European Commission

Urban $PM_{2.5}$ Atlas
Air quality in European cities

P. Thunis, B. Degraeuwe, E. Pisoni,
M. Trombetti, E. Peduzzi, C.A. Belis,
J. Wilson, E. Vignati

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Contact information
Name: Philippe THUNIS
Address: European Commission, Joint Research Centre, Via Enrico Fermi 2749, 21027 Ispra (VA), Italy
Email: Philippe.THUNIS@ec.europa.eu
Tel.: +39 033278-5670

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Urban $PM_{2.5}$ Atlas - Air Quality in European cities

This Atlas provides information on the origins of air pollution ($PM_{2.5}$) in 150 European cities.
The importance of taking city-specific actions at the urban scale is highlighted as well as the important contribution of agricultural activities on urban air quality.

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Foreword

The analysis presented in this Atlas uses the SHERPA screening tool. The SHERPA methodology relies on simplifying assumptions that have been peer-reviewed, but the quality of the results also depends on the quality of the input data. Inevitably, although state of the art, the underlying air quality model is not uniformly accurate across Europe. The same holds for the emission inventory that feeds the model, which is characterised by uncertainties that are known to vary between regions and cities. The Atlas is therefore a first step towards exploring possible options to abate air pollution at the different urban scales. Any final policy design should be based, wherever possible, on full-scale modelling studies including local knowledge to complement the results presented here. In this respect, we hope that this Atlas contributes to improving the integration of local information about air pollution with Europe-wide assessments.

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Authors

P. Thunis

B. Degraeuwe

E. Pisoni

M. Trombetti

E. Peduzzi

C.A. Belis

J. Wilson

E. Vignati

Executive summary

Many European cities suffer from poor air quality and still exceed the European standards prescribed by the Air Quality Directive and the guidelines recommended by the World Health Organization (WHO). This is the case for fine particulate matter (PM_{10}), with concentrations exceeding the EU limit value and WHO guidelines in large parts of Europe, in 2015 (EEA, 2017). Although just 6% of the monitoring stations, exceeded the EU $PM_{2.5}$ limit (annual average of 25 $\mu g/m^3$) in 2015 (EEA, 2017), about 75% of them exceeded the WHO guideline (annual average of 10 $\mu g/m^3$). $PM_{2.5}$ is responsible of adverse health effects and premature deaths, with current estimate suggesting an average life loss of about 8 to 10 months in the most polluted European regions. This Atlas focuses on $PM_{2.5}$.

Policy context

Actions have been proposed and taken at the international, national and local level to reduce air pollution. While they have undoubtedly resulted in an overall improvement of the air quality over the years, there are still problems, which are localised in specific regions and many cities. A key issue is thus to determine at which scale to act in order to abate these remaining air pollution problems most effectively. Central to this for cities, is a quantitative assessment of the different origins of air pollution (urban, regional, national and transboundary) to support the design of efficient, effective air quality plans, which are a legal obligation for countries and regions whenever exceedances occur.

The "Screening for High Emission Reduction Potentials for Air quality" tool (SHERPA) has been developed by the Joint Research Centre to quantify the origins of air pollution in cities and regions (Thunis et al. 2016; Pisoni et al. 2017). In this Atlas, both the spatial (urban, country…) and sectoral (transport, residential, agriculture…) contributions are quantified for 150 European urban areas in Europe, where many of the current exceedances of the air quality EU limit values and WHO guidelines are reported.

Key conclusions

There is a need to provide information to improve air quality policy governance, to support authorities in choosing the most efficient actions at the appropriate administrative level and scale. In particular, actions at the local level focusing on the urban scale and at national/international level need to be carefully balanced. Key conclusions for $PM_{2.5}$ are:

- <u>For many cities, local actions at the city scale are an effective means of improving air quality in that city.</u>

The overall conclusion is that cities have a role to play by taking actions at their own scale. It is important to emphasise that the emissions in cities contribute significantly to country and EU overall PM concentrations, reinforcing the important role of cities in reducing the air pollution through a multilevel approach.

- Target sectors and scales to abate air pollution are city specific.

The impact of a given abatement measure on air quality differs from city to city, even for cities that are located in the same country. Actions taken at different scales or in different activity sectors therefore lead to impacts on air quality that are city-specific. Consequently, it is important to take into account these city-specific circumstances when designing air quality plans. Actions that are efficient in one city might not be efficient in others.

- For many cities, sectoral measures addressing agriculture at country or EU scale would have a clear benefit on urban air quality.

Although agricultural activities take place mostly outside the "city" boundaries, as defined here, agriculture emissions have a significant impact on air quality in many EU cities. The widespread impact of agriculture on air quality is indicative of the potential for EU- or country-wide measures addressing this sector. Moreover, other sectoral measures can have an important potential at the urban scale even though they are applied at EU or country scale. This is the case of road transport where the EURO norms are, in practice, most effective in the areas where traffic is most important, i.e. cities.

Related and future JRC work

About half of the reported EU exceedances occur in the areas covered by the 150 urban areas included in this study. However, many smaller urban areas are not considered in this analysis. It is therefore important to extend this work in future to these smaller urban areas as they may well have their own specific problems and solutions. In addition, a proper estimate of situation at traffic stations would complete this analysis, which is limited to the contributions to the 'urban background' concentrations, in this Atlas.

Quick guide

- Many European cities suffer from poor air quality and regularly exceed both the Air Quality Directive and WHO standards for air quality.
- A key issue is to balance action at the various geographic scales to abate remaining air pollution problems most effectively.
- The SHERPA tool, developed by the Joint Research Centre, is used to quantify the origins of air pollution to urban background fine particulate matter. Both the spatial (urban, country…) and sectoral (transport, residential, agriculture…) contributions are quantified for 150 European urban areas in Europe.
- The results indicate that (1) for many cities, local actions at the city scale are an effective means of improving air quality in that city, as well as having regional benefits; (2) target sectors and scales to abate air pollution are city specific and (3) for many cities, sectoral measures addressing agriculture at country or EU scale have a clear benefit on urban air quality.

1 Introduction

Many European cities suffer from poor air quality and regularly exceed both the European standards prescribed by the Air Quality Directive (EEA, 2017) and guidelines recommended by the World Health Organization (WHO). This is particularly the case for fine particulate matter (PM_{10}), for which both the daily (50 µg/m^3 not to be exceeded on more than 35 days a year) and the yearly average limit values (40 µg/m^3) are often exceeded in many cities and regions in Europe. Even though no minimum threshold could be established below which there are no adverse health effects of particulate matter, the WHO guidelines represent global targets (for both industrialized and developing countries) above which increased mortality responses due to PM air pollution are expected based on current scientific findings (WHO, 2006). For $PM_{2.5}$, the EU limit value (annual average of 25 µg/m^3) is generally met (EEA, 2017), but few cities manage to keep concentrations below the levels recommended by the WHO (10 µg/m^3 on an annual basis) as illustrated in Figure 1.

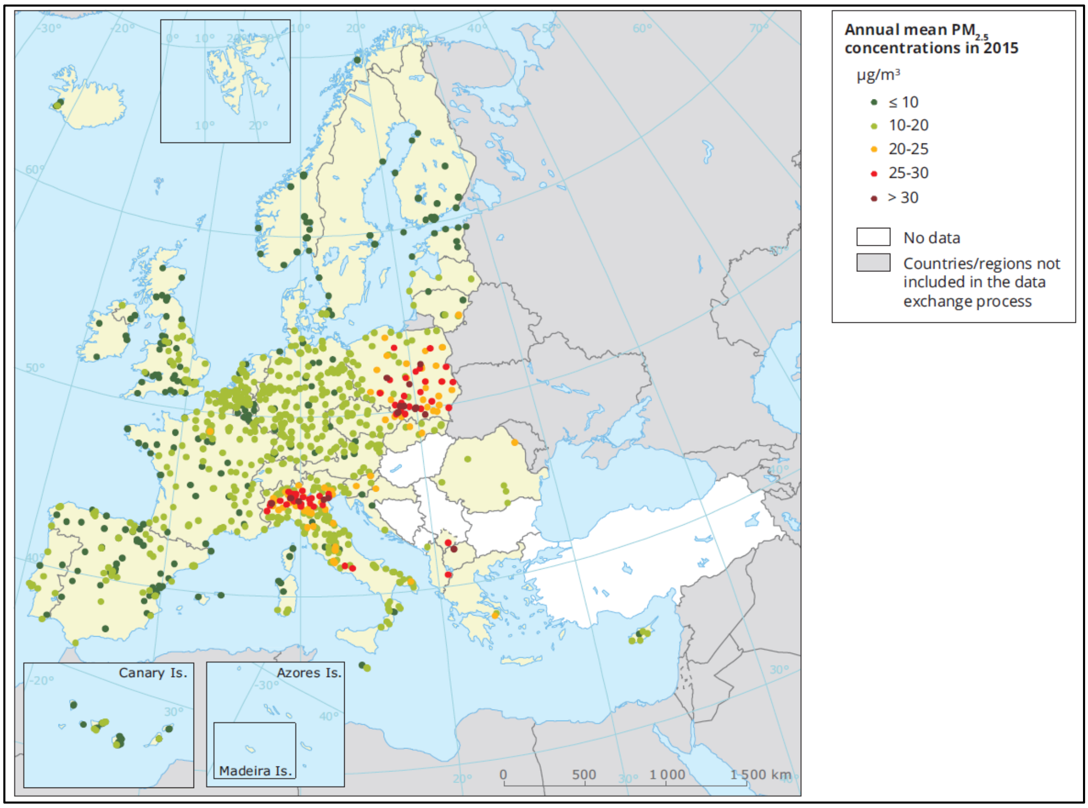

Figure 1: The red and dark red dots indicate stations reporting concentrations above the EU annual target value for $PM_{2.5}$ (25 µg/m^3). The dark green dots indicate stations reporting values below the WHO AQG for $PM_{2.5}$ (10 µg/m^3). Only stations with > 75% of valid data have been included in the map. Source: EEA, 2017.

Adverse health effects and premature deaths are two of the major effects of poor air quality and current estimates suggest that exposure to $PM_{2.5}$ is responsible of an average life loss of about 8 to 10 months in the most polluted European regions (Southern Poland, Po Valley, Benelux…) and cities. Consequently, air pollution remains the single largest environmental health risk in Europe according to WHO (WHO, 2015).

Actions have been proposed and taken at the international (e.g. Amann et al., 2011) national (e.g. D'Elia et al., 2009) and urban scales (e.g. Giannouli et al., 2011) to reduce air pollution. While they have undoubtedly resulted in an overall improvement of the air quality over the years (Maas and Grennfelt, 2016), there are still problems which are localised in specific regions and many cities (Amann et al., 2012). A key issue is thus to determine at which scale to act in order to abate these remaining air pollution problems most effectively. Central to this for cities, is a quantitative assessment of the different origins of air pollution (urban, regional, national and international) and of their impacts to support the design of efficient and effective air quality plans, which are a legal obligation for countries and regions whenever exceedances occur.

Because of its important adverse health effects, this Atlas focus on urban background $PM_{2.5}$. Particulate matter ($PM_{2.5}$) is a pollutant that can be emitted directly (primary particulate) or be formed through series of complex chemical formation processes from other air pollutants (secondary particulate) (see the review by Fuzzi et al. 2015). Depending on meteorological conditions, their residence time in the atmosphere is estimated to range from several days up to one week in the lower troposphere. It is worthwhile to note that for conditions other than the most stable low wind speed events, these residence times imply travel distances in the lower troposphere up to a thousand kilometres. In addition, air masses may follow complex trajectories. For example, under certain circumstances emissions from a city may react with precursors emitted elsewhere to form secondary particles that then return to the city.

Chemistry transport models (CTM) can account for these complex transport, diffusion and chemical transformation processes and can therefore be used to quantify the impact of cities on their pollution levels by performing simulations where emissions are switched on or off in a city. Because these models require intensive computational resources they are generally used to perform this detailed analysis for one city or region at the time. To cope with this limitation, the "Screening for High Emission Reduction Potentials for Air quality" tool (SHERPA - http://aqm.jrc.ec.europa.eu/sherpa.aspx) has been developed by the Joint Research Centre (JRC - Thunis et al. 2016). This simplified screening tool (see Annex 1 for details) mimics a CTM, but with a much faster time response. In this study, SHERPA is used to quantify the origins of air pollution in a large set of European cities. Both spatial (urban, country…) and sectoral (transport, residential, agriculture…) contributions are quantified for 150 European urban areas in Europe, from where many of the current exceedances to the air quality EU and WHO limit values are reported.

2 Objective and structure of this Air Quality Atlas

The main purpose of this Atlas is to support policy makers in designing and assessing their air quality plans, with a focus on $PM_{2.5}$. One particular issue in this respect is governance, namely the selection of the most appropriate and cost-effective strategies within the geographical area under the control of the policy maker. While some abatement measures are taken at European or countrywide level (e.g. EURO standards for vehicles), others are the responsibility of city authorities (e.g. low emission zones for traffic). A wide range of measures remains in between those two scales. This Air Quality Atlas provides detailed information regarding spatial allocation for 150 cities in the EU, for $PM_{2.5}$ yearly average concentrations. The focus is on urban background levels (meaning that local or microscale traffic impacts are not explicitly considered).

Policymakers also require information to prioritise their air quality strategies in terms of activity sectors. Similar to the spatial source allocation, this Air Quality Atlas provides a ranking of the sectoral contributors (i.e. residential, transport, agriculture…) to urban air pollution for each city.

It is important to note that the most effective emission reductions in terms of scales and sectors identified here might not be the most cost-efficient. This study focuses on the impacts on concentrations of emission abatement measures but does not assess their implementation costs.

The Air Quality Atlas is structured as follows. First, an overview of the analysis of all the 150 urban areas is presented both in terms of spatial (Section 3) and sectoral (Section 4) origins of their air pollution. Detailed city-by-city sectoral and spatial source allocation analyses are then presented in Section 5. Finally, the SHERPA screening methodology and a discussion of its associated assumptions, limitations and uncertainties are presented in Annexes 1 and 2.

3 At which scale are actions most effective?

Knowing where urban pollution originates is of particular interest when designing air quality plans as it may help in choosing the right measures and the right spatial scale of implementation. To support this governance challenge, in this section we analyse the contribution from different spatial scales to city concentrations.

In terms of the spatial dimension, source allocation is analysed at three distinct scales: Europe (EU28 plus Switzerland and Norway, referred in the following as EUR30), the country and the "greater city" area. For the largest cities, an additional scale is considered with the split of the greater city into the "core city" and the peripheral "commuting zone".

Core cities are the local administrative units, with a population density above 1,500/km^2 and a population above 50,000, where the majority of the population lives in an urban centre (OECD, 2012).

Greater cities correspond to the functional urban areas (OECD, 2012) and consist of the core city plus the wider commuting zone, defined as the surrounding travel-to-work areas where at least 15% of the employed residents work in the city. Note that the commuting zone is limited in its extension to the country in which the city is located. It does not include transboundary commuting.

Given the SHERPA spatial resolution (~7 x ~7 km^2), only the largest city cores can be considered in the analysis. These include all EU28 capitals and other major urban areas within each country. The final pool of 150 urban areas is shown in Figure 2.

The contributions calculated with SHERPA correspond to the impacts on air pollution that would result if emissions from a particular sector or spatial scale were switched off. SHERPA mimics the "dynamic" responses of a CTM for these emission reductions. We will refer to this type of contributions as "source allocation", in contrast to the 'source apportionment" contributions that correspond to a "static" decomposition of the current air pollution levels. As shown by Clappier et al. (2017), the differences between the two approaches can be important when quantifying the contributions of precursors involved in chemical reactions (secondary particulate matter).

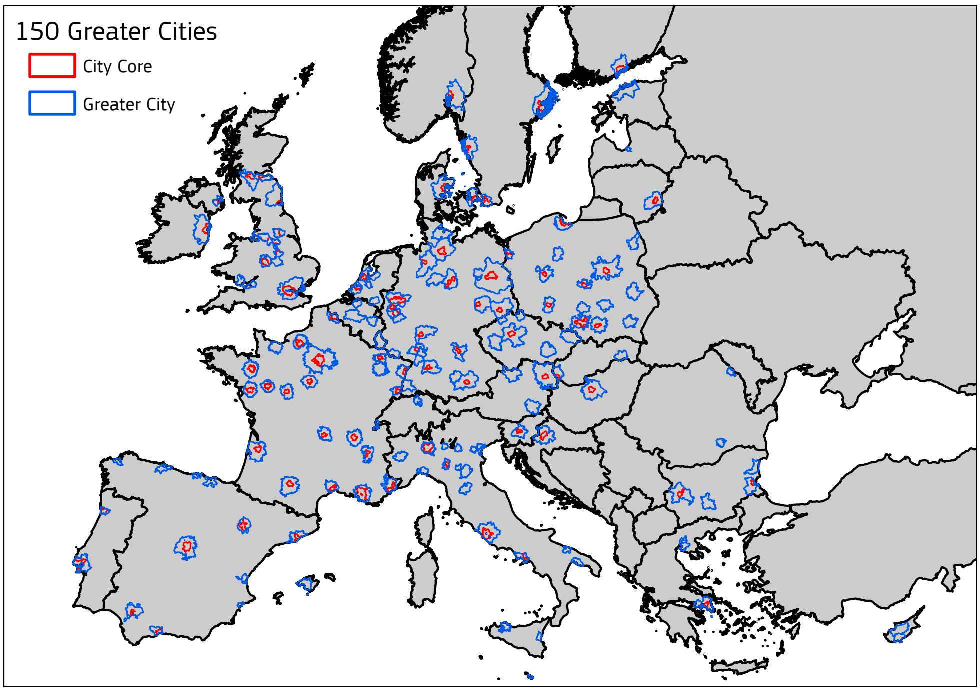

Figure 2: Overview of the core city (in red) and greater city areas (in blue) for all 150 analysed cities.

Figure 3, Figure 4 and Figure 5 show the core city, greater city and country contributions respectively, expressed in relative terms, i.e. as a percentage of the urban concentration (taken at the city location where the highest concentration level is found in that city – see exact location in city fiches in section 5).

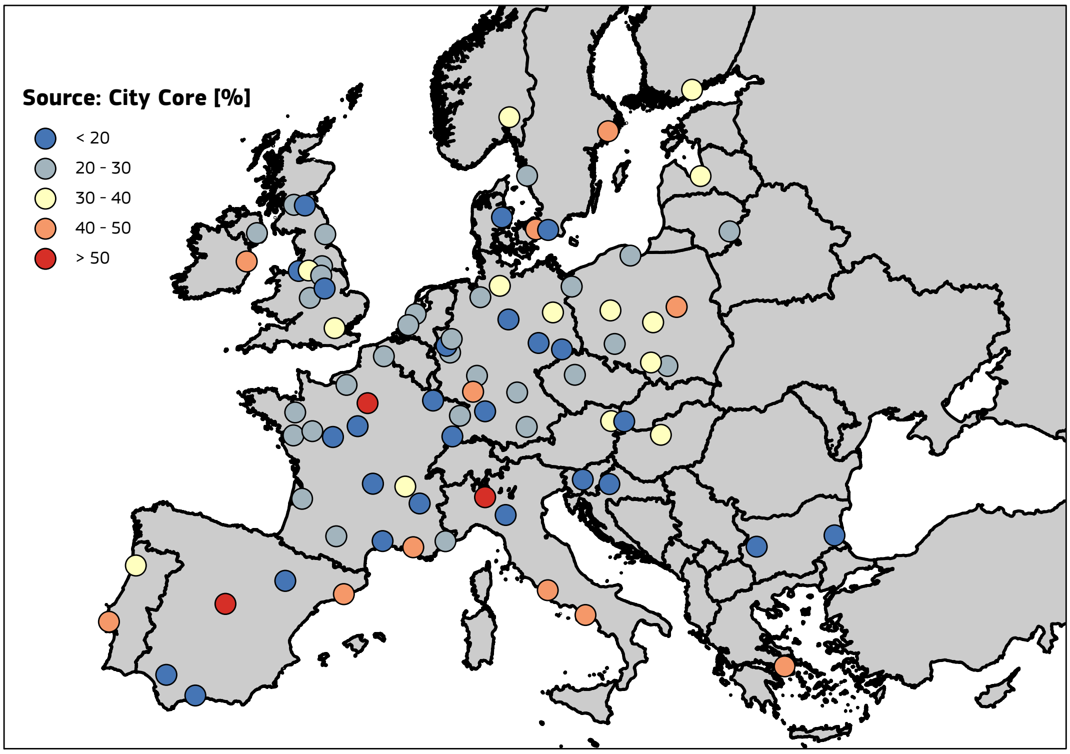

Figure 3: Contribution of city core emissions to urban $PM_{2.5}$ concentration (the 84 dots represent the urban areas where the city core is analysed).

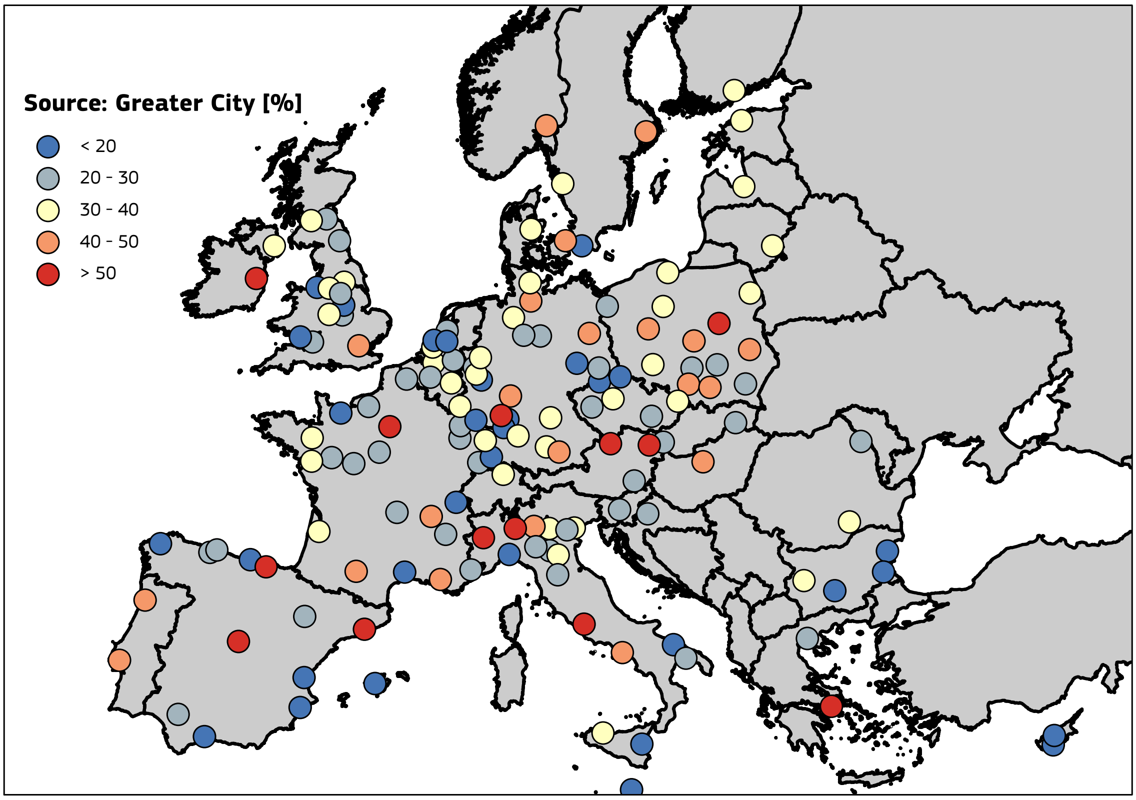

Figure 4: Contribution of greater city emissions to urban $PM_{2.5}$ concentration (city plus commuting zone).

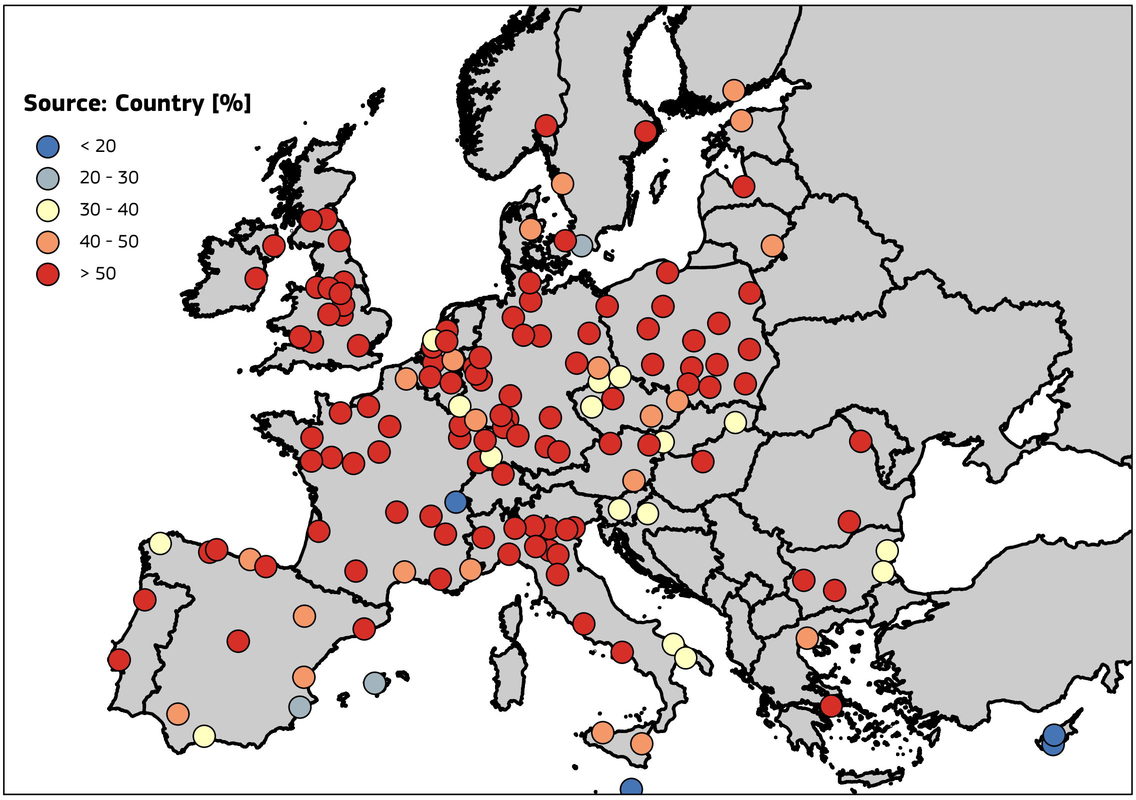

Figure 5: Contribution of the country emissions to urban $PM_{2.5}$ concentration.

Some key points arise from this analysis:

- The city core's own contribution to annual $PM_{2.5}$ concentrations (at its location with the highest concentration) is on average (over the 84 considered cities) around 26%. The largest contributions are found in Milan (57%), Paris (56%), Madrid (52%), Mannheim-Luwigshafen (49%) and Warsaw (48%) and the lowest contributions in Burgas (6%), Leipzig (9%), Dresden (9%), Montpellier (11%) and Dusseldorf (11%). In general, local emissions are a significant contributor to annual PM concentrations in the largest EU cities, stressing the importance of local air quality planning.
- At the greater city scale (city core plus commuting zone), its contribution to annual $PM_{2.5}$ concentrations at the worst spot in the city is on average (over all 150 cities) around 31%. The largest contributions are found in Paris (66%), Madrid (65%), Athens (65%), Turin (63%) and Milan (63%), and the lowest in Nicosia (6%), The Hague (7%), Alicante (7%), Limassol (8%) and Heidelberg (9%). Therefore, actions taken at the greater city scale have a lot of potential in many cities. About 25% of the 150 cities contribute to at least 39% of their pollution if the greater city area is considered and about 50% of the 150 cities contribute to more than 29% (Figure 6).

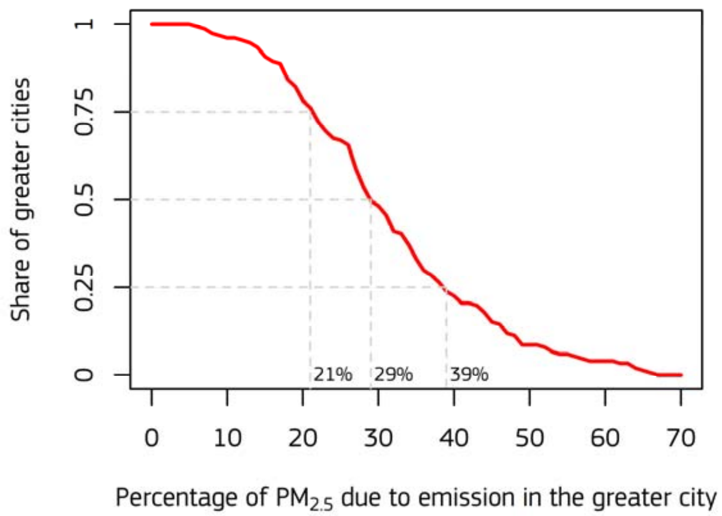

Figure 6: Frequency cumulative distribution showing the share of greater cities (vertical axis) contributing to a given percentage of the $PM_{2.5}$ urban concentration. The 25, 50 and 75% percentiles are highlighted.

- The contribution from the entire country (including city core and commuting zone) to annual $PM_{2.5}$ concentrations at the worst spot in the city is on average (over all 150 cities) around 56%. The largest contributions are found in Milan (89%), Warsaw (85%), Brescia (85%), Paris (84%) and Turin (82%) and the lowest in Valletta (12%), Limassol (14%), Nicosia (16%), Geneva (17%) and Palma de Mallorca (24%).

The remaining sources of emissions in this spatial analysis (transboundary, international shipping and/or natural) play a significant role in cities that are, either close to internal country borders, close to the EUR30 borders or under the influence of Saharan dust events. The largest contributions are found in southern cities, subject to episodic dust events: Valletta (88%), Limassol (86%), Nicosia (84%), Geneve (83%) and Palma del Mallorca (76%).

4 Which are the dominant emission sources in cities?

Pollutant emissions originate from different human activities (like residential heating, transport, etc.) as well as from natural sources (e.g. dust, sea-salt, fires, etc.). The sectoral apportionment of $PM_{2.5}$ reported in this Atlas distinguishes and quantifies the contributions from anthropogenic activity sectors and from natural sources as follows:

Residential: this sector includes emissions from combustion in fireplaces, medium and single-house boilers, cooking and heating stoves in commercial, institutional and residential activities.

Transport (road): this sector includes exhaust and evaporative emissions from light and heavy-duty vehicles and motorcycles as well as non-exhaust PM emissions due to road abrasion of tyres and brake wear.

Agriculture: this sector includes emissions from livestock, fertiliser use and agricultural waste burning.

Industry: this sector combines emissions related to combustion in energy industries (including public power, cogeneration and district heating), industrial combustion and industrial processes.

Natural: This sector includes desert dust and sea salt.

Others: The remaining emissions are grouped in a single category. They include activities such as extraction and distribution of fossil fuels, solvent use, other mobile sources, machinery and waste treatment and disposal.

External: This sector includes the international shipping as well as all emissions occurring outside the EUR30 domain.

We analyse here the relative contribution of these sectors to the $PM_{2.5}$ urban background concentration levels reached in cities. The sectoral contributions are intended here as the overall impact of the emissions from a given sector, regardless of where these emissions originate (no spatial breakdown). For each urban area, results are presented at the location where the maximum concentration is reached within the city-core. This location is visible in the city fiches presented in section 5.

The key points arising from this analysis are synthesised below:

- The average contribution from the residential sector (Figure 7) in the 150 urban areas is 13%. The largest contributions are found in Warsaw (48%), Krakow (40%), Katowice (40%), Lodz (33%) and Poznan (33%) and the smallest in Valletta (1%), Limassol (1%), Nicosia (2%), A Coruña and Leeds (2%). In general, the impact of residential heating is more important in the eastern countries (Poland in particular) and in some cities in Italy. Northern countries (e.g. Scandinavia, UK, Belgium, Germany) do not show a large contribution from this sector.

- The average contribution from the road transport (Figure 8) in the 150 urban areas is 14%. The largest contributions are found in Madrid (39%), Luxembourg (30%), Paris (29%), Verona (27%) and Bologna (27%) and the smallest in Valletta (2%), Varna (2%), Limassol (2%), Nicosia (3%), and Taranto (4%). As expected, transport emissions represent an important contribution in some of the largest cities (Paris, Madrid, London). However, they are also a key contributor in densely populated areas like Belgium and the Netherlands. It is important to note that the numbers concern the transport contribution to urban background concentrations. At traffic stations (not analysed here), the contribution is likely to be proportionally larger.
- The average contribution from agriculture (Figure 9) in the 150 urban areas is 23%. The largest contributions are all found among Germany and Czech Republic cities: Dresden (40%), Braunschweig-Salzgitter-Wolfsburg (39%), Usti nad Labem (38%), Plzen (37%) and Leipzig (36%) and the smallest in Southern Europe: Lisbon (5%), Athens (5%), Limassol (6%), Palermo (7%) and Nicosia (7%). Agricultural activities and related emissions do not normally take place within the urban boundaries, although the greater city areas may include some agricultural areas. Nevertheless, the sector is responsible for a large fraction of the $PM_{2.5}$ concentration (secondary pollution) in many EU cities, especially in central Europe. This finding is in agreement with other work investigating the impact of agricultural emissions (Bessagnet et al. 2014; Bauer et al. 2016).
- The average contribution of industry (Figure 10) in the 150 urban areas is 20%. The largest contributions are found in Mannheim-Ludwigshafen (47%), Bilbao (46%), Linz (44%), Marseille (41%) and Brescia (37%) and the smallest in Malaga (5%), Palma de Mallorca (6%), Alicante (6%), Madrid (7%) and Palermo (8%). Industry plays a key role mostly in some of the Eastern countries (Bulgaria, Romania and Greece) as well as in the western part of Germany. It has a lower importance in southern Europe, although it appears as the key contributor in certain cities like Marseilles and Turin.
- The average contribution of natural sources (Figure 11) in the 150 urban areas is 19%. $PM_{2.5}$ concentration peaks in cities in the Mediterranean area are associated with episodic dust events. The largest contributions are found in Valletta (46%), Limassol (43%), Palma de Mallorca (40%), Nicosia (39%) and Alicante (36%) and the smallest in Warsaw (4%), Katowice (4%), Krakow (4%), Lodz (5%) and Wien (5%). Because natural components are mostly non-reactive, a comparison between the modelled source allocation obtained here and measurement-based source apportionment methods is meaningful. The sum of the $PM_{2.5}$ relative contributions deriving from sea salt and dust in 32 urban areas quantified with receptor models (RM) (Belis et al., 2013) is on average 6% points higher than the one estimated in this study. The largest differences are observed in Atlantic and Mediterranean cities, suggesting that in these areas the role of natural sources could be higher than the one reported in this study. On the other hand, a recent

work on five Southern European cities (Diapouli et al., 2017) reports percentage estimations that are most of the time below those reported in this Atlas.

Other sources of emissions (external, i.e. from outside the EUR30, international shipping; Figure 12) play a significant role in many cities located at the edge of the EUR30 domain (e.g. Burgas, Vilnius) but also in harbour cities where international shipping is a key contributor (e.g. Limassol, Alicante, Malaga).

This variability in terms of sectoral impact, even within a single country, illustrates the scope for targeting air quality plans on a city-by-city basis, as illustrated in the city fiches (Section 5).

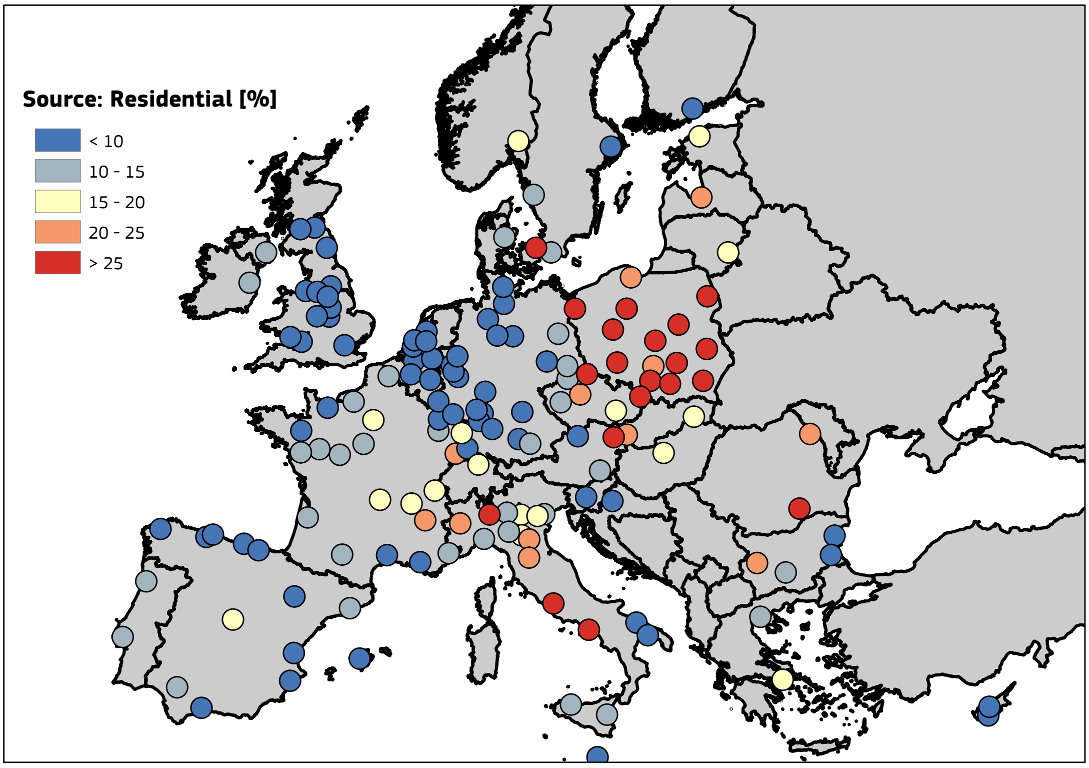

Figure 7: Contribution of the residential sector to the $PM_{2.5}$ urban background concentration. Each dot represents one urban area.

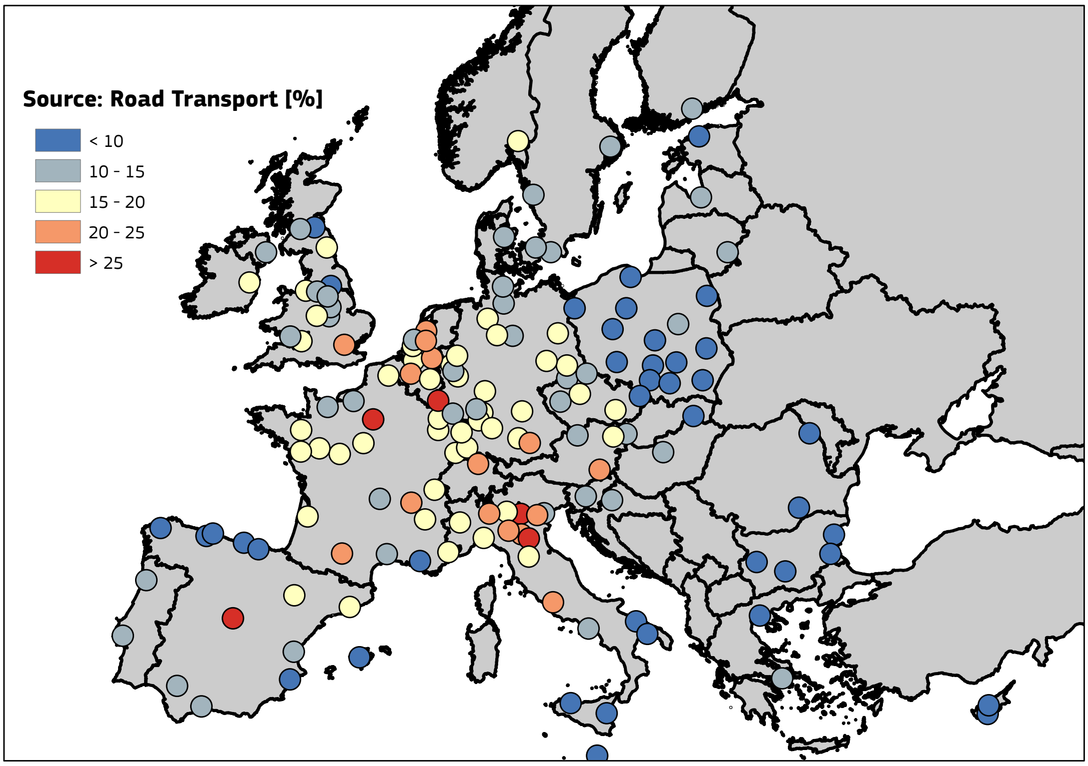

Figure 8: Contribution of the road transport sector to the $PM_{2.5}$ urban background concentration. Each dot represents one urban area.

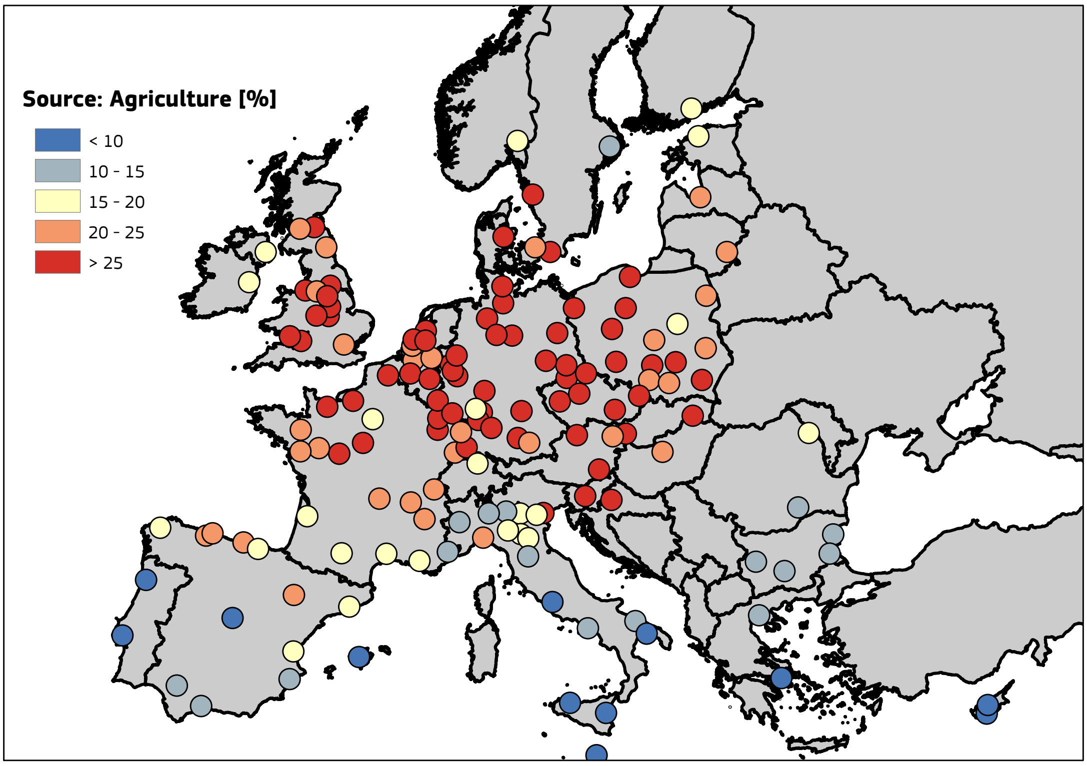

Figure 9: Contribution of the agricultural sector to the $PM_{2.5}$ urban background concentration. Each dot represents one urban area.

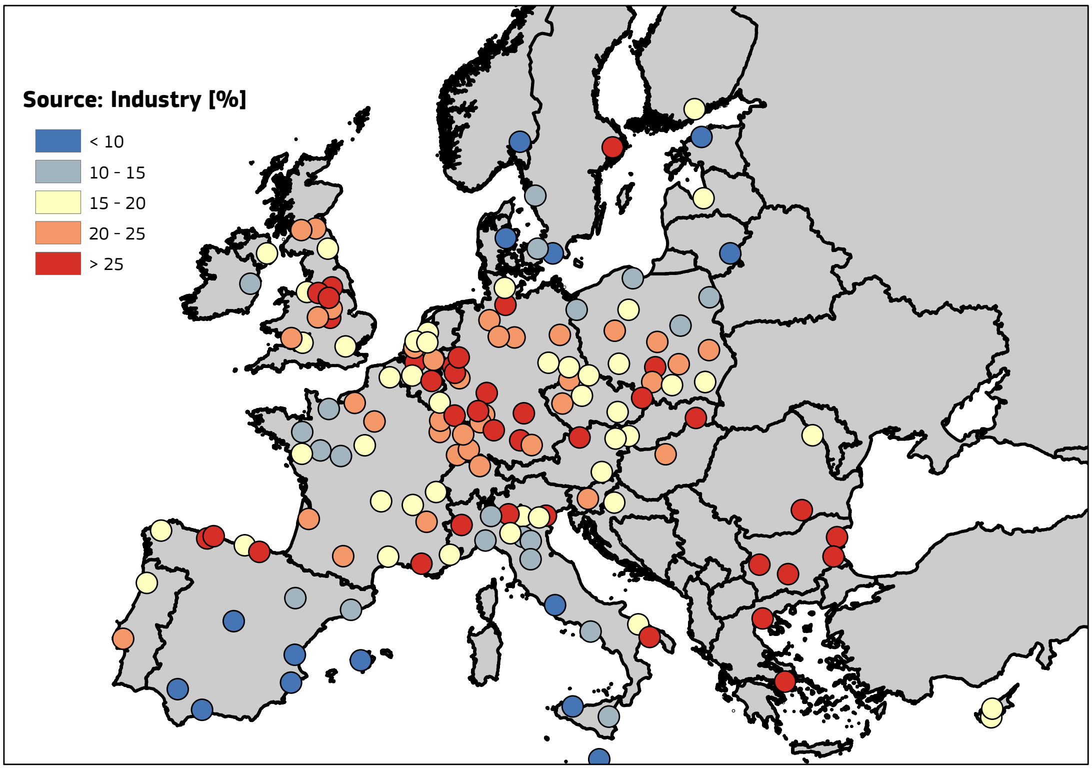

Figure 10: Contribution of the industrial sector to the $PM_{2.5}$ urban background concentration. Each dot represents one urban area.

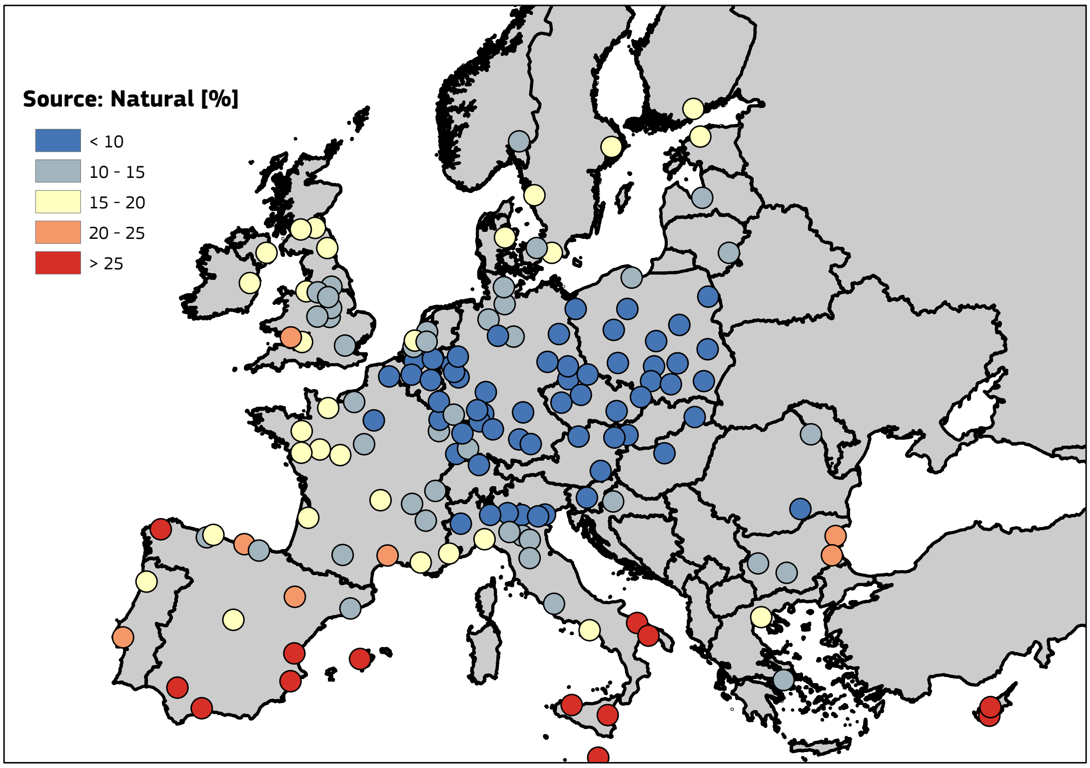

Figure 11: Contribution of the natural sector to the $PM_{2.5}$ urban background concentration. Each dot represents one urban area.

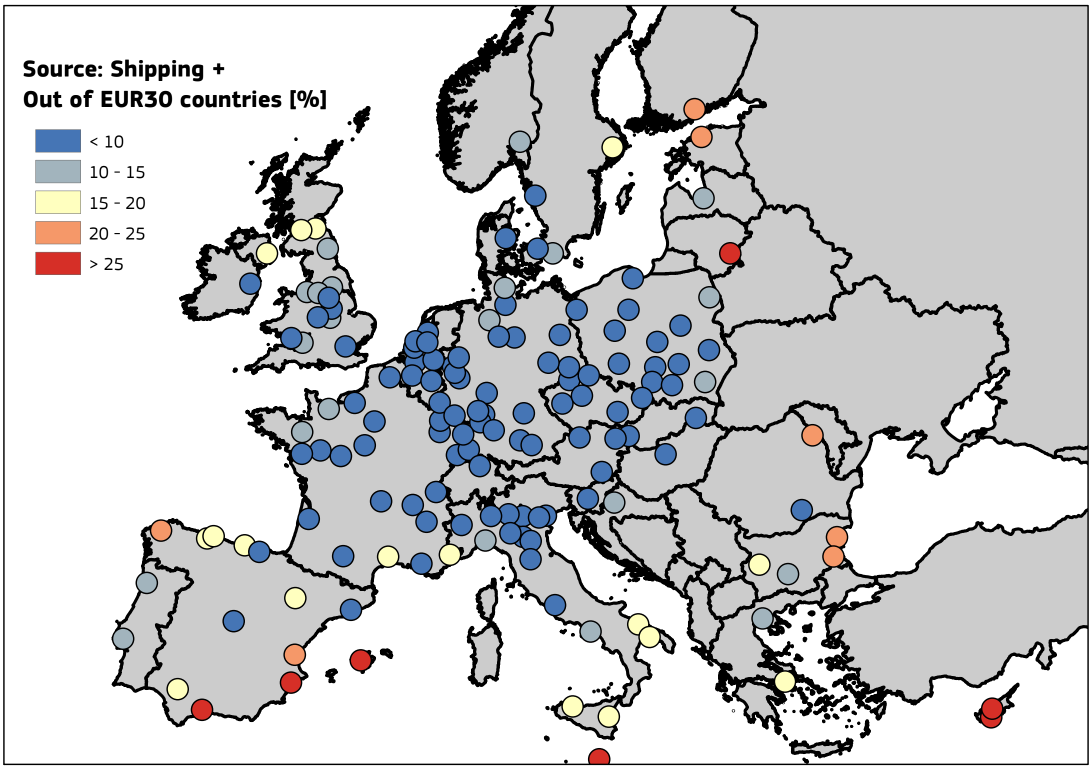

Figure 12: Contribution of the remaining sources (shipping and outside EUR30) to the $PM_{2.5}$ urban background concentration (shown here for information). Each dot represents one urban area.

5 A closer look city by city

In Sections 3 and 4, the contributions to urban $PM_{2.5}$ concentration levels have been analysed in terms of their geographical or sectoral origin respectively. Both aspects are combined here to give a single source allocation overview for each of the 150 cities on a city-by-city basis (see Annex 3).

The first part of this "city fiche" analysis provides some general information regarding the location of the urban area, its population, and the geographical extension of its core city and greater city areas. The black triangle in each city map (top-left) represents the location at which source allocation is performed (receptor point).

Information on measured $PM_{2.5}$ concentration levels and on their compliance with the standards in the EU air quality directive (AQD) and the WHO air quality guideline is given in the top-right of the fiche. The histogram in each fiche provides an overview of reported PM concentrations in the 150 cities (EEA, http://aidef.apps.eea.europa.eu/), while the colour coded dots indicate the values measured at all background monitoring stations located in the greater city area (green: below WHO guidelines: red: above AQD limit values; orange: in between). Because $PM_{2.5}$ measurements are not available in all cities, PM_{10} is included in the monitoring overview. For wider coverage, measured values refer to 2015.

The central panel of the fiche contains the summary source allocation diagram. This diagram breaks down the contributions in terms of their spatial (along the vertical axis) and sectoral (along the horizontal axis) origins. All values are expressed as relative percentages of the urban concentration (at the receptor point). The top bar provides the 'total sectoral breakdown', i.e. the contribution of different sectors to the total concentration of the urban background yearly average $PM_{2.5}$ concentration. Note that the sum of all contributions, including the natural one, is usually less than 100%. The contributions that cannot be allocated are therefore attributed to 'external' emissions from outside EUR30 and shipping. Because of uncertainties the sum of all contributions, including the natural one, are in a few cities slightly larger than 100%. In such cases, contributions are rescaled to sum up to 100%, for consistency. The bars beneath provide similar information but in terms of spatial dimensions. For the largest cities, four spatial areas are considered (core city, commuting zone, rest of country, transboundary) while for smaller cities, the first two scales are merged (greater city only).

The lower and central-right panel provides an overview of the emission breakdown used for the calculations for primary particulate matter ($PPM_{2.5}$), non-methane volatile organic compounds (NMVOC), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and ammonia (NH_3). Each of the graphs shows the dominant sector for each emitted pollutant in the core city (red, when available) and the greater city (blue).

6 Conclusions

There is a need to provide information to improve air quality policy governance, to support authorities in choosing the most efficient actions at the appropriate administrative level and scale. In particular, an appropriate balance between local actions focusing on the urban scale and actions requiring national/international efforts needs to be found. The purpose of this Air Quality Atlas is to provide, based on the SHERPA tool (Thunis et al. 2016), city specific source allocation information on annual $PM_{2.5}$ concentrations in terms of sector and spatial dimensions for 150 cities in the EU. The main findings of this Air Quality Atlas are:

- **For many cities, local actions at the city scale are an effective means of improving air quality in that city.**

Almost half of the considered cities (73 out of 150) have the potential to reduce their annual PM concentration by 30% or more through local (greater city) action. In fact, there is a significant number of cities where the share of their own contributions to PM pollution is even higher: ≥ 40% impact (34 cities) and ≥50% impact (13 cities). Long-range transport is important, particularly in cities located near the EUR30 boundaries. However, the overall finding is that cities have an important role to play by taking actions at their own scale.

It is important to emphasise that the emissions in cities contribute significantly to country and EU overall PM background concentrations, reinforcing the important role of cities in reducing the air pollution through a multilevel approach.

- **Target or key sectors and scales to abate air pollution are city specific.**

Cities differ in the way in which their PM concentrations respond to abatement measures, even when located in the same country. Actions taken at different scales or in different activity sectors lead to impacts that depend on city. Given that measures have so varied effects in different cities, there is a clear need to take into account these city-specificities when designing air quality plans. Actions that are efficient in one city might not be efficient in others.

- **For many cities, sectoral measures addressing agriculture at country or EU scale would have a clear benefit on urban air quality**

Although agricultural activities take place mostly outside the "city" boundaries, as defined here, agriculture emissions considerably impact air quality in many EU cities. Agriculture contributes to more than 30% of the air pollution ($PM_{2.5}$ concentrations) in about 21% of the cities (31 cities out of 150) and to more than 20% in 66% of the cities. The extent of the impact of agriculture on air quality is indicative of the potential of EU- or country-wide measures addressing this sector.

Moreover, other sectoral measures can have an important potential at the urban scale even though they are applied at EU or country scale. This is the case i.e. of road transport where the EURO norms are, in practice, most effective in the areas where traffic is most important, i.e. cities.

About half of the reported EU exceedances occur in the areas covered by the 150 greater cities included in this study. However, many smaller urban areas are not considered in this Atlas. It is therefore important to extend this work in the future to these smaller urban areas as they may have their own specific characteristics. Similarly, within cities, a proper estimate of the contributions at traffic stations would complete this analysis at the local scale.

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List of abbreviations and definitions

AQD	Air Quality Directive
CTM	Chemistry Transport Model
EEA	European Environmental Agency
EUR30	EU28 + Switzerland + Norway
GAINS	Greenhouse Gas - Air Pollution Interactions and Synergies
NH_3	Ammonia
NMVOC	Non Methane Volatile Organic Carbons
NOx	Nitrogen oxides
PM	Particulate matter
$PM_{2.5}$	Particulate matter with diameter inferior to 2.5 μm
PM_{10}	Particulate matter with diameter inferior to 10 μm
PPM	Primary Particulate Matter
RM	Receptor model
SHERPA	Screening for High Emission Reduction Potential on Air quality
SO_2	Sulphur Dioxide
SRR	Source Receptor Relationships
WHO	World Health Organisation

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Annexes

Annex 1: The SHERPA methodology

SHERPA (Screening for High Emission Reduction Potential on Air quality) is a Java/Python tool, developed for the rapid exploration of potential air quality improvements resulting from national/regional/local emission reduction measures. With respect to a full chemistry transport model (CTM), SHERPA relies on simplifying assumptions to speed up the computing time. It uses EU-wide data on emissions and source-receptor models (see below for details), so that it is very easy to start working on any region/local domain in Europe. SHERPA has been developed to address the following tasks:

- Source allocation: this step aims to assess the level of control policymakers have on air pollution over a predefined area. If most of the pollution is imported from outside the region's borders, the level of control will be low (and vice-versa). During this step, SHERPA provides information on (1) the amount of pollution originating from outside the control region and (2) the allocation in terms of activity sectors and precursors for the pollution originating from inside the control region.
- Governance: This step identifies spatially the key contributors (i.e. regions, countries) to the pollution at one given location. The methodology is designed to identify and rank the contribution (to air pollution levels) of all neighbouring and non-neighbouring regions for a specific sector of activity. This step sets the basis for fixing priorities in terms of regional collaboration with a view to increase the efficiency of abatement strategies on a sectorial basis.
- Scenario: The scenario analysis represents the final stage in the process, once the key sectors of activity and their respective impact areas have been identified through the first two steps. Based on these first two steps, the policymaker can decide the desired sector-specific emission abatement in terms of intensity (i.e., percentage reduction) and spatial coverage and test the impact of this specific emission scenario on air quality levels.

SHERPA is based on Source-Receptor Relationships (SRR). These SRR are a simplified version of a Chemistry Transport Model (CTM), used to simulate the contribution to concentration levels due to all precursor emissions (NO_x, NMVOC, PPM, SO_2 and NH_3) from one particular area of the domain (Clappier et al. 2015). They are used to estimate the effect of changes in precursor emissions on pollutant concentrations. In general, a SRR model consists of algebraic relationships between gridded precursor emissions and concentrations.

The most precise way to use a CTM to produce SRR for the model domain would be with a grid cell-to-grid cell approach. This involves simulating independently the effect of emissions changes in each single grid cell in the model domain. It would require changing precursor emissions in individual grid cells (source cells) one at a time and looking at the resulting change in concentrations in each receptor cell. While theoretically very simple, the resulting number of unknown parameters, describing the transfers between source and receptor cells that need to be identified is very large. Because each of these unknowns requires a specific equation, itself deriving from an independent CTM run, this grid cell-to-grid cell option is very costly, and simplifying assumptions that reduce the number of CTM runs are required.

In SHERPA, an approach is taken that reproduces the grid cell-to-grid cell approach, but does not require anywhere near as many CTM model runs. Instead, SHERPA assumes that the unknown parameters, describing the transfers between source and receptor cells, vary on a cell-by-cell basis but are no longer independent of each other. Instead the transfer coefficients are related through a bell shape function, assuming that the impact of emissions (within a source cell) on the concentration at a receptor cell decrease with distance between the source and receptor cells (Clappier et al. 2015, Pisoni et al. 2017).

Given its cell-to-cell characteristics, the SHERPA SRR formulation can be used to assess the impact of emission reductions over any given set of grid cells. Cities, regions or countries can therefore be freely defined in terms of boundaries, to test the effect of emission reduction policies on concentrations. At a given location, the contributions (primary or secondary, or sectoral) from the grid cell emissions belonging to the selected area (city, region or country) are calculated explicitly. These contributions correspond to the impacts on air pollution that would result if emissions from a particular sector or spatial scale were switched off. In other words, SHERPA mimics the "dynamic" responses of a CTM for such emission reductions. We refer to this type of contributions as "source allocation", in contrast to 'source apportionment" contributions that correspond to a "static" decomposition of the current air pollution levels. As shown by Clappier et al. (2017), the differences between the two approaches can be important when quantifying the contributions of precursors involved in chemical reactions leading to secondary particulate matter. Detailed information about the formulation of the source-receptor relationships, their accuracy, robustness and their validation process is available in Clappier et al. (2015), Thunis et al. (2016) and Pisoni et al. (2017).

In its current configuration, SHERPA is based on the CHIMERE (Menut et al. 2014) model covering the whole of Europe at roughly 7 km spatial resolution. The anthropogenic emissions underlying the model simulations are based on GAINS total emissions per country-pollutant-sector for 2010, gridded with proxies from the MACC-TNO emission inventory (Kuenen et al., 2014) with residential sector emissions modified to account for the enhanced wood consumption at extremely low temperatures (Terrenoire et al., 2015). The meteorological input data is based on IFS (Integrated Forecasting System from ECMWF) for the year 2009 (choice discussed further in Annex 2).

Because of its simplifying assumptions and spatial resolution, SHERPA only calculates yearly average concentration levels of $PM_{2.5}$ for relatively large cities (covering a sufficient number of grid-cells).

Annex 2: Uncertainties and limitations

SHERPA

As mentioned in Annex 1, SHERPA relies on simplifying assumptions to speed up the computing time and enable a generalization of its results to most EU cities. The two main assumptions of the approach are: (1) linearity between concentration and emission changes (i.e. a doubled emission reduction will generate a doubled impact) and (2) a simple "bell shape" function to spatially relate emission and concentration changes. These assumptions have been extensively assessed. The validation process, covering test cases in many EU cities, regions and countries, showed good agreement between the SHERPA SRR and the full CHIMERE model (Pisoni et al. 2017). However, these assumptions are not valid for short-term concentration averages and this is why the present analysis is limited to yearly average $PM_{2.5}$ concentrations. Additional information about the formulation of the source-receptor relationships, their accuracy, robustness and their validation process is available in the references listed in Annex 1.

Spatial resolution

SHERPA and its underlying CTM both run with a 7 km spatial resolution. Schaap and al. (2015) showed that this resolution was accurate enough to capture urban background concentrations, the focus of this work. This spatial resolution however limits the analysis to the largest EU cities as smaller cities might cover too few grid cells. This is why a threshold of about 300 km^2 (~ 6 grid cells) is applied on the city selection. Note that emissions within a grid-cell, crossed by the city (or greater city, country) boundaries, are attributed to the city proportionally to the city area included within the grid cell.

The underlying Chemistry Transport Model

The SHERPA results strongly depend on the CTM used to define its SRR. The approaches to represent meteorological and chemical processes indeed vary from one model to the other, leading to potential uncertainties. Although the CHIMERE CTM, in a similar configuration, has been extensively validated against observations (Bessagnet et al. 2016), it is not possible to validate CTMs for model-responses to emission changes. This is the reason why CTMs are regularly tested in the frame of inter-comparison exercises (Cuvelier et al., 2007; Vautard et al. 2007). The robustness of the results can also be assessed by comparing SHERPA responses to responses obtained in specific regional areas with other models, at the same or different resolutions. This process of inter-comparison is on-going, to increase the reliability and robustness of the whole approach.

Data reported as relative fractions

One of the findings of past modelling inter-comparison exercises (e.g. CityDelta, EuroDelta, Cuvelier et al., 2007, Thunis et al., 2007) is that relative fractions (i.e. concentration change divided by concentration) are generally more robust than absolute values (concentration). This is because concentration changes and concentrations are generally correlated (an overestimation of the concentration is likely to lead to an overestimation of the concentration change as well). All results are therefore expressed in terms of relative fractions.

International shipping and external contributions

Although the SHERPA modelling accounts for the impact of emissions from international shipping and from countries outside the EUR30 domain (boundary conditions), these contributions cannot be distinguished from each other. They are grouped in a category named "external". This external impact is important in harbour cities, where international shipping emission can be important and in urban areas that are close to the EUR30 borders.

Emissions

The results presented here strongly depend on the quality of the underlying emission inventory. Uncertainties in emission inventories are known to be high, especially at the urban scale, as highlighted by Trombetti et al. (2017) who compared different EU wide top-down inventories in different cities. Because results directly depend on this input data, the city "fiches" include information on the emissions feeding the model for each urban areas. In this respect, we hope that the results presented here (emissions and source allocation) can be used to trigger the discussion with local air quality managers to detect possible inconsistencies and support the improvement of the underlying emission inventory. Another source of uncertainty is related to the reference year (2010) which does not account for emission changes that occurred in the most recent years.

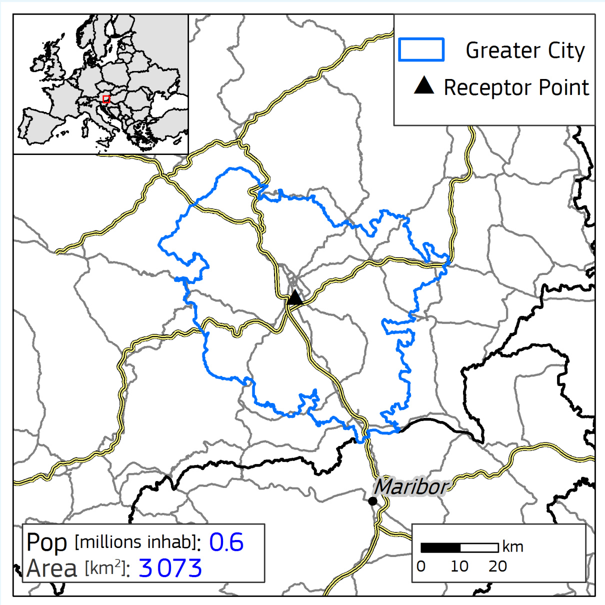
SHERPA distinguishes sectoral impacts, but point sources (for which the release height becomes an important element) and surface sources are treated similarly. This might introduce some uncertainty in the sectoral breakdown when both low- and high-level emission sources are present in a same sector.

Meteorological variability

The results presented in this report are based on a single meteorological year (2009). Although this year is thought to be representative of average meteorological conditions, the current set-up does not account for inter-annual variability. In this respect, repeating the analysis with other years would increase the robustness of the results. The fact that all results are presented in terms of relative fractions, however, reduces the possible impact of inter-annual variability.

Annex 3: A closer look city-by-city (150 city fiches)

Austria, Graz



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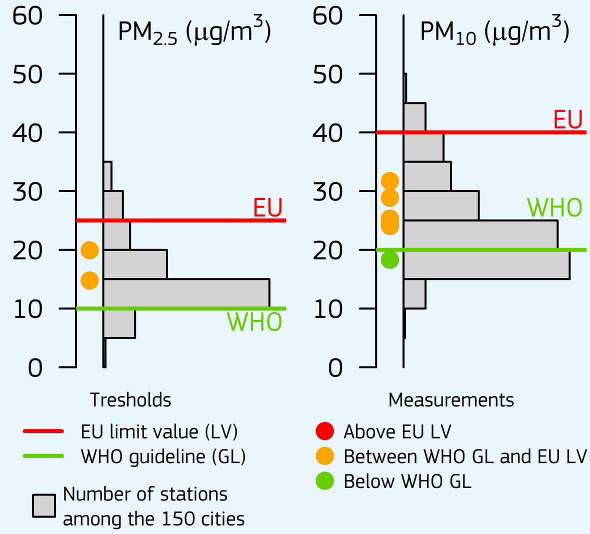
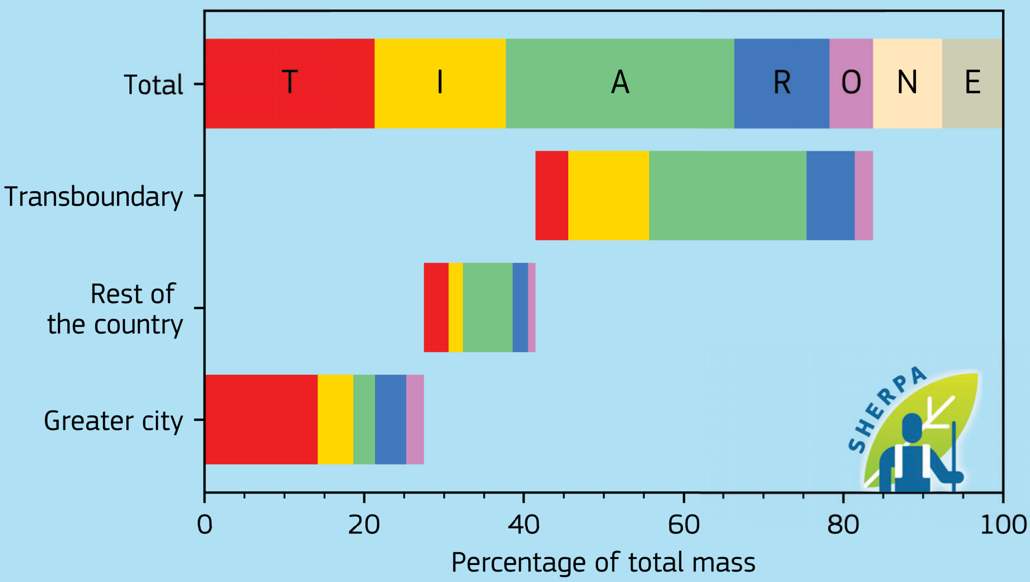


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



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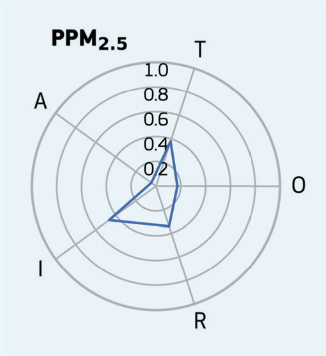
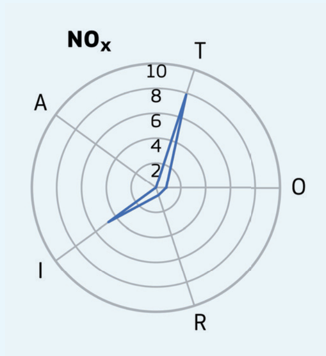
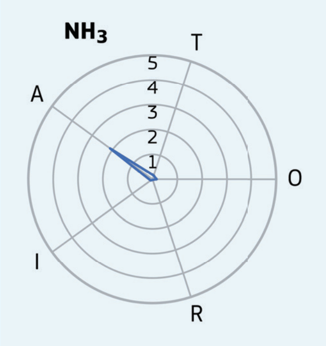
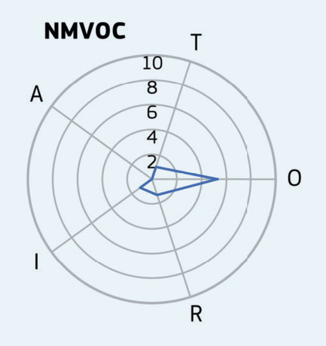
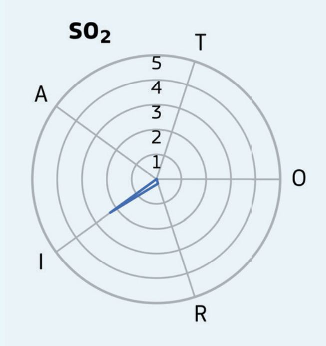


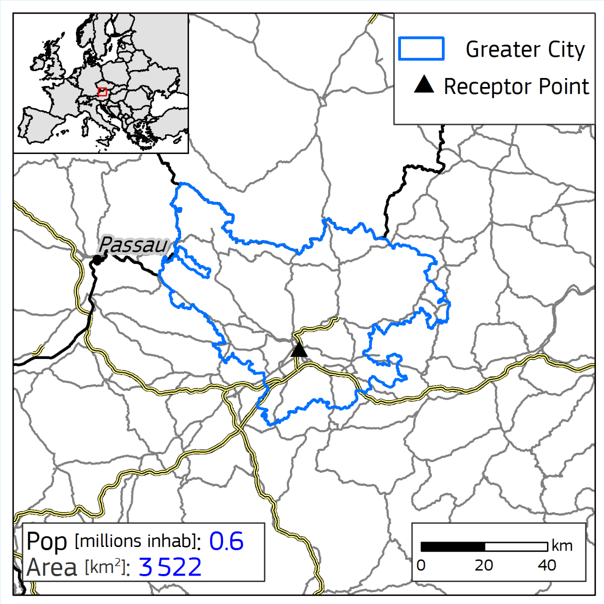








Austria, Linz



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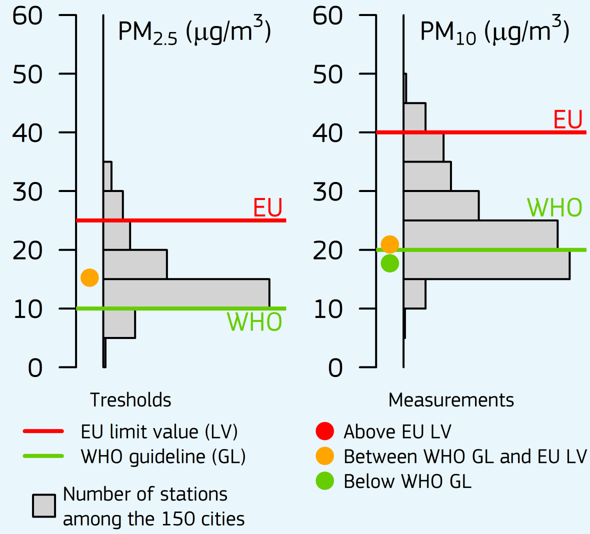
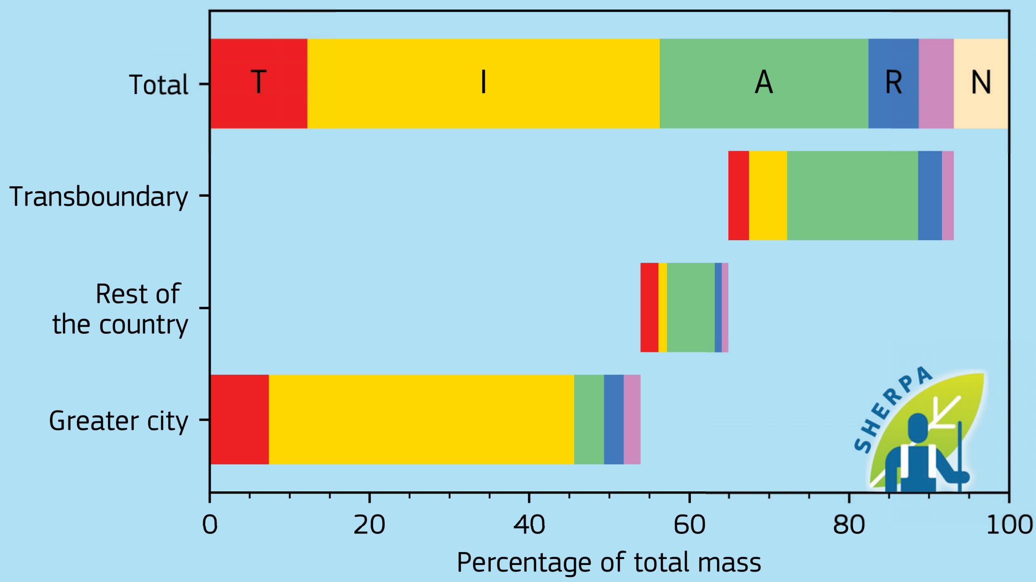


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



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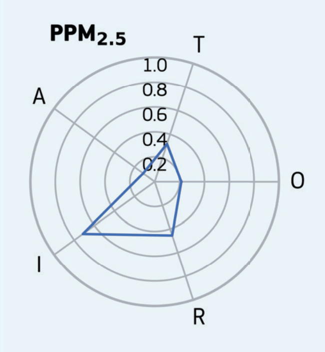
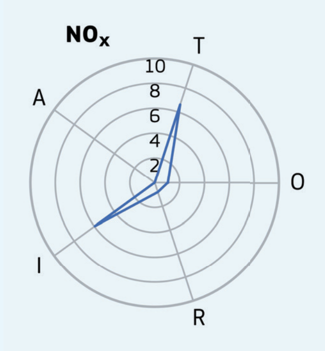
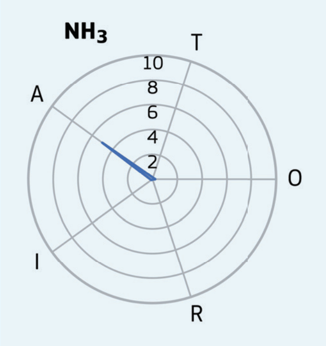
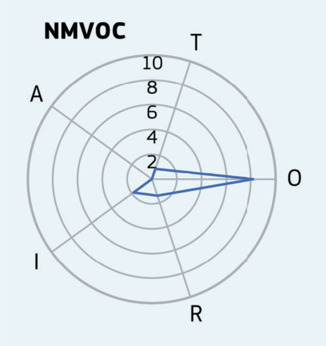
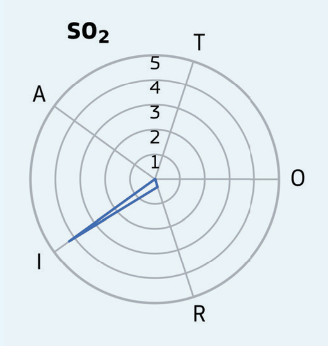


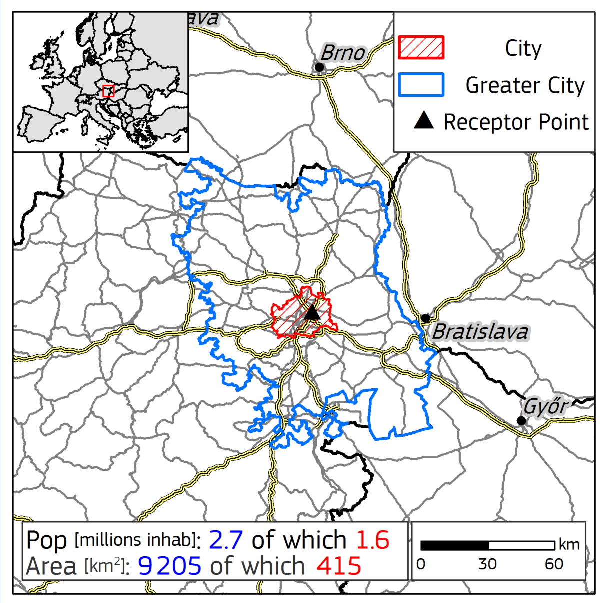








Austria, Vienna



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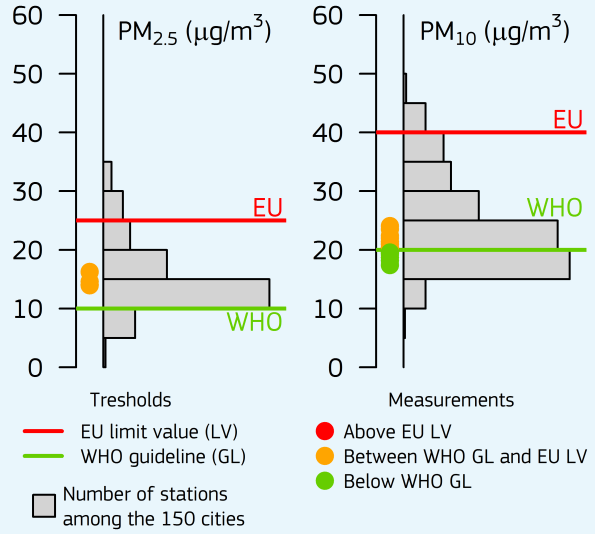
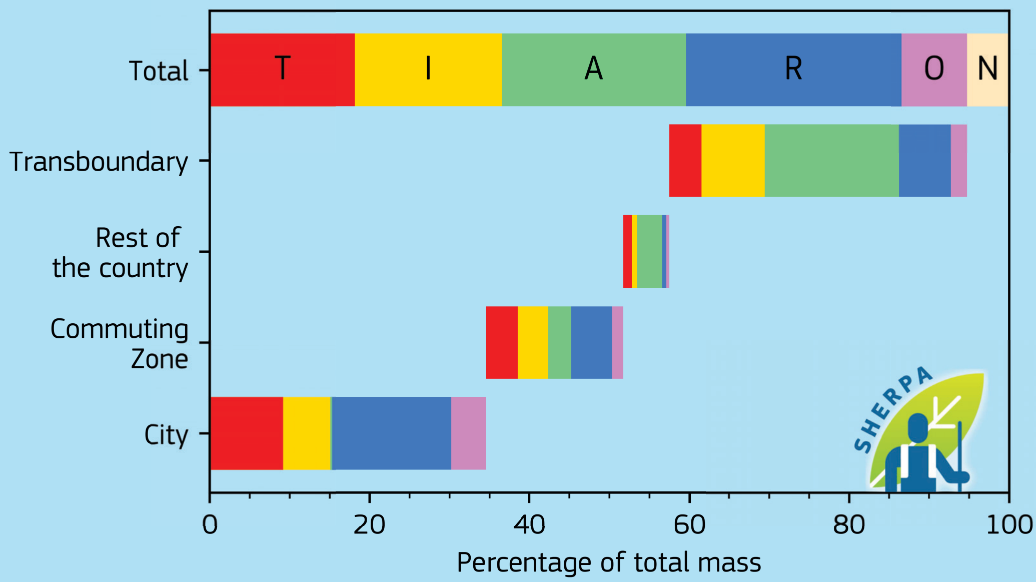


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



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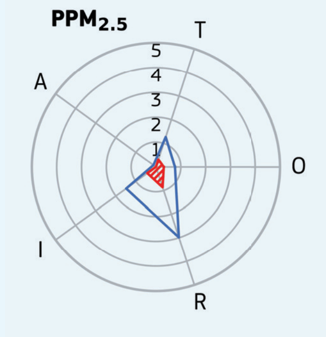
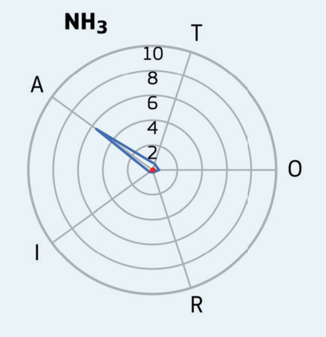
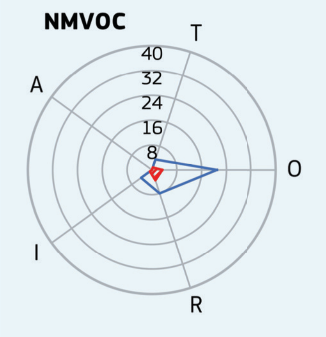
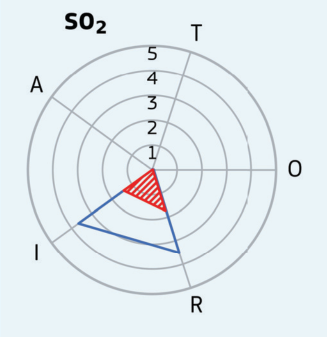
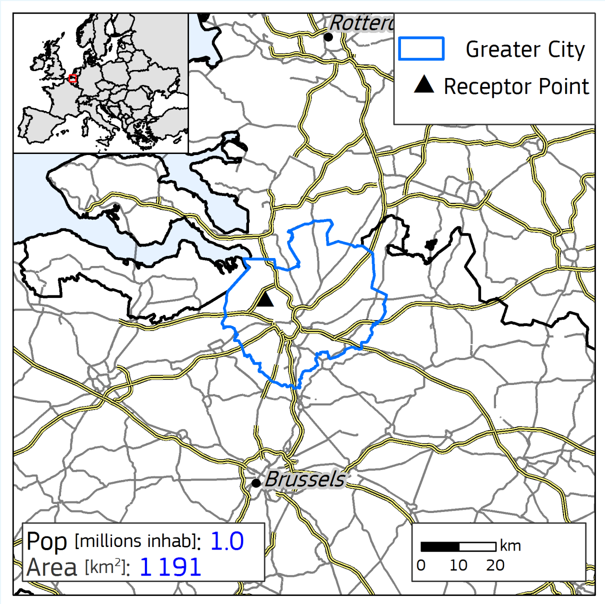




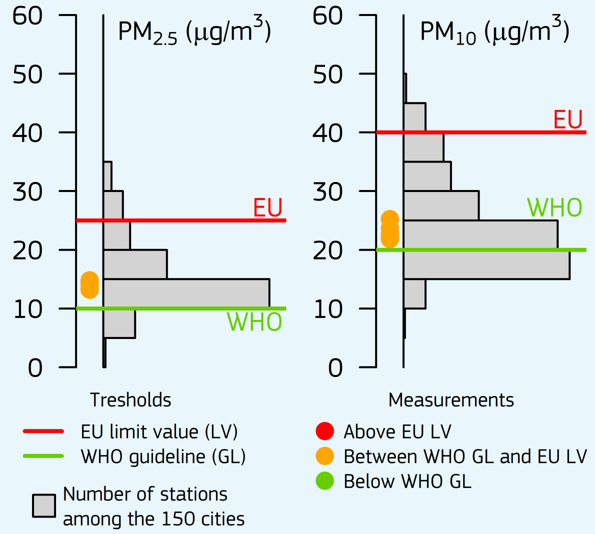




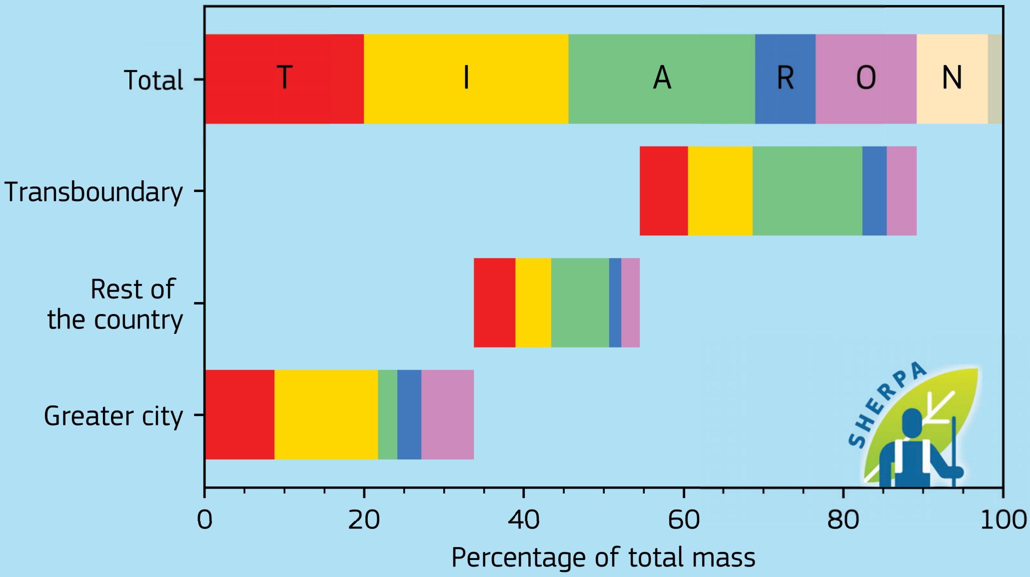
Belgium, Antwerp



Yearly average urban background (2015)



$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



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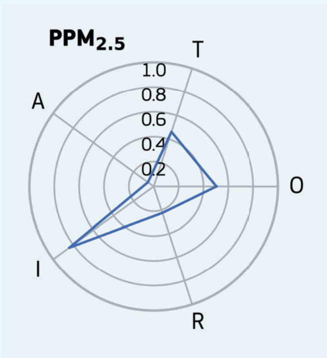
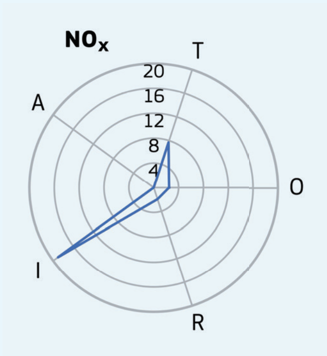
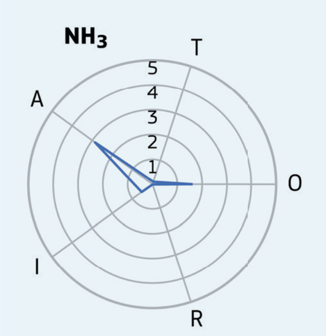
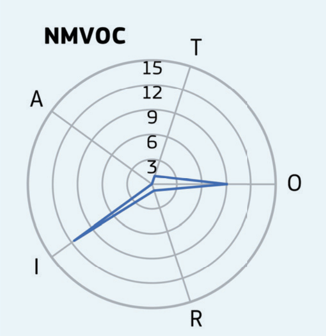
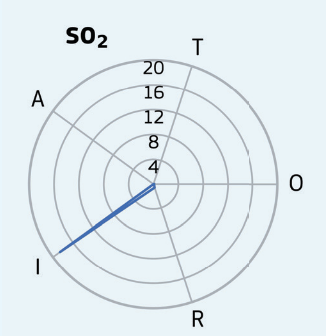


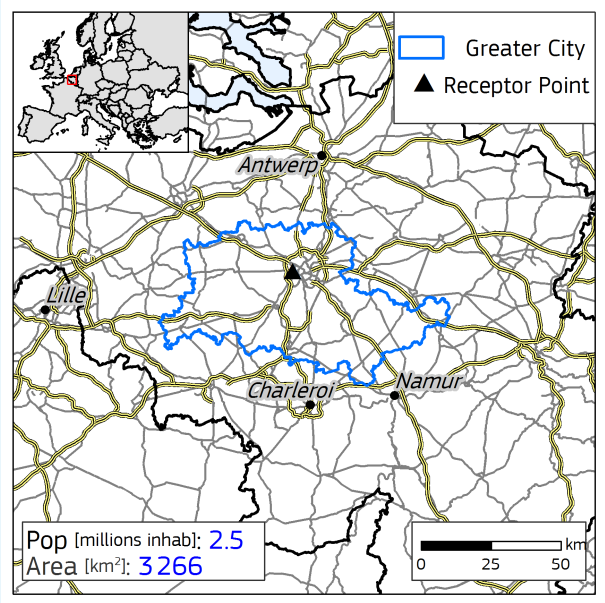




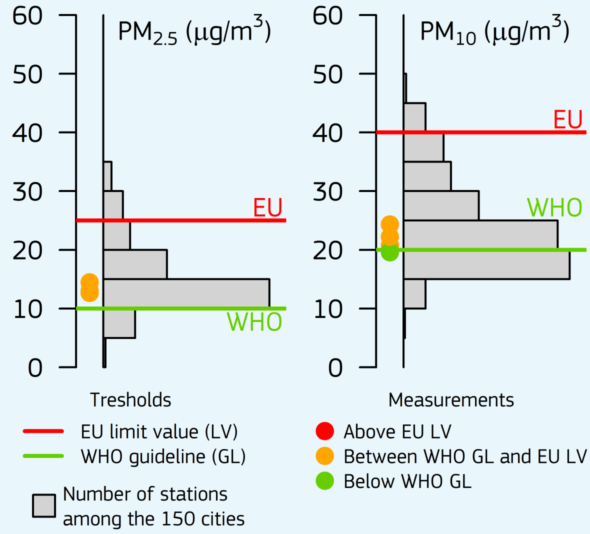




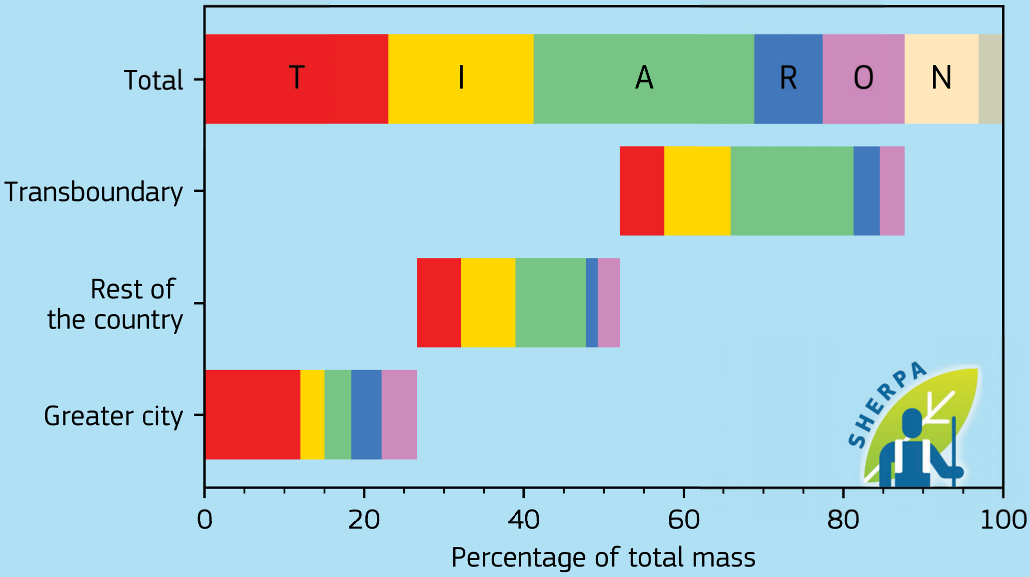
Belgium, Brussels



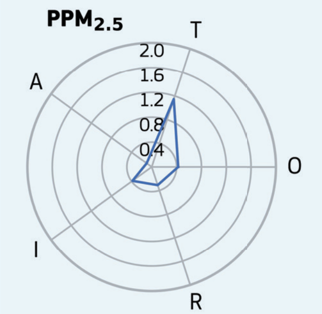
Yearly average urban background (2015)

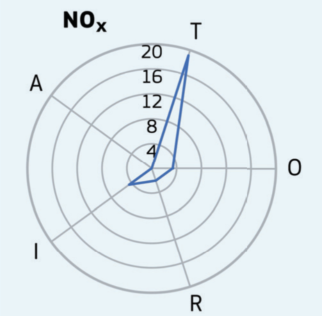


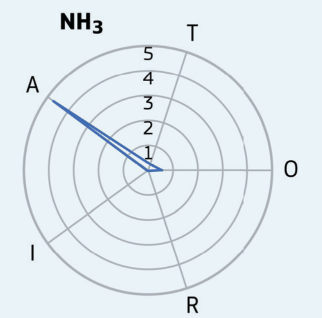
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

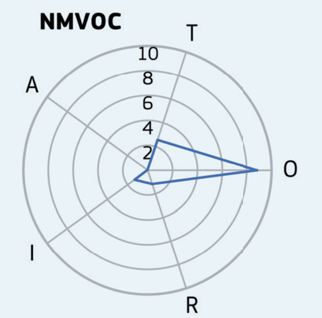


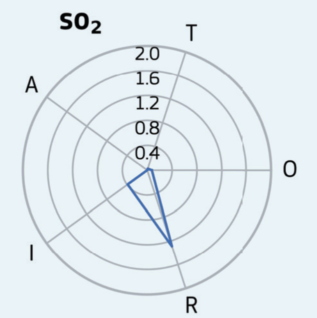
Emissions [kton/year]





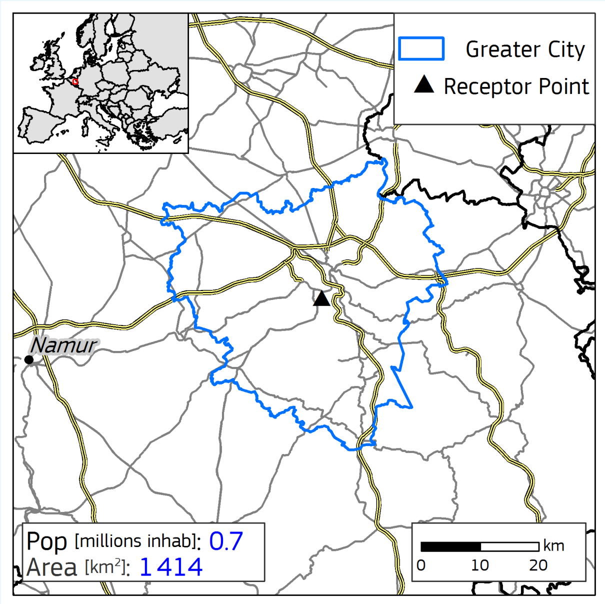




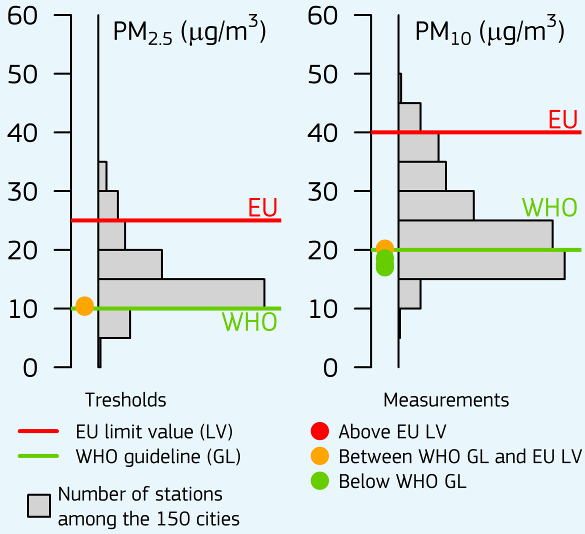


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city

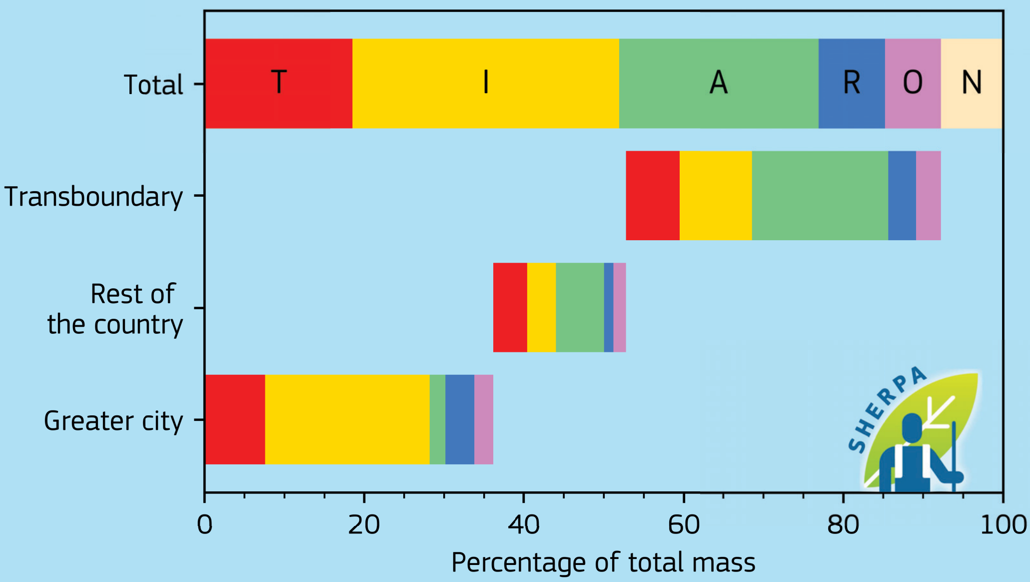
Belgium, Liege



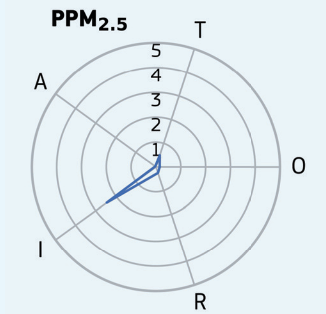
Yearly average urban background (2015)

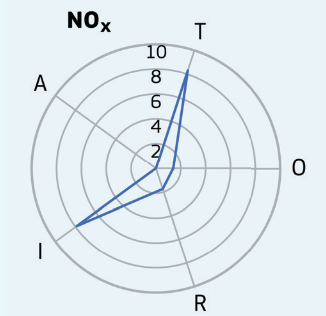


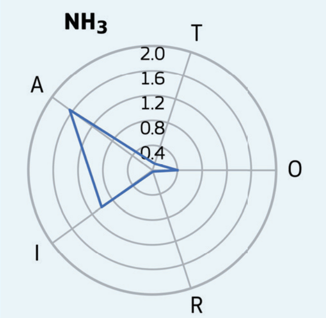
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

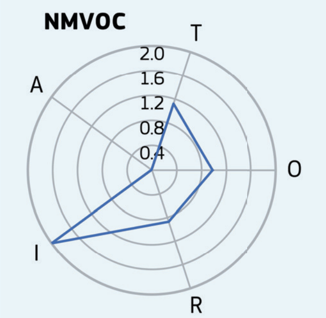


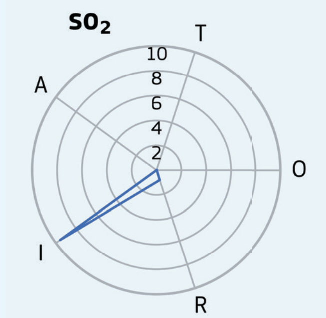
Emissions [kton/year]











- T - Transport
- I - Industry
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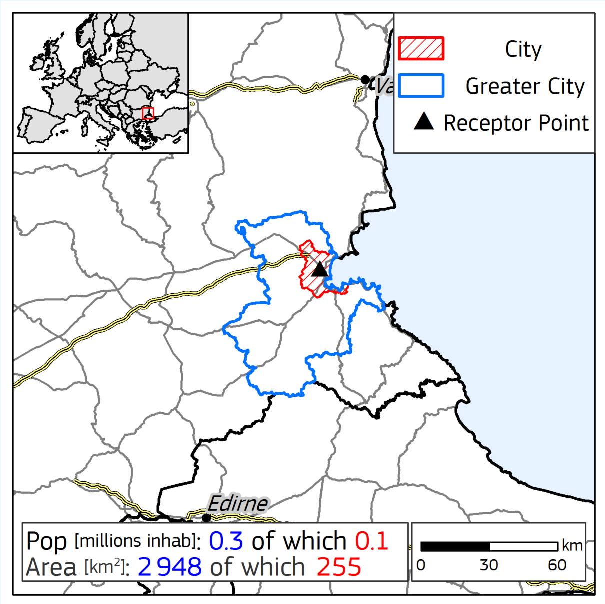
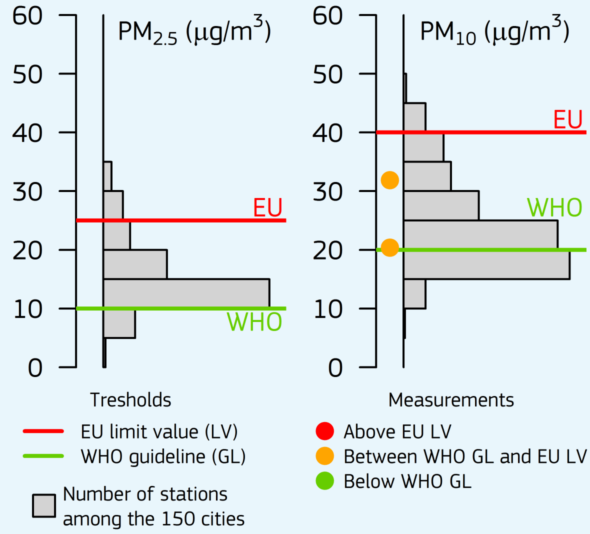
- R - Residential
- O - Other
- N - Natural
- Greater city

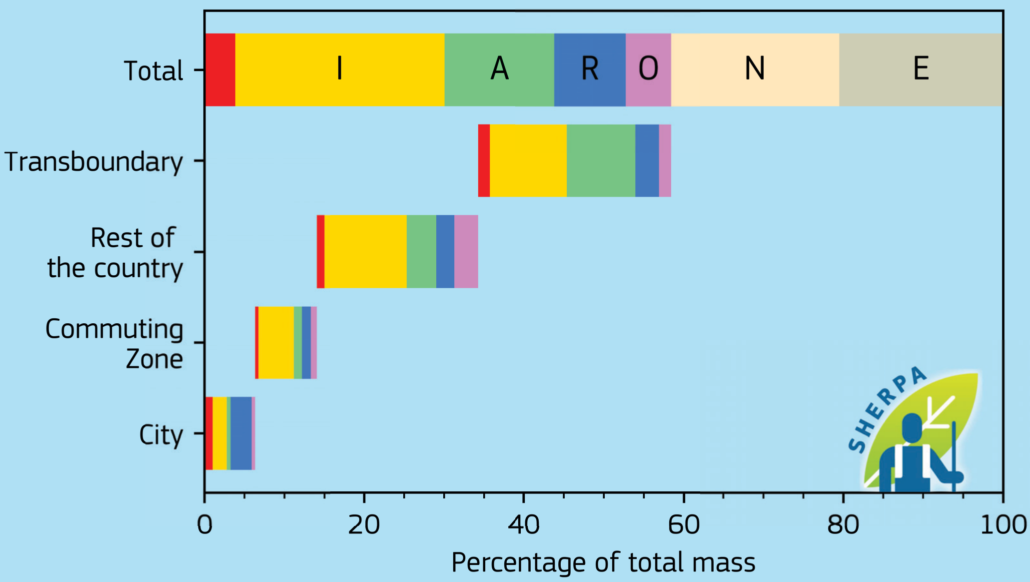
Bulgaria, Burgas



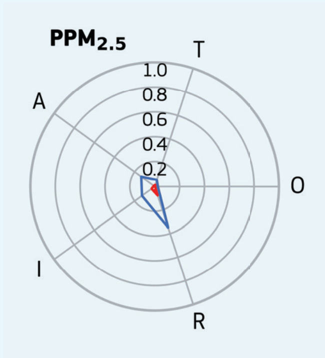
Yearly average urban background (2015)

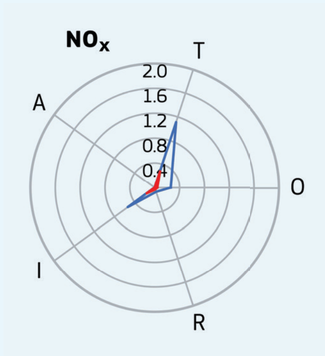


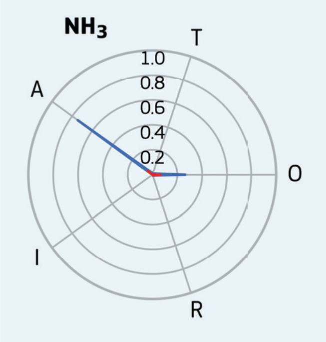
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

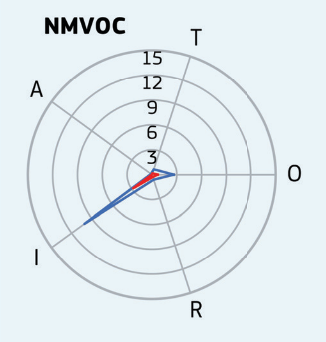


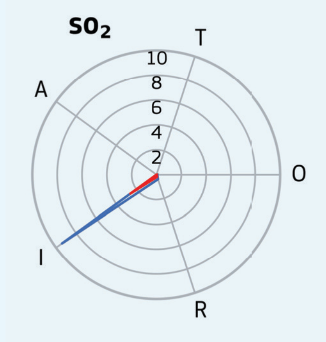
Emissions [kton/year]



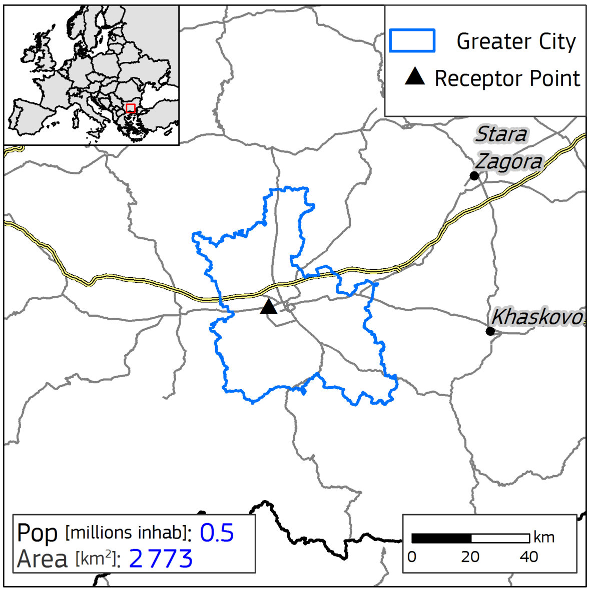




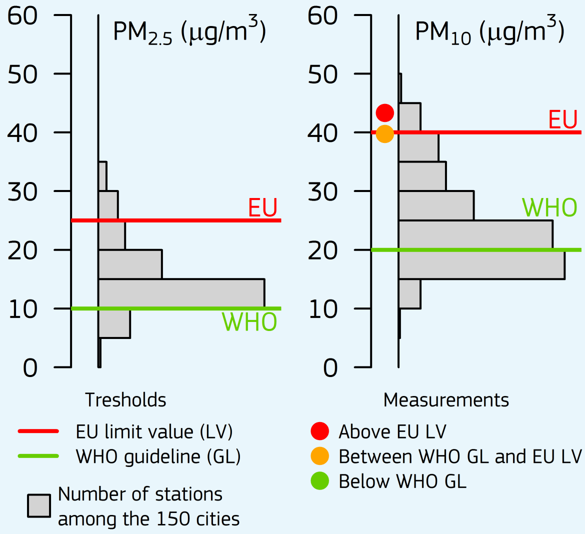




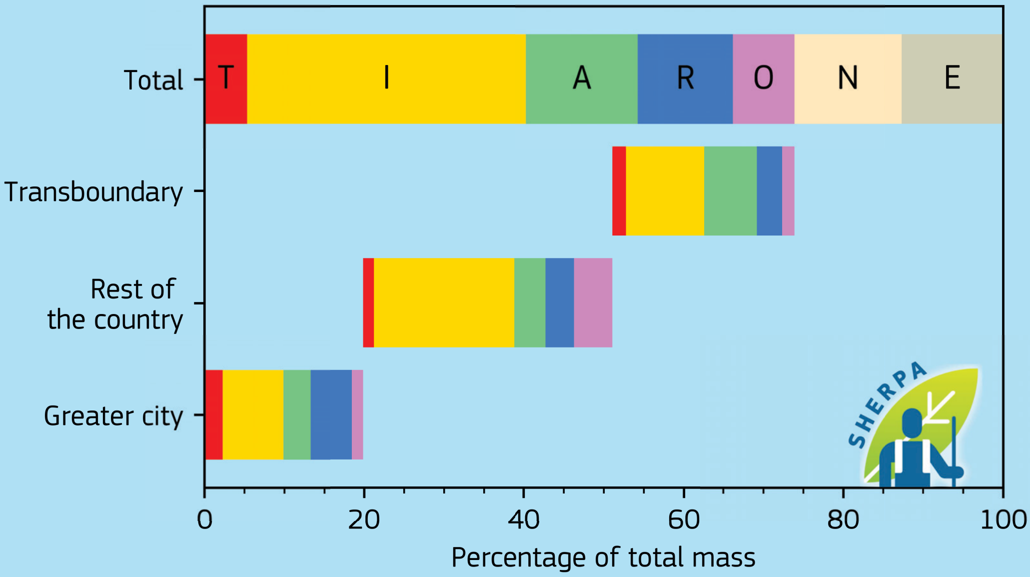
Bulgaria, Plovdiv



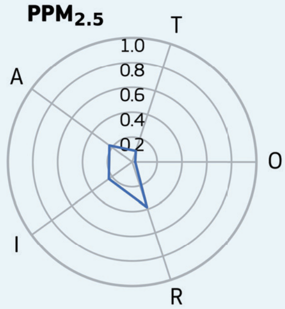
Yearly average urban background (2015)

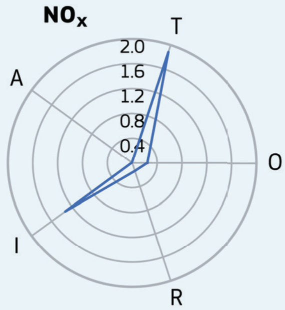


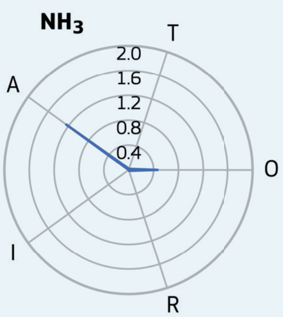
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

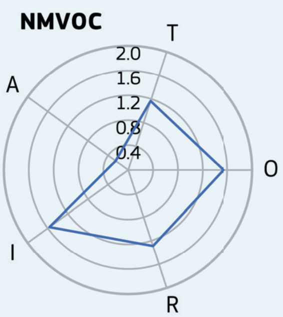


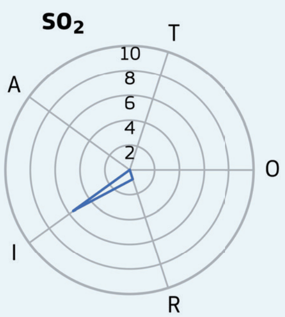
Emissions [kton/year]



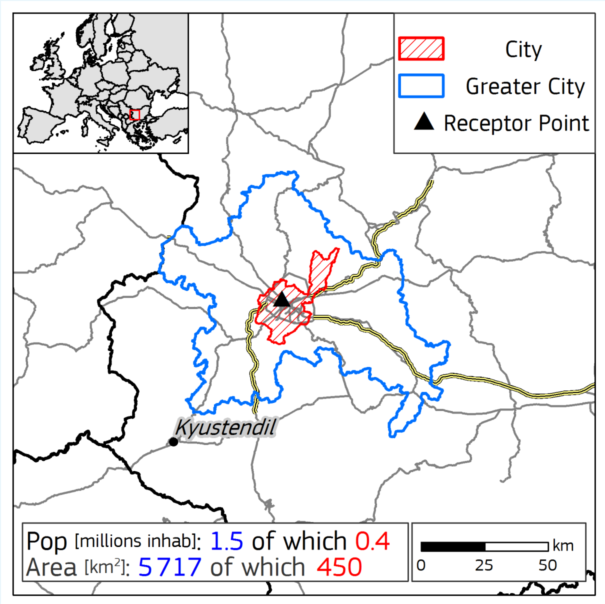




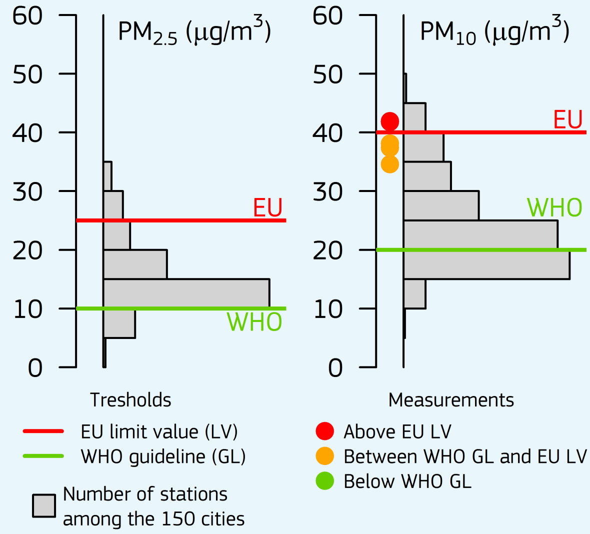




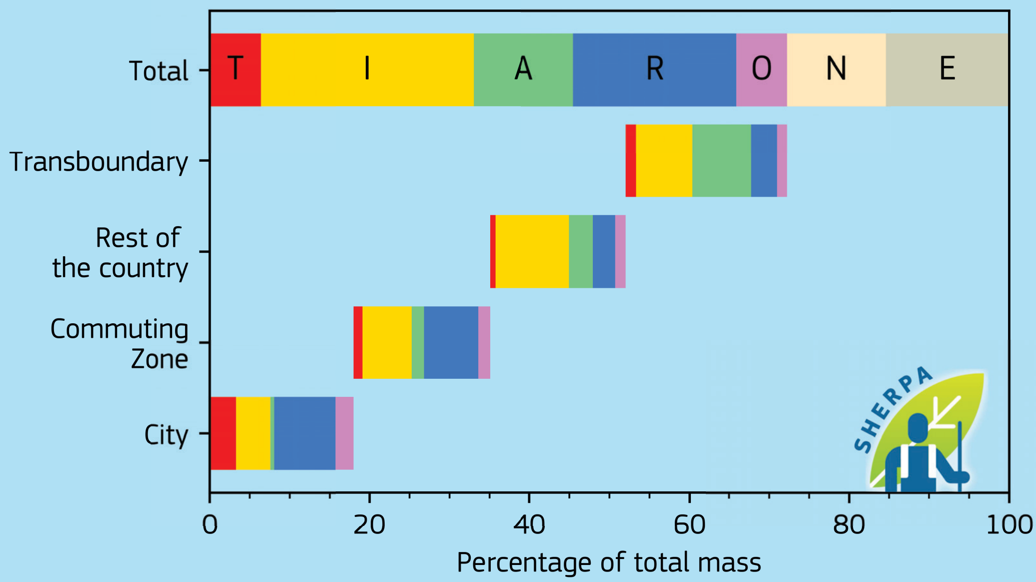
Bulgaria, Sofia



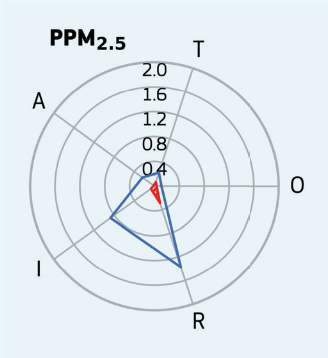
Yearly average urban background (2015)

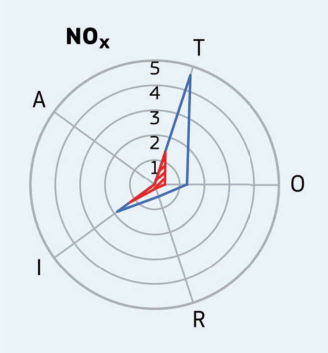


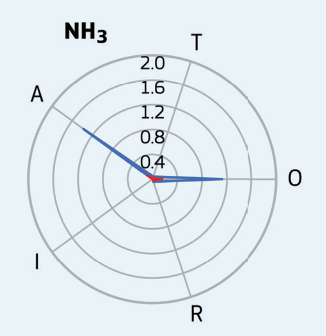
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

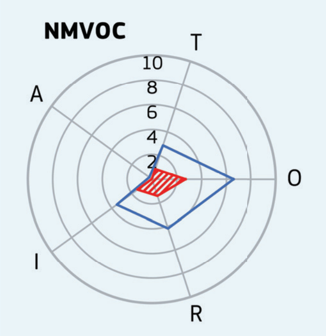


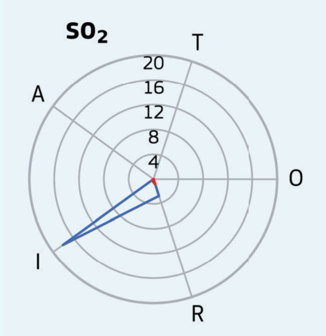
Emissions [kton/year]











- T - Transport
- I - Industry
- A - Agriculture
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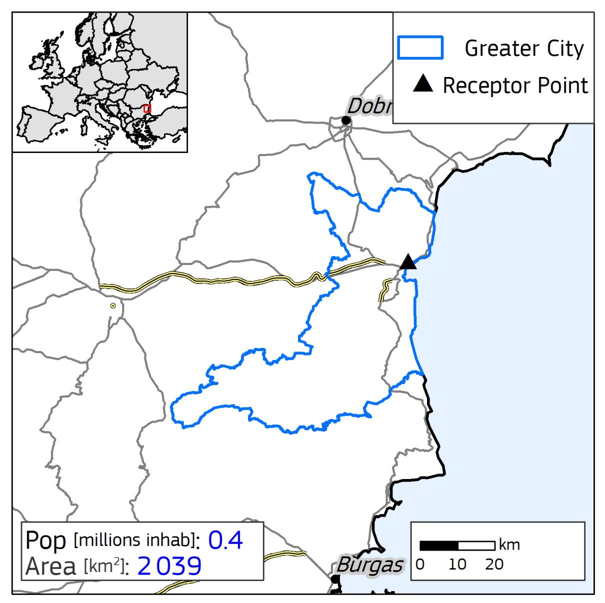
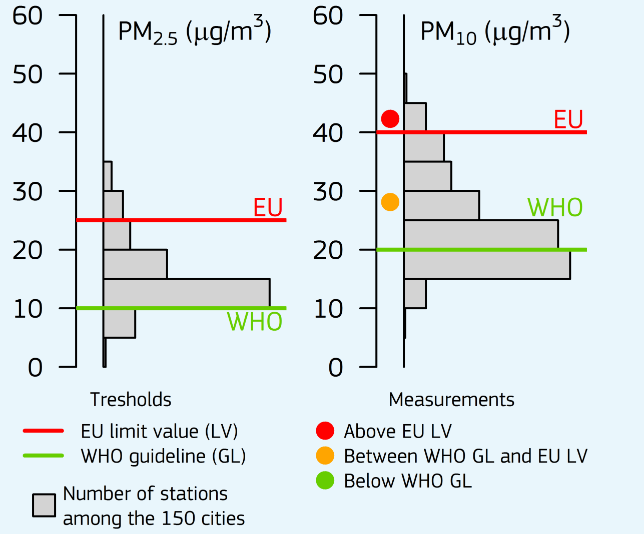
- O - Other
- N - Natural
- E - External
- Greater city
- City

