Spatial and temporal variations of the size distribution of the atmospheric particulate persistent organic pollutants (POPs) and Persistent Bioaccumulative Substances (PBTs) in the Czech Republic

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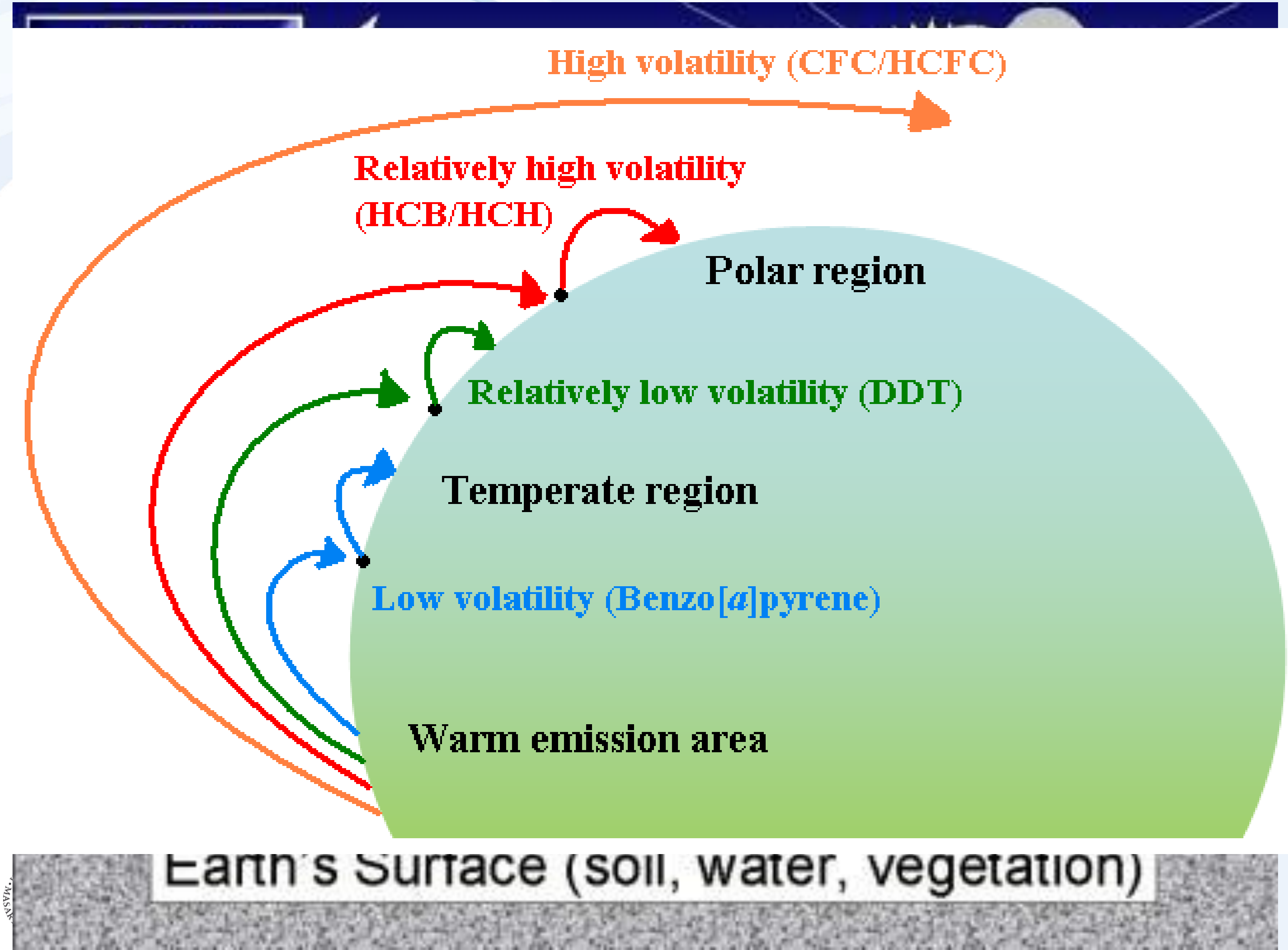
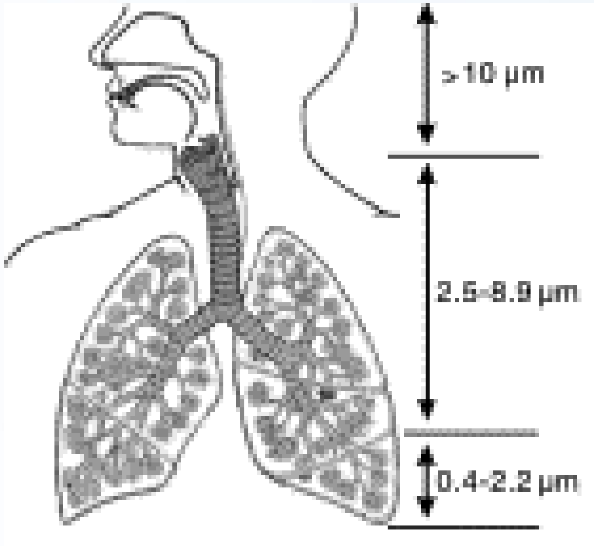
Introduction



Introduction
Size of particles

Size of particles will determine:

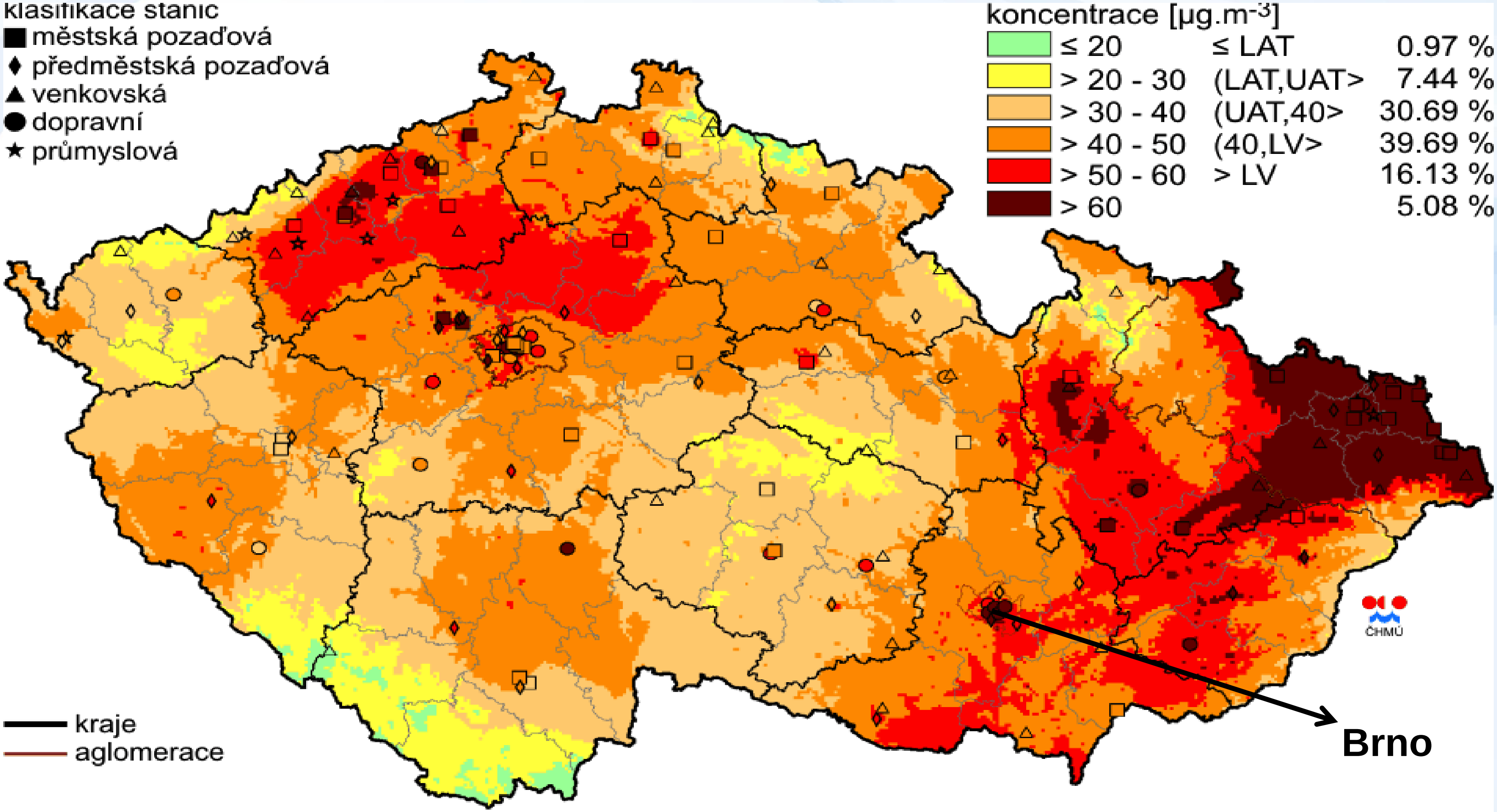
- ➢Residence time in the atmosphere
- ➢ Potential for LRAT
- ➢ Deposition efficiency
- ➢ Human health exposure from inhalation



Methodology

Sampling sites

Data from the Czech Hydrometeorological Institute, 2010 www.chmi.cz



Pole 36. nejvyšší 24hod. koncentrace PM_{10} v roce 2010

Methodology

Sampling sites

Telnice (15km from Brno)
Rural site

Kotlařska (Brno city centre)
Kerbside/Urban site

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Methodology

Air sampling

High volume air sampler equipped with a cascade impactor

Fractions collected on QFFs:

< 0.49 µm

0.49-0.95 µm

0.95-1.5 µm

1.5-3.0 µm

3.0-7.2 µm

7.2-10.0 µm

1 year sampling (Oct 2009-Oct 2010)
Seasonal data corresponding of 3 weeks of sampling

Methodology

Extraction

Methodology

Clean-up

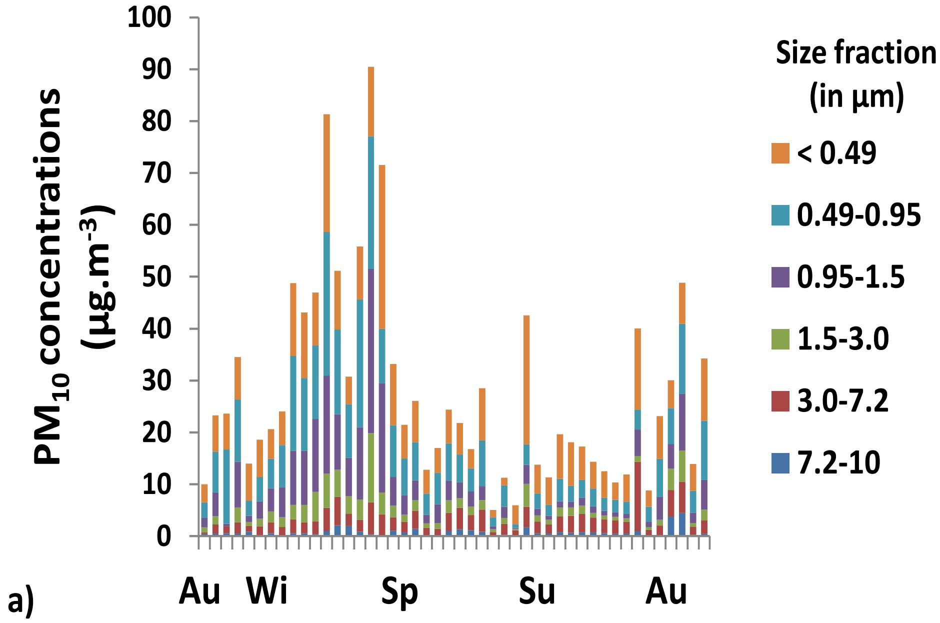
Methodology

GC-MS/LC-MS

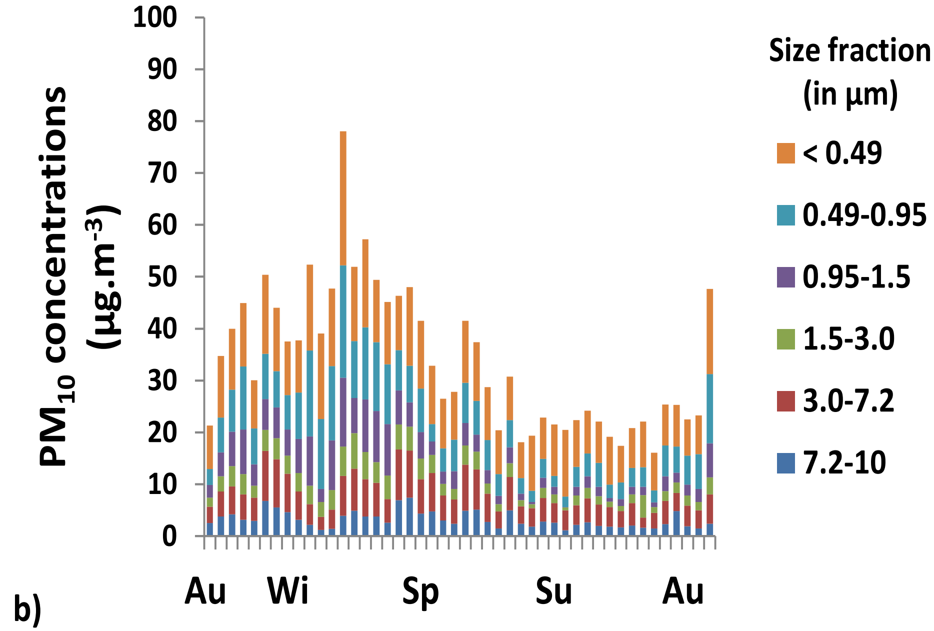
- PAHs: GC-MS Agilent 6890/Agilent 5972
- PCDD/Fs, dl-PCBs, PBDEs and nBFRs: GC-HRMS Agilent 7890/Micromass AutoSpec Premier (sector MS)
- CUPs and HBCDs: LC-MS Agilent 1290-ABSCIEX5500

