

Remote Sensing the Arctic

An Exploration of Nonhuman Perspectives of the Territory

Carolyn Kirschner¹

Abstract

Remote sensing is the acquisition of information about a place or phenomenon without making physical contact, allowing for data collection in dangerous or inaccessible regions. In the middle of an ongoing geopolitical dispute over the Arctic Ocean, where data has become the currency of sovereignty, this technology is proving indispensable. Probes, sensors, and satellites are deployed in growing numbers, tasked with harvesting data and metadata from the seafloor in order to substantiate overlapping and conflicting territorial claims. They have become synthetic species of the polar ecosystems, a vast network of sensors that transmits glimpses of the fluid territory back to stable ground.

In this context, I explore questions of proximity, abstraction, and artificiality. How are ecologies constructed and experienced when they are mediated by machine senses? What is included and what is left out? What alternative, expanded versions of the landscape might emerge?

My research and visual work grapple with these questions by seeking out the gaps and glitches between the physical terrain and its digital alter egos—a slippery space I call the *algorithmic wilderness*. From this vantage point, I consider how sovereign agendas and capitalist enterprises currently distort the landscape, and I use environmental data extracted from the Arctic Ocean to experiment with alternative materialities and visual languages—foregrounding nonhuman senses and non-Western perspectives.

Keywords

Remote Sensing, Geopolitics, Arctic, Borders, Nonhuman

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Data War

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with it, allowing for data collection in remote and inaccessible areas across the globe. Satellites, probes, and sonar and radar systems transmit sights and senses from these edge lands, pulling distant terrains into contemporary political, economic, and ecological frameworks.

This is how parts of the Tibetan mountains, too steep to climb, have been digitally modeled; untapped mineral deposits have been located in the subsoils of Chile; the remaining biomass of Borneo's rainforests has been calculated; and hurricanes forming in the middle of the Atlantic are detected.

But these attempts to expand the human sphere of influence simultaneously create an expanding realm of nonhuman senses. With this ongoing research and design project, I consider these elusive worlds emerging in their wake as we increasingly rely on technologies to encounter distant landscapes. What does it mean to outsource the way we see and sense the planet?

In the Arctic, remote sensors are tasked with delineating sovereign borders as part of an ongoing territorial dispute. The scramble to claim the 1.1-million-square-mile area surrounding the North Pole—currently international waters—is fueled by the promises of global warming: access to troves of untapped resources below the seabed and control over new shipping routes through the thawing sea ice. Canada, Denmark, Norway, Russia, and the US are all vying for a slice of the Arctic Ocean (Durham University 2020). Under guidelines set out by the United Nations Convention on the Law of the Sea (UNCLOS), nations are to substantiate their overlapping territorial claims with an assortment of seismic, geologic and topographic data, in the hopes of proving that the portions of seabed in question are a natural continuation of their continental shelf and therefore “rightfully” theirs (United Nations 1982). What results from the situation is an unusual type of international conflict, in which authority is wielded not through the brutal use of military force, but through the possession of information. Data has become the currency of sovereignty.

As the Arctic remains one of the least accessible regions in the world—a stark landscape of water and ice, perpetually moving, melting, and reforming—the harsh conditions and absence of any fixed land to adhere to means that data collection is almost entirely outsourced to remote sensing technologies. Satellites monitor wildlife (Cilulko et al. 2012) and track icebergs (Smirnov et al. 2019), air guns blast seismic pulses to map undersea

topography (Gisiner 2016), probes equipped with biochemical sensors float in the drift ice (Argo 2016), weather balloons collect atmospheric data (Hall 2019), and hydrophones record underwater sounds (Ocean Conservation Research 2020). Even narwhals are being used as remote sensors, fitted with radio transmitters to collect data from beneath the ice sheets, in areas otherwise impossible for researchers to access (Brennan 2017).

Previously ongoing scientific pursuits in the Arctic have been amplified by the need for data in light of current geopolitical tensions, leaving national research institutes tasked with the pursuit of sovereign agendas. While media narratives praise this setup for promising a nonviolent dispute, instead outsourcing decision making to purportedly objective and reasonable scientific processes, the reality of remote sensing in the Arctic is far more complicated (Anderson and Dombey 2008).

More Data Does Not Equal More Reality

Fittingly, the majority of sensing instruments in use today emerged from military applications spanning the First World War and the Cold War (Cloud 2002). Although now deployed less conspicuously for techno-scientific exploration, they remain entwined in global conflict. Pixels may have shrunk and resolutions improved over time, allowing for increasingly *detailed* representations of global terrains, but to assume the imagery generated from remote sensors is now *equivalent* to the landscape would be a mistake.

Data and metadata harvested from complex ecologies and natural phenomena is inherently incomplete, only ever representing snapshots of a vastly more extensive system. Curtailed by computing power, the limited number and reach of remote sensors, and a limited understanding of polar ecosystems, a need arises for prioritization and decision making: to decide what is worth recording, and what should be left out. The whole of the source material is simply too large to capture. Single droplets of seawater, for example—each with a unique temperature and salinity, home to thousands of plankton and microbial species, interacting as currents, accumulating as waves, freezing as drift ice—are entangled in seemingly infinite micro and macro interdependencies.

