Acoustic Characterization Around the CalWave WEC

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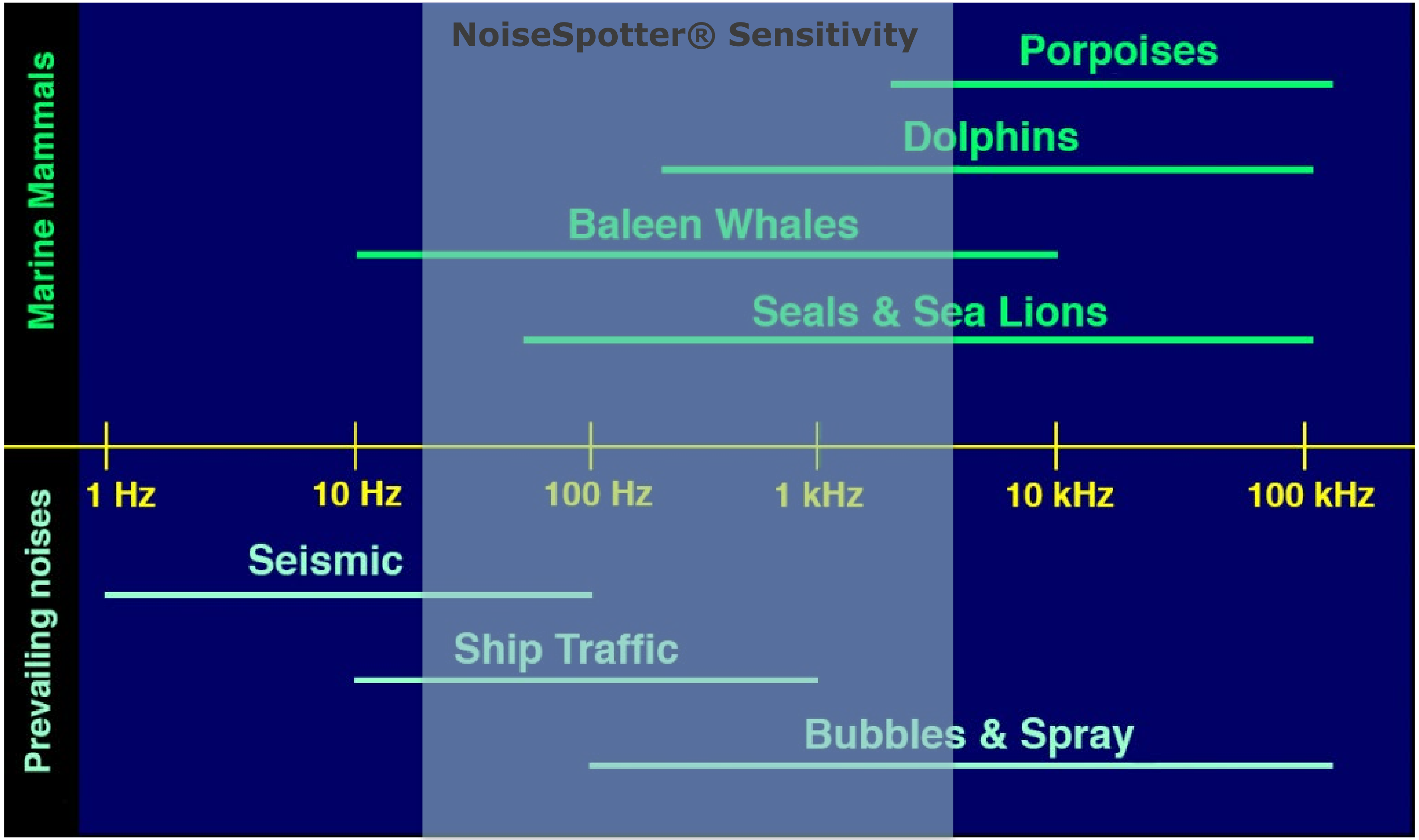
Motivation

- Instrumentation that will facilitate acoustic data collection as a means to reduce risk and streamline environmental permitting
- Expected source intensity levels 106-109 dB re 1 µPa in 125-250 Hz range, 25 m from source (Tougaard et al. 2015)
- Source localization can help isolate device noise from other sounds
- Real-time characterization can help with mitigation efforts.



