

Calibrating Defra's 2017-based Background NO_x and NO₂ Maps against 2019 Measurements



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Introduction

This note compares Defra's 2017-based background mapped NO_x and NO₂ concentrations for 2019¹ against 2019 annual mean measured background concentrations at automatic monitoring sites with more than 75% data capture in the Automatic Urban and Rural Network (AURN), Scottish Air Quality Network (SAQN), Welsh Air Quality Network (WAQN), Air Quality England (AQE) network and King's College London (KCL) network.

The NO_x and NO₂ uplift factors to be applied to Defra's 2017-based mapped concentrations when using 2019 as a base year are set out in Table 1. Mapped concentrations for the base year and each future year should simply be multiplied by the relevant factor. The derivation of these values is explained in the next section. At the time that this note was produced, 2019 was the most recent full calendar year of available measurements and so factors for subsequent years cannot be derived.

For this calibration, 'Inner London' includes those areas defined as either 'Inner' or 'Central' London in the London Atmospheric Emissions Inventory. These are the same definitions used in Defra's Emissions Factors Toolkit.

Table 1: Factors to be Applied to Total Background Concentrations for 2019

Location	2019 Concentration Factors	
	NO _x	NO ₂
Inner London	0.7345	0.8787
Rest of the UK	1.1121	1.0756

Given the apparent spatial variability in the performance of the background maps, particular care should be taken close to the boundary where the factors change. It is also important to consider local factors which might ideally be informed by local background measurements, so long as the monitors are appropriately sited.

Derivation of Factors

The mapped NO_x values in 2019 were initially compared to those measured at the 81 suitable background sites with more than 75% data capture, with individual factors derived for each site plotted to identify any geographical patterns in the data. Nationwide, it was clear that the background maps generally predicted concentrations lower than those measured, but there was an obvious exception to this in Inner London, where the background concentrations were consistently

¹ These maps cover the whole country on a 1x1 km grid and are published for each year from 2017 until 2030, and can be downloaded from <https://uk-air.defra.gov.uk/data/laqm-background-home>

higher than those measured. It would seem most likely that this is due to more rapid reductions in measured concentrations in Inner London than have been predicted in the background maps, most likely due to the implementation of the Ultra Low Emission Zone.

This obvious geographical split necessitated the calculation of two sets of factors. Figure 1 shows that the maps over-predict background NOx concentrations in Inner London in 2019 by 36% on average. The factor for calibrating Defra's background maps in Inner London for NOx for 2019 is thus 0.7345 (i.e. $1/1.3614 = 0.7345$).

Figure 2 shows the same comparison for NO₂; again there is over-prediction in the maps, albeit to a lesser extent. The factor for calibrating Defra's background maps for NO₂ for 2019 is 0.8787 (i.e. $1/1.1381 = 0.8787$).

Figure 3 shows that the maps under-predict background NOx concentrations across the rest of the UK by 11%, on average (i.e. $1/0.8992 = 1.1121$). The factor for calibrating Defra's background maps for NOx for 2019 outside of Inner London is thus 1.1121. Figure 4 shows the same comparison for NO₂; again there is under-prediction in the maps. The factor for calibrating Defra's background maps for NO₂ for 2019 outside of Inner London is 1.0756 (i.e. $1/0.9297 = 1.0756$).

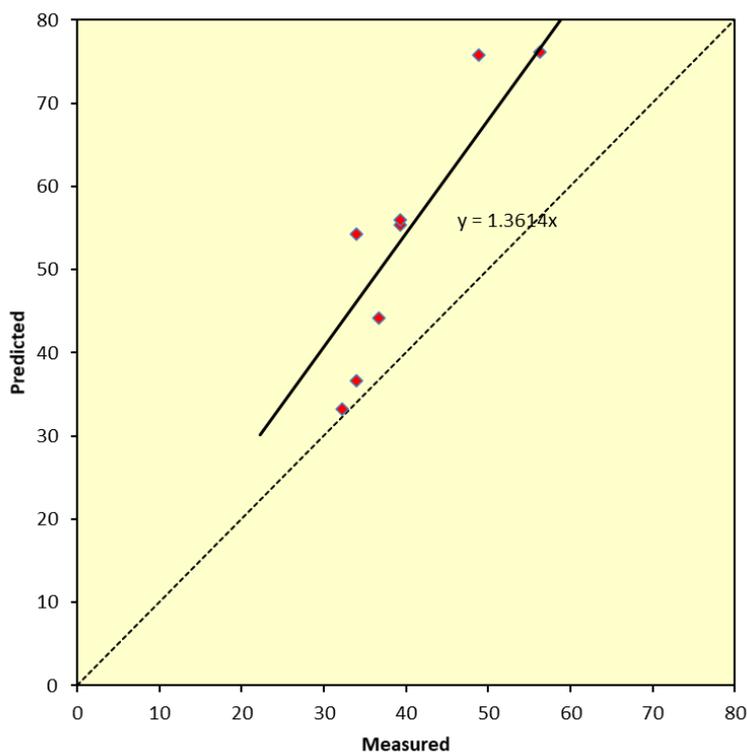


Figure 1: Predicted Mapped versus Measured NOx Concentrations at Background Sites in Inner London in 2019

