

National Facility for Seismological Investigations

Director:

Mladen Nedimović (Dalhousie)

<https://www.nfsi.ca>

Personnel:

Graeme Cairns, Facility Manager

Katie Bosman, Marine Data Technologist

Jonathan Thibodeau, Marine instrument Technologist

Executive Council:

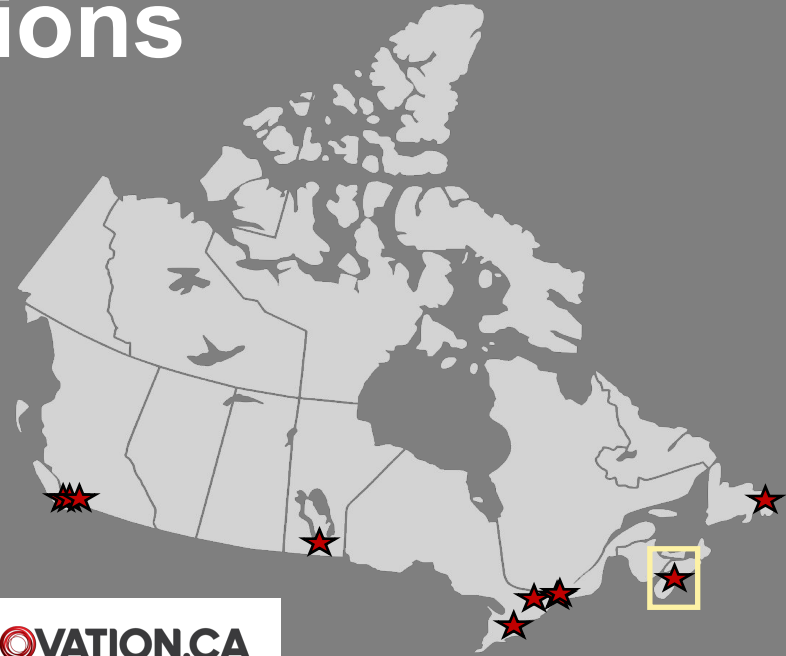
Pascal Audet (uOttawa) – **Michael Bostock** (UBC)

Andrew Calvert (SFU) – **Fiona Darbyshire** (UQAM)

Stan Dosso (Victoria) – **Andrew Frederiksen** (Manitoba)

Qinya Liu (Toronto) – **Yajing Liu** (McGill)

Kim Welford (Memorial)



**DALHOUSIE
UNIVERSITY**

INNOVATION.CA

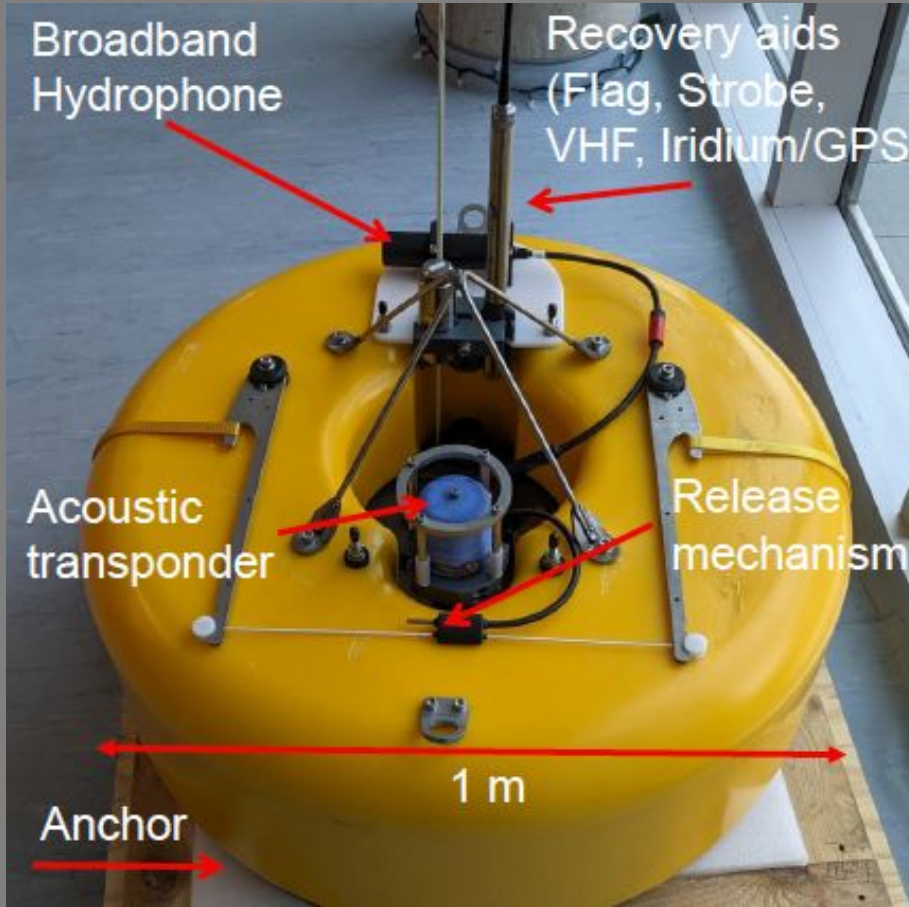
CANADA FOUNDATION
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POUR L'INNOVATION



