Air quality in the Paris region

SUMMARY 2017

► AIR PARIF

AIR QUALITY IN THE PARIS REGION

Summary 2017

March 2018

This report is an English summary of the annual report on ambient air quality in the Paris region.
It gives an overview of the concentrations for the European Union regulated pollutants during the year 2017.

The complete report in French can be downloaded on the AIRPARIF website:
http://www.airparif.asso.fr/_pdf/publications/bilan-2017.pdf

Air quality complete data in the Paris region can be downloaded at:
http://www.airparif.asso.fr/telechargement/telechargement-statistique

Annual air pollution maps are available at *http://www.airparif.asso.fr/etat-air/bilan-annuel-cartes*

All data, reports and studies performed by AIRPARIF are publicly available.
Full and free access is granted on the AIRPARIF website.

Any use of part of this report should mention "AIRPARIF, the Observatory of Air Quality in the Paris Region".

Cover illustration: map of the annual NO_2 concentration in 2017 (Airparif – Google Earth & Landsat data)

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TABLE OF CONTENTS

1.   KEY FACTS FOR 2017

In 2017, particulate matter (PM) and nitrogen dioxide (NO₂) levels within the Paris region remain a problematic issue due to the substantial exceedances of EU limit values. The decrease of chronic pollution levels for these pollutants is still confirmed this year. Concerning ozone (O₃), quality objectives thresholds are still exceeded despite a gloomy spring weather and normal summer conditions.

In terms of meteorological conditions, 2017 was a warm and quite rainy year. Except for a rather cold month of January, the year 2017 had mild winter temperatures. Spring and summer were hot, with peaks of heat between May and August. These particular weather conditions have strongly impacted the Paris region air quality over the year (high local emissions during winter, presence of photochemistry in summer).

On a trend line basis, mean pollution levels of 2017 are, overall, close to those of 2016.

→ Despite an improvement, daily and annual limit values for **PM₁₀ particles** are still exceeded at roadside sites. In total, **more than 100 000 inhabitants living in the Paris area and close to main roads were potentially affected by the PM₁₀ exceedance of the daily limit value** (50 µg/m³ not to be exceeded more than 35 days a year) **in 2017.** This was slightly less than in 2016, due to favorable meteorological conditions for pollution dispersion over a large part of the year leading to a smaller number of pollution episodes.

For **fine particles (PM₂.₅)**, **10 million inhabitants of the Paris region were potentially affected in 2017 by air quality objective exceedance** (10 µg/m³ in annual mean). Background levels away from road traffic were, on average, 1.2 times higher than the quality objective and up to 1.6 times higher in roadside situation. In 2017, the target value in PM₂.₅ (20 µg/m³) is potentially exceeded in the Paris region. The annual limit value (25 µg/m³) is complied for the fourth consecutive year.

→ **The slight decrease of nitrogen dioxide (NO₂) levels is still confirmed** in the Paris urban agglomeration in 2017. This observation is consistent with the known decrease of nitrogen oxide emissions in the region from road traffic, industries and heating.

Along the main roads, average NO₂ levels remain twice the annual limit value (40 µg/m³). On most of the measurement sites, levels are close to 2016. In total, **1.3 million inhabitants of the Paris region (representing around 10 % of the regional population) are still potentially exposed to NO₂ levels exceeding the annual limit value, including nearly 1 Parisian out of 2.**

→ Regarding **ozone (O₃) levels**, **the quality objective is exceeded every year in the whole Île-de-France region, and especially in sub-urban and rural areas.**

→ After a long period of sharp decrease which began at the end of the 1990's, **benzene (C₆H₆)** levels continue to slightly decline and tend to stabilize on the whole region (both near traffic and in background situation). **Less than 1 % of the inhabitants living in the agglomeration and in roadside conditions are still potentially exposed to an exceedance of the annual quality objective for benzene** (2 µg/m³).

→ **Regarding pollution episodes, the information and warning procedure was triggered 12 days in 2017.** This is 6 days less than in 2016. **Half of these episodes are due to PM$_{10}$:** 3 days of exceedance of the information warning threshold and 3 days for the alert threshold (all of them recorded between January 21 and February 11 2017). Six days of exceedance of the ozone information warning threshold were recorded. This is twice more days than in 2016, due to a favorable summerly weather (high temperatures, more sun than usual) at the end of May and in June 2017.

The following table provides a summary of the global trend and the situation of 2017 regarding air pollution standards:
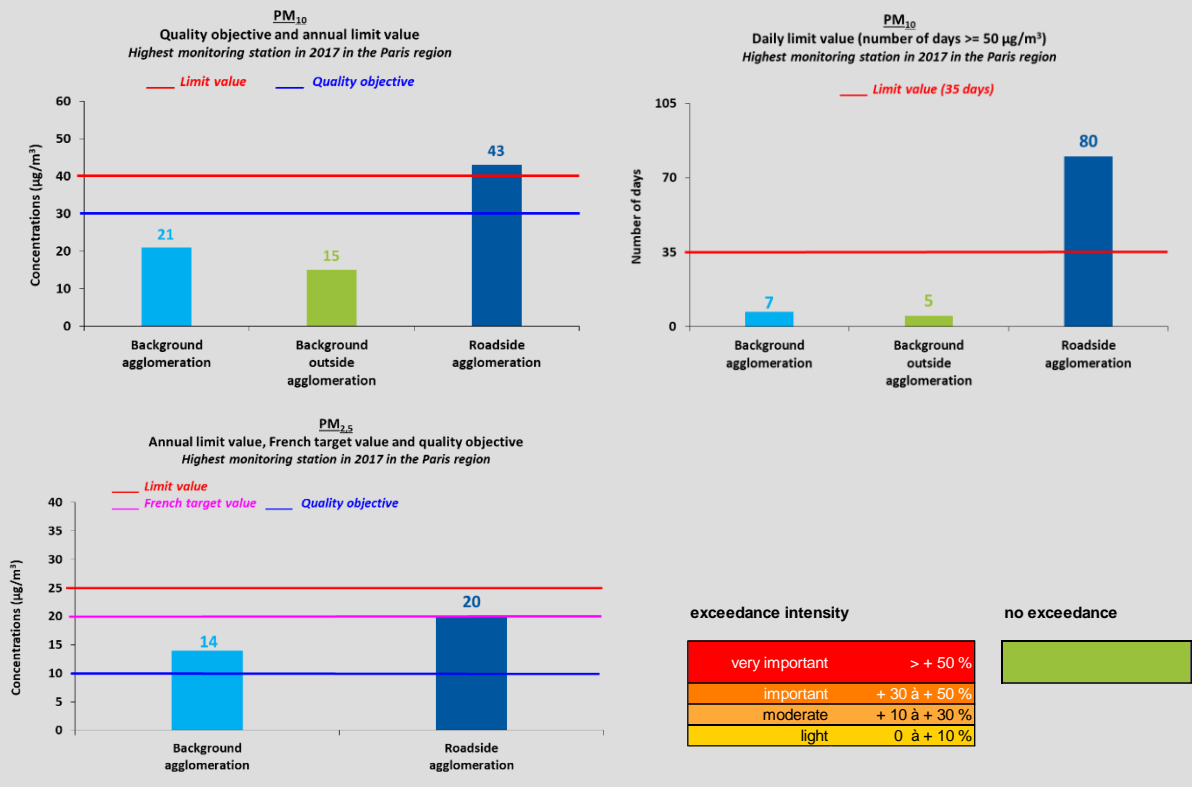
	Standards to be met	Non-binding standards		Trend
	Limit value	Target value	Quality objective	2007-2017
PM$_{10}$	Exceeded		Exceeded	↘
PM$_{2.5}$	Met	Potentially exceeded	Exceeded	↘
NO$_2$	Exceeded		Exceeded	↘
O$_3$		Met	Exceeded	→
Benzene	Met		Exceeded	↘

2. POLLUTANTS EXCEEDING AIR QUALITY STANDARDS

Particulate Matter (PM) in brief

Recurrent and severe exceedances of PM$_{10}$ EU limit values are still observed near traffic
More than 100 000 inhabitants are potentially exposed to an exceedance of the PM$_{10}$ EU daily limit value
Less than 1 % of the population is potentially exposed to an exceedance of the PM$_{10}$ quality objective

PM$_{2.5}$ levels are 1.2 times higher than the quality objective threshold in background situation and 1.6 times higher near traffic. Almost 85 % of the inhabitants living in the Paris region (or 10 million people) are still exposed to an exceedance of this threshold. Nonetheless, a decreasing trend occurred in particular near traffic, where the EU annual limit has not been exceeded for the fourth year running.

PM$_{10}$
Quality objective and annual limit value
Highest monitoring station in 2017 in the Paris region

—— *Limit value*   —— *Quality objective*

PM$_{10}$
Daily limit value (number of days >= 50 µg/m³)
Highest monitoring station in 2017 in the Paris region

—— *Limit value (35 days)*

	Background agglomeration	Background outside agglomeration	Roadside agglomeration
PM$_{10}$ concentrations (µg/m³)	21	15	43
PM$_{10}$ number of days	7	5	80

PM$_{2.5}$
Annual limit value, French target value and quality objective
Highest monitoring station in 2017 in the Paris region

—— *Limit value*
—— *French target value*   —— *Quality objective*

	Background agglomeration	Roadside agglomeration
PM$_{2.5}$ concentrations (µg/m³)	14	20

exceedance intensity		no exceedance	
very important	> + 50 %		
important	+ 30 à + 50 %		
moderate	+ 10 à + 30 %		
light	0 à + 10 %		

Particulate Matter (PM$_{10}$)	2017			2007-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Annual quality objective exceedance			(orange)			(red)
Annual limit value exceedance			(light orange)			(orange)
Daily limit value exceedance			(red)	2007 2009 : station max = threshold		(red)

Particulate Matter (PM$_{2.5}$)	2017			2007-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Quality objective exceedance	(light orange)	(yellow)	(red)	(red)	measured since 2013	(red)
French target value exceedance			(yellow)	2007, 2009		(orange)
Limit value exceedance						every year since 2014

Summary of air quality standards exceedances for Particulate Matter (PM$_{10}$ and PM$_{2.5}$) within the Paris region

2.1 PM$_{10}$ particles

SITUATION IN 2017 RELATED TO AIR POLLUTION STANDARDS

EU daily limit value (50 µg/m³ not to be exceeded more than 35 days a year)

The maps in Figure 1 show the PM$_{10}$ annual number of days exceeding the EU daily limit value within the Paris region, with a focus on Paris and surrounding subsurbs in 2017.
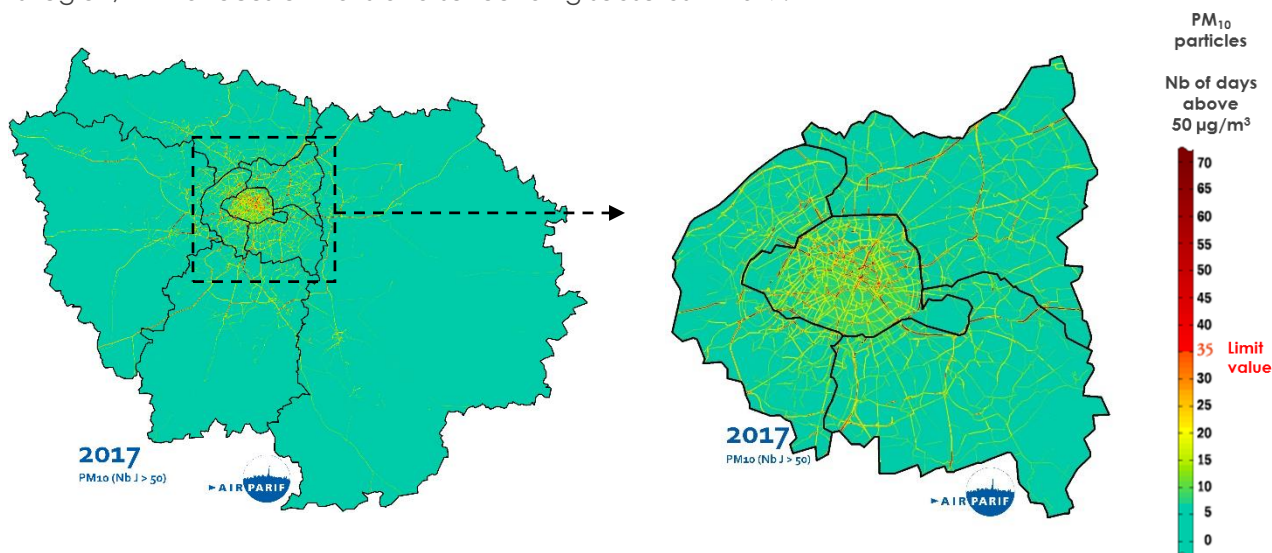

Figure 1: PM$_{10}$ annual number of days exceeding the 50 µg/m³ EU threshold within the Paris region with a focus on Paris and surrounding suburbs in 2017
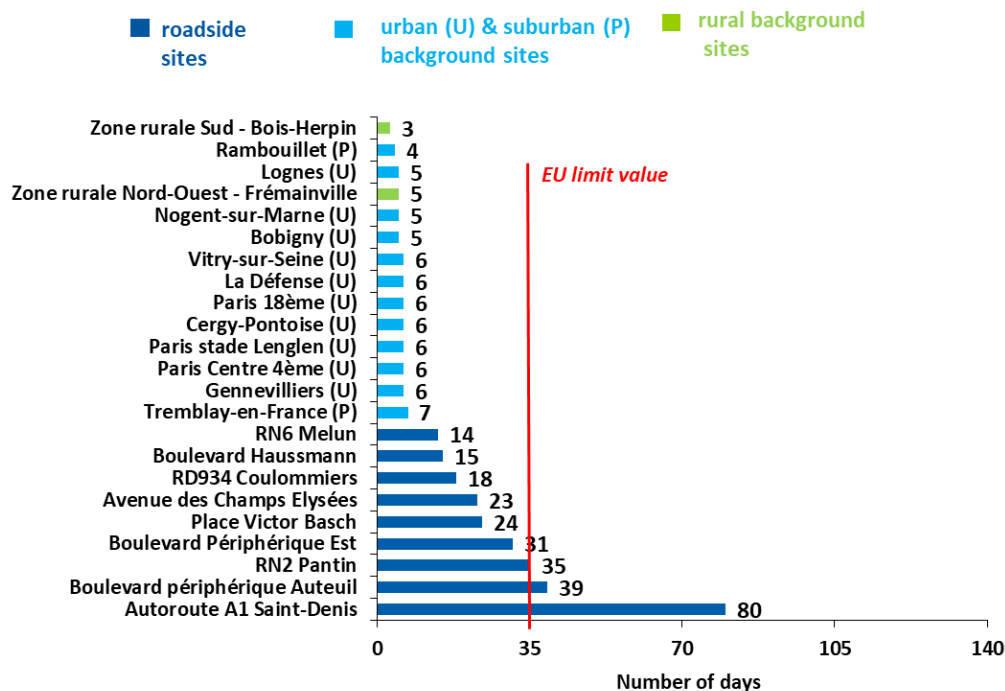
Figure 2: PM$_{10}$ annual number of days exceeding the 50 µg/m³ EU threshold for all continuous monitoring sites within the Paris region in 2017

In 2017, the EU daily limit value is met in background situation (Figure 2). The PM$_{10}$ annual number of days exceeding this threshold is 1.5 to 3 times smaller than in 2016. Weather conditions in 2017 were generally favorable for pollution dispersion and thus better air quality.

Despite an improvement between 2016 and 2017, **the EU daily limit value for PM$_{10}$ particles is still exceeded at roadside sites** (Figure 2). This exceedance is recorded in 2017 on approximately 1 % of the roads in the Paris region. In 2017, 39 and 80 days of exceedance of the PM$_{10}$ daily threshold were observed for 2 out of 9 traffic stations (Ring road BP Auteuil and Highway A1 Saint-Denis, respectively). For the highest traffic site (A1 Saint-Denis), this threshold is exceeded more than 1 day out of 5. In 2017, the number of days exceeding the PM$_{10}$ daily limit value dropped sharply at all the traffic stations (except Ring road BP Auteuil and A1 Saint-Denis) compared to 2016. This can be explained by weather conditions favorable to pollution dispersion at the end of the year, in opposition to December 2016, which recorded a major episode of particulate matter pollution.

In 2017, **more than 100 000 inhabitants are potentially exposed to an exceedance of the PM$_{10}$ EU daily limit value (representing approximately 1 % of the regional population)** (Figure 3).
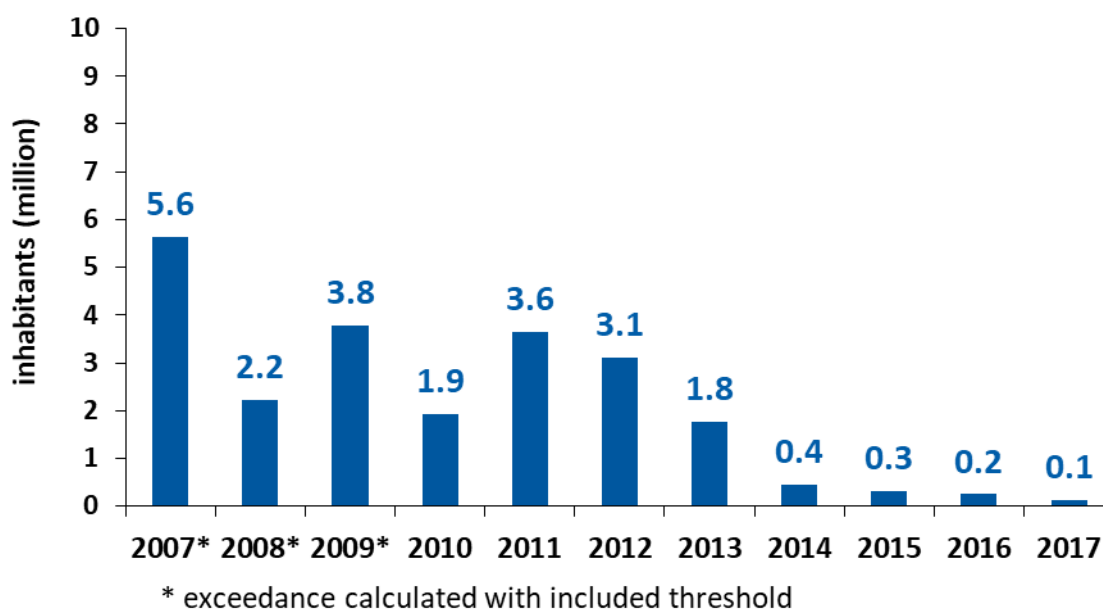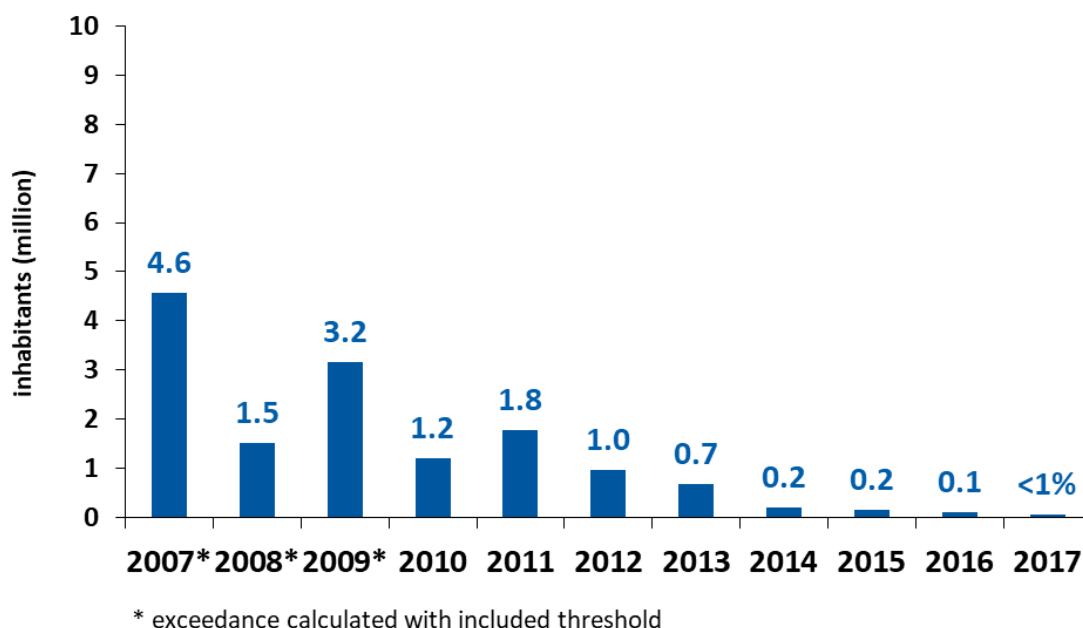

Figure 3: million of inhabitants potentially exposed to a PM$_{10}$ level exceeding the EU daily limit value within the Paris region from 2007 to 2017

These values should be regarded as orders of magnitude because particles have multiple origins of formation: local emissions, resuspending process, atmospheric chemistry, long-range transport…

EU annual limit value (40 μg/m³ on average)