Adapted from www.dosits.org

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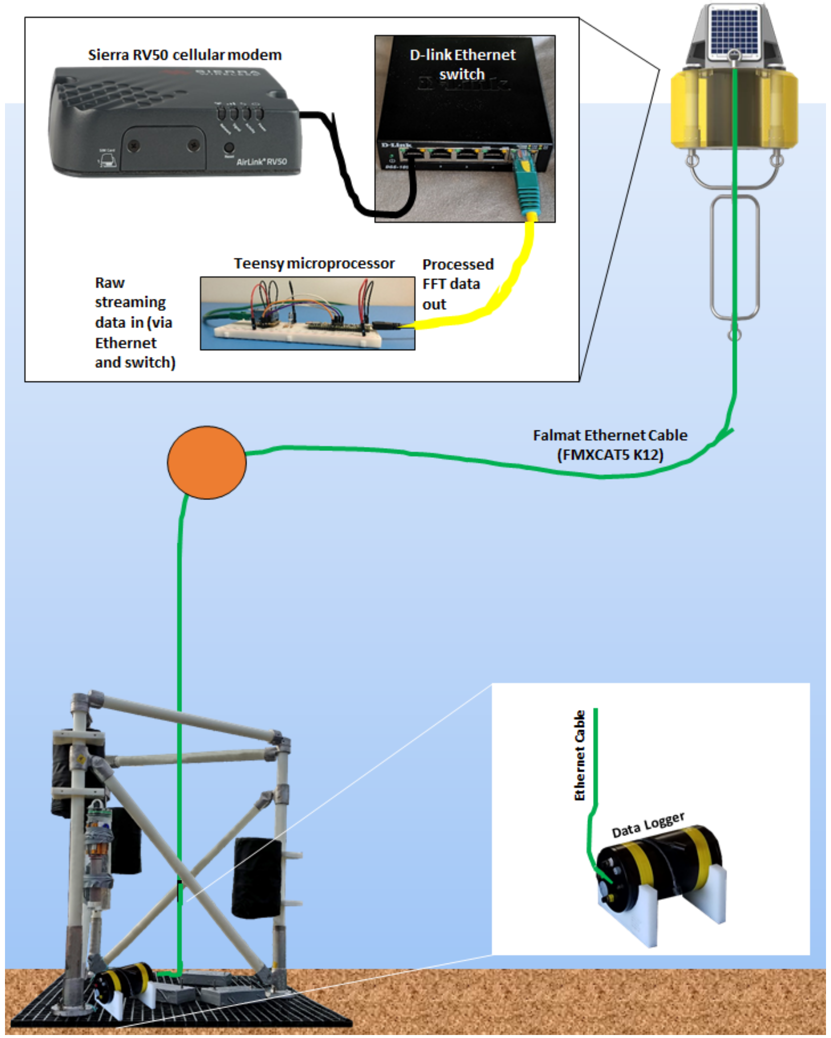
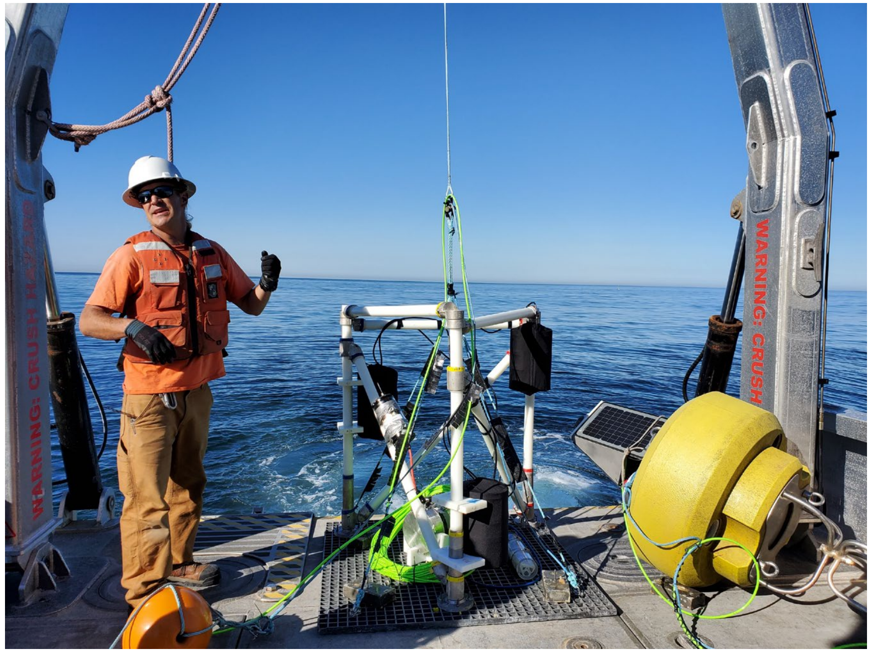
Methods

- NoiseSpotter® passive acoustic monitoring system deployed in 18-25 m water depth.
- Each sensor measures acoustic pressure and 3D particle motion, 50 Hz-3 kHz
- Sensor spacing:
  - Vertical: 35 cm, 50 cm, 70 cm above sea bed.
  - Horizontal: 1 m separation
- Sensors enclosed in flow noise-removal shields