By comparison, their digital alter egos, reconstructed from data, are strikingly stunted versions of the originals, encased as they are in neatly bounded models with strategically isolated inputs and outputs. Patchworks of information collected from the physical terrain rely on abstraction and interpolation between data points to fill the gaps. Raw data is funneled through a process of refinement—corrected, organized,

optimized, and averaged. At each step of the way, the digitally fabricated terrain is removed further from its physical counterpart, stripped of cumbersome complexities. Reality is edited and post-produced. Consider a case in point: in the 1980s, a large hole in the ozone layer appeared above Antarctica. Although NASA had been continuously recording atmospheric data, all data points that indicated these drastic changes to the ozone layer were falsely classified as outliers, and consequently discarded. “In this case, reality itself was an outlier and assumed to be an error” (Brain 2018, 156).

Ultimately, what data is collected and how it is processed is determined by what is considered typical or atypical, important or peripheral. In the context of the Arctic dispute, these decisions are driven by geopolitical agendas at play: variables entwined with resource extraction, trade routes, and the delineation of borders are foregrounded—in everything from models of geological sublayers to iceberg surveillance. The rest is captured at lower resolution or not at all.

But more is at stake than a simple act of omission: discrepancies between different nations’ models of the one and the same area reveal attempts to manipulate the terrain in their favor (Holmes 2008)—“to hide, to scan, to camouflage, to self-display and to trick the world into seeing things not as they are but as they could be or should be,” in an attempt to make their claim more viable (Bratton 2019, 20). As remote sensors piece together a carefully curated digital landscape, commodifying and dividing the land, the seemingly innocuous and purportedly objective visual language of scientific imagery becomes entangled in colonial and capitalist enterprises. So much is lost, altered and edited along the way that remote sensing technologies are not only reading and representing the landscape—they are fabricating it.

The Algorithmic Wilderness

So what if familiar representations of the Arctic are just one possibility among many? Beyond the restrained and streamlined versions remote sensors are currently used to generate, could peering deeper into the expanding datascape and strange realm of nonhuman senses reveal alternative configurations of polar ecologies?

What if we were to look instead to all the things usually redacted or excluded from the realities that these technologies produce? The things that are too slippery to neatly capture, intentional gaps in the data, areas of low resolution, areas of low priority, and conflicting data points? What

alternative versions of the territory might emerge? Trusted with creating de facto placeholders for the distant terrain, remote sensors are able to delineate the boundaries of reality in the Arctic—and maybe stretch them, too.

I describe this elusive exclusion zone, usually relegated to the fringes of reality, as an *algorithmic wilderness*. It is populated by things that are currently not represented in dominant scientific visualizations, either because

1. they take up too much processing power,
2. they are considered to be irrelevant,
3. they are not understood within current scientific frameworks, or
4. they contradict the singular version of reality predicated by Western science.

Icebergs below a certain size, for example, are not recorded. They would overwhelm computational capacities, and are deemed irrelevant since they present little risk of disrupting shipping routes (Scheick, Enderlin, and Hamilton 2018). The Earth's magnetic field remains a mystery and evades scientific models, which are unable to fully explain or predict changes in it (Witze 2019). Any data points that are considered outliers are deleted, just like indigenous models of reality are discounted from official narratives.

In the process of constructing neatly bounded digital alter egos of the Arctic Ocean, a kind of spillover zone emerges for inconvenient data at odds with dominant agendas. It is the inevitable byproduct of a process which attempts to shoehorn irreducibly complex ecologies into tightly constrained technoscientific frameworks. Whereas prevailing representations of the territory are curtailed by a need to organize and rationalize, the algorithmic wilderness is excessive and strange. Could glimpses of this elusive realm expand and unsettle all too familiar conceptions of the territory? Here, unfiltered and unedited data sets collide, overlapping and contradicting each other, drifting across sediments of discarded information. Surreal creatures emerge, giving form to what is usually overlooked.

Curious what the algorithmic wilderness might look like—what new visual and material languages might emerge—I began generating a series of digital models using remote sensing data extracted from the Arctic Ocean. The resulting creature-like forms (which look like they might be found in the dark depths of the polar sea) each emerge from experiments with—or indeed themselves experiment with—alternative configurations of data, or alternative models of reality, beyond Western logics.

CREATURE 1: Border Dispute (between Norway and Russia) + Seismic Pulse + Dolphin

The first creature considers the type of data that accumulates in the wake of a border dispute at sea, focusing on a contentious stretch between Norway and Russia near the Lomonosov Ridge in the Arctic Ocean (see figure 1). Nations rely on surveys of seabed topography and subsurface geology to substantiate their territorial claims according to the frameworks set out by the United Nations Convention on the Law of the Sea (UNCLOS). These are generated using air guns towed along the disputed coordinates by research vessels. Floating in the frigid water, they blast loud, pressurized pulses of air into the ocean, which spread and travel through the water column until they hit the seafloor. Here, the loud pulses enter the sandy sediments of the seabed and reflect echoes of the ragged topography back up to the surface—offering clues as to what lies below. This process is called seismic blasting. The resulting maps, surveys, and charts of the undersea landscape are all familiar representations of a border dispute, a growing paper trail that is in keeping with scientific standards and aesthetics.

