

# 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

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SINTEF Ocean

 NTNU

## DESIGN, EQUIPMENT, SHIP BUILDERS

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Rolls-Royce

ABB



SIEMENS

VARD  
a Fincantieri company



norwegian  
electric systems



## SHIP OPERATORS

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Wilh. Wilhelmsen



SOLVANG ASA



GRIEG STAR



KRISTIAN GERHARD JØBSEN  
SKIPSREDERI

PART OF THE KRISTIAN GERHARD JØBSEN GROUP

## OTHER PARTNERS

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Kystrederiene

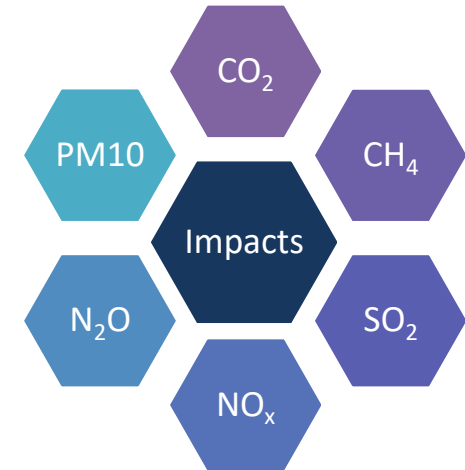
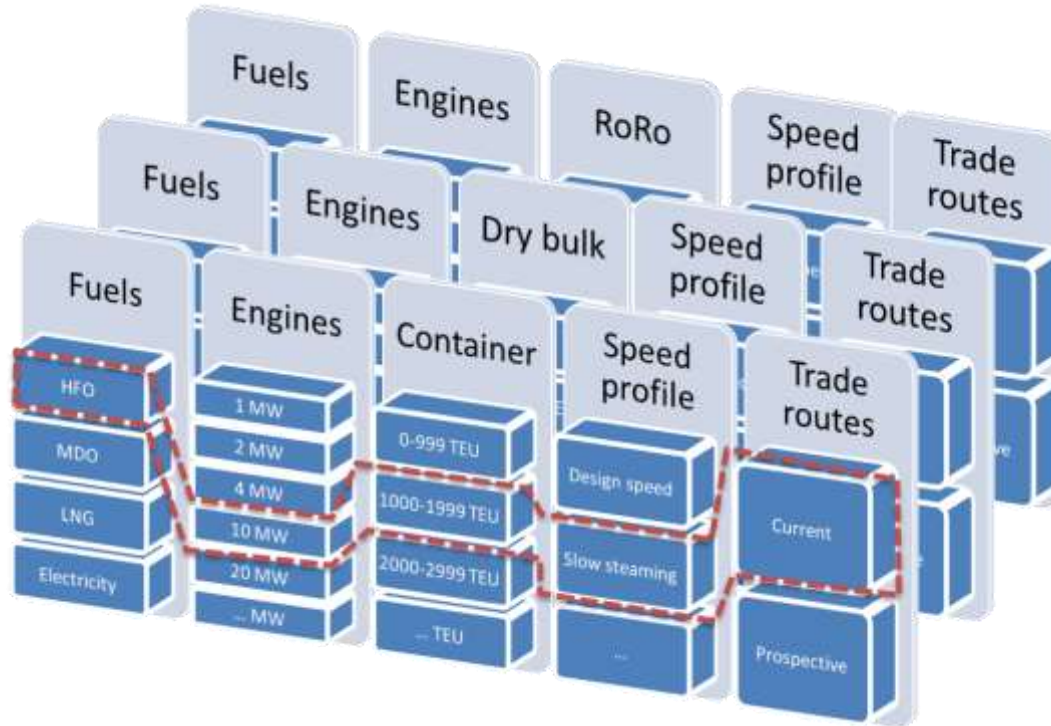


