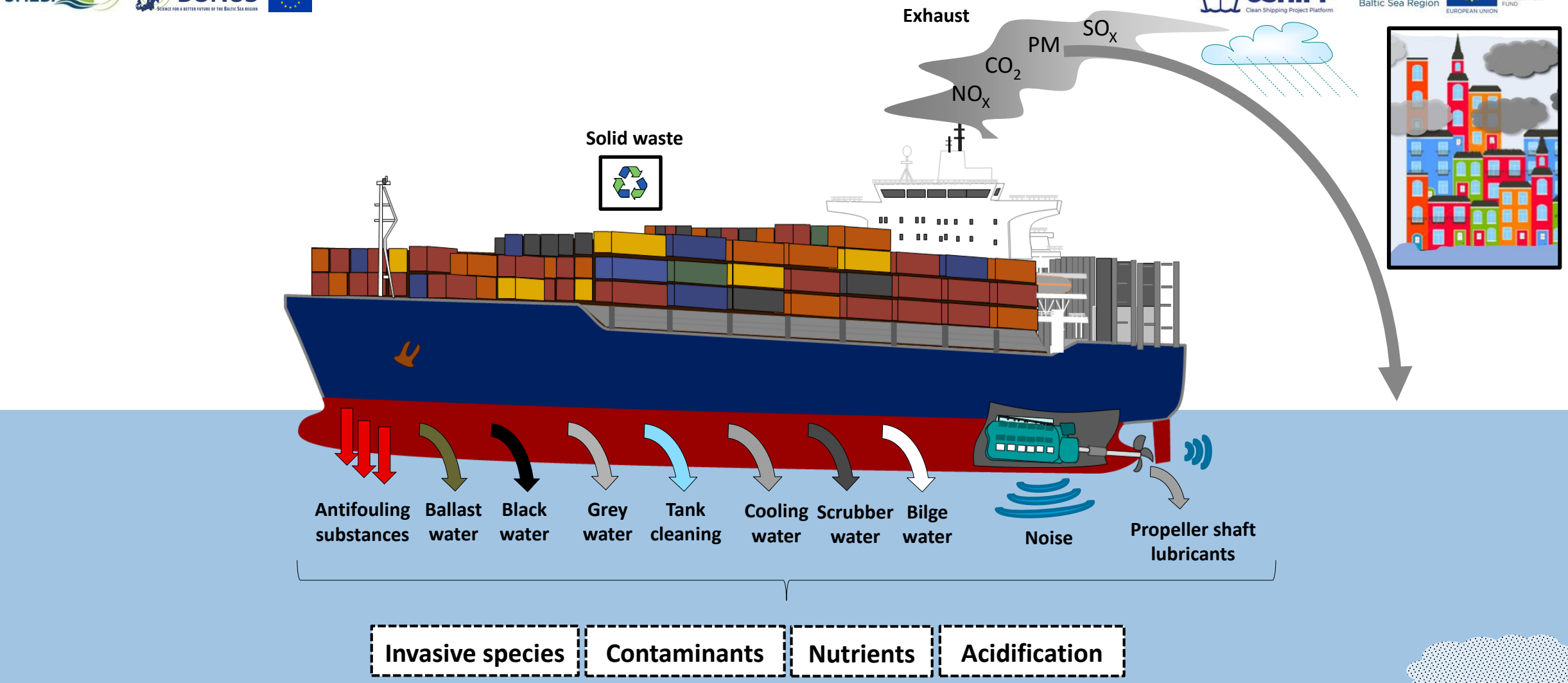
Are we going to achieve sustainable shipping in the Baltic Sea?

Intro

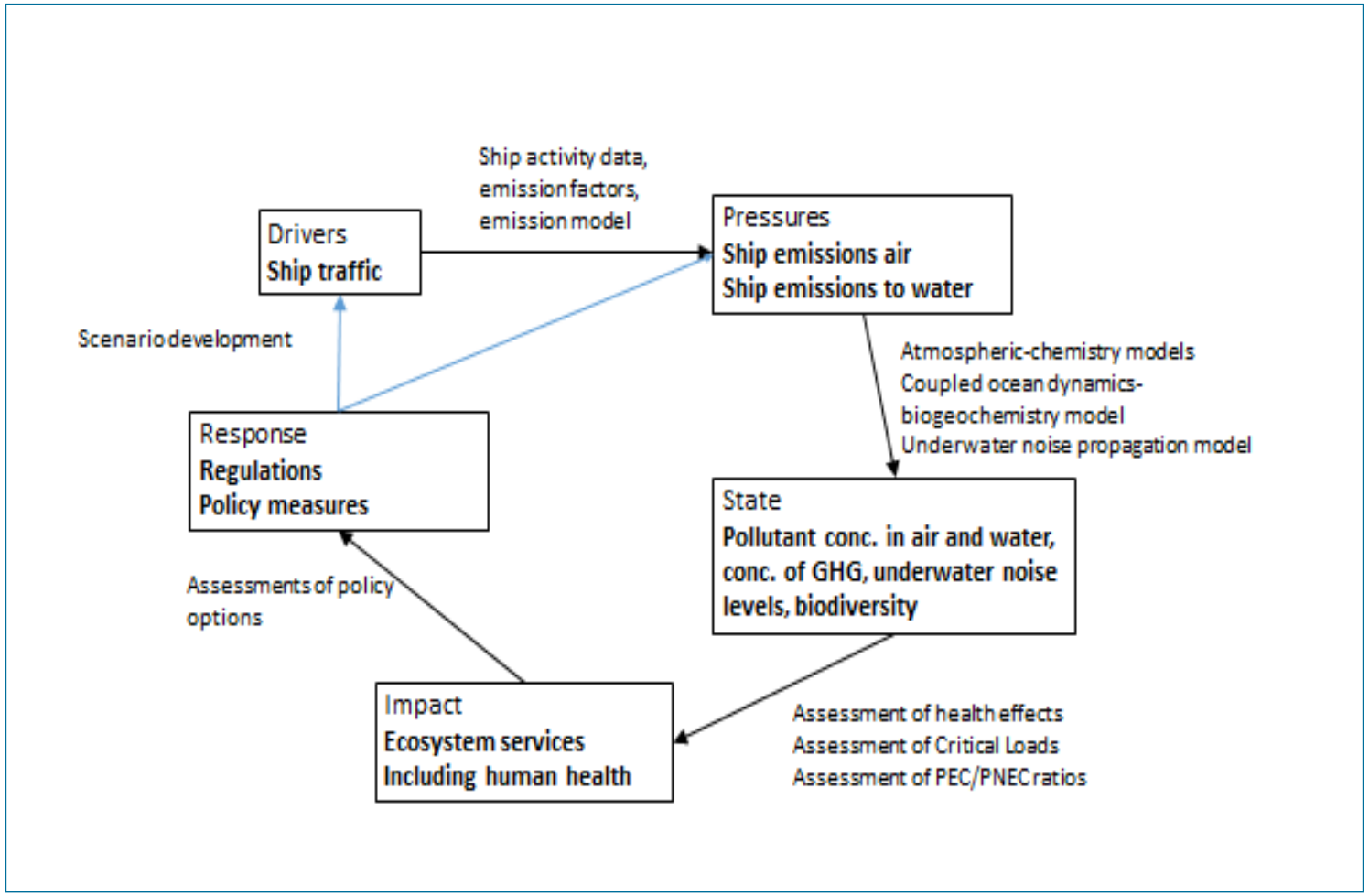
- Shipping plays an important role in transport in the Baltic Region.
- It is subject to influences of political, technical or societal driving forces stimulating/encouraging its development.
- How the future of shipping might look like?
- How will the future shipping impact the environment?
- Scenarios created on trend/experience-related assumptions demonstrate possible outcomes.
- An analytical framework for the integrated assessment of shipping in the Baltic Sea was developed

