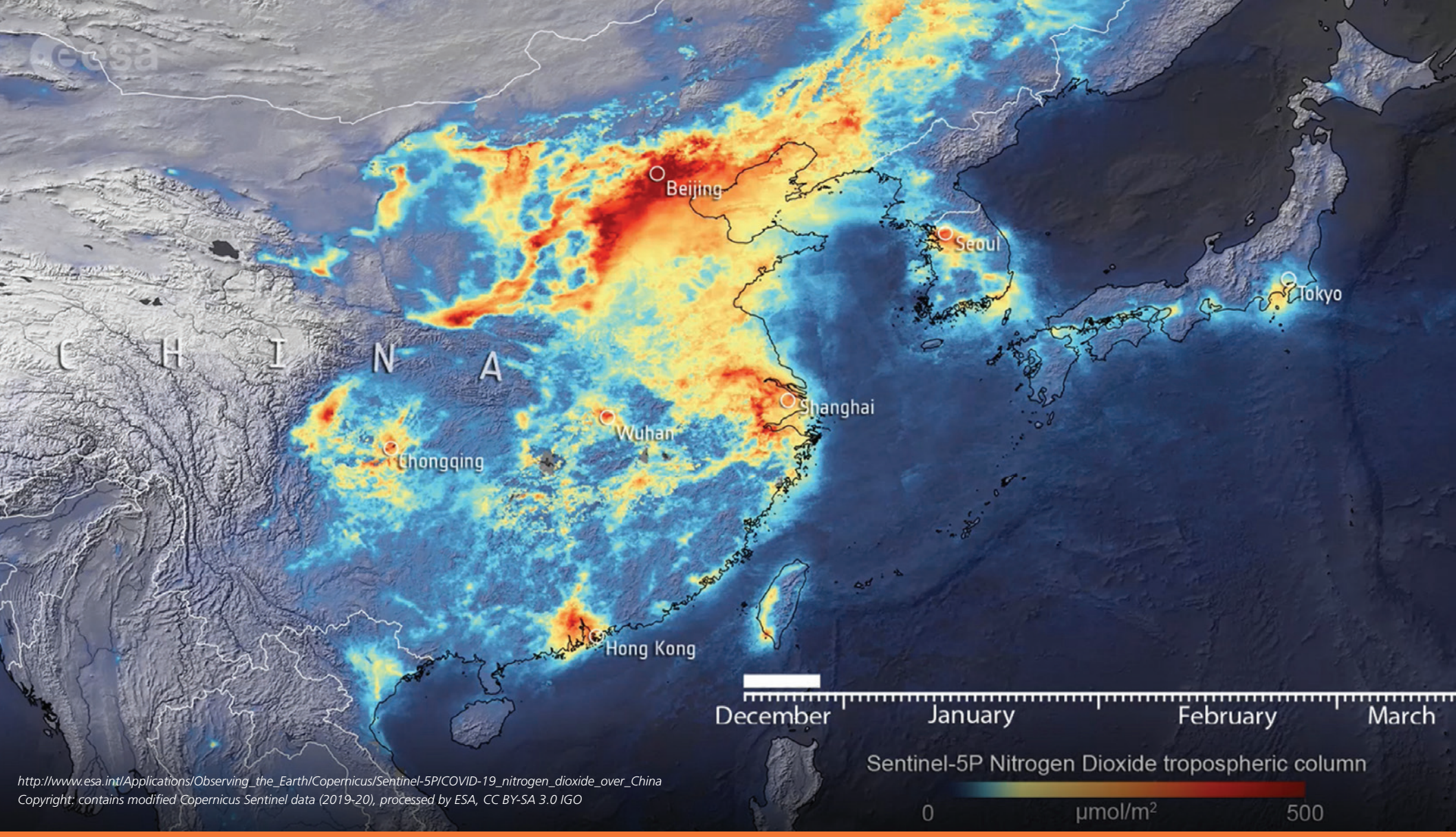


http://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/COVID-19_nitrogen_dioxide_over_China

THE ENVIRONMENTAL IMPLICATIONS OF CORONAVIRUS

A newspaper cartoonist recently joked: "This time next week we could be carbon neutral!"- but is there an element of truth in that assertion? And with travel and economic activity significantly curtailed, is the environment benefitting? We are certainly living in extraordinary times, but maybe the current situation will prove useful as we search for the best ways to deal with climate and pollution emergencies.