RESULTS

PM concentrations



Rural site



Urban site

- Higher PM$_{10}$ concentrations at the urban site
- At both sites, higher concentrations were observed in winter (about 50 µg.m^{-3}) than in summer (20 µg.m^{-3}).
- **54-59%** of particles have a diameter < 0.95 µm

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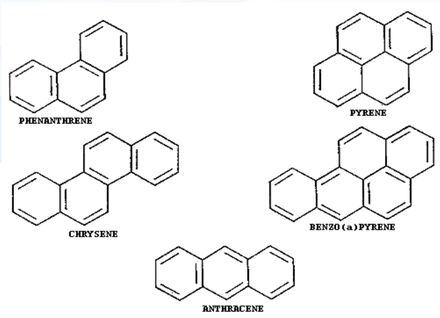
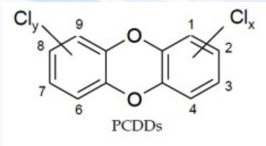
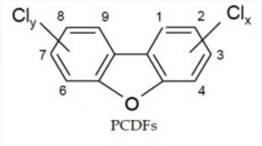
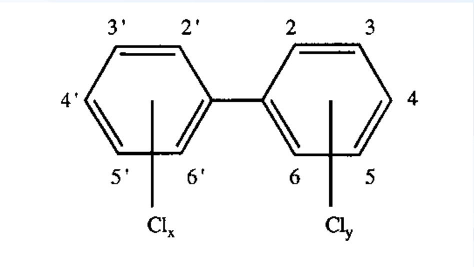
Combustion-related compounds

PAHs | PCDD/Fs | dl-PCBs







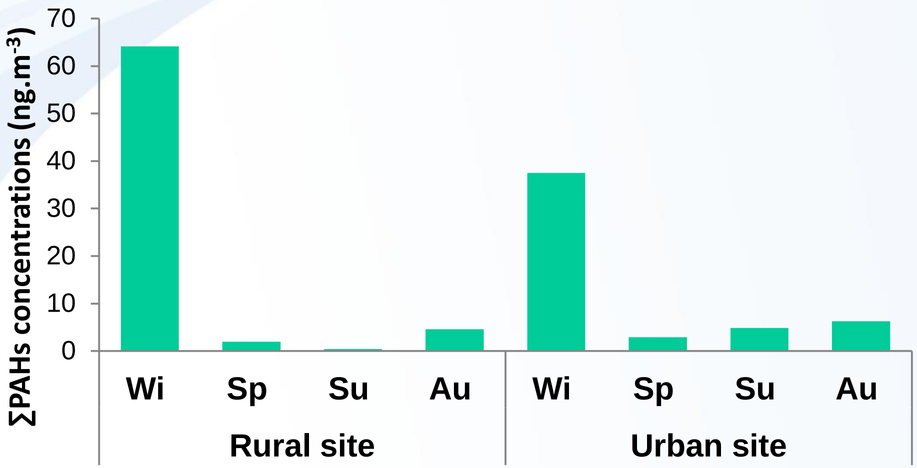


- **<u>Sources</u>**:
  - Natural sources (forest fires, volcanic eruptions, products of biosynthesis of phytoplankton and bacteria)
  - Anthropogenic sources (fossil fuel combustion, residential heating, waste incineration, traffic, oil refining, steel and iron manufacturing, coke and asphalt production and metal reclamation processes)

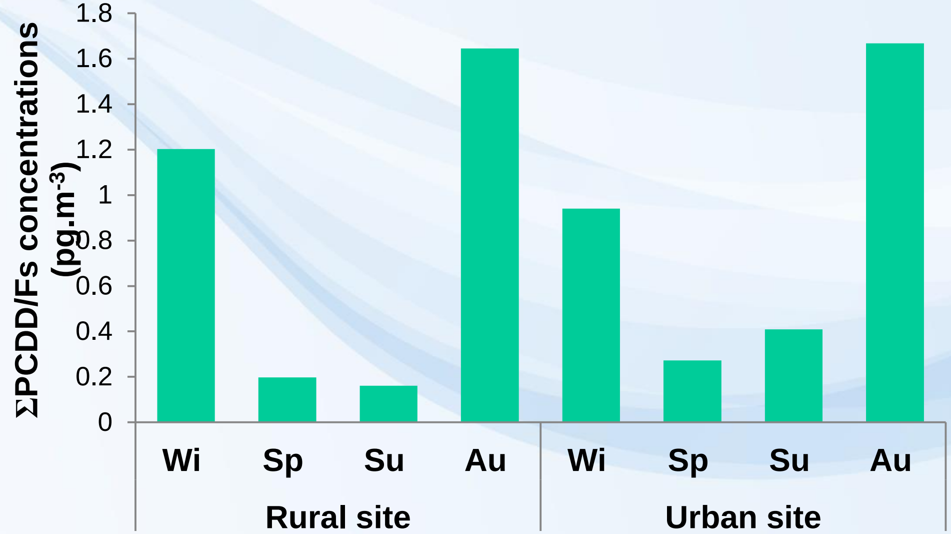
- **<u>Long-half-life in the air, soil, sediment or biota</u>**
- **<u>Health effects:</u>**
  - Carcinogenic and/or mutagenic properties for PAHs and high toxicity for PCDD/Fs and dl-PCBs