University
of Victoria



BBOBS: Güralp Aquarius



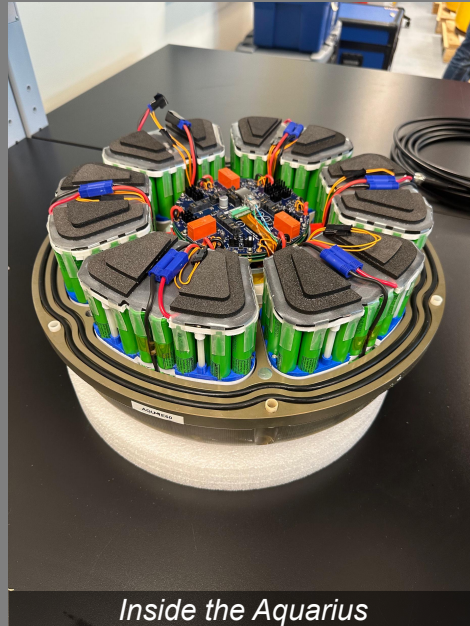
<u>Specifications</u>		<u>Research Impact</u>
number of units	120	High resolution & coverage
clock drift (ms/day)	<0.5	Allows long-term deployments necessary for earthquake monitoring
max deployment (months)	18	
data storage (Gb)	128	
bandwidth (Hz)	120 s – 100 Hz	Joint use for earthquake process and structure imaging studies
dynamic range (bit)	24	
pressure sensor (hydrophone)	100 s – 8 kHz	Acoustic monitoring and compliance
Communication	Acoustic modem	Real-time data to surface from SF instruments
Buoyancy	Syntactic foam	Unsinkable once anchor is released

Additional NFSI infrastructure:

- Instrumentation lab and offices at Dalhousie (Halifax)
- Portable deck units for charging and communications
- Storage space at COVE facility for Marine Technology (Dartmouth, NS)



Deck computers



Inside the Aquarius



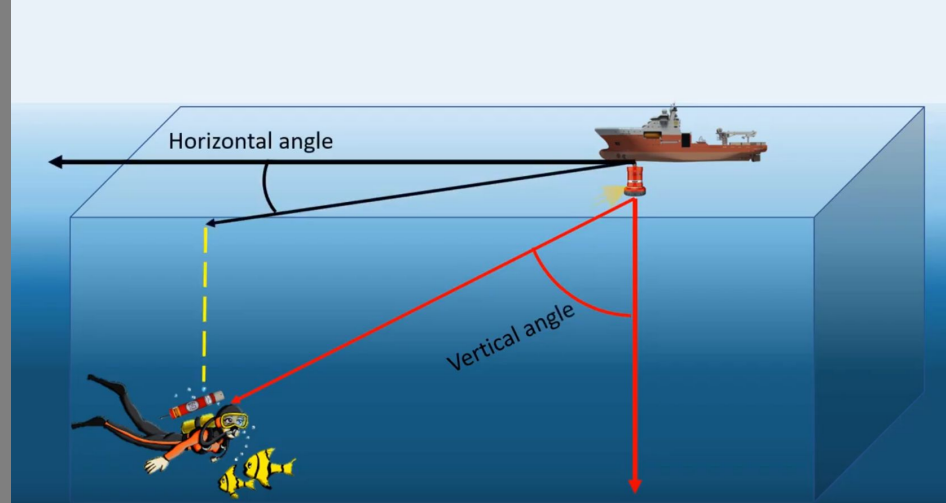
NFSI lab space on the Steele Ocean Sciences Building 4th floor. Instrumentation lab and two Data Analysis rooms.



