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D I G E S T

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Reducing Transport  
Emissions

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**Source:** Murena, F., Mocerino, L.,  
Quaranta, F. and Toscano, D. (2018)  
Impact on air quality of cruise ship  
emissions in Naples, Italy,  
Atmospheric Environment, 187. 70-  
83. Available [Here](#)

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## Impact of cruise ship emissions on air quality



**Ship emissions not only contribute to greenhouse gas (GHG) emissions, but also have an impact on local air quality of port cities. This study calculates the emissions of nitrogen oxides and sulphur oxides (NO<sub>x</sub> and SO<sub>x</sub>) from cruise ships in the Italian port of Naples. It assesses the contribution of cruise ship emissions to air quality by comparing measured concentrations from fixed monitoring stations with modelled emissions. It makes a number of recommendations to improve knowledge of the impact of ship emissions on air quality.**

The port of Naples (Italy) is one of the most important ports in the Mediterranean Sea with a large traffic of passengers and goods. The Municipality of Naples already suffers from poor air quality with cruise ship emissions further adding to atmospheric pollution in the nearby urban area, which can have serious effects on human health. The majority of ship emissions occur within 400km from the coast and account for between 1 % and 7 % of annual particulate matter (PM<sub>10</sub>) levels measured in Naples.

A ship in a port undergoes two different phases: manoeuvring and mooring. The manoeuvring mode includes slow cruising in the port area, approaching, docking and departing. The mooring phase relates to the time a ship stays in port providing hotel services on board to passengers and crew members. During this time, the main engine is turned off and all power requirements are covered by auxiliary engines or, if the ship has a diesel-electric system (as is usually the case for cruise ships), the main engine works at a limited load factor producing the energy required.

There are two different approaches to estimating emission inventories: bottom up and top down. The bottom-up approach is more accurate, but significant efforts are needed for data collection and analysis, particularly for large-scale studies.

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## TRIMIS

The Transport and Research and Innovation Monitoring and Information System (TRIMIS) supports the implementation and monitoring of the Strategic Transport Research and Innovation Agenda (STRIA) and its seven roadmaps.

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## Impact of cruise ship emissions on air quality

This study used a bottom-up approach to assess the impact of cruise ship emissions on air quality in the port of Naples. Simulations were made using the dispersion model CALPUFF and the results were compared to actual collected data from fixed air quality monitoring stations. Although the results do not represent the whole impact of ship emissions in the port of Naples, the study found that cruise ships are responsible for an important fraction of total emissions. Emissions of  $\text{NO}_x$  and  $\text{SO}_x$  from all other passenger ships are lower than those from cruise ships.

Cruise ship emissions were responsible for 2.47 % of the annual average  $\text{NO}_x$  concentrations measured at fixed air quality monitoring stations 2 kilometres from the cruise ship terminal. During the peak tourist season (June-September, 2016), this value increased to 3.58 %.

Higher concentrations were observed inside the port area. When short-term averages are analysed, the contribution of cruise ship emissions to pollutant concentration levels is significantly higher. In particular, if 1-hour peak concentrations are considered, the levels can reach 86.2 %. However, on average, they are 5.18 % during the high season and 3.65 % annually.

In contrast, the annual average contribution of cruise ships to  $\text{SO}_x$  emissions is lower than that for  $\text{NO}_x$  – perhaps due to the low-sulphur fuel used in ships.

Analysis of actual nitrogen dioxide ( $\text{NO}_2$ ) emissions monitoring data and estimated emissions data showed a good correlation among monitored data and a low correlation between monitored data and simulations. The low correlations could be partly due to the uncertainties with regard to the emission rate of each pollutant as much more information is needed to gain an accurate estimate for each ship.

The study concludes that to have more precise knowledge of the impact of ships' emissions on air quality, it is necessary to:

- include  $\text{NO}_x$ ,  $\text{SO}_x$  and PM to all categories of ship;
- reduce uncertainties by evaluating emission rates for each pollutant by gaining knowledge of the engine in the different phases of activity in the port;
- improve dispersion modelling to better reflect the urban conditions;
- consider the formation of secondary pollutants.