



Scottish Pollution Mapping

Justin Lingard

justin.lingard@aeat.co.uk

Overview

- **Scottish modelling method**
- **Scottish model outputs**
- **Projected annual mean concentrations**
- **Results**
 - Modelled annual mean concentrations of NO_x/NO_2 and PM_{10} for 2008
 - Projected annual mean concentrations of NO_x/NO_2 and PM_{10} for 2010, 2015 and 2020

Method

Methodology

Components of the model:

- **Scottish point sources**
 - taken from SEPA database
- **Emissions grid for Scottish combustion sources**
 - taken from UK NAEI
- **Scottish specific dispersion kernel used in area source model**
 - based on wind speed and direction observations from RAF Leuchars
- **2008 pollutant concentration data from Scottish monitoring sites (only) used to calibrate the model**
- **PM₁₀ model accounts for inputs from long range transport and secondary inorganic aerosol**

Outputs

- **Modelled (background & roadside) annual mean concentrations of specific pollutants for 2008**
- **Background maps provide modelled pollutant concentrations on a 1 km² basis**
- **Spatial distribution of annual mean NO_x/NO₂ and PM₁₀ concentrations**
- **Roadside maps provide identification of pollutant concentrations along specific roads and road lengths**

Projections

Background maps of projected pollutant concentrations

- **Background maps provided to assist LAs in support of review and assessment of local air quality**
- **Maps of the total concentration and for a set of source sectors are provided for NO_x and PM₁₀ for 2010, 2015 and 2020 from the base year (2008)**
- **Sources sectors include:**
 - roads(motorways, major & minor 'A' roads), industry, domestic, aircraft, rail, natural sources
 - allows sectors to be subtracted from the total if a more detailed local assessment is to be carried out
- **Include emissions from inside and outside each 1 km grid square**
- **Based on updated emissions projections**

Background maps of projected pollutant concentrations

- UK maps accessed through the Scottish Air Quality archive

The screenshot shows the website 'Air Quality in Scotland' with the URL 'www.scottishairquality.co.uk'. The page is dated Friday, March 26, 2010, and has a 'Low Graphics Mode' option. The navigation menu includes Home, Current Levels, About Air Quality, Maps, Trends, Data, Publications, LAQM, Mobile Web, and Links. A search bar is located in the top right corner.

The main content area is titled 'Local Air Quality Management (LAQM)' and contains a section for 'LAQM Tools'. This section provides information about tools for local authorities, including background maps, tools for diffusion tubes, TEDM VCM correction, and an NO_x from NO₂ calculator. It also lists supplementary assistance spreadsheets for stack height calculation and additional guidance on consideration of railways.

The left sidebar contains 'LAQM Links' and 'Local Authorities'. The 'Local Authorities' list includes: Aberdeen City, Aberdeenshire, Angus, Argyll and Bute, Edinburgh City, Glasgow City, Clackmannanshire, Dumfries and Galloway, Dundee City, East Ayrshire, East Lothian, East Dunbartonshire, East Renfrewshire, Falkirk, Fife, Highland, Inverclyde, Midlothian, Moray, North Ayrshire, North Lanarkshire, Orkney Islands, Perth and Kinross, Renfrewshire, Scottish Borders, Shetland Islands, South Ayrshire, South Lanarkshire, Stirling, West Dunbartonshire, and West Lothian.

Air Quality in Scotland
www.scottishairquality.co.uk

Friday, March 26, 2010
[Low Graphics Mode](#)

Home Current Levels About Air Quality Maps Trends Data Publications LAQM Mobile Web Links

Local Air Quality Management (LAQM)

LAQM Tools

This page provides tools to assist local authorities with the Review and Assessment process. The tools are available to download in a variety of file formats. Some basic information about how to download files and the different file formats supported is provided [here](#). Some of the tools contain macros. Some users of MS Excel may need to alter their "macro security settings" to get these tools to run. Some guidance on this for users of Windows XP can be found by clicking [here](#). Users of other software should contact their IT support. Some of the tools must be downloaded as "zip" files and will need to be "unzipped" prior to use. There is a large amount of free software available on the internet which can perform this task (users might try typing "zip" into a search engine or contacting their IT support).

The following tools are currently available:

- Background Maps**
UK background pollution maps and associated tools can be [downloaded here](#).
- Tools for Diffusion Tubes**
A database of bias adjustment factors for local authorities to use to correct their diffusion tube measurements is [available here](#). If local authorities have their own co-location studies and do not wish to use the factors provided in the database above, they may calculate their own bias adjustment factor. A spreadsheet has been designed to assist with this. The spreadsheet calculates the precision and accuracy (bias) of individual co-location studies and gives 95% confidence intervals in the bias adjustment calculations. [This spreadsheet can be downloaded here](#).
- TEDM VCM Correction**
King's College ERG have developed a new model to correct TEOM concentrations to "gravimetric equivalent" values, based on the purge concentrations measured by FDMS analysers. To assist local authorities with the Volatile Correction Model, ERG has developed a [web portal](#) that will allow the correction algorithms to be automatically applied.
- NO_x from NO₂ Calculator**
This calculator allows local authorities to derive NO₂ from NO_x wherever NO_x is predicted by modeling emissions from roads. The calculator can also be used to calculate the road component of NO_x from roadside NO₂ diffusion tube measurements. It incorporates the impact of expected changes in the fraction of NO_x emitted as NO₂ (f-NO₂) and changes in regional concentrations of NO_x, NO₂ and O₃. [An updated version of the calculator, Version 2.1, released 22 January 2010, can be downloaded here](#). (The earlier Version 1.1 is available [here](#).)
- Supplementary Assistance Spreadsheet for Stack Height Calculation**
A chimney height calculation spreadsheet for sulphur dioxide emissions from small boilers is available. [Download the spreadsheet here](#). Also, a report giving supplementary assistance on stack height determination in relation to sulphur dioxide emissions from small boilers can be downloaded [Supplementary Assistance on Stack Height Determination](#) (PDF).
- Additional Guidance on Consideration of Railways**
Frequently Asked Question giving [guidance on assessing emissions from railway locomotives](#).
- Web-based Reporting**
Defra and the Devolved Administrations will be moving to web-based reporting for Progress Reports and USAs from 2009. This will provide a uniform on-line template which will enable both the production and appraisal of these reports to be carried out in a much simpler manner. Registration on the web-based reporting website can be carried out [here](#).
- Analysis of the relationship between annual mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective**
This report provides an updated analysis of the relationship between the annual mean and the number of exceedences of the 1-hour objective for nitrogen dioxide. It is intended to confirm whether the existing relationship still holds. Such a relationship is useful for Local Authorities who are monitoring annual mean NO₂ concentrations using diffusion tubes, or who wish to estimate the likelihood of the 1-hour objective being exceeded from modelling studies. Monitoring data have been analysed from a multiple network base of around 200 monitoring sites across the UK. This report is supplementary to the LAQM Technical Guidance (09).

Results

Summary: background NO₂

Modelled and projected results* show a reduction in exceedences of the Scottish AQO for NO₂ between 2008 and 2020 at background locations

Year	Total area (km ²)	Total population exposed
2008	2	3358
2010	0	0
2015	0	0
2020	0	0

(* denotes provisional results)

Scottish AQO for NO₂: 40 µg m⁻³ (annual mean)