How did it come to this?

In 2015, Bill Gates gave a TED lecture entitled: 'The next outbreak – we're not ready.' In his presentation, he said: "Of all the things that could kill more than 10 million people around the world in the coming years, by far the most likely is an epidemic." He went on to explain that we should have learned lessons from the Ebola epidemic, adding: "Other diseases — flu, for example — spreads through the air, and people can be infectious before they feel sick, which means that one person can infect many strangers just by going to a public place. We've seen it happen before, with horrific results: In 1918, the Spanish flu killed more than 30 million people. Imagine what it could do in today's highly mobile world."

The world's population increased from 1 billion in 1800, to 7.7 billion in 2019. At the same time, populations are increasingly living in towns and cities. According to the United Nations, urbanisation, coupled with global population growth could add 2.5 billion people to urban areas by 2050.

If we draw an analogy between the current situation and factory farming, there are some striking similarities. For example the three main problems with intensive animal production are welfare, pollution and disease. Animals become stressed when large numbers of them are confined in small spaces; they produce high concentrations of pollution, and when an individual contracts a disease, it can spread like wildfire.

Clearly, the lessons from previous human epidemics have not been learned, and Bill Gates's warning went unheeded. However, despite all of the misery and suffering created by the current pandemic, there are some beneficial side-effects. Previously, it would not have been possible to freeze much of the world's economy and lockdown more than a quarter of the world's population, so in terms of its effects on the environment, the Covid-19 pandemic represents a unique opportunity to study some of the effects of human activity on this planet.

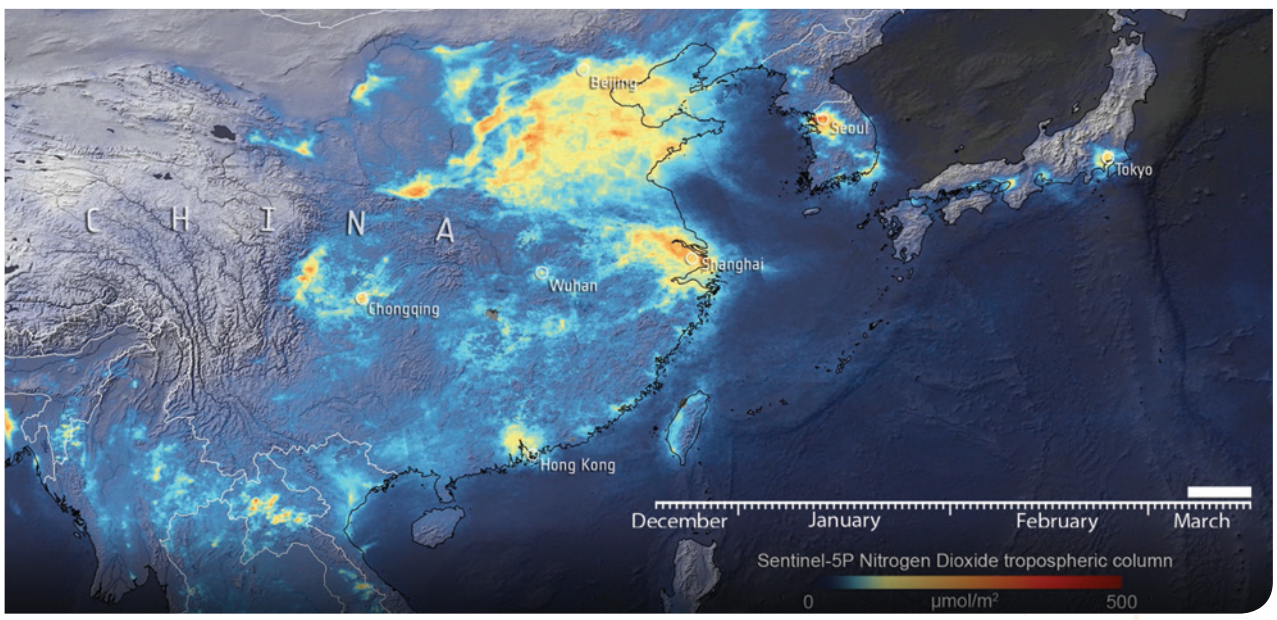
When did human activity start to change?

