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*Supplement of*

## **Sources and contributions of wood smoke during winter in London: assessing local and regional influences**

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Table S1: Average of daily calculated  $EC_{ff}$ ,  $EC_{bb}$ ,  $OC_{bb}$ ,  $OC_{ff}$  and  $OC_{SOA}$  concentrations ( $\mu\text{g m}^{-3}$ ). The  $OC/EC_{veh}$  and  $OC/EC_{bb}$  refers to the source ratio of vehicle emissions and biomass burning, respectively.

Source ratio used	Site		$OC_{bb}$	$EC_{bb}$	$OC_{ff}$	$EC_{ff}$	$OC_{SOA}$
Levogluconan/OC = 0.136 $OC/EC_{veh} = 0.58$ $OC/EC_{bb} = 6$	<b>Detling</b>	Average	0.49	0.08	0.33	0.57	1.29
		Std. Dev.	0.36	0.06	0.19	0.33	1.23
	<b>North</b>	Average	0.57	0.1	0.83	1.44	2.12
		<b>Kensington</b>	Std. Dev.	0.26	0.04	0.49	0.85
Levogluconan/OC = 0.07 $OC/EC_{veh} = 0.3$ $OC/EC_{bb} = 3$	<b>Detling</b>	Average	0.97	0.32	0.10	0.33	1.05
		Std. Dev.	0.71	0.24	0.09	0.30	1.20
	<b>North</b>	Average	1.11	0.37	0.35	1.16	2.06
		<b>Kensington</b>	Std. Dev.	0.51	0.17	0.22	0.75
Levogluconan/OC = 0.17 $OC/EC_{veh} = 1$ $OC/EC_{bb} = 10$	<b>Detling</b>	Average	0.40	0.04	0.61	0.61	1.11
		Std. Dev.	0.29	0.03	0.35	0.35	1.14
	<b>North</b>	Average	0.46	0.05	1.49	1.49	1.58
		<b>Kensington</b>	Std. Dev.	0.21	0.02	0.86	0.86
Levogluconan/OC = 0.136 $OC/EC_{veh} = 0.3$ $OC/EC_{bb} = 6$	<b>Detling</b>	Average	0.50	0.08	0.17	0.57	1.45
		Std. Dev.	0.36	0.06	0.10	0.33	1.31
	<b>North</b>	Average	0.57	0.10	0.43	1.44	2.52
		<b>Kensington</b>	Std. Dev.	0.26	0.04	0.25	0.85
Levogluconan/OC = 0.09 $OC/EC_{veh} = 0.58$ $OC/EC_{bb} = 6$	<b>Detling</b>	Average	0.75	0.13	0.30	0.52	1.06
		Std. Dev.	0.55	0.09	0.19	0.32	1.16
	<b>North</b>	Average	0.86	0.14	0.81	1.39	1.85
		<b>Kensington</b>	Std. Dev.	0.40	0.07	0.48	0.83
Levogluconan/OC = 0.09 $OC/EC_{veh} = 0.3$ $OC/EC_{bb} = 6$	<b>Detling</b>	Average	0.75	0.13	0.16	0.52	1.21
		Std. Dev.	0.54	0.09	0.09	0.32	1.21
	<b>North</b>	Average	0.86	0.14	0.42	1.39	2.24
		<b>Kensington</b>	Std. Dev.	0.40	0.07	0.25	0.83
Levogluconan/OC = 0.098 $OC/EC_{veh} = 0.58$ $OC/EC_{bb} = 8.2$	<b>Detling</b>	Average	0.69	0.08	0.33	0.56	1.10
		Std. Dev.	0.51	0.06	0.19	0.33	1.17
	<b>North</b>	Average	0.79	0.09	0.83	1.44	1.90
		<b>Kensington</b>	Std. Dev.	0.37	0.04	0.49	0.85

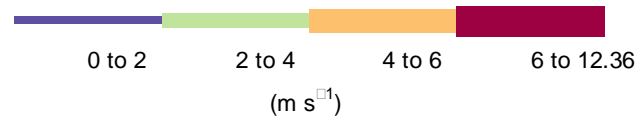
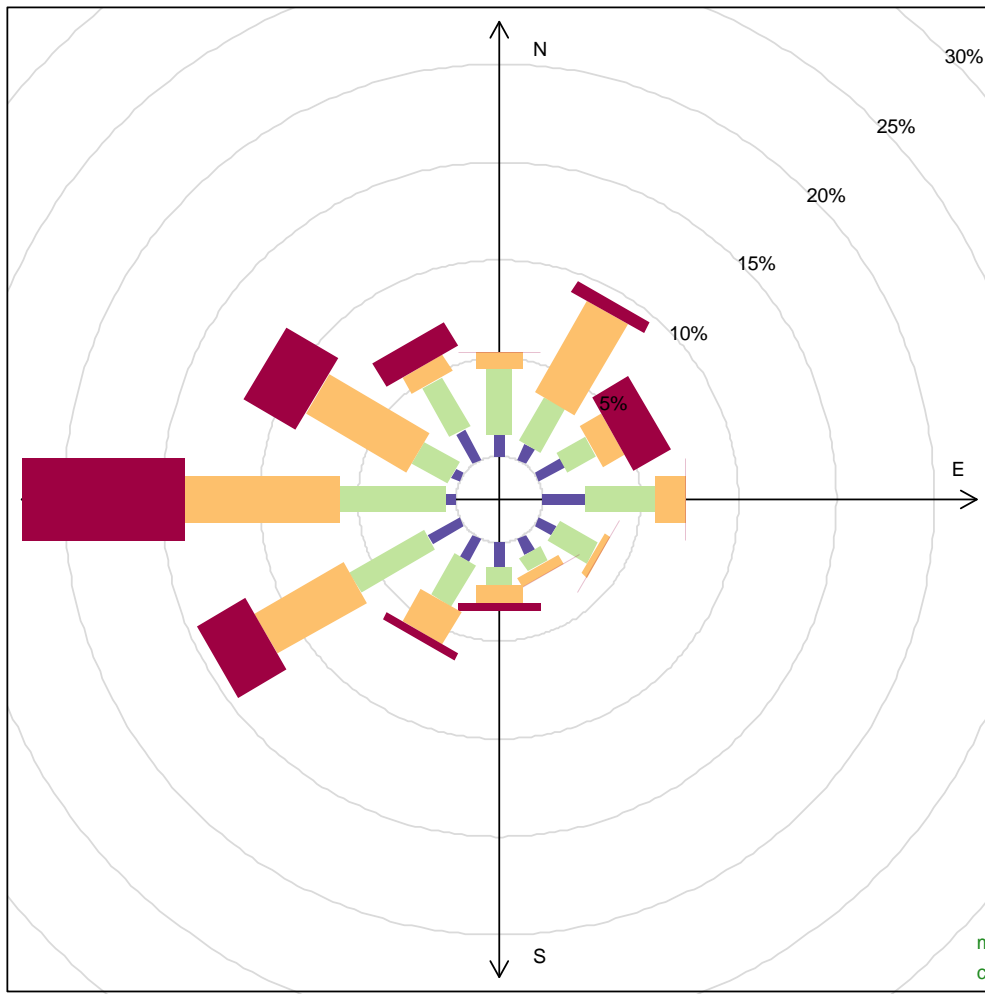
Table S2: Times of extended de-coupling at BT based on estimated turbulent mixing height (TMH) using lidar measurements during the summer and winter intensive observation periods.

<b>Date</b>	<b>Initial time</b>	<b>TMH</b>	<b>Final time</b>	<b>TMH</b>
<b>24/01/2012</b>	23:00	139	06:00	139
<b>03/02/2012</b>	18:00	139	04:00	139
<b>25/07/2012</b>	23:00	63	07:00	189
<b>26/07/2012</b>	22:00	63	08:00	153
<b>30/07/2012</b>	23:00	63	05:00	135
<b>08/08/2012</b>	21:00	99	07:00	63

Note: The minimum observable height depended on the lidar gate and the height that the instrument is placed (above ground level) at each site, and differed between the winter IOP (139 m) and summer IOP (63 m).

