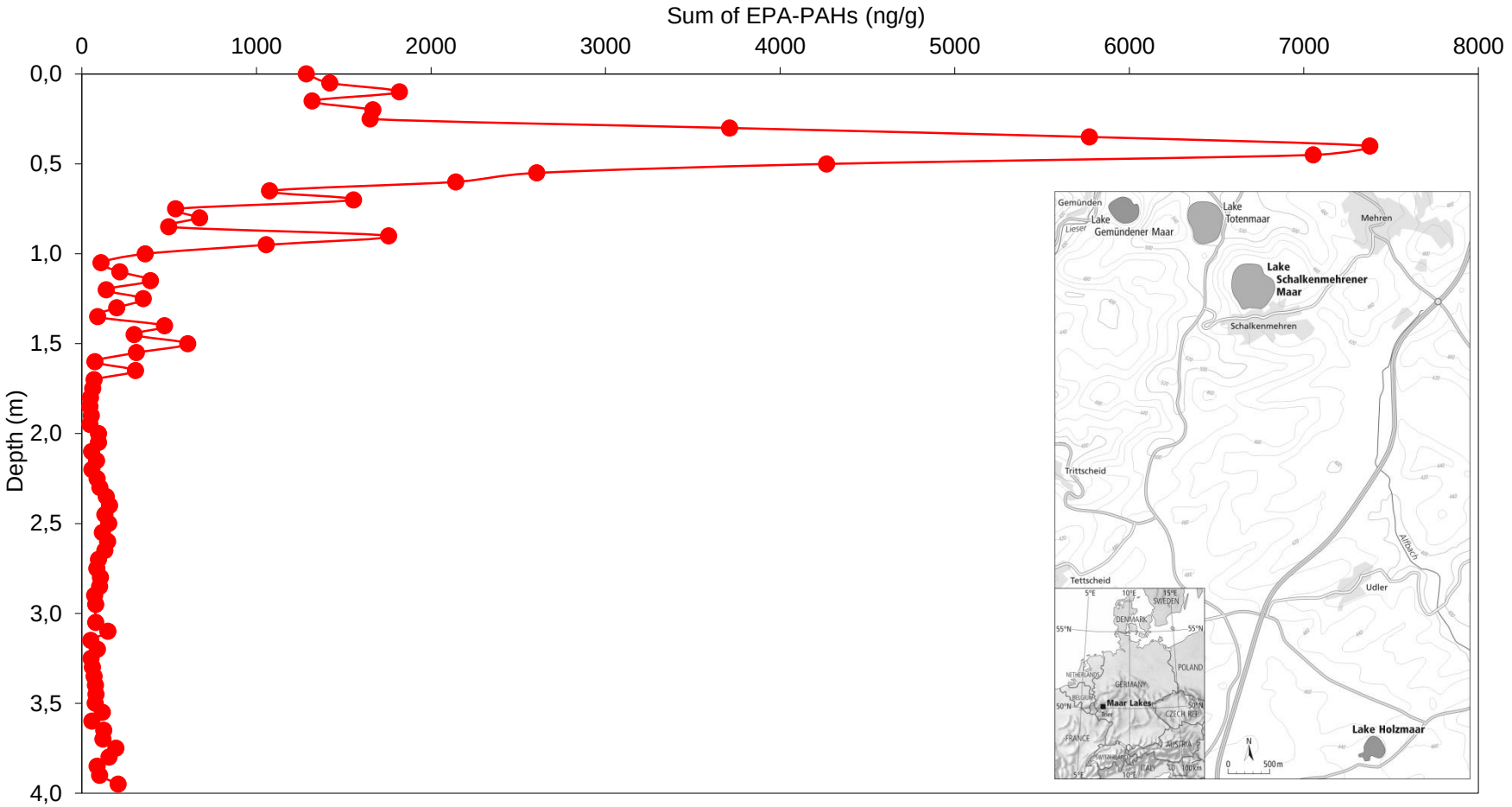
PAHs are produced in any kind of combustion or charring of organic matter (naturally and anthropogenically) and some have partly biological sources (e.g, perylene).

Primary OPAHs are produced together with PAHs in combustion processes and secondary OPAHs are formed from parent-PAHs in the environment. OPAHs can be more toxic than their parent-PAHs.

AZAs contain an N-heterocycle and have been much less studied than other polycycles.

Polycyclic aromatic compounds

Introduction

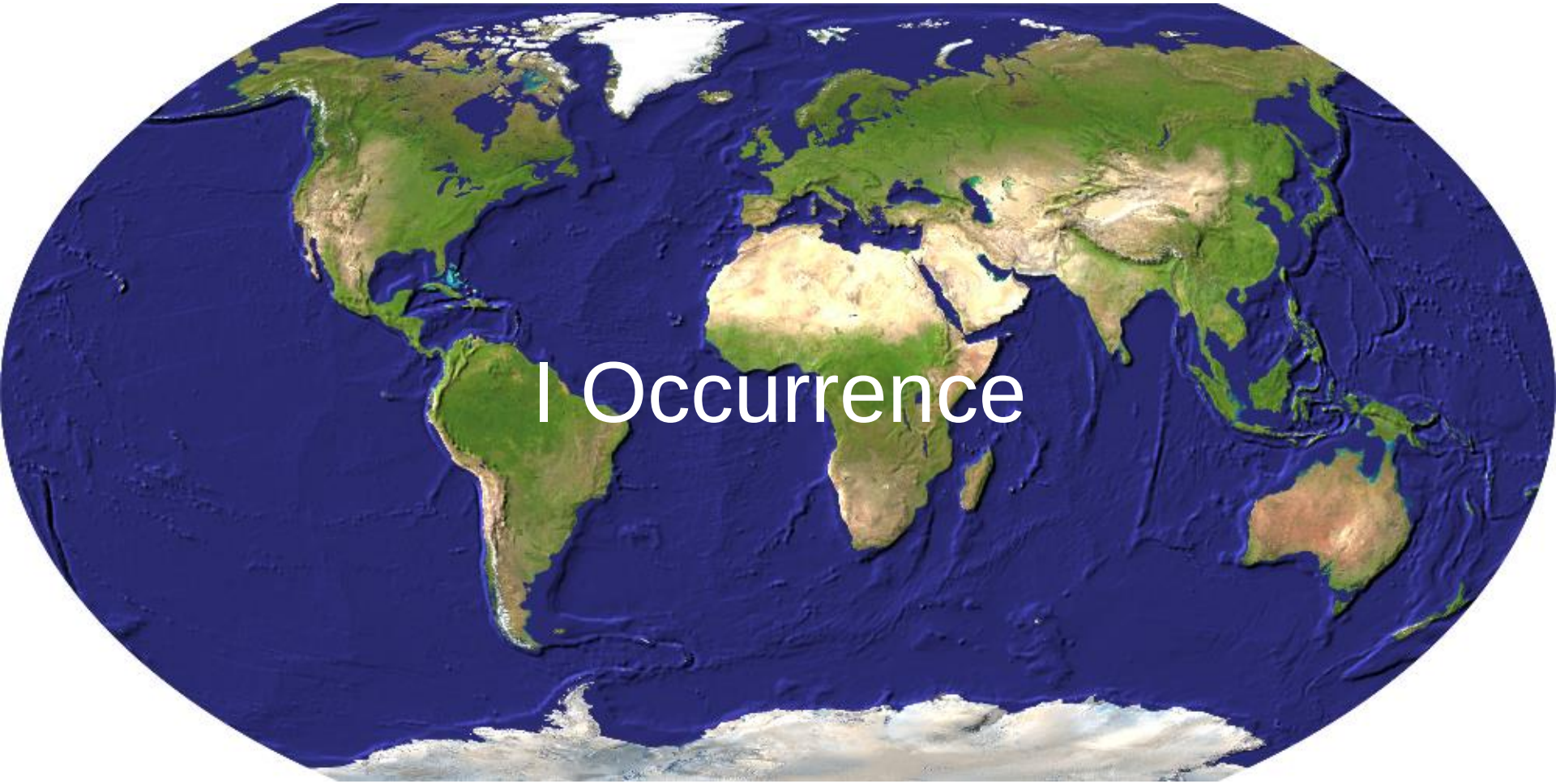


Concentrations of the sum of the 16 EPA-PAHs in a sediment core of Lake Holzmaar, Eifel mountains, Germany.

Bandowe et al. (2014): *Palaeogeogr. Palaeoclim. Palaeoecol.* **401**, 111-121.

