

Supplementary Information

The size-composition distribution of atmospheric nanoparticles over Europe

David Patoulias^{1,2}, Christos Fountoukis^{2,3}, Ilona Riipinen⁴, Ari Asmi⁵, Markku Kulmala, and
Spyros N. Pandis^{1,2,6}

^[1] Department of Chemical Engineering, University of Patras, Patras, Greece

^[2] Institute of Chemical Engineering Sciences, Foundation for Research and Technology Hellas (FORTH/ICE-HT), Patras, Greece

^[3] Qatar Environment & Energy Research Institute, Hamad Bin Khalifa University, Doha, Qatar

^[4] Department of Applied Environmental Science & Bert Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden

^[5] Institute of Atmospheric and Earth System Research / Physics, University of Helsinki, Helsinki, Finland.

^[6] Department of Chemical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA.

S1. Information about the measurement stations

The Aspveten (ASP) site (58° 48' 0" N, 17° 23' 0" E) is located 70 km south west of Stockholm. The station is considered to be representative of the regional background in Mid-Sweden and is situated about 2 km from the coast in a rural area surrounded by forest. A DMPS was used to measure the number size distribution of particles in the size range of 10 to 410 nm.

The Birkenes (BIR) station (58° 23' 18" N, 8° 15' 7" E) is located in the boreal forest with mixed conifer and deciduous trees. The nearest local emission source is the city of Kristiansand (65,000 inhabitants), located 25 km south/south-west of the station having minor or negligible influence on the air quality at the site. A DMPS was used to measure the number size distribution of particles in the size range of 10 to 550 nm.

The Cape Corsica (COR) is located in Erso (42° 58' 10" N, 9° 22' 49" E) near the northern tip of Corsica. The Cape Corsica peninsula is a remote site ensuring that its measurements are not affected by local anthropogenic pollution. An SMPS was used to measure the number size distribution of particles in the size range of 11 to 580 nm.

The Finokalia (FIN) station is located in Crete (35° 19' N, 25° 40' E) the largest Greek island, in the southeast part of Greece. The sampling site is located in a remote coastal area, 50

33 km away from Heraklion (150,000 inhabitants) and at an elevation of 230 m above the sea
34 surface level. The station is characterized as a remote background site without human activity
35 within a radius of approximately 15 km. An SMPS was used to measure the number size
36 distribution of particles in the size range of 9 to 850 nm.

37 The Meteorological Observatory Hohenpeissenberg (HOH) (47° 48' 0" N, 11° 1' 0" E) is
38 located on a solitary hill in the rural countryside of southern Bavaria (980 m. above sea surface
39 level), approximately 40 km north of the Alpine mountain range. An SMPS was used to measure
40 the number size distribution of particles in the size range of 10 to 800 nm.

41 The Hyytiala (HYY) Station for Measuring forest Ecosystem-Atmosphere Relations II
42 (SMEAR II) (61° 51' 0" N, 24° 17' 0" E) is located in Southern Finland. The site represents
43 typical regional background conditions for higher latitudes of Europe, and the air masses are
44 usually influenced by European pollution or clean Arctic air. A DMPS was used to measure the
45 number size distribution of particles in the size range of 3 to 1000 nm.

46 The Ispra (ISP) station (45° 48' 0" N, 8° 38' 0" E) is located in a semi-rural area by the
47 Eastern shore of a sub-alpine lake in Northern Italy, at a height of 2960 m above sea level. The
48 station is several tens of kilometers away from large emission sources like intense road traffic or
49 big factories. A DMPS was used to measure the number size distribution of particles in the size
50 range of 10 to 800 nm.

51 The K-Pusztá (KPU) station is situated in the clearing of a mixed coniferous/deciduous
52 forest on the Great Hungarian Plain (46° 58' 0" N, 19° 35' 0" E) about 80 km SE of Budapest.
53 This rural site is free of local anthropogenic pollution. A DMPS was used to measure the number
54 size distribution of particles in the size range of 6 to 800 nm.

55 The Mace Head (MAC) station (53° 19' 12" N, 9° 52' 48" W) is located on the west coast
56 of Ireland on a hilly area (height around 35 m) surrounded by a number of small lakes and is
57 exposed to the North Atlantic Ocean. It is located 90 km west of Galway (population
58 approximately 60000) which is the nearest major city. An SMPS was used to measure the
59 number size distribution of particles in the size range of 20 to 500 nm.

60 The Melpitz station (MEL) (51° 31' 48" N, 12° 55' 48" E) is located in eastern Germany
61 near the city of Torgau 50 km northeast of Leipzig. The site is surrounded by flat, agricultural
62 pastures, forests and semi-natural grasslands. A TDMPS was used to measure the number size
63 distribution of particles in the size range of 5 to 800 nm.