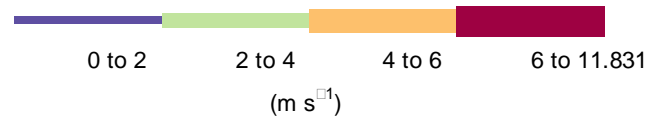
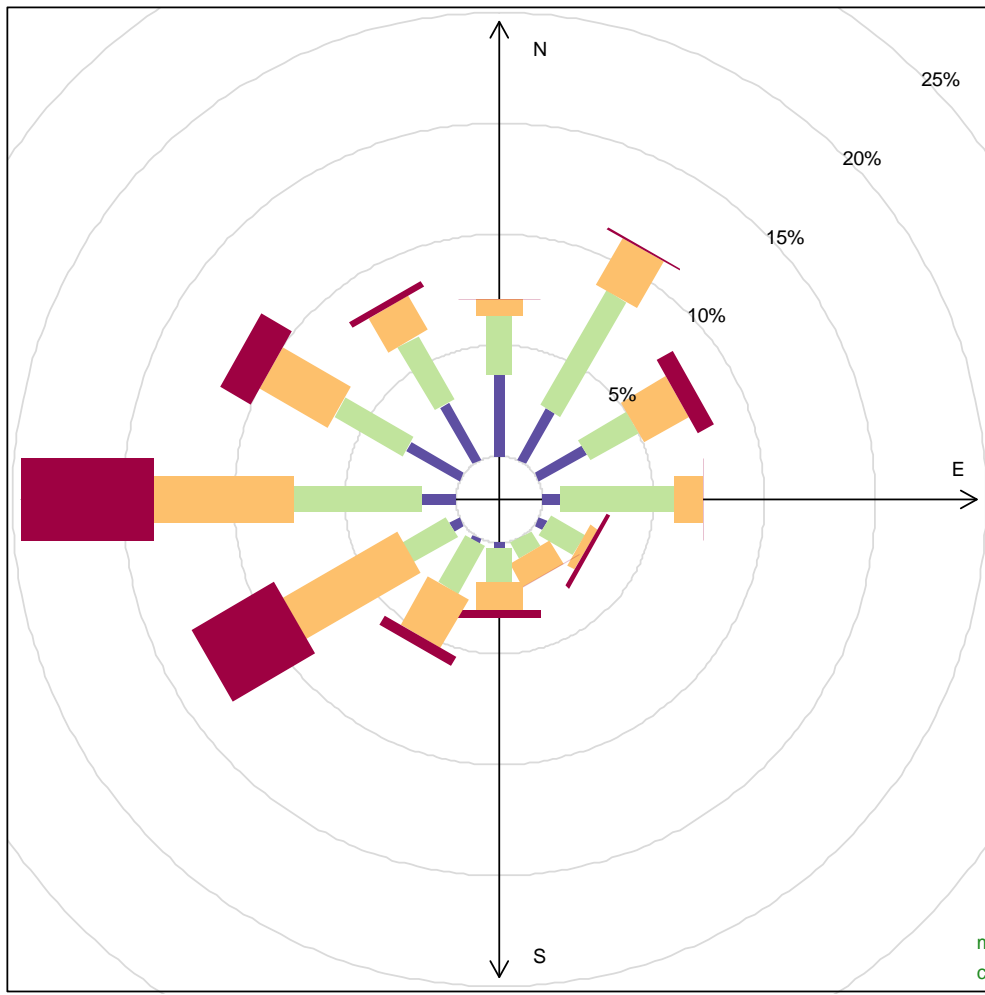
Table S3: Times of de-coupling estimated based on visual inspection of the NO<sub>x</sub> concentrations time series at BT and NK

<b>ID</b>	<b>Start date</b>	<b>Start</b>	<b>Finish</b>
<b>1</b>	15-Apr-12	22:00	06:00
<b>2</b>	19-Feb-12	19:00	07:00
<b>4</b>	11/03/2012	20:00	06:00
<b>5</b>	18/03/2012	20:00	06:00
<b>6</b>	12/04/2012	22:00	03:00
<b>7</b>	17/08/2012	19:00	04:00
<b>8</b>	18/08/2012	22:00	06:00
<b>9</b>	26/08/2012	20:00	00:00
<b>10</b>	07/09/2012	19:30	07:00
<b>11</b>	14/09/2012	19:00	05:30
<b>12</b>	18/09/2012	23:00	05:00
<b>13</b>	06/10/2012	18:00	07:00
<b>14</b>	14/10/2012	18:00	06:00
<b>15</b>	16/10/2012	20:00	03:00
<b>16</b>	29/04/2013	19:00	00:00
<b>17</b>	25/05/2013	20:00	00:00



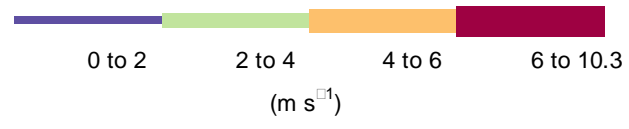
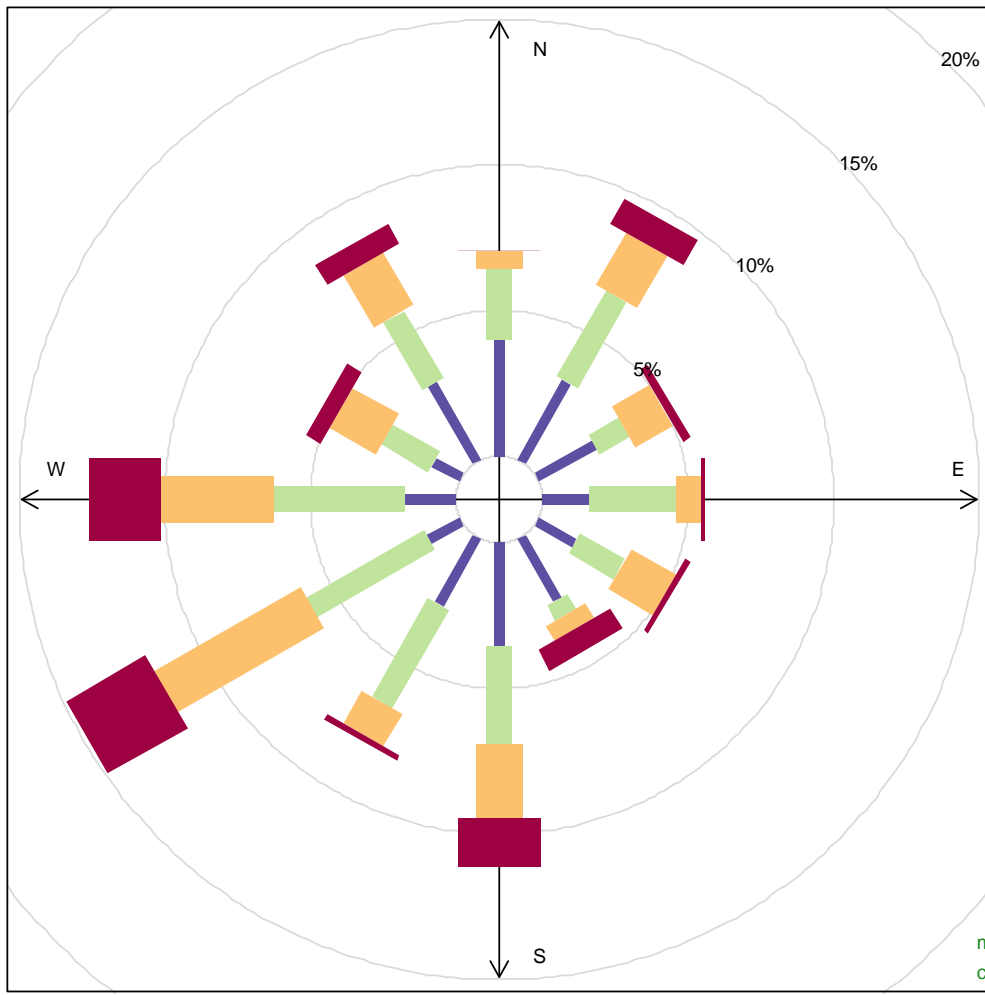
**Frequency of counts by wind direction (%)**

Figure S1: Wind rose plot for the winter IOP at Gravesend station.



**Frequency of counts by wind direction (%)**

Figure S2: Wind rose plot for the winter IOP for Heathrow Airport station.



**Frequency of counts by wind direction (%)**

Figure S3: Wind rose plot for winter IOP at Benson station.

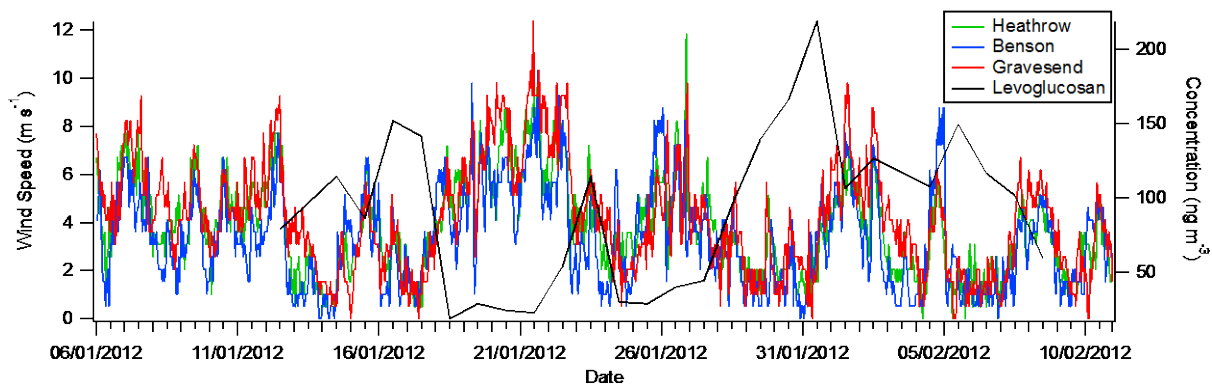


Figure S4: Wind speed as a function of time for the winter IOP. Concentration of levoglucosan included in this plot is from Harwell.

