

Voluminous States

Sovereignty,
Materiality,
and the
Territorial
Imagination

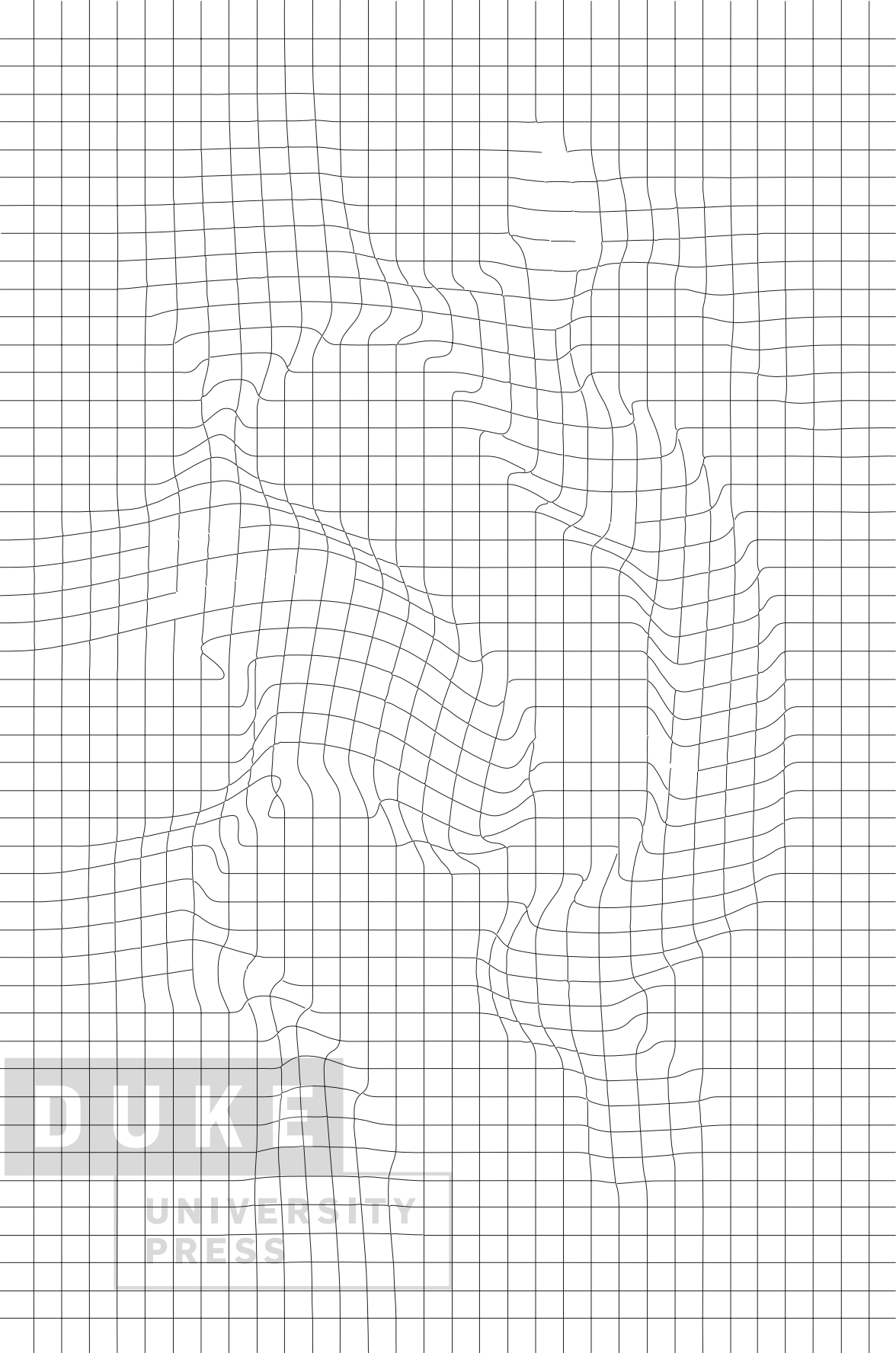
Franck Billé,
editor

With an
afterword
by Debora
Battaglia



Voluminous States

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Edited by
Franck Billé

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For Valerio, Milo, and Max

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Voluminous

An Introduction

FRANCK BILLÉ

Early 2018, Singapore's Urban Redevelopment Authority announced a proposal for an underground masterplan, with pilot areas to be unveiled in 2019. Extending dozens to possibly hundreds of meters below the city-state, the masterplan will free up surface land by stacking up a wide range of human activities and urban infrastructure, from rail and road networks to bus interchange stations, and from substations to reservoirs and sewage systems.¹ While usage of subterranean space is not novel² and is indeed the privileged space for the cable and pipe infrastructure that makes urban life possible, the scale and depth of Singapore's plans are particularly ambitious. Unlike subterranean extensions that tend to be spaces where the entangled messiness of urban life support can be tidied away, Singapore's plans represent nothing less than an unequivocal embrace of the subterranean as urban realm and domain amenable to colonization and control. Singapore's aspiration to make the most of its subsoil and submarine environments echoes statist territorial ambitions elsewhere.³

From the Arctic to the South China Sea, states are vying to secure sovereign rights over vast maritime stretches, undersea continental plates, shifting ice floes, and aerial volumes. These vertical inroads are comparatively new, but the three-dimensional nature of property law has a long genealogy. Well before technology made it possible, ownership of a plot of land was legally understood to represent the intersection of the Earth's surface with a conical

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property extending upward and downward from that surface. *Cuius est solum, eius est usque ad coelum et ad inferos*, or “Whoever’s is the soil, it is theirs all the way to Heaven and all the way to Hell,” as the Latin maxim goes.⁴ But if the three-dimensional nature of land was common knowledge among lawyers, it remained largely a theoretical issue until the advent of air travel and the development of effective ground-excavating methods. Of course, subsurface mineral deposits have long been the subject of territorial disputes, while “aerial arts of war,” in the form of painting, land surveys, and later photography, predate modern technologies such as digital imaging.⁵ However the first genuine attempts to territorialize aerial, maritime, and subterranean spaces only emerged through transformative technologies that made it possible to control, colonize, and populate beyond-the-human worlds previously considered asocial.⁶ Until recently many of these three-dimensional spaces were seen as beyond effective political control: the United Nations Convention on the Law of the Sea (UNCLOS) for instance only came into force in 1994, and there is still no international legal agreement on the vertical extent of sovereign airspace.

