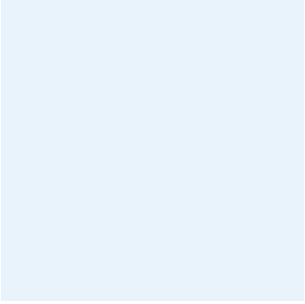


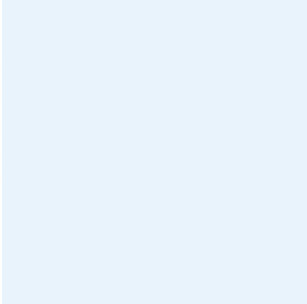
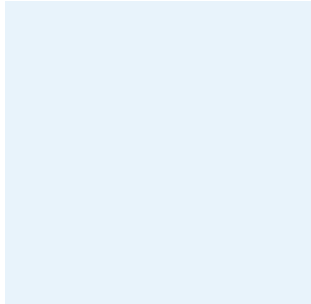
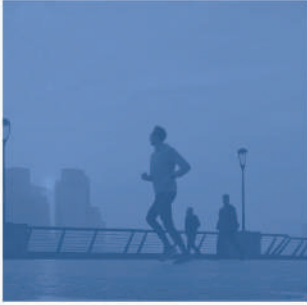
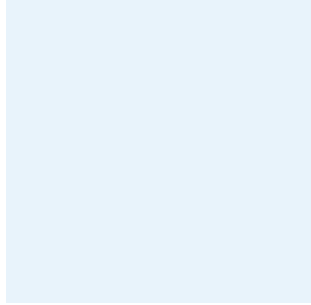
2021



# #SEE WHAT YOU BREATHE

AIR QUALITY REPORT

**BREATHE**







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# / INTRODUCTION

Dear All,

Air pollution is one of the most significant environmental challenges that humanity faces. Studies indicate that exposure to smog negatively affects the respiratory system, cardiovascular system and increases cancer risk, as well as impairing cognitive function. Poor air quality also leads to higher mortality rates for COVID-19 patients - the disease has been observed to spread faster in areas with polluted air. These are scientific facts that cannot be passed over in silence.

In 2016, as students at the University of Science and Technology in Krakow, we wanted to create a technology company that would impact our environment and solve one of the many problems that we face in this world.

Airly's mission is to improve air quality by providing air quality data on a global platform for monitoring and forecasting. Our product is a complete air quality monitoring system used by millions of people around the world. We are working on a system that will change where we live and where our children are going to live.

I am grateful to the 500 local governments around the world who trust us and have started to combat air pollution. Thank you, because it is your actions that have a huge impact on raising citizen awareness. We do our best to make sure that Airly's data helps cities and municipalities make the right decisions in the fight against air pollution.

I would also like to thank more than 400 of our customers and business partners, and especially the Onet team, which was the first medium in Poland that saw the importance of the smog problem and the potential of partnering with Airly.

A word of appreciation also goes to the team of over 50 people who create Airly every day. The team consists of the best engineers, analysts, experts, salespersons, electronics engineers, programmers, administration and marketing specialists. Thanks to the work of the entire team, millions of people can check air quality information each day.

On behalf of the entire Airly management and team, I would like to invite you to read the #SeeWhatYouBreathe 2021 report - we have gathered the most important information and data about air quality issues. Our team of analysts has prepared many interesting statistics which - I hope - will be a compendium of knowledge for everyone in the area of air quality.

**Wiktor Warchalowski**  
CEO of Airly



Airly founders, from the left: Michał Misiak, Aleksander Konior, Wiktor Warchalowski



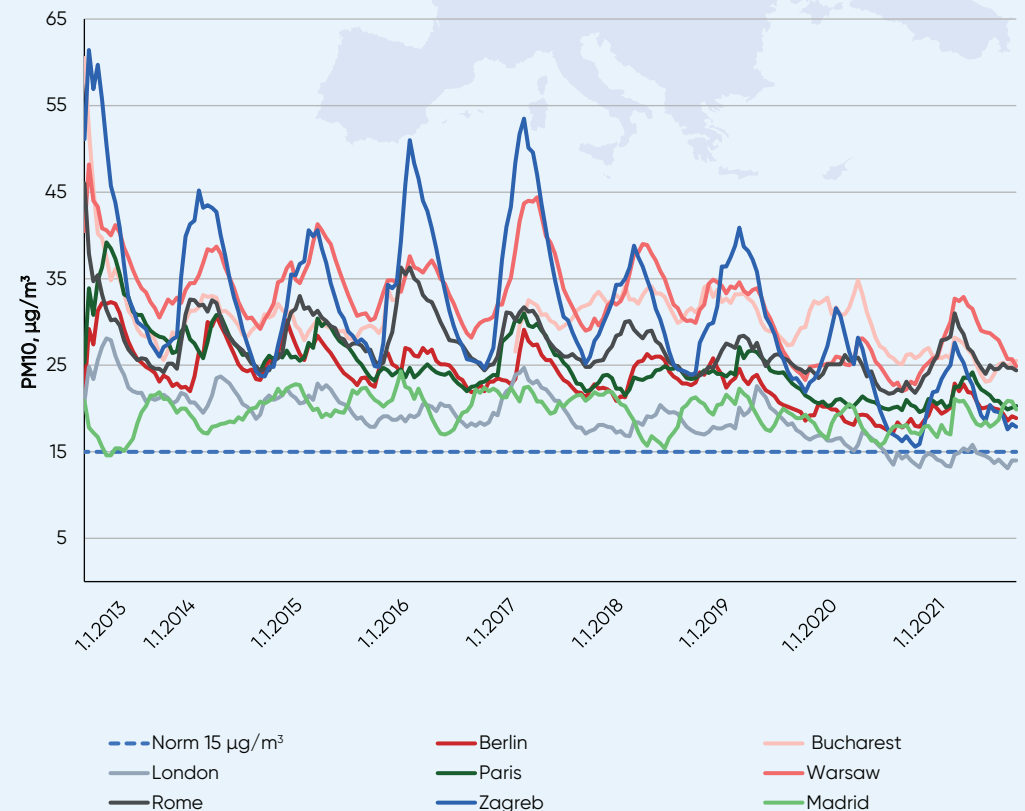
[map.airly.org](https://map.airly.org)

# 8 EUROPEAN CAPITALS OVER THE LAST 8 YEARS

## THE COMPARISON OF AIR QUALITY

- ☀️ Air quality improved in all 8 cities during the study period.
- ☀️ **The lowest average PM10 concentrations are noted in London.**
- ☀️ **The highest average PM10 pollution is observed in Warsaw.**
- ☀️ **Air quality has improved the most for the last 8 years in Zagreb.** In 2013, the average pollution level was  $39 \mu\text{g}/\text{m}^3$ , while in 2021 residents were already breathing 44% better air quality.
- ☀️ **Zagreb** experiences very high pollution peaks in the winter period. Especially in the period 2013–2019 – these peaks were caused by coal heating, which is not environmentally friendly. For the last two years, coal heating in the Croatian capital is successfully replaced by gas heating. As a result, we see noticeably smaller peaks of air pollution during the heating season.
- ☀️ **Until 2019, the average PM10 concentration has been highest in Warsaw.** Despite the fact that air quality in Warsaw is constantly improving, PM10 concentration in the Polish capital was lower than the highest PM10 concentration recorded in London for only 17% of the studied period.
- ☀️ **London has low levels of PM10 pollution.** Since mid-2020, PM10 value has remained at the WHO recommended annual standard (2021 AQG) of:  $15 \mu\text{g}/\text{m}^3$ .

