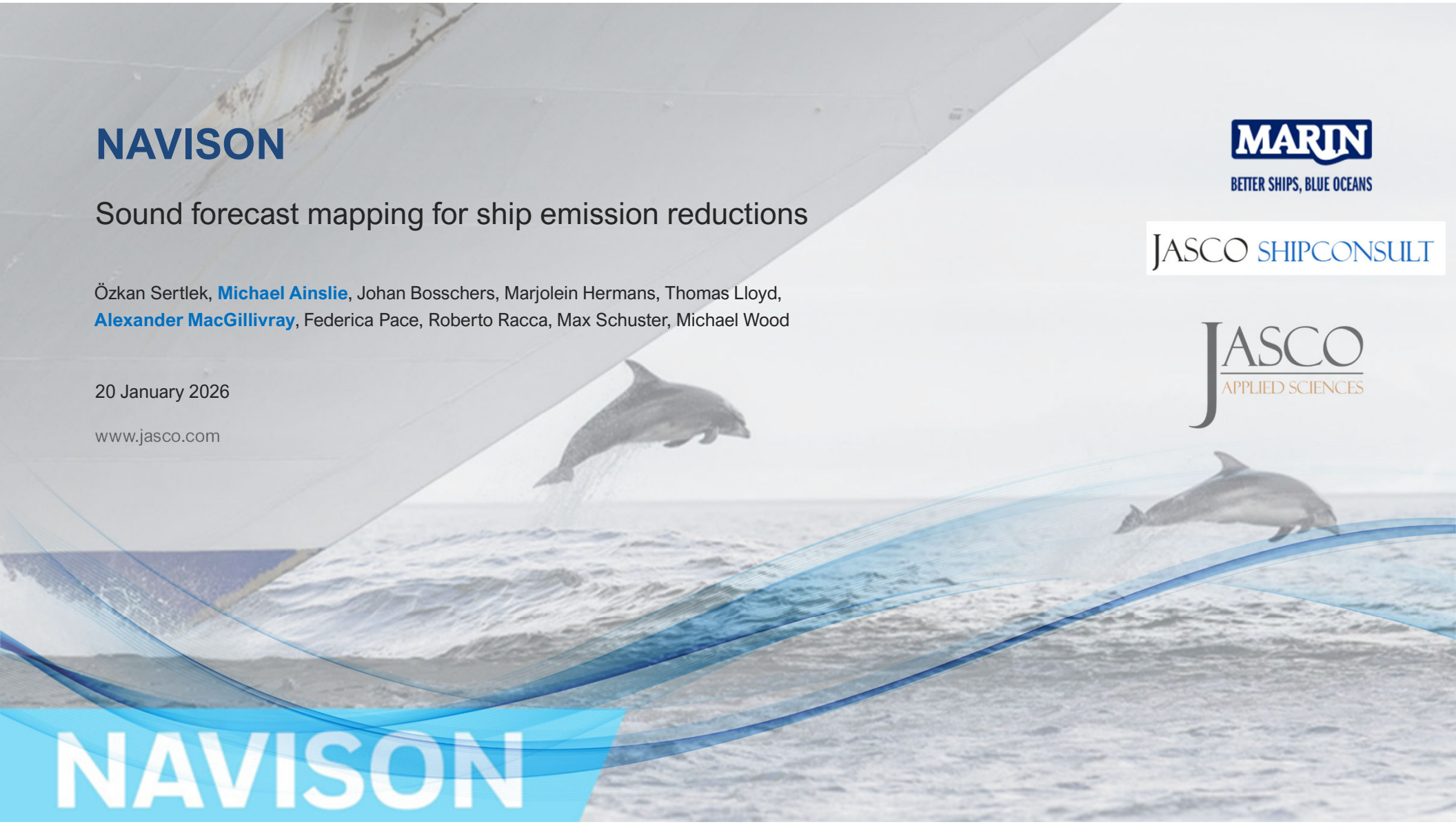

NAVISON

Sound forecast mapping for ship emission reductions

Özkan Sertlek, **Michael Ainslie**, Johan Bosschers, Marjolein Hermans, Thomas Lloyd, **Alexander MacGillivray**, Federica Pace, Roberto Racca, Max Schuster, Michael Wood

