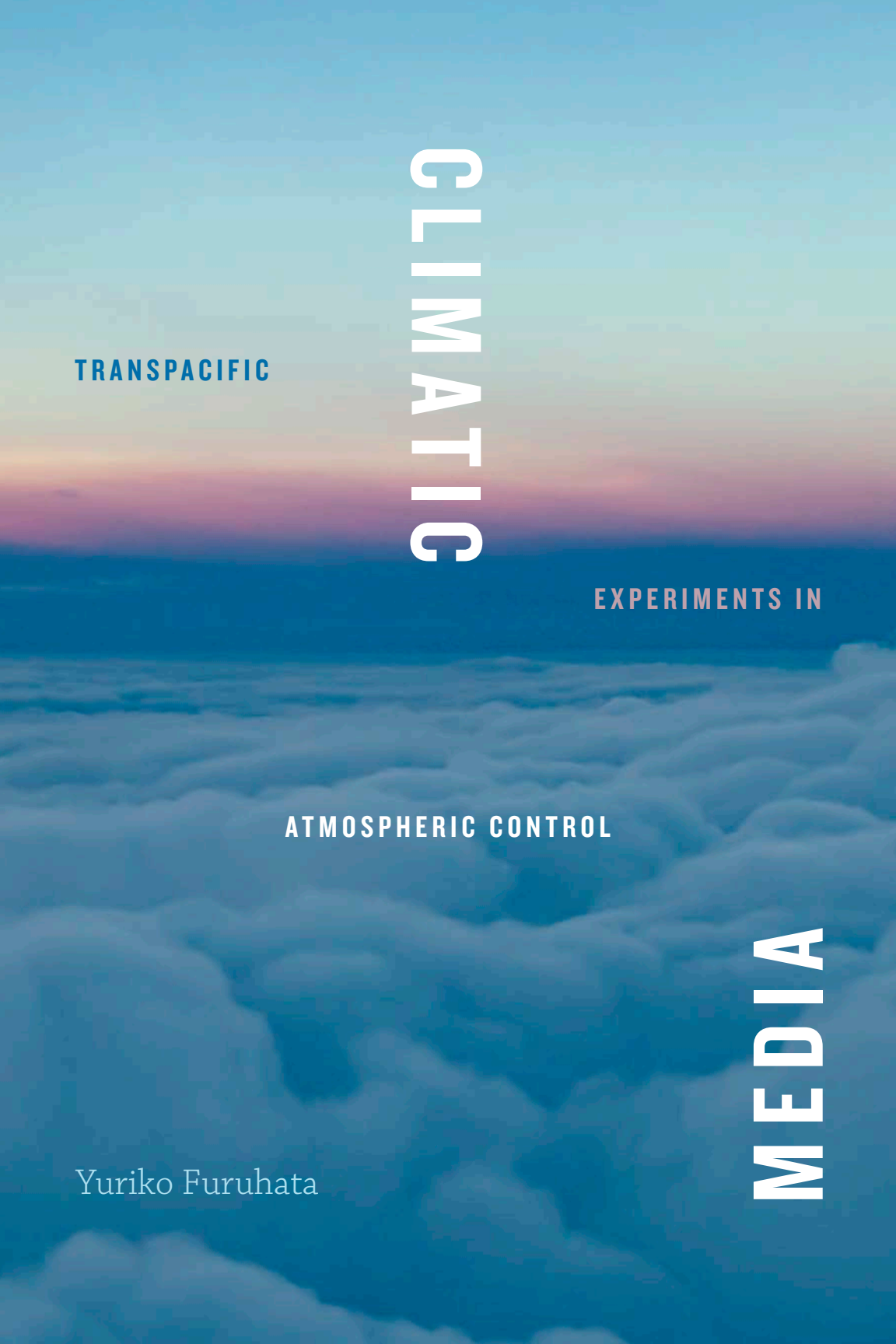
CLIMATIC MEDIA
TRANSPACIFIC EXPERIMENTS IN ATMOSPHERIC CONTROL
Yuriko Furuhata

CLIMATIC MEDIA

ELEMENTS *A series edited by Stacy Alaimo and Nicole Starosielski*

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TRANSPACIFIC EXPERIMENTS IN ATMOSPHERIC CONTROL

YURIKO FURUHATA

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Summer in Asia can be unbearably hot and humid. The rising air temperature in metropolitan cities like Tokyo in the middle of summer makes you duck into shopping malls and underground metro stations, and grasp for handheld miniature fans. A wearable air conditioner that you can slip into the back pocket of a customized T-shirt, which you control with a virtual thermostat on your smartphone app, is apparently the next big thing.[1] As the planet keeps heating up and extreme weather wreaks havoc on our cities, we crave more portable air-conditioned bubbles to carry with us and more climate-controlled shelters to inhabit.

Albeit at an immensely larger scale and by different mechanisms, the desire to cool down the atmospheric bubble in which we inhabit animates the discourse on planetary climate engineering. While we breathe mechanically filtered air and keep our bodies cooled inside air-conditioned houses and offices with the help of computational media such as smartphone apps, the use of solar radiation management to enhance the reflective capacities of clouds to block incoming sunlight and thus cool down the planet is gaining traction among scientists, engineers, and investors. The same thermostatic desire to build microclimates around us and to regulate Earth's macroclimate through geoengineering is increasingly defining the relationship between media and climate that we encounter in our daily life.

This desire for atmospheric bubbles controlled by a virtual thermostat has historical and geopolitical roots. The aim of this book is to trace these roots by offering a media studies perspective on a transpacific genealogy of atmospheric control with emphasis on the legacies of Japan's imperial expansionism and its Cold War alliance with the United States.[2] Central to this story are the crucial roles played by Japanese scientists, architects, and artists in developing and shaping the technologies and media infrastructures used today to monitor and modify both local weather

and planetary climate. Climate engineering is interpreted broadly in this book to mean not only planetary-scale geoengineering but also the modification of microclimates within controlled and enclosed environments, such as a laboratory, a greenhouse, or an air-conditioned building.

Some of these technologies of engineering indoor climates are simple cooling devices, such as fog-based air conditioners, which are now part of the infrastructure of cloud computing. Others involve more complex simulation models and chemical reactions as in the case of numerical weather prediction, cloud seeding, and tear gas. These technologies directly "condition" and alter Earth's atmosphere, albeit at different scales. Conditioning the atmosphere by means of these technologies targets the physicochemical composition of the air, which in turn creates microclimates that affect the behavior or "conduct" of people and things. Conditioning air and conditioning people are two sides of the same operation. As Daniel Barber aptly writes in his analysis of modernist architecture's use of the façade and shades, "Air conditioning is people conditioning."[3] Additional technologies of atmospheric control discussed in this book work through signals in the air and on the ground, as in the case of networked systems of computing and surveillance designed for the purpose of the social conditioning of urban populations. All of these are forms of atmospheric control that operate through the mediation of what I will call, in this book, *climatic media*.

The genealogy of climatic media offered in this book thus covers a range of experiments, from the modification of natural weather in the sky and the production of artificial weather inside built environments to the transformation of urban infrastructures filled with systems of ambient intelligence, smart sensors, cameras, and sometimes clouds of tear gas. By connecting dots and nodes across seemingly distant histories of architecture, atmospheric science, digital computing, and environmental art on both sides of the Pacific, I analyze how media became articulated with climates, and trace climatic operations of media through various technologies and techniques of atmospheric control. Emerging at different historical moments, these media aim to manipulate the atmosphere and exert (or at least aspire to exert) a calculated control over both the environment and the lives within it. Together, they express what I call *thermostatic desire*, a technophilic desire to posit atmosphere itself as an object of calibration, control, and engineering.

This thermostatic desire manifests in both geopolitical and biopolitical motives to secure a livable future environment, either through engi-

neering the atmosphere itself, or engineering built structures to protect certain populations from (and threaten others with) an increasingly inhospitable atmosphere. Engineering of the atmosphere often operates as a means of geopolitical and biopolitical governance. More broadly, the atmosphere and its elements incorporated into climatic media also speak to modern anxieties not only about nature itself—limited resources, increasingly extreme natural weather events, rising sea levels, and warming temperatures—but also about the technologies used to mediate, control, or secure a habitable environment.