COVE facility for Marine Technology

Ancillary Equipment: Sonardyne Ranger 2 LMF Gyro-USBL

- Provides communication and directional ranging to seafloor instruments for rapid positioning.
- Integrated gyro & accelerometer provide compensation for heave, pitch and roll.
- Can be mounted on vessels of opportunity without significant calibration
- LMF frequencies for deep water operations. Used successfully in 4700m to date



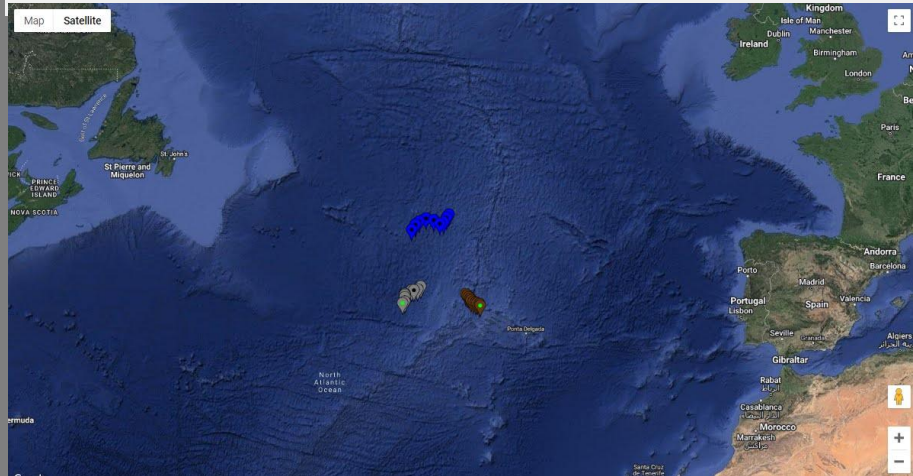
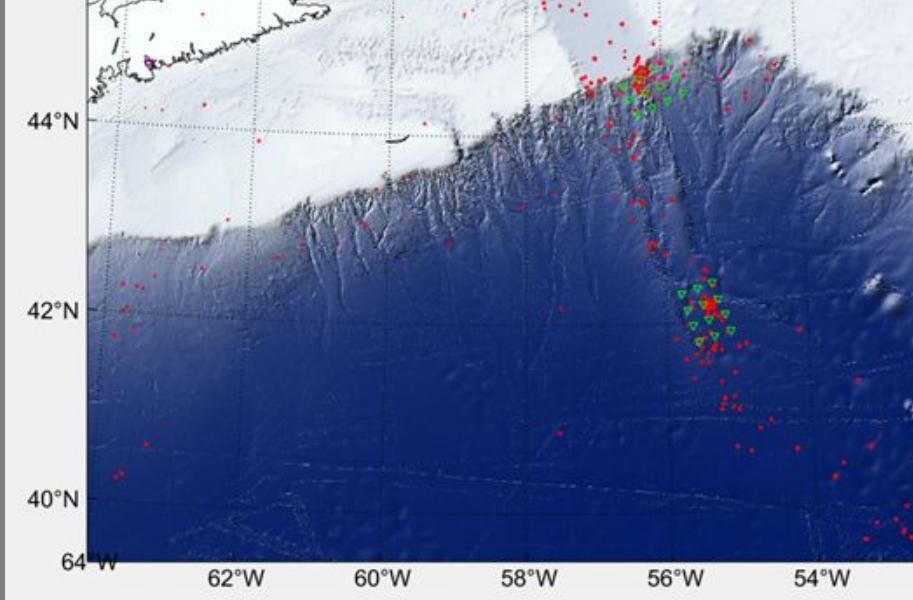
Ancillary Equipment: Sonardyne Modem 6 LMF Directional Dunker

- Alternative to USBL for communicating with and positioning seafloor instruments
- Provides range to seafloor instruments, but not direction. Need to move vessel overhead to triangulate.
- Easy to hang over side from any vessel
- Directional sensitivity blocks out overhead ship noise and surface acoustic bounces
- Used successfully in 3000m of water to date



