

## WIND AS MODEL, MEDIA, AND EXPERIENCE

# Cloud-Connected Ecosystems: Fog as Medium, Model, and Experience of Wind

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This essay takes the perplexing perceptibility of wind and fog through one another as a heuristic to trace a set of material and metaphorical understandings of cloud-connected ecosystems in the San Francisco Bay Area. In an elemental analysis of fog as medium, model, and experience of wind, I explore fog through atmospheric sciences, data centers, embodied encounters, and aesthetic experience. I suggest that *Fog Bridge #72494*, a fog sculpture in the Port of San Francisco by environmental artist Fujiko Nakaya, coalesces ecological, technological, and embodied modes of sensing a local ecosystem. As such, *Fog Bridge #72494* speaks to a wide range of interventions in environmental scholarship and art practices that complicate notions of embodiment and abstraction, measurement and experience, particular and universal, and planet and globe as dualistic modes of environmental perception.

San Francisco. The sky is a stretch of impenetrable blue. The sun burns on my skin. It is the third day of a rare heat wave. The weather forecast announces that relief is finally on its way: “we can see a fog bank offshore” (Graff 2019). Amid California’s dry and warm climate, San Francisco’s summer fog usually offers much needed shade, water, and cooling. Under conditions regular to the twentieth century, the city experiences a daily pattern of fog rolling in by the end of the day. Summertime fog in the area, however, has decreased by a third, and the increased atmospheric temperatures of climate change are among its speculated causes (Johnstone and Dawson 2010, 4533).

While California is threatened by a decrease in summertime fog, fog is also a material and metaphorical resource in the area. Materially, fog is captured for water and simulated as a cooling device. Experiments with fog-catching mesh nets have managed to collect as much as 37 liters of water in a day, and someday California might be covered in fog farms (Branch 2022).<sup>1</sup> Artificial fog production systems cool and humidify data centers, reducing static discharge and electricity use (“Data Center Commercial Humidifier,” n.d.; Furuhata 2019, 208–9). Metaphorically, for Silicon Valley’s tech

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<sup>1</sup> For an account of fog capture experiments in coastal Peru, see Ojani 2023.

companies, fog, clouds, and other vapor states symbolize increasing lightness, or efficient data processing and transmission. On the Google DeepMind website, a wind forecasting AI system is marketed as faster and more energy efficient than traditional computer forecasting (Lam 2023). The company Cisco, named after San Francisco, sells fog computing systems intended to lighten the processing burden for cloud computing (Leslie 2021, 92).<sup>2</sup>

Wind moves fog from the Pacific Ocean to San Francisco. Most days, the wind in San Francisco comes from the northwest due to the North Pacific High, an area of high atmospheric pressure. Out at sea, water evaporates into what is called a marine layer. Along the California coast, the sea surface temperature is cool due to coastal upwelling of subsurface waters and the California Current from the North Pacific. When the marine layer encounters this cold coastal water, it reaches its dewpoint, and liquid water drops form. This is fog. Because it takes time for the sun to warm the San Francisco atmosphere, the wind regularly blows the fog in during the late afternoon. During the day, the sun warms the air until it eventually rises. Colder air then moves in to equalize the lower pressure underneath it. Because wind follows the rotation of the planet, fog moves from the ocean to the city, instead of the other way around.

Wind is also part of the atmospheric process perceived as a fogbank. Fog is a kind of low-hanging cloud that consists of airborne elements (mostly water, but also sea salt, dust, and other nutrients) called cloud condensation nuclei. If I look at a fogbank hanging over the ocean, standing higher up on the cliffs of California's Highway 1, it appears to me like a cotton ball blanket, obscuring the water's surface from my view ([video 1](#)). What I see, however, is not a bank, a blanket, or even an object as such. Fog is not a thing—fog is “processual, dynamic, and intra-active” (Starosielski 2019, 3). Fog becomes visible because it is an ongoing atmospheric process of rising air currents keeping water drops in perpetual fall without falling. Wind, in other words, functions as the infrastructure of fog in the double sense of supporting its occurrence and facilitating its movement. Fog, in turn, is a kind of materialized wind, both as a paradoxically stable visualization of air currents and as an object affected by otherwise invisible wind. Another way to put this is that fog mediates wind and is mediated by it.

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2 On the Cisco name and logo, see Nepori 2022.



Video 1

“Cloud-connected ecosystems” is a phrase that highlights the critical role of wind as it creates fog and transports it to the coast, sustaining intricate ecological connections between oceanic, aerial, and terrestrial environments. The scientific discourse on Pacific coastal fog patterns specifically uses the term “cloud-connected coastal ecosystems” to describe the redwood forests that grow in a narrow belt along the northern coast of California (Johnstone and Dawson 2010, 4533). Redwood trees (*Sequoia sempervirens*) are the largest living species of trees on Earth, and while they used to populate a larger area of the Northern Hemisphere, they are now confined to this smaller territory in California. This is due to their dependence on coastal wind and fog patterns for nutrients and water: damp redwood trees efficiently retain water, and the dew that forms on their branches eventually drips down to the forest floor, moisturizing the soil. Other plants in these forests rely heavily on the capture and distribution of fog by redwood trees since they significantly increase the input of water to the ecosystem (Dawson 1998, 476).

