Numerical Representations of the Particle Number Concentrations in Urban Regions

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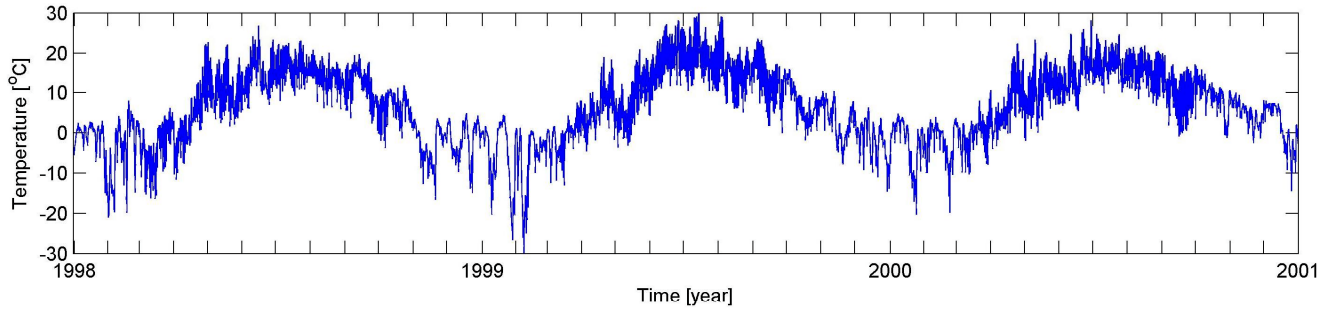
Methodology

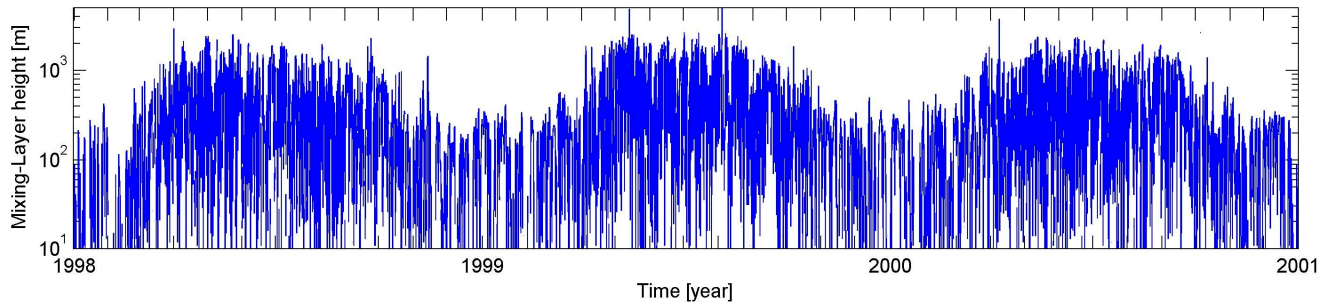
- The measured particle number size distributions were investigated with respect to the pre-processed meteorological parameters.
- Different mathematical functions were tested to best fit the measured particle number size distributions.

