CASE STUDY: AIR POLLUTION IN "LAS FUENTES" SECONDARY SCHOOL OF VILLENA

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1. WHAT IS URBAN AIR POLLUTION?

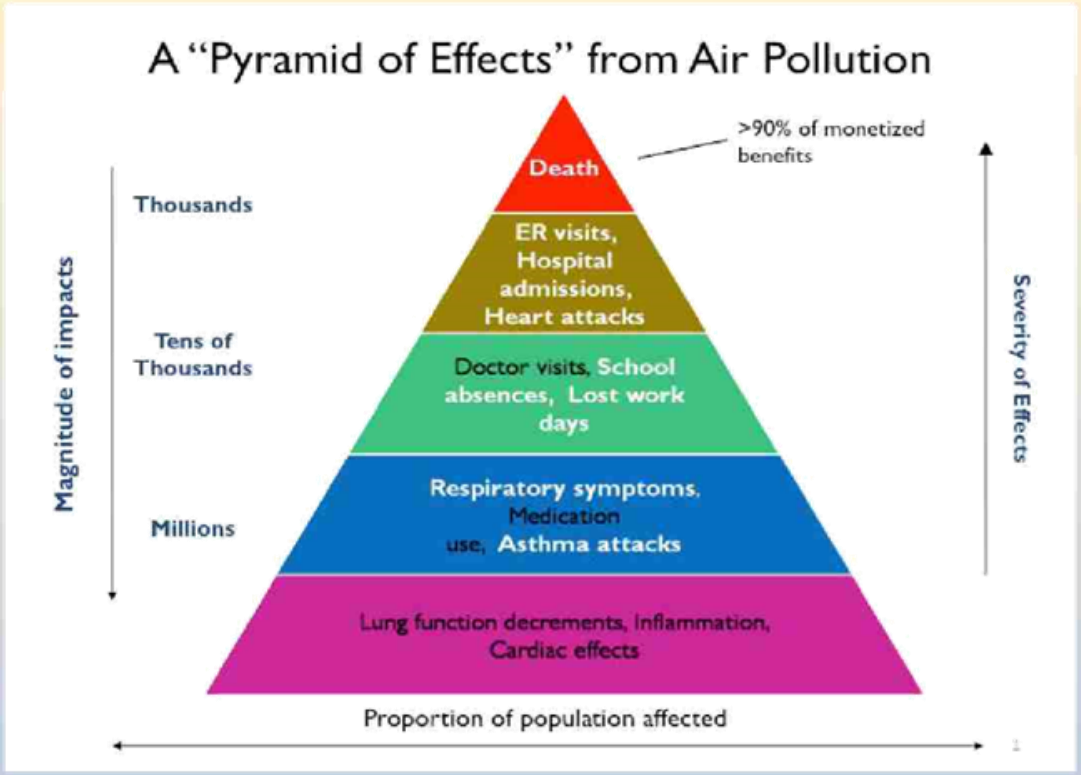
Urban air pollution is a serious problem in many large cities around the world. Intense and incessant traffic, joined to factories which do not control their emissions and emissions from domestic heating, turns the air of cities around the world into real smog clouds. Pollutant particles levels often exceed the WHO safety limit for human health.

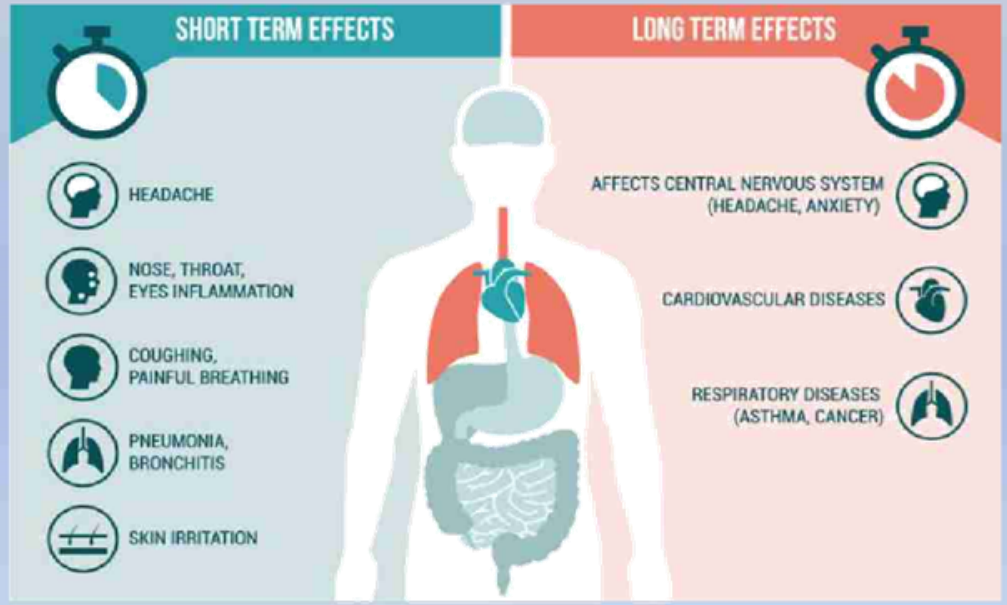
Air pollution in the city of Valencia

2. WHAT ARE THE MAIN HEALTH RISKS?

The main health effects of air pollution range from lung function alterations, heart problems and other symptoms and discomfort to an increase in the number of deaths, hospital admissions and emergency visits, especially for respiratory and cardiovascular causes.