Omitted from these official records, however, are the incredibly damaging effects of seismic pulses on marine life—from zooplankton to whales and dolphins—as seismic blasts travel underwater for up to 2,500 miles and create some of the loudest sounds in the ocean, sometimes repeated as often as every ten seconds for days, weeks, or months at a time. The relentless noise leaves marine life in distress, and indeed leads to injuries and death, as sound plays an essential role in these organisms' ability to feed, mate, communicate, and avoid predators (Oceana 2020).

Since these data sets—the official documentation of the dispute and its detrimental effects on marine life—are never seen in the same contextual frame, I consider what might exist at their intersection. Perhaps, drifting through the tumultuous depths of the algorithmic wilderness, they might collide and congeal, thereby offering an alternative representation of a border dispute. The latitude and longitude of the border in question form the spine of the computer-generated form. Revolving around it are the waves of a seismic pulse. The resulting form is enveloped in the skin of a dolphin.

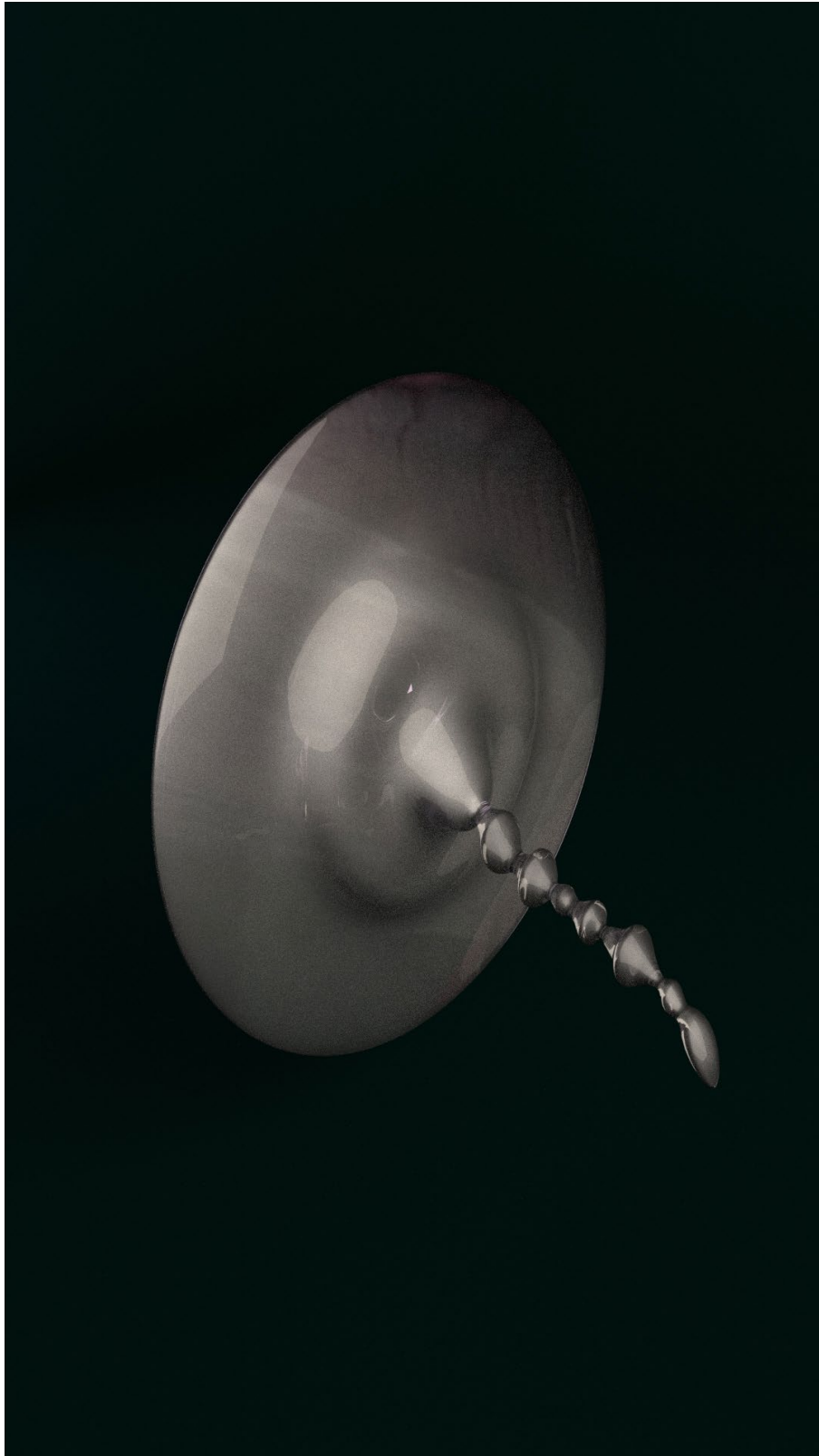


FIGURE 1. “Data Creature 1”: Carolyn Kirschner, *Border Dispute (between Norway & Russia) + Seismic Pulse + Dolphin*. Digital render, 2018.

CREATURE 2: Seal Migration Routes + Annual Ice Extent + Inuit Sea Goddess

This second creature draws on the logics of indigenous mythology, which—like all other versions of reality that contradict dominant narratives—are relegated to depths of algorithmic wilderness (see figure 2).

