



**HAL**  
open science

## COVID-19 pandemic: local pollution drop is the silver lining to lockdowns. (IASI-FT Project)

Cathy Clerbaux

► **To cite this version:**

Cathy Clerbaux. COVID-19 pandemic: local pollution drop is the silver lining to lockdowns. (IASI-FT Project). 2020. insu-04786965

**HAL Id: insu-04786965**

**<https://insu.hal.science/insu-04786965v1>**

Submitted on 16 Nov 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



# COVID-19 pandemic: local pollution drop is the silver lining to lockdowns

Cathy Clerbaux  
CNRS, Sorbonne Université, France

**Pollutant emissions reduced during the COVID-19 lockdowns due to less road and air traffic, combined with limited commercial and industrial activity.**

Over the past 15 years or so, satellites have been used to map pollution and track the movement of pollutants downwind. The infrared atmospheric sounding interferometer (IASI) instrument is a thermal infrared remote sensor that can monitor several pollutants in near real-time. Observations provided by IASI during the pandemic show unprecedented low levels for carbon monoxide (CO)—a good proxy to track man-made activities.

## **Pollutants and impact on health**

According to the World Health Organization (2018), air pollution now kills more than 4 million people a year—more than diseases associated with cholesterol. Projections indicate that 6.5 million people will be affected in 2050. Pollution levels are very unevenly distributed across the globe, with Asia being the most affected, and each individual is impacted differently by pollution episodes. On average, an adult inhales about ten litres of air per minute and up to 100 litres during sporting activities. Among all pollutants, epidemiological

studies show that particulate matter is the most harmful, but the effects of the combined action of different pollutants are still poorly known. Children, the elderly and people with health problems are the most vulnerable.

High concentrations of pollutants are observed over urban areas during the winter as, during this period, several sources of pollution combine: road transport, heating and chimney fires, industrial emissions and agricultural activities in the vicinity. The main gaseous pollutants from January to April are nitrogen oxides ( $\text{NO}_x$ ), emitted by cars and industries; carbon monoxide (CO), mainly related to road traffic, heating systems and industries; and ammonia ( $\text{NH}_3$ ), emitted by agricultural activities and industries, which is also a precursor of particulate matter. Pollution levels depend on several natural factors (solar insolation, orography, meteorological conditions) and anthropogenic factors (a mix of energy production with, in particular, the use of coal, vehicle emission standards, etc.).

## **Tracking pollutants from space**

In the framework of the IASI-FT ERC advanced project, my team and I are analysing the data provided by the IASI satellite instruments residing on the Eumetsat Metop series of polar orbiting satellites (Clerbaux et al., 2009; Hilton et al., 2012). Developed by the French Space Agency CNES, IASI is a sophisticated and versatile mission that was designed to fulfil the needs of three communities: numerical weather prediction, climate research and atmospheric composition monitoring.

IASI is a unique sounder in the satellite era, measuring 'calibrated' radiance in the thermal infrared spectral range, at a global scale and revisiting all points on the Earth's surface twice a day. The recorded radiance spectra exhibit signatures associated with spectroscopic absorption/emission lines of molecules present along the optical path between the Earth's surface and the satellite detectors. From these, geophysical data such as temperature profiles and atmospheric concentrations can be derived in selected spectral windows.





The instrument has a very good horizontal coverage, providing more than 1.2 million (15GB) radiance spectra per day with a footprint on the ground of 12 km diameter pixel (at nadir). IASI is a ground-breaking remote sensor for atmospheric composition sounding, allowing near-real-time mapping of chemical species and aerosols, contributing to air traffic safety and to our understanding of atmospheric transport processes. More than 13 years of data are now readily available, with three instruments currently orbiting around the Earth.

### Results

CO is a good proxy for industrial and transport activity, with a lifetime ranging from approximately one month during the summer to three months in the wintertime. Therefore, we will now show and discuss the carbon monoxide concentration maps (George et al., 2015) as measured by IASI during the pandemic.