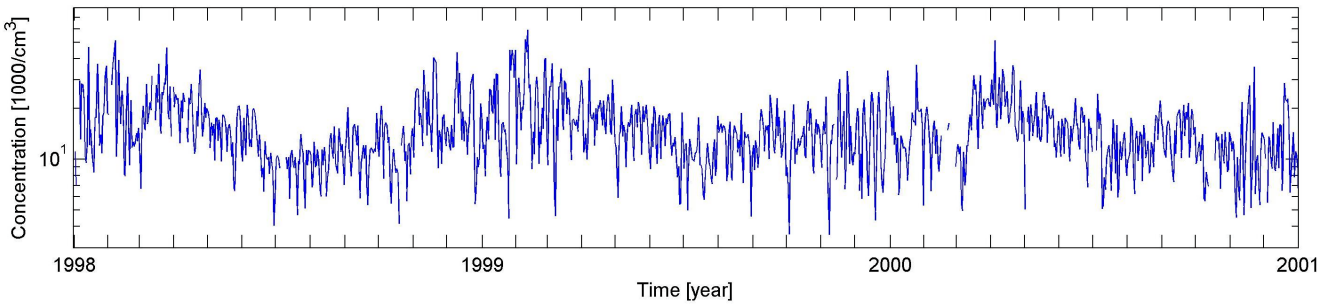
Results…

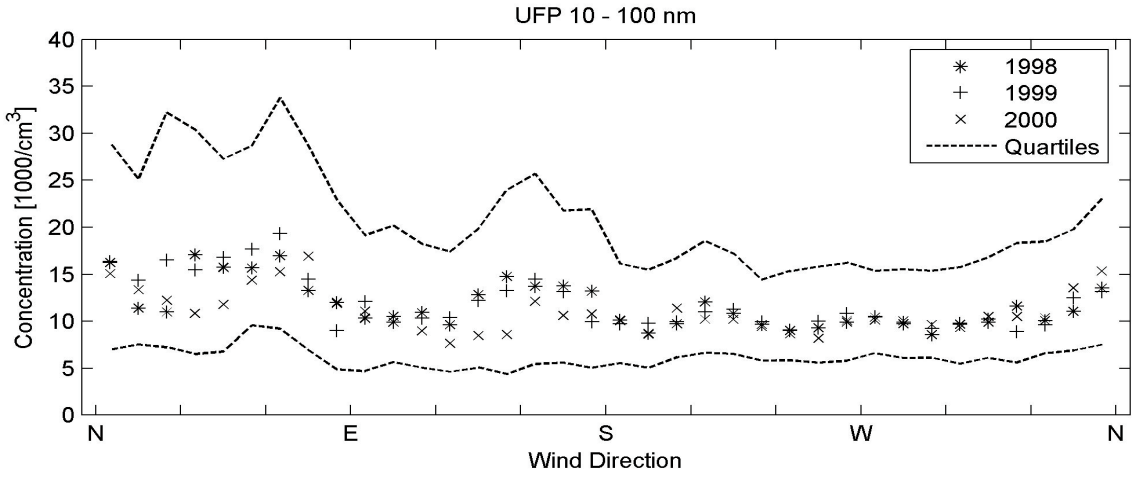
Based on long-term data analysis

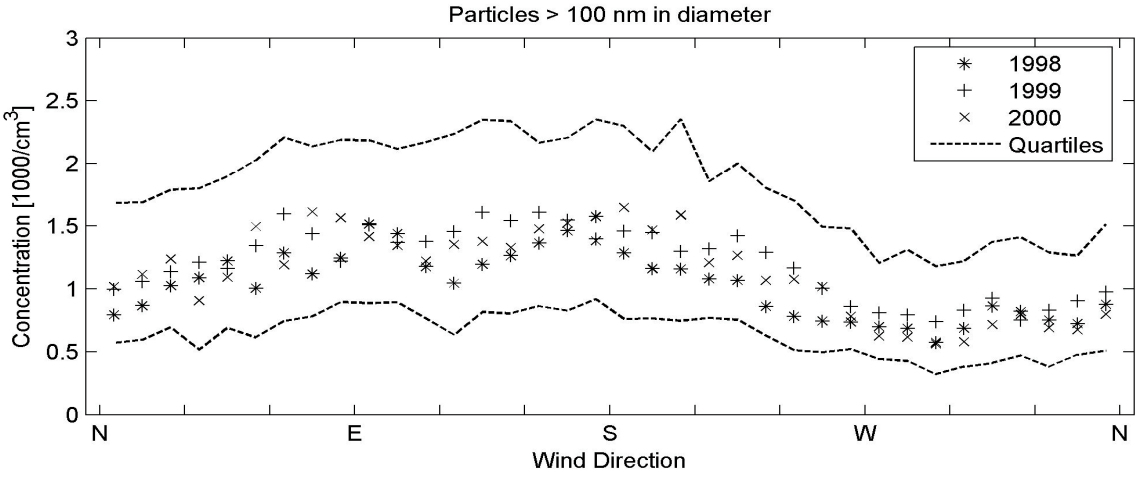
- The aerosol particle number concentrations do not show clear dependencies on the ambient relative humidity and atmospheric pressure.
- As the ambient temperature is temporally a more stable variable than the mixing height, we will in the following consider the ambient temperature in the analysis of aerosol particle number concentrations.
- The most important factors in the local scale are:
  - Ambient temperature.
  - wind direction.
  - wind speed.







