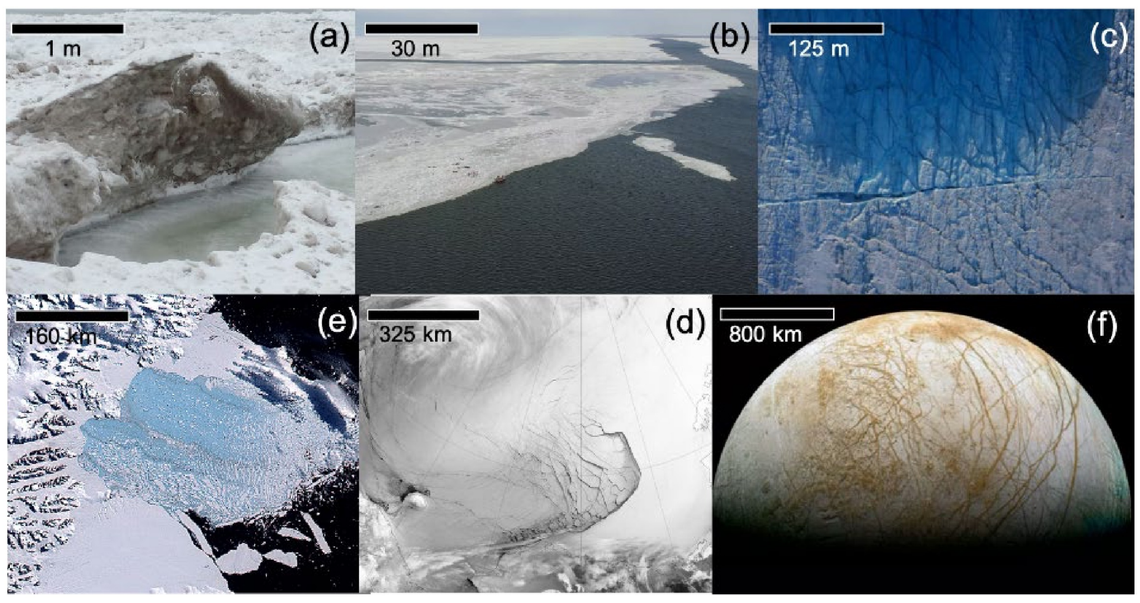
Marine and lacustrine ice fracture detection

John Case, Ph.D. Acoustics – Penn State Graduate Program in Acoustics
Advisors: Dr. Andrew Barnard, Dr. Daniel Brown

Introduction

- Understanding ice fracturing is important in climate science, biological movement, fisheries, global trade and defense
- Ice fracturing happens at many spatial scales
- Larger ice fractures can be easily surveyed via visual methods, but smaller fractures may be hard to detect



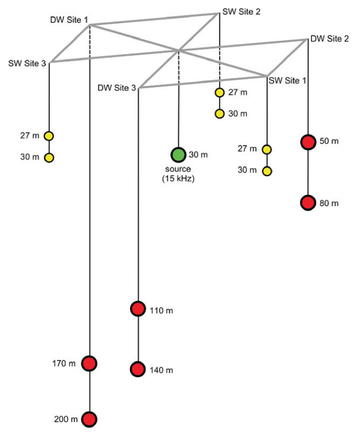
- When ice sheets fracture, acoustic energy is emitted into the water column below the ice, the ice sheet itself, and the air above the ice
- Measuring these acoustic emissions can provide insight into ice sheet health, and the onset of larger fracturing events

Objectives

- Develop a set of algorithms to detect and classify ice fracturing events in acoustic data from arrays of microphones, hydrophones and geophones
- Correlate fracture density and timing to environmental factors like temperature, wind speed/direction, barometric pressure, water temperature, etc.
- Develop a computational model of a floating ice sheet and characterize acoustic transmission through air, water and ice

