

Prospective Life Cycle Impact Scenarios of Container Shipping

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SMART MARITIME

sfi = Centre for
Research-based
Innovation

The Research Council of Norway

Duration: 2015-2023

Budget: 20 MEUR



WP 1

Feasibility studies



WP 2

Hull and propeller
optimization



WP 3

Power systems and
fuel



WP 4

Ship system
integration and
validation



WP 5

Environmental and
economic due
diligence

RESEARCH ORGANISATIONS

SINTEF Ocean

 NTNU

DESIGN, EQUIPMENT, SHIP BUILDERS



Rolls-Royce

ABB



 JOTUN



SIEMENS

VARD
a Fincentieri company



norwegian
electric systems

WÄRTSILÄ

SHIP OPERATORS



Wilh. Wilhelmsen



SOLVANG ASA



GRIEG STAR



KRISTIAN GERHARD JEBSEN
SKIPSREDERI
PART OF THE KRISTIAN GERHARD JEBSEN GROUP

OTHER PARTNERS



Kystrederiene

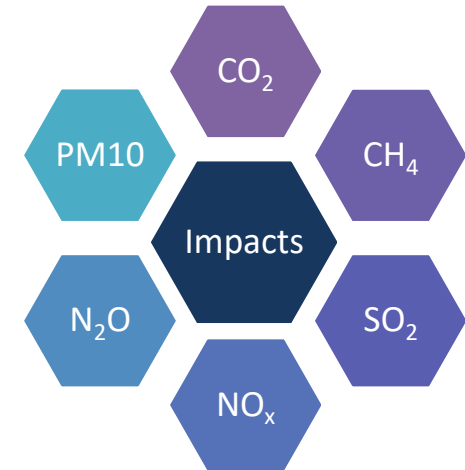
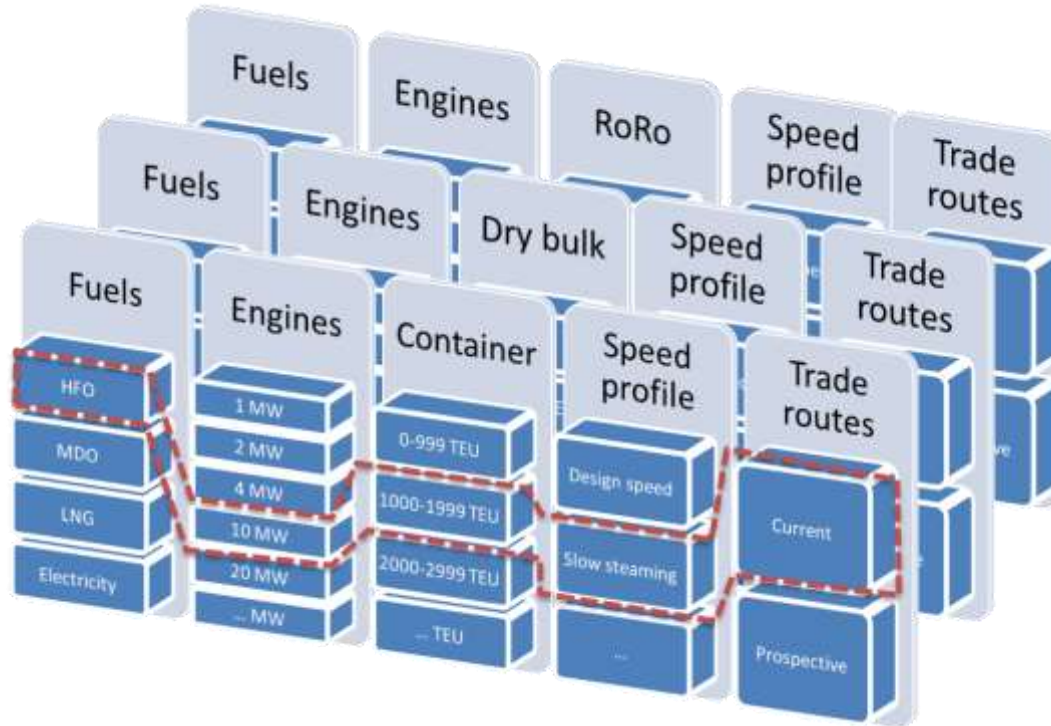