Source: Photo by Holger Link on Unsplash



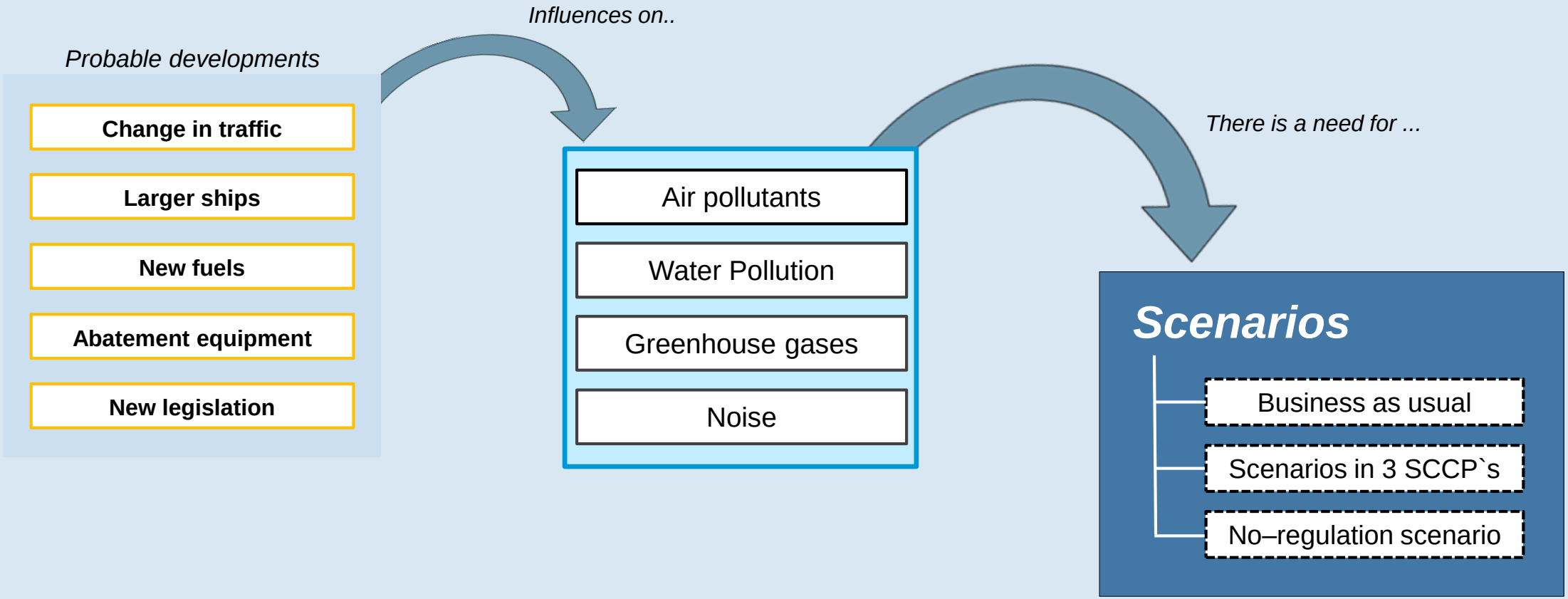
Sketch by Ida-Maja Hassellöv 2018

DPSIR framework for asessment of operational shipping



What will the future look like?

Shipping in the Baltic is expected to keep on increasing in the future. At the same time the ships will likely become more fuel efficient and a number of regulations on emissions to air and water will be enforced. A number of factors will influence the environmental performance.



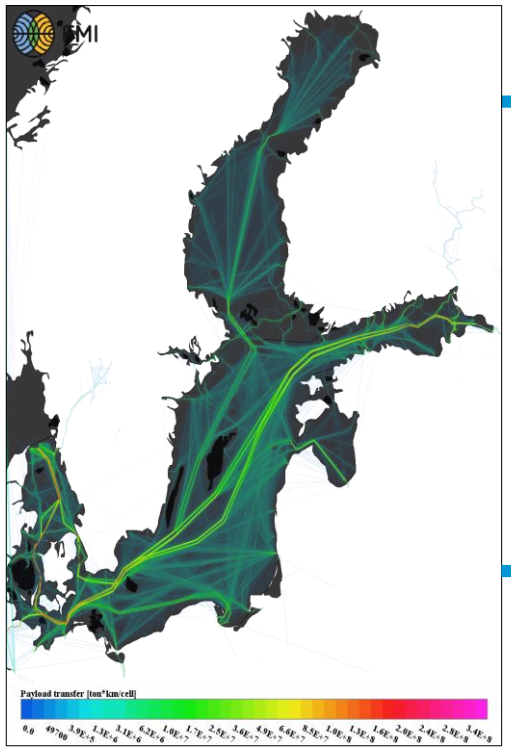
Drivers, scenario building

Ship types



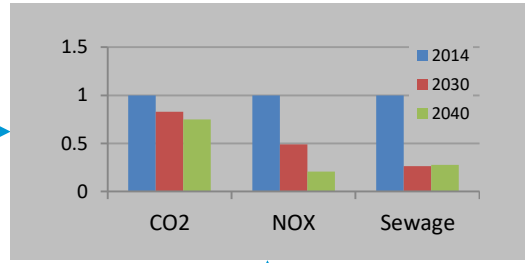


Activity data (AIS)



