4.246 Impact of reduction of ship-induced sulphur emission on climate and health.

Presenting Author:
Mikhail Sofiev, Finnish Meteorological Institute, Atmospheric Composition Department, Helsinki, Finland, mikhail.sofiev@fmi.fi

Co-Authors:
James Winebrake, College of Liberal Arts, Rochester Inst. of Technology, USA
Lasse Johansson, Finnish Meteorological Institute, Atmospheric Composition Department, Helsinki, Finland
Edward Carr, Energy and Environmental Research Associates, LLC, USA
Rostislav Kouznetsov, Finnish Meteorological Institute, Atmospheric Composition Department, Helsinki, Finland
Jukka-Pekka Jalkanen, Finnish Meteorological Institute, Atmospheric Composition Department, Helsinki, Finland
James Corbett, University of Delaware, USA

Abstract:

Ship emission constitutes ~13% of the global fluxes of SOx into the atmosphere. New global standards of sulphur content in the ship fuels, in force on 1 January 2020, reduce the maximum permissible sulphur mass fraction by 7 times – from 3.5% to 0.5%, - which will cut the global annual SOx ship emission from 11,5 Mt yr^{-1} to 2.5 Mt yr^{-1}.
With this talk, the impact of this reduction on global distribution of aerosols, public health and radiative forcing is analyzed following Sofiev et al (2018). The effects are studied using STEAM (ship emission) and SILAM (atmospheric composition) models. We also present later findings referring to regional effects of the reduction.
STEAM provided SILAM with the 3-hourly emission fluxes from ships using their actual locations, speed and physical characteristics as described in (Jalkanen et al. 2016). Since ships, especially oceanic vessels, are strong point sources moving over pristine areas but sometimes passing by densely populated places, the simulations were performed at the resolution of 0.1° (~10km) over the whole globe for the full year of 2015.
The simulations produced high-resolution patterns of the pollution distribution, where one can distinguish dense routes, individual ships ceiling offshore, coastal effects, and concentrations over populated areas.
It was shown that the MARPOL-VI regulations result in substantial reduction of PM concentrations: up to 50% of $PM_{2.5}$ can be shaved out in the vicinity of busy ship routes. We estimated that it can save up to 100,000 premature deaths, mainly in Africa and Asia (Europe and America already control fuel sulphur content).
From the other side, the measures will result in 50-100 mW m^{-2} of lost cooling due to diminishing aerosol concentrations. The bulk of the effect comes from the first aerosol indirect effect: reduction of the cloud droplet number concentrations and cloud albedo.