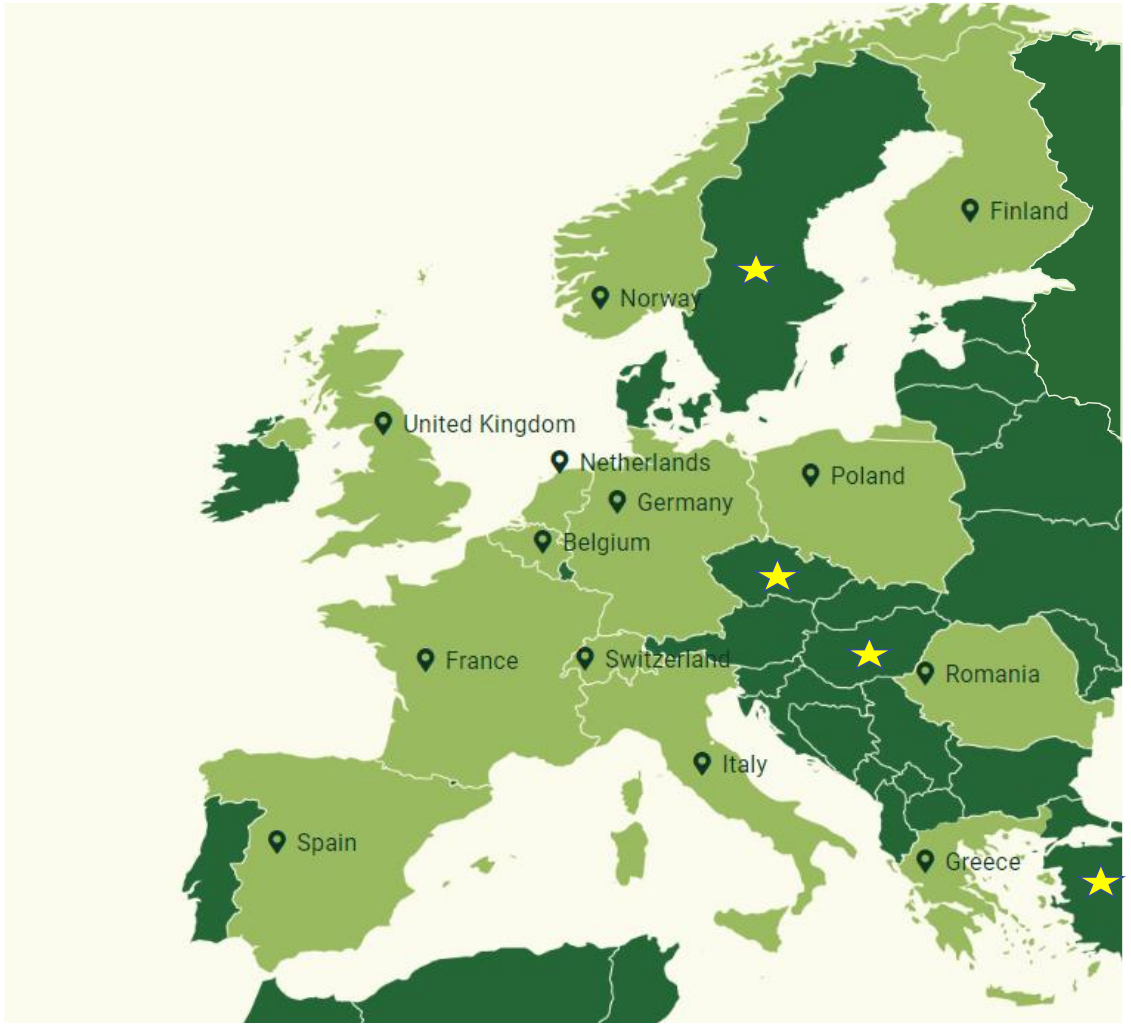
URBAN ULTRAFINE PARTICLES IN EUROPE
RI-URBANS
Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS

RI-URBANS WP1 GROUP

EFCA's 8th Ultra- Fine Particles Symposium, Brussels 5th & 6th July 2022

14 countries, 25 beneficiaries, 1 associated beneficiary, starting with 11 cities



CSIC · HELSINGIN YLIOPISTO · cnrs · Consiglio Nazionale delle Ricerche

UNIVERSITY OF BIRMINGHAM · FORTH · PAUL SCHERRER INSTITUT PSI

vito · Empa · TROPOS Leibniz-Institut für Troposphärenforschung · JÜLICH Forschungszentrum · NILU

ISGlobal Barcelona Institute for Global Health · INERIS · Imperial College London · Institut Mines-Télécom

Meteorologisk institutt · TNO innovation for life · Barcelona Supercomputing Center · UNIWERSYTET WARSZAWSKI