Assumptions in trends in activity data

Scenarios

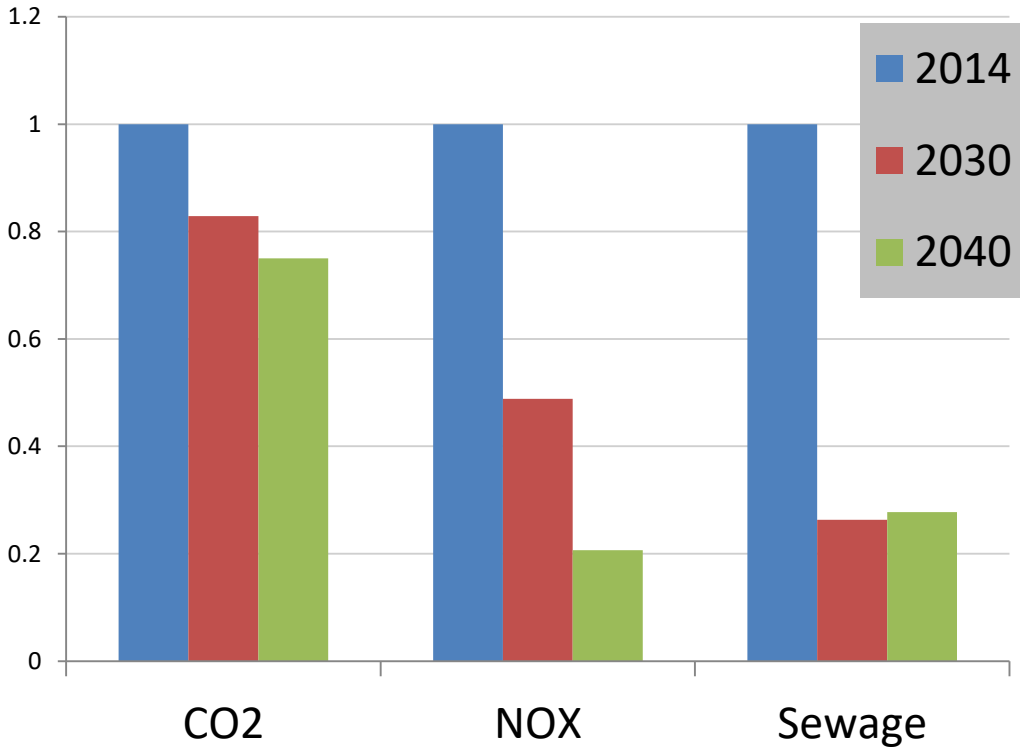


Assumptions in trends in emission factors

STEAM model

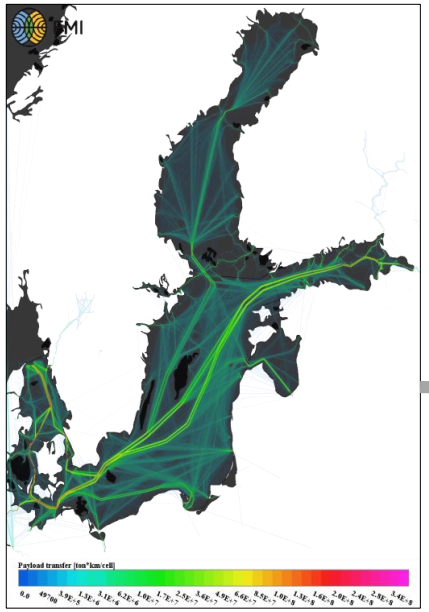
BAU scenario

BAU scenario	
Trends in traffic	The number of ships will increase between 0 and 1.2 % annually, depending on segment.
Ships	The size of ships increases 1.0% - 2.1 % annually, depending on segment. The fuel efficiency increases 1.3% - 2.25% annually. Scrubbers are assumed to be used for larger ships.
Policy measures	The Baltic and North Seas NO_X emission control areas (Tier III demand for new engines from 2021). The energy efficiency design index (EEDI) regulations will drive the fuel efficiency increase. The EU fuel directive will drive an increase in the use of LNG. The Ballast water convention will be in place. A ban on waste and sewage disposal from passenger ships in the Baltic Sea will be in place.



From Drivers to Pressures – developments of STEAM model

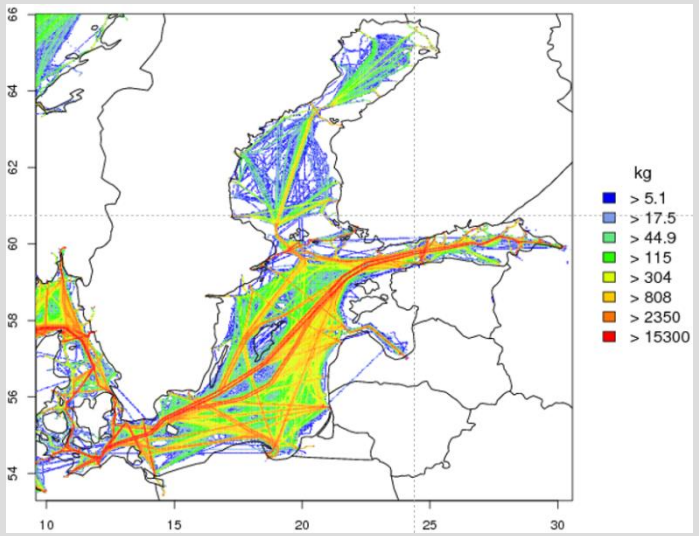
Air pollution



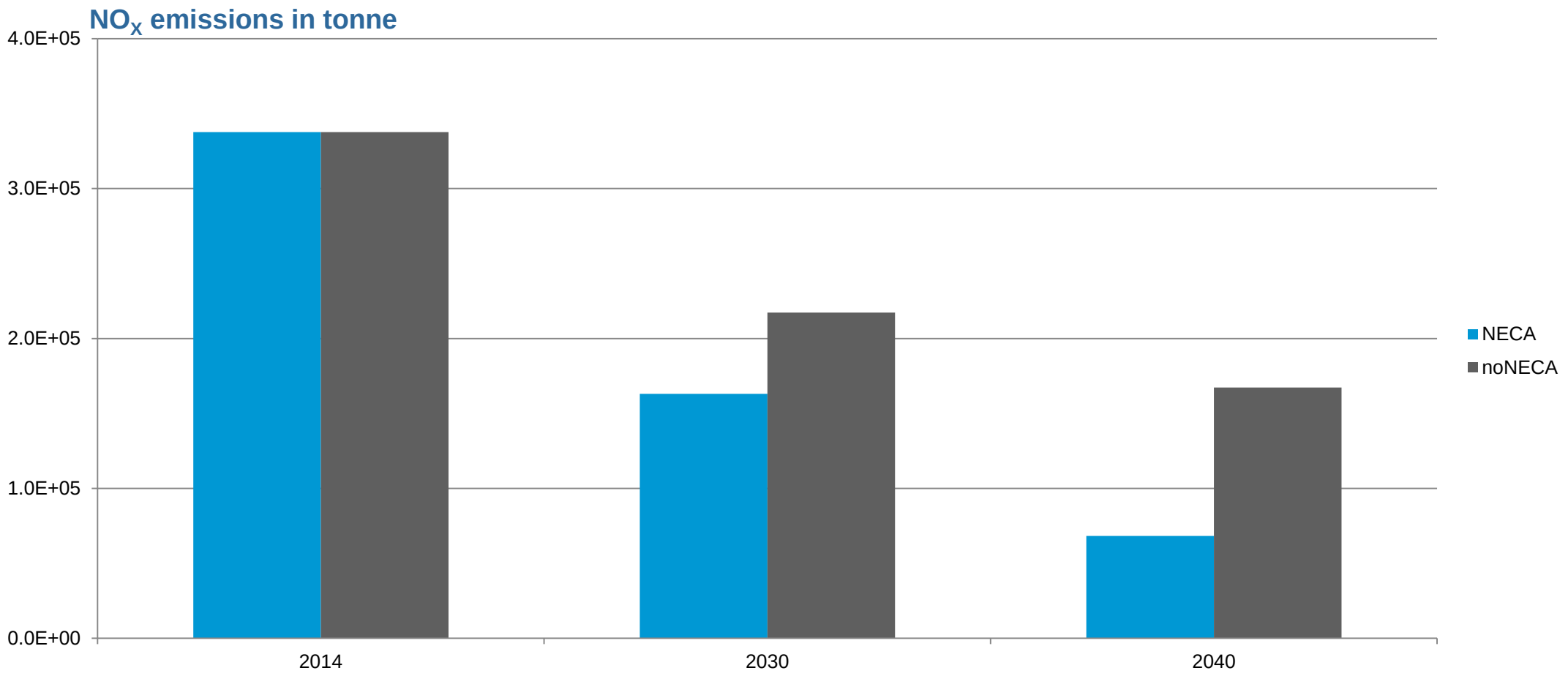
STEAM model

Emission factors air pollutants

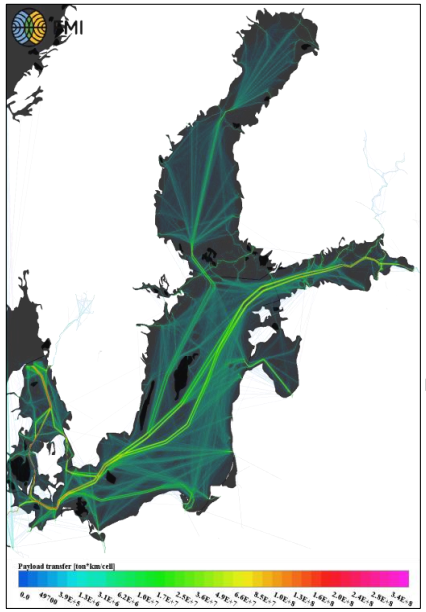
Air emissions



Impact is of the Tier III regulations for NO_X



From Drivers to Pressures – water pollution

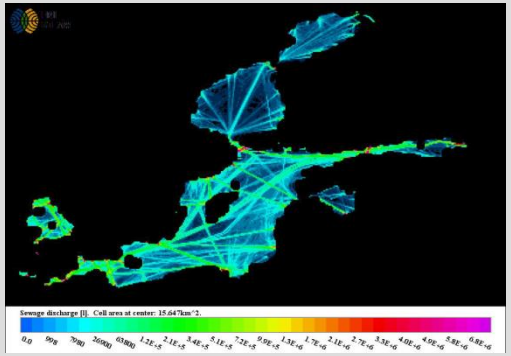


Shipe type specific discharge volumes or amounts:
Bilge, ballast water, scrubber wash water, antifouling, etc.