To follow Peter Sloterdijk's well-known provocation, the twentieth century is marked by a paradoxical process of "explicating" and instrumentalizing the taken-for-granted background givenness of the atmosphere.[4] First with aviation and the use of poison gas, and later with the weaponization of weather and radioactive fallout from atomic bombs during both World War II and the Cold War, technology made explicit (and thus explicated) the question of security as the central focus of territorial control over the atmosphere. With the rise of greenhouse effects and anthropogenic climate change, this territorial understanding of the atmosphere has also yielded to the planetary awareness of Earth's atmosphere as the limits of the habitable environment. The deepening climate crisis poses an existential threat for the future. By way of response, scientists, engineers, policy makers, and others fall back on a reframing of Earth's gaseous envelope via a territorial logic of governance, which began in the mid-twentieth century.

To analyze this process of atmospheric explication from the perspective of media studies, I highlight different ways in which technological conditioning and engineering of indoor and outdoor atmospheres operate as climatic media. My use of the term *climatic media* is in part inspired by the discussion of making climate change legible through the mediation of thermal imaging, photographs, charts, diagrams, and other instruments of data visualization in the field of architecture.[5] In addition to technical images, which make climatic fluctuations legible, I suggest that we need to expand the referential scope of climatic media more broadly, in the following two senses.

First, we can expand the definition of media to include the materiality of elements that condition our milieu. These include natural elements such as fog, snow, and rain as well as chemical elements and compounds such as silver iodide, nitrogen, and phosphorus. My rationale for this comes in the wake of recent turns to environmental studies, infrastruc-

ture studies, media ecology, media archaeology, and so-called German media theory within North American media studies.[6] These reorientations of media studies to move beyond conventional media objects (e.g., film, radio, television, telephone, the internet, and social media) push us to rethink our assumptions about media primarily as tools, channels, and platforms of recording, storage, broadcasting, telecommunicating, and data processing. As John Durham Peters suggests, the natural elements of weather can also be considered "sky media," as the sky has been historically aligned with timekeeping technologies such as the clock and the calendar.[7] Building on these recent elemental approaches in media studies (about which I will say more shortly), I pay close attention to the materiality of natural and chemical elements in my genealogical exploration of climatic media.

Second, I suggest that we expand the definition of media to include the architectural, scientific, and artistic techniques and technologies of producing climate-controlled bubbles and modifying weather. These techniques and technologies work as media that actively mediate and shape what counts as a habitable environment and for whom it appears livable. But habitability is only one part of the story that the following chapters tell. This story of climatic media also includes meteorological experiments such as site-specific modifications of weather by scientists, architects, artists, and militaries. My argument is that intertwined experiments in indoor climate engineering, weather modification, and networked computing in Japan and the United States during World War II and the Cold War played a key role in the later development of the techniques and technologies of building air-conditioned bubbles, which have become an integral part of the critical infrastructures of our contemporary cities.

As David Gissen and others have suggested, the conception of architecture as "a conditioned space" is quite modern.[8] Studying architecture from the standpoint of producing comfort through air-conditioning is also well established. Reyner Banham, for instance, analyzed modernist architecture through its mechanisms of ventilation, air-conditioning, and illumination in his classic work *The Architecture of the Well-Tempered Environment* (1969).[9] More recent studies of air-conditioned spaces further explore the political, environmental, and economic consequences of designing "well-tempered" environments that ostensibly increase the comfort and productivity of those inside them. From British colonial

houses in the tropics to gentrification in American cities (the latter intensified by the air-conditioned interiors of commercial buildings), these studies collectively suggest that climate design has been central to the history of modern architecture.[10]

This book addresses a similar set of concerns but does so with different takeaways in mind. I foreground the imperial roots of Japanese architecture through the work of Tange Lab architects, including those associated with the internationally renowned postwar architectural movement of Metabolism. In particular, I examine their experiments with architectural techniques and technologies of climate engineering in the form of capsule houses and shelters, some of which were designed to withstand extreme weather conditions in Antarctica and the Arctic.

I also read these architectural experiments in relation to meteorological experiments with fog, snow, and rain undertaken by Japanese scientists and artists. The work of the physicist Nakaya Ukichirō—known as the inventor of the world's first artificial snow crystal as well as being an expert on ice, snow, and frost formations—offers one point of scientific anchorage for my inquiry. The Low Temperature Science Laboratory and the Institute of Low Temperature Science at Hokkaidō University, which he established in the 1930s, helped advance research on cryospheric and atmospheric science. Japanese researchers at the laboratory observed and studied the impacts of fog, snow, frost, and ice on farmlands, railroads, housing, and military aircraft. Some of their studies were meant to directly aid Japanese colonial settlements in Manchuria in the 1940s and were later consulted by architects who designed capsule housing for Antarctic expeditions in the 1950s.

The cryospheric and atmospheric research conducted by scientists at the Institute of Low Temperature Science also aided Nakaya Fujiko, Nakaya Ukichirō's daughter and environmental artist known for her exquisite fog sculptures. Moreover, these scientific, architectural, and artistic experiments with weather and climate had institutional and personal ties to North American counterparts as well. These transpacific affiliations and connections span across diverse groups and institutions in the United States, including Experiments in Art and Technology and the Snow, Ice, and Permafrost Research Establishment. Tracing these interdisciplinary arcs, which traverse the Pacific, is like following winds and storms that blow across state borders. It is this spirit of the atmospheric circulations of air that inspires my transpacific approach in this book.

Just as climate design matters to architecture, temperature matters to media. As Nicole Starosielski argues, precise control over temperature at the elemental level of manipulating minerals and metals is crucial for the construction and maintenance of analog and digital media. These minerals and metals are mined, cooked, refined, and homogenized in order to ensure the consistent performance and smooth operation of such media. From the mining of coltan used for smartphones to the purification of copper and silica used for cable networks, thermal manipulations of minerals and metals are integral to our contemporary media conditions.[11]

The elemental conditions of media can also affect the atmospheric bubbles we create and carry around with us. To take a banal example, think of our portable sonic milieu. On extremely cold days, the tiny connector between my iPhone and earphones often stops working as I walk through snowy streets listening to music, bursting the ambient sonic bubble that I had created around me. Such a technological breakdown is a subtle reminder that elemental conditions materially affect the performance of digital media objects. Their optimal performance also relies on other material conditions, such as the extraction and processing of rare earth minerals and metals, which generate toxic by-products and contribute to polluting water, air, and soil. These chemical elements, too, operate as media in their capacity to serve as an intermediary agent of action and as a milieu that surrounds us.

Recently, scholars across disciplines in the humanities and social sciences have turned their eyes to the capacious concept of *element* and developed new materialist, post-phenomenological, and ecocritical approaches to studying relations between human and more-than-human actors. These elemental modes of thinking cover a diverse body of research, some of which treat elements along the lines of the classic primary matter in Greek philosophy (air, water, fire, and earth), while others turn to the molecular compositions of fossils, plastics, and chemical pollutants.[12]

Within the field of media studies, scholars such as Nicole Starosielski, John Durham Peters, Jussi Parikka, and Jennifer Gabrys have called attention to the material and infrastructural reliance of our media objects on the technological manipulation of elements—from laptops to fiber-optic cables. They urge us to rethink the production, distribution,

and operation of technical media in relation to various elements, such as natural weather, metals, minerals, and chemical compounds.[13] My approach to climatic media similarly foregrounds the mediating functions and affordances of natural and synthetic elements, which form the material basis of architectural enclosures and air-conditioning systems that operate as climatic media.

The elemental approach to media that takes material relations and performances of matter seriously is echoed in the study of atmosphere and atmospherics in the fields of cultural and human geography. For instance, Peter Adey draws on the Greek philosophy of classic elements, in particular the element of air and the alchemic metaphor of elemental affinities, to propose an interdisciplinary method of studying "an elemental geography of air." For him, air is as much a primary matter as an affective relation. In dialogue with the works of Ben Anderson and Derek McCormack among others who approach atmosphere relationally, Adey proposes thinking of elements as preindividual tendencies toward structures of feeling, shaped by the geopolitical, economic, and philosophical interests of the time.[14] Other scholars, such as Andreas Philippopoulos-Mihalopoulos and Mark Whitehead, have approached the question of atmosphere in relation to the juridical and governmental practices of partitioning space and instituting laws and civic norms.[15]

A contrasting discourse on atmosphere is found in the field of marketing, where atmospherics is discussed as a retail design practice that aims to manipulate consumers' emotional states and encourage them to purchase products through the use of ambient effects, such as sound, smell, and lighting.[16] Within the field of Japanese media studies, Paul Roquet has taken up this marketing practice of atmospherics to analyze how an ambient factor, such as the background music of Muzak, functions as "a tool of atmospheric mood regulation" and an instrument of neoliberal subjectivization. The simple act of listening to a personally curated playlist in order to motivate oneself to get through the day, for instance, works as a somatic technique of the self.[17]

The growing body of literature on atmosphere and atmospherics explores the affective and sensorial dimensions of atmosphere and their attendant techniques of the self. My approach, by contrast, puts less emphasis on the affective and sensorial processes of subjectivization and focuses instead on the intersections of scientific, architectural, and artistic deployments of the physical atmosphere. I do so in order to analyze the transpacific context of climatic media in the twentieth century

with an eye toward the lingering legacies of Japanese imperialism and the Cold War.

