

URBAN ULTRAFINE PARTICLES IN EUROPE RI-URBANS

Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial Areas



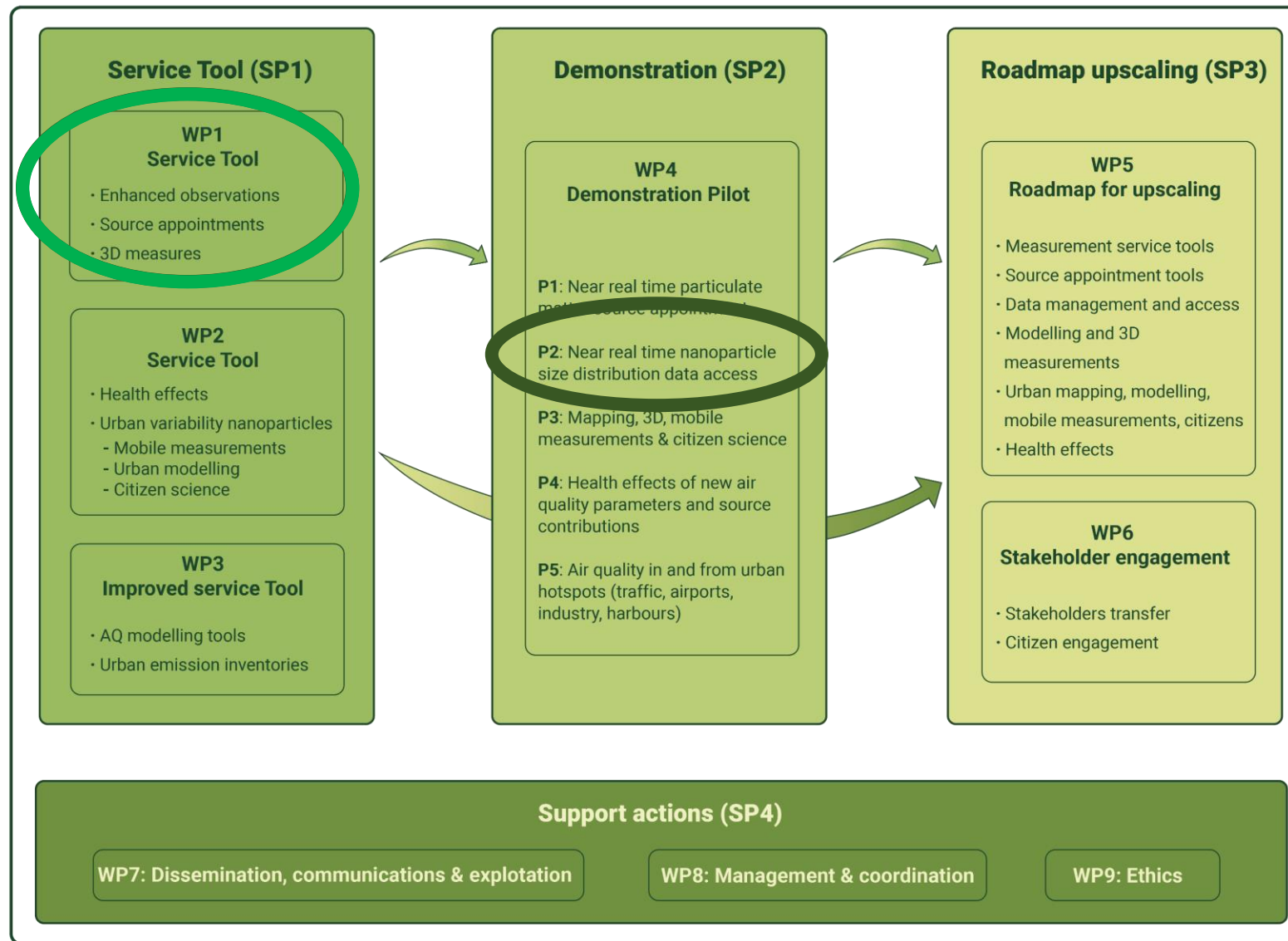
RI-URBANS WP1 GROUP

TFMM Annual meeting, 6th-7th May, 2024



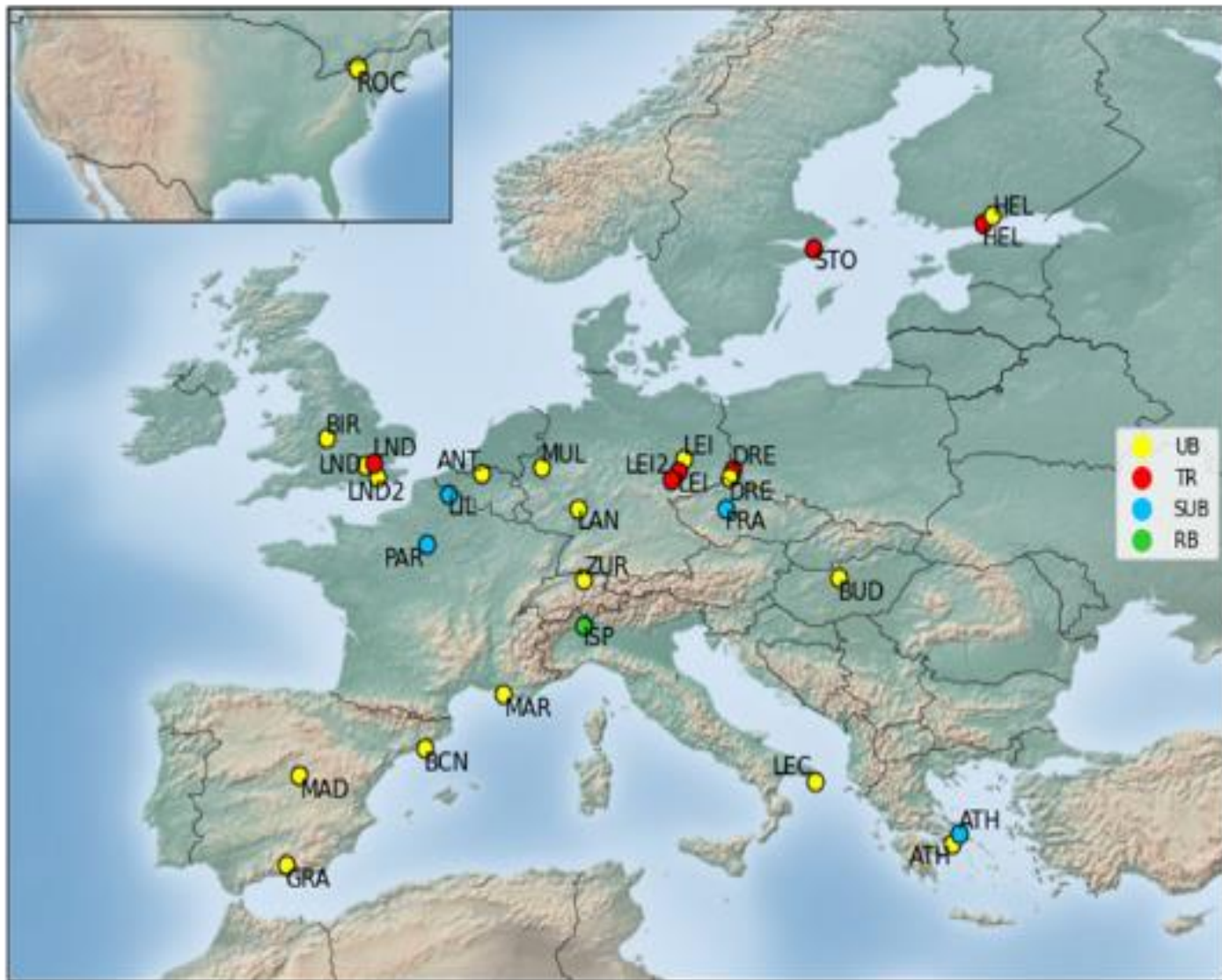
PILLARS & WORK PACKAGES

