NSCAD University

A paper in support of the thesis exhibition *Quiet Listening: What do we hear after glaciers melt?*

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Advisory Committee:

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Ocean Boat Glacier

Proposition:

An art gallery is a space to experience and think about large events happening in the environment in a much smaller way. This is why it is important that art worlds be in dialogue and interaction with science and technology worlds, particularly when it comes to sensitizing ourselves to and thinking about the present and probable futures wrought by climate change.

“Art is not about making]any kind of utopia, but offer[s] an alternative space to step out of our pre-perceived system, [a place] to destabilize what we normally hold still. It matters to destabilize worlds of thinking with worlds of thinking. ”
Donna Haraway [1]

[1]*Donna Haraway, Anthropocene, Capitalocene, Chthulucene: Staying with the Trouble;, Anthropocene: Arts of Living on a Damage*. 2017. Lecture on *Vimeo*, https://vimeo.com/200992946

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My thesis consists of three chapters, each focused on a different aspect and locus of my research, thus Ocean; Boat; Glacier. Each chapter recounts not only a different focus and methodology for thinking about the relations between art, science, technology, and climate-based phenomena but also, distinct projects that test the boundaries and limits between data interpretation and artistic probing of experience and imagination.

In chapter one, Ocean, I begin my struggle with how to describe and work with an encounter between ocean-based scientific data and artistic strategies of visualization. At first, as this chapter describes, I try to incorporate published scientific data in various sorts of visual, sonic, and interactive displays. Here, the problem is always how to visualize and sonify abstract scientific data points and concepts derived from facts that are not inherently visual.

In time, however, I encountered limitations in the methods I was using to integrate a scientific framework into my art. Later I realized that the scientific method, which emphasizes the presentation of information, lacks sufficient capacity to provoke or foster sensory (aesthetic) responses and reflections.

Chapter two, Boat, shifts the discussion from visualizing already recorded data to active fieldwork and data creation and retrieval. In this chapter, I recount my experiences of collaborating with a scientific-oriented ocean tech industry from a boat on the water. In this project, I collected scientific data myself using a hydrophone and underwater cameras. As the project unfolds, I come to realize the significance of human connection and embodied experiences as crucial elements that inform both scientific data collection as well as my artistic practice.

In the third chapter, Glacier, I turn my attention to thinking about how art can help us engage with large-scale and largely invisible climatic shifts. Here I investigate the raw material of iceberg ice — a material that, Olafur Eliasson's 2014 "Ice Watch" projects notwithstanding, doesn't easily give itself up to gallery display in lower latitudes. Gifted some iceberg ice through a chance encounter with climate researchers, I began trying to understand this ice through a sensory, analog approach. I wanted the material and nature of the ice to reveal themselves through my interactions; ultimately, using low-tech "art-based" forms of investigation, I seek to find ways to amplify visually and sonically the experience of melting. In this last

chapter, and my exhibition, I approach metaphorical expression without explicit metaphor, seeking to transform how we see the melting ice without transforming it into data. .

Structure Within the Process:
Pre-Waves

I lived in the desert for four years, surrounded by red rocks, heatwaves, and views of the Antelope Canyon that many photographers would crave. There was a particular aesthetic to the desert that many painters love, seeking to capture a landscape of vast dusty reds and days of unending blue sky. In those days, I had a roommate with whom I used to go on many road trips through the desert; no matter how dry and warm the places we went, her GoPros were always filled with forests and greens. We joked about how much she loved trees, finding them even in the most unlikely of places. This friend still sends me images of her unexpected forests. With her, I learned that looking through another's lens sometimes enables us to see things that most people cannot see. I was reminded of her sense of being on a parallel aesthetic track with my forest-loving friend over the last years as I have worked with scientists and thought intensively about the convergences and divergences between art creation and scientific data collection.

When I moved to Halifax for my Master of Fine Arts degree, I found myself sitting at the waterfront, staring at the oceanfront over and over. It sank me into a world beyond me and my life boundaries, my losses of places and people, and my depression.

Art-making, unless or until subject to the identity of certain physical materials (e.g., ceramics), has no limitations. The boundless nature of art drew me into it and made me believe I could survive in this imaginative and sensuous space for the rest of my life.

Science, in contrast, is empirically focused and operates within a predefined framework. It is inherently focused on addressing specific questions to obtain approximate finite answers. Science progresses by addressing particular inquiries within the constraints of numerous premises. It utilizes imagination, but never in the sorts of intuitive, what-if ways that arts-based wondering and material experiment engages. To find its answers science typically engages a clear question and narrowly defined repeatable processes.

Ironically, standing in front of the ocean in the first year of a graduate art program, I find that soon enough, the ‘no rules’ of art become my biggest enemy.

Hence, I wondered: Would a methodical study of the ocean enhance my understanding of it? Could my passion for the ocean be illuminated through a deeper exploration of its “factual” or empirical aspects? Could integrating scientific truths into my artwork strengthen my arguments? Would the inclusion of scientific facts make my assertions more compelling within the structured framework of science?

In February 2023, I participated in an Ocean Data Challenge hosted by DeepSense, a project based at Dalhousie's Computer Science Department and COVE (Centre for Ocean Ventures and Entrepreneurship). After winning first place in the contest for developing a way to visualize and make music from CBC climate data-related news, I reached out to the data challenge sponsors and ended up gaining an internship that enabled me to be involved with ocean datasets, scientific and ocean industry projects, and interact with people working in those areas.

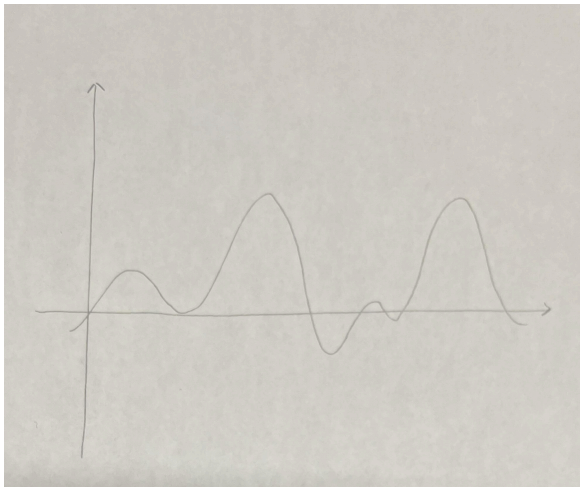
I. Ocean

The Fourier Transform or how we hear and see waves

Fourier Transform is a mathematical operation that converts a function of time or space into its representation in the frequency domain. It breaks down a complex waveform into its constituent frequencies, revealing the amplitude and phase of each frequency component.

From a pure mathematical view, **oscillations** are all the same.

This includes things that we encounter and experience diversely as colour, sound, the movements of the ocean, and the electric-chemical fields and flows of our brain neurons.



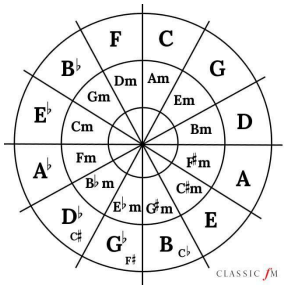
Any digital sound device we use packs Fourier coefficients into zeros and ones.

And when it comes to our other electronic devices, they unpack such information back to Fourier coefficients. During this process of packing and unpacking, some information is lost but human ears cannot hear these differences. Our ears take in the audio and make sense of its most obvious information. We hear one another in similar “lossy” ways because we can never receive and process in full wave periods. With our unaugmented ears and brains, we can only pick the most noticeable signals, the parts closest to each crest and trough.

Our brain neurons generate electric waves, and electric-chemical-electric reactions are constantly transforming as we notice things, as our perceptions shift, as we receive colors and sounds, and generate thoughts, shifting in and out of consciousness. Whether in dream or “reality”, what we think we are seeing is not the fullness of what we are seeing, but only a part of what there is to see or hear, those parts of the waves we take to be “the meaning” of what we see or hear.