While my approach to atmospheric control takes a different path than the body of literature that foregrounds the affective, subjective, and sensorial understanding of atmosphere and atmospherics, it shares an understanding of atmosphere as both meteorological and social, as well as geophysical and political. Indeed, this duality of atmosphere is why I present atmospheric control as a double process of conditioning: *air-conditioning* and *social conditioning*.[18] Both forms of atmospheric control require climatic media as their conduits and means of governing, managing, regulating, and optimizing the movements of elements and lives.

The meaning of atmospheric control is hence twofold. On the one hand, it is about controlling atmospheric phenomena in order to create site-specific microclimates, such as the aesthetic use of artificial fog to create a responsive environment, the weaponization of hurricanes, and the use of artificial fog to cool down data centers. On the other hand, I use the term *atmospheric control* to mean the instrumentalization of built environments and ambient factors such as light, sound, temperature, and humidity for the purpose of policing and managing the circulations of bodies that move through these environments.[19]

A banal example of atmospheric control as an instrument of social conditioning is the deployment of infrasound to keep people and mosquitoes away. Infrasound is allegedly being used by convenience stores in order to deter teenagers from loitering at their storefronts. This experimental use of infrasound for the purpose of deterrence targets the demographic group of youth; a certain range of high frequencies are only audible by young people, and as we grow older we lose our hearing capacity for these frequencies.[20] Such preventive uses of ambient elements like infrasound on humans and insects has increased along with the proliferation of sensors, meters, and surveillance cameras that track down and monitor the movements of the urban population, a situation that has become pervasive in recent smart city initiatives.

More relevant to this book is the example of McDonald's strategic use of hard, uncomfortable seats and overly cold air-conditioning inside their restaurants to discourage customers from remaining too long. Air temperature here works as an atmospheric means of social conditioning, ensuring the continual and fast-paced circulation of customers in and out of the building.[21] An even more obtrusive case of atmospheric control for the explicit purpose of regulating the conduct of people oc-

curs with the use of tear gas for urban policing. Tear gas is a much more harmful form of outdoor air-conditioning that is also a means of social conditioning. Conditioning of the atmosphere is thus part of what Michel Foucault calls the modern regime of governmentality, which operates through the "conduct of conduct," governing people and things by nudging, guiding, leading, and controlling the manner in which they behave.[22] Accordingly, I use the term *conditioning* to mean modifying, habituating, training, acclimatizing, and altering states of being. The processes of atmospheric control that operate at the levels of physical air and social conduct, I argue, are enabled and mediated by a variety of technologies that I heuristically call climatic media. The operations of atmospheric control mediated by climatic media target both the physical air as well as the conducts and behaviors of those who inhale or inhabit such an altered atmosphere.

CULTURAL TECHNIQUES AND ELEMENTAL PHILOSOPHIES

One way to analyze how atmospheric control works through the double process of air-conditioning and social conditioning is to look at specific technologies as they mediate, demarcate, and articulate different actors, objects, and milieus. Here, it is important to keep in mind that these technologies as well as the cultural techniques associated with them are both culturally and historically situated.

The work of the German media scholar Bernhard Siegert provides a useful framework for examining how the nonmechanical techniques as well as technologies of atmospheric control can operate as forms of climatic media. The methodological approach of studying media through the lens of "cultural techniques" (*Kulturtechniken*) often goes by the label German media theory. Like elemental philosophy, this German school of media studies, with its orientation toward archaeology and anthropology, affords a methodological opening to expand the conceptual scope of media.

Media broadly understood as cultural techniques—in addition to machine-based technologies—can encompass humble mediating devices, such as the door and the wall, as Siegert has noted. The built interface of the house provides the technical conditions of possibility for the operation of the symbolic separation between nature and culture, inside and outside, sacred and profane, and other binary distinctions that structure our daily lives.[23] In a predictably post-structuralist manner,

Siegert argues that these binary symbolic distinctions are constantly undone through the intermediary cultural techniques of media themselves. His reliance on structural binaries notwithstanding, a useful takeaway from Siegert's account of cultural techniques is that the technical operation of media is both material and symbolic. The door-as-media, for instance, physically lets something or someone pass through it, as much as it symbolically demarcates the inside from the outside.[24]

Siegert's media archaeological theory of cultural techniques has some methodological limitations, however. As Weihong Bao persuasively argues, Siegert's theory of media reproduces certain colonial assumptions of early cultural anthropology and archaeology about non-Western cultures.[25] With such critique in mind, this book traces the transpacific context of specific techniques and technologies of atmospheric control. I adopt this media archaeological approach to cultural techniques with caution, in no small part because my investigation of climatic media is concerned with the imperial and colonial ambitions that use architecture and science as a means of expanding geopolitical spheres of influence by certain states and empires, including the former Japanese Empire.

As I elaborate more in later chapters, the architectural techniques and technologies of building walls and roofs to construct greenhouses, domed cities, and spaceship-like capsule houses, in fact, have much in common with the modern imperial projects of biopolitically managing habitats and the human populations within them. Like crops and plants grown inside greenhouses, humans have been managed and fostered inside climate-controlled environments. Seemingly innocuous agricultural metaphors that dominate the contemporary vocabulary of geoengineering (e.g., *seeding* clouds with silver iodide particles) also suggest how agricultural techniques for cultivating crops have inspired geoengineering technologies for cultivating rain. Like the plants on the land, the clouds in the sky are seen as cultivable, as if the weather can be tended, fertilized, and harvested like terrestrial vegetation. These agricultural analogies of cultivation point to underlying epistemic assumptions and cultural expectations that accompany the operations of atmospheric control. To read such operations through the media theoretical lens of cultural techniques thus means to attend to the assumptions behind these analogies.

With the advent of digital computers used for weather forecasting and other future-oriented predictions, techniques and technologies for cultivating weather have advanced and converged with techniques and tech-

nologies for designing and constructing air-conditioned computer rooms and data centers. Read alongside earlier colonial practices of building shelters and greenhouses, these climate-controlled "houses" for computers present a variation of the same thermostatic desire. Computers, like humans and plants, need to be sheltered (and cultivated if we follow this analogy) inside architectural bubbles that offer temperate climates. German media theory's take on cultural techniques, in short, enables me to take this methodological move to explore architectural techniques of air-conditioning and geoengineering technologies of weather modification as genealogically linked yet divergent forms of climatic media.

To explain this methodological move, let me turn to another anecdote of air-conditioning in Asia. This anecdote illustrates how the element of wind and its technical manipulation may be analyzed from the perspective of media studies. In my visit to Hong Kong one summer, I was struck by what appeared to be an odd sight. Many of the city's high-rise apartment complexes and skyscrapers showed fairly large holes in their middle sections. What I heard was that in accordance with local lore and the feng shui (literally, "wind and water") principle of not cutting off good energy flows, these holes let mythical dragons fly through the buildings. It turns out that these stunning architectural features have the more pragmatic effect of ventilating air in an otherwise densely built urban environment. Combined with engineering knowledge, these dragon holes help air-condition the island by creating breezeways to let the tropical air circulate.[26]

For Peters, rethinking techniques of controlling natural elements like air and wind requires a philosophy of elements such as the Greek philosophy of primary matter (earth, water, air, and fire).[27] But these mythical dragons slip through the epistemological grid of Greek elemental philosophy, as they follow the Chinese philosophy of five elements, or more precisely, five elemental phases: wood, fire, earth, metal, and water. To commit to fully philosophizing elemental media within media studies requires accounting for different cosmological and epistemological lineages of understanding what we mean by the term *element*, while paying particular attention to the conditions in which such elements are manipulated in attempts to control them. Historically and culturally situated studies of elemental media invite us to think about elemental philosophies in a more comparative framework and to probe the epistemological basis of elements themselves.[28]

This is not, however, a simple call to think elemental philosophies

comparatively beyond the Western cosmological paradigm of Greek philosophy. Nor do I suggest that we need an Eastern cosmology of elemental media based on the philosophy of five phases. After all, there are myriad local interpretative differences, historical transformations, and political appropriations of feng shui (a geomantic art that developed as an imperial practice in ancient China). Unlike Hong Kong and Singapore, where it still exerts some influence on urban design, the Communist government in mainland China banned it as superstition. In Japan, feng shui found its popular application in designing the interior spaces of domestic architecture, rather than locating auspicious sites for ancestral graves or designing harmonious cities as it was originally intended.[29]

More importantly, to analyze the so-called dragon holes in Hong Kong buildings solely through the cosmological or philosophical framework of elements and primary matter is to overlook the important fact that they are not simply built for the cosmological movement of mythical creatures or, more precisely, the auspicious energy that they represent. They are also designed for ventilating the tropical air. In this case the philosophy of elements (be it Greek or Chinese) alone cannot offer a full picture of the architectural technique for ventilating air by creating breezeways in the middle of high-rise buildings. Analyzing this cultural technique of controlling atmospheric phenomena within urban space as a problem of engineering the air, in short, prompts us to pivot away from the philosophical understanding of elemental control and toward a historically situated set of skills, technologies, and knowledges.