The definition and contours of volumetric sovereignty are in constant evolution,⁷ partly through the possibilities afforded by new technologies, but partly also in response to economic opportunities and geopolitical imperatives. The notion of airspace sovereignty was recognized for instance just after World War I as a reaction to aerial reconnaissance and bombings, while the concept of “territorial waters,” in existence since the late eighteenth century and generally limited to three nautical miles (the typical range of cannon fire from shore), began to be challenged in the 1940s. The United States sought to expand it in its pursuit of oil and gas, while for smaller countries like Chile and Iceland, the rationale was greater control over fishing resources.⁸ More recently, the notion of continental shelf—defined as the shallow seabed that extends from the part of the shore permanently submerged down to the continental slope, typically at a depth of one hundred to two hundred meters—has provided coastal states with further possibilities to extend their sovereign rights beyond their exclusive economic zone (EEZ) (see figure I.1).⁹

Such extensions of sovereign rights do not necessarily index an extension of sovereign territory, nor indeed the ambition to acquire any,¹⁰ but they have made the political map more complex, in that territory and sovereignty are now rarely coextensive. As geographer Ian Shaw notes, now more than ever, the planet’s “mosaic of distinct states has melted into a more distorted painting: a scattershot of statelets, militarized cities, and transnational flows.”¹¹ The entanglement of the governmental and the corporate, deeply embedded within the infrastructural stratum of our political and economic environment—what

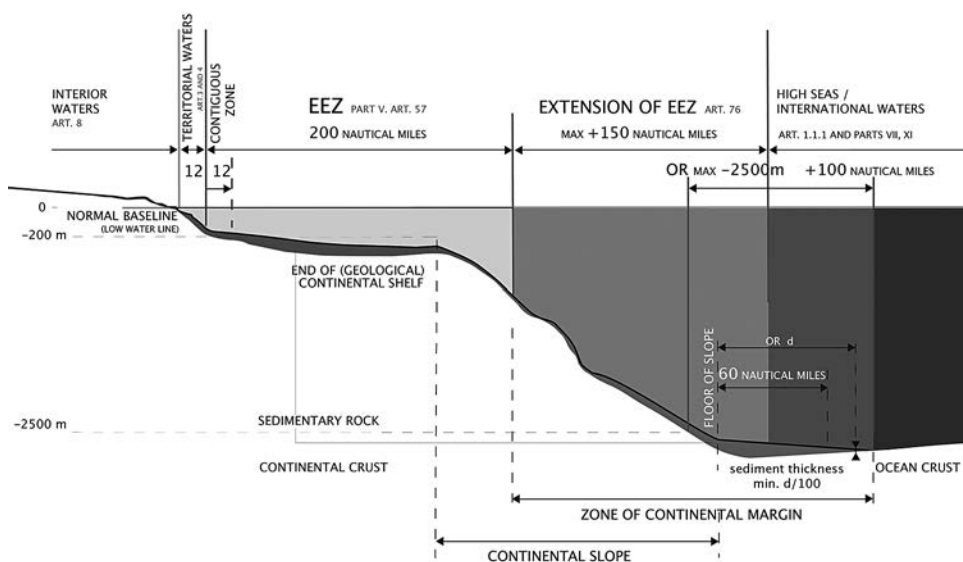


Figure I.1. The exclusive economic zone offshore, UNCLOS. © Nancy Couling.

Keller Easterling has termed *extrastatecraft*—further complicates the practice of territory.¹²

This complexity, somewhat naively imagined as a borderless world in the early 1990s following the collapse of the Soviet Union, has more recently given rise to a propensity to equate the multiplicity, complexity, and increasingly staggered and dispersive nature of border control as a harbinger of deterritorialization.¹³ Yet, as Étienne Balibar notes, the multiple, heterogeneous, hypothetical, and fictive nature of political borders—and by extension the territorial sovereignty they index—does not make them any less real.¹⁴ The discreteness of the nation-state as container may be a potent fiction but it is one to which we are all committed and in which we remain deeply invested. David Ludden's assertion that we are unable to imagine political space beyond a cookie-cutter world of national geography, and that scholars work within that everyday experience, holds true fifteen years later.¹⁵ Almost in spite of ourselves, the state continues to hold our collective political imagination.¹⁶

More than two decades ago, John Agnew warned us about the “territorial trap” that shapes the ways in which international relations are studied.¹⁷ Yet the recent proliferation of border walls is testimony to the continued belief of governments and their citizens in the seductive fiction of the territorial

nation-state.¹⁸ In the last few years, this trend appears to have increased even further with the election of Donald Trump, the United Kingdom's Brexit vote, as well as the rise and consolidation of autocratic regimes in Europe, China, Russia, Turkey, India, and elsewhere. This despite the fact that, as Michael Dear has pointed out, not only is partition the crudest tool in the armory of geopolitics, it is an overt confession of failed diplomacy.¹⁹ Walls are potent symbols of "territory's continued allure,"²⁰ standing tall to "patch" gaps in political borders, aiming to keep at bay feared cultural ingress and economic leakage. But they are also a symptom of weakness, of waning sovereignty as Wendy Brown has argued. For Brown, "rather than resurgent expressions of nation-state sovereignty, the new walls are icons of its erosion."²¹

Walls also project a vision of the world that is resolutely horizontal. As such, they tend to be largely ineffective as barriers to movement: people go around them, above them, below them. More than two hundred tunnels linking Mexico to the United States have been discovered since 1990, the majority of them used for drug trafficking. Walls are also woefully inadequate to stem illegal migration, let alone address larger phenomena requiring containment such as the effects of climate change.²² If walls are a symptom of waning sovereignty, then, they also reveal a recalcitrant tendency to apprehend the world in two dimensions. Recent geopolitical forays into vertical spaces such as the atmosphere or the subterranean have in fact proven extremely challenging to represent, either cartographically or mentally. From the God's-eye perspective to which we are accustomed, the vertical axis collapses on itself and, reduced to a single point, becomes invisible. Such challenges are typically encountered in vertical urban environments such as Hong Kong where the multilevel urban fabric makes it complex to map. Two points may share the same coordinates but be located on a different surface altogether.²³

With scholars in a vast array of disciplines becoming increasingly alert to the necessity of a three-dimensional perspective, the last few years have witnessed a veritable efflorescence of publications on the topic of volume. A seminal intervention that appears to have given the impetus for much of this "volumetric turn" was Stuart Elden's 2013 paper, "Secure the Volume," in which he argued for the necessity to rethink geography in terms of volumes rather than areas.²⁴ While Elden was not the first scholar to draw attention to volumes—indeed his article cites an extensive literature engaging with spaces beyond the surface—he was instrumental in identifying commonalities shared by scholars interested in aerial spaces such as Peter Adey, Derek Gregory, or Alison Williams, and subterranean realms like Eyal Weizman or Bradley Garrett, and to call for an integration of these various strands into a more comprehensive

and coherent volumetric framework.²⁵ Heeding Elden's agenda-setting call, a number of geographers began engaging more actively with the volumetric.²⁶ In parallel with this incipient development, anthropologists and cultural theorists are also becoming increasingly concerned with three-dimensional realms such as air, oceans, riparian environments, and outer space as well as with their social, political, and cultural reverberations.²⁷

Voluminous States brings into crossdisciplinary dialogue these converging interests in volumetric sovereignty and more-than-human geographies. The contributors suggest that this theoretical confluence can be especially illuminating for border processes and phenomena that deploy beyond the two dimensional. As the authors in *Voluminous States* show, the fact that political battles are increasingly being waged in more complex volumetric geographies does not suggest a weakening or dilution of the logics of territorial control. The political and cultural colonization of sea, air, and ice—framed primarily through a land-based imagination, whether through the creation of islands as toeholds in the South China Sea or the planting of flags on ocean floors or ice sheets—is in fact subject to similar cartographic anxieties.²⁸

Conceiving sovereign space as volume is crucial insofar as it reflects the three-dimensional nature of modern territorial control. Airspace surveillance, maritime patrol, and subterranean monitoring are all integral to maintaining territorial sovereignty, yet these dimensions of bordering are rarely if ever addressed by border studies scholars. *Voluminous States* argues that a three-dimensional approach to studying borders and territoriality is imperative to understand how the Westphalian logic of bordering has evolved since the seventeenth century to frame contemporary territorial incursions, especially into places where human interventions are recent and technologically mediated. A two-dimensional analysis feels clearly obsolete when battles are increasingly waged in volumetric space in the form of drone strikes or the amorphous threats of biological warfare and cyberattacks.²⁹