64 The Patras (PAT) station is located 7 km northeast of the city center ($38^{\circ} 18' N$, $21^{\circ} 47'$
65 E) in the Institute of Chemical Engineering Science (ICE-HT/FORTH) at an elevation of 85 m
66 above sea surface level. The area is surrounded by olive trees while the coast is approximately 3
67 km away. A major road is at a distance of 1 km away. An SMPS was used to measure the
68 number size distribution of particles in the size range of 11 to 500 nm.

69 The Schneefernerhaus (SCH) station ($47^{\circ} 25' N$, $10^{\circ} 58' 46'' E$) is located near the top of
70 Zugspitze, which is the highest mountain in Germany, at a height of 2960 m above sea level.
71 UFS is a nine-story building, constructed into the southern flank of the Zugspitze. An SMPS was
72 used to measure the number size distribution of particles in the size range of 10 to 510 nm.

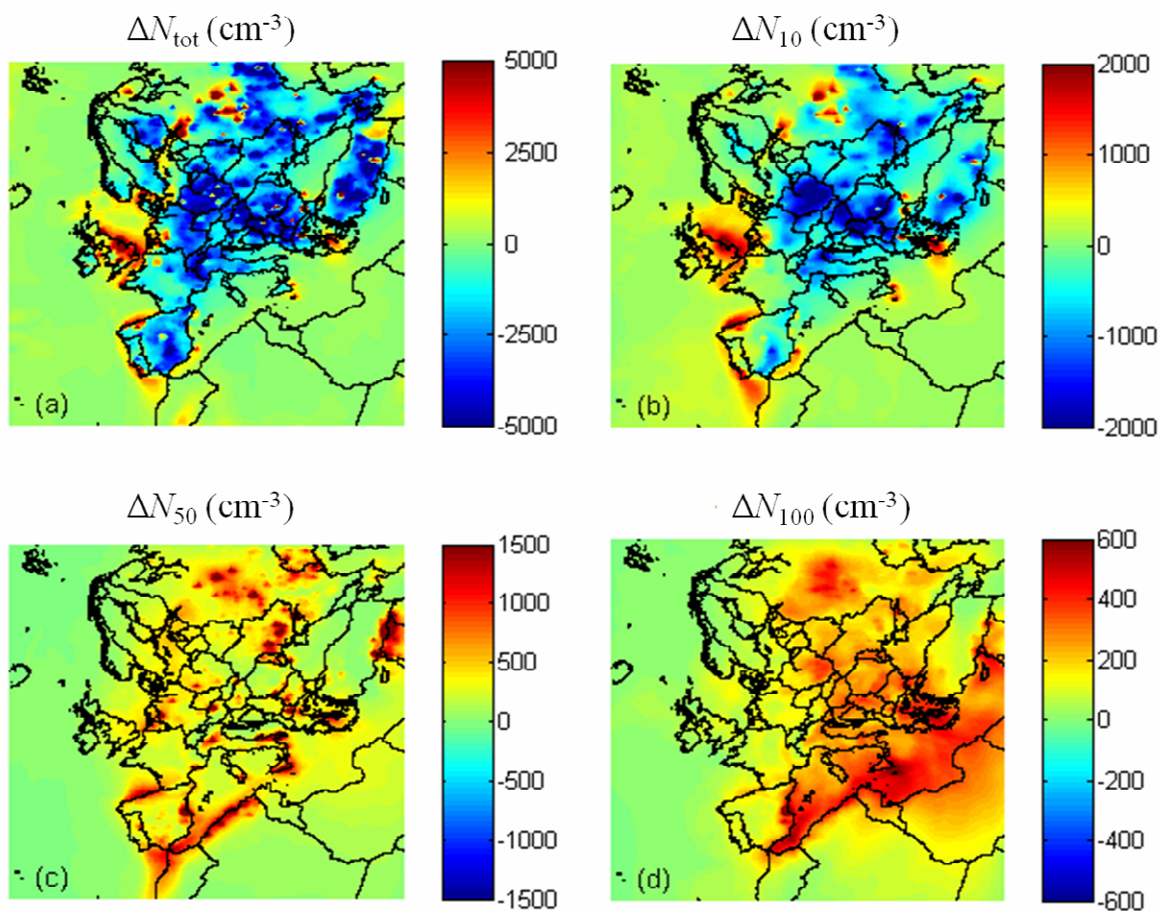
73 The San Pietro Capofiume (SPC) measurement station ($44^{\circ} 39' 0'' N$, $11^{\circ} 37' 0'' E$) is
74 located on a flat, homogeneous terrain of harvested fields, about 40 km north east of Bologna
75 and 30 km south of the Po River. An SMPS was used to measure the number size distribution of
76 particles in the size range of 10 to 800 nm.

