URBAN ULTRAFINE PARTICLES IN EUROPE
RI-URBANS
Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS

RI-URBANS WP1 GROUP

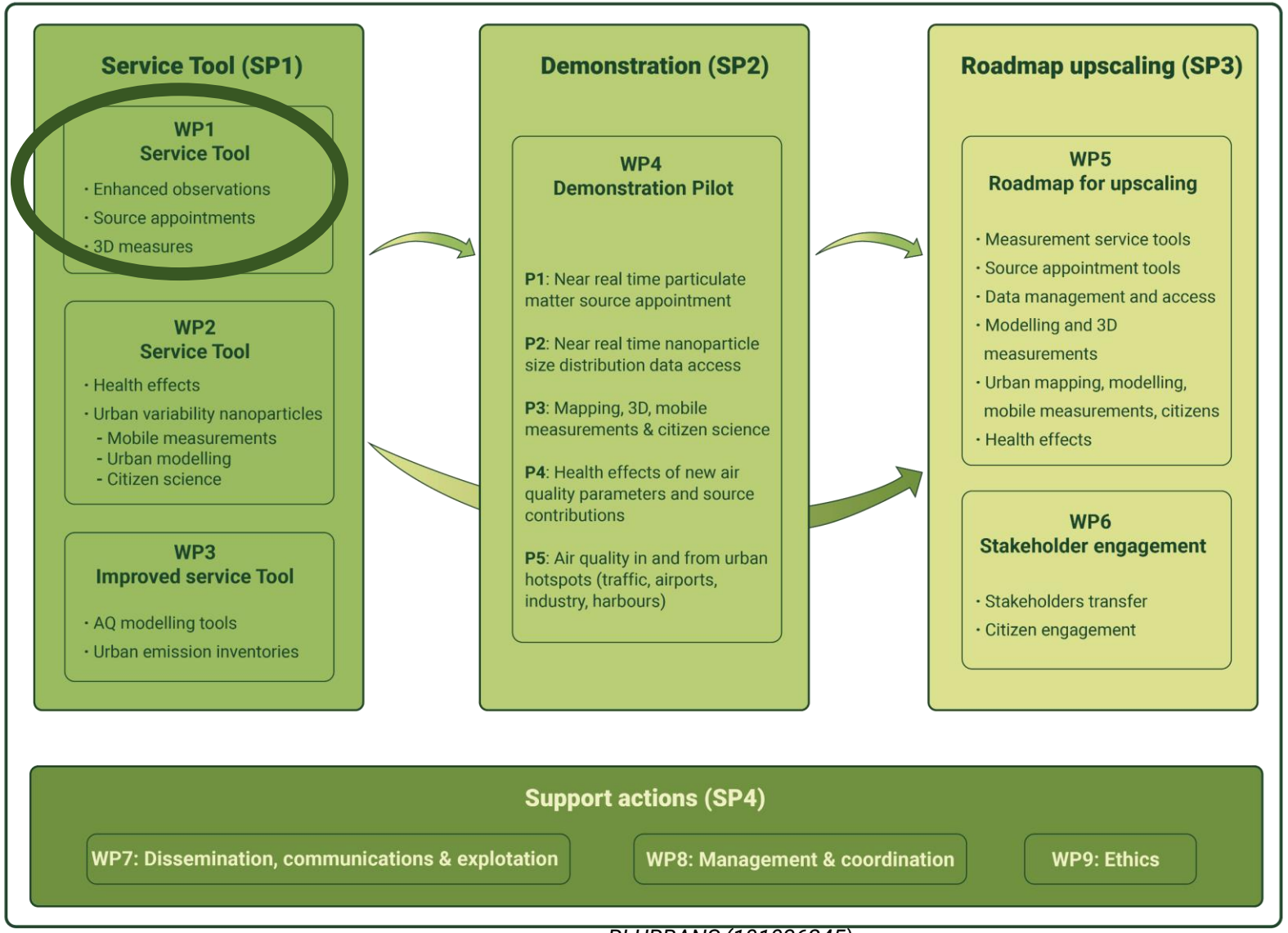
1st RI-URBANS Meeting Science 19th & 20th October 2022

RI-URBANS (101036245)