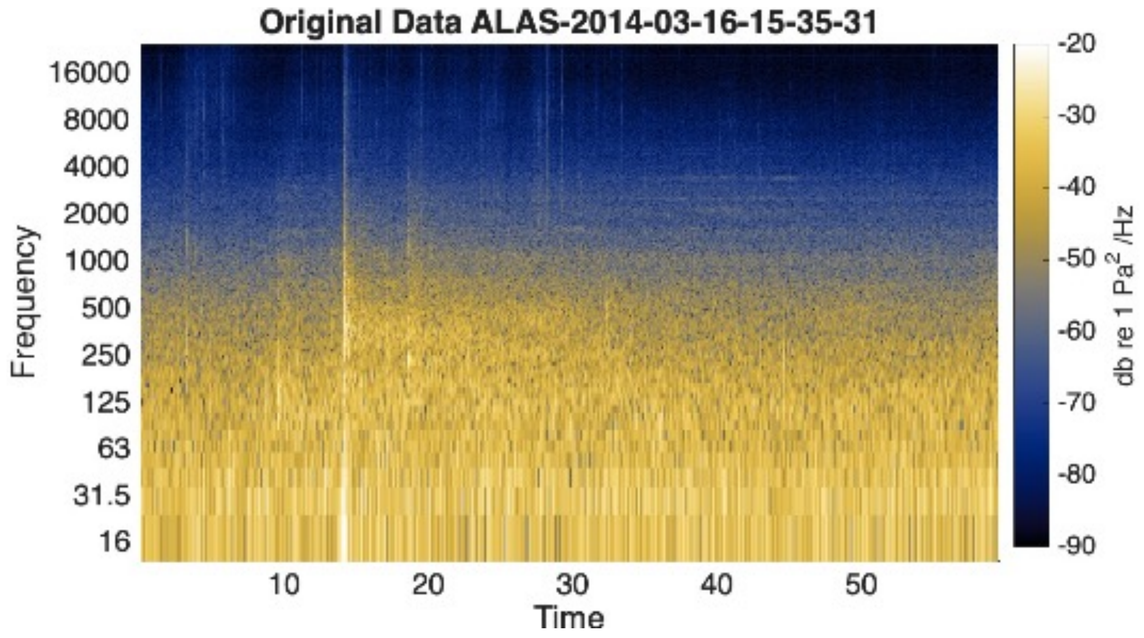
Methodology

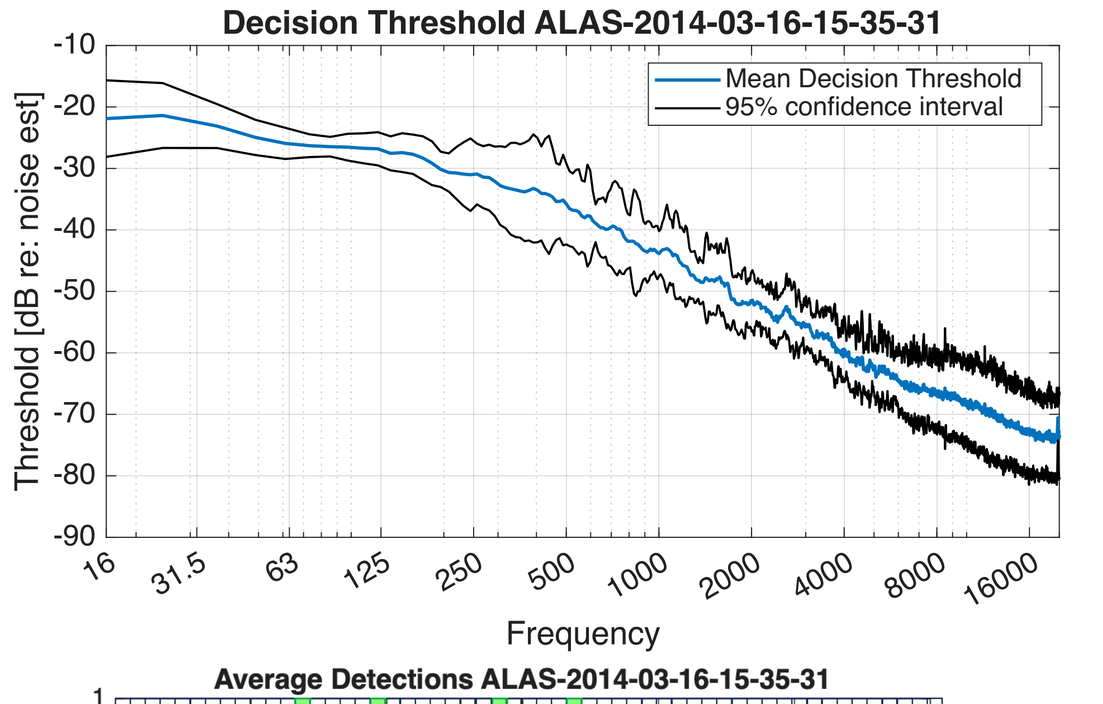
- Several acoustic data sets were curated. The first is from a deep water 12-hydrophone array in the Beaufort sea.