We, as bodily sensors, are both receivers and actants.

From ocean waves to human seeing and hearing, from our biological perceptive limitations to the happenings of the universe, it's all **waves**.



The Circle of Fifths[2]

Waves[3]

Talk to me about waves.
How can I hear a wave?

Use the circle of fifths:
They need some harmony.
Two notes sound harmonious together if they are at certain intervals.
The cycle of fifths sounds quite harmonious:
Go through these notes around the circle and it will sound good.
You can also do variations and stuff.
But using the cycle it will sound much better already.
You can also use triads
and the cycle.
Triads are root-3rd-5th.
You can use minor triads to make it sound sadder/darker.
Or do triads in different modes.

These are exactly analogous:
Color is light waves;
Sound is airwaves;
It's all waves.
And sea waves?
Yes and sea waves.

Think about the waves in the universe:
Every planet is born and dies to generate waves.
And they are still traveling somewhere in this universe.
We are mortal but also a bit immortal because the chemicals and ashes that make us up are stardust from elsewhere.
We share the same atoms with dinosaurs millions of years ago and will
become something else in the who-knows-what-will-happen future.
We are so young and yet so old.

We are nothing yet a bit of everything.

I was thinking the other day–
if the whole world as we know it dies, at least somewhere in the universe there must be sea waves.
It should be fine then.
Because I want to know there will at least be sea waves somewhere.
I really like them.
I was thinking the other day about just things, mundane things.
Everything if you think about it enough is interesting, and has some emotional content.

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[2] "What Is the Circle of Fifths?" *Classic FM*, https://www.classicfm.com/discover-music/music-theory/circle-of-fifths/. Accessed 15 Mar. 2024.
[3] The **Waves** section consists of extractions from a series of conversations with a mathematician who works building models of brain research.

For example, I was thinking about water the other day, and how it's my favorite thing.

And yet old, made up of particles and chemicals and stardust and everything.

Blue is my favorite color as well.
Water is young I feel–
It's like youth.
And it encompasses everything.
It fills everything.
And it can be anything– that's why it's young.
It's pure potentiality.

"Chaque homme porte en lui un monde composé de tout ce qu'il a vu et aimé, et où il rentre sans cesse, alors même qu'il parcourt et semble habiter un monde étranger. "

Everyone carries inside themselves a world composed of everything that they have seen and loved, and to which they return without end, even as, when traveling, they feel as if they are living in a world to which they are a stranger.
Voyage en Italie - Francois-Rene de Chateaubriand[4]

Light Waves

Light is a self-perpetuating electromagnetic wave; the strength of the wave can get weaker with the distance it travels, but as long as nothing absorbs it, it will keep on propagating forever.[5] Can seeing also be perpetual? Is this one of the things that the Webb telescope is telling us?

Light Waves: A Self-Search for My Visual Aesthetic

If everything is analogous, like color and light waves, could both paintings and digital/analog videos be inherently analog?

During the time I was making abstract paintings, I found inspiration in artists such as Sarah Sze, Judy Pfaff, Mark Bradford, Julie Mehretu, and Anselm Kiefer. While some of these artists may not strictly be classified as painters (a detail that no doubt contributes to my ongoing exploration of materials for creating visual experiences), they all excel in constructing and narrating layers of stories and histories within a visual universe.

For me, an imagination of the genesis of the world has perpetually been characterized by fluidity, airiness, and the undulating motion

[4] François-René De Chateaubriand and Thierry Clermont. *Voyage en Italie*. Éditions Payot & Rivages, 2015.
[5] *UCSB Science Line*, scienceline.ucsb.edu/getkey.php?key=2652. Accessed 26 Feb. 2024.

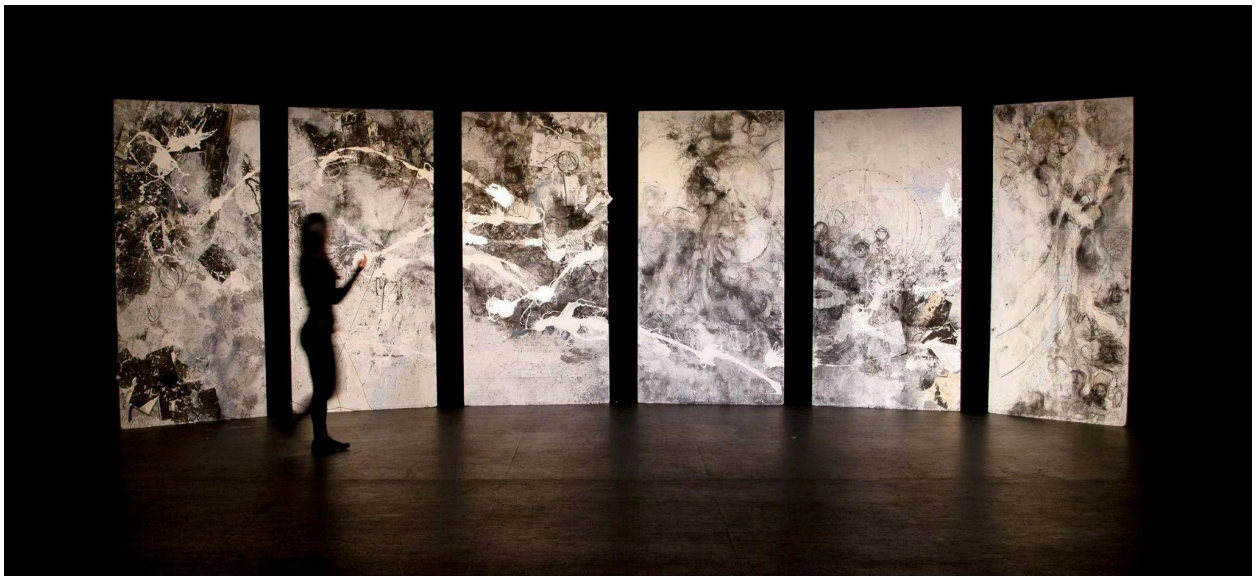
of waves, reminiscent of water and particles moving in fluid ways. Such ideas are widely present too in the historical poems and ancient Chinese philosophy I grew up with; this fluidity shows up in either the ideas or the way the writing rhymes. Despite the shifts in my practice, my fundamental visual taste has remained relatively unchanged. An image of the ocean and space has always been there in my practice, and depicting a sense of time has always attracted me. As I was writing this, I was thinking of inserting an image of the ocean here, but I don't know what kind of ocean image I should insert. I think the image I wanted to insert here is multiple; it is the ocean that I have received as images, as sound, as temperature, as dives, as taste, as the days and nights I have stared at and learned from the water, as the ocean that my body and mind received, as the ocean of my memories, both mental and physical.

If that is my ocean, I can never represent or show it fully. But this is why it is also so perpetually interesting to me as a site for and of my practice. What I investigate is what always escapes me because it is so much larger than I am.

Transitioning from painting to digital processing, I've made attempts to venture beyond what seemed like a clear visual boundary, and yet I constantly find myself drawn back to the massive data-driven aesthetic of the works I've already made, for example, *To Whose Lives*, in which I used crowd-sourced stories to create images:

To Whose Lives Video still from a digital group show in the summer of 2023

The scale of the works means a lot to me; I am drawn to phenomenal, theatrical, immersive experiences. I love the aesthetic of illegible yet beautiful depictions, whether physical or psychological. In this piece for example, entitled “To Whose Lives,” I collected video clips from friends, ranging from the yellow vest protests in front of the Paris French Parliament to the mundane life of visiting a Hello Kitty store in one of the world's largest malls in Tokyo. Mixing audio sources to randomize the visuals, I aimed to compress moments from many lives, for good and for bad, into a container of the contemporary world that makes sense. For me that container is abstraction. It's about the way that an image like a nebula can contain a history of all things, a world composed of both ideas and reality.



