Arctic Ice: A Visual Archive

A unique collaboration among
Cy Keener, Justine Holzman,
Ignatius Rigor, and John Woods

September 15, 2022 – February 15, 2023
NAS Building, Upstairs Gallery
2101 Constitution Ave., N.W.
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Introduction

Integrating field data, remote satellite imagery, scientific analysis, and multimedia visual representation to document Arctic ice that is disappearing due to climate change, this artwork is the outcome of a four-year collaboration involving art, design, and polar science between artist Cy Keener, landscape researcher Justine Holzman, climatologist Ignatius Rigor, and scientist John Woods. With this work, Keener and Holzman’s goal is to make scientific data tangible, visceral, and experiential. They ask how artistic and creative practices can contribute to scientific endeavors while making scientific research visible to the public.

What is unique about this art based on scientific data is that Keener and Holzman were involved in the design and construction of the tools that collected the data as well as their placement in the environment. According to Ignatius Rigor, “the data-collecting instruments are themselves hybrids of art and exquisite engineering.” Rigor is a polar scientist at the University of Washington who has long worked with John Woods, a country director at the Office of Naval Research. Together, they manage the International Arctic Buoy Programme, which is responsible for coordinating the deployment of weather and climate instruments on the Arctic Ocean to maintain a 45-year-record of Arctic climate data.

In 2018, Keener reached out to Woods, who brought Rigor into the conversation, to discuss their mutual need for drifting buoys. The two scientists required the buoys for scientific research, but Keener wanted to gather source material for an artistic investigation. Over a six-month period in 2019, the artists worked with the scientists to develop a Light and Ice Mass Balance buoy that could take measurements in floating sea ice along a string of sensors. Light and easy to deploy—befitting the extreme conditions—the buoy gathers data on sunlight, air pressure, and temperature as well as depth, which are used to estimate the growth and melt of sea ice, called ice mass balance. Rigor admired the buoy: “The hull that protected the electronics of the LIMB buoy was so exquisite, I thought it was a crime to leave this instrument on the remote confines of sea ice to never be seen again.”

Being deeply embedded in each other’s processes created a logic loop that fostered new ideas and unexpected outcomes. Rigor put it this way: “Keener and Holzman’s work uses science to inform their art, which in turn informs science, creating more questions and a cycle where engineering, art, and science interact to expand our knowledge.” This blending creates alternative perspectives on the collection and representation of environmental data that help viewers to better understand the physical, experiential, and technical landscapes of climate science.

The installation photo on the cover is by Kevin Allen. The photo above depicts the flight deck of the HDMS Ejnar Mikkelsen traveling near an iceberg in Western Greenland. Custom drone deployed iceberg tracking device in the foreground.
Collaborators
Supported by the International Arctic Buoy Programme (IABP) and funded by the National Science Foundation and the Office of Naval Research, Cy Keener and Justine Holzman have designed custom instruments, deployed them in the Arctic, and collected the data represented in this catalog. Ignatius Rigor is a polar scientist at the University of Washington and John Woods is the Country Director at the Office of Naval Research. Together, they manage the IABP, an organization responsible for coordinating the deployment of weather and climate instruments on the Arctic Ocean and maintaining a 30-year record of Arctic climate data. Additional collaborators have also been integral to the project: Ben Cohen (Applied Physics Lab at the University of Washington) generated visuals from satellite imagery; Dave Eldenburg wrote and maintained the code that ran the custom sensors; and Lovro Valcic (Bruncin) developed the custom light and temperature sensing hardware used in the sea ice drawings. Keener’s role in bringing these collaborators together and as an embedded artist contributes to the production of scientific research and its communication to broader publics.

Cy Keener
Cy Keener is an interdisciplinary artist focused on recording and representing the natural world. He is an assistant professor of sculpture and emerging technology at the University of Maryland. Since 2018 he has collaborated with scientists to document sea ice, icebergs, and glaciers in the Arctic with funding from multiple institutions including the National Science Foundation. His work includes a range of data-based efforts to visualize diverse phenomena including sea ice, wind, rain, and ocean waves.

Justine Holzman
Justine Holzman is a landscape researcher, designer, and educator with a background in landscape architecture. Holzman is currently training as an historian of science at Princeton University where her doctoral work focuses on how knowledge is produced about environments and how landscapes are designed and transformed for scientific research. Working at the intersection of art, design, and science, Holzman’s interdisciplinary scholarship and creative works have contributed to conversations surrounding climate adaptation, green infrastructure, and environmental monitoring.

