

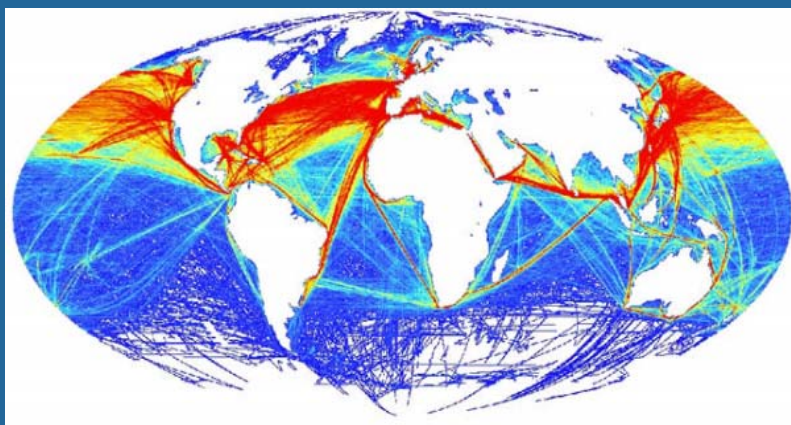


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Office of  
Science &  
Technology

# Ocean Noise and Marine Life:

Improving understanding & management of  
noise impacts from human activities



Jason Gedamke

Ocean Acoustics Program  
NOAA Fisheries Office of Science and Technology

December 6, 2018

# To survive and reproduce, animals need to:

- Attract mates
- Defend territories or resources
- Establish social relationships
- Coordinate feeding
- Interact with parents or offspring
- Avoid predators or threats

Communication is essential.



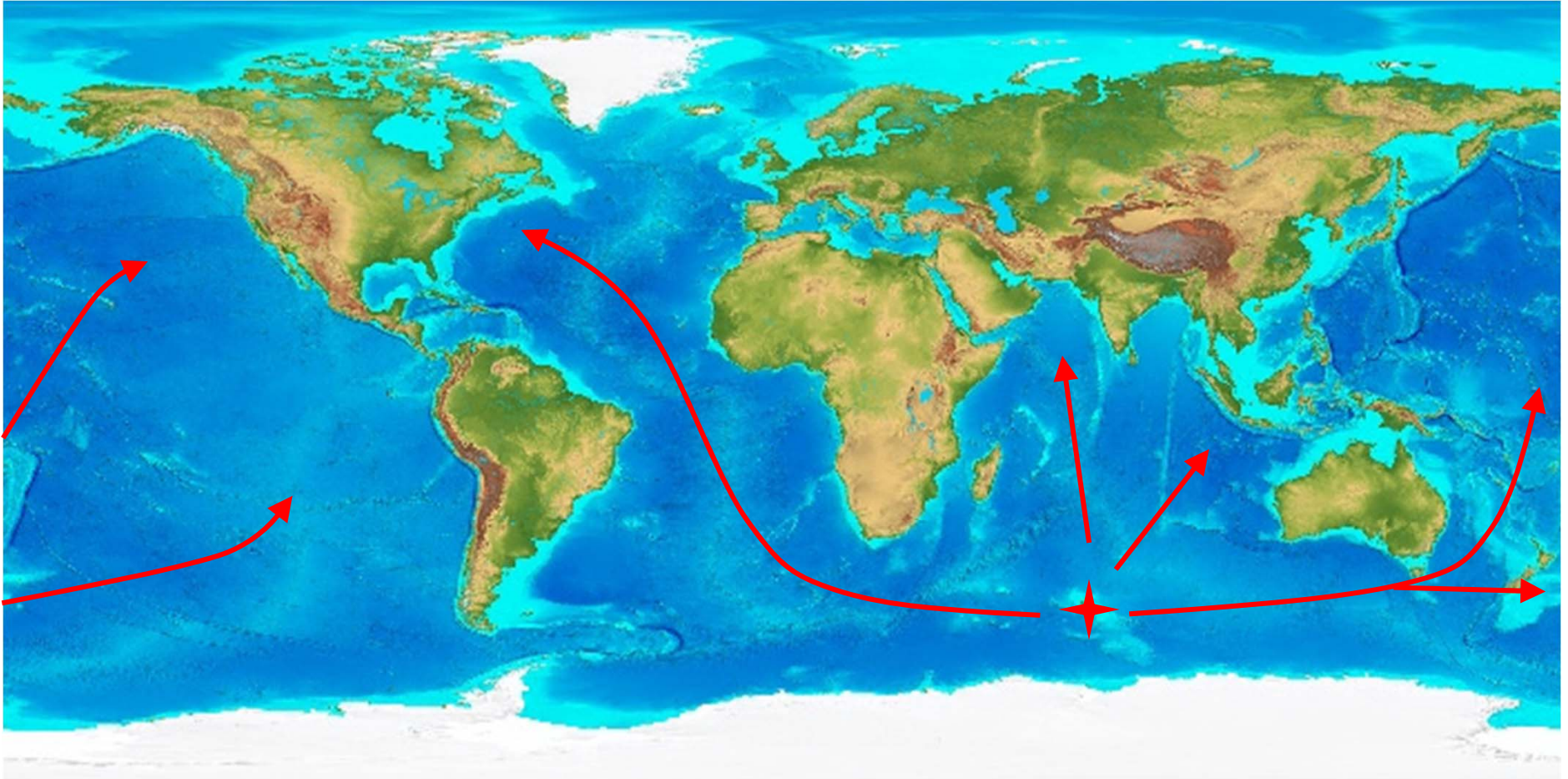


# Communication exists in many forms.





Over large distances in water, most forms of communication are not practical.



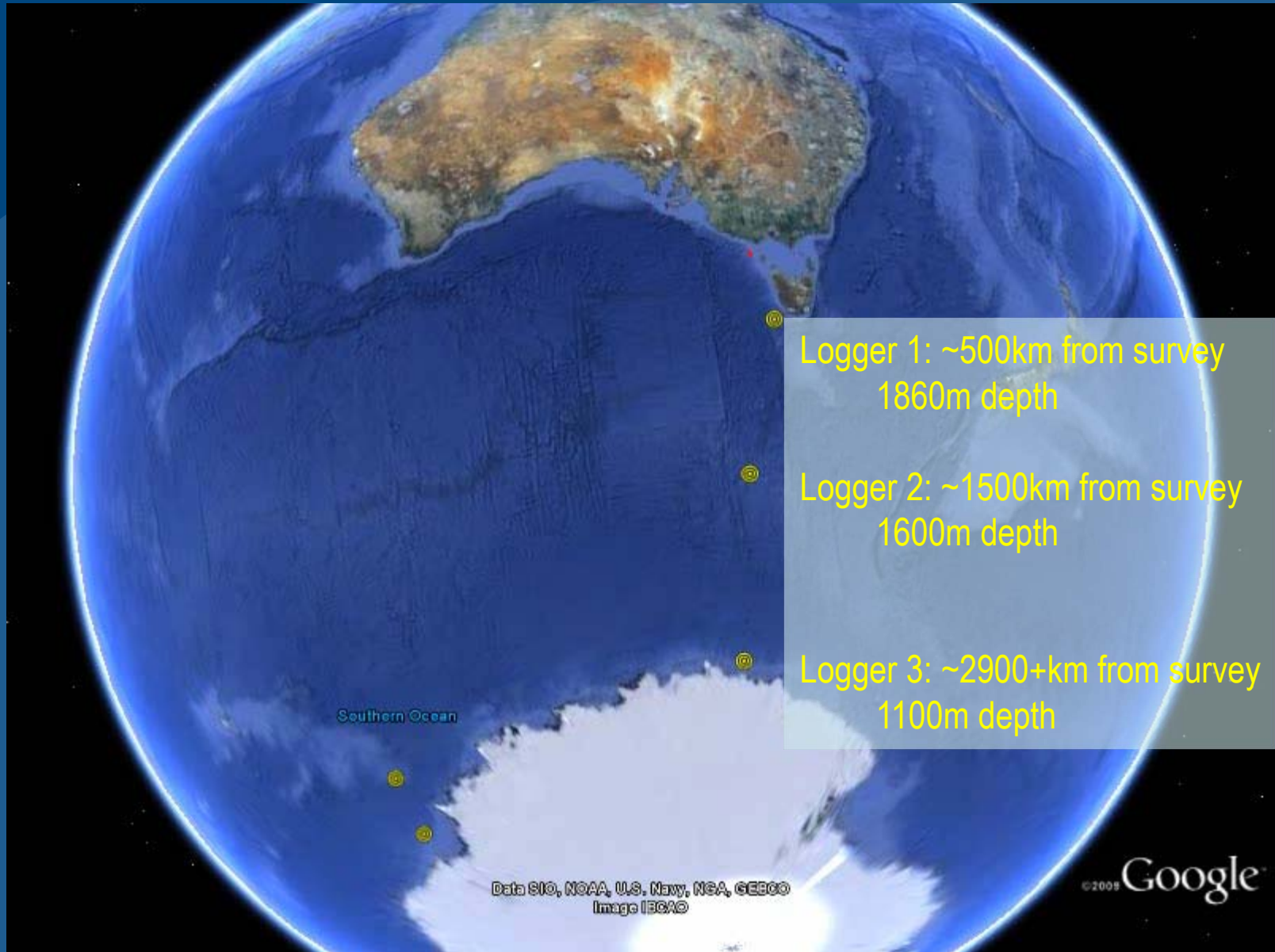
Sound, however, travels exceptionally well underwater.

