

## Impact on air quality in the Île-de-France region of the first days of lockdown as part of the fight against COVID-19

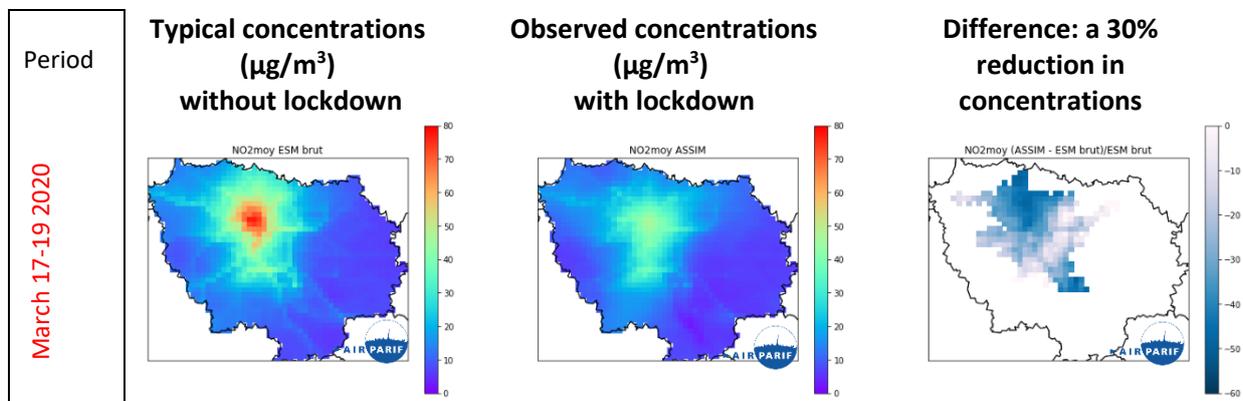
### Preliminary assessment for the week of 16-20 March 2020

In order to limit the spread of COVID-19, authorities implemented confinement measures starting on Tuesday, March 17<sup>th</sup> at noon. This preliminary assessment presents the impact of these measures on air pollution, with a focus on two pollutants: nitrogen dioxide, which comes mainly from road traffic in the Île-de-France region; and particulate matter, whose sources are more diverse. The evolution of air quality is assessed by comparing the pollution levels (emissions and concentrations) of a typical month of March with those of the first days of lockdown.

This assessment highlights an improvement in air quality of around 20 to 30% in the Paris conurbation, due to a drop in emissions of more than 60% for nitrogen oxides. Along traffic routes, this impact may be even greater. However, there was less of an impact for particulate matter (PM10 and PM2.5) during the first days of lockdown. Another piece of good news is that this reduction in air pollutants emissions goes hand in hand with a decrease in carbon dioxide (CO2) emissions, which highlights the many links between air pollutants and greenhouse gases as well as the climate co-benefits of an improvement in air quality.

As soon as confinement measures entered into force on Tuesday, March 17<sup>th</sup>, nitrogen dioxides emissions dropped significantly: more than 60% as of Wednesday, March 18<sup>th</sup>. This drop was largely due to the sharp reduction in road and air traffic, and was not offset by the increase in residential heating, with cool temperatures and more people staying at home. For other activity sectors, the impact of lockdown is less easily quantifiable due to a lack of available data.

For nitrogen oxides, the drop in emissions also translated into lower concentrations: -20 to -30% between March 17<sup>th</sup> and 20<sup>th</sup> (depending on weather conditions). This improvement of air quality is particularly noticeable along main roads where concentrations levels at Airparif monitoring stations sometimes reached background pollution levels. In the 40 years of Airparif monitoring, this situation at traffic stations had never occurred to such an extent and at so many stations.



Maps of average nitrogen dioxide concentrations from 17 to 19 March: under normal conditions, under lockdown, and the difference between the two.