Joint Research Centre JRC

European Commission

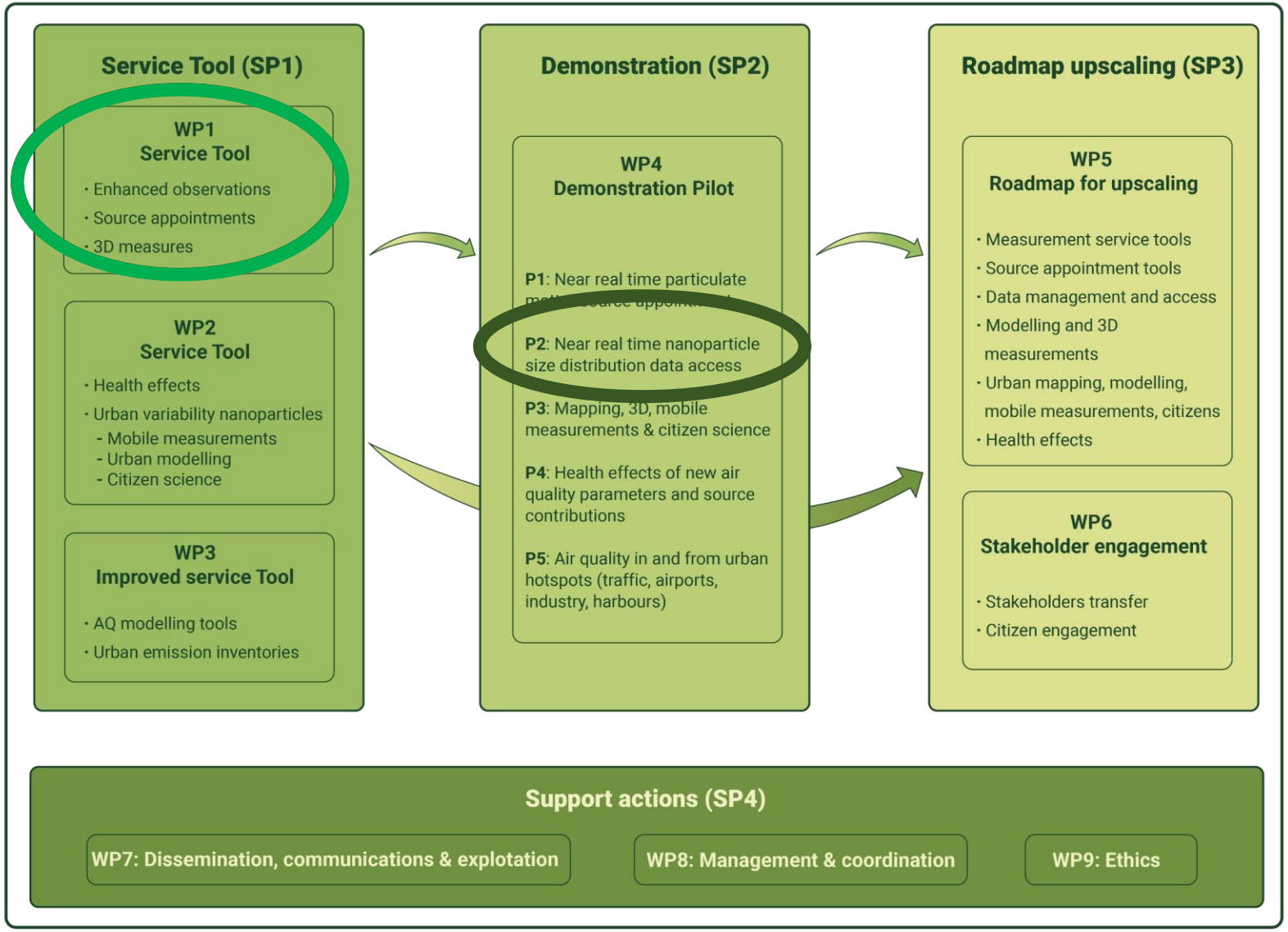
HORIZON 2020

RI URBANS

PILLARS & WORK PACKAGES

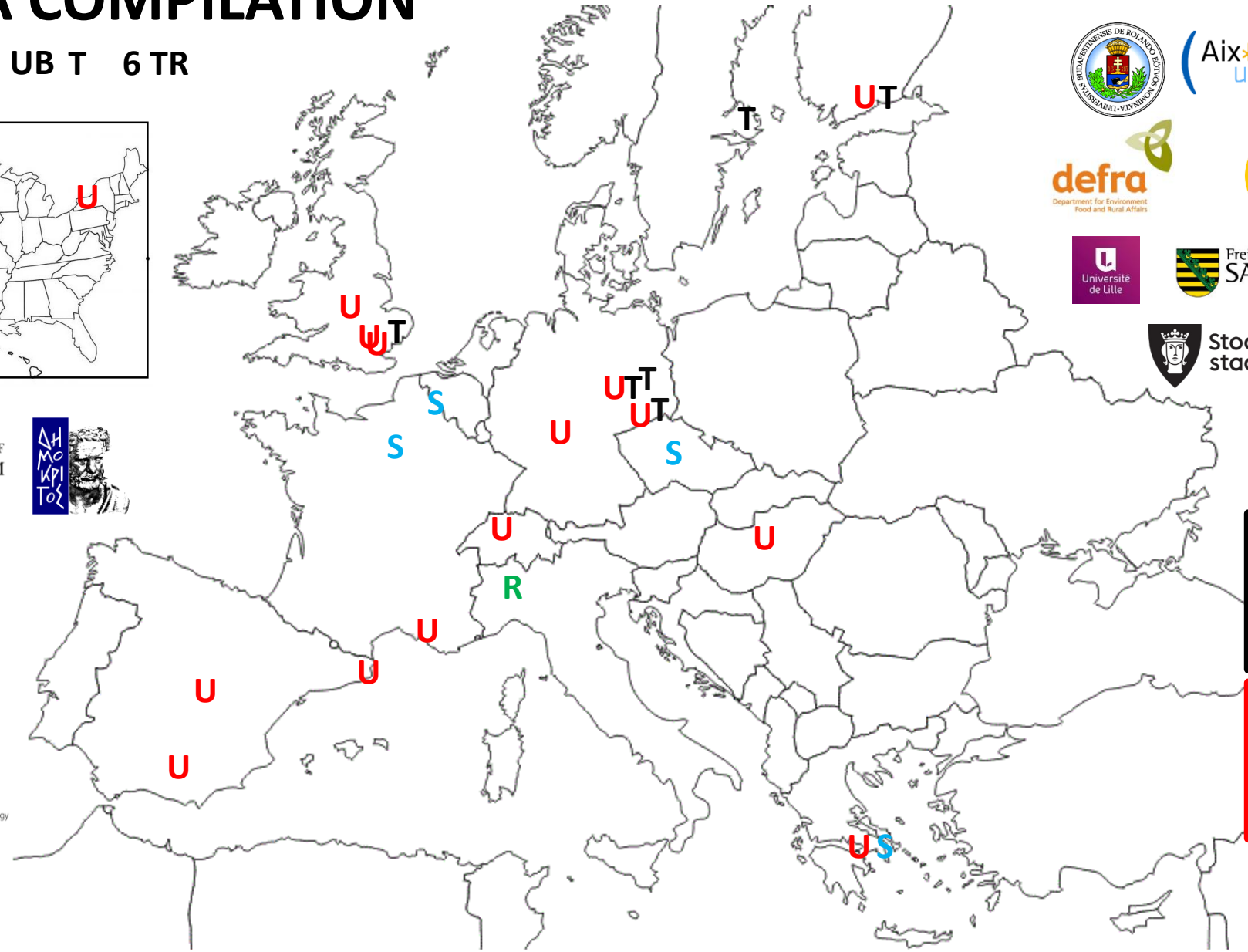
UFP

THIS PRESENTATION



UFP-PSD DATA COMPILATION

R, S 1 REG, 4 SUB U 15 UB T 6 TR



12 datasets

Other than ACTRIS

14 datasets

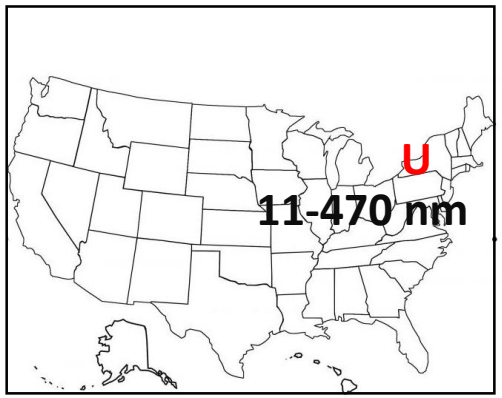
UFP-PSD DATA AVAILABILITY 2017-2019

R, S 1 REG, 4 SUB
U 15 UB
T 6 TR

16 SITES 64-100%
14 SITES >70%
7 SITES <50%

T 47 100 U T 71
U 15
52, 21 Ψ T 46
S 51
U T 69-98
U T 72-78
U 83
S 92
S 86
U 34
U 93
R 95
U 17
U 77
U 43
U 81
64 U S 74

UFP-PSD LOW AND HIGH SIZE DETECTION LIMITS



R, S 1 REG, 4 SUB
U 15 UB
T 6 TR

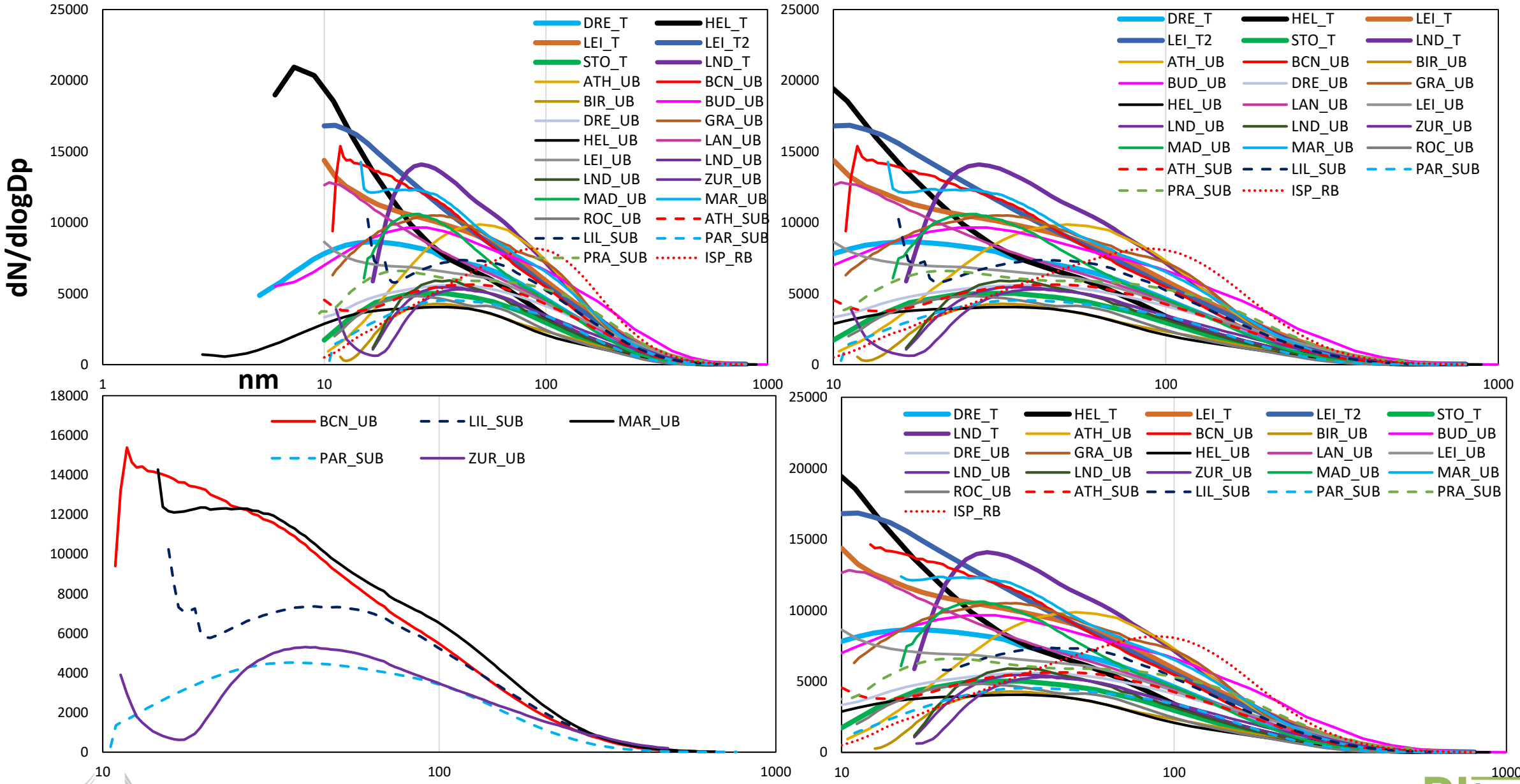
P10	5	470
P25	10	550
P50	10	661
P75	11	800
P90	16	800

10-410 nm
T
UT 3-794 nm UB
6-800 nm TR
13-552 nm
U
17-604 nm
ΨT 17-604 nm
17-604 nm
20-594 nm
S
10-800 nm
10-800 nm
UT 10-800 nm
UT 5-800 nm, 10-800 nm
S
11-791 nm
U
10-544 nm
S 10-519 nm
U 17-478 nm
U 6-994 nm
R 10-800 nm
U 15-661 nm
15-661 nm
U
U
12-478 nm
U
11-496 nm
U S 10-550 nm SUB
10-470 nm UB

