ICARUS

Integrated Climate forcing and Air pollution Reduction in Urban Systems

PAHs in fine particulate matter of six European cities: seasonal and spatial variations and implications for human health

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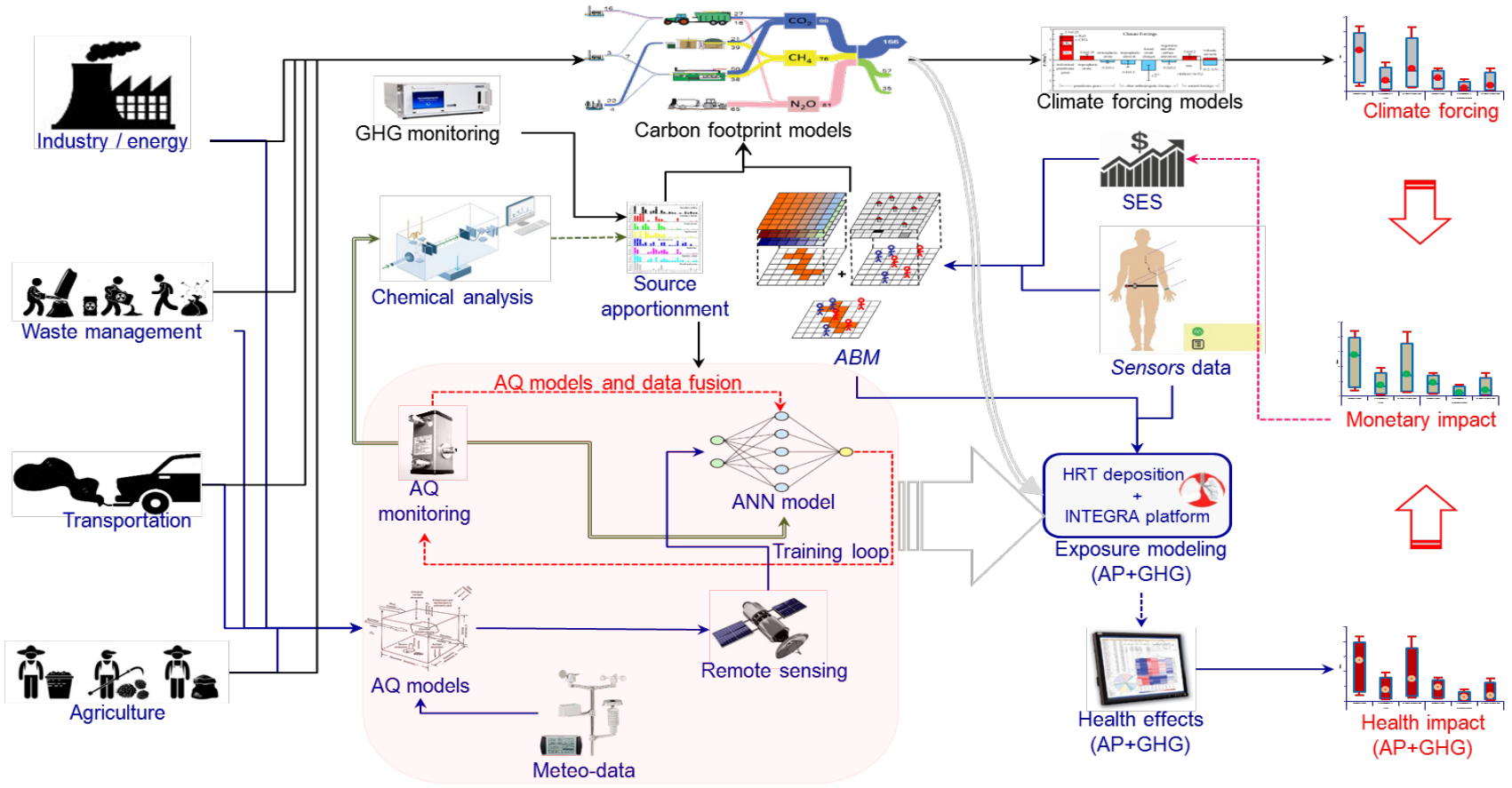
Provide an integrated assessment of policy measures in order to decrease greenhouse gases emissions and improve air quality in selected European cities