77 The Thessaloniki (THE) station is located at the suburbs of Thessaloniki ($40^{\circ} 37' N$, 23°
78 $02' E$). Thessaloniki is the second largest city of Greece, with a population of 1.1 million
79 inhabitants, and is situated in the northern part of the country. The sampling site is located at
80 Eptapyrgio and is considered as a suburban background site. The site is 5 km northeast of the
81 city center, with possible local air pollution sources a major road at a distance of approximately 1
82 km and an industrial region located at a distance of approximately 12 km. An SMPS was used to
83 measure the number size distribution of particles in the size range of 10 to 470 nm.

84 The Vavihill (VAV) site is located at Southern Sweden ($56^{\circ} 1' 0'' N$, $13^{\circ} 9' 0'' E$). There
85 are no local pollution sources in the immediate vicinity of the site. The densely populated areas
86 of Malmo, Copenhagen, and Helsingborg southwest to west of the station are 45, 40 and 25 km
87 away, respectively. An DMPS was used to measure the number size distribution of particles in
88 the size range of 3 to 860 nm.

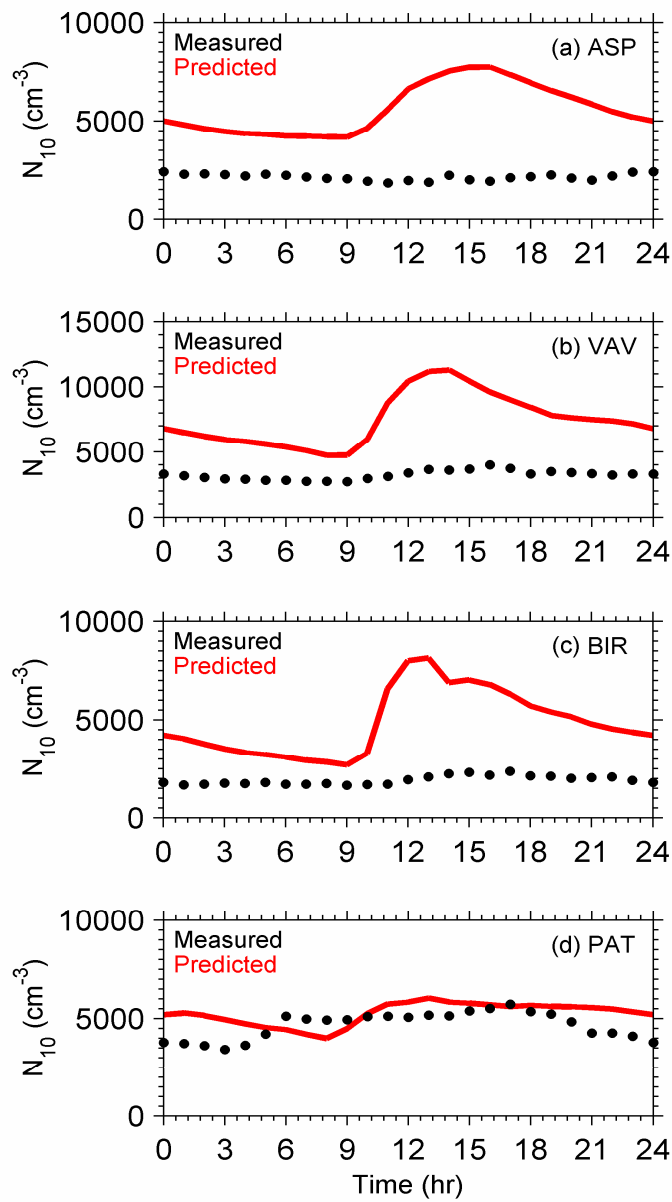
89 The Waldhof site (WAL) ($52^{\circ} 48' 8'' N$, $10^{\circ} 45' 34'' E$) is surrounded by forest in all
90 directions. Measurements here are considered as representative of the background in the North
91 German low lands. An SMPS was used to measure the number size distribution of particles in
92 the size range of 10 to 800 nm.