The effect of air pollution maintains a gradation both in the gravity of its consequences and in the population at risk affected. Thus, as the effects are less severe, the percentage of the population affected is higher.





3. MAIN AIR POLLUTANTS

NITROGEN DIOXIDE (NO2)

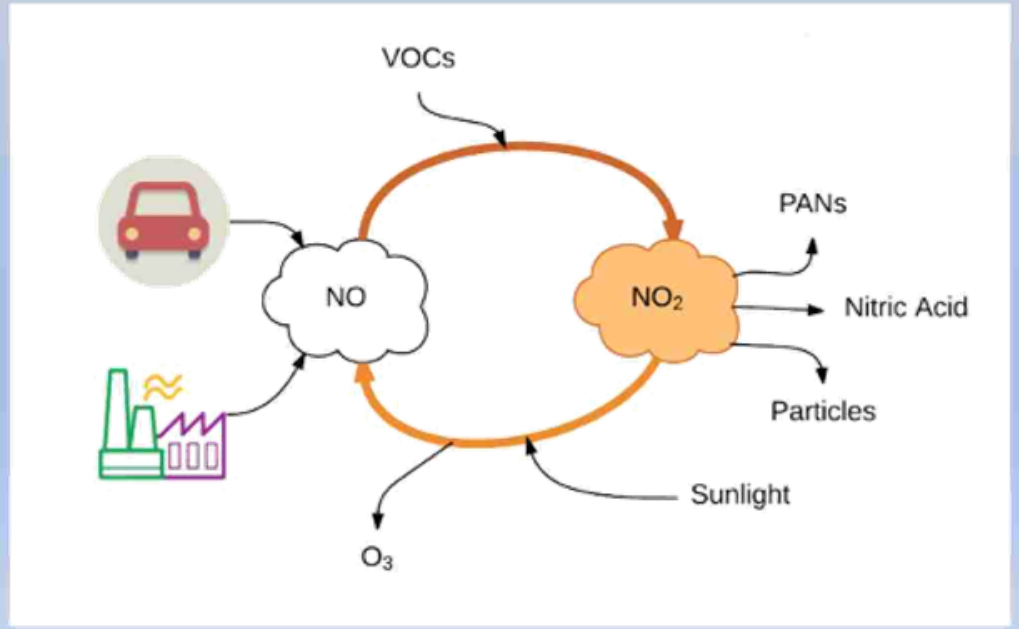
Values set out in the Guidelines

40 µg/m^3 annual average - 200 µg/m3 average in 1h

The main sources of anthropogenic emissions of NO2 are combustion processes (heating, electricity generation and motor vehicles and ships).

Health effects

Studies have shown that the symptoms of bronchitis in asthmatic children increase in relation to prolonged exposure to this contaminant, as well as a decrease in the development of lung function.



SULPHUR DIOXIDE (SO2)