PILLARS & WORK PACKAGES

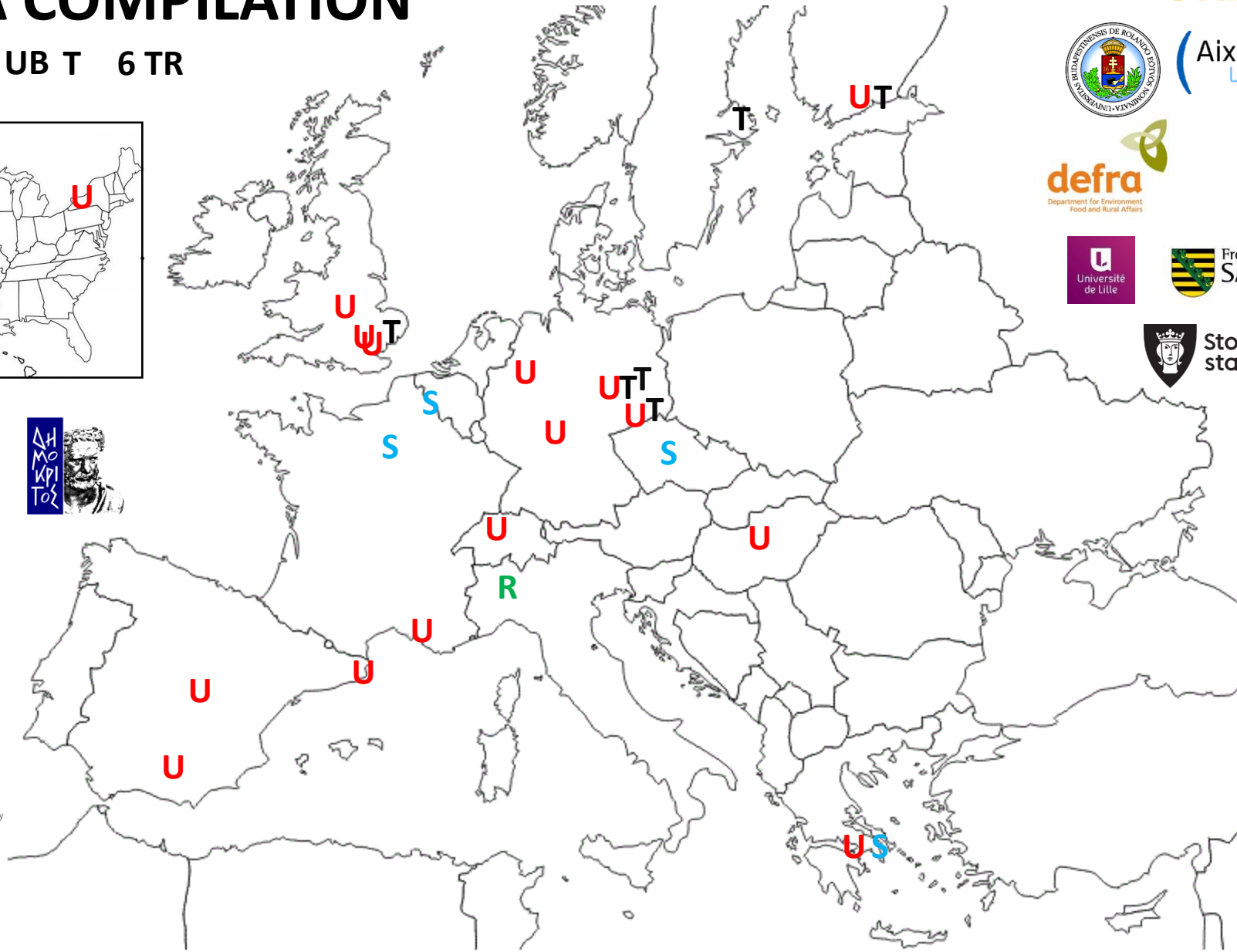
UFP

PNSD



UFP-PSD DATA COMPILATION

R, S 1 REG, 4 SUB U 16 UB T 6 TR



12 datasets

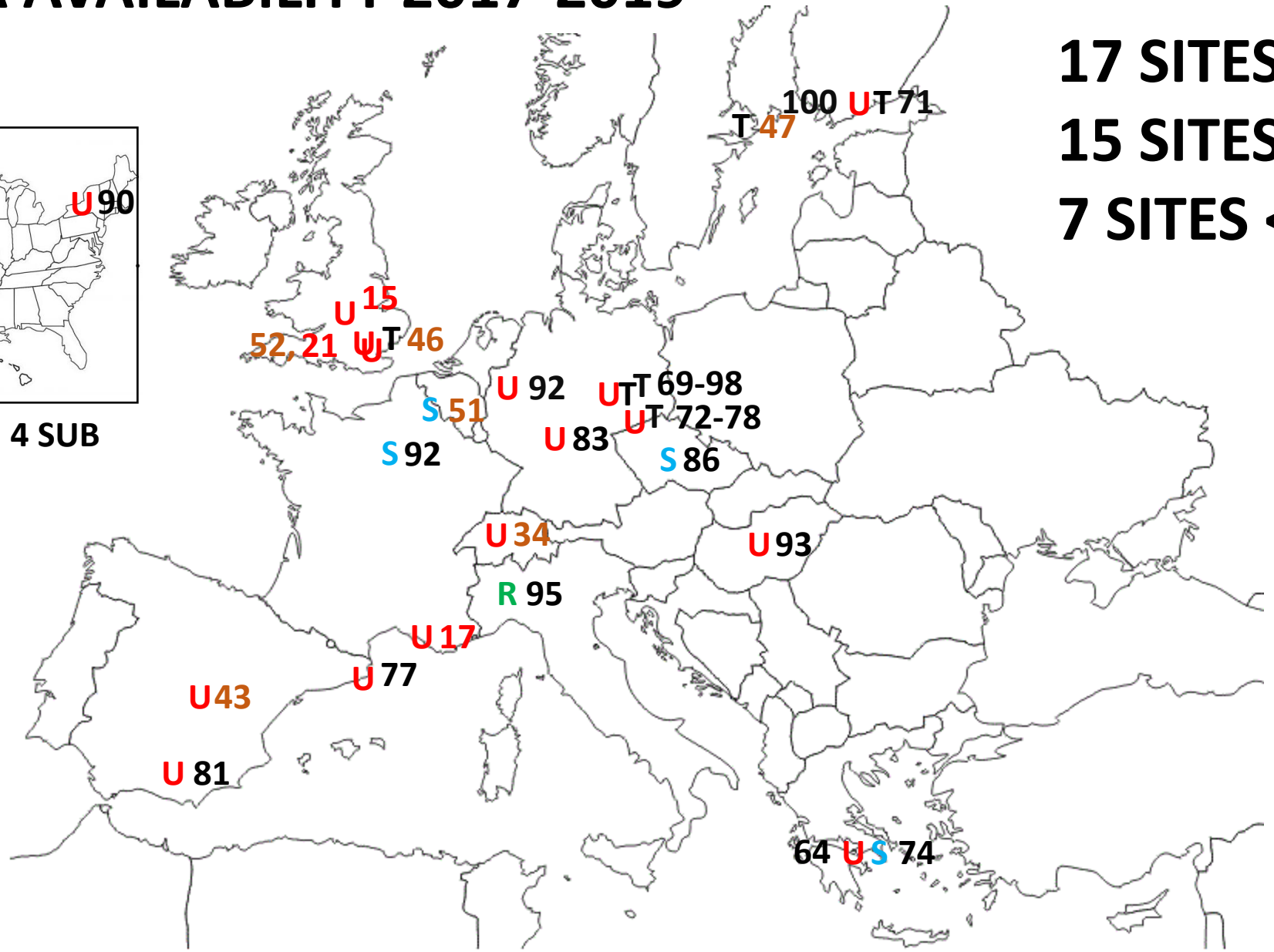
Other than ACTRIS

15 datasets

1st RI-URBANS Meeting Science 19th & 20th October 2022

UFP-PSD DATA AVAILABILITY 2017-2019

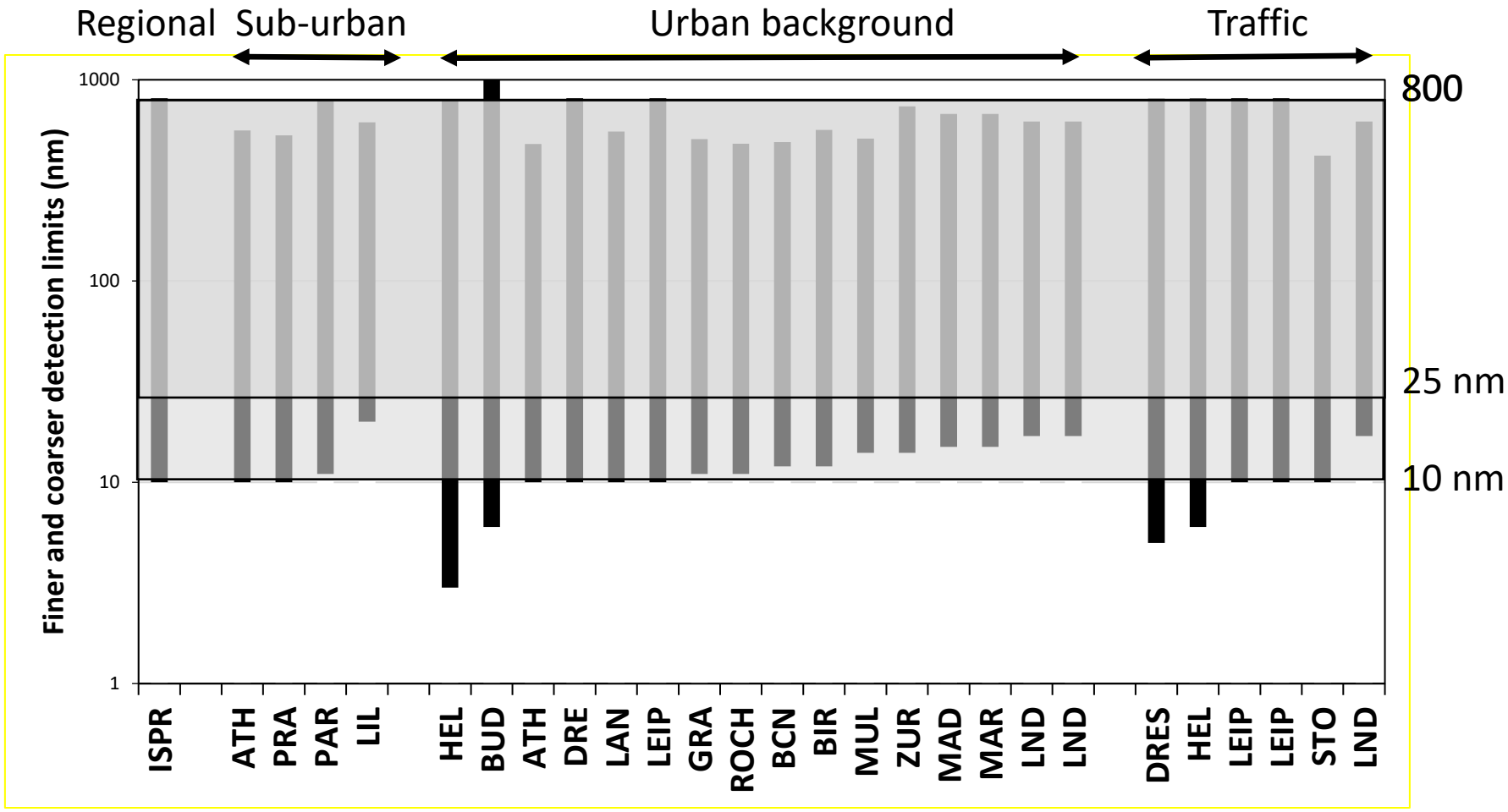
R, S 1 REG, 4 SUB
U 16 UB
T 6 TR

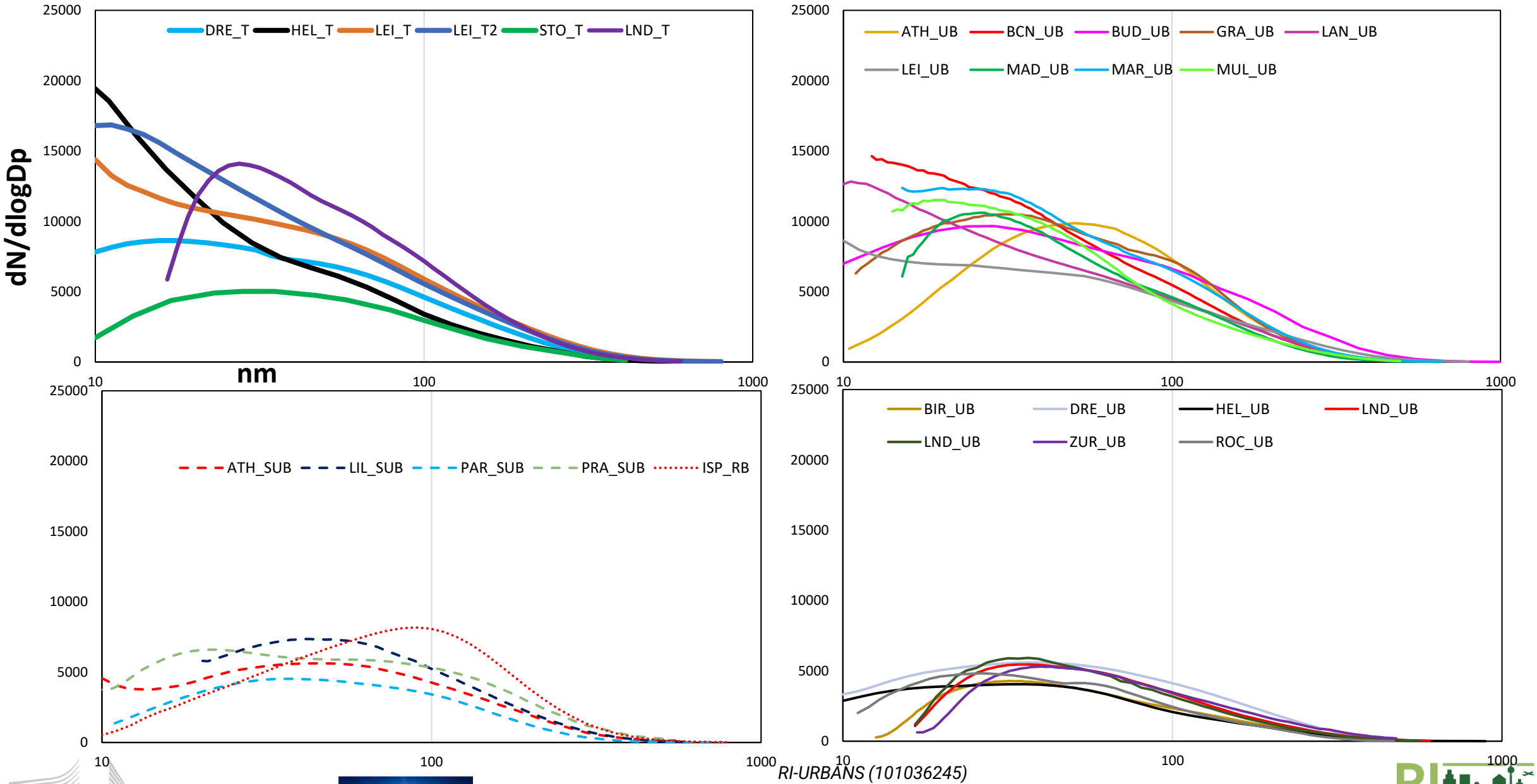


17 SITES 64-100%
15 SITES >70%
7 SITES <50%

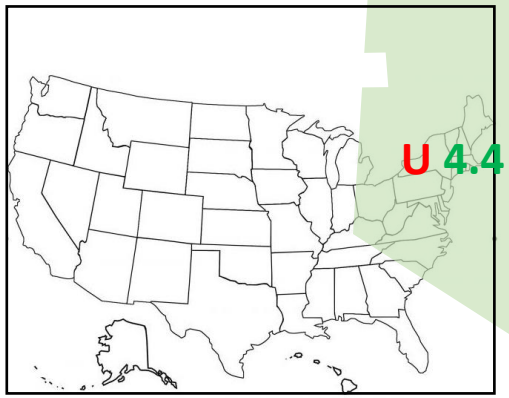
SELECTION OF $N_{10\text{-}800}$ FOR COMPARISON AND HEALTH STUDIES

P10	6	475
P25	10	532
P50	10	604
P75	14	800
P90	17	800




dN/dlogDp
nm
DRE_T
HEL_T
LEI_T
LEI_T2
STO_T
LND_T
ATH_UB
BCN_UB
BUD_UB
GRA_UB
LAN_UB
LEI_UB
MAD_UB
MAR_UB
MUL_UB
ATH_SUB
LIL_SUB
PAR_SUB
PRA_SUB
ISP_RB
BIR_UB
DRE_UB
HEL_UB
LND_UB
LND_UB
ZUR_UB
ROC_UB
25000
20000
15000
10000
5000
0
