

An aerial photograph of a city, likely Thessaloniki, showing a dense urban landscape with numerous buildings and a prominent church spire. The city is set against a backdrop of mountains under a cloudy sky. The text is overlaid in red on the top half of the image.

**20th Joint EIONET & UNECE
Task Force on Emission Inventories & Projections Meeting
Thessaloniki, 13th-15th May 2019**

Quantification of emissions from domestic and service sectors in cities

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ClairCity overall objective

- ◆ *ClairCity is aimed at creating a major shift in public understanding towards the causes of poor air quality, inviting citizens to give their opinions on air pollution and carbon reduction to shape the cities of the future*
- ◆ *ClairCity will integrate and quantify citizens' behaviour and activities to enrich city, national and EU level policy-making, resulting in improved air quality, reduced carbon emissions, improved public health outcomes and greater citizen awareness*

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ClairCity Consortium



1. **Trinomics B.V. (Project Coordinator – Netherlands)**
2. **University of the West of England, Bristol (Technical Lead – UK)**
3. **PBL Netherlands Environmental Assessment Agency (NL)**
4. **Statistics Netherlands CBS (Netherlands)**
5. **Technical University of Denmark (Denmark)**
6. **Norwegian Institute for Air Research (Norway)**
7. **REC Regional Environmental Centre (Hungary)**
8. **TECHNE Consulting (Italy)**
9. **Transport & Mobility Leuven (Belgium)**
10. **University of Aveiro (Portugal)**
11. **Municipality of Amsterdam (Netherlands)**
12. **Bristol City Council (UK)**
13. **Intermunicipal Community of Aveiro Region (Portugal)**
14. **Liguria Region (Italy)**
15. **Municipality of Ljubljana (Slovenia)**
16. **Sosnowiec City Council (Poland)**

ClairCity objectives

The overall objective will be achieved by through the following sub-objectives regarding behaviour and policy, technical tool development, and dissemination and impact:

- ◆ *Putting citizens behaviour and practices at the heart of the debate on air quality and carbon management*
- ◆ *Develop a suite of innovative toolkits for enhanced quantification, engagement and impact evaluation.*
- ◆ *Integrate citizens behaviour in city policies and ensure that future city policies are reflective of citizen's visions for their future city*
- ◆ *Raise awareness of environment changes and their solutions*

ClairCity main activities

- **Through an innovative engagement and quantification toolkit, Clair-City will stimulate the public engagement necessary to allow citizens to define a range of future city scenarios for reducing their emissions to be used for supporting and informing the development of bespoke city policy packages out to 2050**
- **ClairCity will apportion air pollution emissions and concentrations, carbon footprints and health outcomes by city citizens' behaviour and day-to-day activities in order to make these challenges relevant to how people chose to live, behave and interact within their city environment**
- **ClairCity will use six pilot cities/regions**

Domestic and service sectors modeling approach

➤ Activity data

- are collected at most detailed available statistical administrative level (National, Level 0, Level 1, Level 2)
- are evaluated at most detailed available statistical administrative level (Level 2)

➤ Emissions

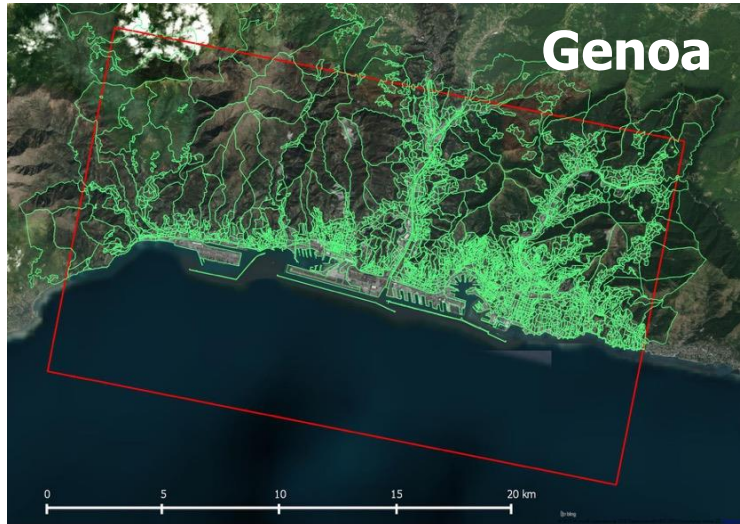
- are allocated inside the 0.25 (D2) and 0.05° (D3) model domains defined for modeling purpose
- are allocated to domains grids with land use maps
- are evaluated at hourly level with proxy variables