However, little impact was found for particulate matter, which originates from more diverse sources. In fact the reduction in traffic did not compensate for the increasing residential heating and the continued agricultural activities. This, combined with weather conditions that were conducive to the creation of particulate matter in the atmosphere, led to sustained levels of particulate matter concentrations in the region, and as a result overall air quality was not as good as expected on Wednesday, March 18<sup>th</sup>. But thanks to the strong traffic reduction, concentrations did not rise so high as to trigger a pollution episode. This would probably have been the case had the traffic been normal.

The change in weather conditions from Saturday the 21<sup>st</sup>, combined with the very significant drop in emissions (particularly from air and road traffic) resulted in "good" air quality at the start of the second week of lockdown. However, the previous meteorological conditions, which were conducive to the creation of fine particulate matter, are typical of the spring season, and are therefore likely to recur.

## ① Impacts on the quantity of pollutants released into the atmosphere (emissions)

Lockdown starts at noon



Total emissions	Monday 16/03	Tuesday 17/03	Wednesday 18/03	Thursday 19/03	Friday 20/03	* Accuracy of results
Nitrogen oxides (NOx)	-7 %	-41%	<b>-62%</b>	<b>-64%</b>	<b>-64%</b>	Good
Particulate matter (PM10)	+9%	4%	<b>1%</b>	<b>0% idem</b>	<b>0% idem</b>	Reasonable

Emissions by activity sectors	Monday 16/03	Tuesday 17/03	Wednesday 18/03	Thursday 19/03	Friday 20/03	* Accuracy of results	
Road traffic	NOx	-7.50%	-46%	-69%	-71%	-72%	Good
	PM10	-5.70%	-44%	-68%	-70,5%	-71%	Good
Air traffic	NOx / PM10	-26%	-38%	-45%	-51%	-55%	Good
Residential buildings	NOx / PM10	+17%	+17%	+17%	+17%	+17%	Reasonable
Commercial buildings	NOx	-78%	-78%	-78%	-78%	-78%	Reasonable
	PM10	-77%	-77%	-77%	-77%	-77%	Reasonable
Agriculture	NOx / PM10	0% Idem	Idem	Idem	Idem	Idem	Reasonable

Comparison of total emissions in the Île-de-France region, and by sector of activity, compared to a typical month of March without lockdown (source: Airparif emissions inventory)

\*Note: the accuracy of the results has been evaluated given the limited information on certain variables for this unprecedented event.

Co-benefits for CO2:

**The reduction in CO2 emissions was estimated at around -30%.** As for air pollution, decreasing emissions for this greenhouse gas were mainly due to the severe restrictions on road and air traffic, as well as on tertiary activities caused by lockdown measures.

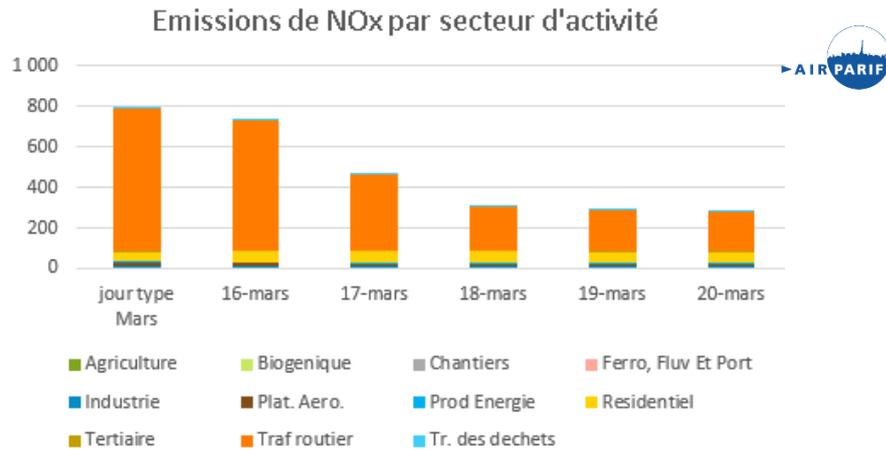
Total emissions	Monday 16/03	Tuesday 17/03	Wednesday 18/03	Thursday 19/03	Friday 20/03	* Accuracy of results
<b>CO2</b>	3%	-17%	-30%	-31%	-32%	Reasonable

