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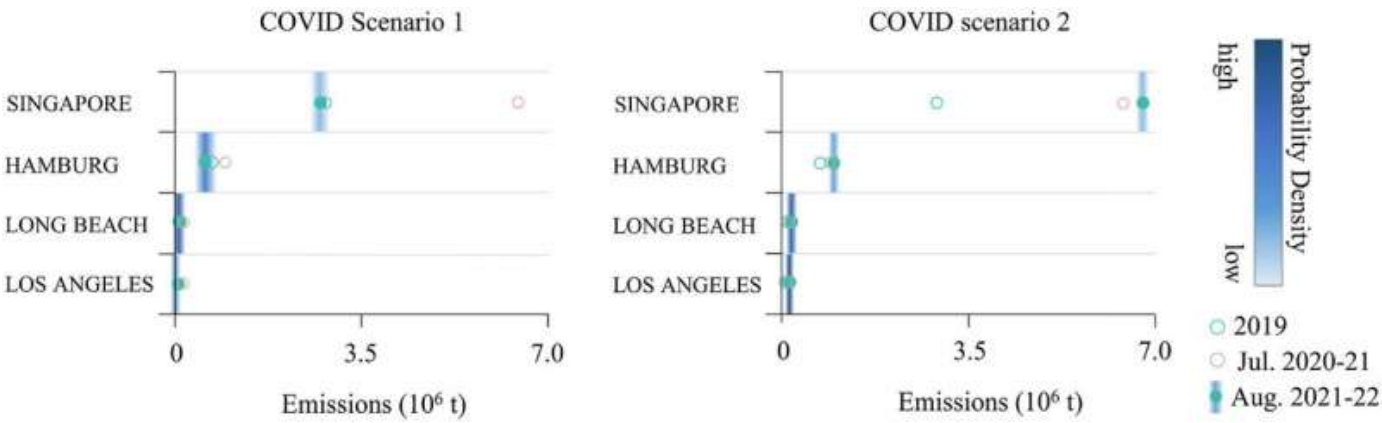
Pollutant emissions in major seaports spiked during the COVID-19 pandemic

by Nanyang Technological University



Graphical abstract. Credit: DOI: 10.1016/j.envres.2021.112246

Researchers from Nanyang Technological University, Singapore (NTU Singapore), have modeled that pollutant emissions from the shipping sector increased significantly in major international seaports during the COVID-19 pandemic.

The findings serve as a stark contrast against findings from the NASA Earth Observatorythatthe freeze in industrial processes and human activity arising from the pandemic resulted in generally lower air pollution.

In Singapore, the NTU research team found that emissions were modeled to have more than doubled (123 percent), during the pandemic period, while they increased twofold in Los Angeles (100 percent), almost two-thirds (65 percent) in Long Beach, California, and over a quarter (27 percent) in Hamburg, Germany.

Container ships and dry bulk carriers marked the sharpest increase of all total emissions, seeing an average increment of 94 percent and 142 percent respectively, compared to before the COVID-19 pandemic.

The NTU research builds upon previous studies that signaled that COVID-19 had a substantial impact on the shipping industry. TheUnited Nations Conference on Trade and Development found that COVID-19-related constraints on ships and crew in many ports led to workforce shortages and operational challenges and affected productivity, while global shipping intelligence provider S&P Global Platts remarked that the unprecedented and volatile surge in cargo demand following the first wave of the COVID-19 caused further delays at almost every seaport worldwide.

The NTU study modeled that ship emissions in all four ports increased by an average of 79 percent because of the prolonged turnaround time in port, said the researchers, with extended 'hotelling' time at berth and anchorage areas as longer operational times were needed due to pandemic-related delays.

The research team's computations of pollutant emissions were from July 2020 to July 2021, which was at the height of the pandemic. The findings were compared to the whole of 2019 which is taken as the baseline year with business-as-usual emissions.

The pollutants studied in the research were carbon dioxide, sulfur oxide, nitrogen oxide, particulate matter, carbon monoxide and methane.

