

DOSITS Webinar Q&A
Acoustic Sensing on Autonomous Underwater Platforms
October 14, 2026

What is the measurement distance for the seaglider self-noise sound pressure levels?

The Seaglider used in this experiment had a hydrophone mounted directly to the hull and sat right above the oil bladder/reservoir that was making the noise during the "bleed" phase. The hydrophone is approximately 0.18 m from the pressurized hull where the pumps and pitch and roll motors are located. The boost pump and main hydraulic pump are approximately 0.23 m and 0.25 m, respectively, from the hydrophone. The pitch motor is approximately 0.75 m from the hydrophone, and the roll motor is approximately 0.78 m from the hydrophone.

Can a glider usually remain at apogee quietly sensing, or if you want to listen to a particular depth is it best to dive past that depth and get it going down and coming?

The seaglider does not usually remain at apogee for very long, as it is designed to move in a sawtooth pattern and relies on changing its buoyancy to generate thrust that it can convert to forward momentum. However, profiling floats can be set to float and record for a duration at a particular depth, though they have less control over their horizontal movement. Additionally, now many of the gliders (including Seagliders) have a "drift" or "loiter" mode where they can act as a drifter for a specified amount of time at a specified depth. I've only tried this for 20-60 minutes at a time, but you could do it for as long as you like.

For the rest of the 94% of the AUV time (not during events of self-noise) what is the soundscape like? very limited self-noise/any at all?

The Seaglider is a very quiet system outside of the discrete self-noise events. The vehicle moves slowly, which helps to limit flow noise, and therefore the Seaglider is able to measure the soundscape with little interference from its own motion or systems.

This might be a very specific question, but could you explain a little more about the "deep bleed" sound you mentioned? My understanding is that the Seaglider never bleeds at depth during either the dive or climb to correct its vertical velocity.

The Seaglider does make adjustments to its buoyancy, pitch and roll throughout its dive to maintain its heading and descent rate as the environment around it changes. These functions are controlled autonomously based on parameters that are set by the Seaglider pilot, such as dive depth, duration and glide angle. The Seaglider may "bleed" in order to adjust its buoyancy based on feedback from its depth sensor and the in-situ density profile that it is able to measure using its on-board sensors. The 'deep bleed' events were classified as any bleed event below 50 meters. There were very few of these events in the dataset.

Was the hydrophone structurally isolated from the seaglider during the measurements? I would be concerned about using a seaglider mounted hydrophone to quantify sound radiated into the water column?

In this case the ceramic sensing element was housed in a nitrile rubber sensor boot with the preamp contained inside an electrically shielded pressure housing (GeoSpectrum Technologies Inc., 2018). The

hydrophone was surrounded by foam and mounted in a cylindrical casing to the outside of the Seaglider body on a removable panel that was attached with screws to the Seaglider fairing. This mounting helped reduce noise transmitted through the glider body to the hydrophone, though noise emitted by the glider into the water still reached the hydrophone.

How often do the various UUV's transmit data at the surface, relatively speaking. Additionally for the lowest energy/longest recording UUV's, what is the approximate cost for one of these devices, and are they available for renting or are there any in operation in the US Gulf of Mexico that are open access?

How often the UUVs transmit at the surface is up to the pilot, but if a glider is diving to 1000 m depth it will come up roughly every 6 hours. The cost very much depends on the vehicle itself including its size and depth rating, but the Seaglider with acoustic sensor was on the order of \$200,000. There are more and more UUV companies moving to an "Equipment as a service" business plan where they provide the equipment and piloting and just give you the data.

False killer whales whistling once per second... like taking a stroll around the park... Are they calling someone or just chilling?

Like in most odontocete (toothed whale) species, whistles are understood to be used in social contexts to communicate with their subgroup or pod and maintain group cohesion and identification. This is incredibly important for highly social species like false killer whales that travel and forage in groups. In contrast, odontocetes use echolocation clicks for foraging and navigation. You can hear more example sounds here: <https://dosits.org/galleries/audio-gallery/marine-mammals/toothed-whales/false-killer-whale/>

Are there any sound recordings available from the false killer whale + glider research?

The raw recordings for the 2022 survey are available from NOAA NCEI Passive Acoustic Data Archive (<https://www.ncei.noaa.gov/maps/passive-acoustic-data/>) and we are in the process of uploading the 2023 data. The 2026 data will eventually be there too.