Emissions by activity sectors		Monday 16/03	Tuesday 17/03	Wednesday 18/03	Thursday 19/03	Friday 20/03	* Accuracy of results
Road traffic	CO2	-7.5%	-45.40%	-69%	-71%	-72%	Good
Air traffic	CO2	-26%	-38%	-45%	-51%	-55%	Good
Residential buildings	CO2	+17%	+17%	+17%	+17%	17%	Reasonable
Commercial buildings	CO2	-78%	-78%	-78%	-78%	-78%	Reasonable
Agriculture	CO2	0%	0%	0%	0%	0%	Reasonable

Nitrogen oxides (NOx)

This pollutant is mainly emitted by traffic in the Île-de-France region, and to a lesser extent by heating.

**A gradual decrease in total nitrogen oxide (NOx) emissions was reported starting on Monday 16<sup>th</sup> (-7% of emissions), continuing on Tuesday 17<sup>th</sup> (-40%), and reaching -60% on Wednesday 18<sup>th</sup> and onwards. This decrease is mainly explained by the drop in road traffic (-70%) and air traffic (-50%) emissions.** NOx emissions from residential heating increased by 17%, however, due to a large proportion of the Île-de-France region inhabitants being confined at home, with fairly cool temperatures for the season. Finally NOx emissions from the agricultural sector are expected to remain stable compared to a typical month of March, given that activities in this sector are not subject to restrictions.



*Evolution of nitrogen oxides (NOx) emissions during the first days of lockdown*

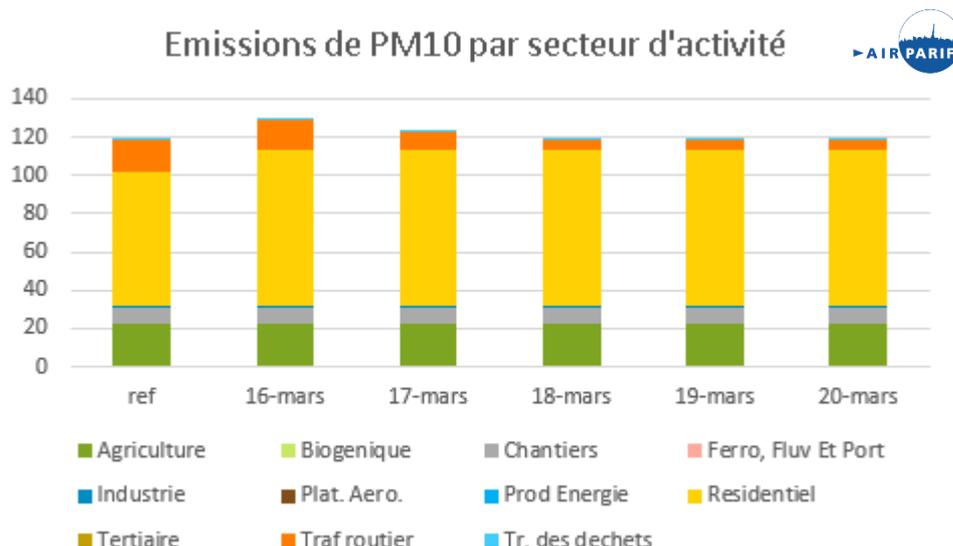
Particulate matter (PM10)

Fine particles are more complex and their sources are much more varied. Primary PM are emitted directly by various activities: mainly traffic, heating (including wood heating), agriculture, quarries and construction sites.

In addition to these direct emissions, other processes are also responsible, such as the creation of secondary PM through chemical reactions in the atmosphere, the transfer of PM over long distances and the resuspension of particles deposited on the ground.