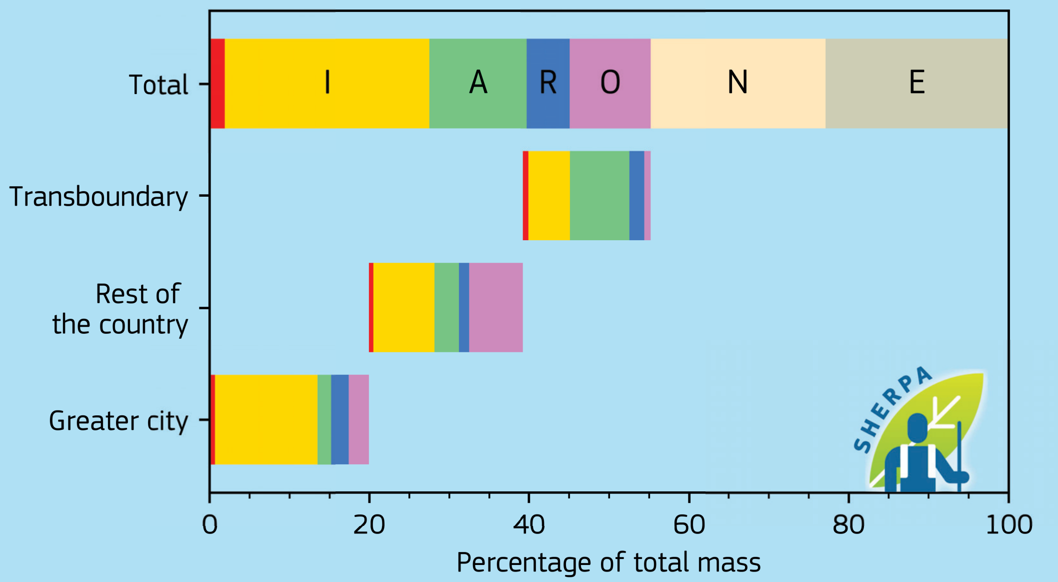
Bulgaria, Varna



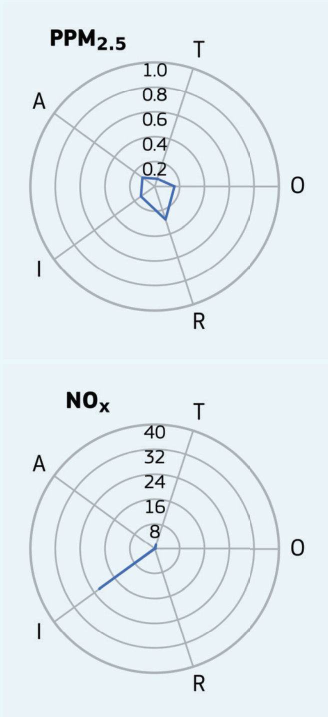
Yearly average urban background (2015)

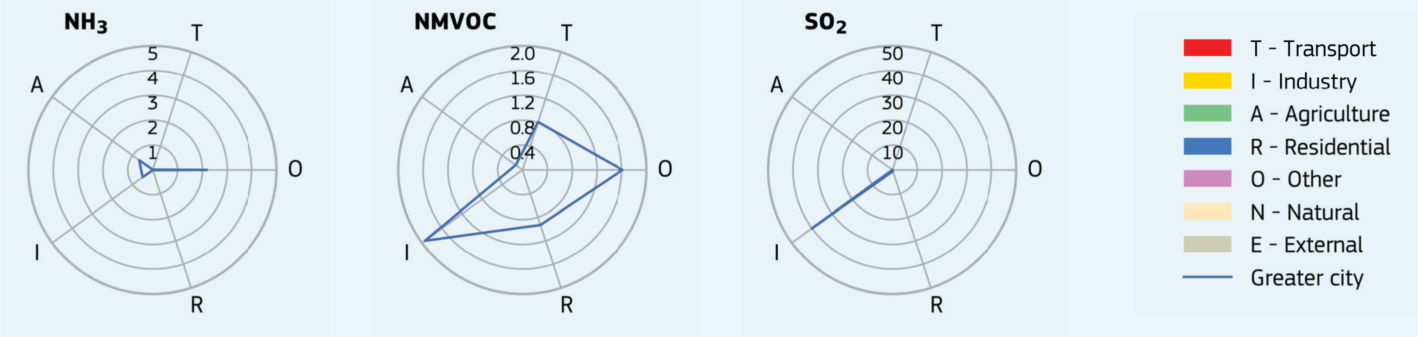


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

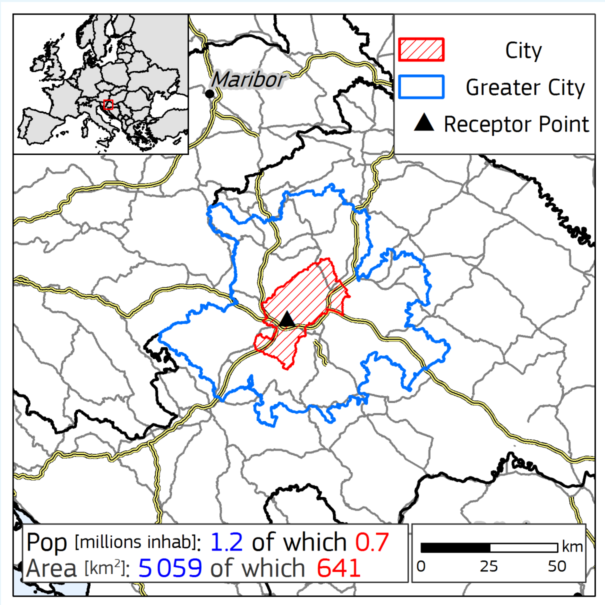


Emissions [kton/year]

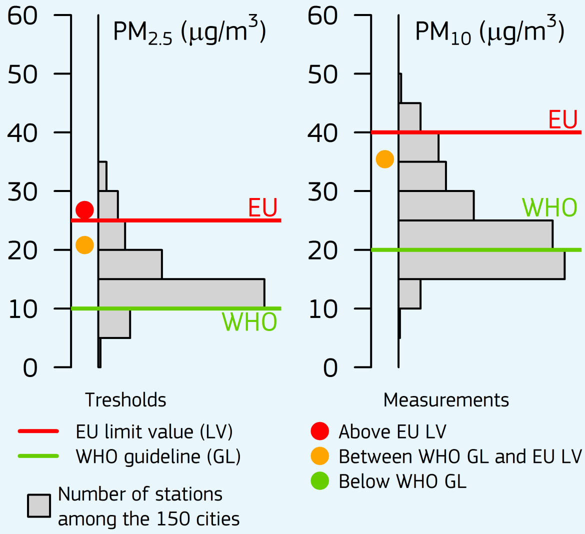




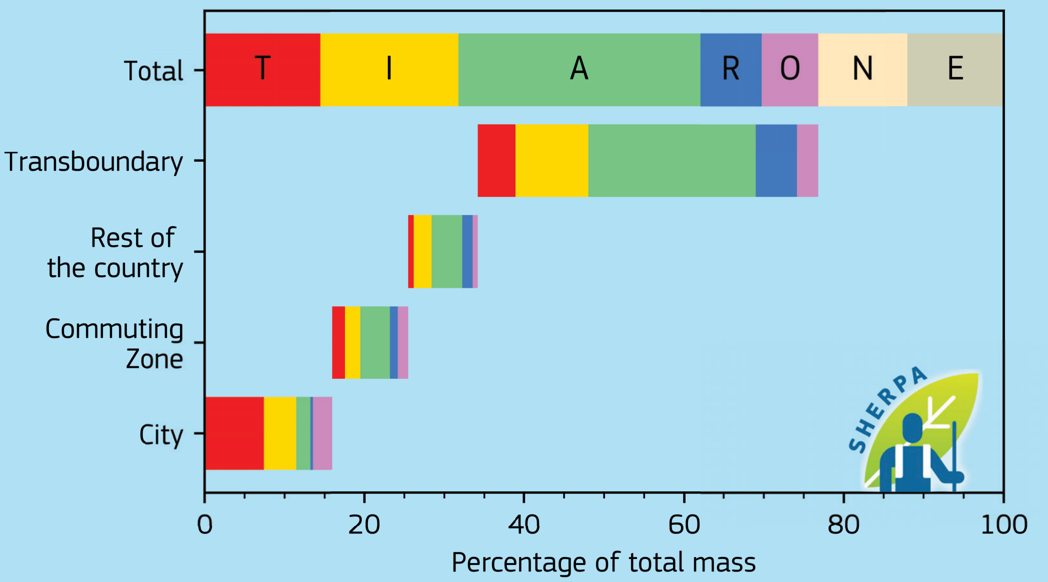
Croatia, Zagreb



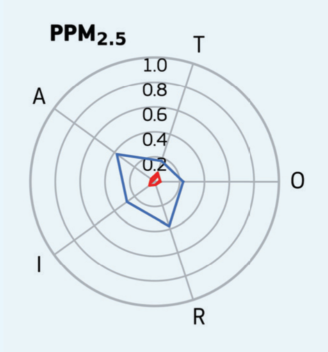
Yearly average urban background (2015)

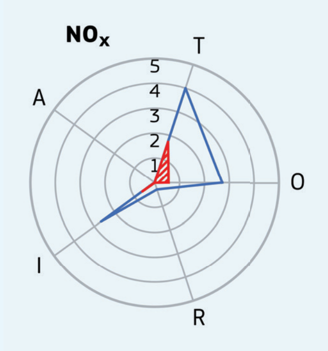


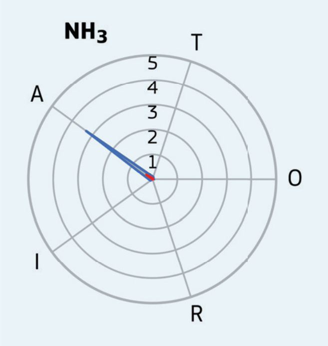
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

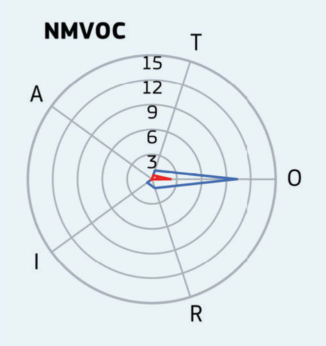


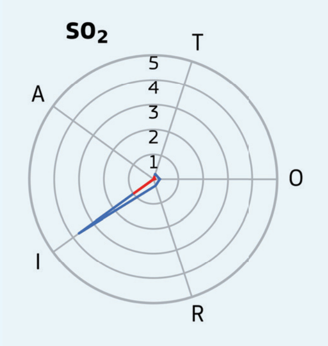
Emissions [kton/year]



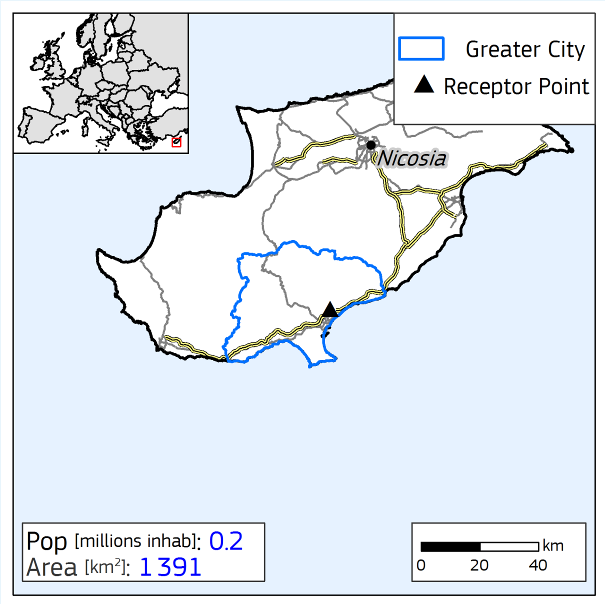




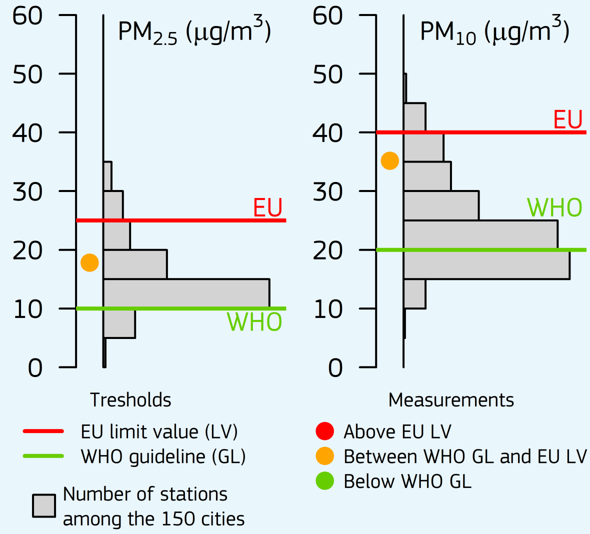




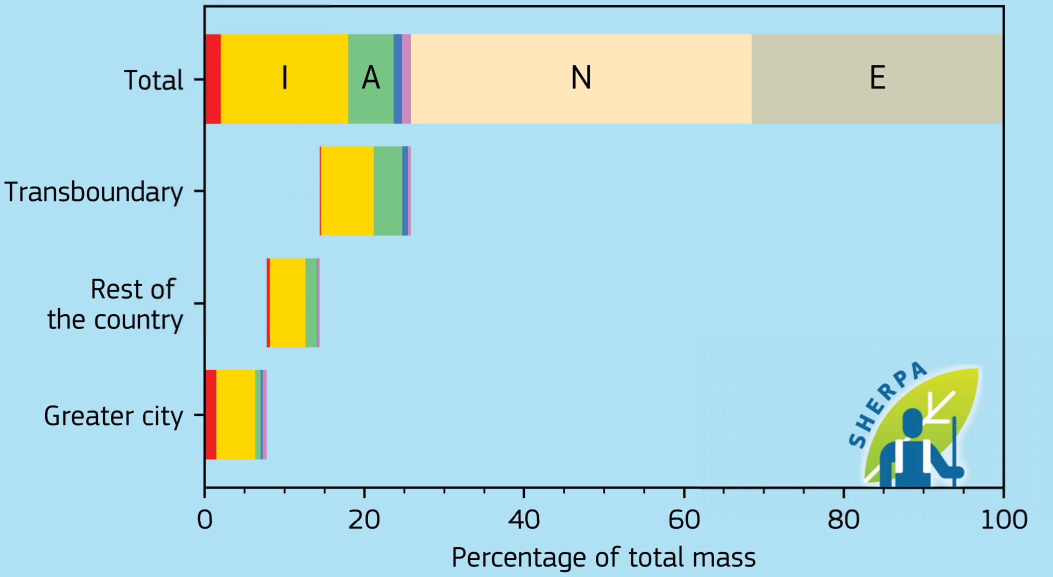
Cyprus, Limassol



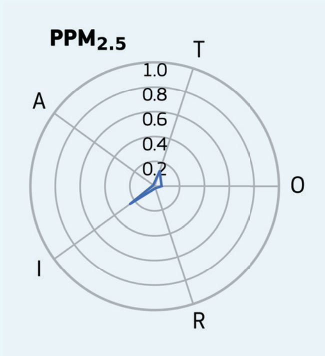
Yearly average urban background (2015)

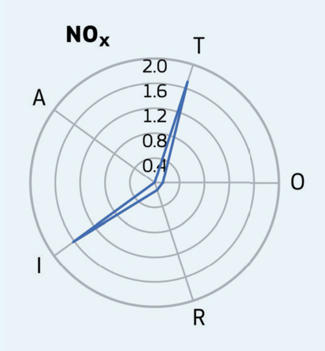


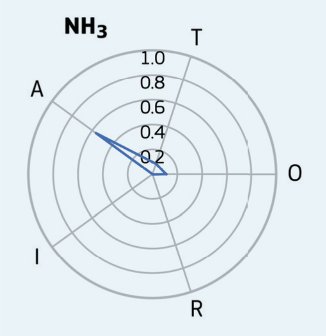
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

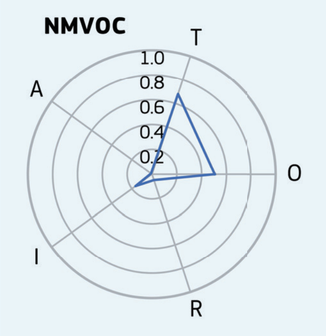


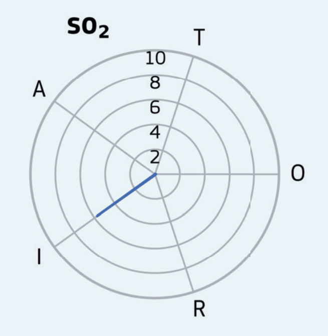
Emissions [kton/year]



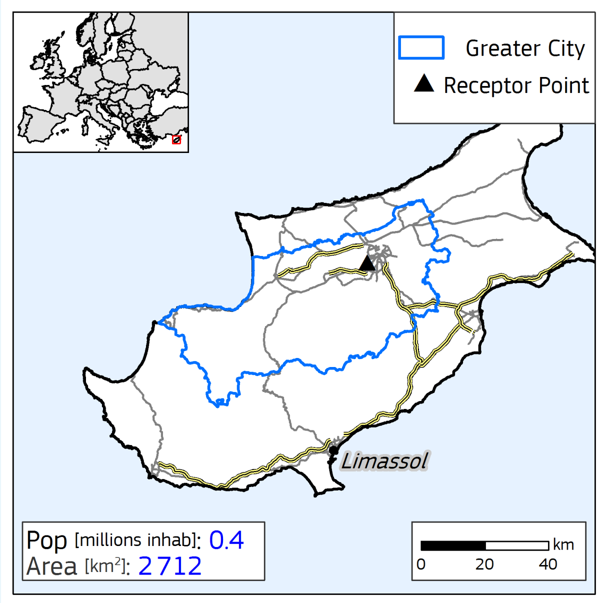




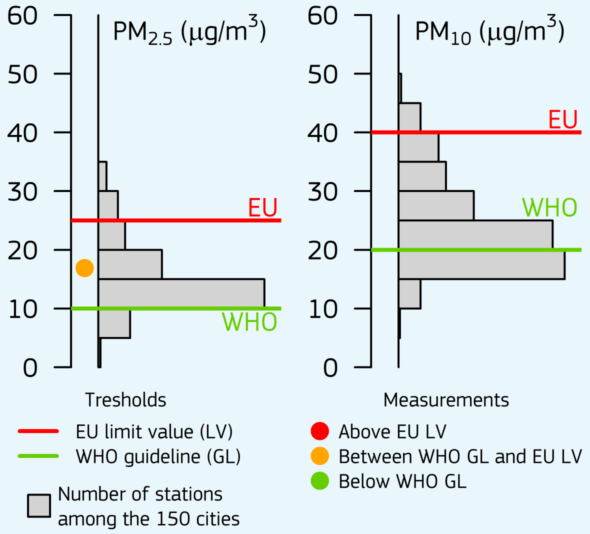




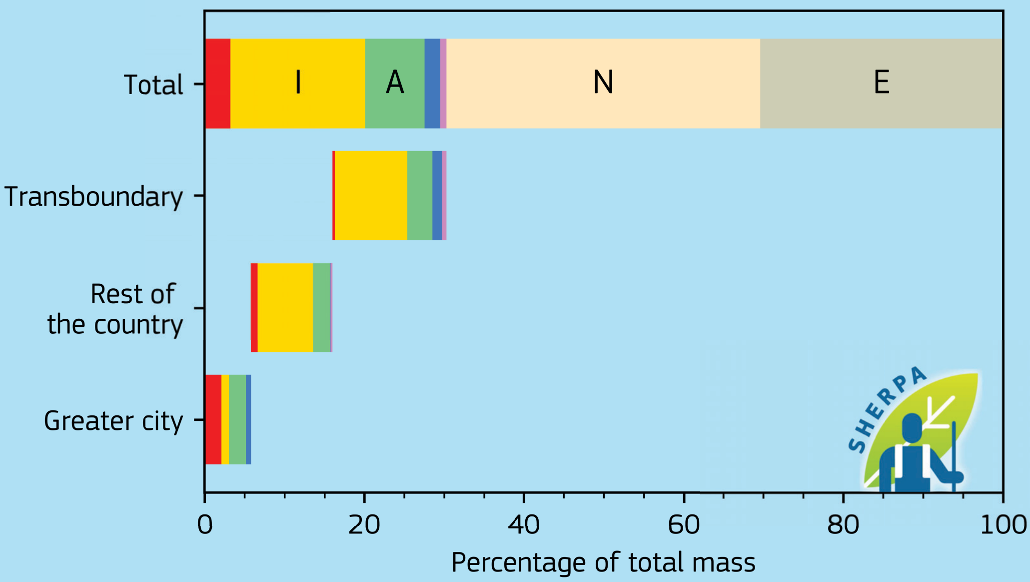
Cyprus, Nicosia



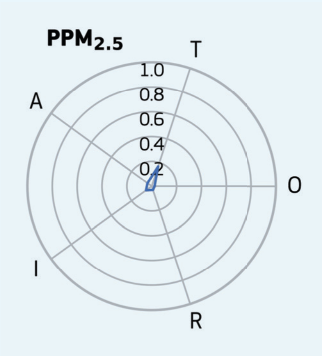
Yearly average urban background (2015)

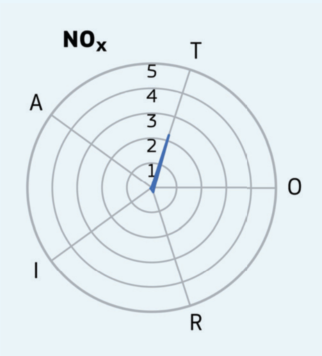


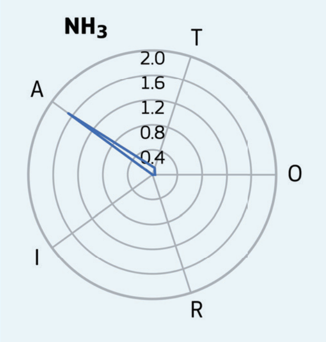
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

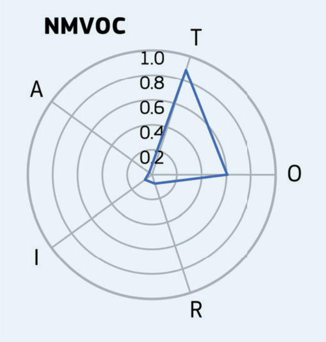


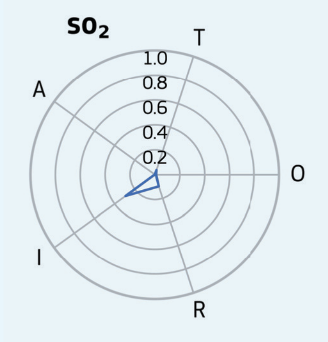
Emissions [kton/year]



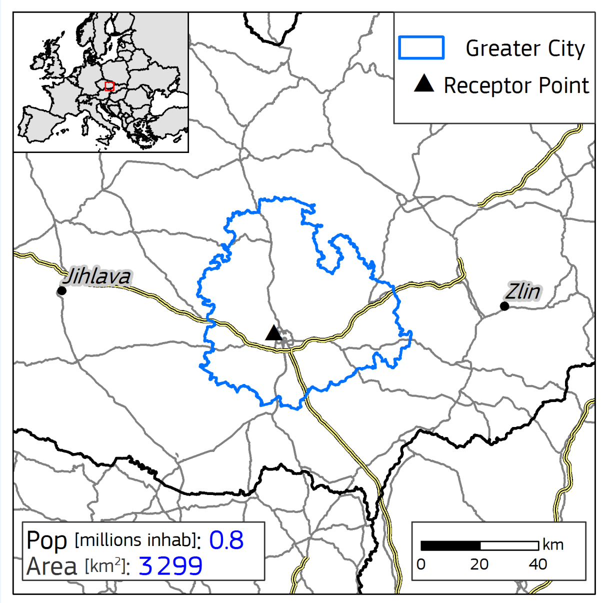




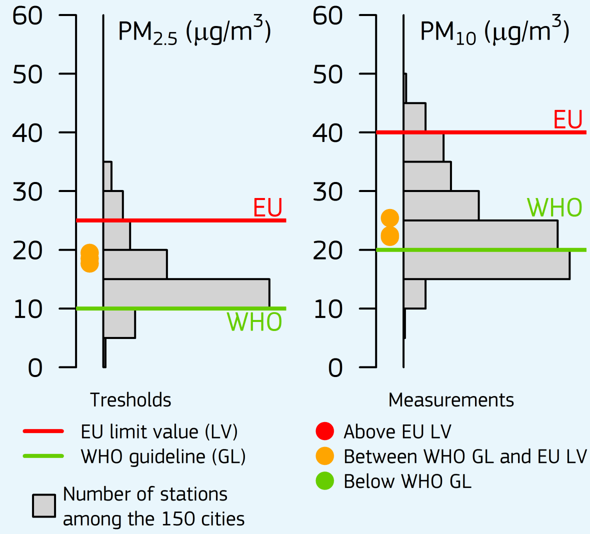




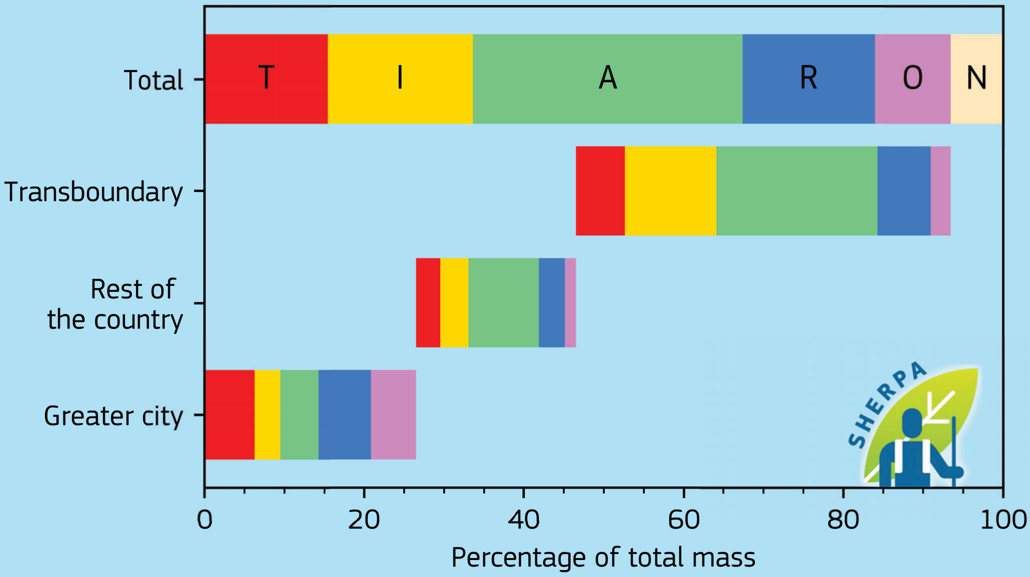
Czech Republic, Brno



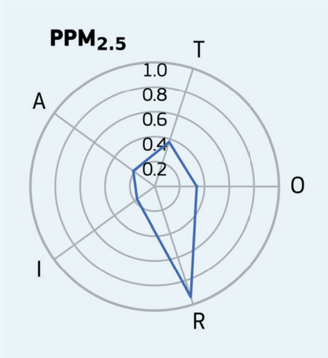
Yearly average urban background (2015)

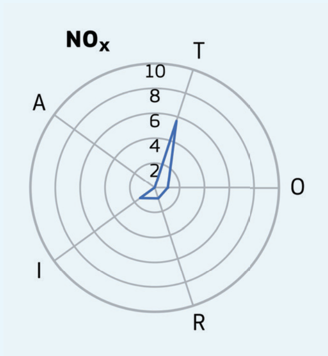


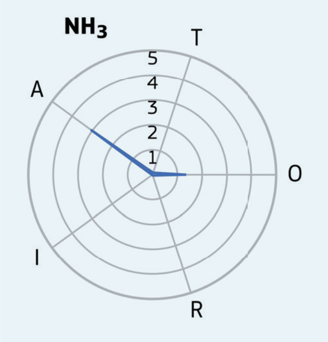
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

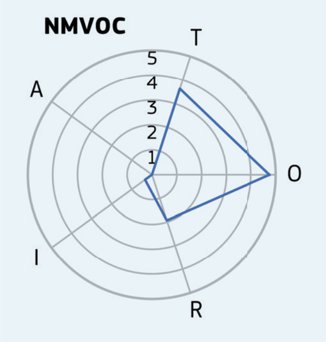


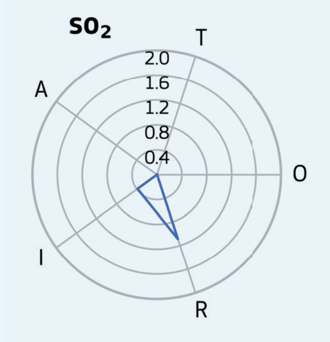
Emissions [kton/year]





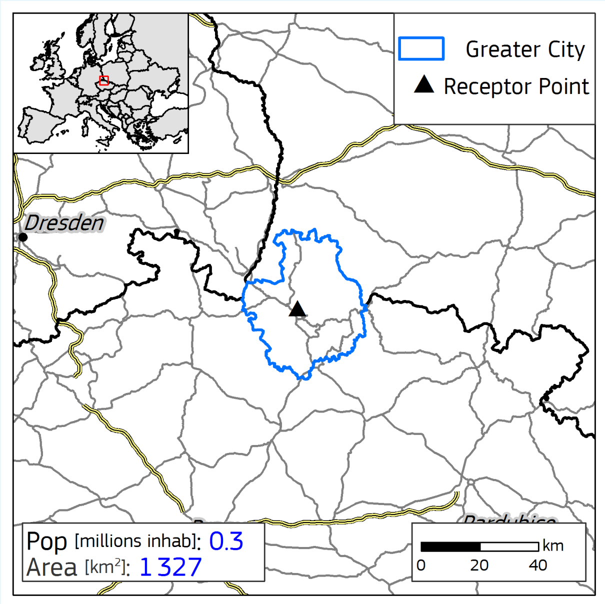




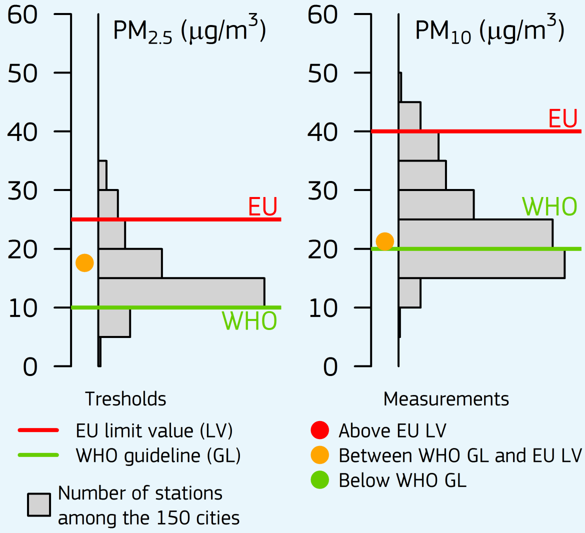


T - Transport
I - Industry
A - Agriculture
R - Residential
O - Other
N - Natural
Greater city

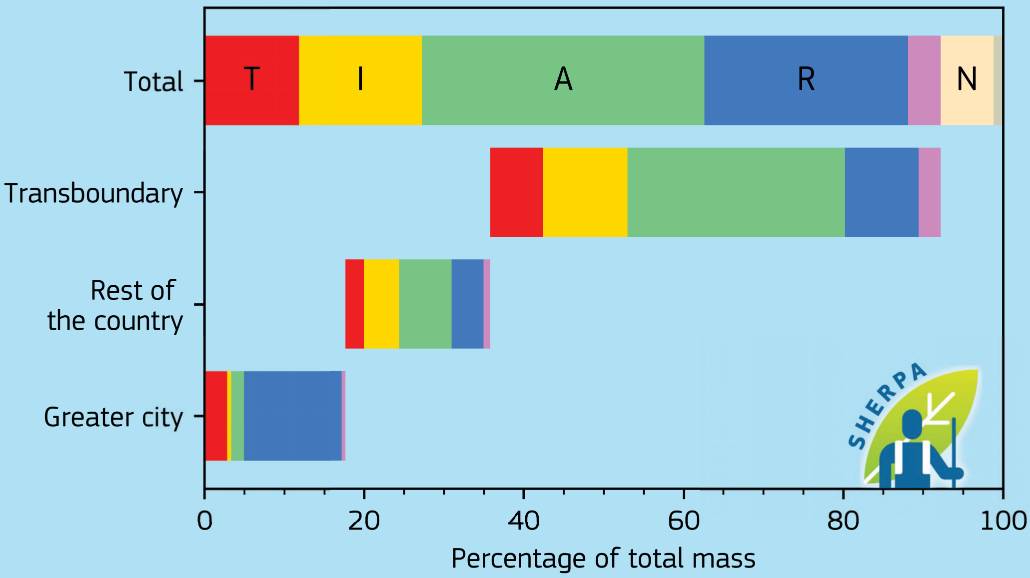
Czech Republic, Liberec



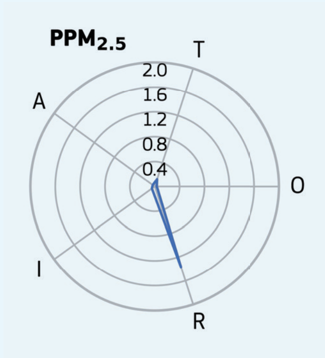
Yearly average urban background (2015)

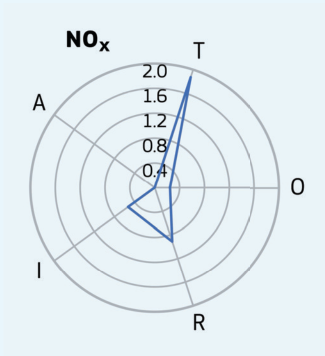


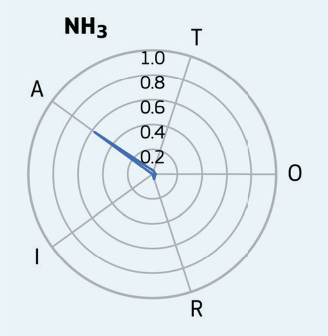
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

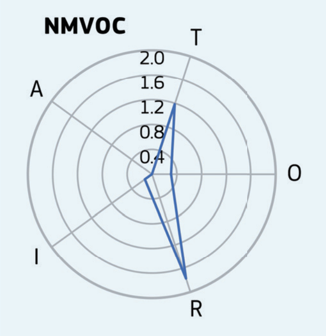


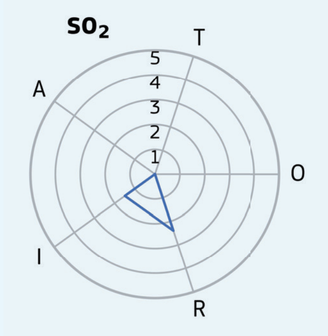
Emissions [kton/year]



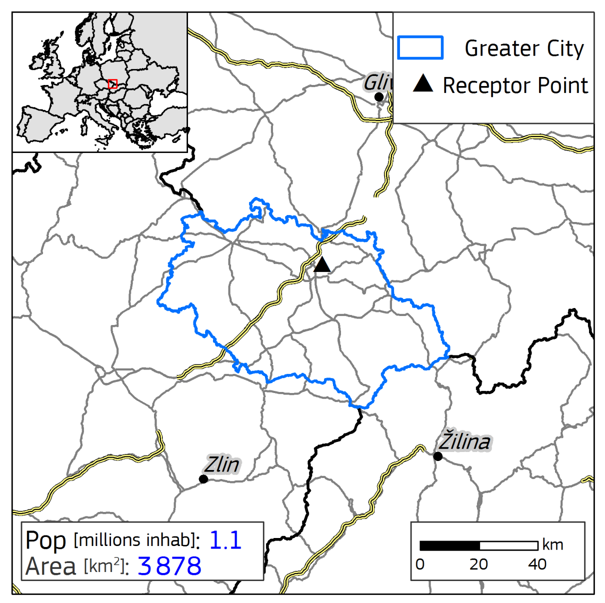




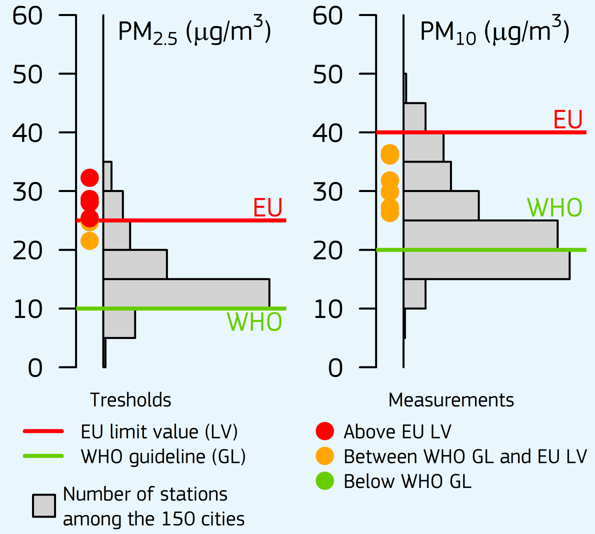




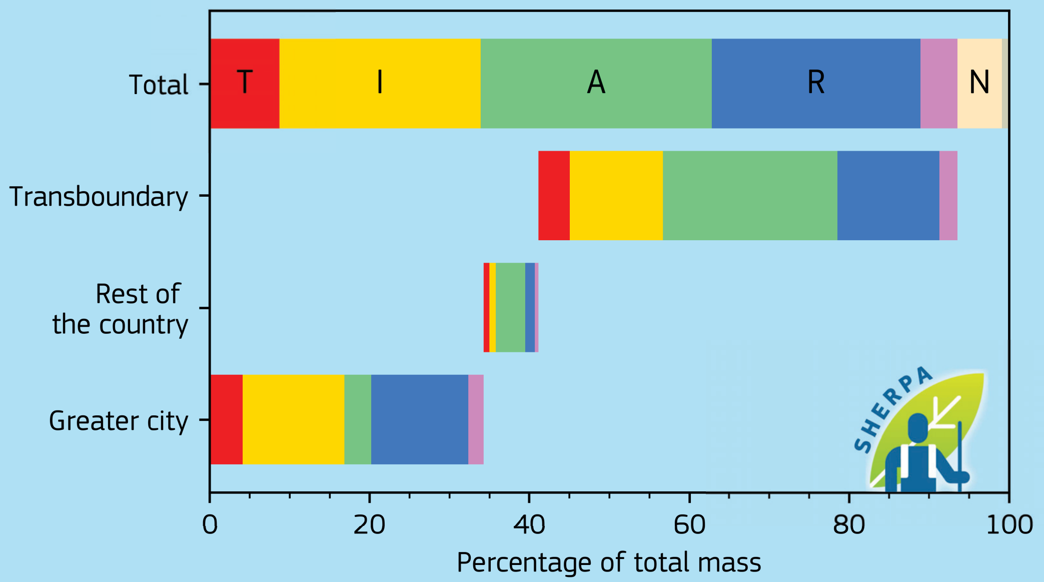
Czech Republic, Ostrava



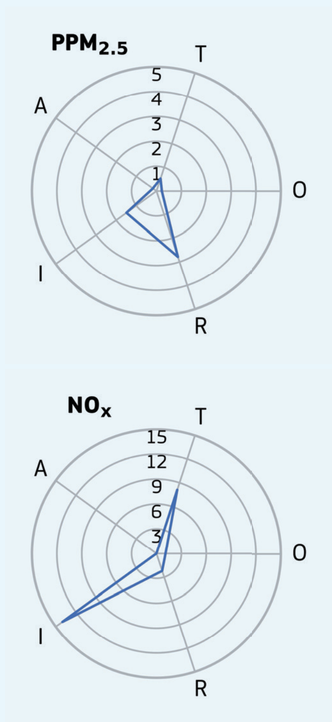
Yearly average urban background (2015)

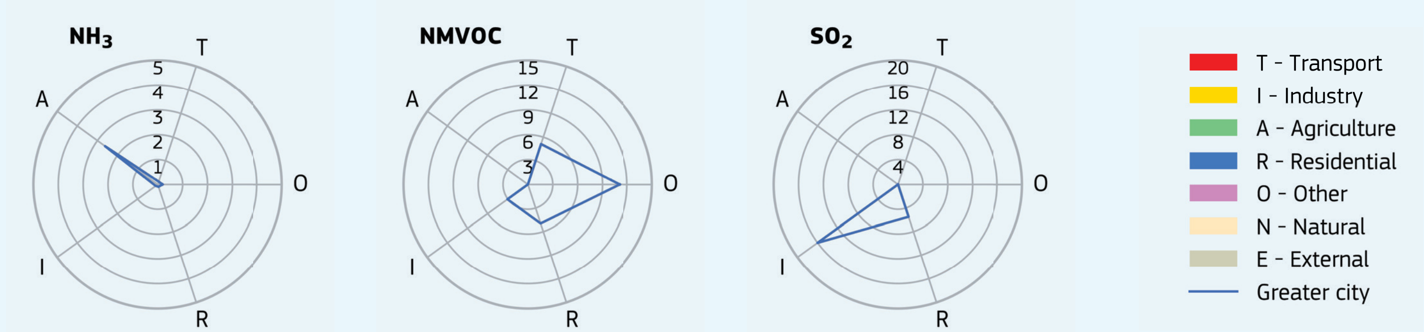


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

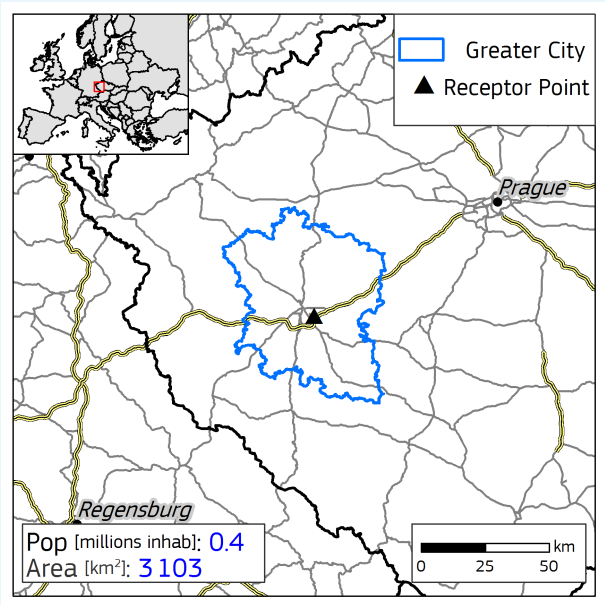


Emissions [kton/year]

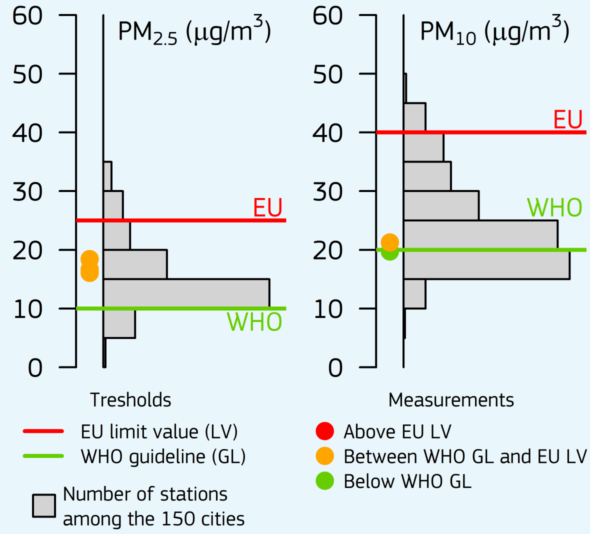




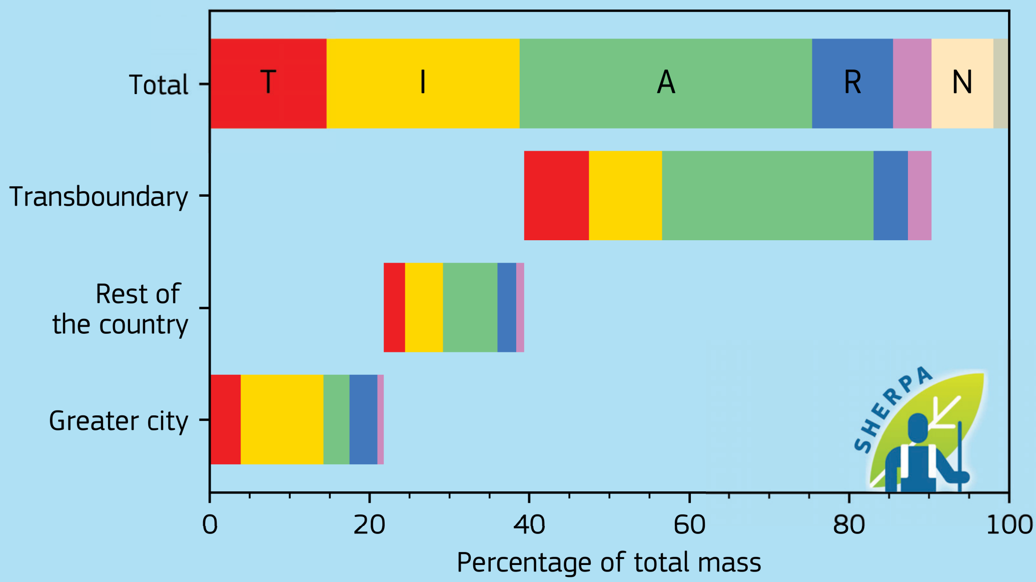
Czech Republic, Pilsen



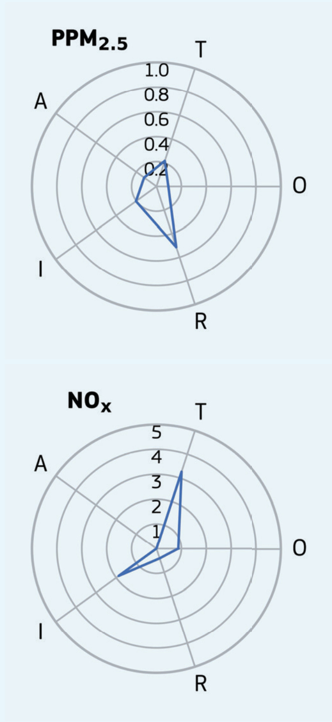
Yearly average urban background (2015)

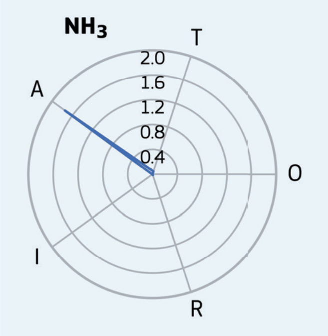


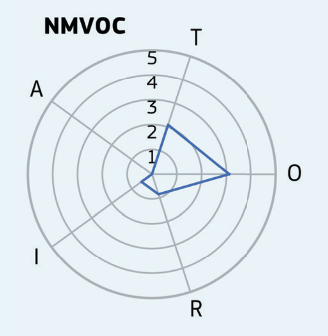
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

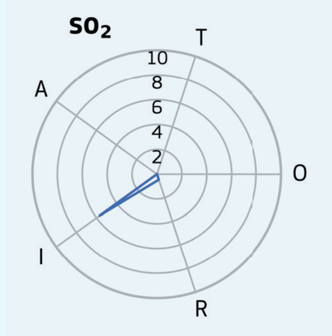


Emissions [kton/year]









T - Transport
I - Industry
A - Agriculture
R - Residential
O - Other
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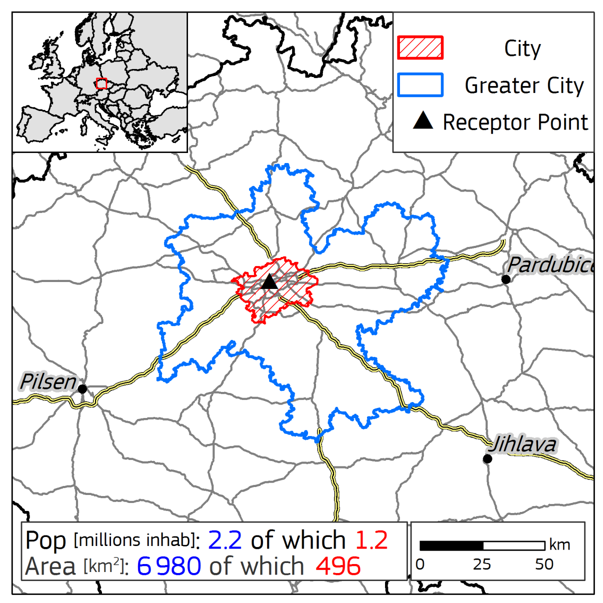
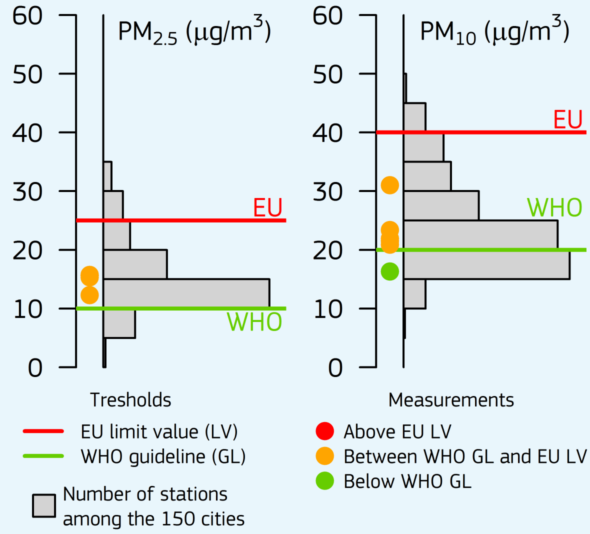
E - External
Greater city

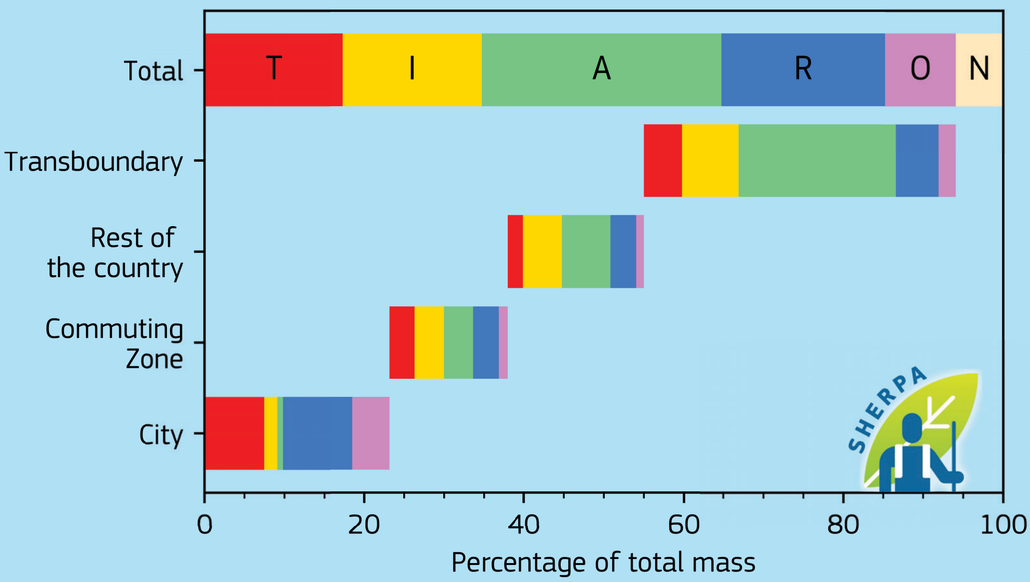
Czech Republic, Prague



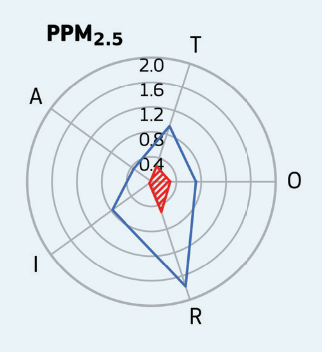
Yearly average urban background (2015)

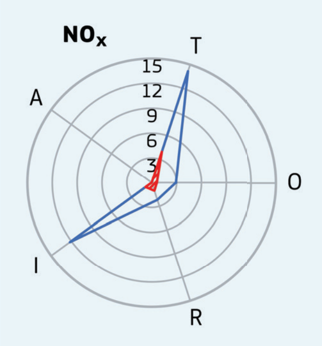


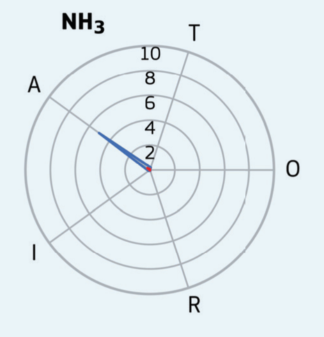
PM2.5 Spatial and sectoral allocation (SHERPA v.1.9)

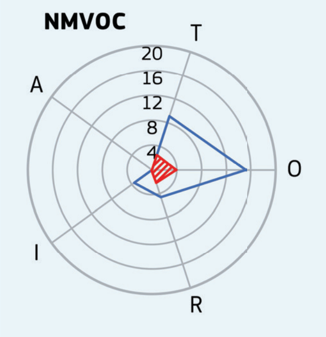


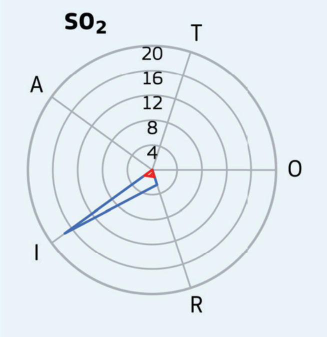
Emissions [kton/year]



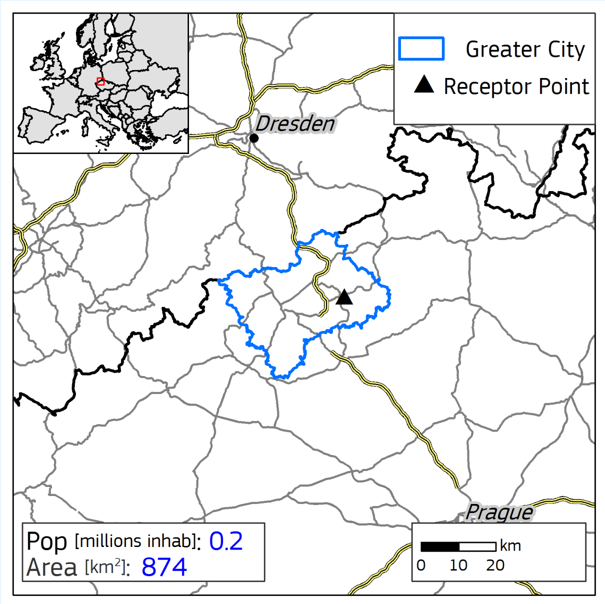




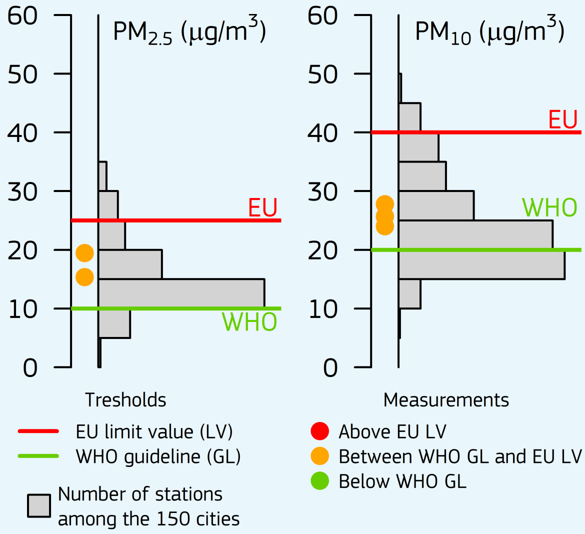




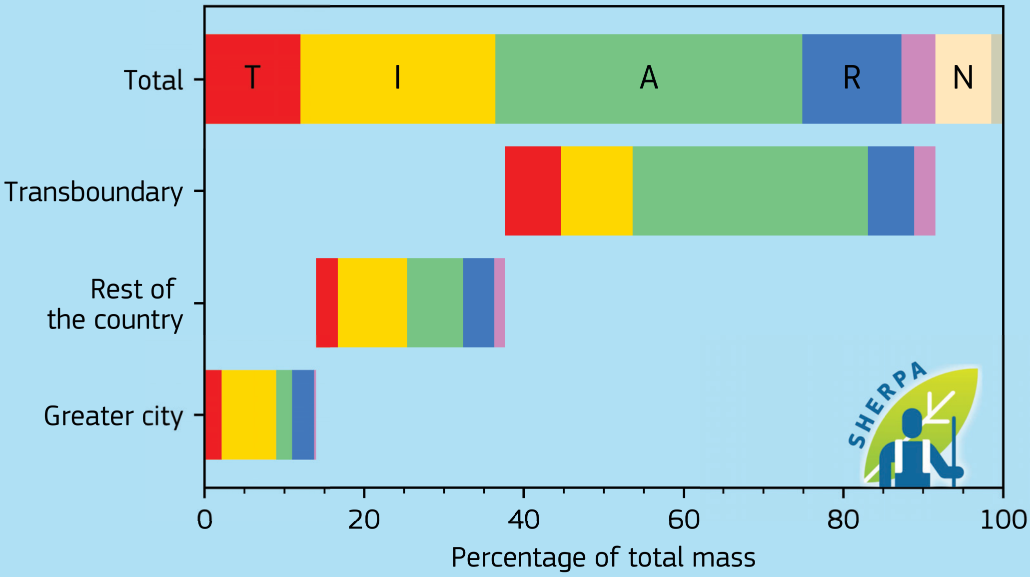
Czech Republic, Ústí nad Labem



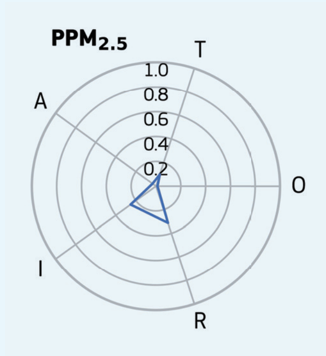
Yearly average urban background (2015)

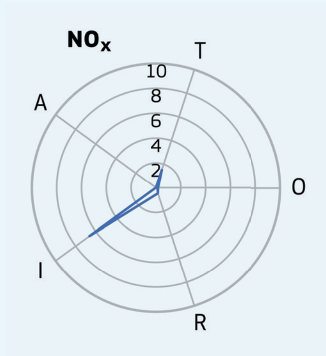


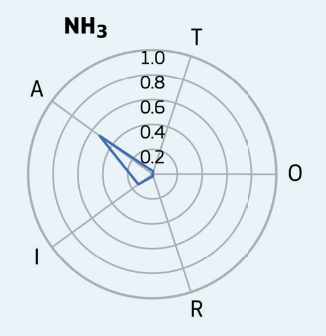
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

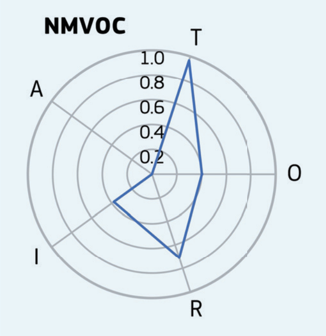


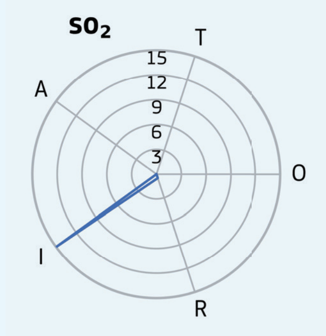
Emissions [kton/year]











- T - Transport
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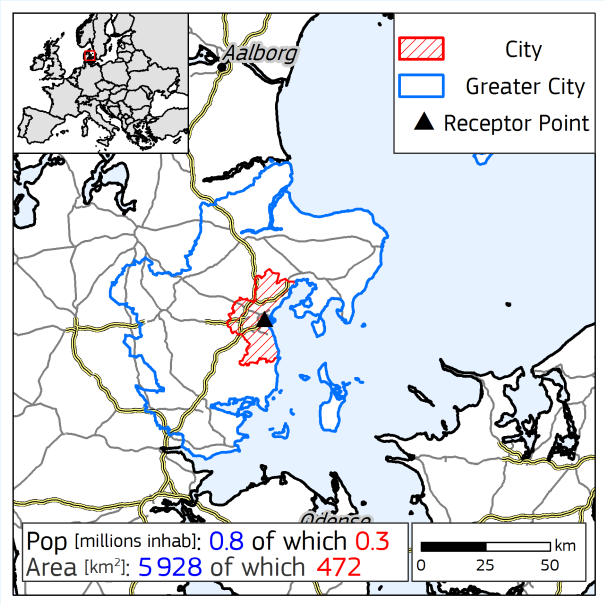
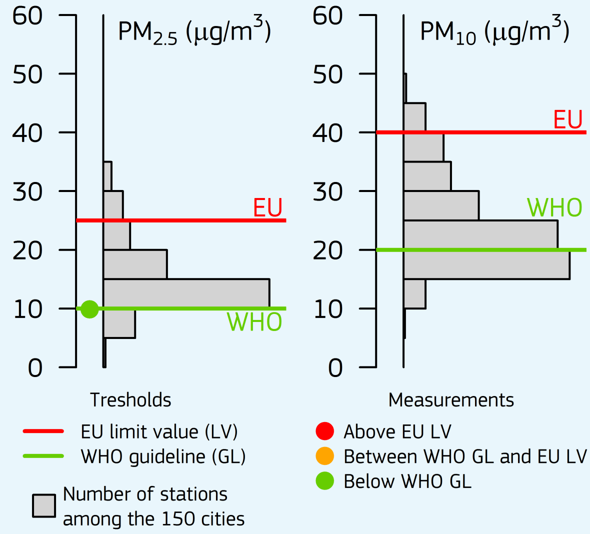
- E - External
- Greater city

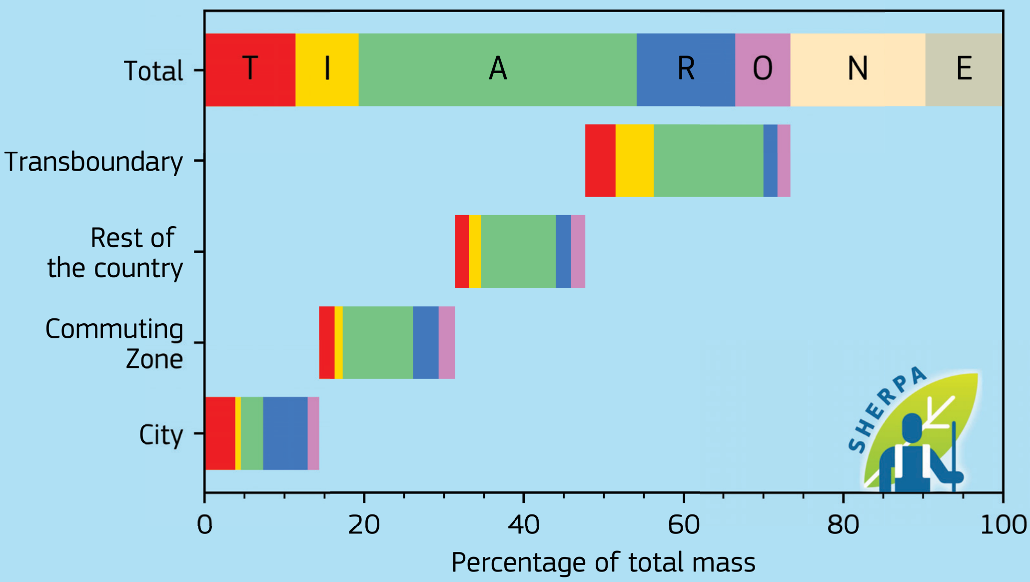
Denmark, Aarhus



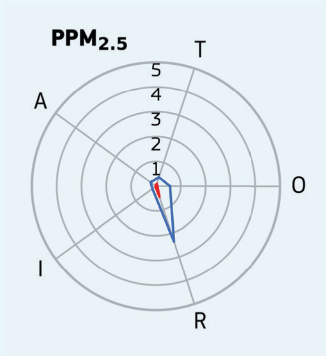
Yearly average urban background (2015)

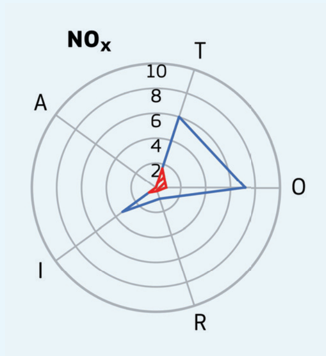


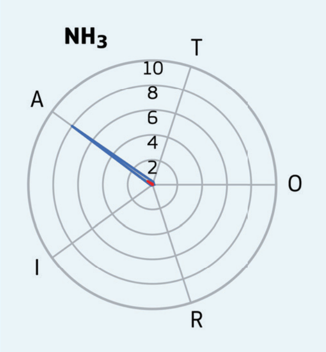
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

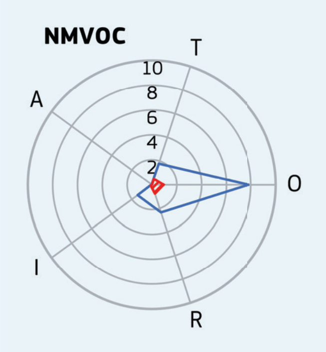


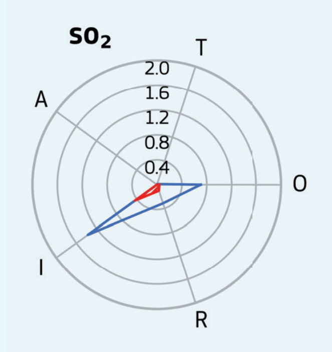
Emissions [kton/year]



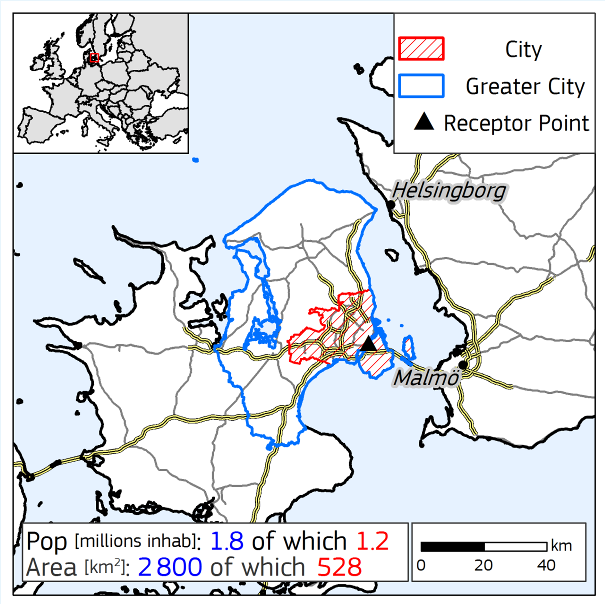




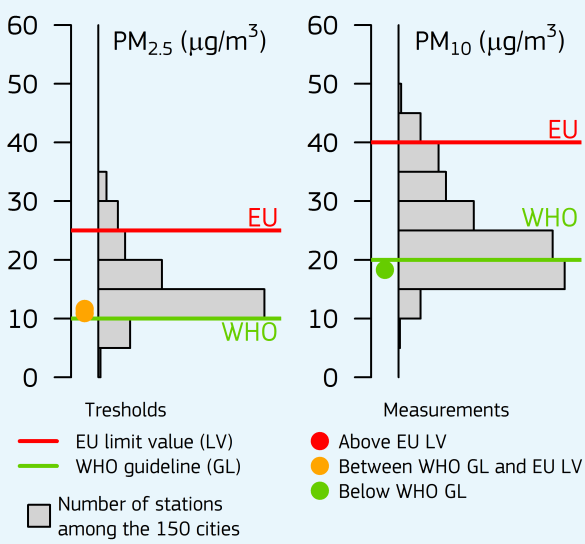




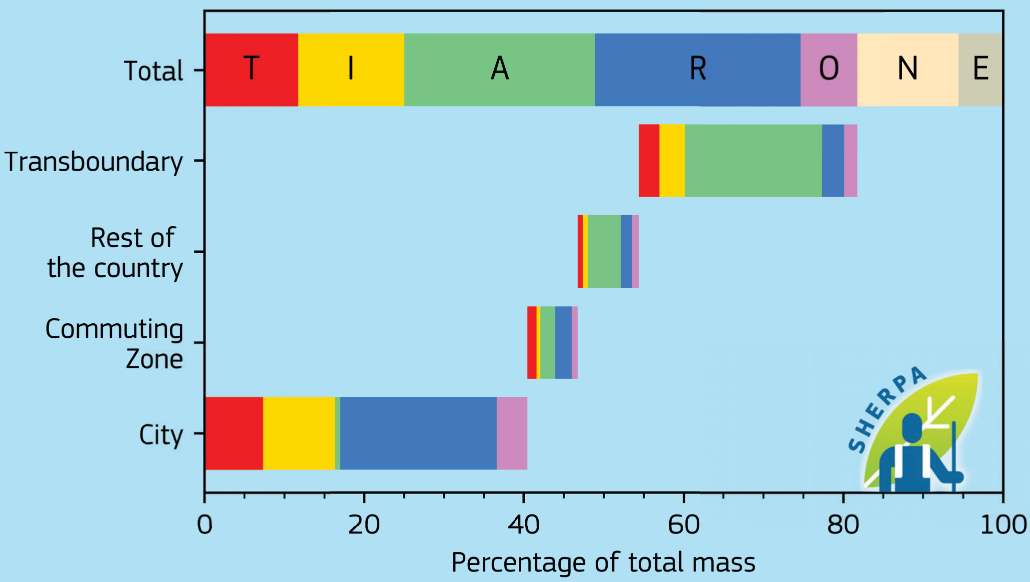
Denmark, Copenhagen



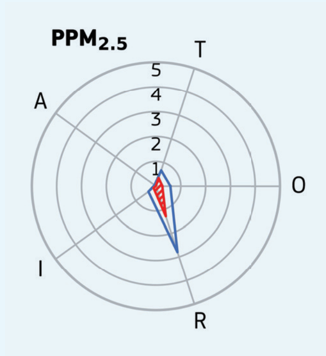
Yearly average urban background (2015)

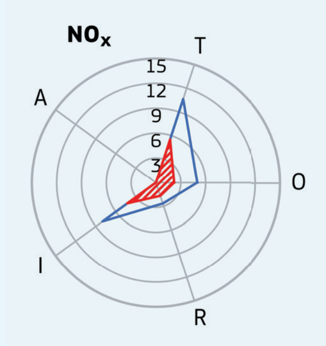


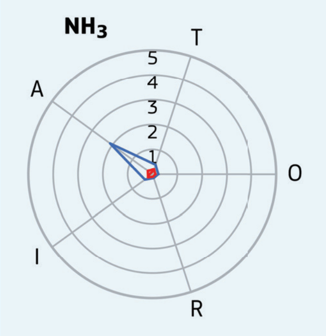
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

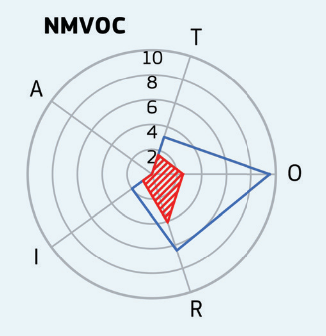


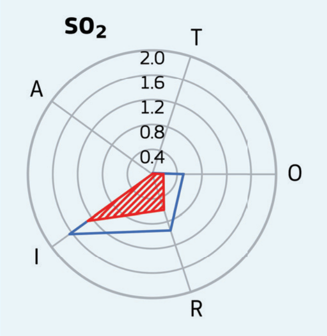
Emissions [kton/year]



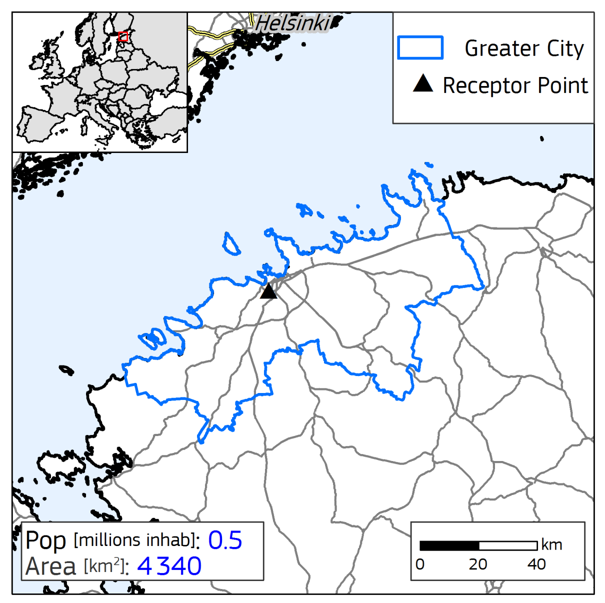


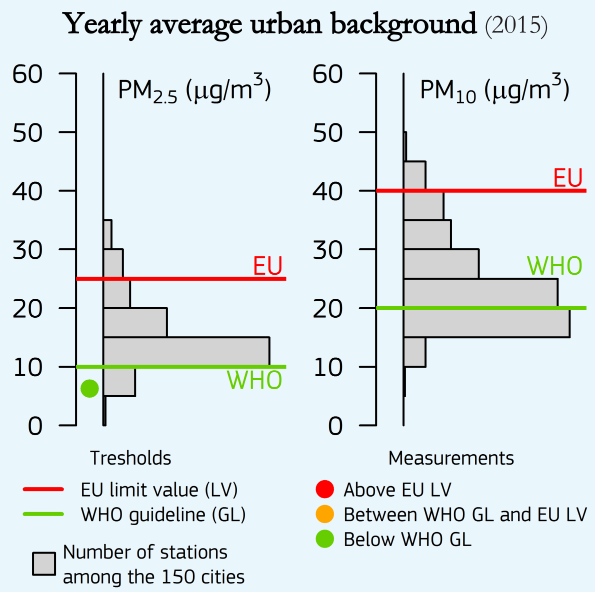


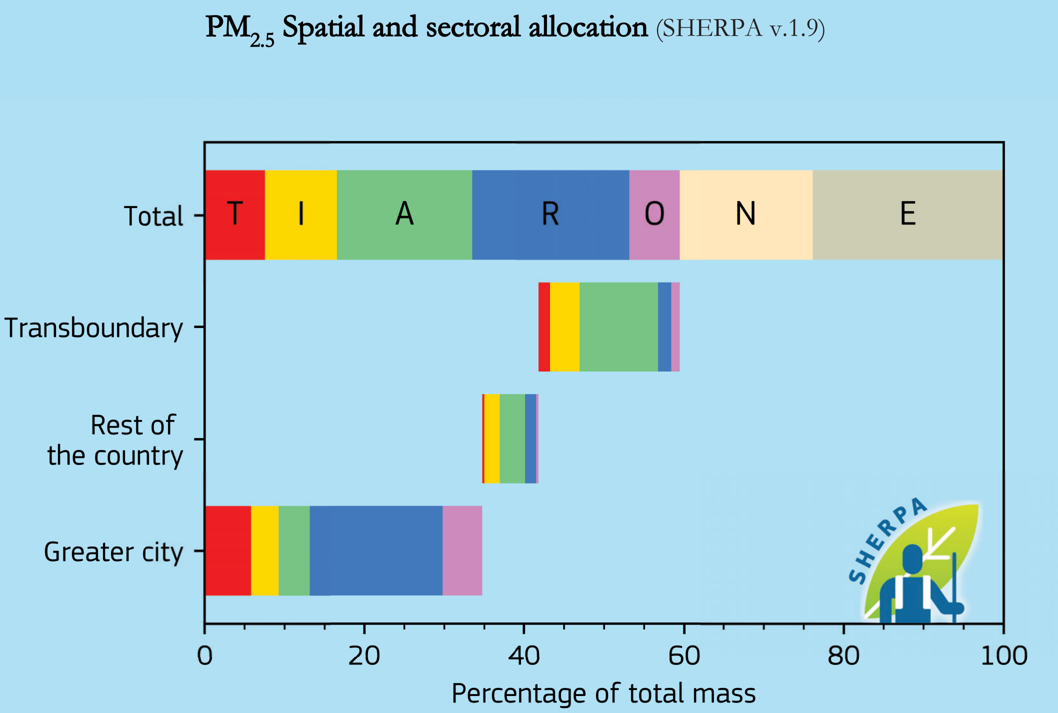


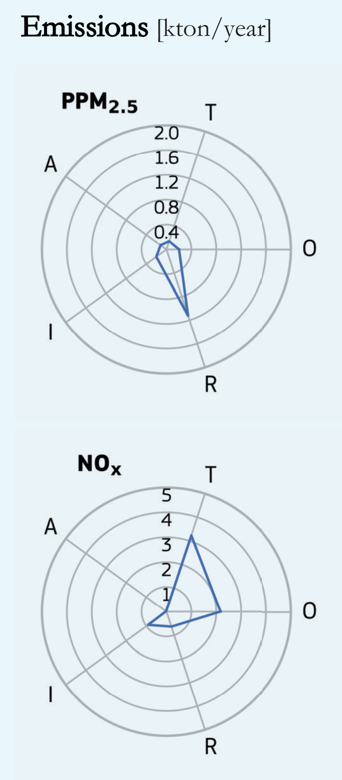


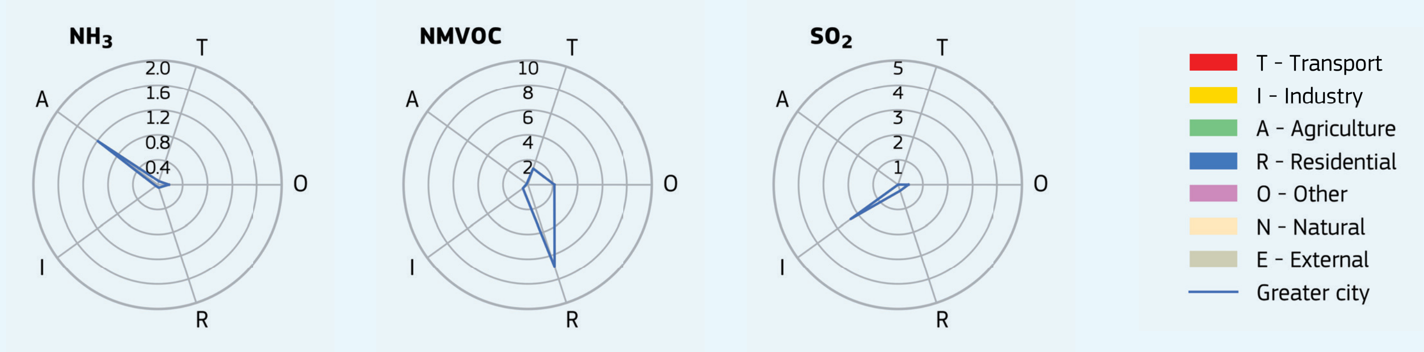
Estonia, Tallinn



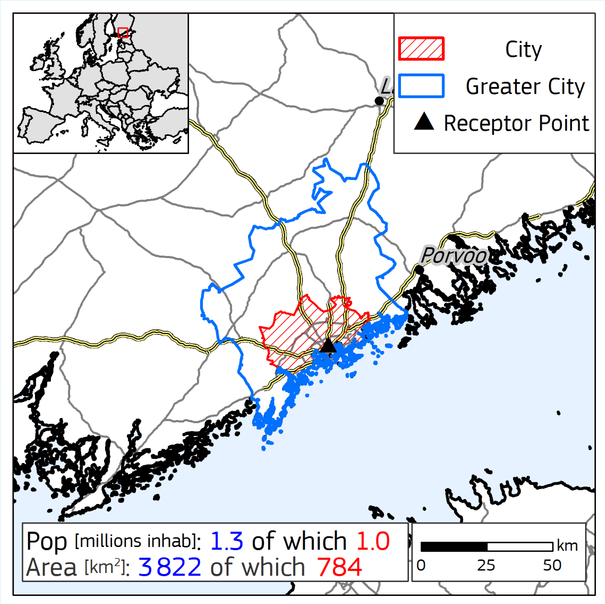




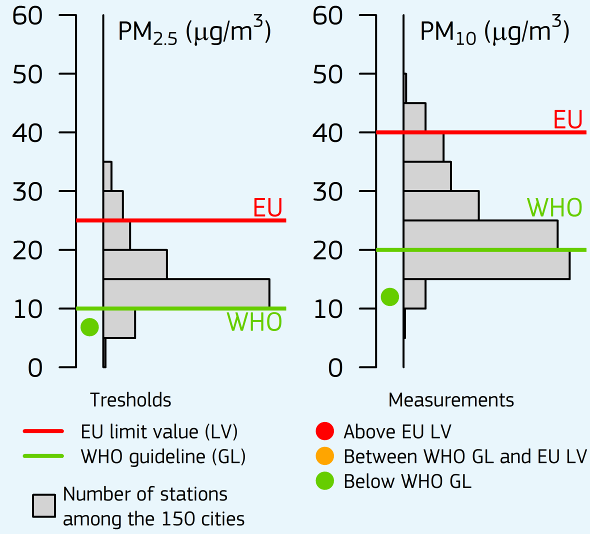




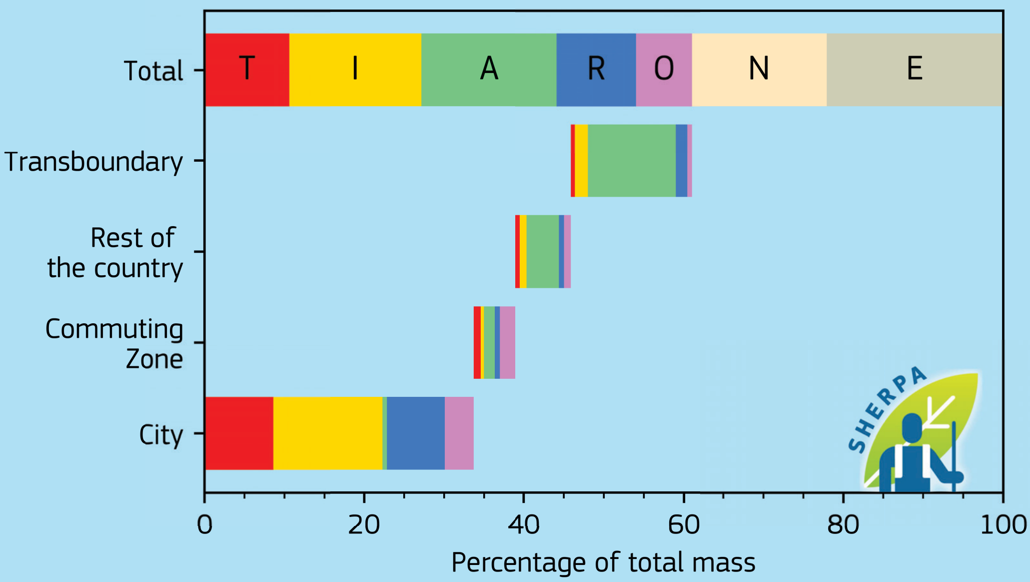
Finland, Helsinki



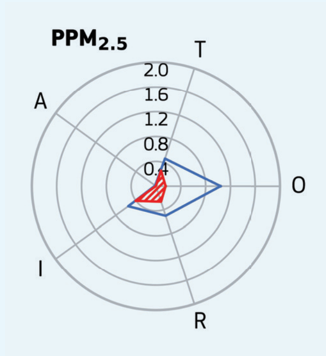
Yearly average urban background (2015)

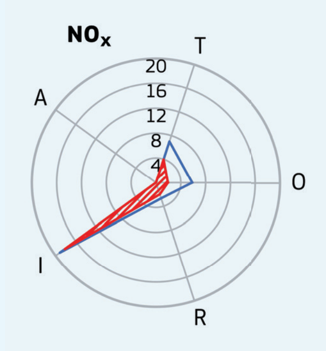


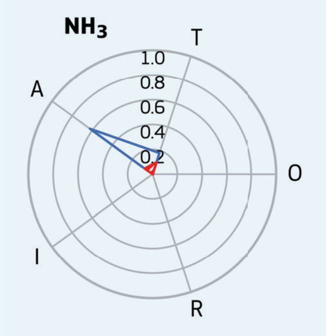
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

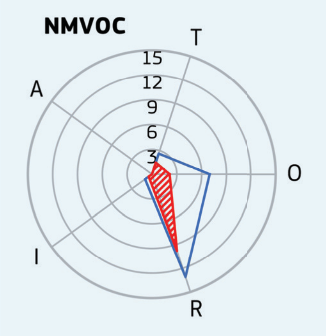


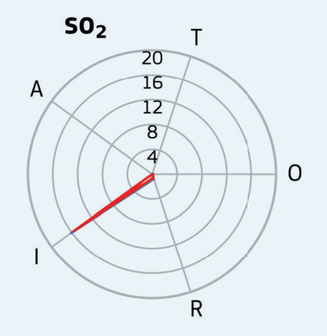
Emissions [kton/year]



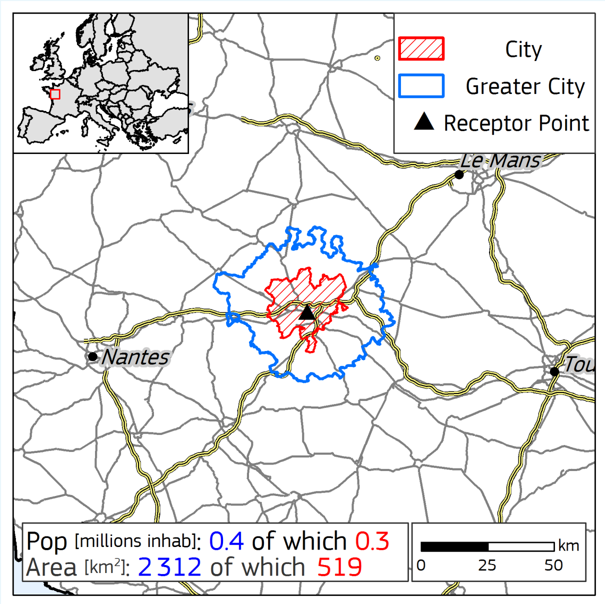




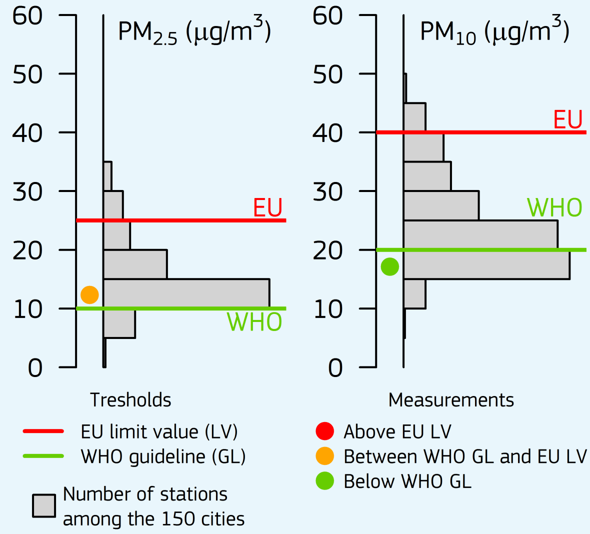




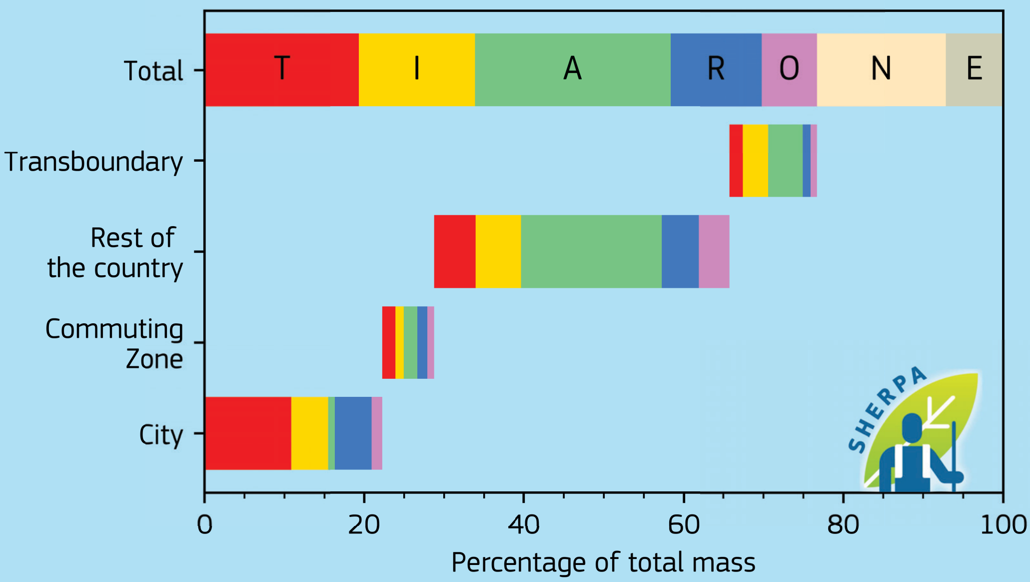
France, Angers



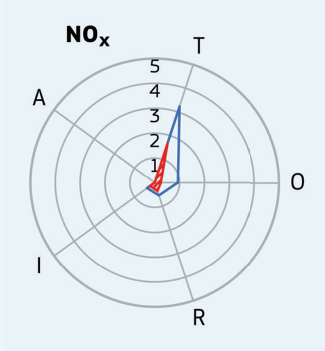
Yearly average urban background (2015)

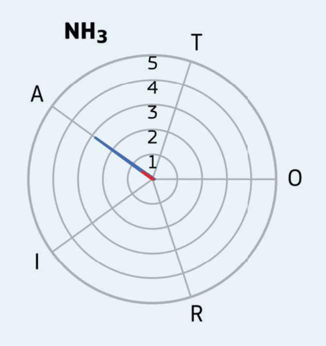


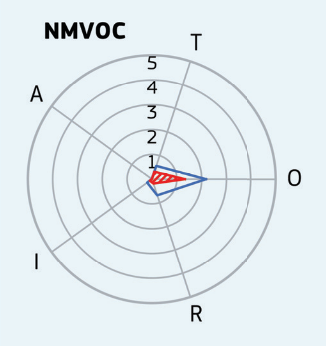
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

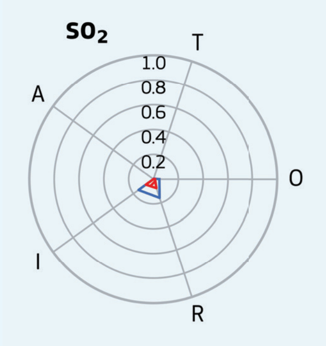


Emissions [kton/year]

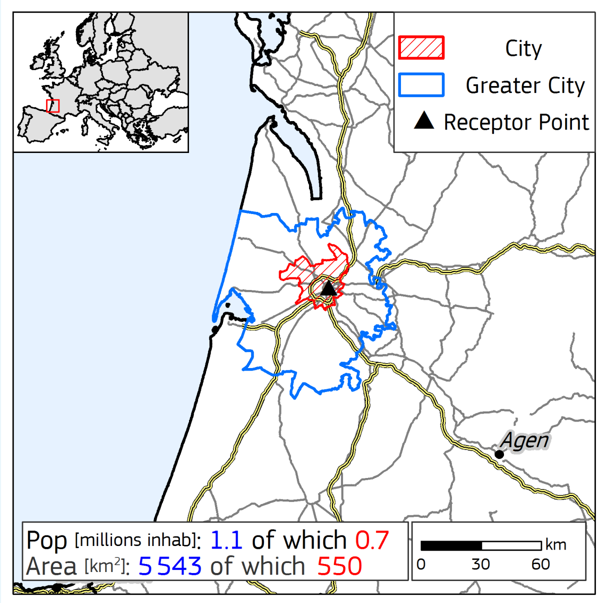




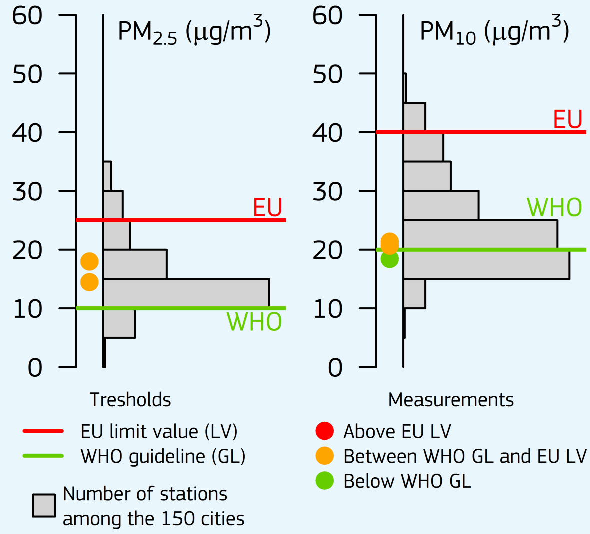




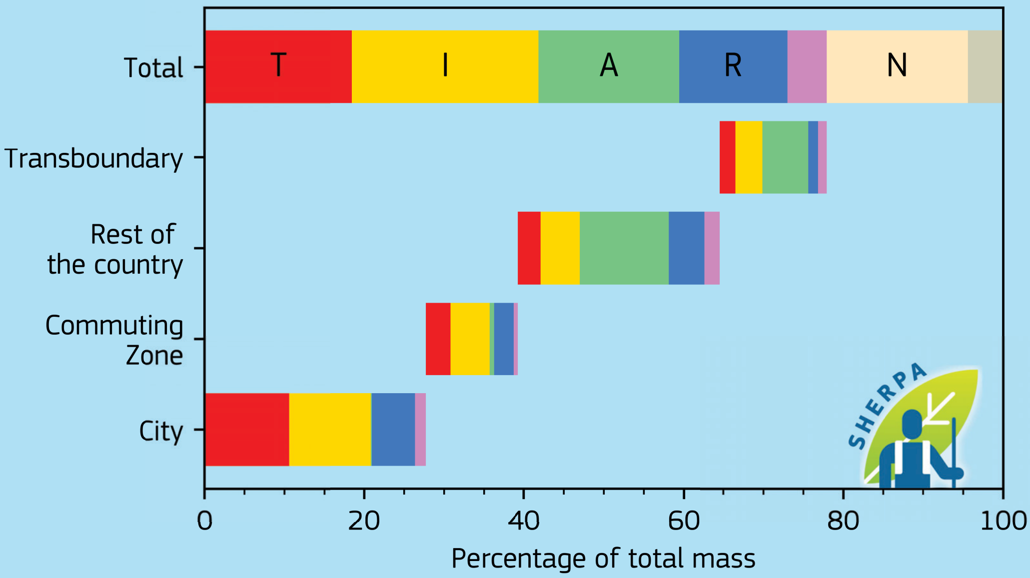
France, Bordeaux



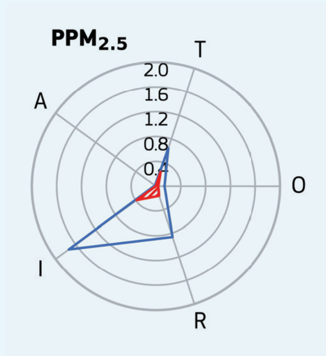
Yearly average urban background (2015)

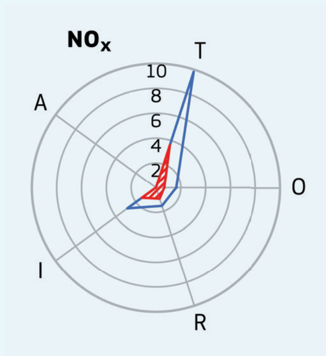


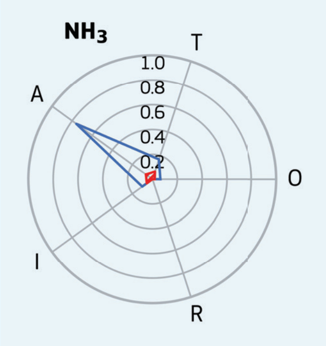
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

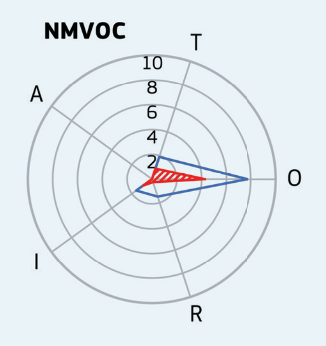


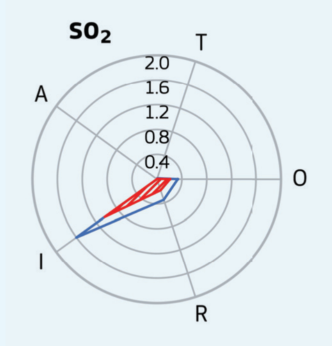
Emissions [kton/year]



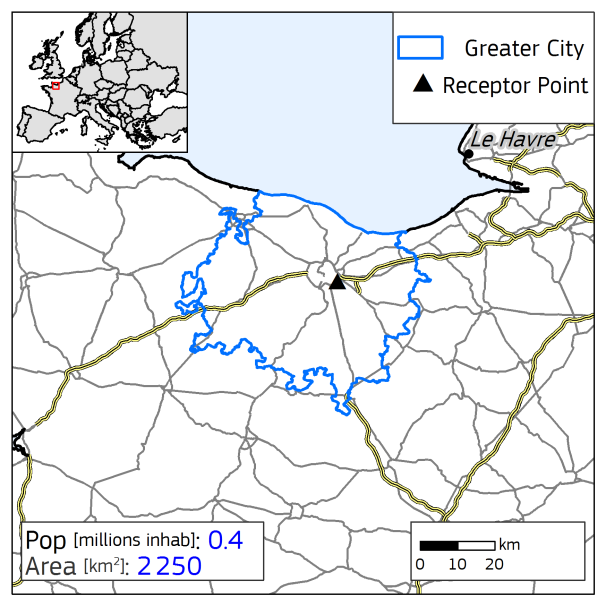


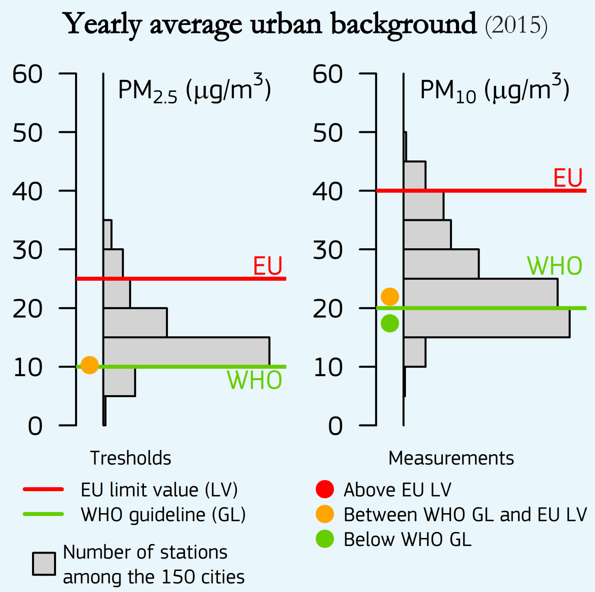


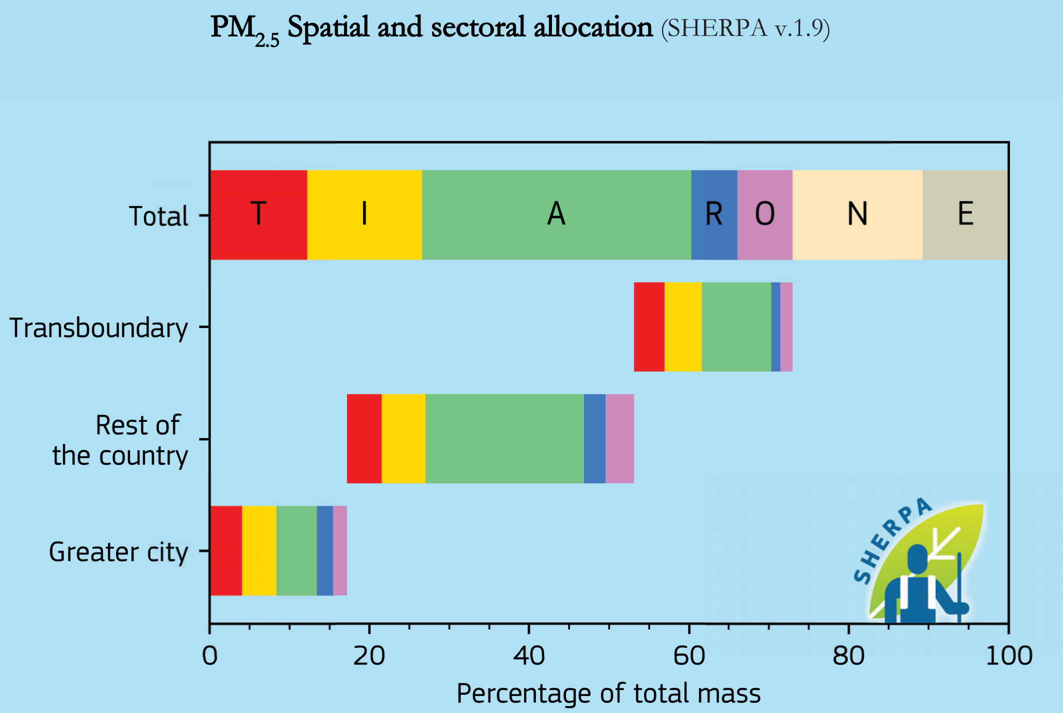




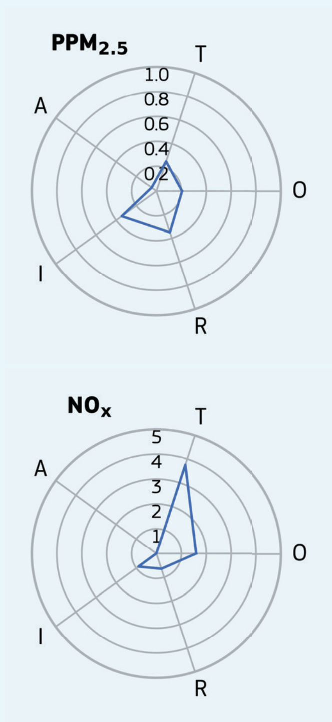
France, Caen

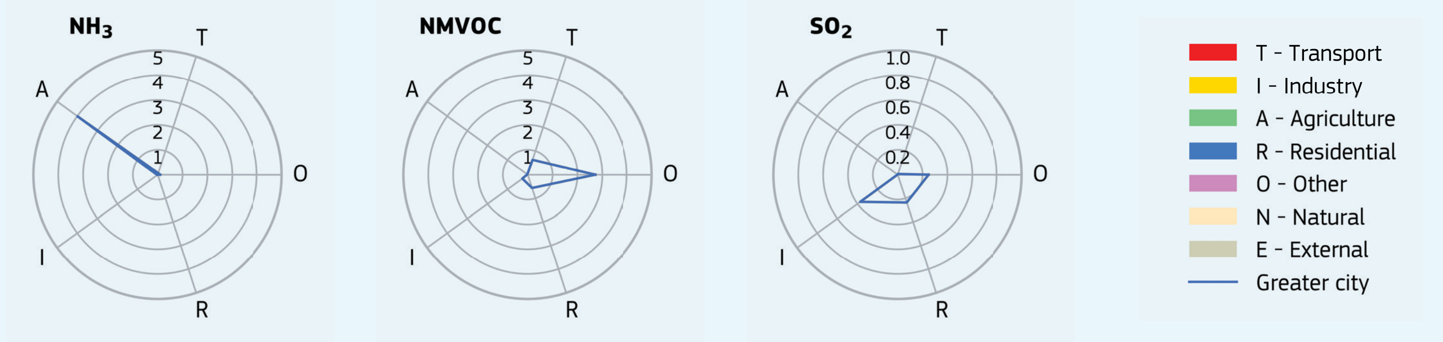




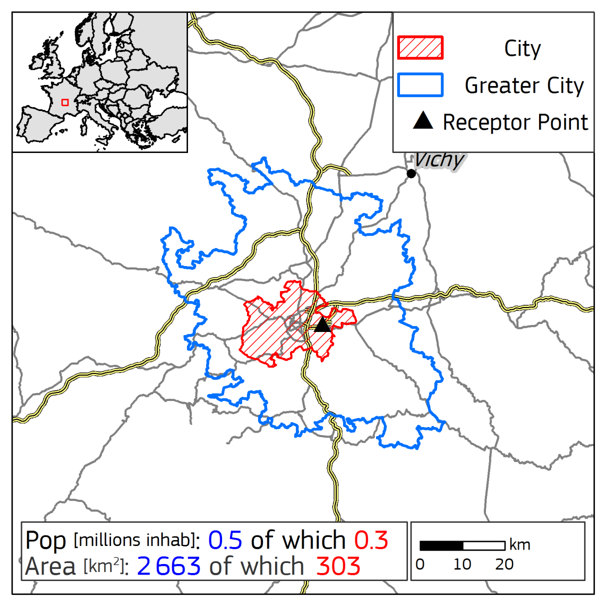


Emissions [kton/year]

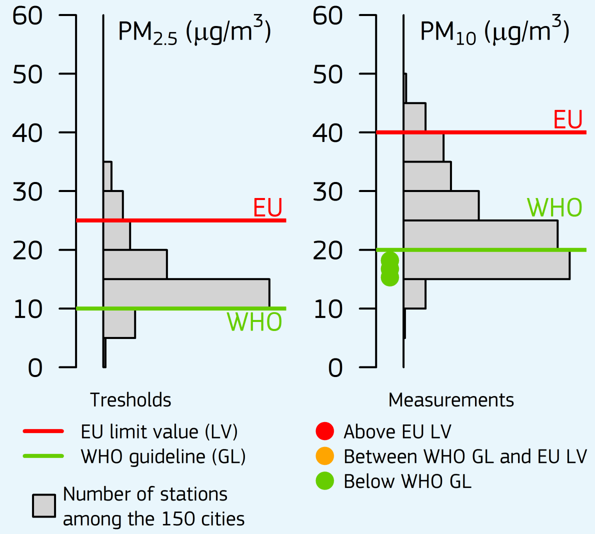




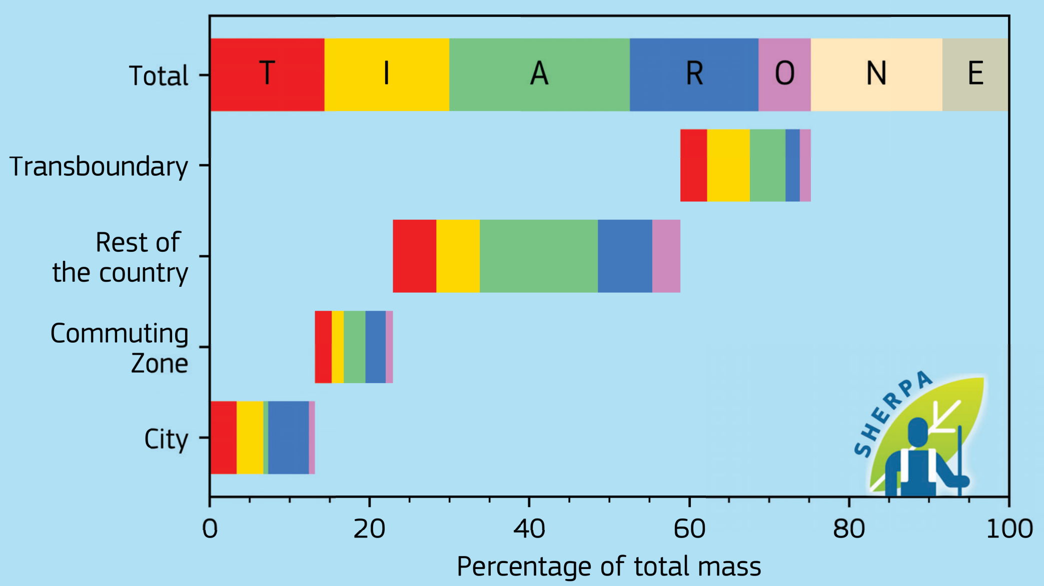
France, Clermont-Ferrand



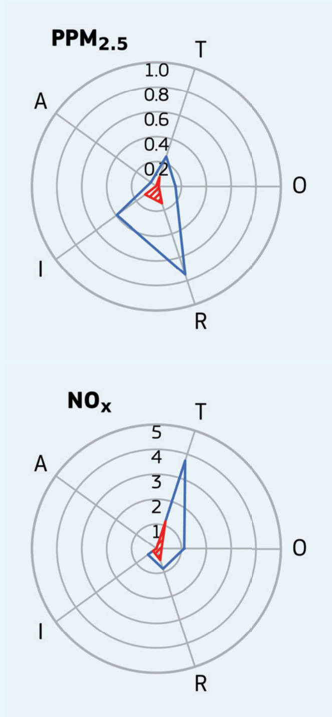
Yearly average urban background (2015)

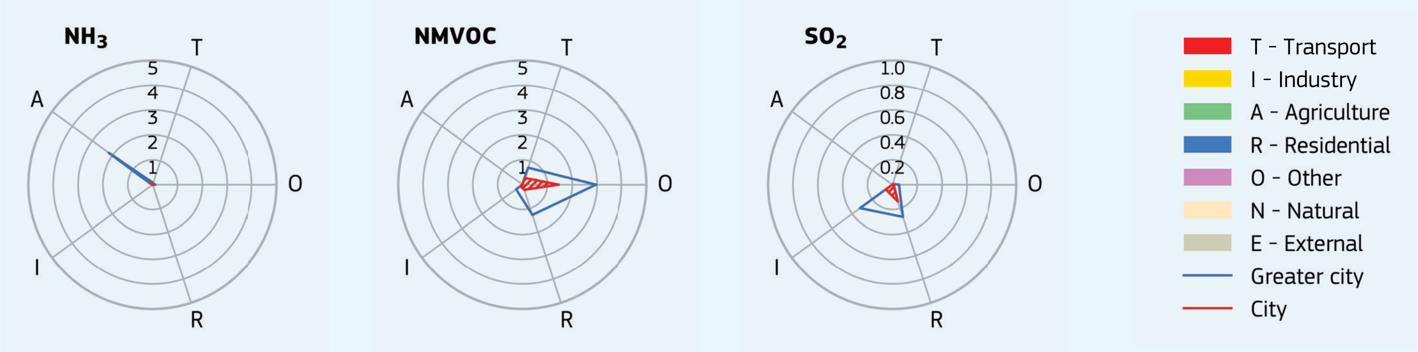


PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

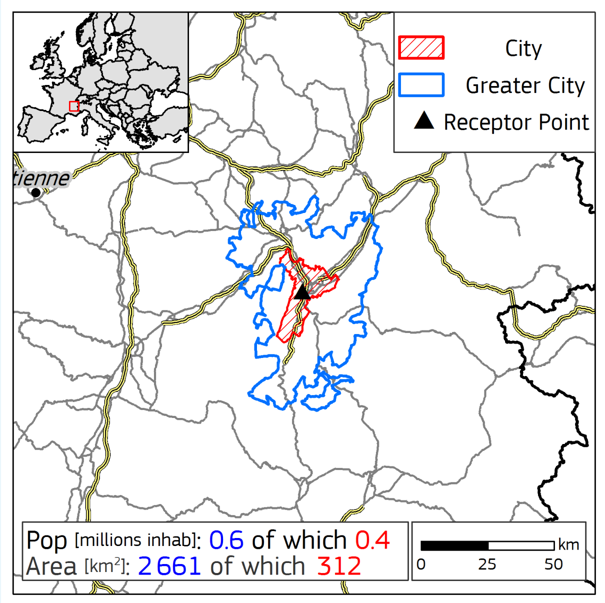


Emissions [kton/year]

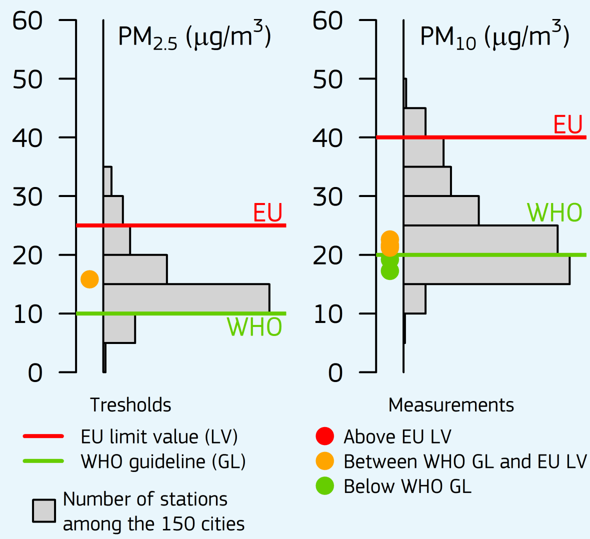




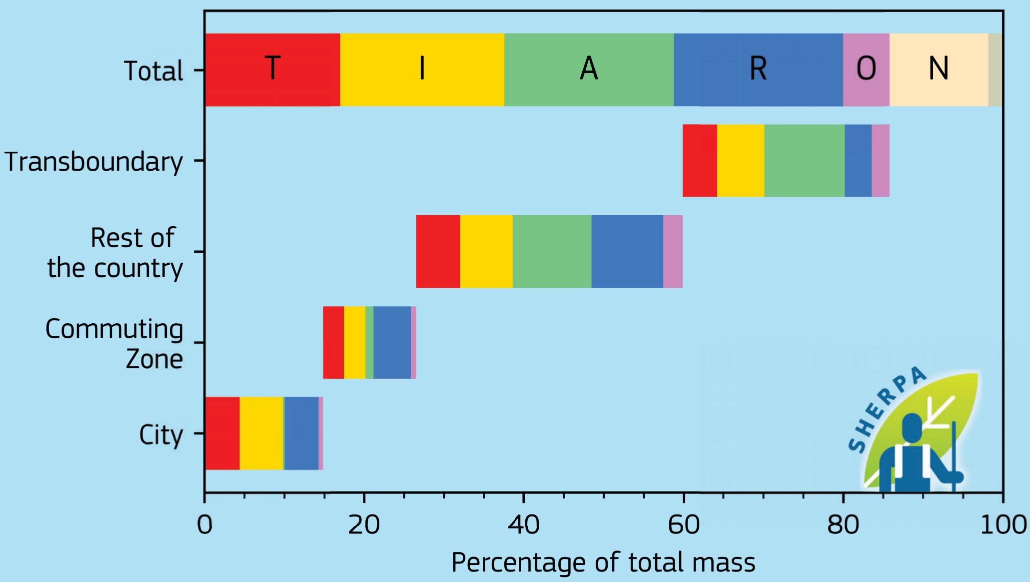
France, Grenoble



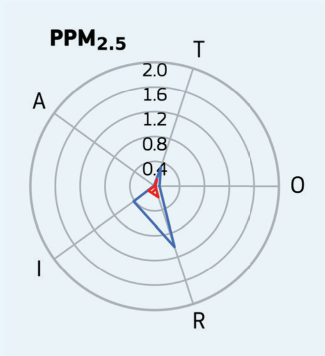
Yearly average urban background (2015)

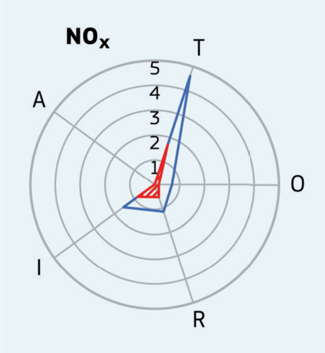


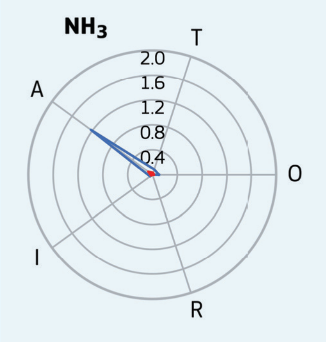
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

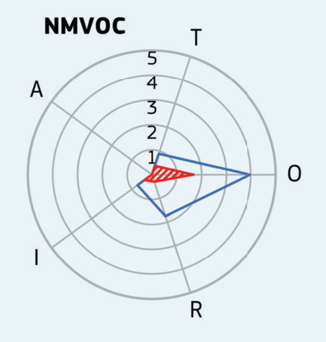


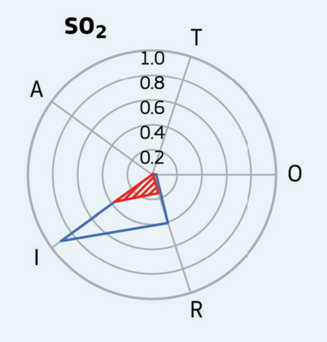
Emissions [kton/year]



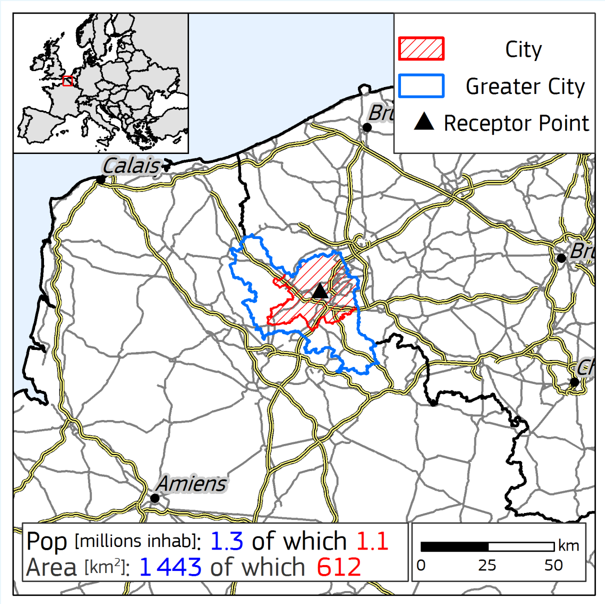




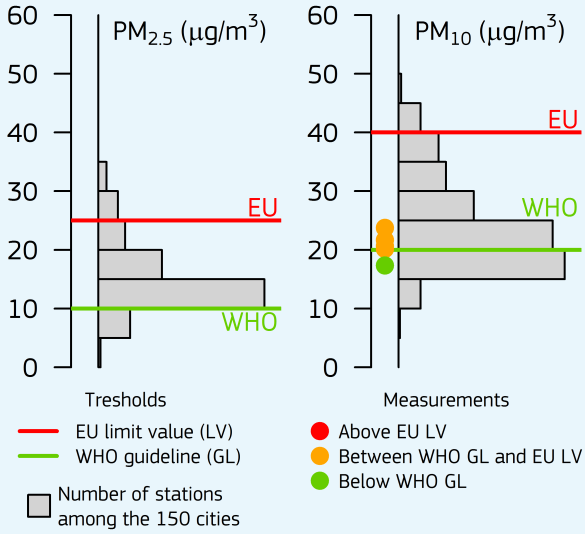




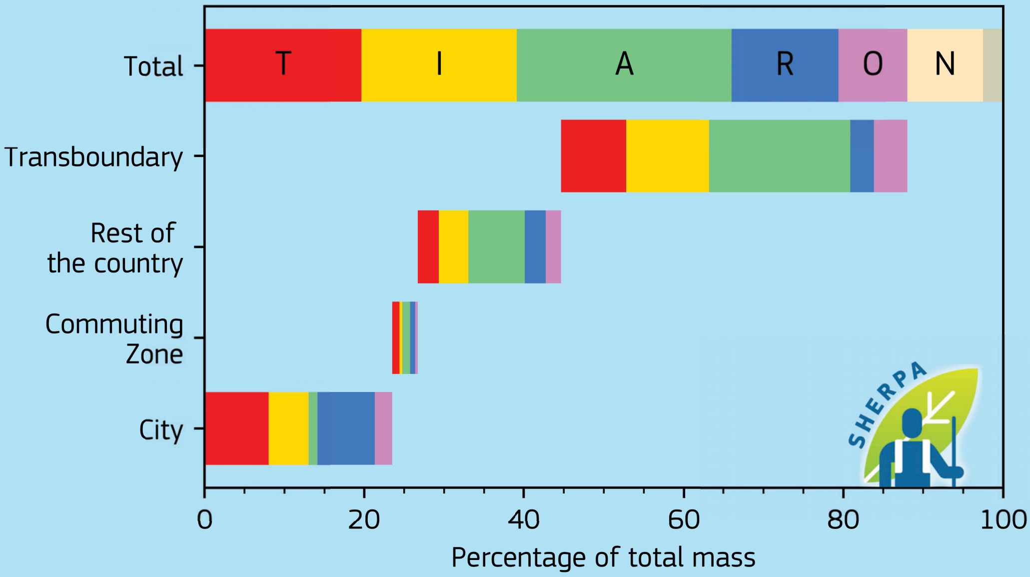
France, Lille



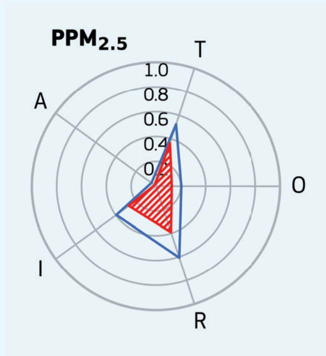
Yearly average urban background (2015)

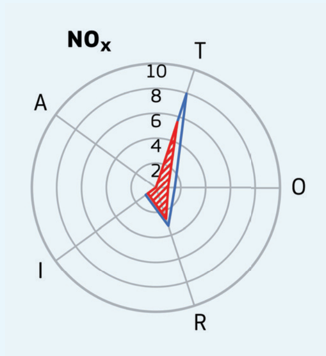


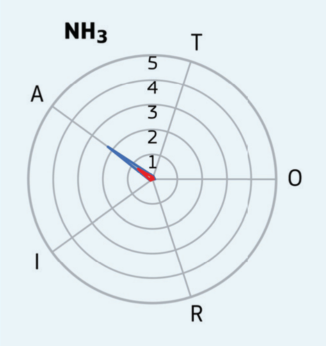
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

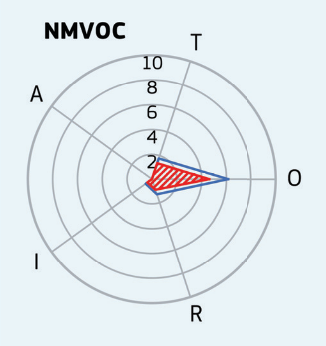


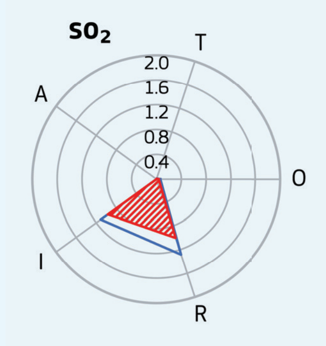
Emissions [kton/year]