The myth of Sedna has taken on many forms, but usually begins with a girl taken out to sea by her father. Following a dispute, he pushes her over the edge of his kayak, leaving her dangling off the sides. As she stubbornly clings on, her fingertips freeze—first turning to ice and then transforming into seals. Her hands become walruses and her forearms become whales. Her body grows a fishtail and sinks to the underworld, where she now commands the mysterious Arctic Ocean. She is the Mistress of the Sea, the mother of all sea life (Laugrand and Oosten 2009).

Flickering between different states of matter, she makes the boundaries between humans, animals, and landscapes impossible to discern. Where Western narratives insist on neat categories and clear delineations, long-standing indigenous oral traditions rely on their inseparability (Cruikshank 2006, 128, 220). Borders between human and nonhuman worlds are permeable in a way that is glaringly at odds with dominant environmental discourse. This leaves the Inuit sea goddess treated as an impossibility, a superstition.

But in the algorithmic wilderness, a collision of data momentarily attests to her existence. A map of seal migration routes across the Barents Sea melds with data describing monthly fluctuations of Arctic ice extent, allowing the shapeshifting goddess to become tangible as multiple states of matter collide.

Where the scientific process relies on strict compartmentalization, focusing on key areas of concern in isolation (with climate scientists tracking ice extent and biologists specializing in seal behaviors), here they merge and accumulate, able to tell different stories than what could be told by either model alone. The resulting sheetlike being is a delicate tangle of data, a computer-generated form that extrudes a two-dimensional surface model of seal routes upwards and downwards, according to corresponding fluctuations in monthly sea ice. Here, it is the framework or reality within the myth that gives form to this combination of data. A creature emerges that unsettles anthropocentric delineations of rigid boundaries between humans, nonhumans, and landscapes.



FIGURE 2. "Data Creature 2": Carolyn Kirschner, *Seal Migration Routes + Annual Ice Extent + Inuit Sea Goddess*. Digital render, 2018.

CREATURE 3: Data Storm, 2003 (Conflicting Data)

The third creature is made of multiple, conflicting data sets of a magnetic storm. It considers the variations, inaccuracies, outliers, and deleted data points that accumulate as remote sensing instruments probe their surroundings (see figure 3).

Magnetic storms are caused by surges of solar wind: electrically charged flares and effervescent ejections of plasma emitted by the sun that eventually crash into the Earth's atmosphere and disturb the outer portion of its magnetic field. The sudden turbulence generates electric currents, which in turn creates more intense magnetic fluctuations: a storm (National Oceanic and Atmospheric Administration 2020). Although magnetic storms are most common at higher latitudes, where they become visible as the northern lights, painting the sky in ethereal greens and purples, they can drastically interfere with electrical infrastructure on a global scale, often inflicting serious damage (Andrews 2019).

In order to anticipate these storms, magnetometers are tasked with measuring localized fluctuations in magnetic field strength. These instruments are highly sensitive and require careful calibration, often returning slightly divergent data of a single magnetic occurrence due to variations or errors across instruments in hardware, location, and programming. Usually—as is standard for the scientific process—this messy, raw data is then subject to a process of refinement: of calculating averages, deleting outliers, and interpolating information in order to streamline findings into a single, more decisive version of events.

But in the algorithmic wilderness, a luminescent, asymmetrical disc gives form to these contradictions. Constructed from local magnetic data collected near the Arctic Circle, it combines conflicting data sets of a particularly violent storm in 2003. Three graphs, each charting magnetic field strength over time, are fanned out around a common origin. By digitally interpolating the spaces “in between,” an intricate form begins to take shape. Variations in its furrowed ridges tell of errors and inconsistencies. As the three contradictory data sets jostle to occupy the same space at the same time, the creature is able to contain multiple versions of the event, or even multiple realities at once—thus bringing the data into a dialogue that is at odds with the singular reality predicated by Western science.

Entering the algorithmic wilderness is a chance for alternative materialities and visual languages to emerge. Data extracted from the polar landscape can be reconfigured in many ways. It can be used to categorize and organize, and to draw up borders and plan shipping routes for pervasive geopolitical schemes. But outside of familiar models and metrics, the very



FIGURE 3. "Data Creature 3": Carolyn Kirschner, *Data Storm*, 2003 (*Conflicting Data*). Digital render, 2018.

same data, clustered in unusual configurations, can reveal more unsettling versions of the landscape. Realities multiply in this strange world of bits and bytes—suited to an Arctic landscape that is itself multiplicitous and fluid, and which slips through the rigid frameworks designed to contain it.

The Wobbling Pole

One such rigid framework: the coordinate grid. Its introduction to Western cartography in the fifteenth century enveloped the planet in an evenly spaced grid of latitudes and longitudes. This improved navigation and fueled a dogged determination to fill the remaining (and now conspicuously) blank spaces on a newly finite and uniform globe (Dalché 2007, 327).

The North Pole, too, moved into the spotlight—as the theoretical point at the top of the globe where this planetary grid converges. This spurred a race to conquer the pole, with the help of indigenous populations who were of course long familiar with these “newly discovered” territories. This despite the fact that the pole itself, for which there was no word in indigenous languages, remained an elusive construct of the Western imagination—leaving Robert Peary’s Inuit assistants allegedly astounded to discover that after “travelling for days over ice and snow, there was nothing [there at the North Pole] except more ice and snow” (Harper 2009).