10
100
1000

$N_{10\text{-}800}$ #/1000/cm^3



U 4.4

R, S 1 REG, 4 SUB

U 16 UB

T 6 TR

5.1 T

4.2 UT 10.5

3.5 U

4.4 4.5 U T 10.6

8.9 U

8.2 UT 13.6, 12.0

6.1 S

4.5 S

10.0 U

6.2 UT 8.8

S 7.9

4.2 U

U 10.8

R 7.4

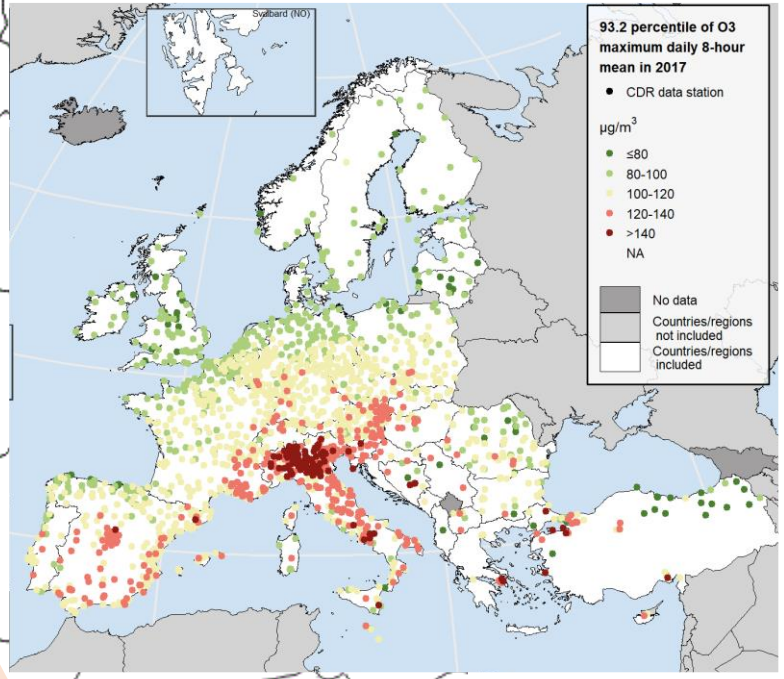
7.9 U

U 10.3

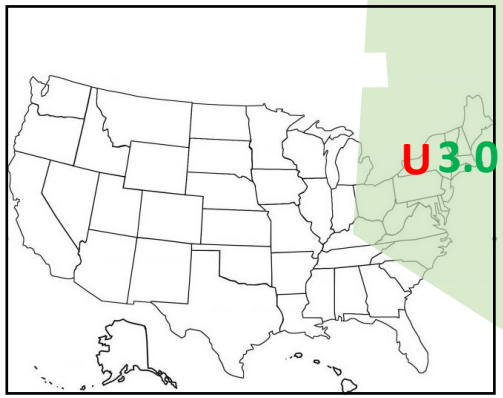
U 11.2

U 10.5

8.6 U S 6.1



$N_{25\text{-}800}$ #/1000/cm^3

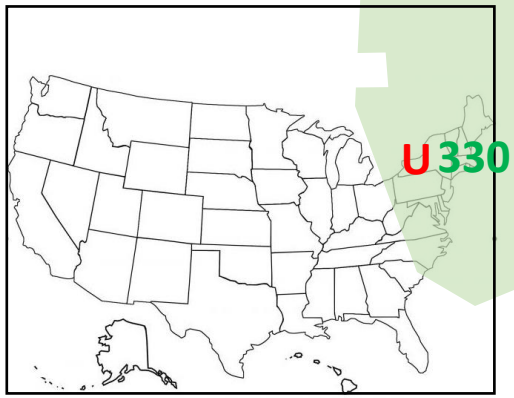


U 3.0

R, S 1 REG, 4 SUB
U 16 UB
T 6 TR

3.4 T
2.8 U T 4.4
2.9 U
3.9 3.9 U T 8.6
6.1
U
4.9 U T 6.8, 6.9
5.6 S
4.2 U T 5.1
5.3 U
3.4 S
S 5.4
U 3.9
U 7.1
R 6.3
7.6
U
6.9 U
5.9 U
U 7.4
7.0 U S 4.4

BC (ng/m³)

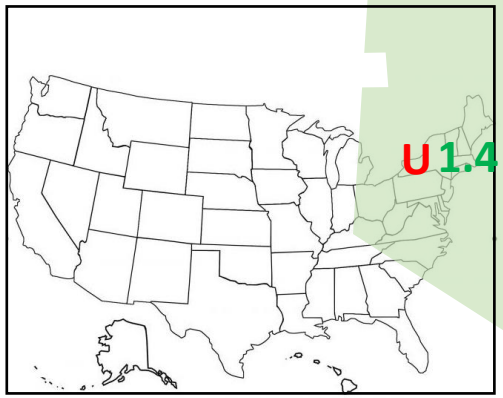


U 330

R, S 1 REG, 4 SUB
U 16 UB
T 6 TR

987 T
433 U T 1010
837 U
829 ND Ψ T 2509
910 U
880 U T 1778, 1512
1021 S
739 U T 1049
641 S
ND U
S ND
U 483
U ND
R 1523
U 1649
1221 U
U 1475
U 1955
1745 U S 824