Norges
Rederiforbund
Norwegian
Shipowners'
Association

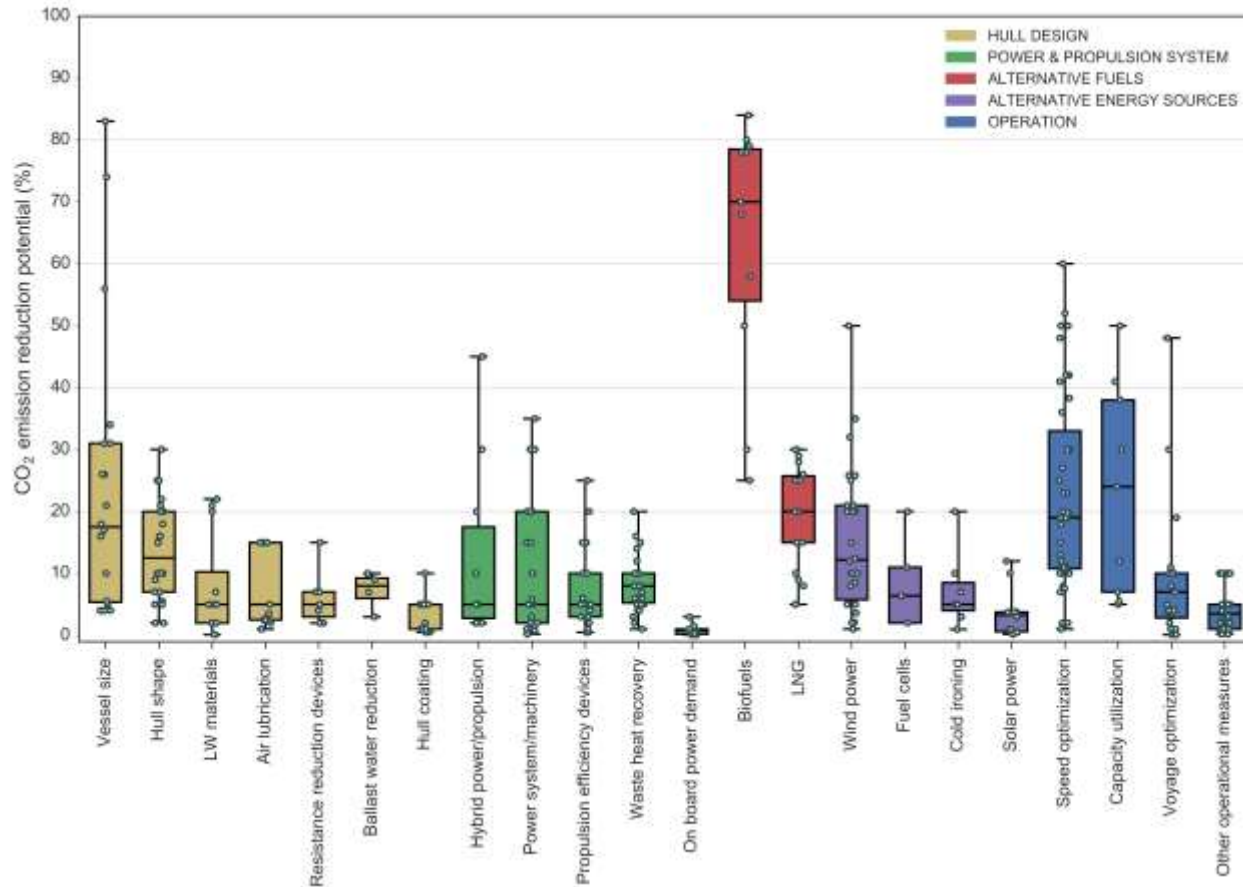


Sjøfartsdirektoratet
Norwegian Maritime Authority

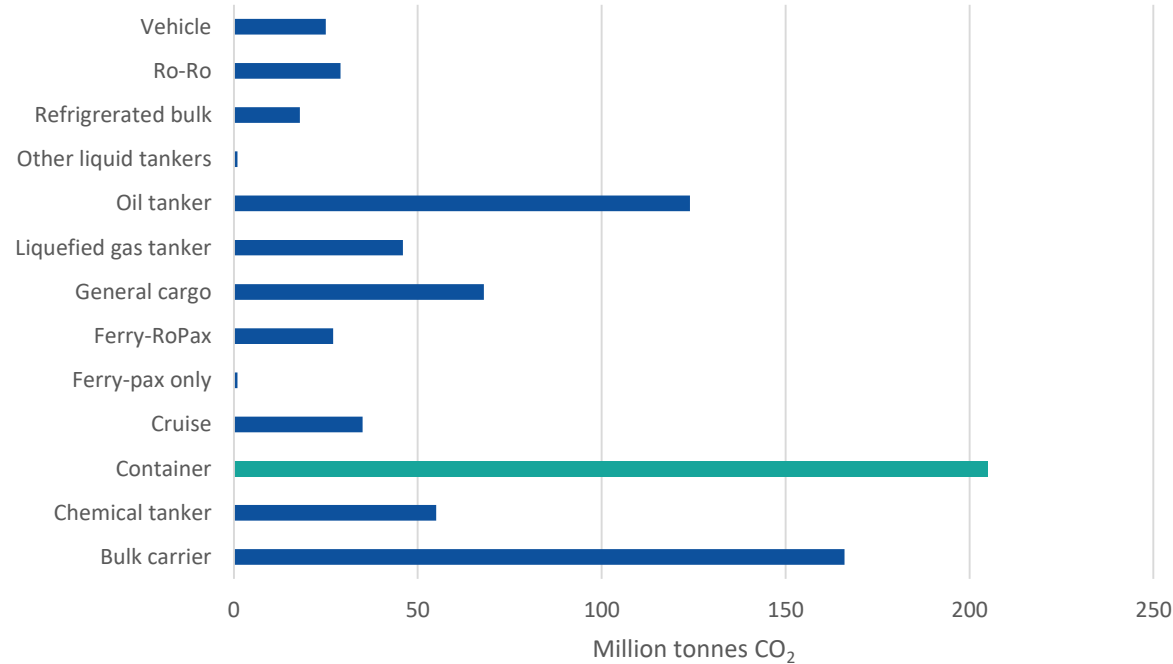
MariTEAM Model - from LCA of individual ship designs to fleet level assessments



Review of mitigation options



Bouman et al. (2017)
Trans. Res. Part D, 52
pp 408-421



Results for the Containership Fleet in 2016



- Economy of scale-effect



0-2300 TEU
38.5 g CO₂e/tkm



2300-4000 TEU
7.30 g CO₂e/tkm
(Ecoinvent size equivalent)