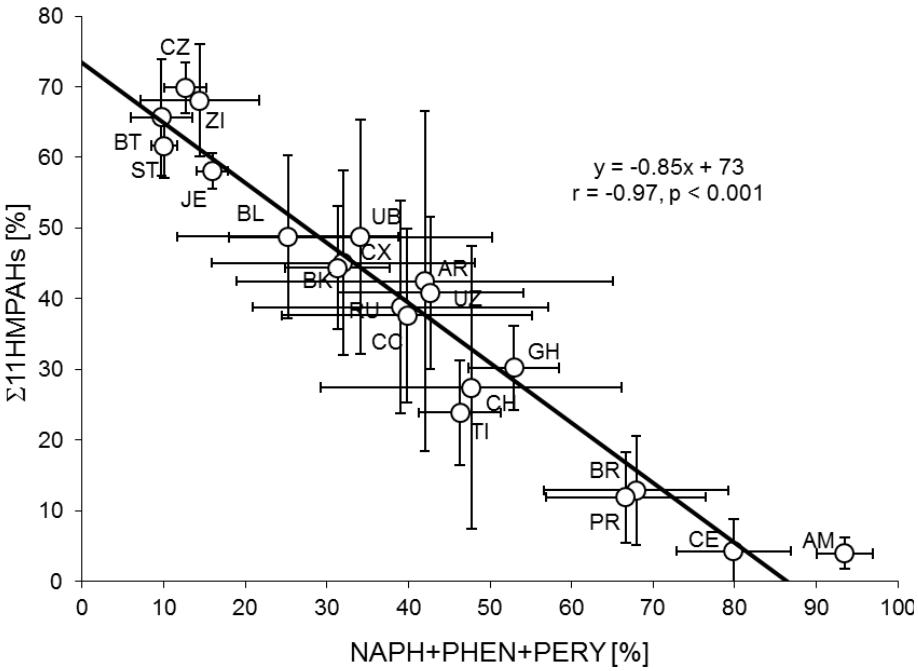
Polycyclic aromatic compounds

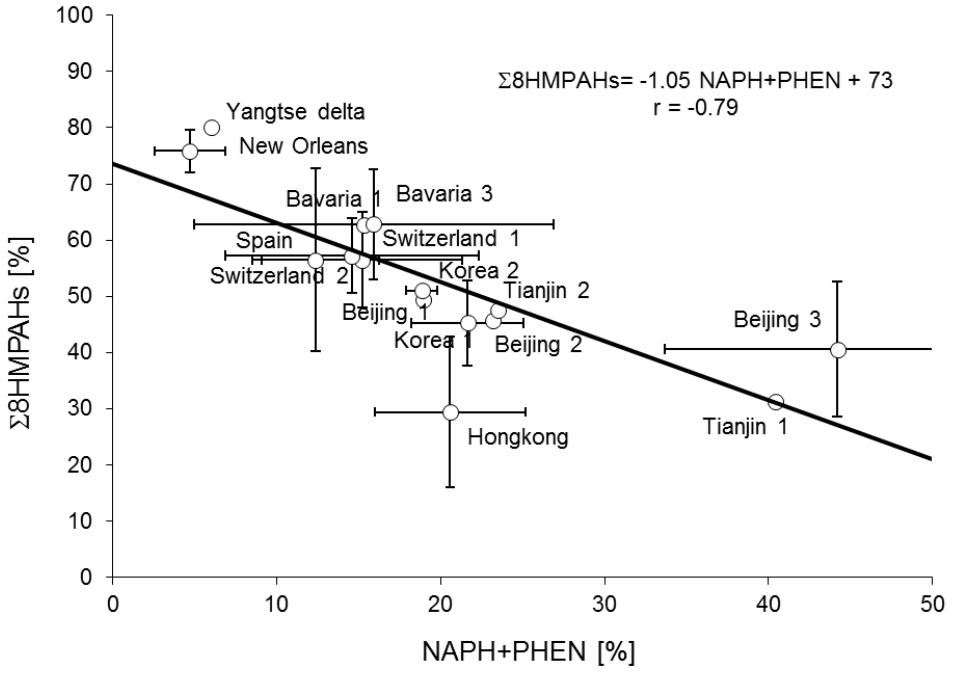
Occurrence



Polycyclic aromatic compounds

Occurrence



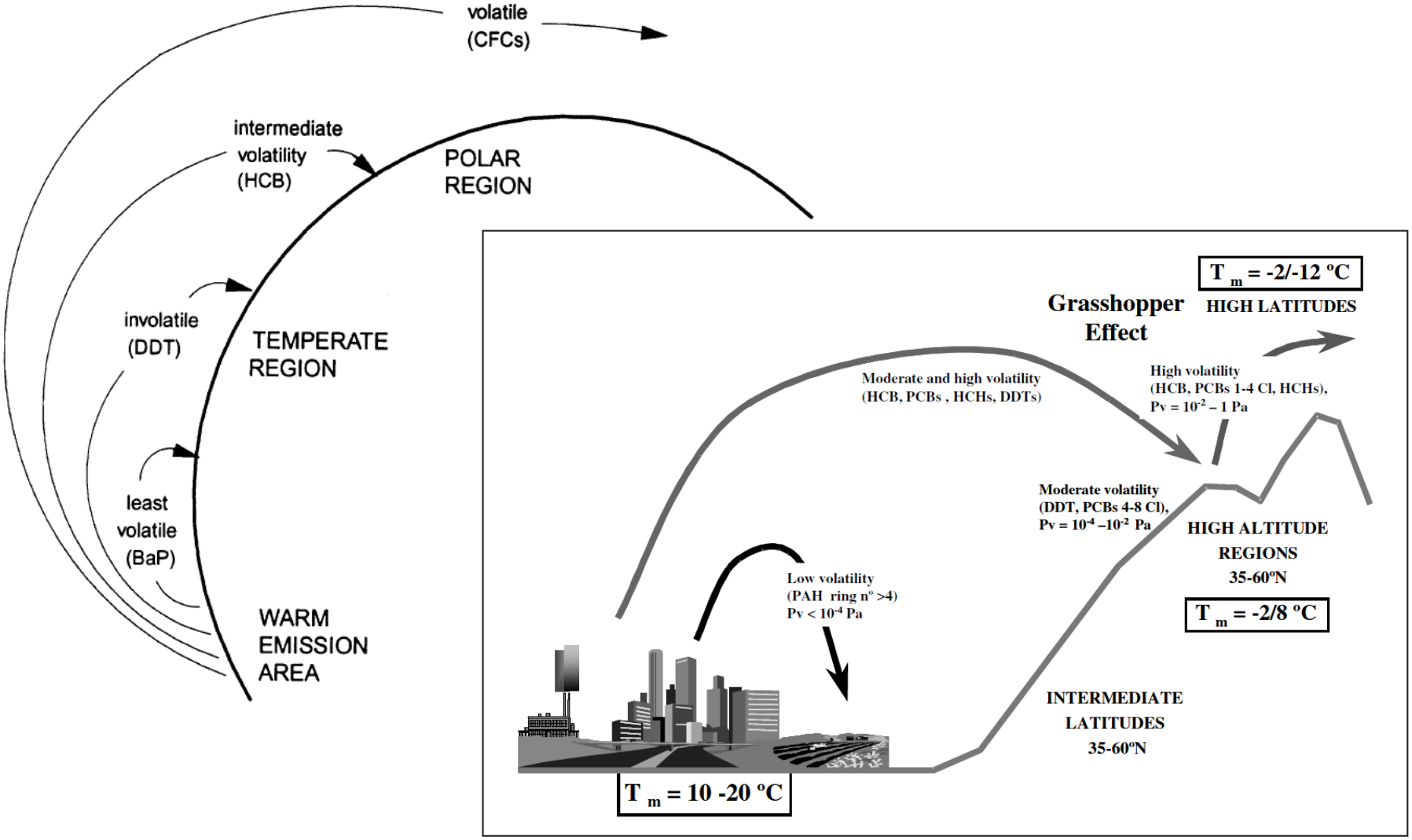


Relationship between background and anthropogenic contributions to the sum of PAH concentrations for own data (left) and for literature data (right, refs. in Wilcke, 2007).

Wilcke (2007): *Geoderma* **141**, 157-166 and additional data.