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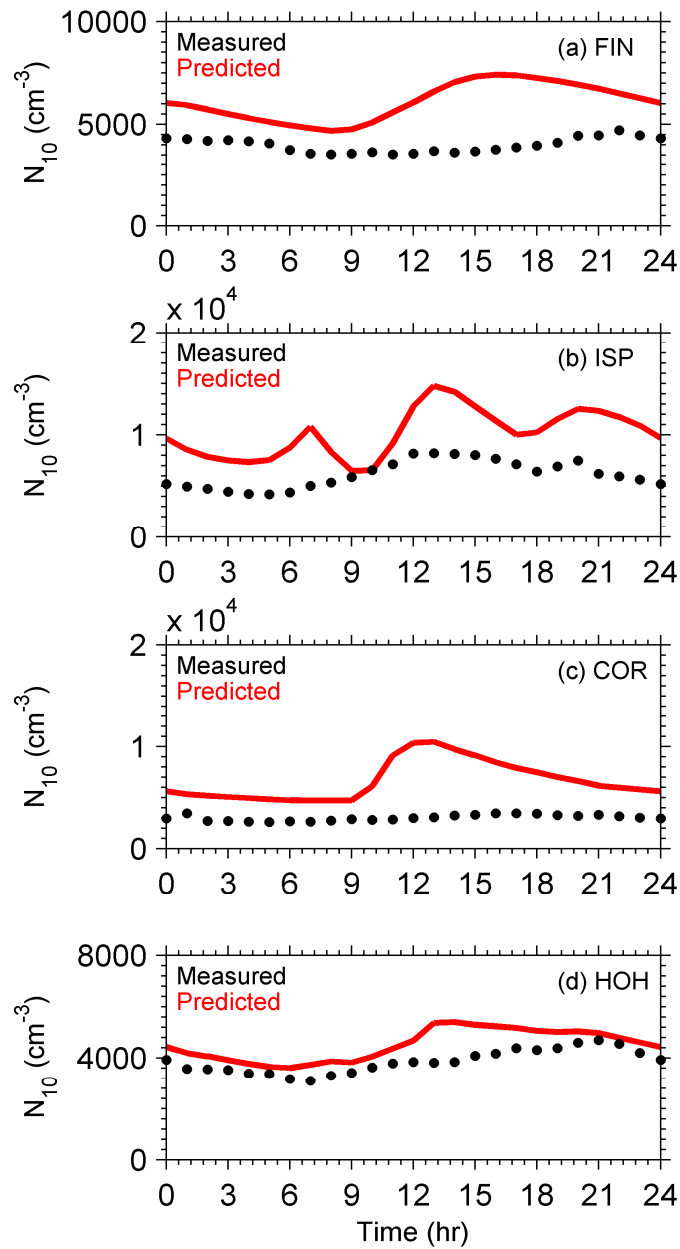
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 95 **Figure S1:** Ground level average increase of number concentration (cm^{-3}) due to the
 96 condensation of organics species predicted during 5 June – 8 July 2012 for: (a) all particles
 97 (ΔN_{tot}); particles above (b) 10 nm (ΔN_{10}); (c) 50 nm (ΔN_{50}); and (d) 100 nm (ΔN_{100}). Different
 98 scales are used.

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101 **Figure S2:** Average diurnal profiles of particle number concentrations (cm^{-3}) above 10 nm in:
 102 (a) Aspvreten (Sweden); (b) Vavihill (Sweden); (c) Birkenes (Norway) and (d) Patras (Greece)
 103 during 5 June – 8 July 2012. Red lines correspond to predictions and black symbols to
 104 observations.