20 January 2026

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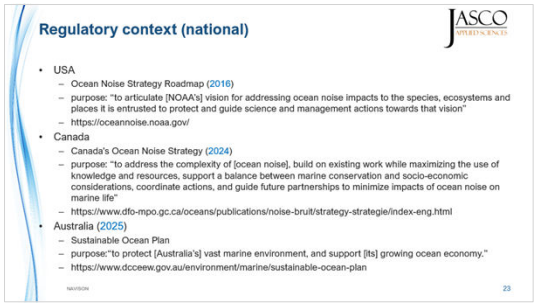
NAVISON: Sound forecast mapping for ship emission reductions

- Background to NAVISON project
  - Regulatory context
  - NAVISON overview
- NAVISON project
  - Hindcast sound maps and trends
  - Forecast sound maps
  - Synergy with greenhouse gas (GHG) emissions
- Conclusions

Regulatory context (national)



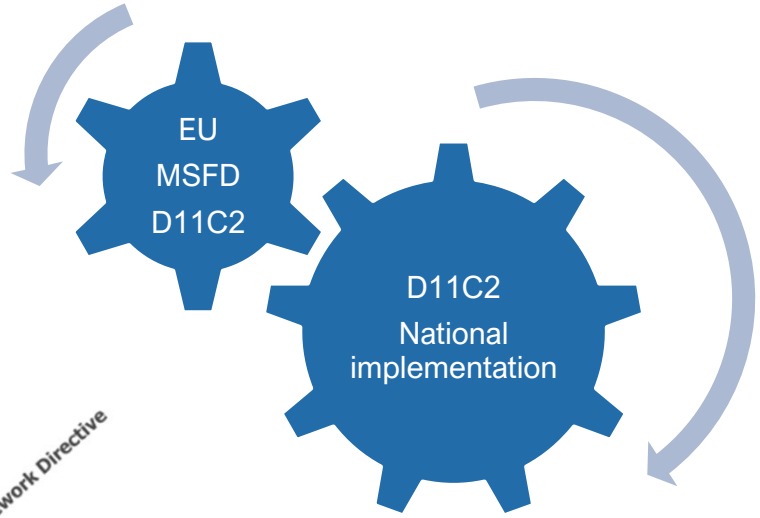
- USA
  - Ocean Noise Strategy Roadmap (2016)
  - "**to articulate [NOAA's] vision** for addressing ocean noise impacts …"
  - https://oceannoise.noaa.gov/
- Canada
  - Canada's Ocean Noise Strategy (2024)
  - "**to … guide future partnerships** to minimize impacts of ocean noise on marine life"
  - https://www.dfo-mpo.gc.ca/oceans/publications/noise-bruit/strategy-strategie/index-eng.html
- Australia (2025)
  - Sustainable Ocean Plan
  - "**to protect** [Australia's] vast marine environment, **and support** [its] growing ocean economy"
  - https://www.dcceew.gov.au/environment/marine/sustainable-ocean-plan

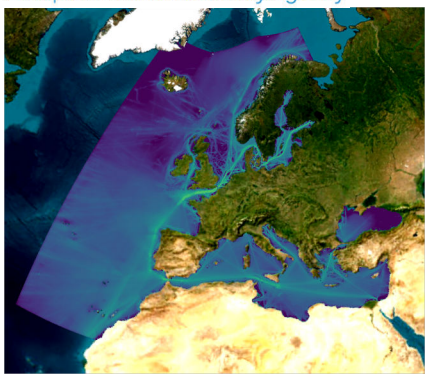
Regulatory context (international)