$N_{x\text{-}25}$ #/1000/cm^3

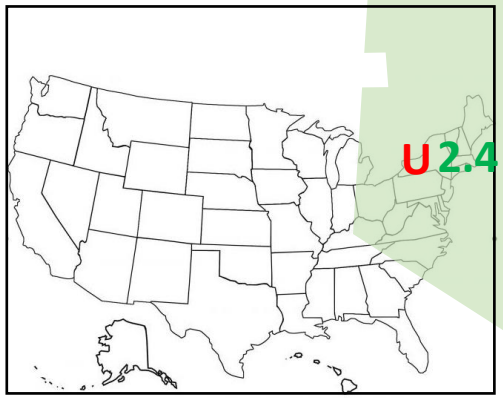


U 1.4

R, S 1 REG, 4 SUB
U 16 UB
T 6 TR

1.6 T
1.4 U T 6.1
0.7 U
ψ T
U
3.2 U T 6.7, 5.2
S
4.6 U
1.9 U T 3.6
1.0 S
S 2.5
U
U 3.7
R 1.0
U
4.2 U
U
U 3.1
1.5 U S 1.7

$N_{25\text{-}100}$ #/1000/cm^3

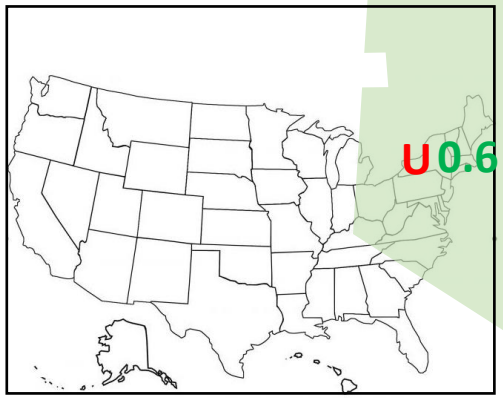


U 2.4

R, S 1 REG, 4 SUB
U 16 UB
T 6 TR

2.8 T
2.1 U T 3.4
2.2 U
3.0 2.9 U T 6.8
5.1
U
3.5 U T 5.3, 5.1
4.1 S
3.0 U T 3.9
4.1 U
2.6 S
S 3.8
U 2.8
U 5.0
R 4.1
5.9
U
5.6 U
4.8 U
U 5.6
5.3 U S 3.2

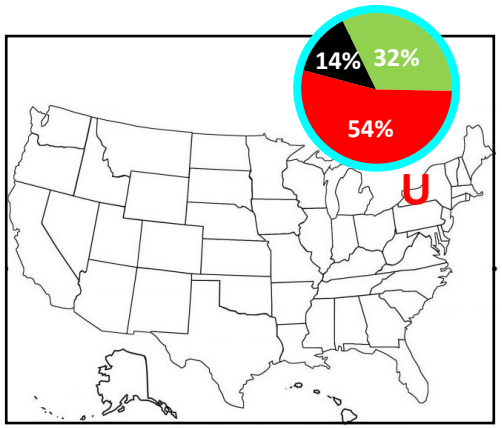
$N_{100\text{-}800}$ #/1000/cm^3



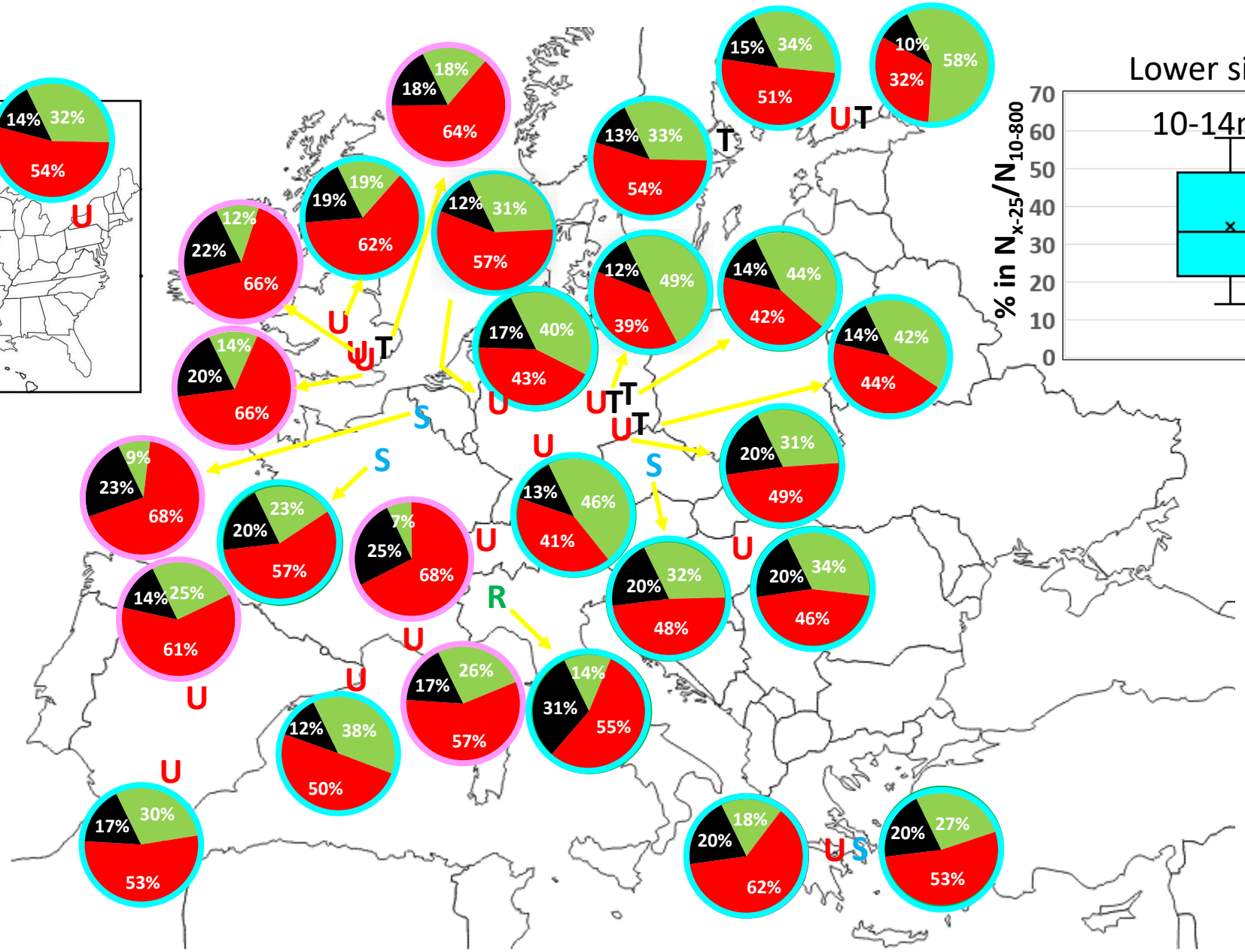
R, S 1 REG, 4 SUB
U 16 UB
T 6 TR

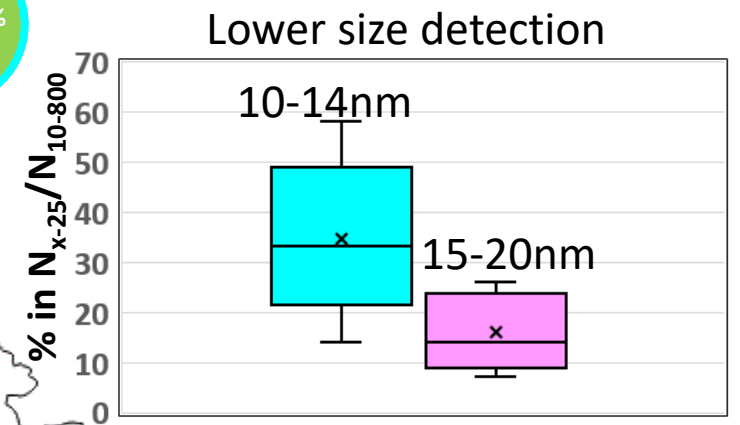
0.7 T
0.6 U T 1.0
0.7 U
0.9 1.0 U T 1.9
1.1 U
1.4 U T 1.6, 1.7
1.4 S
1.2 U T 1.3
1.3 U
0.9 S
S 1.6
U 1.1
U 2.2
R 2.3
1.7 U
1.4 U
1.1 U
U 1.8
1.7 U S 1.2