Polycyclic aromatic compounds

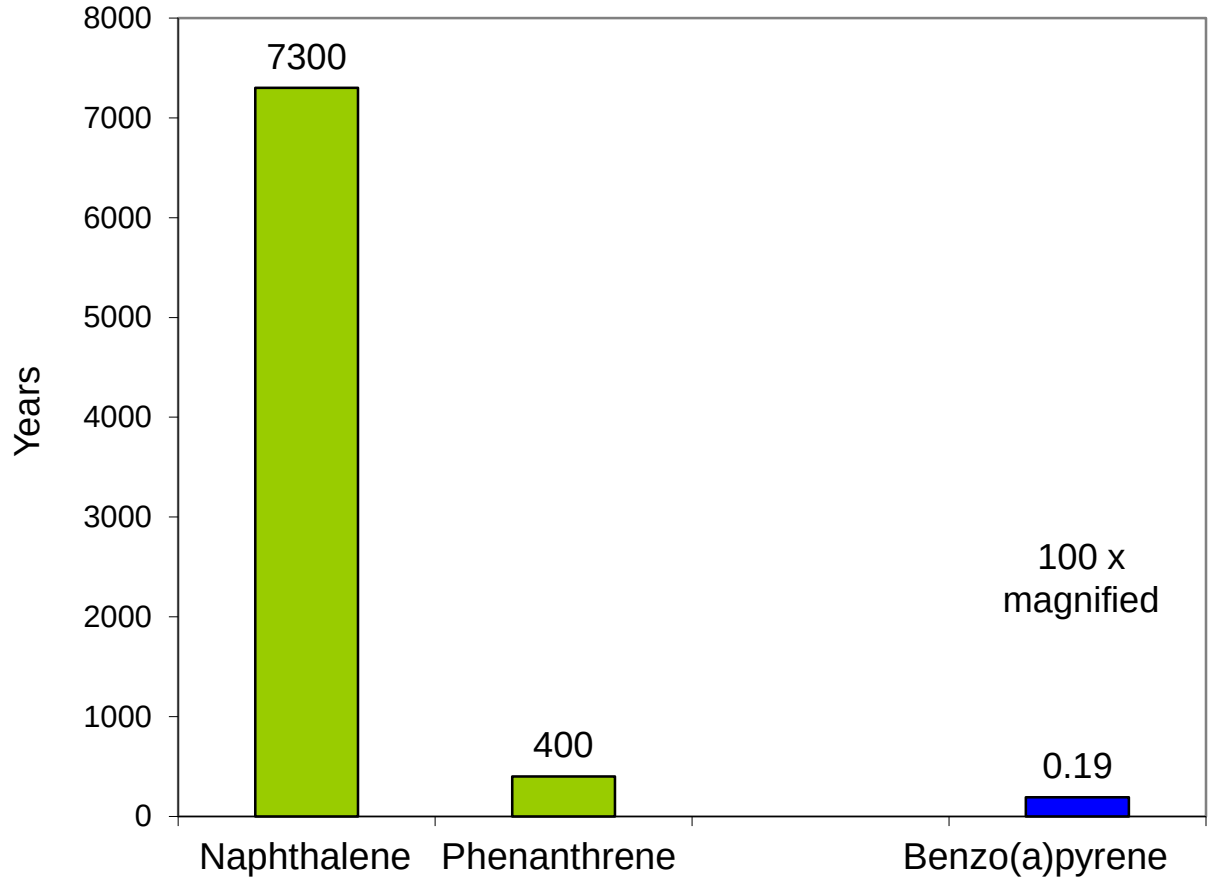
Introduction



Wania and Mackay (1996): *Environ. Sci .Technol.* **30**, A390-396.

Polycyclic aromatic compounds

Occurrence

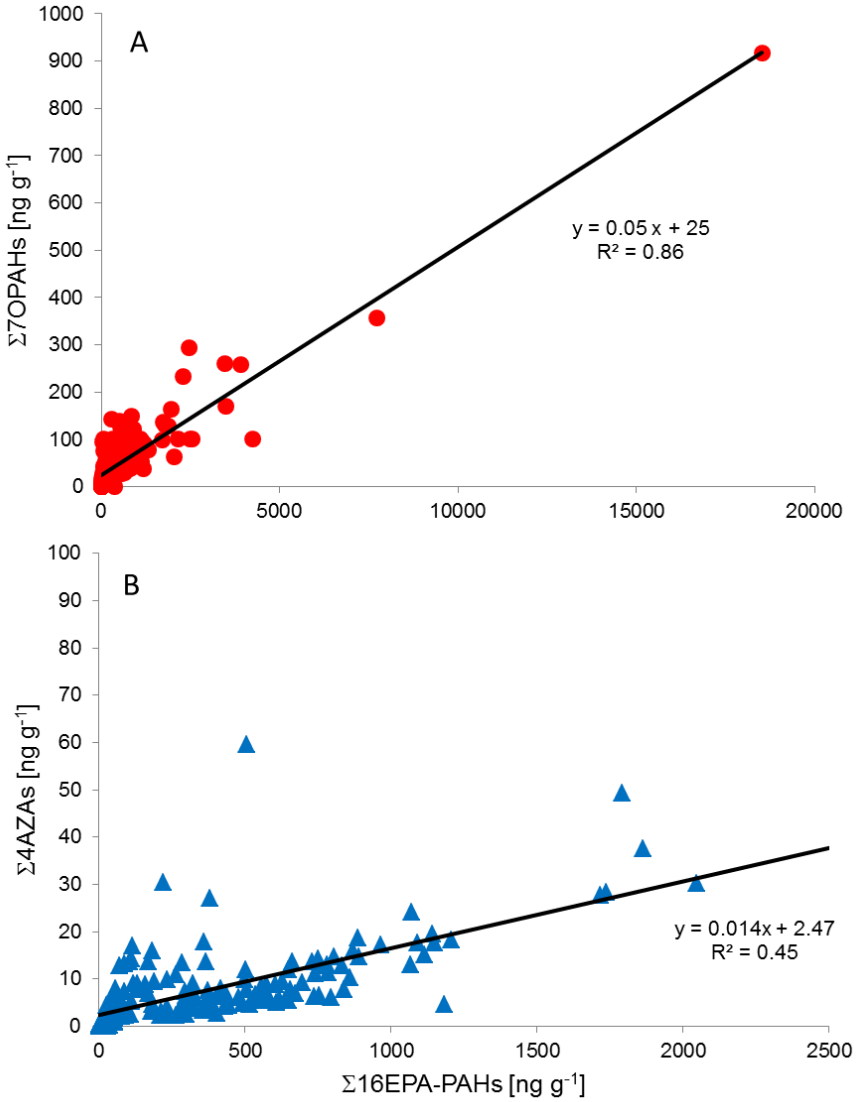


Naphthalene, phenanthrene and benzo(a)pyrene stocks in the Brazilian Cerrado expressed as British deposition equivalents.

Wilcke et al. (2004): *J. Environ. Qual.* **33**, 946-955.