Norges  
Rederiforbund  
Norwegian  
Shipowners'  
Association

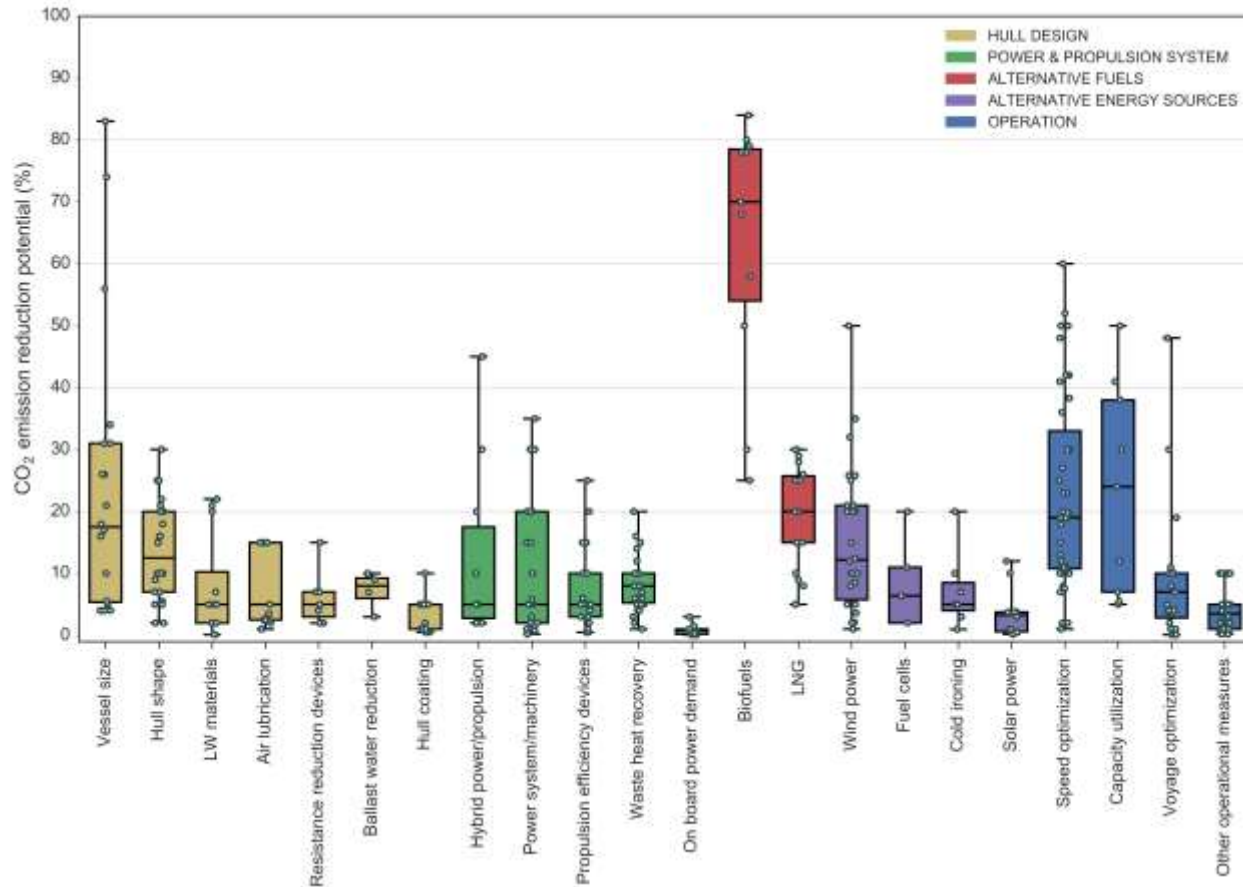


Sjøfartsdirektoratet  
Norwegian Maritime Authority

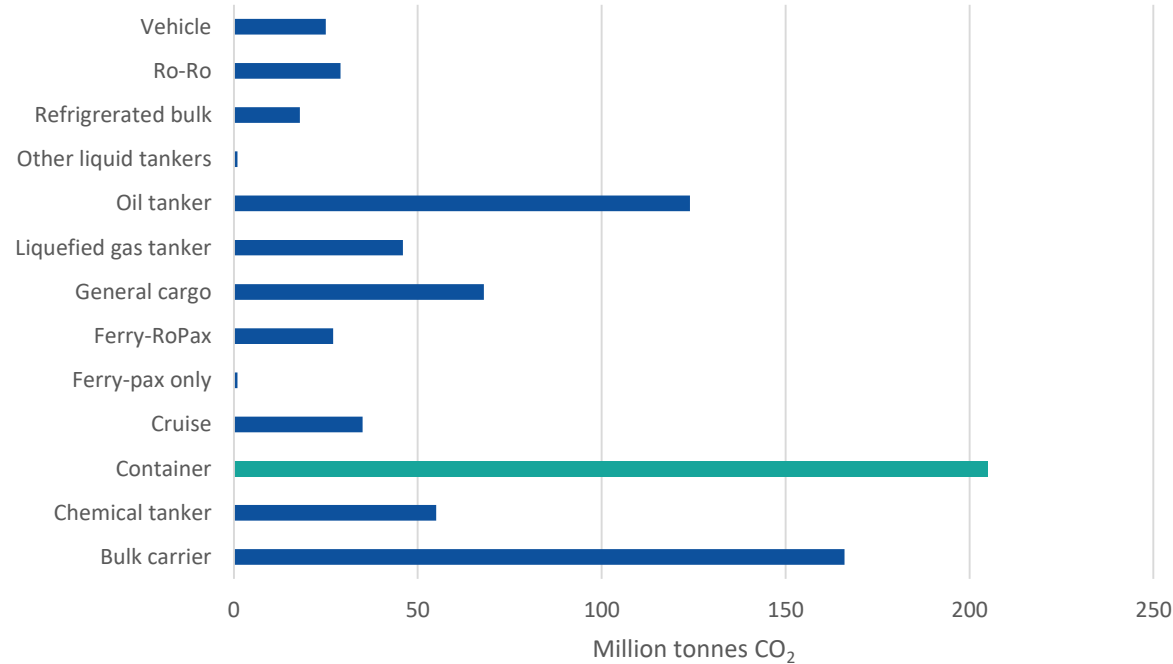
# MariTEAM Model - from LCA of individual ship designs to fleet level assessments



# 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 CO<sub>2</sub>e/tkm



6500-8500 TEU  
4.37 g CO<sub>2</sub>e/tkm



2300-4000 TEU  
7.30 g CO<sub>2</sub>e/tkm  
*(Ecoinvent size equivalent)*



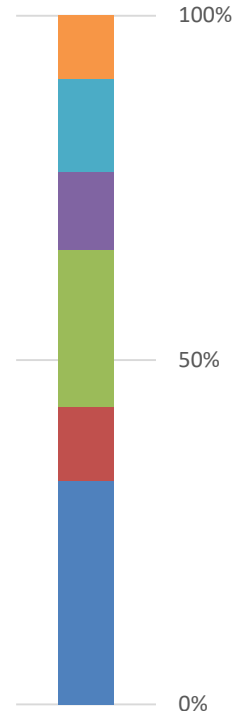
8500-12500 TEU  
3.51 g CO<sub>2</sub>e/tkm