And yet, despite being geologically entirely indistinguishable from its surroundings, its symbolic value continues to prove unwavering. The current territorial claims of Canada, Russia, and Denmark all include the pole (United Nations 2020). Russia even went as far as planting a flag on the seabed in 2007, 14,000 feet beneath the surface, using a miniature robotic submarine (Chivers 2007). To this day, it fuels the ambitions of nation states, with a successful claim suggesting some kind of symbolic mastery of the far north.

This fixed and singular North Pole, however, does not exist. Defined as the point where the Earth’s axis of rotation meets the surface, it may have once been believed to be fixed relative to the surface. But it has since been discovered that the axis wobbles slightly, dragging the North Pole with it (Casselman 2008). What the coordinate system so rigidly attempts to fix in place is undermined by the fact that the pole is perpetually wandering across the Earth’s surface within a range of a few meters. It exists in multiples and continues to evade Western classification schemata, which mistakenly tend to think of territories as solid and containable—as somehow lending themselves to be neatly described and organized with lines on a map.

The ongoing Arctic dispute operates under the same assumption, using remote sensors to tie sovereign borders to geological features with pinpoint precision, in a race to divide the Arctic. Meanwhile, sea levels are rising, continental plates are shifting, and the geological sublayers of the seabed are in perpetual motion. Sovereign borders start shifting with the layers of sand, silt, and clay they are tied to, sliding unpredictably across the terrain. Ultimately, the more instruments flock to the polar region, and the more data that is transmitted, the more precarious any sense of stability becomes. Vast sensor networks and floods of data reveal a slippery terrain that is in constant motion and that contradicts Western cartographic logics.

And in the process of revealing the landscape's slipperiness, remote sensors are *altering* it, too. A strange hybrid landscape is taking shape—part synthetic, part natural, full of sensors and in constant motion. Assemblages of aluminum, silicon, steel, foam, iridium, and rubber become a new technological species of polar ecosystems. As indigenous populations have long known, the Arctic is sentient and “equipped with a sense of hearing, sight and smell” (Cruikshank 2006, 229).

Could expanded access to the sensory capacities of the sentient landscape, the sidelined and censored fringes conveniently relegated to the algorithmic wilderness, offer more complete and unsettling experiences of the Arctic—beyond Western paradigms and human senses? As remote sensors now outnumber humans in the world's most inaccessible regions, how might they expand the way we see and sense landscapes? The instruments are able to confront us with the relentless fluidity of the landscape, unsettling illusions of fixity, borders, maps, and surveys—which in turn calls into question broader constructs underpinning resource extraction, tourism, and nationalism.

A Landscape of False Information

Incidentally, the earliest maps of the poles were also drawn up from a distance, long before explorers were able to reach these remote regions. Like historical predecessors for remote sensing, they were based on scientific observations of their time, made from afar.

Speculations about Antarctica, for instance, also known as the hypothetical continent *Terra Australis*, date back to Roman times and were founded on the guiding principles of symmetry and equilibrium—with the conclusion that the landmasses in the northern hemisphere necessitate a vast continent in the South as a planetary counterweight (see figure 4).



FIGURE 4. Antarctica as Featured in the World's First Modern Atlas.

Abraham Ortelius, "Typus Orbis Terrarum" (24.6 × 48.3 cm), in Ortelius, *Theatrum Orbis Terrarum* (Gilles Coppens de Diest: Antwerp, 1570). Public domain.

Antarctica was featured in the world's first modern atlas as early as 1601 (Oceanwide Expeditions 2018) but remained unseen until 1820 (Armstrong 1971).

Similarly, the first maps of the Arctic were published in the seventeenth century, long before any Western expedition reached the North Pole. The Earth's magnetic field led Flemish cartographer Gerardus Mercator to envision a colossal magnetic mountain near the pole, while vicious currents along the shores of Northern Canada indicated the existence of four large islands surrounding the pole, separated by channels of water which meet in the middle in a reverse whirlpool (see figure 5) (Princeton Visual Materials 1595).

Over time, the Arctic and circumpolar regions were more accurately charted, with the help of transits, sextants, telescopes, chronometers, and prismatic compasses (Cruikshank 2006, 229). Representations of the Arctic multiplied, superseding one another as the contours of the terrain were gradually unveiled. The introduction of remote sensing technologies in the 1970s, in turn, added new layers to the landscape, extruding it upwards



FIGURE 5. Mercator's first map of the Arctic.

Gerhard Mercator, "Septentrionalium Terrarum Descriptio" (engraving with hand coloring on paper, 39.4 × 36.8 cm, 1595). Public domain.

and downwards, with models of atmospheres, currents, underwater topographies, and subterranean worlds.

These vast datascares allowed for more complete understandings of the region. But to this day, the Earth's magnetic field remains a blind spot in our reality. Unlike animals and instruments, we have no natural instinct for it—and no matter how much data is gathered, scientific models are unable to explain or accurately predict changes to it. Mercator's magnetic mountain might have turned out to be a fantastical creation, but scientists are unable to offer alternatives—beyond a suspicion that magnetic fluctuations are linked to turbulence in the Earth's liquid iron core (Witze 2019).