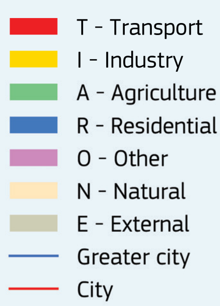




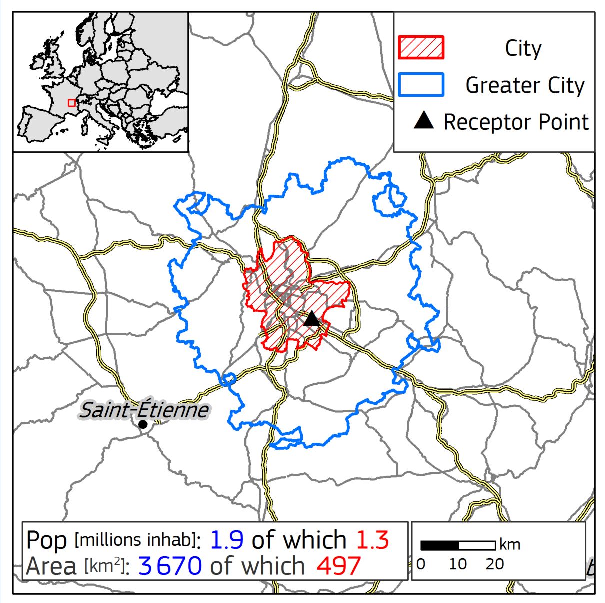




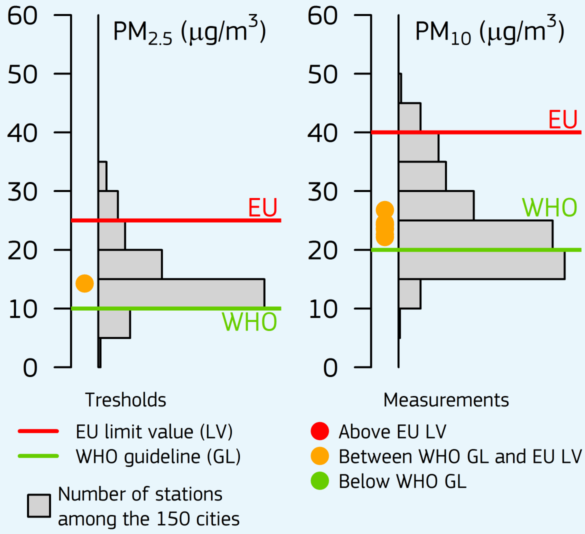




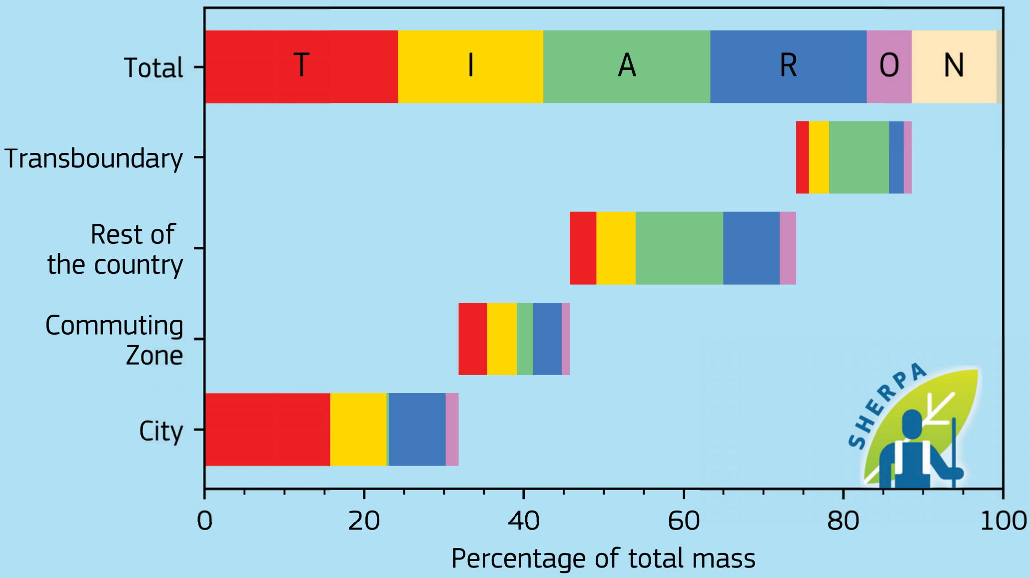
France, Lyon



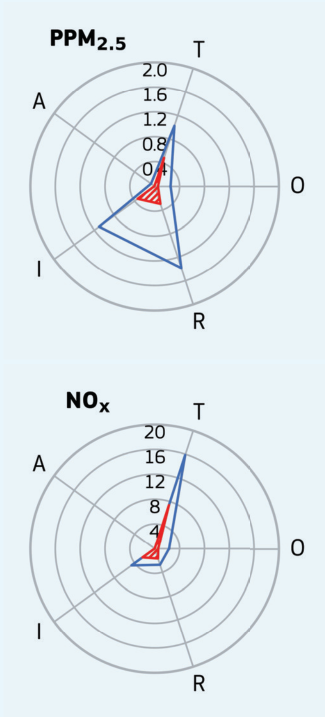
Yearly average urban background (2015)

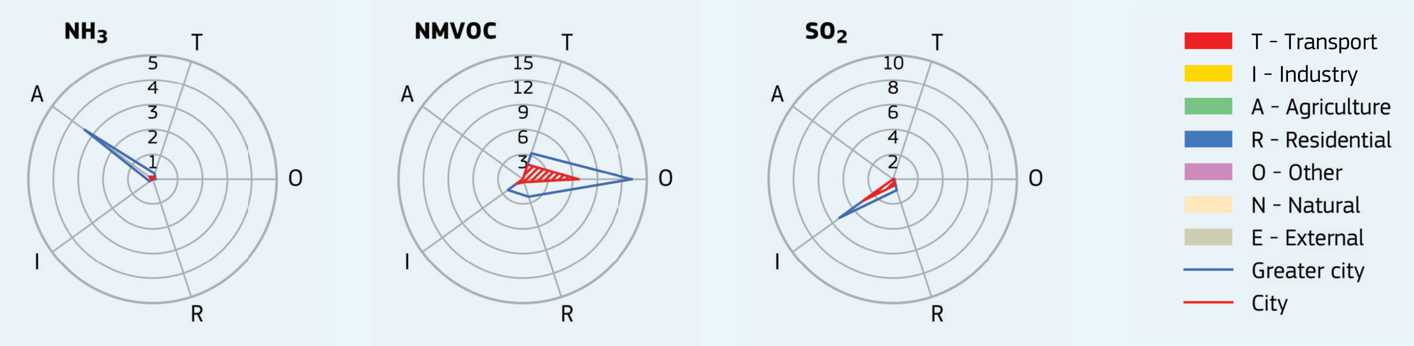


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

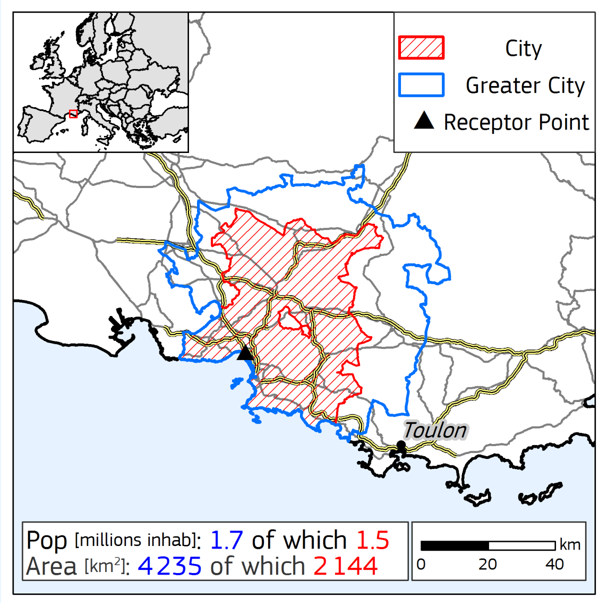


Emissions [kton/year]

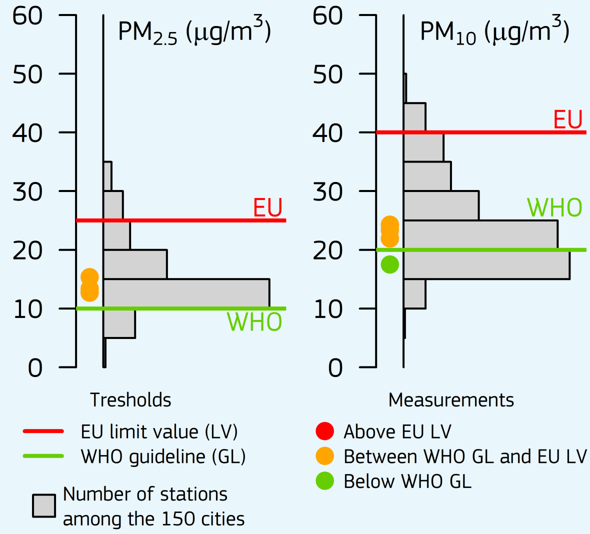




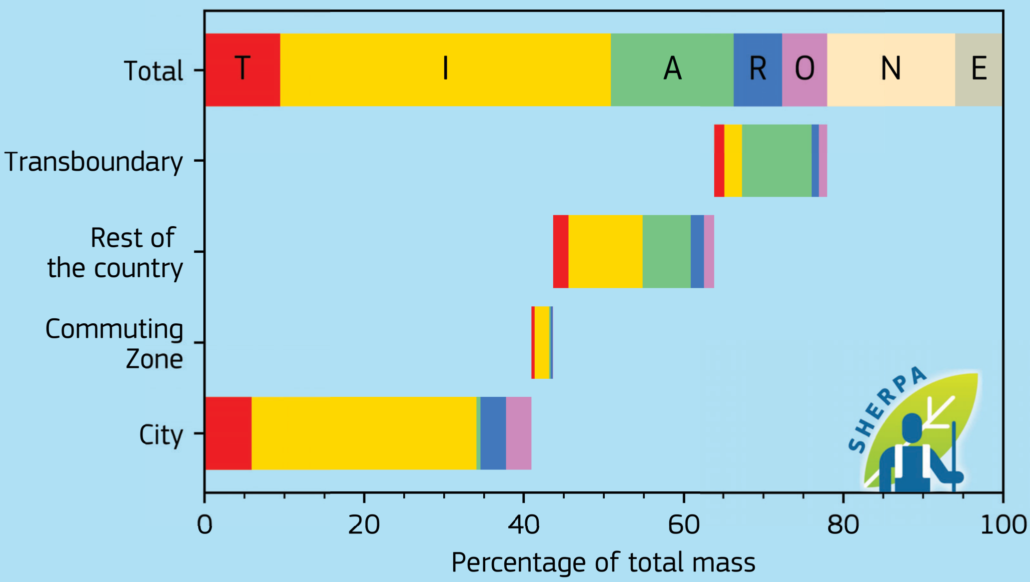
France, Marseille



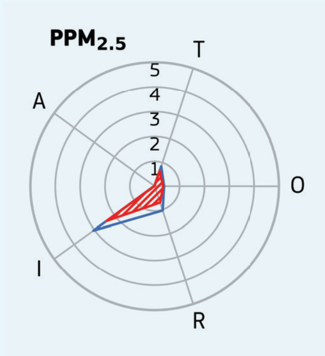
Yearly average urban background (2015)

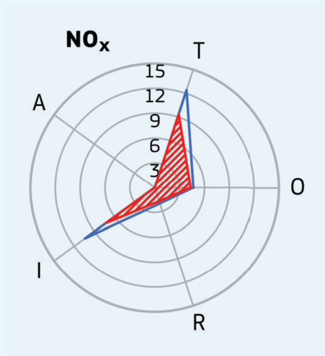


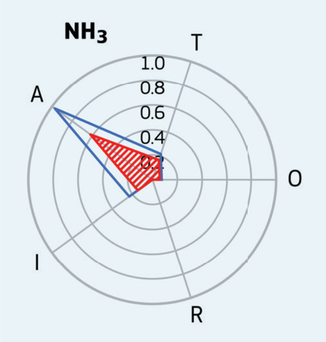
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

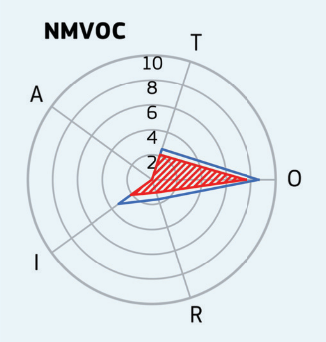


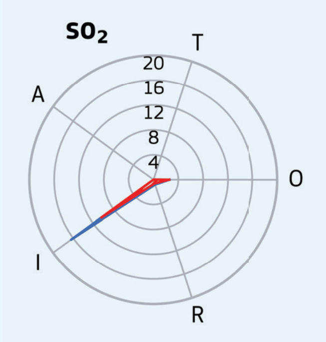
Emissions [kton/year]





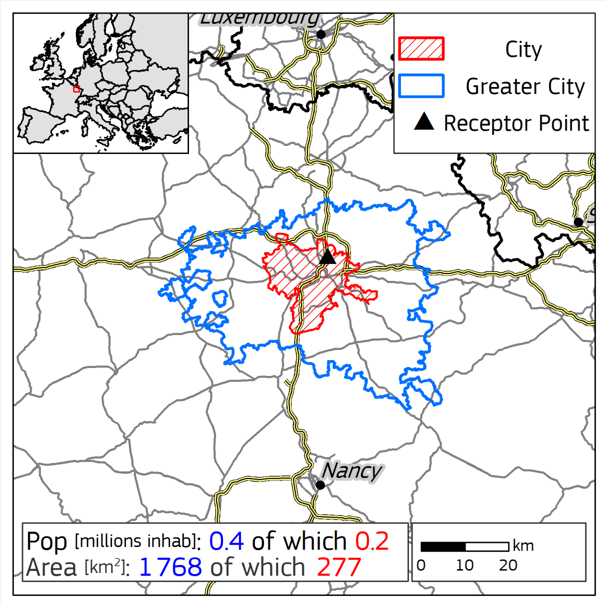




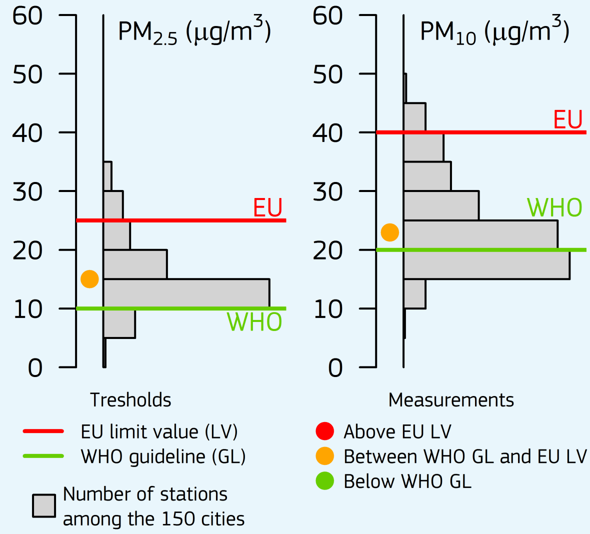


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city
- City

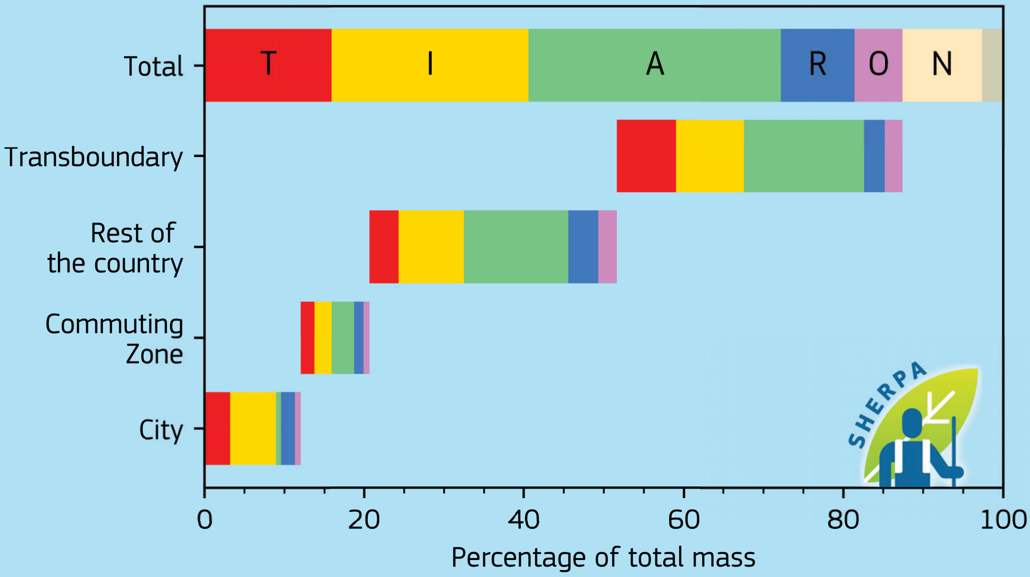
France, Metz



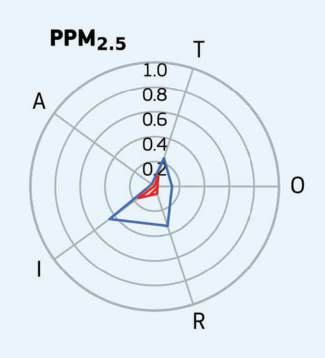
Yearly average urban background (2015)

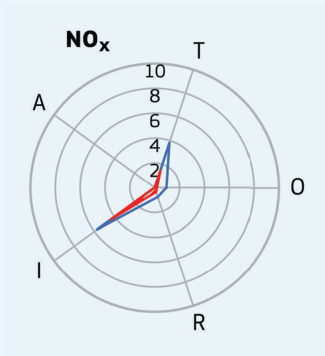


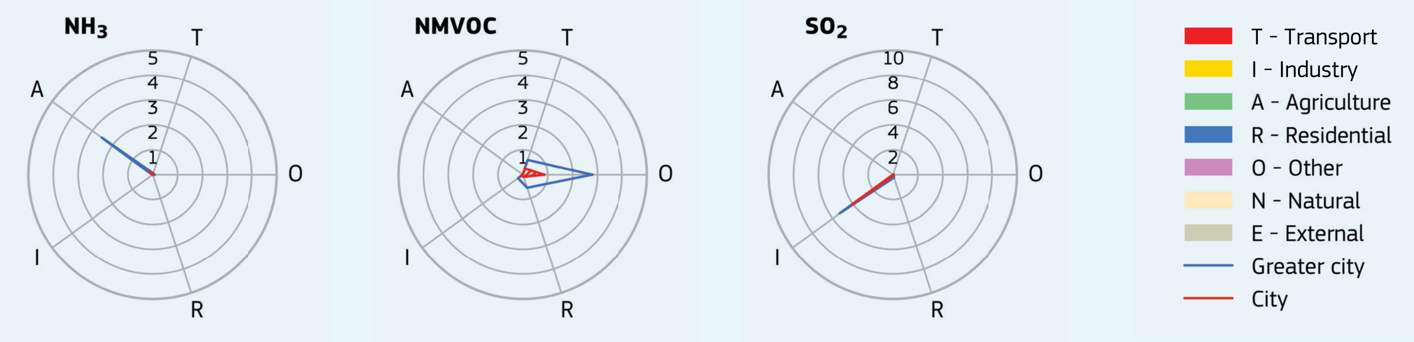
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



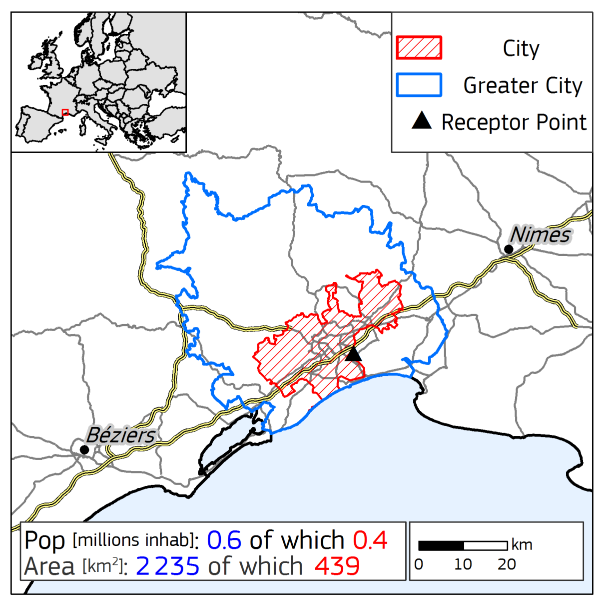
Emissions [kton/year]



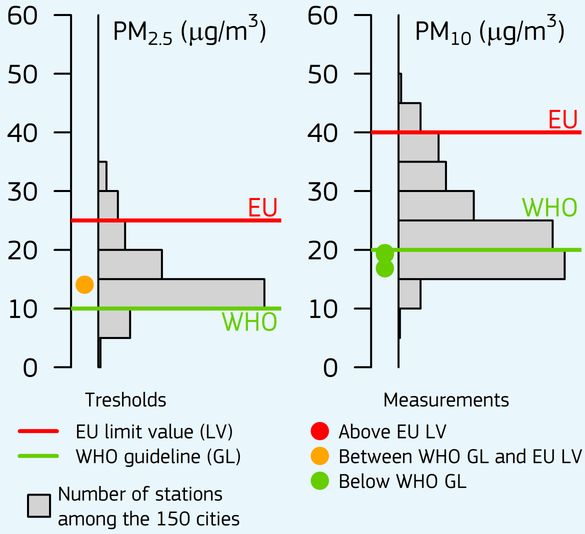




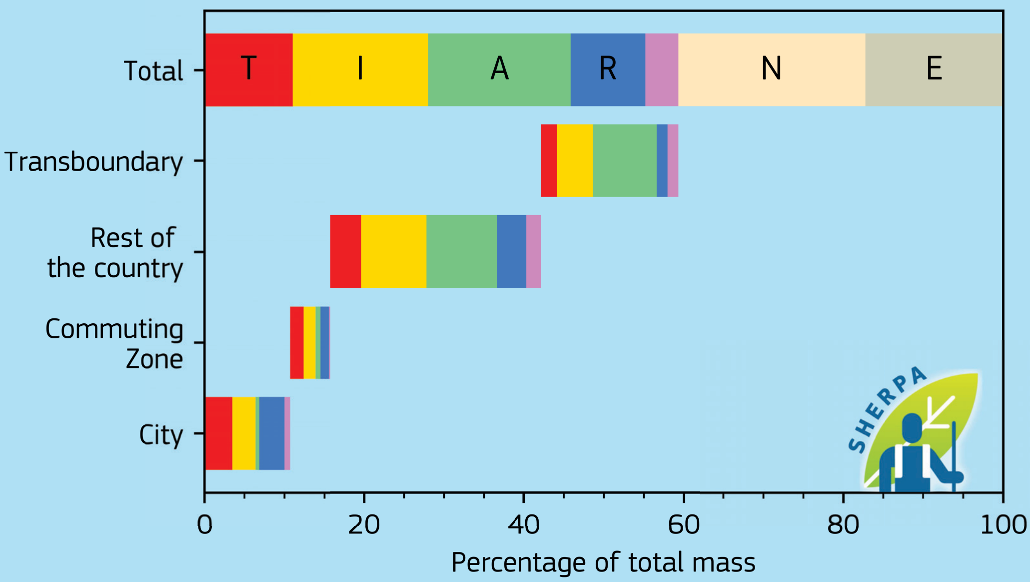
France, Montpellier



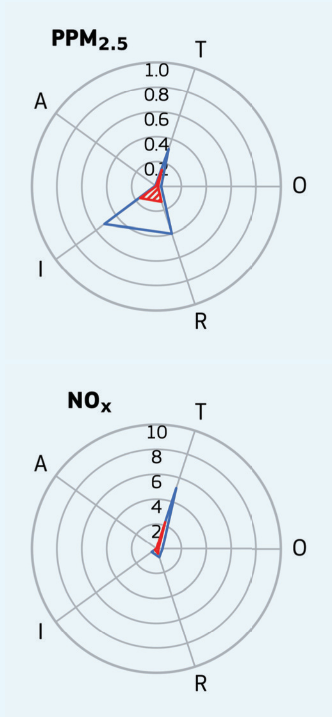
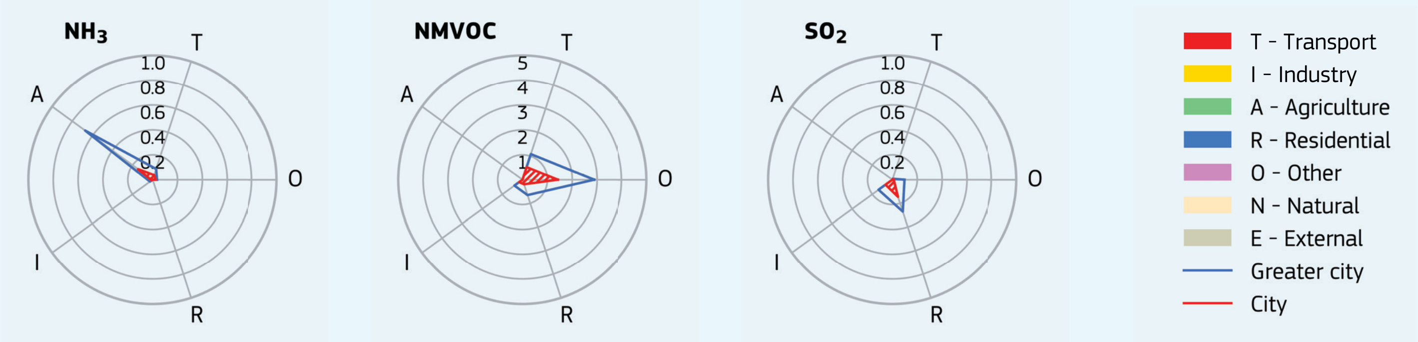
Yearly average urban background (2015)



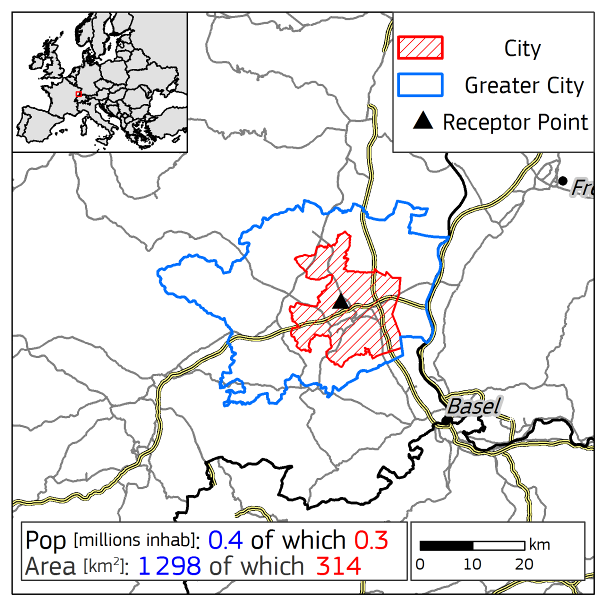
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



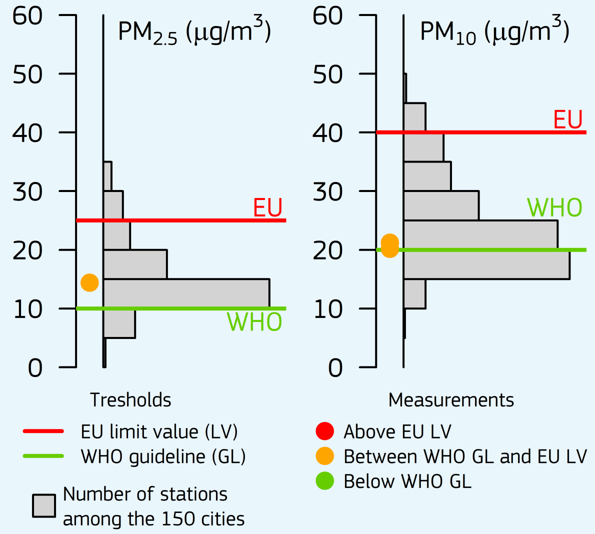
Emissions [kton/year]

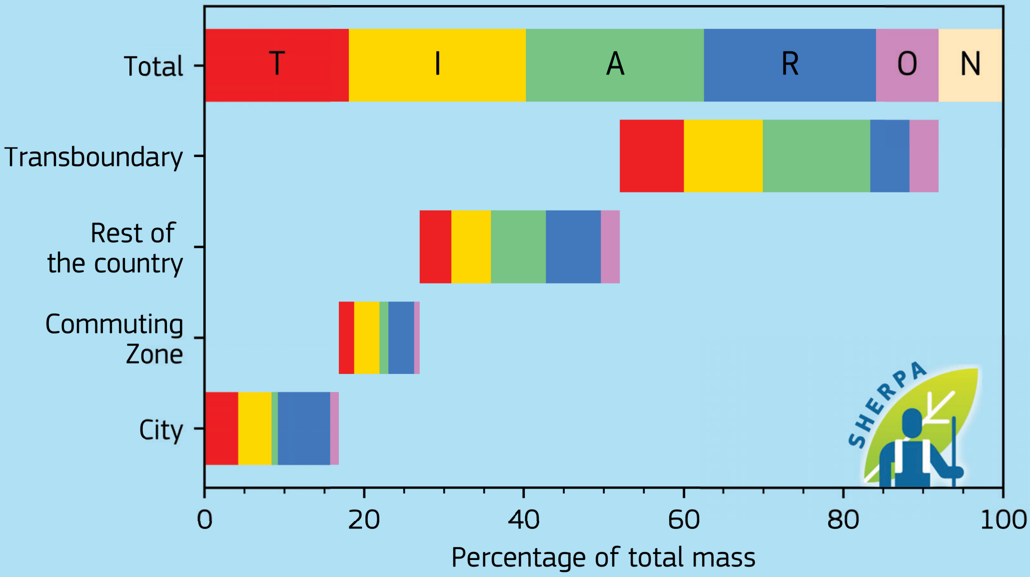
France, Mulhouse



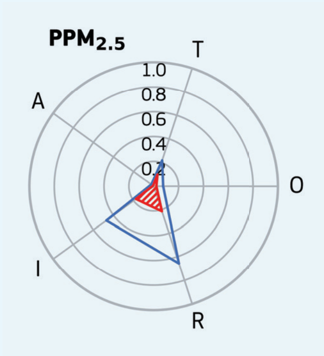
Yearly average urban background (2015)

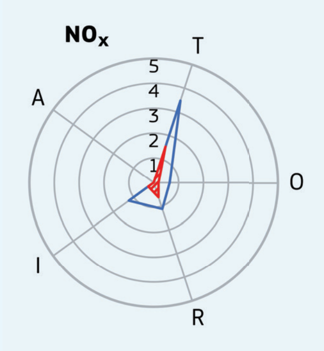


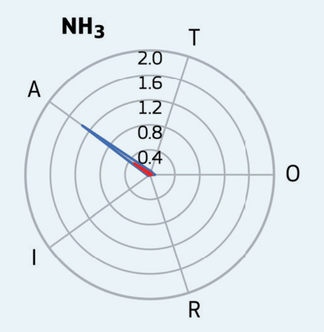
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

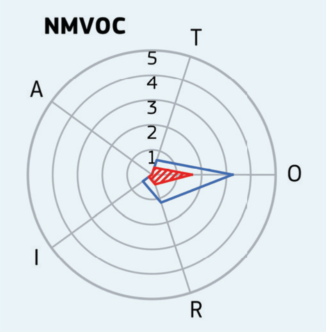


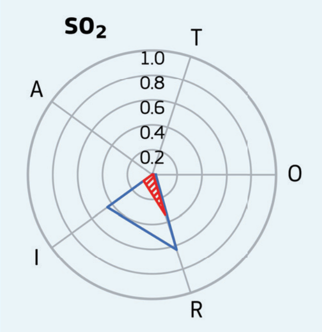
Emissions [kton/year]



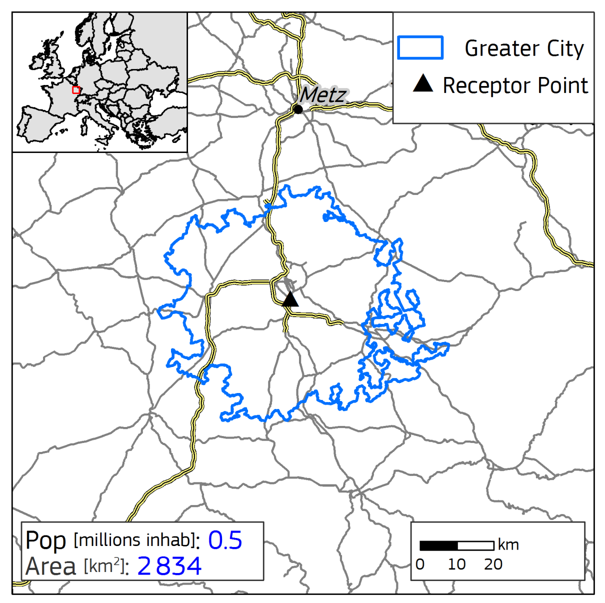




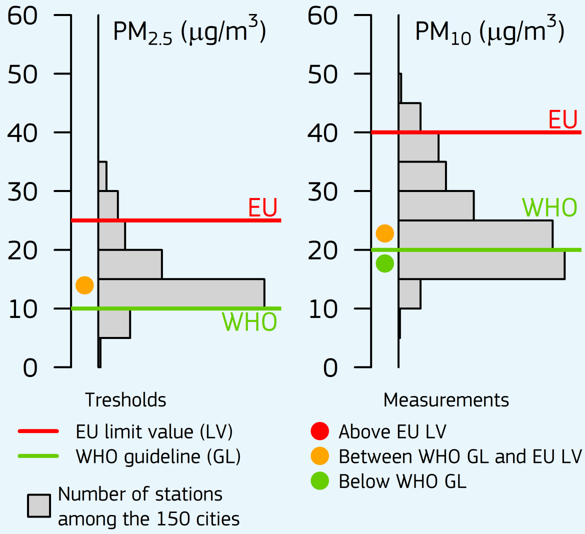




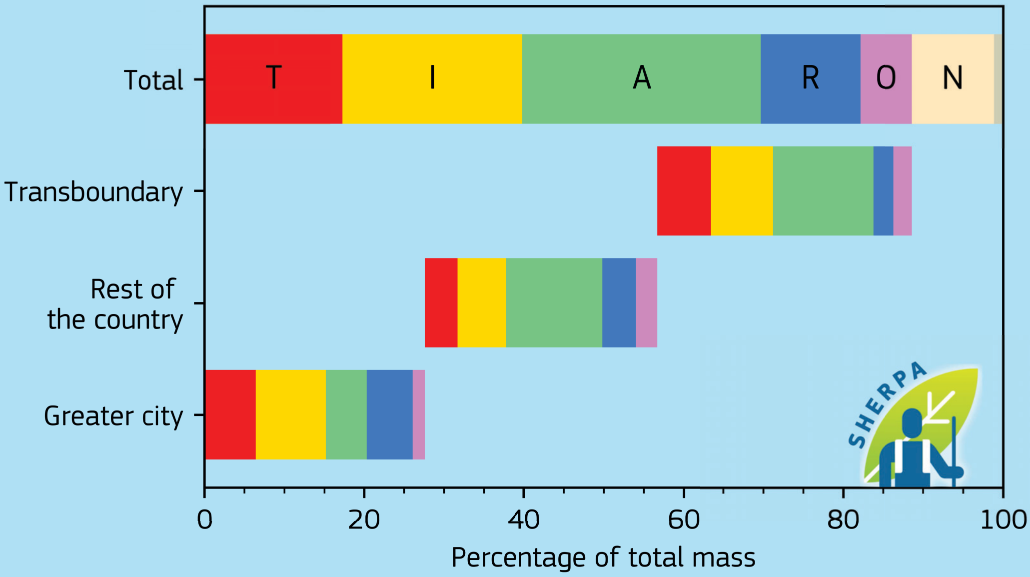
France, Nancy



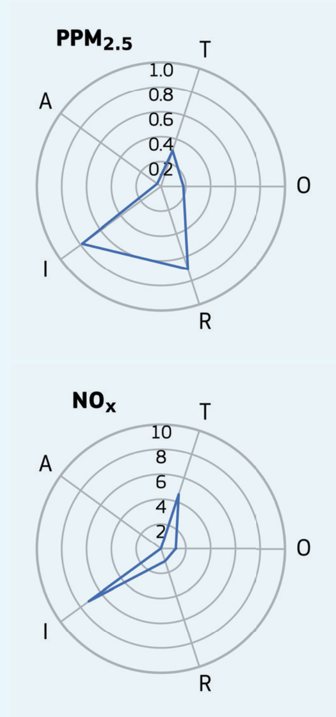
Yearly average urban background (2015)

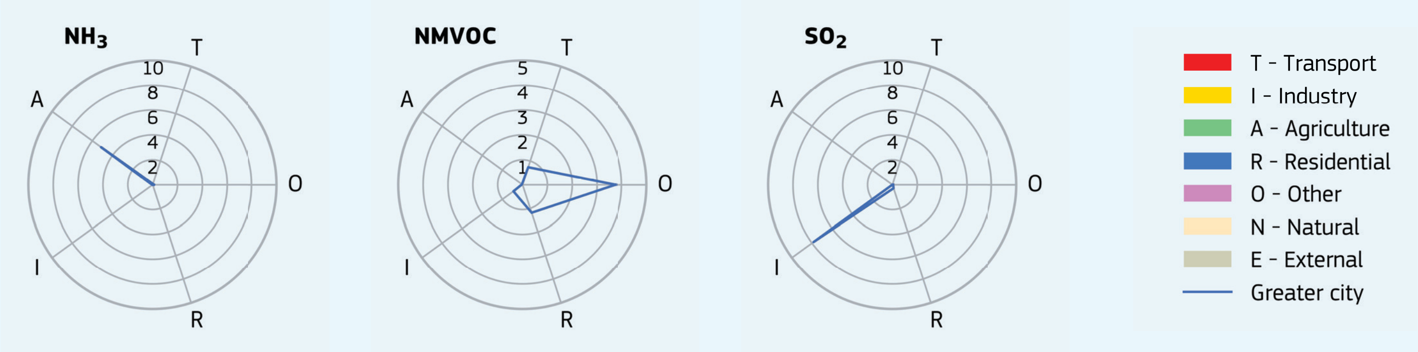


PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

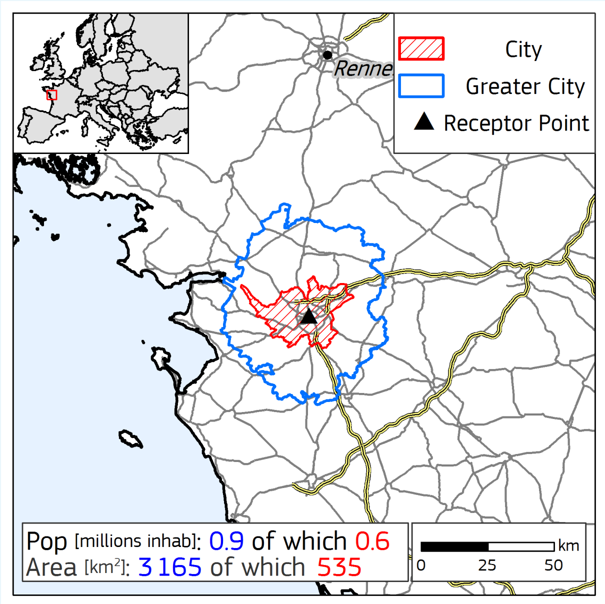


Emissions [kton/year]

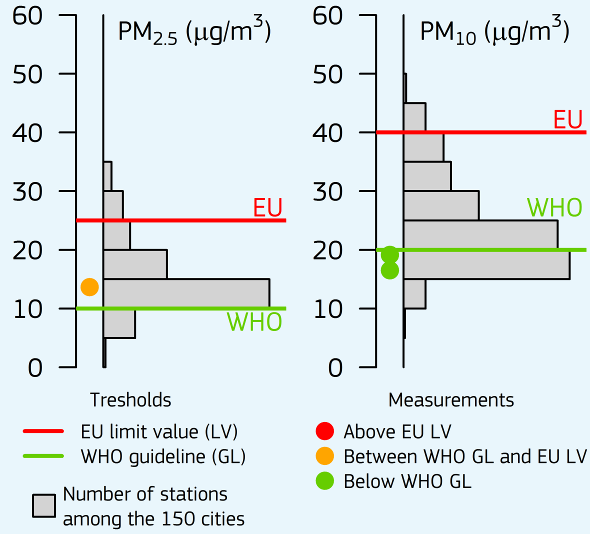




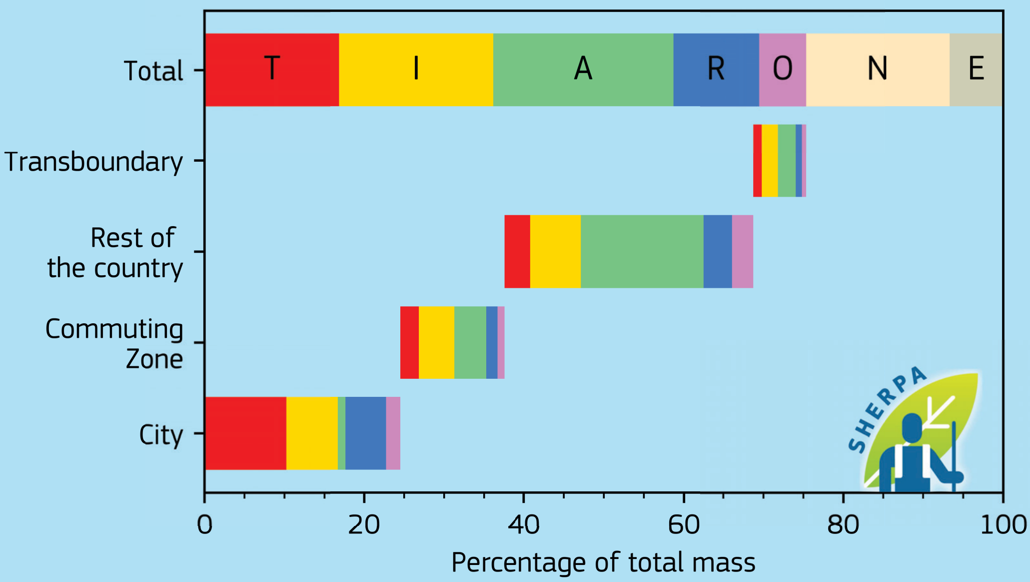
France, Nantes



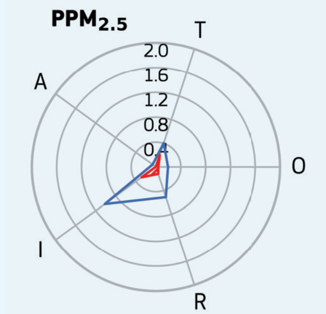
Yearly average urban background (2015)

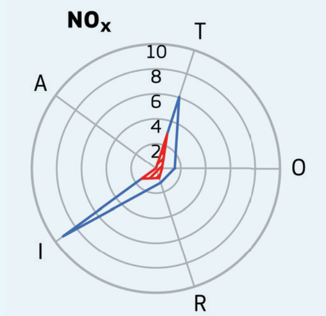


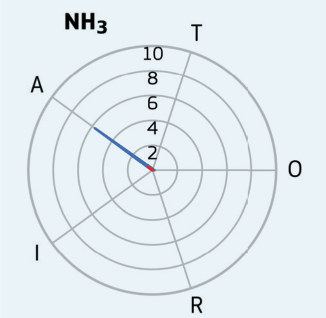
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

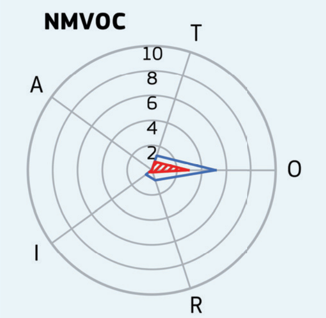


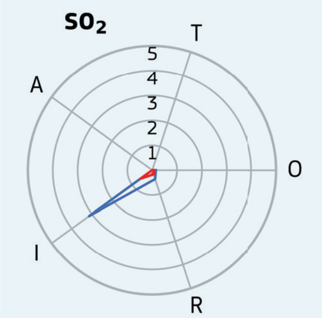
Emissions [kton/year]

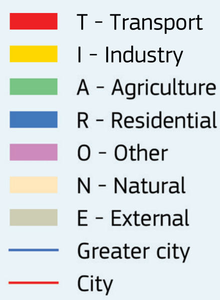


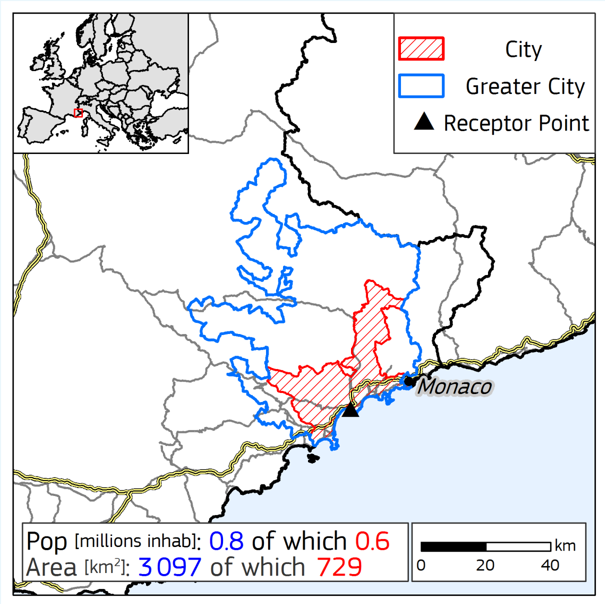




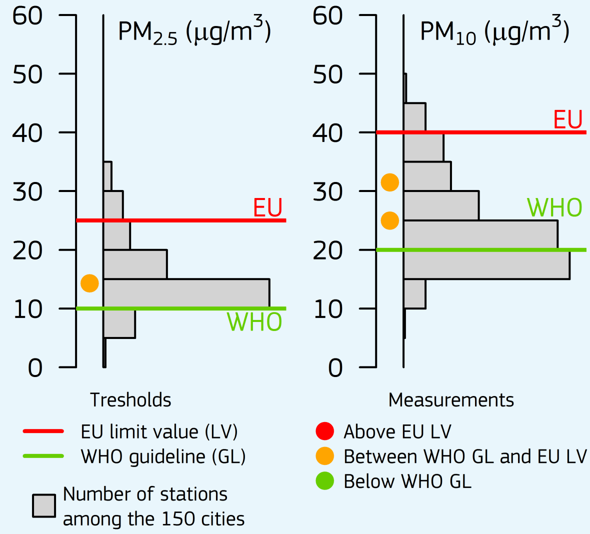




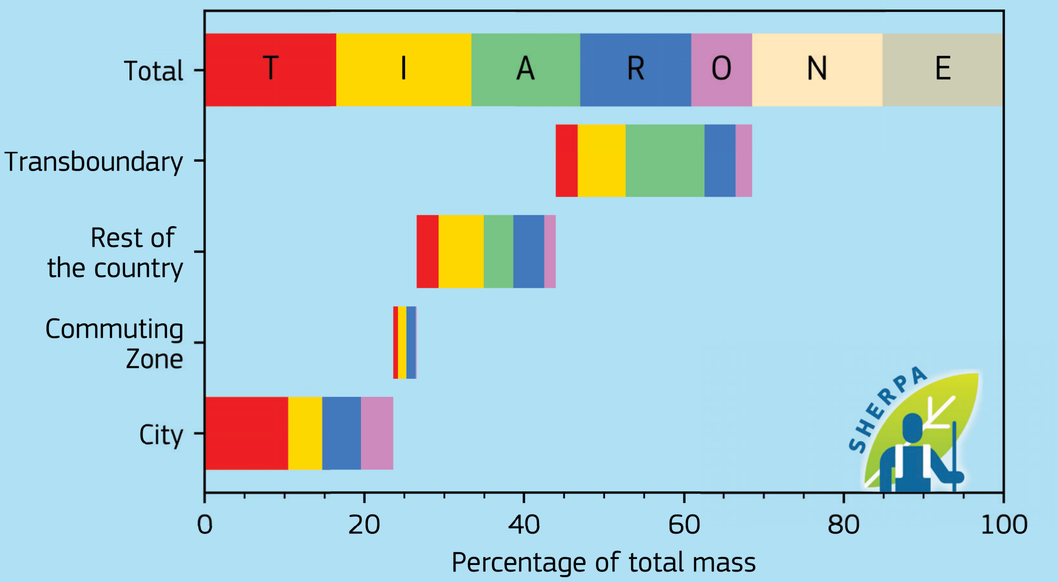




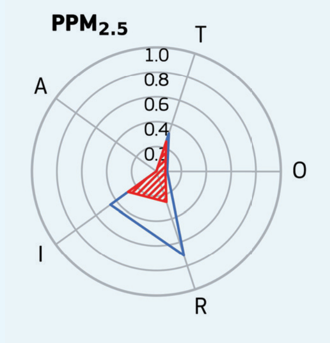
Yearly average urban background (2015)

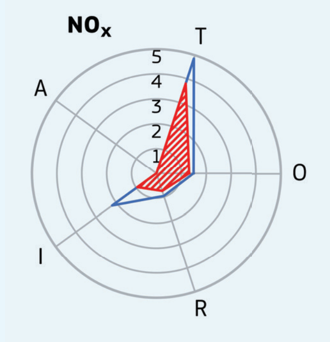


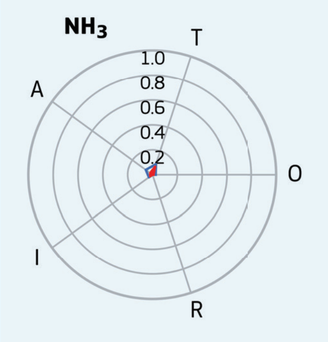
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

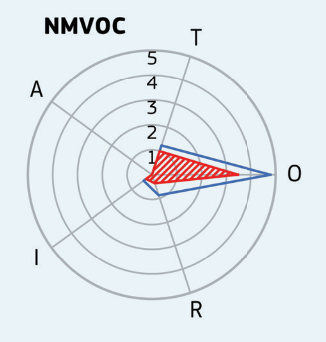


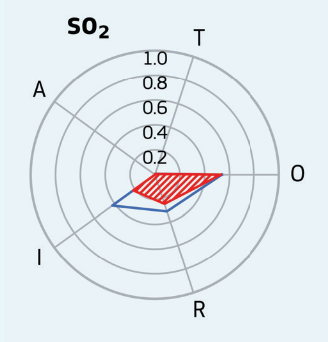
Emissions [kton/year]



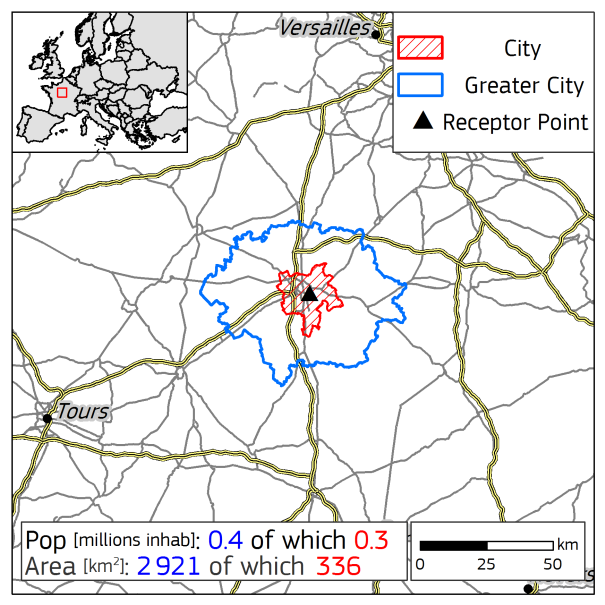




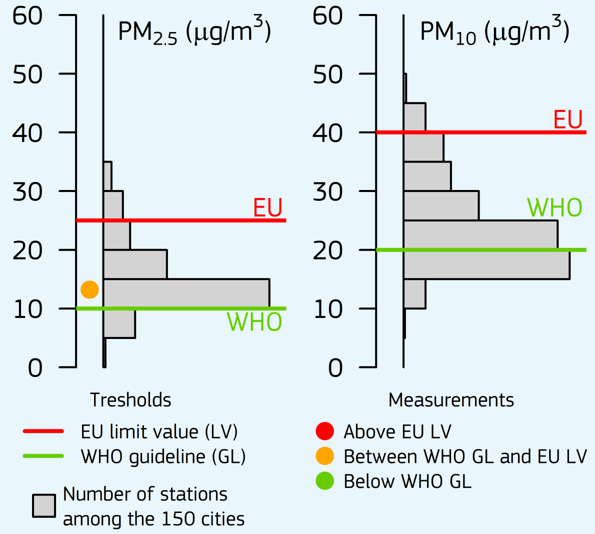




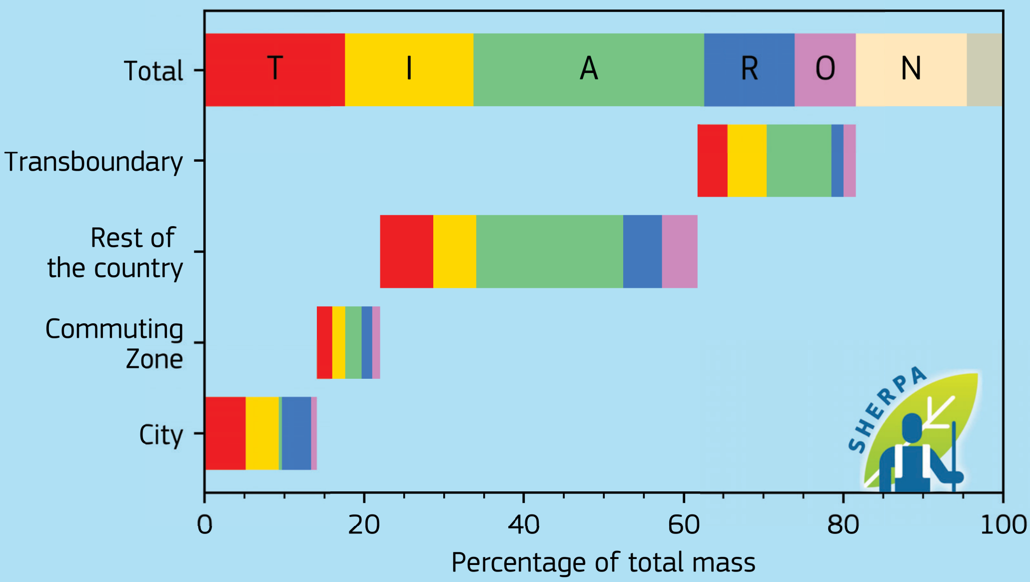
France, Orleans



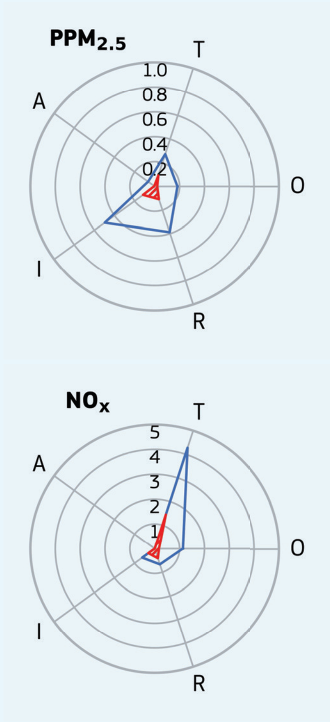
Yearly average urban background (2015)

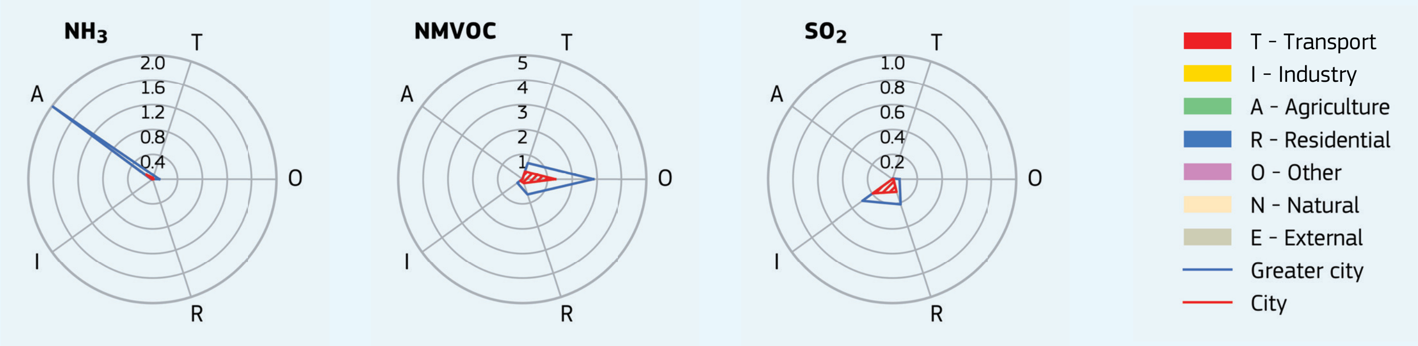


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

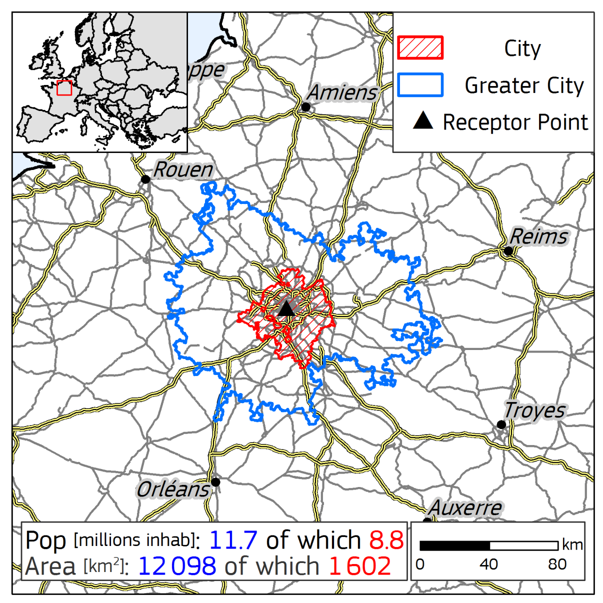


Emissions [kton/year]

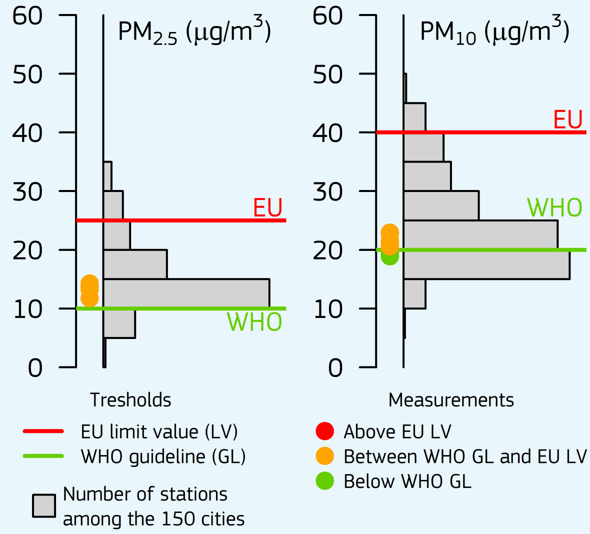




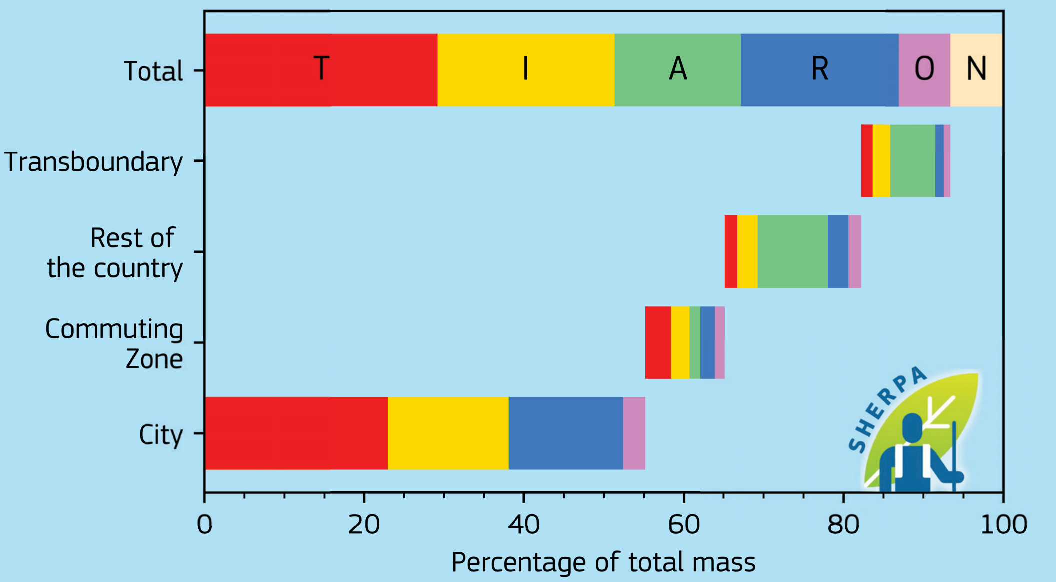
France, Paris



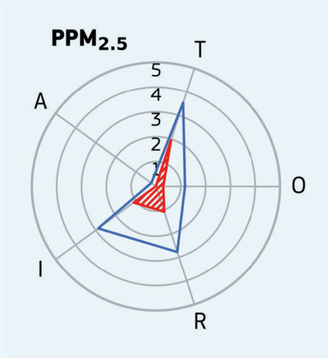
Yearly average urban background (2015)

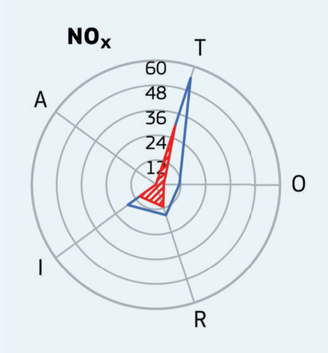


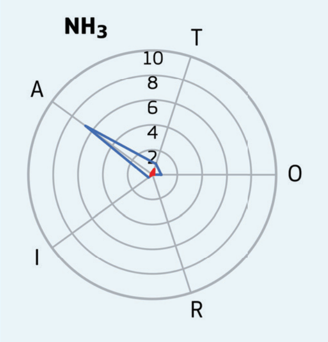
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

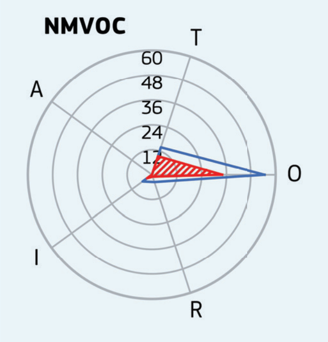


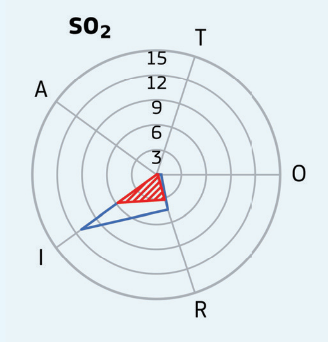
Emissions [kton/year]



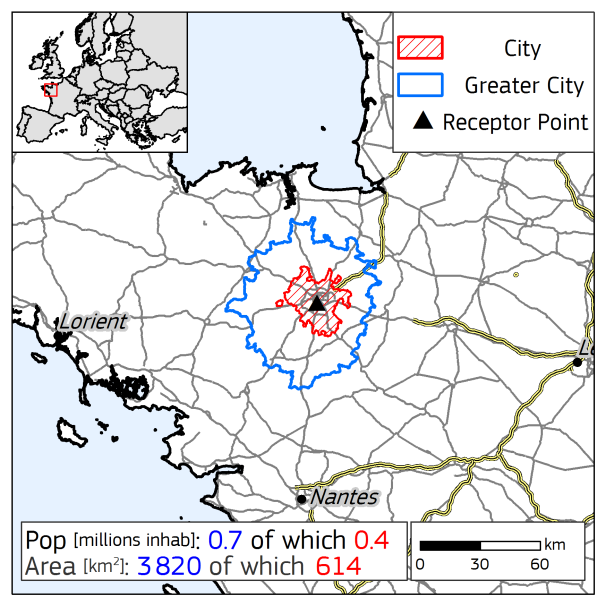




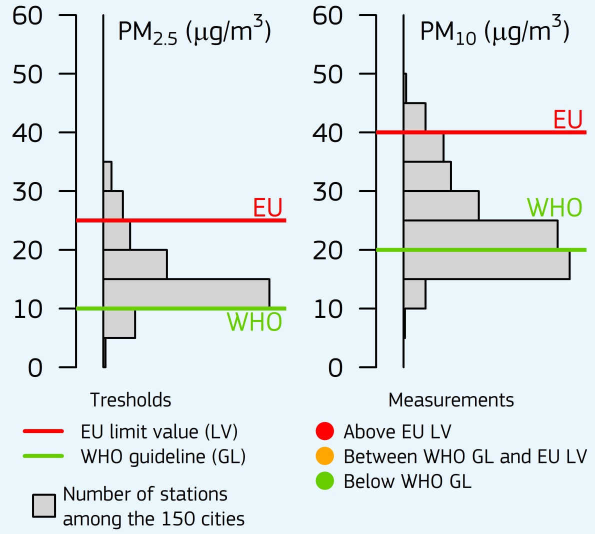




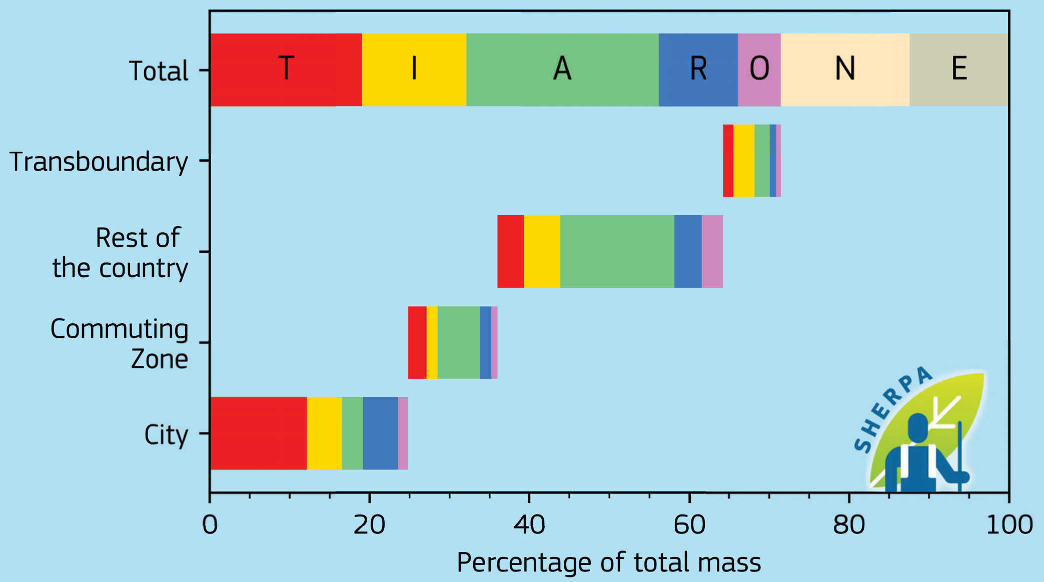
France, Rennes



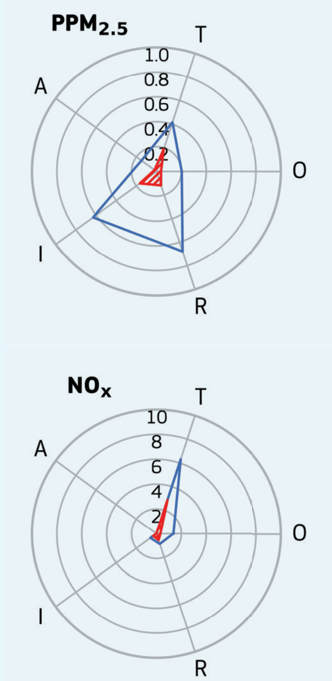
Yearly average urban background (2015)

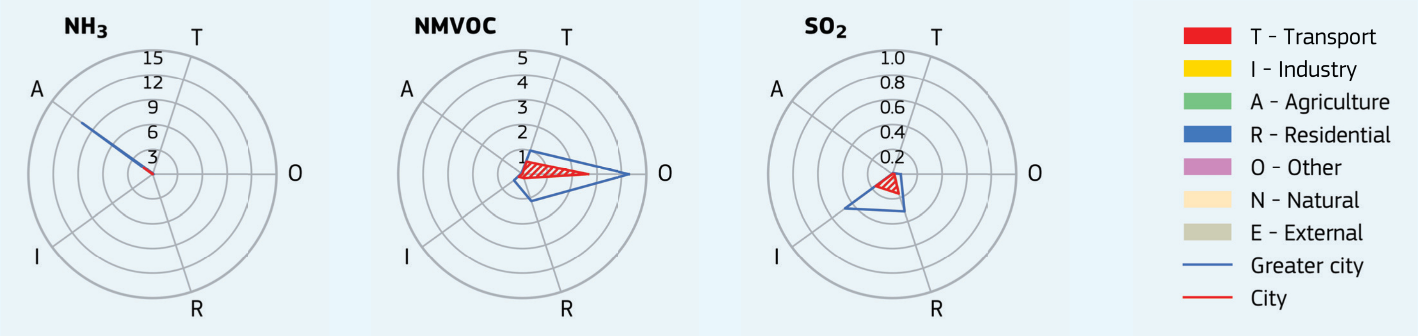


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

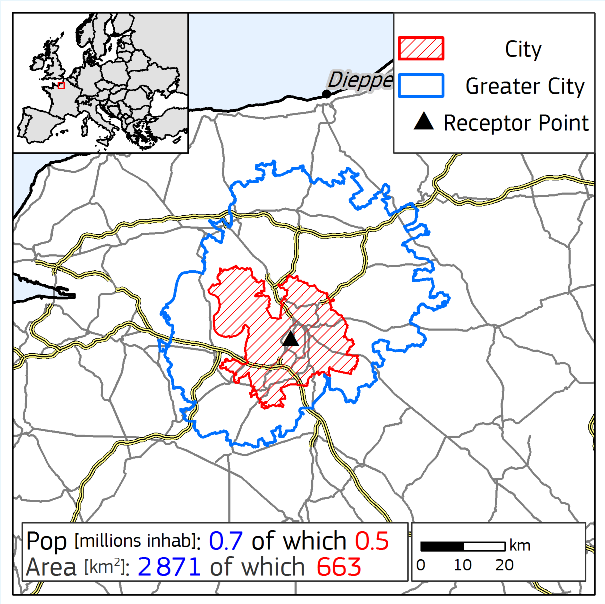


Emissions [kton/year]

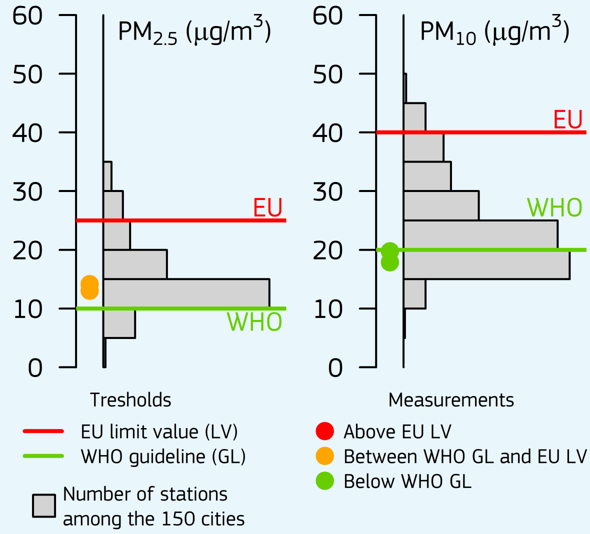




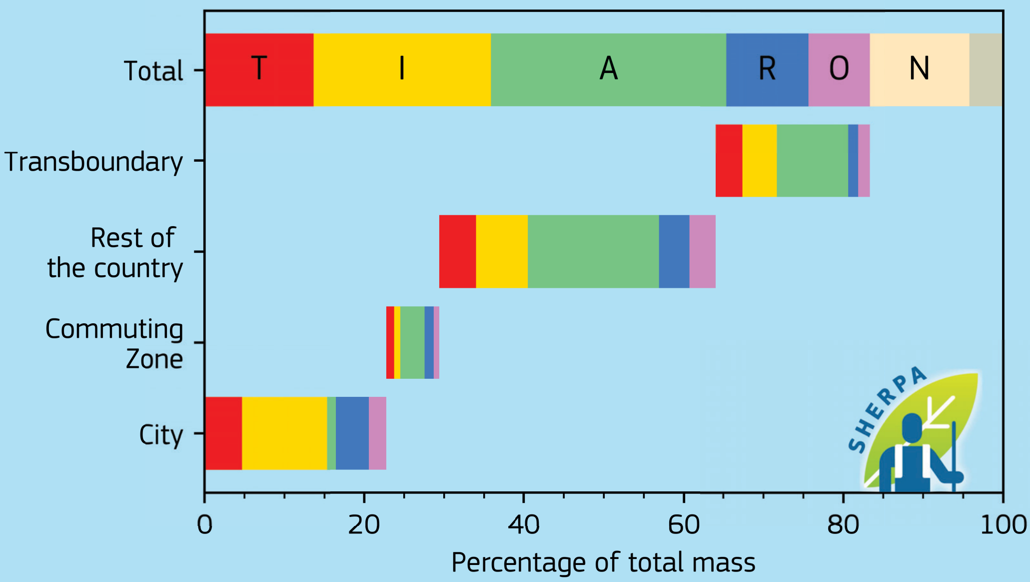
France, Rouen



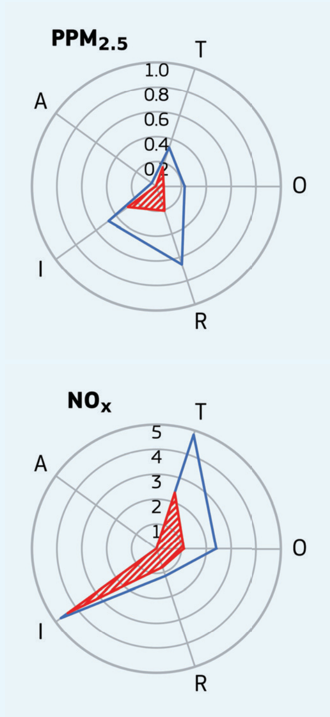
Yearly average urban background (2015)

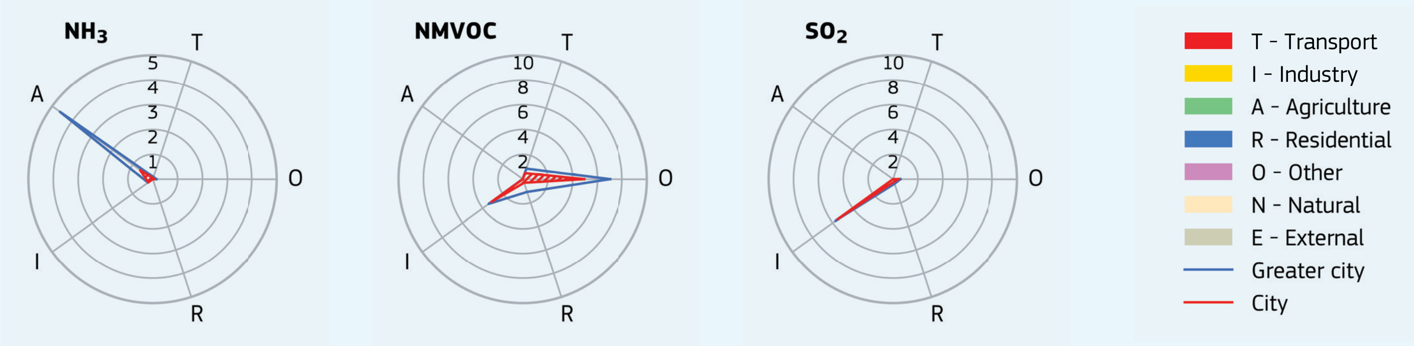


PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

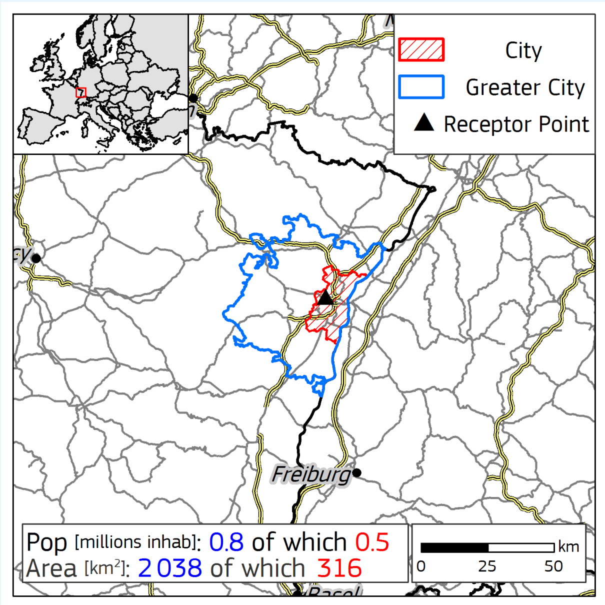


Emissions [kton/year]

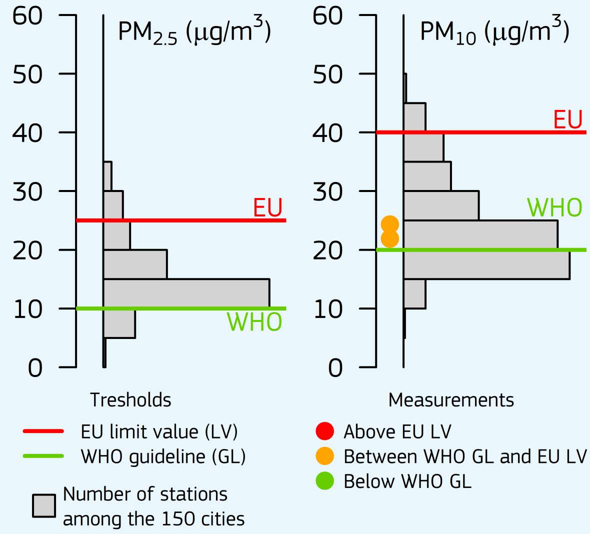




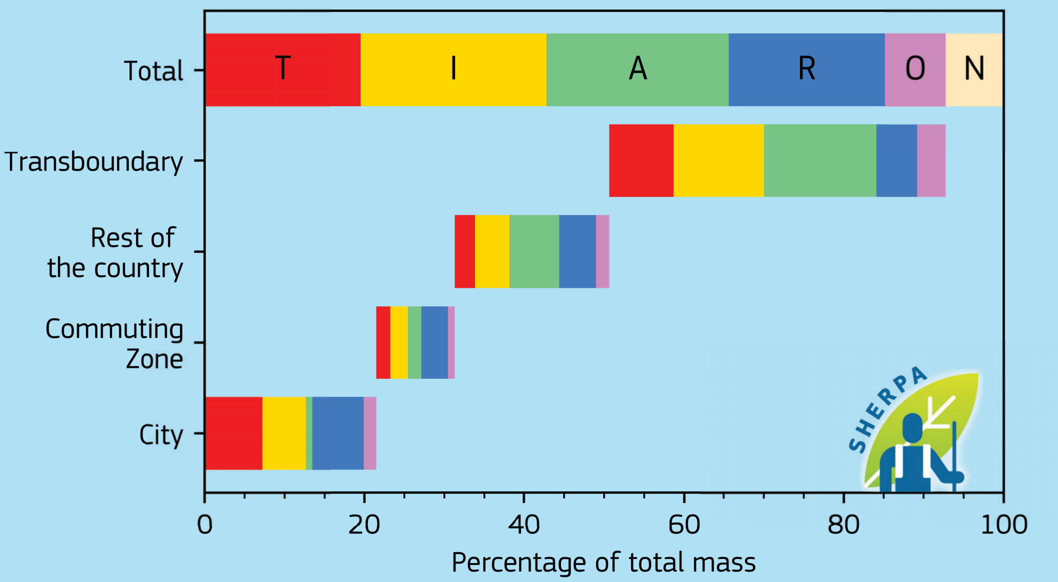
France, Strasbourg



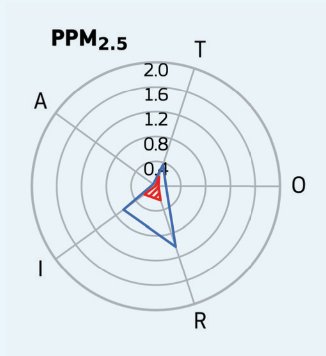
Yearly average urban background (2015)

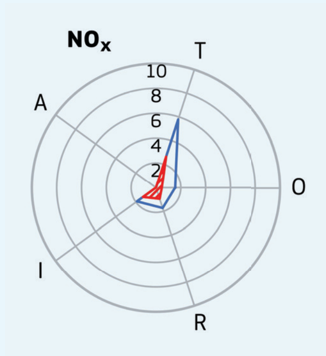


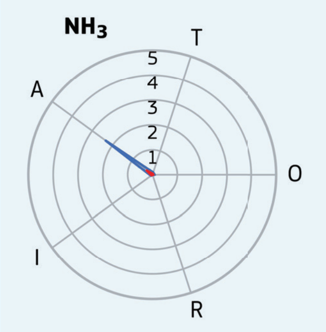
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

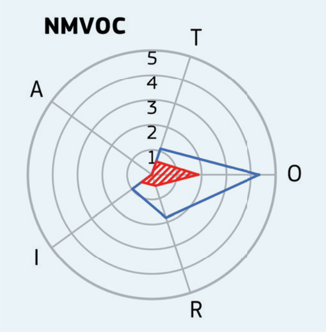


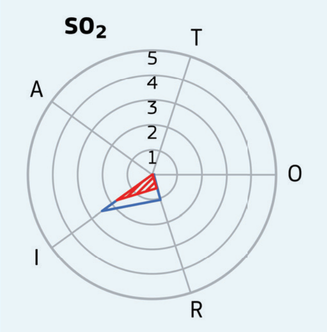
Emissions [kton/year]



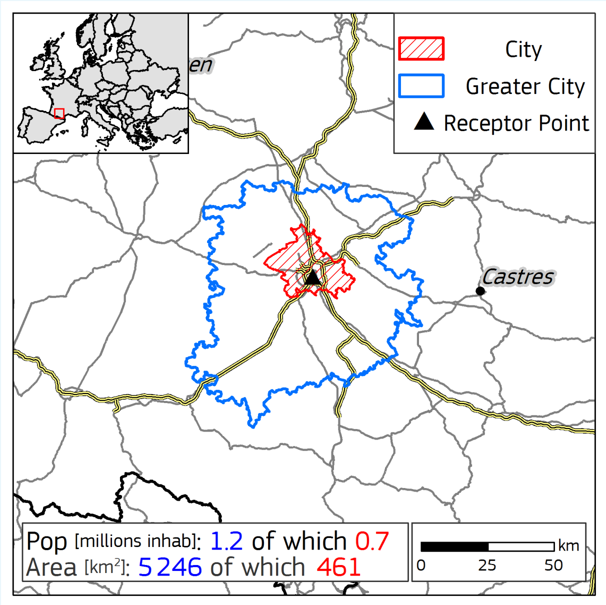




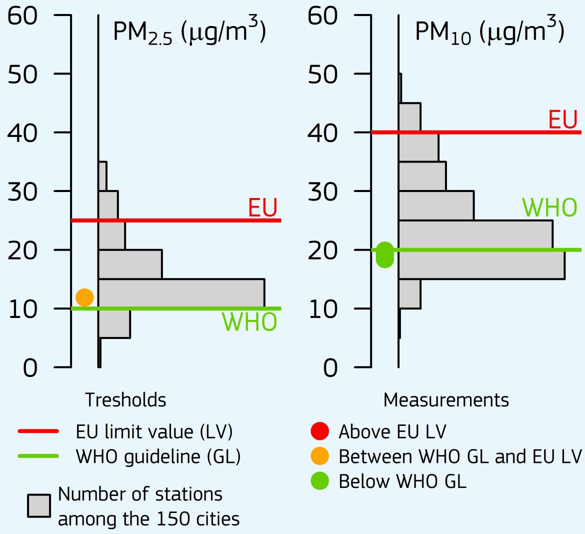




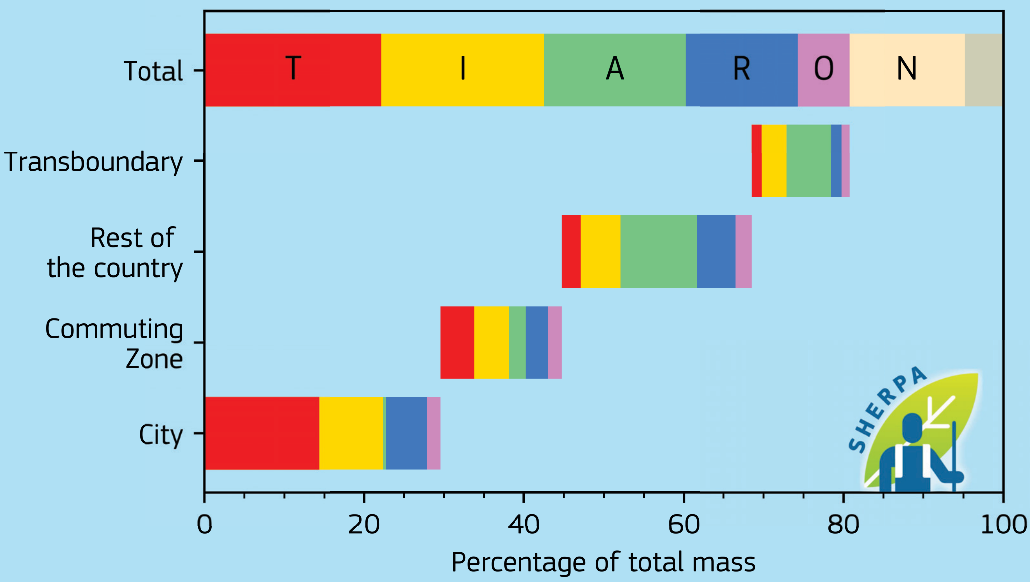
France, Toulouse



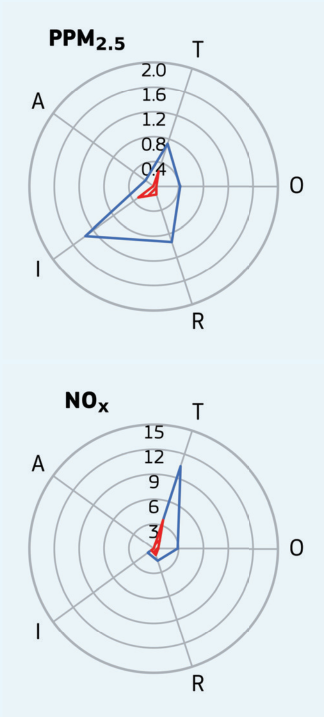
Yearly average urban background (2015)

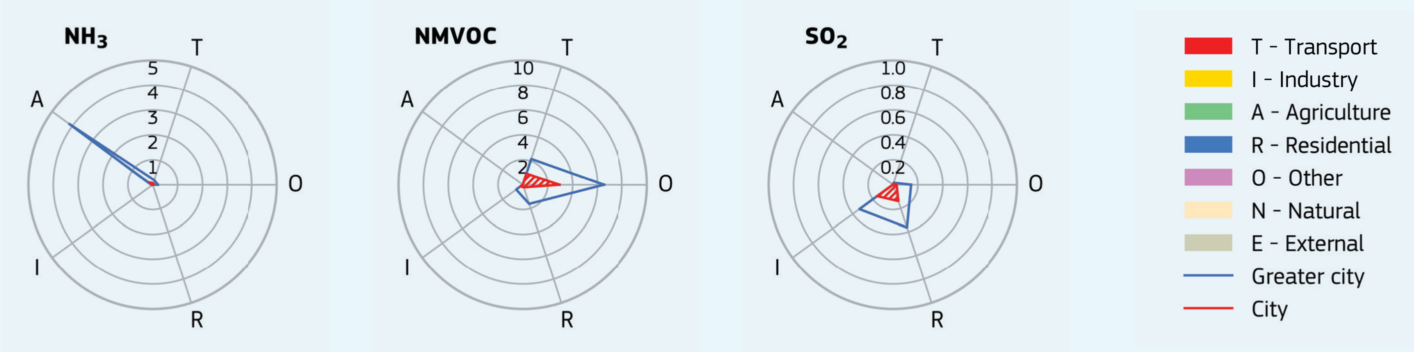


PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

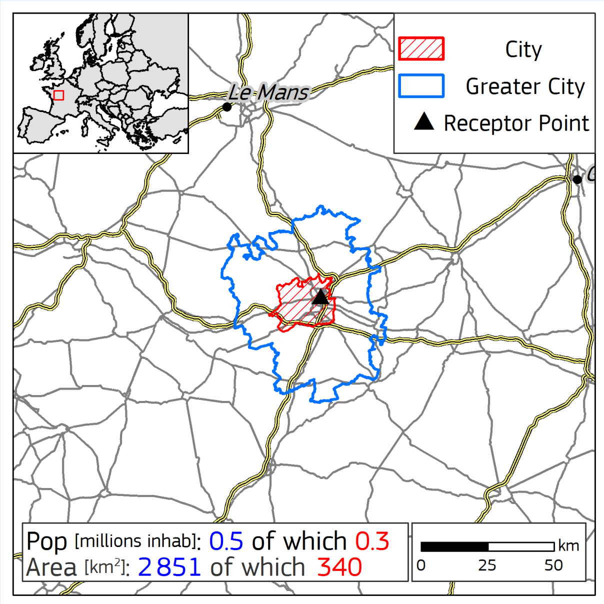


Emissions [kton/year]

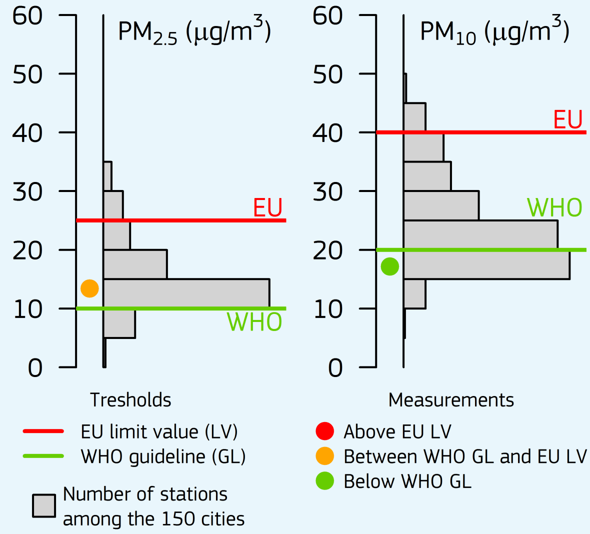




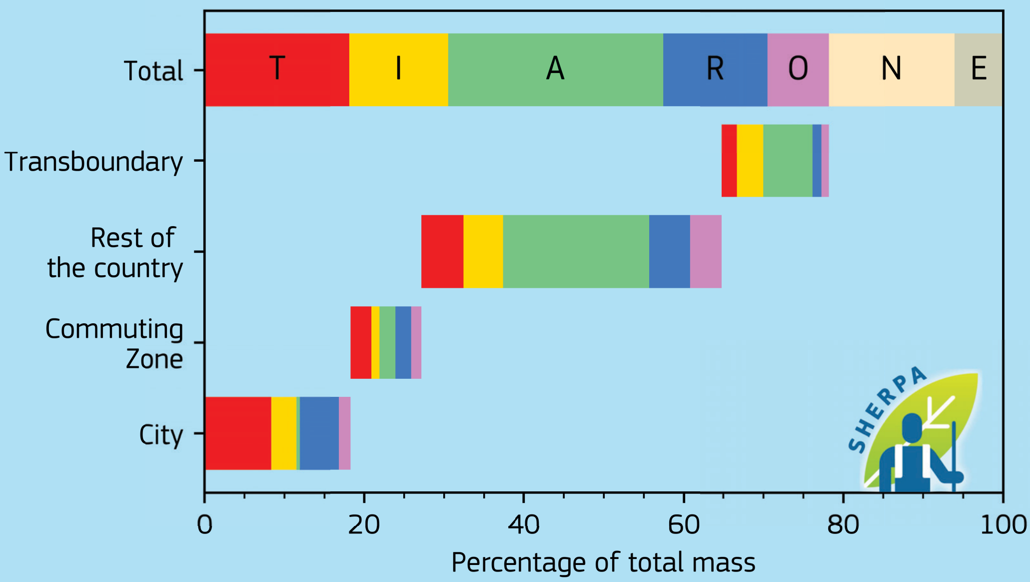
France, Tours



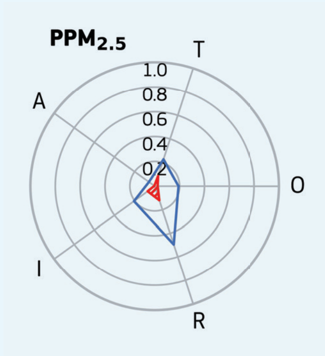
Yearly average urban background (2015)

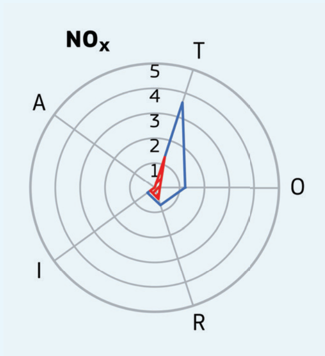


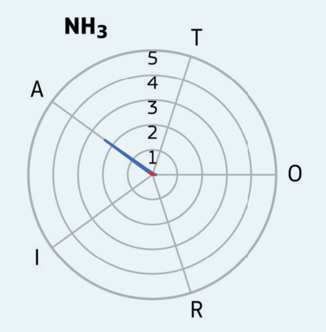
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

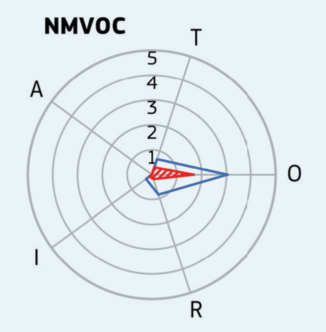


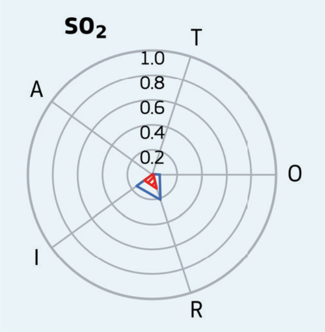
Emissions [kton/year]



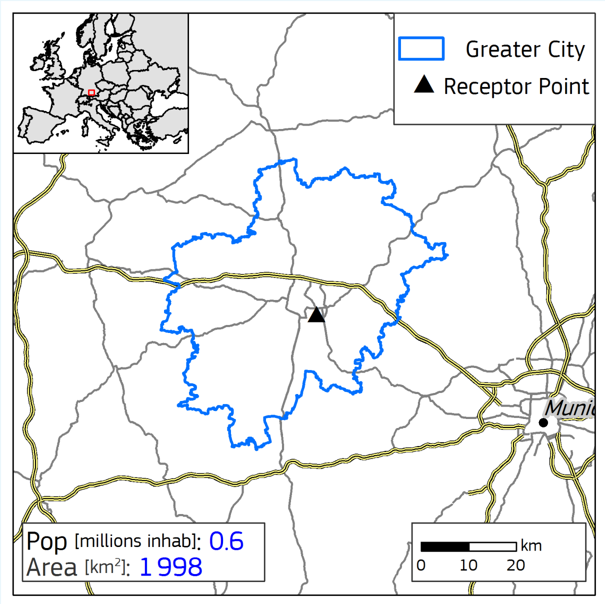




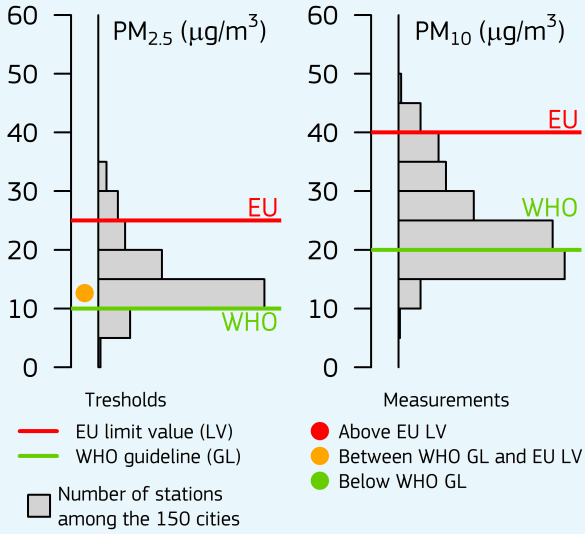




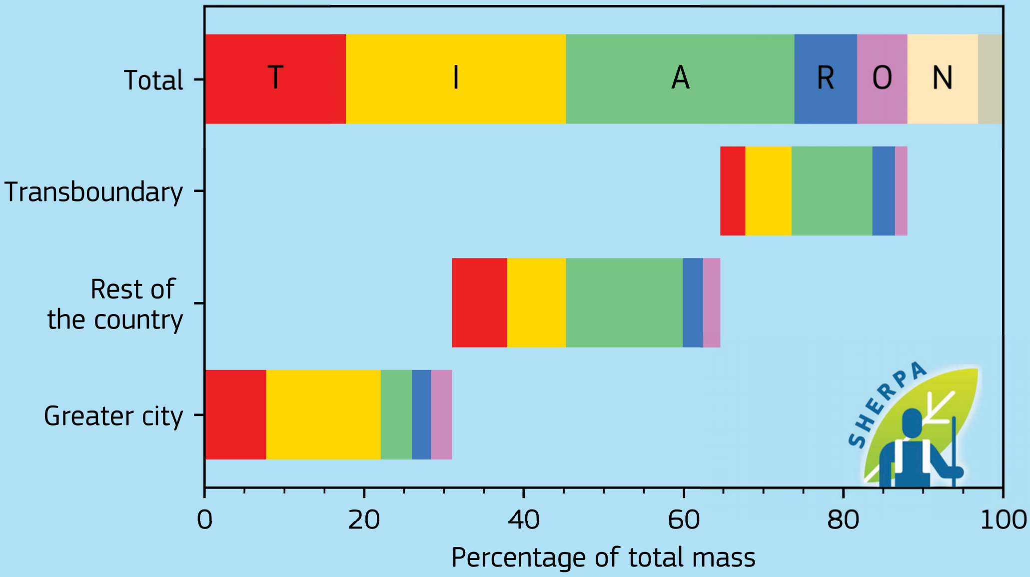
Germany, Augsburg



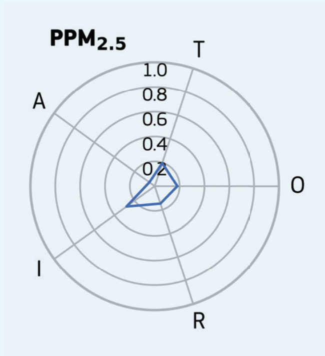
Yearly average urban background (2015)

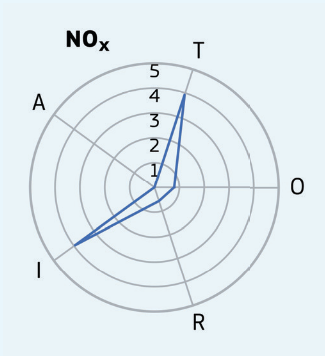


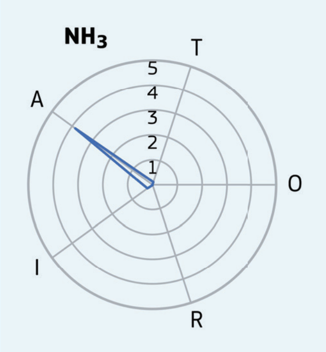
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

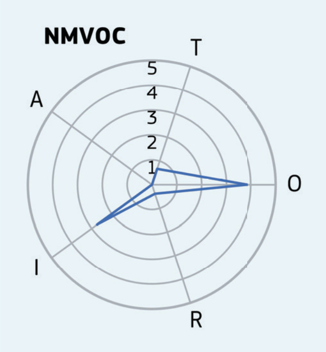


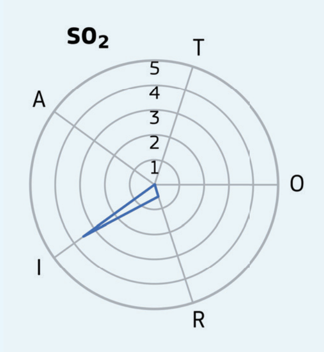
Emissions [kton/year]



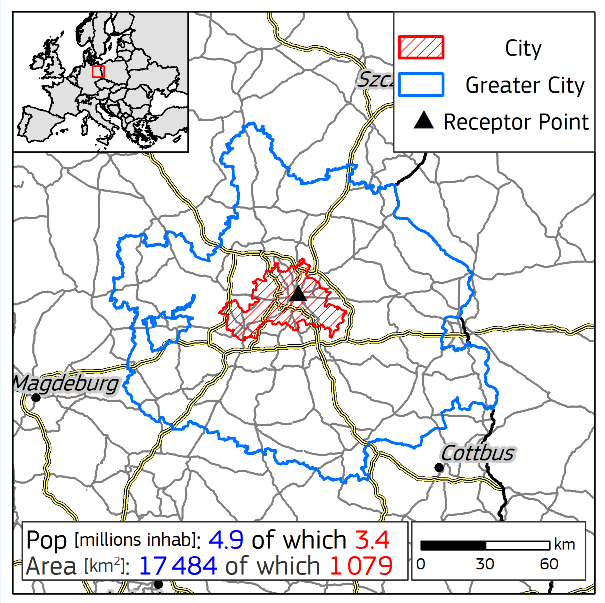




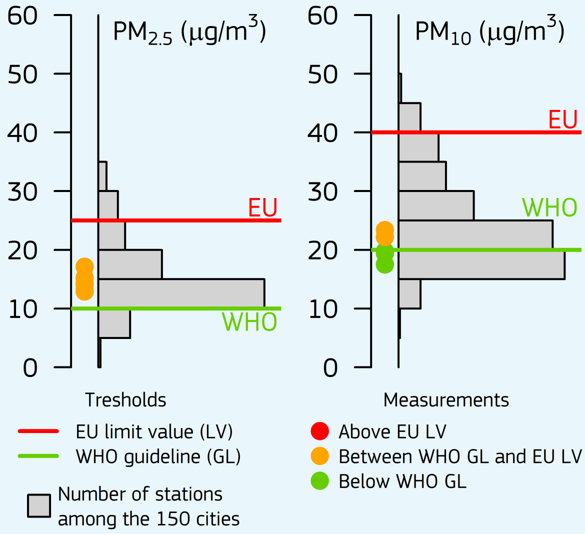




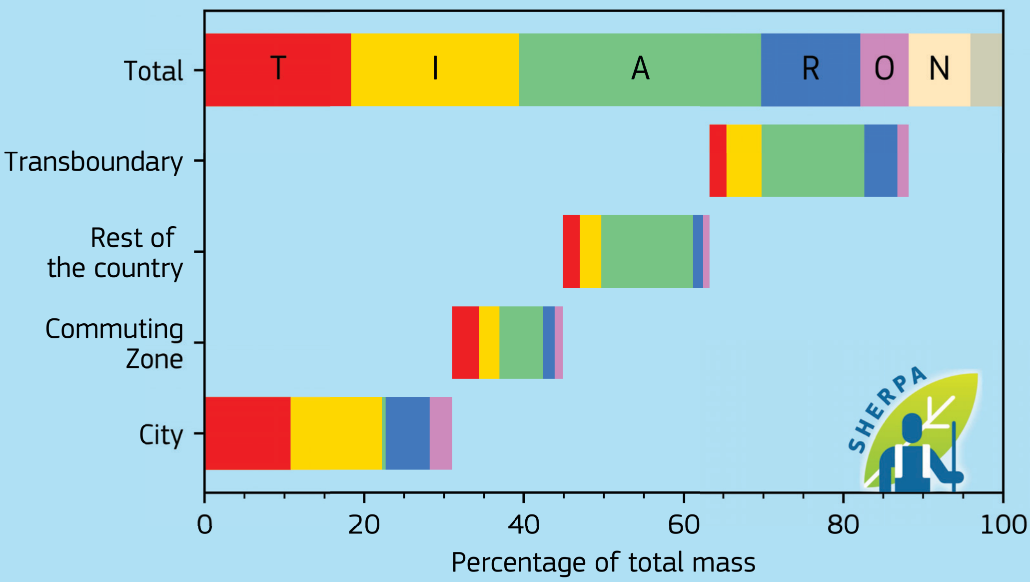
Germany, Berlin



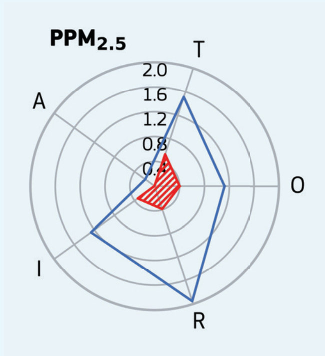
Yearly average urban background (2015)

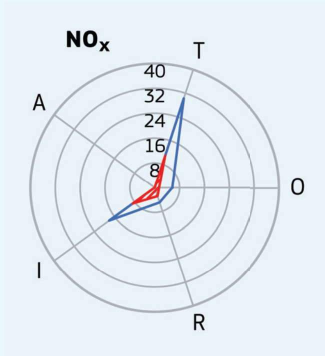


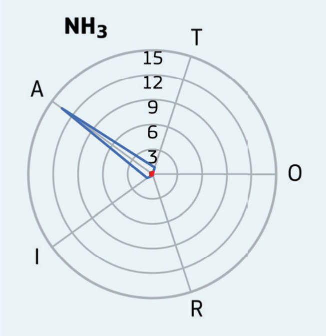
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

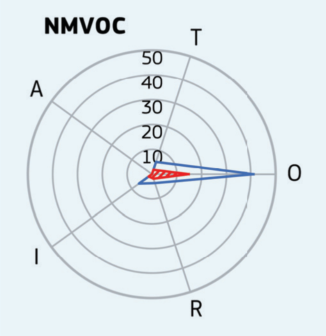


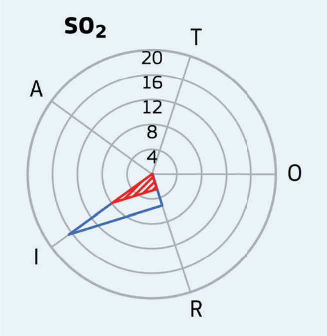
Emissions [kton/year]



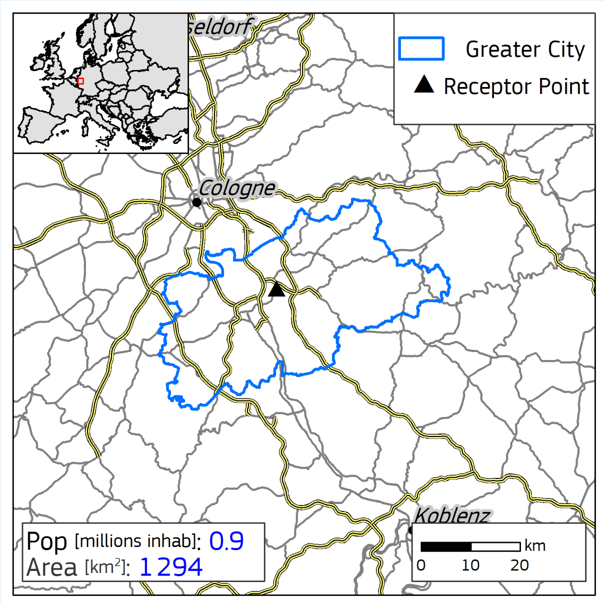




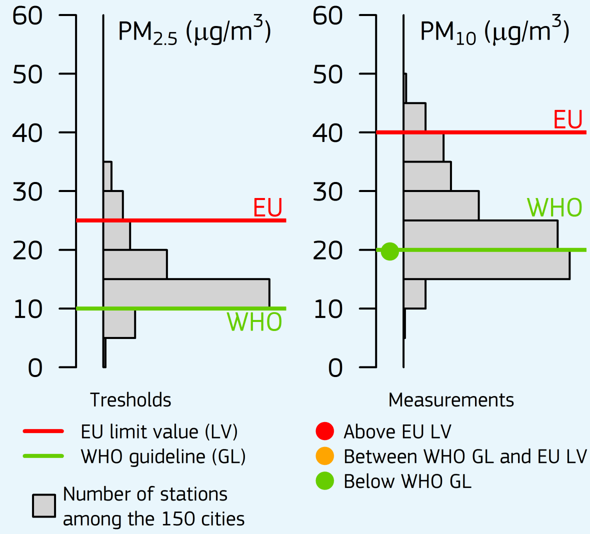




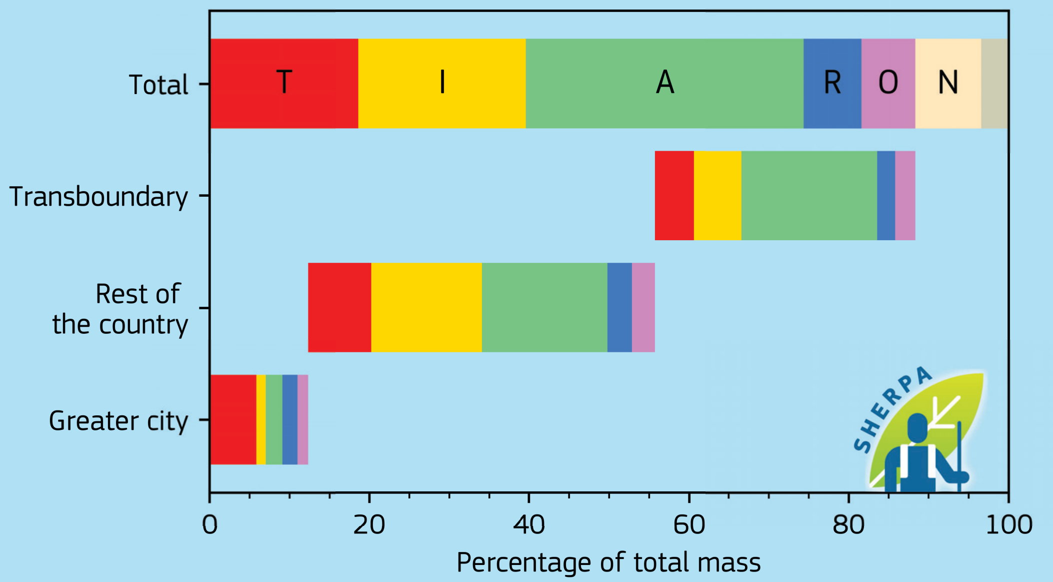
Germany, Bonn



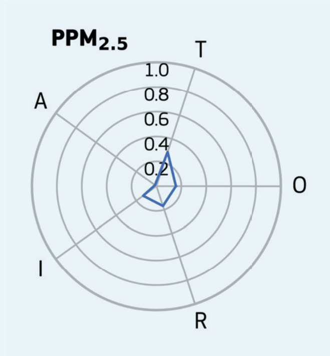
Yearly average urban background (2015)

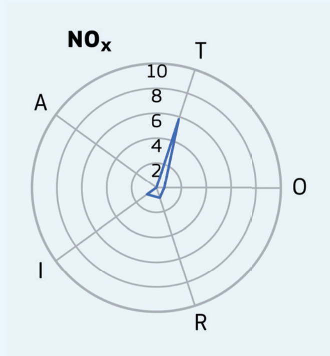


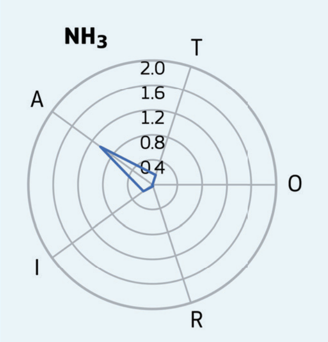
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

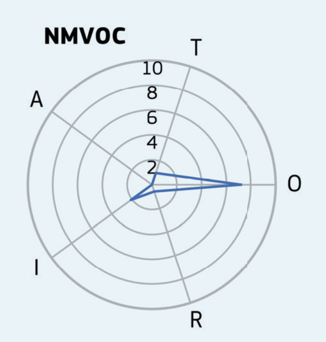


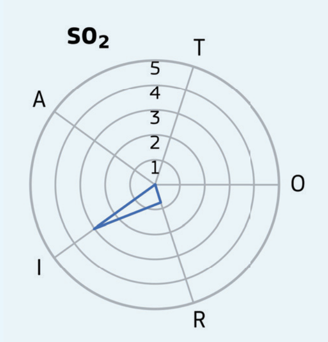
Emissions [kton/year]



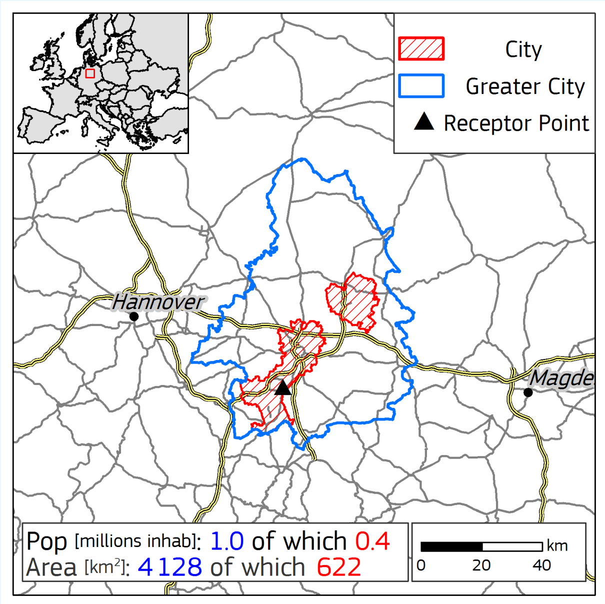




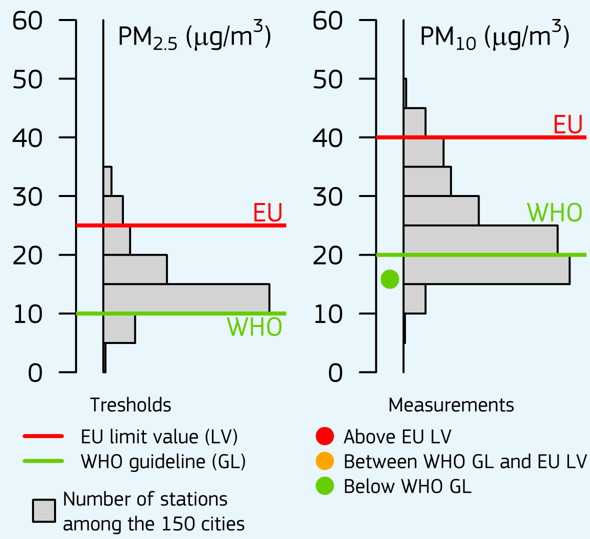




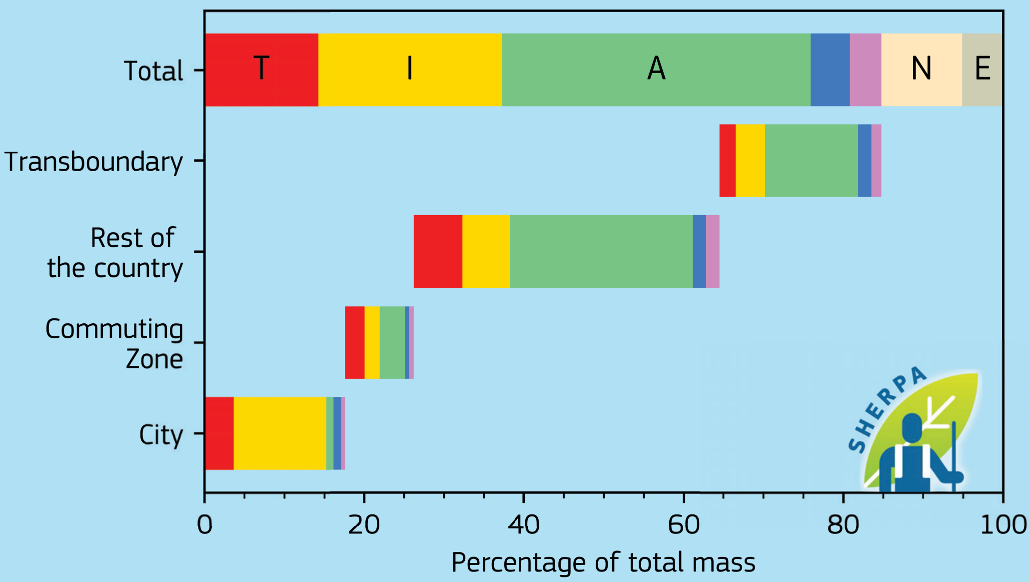
Germany, Braunschweig-Salzgitter-Wolfsburg



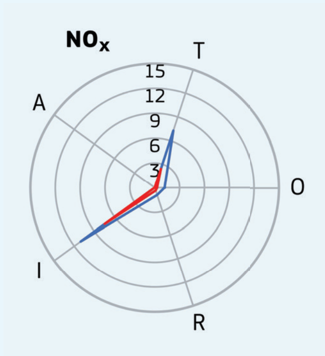
Yearly average urban background (2015)

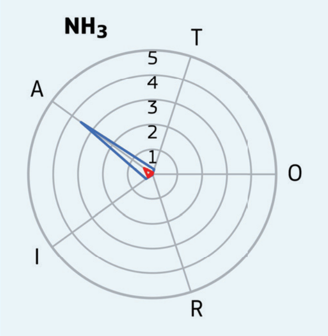


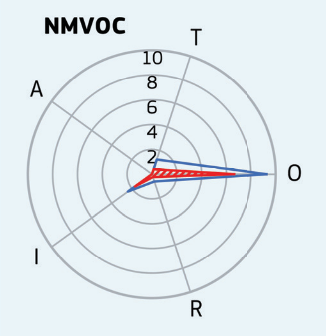
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

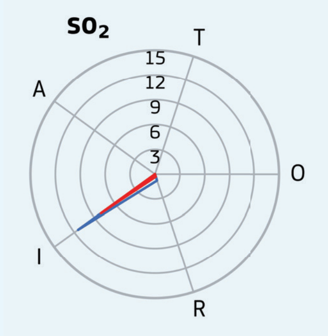


Emissions [kton/year]

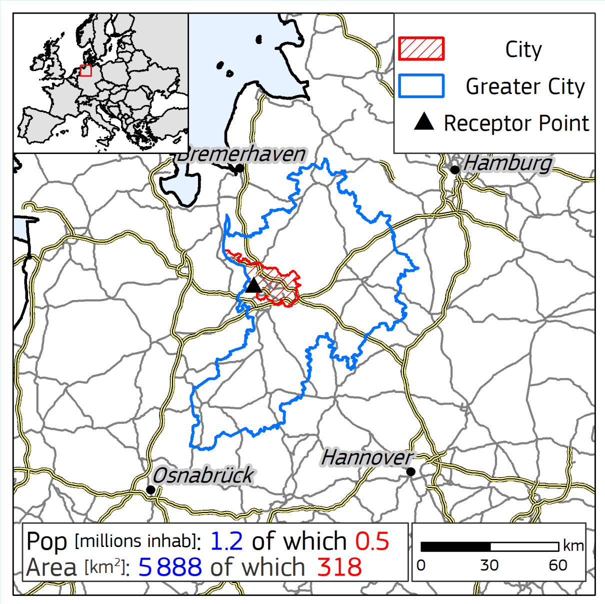




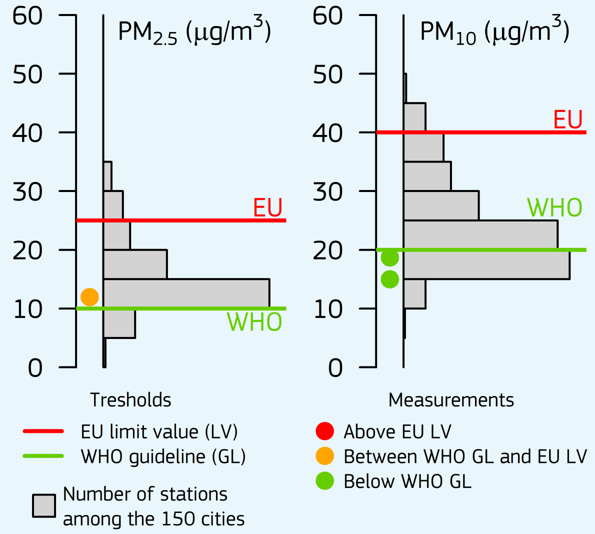




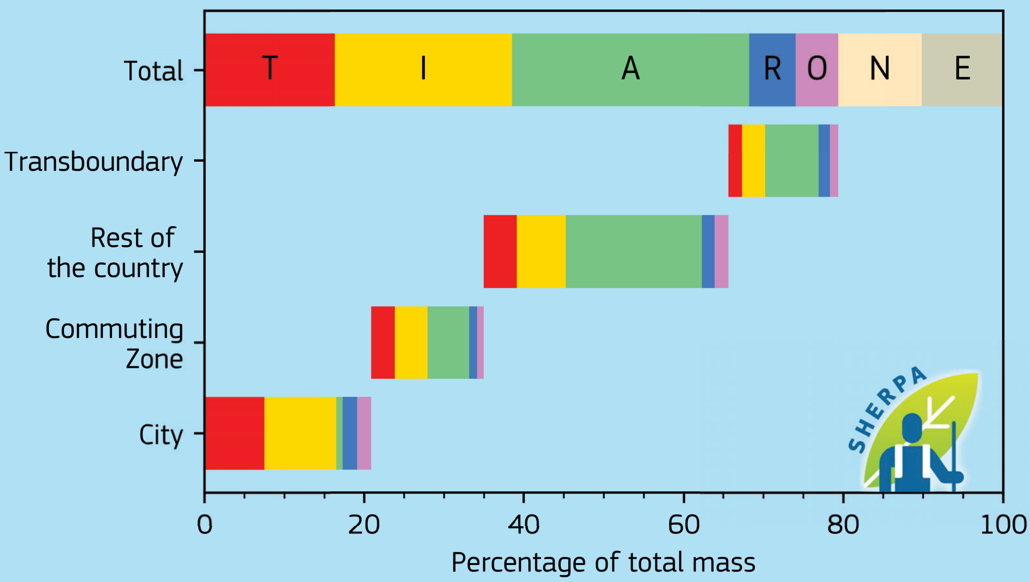
Germany, Bremen



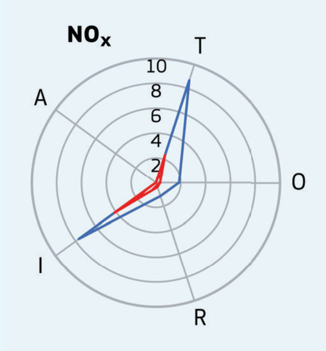
Yearly average urban background (2015)