Changes in average PM10 pollution from 2013 to 2021 for the following European cities: Berlin, Bucharest, London, Paris, Warsaw, Rome, Zagreb and Madrid.



Data source: European Environment Agency and Airly  
Analysed period: 01.01.2013 – 27.09.2021 (averaged every 15 days)

# RANKING OF AIR POLLUTION BY PARTICULATE MATTER PM10 IN EUROPEAN CAPITALS FOR THE YEARS 2019–2021

In the ranking below, we present data on average PM10 concentration for a period of three years in European capitals.



The worst air is breathed by residents of Macedonia's capital **Skopje**. There, the level of PM10, averaging  $46 \mu\text{g}/\text{m}^3$ , exceeds the level of the annual standard by 3 times according to WHO.



**Belgrade**, the capital of Serbia, is the second most polluted city in Europe.

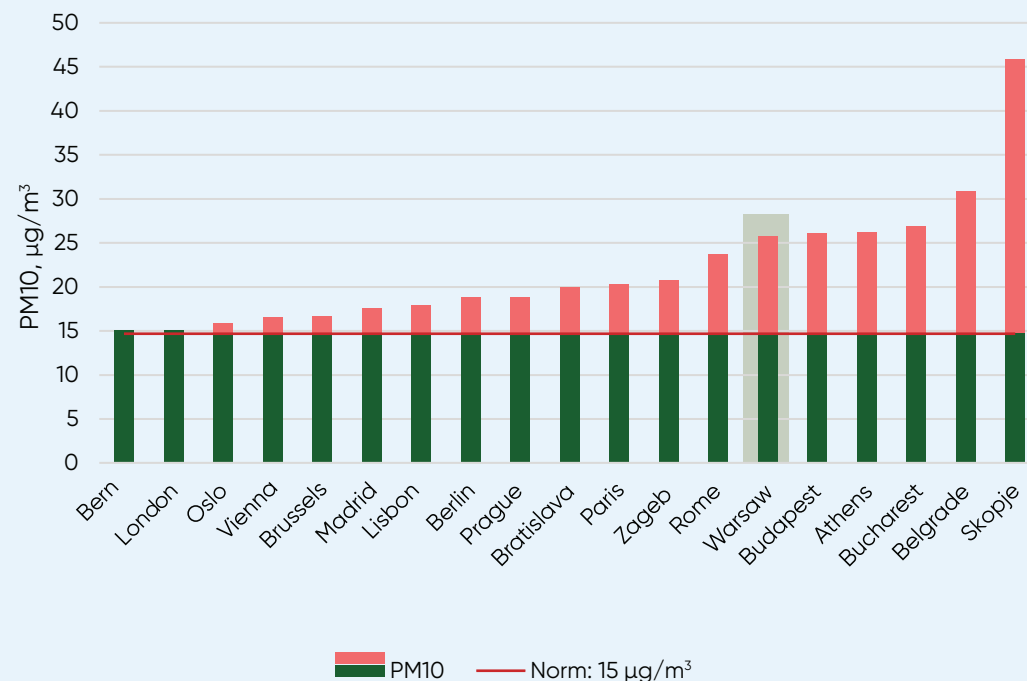
PM10 concentration in **Warsaw** is at the same high level, exceeding the annual norms by more than 70%, as in **Budapest** (Hungary) or **Athens** (Greece).



The cities of **Madrid** (Spain), **Lisbon** (Portugal), **Berlin** (Germany), **Prague** (Czech Republic), **Bratislava** (Slovakia), **Paris** (France) and **Zagreb** (Croatia) have similar PM10 concentrations of approximately  $(20 \pm 2) \mu\text{g}/\text{m}^3$ .

Data source: Airly  
Analyzed period: 01.07.2019–30.06.2021

Average PM10 concentrations for the 2019–2021 season



# 01 /

## WHEN SMOG APPEARS, DOCTORS WARN THAT HOSPITALS ARE FILLING UP

Monika Zieleniewska  
in an interview with **Edward Franek, MD, PhD,**  
and **Michał Pirożyński, MD, PhD**

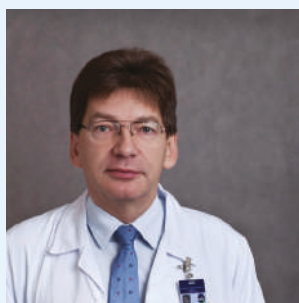


**Prof. Dr. med. Michał Pirożyński**

Distinguished pulmonologist and allergist, Head of the Center of Allergology, Pneumonology and Emergency Medicine – Simulation Center at the Medical Center for Postgraduate Education, and employee of the Witold Orłowski Independent Public Clinical Hospital at Czerniakowska Street in Warsaw. He is the author of 303 scientific works and 9 monographs including: "ABC of nebulization", "Practical Bronchofiberscopy".

His special interests include:

- Inhalation therapy
- Development of new inhalation devices (co-author of 4 European patents and 6 Polish patents)
- Endoscopic examinations of the airways



**Prof. Edward Franek, MD**

Department of Internal Medicine, Endocrinology and Diabetology – Central Clinical Hospital of the Ministry of Internal Affairs in Warsaw. Studied at the Silesian Medical University in Katowice. Worked at the Department of Internal Medicine, Endocrinology and Diabetology of the Central Clinical Hospital of the Ministry of Internal Affairs in Warsaw at the Department of Nephrology, Endocrinology and Metabolic Diseases of the Silesian Medical University. Author of over 130 scientific papers and over 30 chapters in textbooks.

