



Deep learning applied to underwater acoustic data

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Marine Environmental Research Infrastructure for Data Integration and Application Network



- Consortium of ocean researchers, computer scientists, and data managers from across Canada
- ~18 full-time staff
- 3-year grant from CFI* (2017-2020)
- Provide the ocean research community with tools to discover, access, analyze, and visualize marine acoustic data

* Canada Foundation for Innovation



Data ...

discovery

we are building a data discovery service that is listing existing ocean acoustic data making the data findable, accessible, and reusable

analysis

we develop analytical tools e.g. for modeling underwater sound propagation and for detecting and classifying sound sources

visualization

we provide tools for visualizing acoustic data and mapping the noise in the oceans

Metadata and data discovery



The MERIDIAN **metadata standard** has been aligned with already existing international standards. Our standard is based on the Integrated Ocean Observatory System (IOOS) Metadata Convention for Passive Acoustic Records (v. 1.0) and Darwin Core to represent biological information.

Adopting and co-creating metadata standards

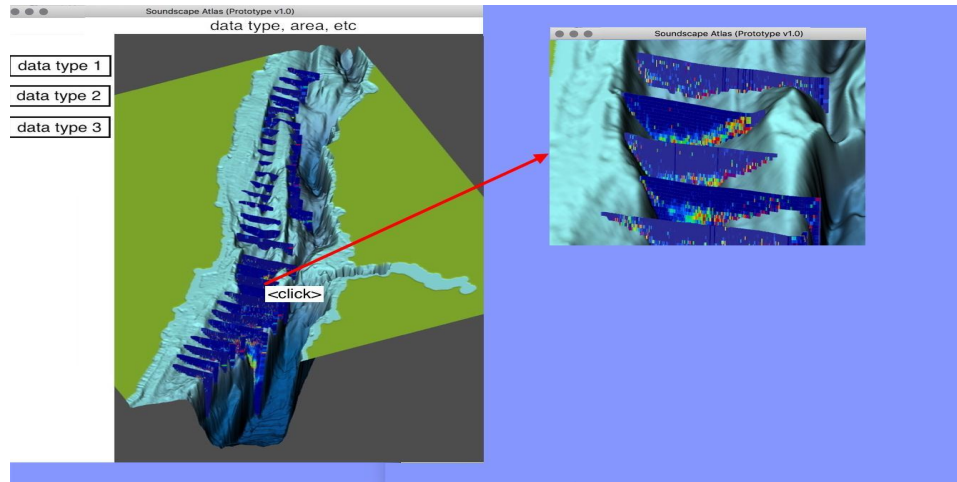
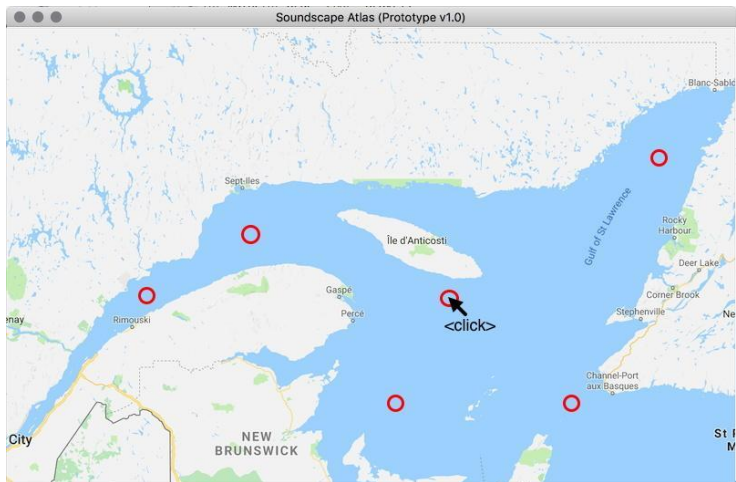


