Calibrating Defra's 2015-based Background NOx and NO_2 Maps against 2016 and 2017 Measurements

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Introduction

This note provides an update to the suggested approach[1] to treating background concentrations of nitrogen dioxide (NO_2) and nitrogen oxides (NOx) when using the Calculator Using Realistic Emissions for Diesels (CURED) model.

In September 2016 a report was issued entitled *"Deriving Background Concentrations of NOx and NO2 for Use with CURED V2A"*[1]. This included a table of scaling factors (Table 2 in the 2016 report) which provided a calibration between 2013-based national pollution maps of ambient background concentrations[2] for 2014 and 2015 and concurrent measured background concentrations at Automatic Urban and Rural Network[3] (AURN) sites. A subsequent note issued in May 2017[4] provided further background calibration factors based on 2016 monitoring data (also to be applied to Defra's 2013-based maps). In January 2018, CURED V3A[5] was published following the release of the latest EFT V8.0 and Defra's 2015-based maps of background concentrations.

This note compares Defra's 2015-based background maps against measurements made during 2016 and 2017. The mapped NOx and NO_2 values for each of these years have been calibrated against monitoring data for the corresponding year from suitable background AURN sites with more than 75% data capture.

The NOx and NO_2 uplift factors to be applied to Defra's 2015-based maps are set out in Table 1 for 2016 and 2017. The derivation of these values is explained in the next section.

1 Air Quality Consultants (2016), Deriving Background Concentrations of NOx and NO2 for Use with 'CURED V2A', [Online], Available: http://www.aqconsultants.co.uk/getattachment/Resources/Download-Reports/Adjusting-Background-NO2-Maps-for-CURED-September-2016.pdf.aspx

2 These maps cover the whole country on a 1x1 km grid and are published for each year from 2015 until 2030, and can be downloaded from https://uk-air.defra.gov.uk/data/laqm-background-home

3 Defra AURN Archive, [Online], Available: http://aurn.defra.gov.uk/

4 Air Quality Consultants (2016), Calibrating Defra's Background NOx and NO2 Maps against 2016 Measurements, [Online], Available: http://www.aqconsultants.co.uk/AQC/media/Reports/2016-Background-Map-Calibration.pdf

5 Development of the CURED V3A Emissions Model, [Online], Available: http://www.aqconsultants.co.uk/AQC/media/Reports/Development-of-CURED-V3A-110117.pdf

Table 1: Uplifts to be Applied to Total Background Concentrations [a, b, c]

Base Year	% Concentration Uplifts Expressed as a Fraction	
	NOx	NO_2
2016	0.2505	0.1280
2017	0.1014	0.0664

[a] the provided uplift factors should be applied to the Defra 2015-based maps.

[b] at the time that this note was produced, 2017 was the most recent full calendar year of available measurements and so uplift factors for subsequent years cannot be derived.

[c] for example 0.2505 means that the measured concentrations were, on average, 25.05% higher than the mapped concentrations.

Derivation of Factors

The mapped NOx values in 2016 have been calibrated against the 47 suitable background AURN sites with more than 75% data capture (Figure 1). This shows that the maps under-predict the background concentrations by 25.0%, on average (i.e. 1/0.7997 – 1 = 0.2505). The value used in Table 1 for NOx for 2016 is thus 0.2505.

Figure 2 shows the same comparison for NO_2. For NO_2, there is also under-prediction in the maps. The value used in Table 1 for NO_2 for a 2016 base year is thus 0.1280 (i.e. 1/0.8865 – 1 = 0.1280).

Following the same approach as above, the mapped NOx values for 2017 have been calibrated against the 51 suitable background AURN sites (Figure 3). This shows that the maps under-predict the background concentrations by 10.1%, on average (i.e. 1/0.9079 – 1 = 0.1014). Figure 4 shows the same comparison for NO_2, which also exhibits an under-prediction in the mapped values of around 6.6% (i.e. 1 /0.9377 – 1 = 0.0664). The values shown in Table 1 for a 2017 base year are thus 0.1014 for NOx and 0.0664 for NO_2.