Prelude - Exhibition View at Blackbox Theater, IL

Mixed Media on Insulation. 2021

Abstract world-building from real-world events has been a cornerstone of my practice and a constantly fascinating process for me. “Prelude” was created during the final months of Trump’s presidency. As alluding to that time, I embedded international students' and scholars' petitions from the Homeland Security website into the underlying layers of this painting, creating a seductive surface in which desperate stories were buried as data. These aesthetic and conceptual elements represented a series of personal discoveries that have served as a reference point for my subsequent works. It also marked the beginning of my efforts to incorporate real-life social events into my practice. I view my digital works of the last two years as an extension of this painting and its processes; everything started there.

Sound Waves:

Digital Cymatics

Cymatics is a field that emerged from a discovery that made a visual translation of sound possible in the discipline of physics. Pioneered by Ernst Chladni in the 18th century, who used a violin bow to vibrate plates covered with sand, observing the patterns that formed, Cymatics was further systematized in the 20th century by Hans Jenny who documented his findings in the book *Cymatics: The Study of Wave Phenomena*. Cymatics explores how sound waves can create patterns and shapes in different mediums such as liquids, powders, and pastes. In my work, I performed a series of experiments on a digital approach to field transformation, to see if I could turn sound into visual data and effects in digital software and coding environments.

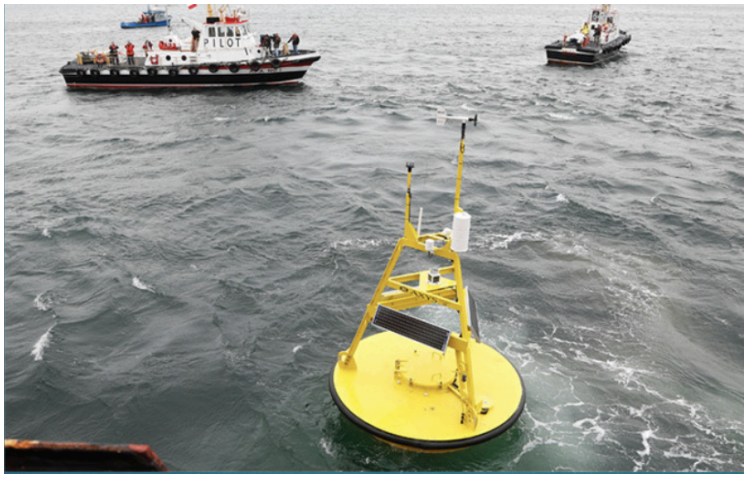
Sound Waves: A Case Study of the Hurricane Fiona Project and Sound Exploration

In mapping numerical data onto chromatic scales, specifically the highest wave data from Hurricane Fiona, I confronted a concern: What if the resulting sound lacks musicality? What if it sounds coarse? (You can tell I am new to the music business.)I envisioned a composition that avoided grandiosity and epic qualities. The backdrop to these musings was Hurricane Fiona's occurrence during my third week in Halifax, a time when I was unfamiliar with even the concept of a rain jacket.

Despite my uncertainty about how to prepare for such a storm, and the frightening experience of the hurricane, the worry persisted that if I created a fearful audio experience, the resulting sounds might prove challenging for the audience.

I got involved in the Smart Atlantic Buoy project a while later, and the CSV file (a text file that has a specific format that allows data to be saved in a table structured format[6]) I received spanned the years 1988 to 2023. My initial instinct was to explore the data specifically concerning Hurricane Fiona.

[6] "CSV File: Definition." *Google Ads Help*, Google, support.google.com/google-ads/answer/9004364?hl=en#:~:text=A%20CSV%20(comma%2Dseparated%20values,in%20a%20table%20structured%20format.



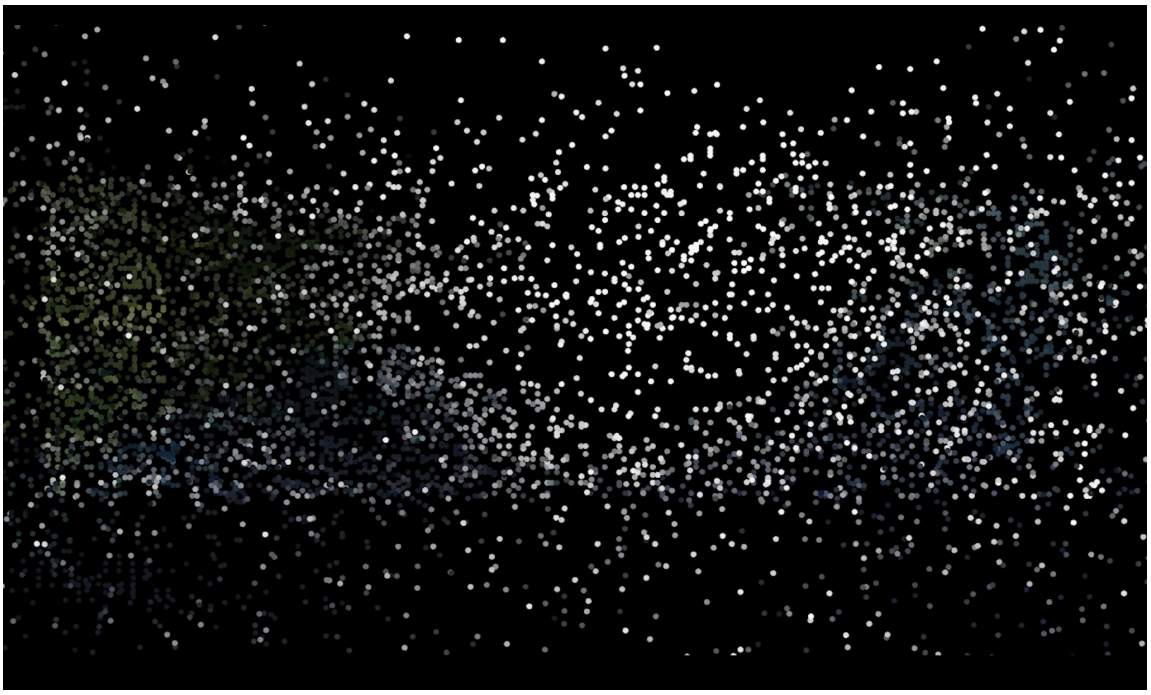
The buoy sits at the mouth of Halifax. [7]

Smart Atlantic Buoys are located along the Atlantic Coast, collecting and sharing real-time weather and ocean data to support coastal, shipping, and ocean management efforts. The Smart Atlantic Buoy located in the Halifax harbor is used by the Atlantic Pilotage Authority to determine if conditions allow for safe entry into the harbor.[8] The research group from which I obtained the Halifax offshore weather data, was concurrently developing a predictive machine-learning model. This model aimed to facilitate management decisions in case the Halifax Harbour buoy went offline, a situation that typically occurs during severe weather events like Hurricane Fiona.

Using the historical data collected by the Halifax Harbour Smart Atlantic Buoy, I created music using wave height data before, during, and after Hurricane Fiona (September 2022). The song is created by assigning wave heights to pitches. The higher the wave, the higher the pitch. The glitch moments of the visual happen when the music reaches a specific pitch, which was the extremely high waves caused by Fiona.

[7] "SmartATLANTIC Consortium Deploys Its First Inshore Weather Buoy to Support Halifax Port Operations and Scientific Research." *Atlantic Pilotage Authority*, www.atlanticpilotage.com/smartatlantic-consortium-deploys-its-first-inshore-weather-buoy-to-support-halifax-port-operations-and-scientific-research/.

