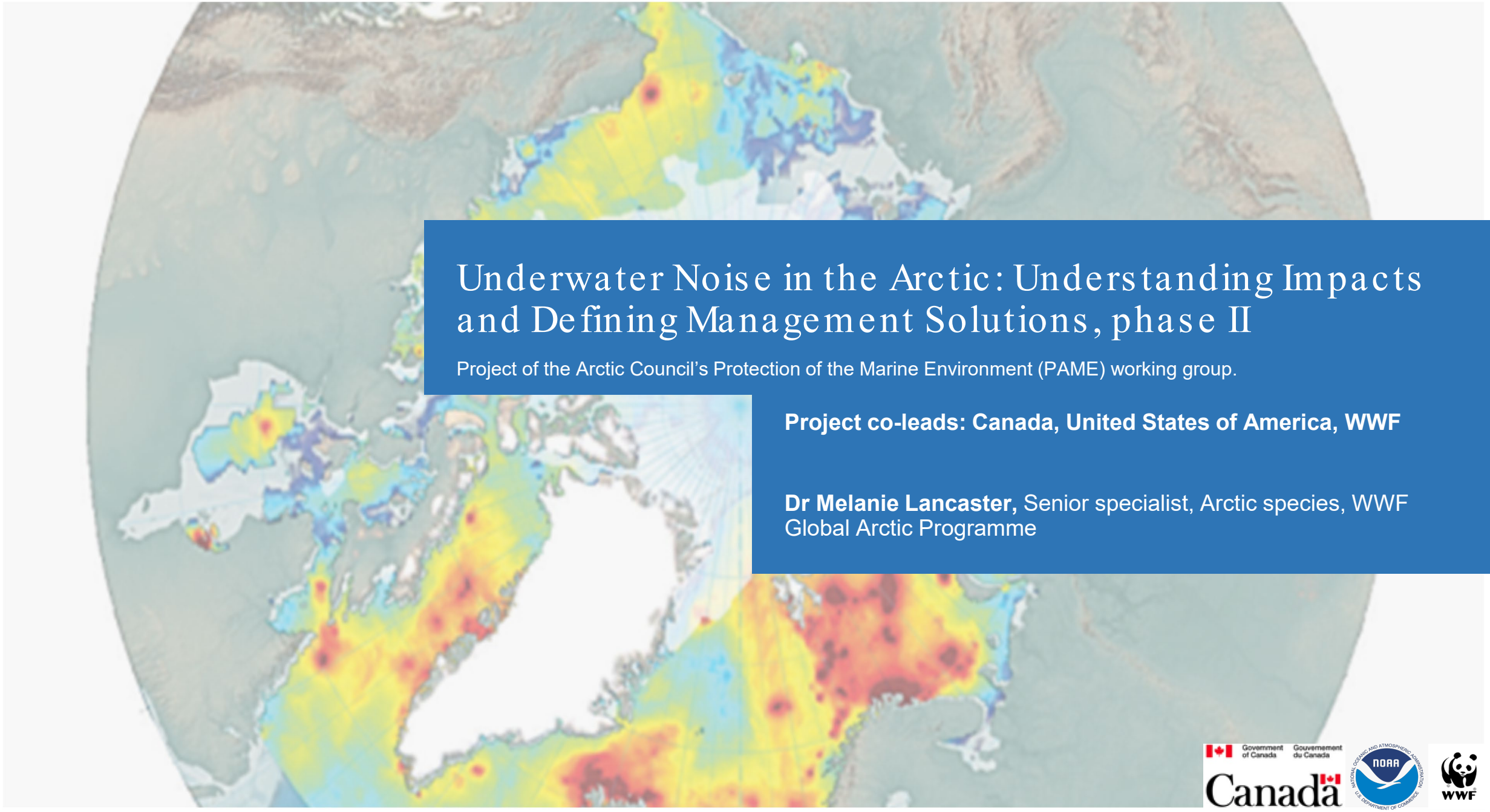


Underwater Noise in the Arctic: Understanding Impacts and Defining Management Solutions, phase II