Furthermore, neither Greek nor Chinese philosophy can explain the epistemic basis of cloud seeding, a chemically induced technology of controlling weather. Operationalized in the 1950s, the modification of weather by seeding clouds with chemical compounds such as silver iodide theoretically allowed one to artificially induce rain. Geoengineering through chemistry, mediated by the scientific knowledge of modern meteorology, has supplanted ritualized forms of rainmaking. With the rise of cloud seeding, *chemical* elements have become the direct medium of controlling the *natural* elements of weather.

Meteorology became the modern science of weather only after its object of study moved away from a wide range of "meteors" in the classic sense. It henceforth became the science of weather devoid of rituals and omens wherein the atmosphere was an object of laboratory experiments and scientific measurements. Before the rise of modern meteorology, technical attempts to modify weather were closely aligned with

cosmological and religious interpretations of atmospheric and celestial phenomena. In Europe, for instance, various phenomena in the sky—not just weather but also comets, eclipses, and even earthquakes—were generally called meteors. Such meteors were interpreted as prophetic omens and messages from the gods and divine entities.[30] In Japan, like other parts of East Asia, folk rituals for rainmaking similarly called upon dragon gods and other divine figures. Weather modification was the domain of rituals, and its operation was not yet technologized.

Crucial to the epistemological shift in emphasis from extraordinary meteor to ordinary weather "was a removal of phenomena from a *spatially* defined region to a *physico-chemically* defined body of air" in the late eighteenth and early nineteenth centuries.[31] Ordinary weather became a scientific object of prediction only after the epistemological reorientation of the atmosphere took place. Meteorological phenomena were no longer explained by mystical interactions between the indivisible elements of air and water in the celestial and sublunary regions, but by Earth's gravity, barometric pressure, and molecular interactions among chemical elements such as oxygen and hydrogen in the atmosphere.

The chemical wonder of cloud seeding to bring artificial rain, unlike rainmaking rituals, presupposed a different cosmological outlook on meteorological conditions, as it aimed to technologically control and modify weather.[32] Since the mid-twentieth century, chemically induced rainmaking has been popular in many parts of East Asia and Southeast Asia where the lore of dragon gods associated with rainmaking rituals and the philosophy of five elemental phases once explained meteorological wonders. Like the United States and Japan, China was one of the early experimenters of cloud seeding.[33] Today, China continues to carry out localized weather modification projects and invests heavily in geoengineering research.[34]

Similarly, Japanese hydroelectric companies have financed a number of weather-modification experiments to increase rainfall since the 1950s. Armed with dry ice and airplanes that spray clouds with silver iodide particles, these modern-day rainmakers have conjured chemically seeded clouds in the sky instead of offering supplication to the dragon gods. Japanese scientists have also long contemplated the possibilities of climate engineering. Take, for instance, a proposal to barricade the Drake Passage by the Japanese physicist and futurologist Higuchi Keiji (who unsurprisingly was also a student of Nakaya Ukichirō). Higuchi proposed a speculative project of engineering the planetary climate by

building a gigantic dam made of ice near Antarctica to alter the direction of ocean currents. Higuchi, an expert on snow and ice science, presented his vision of this "iceberg dam" at the International Conference on Future Research in 1970. His aim was to develop computational models for long-term climate change by thinking through this hypothetical use of icebergs as building materials to create a dam to alter the cold ocean currents flowing from Antarctica to the Japanese archipelago.[35]

At the basis of such a proposal to geoengineer the planet was the cybernetic vision of controlling the planet's imaginary thermostat through feedback loops. This demonstrates a crucial shift from the merely chemical understanding of weather modification to a cybernetic model of geoengineering. Arguably, the epistemological parameters of controlling weather shifted once again: from chemistry to cybernetics.

The discourse of cybernetics hence played a significant role in bridging scientific, architectural, and artistic experiments with artificial weather. Along with systems theory, it not only influenced the futurological vision of climate engineering but also urban planning and design practices in Japan, much as it did in the United States.[36] Dreams of modifying the weather and rerouting ocean currents were fostered in relation to cybernetics. The cybernetic logic of feedback also found its application in architecture and urban design in the mid-twentieth century. While national defense experts associated with think tanks such as the RAND Corporation introduced the view of the city as a cybernetic system to the field of urban planning in the United States, it was Tange Lab and Metabolist architects (some of whom were ardent "futurologists") who helped bring cybernetics and systems theory into urban design in Japan. The connections across futurology, cybernetics, and systems theory that led to proto-smart city experiments, including little-discussed visits by Norbert Wiener to Japan, will be explored in later chapters.

These futuristic dreams of geoengineering the planet and regulating cities as cybernetic systems were in large part prompted by the exponential increase in access to digital computers, which made it easier to simulate climate change and urban developments.[37] Since the 1950s and 1960s, both meteorology and urban design have been mediated by computers. With the increased reliance on numerical computational models and global networks of satellites, sensors, and supercomputers supported by enormous communication and energy infrastructures (not the least of which are air-conditioned data centers), weather prediction has moved far away from reading the sky for signs and interpreting weather

charts. Architects and urban planners have also changed their outlook on cities. One of the goals of this book is to explore how digital computers and cybernetics brought together the seemingly distant fields of atmospheric science and architecture.

TRANSPACIFIC GEOPOLITICS OF CLIMATE

If the planetary scale of climate geoengineering is put into practice, the results will be unevenly distributed; some countries and regions will benefit more while others will suffer more severe droughts, floods, and heatwaves. Engineering of the planetary climate is increasingly seen as "the 'whose-hand-on-the-thermostat' problem."[38] Given there will be no evenly distributed climate across the planet, the question of who gets to program and moderate this geoengineering thermostat remains deeply problematic and is a source of geopolitical tensions as well.

To think about climate is therefore to think about geopolitics. In fact, modern geopolitical thinking was always already climate dependent. That is to say, climate is geopolitical not only because of pragmatic concerns of international regulations over carbon emissions, geoengineering, and climate refugees (though these are certainly important). Climate is also geopolitical because of the historicity of the notion of *climate* and how it has been mobilized in direct support of imperial and settler colonial projects.

In its basic sense climate means the average weather conditions of a particular geographical zone; it has always been integral to the modern discipline of geography. And modern geography started as an imperial science, which shared a climatically determinist view of culture with philosophy and meteorology.[39] Studies of settler colonialism and imperialism have shown that the challenges posed by harsh and unfamiliar climate conditions prompted European settlers, explorers, geographers, architects, and engineers to develop various techniques and technologies of acclimatization. These strategies of acclimatization, including air-conditioning, were often discussed and framed in the climatically determinist discourse of culture and race.[40]

In the nineteenth century, as Japan was developing as a fledgling empire, the climatic determinism that informed Euro-American settler colonial practices also found its home there. From the northern islands of Sakhalin and Hokkaidō, the homeland of the Indigenous Ainu people, to Taiwan, Manchuria, and the Pacific Islands, Japanese colonial adminis-

trators, along with scientists and architects, sought a means of acclimatizing settlers and transforming the climatic conditions of the occupied territories of the Japanese Empire.[41]

For one salient example of Japanese climatic determinism, which was in tune with the state project of empire building, let me briefly turn to the work of the Kyoto School philosopher Watsuji Tetsurō. His well-known analysis of the existential connection between climatic zones and ethnonational characters in *Climate and Culture* (*Fūdo,* 1935) draws heavily on and echoes the language of Euro-American discourses on climatic determinism. As Roquet notes, Watsuji viewed the self-understanding of one's existence as always mediated through one's "affective relationship with the larger climate." A nation's climate also forms the basis of a shared sense of belonging: "Because everyone is shaped by the weather together, Watsuji argues, and (he implies) all shaped *in the same way*, atmosphere can be understood as the original force that ties a nation together."[42] It is this affective process of subjectivization that Roquet links to neoliberal technologies of mood regulation.