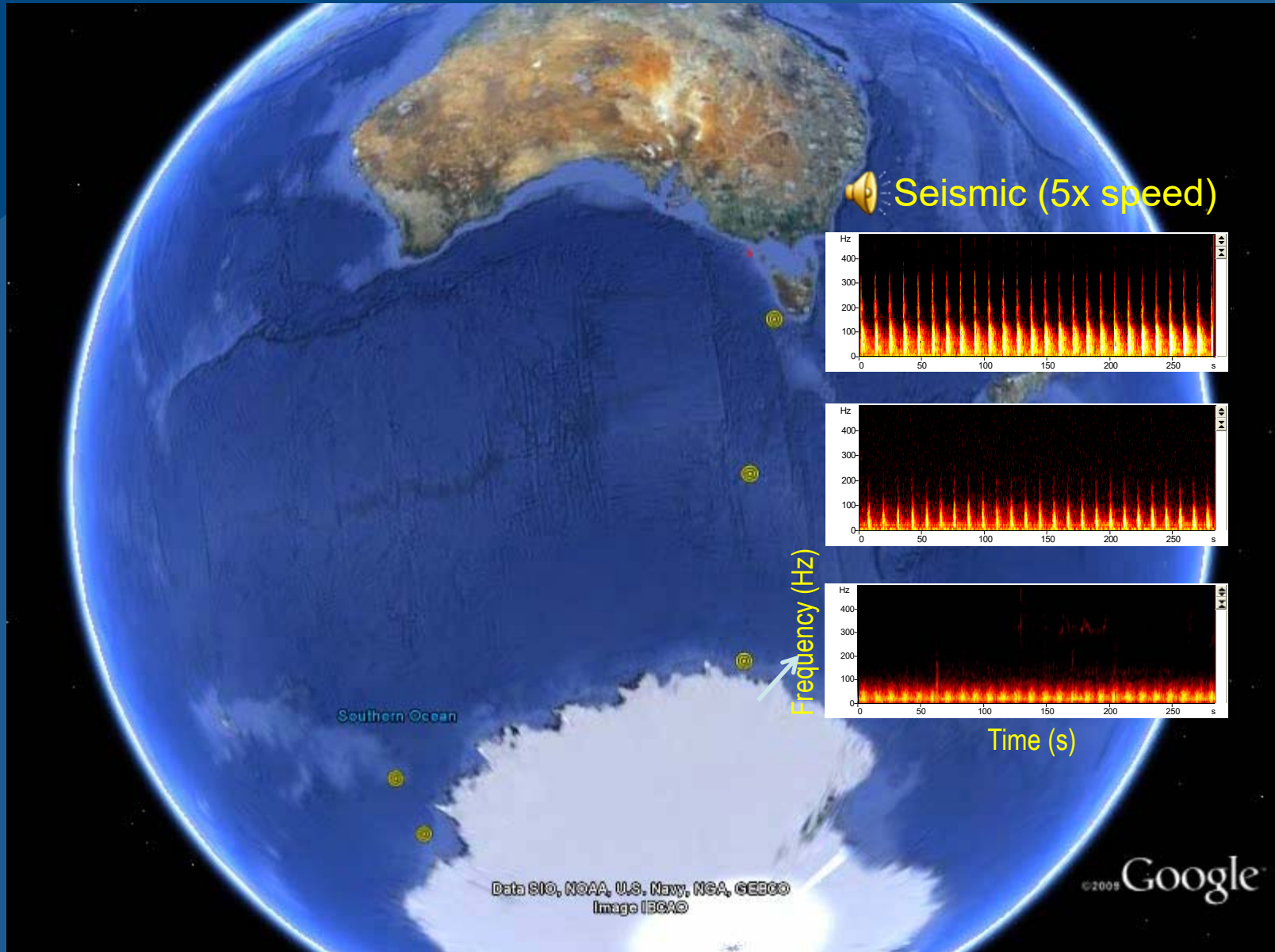


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# Ocean Soundscapes

## Natural Physical



## Natural Biological



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# Ocean Soundscapes

Natural



Man-made sounds



Biological



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# Anthropogenic Ocean Noise

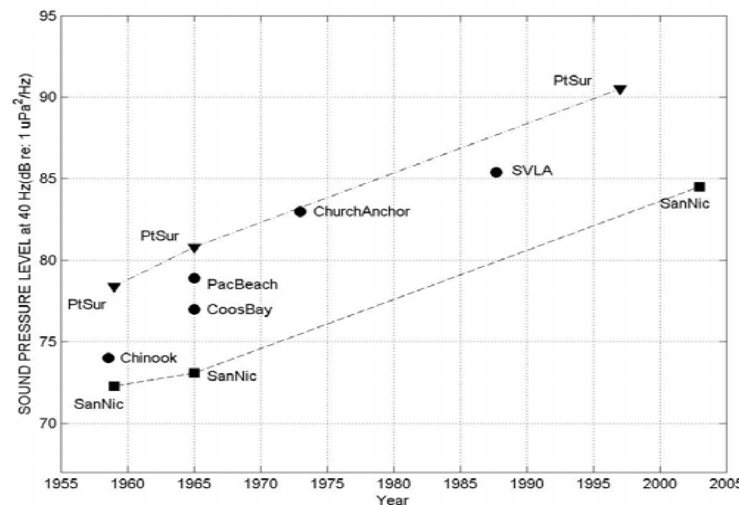
## Currently:

- Human activities produce noise, potentially chronically, and over very large areas
  - More human activities in more coastal and ocean areas means noisier waters
- **Ocean noise is a growing global problem for marine ecosystems**



## Environmental Impact:

- **Acute:** Intense noise events can have adverse physical and behavioral impacts that affect health and fitness
- **Chronic:** Rising background noise limits marine animals' communication range and ability to sense their environment