Removing barriers to finding and accessing data

Soundscape Atlas

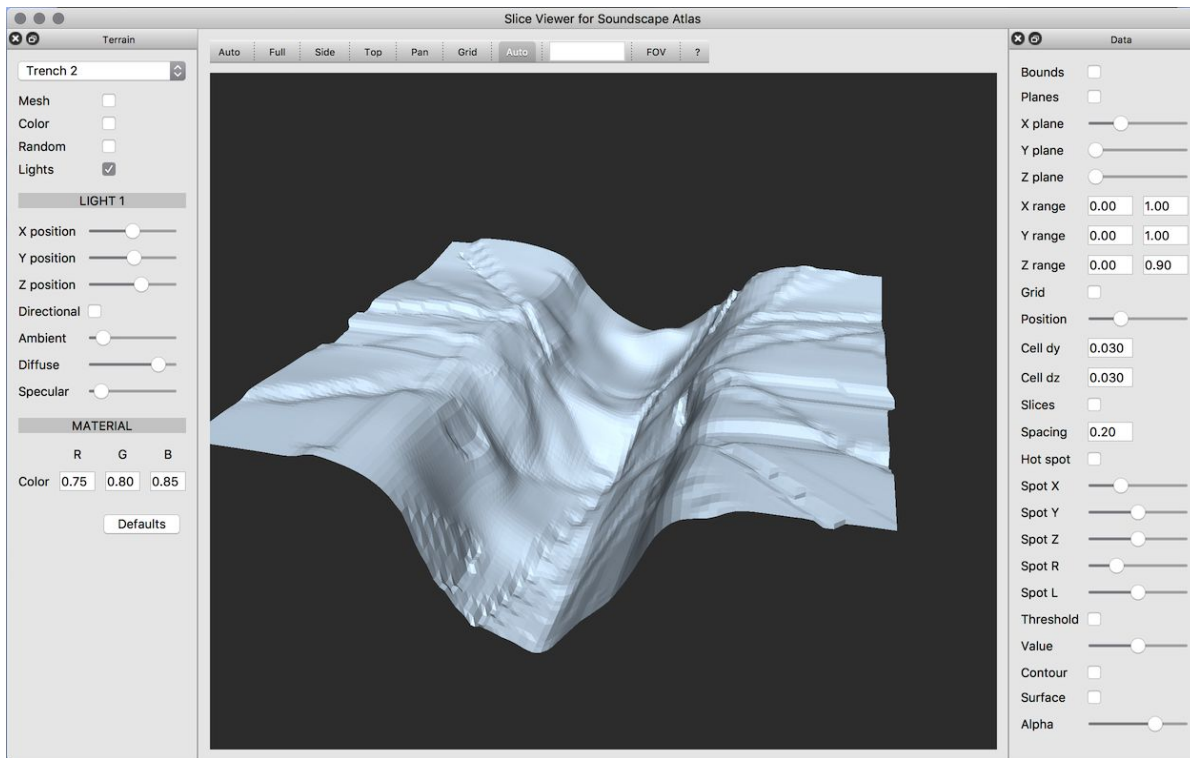


MERIDIAN is developing an interactive tool for modeling and visualizing underwater acoustic data in multiple dimensions (time, space, frequency, source*, etc)



* anthrophony, geophony, biophony, ...

Soundscape Atlas



Analytical Tools



Bringing cutting-edge techniques from Computer Science to Ocean Science



Deep Learning



Applications of Deep Learning:

- Sound detection and classification
- Model underwater noise intensity and propagation from ship tracking data (AIS)
- Compression of acoustic data