In the context of this book, what interests me most about *Climate and Culture*, however, is not Watsuji's theorization of subjectivity, but his turn to a set of texts written by German and Swedish geopoliticians. Starting with the late eighteenth-century German philosopher Johann Gottfried von Herder's coinage of the term *Klimatologie* (climatology), Watsuji reviews the work of the founding figures of German geography including Friedrich Ratzel and Rudolf Kjellén, the latter of whom coined the term *Geopolitik* (geopolitics). Watsuji discusses their geopolitical theory of the state "as a living organism" that naturally propels itself toward expanding its living space (*Lebensraum*) at length.[43] Given the fact that some of the texts he discusses were published just a few years before Watsuji's own work, it is not surprising that, as a philosopher who positioned himself as an interlocutor and critic of Martin Heidegger, Watsuji actively engaged with the latest German scholarship in the late 1920s and early 1930s. The intellectual exchange between the two fascist states—Germany and Japan—is indeed central to the analysis of Japan's wartime discourse on geopolitics that I develop in later chapters.

Watsuji's work also demonstrates that the modern conception of geopolitics is inseparable from climate determinism. This geopolitical view of the state as a living organism heavily influenced the Japanese architectural experiments to expand the living sphere. Architectural experiments with climate-controlled buildings and their views of cities as

living organisms, undertaken by renowned architects associated with Tange Lab (including the Metabolist group) before and during the Cold War, exemplify this geopolitical undertone of atmospheric control as expressed in the field of architecture.

In the 1950s and 1960s, thinking about climate became geopolitical in another sense. It was then that the studies of radioactive fallout caused by nuclear weapons testing reshaped the field of atmospheric science. Global wind patterns were mapped, and ecological and biomedical data of the devastating effects of radiation were collected at testing sites. The United States deliberately chose the Marshall Islands in the Pacific, inhabited by the Indigenous people of the islands, as its nuclear weapons testing site (among other locations) for their presumably insular ecosystem. Atmospheric research on radiation and ecosystem theory then led to the new vision of an integrated planetary biosphere.[44]

It was also during the Cold War that the weaponization of weather control was operationalized (before it was subsequently banned), and the fear of a nuclear winter informed the work of atmospheric chemists such as Paul Crutzen, who later popularized the notion of the Anthropocene and proposed geoengineering as a technological solution to the anthropogenic climate crisis in the 2000s. As Jairus Victor Grove suggests, the concept of the Anthropocene developed by Crutzen and others involved in the debates on nuclear winter during the Cold War is geopolitical through and through.[45] For this reason, I contend that we need to conceive geopolitics broadly in order to account for the ecological dimensions of the *geo-* (literally, "earth"), while keeping in mind that the interests of states have shaped scientific knowledge production in the fields of ecology and atmospheric science.

These broader trends in scientific knowledge production concerning climate and atmosphere are tied to Japan's geopolitical reorientation over the course of the twentieth century. The early decades of the twentieth century witnessed Japan's imperial and colonial project of expanding its living sphere into Northeast Asia, Southeast Asia, and the Southern Pacific. This project relied on various techniques and technologies of infrastructure building such as telecommunications and railroad networks, enlisting myriad collaborations among architects, scientists, and engineers. After the end of World War II, Japan lost its overseas colonies but forged a close geopolitical alliance with the United States. The transpacific geopolitics of the region in the mid-twentieth century is heavily marked by the Cold War period. My exploration of climatic media there-

fore foregrounds technologies of engineering the atmosphere, including fog dispersal, computerized weather forecasting, and geoengineering in the form of weaponized hurricanes. Technologies of inventing artificial weather phenomena such as artificial snow, fog, and storms were often developed in direct service to expanding human habitats in otherwise inhospitable environments as well as maneuvering in battlefields during the Cold War. This was an era when modifying natural elements such as weather and climate became the direct object of national security, territorial expansion, and military science.

In sum, the genealogical analysis of climatic media in this book is oriented around Japan and its geopolitical relationship to the United States. I embrace this position in order to counter the often default assumption that Europe and North America are the global center of media history. By insisting on the transpacific dimension of climatic media, I also depart from the more nation-centric approach to media that is still dominant in area studies.[46] As Lisa Yoneyama reminds us, "Conjunctive critique of the transwar, transpacific connections not only helps us see that the US Cold War Empire cannot be effectively framed as a critical analytic unless the midcentury relationship with Japan is simultaneously scrutinized. It also necessitates a critique of knowledge production about Japan's colonial empire and what its imperializing practices meant varyingly to modernity, race, and visions for the new world."[47]

Highlighting the significance of the transpacific traffic between Japan and the United States also means that we look at geopolitics as relational dynamics of power played out between nation-states bent on expanding their spheres of influence, territories, and securing their national borders while struggling to control the weather and other atmospheric phenomena that elude these borders. Yet, unlike the geopolitical concept of territory, tropical cyclones, heatwaves, the polar vortex, and snowstorms are borderless like the ocean currents that circulate around the globe. A similarly mobile analysis is therefore needed to track these weather phenomena and the technological attempts to contain and cultivate them.

CHAPTER OUTLINES

To unpack this transpacific geopolitical context that gave rise to various technologies of atmospheric control, the first two chapters of the book focus on the artistic and scientific productions of artificial weather, tracing

the inventions and developments of artificial snowflakes, cloud seeding, digital computing, and numerical weather prediction in Japan and the United States. The next two chapters are organized around the architectural experiments of designing climate-controlled and air-conditioned bubbles such as capsule housing and domed cities, and how these experiments are mediated by biopolitical and cybernetic conceptions of organisms and their environments. The final chapter brings together the geopolitical context of the Cold War and the cybernetic approaches to atmospheric control by analyzing tear gas and networked surveillance as intertwined technologies of air-conditioning and social conditioning. Expo '70, Japan's first World's Fair in 1970, offers a connecting thread through the chapters, since many of the engineers, artists, and architects analyzed in this book participated in this fair, which functioned as a social laboratory where various technological experiments with air-conditioning, climate engineering, networked computing, ambient surveillance, and crowd control were executed.

Focusing on the nexus between environmental art, atmospheric science, and cloud computing, chapter 1 traces a genealogy of what I call *site-specific weather control*. Urban infrastructures such as energy grids, fiber-optic cables, air ducts, water pipes, thermostats, and computer systems are all affected by and anticipate the effects of outdoor weather. The recent attempts to use fog and snow as cooling elements for data centers' air-conditioning systems offers an entry point to rethink how weather became articulated with cloud computing. The institutional and technological conditions that connected environmental art to atmospheric science and cloud computing in the 1950s and 1960s offer a useful lens through which to understand how atmospheric control over weather phenomena became integrated into the geopolitical alliance between Japan and the United States during the Cold War.

In order to trace this genealogy of site-specific weather control, I turn to an exquisite work of fog sculpture by Nakaya Fujiko. Foregrounding the institutional nexus between her invention of fog sculpture and the work of her father, Nakaya Ukichirō, who invented artificial snowflakes, this chapter unfolds the artwork's lineage back to the earlier practice of visualizing atmospheric phenomena such as air currents on the one hand, and to the later practice of engineering the atmosphere, including the weaponization of weather, on the other. In so doing, this chapter grounds the book's inquiry into climatic media, analyzing how artificial weather became part of the infrastructure of cloud computing.

Following this connection between artificial weather and digital computing, chapter 2 examines the transpacific context of numerical weather prediction and futurology. Central to my analysis is the material reliance of future forecasting and weather forecasting on the infrastructure of air-conditioning. The argument of this chapter is that the computational prediction of the future relies on artificial climatization. The operationalization of numerical weather prediction was contingent upon cooling down computer rooms at the research institutes where these early experiments of computerized weather forecasting took place. The production of indoor artificial weather by mechanical air-conditioning systems was hence integral to the prediction of outdoor natural weather.