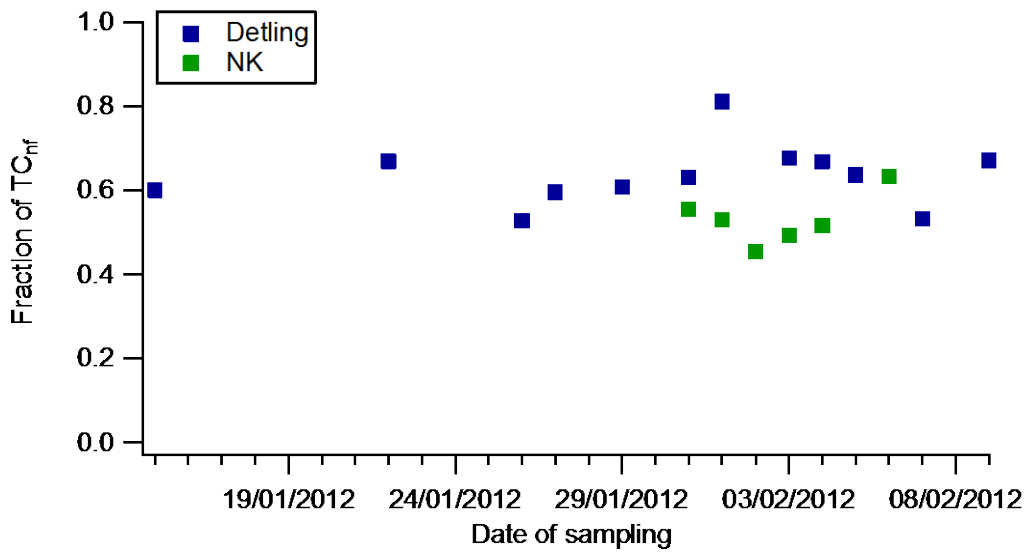


Figure S5: Daily values of the fraction of non-fossil TC ( $TC_{nf}$ ) at Detling and North Kensington. Note the date represent the start date of sampling.



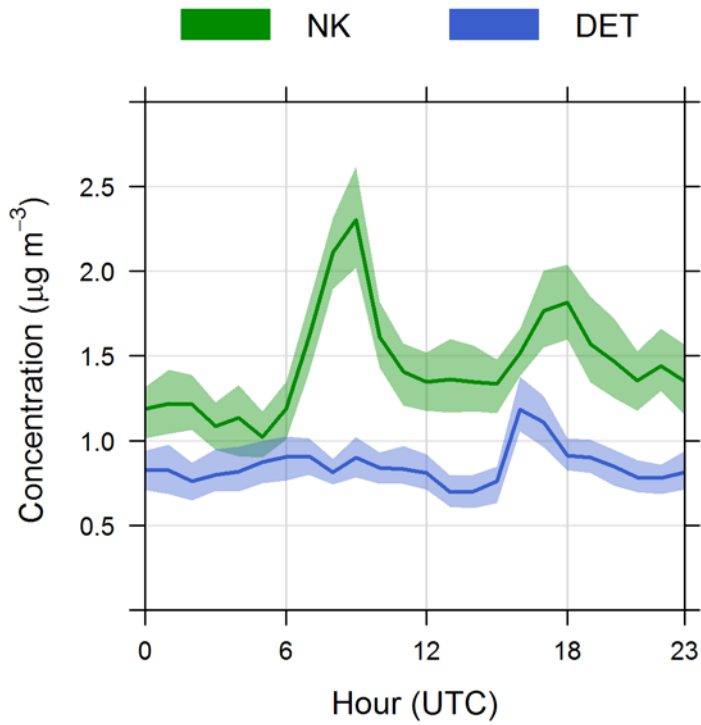


Figure S6: Mean diurnal variations in the BC concentrations during the winter campaign as measured by a 7W AE with the shaded areas indicating the 95% confidence intervals. Note in the key DET and NK represent Detling and North Kensington, respectively.

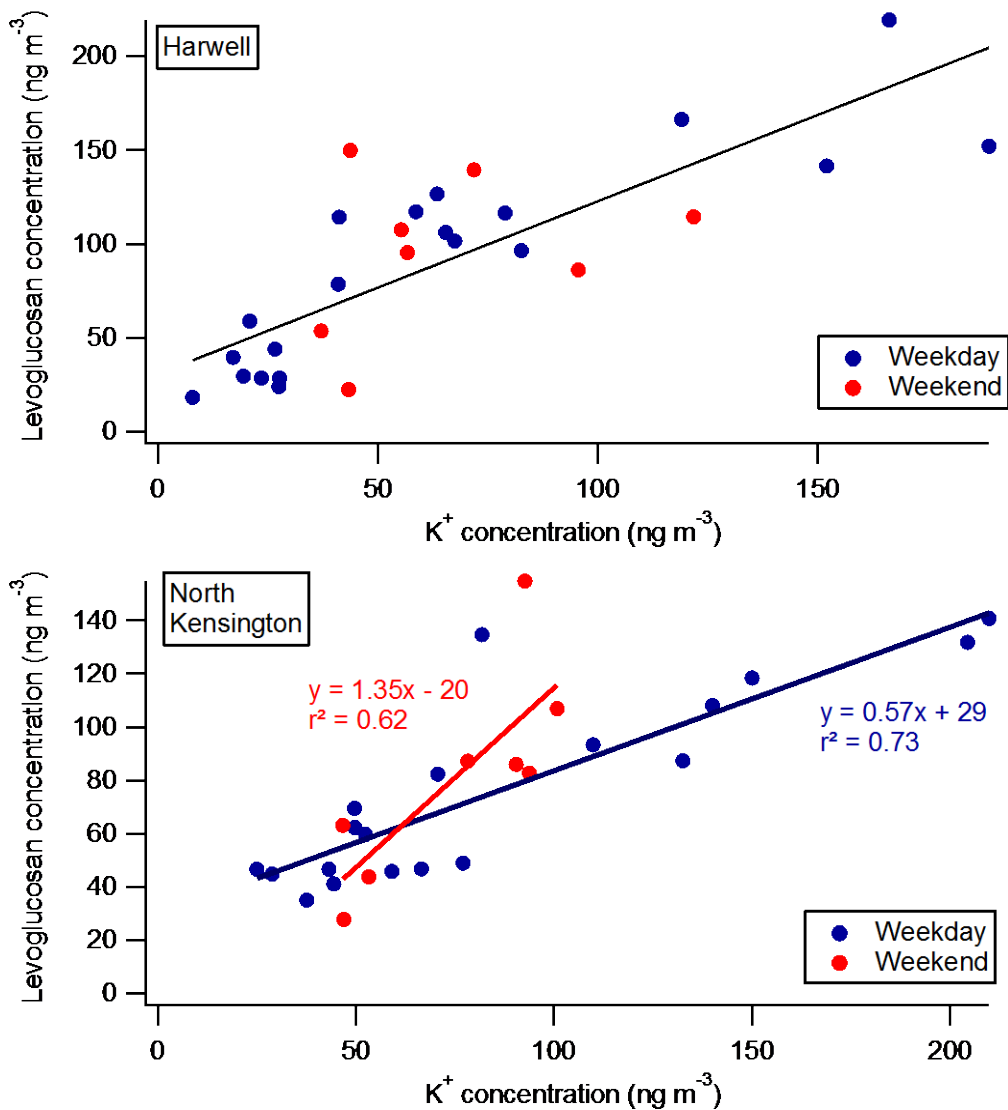


Figure S7: Scatter plots of levoglucosan to K<sup>+</sup> concentrations -as a function of weekday and weekend at Harwell (upper panel) and North Kensington (bottom panel).

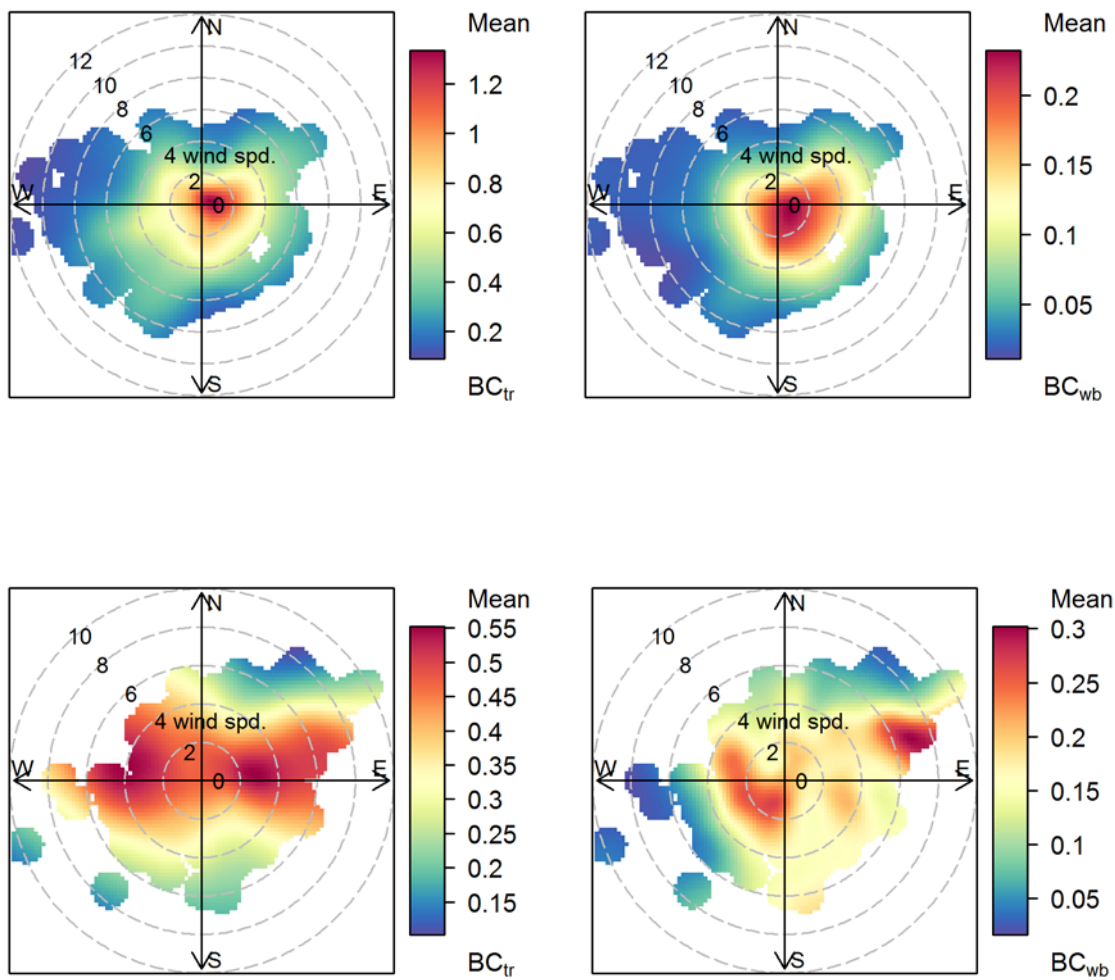


Figure S8: Polar plots of the mean concentration ( $\mu\text{g m}^{-3}$ ) of BC from traffic (BC<sub>tr</sub>) and wood burning (BC<sub>wb</sub>) calculated by the 2 component Aethalometer model at North Kensington (top row) and Detling (bottom row) for the winter campaign. Wind speed is in  $\text{m s}^{-1}$ .

