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Office of
Science &
Technology

Ocean Sound & Ocean Noise:

Understanding the changing underwater acoustic environment

Jason Gedamke
Ocean Acoustics Program

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To survive and reproduce, animals need to:

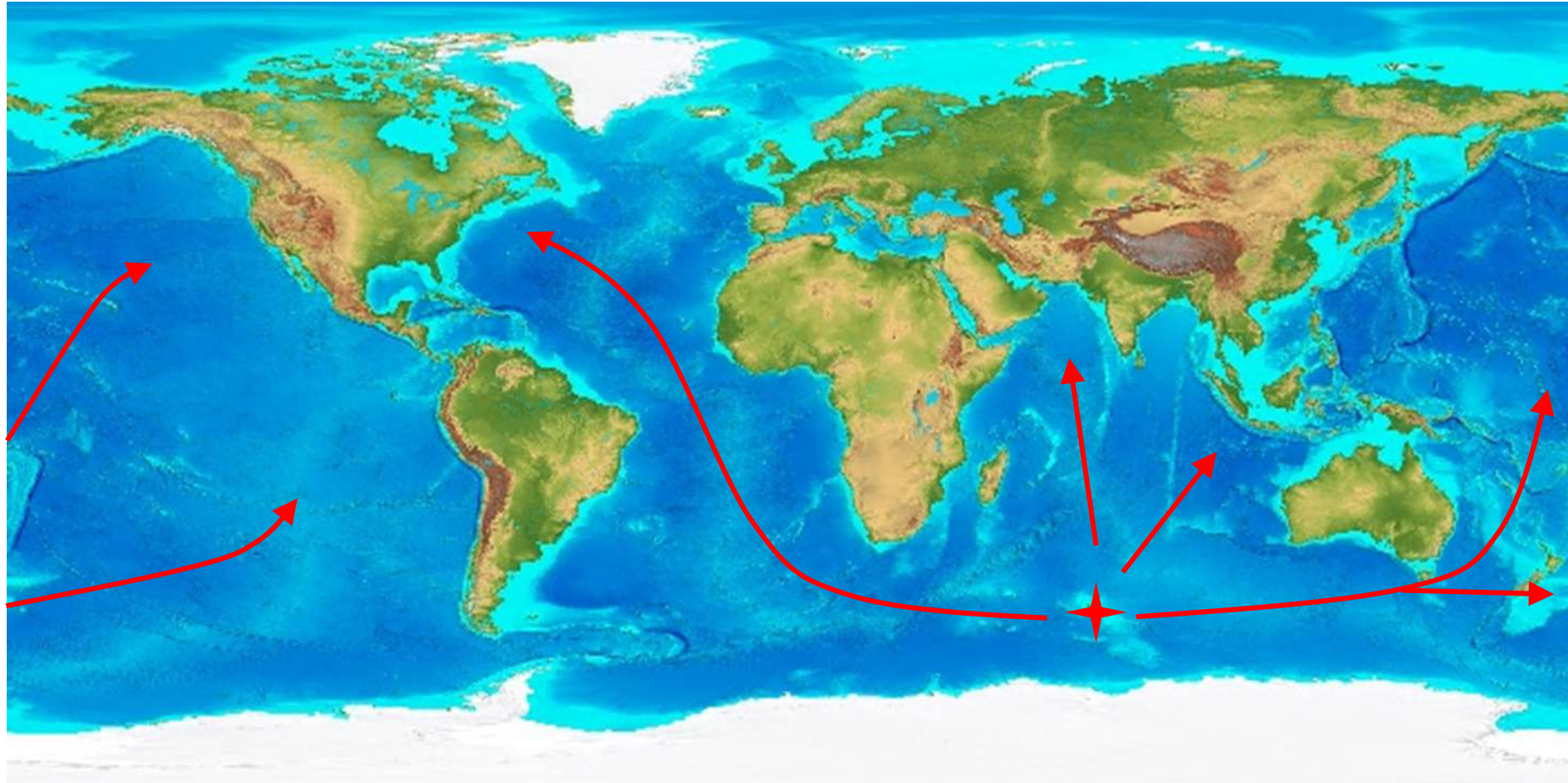
- Attract mates
- Defend territories or resources
- Establish social relationships
- Coordinate feeding
- Interact with parents or offspring
- Avoid predators or threats

Communication is often essential.

