Shipping and Air Pollution

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Air pollution is a major environmental problem affecting developed and developing countries around the world. Increasing amounts of various harmful gases and particles are emitted from different pollutant sources into the atmosphere, resulting in negative impacts on human health and the environment. According to World Health Organization (WHO); there are important evidences that connect air pollution and health problems. Approximately 2 million people are dying earlier because of air pollution. Damage to buildings and structures, agricultural crops, vegetation and forests; reduced visibility; and increasing global warming emissions are additional environmental impacts of air pollution.

Shipping Emissions

Air is one of the most important natural resources; it is shared and used by all humans, animals and plants to sustain their life. Except from many land based emission sources there is a growing awareness about the emissions from the ships also. Maritime transportation is widely recognized as a highly significant source of the total air pollution worldwide. As known, air pollutant emissions from ships do not stop at national boundaries. Pollutants coming from shipping emissions have local, regional effects and they have global impacts. Known health and environmental impacts of emission are premature death, various health and lung impacts and acid rains and climate changes as well. The exhaust gases of the ships are highly toxic and contain a plethora of harmful particulate and gaseous substances. According to previous studies, diesel exhaust contains an estimated total of 450 different compounds; about 40 of the listed are toxic air contaminants which have negative effects on health and the environment.

Estimation Of Shipping Emissions

Shipping emissions are estimated either using a top-down approach based on the amount of bunker fuels sold for maritime transport or a bottom-up approach subject to shipping activities.

Marine bunker fuel is categorized as international and cabotage bunkering and international bunkering is free from duties. Although quantity of fuel sold to ships is known, it is not possible to predict where the fuel is consumed. Thus, estimates based on fuel statistics (top-down) are mainly used for national comparisons and national follow-up (e.g. within the EU or according to UNFCCC for green house gases). When the objective is to use the emissions for dispersion modeling, the spatial distribution is of large importance; therefore bottom up methodology is more suitable. Moreover, specific emission factors change depending on the type of ships, engines, fuels operations of the ships etc.

In estimation of shipping emissions studies, three different operation modes are distinguished, which are called cruising, maneuvering and hotelling.

- Cruising mode the ships sail between ports on open sea at full service speed.
- Maneuvering mode corresponds to the most critical operation of ships from a safety perspective, and covers the operation when leaving from or arriving to a port, shipyard or anchorage area and navigation through narrow channels.
- Hotelling represents ships at berth or moored at sea.

Shipping emissions occur from the main engines for propulsion and a set of auxiliary engines that generate electric power. In cruising mode the main engine at Maximum Continuous Rating (MCR) and generally one of auxiliary engines run. While maneuvering, the power output from the main engine is low and two synchronized auxiliary engines are assumed to be in service. At hotelling mode only one of the auxiliary engines is running.
Emissions can be calculated depending on the different engine loads, number of engines, emission factors, time spend at the different operational modes and the

percentage of engine use.

Information on shipping activity can be gathered from AIS (Automatic Identification System) AIS system is available from 9 July 2007. It is serving with 25 base stations and 2-6 seconds delay.
Ships which are,

- Travelling internationally and more than 300 grosstonage
- Not travelling internationally but more than 500 grosstonage
- All passenger ships without regarding the tonnage are obliged by law to have AIS transponders

Ships activity-based emission results are required to carry out local emission control strategies. Also, temporal and spatial variations in emission rates gathered from this approach can be used for air pollution models to evaluate the possible concentrations of the emissions which cause external costs on health and the environment.