# Emissions from the Baltic Sea shipping in 2009

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## Key messages

Most of the emissions due to Baltic Sea shipping have decreased when compared to 2008

| Indicator | 2009 | 2008 | Change* | |
|---|---|---|---|---|
| Number of ships | 11 663 | 10 773 | +8.3% | |
| $NO_x$, kilotons | 357 | 364 | -2.0% | |
| $SO_x$, kt | 123 | 128 | -3.7% | |
| CO, kt | 63.7 | 62.3 | +2.3% | |
| PM2.5, kt, of which | 23.6 | 24.2 | -2.6% | |
| Elementary Carbon, kt | 2.4 | 2.4 | -1.7% | |
| Organic Carbon, kt | 6.1 | 6.2 | -1.9% | |
| $SO_4$, kt | 10.0 | 10.4 | -3.7% | |
| Ash, kt | 1.7 | 1.8 | -1.9% | |
| Associated $H_2O$, kt | 3.4 | 3.4 | -1.2% | |
| Fuel, kt | 5 734 | 5 839 | -1.8% | |
| $CO_2$, Megatons | 17.9 | 18.1 | -1.7% | |
| Energy consumption, Petajoules | 245 | 249 | -1.8% | |

* Note, that due to technical improvements in the emission model, the exact emission levels between 2009 and 2008 are comparable only within the results presented in this Baltic Sea Environment Fact Sheets

# Results and assessment

## Relevance of the indicator for describing the developments

This indicator shows the annual emission levels of the Baltic Sea shipping in 2009, as well as their change from the previous year.

The indicator addresses the Baltic Sea Action Plan management objective "Minimum air pollution from ships".

## Policy relevance and policy reference

Nitrogen load from the Baltic Sea shipping has slightly decreased when compared to the previous year (2008) most likely due to the global economic downturn. This trend is not likely to continue, however, and this Baltic Sea Environment Fact Sheets already shows that emissions from passenger traffic were largely unaffected by the recession. Emissions of cargo traffic have decreased, but they are expected to increase when the economic growth resumes. HELCOM member countries are working towards declaring the Baltic Sea as a $NO_x$ emission control area. This would eventually decrease the $NO_x$ emissions of new ships by 80 %, but the full effect would not be seen until vast majority of the ships in the Baltic Sea would be replaced with new ships, built after 2015, which is likely to happen in year 2040-2050.

The year 2009 was the last year when 1.5 S% marine fuel was allowed in harbor areas. According to EU directive 2005/33/EC, starting from year 2010 all ships are required to switch to <0.1 S% fuel in harbors if their hoteling period is longer than two hours.

## Assessment

The emission levels of Baltic Sea shipping have decreased in general, carbon monoxide emissions being an exception to this rule. The decrease of $NO_x$, $SO_x$ and PM2.5 were -2 %, -3.7 % and -2.6 %, respectively. Energy consumption, fuel consumption and $CO_2$ emissions have all decreased by 1.8 %.