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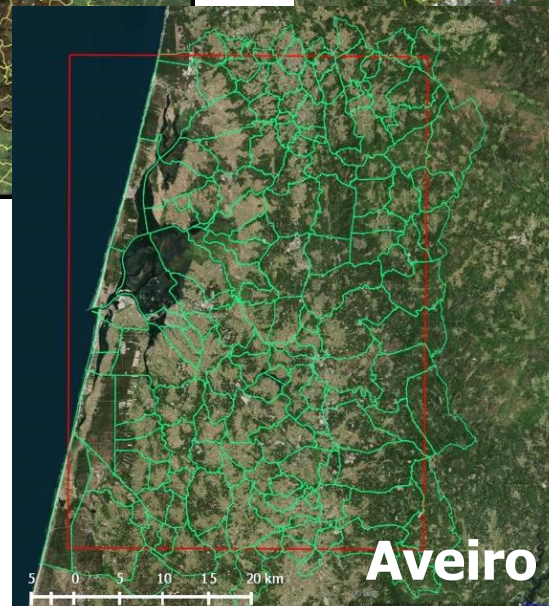
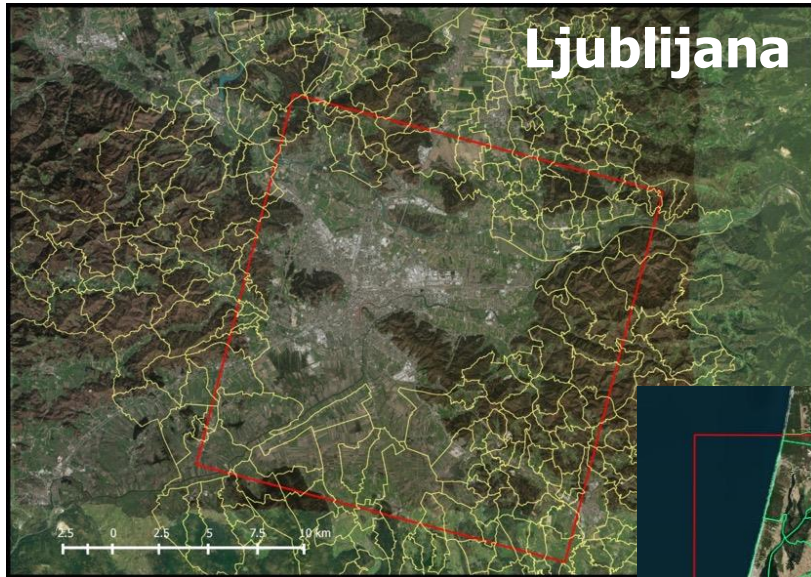
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Level 2 – Emission estimate domains



Level 2 – Emission estimate domains



Modeling approach – Allocation to level 2 of data at level 0 or 1

When data are available only in aggregate figures (level 0 or 1) it is allocated to level 2 using a “proxy” variable available at level 2:

$$A^{L2}_i = A^{L0}_j * P^{L2}_i / \sum_i P^{L2}_i$$

where: A^{L2}_i P^{L2}_i are the indicator of the activity A and the proxy variable P in the level 2 territorial unit **i**, and A^{L0}_j is the indicator of the activity A in the level 0 territorial unit **j**

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Modeling approach - Residential, commercial and institutional sector

Example of administrative levels (Bristol):

- Level 0 – Local Authority (LA)
- Level 1 - Middle Layer Super Output Area (MSOA)
- Level 2 - Lower Layer Super Output Area (LSOA)