**Due to the multiple sources of particulate matter, which are not limited to traffic, the significant decrease observed in nitrogen oxide emissions was not observed for particulate matter. The sharp drop in traffic was not enough to compensate for the increase in heating (including wood heating on some evenings), and the contribution of agriculture, which probably remained unchanged.**

PM emissions linked to heating are somewhat difficult to assess, given the unprecedented situation in which a large proportion of the Île-de-France region inhabitants were confined at home, with fairly cool temperatures for the season in the mornings and evenings, but also sunny afternoons.



*Evolution of PM10 emissions during the first days of lockdown*

## ② Impact on the quality of the air breathed by inhabitants of the Ile-de-France region (concentrations)

The quality of the air we breathe, defined by the concentrations of pollutants in the air, depends both on the intensity of pollutants emissions and on meteorology. Indeed weather conditions determine, among other things, the dispersion, creation, deposition or accumulation of pollutants in the atmosphere.

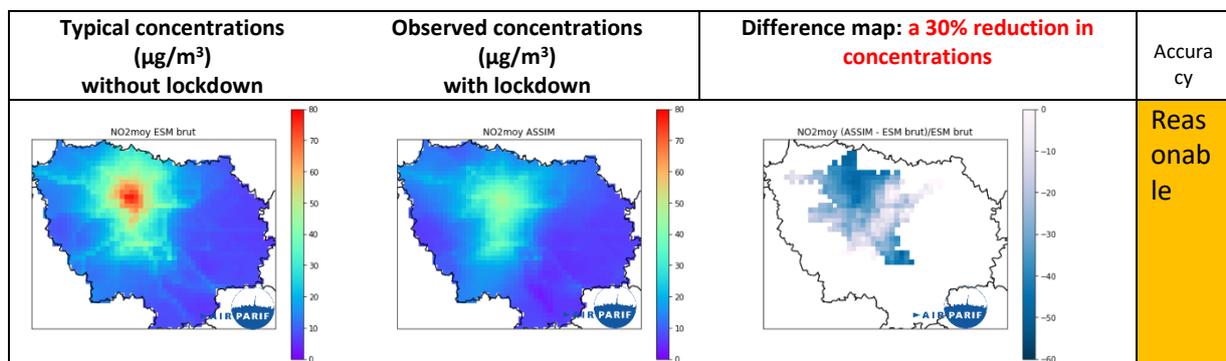
During the week of 16-20 March, anticyclonic conditions (weak East-to-Northeast winds of 1 to 2 m/s, low atmospheric boundary layer in the morning and evening) limited the dispersion of locally emitted pollutants, leading to an increase in the average NOx concentrations. These conditions were also conducive to the formation of secondary PM. Air quality over this week was thus described as “average”, despite the reduction in many activities (especially traffic) due to the lockdown. These weather conditions make it more difficult to assess the impact of the confinement measures on air pollutants concentrations.

### Nitrogen dioxide

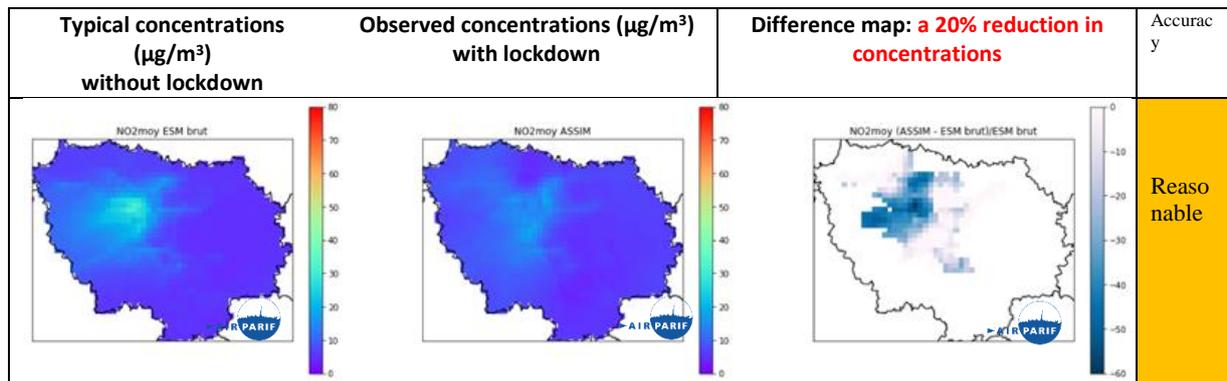
In 2018, 1 million people in the Île-de-France region were living in areas where NOx concentrations exceeded the limit-value. France has been condemned for failing to comply with the regulation.

