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 threat 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: agriculture, 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 January 2021
- research questions:
  1. Which contribution does shipping-related nitrogen deposition have to the marine biomass?
  2. Do reductions in shipping emissions, i.e. by NECAs, lead to a reduced probability of the occurrence of algae blooms?

Conclusions

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

- simulation period: 2012
- 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, flagellates and cyanobacteria blooms in correct months
- concentrations of biogeochemical tracers in realistic magnitudes

Materials and Methods

- 3D atmospheric forcing: COSMO-CLM
- chemistry transport model: Community Multiscale Air Quality (CMAQ)
- emissions: (i) SMOKE for Europe
- (ii) AER data for ships
- hydrodynamic: HIROMB-BDOS Model (HBM)
- ecosystem model: ERGOM
- shipping contribution
- tagged of elements by duplication of tracers and equations (auto generated)
- shipping-related and river-discharged nitrogen tagged

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References | provided on the back side of the A4