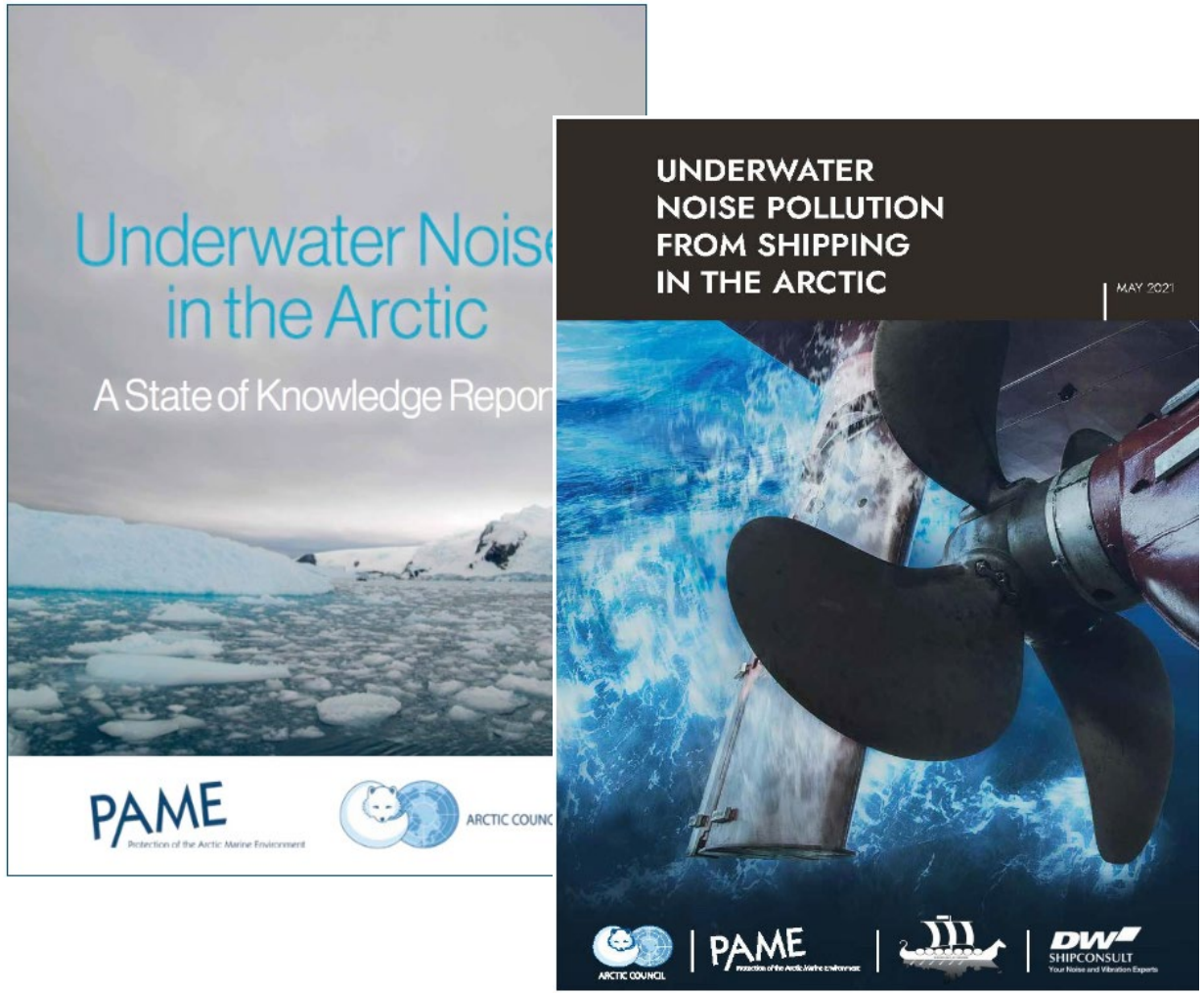
Project of the Arctic Council's Protection of the Marine Environment (PAME) working group.