[8] https://www.smartatlantic.ca/index.html



Fiona Happening
A video still from the Smart Atlantic Buoy project. 2023

Influencing my approach may have been my background in traditional painting, particularly an extensive study of pre-19th-century oil paintings, especially Renaissance Old Master paintings. The concept of "The Vanguard and Zenith of Humanism" resonated with me, along with a broader belief in art as the epitome of human expression — a celebration of the interconnectedness of humanity. Now it also brings out the question of why my love for the ocean is also my love for humanity. Does it have anything to do with the fluid matters in our brains, in our bodies, in the oceanic space of the womb where we all lived before we were born? In the heart-pumping echoing sound that resembles the sound of ocean tide? Regardless, it was important to me that the sonic elements of the composition I co-created with the data retained a softer, non-threatening quality. I wanted it to be alluring as well as thought-provoking, not terrifying, and more or so in the text-data project (CBC Climate Change News, thanks for all the help), and the just-for-fun of the AIS boat location project.

II. Boat

Existence is not an individual affair.
Individuals do not preexist their interactions; rather, individuals emerge
through and as part of their entangled intra-relating.[9]
Karen Barad, Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning

Embodied Methodology: Interdisciplinary Studies in Art Making

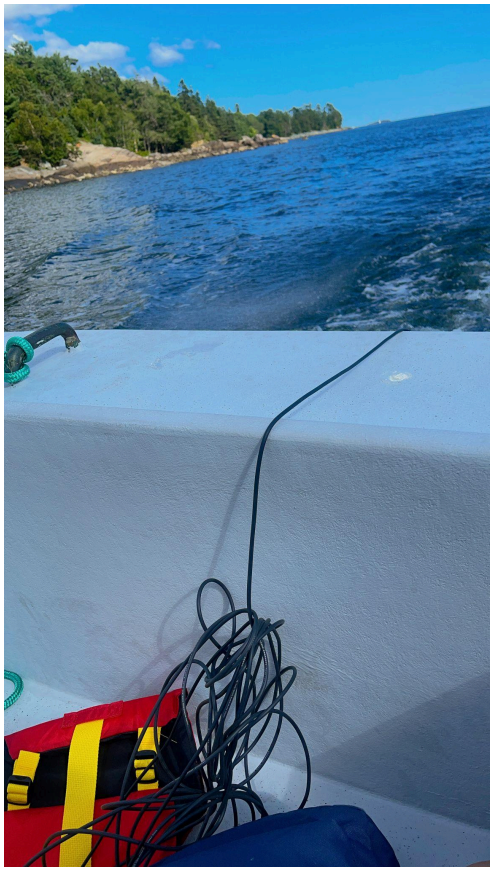
During the summer of 2023, I had the chance to board GlasOcean's boat to record underwater noise with a hydrophone.

[9] Karen Barad. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University Press, 2007.

This boat is named sea cucumber and features the design of a pickled cucumber.

GlasOcean is a company dedicated to transforming traditional vessel engines into electric ones. Their team goes out on the water to collect engine data at various speeds, as well as in turning, acceleration, and still-motion situations. Based on these different scenarios, they optimize their electrical engine design for the most economical and environmentally friendly solution, reducing excessive engine emissions and underwater noise, which, it is now well-known, disturb the communications and lives of many in- and underwater species. On a summer day, the boat set off from Halifax Harbour, and I was fortunate to be part of this project to capture engine sounds.

Using hydrophones, I sampled and analyzed engine noise from both traditional diesel and electronic engines. These sequences of underwater noise were then mapped to the underwater imagery from boat rides, providing a visual representation of these various noises. I conducted and developed a visually meaningful comparative analysis and expression between the two engine noise types.

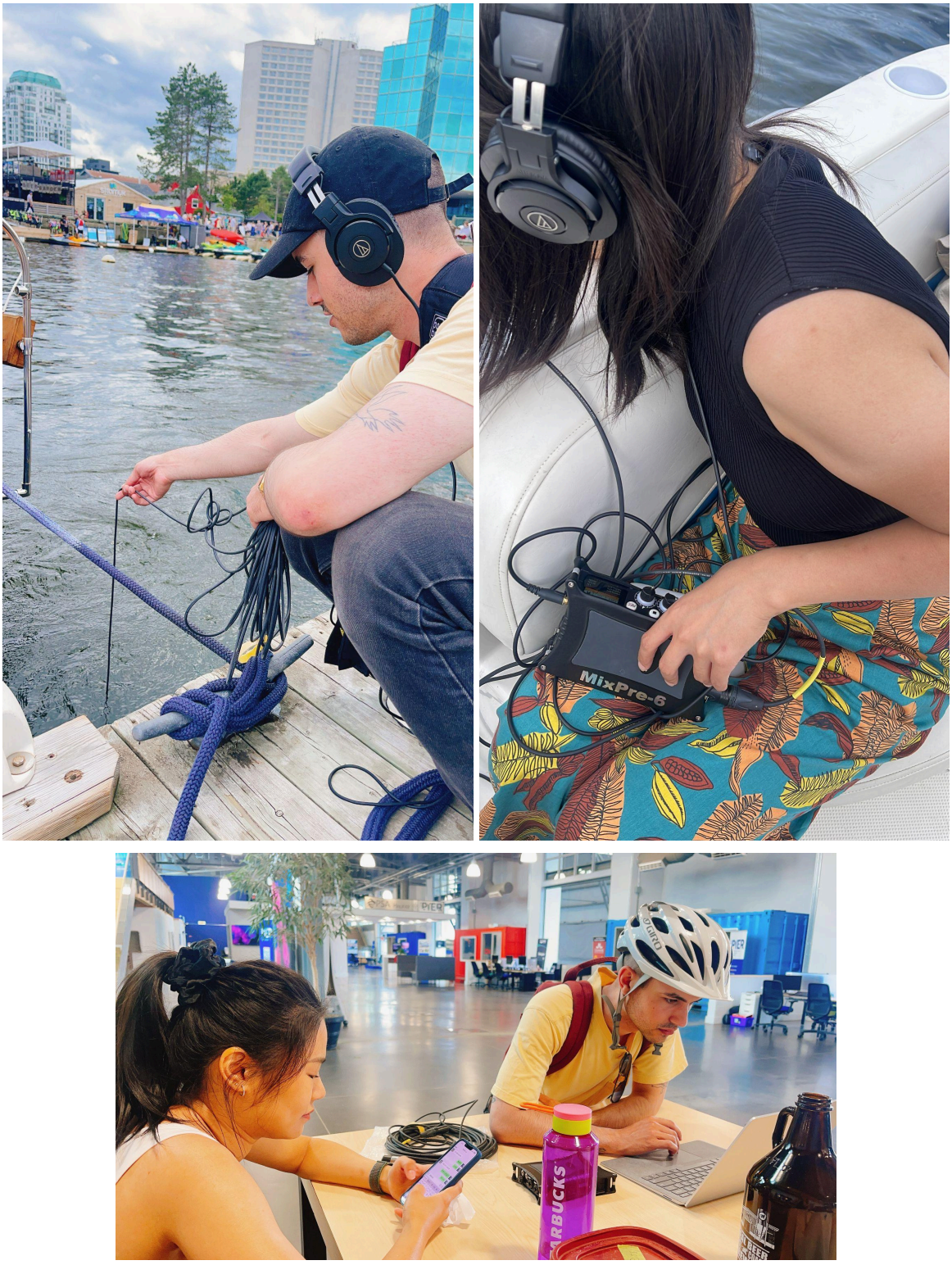


(Based on the artistic presentation of the hydrophone cable you can tell I was also new to physical devices.)

This ostensibly simple project took an incredibly long time to bring to a conclusion. I submitted my proposal to GlasOcean in May. However, at that moment, Halifax experienced devastating forest fires. (At that point researchers were still getting the boat ready but they were saying that they wished there could be rain. Three days after the fire, it rained almost non-stop for a month and a half, making data collection on the water almost impossible, as well as damaging all sorts of infrastructure in the region. After that, the boat broke down for another two weeks. This took us into July.