How are these signals from T1-T5 communicated, via acoustic modems?

The acoustic sources in this experiment were deepwater tomography sound sources (underwater loudspeakers) that were designed to transmit low-frequency modulated signals for the purpose of measuring multipath acoustic propagation. They are somewhat similar to the sources used in the Acoustic Thermometry of Ocean Climate (ATOC) transmissions, which we have an example of here: <https://dosits.org/galleries/audio-gallery/anthropogenic-sounds/atoc-transmission/>

Is it possible to mount more than one hydrophone outside the hull of the seaglider? For triangulation of the sound source.

Yes! Several hydrophones can be mounted to the Seaglider in order to obtain multichannel recordings of sound. Here is one example of Dr. Van Uffelen's work integrating several hydrophones onto the same Seaglider: https://soest.hawaii.edu/ore/OE/Prof.Howe_PDF/DMON_Van_Uffelen_JOE_2017.pdf

How did you groundtruth the animal species with the recorded acoustic data? Did you really see them or from any evidence the acoustics are linked to any species?

We did not see the animals as the glider is being piloted from land (via satellite) and is often many km offshore. But many species have species-specific sounds that have been described in the scientific literature so we can compare what we recorded with validated other recordings to classify to the species level. You're correct that someone, somewhere, sometime has to both see (and identify) the species AND get a recording from it in order for us to learn the species' signature.

Re: edge computing/embedded systems on gliders & computational expense of frequency-domain operations; so we assume that you worked with pre-trained time-domain audio classifiers? Any detail on this? Also, why a Raspberry Pi of all things available today?

The detection system was designed to identify certain spectral features of echolocation clicks. To do this, it ran low-order time-domain filters (so no FFTs) and compared the amount of energy in different spectral bands, essentially looking for certain slopes in the click spectrum. It also had some frequency-of-occurrence checks matched to how often groups of the target species, sperm whales, produce clicks. Here's a paper about it:

Klinck, H., and D.K. Mellinger. 2011. The energy ratio mapping algorithm (ERMA): a tool to improve the energy-based detection of odontocete clicks. J. Acoust. Soc. Am. 129(4):1807-1812, [doi:10.1121/1.3531924](https://doi.org/10.1121/1.3531924).

We used the Raspberry Pi because the WISPR acoustic system we used for recording had been designed to interface with it. They were set up to share microSD storage cards – WISPR to write incoming sound data, the RPi to read and process the data. The RPi also fit our needs for very low power and small physical size.

The low-frequency detection and classification system (LFDCS) used for near-real-time detection of baleen whales operates in the frequency domain to identify tonal sounds. That system *can* do FFTs because the sample rate is much lower, which in turn is possible because the frequency of baleen whale (mysticete) sounds is so much lower than toothed whale (odontocete) sounds. You can learn more about LFDCS in the original publication or the more recent reference manual:

Baumgartner MF, Mussoline SE. A generalized baleen whale call detection and classification system. J Acoust Soc Am. 2011 May;129(5):2889-902. doi: 10.1121/1.3562166. PMID: 21568392.

Wilder, J., Davis, G., DeAngelis, A., Van Parijs, S., & Baumgartner, M. (2023). Low-Frequency Detection and Classification System (LFDCS) Reference Guide. <https://doi.org/10.25923/hsj0-j449>

Question for Dr. Van Uffelen: Have there been issues with the return of AUVs such as AUVs becoming lodged in vegetation/debris or trapped under sea ice? I am trying to get an idea of how successful/feasible it is to collect AUVs that have completed their deployment. AND How often are there vessel collisions with gliders at or near the surface? AND You mentioned using gliders in the Arctic. I was wondering whether they have been used in the winter as well and whether there is a way to program a glider for it to surface in an area that it's pre-known to be ice-free (vs being stuck under the sea ice)?

Lora Van Uffelen: Yes, that can happen. If you notice the picture of a glider that I had on one of my slides, there were some blue paint marks on it, and that's because it came in contact with the hull of a boat. It was okay, but they're not always okay. The ocean is an extreme environment. So anytime you put

anything out there, particularly something that you leave for a long period of time on its own, there is the risk that it's not coming back.