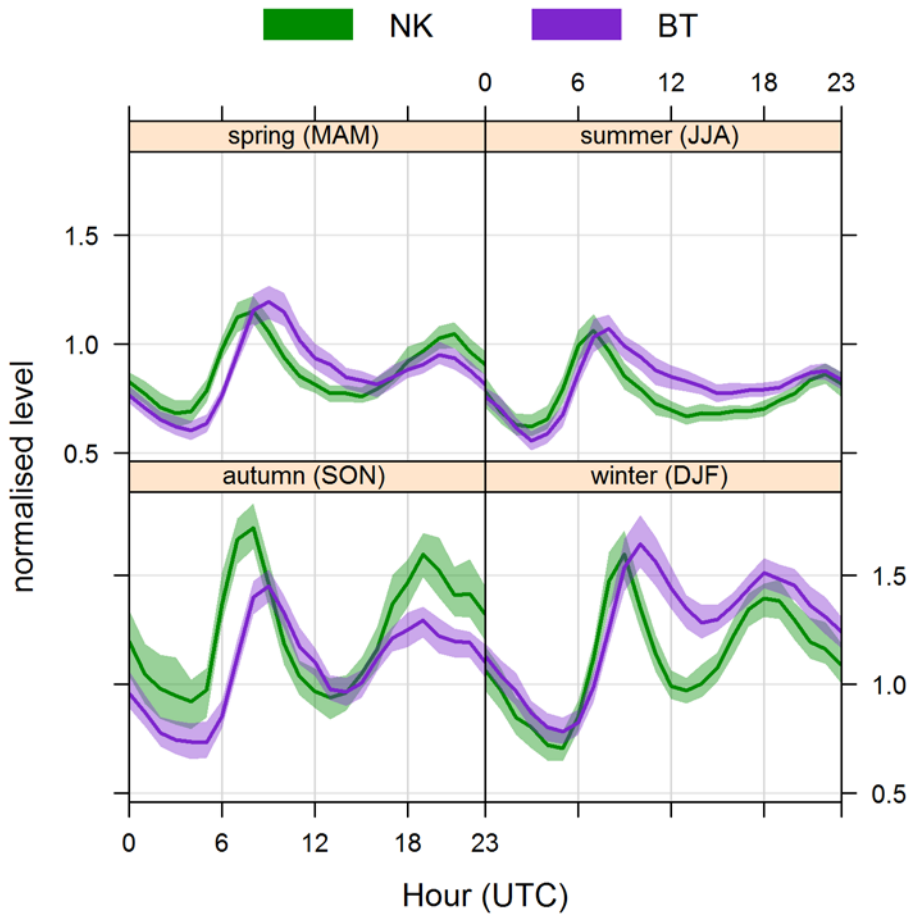


Figure S9: Diurnal cycles of the BC concentrations, normalised by the mean, for each season (note the letters in brackets indicate the months used) at North Kensington (NK) and BT tower (BT).

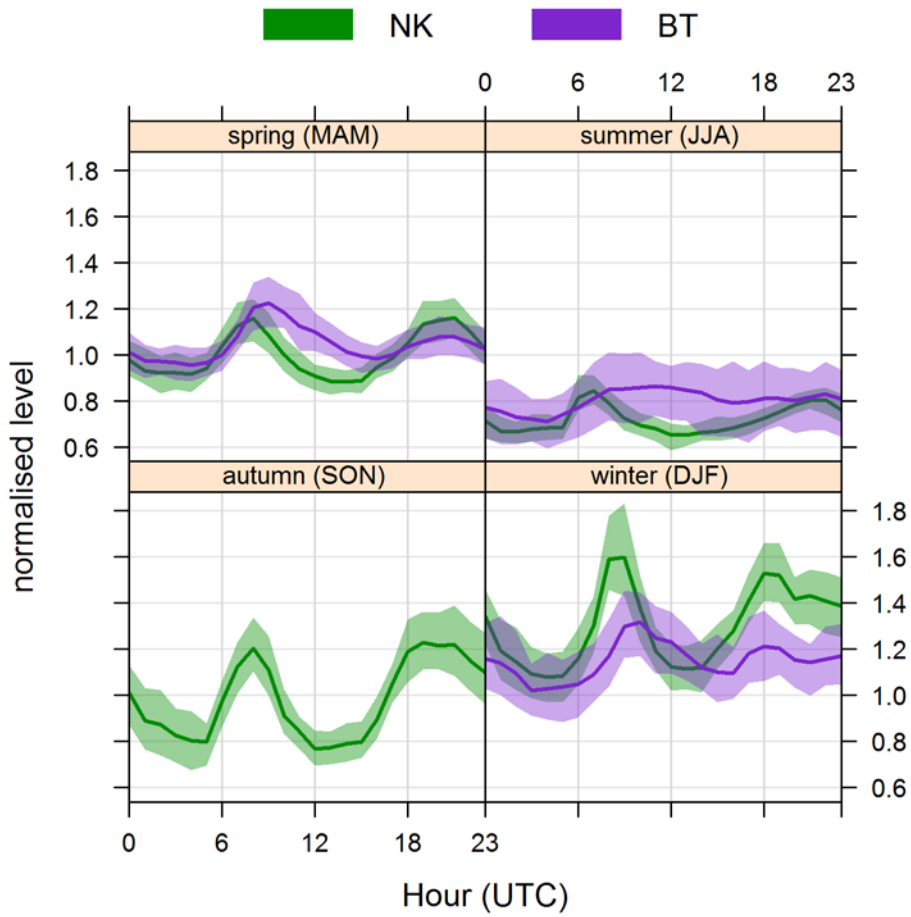


Figure S10: Diurnal cycles of the CO concentrations, normalised by the mean, for each season (note the letters in brackets indicate the months used) at North Kensington (NK) and BT tower (BT).

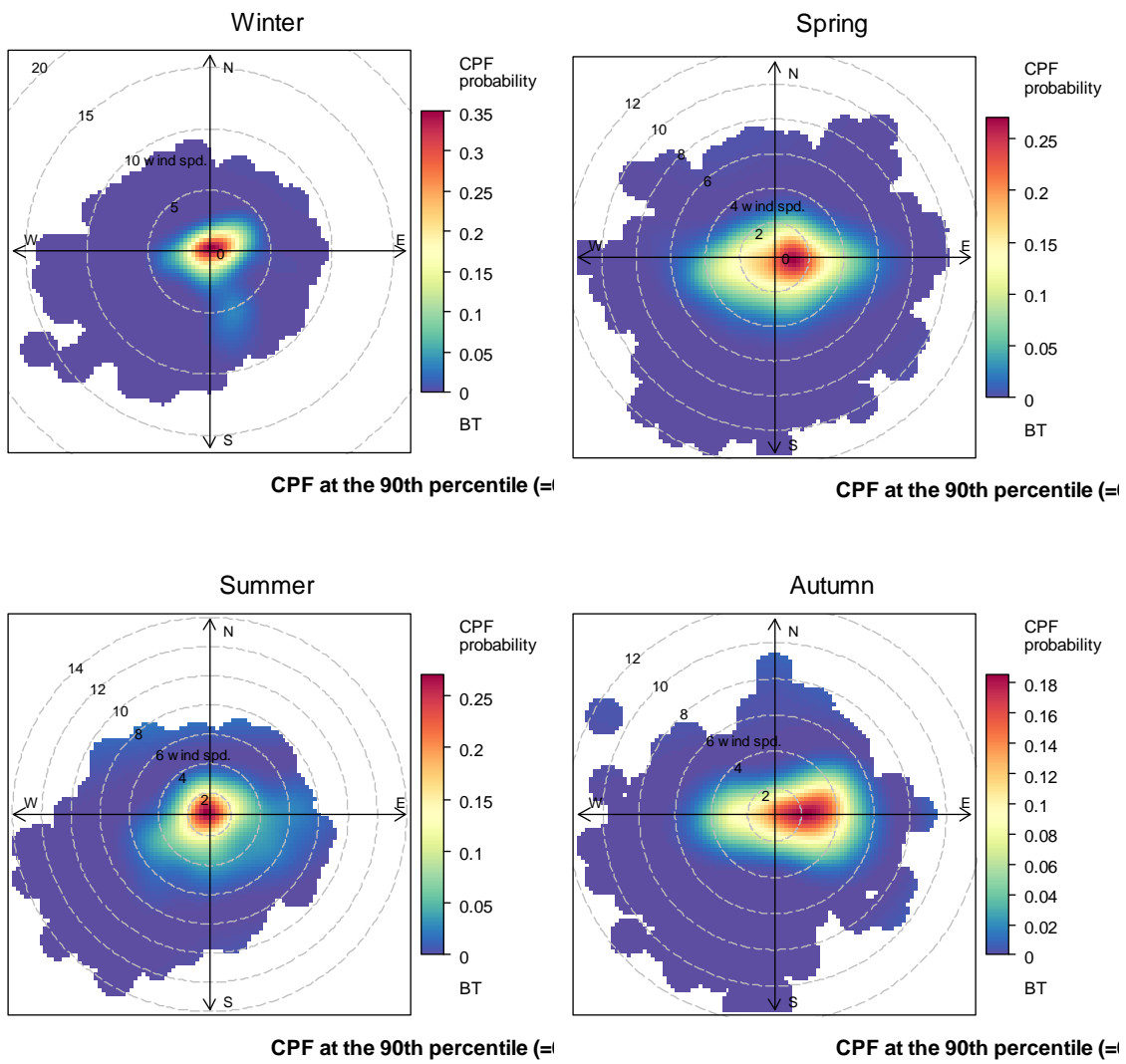


Figure S11: CPF analysis of BC concentrations at 880 nm at BT tower for each season presented as polar plots.

