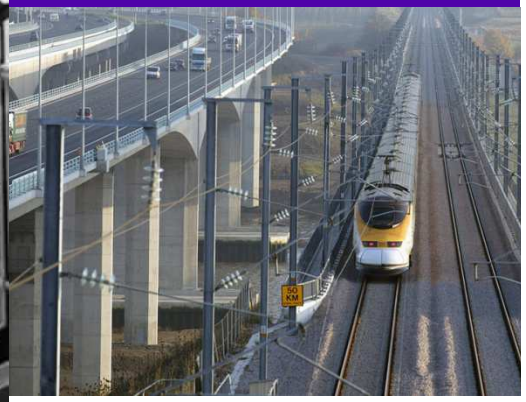
Appendix I – Combined Presentation from Steering Groups B and C

Sheffield Air Quality Modelling – LEZ Phase 1 Steering Group Meetings B and C

September 2012



Sheffield City Council

defra
Department for Environment Food and Rural Affairs

Agenda

- Project Scope and Methodology
- Progress
- Fleet Composition Assumptions
- Impact of Assumptions on Modelled Air Quality
- Comparison of Modelled and Observed Emissions
- Analysis of Contributors to Emissions
- PM10 and Carbon Emissions

Summary of Project Scope and Methodology

- Initial Analysis of Base Emissions (using 2008 Base Model)
- Identification of Key Problem Areas
- Analysis of Main Contributors to Emissions
- Data Collection to Enhance Emissions Calculations
- Updated Emissions Calculations and Forecast for 2015
- Identification of Potential Measures to Reduce Emissions
- Action Plan for Reducing Emissions

ENEVAL (ENvironmental EVALuation Tool)

- Consistent with the TRL's 2009 Road Traffic Emissions Factors
- Uses detailed outputs from Transport Models, including:
  - traffic speeds (on a link-by-link basis)
  - traffic composition (which are then further disaggregated by Euro Class)
- Emissions from traffic queuing at junctions can be calculated and reported separately
- Can predict both current and forecast emissions of NO_X, PM_{10}, total hydrocarbons & CO_2(e)
- Particulates from tail-pipe emissions and 'other' sources (eg brakes and tyres) can be estimated separately
- Fast run times compared to alternative methods
- Can easily handle very large networks

Progress to Date

- Base Year Model flows input to ENEVAL software for initial analysis of emissions
- UK default fleet assumptions used for initial analysis
- Emissions and Observed Air Quality compared to identify key problem areas
- Initial Analysis of Main Contributors to these emissions
- Collection of Data on Fleet Composition, used to update modelling of Base Year Emissions
- Future year (2015) model flows input to ENEVAL to analyse forecast future year emissions
- Further analysis of Contributors to emissions with the updated model inputs

Fleet Composition Assumptions – Buses

- SYPTE have collated data from Bus Operators for 2008 and Current Fleets
- Likely fleet for 2015 estimated through assumed vehicle replacement strategies
- Splits by Euro Class calculated for 2008, 2012 and 2015
- Final version distributed to Operators for review
- Model updated to accept different fleet compositions by operator
- Hybrid routes modelled as a separate operator

Fleet Composition Assumptions – Car/Freight

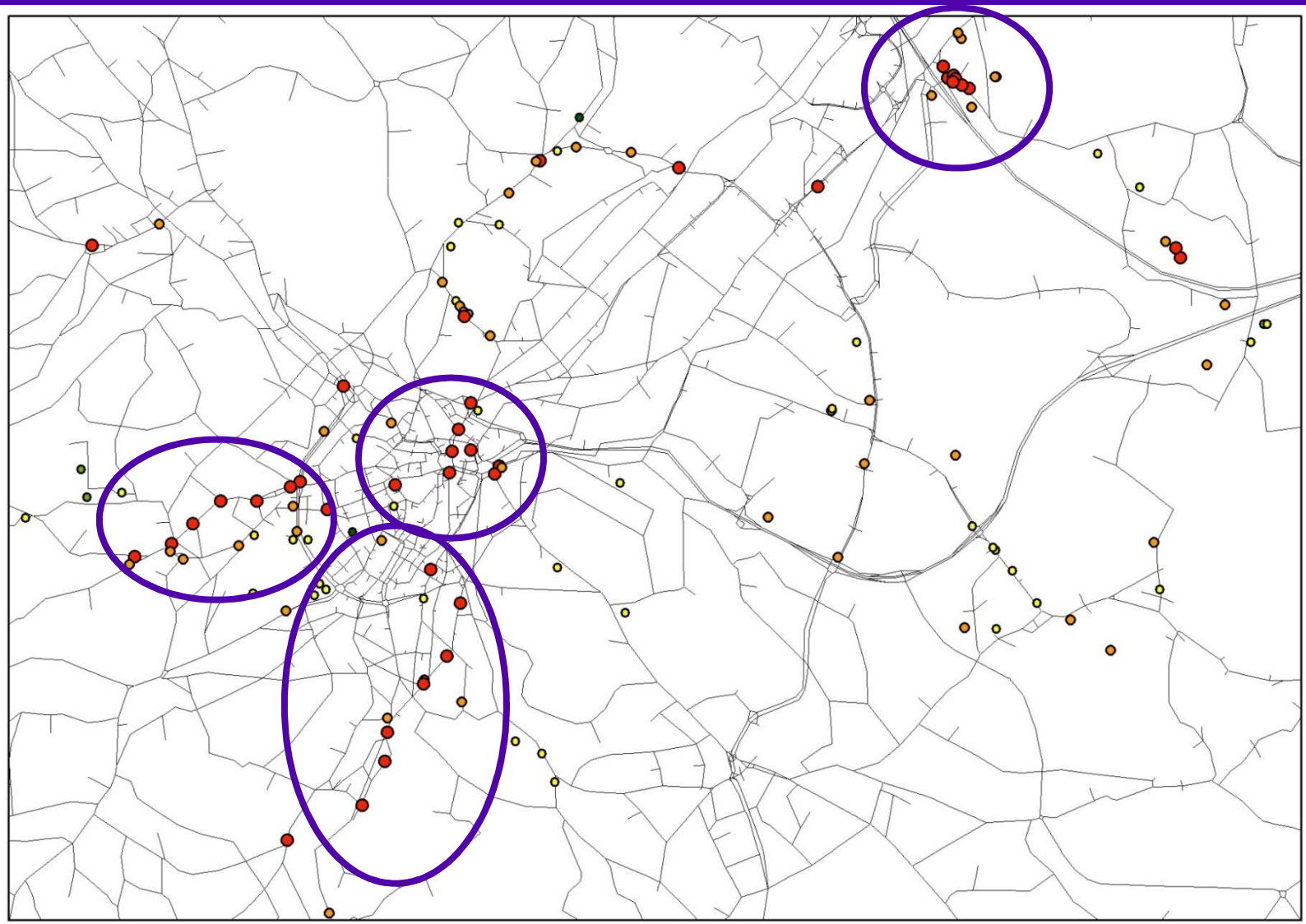
- Provided with summarised ANPR data for 2007, including Euro splits by vehicle type
- Sample of 2012 data received. Euro class calculated by MVA for 2012 based on date of vehicle registration
- Euro split and Petrol/Diesel split estimated for 2008 and 2015, based on 2007 and 2012 sample data.

Presentation of Observed and Modelled Air Quality

Throughout this Presentation:

- Observed Data is Recorded Air Quality including background emissions as well as traffic related emissions
- Modelled Data is Tailpipe Emissions of NO_X
- Background Emissions are not included in Modelled Emissions
- Colour coding of Modelled Emissions is merely to highlight the level of emissions and does not necessarily relate to areas that will exceed targets

Observed Air Quality



Understanding the Impact of Assumptions

Summary of 2008 assumptions in following plots:

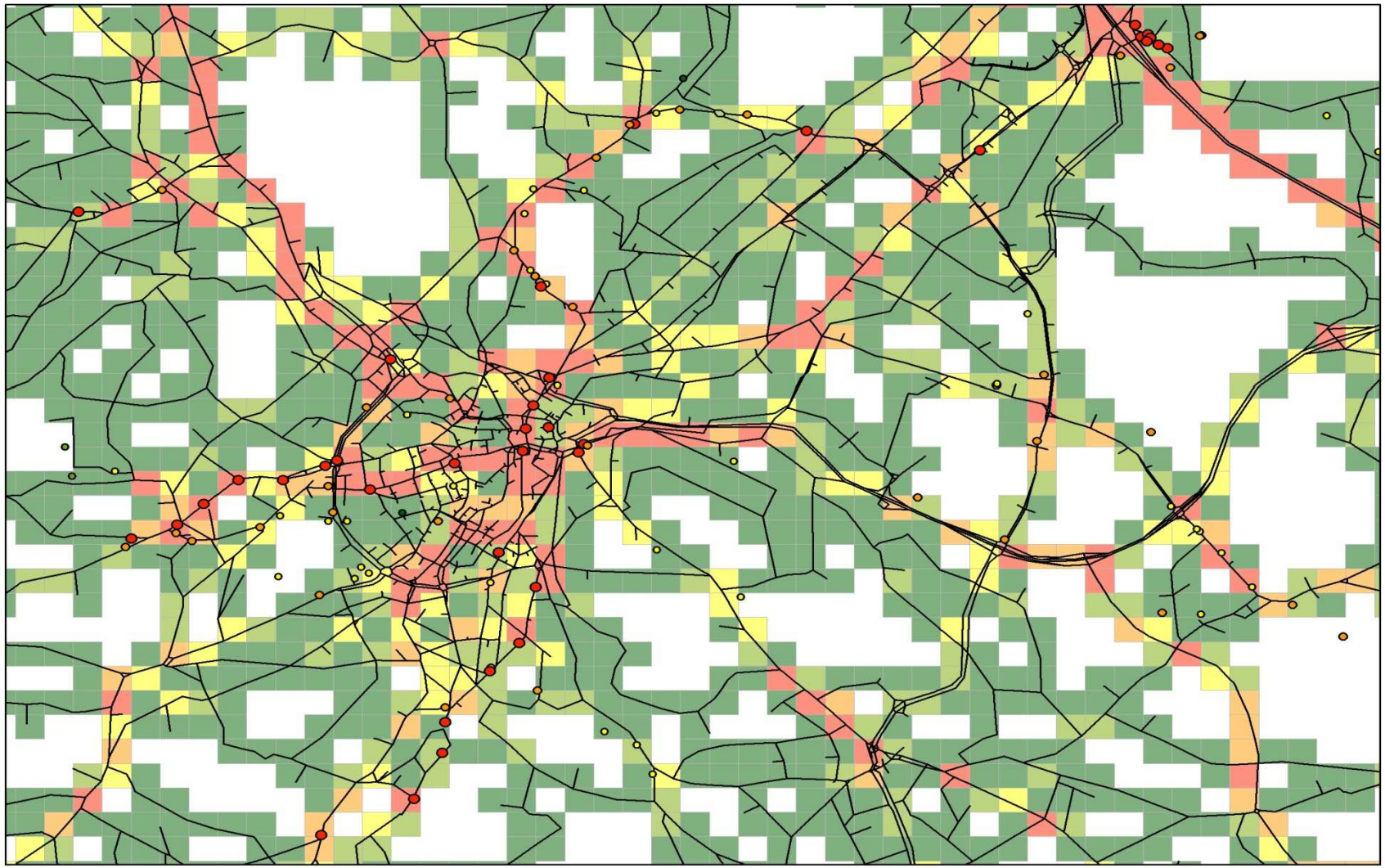
1. Default fleet compositions taken from DEFRA Toolkit for Vehicle Emissions. Emissions Factors are taken from the DfT website (TRL Report PPR353 – Emissions Factors 2009)

2. As 1, but using Sheffield SYPTE bus data

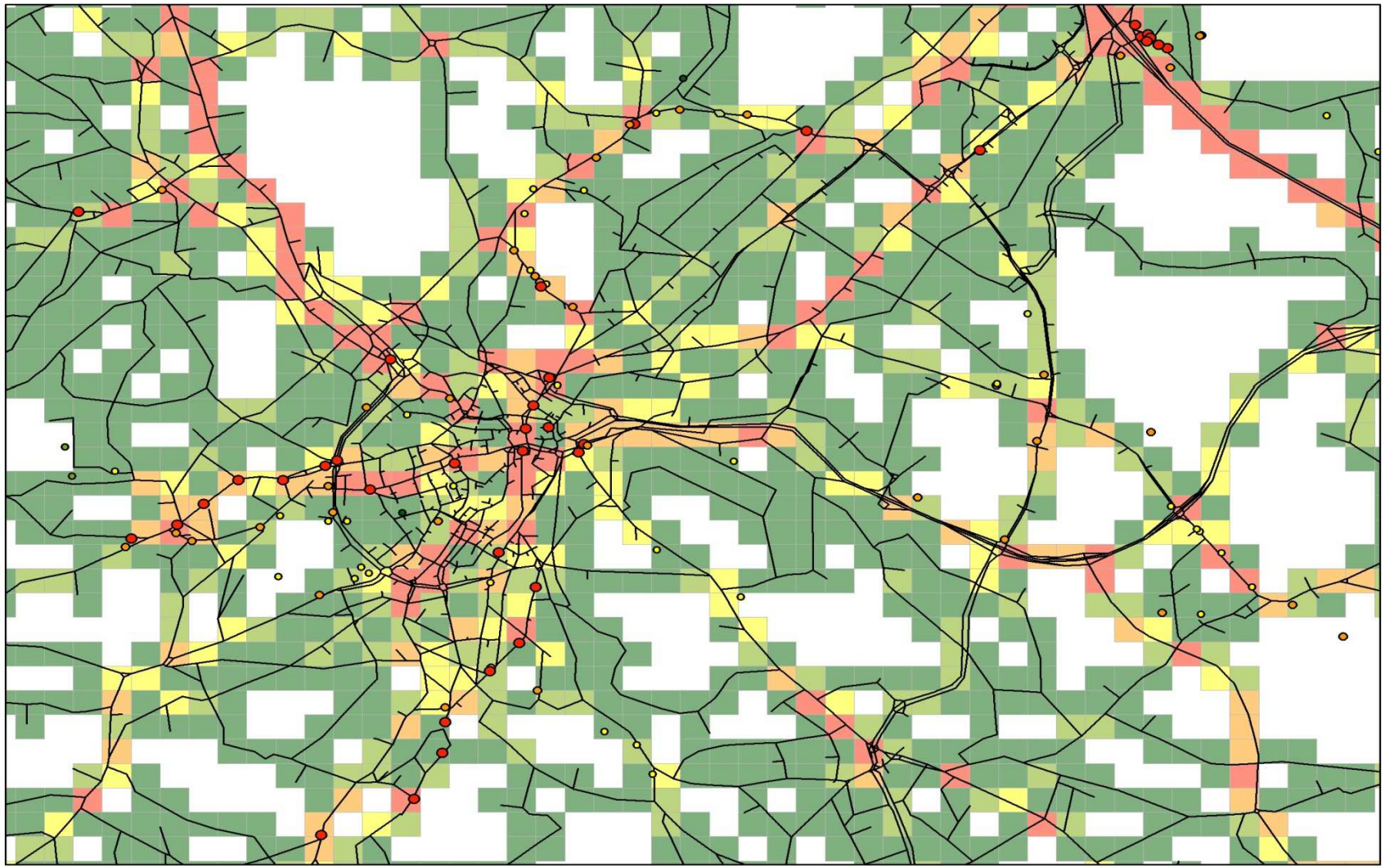
3. As 2, with using estimated Sheffield goods and car splits