Communication exists in many forms.



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



Sound, however, travels exceptionally well underwater.

Soundscapes

Natural Physical

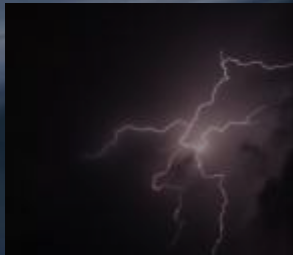


Natural Biological



Soundscapes

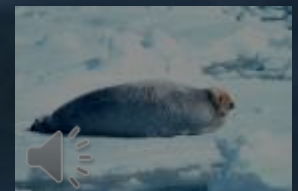
Natural



Human Activities

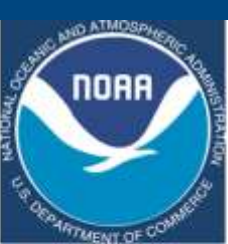


Biological



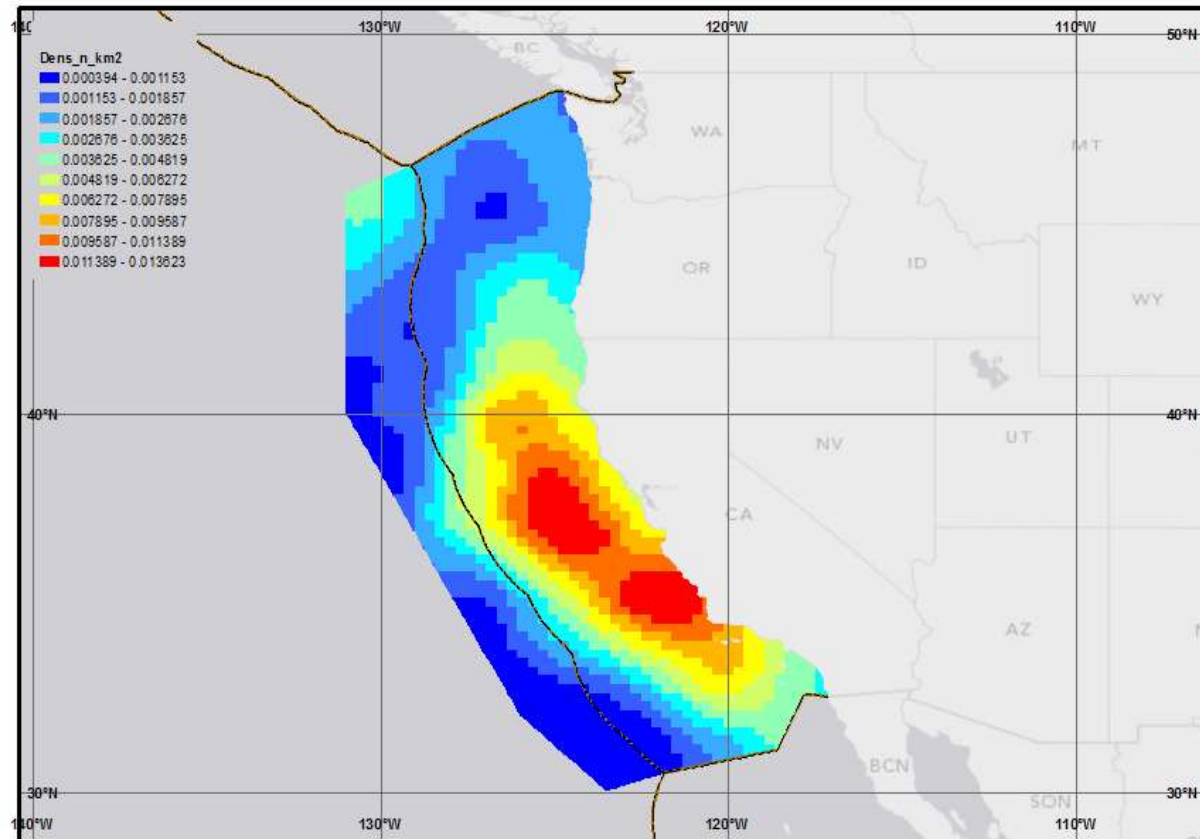
Understanding Changing Soundscapes



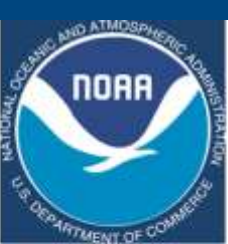


Cetaceans & Sound (CetSound)

