1 Supplement

Table S1. Statistics for model evaluation. M_i represents the modelled value, O_i the observations, $\overline{O}$ the mean of the observations and n the total number of data points.

Mean Bias (MB)	$MB = \dfrac{1}{n}\sum_{i=1}^{n}(M_i - O_i)$,
Mean Error (ME)	$ME = \dfrac{1}{n}\sum_{i=1}^{n}(\lvert M_i - O_i\rvert)$,
Mean Fractional Bias (ME)	$MFB = \dfrac{2}{n}\sum_{i=1}^{n}(\dfrac{M_i - O_i}{M_i + O_i})$,
Mean Fractional Bias (ME)	$MFE = \dfrac{2}{n}\sum_{i=1}^{n}(\dfrac{\lvert M_i - O_i\rvert}{M_i + O_i})$,
Coefficient of determination (R^2)	$R2 = 1 - \dfrac{\sum_{i}^{n}(O_i - M_i)^2}{\sum_{i}^{n}(O_i - \overline{O})^2}$.

Table S2. Statistical analysis for HOA during February-March 2009 periods at 11 AMS sites.

Site	Mean observed HOA ($\mu g\ m^{-3}$)	Mean modelled HOA ($\mu g\ m^{-3}$)	MB ($\mu g\ m^{-3}$)	ME ($\mu g\ m^{-3}$)	MFB [-]	MFE [-]	r	R^2
Barcelona	2.1	0.8	-1.3	1.5	-0.4	0.8	0.4	0.1
Cabauw	0.3	0.4	0.2	0.2	0.6	0.8	0.5	0.2
Chilbolton	0.5	0.3	-0.2	0.3	-0.5	0.7	0.8	0.6
Helsinki	0.4	1.0	0.6	0.7	0.8	0.9	0.2	0.1
Hyytiälä	0.0	0.1	0.1	0.1	0.7	0.8	0.6	0.3
Mace Head	0.1	0.1	-0.1	0.1	0.5	1.1	0.6	0.3
Melpitz	0.1	0.1	0.0	0.1	-0.1	0.6	0.6	0.3
Montseny	0.2	0.1	-0.1	0.2	-0.3	0.8	0.4	0.1
Payerne	0.3	0.3	-0.1	0.2	0.0	0.6	0.4	0.1
Puy de Dôme	0.0	0.1	0.0	0.0	0.3	0.8	0.1	0.0
Vavihill	0.4	0.2	-0.2	0.2	-0.4	0.7	0.5	0.2

Table S3 Statistical analysis for BBOA during February-March 2009 periods at 11 AMS sites.