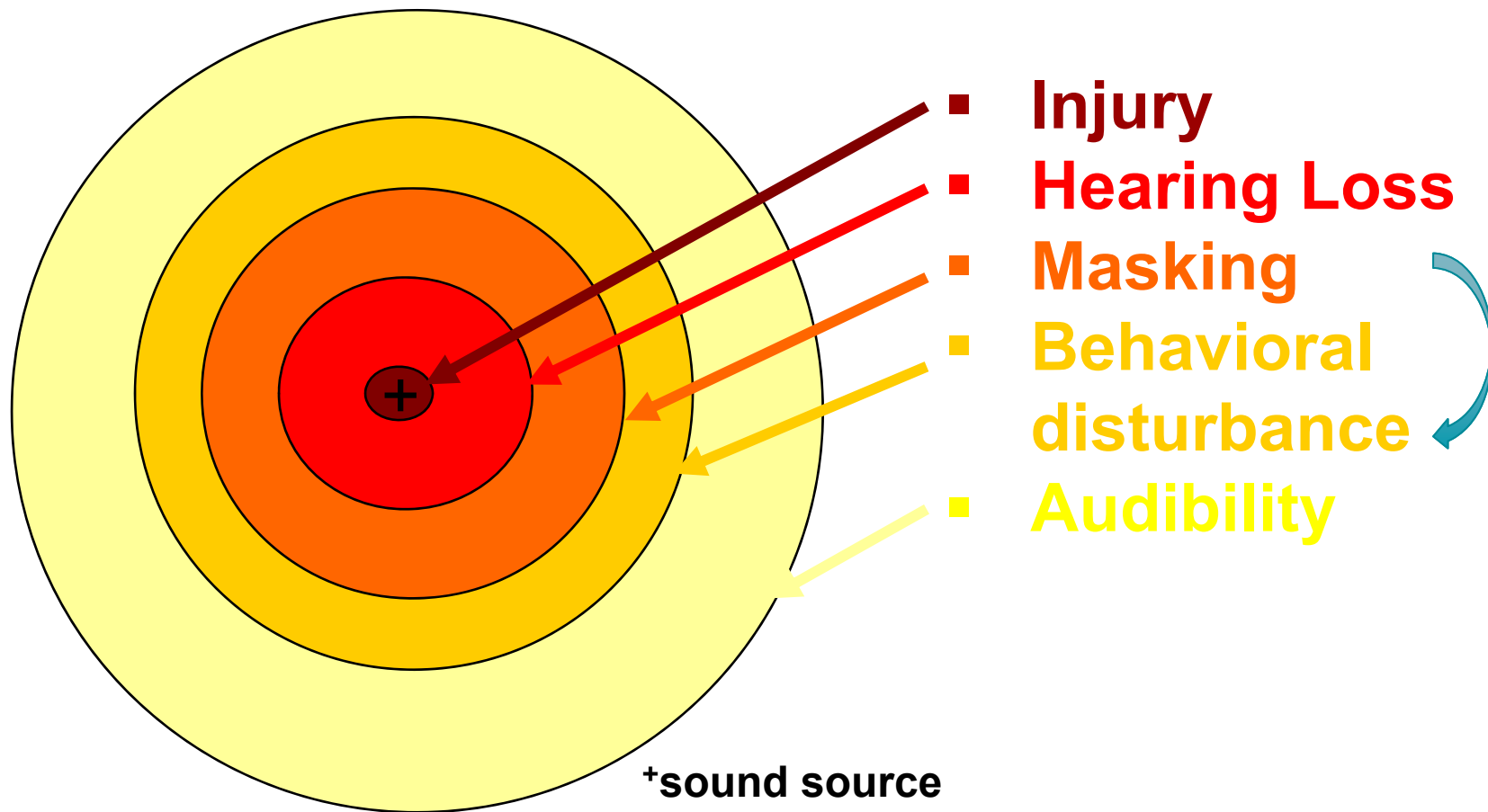
Modified from McDonald et al. (2006)



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# Zones of Noise Influence

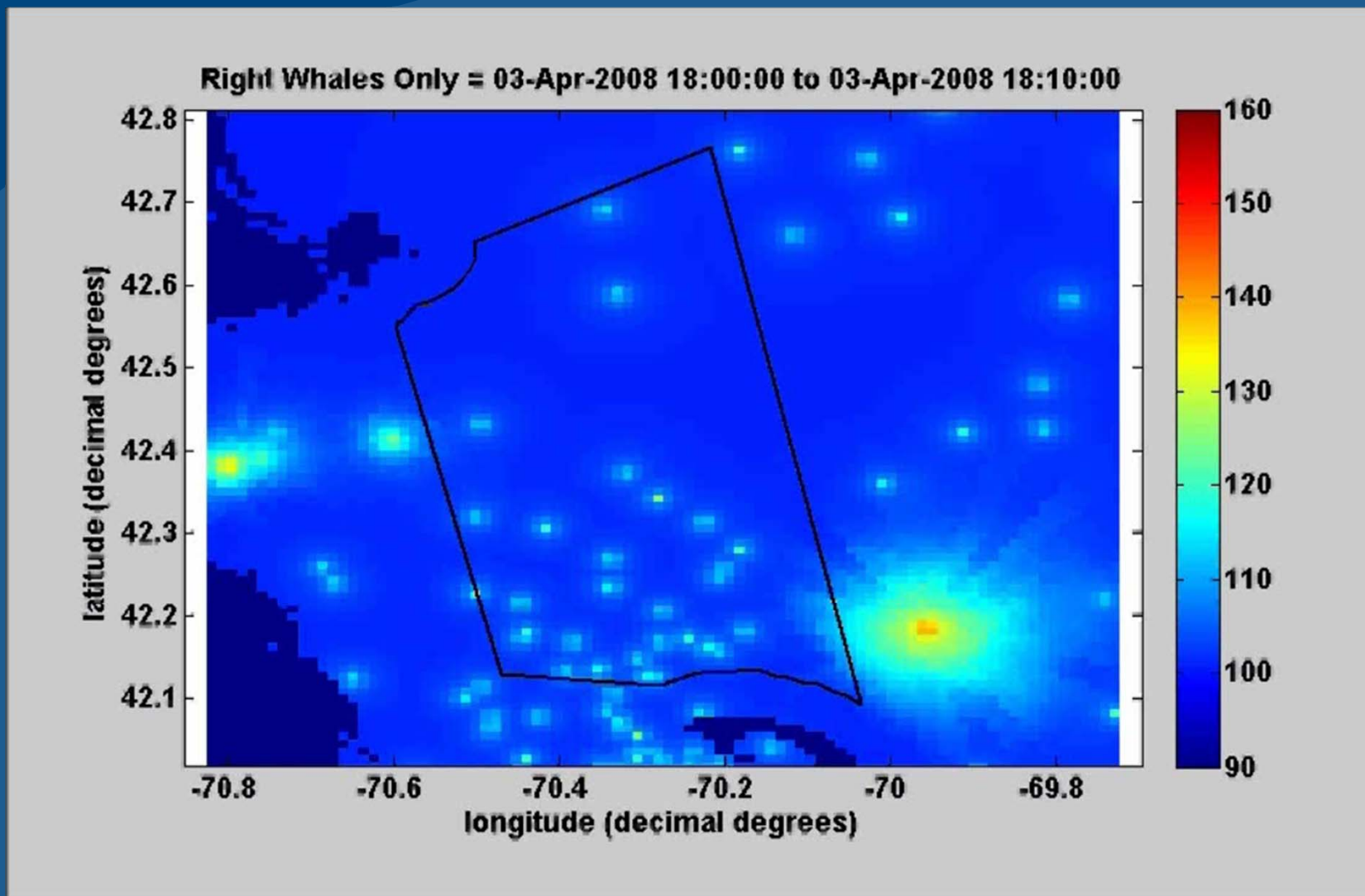


Adapted from Richardson *et al.*, 1995



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# Loss of Communication Space



Hatch, Clark, Van Parijs, Frankel and Ponirakis (2012) *Conservation Biology*



# Anthropogenic Ocean Noise

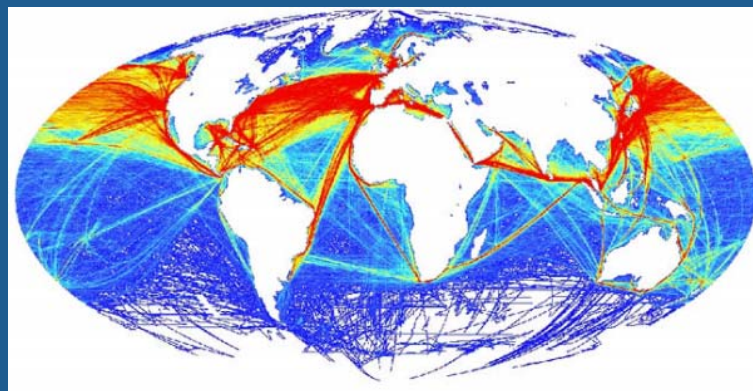
## Current Noise Management:

- Mainly activity by activity
- Relatively short term, small scale
- Thresholds for high intensity, transient sources
- Difficulties due to ambient noise variability (natural & anthropogenic)
- Heavy emphasis on marine mammal impacts



## Goals for Future Noise Management:

- Cumulative footprints from multiple source types
- Ecologically-relevant scales (space & time)
- Addressing chronic lower intensity sources
- Incorporating ambient noise variability
- Emphasizing impacts to a variety of marine animals and habitats





# Ocean Noise Strategy

## *Phase I—CetSound (Cetaceans & Sound)*



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# Phase I-CetSound

## 2010 multifaceted NOAA commitment:

- Developing tools & soliciting stakeholder input
- To help comprehensively address cumulative impacts of human-induced sound

## CetSound Working Groups (Jan. 2011-May 2012):

- **CetMap:** new tools to map cetacean density, distribution & important areas; provide context for impact analyses
- **SoundMap:** new tools to map noise & contributions from multiple sources

## Symposium (May 2012):

- Share products, talk about *potential* management applications, & solicit input from multi-stakeholder audience

Website: [cetsound.noaa.gov](http://cetsound.noaa.gov)