”

*- There is a lot of material about particulate matter and its impact on the respiratory system, but in the long term greenhouse gases are probably the most dangerous, such as carbon dioxide or methane, which can threaten in various ways not only a single person, but the whole of humanity.*

*- says Professor Edward Franek, MD.*

### ***How can we protect ourselves from smog?***

*First, you can invest in public health and buy an electric car, or use public transportation or a bicycle instead of your old diesel. Secondly, you can avoid going outside on days when pollution exceeds standards, which can easily be checked at any time. Of course the smoking habit has to be stopped, because smoking indoors causes even more pollution than the pollution is outside. You can also place air filtering devices in your home.*

*- says Prof. Michał Pirożyński, MD.*



# 01

## WHEN SMOG APPEARS, DOCTORS WARN THAT HOSPITALS ARE FILLING UP

☀️ **The direct impact of smog on health is, despite appearances, difficult to study. Researchers at the Ministry of Internal Affairs and Administration (MSWiA) hospital, for example, discovered that the impact of air pollution peaks causes a worsening of diseases or the appearance of new, more serious symptoms that require hospital treatment, but only when taking into account hospitalizations occurring at least a week after the pollution peak. It turned out that there was a time gap between a pollution peak and an increase in the number of hospitalizations.**

☀️ **Poland, despite extremely liberal standards, has been a red light on the map of Europe for a long time. We asked experts what smog is, whether it really is deadly, and how to tackle the problem.**

### What diseases are caused by smog?

The respiratory system is the most exposed to pollutants, because they enter the body through the lungs. The worst consequences are lung cancer, chronic obstructive pulmonary disease and bronchial asthma, as well as respiratory infections – explains Prof. Franek. – With regard to the cardiovascular system, on the other hand, air pollution can cause atherosclerosis and an increased tendency to form blood clots, with all the consequences, such as heart attacks, strokes, hypertension and cardiac arrhythmias. Negative effects of air pollution can also be observed in the central nervous and reproductive systems.

It is no secret that air pollution is related to the occurrence of allergies. Our skin is directly exposed, which can result, for example, in atopic dermatitis or contact allergy. Allergic respiratory diseases – allergic rhinitis or bronchial asthma – can also occur.

The ability of heavy metals to accumulate in our bodies leads to damage to the nervous system, anaemia, sleep disorders, mental deterioration, aggressive behaviour and finally cancer.

PM2.5 dust penetrates the deepest parts of the lungs, where it is accumulated or dissolved in biological fluids and then transported with the blood to other parts of the whole body. It can exacerbate asthma, cause acute respiratory reactions, or impair lung function.

### What are the sources of pollution?

The air is polluted mainly by combustion products of fuels, used both in industry and households as well as in transport. For example, most sulphur dioxide comes from burning coal (97%), and Poland ranks first in the EU in terms of sulphur oxide emissions. Fuel combustion is also the largest source of nitrogen oxide emissions. Here, road transport is the leader (39 %), and a significant increase in the number of cars means that despite the higher quality of fuels, the content of these oxides in the air is not decreasing. In terms of their emissions Poland is on the fourth place after Germany, Great Britain and France.



# 02 / AIR POLLUTION CAUSES DAMAGE TO NEARLY ALL TISSUES AND ORGANS



Adrian Dąbek  
in a conversation  
with **Tadeusz M. Zielonka, Ph.**

## Tadeusz M. Zielonka, MD

Lung disease and internal medicine specialist, working at Medical University of Warsaw and Czerniakow Hospital, doctor accredited by the French Embassy in Poland. Founder and Chairman of Coalition of Physicians and Scientists for Healthy Air. Chairman of the Warsaw branch and member of the Board of the Polish Lung Association for many years.

Author of over 500 articles on lung diseases, health effects of air pollutants, interstitial lung diseases, tuberculosis, respiratory infections, prevention of respiratory diseases, obstructive lung diseases, tobacco addiction, functional tests of the respiratory system and medical ethics.

- ☀️ **The WHO recently introduced new recommendations on the health effects of air pollution. The document was written 16 years since the previous opinion and it is important because the knowledge about the impact of environmental pollution on health has covered the past two decades.**
- ☀️ **There are fundamental statements in this document that should stick in the minds of all doctors as well as the public.**
- ☀️ **Air pollution causes damage to virtually all tissues and organs. It has been proven that smog has a harmful effect on practically every organ of the body.**

”

*A particularly important problem is the effect of smog on unborn children. We talk a lot about protecting conceived life, but in fact we do not protect it, because we expose it to very serious damage to health.*

*We don't realise that if a woman gets pregnant in a smoggy region during the heating season in Poland, her child will be sickly for the rest of its life.*

*Smog makes asthma worse and causes infections. The links between smog and asthma worsening are very clear and proven.*

Dr. Tomasz M. Zielonka says that the disastrous effect of smog on our health is multifaceted. Smog does not only attack the respiratory or circulatory system, but it also affects our cognitive functions, our eyesight and above all the development of fetal life. Dr. Zielonka directly refers to the discussion on the protection of unborn life indicating that by tolerating smog we are far from real protection of fetuses. He also points out that there is a clear link between the smog season and the increase in the number of cases of COVID-19. Further, he says that smog may not only exacerbate asthma, but may even cause it. Dr. Zielonka calls for anti-smog actions at all levels.

You can read more at:

[oddychajpolsko.onet.pl/index\\_en.html](https://oddychajpolsko.onet.pl/index_en.html)

# NO<sub>2</sub> RANKING FOR EUROPEAN CAPITALS



The coronavirus pandemic caused drops in NO<sub>2</sub> concentrations in almost all European capitals analysed. On average, concentrations of this gas fell by as much as 20%.



Of the most polluted cities, the largest decrease occurred in **Madrid** (32% decrease) and the smallest in **Athens** (only an 11% decrease).



Before the pandemic, **Bucharest was the pollution leader**, and after the pandemic, **Athens became the most polluted city in Europe**.



**Tallinn** both before and after the pandemic outbreak was **the cleanest city in Europe** in terms of concentration of this gas.

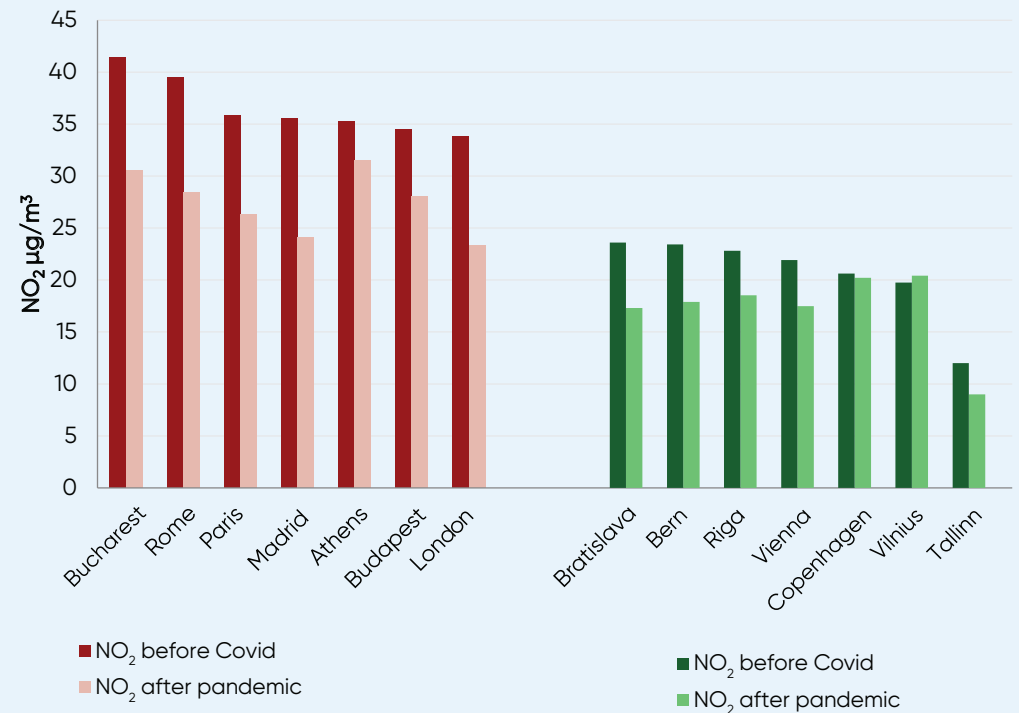
NO<sub>2</sub> is a toxic gas that pollutes the air. It is characterised by a sharp smell and a specific brown colour. This gas is the main cause of photochemical smog in cities with the highest car traffic.