4. As 3, using COPERT NO_x function instead of TRL NO_x function.

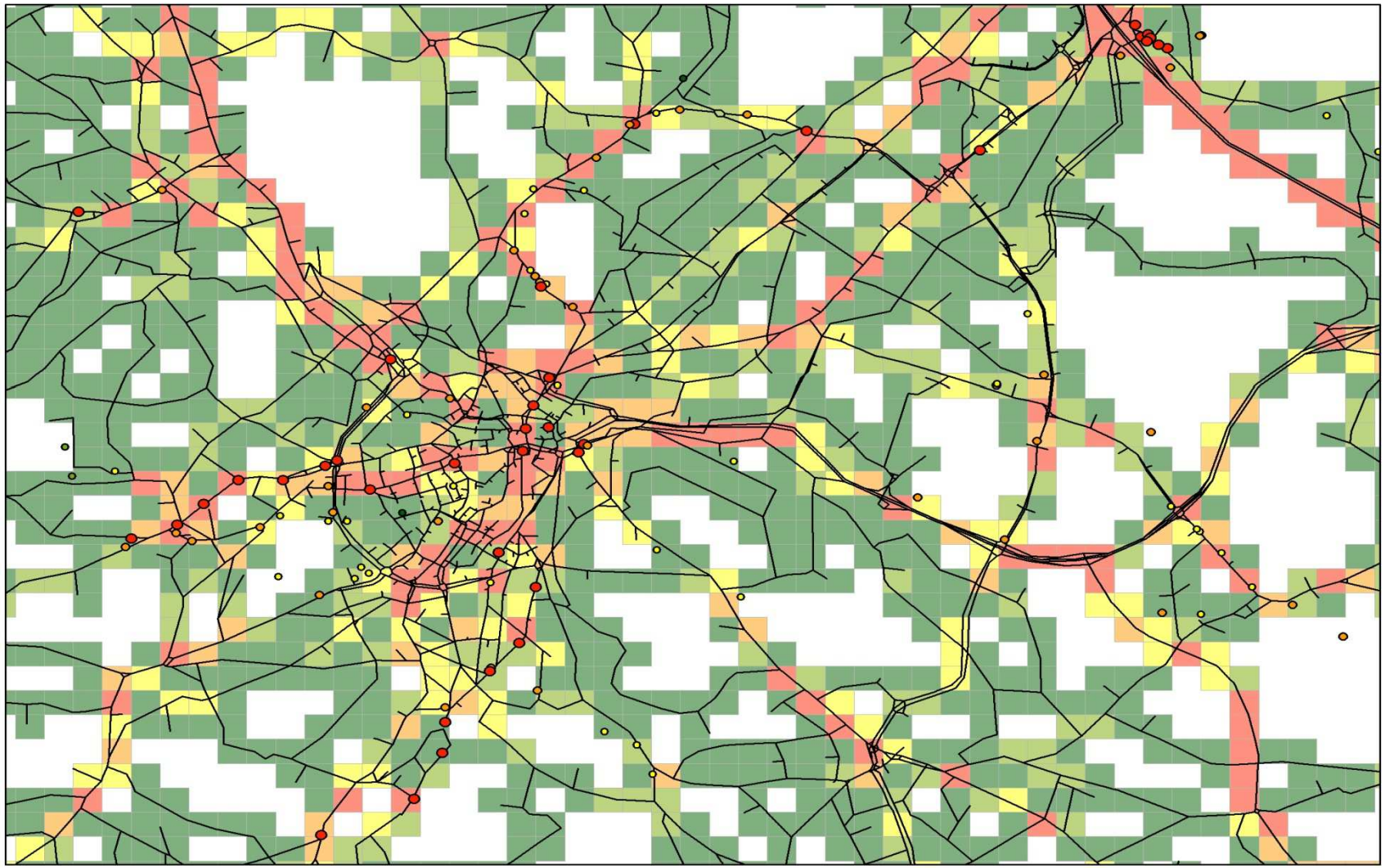
1. Previous comparison of Observed Air Quality and Modelled Emissions at 2008 (standard inputs)



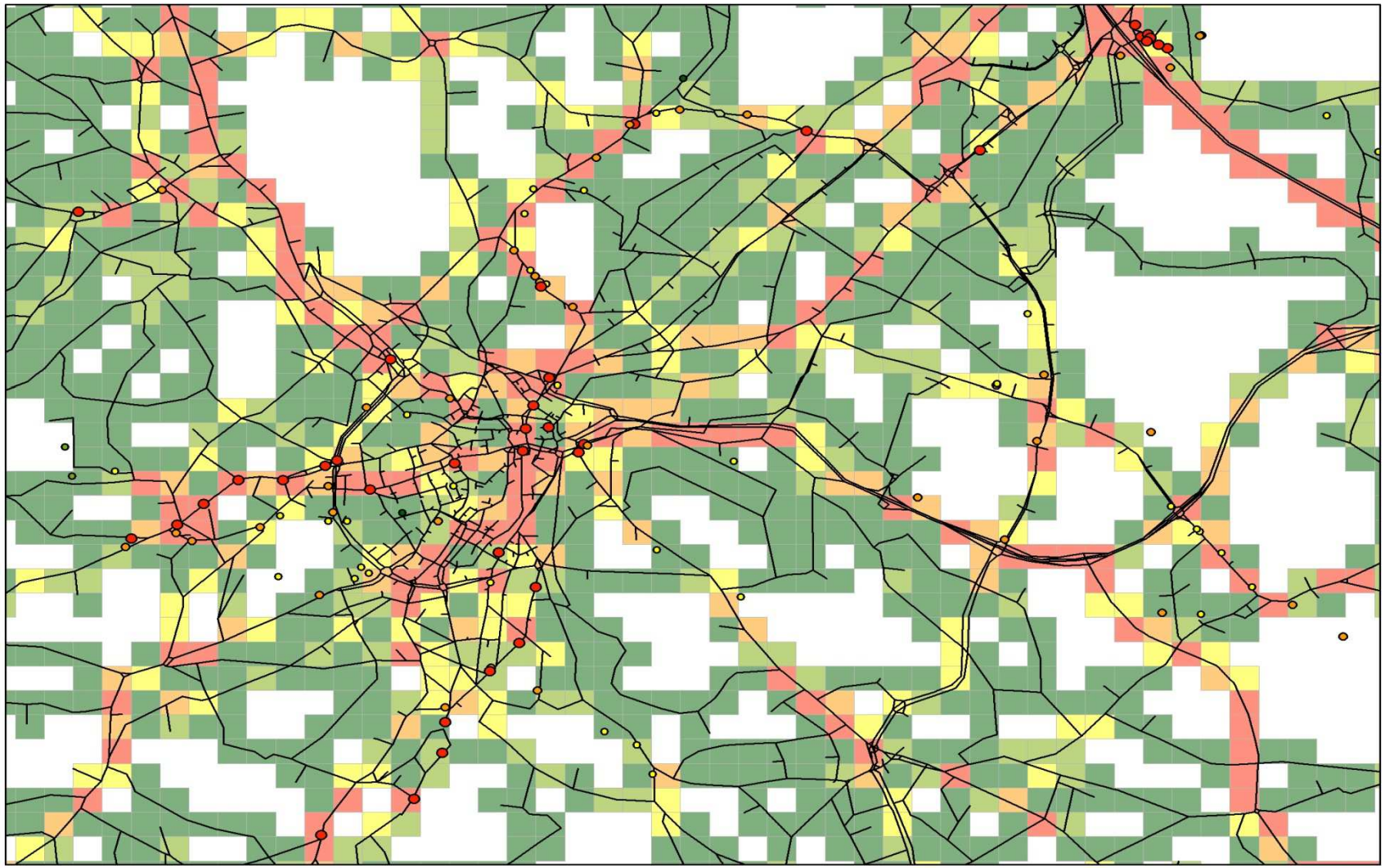
2. With Sheffield bus fleet at 2008



3. With Sheffield bus fleet and estimated Sheffield car/freight split at 2008



4. With Sheffield bus fleet and estimated Sheffield car/freight split and COPERT NO_x calculation at 2008



Impact of assumptions

Change in total NO_x compared with national assumptions for plotted area excluding the motorway

Inputs	% Change in NO_x
Sheffield Bus	-7%
+ Sheffield Freight/Car	3%
+ COPERT NO_x	14%

The Contributors to Emissions at 2008

NO_x Emissions (tonnes) and Proportions in Sheffield by Model User Class (excluding Motorway)

	Car	LGV	OGV	Bus
National	400 (33%)	101.8 (8%)	337.2 (28%)	379.3 (32%)
Sheffield Bus	399.1 (35%)	101.8 (9%)	337.6 (30%)	296.7 (26%)
+ Sheffield Freight/Car	551.4 (43%)	53.9 (4%)	360.3 (29%)	295.7 (24%)
+ COPERT NOx	652.8 (48%)	66.1 (5%)	339.8 (25%)	298 (22%)

Note that throughout this work LGV relates to goods vehicles less than 3.5 tonnes, and OGV to goods vehicles over 3.5 tonnes.

Impact of assumptions at 2008

- Use of local bus fleet splits results in lower NO_X emissions
  - Higher single deck proportions than national average
- Use of Sheffield car and freight splits results in increased NO_x emissions
  - Older Euro composition than national average
- Use of the COPERT function results in increased NO_x emissions.
  - TRL function is known to underestimate NO_x emissions for car, particularly diesel engines.
- In each case the proportion of NO_X emissions from car increases

2015 Forecasts

- 2015 Forecasts from BRT North work
- Local Low Growth forecasts
- Tram-Train and Supertram additional vehicles not included

Analysis of 2015 Forecasts

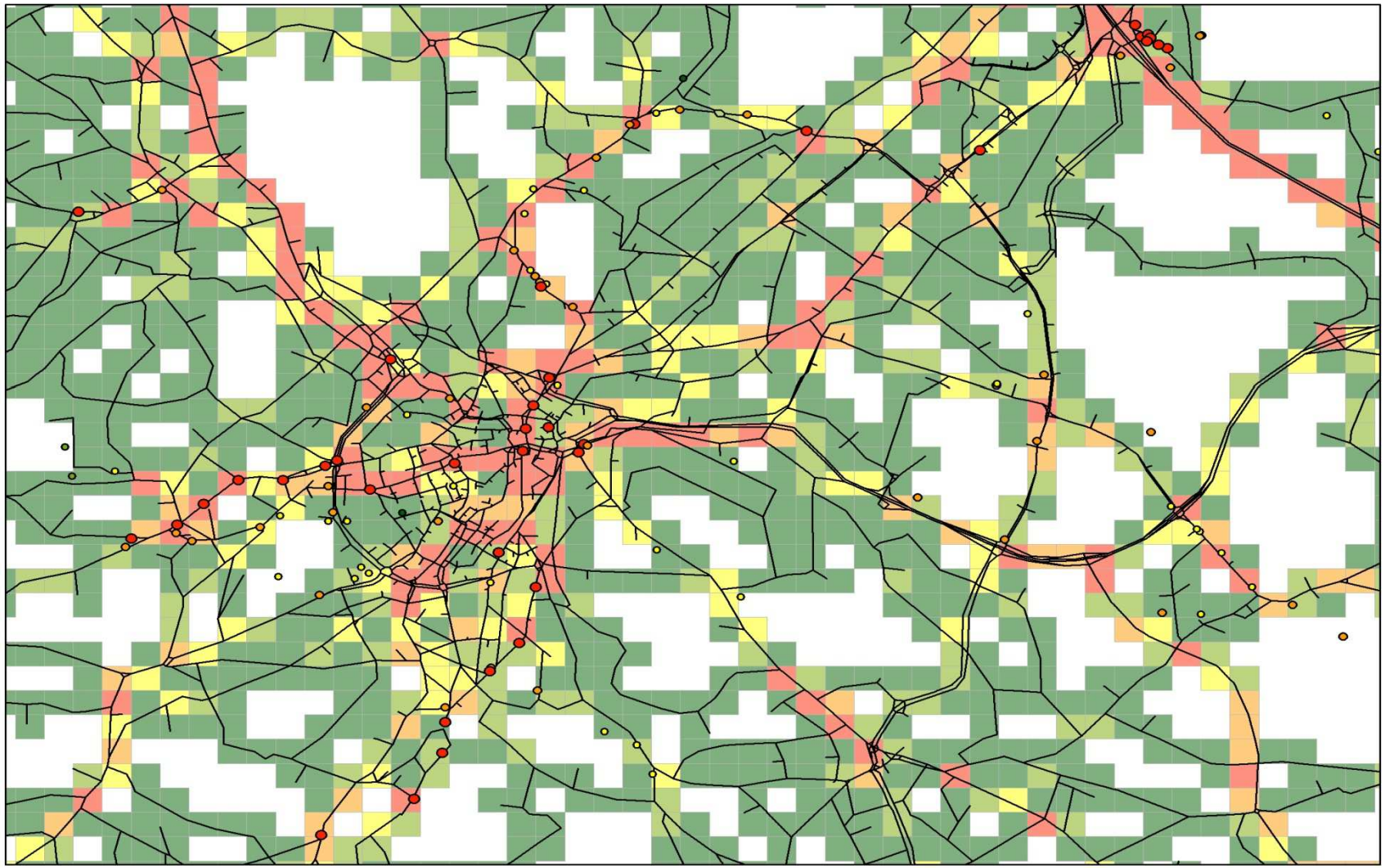
Three sets of Assumptions used for alternative forecasts:

1. Default fleet compositions and TRL Emissions Factors

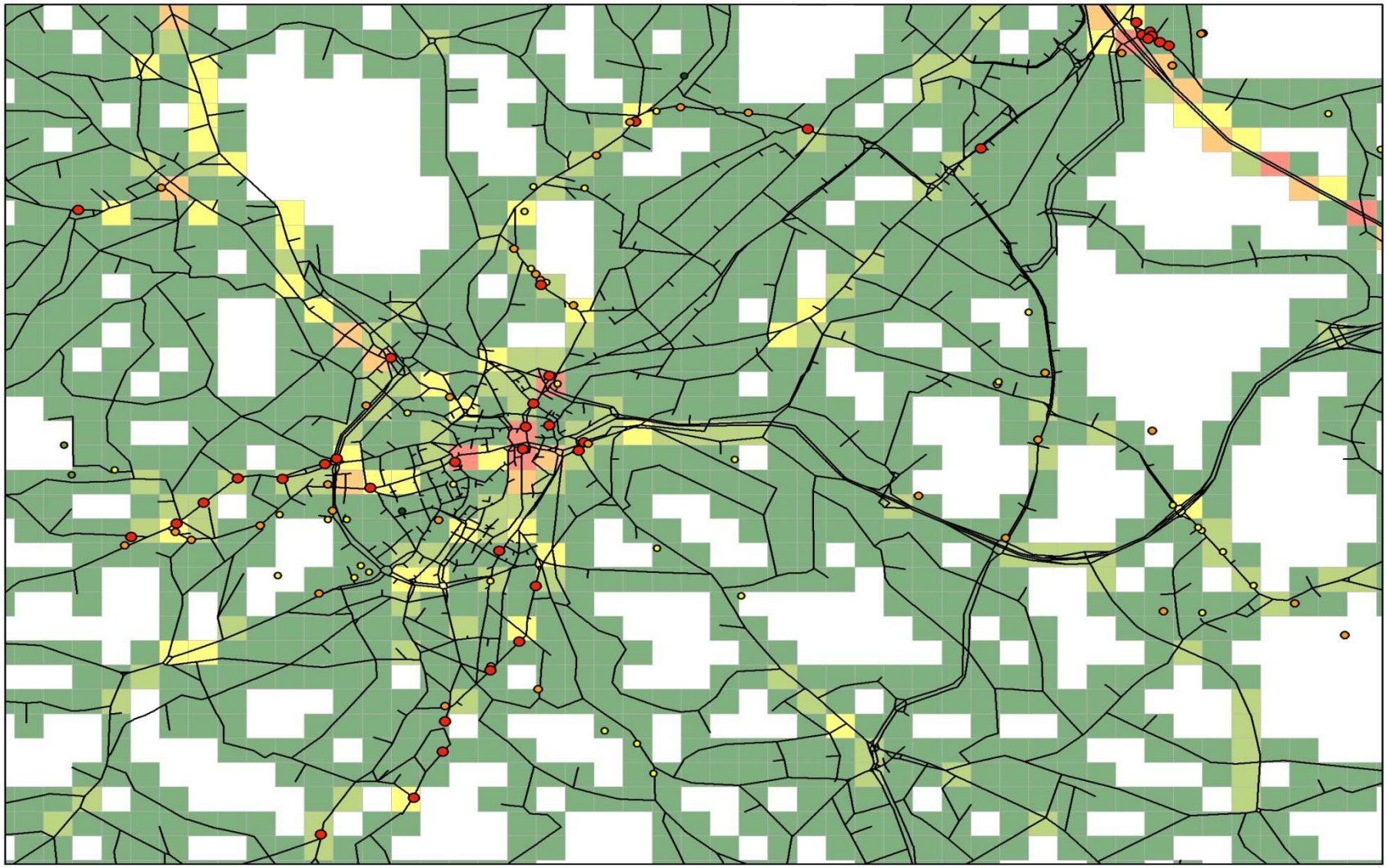
2. As 1, but with local SYPTE bus data and estimated Sheffield car and freight Euro standard splits. Use of COPERT NO_x function instead of TRL NO_x function.

