

Supplementary File 2: Nowcast method description and evaluation

Method

KCLurban is an established emissions dispersion model capable of producing annual mean pollutant concentrations across Greater London at a resolution of 20 m x 20 m. Development of the KCLurban model is described in Kelly *et al.* (2011). The model provided an estimate of the annual mean pollutant concentration at each residential postcode within the SLSR. Time series exposure estimates were derived at the address point by scaling modelled annual mean concentrations according to a 'Nowcast' factor (f) calculated for each pollutant for each day of the analysis period. Similar methods have been used by Dons *et al.* (2014) and Johnson *et al.* (2013).

The Nowcast factor (f) was defined as the ratio between concentration of each pollutant measured by a local subset of continuous air pollution monitoring sites (L) in the prior period (t), and the annual mean (a) measured by the same sites. Thus, the acute exposure concentration estimate [P] at time t for point (x,y) was calculated as:

$$[P]_t^{(x,y)} = f \cdot [P]_a^{(x,y)} \quad \text{where } f = \frac{[P]_t^L}{[P]_a^L}$$

For this study 'Nowcast' scaling factors were calculated for each day between 2005 and 2012 to obtain spatially resolved time-series of daily mean PM_{2.5}, PM₁₀, O₃, NO₂ and NO_x concentrations and daily maximum 8-hour mean O₃ concentrations. To derive scaling factors measurements were averaged across all urban background and roadside continuous monitoring sites within and surrounding the London boroughs of Lambeth and Lewisham (the SLSR capture area). Due to the small number of sites monitoring O₃ and PM_{2.5}, the monitor pool was extended to cover the whole of Greater London for those pollutants. All measurements were taken from the London Air Quality Monitoring Network (LAQN, www.londonair.org.uk).

Evaluation

The Nowcast method has previously been evaluated according to the metrics recommended for the evaluation of air quality models for defra (Derwent *et al.* 2010). NO₂ and PM₁₀ Nowcast factors were calculated for address points coincidental with a randomly selected subset of London Air Quality Monitoring Network (LAQN, www.londonair.org.uk) monitoring sites and compared to measured concentrations over two years from June 2008 to May 2010. The test included 268,000 comparisons for PM₁₀ and 197,000 for NO₂. The results of the Nowcast evaluation are shown in Table 1. There was a bias evident in both pollutant models, with the Nowcast tending to under predict measured concentrations. This is due to two factors; 1) the 20 m resolution of the model means that it cannot reflect high concentrations within a few metres of roads and may underestimate kerbside concentrations and 2) part of the Nowcast calculation is based on median rather than mean concentrations to avoid undue influence from extraneous high or low measurements. The normalised mean bias for NO₂ and PM₁₀ is within the defra recommended bounds of ± 20% and the FAC2 (fraction of predictions within a factor of 0.5 to 2) is well above the recommended 50%.

	Measured Mean µg m ⁻³	Modelled Mean µg m ⁻³	Mean error µg m ⁻³	Standard deviation µg m ⁻³	Normalised mean bias %	Normalised mean gross error %	FAC2 %
PM ₁₀	25	23	2	7	9	19	99
NO ₂	56	52	5	30	8	34	85

Table 1 Results of the Nowcast evaluation Jan 2009 to May 2010, representing mean performance across all model runs.

Table 2 shows Nowcast performance at each of the 16 PM₁₀ monitoring sites in the evaluation. The FAC2 is greater than 50% at all sites meeting the defra criteria. The normalised mean bias is inside the defra recommended range of $\pm 20\%$ at 13 sites. At three sites close to roads (highlighted in grey) normalised mean bias is outside the range of $\pm 20\%$. At these sites the 20 m model resolution cannot fully represent peak concentrations within a few metres of traffic sources.

Site	Measured Mean $\mu\text{g m}^{-3}$	Modelled Mean $\mu\text{g m}^{-3}$	Mean error $\mu\text{g m}^{-3}$	Standard deviation $\mu\text{g m}^{-3}$	Normalised mean bias %	Normalised mean gross error %	FAC2 %
BL0(B)	19	19	0	4	1	15	100
BN1(K)	23	25	-2	3	-8	11	100
BT1(B)	18	17	0	3	2	9	100
CD3(R)	30	26	4	5	13	16	100
GR4(B)	24	19	5	4	19	20	100
HG1(R)	22	19	3	4	14	16	99
HR1(B)	17	17	0	2	-2	9	100
HS5(R)	32	21	11	15	34	35	89
IS2(R)	27	25	3	4	10	15	100
KC1(B)	21	19	2	2	10	11	100
KC2(R)	28	26	1	4	4	12	100
LH2(B)	23	20	3	4	14	16	100
MY1(K)	36	44	-8	13	-21	33	96
ST4(K)	25	17	8	4	31	31	97
TH1(B)	22	19	3	3	13	14	100
TH4(R)	34	29	5	7	14	18	99

Table 2 Individual site results of the Nowcast evaluation Jan 2009 to May 2010 for 16 PM₁₀ sites (c. 11,000 predictions). Letters following the site code denote the site type, (K) = kerbside, (R) = roadside and (B) = background or suburban.

Table 3 shows the Nowcast performance at 12 NO₂ sites. The FAC2 is greater than 50% at all sites meeting the defra criteria. The normalised mean bias is inside the recommended range of $\pm 20\%$ at nine of the twelve sites. It was outside the range of $\pm 20\%$ at two sites close to roads (highlighted in grey) where the 20 m model resolution cannot fully represent peak concentrations within a few metres of traffic sources. The normalised mean bias was also outside $\pm 20\%$ at one background site.

Site	Measured Mean $\mu\text{g m}^{-3}$	Modelled Mean $\mu\text{g m}^{-3}$	Mean error $\mu\text{g m}^{-3}$	Standard deviation $\mu\text{g m}^{-3}$	Normalised mean bias %	Normalised mean gross error %	FAC2 %
BN1(K)	68	61	7	24	11	29	91
BT1(B)	32	31	1	12	3	30	86
CD3(R)	84	65	18	25	22	30	86
EA1(B)	40	41	-1	11	-3	21	97
EA2(R)	58	53	5	22	9	26	94
GR4(B)	24	30	-6	10	-23	38	73
HR1(B)	26	29	-3	11	-10	34	82
HS5(R)	59	48	11	19	19	28	90
IS2(R)	59	62	-2	20	-4	28	92
MY1(K)	107	116	-9	62	-9	48	72
ST4(K)	76	42	34	42	44	50	63
TH1(B)	37	37	1	10	2	19	99

Table 3 Nowcast evaluation Jan 2009 to May 2010 run in retrospective mode for 12 NO₂ sites (c. 197,000 predictions). Letters following the site code denote the site type, (K) = kerbside, (R) = roadside and (B) = background or suburban.

References

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