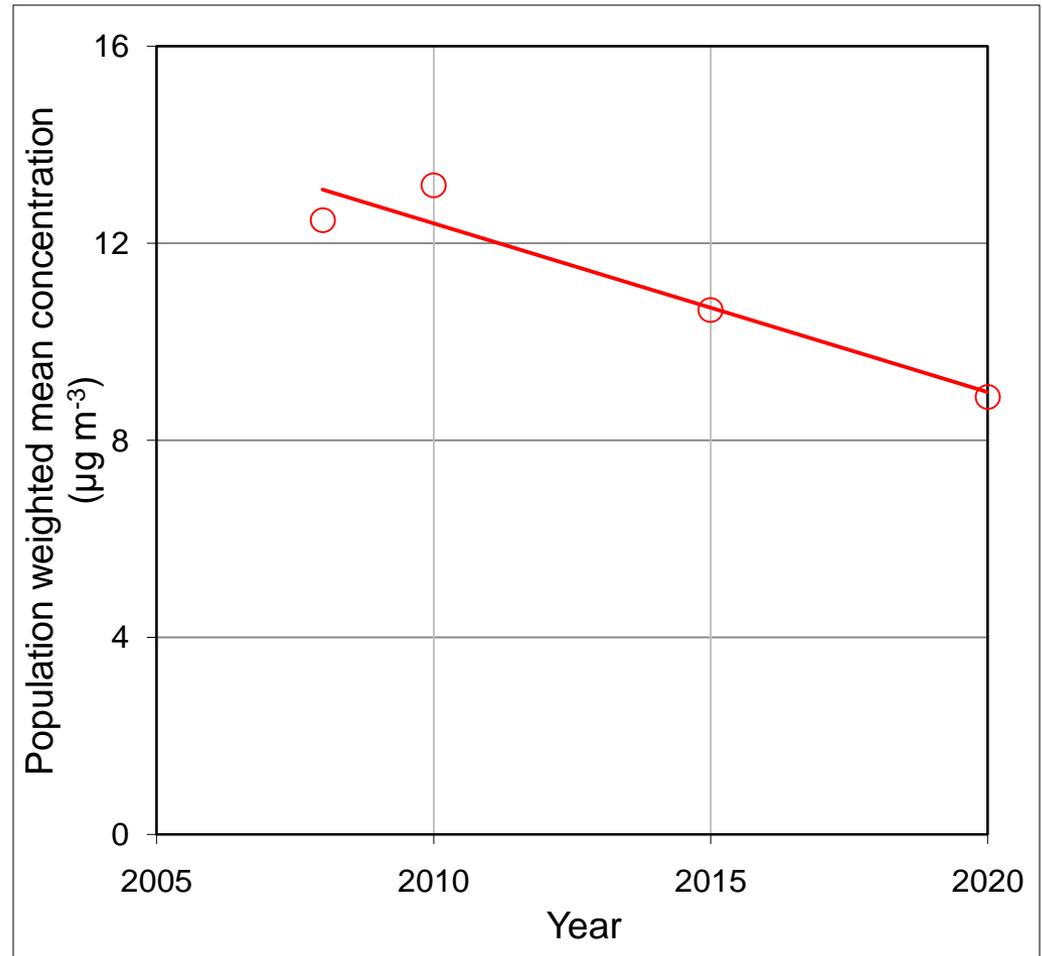
Population weighted mean NO₂ concentration

**Downward trend for
population weighted mean
NO₂ concentration**

2008* : 13 $\mu\text{g m}^{-3}$

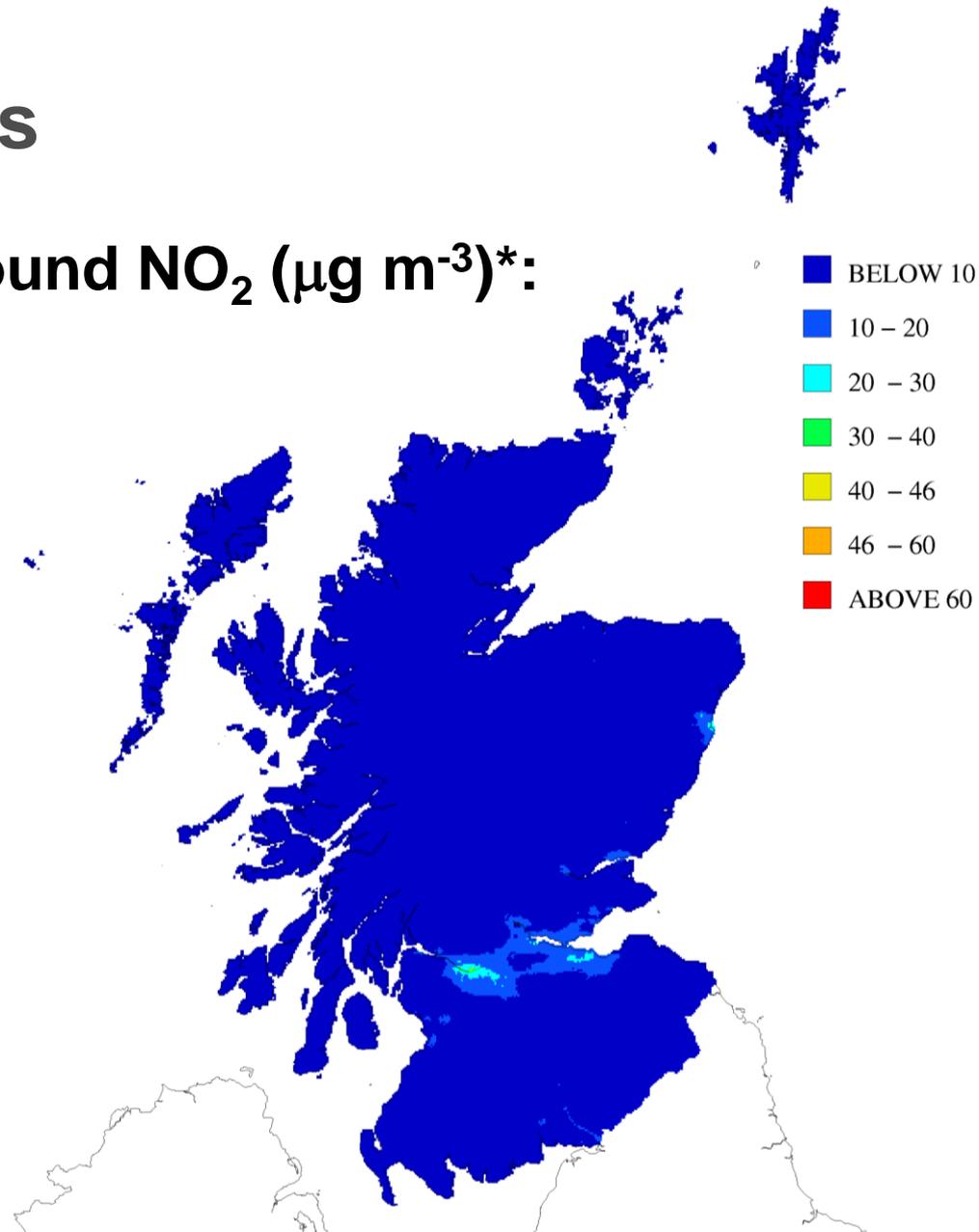
2020* : 9 $\mu\text{g m}^{-3}$

(* denotes provisional results)