Polycyclic aromatic compounds

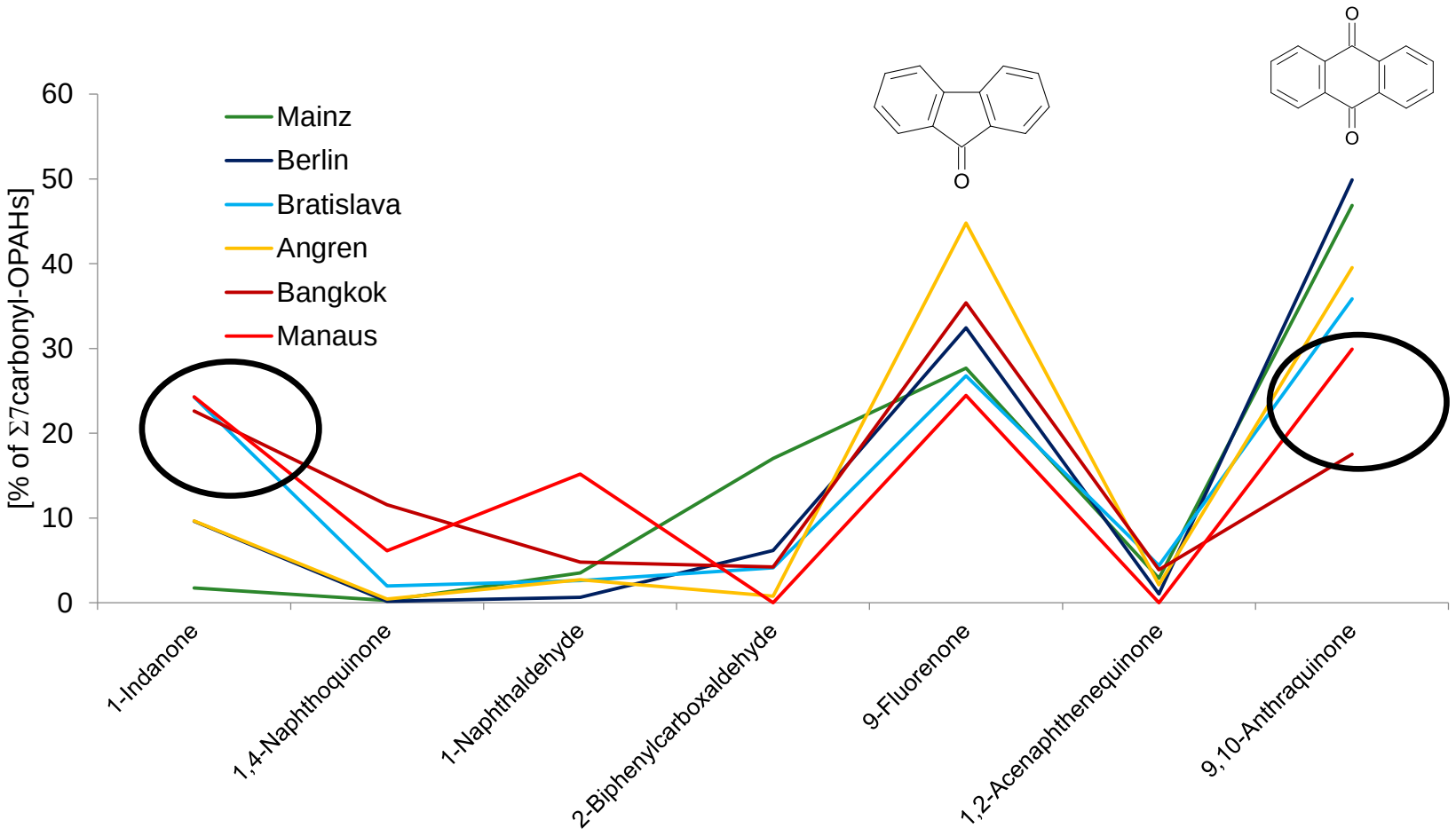
Occurrence



Relationship between the concentrations of ∑16EPA-PAHs and (A) ∑7OPAHs and (B) ∑4AZAs in surface soils.

Polycyclic aromatic compounds

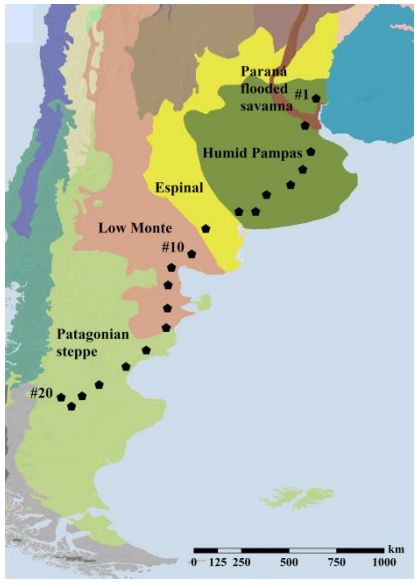
Occurrence

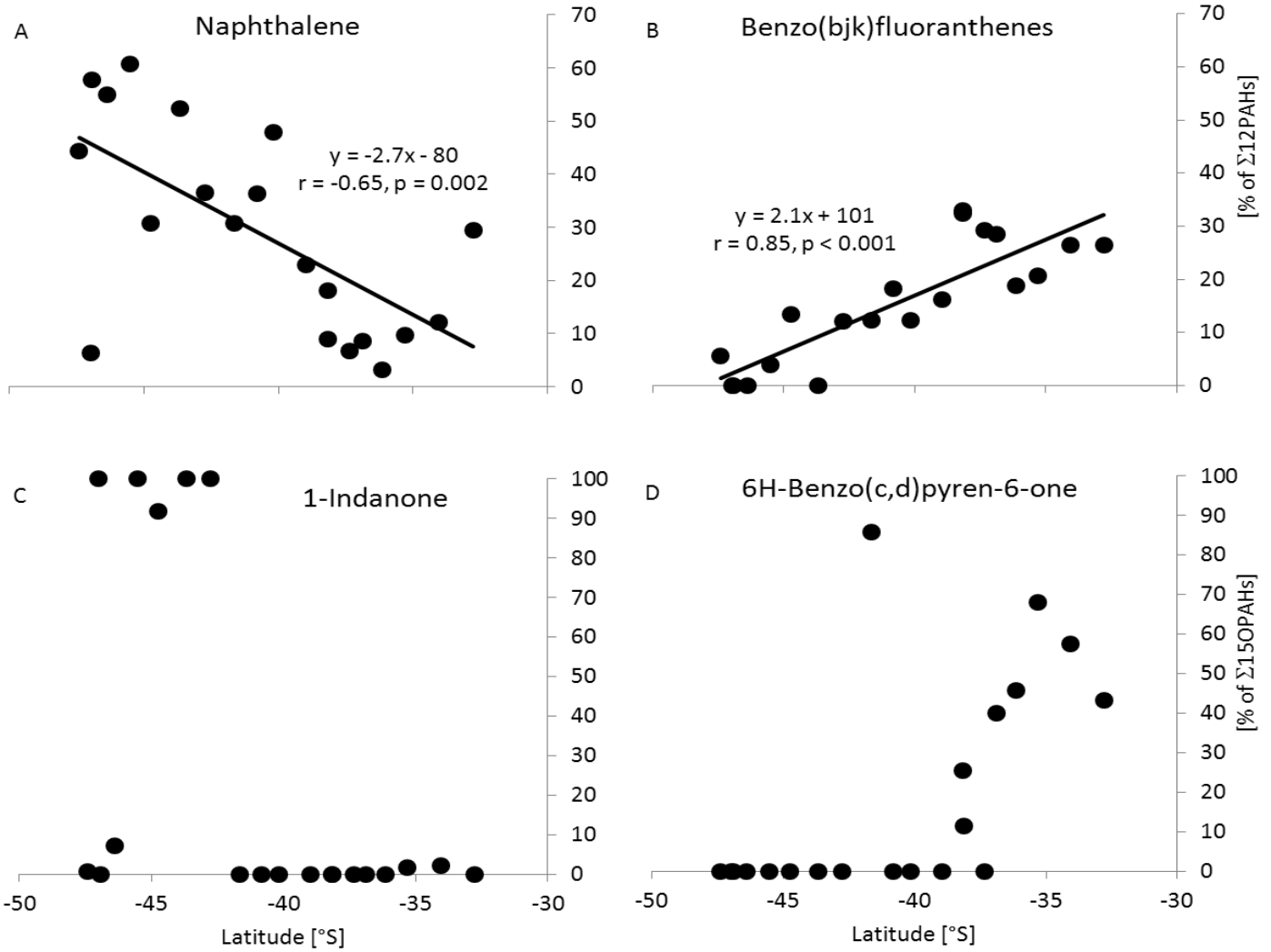


Composition pattern of OPAHs mixtures in topsoils.

Polycyclic aromatic compounds

Occurrence



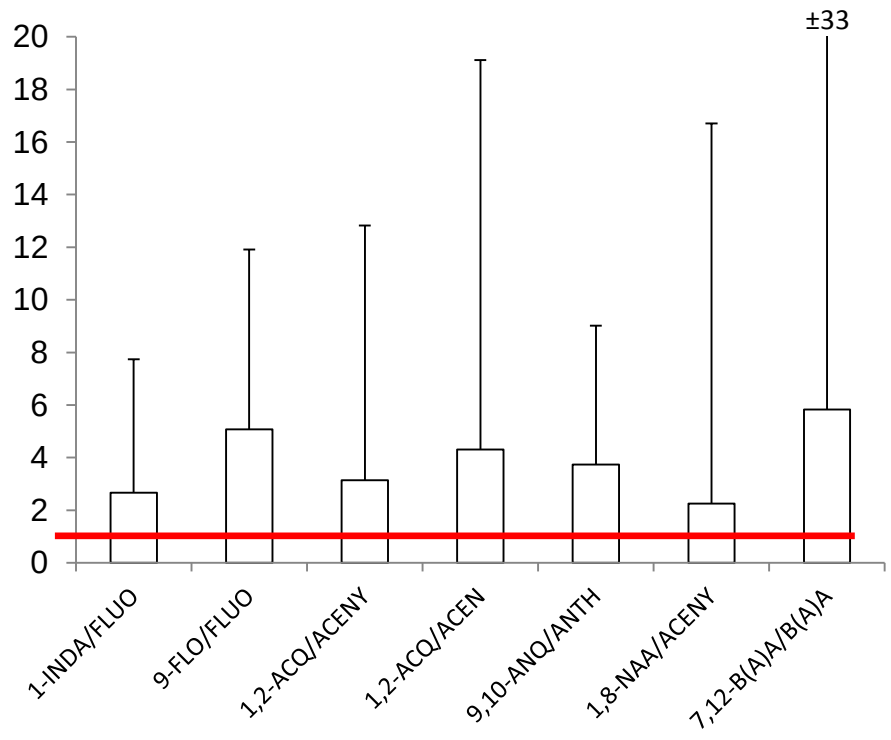


Relationships between latitude and (A) NAPH, (B) B(BJK), (C) 1-INDA and (D) BPYRone contributions to the respective sum of compound concentrations.