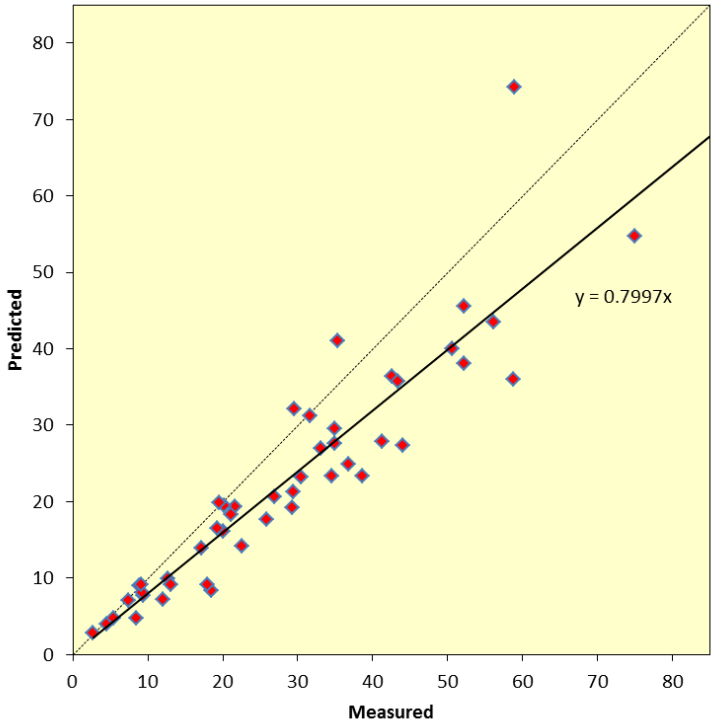

Figure 1: **Predicted Mapped versus Measured NOx Concentrations at AURN Background Sites in 2016**

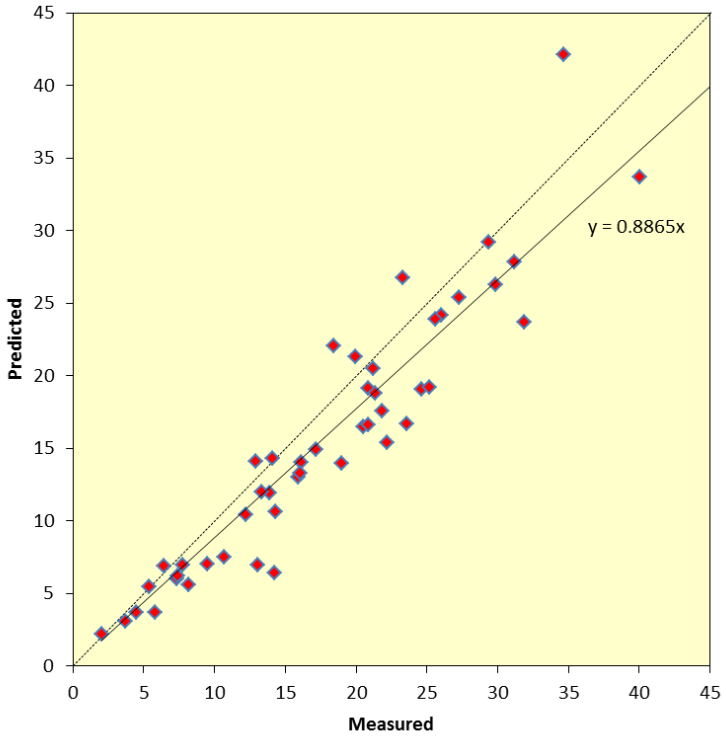

Figure 2: **Predicted Mapped versus Measured NO_2 Concentrations at AURN Background Sites in 2016**