RECOMMENDATIONS

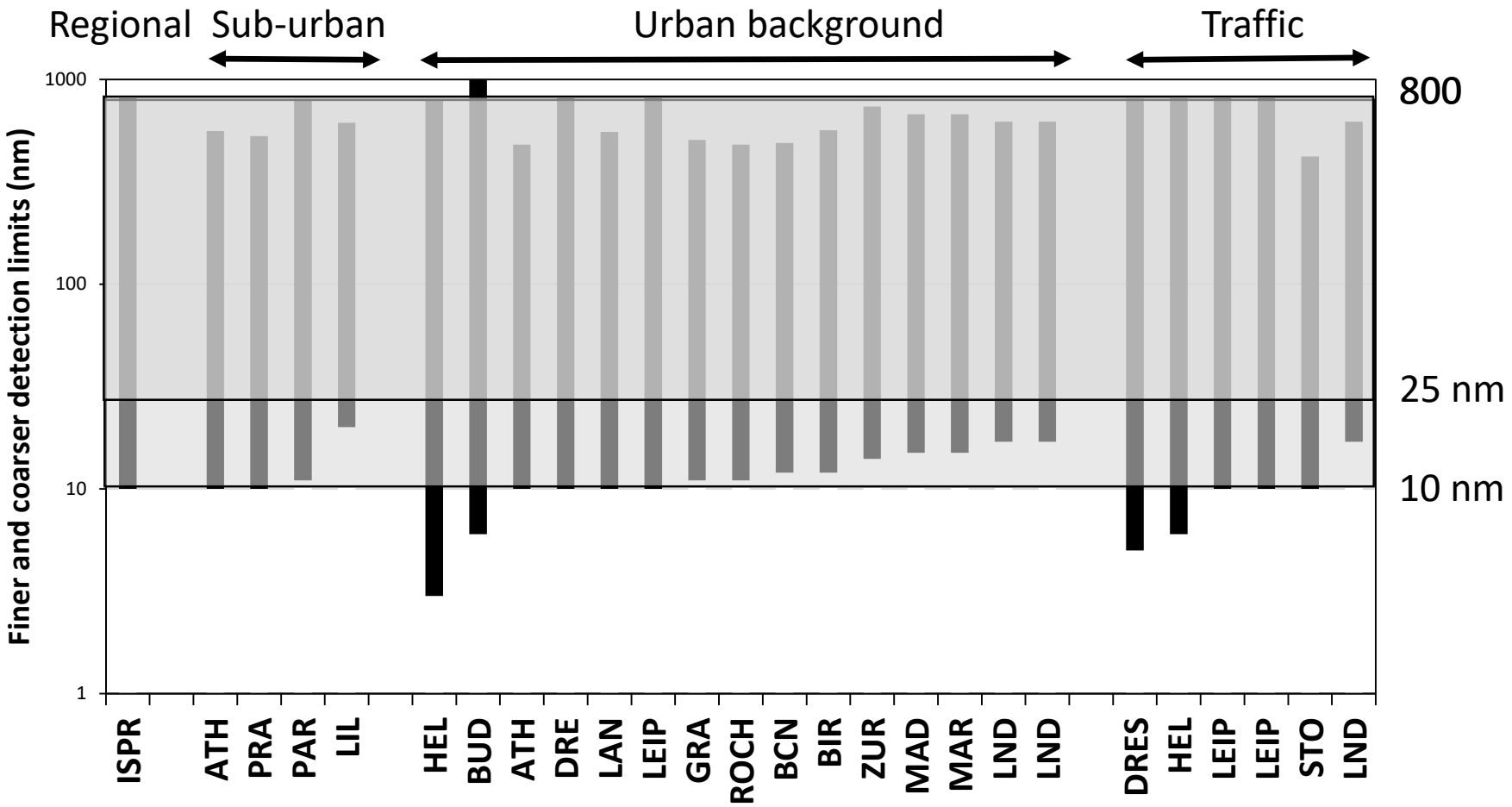
10-800 nm ACTRiS

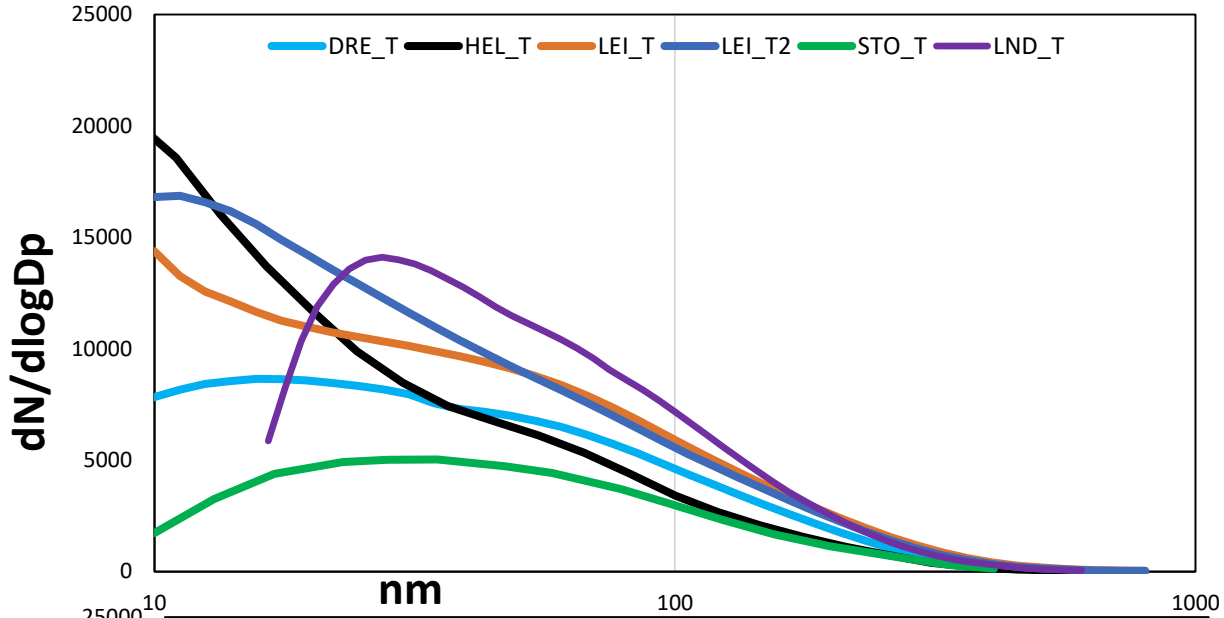
10-800 nm cen

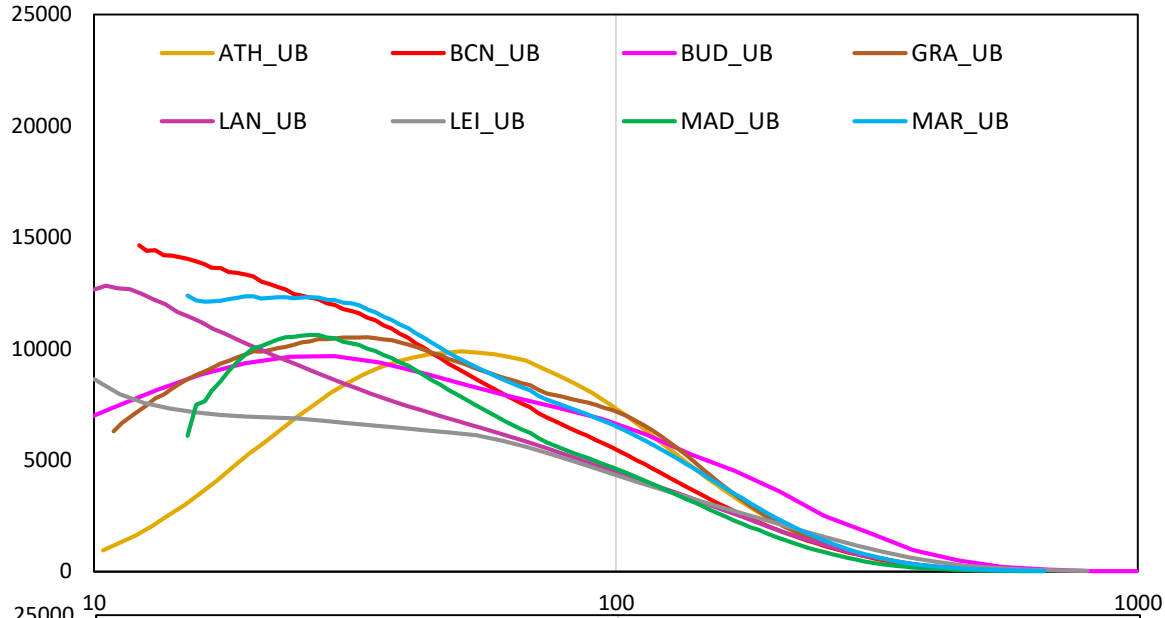

dN/dlogDp
nm
DRE_T
HEL_T
LEI_T
LEI_T2
STO_T
LND_T
ATH_UB
BCN_UB
BIR_UB
BUD_UB
DRE_UB
GRA_UB
HEL_UB
LAN_UB
LEI_UB
LND_UB
LND_UB
ZUR_UB
MAD_UB
MAR_UB
ROC_UB
ATH_SUB
LIL_SUB
PAR_SUB
PRA_SUB
ISP_RB

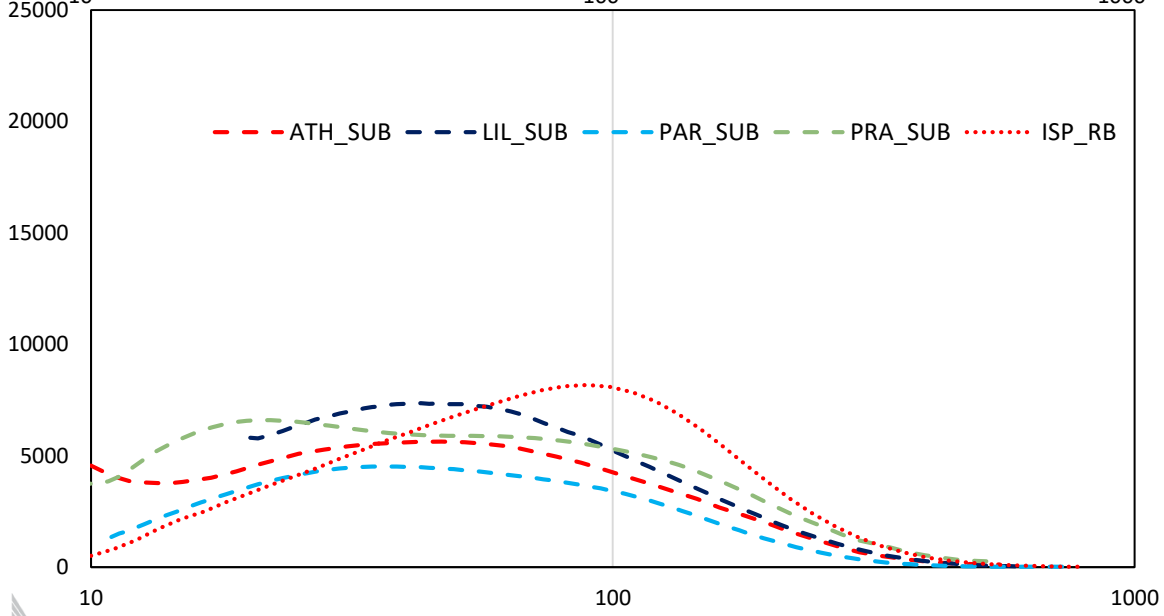
SELECTION OF $N_{10\text{-}800}$ FOR COMPARISON AND HEALTH STUDIES

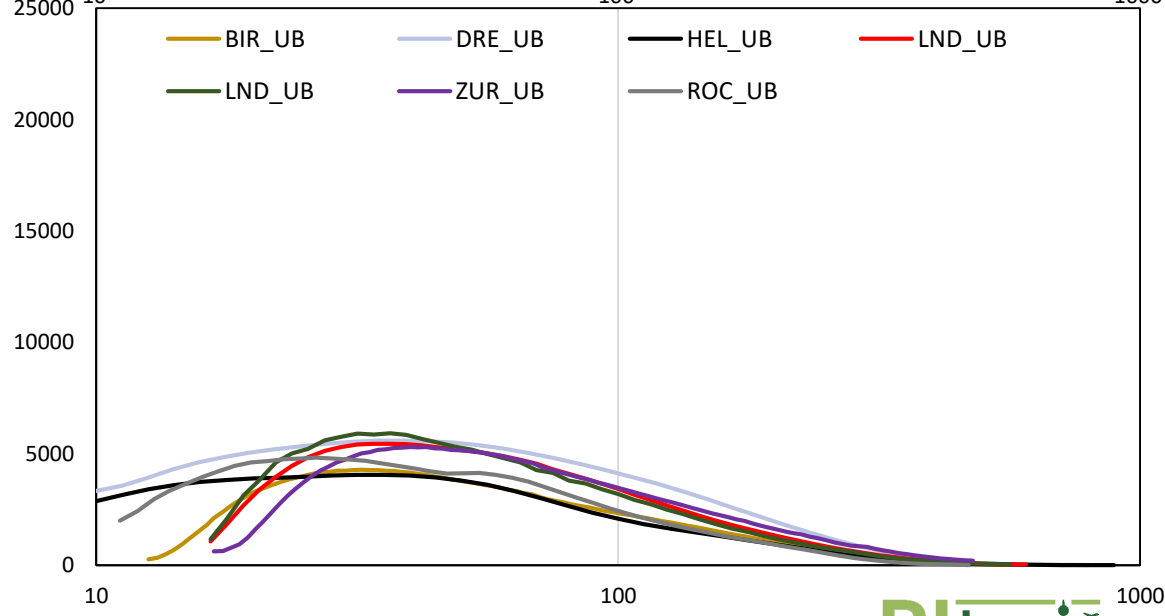
P10	10	470
P25	10	550
P50	10	661
P75	11	800
P90	17	800



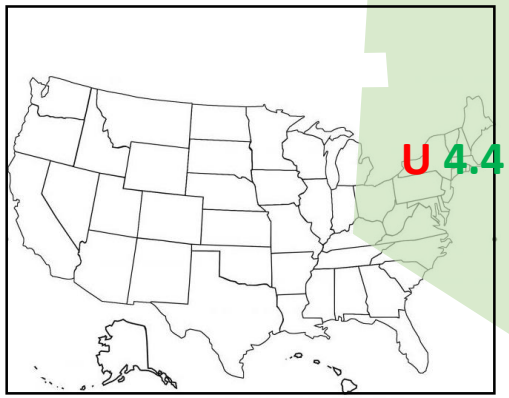

DRE_T
HEL_T
LEI_T
LEI_T2
STO_T
LND_T
dN/dlogDp
nm
25000
20000
15000
10000
5000
0
10
100
1000


ATH_UB
BCN_UB
BUD_UB
GRA_UB
LAN_UB
LEI_UB
MAD_UB
MAR_UB
25000
20000
15000
10000
5000
0
10
100
1000


ATH_SUB
LIL_SUB
PAR_SUB
PRA_SUB
ISP_RB
25000
20000
15000
10000
5000
0
10
100
1000


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

5.1 T

4.2 UT 10.5

3.5 U

4.4 4.5 UT 10.6

6.1 S

4.5 S

8.2 UT 13.6, 12.0

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 US 6.1

R, S 1 REG, 4 SUB

U 15 UB

T 6 TR

4.6-6.1 SUB (7.4 ISP, 7.9 PRA)

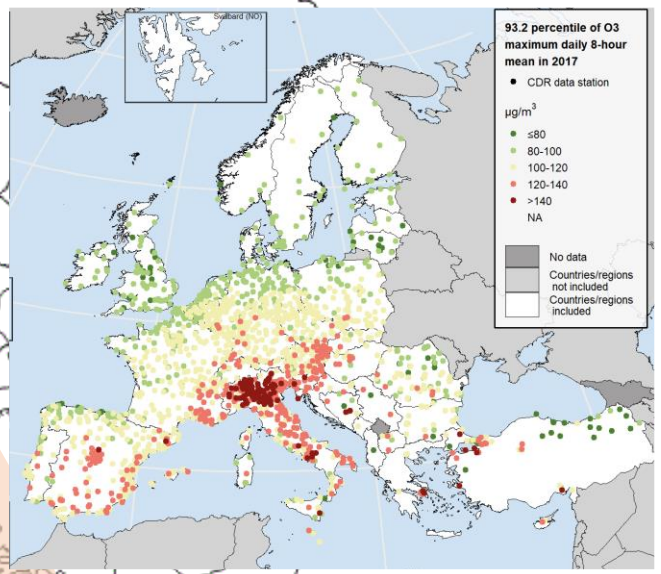
3.5-4.4 UB (N-EU+UK+ROC)

6.2-10.0 UB (C-EU, 4.2 ZUR)