CetMap: Mapping cetaceans in U.S. waters

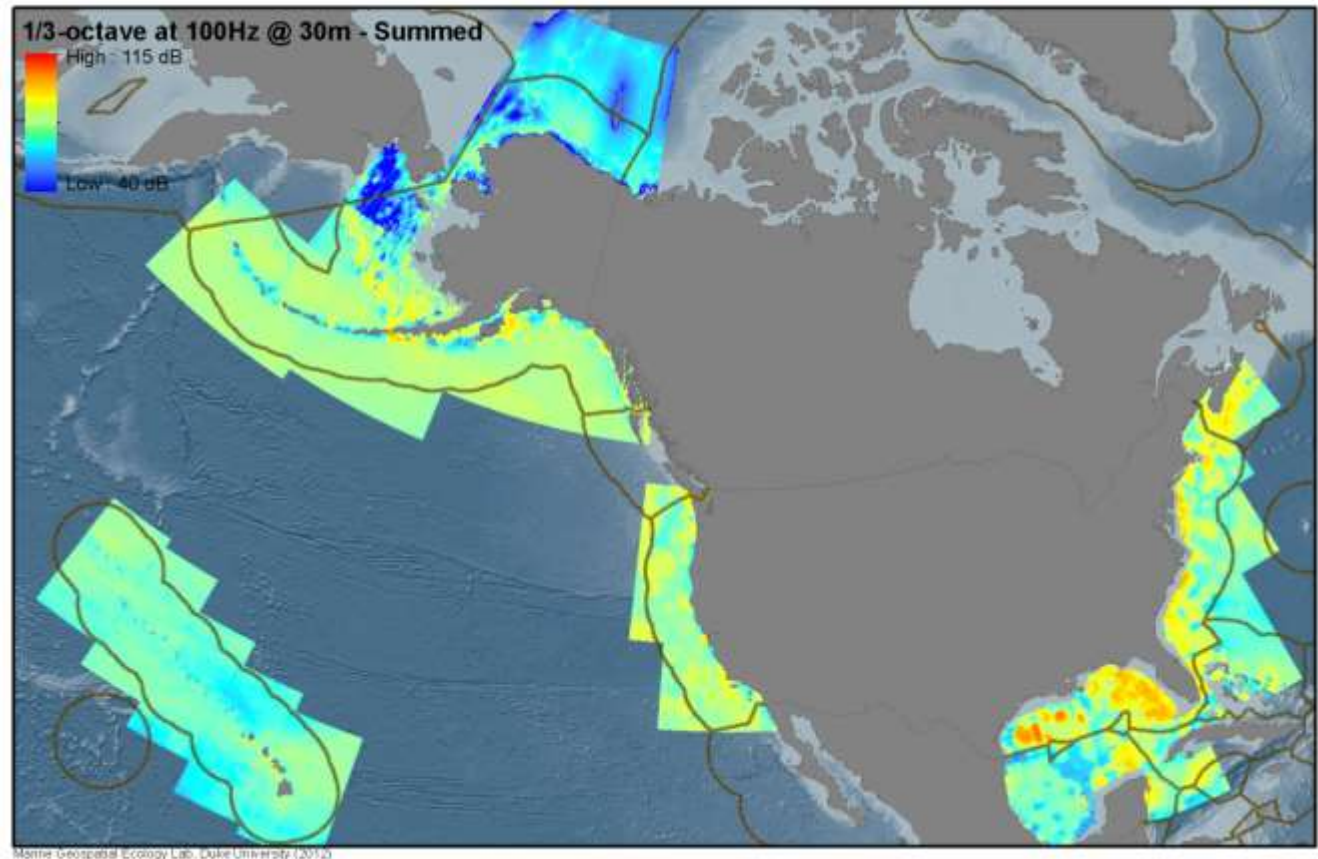


<http://cetsound.noaa.gov>



Cetaceans & Sound (CetSound)

SoundMap: Mapping man-made sound in U.S. waters



<http://cetsound.noaa.gov>

International Workshop on Global Soundscape Modeling (April, 2014)

Organized and sponsored by:

- International Whaling Commission—Scientific Committee
- U.S. (NOAA & Navy)
- Netherlands
- the International Council for Science—Scientific Committee on Oceanic Research

JOINT WORKSHOP SPONSORED BY THE IWC, IQOE, US NOAA & ONRG, AND NETHERLANDS TNO & MINISTRY OF INFRASTRUCTURE AND THE ENVIRONMENT

JOINT WORKSHOP REPORT: PREDICTING SOUND FIELDS—GLOBAL SOUNDSCAPE MODELLING TO INFORM MANAGEMENT OF CETACEANS AND ANTHROPOGENIC NOISE

15-16 April 2014

TNO- Gorter Building, Wassenaarseweg 56

Leiden, Netherlands

OVERVIEW: A two-day workshop was sponsored by the International Whaling Commission (IWC), the International Quiet Ocean Experiment (IQOE), the U.S. National Oceanic and Atmospheric Administration (NOAA), Office of Naval Research Global, and the Netherlands Organisation for Applied Scientific Research (TNO) and the Netherlands Ministry of Infrastructure and the Environment. Twenty-six international experts came together from 11 countries to discuss regional and ocean-basin scale underwater sound field mapping techniques to provide support for decision makers seeking to characterize, monitor, and manage the potential impacts of chronic or cumulative anthropogenic noise on marine animals. The workshop product is a meeting report that includes recommendations directed to sponsoring international organizations and/or their science advisory groups to support the development and implementation of soundscape modelling and mapping tools needed to make informed management decisions.

RATIONALE: Over the past decade, the effects of anthropogenic noise have become a recurring agenda item for discussion within several international fora focused on the conservation and management of marine biota. Initially, concerns primarily targeted the potential effects of acute sources of sound that could lead to very near term