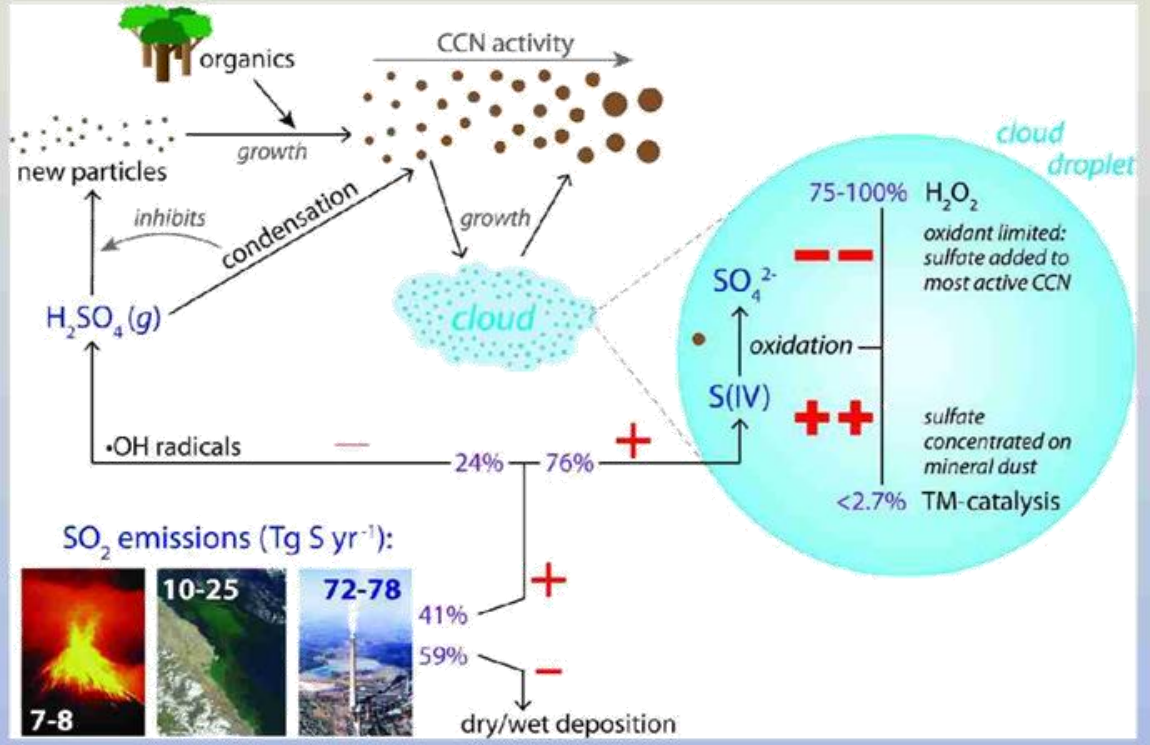
Values set out in the Guidelines

20 µg/m3 on average in 24h - 500 µg/m3 on average in 10 min

The main anthropogenic source of SO2 is the combustion of sulphur-containing fossils used for domestic heating, electricity generation and motor vehicles.

Health effects

SO_2 can affect the respiratory system and lung functions, and cause eye irritation. Hospital admissions for heart disease and mortality increase on days when SO2 levels are highest. In combination with water, SO2 is converted to sulfuric acid, which is the main component of acid rain that causes deforestation.



OZONE (O3)

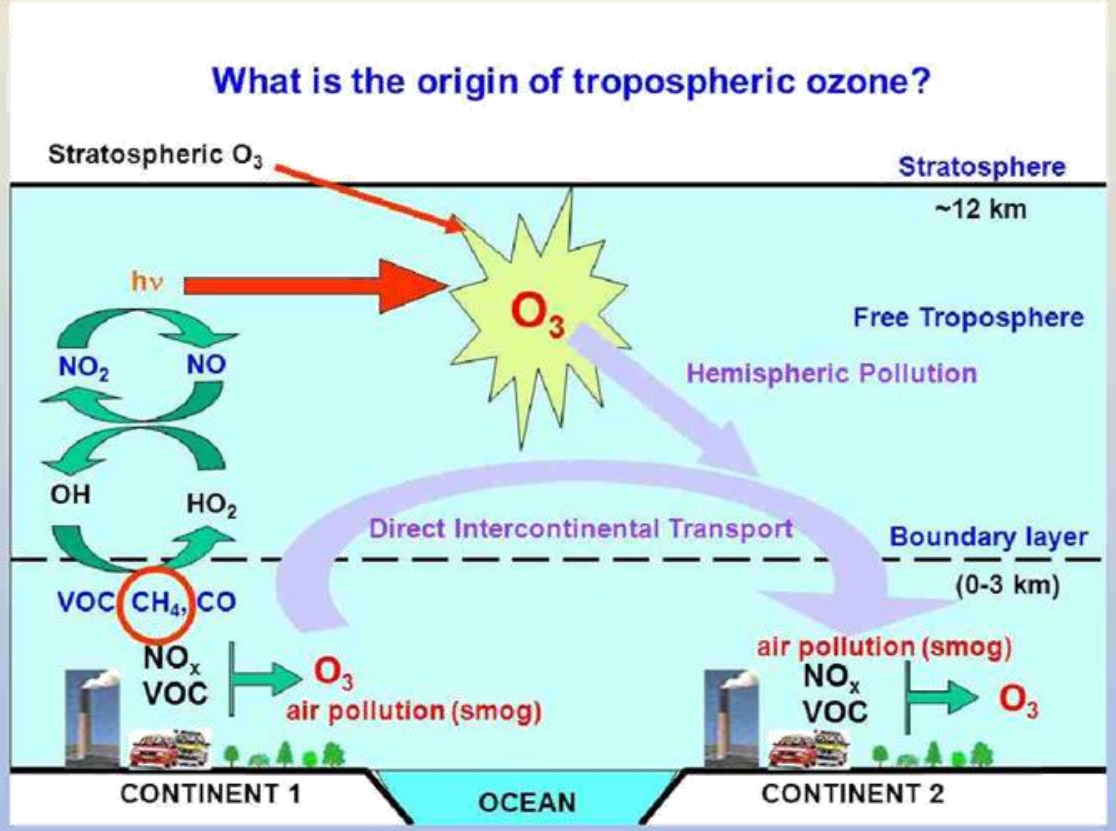
Values set out in the guidelines

100 µg/m3 on average by 8h

Ground-level ozone (not to be confused with the ozone layer in the upper atmosphere) is one of the main components of smog. This is formed by the reaction with sunlight (photochemical) of pollutants such as nitrogen oxides (NOx) The highest ozone levels are recorded during periods of sunny weather.

Health effects

It can cause respiratory problems, cause asthma, reduce lung function, and cause lung disease. It is currently one of the most worrying air pollutants in Europe.