The maps in Figure 4 show the annual mean PM$_{10}$ concentration within the Paris region, with a focus on Paris and surrounding subsurbs in 2017.
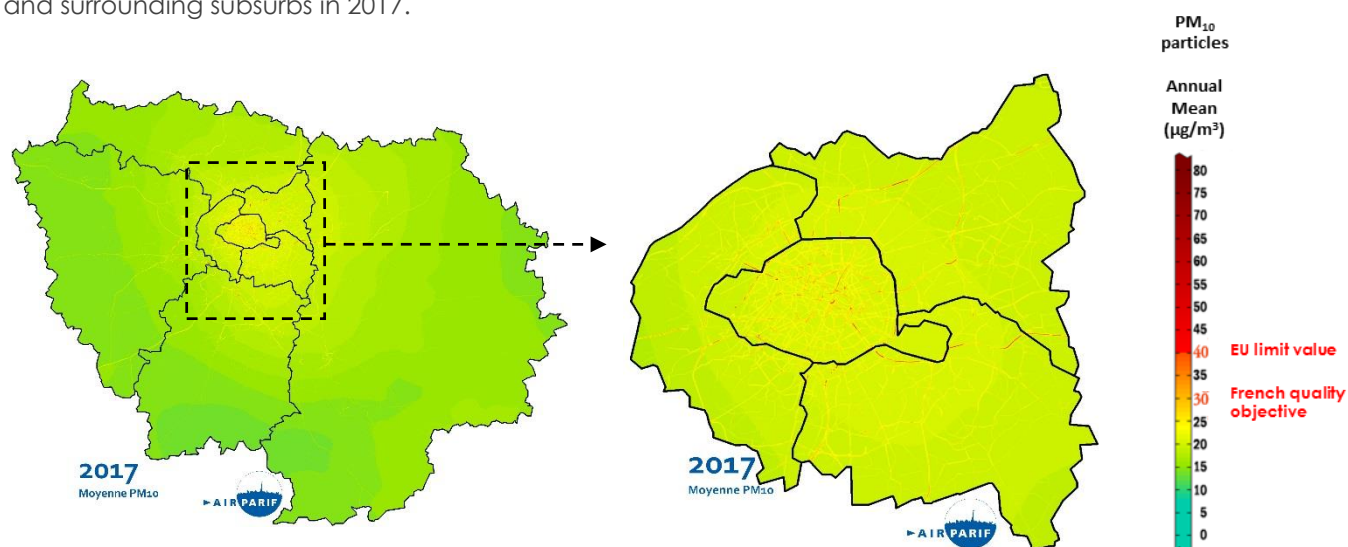
Figure 4: PM$_{10}$ annual mean concentration within the Paris region
with a focus on Paris and surrounding suburbs in 2017

As in 2015 and 2016, PM$_{10}$ background levels measured within the Paris agglomeration are fairly homogeneous in 2017 (between 19 and 21 μg/m³). A slight decline in PM$_{10}$ concentrations from the Paris agglomeration (Paris, Vitry-sur-Seine, Gennevilliers, Bobigny, La Défense cities) to the periphery of the region (Cergy-Pontoise, Lognes, Rambouillet cities) is observed (Figure 5). In general, **background annual mean levels are slighty lower in 2017 than in 2016.**

PM$_{10}$ standard values (EU annual limit value and French annual quality objective) are widely met in background and rural situations.
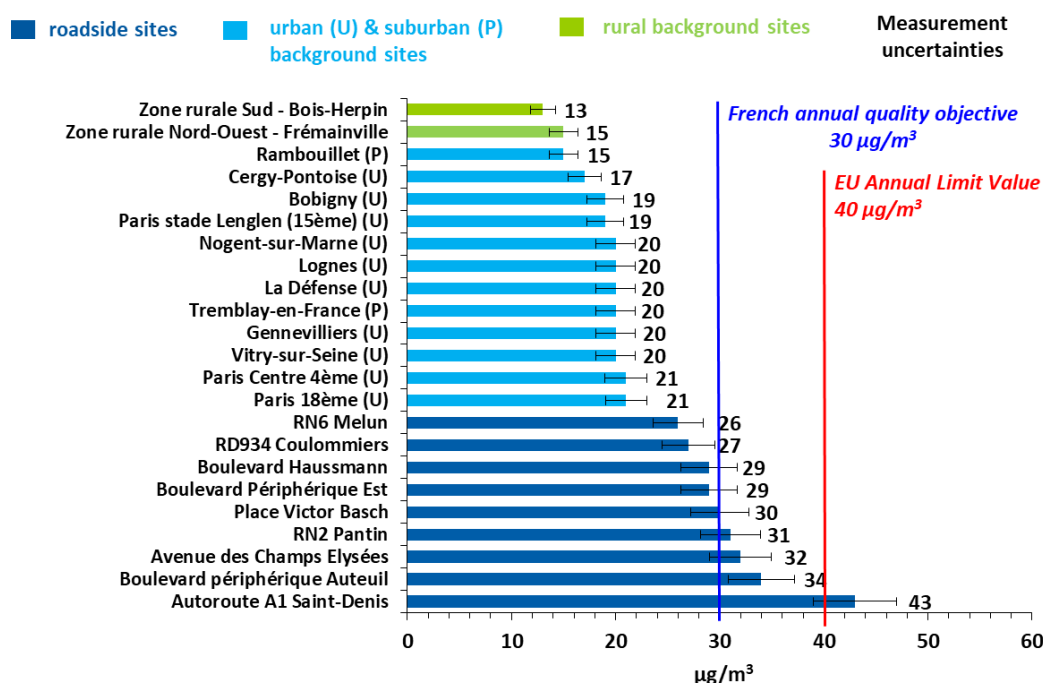
Figure 5: PM$_{10}$ annual mean concentrations for all continuous monitoring sites in the Paris region in 2017

Highest PM$_{10}$ mean concentrations were measured near main roads and highway connections in 2017. PM$_{10}$ levels near traffic can be up to **twice higher** than those measured in background situation (26-43 µg/m³). However, **PM$_{10}$ concentrations slightly decline between 2016 and 2017 at roadside sites** (except the Boulevard Haussman and the Highway A1 Saint-Denis stations which remain stable).

In 2017, **the French annual quality objective for PM$_{10}$ particles is exceeded for most of the main roads located in the Parisian agglomeration.** As in 2016, the EU annual limit value (40 µg/m³) is exceeded in 2017 at the traffic monitoring station Highway A1 Saint-Denis. This threshold is met at other monitoring stations.

In 2017, less than 1 % of the regional population (corresponding to around 50 000 inhabitants) are potentially exposed to an exceedance of the PM$_{10}$ quality objective (Figure 6). This value is lower than last year. In 2007, almost 30 % of the regional population were concerned by this exceedance.

* exceedance calculated with included threshold

Figure 6: million of inhabitants potentially exposed to a PM$_{10}$ level exceeding the French quality objective in the Paris region from 2007 to 2017

LONG-TERM TRENDS

Besides the amount of pollutants released to the atmosphere, PM$_{10}$ levels are strongly impacted by meteorological conditions from one year to the next. The years 2010 and 2015 were characterised by weather conditions that were conductive to good air quality, resulting in few high-intensity particle episodes. Conversely, in 2007, 2009, and from 2011 to 2013, unfavourable weather conditions associated with higher PM$_{10}$ emissions (especially due to wood burning combustion during wintertime episodes) led to high PM$_{10}$ levels in winter and spring. As in the last 4 years, **2017 is a year with favorable meteorological conditions for pollution dispersion, but with some contrasts.**

In January 2017 (a month with several episodes of freezing rain, snow and two cold waves interspersed by a storm) the information (50 µg/m³ daily average) and alert (80 µg/m³ daily average) thresholds for PM$_{10}$ were exceeded during 5 days. The strong and durable anticyclonic conditions (no wind, strong and very low temperature inversion) that prevailed in the region for a week, were favorable to a significant increase in PM$_{10}$ concentrations from residential heating (mainly wood burning) and road transport. This impact is particularly important for daily concentrations. These differences are reflected in the maps representing the number of days exceeding the threshold of 50 µg/m³ from 2007 to 2017 in the Paris region (Figure 7).
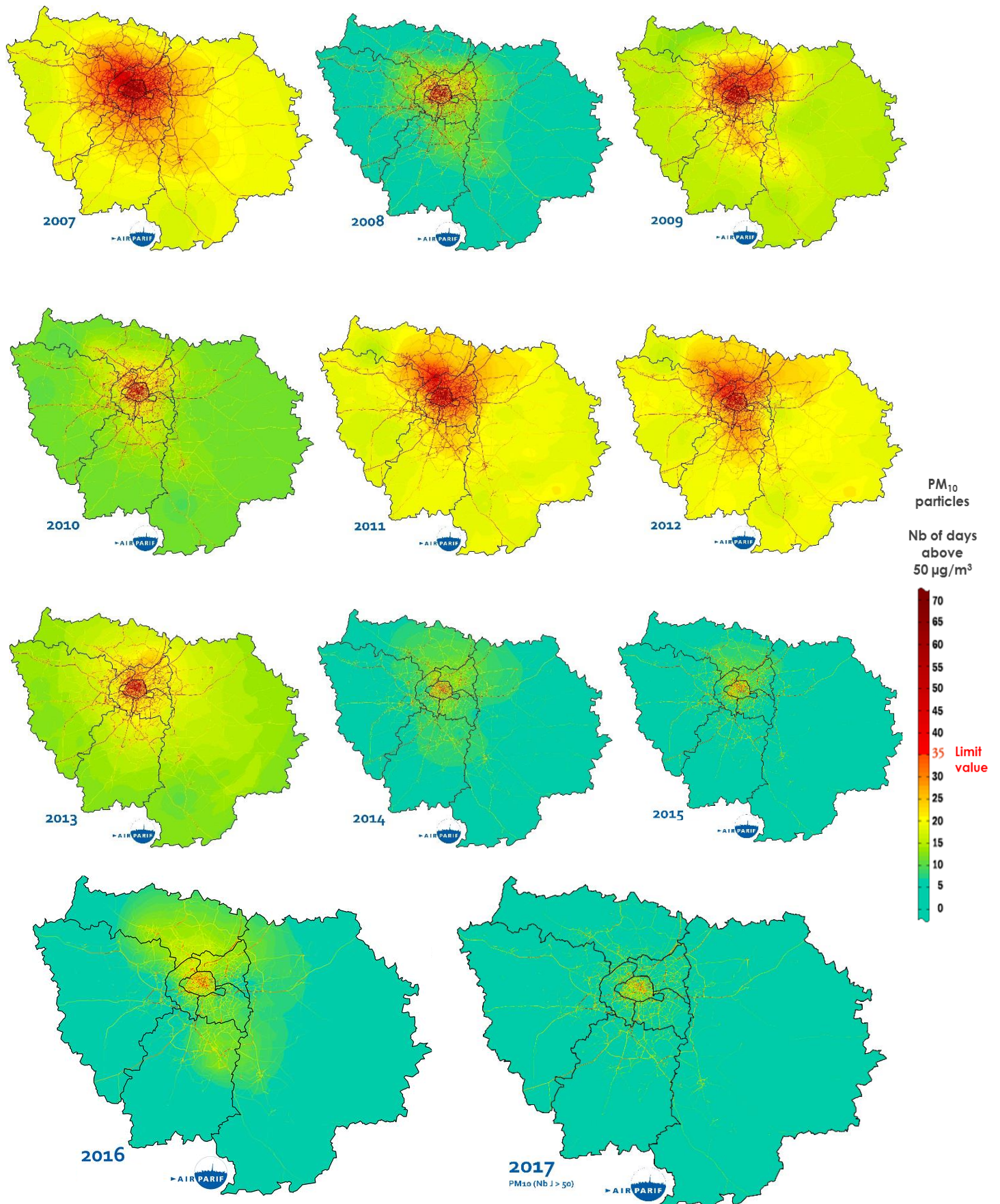
Figure 7: number of days exceeding the EU daily limit value in PM_{10} in the Paris region from 2007 to 2017

Besides these seasonal changes, **the number of days exceeding the 50 µg/m³ EU limit value is decreasing since 2007, especially near main roads and highway connections.**

The Figure 8 shows **a downward trend of PM$_{10}$ mean concentrations in background agglomeration.**
These PM$_{10}$ levels decreased by about 30 % from 1999-2001 to 2015-2017. This is related to the PM$_{10}$ regional
emission reductions for almost -50 % between 2000 and 2012. **This decline is particularly strong over the past**
3 years in background situation. This decrease is also observed in rural agglomeration.

* Mean concentrations recalculated for integrating the PM volatile fraction and allowing a comparison with the post-2006 measurements
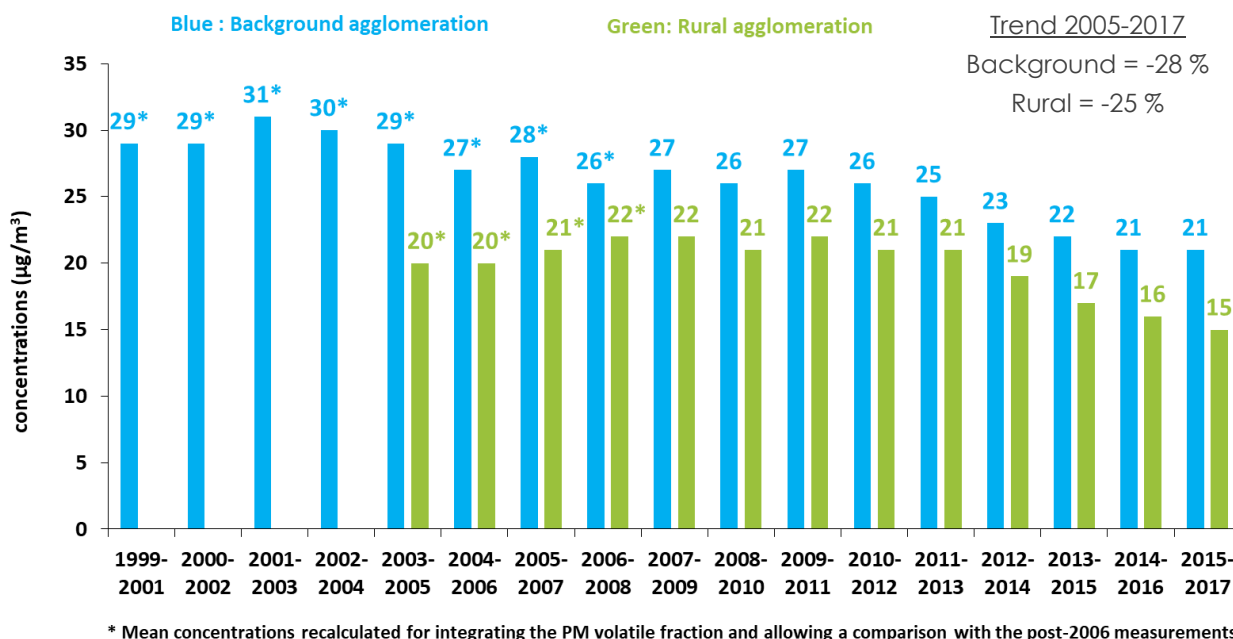
Figure 8: trend in the PM$_{10}$ tri-annual mean concentration (based on a scalable sample of background sites located within and out of the Paris agglomeration) from 1999-2001 to 2015-2017

The traffic monitoring station Ring road BP Porte d'Auteuil is providing PM$_{10}$ measurements since 1998 and
Place Victor Basch since 2003. The Figure 9 shows **a downward trend of PM$_{10}$ mean concentrations** of
-37 % for Place Victor Basch and -28 % for BP Porte d'Auteuil. For the BP Porte d'Auteuil traffic site, this
reduction reaches -35 % from 1998-2000 to 2015-2017. This trend can be explained by a greater decline in
particle emissions from road traffic (around -55 % between 2000 and 2012), especially due to **the progressive**
introduction of diesel particulate filters.

* Mean concentrations recalculated for integrating the PM volatile fraction and allowing a comparison with post-2006 measurements
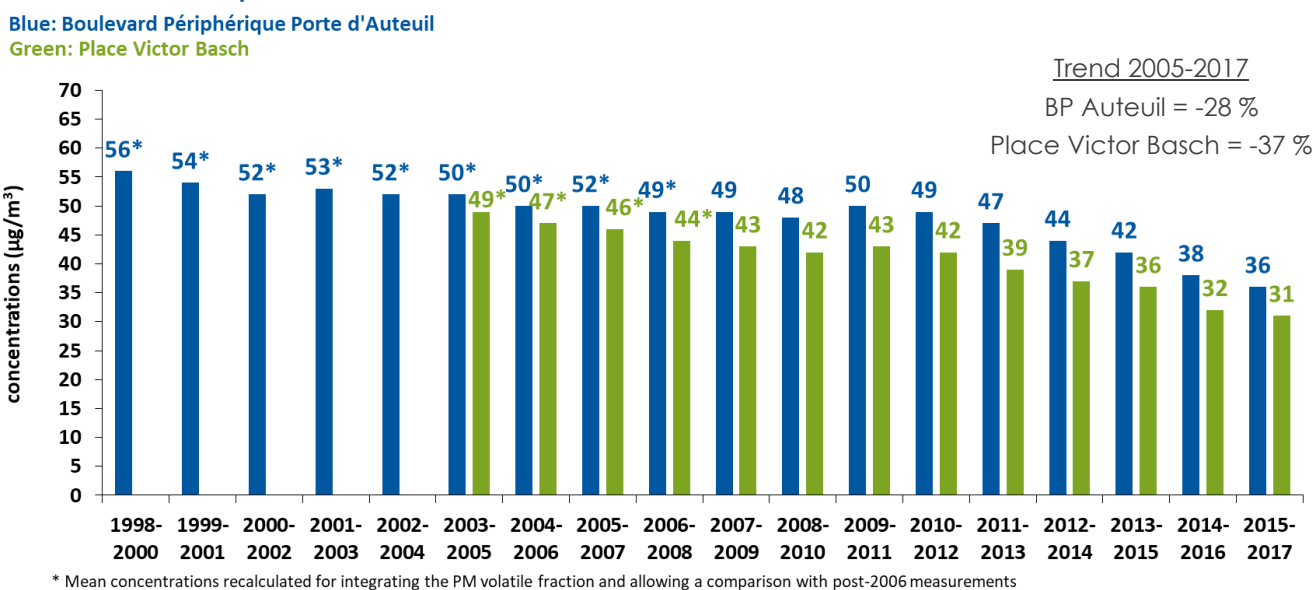
Figure 9: trend in the PM$_{10}$ tri-annual mean concentration at the Place Victor Basch and BP Porte d'Auteuil stations from 1998-2000 to 2015-2017

2.2 PM$_{2.5}$ particles

SITUATION IN 2017 RELATED TO AIR POLLUTION STANDARDS

The maps in Figure 10 show the annual mean PM$_{2.5}$ concentration within the Paris region, with a focus on Paris and surrounding subsurbs in 2017.
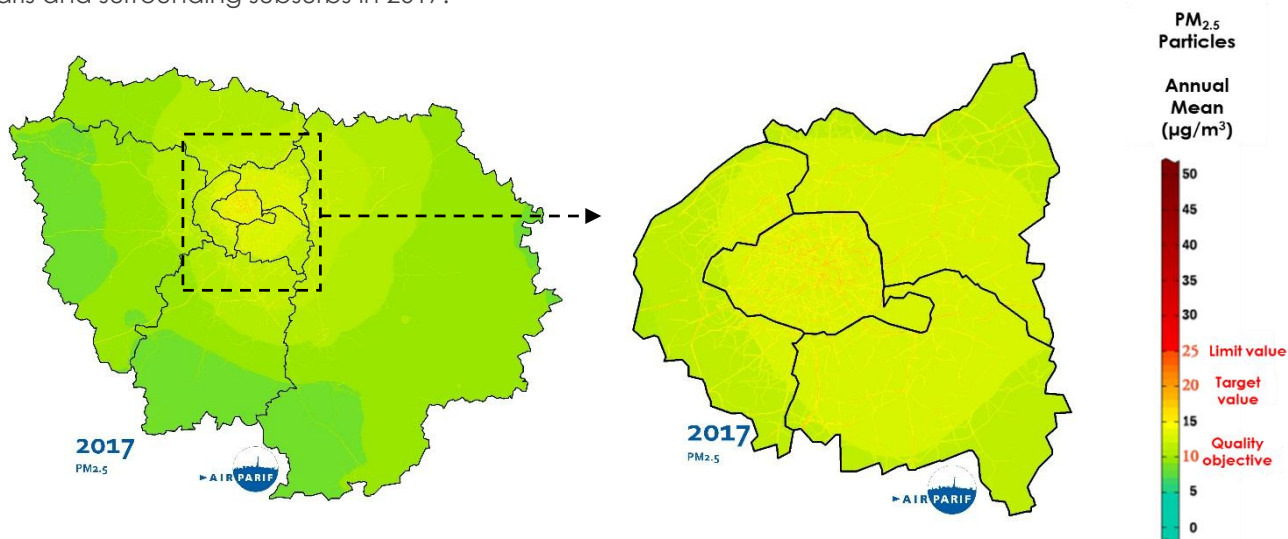
Figure 10: annual mean concentration of fine particles PM$_{2.5}$ in the Paris region, with a focus on Paris and surrounding suburbs in 2017

As in 2015 and 2016, there is a small difference in PM$_{2.5}$ concentrations between (sub)-urban and rural areas in 2017. PM$_{2.5}$ annual mean concentrations range from 7 to 10 µg/m^3 in rural situation and from 8 to 14 µg/m^3 for urban and suburban background sites (Figure 11).

