Polycyclic aromatic hydrocarbons (PAHs) in the air

Barbora Nežiková

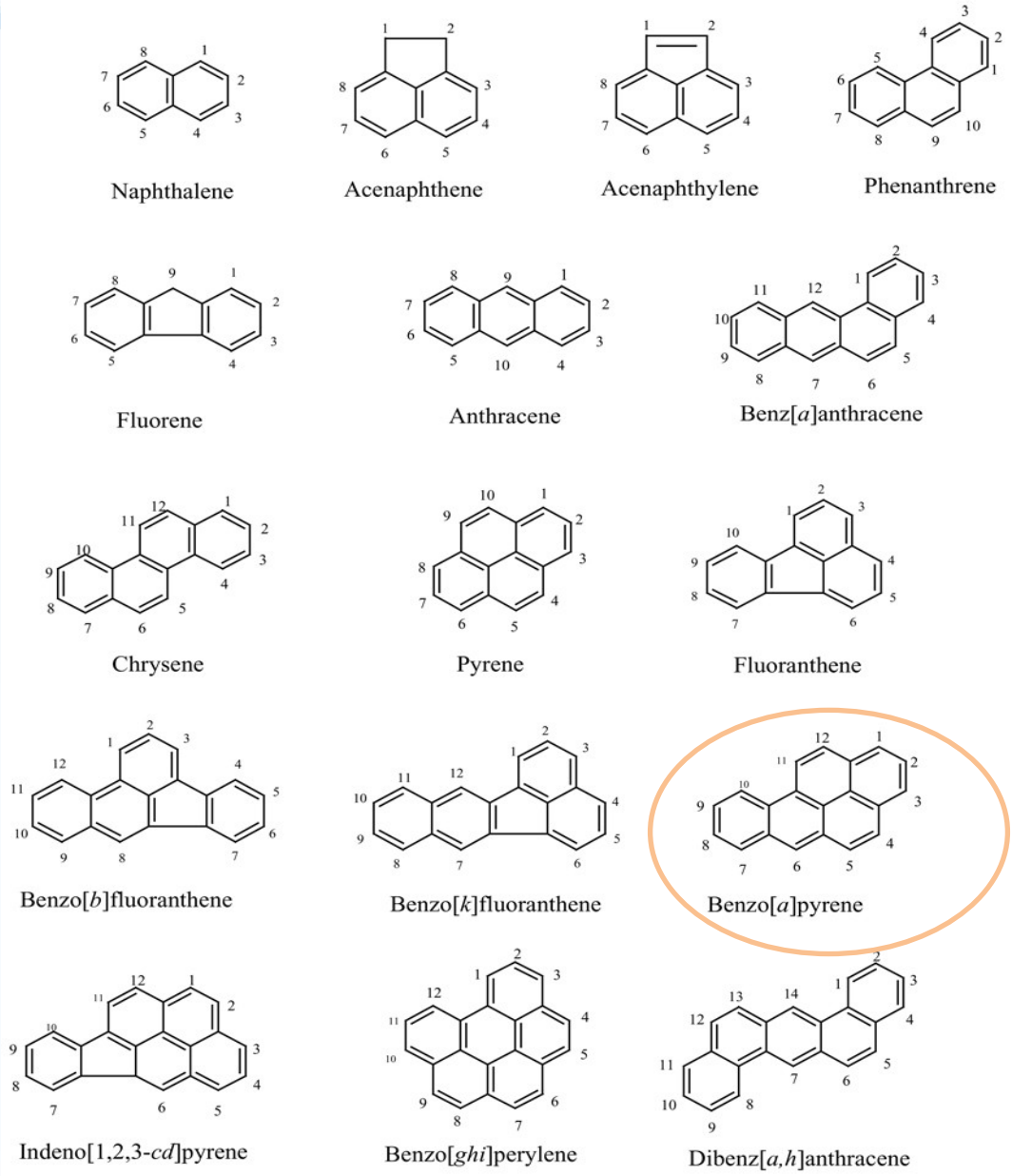
Outline

- Polycyclic aromatic hydrocarbons (PAHs)
- Air
- Conclusion

Polycyclic aromatic hydrocarbons (PAHs)

- Organic compounds with two or more fused aromatic rings
- Always in mixture, analysis only of few selected
  - 16 EPA priority

  + other depending on the study



PAHs

- Sources – Burning processes
  - Anthropogenic – generally byproduct
  - Natural – forest fires, volcanos
- Biggest jump in concentration in history
  - Industrial Revolution
  - More common use of cars
- Pseudo-persistent
  - Destruction on sun, biodegradation, reaction with other compounds

PAHs - Sources

Table 7.2 Main source sectors for PAHs in 1994 in six European countries (Austria, Denmark, Germany, Luxembourg, Norway, and the United Kingdom)

Sector	PAH emissions	
	Amount (tonnes per year)	Percentage of total
Combustion of energy and transformation industries	6.1	0.3
Non-industrial combustion plants plus wood burning	1120	60
Combustion in manufacturing industry	63	3.4
Production processes	248	13
Road transport	383	20
Other mobile sources	10	0.5
Waste incineration	30	1.6
Agriculture and forestry	1	< 0.1
Natural sources	8	0.4
Total (approximately)	**1900**	

Reproduced from Boström *et al.* (2002).