consequences (e.g. behavioural changes, strandings). In recent years, however, there has been a distinct broadening of the focus of noise impacts to include the much larger scale, and longer term chronic effects of increases in ocean noise and changes in underwater soundscapes. An increasing number of scientific efforts (International Quiet Ocean Experiment (IQOE), U.S.'s National Oceanic & Atmospheric Administration CetSound effort) directed at this topic reflect this broader scope. In September 2011, the IQOE held an open science planning meeting¹ where research into soundscape characterization and modelling were identified as one of the four key themes to be contained in the IQOE's Science Plan. NOAA has similarly recognized the need for this work through the convening of the Cetaceans and Sound (CetSound) project in which it is developing mapping tools to produce underwater sound-field maps, along with cetacean density and distribution maps². In addition, to meet the noise-related Good Environmental Status objectives of the European Marine Strategy Framework Directive, sound field modelling and mapping comprise a substantial portion of the recommended monitoring programs for noise assessment³. In this relatively new field of knowledge, cooperation between nations will increase advances and such cooperation is actively pursued as stated, for example, between the US, Canada and the European Union in the Galway Statement on Atlantic Cooperation⁴. The International Whaling Commission (IWC) has also exhibited an interest in the more regional effects of noise pollution. During the meeting of the IWC Scientific Committee in June 2012, the U.S. presented the CetSound project and its preliminary results. The IWC Scientific Committee strongly recommended support for further development and improvement of these sound and cetacean mapping tools, and subsequently provided support for a joint workshop (with IQOE, NOAA, and the Ministries of Infrastructure and the Environment, Netherlands) to expand these tools and their global application in order to better inform the management and conservation of marine species, including cetaceans.

