Energy Efficiency and Underwater Noise

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Vessel fuel efficiency has been a focus for many years.

Reducing fuel use, CO_2 and other air emissions in customers' supply chains.

- Vessels have become significantly more fuel efficient.
  - Maersk vessels produced **47% less CO_2** (2019 vs. 2008, per container per km)
  - New larger vessels, retrofits, network design / execution and Connected Vessel Strategy

- Shipping is the only industry with global decarbonization goals, metrics and reporting (IMO MEPC80, July 2023)

- New fuels and propulsion systems are becoming realities to decarbonize and comply with IMO.

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Maersk G-Class Vessel radical retrofit program

12 vessels in G classes

Retrofit dry dockings

11 vessels 2/2015 – 8/2016	
Final vessel	4/2018

Example: Gudrun Maersk

Year Built:	2005
Retrofitted:	2015
Size:	367 m x 43 m max draft 15.9 m
Gross Tonnage:	98,648
Current capacity:	11,078 TEU

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“Radical Retrofits” to improve vessel energy efficiency

G vessels:

<u>Energy Efficiency & Environmental Technologies</u>

- New bulbous bow
- New propeller and propeller boss cap fins
- Engine de-rating
- Fuel flow meters

<u>Capacity Boost</u>

- Raise wheelhouse
- Upgrade lashing bridges and hatch covers
- Scantling draft evaluation

Is there an optimum solution for both the environment and operations?

SAFETY	ENERGY EFFICIENCY	AIR EMISSIONS	GREENHOUSE GASES
PORT COMMUNITY CONCERNS	COSTS	ON TIME	MARINE MAMMALS

Sources of sound from commercial shipping

Cavitation related to propulsion systems is typically the dominant source of underwater noise

- Design and type
- Boss cap fins and ducting technologies
- Speed optimization and depth
- Cleaning and maintenance

Primary factors for vessels

- Propulsion system design, operations, cleaning and maintenance
- Flow around hull and Sea chests
  - Trim optimization
  - Bulbous bow design
  - Maintenance and cleaning
- Equipment noise and isolation
- Speed optimization
- Depth finders

Port operations and harbor craft are also sources of underwater sound.

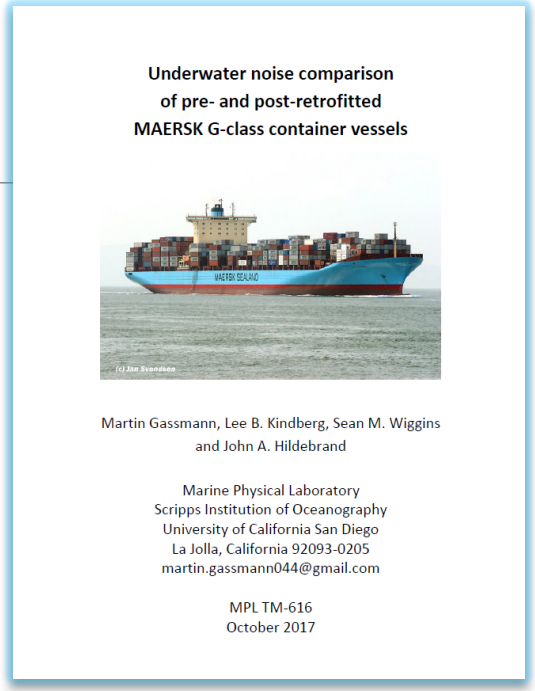
Reduced underwater noise generation related to the Radical Retrofit

- Scripps Institution of Oceanography had collected underwater sound data in the Santa Barbara Channel for over 10 years.
- Five Maersk vessels were evaluated before and after retrofit
- Source Sound Pressure Level (SPL) when corrected for vessel speed and draft was estimated to be:
  - 6 dB lower in the 8-100 Hz band
  - 8 dB lower in the 100-1000 Hz band

6 dB is 75%

- Conclusion: *"Reductions of ship source sound pressure level due to changes such as those employed by the radical retrofits may result in ocean-basin-wide noise reductions."*

http://cetus.ucsd.edu/Publications/Reports/GassmannMPLTM616-2017.pdf



Underwater noise comparison
of pre- and post-retrofitted
MAERSK G-class container vessels