UFP
THIS
PRESENTATION



UFP-PSD DATA COMPILATION

1 R 4 S 18 U 6 T



12 datasets

ACTRIS

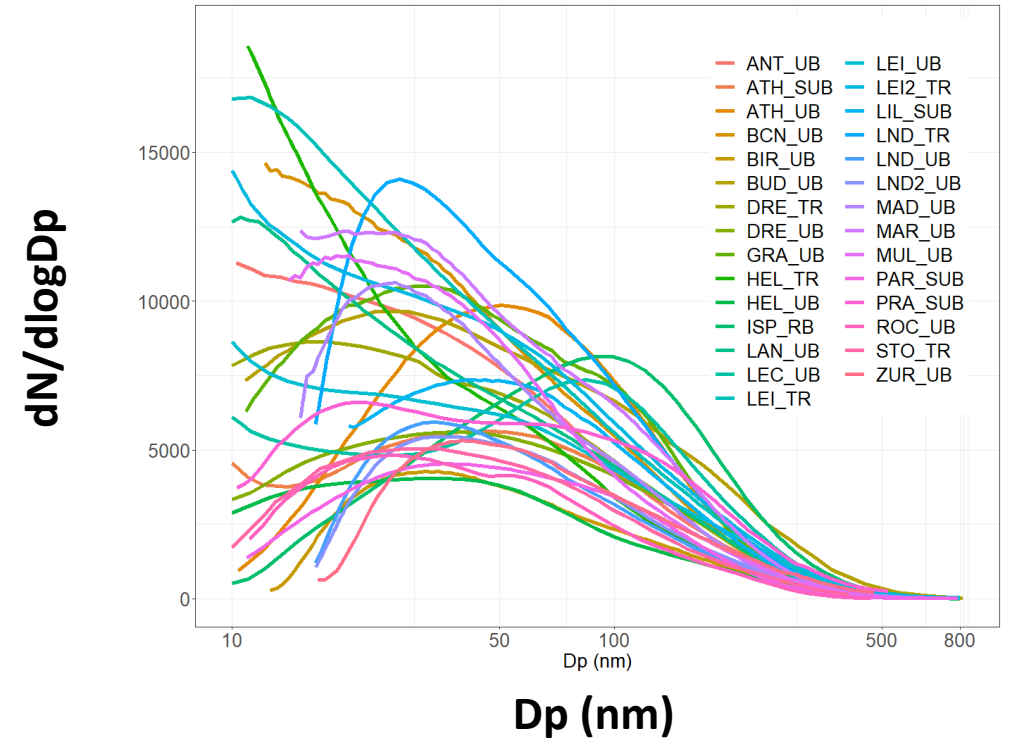
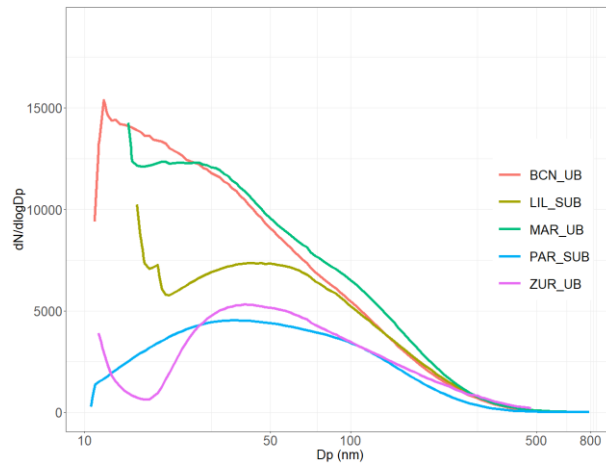
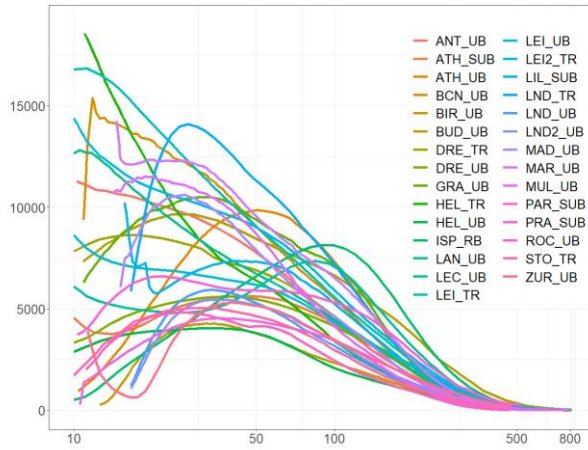
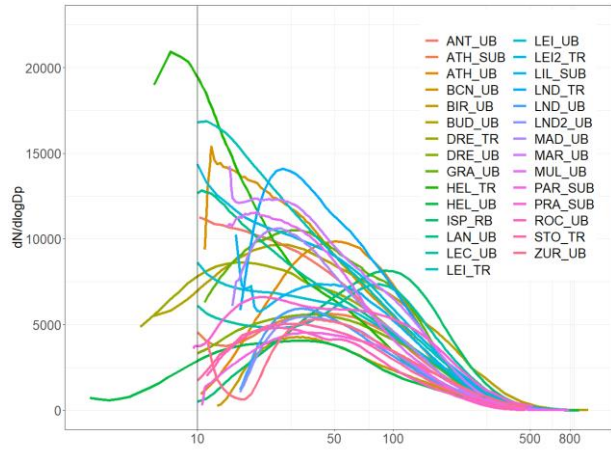
Other than
ACTRIS