- Europe
  - Marine Strategy Framework Directive (EU, 2008)
  - Supplemented by
    - UK Marine Strategy (UK)
    - Integrated ocean management plans (Norway)
  - Goal: **to achieve or maintain Good Environmental Status**
    - Descriptor 11: “Introduction of energy (including underwater noise) does not adversely affect the ecosystem”
    - Low frequency continuous sound → D11C2

- UN International Maritime Organization (IMO)
  - Marine Environment Protection Committee (MEPC)
  - Underwater radiated noise (URN) management
    - High level URN guidelines (MEPC.1/Circ.883, 2014)
    - Major update to URN guidelines, with technical provisions (MEPC.1/Circ.906, 2023)
    - Experience Building Phase (EBP) (2023-2026)
      - seeks synergies between “energy efficiency, GHG and URN reduction while adhering to regulatory obligations”
      - https://www.imo.org/en/ourwork/environment/pages/imo-strategy-on-reduction-of-ghg-emissions-from-ships.aspx

MSFD timeline (2008-2024)





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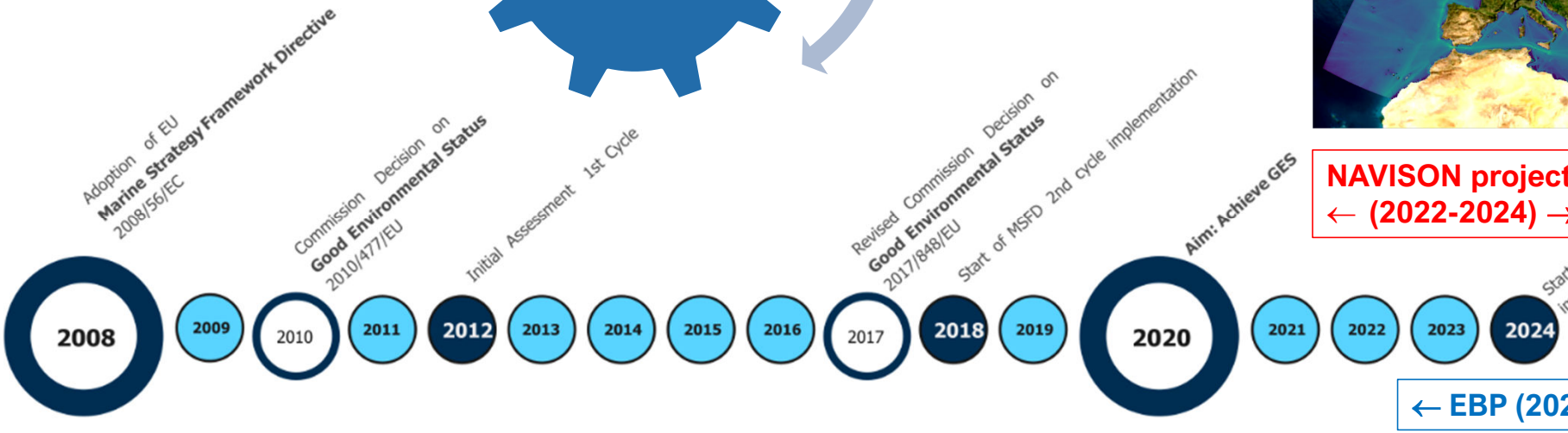
European Maritime Safety Agency

NAVISON project ← (2022-2024) →



← EBP (2023-26) →

← NAVISON (AIS, 2016-2023) →

Source: NAVISON, EMSA (2025)

IMO timeline (2018-2025)

GHG

Initial Strategy on reduction of GHG emission from ships

4th IMO GHG Study

Revised procedure on assessment of impacts on States

2023 Strategy on reduction of GHG emission from ships

Comprehensive impact assessment

Objectives:

20% reduction GHG 2030

70% reduction GHG 2040

Net-zero GHG 2050

2018 2019 2020 2021 2022 2023 2024 2025

URN

Revised URN Guidelines Approved	SDC Action Plan Approved	**IACS Rec. 181** Noted

SDC: Sub-Committee on Ship Design and Construction

IACS: International Association of Classification Societies

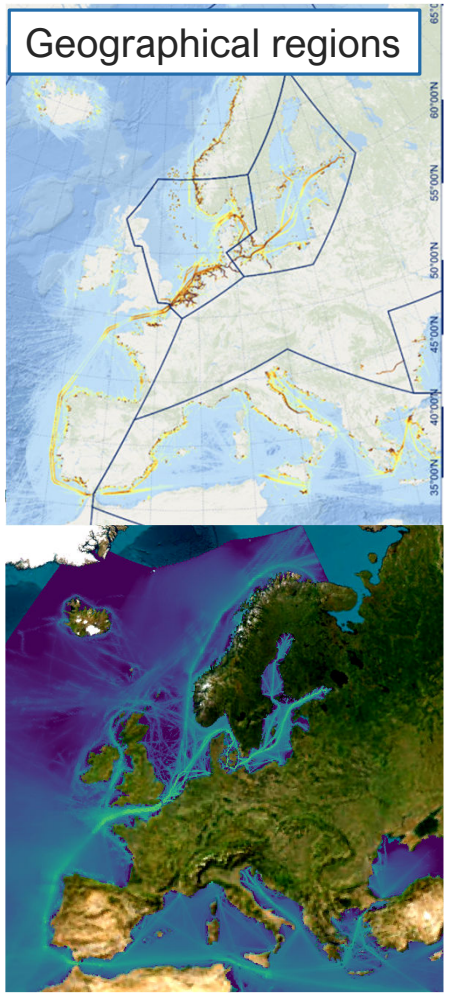
← **Experience Building Phase (2023-26)** →

← **NAVISON (2022-24)** →

← **NAVISON (AIS, 2016-2023)** →

NAVISON project

- NAVISON (Navis Sonus)
  - Sponsor: European Maritime Safety Agency (EMSA)
  - Duration: 2022 to 2024
  - Goal: shipping sound maps for European seas
- Hindcast sound maps (AIS)
  - 2016-2023
  - MSFD frequency bands (63 Hz, 125 Hz)
- Forecast scenarios (explore GHG, URN synergy)
  - 2030, 2040, 2050
  - 63 Hz frequency band
- 5 vessel categories
  - Cargo vessels and bulk carriers (CAR)
  - Container ships (CON)
  - Cruise and passenger vessels (PAS)
  - Tankers and gas carriers (TGC)
  - Roll-on-roll-off vessels (cargo and passenger) (RRO)
- Mechanisms
  - Cavitation
  - Machinery
  - → Dependence on operational conditions
    - e.g., ship speed

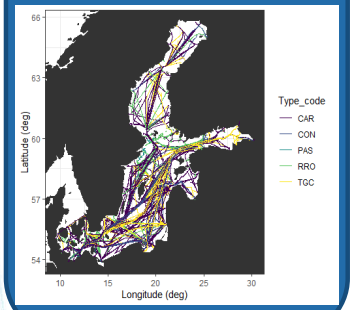


Source: NAVISON, EMSA (2025)

Alex

Model overview

Ship track data (AIS)



PIANO

Cavitation Noise

MARIN

Machinery Noise

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Validation Data

ECHO PROGRAM

PORT of vancouver | Vancouver Fraser Port Authority

$\int dt$

EMODnet

Copernicus

ARTEMIA

Sound Propagation

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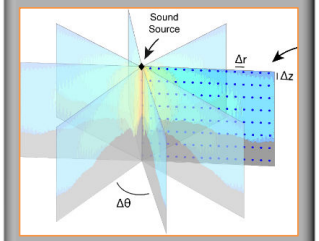
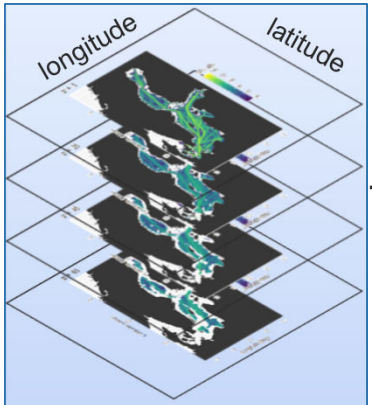
OpenMP