- 520 000 tones per year globally
- China, India and USA – biggest contributors

PAHs - Sources

Table 7.1 Main sources of emission for the United States Environmental Protection Agency 16 priority PAHs in China, India, and the USA

Source	Global	China	India	USA
Biofuel	56.7%	66.4%	92.5%	9.1%
Wild fire	17.0%	0%	0%	3.3%
Consumer product use	6.9%	0.9%	0.6%	35.1%
Traffic oil	4.8%	2.0%	IS	23.0%
Domestic coal	3.7%	10.7%	1.3%	IS
Coke production	3.6%	14.4%	IS	IS
Petroleum refining	2.4%	1.0%	IS	8.7%
Waste incineration	1.9%	IS	IS	9.5%
Aluminium electrolysis	1.4%	IS	IS	1.9%
Open straw burning	IS	2.0%	3.2%	IS
Gasoline distribution	IS	IS	IS	3.0%
Aerospace industry	IS	IS	IS	2.5%
Other	1.5%		2.7%	3.9%
Tonnes in thousands	530	114	90	32

IS, insignificant.
Compiled from Zhang and Tao (2009).

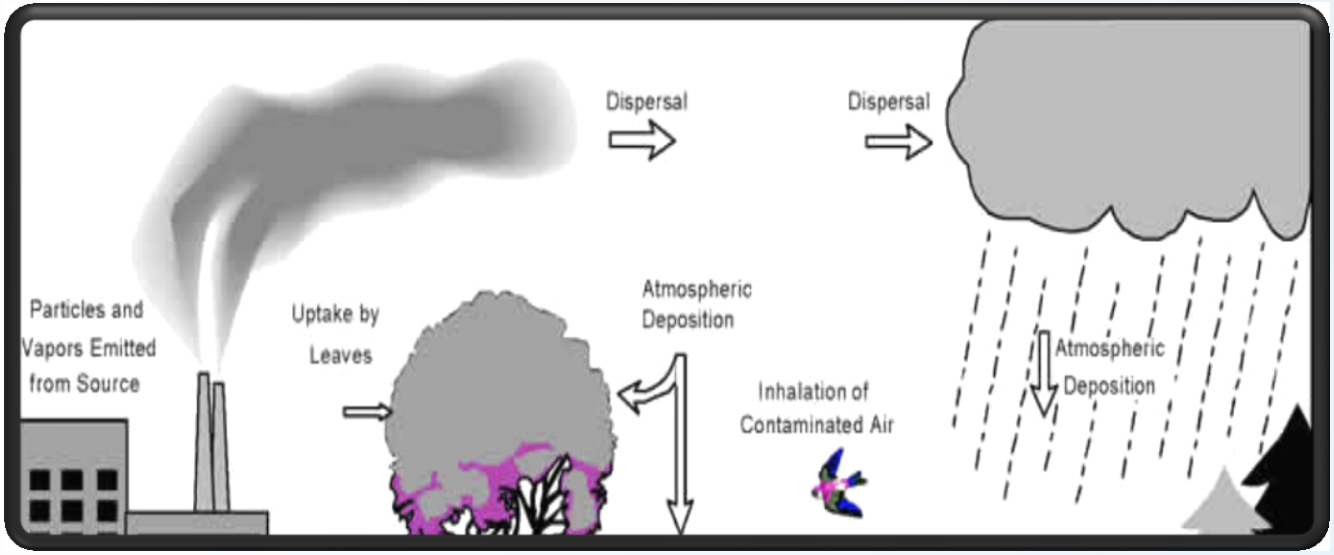
PAHs

- Toxicity – carcinogenic and mutagenic
  - Benzo[a]pyrene – 1 IARC
  - Dibenzo[a,h]anthracene – 2A IARC
  - Benz[a]anthracene – 2B IARC

Number	Meaning
1	Carcinogenic to humans
2A	Probably carcinogenic to humans
2B	Possibly carcinogenic to humans
3	Not classifiable
4	Probably not carcinogenic to humans