Speaking Volumes

The theoretical ambition of the book is threefold, as reflected in the book's subtitle. *Voluminous States* is concerned on the one hand with the extension of sovereignty into spaces previously beyond the realm of human intervention. Polar regions, high-altitude mountains, the air, the sea, and the subterranean are some of the locations discussed by the authors. These spaces are more than simply a backdrop to the discussion; their materiality is key to the discussion. If the growing literature on volumetric sovereignty is making significant forays into previously

unexplored realms, comparatively few scholars have been as attentive to the entanglement of axes and layers, and to the “stuffness” of this resultant volumetric space. The term *voluminous* in the title—rather than a more abstract *volumetric*—alludes here to the significance and physical presence of the state. Several chapters in the book, such as Jerry Zee’s on dust, Jason Cons’s on floods, or Clancy Wilmott’s on fluctuating sea levels, foreground the material entanglements, constraints, and elusiveness of this three-dimensional space.³⁰ This very complexity, as geographer Jason Dittmer has argued, speaks to an apprehension of systems as “always dynamic and interacting in ways that defy attempts to model them.”³¹

While all chapters are concerned with an evolving imaginary of territorial sovereignty, a number of chapters address it more specifically. Wayne Chambliss’s contribution on military incursions into the subterranean realm evokes for instance an incipient downward extension of territorial sovereignty through subsurface mapping.³² Aihwa Ong’s analysis of land reclamation in Singapore also suggests a steady expansion of the state to encompass both watery and subterranean spaces—an ambition China has also pursued, albeit differently, through the notion of “blue territorialization.” Emerging three-dimensional views of national territory make a stark contrast with the wall-building exercises being deployed around the world, yet these views are not mutually exclusive. Calls for an old-school US-Mexico border wall thus cohabit, uneasily, with an imaginary of warfighting that is increasingly non-planar, noncontiguous, and deterritorialized.³³

The three keywords—*sovereignty*, *materiality*, and *imaginary*—that contour the narrative arc of the book run in some form through all the chapters. As such, the chapters’ distribution and order in the book denotes emphasis of content rather than exclusive focus. Because of the way the project has grown over the last three years, organically and in dialogue between the authors and editor, there is much entanglement between the chapters. The book should be seen primarily as a jigsaw puzzle, each piece bringing further clarity to the topic of volumetric sovereignty. The puzzle made up by this edited collection also extends beyond the book, with two online collections of fifty short essays, published across two journals in the two core disciplines: *Cultural Anthropology* (2017–18) and *Society and Space* (2019).³⁴

Sovereignty

Over the last decade, the field of border studies has grown exponentially, largely in reaction to ever more complex and sophisticated forms of border control and to the considerable human suffering they engender. The recognition that

borders impact individuals very differently depending on their ethnicity, economic status, and national origin, and the realization that the early 1990s notion that borders were becoming obsolete came from a place of privilege, contributed to the deconstruction of the concept of *border* and to numerous studies of processes, such as document procurement, offshore detention facilities, data monitoring, and immigration raids, that take place far from the geographical border.³⁵

The increasingly staggered nature of the border and border controls, combined with constraints placed on sovereignty with regards to exchange rates, monetary policy, arms control, chemical weapons, landmines, warfare, environmental control, minority rights, etc., can convey the impression that the omnipotent nature of sovereignty is in recession.³⁶ It is worth reiterating here, as political theorist Joan Cocks has argued, that sovereignty is an illusion insofar as the “power to command and control everything inside a physical space” is unattainable, and never more so than today. And yet, the longing for that sovereign power clearly continues to haunt contemporary politics, thereby reifying this illusion.³⁷ Counterinstinctively perhaps, the very interconnect-edness of sovereignties, rather than weakening the concept, may actually be strengthening it.³⁸ Thus the presence of US border controls at European airports for instance, thousands of miles away from US territory, does not signify a waning or blurring of territorial sovereignty. To the extent that these practices are mutually agreed upon and potentially replicated by European partners, they help bolster border controls as well as reinforce the very idea of territorial sovereignty that is indexed by borders. It is also worth keeping in mind that “attack” and “defense” rely on very different assumptions: if powerful states routinely encroach upon the territorial sovereignty of weaker states, the reverse is not true. Borders are lines only the powerful may trespass.³⁹

The persistent currency of the notion of territorial sovereignty is evident from the spatial extensions of sovereign power currently taking place across maritime, aerial, and subterranean spaces. By using rocks and shoals as footholds to solidify (in the sense of treating as solid) the fluid geographies of the South China Sea, China has been actively engaged in expanding its territorial foothold.⁴⁰ Islands allow states to claim additional territorial waters to a radius of twelve nautical miles but since 1982 they have also granted them authority to exploit resources within an EEZ extending to two hundred nautical miles. As a result, terraforming has proven a very effective way to claim sovereign rights to vast expanses of what were previously classified as “high seas.”⁴¹ Expanding further on the EEZ jurisdiction, the Straddling Stocks Fish Agreement (entered into force in 2001) grants each coastal state the authority

to regulate exploitation of highly migratory species and straddling stocks in areas of the high seas adjacent to its EEZ so as to conserve the abundance of these species within its EEZ.⁴² The United Nations Convention on the Law of the Sea (UNCLOS) grants coastal states additional sovereign rights over extended continental shelves, up to 350 nautical miles from the coastal baseline, provided certain geological and bathymetric conditions are met. These sovereign rights do not imply full territorial sovereignty: relating to the subsurface only, they have no incidence on the legal status of the superjacent waters as high seas or that of the airspace above those waters. But they speak to a gradual arrogation of spaces previously found beyond the realm of human existence and colonizing possibilities.

Increasingly the reach of the state has also been directed downward, penetrating ever deeper into the subterranean realm. With so much of its power relying explicitly on visibility, the opacity of the Earth's surface has long marked a hard ontological boundary for the state. The triumph of the surface, in Ryan Bishop's phrasing, has thus been echoed by a subterranean impotence.⁴³ Unsurprisingly, as Caroline Humphrey, Elizabeth Dunn, and Wayne Chambliss all discuss in their respective chapters, the underground has frequently been a space associated with resistance, a place of escape from the state's sight and control. In the context of the city of Odessa, Ukraine, as Humphrey discusses, if the maze of tunnels beneath the city has been used for most of its history as a nexus of resistance and evasion, the position of the subterranean vis-à-vis the state is more complex and not necessarily always adversarial. The evolving and adaptable use of Odessa's catacombs is, for Humphrey, a symptom of the very nature of this kind of space. As cellular social places that have developed incrementally, warrens obey their own infrastructural regimes, ultimately escaping the grasp of their original architects.⁴⁴

If the subterranean realm is one often occupied and taken advantage of by nonstate actors,⁴⁵ Eyal Weizman's work on the Israel-Palestine border has shown this facile dichotomy does not necessarily hold true everywhere.⁴⁶ Faced with threats both within and under urban environments, the Israeli army has been exploring new strategies to destroy underground tunnels but also to short-circuit and recompose the architectural and urban syntax.⁴⁷ Avoiding the streets, roads, alleys, and courtyards that define the logic of movement through the city, Israeli soldiers are punching holes through walls, ceilings, and floors, moving across a three-dimensional volume of dense urban fabric.⁴⁸

Similar spatial processes are explored in Elizabeth Dunn's chapter on the Roki Tunnel linking Russia and Georgia. The aim of the tunnel, initially envisioned in the 1960s and completed in 1984, was to cut across the Greater

Caucasus mountain range that had proven a near impassable wall on Russia's southern border. In bypassing the six mountain passes that allowed movement but also acted as chokepoints,⁴⁹ the tunnel would literally flatten volumetric space, ignoring its vertical dimension and turning it into what Deleuze and Guattari have called a "smooth space" where the mountainous topography on which locals relied could be obliterated.⁵⁰ But in doing so, the tunnel also created a "striated space"—a conduit able to channel, and therefore control, movement. What ultimately makes tunnels (potentially) successful political technologies for state actors, Dunn argues, is their capacity to *collapse* the volume, to make the terrain legible and controllable, and to force conflict back onto terrain where the state has considerable technological advantage.