Local Authority Name	Local Authority Code	Middle Layer Super Output Area (MSOA) Name	Middle Layer Super Output Area (MSOA) Code	Lower Layer Super Output Area (LSOA) Name	Lower Layer Super Output Area (LSOA) Code
Bristol, City of	E06000023	Bristol 001	E02003012	Bristol 001A	E01014601
Bristol, City of	E06000023	Bristol 001	E02003012	Bristol 001B	E01014602
Bristol, City of	E06000023	Bristol 001	E02003012	Bristol 001C	E01014603
Bristol, City of	E06000023	Bristol 001	E02003012	Bristol 001E	E01014605
Bristol, City of	E06000023	Bristol 001	E02003012	Bristol 001G	E01032516
Bristol, City of	E06000023	Bristol 001	E02003012	Bristol 001H	E01032517
Bristol, City of	E06000023	Bristol 002	E02003013	Bristol 002A	E01014688
Bristol, City of	E06000023	Bristol 002	E02003013	Bristol 002B	E01014689
Bristol, City of	E06000023	Bristol 002	E02003013	Bristol 002C	E01014690
Bristol, City of	E06000023	Bristol 002	E02003013	Bristol 002D	E01014691
Bristol, City of	E06000023	Bristol 002	E02003013	Bristol 002E	E01014692
Bristol, City of	E06000023	Bristol 002	E02003013	Bristol 002F	E01014693
Bristol, City of	E06000023	Bristol 002	E02003013	Bristol 002G	E01014694

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Bristol Case study 1 – Residential gas consumptions data on level 2 (LSOA)

Local Authority Name	Local Authority Code	MSOA Name	Middle Layer Super Output Area (MSOA) Code	LSOA Name	Lower Layer Super Output Area (LSOA) Code	Consumption (kWh)
Bristol, City of	E06000023	Bristol 023	E02003034	Bristol 023A	E01014485	7.992.285
Bristol, City of	E06000023	Bristol 023	E02003034	Bristol 023B	E01014486	9.963.204
Bristol, City of	E06000023	Bristol 020	E02003031	Bristol 020A	E01014487	9.941.263
Bristol, City of	E06000023	Bristol 023	E02003034	Bristol 023C	E01014488	9.526.553
Bristol, City of	E06000023	Bristol 023	E02003034	Bristol 023D	E01014489	9.668.973
Bristol, City of	E06000023	Bristol 020	E02003031	Bristol 020B	E01014491	9.331.791
Bristol, City of	E06000023	Bristol 008	E02003019	Bristol 008A	E01014492	6.023.575
Bristol, City of	E06000023	Bristol 008	E02003019	Bristol 008B	E01014493	6.065.267
Bristol, City of	E06000023	Bristol 008	E02003019	Bristol 008C	E01014494	6.831.767
Bristol, City of	E06000023	Bristol 008	E02003019	Bristol 008D	E01014495	7.238.350
Bristol, City of	E06000023	Bristol 008	E02003019	Bristol 008E	E01014496	8.803.990
Bristol, City of	E06000023	Bristol 003	E02003014	Bristol 003A	E01014497	6.772.083
Bristol, City of	E06000023	Bristol 003	E02003014	Bristol 003B	E01014498	7.368.124
Bristol, City of	E06000023	Bristol 008	E02003019	Bristol 008F	E01014499	6.624.754
Bristol, City of	E06000023	Bristol 039	E02003050	Bristol 039A	E01014500	7.789.649
Bristol, City of	E06000023	Bristol 041	E02003052	Bristol 041A	E01014501	8.732.066
Bristol, City of	E06000023	Bristol 039	E02003050	Bristol 039B	E01014502	7.306.783
Bristol, City of	E06000023	Bristol 041	E02003052	Bristol 041B	E01014504	7.272.162
Bristol, City of	E06000023	Bristol 041	E02003052	Bristol 041C	E01014505	8.051.090
Bristol, City of	E06000023	Bristol 041	E02003052	Bristol 041D	E01014506	8.224.661
Bristol, City of	E06000023	Bristol 016	E02003027	Bristol 016A	E01014507	8.161.559
Bristol, City of	E06000023	Bristol 016	E02003027	Bristol 016B	E01014508	8.034.177
Bristol, City of	E06000023	Bristol 016	E02003027	Bristol 016C	E01014509	8.370.226
Bristol, City of	E06000023	Bristol 010	E02003021	Bristol 010A	E01014510	8.841.942
Bristol, City of	E06000023	Bristol 016	E02003027	Bristol 016D	E01014511	6.694.163
Bristol, City of	E06000023	Bristol 016	E02003027	Bristol 016E	E01014512	8.414.278