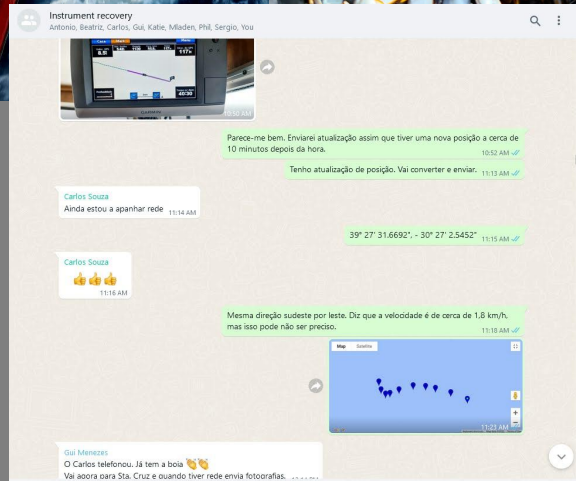
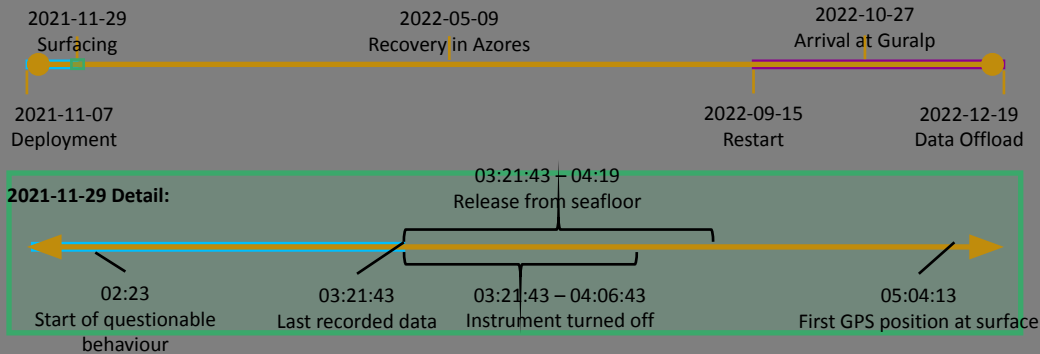
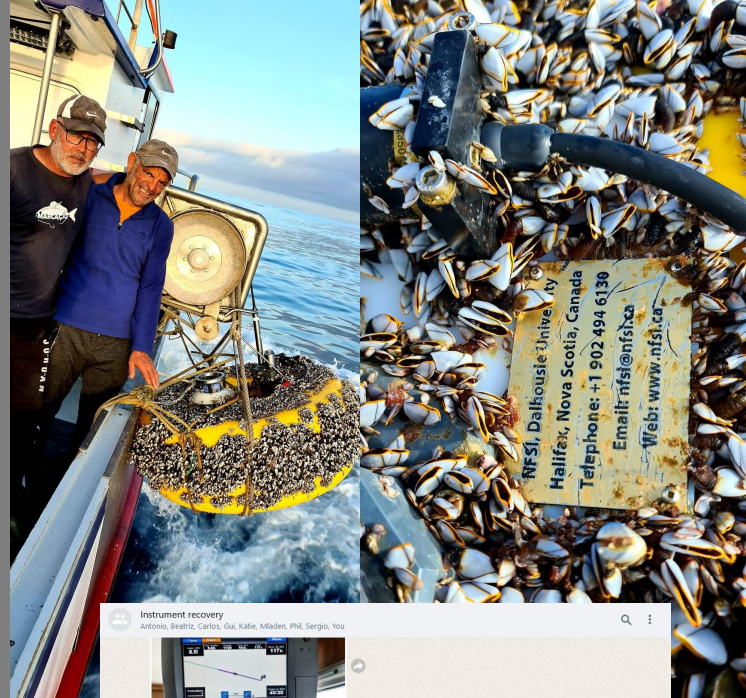
Laurentian Fan sea trials: Nov 2021 – Dec 2022

- Pis: M. Nedimovic (Dalhousie); Collaborator: A. Plourde
- 12 OBS deployed November 2021 in first long-period field test.
- 3 surfaced prematurely within 6 weeks, tracked across Atlantic, 1 recovered.
- 8 instruments recovered in August 2022. No response from the last instrument.
- Issue with data corruption after 3 months due to software bug.