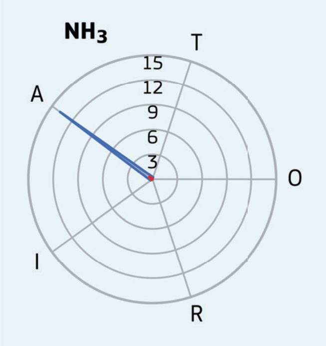


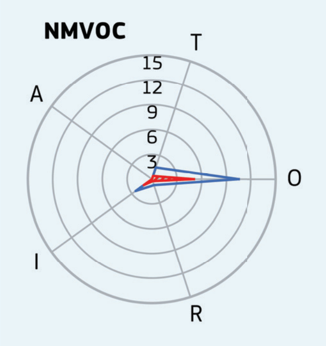
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



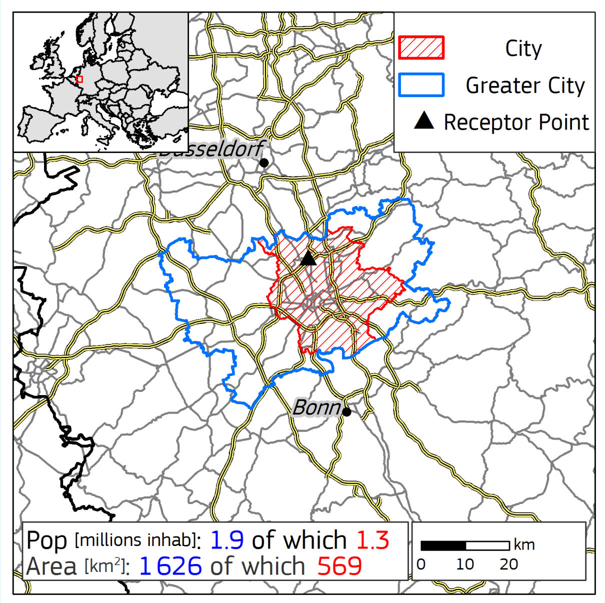
Emissions [kton/year]



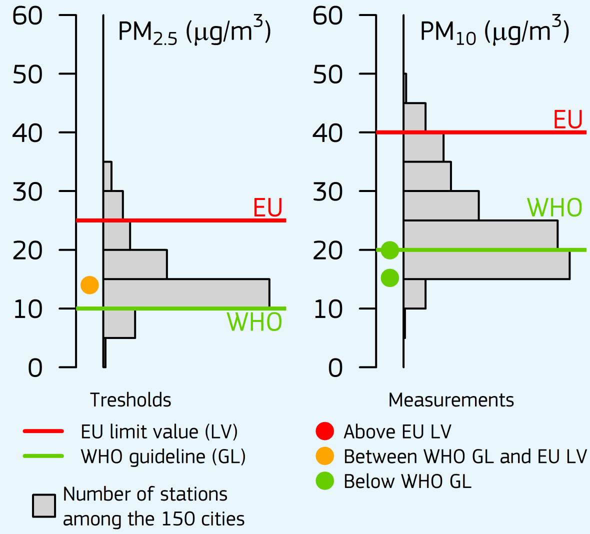




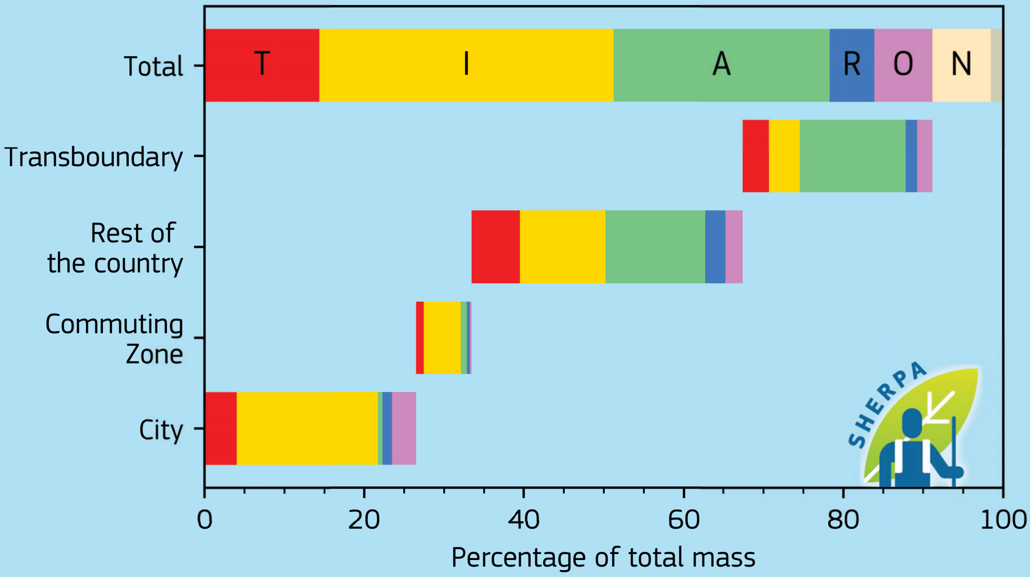
Germany, Cologne



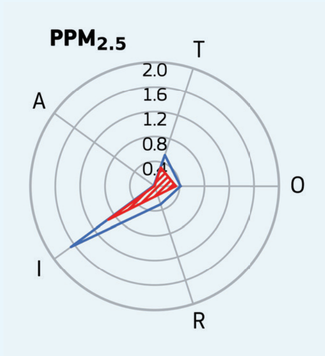
Yearly average urban background (2015)

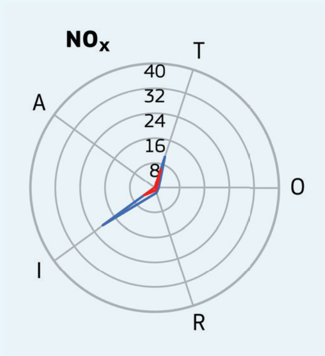


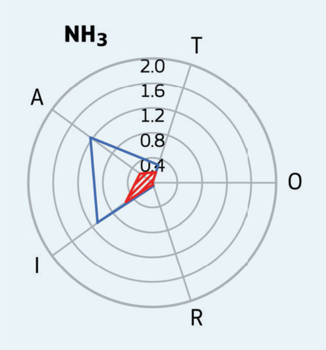
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

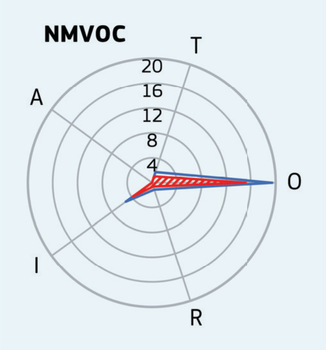


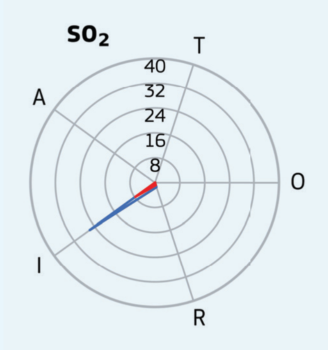
Emissions [kton/year]



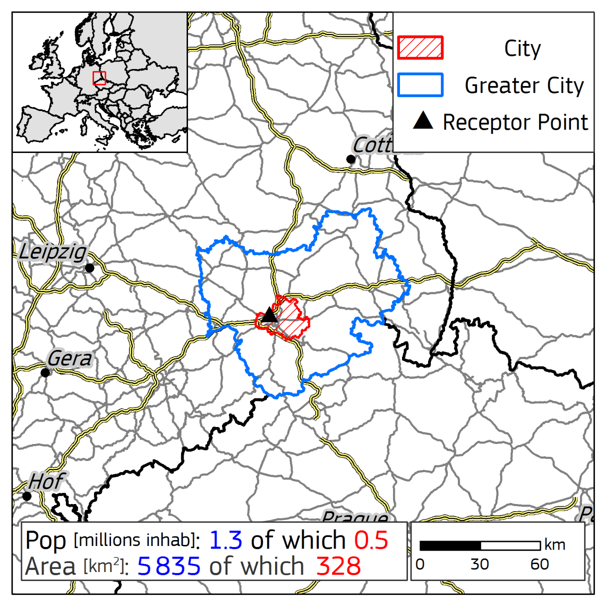


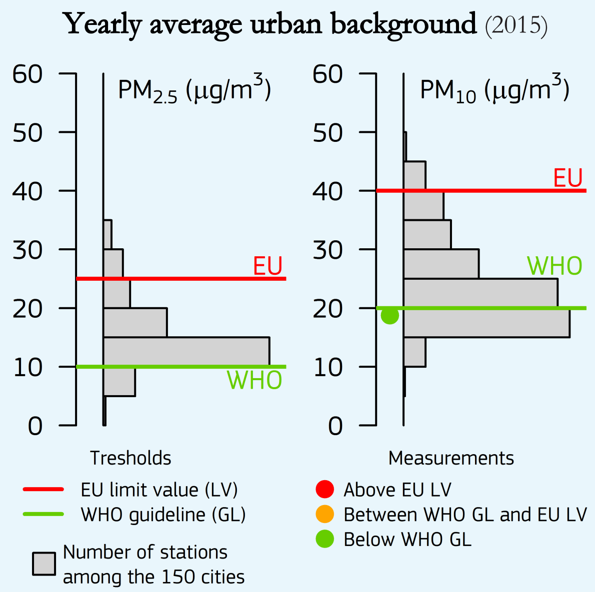


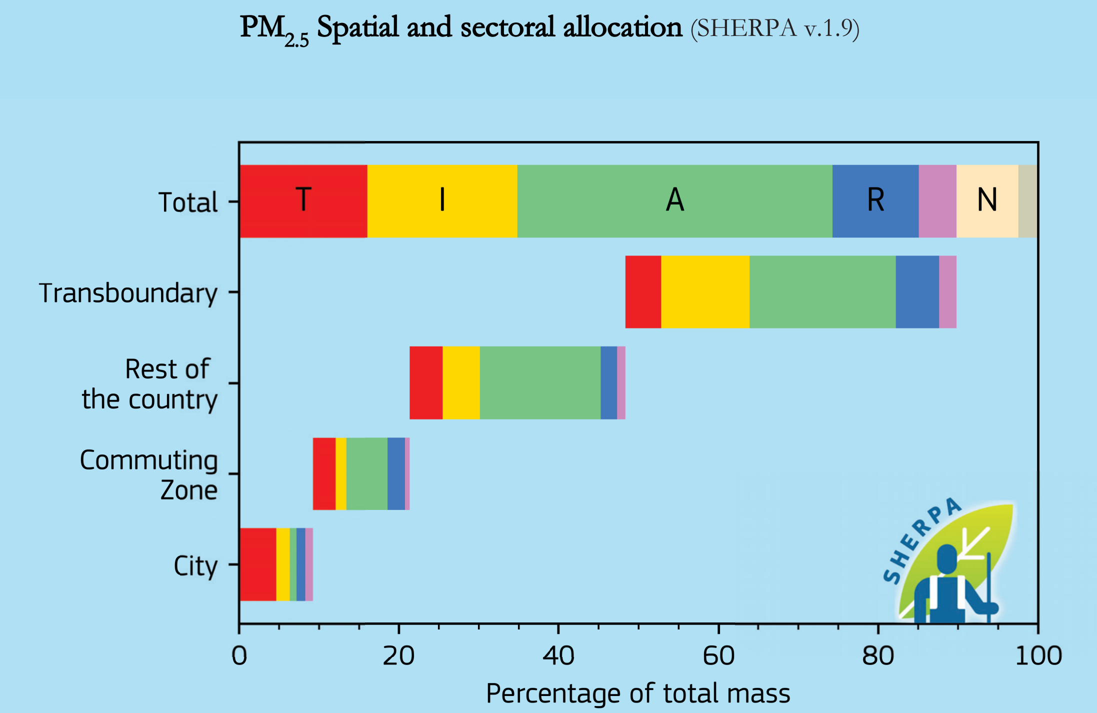


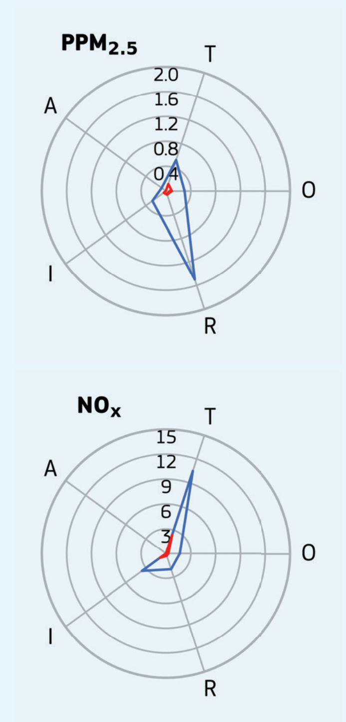


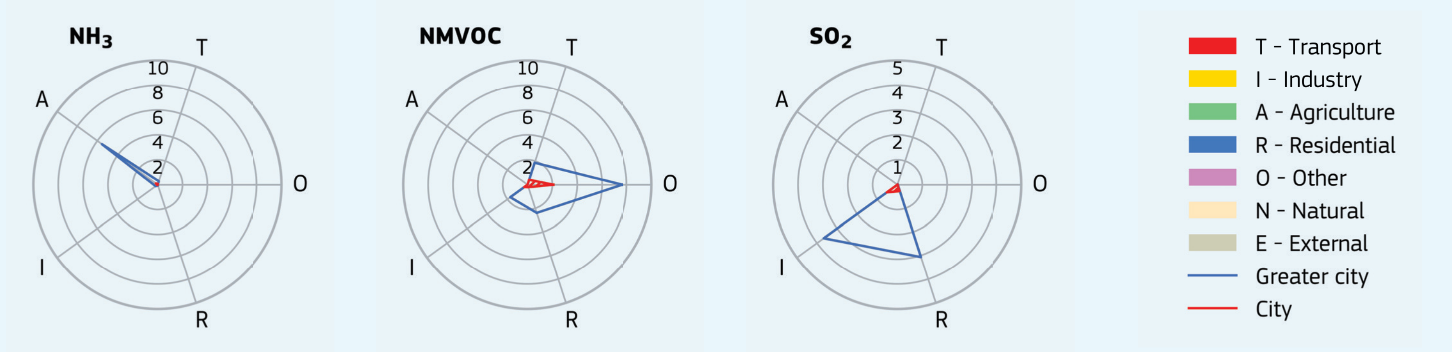
Germany, Dresden



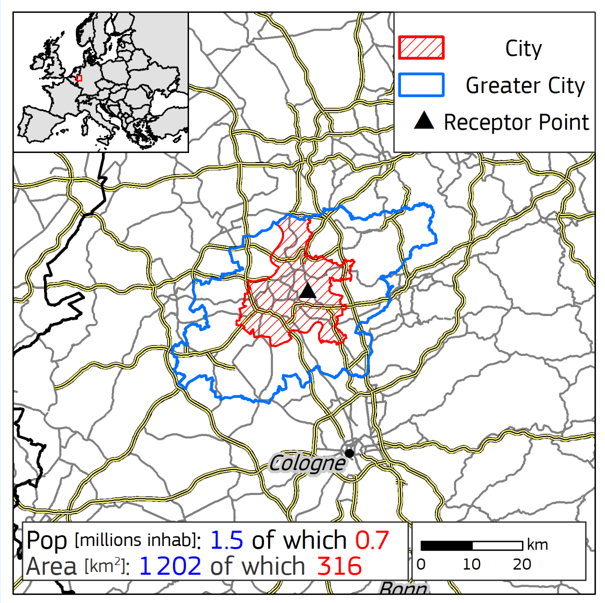




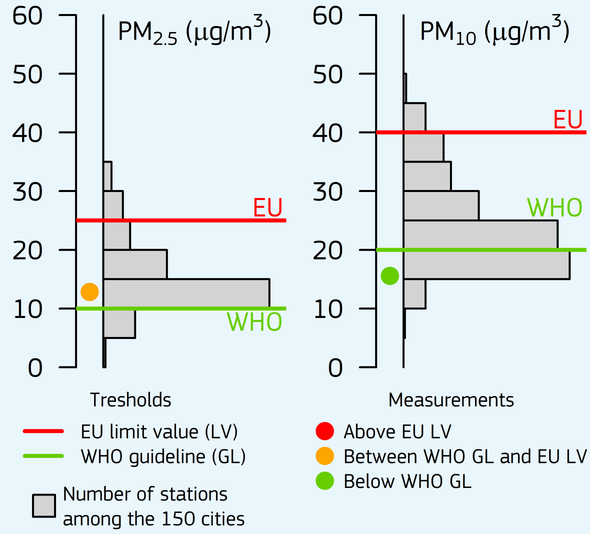




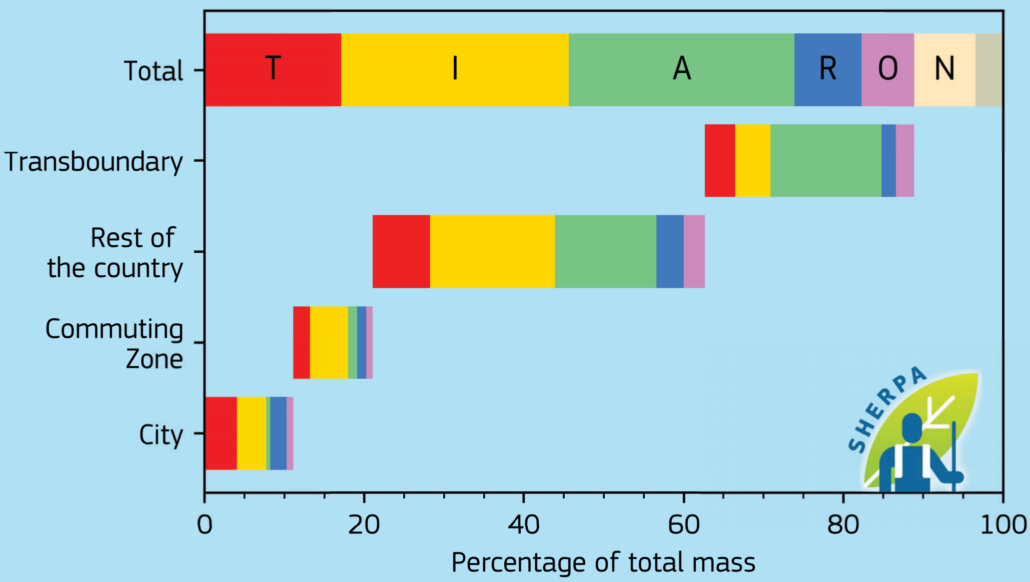
Germany, Düsseldorf



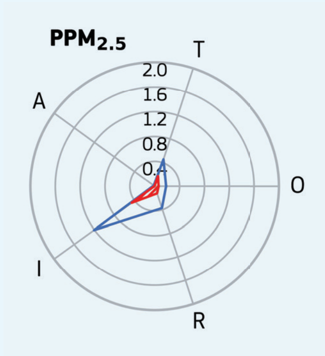
Yearly average urban background (2015)

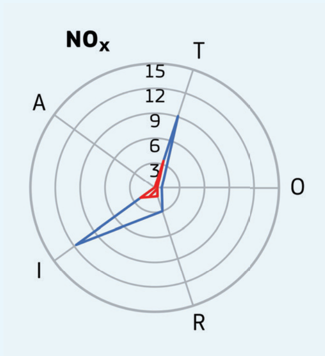


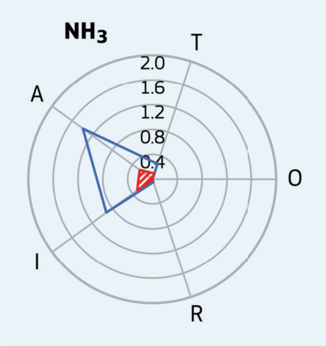
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

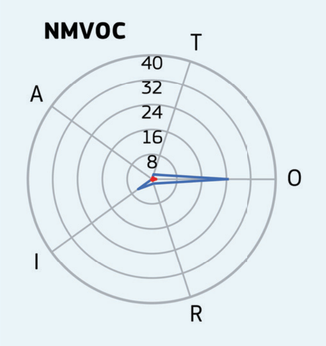


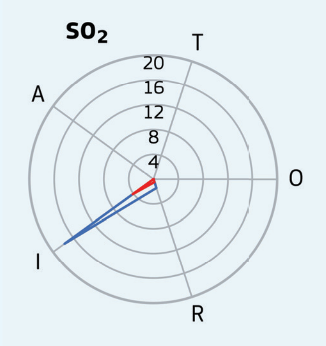
Emissions [kton/year]



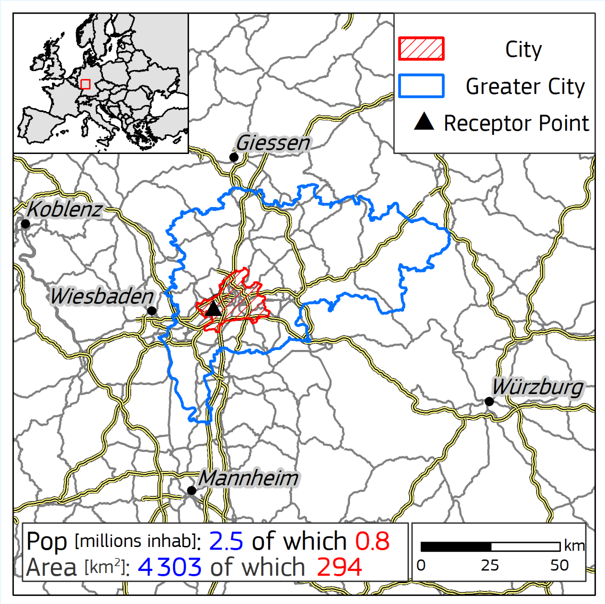




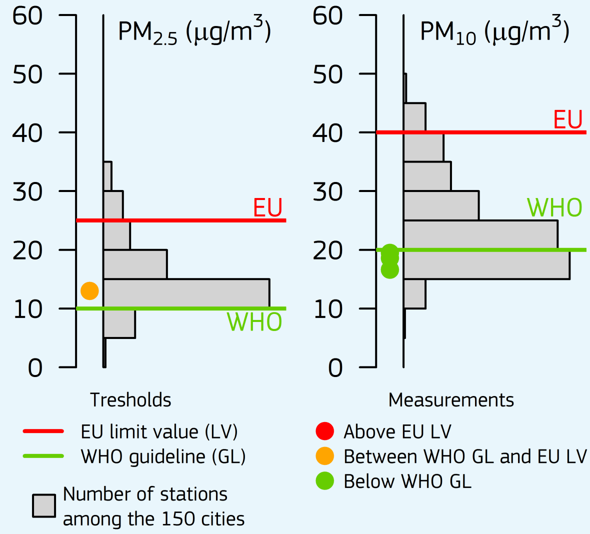




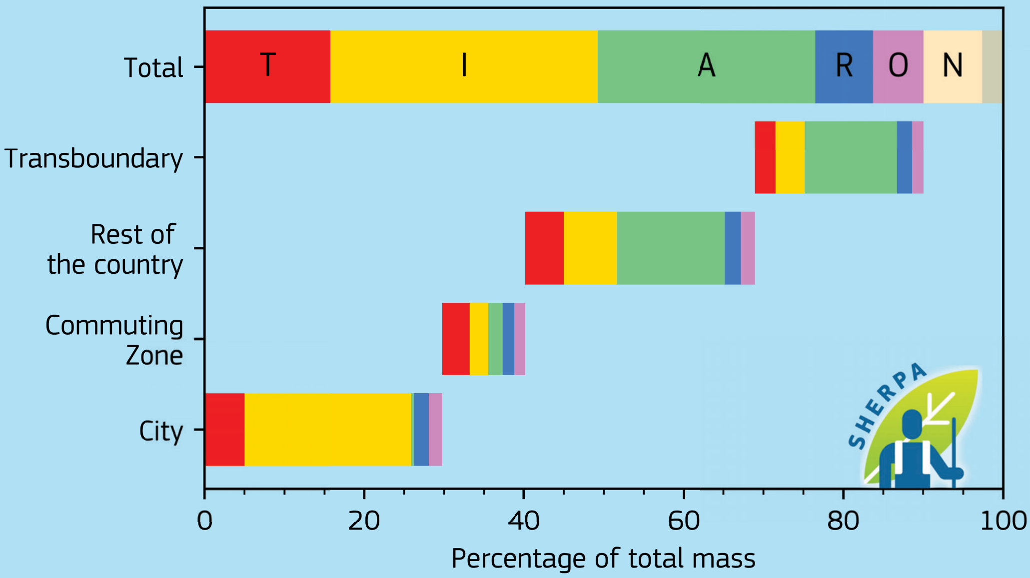
Germany, Frankfurt



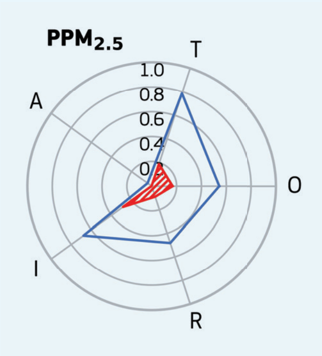
Yearly average urban background (2015)

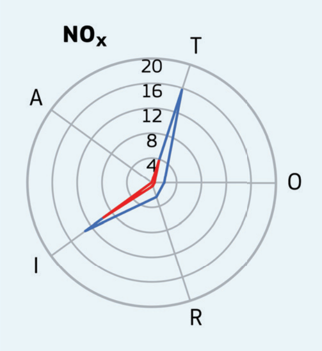


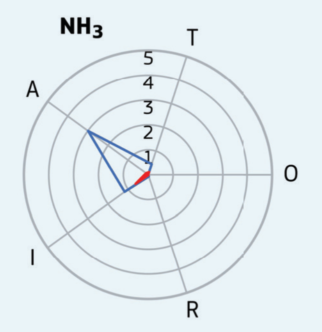
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

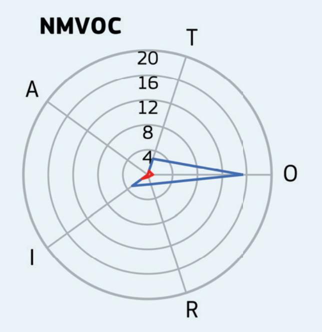


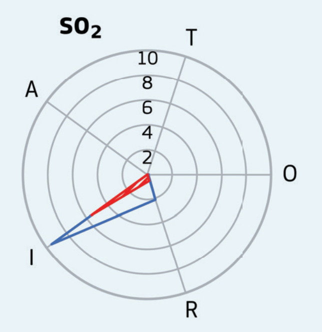
Emissions [kton/year]



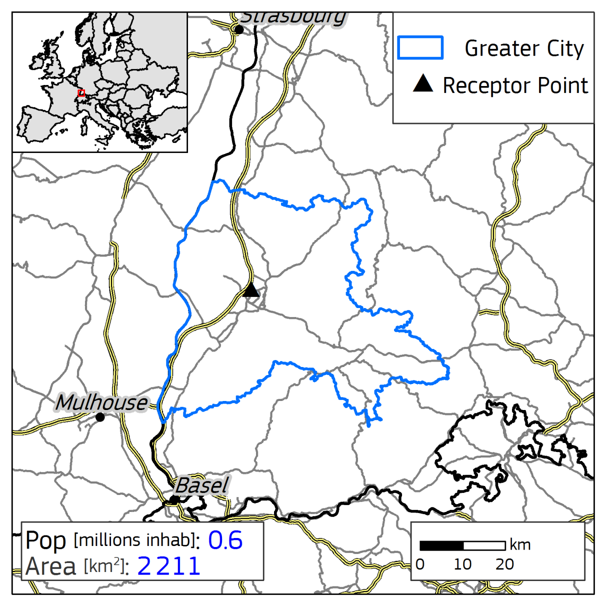




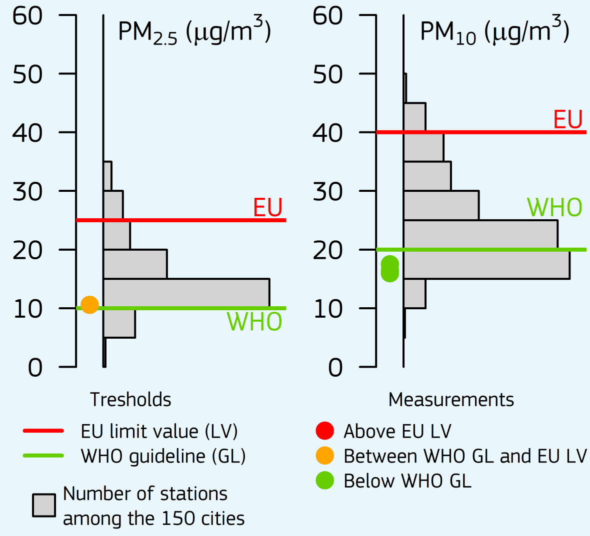




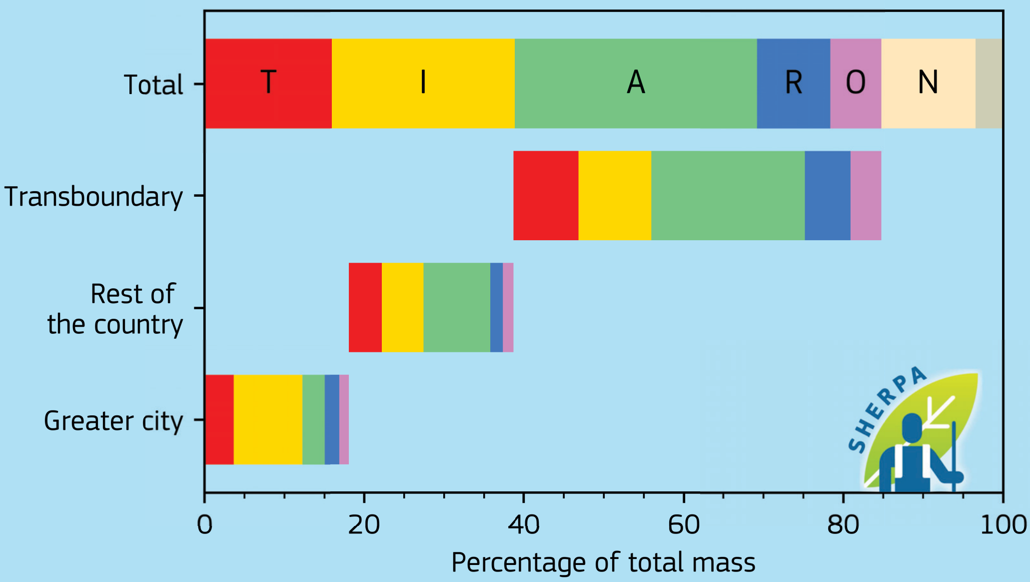
Germany, Freiburg im Breisgau



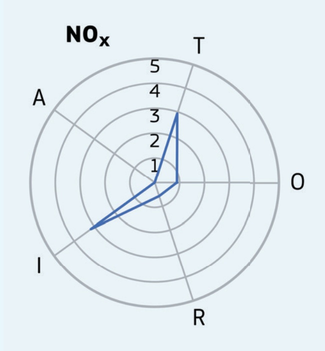
Yearly average urban background (2015)

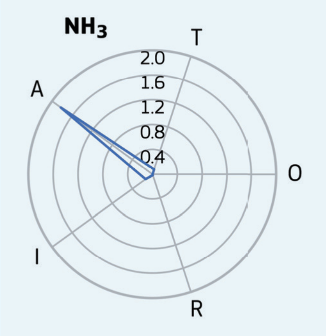


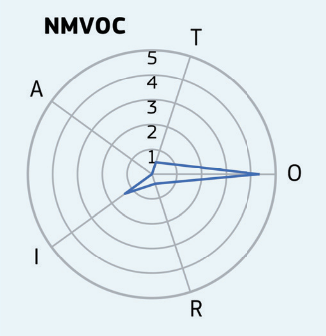
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

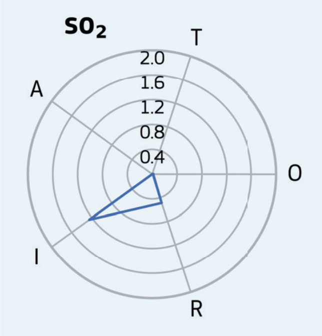


Emissions [kton/year]

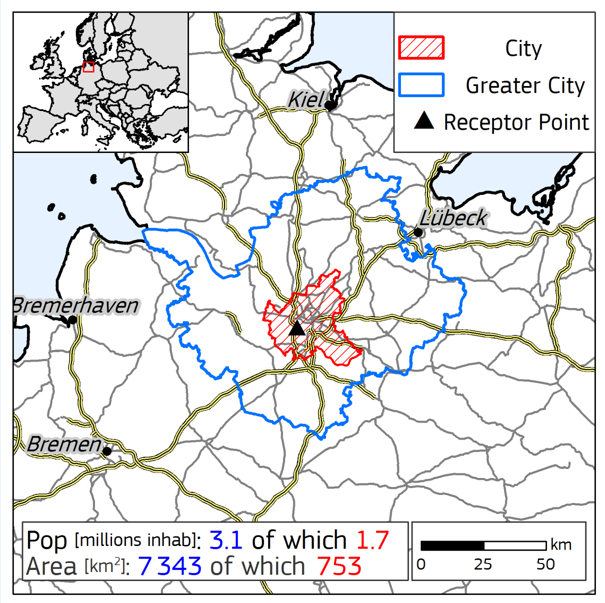




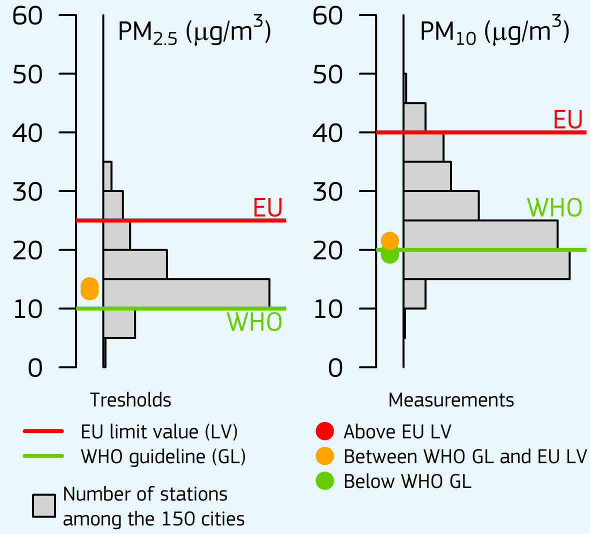




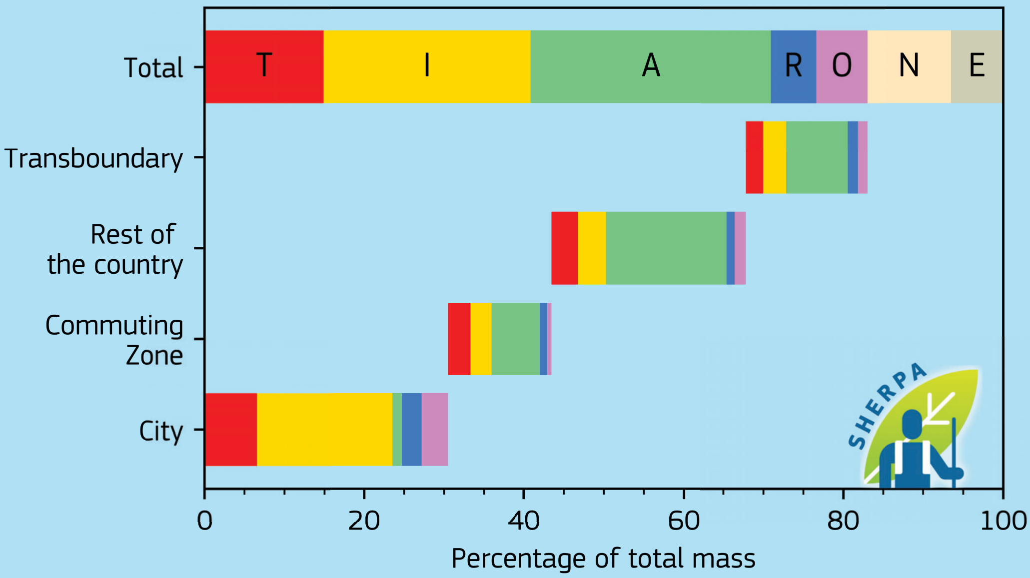
Germany, Hamburg



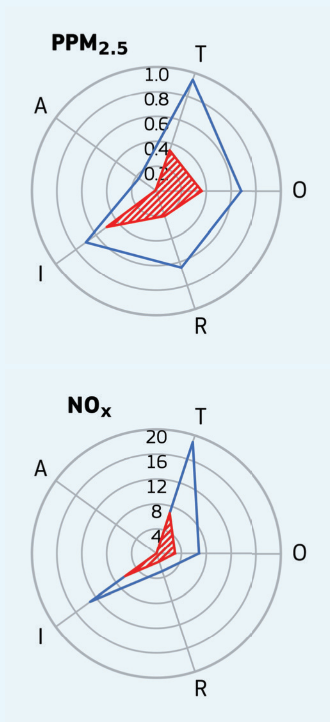
Yearly average urban background (2015)

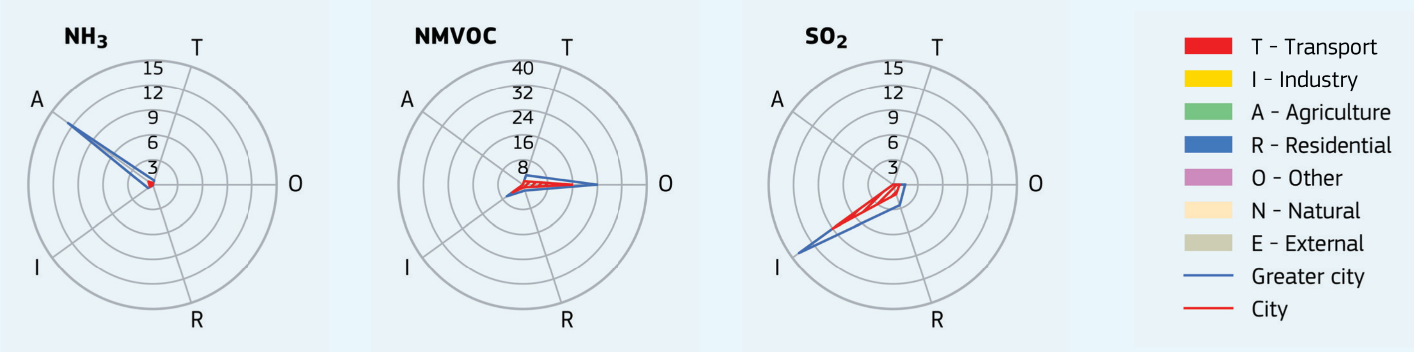


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

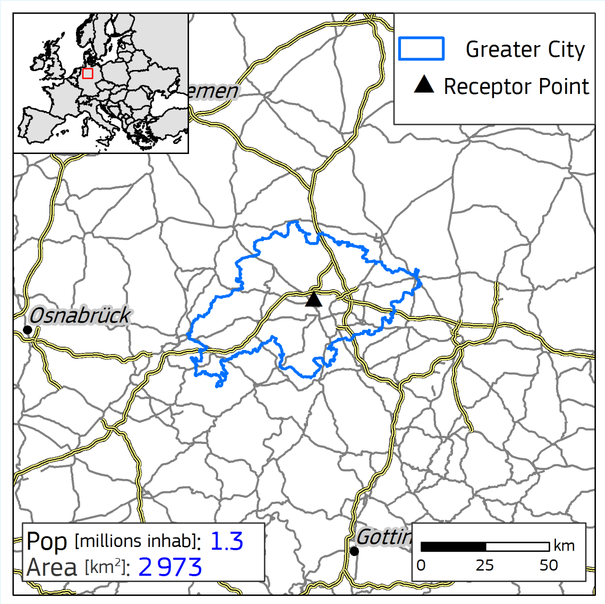


Emissions [kton/year]

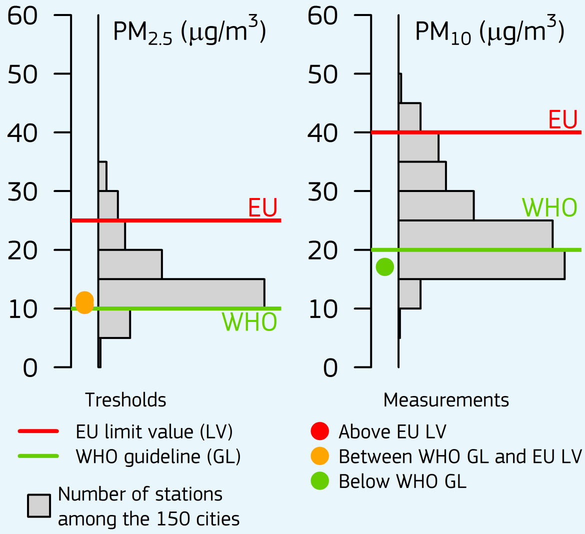




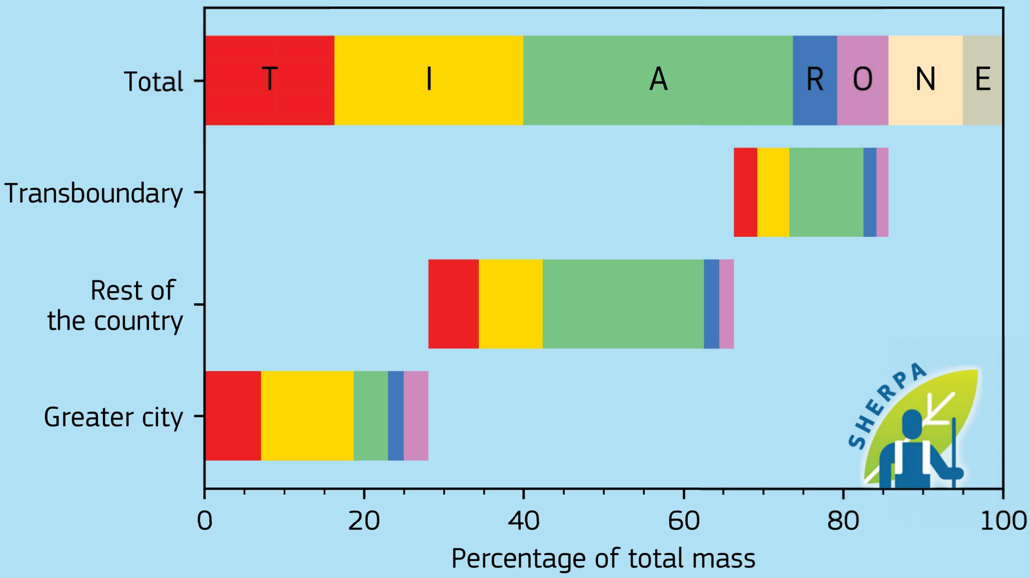
Germany, Hannover



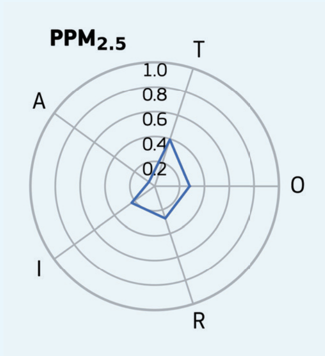
Yearly average urban background (2015)

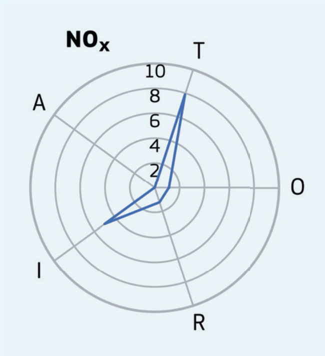


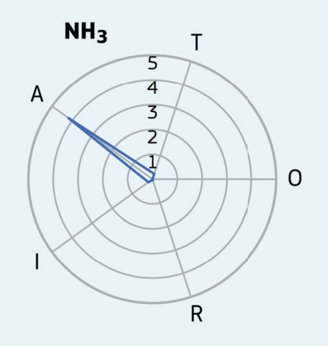
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

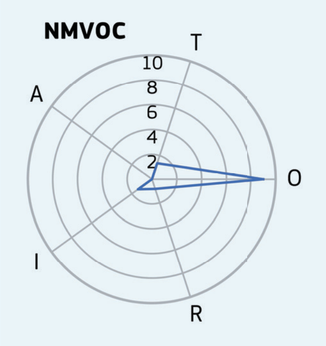


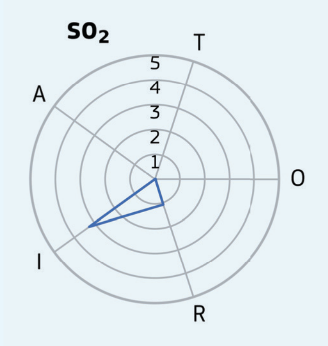
Emissions [kton/year]



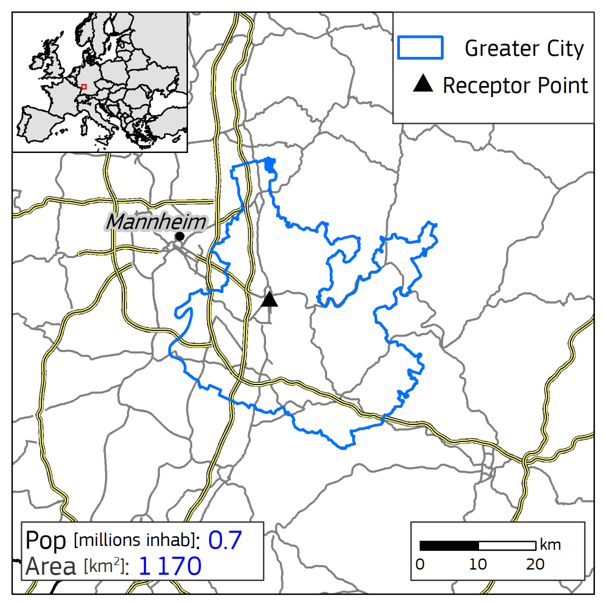




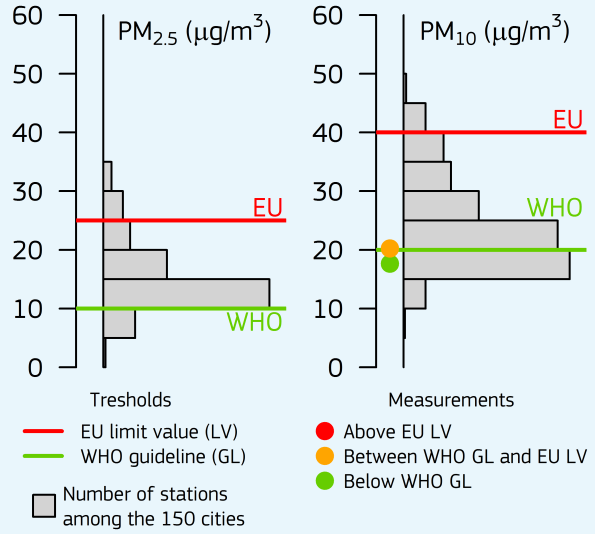




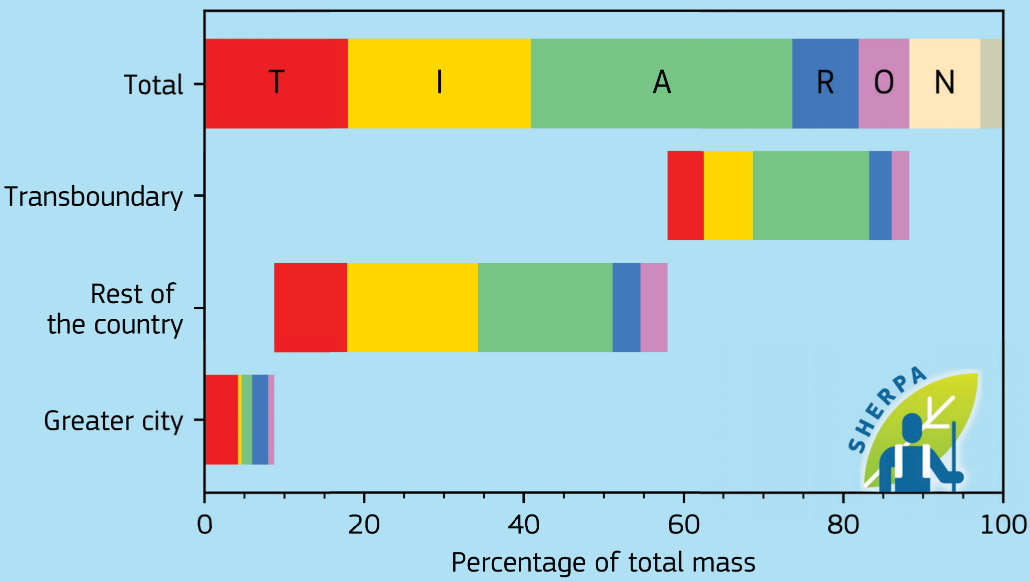
Germany, Heidelberg



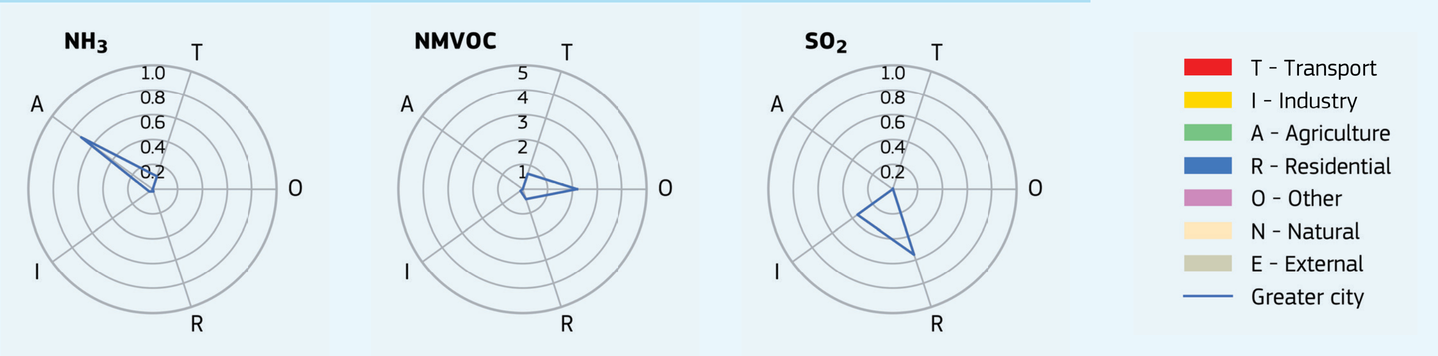
Yearly average urban background (2015)



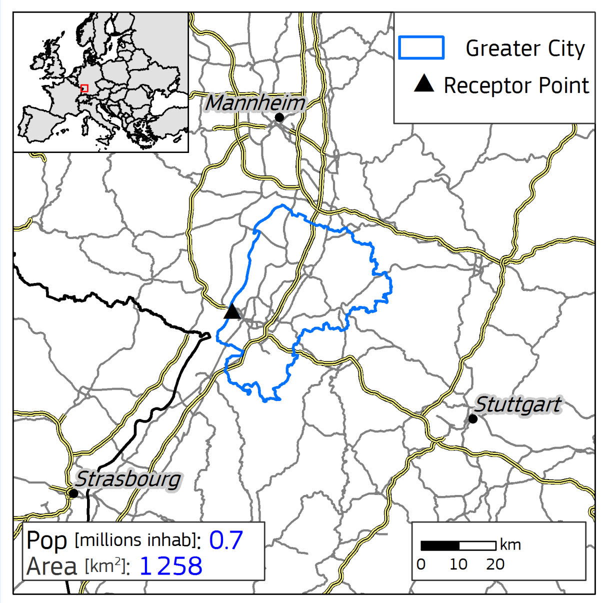
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



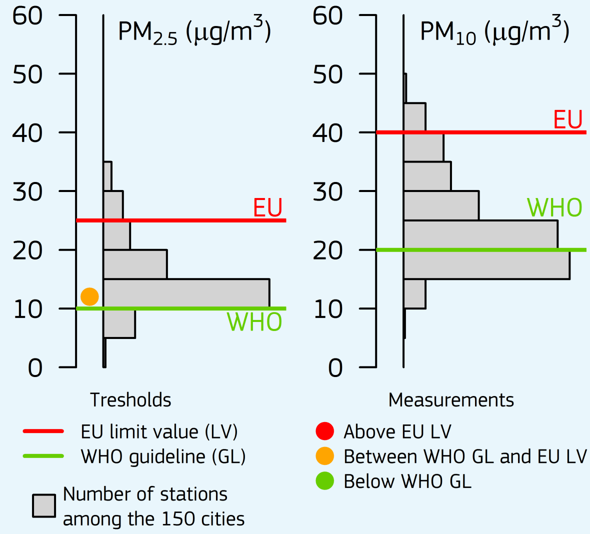
Emissions [kton/year]



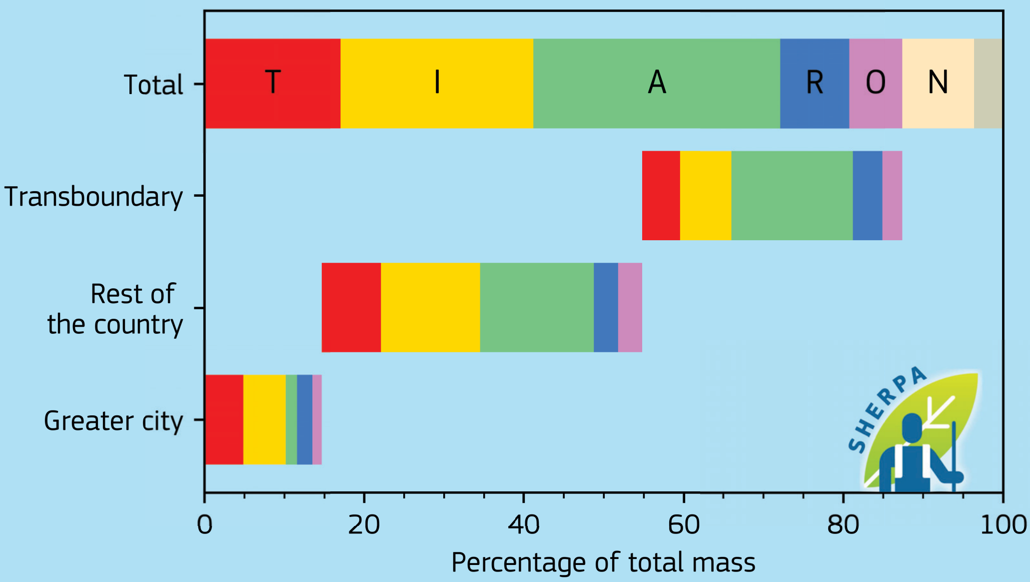
Germany, Karlsruhe



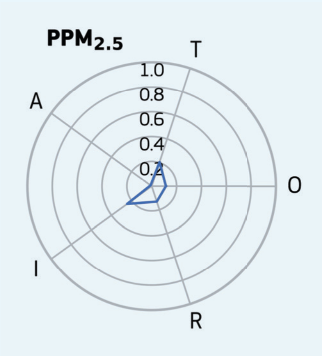
Yearly average urban background (2015)

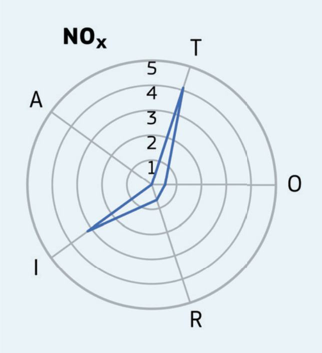


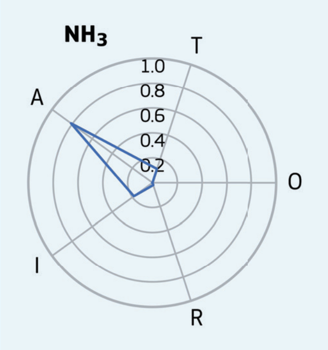
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

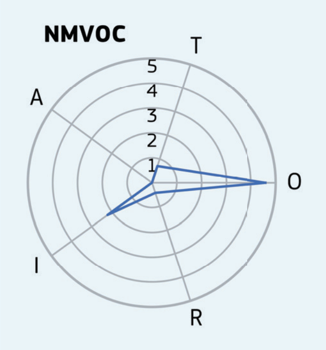


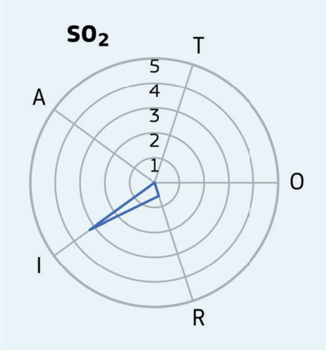
Emissions [kton/year]



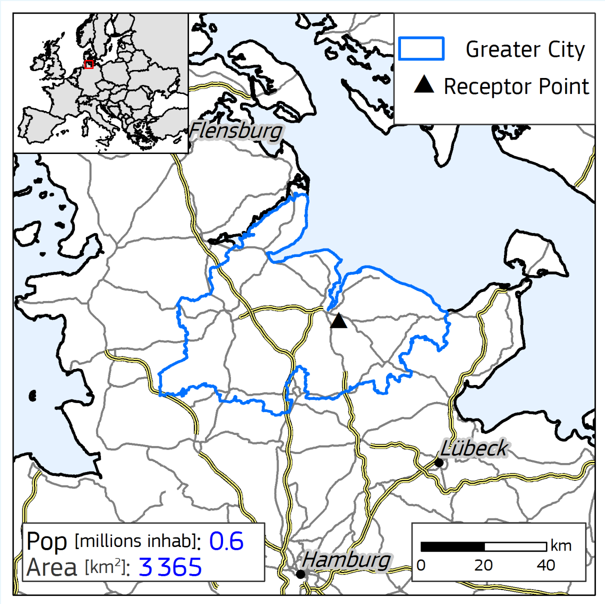




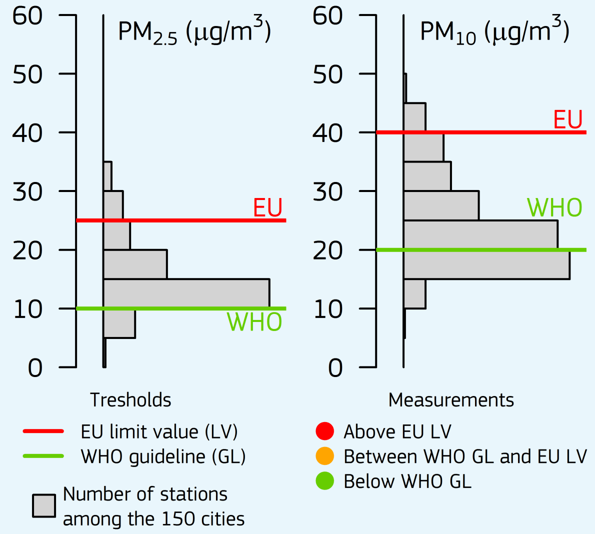




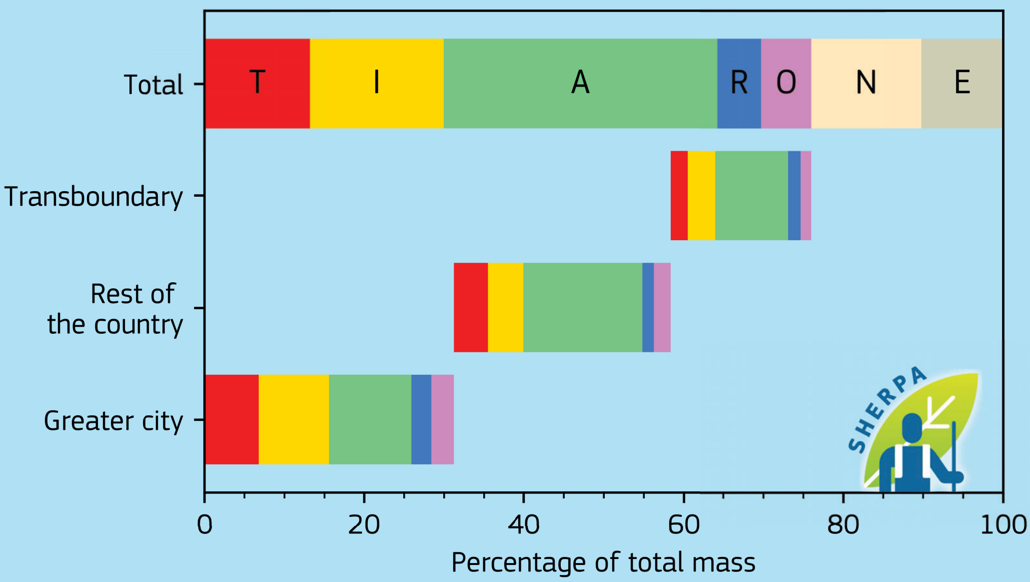
Germany, Kiel



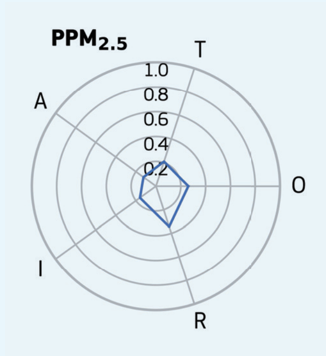
Yearly average urban background (2015)

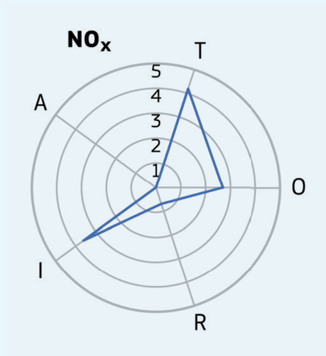


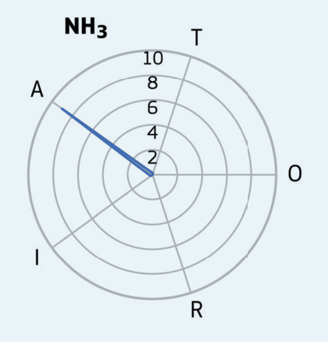
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

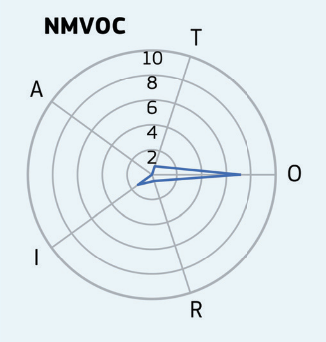


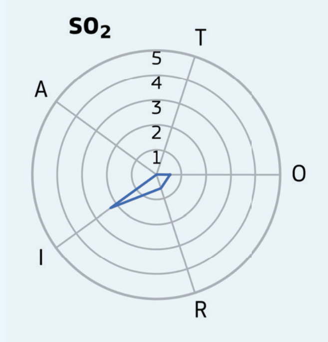
Emissions [kton/year]



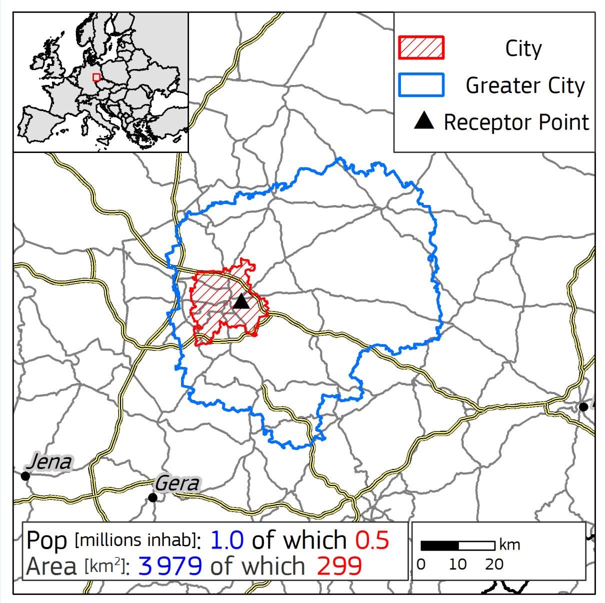




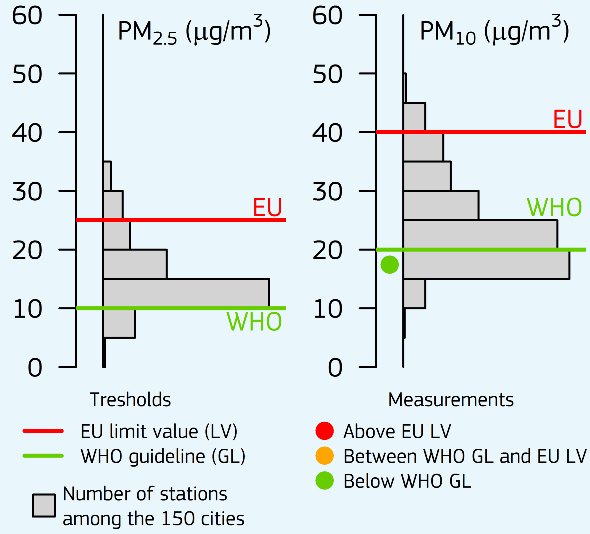




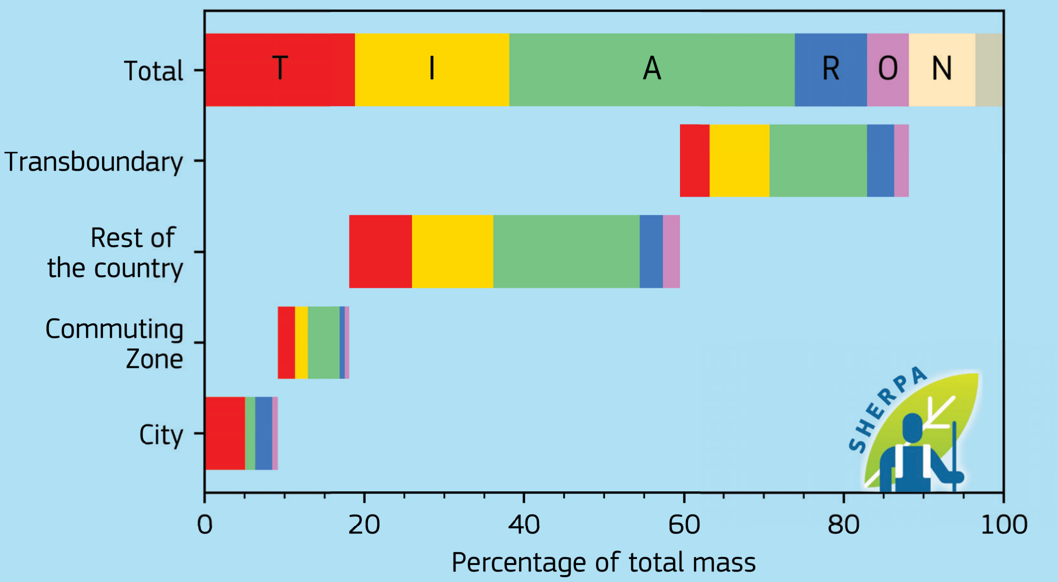
Germany, Leipzig



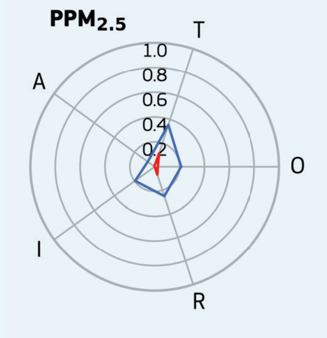
Yearly average urban background (2015)

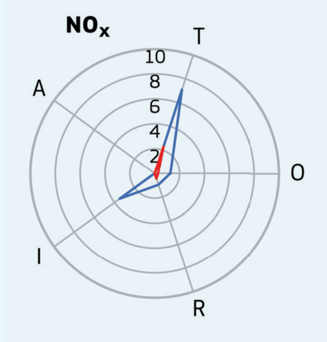


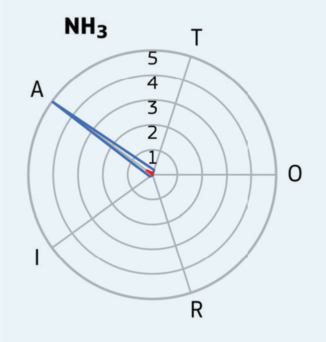
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

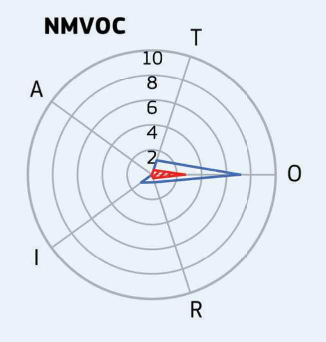


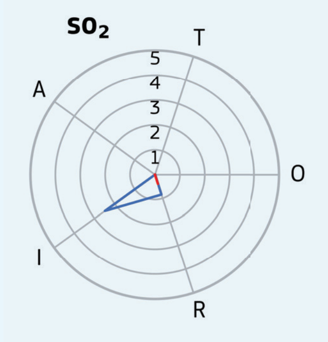
Emissions [kton/year]

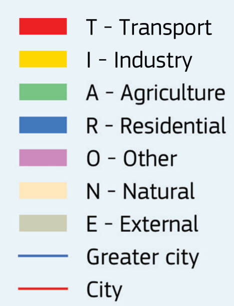




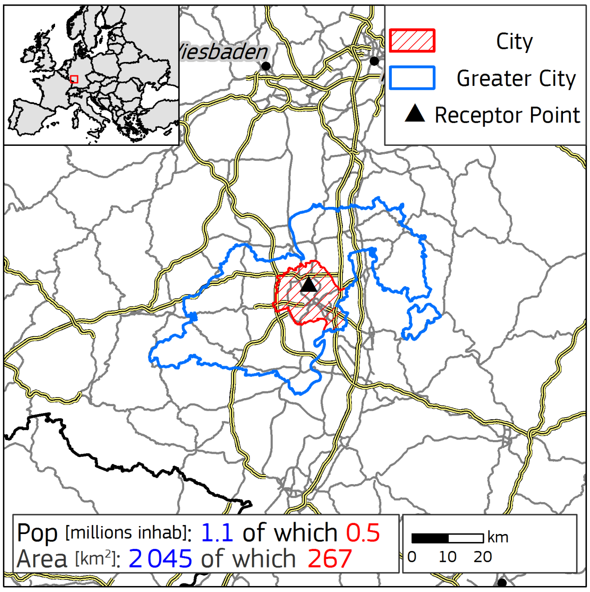




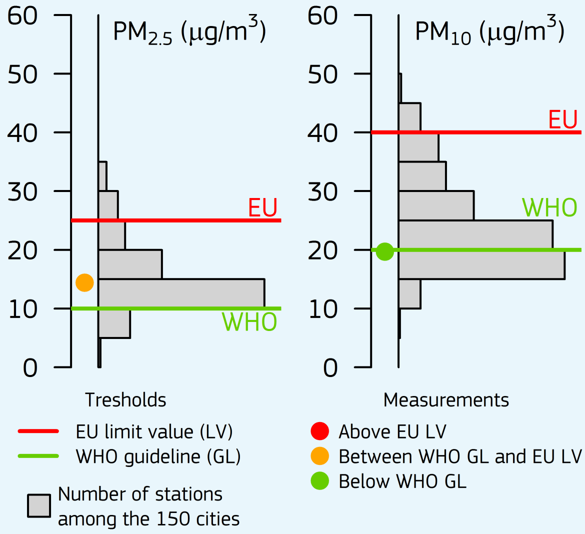




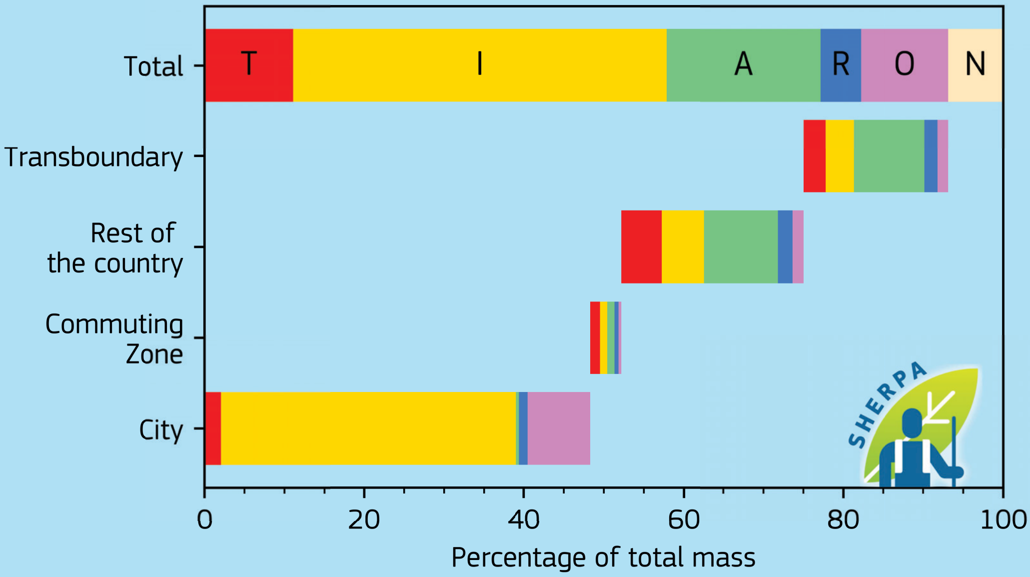
Germany, Mannheim-Ludwigshafen



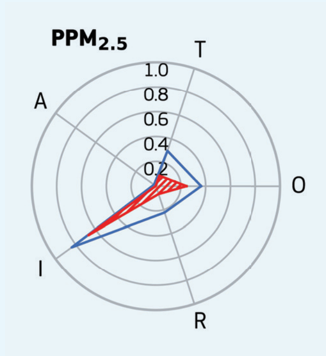
Yearly average urban background (2015)

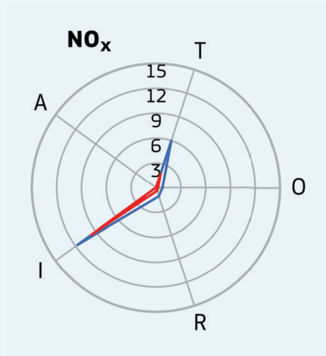


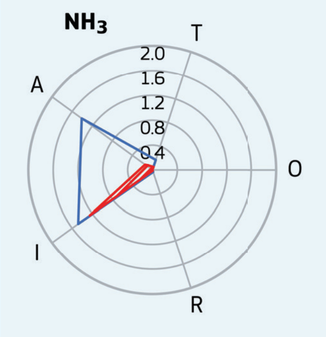
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

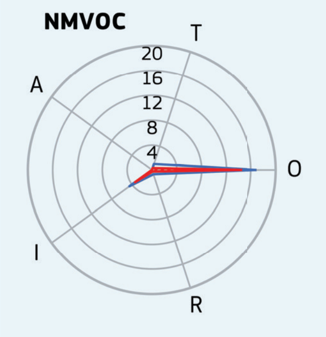


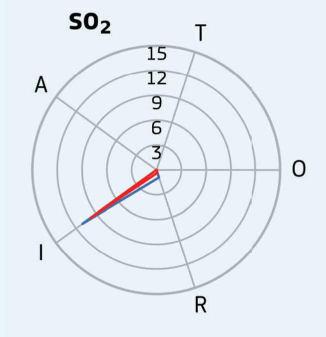
Emissions [kton/year]



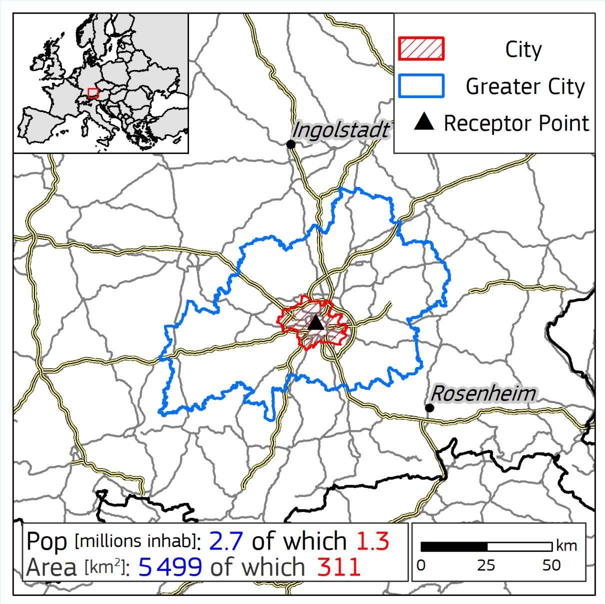




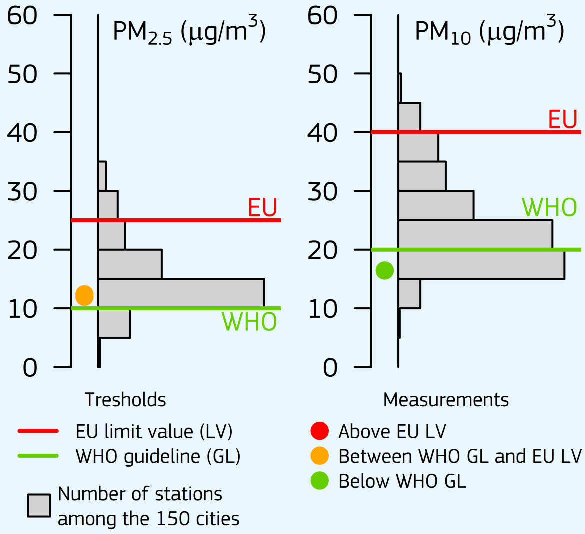




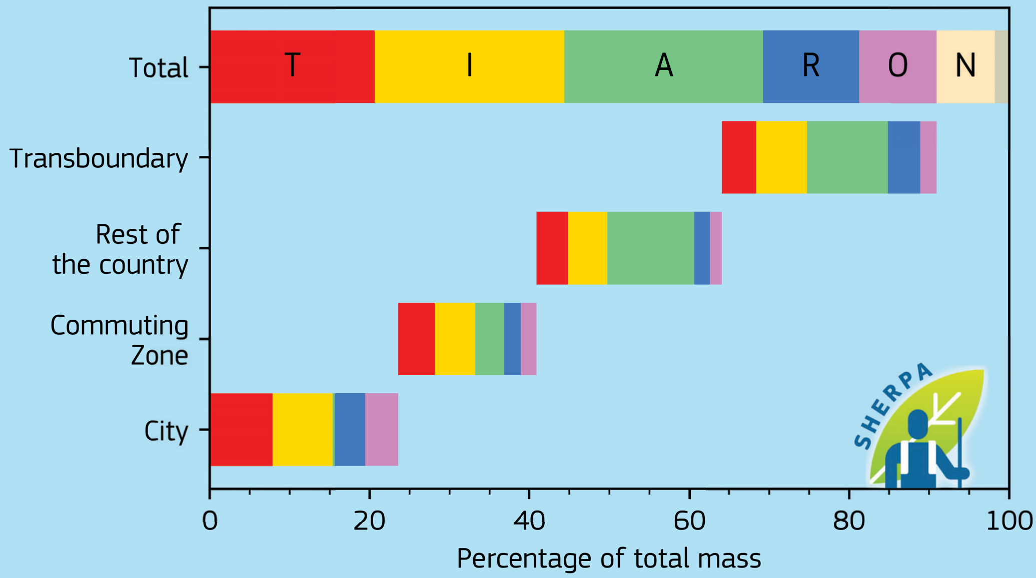
Germany, Munich



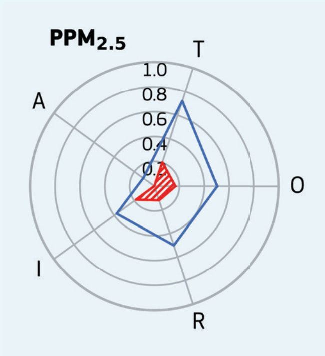
Yearly average urban background (2015)

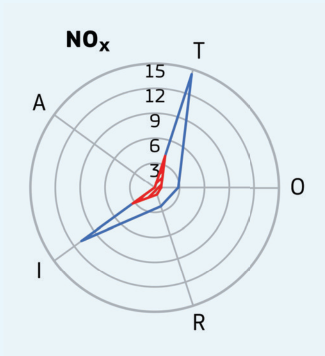


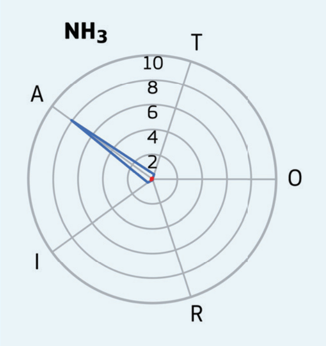
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

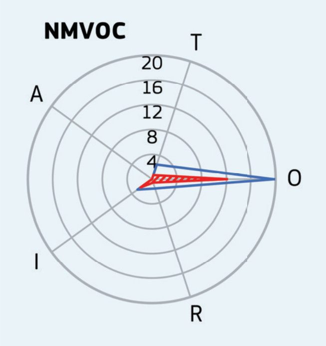


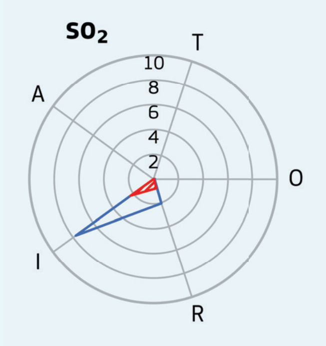
Emissions [kton/year]



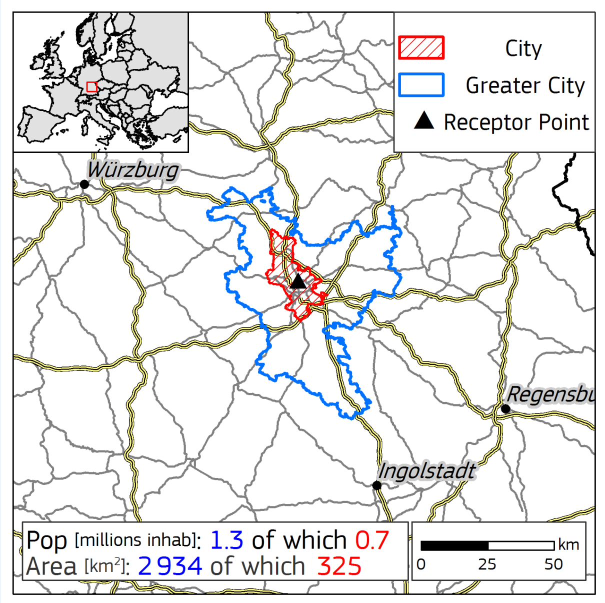




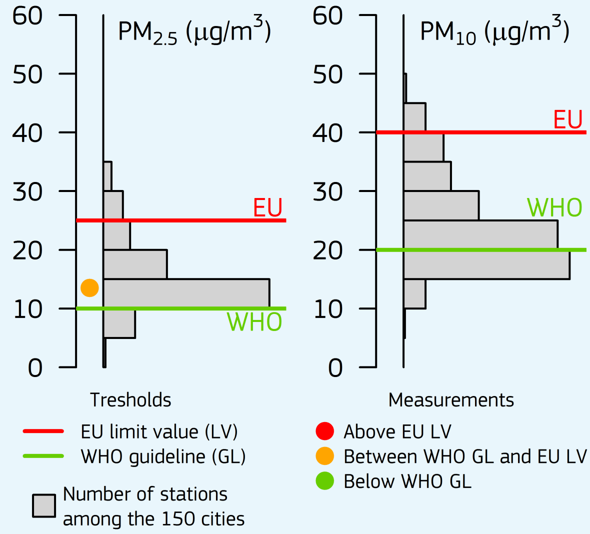




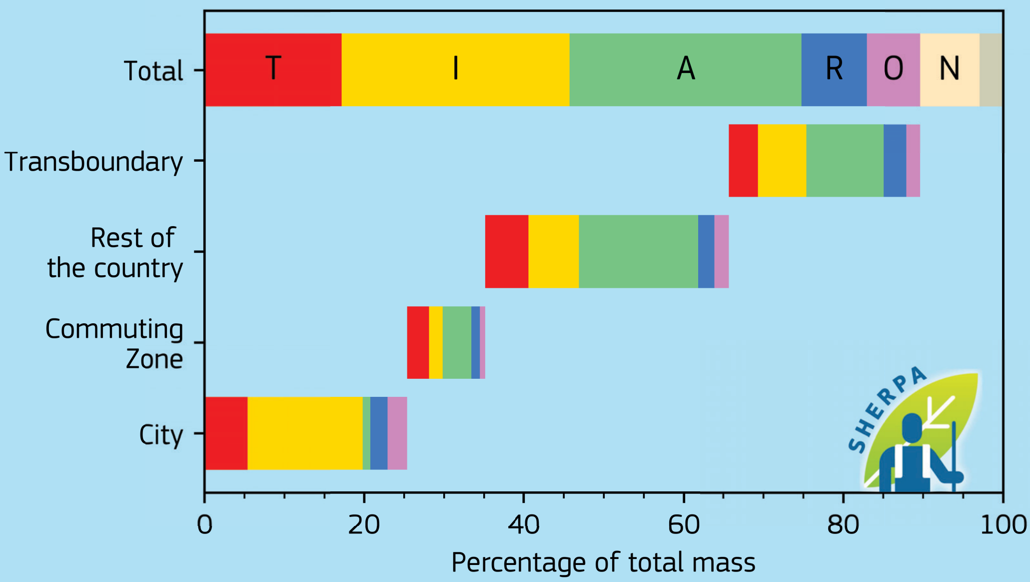
Germany, Nuremberg



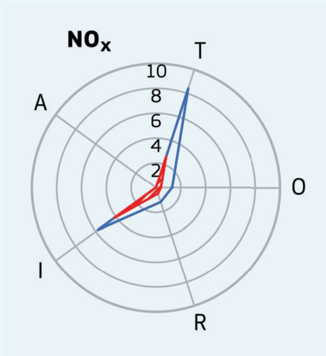
Yearly average urban background (2015)

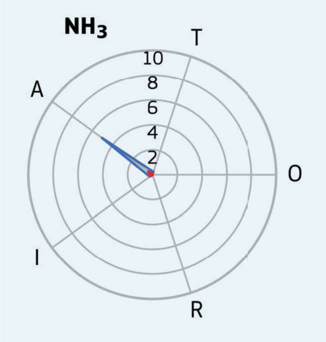


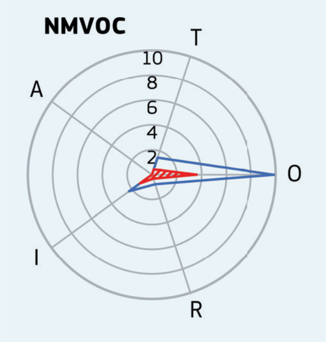
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

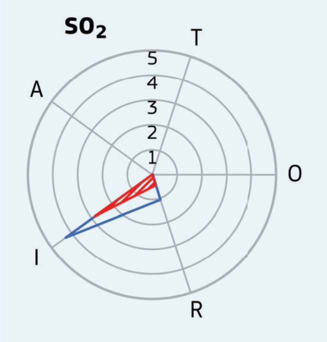


Emissions [kton/year]

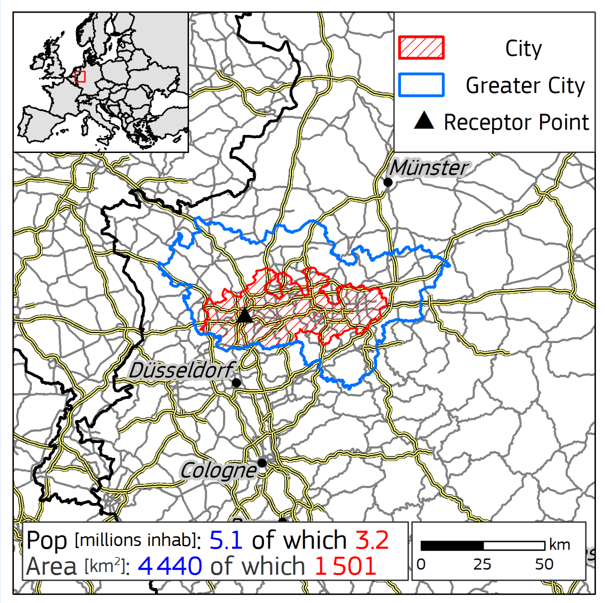




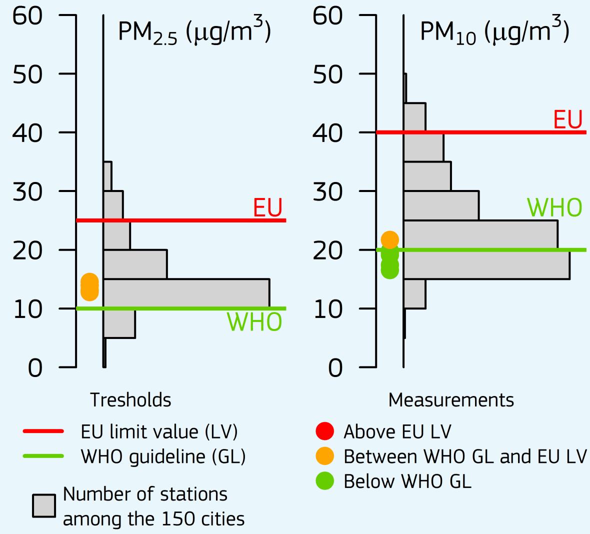




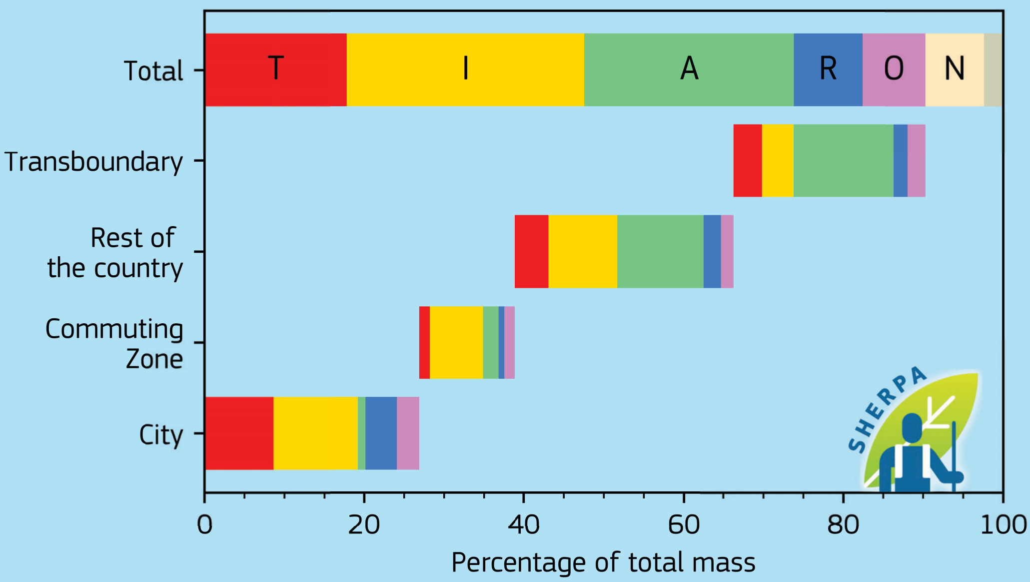
Germany, Ruhr Area



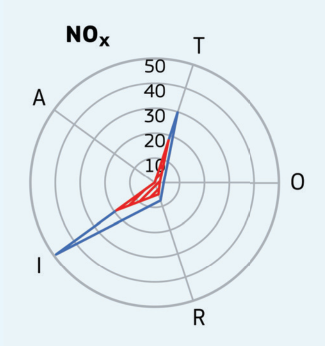
Yearly average urban background (2015)

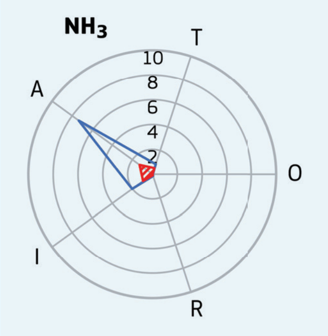


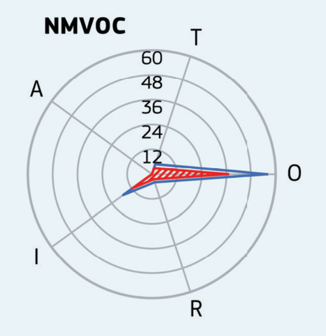
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

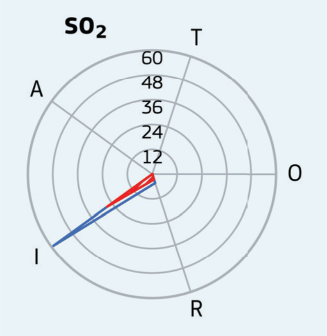


Emissions [kton/year]

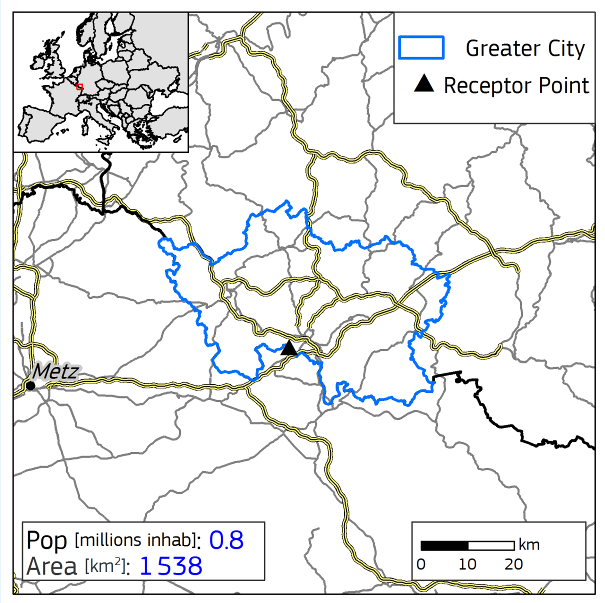




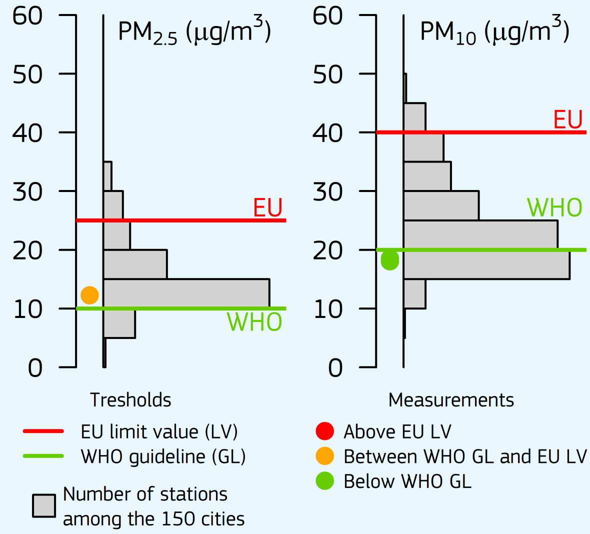




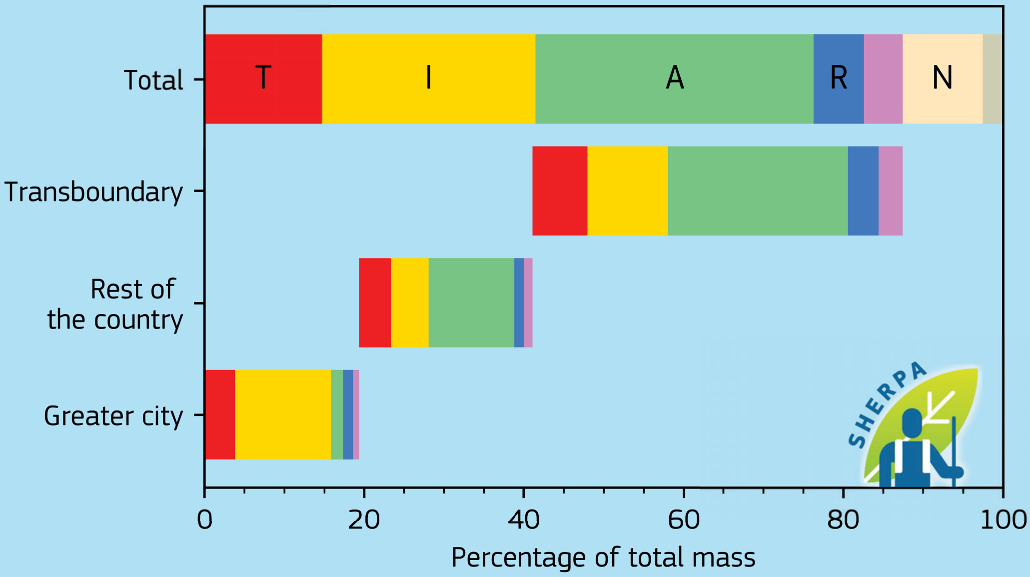
Germany, Saarbrücken



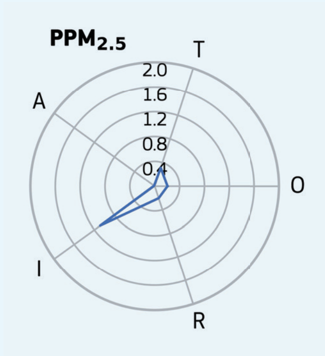
Yearly average urban background (2015)

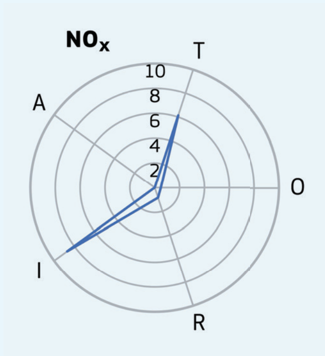


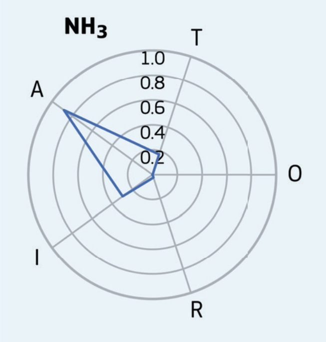
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

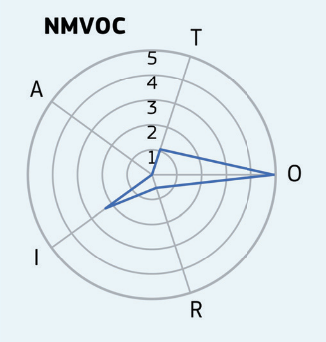


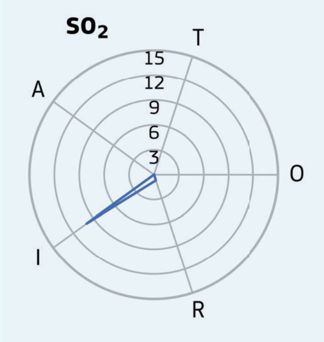
Emissions [kton/year]



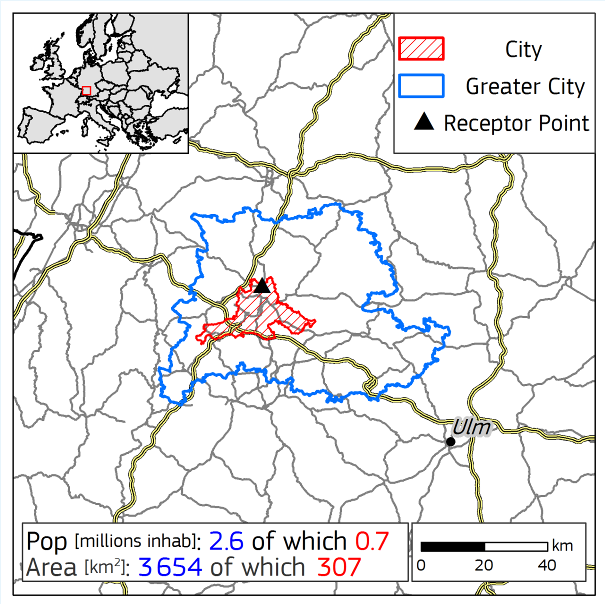




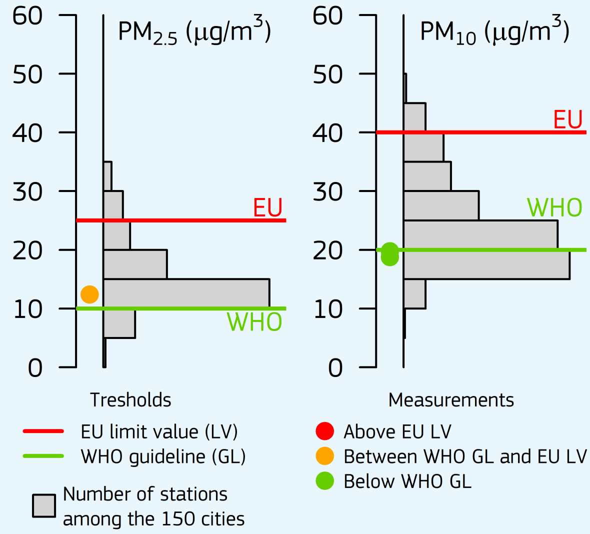




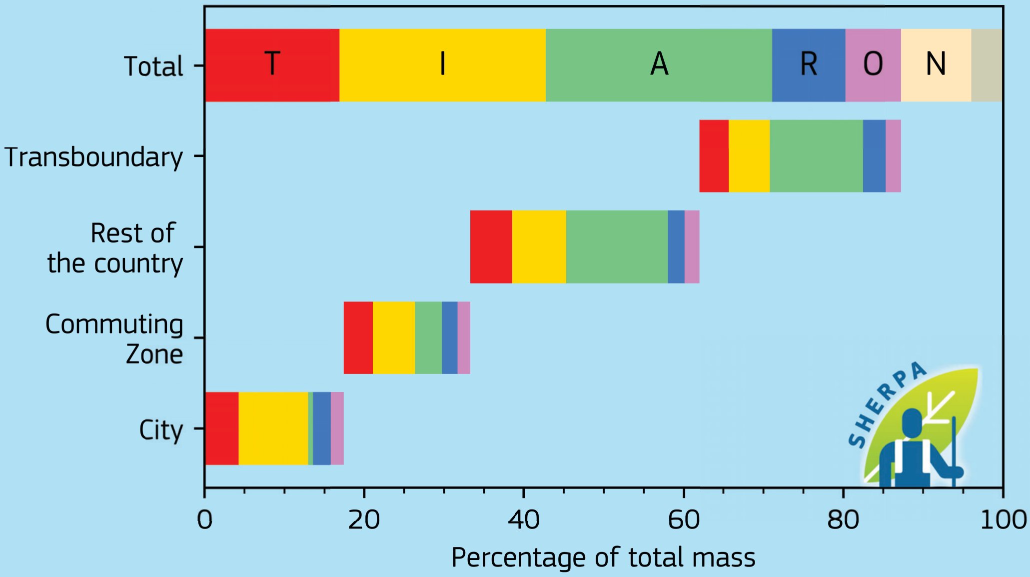
Germany, Stuttgart



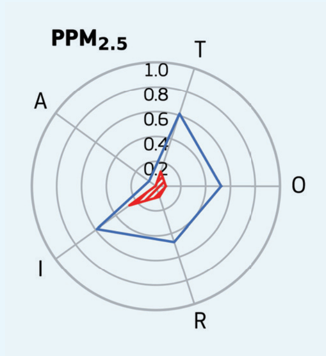
Yearly average urban background (2015)

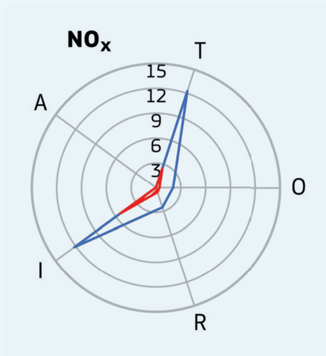


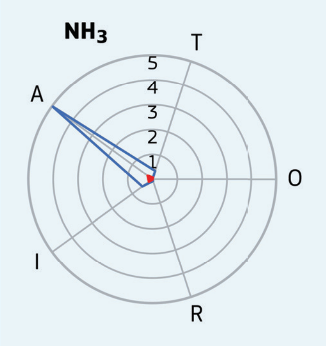
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

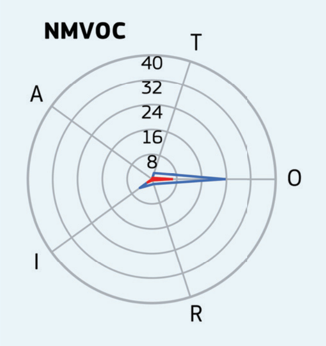


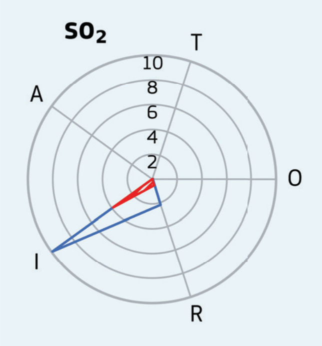
Emissions [kton/year]



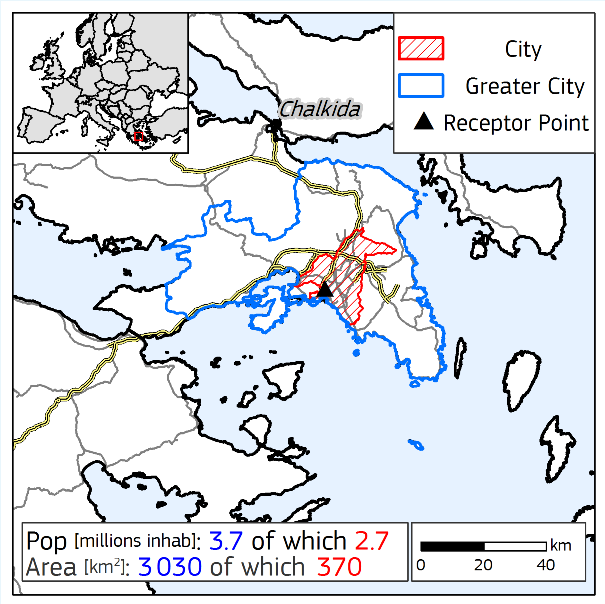




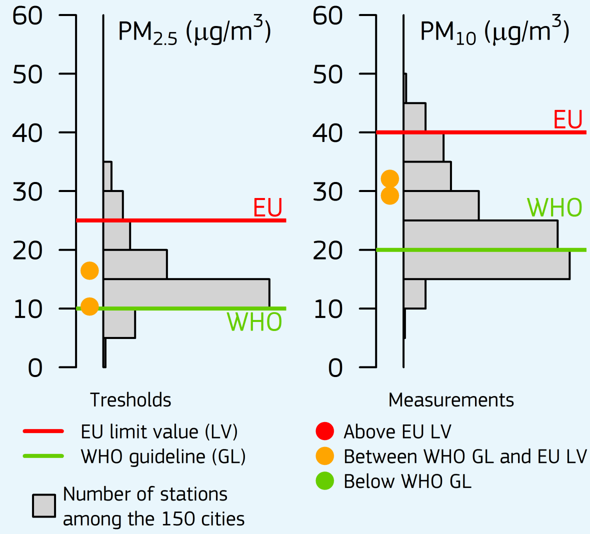




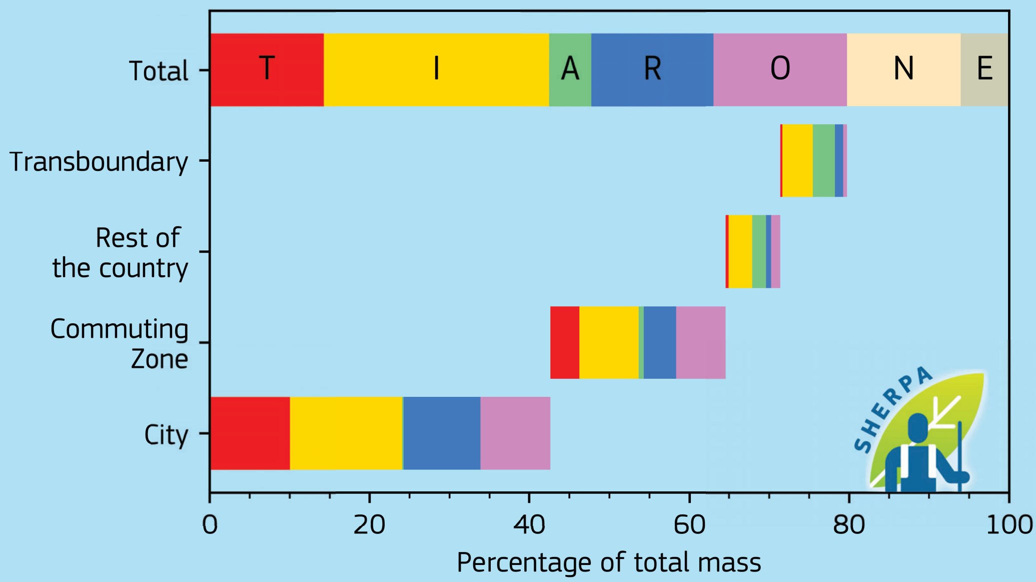
Greece, Athens



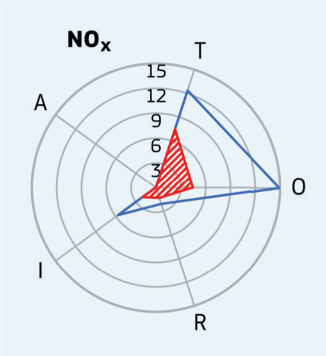
Yearly average urban background (2015)

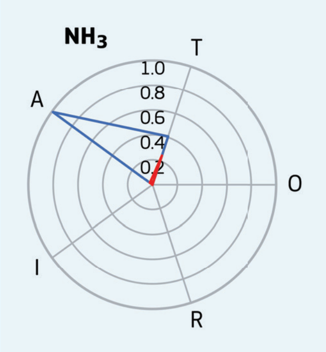


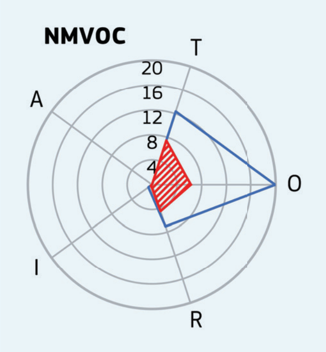
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

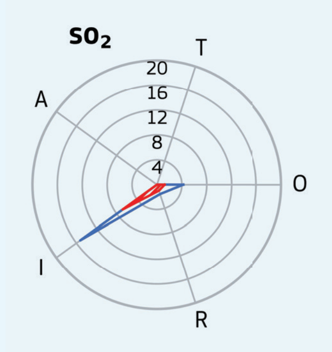


Emissions [kton/year]

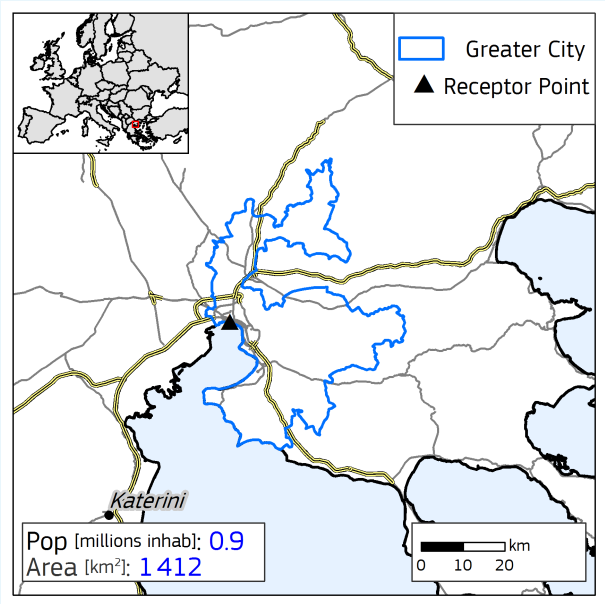




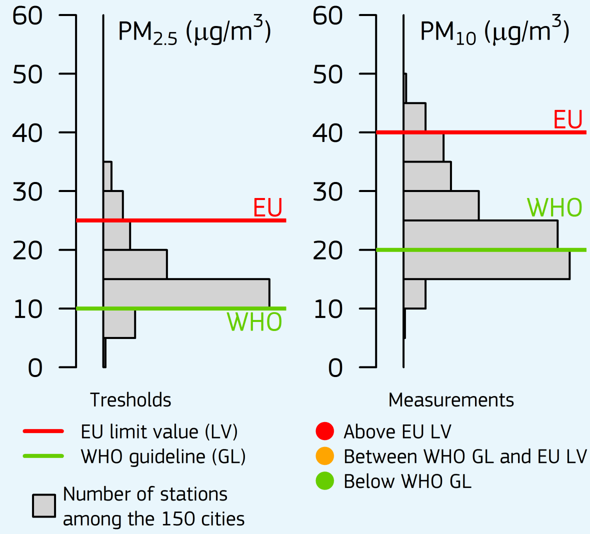




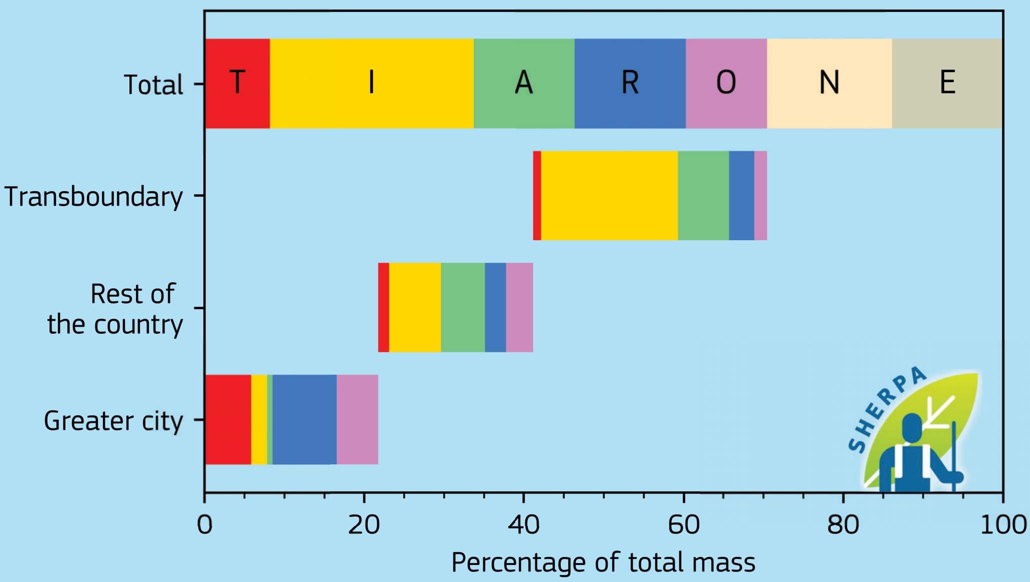
Greece, Thessaloniki



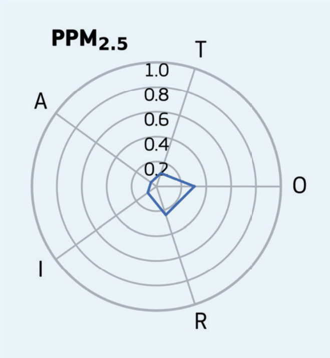
Yearly average urban background (2015)

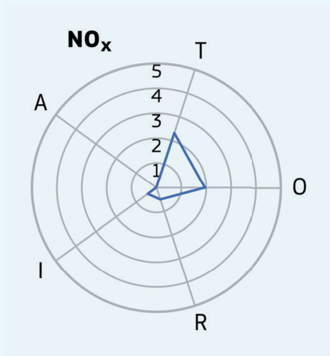


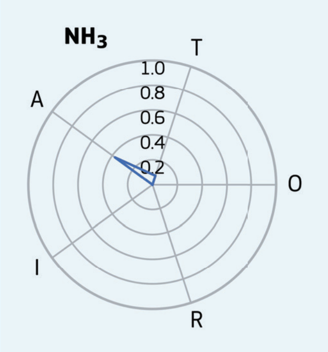
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

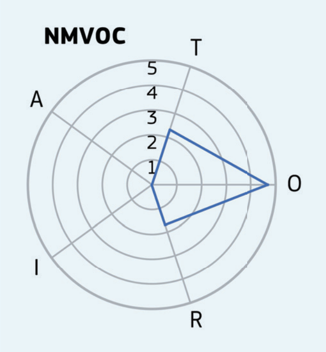


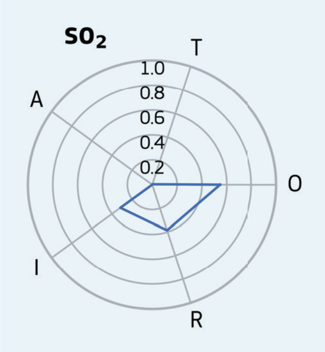
Emissions [kton/year]





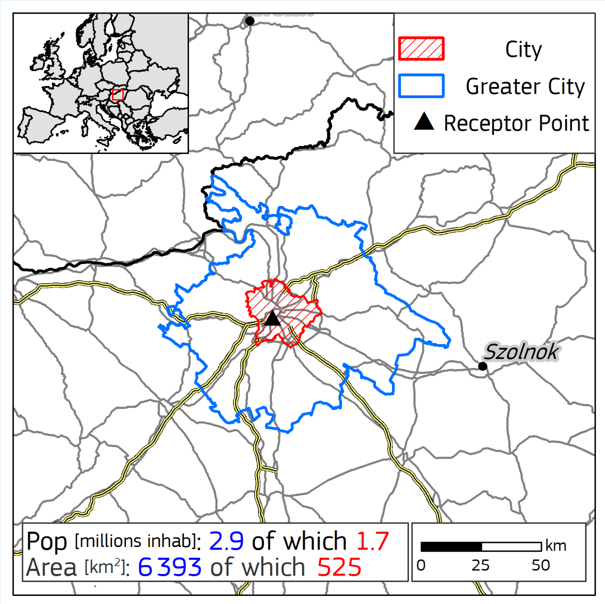




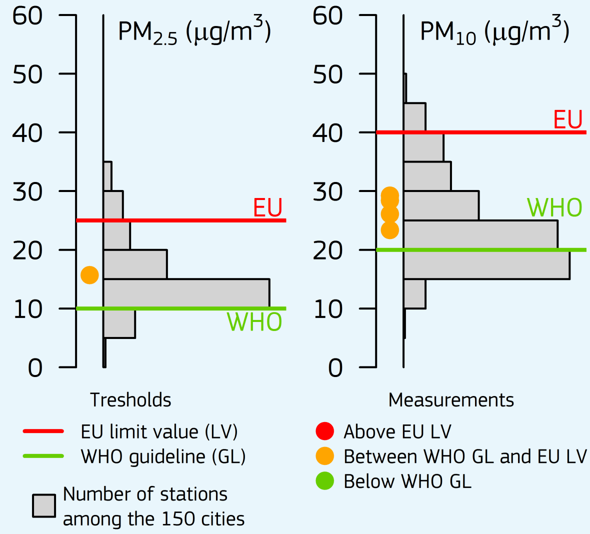


T - Transport
I - Industry
A - Agriculture
R - Residential
O - Other
N - Natural
E - External
Greater city

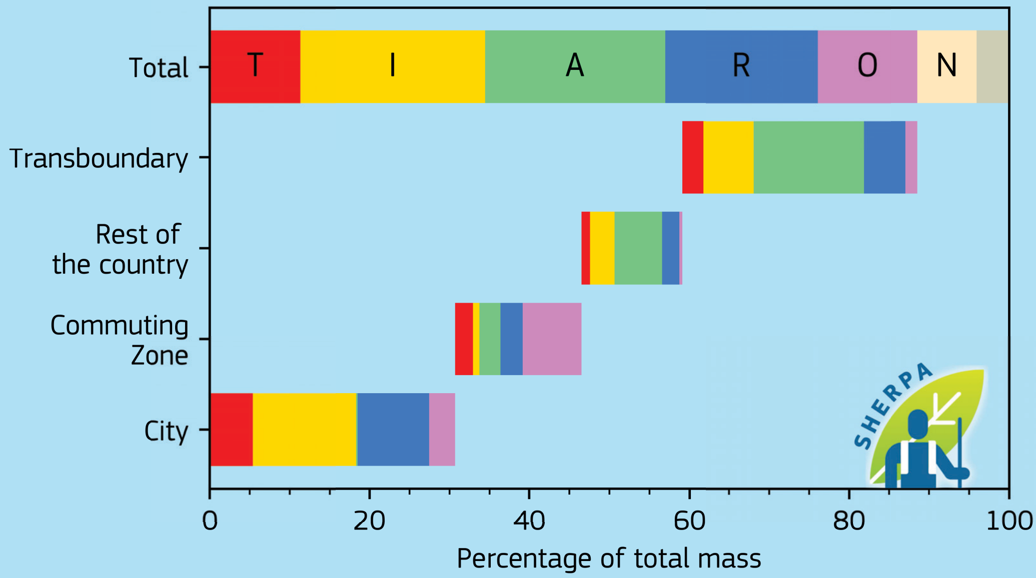
Hungary, Budapest



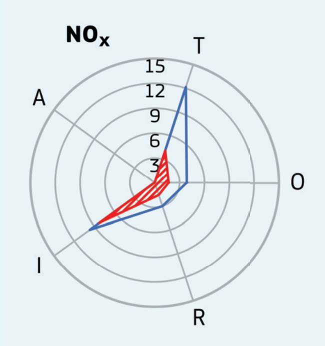
Yearly average urban background (2015)