Given the weather changes observed between March 19<sup>th</sup> and 20<sup>th</sup>, 2 distinct periods can be identified (see details in Appendix 2):

- March 17-19: weathers conditions that were not very dispersive, and weak, variable winds. **The estimated drop in NOx concentrations, taking into account the decrease in activities and in particular traffic, is estimated at around 30%** (in the Paris conurbation) compared to normal emissions levels. This translates to an average gain of 10 to 15 µg/m<sup>3</sup> in the Paris conurbation.



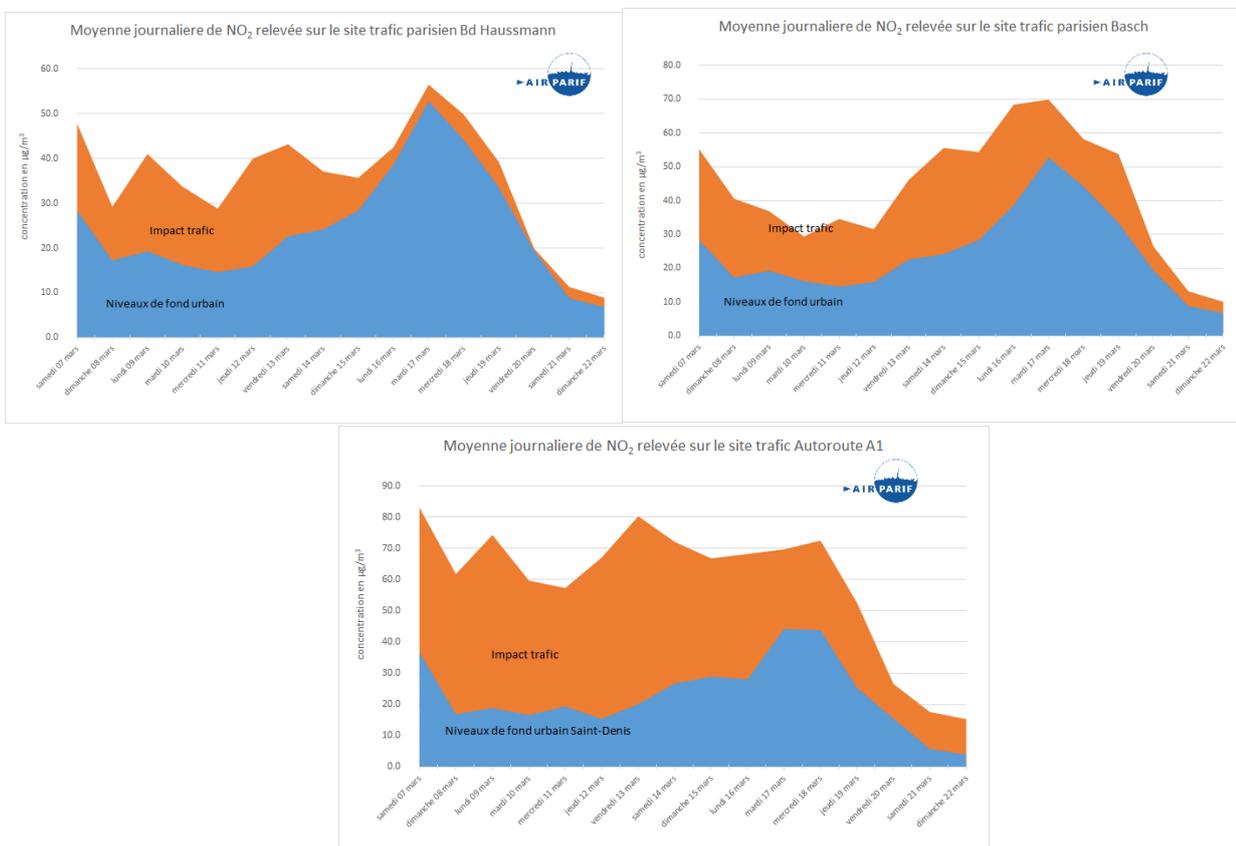
- March 20-21: sustained East-to-Northeast winds. **The estimated drop in concentrations is estimated at around 20% (in the Paris conurbation), compared to normal emissions levels.** As emissions levels are lower on this period, the gain in average concentrations is lower: estimated at 3 µg/m<sup>3</sup>, up to 8 µg/m<sup>3</sup> locally.