Introduction – ICARUS sampling campaign

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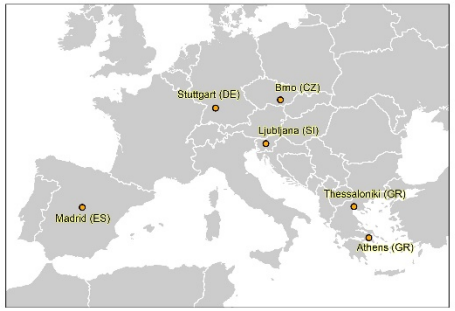

- 6 participating cities: Athens, Brno, Ljubljana, Madrid, Stuttgart and Thessaloniki
- For each city, one traffic site, one urban background site and one regional site
- Daily air samples were taken 30 days in winter and 30 days in summer at each of the site with high/low volume air sampler with PM2.5 inlet

Aim of this study

- Provide novel atmospheric data on PAHs at each a traffic (T), an urban background (UB) and a rural (R) site collected in winter and summer 2017 at/near Athens (GR), Brno (CZ), Ljubljana (SLO), Madrid (ES), Stuttgart (DE) and Thessaloniki (GR)
- The seasonal and spatial variations of PAHs as well as their cancer risks from inhalation were investigated

		Winter	Summer
Athens	R	14	0
	T	39	36
	UB	37	36
Brno	R	8	8
	T	30	30
	UB	30	30
Ljubljana	R	0	0
	T	30	27
	UB	30	29
Stuttgart	R	8	27
	T	24	31
	UB	25	27
Thessaloniki	R	22	28
	T	31	27
	UB	33	25
Total		**361**	**361**
			722

- Extraction with (automatic) Soxhlet extractor

- Clean-up

- Analysis by GC-MS

- Target compounds

16 PAHs
naphthalene
acenaphthylene
acenaphthene
fluorene
phenanthrene
anthracene
fluoranthrene
pyrene
benz(a)anthracene
chrysene
benzo(b)fluoranthene
benzo(k)fluoranthene
benzo(a)pyrene
indeno(1,2,3-c,d)pyrene
dibenzo(a,h)anthracene
benzo(ghi)perylene