Project co-leads: Canada, United States of America, WWF

Dr Melanie Lancaster, Senior specialist, Arctic species, WWF Global Arctic Programme

Arctic Council work on underwater noise

- Arctic Marine Shipping Assessment (2009)
- State of knowledge report on underwater noise in the Arctic (2019)
- Underwater Noise in the Arctic: understanding Impacts and Defining Management Solutions, phase I (2021).
- Underwater Noise in the Arctic: understanding Impacts and Defining Management Solutions, phase II (2021 – 2025)



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Underwater Noise in the Arctic: Understanding Impacts and Defining Management Solutions, phase II

Project aims

1. Assess the current and projected contributions of underwater noise from shipping under various economic and environmental scenarios

2. Explore the noise implications of a variety of vessel management measures

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Geographic scope

Whole Arctic and three sub-regions: Baffin Bay, Barents Sea, Chukchi Sea

Temporal scope

2019 – to represent “current” Arctic shipping

2030 – to represent near-future potential Arctic shipping

Month of September assessed in both years

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1. Assess current and projected contributions of underwater noise from shipping

Shipping models for 2030

Scenario based on trends affecting ship traffic:

- Projected changes in fisheries, extractives (oil and gas, mining), cruise tourism and transit shipping sectors.
- Existing plans for extractives projects that include shipping
- Northward movement of commercially important fish species
- additional shipping routes becoming available due to less ice-impeded conditions.

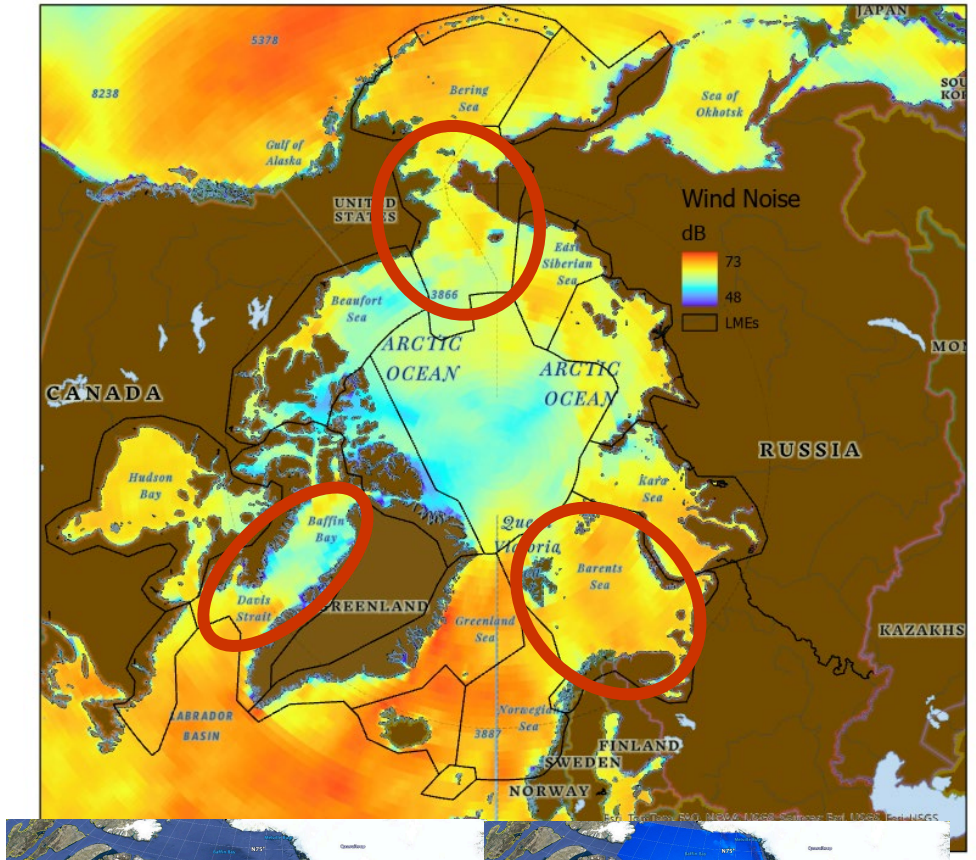
Natural underwater sound

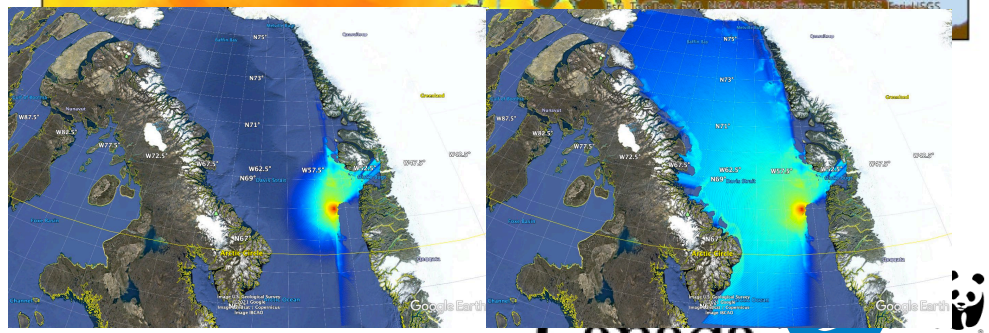
Modelled wind speed over the Arctic Ocean's surface was used to estimate natural underwater sound levels in 2019 and 2030.