Ignatius Rigor
Ignatius Rigor is a climatologist at the Polar Science Center, Applied Physics Laboratory, and an affiliate assistant professor in the School of Oceanography at the University of Washington in Seattle. Rigor studies Arctic and Antarctic sea ice, which is one of the primary indicators of global climate change. The ice waxes and wanes driven by variations in sunlight and temperature. Changes in wind and ocean currents also play an important role by redistributing the ice across the Polar Oceans creating areas of open water, and by compressing this ice into ridges. Making sense of the complex interplay between the air, ocean and sea ice is a challenging puzzle that motivates Rigor’s research.

John Woods
John Woods is the Deputy Director for the U.S. Navy’s International Engagement Office, responsible for bilateral and multilateral cooperation with Allies and Partners. Woods served for over 12 years on active duty first as a Surface Warfare Officer aboard USS Cleveland (LPD-7) and then as a Meteorology and Oceanography (METOC) Officer. His METOC tours included the Naval Postgraduate School, the U.S. National/Naval Ice Center and the U.S. Naval Academy Oceanography Department as a military instructor. While at the U.S. Naval Academy he was responsible for the creation of the Polar Science Program, supported by the Office of Naval Research. In his civilian career, Woods supported NASA’s Earth Science Division, as the project manager for Operation IceBridge, a global airborne science mission deploying to both North and South Polar regions. He has also served as a physical scientist for the National Oceanic and Atmospheric Administration assigned as the Snow and Ice Product Area Lead at the U.S. National Ice Center.
Cy Keener and Justine Holzman: An Interplay of Art and Science
By Ignatius Rigor

By capturing mundane measurements in the environment, Cy Keener and Justine Holzman create art that draws in scientists and lay people alike, while also inspiring the exploration of new scientific questions.

In 2015, Keener’s “Remote Winds” exhibit started in a field of handmade wind sensors at Jasper Ridge Biological Preserve, Woodside, California. Four miles away, in a gallery at Stanford University, viewers could see the data, manifested as a wall covered with the lights, and watch the way wind coheres over large spatial scales.

In Keener’s art, the data collecting instruments are themselves hybrids of art and exquisite engineering. The elegant glass buoy, “Agulhas Drifter,” took observations as it floated in the Indian Ocean. Keener then displayed the data in a South African gallery using a vertical column of light to reproduce the dance of the waves on the ocean’s surface. Sometime in 2018, Keener reached out to my colleague John Woods about our work managing science experiments in the Arctic. It was a fated meeting, because we all needed drifting buoys—John and I for our research, and Keener and Holzman for their art. Over a six month period in 2019, the artists developed a Light and Ice Mass Balance (LIMB) buoy that takes measurements in floating sea ice along a string of sensors. It’s light and easy to deploy—befitting the extreme conditions—and it gathers data on sunlight, air pressure, and temperature as well as depth, which are used to estimate the growth and melt of sea ice. The hull that protected the electronics of the LIMB buoy was so exquisite, I thought it was a crime to leave this instrument on the remote confines of sea ice to never be seen again. Data from this became part of the “Digital Ice Core” exhibit.

Our most recent collaboration, the Iceberg Portraiture series, grew out of an international effort to study icebergs, which are proliferating because global warming is melting the Greenland Ice Sheet. Icebergs are an entirely different beast than the sea ice we usually work with. Sea ice is 2-3 meters thick and it is driven along mostly by winds. In contrast icebergs can be 100 meters tall and hundreds of meters across, and they drift slowly with ocean currents. What’s more, icebergs have their own microclimates where the winds are deflected over the iceberg creating vortices and clouds as the air flows over them. As the icebergs melt, their center of balance changes and they roll to reveal yet another very different face that was hidden below the water line. Tracking these complicated forms presents many engineering challenges, but working with Keener and Holzman, we figured out how to outfit each buoy with spikes so it would stick to the iceberg, and designed trackers that would sink when the big ice rolls. Using drones, controlled from a ship, the trackers were dropped on icebergs in the spring of 2021.
This process yielded new ways to understand the behavior of icebergs. Earlier studies of iceberg drift relied on basic measurements of width and height, and a rough description of shape. But Keener and Holzman used photos and videos to create accurate 3-D models of the shape, volume, and mass of individual icebergs, which allowed scientists to study how they interact with wind and ocean currents. At the same time, Keener and Holzman’s models captured the intricate color patterns of the icebergs, reminding us that they are much more than data.