NUCLEATION, AITKEN & ACCUM SIZES (1000#/cm^3) AVERAGE DAILY PATTERNS



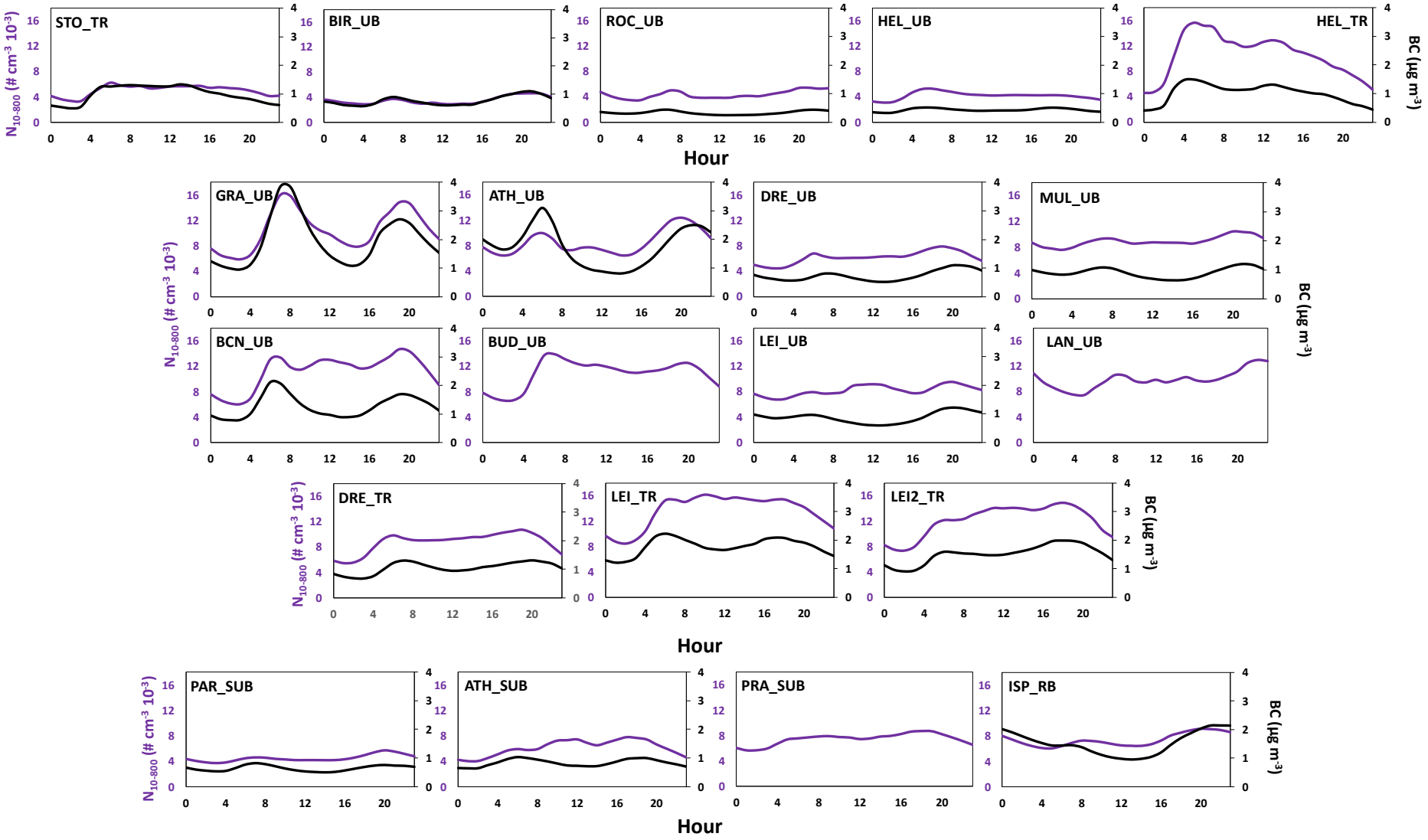
UFP-PSD





BC (µg/m³) & N10-800 (1000#/cm³) AVERAGE DAILY PATTERNS

Excluding $N_{15\text{-}800}$, $N_{17\text{-}800}$, $N_{20\text{-}800}$



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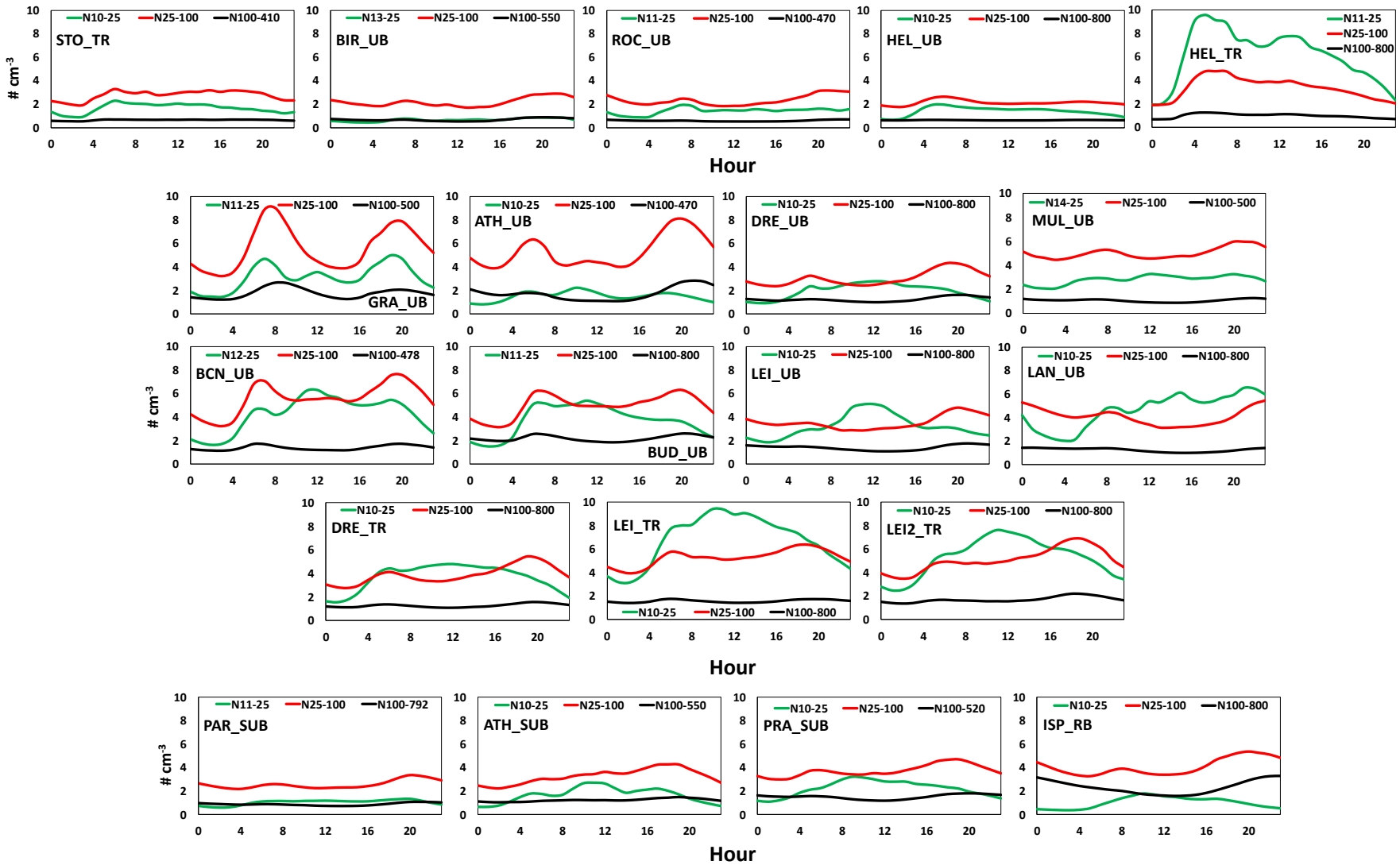
NUCLEATION, AITKEN & ACCUM SIZES (1000#/cm^3) AVERAGE DAILY PATTERNS