17 datasets



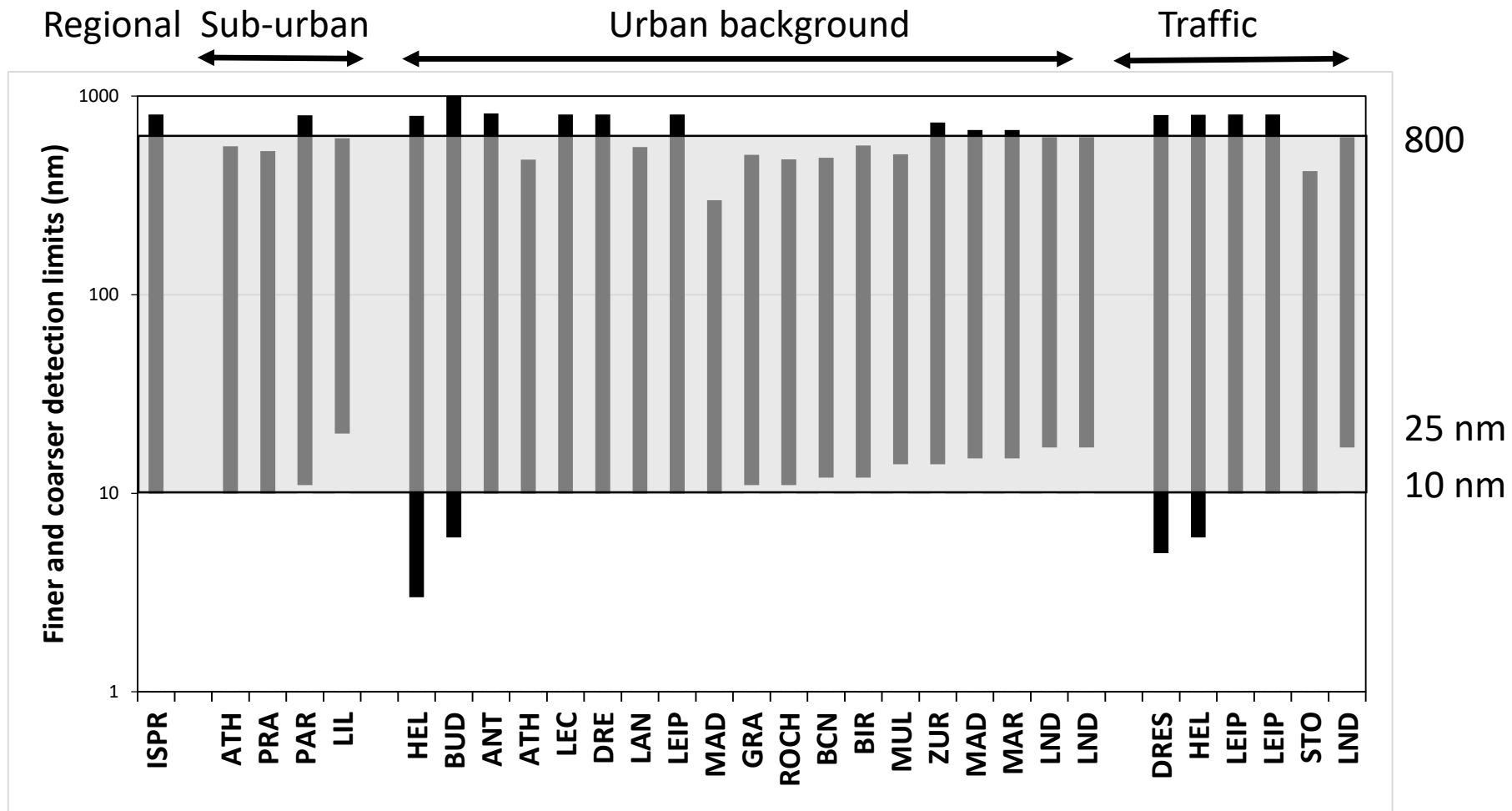
TFMM Annual meeting, 6th-7th May, 2024

SELECTION OF N_{10-800} FOR COMPARISON AND HEALTH STUDIES

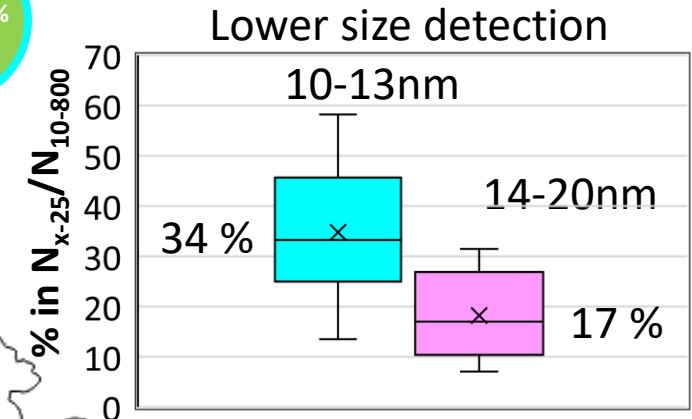
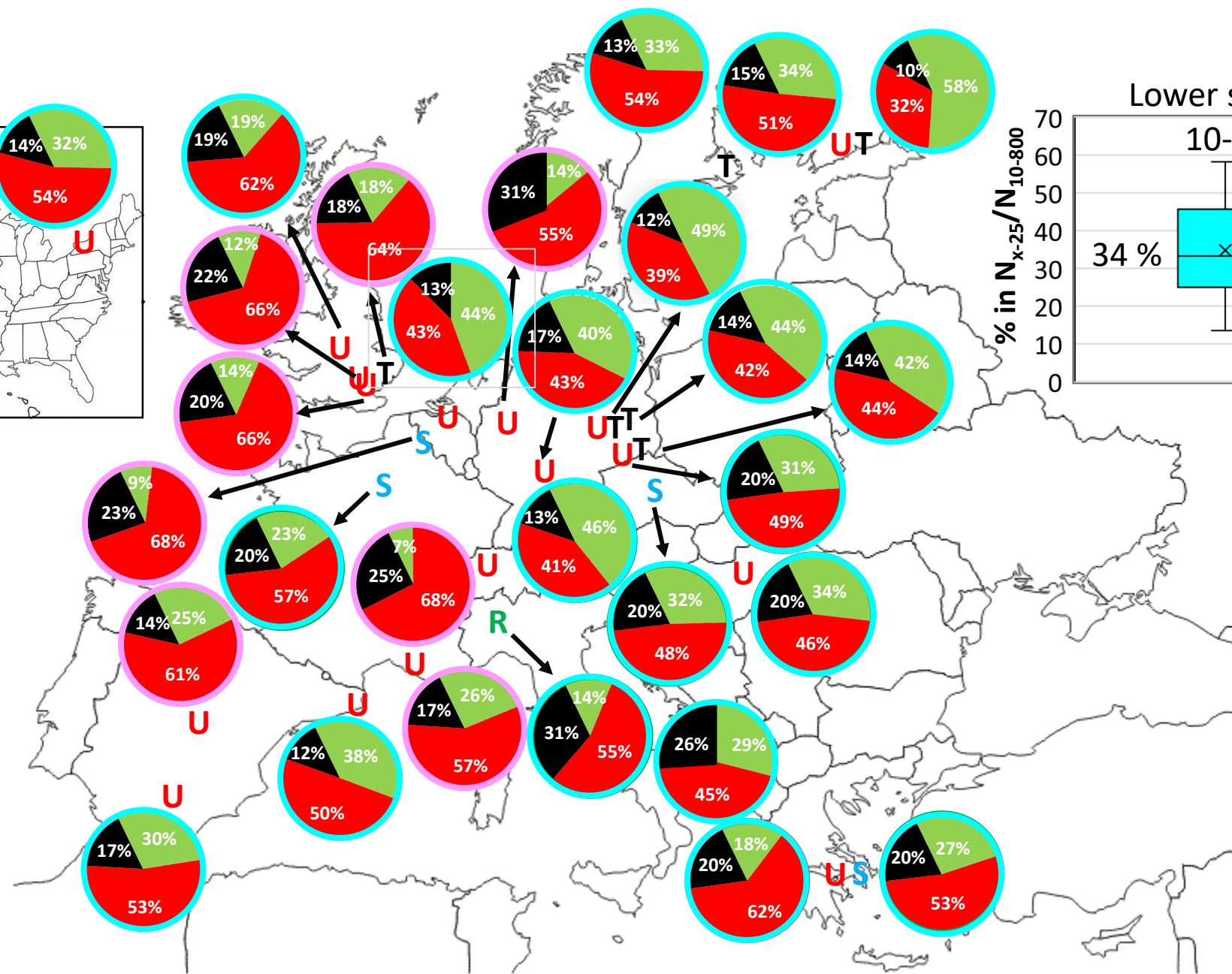
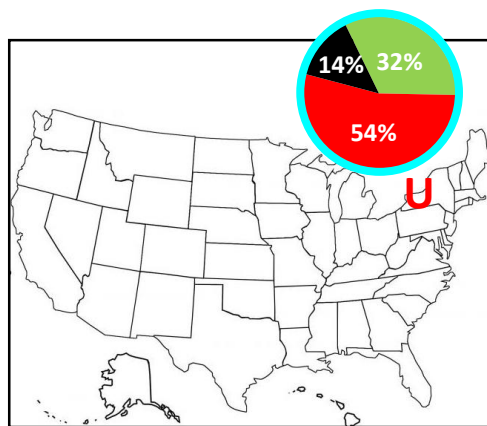