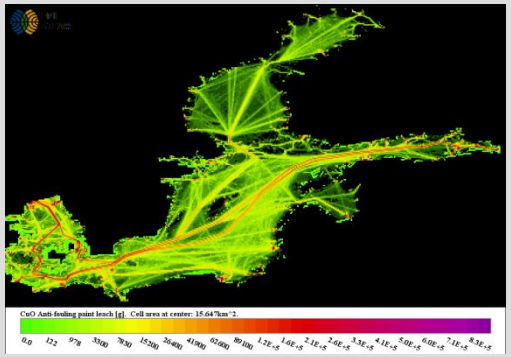
STEAM model

Contaminant concentrations in discharges

Emissions to water



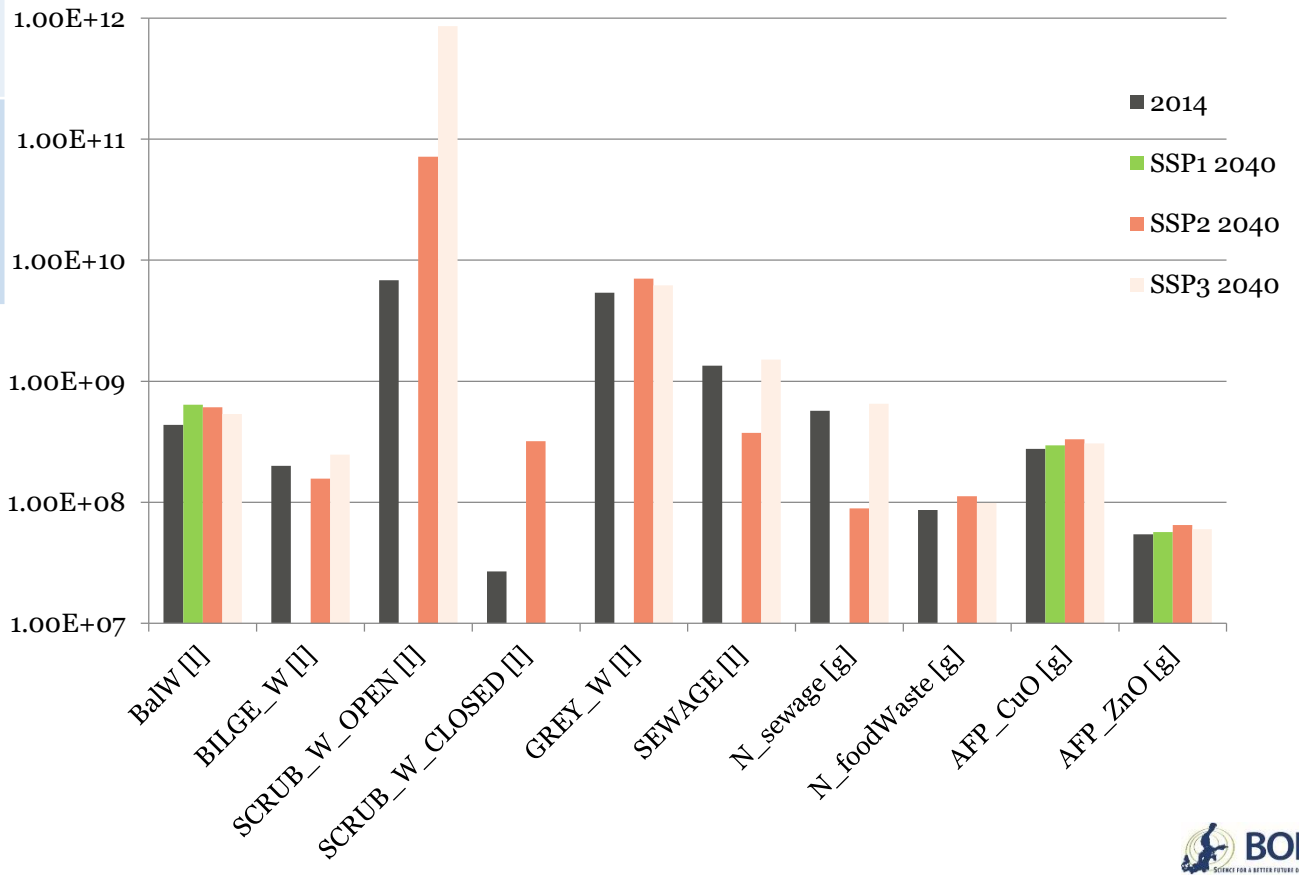
Sewage water release during year 2017 from Baltic Sea shipping