Excluding $N_{15\text{-}800}$, $N_{17\text{-}800}$, $N_{20\text{-}800}$



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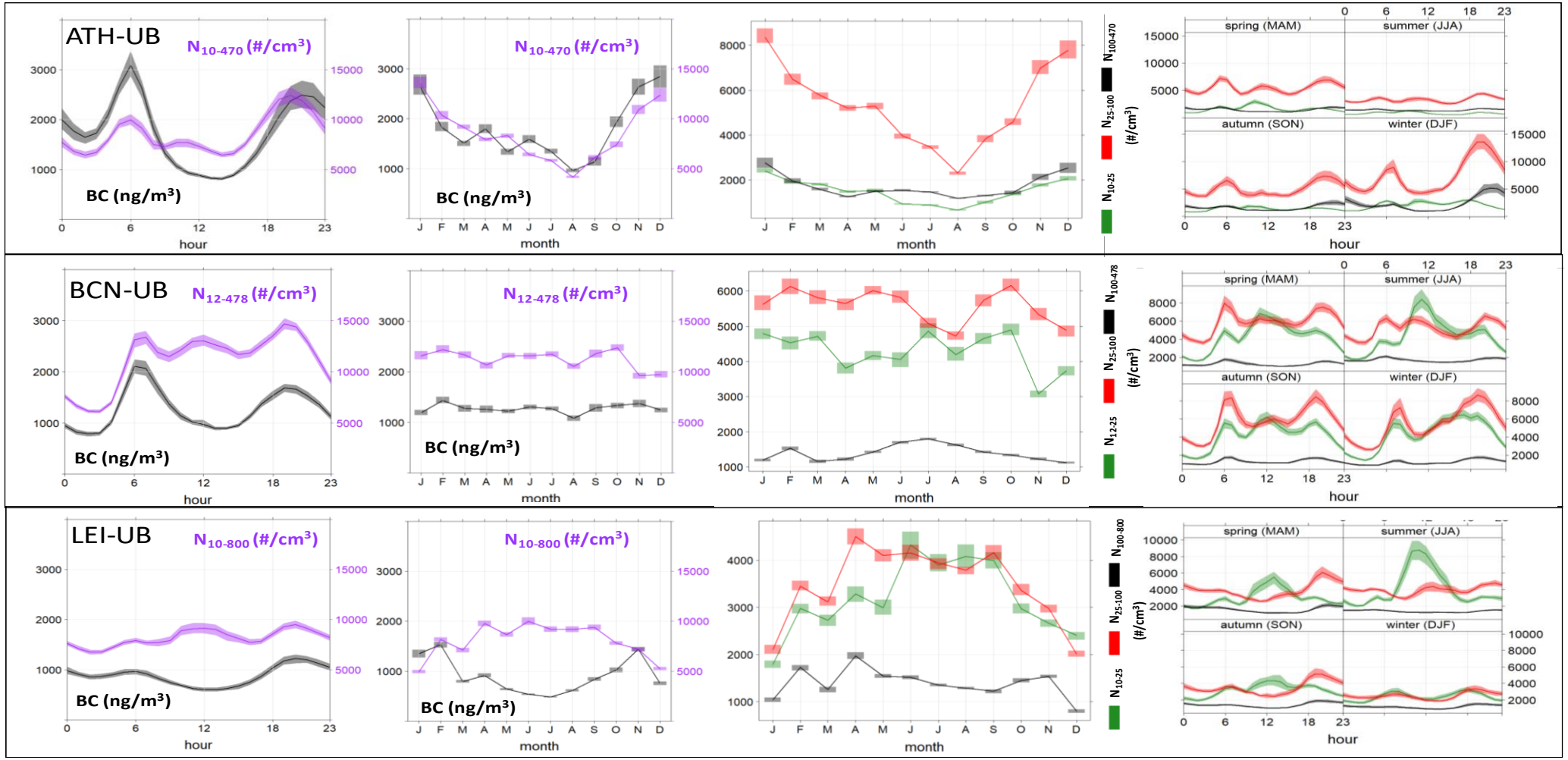
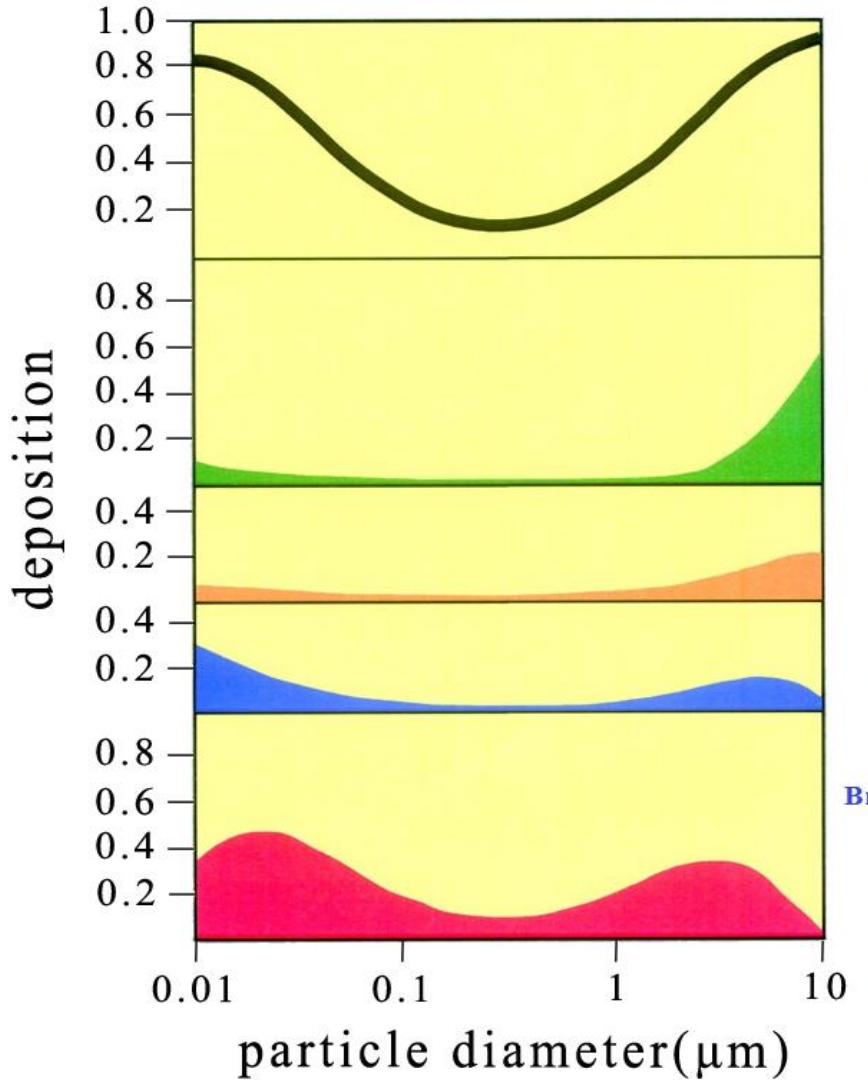
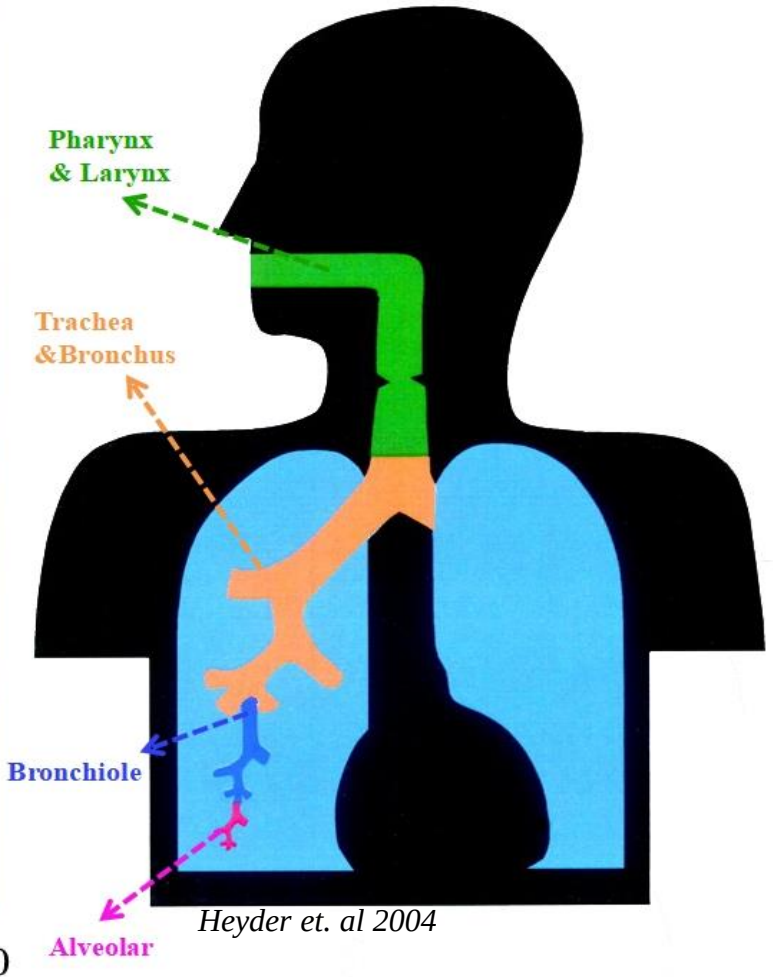
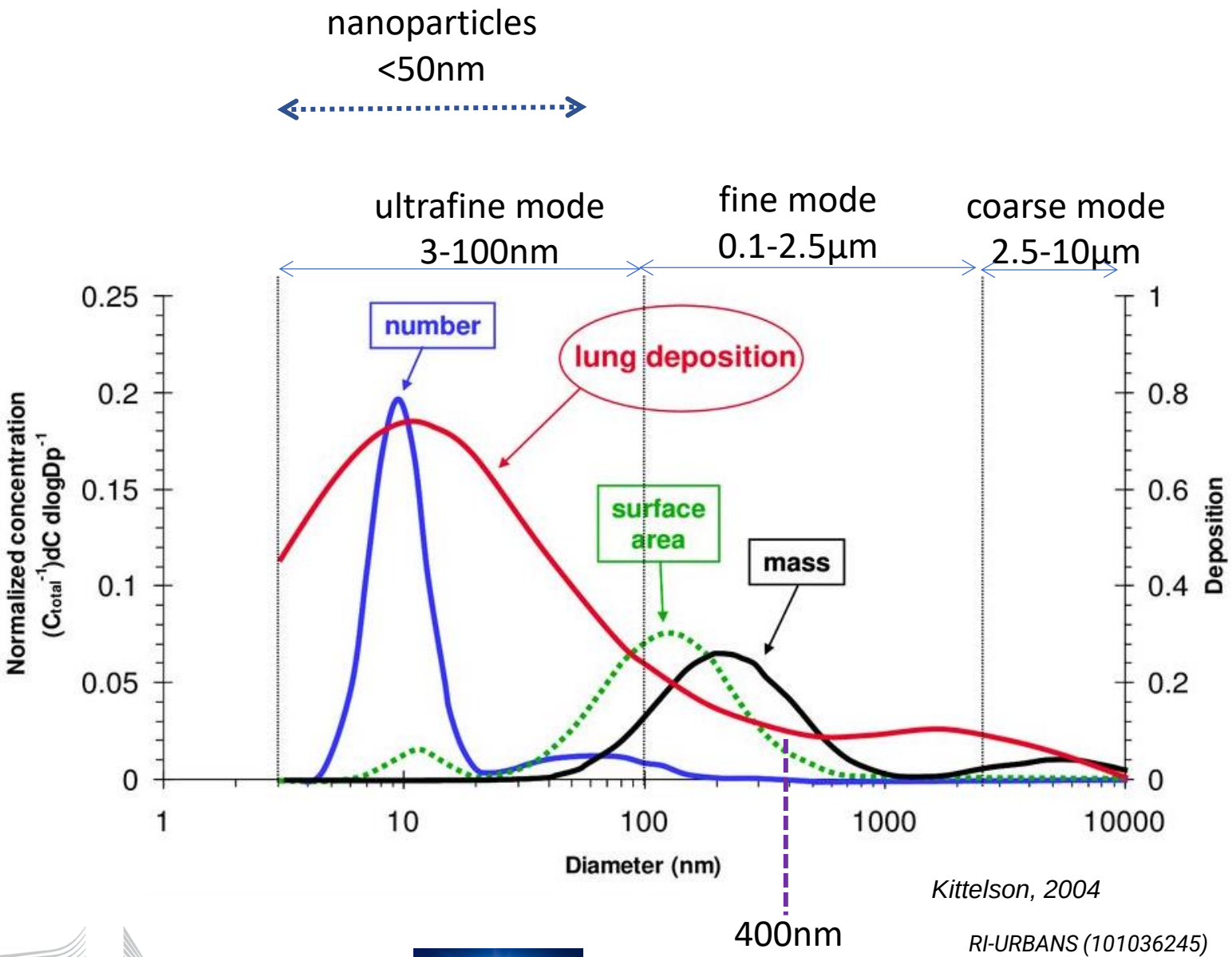
SEASONAL PATTERNS