Highest PM$_{2.5}$ mean concentrations were measured within the Paris agglomeration and also near main roads and highway connections. In roadside situation, annual mean PM$_{2.5}$ concentrations range from 13 to 20 µg/m^3. They are slightly lower than those measured in 2016.
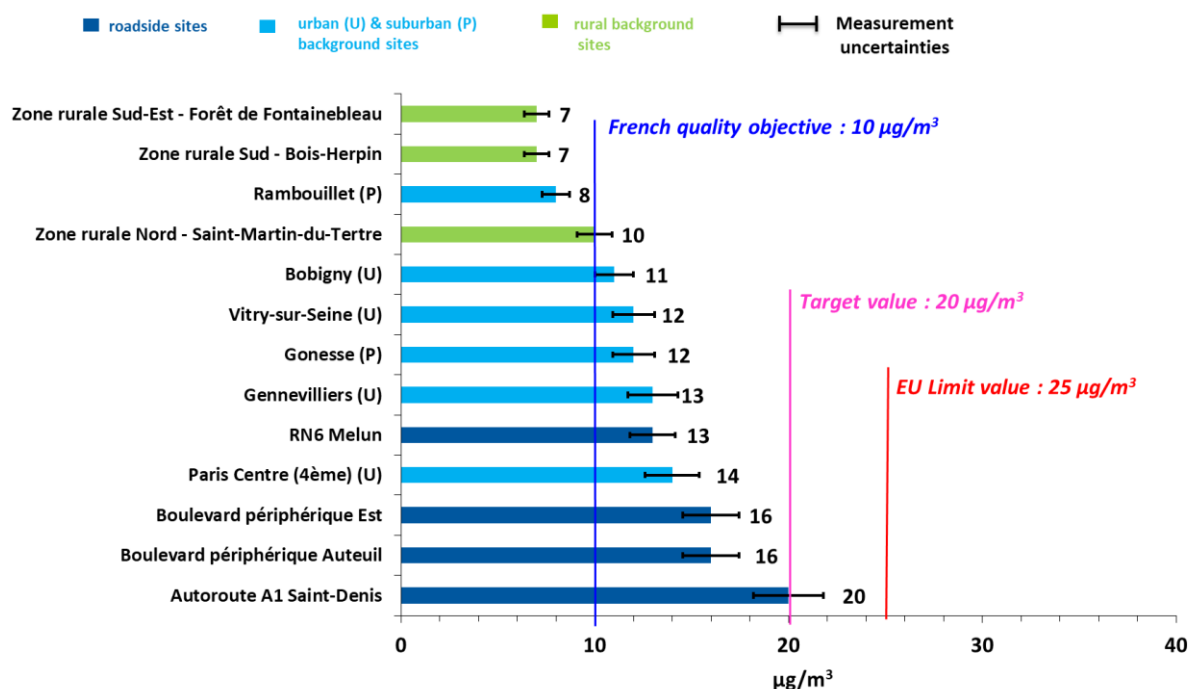
Figure 11: PM$_{2.5}$ annual mean concentration for all continuous monitoring sites in the Paris region in 2017

For the fourth year running, the EU limit value for fine particles PM$_{2.5}$ (25 µg/m^3) is met at all the monitoring stations. In 2017, none of the traffic monitoring stations exceed **the PM$_{2.5}$ target value (20 µg/m^3)**. On the station usually measuring the highest concentrations (Highway A1 Saint-Denis), the PM$_{2.5}$ annual mean reaches the target value. **The exceedance of the PM$_{2.5}$ target value is considered as unlikely throughout the Paris region.**

PM$_{2.5}$ mean levels are 1.1 to 1.4 times higher above **the French quality objective for fine particles PM$_{2.5}$ (10 µg/m^3)** in background situation and more than 1.6 times higher near traffic. **Almost 85 % of the inhabitants living in the Paris region (or around 10 million people) would be exposed to an exceedance of this French PM$_{2.5}$ quality objective (Figure 12).**

* exceedance calculated with included threshold
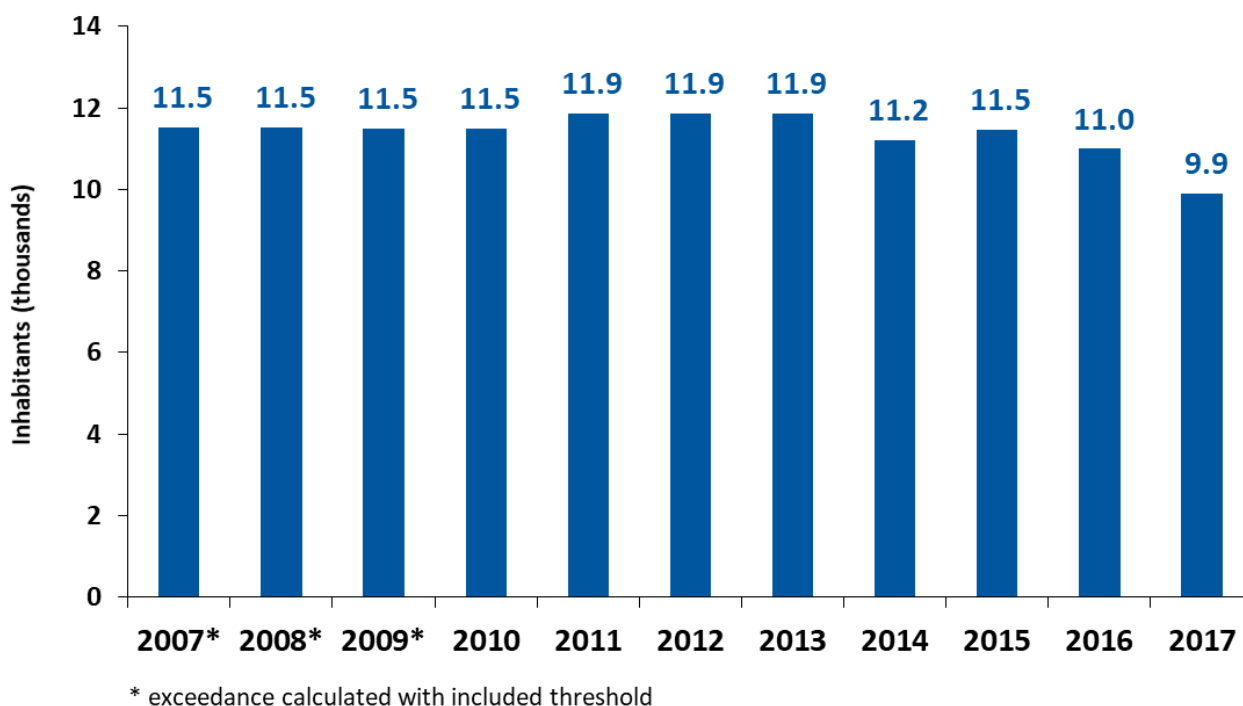
Figure 12: thousands of inhabitants potentially exposed to an exceedance of the French quality objective value for fine particles PM$_{2.5}$ (10 µg/m^3) in the Paris region from 2007 to 2017

Similar to PM$_{10}$ particles, an overall downward trend is observed for fine particules PM$_{2.5}$, as illustrated in Figure 13.
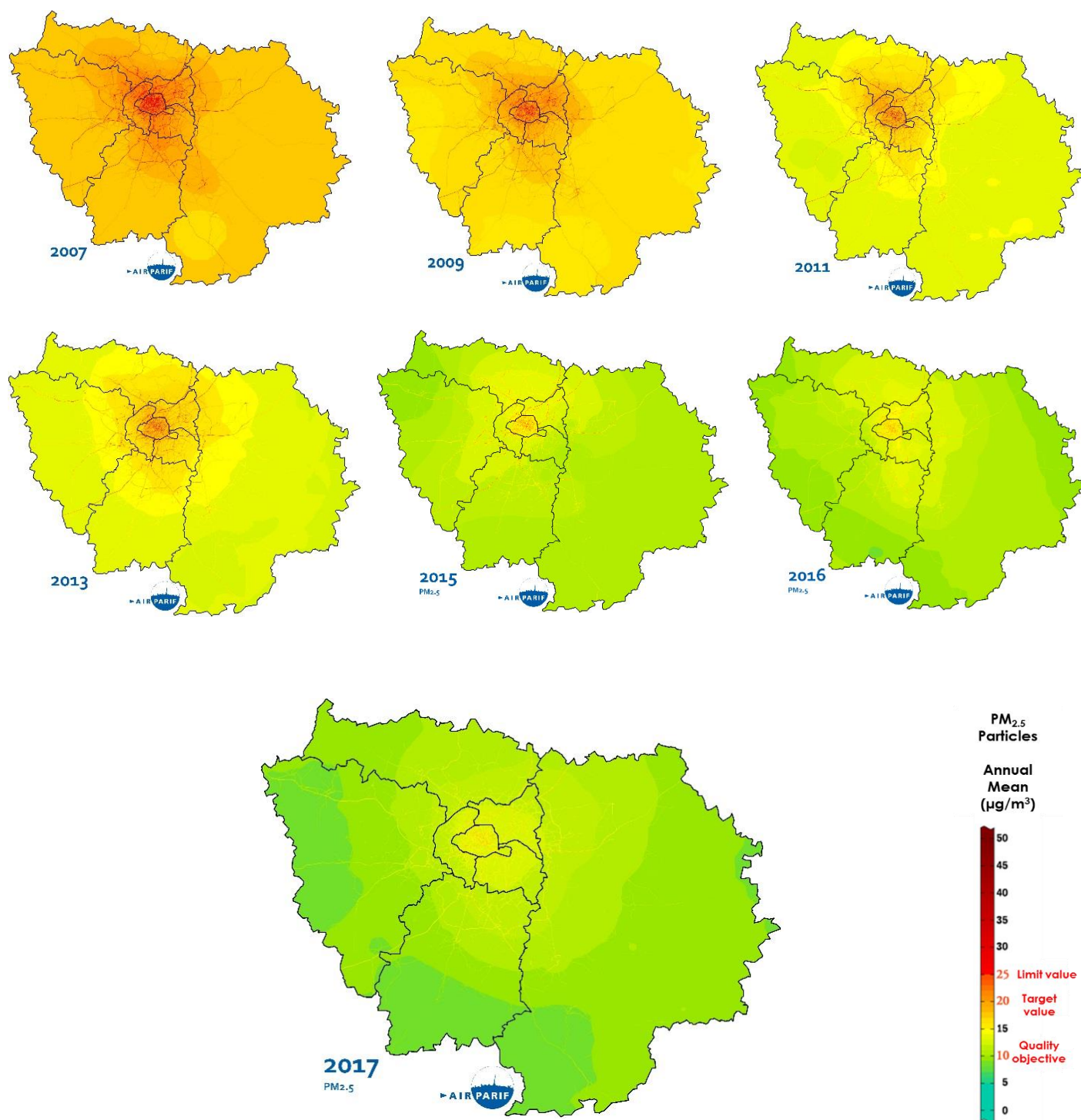
Figure 13: annual mean concentrations of fine particles PM$_{2.5}$ from 2007 to 2017 in the Paris region

PM$_{2.5}$ tri-annual mean levels reflect a significant decline of -38 % from 2000-2002 to 2015-2017 in background situation (Figure 14).
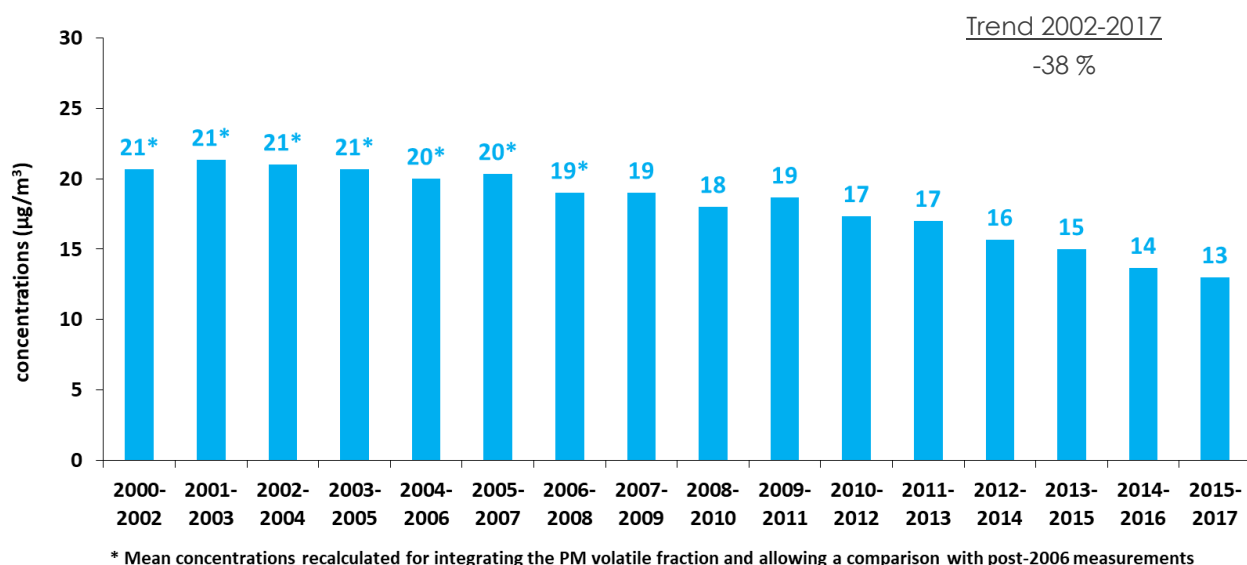
Figure 14: trend in the PM$_{2.5}$ tri-annual mean concentrations (based on a scalable sample of urban background sites) within the Paris agglomeration from 2000-2002 to 2015-2017

The decline of PM$_{2.5}$ concentrations is particularly acute for the Ring road BP Porte d'Auteuil traffic monitoring station (Figure 15). A significant reduction in PM$_{2.5}$ levels of -56 % is observed from 1999-2001 to 2015-2017. As for PM$_{10}$, this decrease is related to the reduction of primary particle emissions from diesel exhaust (approximately -60 % between 2000 and 2012). **The decrease is greater for PM$_{2.5}$ than for PM$_{10}$ particles as most of PM$_{2.5}$ particles are emitted in vehicles exhaust.** A large part of PM$_{10}$ particles are emitted by tyre-wear, brake-wear, road abrasion and dust suspension.
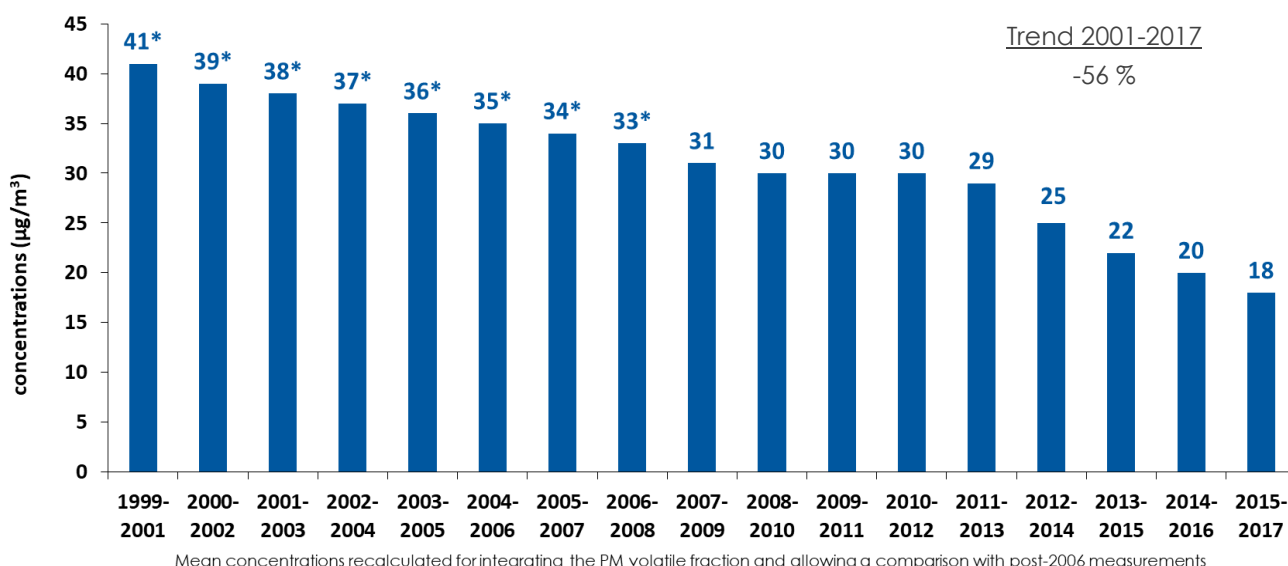
Figure 15: trend in the PM$_{2.5}$ tri-annual mean concentration for the traffic monitoring station Ring road BP Porte d'Auteuil from 1999-2001 to 2015-2017

Nitrogen dioxide (NO$_2$) in brief

Nitrogen dioxide remains an important issue in the Paris region

The main source of NO$_2$ is road traffic
Levels along major roads are in some cases two times higher than the EU annual limit value

Around 1.3 million inhabitants (or around 10 % of the regional population) living in the centre of the agglomeration are potentially exposed to an exceedance of the EU annual limit value

The decreasing trend of background levels observed within the agglomeration since the beginning of the 2000's goes on between 2016 and 2017
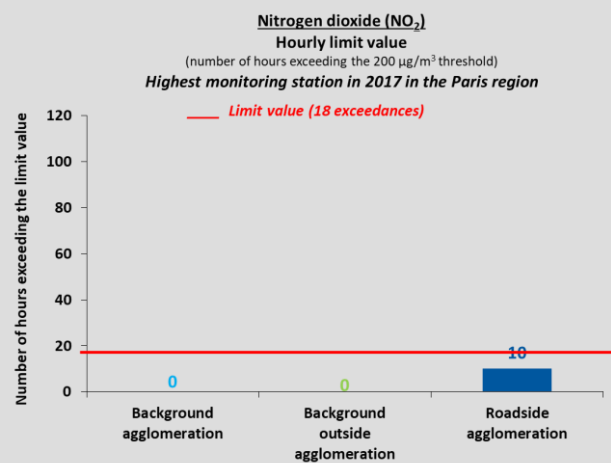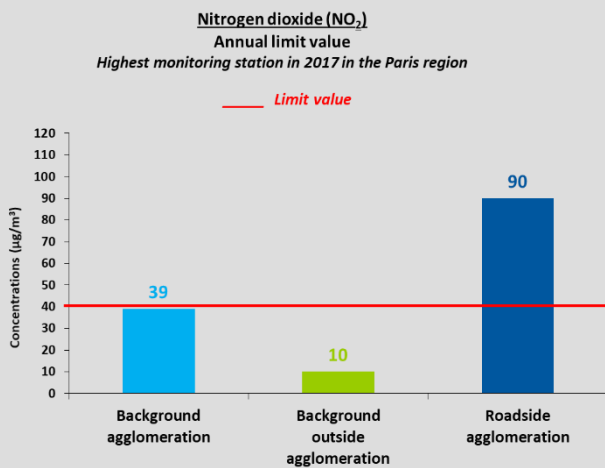
Nitrogen dioxide (NO$_2$)
Annual limit value
Highest monitoring station in 2017 in the Paris region

——— *Limit value*

Nitrogen dioxide (NO$_2$)
Hourly limit value
(number of hours exceeding the 200 µg/m^3 threshold)
Highest monitoring station in 2017 in the Paris region

——— *Limit value (18 exceedances)*

exceedance intensity

very important	> + 50 %
important	+ 30 à + 50 %
moderate	+ 10 à + 30 %
light	0 à + 10 %

no exceedance

Nitrogen dioxide (NO$_2$)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Annual limit value exceedance *				2003, 2007, 2009, 2010, 2011, 2012, 2013, 2014		every year
Hourly limit value exceedance *						since 2006

* considering margins of tolerance decreasing from year to year

Summary of air quality standards exceedances for nitrogen dioxide (NO$_2$) in the Paris region