Results

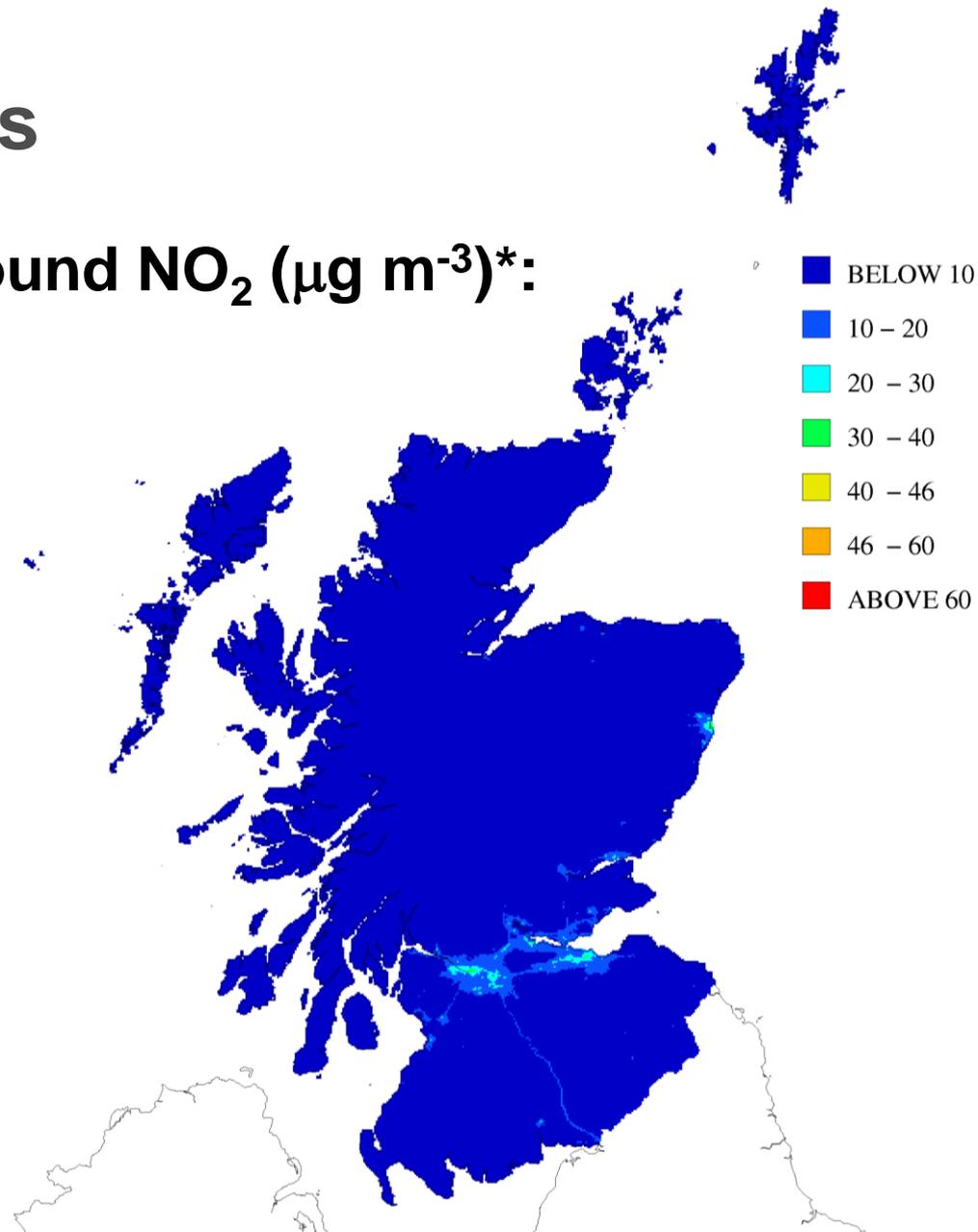
Background NO₂ (μg m⁻³)*:
2008



* denotes provisional results

Results

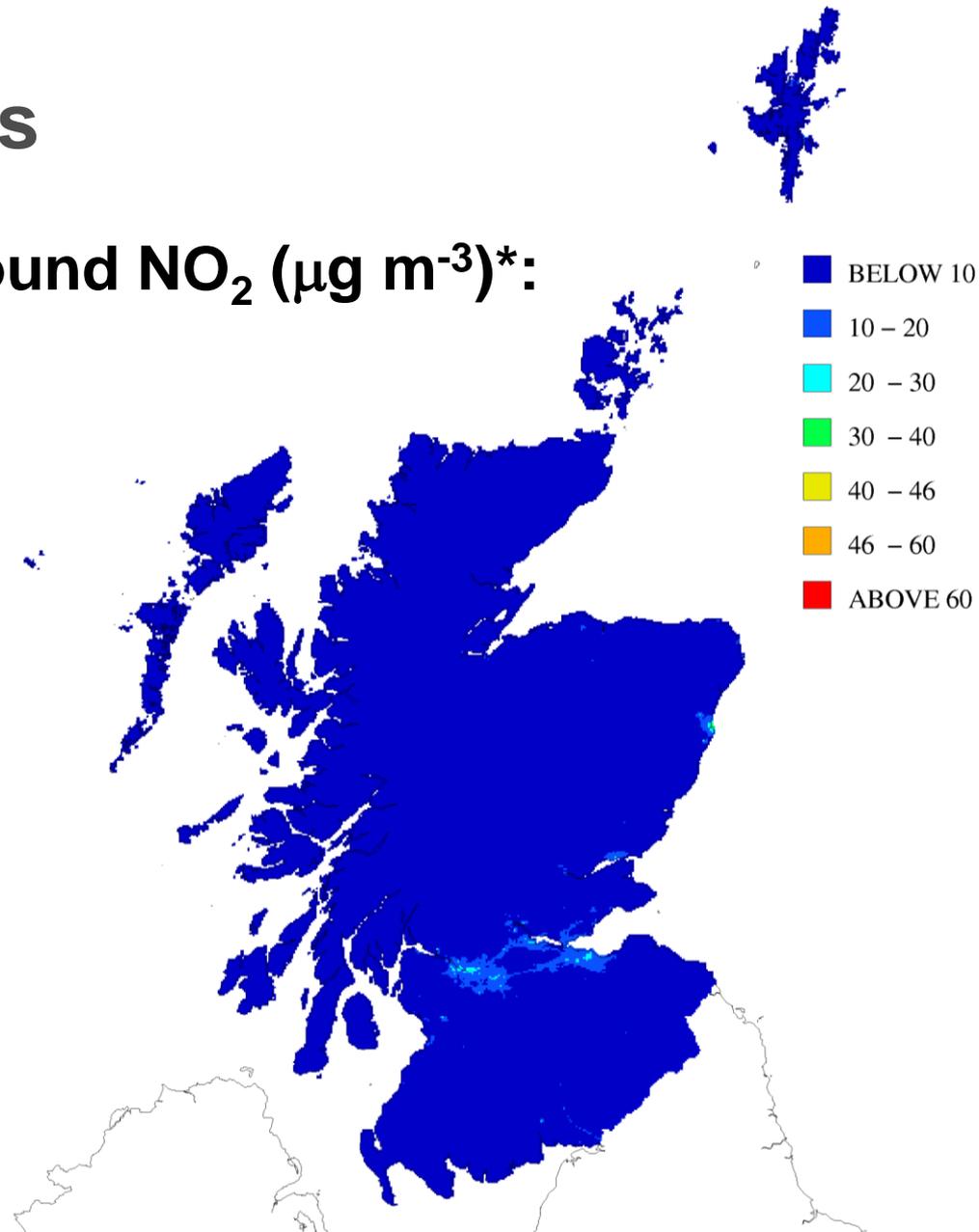
Background NO₂ (μg m⁻³)*:
2010



* denotes provisional results

Results

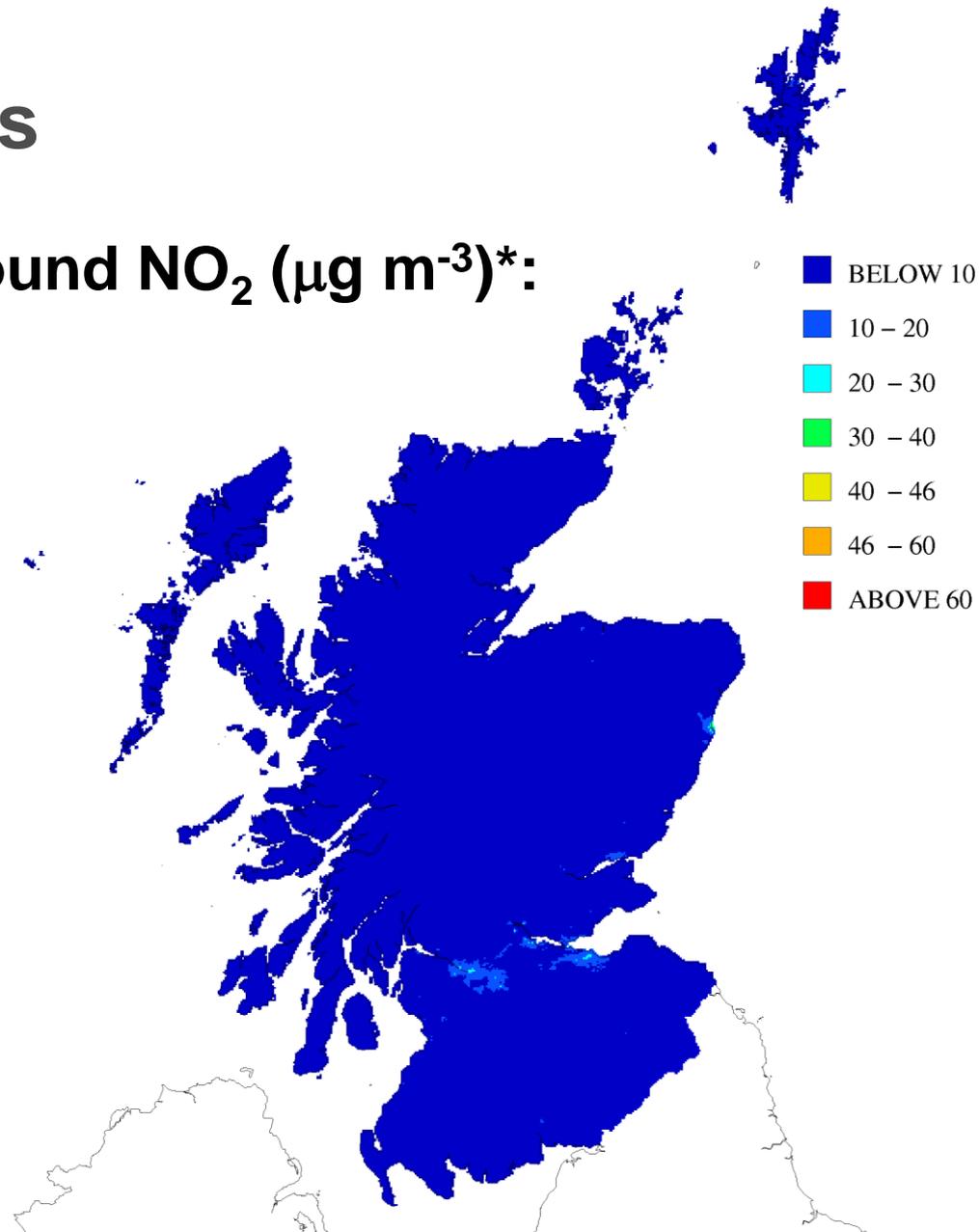
Background NO₂ (μg m⁻³)*:
2015



* denotes provisional results

Results

**Background NO₂ (μg m⁻³)*:
2020**



* denotes provisional results

Summary: roadside NO₂

Modelled and projected results* show a progressive decrease in exceedences of the Scottish AQO for NO₂ between 2008 and 2020 at the roadside