PAHs, PCDD/Fs and dl-PCBs
Total particulate concentrations

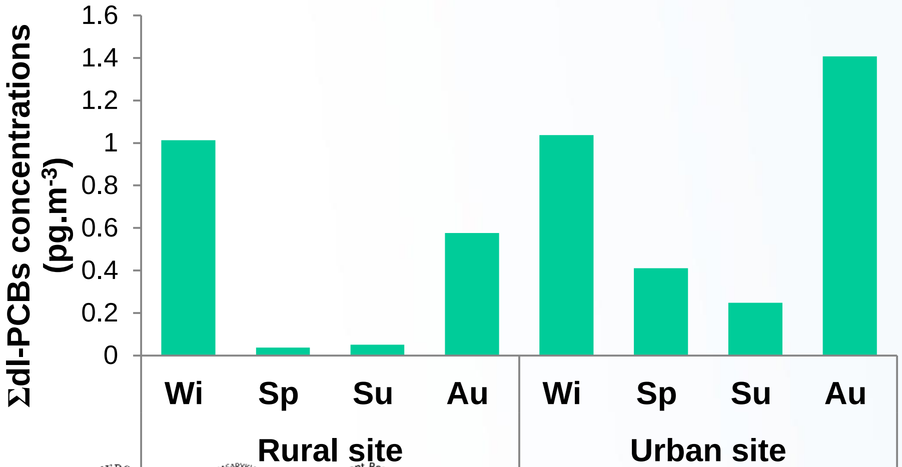
PAHs



PCDD/Fs



dl-PCBs



- Higher concentrations in cold seasons for all of the compounds at both sites
- Higher concentrations at the rural site for PAHs and PCDD/Fs in winter, which might reflect the spatial difference in domestic heating

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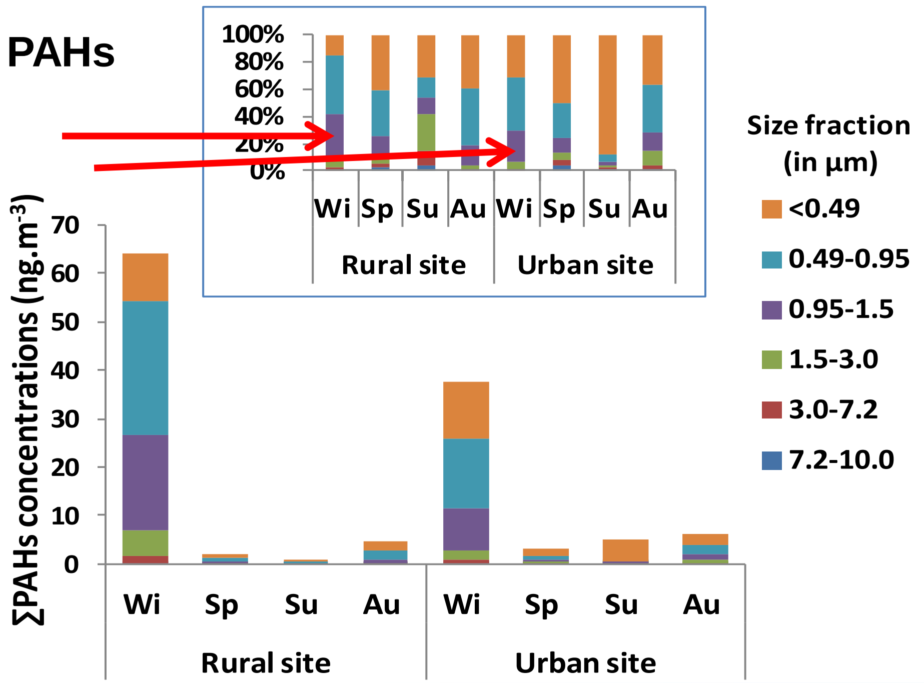
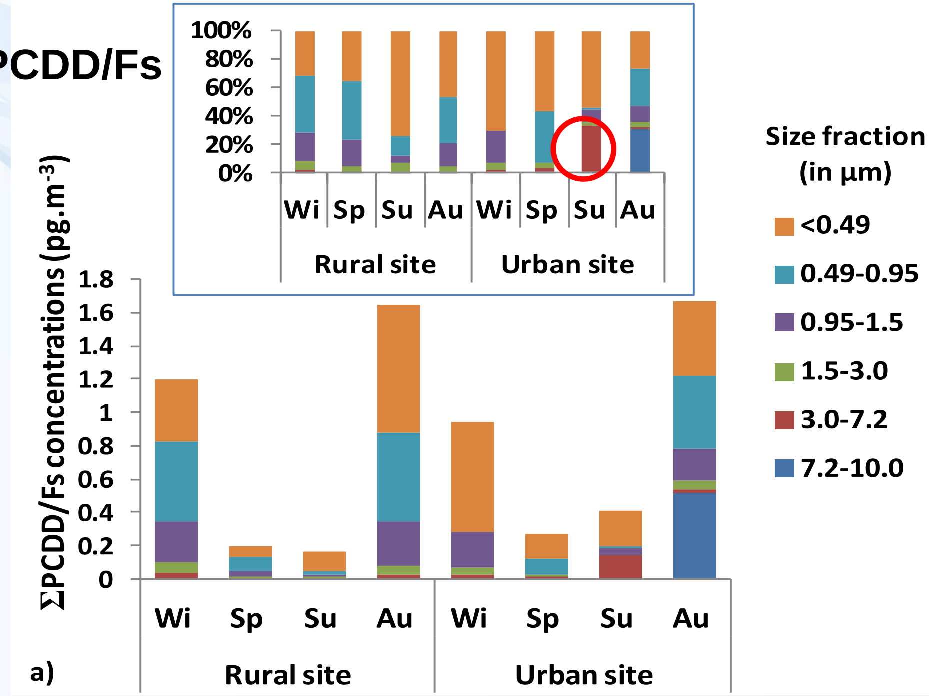
PAHs, PCDD/Fs and dl-PCBs Size distribution

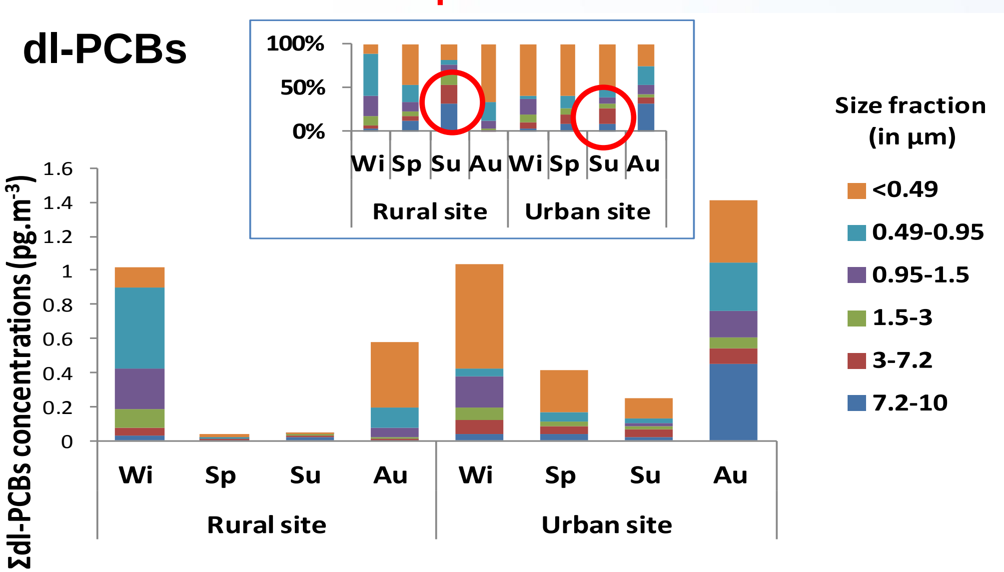
71% of PAHs < 0.95 µm

73% of PCDD/Fs < 0.95 µm





60% of dl-PCBs < 0.95 µm



- Strong accumulation in the fine fraction for all compounds regardless the site or the season
- Higher contribution of the 0.95-1.5 µm fraction for PAHs in winter
- Increase of coarse particles in summer for PCDD/Fs and dl-PCBs