SELECTION OF N_{10-800} FOR COMPARISON AND HEALTH STUDIES

P10	6.0	470
P25	10.0	525
P50	10.0	633
P75	13.5	800
P90	17.0	800

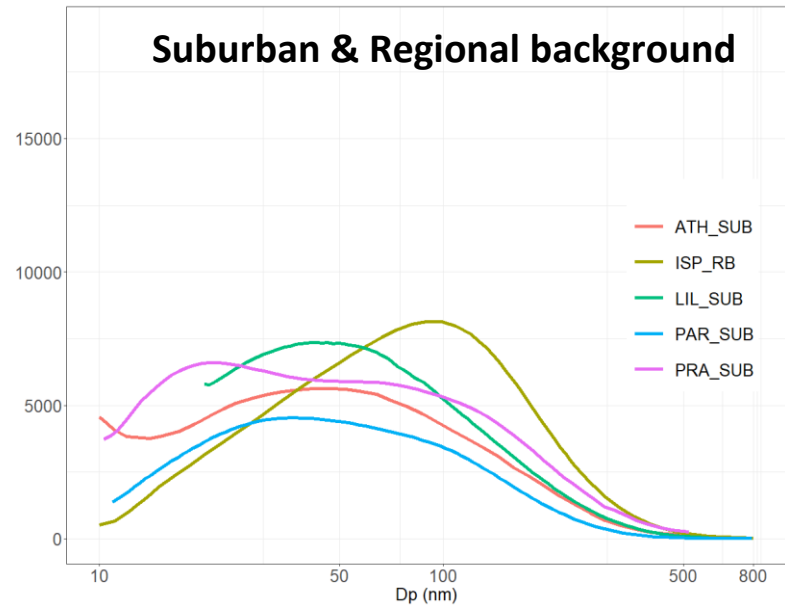
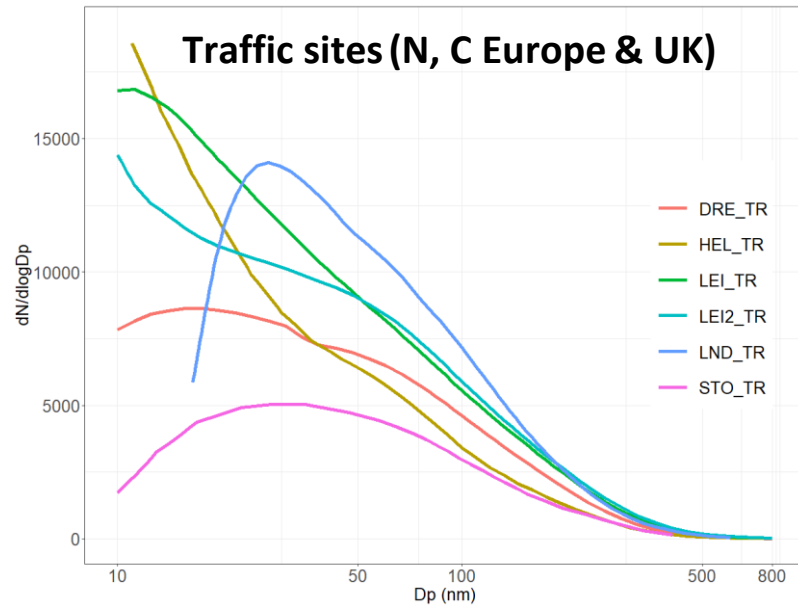
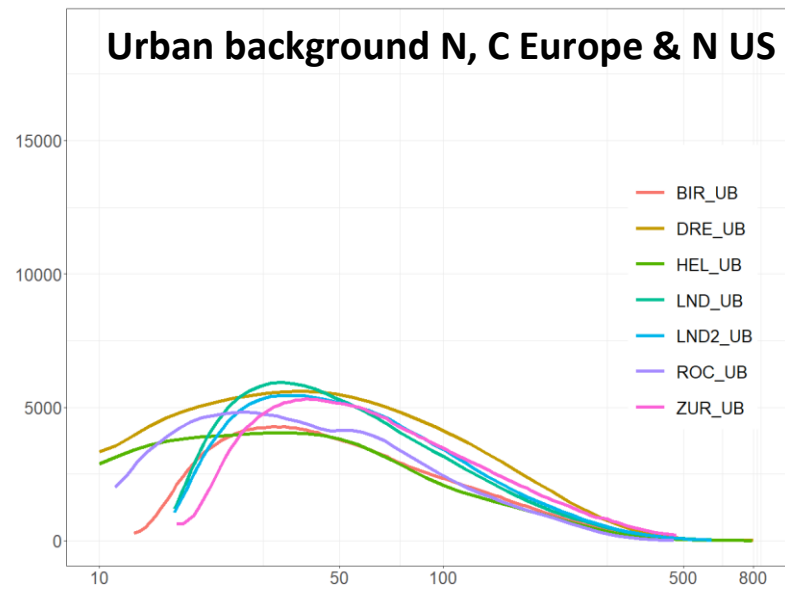
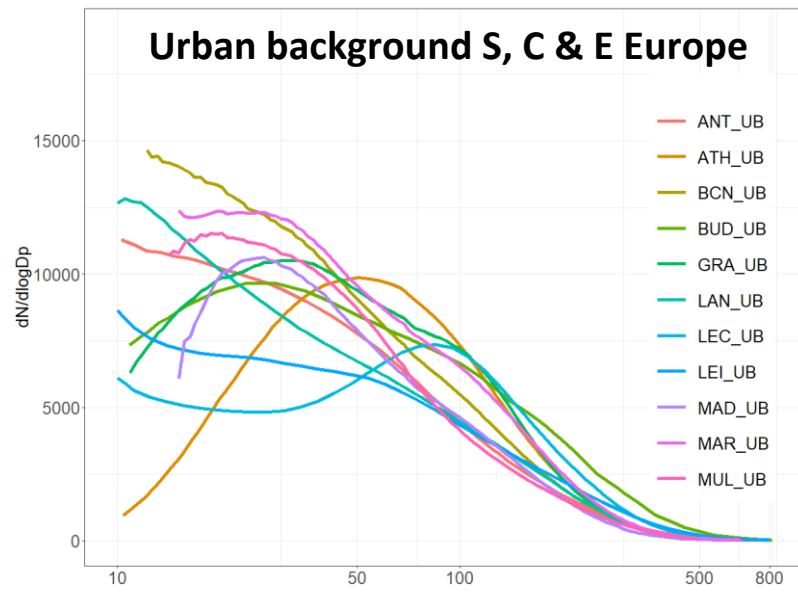