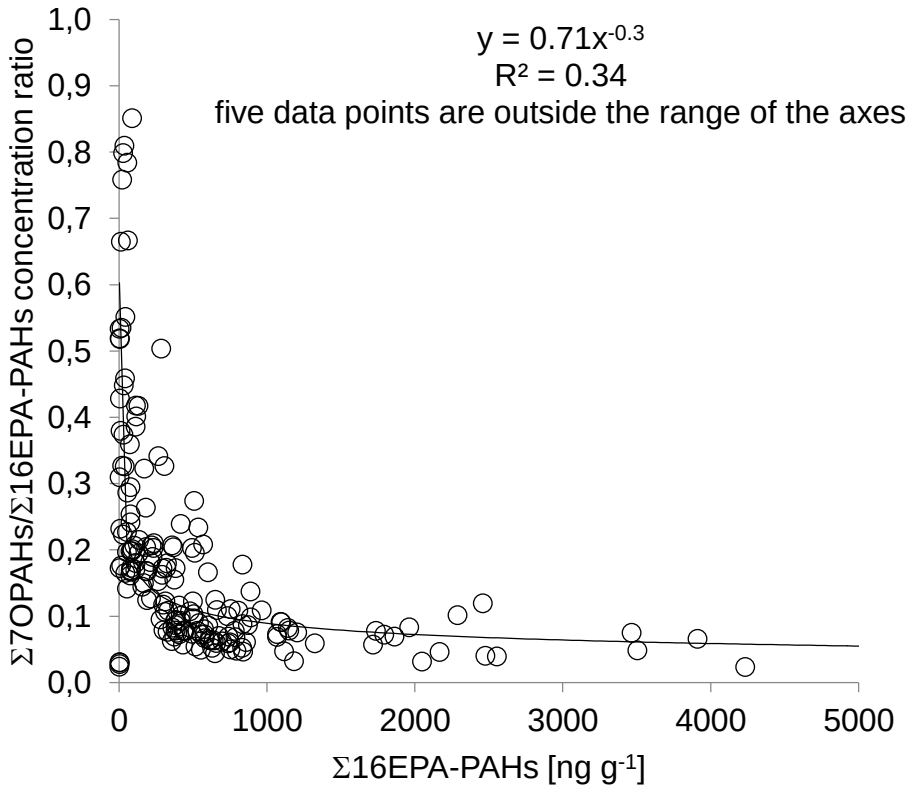
Wilcke et al. (2014): *Sci. Tot. Environ.* **473-474**, 317-325.

Polycyclic aromatic compounds

Occurrence



Mean OPAH to related parent-PAH ratio. Error bars show standard deviations (n = 176-190).

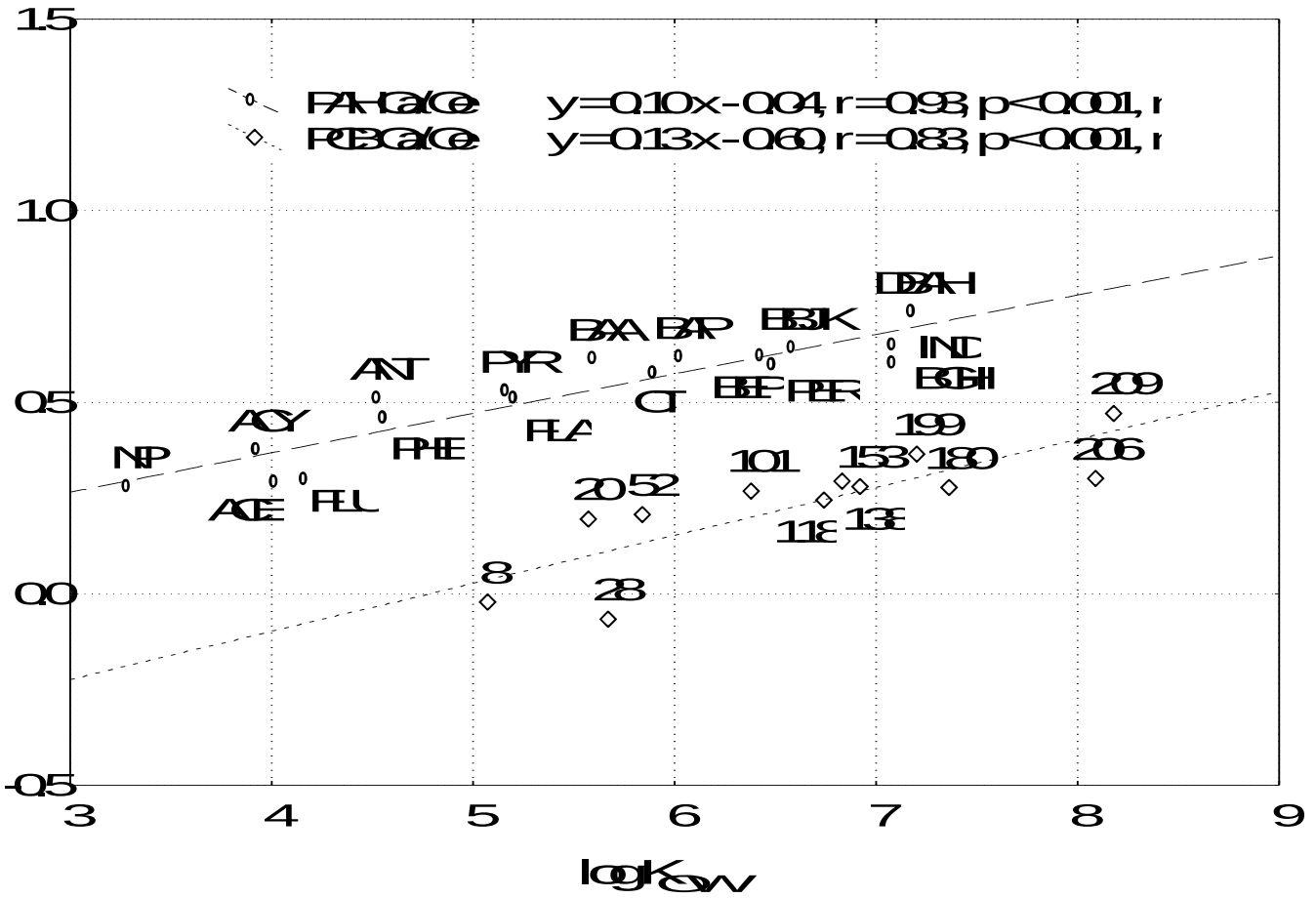


Relationship between the Σ16EPA-PAHs concentrations and the Σ7OPAHs/ Σ16EPA-PAHs concentration ratios.