Site	Mean observed BBOA ($\mu g\ m^{-3}$)	Mean modelled BBOA ($\mu g\ m^{-3}$)	MB ($\mu g\ m^{-3}$)	ME ($\mu g\ m^{-3}$)	MFB [-]	MFE [-]	r	R^2
Barcelona	0.7	1.1	0.5	0.7	0.6	0.8	0.4	0.2
Cabauw	0.1	0.5	0.3	0.3	1.0	1.1	0.5	0.3
Chilbolton	0.5	0.2	-0.3	0.3	-0.6	0.8	0.6	0.4
Helsinki	0.4	1.4	1.0	1.1	1.1	1.1	0.1	0.0
Hyytiälä	0.1	0.5	0.4	0.4	1.5	1.5	0.7	0.5
Mace Head	0.3	0.0	-0.3	0.3	-0.9	1.4	-0.1	0.0
Melpitz	0.2	0.3	0.1	0.2	0.7	0.9	0.4	0.2
Montseny	0.2	0.3	0.1	0.2	0.5	0.8	0.2	0.1
Payerne	0.4	0.8	0.4	0.5	0.8	0.9	0.6	0.3
Puy de Dôme	0.1	0.2	0.1	0.2	0.5	1.0	0.3	0.1
Vavihill	0.7	0.7	0.1	0.5	-0.1	0.7	0.5	0.2
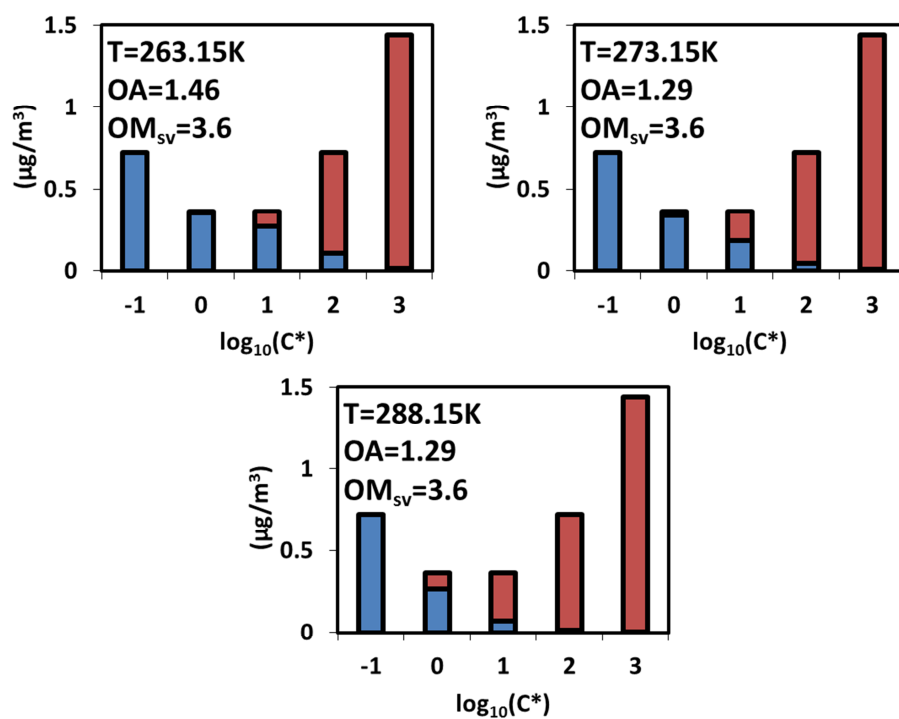
Figure S1. Box-model partitioning of biomass burning POA at about 1 μg m^{-3} OA at different temperatures (263.15, 273.15 and 288.15 K) using volatility distributions proposed by May et al. (2013). Particle phase is represented blue and gas phase in red.
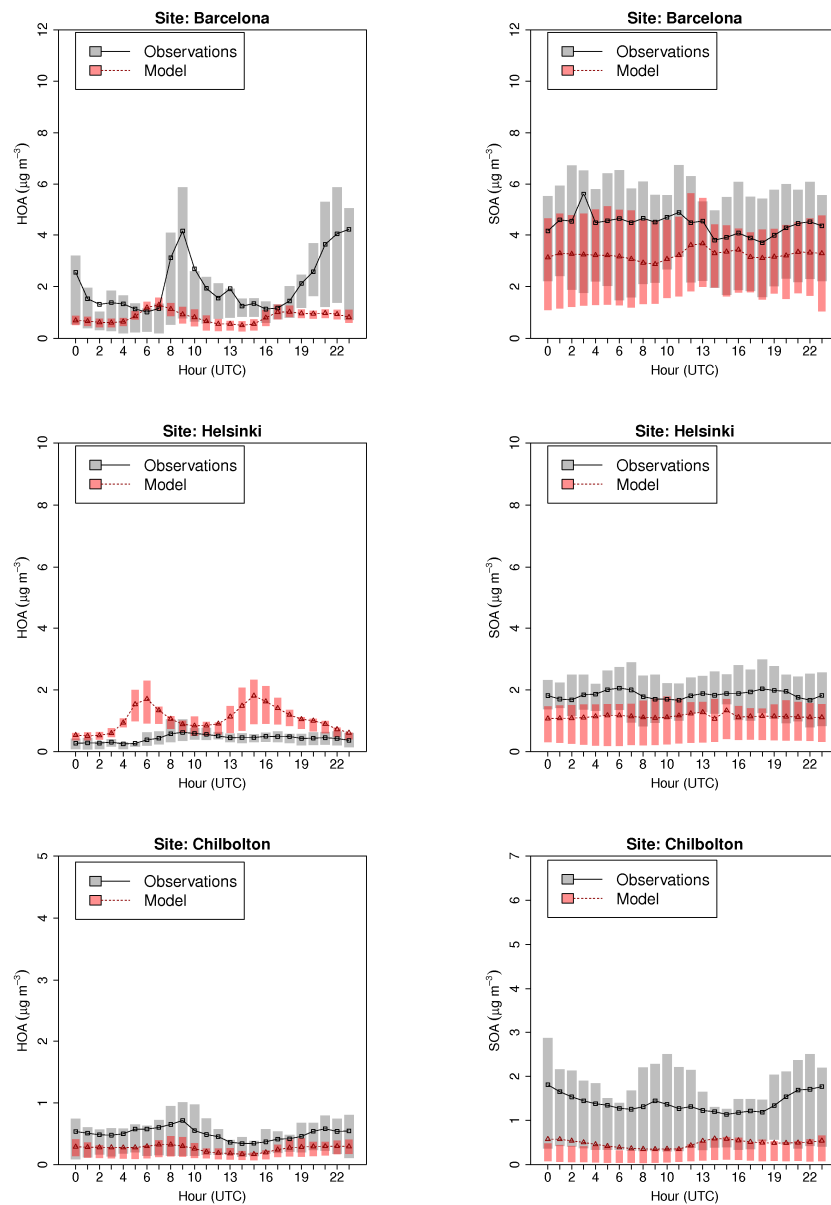
Figure S2 Comparison of modelled (red) and measured (grey) HOA and SOA diurnal profiles at the sites of Barcelona, Helsinki and Chilbolton. The extent of the bars indicates the 25th and 75th percentiles.

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