Interlaboratory comparison

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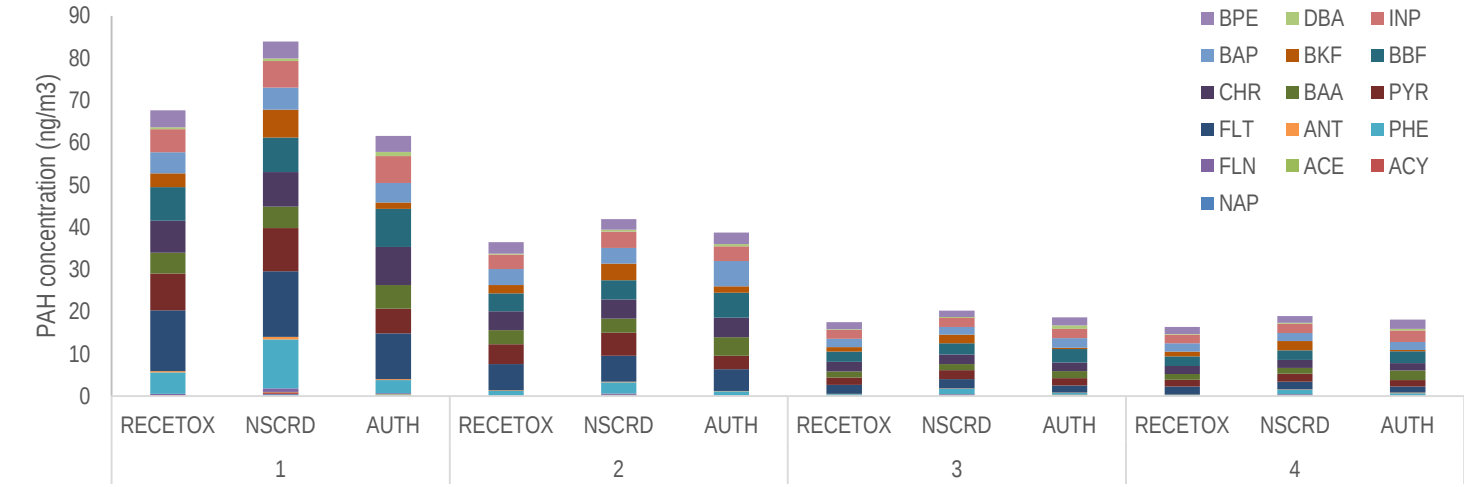