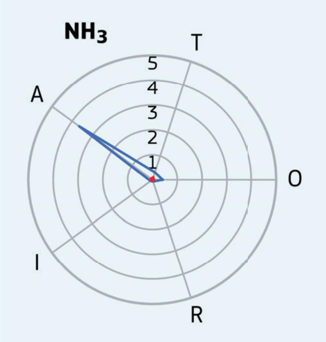


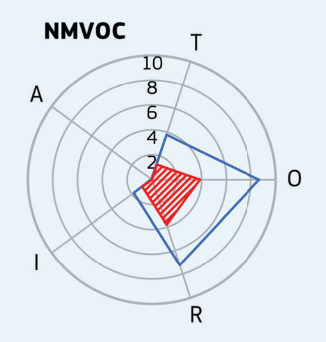
PM2.5 Spatial and sectoral allocation (SHERPA v.1.9)

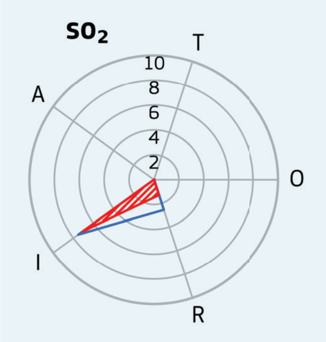


Emissions [kton/year]

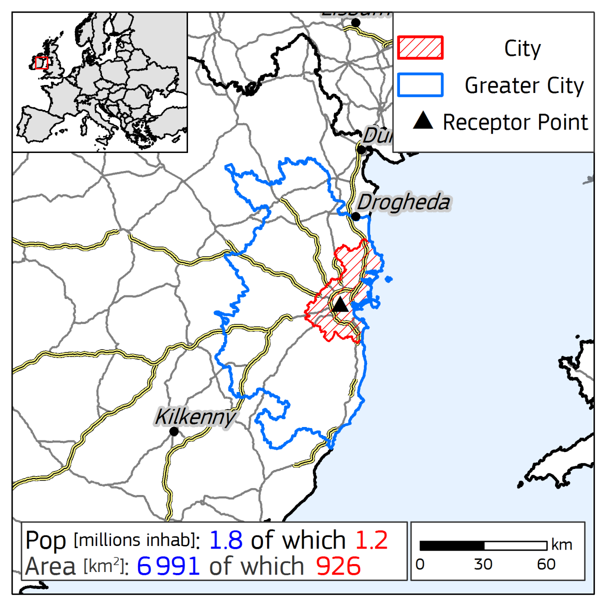




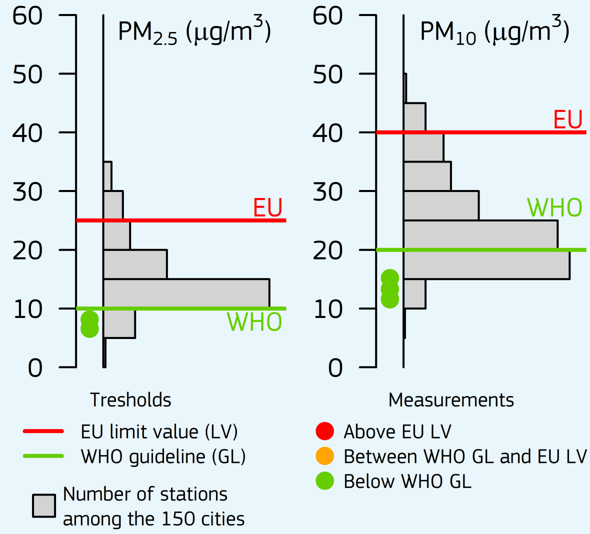




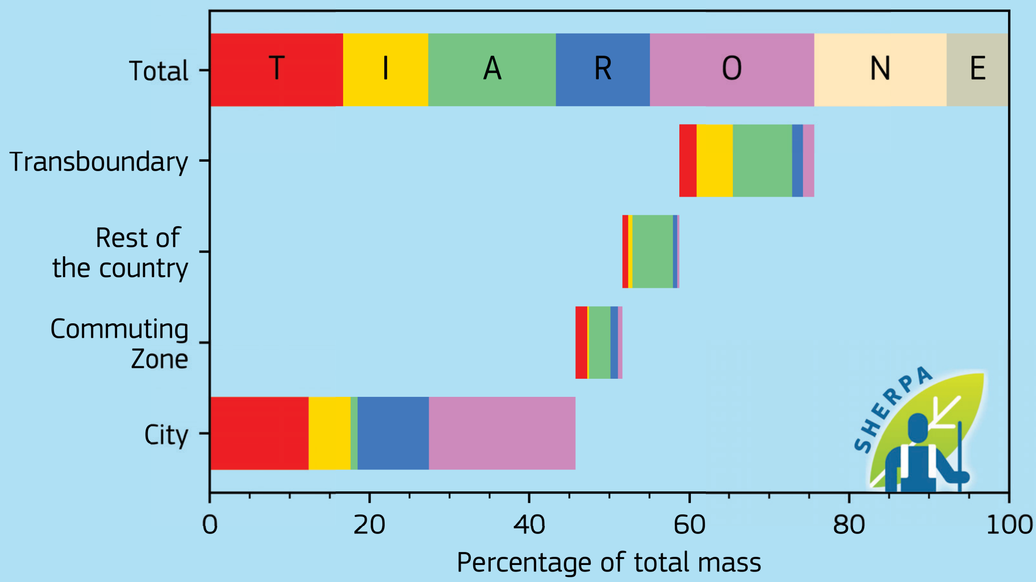
Ireland, Dublin



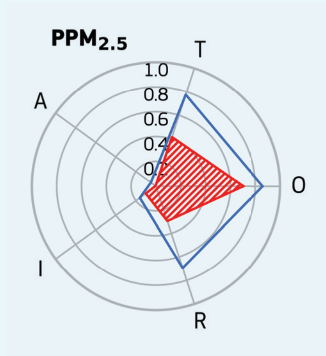
Yearly average urban background (2015)

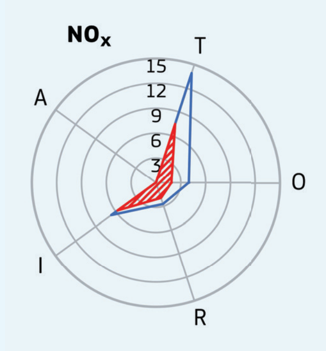


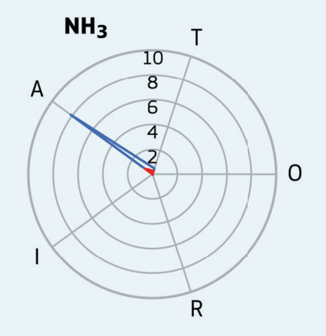
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

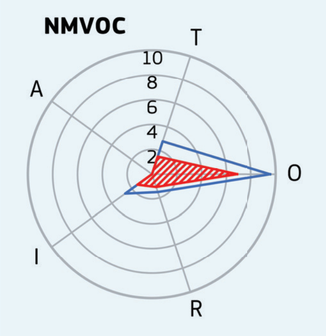


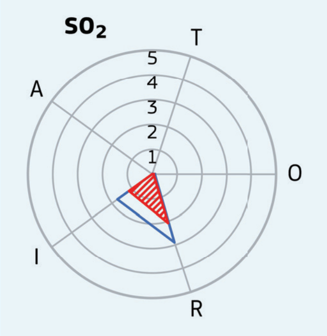
Emissions [kton/year]





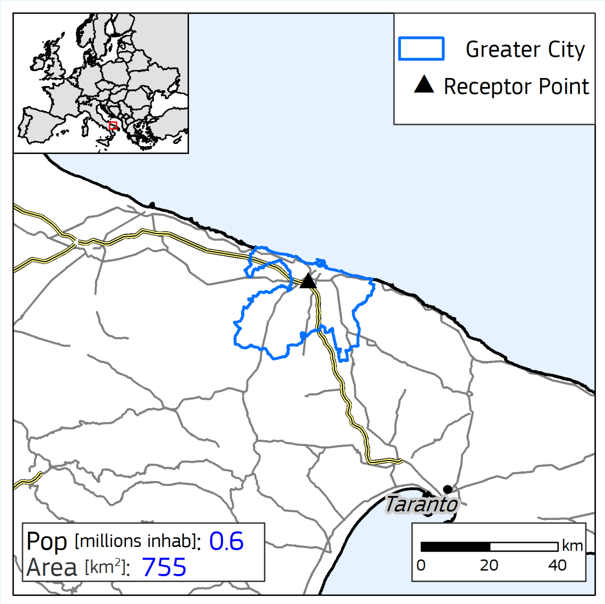




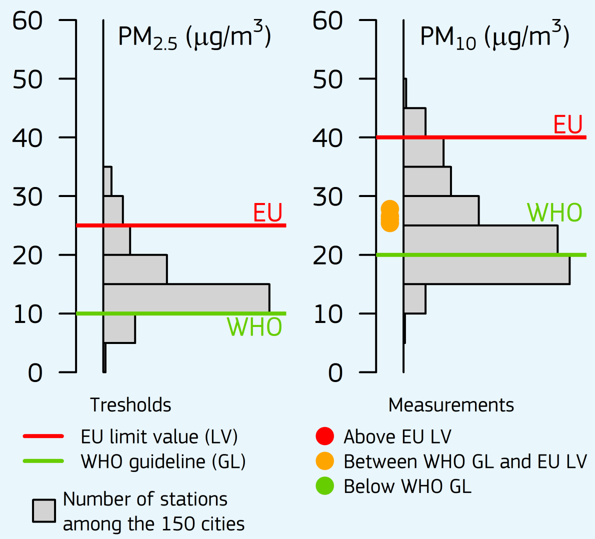


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city
- City

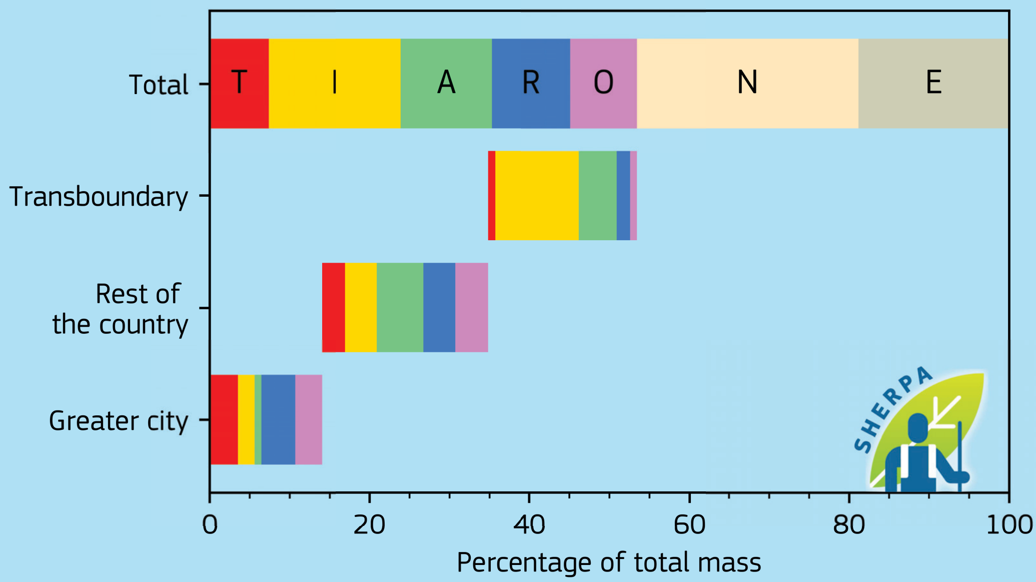
Italy, Bari



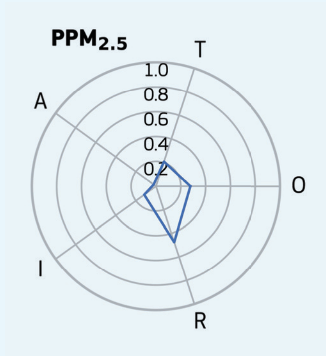
Yearly average urban background (2015)

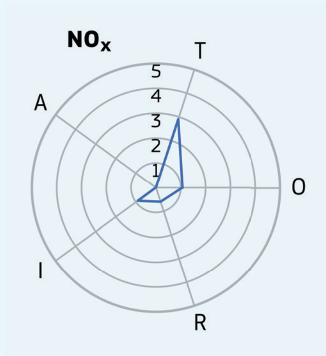


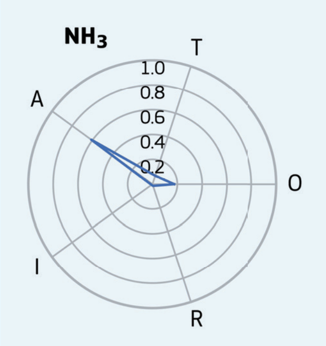
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

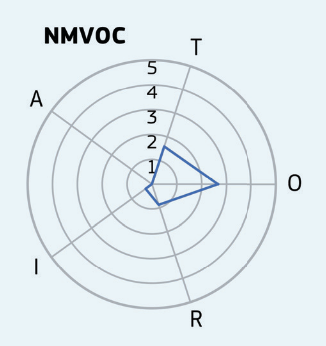


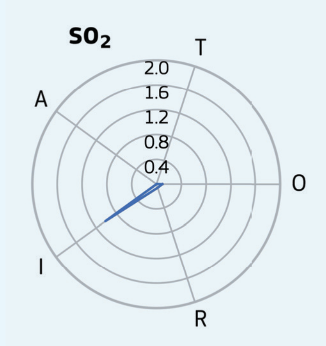
Emissions [kton/year]



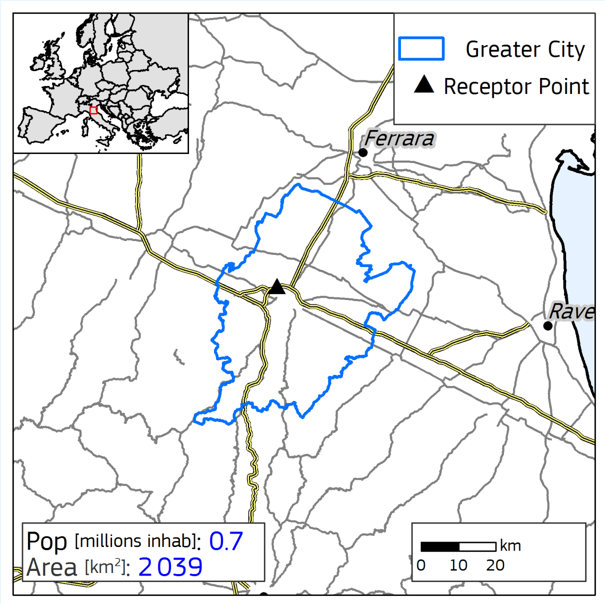




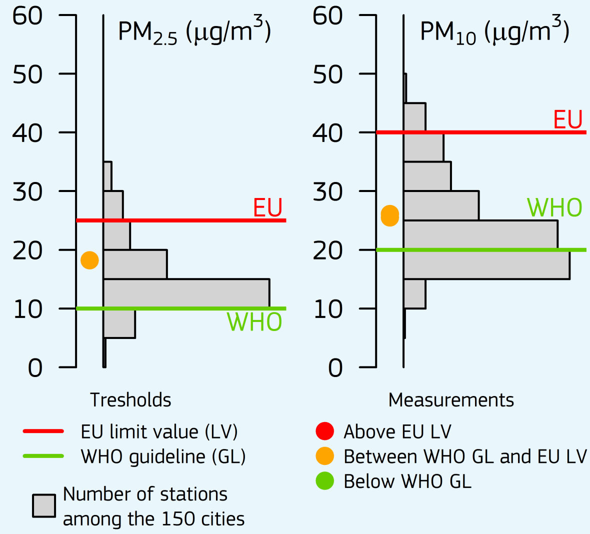




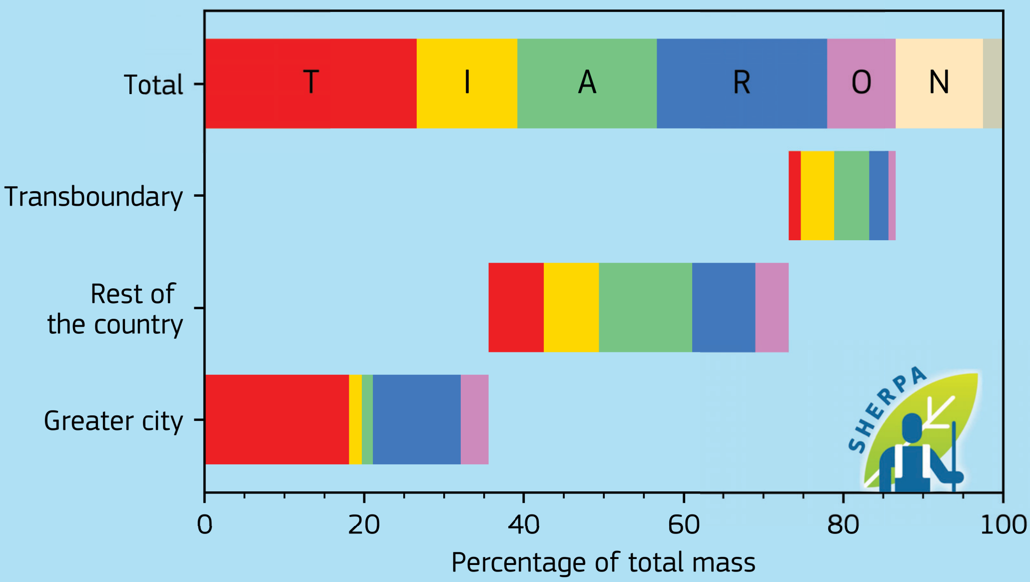
Italy, Bologna



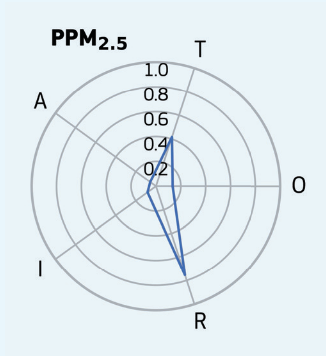
Yearly average urban background (2015)

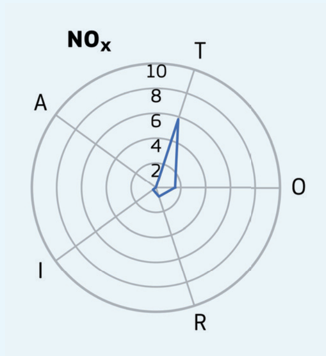


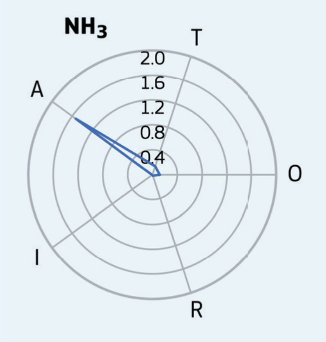
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

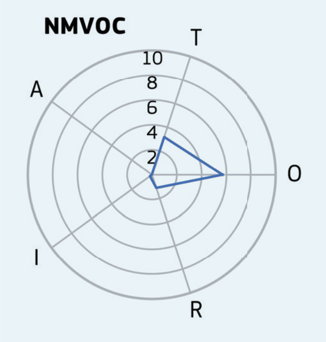


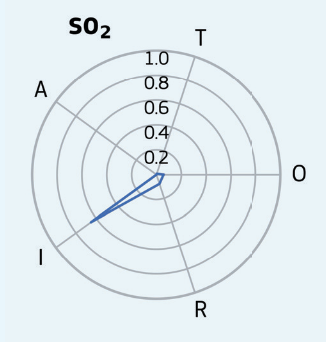
Emissions [kton/year]





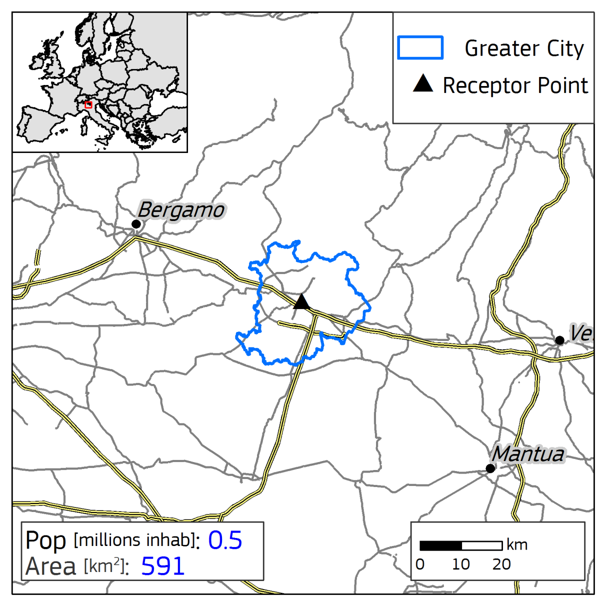




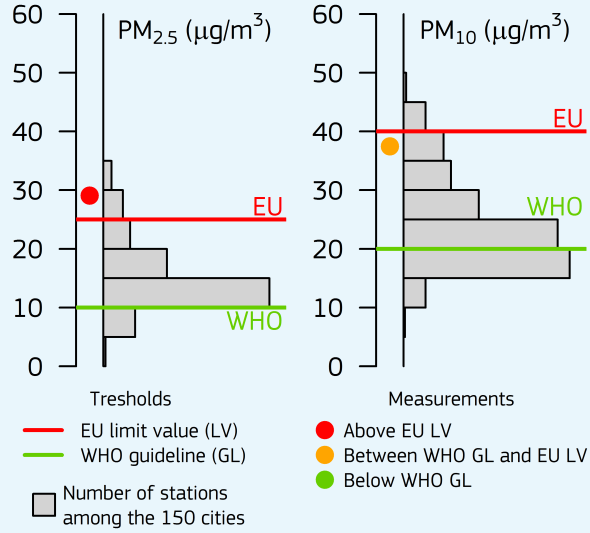


T - Transport
I - Industry
A - Agriculture
R - Residential
O - Other
N - Natural
E - External
Greater city

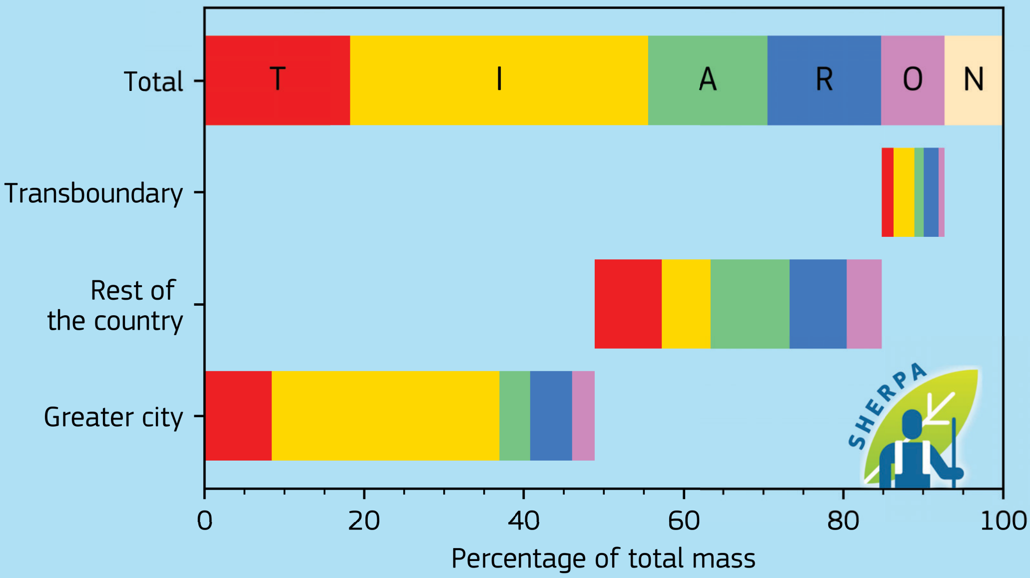
Italy, Brescia



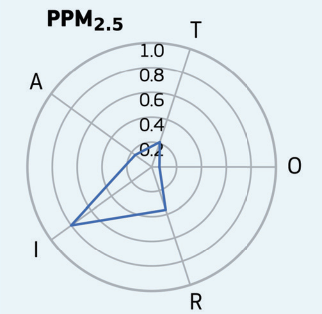
Yearly average urban background (2015)

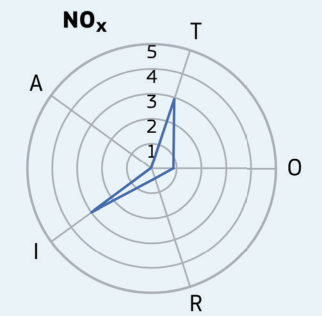


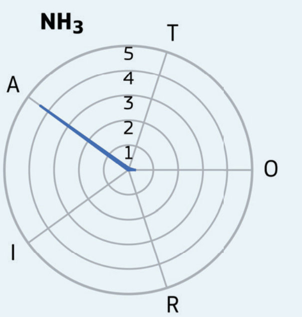
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

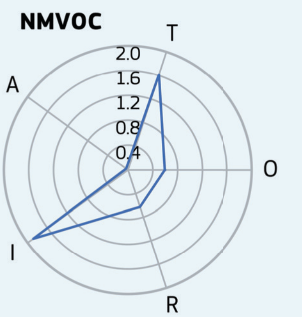


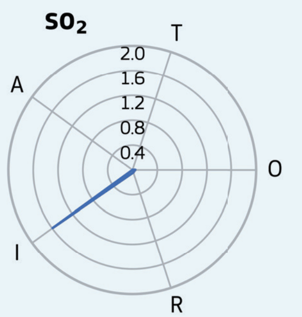
Emissions [kton/year]





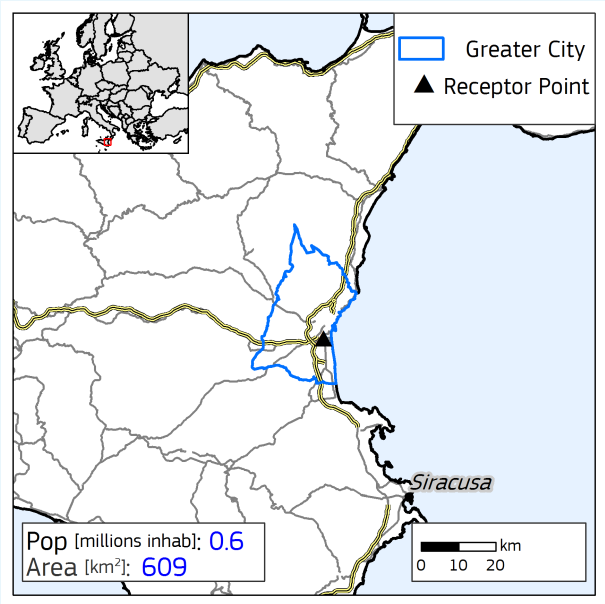




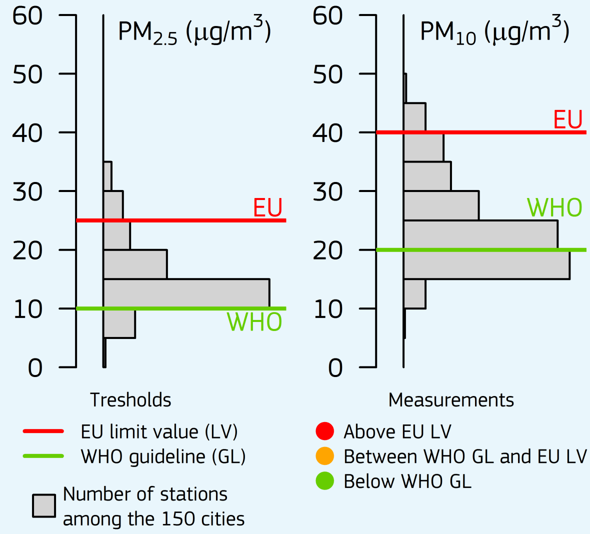


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- Greater city

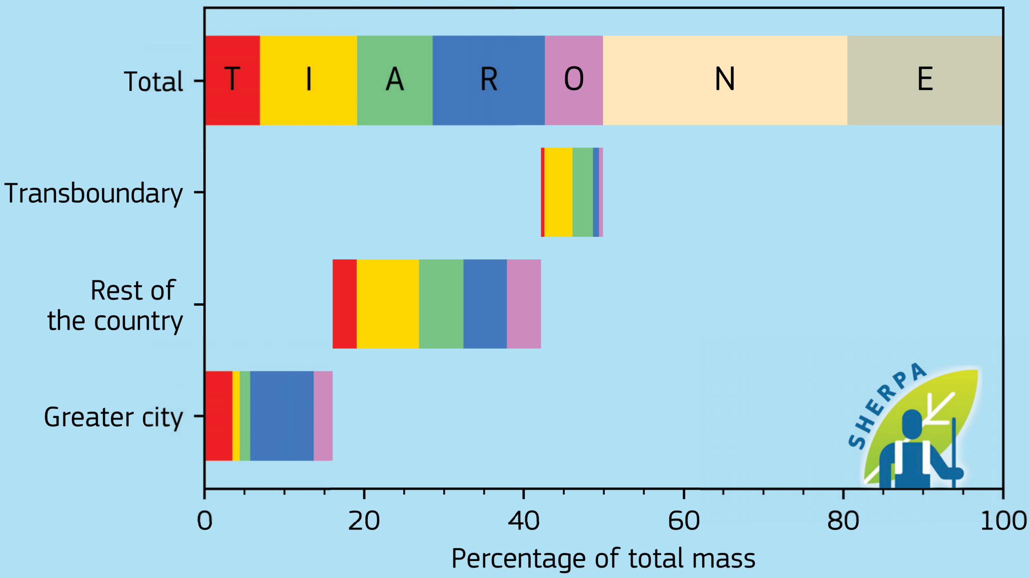
Italy, Catania



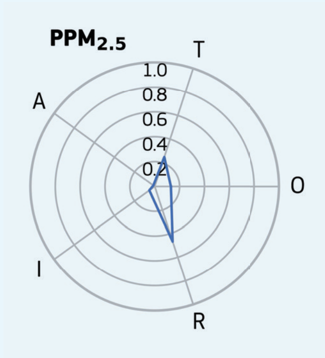
Yearly average urban background (2015)

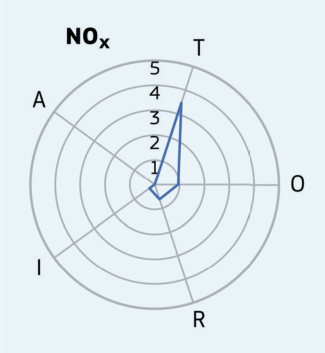


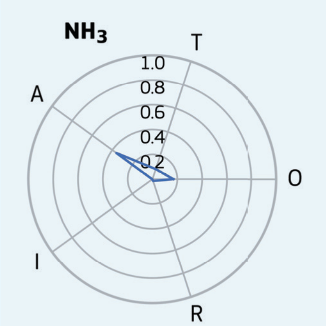
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

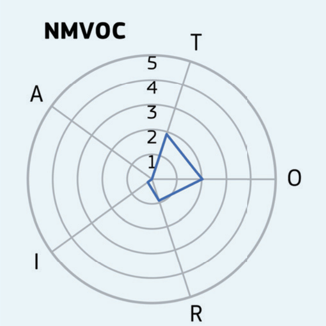


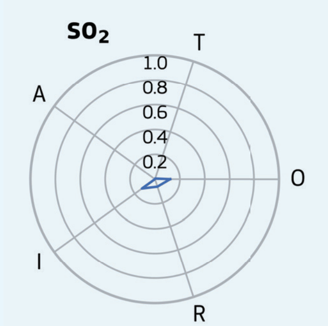
Emissions [kton/year]



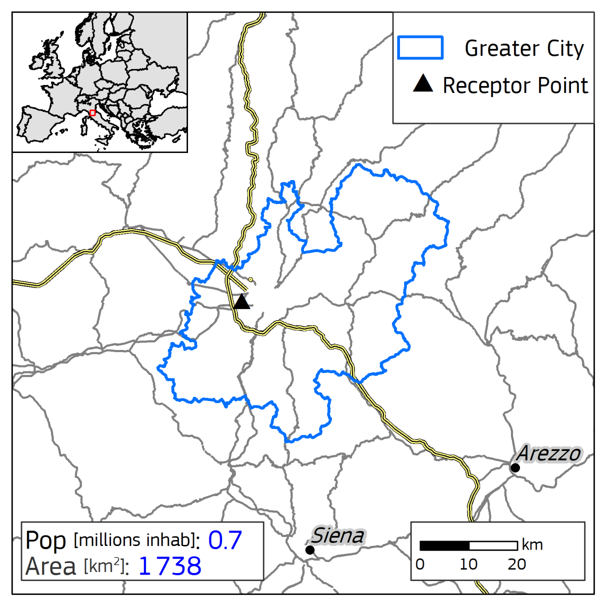




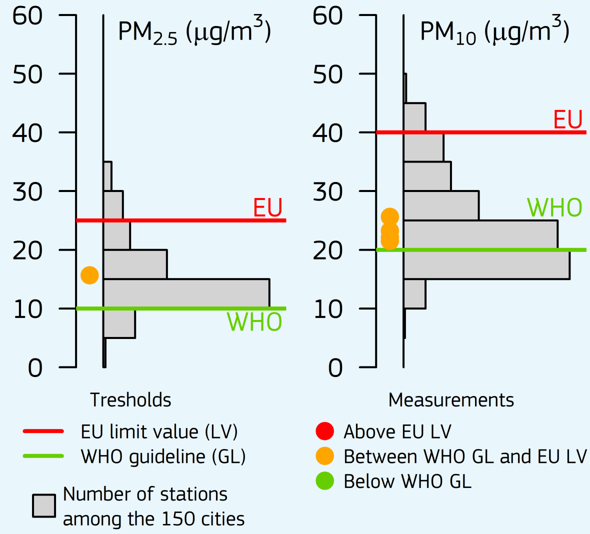




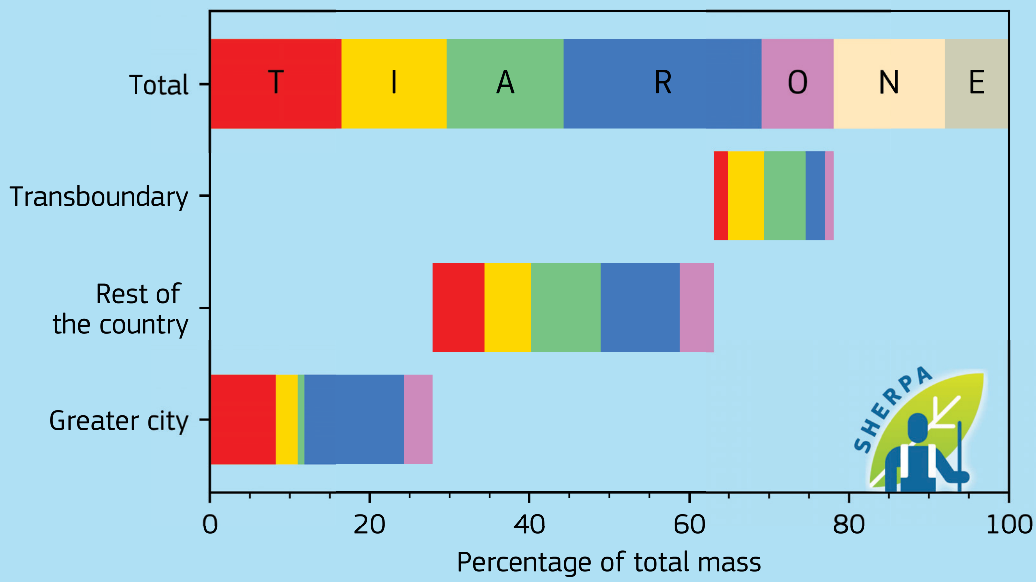
Italy, Florence



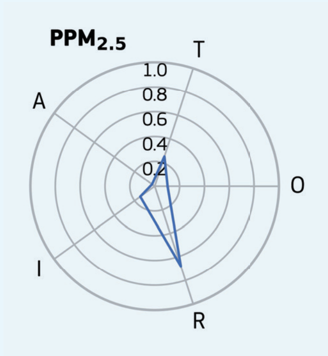
Yearly average urban background (2015)

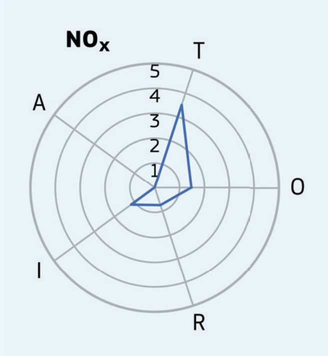


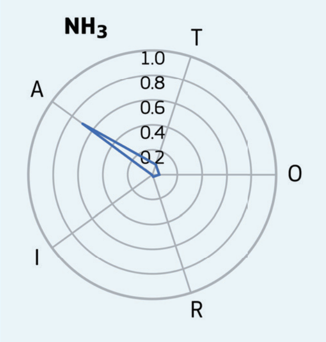
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

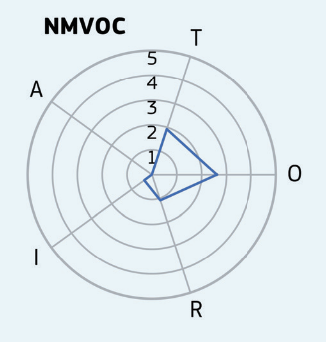


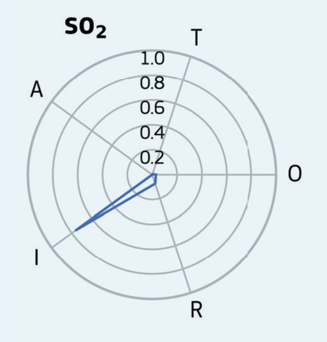
Emissions [kton/year]



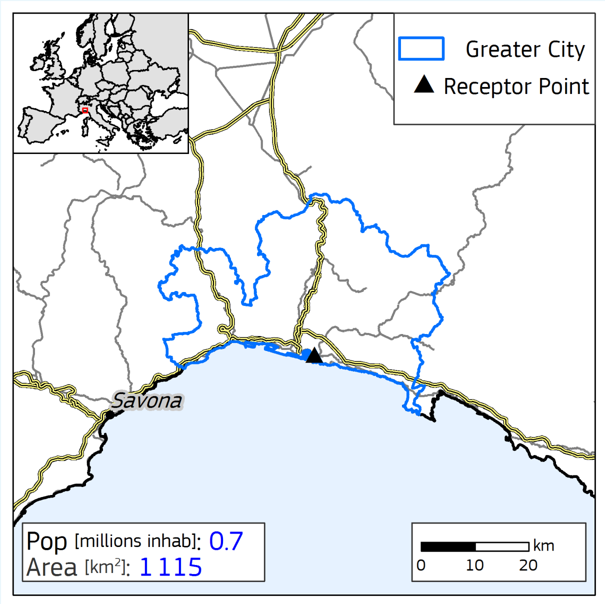




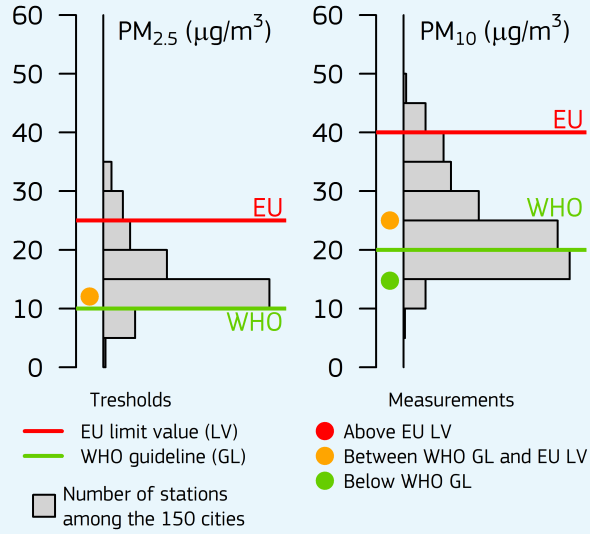




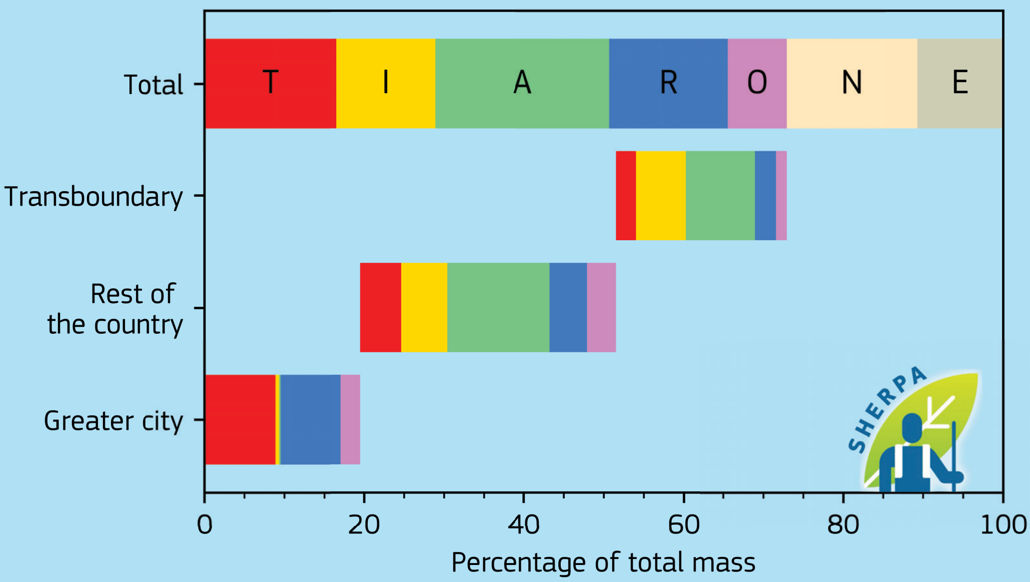
Italy, Genoa



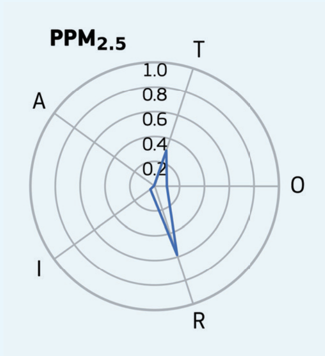
Yearly average urban background (2015)

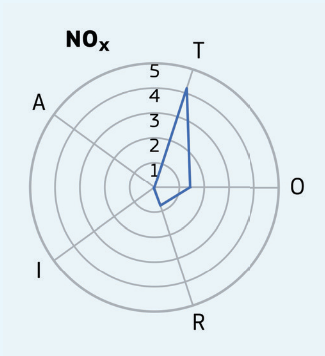


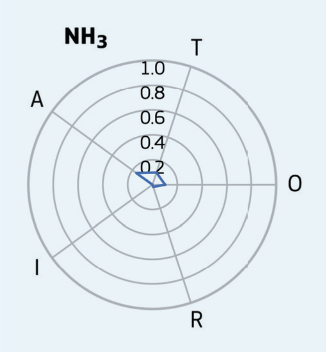
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

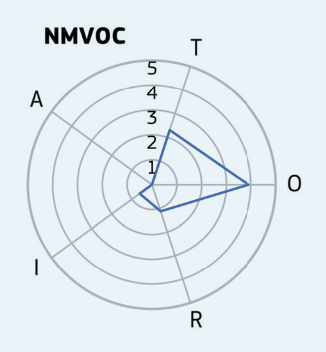


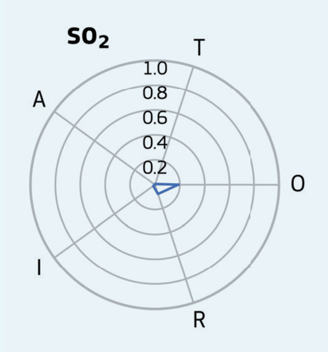
Emissions [kton/year]





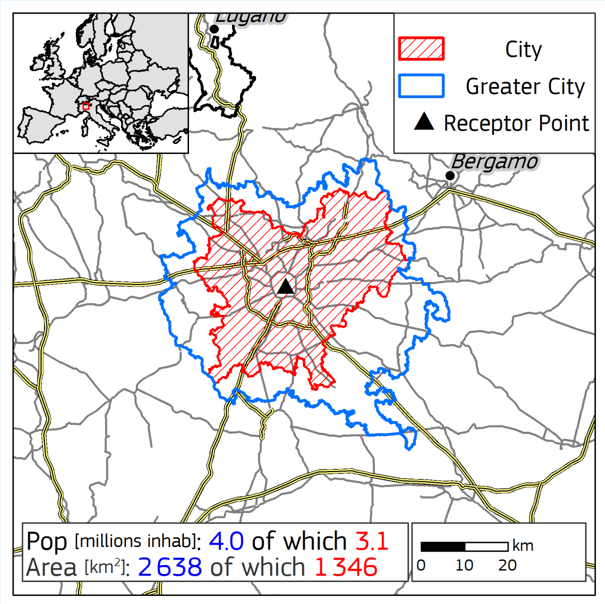




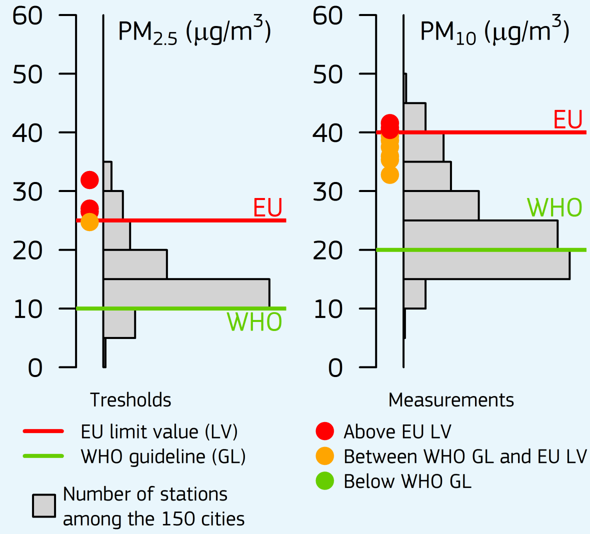


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city

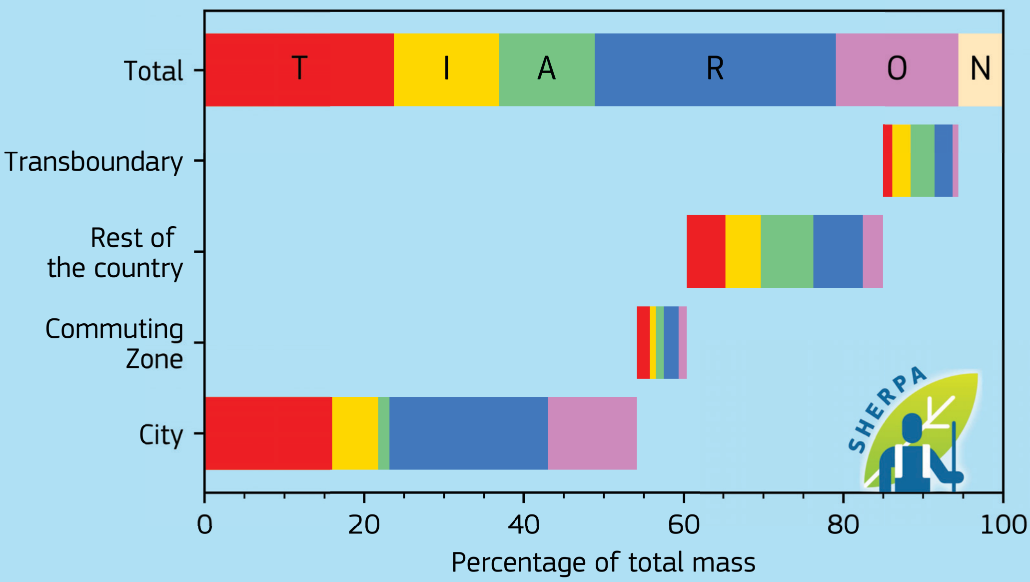
Italy, Milan



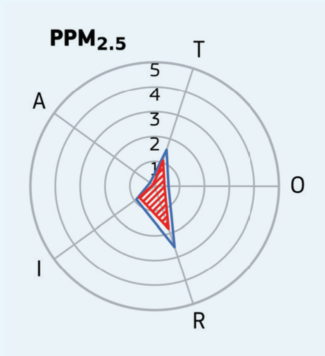
Yearly average urban background (2015)

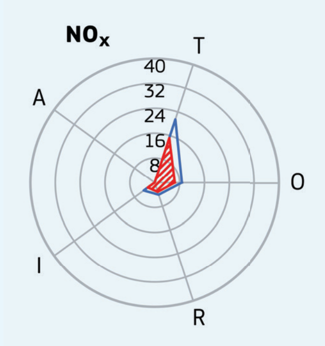


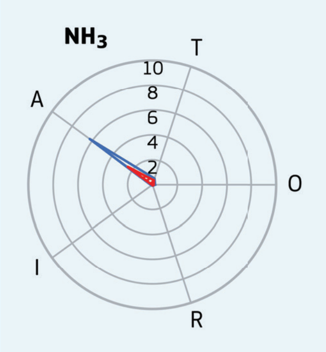
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

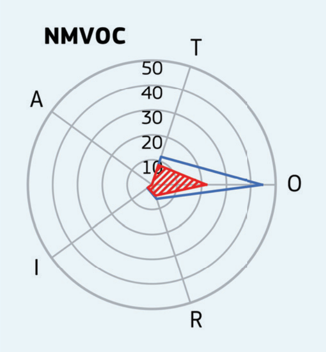


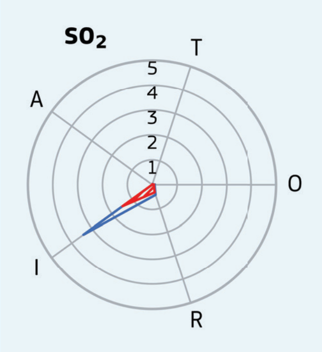
Emissions [kton/year]



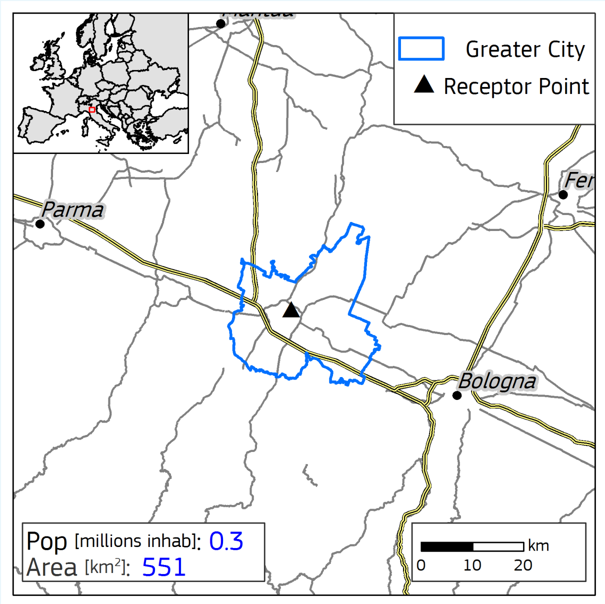




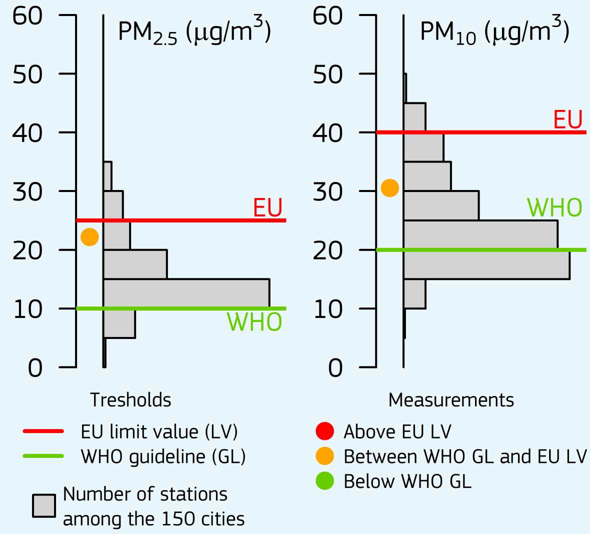




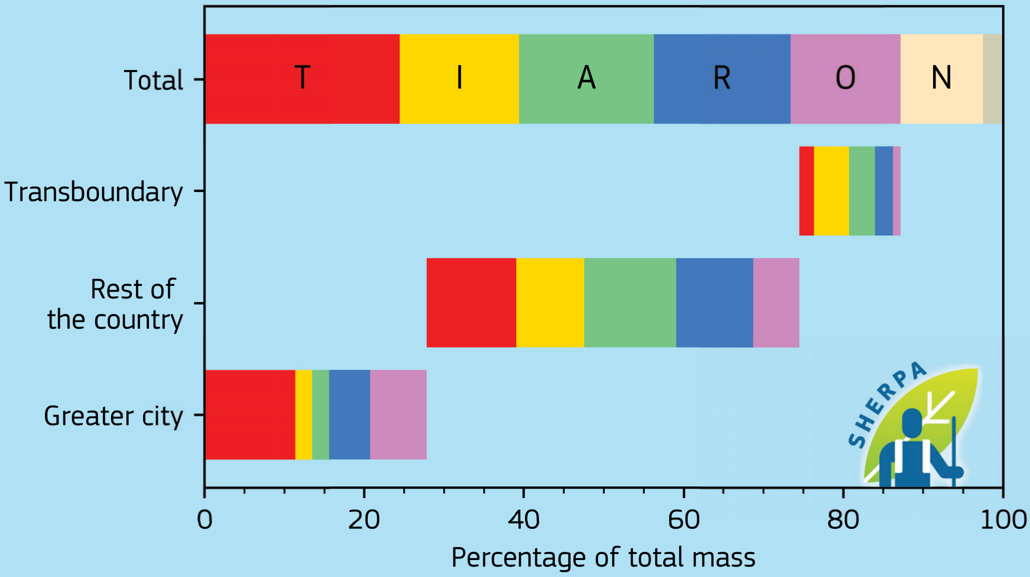
Italy, Modena



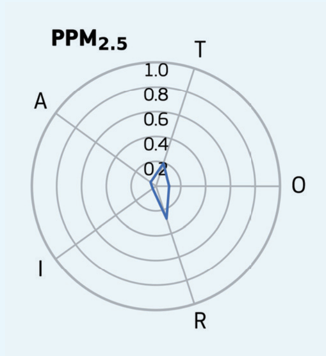
Yearly average urban background (2015)

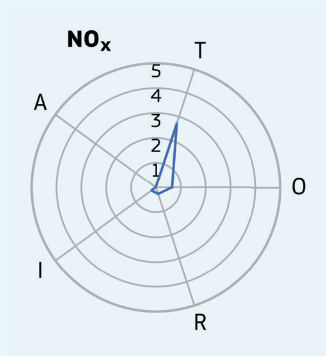


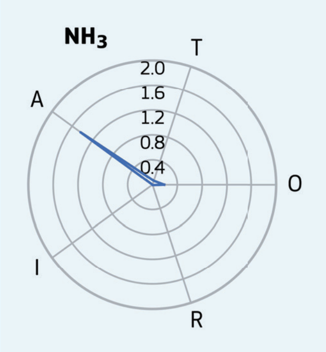
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

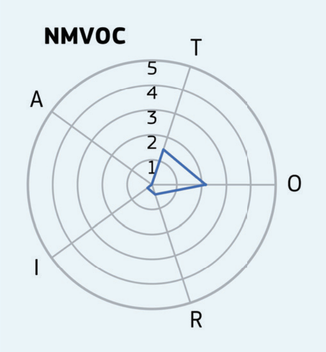


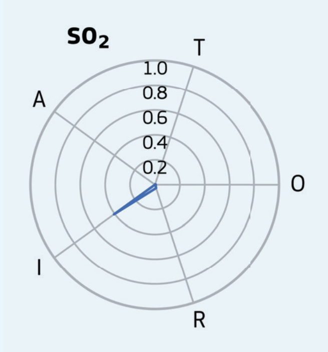
Emissions [kton/year]



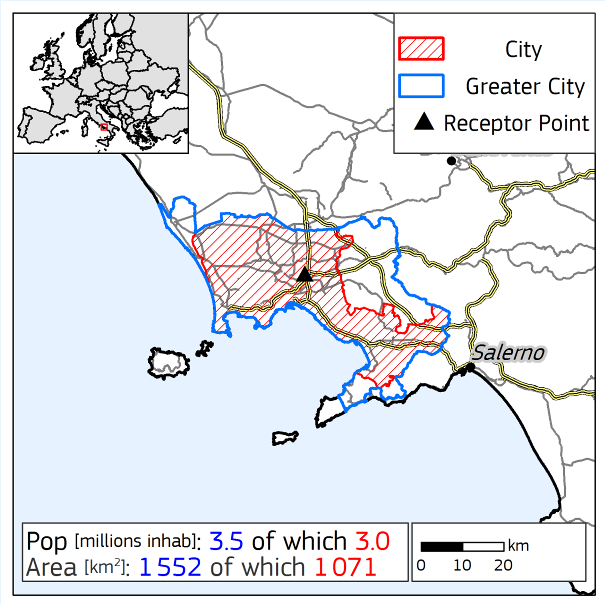




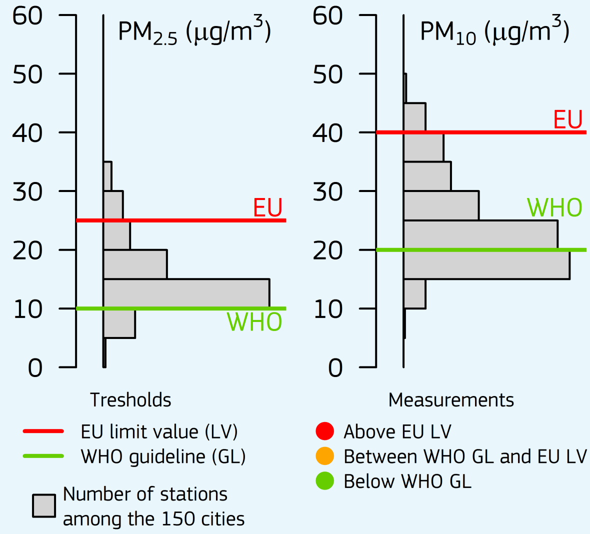




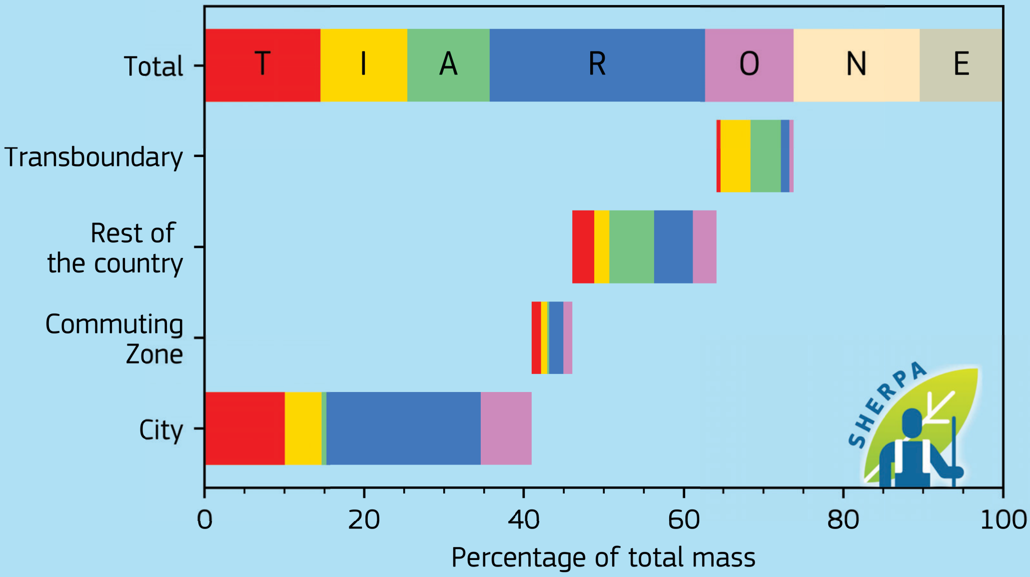
Italy, Naples



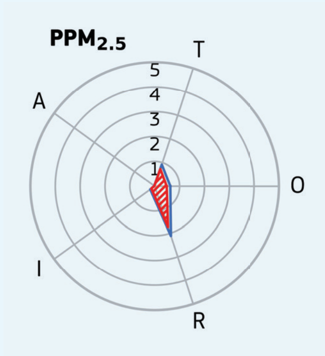
Yearly average urban background (2015)

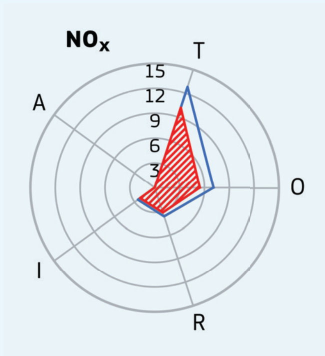


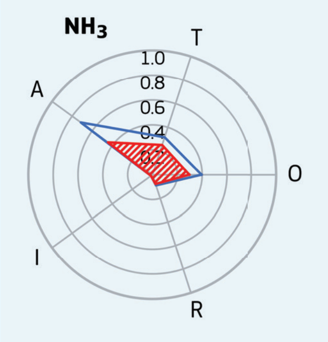
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

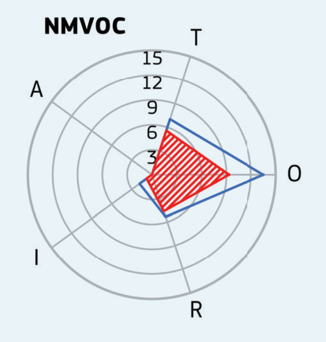


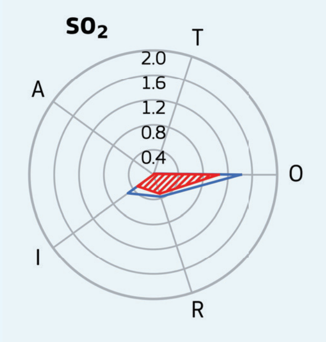
Emissions [kton/year]



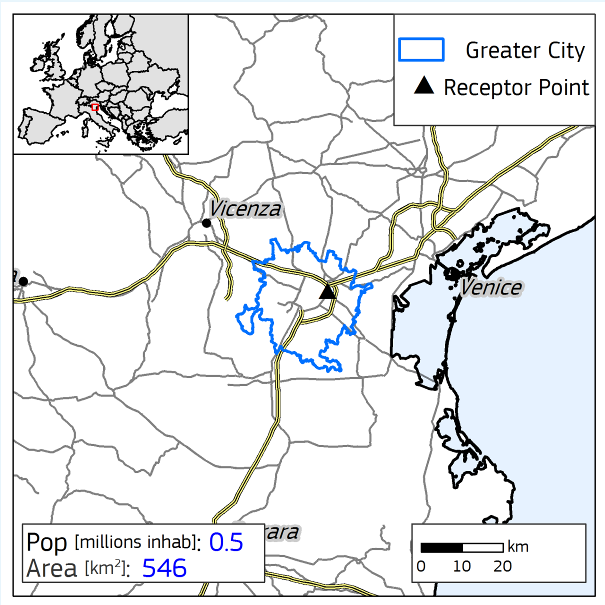




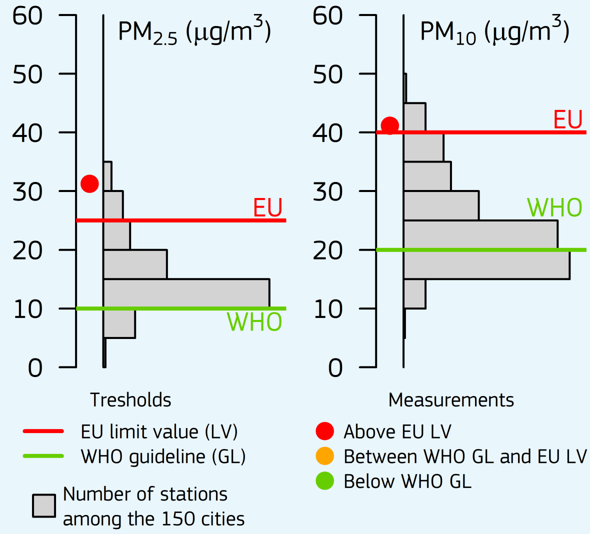




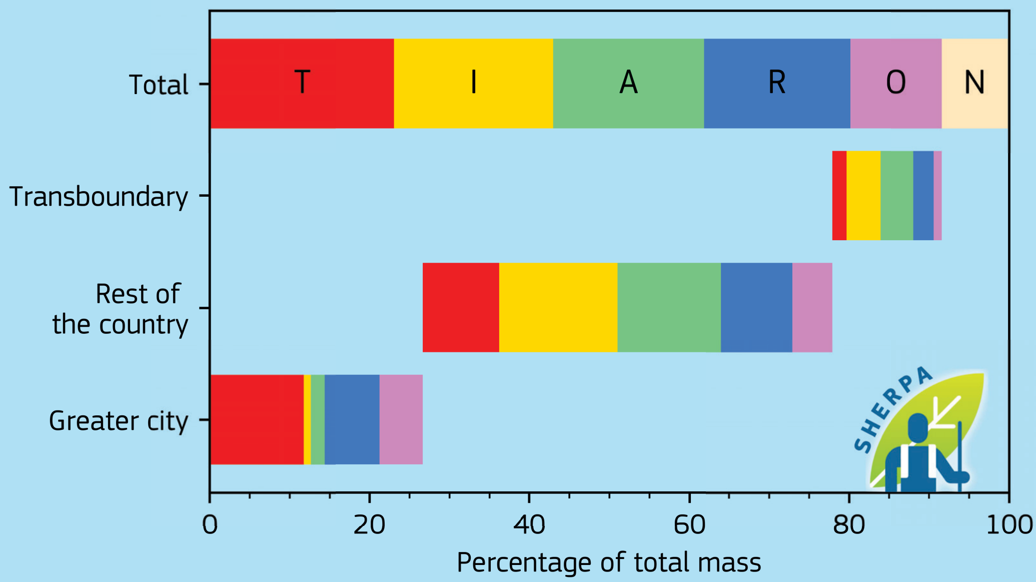
Italy, Padua



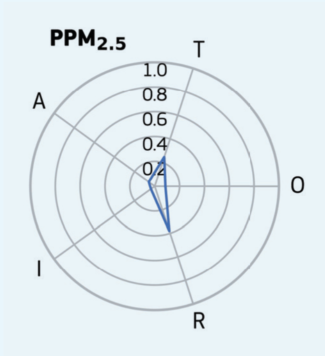
Yearly average urban background (2015)

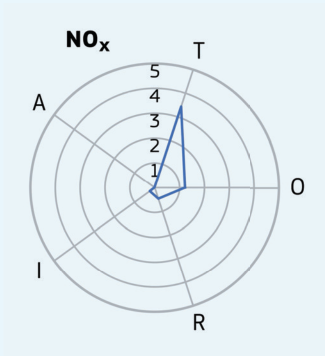


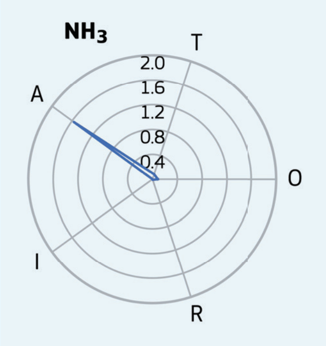
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

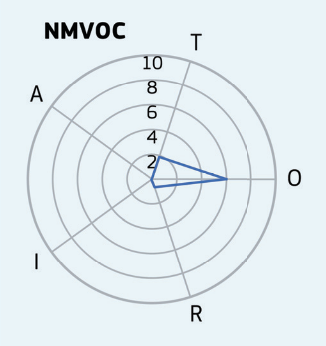


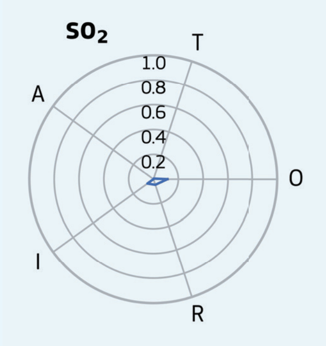
Emissions [kton/year]



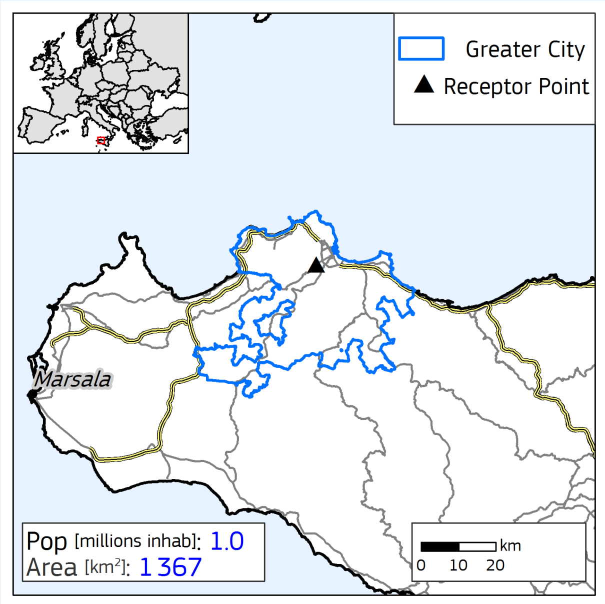




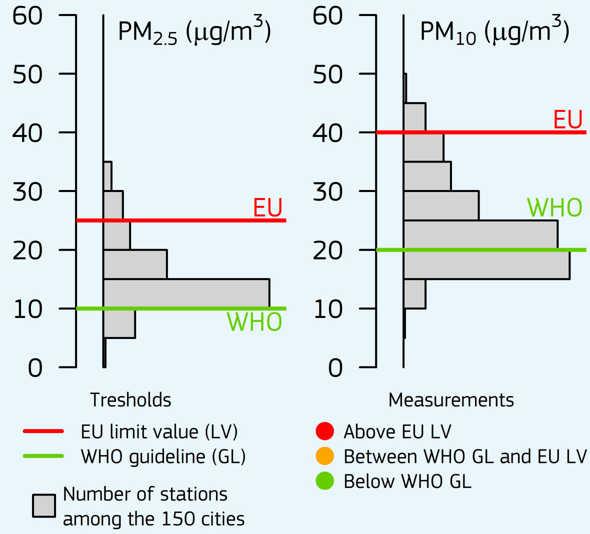




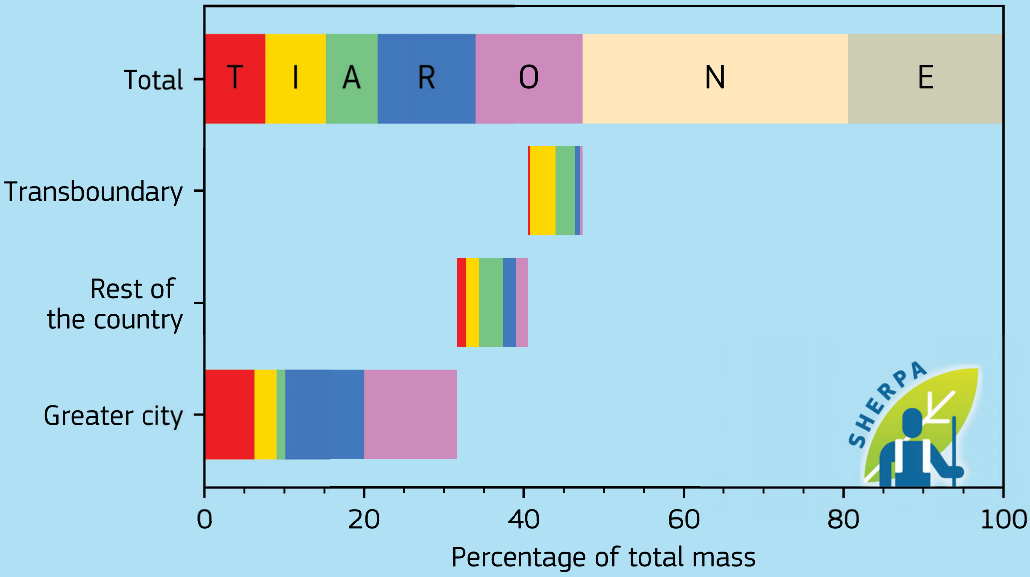
Italy, Palermo



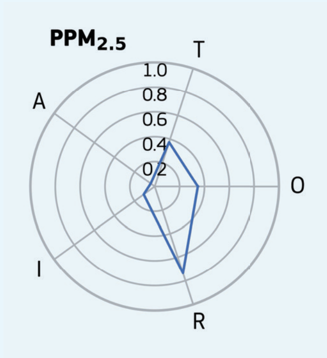
Yearly average urban background (2015)

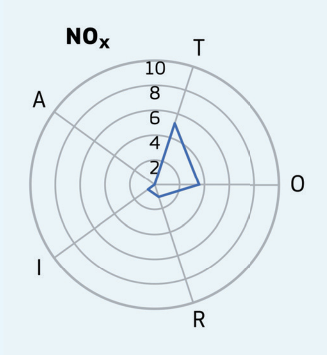


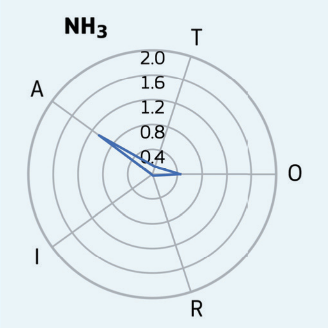
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

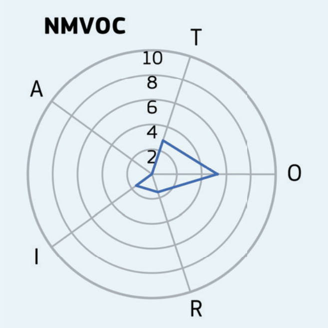


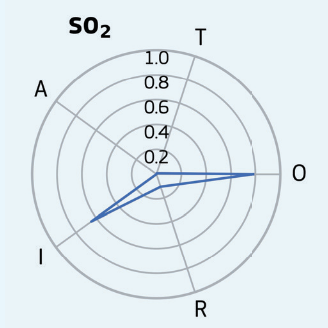
Emissions [kton/year]



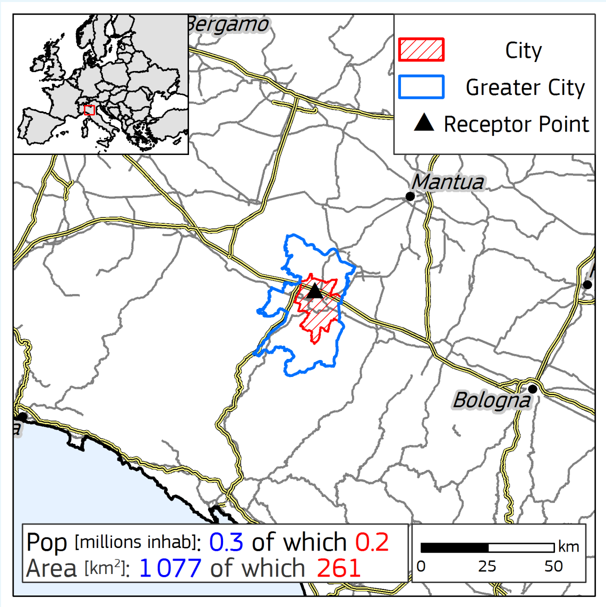




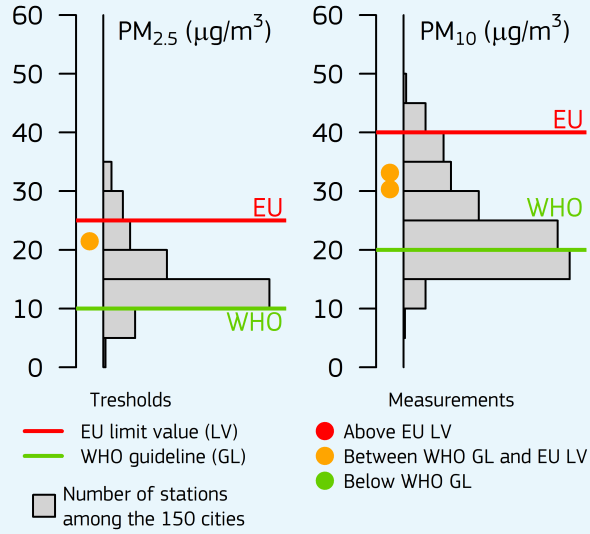




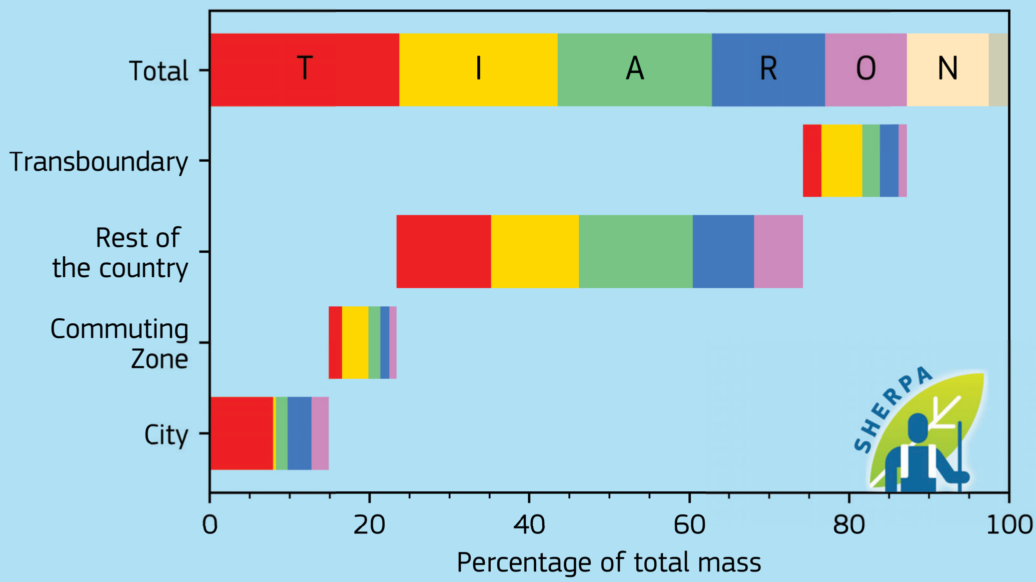
Italy, Parma



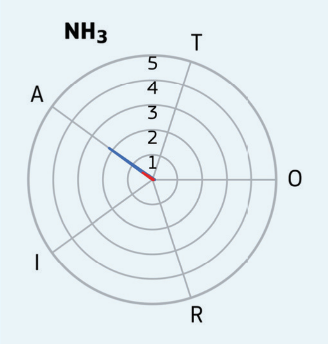
Yearly average urban background (2015)

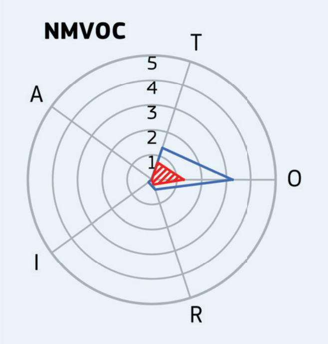


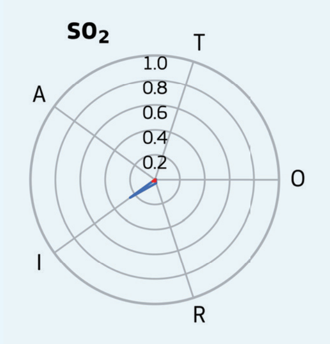
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



Emissions [kton/year]







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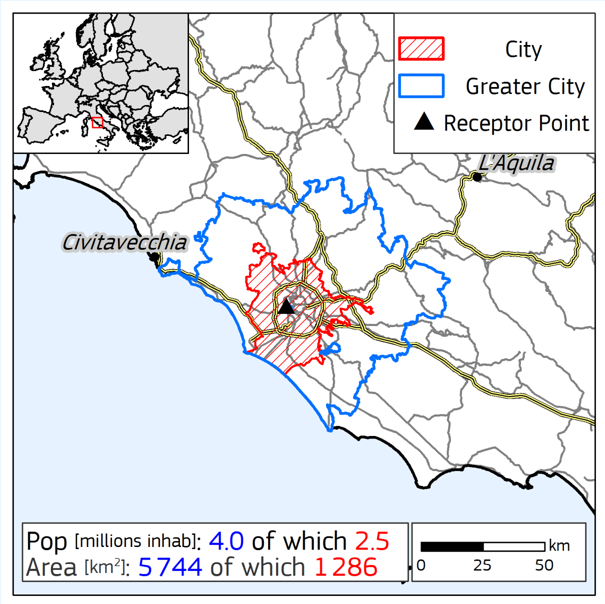
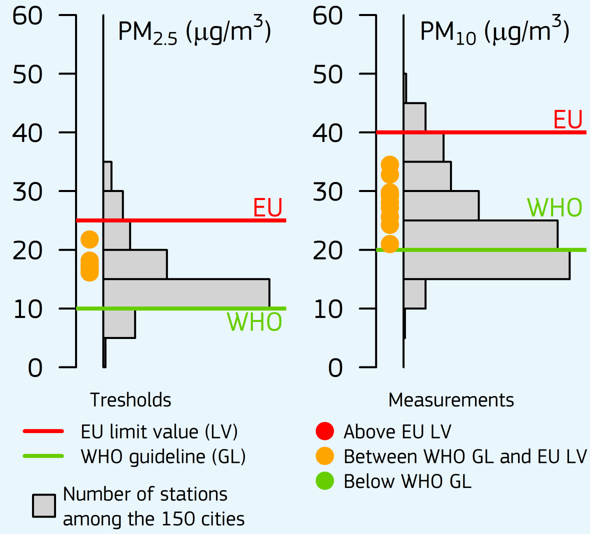
- Greater city
- City

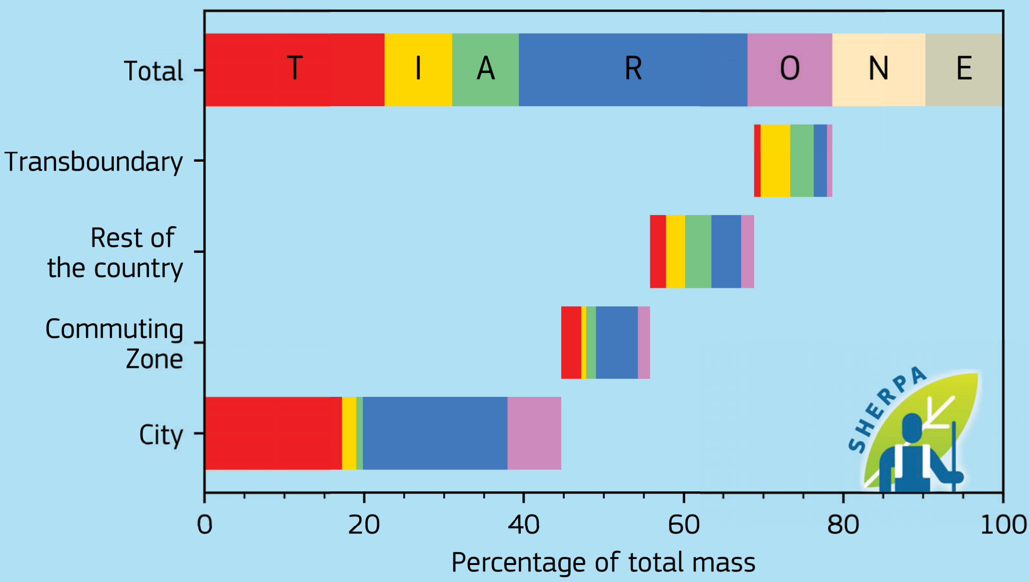
Italy, Rome



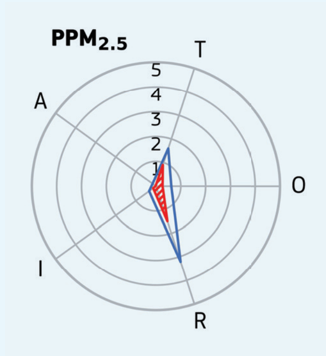
Yearly average urban background (2015)

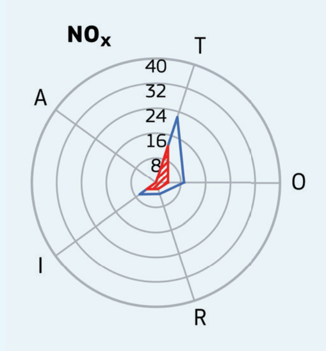


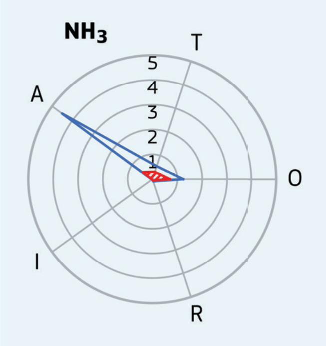
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

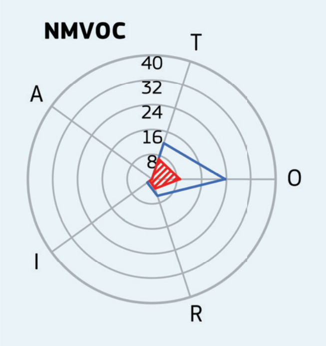


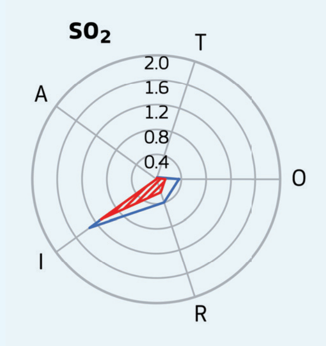
Emissions [kton/year]



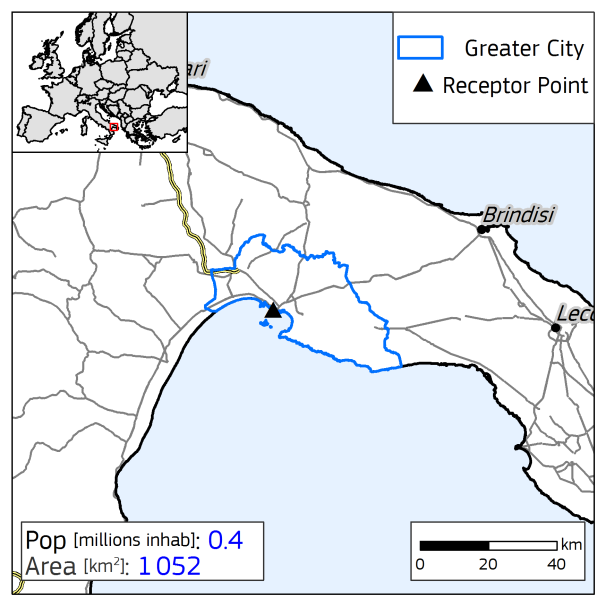




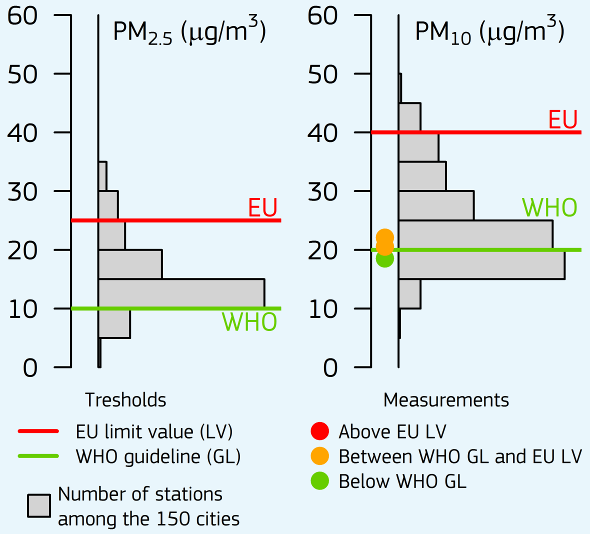




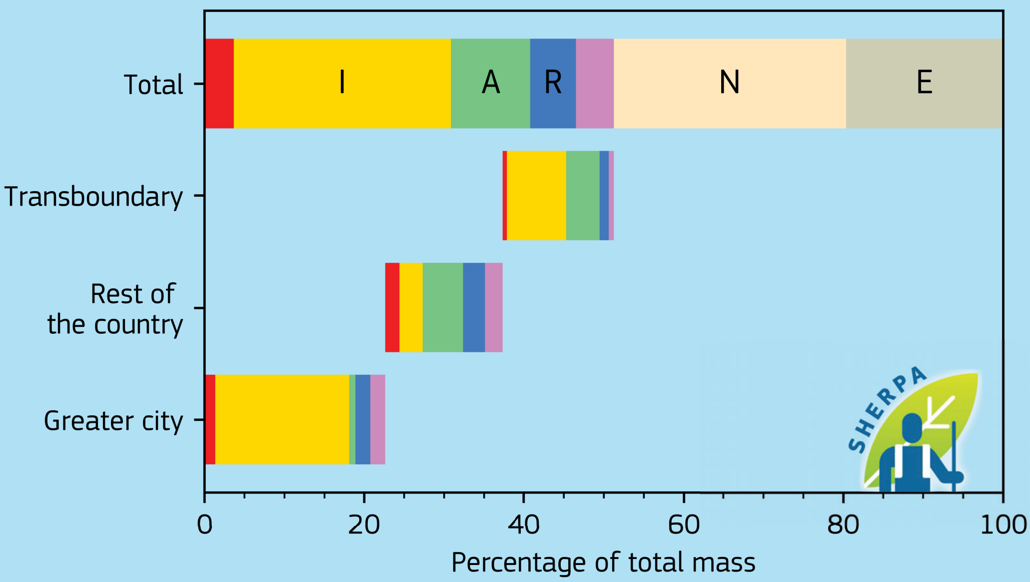
Italy, Taranto



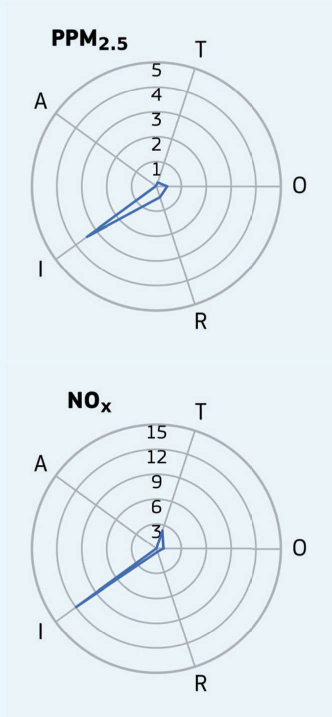
Yearly average urban background (2015)

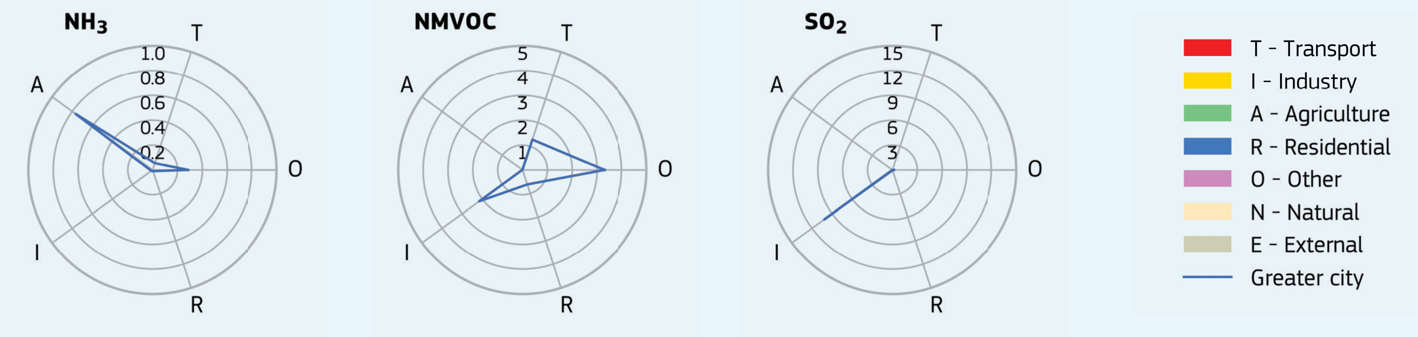


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

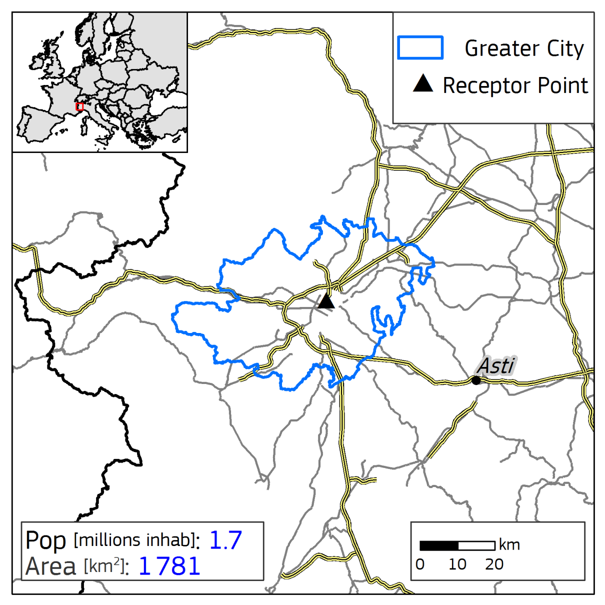


Emissions [kton/year]

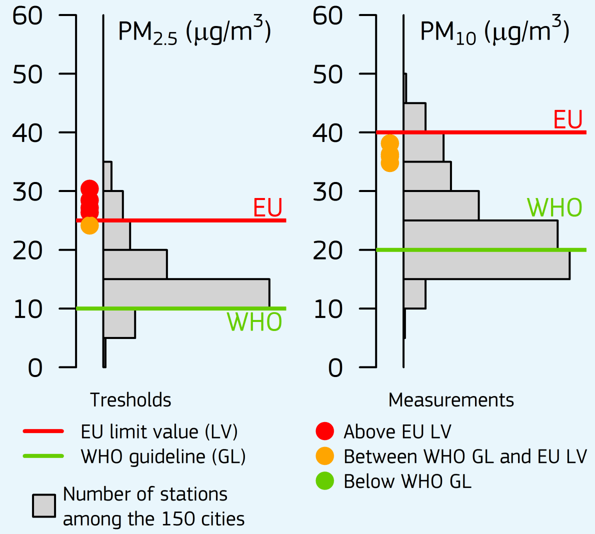




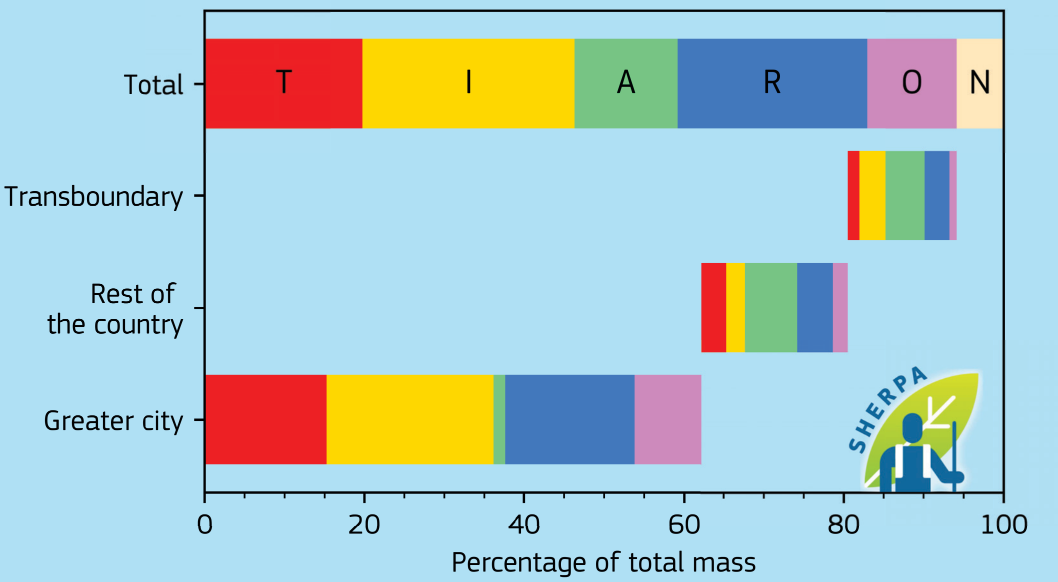
Italy, Turin



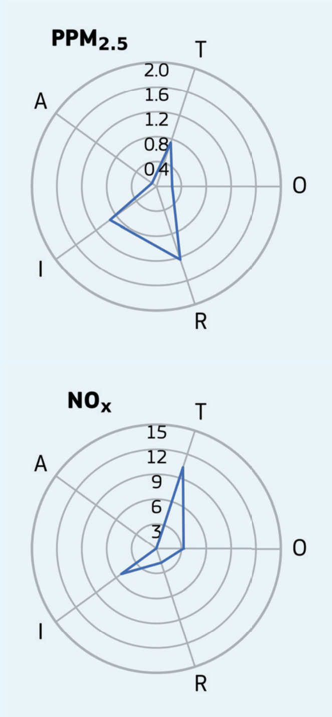
Yearly average urban background (2015)

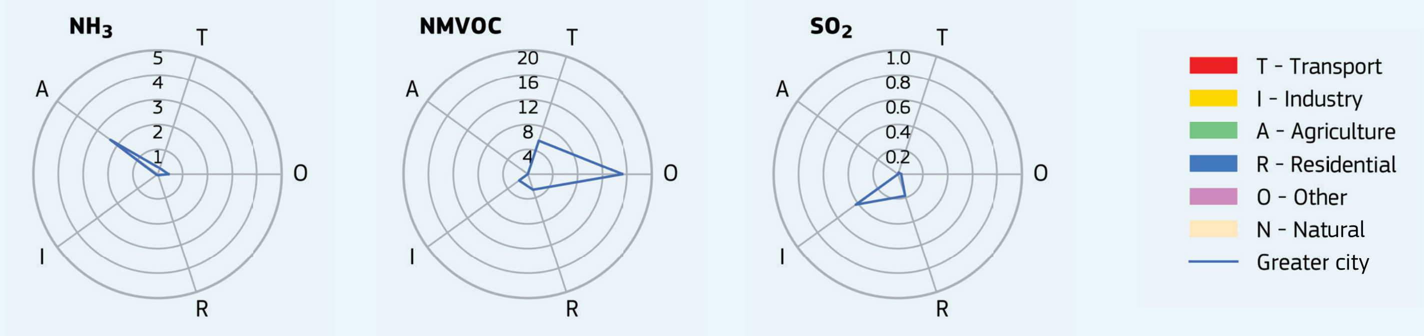


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

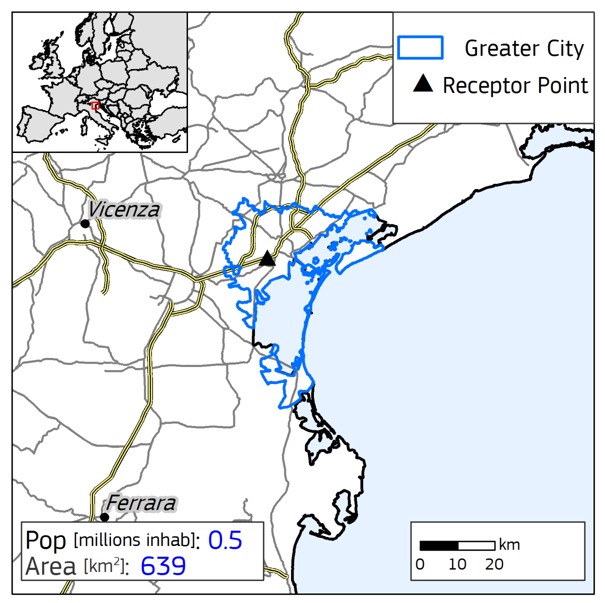


Emissions [kton/year]

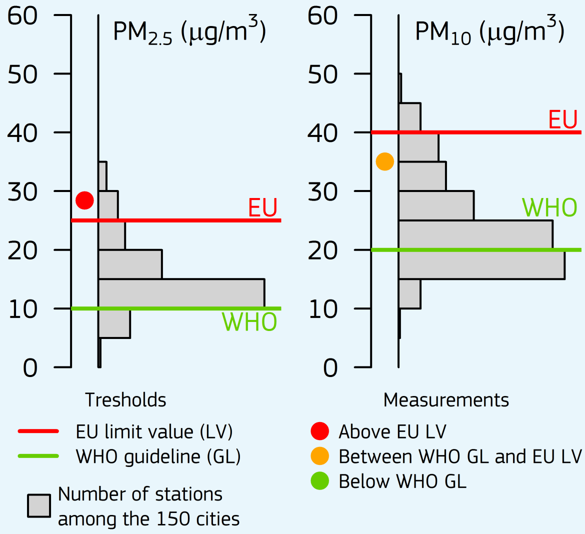




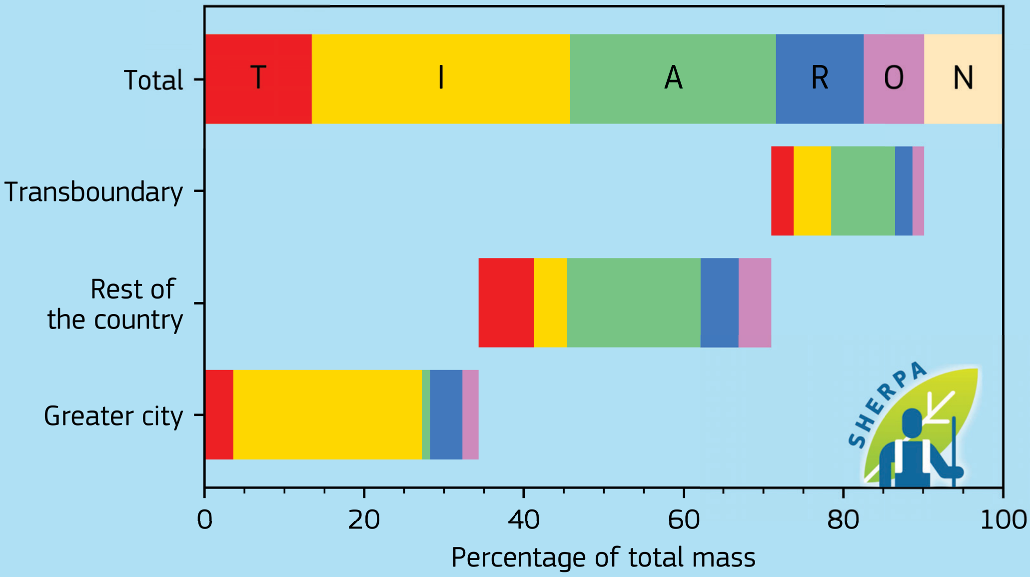
Italy, Venice



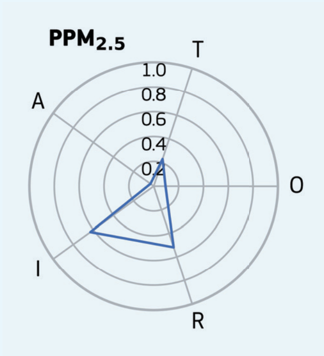
Yearly average urban background (2015)

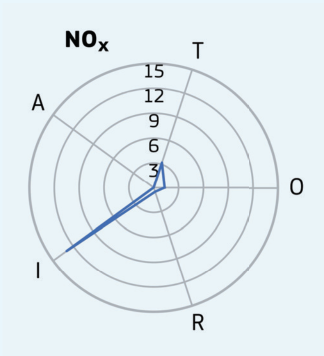


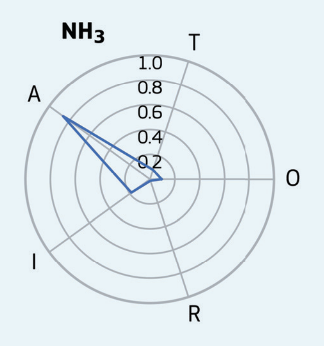
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

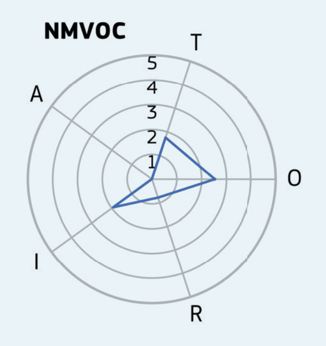


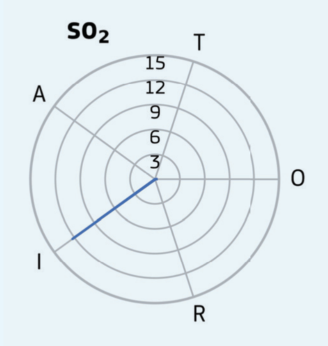
Emissions [kton/year]



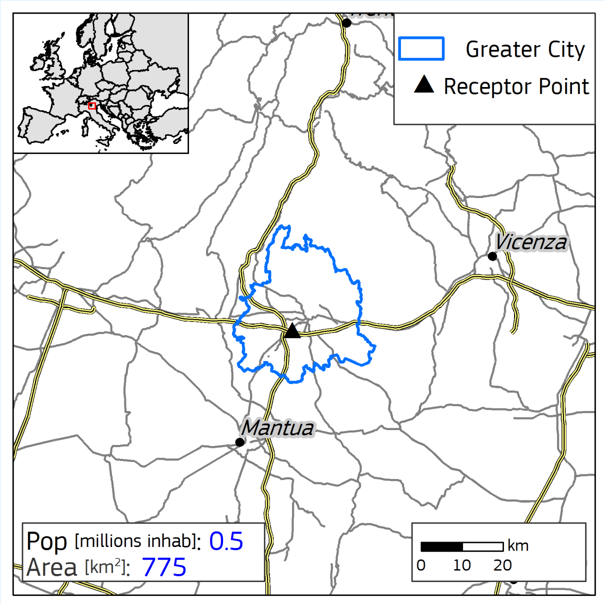




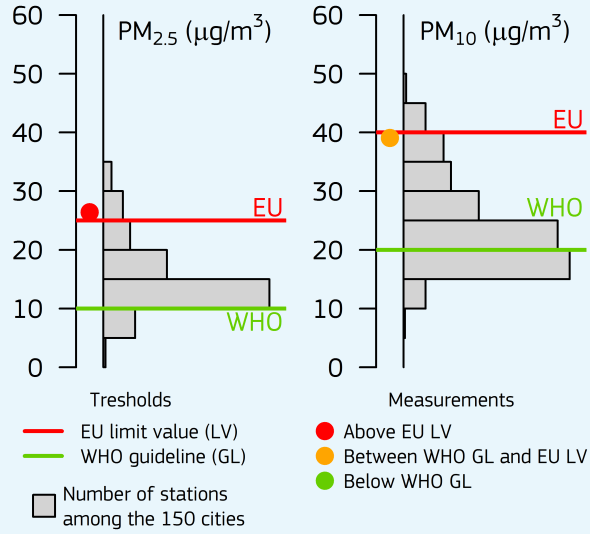




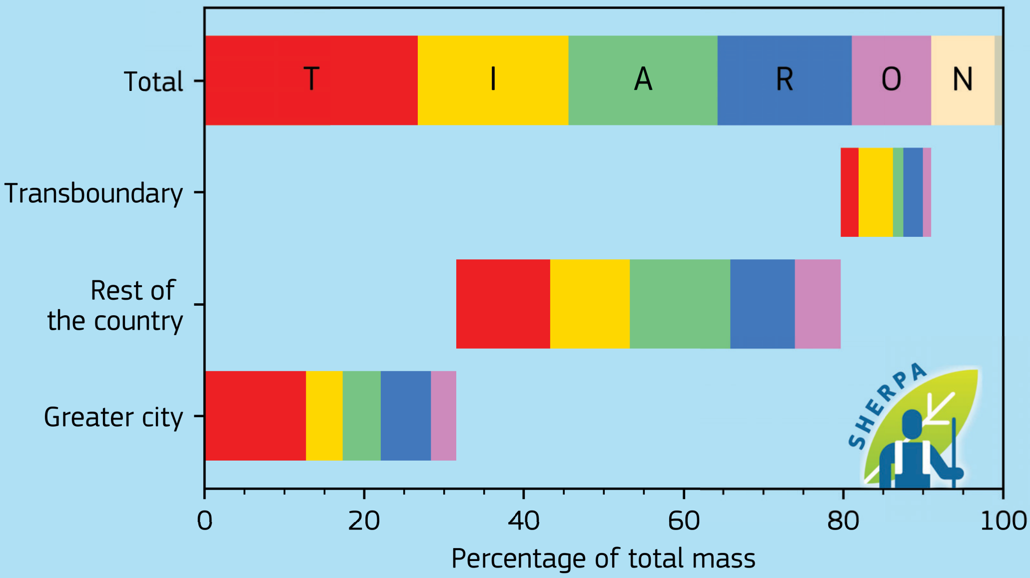
Italy, Verona



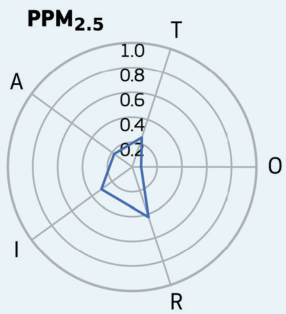
Yearly average urban background (2015)

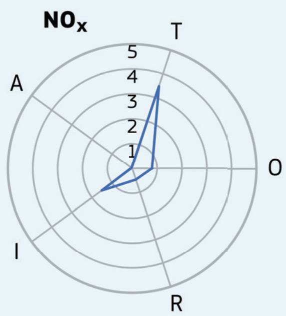


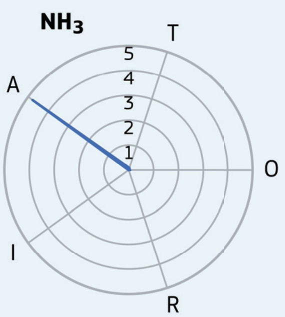
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

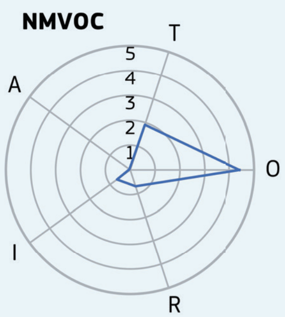


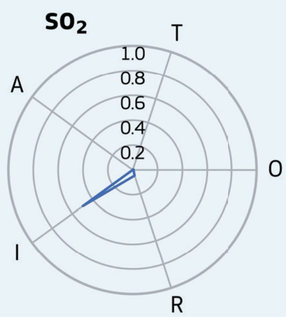
Emissions [kton/year]





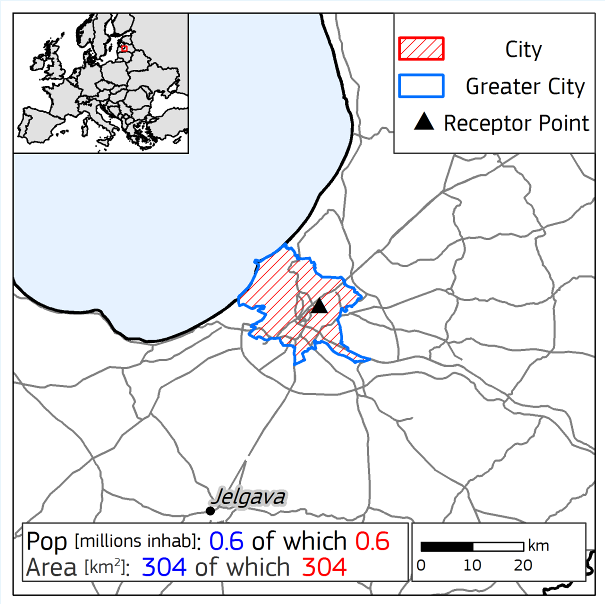




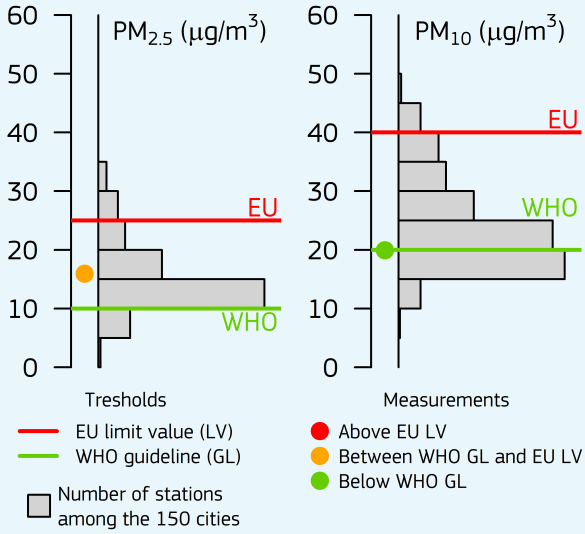


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city

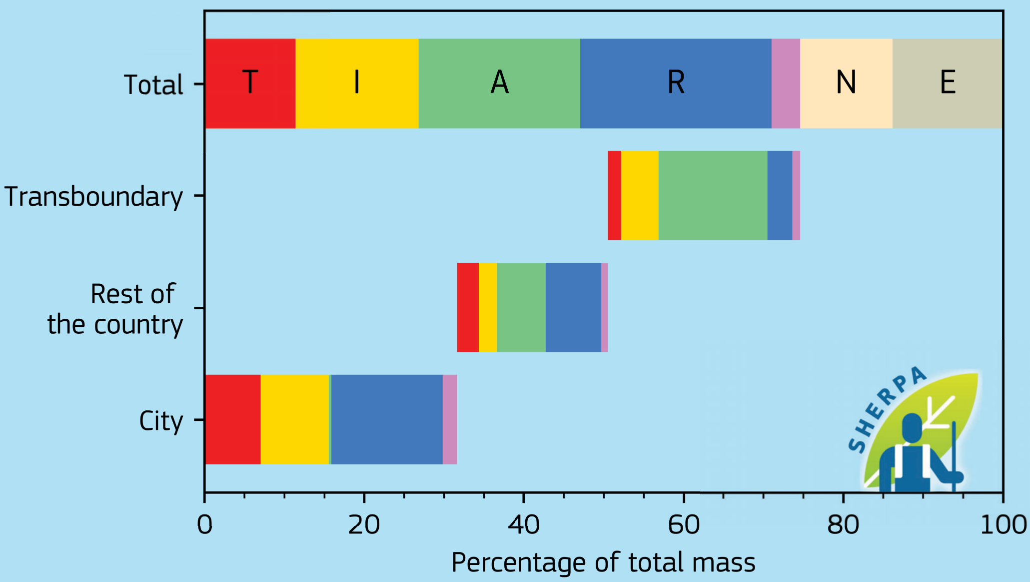
Latvia, Riga



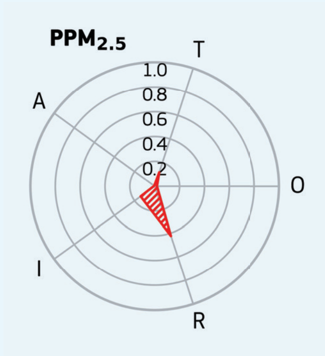
Yearly average urban background (2015)

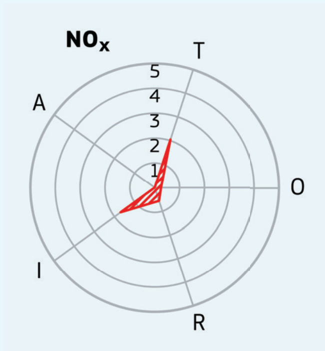


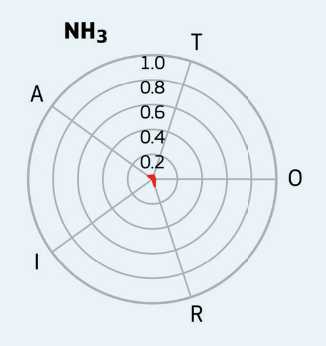
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

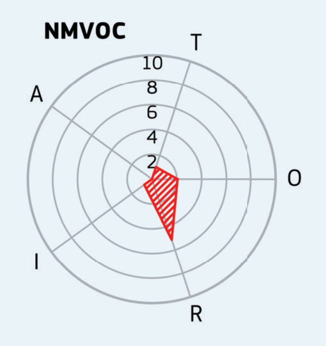


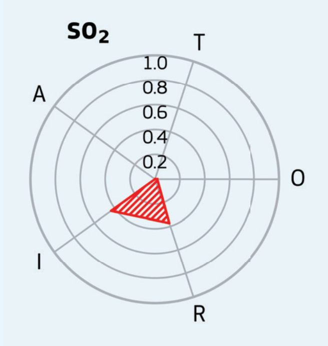
Emissions [kton/year]



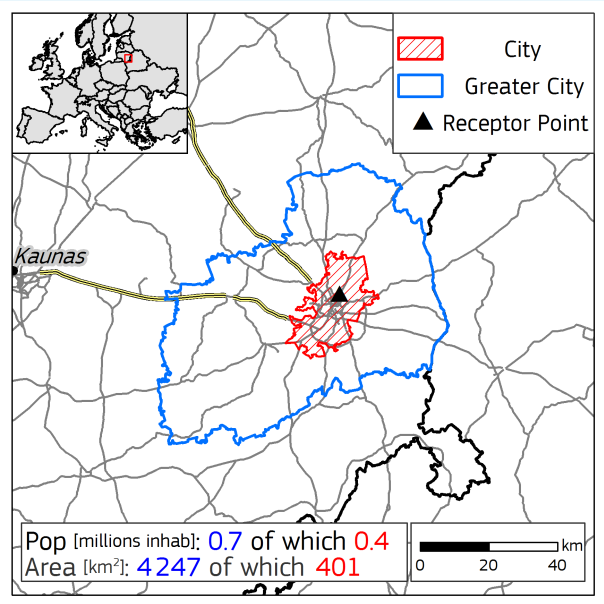




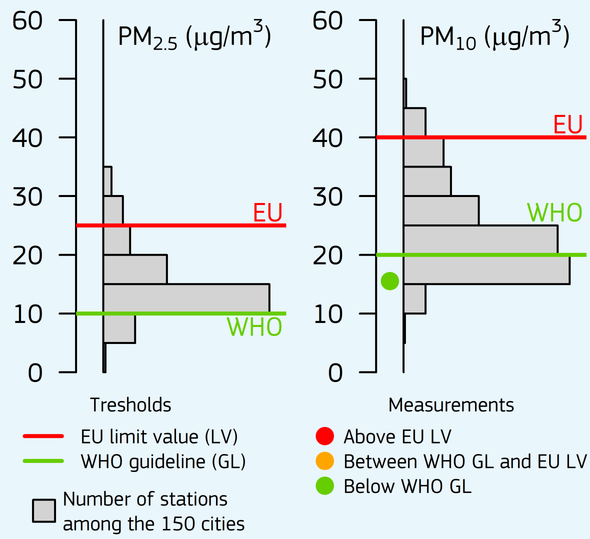




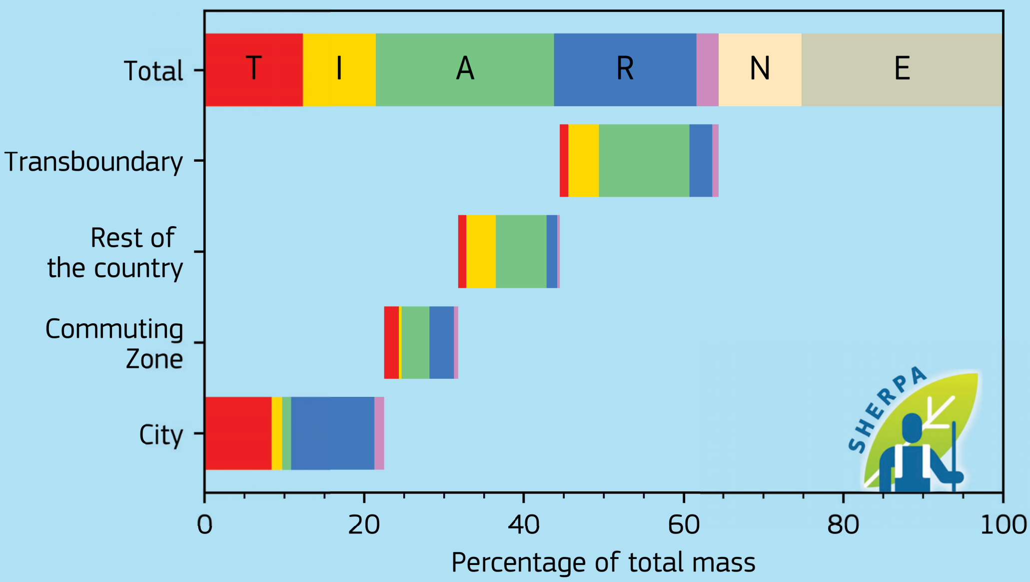
Lithuania, Vilnius



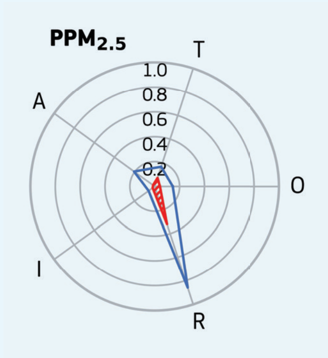
Yearly average urban background (2015)

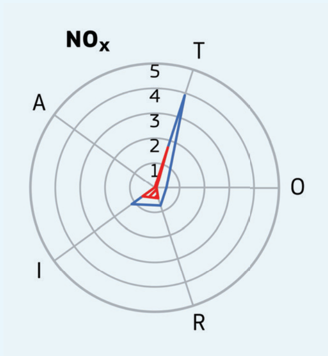


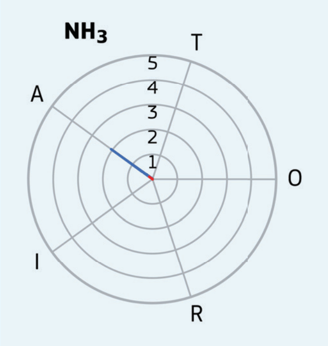
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

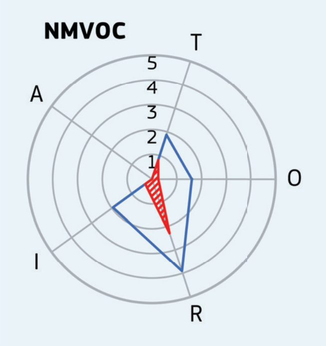


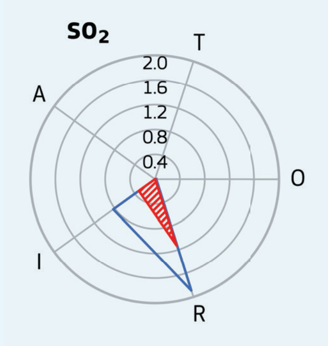
Emissions [kton/year]