Acoustic detection and classification

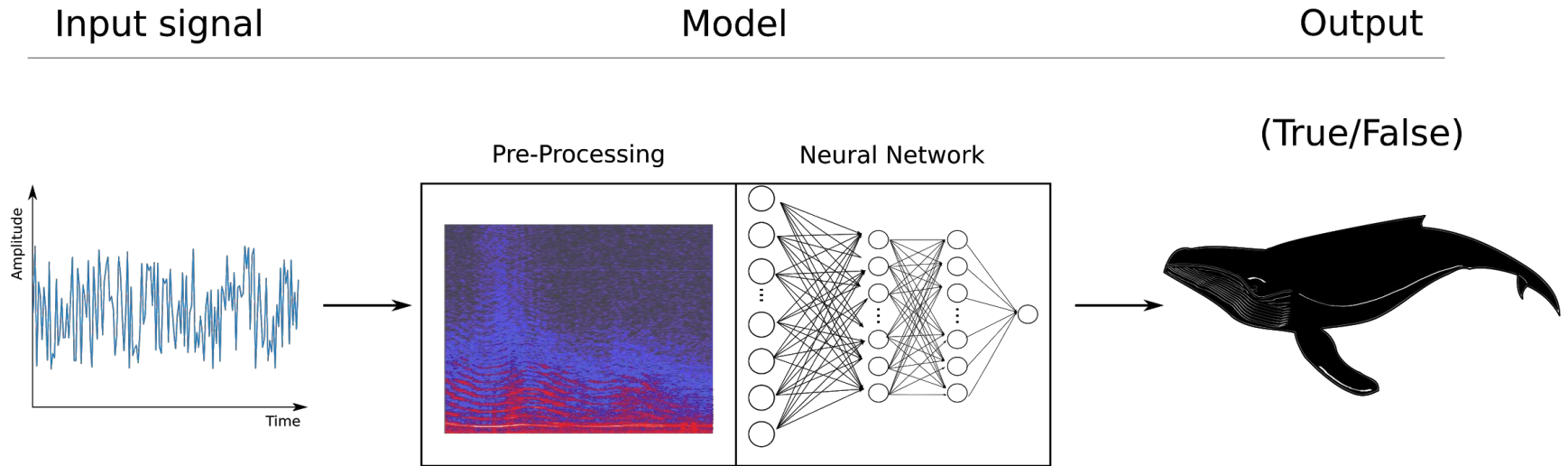


We are using Deep Neural Networks to develop tools for the detection and classification of marine mammals and fish.

These tools aim to automatically extract and classify sounds of interest from large acoustic data sets or from streaming data produced by survey equipment.



Acoustic detection and classification



Data sets

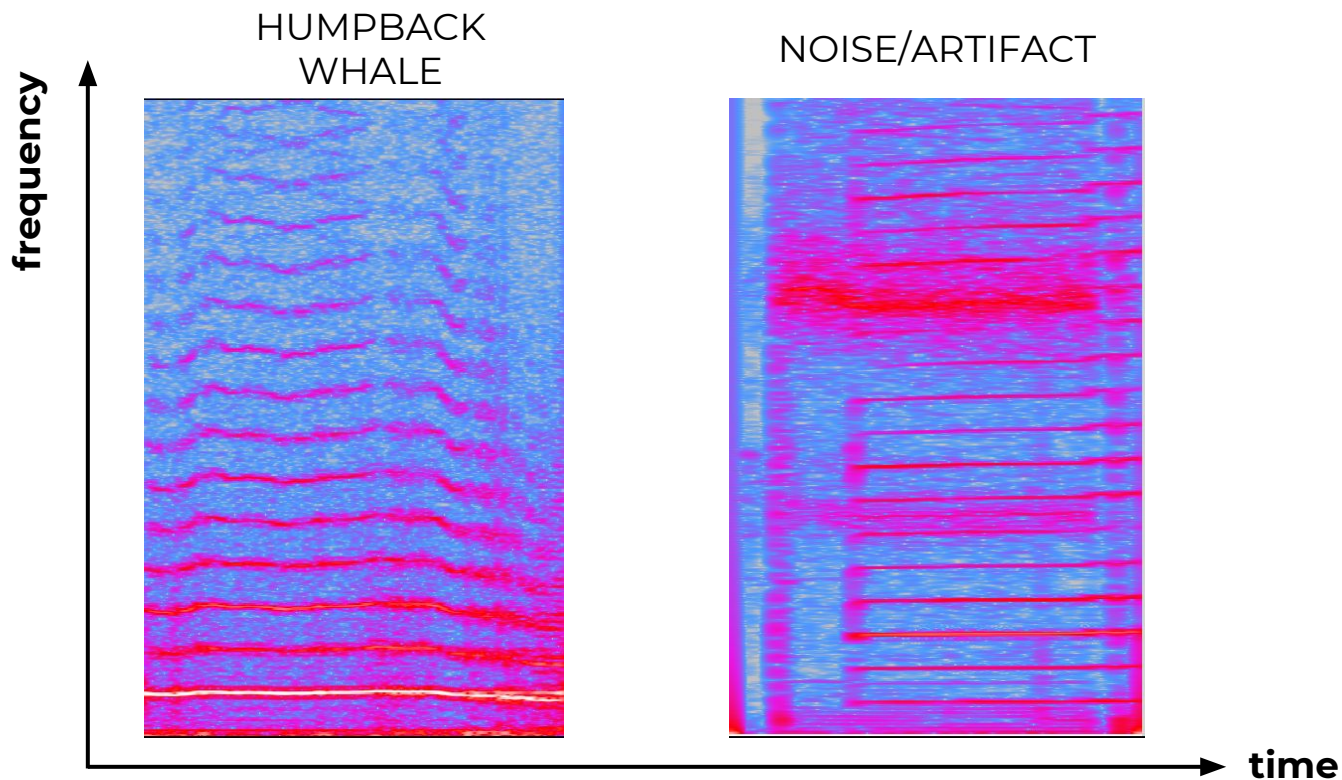
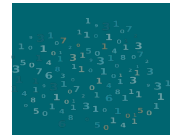


