Employing high resolution nitrogen deposition data from atmospheric chemistry transport model simulations in ecosystem model studies with HBM-ERGOM

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Introduction

- **eutrophication** of **marine water bodies** is a **serious thread** for the marine **ecosystem** and for their **recreational** and **economic value**
- **atmospheric deposition** contributes ≈ **1/3 to the nitrogen input** into the North and Baltic Sea
- **major contributing sectors** to **emission** of nitrogen compounds: agriculutre, energy production, road transport, and **shipping**
- **shipping sector** contributes **10% - 20%** to marine **nitrogen deposition**
- **North** and **Baltic Sea** designated as **nitrogen emission control areas** (NECAs) from Janury **2021** to improve **air quality** ■

research questions:

1. Which contribution does shipping-related nitrogen deposition have to the marine biomass?
2. Does reductions in shipping emissions, i.e. by NECAs, lead to a reduced probability of the occurance of algae blooms? ■

Figure 1: sources of atmospheric nitrogen compounds

Conclusions

- longer time periods needed
- shipping is relevant contributor to nitrogen deposition but not for the biomass generation (short term) ■

Outlook and further plans

- simulation over 2 to 10 years
- **compare** models: **tagged shipping**-related nitrogen **vs. no shipping**-related nitrogen
- do specific NECA runs
- consider further atmospheric nitrogen sources and tag them (i.e. agricultural emissions) ■

Results and Discussion

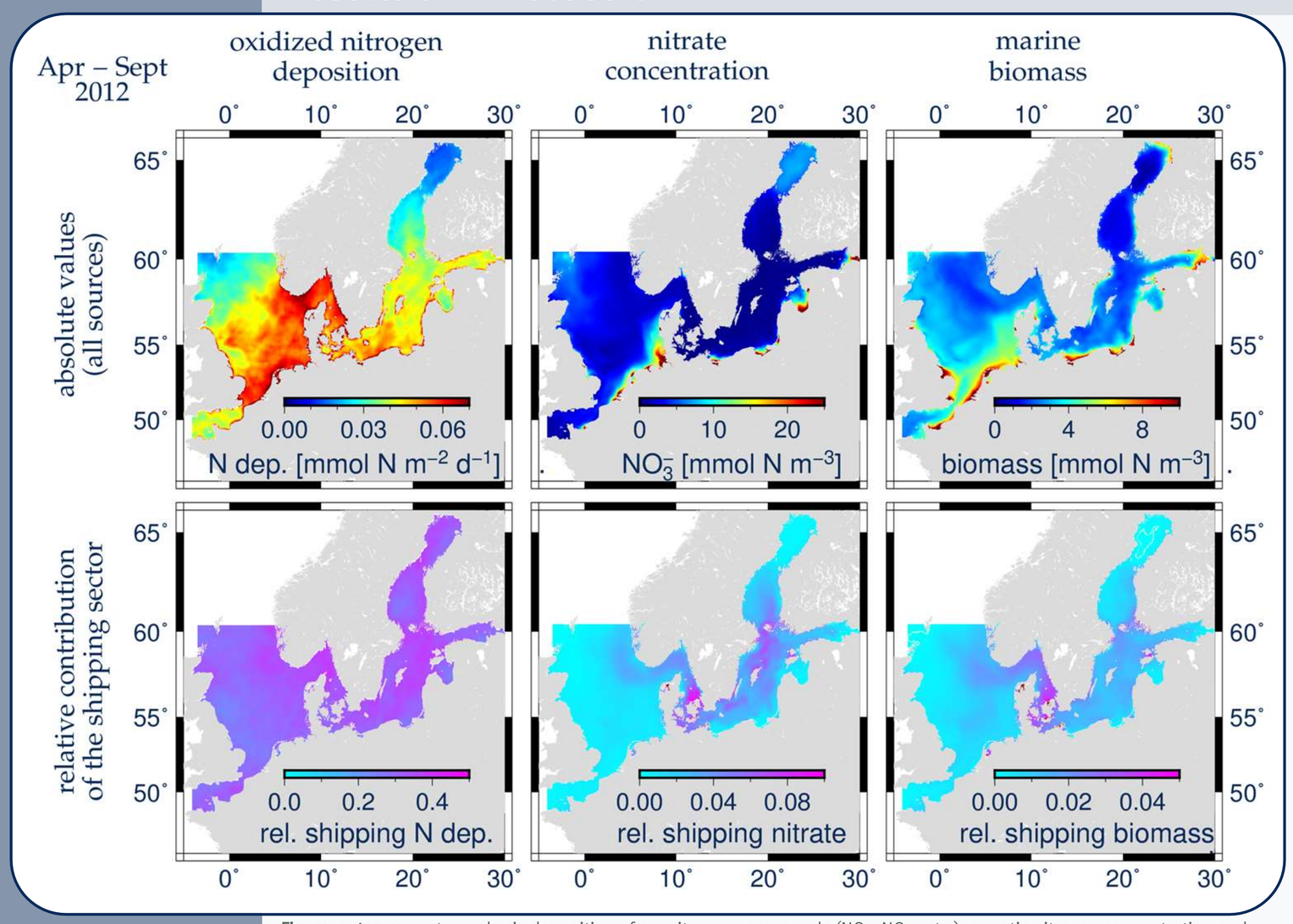


Figure 2: **top row:** atmospheric deposition of ox. nitrogen compounds (NO_X, NO_3^-, etc.), aquatic nitrogen concentration and marine biomass; **bottom row:** relative contribution of the shipping sector to deposition, nitrogen concentration and biomass.