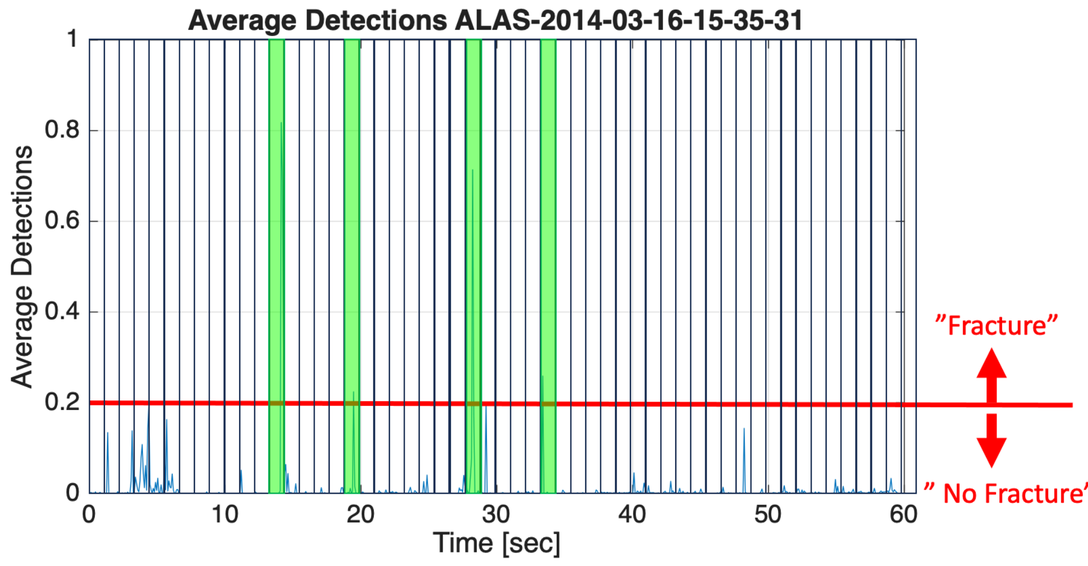


- The second data set was recorded in March of 2024 on Portage Lake in Michigan's Upper Peninsula. This data set contains 1 week of continuous time series data from 4 hydrophones, 4 microphones and a tri-axial geophone set

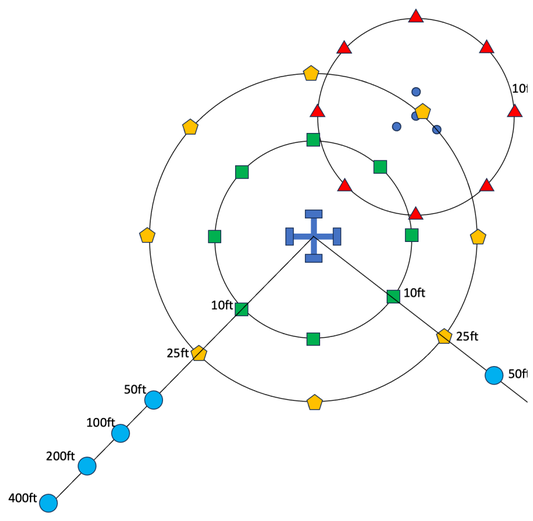
Results / Analysis

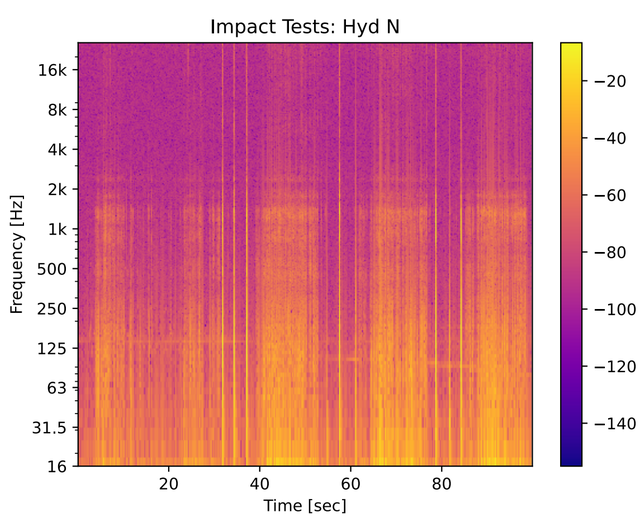






Future Objectives





Acknowledgements

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References

[Williams et al., 2018] Williams, K. L., Boyd, M. L., Soloway, A. G., Thorsos, E. I., Kargl, S. G., and Odom, R. I. (2018). Noise background levels and noise event tracking/characterization under the arctic ice pack: Experiment, data analysis, and modeling. *IEEE Journal of Oceanic Engineering*, 43(1):145–159.