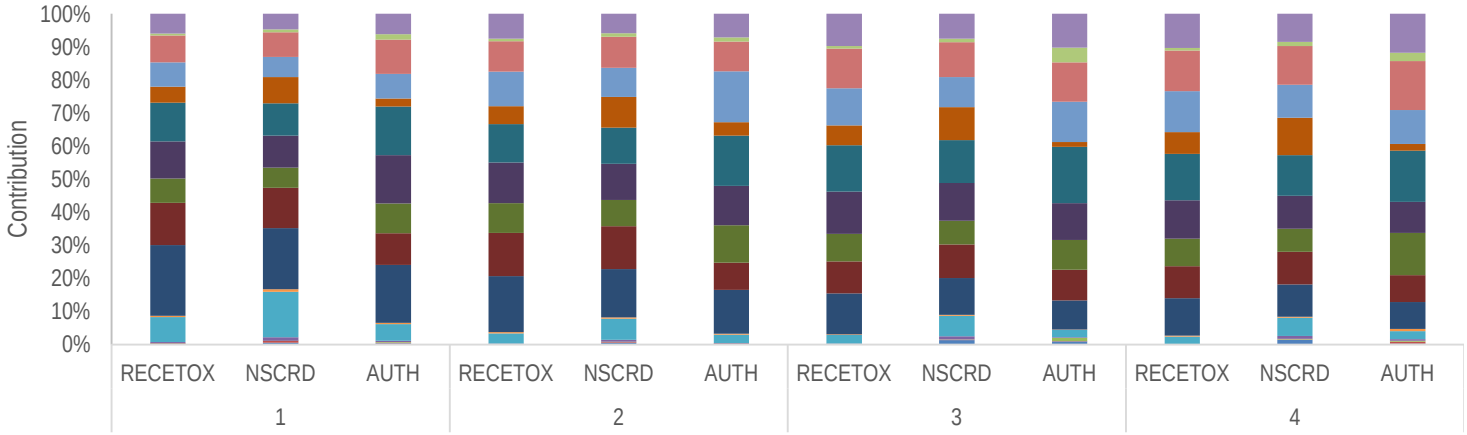
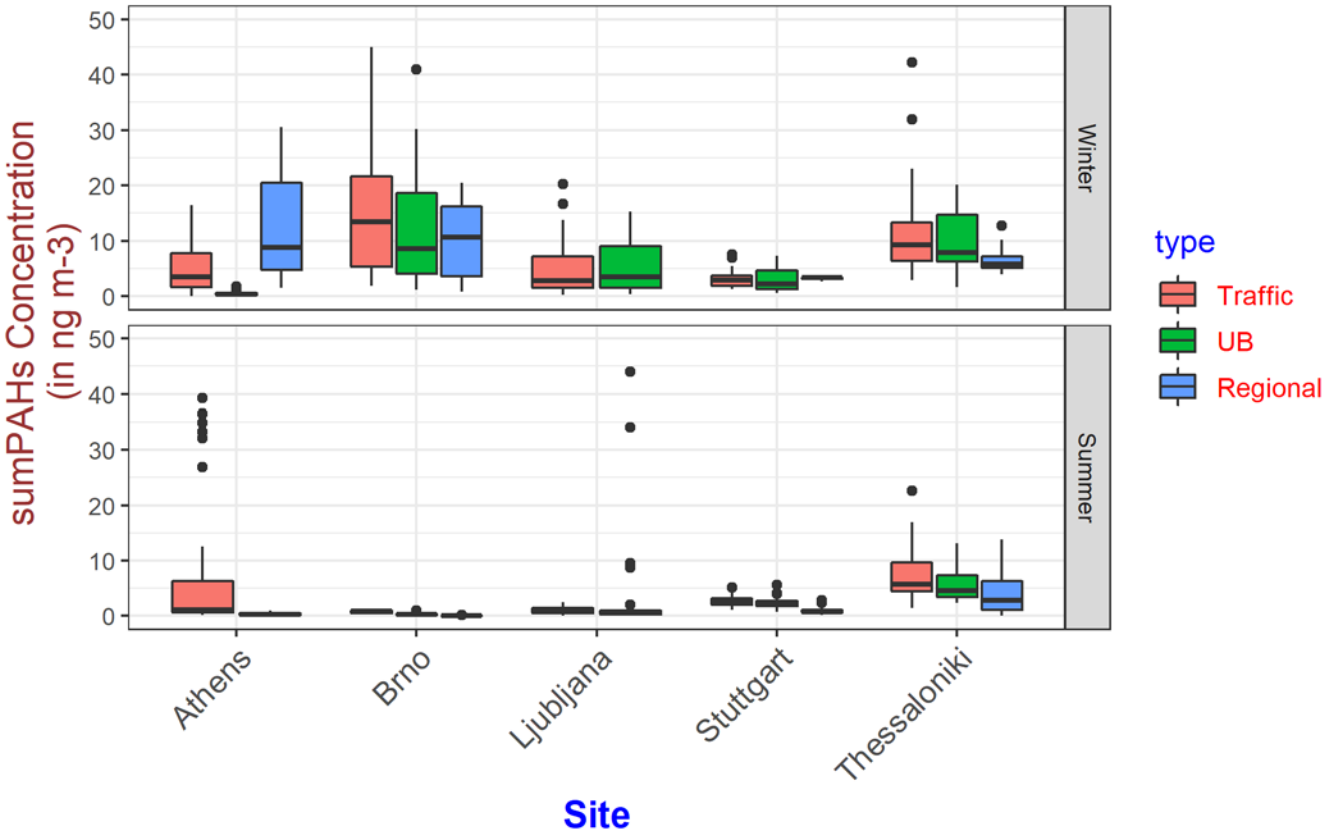