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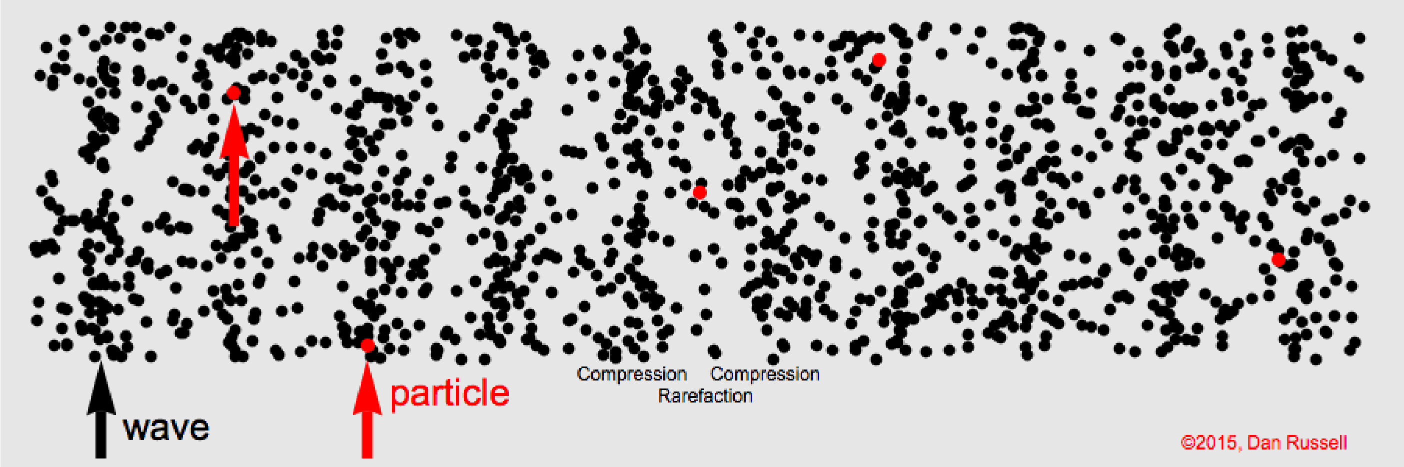
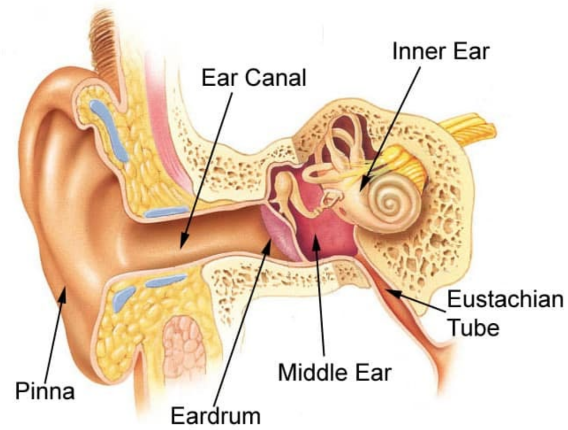
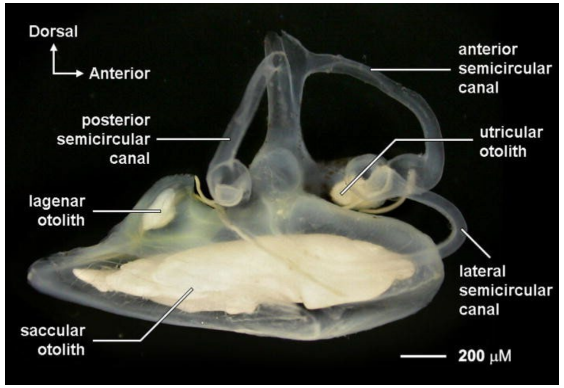
Acoustic pressure versus particle motion



Human Ear - Evolved to sense pressure



Fish Ear - Evolved to sense particle motion



Arthur N. Popper; Anthony D. Hawkins; *The Journal of the Acoustical Society of America* **143,** 470-488 (2018)
DOI: 10.1121/1.5021594