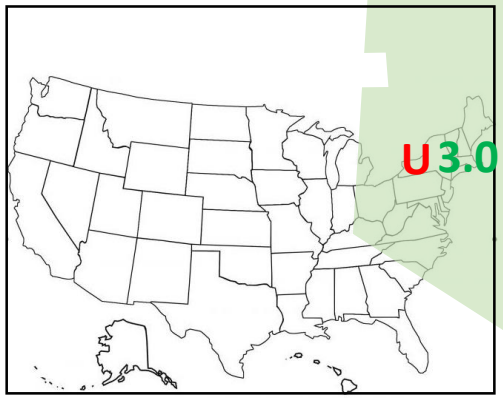
7.9-10.8 UB (S-EU+BUD)

8.8-13.6 T (N&C-EU + UK, 5.1 STO)

No T in S-EU and E-EU



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



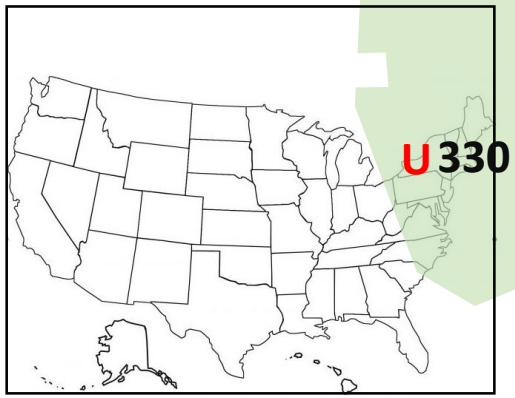
U 3.0

R, S 1 REG, 4 SUB
U 15 UB
T 6 TR

3.4 T
2.8 U T 4.4
2.9 U
3.9 3.9 U T 8.6
5.6 S
3.4 S
4.9 U T 6.8, 6.9
4.2 U T 5.1
5.3 U
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

3.4-5.6 SUB (6.3 ISP)
2.8-3.9 UB (N-EU+UK+ROC)
3.9-5.3 UB (C-EU)
5.9-7.6 UB (S-EU+BUD)
4.4-8.6 T (N&C-EU + UK, 3.4 STO)

BC (ng/m³)



U 330

987 T

433 UT 1010

837U

829 ND ψT 2509

880 UT 1778, 1512

1021 S

739 UT 1049

ND U

641 S

S ND

U 483

U ND

R 1523

U 1649

1221U

U 1475

U 1955

1745 U S 824

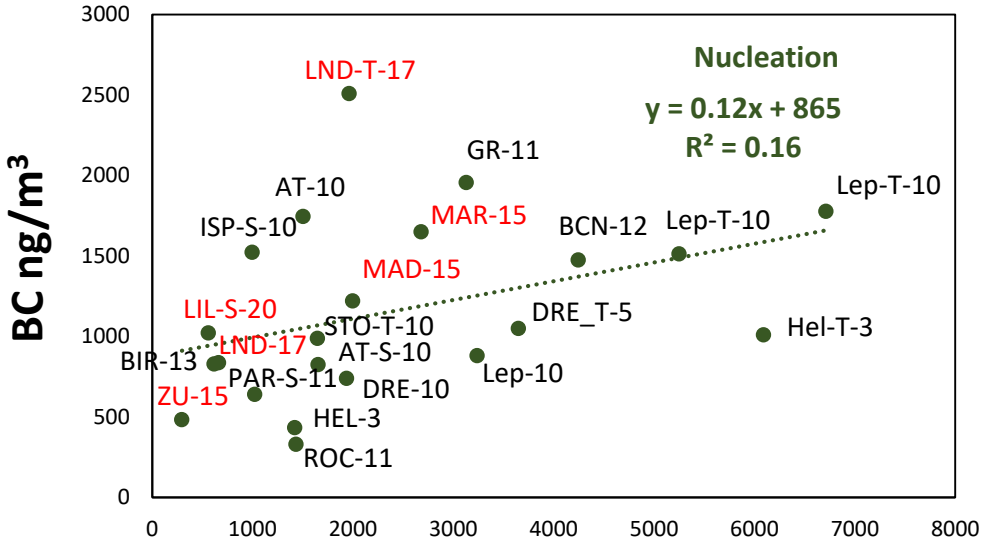
R, S 1 REG, 4 SUB

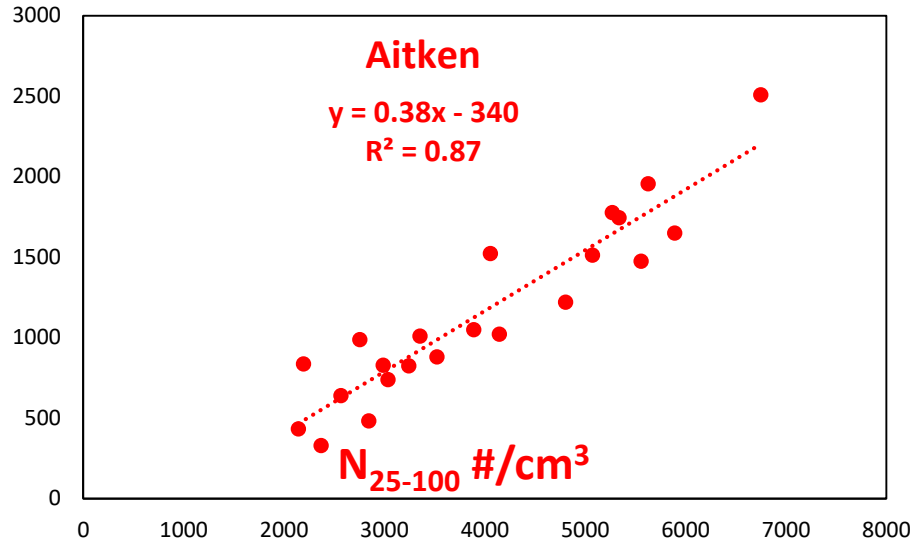
U 15 UB

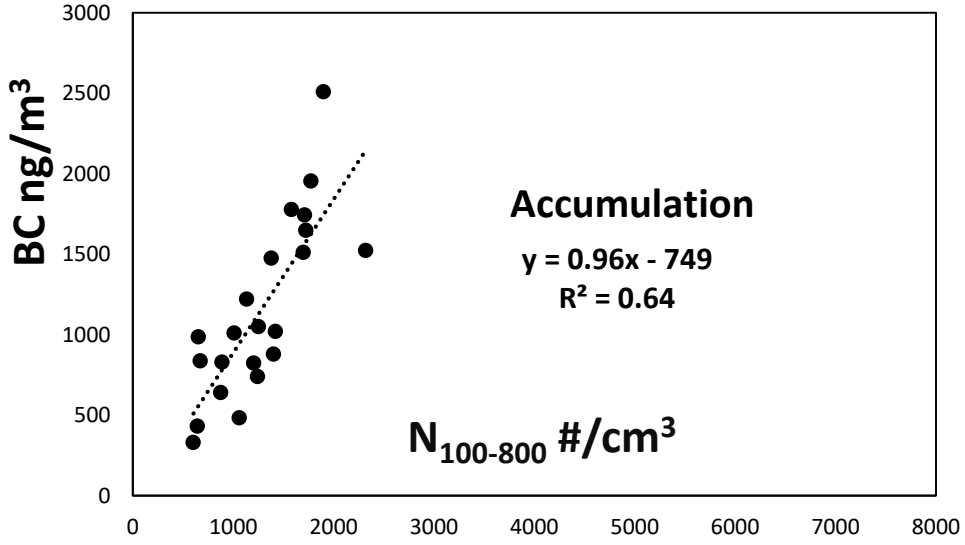
T 6 TR

BC	
1.5	RB
0.6-1.0	SUB
0.3-0.4	UB (N-EU+N-USA)
0.7-1.0	UB (C-EU+UK, 0.5 ZUR)
1.2-2.0	UB (S-EU)
1.0	T (N-EU)
1.0-2.7	T (C-EU+UK)