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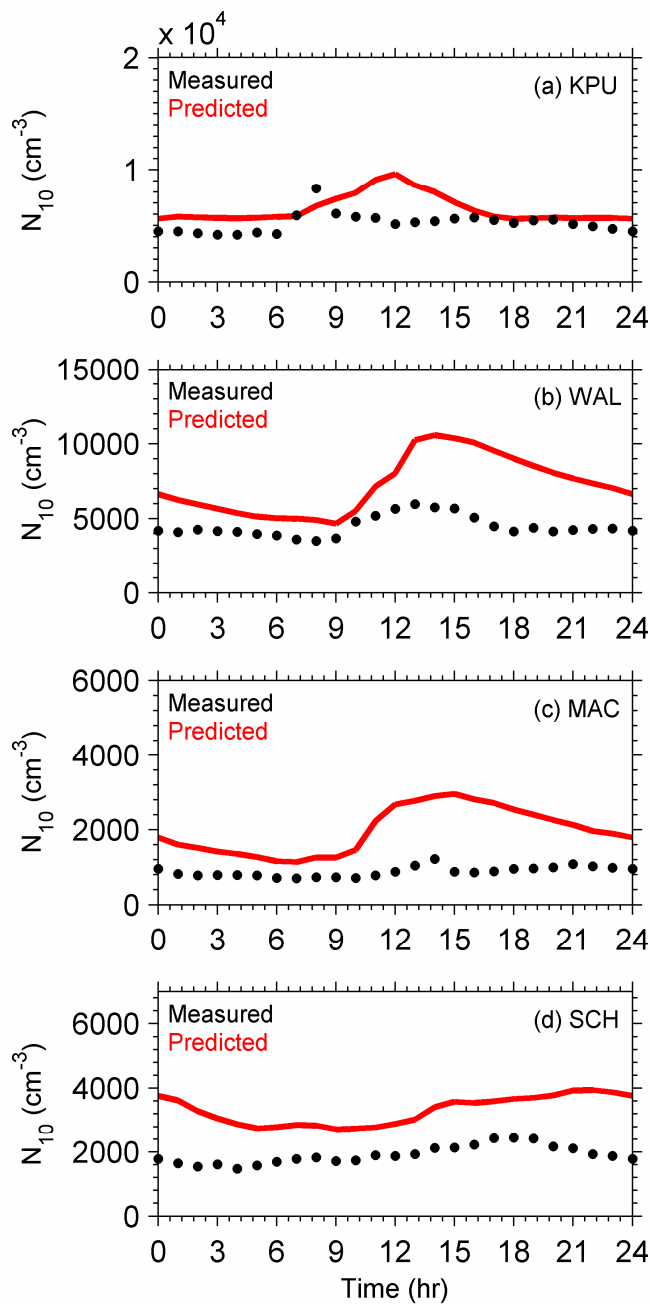
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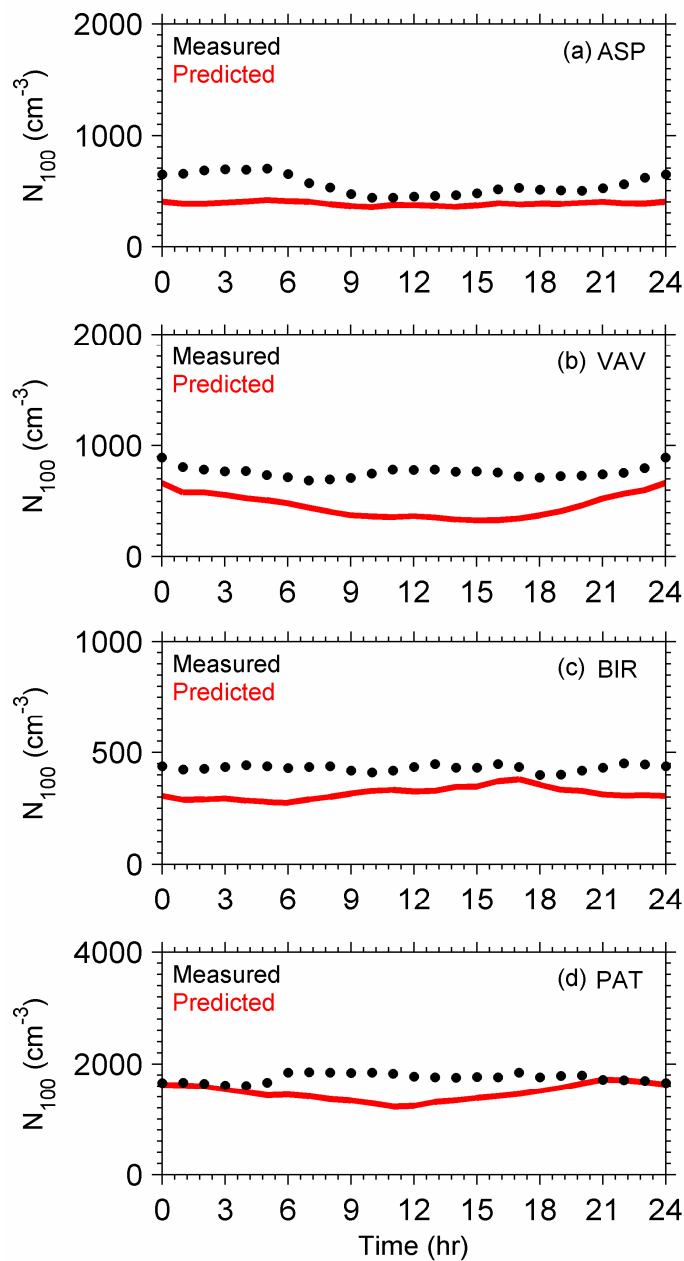
Figure S3: Average diurnal profiles of particle number concentrations (cm^{-3}) above 10 nm in: (a) Finokalia (Greece); (b) Ispra (Italy); (c) Corsica (France) and (d) Hohenpeissenberg (Germany) during 5 June – 8 July 2012. Red lines correspond to predictions and black symbols to observations.