This work has enabled scientists to improve predictions about the way icebergs drift, which could help make ships safer as they navigate around ice-infested waters. But already new questions have developed. For example, how did the local temperature of the air and ocean contribute to the melt of each iceberg? How can we get a better picture of the icebergs below the water line to produce more complete 3D models of the icebergs? Keener and Holzman’s work uses science to inform their art, which in turn informs science, creating more questions and a cycle where engineering, art, and science interact to expand our knowledge and capture the beauty of the world around us.

Beyond the broad histories that shaped these works, are there specific stories, specific meanings I should find? Perhaps lessons about how traditional practices and values can help people navigate the modern world, even heal it?
The Iceberg Portraiture series shows how icebergs undergo constant change as they journey from glacier to fjord to coastal islands to the ocean beyond. The icebergs recorded have vastly different scales and shapes—some the size of a car and others a third of a mile wide. The series combines a range of digital capture and scale drawing techniques to provide a glimpse into the life of four icebergs observed and recorded in August of 2021 in western Greenland. The background of the drawing is a synthetic aperture radar composite of Disko Bay, where the icebergs were documented and tagged with GPS trackers. The path of each iceberg—from initial tag to final transmit—is geospatially referenced on the map, where their locations can be seen mingling with the flows and swirls of other icebergs in the bay. Scaled outlines drawn from satellite imagery are arranged on the lower left edge, showing an approximated shape of the iceberg above and below (dashed lines) the water as it changes over time.
Art Historian Aneta Georgievska-Shine Interviews Cy Keener and Justine Holzman

The following transcript is derived from an interview art historian Aneta Georgievska-Shine conducted with artist Cy Keener and landscape researcher Justine Holzman in September 2022.

Georgievska-Shine: Let’s begin with one of the most basic and essential questions related to this exhibition. How did this collaboration between the two of you come about?

Keener: Justine and I met while working on a year-long design competition addressing sea level rise in the San Francisco Bay Area. Part of our contribution to our team’s design was an environmental monitoring strategy using fluvial sensors to understand the existing river and estuary landscape. We both came from a design background and had experience with environmental sensing. We both had formative experiences at UC Berkeley’s College of Environmental Design, and we were separately artists in residence at Autodesk (a software company) working on innovative sensor designs.

Holzman: We were easily able to collaborate through shared language and skills in design and fabrication, while complementing each other with different disciplinary perspectives. Cy developed incredible technical skills in fabrication and electronics during his time as a builder, architect, and then artist at Stanford. My academic and design work in landscape architecture focused on interdisciplinary collaboration with scientists and engineers, with specific interests in how artists and designers were using environmental sensors and emerging technologies. I have always been curious about how knowledge, especially scientific knowledge, is produced about environments, which is what led me to begin my current studies in the history of science at Princeton.

Georgievska-Shine: Cy, you have worked at the intersection of art and science for many years. Some of your projects have involved kinetic sculptures that monitor, record, and represent atmospheric phenomena. “Arctic Ice: A Visual Archive” is a continuation of this long-standing investigation of the ways in which one can give visual form to complex environmental processes. At the same time, I feel that there is something different happening this time around. Can you speak a bit about that “difference”?

Keener: Yes, one of the exciting things about collaboration is the opportunity to evolve. The work Justine and I have put together here feels quite different from the work I do on my own. Much of my previous work was trying to create situations in which people could experience an aspect of nature in a gallery. In one case that meant using actual ice and sunlight. In other cases, I used live data transmitted from remote locations. Over the past three years I have had the privilege of making trips to the Arctic with John Woods and Ignatius Rigor. This collaboration with Justine is an effort to distill and preserve moments from those experiences, an archive of sorts, to use data to communicate fleeting events and to visually represent the transitory nature of the landscape.