How does the amount of ship noise put into the Arctic Ocean relate to the natural sound levels animals are already exposed to?

Ship noise field maps

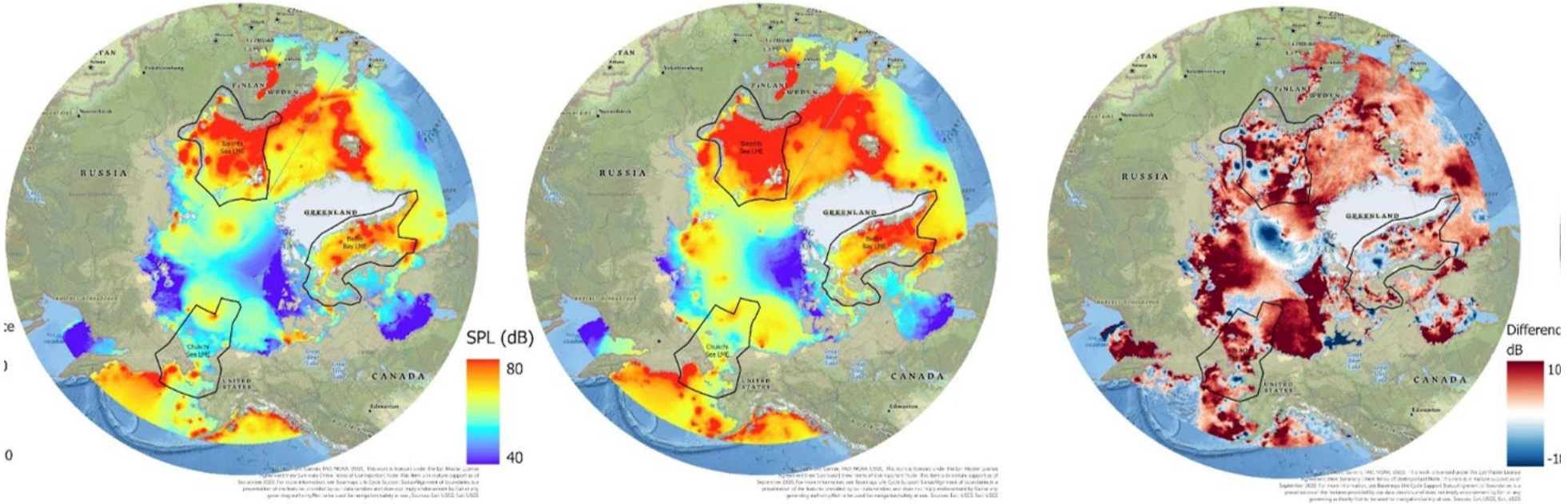
Based on ship source noise levels and affecting spread of noise in water (water depth, bathymetry, seafloor type, temperature and salinity, sea ice extent and ice edge location).