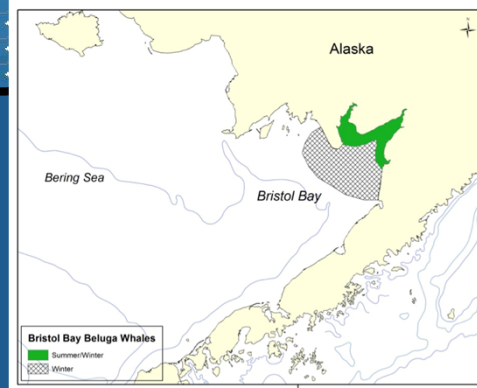
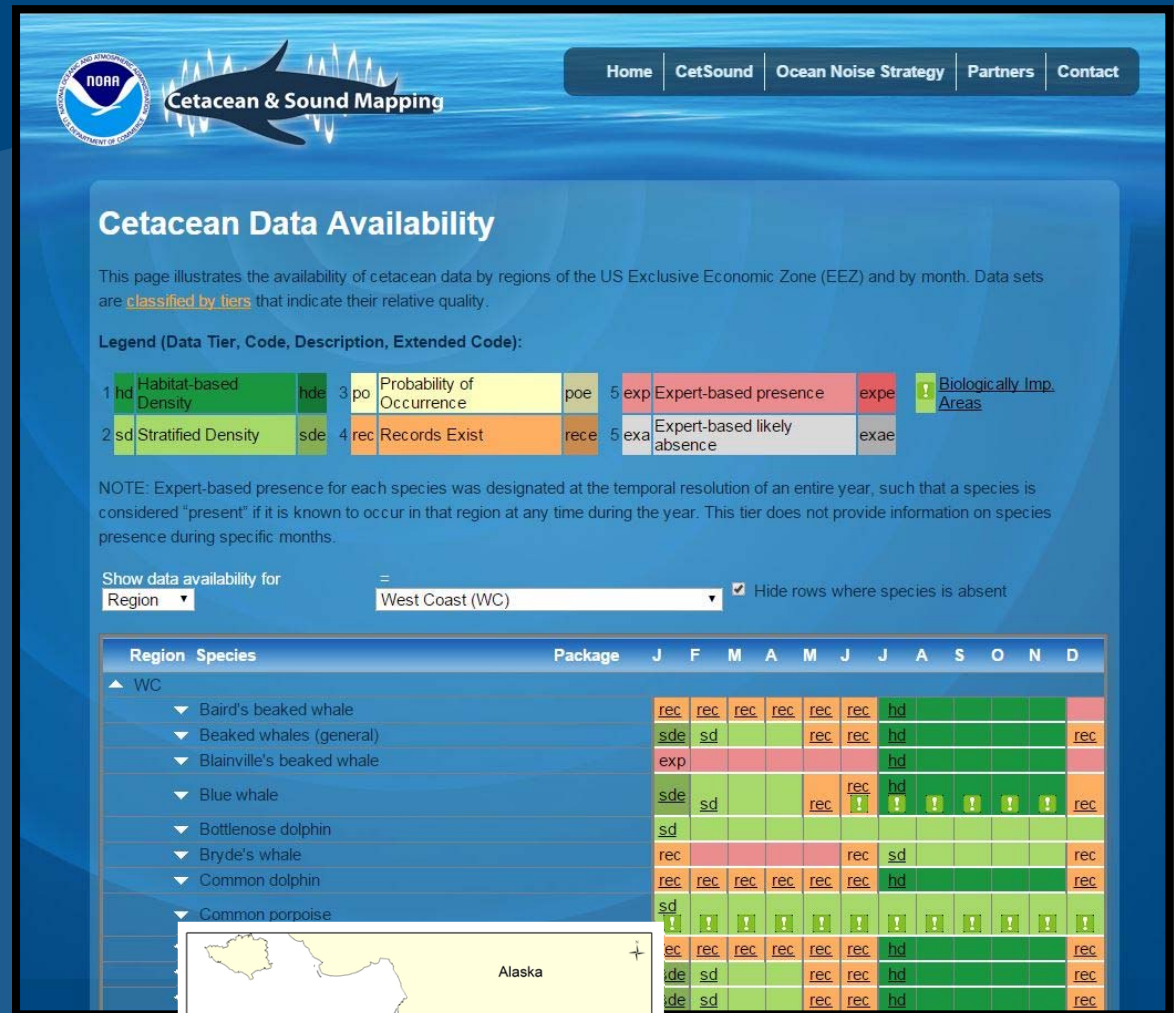
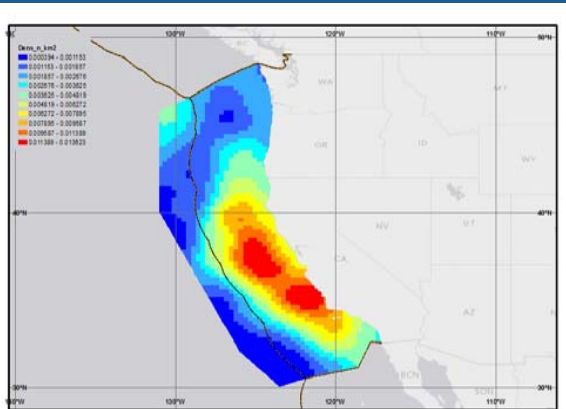
Supported by:



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# CetMap

- Cetacean Data Availability Analysis
- New Density Modeling
- Biologically Important Area Identification
- Mapping and Public Accessibility to Products

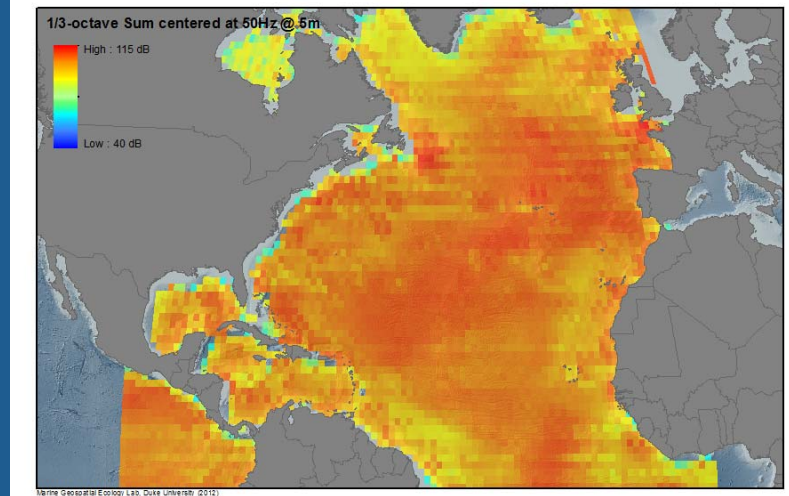
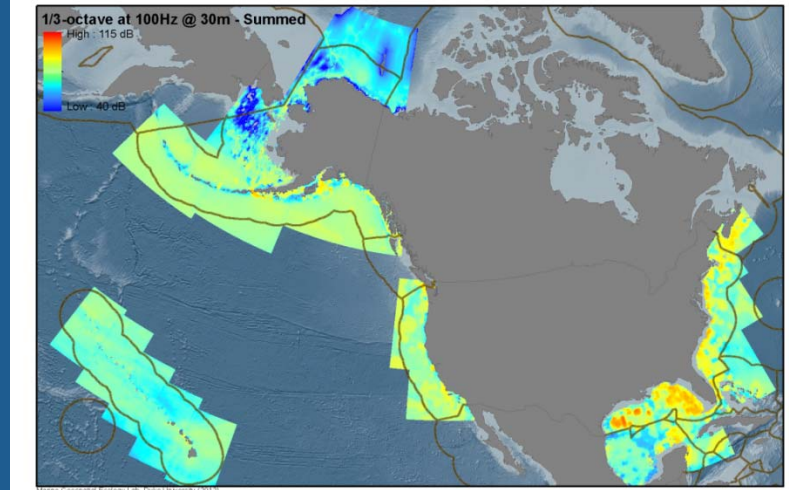
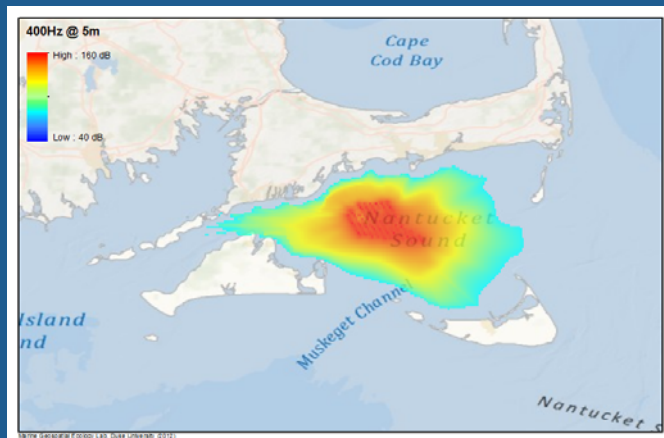