SUSPENDED PARTICULATES (PM)

Values set out in the Guidelines

PM2.5: 10 µg/m3 annual average - 25 µg/m3 24h average
PM10: 20 µg/m3 annual average - 50 µg/m3 24h average

PM affects more people than any other contaminant and its main components are sulfates, nitrates, ammonia, sodium chloride, coal, mineral dust and water. MPs consist of a complex mixture of particles and are classified according to their aerodynamic diameter in:

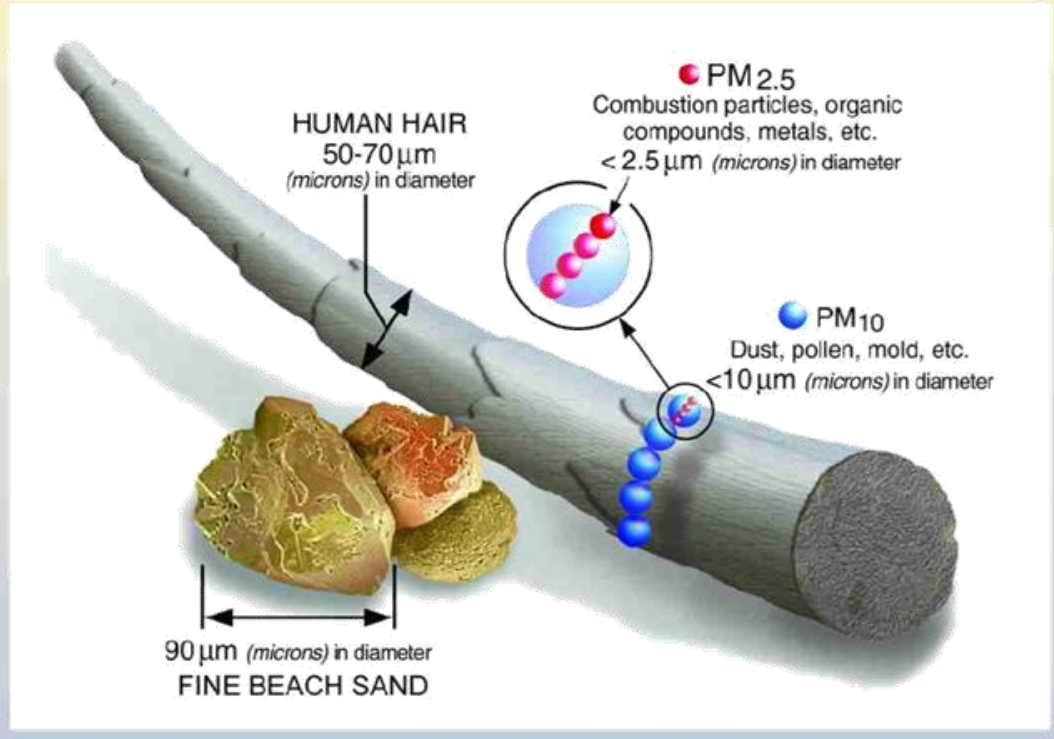
PM10 (particles with an aerodynamic diameter of less than 10 µm)

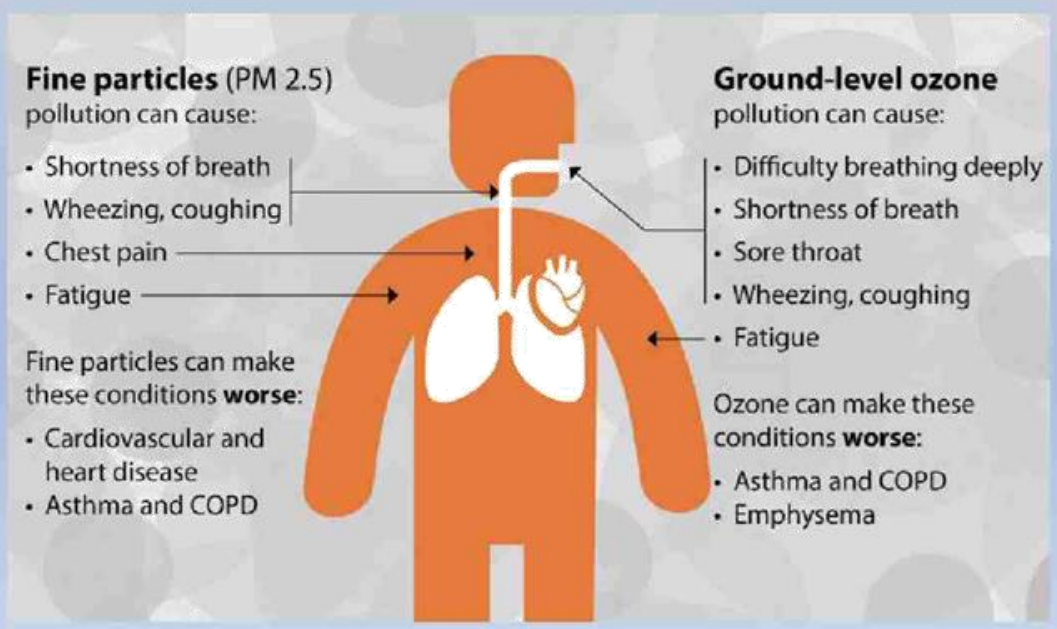
PM2.5 (aerodynamic diameter less than 2.5 µm).

The latter are more dangerous because, by inhaling them, they can reach the peripheral areas of the bronchioles and alter the pulmonary exchange of gases.

Health effects

Chronic exposure to particulates increases the risk of cardiovascular and respiratory diseases, as well as lung cancer. Mortality in cities with high levels of pollution is between 15 and 20 per cent higher than in cleaner cities. Even in the EU, average life expectancy is 8.6 months lower due to exposure to PM 2.5 from human activities.