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 112 **Figure S4:** Average diurnal profiles of particle number concentrations (cm^{-3}) above 10 nm in:
 113 (a) K-Puszta (Hungary); (b) Waldhof (Germany); (c) Mace Head (Ireland) and (d)
 114 Schneefernerhaus (Germany) during 5 June – 8 July 2012. Red lines correspond to predictions
 115 and black symbols to observations.

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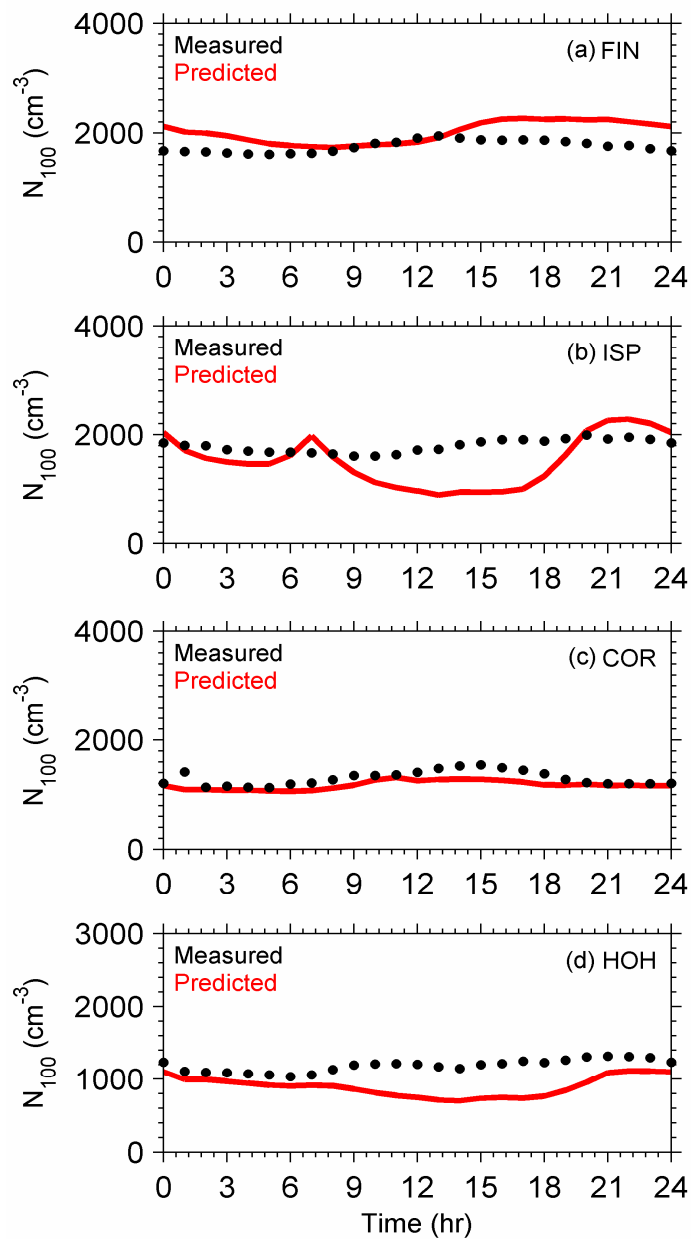
119 **Figure S5:** Average diurnal profiles of particle number concentrations (cm^{-3}) above 100 nm in

120 ((a) Aspvreten (Sweden); (b) Vavihill (Sweden); (c) (a) Birkenes (Norway) and (d) Patras

121 (Greece) during 5 June – 8 July 2012. Red lines correspond to predictions and black symbols

122 to observations.