Selected results: whole Arctic 2019 and 2030

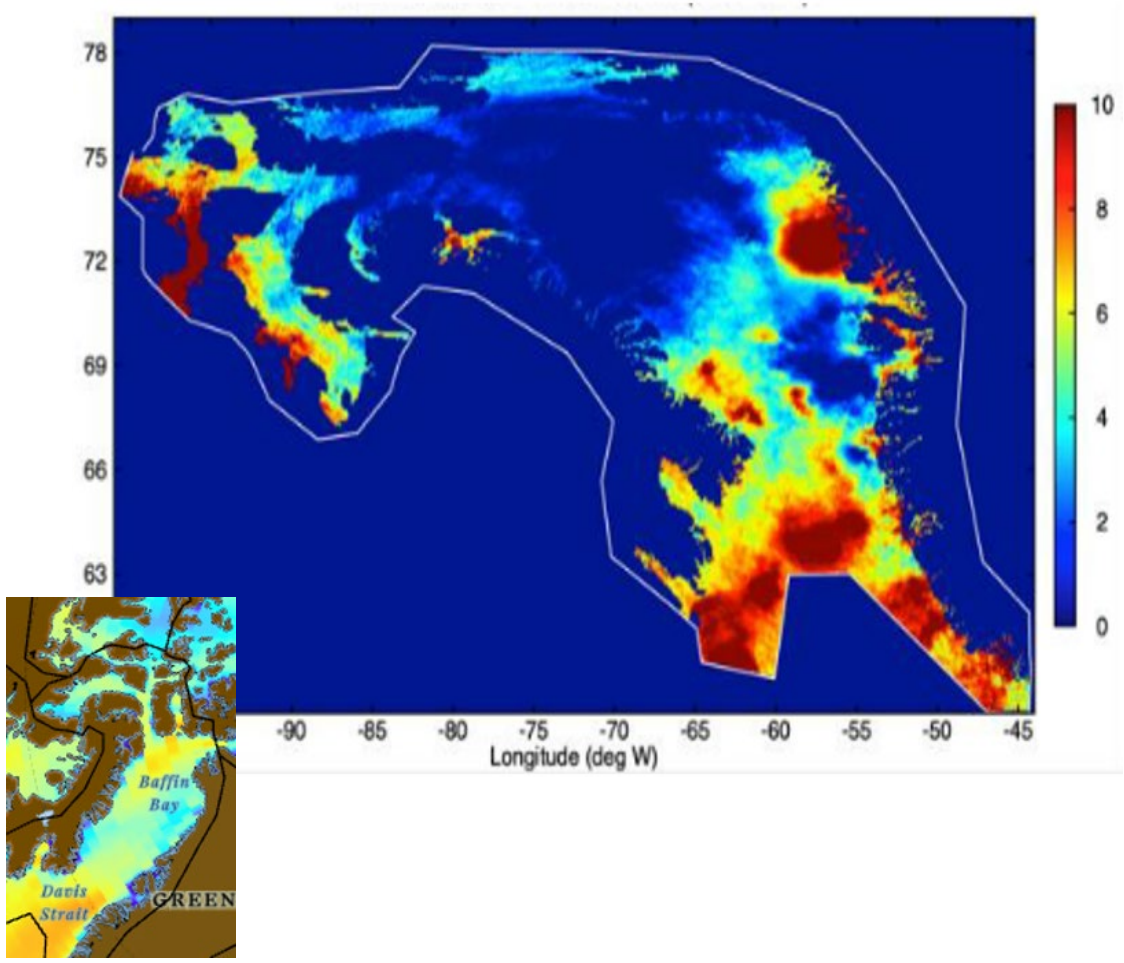
Explainer: 3 dB represents a doubling of sound pressure, and roughly a quartering of communication space for species that use sound.



- By 2030, underwater noise from shipping will increase across the Arctic Ocean, including into the Central Arctic Ocean, by, on average, 5 dB.
- Increase not uniform. Few areas experience a drop in noise, while much of the region would experience an increase, up to or exceeding 10 dB.

Selected results: Sub-regional underwater sound (ship noise + wind)

Baffin Bay



2019

Ship traffic cargo vessels (35%), fishing vessels (28%), and passenger vessels (9%), largely servicing the Mary River mine and mines along the west coast of Greenland.

Underwater soundscape louder in north due to wind and shipping (including milling traffic), very quiet in archipelago, relatively quiet in south.