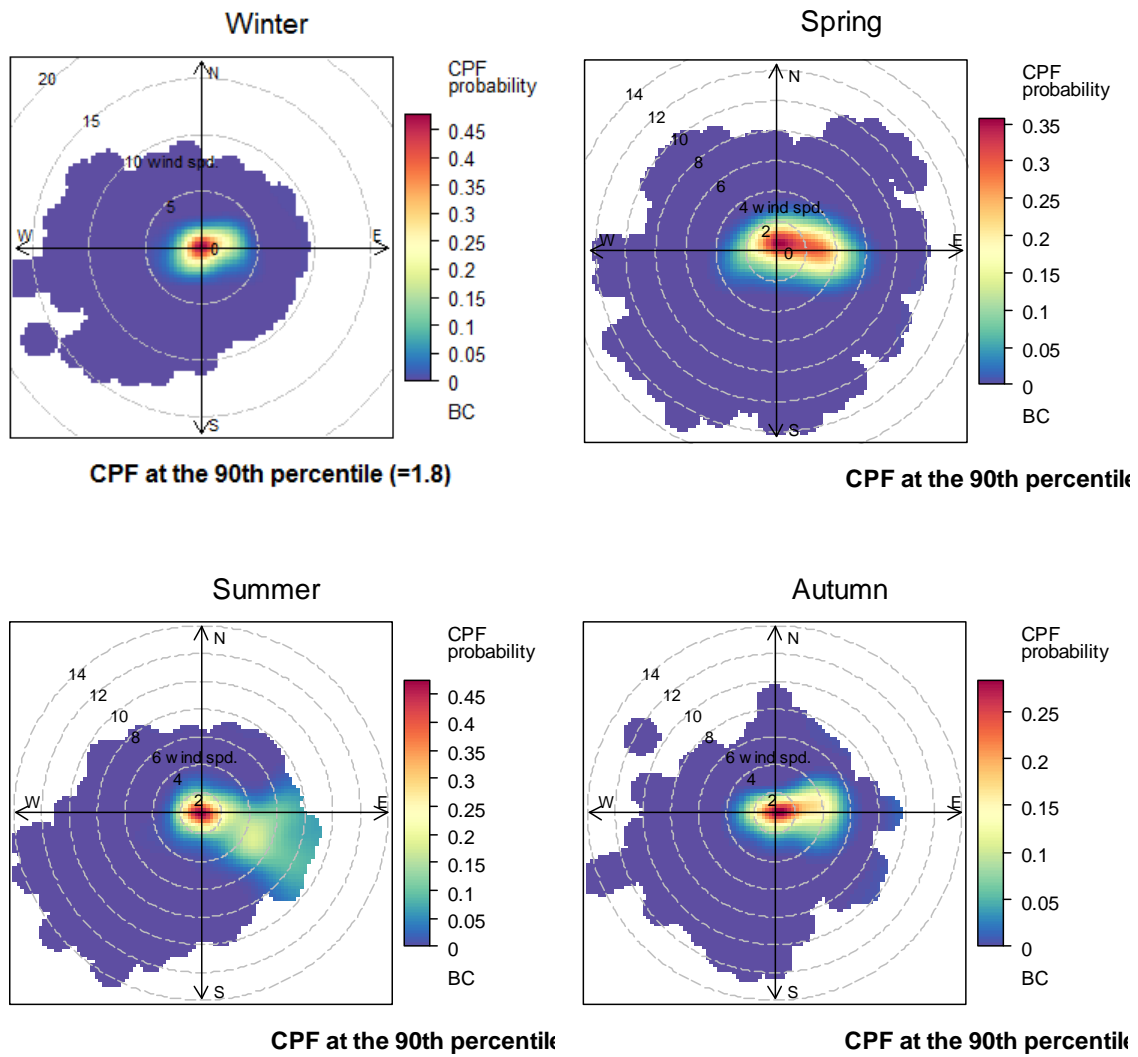


Figure S12: CPF analysis of the BC concentrations at 880 nm at North Kensington for each season presented as polar plots.

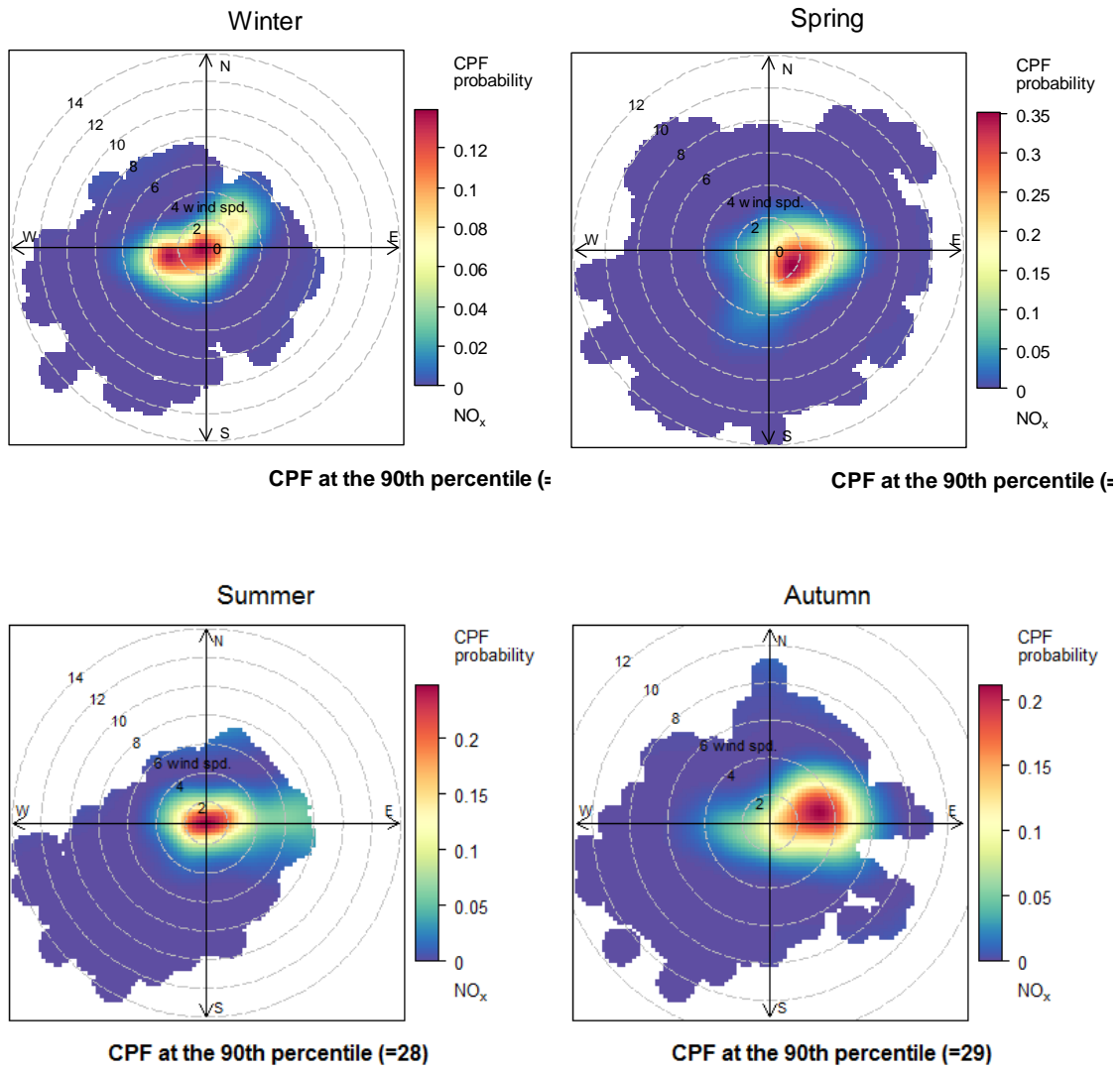


Figure S13: CPF analysis of NO<sub>x</sub> concentrations at BT tower for each season presented as polar plots.



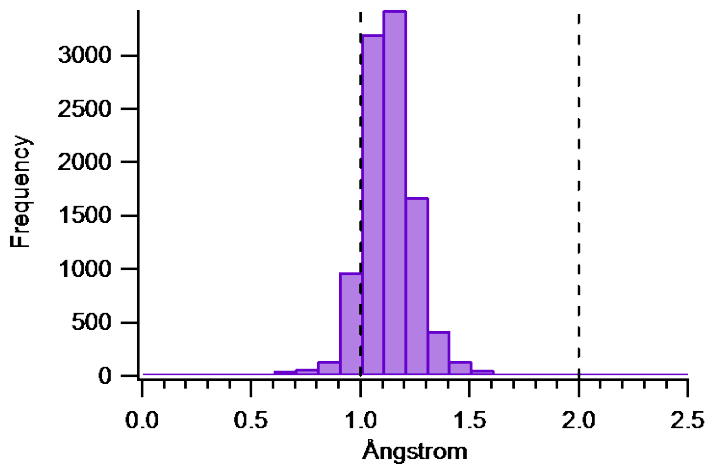


Figure S14: Histogram of hourly absorption Ångstrom co-efficient ( $\alpha$ ) for the whole sampling period at BT tower.