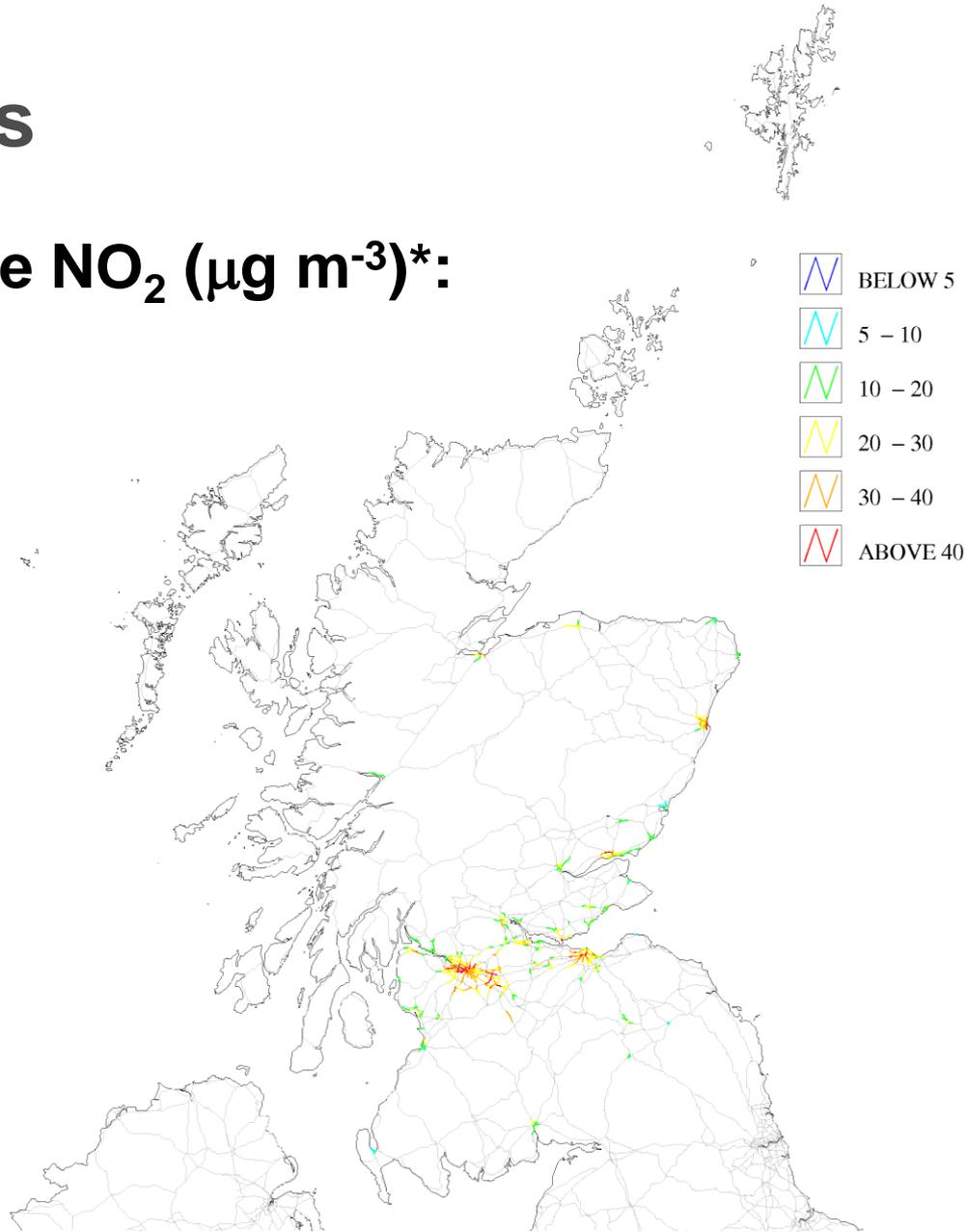
Year	Total road links (% of Scottish total)	Total road length (km) (% of Scottish total)
2008	72 (11)	104 (10)
2010	45 (7)	69 (6)
2015	3 (<1)	5 (<1)
2020	0 (0)	0 (0)

(* denotes provisional results)

Scottish AQO for NO₂: 40 µg m⁻³ (annual mean)