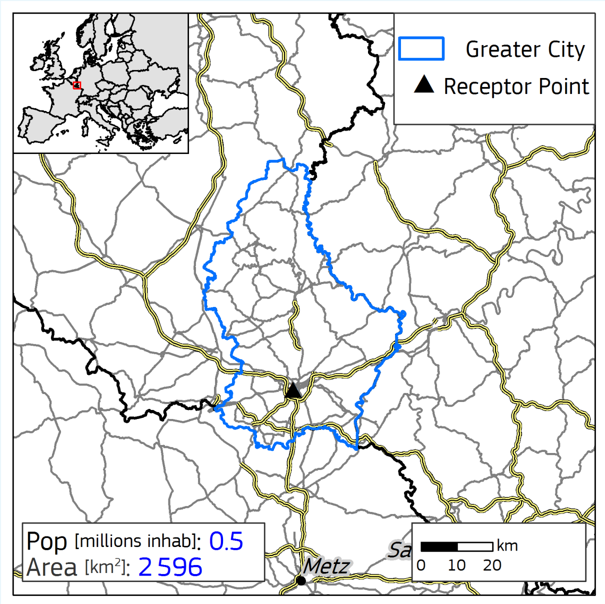




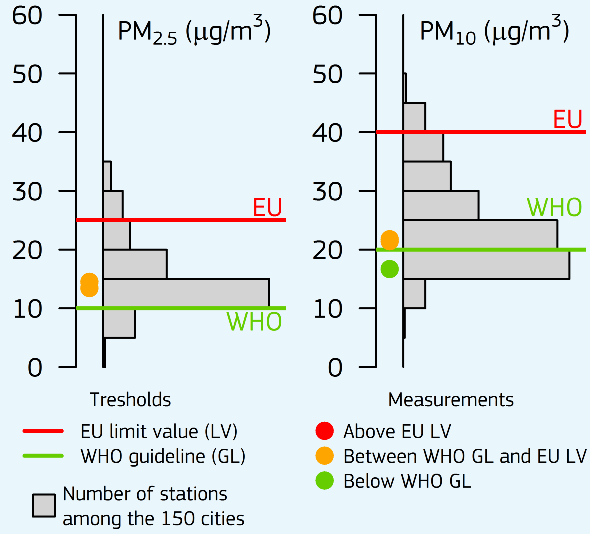




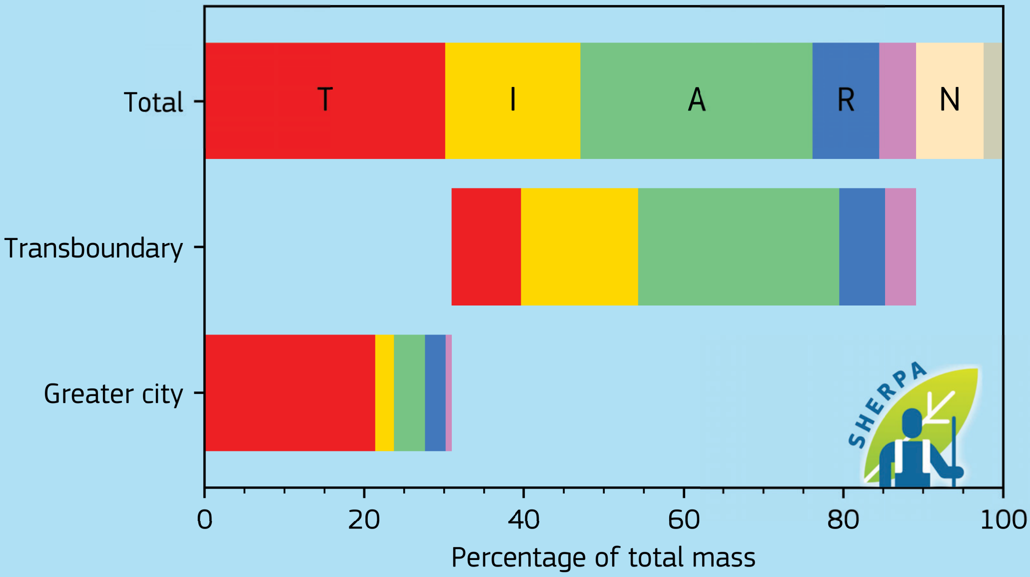
Luxembourg, Luxembourg



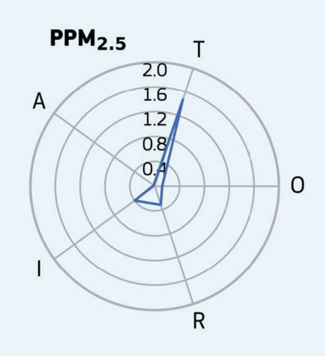
Yearly average urban background (2015)

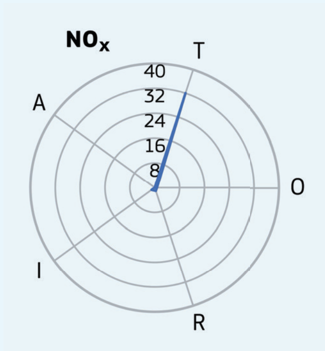


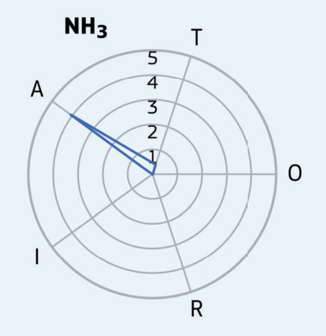
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

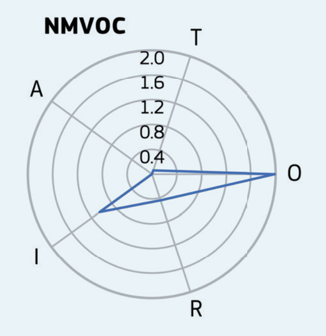


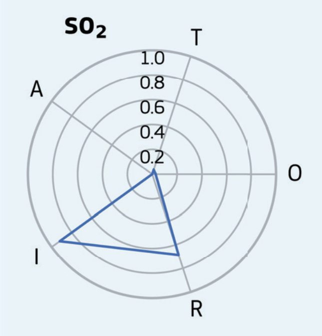
Emissions [kton/year]



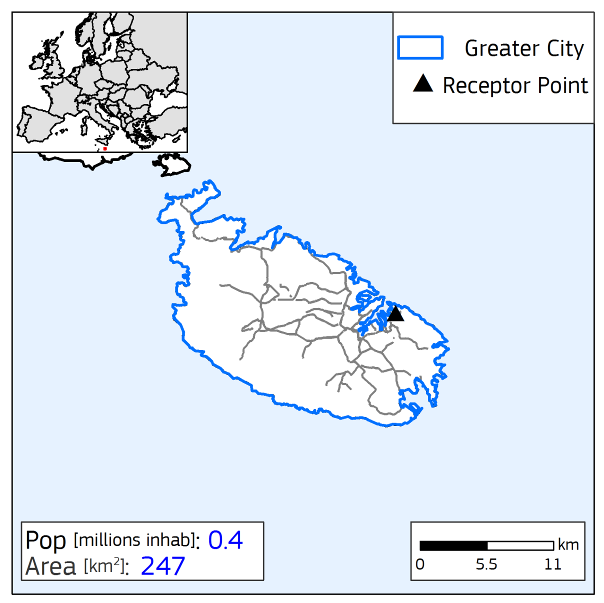




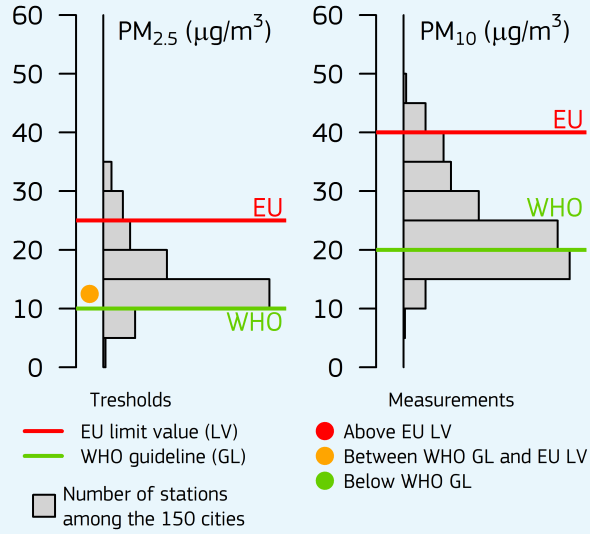




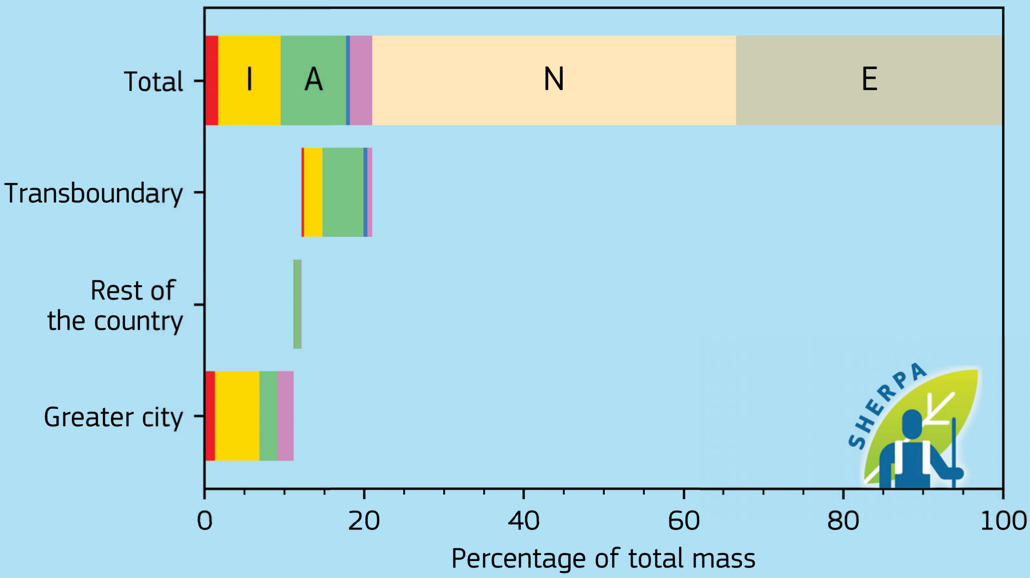
Malta, Valletta



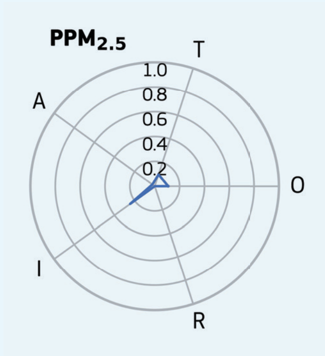
Yearly average urban background (2015)

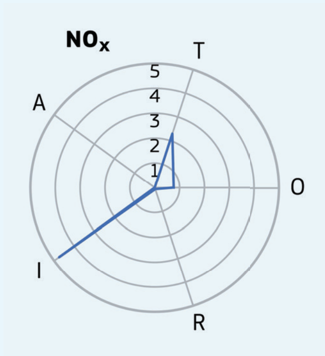


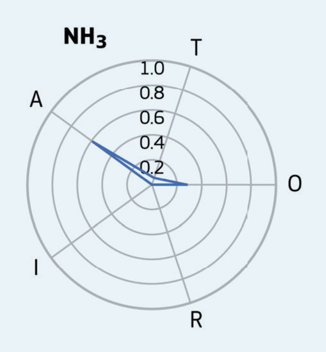
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

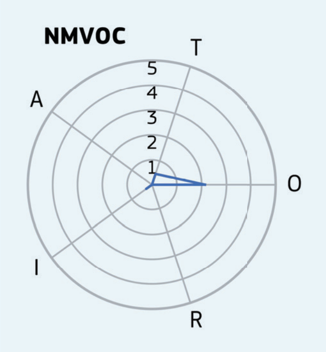


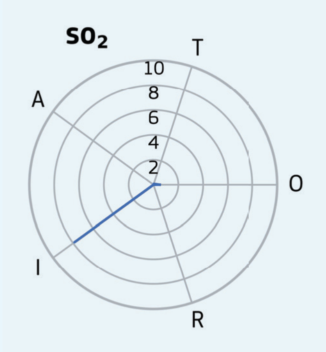
Emissions [kton/year]



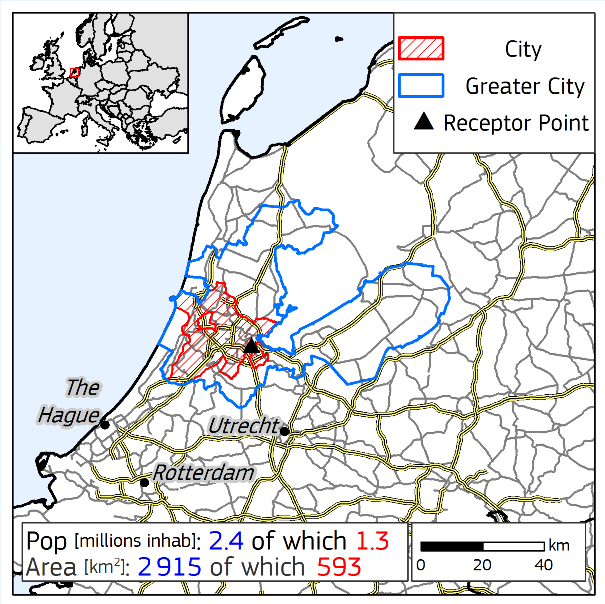




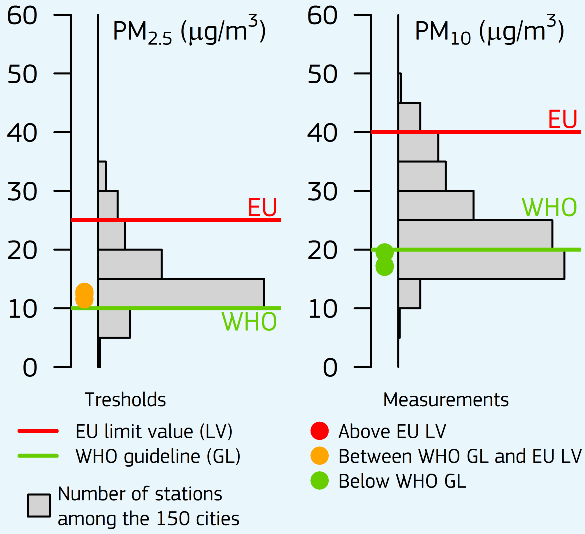




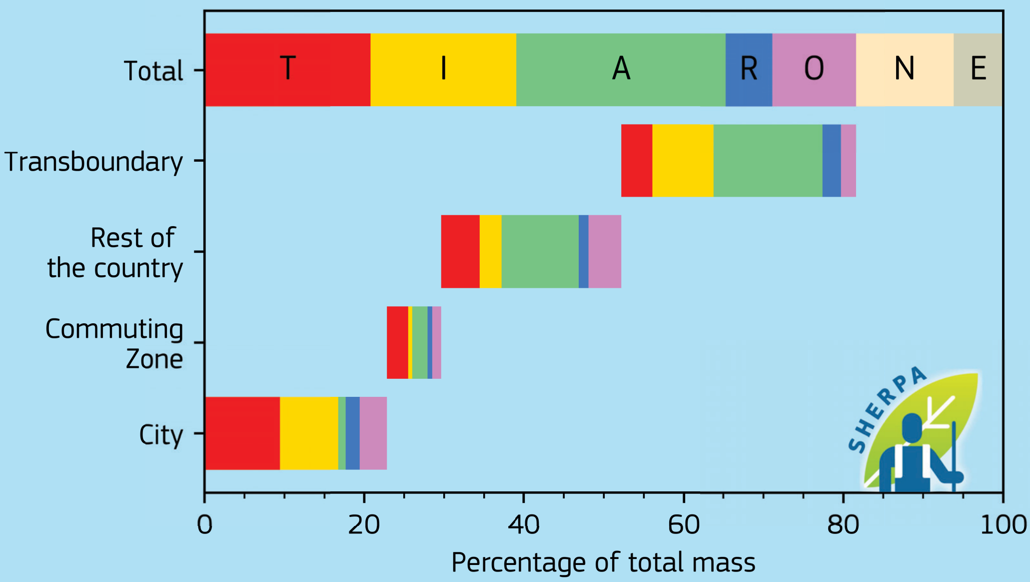
Netherlands, Amsterdam



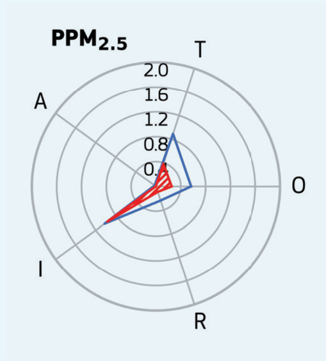
Yearly average urban background (2015)

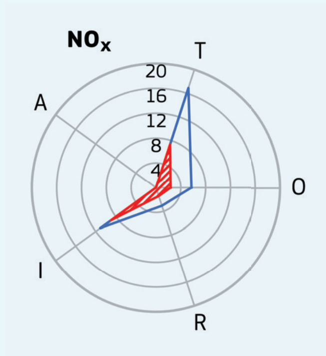


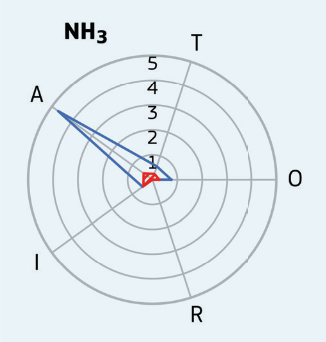
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

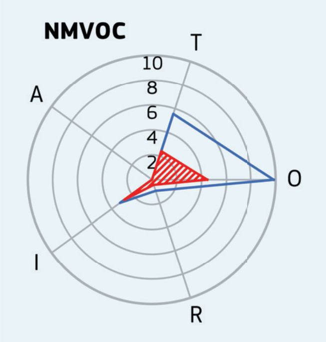


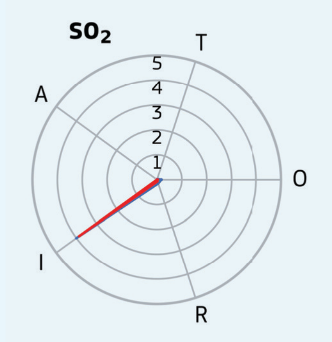
Emissions [kton/year]



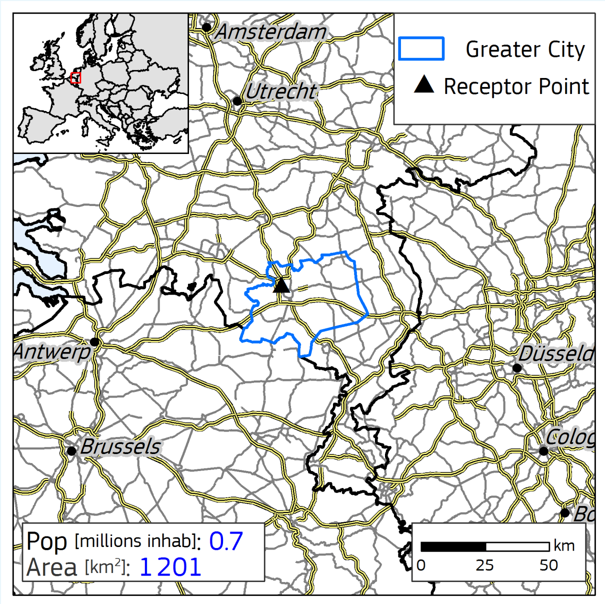




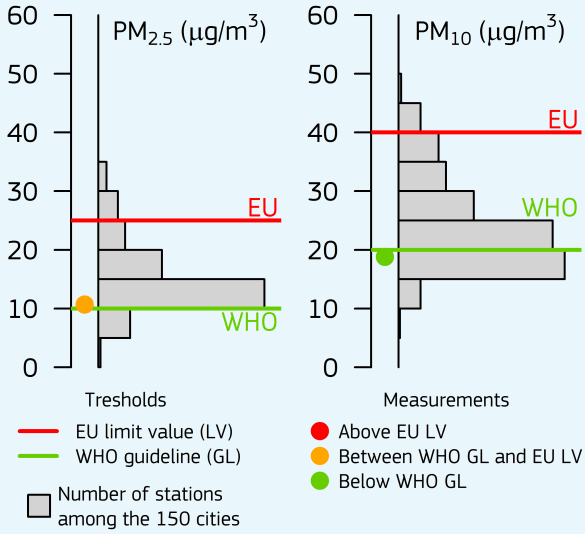




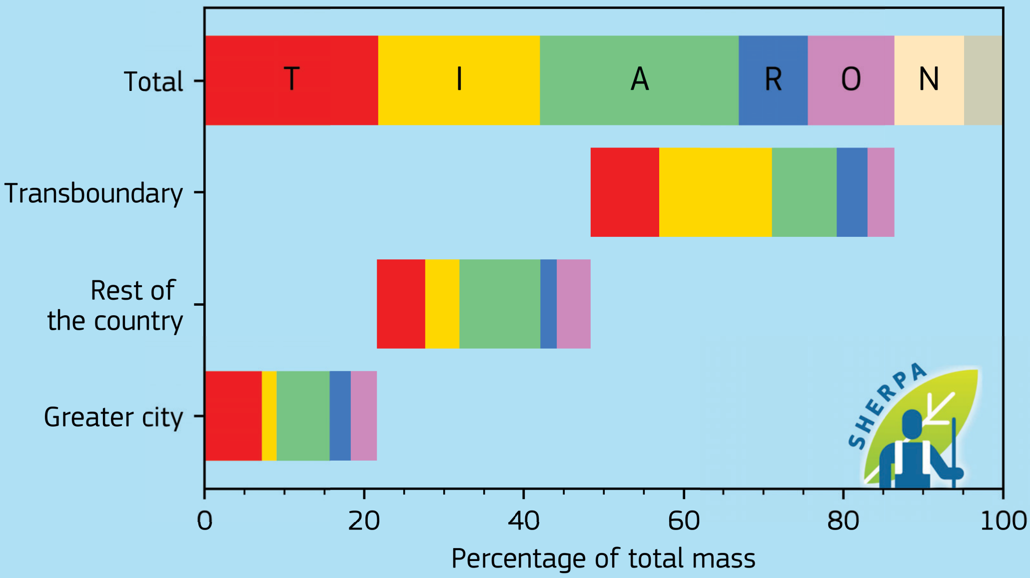
Netherlands, Eindhoven



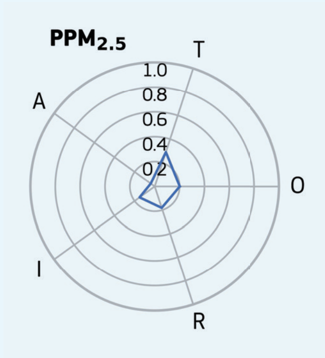
Yearly average urban background (2015)

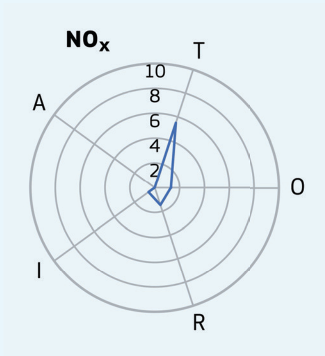


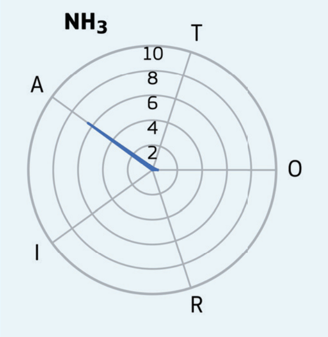
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

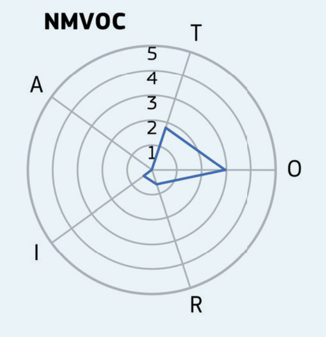


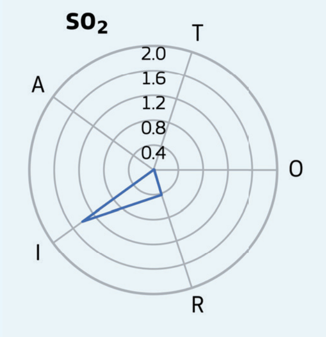
Emissions [kton/year]



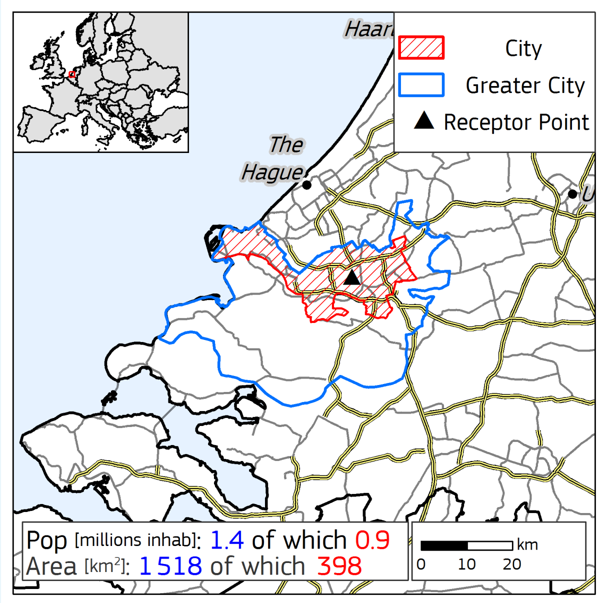




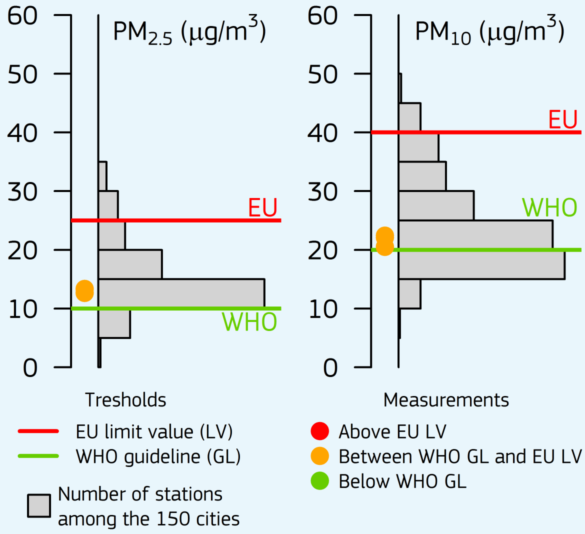




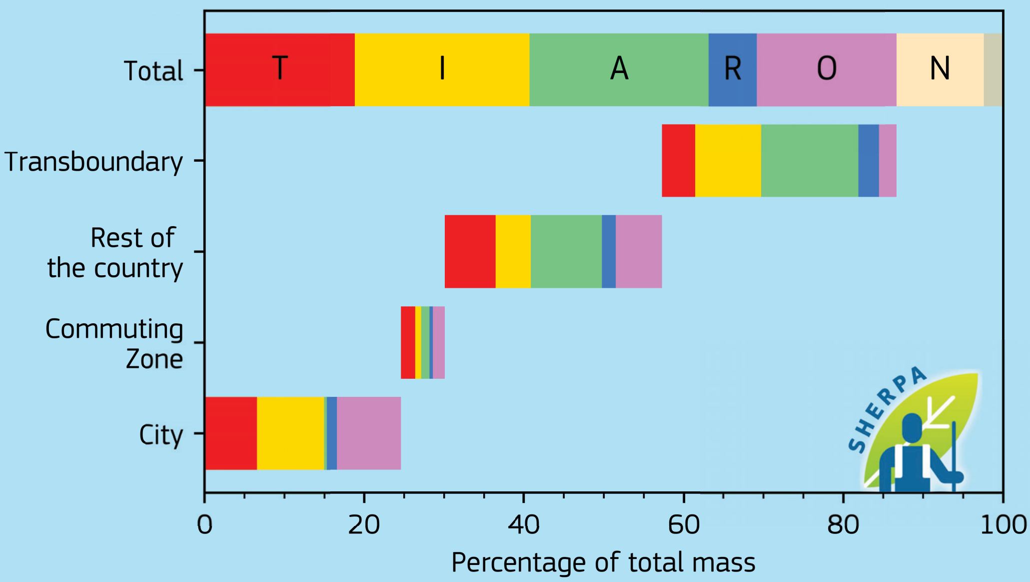
Netherlands, Rotterdam



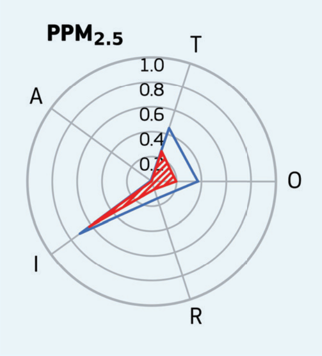
Yearly average urban background (2015)

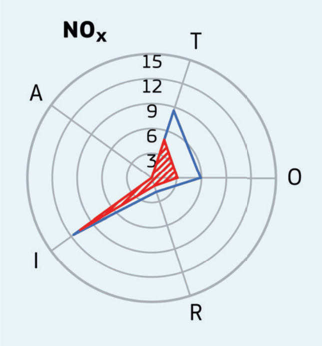


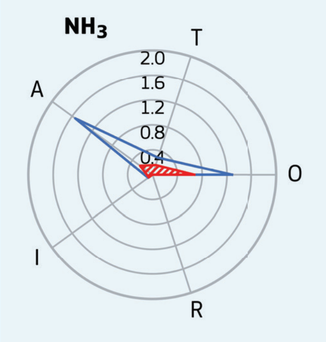
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

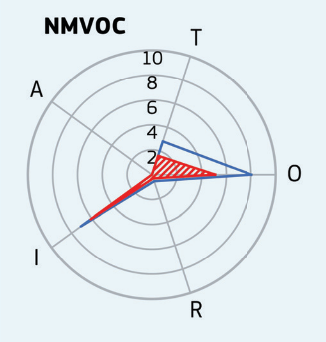


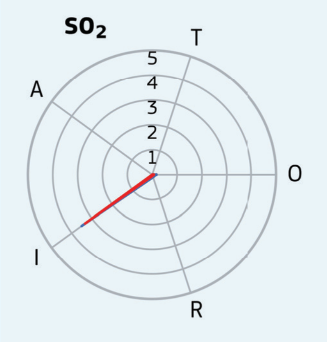
Emissions [kton/year]



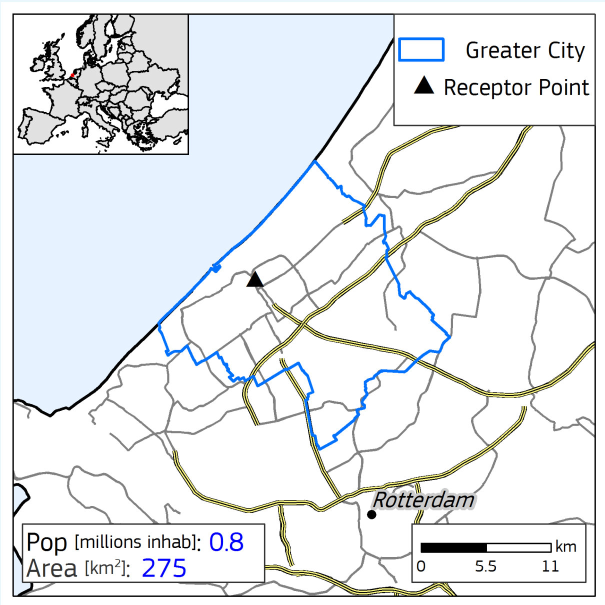




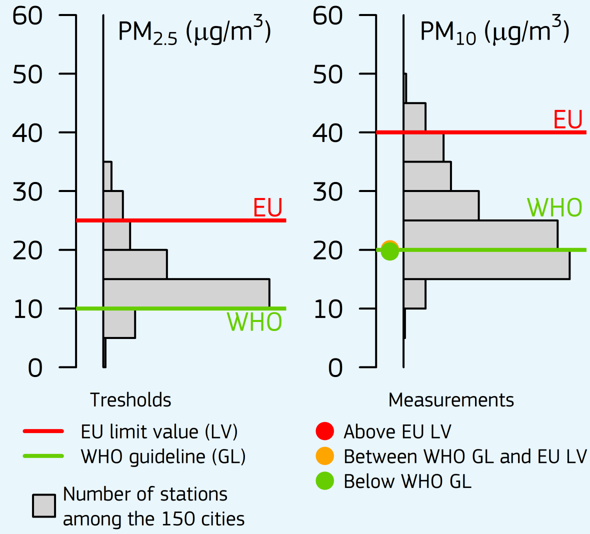




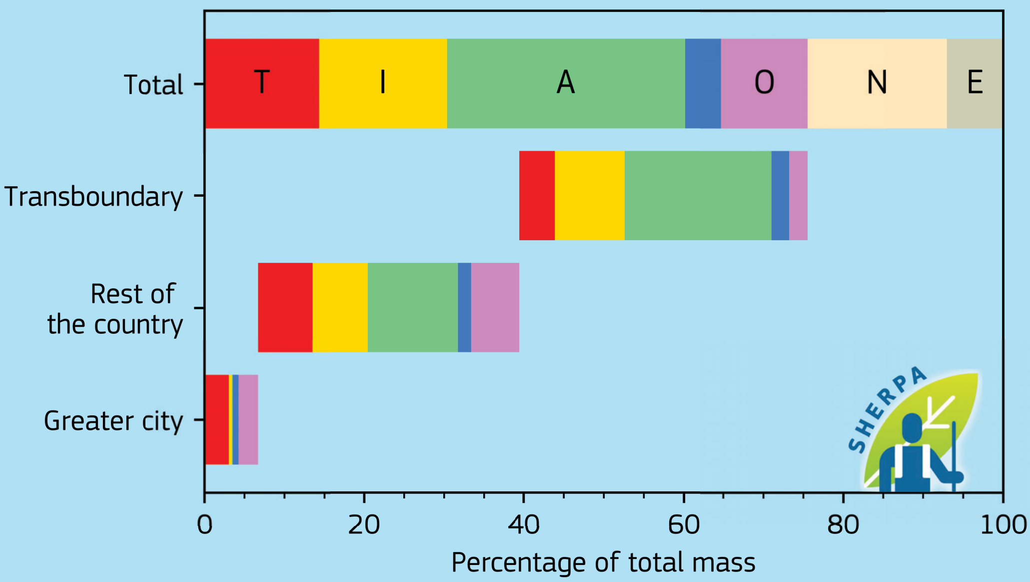
Netherlands, The Hague



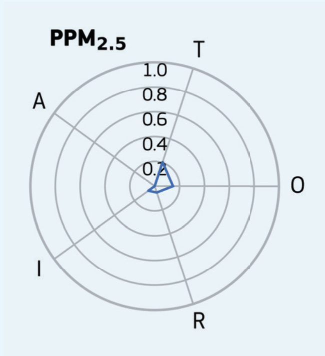
Yearly average urban background (2015)

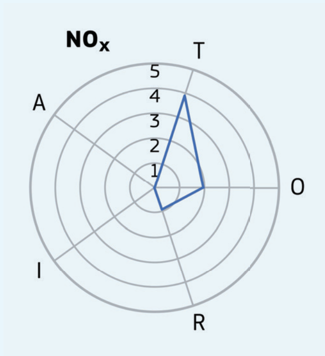


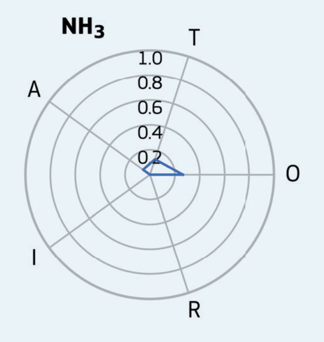
PM2.5 Spatial and sectoral allocation (SHERPA v.1.9)

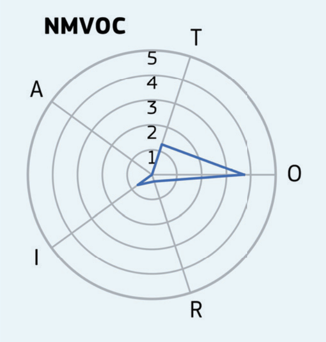


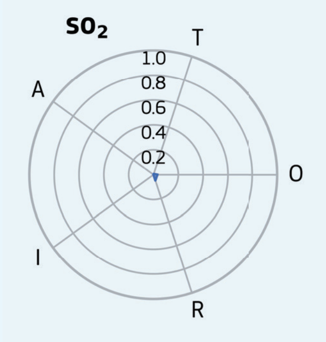
Emissions [kton/year]



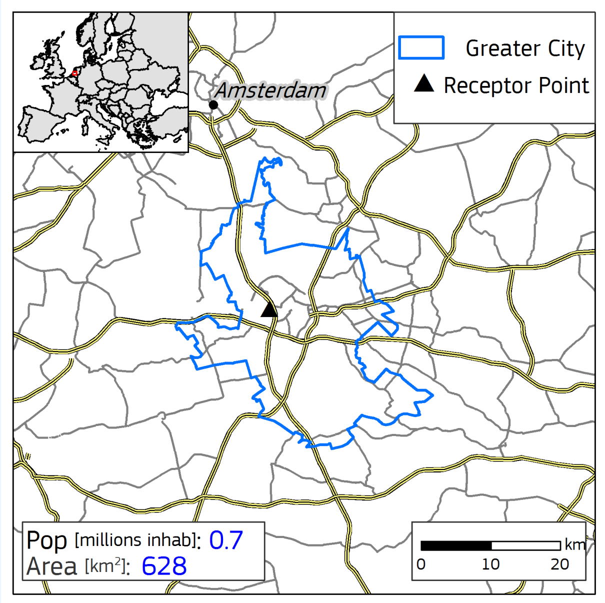




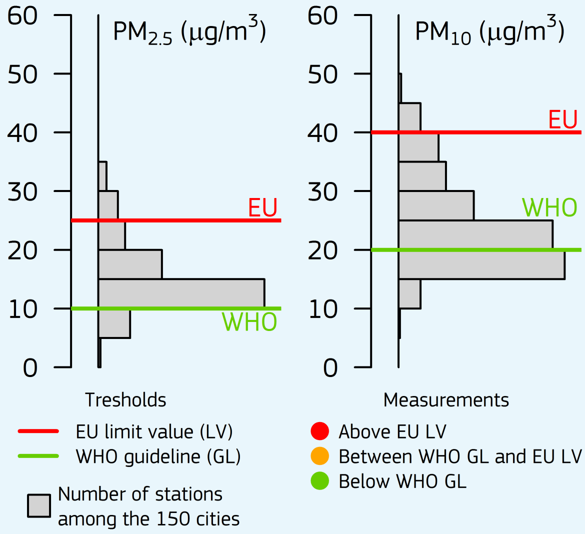




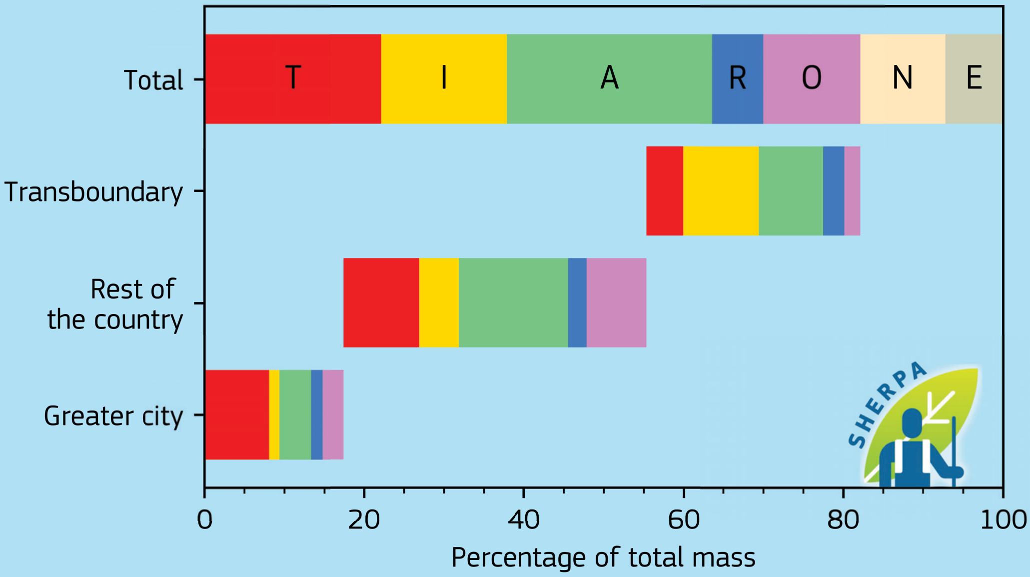
Netherlands, Utrecht



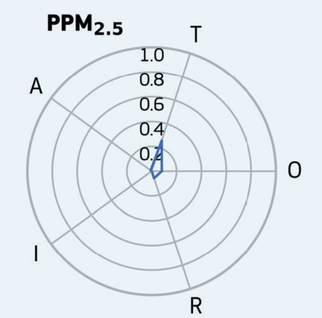
Yearly average urban background (2015)

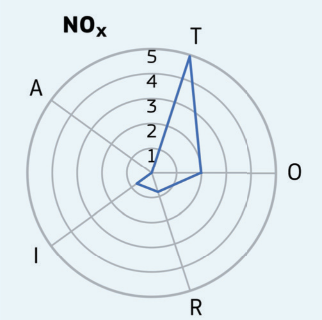


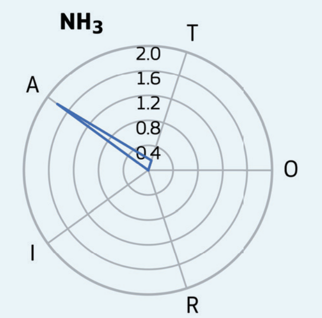
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

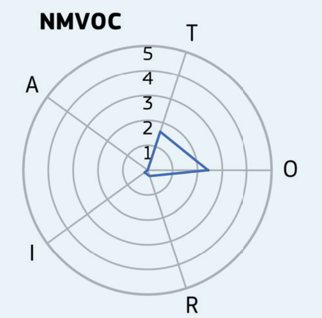


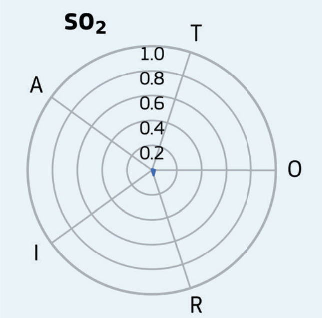
Emissions [kton/year]











T - Transport
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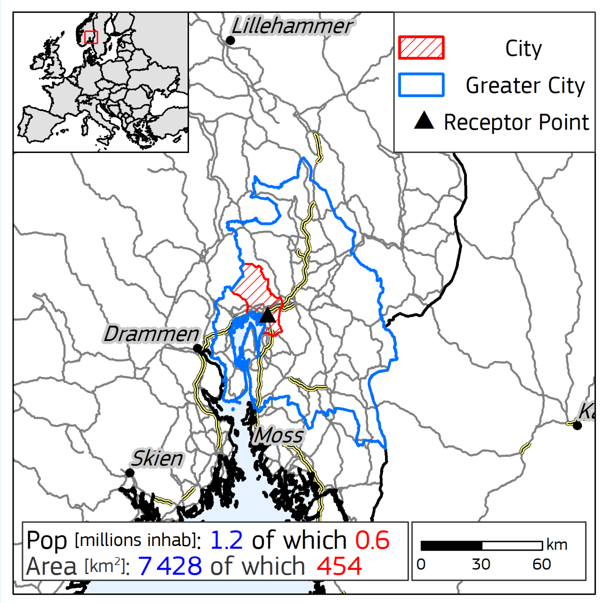
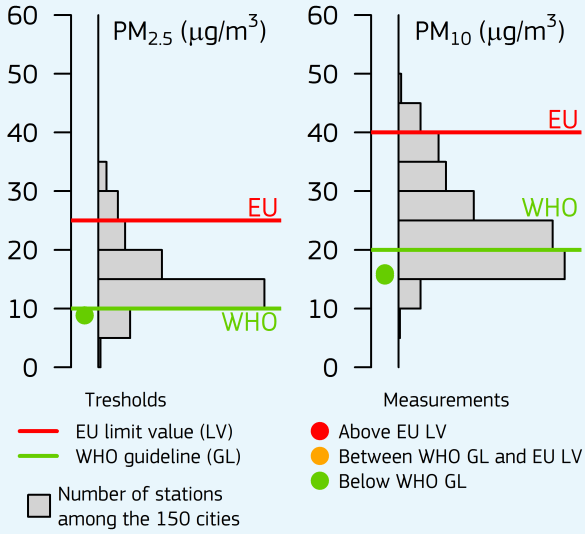
E - External
Greater city

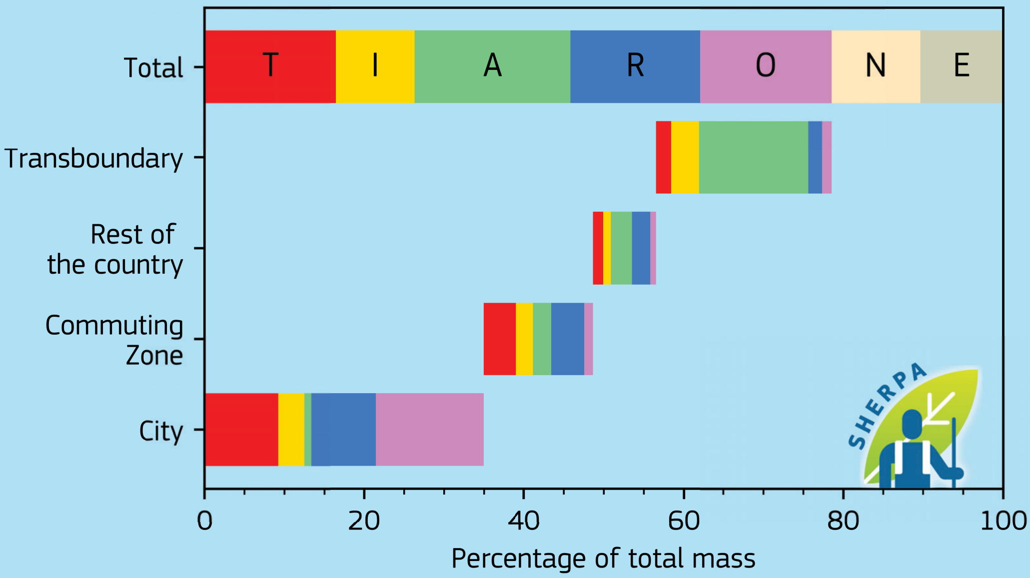
Norway, Oslo



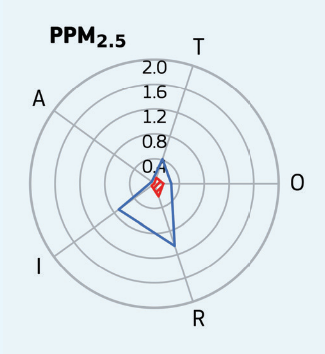
Yearly average urban background (2015)

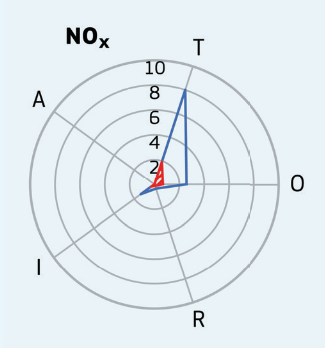


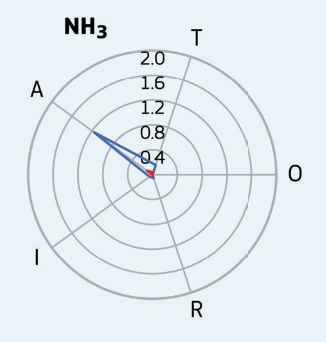
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

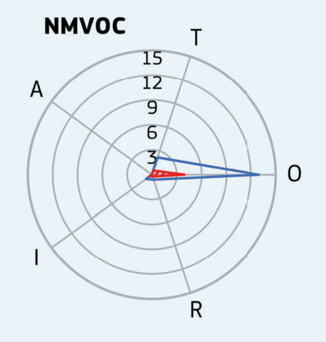


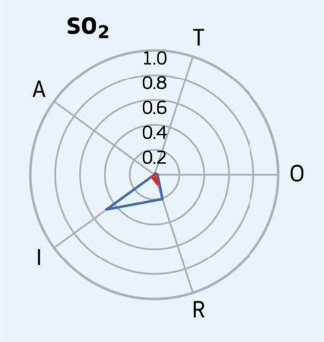
Emissions [kton/year]



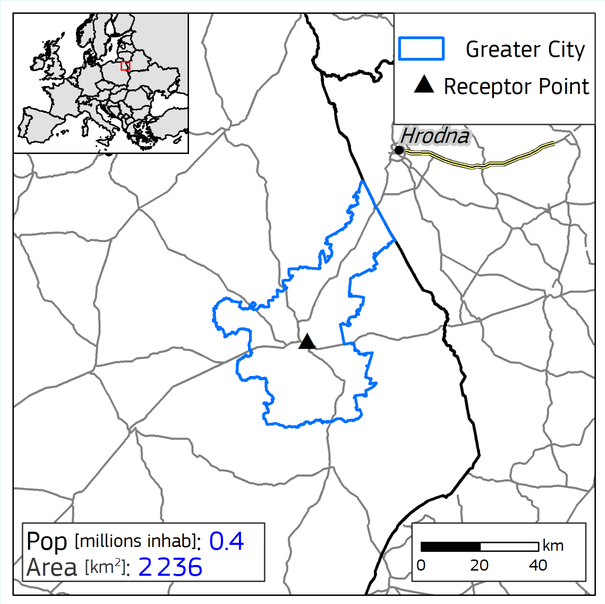




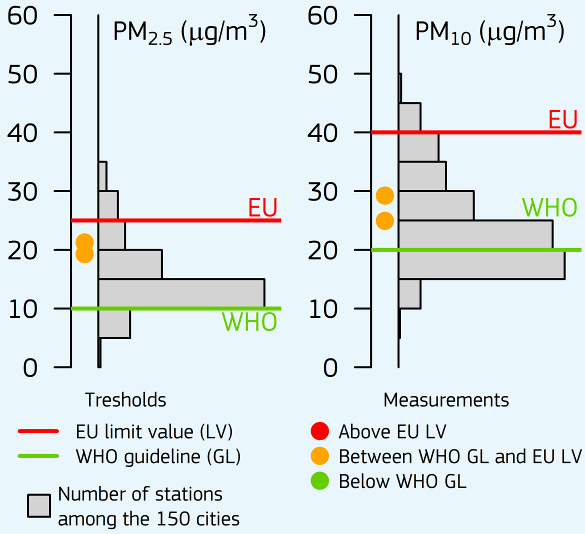




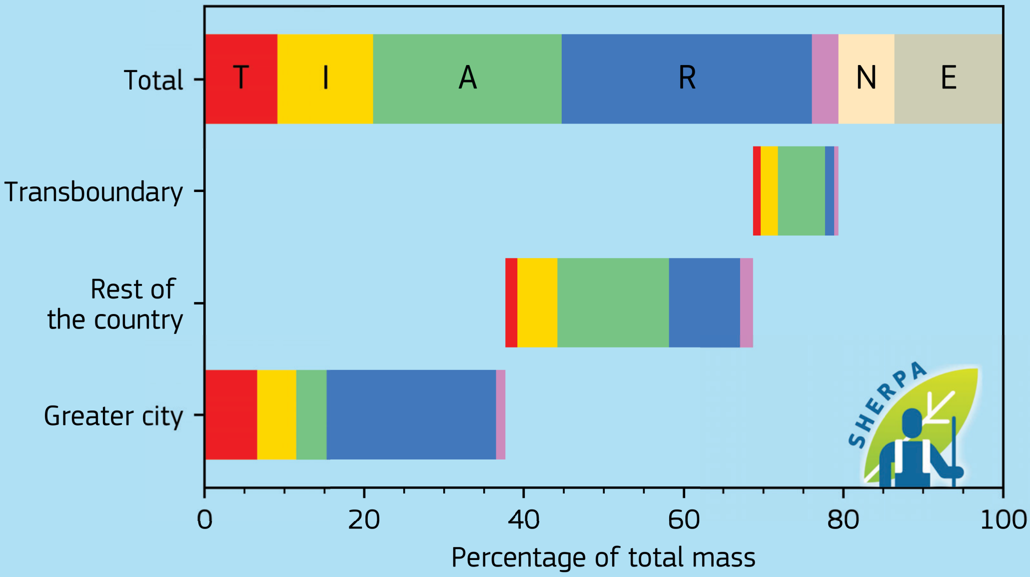
Poland, Białystok



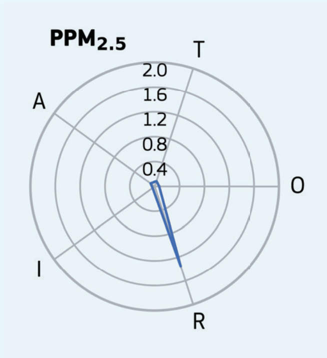
Yearly average urban background (2015)

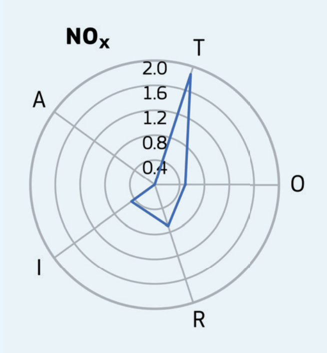


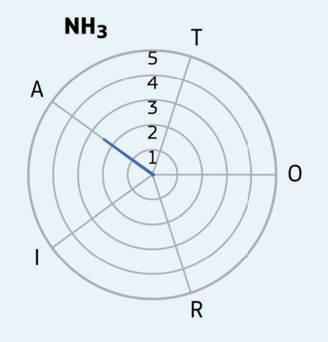
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

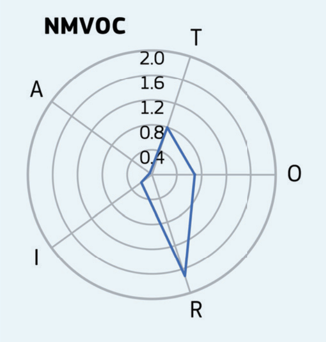


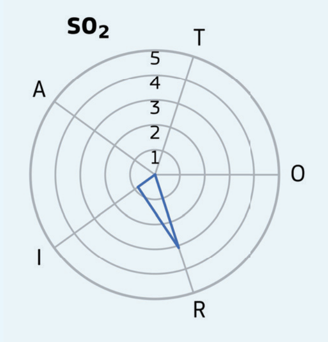
Emissions [kton/year]



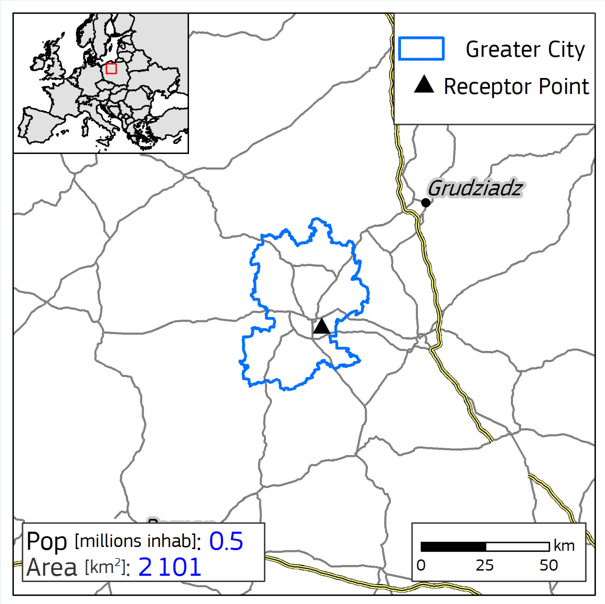




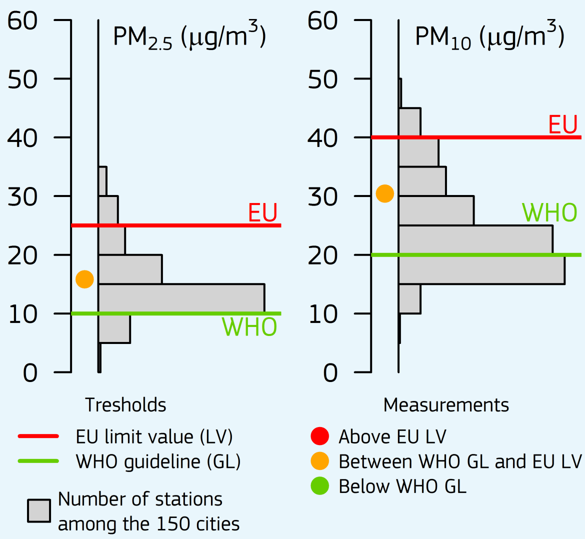




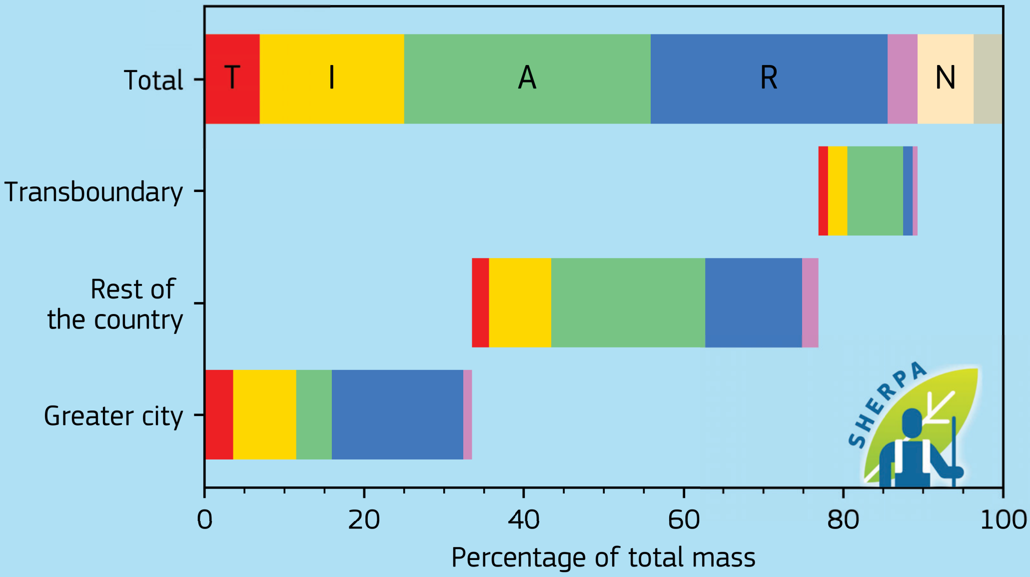
Poland, Bydgoszcz



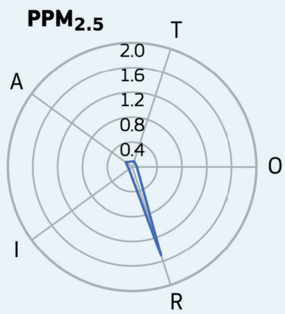
Yearly average urban background (2015)

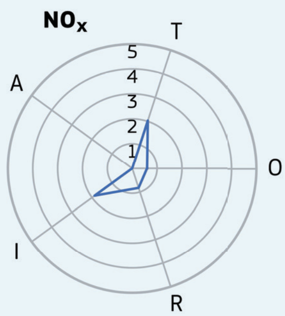


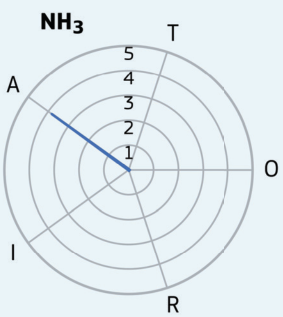
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

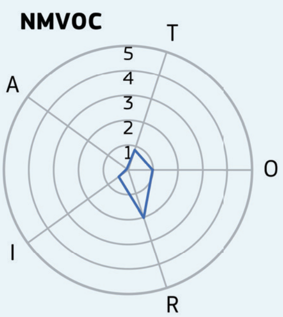


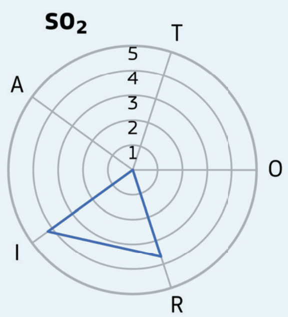
Emissions [kton/year]











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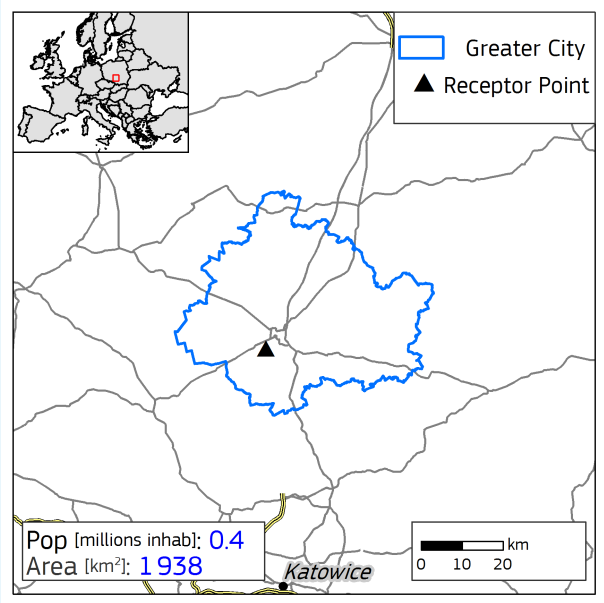
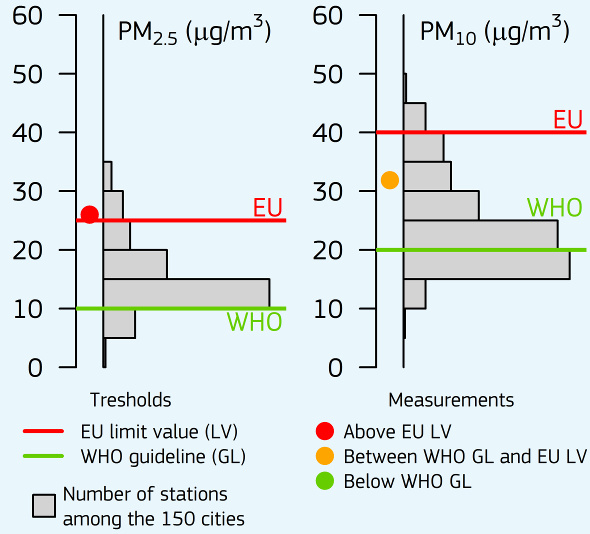
- E - External
- Greater city

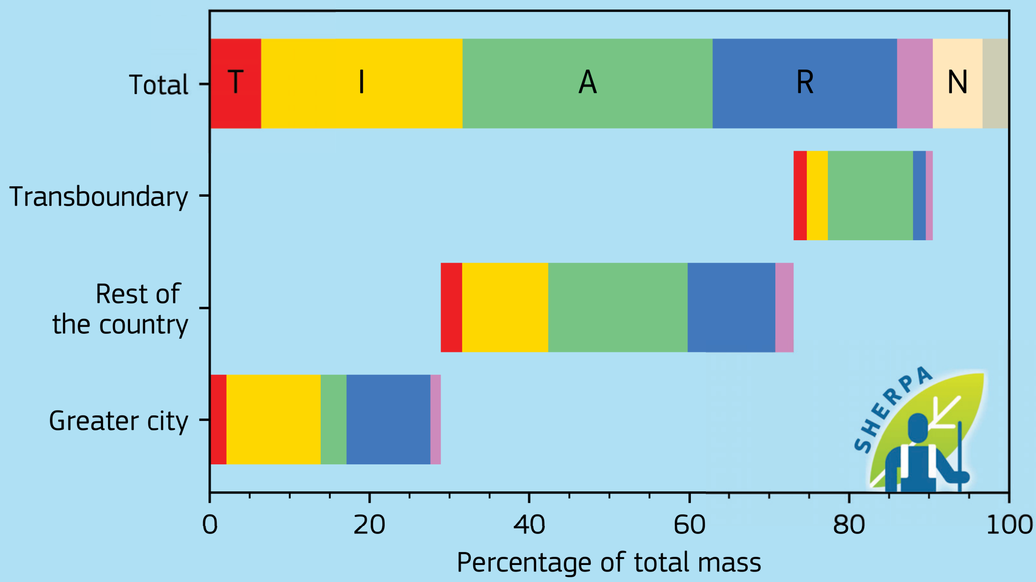
Poland, Częstochowa



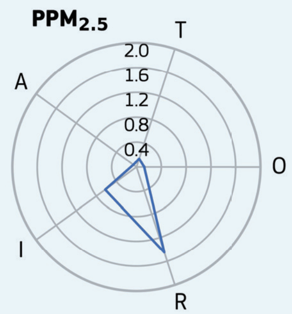
Yearly average urban background (2015)

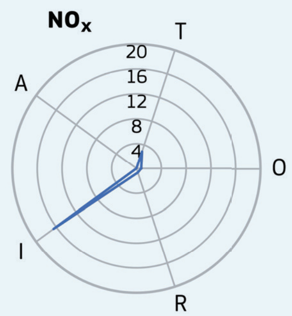


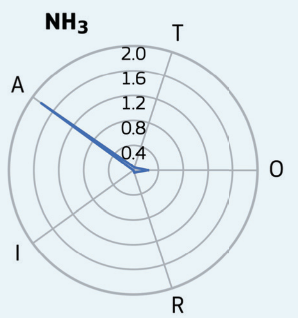
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

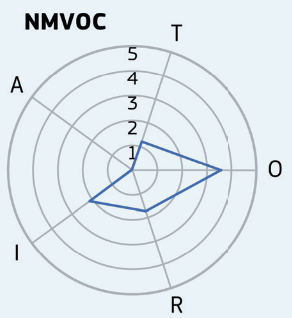


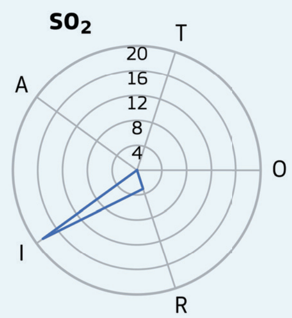
Emissions [kton/year]

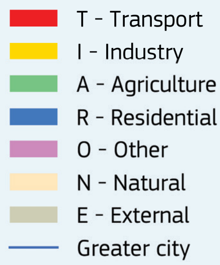




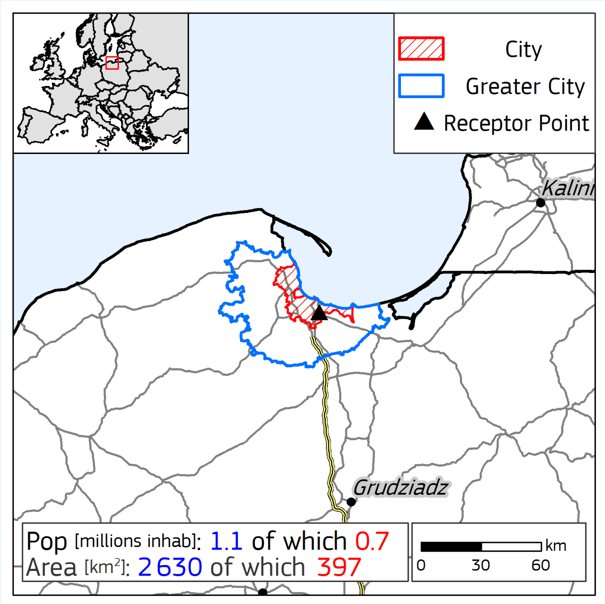




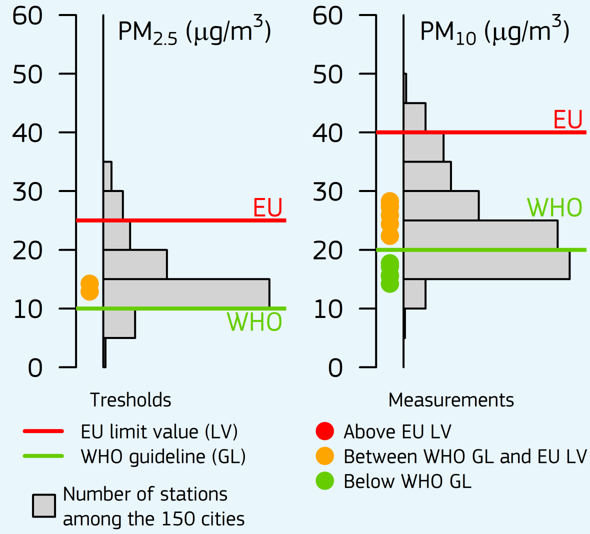




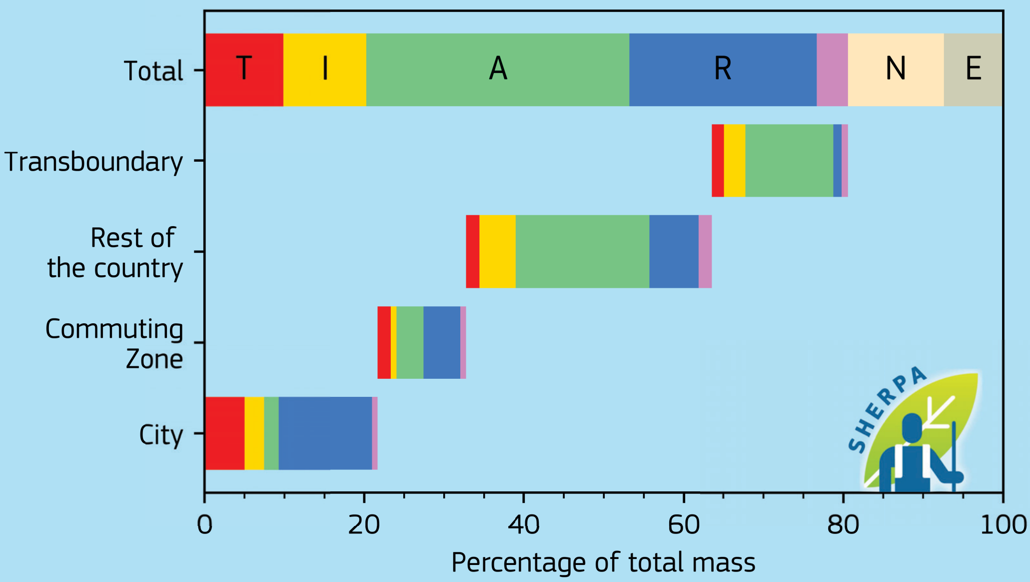
Poland, Gdańsk



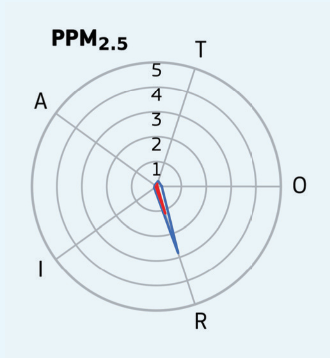
Yearly average urban background (2015)

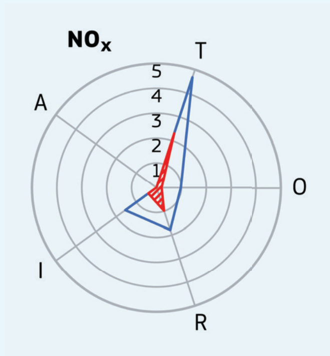


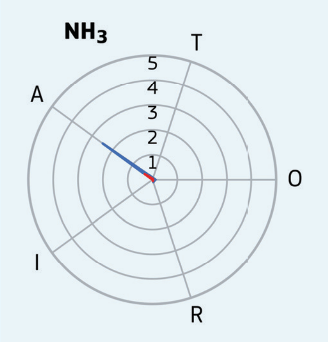
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

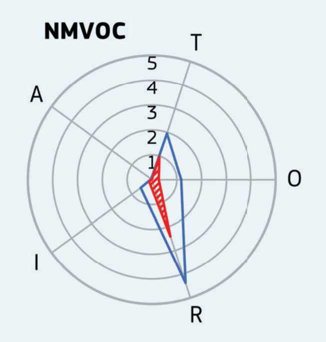


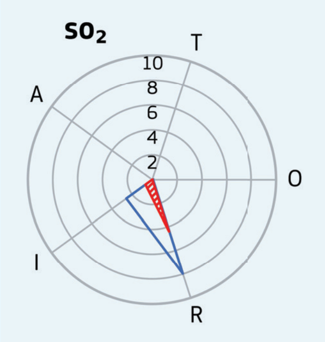
Emissions [kton/year]



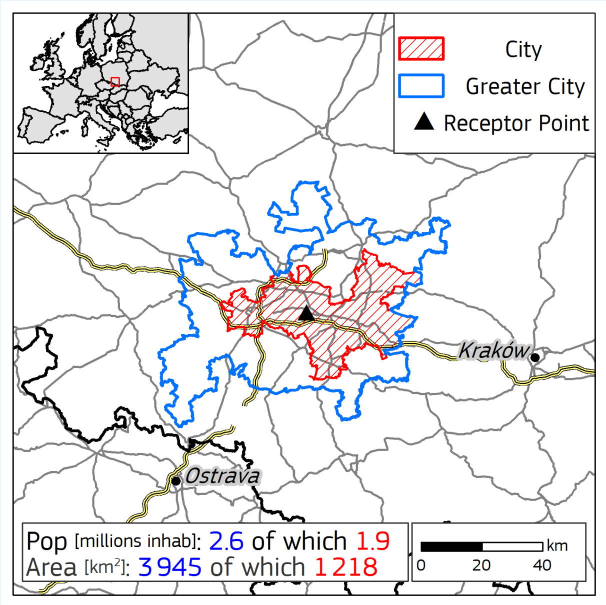




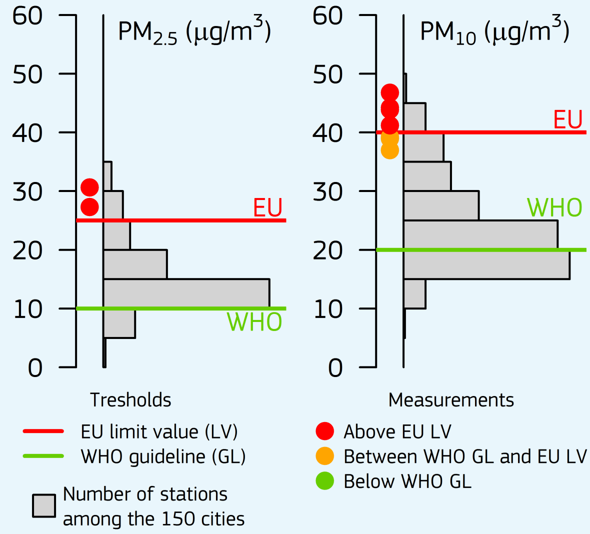




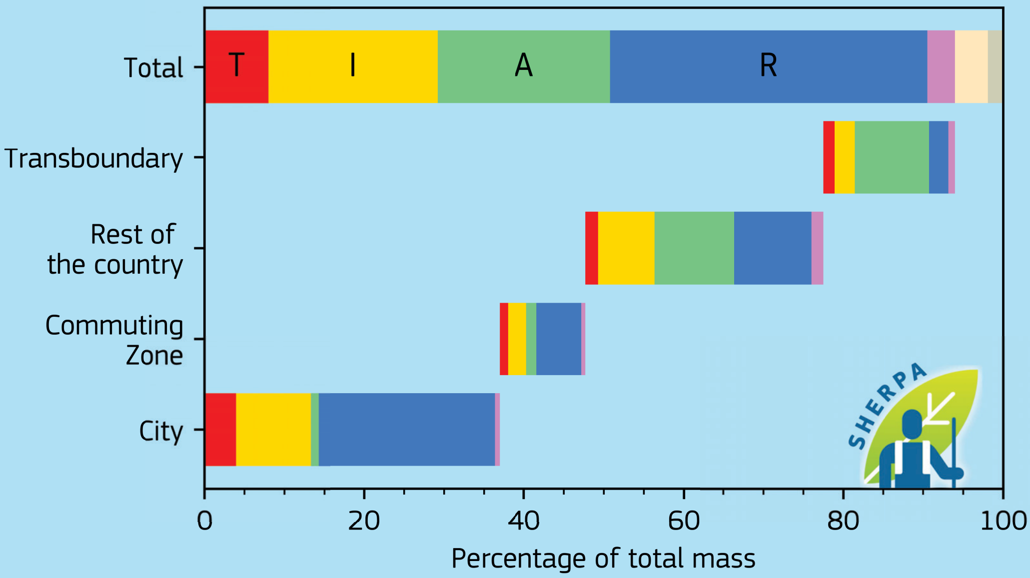
Poland, Katowice



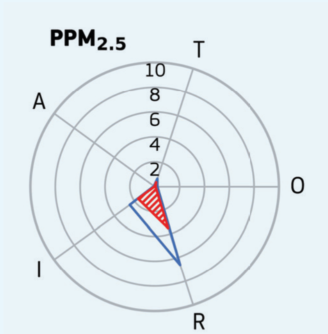
Yearly average urban background (2015)

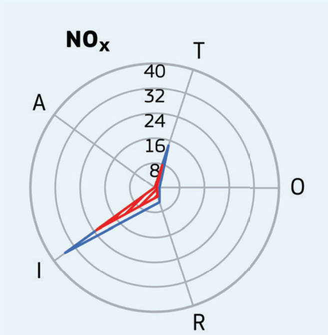


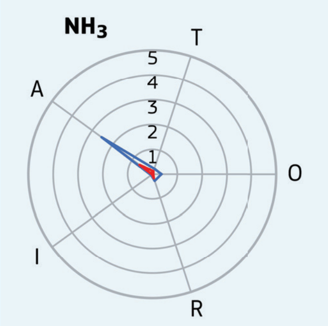
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

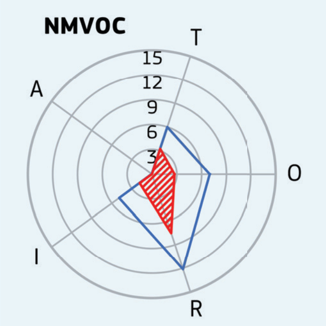


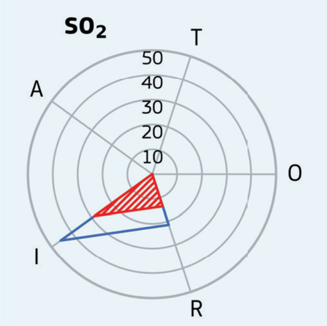
Emissions [kton/year]



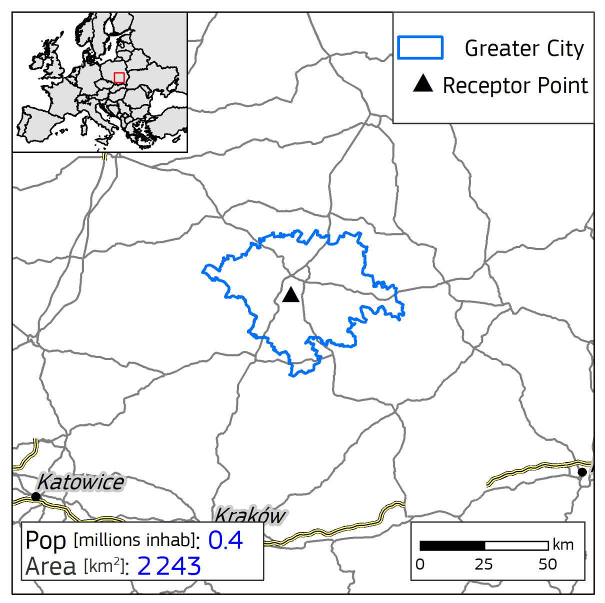




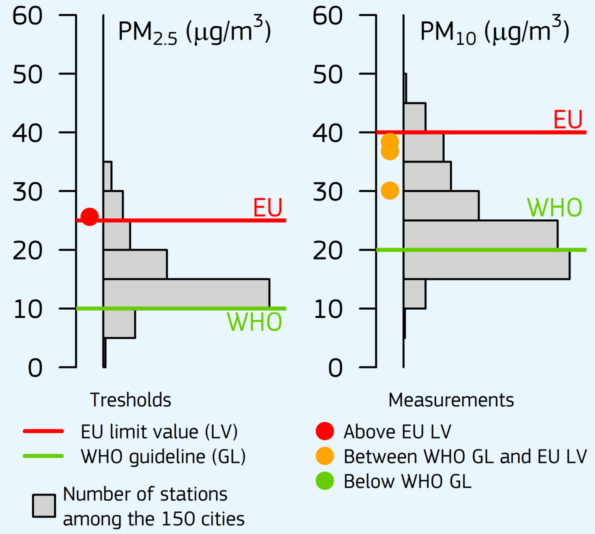




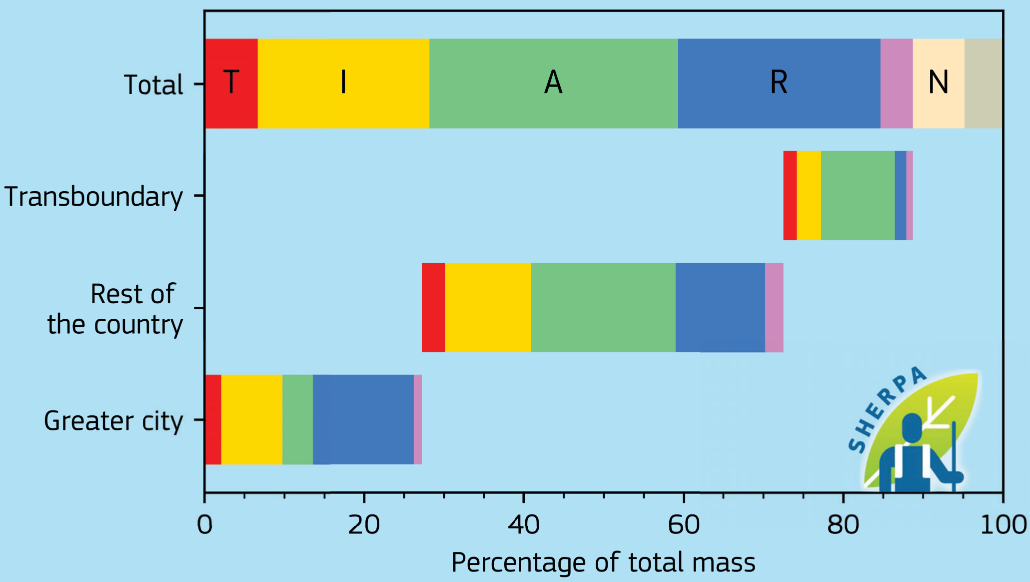
Poland, Kielce



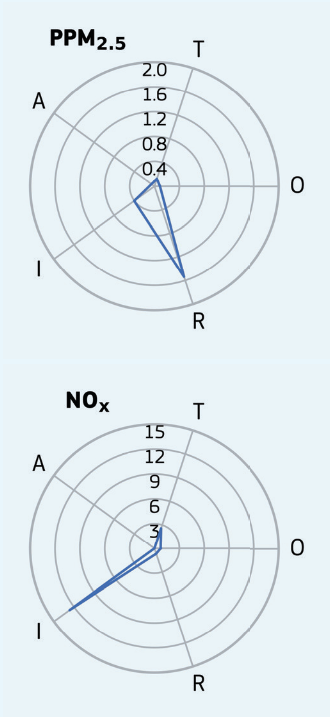
Yearly average urban background (2015)

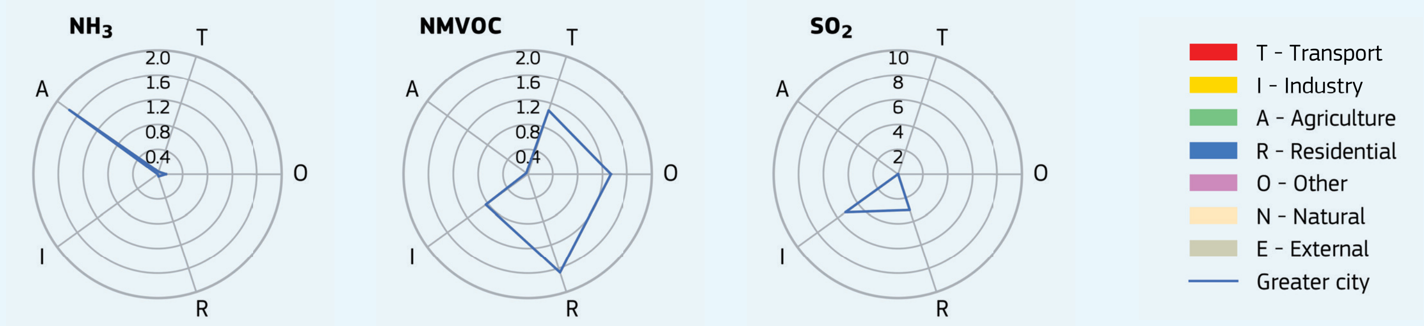


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

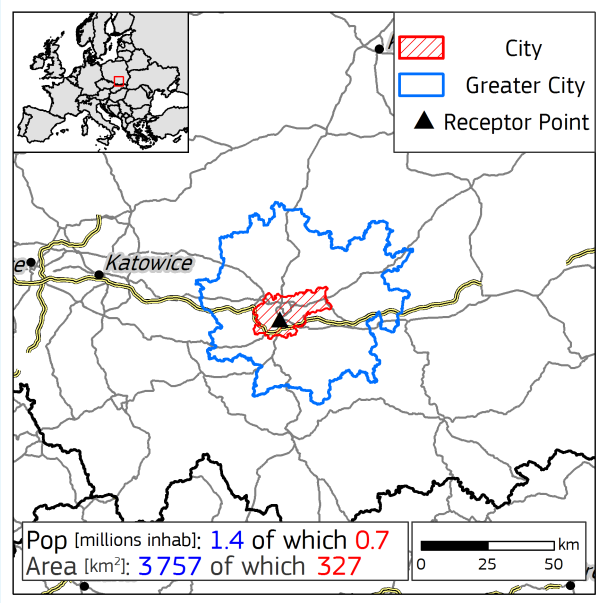


Emissions [kton/year]

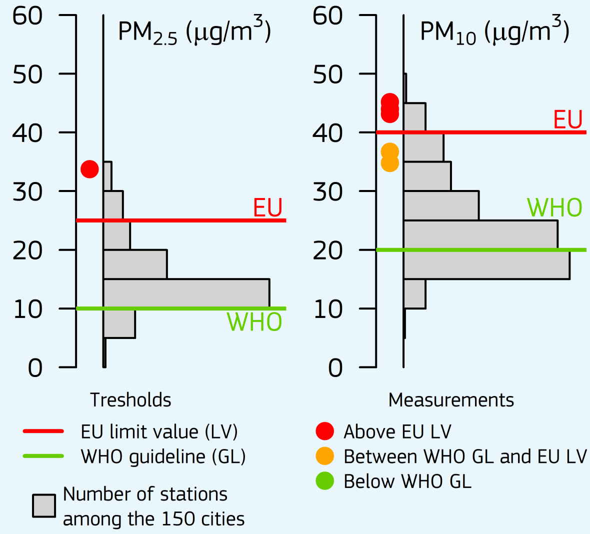




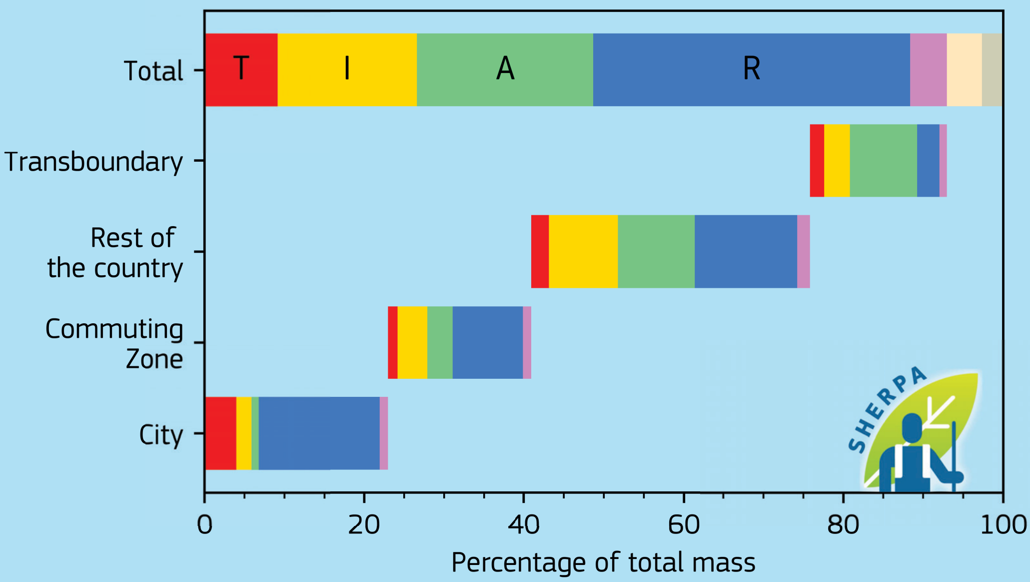
Poland, Kraków



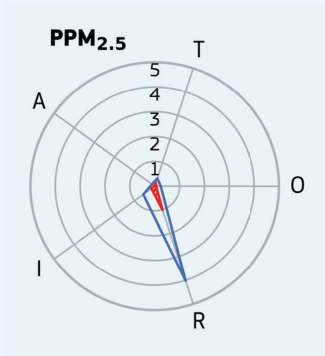
Yearly average urban background (2015)

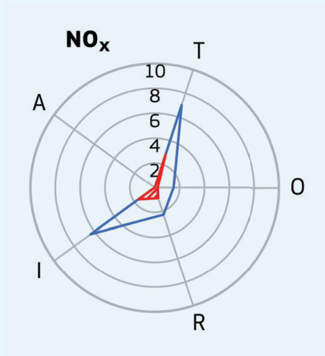


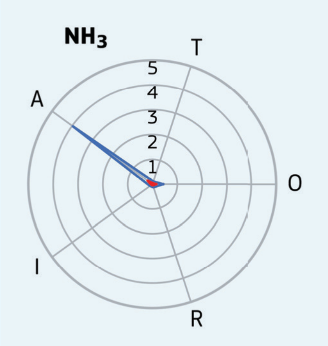
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

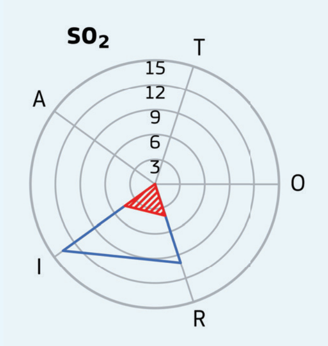


Emissions [kton/year]

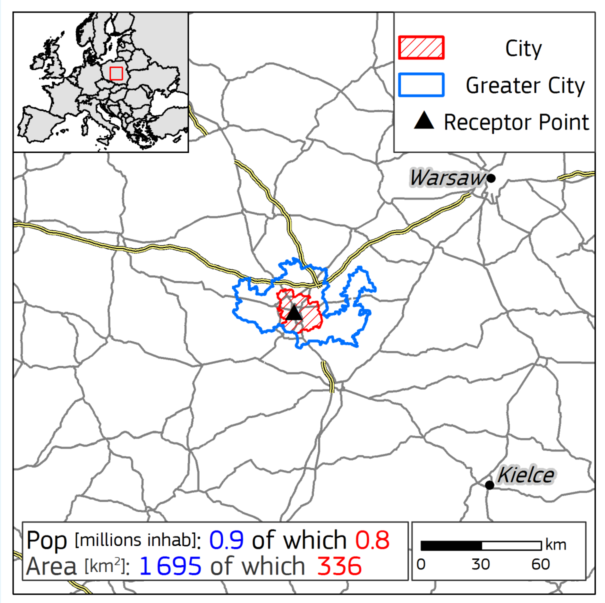




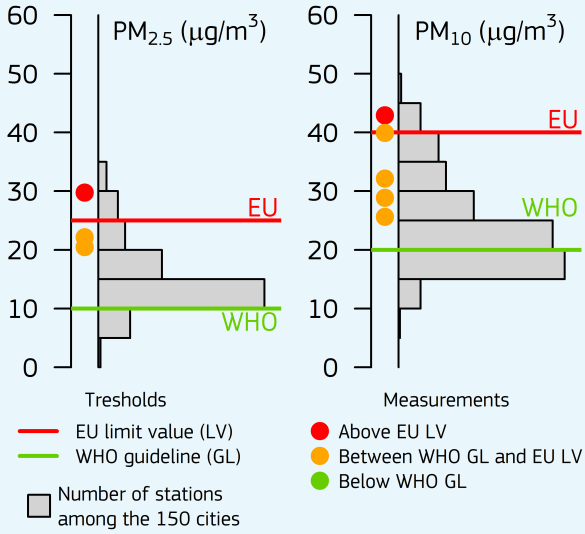




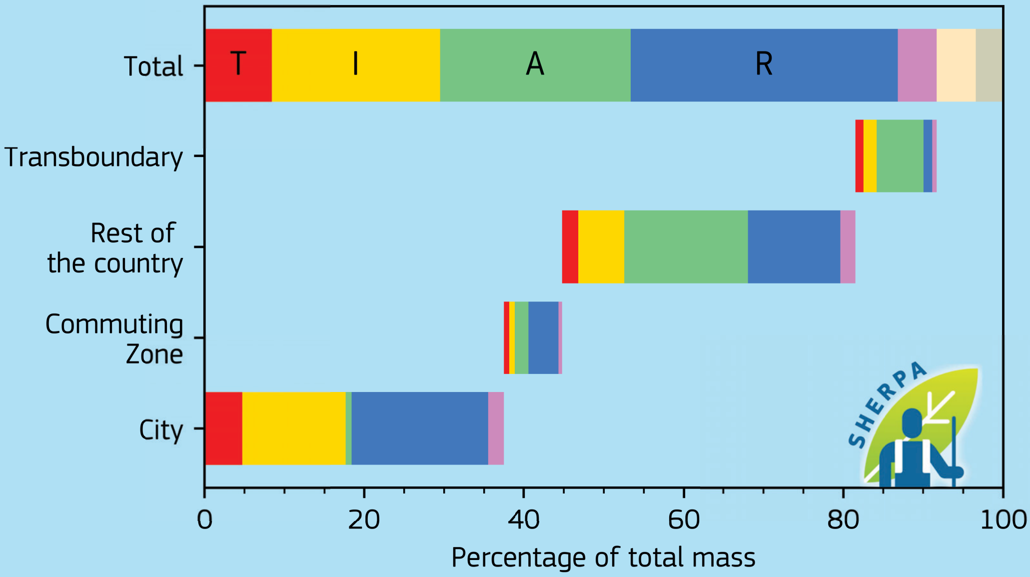
Poland, Łódź



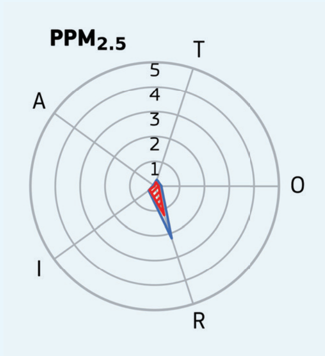
Yearly average urban background (2015)

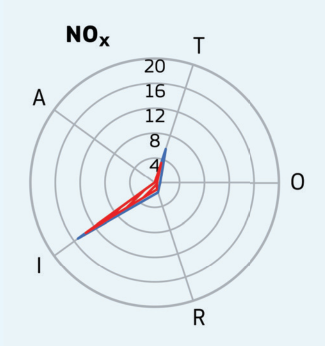


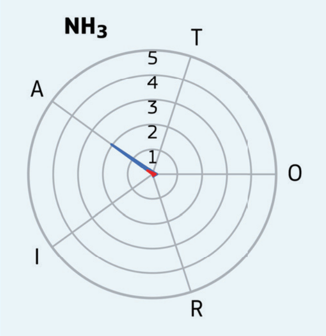
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

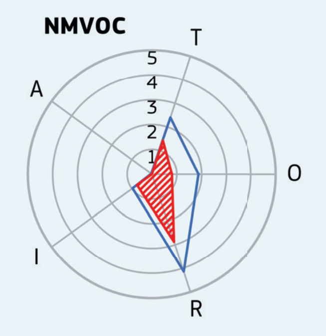


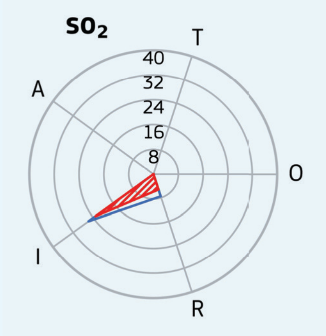
Emissions [kton/year]



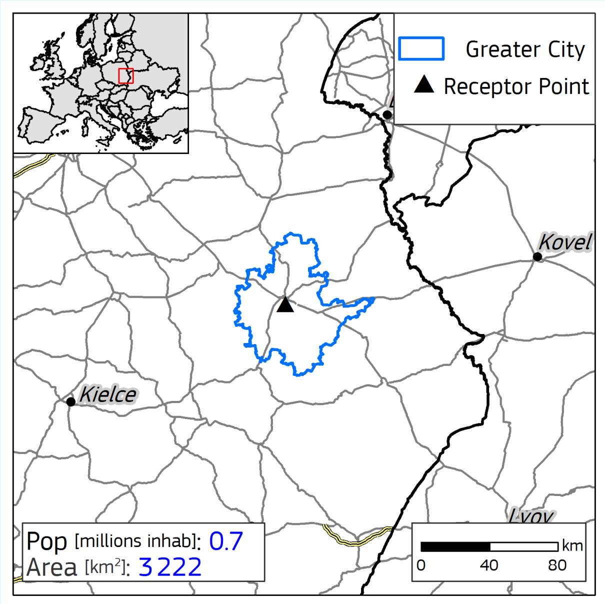




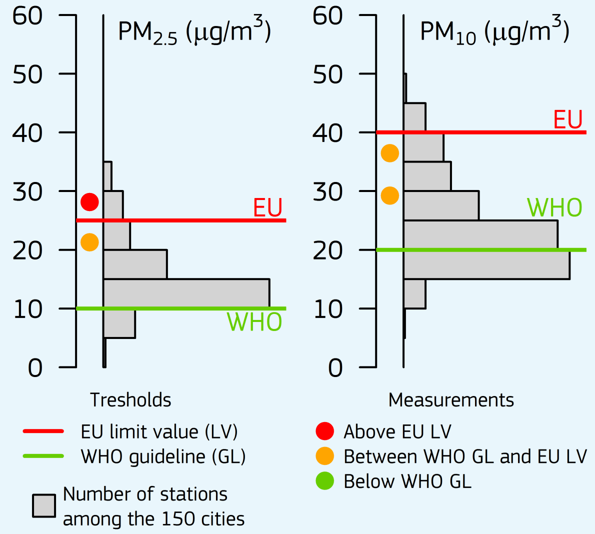




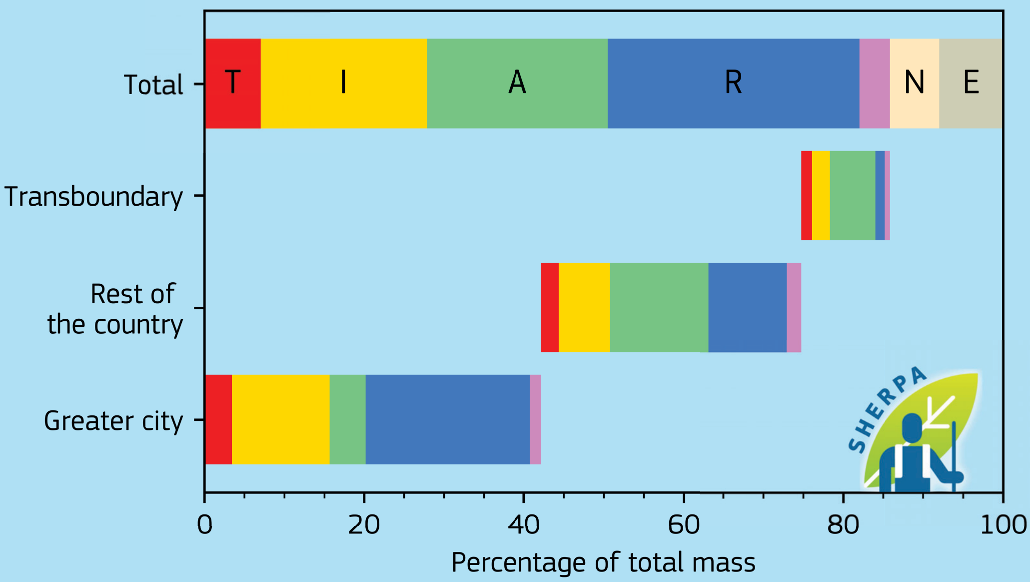
Poland, Lublin



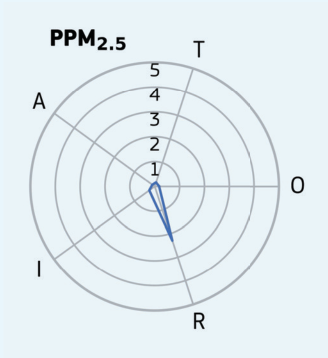
Yearly average urban background (2015)

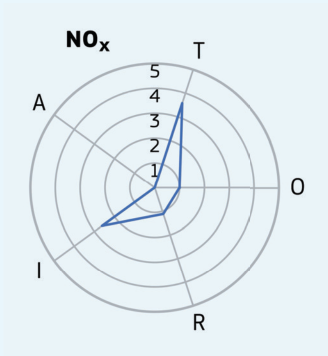


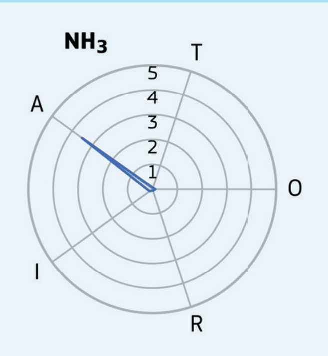
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

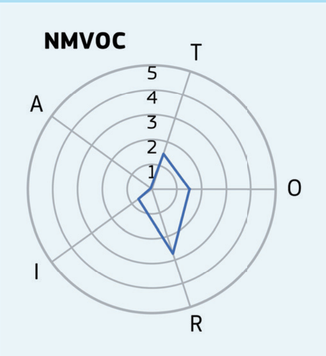


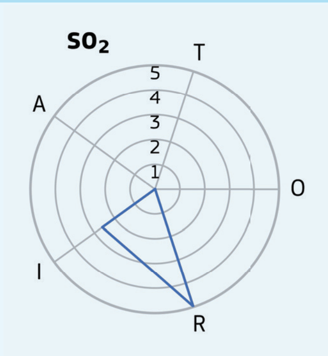
Emissions [kton/year]



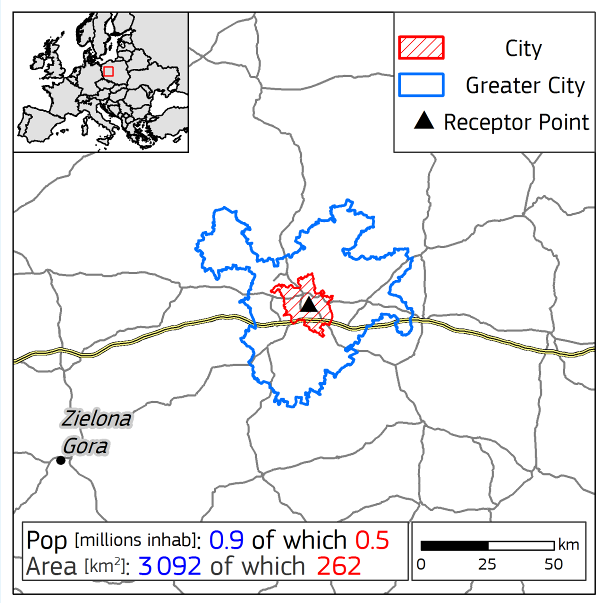




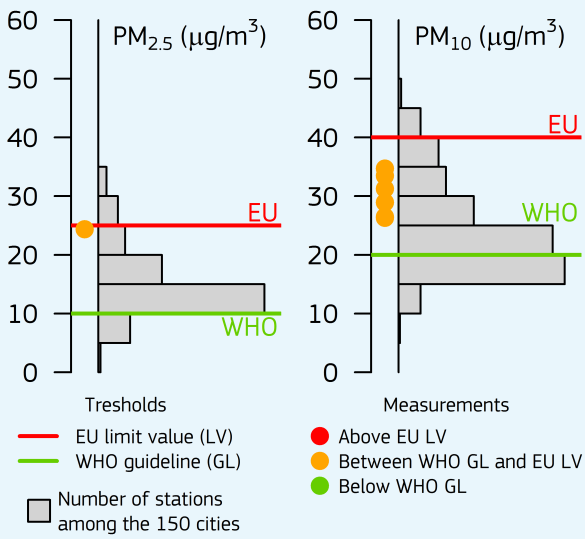




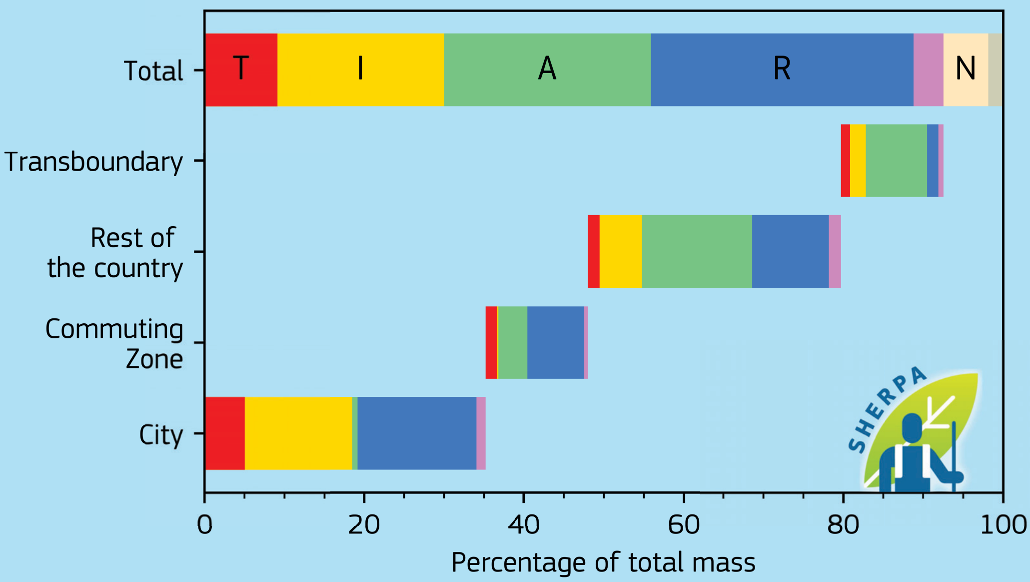
Poland, Poznań



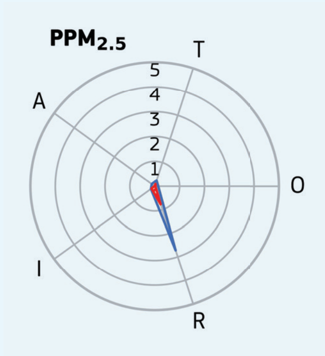
Yearly average urban background (2015)

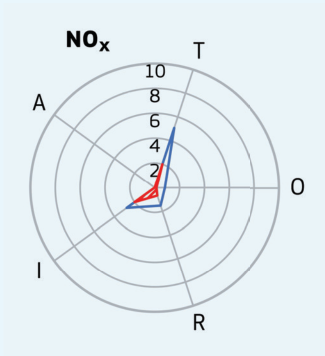


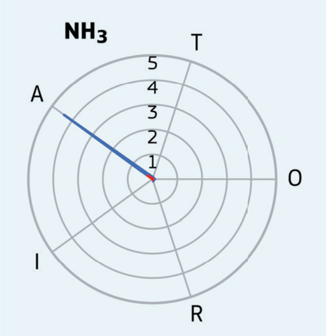
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

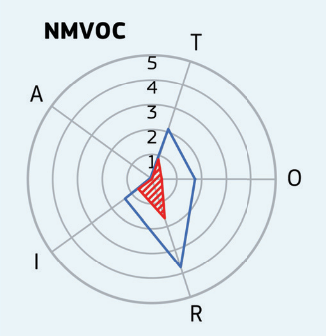


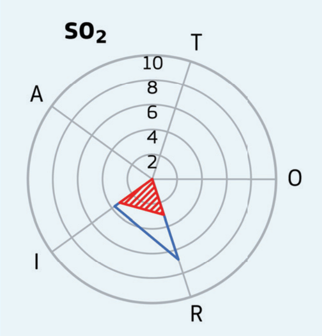
Emissions [kton/year]



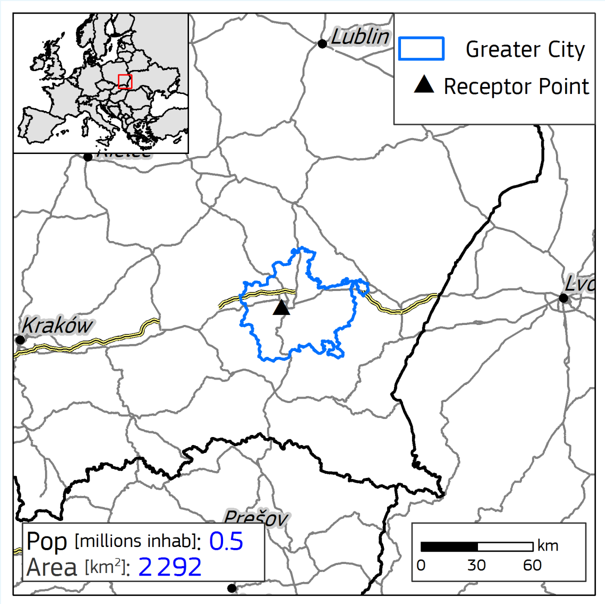




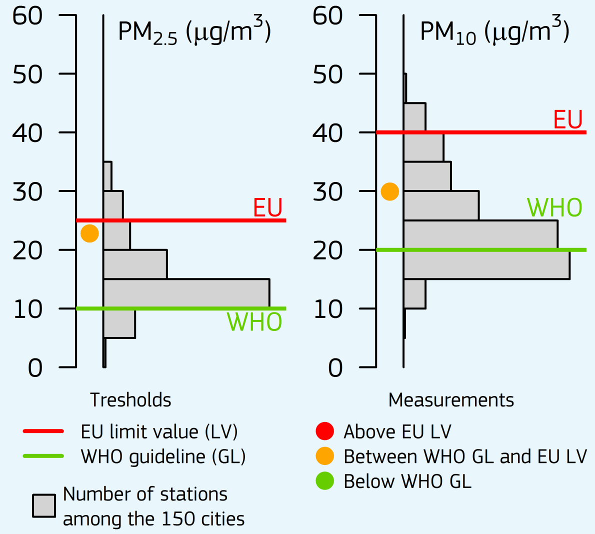




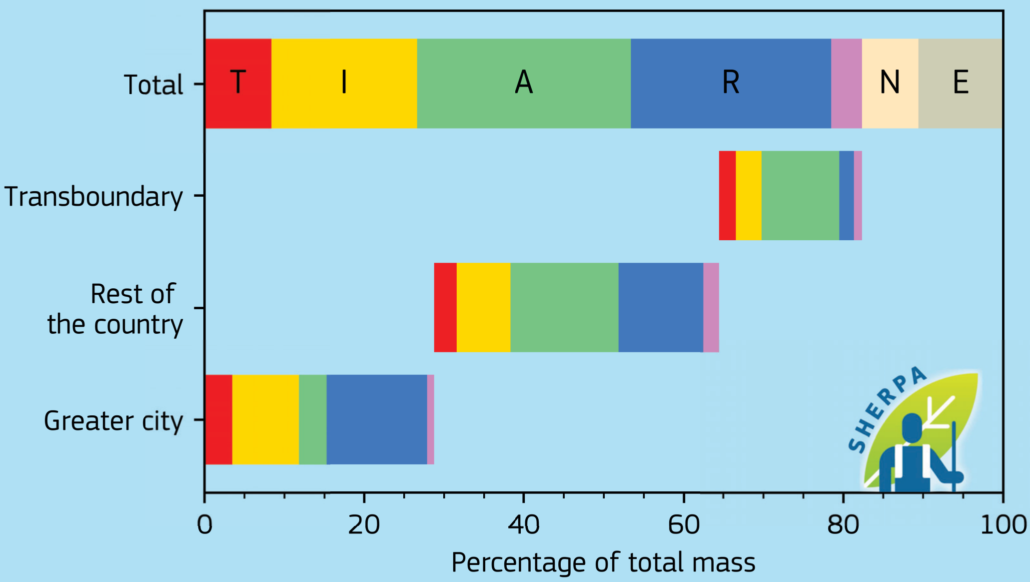
Poland, Rzeszów



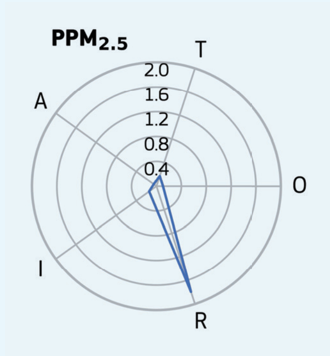
Yearly average urban background (2015)

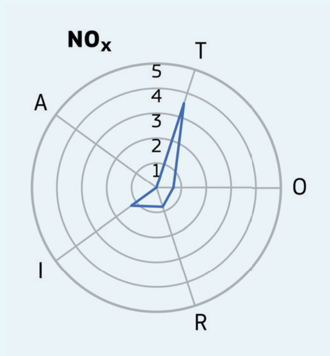


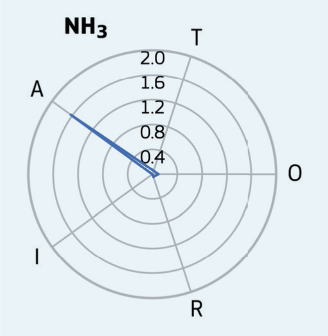
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

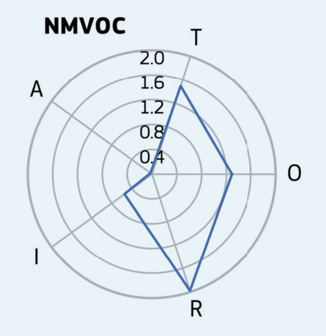


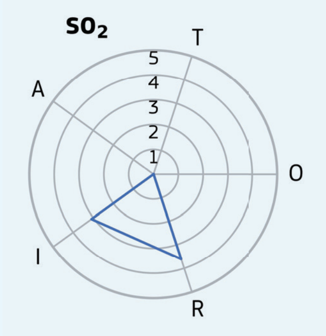
Emissions [kton/year]



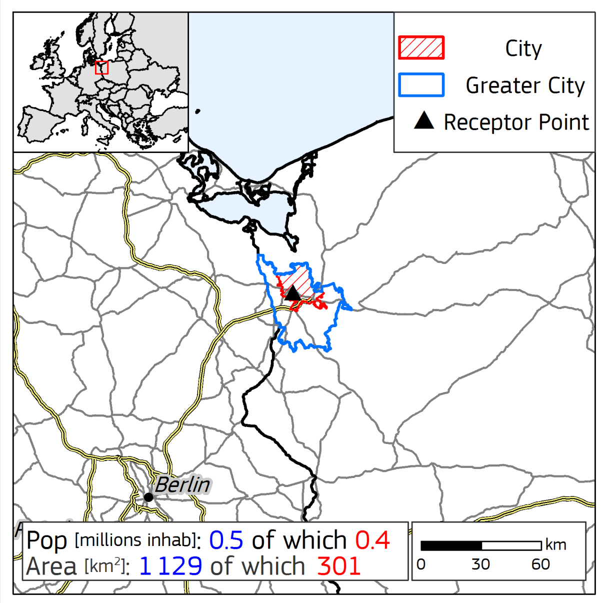




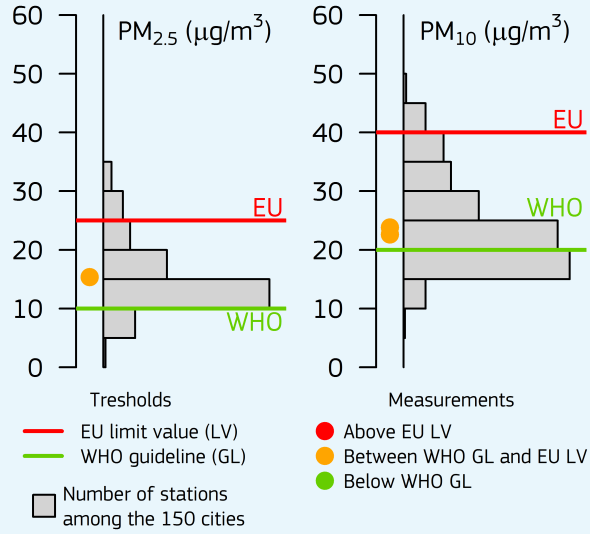




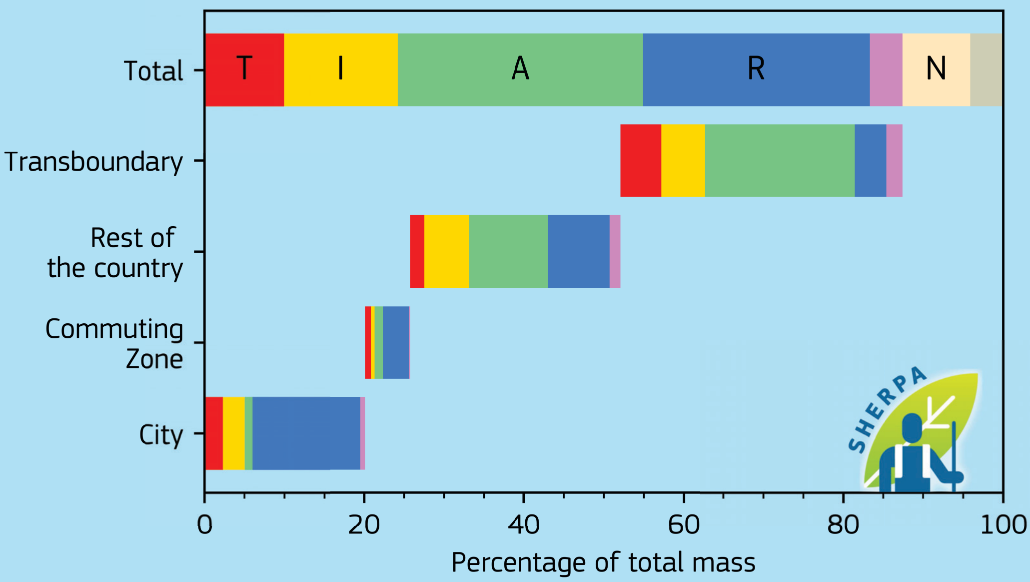
Poland, Szczecin



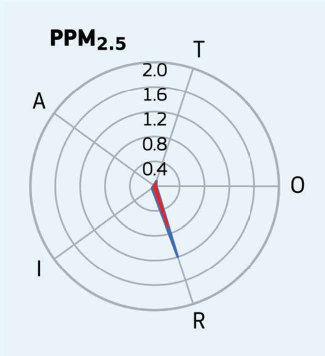
Yearly average urban background (2015)

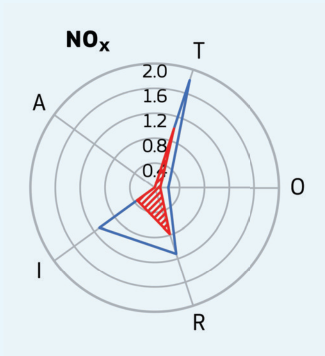


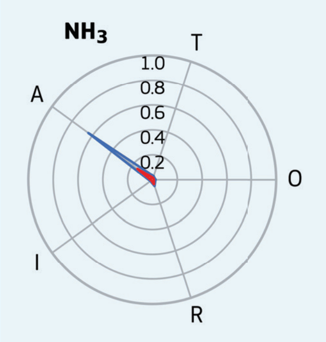
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

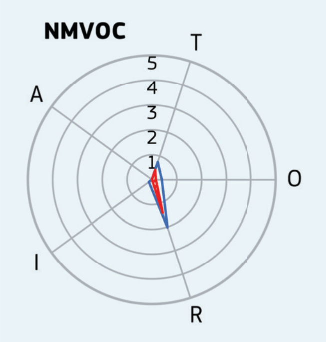


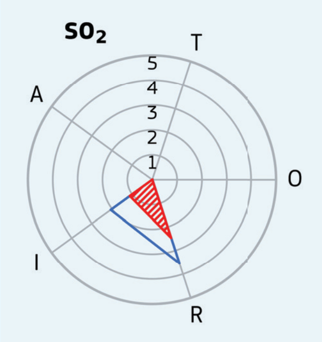
Emissions [kton/year]



