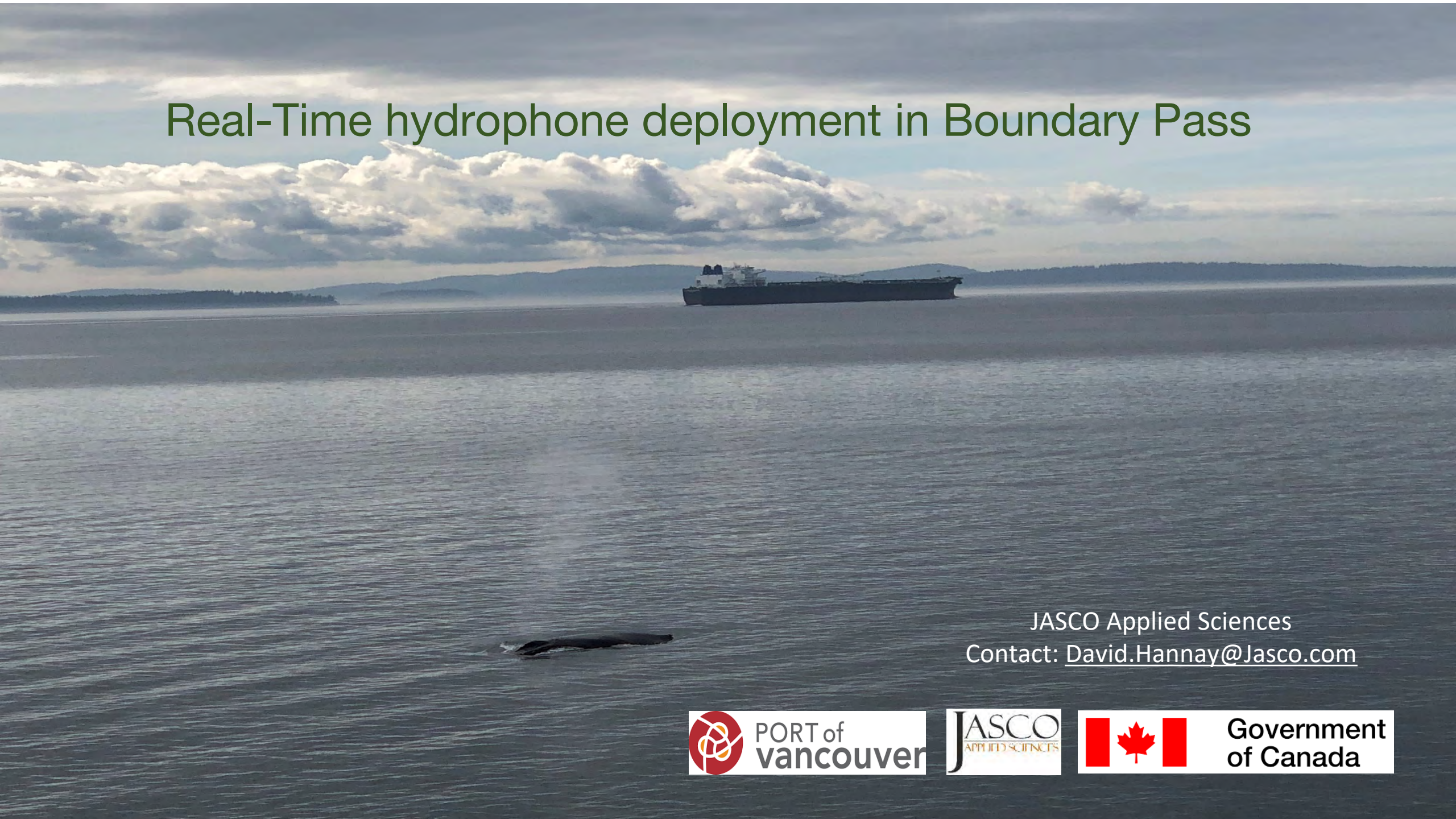
Real-Time hydrophone deployment in Boundary Pass