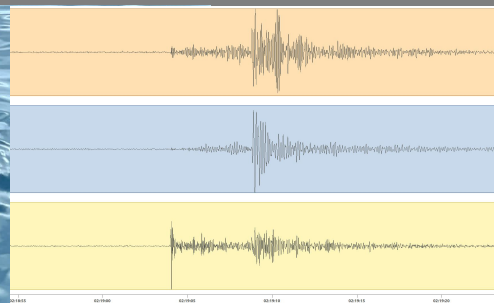
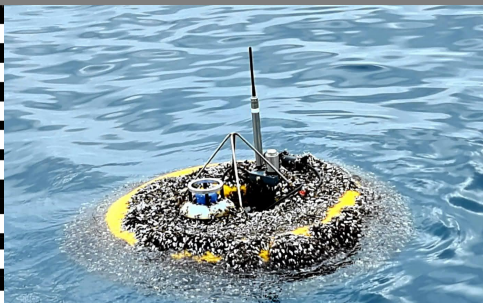
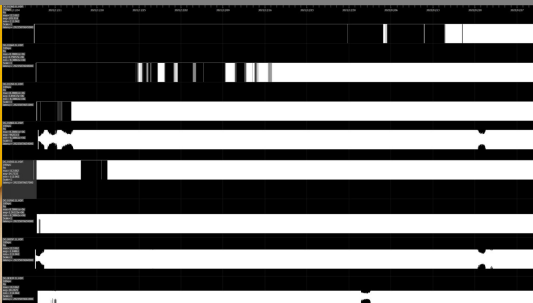
Instrument issues

Usable data	Noisy data / unreliable time	No usable data	Incomplete deployment	Lost instrument
Station	Seismometer Z	Seismometer E	Seismometer N	Hydrophone
LF01				
LF02				
LF03				
LF04				
LF05				
LF06				
LF07				
LF08				
LF09				
LF10				
LF11				
LF12				

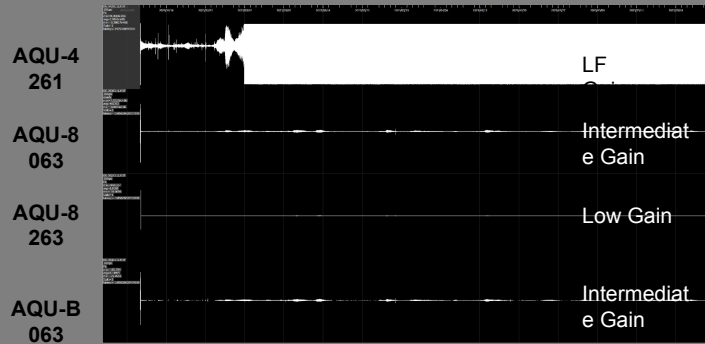


2021 – First Long Period Field Test

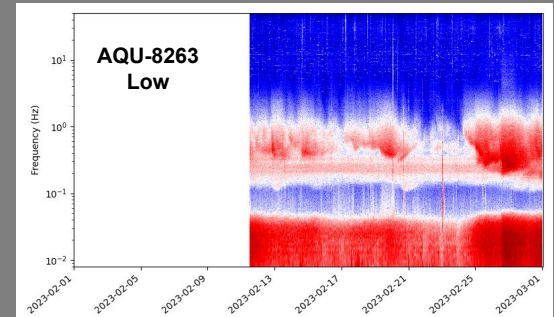
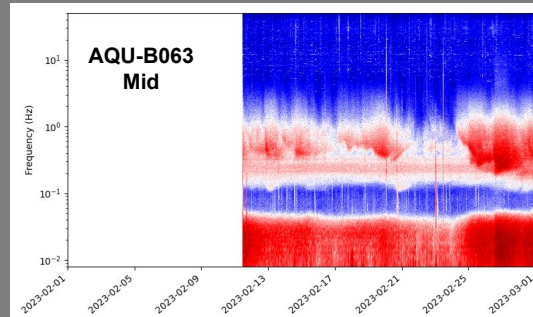
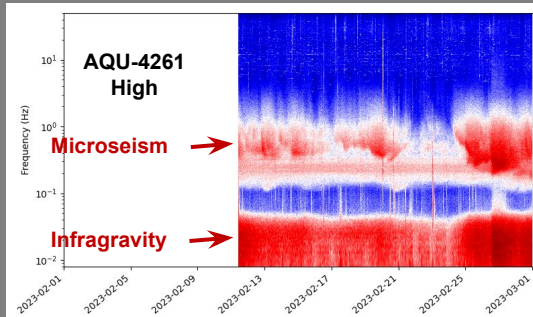
ISSUE	ACTION
Data corruption after 3 months due to register overflow	One line code modification
Hydrophone data clipped due to excess gain and feedback loop instability	3-month field test with different gain setting carried out in Q1 2023, leading to revised specifications currently being implemented
Oxidation of metal inserts due to dissimilar grades of stainless steel from components supplier	All inserts replaced and sacrificial anodes added
Premature release of instruments, thought to be due to current leakage between connector pins	Design modification to have burnwire cables go through independent connector
Acoustic communication problems using omni-directional dunker in deep water	Upgrade from surface-noise sensitive omni-directional dunker to downward looking directional dunker
Failure of Xeos Apollo recovery devices due to a batch manufacturing issue	Recall and replacement of the entire batch by Xeos, with modification of their design and manufacturing process