Nitrogen oxides are also associated with the formation of the greenhouse effect and the phenomenon of acid rain acidifying the soil.

Data Source: Airly  
Analyzed period: 01.06.2018 - 01.03.2020

## Europe's most polluted capitals

## The cleanest European capitals



# 03 / DATA IS THE KEY TO TRUTH. HOW TO USE IT TO MAKE DECISIONS.

Collecting air quality data is just the beginning. The real challenge is to analyze it and draw appropriate conclusions. At Airly, the Data Science department provides the analysis that is used by leading media outlets around the world.

**Airly's Data Science team consists of world-class experts with expertise in analytics, geography, IoT, and artificial intelligence (AI) to produce reports on the most current and socially engaging topics.**

Some examples of analyses widely published by global media such as CNN (USA), Daily Mail (UK), GEO (France), NTV (Turkey), Youm7 (Egypt) or Malta Daily (Malta) have covered topics like Europe's most polluted tourist destinations, the air quality of Europe's coastlines and the impact of air quality on the COVID-19 pandemic.

## Europe's most polluted tourist destinations

The main conclusions of the analysis were:

- particulate pollution during the summer season in Europe is much lower than during the winter season because there is no pollution from burning solid fuels for heating in summer,
- pollution on the coasts is generally lower than inland, mainly due to the strong and frequent winds,
- on the other hand, coastal areas suffer from natural dust from sea salt,
- in southern Europe, pollution of natural origin plays a major role - due to the dry landscape, and dust pollution from Africa
- pollution in the worst coastal regions (PM10 = 30 µg/m<sup>3</sup>) is below the annual EU standard (40 µg/m<sup>3</sup>),
- the highest pollution is observed on islands/coasts that are highly urbanized where all the industry that supports the economy of the area must be concentrated in a small space and high traffic intensity is observed.

## Impact of air quality on the COVID-19 pandemic

When talking about air pollution data, it is hard to ignore the health aspect of this phenomenon. At the beginning of 2020, the whole world was faced with the massive and unprecedented challenge of the COVID-19 pandemic, and the link between the spread of the coronavirus and the air quality in a given area very quickly emerged. Back in the spring of 2020, we investigated these connections in detail and came to conclusions that confirmed the link.

## Ranking air quality on the European coast

This was a groundbreaking analysis, as no one had previously analyzed air quality from this perspective. We checked the air quality in detail during the summer months in the most popular holiday resorts.

☀️ The beaches of the Canary Islands, Malta and Sardinia are the most exposed to particulate matter (PM) pollution.

☀️ The UK, the Portuguese Azores and the Pomeranian Voivodeship are at the top of the list of the cleanest coastal areas.

## DATA SCIENCE TEAM AT AIRLY:

**Piotr Kowalski, Ph.D., D.Sc.**, Professor at AGH University of Science and Technology; Data Scientist – Machine Learning and AI Expert

**Marcin Szwagrzyk, M.Sc.**, Ph.D. candidate, Jagiellonian University, Geographical Researcher and Data Analyst in Airly

**Aleksander Konior**, Head of Data Science, M.Eng., Physicist, AGH University of Technology and Science, co-founder of Airly

**Ehsan Danesh Ph.D.**, Air Quality Expert, Ph.D. MRSC, Gas Sensor Scientist, IoT and AI enthusiast

**Maciej Kusy, Ph.D., D.Sc.**, Professor at Rzeszow University of Technology; Data Scientist

**Jan Izydorczyk**, second-year student of Computer Science at AGH UST and first-year student of Mathematics at the Jagiellonian University