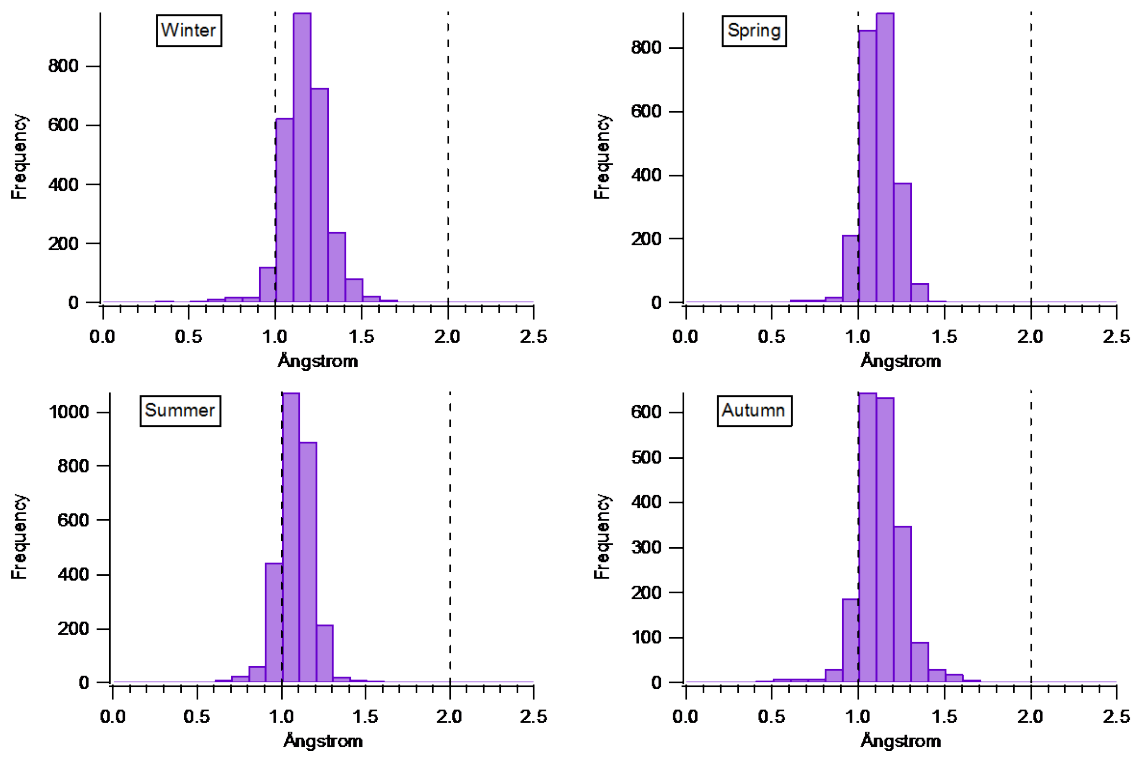


Figure S15: Histogram of hourly absorption Ångstrom co-efficient at BT tower by season.

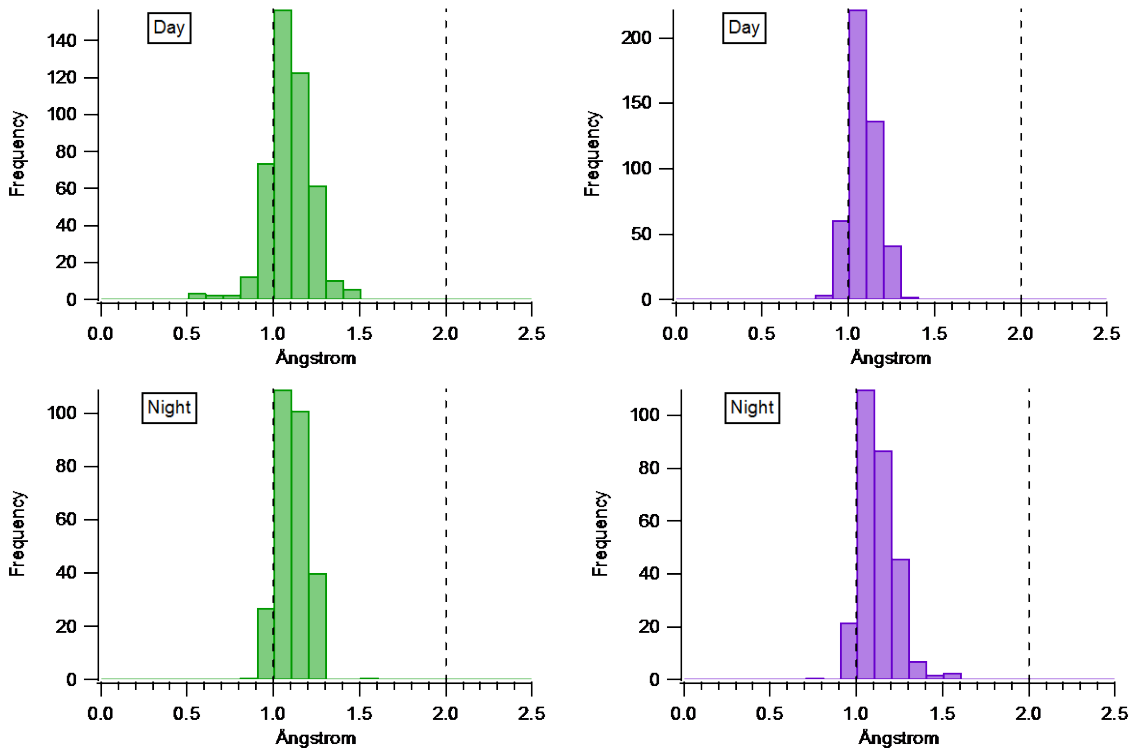


Figure S16: Histogram of hourly Ångstrom coefficients at North Kensington (green, left column) and BT tower (purple, right column) during the summer campaign for daytime and night time (21.00 until 05.00 inclusive).

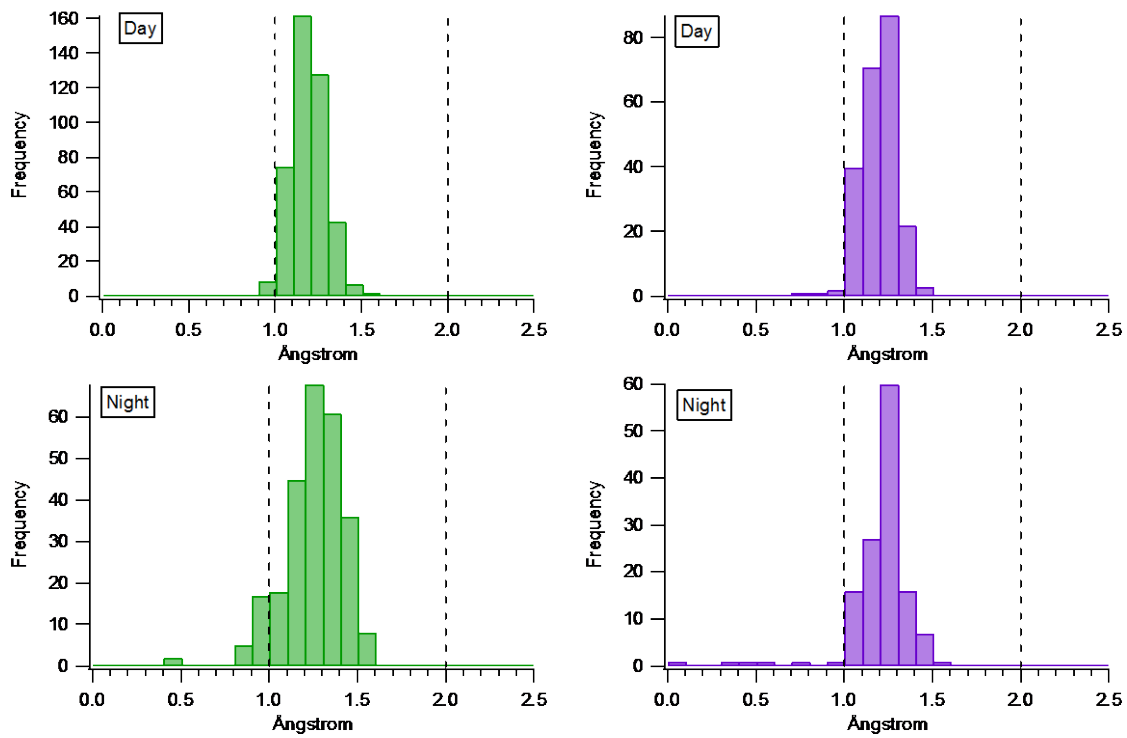


Figure S17: Histograms of hourly Ångstrom coefficients for the winter campaign at North Kensington (green, left column) and the BT tower (purple, right column) for day and night time (21.00 until 0.500 inclusive).