4000-6500 TEU
6.37 g CO₂e/tkm



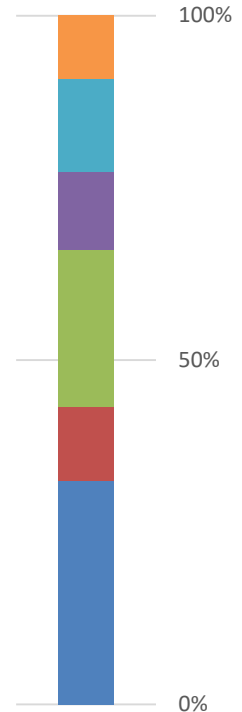
6500-8500 TEU
4.37 g CO₂e/tkm



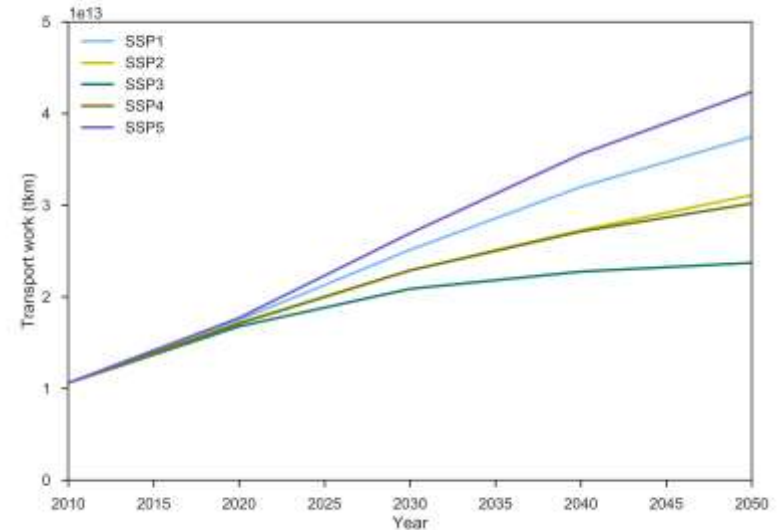
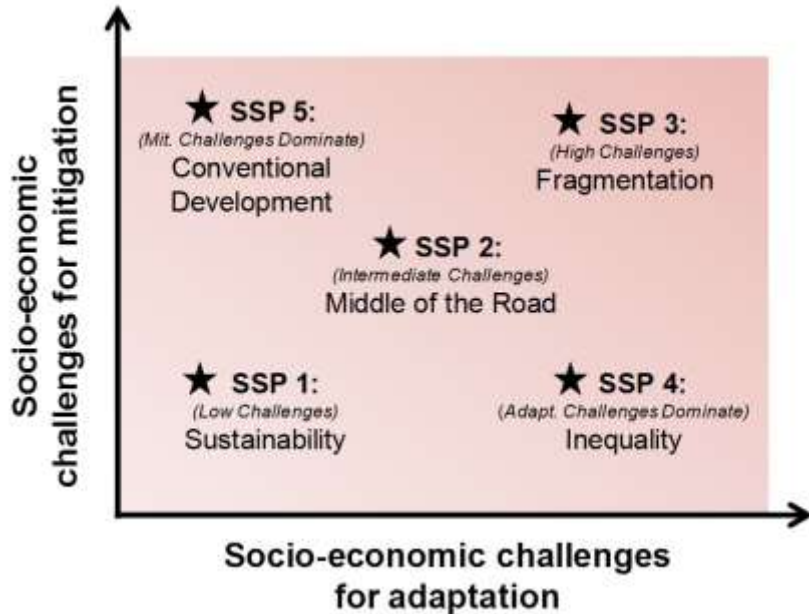
8500-12500 TEU
3.51 g CO₂e/tkm



