LIVING MARINE RESOURCES PROJECT 74

Navy Received Level Propagation Modeling Alignment Working Group

NEED

The Navy uses behavioral response functions in environmental compliance analyses and take estimates. Traditionally the response data are only used in the models if they include a measured received level (e.g., an acoustic tag recording). For tags that do not include acoustic recording capabilities and for passive acoustic monitoring used to track marine mammals, received levels are often based on propagation modeling. Because multiple propagation modeling methods are used, the Navy needs more information on the various models and how outcomes could vary.

SOLUTION

This project will convene a working group to examine existing propagation models and their underlying assumptions and methodologies. The group will use common datasets in each model, adjusting model parameters and comparing outcomes to understand how each model works. The group will consider modeling paradigms when animal or source locations are uncertain and will propose a unified approach to be considered by all groups relying on propagation-modeled received levels to promote comparable values across projects and regions. This is not intended to require use of a single model but will work toward outcomes that can be compared and used reliably when combined in future risk function development.

METHODOLOGY

The project will form a working group of Navy and non-Navy research partners currently using propagation models in their analyses. The group will review and test various types of propagation models, including ray tracing, normal mode and parabolic equation models.

The group will include three teams: modeling, analysis and field teams. The modeling team will run and iteratively test the different propagation models. The analysis team will help to process and compare the model results. The field team, to include those who collect and use data, will contribute tag data for testing and comparison, as well as inform and support the data analyses. Outside technical experts could also be involved as consultants on topics of propagation if needed.

Work will be organized into four primary tasks.

- **Task 1: Initial propagation model comparison and analysis**

  The project lead will work with each of the modeling team members to complete an initial basic propagation model comparison and analysis. Insights and lessons will be compiled into a report to be shared with the whole working group and used as the starting point for the full analysis.

- **Task 2: Detailed propagation model comparisons**

  The working group will then make initial decisions regarding which datasets and model parameters to use for modeling, how to deal with positional uncertainty and what other approaches to consider. The modeling team, supported by the analysis team as needed, will process the agreed upon test dataset(s) using the selected propagation models and parameters. This will be an iterative process in which multiple datasets are selected that capture the different environments, focal species and signals relative to each contributing project. Following each test round, the team will discuss input parameters and compare outputs.

NAVFAC Naval Facilities Engineering Systems Command
EXWC Engineering and Expeditionary Warfare Center

Once the preceding steps are completed, the full team will meet to compare and discuss the results.

- **Task 3: Discussion of reporting metrics**
  The analysis team will discuss the different approaches currently used and will present the types of metrics reported and how they are reported. This will guide best practices for reporting the model outputs, with a goal of a unified approach on reporting metrics and variance that can be used in future behavioral response functions (or other Navy applications).

- **Task 4: Determination of aligned modeling approaches**
  All preceding pieces will be compiled, and the full working group will meet to discuss lessons learned on input parameters, modeling approaches and reporting methods. The goal will be to come to an agreement on how to move forward to achieve reasonably comparable results in the future when using different models.

The working group will prepare a final technical report that describes the results of the model comparison, the metrics selected for reporting and the final outcomes. This could be used as a guide for working group members as well as future modeling efforts to ensure continued alignment.

SCHEDULE

The project begins in early 2025 and will be conducted over three years with a final technical report in late 2027.

