Supplementary material

Table S1: Parameters (diameters (D_p), standard deviation (σ) and number concentration fractions ($N_{mode,i}/N_{tot}$)) used for the size resolved anthropogenic primary particle emissions.

	Mode 1	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**
Dp road (nm)	3.0[a]	20.0[a]	77.0[a]	-	-
σ road	1.25[a]	1.9[a]	1.75[a]	-	-
$N_{mode,i}/N_{tot}$ road	0.02[a]	0.90[a]	0.08[a]	-	-
Dp ship (nm)	14.0[b]	90.0[b]	-	-	-
σ ship	1.45[b]	1.52[b]	-	-	-
$N_{mode,i}/N_{tot}$ ship	0.438[b]	0.562[b]	-	-	-
Dp wood (nm)	7.7[c]	23.8[c]	64.2[c]	150.0[c]	530.0[c]
σ wood	1.26[c]	1.49[c]	1.50[c]	1.60[c]	1.30[c]
$N_{mode,i}/N_{tot}$ wood	0.032[c]	0.241[c]	0.497[c]	0.227[c]	0.003[c]

[a]Value from Kristensson et al. (2004) for LDV at 70 km/h, [b]Values from Petzold et al. (2008), [c]Values from Kristensson (2005).

Table S2. Parameters used to calculate temperature dependent aerosol yields for oxidation products of different organic compounds.

Org. comp.	**Ox. Agent**	α_1	α_2	$K_{om,1}$ ($m^3/\mu g$)	$K_{om,2}$ ($m^3/\mu g$)	ΔH_1 (kJ/mol)	ΔH_2 (kJ/mol)	$T_{ref,1}$ (K)	$T_{ref,2}$ (K)
α-pinene	OH	0.5[a]	-	0.02[a]	-	40[a]	-	320[a]	-
	O_3	0.08[a]	0.42[a]	0.5[a]	0.005[a]	100[a]	38[a]	310[a]	310[a]
	NO_3	0.1[a]	-	0.02[a]	-	40[a]	-	310[a]	-
β-pinene	OH	1.0[a]	-	0.02[a]	-	60[a]	-	310[a]	-
	O_3	0.03[a]	0.38[a]	0.5[a]	0.005[a]	100[a]	40[a]	310[a]	300[a]
	NO_3	1.0[b]	-	0.0163[b]	-	60[b]	-	~310[b]	-
Δ3-carene	OH	0.054[b]	0.517[b]	0.043[b]	0.0042[b]	100[c]	40[c]	~310[b]	~310[b]
	O_3	0.128[b]	0.068[b]	0.337[b]	0.0036[b]	100[c]	40[c]	~310[b]	~310[b]
	NO_3	0.743[b]	0.257[b]	0.0088[b]	0.0091[b]	80[c]	40[c]	~310[b]	~310[b]
D-limonene	OH	0.239[b]	0.363[b]	0.055[b]	0.0053[b]	100[c]	40[c]	~310[b]	~310[b]
	O_3	0.03[c]	0.38[c]	0.055[c]	0.0053[c]	40[c]	100[c]	~310[b]	~310[b]
	NO_3	1.0[c]	-	0.055[c]		80[c]	80[c]	~310[b]	~310[b]
Isoprene	OH	0.232[d]	0.0288[d]	0.00862[d]	1.62[d]	-	-	-	-
	O_3	0.232[d]	0.0288[d]	0.00862[d]	1.62[d]	-	-	-	-
	NO_3	0.232[d]	0.0288[d]	0.00862[d]	1.62[d]	-	-	-	-
Benzene	OH+NO	0.072[e]	0.888[e]	3.315[e]	0.0090[e]	40[c]	40[c]	300[c]	300[c]
	$OH+HO_2$	0.37[e]	-	-	-	-	-	-	-
Toluene	OH+ NO	0.095[a]	0.20[a]	0.5[a]	0.005[a]	40[a]	40[a]	300[a]	300[a]
	$OH+HO_2$	0.36[e]	-	-	-	-	-		
Xylene	OH+NO	0.044[a]	0.15[a]	0.5[a]	0.005[a]	60[a]	60[a]	300[a]	300[a]
	$OH+HO_2$	0.30[e]	-	-	-	-	-	-	-
POA	OH, O_3, NO_3	0.28[c]	0.72[c]	1.0[c]	0.01[c]	130[c]	100[c]	300[c]	300[c]
IVOC	OH, O_3, NO_3	0.45[c]	0.55[c]	0.001[c]	0.0001[c]	100[c]	90[c]	300[c]	300[c]
POA and IVOC oxidation products		1.0[c]	-	-	-	-	-	-	-