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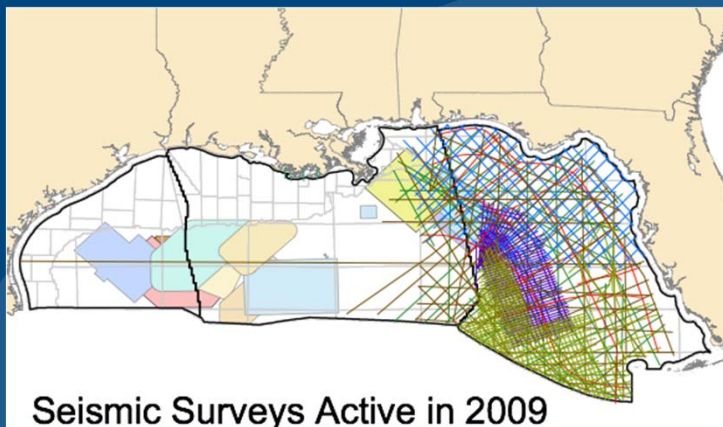


# SoundMap

- Chronic, regional to ocean-basin scale sound fields associated with multiple source types
- More comprehensive representations of local sound fields associated with shorter-term exemplar “events”

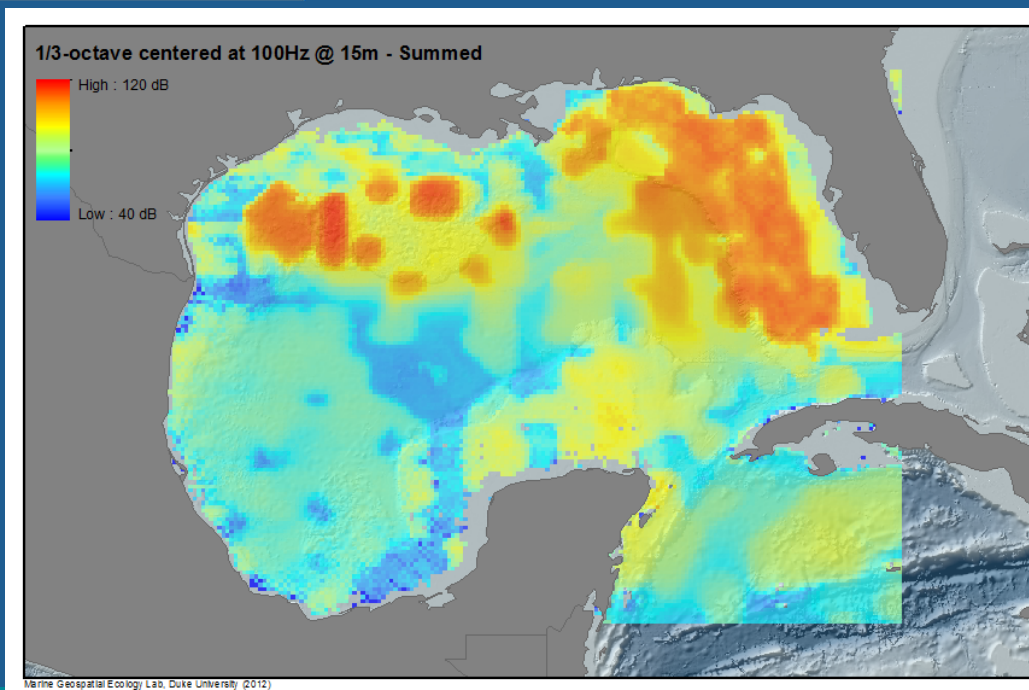


# Cumulative Chronic Low-Frequency Noise: Gulf of Mexico Example



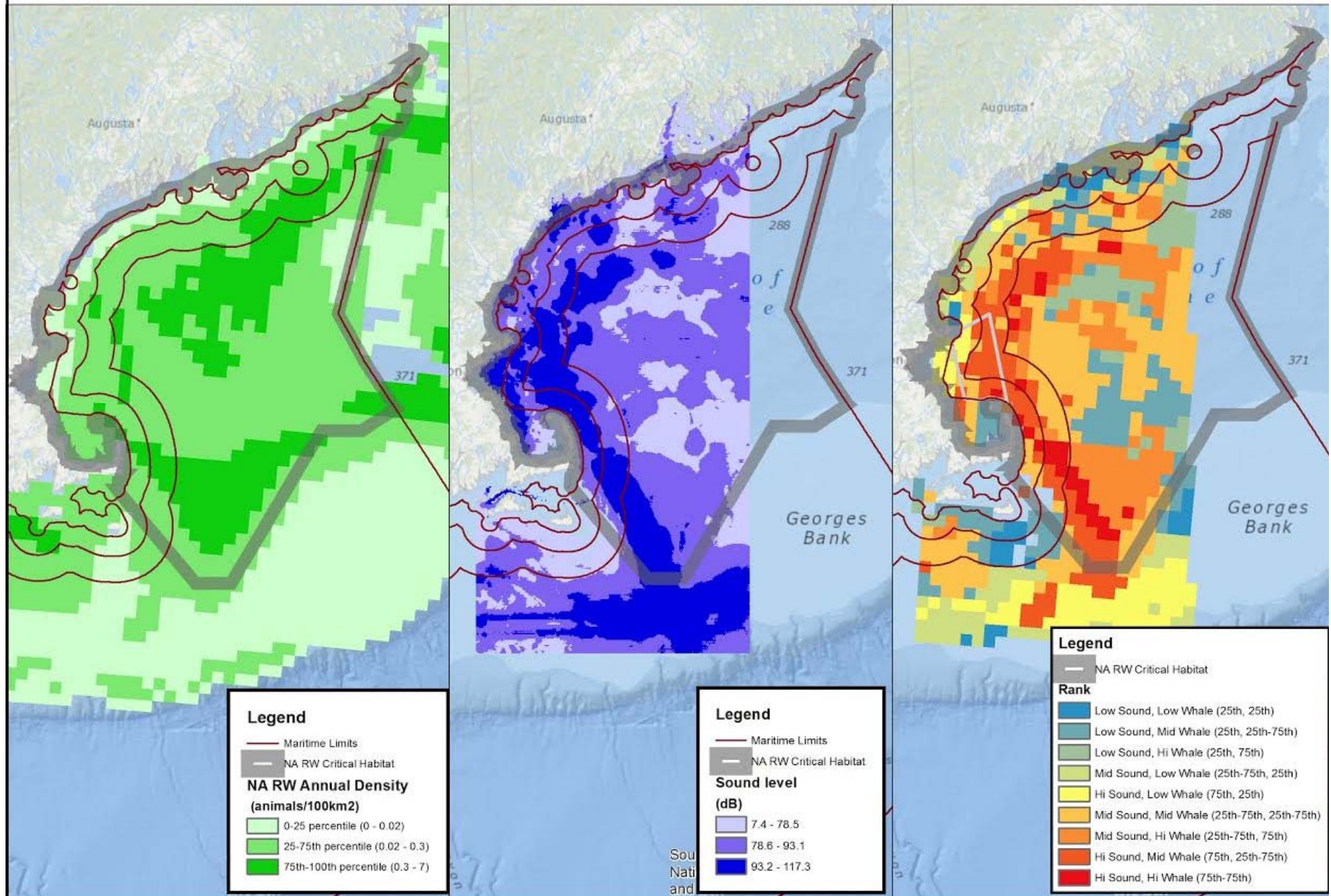
Predicted average annual summed noise contributions from:

- Merchant shipping
- Cruise and large passenger vessels
- Support of O&G platforms
- G&G airgun survey activity