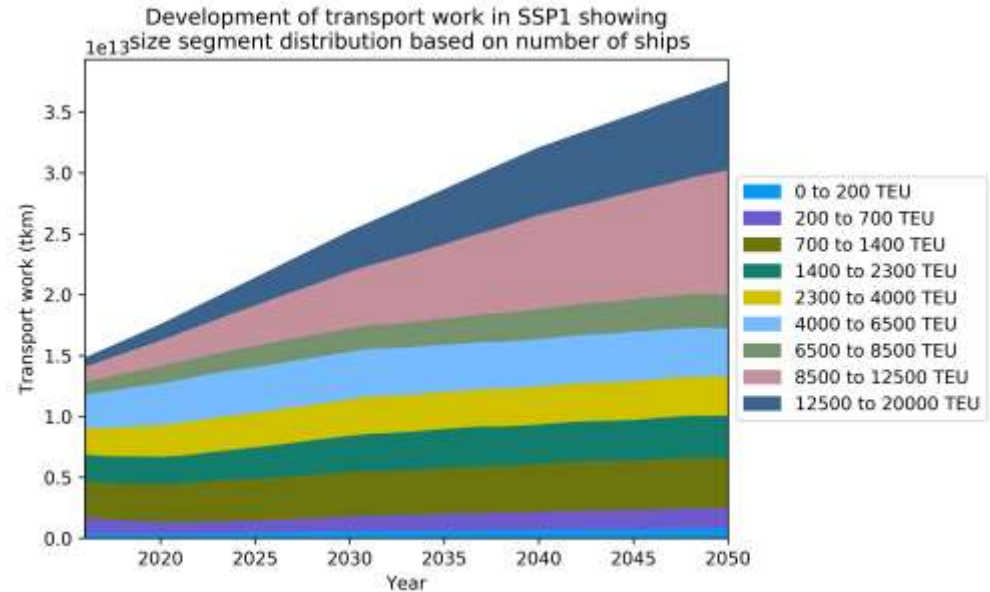
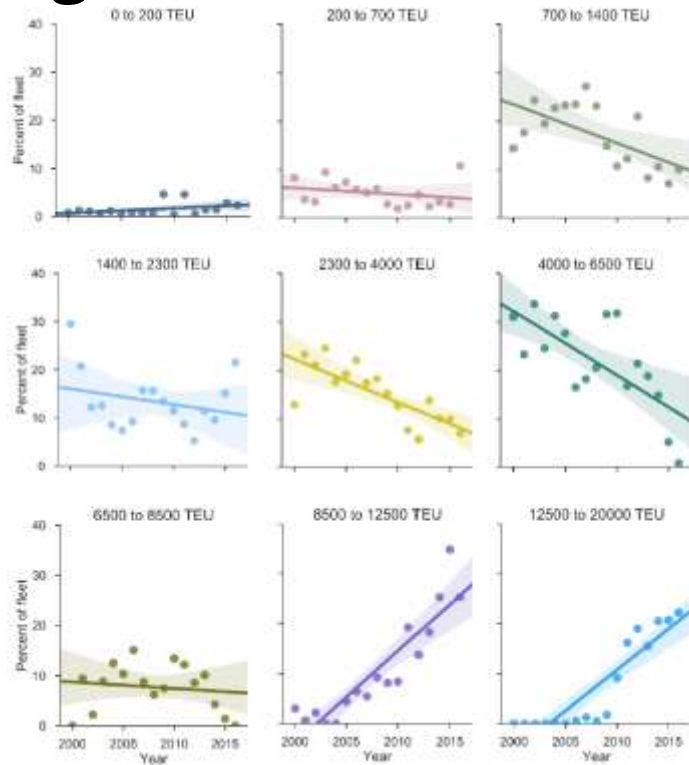
12500-20000 TEU
2.64 g CO₂e/tkm



Designing Shipping Scenarios aligned with the Shared Socioeconomic Pathways (IPCC)



Historic fleet data inform scenarios for different segments



Results obtained for individual ships as well as for fleet level scenarios



12500 to 20000 TEU

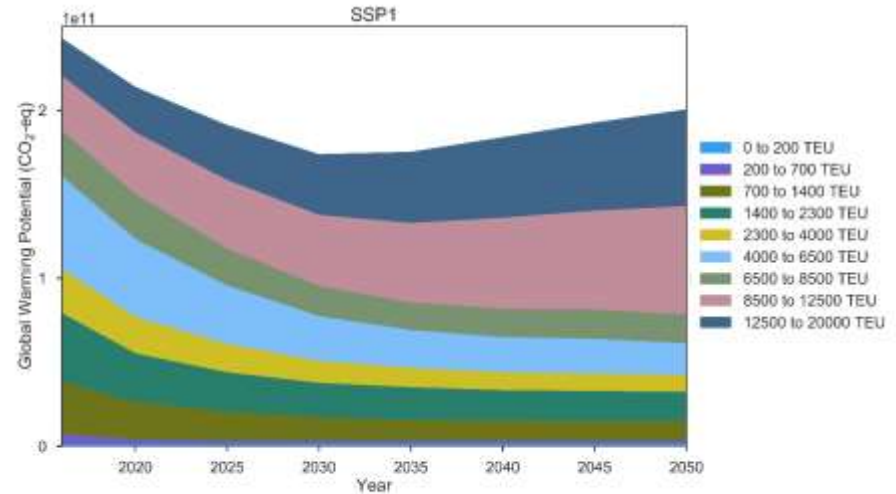
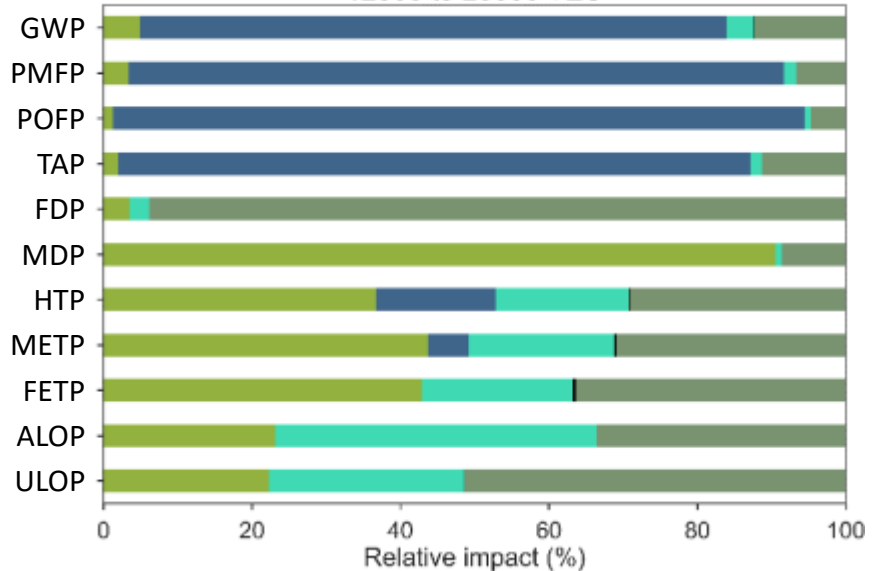


Figure 5-3: Development of GWP from 2016 to 2050 in SSP1.