And yet, we have constructed entire realities around the mysterious electromagnetic forces. Planetary infrastructures, from GPS to national

borders, communications, consumer electronics, smartphone compasses, shipping and air traffic, satellites, and sensors all depend upon it. They organize the globe into a here and a there, and are able to pinpoint locations and orient flows of information, people, and goods. But they need to be constantly recalibrated to account for the moving magnetic pole, the universal reference point that underpins all navigation systems. And while the North Pole wobbles within a range of a few meters (Battersby 2006), the Magnetic Pole has wandered around 700 miles in the twentieth century alone (Robinson 2009, 65)—leaving geophysicists playing a constant game of catch up. With the help of remote sensing data, they plot paths and timelines, intent on charting the invisible forcefield while making estimates of its future trajectory.

But it continues to evade capture: like in early 2019, when the magnetic pole inexplicably sped up and veered off its predicted course. Coinciding with the US government shutdown, shuttered national research institutes were unable to locate it for several weeks (Wei-Haas 2019). As simply as that, a single swell inside the Earth's liquid crust exposed the shaky foundations many human worlds are built upon—momentarily unraveling global infrastructures and any delusions of control, of having conquered the planet, and of being above (and outside of) neatly contained constructs of nature. We are at the whim of the Earth's magnetic field, of mysterious and erratic electromagnetic waves beyond human perception.

It leaves in its wake a growing pile of human errors, false predictions, and miscalculations. Discredited models of the magnetic field are hastily discarded, left to accumulate in the algorithmic wilderness. It's like a digital spillover zone. Here, a very different configuration of the magnetic field takes shape. This computer-generated piece (see figure 6), constructed from data, makes these past versions tangible, imagining them congealed into a strange topography. The coordinate data of the recently predicted path, considered credible until the pole's sharp derailing, meets the magnetic mountain from Mercator's first map of the Arctic, which was accompanied at the time by (pseudo)scientific descriptions of the dimensions and materiality of the elusive mountain. It is a landscape of false information, a chronology of once-accepted realities that have since been proven false. And it is bound to continue growing—building up over time like an ice core, but a cross-section of human misunderstandings and misinterpretations.

Confronted with this tangible buildup of slipups, any current grasp on reality suddenly seems tenuous too. The vast networks of remote sensors that envelop the planet might, at first glance, suggest a total human mastery over the natural world. But in fact they lay bare the fragility of these

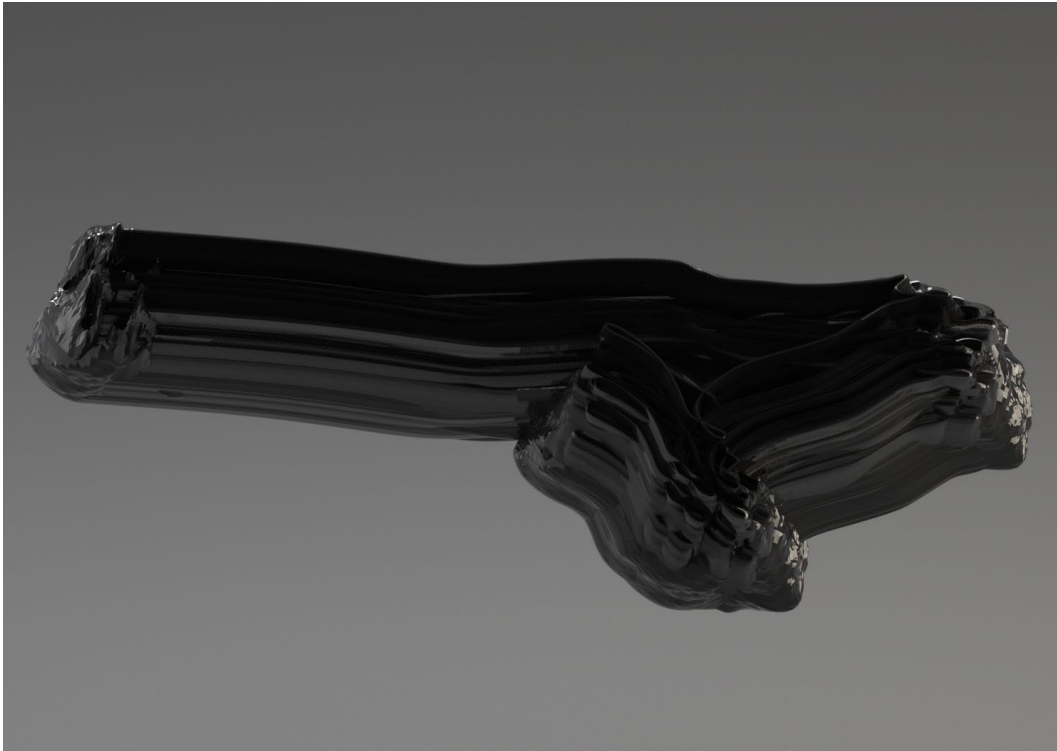


FIGURE 6. Carolyn Kirschner, *A Landscape of False Information*. Digital render, 2019.

hierarchies. Perhaps this is a chance to consider how remote sensors might unravel relationships between humans and ecologies entirely.