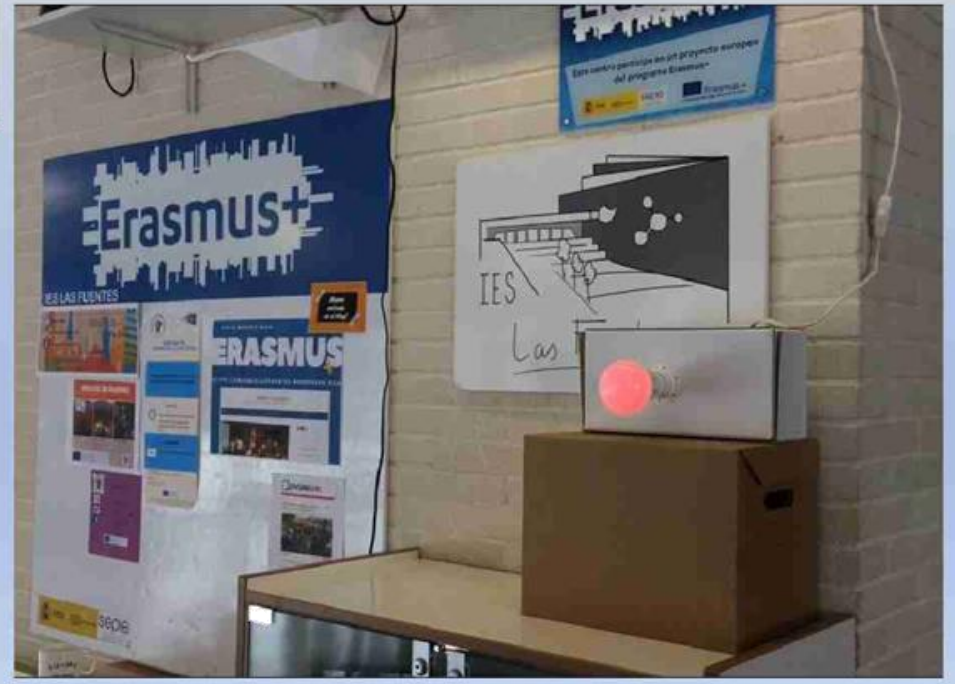


4. AIR POLLUTION IN OUR CITY

Villena is a medium sized city (35,000 inhabitants) with not too much industrial factories so we believe that it does not have a very high urban air pollution. Even so, in the area where our educational centre is located (Las Fuentes high school) coincides with three other educational centres and there are significant traffic problems in the peak hours in addition to the heating emissions of all centres. Our interest was focused on knowing the levels of pollution in our area as well as whether these traffic peaks affected the quality of the air that students breathe.

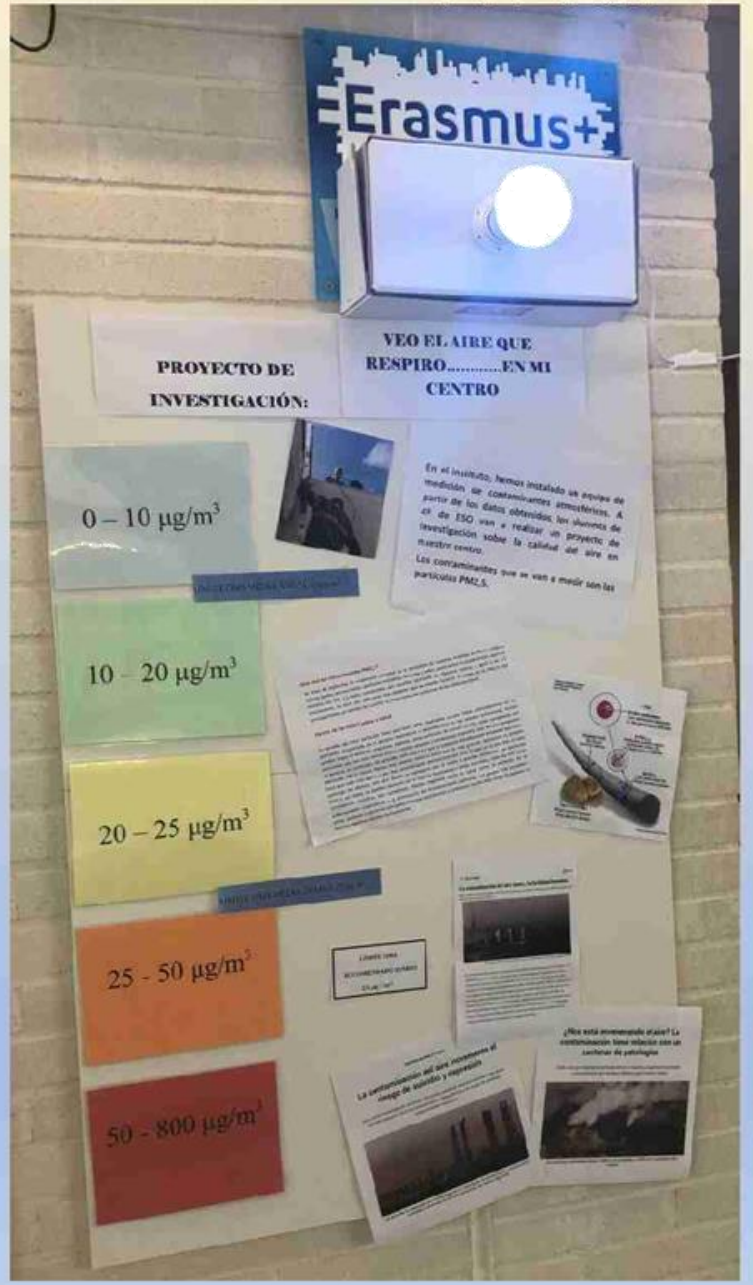
As mentioned above, the most harmful contaminants, which cause the most health problems, are particulate matter (PM). We were therefore interested in doing a study of this pollutant nearby our centre. For this, we contacted the VÉOLO programme.