- The concentrations as well as the composition profile were comparable between the different laboratories involved

Results – Concentrations of PAHs



- Except for Thessaloniki, PAHs concentrations were significantly higher in winter
- Clear traffic to UB to rural gradient was only observed for Brno and Thessaloniki
- Athens had winter PAHs concentrations higher at the rural site (influence of wood burning)

Results – Concentrations of BaP

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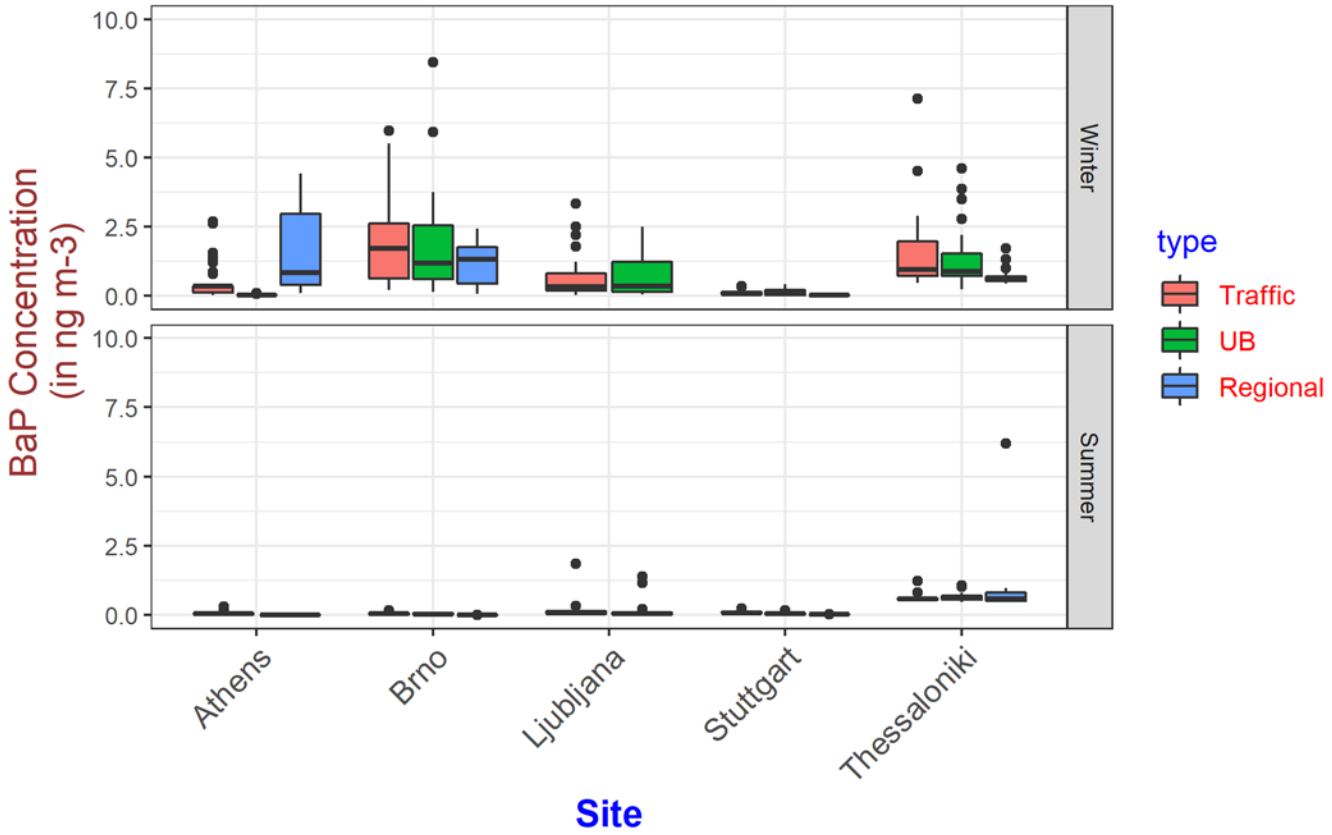
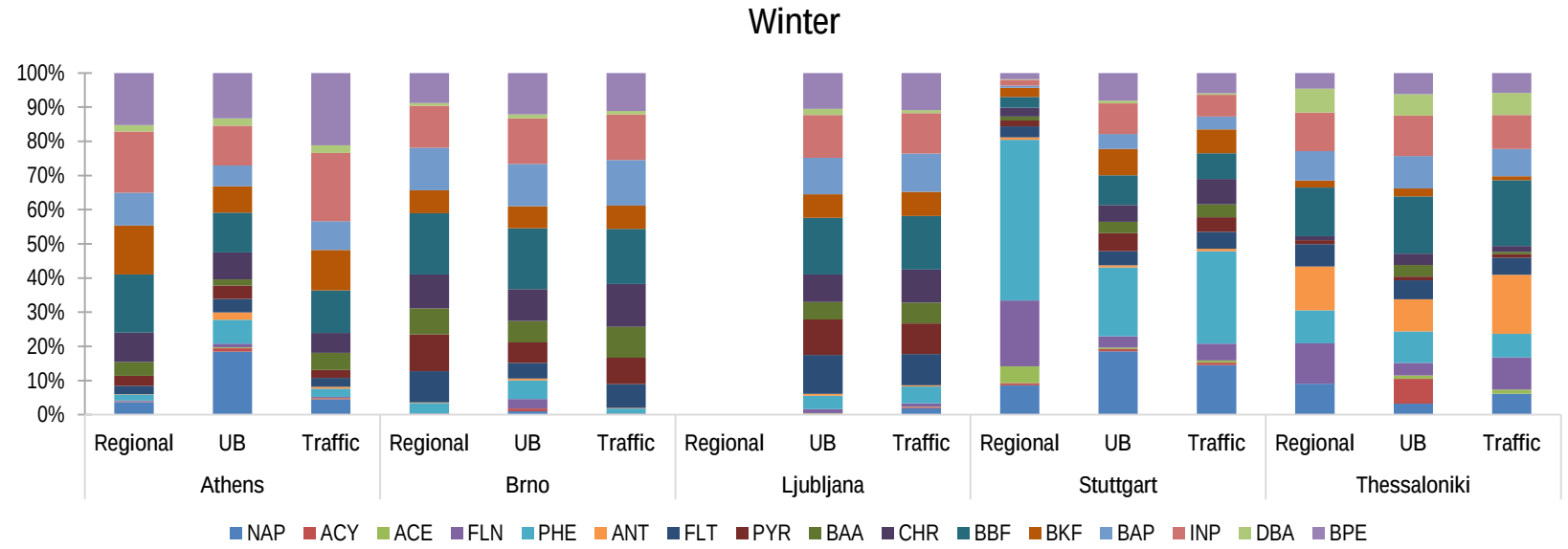
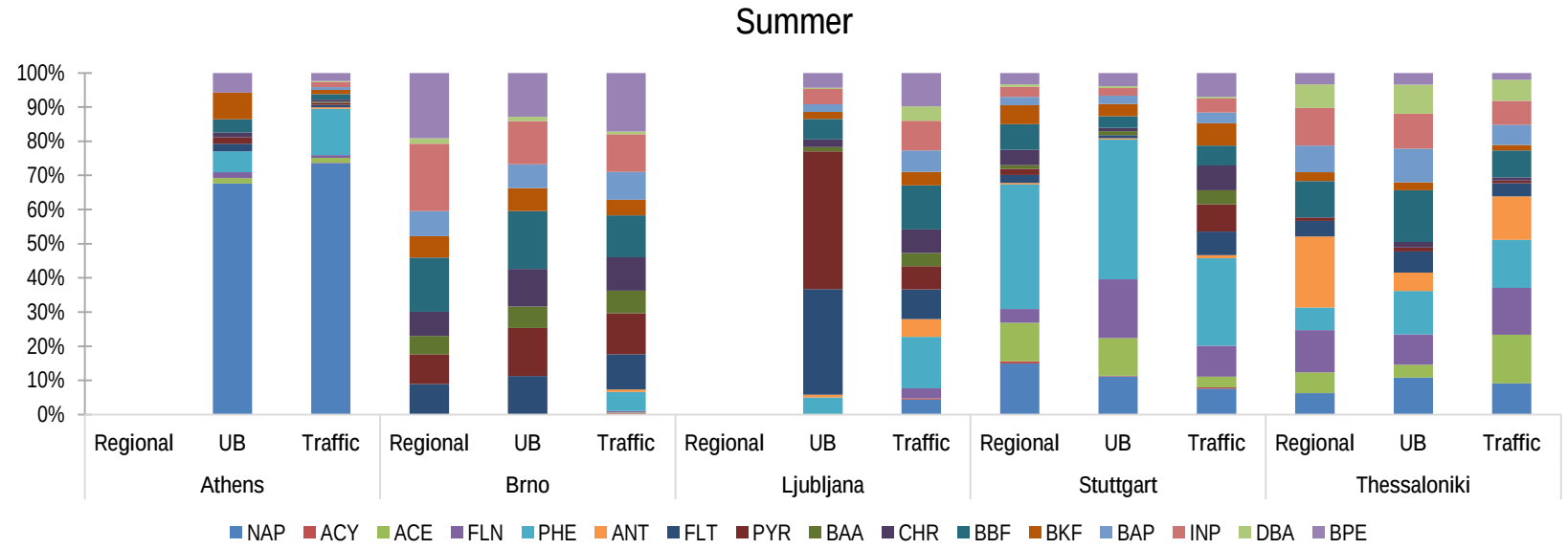