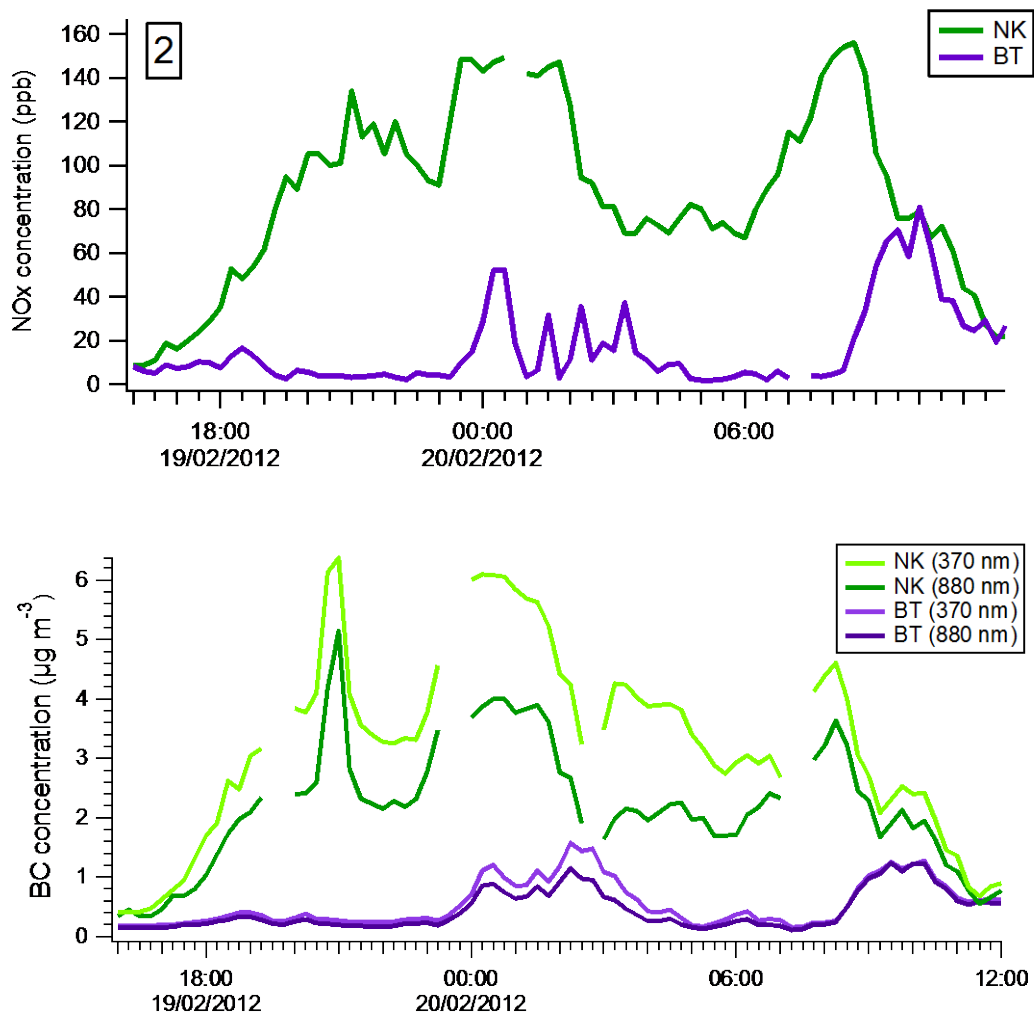


Figure S18: Time series of NO<sub>x</sub> (top) and BC concentrations measured at 370 and 880 nm (bottom) at North Kensington (NK) and the BT tower (BT) during de-coupling event 2 (Table S2). Note the BC concentrations were determined using a 2 wavelength aethalometer at NK.

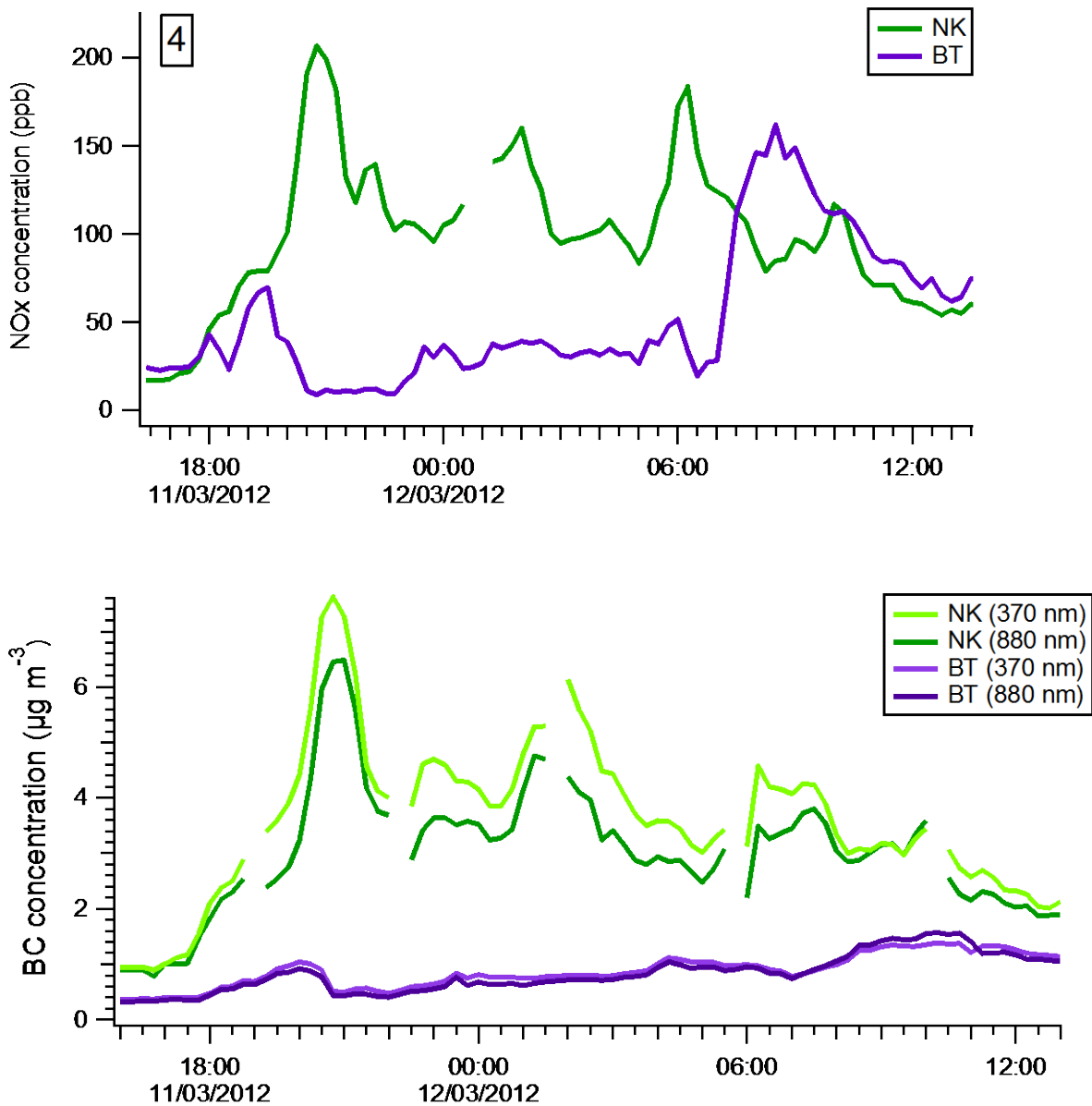


Figure S19: Time series of NO<sub>x</sub> (top) and BC concentration measured at 370 and 880 nm (bottom) at NK and the BT tower (BT) during de-coupling event 4 (Table S2). Note the BC concentrations were determined using a 2 wavelength aethalometer at NK.

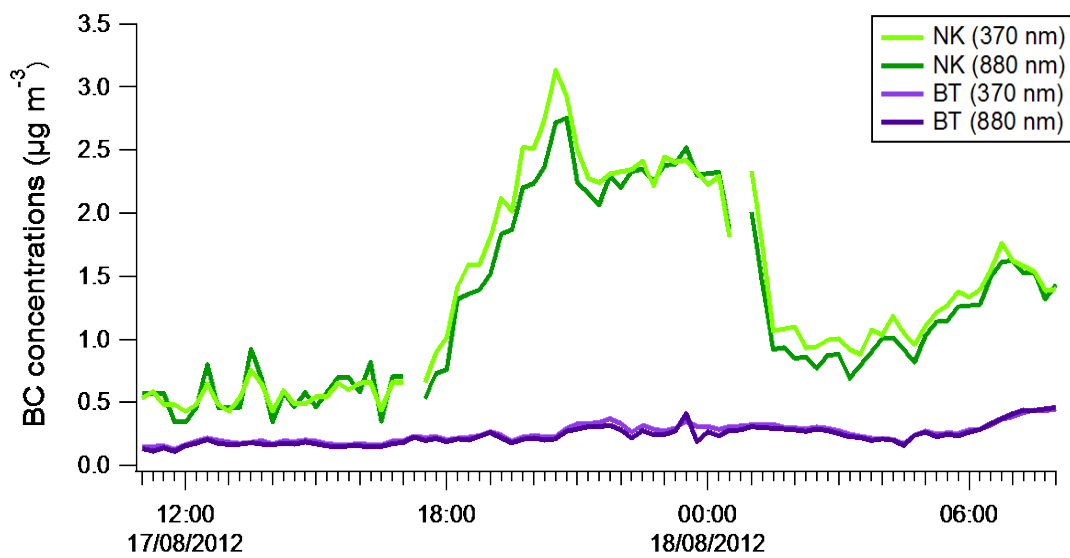
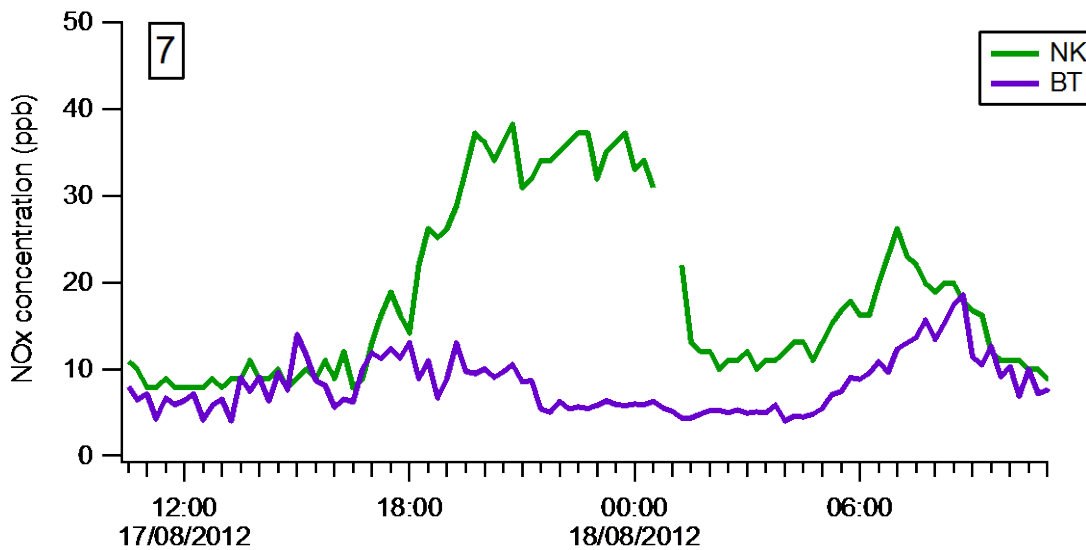