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# Ocean Noise Strategy

## *Phase II—Ocean Noise Strategy Roadmap*



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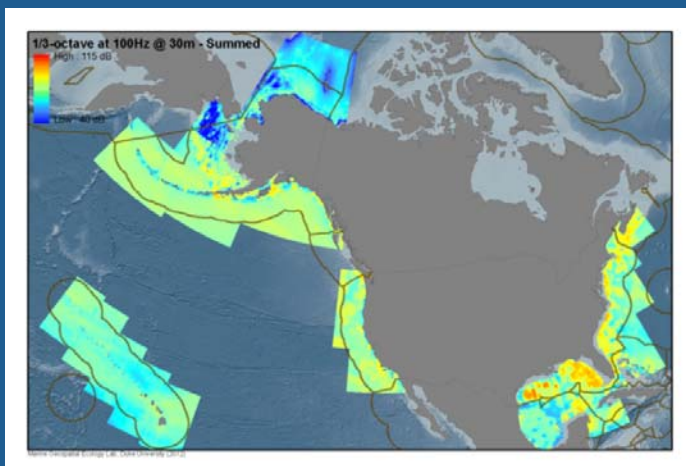
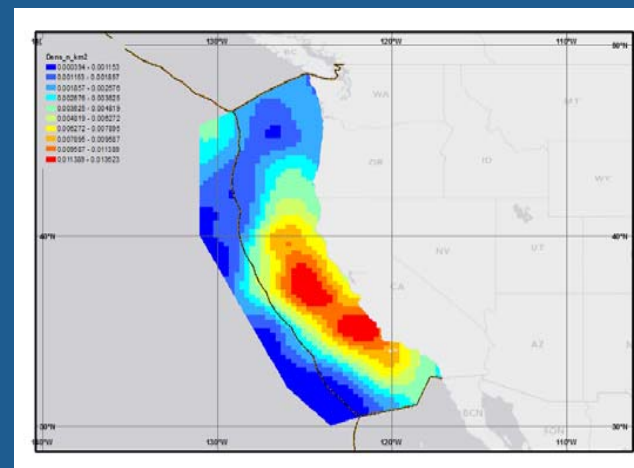
# Phase II: Ocean Noise Strategy

## 10 Year Vision

*The ONS is an initiative to guide NOAA towards a more comprehensive and effective understanding and management of ocean noise impacts*

**Science:** NOAA and federal partners are filling critical knowledge gaps and building understanding of noise impacts over ecologically-relevant scales.

**Management:** NOAA's actions are integrated across the agency and minimizing the acute, chronic, and cumulative effects of noise on marine species and their habitat.



**Decision Support Tools:** NOAA is developing publically available tools for assessment, planning and mitigation of noise-making activities over ecologically-relevant scales.

**Outreach:** NOAA is educating the public on noise impacts, engaging with stakeholders and coordinating with related efforts internationally.



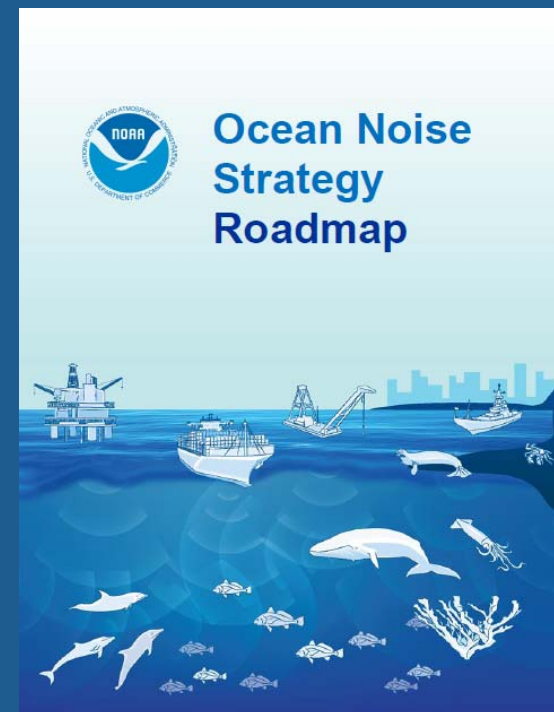
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# Ocean Noise Strategy Roadmap

Website: [cetsound.noaa.gov](https://cetsound.noaa.gov)

## Purpose

- Summarize status of science and management of noise impacts on protected marine taxa
- Provide robust support for need to better address acoustic habitat and chronic/cumulative effects
- Outline broad recommendations for better addressing noise impacts through NOAA science and management activities



## Content

- *Executive Summary*
- *1- The NOAA Ocean Noise Strategy and Managed Species*
- *2- Acoustic Habitat and NOAA 's Ocean Noise Strategy*
- *3- Enhancing NOAA 's Ability to Characterize Aquatic Soundscapes*
- *4- NOAA Ocean Noise Strategy Implementation Case Studies*
- *Appendices*

ONS Leads: Jolie Harrison (NMFS-OPR), Leila Hatch (NOS-ONMS), Jason Gedamke (NMFS-OST)



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# Ocean Noise Strategy

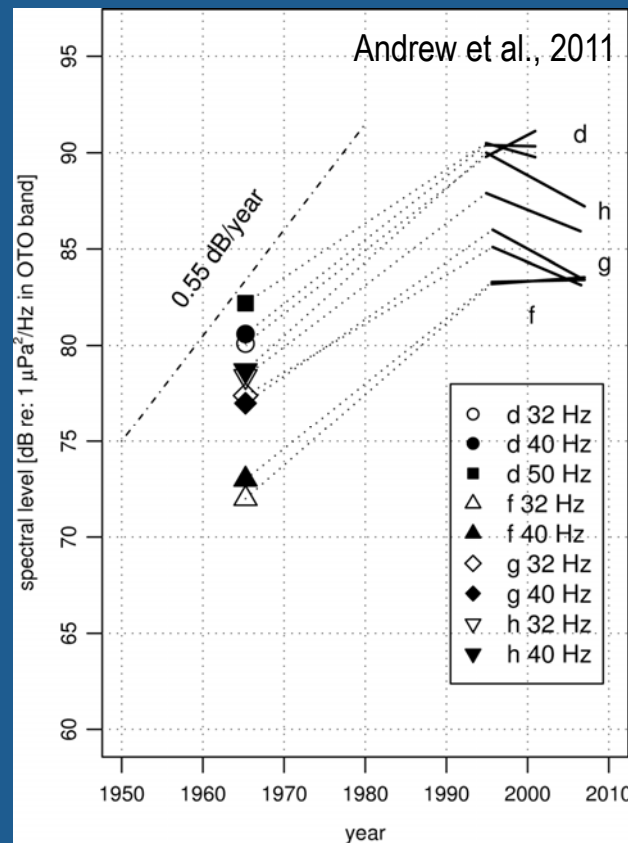
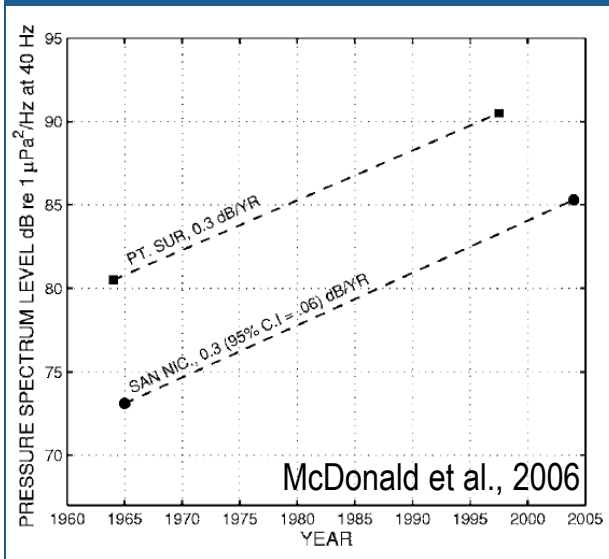
## *Phase III: Implementation and Flagship Projects*



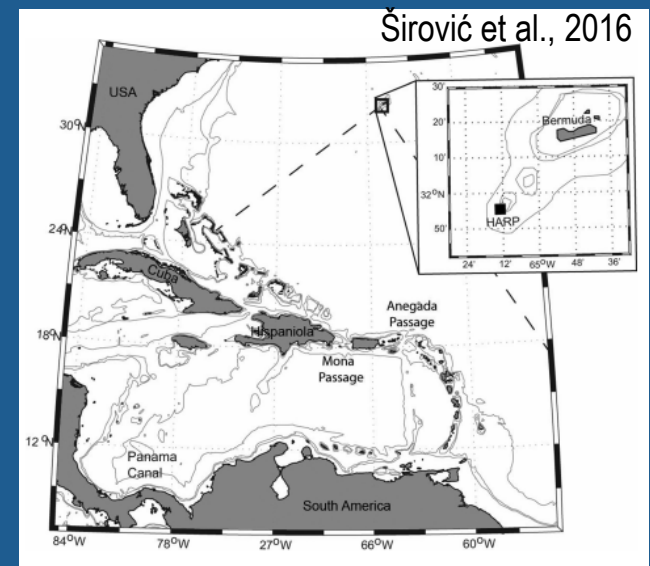
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# Assessing long-term trends and changes in underwater soundscapes