NUCLEATION, AITKEN & ACCUM SIZES (1000#/cm³) AVERAGE DAILY PATTERNS

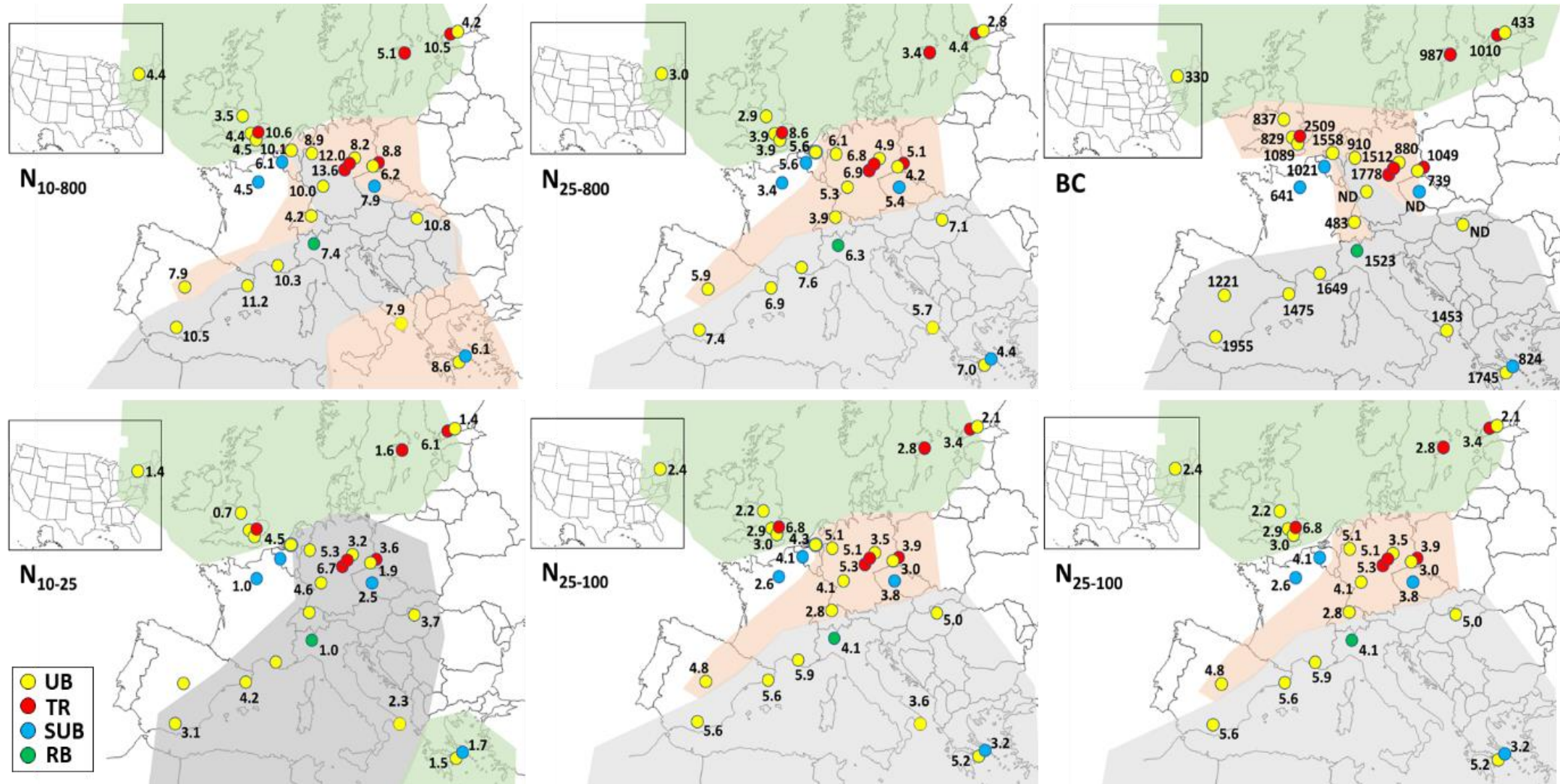


UFP-PSD

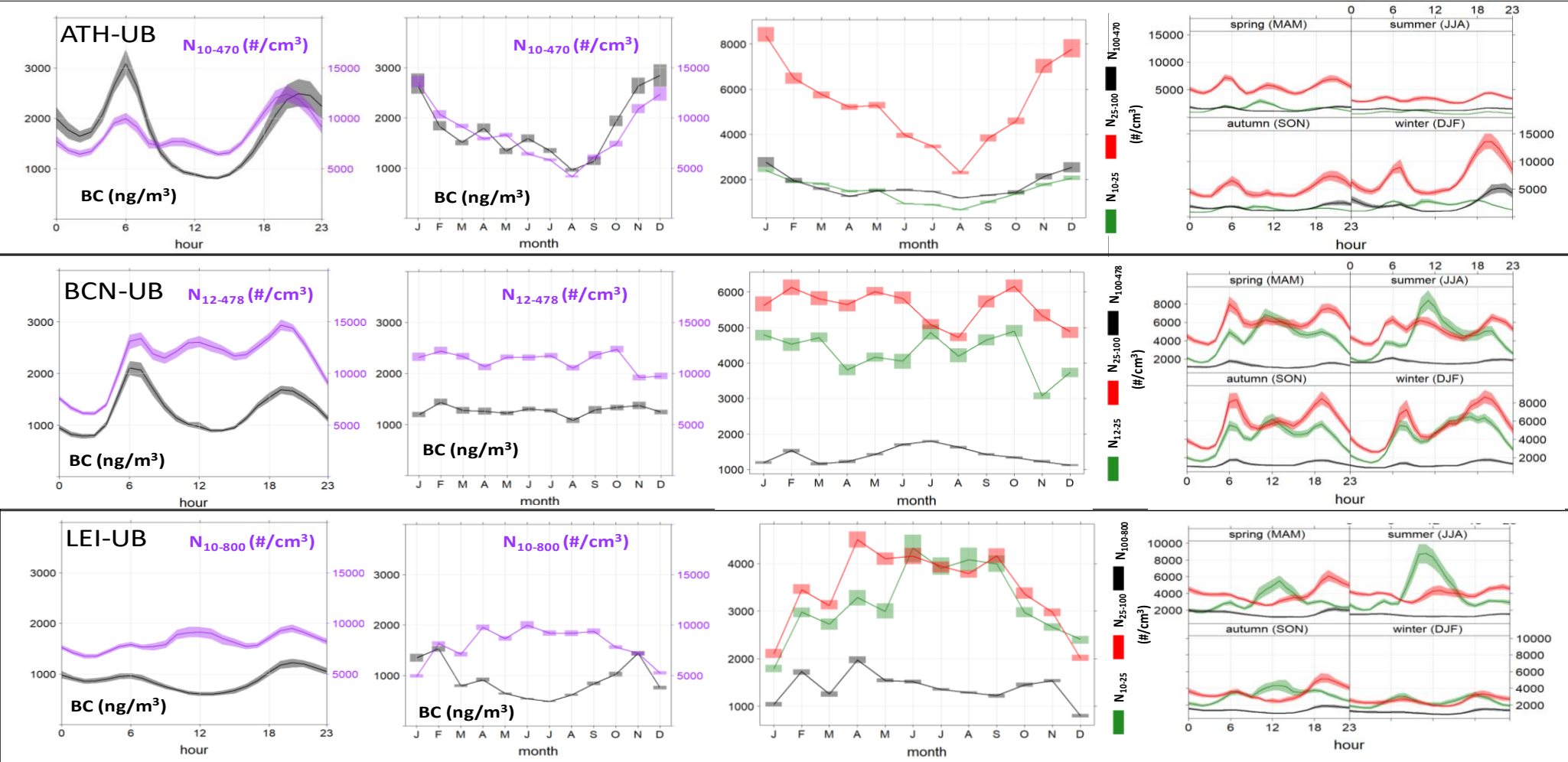




UFP & BC CONCENTRATIONS ACROSS URBAN EUROPE



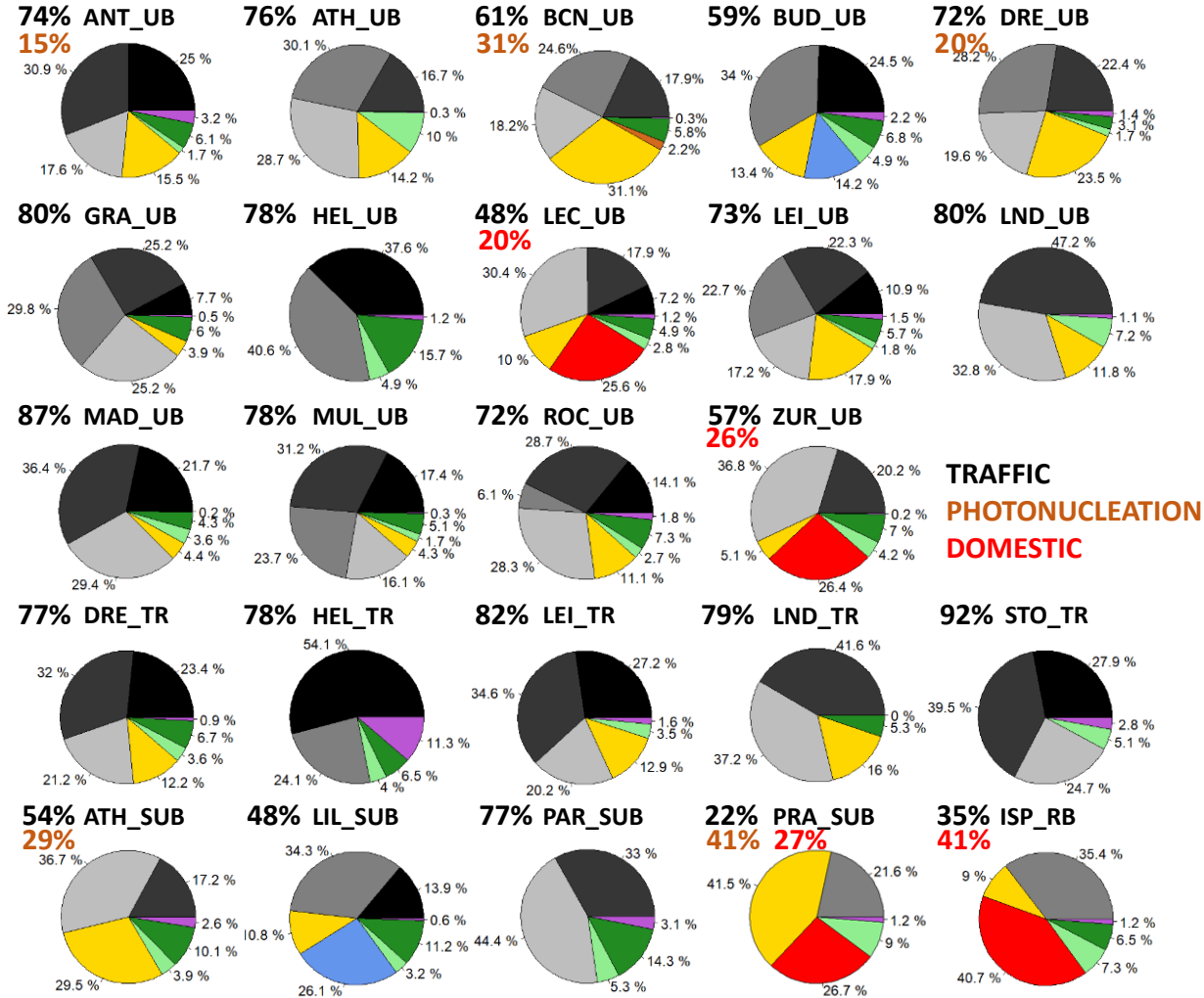
DAILY, WEEKLY & SEASONAL PATTERNS



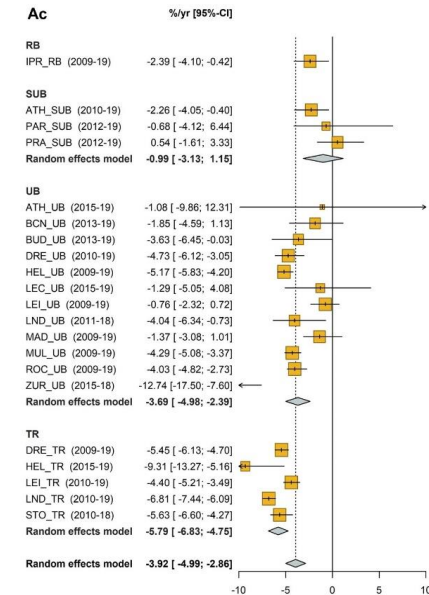
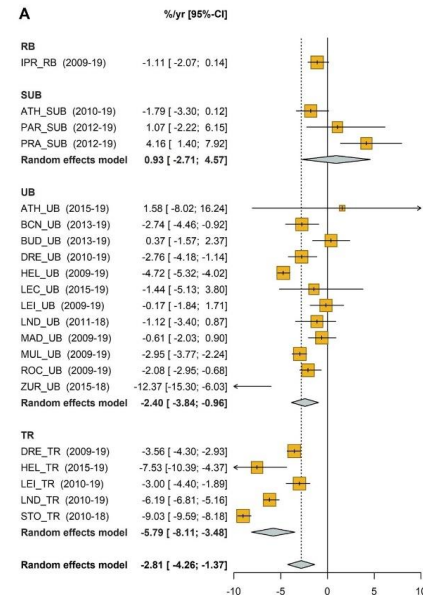
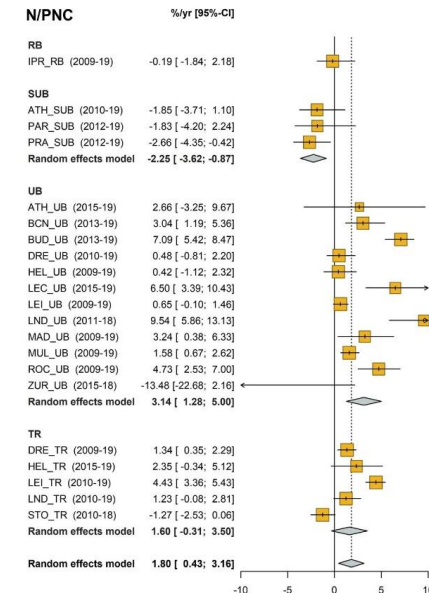
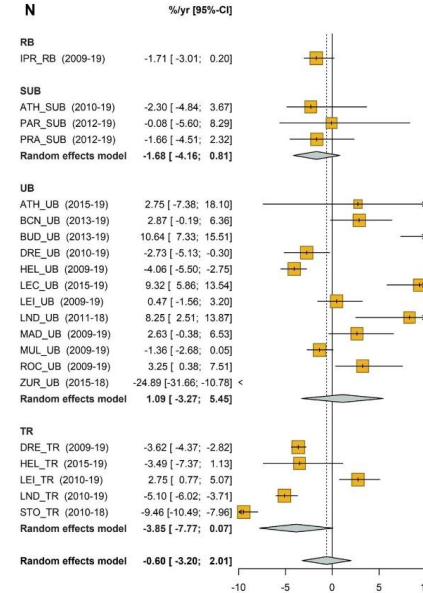
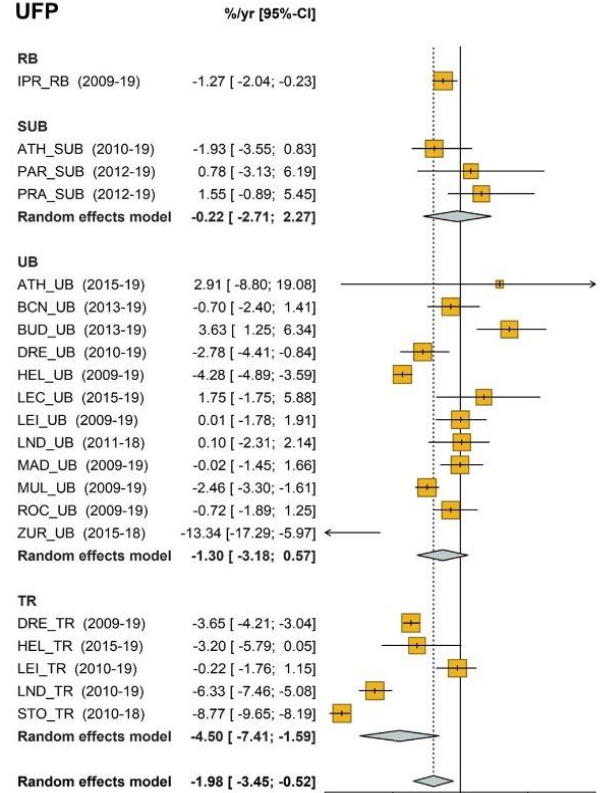
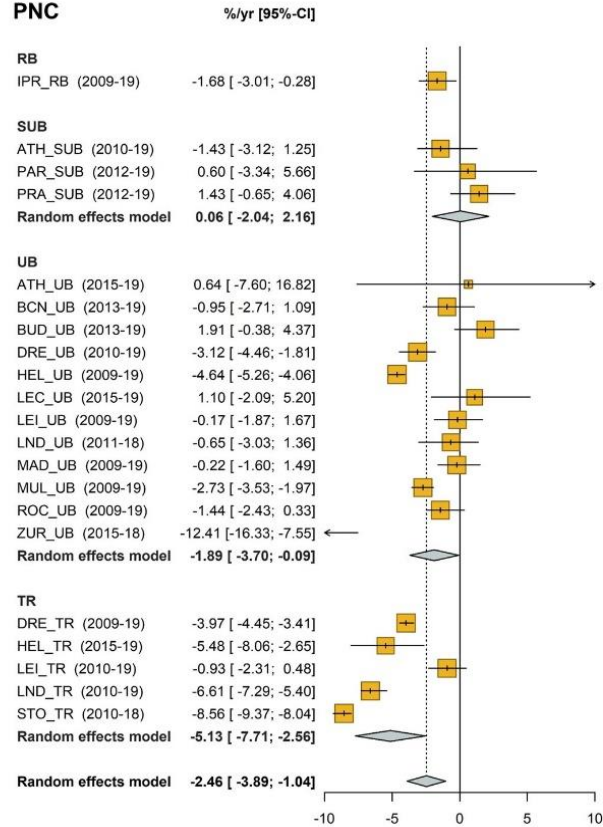
UFP SOURCE APPORTIONMENT USING RECEPTOR MODELLING (PMF)

- **Traffic 1:** Major size mode around 30-35 nm. Associated to gasoline vehicle emissions, freshly emitted traffic particles or nucleation of diesel particles. Peaks observed during traffic rush-hours and minimum values occur on weekends.