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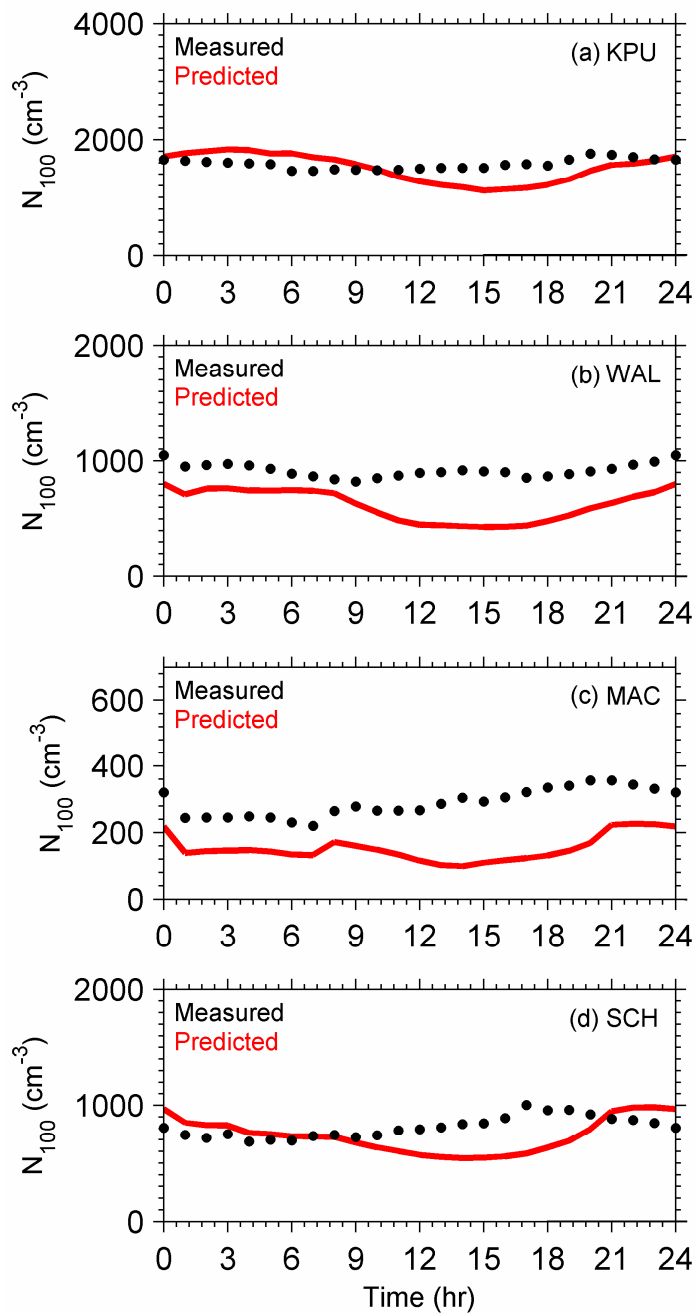
125 **Figure S6:** Average diurnal profiles of particle number concentrations (cm^{-3}) above 100 nm in:

126 (a) Finokalia (Greece); (b) Ispra (Italy); (c) Corsica (France) and (d) Hohenpeissenberg

127 (Germany) during 5 June – 8 July 2012. Red lines correspond to predictions and black

128 symbols to observations.

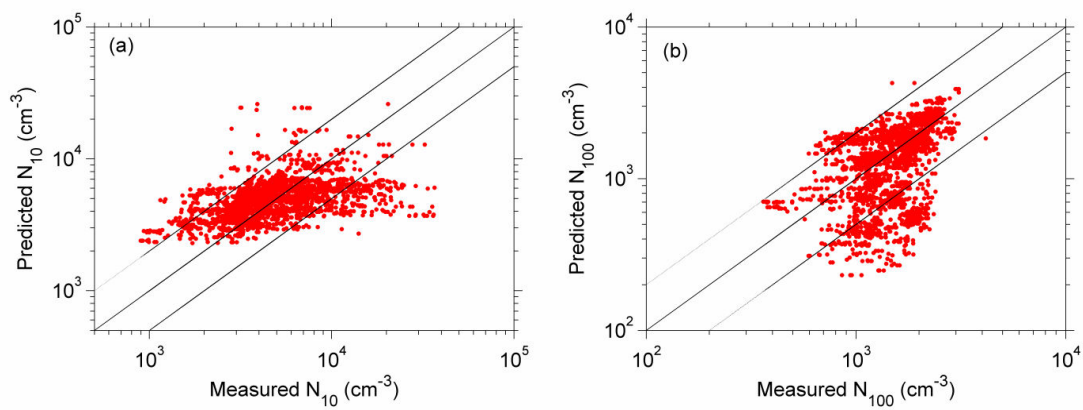
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131 **Figure S7:** Average diurnal profiles of particle number concentrations (cm^{-3}) above 100 nm in:
 132 (a) K-Puszta (Hungary); (b) Waldhof (Germany); (c) Mace Head (Ireland) and (d)
 133 Schneefernerhaus (Germany) during 5 June – 8 July 2012. Red lines correspond to predictions
 134 and black symbols to observations.