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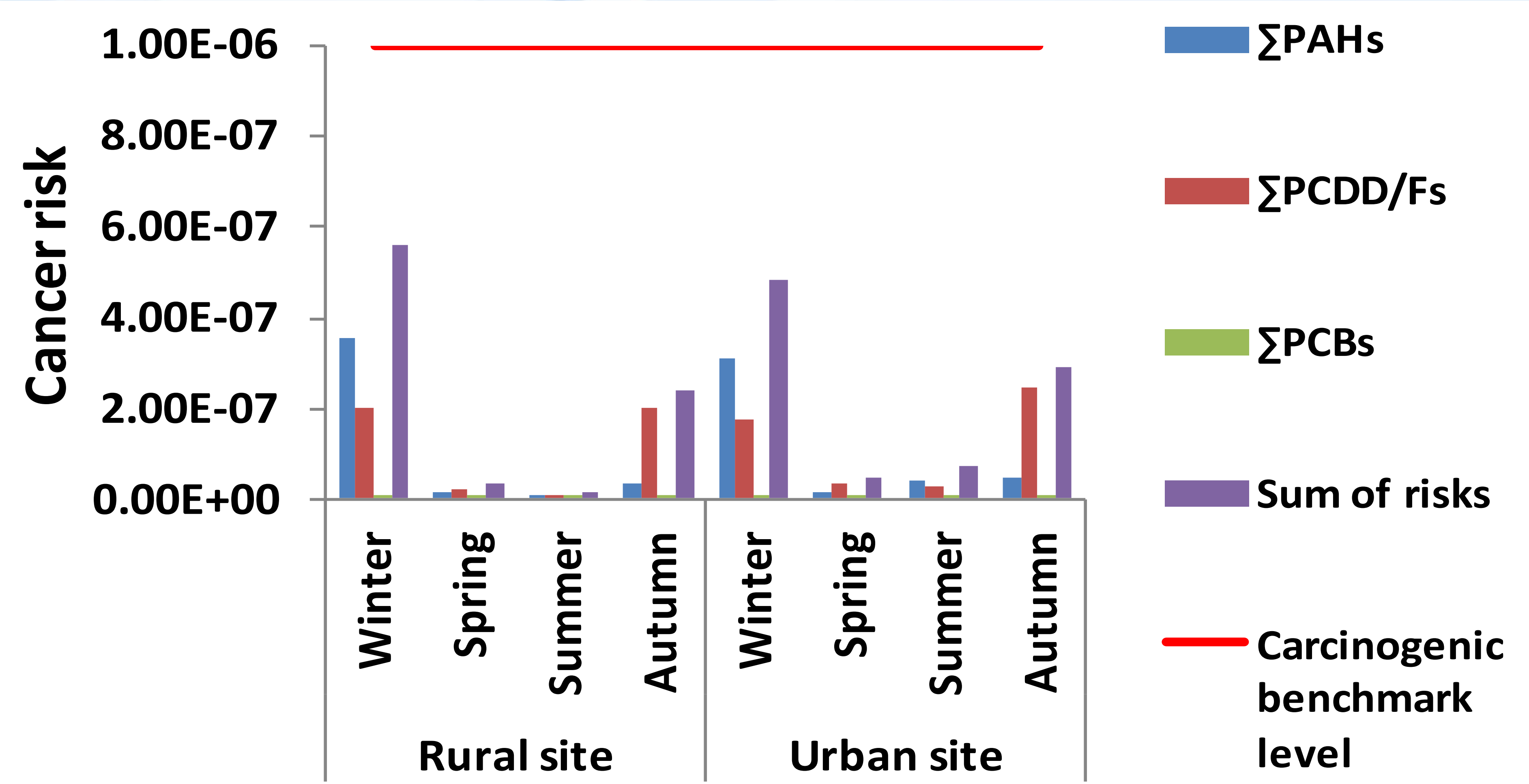
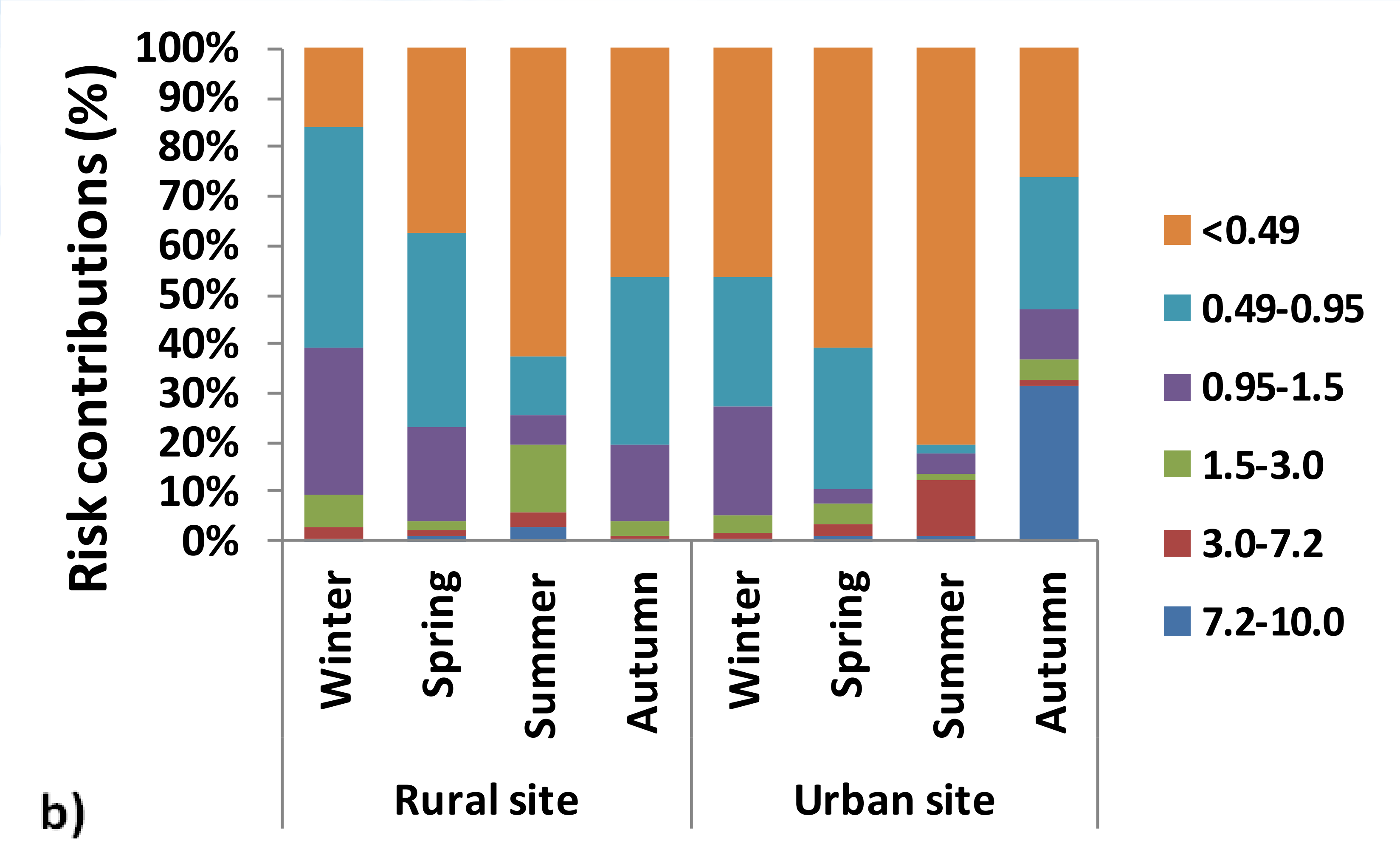
Cancer risks from inhalation exposure