[a]Values from Svendby et al., 2008, [b]Values from Griffin et al., 1999, [c]Estimated values for this work, [d]Values from Henze and Seinfeld, 2006, [e]Values from Ng et al., 2007

Table S3. Emission fractions of existing non-volatile POA emissions which are used when the POA is treated as semi-volatile and IVOC emissions are included.

C* at 298 K ($\mu g/m^3$)	10^{-2}	10^{-1}	1	10^{1}	10^{2}	10^{3}	10^{4}	10^{5}	10^{6}
Emission fractions[a] SVPOA	0.03	0.06	0.09	0.14	0.18	0.30	0.20	0	0
Emission fractions[a] IVOCs	0	0	0	0	0	0	0.20	0.50	0.80

[a]Mass ratio to existing EMEP POA emissions, values adopted from Robinson et al. (2007), Shrivastava et al. (2008) and Tsimpidi et al. (2010).

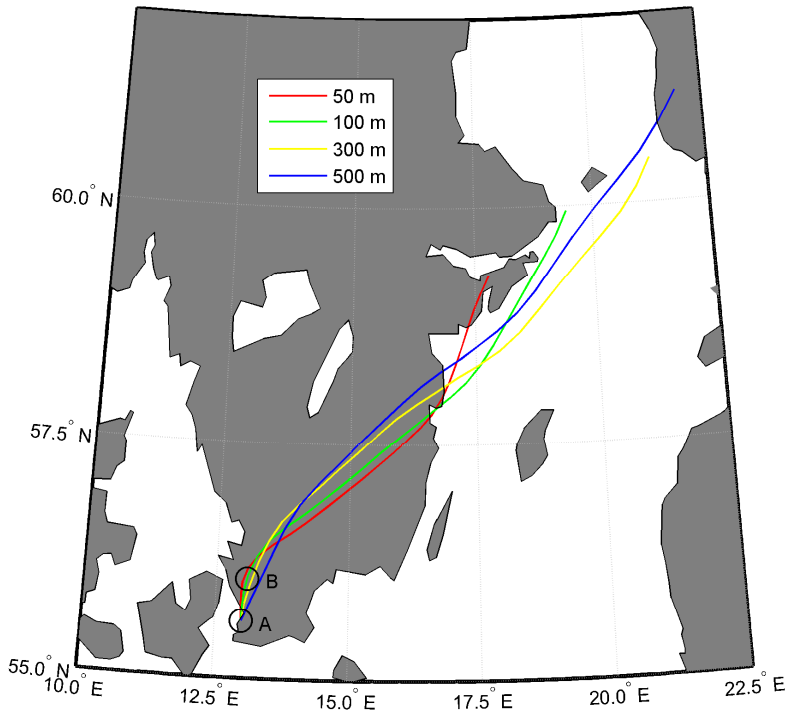
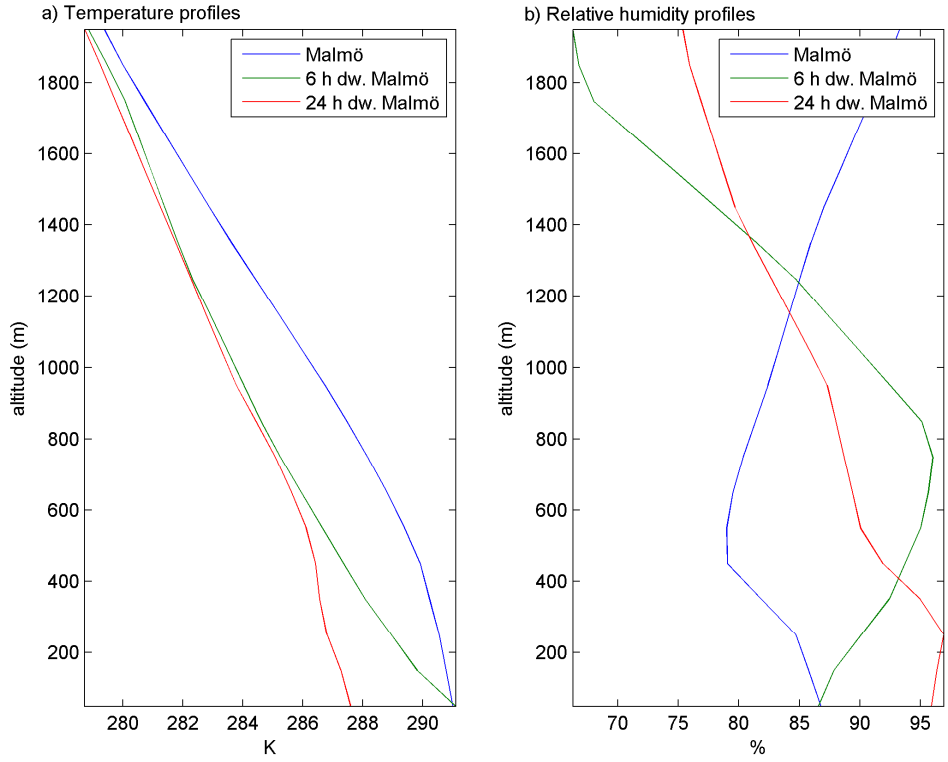