3. As 2, with 2015 petrol/diesel splits for car and freight based on observed Sheffield data.

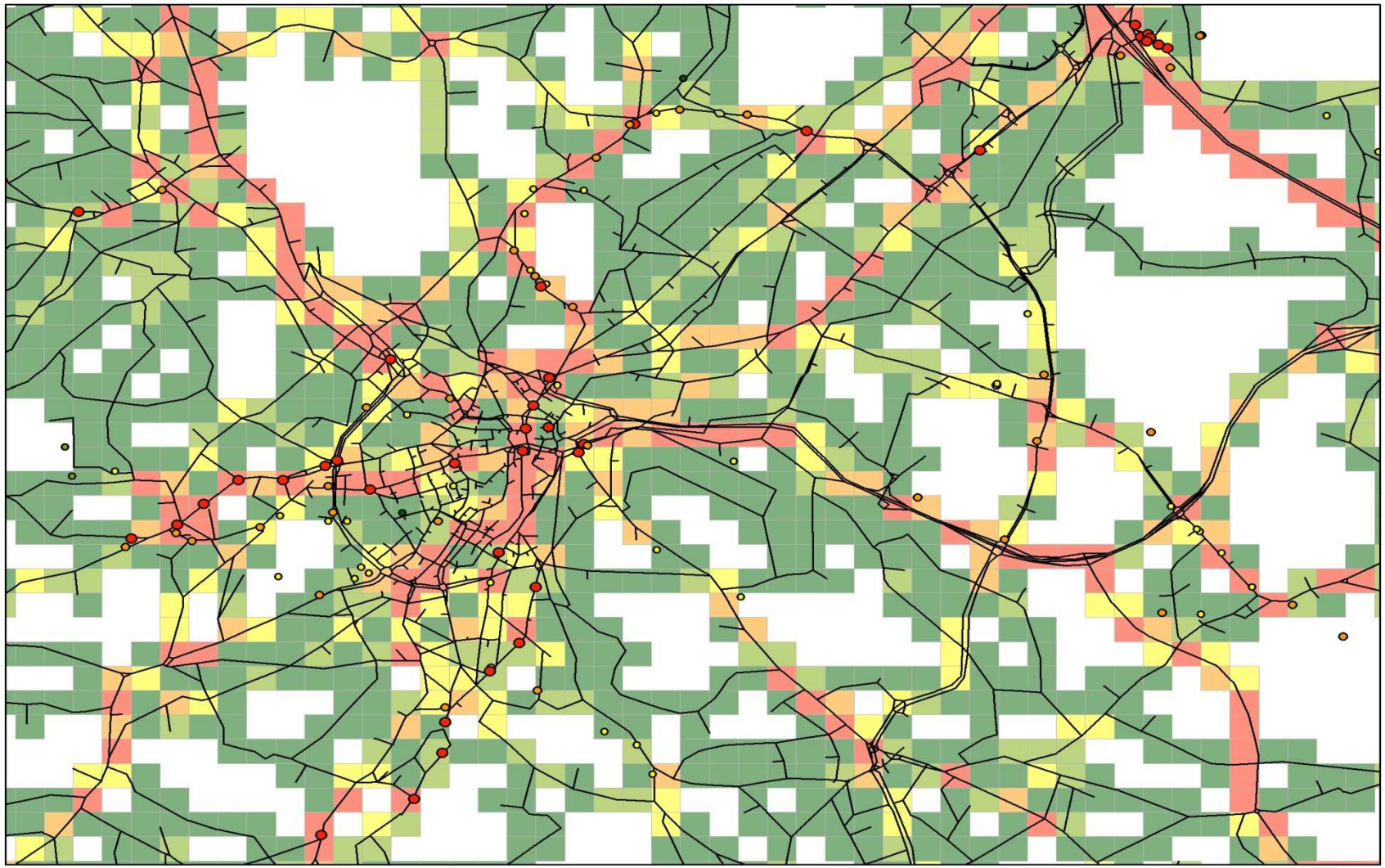
1. 2008 Plot with standard inputs



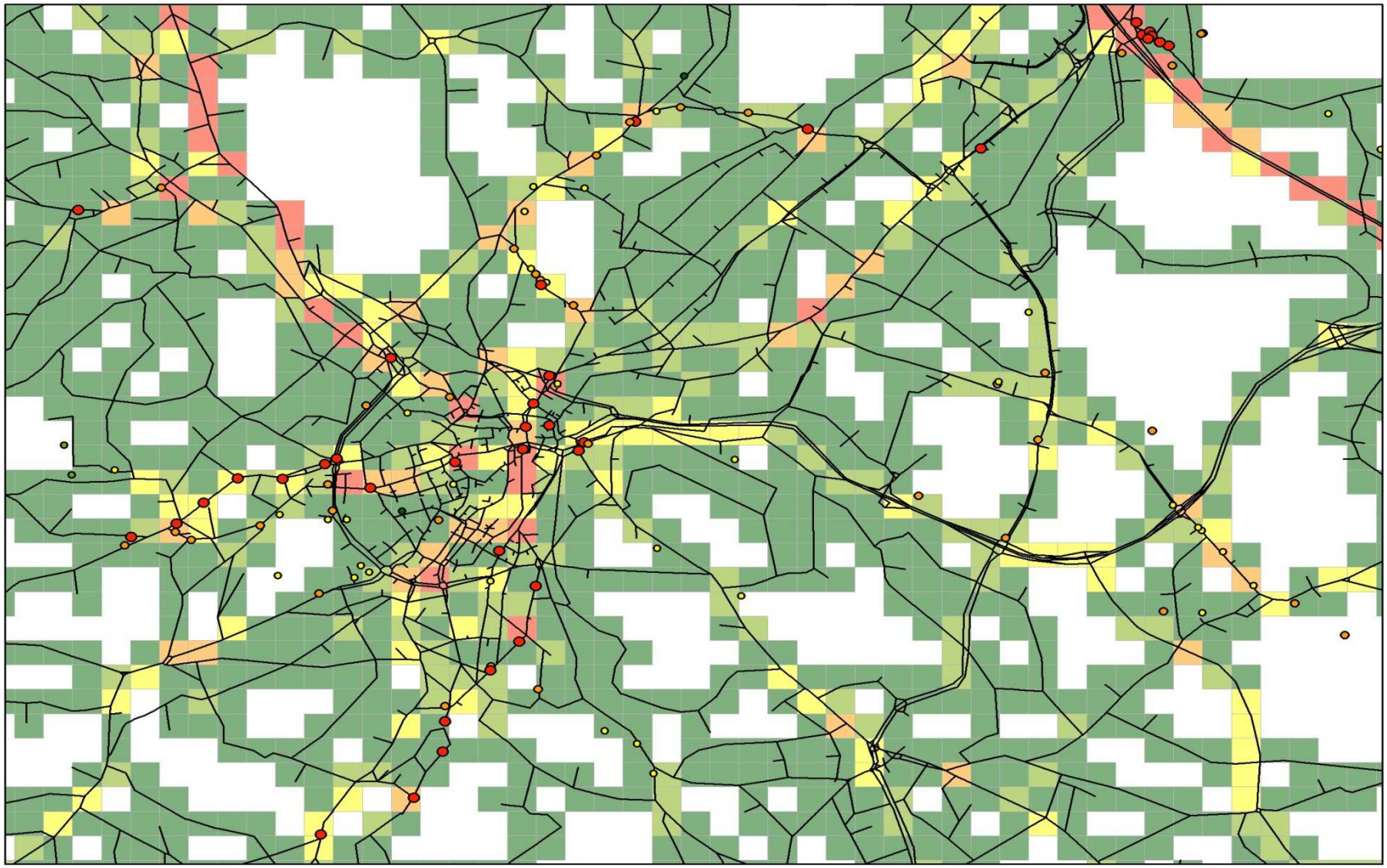
1. 2015 Plot with standard inputs



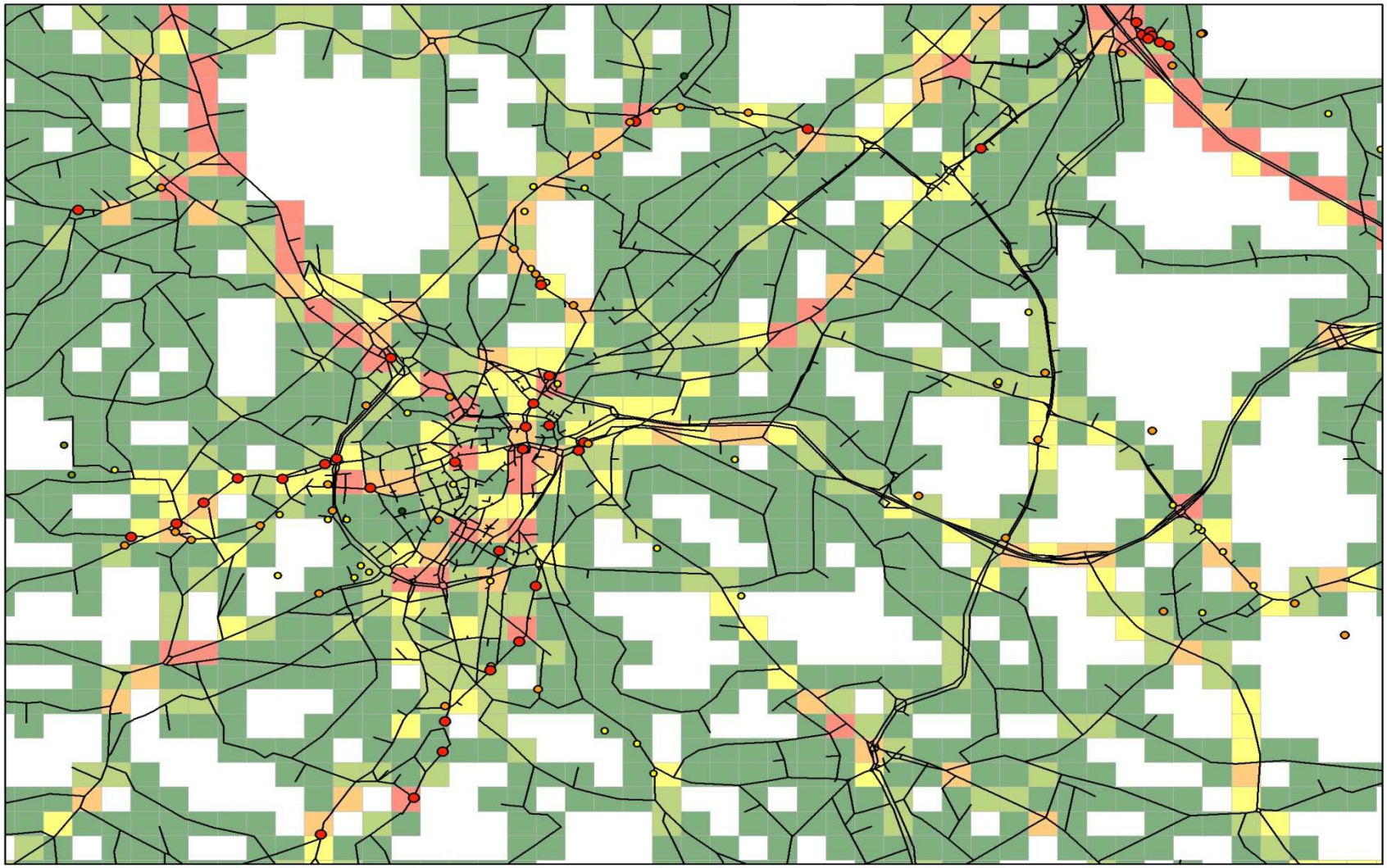
2. 2008 plot with Sheffield bus fleet and estimated Sheffield car/freight split and COPERT NO_x calculation



2. 2015 Plot with Sheffield bus fleet and estimated Sheffield car/freight split and COPERT NO_x calculation



3. 2015 Plot with Sheffield bus fleet and estimated Sheffield car/freight split, COPERT NO_x calculation and new Diesel/Petrol split



Impact of assumptions

Change in total NO_x at 2015 compared with 2008 data for plotted area excluding the motorway

Inputs	% Change in NO_x
National	-52%
Sheffield Bus/Freight/Car & COPERT NOx	-38%
+ New Petrol/Diesel Split	-30%

The Contributors to Emissions at 2015

NO_x Emissions (tonnes) and Proportions in Sheffield by Model User Class (excluding Motorway)

	Car	LGV	OGV	Bus
National	189.5 (33%)	59.6 (10%)	141.7 (25%)	183.8 (32%)
Sheffield Bus/Freight/ Car & COPERT NOx	299.6 (35%)	60 (7%)	266.8 (32%)	218.1 (26%)
+ New Diesel/ Petrol Split	398.4 (42%)	62.6 (7%)	266.8 (28%)	217.4 (23%)

The Contributors to Emissions

% Change from 2008 to 2015 in NO_x Emissions in Sheffield by Model User Class (excluding Motorway)

Inputs	Car	LGV	OGV	Bus
National	-51%	-39%	-57%	-51%
Sheffield Bus/Freight/ Car & COPERT NO_x	-54%	-9%	-21%	-27%
+ New Diesel/ Petrol Split	-39%	-5%	-21%	-27%