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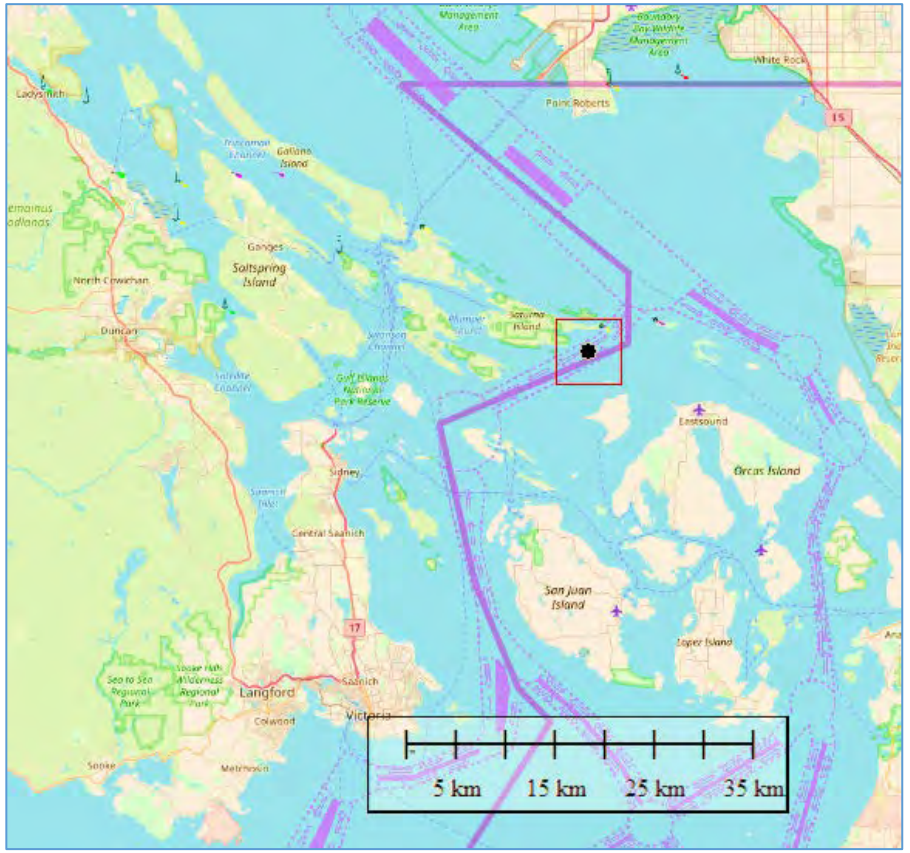
PORT of vancouver