CORRELATION WITH BC AND OTHER POLLUTANTS

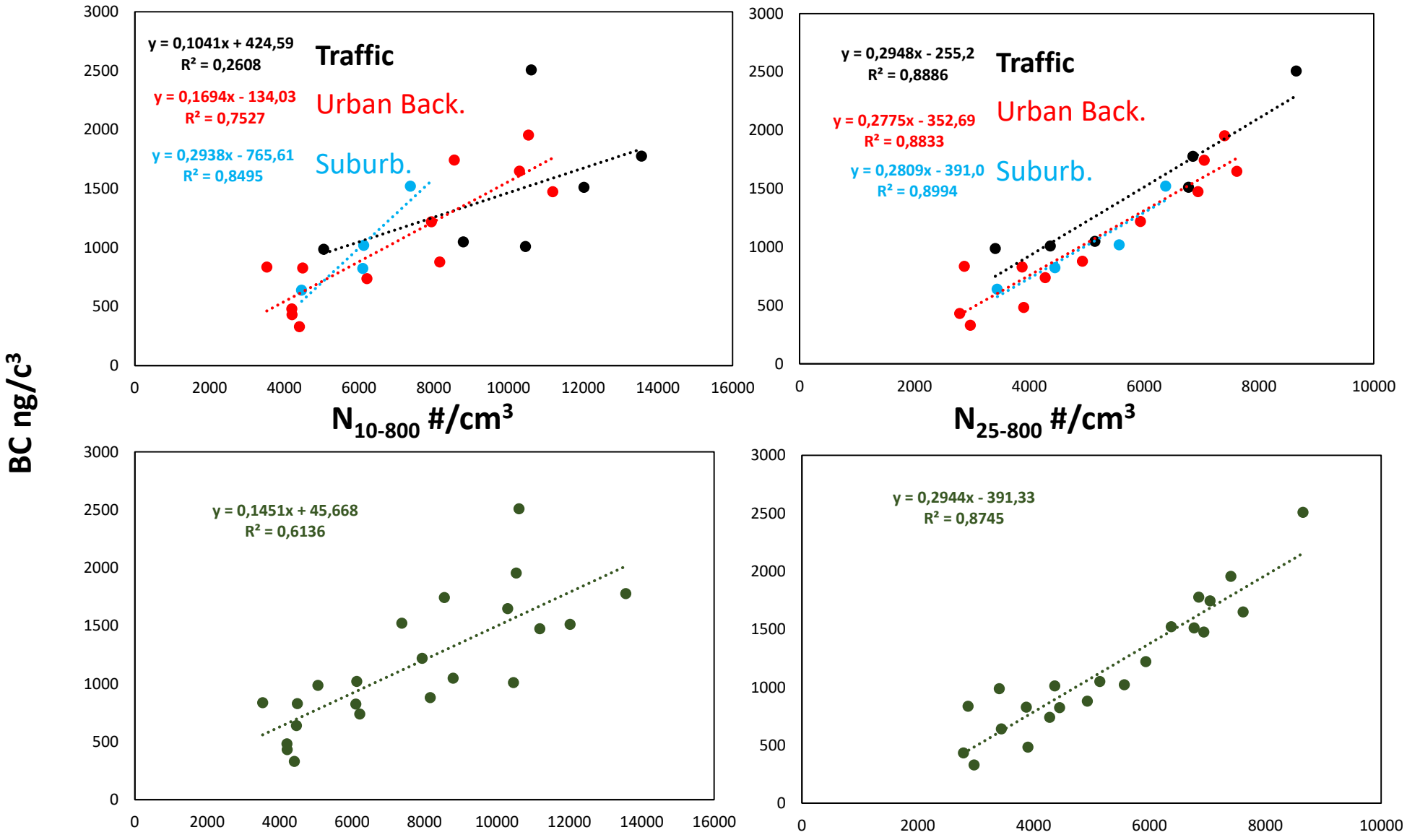




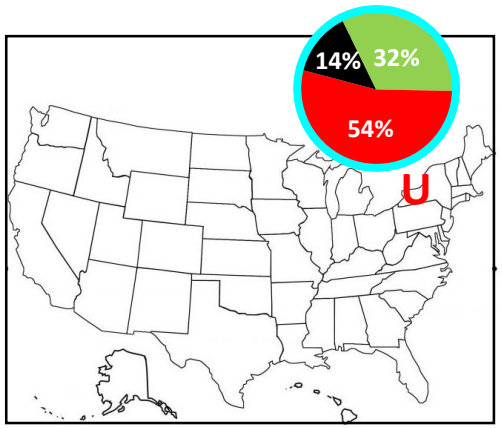


R2 with N10-800 and N25-800 POSITIVE & NEGATIVE SLOPES

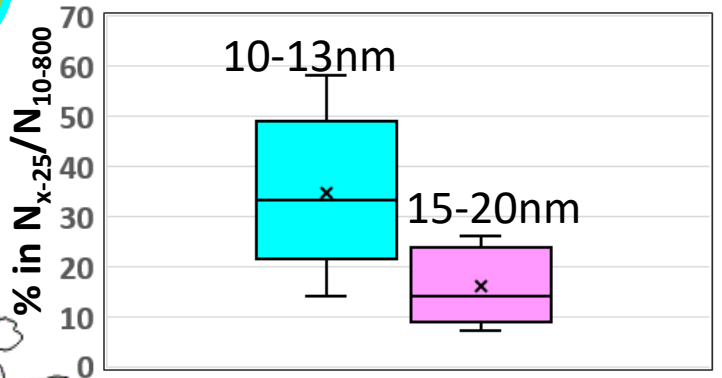
		PM10	PM2.5	BC	WS	RH	T	RAD
N10-800	TR	0.32	0.05	0.26	ND	ND	ND	ND
	UB	0.39	**0.44**	**0.75**	0.07	0.27	0.39	0.28
	SUB	**0.68**	**0.77**	**0.85**	ND	ND	ND	ND
N25-800	TR	0.00	**0.77**	**0.89**	ND	ND	ND	ND
	UB	**0.55**	**0.53**	**0.88**	0.04	**0.46**	**0.53**	**0.46**
	SUB	**0.91**	**0.91**	**0.90**	ND	ND	ND	ND
		NOx	**NO**	**NO2**	**CO**	**SO2**	**O3**	
N10-800	TR	0.05	0.06	0.02	0.04	**ND**	**0.72**	
	UB	0.36	0.28	**0.41**	0.21	0.28	0.02	
	SUB	0.02	0.23	0.00	0.00	ND	0.04	
N25-800	TR	**0.69**	**0.70**	**0.63**	0.36	ND	**0.91**	
	UB	**0.48**	0.37	**0.54**	0.21	**0.47**	0.07	
	SUB	0.07	**0.63**	0.00	0.08	ND	0.24	


BC ng/c3
y = 0,1041x + 424,59
R² = 0,2608
Traffic
y = 0,1694x - 134,03
R² = 0,7527
Urban Back.
y = 0,2938x - 765,61
R² = 0,8495
Suburb.
N10-800 #/cm3
y = 0,2948x - 255,2
R² = 0,8886
Traffic
y = 0,2775x - 352,69
R² = 0,8833
Urban Back.
y = 0,2809x - 391,0
R² = 0,8994
Suburb.
N25-800 #/cm3
y = 0,1451x + 45,668
R² = 0,6136
y = 0,2944x - 391,33
R² = 0,8745

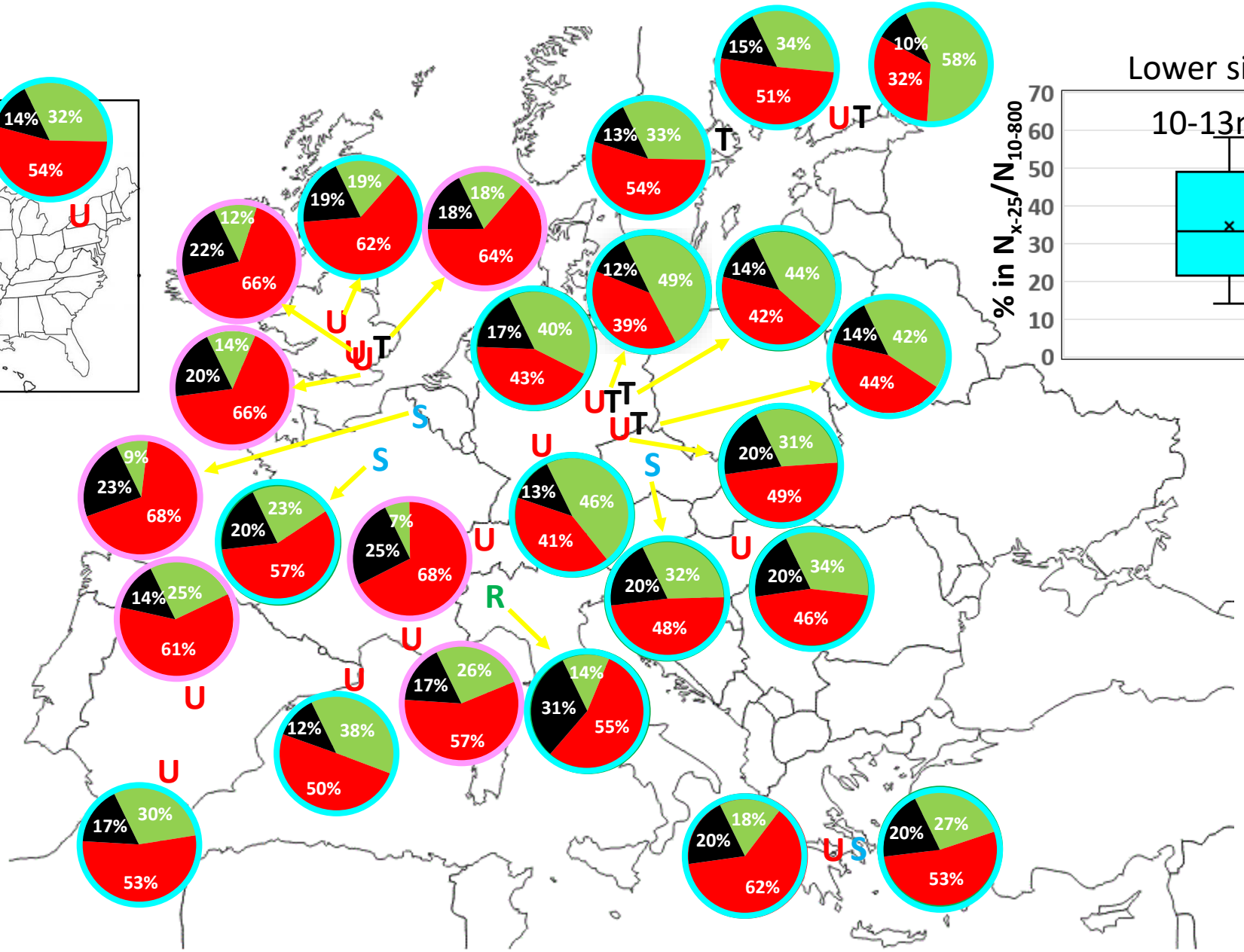
NUCLEATION, AITKEN & ACCUM SIZES (1000#/cm^3) AVERAGE DAILY PATTERNS



Lower size detection



UFP-PSD



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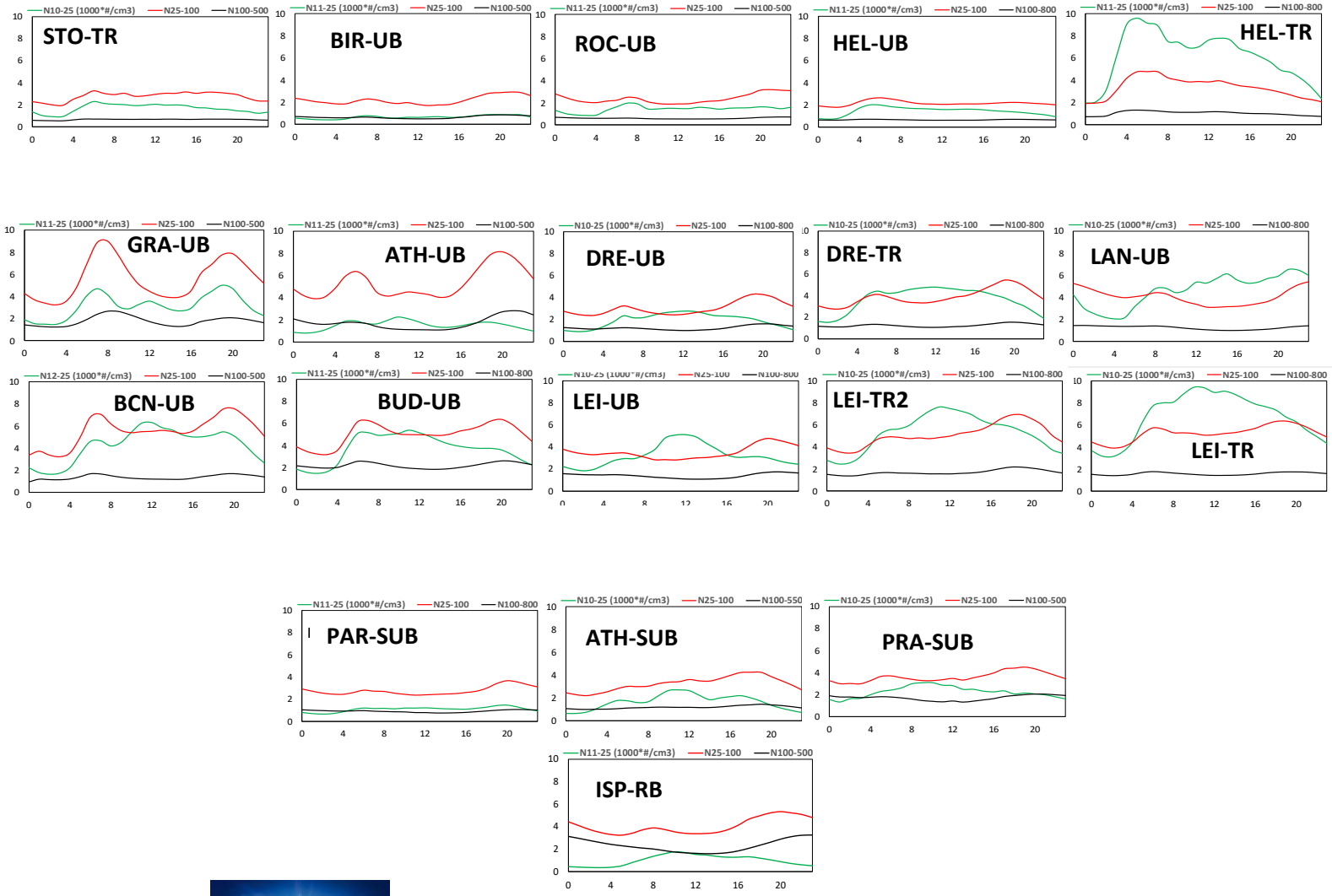
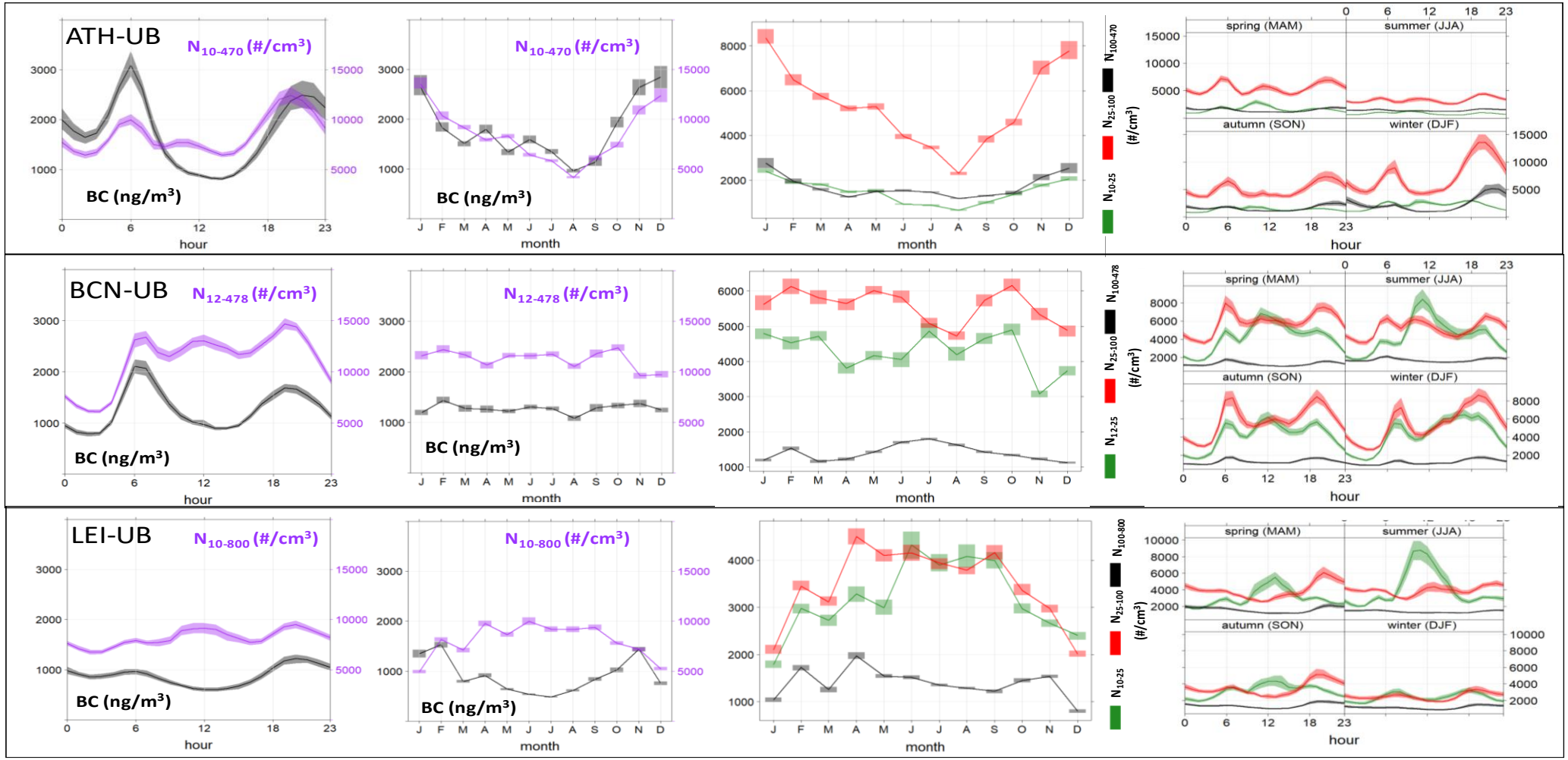
NUCLEATION, AITKEN & ACCUM SIZES (1000#/cm^3) AVERAGE DAILY PATTERNS