By unpacking the epistemological claims behind futurology and its utopian embrace of digital computing, this chapter also situates thermostatic desire in relation to the territorial understanding of atmospheric futurity. This way of imagining the atmospheric future, moreover, is what drives the ongoing acceleration and intensification of hyperlocalized weather forecasting and smart air-conditioning today. Thus, I end this chapter with an examination of the territorializing impulse that undergirds atmospheric control.

After mapping how weather forecasting, weather control, and air-conditioning work together to posit the atmospheric future as an object of computing and engineering, in chapter 3 I turn to architecture as climatic media. My argument is that architectural techniques and technologies of building walls and roofs, including those for computer rooms and data centers, function as media of atmospheric control. To ground this investigation of architectural techniques and technologies of atmospheric control, I trace the imperial roots of Tange Lab, the internationally celebrated center of Japanese architectural experimentation in the mid-twentieth century. The goal of this chapter is to situate architecture as climatic media within the transpacific geopolitics of Japan's colonial history and its subsequent Cold War alliance with the United States. With this context established, this chapter narrates the desire to colonize and territorialize hitherto inhospitable environments through architectural techniques and technologies of creating atmospheric bubbles. These architectural bubbles, I argue, operate as greenhouses for human inhabitants.

More specifically, chapter 3 delves into the geopolitical discourse of expanding the empire's living sphere toward cold climate regions. In so

doing, this chapter tracks the same territorializing impulse—running from Tange Lab architects' proposals to build capsule housing and domed cities in Antarctica and the Arctic to contemporary examples of similarly domed bubbles such as Amazon's Spheres, the tech company's signature headquarters building in Seattle. Paying close attention to the wartime geopolitical understanding of organisms and their living spheres—the view of territoriality that informed architectural design—I analyze how thermostatic desire works across differently scaled and imagined territorial "spheres."

Chapter 4 turns to Tange Lab affiliated Metabolist architects' use of petrochemical products, in particular plastics, as their building materials. I take their design of prefabricated "capsules" as a point of departure to analyze how capsule architecture as climatic media elucidates current debates on the petro-economy, climate change, and planetary geoengineering. My argument is that atmospheric control through climatic media is often imagined as scalable, and thus applicable to the smaller units of capsule houses and space capsules, as well as to the larger units of cities and even the entire planet. To unpack this fantasy of scalability at the core of Metabolist capsule architecture exemplified by the work of Kurokawa Kishō, I focus on the ecosystem analogy of Earth as a spaceship (i.e., "Spaceship Earth") that gained traction among architects, economists, and scientists in the late 1960s. Once it was imagined as a gigantic space capsule covered with its atmospheric shell, Earth emerged as an object of technological intervention, namely, geoengineering. This imagination of the planetary capsule has recently returned with vigor amid contemporary debates on the Anthropocene.

In order to clarify the relevance of Metabolist architecture to the current discourse on geoengineering, this chapter zooms in on the central metaphor of *metabolism* that Metabolist architects used as their group's namesake, a metaphor they borrowed from the work of Marx and Engels in order to highlight their ecological vision of capsules and megastructures as living organisms. Read alongside the more recent Marxist ecological theory of the "metabolic rift" and debates on the Anthropocene, the ecological undertones of Metabolist architecture present an ecological dilemma of sustainability: they aspire to produce sustainable architecture, and yet their reliance on plastics and their petro-economic financing undermine their aspiration at the material level. I suggest that current debates around geoengineering, such as the seeding of the

stratosphere with sulfur dioxide particles to bring down the temperature of Earth's atmosphere, exemplify similar ecological and ideological dilemmas.

After unfolding these transpacific genealogical affinities among the developments of computing, architecture, and climate engineering in earlier sections of the book, chapter 5 turns our attention to the (geo) political stakes of atmospheric control from the confluence of two types of climatic media used to condition and govern urban populations: tear gas and networked surveillance. Tear gas and networked surveillance emerged as twin strategies of urban policing in the mid-twentieth century on both sides of the Pacific as street-based protests against state-sanctioned racism, the Vietnam War, and the Japan-US Security Treaty unfolded in urban spaces. Here, I trace the intersecting lineages of these policing tactics, as tear gas descended directly from earlier military uses of poison gas, and networked surveillance anticipated the proliferation of ambient sensors in the urban environment. Analyzing how these two forms of climatic media developed simultaneously to police, monitor, and manage the movements of urban populations, this chapter also brings us back to atmospheric control's reliance on computation.

Tear gas and networked surveillance work together to condition air and people. The genealogical development of air-conditioning and social conditioning performed by these media, I suggest, comes into view when read through what I call "the cybernetic turn" of architecture and urban design. Put differently, the genealogical threads of digital computing and future forecasting established in earlier chapters return here through the lens of cybernetics. More specifically, this chapter traces crucial connections between the American cybernetician Norbert Wiener and Japan. Following this transpacific nexus between Japanese and American cybernetic discourses, I then explore how the logics of cybernetics became part of networked surveillance, which then paved the ground for later experiments with smart urbanism.

In the conclusion, I offer a reflection on my own genealogical method of analyzing climatic media by considering the similarity between the critical act of explication and the failure of infrastructure. I also briefly discuss the historicity of ecological metaphors in relation to the methodological approach known as "media ecology."

Together, these chapters track the parallel and intertwined historical developments of digital computers, atmospheric science, and architectural and artistic experiments. In doing so, this book moves genea-

logically across multiple fields of inquiry, unearthing hidden affinities among different actors and institutions. Connecting the dots from the past to the present thus assists us in making sense of the ongoing—and intensifying—investment in techniques and technologies of manipulating the atmosphere to suit human needs.

From the transformation of artificial fog from an artistic medium that shapes a responsive environment to an infrastructural means of cooling data centers (chapter 1); from the birth of numerical weather prediction and regional air-conditioning to the rise of hyperlocalized weather prediction using artificial intelligence and smart air-conditioning that individually curate air flows (chapter 2); from the imperial project of expanding the living sphere of the Japanese Empire as a living organism to the Silicon Valley dream of space settlements (chapter 3); from the early application of plastics to make Metabolist capsules to the current proposal to geoengineer the stratosphere to cool down Earth's atmosphere (chapter 4); and from the earlier use of tear gas and networked surveillance to police urban populations to the contemporary use of microsensors, trackers, and other data collecting devices that form our increasingly smart urban infrastructures (chapter 5); each of these chapters reads the past as the historical a priori of the present we live in.

This present we inhabit is marked by both intensifying climate instability and media connectivity. We are living through the time of climate crisis and the option of geoengineering is now back on the table or at least debated earnestly as a supposedly viable means of mitigating the impact of global warming. If engineering a personally curated atmospheric bubble by a wearable air conditioner is one response to current climate conditions, the other pole is the planetary cooling of the atmosphere through technologies of geoengineering. Both are technophilic responses to the rising temperature of our lived environment. In the meantime, we continue to feed data to and live with a proliferating number of smart media devices that operate in the predictive mode of anticipating our moves and desires in a constant feedback loop. This is the mode of atmospheric futurity whose genealogies this book tracks.

In sum, to analyze atmospheric control through the lens of climatic media means to follow and unpack these elemental, material, infrastructural, and geopolitical loops that bind media to climate. It is to this task of tracing such loops that I now turn.

INTRODUCTION

1. See news coverage on Sony's "Reon Pocket" wearable air conditioner: "Sony 'kirareru eakon' kaihatsu: Senyō shitagi ni chakusō," *Nihon Nikkei shinbun*, July 22, 2019, https://www.nikkei.com/article/DGXMZ047620540S9A720C1000000/; Matthew Humphries, "Sony's Reon Pocket Is a Wearable Air-Conditioner," *PC Reviews*, July 29, 2019, https://www.pcmag.com/news/369805/sonys-reon-pocket-is-a-wearable-air-conditioner; Ruchi Thukral, "Sony's Wearable, Pocket-Sized Air Conditioner Is Finally Available for Sale!," *Yanko Design*, July 6, 2020, https://www.yankodesign.com/2020/07/06/sonys-wearable-pocket-sized-air-conditioner-is-finally-available-for-sale/.

2. My use of genealogy as a critical method for making sense of the present is clearly indebted to the work of Michel Foucault. As is evident in the following chapters, I draw in particular on his lecture series, *Security, Territory, and Population: Lectures at the Collège de France, 1977–1978*, trans. Graham Burchell (New York: Palgrave Macmillan, 2007). For more on his take on genealogy, see *Discipline and Punish*, trans. Alan Sheridan (New York: Vintage Books, 1995), and his essays, "What Is Enlightenment?" and "Nietzsche, Genealogy, History," in Paul Rabinow, ed. *The Foucault Reader* (New York: Pantheon, 1984), 32–50, 76–100.