In an analysis of fog as medium, model, and experience of wind, this essay takes the perplexing perceptibility of wind and fog through one another as a heuristic to trace a set of material and metaphorical understandings of cloud-connected ecosystems in the San Francisco Bay Area. As *medium* of wind, fog in art and science visualizes otherwise imperceptible air currents, as for example in the cloud chambers of the nineteenth century that made intelligible air currents invisible to the human eye. Cloud chambers in this sense are comparable to the big data of modern climate science, as they both render perceptible processes beyond human comprehension and sensibility (Amoore 2016, 2). As *model* of wind, fog and other vapor states express

an imagery of complete techno-ecological interconnection, of an ecology of cloud computing (Douglas-Jones 2020, 244). For the big tech companies of Silicon Valley, terms like “cloud,” “connection,” and “ecology” denote the integration of networked computing and data analytics, used in the predicting or manipulating of wind. As *experience* of wind, fog highlights seeing as embodied perception. The experience of being surrounded by fog, rather than only disorienting or limiting visibility, challenges notions of distanced or detached vision (Martin 2011, 456). Building on scholarship that has examined fog in relation to the atmospheric sciences, cloud computing, and phenomenology, this essay assembles these various approaches in an analysis of fog as medium, model, *and* experience of wind in the cloud-connected ecosystems of Northern California.

Combining experiential descriptions and short videos taken in and around the San Francisco Bay Area, this essay centers around *Fog Bridge #72494* (2013), a fog sculpture in the Port of San Francisco by environmental artist Fujiko Nakaya. I argue that this fog sculpture coalesces ecological, technological, and embodied modes of sensing a local ecosystem. By blending fog as medium, model, and experience, the sculpture blurs the distinctions between these three modes of environmental perception. In my analysis, *Fog Bridge #72494* invites a consideration of fog as it is engineered or modeled; works as environmental, artistic, and scientific medium; and manifests as sensorial or aesthetic experience. *Fog Bridge #72494* therefore speaks to a wide range of interventions in environmental scholarship and art practices that complicate notions of embodiment and abstraction, measurement and experience, particular and universal, and planet and globe as dualistic modes of environmental perception. This essay’s combination of autoethnographic writing and short videos is intended to similarly bring together situated experiences and recorded reproductions, in an elemental analysis of fog as a processual phenomenon.<sup>3</sup>

This essay takes methodological inspiration from Nicole Starosielski’s definition of “elemental analysis” and Timothy Choy’s experiment with turning the “diffuse into something substantive” (2019, 2; 2011, 146). Starosielski argues that an elemental analysis, by destabilizing traditional framings of the environment and media, connects the study of media to infrastructures and ecologies as well as to scholarship working with them (2019, 3). Choy, in an analysis of air in Hong Kong, collects details in a diffuse set of contexts to distill substance, mimicking pollution measurement methods of ingesting large volumes of air to condense and count particles (2011, 146). My “diffused” gathering of field sites and scholarly fields across environmental science, cloud computing, perception, and aesthetics aims

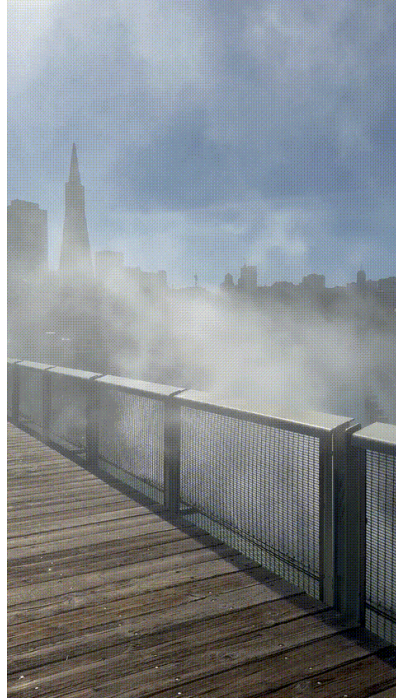
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3 All videos in this essay were filmed by the author in Northern California during the fall of 2023, except for [video 5](#), which was filmed according to the author’s guidelines (thanks again Jonas!). Due to technical limitations, the videos have been converted to GIFs (thanks again Maximilian!).

to convey how fog and wind as “elemental media” enmesh the seemingly discrete while also attending to their distinct local effects. In short, redwood trees, Silicon Valley, and *Fog Bridge #72494* are immersed in the Bay Area’s cloud-connected ecosystem. Across these trees, data centers, and artworks located in close geographical proximity, fog mediates wind and wind mediates fog—distinctly, but not discontinuously.<sup>4</sup>