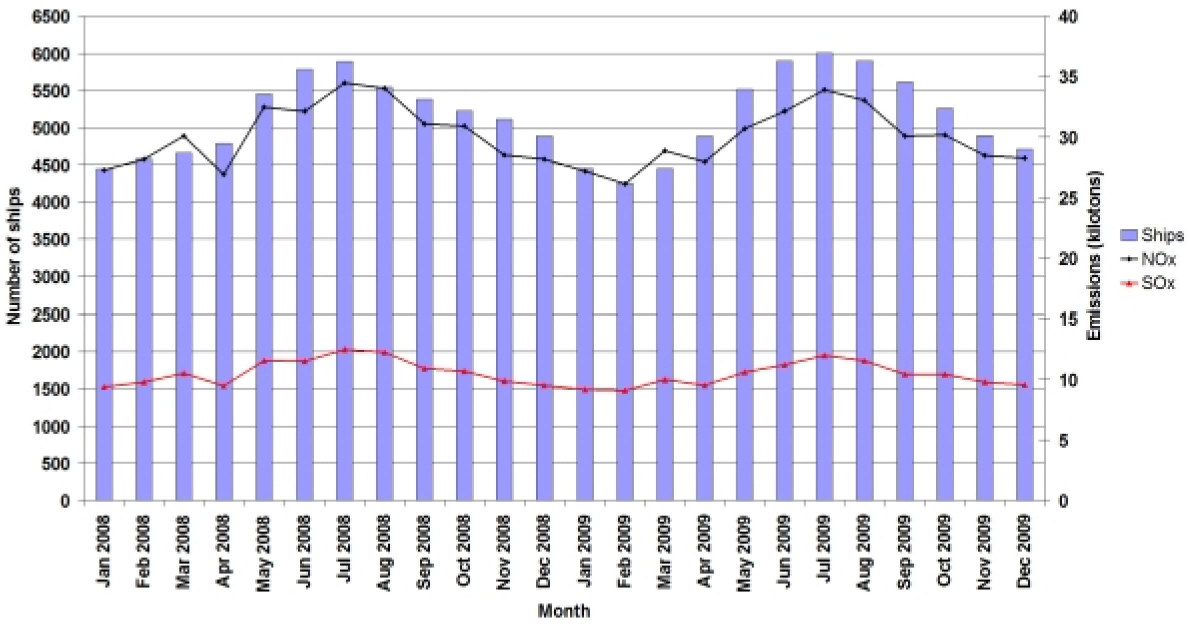


**Figure 1.** Number of ships (bars), $NO_x$ (black line) and $SO_x$ (red line) emissions from Baltic Sea shipping in 2008-2009.

**Table 1.** $NO_x$ emissions of different types of ships in the Baltic Sea, 2008-2009

| Shiptype | $NO_x$ (tons), 2008 | $NO_x$(tons), 2009 | Change, % |
|---|---|---|---|
| RoRo/Passenger (RoPax) | 85 128 | 84 751 | -0.4 |
| General Cargo | 45 584 | 40 937 | -10.2 |
| Container Cargo | 44 719 | 37 131 | -17.0 |
| Chemical tankers | 31 869 | 35 583 | 11.7 |
| RoRo Cargo | 31 586 | 27 749 | -12.1 |
| Small vessels | 26 993 | 34 124 | 26.4 |
| Crude oil tankers | 23 163 | 24 334 | 5.1 |
| Bulk Cargo | 20 363 | 21 499 | 5.6 |
| Oil product tankers | 9 651 | 9 658 | 0.1 |
| Cruise ships | 9 108 | 9 835 | 8.0 |
| Refrigerated Cargo | 9 088 | 8 413 | -7.4 |
| Vehicle carriers | 8 610 | 3 565 | -58.6 |
| Tugboats | 5 771 | 6 118 | 6.0 |
| Fishing vessels | 2 721 | 2 487 | -8.6 |

Summer months dominate the emissions and also the number of ships peak during June, July and August when the passenger traffic most intensive (Figure 1). Most notable is the increase of the number of ships while emissions decrease. The number of ships is based on the number of unique Automatic Identification System (AIS) transmitters in the Baltic Sea. Since the AIS equipment is becoming popular among recreational craft the number of ships may show significant increase.

Considering the changes in annual levels of $NO_x$ emissions, there are large differences between ship types. This reflects the fact that some ship transport types were more affected by the recession than others. For example, large changes in $NO_x$ emissions from containerships, car carriers and RoRo cargo vessels indicate that cargo transport volumes have decreased significantly, whereas passenger traffic (RoPax, Cruise ships) and oil/chemical transports do not necessarily follow this trend (Table 1).

The geographical distribution of $NO_x$ emissions in the Danish Straits arising from the Baltic Sea shipping is shown in Figure 2.