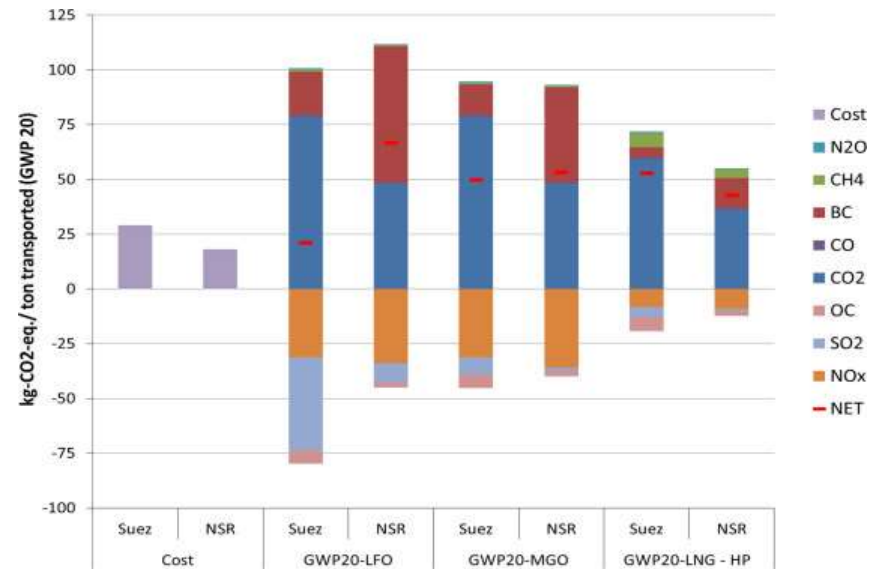
Location affects the climate impacts of emissions



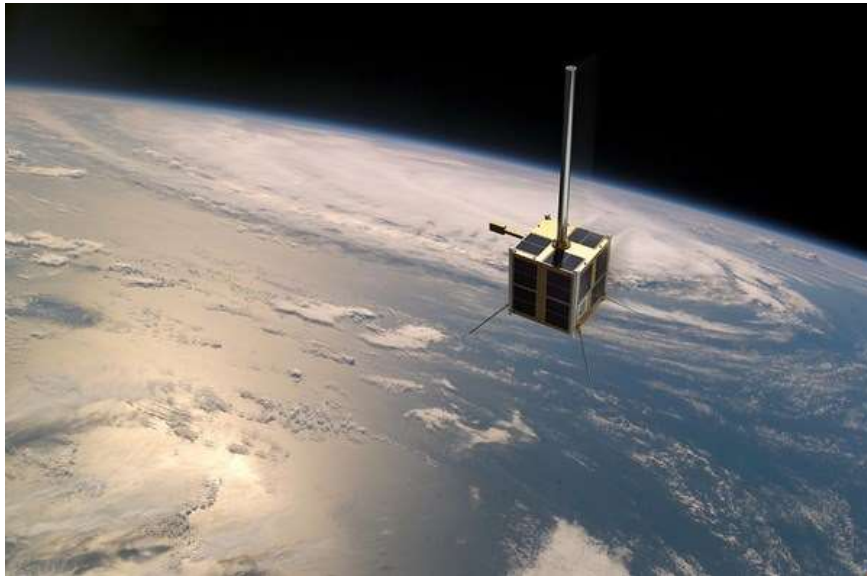
Table 3
Global Warming Potential (kg-CO₂-equivalents/kg emission).