2.3 Nitrogen dioxide (NO$_2$)

SITUATION IN 2017 RELATED TO AIR POLLUTION STANDARDS

The maps in Figure 16 show the annual mean NO$_2$ concentrations within the Paris region, with a focus on Paris and surrounding subsurbs in 2017.
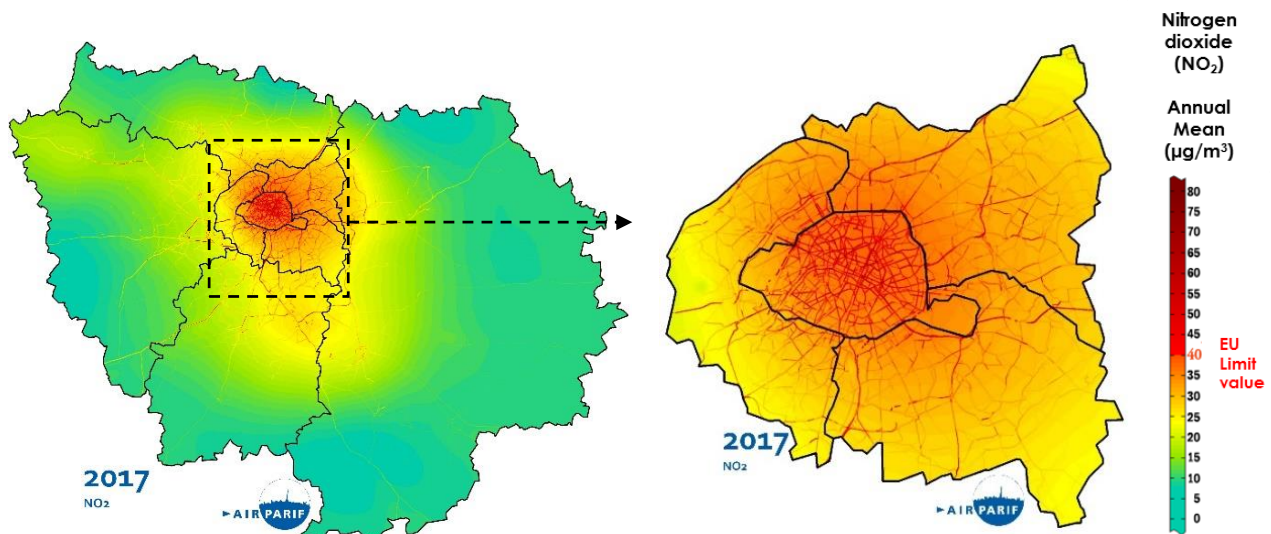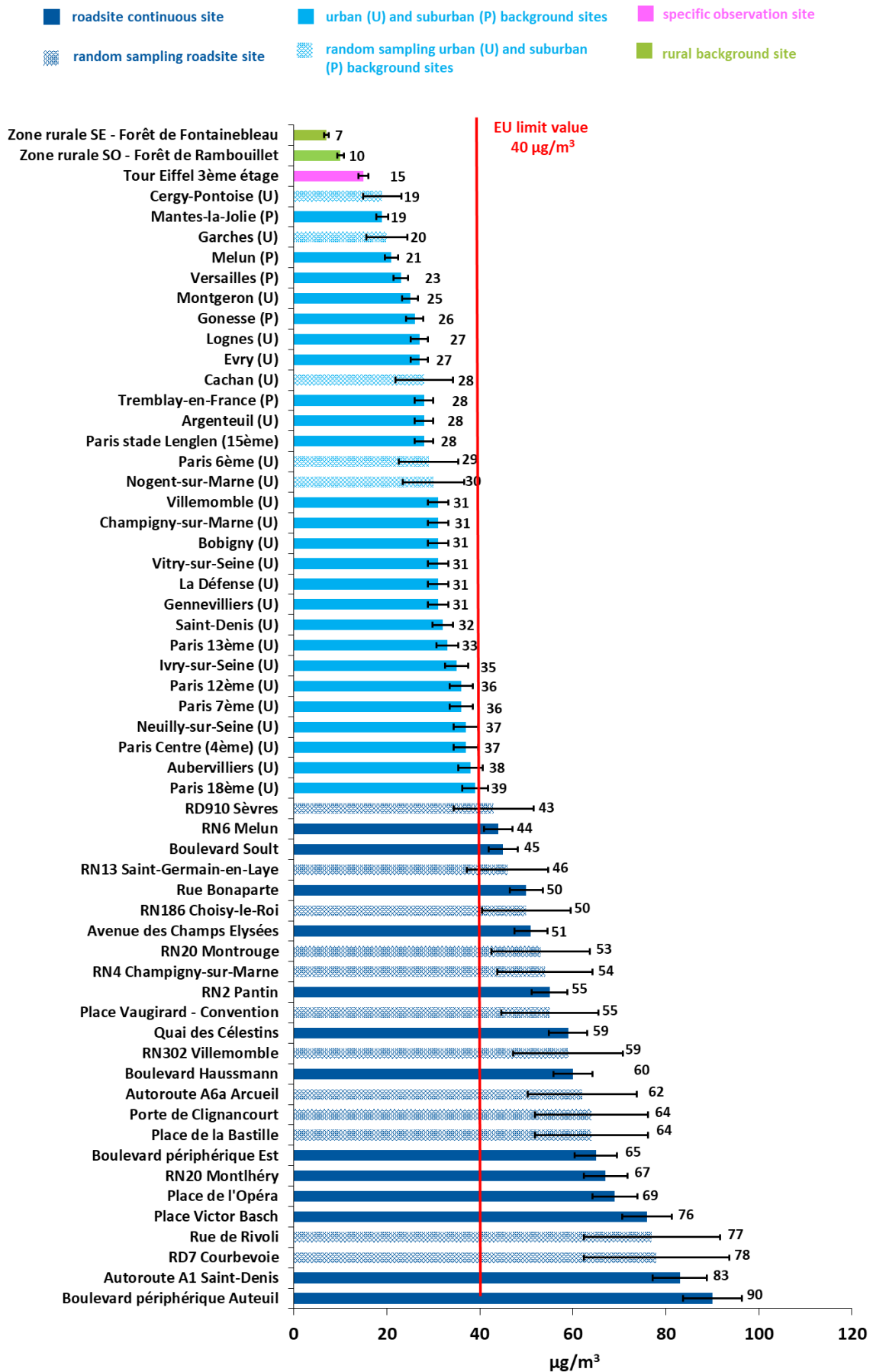

Figure 16: nitrogen dioxide (NO$_2$) annual mean concentration within the Paris region, with a focus on Paris and surrounding suburbs in 2017

There is a **strong NO$_2$ background concentrations gradient** between rural areas and the centre of the Parisian agglomeration. Thus, annual mean levels measured within the agglomeration reach 39 µg/m^3 (Figure 17) and the mean regional background level of NO$_2$ is close to 10 µg/m^3 in 2017.

Highest NO$_2$ mean concentrations are measured within the Paris agglomeration, near major traffic roads (motorways and national highways)**.** In Paris, the right bank of the Seine River is broadly more polluted than the left bank because of higher roads density.

Since 2015, the EU limit value for nitrogen dioxide (40 µg/m³) is met at all the monitoring stations in background situation. Background mean concentrations are similar to those measured in 2015 and 2016.

NO$_2$ levels along major roads are twice those in background situation. In some cases, they are two times higher than the EU annual limit value. The threshold exceedance has been confirmed in 2017 for approximately 900 kilometres of roads and highway connections. This corresponds to approximately 10 % of the main road network modeled by Airparif. These road axes are mainly located in the urban area of Paris.

Legend:
- roadsite continuous site
- urban (U) and suburban (P) background sites
- specific observation site
- random sampling roadsite site
- random sampling urban (U) and suburban (P) background sites
- rural background site

EU limit value 40 µg/m³

Site	Value (µg/m³)
Zone rurale SE - Forêt de Fontainebleau	7
Zone rurale SO - Forêt de Rambouillet	10
Tour Eiffel 3ème étage	15
Cergy-Pontoise (U)	19
Mantes-la-Jolie (P)	19
Garches (U)	20
Melun (P)	21
Versailles (P)	23
Montgeron (U)	25
Gonesse (P)	26
Lognes (U)	27
Evry (U)	27
Cachan (U)	28
Tremblay-en-France (P)	28
Argenteuil (U)	28
Paris stade Lenglen (15ème)	28
Paris 6ème (U)	29
Nogent-sur-Marne (U)	30
Villemomble (U)	31
Champigny-sur-Marne (U)	31
Bobigny (U)	31
Vitry-sur-Seine (U)	31
La Défense (U)	31
Gennevilliers (U)	31
Saint-Denis (U)	32
Paris 13ème (U)	33
Ivry-sur-Seine (U)	35
Paris 12ème (U)	36
Paris 7ème (U)	36
Neuilly-sur-Seine (U)	37
Paris Centre (4ème) (U)	37
Aubervilliers (U)	38
Paris 18ème (U)	39
RD910 Sèvres	43
RN6 Melun	44
Boulevard Soult	45
RN13 Saint-Germain-en-Laye	46
Rue Bonaparte	50
RN186 Choisy-le-Roi	50
Avenue des Champs Elysées	51
RN20 Montrouge	53
RN4 Champigny-sur-Marne	54
RN2 Pantin	55
Place Vaugirard - Convention	55
Quai des Célestins	59
RN302 Villemomble	59
Boulevard Haussmann	60
Autoroute A6a Arcueil	62
Porte de Clignancourt	64
Place de la Bastille	64
Boulevard périphérique Est	65
RN20 Montlhéry	67
Place de l'Opéra	69
Place Victor Basch	76
Rue de Rivoli	77
RD7 Courbevoie	78
Autoroute A1 Saint-Denis	83
Boulevard périphérique Auteuil	90

µg/m³

In addition to continuous measurements of NO₂, discontinuous measurements are performed by AIRPARIF since 2007. These measurements are carried out using passive diffusion tubes during 12 uncontinuous weeks evenly distributed over the year. For these sampling sites, the results reported in this figure represent the average of twelve weeks measurements.

Figure 17: nitrogen dioxide (NO₂) annual mean concentration for all monitoring sites in the Paris region in 2017

Air quality in the Paris region in 2017: Summary – March 2018
AIRPARIF – Air quality observatory in the Paris region
Page 21

NO₂ mean concentrations are highly variable from one traffic site to another. They reflect a wide range of concentrations measured near major traffic roads. They are due to **differences in traffic conditions** (traffic flow, speed, vehicle fleet) **and topography** that are more or less favorable to the pollutants dispersion. They also explain differences in NO₂ concentrations in background situation.

In 2017, **around 1.3 million inhabitants (or around 10 % of the regional population) are potentially exposed to an exceedance of the NO₂ EU annual limit value** (Figure 18). They are mainly living within the Parisian agglomeration. **Nearly half of all Paris inhabitants** are concerned by the exceedance of the NO₂ annual limit value. A very slight decrease in the number of inhabitants exposed to the EU annual limit value was observed between 2016 and 2017.
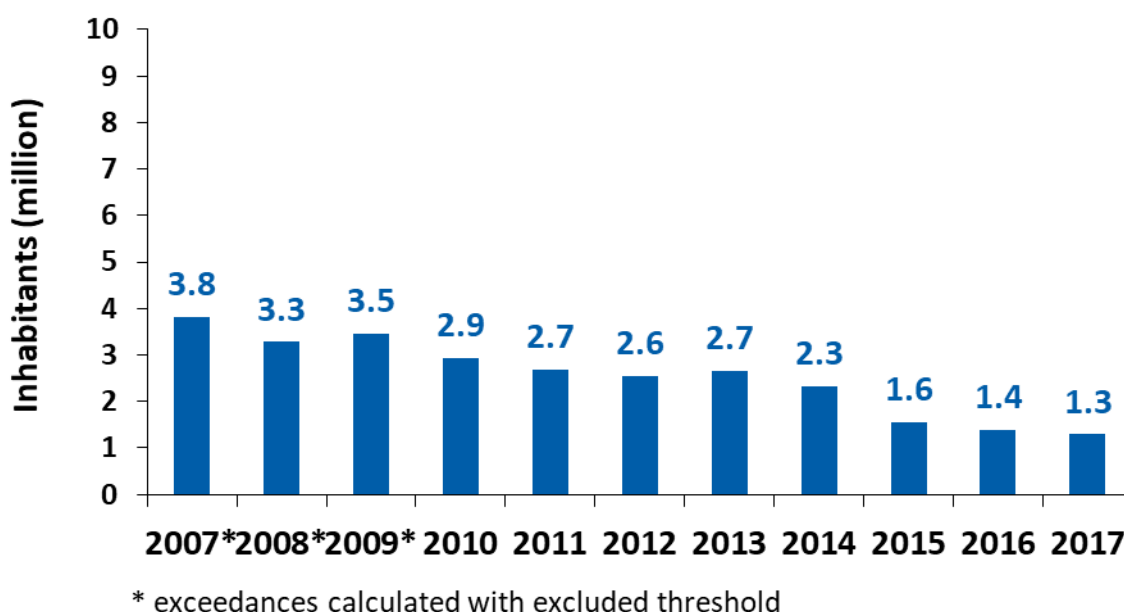
Figure 18: million of inhabitants potentially exposed to a nitrogen dioxide (NO₂) level exceeding the EU annual limit value in the Paris region from 2007 to 2017

Due to the high road density within the Paris region, modelling tools do not currently allow any estimation of the number of hours exceeding the NO₂ hourly threshold (200 µg/m³) throughout the regional road network. Developments are ongoing to estimate kilometres of roads, surface areas and the number of inhabitants exposed to an exceedance of this NO₂ hourly limit value (200 µg/m³ not to be exceeded more than 18 times per year).

In 2017, **the NO₂ hourly limit value is exceeded** at a single traffic monitoring station (33 exceedances for the Ring road BP Auteuil site). **The number of monitoring stations prone to an exceedance of the hourly limit value is lower than in 2016.** The Ring road BP Auteuil site does not allow, regarding European criteria, to assess the exceeding of the limit value, because the public does not have access to it. Nevertheless, it allows us to characterise the maximum impact observed in the immediate vicinity of a major axis, which is particularly representative of the exposure of the users of this axis.

The NO₂ hourly limit value is met at all the background stations. In 2016, 3 traffic stations exceeded the hourly limit value. The number of hours exceeding this threshold has significantly decreased at all traffic stations in 2017, particularly because of the absence of a lasting winter episode, unlike December 2016.
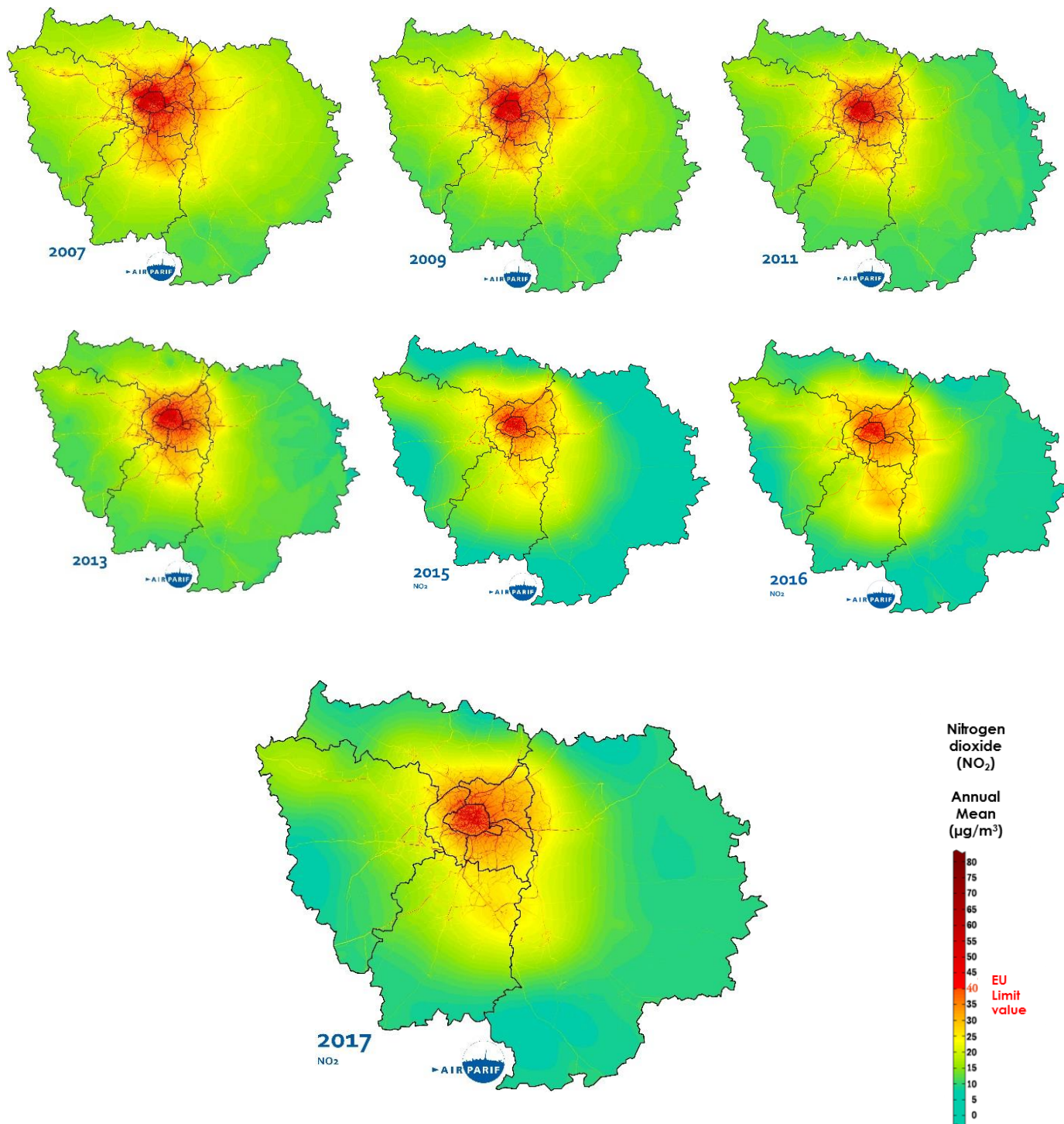
Figure 19: annual mean concentrations of nitrogen dioxide (NO₂) from 2007 to 2017 in the Paris region

The maps in Figure 19 show a similar pollution pattern illustrating **a downward trend of NO₂ annual mean concentrations between 2007 and 2017 within the Paris region.**

A downward trend of NO₂ tri-annual mean levels is observed since the end of the 1990's at background sites (Figure 20). Technological improvements of emission sources (road traffic, heating, industry) can explain reduced NO₂ levels, especially due to **the progressive expansion of catalytic converters on gasoline and diesel vehicles.** NO₂ tri-annual mean concentrations are broadly stable from 1992-1994 to 1999-2001. The average annual decrease of about -4 % from 2000 to 2006. Since 2007, the decrease is much slower (an average of -1 % per year).
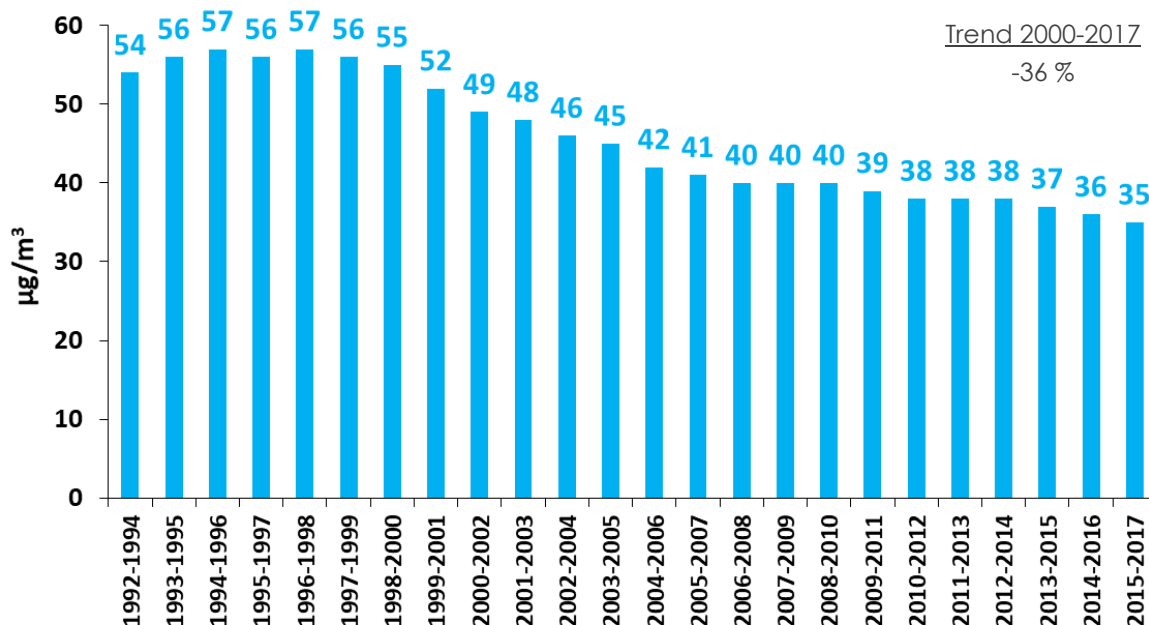
Figure 20: trend in the NO₂ tri-annual mean concentration (based on a sample of the same six urban background sites) within the Paris agglomeration from 1992-1994 to 2015-2017

The trend in NO₂ tri-annual mean concentrations is quite different in roadside situation. **NO₂ levels based on a permanent sample of traffic stations are broadly constant between 1998 and 2012. A downward trend of NO₂ concentrations is observed since the 2011-2013 period** (Figure 21). NO₂ tri-annual mean concentrations decrease of about -10 % in roadside situation from 2011-2013 to 2015-2017.
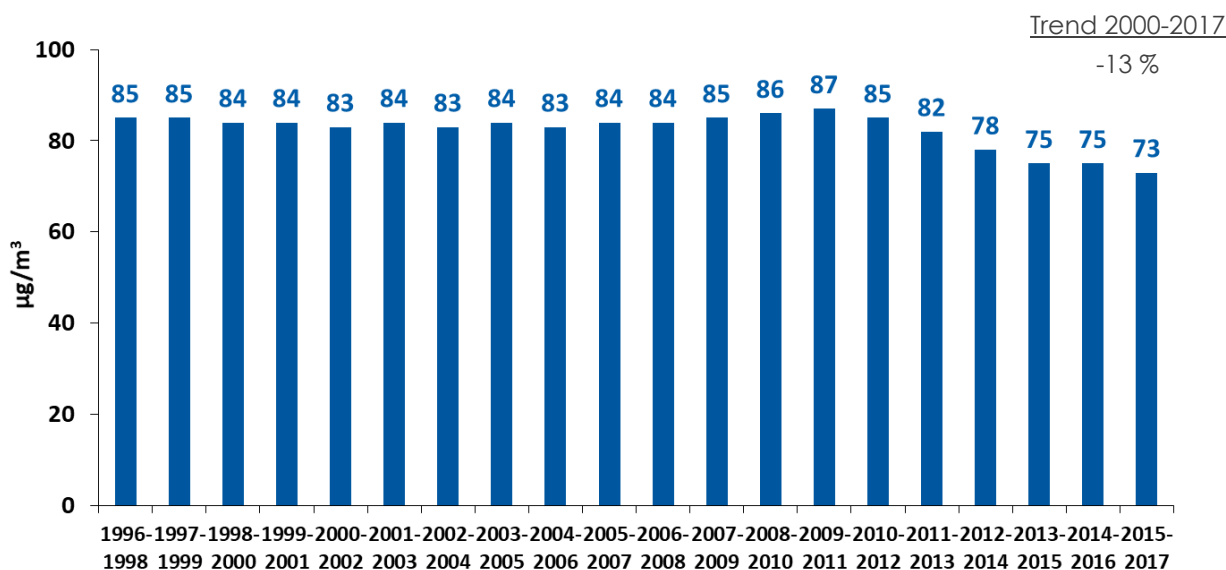
Figure 21: trend in NO₂ tri-annual mean concentration (based on a sample of the same five roadside sites) within the Paris agglomeration from 1996-1998 to 2015-2017

Nitrogen dioxide (NO_2) is a complex pollutant related to direct emissions (from transport, heating and industry sectors) and chemical reactions with other atmospheric pollutants, especially ozone (O_3). The global stability of NO_2 levels in roadside situation before 2011 can be explained by high nitrogen oxides concentrations (NO_x – pollutants from vehicles) associated with high background levels of ozone. Moreover, the spread of diesel-engined vehicles is an adverse factor for NO_2 concentrations along roads. Although catalysed particulate filters provided on the new diesel vehicles reduce particulate emissions, those using oxidation catalysis increase the proportion of nitrogen dioxide within the NO_x emissions.