Hydrophone tests: Italy (4 co-located OBS)



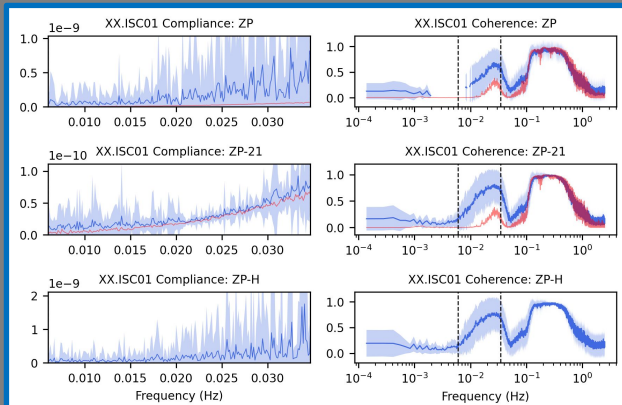
- Generally, the same signal recorded by all hydrophones
 - High gain hydrophone begins railing on March 1st
- Low gain hydrophone (right) appears to show higher noise floor in 0.05-0.1 Hz band (10-20 sec)
 - Relatively low-noise band between microseism and infragravity waves



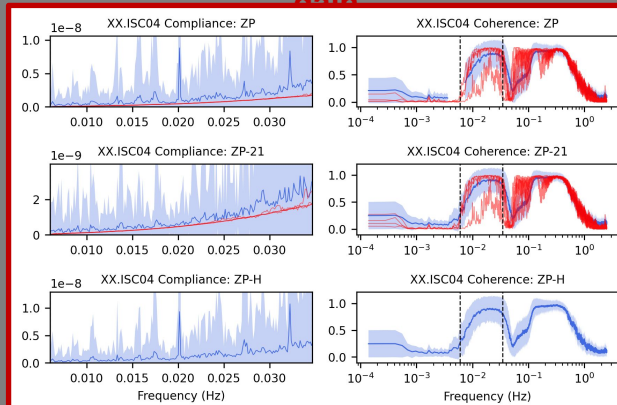
Hydrophone tests: Compliance

- Compliance (units of 1/Pa) and coherence calculations in the infra-gravity band; daily (blue: mean +/- std) and 30-day averaged (red) curves
- **Mid** and **high** gains generate similar compliance and coherence curves; 3-day average better for mid gain; daily averages better for low gain; greater coherence for mid gain; best results for low gain with tilt removed
- **High** gain shows high variance and low coherence in the infra-gravity band; coherence OK in the micro-seismic band
- Difference in gain shows up as ~1 order of magnitude difference in compliance units