Excluding N_{15-800}, N_{17-800}, N_{20-800}



SEASONAL PATTERNS



FINAL CONSIDERATIONS

- 15 urban background and 6 traffic 2017-2019 datasets (& 4 suburban + 1 regional) were compiled
- From the urban or traffic sites 21 only 8 datasets are available in ACTRIS (open), thus an effort should be done to include this in ACTRIS
- Complexity measurements & maintenance: Only 14/26 have >70% data availability and 7/26 <50%
- Errors detected in 5/26 datasets close to the finer detection limit. Stricter data evaluation required (following ACTRIS level 2 and 3)
- 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 $N_{10\text{-}800}$ and $N_{25\text{-}800}$: Gradient to decrease S>C>N Europe, and (as expected) T>UB>SUB
- Very high correlation $N_{25\text{-}800}$/BC (R^2=0.9), lower with other pollutants (PM2.5 and NO_2, R^2=0.5-0.7, T & UB)
- 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 nucleation or vertical atmospheric transport accounts for a very relevant proportion
- High midday or morning non-traffic related peaks are not always higher in S-Europe (higher insolation)
- Seasonal patterns might completely differ
- NEXT STEPS: Source apportionment and epidemiology studies for short term effects

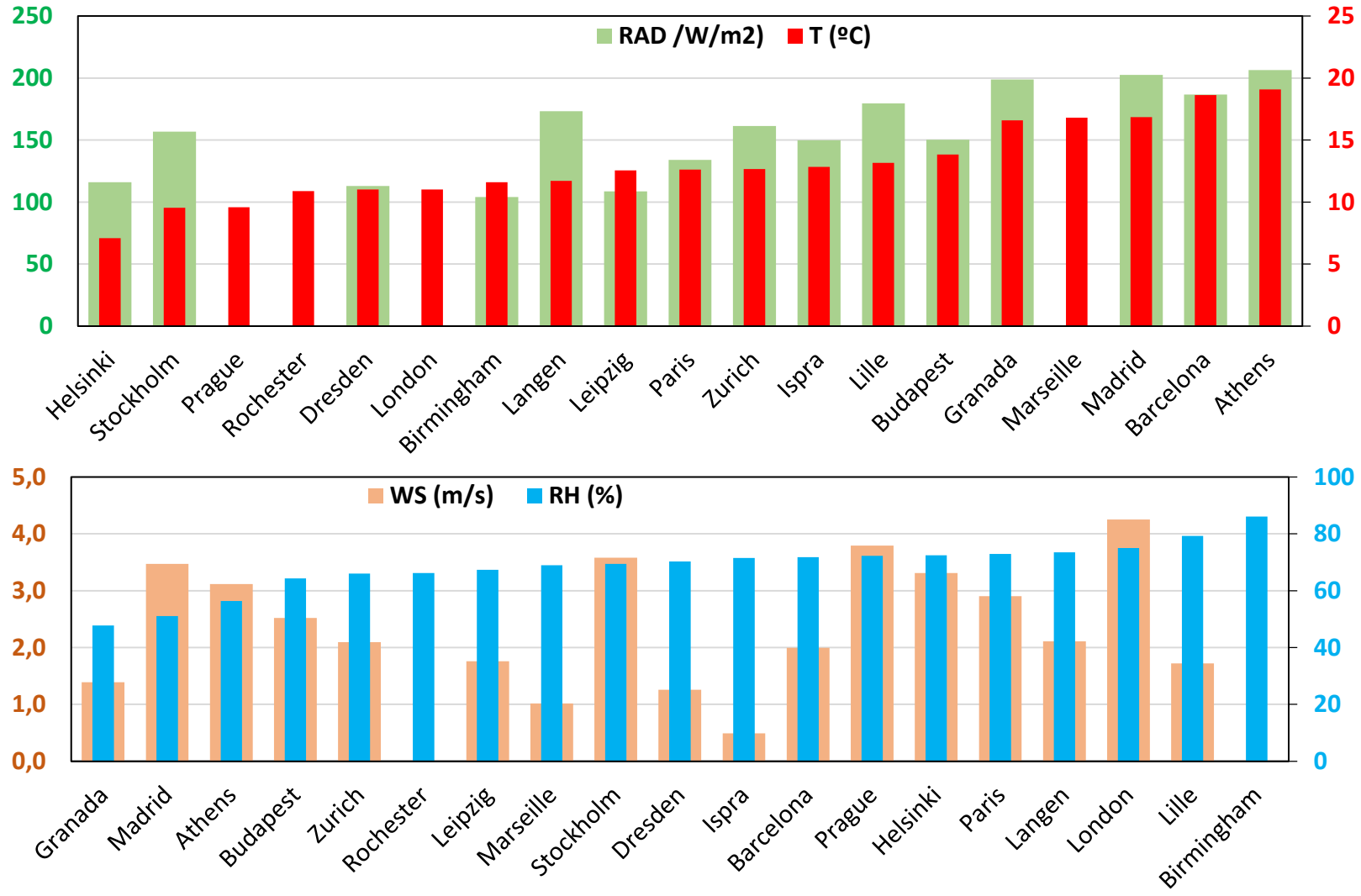
Thanks for your attention!!!!