Pushing back ever further on the ground's intrinsic opacity, state actors have been relying on new technologies—such as magnetometers and other metal detectors, electromagnetic induction, electrical resistivity, gravity measurement technology, and seismic and acoustic sensors—to map the subsurface and combat "striated space."⁵¹ Of all these techniques, Wayne Chambliss argues, gravity measurement technology is especially promising in that it relies on differences in materials' density and, unlike LIDAR, multispectral cameras, or ground-penetrating radars that can be thwarted by various countersurveillance tactics, gravimetry recruits the Earth itself as informant. Because the Earth's composition is not homogenous, the force of gravity varies at every point of the Earth's surface by a tiny amount. As Chambliss explains, the US military is currently mapping the subterranean to create a baseline. Subsequent changes in the gravitational fields, such as the creation of underground bunkers or a military facility, will alter the structure's gravitational signature, making the structure visible. If it is feasible in theory to spoof these mapping technologies (by adding heavy material to counterbalance the missing soil), it will prove increasingly difficult to do so as the technology becomes more sophisticated.

With the Earth plumbed at increasing depths and resolutions, well beyond what was previously imagined possible, new resource exploitation opportunities have opened up, extending the remit of state sovereignty and complicating the relationship between the surface and the subsoil. Fracking and horizontal drilling have caused the emergence of the issue of extralateral rights, i.e., the right to chase resources beyond the surface boundaries of an initial land grant—essentially allowing serpentine underground claims to supersede the surface grid.⁵² Counterintuitively, technological advances have reduced rather than extended the state's lower and upper limits. The assumption that sovereignty extended upward and downward ad infinitum was only challenged when the technological means to colonize these upper and lower reaches

became available. It was only then that limits had to be determined—though paradoxically it is anticipated that they will be extended and revised further as technology develops.

Just as exploitable depth will eventually reach a point where pressure and temperature render the issue of property moot, the upper bound to sovereignty is generally agreed to be the Kármán line, sixty-two miles above sea level, where the atmosphere is no longer sufficiently dense to provide any appreciable aerodynamic lift. An upper limit is in any event necessary given that the Earth is in motion; without one, nations would be sovereign over a constantly changing sliver of space.⁵³ As multimedia artist Dario Solman stated, “verticality pushed to its extreme becomes orbital.” At such point, “the difference between vertical and horizontal ceases to exist.”⁵⁴ This is not to say that sovereignty cannot be extended to outer space—there are in fact over four hundred communication satellites in geosynchronous orbit—only that it can no longer operate along the same spatial logic of terrestrial sovereignty, as a mere vertical extrapolation of terrestrial borders. The politics of tethering here are of a different nature. The geosynchronous orbit, located at 22,236 miles above the equator and with an orbital period matching that of the Earth, has become incredibly valuable real estate as it is ideally positioned to monitor weather, communications, and surveillance. This is especially true of the geostationary orbit, a segment of the geosynchronous orbit located right above the equator in which an orbiting satellite will appear stationary with respect to Earth. So valuable is the geostationary orbit that it is increasingly clogged up by satellites belonging to a handful of states.⁵⁵ As Gbenga Oduntan suggests, the very fact that an object hangs permanently over a state suggests it has a special relationship to it, which cannot be easily overlooked.⁵⁶

The terrestrial referent, speaking to a land-based imagination, has in fact been regularly noted in state incursions into more-than-human spaces.⁵⁷ In her discussion of the International Space Station in the afterword to this collection, Debora Battaglia notes that at the end of a working day or in the event of an emergency, astronauts return to their slice of national territory as it is constructed onboard. In my own chapter on the enclave complex of Baarle-Hertog and Baarle-Nassau, we witness a strong will to twist and bend the material and social fabric of the two towns in ways consonant with a Westphalian imaginary—in spite of the highly fractured nature of the enclaves, which ultimately makes it impossible. The development of oceanic space is similarly framed by a land-based imagination, “mobilizing territorial metaphors similar to the terrestrial equivalent of land grabbing,” even though the established and fixed grid coordinate system of terrestrial boundaries is poorly suited to accommodate the unique aquatic materiality of ocean space.⁵⁸ In the

context of the South China Sea, the People's Republic of China has been replicating narratives of development in Xinjiang and other remote borderlands. Its new official map, unveiled in 2014, makes assertive claims toward enlargement of its territorial footprint by claiming sovereignty over vast expanses of oceanic space, but it also does much more than that. Unlike the previous map which depicted noncontiguous territories in cutaway boxes—as is the case for instance with the United States' customary representation of Alaska and Hawaii—the so-called vertical map is singular and continuous and includes the vast body of water south of Hainan Island.⁵⁹ In the new map, the mainland, islands, and claimed waters in the South China Sea are all featured on the same scale in one complete map, thereby placing the islands, but also the entirety of the maritime space, in direct visual equivalence with the mainland.⁶⁰

In spite of its shortcomings vis-à-vis territories beyond land and beyond the horizontal, cartography continues to hold a crucial place in the way territorial sovereignty is imagined and borders are managed.⁶¹ In her chapter on the Sino-Indian border across the Himalayan range, Tina Harris explores the challenges of bordering at sixteen thousand feet. As she shows, the siting of border posts remains constrained by limitations imposed by the environment: the India-China boundary line is actually too high to be physically occupied by humans, and military bases are therefore placed in more habitable zones, far away from the “actual” border zone. Natural seasonal and environmental changes such as the freezing of mountain passes or monsoon-related landslides in the Himalayas may also shift the border to new locations or may mean that humans can only access it at specific times of the year. There is a sense however that the Indian and Chinese sides are creeping toward full appropriation of the border with the aid of new technologies such as laser fences, motion sensors, CCTV cameras, and a network of radars, and that the gap—or *lag* in Tina Harris's phrasing⁶²—will eventually disappear.

This gap between confidently mapped borders and actual realities on the ground is especially vivid at the India-China border but even the most established borders are never as stable as they claim. Italy's northern border with Austria and Switzerland follows the watershed that separates the drainage basins of Northern and Southern Europe. Running at high altitudes, the border crosses snowfields and perennial glaciers—all of which are now melting as a result of anthropogenic climate change. “As the watershed shifts so does the border, contradicting its representations on official maps. Italy, Austria, and Switzerland have consequently introduced the novel legal concept of a ‘moving border,’ one that acknowledges the volatility of geographical features once thought to be stable.”⁶³ A grid of twenty-five solar-powered sensors has been

fitted on the surface of the glacier at the foot of Mount Similaun; every two hours these sensors record data, allowing for an automated mapping of the shifts in the border. In these two very different border contexts, technology aims to close the gap between physical reality and representation, between map and territory. The promissory role of sensors tracking borders in real time, or of drones surveilling spaces beyond human reach, assuages cartographic anxieties and maintains the totalizing fiction of the nation-state in suspended belief. The more precise and sophisticated these technologies, the more ontologically secure the borders.