VÉOLO is a social innovation project that stimulates society's commitment to improving air quality in cities. Thanks to the participation in this project we obtained the transfer for a few months of a PM10 and PM2.5 particle measurement kit.



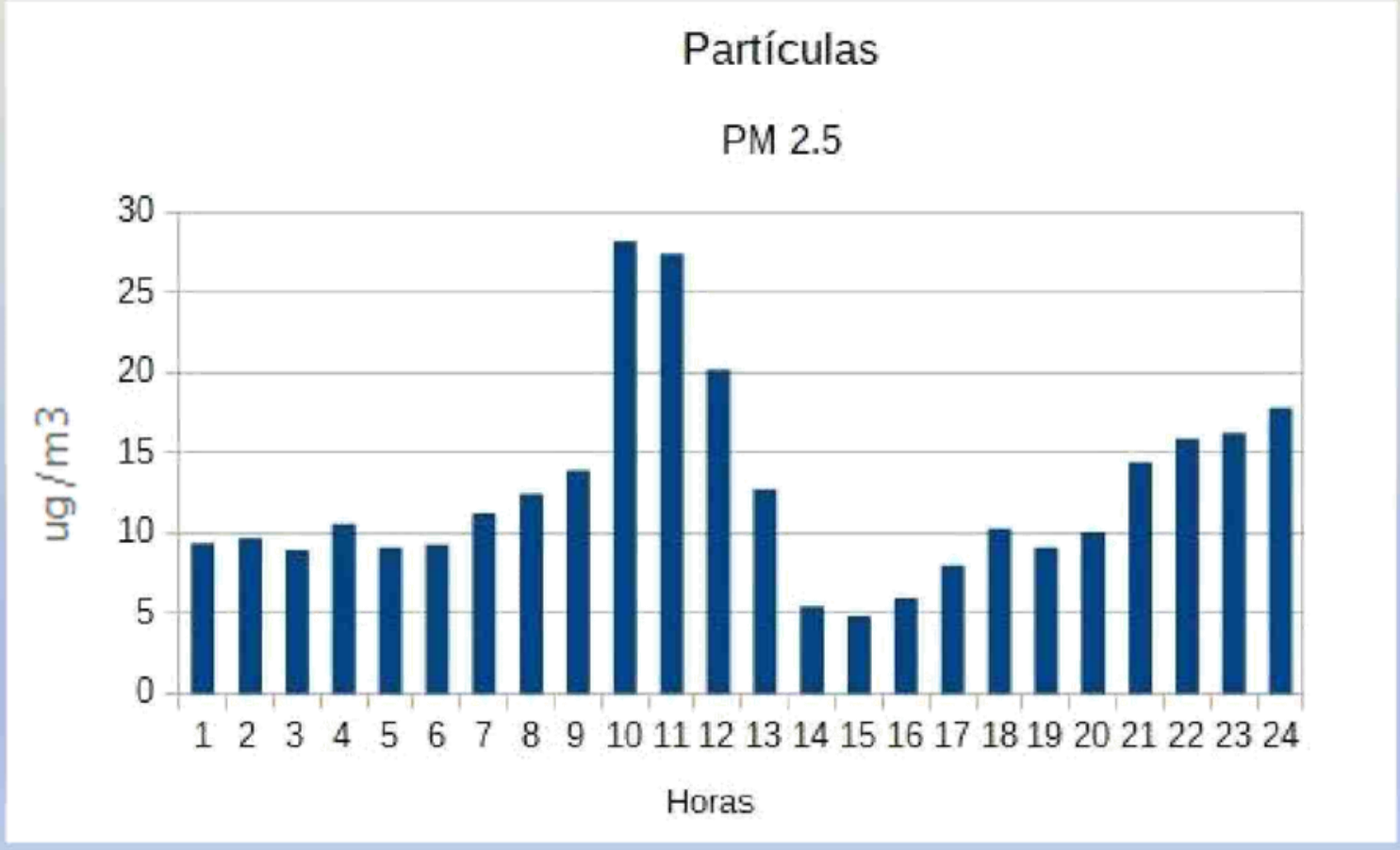
The kit, installed in February 2020, had a light bulb that was located at the entrance of the high school and that changed color according to the concentration of outdoor PM.

The students of the ERASMUS+ project made an information panel so that the rest of the students of the school knew the meaning of the bulb. Outreach activities were also carried out at all classrooms of the centre. The students explained to the rest of the students the problem of air pollution and the characteristics of the project.