- Cancer risks were lower than the carcinogenic benchmark level
- Higher risks in winter

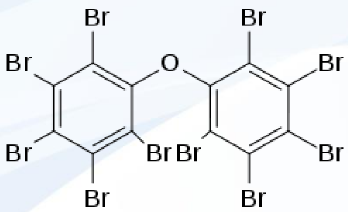
Cancer risks from inhalation exposure



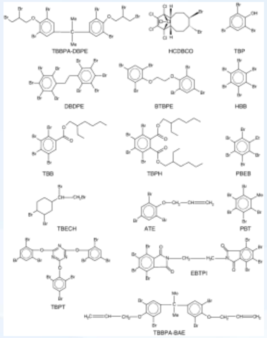
- Most of the risks are due to fine particles
- However, the cancer risks can be overestimated by up to a factor of 2 in situations where there is a large amount of coarse particles.

Flame retardants
PBDEs, nBFRs and HBCDs

PBDEs

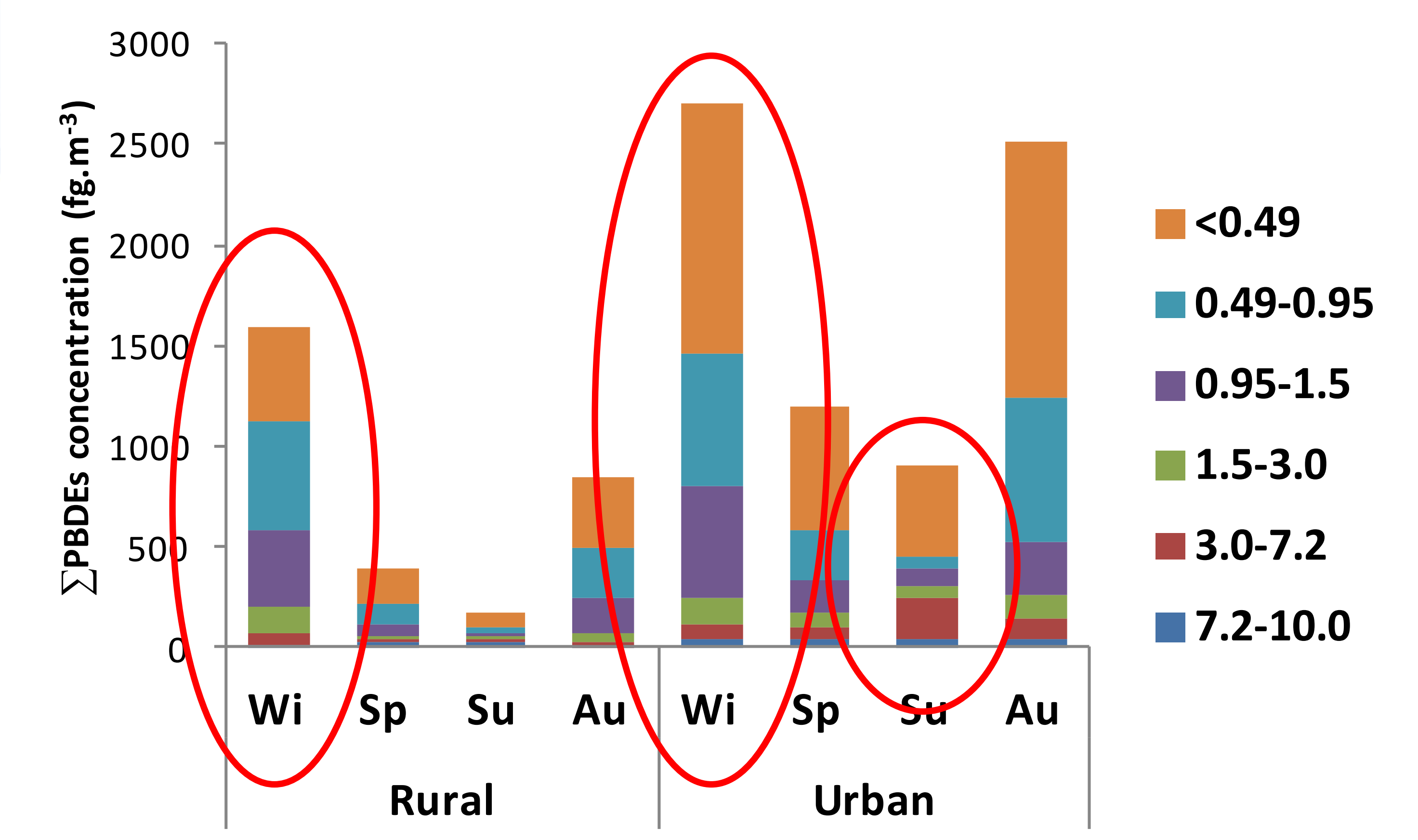


nBFRs



- Flame retardants additives used in electronics (computers, mobile phones, kitchen appliances), textiles, building materials, plastics, paints.
- Due to the restriction of some of PBDEs, nBFRs use has increased consistently for the last decade.
- Sources in the air: Release during production, volatilization during the use of products and inappropriate disposal.
- Bio-accumulative, persistent and toxic