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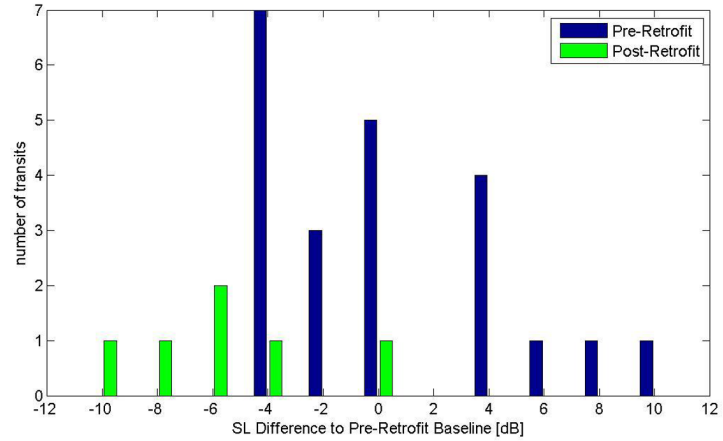
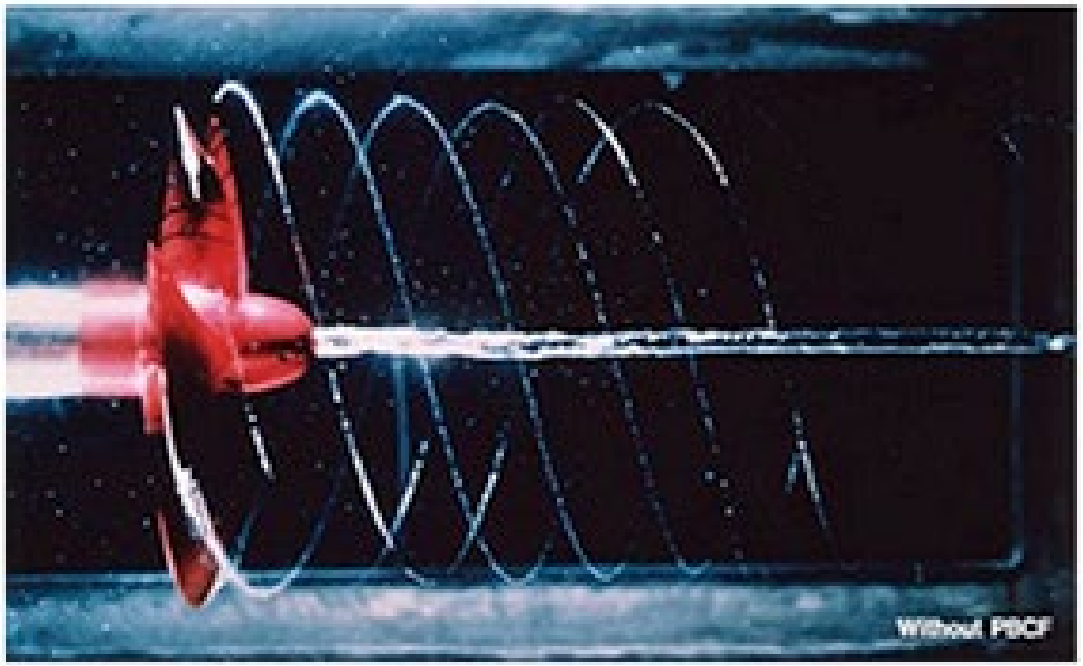
MPL TM-616
October 2017

