



THE
SCIPPER
PROJECT



Shipping contribution to total emissions

H2020 EMERGE and SCIPPER projects

Posidonia 2022

Elisa Majamäki

Finnish Meteorological Institute



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nr.814893 and Nr.874990



THE
SCIPPER
PROJECT



Outline

- **Shipping emissions** – why bother?
- **Emission modelling** – how are emission inventories produced?
- **EMERGE and SCIPPER projects**

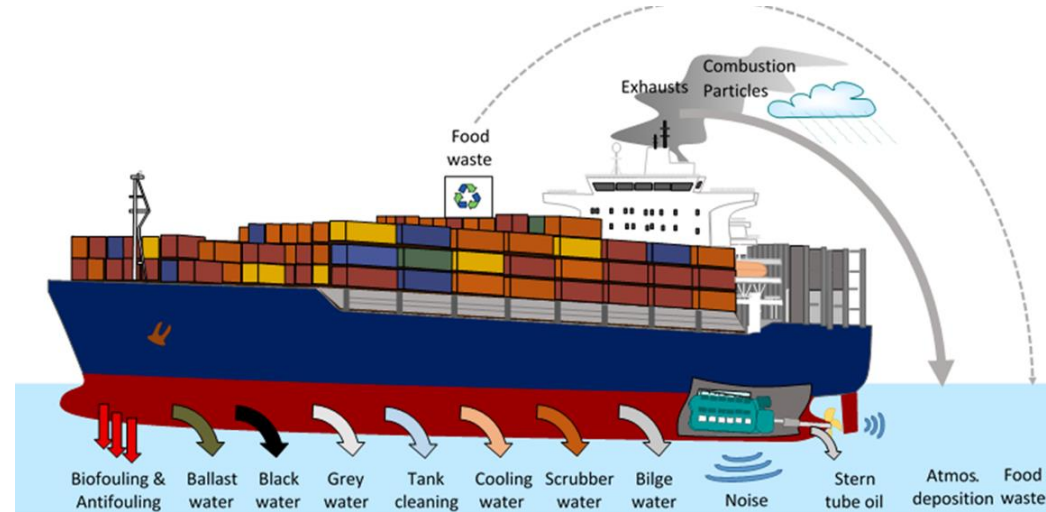


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nr.814893 and Nr.874990



Air pollution from shipping

- Sources:
 - Engines, fuel tanks, cargo holds, ...
- Effects:
 - Human health issues and premature deaths
 - Climate change
 - Acidification



Jalkanen et al, Ocean Science, 2021

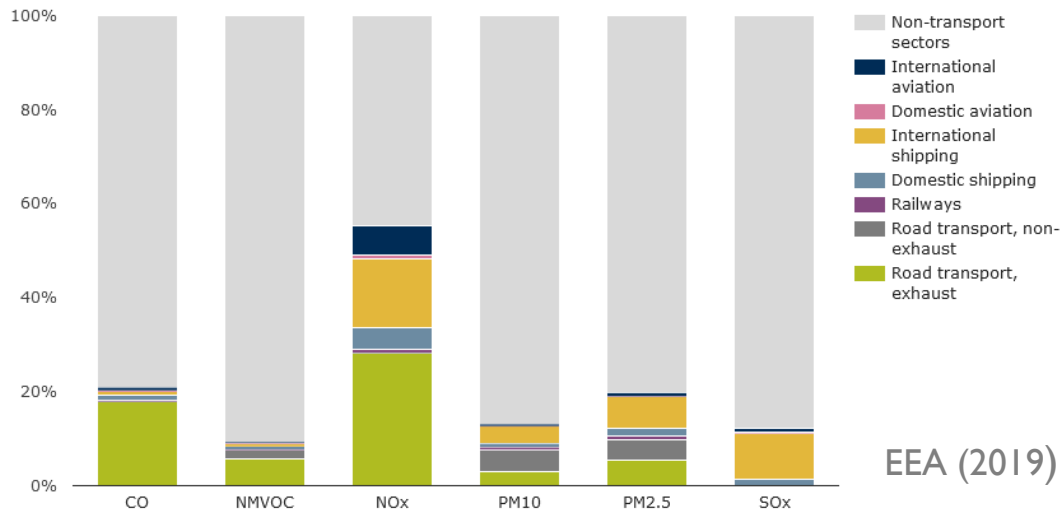


Air pollution from shipping



- Shipping contributes to **2-3% of global GHG emissions**
- Majority of emissions take place near the coastline – **affects air quality in cities**
- Maritime **transport work expected to increase** in the future