PBDEs (without BDE-209)

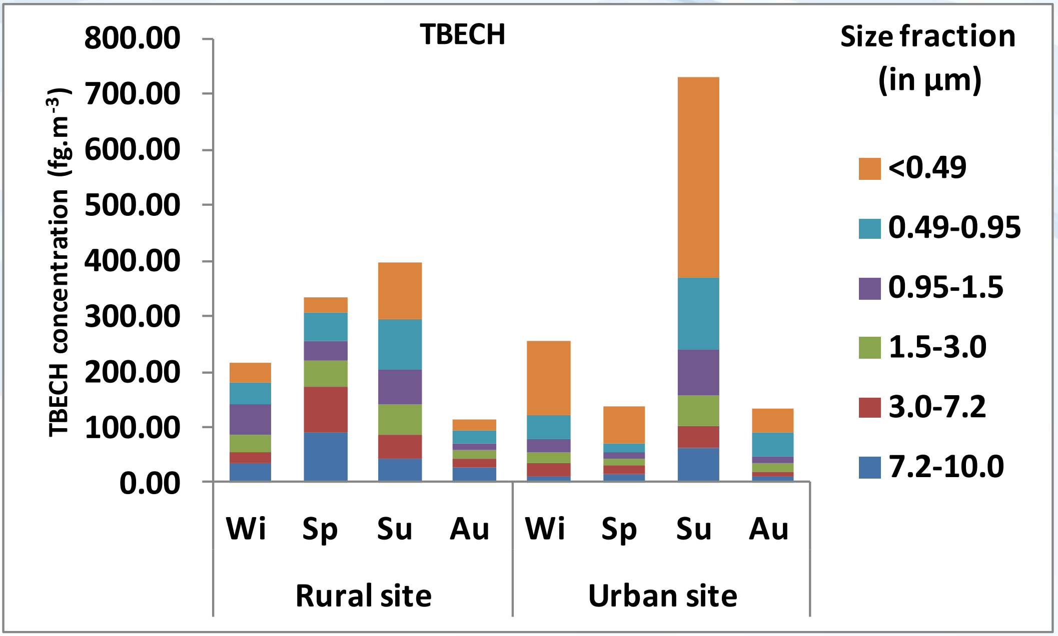


- Higher concentration at the urban site
- 4x higher winter concentrations compared to summer concentrations
- 55% of PBDEs were associated to fine particles
- Increase of coarse fraction in summer due to volatilization and condensation onto coarse particles

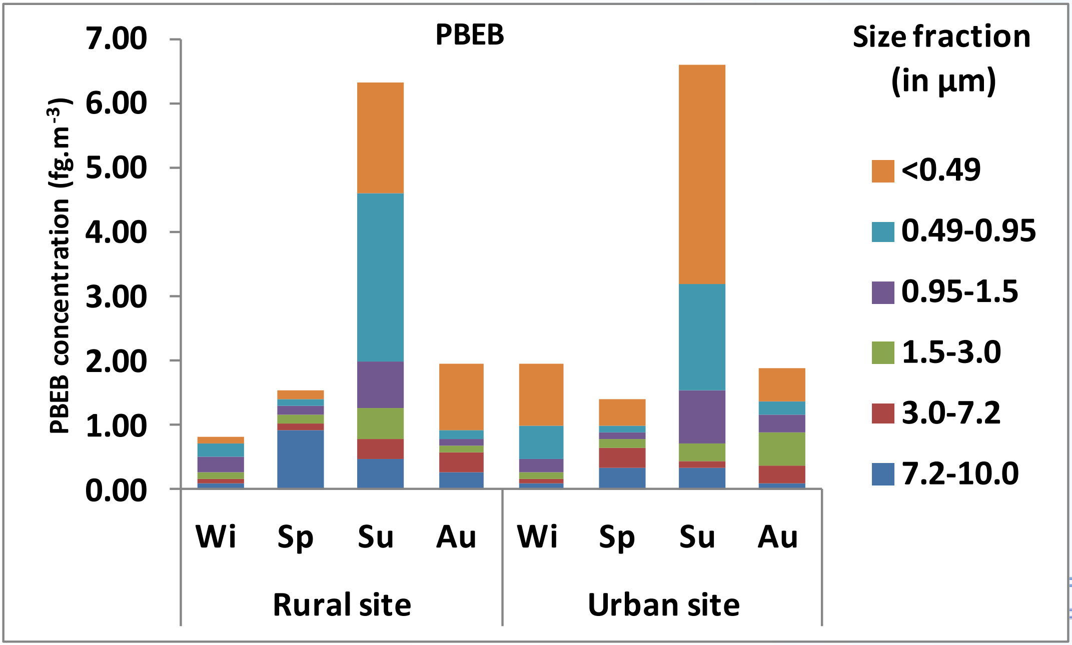
nBFRs

- 10 target compounds
- 3 were not detected at all (TBCO, p-TBX and HCDBCO)
- In general, higher summer concentrations due to indoor emissions
- Higher concentrations at the urban site
- In some cases, higher n-BFRs concentrations than PBDEs reflecting the growing use of alternative flame retardants