The trend in NO_2/NO_x tri-annual mean concentration ratio at all the roadside stations is shown in Figure 22. NO_2 background levels were subtracted in order to obtain an optimal NO_2/NO_x emission ratio (also considered to evaluate the impact of road traffic emissions). While the NO_2 impact near traffic roads would represent less than 10 % in 1998, it has more than doubled in 10 years (24 % in 2011). However, a downward trend of the NO_2/NO_x ratio is observed since 2012. This decrease can be explained by the increasing share of Euro 5 vehicles in the traffic fleet.
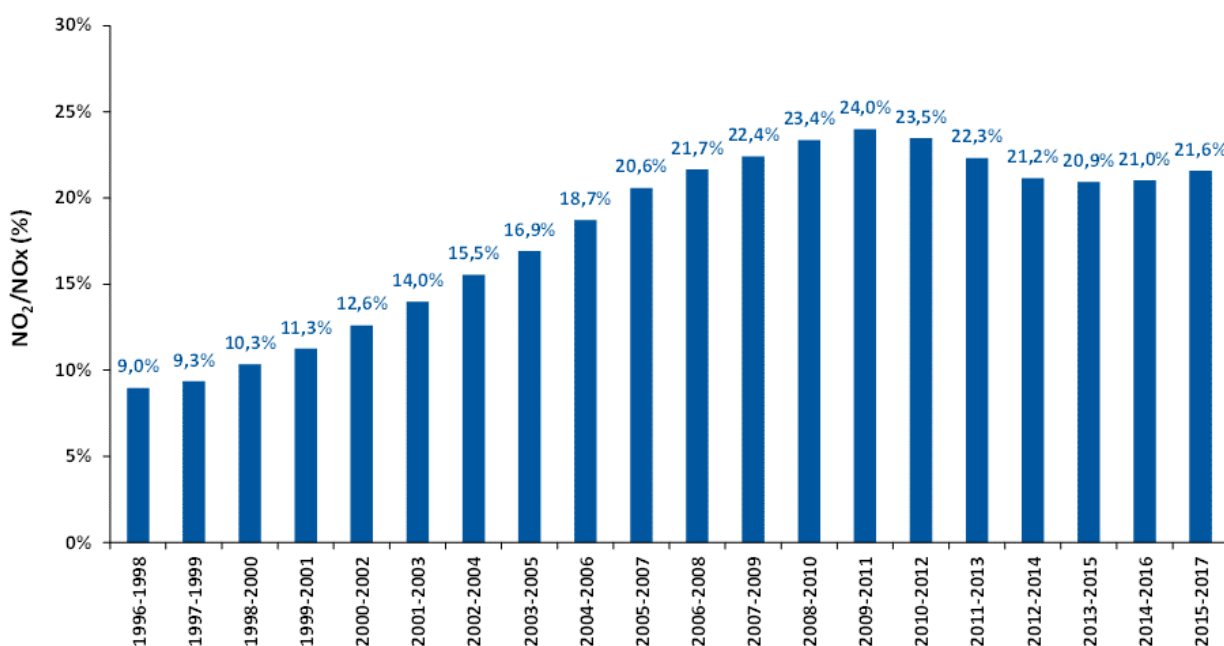
Figure 22: trend in [NO_2] / [NO_x] tri-annual mean ratio at all the roadside sites in the Paris agglomeration (background level subtracted) from 1996-1998 to 2015-2017

Ozone (O₃) in brief

Stabilization of O₃ mean levels since 2003
Target values for the protection of Human Health and vegetation met
The French quality objectives are still exceeded in 2017

Ozone remains an important issue in the Paris region

Ozone (O₃) Human Health
Target value
Highest monitoring station in 2017 in the Paris region

_____ *Target value (25 days)*

Number of days

- Background agglomeration: 13
- Background outside agglomeration: 13
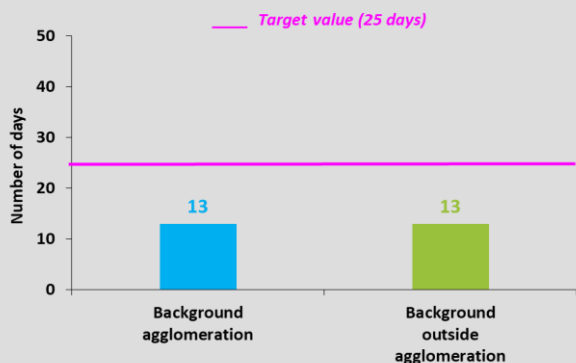
Ozone (O₃) Human Health
Quality objective and long-term objective
Highest monitoring station in 2017 in the Paris region

_____ *Quality objective and long-term objective (no exceeding day)*

Number of days

- Background agglomeration: 13
- Background outside agglomeration: 15
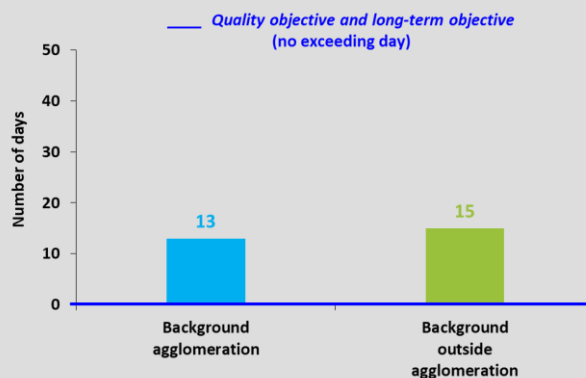
Ozone (O₃) vegetation
Target value
Highest monitoring station in 2017 in the Paris region

_____ *Target value*

AOT40 (µg/m³.h)

- Background agglomeration: 11 897
- Background outside agglomeration: 11 359
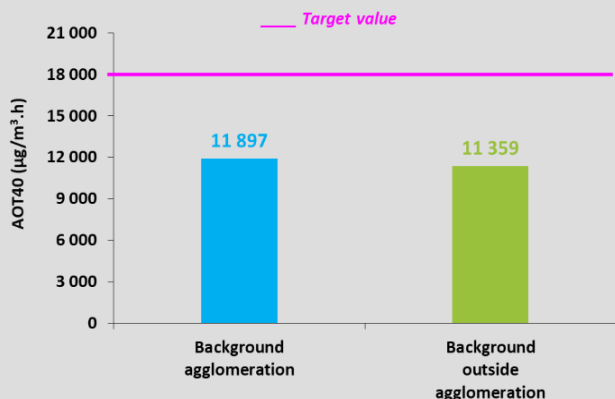
Ozone (O₃) vegetation
Quality objective and long-term objective
Highest monitoring station in 2017 in the Paris region

_____ *Quality objective*

AOT40 (µg/m³.h)

- Background agglomeration: 12 367
- Background outside agglomeration: 13 079
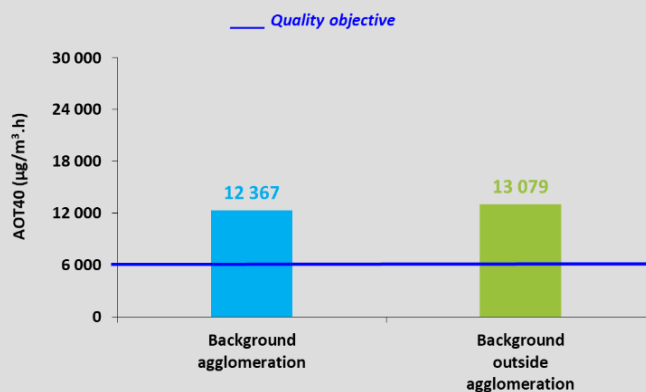
exceedance intensity

very important	> + 50 %
important	+ 30 à + 50 %
moderate	+ 10 à + 30 %
light	0 à + 10 %

no exceedance

Ozone (O₃)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Quality objective exceedance (health) Long term objective applicable in 2020 (health)			*no measurement*	every year	every year	*no measurement*
Target value exceedance (health)			*no measurement*	every year until 2006	every year until 2006	*no measurement*
Quality objective exceedance (vegetation) Long term objective applicable in 2020 (vegetation)			*no measurement*	every year	every year	*no measurement*
Target value exceedance (vegetation)			*no measurement*			*no measurement*

Summary of air quality standards exceedances for ozone (O₃) in the Paris region

2.4 Ozone (O₃)

SITUATION IN 2017 RELATED TO AIR POLLUTION STANDARDS

Ozone (O₃) is a secondary pollutant (and also a greenhouse gas) not directly emitted to the atmosphere but formed in air from complex reactions between the precursor gases (nitrogen oxides (NO_x) and volatile organic compounds (VOC)) in the presence of sunlight and high temperatures. Meteorological conditions (especially in spring and summer) influence O_3 concentrations. After a year 2016 globally close to standards (with a very cool and rainy spring, followed by a summer with an alternation of freshness and heat (heat wave in late August)), the year 2017 was slightly warmer. The anticyclonic conditions observed in June 2017, coupled with a heat wave episode and a high level of sunshine, led to a rise in summer ozone concentrations. As a result, ozone levels are slightly higher than those recorded in 2016. This particularly concerns exceedances of the 120 µg/m³ threshold (on a maximum daily 8-hour mean).

Protection of Human Health

As in previous years, **the O₃ quality objective for the protection of human health** (120 µg/m³ on a maximum daily 8-hour mean per civil year) **is exceeded over the whole Paris region in 2017** (Figure 23)**. Suburban and rural areas are more commonly affected than the Paris agglomeration.** Annual prevailing meteorological conditions (mainly summer conditions) have an impact on the number of threshold exceedances.
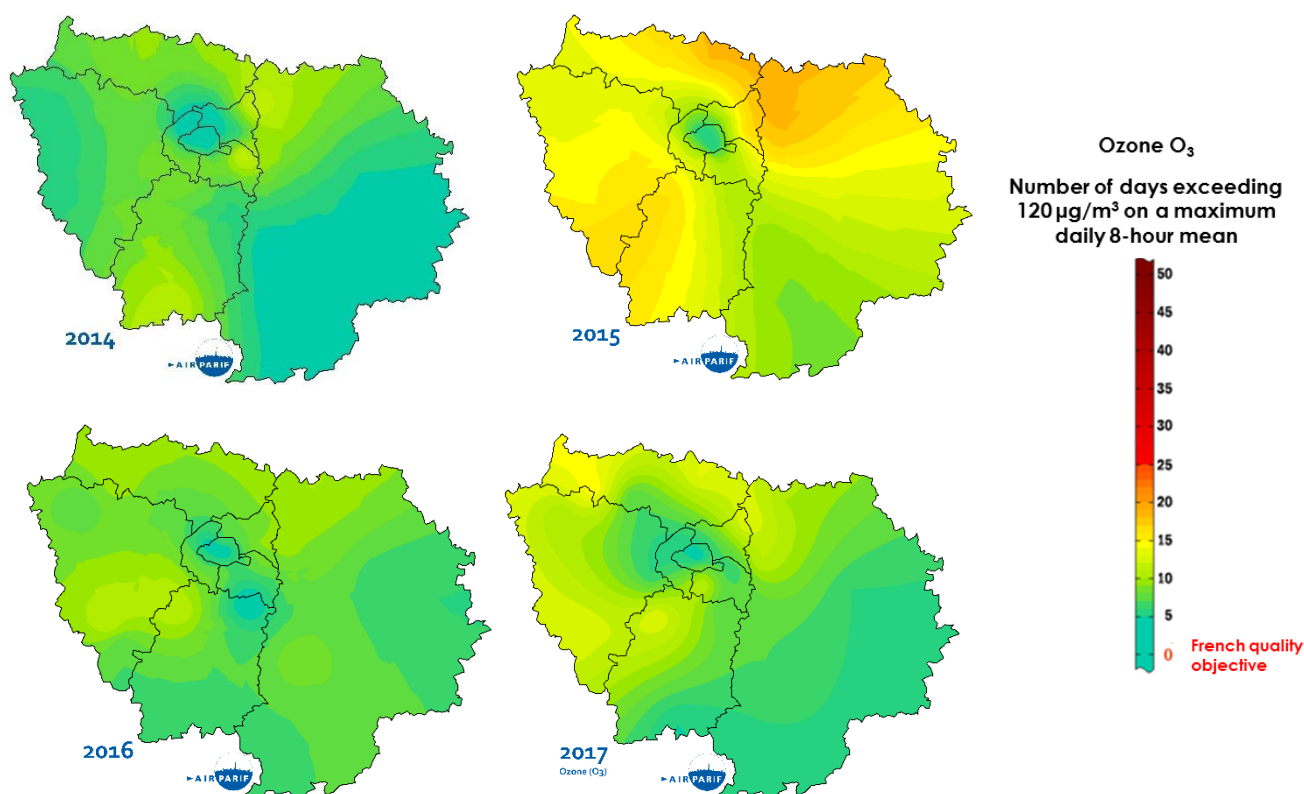
Figure 23: number of days exceeding the French quality objective (=EU long-term objective) threshold of 120 µg/m³ on a maximum daily 8-hour mean (objective = no exceedance) for ozone (O₃) in the Paris region from 2014 to 2017

Due to higher sunlight and temperatures from May to July, **the year 2017 recorded a number of days exceeding the quality objective slightly higher than in 2016 (an average of +2 days for rural stations).**

The **target value for the protection of human health** (calculated on a 3-year average) was exceeded until 2007 within southwest rural areas and in the north of the Paris region. **This regulating threshold is no longer exceeded in the Paris region since the 2006-2008 period.** This observation is confirmed for the 2015-2017 period (Figure 24).
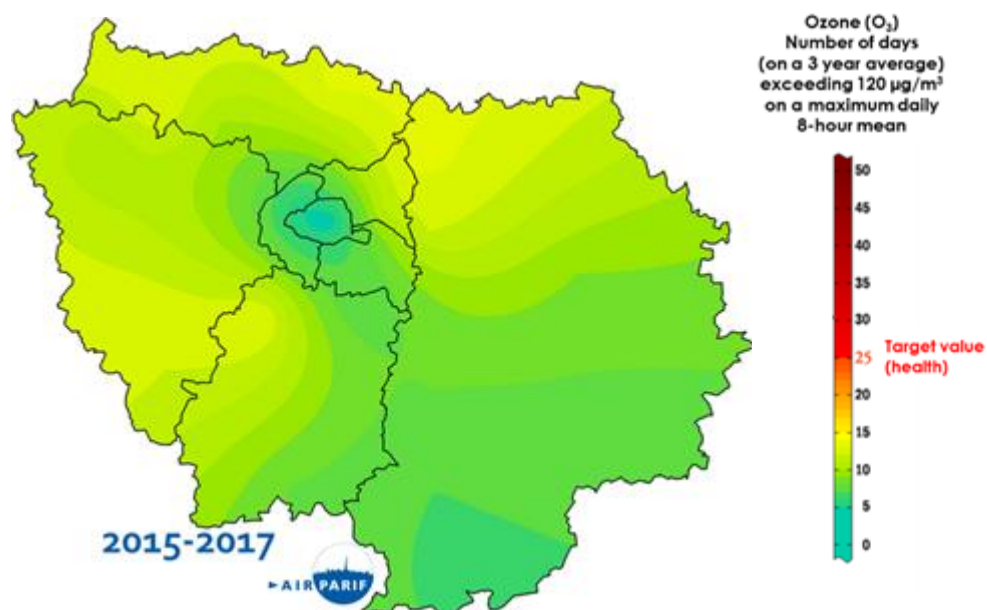
Figure 24: number of days exceeding the O_3 target value for the protection of human health (120 µg/m³ for the daily maximum on an 8-hour average not to be exceeded more than 25 days per calendar year calculated on a 3-year average) within the Paris region for the 2015-2017 period

The average number of days exceeding the O_3 target value is usually higher in rural and suburban areas than in the Paris agglomeration. This is due to the « ozone sinks » effect. It is specific to large metropolitan areas which concentrate NO_x sources from road traffic and residential heating. As a consequence, ozone is consumed by NO_x emissions through photochemical reactions.
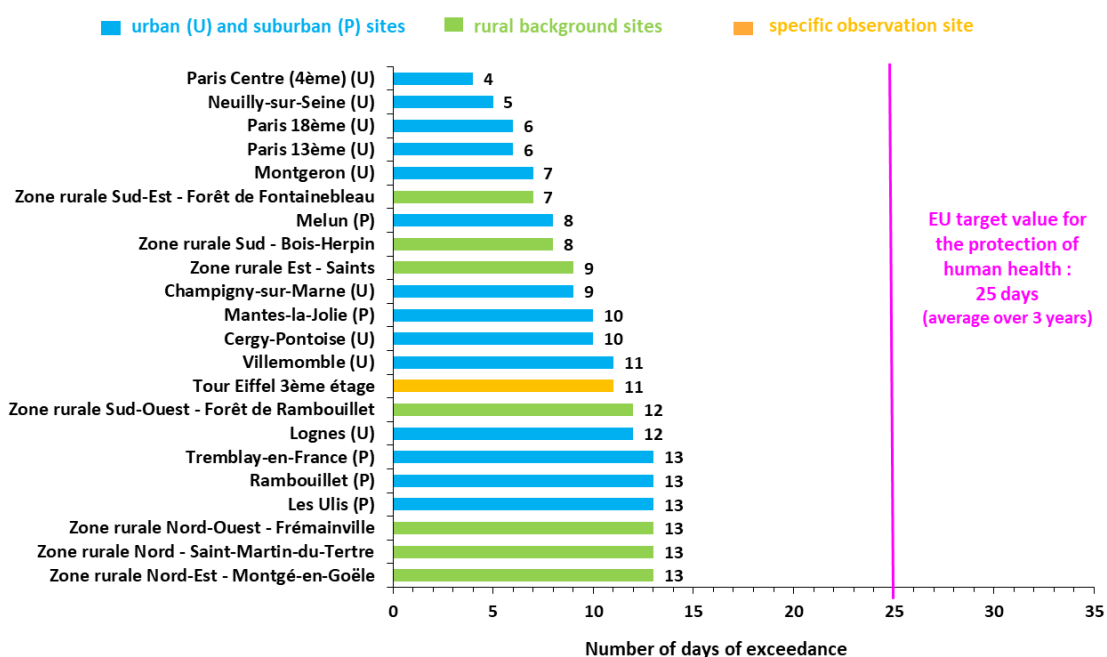
Figure 25: number of days exceeding the O_3 EU target value for the protection of human health (120 µg/m³ 8-hour) in the Paris region (average 2015-2017)

Air quality in the Paris region in 2017: Summary – March 2018
AIRPARIF – Air quality observatory in the Paris region
Page 28

Protection of vegetation

Many scientific studies have revealed the ozone negative effects on the vegetation (forests, ecologically or biologically significant areas and cereal/wheat crops) due to its strong oxidizing action. Consequently, European regulations focus the **quality objectives and target values for the protection of vegetation on growing vegetation and crops periods, in the spring and early summer**.

AOT 40 (corresponding to '*Accumulated Ozone exposure over a Threshold of 40 parts per billion (ppb)*') means the sum of the difference between hourly concentrations greater than 80 μg/m³ (=40 ppb) and 80 μg/m³ over a given period using only the one-hour value measured between 8.00 am and 8.00 pm Central European Time (CET) each day. It is expressed in μg/m³.h^{-1}.

The EU target value for the protection of vegetation (18 000 μg/m³.h^{-1}) is calculated on a 5-year average. The averaged value is less prone to fluctuations from one year to the next. In 2017, **the EU target value is met in the whole Paris region.** The highest average recorded per station over the 2013-2017 period is 11 897 μg/m³.h^{-1} (+5 % compared to 2016).