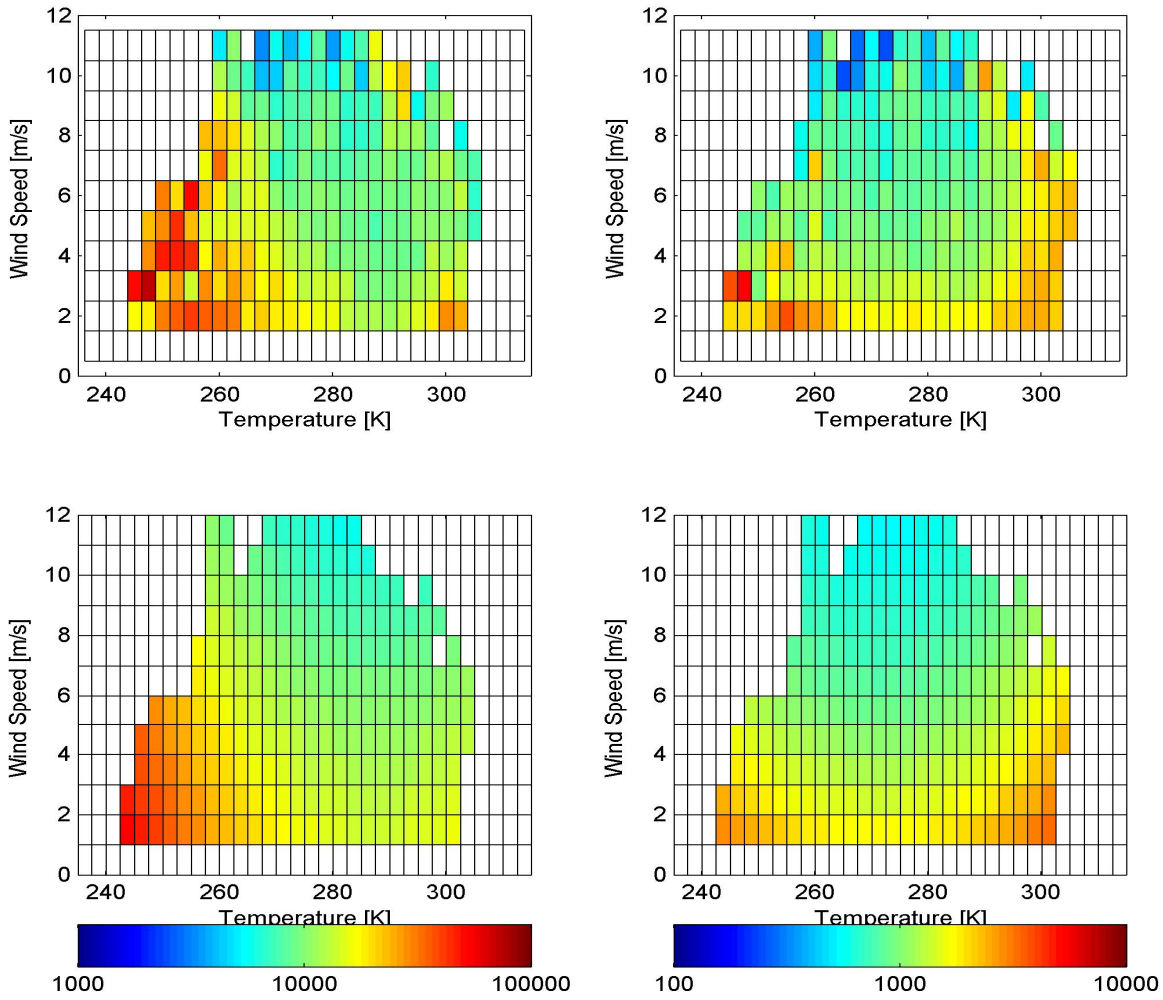


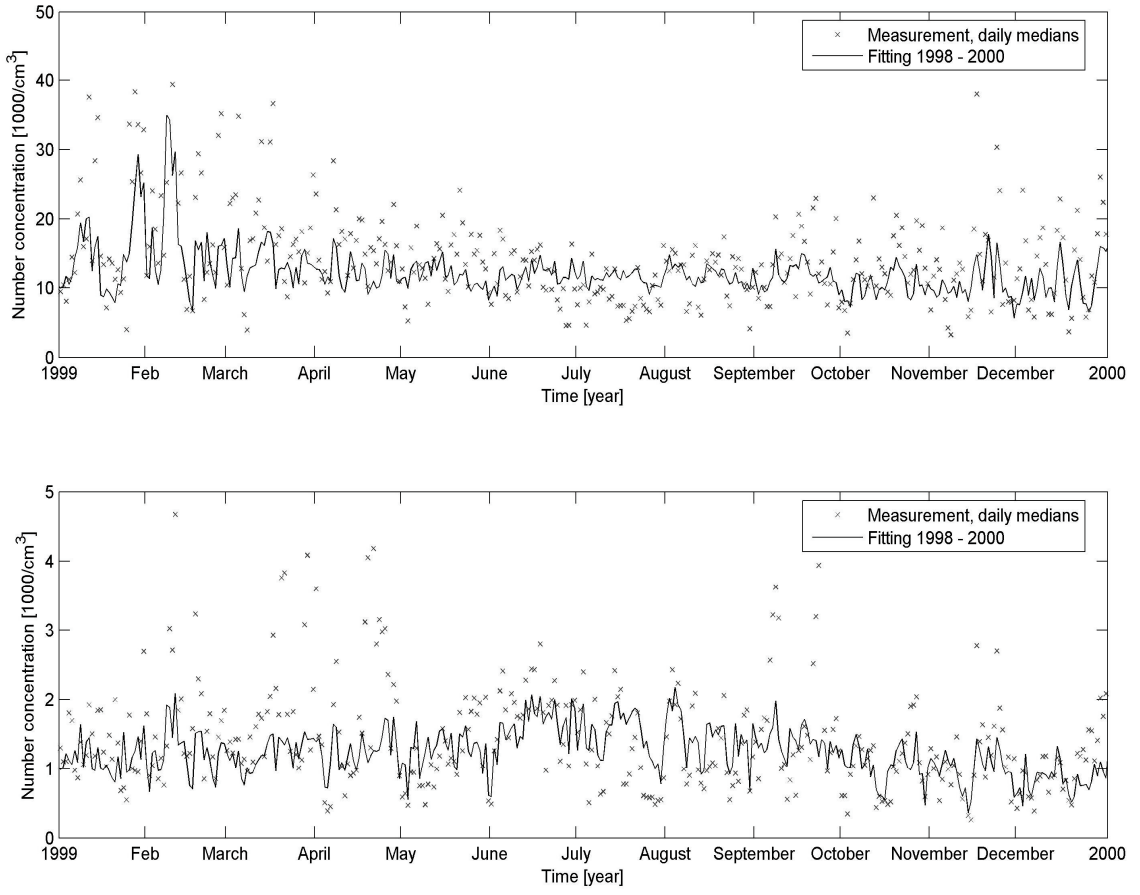


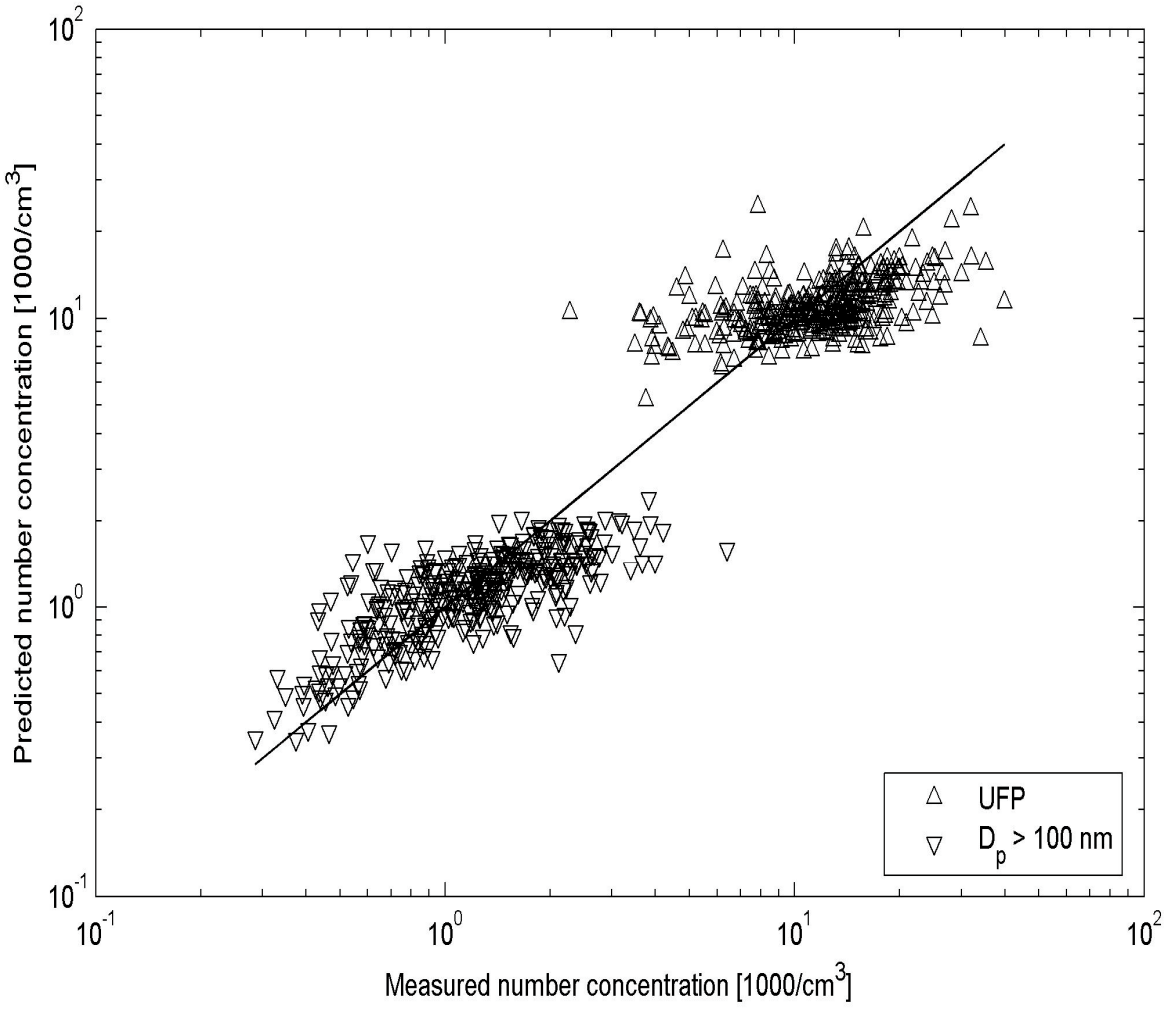
Best Mathematical Representation…

- The mathematical function that best fits the measured particle number size distributions was found in the form:

$$N_{D_p} = Ae^{a_1 U + a_2 U^2} e^{b_1 T + b_2 T^2}$$

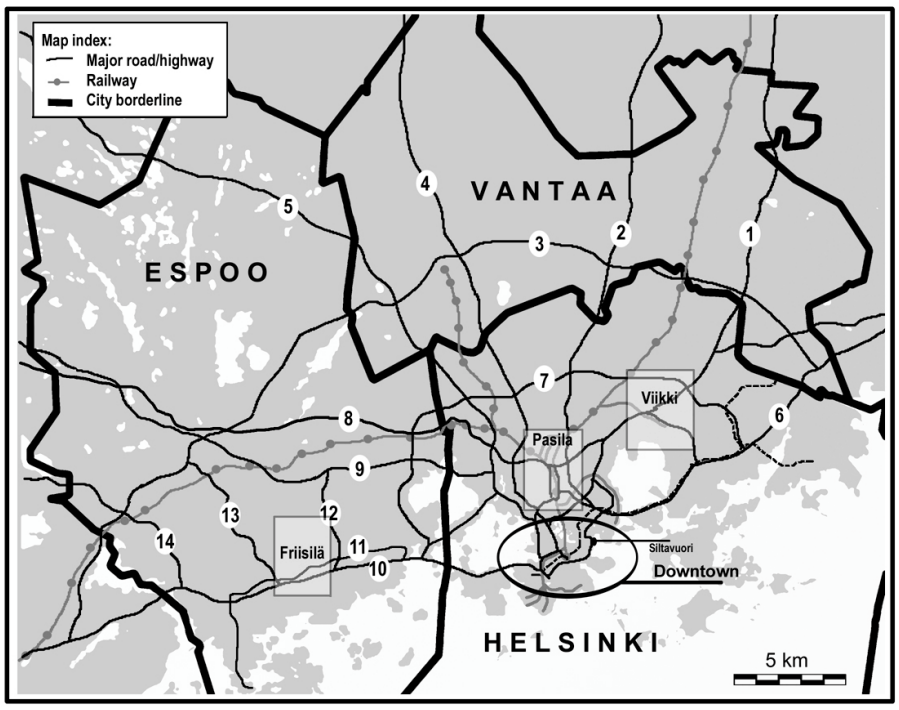

Wind Speed [m/s]
Temperature [K]
0
2
4
6
8
10
12
240
260
280
300
1000
10000
100000
100
1000
10000


Number concentration [1000/cm3]
Time [year]
Measurement, daily medians
Fitting 1998 - 2000
1999
Feb
March
April
May
June
July
August
September
October
November
December
2000
0
10
20
30
40
50
0
1
2
3
4
5