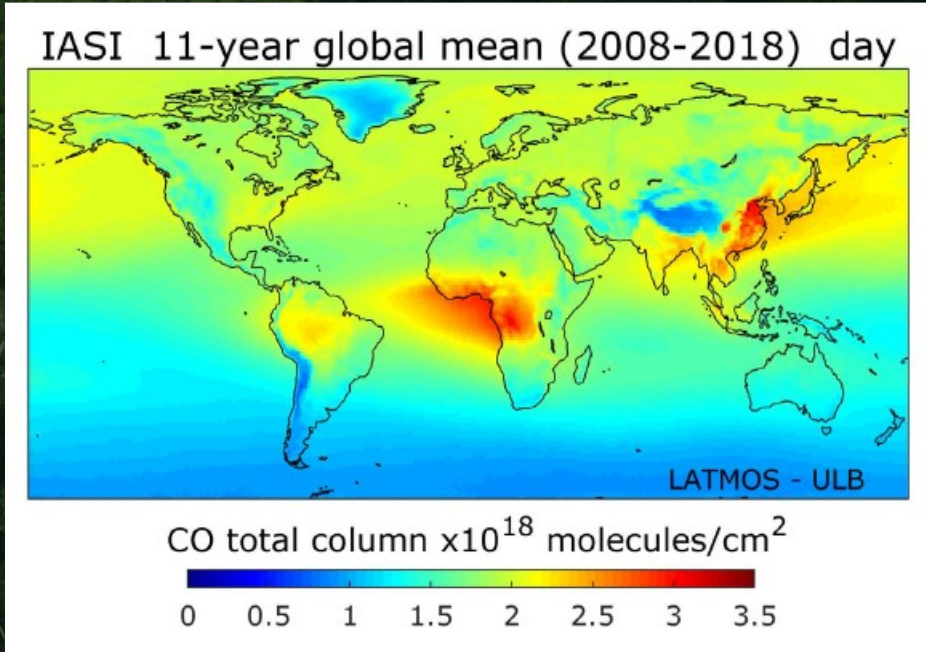


Figure 1: A composite image depicting carbon monoxide (CO), measured as a total column, i.e. the concentration measured from the ground to ~20 km. The plot shows the CO observations (high values are in red) averaged over 11 years (2008–2018). Credit Maya Gorge (LATMOS).