As every year, the French quality objective for the protection of vegetation (6 000 μg/m³.h^{-1} from May to July 8 am to 8 pm, equivalent to EU long-term objective) **is exceeded in the Paris region.** In 2017, all the stations of the Airparif network recorded levels above the quality objective for the protection of vegetation (while 17 stations complied with this regulatory value in 2016). Exceedance is generally pronounced in rural and peri-urban areas aimed by this protection threshold, where the levels are up to about 2.2 times higher than the norm (Figure 26).
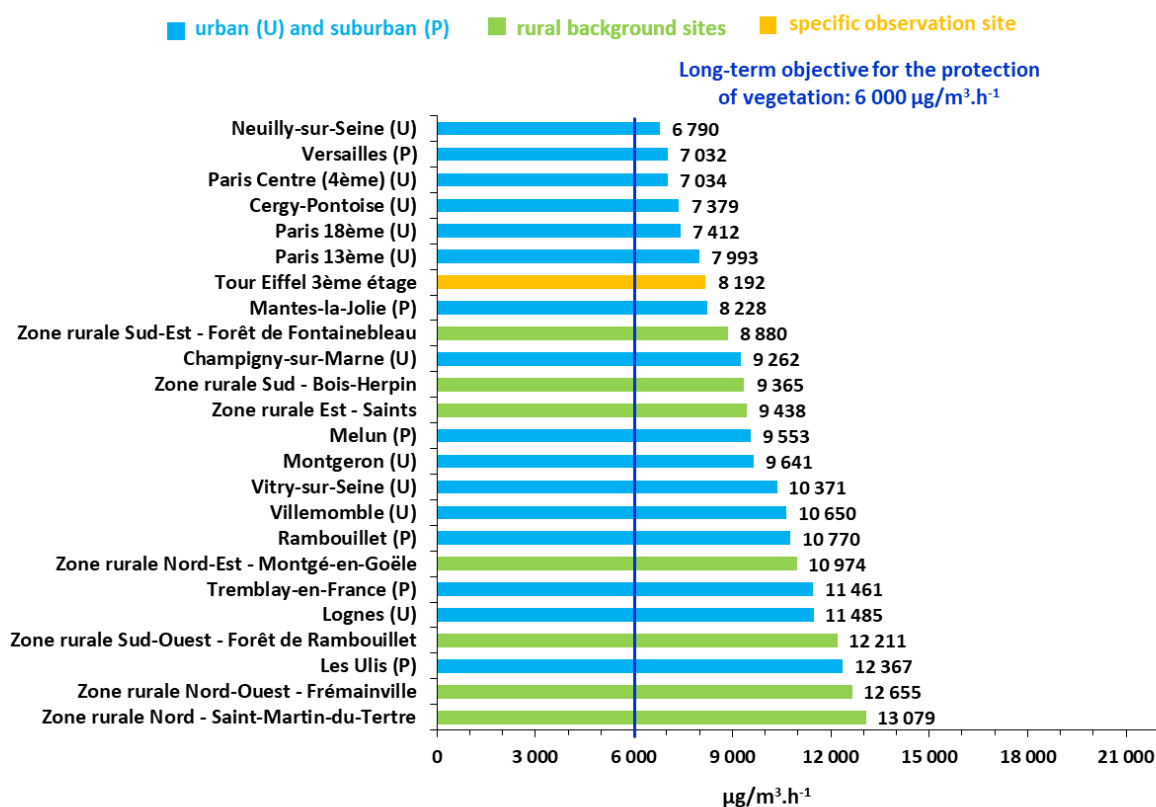
Figure 26: long-term objective in ozone (O₃) for the protection of vegetation
(AOT40, threshold of 6 000 μg/m³.h^{-1}) in the Paris region in 2017

AVERAGE ANNUAL TRENDS FOR THE PROTECTION OF HUMAN HEALTH

Due to strong interannual fluctuations related to meteorological conditions, the average number of exceedance days of the quality objective for the protection of human health (120 µg/m³ 8-hour average) can vary considerably over time. It depends on summer weather conditions, and in particular the presence of durably warm periods.

While the year 2017 is characterised by an average insulation and a number of days of high heat above average (14 in 2016, 17 in 2017), the number of days exceeding the quality objective in the agglomeration and in rural areas in 2017 are relatively comparable to those of 2009, 2012, 2014 and 2016 (Figure 27); those four years being in the low average in terms of weather conditions.

Over the period 1998-2017, the number of exceedance days does not show a clear downward trend. It still exceeds the quality objective (no exceedance allowed).
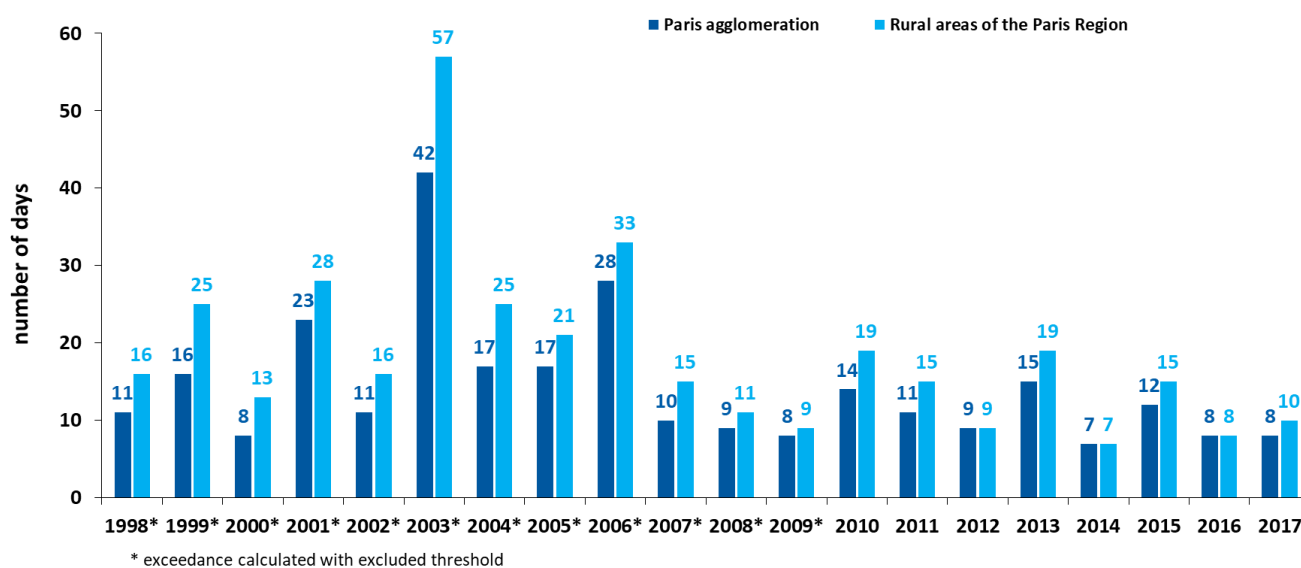
Figure 27: average number of days exceeding the O₃ quality objective for the protection of human health (120 µg/m³ 8-hour average) in the Paris region from 1998 to 2017

Due to the strong dependence to weather conditions, the evolution of the number of days exceeding the threshold of 120 µg/m³ over 8 hours can only be meaningful in the medium term. The number of days exceeding the EU target value for the protection of human health on a 3-year period is shown in Figure 28.

In 2017, **this regulated threshold is met in the agglomeration and rural areas of the Paris region** for the tenth and the ninth consecutive year, respectively. Over the 2015-2017 period, the number of days exceeding the target value for the highest monitoring stations in the agglomeration and in rural areas is comparable to those observed over the 2014-2016 period. These two periods record the lowest number of exceedance days on the entire history (13 days).

The exceedance of the target value therefore seems unlikely in the future, including in rural and peri-urban areas of the Paris region.
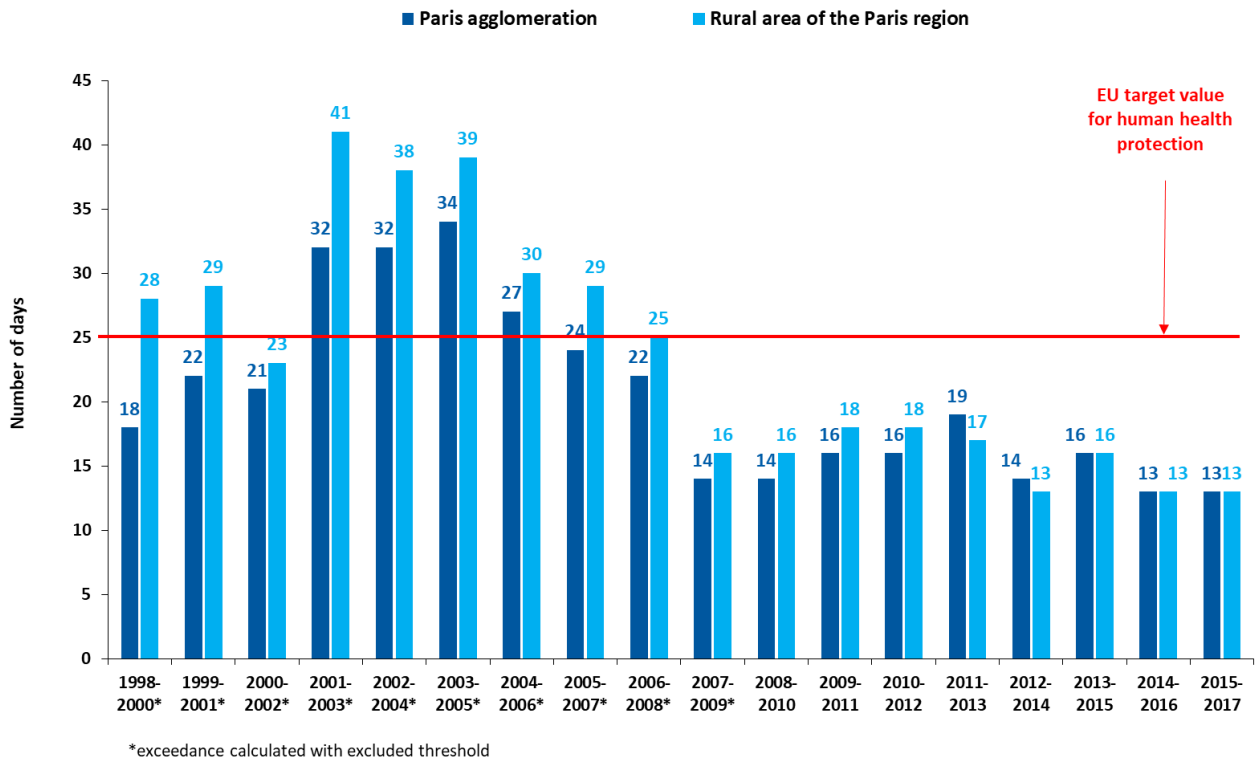
Figure 28: number of days exceeding the EU target value for the protection of human health (120 µg/m³ 8-hour average, not over 25 days of exceedance on a 3-year period) for the highest monitoring station in the Paris region from 1998-2000 to 2015-2017

The trend of the O_3 tri-annual mean concentrations measured within the Paris agglomeration is shown in Figure 29. These O_3 levels rose by 90 % between 1994 and 2017. **The annual average rate reached 7 % per year between 1994 and 2003. Urban background ozone concentrations are statistically stable since 2003.** This increase was seen in France, but also everywhere in Europe. It is related to the overall increase in the emissions of ozone precursors and the decrease of NO_x levels in large cities. The steady decline in NO levels (that chemically consumes ozone in urban areas) has an upward effect of average ozone levels.
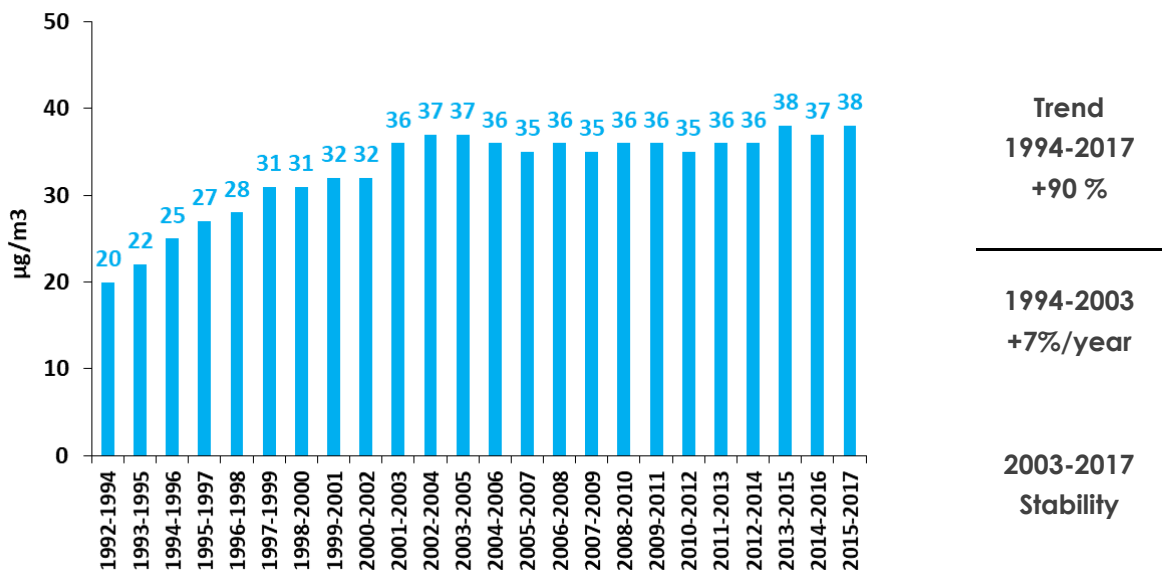
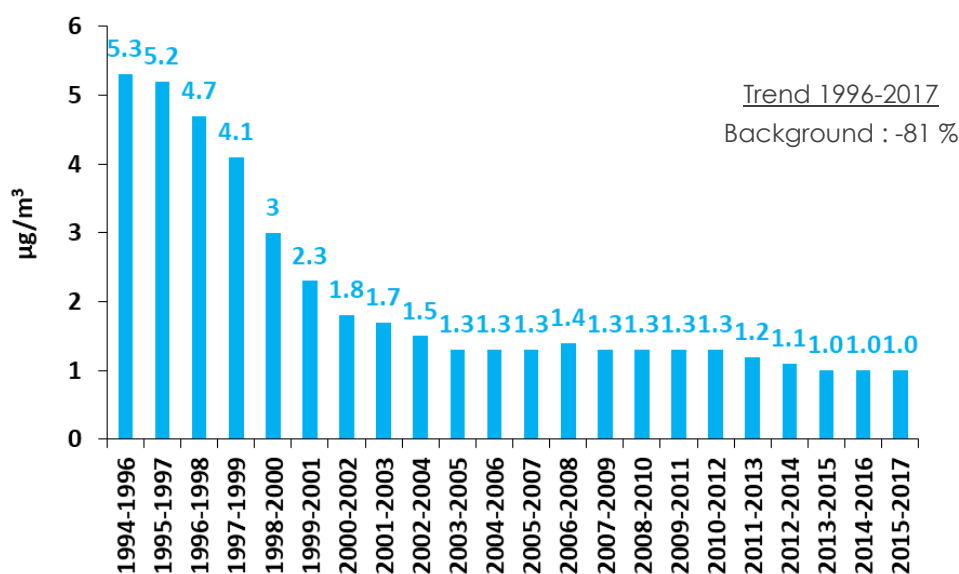**Figure 29: trend in the O_3 tri-annual mean concentrations (based on a sample of the same three urban background sites) within the Paris agglomeration from 1992-1994 to 2015-2017**

Benzene (C$_6$H$_6$) in brief

Annual limit value for benzene (5 µg/m³) is met everywhere in the Paris region in 2017
Exceedance of the quality objective (2 µg/m³) near traffic

Less than 1 % of the regional population are potentially exposed to an exceedance
of the annual quality objective (2 µg/m³)

The decreasing trend of benzene levels observed within the Paris region from 1994 to the beginning
of the 2000's goes on but at a significantly lower pace over the 2007-2017 period

Benzene levels are globally stable between 2016 and 2017
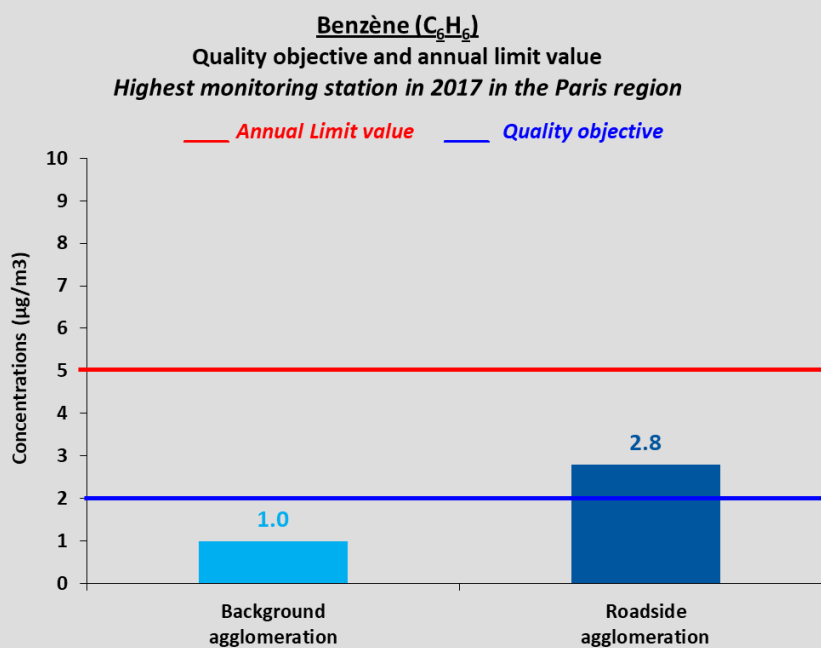
Benzène (C$_6$H$_6$)
Quality objective and annual limit value
Highest monitoring station in 2017 in the Paris region

_____ *Annual Limit value*   _____ **Quality objective**

exceedance intensity	
very important	> + 50 %
important	+ 30 à + 50 %
moderate	+ 10 à + 30 %
light	0 à + 10 %

no exceedance

Benzene (C$_6$H$_6$)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Quality objective exceedance		*no measurement*			*no measurement*	every year
Limit value exceedance		*no measurement*			*no measurement*	

Summary of air quality standards exceedances for benzene (C$_6$H$_6$) in the Paris region

2.5 Benzene (C_6H_6)

The maps in Figure 30 show the annual mean benzene concentrations within the Paris region, with a focus on Paris and surrounding subsurbs in 2017.
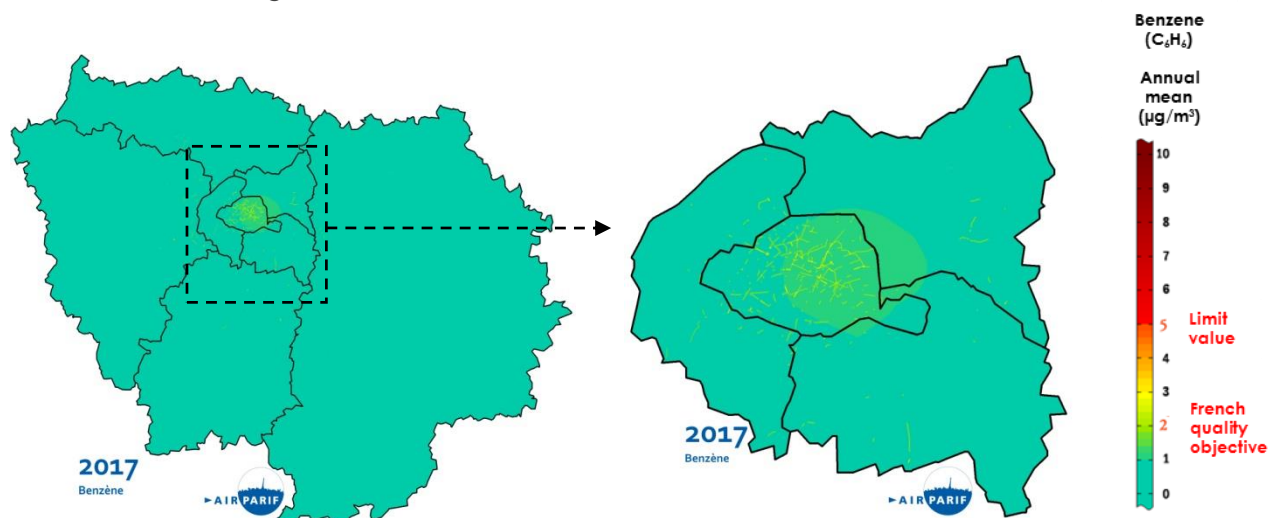
Figure 30: annual mean concentration of benzene (C_6H_6) in the Paris region,
with a focus on Paris and surrounding suburbs in 2017

Every year, annual mean concentrations of benzene are slightly higher in the Paris agglomeration than in the periphery of the region. There is a slight decline of C_6H_6 levels in accordance with the distance from the Paris centre. **Background benzene concentrations are lower than the French quality objective and the EU annual limit value** (2 and 5 µg/m³, respectively). In 2017, background benzene levels (from 0.9 to 1.0 µg/m³) are similar to those in 2015 and 2016 (Figure 31).

Highest annual mean concentrations of benzene were measured near main roads located in the Paris agglomeration, due to traffic-clogged conditions associated with unfavourable conditions for pollution dispersion (major traffic roads contained in the urban fabric like street canyons). These concentrations are between 1.3 and 2.8 µg/m³ for the traffic monitoring stations. They are in the same range than those measured in 2016.

For several years now, benzene levels are on a slightly downward trend, especially along traffic roads.

In 2017, the French quality objective is exceeded at 5 out of 12 traffic monitoring stations. Benzene annual levels are way lower than the EU limit value (5 µg/m³). These findings are based on modeling results and measurement network observations, especially onto heavily-loaded traffic roads. These results have to be considered without being directly influenced by local point sources of VOC (in particular benzene). Highest concentrations can be observed in close proximity to emission sources such as service stations or garages.

Roadside sites
- continuous
- random sampling

Urban (U) and suburban (P) background sites
- continuous
- random sampling

Measurement uncertainties

French Quality objective: 2 µg/m³

EU limit Value: 5 µg/m³

Site	µg/m³
Gonesse (P)	0.8
Paris Stade Lenglen	0.9
Vitry-sur-Seine (U)	0.9
Saint-Denis (U)	0.9
Neuilly-sur-Seine (U)	0.9
Gennevilliers (U)	0.9
Nogent-sur-Marne (U)	1.0
Paris Centre (4ème) (U)	1.0
RD934 Coulommiers	1.3
Boulevard périphérique Est	1.4
RN2 Pantin	1.4
RN20 Montlhéry	1.8
Boulevard Haussmann	1.8
RD7 Courbevoie	2.2
Place de l'Opéra	2.6
Place Victor Basch	2.6
Place de la Bastille	2.8
Rue de Rivoli	2.8

µg/m³ (x-axis: 0 1 2 3 4 5 6 7 8)

In addition to continuous measurements of benzene, discontinuous measurements are performed by AIRPARIF since 2007. These measurements are carried out using passive diffusion tubes during 12 uncontinuous weeks evenly distributed over the year. All these sites are characterised by a high pedestrian density and the presence of residences near road axes. For these sampling sites, the results reported in this figure represent the average of twelve weeks measurements.