Heyder et. al 2004



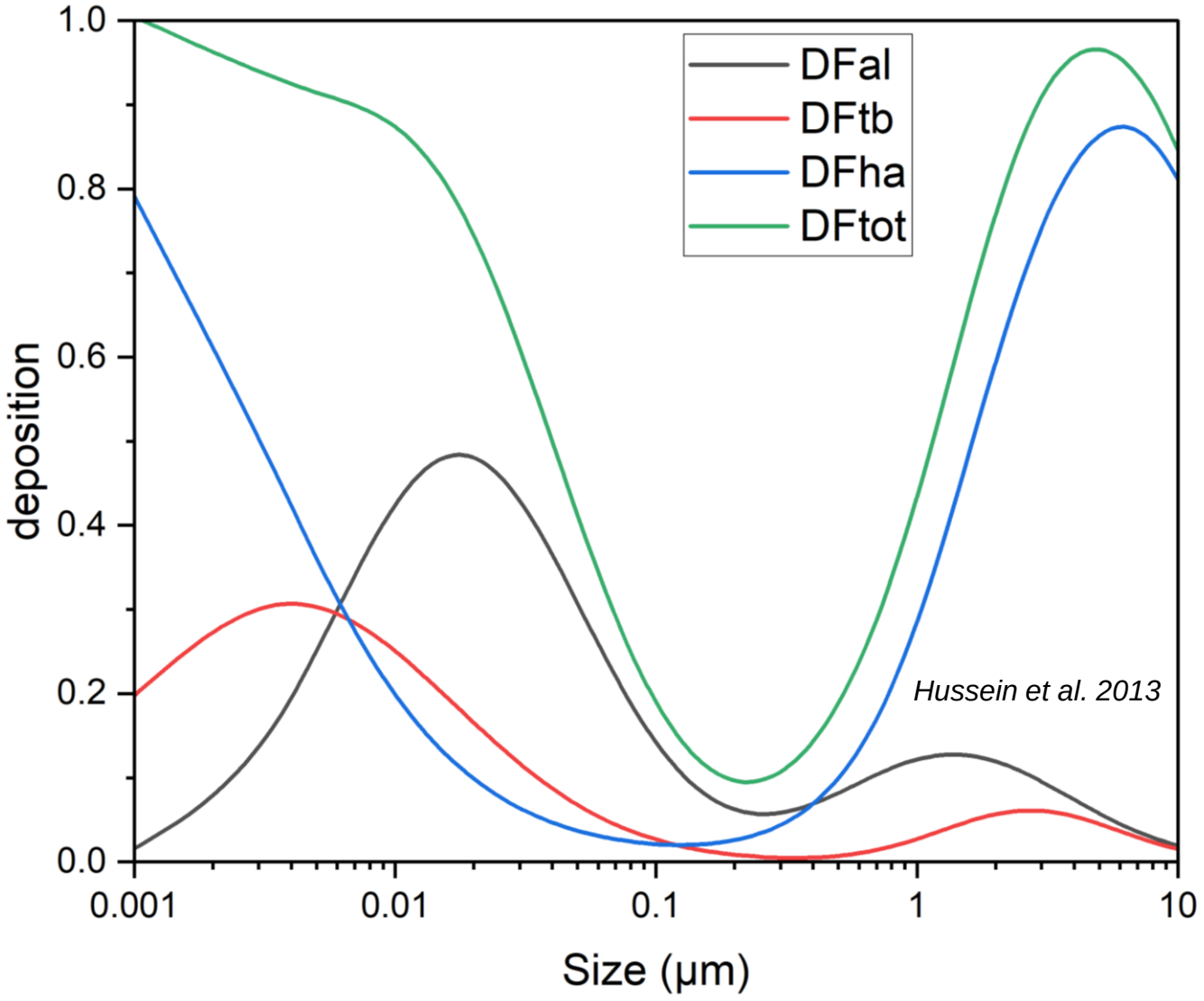
Kittelson, 2004

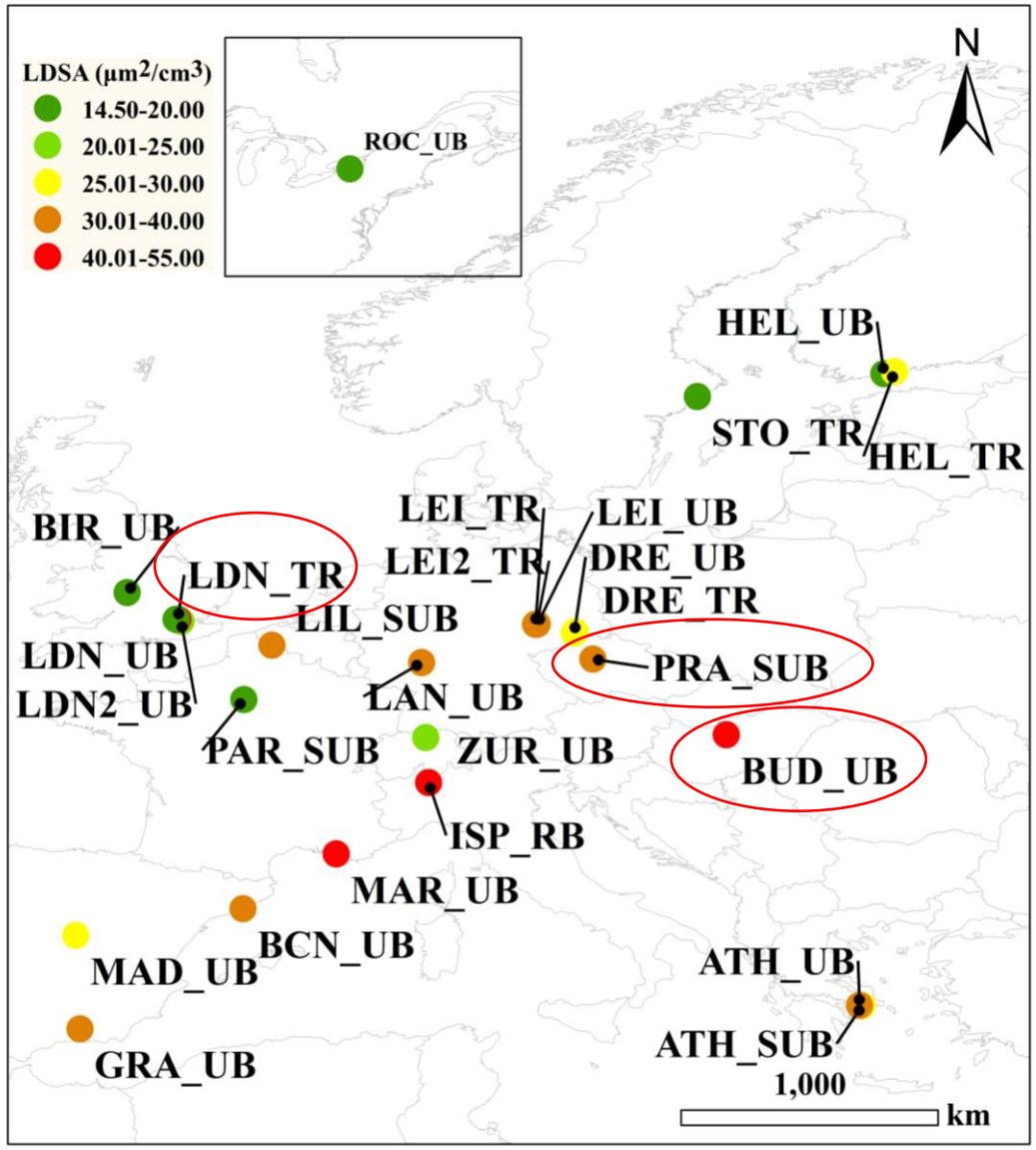
- LDSA is lung deposited surface area, which is the most relevant physical metric for quantifying exposure to particles