5. ANALYSIS OF RESULTS

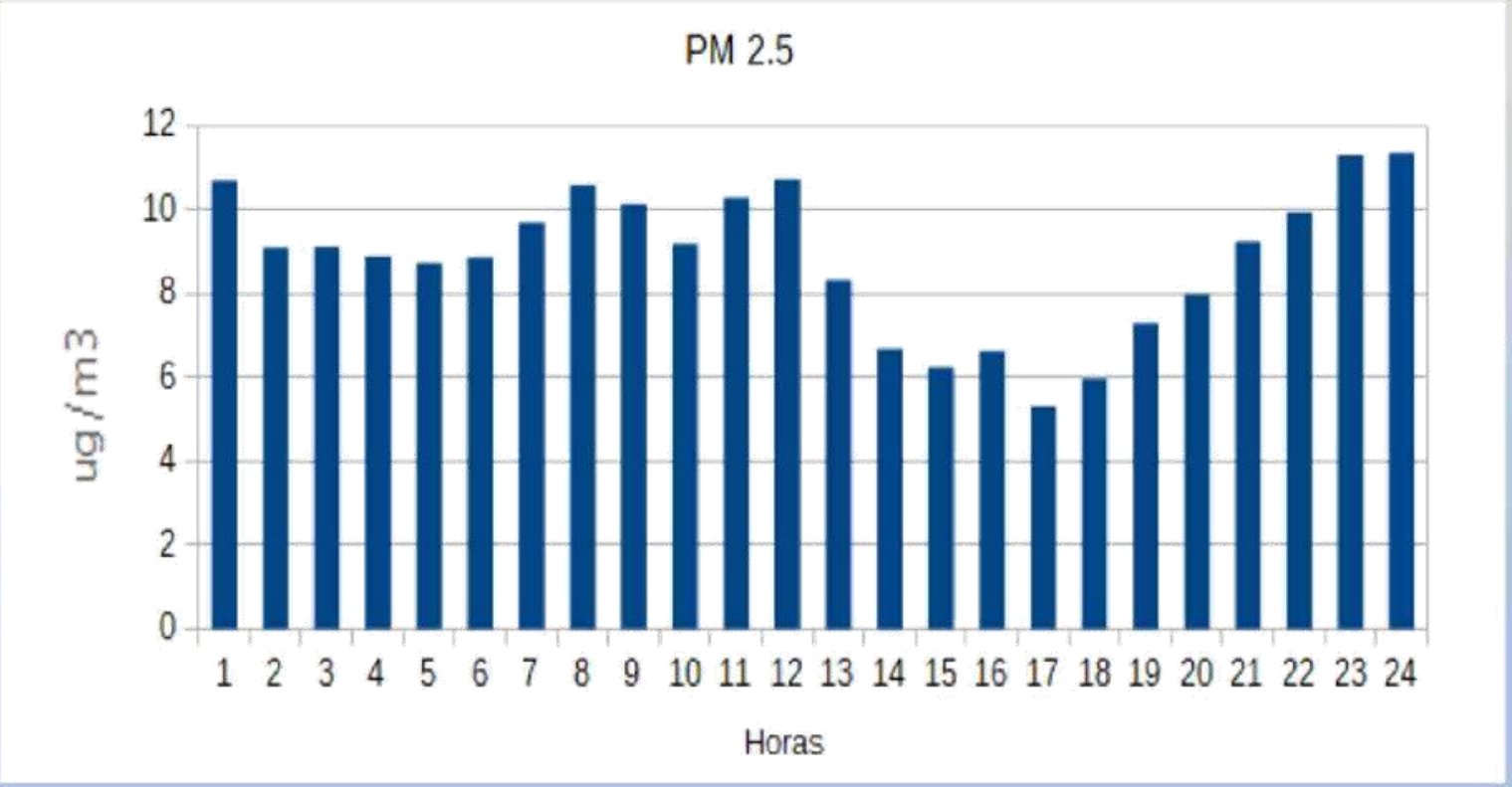
The analysis of the results obtained by the kit for PM2.5 particles showed clearly an increase in concentration values with a delay of 1 hour after the entry of students to the educational centres of the area (one hour after peak traffic in the morning). In the following graph we can see the evolution of these data (concentration in **mg/m**3) for a full day (1/2/2020).



Similar results were obtained during the month of February on all working days, with a peak concentration in the middle of the morning. At these peaks, the maximum WHO recommended value of 25 mg/m**3** is normally exceeded.

Logically the study would have required a longer analysis time due to the situation generated by the COVID pandemic-19, on March 13, the suspension of classes and the house confinement of the population took place, which lasted until the end of the academic year.

During the confinement period, the kit continued to take data and this has allowed us to make a comparison of the values before and during the suspension of classes. In the following graph we can see the evolution of the concentration of PM2.5 in a day during confinement (18/3/2020).