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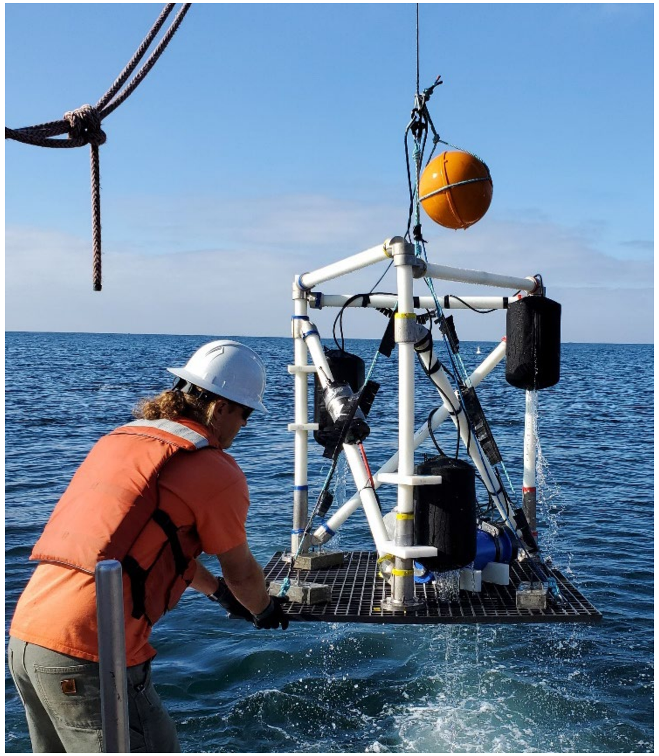
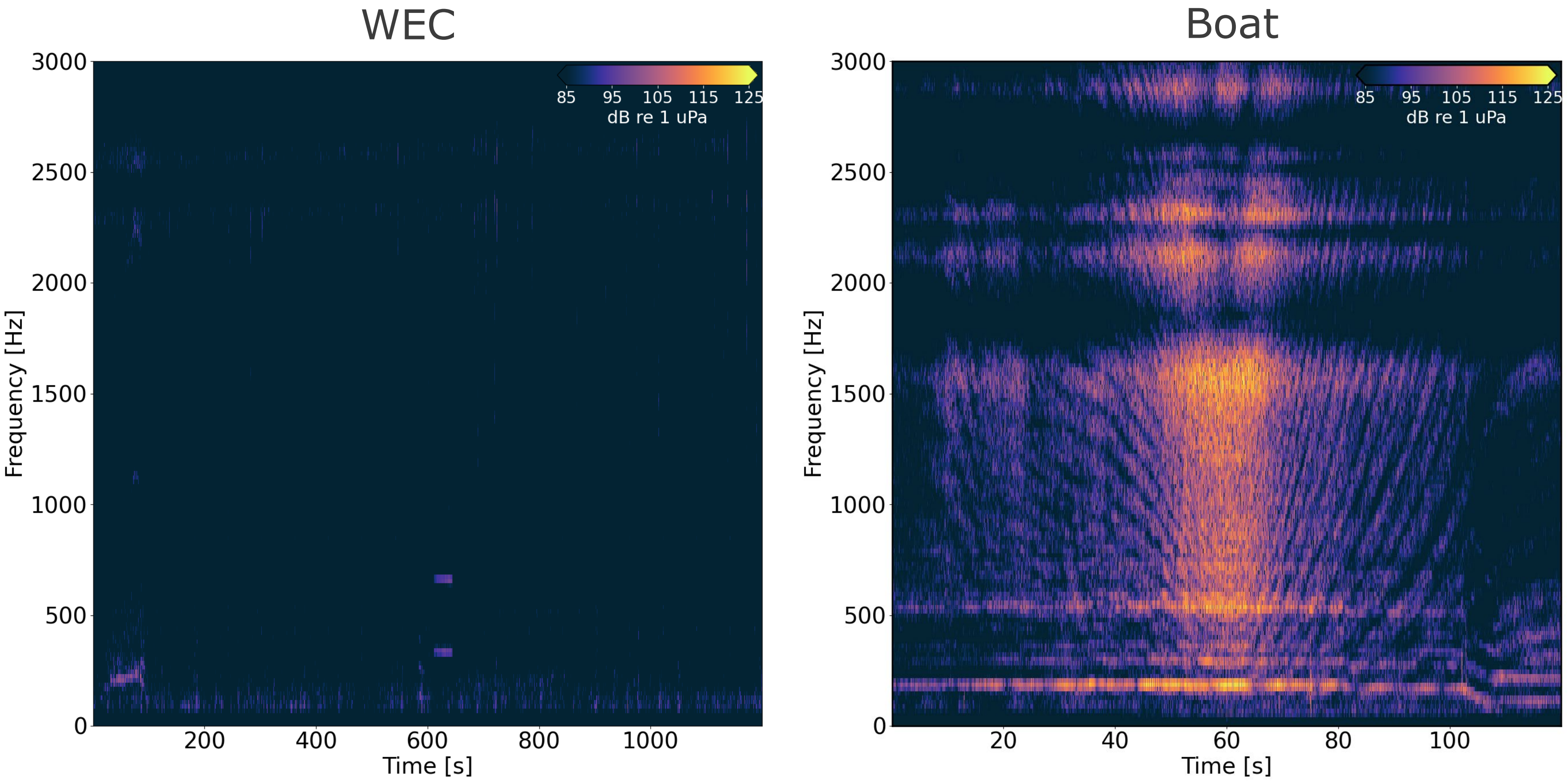
November 2021 Deployment

Date	Objective
November 13	Mobilization
November 14	NoiseSpotter® as drifting system, along with DAISY
November 15-16	Real-time NoiseSpotter®
November 17-18	Non-real time NoiseSpotter®, 100 m and 200 m from WEC along four cardinal directions
November 19-22	Multi-day non-real time NoiseSpotter®
November 22	Demobilization