Figure 31: annual mean concentration of benzene in the Paris region in 2017

In 2017, less than 1 % of the regional population are potentially exposed to an exceedance of the annual quality objective for benzene. People concerned by this exceedance are mainly living within the Paris agglomeration.

The number of inhabitants potentially exposed to an exceedance of the benzene quality objective has dropped significantly since the beginning of the 2000's (Figure 32). In 2002, 3.2 million of inhabitants were potentially concerned by this threshold exceedance.

inhabitants (thousands)

Year	inhabitants (x1000)
2007*	1 800
2008*	1 900
2009*	1 100
2010	900
2011	1 000
2012	400
2013	300
2014	100
2015	<100
2016	<100
2017	<50

* exceedance calculated with included threshold
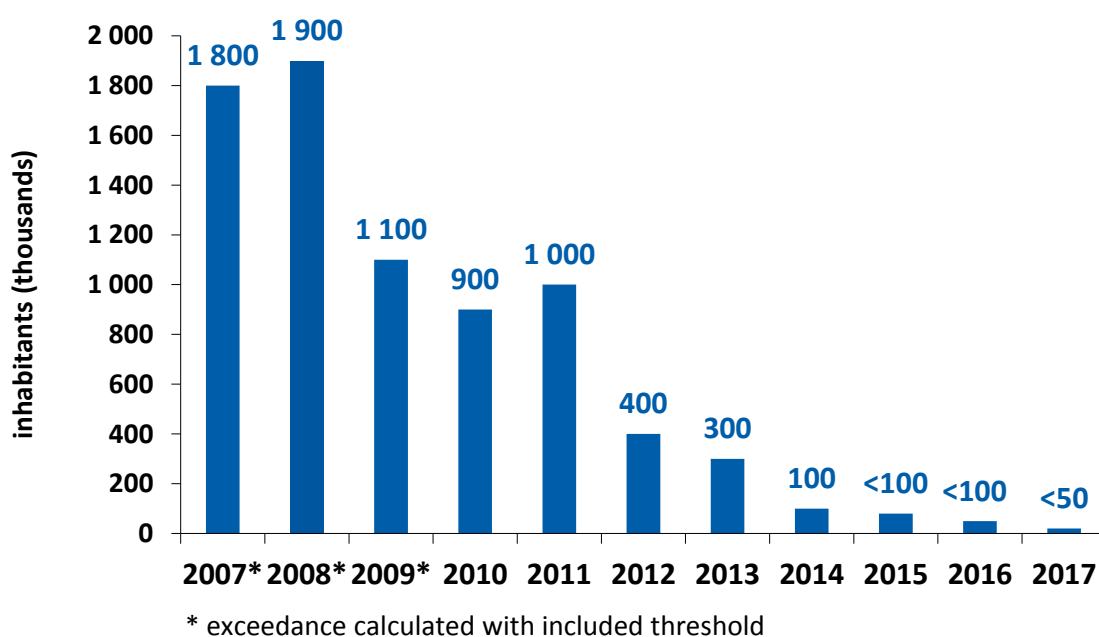
Figure 32: Number of inhabitants (x1000) potentially exposed to an exceedance of the benzene French quality objective (2 µg/m³) in the Paris region from 2007 to 2017

Air quality in the Paris region in 2017: Summary – March 2018
AIRPARIF – Air quality observatory in the Paris region
Page 34

The maps in Figure 33 show the annual mean benzene concentrations within the Paris region, from 2011 to 2017.
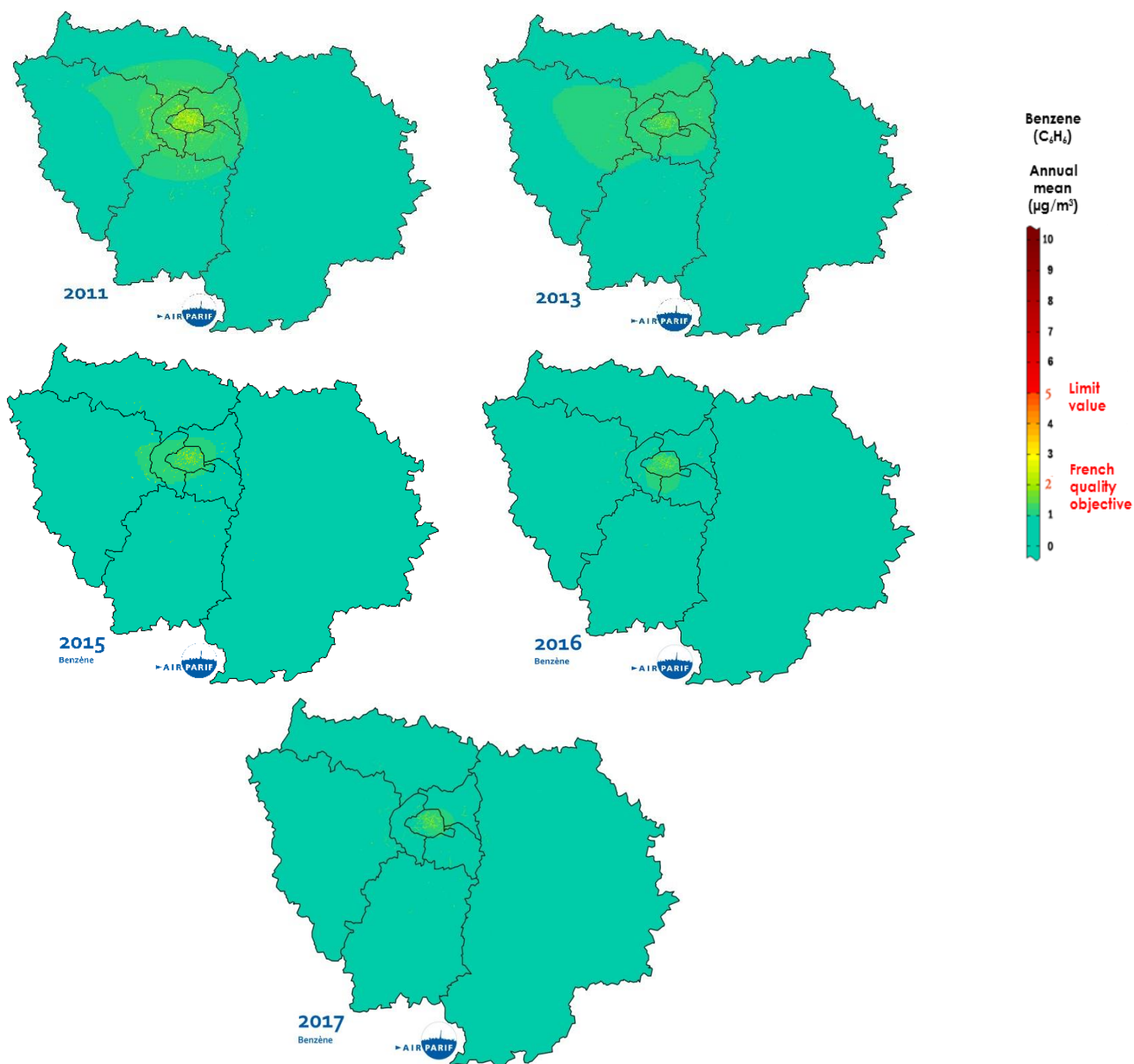
Figure 33: annual mean concentrations of benzene (C_6H_6) from 2011 to 2017 in the Paris region,

After a significant decrease of benzene concentrations since the beginning of the 2000's (-66 % between 1994-1996 and 2000-2002, due to the decline in the benzene content of petrol), levels are stable in the recent years (Figure 34).

Figure 34: trend in the benzene tri-annual mean concentrations (based on a scalable sample of urban background sites) within the Paris agglomeration from 1994-1996 to 2015-2017

In roadside situation, the trend in benzene concentrations is consistent with those of other primary pollutants directly emitted by road traffic (particles, NO₂). However, a decline in benzene levels is more marked since 2000 (date on which an EU regulation limiting the benzene content in petrol is implemented) (Figure 35). Benzene average concentrations decreased by approximately threefold from 1994-1996 to 2000-2002. This decline has slowed down substantially since 2007 (-40 % between 2007 and 2017).
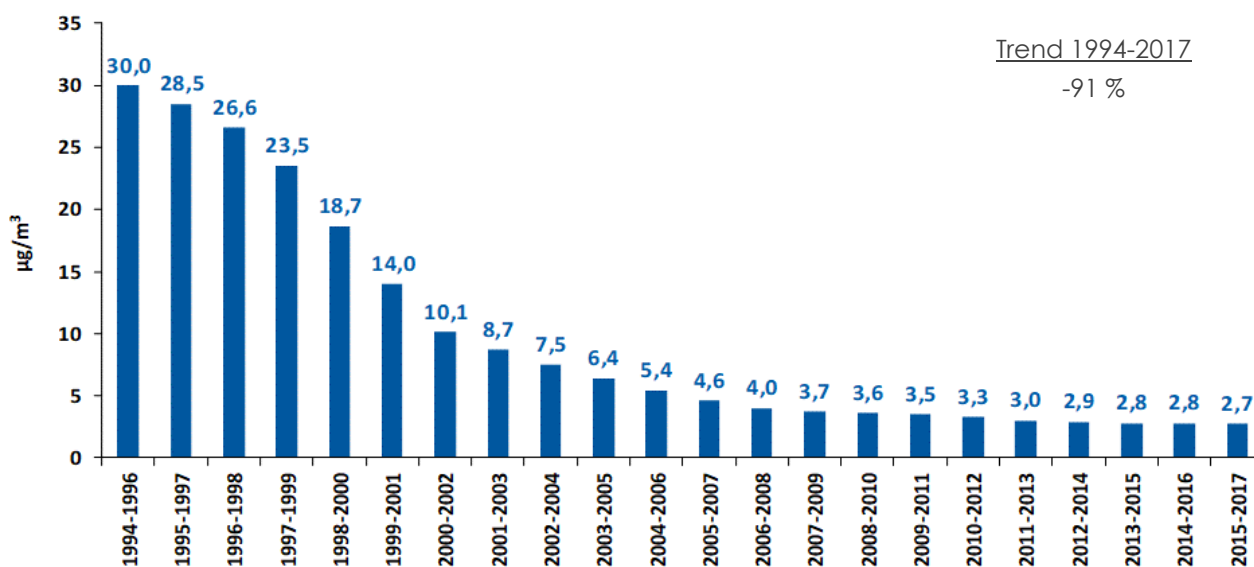
Figure 35: trend in benzene annual mean concentrations at the traffic monitoring station Place Victor Basch from 1994-1996 to 2015-2017

3. Pollutants meeting air quality standards

In brief:

Benzo(a)pyrene (BaP)

Benzo(a)pyrene (BaP)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Target value exceedance		*no measurement*			*no measurement*	

Metals (Lead, Arsenic, Cadmium and Nickel)

Lead (Pb)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Quality objective exceedance		*no measurement*			*no measurement*	
Limit value exceedance		*no measurement*			*no measurement*	

Arsenic (As) , Cadmium (Cd) , Nickel (Ni)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Target value (2015) exceedance		*no measurement*	*no measurement*		*no measurement*	

Carbon monoxide (CO)

Carbon monoxide (CO)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Quality objective exceedance		*no measurement*			*no measurement*	
Limit value exceedance		*no measurement*			*no measurement*	

Sulfur dioxide (SO₂)

Sulfur dioxide (SO$_2$)	2017			2005-2016		
	Background agglomeration	Rural background	Roadside	Background agglomeration	Rural background	Roadside
Quality objective exceedance						
Hourly limit value exceedance						
Daily limit value exceedance						

exceedance intensity   **no exceedance**

exceedance intensity	
very important	> + 50 %
important	+ 30 à + 50 %
moderate	+ 10 à + 30 %
light	0 à + 10 %
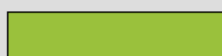
Summary of air quality standards exceedances for B(a)P, metals (Pb, As, Cd, Ni), CO and SO₂ in the Paris region

3.1 Benzo(a)pyrene (BaP)

The BaP EU target value (1 ng/m³) is widely met at the five Airparif monitoring sites (Figure 36).

Differences in B(a)P levels are mainly observed in background situation. **Local emissions (related to wood burning fireplaces, open uncontrolled burning of wastes) are more significant in suburban residential areas (Gennevilliers, Argenteuil), even in the greater Paris area (Pommeuse), than in Paris and its neighbouring cities.**

The peri-urban site at Pommeuse was implemented at the end of 2016, following a study program launched by Airparif in 2012, whose the objective was to identify areas which could potentially present a greater risk for BaP within the Paris agglomeration and outside urban areas. The Pommeuse site (77), representative of a residential area consuming firewood in the outer suburbs [Airparif, October 2015], records the highest concentrations of BaP of the monitoring network (between 1.7 and 3 times greater than those of the other stations of the network).

In 2017, the BP Est traffic site recorded levels comparable to those measured in Gennevilliers and Argenteuil.
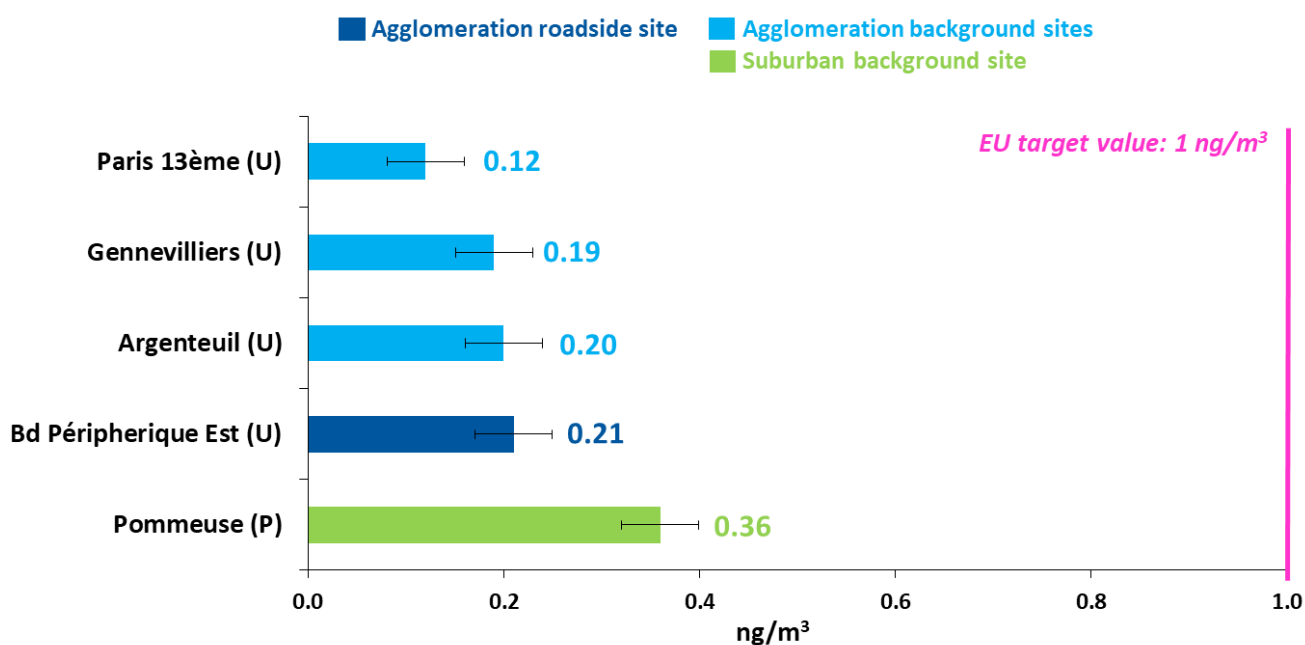
Figure 36: benzo(a)pyrene annual mean concentrations for all monitoring sites in the Paris region in 2017

A significant decrease of BaP levels is observed near traffic roads (-77 %) between 1998 and 2017 (Figure 37). For several years now, it slowed down substantially. However, there is no clear trend in background situation. BaP levels are prone to fluctuations from one year to the next due to inter-annual meteorological variations.
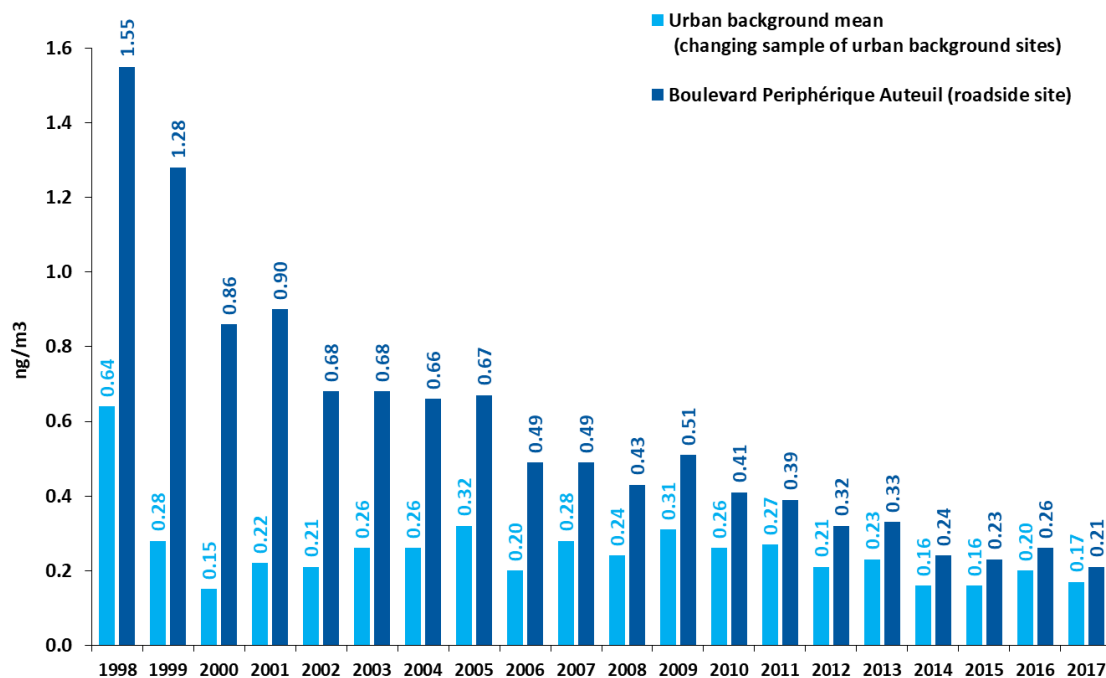
Figure 37: trend in the benzo(a)pyrene annual mean concentrations (based on the means of urban background sites and the Boulevard Périphérique site) in the Paris agglomeration from 1998 to 2017

3.2 Metals (Lead, Arsenic, Cadmium and Nickel)

SITUATION IN 2017 RELATED TO AIR POLLUTION STANDARDS AND LONG-TERM TRENDS

Lead (Pb) annual mean concentrations significantly decreased in 15 years (-97 % between 1991 and 2005), due to its gradual disappearance in fuels since 2000 (Figure 38). Lead no longer represents a relevant indicator of road traffic. As a consequence, lead measurements at the Place Victor Basch site were stopped at the end of 2005. Each year, lead concentrations are very low and close to the limits of quantification in background and industrial situations. **The EU limit value and the French quality objective for lead are widely met (the 2017 annual value being from 25 to 50 times below air quality standards).**

Air quality in the Paris region in 2017: Summary – March 2018
AIRPARIF – Air quality observatory in the Paris region
Page 39
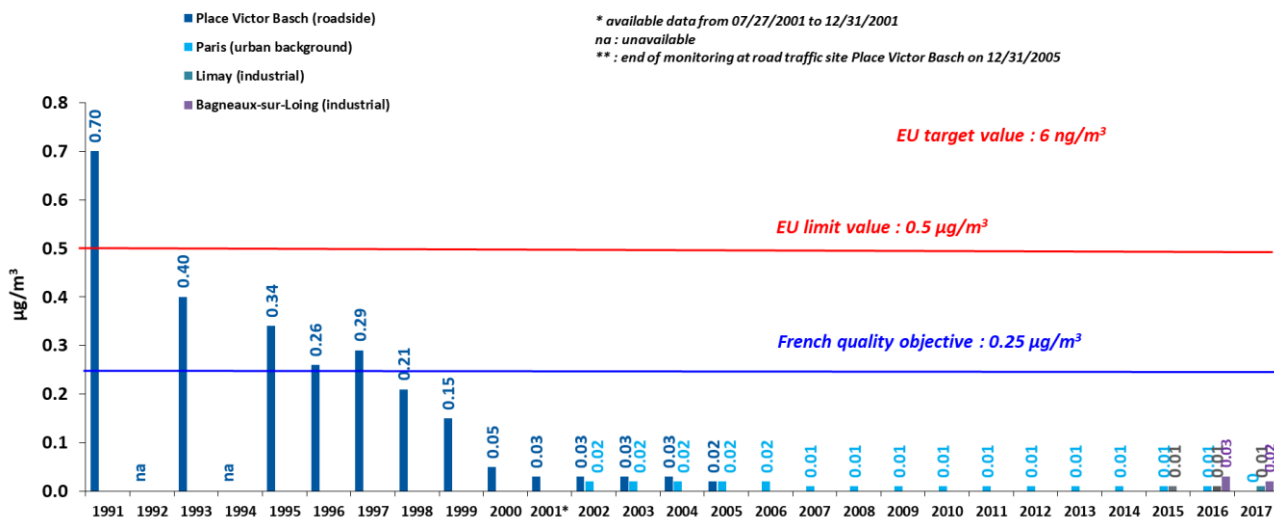
Figure 38: trends in the lead (Pb) annual mean concentration at urban background, roadside and industrial sites within the Paris region from 1991 to 2017

After a significant decrease of **arsenic (As)** concentrations between 2007 and 2008 (around -50 %), an increasing trend was observed from 2008 to 2011 in background situation. It ended in 2012. In 2017, arsenic levels measured in background situation decreased compared to the previous years (Figure 39). The Limay industrial station (located near a glass factory, an arsenic emitting installation) shows slightly higher levels but, however, lower than those in 2015 and 2016.