JASCO APPLIED SCIENCES

Government of Canada

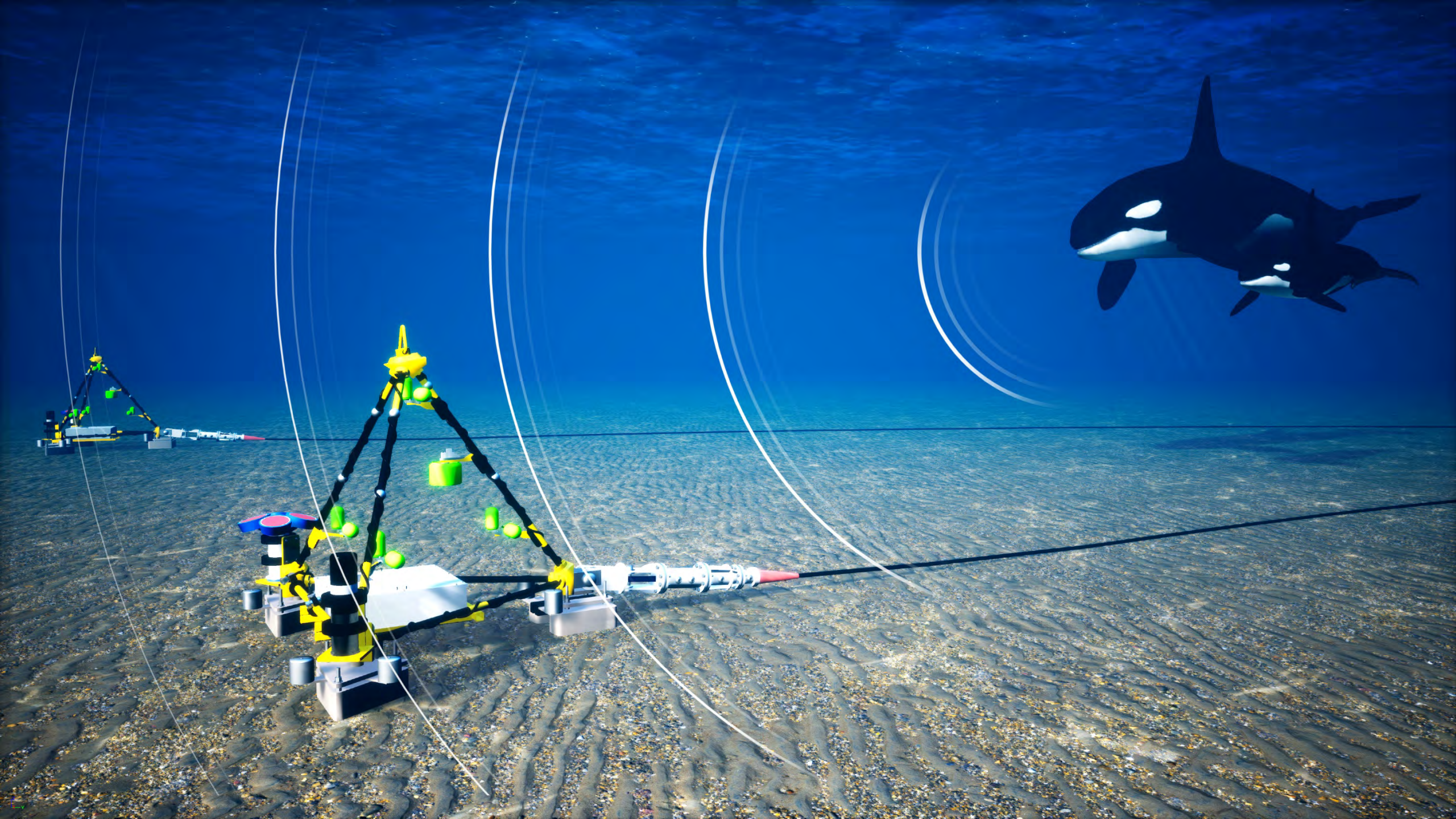
Boundary Pass Underwater Listening Station (ULS)

- Transport Canada system for ship noise measurements and marine mammal detection
- Successfully deployed between the in-bound and out-bound shipping lanes in May 2020
- Two compact tetrahedral hydrophone arrays on the seabed at 190 m water depth, separated by 300 m
- Capable of acoustic vessel and marine mammal tracking through individual array beamforming and cross-fixing
- Cabled to shore at Saturna Island via two 2.8 km fibre optic cables
- Planned operations through March 2023 with 4 year optional extension