WEC v/s Boat Sounds



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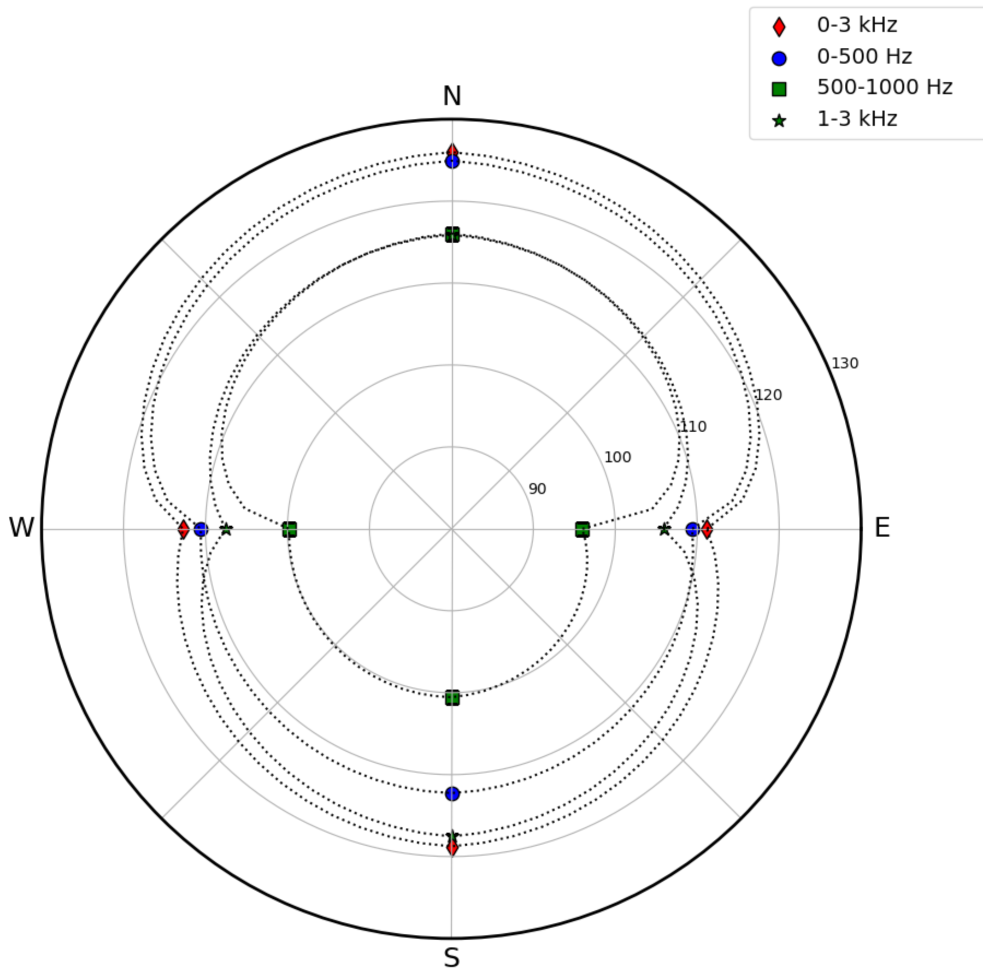