- **Traffic 2:** Major size mode around 60-80 nm. Associated to diesel vehicle emissions or coagulation of traffic particles when moving from the sources. Peaks observed during traffic rush-hours and minimum values occur on weekends.
- **Mixed traffic:** Major size mode between those of Traffic 1 & Traffic 2, due to a mix of all traffic sources and other sources not related to traffic, such as domestic heating.
- **Traffic nucleation:** Major size mode around 10-20 nm. Associated to the nucleation of particles generated during dilution of diesel exhaust emissions. Trends are similar to those described for the aforementioned traffic sources.
- **Photonucleation:** Major size mode around 10-20 nm. A midday peak is found when high photochemical activity leads to new particle formation events.
- **Urban background:** Major size mode around 100-170 nm. It is influenced by traffic emissions, exhibiting similar trends to those of the traffic sources.
- **Regional background:** Typically, it shows a bimodal distribution with a primary size mode above 150 nm, reaching its maximum during summer and at midday. In HEL_TR this includes also important contributions from local traffic.
- **Regional nitrate:** It shows a distribution similar to the previous one, but with the maximum occurring during winter and at night.
- **Domestic heating:** Major size mode above 100 nm. It is associated with the combustion of fuels, and peaks during the night and winter.
- **Long distance transport:** Multimodal distribution with a primary mode around 300 nm. Associated to dust from deserts, traffic, forest fires, etc.