### ***Fog Bridge #72494: Sensing Cloud-Connected Ecosystems***

*Fog Bridge #72494* is permanently installed on the bridge that connects piers 15 and 17 in the Port of San Francisco, which is an especially windy spot for a fog sculpture. When I visited the artwork, some years after the heat wave I experienced, it was another warm day. Waiting for *Fog Bridge #72494* to come on at a designated time, I sought refuge on a bench in the shade and looked out on the bridge. The city rumbled in the background; no one else was waiting. It started with a hiss: rows with nozzles on both sides of the bridge came on. Fog appeared around the bridge, billowing up on each side like smoke, sometimes melting into a fogbank. The nozzles turned on and off intermittently at separate places around the bridge. As soon as they turned off, the wind got ahold of the fog, dispersing and displacing it. I spent a few moments shrouded on the bridge, watching the bright sunlight filter through the chilly condensation, until the nozzles turned off and wind blew the fog away ([video 2](#)).



Video 2

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<sup>4</sup> Thanks to Maximilian Gregor Hepach, J. R. Carpenter, and the other editors of this stream for their feedback and support. I am also grateful for rich commentary from three anonymous reviewers.

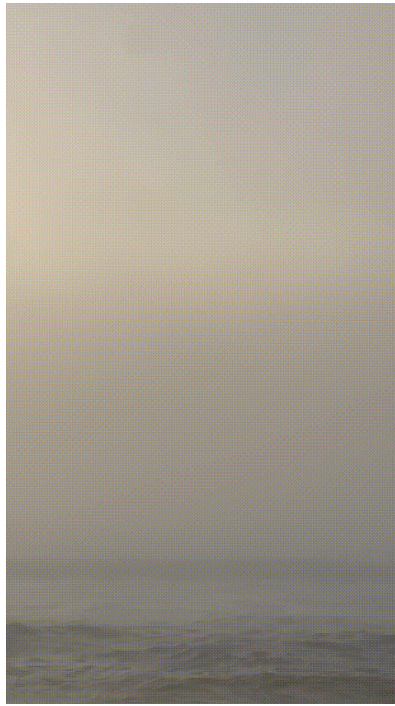
The technological system that produces the fog in her sculpture was developed by Nakaya herself, in collaboration with cloud physicist Thomas Mee. In Nakaya and Mee's invention, compressed air forces water through an array of nozzles. Each nozzle has a microscopically small opening in which an equally small pin atomizes water into billions of fog droplets. Whereas before their invention fog could only be produced chemically, which means that it might look like fog but not behave or feel like it, the system used in Nakaya's fog sculptures accurately simulates the suspended waterdrops of fog (Furuhata 2019, 204).

When *Fog Bridge #72494* produces waterdrops, and as these are continuously replaced by new condensing ones, the sculpture interacts with local organic and inorganic materials, structures, and atmospheric conditions. As it depends on air currents for its aesthetic effect and is taken up by the wind, blown away from its site of production, the artwork physically merges with its local environment. In Nakaya's fog sculptures, the continuously fleeting and reemerging atmospheric conditions that create fog are ecological but also artistically engineered. These techno-aesthetic-ecological interconnections are partly made perceptible as the fog is contingent and specific to the location of each sculpture, and as such, the installations are a way of sensing their local environment.

*Fog Bridge #72494* mediates the wind and air currents central to the cloud-connected ecosystems of the Bay Area. Wind, in these ecosystems, has a twofold role. Air currents keep water droplets from falling to the ground, and air pressure differences blow fogbanks toward the California coast. The environmental sciences therefore refer to fog as a “medium, vector, and connector” (Weathers, Ponette-González, and Dawson 2020).<sup>5</sup> Cloud-connected ecosystems, as a scientific concept, indicate how fog is an environmental medium or a media ecology that interlinks the hydrosphere, atmosphere, and biosphere ([video 3](#)). Clouds at a higher altitude also function as a connector in the hydrological cycle, but in cloud-connected ecosystems condensation does not happen in the atmosphere, creating rain, but in the contact between fog and vegetation, creating dew. The concept makes legible how wind facilitates a chain of dependencies between ocean and forest—from the cold upwelling waters of the Pacific Ocean to the droplets formed in the air above it and to the trees that catch and distribute moisture.

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<sup>5</sup> Weathers, Ponette-González, and Dawson also include montane cloud forests in their analysis.