All cities, except Stuttgart faces BaP concentrations > 1 ng m^{-3} in winter

Results – Composition profiles of PAHs





- In general, differences in the composition profile of PAHs were more pronounced between the cities rather than between the type of sites
- The PAHs composition profile of Athens, Ljubljana and Stuttgart were different in winter and summer

Results – Cancer risks from inhalation

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Method 1:

Incremental Lifetime Cancer risk =

$$1 - e^{-\left(\frac{IR \times EF \times ED \times ET}{BW \times AT}\right) IUR_i \times CPA_{Hi}}$$

IR = Inhalation Rate (m^3 day^{-1}), EF = Exposure Frequency (days $year^{-1}$), ED = Exposure Duration (year), ET = Exposure Time (day $year^{-1}$), BW = Body Weight (kg), AT = Averaging Time (days), IUR_i Inhalation Unit Risk (m^3 ug^{-1}), $C_{PAH,i}$ = the particulate concentration of PAHi (in ng m^{-3})

Over 70 years lifetime, **for an outdoor worker**

Method 2:

Excess Cancer risk = $\Sigma(C_{PAH,i} \times RPF_i) \times UR_{BaP}$

$C_{PAH,i}$ = the particulate concentration of PAHi (in ng m^{-3}), RPF_i = the relative potency factor of PAHi and UR_{BaP} = the unit risk of exposure to BaP