Blurry Borders and Boundaries

Ultimately, the instruments may be deployed with the intent of organizing the landscape, but in fact they expose its inability to be organized—often making the slippery terrain even slipperier. Satellites, for instance, only recognize ships if they are larger than twenty pixels—and misidentify smaller ships as waves (Corbane et al. 2010). Elaborate wave formations, in turn, are occasionally misidentified as ships (Heiselberg and Heiselberg 2017). Boundaries between what is territory, technology, human, and animal become blurry through the eyes of remote sensors.

Polar bears are equally elusive. Their dense coat absorbs portions of the electromagnetic spectrum, making them invisible to infrared cameras tasked with wildlife observation (Preciado 2002). Their shadows might be their only trace. As remote sensors offer new ways of seeing, sensing, and smelling complex ecologies, how might this begin to infiltrate human



FIGURE 7. Carolyn Kirschner, *Rug in the Shape of the Shadow of a Polar Bear*, 2020. Semitransparent urethane sheet, 200 × 200 cm. Photograph: Andrew Gibbs.

spaces and value systems? Figure 7, a rug in the shape of the shadow of a polar bear, brought into a domestic setting, is like a hunting trophy from a wider reality. The translucent rug is made to look as if it itself is a shadow on the ground, an elusive fragment from the algorithmic wilderness. It makes tangible expanded versions of species that emerges in the wake of remote sensors. Unlike Western classification schemes, which rely on the confines of skin and fur to define where an animal begins and ends, machine senses stretch those boundaries to include entanglements and exchanges with their surroundings—like a polar bear’s shadow. Although as the effects of global warming are likely to bring the species to extinction within the next eighty years, the polar bear’s shadow might one day be the only piece of it left (Dickie 2020).

It’s clear that the inner workings of remote sensors are glaringly incompatible with scientific categories and classifications. No matter the technological advances, whether in processing power or in resolution, they are different ways of looking at the world. The Arctic blurs and blends through the eyes of machines, which turns it into an assemblage of pixels with no clear beginnings or ends. Being able to see the Arctic Ocean through nonhuman eyes is not only a chance to recalibrate contrived borders and

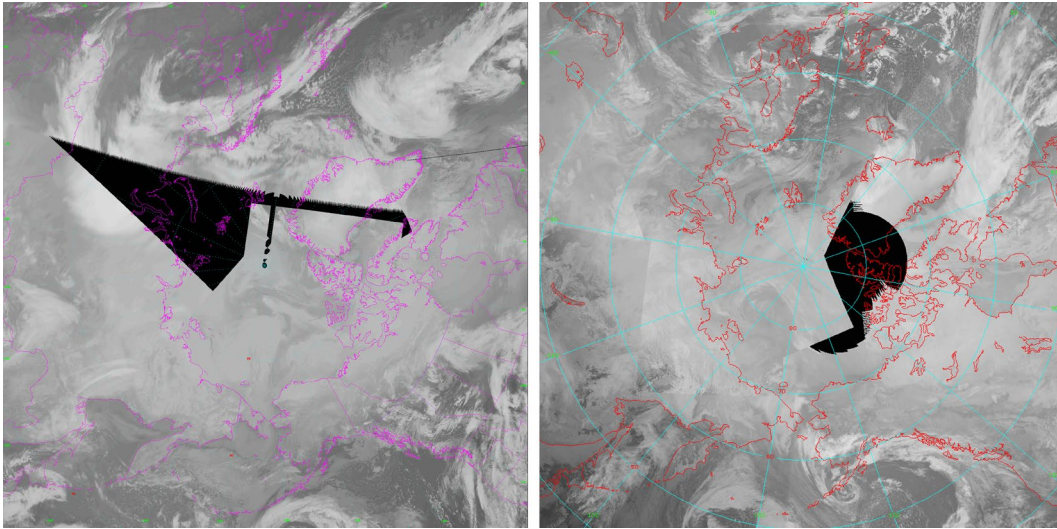


FIGURE 8. Unrecorded gaps in satellite imagery of the North Pole.

Digital images from the Unidata-Wisconsin Datastream Satellite Imagery, July 19–24, 2019. Accessed at Unidata: Data Services and Tools for Geoscience (<https://www.unidata.ucar.edu/data/uniwisc.html>).

boundaries between nations and species, it's also a chance to discover what lies beyond official charts, maps, and surveys of the Arctic. Perhaps the gaps and glitches in familiar representations of the Arctic become entry points to a parallel realm, the rich datascares of the algorithmic wilderness.

Huge, unrecorded gaps in satellite imagery of the North Pole, for example, are commonplace (see figure 8). These strangely shaped, blank regions are the result of reduced satellite density at the poles. They reconfigure every hour, along with the changing constellation of satellites above, leaving behind a growing collection of voids (Unidata 2020). By turning them into three-dimensional scientific specimen (see figure 9), I shift the focus from the image to the gaps. Finished with a matte black paint that absorbs 96% of visible light, they look like they exist somewhere at the fringes of our reality—at once real and not real, present and absent—and hint at the expansive portions of the Arctic that we are currently unable to see.