Video 3

The chain of dependencies mediated by wind and fog in cloud-connected ecosystems can be vulnerable to environmental and climatic changes. When I walked around the San Francisco Botanical Garden to see its cloud forest gardens, an information leaflet explained that the garden's Mesoamerican, Southeast Asian, and Andean cloud forests can be grown there because of the unique foggy conditions of the area, making it one of few outdoor botanical gardens where these cloud forest plants thrive (Pacific Horticulture 2023). I also noticed frequent signs that discourage drinking from the garden's watering systems, which use recycled water—it would be remarkable for a botanical garden to jeopardize its collections by relying on its local cloud-connected ecosystems alone.<sup>6</sup>

*Fog Bridge #72494* is relatively exposed to its local ecology, and in this sense, the sculpture is slightly different from some of Nakaya's other works. *Fog Bridge #72494* relies on (desalinated) water from the San Francisco Bay since it was deactivated and altered in 2014 in response to California's multiyear drought (Exploratorium, n.d.). More importantly, the interactions of *Fog Bridge #72494* with its local atmosphere are not necessarily readily available to visitors. Water drawn from the bay and the air currents around the bridge make the simulation of fog possible, but the windy conditions in the San Francisco harbor might blow away the sculpture. For her first sculpture at the Pepsi Pavilion during Expo '70 in Osaka, Japan, Nakaya extensively studied

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<sup>6</sup> Remarkable, but not improbable. When I took a tour of the University of Dundee Botanic Garden, Scotland, in 2023, its curator Kevin Frediani explained that he had turned off the watering systems two years ago. Since then, several plants in the garden had died, and none will survive a two-degree rise of global temperatures. For more on Frediani's work, see "Frediani, Kevin," n.d.

the local weather patterns and the topography of the surrounding area to understand their potential impact on the aesthetics of the simulated fog (Furuhata 2019, 204). While it was essential to Nakaya that the fog would be vulnerable, that it would disappear and not persist, these careful studies made sure that the fog would stay in place long enough to shroud the pavilion and for visitors to interact with it as a “living responsive environment” (Furuhata 2019, 202–3). As with other works such as *Fog Sculpture #94925* (1976), the fog covering the pavilion indeed appeared immobile, parting mostly in response to the movements of visitors.<sup>7</sup> Visiting *Fog Bridge #72494*, however, I had little time to marvel at this triumph of engineering, as the artistic simulation of an environmental phenomenon was quickly lost in the rising wind.

### **Fog as Medium of Wind: Simulating Fog, Engineering the Atmosphere, and the Globe**

*Fog Bridge #72494* is ecologically entwined with San Francisco’s atmosphere, biosphere, and hydrosphere, and the technological and scientific conditions that enabled Nakaya to use fog as medium tie the artwork to the scientific lineage of the militarization and weaponization of the air during the Second World War and the Cold War (Furuhata 2019, 291). In a brilliant analysis of art, science, industry, and warfare, media scholar Yuriko Furuhata shows how developments in engineering and science fed into art practices, establishing a common ground between Nakaya’s fog sculptures and the “military-industrial-academic complex” (2019, 206). This common ground, Furuhata shows, is the geo- and biopolitics of visualizing and engineering the atmosphere historically specific to the twentieth century, ranging from military control over the weather as a weapon to civilian food security tool (2019, 199).<sup>8</sup>

The geopolitics of artificial replication of meteorological phenomena situates *Fog Bridge #72494* within a history of making environments visible and controllable, also theorized as a global aesthetics or perspective. This global aesthetics refers to the external perspective required for an overview of the Earth as a round globe, as a discrete unit (Ingold 2000, 29). The Earth becomes visible as a globe by taking photographs of it from space, for example, but it also becomes visible when climate science uses vast computing systems and a multitude of data to make global dynamics knowable (Edwards 2010, xv; Gabrys 2018, n.p.).<sup>9</sup>

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<sup>7</sup> Here, I rely on Janine Randerson’s account of Nakaya’s works in *Weather as Medium: Towards a Meteorological Art* (2018).

<sup>8</sup> See also Furuhata, *Climatic Media* (2022).

<sup>9</sup> See also Halpern, *Beautiful Data* (2015).

*Fog Bridge #72494* speaks to an extensive history of aesthetic, epistemological, and technological attempts to oversee and direct the Earth by rendering visible phenomena that exceed direct human observation. This detached representation derives from colonial histories of enclosure and implies a sense of control over an externalized environment (DeLoughrey 2014, 261; Gabrys 2018, n.p.; Spivak 2003, 72). These historical connections are not only linear but also multidirectional: the short film *Atmospheric Feedback Loops* (2017) by scholar and artist Susan Schuppli features a Dutch climate scientist explaining that works by sixteenth-century Dutch landscape painter Jacob van Ruisdael have served as important sources of data about changes in the atmosphere (15:53–16:12). The Earth as a globe is thus not only a function of late twentieth-century science and technology but also a historical aesthetics, including oil paintings of clouds.<sup>10</sup>

Concretely, in the long history of imagining the Earth as globe, technologies that simulate the airborne drops of fog have aided tracing otherwise invisible air, air currents, and wind. When, in the late nineteenth century, scientists built enclosed condensation chambers to study cloud formation in the controllable environment of a lab, they found that these “cloud chambers” brought into proximity perception of the otherwise imperceptible subatomic world (Amoore 2016, 2; Furuhashi 2019, 192–93; Galison 1997, 140). Particles such as alpha, beta, and gamma radiation could not be directly observed, but their path became visible in the trail left by condensation in the cloud chamber (Amoore 2016, 2). In other words, in cloud chambers and beyond, fog itself can be a medium as it visualizes traces of air, air currents, and wind.<sup>11</sup> As a medium of atmospheric currents, fog makes comprehensible processes that exceed the human eye, and as such, simulated fog can feed into the aesthetics, epistemologies, and technologies that render a global perspective of the atmosphere.