3. Daniel Barber, *Modern Architecture and Climate: Design before Air-Conditioning* (Princeton, NJ: Princeton University Press, 2020), loc. 509, Kindle edition.

4. Peter Sloterdijk, *Terror from the Air*, trans. Amy Patton and Steve Corcoran (Cambridge, MA: MIT Press, 2009), 79.

5. Nick Axel, Daniel A. Barber, Nikolaus Hirsch, and Anton Vidokle, "Editorial: Accumulation," *e-flux: architecture*, accessed August 9, 2019, https://www.e-flux.com/architecture/accumulation/100048/editorial/. Summarizing this primacy of visualization in their definition of "climatic media," the architectural historian Daniel A. Barber writes: "Historically, climatic media within the field of architecture have ranged from technical images of thermal comfort and considerations of solar paths to speculative forms for living in a range of climates and, more recently, the manipulation of false color diagrams in which climatic effects are themselves taken as a space of creativity. In this sense, the coming together of climate and architecture reinforces a positioning of the architect as mediatic agent and opens out to a more general analysis of spatial, material, urbanistic, and climate engaged media production. Artistic practices, methods of resistance

and literary tropes similarly operate across this nexus of aesthetics, space and climate." In his later work, *Modern Architecture and Climate*, Barber expands his discussion of media to include the facade, shades, and other functional components of architecture that mediate indoor and outdoor climates.

6. A number of media scholars have explored the environmental dimension of media. See, for instance, Weihong Bao, *Fiery Cinema: The Emergence of an Affective Medium in China, 1915–1945* (Minneapolis: University of Minnesota Press, 2015); Mark B. N. Hansen, *Feed-Forward: On the Future of Twenty-First-Century Media* (Chicago: University of Chicago Press, 2015); Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge, MA: MIT Press, 2015); and Antonio Somaini, "Walter Benjamin's Media Theory: The *Medium* and the *Apparat*," *Grey Room* 62 (January 2016): 6–41.

7. John Durham Peters, *The Marvelous Clouds: Toward a Philosophy of Elemental Media* (Chicago: University of Chicago Press, 2016), 165–66.

8. David Gissen, *Manhattan Atmospheres: Architecture, the Interior Environment, and Urban Crisis* (Minneapolis: University of Minnesota Press, 2013), 38.

9. Reyner Banham, *Architecture of the Well-Tempered Environment* (Chicago: University of Chicago Press, 1969).

10. Jiat-Hwee Chang, "Thermal Comfort and Climatic Design in the Tropics: An Historical Critique," *Journal of Architecture* 21, no. 8 (2016): 1171–202; Jiat-Hwee Chang, *A Genealogy of Tropical Architecture: Colonial Networks, Nature and Technoscience* (London: Routledge, 2016).

11. Nicole Starosielski, "Thermocultures of Geological Media," *Cultural Politics* 12, no. 3 (2016): 293–309.

12. See, for instance, Timothy Choy, *Ecologies of Comparison: An Ethnography of Endangerment in Hong Kong* (Durham, NC: Duke University Press, 2011); Douglas Kahn, *Earth Sound Earth Signal* (Berkeley: University of California Press, 2013); Peter Adey, "Air's Affinities: Geopolitics, Chemical Affect and the Force of the Elemental," *Dialogues in Human Geography* 5, no. 1 (2015): 54–75; Cara New Daggett, *The Birth of Energy: Fossil Fuels, Thermodynamics, and the Politics of Work* (Durham, NC: Duke University Press, 2019); and Melody Jue, *Wild Blue Media: Thinking through Seawater* (Durham, NC: Duke University Press, 2020).

13. On these elemental and geological approaches to rethinking media, see Nicole Starosielski, "Thermocultures of Geological Media" and *Media Hot and Cold* (Durham, NC: Duke University Press, 2021); Jussi Parikka, *A Geology of Media* (Minneapolis: University of Minnesota Press, 2015); and Jussi Parikka, "The Alchemic Digital, the Planetary Elemental," in *Subcommunity: Diabolical Togetherness beyond Contemporary Art*, ed. Julieta Aranda, Brian Kuan Wood, and Anton Vidokle, *e-flux journal* (London: Verso, 2017), 341–47. On the environmental impact and logistics of shipping and processing electronic wastes, see Jennifer Gabrys, "Shipping and Receiving: Circuits of Disposal and the 'Social Death' of Electronics," in *Digital Rubbish: A Natural History of Electronics* (Ann Arbor: University of Michigan Press, 2013), 74–98. See also Yuriko Furuhata, "Archipelagic

Archives: Media Geology and the Deep Time of Japan's Settler Colonialism," *Public Culture* 33, no. 3 (forthcoming).

14. Adey, "Air's Affinities," 61. Adey's survey of a wide range of texts that discuss air in relation to geography covers fiction such as Goethe's *Elective Affinities* as well as cultural climatology, science, and political theory including Carl Schmitt's classic works, *Land and Sea* (1942) and *Nomos of the Earth* (1950). Schmitt, he writes, "is explicit in his interest in the geopolitical import of particular kinds of territory which he calls elemental, locating them in the classical form of land (earth), sea (water), air and fire" (68). See also Ben Anderson, "Affective Atmospheres," *Emotion, Space and Society* 2, no. 2 (2009): 77–81; Peter Adey and Ben Anderson, "Anticipation, Materiality, Event: The Icelandic Ash Cloud Disruption and the Security of Mobility," *Mobilities* 6, no. 1 (2011): 11–23; and Derek P. McCormack, *Atmospheric Things: On the Allure of Elemental Envelopment* (Durham, NC: Duke University Press, 2019).

15. Mark Whitehead also uses the Foucauldian framework of "conduct" as a type of discipline to talk about air as part of personal health and hygiene in the United Kingdom in the nineteenth and twentieth centuries. Methodologically, his approach to thinking about "atmospheric government" as a set of "conduct" that combines the public knowledge of atmospheric science with the (neo)liberal personalized "atmospheric self care" responsibilities is resonant with the approach I take toward atmospheric conditioning. See Mark Whitehead, *State, Science and the Skies: Governmentalities of the British Atmosphere* (West Sussex, UK: Wiley-Blackwell, 2009); and Andreas Philippopoulos-Mihalopoulos, *Spatial Justice: Body, Lawscape, Atmosphere* (Oxfordshire, UK: Routledge, 2015).

16. See Philip Kotler, "Atmospherics as a Marketing Tool," *Journal of Retailing* 49, no. 4 (winter 1973–74): 48–64. Peter Sloterdijk connects this marketing use of atmospherics to the architectural form of arcades as a space of commerce: "Let us not forget that today's so-called consumer society was invented in a greenhouse—in the very same glass-canopied, nineteenth-century arcades in which the first generation of 'experience customers' learned to breath the intoxicating scent of an enclosed, interior-world full of commodities." Sloterdijk, *Terror from the Air*, 95–96.

17. Paul Roquet, *Ambient Media: Japanese Atmospheres of Self* (Minneapolis: University of Minnesota Press, 2016), 4–15.

18. In his analysis of the facade as a medium that regulates interior climate before the rise of mechanical air-conditioning, Barber also suggests the multifaceted nature of conditioning. See *Modern Architecture and Climate*, loc. 509 of 9068.

19. My approach is closer to that of Anna Feigenbaum and Anja Kanngieser, who analyze tear gas and sonic warfare as "technologies and techniques for controlling populations" through their relationship with air, which operate as a form of atmospheric policing. Anna Feigenbaum and Anja Kanngieser, "For a Politics of Atmospheric Governance," *Dialogues in Human Geography* 5, no. 1 (2015): 81.

20. "Sonic Science: The High-Frequency Hearing Test," *Scientific American*, May 23, 2013, https://www.scientificamerican.com/article/bring-science-home-high-frequency-hearing/. For more on the policing use of infrasound and sound, see Steve Goodman, *Sonic Warfare: Sound, Affect, and Ecology of Fear* (Cambridge, MA: MIT Press, 2012).

21. Azuma Hiroki reads this strategy by McDonald's through Foucault's concept of governmentality. See Azuma Hiroki, *Hihyō no seishin bunseki: Azuma Hiroki korekushon D* [A psychoanalysis of criticism: Azuma Hiroki collection D] (Tōkyō: Kōdansha, 2007), 351. Azuma notes that his understanding of McDonald's comes from the work of sociologist George Ritzer, *The McDonaldization of Society: An Investigation into the Changing Character of Contemporary Social Life* (Thousand Oaks, CA: Pine Forge Press, 1996).