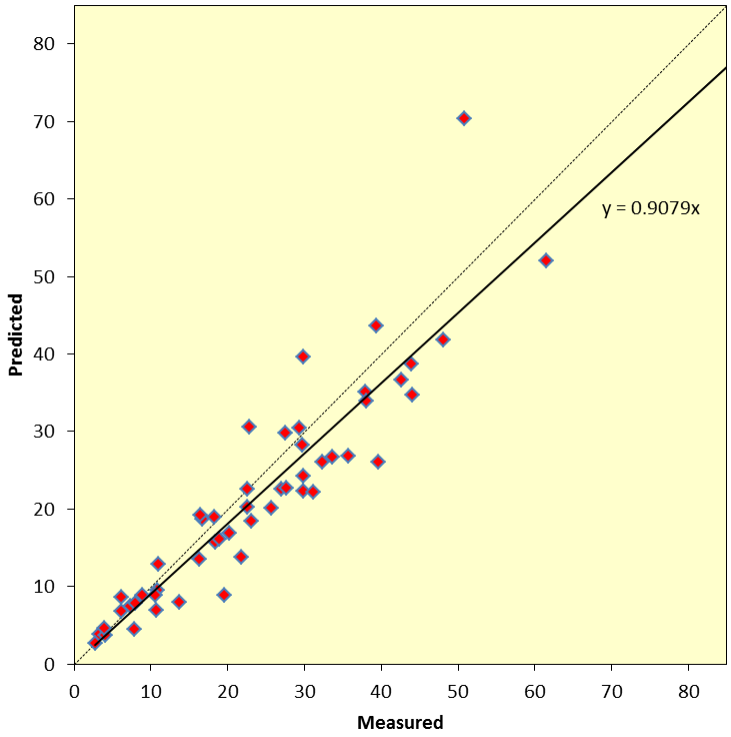

Figure 3: Predicted Mapped versus Measured NOx Concentrations at AURN Background Sites in 2017

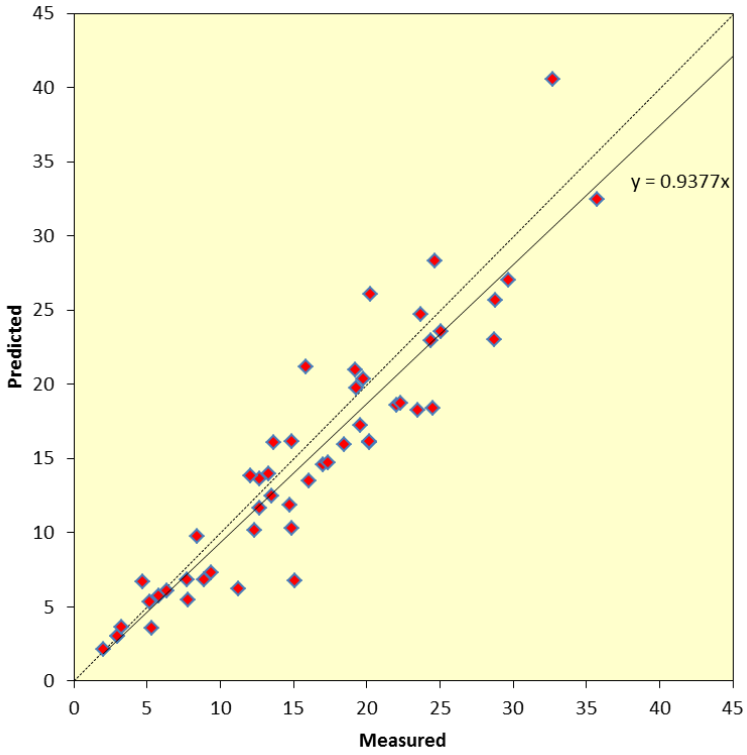

Figure 4: Predicted Mapped versus Measured NO_2 Concentrations at AURN Background Sites in 2017