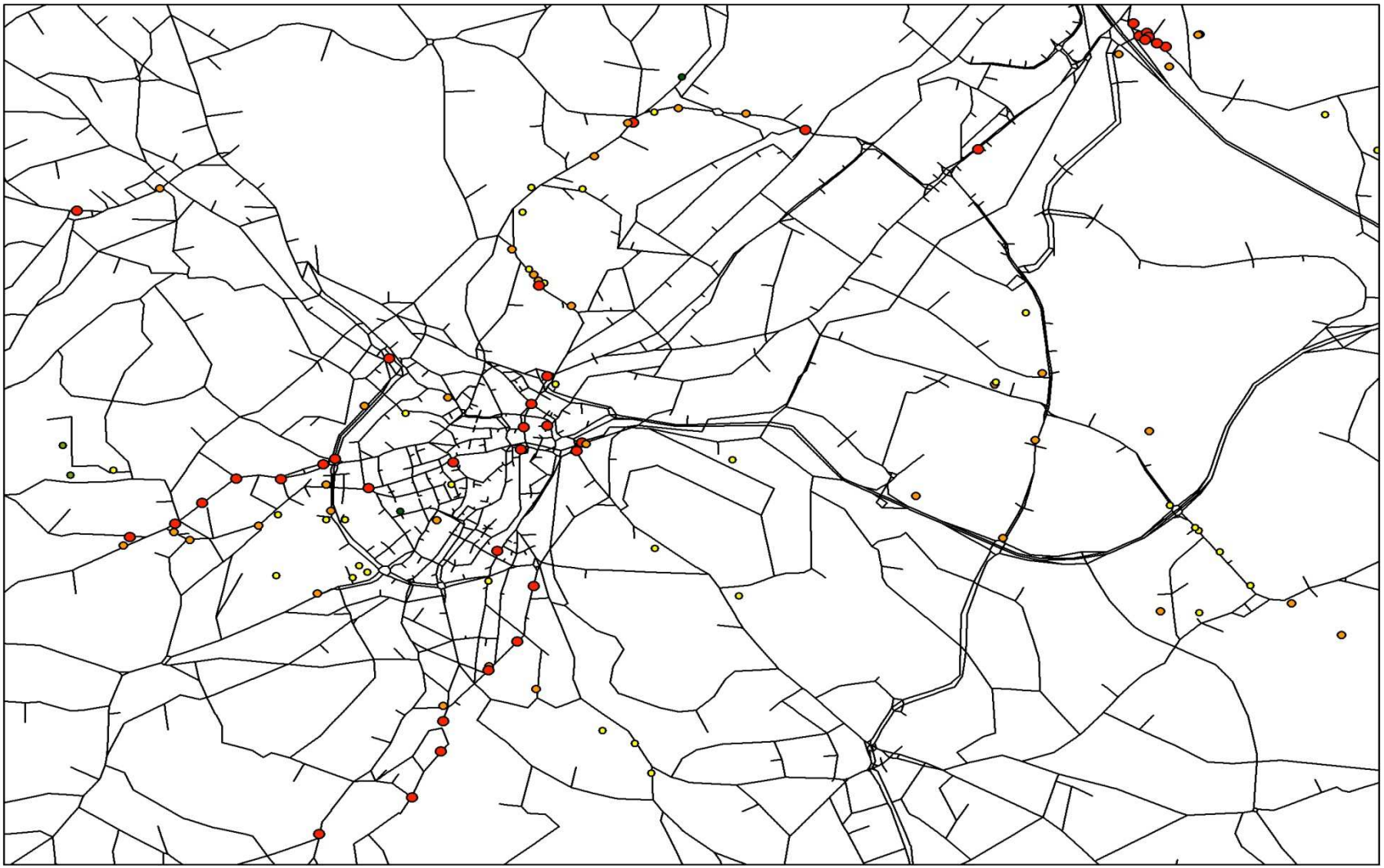
Conclusions of Impact of Assumptions

- Results highlight the importance of assumptions in forecasting emissions:
  - Petrol/Diesel split of cars is particularly important
  - Forecast NO_X emissions by vehicle type, particularly for diesels, has significant impact
- Other studies have highlighted the impact that increasing diesel car proportions have on emissions
- Other studies have shown that later Euro standards have not had the expected impact on NO_X emissions, particularly for diesel cars

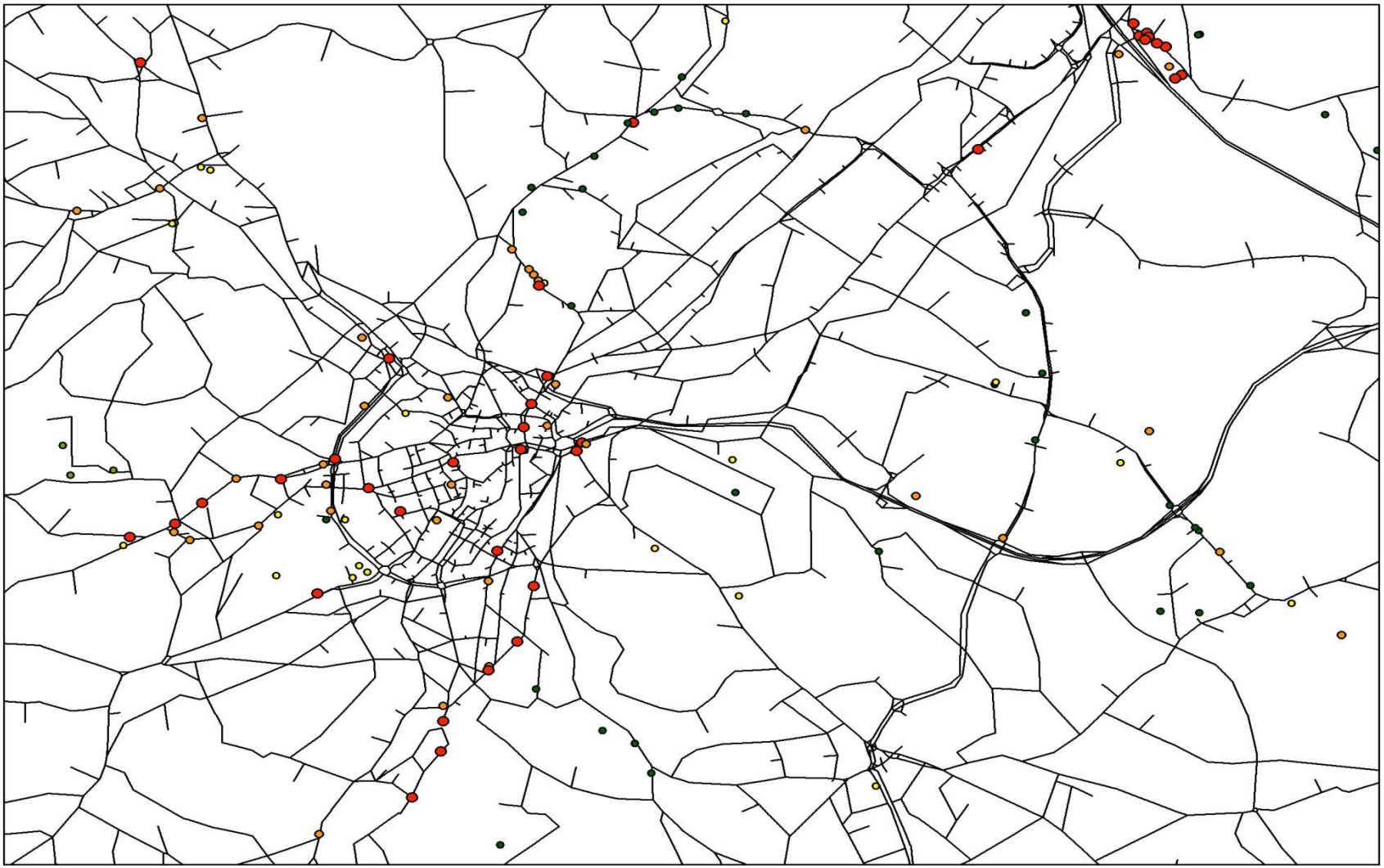
Comparison of Modelled and Observed Emissions

- Uses model forecasts with local fleet composition assumptions and use of COPERT NOx calculation
- 2011 Observed Data also considered
- Note that LGV Model Flows are slightly lower than observed counts in the Modelled Base Year. However, this will not impact significantly on the results presented.