The Bagneaux-sur-Loing station recorded much higher levels in 2017 than in 2016. Installed on the municipal territory of Bagneaux-sur-Loing (77), the Keraglass and Corning SAS factories are specialised in the manufacture of glasses special items (glass-ceramic glass, eyeglasses and optical glasses, respectively). This industrial production emits heavy metals, and more particularly lead and arsenic. In the vicinity of the Keraglass industry, significant arsenic emissions were occasionally measured in ambient air. This industrial site is the leading arsenic emitter in the Paris region and the fifth largest national emitter. It should be noted that these emissions can vary greatly from one year to another depending on the productions [Airparif, 2014].
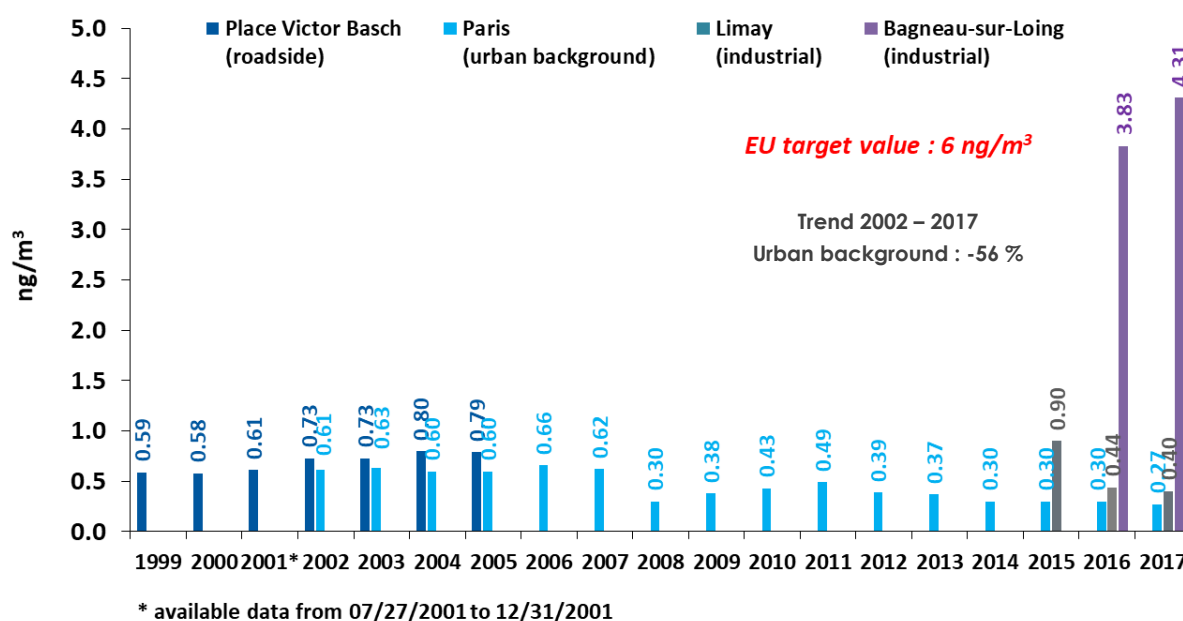
Figure 39: trends in the arsenic (As) annual mean concentrations at urban background, roadside and industrial sites within the Paris region from 1999 to 2017

For the **cadmium (Cd)**, a downward trend of annual mean levels was observed both in urban background and roadside situations between 1999 and 2005. Since 2008, there is no clear downward trend of cadmium concentrations. The annual average concentration measured in background situation in 2017 is similar to that of 2016 (Figure 40). **It is 50 times lower than the EU target value (5 ng/m³).**

The Limay industrial site records 1.5 times higher levels than in urban background situation. However, they remain low. The cadmium annual mean level measured at the Bagneaux-sur-Loing site is comparable to that in background situation in 2016. The Bagneaux-sur-Loing site (industrial) recorded an average annual level lower in 2017 than in 2016 (-30%).
These values are way lower than the target value of 5 ng/m³.
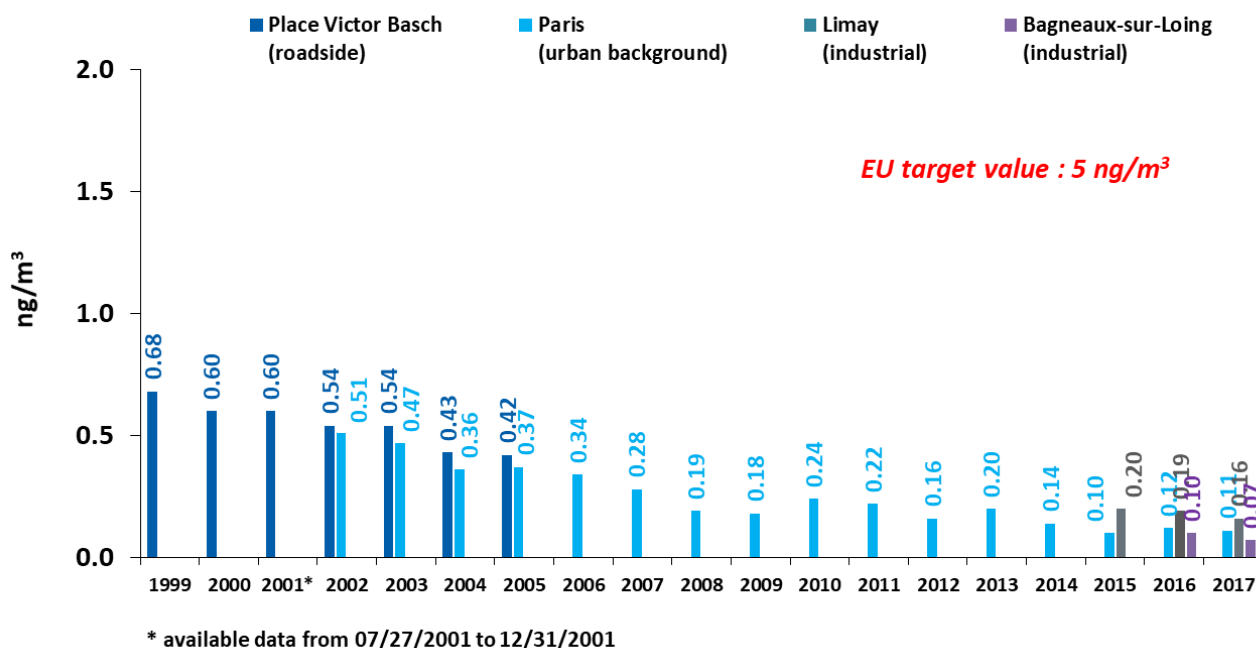
Figure 40: trends in the cadmium annual mean concentrations at urban background, roadside and industrial sites within the Paris region from 1999 to 2017

Nickel levels were measured from 2007 to 2010 at the reference monitoring station Paris 1er les Halles. Due to renovation on this site, nickel is now measured at the Paris 18ème station. Annual background mean concentrations are in the range of 0.9 to 2.6 ng/m³ (Figure 41). **These nickel levels are from 8 to 20 times lower than the EU target value** (20 ng/m³). Nickel background levels are slightly higher in 2017 than in 2016. Nickel levels measured at the Limay industrial station are lower than in 2016 and are close to the levels at the urban reference site. The annual mean concentration at Bagneaux-sur-Loing industrial site is similar to 2016 and remains lower than the ones measured in urban areas.

EU target value : 20 ng/m³

na : non available
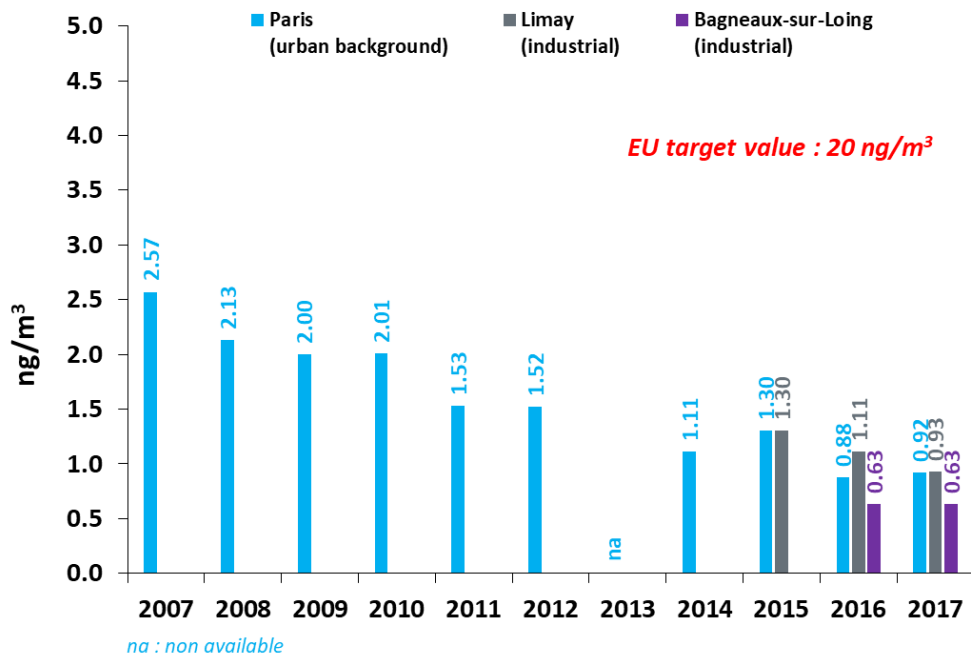
Figure 41 trend in the nickel (Ni) annual mean concentrations at urban background and industrial sites within the Paris region from 2007 to 2017

3.3 Carbon monoxide (CO)

SITUATION IN 2017 RELATED TO AIR POLLUTION STANDARDS

The carbon monoxide EU limit value for the protection of human health (10 000 µg/m³ for the maximum 8-hour mean) **is widely met at urban background sites** (max. in 2017 = 1 488 µg/m³) **and at roadside sites** (max. = 1 475 µg/m³) (Figure 42). In 2017, mean CO levels are comparable to those measured in 2016. However, CO maximum 8-hour mean decreased.
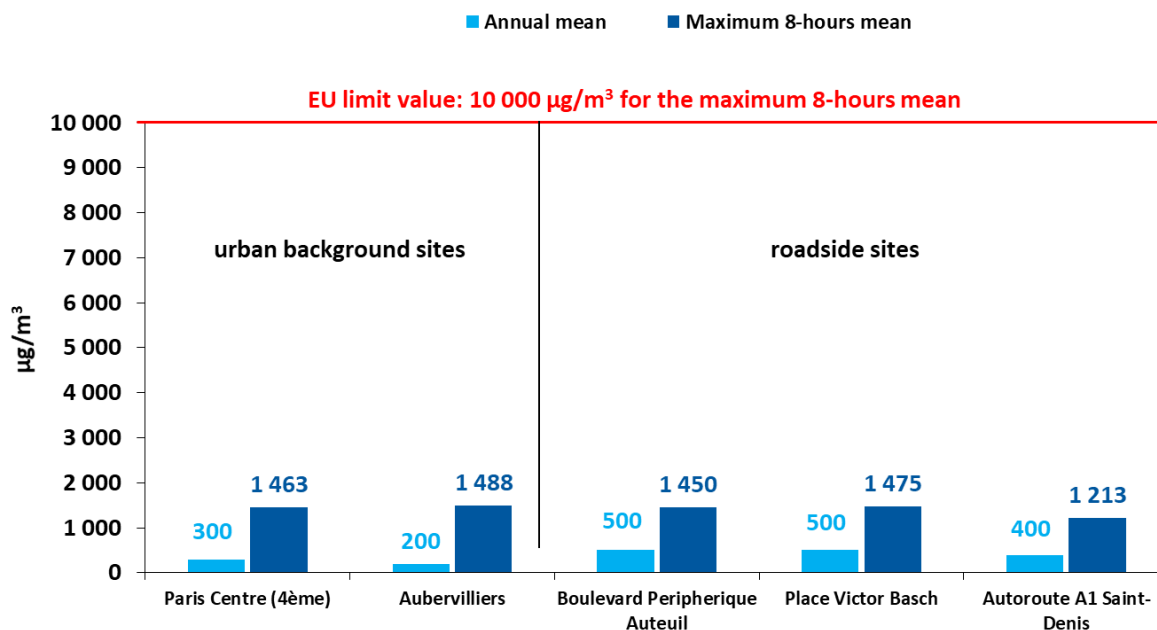
Figure 42: carbon monoxide (CO) annual mean and annual maximum 8-hour mean concentrations for all continuous monitoring sites in the Paris region in 2017

CO annual maximum 8-hour mean concentrations have significantly decreased between 1996 and 2017 (-88 %) (Figure 43). Maximum concentrations are 10 times lower than those at the beginning of the 1990's. **Major technological improvements in emissions from on-road vehicles explain this long-term trend.**
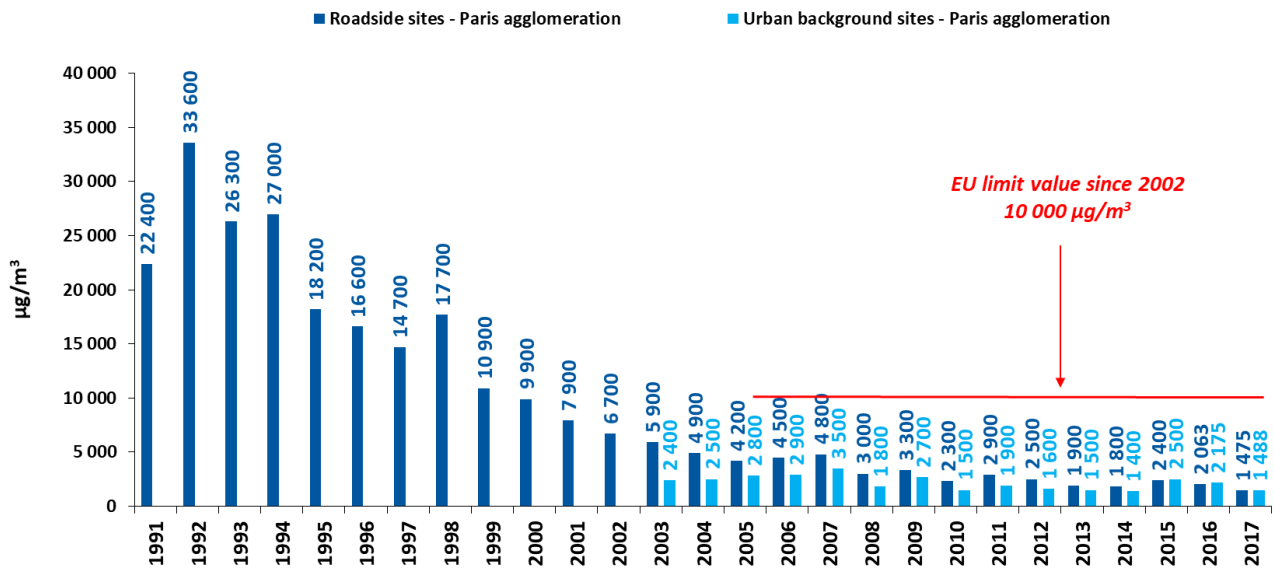
Figure 43: trend in the carbon monoxide (CO) annual maximum 8-hour mean concentrations at roadside and urban background sites within the Paris agglomeration from 1991 to 2017

3.4 Sulfur dioxide (SO₂)

The sulfur dioxide (SO_2) tri-annual mean concentrations are lower than the detection limit (5 µg/m³) at all the five monitoring stations, even at the Ring road BP Auteuil site (Figure 44). **For several years now, they are widely lower than the French quality objective** (50 µg/m³).

SO_2 limit values are also widely met over the whole monitoring stations in the Paris region. No exceedance of the 125 µg/m³ daily threshold and the 350 µg/m³ hourly threshold was observed in 2017.
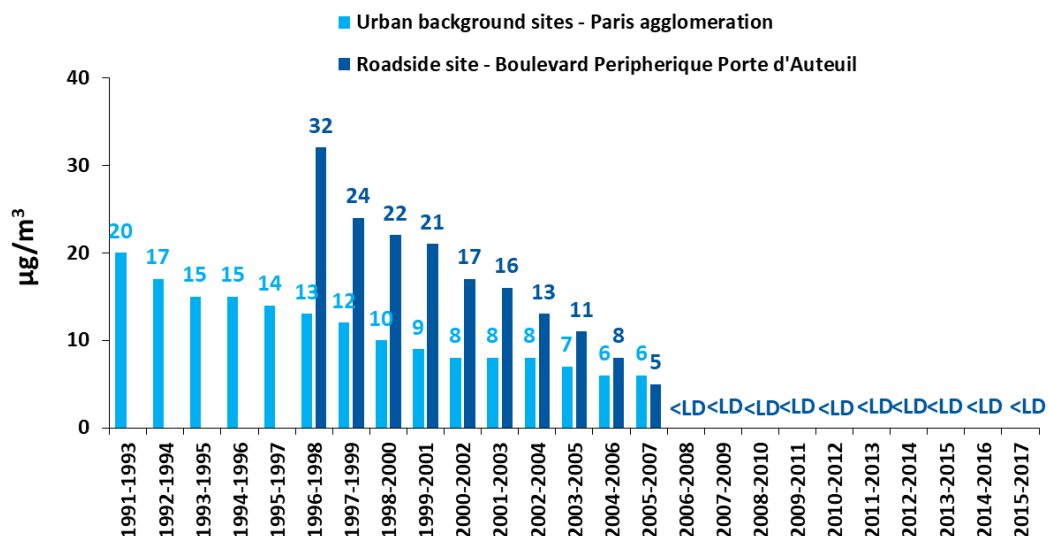
Figure 44: trend in the sulfur dioxide (SO₂) tri-annual mean concentrations (based on a scalable sample of urban background sites and one roadside station) within the Paris agglomeration from 1991-1993 to 2015-2017

A significant decrease of SO₂ levels was observed over the long-term (Figure 45). Considered as a relevant pollution indicator related to heating and electricity generation activities, the trend in SO_2 concentrations spectacularly dropped since the 1950's (SO_2 levels divided by 100). It is related to the decrease of the number of industrial sites in the Paris region since the 1950's. The sharp decrease in the use of some fuels (such as coal) and the decline of sulphur content in fuels also explain this trend.
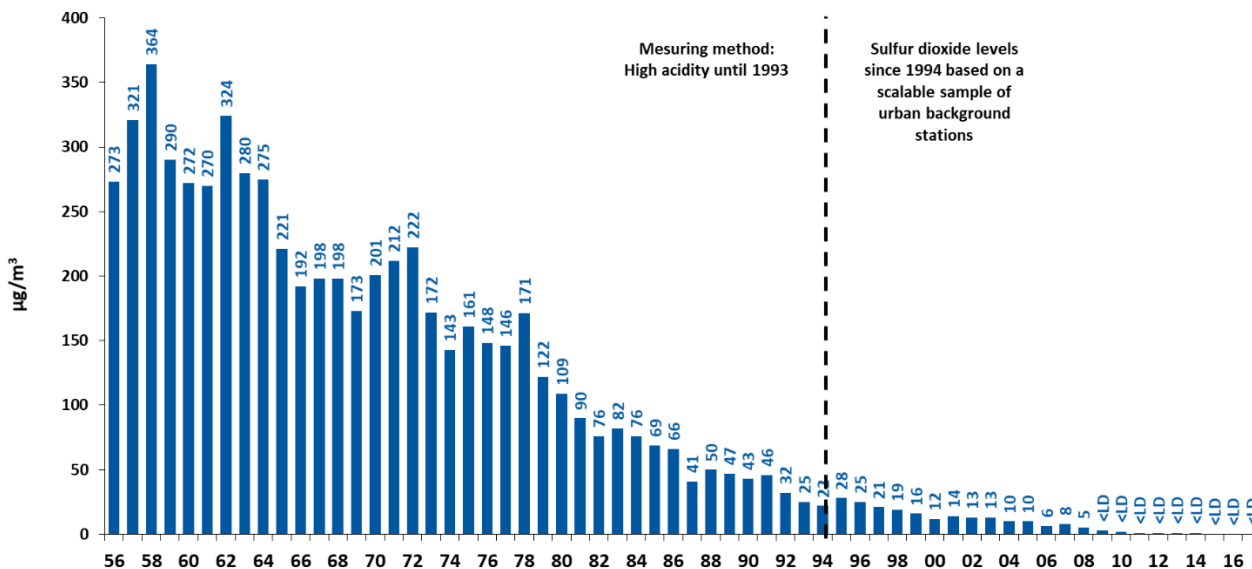
Figure 45: trend in the sulfur dioxide (SO_2) winter mean concentrations in Paris since the end of 1950's

LIST OF FIGURES