## **Fog as Model of Wind: Cloud Computing, Fogging, and the Planet**

The innovative fog simulation technology developed by Nakaya and Mee is used to make sculptures, but it is also used to cool data centers. Since further developing the system in the 1980s, the company MeeFog, founded by Mee, sells evaporative cooling systems to data centers (“About Mee,” n.d.; Furuhashi 2019, 208–9). Besides this material relation to the operation of data centers, words such as “cloud,” “connection,” and “ecosystem” on the Google Cloud

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<sup>10</sup> Anthropologist Kenneth Olwig, for example, suggests that the rediscovery of Euclidian geometry and its understanding of space as a uniform grid in the Renaissance is the foundation of both global expansion and perspectival representation in Venice and elsewhere (Haraway et al. 2016, 560). Similarly, media theorist Bernhard Siegert argues that Dutch seascape paintings are based on the “cultural technique” of navigation, piracy, and nation building (2014, 9).

<sup>11</sup> For scholarship on how environments become media, see, for example, Peters 2015; Jue 2020; Jue and Ruiz 2019; Parikka 2015; Starosielski 2015; Starosielski and Walker 2016.

blog comprise a metaphorical model representing the world of networked computing, data analytics, artificial intelligence (AI), and machine learning (Google Cloud Blog, n.d.-a, n.d.-b, n.d.-c, n.d.-d, n.d.-e).

One way a company like Google aspires to use cloud computing is to develop increasingly accurate predictions of wind and increase the value of wind energy. Google GraphCast, a 2023 AI model described as “the most accurate 10-day global weather forecasting system in the world” on the Google DeepMind website, relies on historical weather data instead of the physics equations and algorithms of traditional computer forecasting (Lam 2023). Besides “unprecedented accuracy,” Google markets GraphCast as “highly efficient”: whereas conventional weather forecasting methods could take hours, GraphCast is said to produce a ten-day forecast in under a minute (Lam 2023). “We can’t eliminate the variability of the wind,” states a Google blog post, “but our early results suggest that we can use machine learning to make wind power sufficiently more predictable and valuable” (Witherspoon and Fadrhonc 2019).<sup>12</sup>

If a global perspective aids the prediction and valuation of wind as a quantified entity, a planetary perspective demonstrates that wind is embedded and embodied. A planet (or sphere) is experienced from within, in relation, and never seen as a discrete whole (Ingold 2000, 30; Spivak 2003, 73). Anthropologist Cymene Howe, for example, complicates a wind energy development project in Mexico by emphasizing that wind becomes visible only in relation, in “the context of contact,” through its impact on other materials (2019, 11). Research in media studies, furthermore, has traced the vast consumption of resources by data industries otherwise obscured by the conceptualizing of a mass of infrastructural components as a cloud (Gabrys 2011; Hogan 2018; Holt and Vonderau 2015; Parikka 2015; Velkova 2016).<sup>13</sup> Such material approaches are a powerful corrective of weightless and frictionless accounts of cloud computing and the prediction and extraction of wind.

The central intervention in theories of environmental perception is that while the globe and planet can be described as two perspectives, they are answers to the same question: one that pre-establishes an in- or outside (Ingold 2000, 39). Analyses that materialize wind and the cloud to complicate atmospheric abstraction and extraction therefore need to be wary of reproducing dichotomous accounts of global and planetary models, and of reinstating vision as distinct or superior mode of perception. By locating the cloud and

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<sup>12</sup> Making wind predictable is of interest to Google because it could reduce the company’s own resource consumption, and making wind power more valuable is relevant to Google because the company might also sell wind energy. The company Google Energy LLC, founded in 2011 and referred to as “Google Environment” on a Google Blog, is supposed to reduce Google’s energy costs and to produce and sell green energy (Weihl 2010). Additionally, the Google Loon Project experimented with the use of datasets that predict the trajectory of wind to use wind as infrastructure, transporting balloons as high-altitude platforms for wireless internet distribution (McCormack 2018, 199–201).