II Transformations

Polycyclic aromatic compounds

Transformations

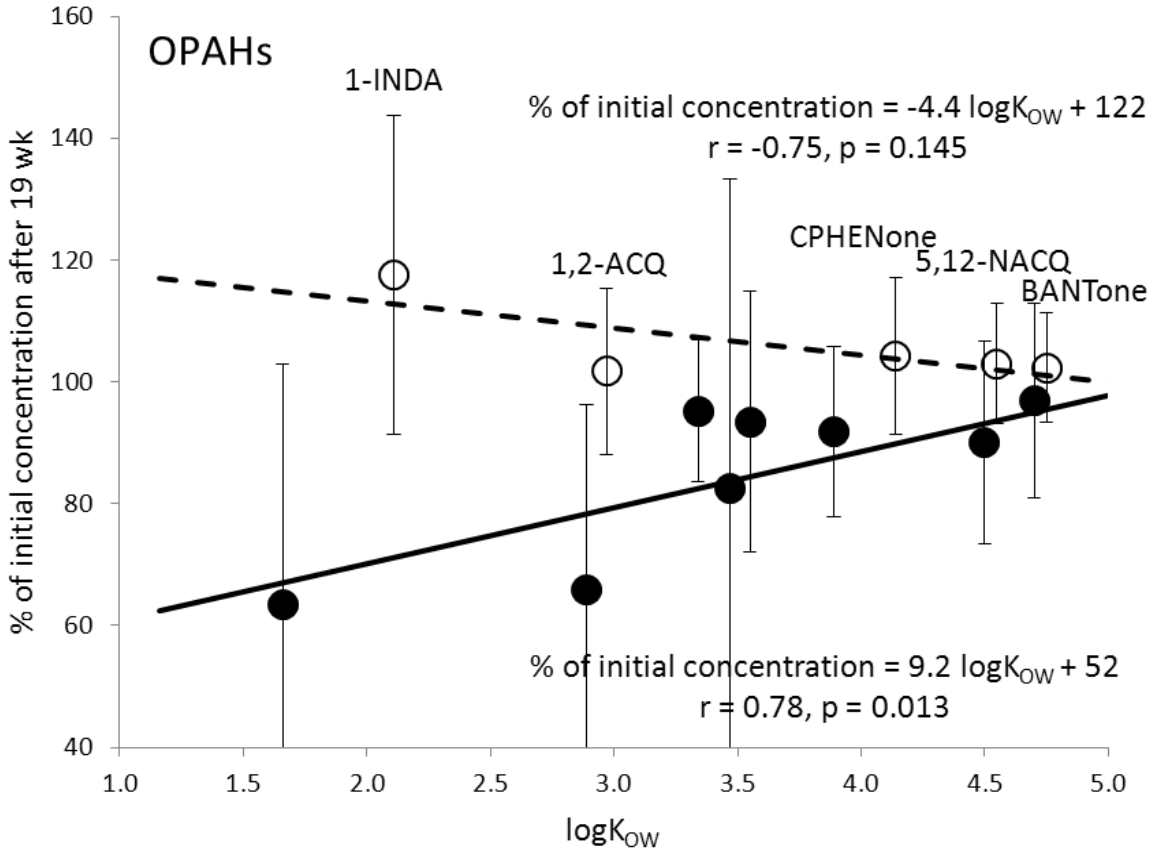


Relationship between *log* K_{OW} and mean enrichment factors *log* $e_{Oa/Oe}$ of PAHs and PCBs (n=15).

Krauss et al. (2000): *Environ. Pollut.* **110**, 79-88.

Polycyclic aromatic compounds

Transformations

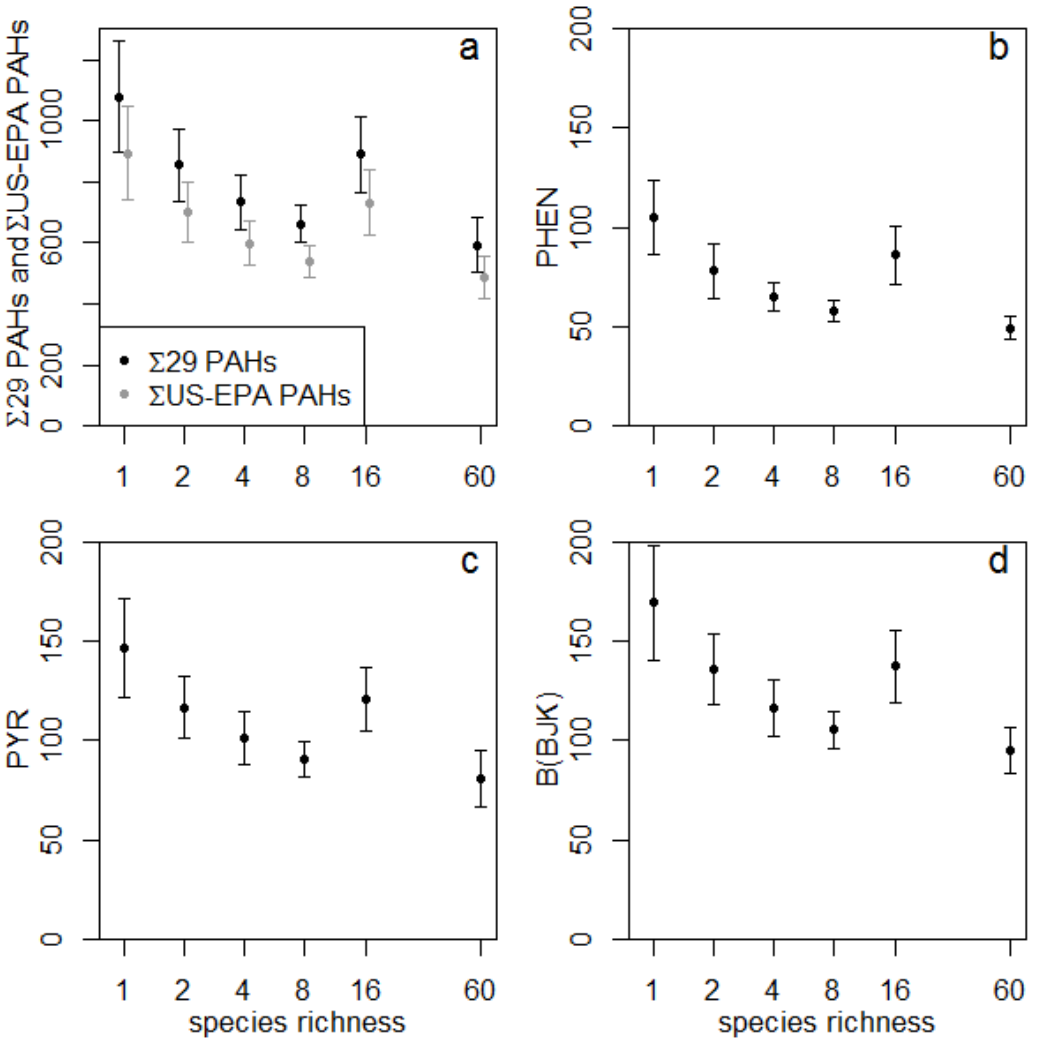


Relationship between logK$_{OW}$ and mean remaining percentages after 19 wk of incubation of the initial concentrations of 14 OPAHs. Error bars indicate standard errors of the means (error propagation considered).

Wilcke et al. (2014): *Environ. Pollut.* **184**, 385-390.