sound map layers

$L_p\ (\varphi, \lambda, z)$

- *by vessel type*
- *by mechanism*
- *by frequency band*
- *by season*
- *by year*
- *by scenario*

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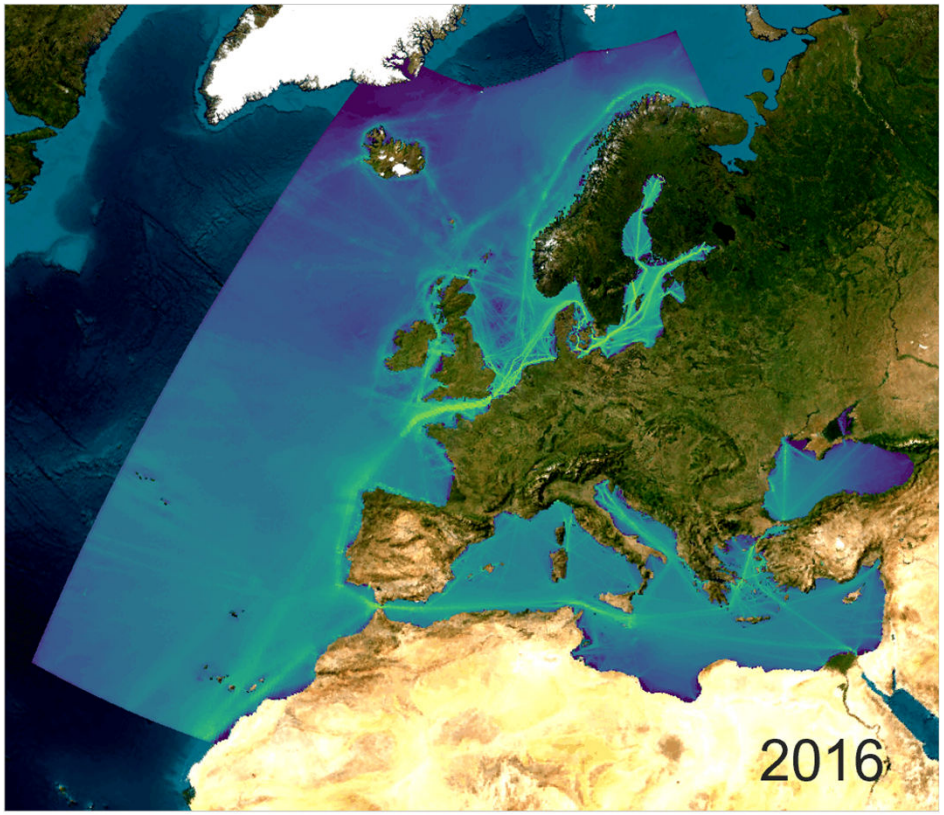
NAVISON Hindcasts

Sound pressure level maps (63 Hz)



