

The Worldwide COVID-19 Lockdown Impacts on Global Secondary Inorganic Aerosols and Radiative Budget

Takashi Sekiya

Japan Agency for Marine-Earth Science and Technology, Japan

Author list (excluding presenting author)

Kazuyuki Miyazaki, Henk Eskes, Kevin Bowman, Kengo Sudo, Yugo Kanaya, Masayuki Takigawa

Abstract

Human activities strongly influence atmospheric trace gases and aerosols, while natural emissions and meteorological variability make it difficult to quantify the impact of human activities, including mitigation measures. Global lockdown measures to prevent the spread of the coronavirus disease 2019 (COVID-19) rapidly reduced human activities and associated emissions, providing a unique opportunity to study the impact of human activities on anthropogenic emissions, air pollutants, and climate change. While the COVID-19 lockdown impacts on both trace gases and total particulate matter have been widely investigated, secondary aerosol formation from trace gases remains unclear. To this end, we quantify the COVID-19 lockdown impacts on NO_x and SO₂ emissions, sulfate-nitrate-ammonium aerosols, and radiative budget using multi-constituent satellite data assimilation and model simulations. As summarized in Sekiya et al. (2023), we find that anthropogenic emissions over East Asia, Europe, and North America were reduced by 19 to 25% for NO_x and 14 to 20% for SO₂ during April 2020. These emission reductions led to 8 to 21% decreases in sulfate-nitrate-ammonium aerosols over eastern China, Europe, and the eastern United States, corresponding to >34% of the observed aerosol optical depth declines and a global aerosol radiative forcing of +0.14 W m⁻² relative to business-as-usual scenario (i.e., without lockdown measures) for April-June 2020. The estimated positive forcing of aerosol reductions was larger than the negative forcings of CO₂ (by -0.025 W m⁻², Forster et al., 2020) and ozone reductions (by -0.032 W m⁻², Miyazaki et al., 2021) during the same period. These results point to the critical importance of secondary aerosol pollutants in quantifying climate impacts of future mitigation measures.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Regional Working Groups

Japan National Committee