Dave Mellinger: I lost a glider in the Gulf of Mexico once when the recovery boat accidentally hit it and we never saw it again. I'll echo Lora: anytime you put something in the ocean, you have to be prepared for it not to come back. One of my slides showed a glider diving into the depths, and that's a very famous glider picture, but it's also the very last time that glider was ever seen. It just disappeared - it dove and didn't come back up. NOAA folks in Hawaii that Selene and I work closely with lost a glider this spring; it seemed to be working just fine and then it just disappeared. I've also recovered a glider with shark bite marks on it, and a shark tooth embedded in it, so that can happen too.

Cristian Graupe: Not just sea gliders, but buoys or any kind of sensor that you're leaving out in the ocean for a long time is always going to be subject to the environment, and part of that is challenges with vessel strikes.

Lora Van Uffelen: In the experiment I showed, we were actually hoping to go under ice, but there was no ice in the Arctic at that time that we were up there. It was in the summer. And so we didn't. But there is the group from University of Washington has operated gliders under the ice, and the way they do it is they don't come all the way up from that sawtooth pattern, but they'll come part of the way up and then go back down again. And so you can give it a waypoint and, you know, essentially tell it how many times to dive under... underneath the ice before it surfaces, but that's one of the research areas that we're looking towards, too, is can we use, long-range acoustics to communicate with these vehicles and give them directions? I think that's one thing, you know, that we have on our dream boards.

Dave Mellinger: There are also ice detection algorithms that work using sound. The sea surface sounds very different when it has ice on it than when it doesn't. And so you can use the acoustics you're getting to figure out whether there's ice up there, whether it's safe to surface.

Lora Van Uffelen: Yeah, there's also some ice avoidance measures that are commonly used on floats where they can detect whether there's ice through the connectivity, temperature, and depth profile. And so then if it's there, then they'll head back down. There are ways, but, but it's definitely, it's definitely a region where we can improve.

Could AI reduce the need for human interpretation in real time?

Absolutely! We're working on machine learning algorithms for identifying false killer whales and other species. Part of the challenge for AI is that the ocean sounds different in different places, so you might have very similar-sounding species in one place and not in another.

Since acoustic waves propagate over long distances, how did you identify if the animals are nearby or are actually far from the glider so you can identify the animal populations are within any location range?

This is one of the trickiest parts of estimating animal density or abundance from passive acoustic data and then relating animal presence to environmental variables. With a single hydrophone we do not know exactly where the animal is. With multiple hydrophones we could potentially get a bearing and range and localization would be possible with multiple gliders. For single hydrophone systems like many gliders we are using, we estimate the maximum detection range using sound propagation modeling and

then make assumptions about the animal being present in some radius around the glider. For high frequency whales like beaked whales, this is on the order of just a few kilometers, for low frequency baleen whales this is on the order of tens to even hundreds of kilometers in the right conditions.

Are DTAGS ever used in combination with gliders to ground-truth call rate, or to assist with localization?

Yes, DTAGs and other animal-borne sound-recording tags are extremely useful for learning call rates. Even they are not perfect, however, since it can sometimes be hard to tell if a call in a recording was made by the animal the tag is on or another one that's very close by. As far as I know they haven't been used for localization though.

For the fin whale density study, are hydrophone arrays like bottom 1D/2D arrays used?

The hydrophone array used in the fin whale density study was a sparse 2-D array of over 100 single hydrophones each a few kilometers apart mounted on the seafloor and with cables transmitting the data in real time to a shore station.

With all of the Acoustic data that we collect on these platforms, obviously there's a huge volume of data, and what you do with that data is dependent on your ability to actually get the recordings and the sound events that you want out of them?

Cristian Graupe: And just because we're sort of in this world where we're seeing the advent of AI and, you know, detection algorithms, one person is asking, could AI reduce the need for human interpretation in real-time data? And that sort of goes along with these questions that we have about the need for advanced edge processing and the ability to process data on board of the vehicle itself.

David Mellinger: Certainly, people are working on AI-driven methods for doing detection and classification on board the gliders. There's a fellow in Hawaii who's doing that right now, to look at false killer whale sounds. Power is a big issue. AI methods are pretty power-intensive generally, but there are some ways of reducing the power needs, to make them somewhat practical for use on a glider. The way you design it is have a first stage system that runs all the time that picks out times when maybe there's something there. And that stage has to be super efficient, but then it only detects things every once in a while, and so every once in a while you fire up your less-efficient AI system to verify whether or not it's the target species or the target sound that you're looking for.