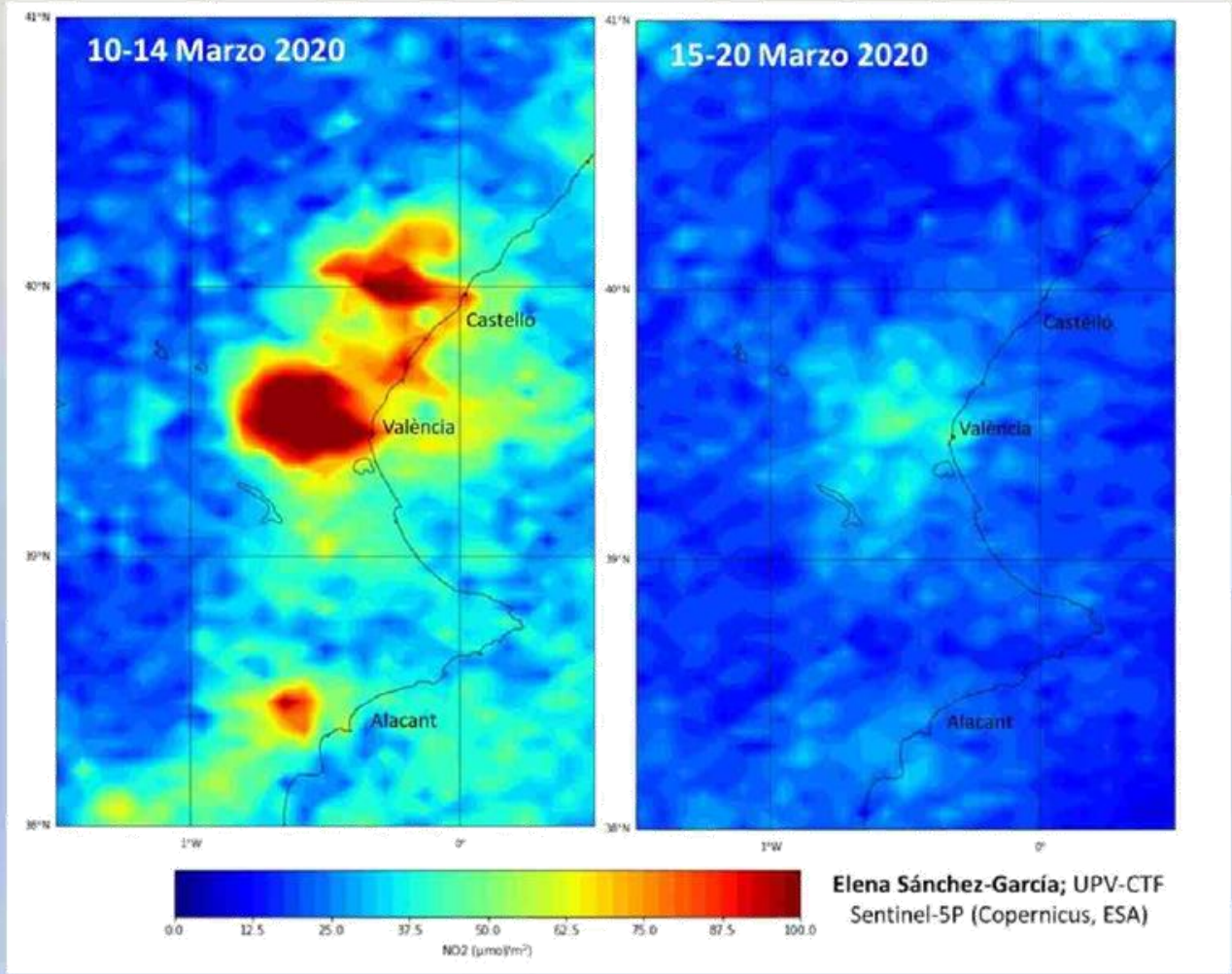


This graph shows lower values than those recorded before confinement, and no peak concentration is observed due to traffic at the entrance of schools.

Due to the confinement situation the air quality of our city improved.

This improvement in air pollution was logically due to the decrease in traffic and industrial activity and took place in all the cities of the world.

In the following images we can see the decrease in NO2 concentrations in our region (Valencian Community) before and after the declaration of the state of alarm by the COVID-19 pandemic.



In this image we see that the most important problems of air pollution in our region are mainly located in the capital, Valencia. It is a city of 2.5 million inhabitants (3rd most populated city in Spain), very industrialized and with serious traffic problems.

There are also significant concentrations of pollution in the other two provincial capitals, Castellón and Alicante.

We see how the pollution decreases were drastic during confinement. These values have, of course, increased again after the end of confinement, although they have not reverted to the previous values since the situation is not fully normalized and there are currently restrictions on mobility between regions.

6. CONCLUSIONS AND MEASURES

As we have seen, the traffic in our city causes concentrations of PM2.5 particles higher than the recommended limits at certain times of the day.

To improve this situation, environmental policies would be needed to reduce exposure to outdoor air. These policies should include:

- Traffic restrictions
- Promote the use of public transport, and make it less polluting: Transport vehicles and utilities, hybrid or electric.
- Reduced speed on roads, especially on surrounding areas.
- Promote walking and cycling in the city centre by adapting the city to cyclists.
- More pedestrian streets or restricted access to residents.
- Meters in the areas with the highest concentration of pollution that provide reliable data on which to base.
- Encourage initiatives to share private vehicles or car-sharing companies.
- Financial support for the purchase of electric vehicles
- Raising public awareness of the importance of reducing pollution in cities and related health problems.

Without more ambitious policies to combat urban pollution, by 2050:

Air pollution will become the leading environmental cause of premature mortality in the world. It is estimated that by 2050 the number of premature deaths from exposure to suspended particles will be more than double and will reach to 3.6 million per year on the planet.

In addition, more damaging climate change is likely to occur, as global greenhouse gas (GHG) emissions are projected to rise by 50 per cent, mainly due to the 70 per cent increase in energy-related CO2 emissions.