The process of terrestrial globalization, Peter Sloterdijk writes, reached its completion “with the installation of an electronic atmosphere and a satellite environment in the earth’s orbit.”⁶⁴ The provision of television, radio, and internet signals serve as confirmation of sovereign power insofar as states are invested in providing access to the entire territory over which they have sovereignty, and as gaps in coverage tend to be perceived as symptomatic of state weakness.⁶⁵ As early as 2011, China Mobile announced for instance that residents of the Spratly Islands (which until recently were uninhabited) would be enjoying full cellphone coverage. Elsewhere, telephone signals have been known to mold more overtly patterns of human settlement. In occupied Palestine, the erection of a cellphone tower by the Israel Electric Corporation allowed a settler outpost to emerge and grow steadily, highlighting the capacity of technology to act as a prosthetic device for territorial sovereignty.⁶⁶

Often, these technologies originate with the military and later enter the civilian domain. As Caren Kaplan writes, military ways of seeing and doing have been foundational to whole areas of culture that compose the ground of everyday life—including those that might seem unrelated to the project of state security or waging war, such as modes of making and reproducing art, or industrial design and technologies.⁶⁷ In his chapter based on research carried out in North Dakota, Marcel LaFlamme looks at how the maturation and proliferation of unmanned aircraft or drones, greatly aided by smartphone applications, is posing significant challenges to existing regimes of traffic management and is giving rise to new modes of volumetric sovereignty. Unlike many countries that have already transferred system management to various corporate structures, LaFlamme explains, the United States continues to retain direct responsibility over its air traffic control. However, various emerging forms of marketization are gradually transforming the way in which sovereignty is governed across borders as well as within them.

LaFlamme’s chapter brings into sharp relief the fractured and nonhomogeneous nature of political space, a point other scholars have made with respect

to digital enclosure, territorial airspace, or the management of oil pipelines.⁶⁸ This complexity highlights the importance of apprehending the state as a volumetric entity, rather than the mere intersection of the horizontal and the vertical. As Jason Cons and Michael Eilenberg have recently noted, we need to attend to the assemblages “constituted of intertwined materialities, actors, cultural logics, spatial dynamics, ecologies, and political economic processes.”⁶⁹ As the next section discusses in more depth, these state assemblages—these “acephalous ad hoc groupings of diverse elements”⁷⁰—are more than a set of discrete layers: they interact and provoke cross-scale entanglements that can remain beyond the threshold of conscious detectability yet have deleterious or even lethal consequences on the body.⁷¹ It is both timely and imperative that we attend to their material presence, to the vibrant matter that composes them—the swirling of the air, the roiling of the water, the churning of the soil, the melting of the ice.

Materiality

Voluminous States challenges an imaginary of space that is disembodied and abstract, taking issue with the notion propounded by some cartographers that the move from map to GPS has caused an uncoupling of territory and sovereignty and has led to a predominance of coordinates beyond any geographic commitment.⁷² As our bodies grate against the textured materiality of that purportedly empty space, as we choke on its dust, as our lungs struggle to fill with oxygen, and as our social lives become enmeshed in and demarcated by invisible electromagnetic fields, we are continually confronted with the textured and voluminous presence of this space.⁷³

Remaining attuned to the sensory (even *sensuous*) and synesthetic texture of this three-dimensional space is an important thread linking all contributions and in particular the five chapters found in the “Materiality” section. That “volume” and “materiality” cannot be dissociated from each other is especially evident in Klaus Dodds’s chapter focusing on the Arctic.⁷⁴ Drawing on the notion of fissure to foreground the elemental and more-than-human qualities of territory, Dodds reflects on what is at stake when ice, land, air, and water crack up and scramble established imaginative legacies of place framing. In the two Cold War-era vignettes he presents, on secret subterranean operation Camp Century/Project Ice Worm and the USS *Skate* submarine, the Greenlandic ice sheet ultimately proved to be a noncompliant and undomesticated partner. Geopolitical forays into the Arctic—an increasingly attractive site of resource extraction and global navigation given the compounding effects

of climate change—have underscored the complex and materially recalcitrant nature of the region, neither solid nor liquid. The symbolic planting of a flag, if attempted at the surface of the North Pole, would not take place on “solid, spatially fixed land but on a mathematically determined spot marked on a maze of mobile and shifting ice floes.”⁷⁵ Russia’s planting of a titanium flag on the bottom of the Central Arctic Ocean in August 2007 circumvented this icy conundrum by choosing earthly attachment instead.⁷⁶

As geographer Philip Steinberg has argued, sea ice holds particular interest precisely because of its liminality: while it is juridically and cartographically of the sea, its tactile, functional, and visual properties more closely resemble land.⁷⁷ This very material liminality became in fact a point of contention in a murder case that took place in 1970 on T-3, an ice island that from 1952 through 1978 served as a US Navy research station as it floated around the Arctic Ocean. At the time of the murder, T-3 was situated in international waters, though it had originally calved off Canada’s Ellesmere Island. Should T-3 be considered a vessel, under the jurisdiction of the United States, or a piece of sovereign territory, and therefore Canadian?⁷⁸ As a prosthetic technology of territory, Johanne Bruun and Philip Steinberg write, T-3 operated as an elemental nodal point, pulling together a complex territorial assemblage of matter and meaning in an environment whose physical properties crack apart commonplace understandings of terrain.⁷⁹

Voluminous space is an entanglement of materialities but also of scales, from the planetary to the granular. “Seemingly insignificant ‘specks’ accumulate, taking shape from barely noticeable singularities to unavoidably complex entities. As discrete units that aggregate to immense numbers, they exhibit a continuous fluid medium of their own—viscous, gravitational, flowing, blowing—constantly composing, and recomposing itself, instigating morphological variation.”⁸⁰ A pertinent example of this transscalar multimateriality is the so-called Great Pacific garbage patch—a plastic vortex of flotsam and jetsam whose contents and boundaries defy both spatial definition and visibility. Larger than Texas—and possibly twice the size of America⁸¹—evaluations of its size speak to the ambition, and ultimate impossibility, of comparing it to a landmass since the nature of the patch invalidates attempts at territorial referentiality.⁸² As the gyre churns vast quantities of discarded plastics, the material is broken down into ever smaller components. Most of the contents of the garbage patch are in fact so small that they are invisible to the naked eye, yet the impact of its overall mass—amounting to as much as a six-to-one ratio of plastic to zooplankton—is all too real. In suspension below the ocean’s surface, these particles alter the usual transparency of the water, blocking sunlight in part or completely.⁸³

Frequently imagined as a vast floating collection of refuse, the garbage patch is a ghostly presence reaching across scales, both immense and minuscule.⁸⁴

The complex planetary assemblage of the Great Pacific garbage patch is also palpable through its environmental impact. The harmful effect of microplastic on fish, birds, and other animals is well known but other classes of organisms actually benefit from the plastic debris. Water skater insects that live on hard surfaces in the water, for instance, have been laying their eggs on pieces of plastic in much greater numbers than ever before, extending their range considerably as a result.⁸⁵ Examples such as these speak to the complexity of entanglements between human and nonhuman animals, the organic and nonorganic, the animate and the inert. They also shed light on the planetary scale of environments and (mega)events such as climate change—as the work of Tim Morton on hyperobjects has shown.⁸⁶

Similar processes inform atmospheric entanglements. In his chapter on the movement of airborne particulate matter across the Pacific, Jerry Zee notes that the impact that dust storms originating in China have on California's air quality is often so significant that they can push air quality over regulatory thresholds. In measuring the quality of the air before it is impacted by domestic pollution, analyses carried out by the Lawrence Berkeley National Labs on the summit of Mount Tamalpais, north of San Francisco, are able to provide a "fingerprinting of the inbound airmass" and estimate how much of China drifts into American air. As Zee notes, these floating dusts blast apart a distinction between land and air, solid and gas, dramatizing their continuity as a choreography of materials.