# ANALYSIS OF NO<sub>2</sub> CONCENTRATIONS IN EUROPEAN CAPITALS

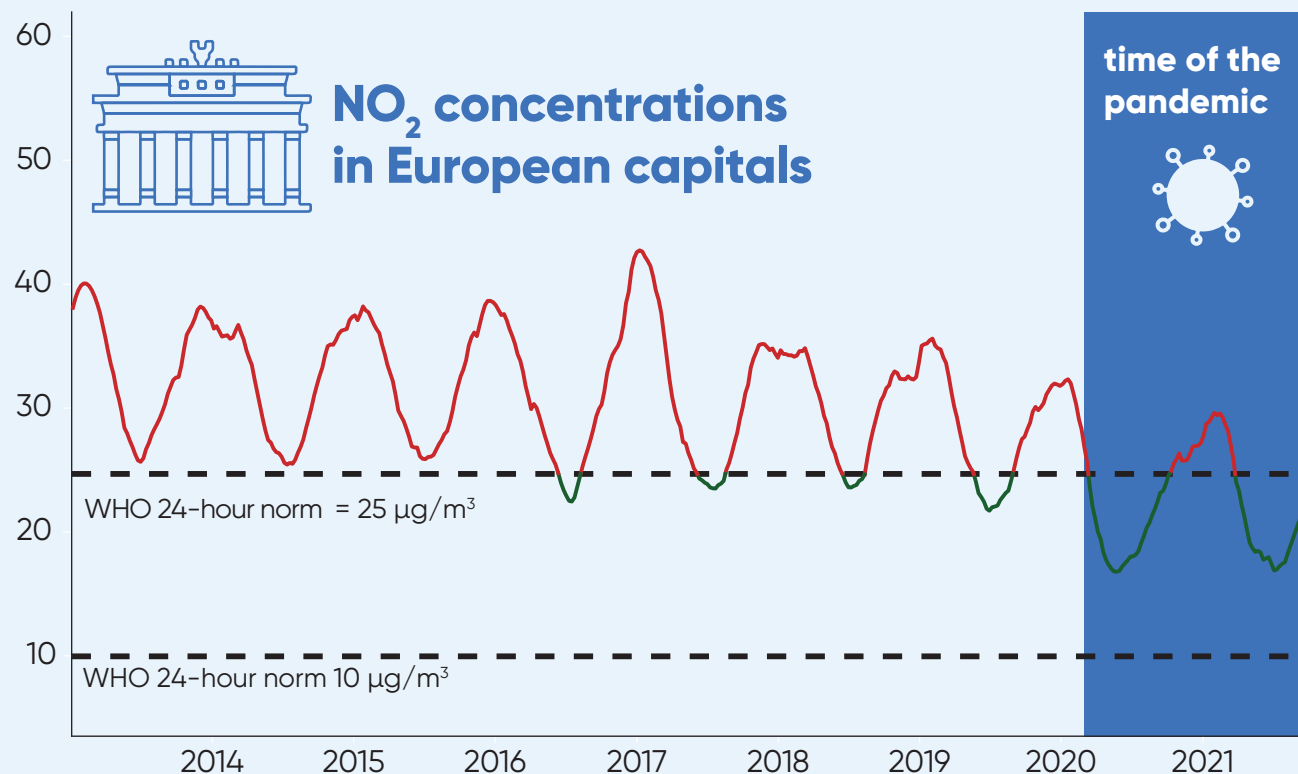


NO<sub>2</sub> is a toxic air pollutant gas, **mainly caused by emissions from road traffic**. Nitrogen dioxide damages immune system cells in the lungs and **causes increased susceptibility to respiratory infections**. It can make asthmatics more sensitive to allergens.

The greatest improvement in air quality was observed in 2020, during the COVID-19 pandemic.

Between **2013 and 2019**, NO<sub>2</sub> concentrations in all European capitals which were analysed exceeded the WHO annual limit by **3 times on average**.

Before the pandemic in **2014-2019**, the average NO<sub>2</sub> concentration was **31 µg/m<sup>3</sup>**. After the pandemic outbreak in **2020**, it **dropped to 22 µg/m<sup>3</sup>**, but it **still exceeds the WHO annual standard of 10 µg/m<sup>3</sup> by more than 2 times**.



Data sources: Airly  
Analyzed period: 01/01/2013- 31/12/2020

# 04 / BY FIGHTING SMOG WILL WE STOP CLIMATE CHANGE?

**Jakub Jędrak**

from the SmogLab web portal

**It is still common to mix up two topics: air quality and climate change.**

The problem of climate change and greenhouse gas emissions is often confused with smog, which is the poor quality of air we breathe. However, these are two different problems, although they are strongly and in many ways interrelated.

## **SMOG AND GREENHOUSE GASES**

Greenhouse gases are those gases which have the ability to absorb infrared radiation emitted by the Earth. As their name suggests, they cause **the greenhouse effect**. Their excess in the atmosphere is responsible for the rapid warming of our planet that is currently taking place. Not all of the gases present in the Earth's atmosphere are greenhouse gases. In particular, neither nitrogen (N<sub>2</sub>) nor the "normal" two-atom oxygen (O<sub>2</sub>) is a greenhouse gas.

**Some of them heat our planet**, such as tropospheric ozone, an important greenhouse gas, or black carbon (BC), which is usually included in particulate matter. **Others are cooling**, like some components of particulate matter, such as the sulfate aerosols formed from sulfur dioxide.

Climate change and smog can confuse us for another reason. The most important greenhouse gas, carbon dioxide, and smog-forming substances largely have common sources.

In both cases, the dominant source of emissions is the burning of fossil fuels (coal, oil derivatives, and natural gas) and biomass (e.g., wood).

**Climate change is, of course, affecting the weather, which has or could have serious consequences for air quality.**

Firstly, much warmer and probably windier winters translate into less smog and lower concentrations of pollutants during the heating season. It is just small luck in misfortune.

On the other hand, the consequence of climate change is (and will be in the near future) more frequent and more intense forest fires, directly worsening air quality.

**IS IT EASIER TO GET RID OF SMOG THAN TO STOP A CLIMATE CATASTROPHE?**

The consequences of bad air quality (or smog, if you prefer) are very serious – every year, several million people die prematurely because of it all over the world.

**Fighting against smog does not require a move away from fossil fuels.**

Coal, oil, gas and biomass can be burned in a way that does not cause smog. This can be done by using modern heating devices and combustion engines, as well as by using various types of filters, catalysts and other technical solutions, as is the case of the professional power sector. Sometimes it is enough to simply replace other fuels with natural gas, which can be used to heat our homes or to produce electricity (instead of coal and biomass) or in internal combustion engines (instead of diesel).

## **Natural gas is not a smaller climate evil than coal**

Although CO<sub>2</sub> emissions per unit of energy obtained from combustion of gas are lower than in the case of coal or crude oil (but still high), we must not forget about one "minor" detail: leakages of natural gas during its extraction, transport and storage. And natural gas consists mainly of methane – the most important greenhouse gas after CO<sub>2</sub>.

Therefore, the climate impact of natural gas may be as great as that of coal, at least in the short term, up to 20-30 years after emission.

## **It is easier to clean the air from smog than from greenhouse gases**

If we just stop emitting "smog components" like dust, nitrogen oxides, and sulfur oxides, the air will clear itself of them without our interference.

It is not that simple with carbon dioxide – if it is emitted into the atmosphere, it enters the so-called fast carbon cycle and circulates between the atmosphere, biosphere and oceans, influencing the climate of our planet for thousands of years. To return the atmosphere to its original state (i.e. the state before the industrial revolution), we must actively remove CO<sub>2</sub> directly from the air.

## **Do milder winters mean less smog?**

Paradoxically, in Poland it is most likely climate change that has made the winter smog a little more comfortable.

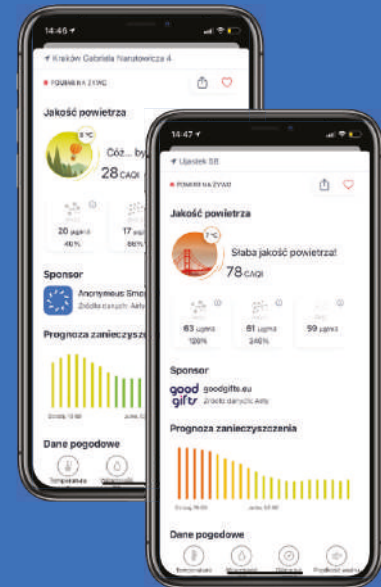
With higher air temperatures during the heating season, we need to burn less coal or wood. And that means fewer emissions of harmful substances. However, how high the concentration of pollutants in the air is depends not only on the amount of emissions, but also to a large extent on the wind, i.e. whether the pollutants are dispersed, or diluted.

You can read more at:

[oddychajpolsko.onet.pl/index\\_en.html](https://oddychajpolsko.onet.pl/index_en.html)



The current air quality can be checked in the Airly mobile application available for Android, iOS and Huawei.