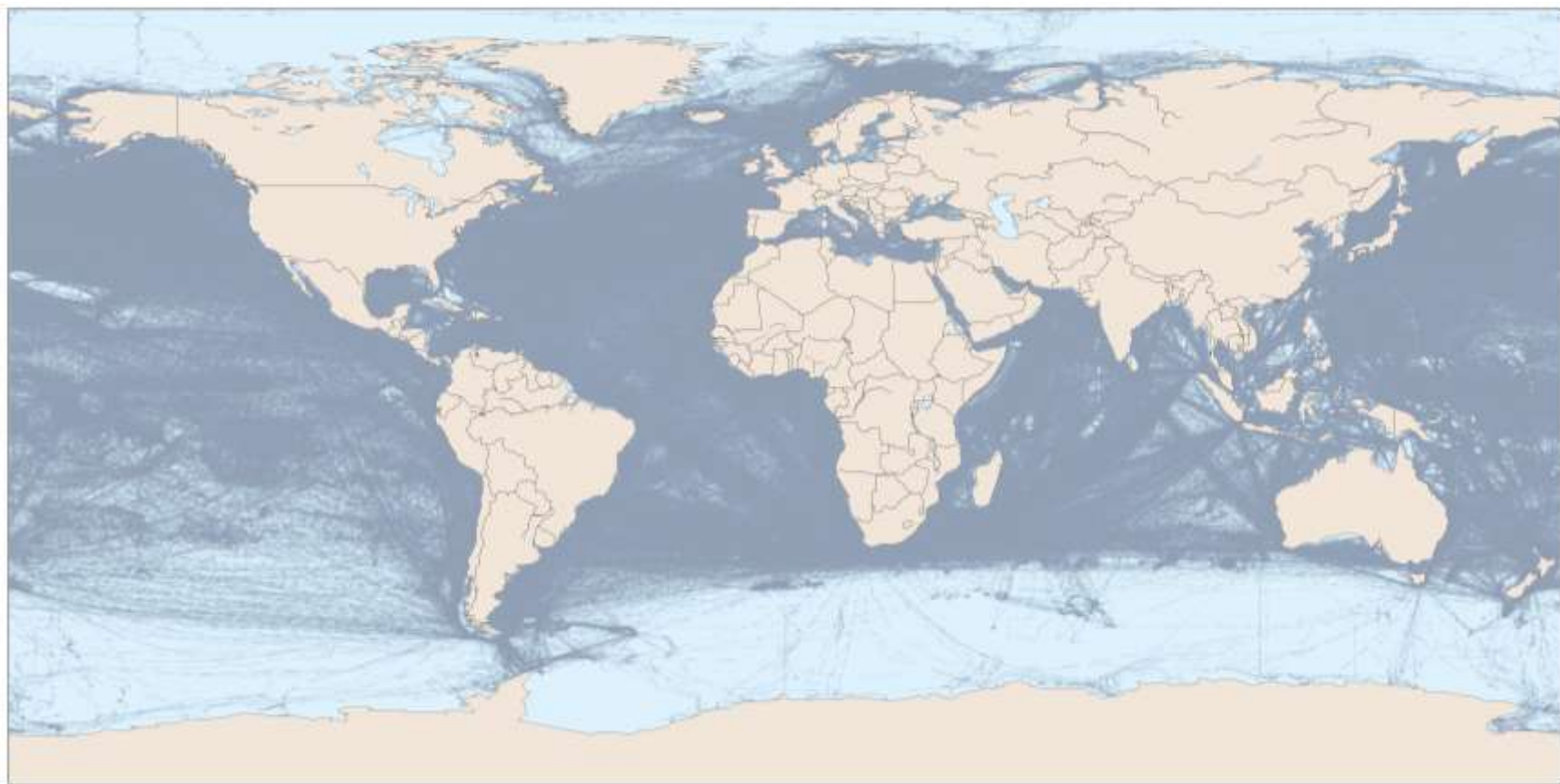
Emission type	CO ₂	BC	CH ₄	CO	N ₂ O	NO _x	SO ₂	OC
GWP ₂₀ world factors	1	1200	85	5.4	264	-15.9	-141	-240
GWP ₂₀ Arctic factors	1	6200	85	5.4	264	-31	-47	-151
GWP ₁₀₀ world factors	1	345	30	1.8	265	-11.6	-38	-69
GWP ₁₀₀ Arctic factors	1	1700	30	1.8	265	-25	-13	-43

Negative values shown in Table 3 have a cooling effect and positive has a warming effect.