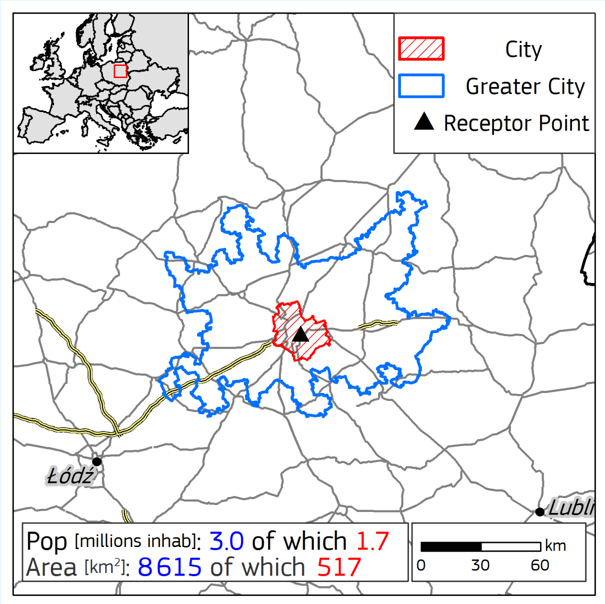




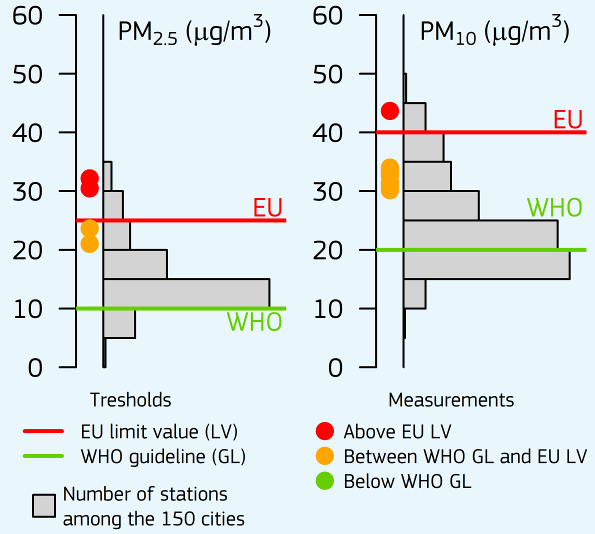




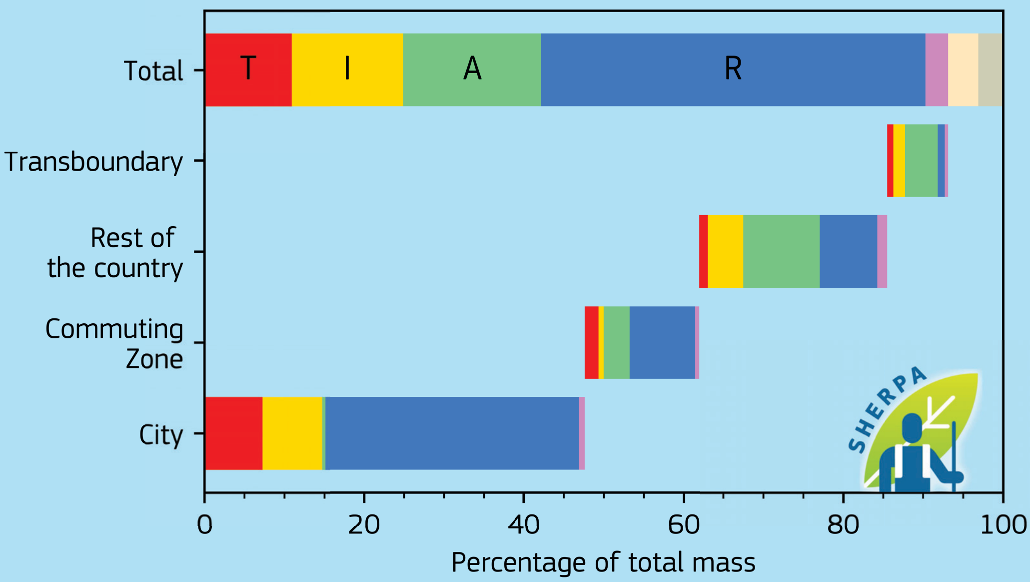
Poland, Warsaw



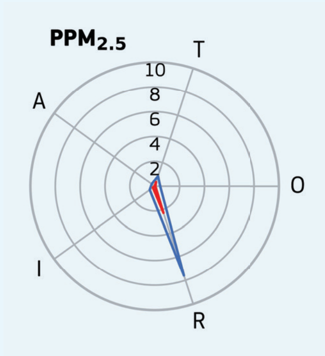
Yearly average urban background (2015)

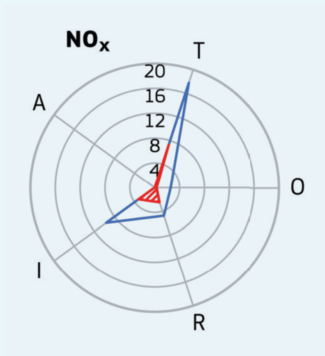


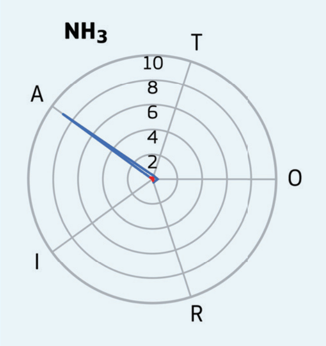
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

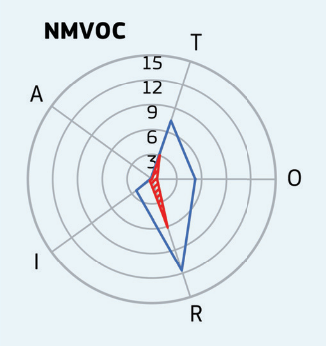


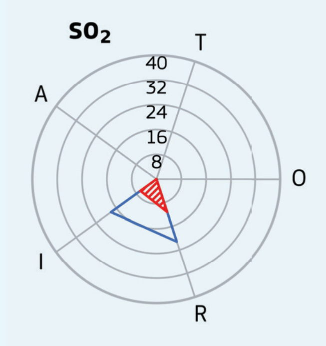
Emissions [kton/year]



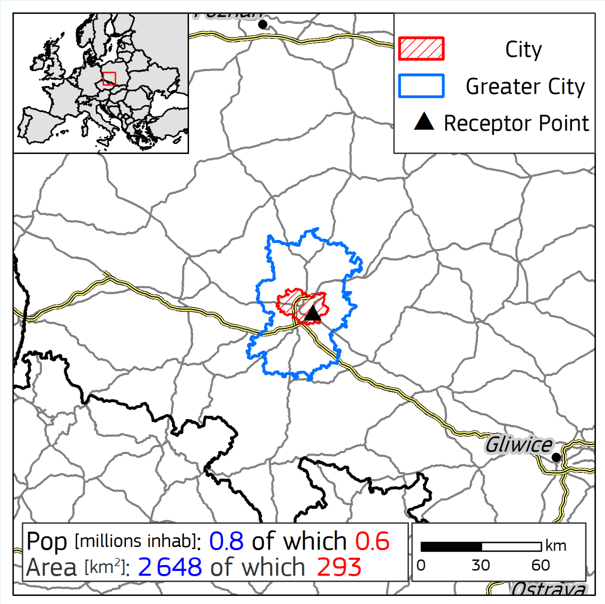




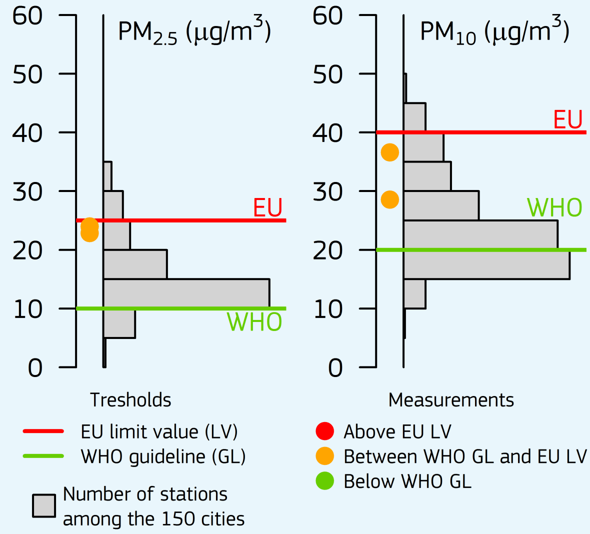




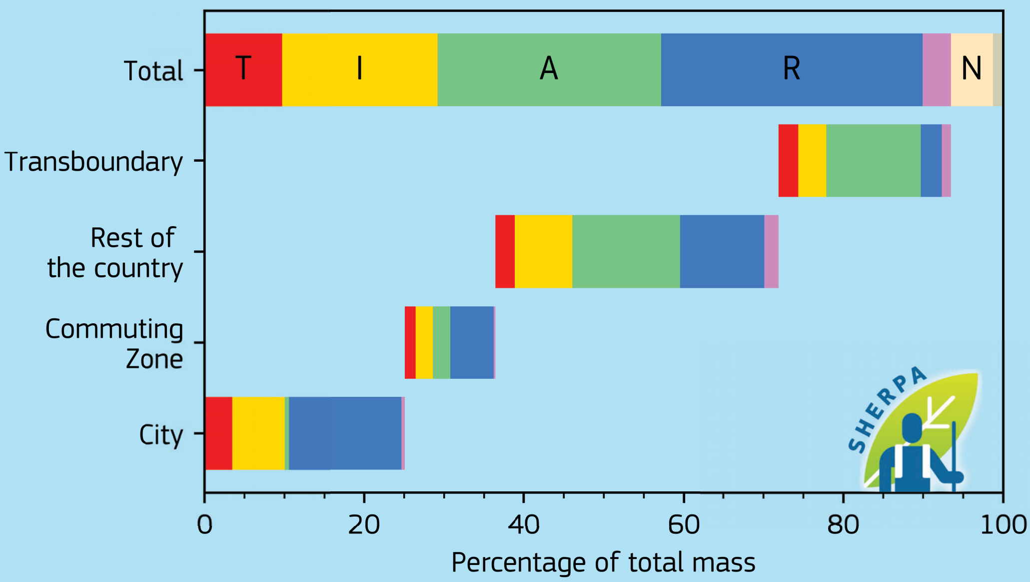
Poland, Wrocław



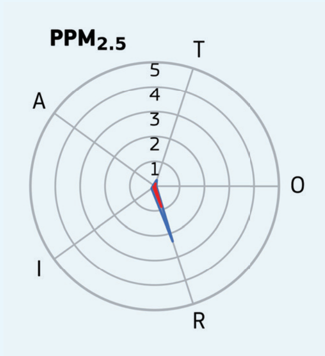
Yearly average urban background (2015)

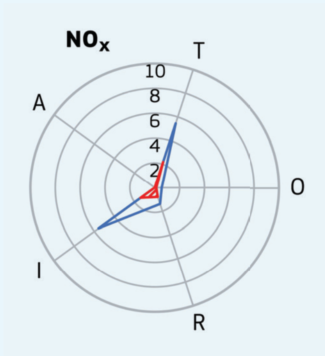


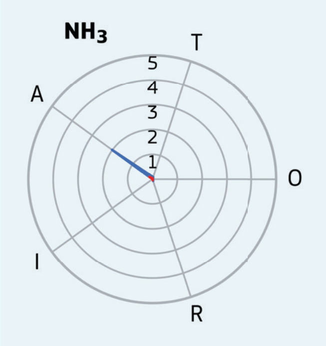
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

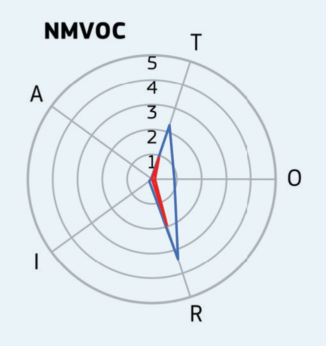


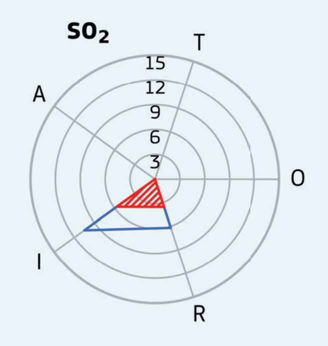
Emissions [kton/year]



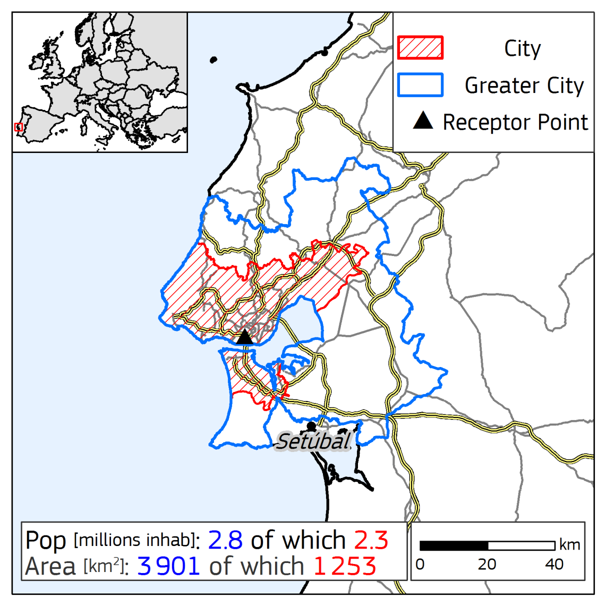




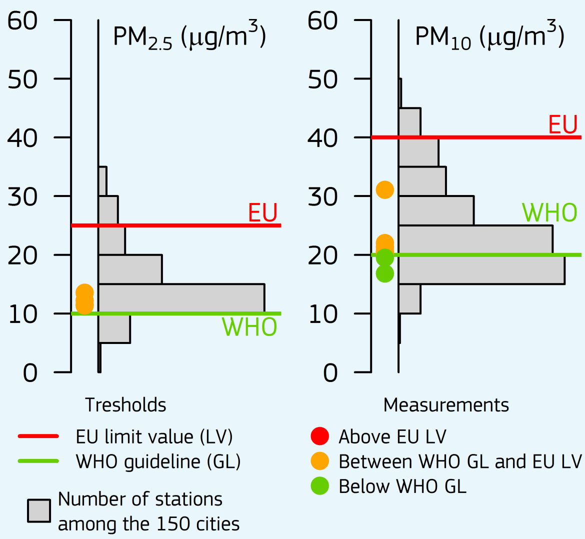




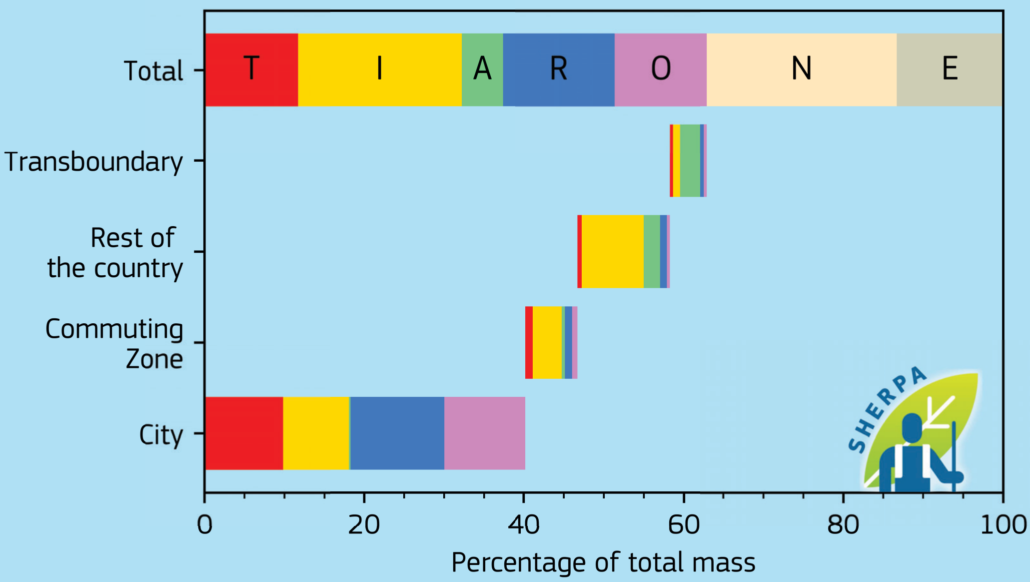
Portugal, Lisbon



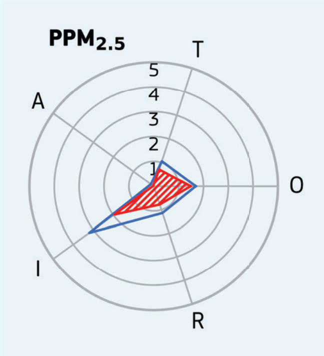
Yearly average urban background (2015)

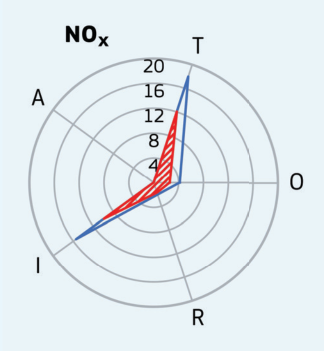


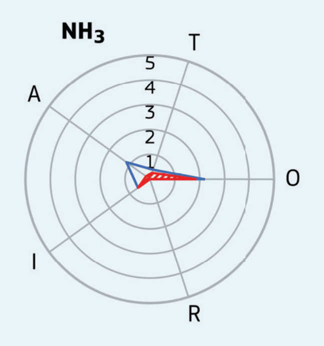
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

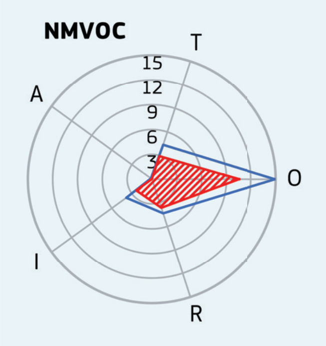


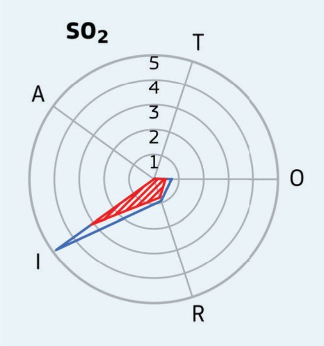
Emissions [kton/year]



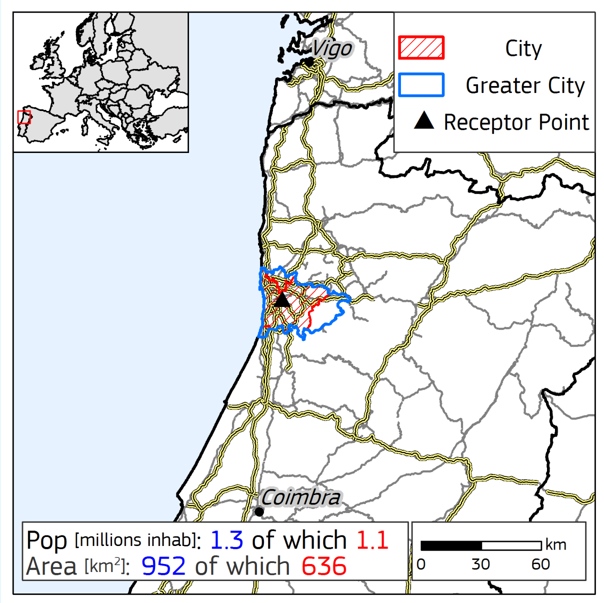




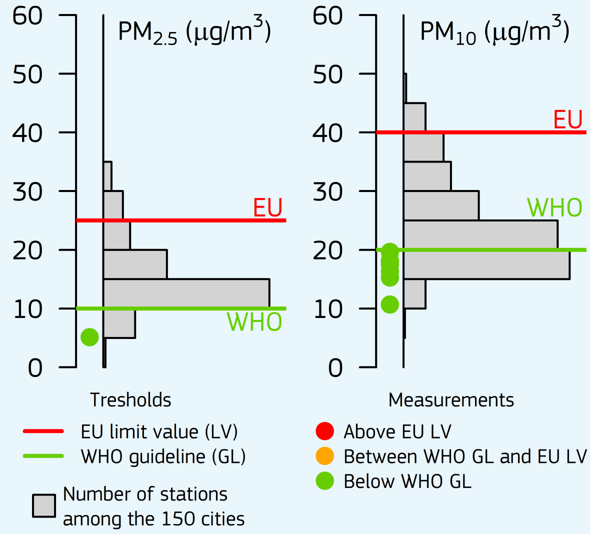




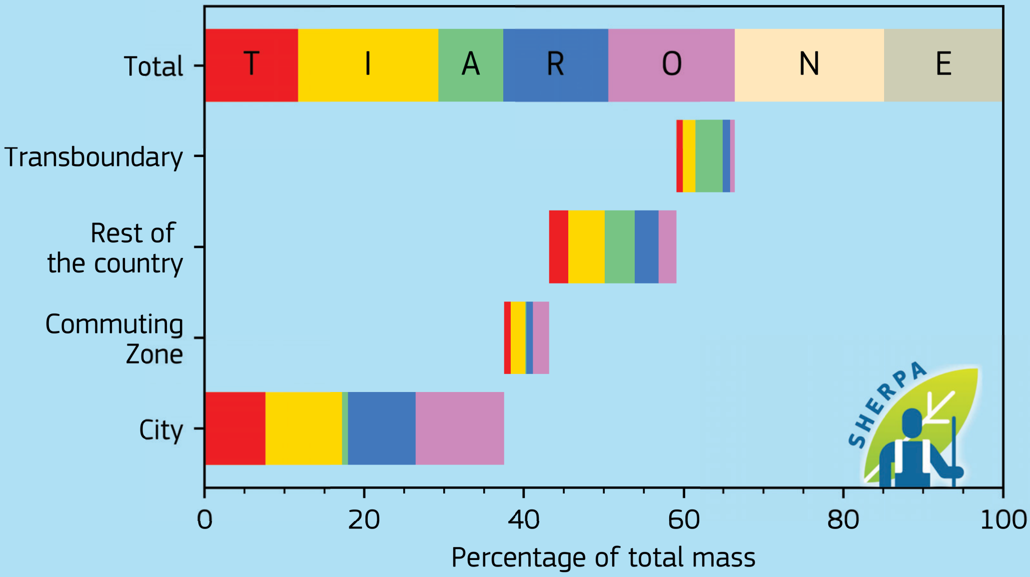
Portugal, Porto



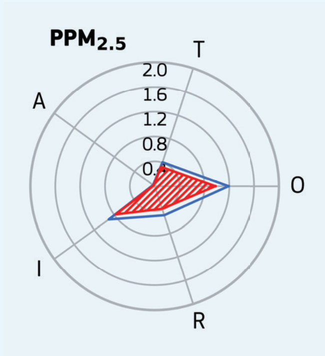
Yearly average urban background (2015)

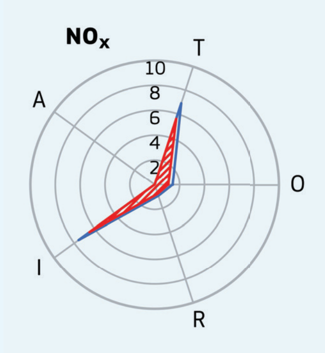


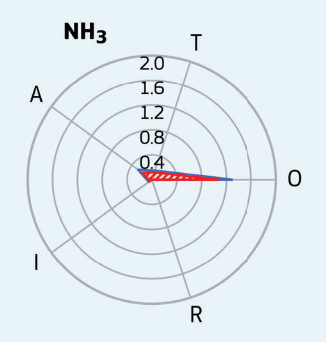
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

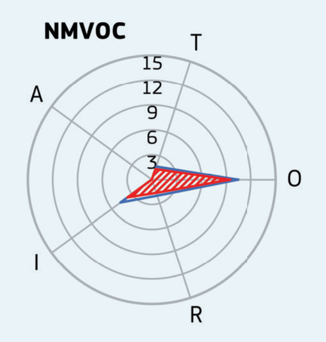


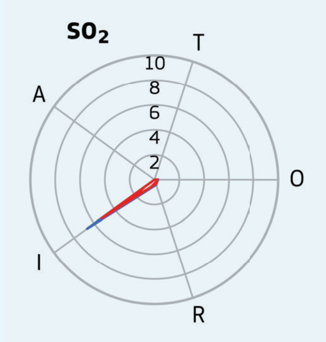
Emissions [kton/year]





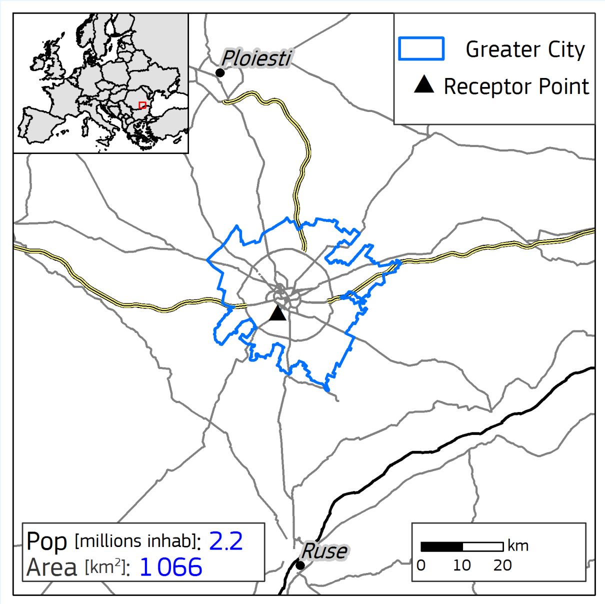




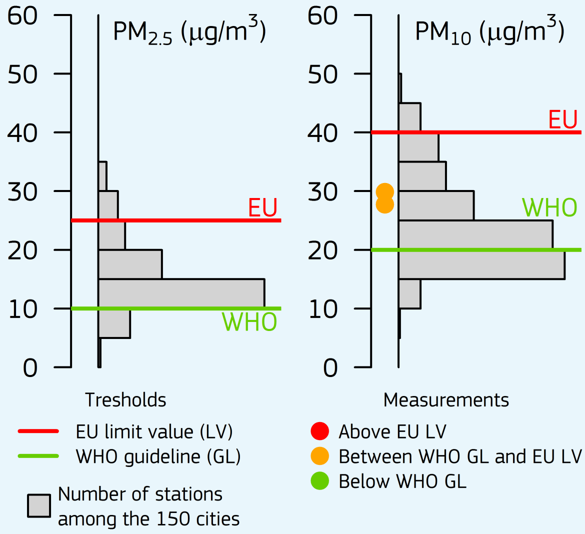


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city
- City

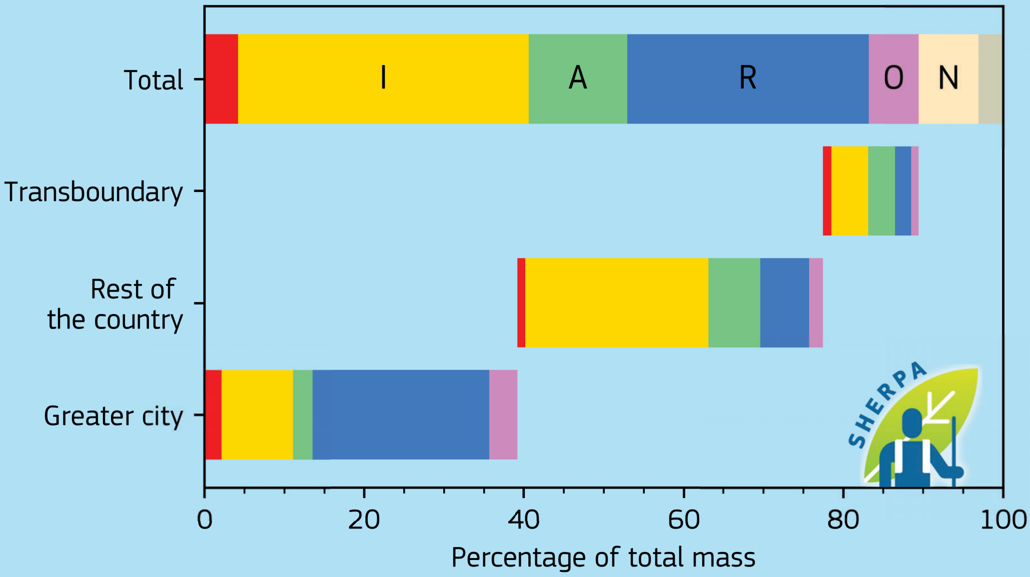
Romania, Bucharest



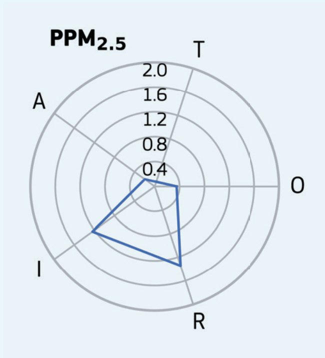
Yearly average urban background (2015)

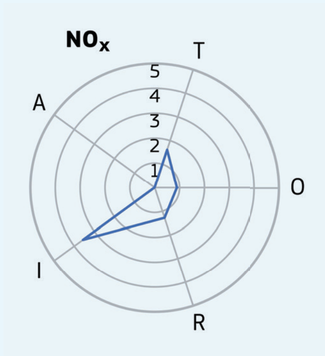


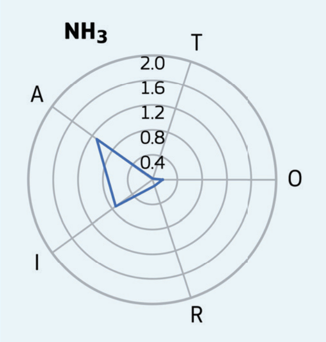
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

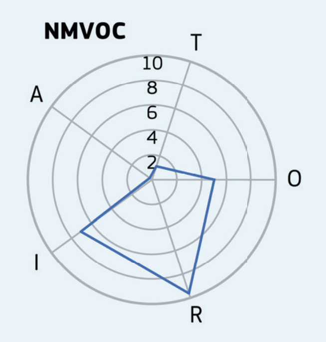


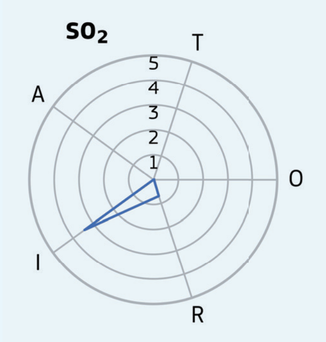
Emissions [kton/year]



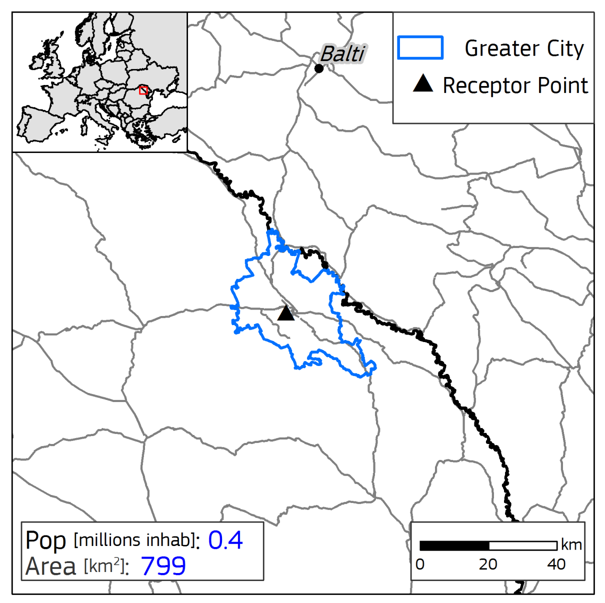


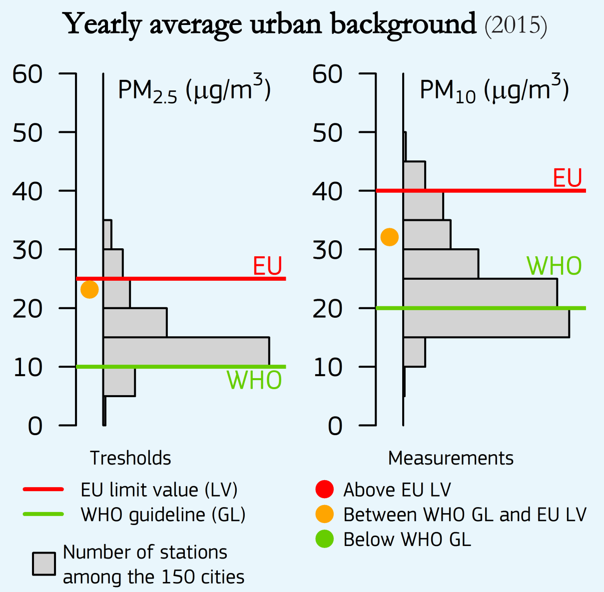


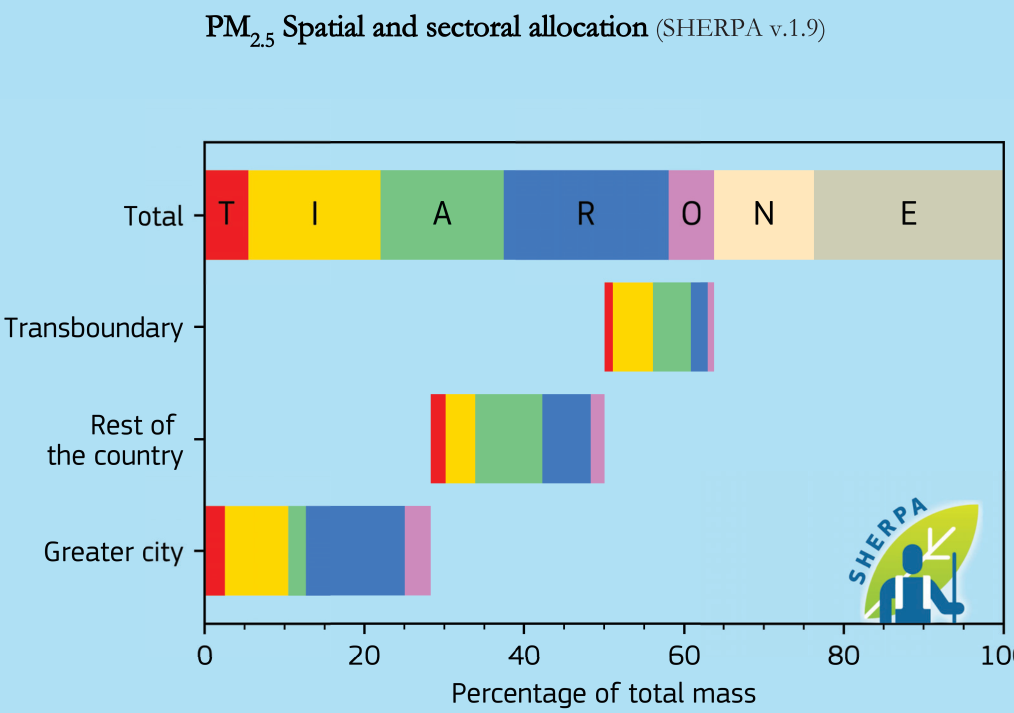




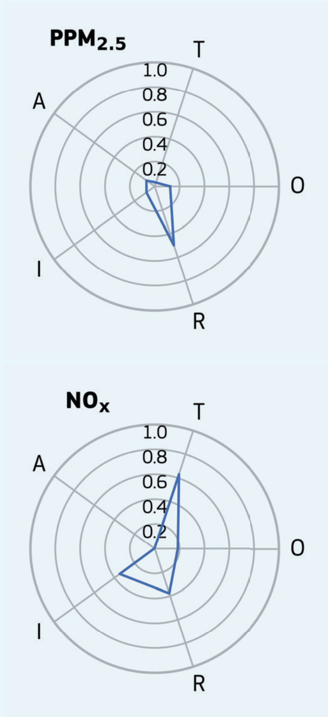
Romania, Iaşi

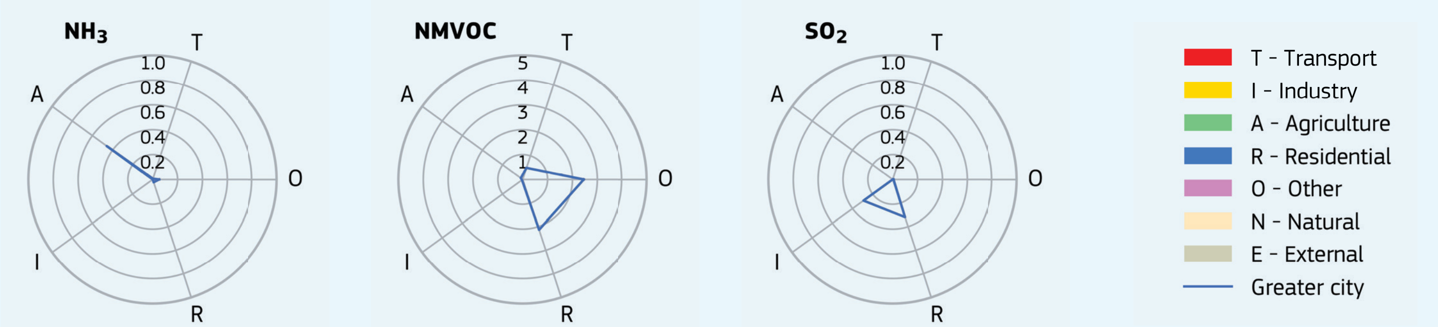




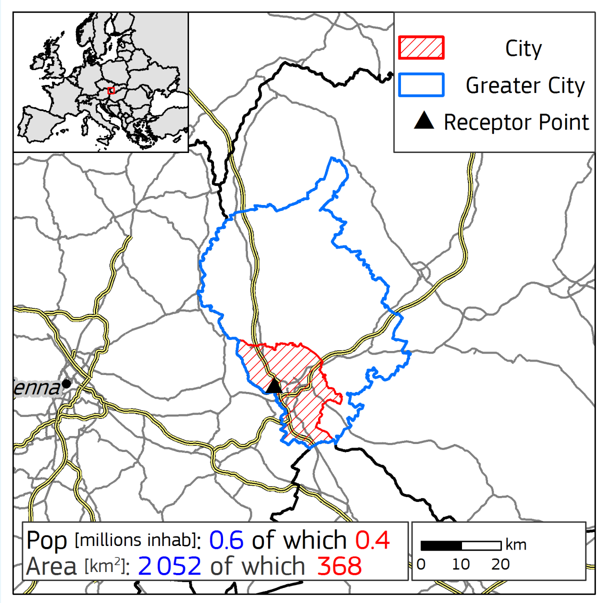


Emissions [kton/year]

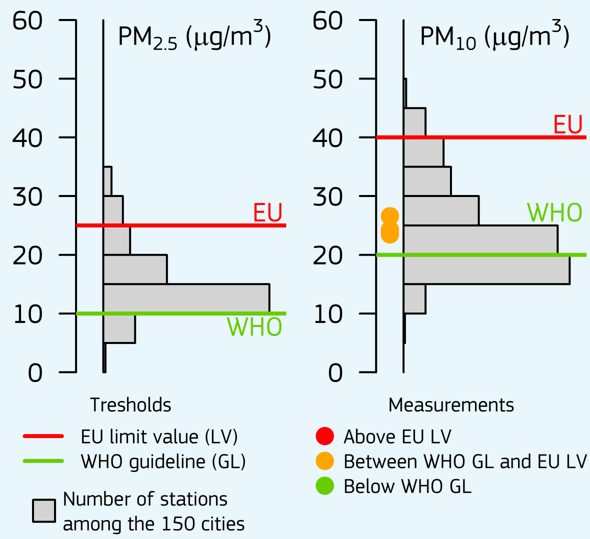




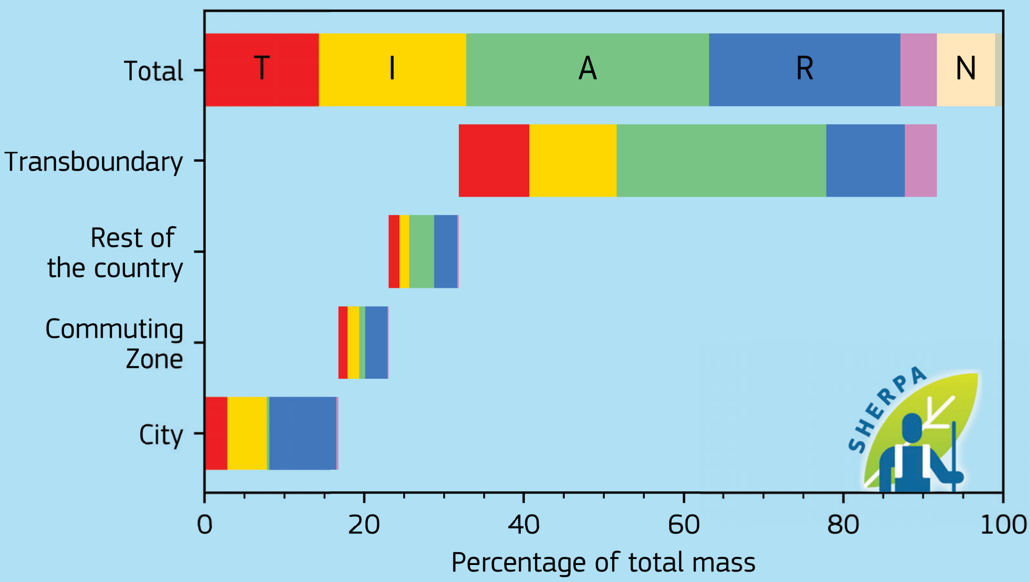
Slovakia, Bratislava



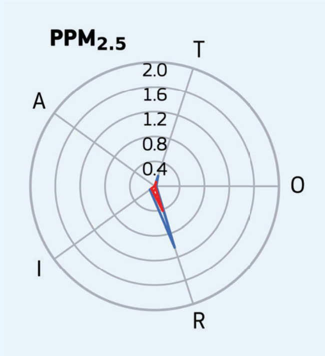
Yearly average urban background (2015)

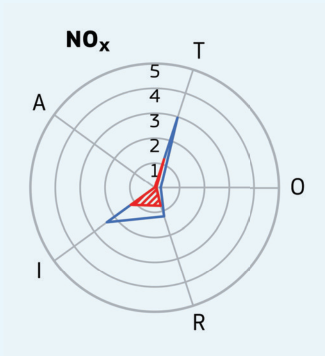


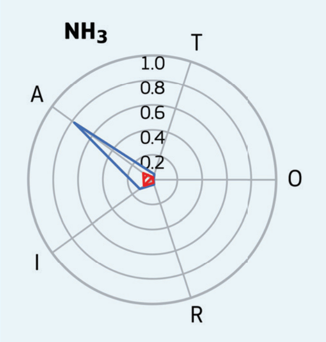
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

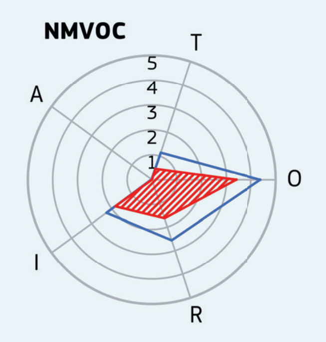


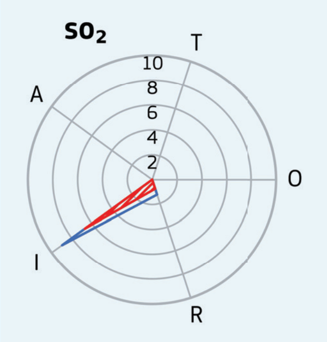
Emissions [kton/year]



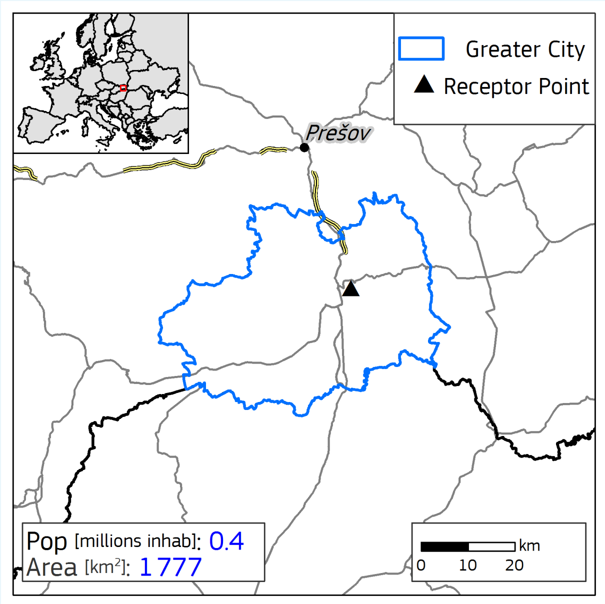




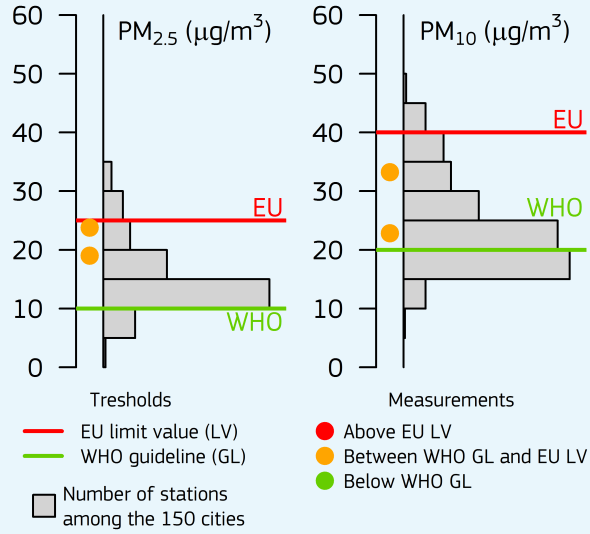




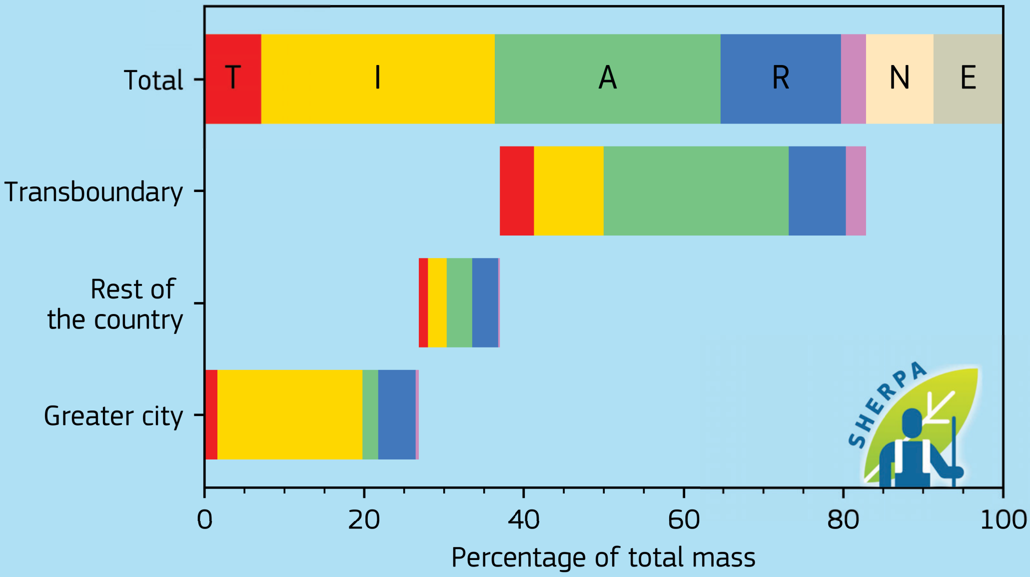
Slovakia, Košice



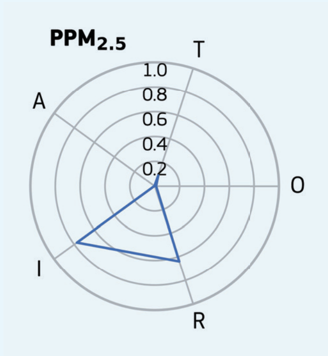
Yearly average urban background (2015)

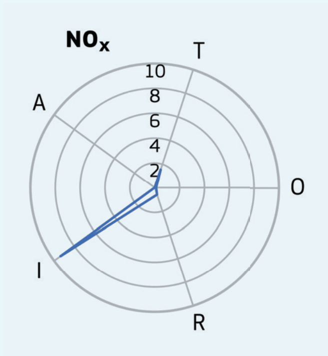


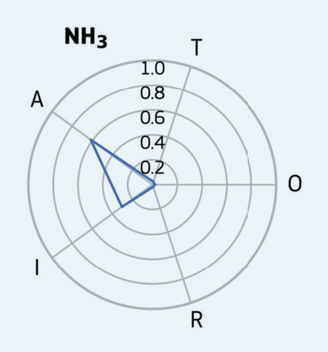
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

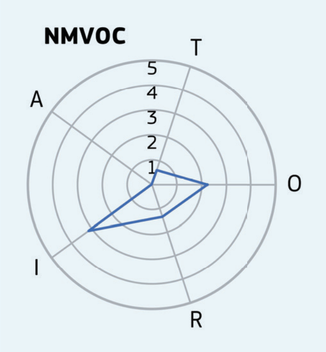


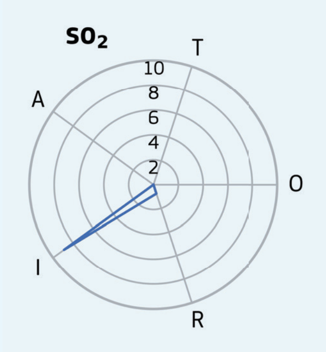
Emissions [kton/year]



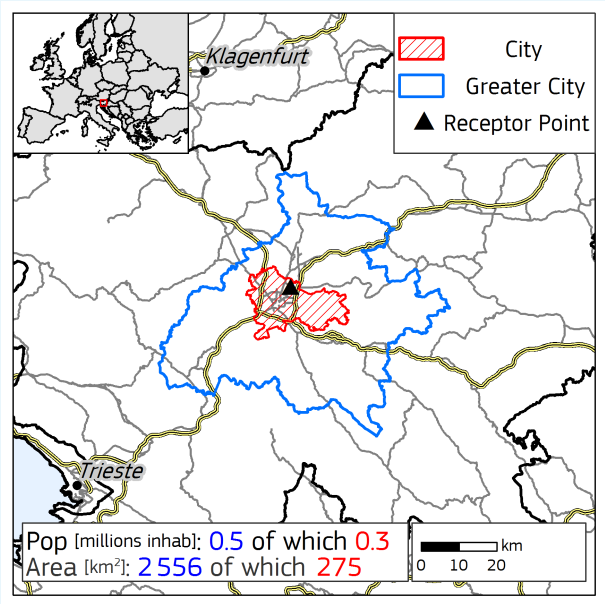




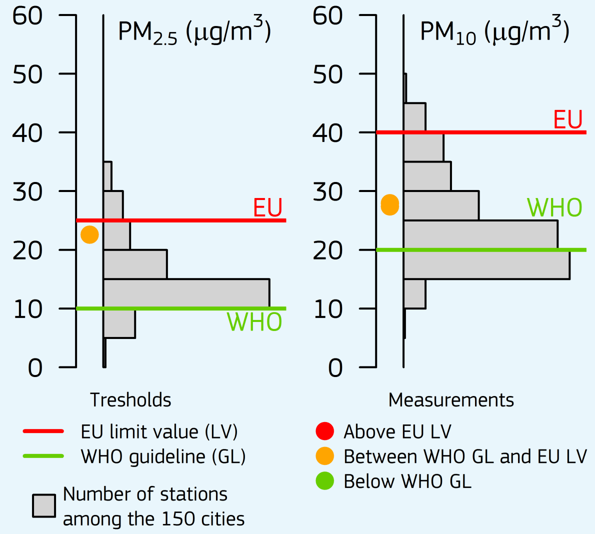




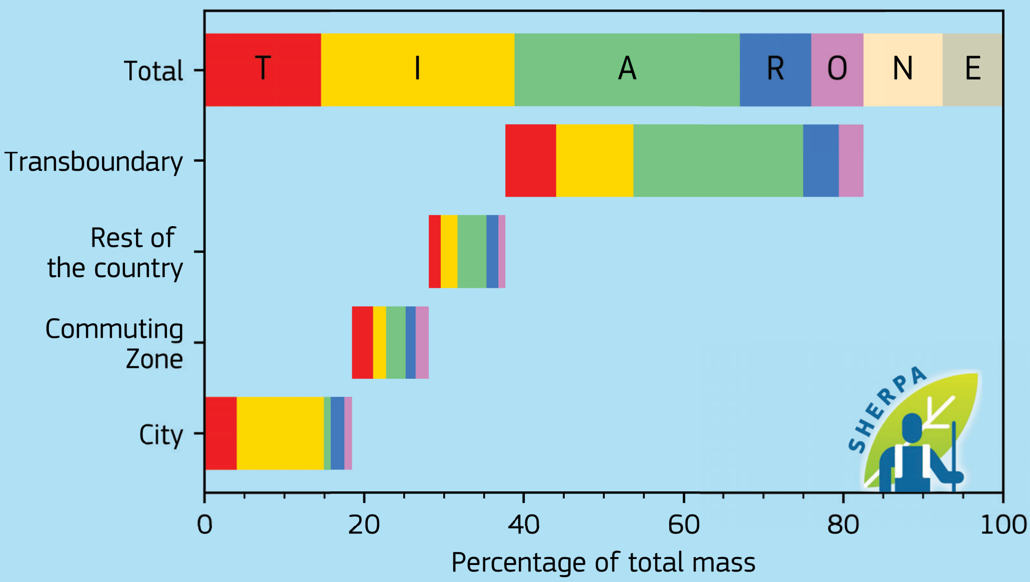
Slovenia, Ljubljana



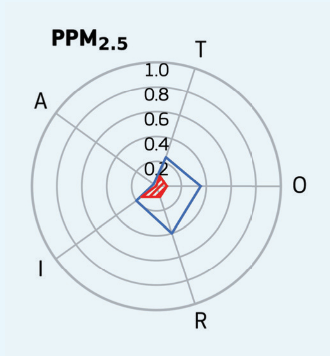
Yearly average urban background (2015)

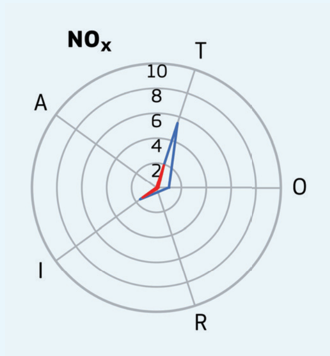


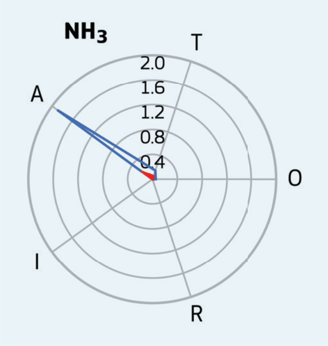
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

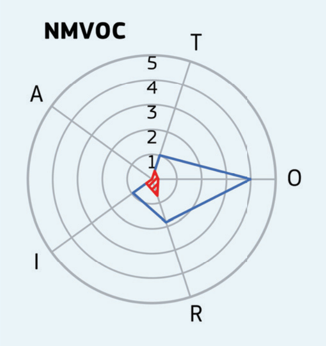


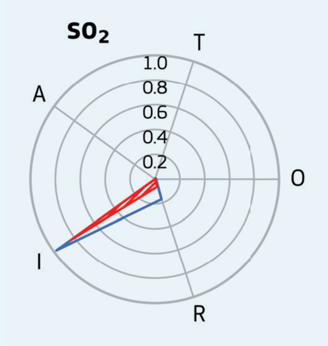
Emissions [kton/year]



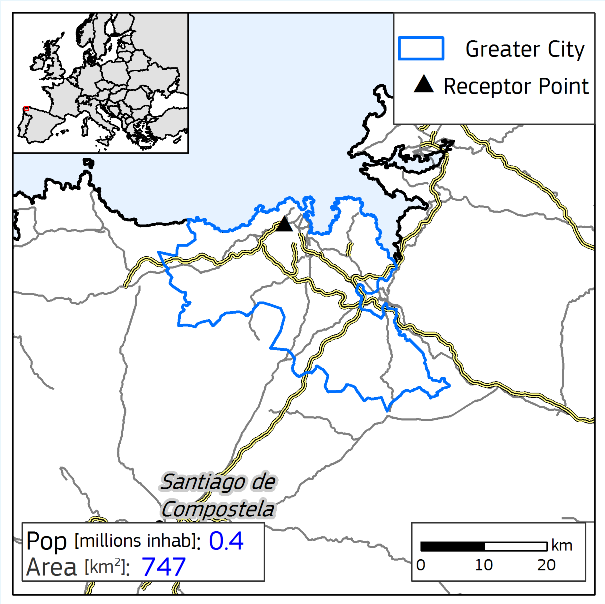




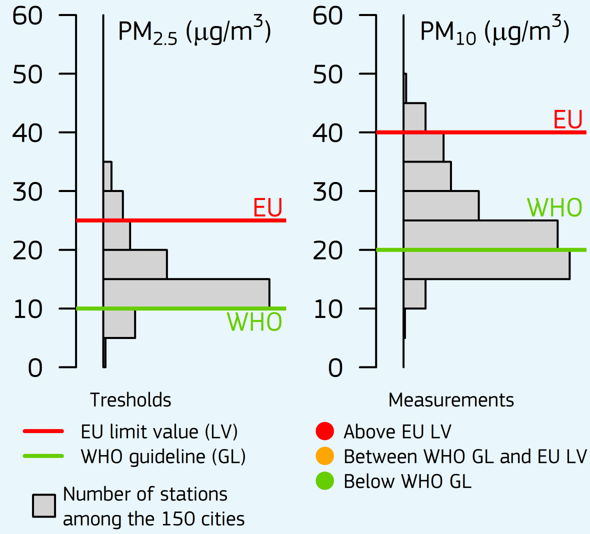




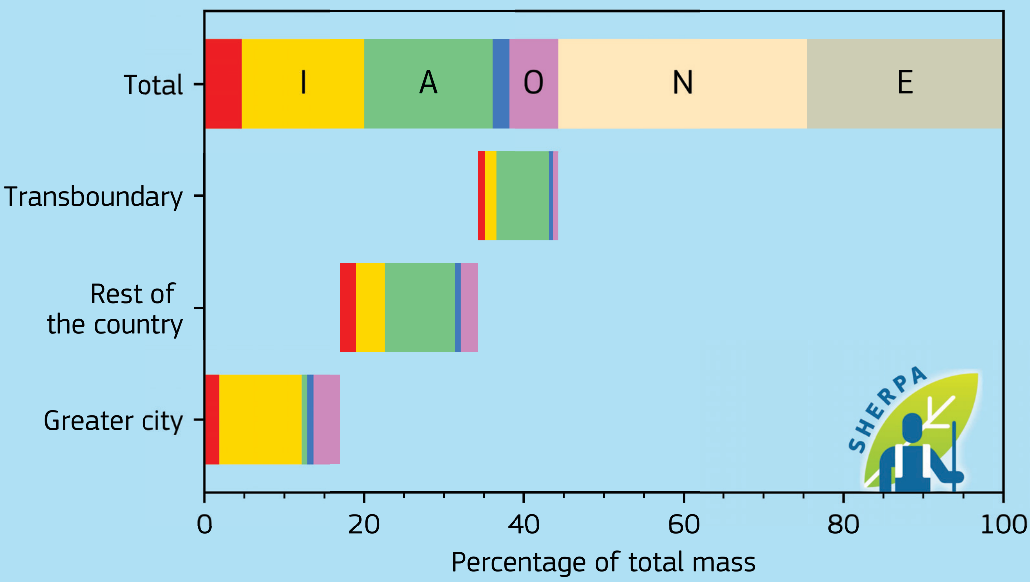
Spain, A Coruña



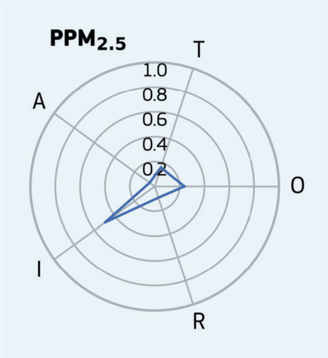
Yearly average urban background (2015)

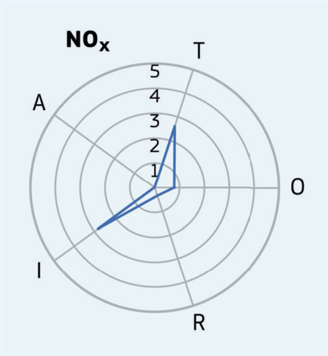


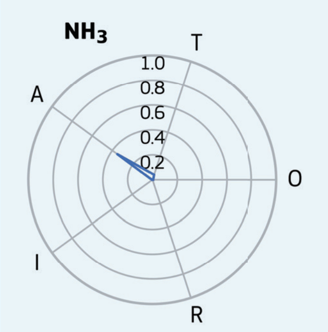
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

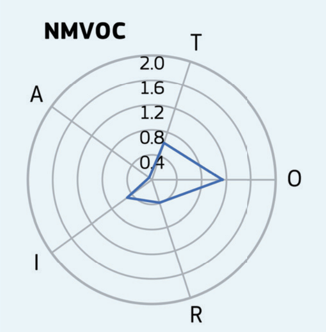


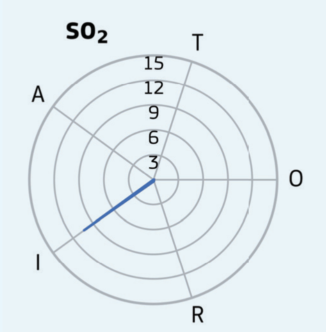
Emissions [kton/year]



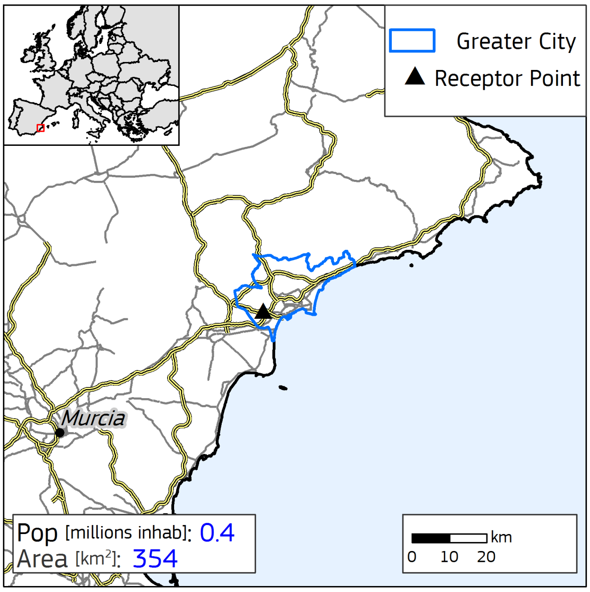




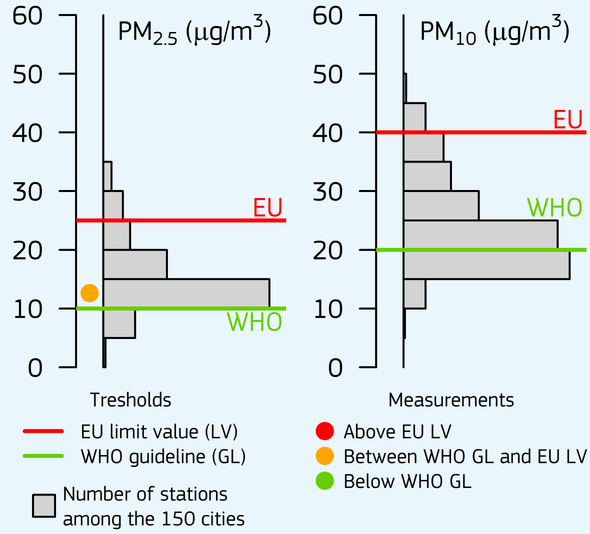




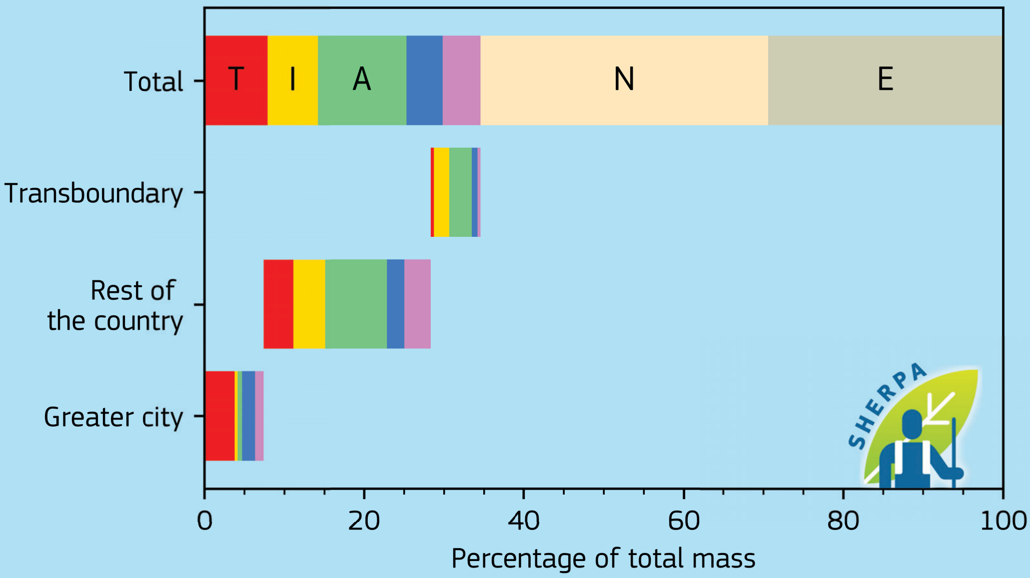
Spain, Alicante



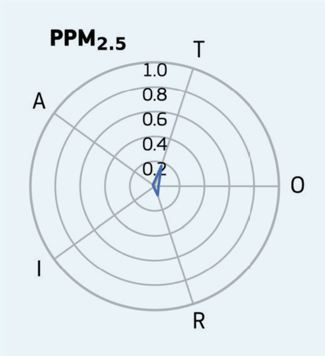
Yearly average urban background (2015)

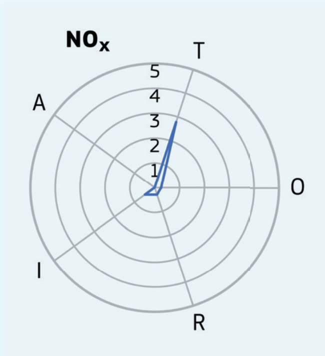


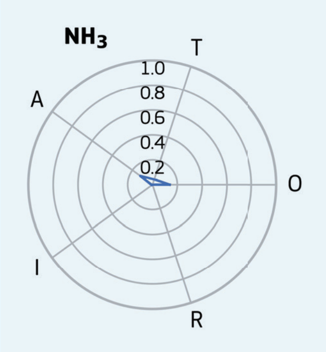
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

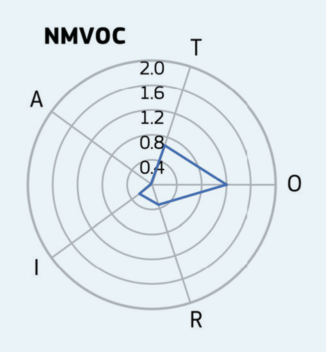


Emissions [kton/year]



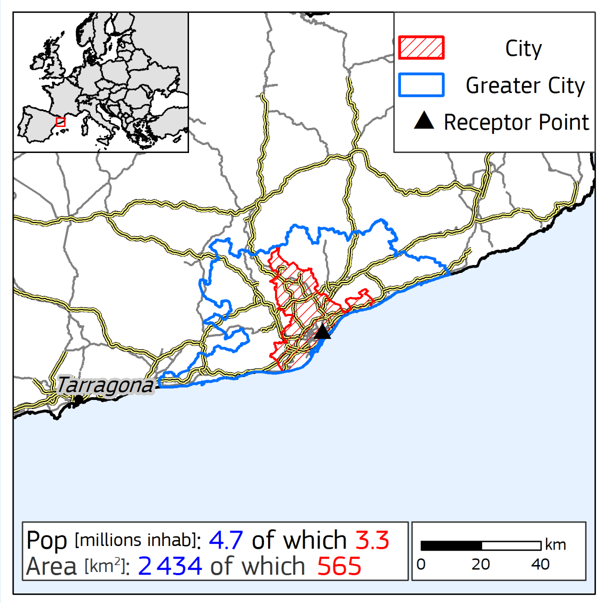




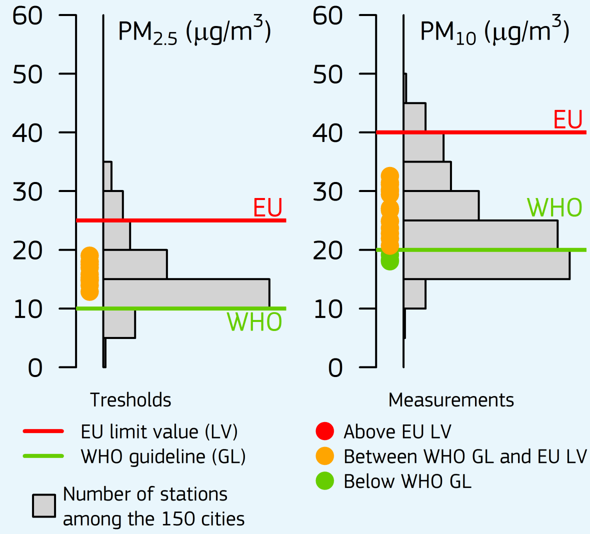


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city

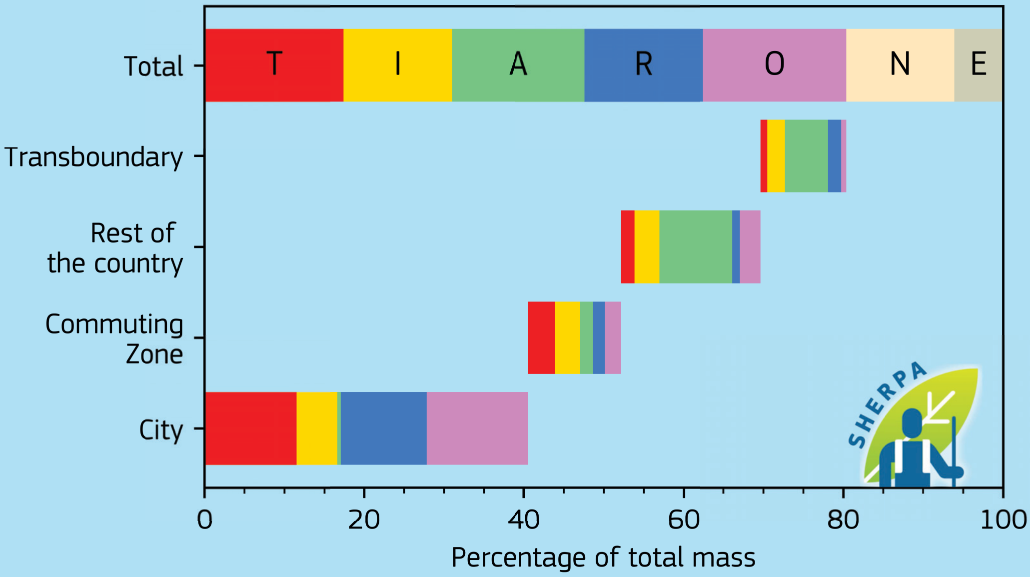
Spain, Barcelona



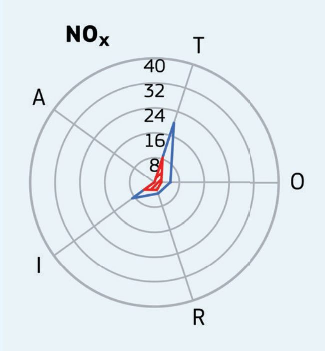
Yearly average urban background (2015)

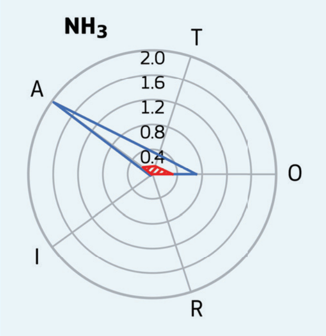


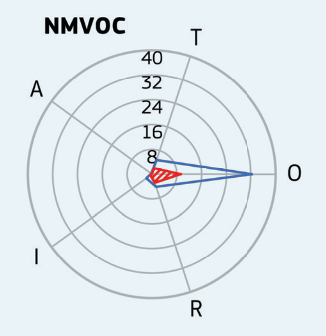
PM2.5 Spatial and sectoral allocation (SHERPA v.1.9)



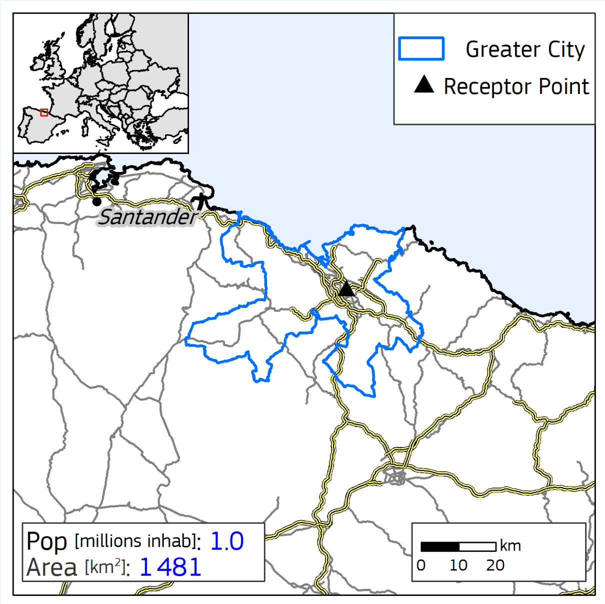
Emissions [kton/year]



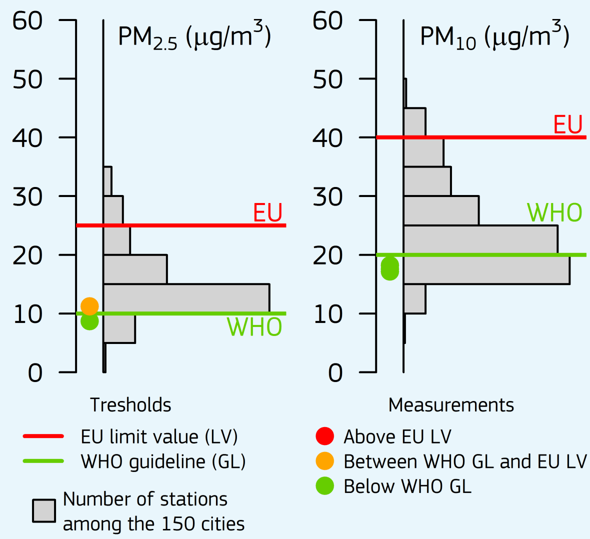




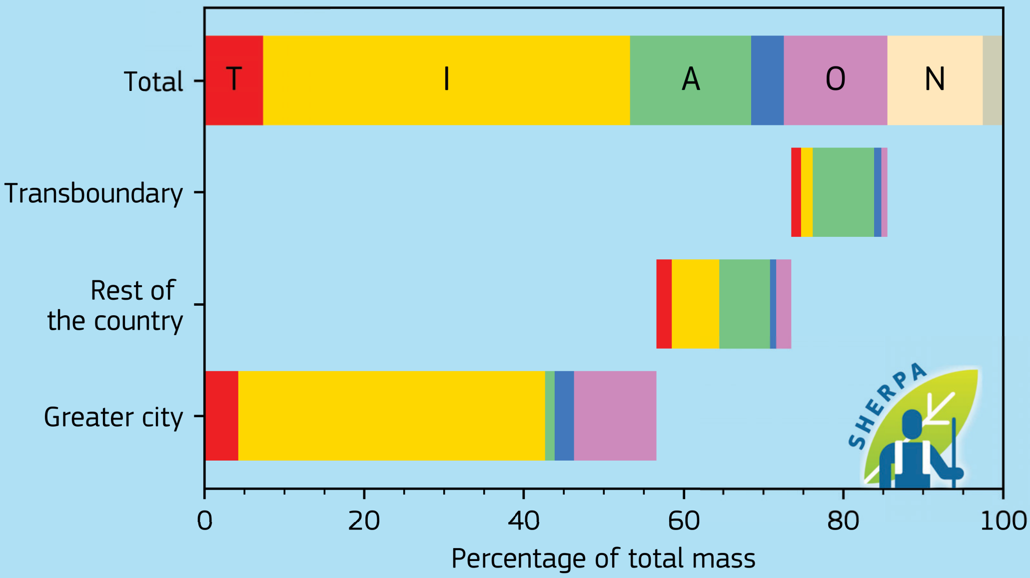
Spain, Bilbao



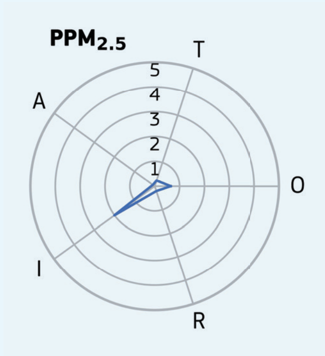
Yearly average urban background (2015)

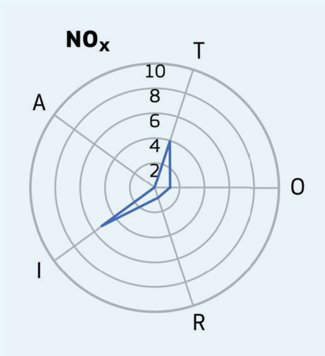


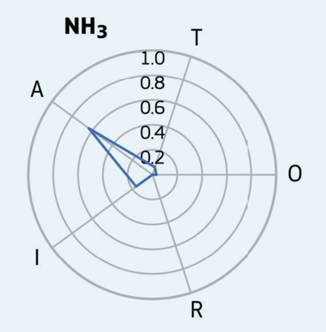
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

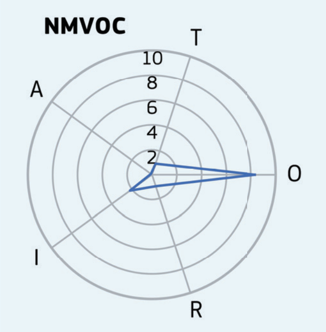


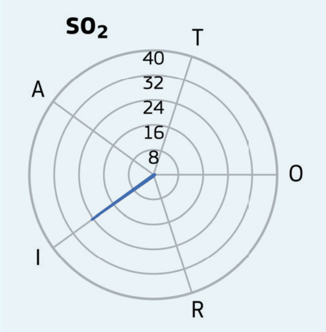
Emissions [kton/year]



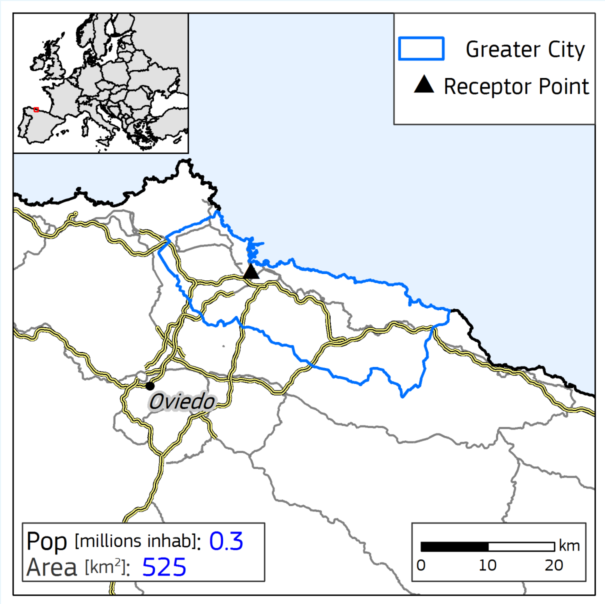




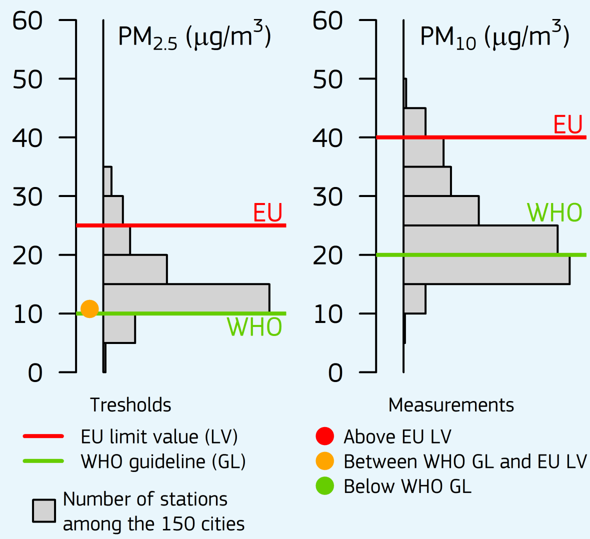




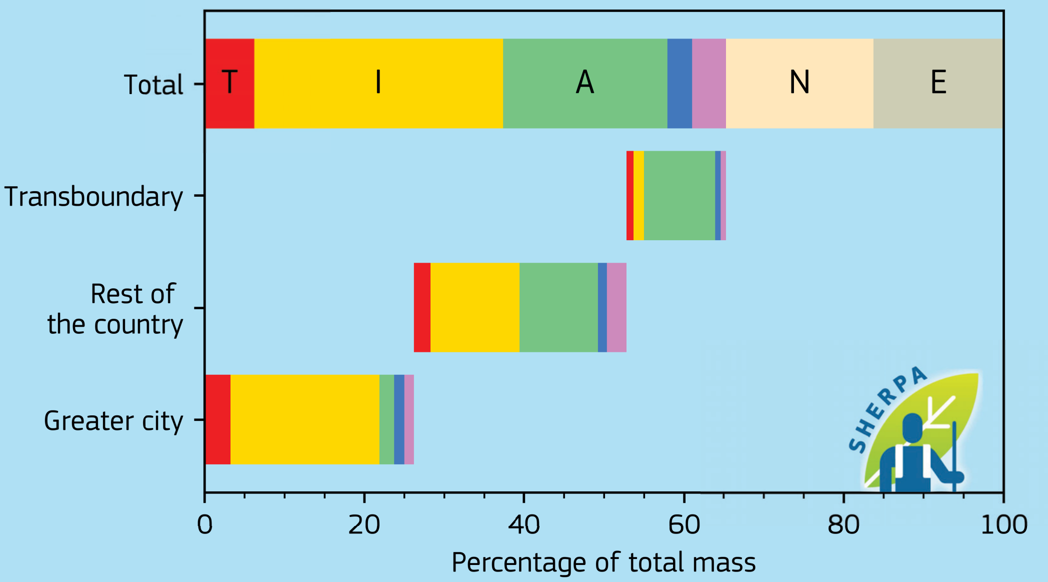
Spain, Gijón



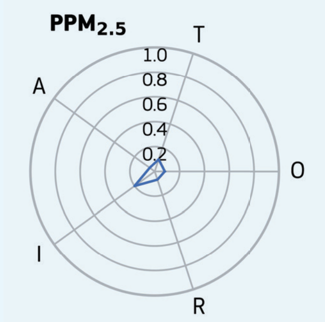
Yearly average urban background (2015)

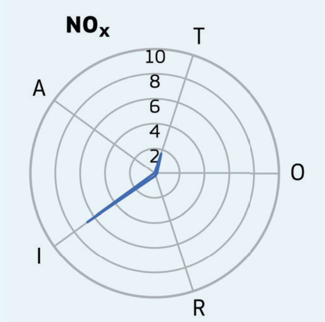


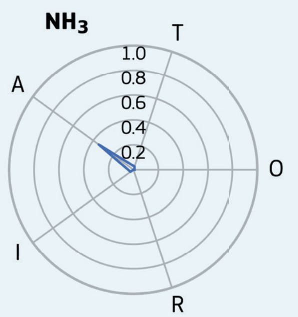
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

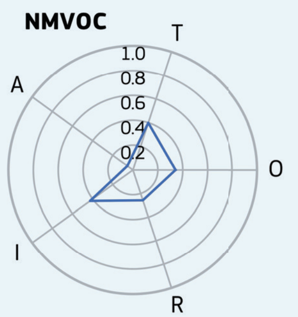


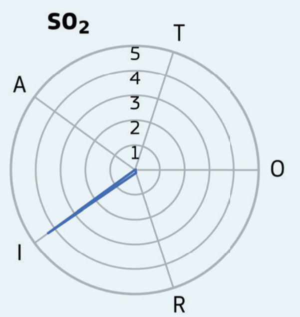
Emissions [kton/year]





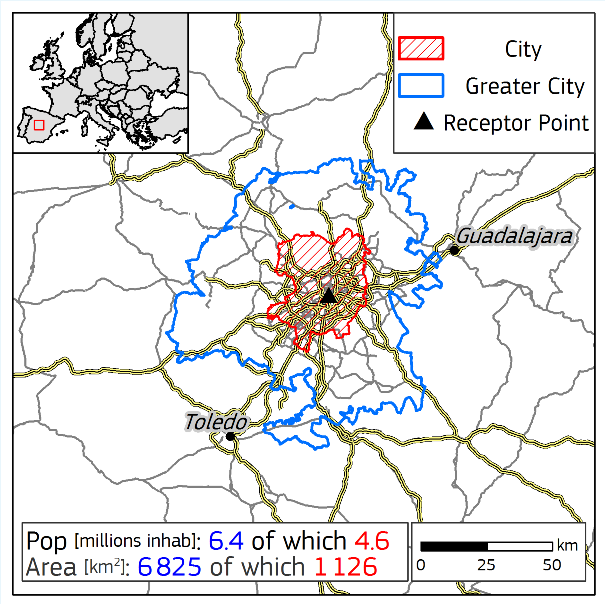




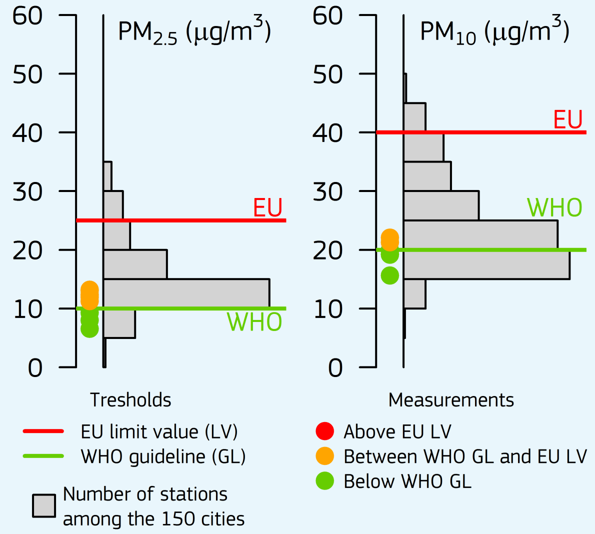


T - Transport
I - Industry
A - Agriculture
R - Residential
O - Other
N - Natural
E - External
Greater city

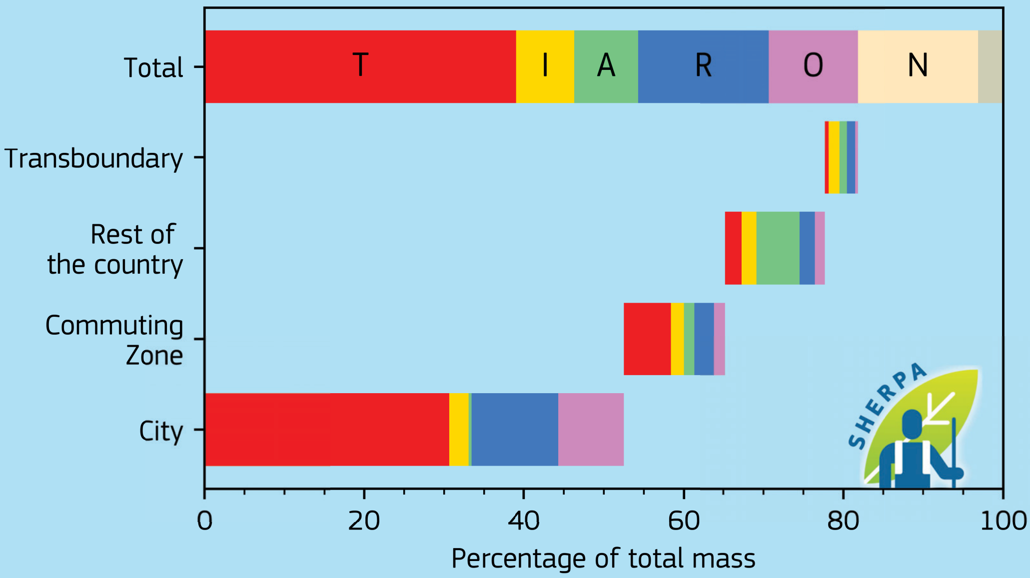
Spain, Madrid



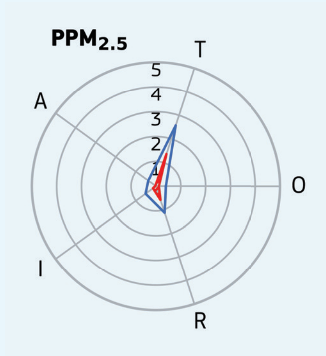
Yearly average urban background (2015)

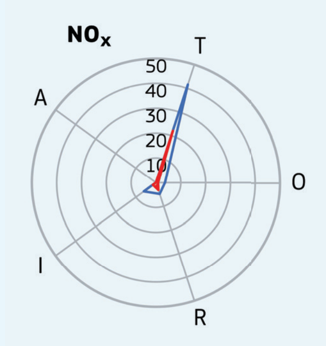


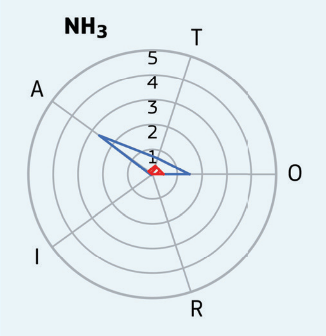
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

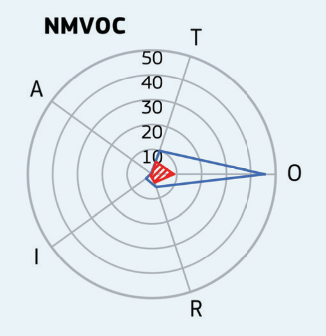


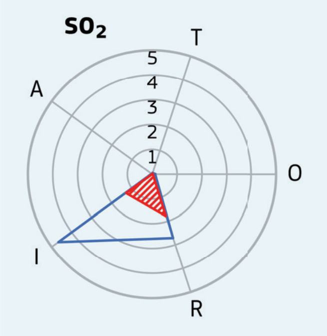
Emissions [kton/year]



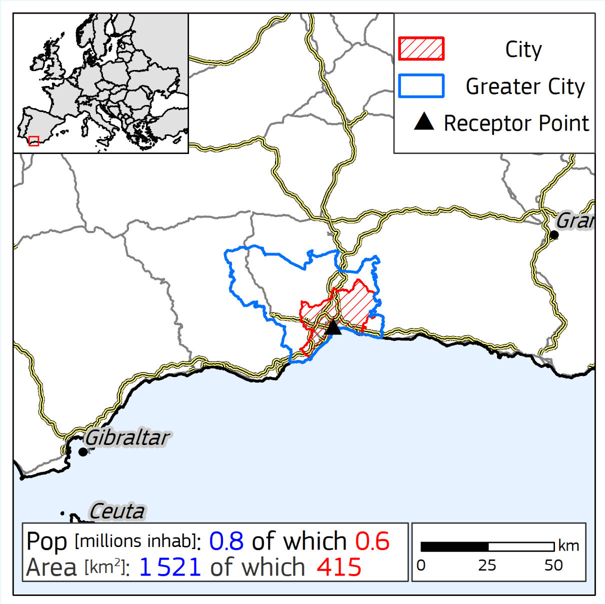




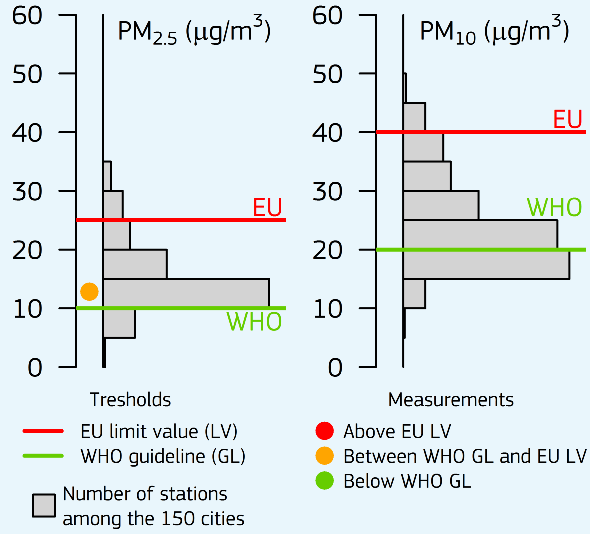




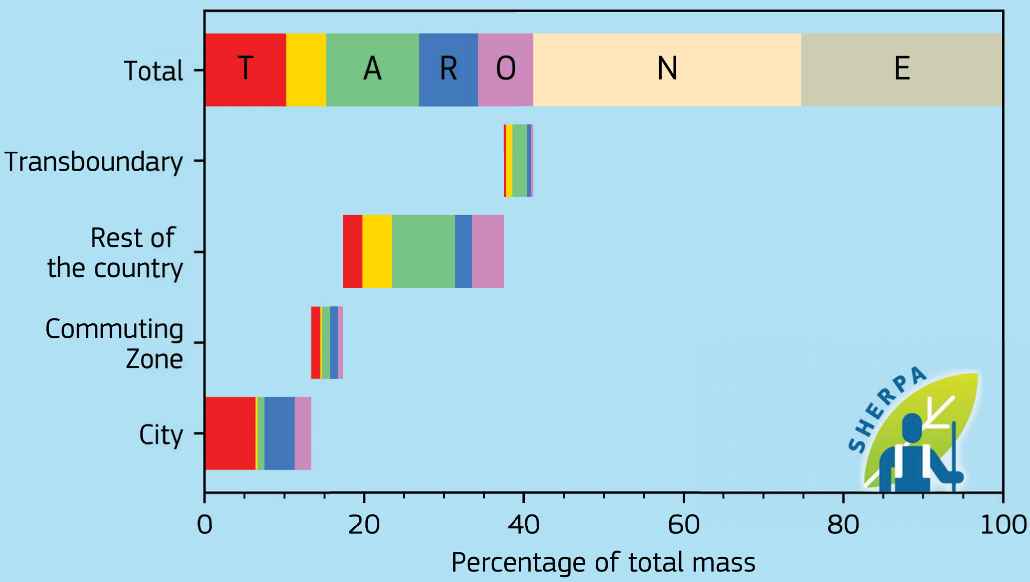
Spain, Malaga



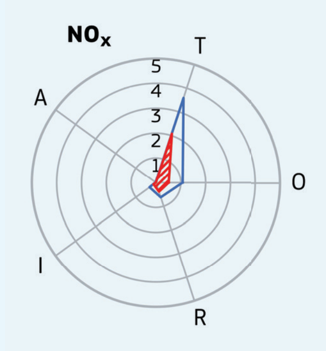
Yearly average urban background (2015)

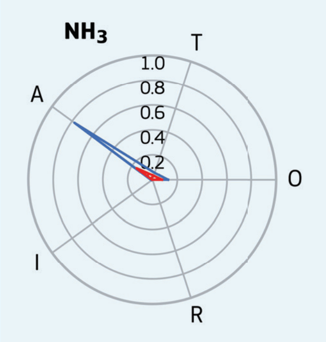


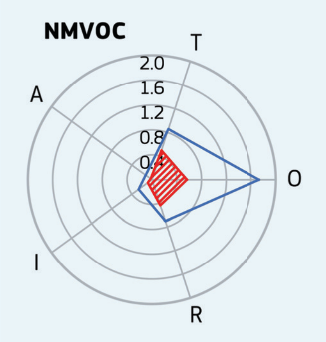
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



Emissions [kton/year]

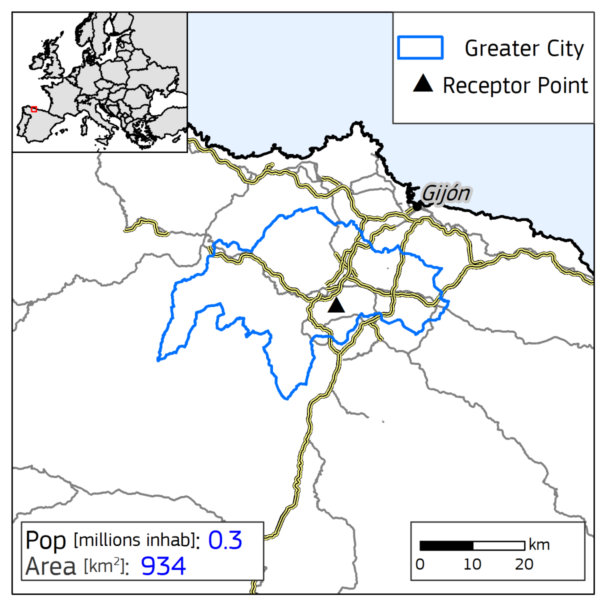




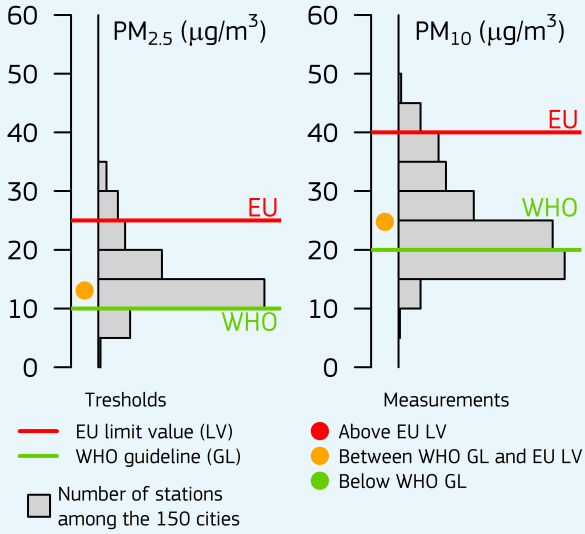


- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city
- City

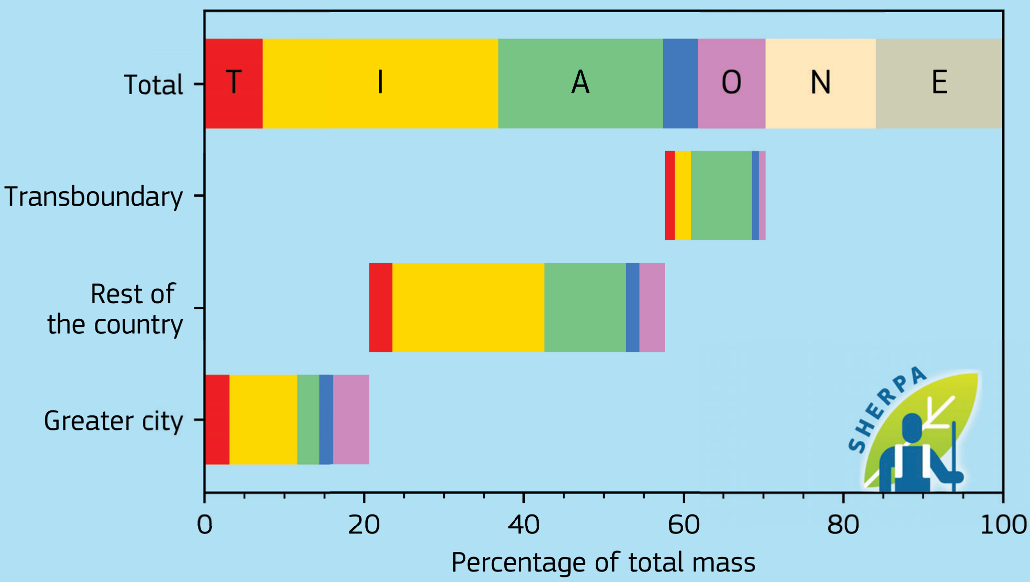
Spain, Oviedo



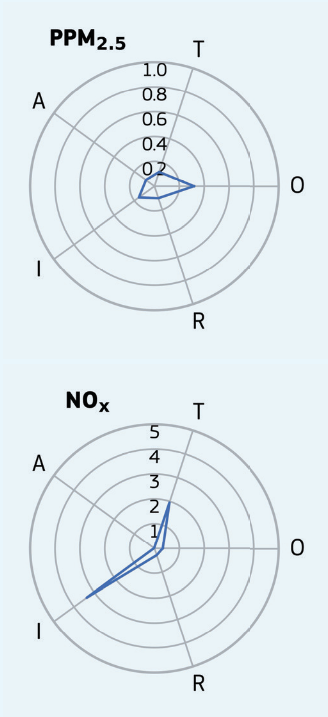
Yearly average urban background (2015)

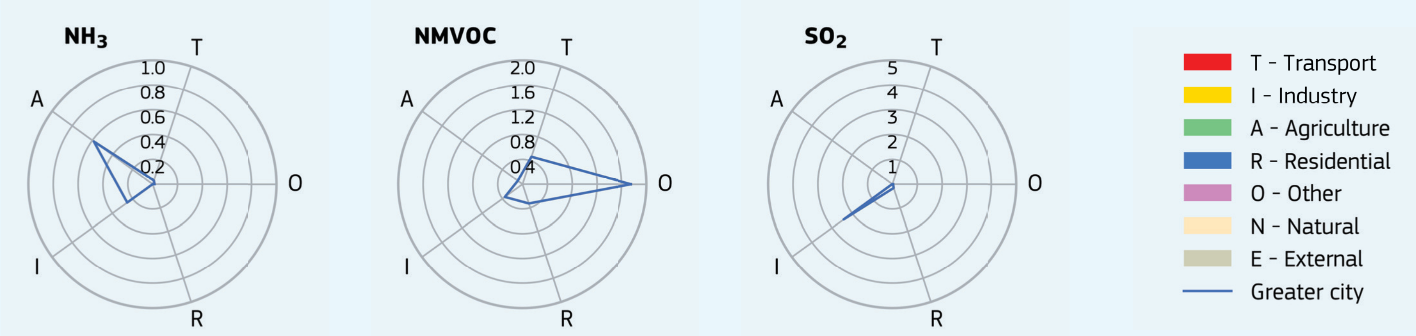


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

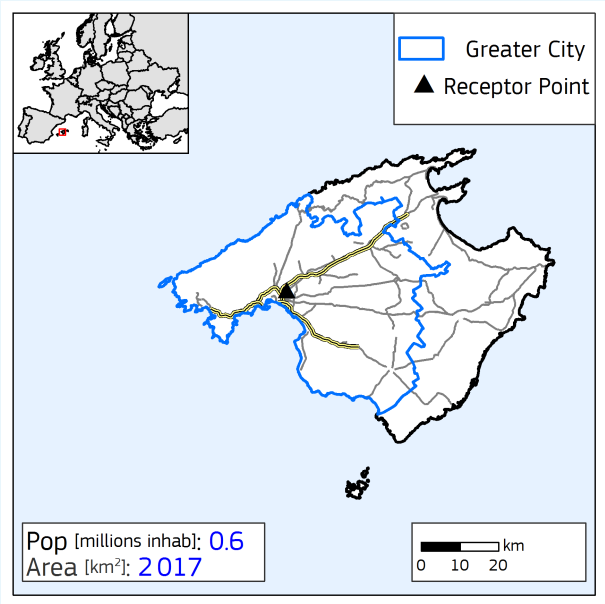


Emissions [kton/year]

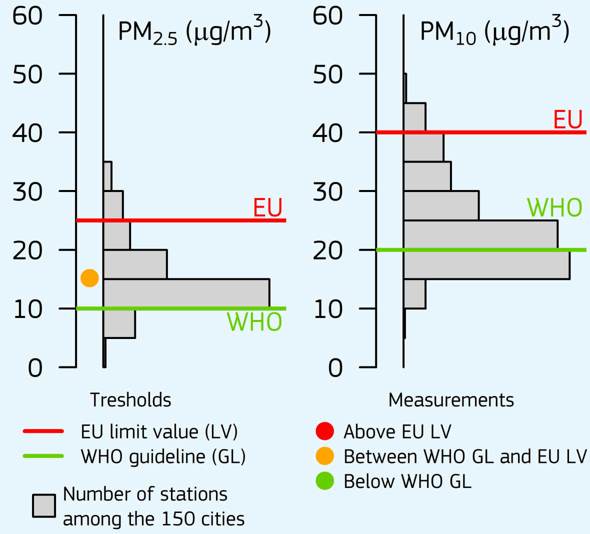




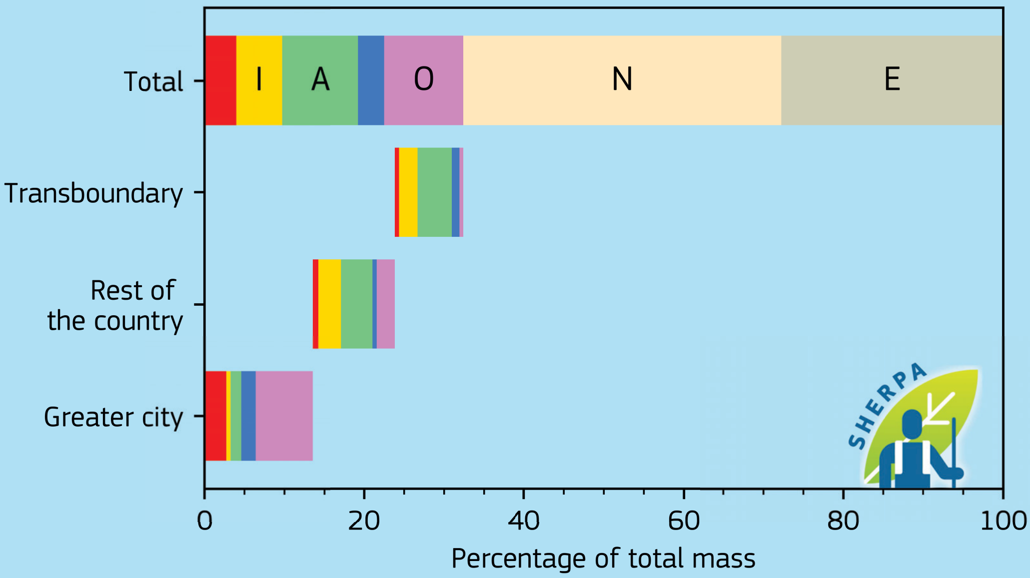
Spain, Palma de Mallorca



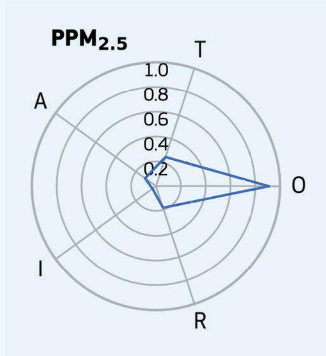
Yearly average urban background (2015)

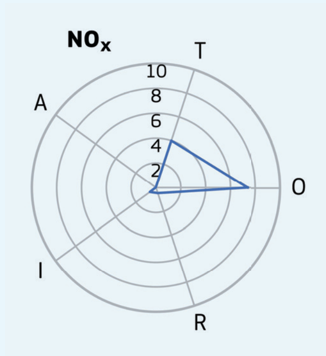


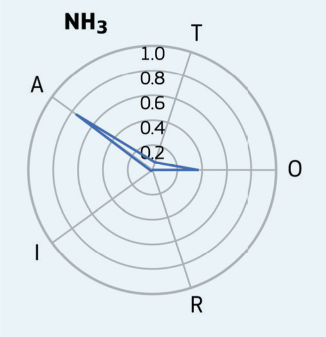
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

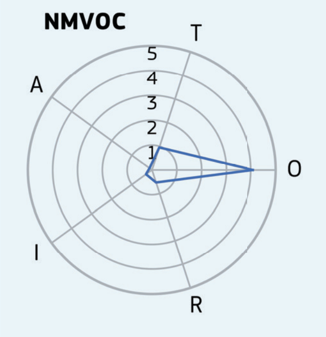


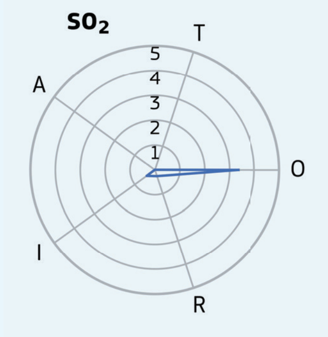
Emissions [kton/year]











- T - Transport
- I - Industry
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- O - Other
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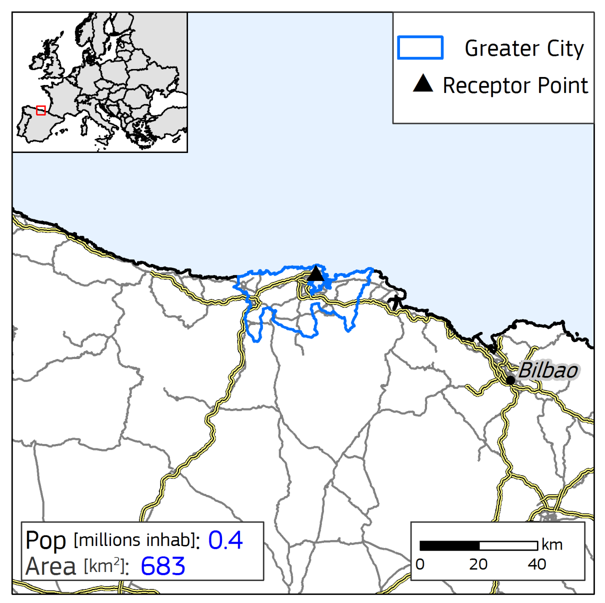
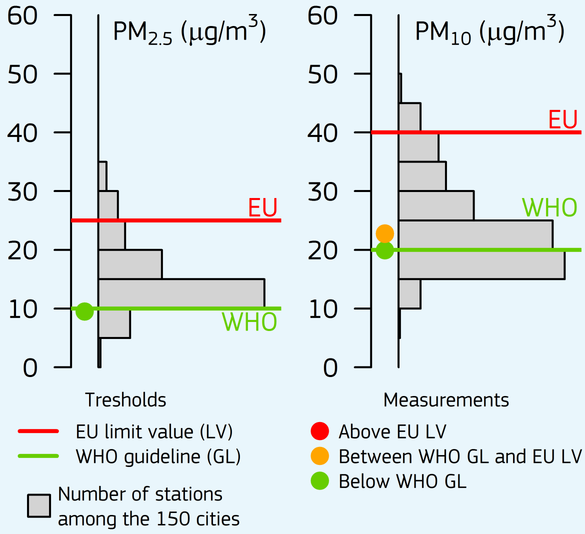
- E - External
- Greater city

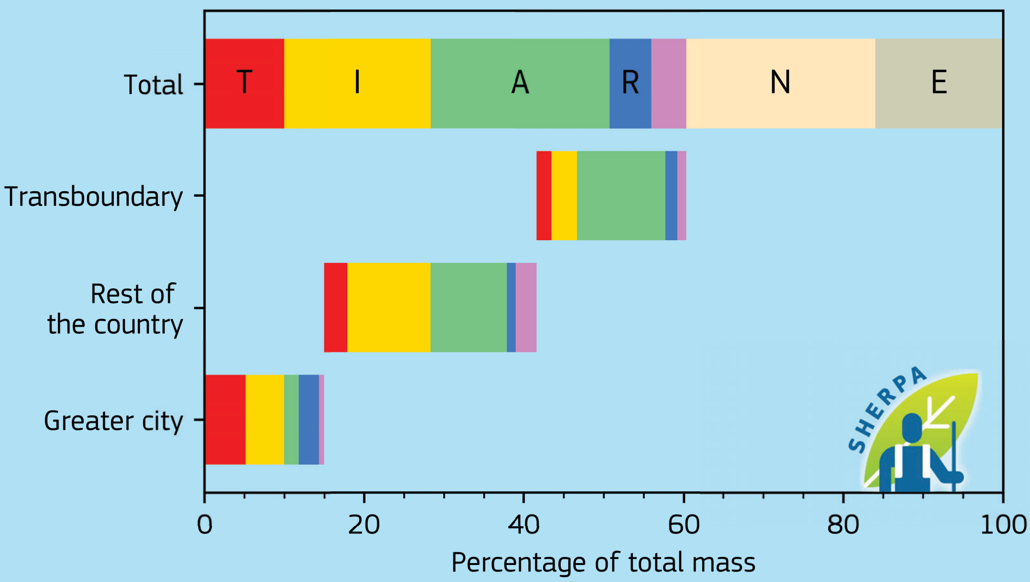
Spain, Santander



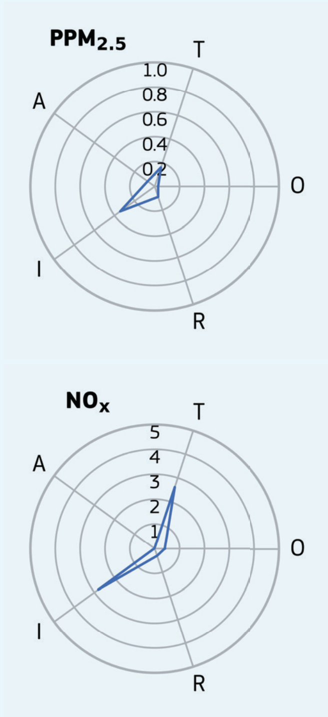
Yearly average urban background (2015)

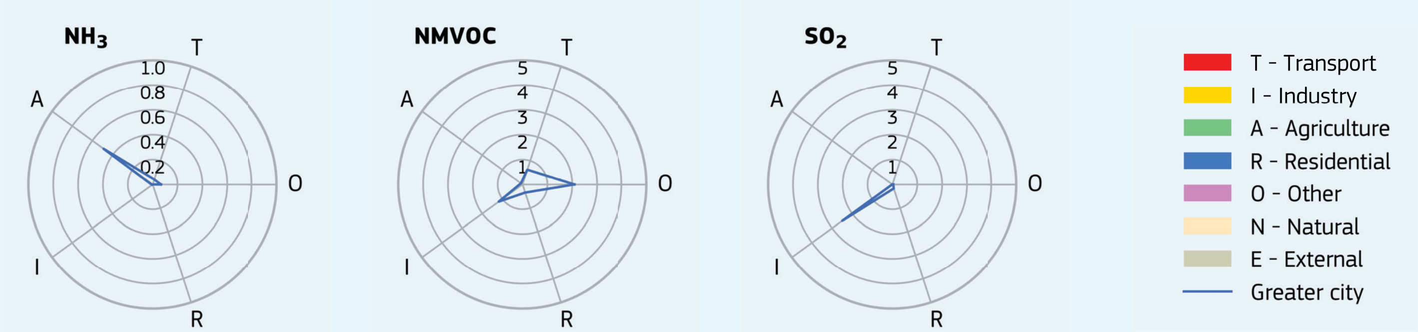


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

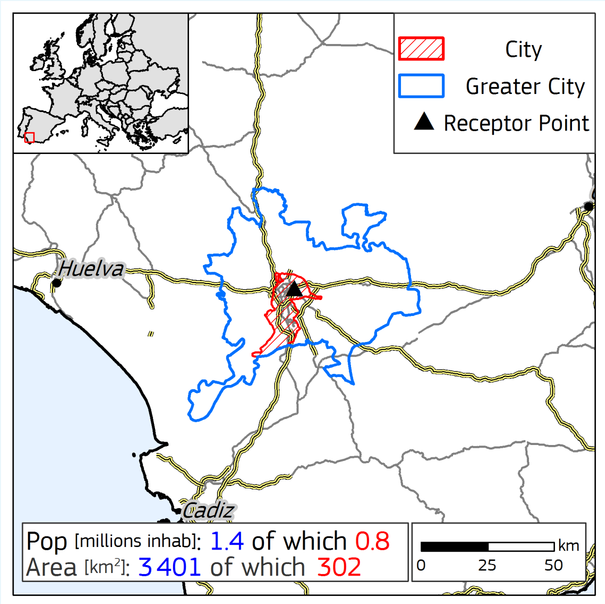


Emissions [kton/year]

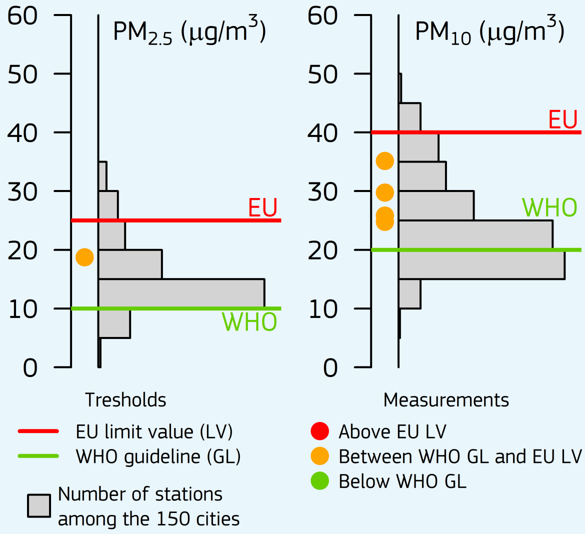




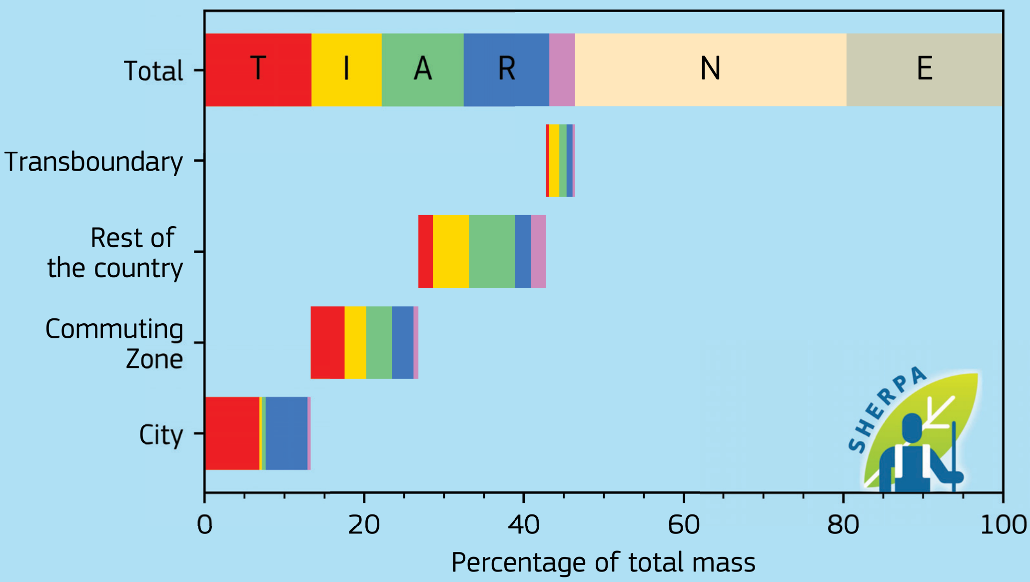
Spain, Seville



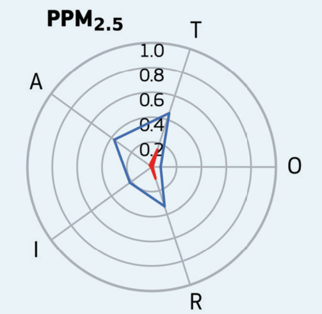
Yearly average urban background (2015)

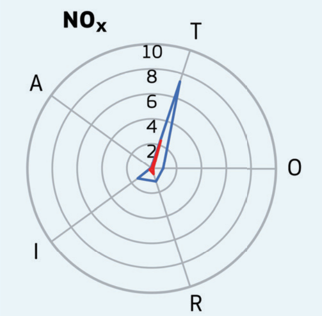


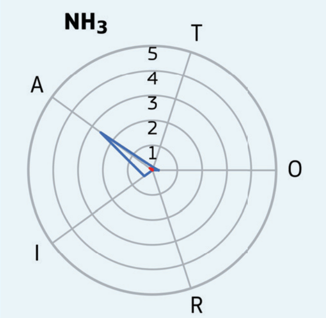
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

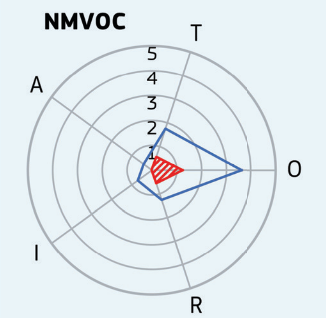


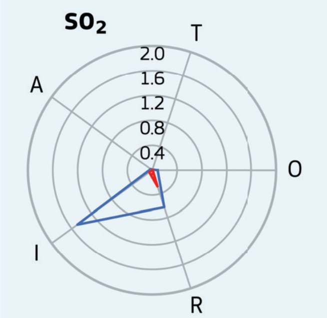
Emissions [kton/year]

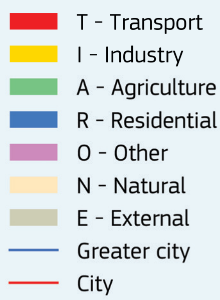




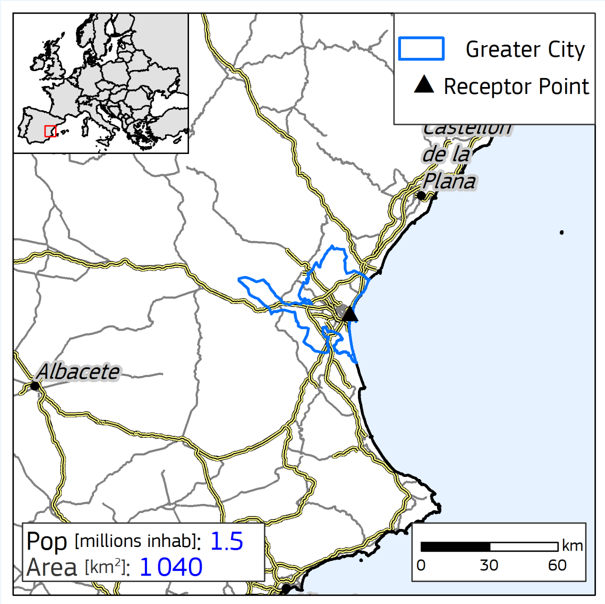




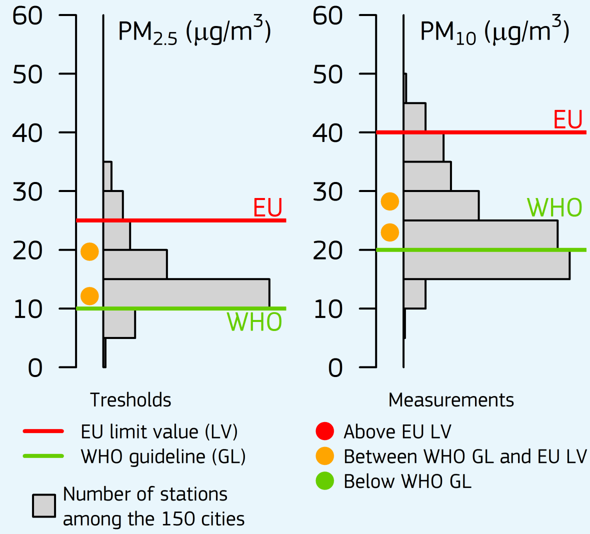




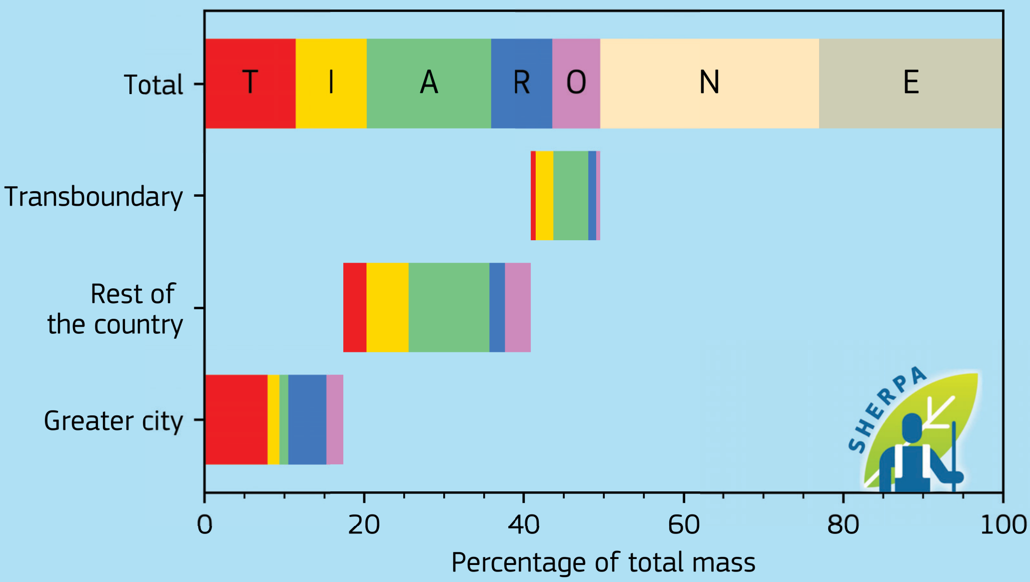
Spain, Valencia



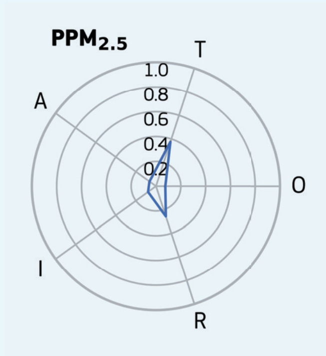
Yearly average urban background (2015)

