NEWS RELEASE

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Pollutant emissions in major seaports likely to have spiked during the COVID-19 pandemic, finds NTU Singapore study

Researchers from **Nanyang Technological University, Singapore (NTU Singapore)**, have modelled 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[1] from the NASA Earth Observatory that the 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 modelled to have more than doubled (123 per cent), during the pandemic period, while they increased twofold in **Los Angeles** (100 per cent), almost two-thirds (65 per cent) in **Long Beach, California,** and over a quarter (27 per cent) in **Hamburg, Germany**.

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

The NTU research builds upon previous studies that signalled that COVID-19 had a substantial impact on the shipping industry. The United Nations Conference on Trade and Development[2] 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[3] 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.

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[1] NASA Earth Observatory. Environmental Effects of COVID-19 Quarantines (2021).

[2] United Nations Conference on Trade and Development. Review of Maritime Transport (2020).

[3] S&P Global Platts. Container volumes at Singapore port hit record high in March, up 2.3% on year. (2021).

The NTU study modelled that ship emissions in all four ports increased by an average of 79 per cent because of the prolonged turnaround time in port, said the researchers, with extended 'hotelling' time[4] 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, sulphur 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 PhD 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

[4] Hotelling is the phase when ships are berthed at the wharves but continue to emit exhaust gases while they await cargo load/discharge or their next voyage.

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."

The results of the study were published in the peer-reviewed academic journal *Environmental Research* in October.

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:

I. 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

II. 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 per cent probability) that ship emissions would decrease by at least 34 per cent 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 per cent probability) to have a further emission increase of about 6 per cent higher, and with a cumulative increase of 137 per cent 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.

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Note to Editors:

The NTU research paper titled *“Assessment of COVID-19 pandemic effects on ship pollutant emissions in major international seaports*” is published in *Environmental Research*, 23 Oct 2021. DOI 10.1016/j.envres.2021.112246

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Media contact:

Mr Joseph Gan
Manager, Media Relations
Corporate Communications Office
Nanyang Technological University, Singapore
Email: joseph.gan@ntu.edu.sg

About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the Engineering, Business, Science, Humanities, Arts, & Social Sciences, and Graduate colleges. It also has a medical school, the Lee Kong Chian School of Medicine, established jointly with Imperial College London.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of Singapore, and Singapore Centre for Environmental Life Sciences Engineering – and

various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI) and Energy Research Institute @ NTU (ERI@N).

Ranked amongst the world's top universities by QS, NTU has also been named the world's top young university for the last seven years. The University's main campus is frequently listed among the Top 15 most beautiful university campuses in the world and it has 57 Green Mark-certified (equivalent to LEED-certified) building projects, of which 95% are certified Green Mark Platinum. Apart from its main campus, NTU also has a campus in Singapore's healthcare district.

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

For more information, visit www.ntu.edu.sg