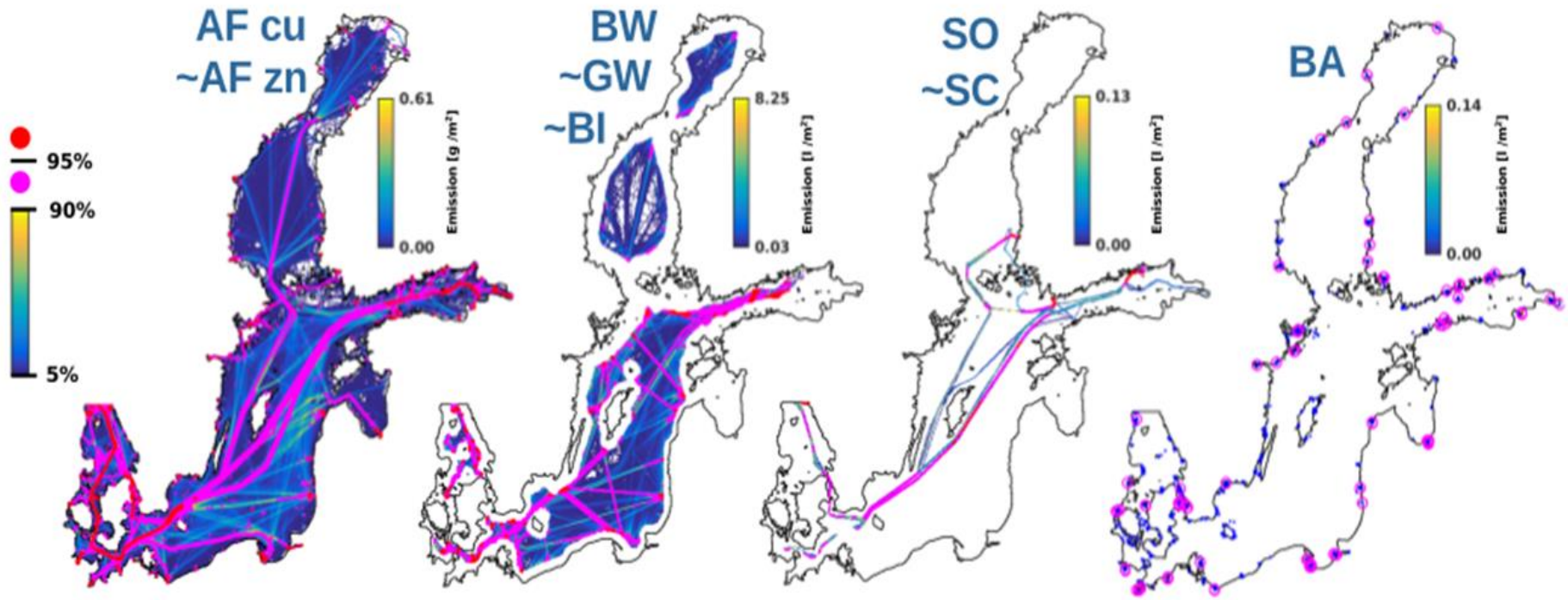
Cu(I)O from anti-fouling paints

Cumulative scenarios

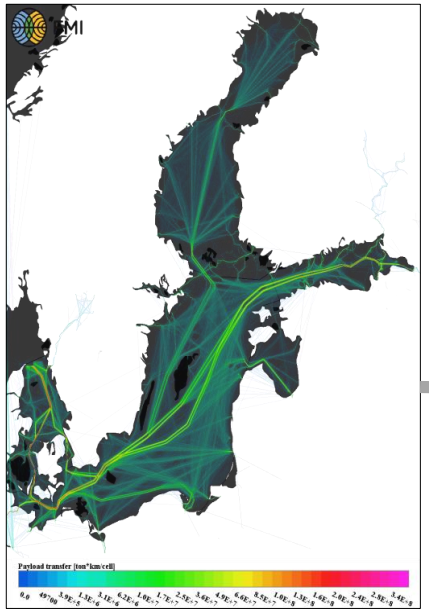
Name	Description
Business as usual (SSP2)	Includes current trends in the development of shipping and already decided regulations
SSP1 - Sustainability	A development with high concern for the environment and good technology development
SSP3 - Fragmentation	Development in some regions and poverty in others. Continued fossil fuel dependency and failure to meet environmental goals.



Different types of emission/discharge patterns in the Baltic Sea (BAU)

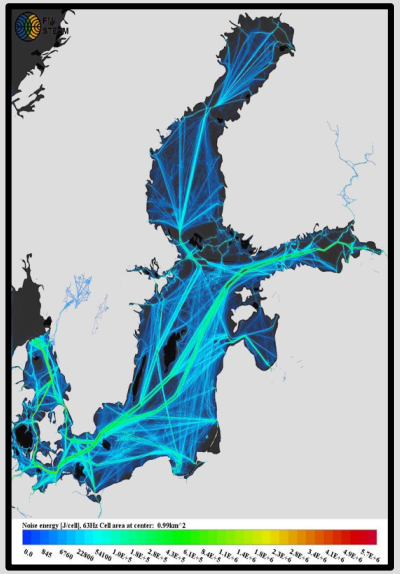


From Drivers to Pressures – Underwater noise

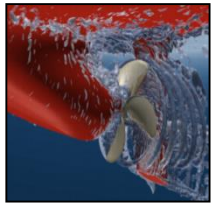


STEAM model

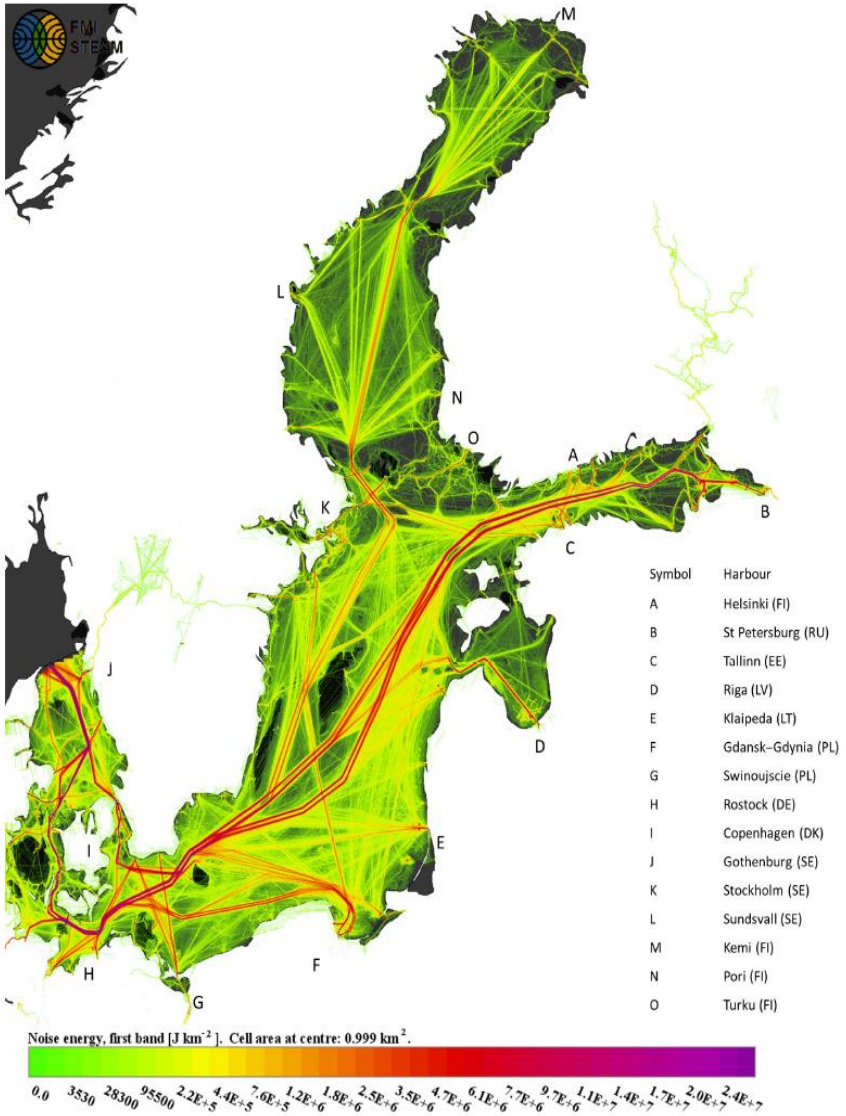
Emissions of uderwater noise



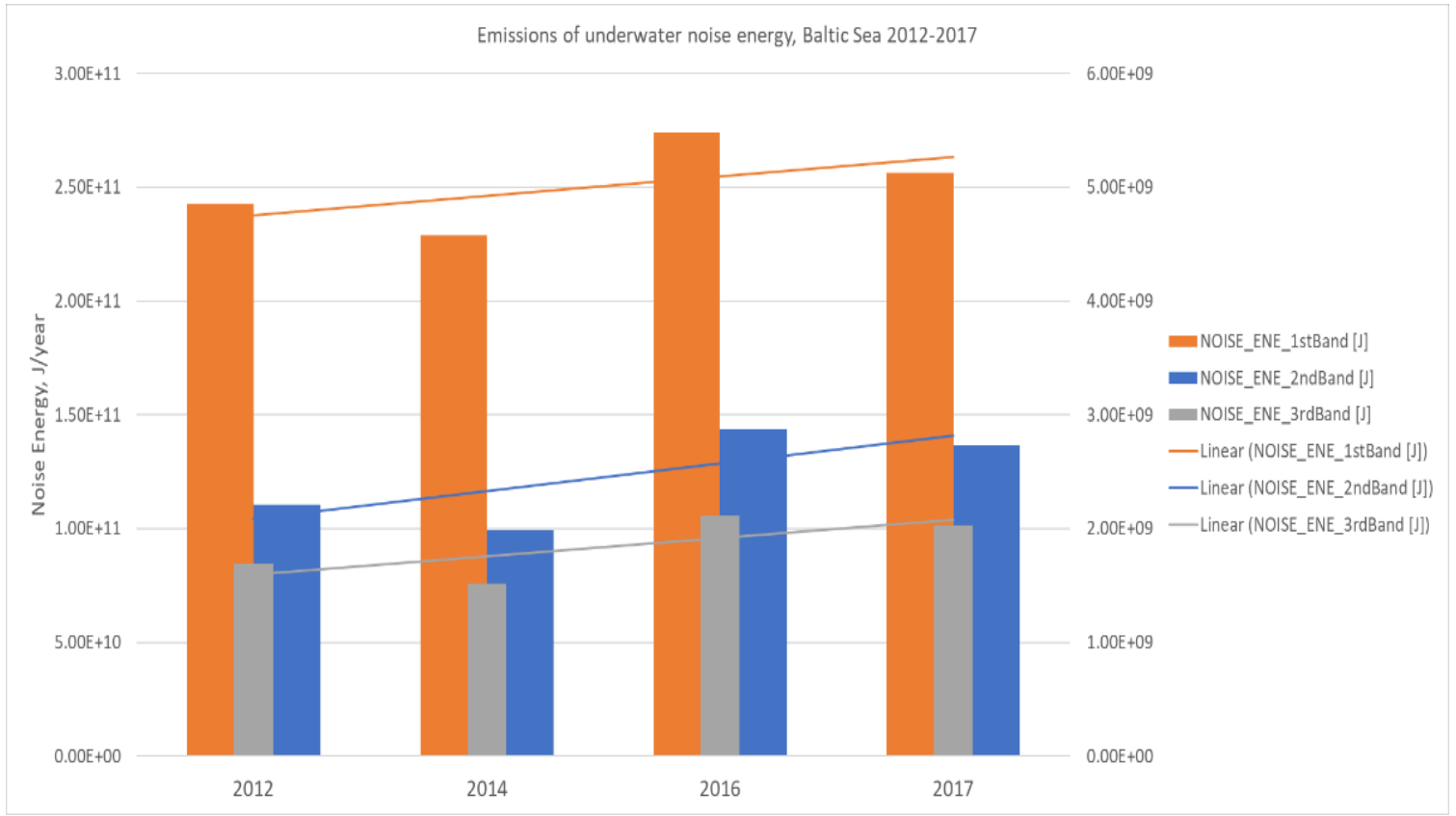
Shipping induced underwater noice parameters (engine propeller, hull, speed)