COVID-19 stands for Corona (CO) Virus (VI) Disease (D) and 19(2019) is the year that the first cases were detected – during November in China's Wuhan City, which was eventually locked down on 23rd January 2020. Wuhan has 11 million inhabitants, but tens of millions of citizens in nearby cities were also locked down.

In Italy, on 8th March several northern provinces were placed under lockdown, and this was extended nationwide the following day.

Soon thereafter (17th March), the European Council agreed to ban incoming travel. On 25th March India placed its entire 1.3 Billion population on lockdown for 21 days. By the end of March around one third of the global population was on Coronavirus lockdown.

In many countries only essential travel is being allowed, leaving motorways largely deserted. Hundreds of thousands of flights were cancelled globally in March. According to the travel data organisation Cirium, on 27th March the worldwide total of in-active aircraft was more than 8,500.



China after lockdown
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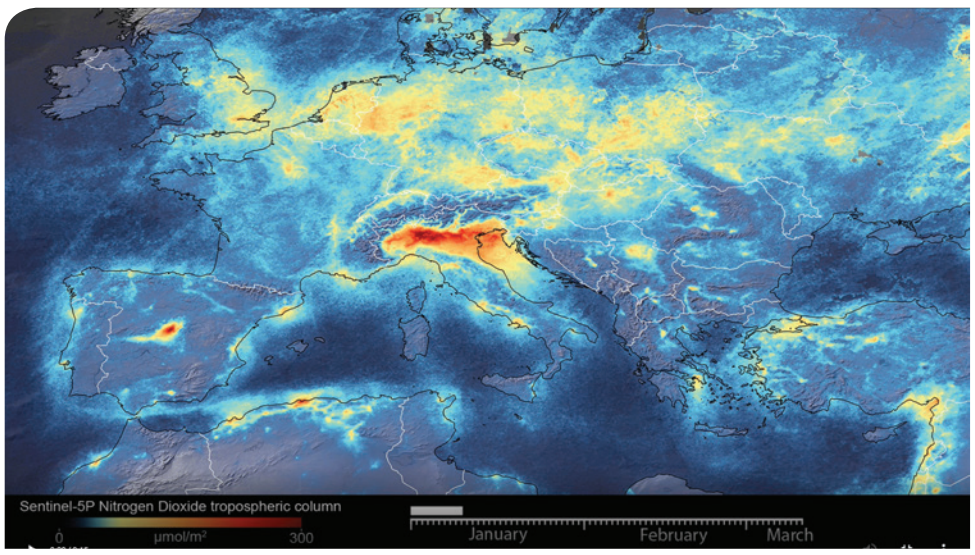
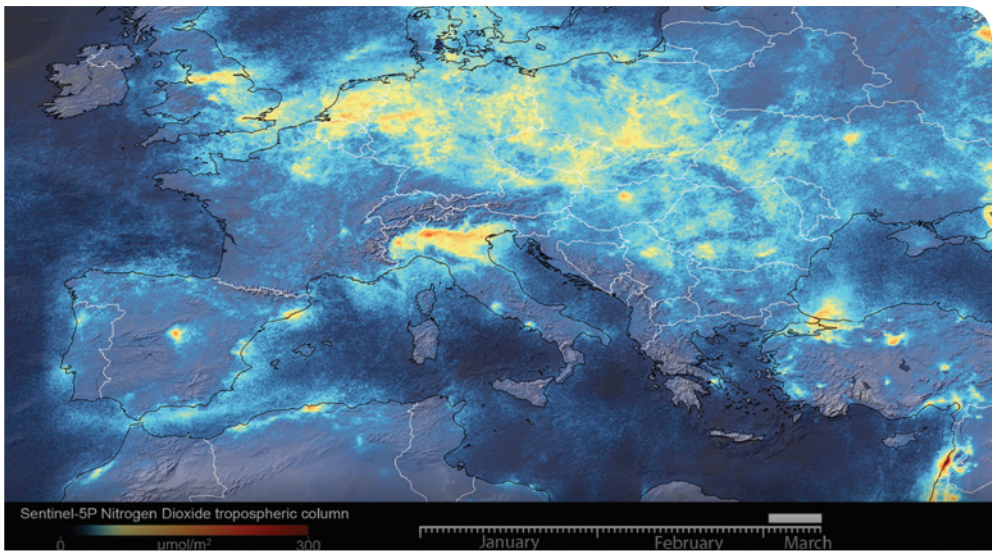