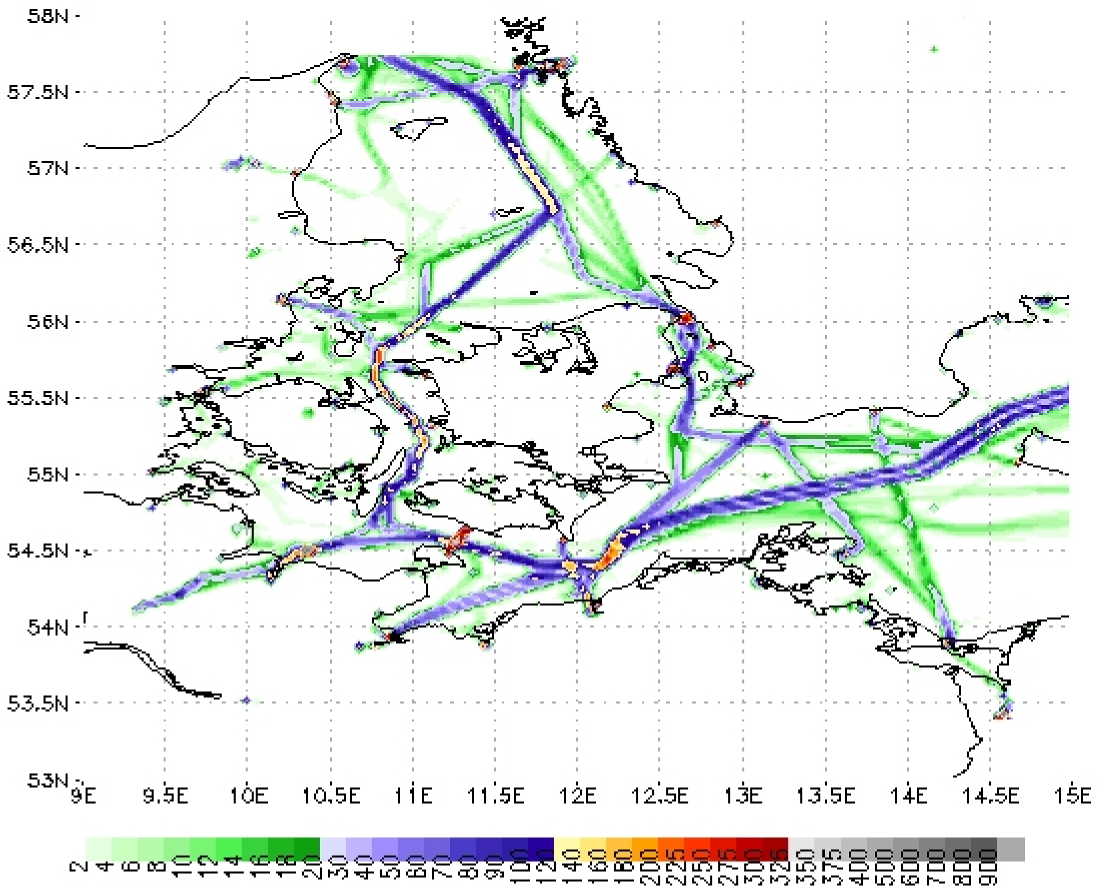


**Figure 2.** The geographical distribution of $NO_x$ (in tons of $NO_x$) in the Danish Starits arising from the Baltic Sea shipping in 2009

A significant area of emission reduction, which coincides with Vuosaari harbor, Finland and the nearby shipping lane, can be seen in the map of Figure 3.