Shipping noise in the Baltic Sea area



FDistribution of underwater noise emissions in the Baltic Sea area during 2016. Image from Jalkanen et al., Ocean Sci., 14 (2018) 1373-1383.

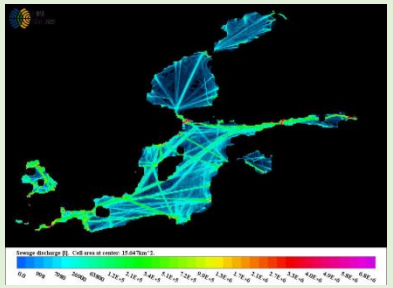


Underwater noise emissions from Baltic Sea shipping. Noise energy in Joules/year is described in 63, 125 and 2000 Hz bands (1/3 octave bands). Two lowest bands are indicated by orange and blue bars and left axis, whereas the 2000 Hz band is plotted in grey and right axis.

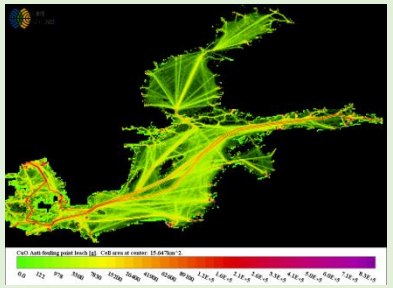
From drivers to pressure – water pollution