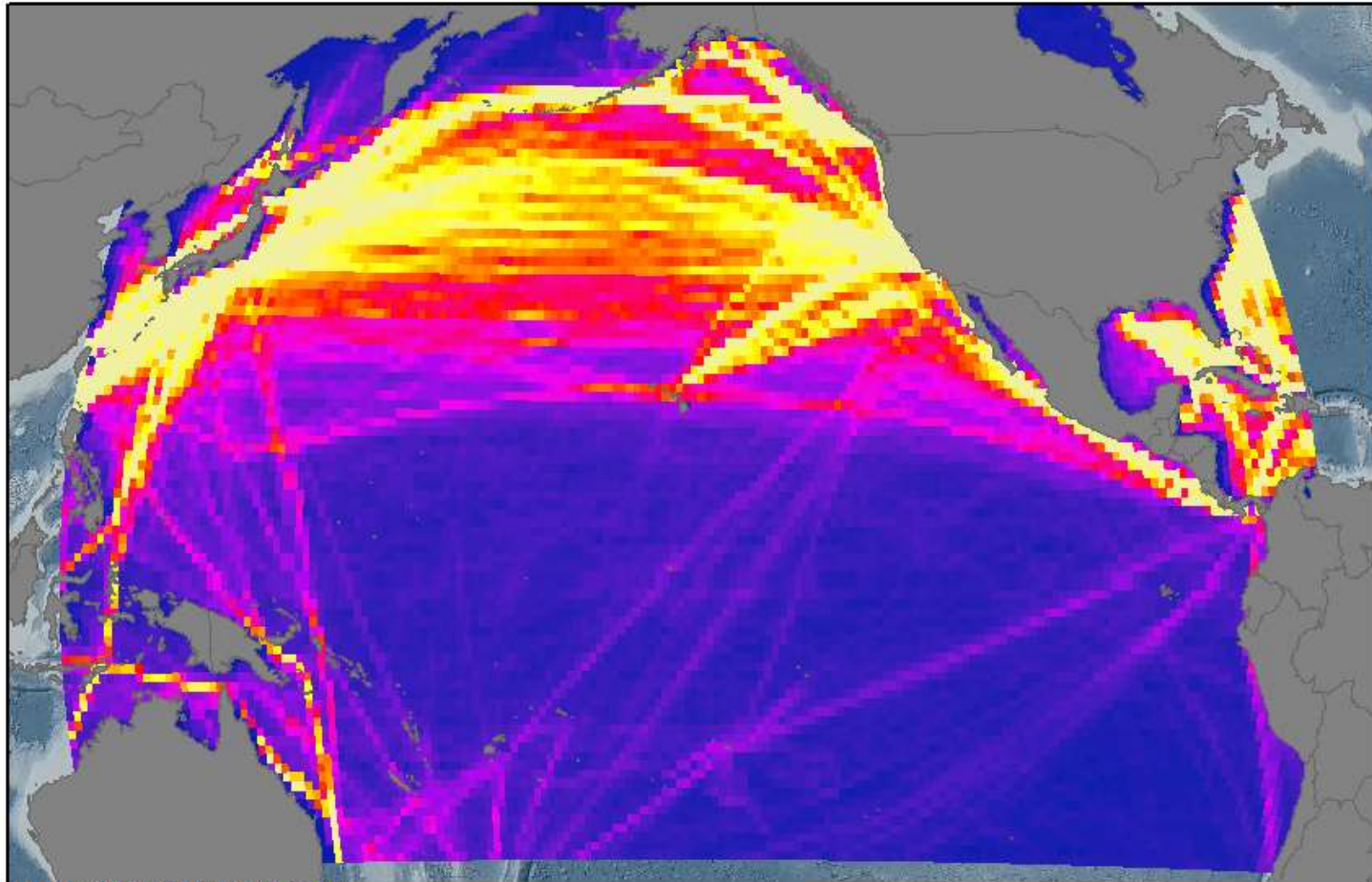
TERMS OF REFERENCE:

The general terms of reference for the joint workshop were to:

- Exchange, evaluate, and analyse sound modelling and mapping methodologies at spatial, temporal and spectral scales relevant to chronic and cumulative noise assessments with a view to optimizing techniques and their transferability in order to increase the accessibility of these methodologies to a wider range of researchers, governments, industry, and organizations.
- Identify and assess information needs, within priority regions, for 1) sound field characterization at spatial, temporal and spectral scales relevant to chronic and cumulative noise assessments, including human use, and 2) sound source and propagation medium data that are necessary to model longer-term and larger-scale anthropogenic noise contributions.

Mapping Distribution and Density of Sound-producing Human Activities:

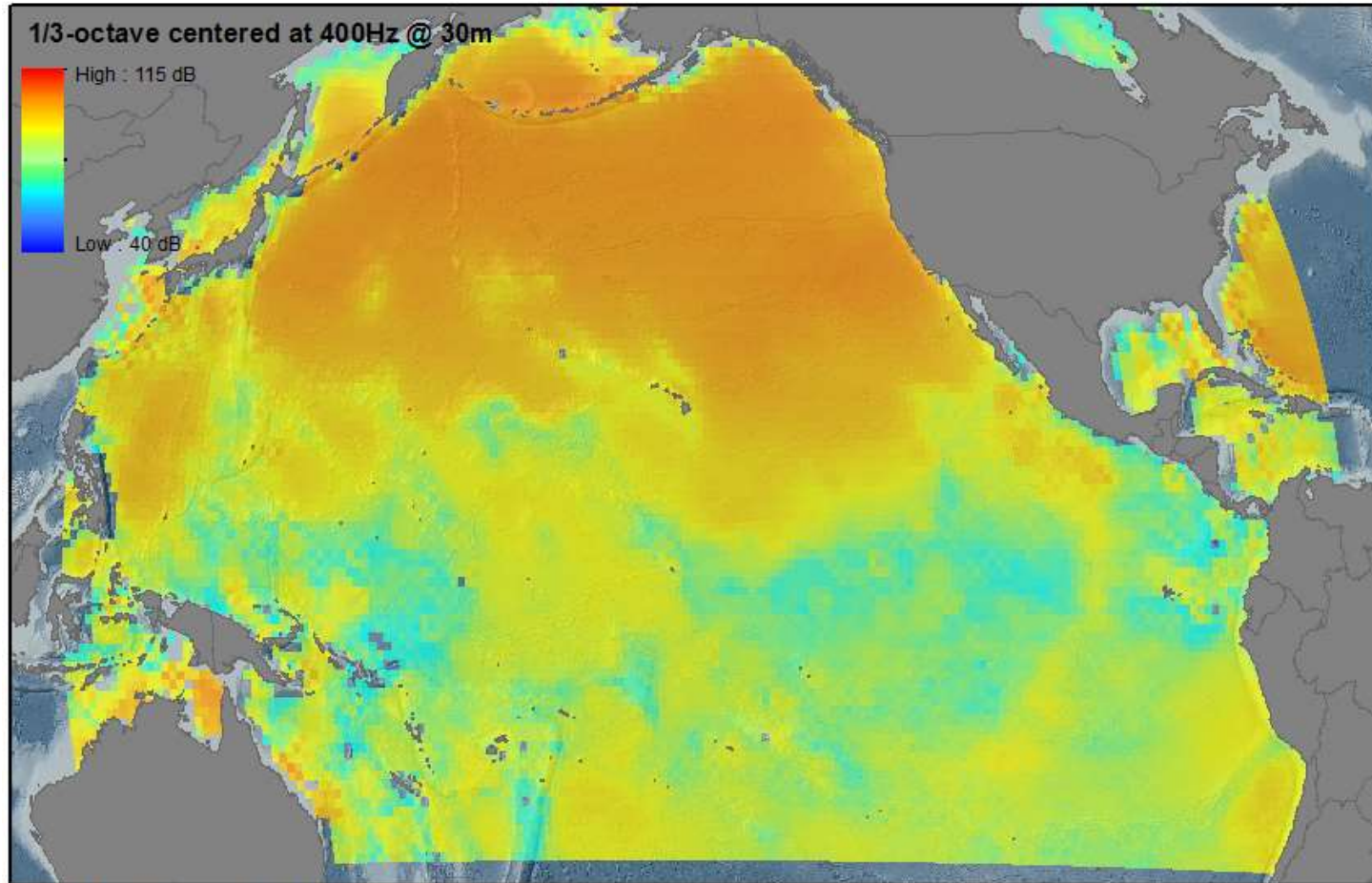
Example—Merchant Shipping Density in the North Pacific