Outnumbered by Instruments

As it turns out, despite intricate networks of sensors transmitting floods of information to research institutes across the globe, the Arctic Ocean remains—to this day—one of the least understood regions in the world (Harris 2005). It is brimming with mysterious sea creatures, unpredictable

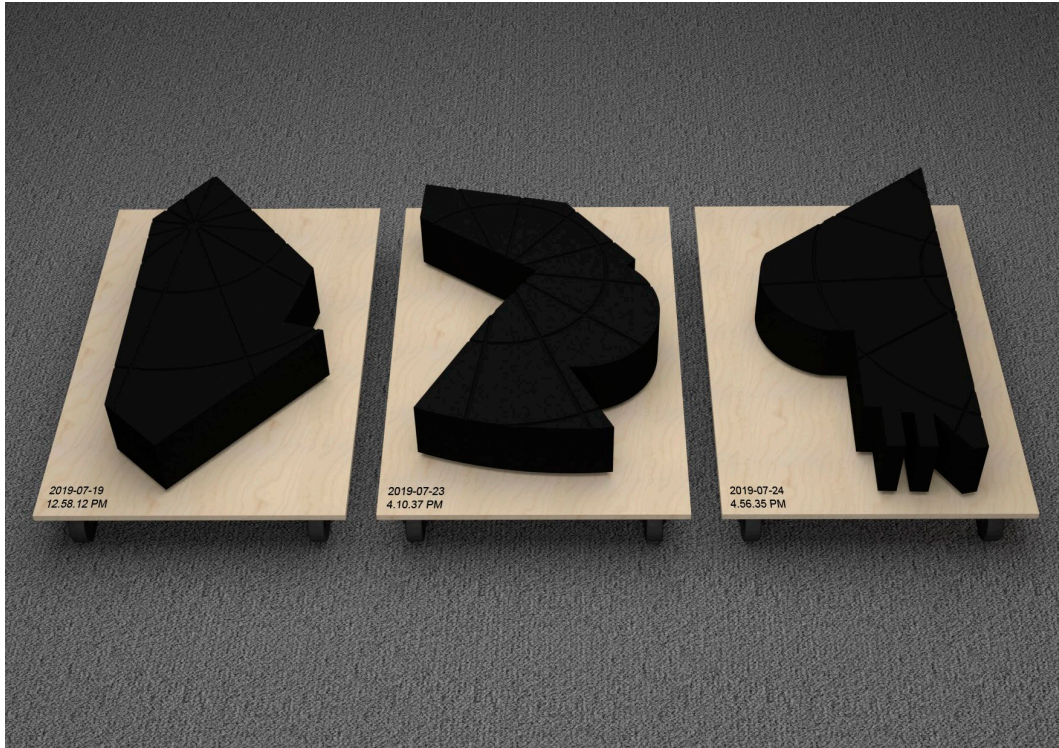


FIGURE 9. Carolyn Kirschner, *Satellite Gaps as Scientific Specimen*. Digital render, 2020.

weather patterns and ocean currents, shifting sediments, and erratic geomagnetic forces. As historian Richard White observes (1992), there is a tangible physical world out there that sometimes affirms but often mocks the representations and computational models we design to constrain it.

Scientific and cartographic processes of course offer valuable modes of study. But they paint a strikingly incomplete portrait of the Arctic and only offer partial glimpses of the rich realities forged by remote sensors. Multiple *alternative* conceptions of the polar north exist in the peripheral, defunct, or censored fringes of scientific models. Here, in the algorithmic wilderness, ecologies multiply and expand. Borders become fluid, the invisible becomes tangible, alternative models of reality appear, contradictory versions exist all at once, and sidelined fringes become the centerpiece. These alternative perspectives offered by technologies, however, are currently largely unaccounted for in ecological thinking. A whole realm of nonhuman consciousness is disregarded.

Meanwhile, remote sensors are tasked with making critical decisions that radically reconfigure the planet for humans and nonhumans alike; suggesting wildlife conservation strategies (Tibbetts 2017), plotting shipping routes (Bychkova and Smirnov 2018), selecting key sites for resource extraction (University of Bergen 2020), and mediating territorial disputes.

Their depictions of landscapes—although abstract and intangible—guide social, political, economic, and ecological activity. With that, they have a huge degree of agency, especially in regions such as the Arctic Ocean, where almost our entire understanding of the area is filtered through the eyes of machines.

But of course, neither official representations nor sidelined versions in the algorithmic wilderness are accurate representations of distant ecologies. It is impossible to digitally capture intricate earth systems and complex species in their entirety. No amount of data will offer the “truth” on the mysteries the Arctic Ocean conceals. Rather, the digital abstractions remote sensors offer are a lens through which to (re)calibrate our relationship to the natural world.

In an area ravaged by the effects of global warming, the streamlined imagery generated in the past and over the course of the ongoing territorial dispute has not succeeded in communicating the urgency of the environmental crisis. Rather, the region remains abstract and removed, too far away for human populations to feel the immediate effects of or to really understand their significance. So what lies beyond the confines of Western models and human senses? As climate change is physically shrinking the Arctic, could we find expanded ways of thinking about it?

Really seeing the world through the eyes of remote sensors is a chance for more visceral connections with distant ecologies: blurrier and messier than familiar imagery, and entangling us with bits, bytes, territories, species, and atmospheres. These otherworldly alter egos of the planet are a chance to develop new visual languages and expand representational paradigms in design and environmentalism. As remote sensors outnumber humans in the world’s most inaccessible regions, the stretchy machine realities forming in their wake reveal alternative conceptions of ecologies, of technologies, and of us.

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