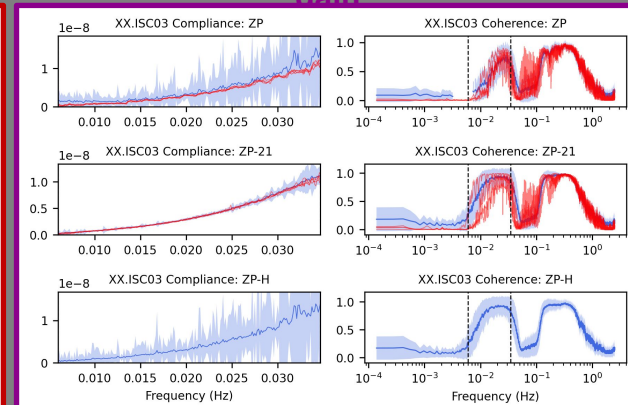
High gain



Mid gain

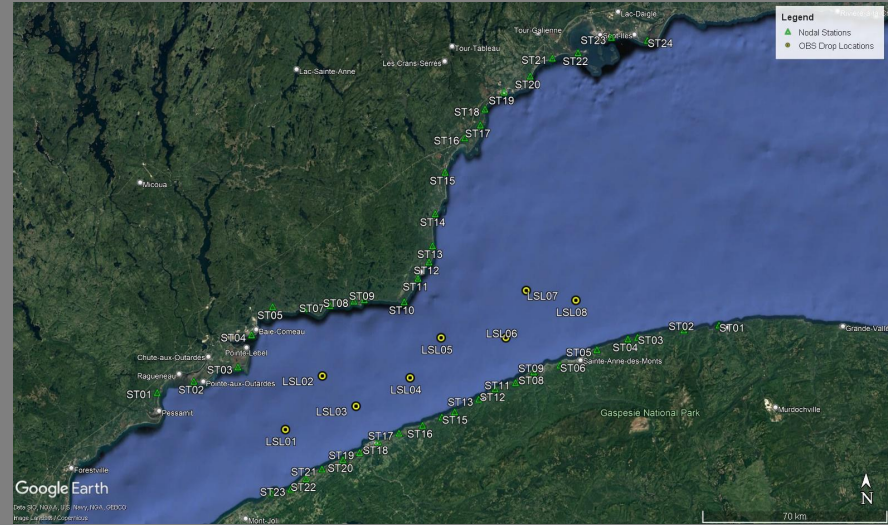


Low gain



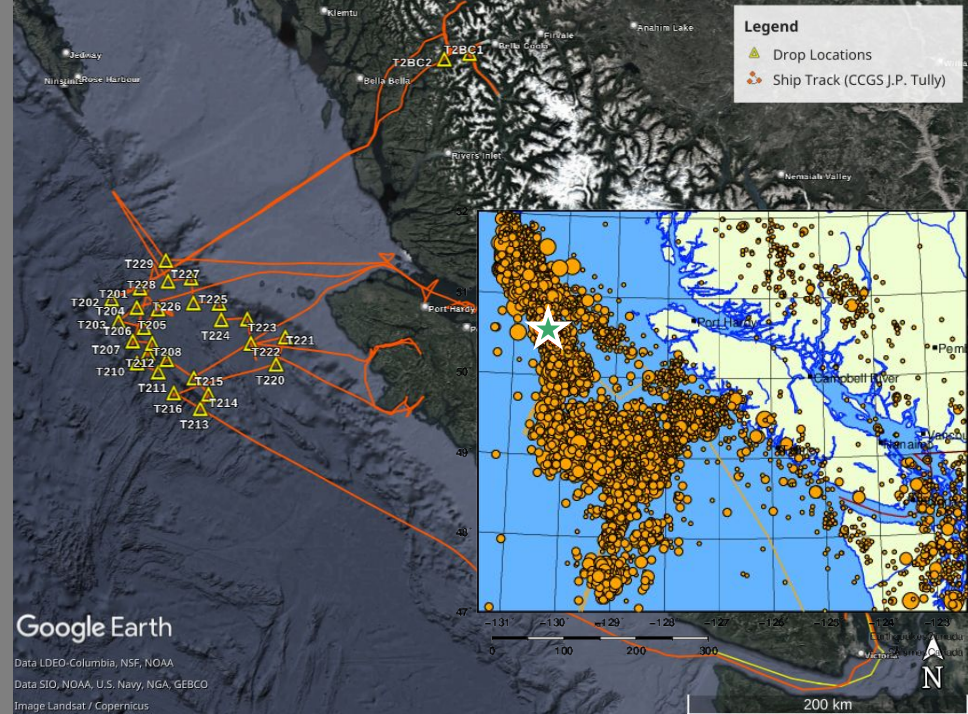
Deployments: Lower St-Lawrence (Sept 26-29, 2023)

- PIs: Y. Liu (McGill), M. Nedimovic & M. Zhang (Dalhousie); Collab: A. Plourde (GSC)
- Track whales and collect seismic data; however unable to get hydrophone replacements on time.
- Original plan scaled back due to hurricane.
- 8 instruments deployed with small fishing vessel.
- Deployment of land stations along both banks