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Bristol Case study 2 –residential gasoil consumptions at level 0 allocated to level 2 using census dwellings number

Sub-national estimates of non-gas, non-electricity and non-road transport fuels in 2015										Thousand tonnes of oil equivalent (ktoe)			
LA Code ¹	LAU1 Areas	Petroleum						Coal	Manufactured Solid Fuels	Bioenergy & Wastes ⁴	All Fuels		
		Industrial	Domestic	Rail	Public Administration	Commercial	Other						
W06000019	Blaenau Gwent	3,8	0,4	0,1	0,0	0,0							10,7
W06000013	Bridgend	8,9	1,7	2,0	0,0	0,1							43,0
W06000018	Caerphilly	11,7	1,5	1,3	0,0	0,1							33,0
W06000015	Cardiff	8,5	1,1	2,9	0,1	0,3	0,7	2,7	1,1	11,3	0,9	12,3	41,9
W06000010	Cardiffmarthenshire	18,0	39,1	1,5	0,1	0,6	28,5	5,0	6,4	5,1	3,0	14,3	121,6
W06000008	Ceredigion	16,0	24,4	0,8	0,1	0,4	18,2	1,8	3,6	0,0	1,7	7,3	74,2
W06000003	Conwy	6,5	7,5	1,1	0,1	0,1	4,6	1,7	1,9	0,0	1,0	7,4	31,8

LA level consumptions

CDU_ID	GEO_CODE	GEO_LABEL	GEO_TYPE	GEO_TYP2	F1386
18373	95AA01S1	Aldergrove_1	LowerSuperOutputAreasandDataZones	LSOAZ	368
18374	95AA01S2	Aldergrove_2	LowerSuperOutputAreasandDataZones	LSOAZ	652
18375	95AA01S3	Aldergrove_3	LowerSuperOutputAreasandDataZones	LSOAZ	633
18376	95AA02W1	Bally	LowerSuperOutputAreasandDataZones	LSOAZ	929
18377	95AA03W1	Bally	LowerSuperOutputAreasandDataZones	LSOAZ	880
18378	95AA04W1	Clad	LowerSuperOutputAreasandDataZones	LSOAZ	1061
18379	95AA05W1	Cranfield	LowerSuperOutputAreasandDataZones	LSOAZ	960
18380	95AA06S1	Crumlin_1_Antrim	LowerSuperOutputAreasandDataZones	LSOAZ	741
18381	95AA06S2	Crumlin_2_Antrim	LowerSuperOutputAreasandDataZones	LSOAZ	888

LSOA dwelling

lancode	lsoacode	lsoa	LSOA_VAL
E06000019	E01013986	Herefordshire012A	27
E06000019	E01013987	Herefordshire011A	25
E06000019	E01013988	Herefordshire011B	34
E06000019	E01013989	Herefordshire012B	21
E06000019	E01013990	Herefordshire018A	29
E06000019	E01013991	Herefordshire018B	20
			22
			22
			23