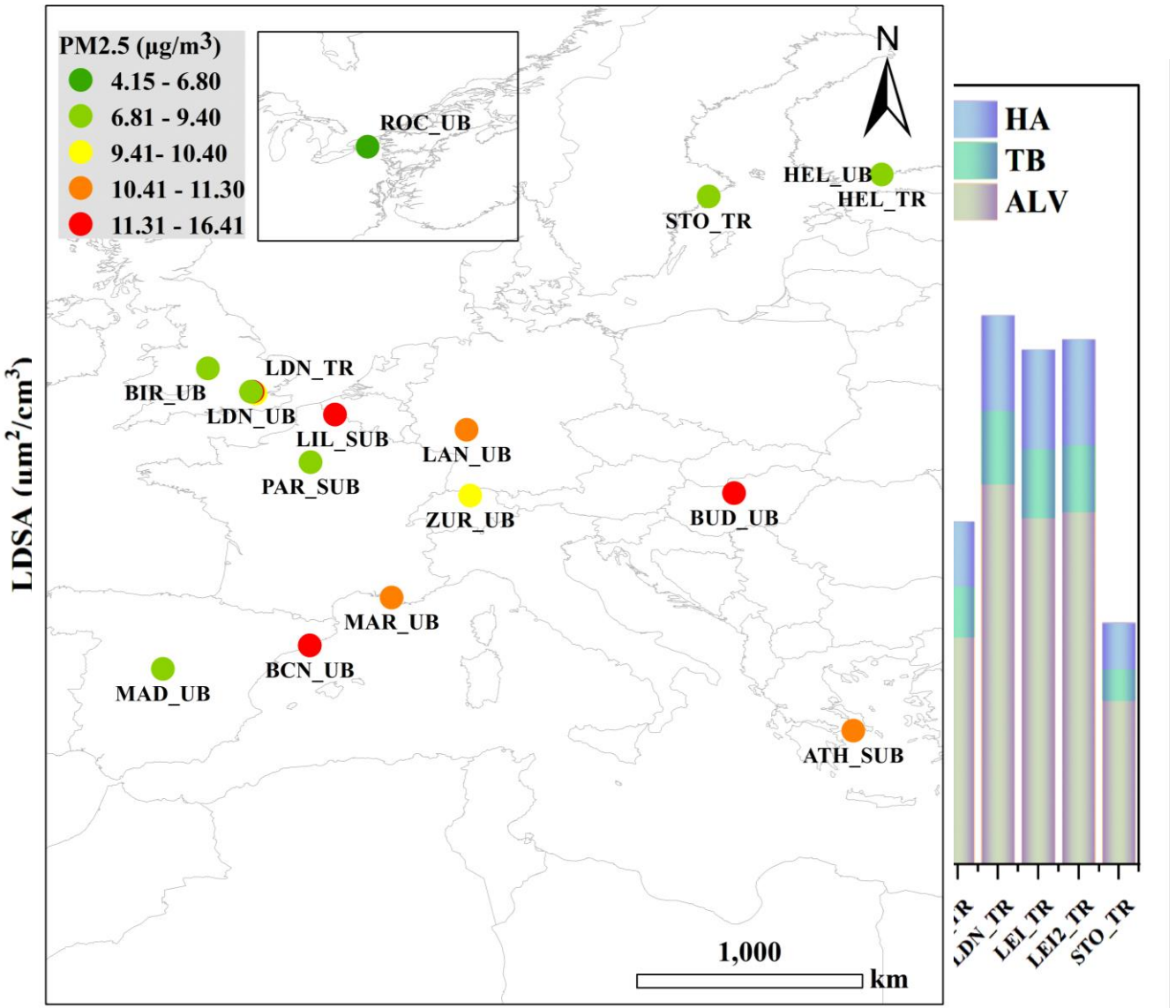
$$\mathrm{DF}_{\mathrm{HA},i} = \left(0.5 + \frac{0.5}{1 + 0.00076 \times D_{p,i}^{2.8}}\right) \times \left(\frac{1}{1 + \exp\left(6.84 + 1.183 \ln D_{p,i}\right)} + \frac{1}{1 + \exp\left(0.924 - 1.885 \ln D_{p,i}\right)}\right),$$

$$\mathrm{DF}_{\mathrm{TB},i} = \frac{0.00352}{D_{p,i}} \times \left(\exp\left(-0.234\left(\ln D_{p,i} + 3.40\right)^2\right) + 63.9 \exp\left(-0.819\left(\ln D_{p,i} - 1.61\right)^2\right)\right).$$

$$\mathrm{DF}_{\mathrm{AR},i} = \frac{0.0155}{D_{p,i}} \times \left(\exp\left(-0.416\left(\ln D_{p,i} + 2.84\right)^2\right) + 19.11 \exp\left(-0.482\left(\ln D_{p,i} - 1.362\right)^2\right)\right)$$



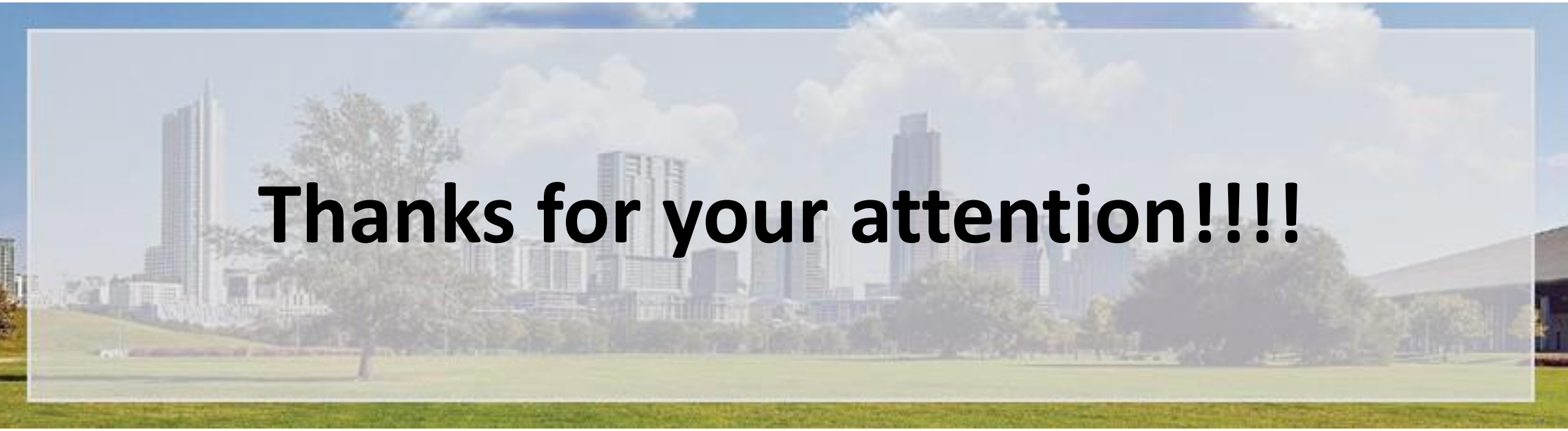




- **2017-2019 average concentrations of total LDSA in twenty-five European sites and one in USA**
- **The contribution of annual average LDSA in different regions of the respiratory tract, including head (HA), tracheobronchial (TB), and alveolar (ALV)**

FINAL CONSIDERATIONS

- 16 urban background and 6 traffic 2017-2019 datasets (& 4 suburban + 1 regional) compiled
- Complexity measurements & maintenance: 15/27 have >70% data availability and 7/27 <50%
- Comparing PNC <25 nm is difficult due to different size detection limits and measurement errors
- For $N_{10\text{-}800}$ and $N_{25\text{-}800}$: Gradient to decrease S>C>N Europe, and (as expected) T>UB>SUB
- The proportions of nucleation/aitken/accumulation, seasonality and daily patterns, widely vary
- PNC seems to be dominated by road traffic contributions (correlation with BC), but in some cities midday or morning photochemical nucleation accounts for a very relevant proportion
- High midday photochemical nucleation is not always higher in S-Europe (higher insolation), but not exclusively
- Seasonal patterns might completely differ
- LONGER TIME SERIES COMPILED AND AVAILABLE IN D1 FOR HEALTH STUDIES
- NEXT STEPS:
  - **Include dataset in EBAS**
  - **Stablish data flow of non-ACTRIS datasets to ACTRIS EBAS**
  - Source apportionment and epidemiology studies for short term effects
  - Risk analysis using PNSD



Thanks for your attention!!!!