As dust plumes move across and between continents, heavier dust particles are among the first elements to descend, while finer dusts that carry highly carcinogenic toxic material (far more likely to be inhaled deeply) travel to more geographically distant locations.⁸⁷ Importantly, these dust plumes are an assemblage of both organic and inorganic material. Suspended in the estimated two billion metric tons of dust lifted in the atmosphere every year are soil pollutants such as herbicides and pesticides, as well as microorganisms (bacteria, viruses, and fungi) in such quantities that sediment-borne bacteria could form a microbial bridge between Earth and Jupiter.⁸⁸ The astonishing magnitude by which desert soils are aerosolized into the giant clouds of dust discussed by Zee means that the sediments and their tiny inhabitants, once airborne, can settle thousands of miles from their site of origin, impacting the health of human and nonhuman animals where they make landfall.⁸⁹

These "bacterial passengers" do more of course than merely hitch a ride on dust particles. They are an intrinsic part of both human and nonhuman ani-

mal bodies insofar as microorganisms outnumber human cells in the body by a ratio of ten to one.⁹⁰ The increasing recognition of widespread bacterial and cross-species entanglements means that symbiogenesis—the horizontal transfer of genetic traits—is gradually replacing the cruder model of neo-Darwinian evolutionary theory. From biotic entities organized into clusters of genomes with unstable group boundaries (in the case of some influenza strains) to organisms such as certain fungi where the concept of species is largely irrelevant, scholars are increasingly attuned to the coevolution of organisms.⁹¹

This dramatic shift in conceptual models has had important repercussions on the way state borders are conceptualized and approached.⁹² In a chapter deploying the concept of ecotone—the interface between two different ecological habitats—Hilary Cunningham embraces a volumetric sensibility in order to remain attuned to the different kinds of space, bodywork, and somatic edges that are created by borders, especially as they impact the nonhuman. Ecotones, she writes, exhibit a rich variety and abundance of life. The potential erection of a US-Mexico border wall, in addition to its intended effect on human movement, will turn this particular ecotone into what she terms a *necrotone*—a death-dealing place. Not only will a continuous border wall interrupt the migratory patterns and ranges of animals living at the surface, but its subterranean extension will impact the burrows and movements of subterrestrial animals, while artificial light and the creation of twenty-four-hour daylight conditions will create maladaptive behaviors and disrupt bird flights and migrations.⁹³ A volumetric approach, Cunningham argues, situates human and nonhuman wellbeing at the same crossroads, recognizing that the planet's most vulnerable human and nonhuman populations are on the frontiers of social marginalization and ecological destruction.

The planned border wall is an especially egregious disruption of the thickness and mobility inherent to transitional zones, but of course all borders, including “natural” ones, are political and cartographic fictions imposed on the world.⁹⁴ Sarah Green's evocative metaphor of the tidemark to refer to the temporal oscillation of lines of sovereignty over space is particularly useful here in that it is alert to more-than-human forces, but it may be productive to extend it along a vertical axis as well to give it volume.⁹⁵ Thus in her chapter on Hong Kong, Clancy Wilmott traces how surfaces are imagined, produced, and lived in the context of voluminous urban spaces. Measuring height, she writes, is both situated and relative, since landscapes rise and sink, the tide washes up and down, and the oceans are not consistently level across the world. In a city like Hong Kong where building space is limited, upward construction has been accompanied with extensive land reclamation,⁹⁶ but the baseline for this

urban expansion—the “surface” of the city—lacked stability and definition. In 1866 a copper bolt was driven into the naval dockyard’s pier to determine a consistent sea level for the measurement of the hills, but when the dockyard had to be rebuilt, this led to a new, unfixed zero point, somewhat lower than when it was last checked. When the dockyard was moved a second time, the bolt was repositioned again, and a few more feet were lost.⁹⁷

Doreen Massey wrote that the Euclidean notion of space as a stable surface provides “unwelcome constraints that separate spaces from the matter and meanings that occur within.” Because the foundational space that remains after substance has been stripped away is empty, abstracted, and atemporal, this makes for a poor foundation for theorizing relational geographies of immanence.⁹⁸ Mining the gap between *volumetric* and *voluminous*—between measured abstract space and lived space—and tracking Hong Kong’s urban evolution through its verticality, materiality, and temporality, Wilmott is also attentive to the “chaotic underpinnings and experience of place.”⁹⁹

Philip Steinberg and Kimberley Peters have argued that the ocean is an ideal spatial foundation to challenge approaches that portray space as dematerialized, static, and periodized. As a voluminous and material environment undergoing continual reformation, the persistent and underlying churn of the ocean is ideally suited, they write, to “reinvigorate, redirect, and reshape debates that are all too often restricted by terrestrial limits.”¹⁰⁰ Their oceanic “wet ontology” is theoretically productive, especially as chaos and turbulence are not the exclusive property of liquids. Solids can also become turbulent under extreme conditions, or relative to geologic time.¹⁰¹ As Nigel Clark reminds us, “strata-forming processes are incessantly active, and the uppermost layers of the Earth’s crust are in constant interaction with the swirling mobility of air, water, and life at the planet’s surface.”¹⁰²

The notion of turbulence brings in an important elemental dimension which has thus far remained unexplored in the emerging literature on volume, that of gravity. As Gastón Gordillo writes in his contribution, gravity affects everything that exists, lives, and happens on Earth. If this statement appears self-evident, it does not diminish its force in any way. In fact, this very assumed and invisible omnipresence tends to obfuscate the implications of thinking gravity materially, territorially, and philosophically.¹⁰³ Like Wayne Chambliss discusses in his chapter on gravimetry, attentiveness to gravity reveals the irreducible materiality of the planet’s terrain. In his essay, Gordillo foregrounds the body as the main recipient of what Derek McCormack terms *elemental envelopment*.¹⁰⁴ The microphysics of warfare in Afghanistan which Gordillo describes reveal the ways in which the power of gravity over human

action has contingent yet consequential impacts on the deployment of state sovereignty. In an echo of the battles waged between Russian and Caucasians that are discussed in Dunn's chapter, warfare in Afghanistan brings to light the stark differences in the way terrain is apprehended by invading armies and local fighters. These distributive differentials, in turn, demand renewed attention to the ways in which the world that envelops us is experienced, embodied, and imagined.