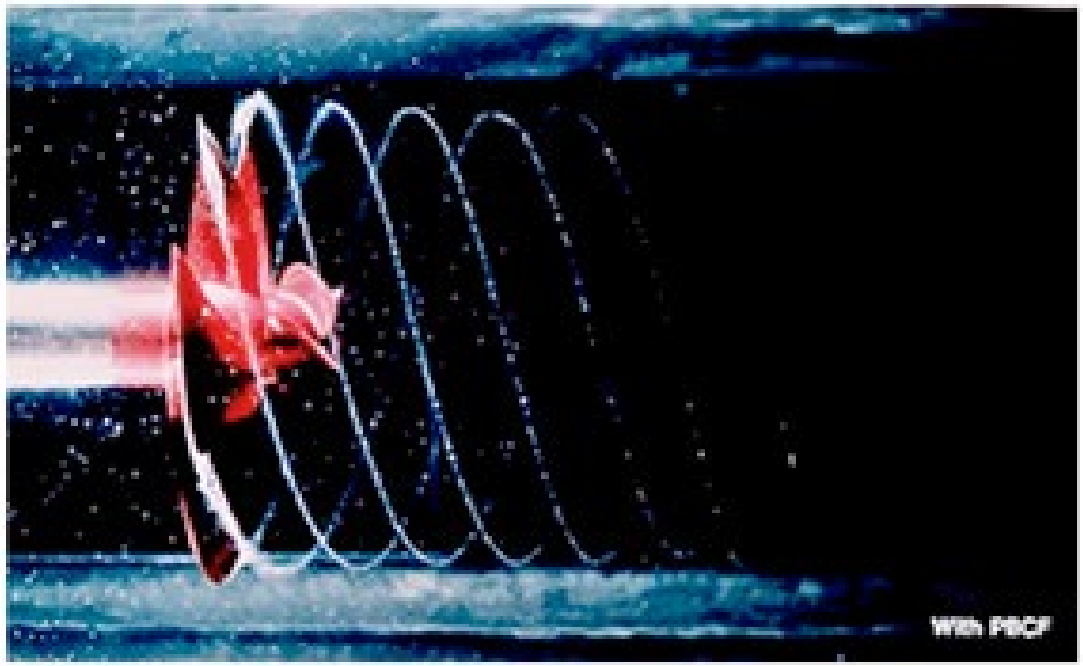
8-100 Hz Sound Pressure Levels



Comparison of Hub Vortex



Before installation of PBCF



After installation of PBCF

Source: Dr. John Hildebrand, Scripps Institution of Oceanography

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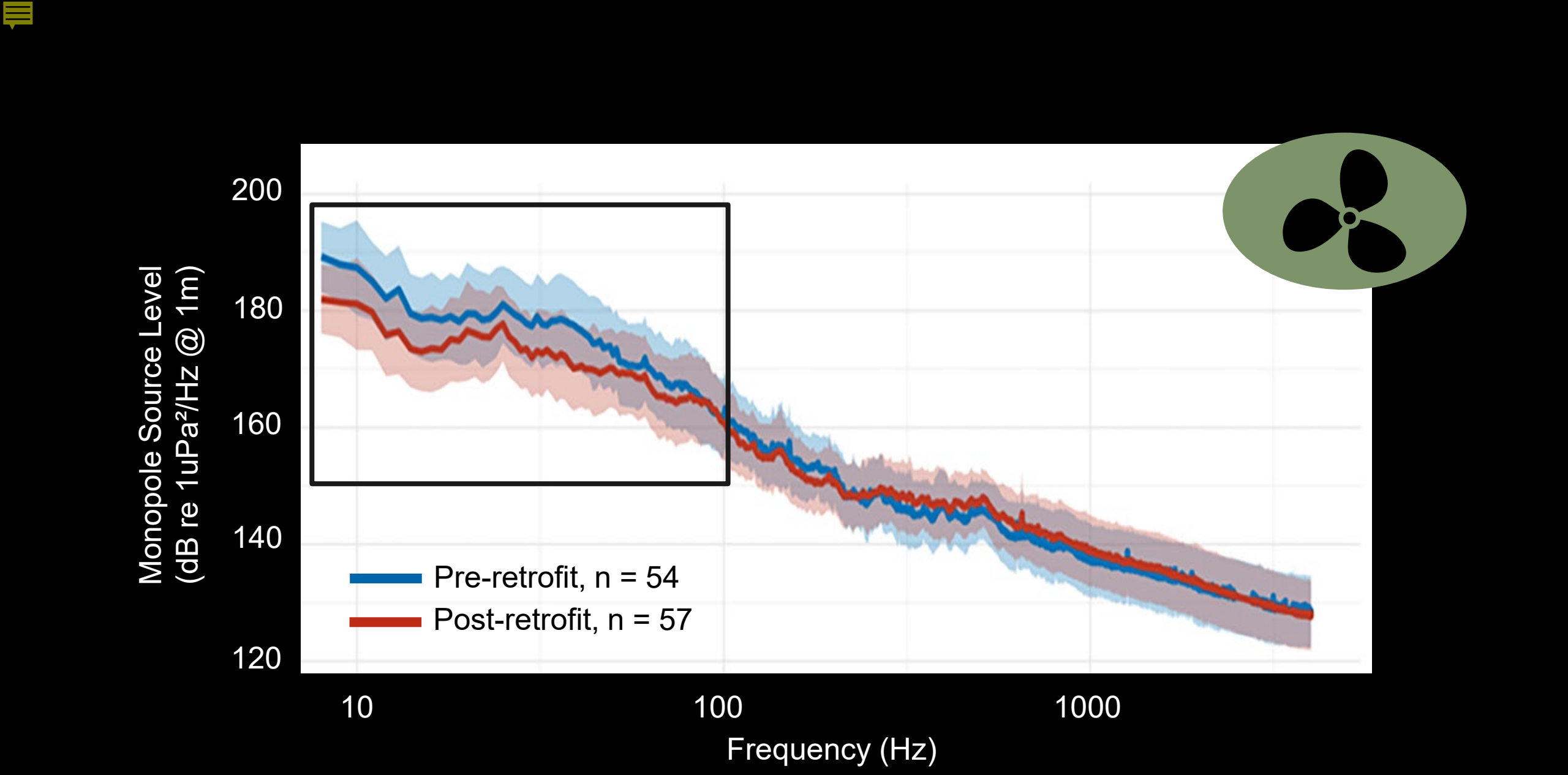


ZoBell et al. 2023

What have we learned?

- Vessel retrofits can reduce fuel consumption and related air emissions, and also may reduce underwater sound.
  - Both vessel equipment and operating factors should be considered in underwater sound programs.
    - Some technology approaches appear to offer win-win solutions.

- Significant expertise is required to analyze sound generation and impacts in real-world settings.
  - Consistent methodologies and actual vessel conditions are essential

- These studies and others are early steps toward understanding anthropomorphic underwater sound generation from shipping and ways to manage and reduce impacts on marine mammals.