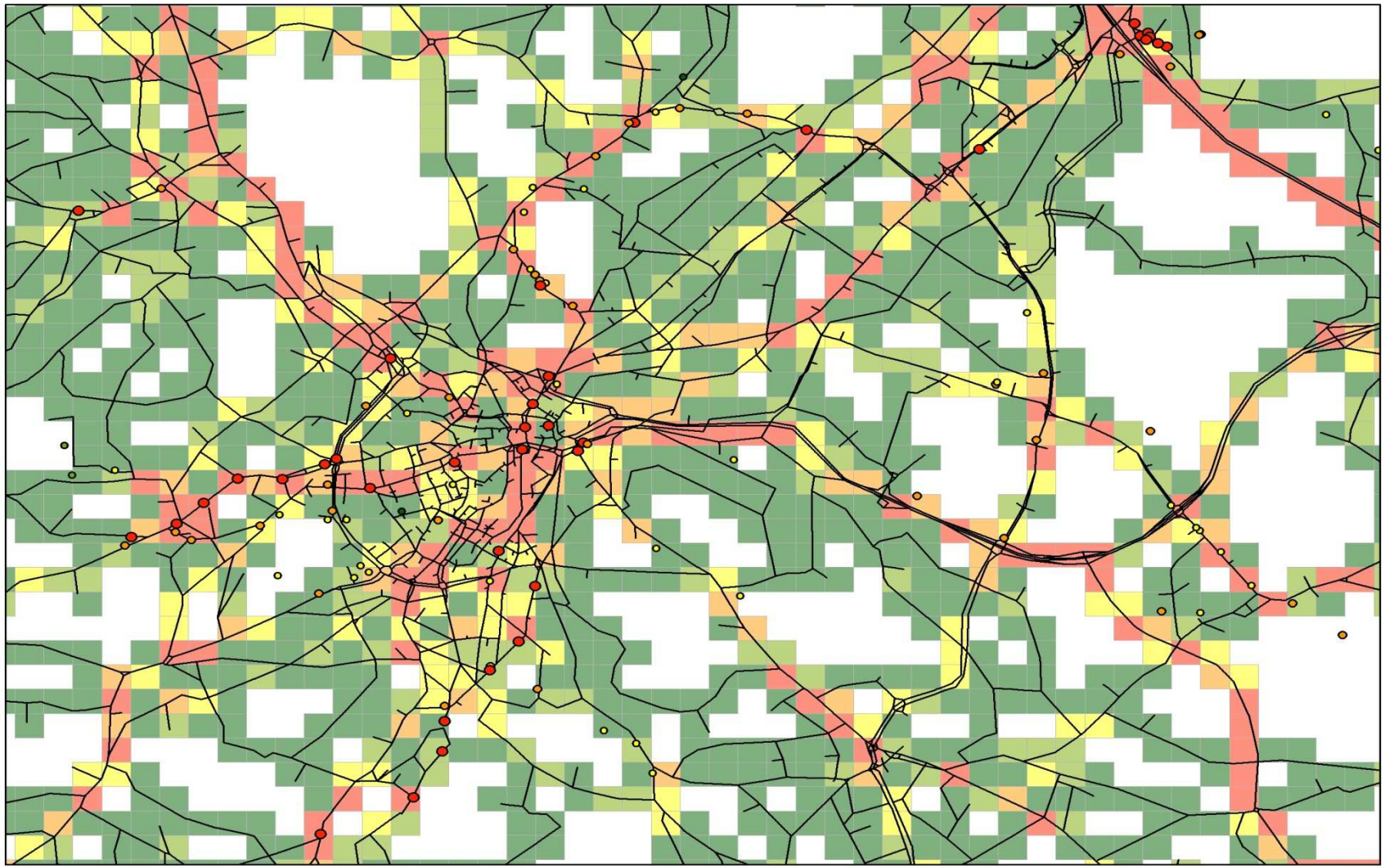
Observed NO_x Air Quality at 2008



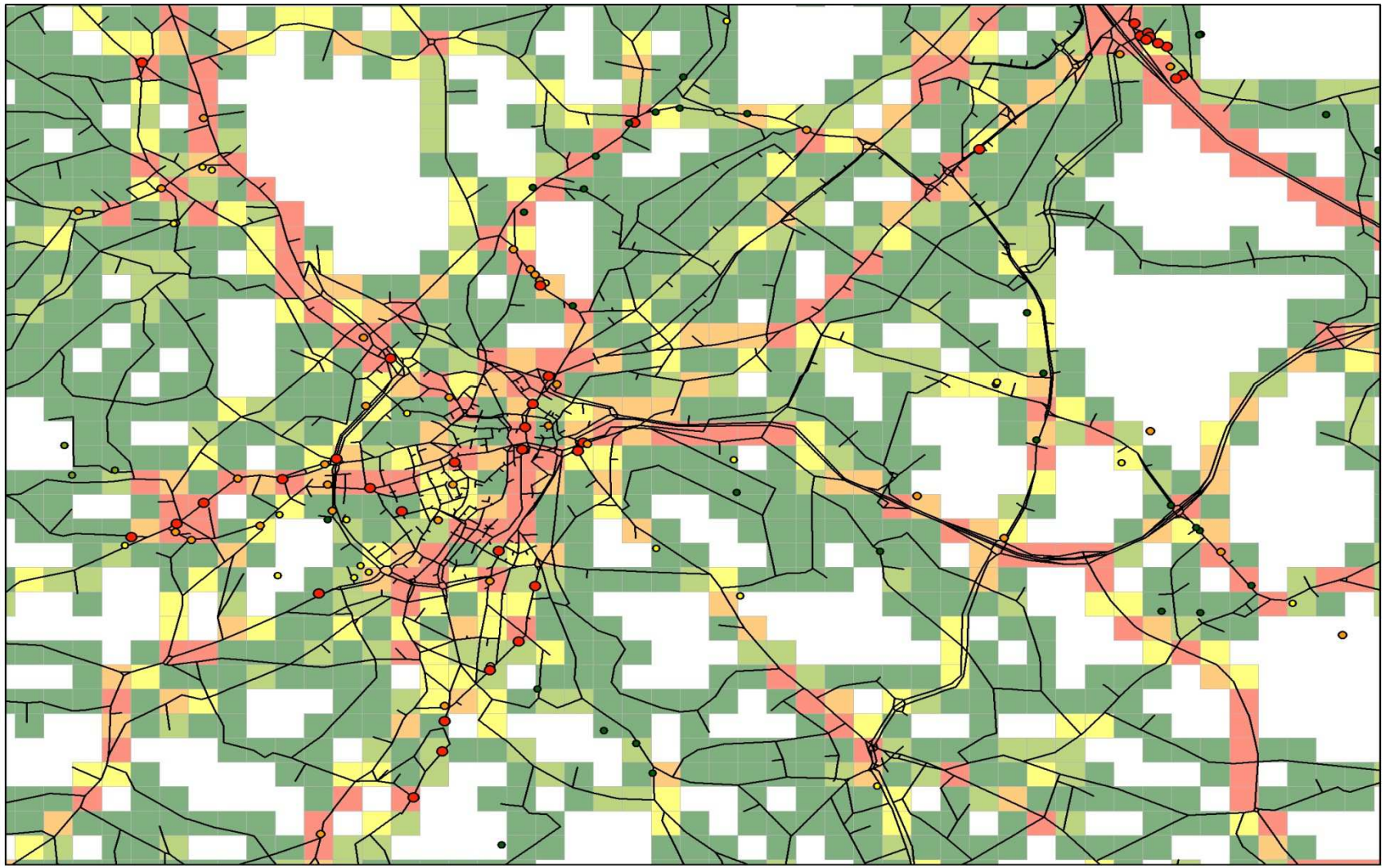
Observed NO_x Air Quality at 2011



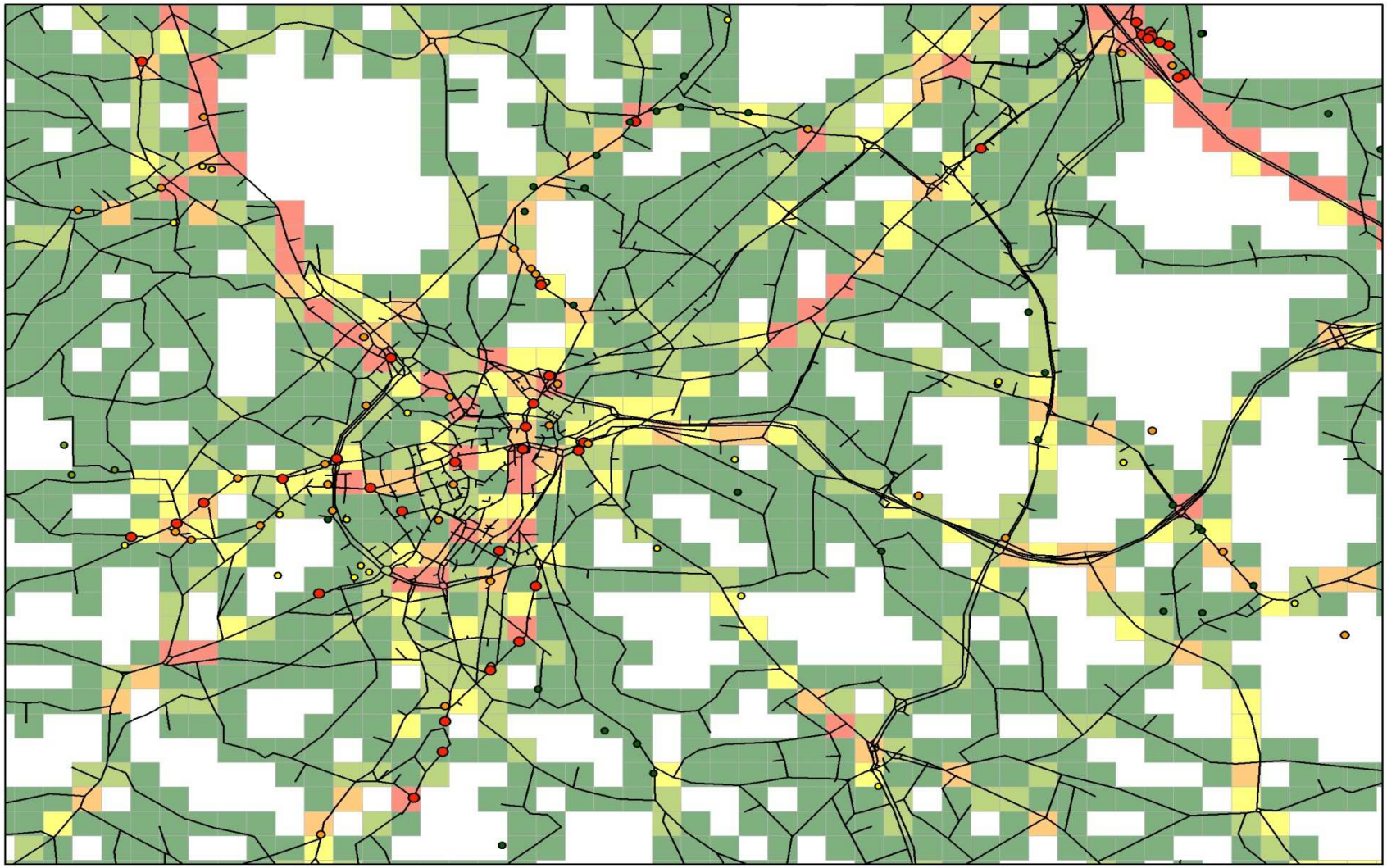
Comparison of Observed NO_x Air Quality at 2008 and Modelled NO_x Emissions at 2008



Comparison of Observed NO_x Air Quality at 2011 and Modelled NO_x Emissions at 2008



Comparison of Observed NO_x Air Quality at 2011 and Modelled NO_x Emissions at 2015



Analysis of Contributors to Emissions

- All forecasts use local fleet compositions
- COPERT NOx Function used in all cases
- Analysis of emissions on key links in problem areas

Wider Area Results

NO_x Emissions (tonnes) in Sheffield by Model User Class (excluding motorway)

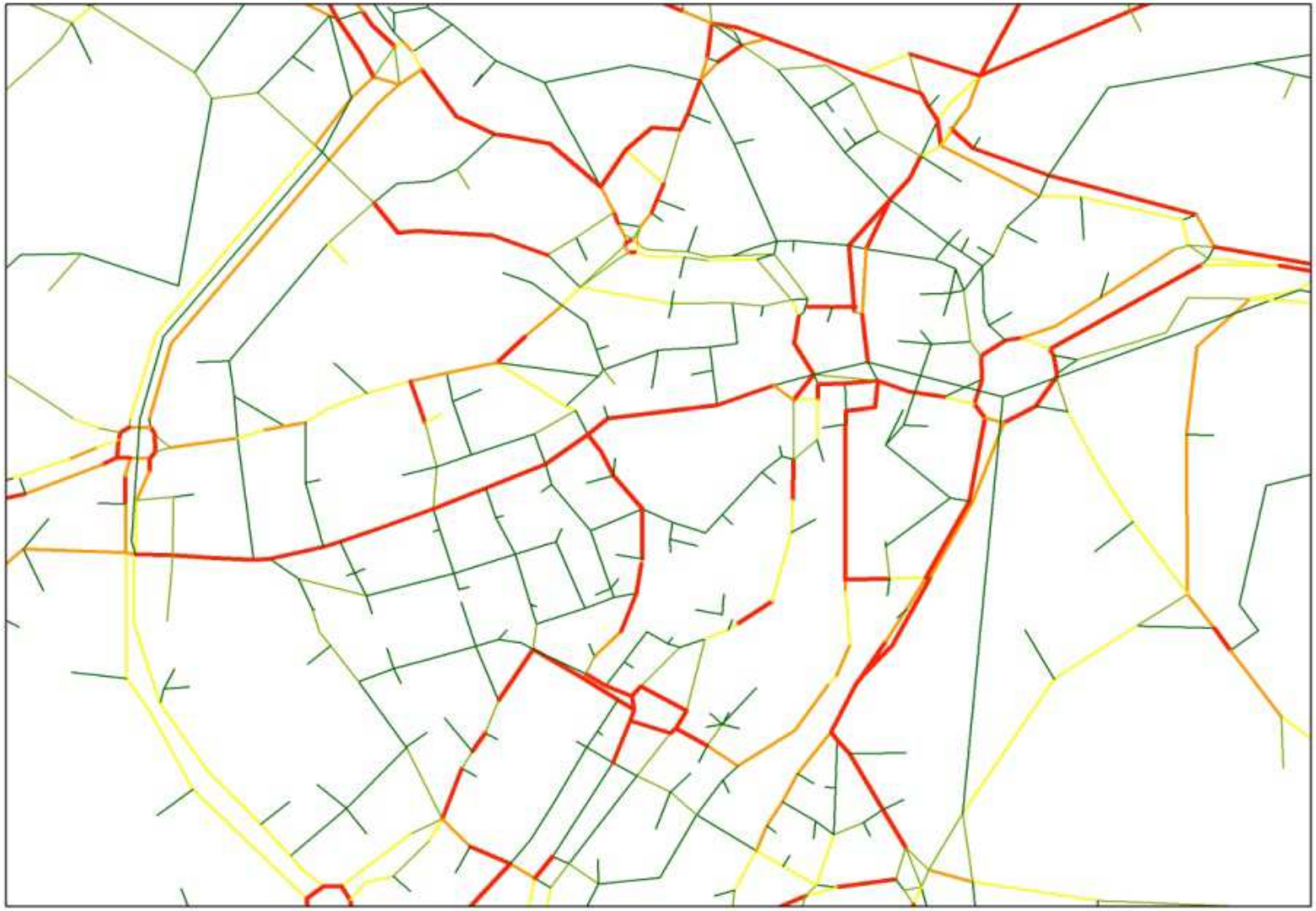
	All	Car	LGV	OGV	Bus
2008	1356.60	652.78	66.10	339.77	297.95
2015	945.24	398.41	62.61	266.82	217.39
% Change	-30.3%	-39.0%	-5.3%	-21.5%	-27.0%

City Centre Results

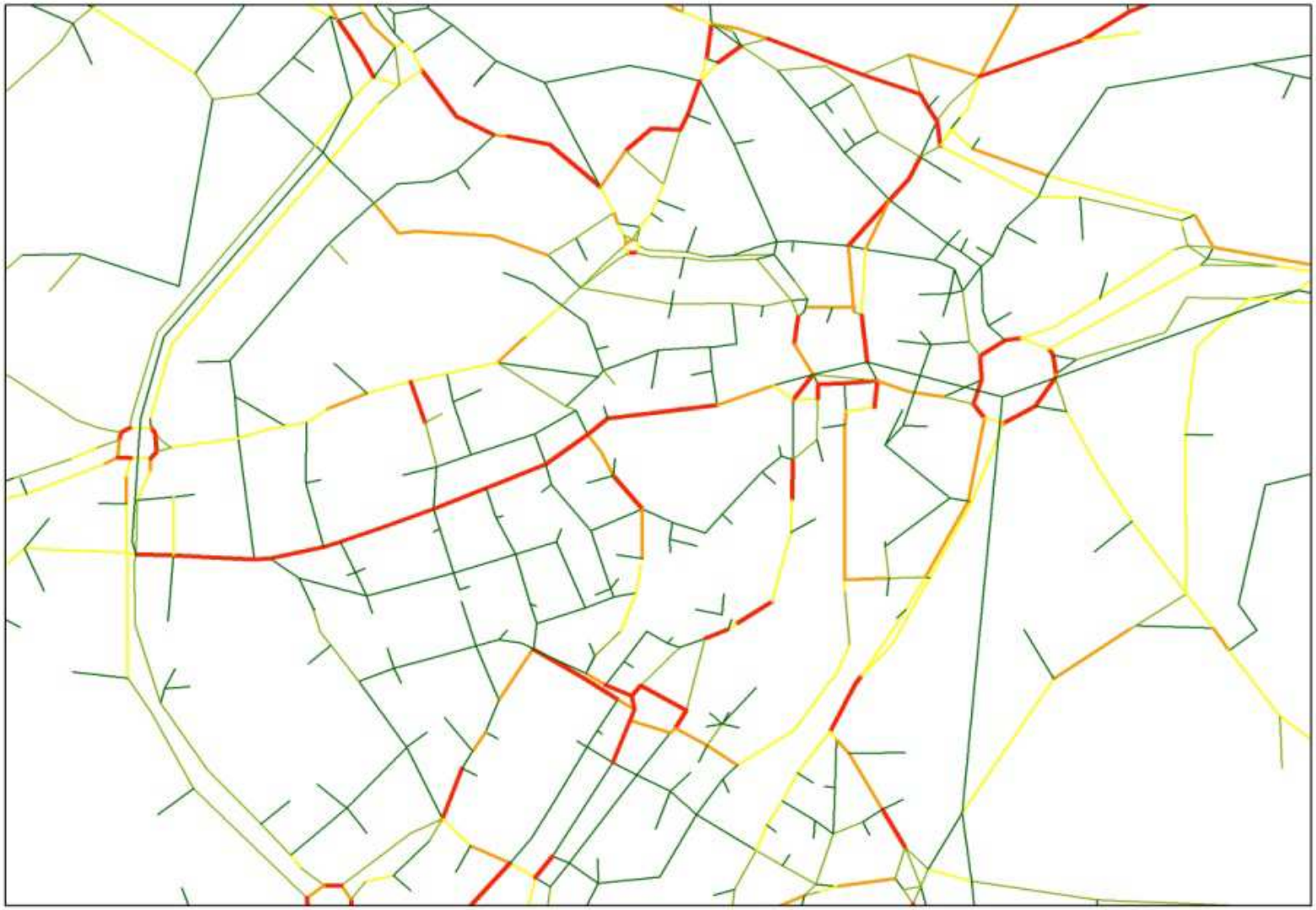
NO_x Emissions (tonnes) in City Centre Area by Model User Class

	All	Car	LGV	OGV	Bus
2008	192.64	76.98	8.64	32.47	74.55
2015	142.53	53.47	8.42	25.90	54.74
% Change	-26.0%	-30.5%	-2.5%	-20.2%	-26.6%

City Centre Emissions at 2008



City Centre Emissions at 2015



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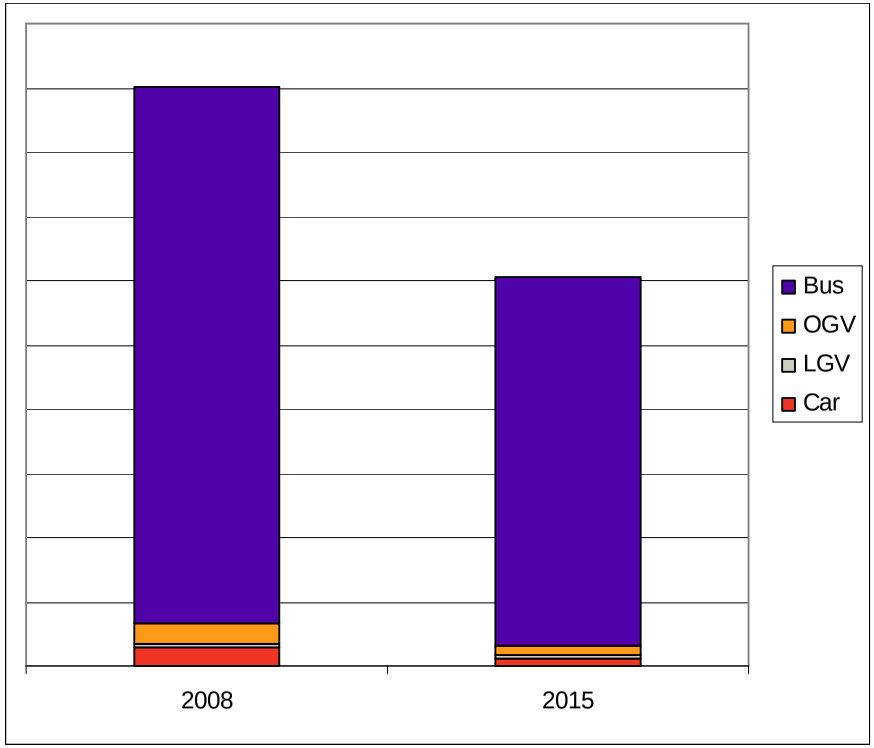
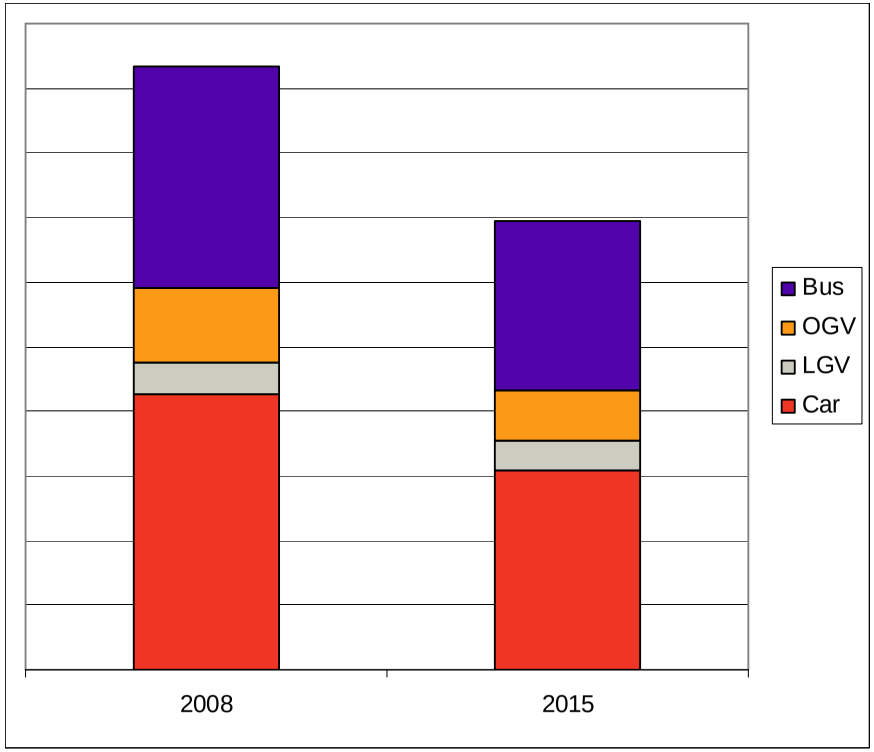
Proportions on Key Links – City Centre