During my quest for a hydrophone, the Centre for Ocean Ventures and Entrepreneurship (COVE) in Dartmouth provided me with one free of charge. Situated on the Dartmouth shore opposite Halifax, COVE supports a variety of small experimental projects. Reilly, a kind soul at COVE, graciously offered to transport the borrowed hydrophone to the Halifax side, but he inadvertently left it on top of his car and drove away. COVE was then down one hydrophone.

In a stroke of luck, Kate, also from COVE, came to my rescue by delivering another hydrophone. However, it soon became apparent that this type of hydrophone wouldn't connect to a recording device — a realization that exposed my background as a painter and my unfamiliarity with certain technicalities. My studio supervisor during the summer, Will Robinson, introduced me to the Centre for Art Tapes (CFAT), where they accommodated my unpredictable schedule, considering the limitations imposed by weather conditions on the boat's outings. The team at CFAT not only assisted practically but also offered valuable advice. On top of that, they are amazingly generous souls. To make a few simple audio and visual recordings then, it took two months and several scientists, artists, and technicians.



Alex and Yilu accompanied me on lobster boats to test the hydrophone and recording equipment.

Through reflection, I've come to understand that my interactions with individuals are integral to my art-making process. The knowledge

gained during my time on the boat, including insight into how the boat works; how patient or impatient we might be in waiting for the right weather; the numbers of physical preparations required to get the boat running prior to collecting data; as well as the views and understandings of field researchers who actually go to sea, which is different from those sitting in front of a laptop dealing with numbers about the ocean, surpassed anything I could have garnered from conventional databases. I found the expansiveness and complexity of this embedded fieldwork far more interesting than any of the narrow "scientific data" we actually obtained on these journeys. The ambient sounds and personal stories of those going out on the ocean together, as well as what brings people of different backgrounds together on the same boat, provided a unique education that illuminated a crucial realization for me: it is these sorts of sensory experiences, emotions, and memories, together with the professional and personal knowledges they produce and share, that really inform my art. Conversations with individuals from various disciplines became essential, and started to influence the direction of my work.

Prior to this fieldwork-induced revelation, my focus was primarily on exploring data: in particular, in treating datasets as my paints and brushes to narrate the story of climate-related scientific research and to demonstrate its significance for humanity. However, during the months that I worked with strictly science-generated data sets, and thanks to my complex experiences on and with the boat, I shifted towards working with more sensory materials, including transitioning from dealing with text and numbers to collecting sounds.

This shift from a scientific framework, where data acquisition and integration were paramount, towards a more artistic framework, opened up new avenues for exploring different experiences. I began to see the value of dialogue and shared questions and emotions with people from all disciplines as crucial in my artistic endeavors. Art, for me, I began to understand, encompasses emotions and experiences that cannot be captured within a purely scientific structure.

While this shift in my realization and practices does not mean I have or will abandon the use of scientific data as raw material for storytelling, the emotions stemming from interactions with people and their stories are the primary artistic materials I use. In the wake of my experiences with GlasOcean, I find the idea of certain processes more compelling than the final product.

"If art is the search for perfect order, surely man would have found it by this time, or would have given up the searching job."

– Morse Peckham
Man's Rage for Chaos: Biology, Behavior, and the Arts[10]

The Visual and Invisible Spectrum: An Interdisciplinary Journal of Art and Science Research

"This is the dance of anthropocentrism: transparency does not equate to understanding; seeing does not mean knowing or dominating." – James Bridle[11]

During my program, I've grappled with maintaining an organic appearance in my work. As I interpret data, I question whether I'm simply adding to the stories or contributing meaningfully. I've felt a split between the scientific and artistic aspects of my work. While transforming data into visuals and audio, I've noticed a clear division between the artistic and scientific components.

Initially, I focused intensively on preserving the integrity of the data I had received, not altering a single number, volume, or word during the transformation into visuals and sound. However, the system in use is based on a finite procedure and framework, meaning the structures I work with lack a certain artistic fluidity and fluency, a sense of how phenomena *feel.*

For a while, I thought my project would be to tell the story behind scientific research through data. But later I figured out that what transforms a dataset isn't the story behind it or the takeaway, but the framework itself. Working with specific datasets, I only have access to a partial story that is dedicated to isolating one piece of the puzzle from the whole picture or story. We use a scientific approach to understand the world, but each data set is only a small portion of the supporting material. The data set alone lacks the complexity and contradictoriness of phenomenological experience, which is the rich soil in which art or literature happens. This is why telling the story of some of the many things I learned from trying to record data from a boat is so important to me, From this expanded experiential and interactive view, the data we collected are just one tiny thing, and not at all about how hard it can be to get onto the water,

[10] Morse Peckham. *Man's Rage for Chaos: Biology, Behavior, and the Arts*. Maisonneuve Press, 2004.
[11] James Bridle. *Ways of Being: Animals, Plants, Machines: The Search for a Planetary Intelligence*. Penguin Books, 2023.

and consequently, how little we know about this oceanic mass that makes up so much of our planet.

Art and science both ask questions and expand our understanding of the known universe. However, science is dedicated to proceeding by way of asking exact questions and looking for reproducible answers through defined procedures. Art, on the other hand, is a way of formalizing intangible connections and drawing the subconscious or the “un- or not fully known” into material presence. Art doesn't seek necessary and sufficient conditions but expresses human-emotional-intellectual worlds about the environment. As my practice has unfolded throughout this degree, I have realized that I am not drawn so much to finite approximations, but to possibilities. Put another way, my greatest interest lies not in numbers or “data,” but in framing experiences based on data for people to have and develop conversations.

Question.
What if your thesis work really focuses on ice and water; on holding the one and being on or in the other; on the hand (where is your hand now?), and the engagement of experience? Can you perceive climate change? If you cannot "really" perceive it in the world in the day-to-day, what kinds of experiences can the gallery offer? Can it "package" these experiences the way narrative tells us what and how other generations thought and felt and feel? The gallery picks up a tiny thing, as does a thesis, and holds it to the light so that you can see it, touch it, feel it. This experience may not be about "waves" at all as such, and yet it happens because and when we notice how waves touch us, pass through us, make use of us to tell stories that seem as if they are at some distance from us.[12]

III. Glacier

In which I get some ice from an iceberg, which is to say a glacier

Another important thing somewhere between science and art happened after the summer of 2023. I was given a hunk of glacial ice.
Each summer in the Arctic, glacial ice melts and breaks away or “calves”, forming icebergs that drift from Greenland into bays in Newfoundland. At the start of the summer, I presented some of my data visualization work at the CaNOE (Canadian Network for Ocean Education) conference, where I connected with Patrick Wells from Memorial University. He conducted a workshop on iceberg ice's capacity to preserve carbon dioxide in the atmosphere. In the fall, through several connections, I obtained leftover iceberg ice from their summer field trip collection.

[12] Karin Cope in a conversation with me about my thesis work. February 2024.

Sounds of glaciers

> As glacial ice melts, pressurized ancient air bubbles are released into the surrounding water, generating noise levels surpassing even those found in tumultuous seas battered by 6-meter waves. This noise persists throughout the year and reaches peak intensity at frequencies ranging from 1 to 3 kilohertz, akin to the pitch range of a piano's uppermost octaves.[13]

I became fascinated by the possibilities of making something with the sounds that glaciers make as they melt and break apart. This sound is not referred to or assigned to a data set, as with my previous work, but is direct, an experiential, phenomenological property of the material itself. When glaciers melt, the centuries-old pressurized air trapped within the ice is released, creating sizzling sounds, and echoes from a world long ago. As I thought about the possibilities of this phenomenon, I also began to wonder, when the ice melts, and a glacier disappears, what is left for us to hear? Does the past also disappear then? I am far from being the only artist to wonder this, and works by artists as diverse as Roni Horn (Library of Water), Katie Patterson (Langjökull, Snæfellsjökull, Solheimajökull), and Andri Snaer Magnason, (“A Letter to the Future”), suggest that the question of glacial memory and glacial loss is a problem that presses upon many of us right now.