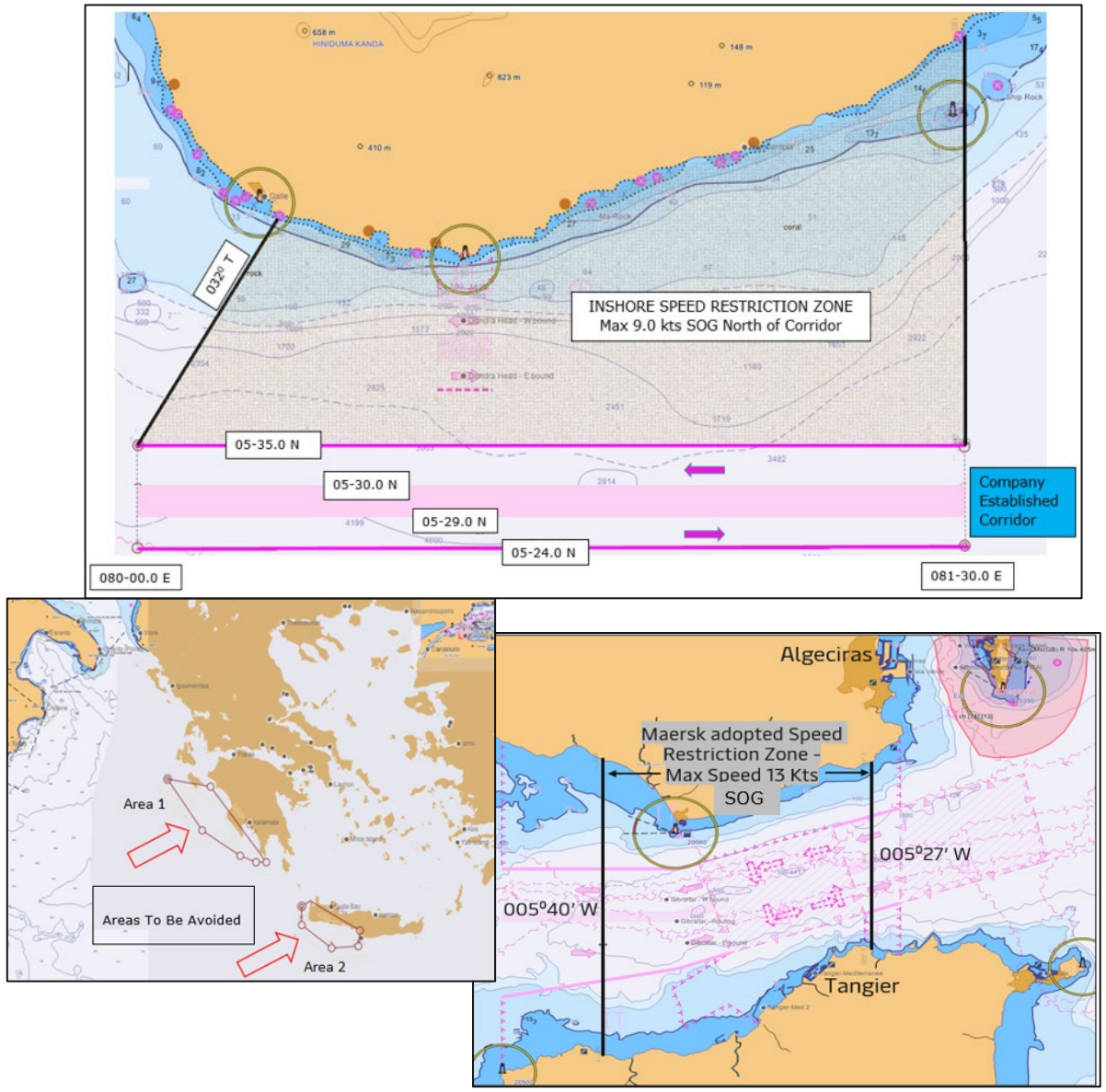
URN in Maersk today

How we see it:

- Considered as an important environmental focus area under rapid development
- Receiving increasing attention across the maritime industry, including the regulatory bodies (IMO)
- Regulation on voluntary basis for now, but under development and seen as becoming mandatory in near future
- Especially in the IMO, URN is an active area under development
- Future mandatory regulation will potentially have significant impact on how vessels are designed and operated

What we are doing:

- Striving to understand the theory behind, to be able to comply with possible future mandatory regulation
- Participating in the ECHO program by Port of Vancouver
- Following voluntary speed reduction zones for whale protection (especially US East and West coast)
- Implementing company specific speed reduction zones such as Hellenic Trench and Strait of Gibraltar
- Zones are integrated in internal voyage planning tool
- Proactively working together with Mediterranean Shipping Company (MSC) and World Shipping Council (WSC) on moving vessel traffic south of Sri Lanka



Challenges – and some opportunities...

Schedule reliability and fuel consumption:

- Reduction of speed in certain areas without causing delays
- Increased fuel consumption for catching up
- New whale protection zones introduced on short notice

Impact on CII ratings:

- Dilemma if URN and CII works opposite: Fuel efficiency or low noise?

Class notations:

- How to ensure equivalent requirements across classification societies (relevant for vessel transfers between classes)?
- How to ensure standardized methods for verification of compliance?
- Should class notations drive improved technical capabilities or improved mammal living conditions?