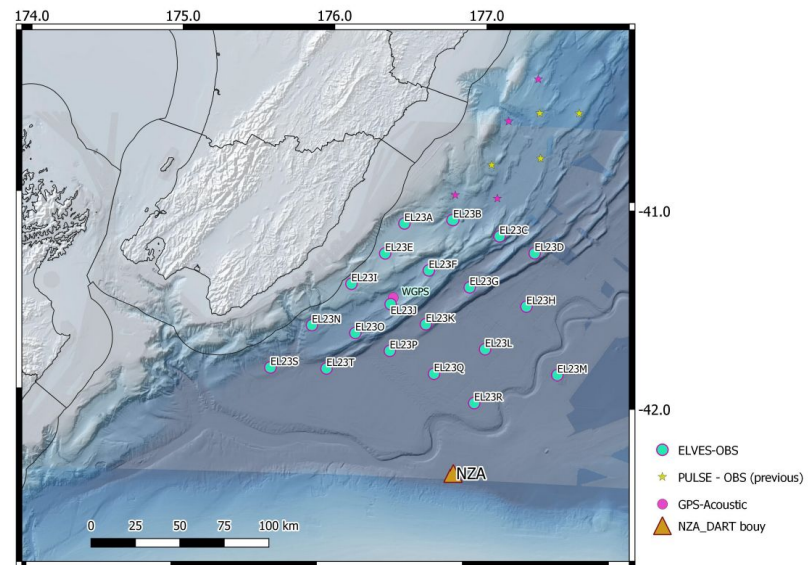
Deployments: QCF (Oct 11-27, 2023)

- Pis: M. Bostock (UBC), M. Nedimovic (Dalhousie), S. Peacock (UBC), E. Nissen (uVic), M. Zhang (Dalhousie); Collab: A. Schaeffer, T. Sun et al. (GSC)
- 28 instruments deployed from R/V Tully; 8 were positioned; 2 surfaced early, 1 recovered
- Deployment site plan changed repeatedly due to bad weather. 3 interruptions to transit to shelter.
- M~5 earthquake within days of first



Deployments: ELVES (Nov 25-Dec 1, 2023)

- Earthquake and Locking inVEstigation of Subduction
- M. Savage (VUW), E. Warren-Smith & K. Jacobs (GNS), P. Audet (uOttawa), M. Nedimovic (Dalhousie)
- 20 instruments deployed; all positioned; none



Future deployments (pre-proposal stage)

- Baffin Bay (Arctic) deployment with Defence Research and Development Canada (DRDC)
- Southern Adriatic Sea deployment with collaborators from Italy, France, Montenegro and Albania.
- Endeavour Ridge segment with collaborators in the northwestern US.
- *We work on proposals until we run out of instruments on a first-come, first serve basis.*



2023 Marine Seismology Workshop

May 2023 at Dalhousie University, Nova Scotia, Canada

Organizers:

- Pascal Audet, Mladen Nedimović

Participation:

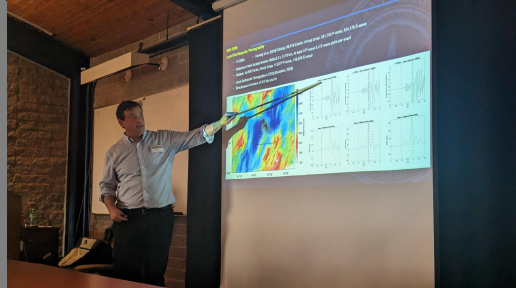
- 39 participants; 20 graduate students; 6 countries.

Scope:

- Provide training in marine seismology, including passive and controlled source methods, ocean-bottom seismic instrumentation, deployment/recovery and location on the seafloor, data collection, data processing, and survey proposal planning.

Activities:

- Icebreaker reception; Lectures; Hands-on practicals (OBStools and earthquake location); Tour of facility; Field trip (mock deployment); Seminars by guest speakers (H. Janiszewski & P. Canales); Proposal and



More information:

- Website: <http://nfsi.ca>
- Email: nfsi@nfsi.ca
- Mailing list: <http://nfsi.ca/outreach/mailing/>
- GitHub Organization Page: <https://github.com/nfsi-canada>
- OBS contract announcement:
<http://nfsi.ca/outreach/blog/obs-contract-announcement/>