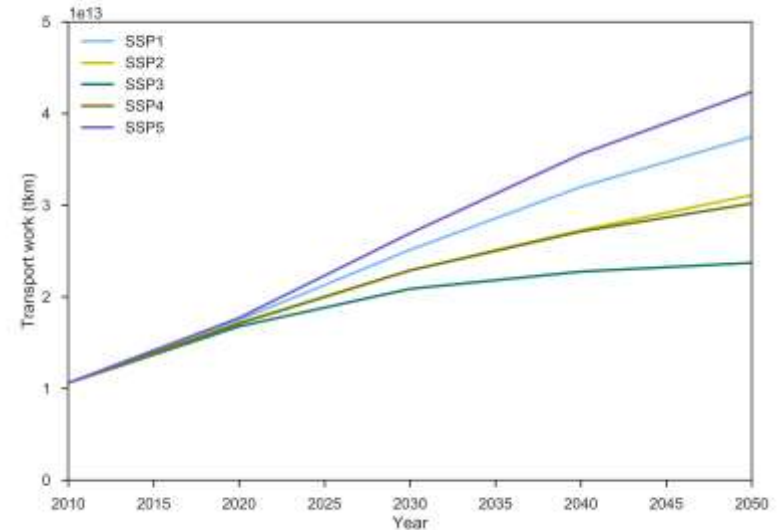
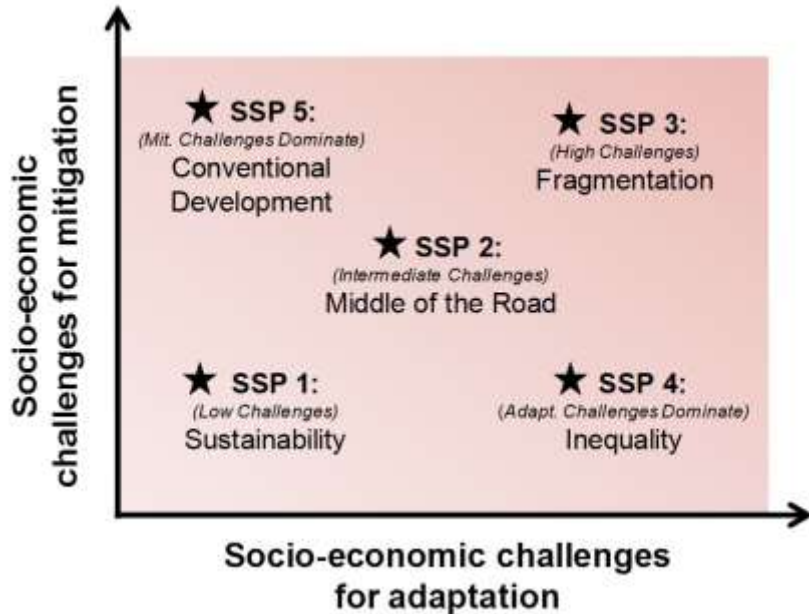
4000-6500 TEU  
6.37 g CO<sub>2</sub>e/tkm



12500-20000 TEU  
2.64 g CO<sub>2</sub>e/tkm

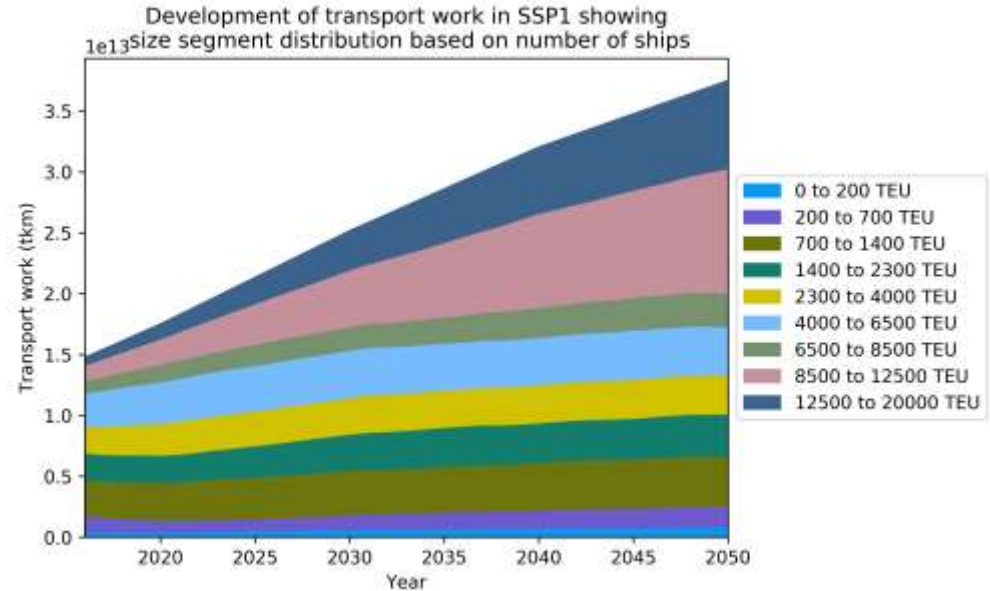
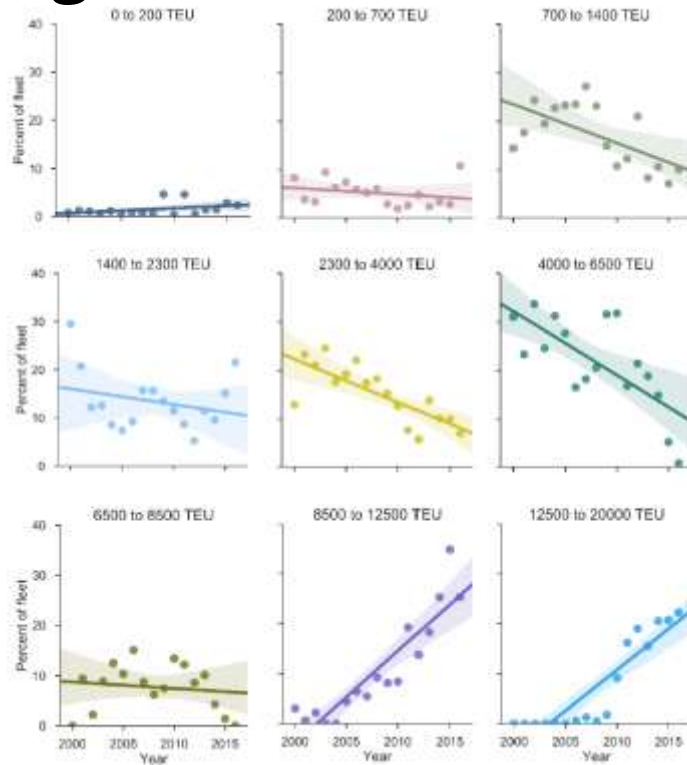