West Street
(between Regent St and Mappin St)



A61
(Approach to Inner Ring Road)

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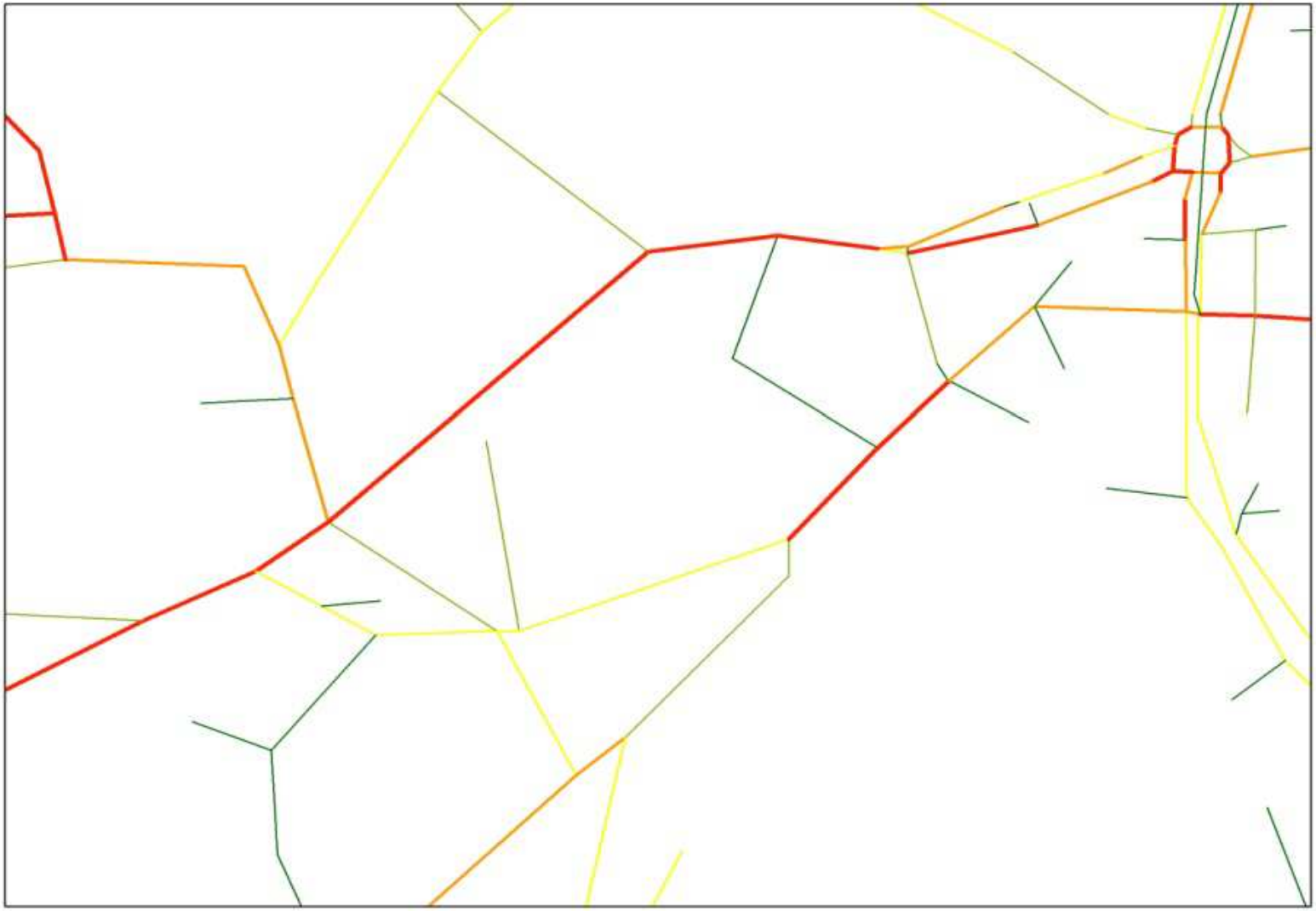
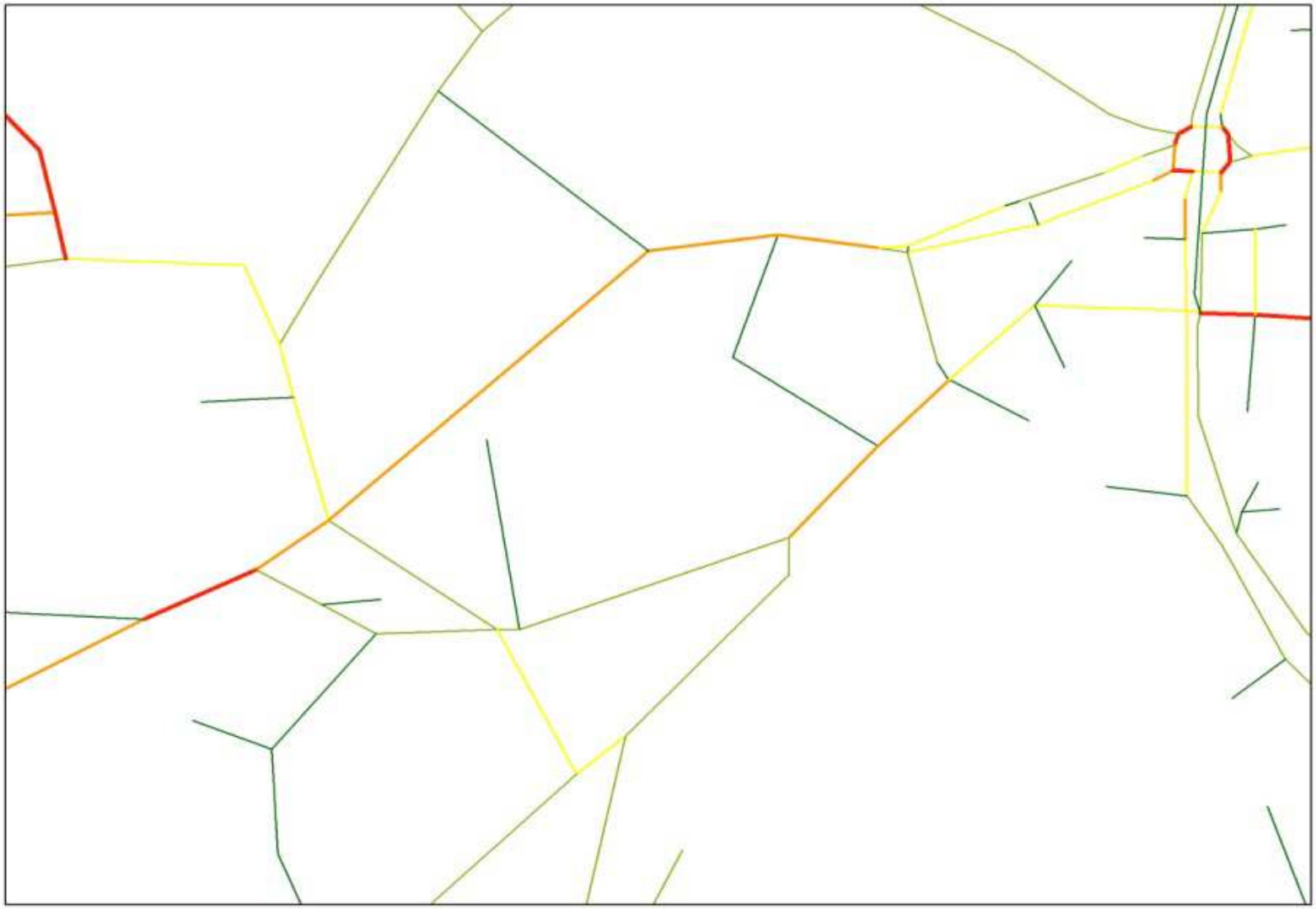
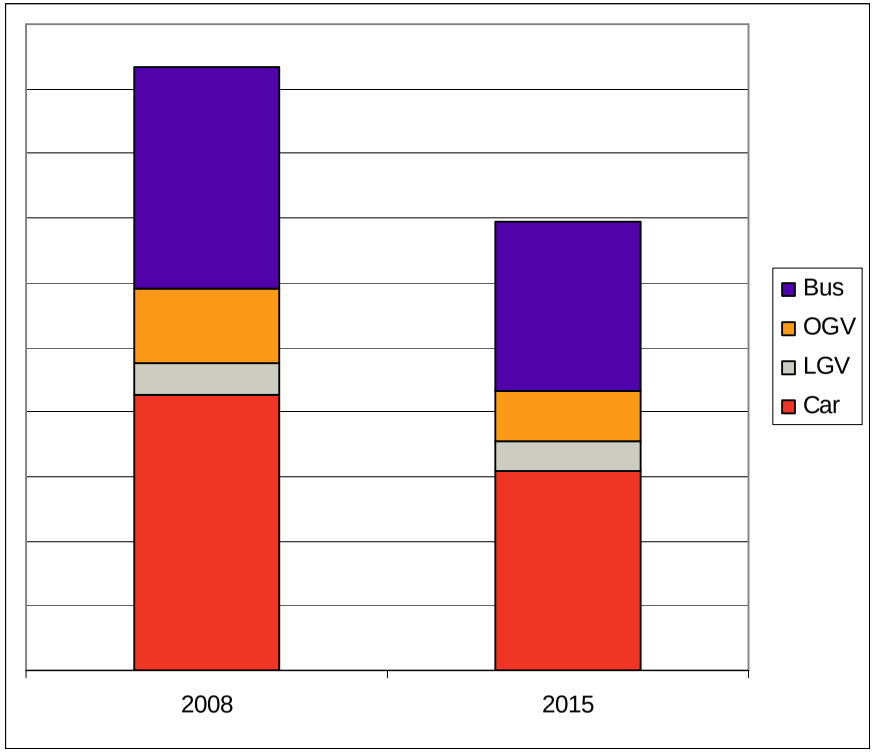
University / Broomhill Corridor Emissions at 2008



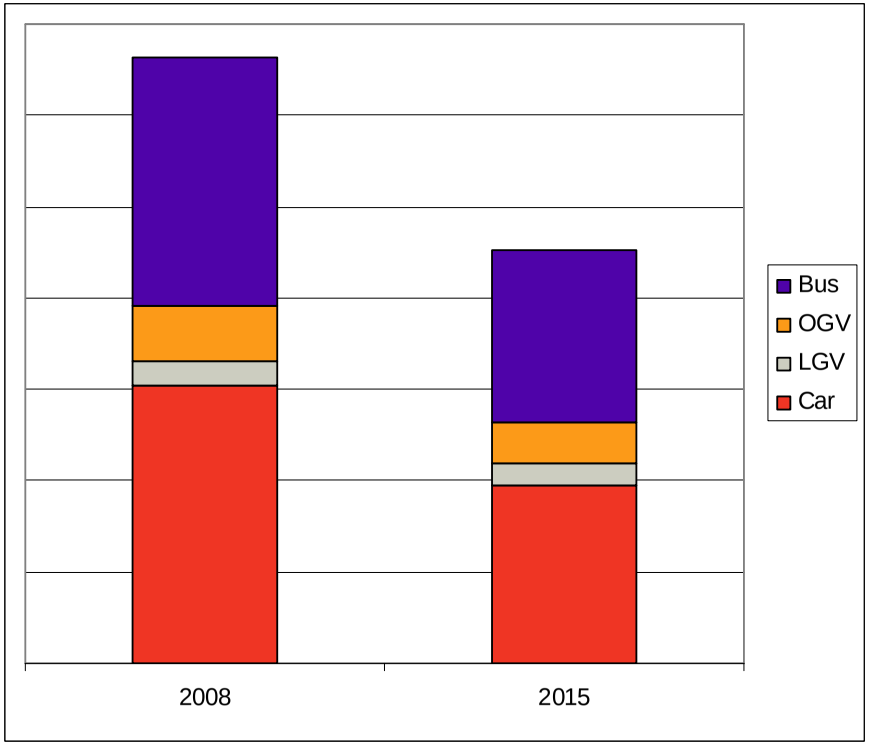
University / Broomhill Corridor Emissions at 2015



Proportions on Key Links – A57/Broomhill



Fulwood Road
(between Manchester Rd and Glossop Rd)



A57
(Whitham Rd, Broomhill)

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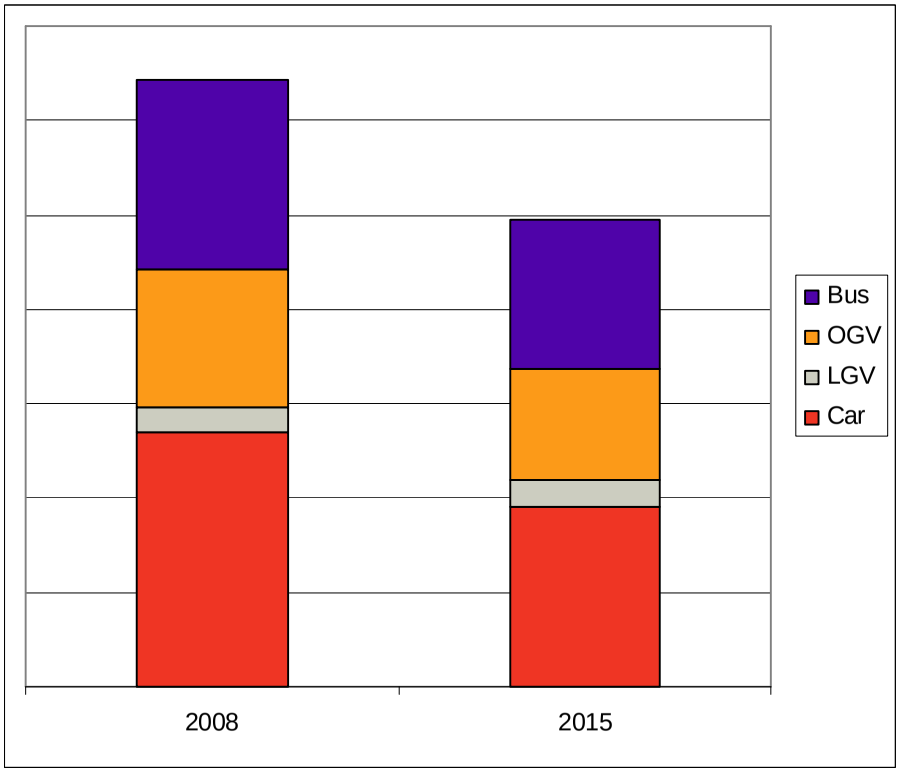
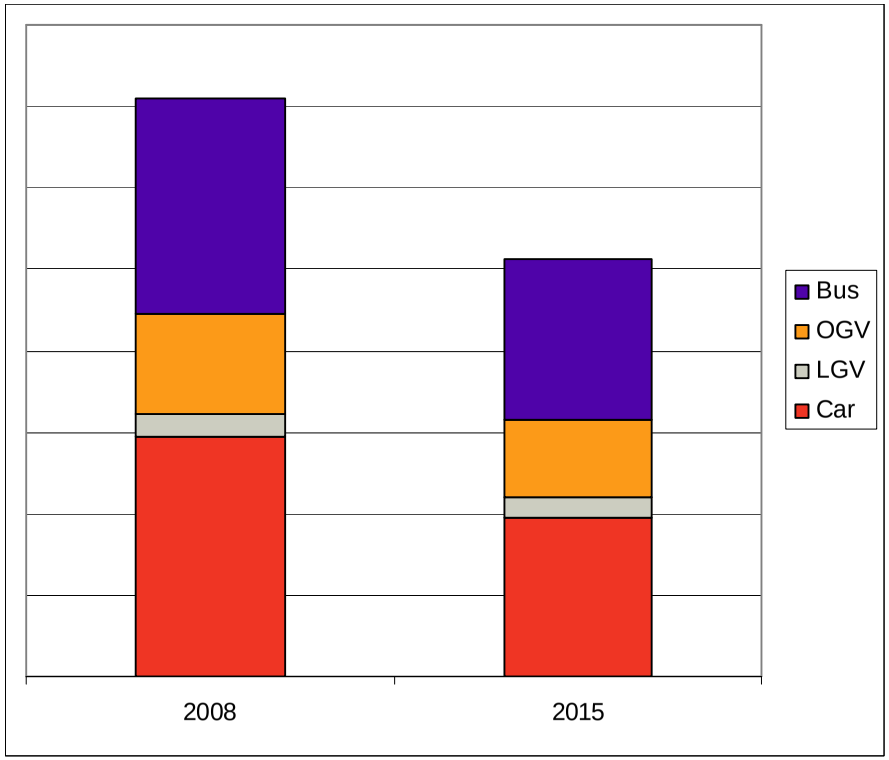
Abbeydale Road / London Road Corridor Emissions at 2008