Fig. S1. Air mass trajectories from the HYSPLIT model (Draxler and Rolph, 2011). The trajectories start over Malmö (A) the 21st of June, 2006, at 6 am, 50, 100, 300 and 500 m a.g.l.. Downwind of Malmö the trajectory moves northward over Sweden and pass over or near the Vavihill measurement station about 50 km north from Malmö.



1

2 Fig. S2. Vertical temperature (a) and relative humidity (b) profiles from the Global
3 Data Assimilation System (GDAS) which were downloaded from NOAA Air
4 Resource Laboratory Real-time Environmental Application and Display sYstem
5 (READY) (Rolph, 2011), over Malmö and 6 and 24 hours downwind (dw.) of
6 Malmö.

7

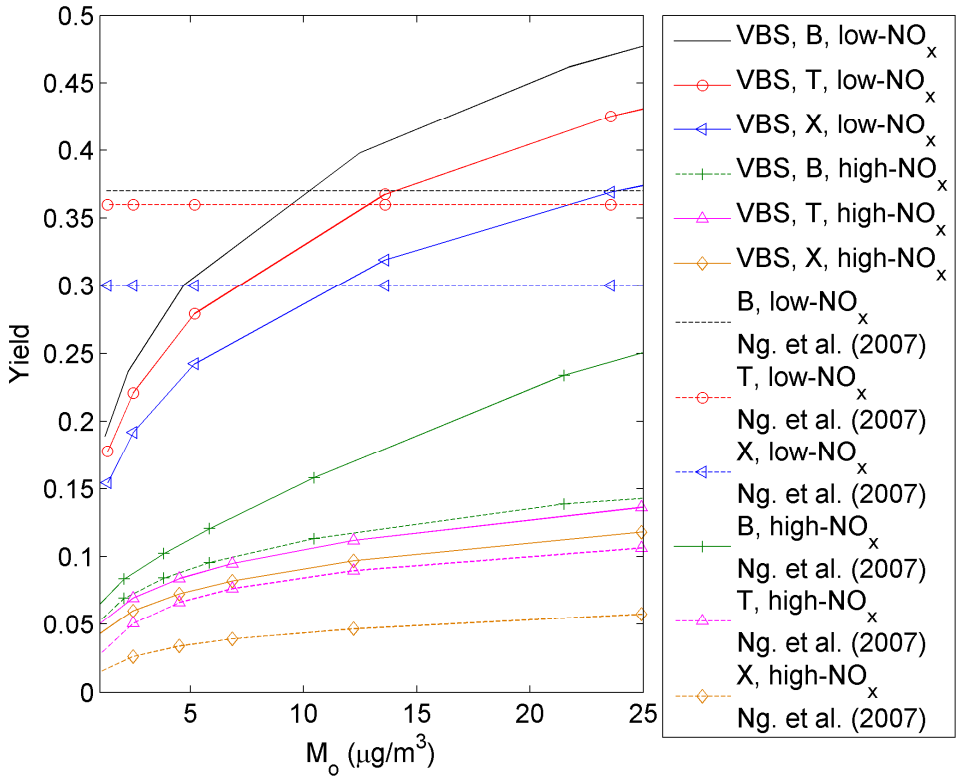


Fig. S3. SOA yields for benzene (B), toluene (T) and xylene (X), at 300 K, at high NO_x and low NO_x conditions (Ng et al., 2007) and benzene, toluene and xylene SOA yield at 300 K from the 2D-VBS model used in ADCHEM.