Polycyclic aromatic compounds

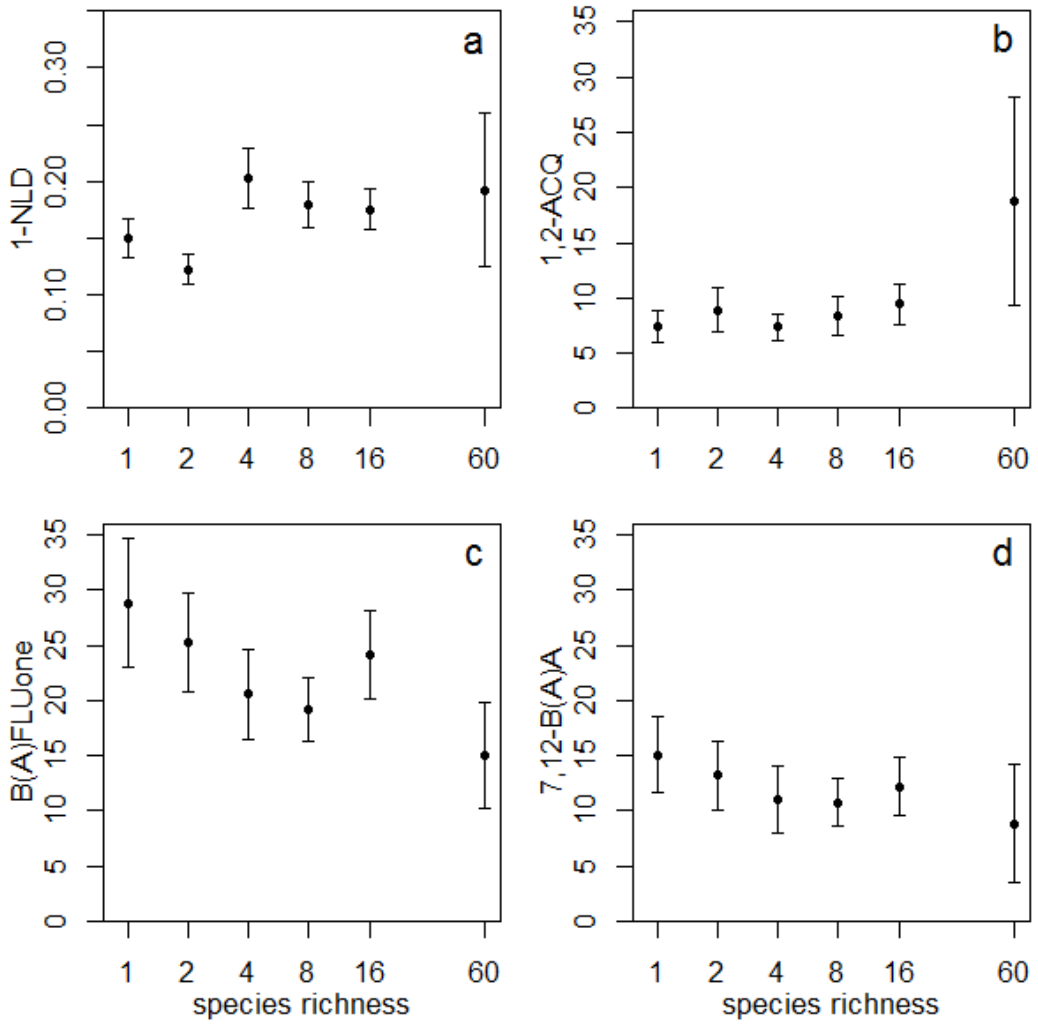
Transformations



Relationship between plant species richness and mean concentrations of a) the sum of 29 PAHs (black) and the sum of the 16 EPA-PAHs (gray), b) phenanthrene, c) pyrene and d) the benzo(bjk)fluoranthenes. Error indicators show standard deviations (n = 4-14).

Polycyclic aromatic compounds

Transformations

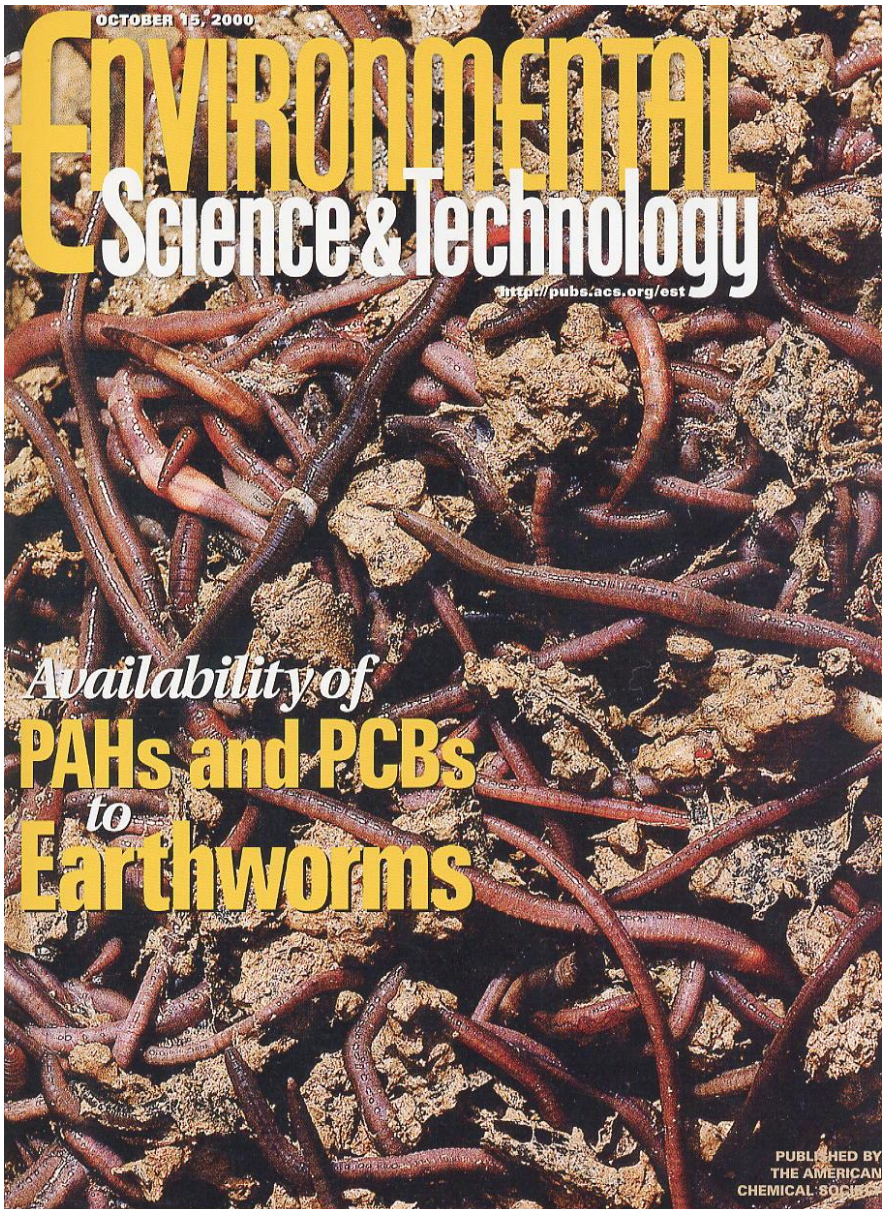


Relationship between plant species richness and concentrations of a) 1-naphthaldehyde, b) 1,2-acenaphthenequinone (1,2-ACQ), c) benzo-[a]fluorenone (B(A)FLUone), and d) benzo[a]anthracene-7,12-dione (7,12-B(A)A). Error indicators show standard deviations (n = 4-14).