# A NINE-YEAR-OLD GIRL PASSED AWAY DUE TO SMOG.

## SHE WAS THE FIRST OFFICIALLY DEEMED AIR POLLUTION VICTIM IN THE WORLD.

Adrian Dqbek

- ☀️ **On December 16, 2020, a coroner in London concluded that air pollution "significantly contributed" to the death of nine-year-old Ella Kissi-Debrah.**
- ☀️ **The girl died in February 2013. This is the first time in the UK, and most likely the world, that exposure to air pollution above standards has been formally recognized as a cause of death.**
- ☀️ **The girl lived just off one of the city' ring roads, where air pollution norms are regularly exceeded.**

Ella had been suffering from asthma for three years. Just before her seventh birthday, she started experiencing a rare and life-threatening form of the disease, but it was undiagnosed at the time. A few months later, she stopped breathing and was taken to intensive care. In December 2010, she fell into a coma, underwent tests for cystic fibrosis and epilepsy. Until a tragic attack of the disease in February 2013. Ella had been in five different hospitals nearly 30 times due to asthma attacks. Her mother said years later that the doctors never brought up the topic of air pollution during those visits.

An investigation in November 2020 found that "air pollution was a significant contributing factor in both triggering and exacerbating the girl's asthma."

Coroner Philip Barlow argued that Ella was exposed to excessive levels of air pollution - nitrogen dioxide levels near Ella's home far exceeded standards set by the World Health Organization and the European Union.

The coroner concluded that nothing was done to reduce the levels of nitrogen dioxide shown where the girl lived, which likely contributed to her death. Ella's death was also influenced by the lack of communication to the girl's family about the harmfulness of the air and its impact on health.



Ella Adoo-Kissi-Debrah  
[ellaroberta.org](http://ellaroberta.org)



# AVERAGE NO<sub>2</sub> CONCENTRATIONS IN EUROPE



The occurrence of high concentrations of NO<sub>2</sub> is associated with large urban areas: The pollution map shows in particular areas of Paris, Madrid, London, the Ruhr region and the Krakow agglomeration.



On the map the so-called **European banana belt** is also clearly visible - a densely populated urbanized area, stretching in a smooth arc from England, through Benelux, the western part of Germany, to northern Italy.



The highest concentrations at single stations were recorded in Athens and Paris.

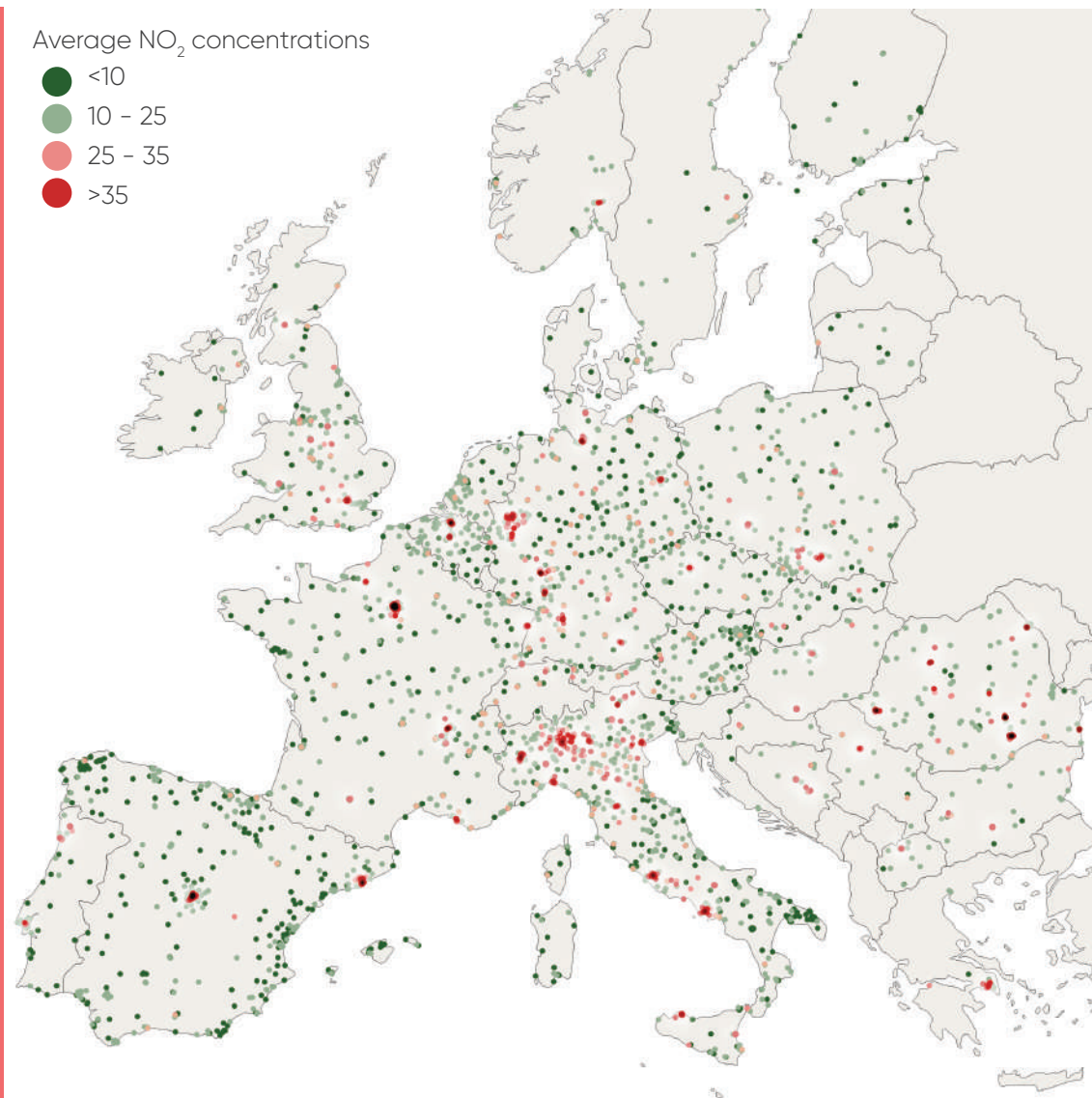


## 76%

% of analysed stations and sensors exceed the WHO annual NO<sub>2</sub> standard (10 µg/m<sup>3</sup>).

Average NO<sub>2</sub> concentrations

- <10
- 10 - 25
- 25 - 35
- >35



Data sources: EEA, Airly  
Analysis period: 01.08.2020- 01.08.2021

# 06 /

## WHAT IS IN THE SMOKE FROM BURNING WOOD?

**Jakub Jędrak,  
Piotr Kleczkowski  
and Michał Krzyżanowski**

from the SmogLab web portal



**For many people, wood smoke has a pleasant smell and brings to mind nice thoughts. In contrast to coal, wood is often considered an "ecological" fuel. However, the smoke produced by burning biomass contains many substances harmful to health. Among them the most important is particulate matter.**

In smoke from burning wood we can also find carbon monoxide, benzene, toluene, styrene, formaldehyde or acrolein. And also carcinogenic and mutagenic polycyclic aromatic hydrocarbons (PAH), including benzo[a]pyrene, and many other chemical compounds. Among the products of wood combustion we can even find very harmful dioxins.