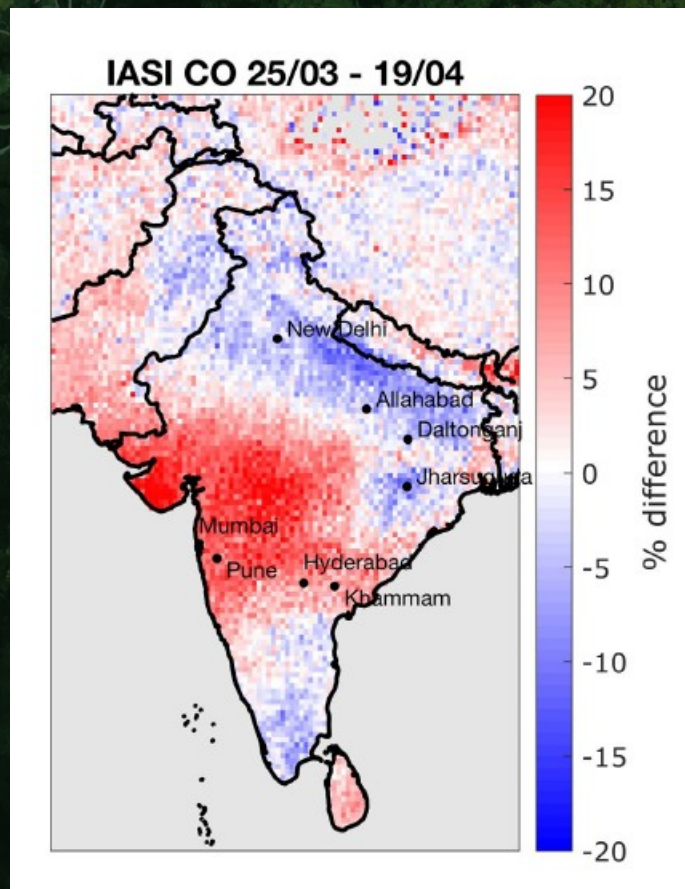
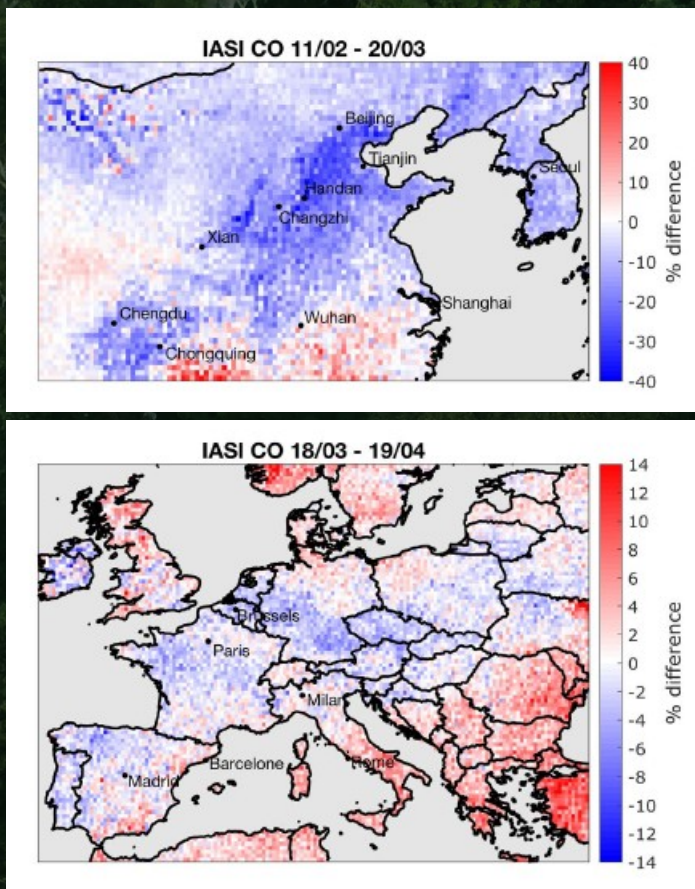


Figure 2: Maps showing the percentage difference when comparing the CO distributions over China (top left), Europe (bottom left) and India (right) during the weeks when transport and industrial activities decreased or stopped. Credit Anne Boynard (LATMOS).



In general, high levels of CO are found in both hemispheres, essentially above urban areas due to industry, motor vehicle traffic and domestic heating, and over areas where biomass fires occur. These fires are a result of wildfires, agricultural and deforestation burning. Pollution plumes are transported trans-boundary, affecting air quality in regions far from industrial and vegetation burning activity.

As the Covid-19 pandemic aged and spread, IASI observed a drop in pollution levels as the various countries entered total or partial lockdowns.

- **In China**, where the pandemic started, the densely populated urban areas between Wuhan and Beijing run coal-fired power plants at full capacity during the winter. These plants emit CO in large quantities. Maps obtained with IASI during the lockdown weeks showed decreases fluctuating between 10 and 40 per cent compared to the two previous years throughout the area between Wuhan and Beijing.
- **In the Pô valley and Europe**, where the pandemic was peaking in Lombardy, satellite observations usually show

permanently high concentrations of pollutants as it is an industrial hub surrounded by mountains. In 2020 the CO concentration columns as measured by IASI showed a drop of ~5–10 per cent, similar to elsewhere in central Europe. It is worth noting that, in contrast, an increase of CO is measured outside Europe.

- **In India**, a 10–15 per cent drop of pollutants was observed by IASI in the densely populated and fertile Indo-Gangetic Plain, whereas an increase of CO is observed in the Mumbai area.

We also observed that once containment stopped and economic activity resumed, CO concentrations rose to higher levels similar to previous years. All of our maps—before, during and after the lockdown—for other regions of the world are available online: <https://iasi.aeris-data.fr/covid-19>. All the satellite data demonstrate what the future could look like if stronger measures are taken to reduce air pollution and move towards renewable energy (European Research Council, 2020).