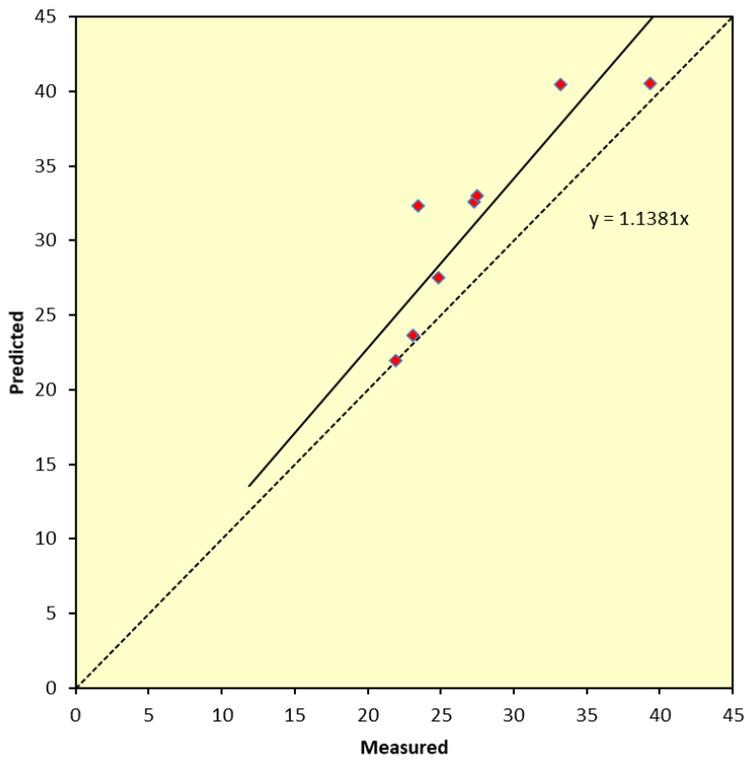


Figure 2: Predicted Mapped versus Measured NO₂ Concentrations at Background Sites in Inner London in 2019

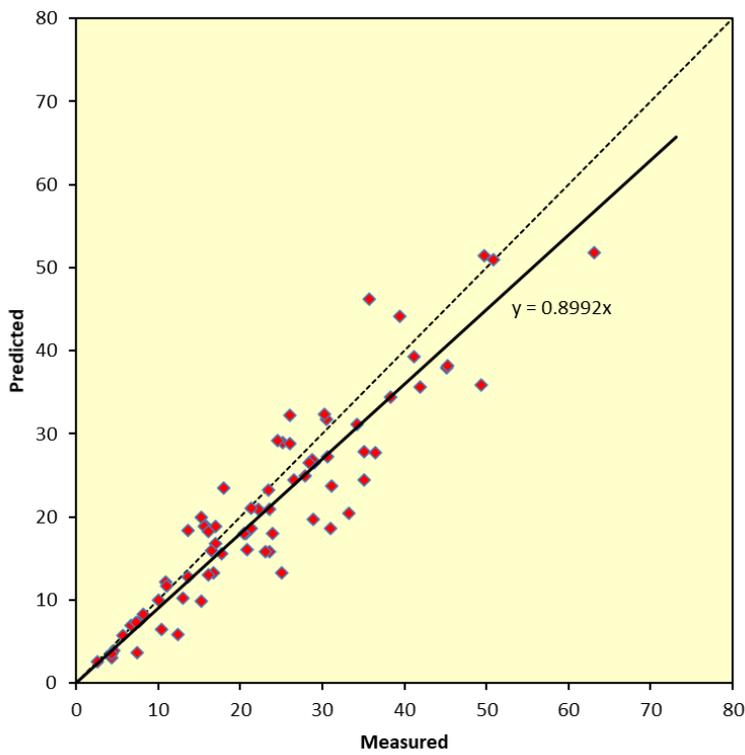


Figure 3: Predicted Mapped versus Measured NO_x Concentrations at Background Sites in the Rest of the UK in 2019

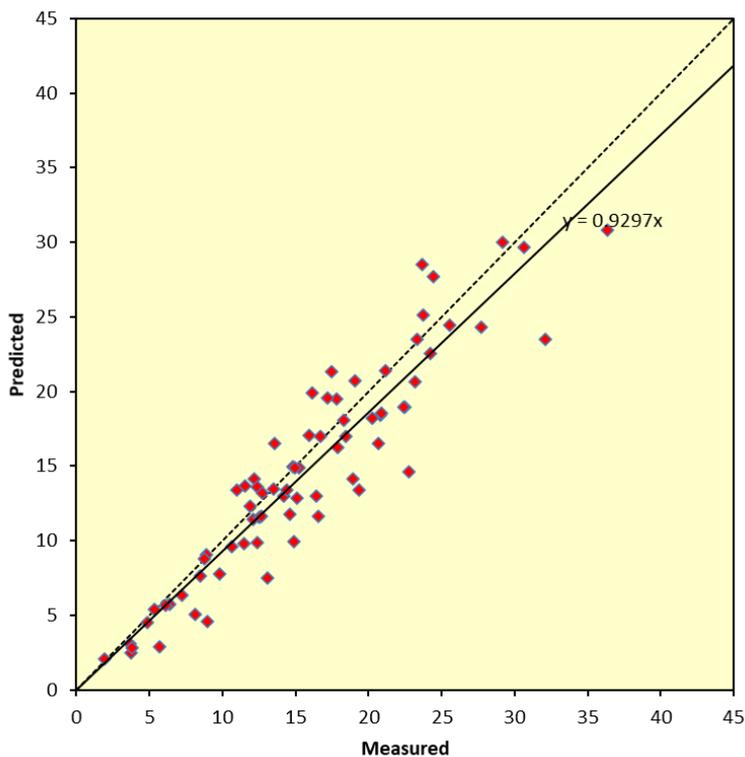


Figure 4: Predicted Mapped versus Measured NO₂ Concentrations at Background Sites in the Rest of the UK in 2019