Urban, suburban, traffic influence

Figure 1



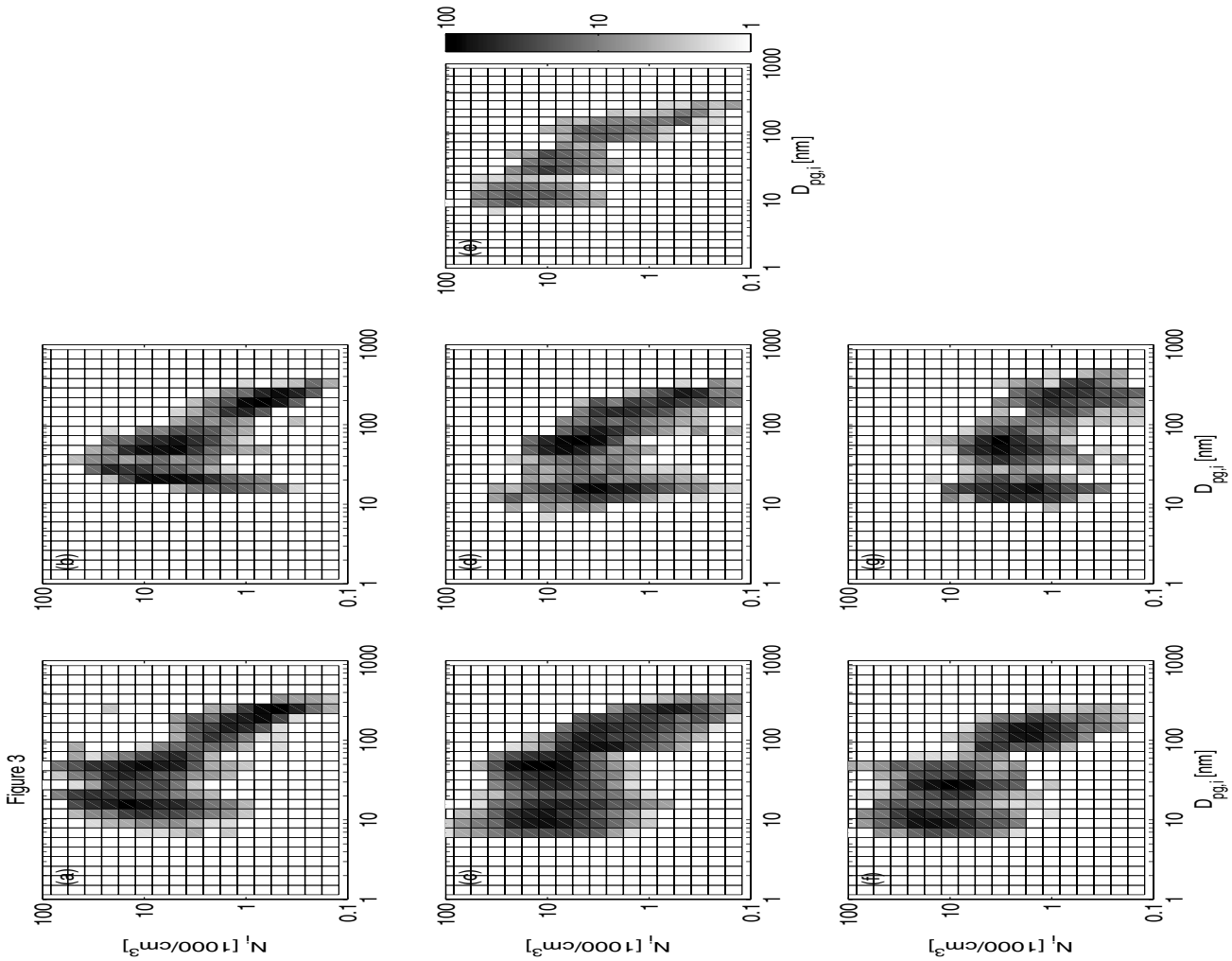