Results

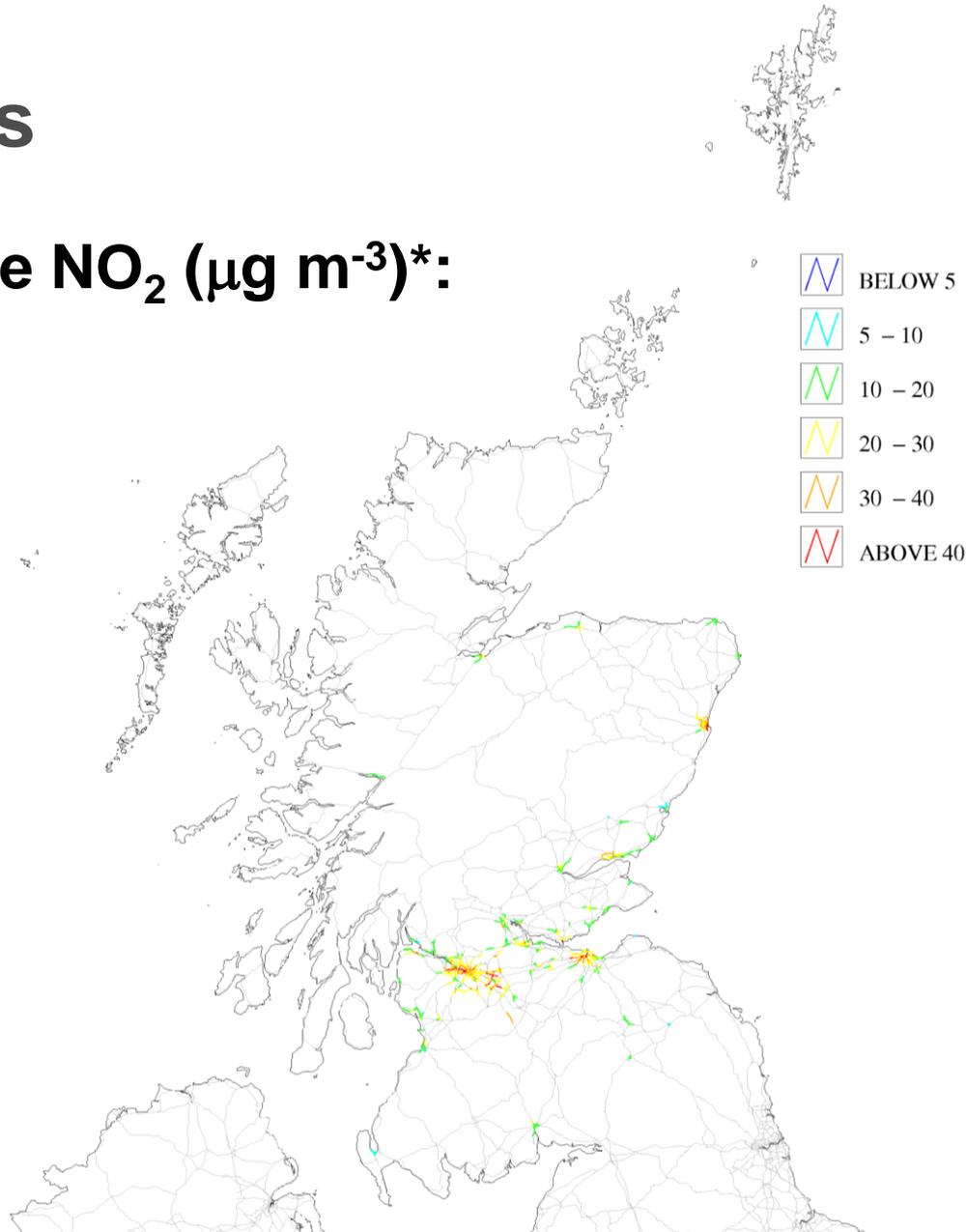
Roadside NO₂ (µg m⁻³)*: 2008



* denotes provisional results

Results

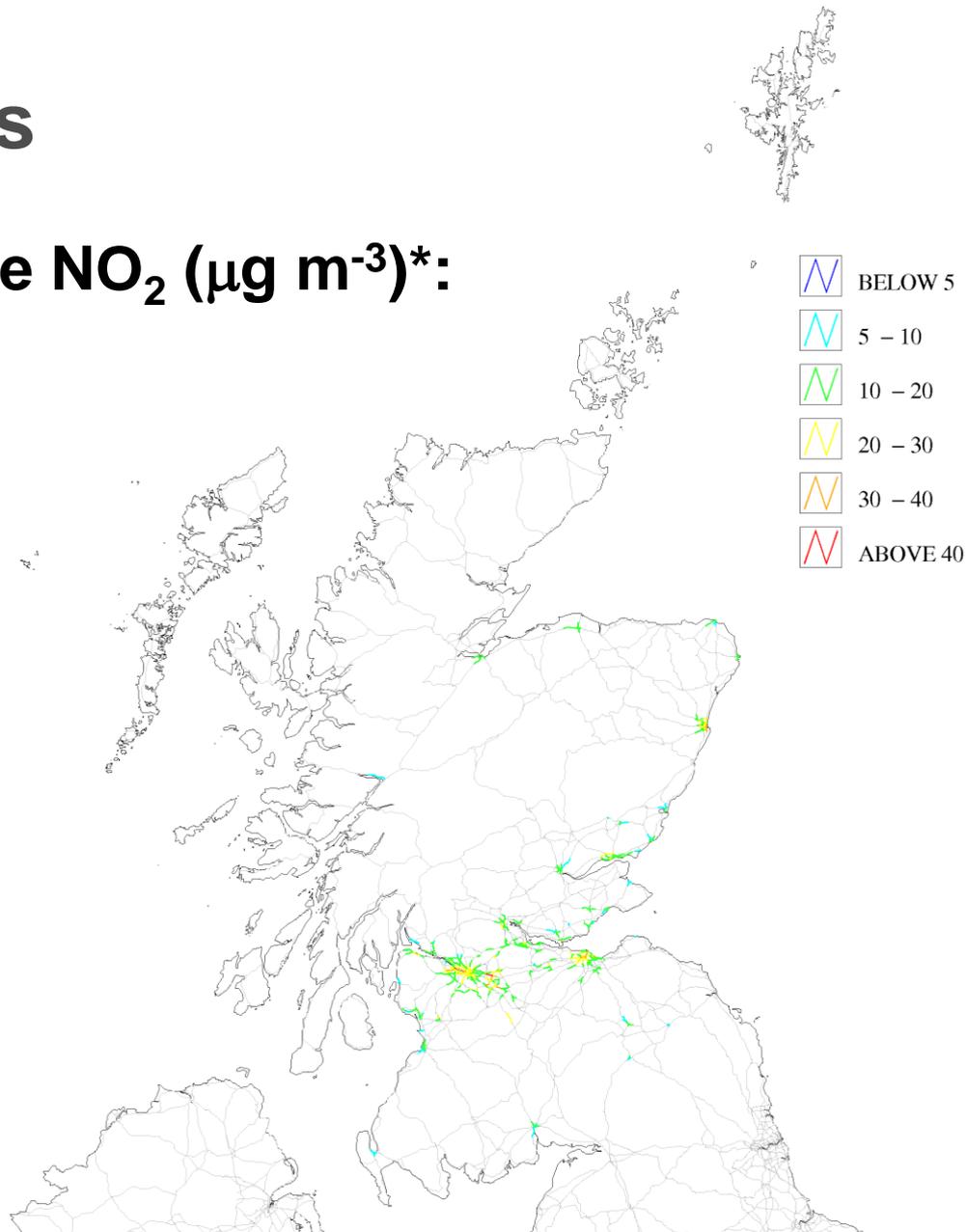
Roadside NO₂ (µg m⁻³)*: 2010



* denotes provisional results

Results

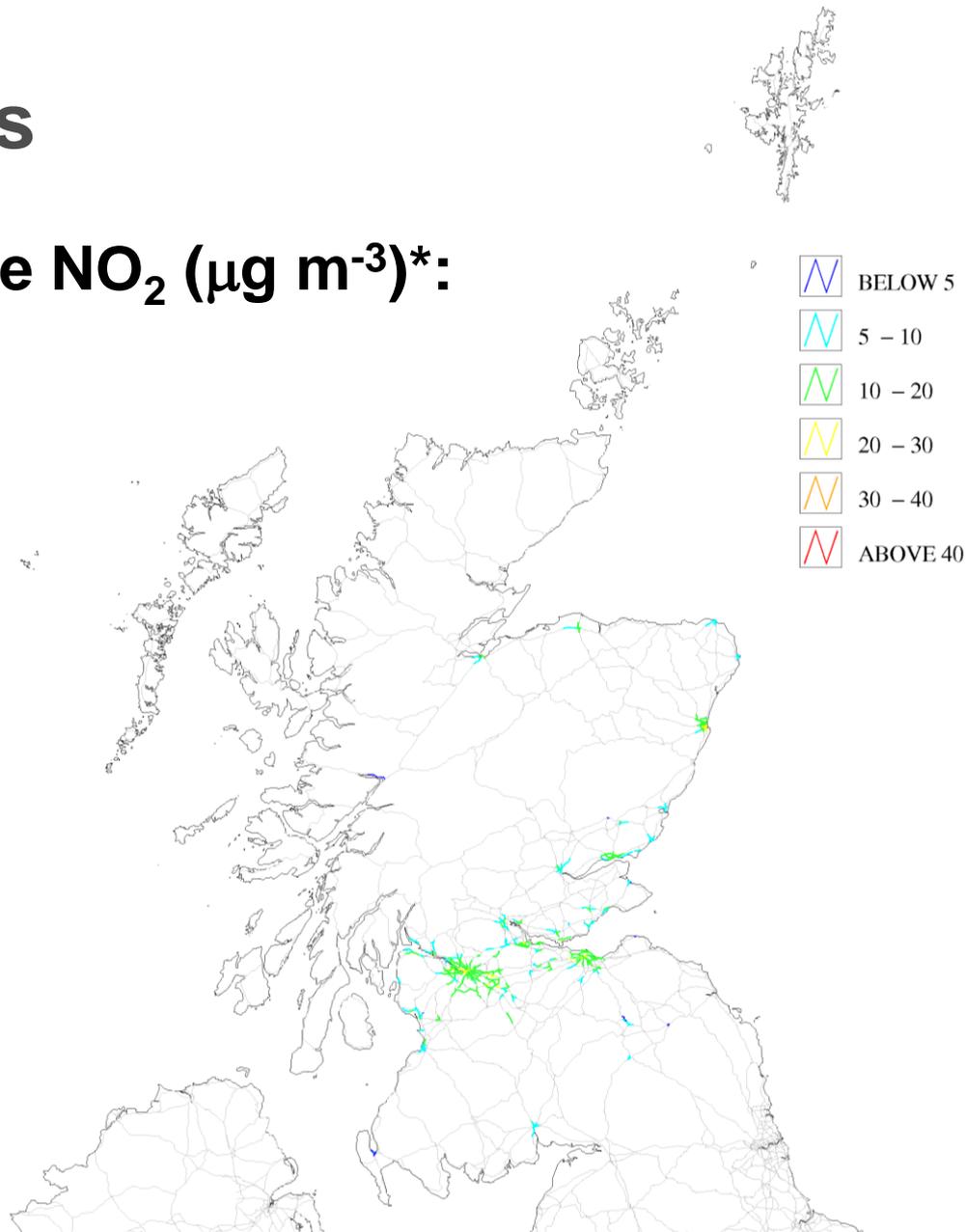
Roadside NO₂ (µg m⁻³)*: 2015



* denotes provisional results

Results

Roadside NO₂ (μg m⁻³)*: 2020



* denotes provisional results

Summary: roadside & background PM₁₀

Modelled results* show exceedence of the Scottish PM₁₀ AQO along 130 road links (167 km of road) in 2008