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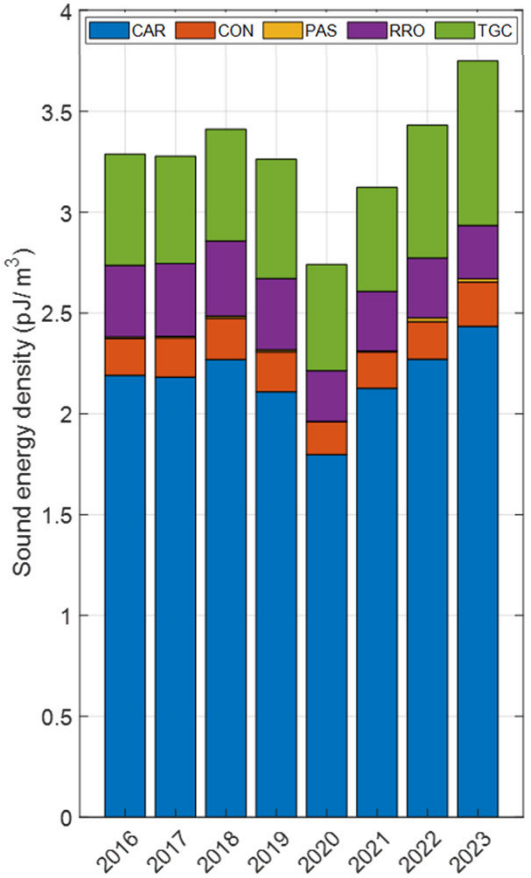
Sound energy density



$$\text{S.E.D.} = \frac{\text{total sound energy}}{\text{volume of sea water}}$$

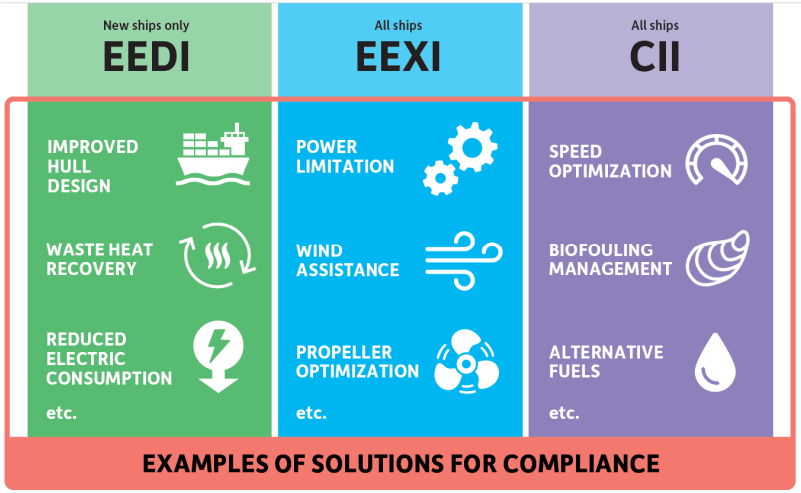
Source: NAVISON, EMSA (2025)

Forecast scenarios (2030, 2040, 2050)

Baseline year is 2022

- Scenario 1: Business as Usual
  - Increasing traffic over time
- Scenario 2: GHG emissions roadmap
  - More efficient propellers
  - Biofouling management
  - Optimized hull form
  - Speed reduction
- Scenario 3: URN management in isolation
  - Quiet propeller
  - Air injection
  - Speed reduction
- Scenario 4: URN management plus GHG emissions roadmap
  - Six combined measures