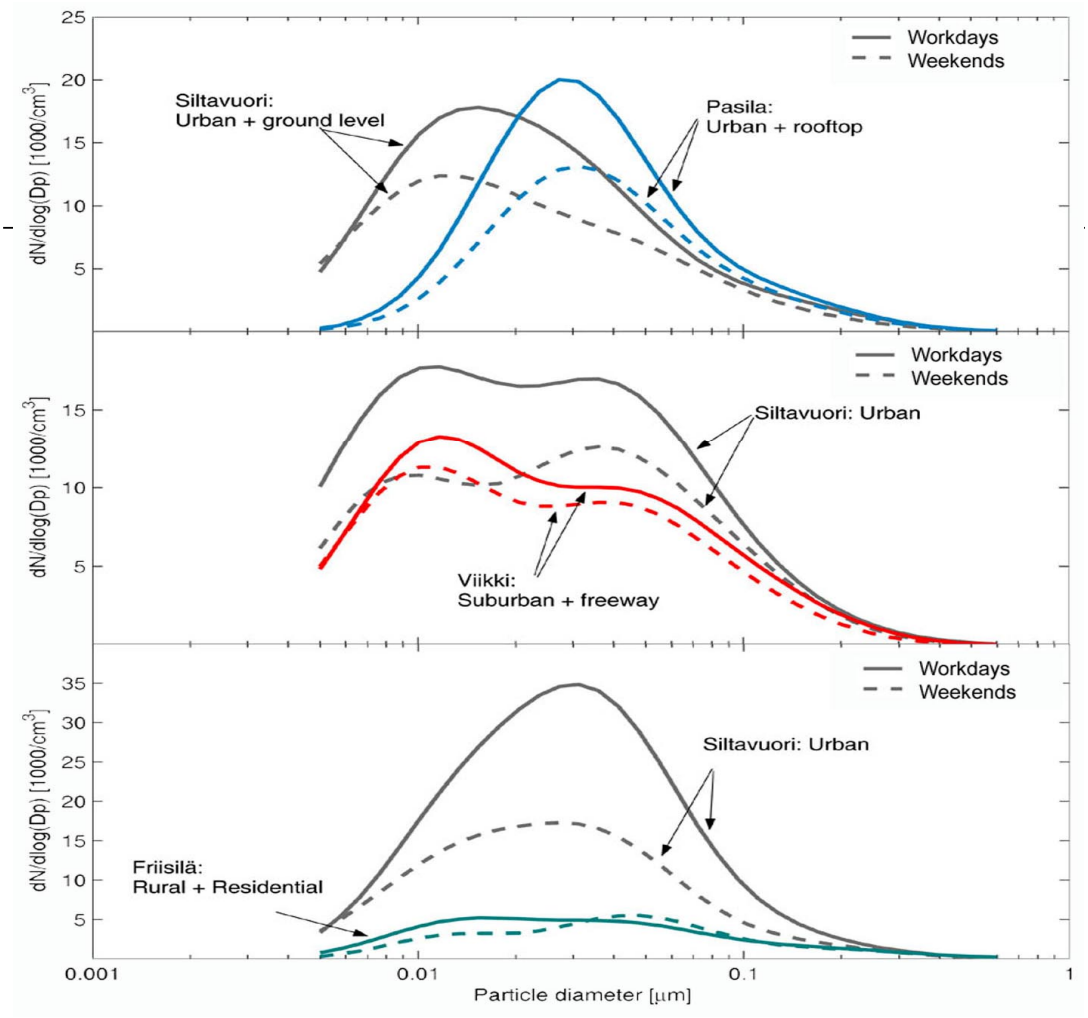
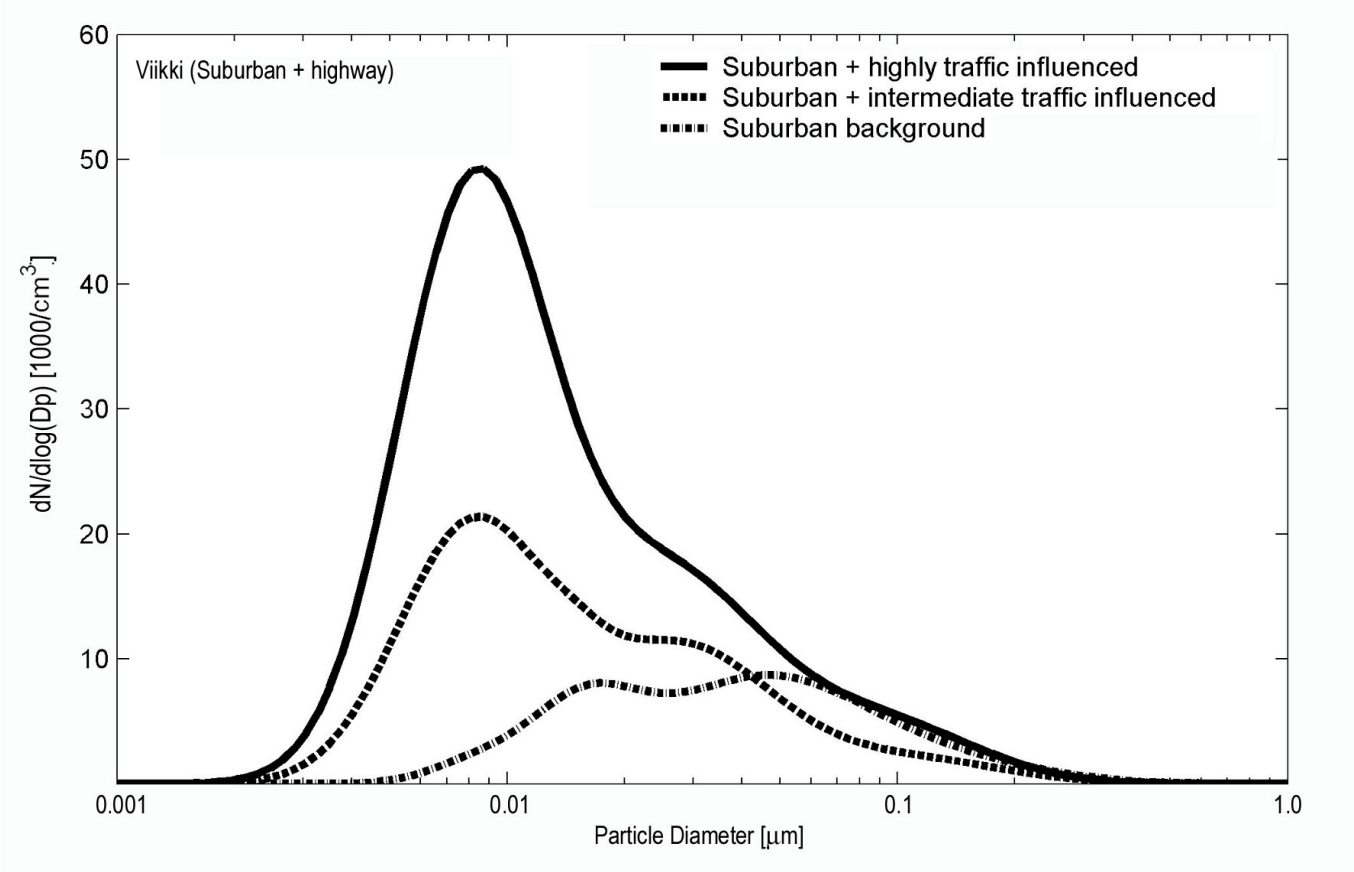