LSOA level consumptions

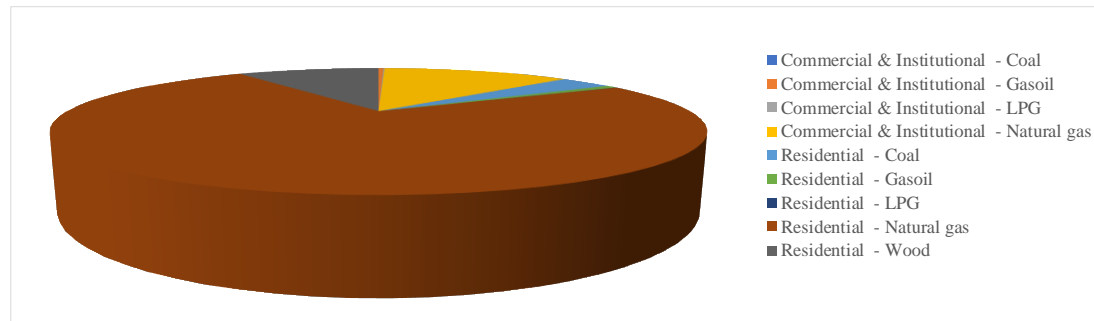
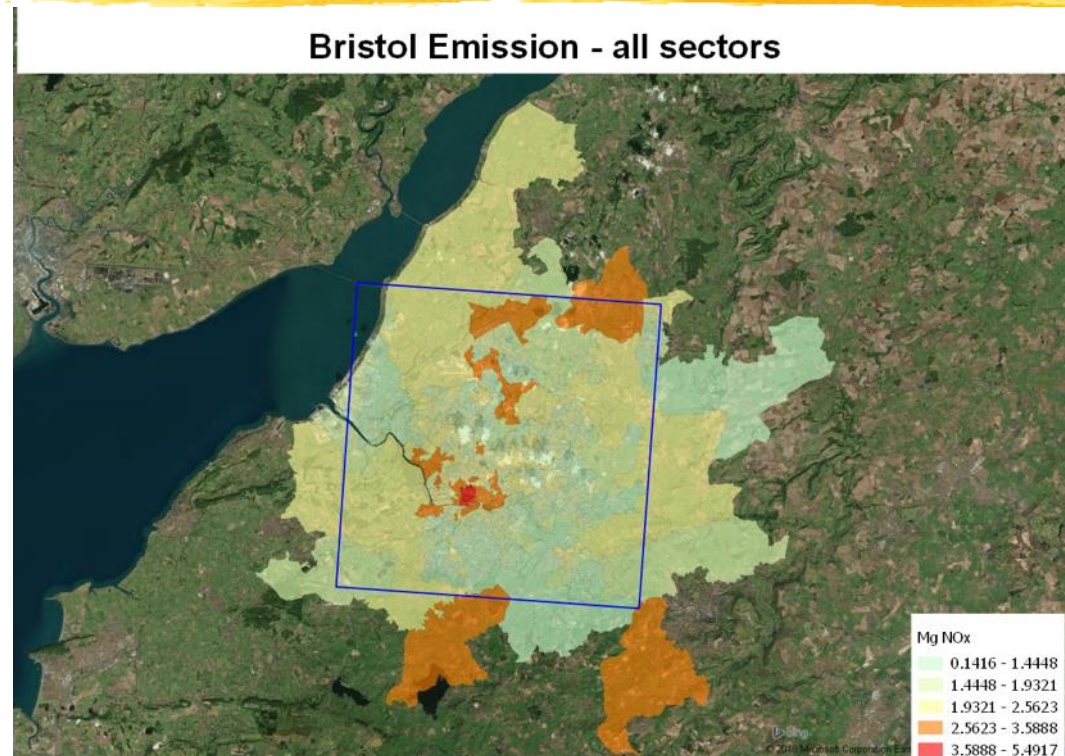
E06000019	E01013995	Herefordshire017D	27
E06000019	E01013996	Herefordshire016A	25
E06000019	E01013997	Herefordshire016B	31

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Case study results: Bristol NOx



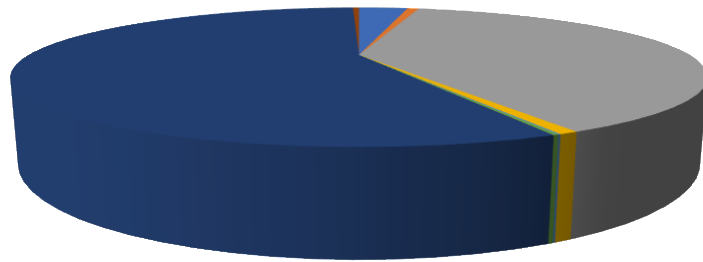
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Case study results: Amsterdam NO_x

Amsterdam Emission - all sectors



- Commercial & Institutional - Gasoil
- Commercial & Institutional - LPG
- Commercial & Institutional - Natural gas
- Commercial & Institutional - Wood
- Residential - Gasoil
- Residential - LPG
- Residential - Natural gas
- Residential - Wood