# Designing Shipping Scenarios aligned with the Shared Socioeconomic Pathways (IPCC)





# Historic fleet data inform scenarios for different segments



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



12500 to 20000 TEU

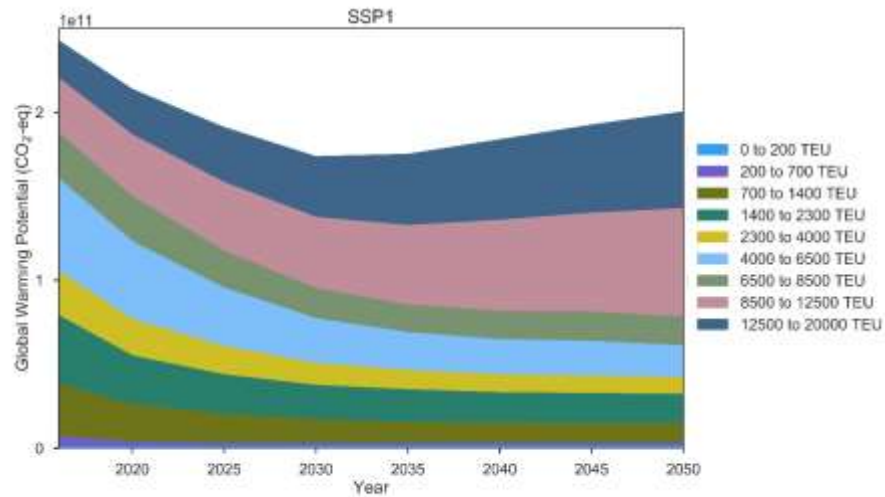
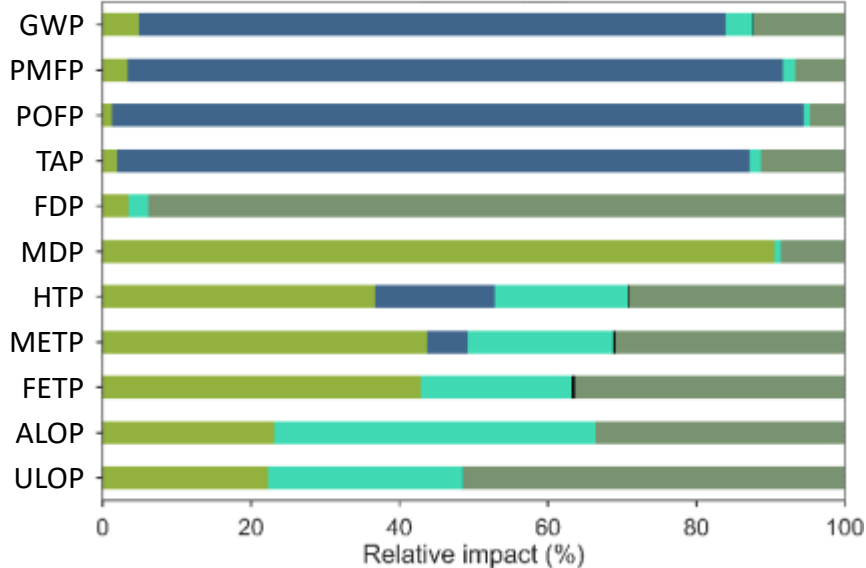


Figure 5-3: Development of GWP from 2016 to 2050 in SSP1.