<sup>13</sup> For an up-to-date comprehensive bibliography of data center studies, see Hogan, n.d., “Critical Data Center Studies.”

bringing it into vision, as geographer Louise Amoore shows, some analyses of cloud computing risk dichotomizing the abstract and the material and as such remain within a paradigm of observability. This paradigm, Amoore summarizes, “sustains the idea that one can have a more beautiful sight, a means of seeing more clearly and rendering coherent and intelligible” (2016, 7). Amoore’s “cloud as analytic,” therefore, does not ask “where is the cloud” but instead “how does it [the cloud] perceive and analyze the world” (2016, 9)? The challenge of analyzing cloud computing imaginaries, as formulated by Amoore, speaks to the challenge of describing a planet that is not predicated on opposition to the globe (Spivak 2003, 73). Combining theories of perception and aesthetics with critical analyses of cloud computing, here, makes apparent that neither complete connection nor absolute separation, in cloud computing imaginaries, leaves any excess to comprehension.<sup>14</sup>

The dynamic of globe and planet as two sides of the same coin manifests in pursuits of a state of continuous, all-encompassing interconnection. Anthropologist Rachel Douglas-Jones refers to these pursuits as expressing a desire for immersion in computing (2020, 244). In the work of media scholar Tung-Hui Hu, this stability through instability is recognizable in a 1970s American Telephone and Telegraph Company (AT&T) diagram where three clouds represented the amorphous and constantly shifting boundaries of the mixture of digital and analog networks that its videoconferencing system worked on (Hu 2016, X). Since the cloud comprises innumerable connected devices that are all dependent on data flow between these “things” and the cloud, the perceived lightness of cloud computing relies on the speed by which data is transported from where it is produced to where it is stored and to where it is used (Douglas-Jones 2020, 236).

If the cloud represents the idea of a computational system that works by (not just despite) its ever-changing compositional parts, this stability through instability is pushed further in post-cloud computing imaginaries such as fog, mist, and dew computing.<sup>15</sup> Processing or energy inefficiency, transfer cost, and latency threaten the speed, intimacy, and prediction necessary for an envisioned state of continuous interconnection, and therefore computer scientists develop system architectures that are supposed to lighten the cloud (Douglas-Jones 2020, 239). “The main task of fogging,” according to Cisco, “is positioning information near to the user at the network edge” (Abdelshkour 2015). In these atmospheric computing metaphors, the cloud represents the interconnection of data centers and other devices, analogous to a high-altitude cloud bringing water to land-based ecologies, where

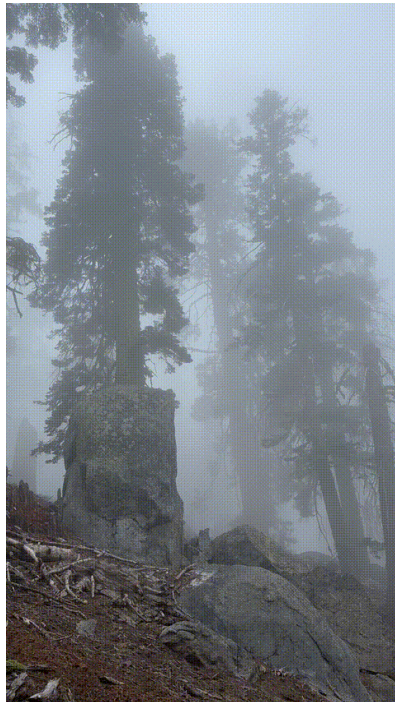
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<sup>14</sup> Timothy Choy phrases this succinctly as “universalizing or particularizing” being “of a piece” because both “seek solid analytic ground, and both find their ground through resort to a ‘one’” (2011, 144).

<sup>15</sup> See also J. R. Carpenter’s remarkable critical-creative investigation of the intersections between meteorology, data storage, and climate change in *The Gathering Cloud* (2017).

condensation happens in the cloud. Fog, mist, and dew computing each promise ever-increasing immediacy and immersion by playing on the notion that these vapor states represent condensation closer and closer to the ground, as in San Francisco's cloud-connected ecosystems where condensation occurs in the contact between moisture suspended in air and rooted "things" (Douglas-Jones 2020, 240).

The material and metaphorical connections between *Fog Bridge #72494* and the cloud computing technologies of the Bay Area invite a consideration of the artwork in relation to these practices of computational modeling and prediction of atmospheric wind patterns. When Silicon Valley's tech companies use words like "cloud," "connection," "ecology," and "fog," they refer to practices where control is achieved *through* uncertainty, vulnerability, and distribution. It is by virtue of connection, ecosystems, clouds, and other vapor states that Google aspires to predict and sell wind energy. Atmospheric metaphors of connection and relation, not as a particular and vulnerable relation between wind and water, fog and tree, but as being everywhere at the same time and thus nowhere in particular, support the idea that data gathering provides unmediated and complete access to the world ([video 4](#)).<sup>16</sup>



Video 4

The data of cloud computing and the cloud chambers of the nineteenth century are comparable in the sense that these technologies *almost* see: they are modes of oblique or indirect perception, like observing the motion of

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<sup>16</sup> On data as unmediated access to the world, see Bridle 2016.

particles through condensed traces (Amoore 2016, 9–10).<sup>17</sup> I argue that *Fog Bridge #72494*, as it is materially and metaphorically intertwined with the cloud-connected ecosystems and cloud computing technologies of San Francisco, speaks to the subtle challenge of thinking of a world that is neither fragmented nor coherent. If *Fog Bridge #72494* is historically situated (continuous with the aesthetics, epistemologies, and technologies that render a global perspective of the atmosphere) *and* phenomenologically experienced (giving a sense but not exactly an overview of its local cloud-connected ecosystems), the artwork coalesces situated experience and global measurement. If the cloud is not about obfuscation but about modes of indirect perceptibility, then what experience of wind does fog enable in *Fog Bridge #72494*?