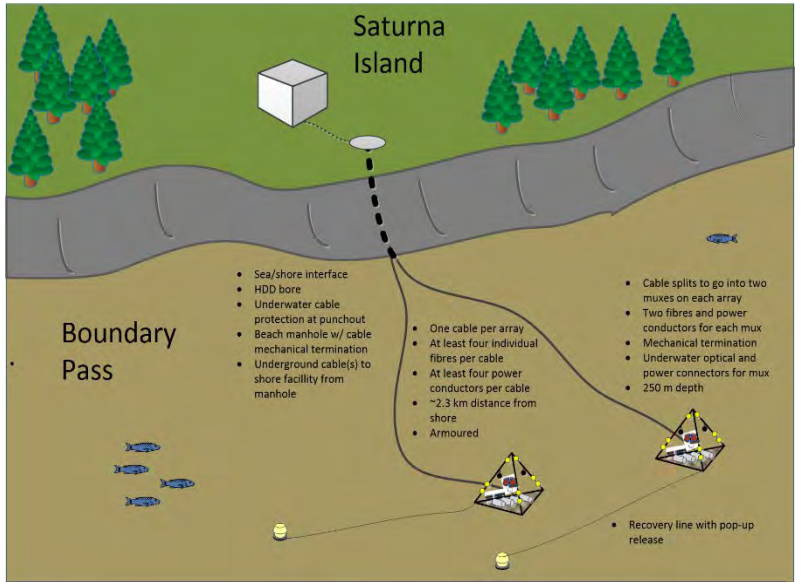
Boundary Pass system technical details

- Each array has four GeoSpectrum M36 hydrophones and four HTI-96 hydrophones. All spaced at 1.65 m.
- JASCO Observer™ data acquisition and processing system (512 kHz sampling all channels simultaneously at 24 bit)
- GeoSpectrum projectors controlled by JASCO AMAR-G4 for daily calibration at multiple frequencies
- Each array also includes CTD, ADCP, video camera and fully-redundant power supplies and acoustic acquisition systems
- All data streamed to Saturna Island data station where they are processed in real-time
- AIS and weather station data are automatically fed into the system database

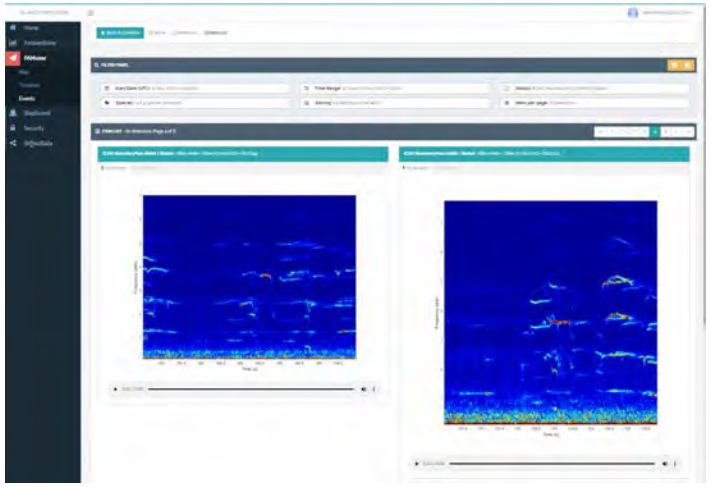


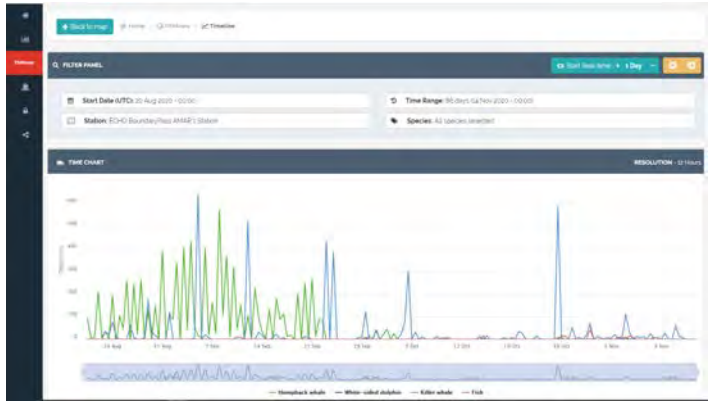
Saturna Island Shore Station

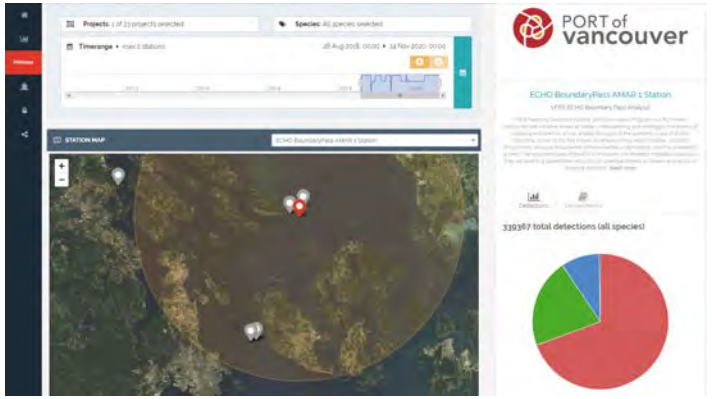
- The cables pass from underwater to land in holes drilled through the bedrock shore
- Cables are terminated in a professional server room with power conditioning and generator backup
- Due to relatively low internet bandwidth to the island, all data processing is done at the shore station