Construction    Operation, Propulsion    Operation, Other    End-of-Life    Fuel

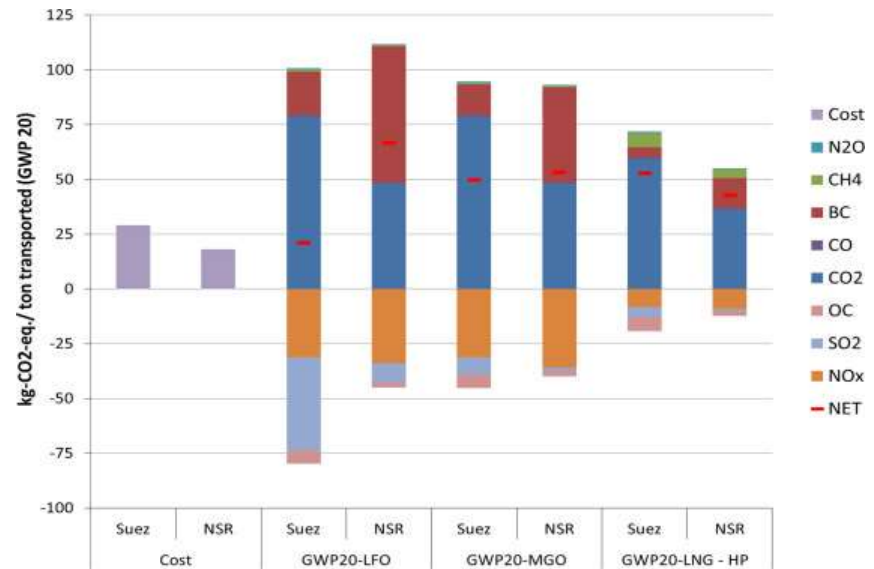
# Location affects the climate impacts of emissions



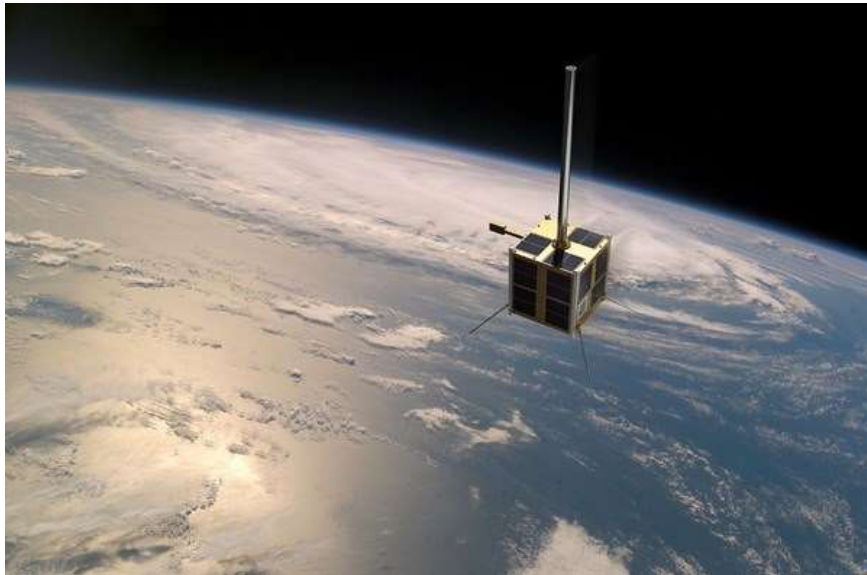
**Table 3**  
Global Warming Potential (kg-CO<sub>2</sub>-equivalents/kg emission).