## Low frequency noise in the N. Pacific (US West Coast)

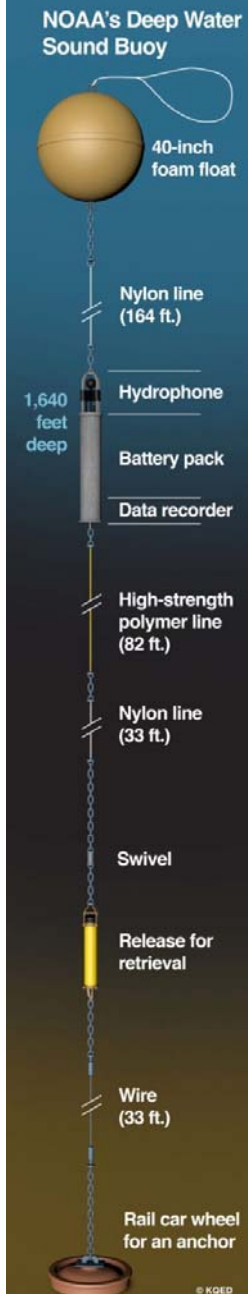


## Low frequency noise in the Atlantic



# NOAA Noise Reference Station (NRS) Network

Low frequency, long-term passive acoustic monitoring



Long-term deployment of calibrated recording packages to allow comparison between and within sites over time

Addressing needs:

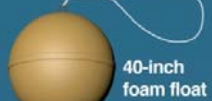
- Characterization and comparison of soundscapes broadly across US waters
- Empirical validation of predictive soundscapes
- Assessment of long-term trends and changes in soundscapes



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## NOAA's Deep Water Sound Buoy



40-inch foam float

Nylon line  
(164 ft.)

1,640 feet deep

Hydrophone

Battery pack

Data recorder

High-strength polymer line  
(82 ft.)

Nylon line  
(33 ft.)

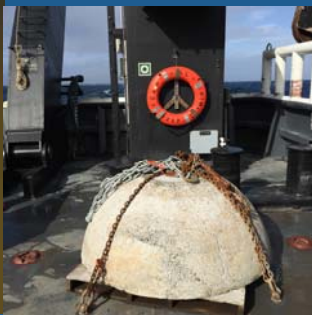
Swivel

Release for retrieval

Wire  
(33 ft.)

Rail car wheel  
for an anchor

© KOED



# Deployment Configurations

Deep-water mooring

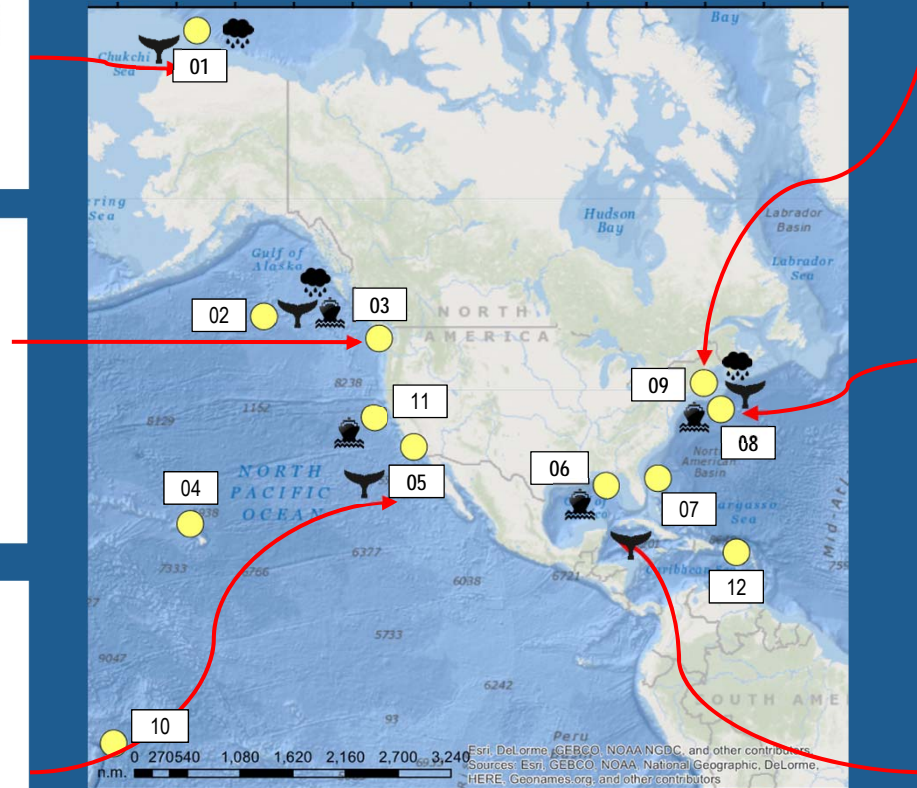
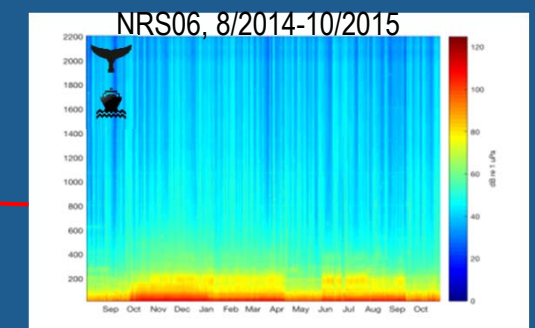
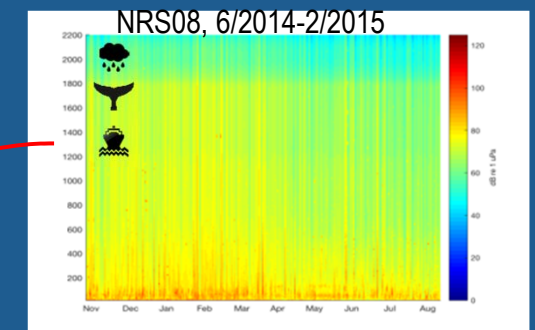
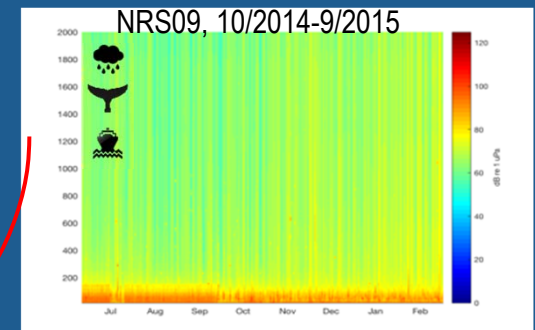
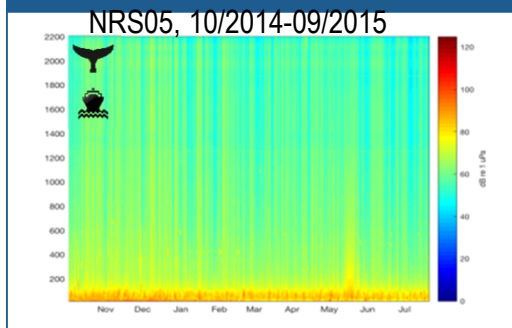
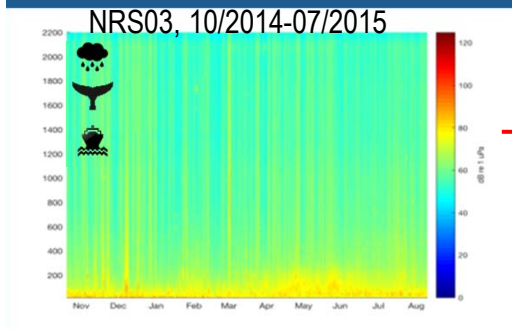
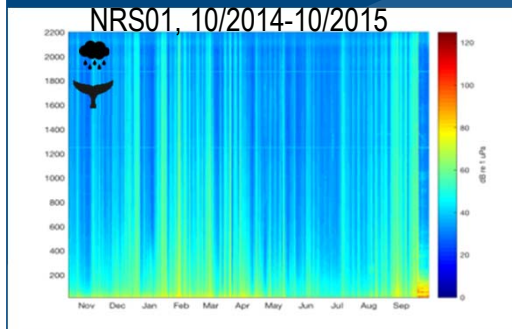
Shallow water lander



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# NOAA Noise Reference Stations (NRS)

Long Term Spectrograms of NOAA NRS  
data in-hand (as of 9/2016)



Dominant noise contributors:

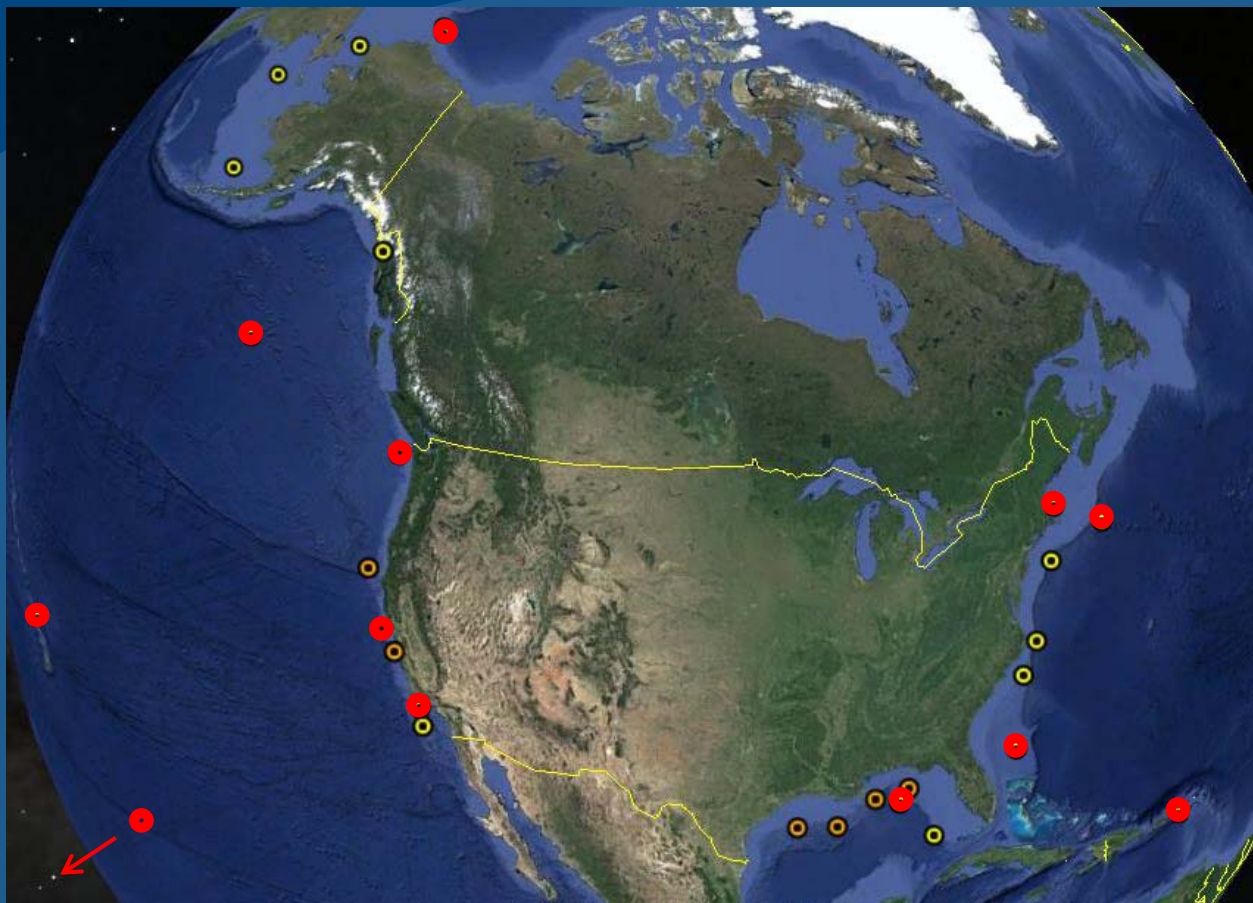
Anthropophony, Biophony, Geophony



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# Potential Expanded PAM Network Sites



## Criteria:

- Longevity—min. 3+ years
- Spatial Coverage
- Data Quality
- Data Access

## Network of 30 sites :

- 23 existing incl. NOAA, BOEM, Navy, NPS sponsored instruments\*
- 7 new sites

\*3 existing sites (Am. Samoa, Saipan, Wake) not shown



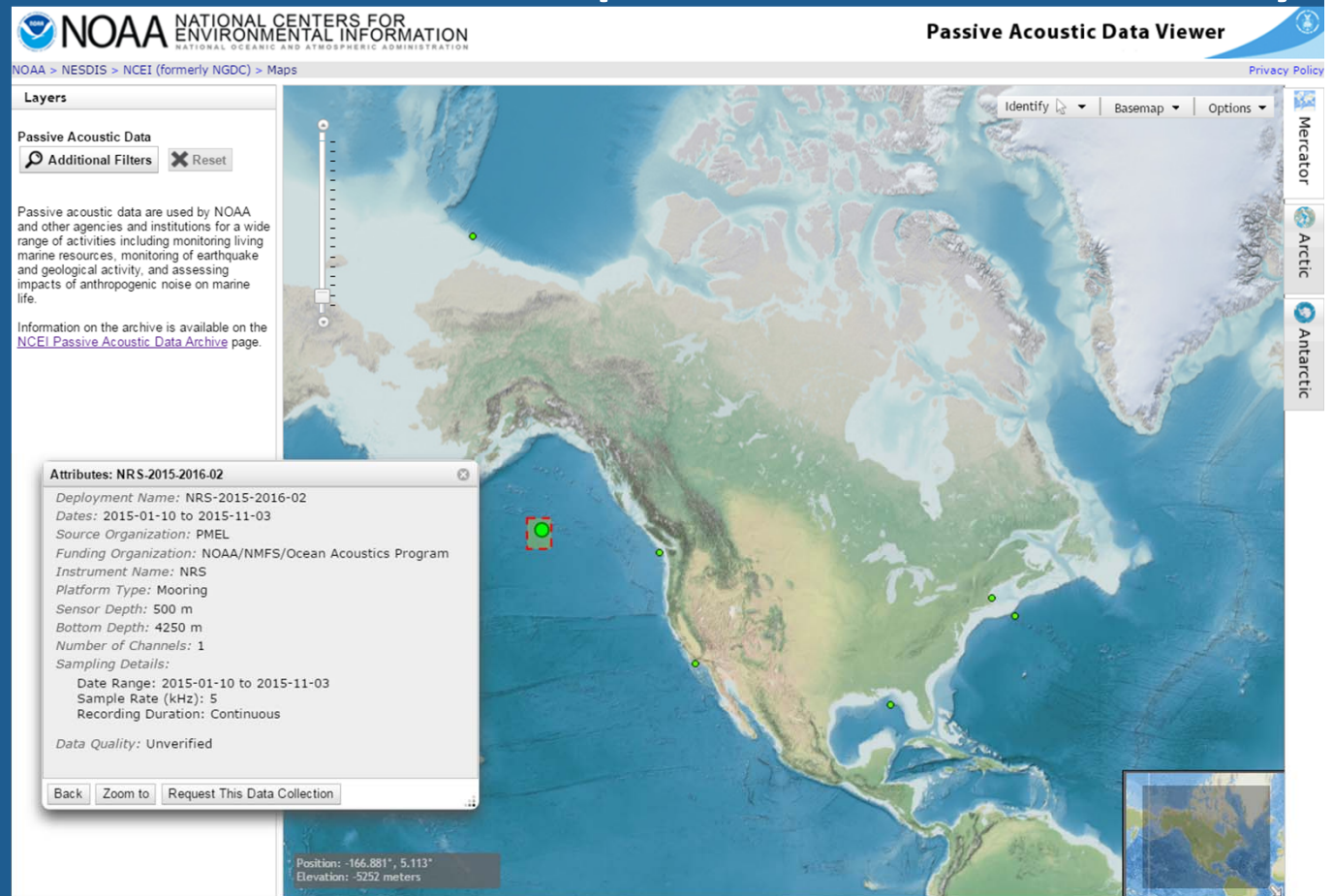
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# Public Archive for Passive Acoustic Data

## Map Viewer and Data Delivery

- NMFS and NCEI joint project to provide long-term PAM data archive
- 7 NRS stations archived to date—seen on the map viewer where data can be queried and requested
- Information shown for each station reflects the metadata provided using data submission tool



National Centers for  
Environmental Information  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

<https://www.ngdc.noaa.gov/mgg/pad/>

Carrie Wall, Project Lead & Charles Anderson, Data Manager



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# Summary

- Underwater sound, both natural and anthropogenic, travels great distances. Marine life relies heavily on sound to communicate and sense their surroundings.
- Sound from human activities can have a wide range of potential impacts on marine life, of varying severity, and over short to long time scales
- NOAA's recent Ocean Noise Strategy initiative aims to improve NOAA's ability to understand and manage impacts from Ocean Noise on our trust resources over the next decade.
  - Phase I—CetSound working groups
  - Phase II—ONS Roadmap outlining long-term goals & recommendations
  - Phase III—Implementation actions (e.g. Office workplans, Flagship Projects)