Chart — Contribution of the transport sector to total emissions of the main air pollutants



EEA (2019)

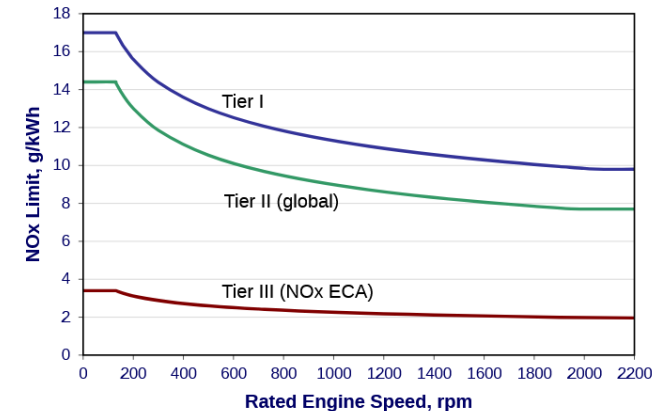
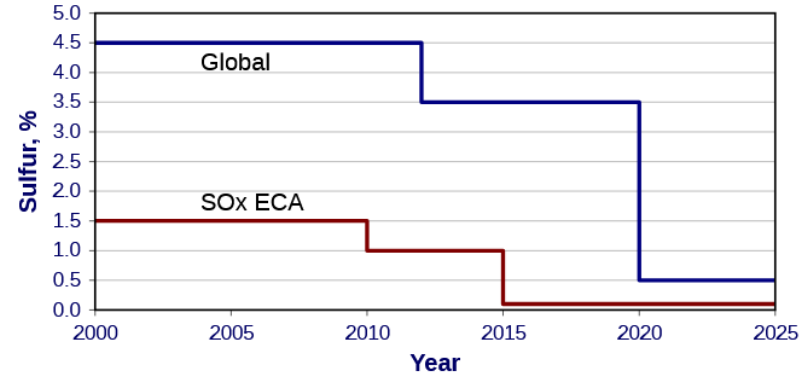
Contribution of the transport sector to total emissions of the main air pollutants



Regulations

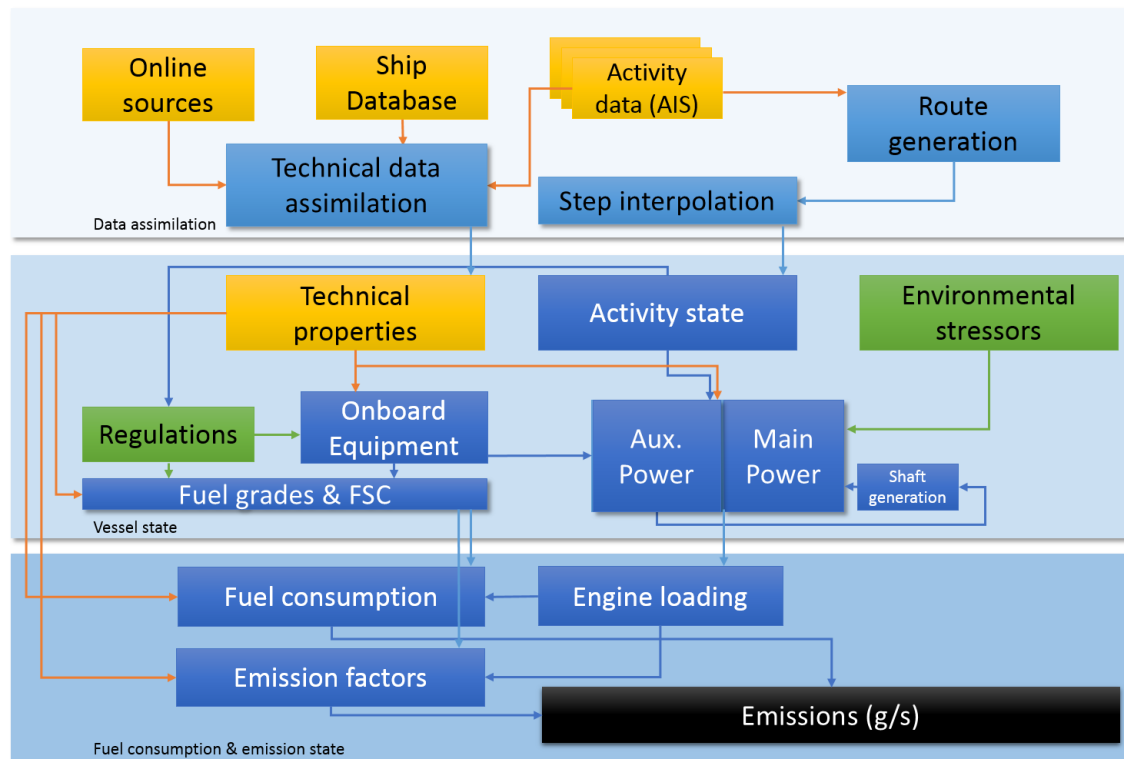
- IMO (MARPOL 73/78 – Annex VI)
 - Global limit values
 - Emission control areas
 - Energy efficiency requirements
- EU directives
- Local rules