RI-URBANS 1st SCIENCE MEETING

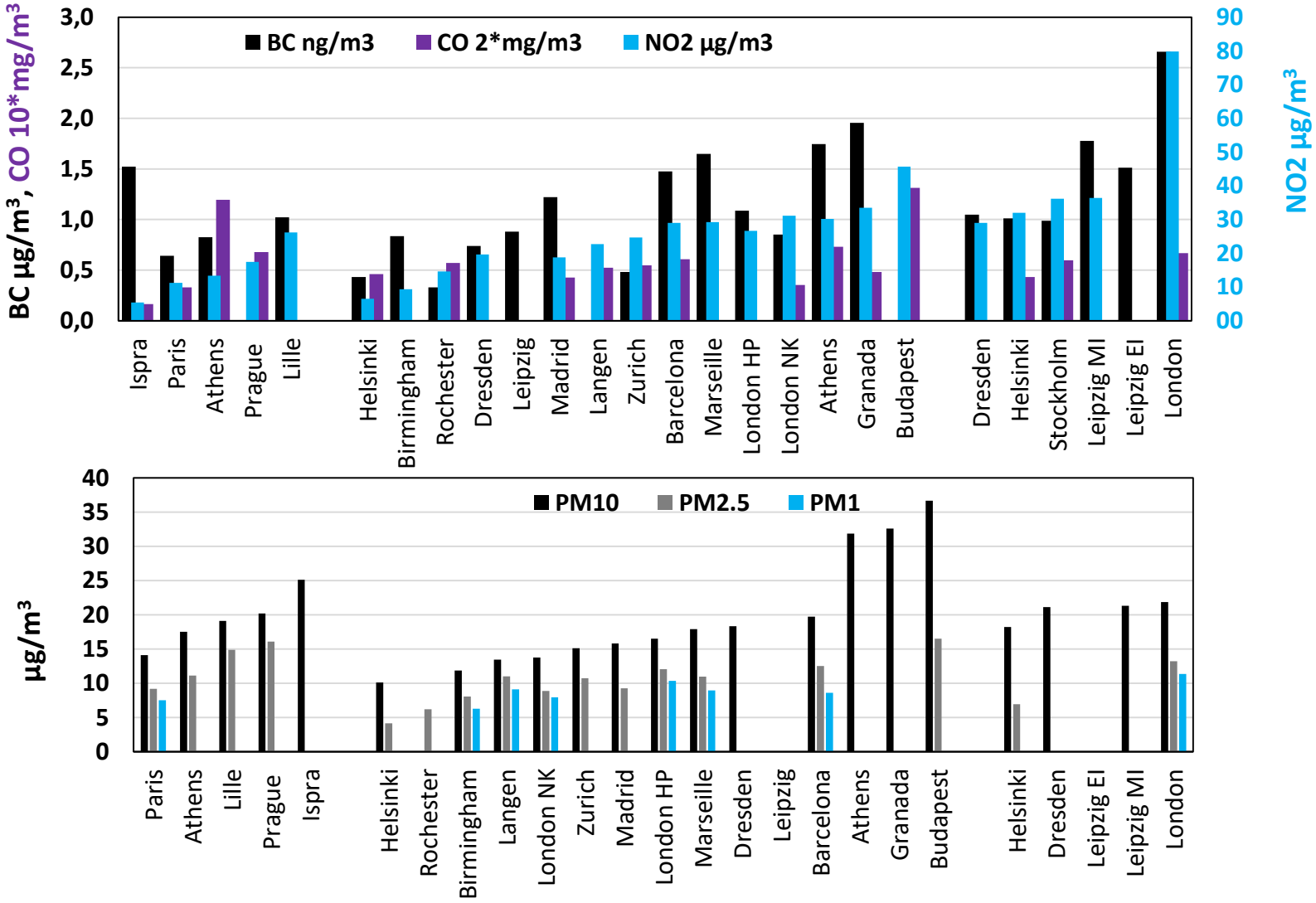
Results from data analysis and pilots

19-20 October 2022, Barcelona, Spain

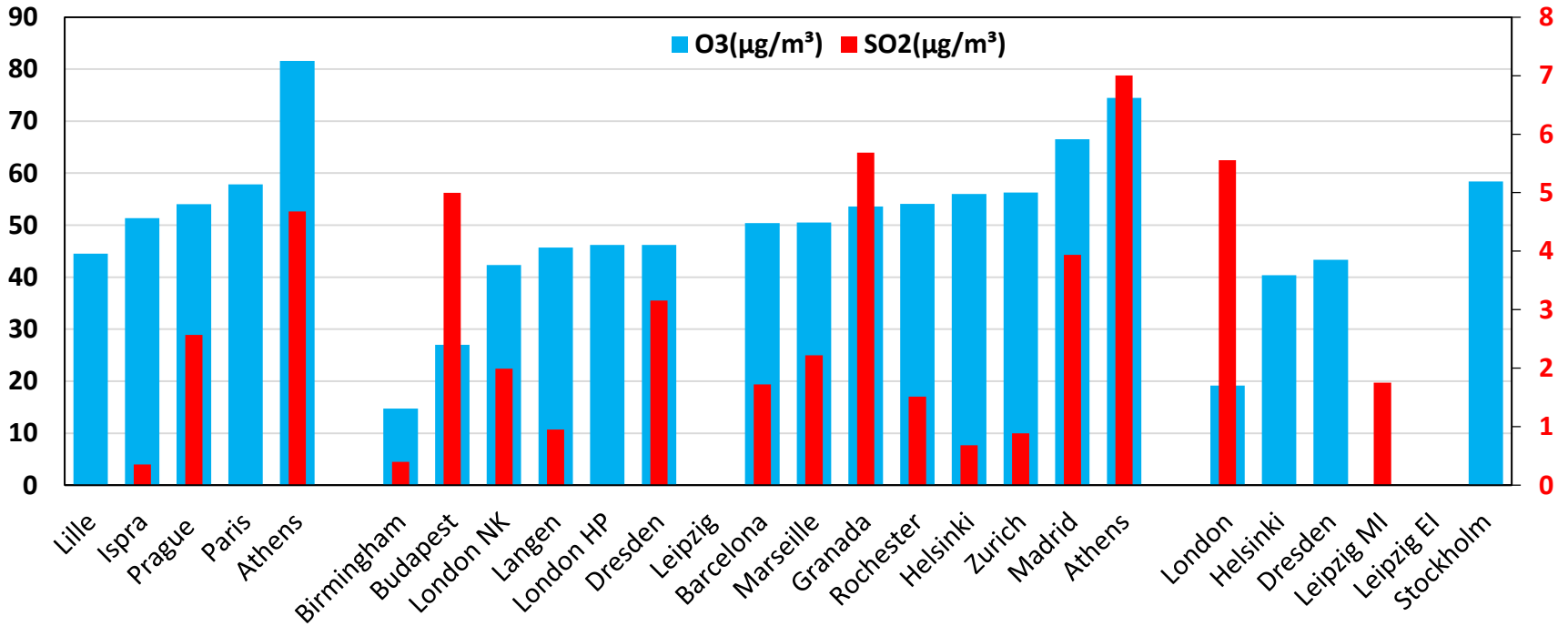
CLIMATE PATTERNS COVERED



POLLUTION PATTERNS COVERED



POLLUTION PATTERNS COVERED

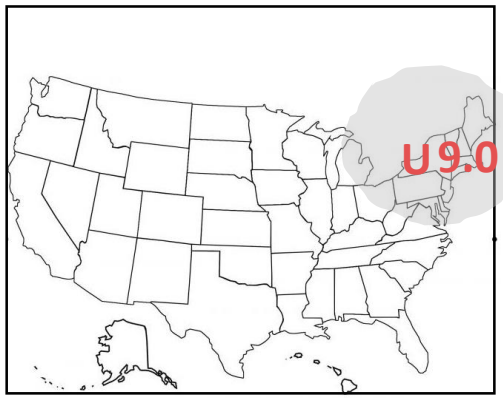


Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS (RI-URBANS)

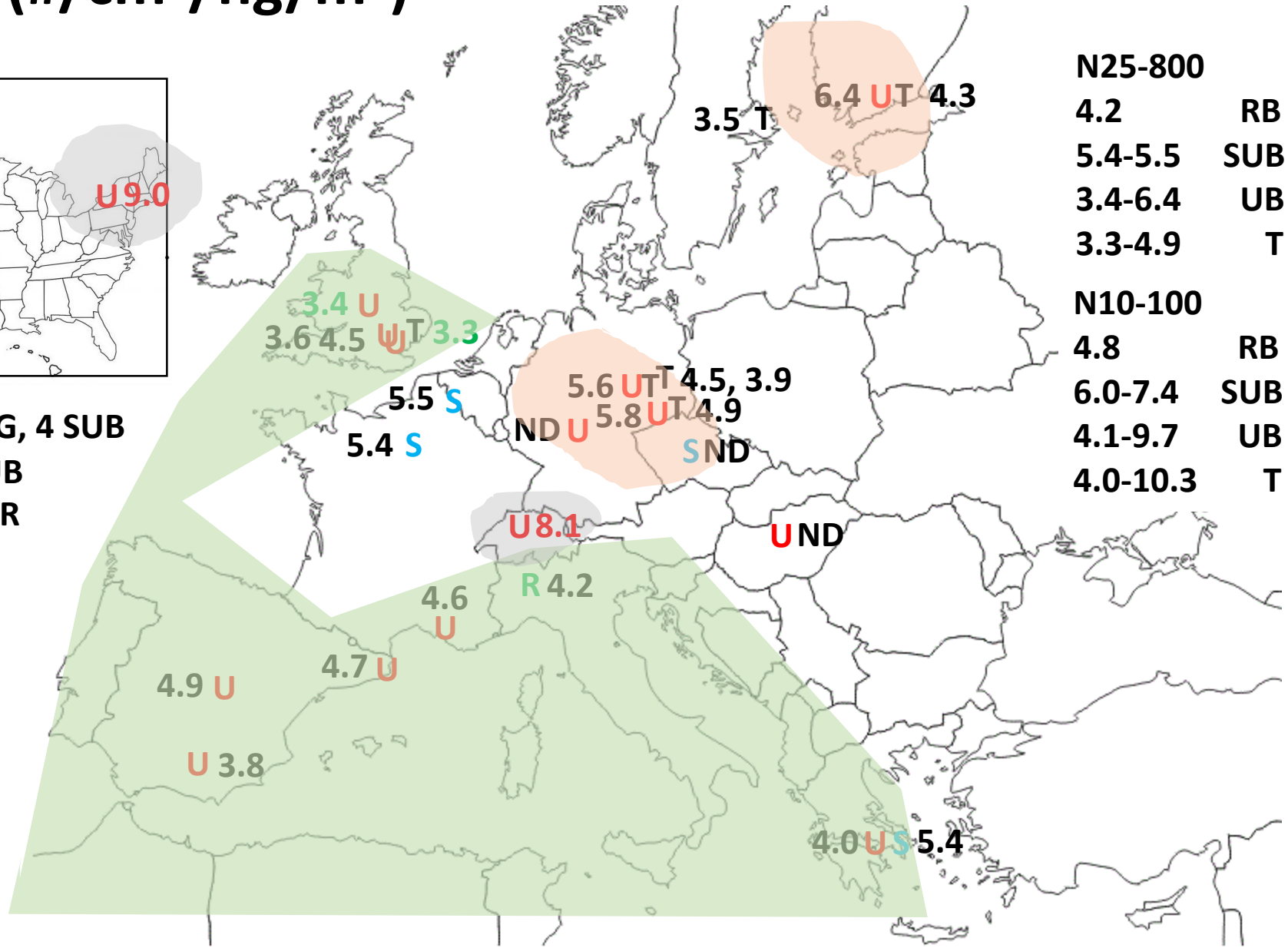
RI URBANS

Horizon 2020, LC-GD-9-1-2020,
Work programme H2020-2018-2020
Research & Innovation Action
Number: 101036245
Budget: 8,000,000 €
Duration: 48 months, 01/10/2021-30/09/2025

$N_{25\text{-}800}$ / BC (#/cm³/ng/m³)