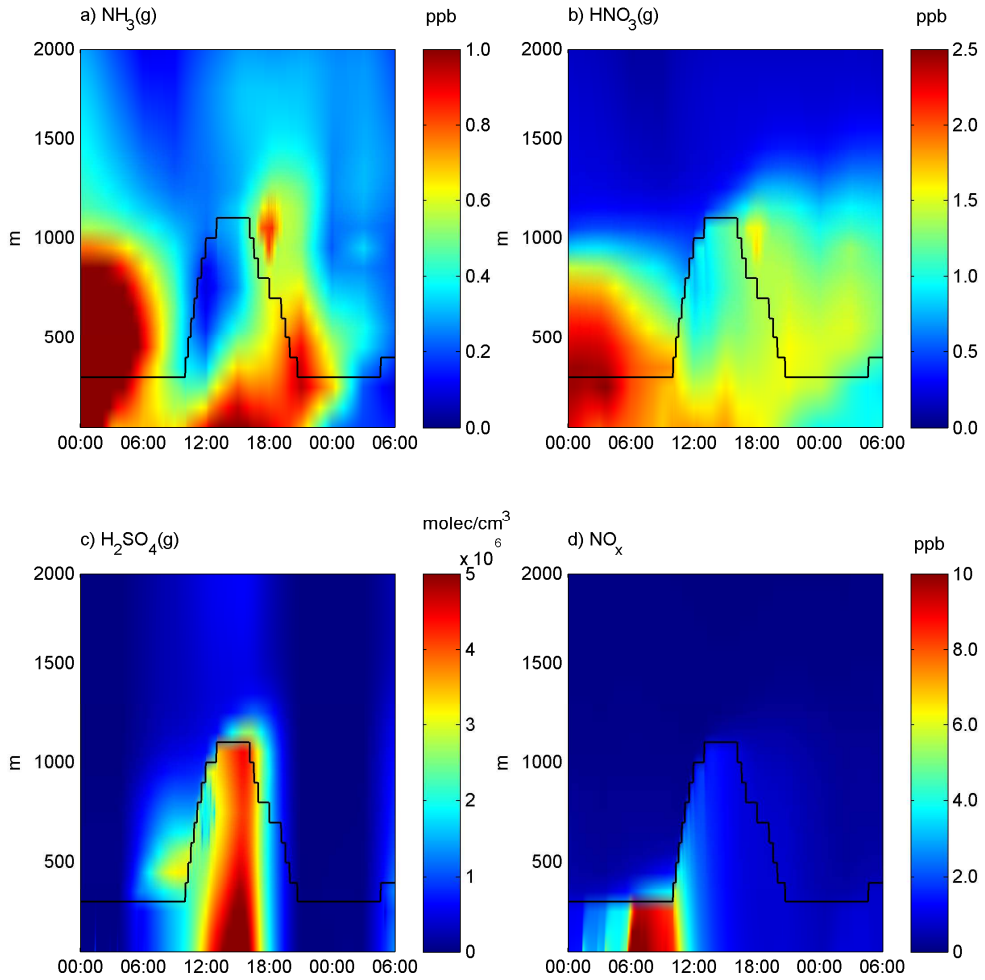


Fig. S4. Modeled ammonia (a), nitric acid (b), sulfuric acid (c) and NO_x (d), from 6 hours upwind of Malmö (00:00) until 24 hours downwind of Malmö, in the vertical direction (0-2000 m a.g.l.), in the center of the urban plume. The mixing height along the trajectory is also displayed.

References

Draxler, R. R., and Rolph, G. D.: HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Wedsite (http://ready.arl.noaa.gov/HYSPLIT.php), NOAA Air Resources Laboratory, Silver Spring, MD, Tuesday, March 01, 2011, 8:26 AM.

Griffin, R. J., Cocker, III D. R., Flagan, R. C., and Seinfeld J. H.: Organic aerosol formation from the oxidation of biogenic hydrocarbons, J. Geophys. Res., 107, D3, 3555-3567, 1999.

Henze, D. K., and Seinfeld, J. H.: Global secondary organic aerosol from isoprene oxidation, Geophysical Research Letters, 33, L09812, 2006.

Kristensson, A., Johansson, C., Westerholm, R., Swietlicki, E., Gidhagen, L., Widequist, U., and Vesely, V.: Real-world traffic emission factors of gases and particles measured in a road tunnel in Stockholm, Sweden, Atmospheric Environment 38, 657-673, 2004.

Kristensson, A.: Aerosol Particle Sources Affecting the Swedish Air Quality at Urban and Rural Level, Doctoral Dissertation at Department of Physics, Lund University, ISBN: 91-628-6573-0, 2005.

Ng, N.L., Kroll, J. H., Chan, A. W. H., Chhabra, P. S., Flagan R. C., and Seinfeld, J. H.: Secondary organic aerosol formation from m-xylene, toluene, and benzene, Atmospheric Chemistry and Physics, 7, 3909-3922, 2007.