IMO target to cut GHG emissions from shipping by 50% by 2050





Emission modelling - Methodology

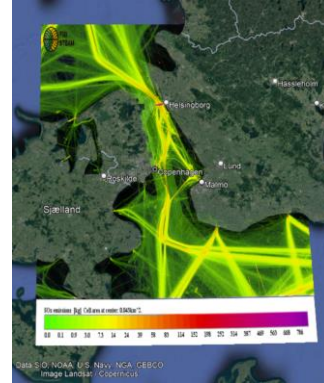


Johansson et al, Atm. Env., 2017



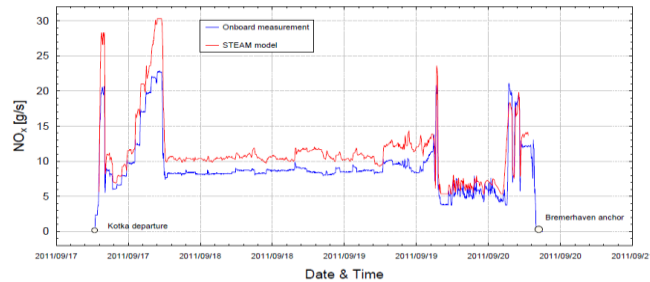
From individual ships to global

Total SOx emissions in 2018



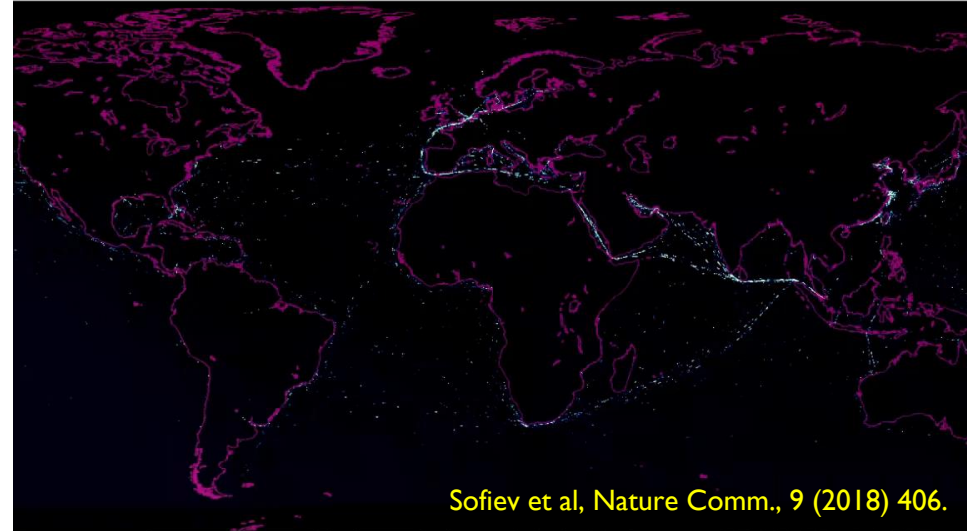
SOx emissions from ships [kg/cell]