Georgievska-Shine: I am struck by your emphasis on “experience” because it involves both your own reflections on what you witnessed during your journeys and the experience arising from the collaboration, one that is, by necessity, inflected by multiple perspectives and approaches. Were there moments in which you found yourself thinking very differently from the other participants about the meaning of the process you were observing and recording, and how it was going to be visualized? Or how this “archive” was to be presented to others? (Interview continues)
Arctic Ice: A Visual Archive

Iceberg Portraiture
2022
aluminum, ink, and wax pastel
84 x 42 inches
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Iceberg Portraiture
2022
aluminum, ink, and wax pastel
84 x 42 inches
Keener: Experience is so individual. For me, the most powerful part of going to the Arctic has been these moments where I am visually experiencing immense swaths of glacial or sea ice that exist on a scale I normally associate with geology, like mountains or rivers, but then my brain interrupts to remind me that this landscape is temporary on the order of weeks to months, as opposed to millennia. As an artist, I try to translate some of what I experience through installation, drawing, and sculpture. These tools can't provide the immediacy of the experience, but the exciting thing about data is that it can extend the experience through time and tell a longer story. I get to see the ice once, and I leave the sensor behind. Through the data it transmits we can build a story through time that can be powerful. I don't know what kind of experience John and Ignatius have with the same landscape when we are there. I do know that Ignatius interprets what happens out there through the data we gather. He is a detective who can read wind and currents in the buoy data over time.

Holzman: Our experience working with the dataset for our first iteration of the “Sea Ice Daily Drawings,” informed our current version. This was initially a time-based installation; we printed and hung the drawings in the gallery as we received the data. It was our first year of data, and before we made the piece, we both thought we would end up with a graph-like depiction of melting ice over time. Instead, the changes in the ice were much more complex, and our experience of working with the data challenged our assumptions and instead became more of a window onto the larger landscape. For the NAS works, which were created in advance, we kept the 1:1 scale relationship between the sea ice and the drawing. Among a few other changes, we added archival paper behind the strips, so that as you get closer and walk around them, data about the location (longitude and latitude) of the buoy, overall sea ice extent in the Arctic, and carbon in the atmosphere collected on corresponding days comes into view. These layers were meant to emphasize that each strip is just one point of data in a much larger repository and narrative about climate change.

Georgievsk-Shine: Justine, I am fascinated by the “Iceberg Portraiture Series.” There is something so paradoxical about tagging an iceberg that has detached itself from a larger mass and is moving away, melting along until it eventually dissolves into the ocean. Together with Cy, you develop this body of drawings based on the photogrammetry collected. Though they begin from seemingly objective records, they can be quite mystifying. On the one hand, they make us aware of the inherent complexity of visualizing scientific data. On the other hand, we are drawn to their aesthetic properties: the play of delicate colors and lines, the layering of shapes on top of one another, and the artful sense of abstraction.

Holzman: As noted earlier, the “Sea Ice Daily Drawings” are a second iteration, whereas the iceberg portraits are new work. Both deal with the ephemerality of the material and of ice, but work with really different datasets. The bulk of the drawings are produced using 3D digital photogrammetry models of individual icebergs that were tagged with GPS sensors. Each digital model is made up of hundreds of images of the iceberg taken from different angles, some from the ship and some from a drone. They are heavy datasets, composed of an extraordinary number of points. We wanted to expose the technologies of data capture and organization, and make clear that these are incomplete representations. The photogrammetry only provides a momentary glimpse into the life of this ice, we can't see below the water, and in areas the model has holes and glitches where the edges of ice become confused with water and air. We decided to use hand drawing to fill in holes, and speculate on what lies below the waterline. The hand drawing is purposefully vague and is intended to hint towards the necessarily approximate and imaginative efforts required to think through the dynamics of these ever-changing landscapes of ice.

(Interview continues)
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Iceberg Portraiture
2022
aluminum, ink, and wax pastel
84 x 42 inches
Georgievska-Shine: Cy, in our conversations, you have often mentioned other artists who have influenced your own thinking about art, or whom you have been especially interested in at some point of your development. Robert Irwin and James Turrell, for instance, two of the key figures associated with the Light and Space movement of the sixties and the seventies. As I contemplate this installation at the NAS, I am also reminded of these artists' ambiguous environments that emphasize the experience of perception, rather than of an object per se. What is it about their practices that you see as being especially important to your own? Is it their interest in the dissolution of boundaries between sculpture and architecture, the object and the environment, the matter and the void? How important is their minimalist aesthetic?

Keener: Yes, in my formal architectural training I was most excited by experiential and abstract installation spaces like those by Irwin and Turrell. The “Sea Ice Daily Drawings” retain some of this aspiration and sensibility. They are a color field and work with light and shadow. The departure from the Light and Space-inspired work is that we didn’t pick the colors for effect — each strip documents the color in the ice and ocean around noon. So, we are working with a similar language but using it to give voice to moments in the environment. The “Iceberg Portraiture” series is quite different. These reference the history of portraiture in art, but are architectural drawings on a technical level. They rely on conventions of scale, three dimensional digital models, and they express the essence of something that does not exist.