22. Colin Gordon, "Governmental Rationality: An Introduction," in *The Foucault Effect: Studies in Governmentality*, ed. Graham Burchell, Colin Gordon, and Peter Miller (Chicago: University of Chicago Press, 1991), 1–51; Foucault, *Security, Territory, and Population*, 121.

23. Bernhard Siegert, *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*, trans. Geoffrey Winthrop-Young (New York: Fordham University Press, 2015), 13–14.

24. Siegert, *Cultural Techniques*, 193.

25. Weihong Bao, "Archaeology of a Medium: The (Agri)Cultural Techniques of a Paddy Film Farm," *boundary 2* 49, no. 1 (forthcoming). See also Bernard Dionysius Geoghegan, "After Kittler: On the Cultural Techniques of Recent Media Theory," *Theory, Culture and Society* 30, no. 6 (2013): 66–82.

26. Andrea Lo, "The Truth behind the Mysterious Holes in Hong Kong's High-Rises," CNN, March 28, 2018, https://www.cnn.com/style/article/hong-kong-skyscrapers-with-holes/index.html; Matthew Keegan, "Hong Kong: The City Still Shaped by Feng Shui," *Guardian*, July 19, 2018, https://www.theguardian.com/cities/2018/jul/19/hong-kong-the-city-still-shaped-by-feng-shui; Department of Architecture, Chinese University of Hong Kong, "Feasibility Study for Establishment of Air Ventilation Assessment System," November 2005, accessed March 9, 2019, https://www.pland.gov.hk/pland_en/p_study/comp_s/avas/papers&reports/final_report.pdf.

27. Peters, *Marvelous Clouds*, 3–4.

28. For more on this speculative and comparative approach to the philosophy of elements, see Yuriko Furuhata, "Of Dragons and Geoengineering: Rethinking Elemental Media," *Media+Environment* 1, no. 1 (2019), https://doi.org/10.1525/001c.10797.

29. Manuela Madeddu and Xiaoqing Zhang, "Harmonious Spaces: The Influence of Feng Shui on Urban Form and Design," *Journal of Urban Design* 22, no. 6 (2017): 709–25; Miyauchi Takahisa, "Kasōkan no juyō katei ni kansuru minzokugaku teki kenkyū oboegaki," *Hikaku minzoku kenkyū* 3 (March 1993): 214–29; Suwa Haruo, *Nihon no fūsui* (Tokyo: Kadokawa sensho, 2018).

30. On European, Chinese, and Japanese cosmological views of meteorological

phenomena before modernity, see Sara J. Schechner, *Comets, Popular Culture, and the Birth of Modern Cosmology* (Princeton, NJ: Princeton University Press, 1997); Qiong Zhang, "From 'Dragonology' to Meteorology: Aristotelian Natural Philosophy and the Beginning of the Decline of the Dragon in China," *Early Science and Medicine* 14, nos. 1–3 (2009): 340–68; and Hayashi Makoto, *Tenmonkata to onmyōdō* [Astronomers and onmyōdō] (Tokyo: Yamakawa shuppan, 2006).

31. Vladimir Jankovic, *Reading the Sky: A Cultural History of English Weather, 1650–1820* (Chicago: University of Chicago Press, 2000), 156 (emphasis in the original). See also Gabrielle Walker, *An Ocean of Air: A Natural History of the Atmosphere* (London: Bloomsbury, 2007).

32. James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010).

33. China first seeded the clouds to induce artificial rain after it was hit by a severe drought in 1958. Kristine C. Harper, *Make It Rain: State Control of the Atmosphere in Twentieth-Century America* (Chicago: University of Chicago Press, 2017), 162.

34. Clive Hamilton, *Earthmasters: The Dawn of the Age of Climate Engineering* (New Haven, CT: Yale University Press, 2013), 142–43.

35. Higuchi Keiji, *Chikyū kara no hassō* [Ideas that come from Earth] (Tokyo: Asahi bunko, 1991), 26–27.

36. On the history of cybernetics and urban planning in the United States, see Jennifer S. Light, *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America* (Baltimore, MD: Johns Hopkins University Press, 2003).

37. For more on the history of climate modeling and global data collection, see Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010).

38. Oliver Morton, *The Planet Remade: How Geoengineering Could Change the World* (Princeton, NJ: Princeton University Press, 2016), 164.

39. On the genealogy of the environmentally determinist views of race and culture associated with climate, see David N. Livingstone, "Race, Space, and Moral Climatology: Notes toward a Genealogy," *Journal of Historical Geography* 28, no. 2 (2002): 159–80. On the historical development of geography as imperial science, see Gearóid Ó Tuathail, *Critical Geopolitics* (Minneapolis: University of Minnesota Press, 1996).

40. See, for instance, Eric T. Jennings, *Curing the Colonizers: Hydrotherapy, Climatology, and French Colonial Spas* (Durham, NC: Duke University Press, 2006); and Lorenzo Veracini, *Settler Colonialism: A Theoretical Overview* (London: Palgrave Macmillan, 2010).

41. On the historicity of Japan's colonial settlements in Hokkaidō, see Katsuya Hirano, "Settler Colonialism in the Making of Japan's Hokkaidō," in *The Routledge Handbook of the History of Settler Colonialism*, ed. Edward Cavanagh and Lorenzo Veracini (Abingdon, UK: Taylor and Francis, 2016), 351–62. The work of Danika Medak-Saltzman offers an intersectional approach for situating the history of Japanese settler colonialism in relation to Native American and Indigenous

studies. See Danika Medak-Saltzman, "Settler Colonialism and Phantasmagoria: On Asian, Asian Diaspora, and Indigenous Intersections," *Verge: Studies in Global Asias* 5, no. 1 (spring 2019): 39–46.

42. Roquet, *Ambient Media*, 7 (emphasis in the original). Roquet writes: "For Watsuji, being Japanese is not an accident of birth or the result of a historical formation; rather, it is a unilateral collective process of atmospheric subjectivation. Through reference to this totalizing understanding of atmosphere, *Climate and Culture* presents a highly reductive model of environmental determinism, dividing human civilizations into 'Monsoon,' 'Desert,' and 'Meadow' types and positioning Japan against the 'West,' China, and India. The seemingly 'natural' process of climatic attunement serves as a feint for establishing the authority of the nationalist self" (7). On the critique of Watsuji's epistemic reliance on the dichotomy between the East and the West, which undergirds his typological analysis of "Pastoral Europe" and "Monsoon Asia," see Naoki Sakai, "Return to the West/Return to the East: Watsuji Tetsuro's Anthropology and Discussions of Authenticity," *boundary 2* 18, no. 3 (autumn 1991): 157–90. On the Kyoto School's complicity with the state project of imperialism, see Harry Harootunian, *Overcome by Modernity: History, Culture, and Community in Interwar Japan* (Princeton, NJ: Princeton University Press, 2000). According to Harootunian, Watsuji thought culture alone could not provide an adequate explanation for the formation of a national community unless it was supplemented by a consideration of climate and environmental conditions, what he "conceptualized as 'climate and culture' (*fūdo*), which became the basis of a unique mode of analysis" (252).

43. Watsuji Tetsurō, *Fūdo: Ningengaku teki kōsatsu* [Climate and culture: Some humanistic reflections] (Tokyo: Iwanami bunko, 1979), 352.

44. Joseph Masco, "Bad Weather: On Planetary Crisis," *Social Studies of Science* 40, no. 1 (February 2010): 7–40; Elizabeth M. DeLoughrey, "The Myth of Isolates: Ecosystem Ecologies in the Nuclear Pacific," *Cultural Geographies* 20, no. 2 (April 2013): 167–84.

45. Jairus Victor Grove, *Savage Ecology: War and Geopolitics at the End of the World* (Durham, NC: Duke University Press, 2019), 38–39.

46. For more on the critical "transpacific" approach to studying flows of people, culture, and capital across the Pacific Ocean, see Viet Thanh Nguyen and Janet Hoskins, "Introduction: Transpacific Studies; Critical Perspectives on an Emerging Field," in *Transpacific Studies: Framing an Emerging Field*, ed. Janet Hoskins and Viet Thanh Nguyen (Honolulu: University of Hawai'i Press, 2014), 1–38.

47. Lisa Yoneyama, "Toward a Decolonial Genealogy of the Transpacific," *American Quarterly* 69, no. 3 (September 2017): 473.

CHAPTER 1: **Outdoor Weather**

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