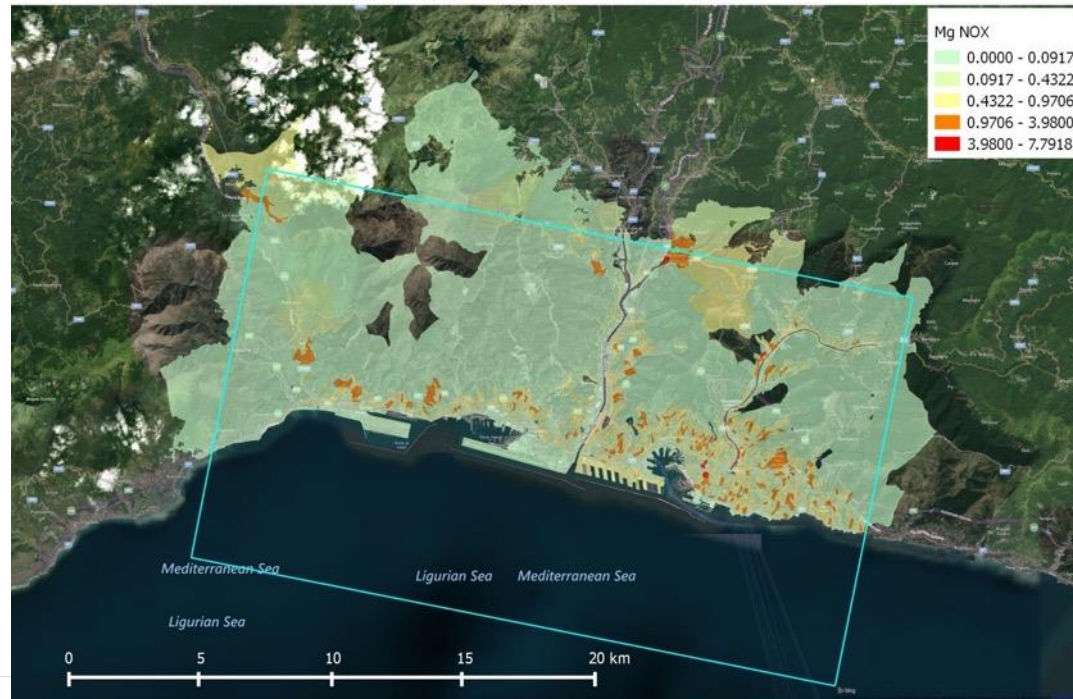
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Case study results: Genova NO_x

Liguria Emission - all sectors



- Commercial & Institutional - Gasoil
- Commercial & Institutional - LPG
- Commercial & Institutional - Natural gas
- Residential - Gasoil
- Residential - LPG
- Residential - Natural gas
- Residential - Wood

