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Newsletter for An Interdisciplinary Study toward Clean Air, Public Health and Sustainable Agriculture: The Case of Crop Residue Burning in North India

How might the unexpected change in air quality caused by the lockdown in India change people's future behaviour?

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The Aakash Project commenced on April 1, 2020 at the Research Institute of Humanity and Nature (RIHN) in Kyoto, Japan (https://www.chikyu.ac.jp/rihn_e/project/FS-2019-01.html). The full title of the project is “An Interdisciplinary Study Toward Clean Air, Public Health and Sustainable Agriculture: The Case of Crop Residue Burning in North India”. We chose the name *Aakash*, which is the Hindi word for sky, because this study addresses the air pollution caused by large-scale post-harvest burning of rice straw in October and November in the states of Punjab and Haryana in northwestern India. This burning causes severe air pollution in the surrounding areas, most notably in the National Capital Region comprising Delhi and its surrounding districts. Some evidence suggests that crop-residue burning negatively affects air quality over the entire Indo-Gangetic Plain (IGP)[1, 2], demonstrating the weaknesses of current policies on regional air quality, which affects the health and well-being of hundreds of millions of people[3].

Before starting the project, we planned to organize the first India–Japan project conference in Delhi at the end of March to promote mutual understanding and collaboration between the Indian and Japanese project members and other stakeholders. However, India was placed on lockdown on March 25 to stop the spread of the coronavirus, and thus we were forced to cancel the

conference. Soon after, we heard news reports of clean air in Delhi and other large cities around the world known for their pollution[4,5,6]. It was surprising and rather ironic for us to see the clean air that we were aiming for before we could even start our project.

Inspired by the sudden appearance of clean air, members of Working Group 2 (WG2), whose focus is atmospheric research, held online meetings four times in April and into May to quantify the reduction in the emission of air pollutants in Delhi. From these meetings, we decided to begin a new activity, which we named “Mission DELHIS (Detection of Emission Change of air pollutants: Human Impact Studies)”. This activity aims to quantify the reduction in emissions due to the temporary suspension of anthropogenic pollutant emissions. By comparing the concentrations of air pollutants before and after the lockdown was instituted, it may be possible to accurately quantify anthropogenic emissions. In addition, by estimating non-agricultural anthropogenic emissions, it may be possible to determine the contribution of agricultural burning to the total pollutants emissions. The coronavirus pandemic has presented us with an unexpected opportunity to conduct a social experiment on a large scale.

Lockdown observed from space

Since the 1990s, research and development of new technologies has made it possible to measure air pollutants from space, and today several satellite sensors are used to observe various air pollutants. Among these pollutants, particulate matter (aerosols) and nitrogen dioxide (NO₂) are major concerns. The concentration of these pollutants varies according to the degree of emissions from industrial activity, transportation, and daily activities such as cooking; therefore, we can better understand the effects of human activity by monitoring the concentrations of these pollutants. Today, satellite observation not only identifies what is present on the ground, but also reveals what is happening there.

Beijing was once known for its heavily polluted air, and which caused some athletes to withdraw from the 2008 Olympics. As a result of the Chinese government’s various measures against air pollution, the air quality has improved considerably. A satellite sensor, the Ozone Monitoring Instrument, observed a sudden decline in NO₂ concentrations over Beijing in August 2008 when the Olympics were held[7]. At present, many countries have instituted urban lockdowns and self-quarantine to slow the spread of the coronavirus. As a result, there have been a series of reports that NO₂ concentrations in large cities such as Paris and Wuhan have declined dramatically during the lockdown period[8,9].

The Indian capital of Delhi has been called the world’s most heavily polluted city[10]. However, the skies have turned blue as a result of the sudden lockdown, much to the delight of local residents [11].

We analysed the data obtained by the TROPOMI sensor onboard the European Space Agency satellite Sentinel-5 Precursor TROPOMI(ESA: <http://www.tropomi.eu>) and found that NO₂ clearly decreased after the lockdown was instituted (Figure 1). Because air pollutants emitted from

sources such as factories and vehicles are carried by the wind, their concentrations depend on weather conditions, and thus it is inherently difficult to uniquely associate atmospheric pollutant concentrations with their source. However, in the case of NO₂, it is relatively easy to identify the source because NO₂ has a relatively short atmospheric lifetime and remains close to its emission source; therefore, the difference between the two images in Figure 1 clearly indicates a reduction in emissions.

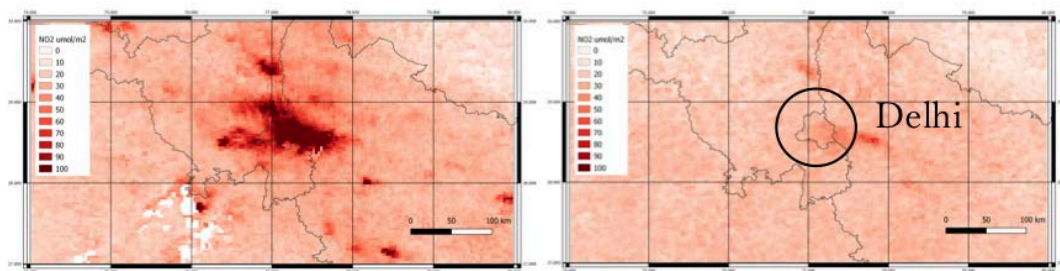


Figure 1: (left) Mean NO₂ concentration March 2–6, 2020 (before the lockdown), and (right) March 30–April 4, 2020 (during the lockdown). NO₂ data was taken from TROPOMI (ESA: <http://www.tropomi.eu>).

At present, the members of WG2 are working tirelessly to quantify the reduction in NO₂ emissions. In future research, we will use in situ measurements, satellite data, and model simulations to determine the change in air pollutant concentrations.

Unexpected changes in people's behaviour

Our original project goal was to “explore ways to change people's behaviour towards sustainable agriculture in Punjab, and towards clean air and improved health outcomes”. When we proposed this research plan two years ago, the RIHN Research Evaluation Committee doubted the idea that people's behaviour could be so easily changed. However, the coronavirus pandemic has changed many aspects of people's behaviour in a very short time. People's interest in health, especially respiratory system disorders, has increased dramatically, and many people have begun wearing masks. Reports of high mortality from COVID-19 in heavily air-polluted areas [12,13] may also have come as a shock to many Delhi residents.

Clean air in Delhi has been made possible by this temporary lockdown and the resulting halt of economic activity, but air pollution is expected to return to pre-lockdown levels when the lockdown is lifted and economic activity resumes. However, the change in people's behaviour may not be so easily reversed. People have gradually begun to realize the value of their own health and have become aware of the effects of air pollution and its impact on lung function. The practice of wearing masks in public may become more commonplace. In addition, residents' experience with clean air and blue skies may have helped them to realize the value of environmental health. How

much did the residents of Delhi enjoy having clean air and what did they learn from the experience?

We are currently planning to conduct a questionnaire survey of residents in Delhi and the surrounding rural areas. It is important to obtain data that can be observed only now. We should endeavour to “detect” what people feel at present in addition to the current concentration of pollutants. We must learn as much as possible while we can, so our motto has become “detection, detection, detection”.

(The original version was released on May 25 at Aakash HP: <http://aakash.wp.xdomain.jp>)

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