Territorial Imagination

Just as space is never empty, time is never even, Karen Barad writes. Time is "drawn out like taffy, twisted like hot metal, cooled, hardened, and splintered."¹⁰⁵ Temporality is an important aspect of the concept of tidemarks deployed earlier as well as a significant dimension of border control, as is nicely illustrated in Harris's ethnographic case. While temporality in the Himalayas is uniquely shaped by altitude, temperature, plate tectonics, and climate change, time is a universal (though unequal) factor of border crossings—if only in terms of the time it takes to physically go through customs and passport controls, and/or scramble over mountainous terrain, trek across desert, and cross rivers in an attempt to avoid official border crossings.¹⁰⁶

Time is also experienced differently depending on the scale that is privileged.¹⁰⁷ In her chapter on the Greek-Albanian border region of Epirus, Sarah Green fuses human and geological perspectives—a two-speed ethnography—to highlight the productive intersections that inform the relations of local people with their politically and tectonically unstable region. Being attuned to these different temporalities brings into view certain spaces that were assumed to be static and immobile,¹⁰⁸ and is also key to understanding different logics of spatiality—in this case the Westphalian logic of the nation-state; the remaining traces of the Ottoman Empire's logic of statecraft; and the social logic of the people of the Greek-Albanian border.

The complex entanglements of time, space, and materiality—what Karen Barad terms *spacetime-mattering*¹⁰⁹—do not always take place in spaces or time-frames accessible or even perceptible to prosthetic-free human experience.¹¹⁰ As scholars in the humanities and social sciences gradually take these different temporalities into their stride,¹¹¹ the importance of taking volume into consideration is gaining recognition in analyses of social and political life. In urban contexts in particular, Stephen Graham has argued, horizontal imaginations are woefully inadequate to understand the urban labyrinths which seamlessly weave together the surface, the overground, and the subterranean. If they fail

to apprehend cities as volumes, he continues, urban planners and researchers “will struggle to contest their designs and exclusions and address their palpable problems.”¹¹²

A volumetric imaginary is also eminently suited to exploring amorphous and seemingly immaterial realms such as radio and sonic waves or the invisible topographies of electromagnetic space, none of which overlay precisely onto a geopolitical organization of space but instead have the capacity to crisscross, bleed through, and undermine political boundaries.¹¹³ Again, their nonlinear and leaky qualities are not foreshadowing deterritorialization necessarily. As Keller Easterling reminds us, despite being atomized and airborne, mobile telephony must nonetheless “tap into that physical broadband network, and at these or any other switching points, a bottleneck or monopoly can develop.”¹¹⁴ A similar argument was developed by Nicole Starosielski in her work on undersea cables. Signal traffic, she writes, is “wired rather than wireless; semicentralized rather than distributed; territorially entrenched rather than deterritorialized; precarious rather than resilient; and rural and aquatic rather than urban.”¹¹⁵ Contrary to popular representations, only a very small proportion of this traffic is actually airborne.¹¹⁶ It is also highly concentrated, due in part to the considerable costs of each system and the presence of existing networks, originally designed for older technologies such as the telegraph and the telephone.¹¹⁷ Not only are communications networks “grounded” in particular topographies but their design and placement take into account the local geography, climate, and existing infrastructure. Mindful of the high temperatures generated by search engines, Google has for instance chosen to locate some of its European servers in Hamina, Finland, where the seawater cooling system can be more energy efficient.¹¹⁸ While the coldness of the Arctic is proving a useful accomplice for global infrastructures, the physical geography of the seabed has proven an essential partner for transoceanic cabling, providing a resting space that is far removed from the hulls of passing ships.¹¹⁹

The two case studies in Aihwa Ong’s chapter show particularly well the tension and play between an imaginary of the nation-state as fixed and bound by its borders, and sovereign practices that are increasingly complex and deterritorialized—a phenomenon she termed *graduated sovereignty* in an earlier text.¹²⁰ In Singapore, the seaward extension of territory, in the form of land reclamation and novel usages of oceanic surface, is seeing the island nation’s geobody technologically sustained in a fluid material environment. Reimagined as a hydroterritorial entity,¹²¹ Singapore has literally become buoyant. China has also, in very different forms, sought to extend its territorial footprint to spaces beyond terra, embarking on a process of technological and

ecological manipulation of land/sea/sky interfaces. The imaginary here is one of flows and connections, reliant on the Maritime Silk Road project to weave an extensive economic and political web well beyond China's mainland. If Singapore's volumetric expansion is sustained by a terrestrial referent, in that buoyancy implies an upward force resistant to gravity, the infrastructural assemblage behind the extension of China's volumetric sovereignty is less reliant on geographical constraints. Borrowing deterritorializing moves from America's hyperpower playbook, Ong writes, China has been able to leverage its political and economic clout to reinterpret and bend territorial sovereignty rules. Still, even here, the metaphoric references remain terrestrial and horizontal: "Great Firewall," "Great Wall of Sand," "Great Wall in the Sky."

The flows and forces discussed by Ong depart in important ways from the abstract and immaterial models that some imagined would be replacing the bipolar world order that had defined global relations until the collapse of the Soviet Union in 1991. The material nature of these flows is foregrounded even further in Jason Cons's chapter on Bangladesh's delta region. Noting how anticipatory fears of inundation dominate imagined geographies, Cons urges us to pivot away from catastrophic events as the primary logic of the future and focus instead on alternative visions of environmental transformation. Equally pressing—less dramatically apparent but with important implications for a better understanding of borders and volume—the notion of seepage, Cons argues, is a more useful tracker of anthropogenic change. A significant dimension of material and volumetric instability in the delta comes from river siltation, a consequence of the shrimp industry as well as upstream dams and barrages on major rivers in India that subsequently flow into Bangladesh. These processes are also more-than-human: plate tectonics are causing the Sundarbans region itself to seep out of India and into Bangladesh, a gradual eastward flow that has led to speculative plans to rethink the delta space. The fugitive nature of matter brings different planes into relation in "ways that are constitutive of new, multidimensional spatial forms," blurring "borderlines not only between spatial planes, but also in terms of experiences of territory."¹²²

Such spatial entanglements substantiate Steinberg and Peters's assertion that a wet ontology can be productively extended to spaces beyond the oceanic. Territorial management indeed appears to be increasingly predicated on mobility across planes and scales. Layered representations of the state—to say nothing of flat cartographic models—are poorly suited to reflect the complexities of territorial control. Such is this complexity that organizational models are gradually skewing human/nonhuman assemblages in favor of nonhuman models.¹²³ Technological-entomological amalgams such as the swarm give

precedence to autonomy, emergence, and distributed functioning, and operate at speeds and altitudes beyond human capabilities. As the breach widens between human experience and the new realities of territorial management, a volumetric imaginary attuned to these evolving paradigms has become critical.¹²⁴

Counterintuitively perhaps, a sensorial, synesthetic approach grounded in human experience might be the best way to achieve this. A “confusion of the sensorium,” Ryan Bishop has argued, is key to the status of the subject with regard to agency and control,¹²⁵ working here against the privileged position that sight has long occupied in geopolitics.¹²⁶ More proxemic senses such as sound, smell, or touch can open up different perspectives insofar as they are tied to bodily presence.¹²⁷ Thus, as architectural theorist Juhani Pallasmaa reminds us, in a large or dark environment, it is through the echoes of our own footsteps or the sound of dripping water that the ear can carve a volume and make sense of the surrounding space.¹²⁸

In her chapter about the demilitarized zone (DMZ) separating North from South Korea, Lisa Sang-Mi Min deploys the notion of echolocation to come to terms with the paradox of an experience that is heavily reliant on the optical yet leaves the observer strangely disoriented. Optical techniques to locate the DMZ, such as large panoramic windows, binoculars, or guard posts, invoke a sense of frozen staticity. Sound, by contrast, relates to the border in ways that elude the burden of these optics. “Sound cannot be contained in the same way that optics seek maintenance upon territory,” she writes. While vision renders the landscape flat, the sonic environment is voluminous, embracing, expanding, contracting. Min describes how the rolling sounds of propaganda, world news, K-pop, military marches, and songs of love, longing, and loss are reflected and deflected by topography and weather. Echolocation is more than wayfinding. It is, first and foremost, a way of being in the world.

