The impact of shipping on nitrogen deposition in North Sea coastal areas

VOLKER MATTHIAS[1*], ARMIN AULINGER[1], JOHANNES BIESER[1] AND MARKUS QUANTE[1]

[1]Helmholtz-Zentrum Geesthacht, Max-Planck-Strße 1, 21502 Geesthacht, Germany, (correspondance: volker.matthias@hzg.de)

Introduction

Ships emit large amounts of nitrogen oxides and sulphur oxides into the coastal atmosphere. Europes three biggest ports are located at the North Sea coast. Therefore this region is particularly affected by air pollution from ships. These pollutants undergo chemical transformation in the atmosphere, they are transported into other areas and finally deposited. Thereby, they contribute to acidification and eutrophication. The share of ships in the total deposition will very likely increase in the future, because ship traffic will increase and emission redcution technologies are not yet implemented in this sector.

Methods

Emissions from ships in the North Sea were calculated for the year 2011 based on AIS position data and ship characteristics data [1]. Future shipping emissions were simulated for three scenarios for 2030 [2]. These emissions were used together with land based emissions to calculate the impact of shipping to concentrations of air pollutants and deposition of nitrogen and sulfur by means of the chemistry transport model system CMAQ [3]. Meteorological fields were taken from the mesoscale model COSMO-CLM [4].

Results

The contribution of shipping to the concentrations of the gaseous pollutants NO_2, SO_2 was found to be in the order of 20-30 % of the total concentrations of these substances in North Sea coastal areas. The aerosol bound pollutants NO_3^- and SO_4^{2-} had a lower share, around 15-20% of the total, but were more widespread. Aerosol concentrations were mainly enhanced in summer. The contribution of shipping emissions to the deposition of oxidised nitrogen reached more than 40 % in summer in the English Channel and its surrounding areas. The scenarios for 2030 revealed that this share will increase further if no additional emission reduction measures will be taken.

[1] Aulinger *et al*. (2015), *ACPD*. [2] Matthias *et al*. (2015) *ACPD*. [3] Byun & Ching (1999), *US EPA*. [4] Rockel *et al*. (2008) *MetZ*.