2030

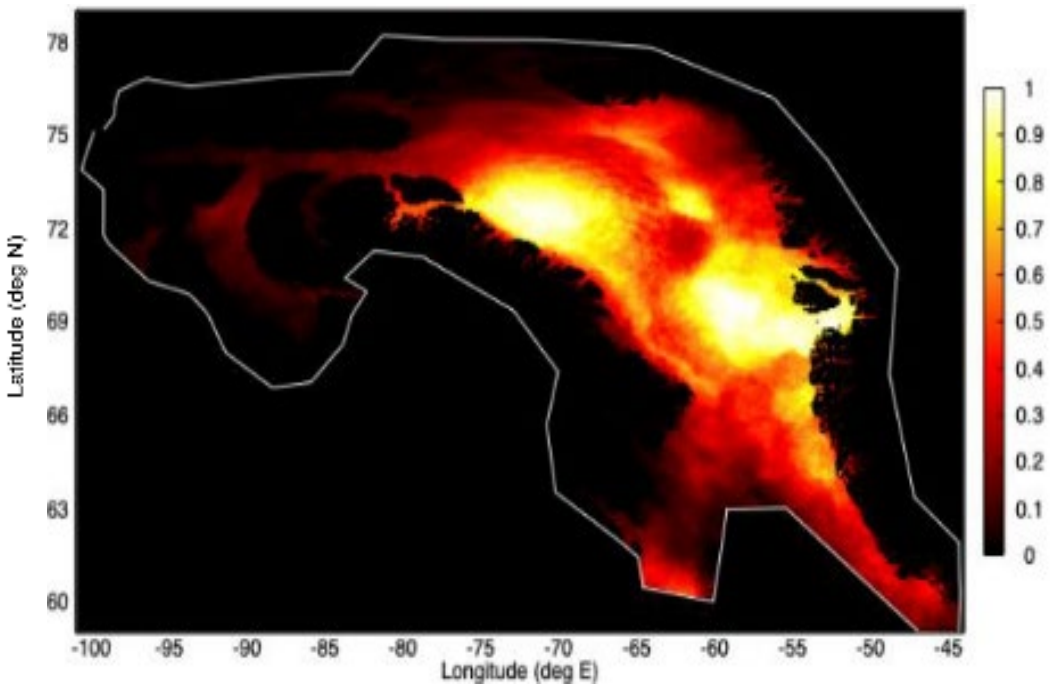
44% increase in fishing vessel traffic, 33% decrease in cargo vessel traffic due to proposed rerouting of mining traffic.

Concentration of noise outside Eclipse gone, louder now in Archipelago and southern Baffin Bay due to fishing, mining traffic re-entering Baffin Bay via Hudson Strait.

Change of up to 10 dB in some parts of Baffin Bay between 2019 and 2030.

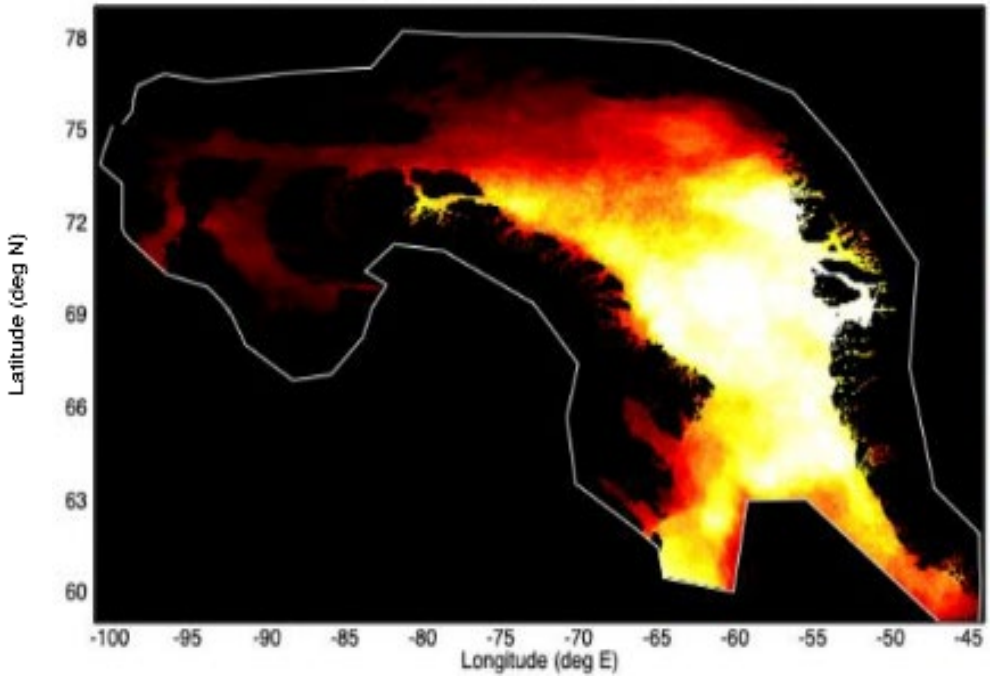
Selected results: Sub-regional ship noise intensity above wind levels

2019



- Ship noise higher than background wind levels across almost half (40 %) of the LME.
- On average by 6 dB.
- In two spots, ship noise was consistently higher than background levels for the whole month.