### Fog as Experience of Wind: Fog-Bound Globe and Planet

Fog is a kind of grounded cloud composed like any cloud of tiny drops of water or of ice crystals, forming an ice fog.

Since water is 800 times denser than air, investigators were long puzzled as to why fog did not quickly disappear through fallout of water particles to the ground.

It turns out that the drops do fall, but in fog creating conditions, they are buoyed up by rising currents, or they are continually replaced by new drops condensing from water vapor in the air.

Their realism is enhanced by smoothing away or ignoring discontinuities in the fog, for images of what we really see when we travel. Beautiful, unrepeatable, fleeting impression can be framed only within the contradicting ambition of her consciousness to acquire impressions and retain her feeling, a way of repeating a dream.

—Mei-Mei Berssenbrugge, “Fog,” *I Love Artists*, 38

When spending time on the pier at Fisherman’s Wharf in San Francisco, a fogbank rolling in through the Golden Gate coastal opening can appear nearly solid. A fogbank, in a moment like this, is a visually coherent mediation of wind. A fogbank looks like a discrete object moved by wind, but it is a dynamic meteorological process, a continuous interplay of water droplets and air currents. As the speaker of the poem “Fog” by Mei-Mei Berssenbrugge notes, because water is so much denser than air, the individual drops of water that make up a fogbank are in a state of constant fall. While

<sup>17</sup> Amoore distinguishes three modes of algorithmic reason, see also *Cloud Ethics* (2020).

continuously falling, “they are buoyed up by rising currents” (2006, 38).<sup>18</sup> Fog is a contradictory visual phenomenon, the speaker continues, in the sense that it is a “[b]eautiful, unrepeatable, fleeting impression,” an ephemeral instance the observer seeks to frame and to retain as “realism” to become an impression as such (Berssenbrugge 2006, 38).<sup>19</sup>

Because air is matter that cannot be seen, smelled, touched, heard, or tasted but does have mass and weight, we see the water suspended in it, though not as drops continuously buoyed by currents but as a fogbank or a cloud. In an essay on eighteenth-century cloud paintings by English Romantic John Constable, literary scholar Mary Jacobus suggests that clouds as such verge on aesthetic indeterminacy: they are confusing not only because they mix elements and change shape but also “because they challenge the phenomenology of the visible” (2018, 221). It is because air is invisible and because we cannot see the movements of minuscule waterdrops that clouds become perceivable objects. To stick with cloud paintings, the famous skies of sixteenth-century Dutch landscape paintings are, in Berssenbrugge’s language, framed and retained: strangely stable yet processual phenomena. Schuppli’s film *Atmospheric Feedback Loops* mentions that the artist Joseph Beuys speculated that the intensification of land reclamation in the Netherlands ruined the unique quality of light that historically drew painters to the Netherlands, because this significantly lowered the amount of water dispersed in the atmosphere (15:11–15:51). It was not just clouds as units but also the airborne invisible multitude of waterdrops redirecting sunlight that generated the aesthetics of these celebrated landscape paintings.

If the cloud and atmospheric clouds are modes of mediated perceptibility, and a cloud analytic involves a sense of incomplete understanding, then a fog analytic (as elemental analytic) entails a similar sensitivity to excess. One way to think about a fog analytic in this sense is through scholarship in media and literary studies that has taken up the complexities of atmospheric formations in their analytic concepts. Derek McCormack’s concept “envelopment” and Margaret Ronda’s “remainders,” for instance, both grapple with the substances and entities carried in air and how they index or give a sense of their condition of immersion without full disclosure or overview (McCormack 2018, 4–5; Ronda 2018, 43–44).

A fog analytic, like the experience of being surrounded by fog, is suspended between global and planetary modes of environmental perception. Once, while walking to the Golden Gate Bridge, an incoming fogbank took me by surprise. As my skin contracted, raising the hairs on my arms in response to its

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<sup>18</sup> For an analysis of Berssenbrugge as a phenomenological poet, see Simpson 2000.