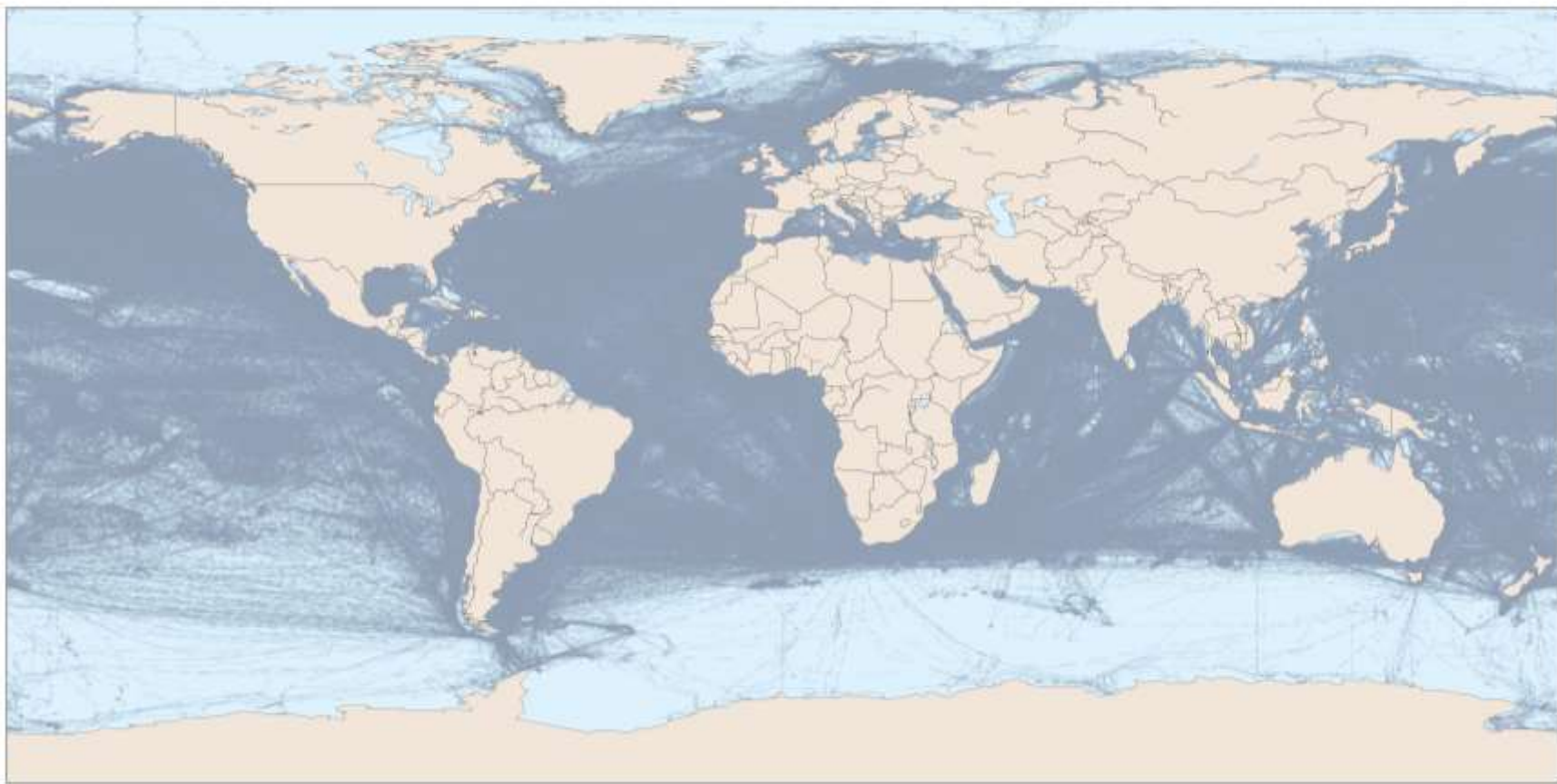
Emission type	CO <sub>2</sub>	BC	CH <sub>4</sub>	CO	N <sub>2</sub> O	NO <sub>x</sub>	SO <sub>2</sub>	OC
GWP <sub>20</sub> world factors	1	1200	85	5.4	264	-15.9	-141	-240
GWP <sub>20</sub> Arctic factors	1	6200	85	5.4	264	-31	-47	-151
GWP <sub>100</sub> world factors	1	345	30	1.8	265	-11.6	-38	-69
GWP <sub>100</sub> 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.



