

SOLAS Open Science Conference 2009
Discussion Session Report:
Ship plumes
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Emissions of gases (mainly NO_x and SO₂) and particles from ocean-going ships have major impacts on photochemistry in the marine boundary layer and are potentially important for the deposition of nutrients to the ocean. Throughout large regions of the oceans, ship emissions dominate the natural sulphur emissions, largely of DMS, and have therefore to be considered in estimates of climate forcing by sulphate aerosols. Ship traffic has increased significantly in the last decade (but declined in the last year due to the economic crisis) and is projected to keep increasing.

This topic is one of the topics selected by the SOLAS SSC in their Mid-term Strategy Plan as a potential focus for future SOLAS work. The discussion session was attended by 27 participants. It was opened by Roland von Glasow (University of East Anglia) with an introduction to the topic which has seen a strong increase in the number of publications since the first emission inventory for ship-derived NO_x and SO₂ (Corbett et al., 1997). In addition to the production of ozone due to ship-derived NO_x, the mix of sea salt aerosol and ship-derived pollution is potentially important for the release of chlorine from sea salt and resulting effects on the oxidation of CH₄ and DMS (e.g. von Glasow, 2008). The extent of the deposition of nitrate to the oceans has only started to be assessed and no information about potential impact on ocean biogeochemistry is so far available.

François Dulac (CEA/LSCE) introduced ChArMEx (Chemistry-Aerosol Mediterranean Experiment, <http://charmex.lsce.ipsl.fr>) which is a large multi-year project on atmospheric chemistry and aerosols in the Mediterranean initiated by France. Ship plumes are important contributors to anthropogenic emissions in the Mediterranean Sea which receives a significant part of the global ship traffic (Wang et al., 2008).

Nicolas Marchand (LCP, Aix Marseille University) talked in general about shipping emissions in the Mediterranean Sea, highlighting the importance of these emissions not only for the open sea but also for ports (example: Toulon). He gave more details about the ship emissions component of ChArMEx, which includes long term sampling, several focused field campaigns and computer modelling. The goals are to improve our knowledge of ship emissions in terms of emission factors and chemical fingerprints in order to improve existing emissions inventories. He also presented the proposed project APICE, which aims at investigating air quality in 5 large Mediterranean harbours with one focus being the source apportionment of particulate matter.

Jerome Hilaire (Manchester Metropolitan Univ.) showed first results from the inclusion of a ship plume parameterization in a global CTM (MOZART4) in order to account for nonlinear effects in the early plume which cannot be reproduced by global models due to the coarse spatial resolution. He used the parameterisation of Cariolle et al. (2009), which was originally developed for aircraft emissions and adjusted it for ship emissions. First results suggested a small effect on resulting ozone production (<-2% difference on 1-month) which is surprising

as more detailed, process based models have suggested a significant effect on the non-linearities in plumes. This work and comparison with previous studies is ongoing.

Bärbel Langmann (Univ. Hamburg) showed results from Marmer and Langmann (2005) about the impact of ship emissions on Med. Pollution, where 58% of aerosol surface sulphate is from ship emissions with the remainder being from continental emissions. She also pointed out that non-linear effects in ship plumes are in principle not different from similar effects in land-based (or aircraft) plumes. In the resulting discussion it was however remarked that a potentially important difference is the fact that many ship plumes are released in rather clean areas compared to, for example, power plant plumes which are often located in polluted areas. She also pointed out the present reduction of the ship traffic due to the current global economic crisis and that the opening of the Arctic shipping lanes in summer (due to reduction of sea ice) should lead to a reduction in the traffic through the Suez Canal with positive impacts for air quality in the Mediterranean but obviously potentially very serious problems for the Arctic.

The ensuing discussion focused on atmospheric points. The representation of the oceanic community was unfortunately very limited so that we could not discuss the potential importance of deposition to the oceans from ship plumes on ocean biogeochemistry. Deposited nitrate might lead to fertilisation whereas the presence of trace metals in ship plumes could be toxic. This and other topics will be part of future related discussions.

We plan to organise a session on this topic with a “SOLAS” focus in an upcoming international conference (e.g. EGU 2011) and look forward to input from the ocean community on the relevance of ship-derived pollutants or nutrients into the ocean.