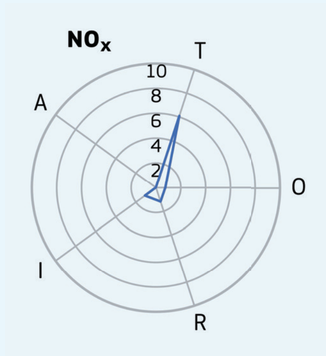


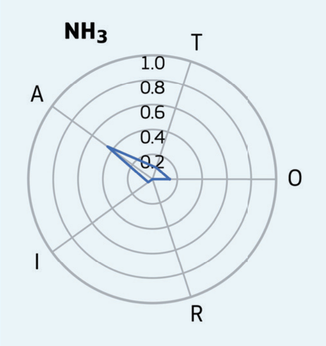
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

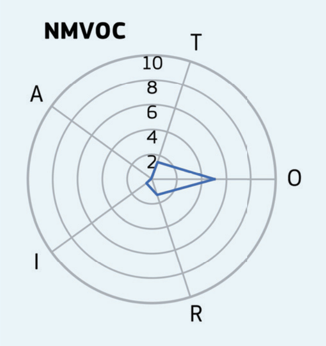


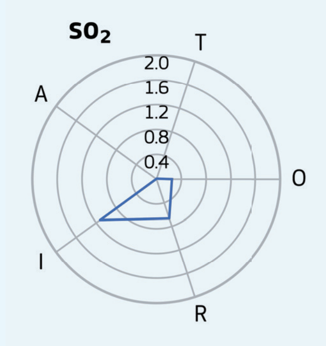
Emissions [kton/year]



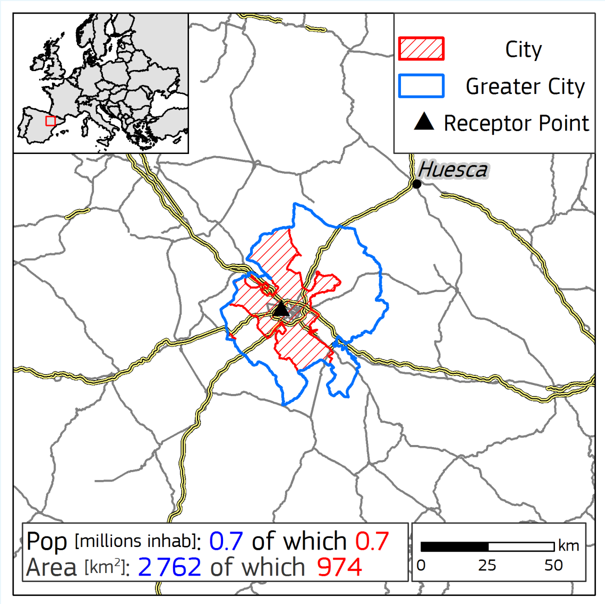




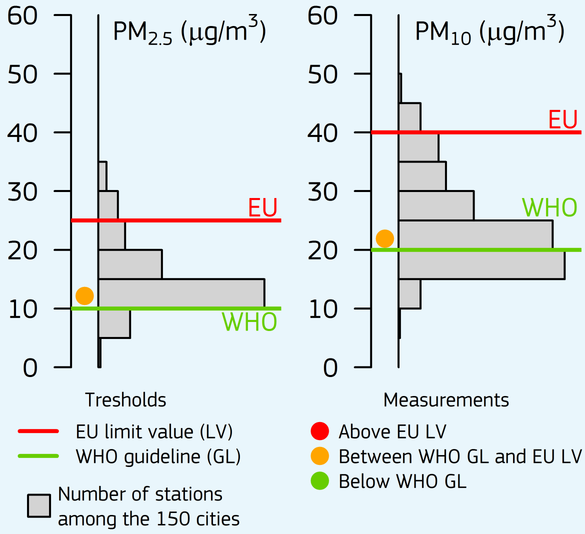




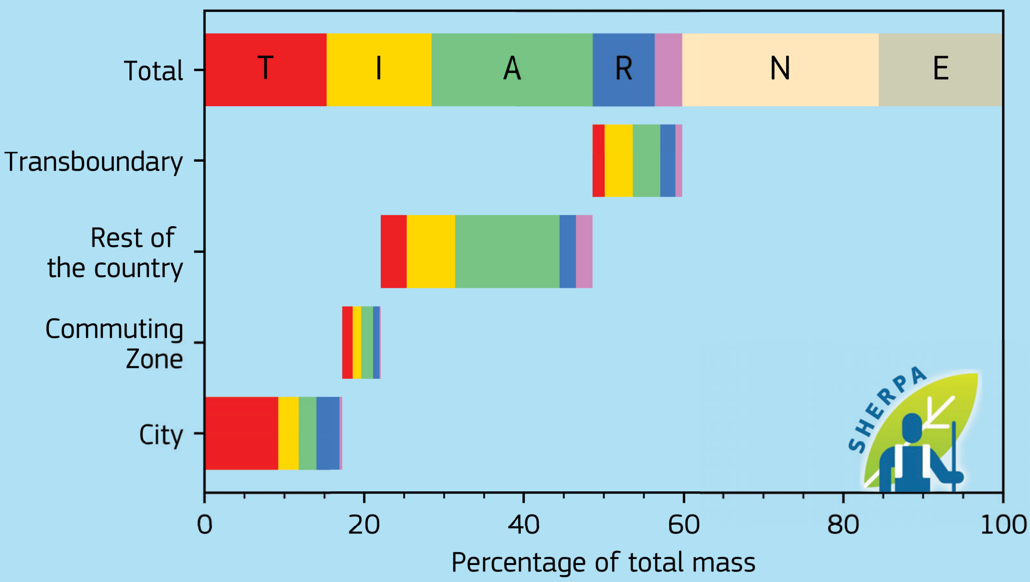
Spain, Zaragoza



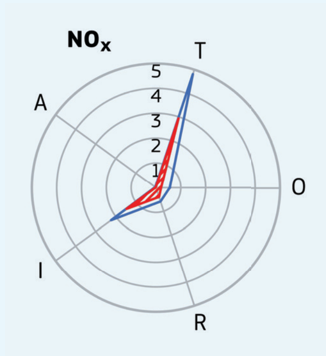
Yearly average urban background (2015)

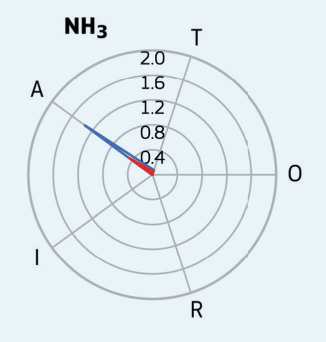


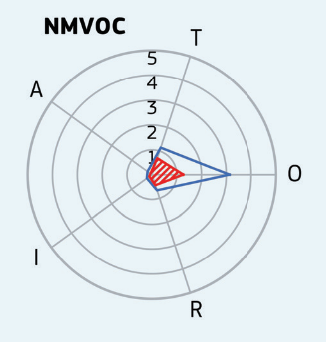
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

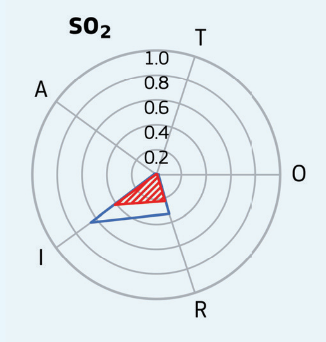


Emissions [kton/year]

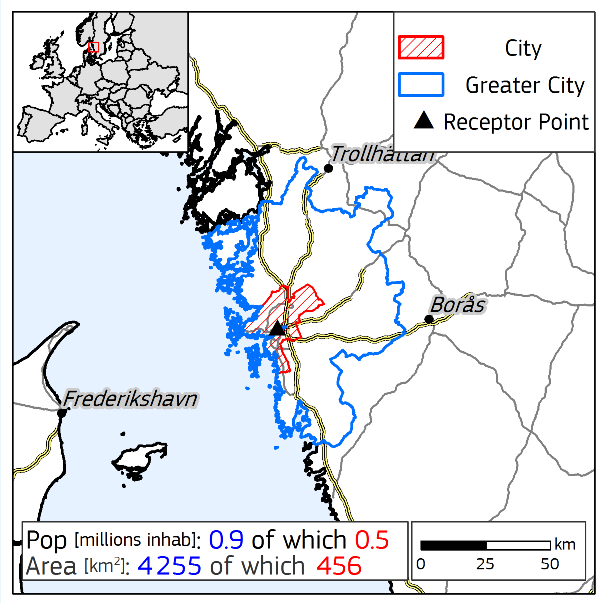




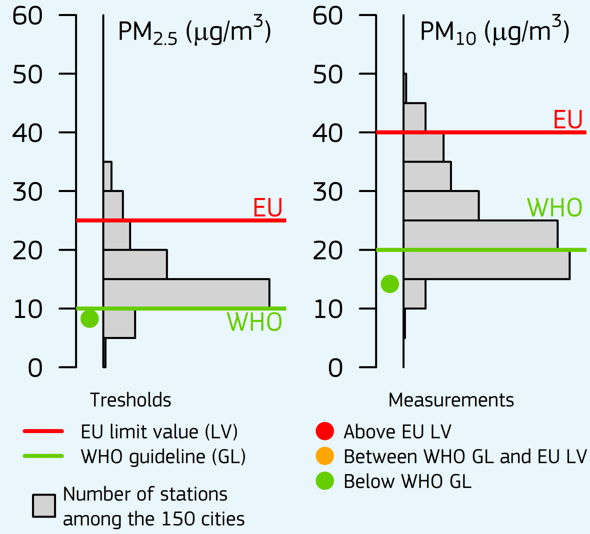




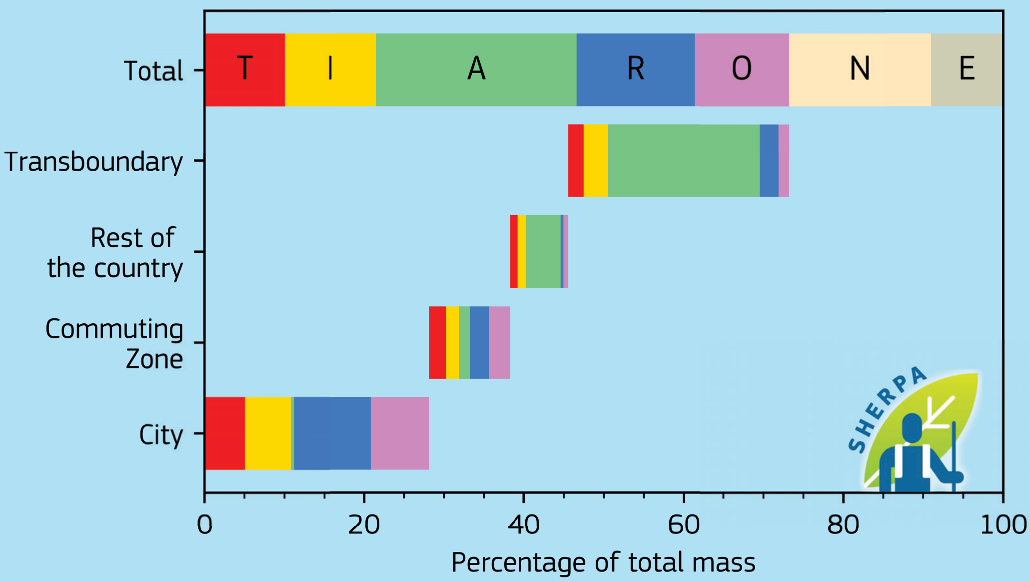
Sweden, Gothenburg



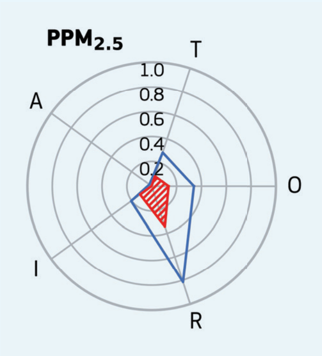
Yearly average urban background (2015)

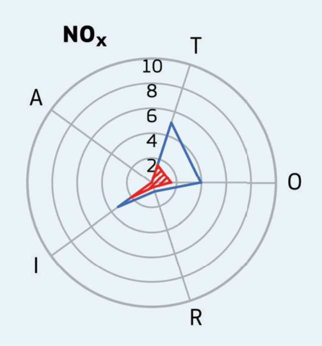


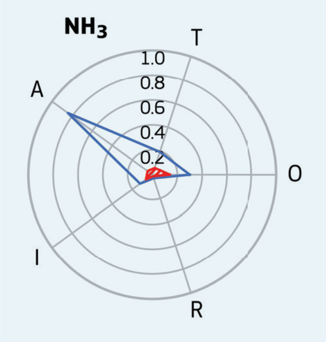
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

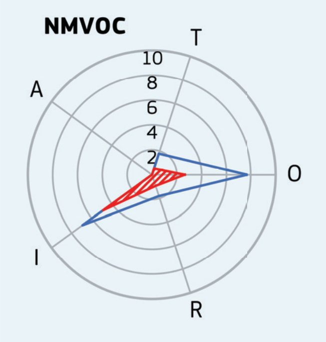


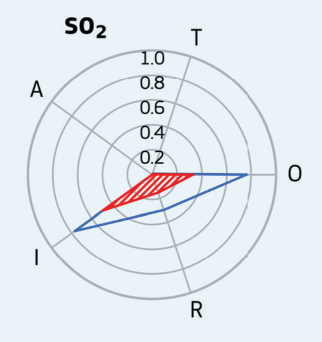
Emissions [kton/year]



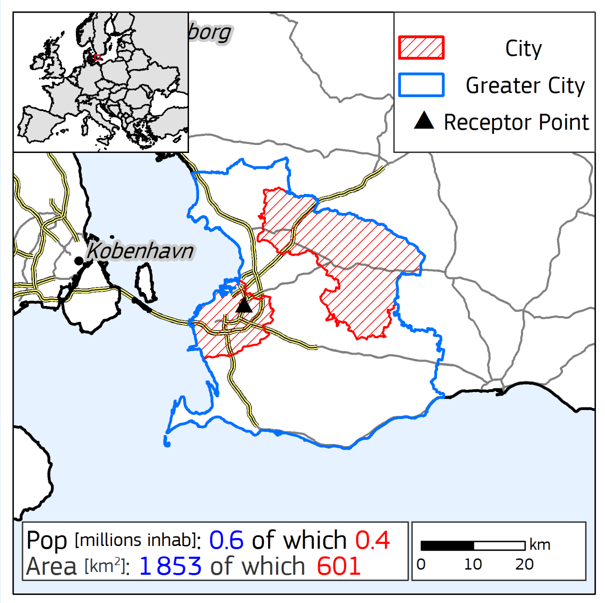




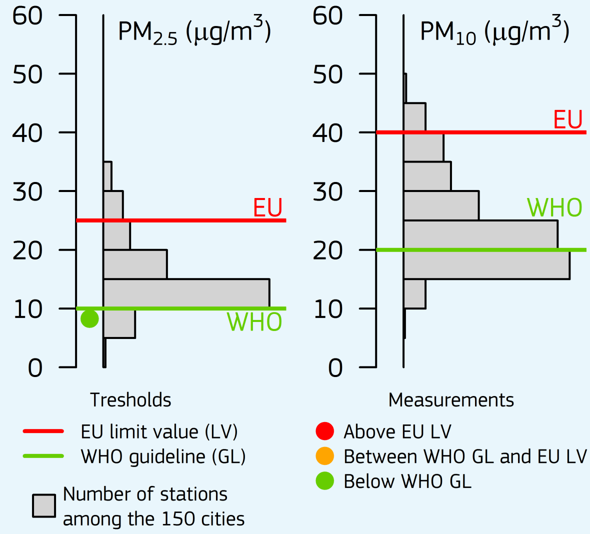




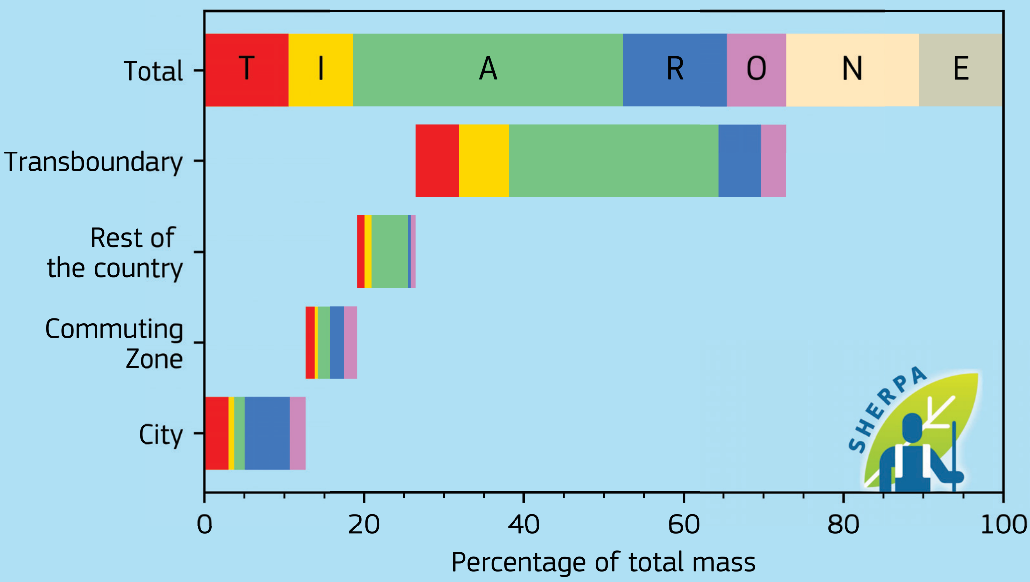
Sweden, Malmö



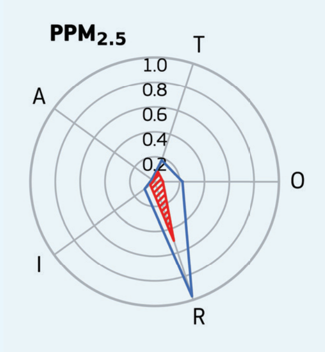
Yearly average urban background (2015)

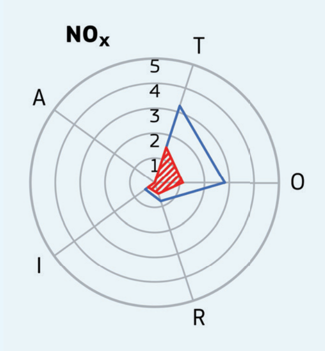


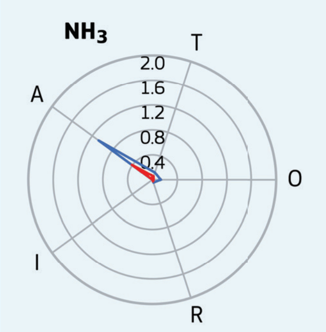
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

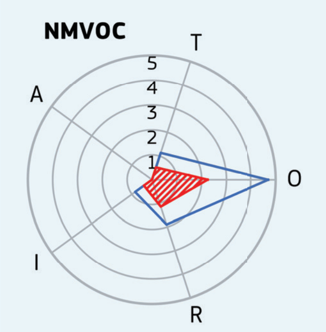


Emissions [kton/year]

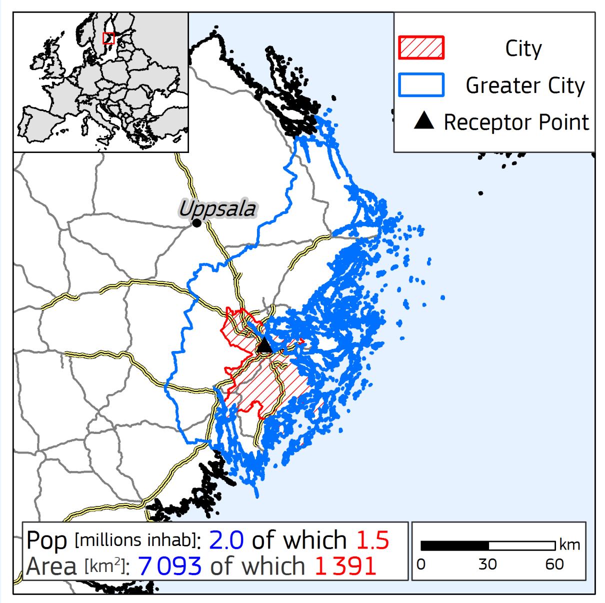




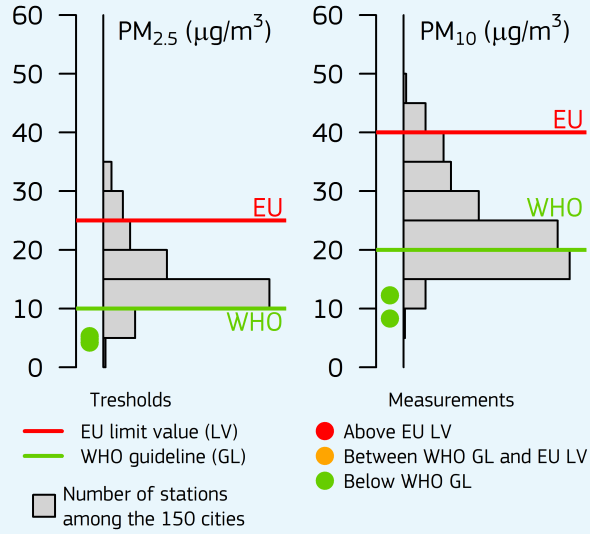




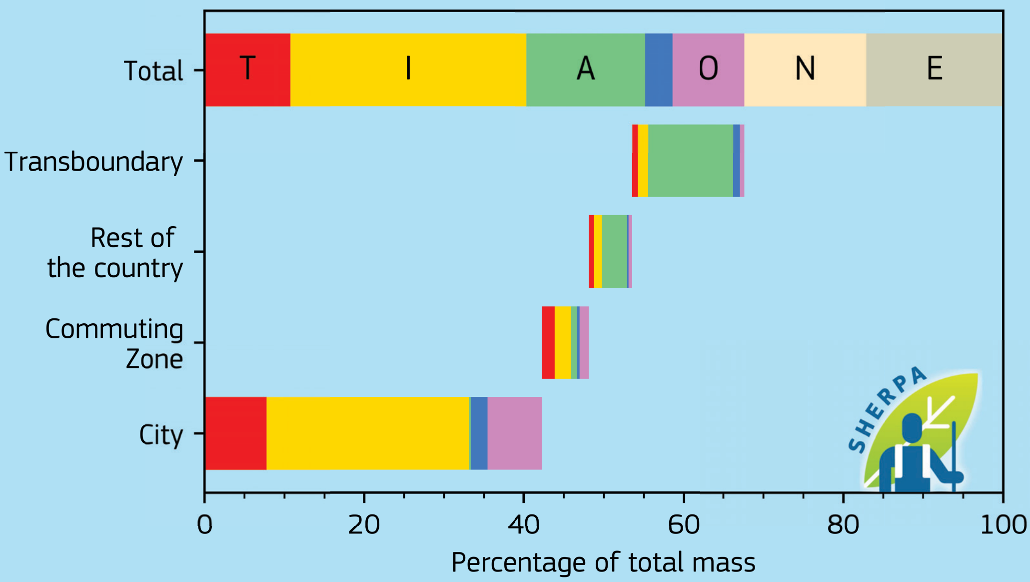
Sweden, Stockholm



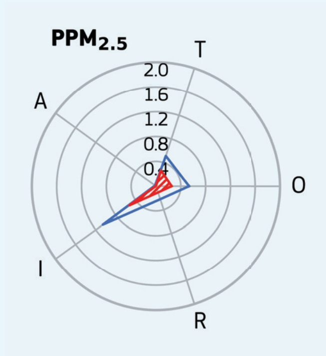
Yearly average urban background (2015)

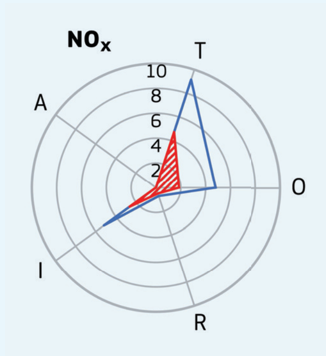


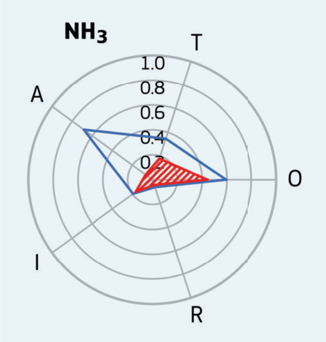
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

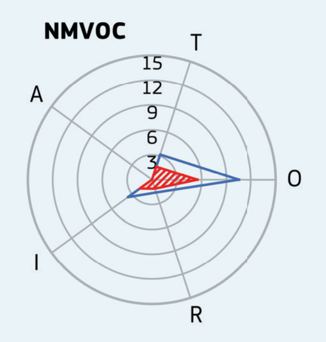


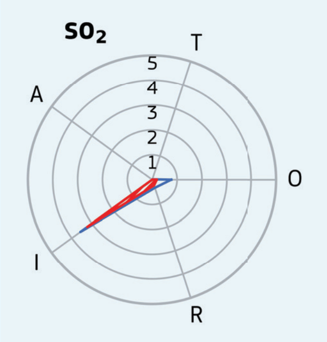
Emissions [kton/year]



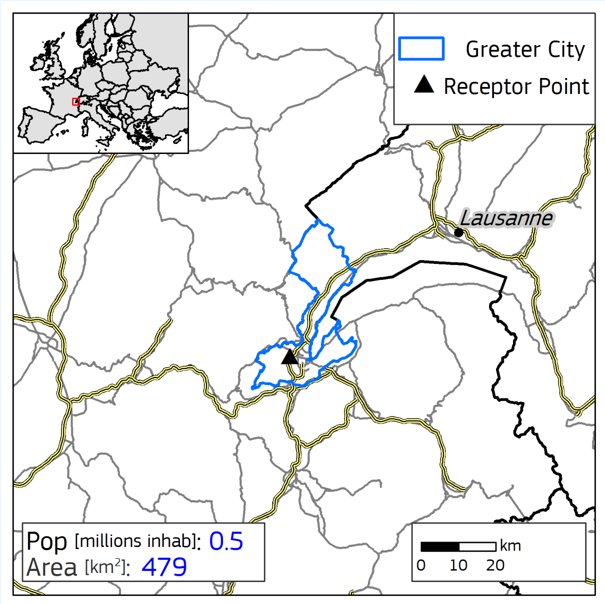




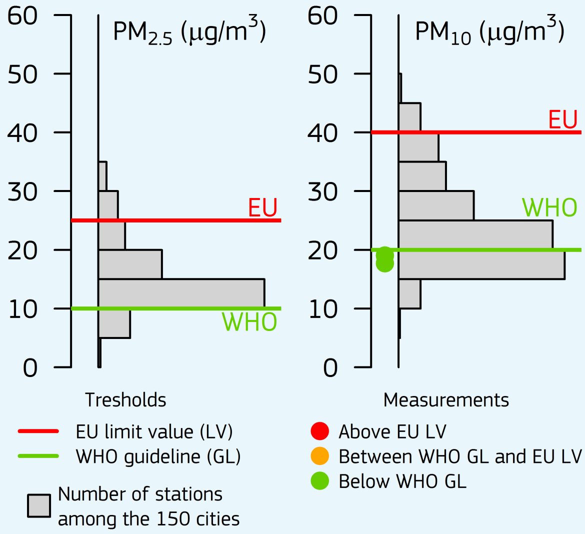




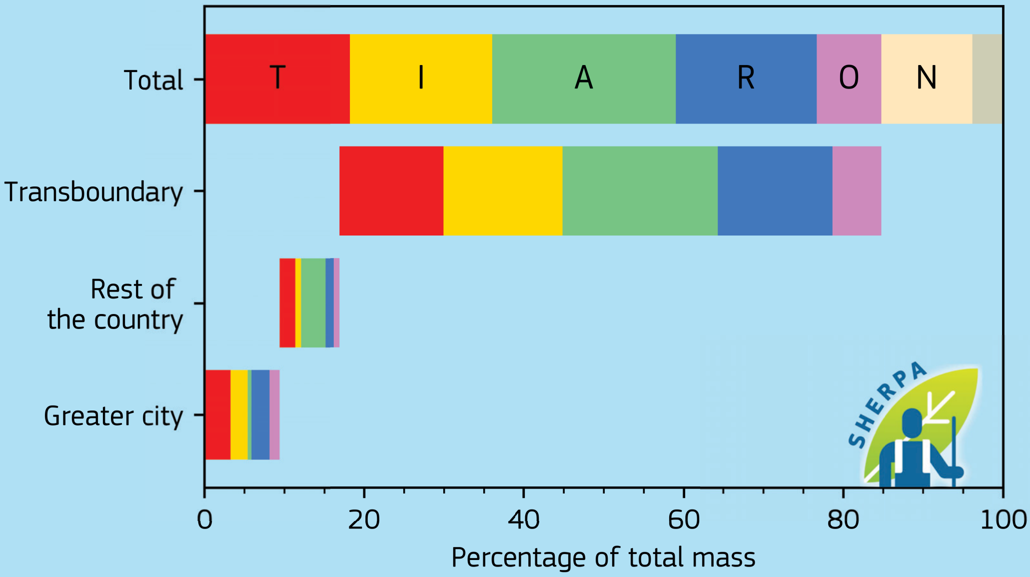
Switzerland, Geneva



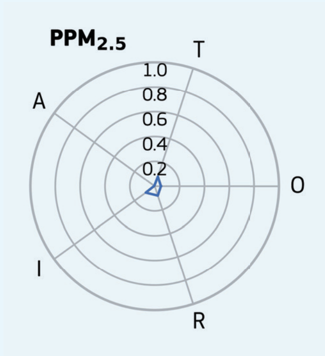
Yearly average urban background (2015)

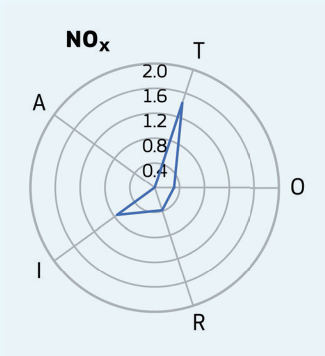


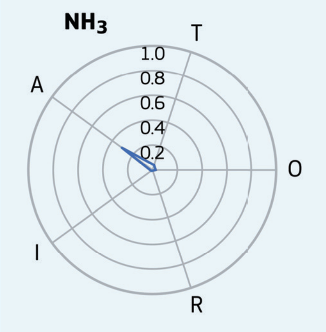
PM$_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

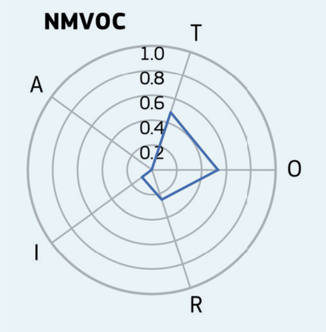


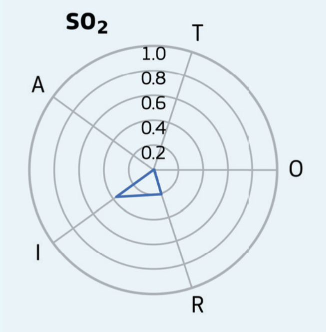
Emissions [kton/year]



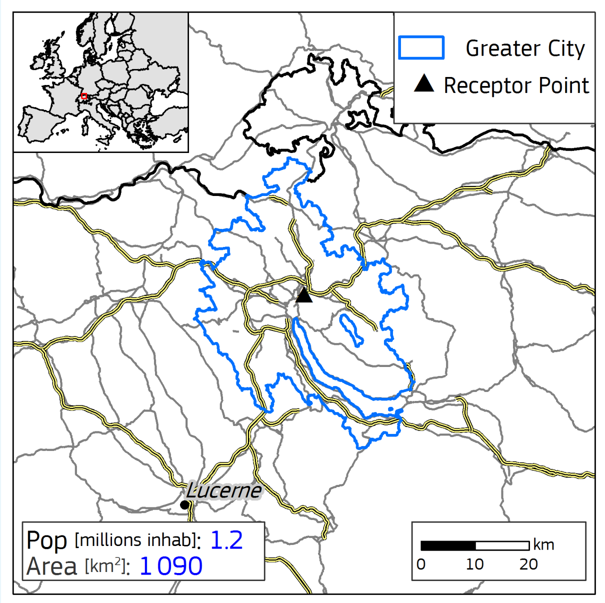




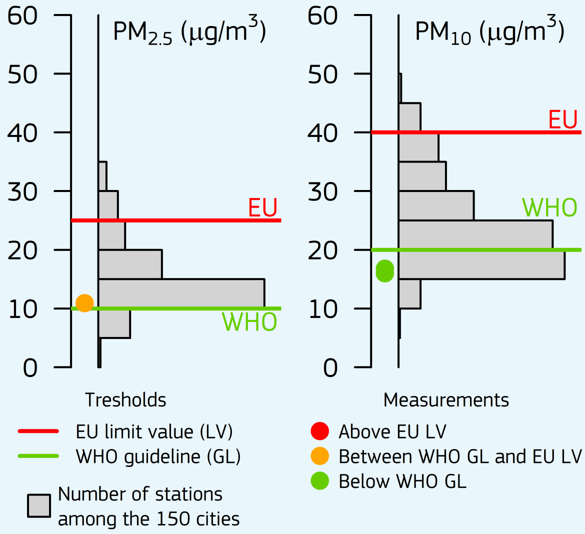




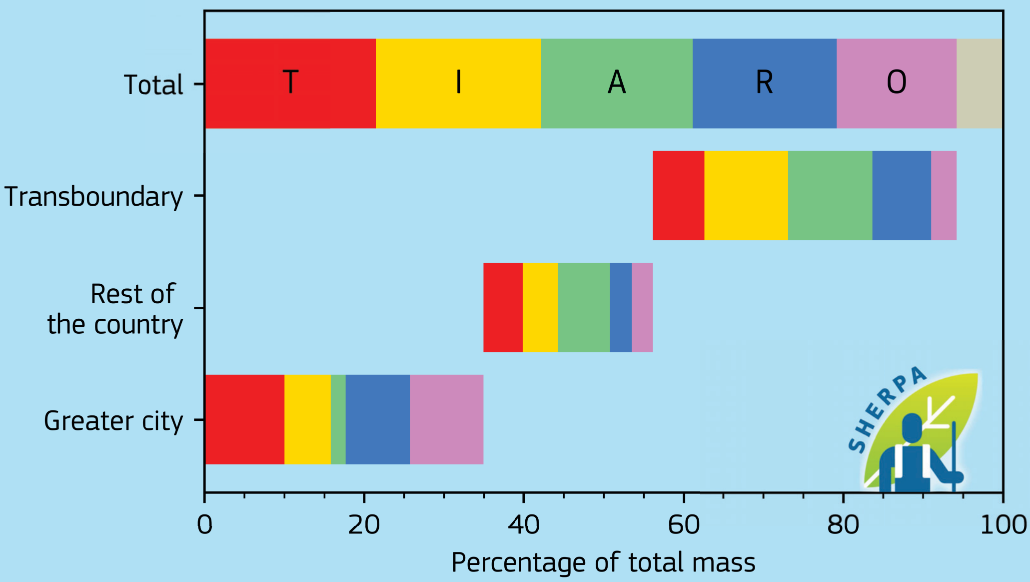
Switzerland, Zürich



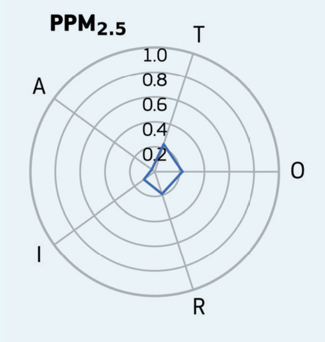
Yearly average urban background (2015)

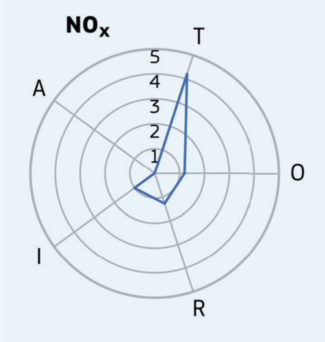


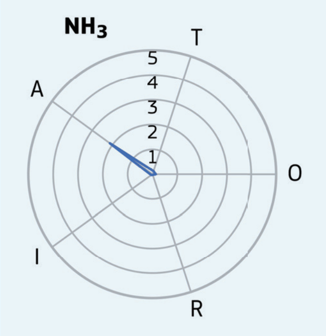
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

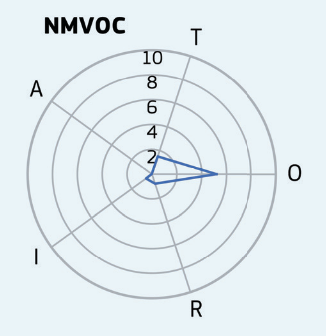


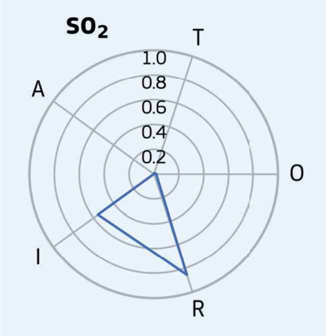
Emissions [kton/year]



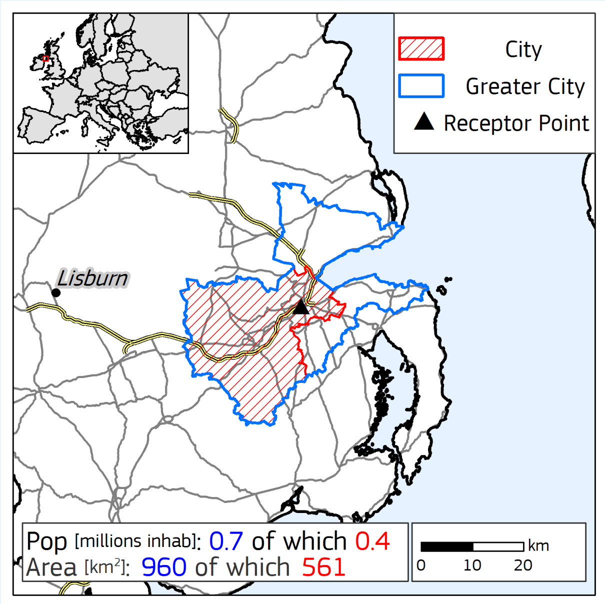




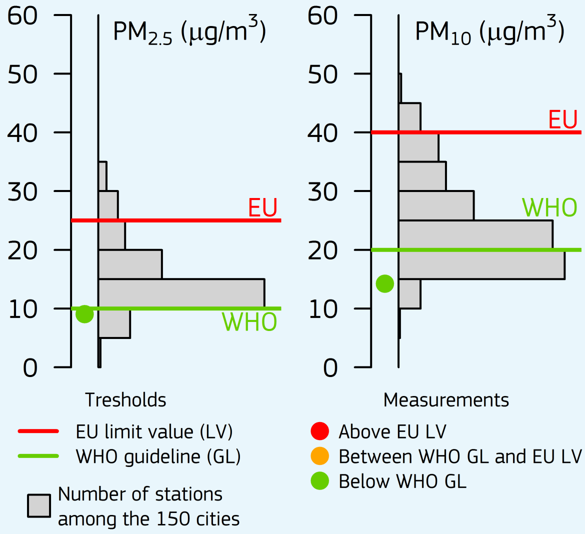




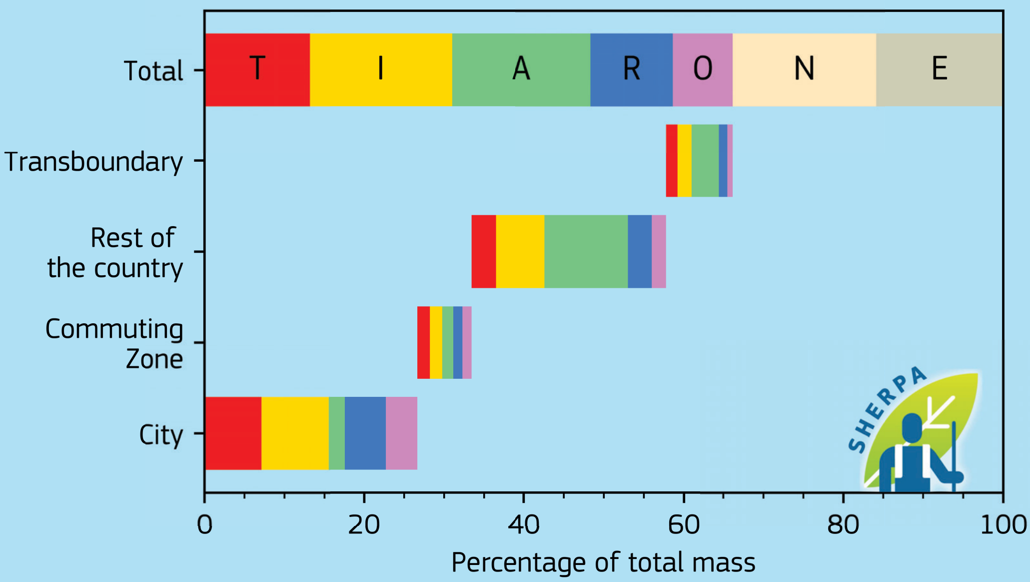
United Kingdom, Belfast



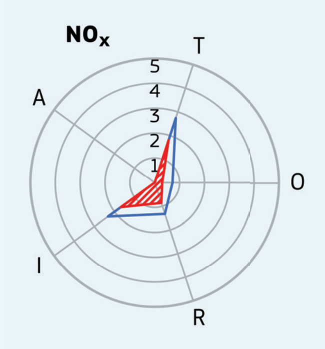
Yearly average urban background (2015)

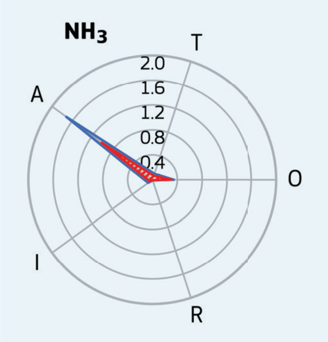


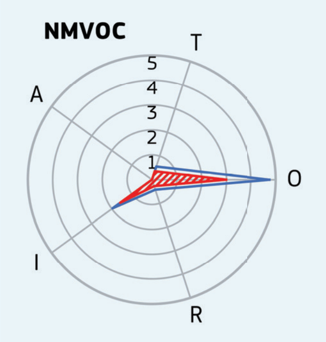
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)



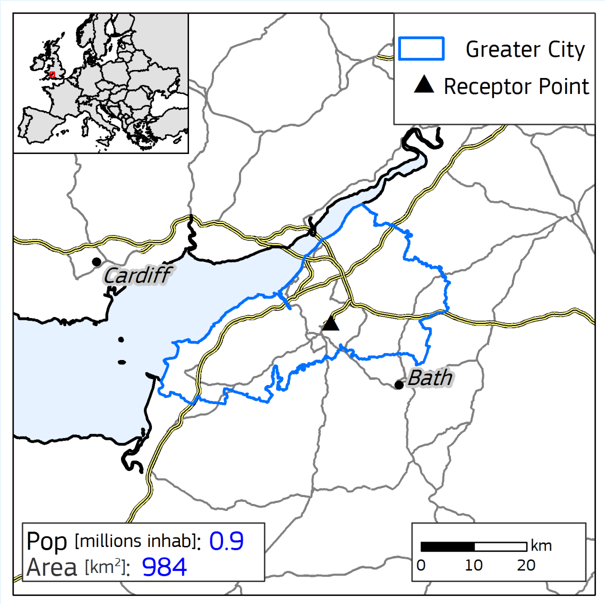
Emissions [kton/year]



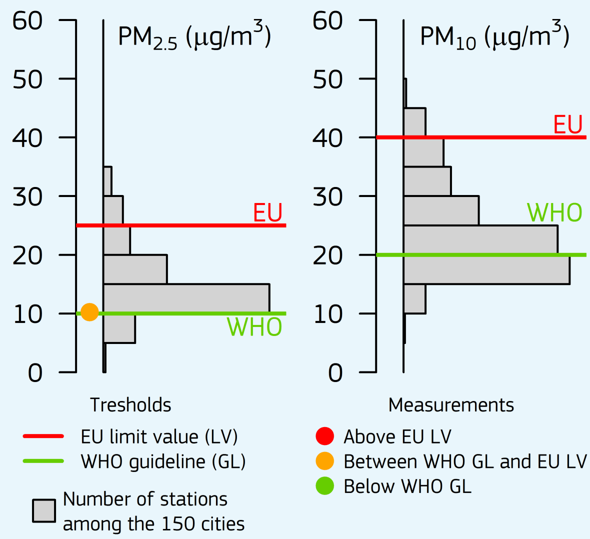




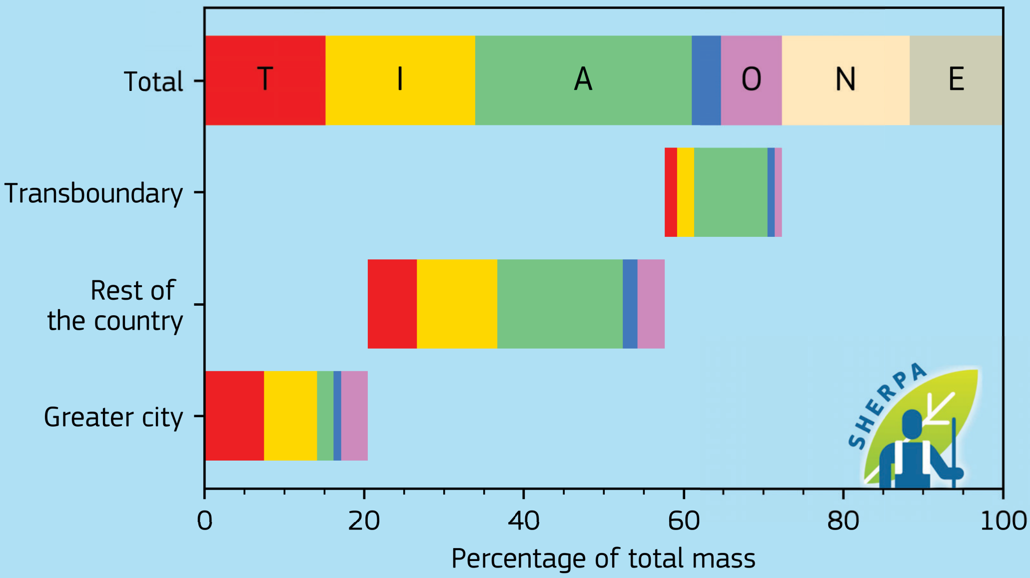
United Kingdom, Bristol



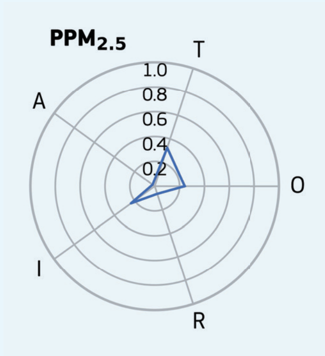
Yearly average urban background (2015)

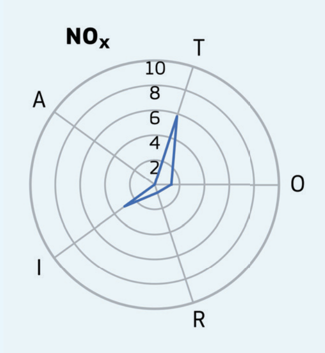


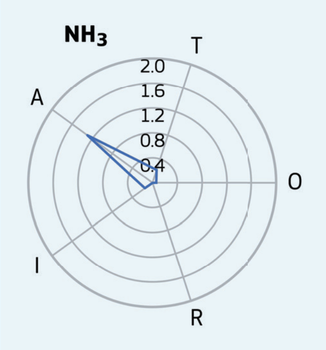
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

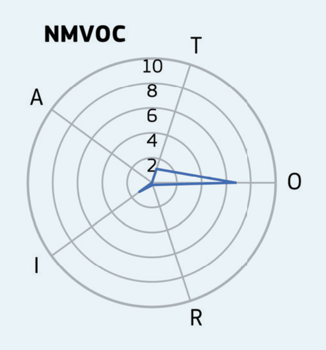


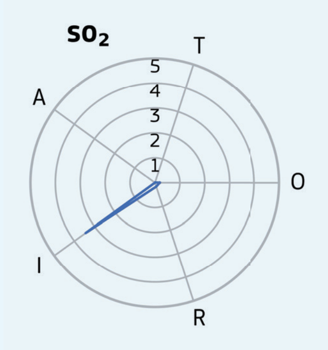
Emissions [kton/year]



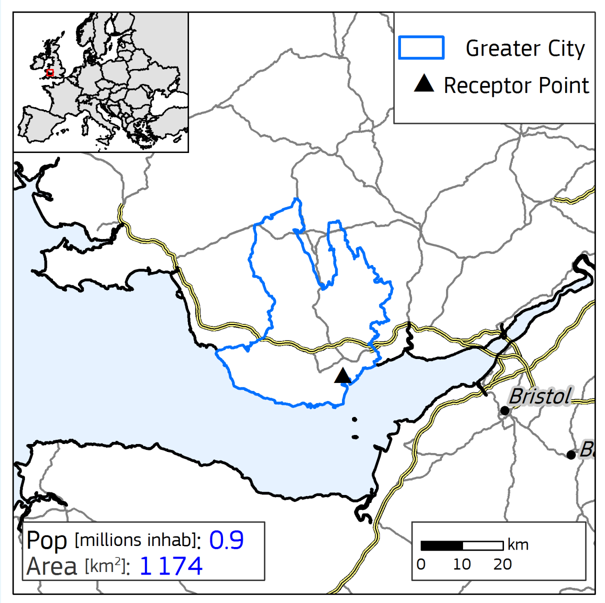




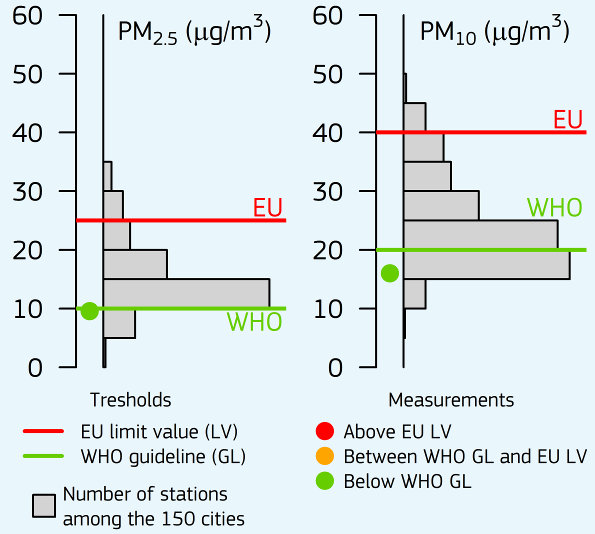




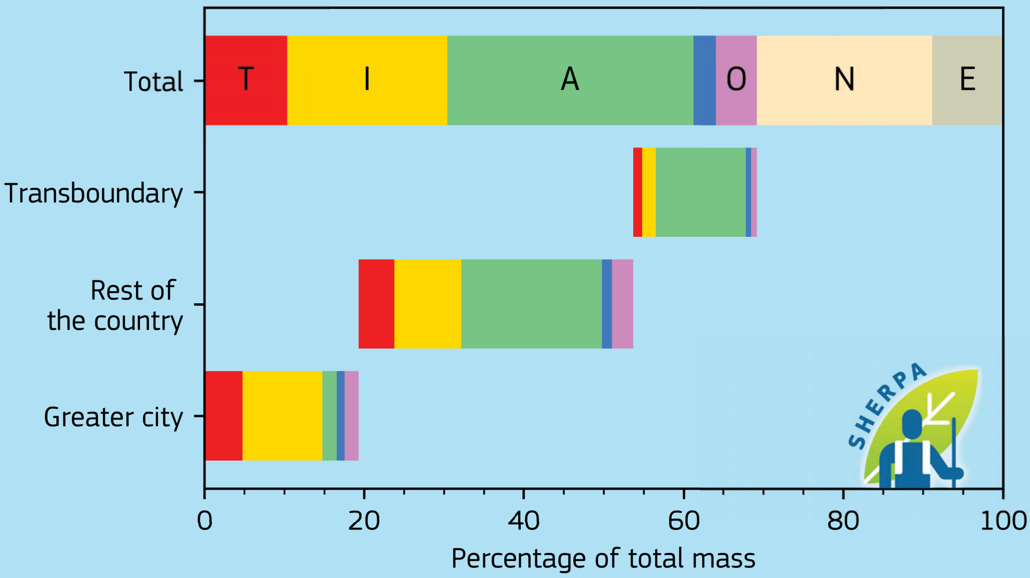
United Kingdom, Cardiff



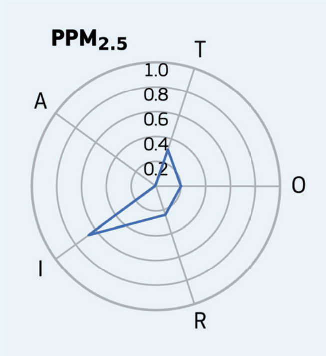
Yearly average urban background (2015)

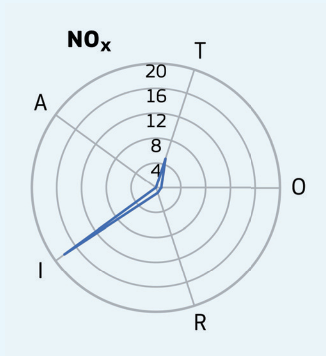


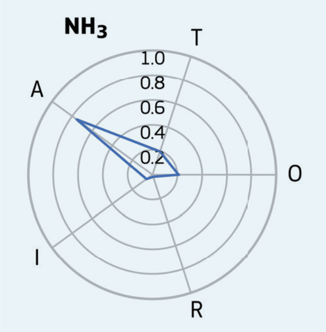
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

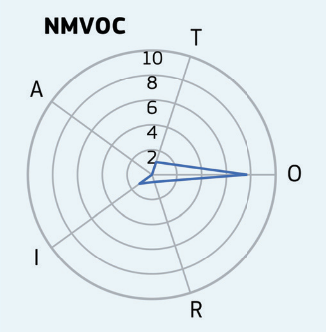


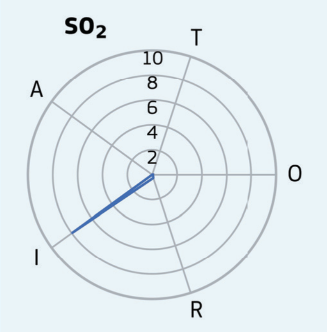
Emissions [kton/year]



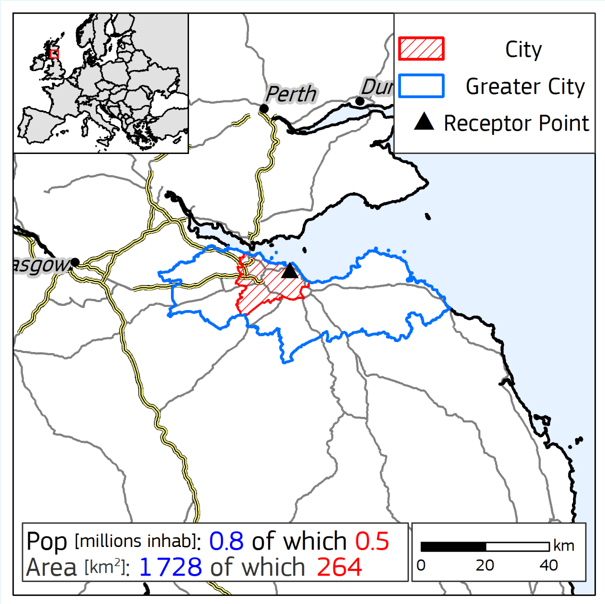




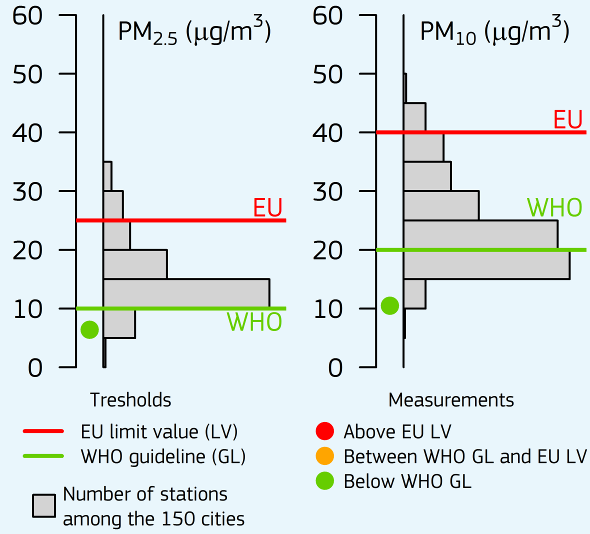




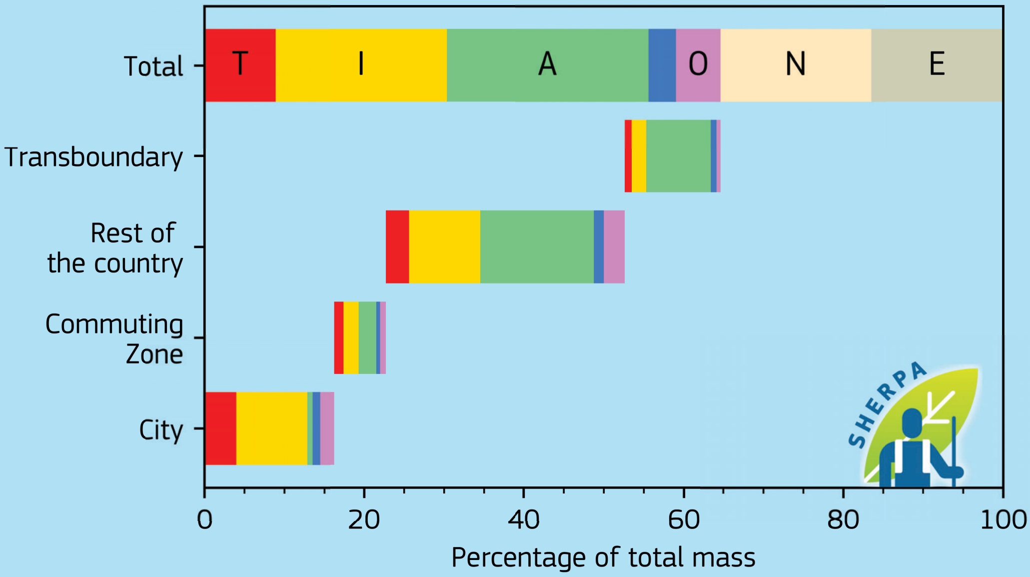
United Kingdom, Edinburgh



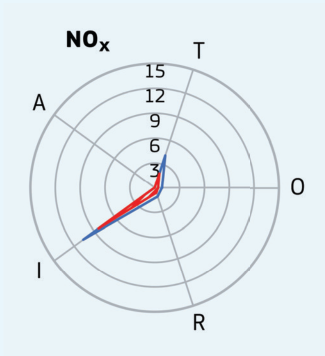
Yearly average urban background (2015)

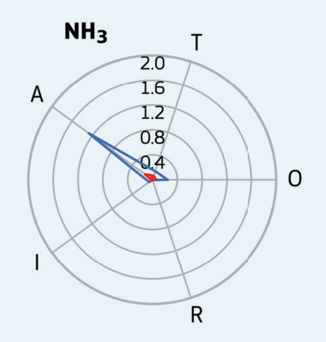


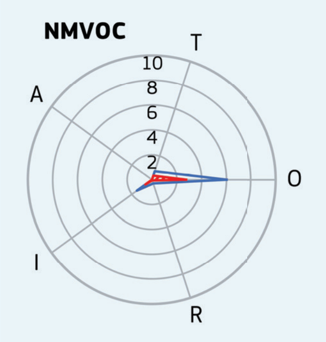
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

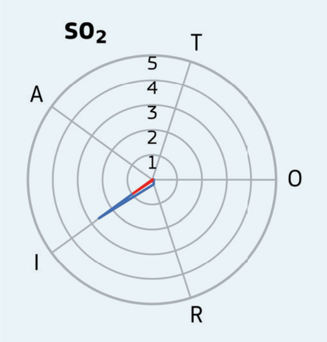


Emissions [kton/year]

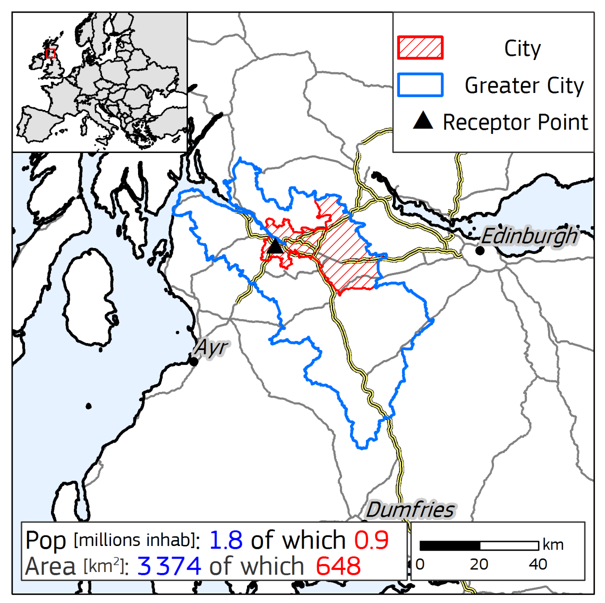




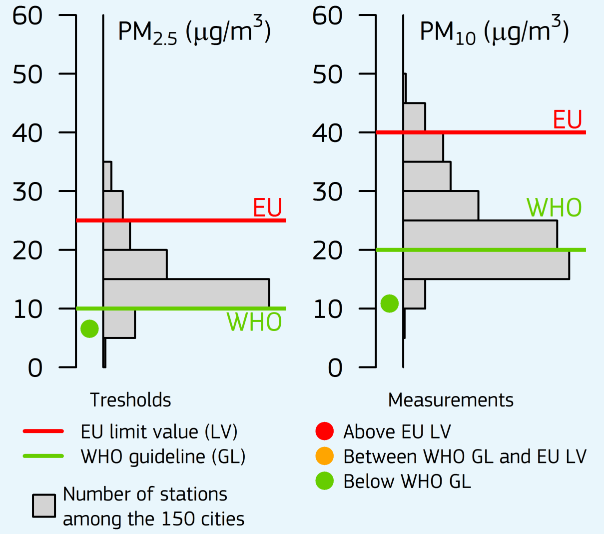




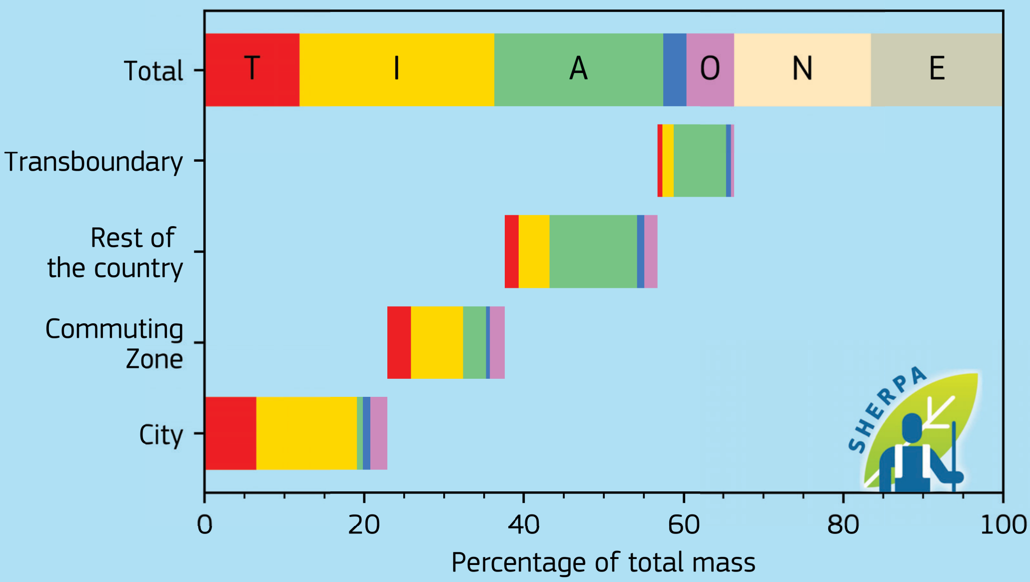
United Kingdom, Glasgow



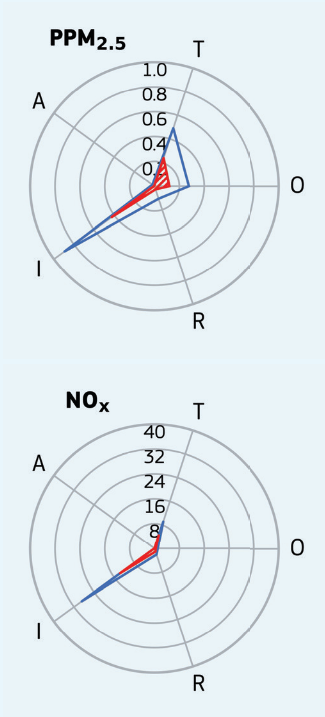
Yearly average urban background (2015)

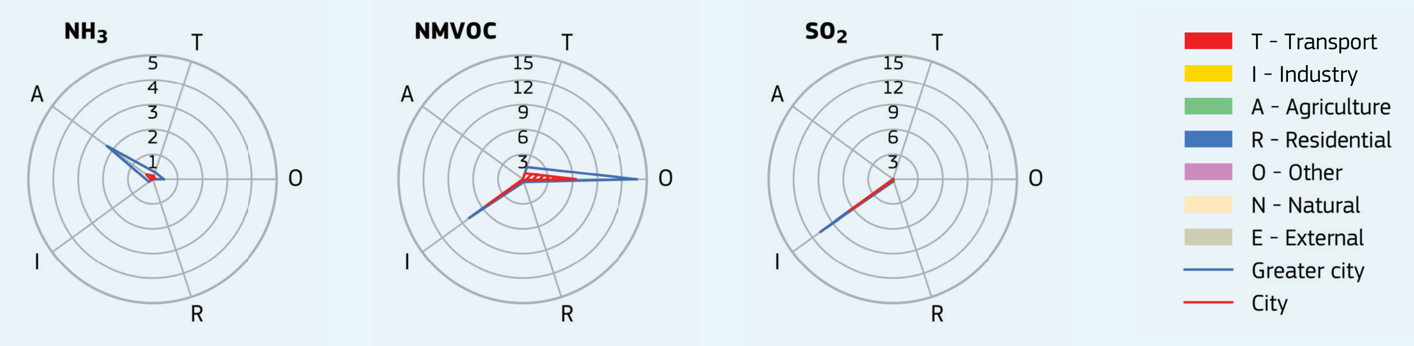


$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

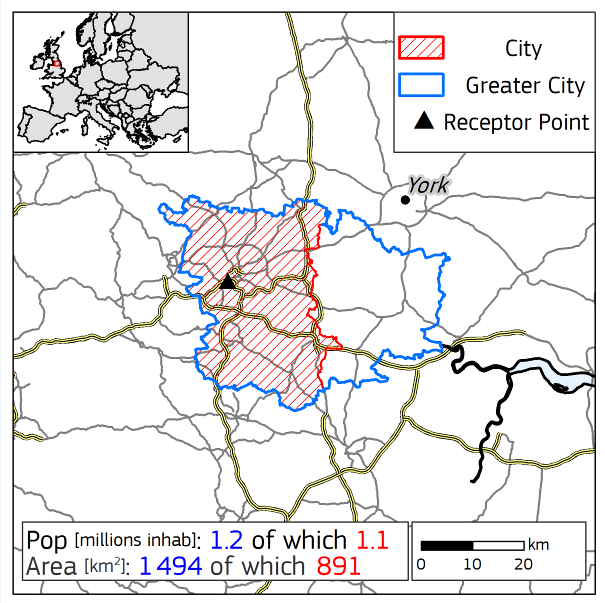


Emissions [kton/year]

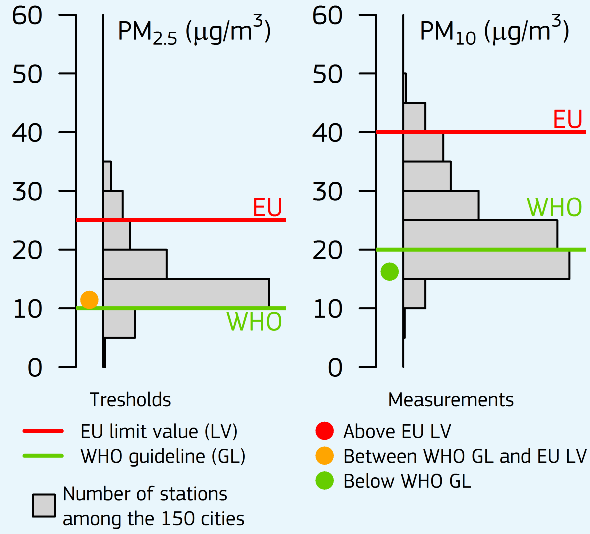




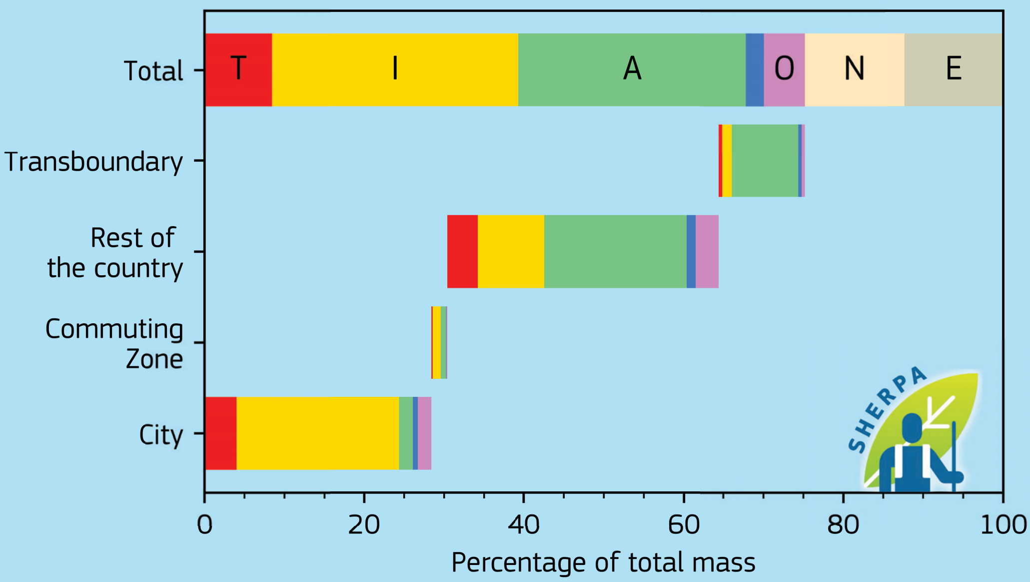
United Kingdom, Leeds



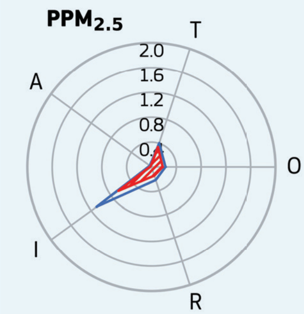
Yearly average urban background (2015)

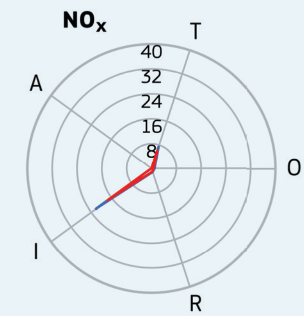


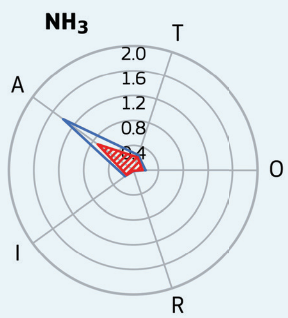
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

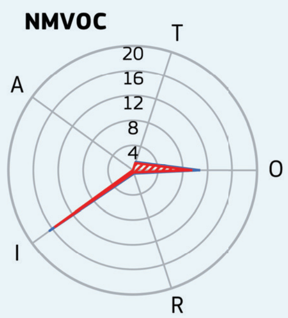


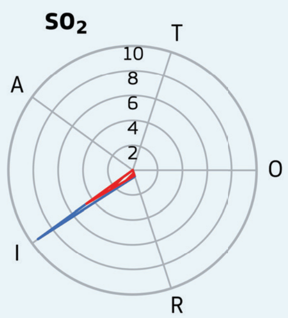
Emissions [kton/year]

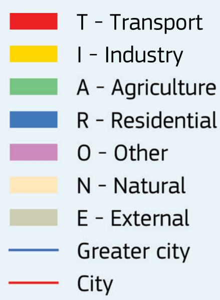




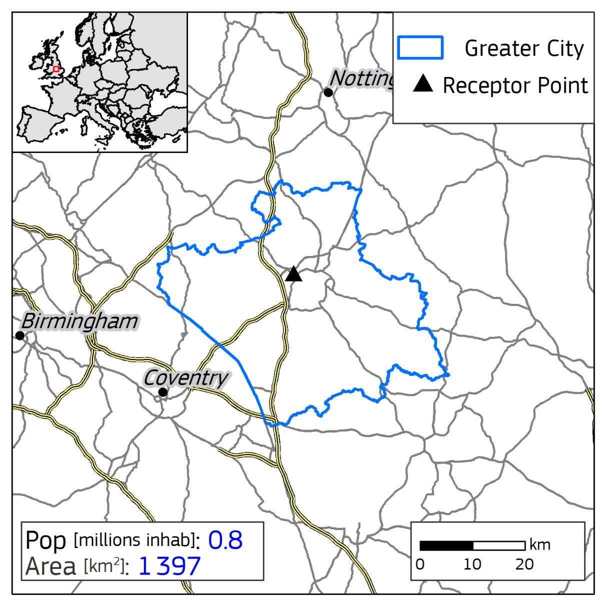




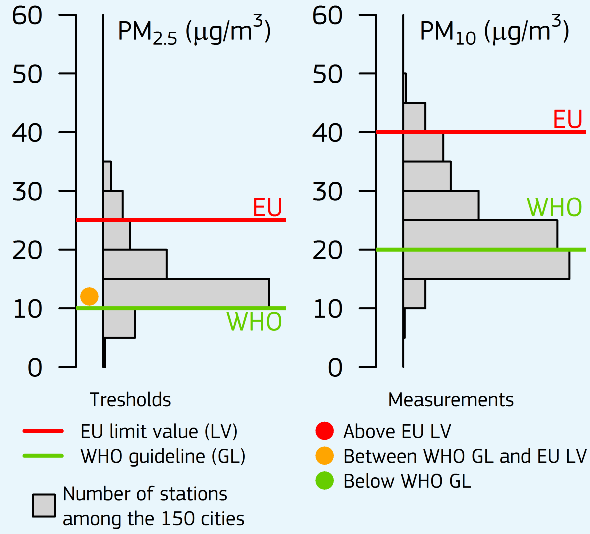




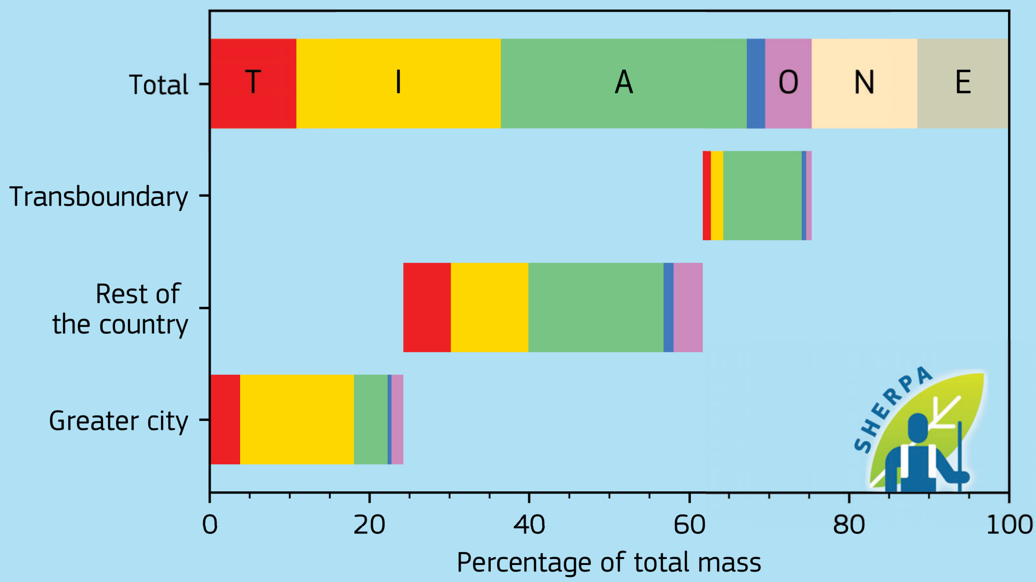
United Kingdom, Leicester



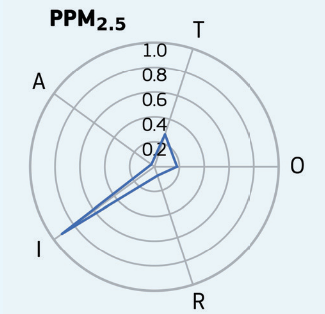
Yearly average urban background (2015)

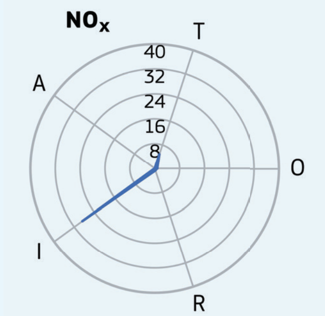


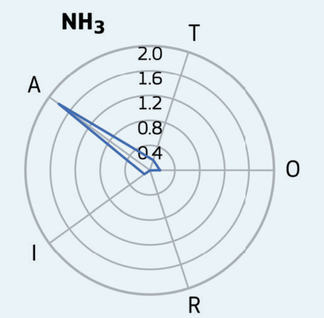
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

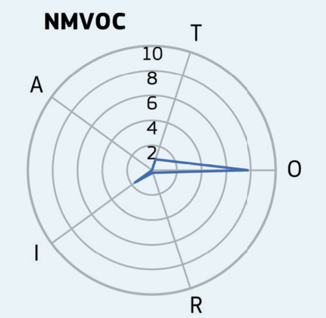


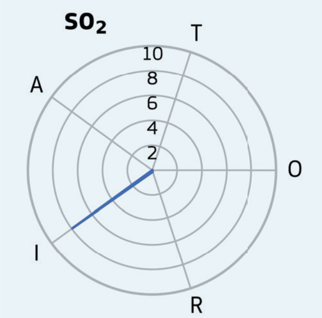
Emissions [kton/year]



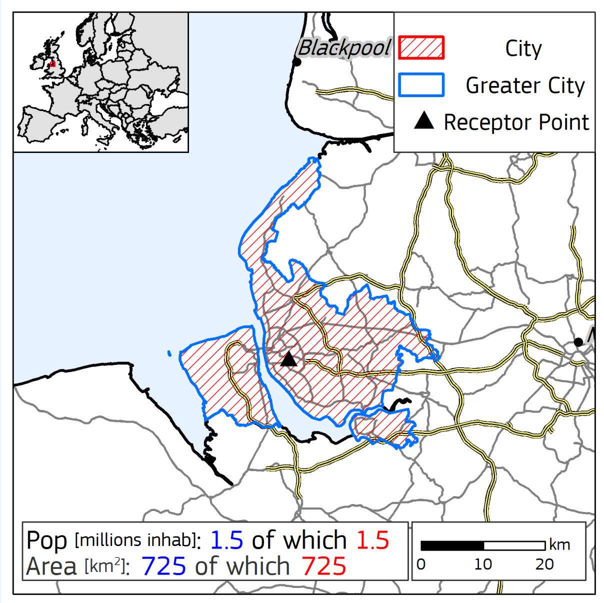




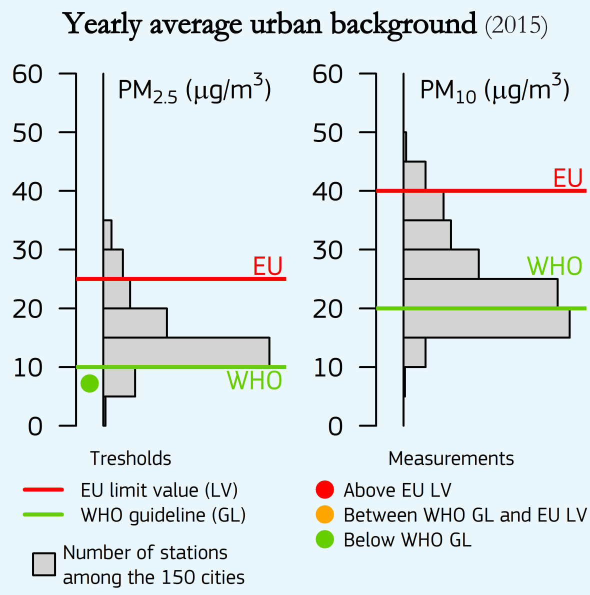




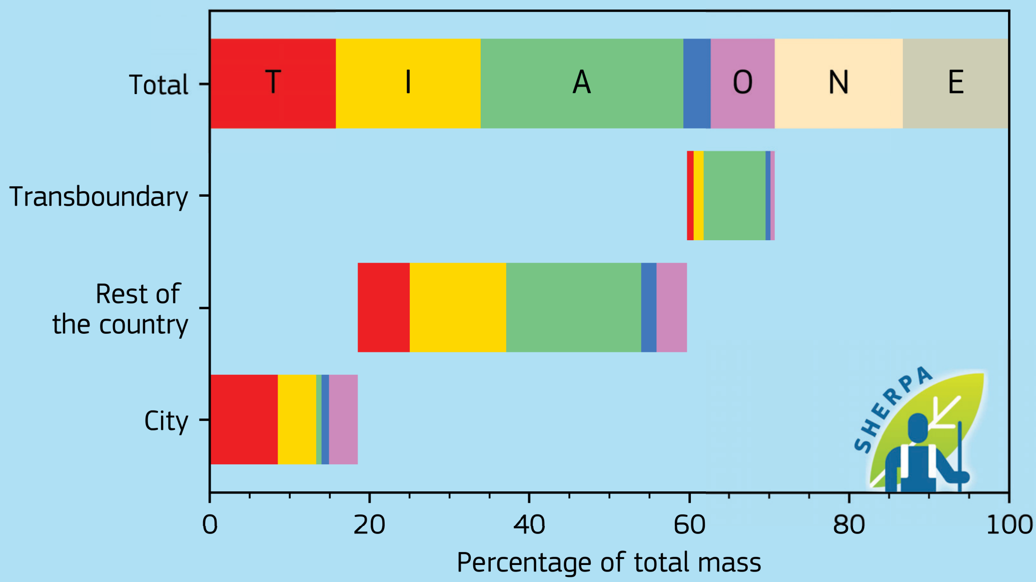
United Kingdom, Liverpool



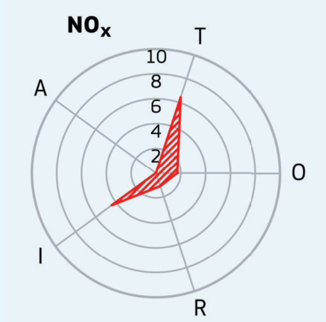
Yearly average urban background (2015)

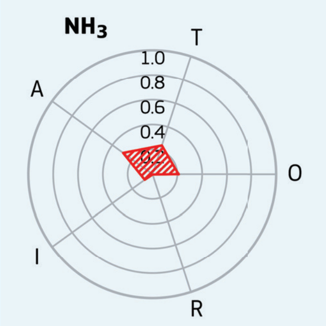


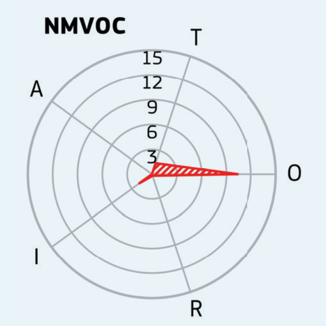
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

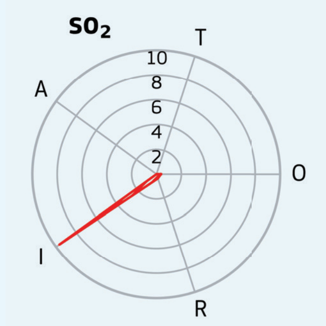


Emissions [kton/year]



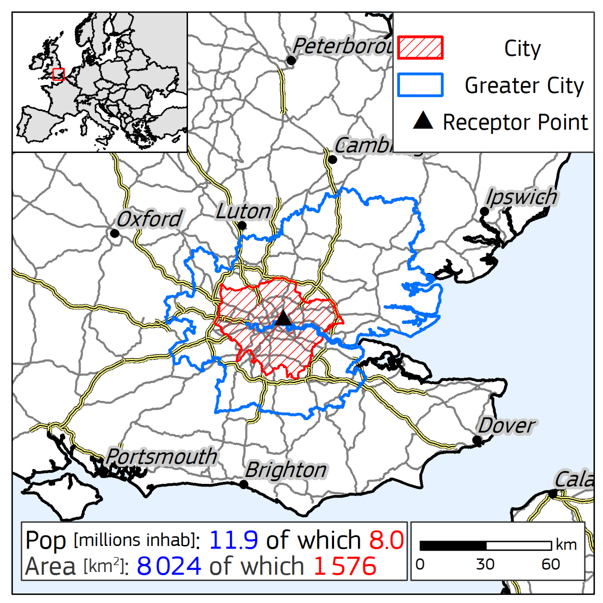




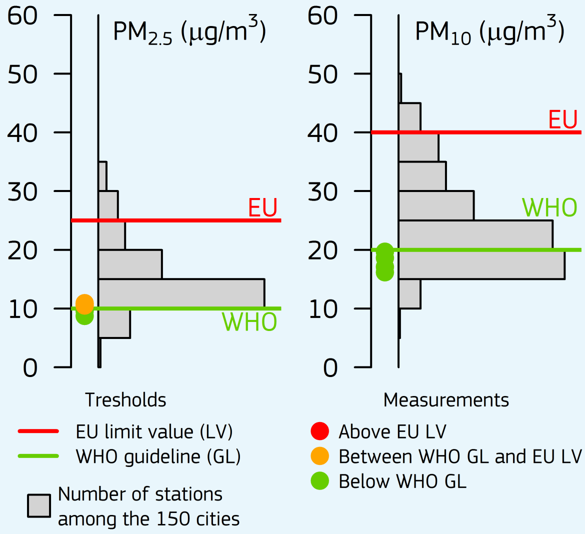


T - Transport
I - Industry
A - Agriculture
R - Residential
O - Other
N - Natural
E - External
Greater city

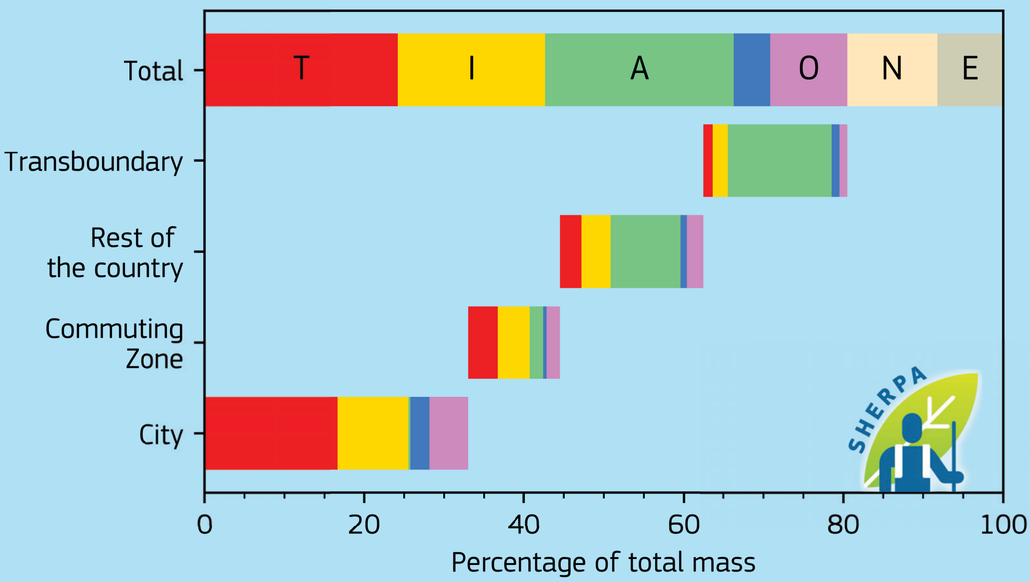
United Kingdom, London



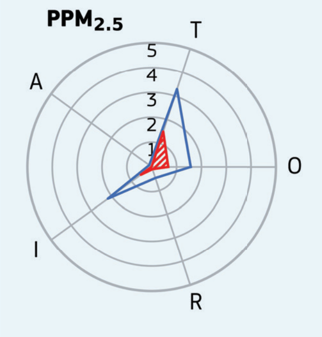
Yearly average urban background (2015)

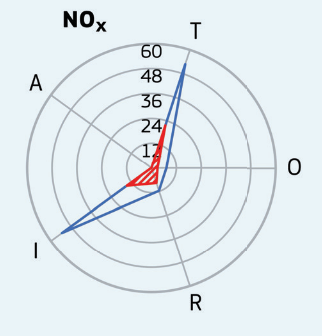


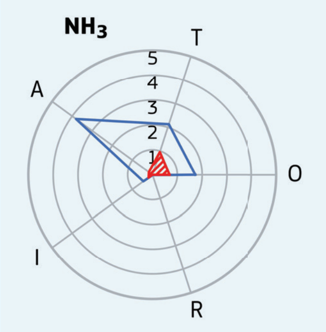
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

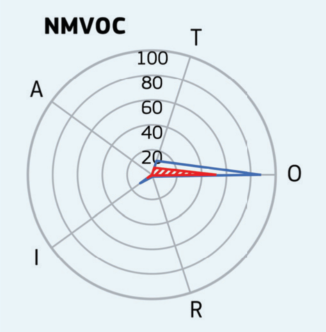


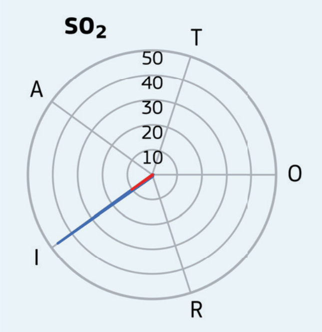
Emissions [kton/year]



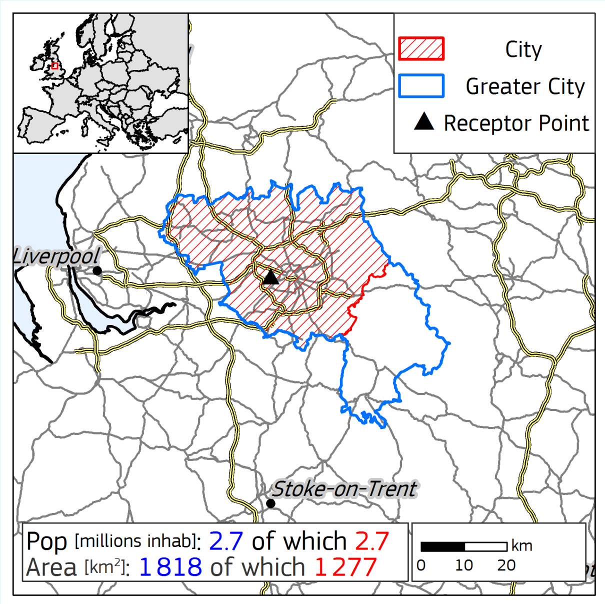




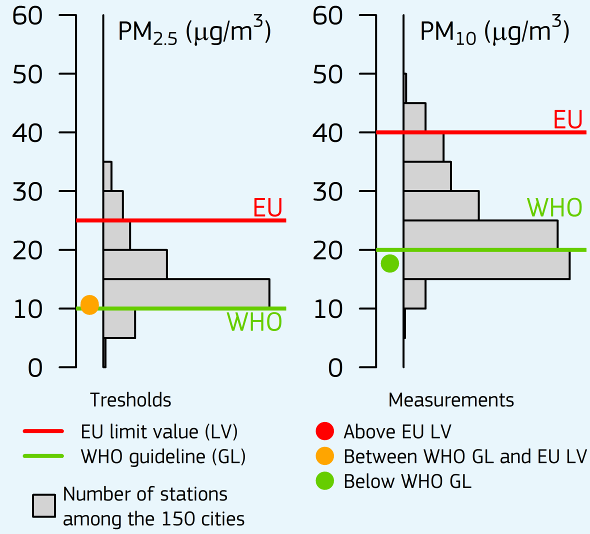




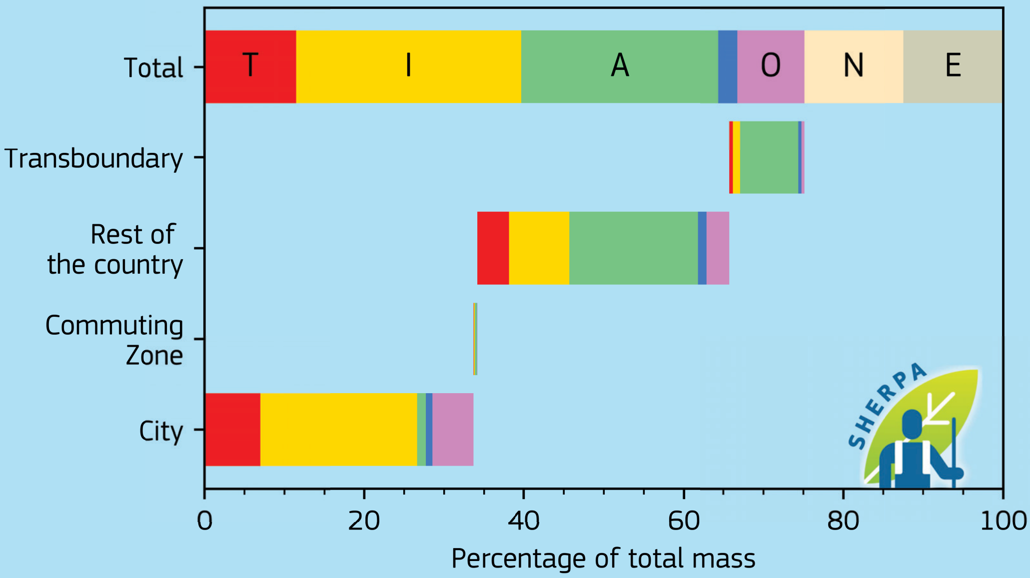
United Kingdom, Manchester



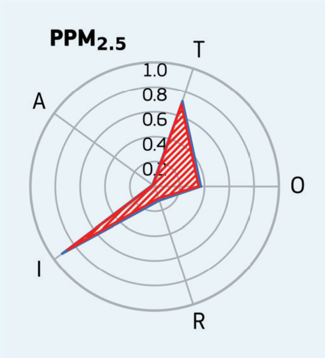
Yearly average urban background (2015)

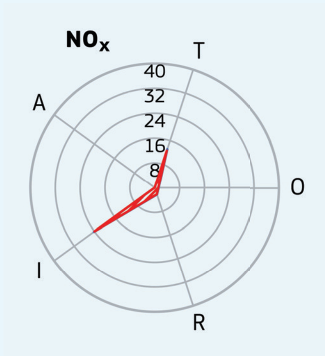


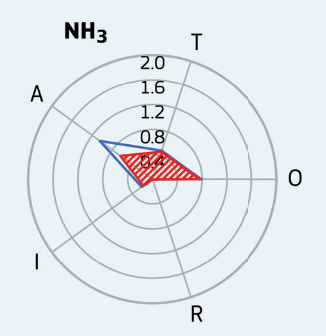
PM2.5 Spatial and sectoral allocation (SHERPA v.1.9)

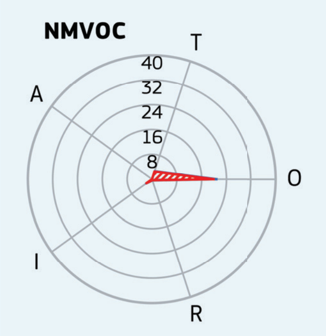


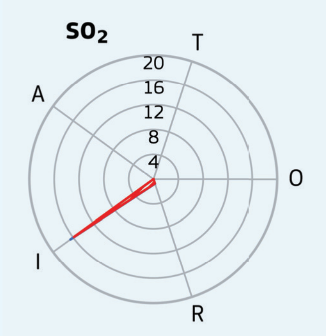
Emissions [kton/year]



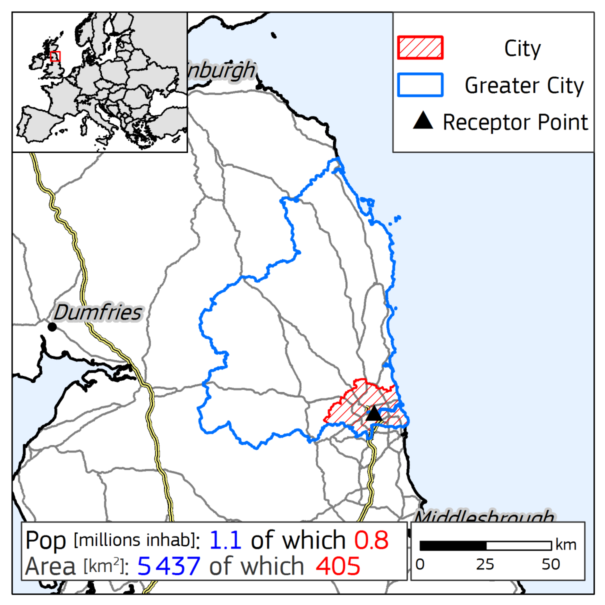




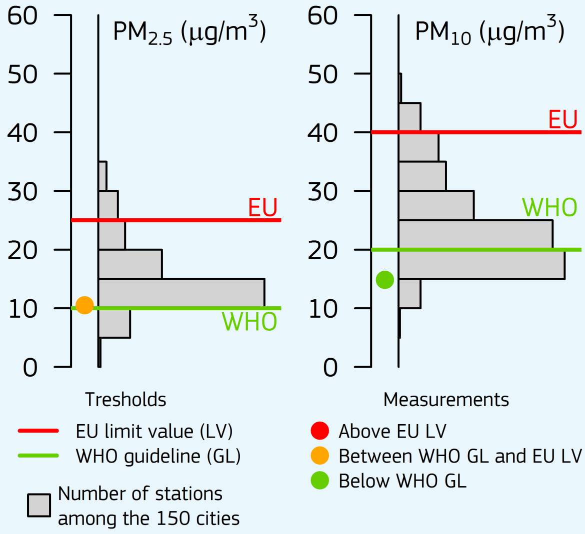




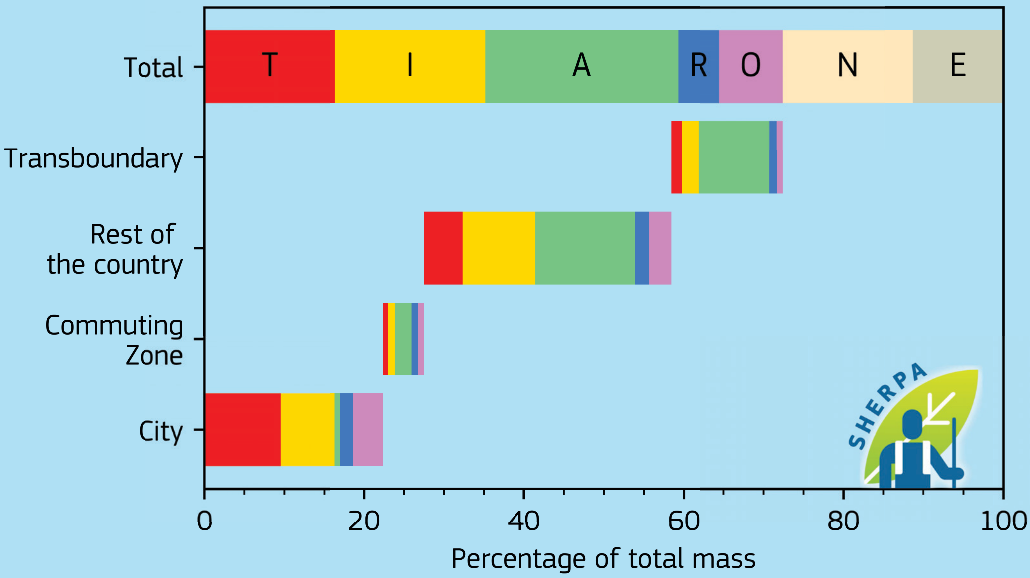
United Kingdom, Newcastle upon Tyne



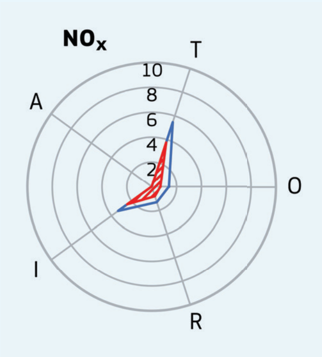
Yearly average urban background (2015)

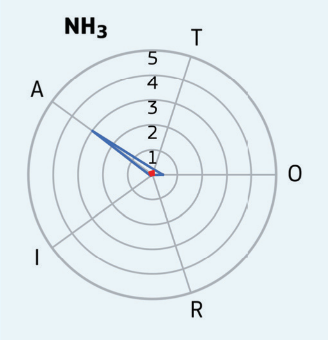


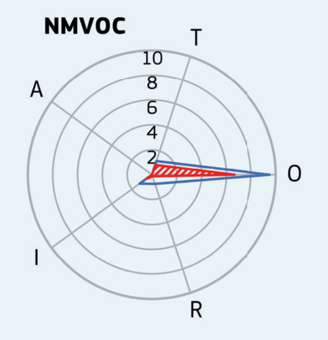
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

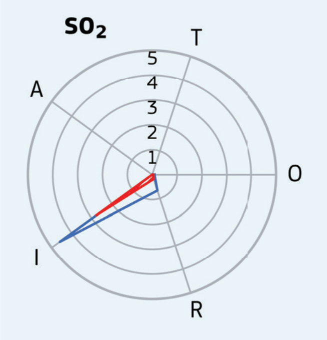


Emissions [kton/year]

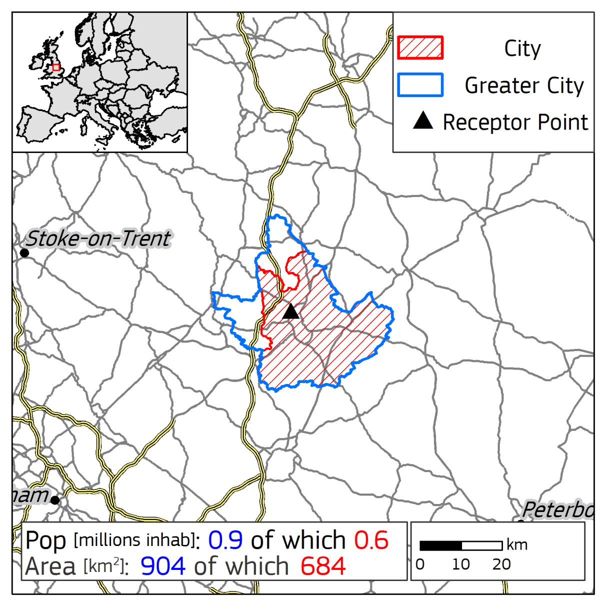




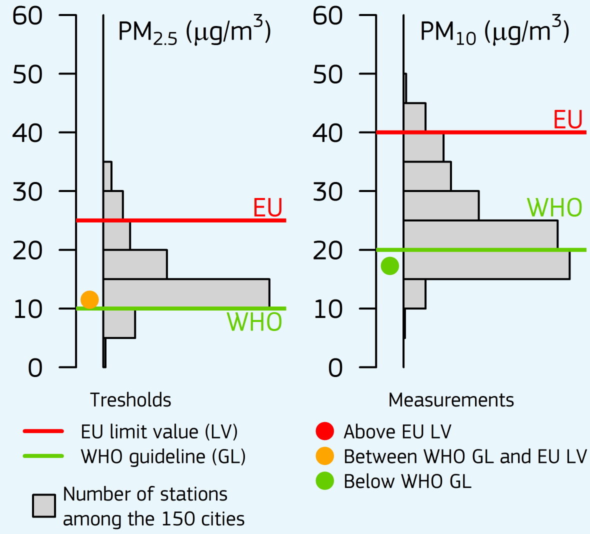




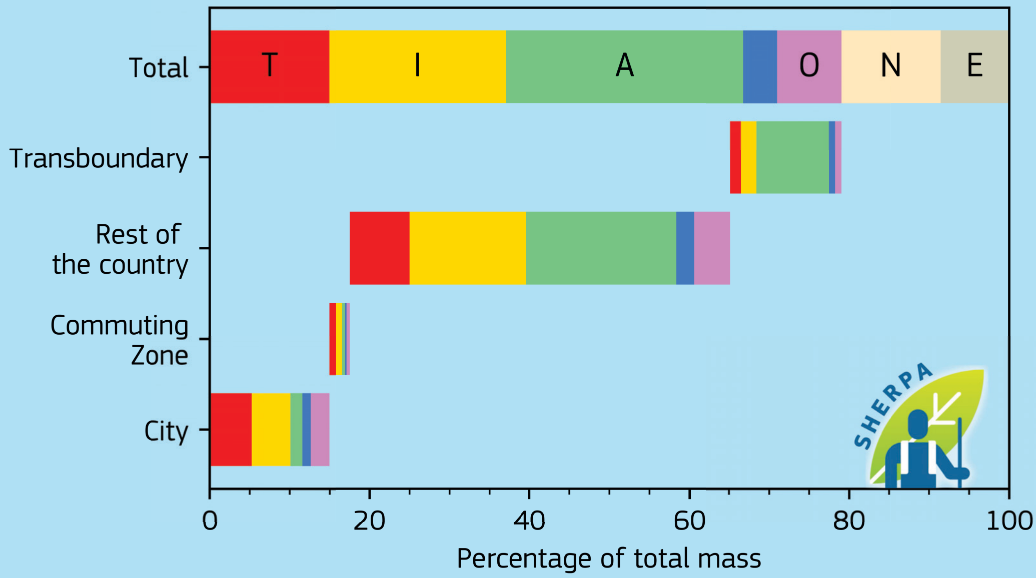
United Kingdom, Nottingham



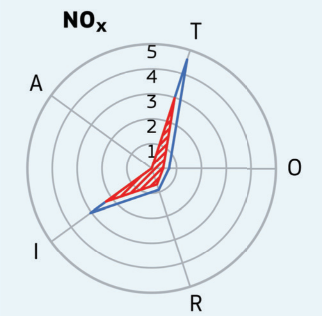
Yearly average urban background (2015)

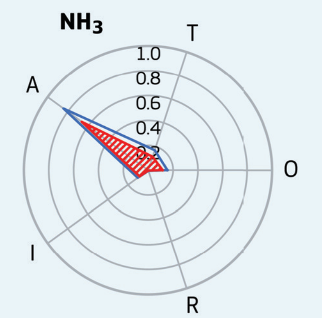


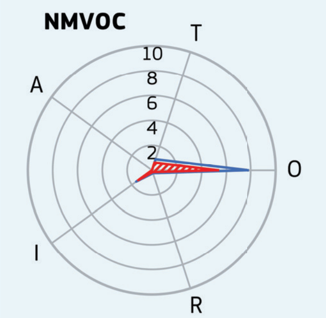
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

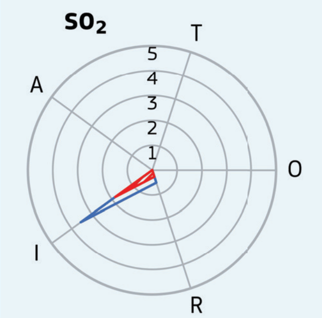


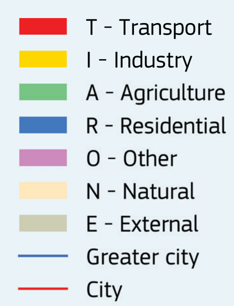
Emissions [kton/year]



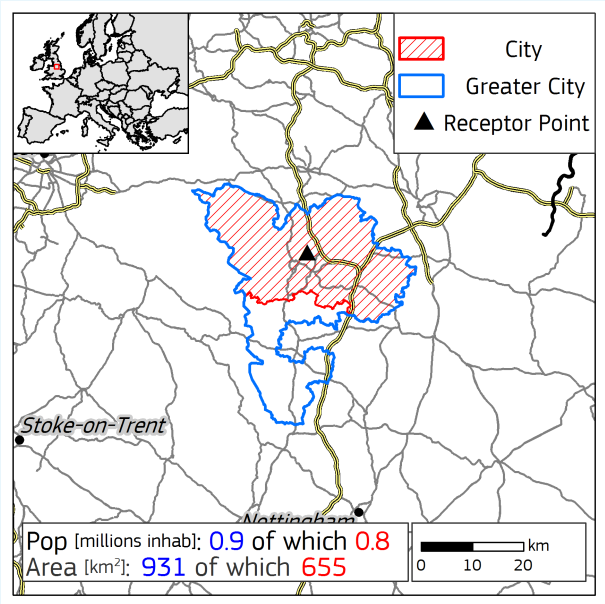




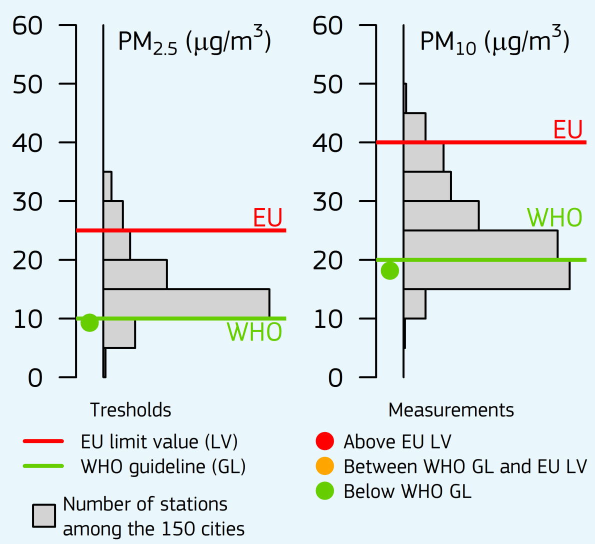




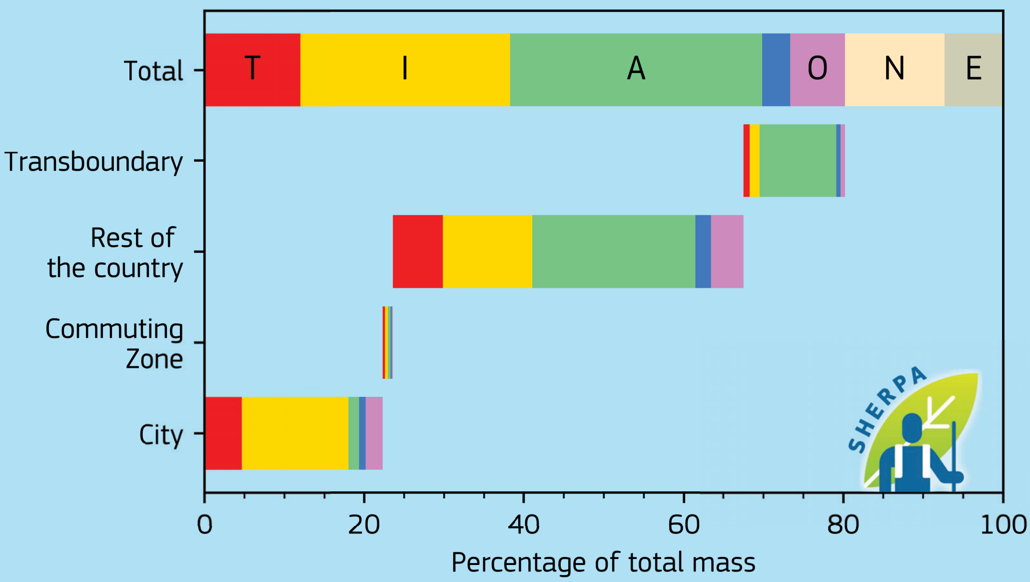
United Kingdom, Sheffield



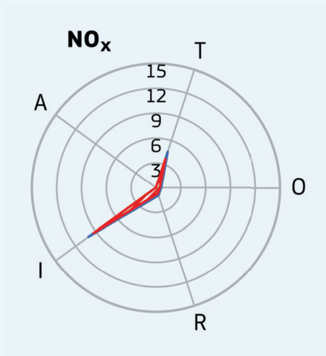
Yearly average urban background (2015)

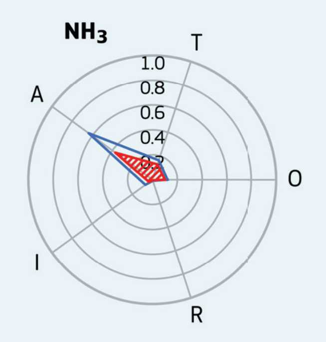


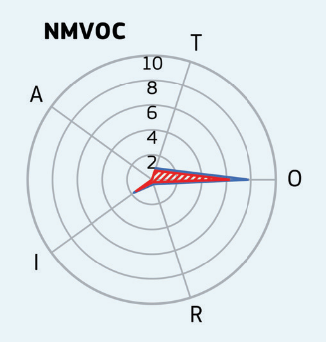
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

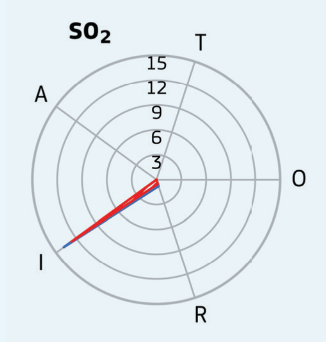


Emissions [kton/year]

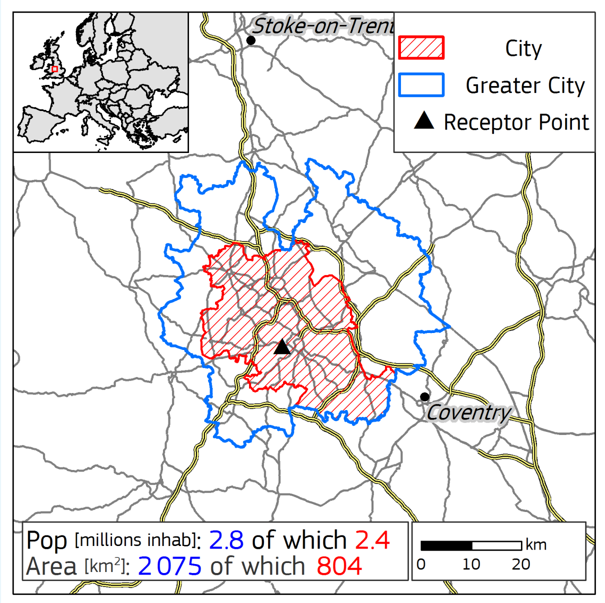




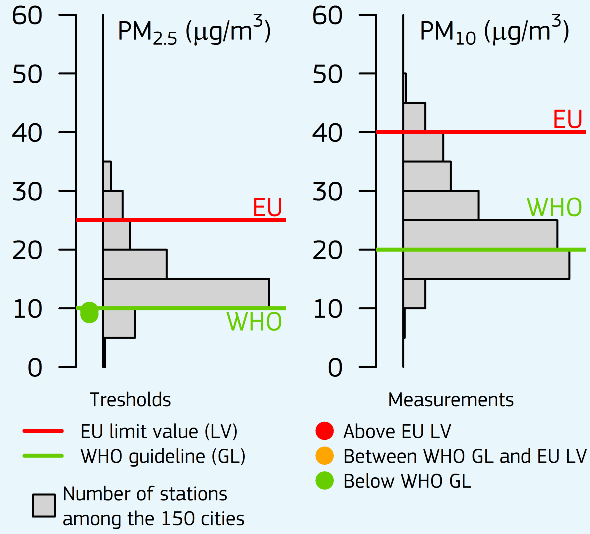




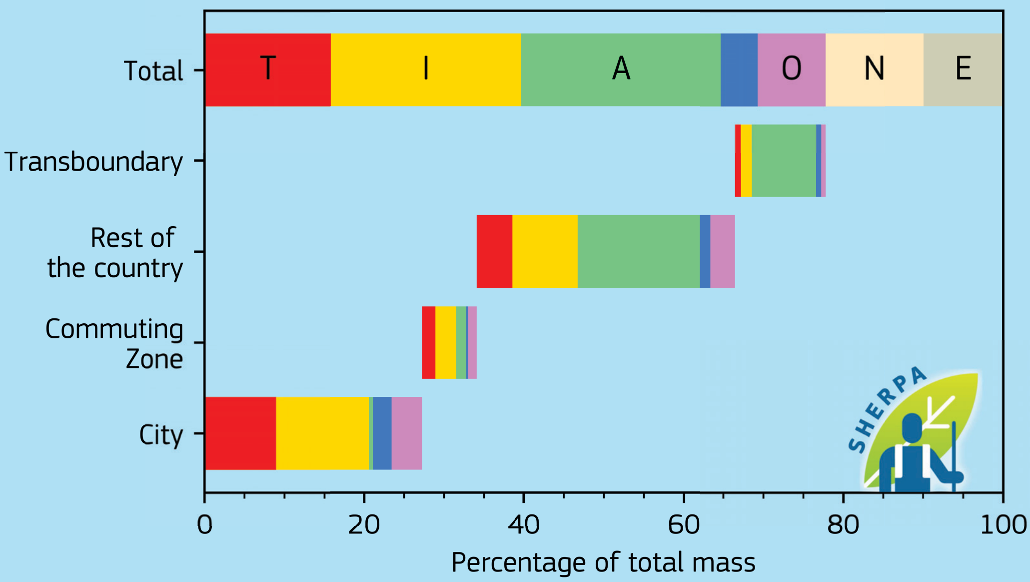
United Kingdom, West Midlands urban area



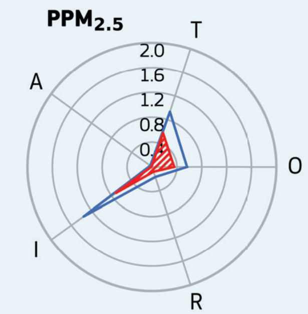
Yearly average urban background (2015)

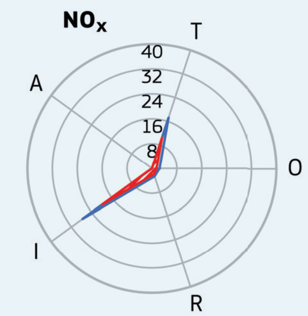


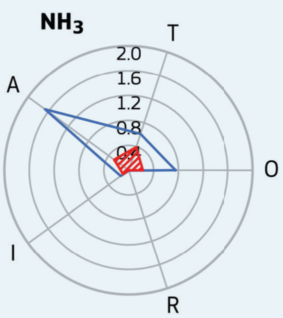
$PM_{2.5}$ Spatial and sectoral allocation (SHERPA v.1.9)

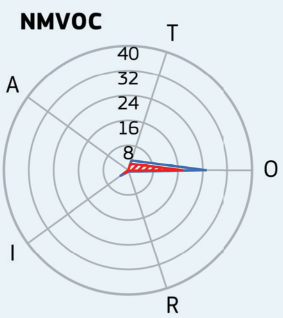


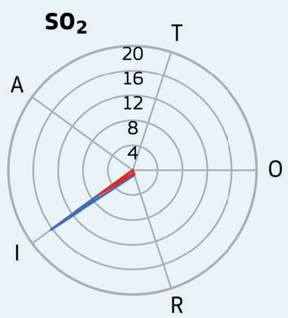
Emissions [kton/year]











- T - Transport
- I - Industry
- A - Agriculture
- R - Residential
- O - Other
- N - Natural
- E - External
- Greater city
- City

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