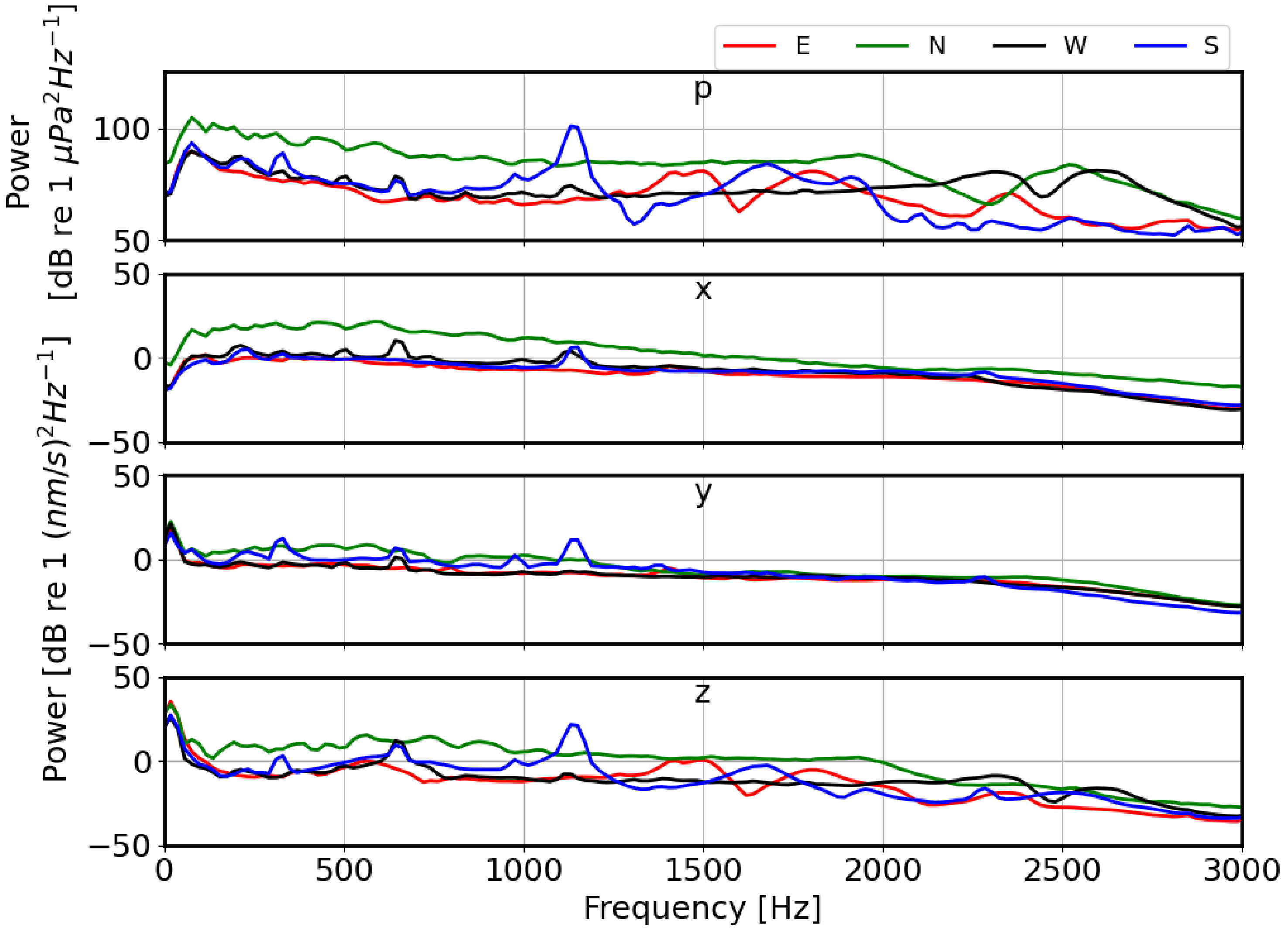
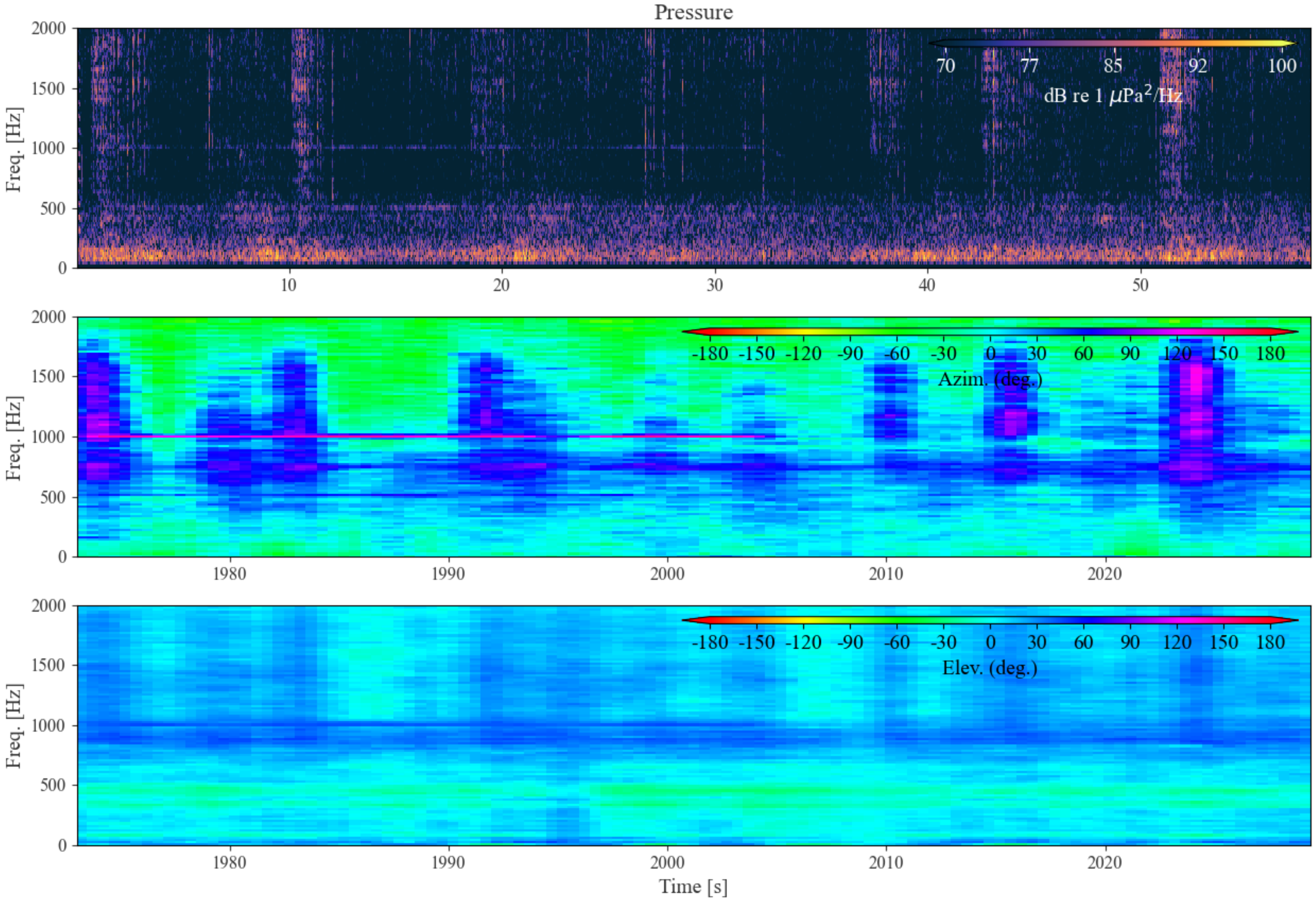
CalWave Deployment: Azimuthal Anisotropy