Italy before lockdown



Italy after lockdown

https://www.esa.int/ESA_Multimedia/Videos/2020/03/Coronavirus_nitrogen_dioxide_emissions_drop_over_Italy
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What environmental effects have there been?

Clearly, the pandemic is reducing the use of fossil fuels for travel, but it is also limiting industrial activity which lowers the consumption of oil and coal for example. In China, the world's largest emitter of carbon, it has been estimated that emissions over February/March have been about 25% lower than normal. This is unsurprising because major impacts on the economy generally drive a temporary decline in carbon emissions. During the 2008 recession, for example, the Netherlands Environmental Assessment Agency (NEAA) reported that the rise in the world's CO_2 emissions from fossil fuel burning and cement production in 2008 was just 1.7%, compared with 3.3% in 2007.

An analysis on the climate website Carbon Brief reported the reductions in the use of coal and crude oil indicate a reduction in CO_2 emissions of 25% or more, compared with the same two-week period following the Chinese New Year holiday in 2019. This amounts to approximately 100Mt CO_2 – or 6% of global emissions over the same period.

The reduction of CO_2 emissions, a major Greenhouse Gas, has important implications for the climate emergency, but positive effects on air quality are also being recorded. Data from the European Environment Agency (EEA) are showing large decreases in air pollutant concentrations; and of nitrogen dioxide (NO_2) in particular. This is largely due to reduced traffic and other activities, especially in major cities under lockdown, where pollutant levels have been reduced by up to 50%. For example, in Milan, during the 4 weeks preceding 25th March, average concentrations of NO_2 were at least 24% lower than four weeks earlier, and the average concentration during the week of 16-22 March was 21% lower than for the same week in 2019. In Bergamo, there has been a constant decline in NO_2 pollution over the same period. The average concentration during the week of 16-22 March was 47% lower than for the same week in 2019. In Rome, average NO_2 concentrations were 26-35% lower than for the same weeks in 2019.

In Spain, Barcelona's average NO_2 level reduced by 40% from one week to the next, and compared with the same week in 2019, the reduction was 55%. In Madrid, average NO_2 levels went down by 56% from one week to the next, and compared with the same week in 2019, the reduction was 41%.

In Portugal, Lisbon's average NO_2 levels went down by 40% from one week to the next, and compared with the same week in 2019, the reduction was 51%.