When We See and When You Hear, 2023

[13] Glowacki, Oskar, and Grant B. Deane. “Quantifying Iceberg Calving Fluxes with Underwater Noise.” *The Cryosphere*, vol. 14, no. 3, Mar. 2020, pp. 1025–42. *DOI.org (Crossref)*, https://doi.org/10.5194/tc-14-1025-2020.

What became the video projection, When We See and When You Hear, began when I aimed to capture the sizzling sound of glaciers melting but ended up realizing that the visuals of human hands melting glacial ice were also compelling. In this work, the behind-the-scenes became the seen.
In nature, the pressures of the ocean are large enough to squeeze noises from the ice. But in a synthetic studio setting, human hands become the high-pressure agent, and ice melt results from our actions.

The sounds of water, the ocean, and waves.

The sound of a glacier melting isn't something we typically hear, but when we do, it's different from what we might expect. In what should be one of the world's scariest phenomena for humans due to global warming and the resulting rise in sea levels, the sizzling sound of glacier ice melting possesses a popping, crisp, yet lingering quality. It sounds oddly enjoyable, almost like ASMR.

Glacial ice with its millions of years of history, is crucial to planetary well-being around the globe. For example, glaciers store and release fresh water in dry seasons for more than 2 billion people and many millions of species in Central Asia and the subcontinent. Relationships between ice movements and life forms at high latitudes and altitudes inform every aspect of life on planet Earth. Shouldn't we be listening more carefully to what the ice has to say and teach? As US NOAA (National Oceanic and Atmospheric Administration) communicators explain: "Originally, scientists began studying glaciers only for the clues they offered about Earth's climate during past ice ages and the role they played in shaping the landscape. Today, they are also trying to understand how quickly human-caused climate change will cause them to disappear. " [14]
Geophysical researchers, Erin Christine Pettit and collaborators explain the problem even more fully:

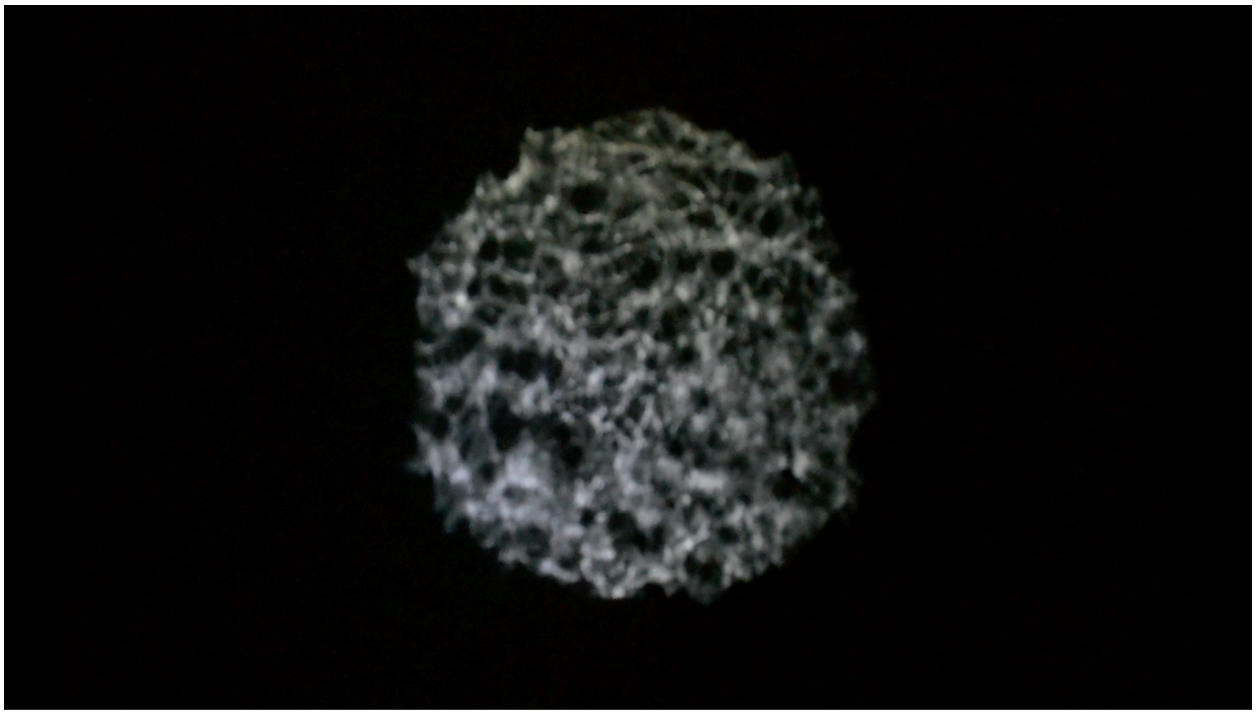
> Marine noise pollution, and ocean noise in general, has received much attention from scientists. Human activity in the ocean is ever increasing and the trend is not likely one to stop. But despite all of this interest, there is a lot about ocean noise that still needs to be learned. For instance, we are only beginning to characterize what "normal" background noises in the ocean are…Fjords that still contain glaciers (or glacierized fjords) are extremely dynamic and active – anyone who's

[14] *Climate Change: Mountain Glaciers | NOAA Climate.Gov*. http://www.climate.gov/news-features/understanding-climate/climate-change-mountain-glaciers. Accessed 3 Dec. 2023.

> ever seen a calving glacier can attest to the sheer loudness that's typical of a glacierized fjord.
>
> …With climate change on everyone's minds, it's even more imperative that scientists study these regions as they are quickly disappearing with rising temperatures. [15]

As a musician or sound artist, Pauline Oliveros urges us to listen to the sound disappearing. When does the memory begin? [16]
Does it begin to end when the sound that provokes it also ends?

Quiet Listening: How Can We See Glacial Melt?



The projection on the wall depicts, at a certain level of abstraction, iceberg ice melting, recorded using a Schlieren Schematic photographic technique

[15] Pettit, Erin Christine, et al. "Unusually Loud Ambient Noise in Tidewater Glacier Fjords: A Signal of Ice Melt." *Geophysical Research Letters*, vol. 42, no. 7, Apr. 2015, pp. 2309–16. *DOI.org (Crossref)*, https://doi.org/10.1002/2014GL062950.