Data Analysis and Reporting



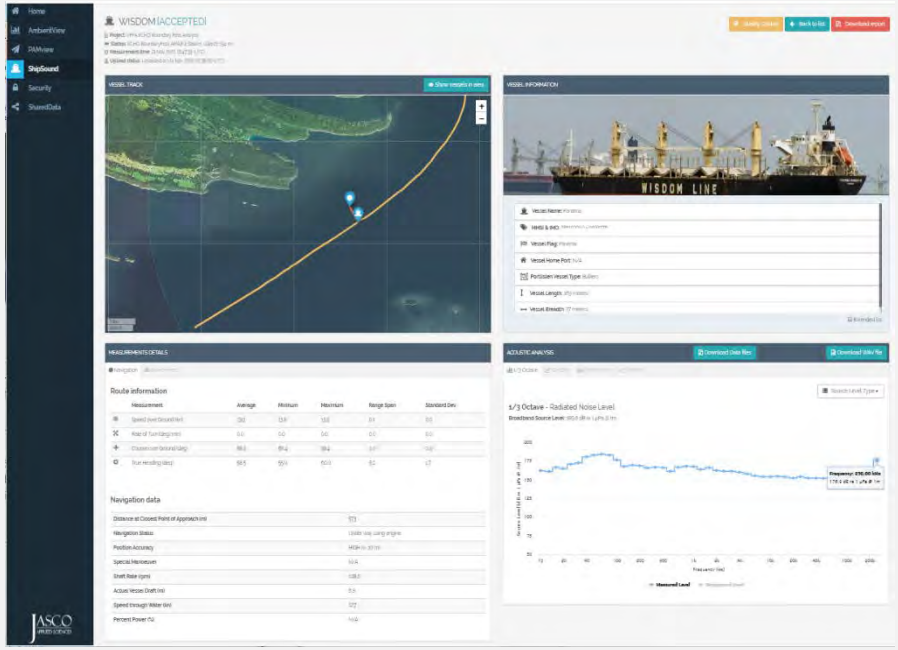


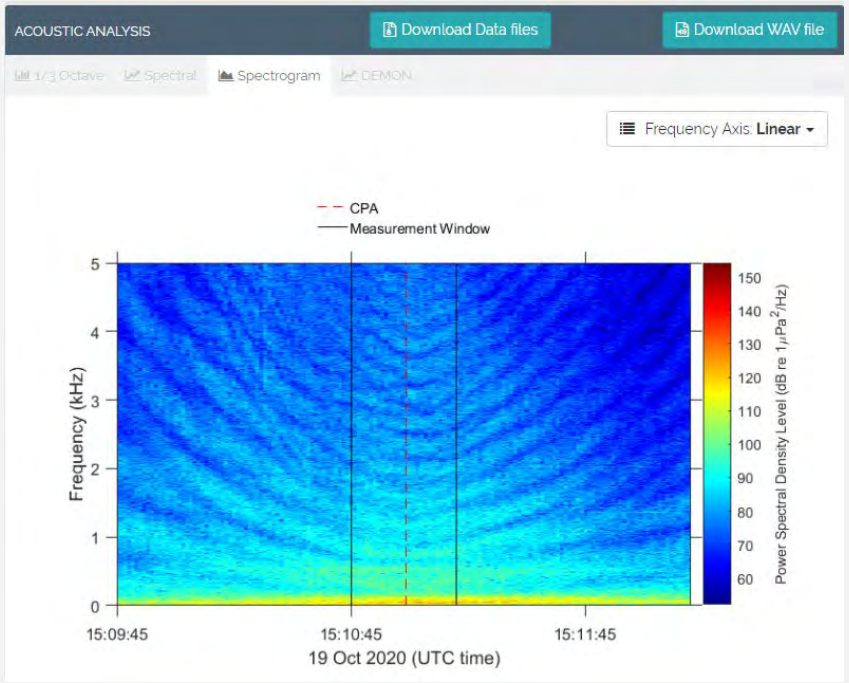


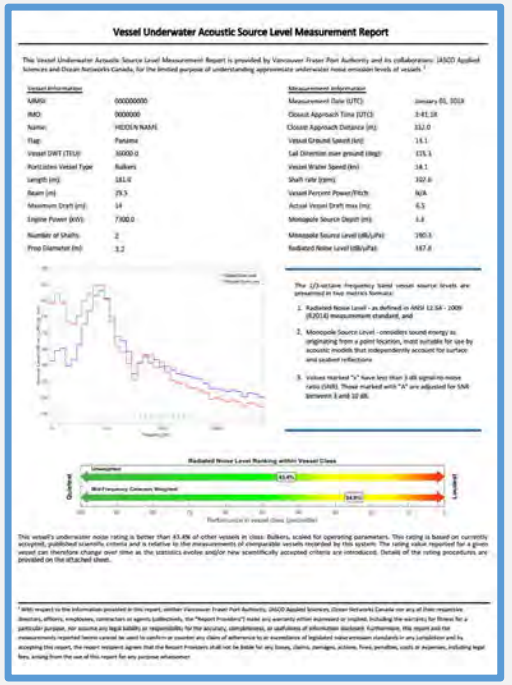
- Managed under a Vancouver Fraser Port Authority ECHO Program Project
- PortListen™ Application for real-time data analysis and web-based presentation

Three primary real-time data products

1. Marine mammal detections/notifications
2. Long-term Ambient Noise Analysis
3. Ship Noise measurements to ANSI S12.64





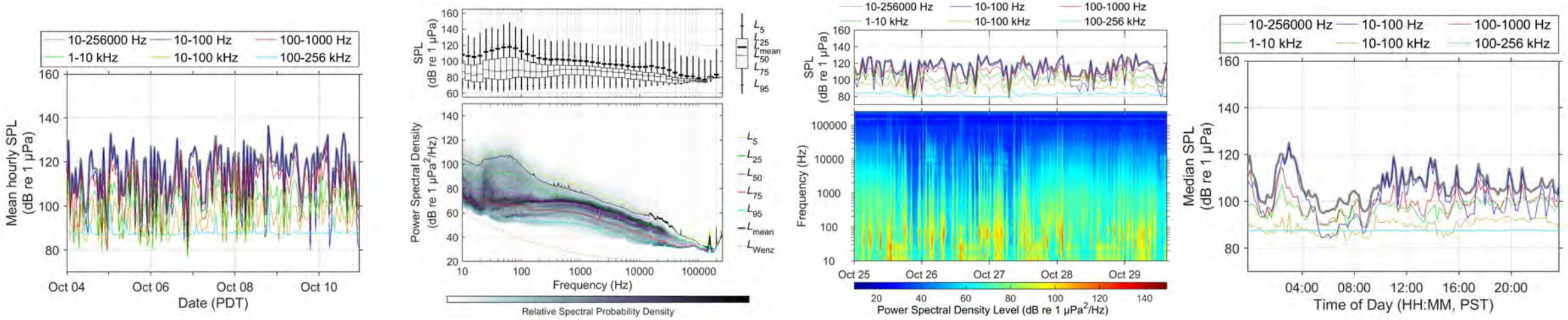


Ship Noise Analysis System (ShipSound)

- Advanced AI system for automatic ship noise measurements
- Produces ANSI S12.64 measurements (single pass)
- Calculates Radiated Noise Levels (RNL) and monopole source levels (MSL) in decidecade bands, and spectra
- Automatic shaft rate calculations using DEMON
- Full-featured interface with all results stored in searchable database

Results to Date

- Over 10,500 accepted vessel pass measurements, including during the slow-down trial from June-October this year
- Average 17 new accepted ship pass measurements each day (about 6000/year)
- These measurements are compatible with the ECHO program's ~7000 measurements made from 2015-2018 in Strait of Georgia and Haro Strait
- An additional 4450 rejected vessel pass measurements are stored in the database
- Real time marine mammal detections are being performed. Several thousand calls from humpback whales and killer whales have been detected
- Ambient noise results are available in daily, weekly, and monthly formats, allowing tracking of underwater noise in critical habitat of endangered SRKW



Octopus June 6, 2020