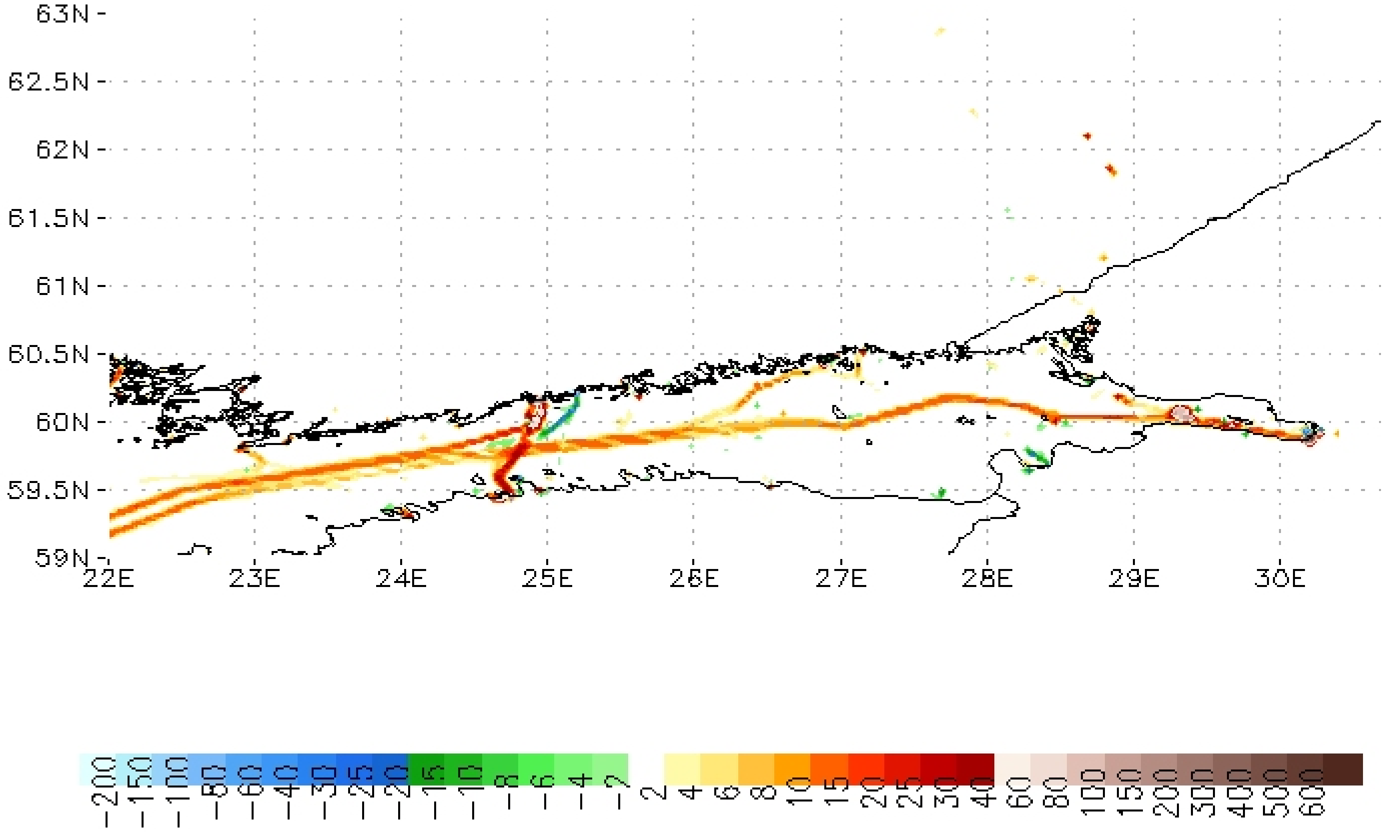


**Figure 3.** Emission change from Baltic Sea shipping; $NO_x$ reduction in the Gulf of Finland. Difference is shown in tons of $NO_x$ between years 2008 and 2009.

# Metadata

## Technical information

Emission estimates are based on HELCOM Automatic Identification System (AIS) data automatically sent by all the ships and collected by the member states. For that purpose, over 261 million position reports were analyzed which indicate the location and transient speed of every ship carrying an AIS transmitter as required by the IMO. Based on current speed-design speed relation and technical data of ships' engines, an emission estimate can be made based on instantaneous power levels of the engines[a]. This Baltic Sea Environment Fact Sheets was produced with regular lat/lon grid with resolution of 0.03 degrees, which corresponds to 1.7 km by 3.2 km grid cell size.

It is possible to extend emission evaluation to other areas where AIS data is readily available. Several emission abatement techniques are included and their impacts to emissions are modeled as are ship specific $NO_x$ emission certificates.

## Quality information

Engine load levels can significantly affect the emissions of PM2.5/CO and this is taken into account, but *the results of this new method are not directly comparable with the ship emission Baltic Sea Environment Fact Sheets from previous years*. The fuel consumption predictions are compared to real-world fuel consumption data from Finnish ship owners. However, more comprehensive checks using direct stack measurements are in progress. Detailed description of uncertainties and their magnitudes are given elsewhere[b]. Future enhancements include direct stack measurements onboard ships and inclusion of ambient effects (sea ice, currents) to enhance the accuracy of the emission model.

## References

[a] J.-P. Jalkanen, A. Brink, J. Kalli, H. Pettersson, J. Kukkonen, and T. Stipa, ”A modelling system for the exhaust emissions of marine traffic and its application in the Baltic Sea area”, *Atmos. Chem. Phys.*, **9** (2009) 9209.

[b] Stipa T., Jalkanen J.-P., Hongisto M., Kalli J., Brink A., ”Emissions of NOx from Baltic Sea shipping and first estimates of their effects on air quality and eutrophication of the Baltic Sea”, ISBN 978-951-53-3028-4, Helsinki, Finland 2007. Available from http://www.helcom.fi/press_office/news_helcom/en_GB/HELCOM_submission_to_IMO/

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