Abbeydale Road / London Road Corridor Emissions at 2015

Proportions on Key Links – Abbeydale Road/London Road



Abbeydale Road
(South of Broadfield Rd)



Chesterfield Road
(South of Little London Rd)

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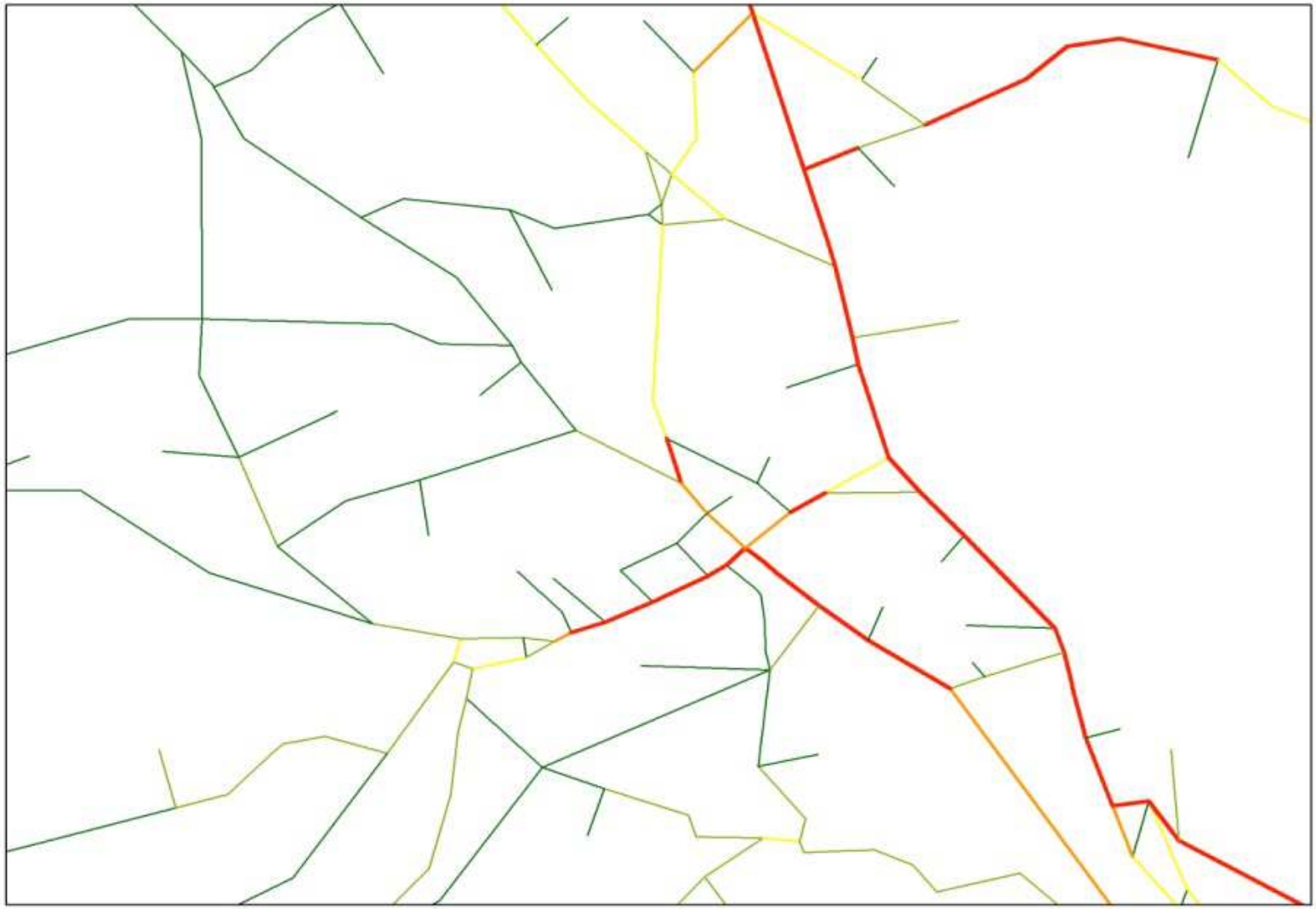
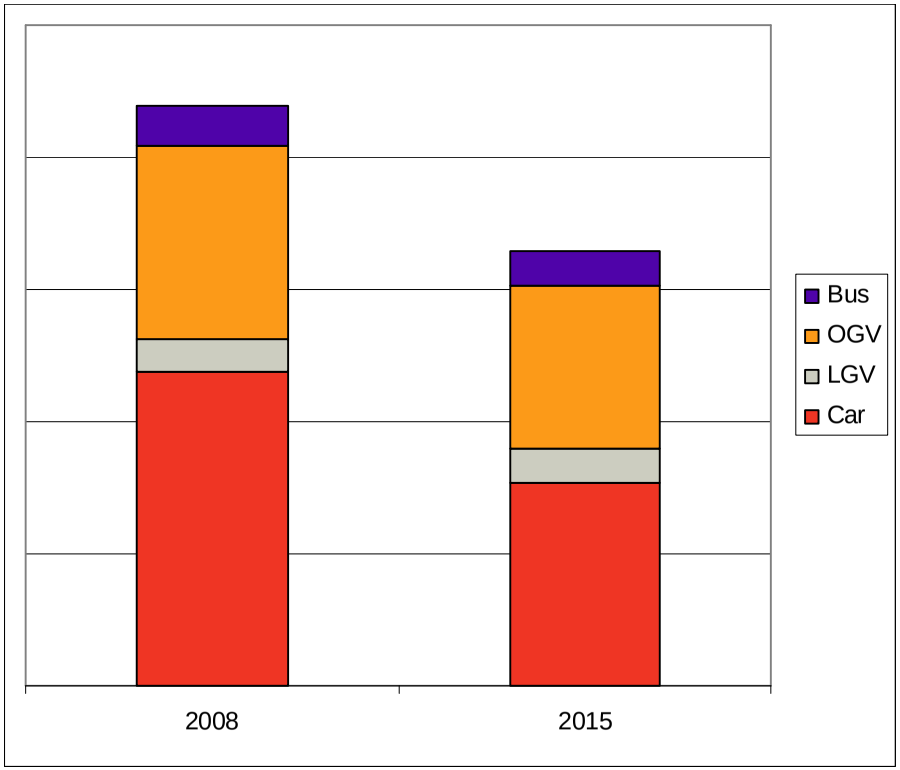
Penistone Road Corridor Emissions at 2008

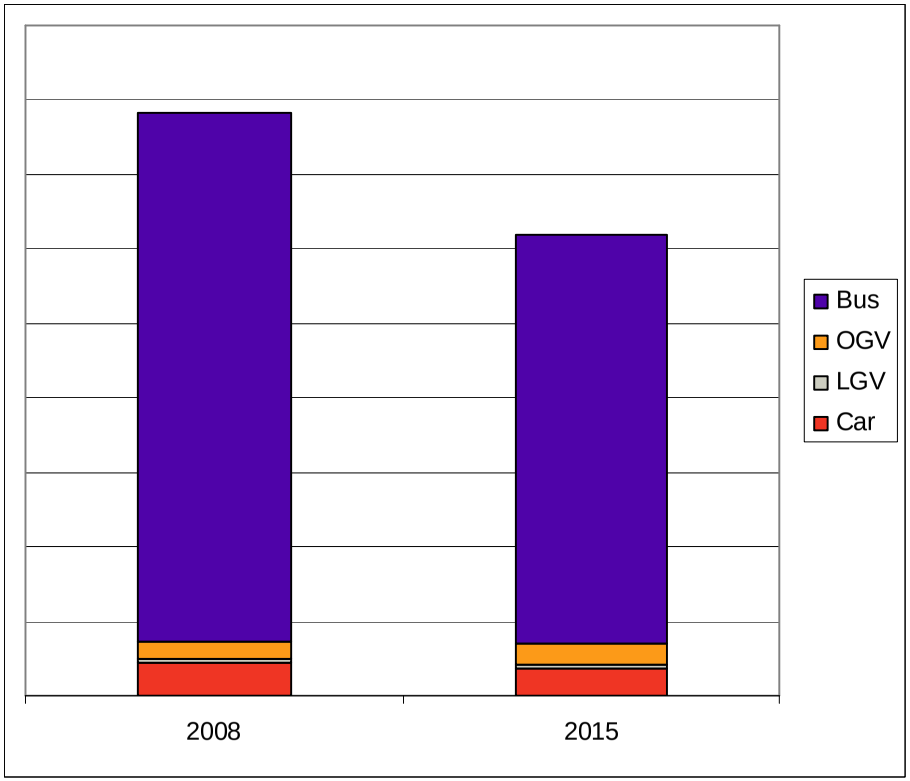
Penistone Road Corridor Emissions at 2015



Proportions on Key Links – Penistone Road/Hillsborough



Penistone Road
(South of Bamforth St)



Langsett Road
(South of Bamforth St)

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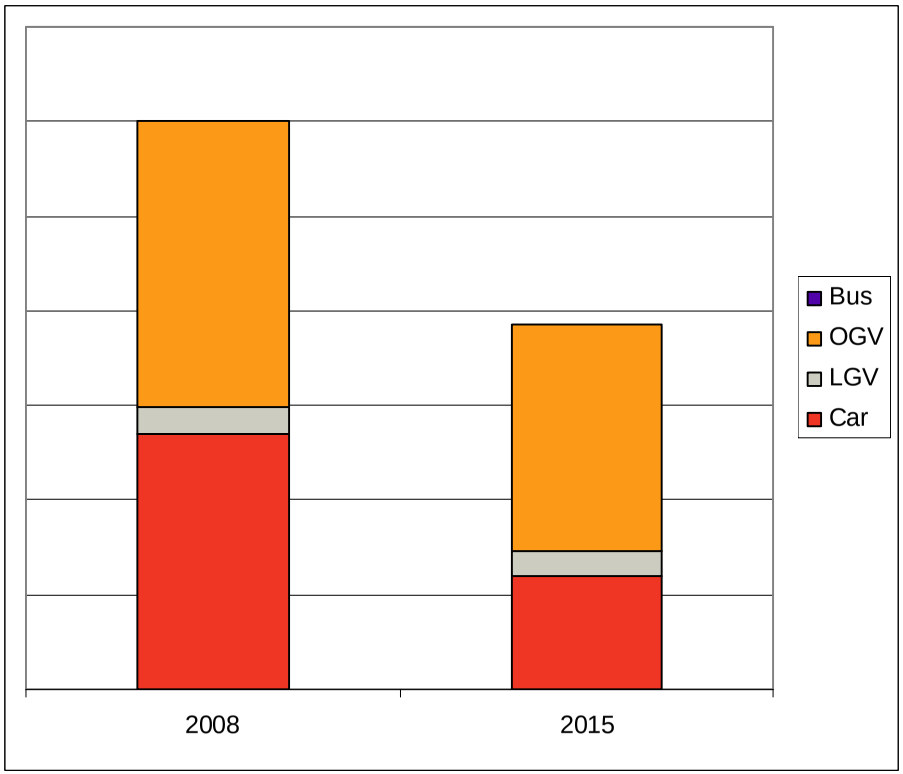
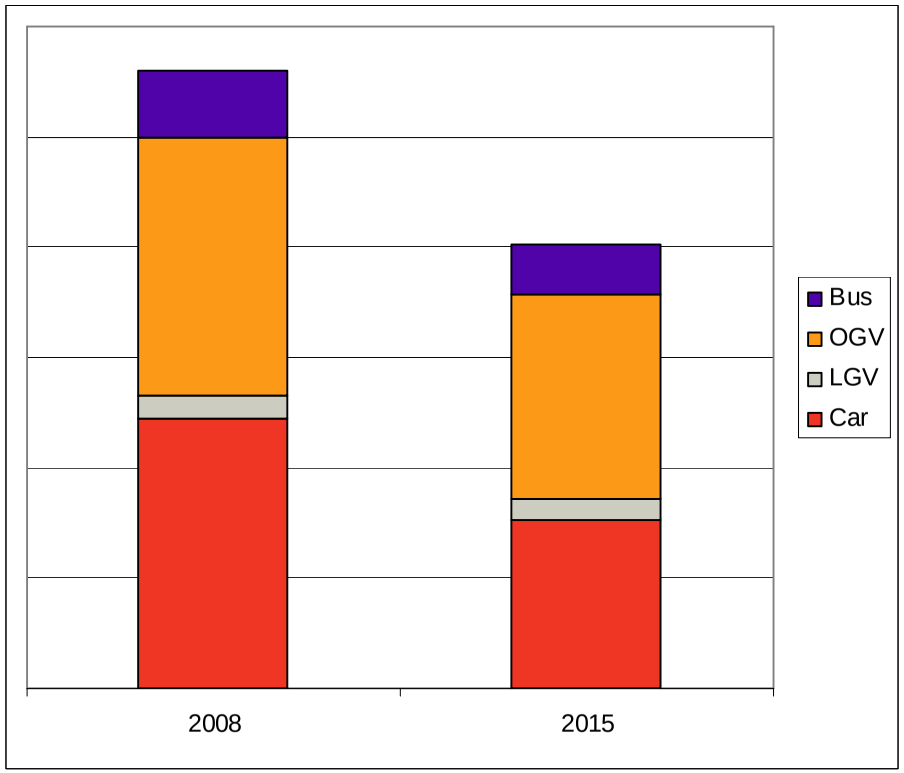
Emissions Close to the M1 Corridor at 2008

Emissions Close to the M1 Corridor at 2015

Proportions on Key Links – M1 Corridor



M1 Northbound
(Approach to J34)



Meadowhall Road
(Approach to M1 J34)