In the case of many pollutants, their amount in the smoke may strongly depend on the type and quality of fuel (especially its humidity). And also on the appliance in which we burn it. Other

emission of pollutants from a tiled stove, from a primitive boiler (the so called "goat") or from a simple, traditional fireplace will be different, and different - usually much lower - in case of a modern fireplace (especially equipped with an electrostatic precipitator), a boiler gasifying chunk wood or a boiler for wood pellets.

However, practice shows that actual emissions - for example from fireplaces - can be very high. The skills and experience of the person burning the stove or fireplace also have a large impact on the emissions.

It should be noted that we are still talking here only about burning pure wood and not chipboard or varnished or impregnated wood. Burning this type of "fuel" significantly increases the emission of various toxic substances, including volatile organic compounds, formaldehyde, PAHs and dioxins (compared to the situation when we burn pure wood). It is also illegal to burn unsafe waste rather than legal fuel.

### COMPARISON: WOOD VERSUS COAL

Many harmful substances are present in both wood and coal smoke. For example, particulate matter. Dust emitted during biomass combustion is usually finer than dust produced during coal combustion. In other words, the content of PM2.5 in PM10 dust is very high. **This is important, because the smaller the dust particles are, the more dangerous they are to our health.**

**For both coal and wood, the chemical composition of the fumes and the amount of pollutants emitted depend on the combustion conditions and the quality of the fuel.** Usually, however, the composition of smoke from coal combustion and that from wood combustion differ from each other to such an extent that we won't be able to confuse them even following our own nose, just by the smell.

- ☀️ **Wood typically contains much less sulfur than coal. Therefore, sulfur dioxide emissions are much lower when biomass is burned than in the case of hard coal.**
- ☀️ **Compared to hard coal, nitrogen oxide emissions are also lower (due to lower biomass combustion temperature).**
- ☀️ **In contrast to hard coal and lignite, biomass contains at most marginal amounts of mercury. Therefore, when burning biomass, the problem of emitting this toxic element is eliminated.**

### WOOD BURNING SMOKE AND CIGARETTE SMOKE

Wood smoke can also be compared to cigarette smoke. The similarities here are even greater than in the case of burning coal, which should not surprise us.

Burning one kilogram of wood can produce as much dust as burning a few hundred cigarettes. But in the case of one of the most harmful compounds from the PAH group - benzo[a]pyrene - the number of cigarettes is much higher: several to tens of thousands! It follows that the same amount (mass) of smoke from burning wood usually contains much higher amounts of benzo[a]pyrene (and many other PAH) than tobacco smoke!



# EUROPEAN PM10 AIR POLLUTION MAP



The average concentration of PM10 during the analysed period exceeds the annual WHO standard ( $15\mu\text{g}/\text{m}^3$ ) in 71% of the European Union countries. This area is home to 86% of the EU population!



On the map of Europe, the **2 most polluted regions** are noticeable:

-  Southern Poland (Silesia, Lesser Poland)
-  Balkan countries (Serbia, Macedonia, Albania)

In these regions, the source of high pollution is **home heating (coal-fired central heating and wood burning) and unfavourable environmental conditions.**

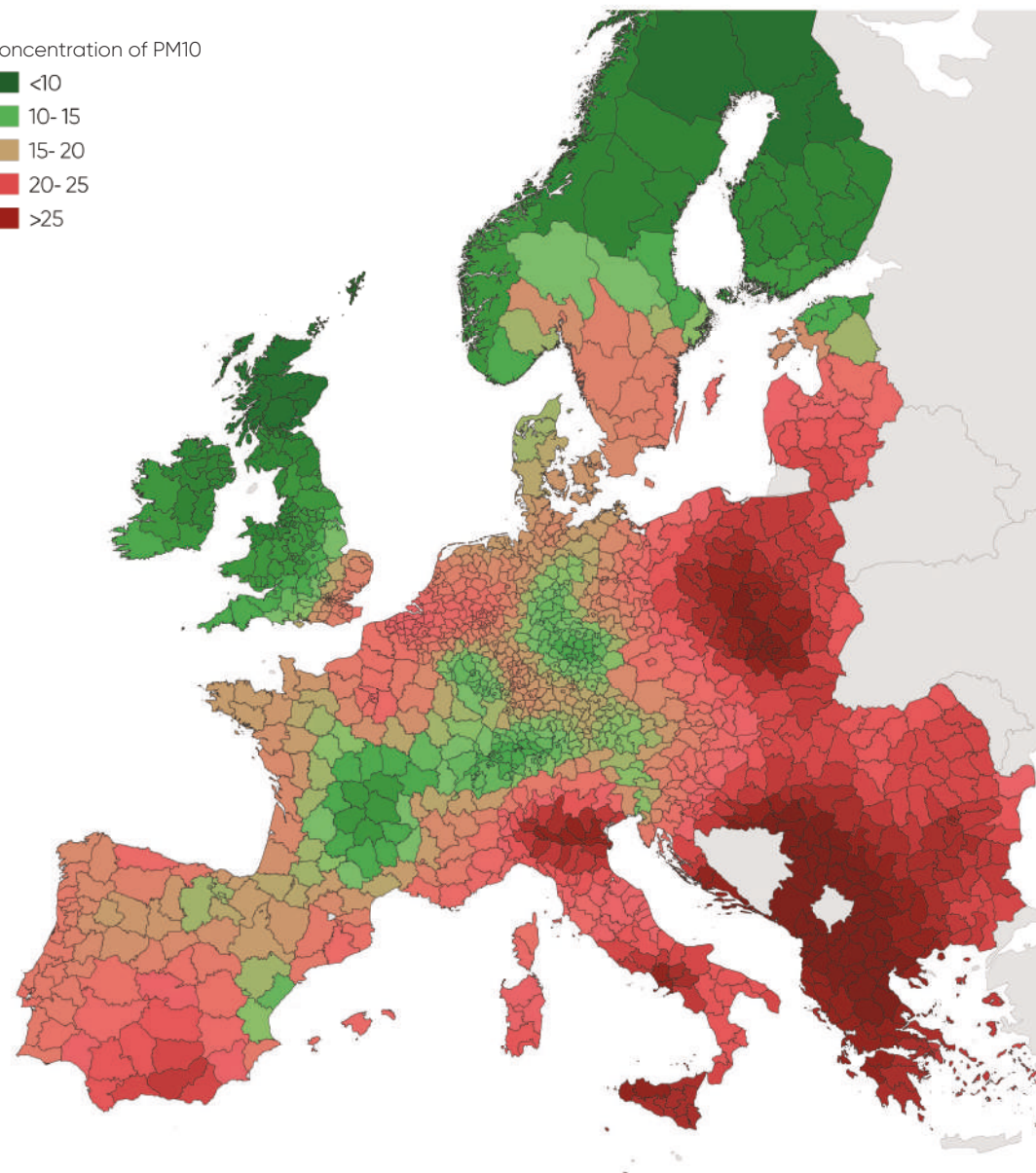
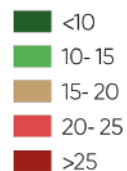