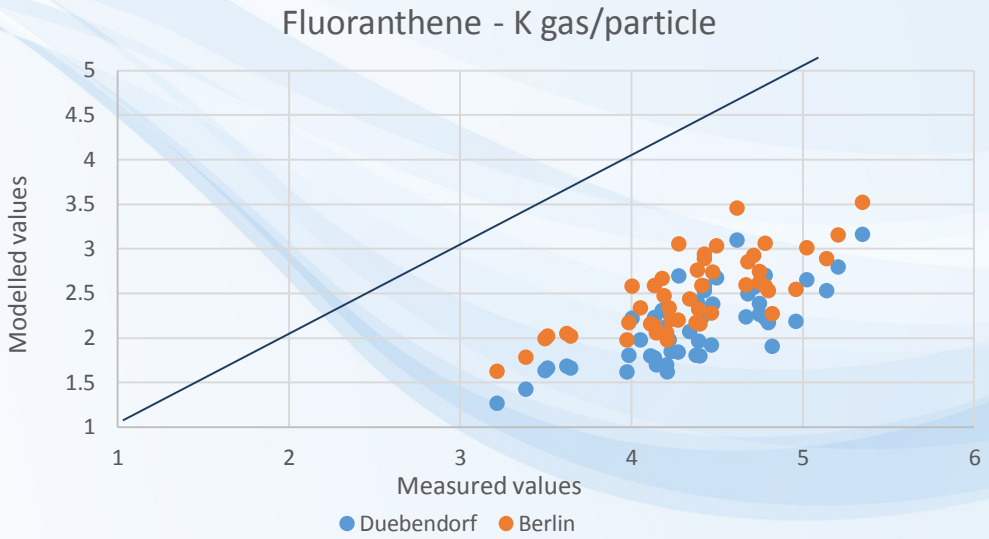
Fate in the air

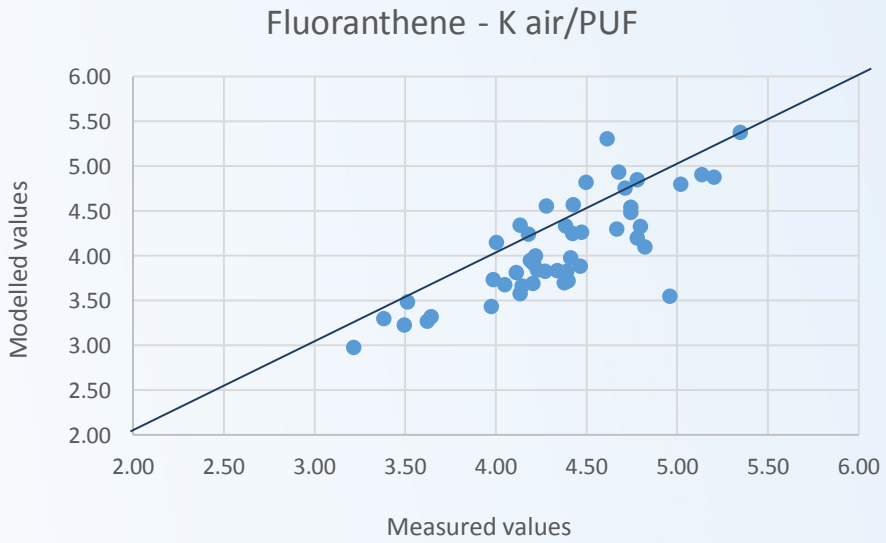
- Depending on properties of PAHs and meteorological factors
- Most important – partitioning between gaseous and particulate phase
  - Defined by partitioning constant Kp



Modelling of Kp

- Different models, different approaches
  - Single parameter
  - Poly parameter





Transformations

- Can transform
  - NO_2-PAHs, OH-PAHs, Oxy-PAHs,…
- Can be more toxic
- Less information about them
- Problems with methodology and lack of data

Air

- Dynamic and homogenous matrix
- Sampling
  - Active x passive
  - Gaseous x particulate phase
  - Indoor x outdoor
- Many different studies, lots of data
  - Can we compare them?

Concentration

- Strongly depending on locality and part of year
- Differences in gaseous and particulate phase
- Indoor
  - Depending on smoking and cooking
  - About dozens ng/m^3
- Outdoor
  - Background locality – about units ng/m^3
  - Urban areas – even hundreds ng/m^3

Legislation

- Not part of Stockholm convention
- Included in Convention on Long-range Transboundary Air Pollution
- Emission limit for B[a]P – 1 ng/m^3

Methodology

- Very traditional pollutants in traditional matrix
- Good analytical and sampling methods
  - Careful about sampling artefacts!
  - Problem with dibenz[a,h]anthracene and benzo[k]fluoranthen

No need for improvement

Connection to human

- Biggest exposure of PAHs for humans is from food
- Important source from air - smoking
- Increased risk of cancer
  - Mostly associated with $PM_{2.5}$

What now?

- Educate public about health hazards associated with PAHs
- Do one uniform method so we can compare and share data
- Fill the gaps about toxicology and methodology of derivatives of PAHs

What then?

- Impossible to ban (natural sources) → try to lower anthropogenic sources
  - Improve our technologies and vehicles
- Continue to monitor PAHs in the air
  - But be careful about data and how they were „created“!
  - Widen monitoring data to humans

- Thank you for your attention!
- Any questions?