- C. Taggart @ Dal
 - Whales (humpback, right, fin, sei)
 - 30,000 identified calls
- F. Juanes and A. Riera @ UVic
 - Arctic Cod (in captivity)
 - 38 identified calls

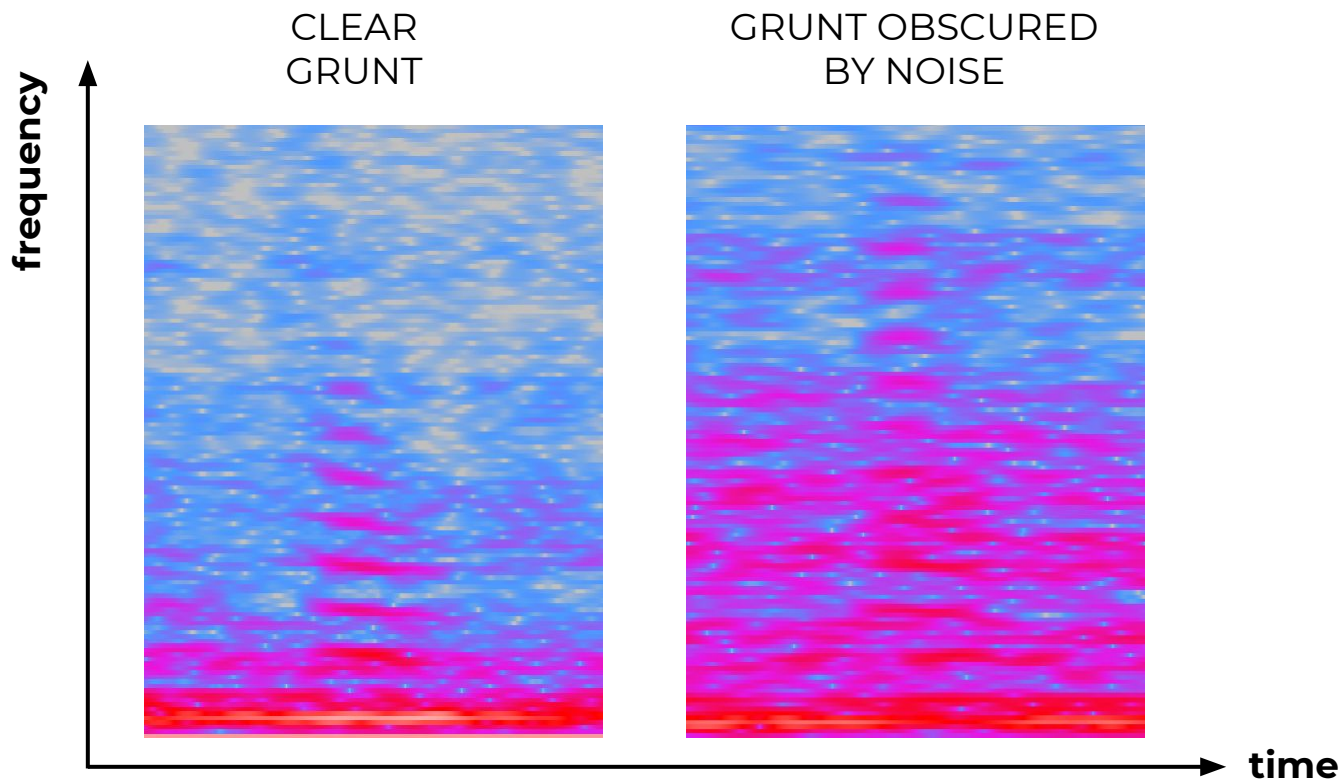
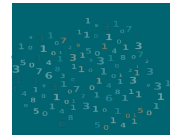


Working on obtaining more data sets ...