Georgievska-Shine: I am reminded of Robert Irwin’s emphasis on the infinite wonder of nature, and how “spectacular” our world truly is if we only pay attention. This is what those “Sea Ice Daily Drawings” allow us to do; they allow us to become more attentive. The myriad hues you have captured here take us back to those moments of your experience while also making us aware of how irretrievable that experience is. How important was it for you to convey this sense of loss?

Keener: I think that’s a nice parallel. There is this element of asking the viewer to be present with the drawings in the same way I was present with the place in the field. But strangely, the sensor data and drawings reveal much more than I get to see in the field. When we deploy the instruments, all I see is the top few inches of a two inch-wide hole that immediately gets filled with sea water. As for the idea of loss, I think it is a part of the work, but I hope the work can generate some kind of connection between the viewer and these recordings or documentation. That connection will have a different emotional or experiential tone for each of us.

Georgievska-Shine: As I look at the ways you have worked together on this project, I think of other artists who have addressed global warming with particular focus on the melting of the Arctic ice. One example that comes to mind is Olafur Eliasson’s project begun in 1999, The Glacier Series, which took the artist around Iceland to photograph various parts of the country’s icy landscape. Another is Roni Horn’s Water, Selected (2003-07), a permanent installation of water collected as ice from the glacial parts of that same country. How would you relate your own collaborative project to those, or other similar projects?

Keener: I am fond of the Eliasson and Horn works you mention because they are documenting actual glaciers as opposed to being generally inspired by glaciers or climate change. I think this is an important difference. The work Justine and I are presenting here is a bit different because we have had agency in how we collect the data, in the actual tools used to collect it, and we are working in what we see as a reciprocal way with scientists. This doesn’t necessarily make (Interview continues)
Iceberg Portraiture
2022
aluminum, ink, and wax pastel
84 x 42 inches
better art, but I think it is an exciting expansion of what artists can do.

Georgievska-Shine: Justine, in what ways is this collaboration changing how you think about your own work? Where do you see the line that separates or connects your practices? How do you see the relationship between the different components within this installation, both conceptually and formally?

Holzman: I’ve always been interested in the productive overlap between artistic and scientific practices, both historically and in our current moment. The space of the museum, the archive, and practices of collecting are all areas of art, science, and knowledge production that are constantly being reworked, rethought, and critiqued. To bring this largely digital data set into the realm of physical objects, we made a lot of choices about how to reference the landscape, how to reveal it as data, and how to keep it open for interpretation. These works are now things, things that must be cared for, and looked after. Hopefully, they allow for a different kind of reading outside of typical scientific spaces and publications.

Georgievska-Shine: I would not doubt that for a moment. By turning data sets into visually compelling objects, the two of you have created a space for reflection, both about the relationship between visual signs and their meanings, and about the ways in which these artifacts, or “things that must be cared for, and looked after” speak of the “things” in that larger world of continuous change, which we have, unfortunately, taken for granted for too long.
The Sea Ice Daily Drawings show subtle temperature and color variation throughout a vertical profile of air, sea ice, and ocean in the Arctic, creating an archive of sea ice change over time. Sea ice forms on the surface of the ocean during winter in the Arctic and Antarctic. These drawings represent sea ice that is about 5 to 6.5 feet thick, a measurement meaning that the ice has survived a prior summer and is considered multi-year ice. Before the 1980s, the surface of the Arctic Ocean was covered with this thick multi-year ice. Since then, ice surviving 3 to 5 years has all but disappeared. Multi-year ice of the kind documented here is predicted to disappear by the middle of the century. Behind the daily representations of sea ice cores, inscriptions mark additional data on archival paper. Written in ink from bottom to top: the latitude and longitude coordinates of the device; a line demarcating ocean from ice; the overall sea ice extent in the Arctic on the corresponding date according to satellite analysis performed by the National Ice Service; and measurements of carbon dioxide in the atmosphere.
Arctic Ice: A Visual Archive

Sea Ice Daily Drawings (detail)
2021
aluminum, acrylic, paper, and ink
95 x 16 inches each
Arctic Ice: A Visual Archive

Sea Ice Daily Drawings (detail)
2019
aluminum, acrylic, paper, and ink
95 x 16 inches each