SHEBA
Sustainable Shipping and Environment of the Baltic Sea region

Emissions to water



Sewage water release during year 2017 from Baltic Sea shipping

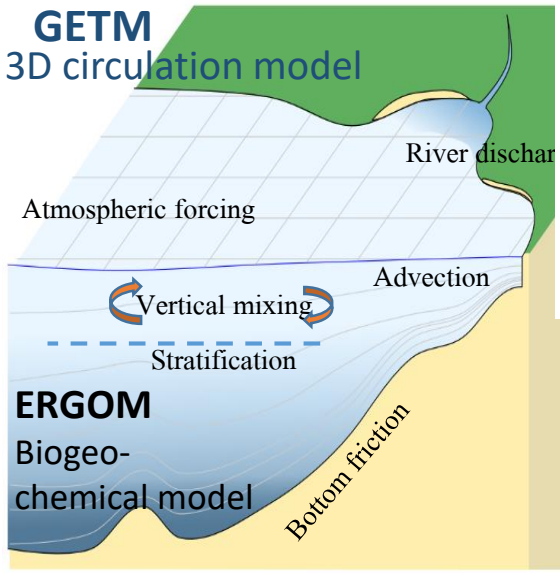


Cu(I)O from anti-fouling paints

Contaminants as passive tracers

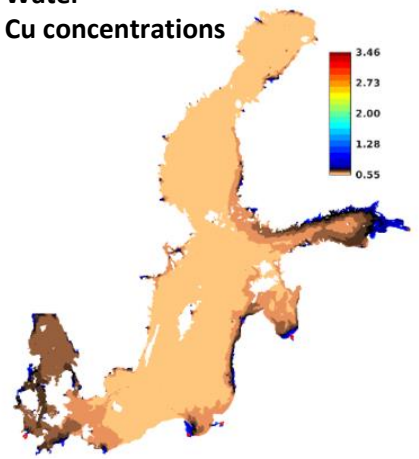
Nutrients

GETM
3D circulation model

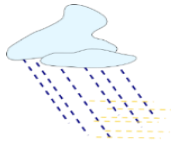


ERGOM
Biogeo-chemical model

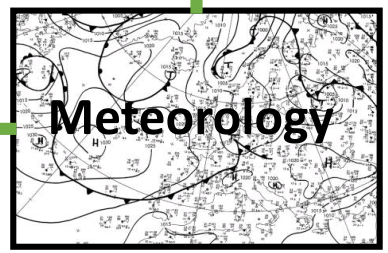
Water
Cu concentrations



Chemistry transport models: CMAQ, EMEP, SILAM model

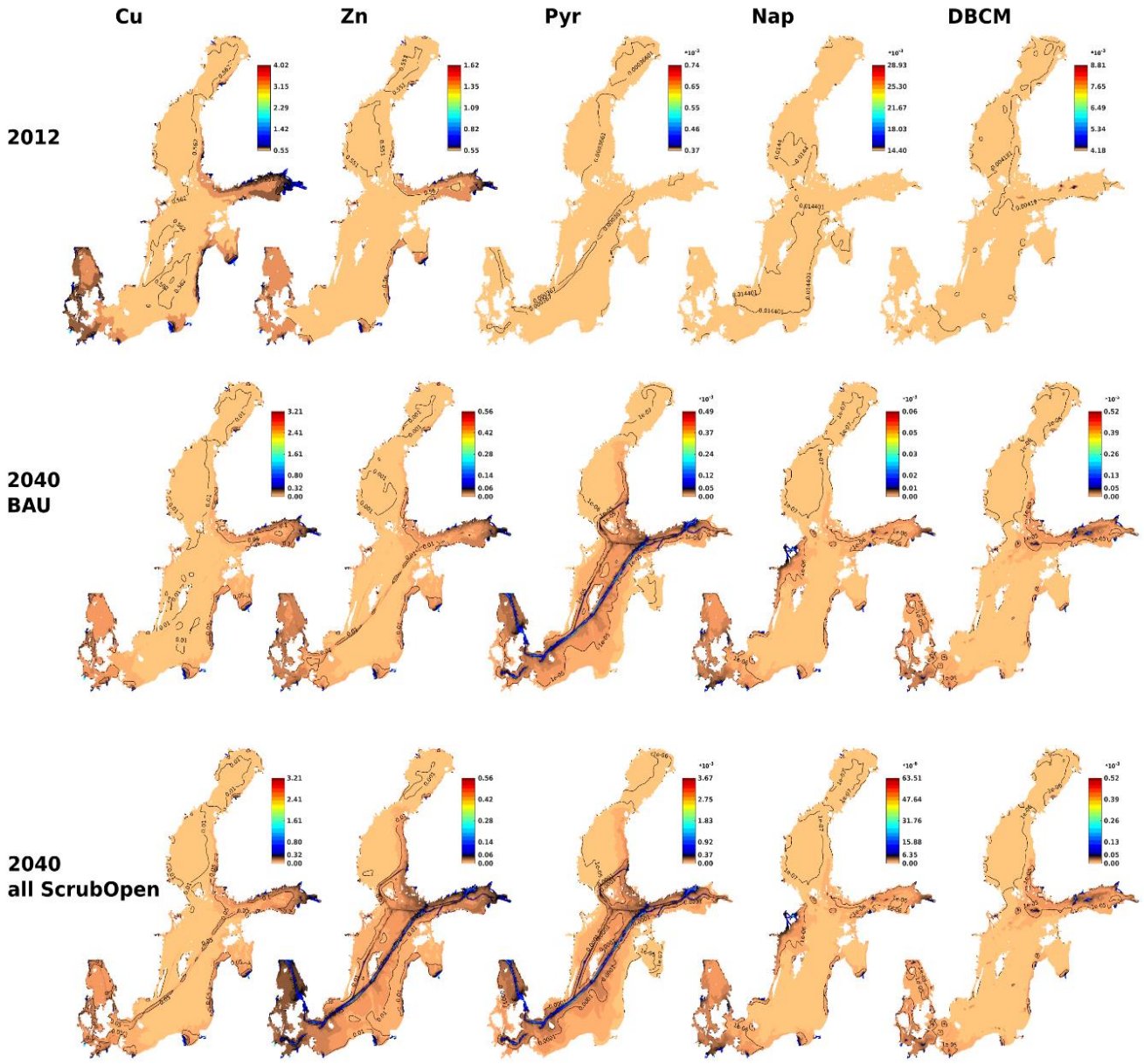


Atmospheric deposition



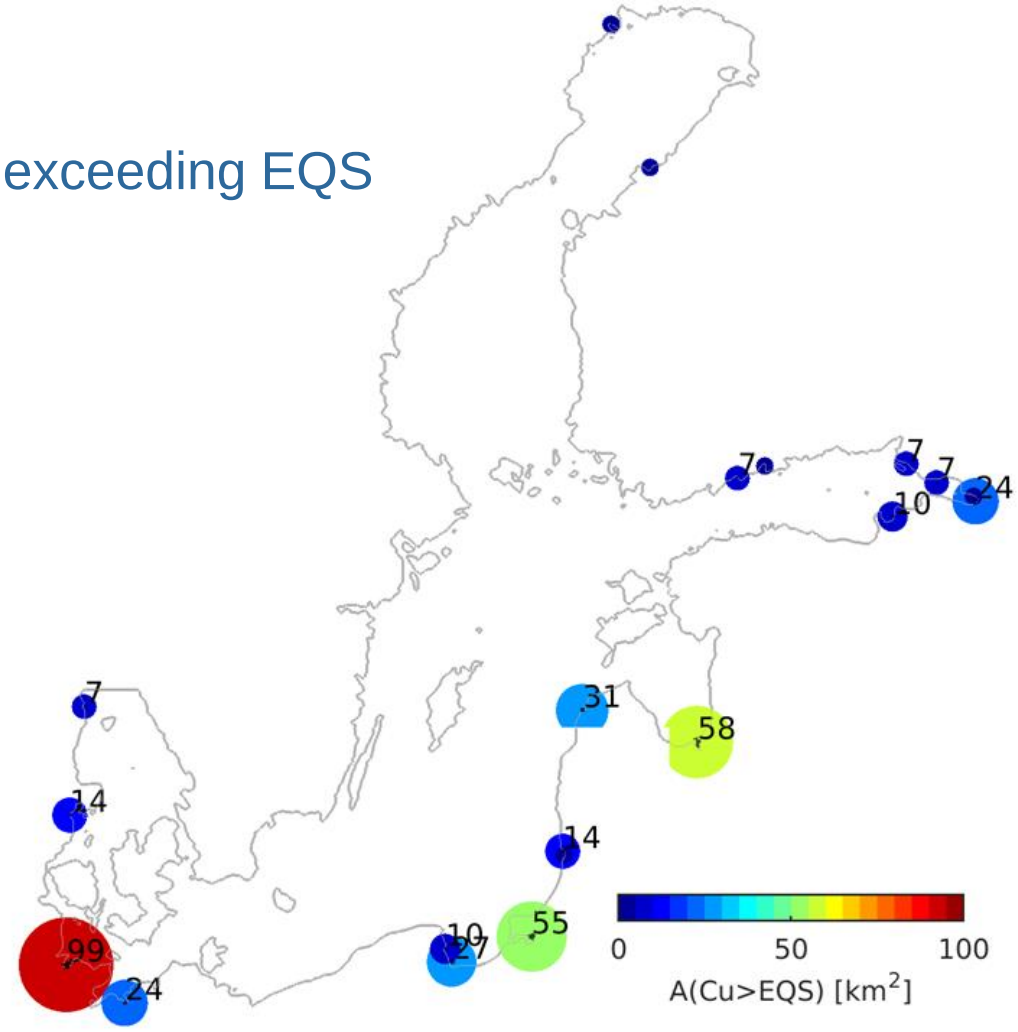
BONUS

Contaminant concentrations in the water



Shipping pollution in relation to EU environmental directives

Copper concentrations exceeding EQS



From pressures to state – air pollution

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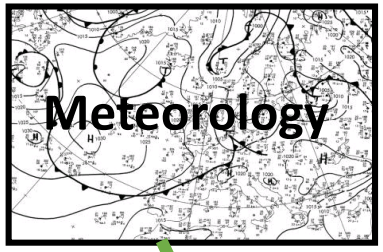
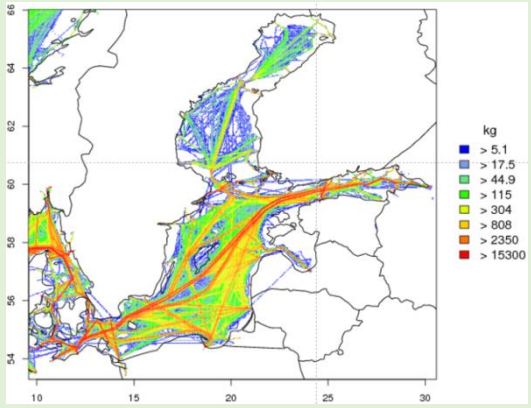
Sustainable Shipping and Environment of the Baltic Sea region