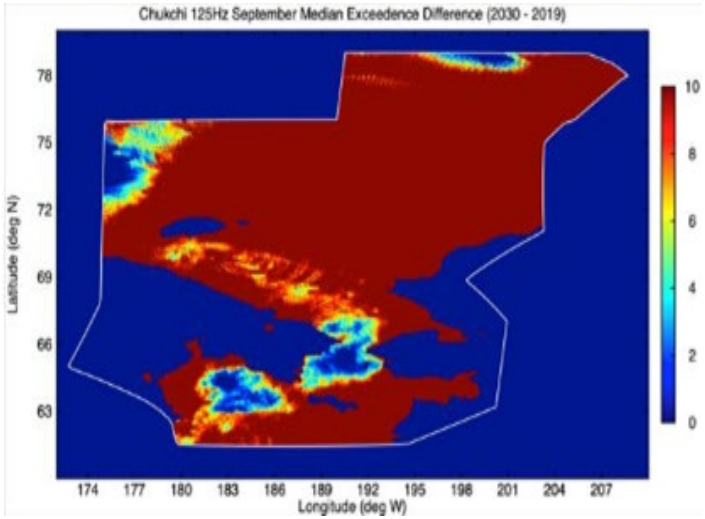
2030



- Ship noise higher than background wind levels across 60% of the LME.
- On average by 8 db.
- Ship noise levels were consistently higher than background levels for the whole month in much of the LME

Selected results: other sub-regions

Chukchi Sea



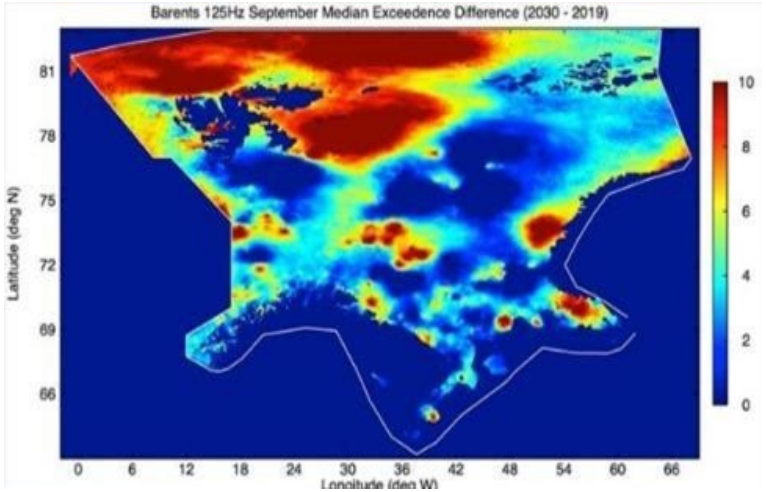
- In 2019, most of the sub-region influenced by natural sound rather than shipping-driven noise
- By 2030, ship noise predicted to be louder than wind levels across around two thirds of the sub-region

Large increase in noise despite only modest increases in shipping

Barents Sea

- In 2019, the contribution of ship noise to the soundscape already sizeable.
- In 2030, increased shipping would leave few areas of the Barents Sea free from ship noise. Further, ship noise would spread farther north.

Overall changes not as marked due to higher noise baselines



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2. Explore noise implications of a variety of vessel management measures

How might different vessel management strategies affect underwater noise levels?

For the three sub-regions of interest, we simulated shipping management measures:

- re-routing of ships (via areas to be avoided or recommended paths)
- speed reductions
- reduction of ship's radiated source level via technological solutions.

Some measures are already in place (either voluntary or mandatory), while others were introduced as hypothetical measures.

We simulated these in each sub-region in 2019 and 2030 and assessed effects on the underwater soundscape locally and at the ecosystem scale.