<sup>19</sup> From Michelle N. Huang’s interview with Berssenbrugge and Teddy Yoshikami, I learned that the poem is part of a set of three about the transitional states of water: “Fog” is preceded by the poems “Mizu” (water) and “Alakanak Break-Up” (ice), forming a poetic ecology, see Huang 2020.

cool presence, I could see neither the sky nor the land on the opposite end of the bridge, seemingly suspended in the clouds ([video 5](#)). Fog as material and metaphor has therefore often been imagined in terms of opacity, erasure, loss, and disorientation (Martin 2011, 454). The association of fog with invisibility is reversed by geographer Craig Martin and scholarship in the wake of his theorization of the “fog-bound” by exploring how fog instead highlights relational visibility (2011, 456).<sup>20</sup> Notably, Martin discusses the relational or gathering power of fog in relation to a bridge, as both “serve a similar purpose in relation to their connective potential” (2011, 462). When we are surrounded by fog, we perceive the usually invisible state of immersion in air that conditions our vision, paradoxically not because air becomes any more visible but because we see suspended waterdrops and because other elements in our environment are obscured. Fog, in sum, hovers between clarity and opacity, vision and immersion, and distance and proximity (Martin 2011, 465).



Video 5

### ***Fog Bridge #72494: Conversing with Wind***

When *Fog Bridge #72494* simulates fog, it sometimes makes this fog readily available for visitors to interact with it, comparable to how MeeFog Systems produces fog for tech companies to use as cooling infrastructure. Other times, the wind takes hold of the sculpture. Nakaya once remarked that she appreciates the impetuous atmospheric conditions of San Francisco because

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<sup>20</sup> Such as feminist scholars Sonja Boon, Lesley Butler, and Daze Jefferies, scholar of political aesthetics Esther Leslie, and interdisciplinary researcher Ifor Duncan, see Boon, Butler, and Jefferies 2018, 65; Duncan 2021, 39; Leslie 2021, 98.

it allows her to “converse with the wind more” (Exploratorium 2024, 01, 40–01, 55). In other words, while her previous fog sculptures also interacted with air currents and other atmospheric conditions, *Fog Bridge #72494* is subjected to these conditions: it is sometimes disrupted by the wind ([video 6](#)).



Video 6

Fog engineered to converse with the wind, fog simulated to humidify data centers. Cloud infrastructures developed to predict and control wind, cloud-connected ecosystems precariously dependent on wind. Redwood trees and artificial mesh nets capturing fog and distributing water. Connection as partial and particular, connection as everywhere simultaneously. This essay has traced some of the cultural and environmental connections between *Fog Bridge #72494* in the San Francisco harbor, the Bay Area’s cloud-connected ecosystems, and Silicon Valley’s cloud-computing imaginaries. As medium of wind, suspended airdrops can make otherwise invisible air currents available, rendering wind traceable and measurable, though always obliquely. As model of wind, fog and other vapor-state computing metaphors highlight imaginaries of complete immersion in a quantified atmosphere. As experience of wind, being surrounded by fog lets us see the air that we otherwise see in and through. Prompted by the mutual relation between wind and fog, in which fog is a medium of wind and where wind also mediates fog, where fog and wind function as each other’s mediums, this essay has explored how *Fog Bridge #72494* coalesces technology and ecology, perception and milieu, and media and environments.

Its vulnerability to—its conversing with—wind makes *Fog Bridge #72494* different from, for example, environmental artist Olafur Eliasson's use of haze machines to fill the Tate Modern's Turbine Hall with fog for *The Weather Project* (2003). Haze machines are commonly used in clubs or concert venues because they create a translucent fog that enhances the visibility of light shows.<sup>21</sup> As literary scholar Louise Hornby argues against the critical reception of Eliasson's work, *The Weather Project* reifies the experiencing agent by centralizing an individual encounter with the atmosphere, foreclosing any notion of excess, or atmospheres beyond a witnessing subject (2017, 81). Whereas *The Weather Project* puts fog into an enclosed space to render it available and overseen by visitors, *Fog Bridge #72494* performs the laborious work of simulating fog and then sacrifices it to atmospheric circumstances beyond technological control or individual experience.

*Fog Bridge #72494* is therefore more like geographer Sasha Engelmann's description of art projects like the *Open-Weather Community* (n.d.) and the World Weather Network (2022), which reappropriate technologies for remote sensing, prediction, and measurement to use alongside embodied investigations of weather.<sup>22</sup> As Engelmann notes, while cultural geography, feminist science and technology studies, and anthropologists have often worked to resist technoscientific accounts of the atmosphere, to resist the global perspective, accounts of the weather that combine bodily and infrastructural methods can avoid reproducing dichotomous accounts of bodies and technologies, ground and sky, and situated context and abstract measurement (Engelmann 2023, 2–3, 14).<sup>23</sup> *Fog Bridge #72494* does so every time it simulates fog, activating centuries of military, scientific, and technological research into atmospheric control, only to disperse in the wind.

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21 See also PLASA (Professional Lighting and Sound Association) North America 2015.

22 For another comparable art-science project, see Bremner et al., *Monsoon as Method: Assembling Monsoonal Multiplicities* (2022).

23 In addition, see Richardson and Munster 2023 for a reading of machine envisioning as radically incomplete and Kroth 2024 for an account of a shift in feminist scholarship from criticism *of* remote sensing to criticism *with* remote sensing.

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