Figure S20: Time series of NO<sub>x</sub> (top) and BC concentration measured at 370 and 880 nm (bottom) at NK and the BT tower (BT) during de-coupling event 7 (Table S2). Note the BC concentrations were determined using a 2 wavelength aethalometer at NK.

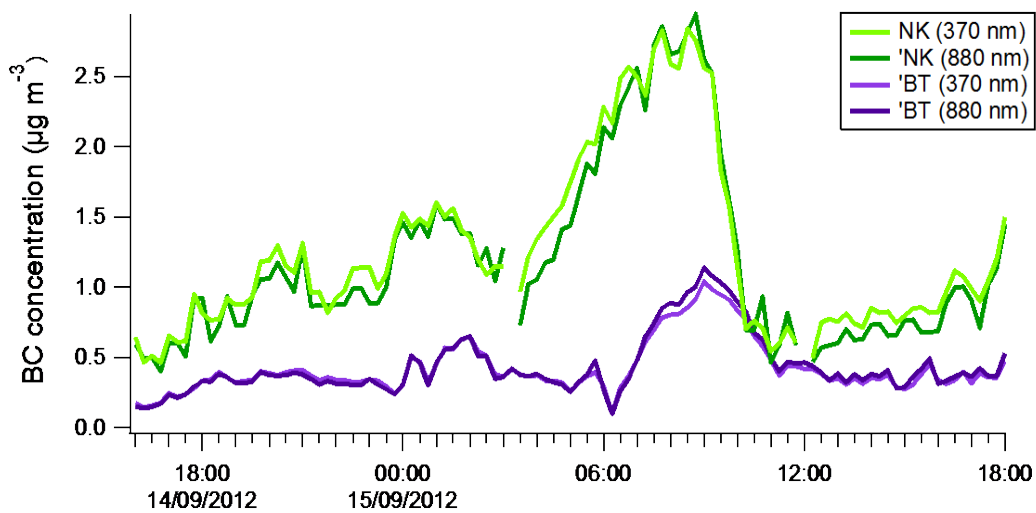
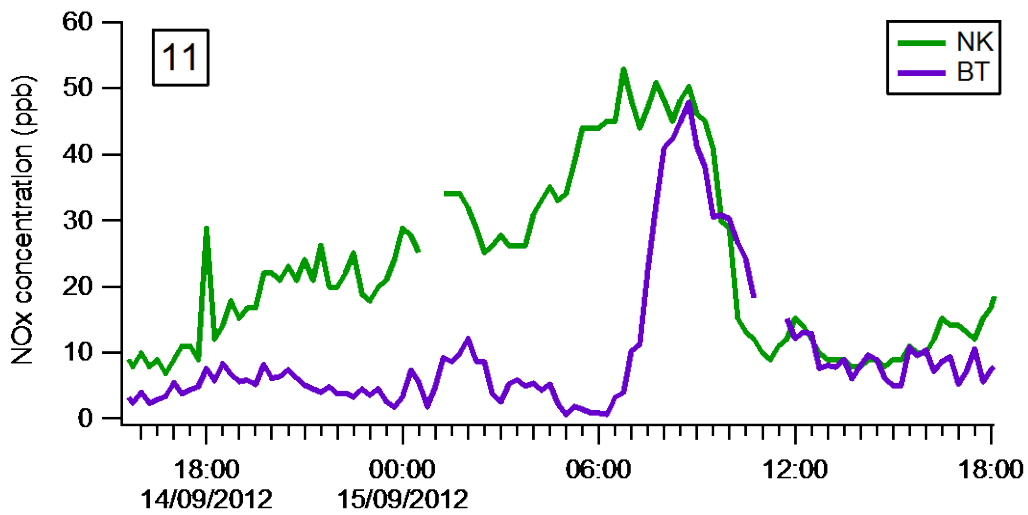


Figure S21: Time series of NO<sub>x</sub> (top) and BC concentration measured at 370 and 880 nm (bottom) at NK and the BT tower (BT) during de-coupling event 11 (Table S2). Note the BC concentrations were determined using a 2 wavelength aethalometer at NK.



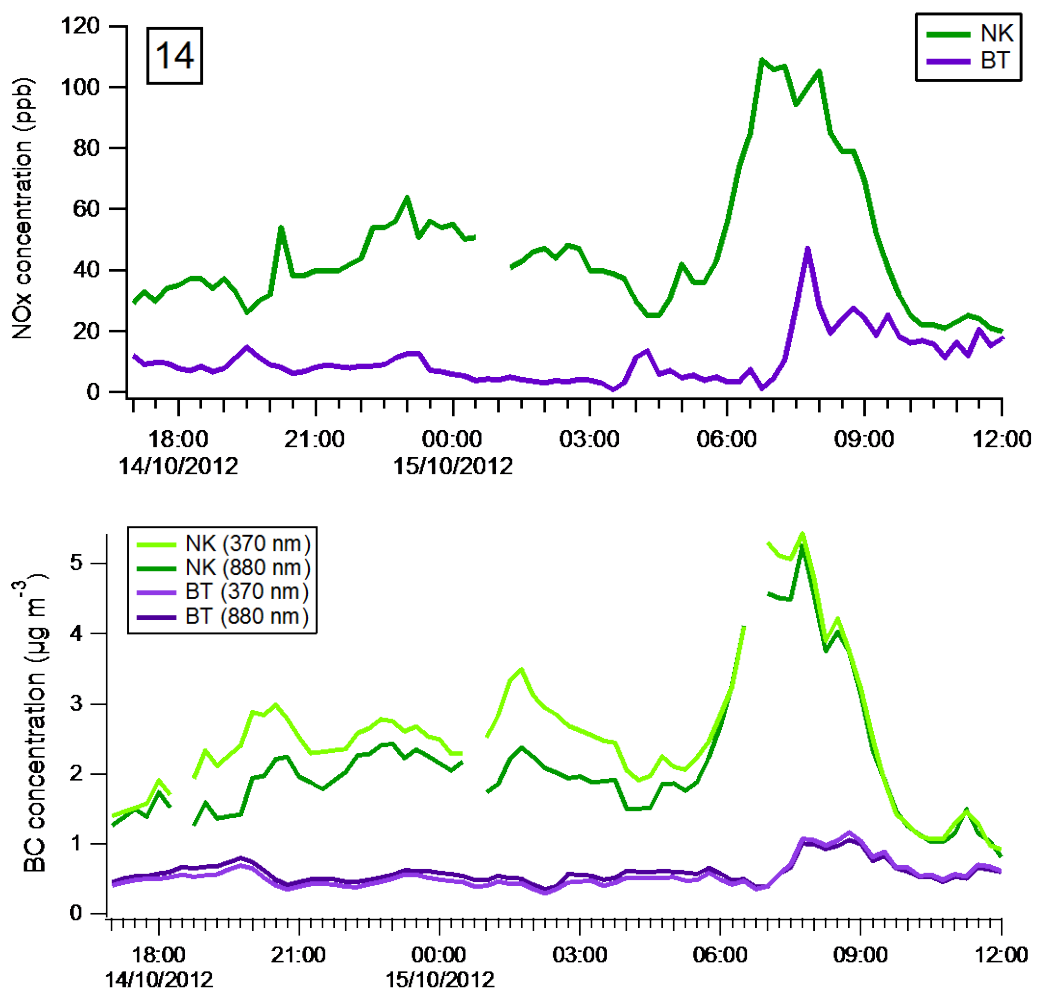


Figure S22: Time series of NO<sub>x</sub> (top) and BC concentration measured at 370 and 880 nm (bottom) at NK and the BT tower (BT) during de-coupling event 14 (Table S2). Note the BC concentrations were determined using a 2 wavelength aethalometer at NK.