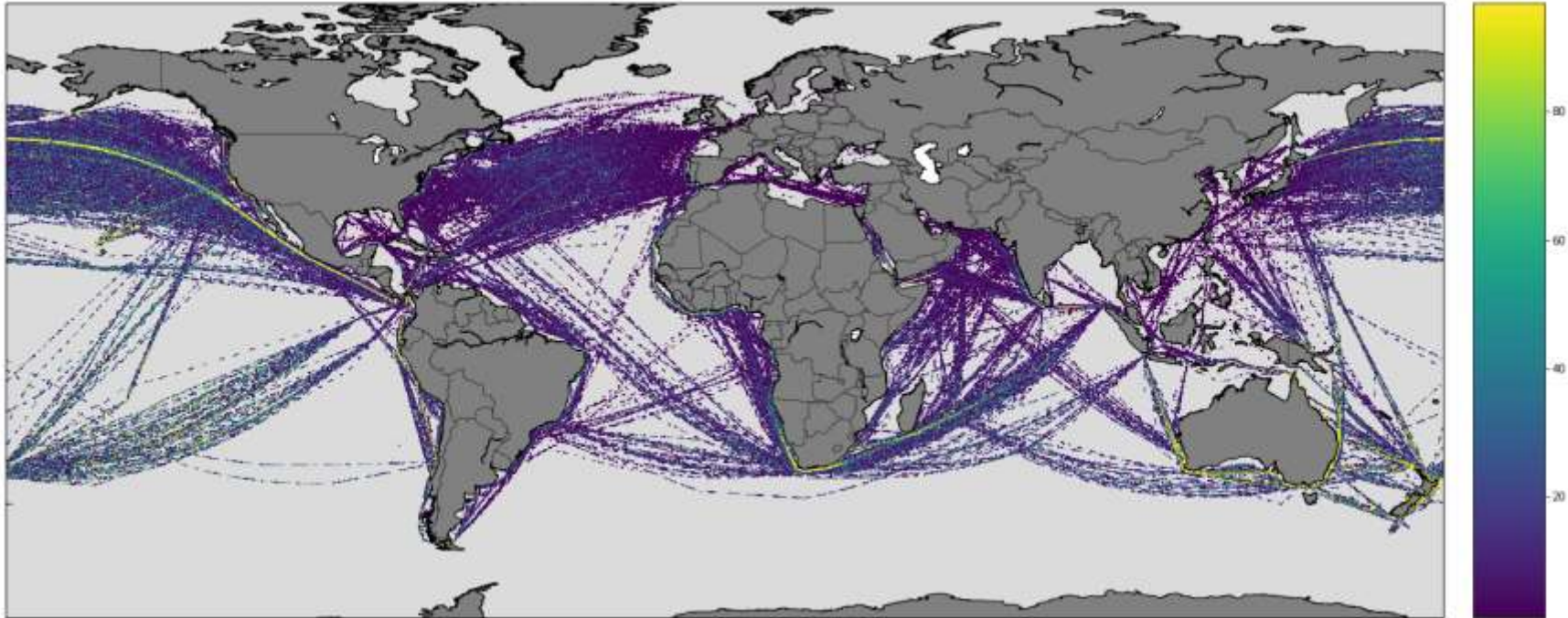
AISsat 1 & 2 data covers global fleet



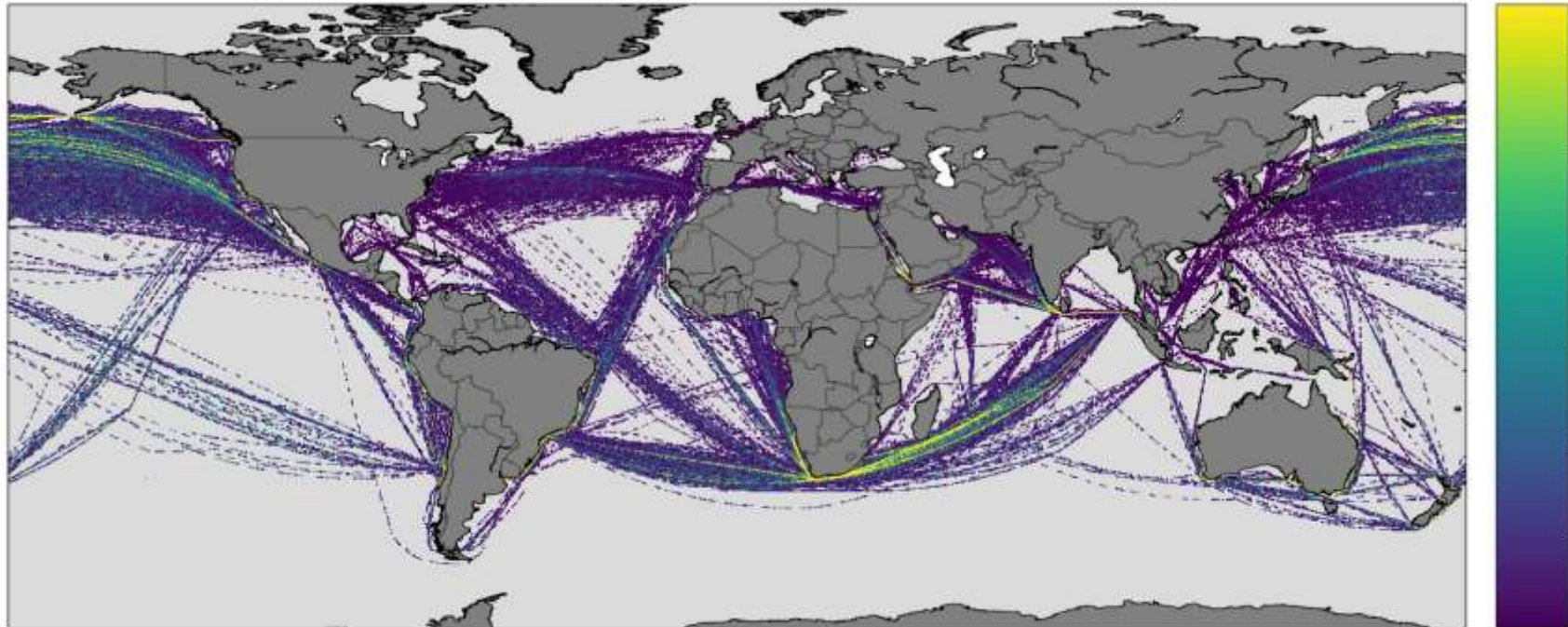


Message density, Panamax (738 ships)