In Western Europe, **the most polluted region is Northern Italy** – more specifically the Po Plain, where the determining factor is **unfavourable topography combined with a high degree of urbanisation and industrialisation.**



The southern ends of the continent also experience **high levels of pollution – Andalusia, Sicily, and the Peloponnese – due to dry climate and large amounts of naturally occurring dust.**

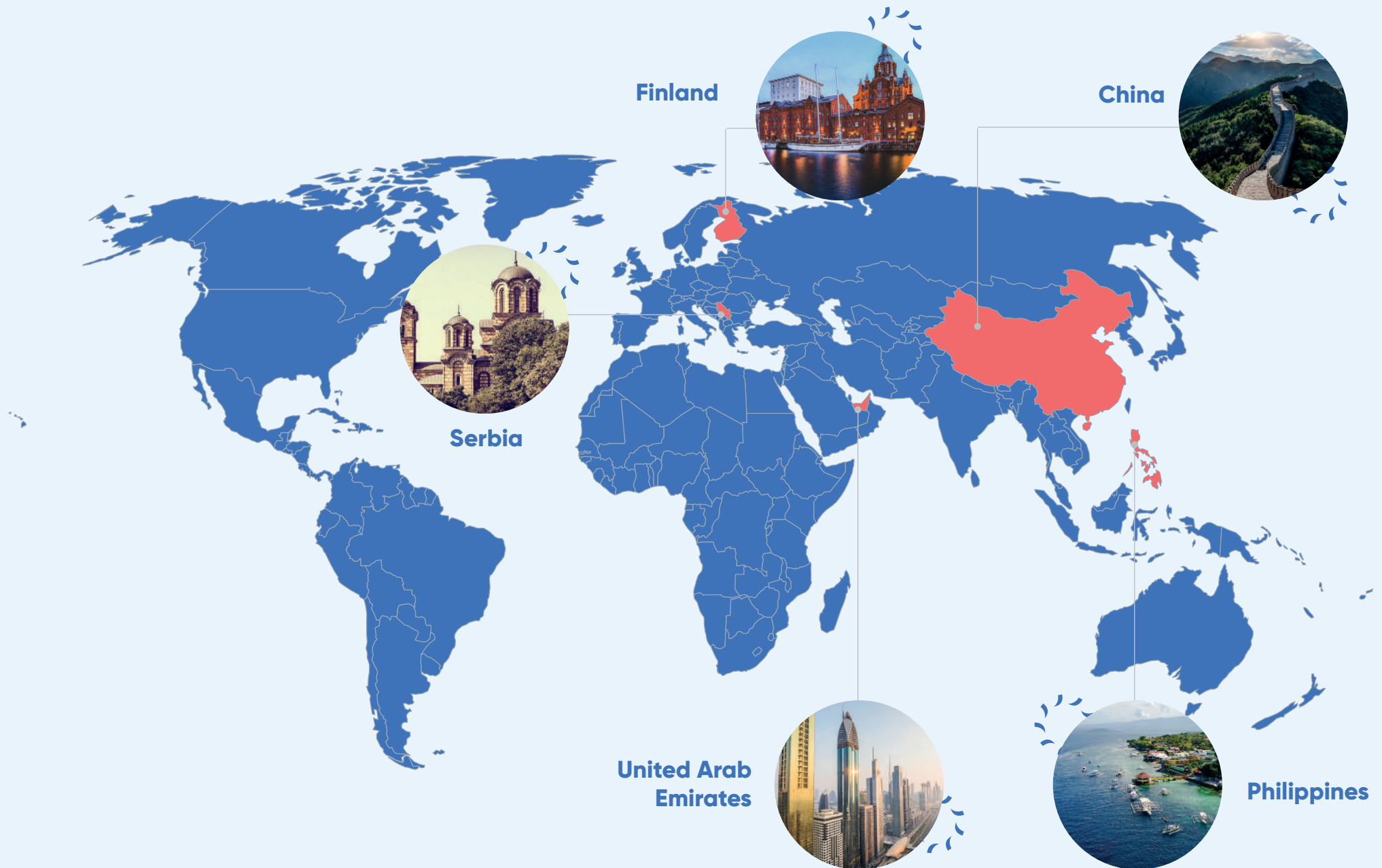
Concentration of PM10





# THE MOST INTERESTING INTERNATIONAL LOCATIONS

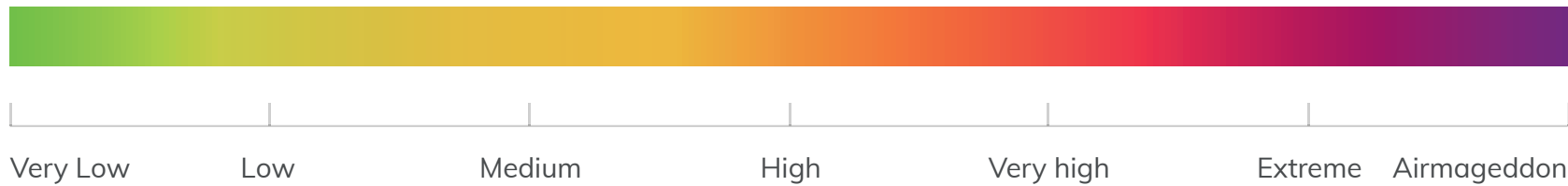
## WHERE WE INSTALLED AIRLY SENSORS IN 2021





# Air pollution index

Airly uses the CAQI (Common Air Quality Index) scale and WHO air quality standards for data presentation. The colors reflect the levels of the CAQI scale with appropriate numerical and percentage weights.





Airly was founded in 2016 in Kraków as a project created by three graduates of the AGH University of Science and Technology – Wiktor Warchałowski, Michał Misiak, Aleksander Konior. Airly provides the most advanced information about air quality. Our solution is a complete, fully integrated global platform for monitoring air quality around the world. Through Airly sensors, it is possible to collect, process and interpret data in real time. Based on this data, air quality information is presented on an online map [map.airly.org](http://map.airly.org) and in a mobile application. The Airly system measures key components of air pollution, such as particulate matter and gases.

The Airly air quality monitoring system helps build awareness and gathers information about the causes of air pollution in a given area. This knowledge allows local governments, businesses and communities around the world to locate sources of air pollution, and plan and implement measures to improve it. By the end of 2021, Airly have more than 25,000 active measurement points operating worldwide. Airly sensors are installed in 40 countries, providing air quality data to millions of people on each continent.



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