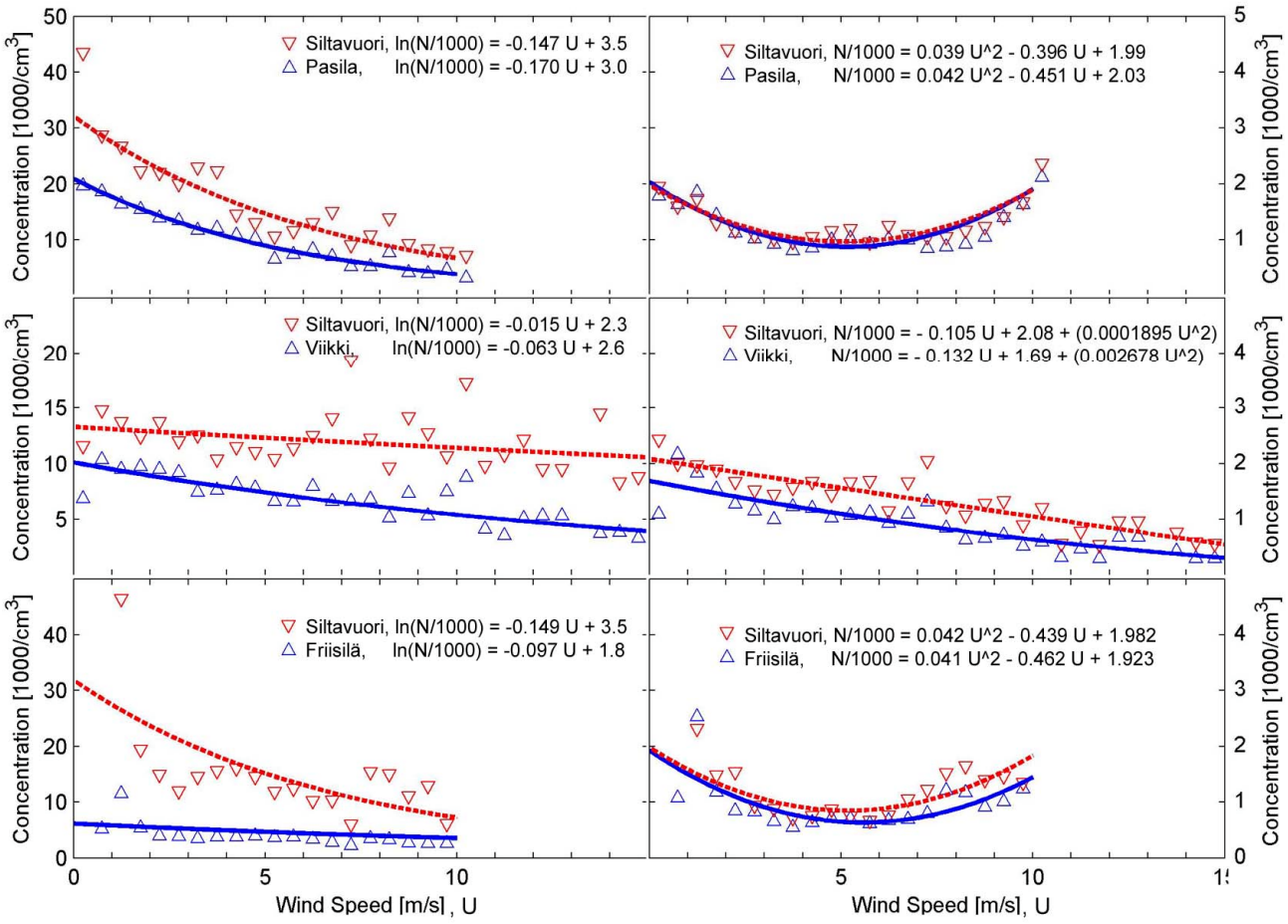
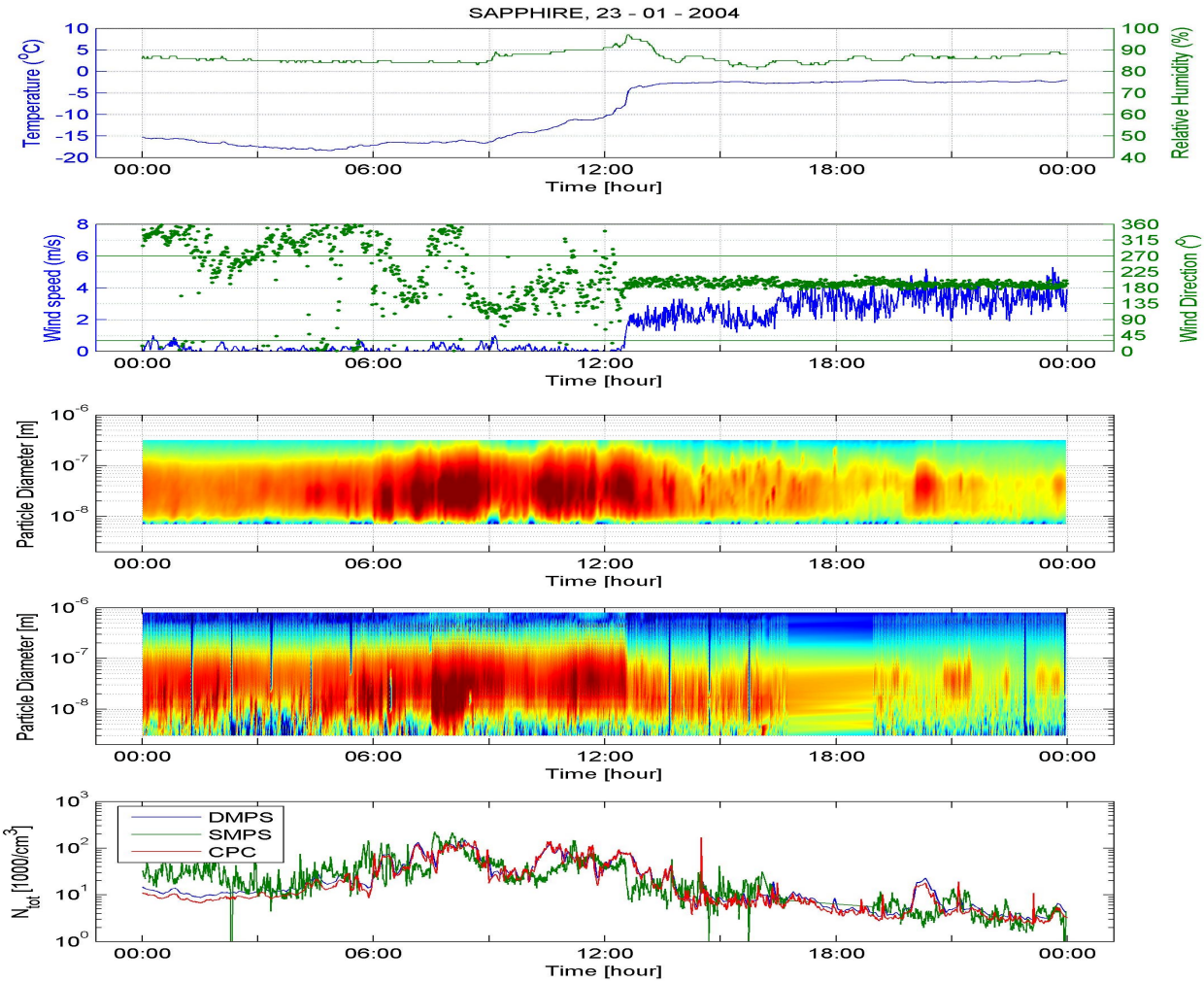