## References

World Health Organization (2018) Ambient (outdoor) air pollution. Who.int, [online]. Available at: <[https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)>.

Clerbaux, C., Boynard, A., Clarisse, L., George, M., Hadji-Lazaro, J., Herbin, H., Hurtmans, D., Pommier, M., Razavi, A., Turquety, S., Wespes, C. and Coheur, P. (2009) Monitoring of atmospheric composition using the thermal infrared IASI/MetOp sounder. *Atmospheric Chemistry and Physics*, 9(16), pp. 6041–6054.

Hilton, F., Armante, R., August, T., Barnet, C., Bouchard, A., Camy-Peyret, C., Capelle, V., Clarisse, L., Clerbaux, C., Coheur, P., Collard, A., Crevoisier, C., Dufour, G., Edwards, D., Faijan, F., Fourrié, N., Gambacorta, A., Goldberg, M., Guidard, V., Hurtmans, D., Illingworth, S., Jacquinet-Husson, N., Kerzenmacher, T., Klaes, D., Lavanant, L., Masiello, G., Matricardi, M., McNally, A., Newman, S., Pavelin, E., Payan, S., Péquignot, E., Peyridieu, S., Phulpin, T., Remedios, J., Schlüssel, P., Serio, C., Strow, L., Stubenrauch, C., Taylor, J., Tobin, D., Wolf, W. and Zhou, D. (2012) Hyperspectral Earth Observation from IASI: Five Years of Accomplishments. *Bulletin of the American Meteorological Society*, 93(3), pp. 347–370.

George, M., Clerbaux, C., Bouarar, I., Coheur, P., Deeter, M., Edwards, D., Francis, G., Gille, J., Hadji-Lazaro, J., Hurtmans, D., Inness, A., Mao, D. and Worden, H. (2015) An examination of the long-term CO records from MOPITT and IASI: comparison of retrieval methodology. *Atmospheric Measurement Techniques*, 8(10), pp. 4313–4328.

European Research Council (2020) #ERCAsks - Lockdown Life - Cathy Clerbaux on clean air [Podcast]. May 2020. Available from: [https://soundcloud.com/erc\\_research/ercasks-lockdown-life-cathy-clerbaux-on-clean-air](https://soundcloud.com/erc_research/ercasks-lockdown-life-cathy-clerbaux-on-clean-air)

## PROJECT SUMMARY

The ERC advanced “IASI-FT” project exploits the space-based instantaneous spectrally resolved observations provided by the family of IASI thermal infrared instruments to (1) monitor atmospheric composition changes and (2) establish climate records. More than 3.5 million of data are available each day, from which near-real-time information on the atmospheric state can be inferred.

## PROJECT LEAD PROFILE

**Cathy Clerbaux** is a senior scientist at CNRS and works at LATMOS/IPSL (Sorbonne Université, Paris). She is also a visiting professor at Université Libre de Bruxelles (ULB, Brussels), as well as an affiliate scientist at NCAR, Colorado (USA). She is internationally recognised as an expert in satellite remote sensing for the study of atmospheric composition changes. She has authored about 200 peer-reviewed publications.

## PROJECT PARTNERS

The IASI-FT team resides in two locations. The LATMOS group is part of the Sorbonne University, downtown Paris. The SQUARES group is established at Université Libre de Bruxelles. This configuration has already led to numerous papers on atmospheric chemistry over the past 18 years, strong international collaborations, outreach actions/media interest, and sustainable distribution of data for societal purposes.

## CONTACT DETAILS

**Cathy Clerbaux**

LATMOS/IPSL - Sorbonne Université,  
4 Place Jussieu, 75005 Paris, France

✉ [cathy.clerbaux@latmos.ipsl.fr](mailto:cathy.clerbaux@latmos.ipsl.fr)

🌐 [iasi-ft.eu/covid-19/](https://iasi-ft.eu/covid-19/)



## FUNDING

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme under grant agreement no. 742909.