The NTU team calculated the fuel consumption and pollutant emissions of the ships using actual ship movement data sourced through AXSMarine, a global provider of dry, tanker and liner chartering. It provided information of the ships, including their sailing speed, time duration, coordinates, navigational status, as well as ship-specific information such as the name, type of carrier, and deadweight tonnage (DWT), which is a measure of how much weight a ship can carry.

Additional information was also obtained from the various port administration authorities where the study was done, as well as from the intelligence arm of international UK shipping services provider Clarksons, which provided ship specification information, such as the ships' designed maximum speed, engine type, and rated engine power.

Professor Law Wing Keung, Adrian, from NTU's School of Civil and Environmental Engineering, who led the study, said: "Our study presents a review of the ship emission outlook amid the pandemic uncertainty. Lockdown measures and other COVID-19 restrictions on human activity have upended the landscape for the shipping sector and significantly affected the operating patterns of maritime and trade, leading to the computed outcome revealing significant increase in pollutant emissions in the seaports in our study."

Ms Liu Jiahui, a Ph.D. student from NTU's School of Civil and Environmental Engineering, who was first author of the study, said: "Although they typically spend the least time in ports, dry bulk carriers, which are merchant ships designed to transport unpackaged bulk cargo, such as grains, coal, ore, and cement, experienced the biggest increase in pollutant emissions. This is due to a combination of COVID-19 precautions at ports and the increased demand for raw materials due to the resumption of industrial activity in the second half of 2020, which resulted in a spike in dry bulk carriers in ports."

Emissions are here to stay

The study also reports the ship emission simulations for two future COVID-19 scenarios from August 2021 to August 2022:

Scenario 1 assumes that the port congestion due to COVID-19 is resolved and the port turnaround time returns to levels in 2019 before the pandemic

Scenario 2 assumes that the port congestion due to COVID-19 continues next year in the same manner as the current situation in the four major ports.

In Scenario 1, the researchers predict that there will be a high likelihood (over 50 percent probability) that ship emissions would decrease by at least 34 percent compared to the July 2020–July 2021 pandemic period.

However, in Scenario 2, substantial ship pollutant emissions are expected to continue, with Singapore most likely (90 percent probability) to have a further emission increase of about 6 percent higher, and with a cumulative increase of 137 percent from 2019 levels. The ports of Hamburg, Long Beach and Los Angeles would also be likely to continue the increase with marginally higher emissions.

The researchers attributed this outcome to the effects of ship traffic growth, and the prolonged port turnaround time at berth and anchorage areas, leading to longer periods of adverse impacts.

Addressing the two predictive outcomes, Prof Law added: "Our scenarios have drawn attention to a shift in the overall emission pattern during the pandemic period compared to pre-pandemic levels. We hope that the results can assist in the development for countermeasures and compensatory plans to mitigate the impacts in a post-COVID future around the world, especially in the current highly volatile shipping industry. Meeting these goals in the long run will require radical changes in ship engines and fuel technology, the adoption of low-carbon or zero-emission energy sources, and the usage of updated technology at shore to cut down on the time a ship takes to come and go. We are however glad to note that these innovations are already being actively pursued locally."

Ms Liu added: "We hope that our study provides policymakers with a comprehensive emission outlook at major seaports during the pandemic period. As our study highlights that ships emit the most pollutants during hotelling, that is when they are berthed while awaiting either cargo load, cargo discharge or their next voyage, this would suggest the need for suitable policy responses and measures to mitigate the impacts of idling ships on air quality."

The team hopes to carry out further research to improve the predictions from their model including more accurate measures of port turnaround time and ship movements. They would also be developing other more detailed emission scenarios and comprehensive analyses on the pollutant emissions of the shipping industry going forward.

More information: Jiahui Liu et al, Assessment of COVID-19 pandemic effects on ship pollutant emissions in major international seaports, *Environmental Research* (2021). DOI: 10.1016/j.envres.2021.112246

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