Vision:

- We want to be a leading and responsible industry partner, ensuring improved living conditions for marine mammals in our corridors through timely management of our fleet noise signature

Suggestion:

- New URN network group under Danish Shipping as a platform for further discussion, alignment and knowledge sharing across the Danish maritime industry

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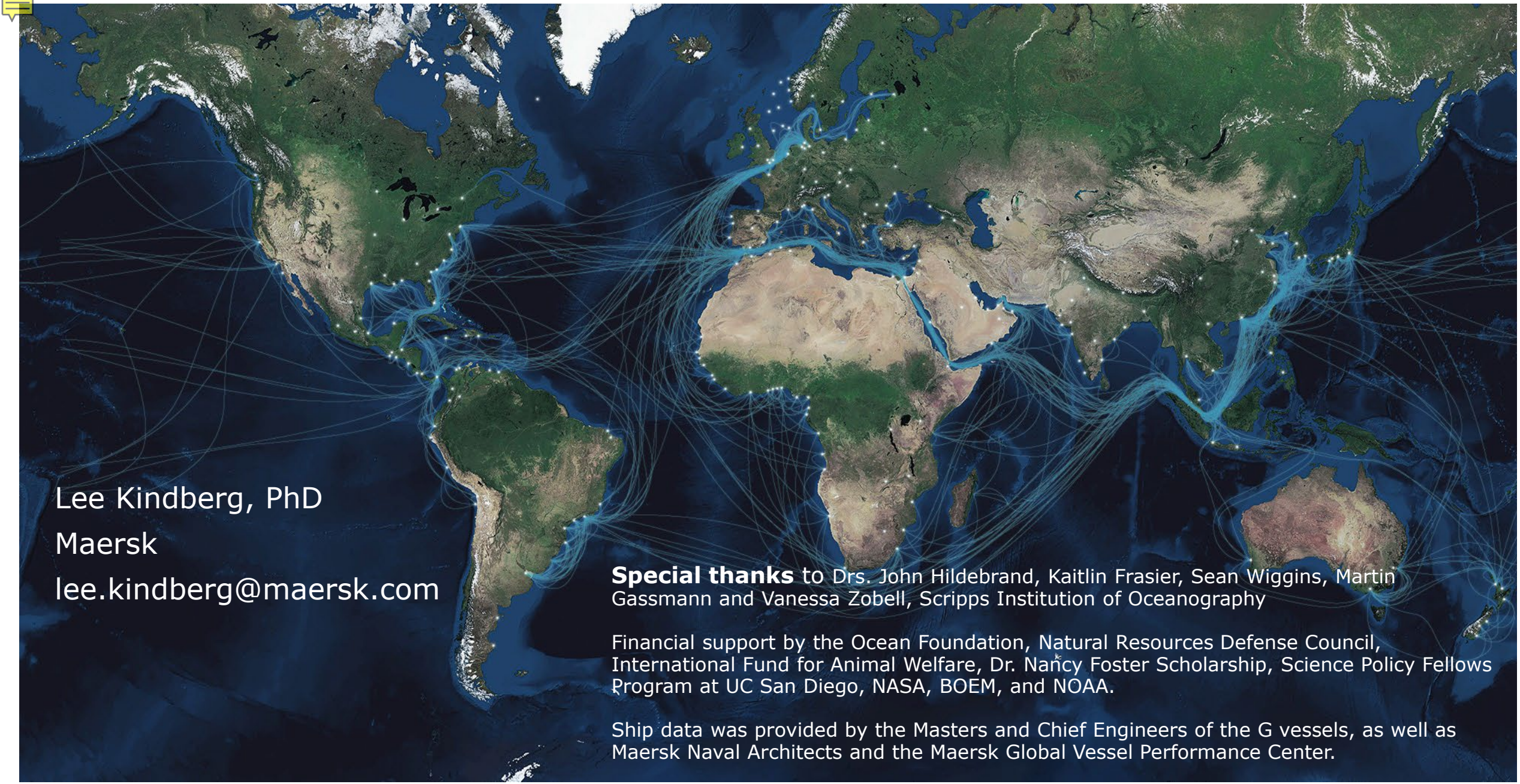

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