Modelled and projected results* show a progressive decrease in exceedences of the Scottish AQO for PM₁₀ between 2008 and 2020 at background locations

Year	Total area (km ²)	Total population exposed
2008	1	2595
2010	2	133
2015	1	29
2020	1	29

(* denotes provisional results)

Scottish AQO for PM₁₀: 18 µg m⁻³ (annual mean)

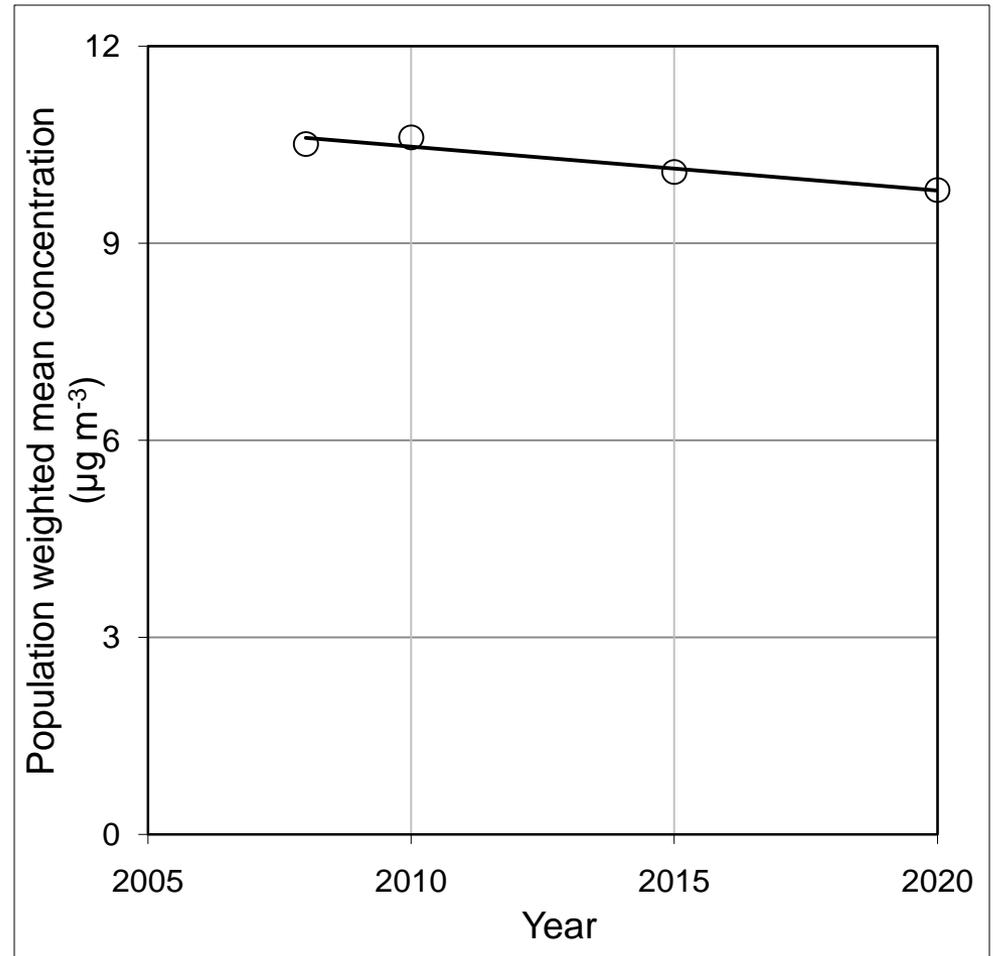
Population weighted mean PM₁₀ concentration

Slight decrease in the population weighted mean PM₁₀ concentration

2008* : 11 $\mu\text{g m}^{-3}$

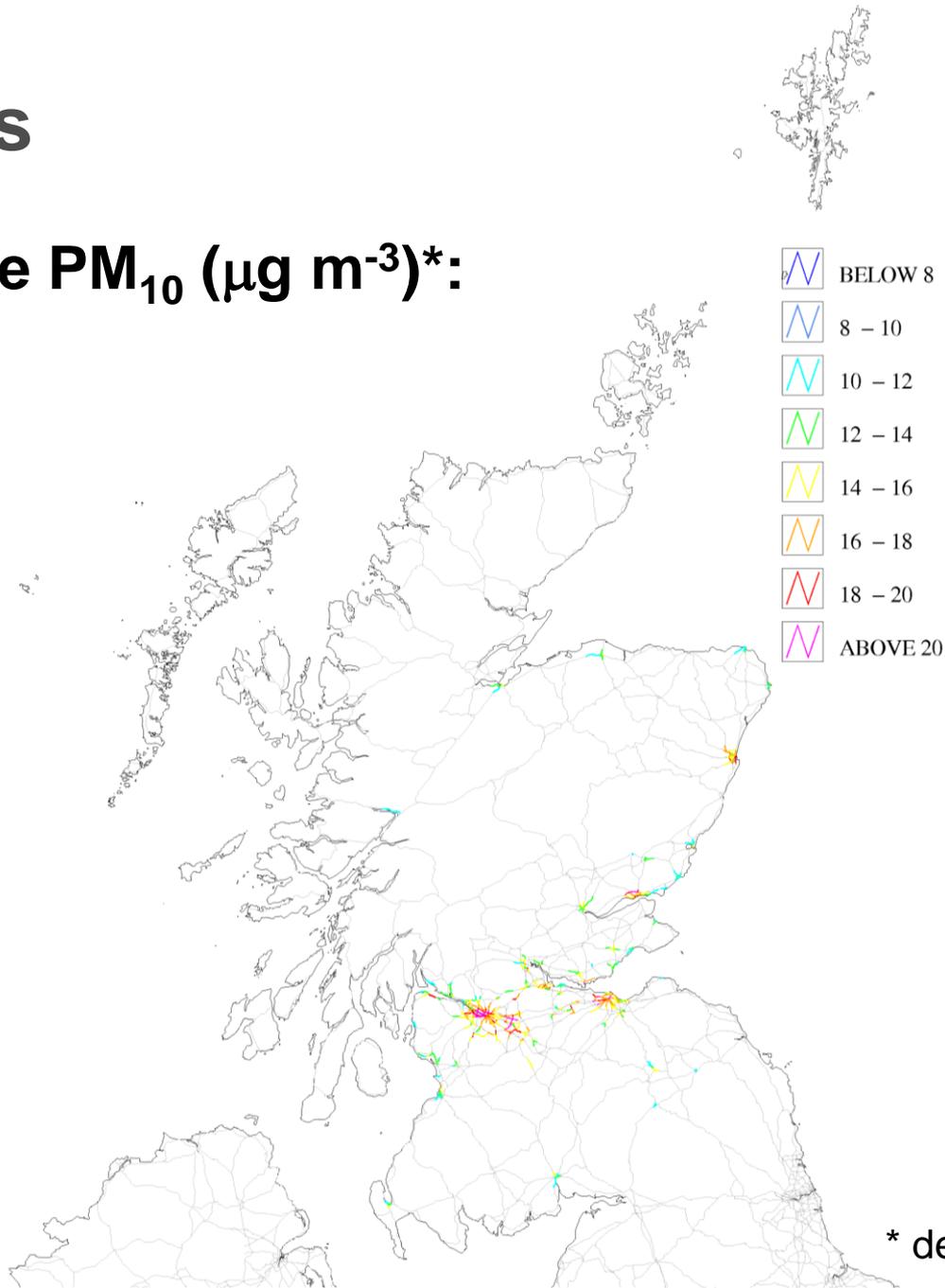
2020* : 10 $\mu\text{g m}^{-3}$

(* denotes provisional results)