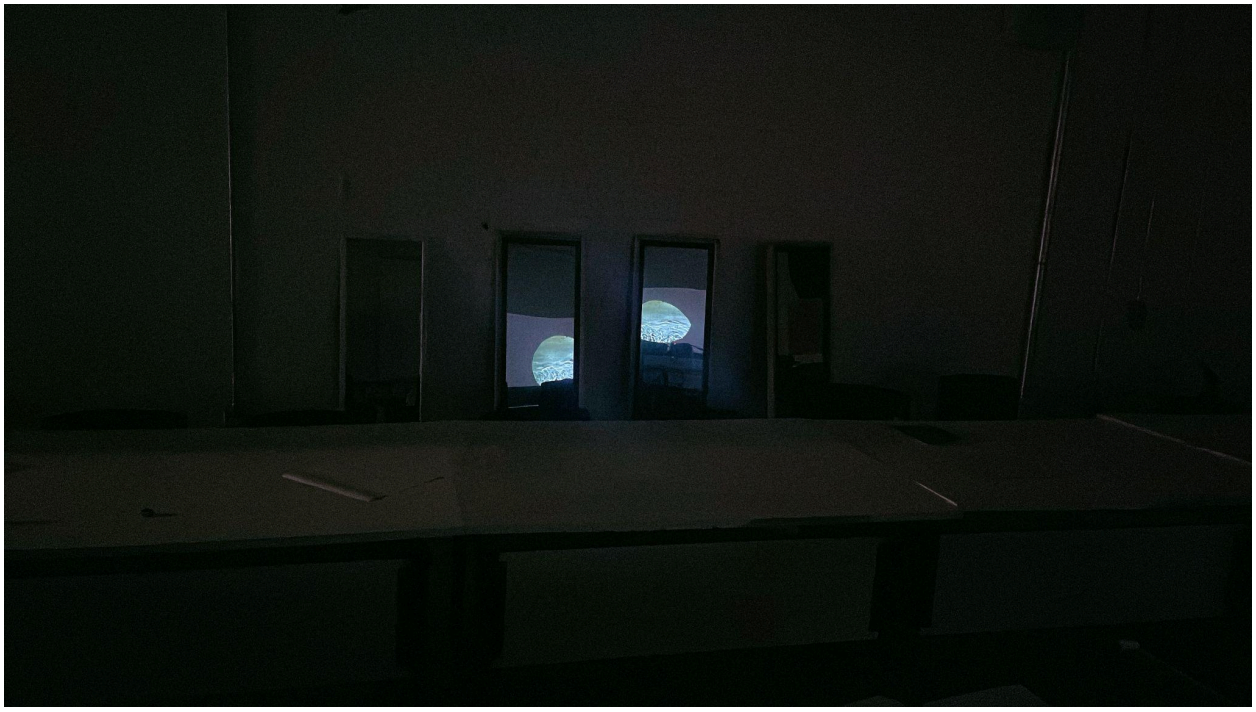
[16] Pauline Oliveros. Quantum Listening, Ignota Books, London, 2022.

When the glacial melting occurs before our eyes, it's already in the past.

In traditional Eastern Asian painting, the significance of negative space rivals that of the ink works. Similarly, in music, empty beats are acknowledged as beats, carrying equal importance to the musical notes.

I wondered if I could use the art gallery as a space to think about the environment in a much smaller but direct, rather than data-mediated way. Or as Donna Haraway says about the force of art to stimulate our thinking, it is

“Not [as] any kind of utopia, but to offer an alternative space to step out of our pre-perceived system, to destabilize what we normally hold still. It matters to destabilize worlds of thinking with worlds of thinking.” [17]

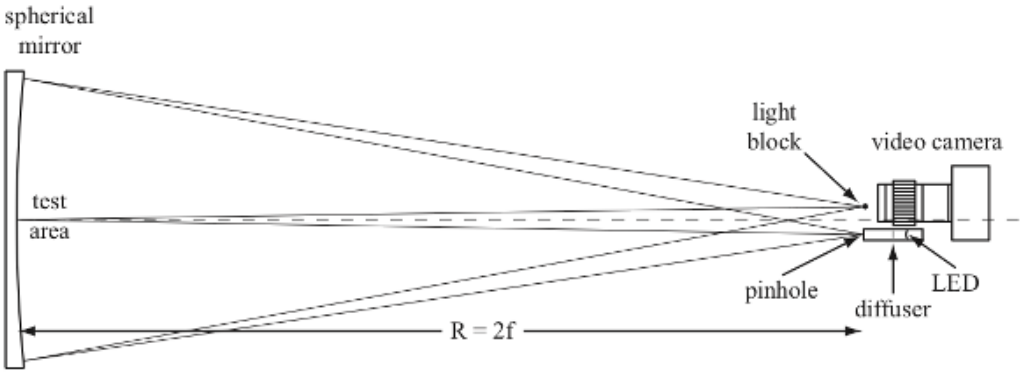


The mirrors test set up in the Port campus

[17]Donna Haraway. “Donna Haraway, ‘Anthropocene, Capitalocene, Chthulucene: Staying with the Trouble’, Anthropocene: Arts of Living on a Damage.” Edited by Studio Olafur Eliasson, *Vimeo*, 21 Feb. 2024, vimeo.com/200992946.

Schlieren Schematic

After working with numerous datasets and attempting to transform them into sound and images, I decided to aim for a direct visual presentation of the ice. This led me to something called the Schlieren Schematic. The Schlieren schematic effect emphasizes reality, amplifying rather than interpreting it, allowing people to see things that usually can't be seen.



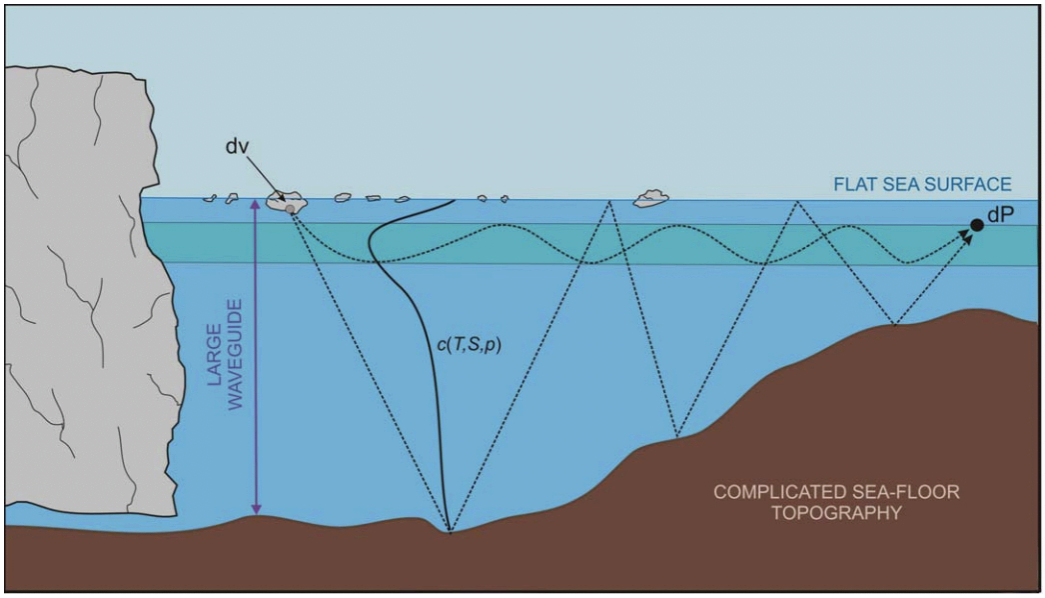
[18]

Reflection due to the lack of homogeneity in the air is visible through the Schlieren setup.

More specifically, Schlieren imaging is a technique used to visualize density variations in transparent media. It is based on the principle that light passing through a medium will be refracted if the refractive index of the medium changes. In a Schlieren setup, light is focused onto a knife-edge or similar obstruction, which blocks most of the light but allows a small amount to pass through.

If there are density variations in the medium (caused by, for example, changes in temperature or pressure, the refracted light will have slightly deviated from its original path. This deviation is typically very small but can be amplified using lenses and mirrors to create a visible pattern. This pattern is then captured by a camera and processed to create an image showing the density variations.

[18] *Schlieren Optics*. https://sciencedemonstrations.fas.harvard.edu/presentations/schlieren-optics. Accessed 15 Mar. 2024.



[19]

To gain the best understanding of iceberg melting, observing the deeper water is more effective than focusing solely on the surface. The setup of the Schlieren Schematic visually corresponds to how the noise of iceberg melting reflects in the ocean and seafloor.

What we witness when we look at the world and its phenomena is not always a whole or current reality, but a broken-up, refracted reflection of what has occurred. There's no way to reverse it, and sometimes it contradicts our expectations or desires.

What unfolds after an event like irreversible melting has already transpired?