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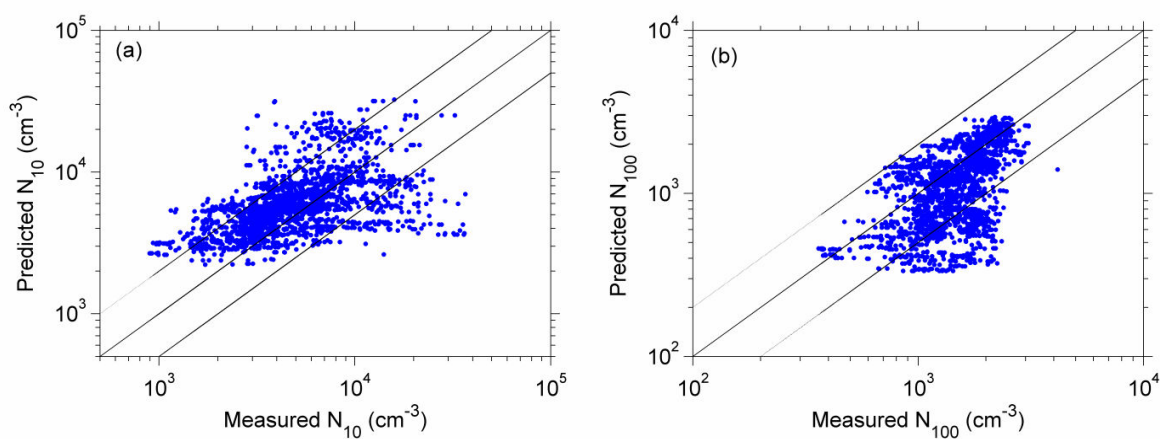
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137 **Figure S8:** Comparison of predicted (with organics) versus observed (Zeppelin) particle number
 138 concentrations (in cm^{-3}) for (a) N_{10} and (b) N_{100} of 25 flights over the Po Valley during the
 139 PEGASOS campaign. Also shown the 1:1, 2:1 and 1:2 lines.

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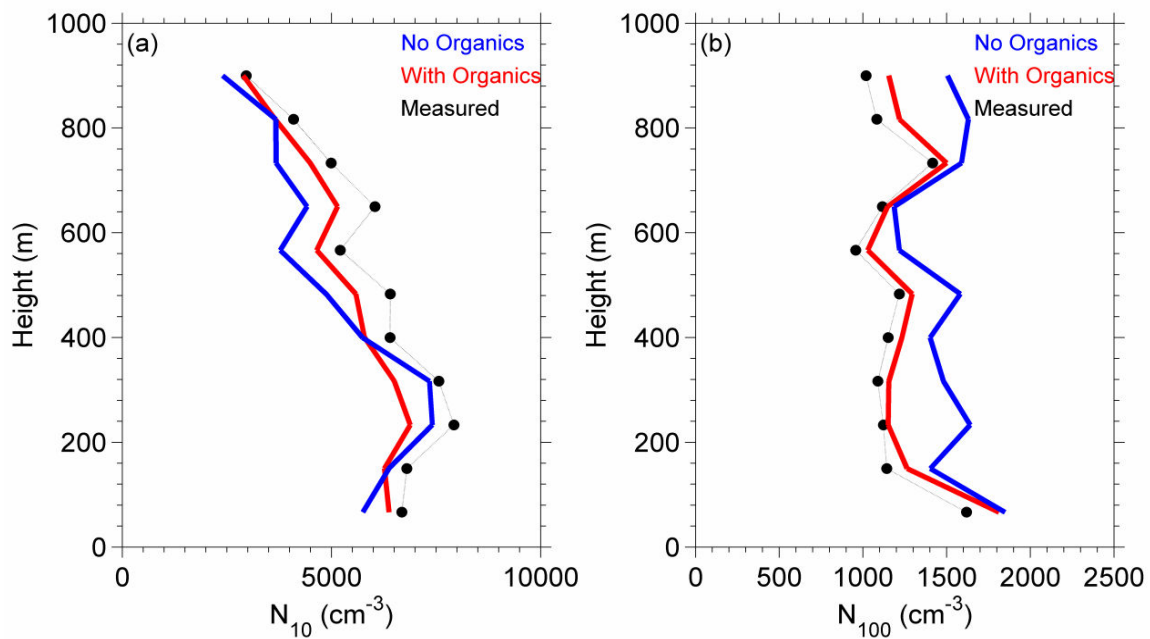
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Figure S9: Comparison of predicted without organics versus observed of Zeppelin particle number concentrations (cm^{-3}) for (a) N_{10} and (b) N_{100} of 25 flights over the Po Valley during the PEGASOS campaign. Also shown the 1:1, 2:1 and 1:2 lines.



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Figure S10: Comparison of predicted PMCAMx-UF (red line: with organics; blue line: without organics) vs. observed (black dots) vertical profiles of averaged particle number concentrations for (a) N_{10} and (b) N_{100} of 25 flights over the Po Valley during the PEGASOS campaign.