(a)
(b)
(c)
(d)
(e)
(f)
N_i [1000/cm^3]
$D_{pg,i}$ [nm]
100
10
1
0.1
1000

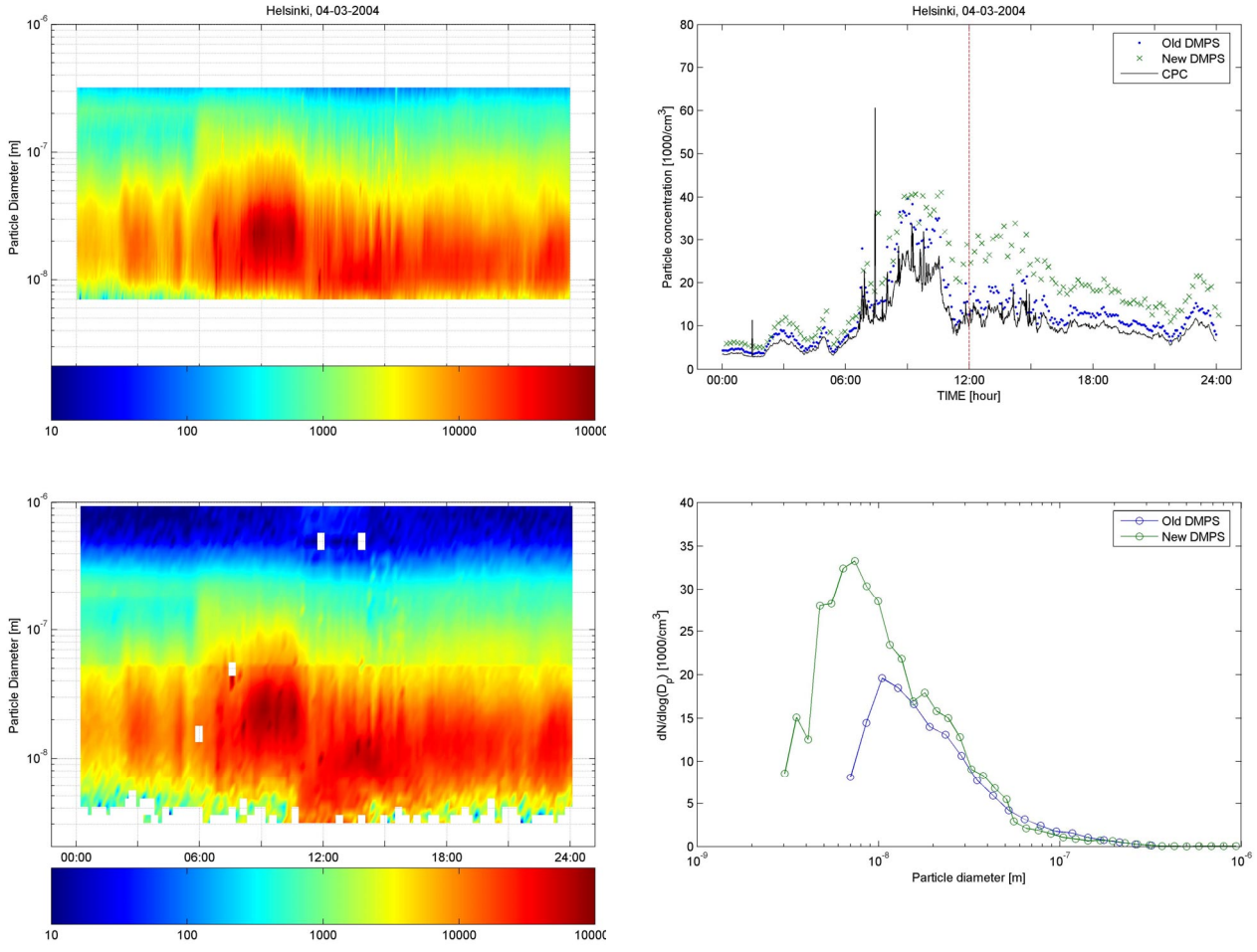
Figure 3

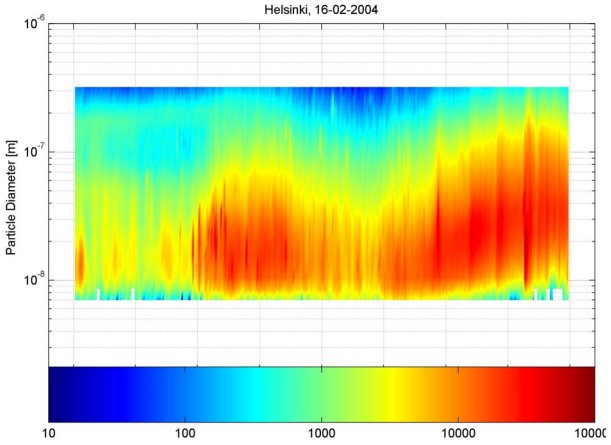

Workdays
Weekends
Siltavuori:
Urban + ground level
Pasila:
Urban + rooftop
Siltavuori: Urban
Viikki:
Suburban + freeway
Friisilä:
Rural + Residential
dN/dlog(Dp) [1000/cm^3]
Particle diameter [µm]
0.001
0.01
0.1
1

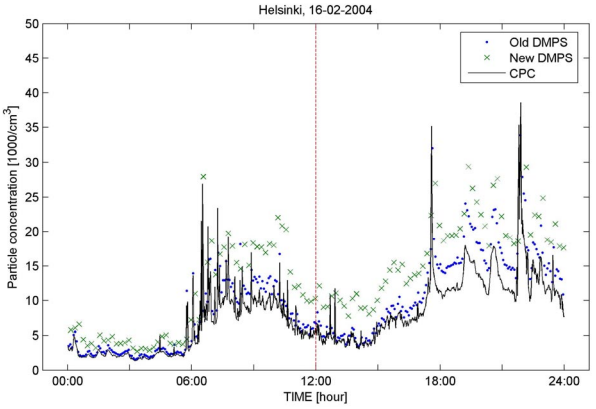

Viikki (Suburban + highway)
Suburban + highly traffic influenced
Suburban + intermediate traffic influenced
Suburban background
dN/dlog(Dp) [1000/cm3]
Particle Diameter [µm]
60
50
40
30
20
10
0.001
0.01
0.1
1.0

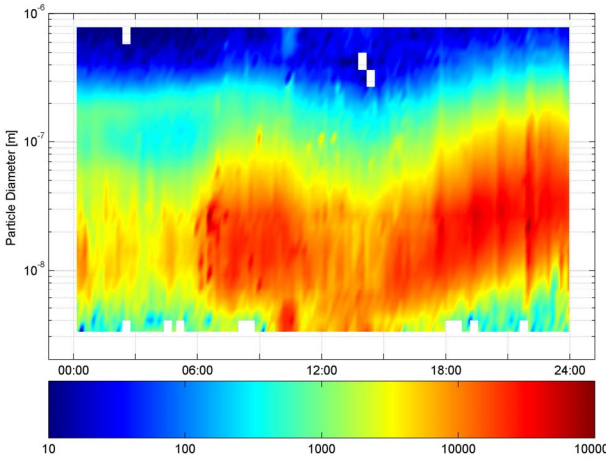

Siltavuori, ln(N/1000) = -0.147 U + 3.5
Pasila, ln(N/1000) = -0.170 U + 3.0
Siltavuori, N/1000 = 0.039 U^2 - 0.396 U + 1.99
Pasila, N/1000 = 0.042 U^2 - 0.451 U + 2.03
Siltavuori, ln(N/1000) = -0.015 U + 2.3
Viikki, ln(N/1000) = -0.063 U + 2.6
Siltavuori, N/1000 = - 0.105 U + 2.08 + (0.0001895 U^2)
Viikki, N/1000 = - 0.132 U + 1.69 + (0.002678 U^2)
Siltavuori, ln(N/1000) = -0.149 U + 3.5
Friisilä, ln(N/1000) = -0.097 U + 1.8
Siltavuori, N/1000 = 0.042 U^2 - 0.439 U + 1.982
Friisilä, N/1000 = 0.041 U^2 - 0.462 U + 1.923
Concentration [1000/cm3]
Wind Speed [m/s], U

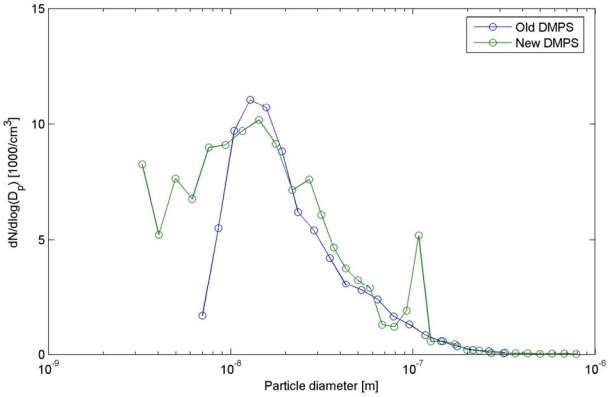

SAPPHIRE, 23 - 01 - 2004
Temperature (°C)
Relative Humidity (%)
Time [hour]
Wind speed (m/s)
Wind Direction (°)
Particle Diameter [m]
N_tot [1000/cm^3]
DMPS
SMPS
CPC
00:00
06:00
12:00
18:00


Helsinki, 04-03-2004
Particle Diameter [m]
Particle concentration [1000/cm^3]
TIME [hour]
Old DMPS
New DMPS
CPC
dN/dlog(D_p) [1000/cm^3]
Particle diameter [m]


Helsinki, 16-02-2004
Particle Diameter [m]
10
100
1000
10000


Helsinki, 16-02-2004
Old DMPS
New DMPS
CPC
Particle concentration [1000/cm3]
TIME [hour]
00:00
06:00
12:00
18:00
24:00


Particle Diameter [m]
00:00
06:00
12:00
18:00
24:00
10
100
1000
10000


Old DMPS
New DMPS
dN/dlog(Dp) [1000/cm3]
Particle diameter [m]