Can hot activism–the activism of emergencies and catastrophe, activism that requires quick responses also be cool or cold activism, activism that isn't all about speed, but can look at and respond to processes that unfold over long periods of time? What could we call an activism that calls us to attend to and to see slow but massive processes? Is that slow activism, "cool" activism?[20]

Global sea level is rising due to human-induced global warming, recent rates are unprecedented for over two centuries. The evolution of glaciers and the production of icebergs by melting ice directly influence this parameter.[21]

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[19] Oskar Glowacki, et al. "The impact of glacier meltwater on the underwater noise field in a Glacial Bay." Journal of Geophysical Research: Oceans, vol. 121, no. 12, Dec. 2016, pp. 8455–8470, https://doi.org/10.1002/2016jc012355.

[20] Questions posed by Karin Cope, during my time as a Teaching Assistant in her class, AHIS 3011 Art and Activism

[21] Laurie Henry. "The Underwater Sounds of Glaciers, Valuable Clues for Estimating Sea Level Rise." *Connected Ocean*, 5 Mar. 2023, oceansconnectes.org/en/the-underwater-sounds-of-glaciers-valuable-clues-for-estimating-sea-level-rise/.

Sarah Sze talked about the fragility of our pursuit of artists trying to understand this universe. We build things to occupy a room, a space. But eventually, we "want to occupy the memory."[22] But can we? Will we be able to do that?

Quiet Listening: How Can We See Glacial Melt? – The Installation View

Quiet Listening: What do we hear after glaciers melt?
Installation View
Anna Leonowens Gallery, 2024

[22] Sarah Sze. "How We Experience Time and Memory through Art." *Sarah Sze: How We Experience Time and Memory through Art | TED Talk*, www.ted.com/talks/sarah_sze_how_we_experience_time_and_memory_through_art. Accessed 12 Feb. 2024.

The video projected on the wall depicts imagery filmed in the reflection of a telescope mirror as a piece of glacier ice melted in water, using Schlieren effect refractions. This choice of imagery led me to contemplate Schlieren imaging, as well as reflection and refraction. This was a departure from my previous work, where I interfered with the visual representation of various phenomena and occurrences in digital works. Schlieren imaging is more direct in some ways: it is used to visualize optical inhomogeneities in transparent media that are not readily visible to the human eye, but it doesn't really alter those wave formations or convert them into other forms. Thus unlike my past works that imported data to generate imagery through algorithms, using reflection and refraction to develop this work involved highlighting something already present in what we perceive and amplifying it visually.

The circular projection raised a question: was it portraying a microscopic or macroscopic entity? The audience interpreted the circular shape of the telescope mirror in the exhibition as alternately a microscope or a globe. Additionally, viewers provided feedback that the melting ice in the water resembled clouds, fog, and water in motion; these interpretations came close to my hope for more organic, natural-looking, holistic phenomena in this show.

From the perspective of ice, it can be seen as a lively entity participating in the hydrological cycle. My glacial ice may have formed prior to human existence; the atoms in that body continue to circulate, even as they become water, although we can no longer see or experience or perhaps even remember the ice. A melting glacier, any melting glacier of the nearly 200,000 still extant on earth, represents a macroscopic perspective, offering a sense of a time span that stretches beyond human memory. The microscopic perspective is what we see in the gallery, from a video recording of a piece of glacier ice, a tiny speck of a global event; when the recording is over, the ice has already melted.

There is the paradox of isolating focus in the white box gallery on a certain "real" phenomenon and contemplating its significance. The enlarged visual representation of this tiny bit of melting ice provides a controlled depiction of glacial melt, including icebergs melting in the ocean. Attending to this phenomenon should take the central place in the gallery; it can be enlarged, yet such a visual can never surpass the reality of the turbulence caused by the melting of the world's ice sheets and glaciers. What we see in the art gallery is just a tiny part of this phenomenological process which remains, everywhere, almost completely invisible and imperceptible to our senses.

The sound in the installation was derived from a soundtrack produced when several artist-participants–fellow MFA students past and present–contributed to making a small bit of glacial ice melt with the warmth of their hands, alongside with recordings of me alone also melting ice by holding it in my hands. The edited sound included the cracking of ice, the sound of melted water dripping, and the breathing and panting of all of us as we squeezed the ice. A human presence is implied in the sound, as it is in the staggered mirrors in the gallery. If we look at ourselves, we see ourselves in the frame with the melting ice, but we have a very hard time concentrating on both.

This is because the human brain tends to focus on immediate sensory input. Despite my research focusing on environmental issues, I recognize that I cannot constantly think about them. Human cognitive limitations mean that we only attend to environmental issues periodically, no matter how significant or catastrophic they may be.

Nevertheless, the melting of ice is a global reality and incipient catastrophe; the projected imagery in the installation thus serves as a moment of attention to this process. The sound also serves as a residue of something that has already occurred, allowing for a simultaneous perception and discussion of both an ongoing process as well as what has already transpired. The mirrors sketch an opportunity to contemplate the present moment and our human presence in the global context of glacier ice melting. As audience members walk by the mirrors, they can see staggered parts of their own reflections along with portions of the recorded image. The refractions and interplay of reflections in the space shift as viewers move through it.

Viewers are invited to see themselves in the exhibition, although they may only be partially visible at times as they move about. We are part of the continuous flow of information, phenomena, and matter even as our shifting attention is itself part of the noise that can obscure our ability to fully comprehend and address glacial melt.

I want to ask then: the thoughts we generate, the sounds we hear, and the images we see, how long will they last?

When the ice disappears, will we too fall silent, unremembered matter?

Waves in the future:

As I have worked towards my thesis show and paper, I've come to realize that some of my studio practice might be shifting from a focus on research and digital production to the exploration of sculptural components and visual storytelling within gallery spaces. I still have much to learn about how to do this, but I see clearly that learning more fully to create experiences in three-dimensional spaces will be crucial for my future art practices.

I've struggled to connect the research story sketched in this paper to narratives more typically encountered within gallery spaces. During my work process for "Quiet Listening," Katie Paterson's piece "Vatnajokull (the sound of)"[23](2007–08) has been on my mind. This work explores underwater sounds produced by the melting of Iceland's largest glacier and unfolded in a gallery space where viewers could connect with the glacier by calling a number. Only one person at a time could listen to the glacier's underwater movements, creating a profound but very fleeting and isolated connection across vast geological distances.

Paterson's work, along with installations by Roni Horn (Library of Water) and sound pieces by Jana Winderen sketch the direction I want to take in my art practice. This sort of work requires the difficult labour of obtaining raw experience and sometimes materials, of working with other researchers and obtaining all sorts of permissions to get on the land or the water, of figuring out complicated "live" projects such as placing a hydrophone in the Icelandic ocean, or gathering a hundred and seventy fossils as seen in Paterson's "Fossil Necklace" (2013).

Another question I've asked myself is about my aesthetic sense, which, as I suggested earlier in this paper, I've long associated with the concept of waves and flow, a notion present since the early days of painting. This aesthetic emerges from the rhymes of poetry and literature, spaces both written and unwritten, the notes of music played and yet to be played, and the movements of water and melting ice. It can also manifest in performative art through body or object movements. Such notions of "wave action" have consistently informed my work. In both the present and the future, I aim for my work in media art about the ocean to push such questions and boundaries further. What is the significance of this aesthetic of wave or flow, and how can it be more fully integrated

[23] Hana Nikčević. *Performing Ecological Loss in Contemporary Art*, Department of Art History and Communication Studies McGill University, Mar. 2021, katiepaterson.org/wp-content/uploads/2022/03/5329a829-036f-4b1c-b370-e51edb6bb60f.pdf.

with time-based arts like storytelling? Can the flow of image, word, and ocean be more closely intertwined, capturing or propagating flows that run through them all?

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