Containerships 3000-6000 TEU and beam < 32.3 m

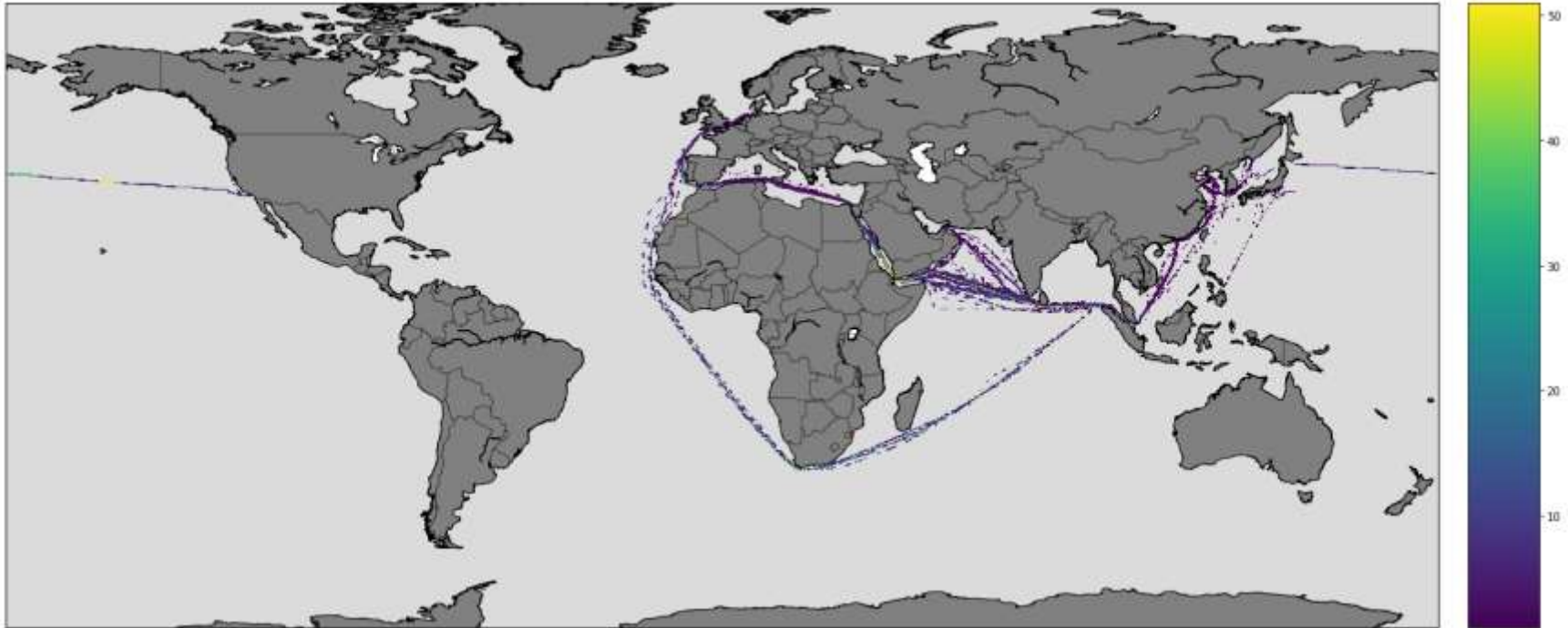


Message density, Post-Panamax (1084 ships) Containerships 4500-10000 TEU and beam > 32.3 m



Message density, Ultra Large Container Vessels (81 ships)

Containerships > 14500 TEU



Example results



Containership

46 m beam

304 m length_BP

14.5 m draught

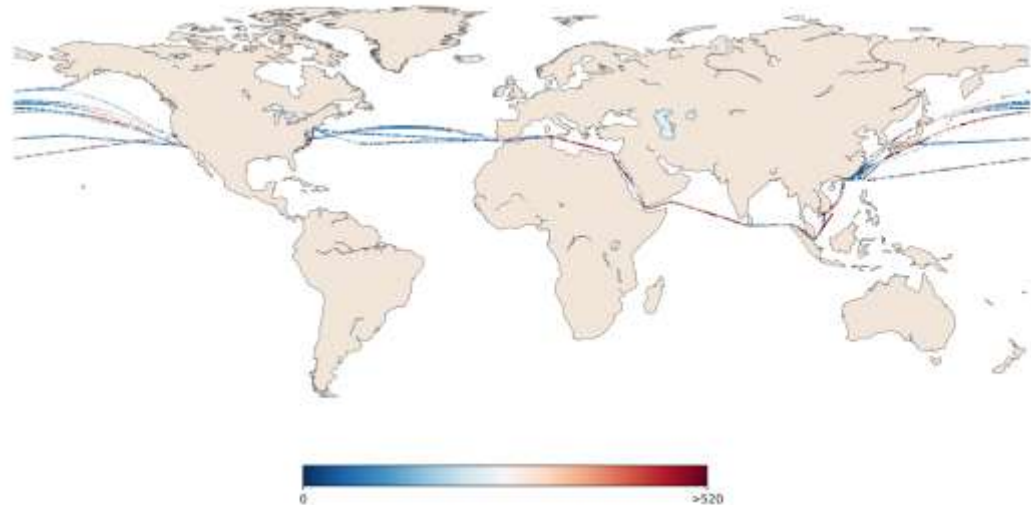
90647 ton

displacement

64 1 MW engine



SO₂ emissions in kg yr⁻¹ along a maritime route on 0.1 x 0.1 degree grid



Example results



Containership

46 m beam

304 m length_BP

14.5 m draught

90647 ton

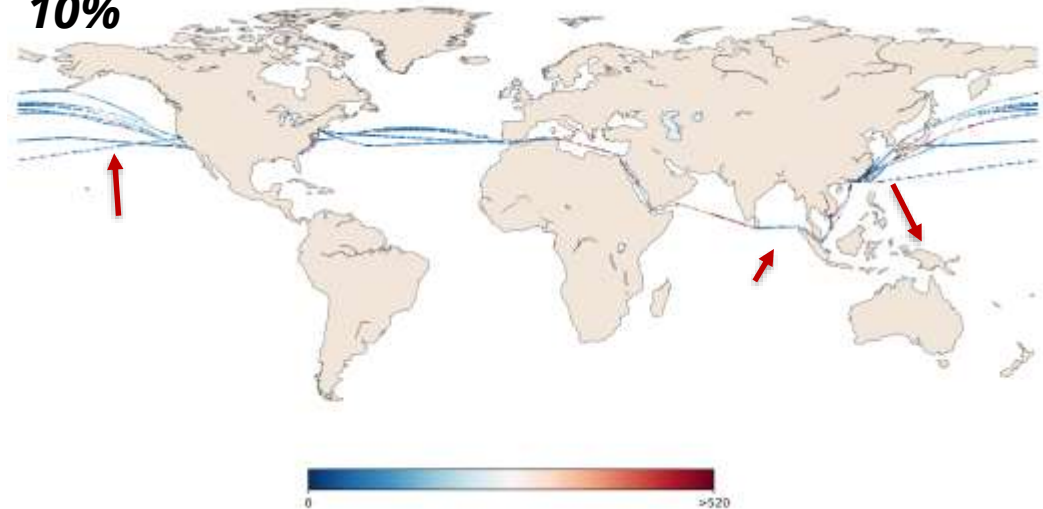
displacement

64.1 MW engine



SO₂ emissions in kg along a maritime route on 0.1 x 0.1 degree grid **when speed is reduced with 10%**

→
Less
red



MariTEAM Model

