

Commercial ships spew half as much particulate pollution as world's cars

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Globally, commercial ships emit almost half as much particulate pollution into the air as the total amount released by cars, according to a new study. Ship pollutants affect both the Earth's climate and the health of people living along coastlines.

The study is the first to provide a global estimate of maritime shipping's total contribution to air particle pollution based on direct measurements of emissions. The authors estimate that worldwide, ships emit 0.9 teragrams, or about 2.2 million pounds, of particulate pollution each year. Shipping also contributes almost 30 percent of smog-forming nitrogen oxide gases.

"Since more than 70 percent of shipping traffic takes place within 250 miles of the coastline, this is a significant health concern for coastal communities," says lead author Daniel Lack, a researcher at the National Oceanic and Atmospheric Administration (NOAA)'s Earth System Research Laboratory in Boulder, Colorado. He and his colleagues reported their findings on 25 February 2009 in the *Journal of Geophysical Research - Atmospheres*, a publication of the American Geophysical Union (AGU).

Earlier research by one of the study's authors, James Corbett, of the University of Delaware, in Newark, linked particulate pollution to premature deaths among coastal populations.

Commercial ships emit both particulate pollution and carbon dioxide.

Carbon dioxide from ships makes up roughly three percent of all human-caused emissions of the gas. But particulate pollution and carbon dioxide have opposite effects on climate. The particles have a global cooling effect at least five times greater than the global warming effect from ships' carbon dioxide emissions, Lack says.

Lack is also with the Boulder-based Cooperative Institute for Research in Environmental Sciences, which is jointly supported by NOAA and the University of Colorado, Boulder.

During the summer of 2006, Lack and colleagues, aboard the NOAA ship Ronald H. Brown, analyzed the exhaust from over 200 commercial vessels, including cargo ships, tankers and cruise ships, in the Gulf of Mexico, Galveston Bay, and the Houston Ship Channel. The researchers also examined the chemistry of particles in ship exhaust to understand what makes ships such hefty polluters.

Ships emit sulfates – the same polluting particles associated with diesel-engine cars and trucks that prompted improvements in on-road vehicle fuel standards. Sulfate emissions from ships vary with the concentration of sulfur in ship fuel, the authors find. Globally, fuel sulfur content is capped under the International Convention for the Prevention of Pollution from Ships. As a result of the cap, some ships use "cleaner," low-sulfur fuels, while others continue to use the high-sulfur counterparts.

Yet, sulfates make up just under half of shipping's total particle emissions, according to the new study. The other half, composed by organic pollutants and sooty, black carbon, are not directly targeted by today's regulations.

A 2008 study by Lack's team focused exclusively on soot. Emissions of these non-sulfate particles, the earlier study found, depend on the

operating speed of the engine and the amount of lubricating oil needed to deal with wear and tear from burning less-refined fuels. "Fortunately, engines burning 'cleaner,' low-sulfur fuels tend to require less complex lubricants. So the sulfur fuel regulations have the indirect effect of reducing the organic particles emitted," says Corbett.

One surprising result of burning low-sulfur fuels is that, although total particle emissions diminish, the time that particles spend in the air appears to increase. It's while they're airborne that particles pose a risk to human health and affect climate.

Lack and colleagues find that the organic and black carbon portion of ship exhaust is less likely to form cloud droplets. As a result, these particles remain suspended for longer periods of time before being washed to the ground through precipitation.

More information: " Particulate emissions from commercial shipping: Chemical, physical, and optical properties",
[dx.doi.org/10.1029/2008JD011300](https://doi.org/10.1029/2008JD011300)

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