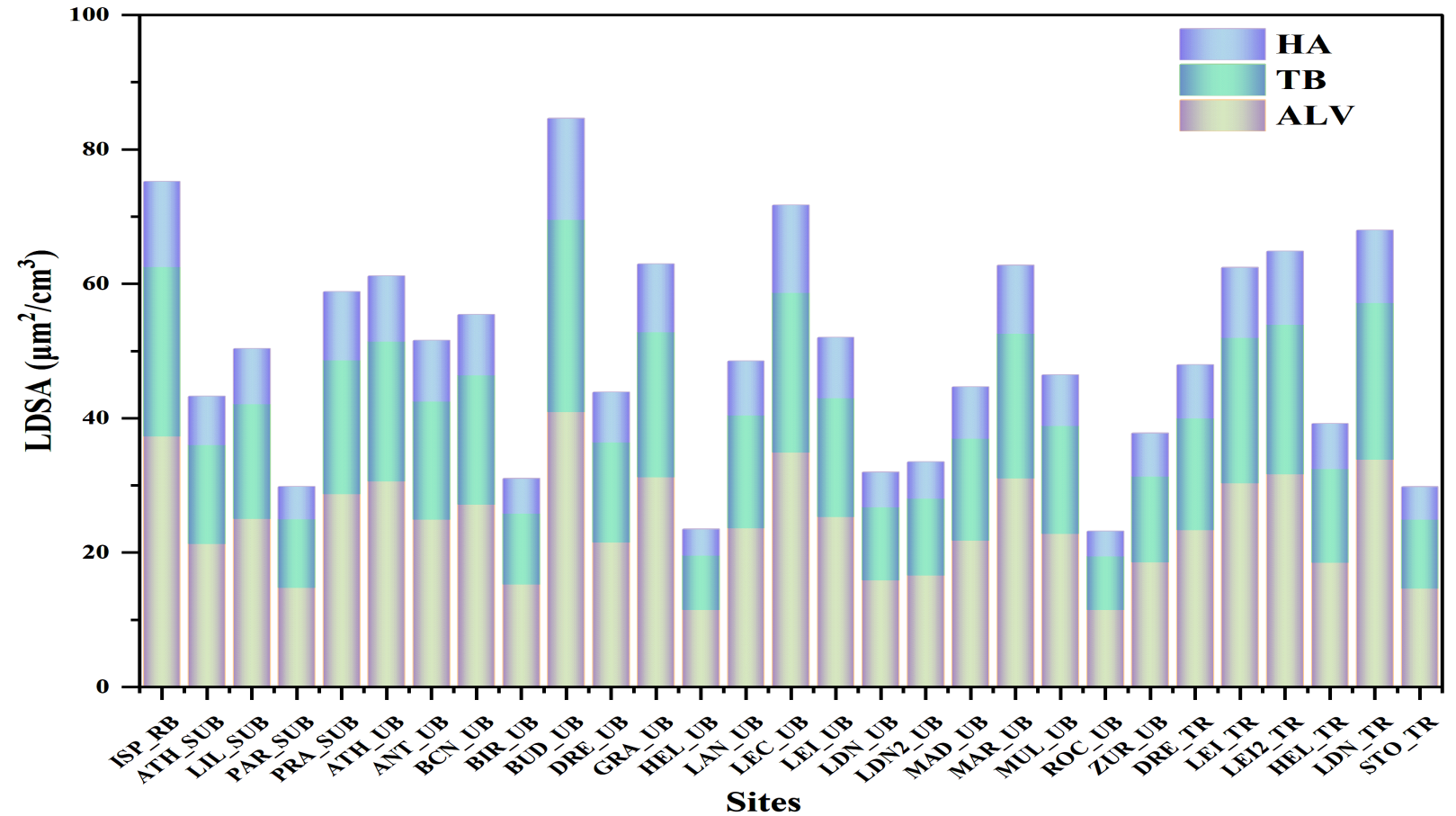
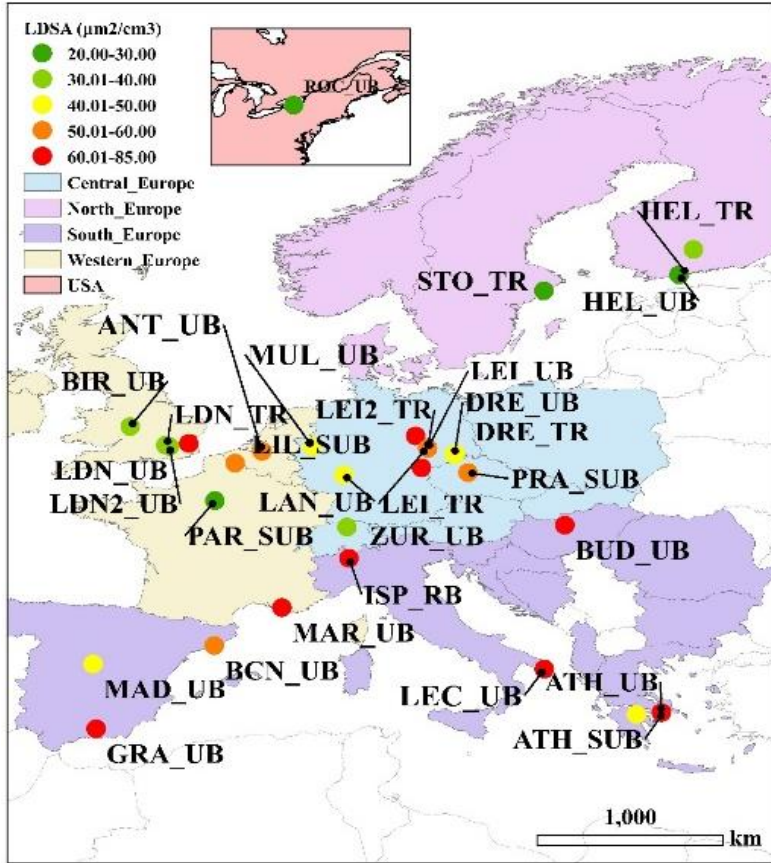
UFP SOURCE APPORTIONMENT USING RECEPTOR MODELLING (PMF)



UFP TREND ANALYSIS 2009-2019



CONCENTRATIONS OF LUNG DEPOSITED SURFACE AREA DETERMINED FROM PNSF



FINAL CONSIDERATIONS

- Comparing PNC <25 nm is difficult due to different size detection limits and measurement errors
- Improvements in the quality of <20 nm measurements (by implementing CEN and ACTRIS recommendations) are urgently needed in an important proportion of sites
- For N_{10-800} and N_{25-800} : Gradient to decrease S>C>N Europe, and (as expected) T>UB>SUB
- Very high correlation N_{25-800}/BC ($R^2=0.9$), lower with other pollutants (PM_{2.5} and NO₂, $R^2=0.5-0.7$, T & UB)
- The proportions of Nucleation/Aitken/Accumulation, seasonality and daily patterns, widely vary
- Road traffic contributions reach 70-80% in most cases, followed by photo-nucleation (in a proportion of cities) and domestic combustion (for another proportion of cities)
- High midday photochemical nucleation is not always higher in S-Europe (higher insolation)
- Seasonal patterns might completely differ
- Clear downward trend for Aitken and Accumulation modes. Less clear for nucleation. Clear effect of EURO 5&6 DPFs and road traffic measures
- NEAR FINISHED: Epidemiology studies for short term effects

Thanks for your attention!!!!

RI  **URBANS**