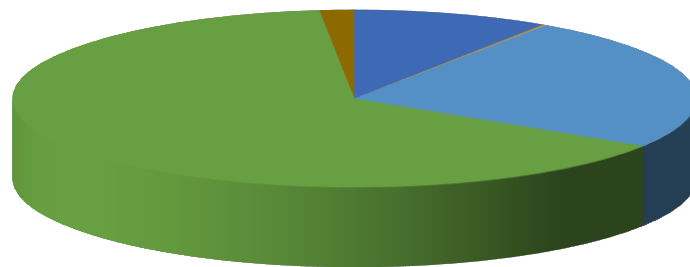
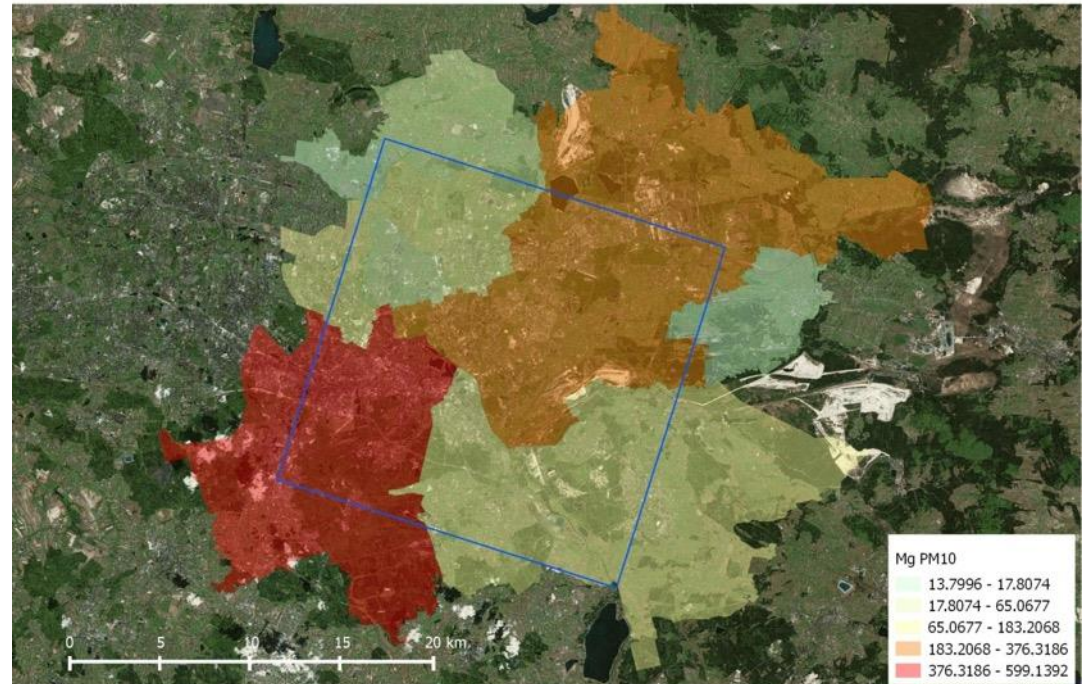
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Case study results: Sosnowiec PM₁₀

Sosnowiec Emission - all sectors Hard Coal

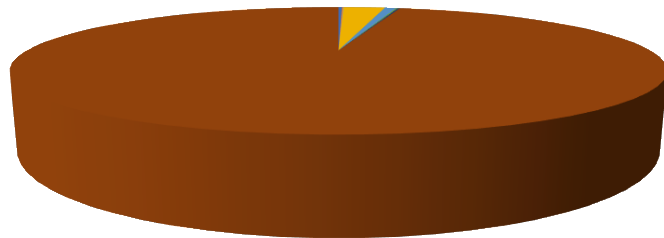
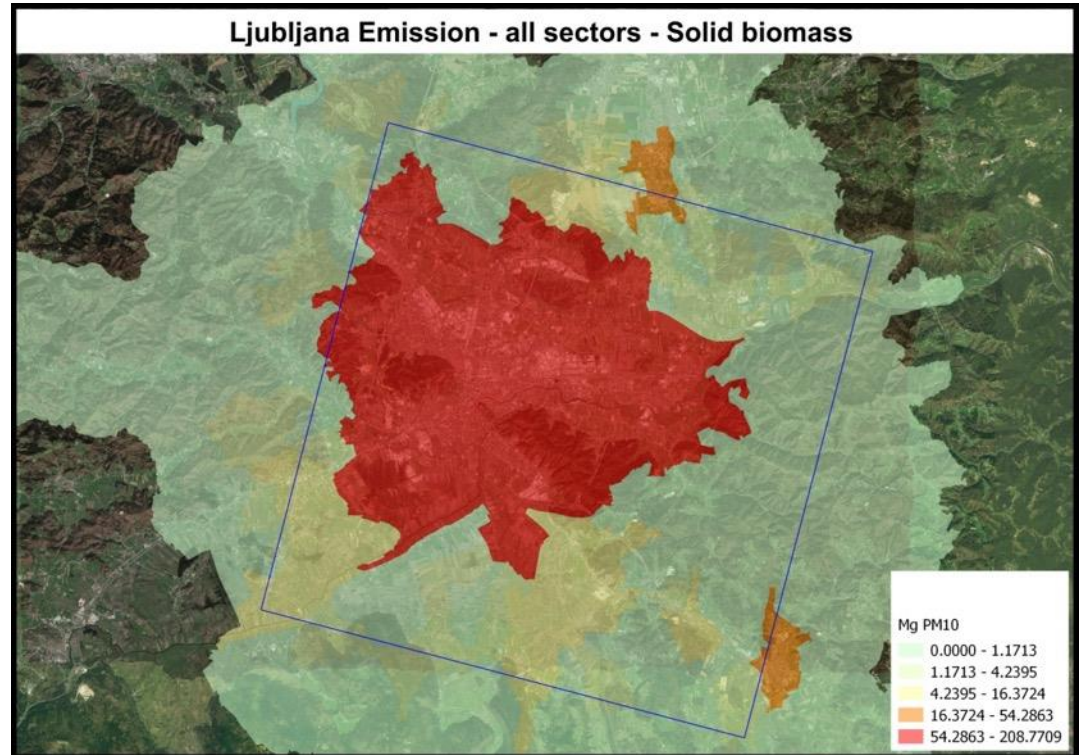