IMO GHG emissions roadmap scenario

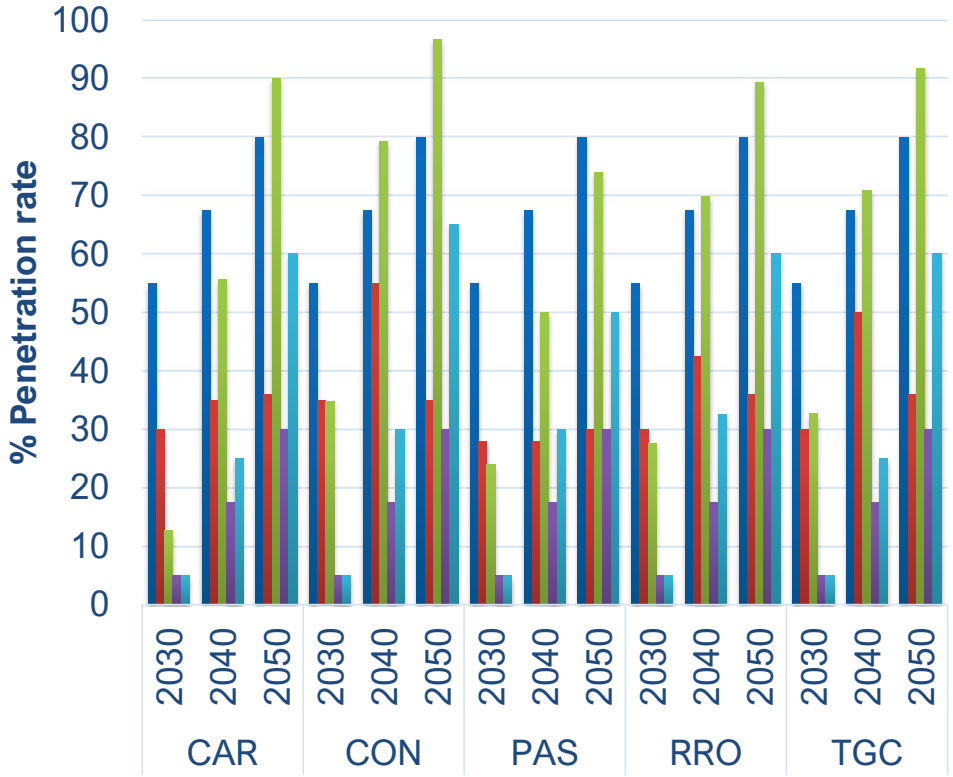


Mitigation measures modelling

Measure name	Category	Type	Main stakeholder group(s)	Cavitation	Machinery
Speed reduction	GHG/URN	Operational	Regulatory bodies	✓	✓
Hull and propeller cleaning	GHG	Operational	Ship operators	✓	✓
More efficient propeller	GHG	Technical	Propeller designers	✓	✓
Optimised hull form	GHG	Technical	Ship builders/ naval architects	✓	✓
Air injection (for propeller and machinery noise)	URN	Technical	Equipment manufacturers/ ship builders	✓	✓
Quieter propeller	URN	Technical	Propeller designers	✓	×

In PIANO, changes in URN depend on vessel design & operating condition

Forecast input: Combined GHG and URN Scenario



		Penetration Rate (%)				
Ship type	Year	Hull and propeller cleaning	Efficient propeller	Optimised hull form	Air injection	Quieter propeller
Cargo	2030	55	30	12.7	5	5
	2040	67.5	35	55.6	17.5	25
	2050	80	36	90	30	60
Container	2030	55	35	34.8	5	5
	2040	67.5	55	79.3	17.5	30
	2050	80	35	96.7	30	65
Passenger	2030	55	28	23.9	5	5
	2040	67.5	28	50	17.5	30
	2050	80	30	73.9	30	50
Roro	2030	55	30	27.6	5	5
	2040	67.5	42.5	69.8	17.5	32.5
	2050	80	36	89.3	30	60
Tanker	2030	55	30	32.7	5	5
	2040	67.5	50	70.9	17.5	25
	2050	80	36	91.8	30	60

- Hull and propeller cleaning
- Efficient propeller
- Optimised hull form
- Air injection
- Quieter propeller

Forecast sound map layers: 2030, 2040 and 2050

Difference between Business As Usual and mitigated forecast sound map layers, 63 Hz

GHG 2030

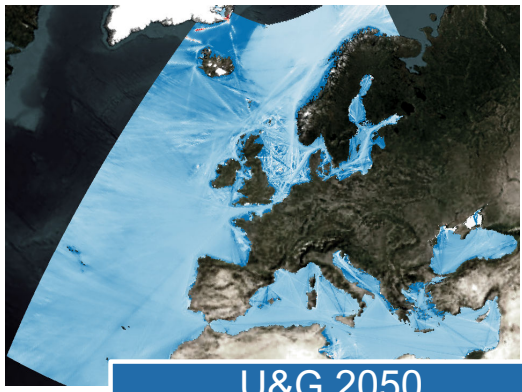
URN 2030

U&G 2030

Including all vessel categories

GHG 2050

URN 2050



U&G 2050

Source: NAVISON, EMSA (2025)