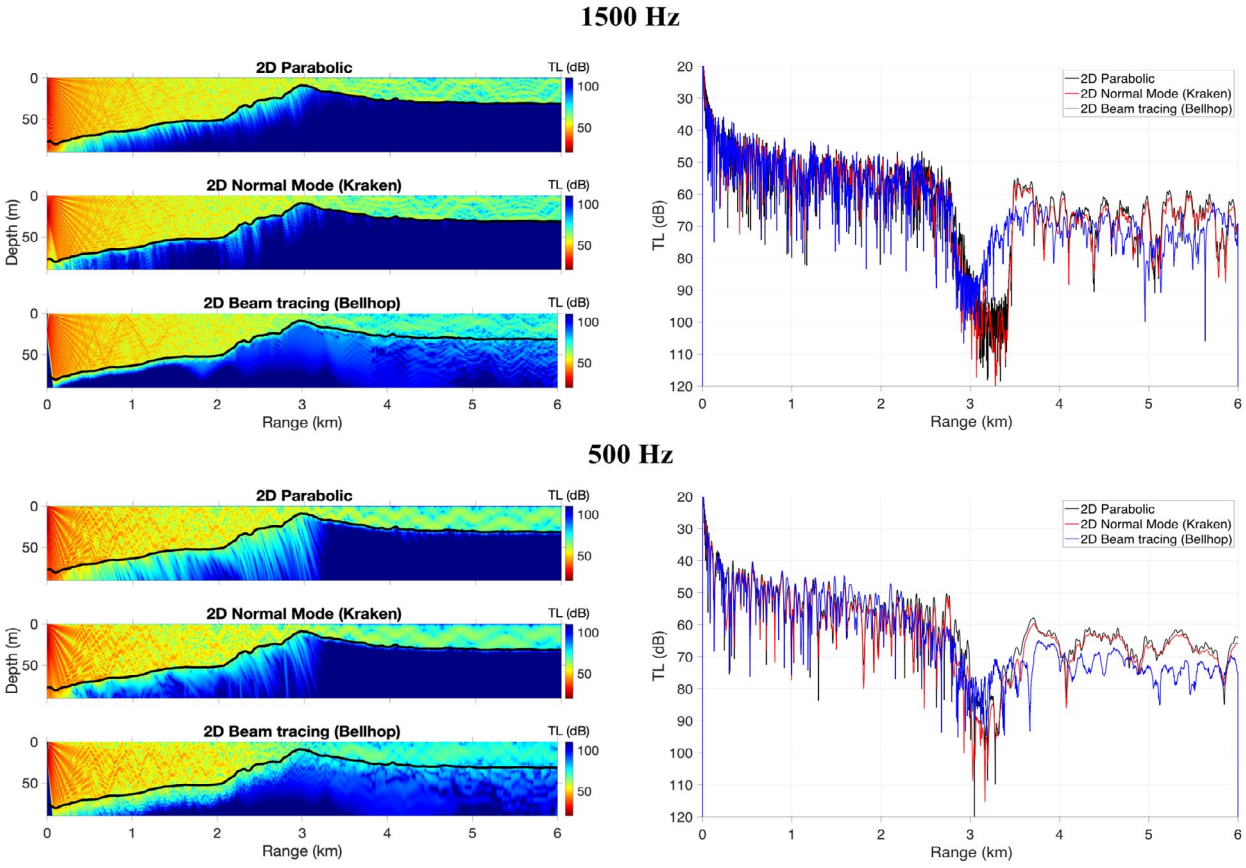

Figure demonstrates sound propagation over a shallow sandbar at two frequencies (1500 Hz and 500 Hz) using three different propagation models, and highlights the differences between the model results.

Oliveira, Lin, and Porter (2021). Underwater Sound Propagation Modeling in a Complex Shallow Water Environment. Frontiers in Marine Science, *2021 (8), https://doi.org/10.3389/fmars.2021.751327*

NAVY BENEFITS

The project will enable more consistent use of received level data resulting from ongoing behavioral response studies that utilize passive acoustics or non-acoustic tags (e.g., satellite tags). It will also provide practitioners who analyze tag data clear guidance on the different propagation models and when each may be more appropriate for use. This has the potential to result in additional behavioral response data being incorporated into future Navy behavioral response functions and the permitting processes.

TRANSITION

In addition to regular reports to LMR, the team will prepare a technical report. Journal papers and conference presentations will be considered as appropriate.

ABOUT THE PRINCIPAL INVESTIGATOR

Elizabeth Henderson is a bioacoustics scientist at the Naval Information Warfare Systems Center (NIWC) Pacific and leads NIWC's Whale Acoustic Reconnaissance Project Lab. She has extensive experience analyzing marine mammal acoustic behavior and noise impacts for environmental compliance, and developed the Navy's Behavioral Risk Functions in Phase III and Phase IV of the Navy's environmental compliance assessment. Her expertise includes cetacean behavioral ecology, bioacoustics and behavioral responses to anthropogenic activities. Dr. Henderson earned her Biological Oceanography and Bioacoustics Ph.D. at the University of California San Diego.

About the LMR Program

The Living Marine Resources (LMR) program seeks to develop, demonstrate, and assess data and technology solutions to protect living marine resources by minimizing the environmental risks of Navy at-sea training and testing activities while preserving core Navy readiness capabilities. For more information, contact the LMR program manager at exwc_lmr_program@navy.mil or visit exwc.navfac.navy.mil/lmr.