Over 70 years lifetime, **all the time**

Results – Cancer risks from inhalation

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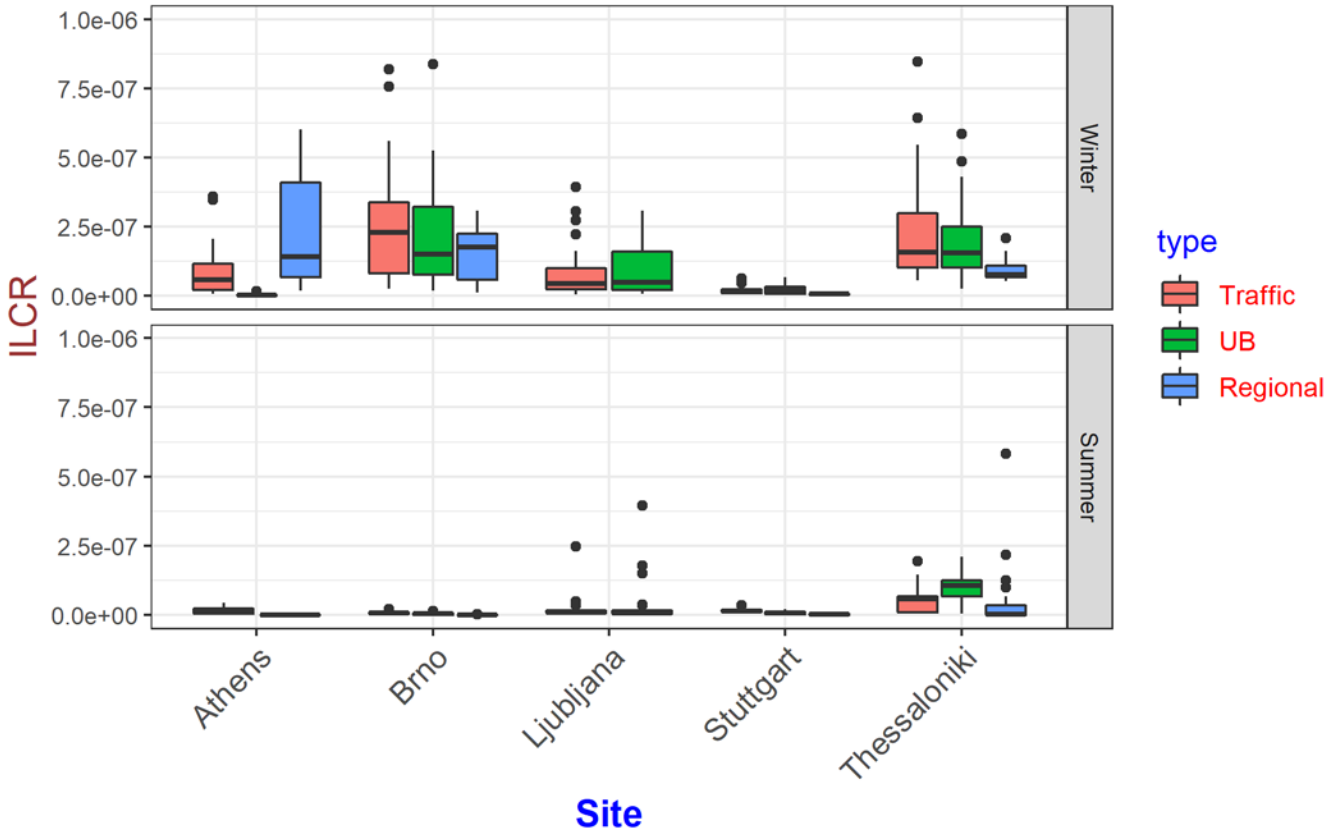
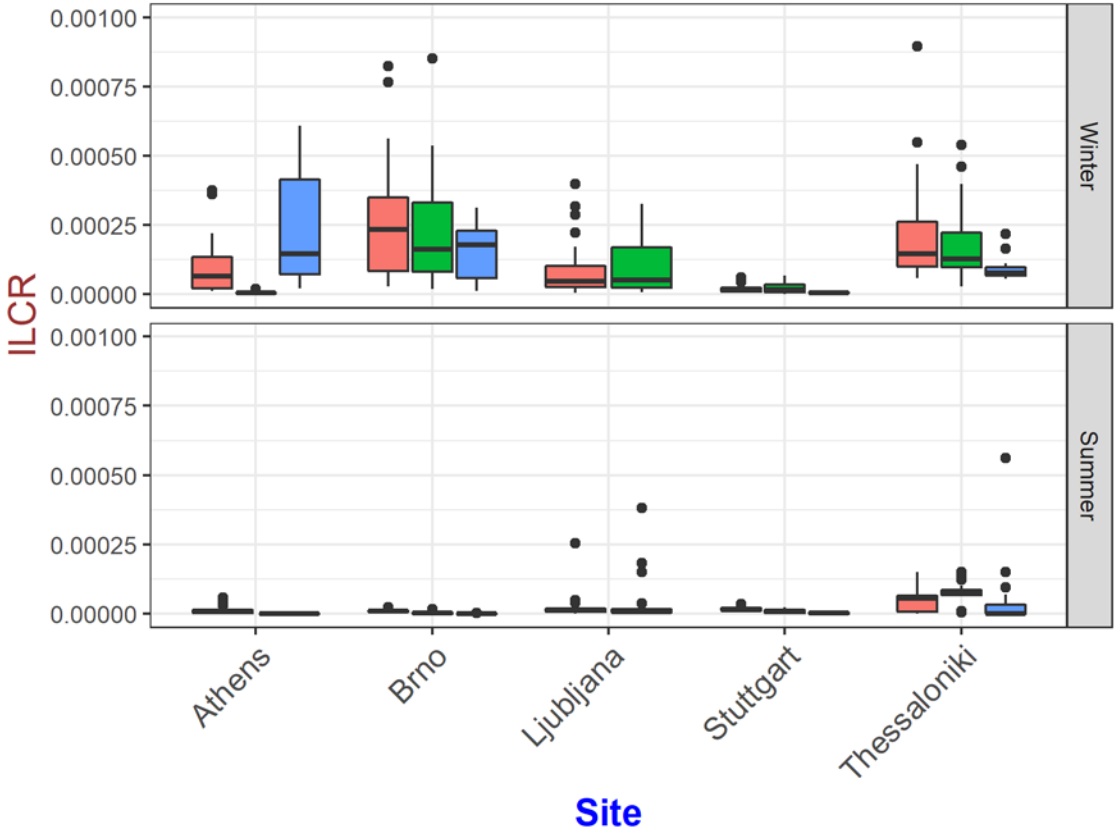
Method 1:



Method 2:



- The same trends were observed but the estimated risks differed by up to 3 orders of magnitude

Conclusions

- This study provided an overview of PAHs in 5 European cities
- Strong variability in the spatial variations were observed between the cities
- Further work will focus on the identification of the drivers of PAH concentrations and composition profile for each site, city and season

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- All colleagues who contributed to that research

Thank you for your attention. Any questions?