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Impact of sulfur content regulations of shipping fuel on coastal air quality

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Shipping traffic is a sector that faces an enormous growth rate and contributes substantially to the emissions from the transportation sector, but lacks regulations and controls. Shipping is not enclosed in the Kyoto Protocol. However, the International Maritime Organization (IMO) introduced sufhur limits for marine heavy fuels, nitrogen oxide limits for newly-built ship engines and established Emission Control Areas (ECA) in the North and Baltic Sea as well as around North America with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78 Annex VI).
Recently, on the 1st of January 2015, the allowed sulfur content of marine fuels inside Sulfur Emission Control Areas has been significantly decreased from 1.0% to 0.1%. However, measurements of reactive trace gases and the chemical composition of the marine troposphere along shipping routes are sparse and up to now there is no regular monitoring system available.

The project MeSmarT (measurements of shipping emissions in the marine troposphere) is a cooperation between the University of Bremen, the German Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie, BSH) and the Helmholtz-Zentrum Geesthacht.

This study aims to analyse the influence of shipping emissions on the coastal air quality by evaluating ground-based remote sensing measurements using the MAX-DOAS (Multi AXis Differential Optical Absorption Spectroscopy) technique. Measurements of the atmospheric trace gases nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) have been carried out in the marine troposphere at the MeSmarT measurement sites in Wedel and on Neuwerk and on-board several ship cruises on the North and Baltic Sea.
The capability of two-channel MAX-DOAS systems to do simultaneous measurements in the UV and visible spectral range has been used in the so called "onion-peeling" approach to derive spatial distributions of ship emissions and to analyse the movement of the exhausted plumes.
Long term time evolutions have been evaluated to show the impact of recent sulfur emission regulations on the measured SO_2 pollution levels. In 2015, a significant decrease of SO_2 emissions has been found compared to the years before. This shows that the new, more restrictive fuel sulfur content limits lead to a clear improvement in coastal air quality.