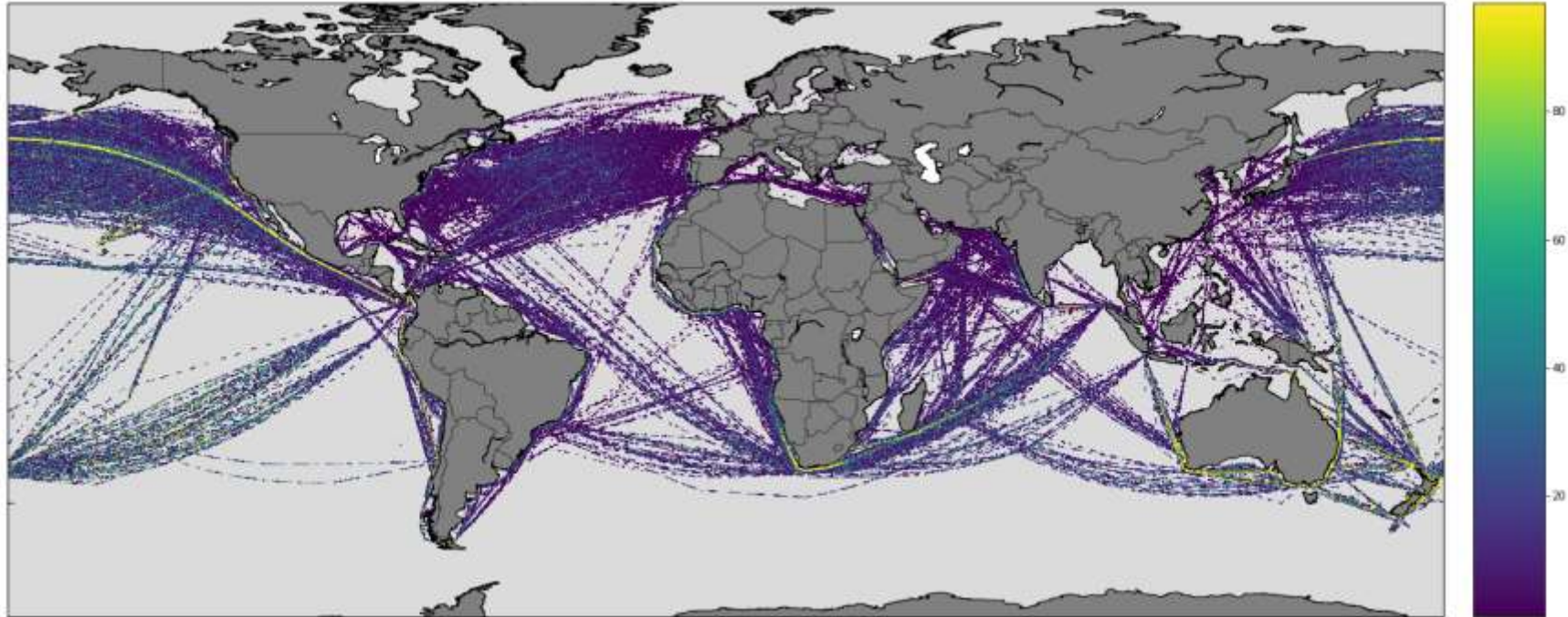
# AISsat 1 & 2 data covers global fleet



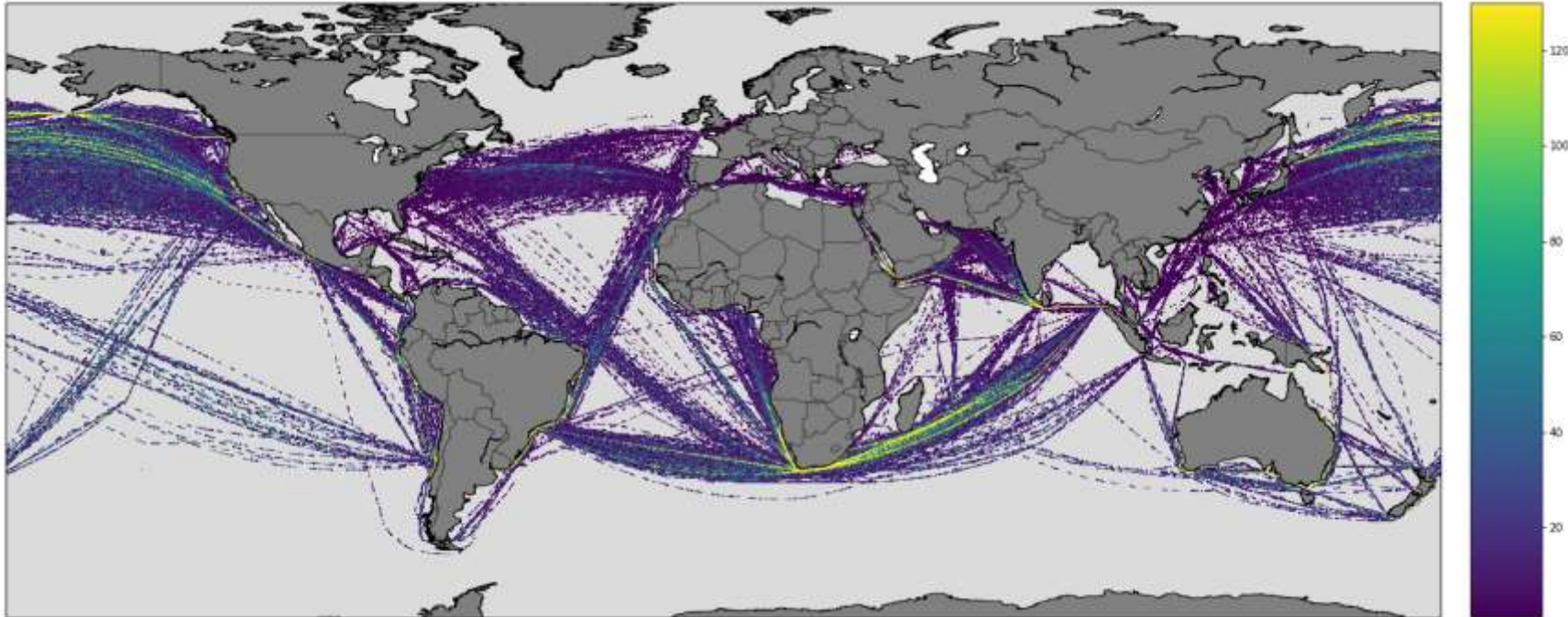


# Message density, Panamax (738 ships)

## Containerships 3000-6000 TEU and beam < 32.3 m

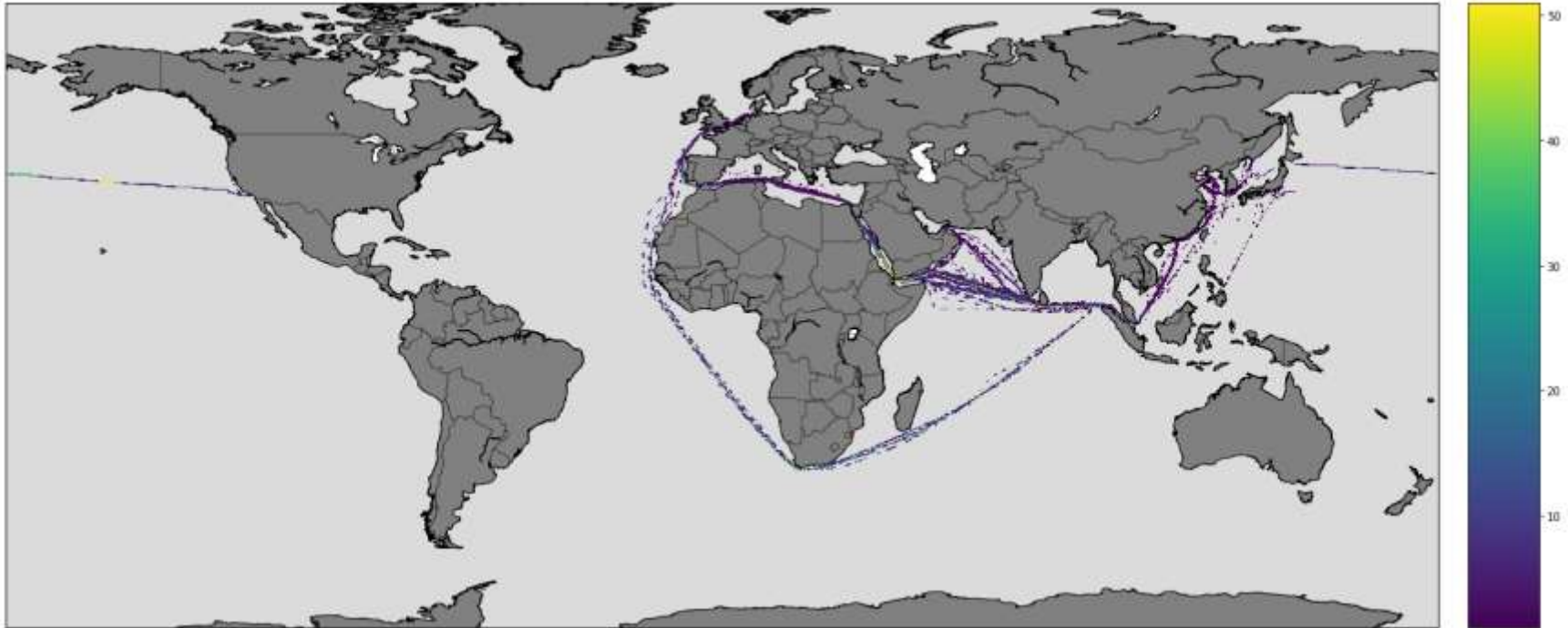


# Message density, Post-Panamax (1084 ships) Containerships 4500-10000 TEU and beam > 32.3 m



# 