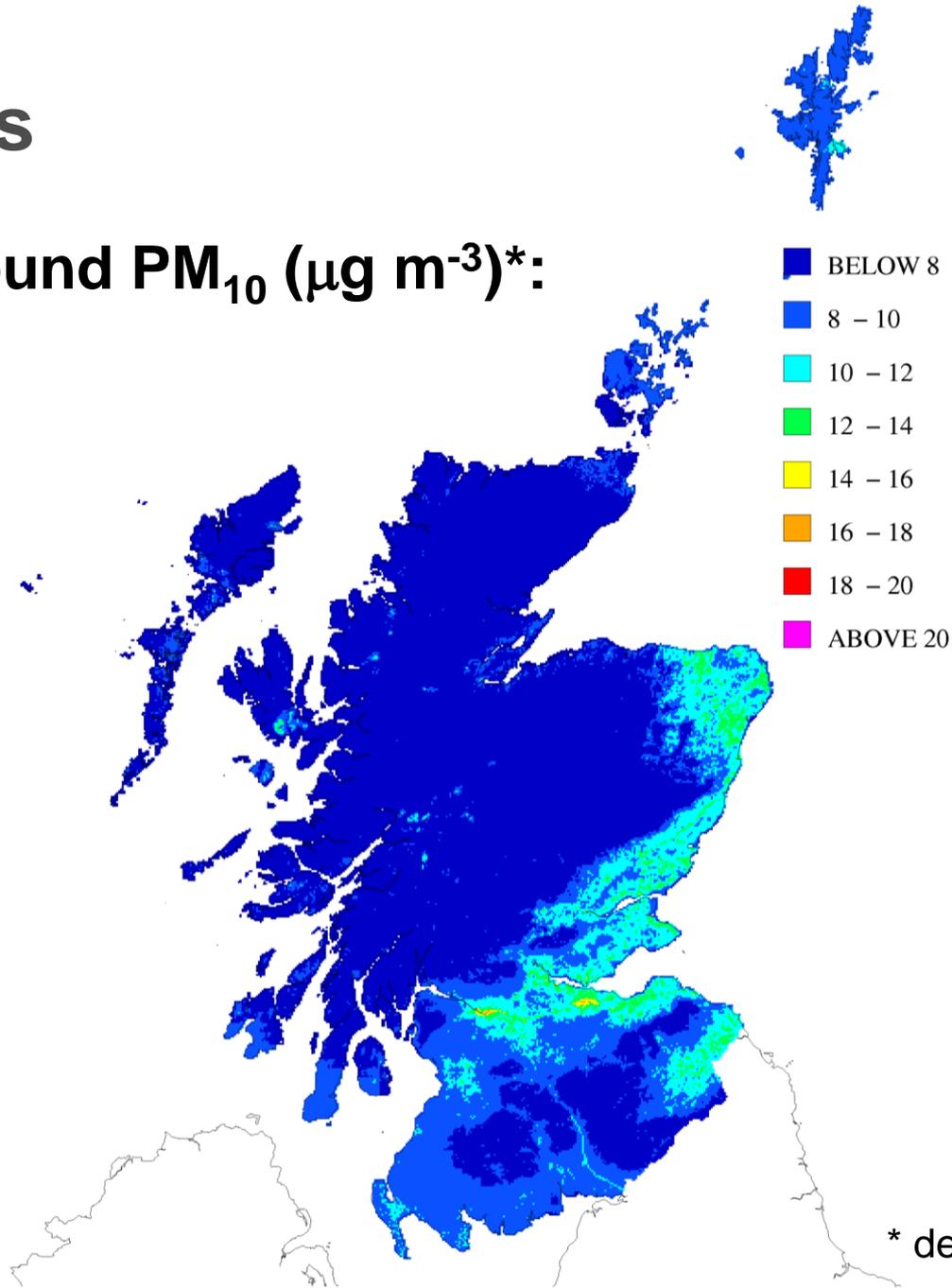
Results

Roadside PM₁₀ (μg m⁻³)*: 2008



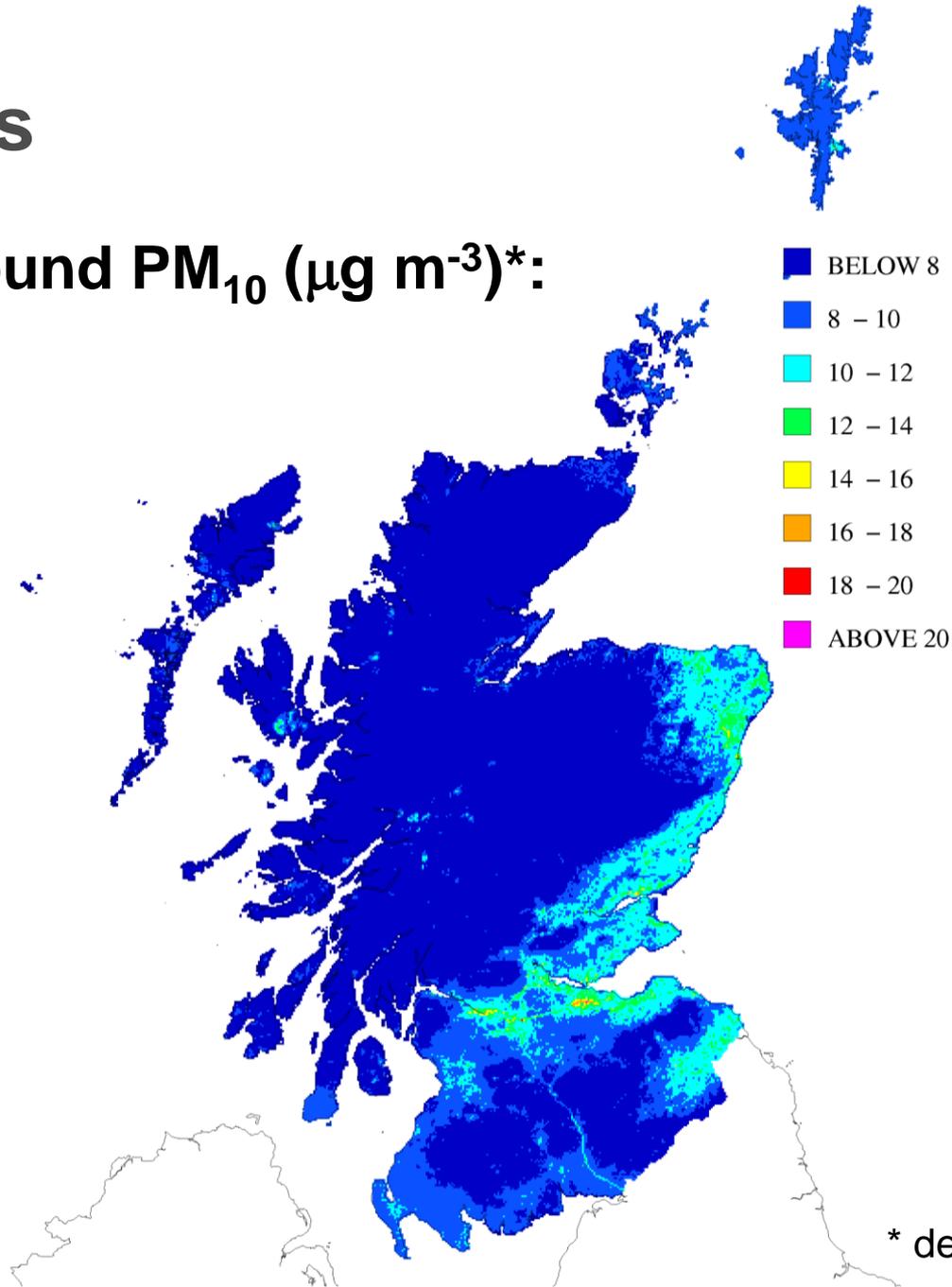
Results

Background PM₁₀ ($\mu\text{g m}^{-3}$)*: 2008



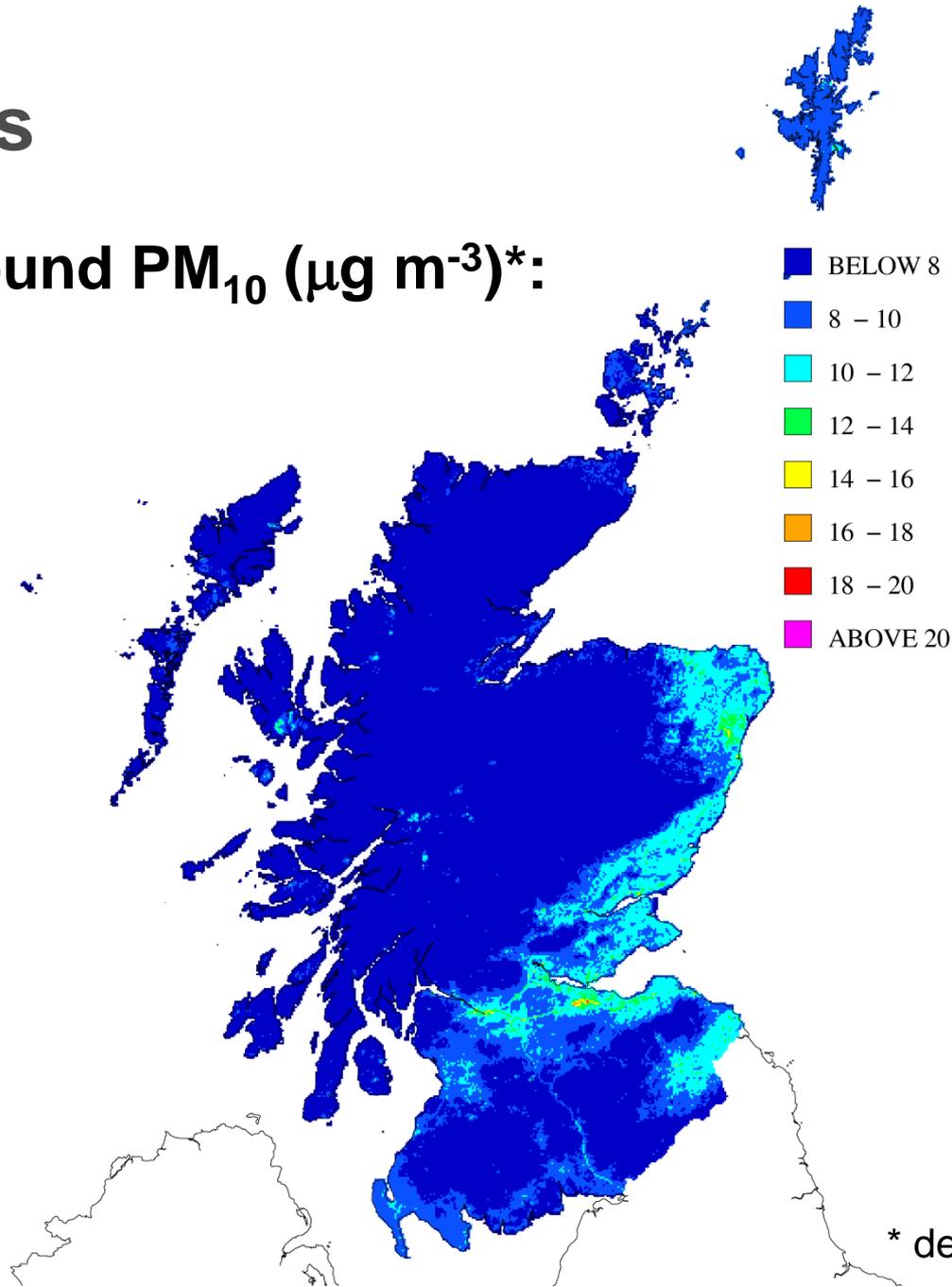
Results

Background PM₁₀ ($\mu\text{g m}^{-3}$)*:
2010



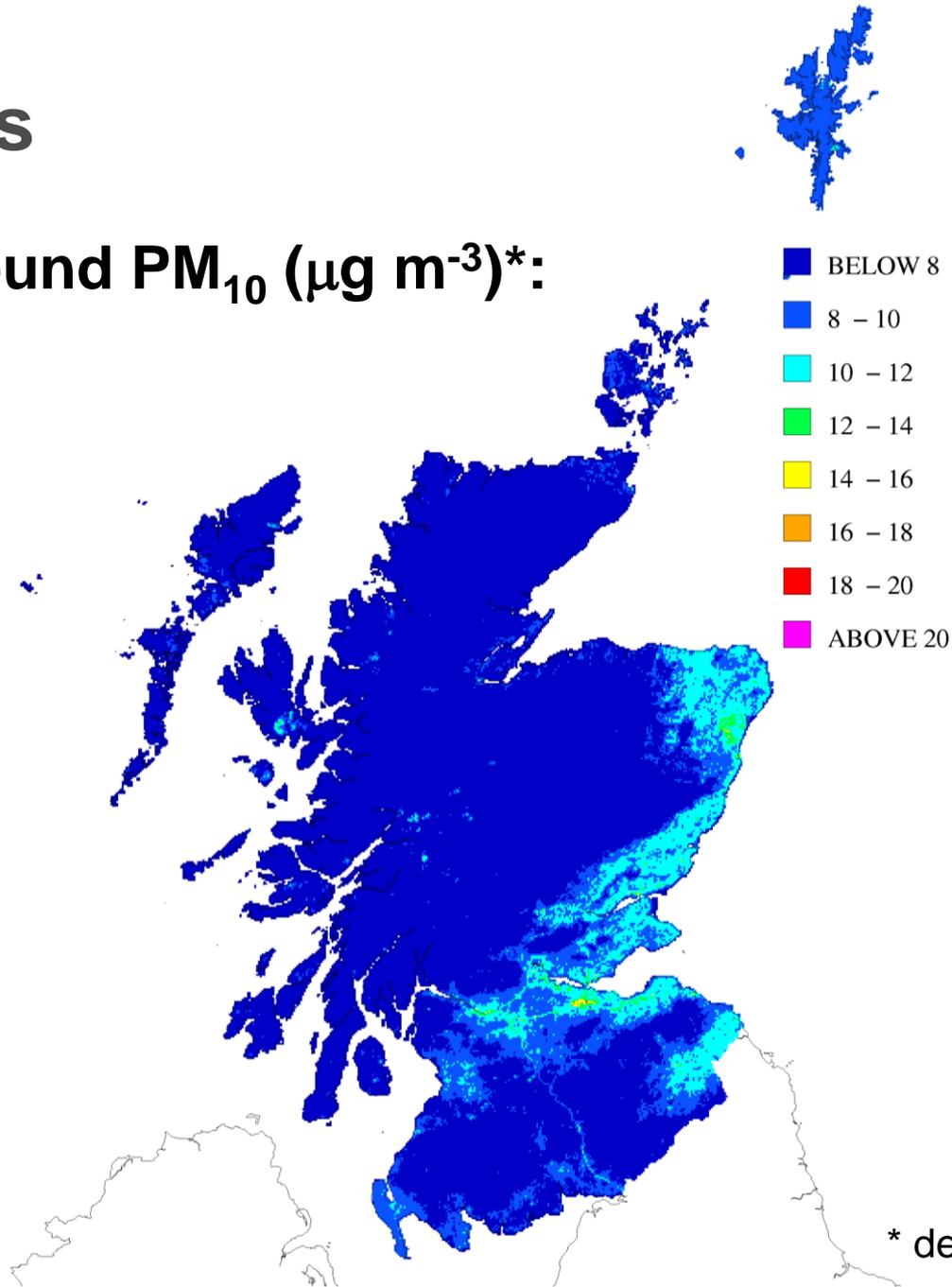
Results

Background PM₁₀ ($\mu\text{g m}^{-3}$)*: 2015



Results

Background PM₁₀ ($\mu\text{g m}^{-3}$)*: 2020



Conclusions

- **Modelled (background & roadside) annual mean concentrations of specific pollutants for 2008 of NO_x/NO₂ and PM₁₀**
- **Modelled projected concentrations of NO_x/NO₂ and PM₁₀ for 2010, 2015 and 2020 from base year (2008)**
- **2008 modelled annual mean concentrations results show:**
 - Modelled results* show exceedence of the Scottish NO₂ AQO along 72 road links (104 km of road) in 2008
 - Exceedence of the Scottish NO₂ AQO in 2 grid squares
 - Modelled results* show exceedence of the Scottish PM₁₀ AQO along 130 road links (167 km of road) in 2008
 - Exceedence of the Scottish PM₁₀ AQO in 1 grid square

* denotes provisional results

Conclusions

- **Projected annual mean concentrations* show that between 2008 and 2020:**
 - 5 $\mu\text{g m}^{-3}$ reduction in the population weighted mean NO_2 concentration
 - Progressive decrease in the number of road links along which the Scottish NO_2 AQO is exceeded from 72 to almost none
 - 1 $\mu\text{g m}^{-3}$ reduction in the population weighted mean PM_{10} concentration
 - Decreases in the population exposed to exceedences of both NO_2 and PM_{10}

* denotes provisional results

Questions



Justin Lingard

justin.lingard@aeat.co.uk

0870 190 6756