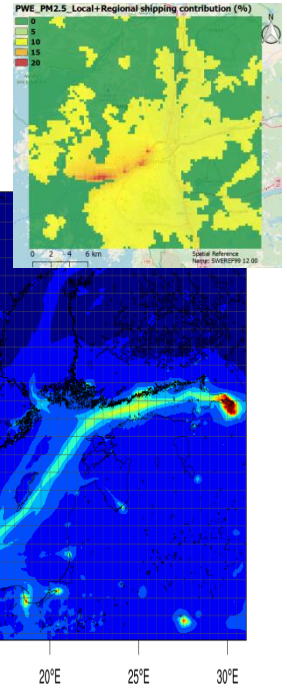


Air emissions



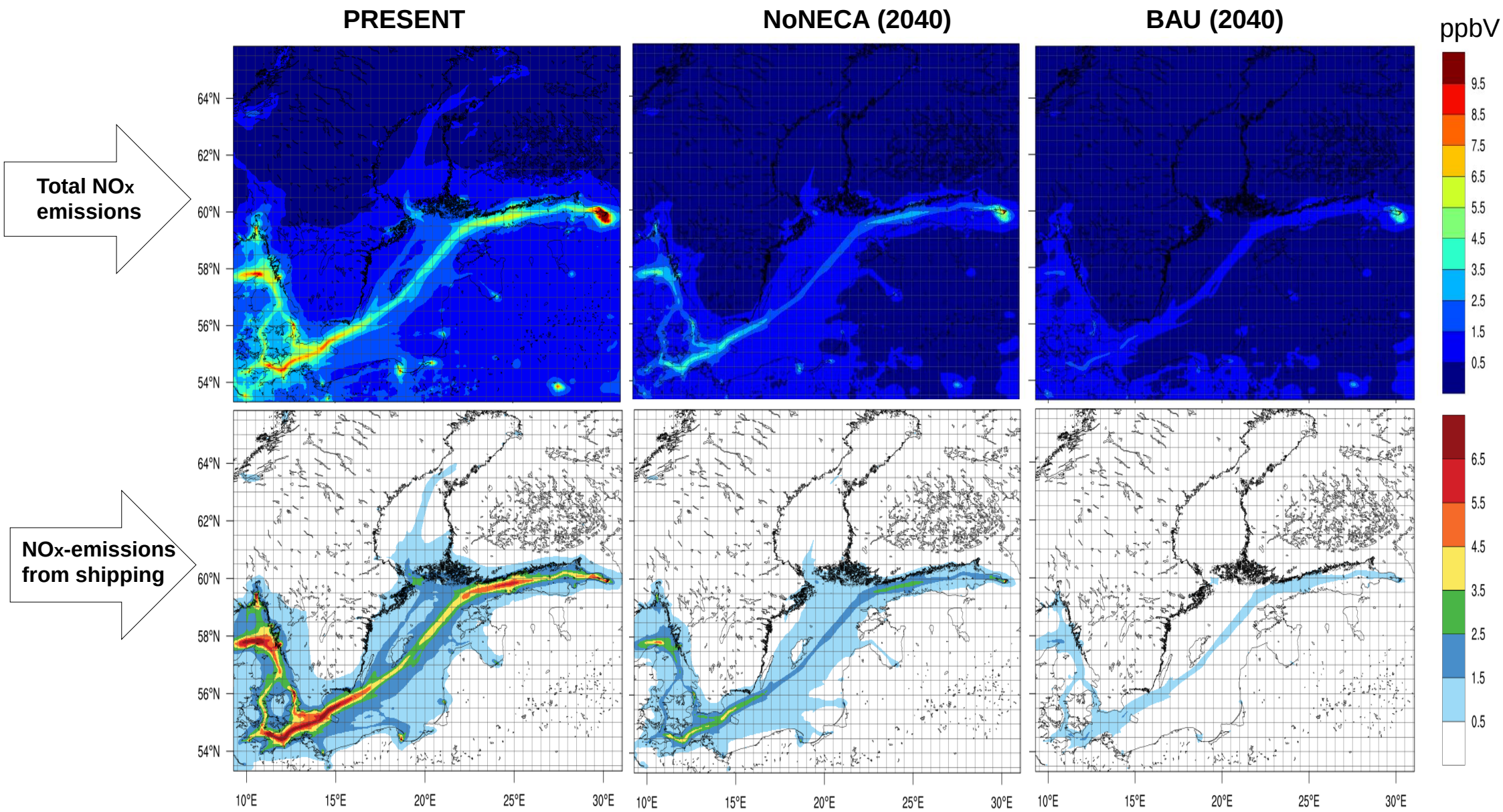
Chemistry transport models: Regional & urban scale

Atmospheric concentrations & depositions

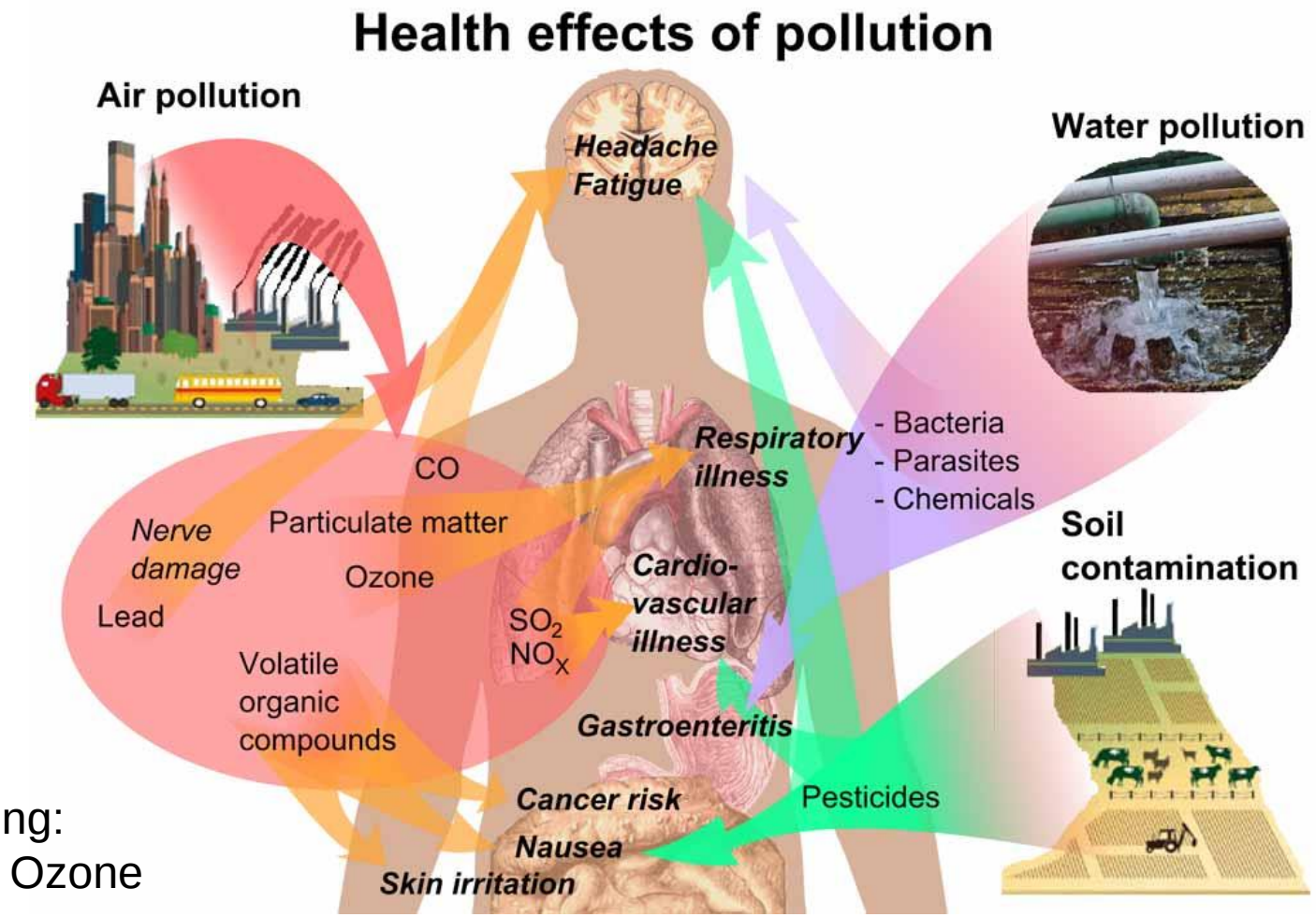


BONUS

NO_2 concentration



Effects of air pollution on health



From shipping:
NO_2, $PM_{2.5}$, Ozone

Evaluation of effects on human health – efficiency of policy measures

Policy options	Damage valuation, mid VOLY (M€/year)	Damage valuation, mid VSL (M€/year)	Valuation of lost working days (M€/year)
Slow steaming (SlSt-BAU)	-53	-211	-3
Stricter EEDI (BAU-EEDI)	-136	-527	-6
LNG (LNG-BAU)	-89	-356	-4

Evaluation of effects on human health (year 2040, compared to BAU)