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

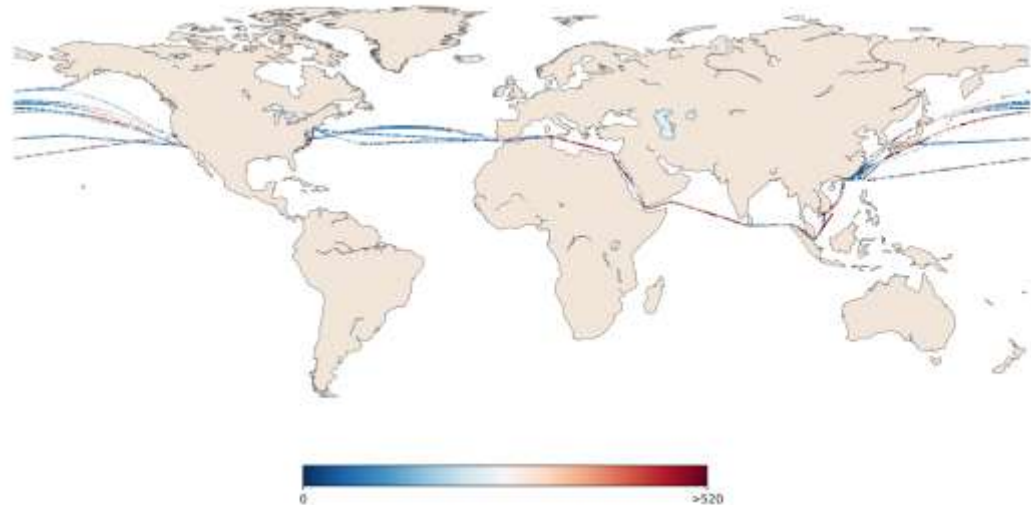
90647 ton

displacement

64 1 MW engine



SO<sub>2</sub> emissions in kg yr<sup>-1</sup> 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

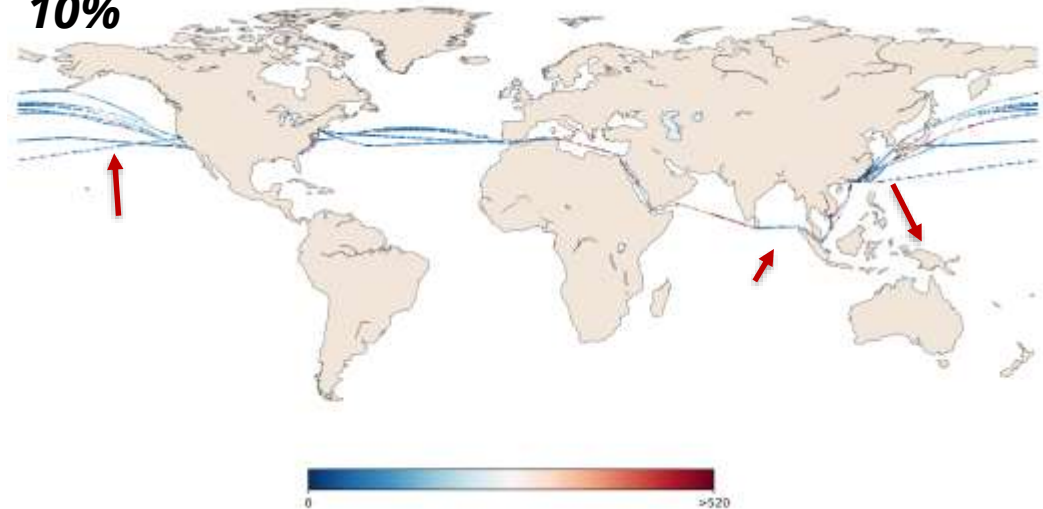
displacement

64.1 MW engine



SO<sub>2</sub> 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