Whale song



Cod grunt

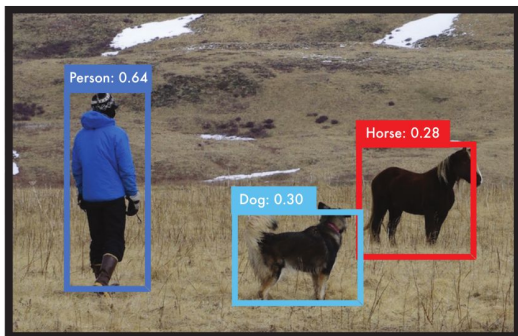


Deep learning techniques



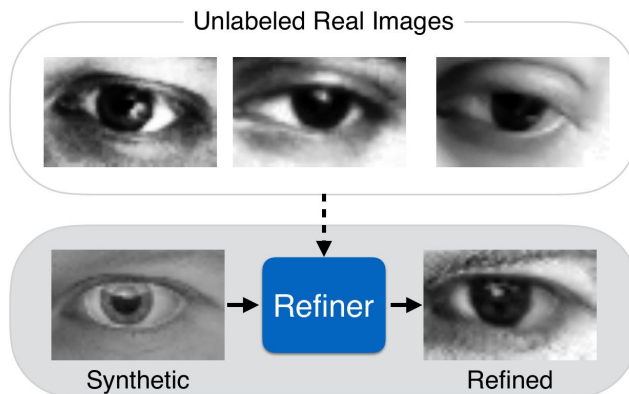
Object Detection

You Only Look Once (YOLO)
Redmon et al. 2016
<http://pireddie.com/yolo/>



Synthetic training data

Generative Adversarial
Networks (GAN)
Shrivastava et al. 2016
<https://arxiv.org/abs/1612.07828>



Action segmentation and detection

Temporal Convoluted Network (TCN)
Lea et al. 2017
<https://arxiv.org/abs/1611.05267>

50 Salads



Training



Workshops
(Starting in August)

Hacky hour
(Starting in September)



Conclusion



MERIDIAN'S VISION IS TO
ENHANCE CANADA'S LEADERSHIP IN THE OCEAN DATA INTEGRATION, MANAGEMENT AND
ANALYSIS BY CREATING A WORLD-CLASS INFRASTRUCTURE, BASED ON HUMAN RESOURCES
AND COMPUTING, TO INCREASE THE DATA'S VALUE AND VISIBILITY ACROSS BORDERS.



WHO WE ARE

We are a multi-institutional and multi-disciplinary consortium of ocean researchers, computer and data management professionals that are developing a data infrastructure to consolidate and support the national and international ocean acoustic data community. Our team members are based at Dalhousie University, University of Victoria, University of British Columbia, Simon Fraser University and Université du Québec à Rimouski.



WHAT WE DO

We are building a platform that will assist the ocean data community in the use of advanced data science technologies to discover, access, analyse and visualize global marine data. MERIDIAN is developing open-source data analysis and visualization tools for academic, government and industry stakeholder as well as other interested individuals. We are providing data management expertise to ensure FAIR (Findable, Accessible, Interoperable, Re-useable) data no matter their physical location.



OUR INFRASTRUCTURE

DATA DISCOVERY SERVICE

We store and manage data collection descriptions in our online registry enhancing their discoverability. Open and shared datasets are accessible and re-usable (license applied) via our partners.

TOOLS

Log in to access a growing number of analytical and visualization tools to manipulate and map ocean acoustic data.

WHAT ELSE

We are looking into offering a community platform, training modules for our tools, minting service for digital object identifier and many more.

INNOVATION.CA
CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

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Nova Scotia Research and Innovation Trust

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University of Victoria



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Thank you!

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