Marine Geospatial Ecology Lab, Duke University (2012)

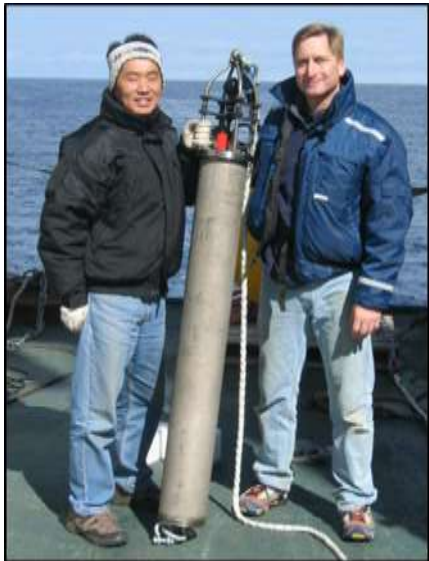
Mapping Predicted Noise Levels from Sound-producing Human Activities:

Example—Merchant Shipping Predicted Noise Levels



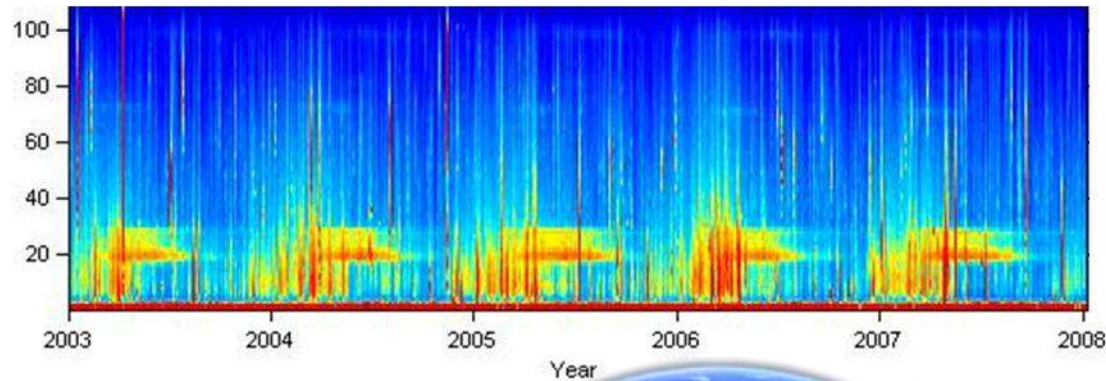
Ocean Noise Reference Station Network

NOAA's first across agency acoustic monitoring system



Partners:

- OAR-PMEL
- NOAA Fisheries Science Centers
- NOAA Fisheries OST
- National Marine Sanctuaries



Conclusions & Future Directions

Underwater sound is efficient for communication. Marine mammals have evolved to heavily rely on sound.

Anthropogenic sound also travels far—man has fundamentally altered the ocean soundscape in the last century.

NOAA is developing a forward looking, long-term Ocean Noise Strategy, aiming to:

- Integrate science and management actions
- Conduct research to fill critical knowledge gaps
- Develop tools to support noise assessment, planning, and mitigation
- Promote public understanding of noise impacts

Questions?