In the UK, Prof. James Lee and his colleagues at the National Centre for Atmospheric Science are tracking air quality data. He says: "Pollution levels are clearly lower than the average of the previous five years. I would expect them to drop even further over the coming weeks." In an interview with the Guardian newspaper he explains further: "There are big changes – pollution levels are the equivalent at the moment to a holiday, say an Easter Sunday, and I think we will see an even starker drop-off when the weather changes." Most areas are showing improvements in levels of NO_2 and PM2.5, however, ozone levels have generally risen slightly.

The effects of short-term traffic removal from urban areas have been studied previously. For example, measurements taken by King's College London during the 2018 London Marathon demonstrated an 89% drop in air pollution levels in the capital. The researchers monitored levels of nitrogen oxides (NO_x) for a 12 hour period on Sunday 22 April, and compared these levels with the previous Sunday. Similarly, in May 2018, Cardiff Council organised a car-free day in the city's central area, and air quality monitoring data showed an average 69% drop in NO_2.

Monitoring from Space

The Coronavirus countermeasures undertaken in China in late January led to a dramatic reduction in NO_2 concentrations – those released by power plants, industrial facilities and vehicles – in all major Chinese cities between late-January and February.

Sentinel 5P satellite *© ESA/ATG medialab*

The drop in concentrations also coincided with Lunar New Year celebrations, which normally see a similar drop in concentrations.

The European Space Agency's Copernicus Atmosphere Monitoring Service (CAMS) observed a decrease of fine particulate matter in February 2020 compared to the previous three years. By combining satellite observations with detailed computer models of the atmosphere, their studies indicated a reduction of around 20-30% in surface particulate matter over large parts of China.

Data from the Copernicus Sentinel-5P satellite has also revealed the decline of air pollution, especially NO_2, over Italy. This reduction is particularly evident in northern Italy which coincides with the nationwide lockdown.

Sentinel-5P is the first Copernicus mission dedicated to monitoring the Earth's atmosphere. The satellite carries the state-of-the-art Tropomi instrument to map trace gases such as nitrogen dioxide, ozone, formaldehyde, sulphur dioxide, methane, carbon monoxide and aerosols. With a swath width of 2600 km, it is able to map the entire planet every day with a resolution as high as 7 km × 3.5 km. The mission will also contribute to services such as volcanic ash monitoring for aviation safety and for services that warn of high levels of UV radiation which can cause skin damage.

What lessons will we learn?

The sudden imposition of travel restrictions and self-isolation have forced organisations and individuals to rapidly adapt to the new normal, and many have been surprised how well and how quickly this has happened. In the past, employers have been reluctant to allow workers to work from home for a variety of reasons. Some fear that workers may not work as hard or may become distracted, whilst others harbour concerns that staff will miss important meetings, and the quality of their work will suffer from a lack of interaction with colleagues. However, many are reporting that these fears have been groundless, and workers have been able to operate very well remotely. In fact, many are reporting a better work/life balance with less time wasted travelling.

As a one-off emergency measure, organisations such as the 189-nation International Monetary Fund and its sister lending organisation, the World Bank, will replace their usual spring gathering in Washington with a virtual teleconference. It will be interesting to see if the economic and carbon savings from this measure will prompt calls for it to become the norm in future years.

Already, organisations are starting to question the need for a large head office staffed by the same people every day. Internet based communications and video conferencing have boomed, so it seems inevitable that post-Corona there will be less reliance on travel and that the environment will benefit accordingly.

Finally, in the face of thousands of deaths from the Covid-19 emergency, many governments have acted in rapid and dramatic fashion; spending enormous sums of money. The impacts of climate change happen more slowly, but many governments accept that this is also an emergency, so will their response be as emphatic?

Similarly, according to the World Health Organisation, ambient air pollution accounts for an estimated 4.2 million deaths per year due to stroke, heart disease, lung cancer and chronic respiratory diseases. The death certificates for these people are not likely to list air pollution as the cause of death… perhaps they should?

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