Prediction of NOx emissions from one vessel

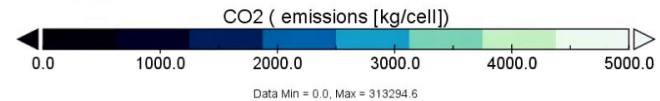


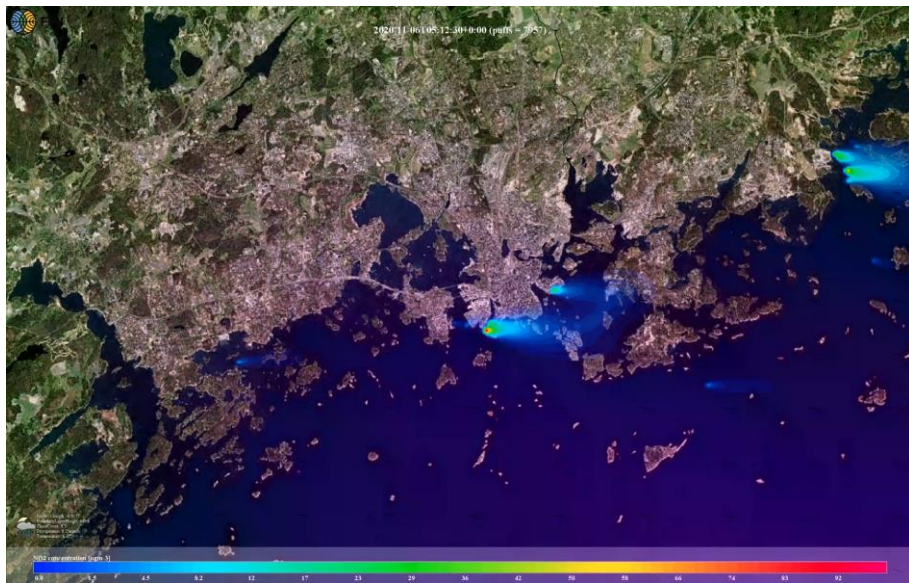
Carbon dioxide emissions from ships, March 2020

Time: 2015-03-01 00:00

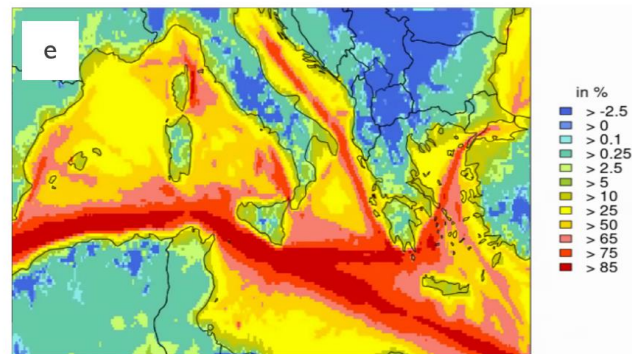


Sofiev et al, Nature Comm., 9 (2018) 406.

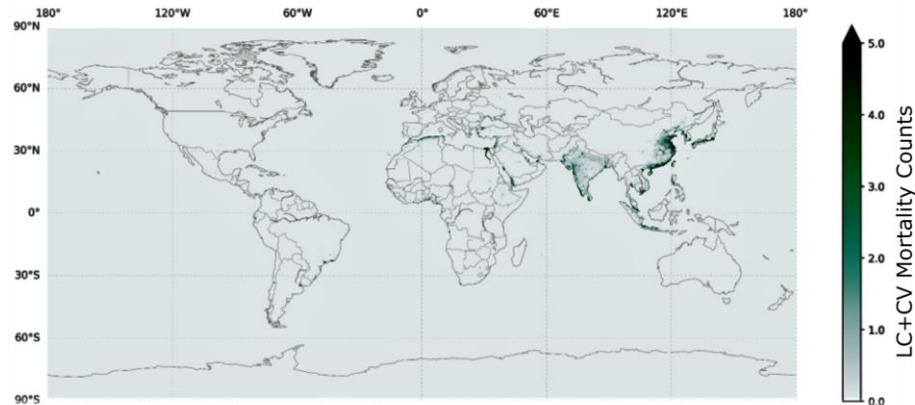




Ship plumes in Helsinki, Finland modelled with FMI-STREAM model
(c) Lasse Johansson, FMI



Annual mean NO₂ ship contribution (model: LOTOS-EUROS)



Combined avoided mortality results with 2020 actions (Sofiev et al. 2018)