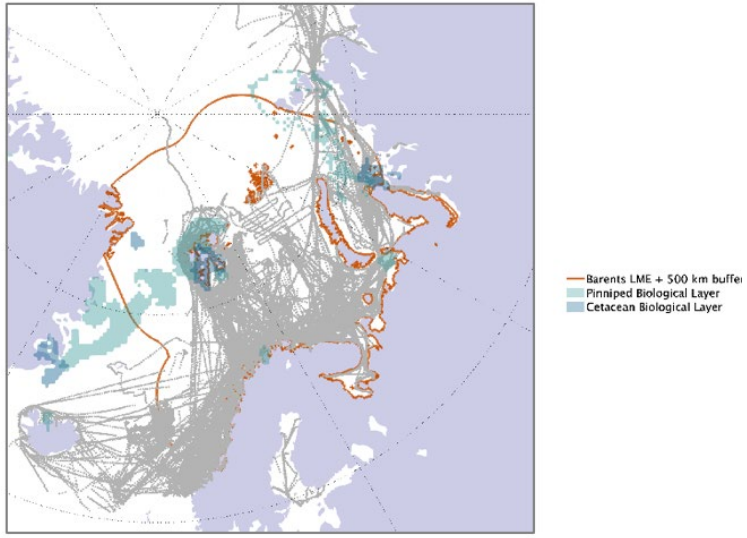
Icebreaker convoy north of the Bering Strait, along the Northern Sea Route

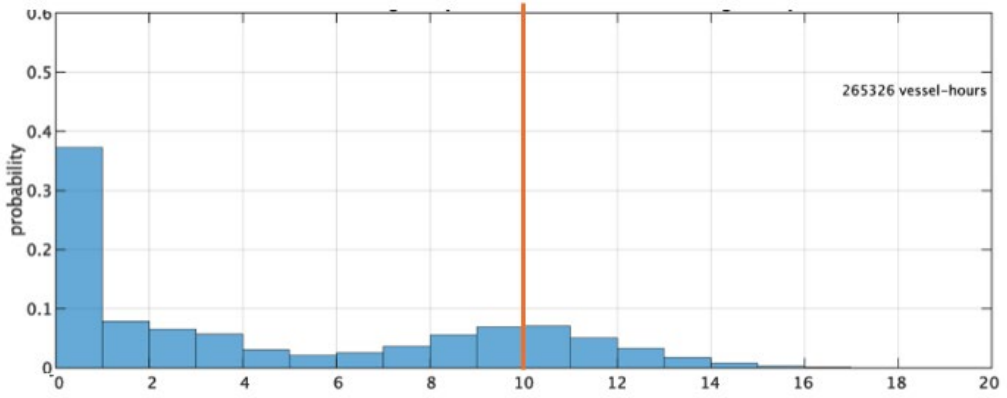
Selected results: Barents Sea vessel management

Speed reduction to 10 knots of all vessels in important habitats for Arctic marine mammals

- Reducing ship speed an effective operational measure for reducing underwater noise (MEPC 2014).
- 10 knots selected as it is below onset of propeller cavitation, and at which the risk of fatal collisions between ships and whales is significantly reduced.
- Spatial boundaries based on known important areas for Arctic marine mammals

Do ships overlap with important areas and how many ships are affected?





16.9% of cruise/passenger vessel hours, 18% of cargo traffic vessel hours and 11.7% of fishing vessel hours.

Selected results: Barents Sea vessel management

Reducing the speed of all vessels within important areas for marine mammals to 10 knots

Less than 0.1 dB reduction in underwater noise from ships in those areas – a small change.

Why?

- Operational speeds for many ship classes in areas of concern were mostly below 12 knots. Many ships were already travelling at 10 knots or less, so the slowdown measure only applied to a fraction of vessel traffic.

- The important marine mammal areas are quite small, so if nearby ships are not modifying their speed, their noise spreads into the slowdown areas.

Key take-aways

- Vessel management measures, whether directed to reduce underwater noise or with indirect noise consequences, can be modelled to inform and support policy- and decision-making
- If reducing underwater noise in an area is a goal, it must be considered explicitly in vessel management measures that are applied
- Spatial scale, existing vessel behaviour and how underwater noise spreads in the Arctic Ocean are important to consider in noise reduction goals, because
  - Measures (e.g. re-routing) that are effective at reducing underwater noise in a local area of concern can result in increases in noise elsewhere.
  - Noise from vessels adjacent to a local area of concern can permeate in if vessel behaviour is not adjusted over a large enough area
  - Only a fraction of vessels may be affected by a measure (e.g., speed reduction) if they are already travelling below a threshold speed.
- Measures put in place need to be dynamic enough to allow for shifts in and changing behaviour of noise-sensitive species in response to climate change.

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Icebreaker convoy north of the Bering Strait, along the Northern Sea Route
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