R, S 1 REG, 4 SUB
U 15 UB
T 6 TR



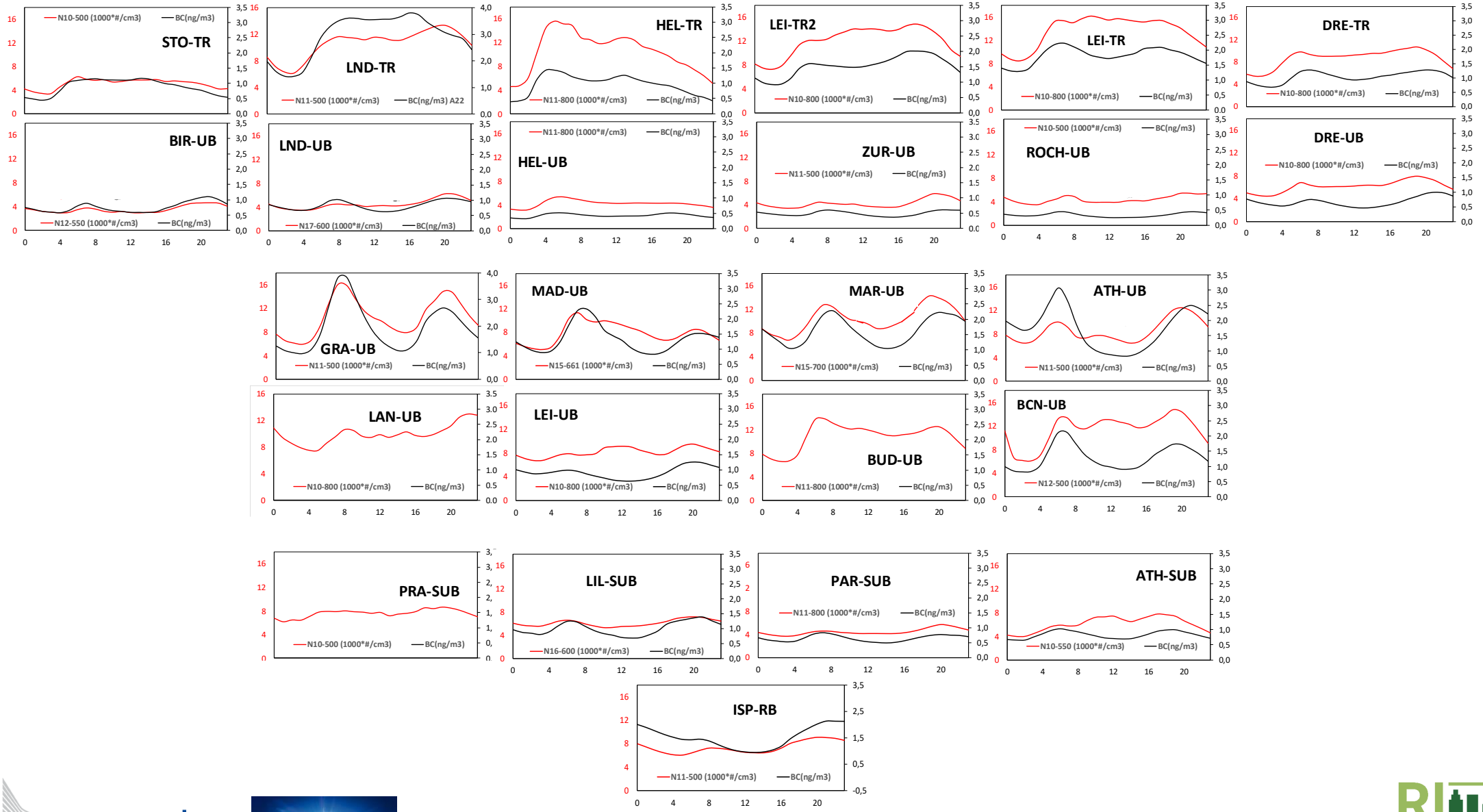
N25-800

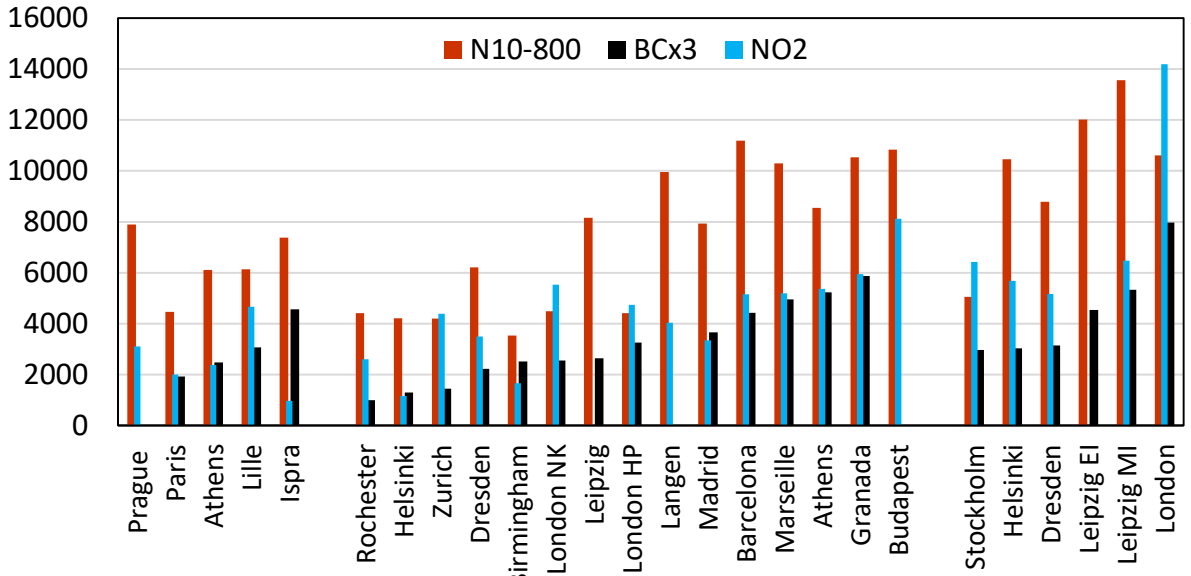
4.2	RB
5.4-5.5	SUB
3.4-6.4	UB (8-9 ROC, ZUR)
3.3-4.9	T

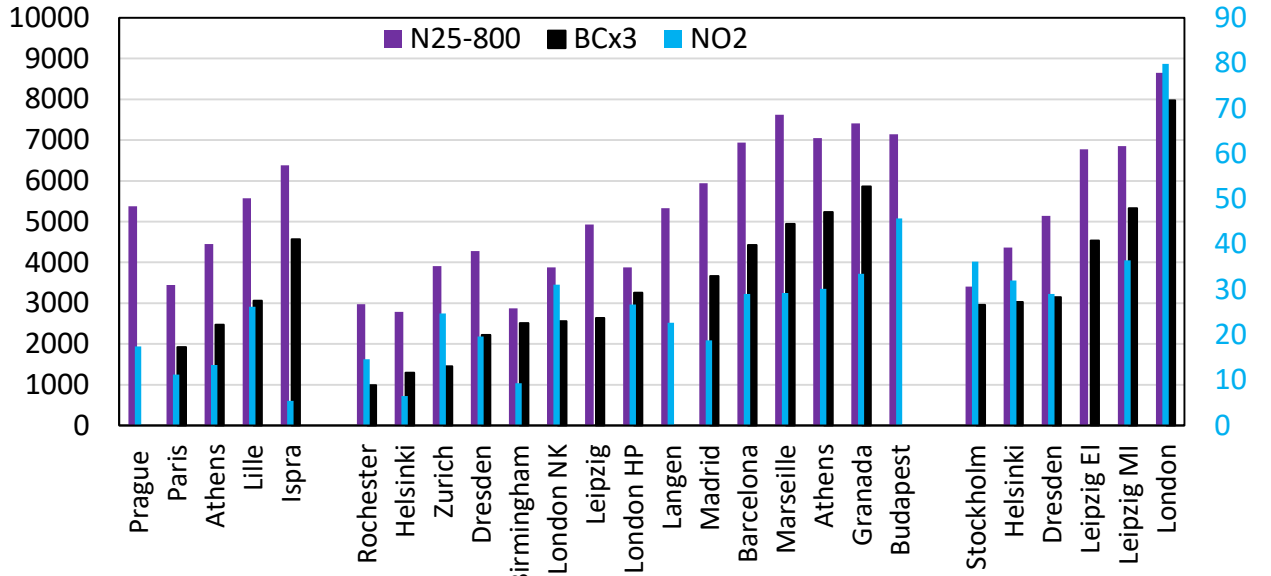
N10-100

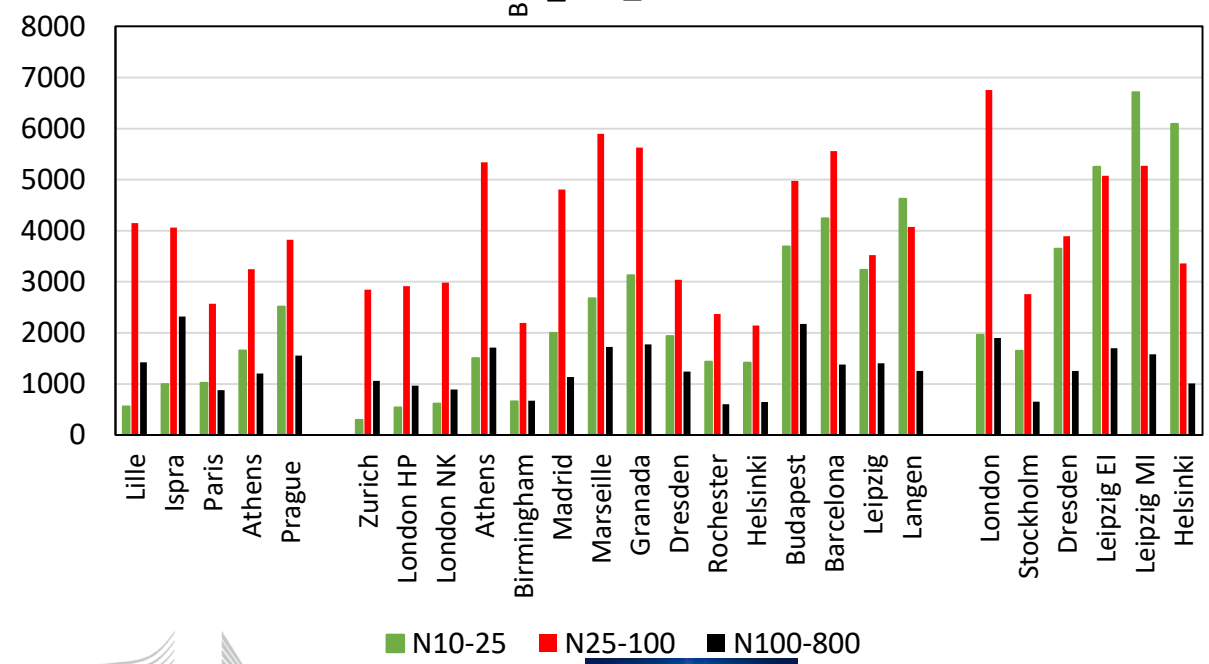
4.8	RB
6.0-7.4	SUB
4.1-9.7	UB (13 ROC)
4.0-10.3	T

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




N10-800
BCx3
NO2
Prague
Paris
Athens
Lille
Ispra
Rochester
Helsinki
Zurich
Dresden
Birmingham
London NK
Leipzig
London HP
Langen
Madrid
Barcelona
Marseille
Athens
Granada
Budapest
Stockholm
Helsinki
Dresden
Leipzig El
Leipzig MI
London


N25-800
BCx3
NO2
Prague
Paris
Athens
Lille
Ispra
Rochester
Helsinki
Zurich
Dresden
Birmingham
London NK
Leipzig
London HP
Langen
Madrid
Barcelona
Marseille
Athens
Granada
Budapest
Stockholm
Helsinki
Dresden
Leipzig El
Leipzig MI
London


Lille
Ispra
Paris
Athens
Prague
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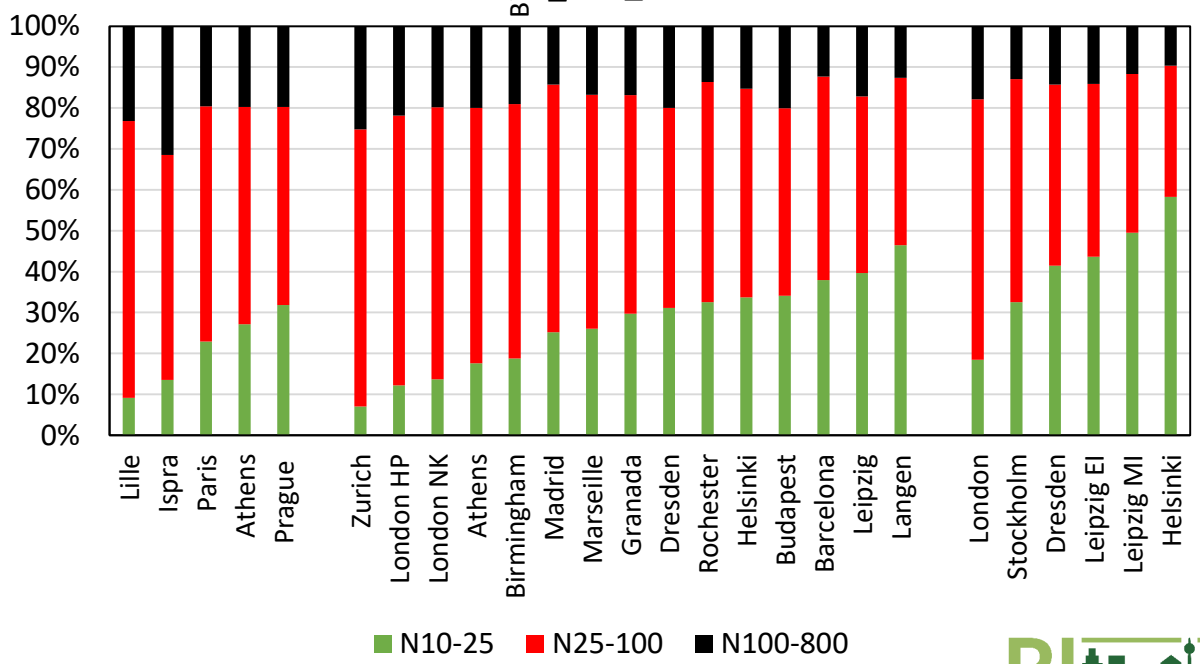
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