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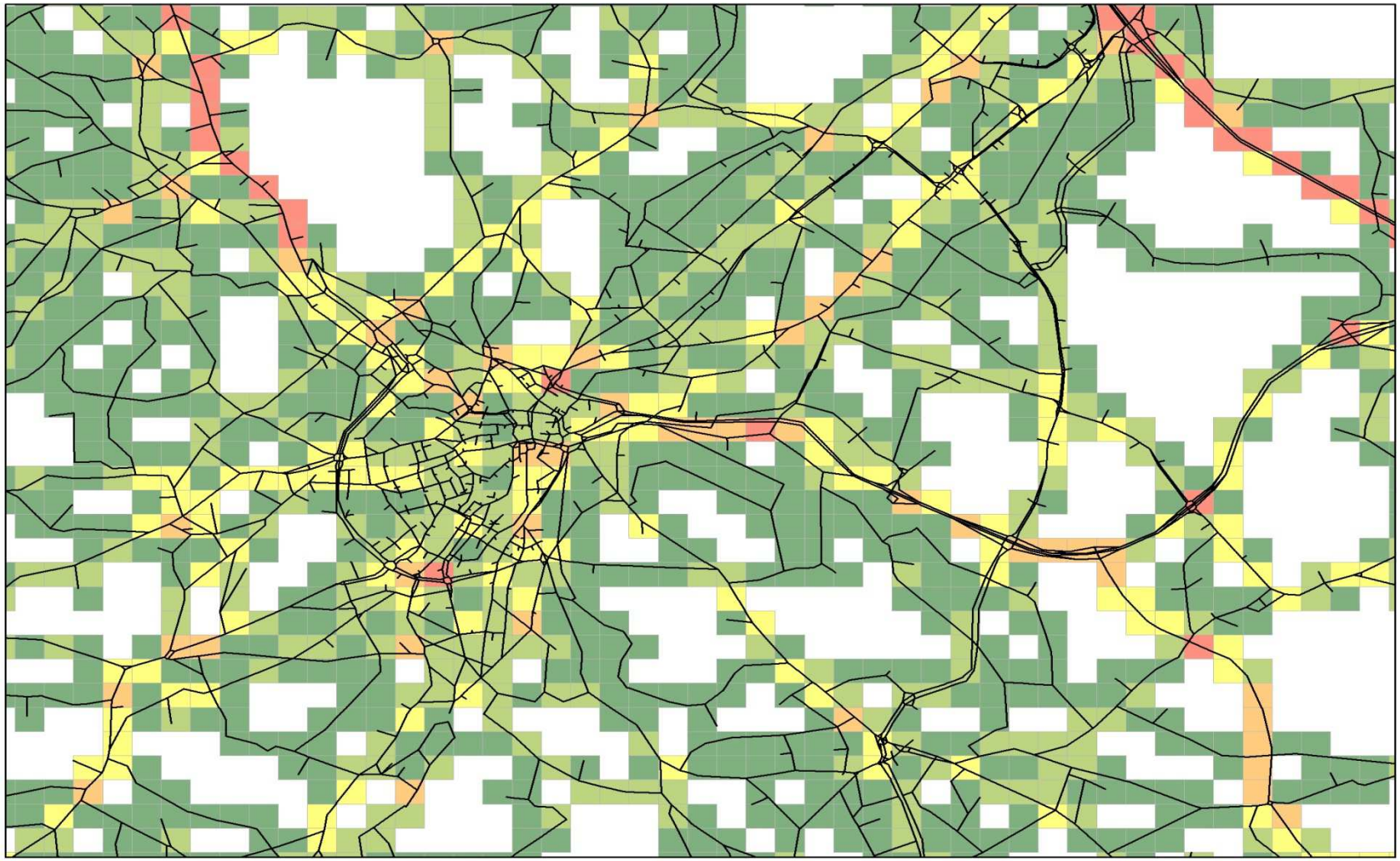
Conclusions from Analysis of Contributors to Emissions

- The main contributors to emissions vary by area
- LGV is not contributing significant amounts in any area, so any policy aimed at LGVs will have little impact
- Buses contributing significant amounts in the City Centre, through Hillsborough and on A57/Broomhill.
- HGV contributing significant amounts towards the M1 and on Penistone Road
- Car contributing significant amounts in all areas

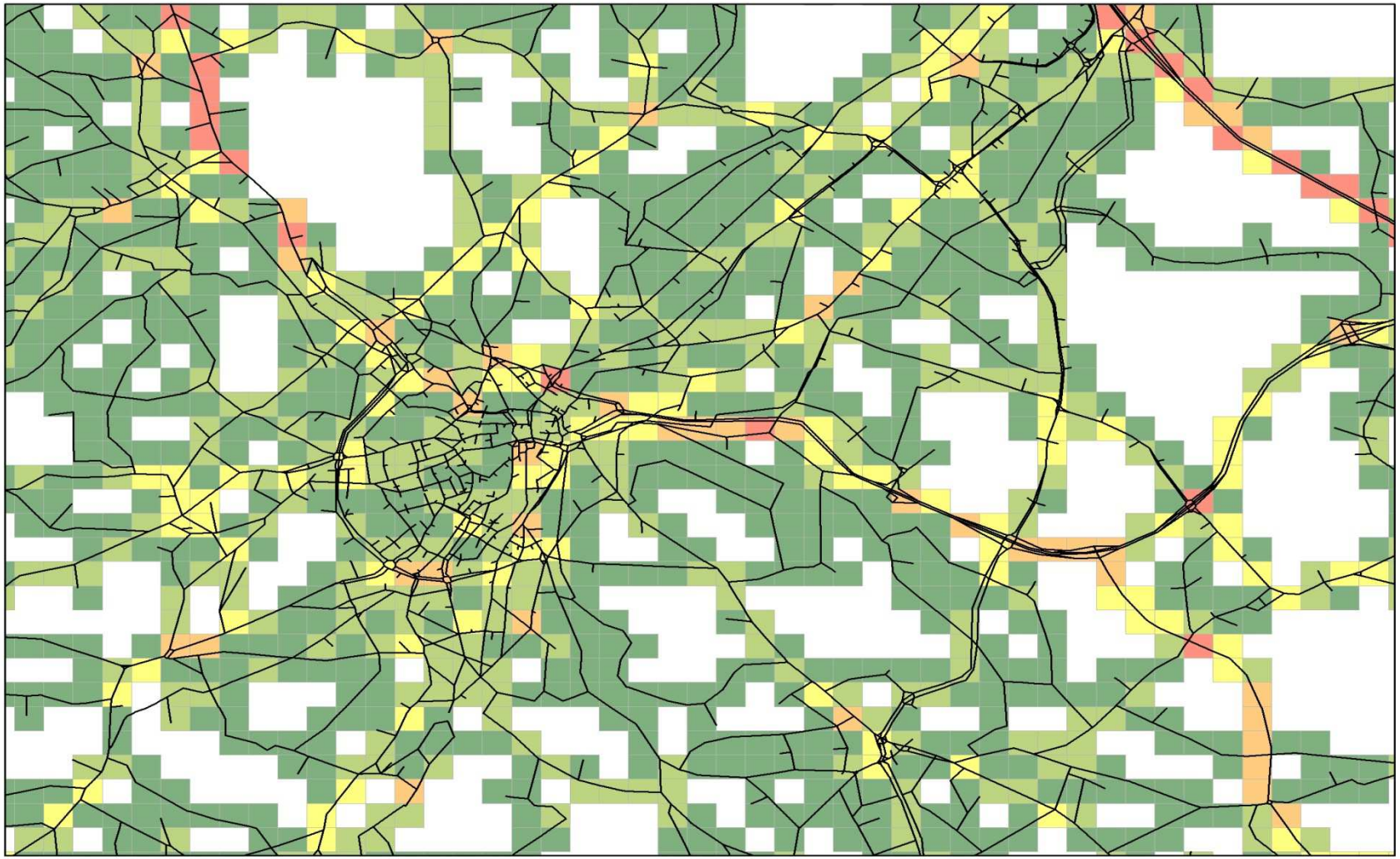
PM_{10} and Carbon Emissions

- We currently do not have any observed data for PM_{10} or Carbon
- The plots give an indication of which areas have high levels of tail pipe emissions. The range has not been calibrated against observed data.
- The tables show the change (% and absolute) between 2008 and 2015 for both PM_{10} and Carbon.

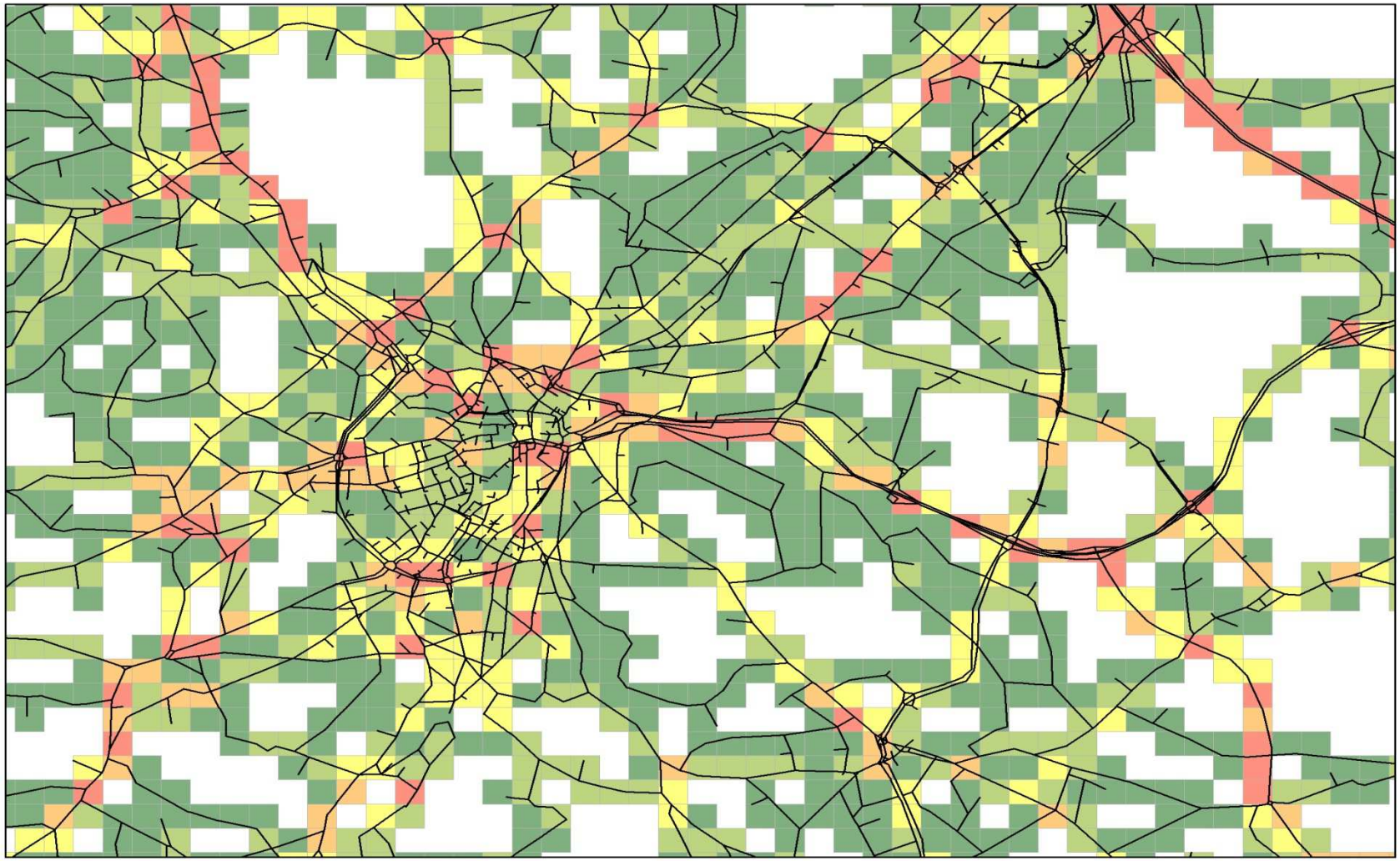
PM10 Emissions at 2008



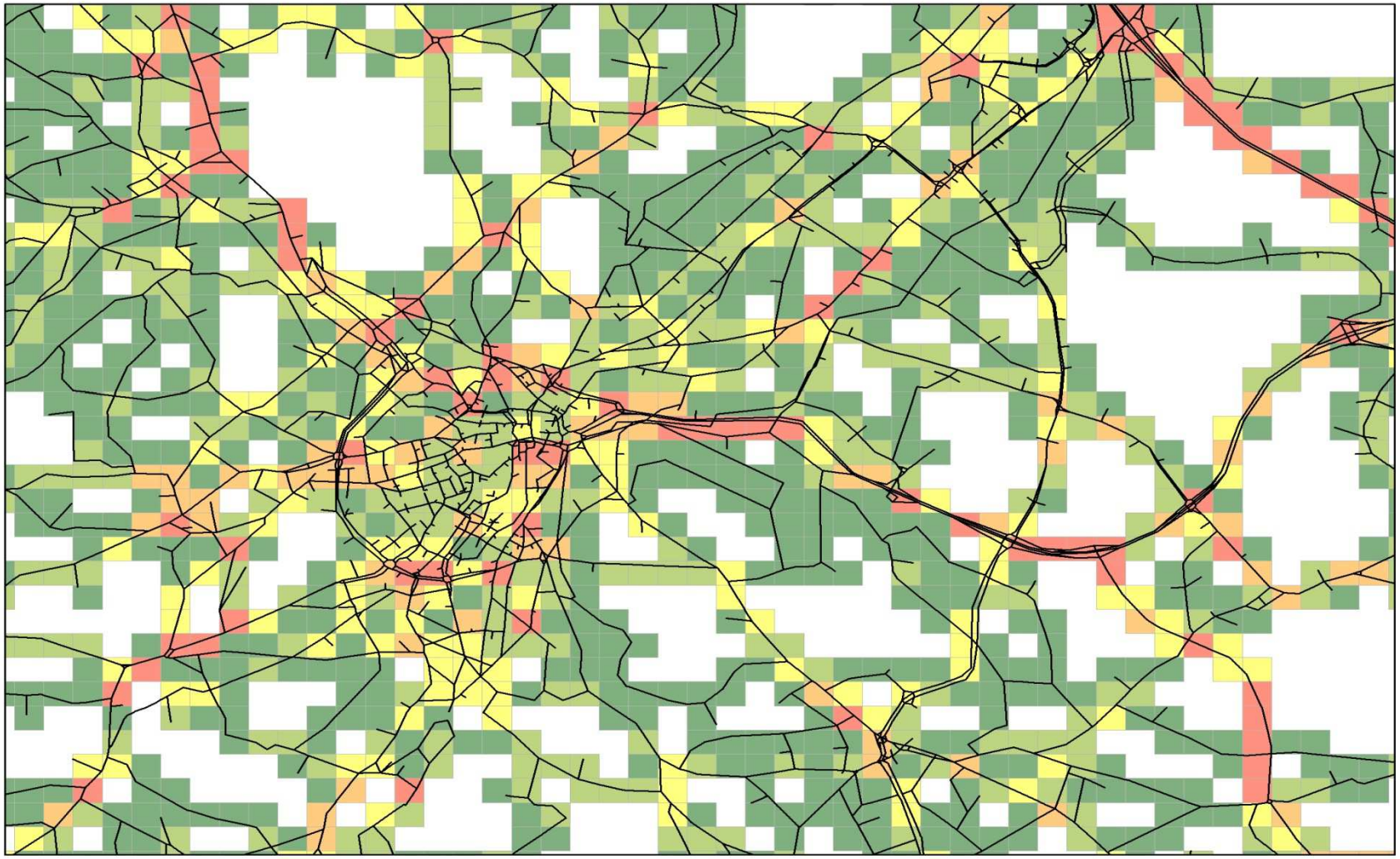
PM10 Emissions at 2015



Carbon Emissions at 2008



Carbon Emissions at 2015



Results for other Emissions

Other Emissions in the Sheffield Area (excluding motorway)

	PM_{10} (tonnes)	Carbon (tonnes from CO_2)
2008	67.87	87,455.09
2015	62.78	87,169.96
% Change	-7.5%	-0.3%

Sheffield City Council gratefully acknowledge the support provided by the Department for Environment Food and Rural Affairs in advancing this important project