Polycyclic aromatic compounds

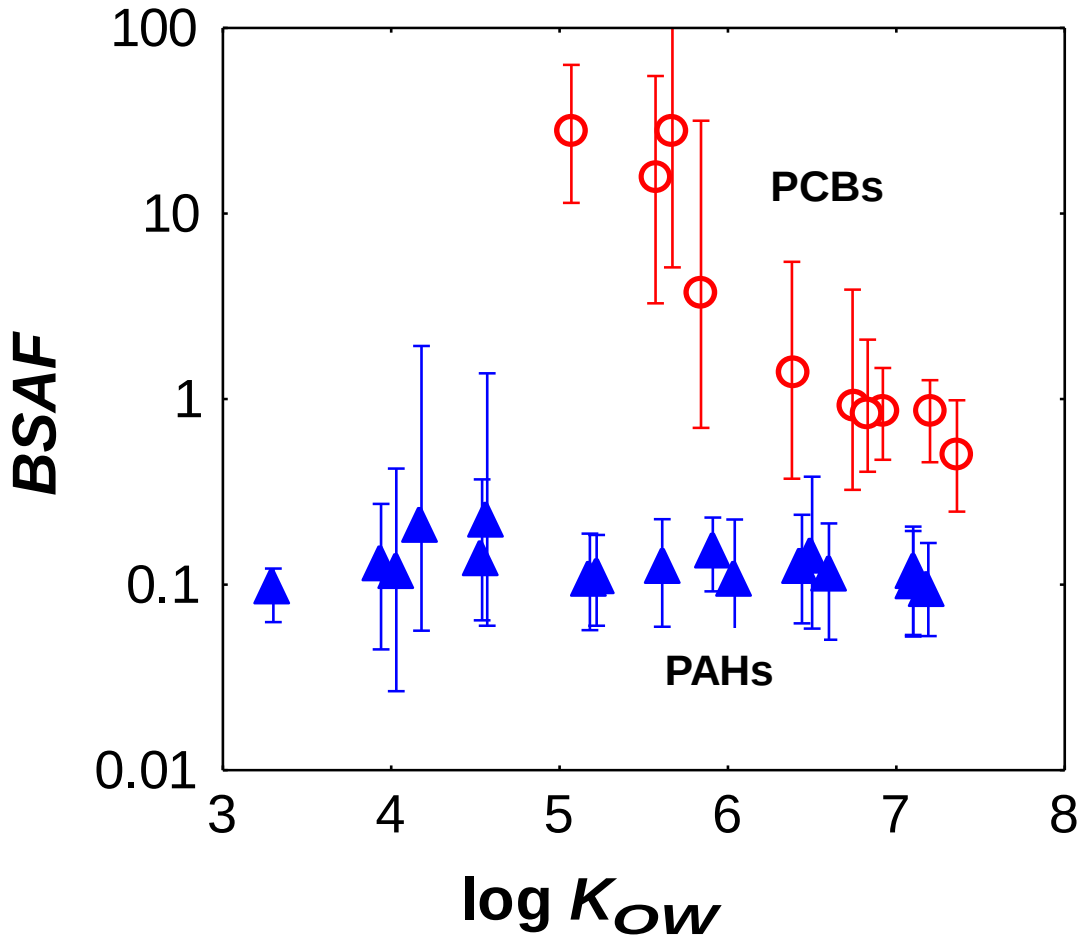
Availability

III Availability



Polycyclic aromatic compounds

Availability

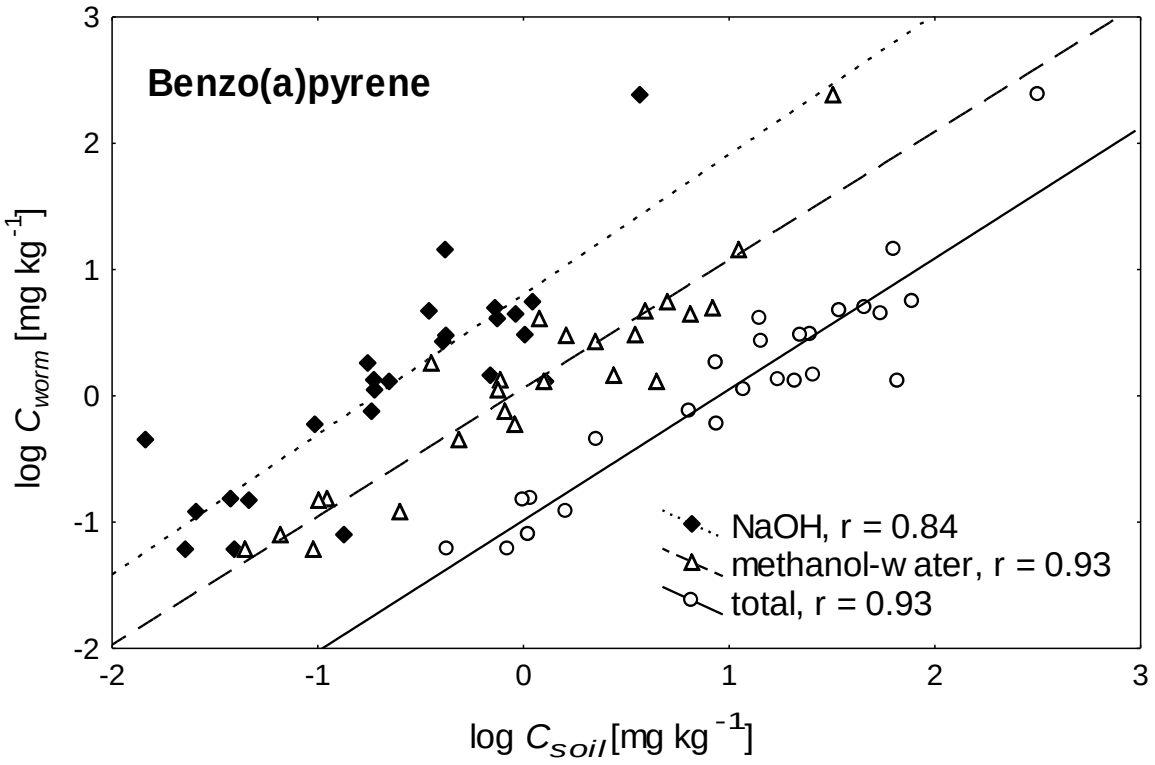


Biota-to-soil accumulation factors of PAHs and PCBs (means and ranges, 11 soils).

Krauss & Wilcke (2001): *Environ. Sci. Technol.* **35**, 3931-3935.

Polycyclic aromatic compounds

Availability

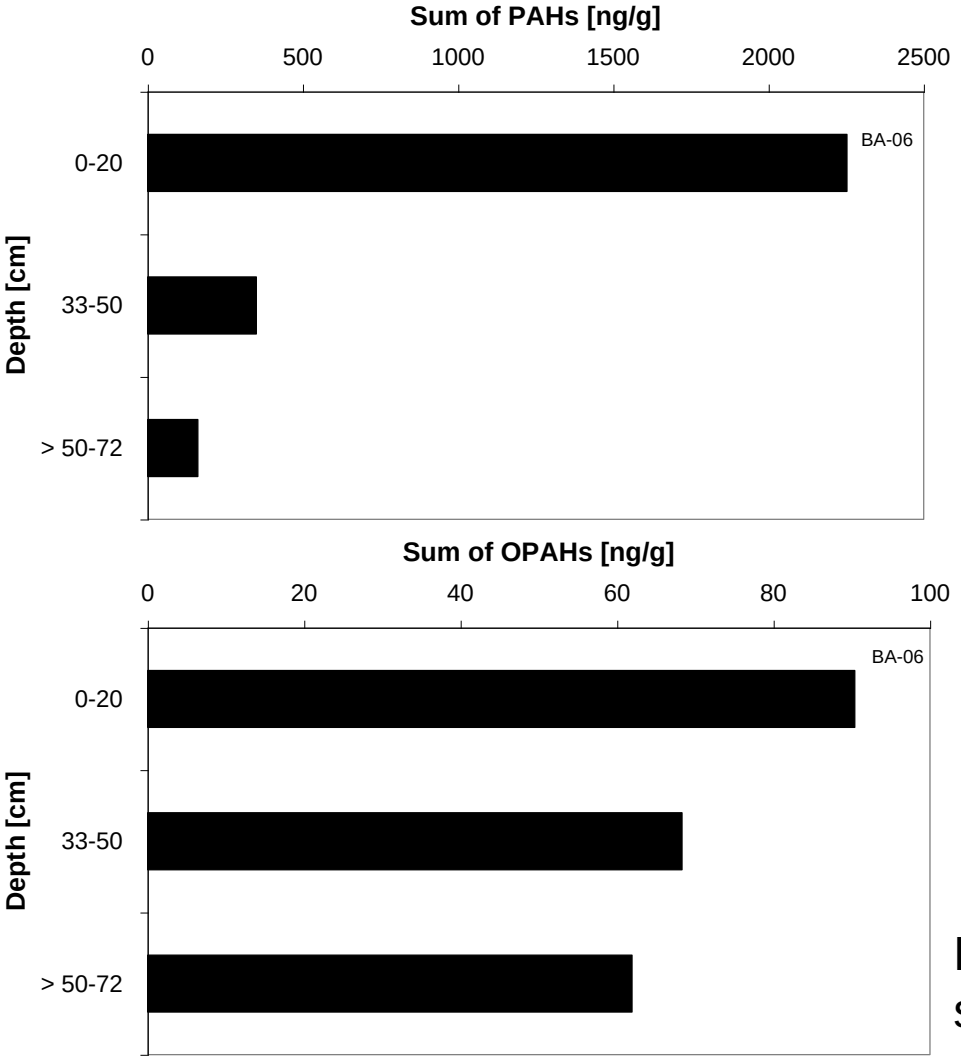


Concentrations of benzo(a)pyrene and PCB 153 in earthworm lipid as a function of concentration in different soil pools (log-transformed data, n = 25).

Krauss et al. (2000): *Environ. Sci. Technol.* **34**, 4335-4340.

Polycyclic aromatic compounds

Availability



Depth distribution of PAHs and OPAHs in soil at a selected site in Bratislava.

Bandowe et al. (2011): *Environ. Pollut.* **159**, 539-549.

Polycyclic aromatic compounds

Conclusions

- The global distribution of PAHs can be explained by global distillation and biological sources, but only occasionally by oil spills.
- PAH concentrations correlate closely with those of other PACs.
- OPAHs are transformed from PAHs in soils in a short time.
- OPAH concentrations can be higher than those of the related parent-PAHs and OPAHs are more soluble.
- The assessment of bioavailability of PACs depends on the kind of uptake.

I gratefully acknowledge the support of:

Wulf Amelung • Adelmar Bandeira • Benjamin Bandowe • Marcos Bragança • Ludolf Eusterbrock • Alexander Fokin • Marcos Garcia • María Gómez • Thorsten Hoffmann • Michael Kersten • Nualsri Kanchanakool • Martin Kaupenjohann • Mario Kiesewetter • Jozef Kobza • Martin Krauss • Volker Laabs • Sophia Leimer • Julia Lilienfein • Christopher Martius • Hannah Meusel • Silke Müller • Yvonne Oelmann • Daniel Rückamp • Marc Ruppenthal • Grigorij Savronov • Nosir Shukurov • Jaroslava Sobocka • Prakash Srinivasan • Hector del Valle • Andre Velescu • Wolfgang Zech

The German Research Foundation (DFG), the Swiss National Science Foundation (SNSF), the Bavarian Staatskanzlei and the Earth System Science Research Center of the Johannes Gutenberg University Mainz for funding.