validation

- CTM reproduced measurements of air quality backgr. stations (EMEP)
- N **deposition** in the range of lit. values for **Baltic** (**178 kt N a^{-1}**) but below for **North Sea** (**314 kt N a^{-1}**)
- **correct system behavior** (ecosys.): diatoms, flaggelates and cyano bacteria **blooms** in correct months
- concentrations of biogeochemical tracers in realistic magnitudes ■

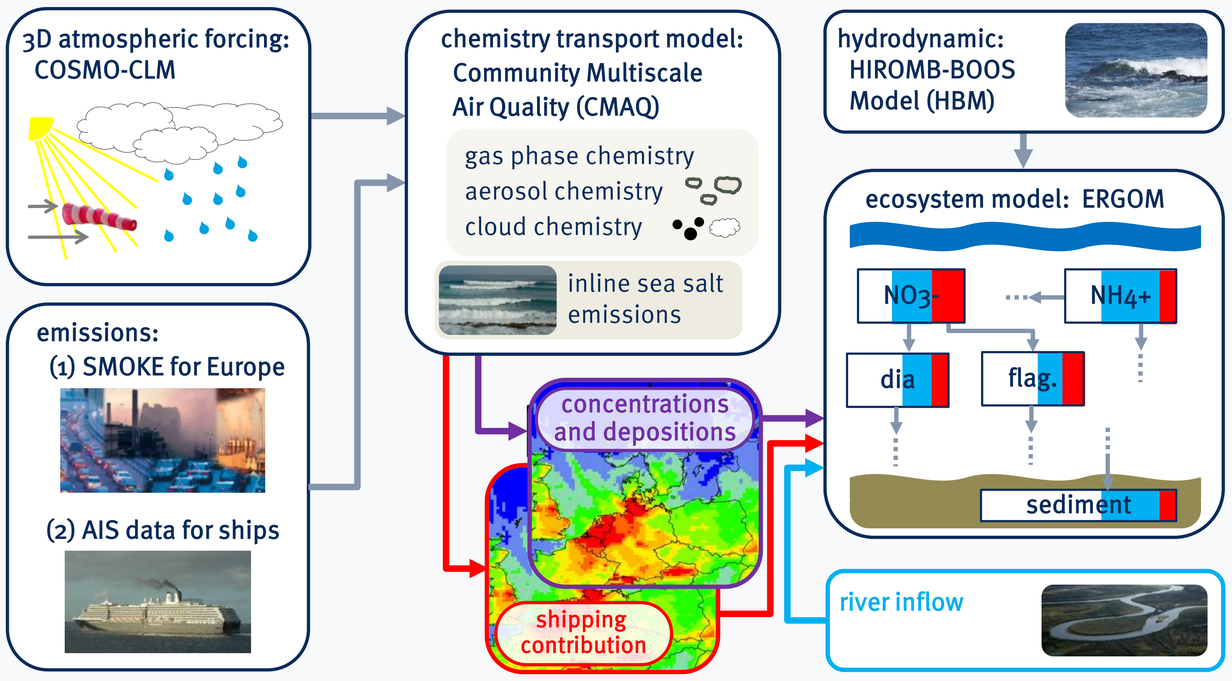
results

- **shipping** contribution to nitrogen **deposition** into North and Baltic Sea: **13% and 15%**
- **shipping-related** nitrogen in **NO_3^-** and in marine **biomass below 5%**

discussion

Contribution of **shipping sector** to **marine biomass is low**. Thus, short-term **reduction of algae blooms** by a **NECA** is **questionable**. **Tagging** and **deactivating** shipping emissions might have **different impacts**. ■

Materials and Methods



- simulation period: 2012
- CTM simulations (partly provided by Horizon 2020 project SHEBA):
  - 64x64 km² (Europe + N. Africa)
  - 16x16 km² (Centr. + N. Europe)
  - 6x6 km² (N. + B. Sea)
- HBM setup (from BSH):
  - 5'x3' (North + Baltic Sea)
  - 50''x30'' (German waters)
- ERGOM:
  - tagging of elements by duplication of tracers and equations (auto generated)
  - shipping-related and river-discharged nitrogen tagged ■

Acknowlegdements

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References | provided on the back side of the A4 printouts of this poster