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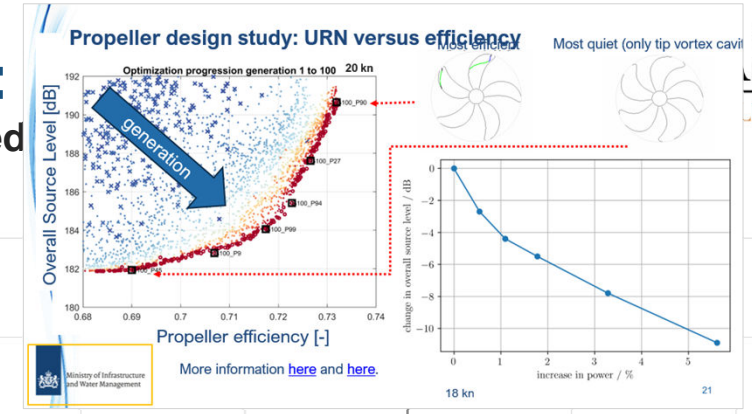
total over all 5 ship categories

EMSA European Maritime Safety Agency

Forecast sound energy densities:

Difference between Business As Usual and mitigated



Source: NAVISON, EMSA (2025)

Conclusion

Noise hotspots

Highest SPL: English Channel, Strait of Gibraltar, Dardanelles, and some regions in the Baltic Sea

Lowest SPL: northwest part of the northeast Atlantic Ocean, southern part of Mediterranean Sea and east of Black Sea.

Environmental parameters

Bathymetry: SPL values are lower in the deeper parts of the Ionian Sea and the Bay of Biscay for similar source levels

Sea surface temperature: strong sound propagation in the winter (and spring) and weak propagation in the summer.

Mitigation measures

- GHG Scenario -more efficient propeller: increases average source level for some categories
- U&G scenario: following initial increase, sound energy density decreases for later forecast years as an increasing proportion of vessels are equipped with a Quieter Propeller rather than a More Efficient one.

Study findings are based on 2018 GHG Strategy. Revised 2023 GHG Strategy now published.

Project funding

EMSA

European Maritime Safety Agency

Samy Djavidnia, project director

Project number EMSA/OP/18/2021

https://www.emsa.europa.eu/navison.html

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Special thanks

ECHO PROGRAM

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Permission to use source levels for model validation

Questions?

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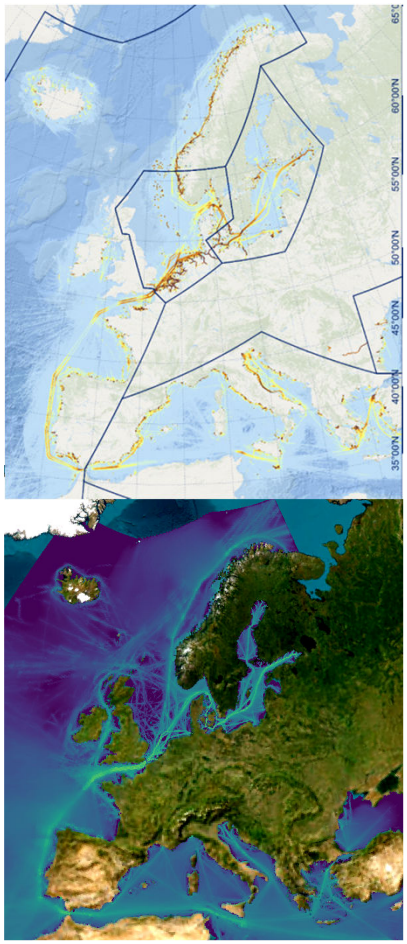

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European Maritime Safety Agency