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Case study results: Ljubljana PM₁₀



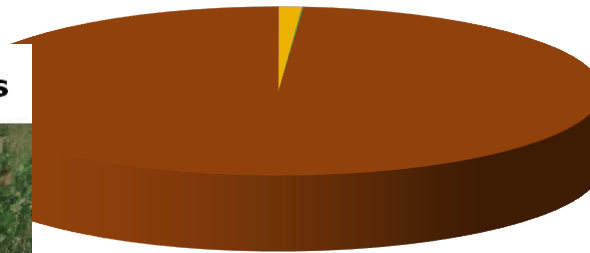
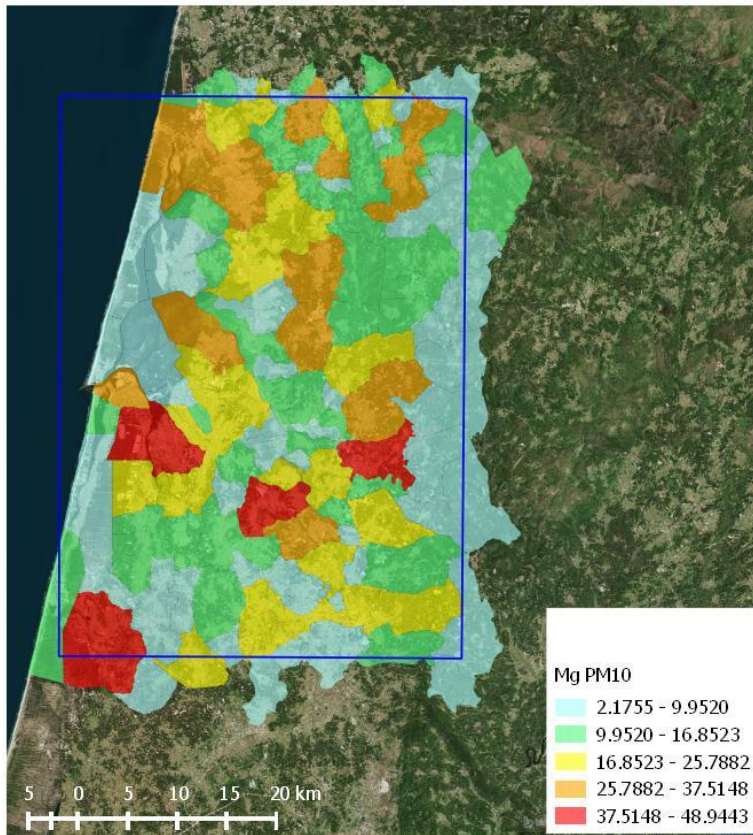
- Commercial & Institutional - Gasoil
- Commercial & Institutional - LPG
- Commercial & Institutional - Natural gas
- Commercial & Institutional - Wood
- Residential - Gasoil
- Residential - LPG
- Residential - Natural gas
- Residential - Wood

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Aveiro Emission - all sectors - Solid biomass



- Commercial & Institutional - Gasoil
- Commercial & Institutional - LPG
- Commercial & Institutional - Natural gas
- Commercial & Institutional - Wood
- Residential - Gasoil
- Residential - LPG
- Residential - Natural gas
- Residential - Wood

**Case study results:
Aveiro PM₁₀**

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THANK YOU FOR THE ATTENTION

QUESTIONS?