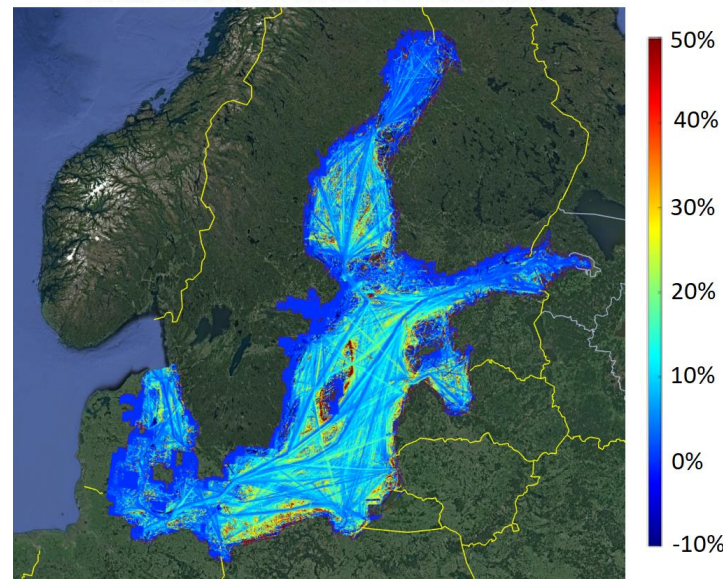
- Assess the **impacts of shipping emissions on air quality** under different scenarios
- An integrated modelling chain from **emissions to impacts in air and water**
- **Measurement campaigns**: implementation and validation as input for air quality simulations
- **Case studies** in several harbor cities – modelling and measurements
- Intercomparison of **different models, measurements and satellite data**





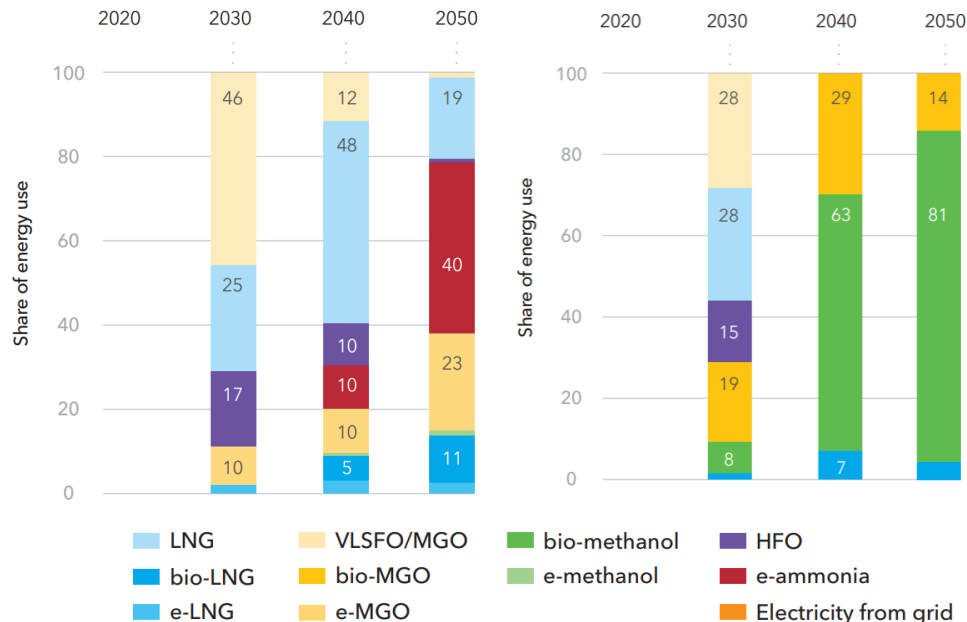
- Improvements include:
 - Updated **emission factors**
 - Updated method for **LNG engines and methane slip**
 - Modelling of new fuels: **Ammonia and methanol**
 - Modelling of **auxiliary machinery**
 - Impact of **weather and sea conditions**
 - Impact of **abatement systems**: scrubbers, SCR
 - Local **regulations**

IMPACT OF SEA WAVES ON TOTAL CO₂ EMISSIONS
FROM SHIPPING IN THE BALTIC SEA IN 2018



- Various scenarios:
 - Different transport work projections
 - Different energy use projections
 - Alternative fuels and electricity
 - Use of abatement systems: Scrubbers, SCR..
 - New emission control measures and non-compliance

→ Recommendations on policy actions



©DNV GL 2020

Maritime fuel mixes for 2020-2050 predicted by DNV-GL (2020)



Conclusions



- Ship emissions contribute to the climate change and local air pollution problems
- Emissions can be estimated with emission models
 - Model integration enables impact assessment
- SCIPPER and EMERGE projects
 - Expand knowledge of shipping emissions
 - Evaluate impact of shipping on air quality under different scenarios
 - Compare different approaches for evaluating shipping emissions





THE
SCIPPER
PROJECT

Thank You

 @scipperproject

 @ScipperProject

 @SCIPPER project

 @ScipperProject

<https://www.scipper-project.eu/>

 @ EuEmerge

 @EuEmerge

 @EuEmerge

 @EMERGE EU PROJECT

<https://emerge-h2020.eu/>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nr.814893 and Nr. 874990