Petzold, A., Hasselbach, J., Lauer, P., Baumann, R., Franke, K., Gurk, C., Schlager, H., and Weingartner, E.: Experimental studies on particle emissions from cruising ship, their characteristic properties, transformation and atmospheric lifetime in the marine boundary layer, Atmospheric Chemistry and Physics, 8, 2387-2403, 2008.

Robinson, A. L., Donahue, N. M., Shrivastava, M. K., Weitkamp, E. A., Sage, A. M., Grieshop, A. P., Lane, T. E., Pierce, J. R., Pandis, S. N.: Rethinking organic aerosols: Semivolatile emissions and photochemical aging, Science, 315, 1259-1262, 2007.

Rolph, G.D.: Real-time Environmental Applications and Display sYstem (READY) Website (http://ready.arl.noaa.gov/index.php), NOAA Air Resources Laboratory, Silver Spring, MD, Tuesday, March 01, 2011, 8:26 AM.

Shrivastava, M. K., Lane, T. E., Donahue, N. M., Pandis, S. N., and Robinson, A. L.: Effects of gas particle partitioning and aging of primary emissions on urban and regional organic aerosol concentrations, Journal of Geophysical Research, 113, D18301, doi:10.1029/2007JD009735, 2008.

1 Svendby, T. M., Lazaridis, M., and Tørseth, K.: Temperature dependent secondary
2 organic aerosol formation from terpenes and aromatics, Journal of Atmospheric
3 Chemistry, 59, 25-46, 2008.

4 Tsimpidi, A. P., Karydis, V. A., Zavala, M., Lei, W., Molina, L., Ulbrich, I. M.,
5 Jimenez, J. L., and Pandis S. N.: Evaluation of the volatility basis-set approach for the
6 simulation of organic aerosol formation in the Mexico City metropolitan area, Atmos.
7 Chem. Phys., 10, 525–546, 2010.