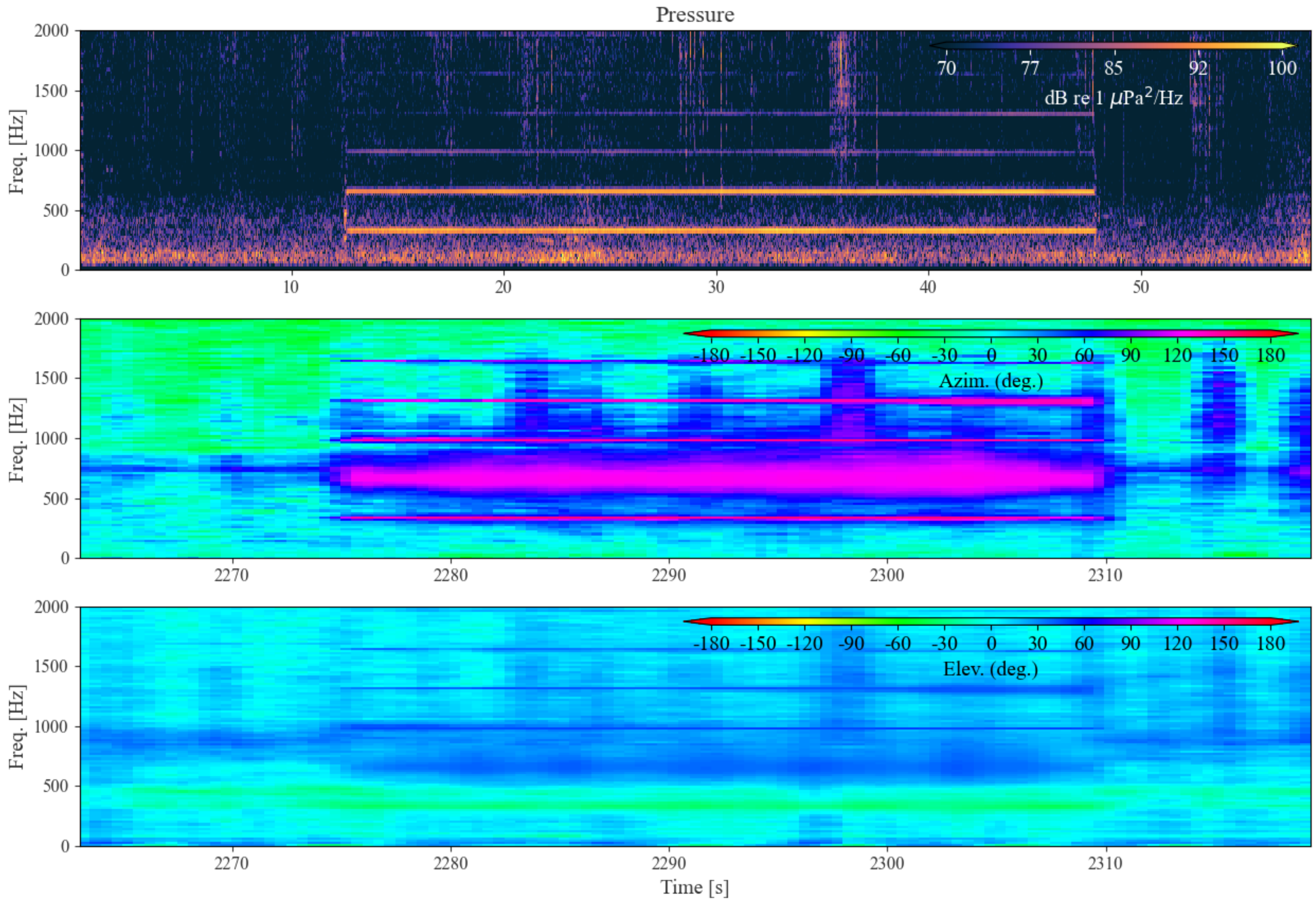




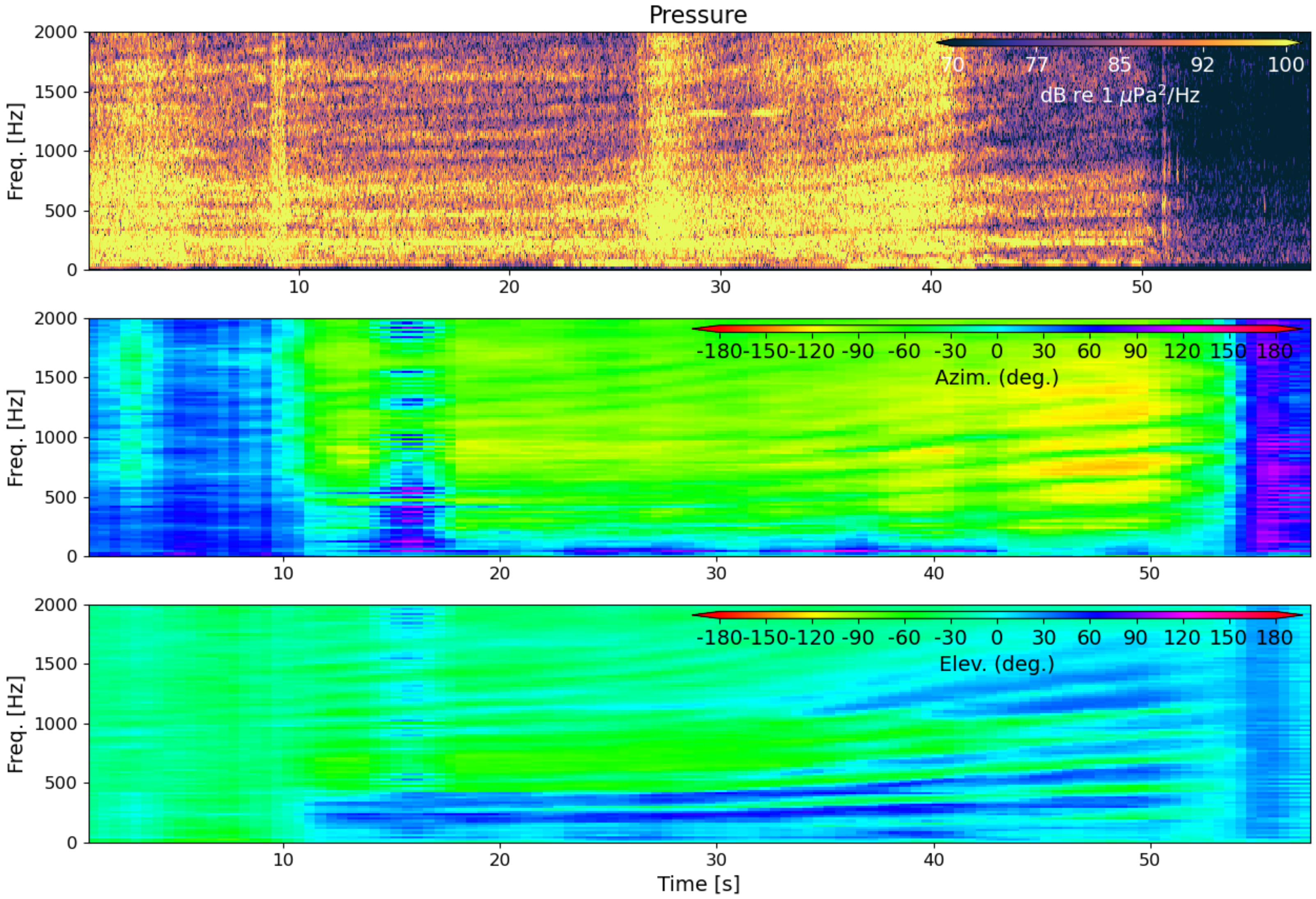
CalWave: WEC Sounds



CalWave: Helicopter Sounds



CalWave: Boat



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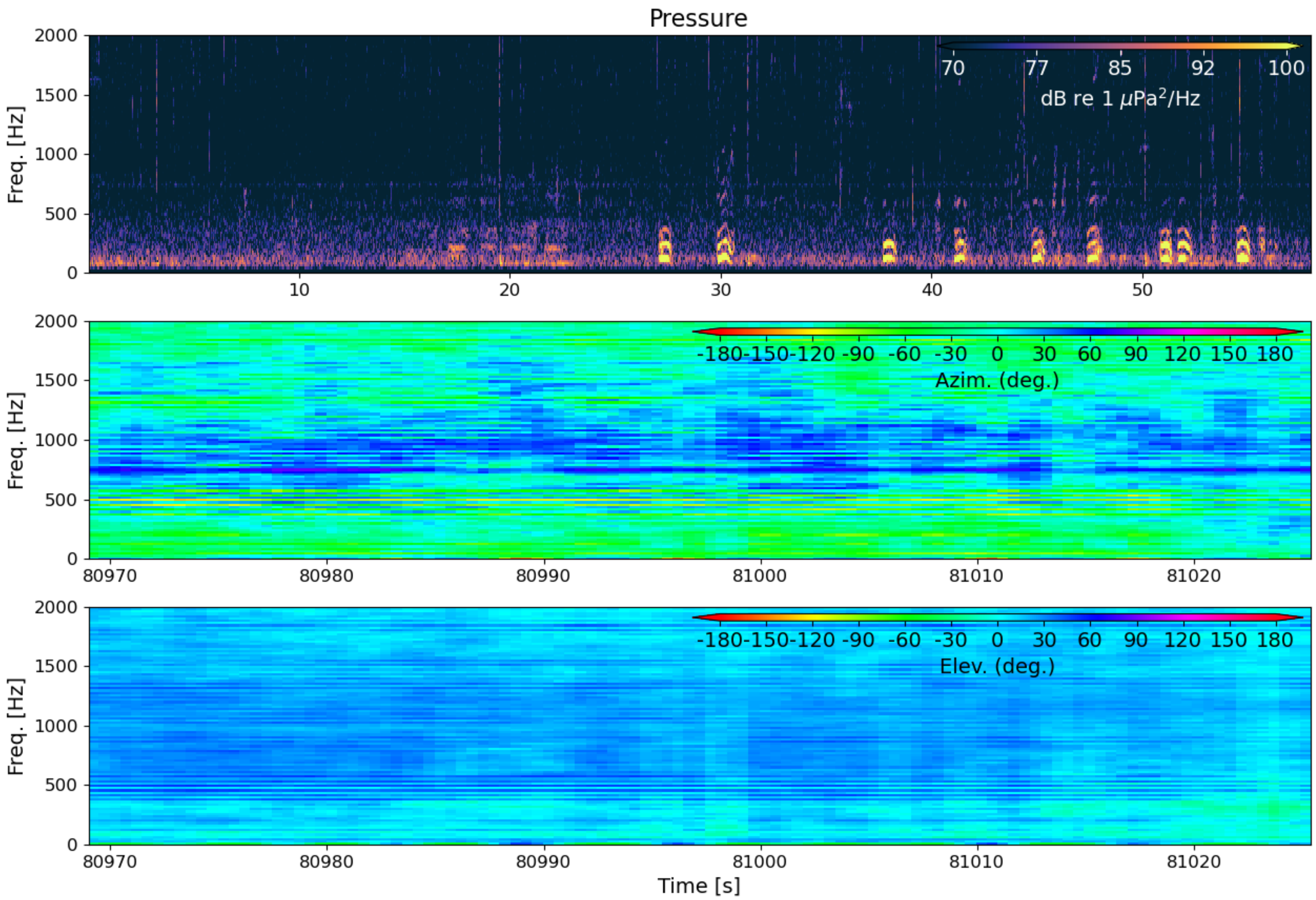
CalWave: Whale



Source	$L_{E,60\ s}$ (dB re 1 μPa² s)
WEC	139 dB re 1 μPA
Boat	147
Helicopter	140
Gray Whale	138 dB

Conclusions

- WEC sounds at considerably lower levels than ambient sounds such as boats
- Directional processing helps isolate WEC sounds from background
- Some directional anisotropy, likely due to bathymetric variability around WEC

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