n-BFRs size distribution

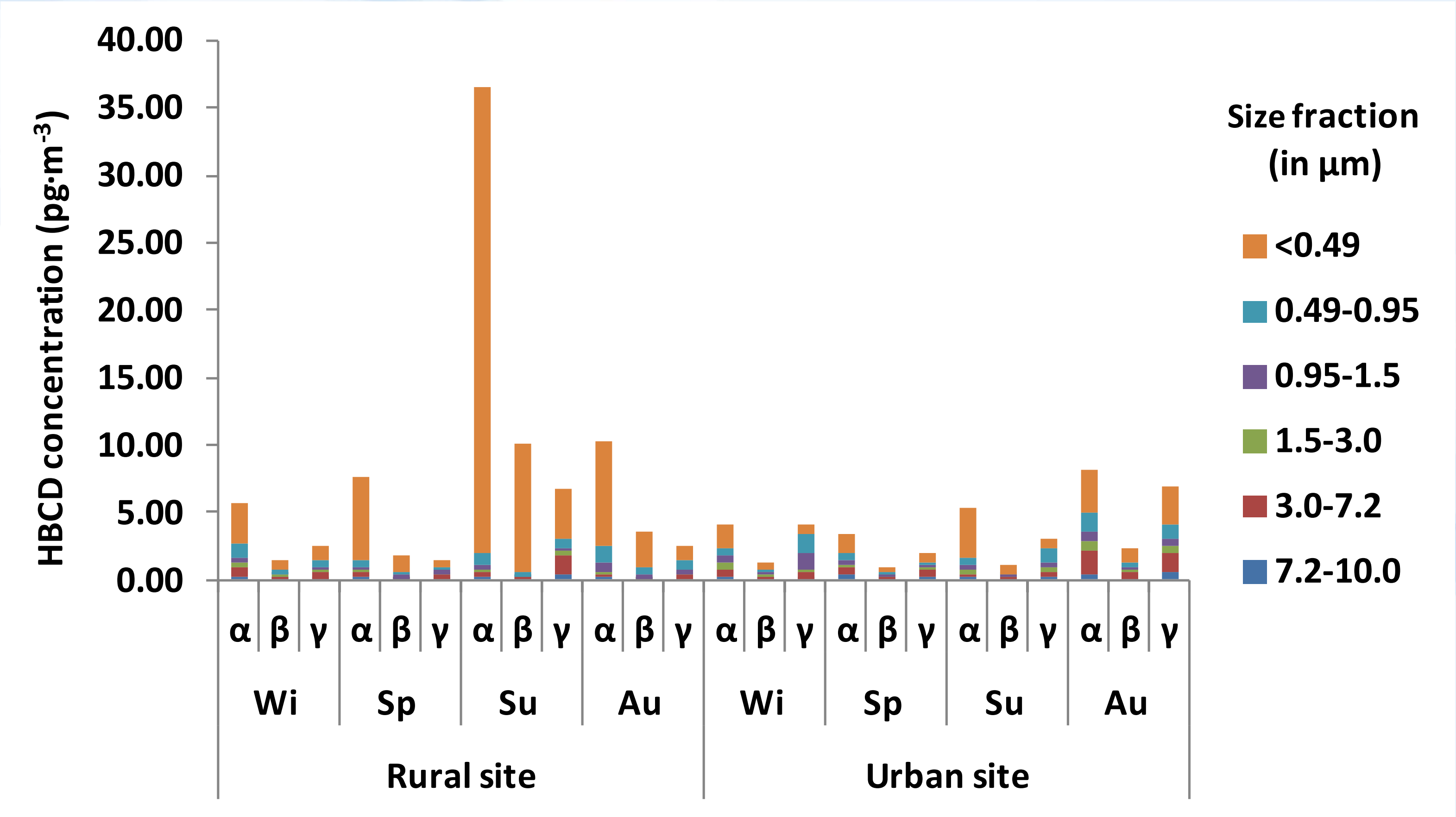


4/7 n-BFRs (TBECH, PBT, HBB and BTBPE) showed strong affinity toward fine particles



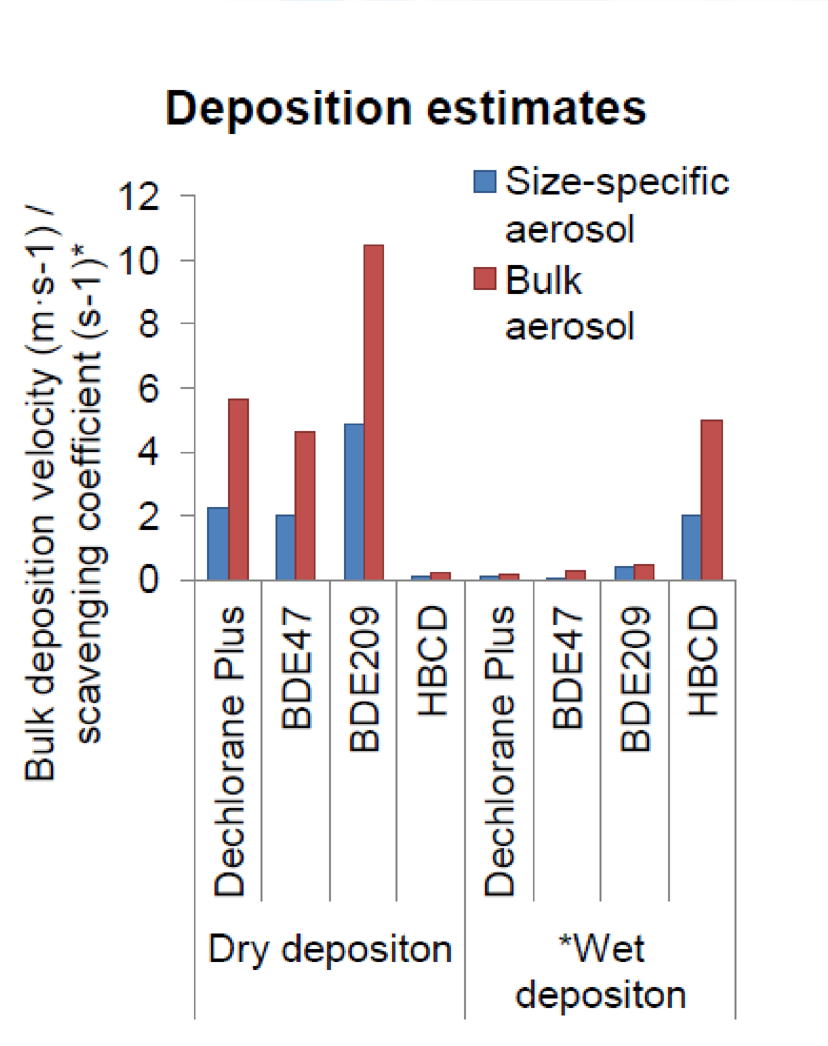
3/7 n-BFRs (s-DP, a-DP and PBEB) showed similar concentrations across size fractions

HBCDs

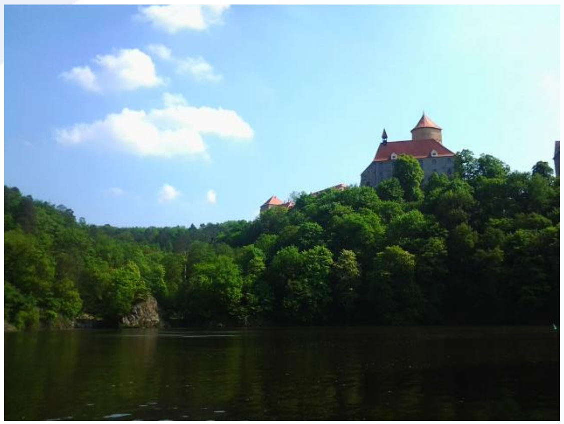


- Higher concentrations in summer
- Higher concentrations at the rural site (-> influence of the construction of new houses?)
- Strong accumulation in the fine fraction (57-74%)

Estimation of the wet and dry deposition



Thanks for your attention
Any questions?



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