Focus on road traffic

The unprecedented drop in road traffic is reflected in the lower concentrations measured at all monitoring sites from Friday, March 20<sup>th</sup> onwards (approximately -80% to -90% compared to the typical situation). Pollution levels along traffic became equivalent to those measured in parks (i.e. background pollution, representative of the minimum exposure to which one is subjected throughout the day).

The figures below represent the evolution of daily average nitrogen dioxide concentrations from March 7<sup>th</sup> to 22<sup>nd</sup>, 2020 measured at the traffic stations of the Airparif network. They show an overall increase in average nitrogen dioxide concentrations between March 15<sup>th</sup> and 19<sup>th</sup> at various traffic stations of the Airparif network.



*Trends in mean daily NO<sub>2</sub> concentrations from March 7th to 22nd, 2020  
measured at the traffic stations of the Airparif network with the share of background pollution (in blue)  
and the share of traffic pollution (in orange)*

Emissions related to road traffic are gradually decreasing as of Monday, March 16<sup>th</sup> in Paris. However, for certain sites with heavy traffic, such as on the Place Victor Basch (Carrefour d'Alésia in the 14<sup>th</sup> arrondissement), or on the A1 motorway, the decrease is slower, and is only really significant from Friday, March 20<sup>th</sup>. A significant decrease in the impact of traffic is thus observed on the Paris traffic sites (-70% from the beginning of the week), and more gradually on the sites of the Place Victor Basch and the A1 motorway (from approximately -20 to -40% at the beginning of the week compared to the average situation).

### Particulate matter

The European Commission has initiated an infringement proceeding against France for failure to comply with the Ambient Air Directive's requirements for PM<sub>10</sub> particles. For this pollutant, 100,000 people in the Ile-de-France region were still exposed to levels exceeding the regulations in 2018. As for smaller particles (PM<sub>2.5</sub>), 85% of residents in the Ile-de-France region were exposed to concentrations exceeding WHO recommendations.

The weather conditions of the first days of lockdown, combined with the continuation or even increase of certain activities, did not allow for a significant decrease in PM<sub>10</sub> levels, contrary to what was expected. However, these levels would have been much higher, likely to result in a pollution episode, if traffic conditions had been normal.

Spring weather in the early days of the lockdown was conducive to chemical reactions leading to the creation of so-called "secondary" particles from:

- Nitrogen oxides (mainly related to heating, traffic being extremely restricted),
- Ammonia (from agricultural activities).

These particles added to those emitted by wood heating in the evening, as well as to those produced by the transfer of pollution, since part of France is subject to the same conditions. However, traffic-related particulate matter levels are very low. The increase observed for PM<sub>10</sub> concentrations would have been much higher under normal traffic conditions, resembling levels during the spring episode of 17 March 2014, which led to the re-introduction of alternate traffic circulation.

This situation highlights the various sources contributing to air pollution and the specific effect of weather conditions.