Perhaps even more than hearing—which Pallasmaa considers, along with vision, one of the two privileged sociable senses—smell and touch can be productive contributors to a synesthetic and *voluminous* spatial imaginary. These senses tap into an apprehension of space that is generally relegated to the private realm, “archaic sensory remnants . . . usually suppressed by the code of culture.”¹²⁹ Smellscapes, immersive and volatile, can help map elusive olfactory traces that index tangible social inequalities,¹³⁰ while alertness to tactile and haptic dimensions brings to the fore an intersensoriality in politics that is rarely made explicit yet molds international relations and policy.¹³¹ Vibration, implicating both sound and touch, similarly opens up volumetric dimensions that are difficult to map or visualize. In the context of horizontal drilling and fracking, the anthropogenic nature of induced vibration engages subterra-

nean spatial logics that contrast dramatically with territorial encounters as well as challenge the cohesion implicit in Steinberg and Peters's notion of wet ontology.¹³² Effects of vibrations on the body itself can be harmful, if not lethal, even if they are not consciously registered. Frequencies of seven hertz, coinciding with theta rhythms, can induce moods of fear and anger, while infrasonic resonance can produce intense friction between internal organs. The weaponization of vibratory space, with infrasonic acoustic guns or through the panic-inducing violence of high-volume frequencies, is another example of the mobilization of voluminous space for political aims.¹³³

Untethered Spaces?

On September 5, 1962, a fragment of the Soviet spacecraft Sputnik IV crashed in Manitowoc, Wisconsin. This more-than-Earth encounter remained a local news story until 2007, when the town launched the now yearly Sputnikfest, with contests such as the Ms. Space Debris Pageant, open to “all human life forms.”¹³⁴ In Kazakhstan and in the Russian Altai Republic, both on the rocket flightpath of the Baikonur Cosmodrome, Russian space debris are a far more common occurrence.¹³⁵ This has caused a niche scrap metal economy to develop in Kazakhstan, with groups of specialized collectors combing the steppe after each launch in search of salable metals. Through established norms and principles, as well as per the 1974 Convention on Registration of Objects Launched into Outer Space, while outer space is considered neutral territory, human-made objects remain the property of the launching state—constituting in effect orbital ambulatory exclaves of sovereign territory.¹³⁶ For Kazakhstan, both Baikonur and the space objects taking off from it remain intimately entangled in debates about the meaning of national sovereignty, as well as about Russia's protracted presence in post-Soviet Central Asia.¹³⁷

Like the economic zones discussed in Ong's chapter, these territorial fragments constitute spaces of exception within the recognized world state system but belong to a specific subset insofar as their sovereign status is predicated on movement. Like a ship or aircraft registered under a particular flag but crossing other sovereign spaces, their jurisdiction is dependent on location. These mobile pieces of sovereign territory also share characteristics with the cross-border movement of water and sewerage discussed in the context of Baarle-Nassau and Baarle-Hertog which pass from a sovereign space to another and require mutual agreement to sustain the illusion. Unlike economic zones that are carved out for specific (usually economic) aims, ambulatory spaces and temporal exceptions function as devices designed to work within the agreed

system without having to challenge its core tenets. An extreme example is Suite 212 at Claridge's Hotel in London—a temporary Yugoslavian enclave that was created for a single day in 1945 to ensure the heir of the throne would be born on Yugoslavian soil.¹³⁸

These spaces of volumetric exception illustrate the difficulty of creating imaginaries of political order beyond the nation-state or forms of sovereignty that are truly deterritorialized.¹³⁹ Even utopian projects like the sixty or so micronations that have been declared worldwide have a territorial referent: a sliver of no-man's land (Liberland), a city's neighborhood (Christiania), an off-shore platform in the North Sea (Sealand), a section of ocean space (Republica Glaciar), a satellite in outer space (Asgardia). As geographer Alastair Bonnett notes, "the notion that sovereignty can be based within a network of people and not defined by borders isn't easy to get one's head around."¹⁴⁰ Surprising contenders may be supranational organizations or networks such as the internet or the International Organization for Standardization (ISO). Writing of the latter, Keller Easterling notes that some observers regard it as the beginnings of a "world state" in that it "formats the performance and calibration of many components of infrastructure space at every scale, from the microscopic to the gigantic."¹⁴¹ The internet has also been described as a sovereign territory even if such statements belong in the domain of the metaphorical since, in practice, the United States exercises superjurisdiction over it.¹⁴² Yet it is these novel and volumetric geographies—specifically the planetary-scale computation which Benjamin Bratton terms *the Stack*—that are set to have the most dramatic impact on our geopolitical realities: "Planetary-scale computation takes different forms at different scales—energy and mineral sourcing and grids; subterranean cloud infrastructure; urban software and public service privatization; massive universal addressing systems; interfaces drawn by the augmentation of the hand, of the eye, or dissolved into objects; users both over-outlined by self-quantification and also exploded by the arrival of legions of sensors, algorithms, and robots."¹⁴³ Together, these computations distort and deform modern political geographies, producing new territories in their own image and ushering in a new model of geopolitical architecture. The gap between human imaginaries and the new realities of territorial management and sovereignty appears however to be widening and deepening, as cartographic two-dimensional representations continue to hold sway and elicit much affective force in spite of their inadequacies.¹⁴⁴

NOTES

- 1 Jun Sen Ng, "Masterplan of Singapore's Underground Spaces Ready by 2019," *Straits Time*, February 5, 2018, <https://www.straitstimes.com/politics/masterplan-of-spores-underground-spaces-ready-by-next-year>.
- 2 See discussion in Humphrey, this volume.
- 3 See also Jerome Whittington, "Modernist Infrastructure and the Vital Systems Security of Water: Singapore's Pluripotent Climate Futures," *Public Culture* 28, no. 2 (2016): 415–41.
- 4 Stuart Banner, *Who Owns the Sky? The Struggle to Control Airspace from the Wright Brothers On* (Cambridge, MA: Harvard University Press, 2008).
- 5 Caren Kaplan, *Aerial Aftermaths: Wartime from Above* (Durham, NC: Duke University Press, 2018).
- 6 Carl Schmitt, *Nomos of the Earth in the International Law of Jus Publicum Europaeum* (New York: Telos, [1950] 2003).
- 7 See, for instance, Irus Braverman, Nicholas Blomley, David Delaney, and Alexandre (Sandy) Kedar, *The Expanding Spaces of Law: A Timely Legal Geography* (Stanford, CA: Stanford University Press, 2014).
- 8 William Rankin, *After the Map: Cartography, Navigation, and the Transformation of Territory in the Twentieth Century* (Chicago: University of Chicago Press, 2016).
- 9 As defined by the International Seabed Authority (ISA). The ISA was established under UNCLOS to control activities within areas of the seabed located outside national jurisdiction (see International Seabed Authority, "Continental Shelf," official website of International Seabed Authority, accessed January 17, 2019, <https://www.isa.org.jm/continental-shelf>). As Klaus Dodds writes, registering for extended continental shelf (ECS) status is an expensive and technical business (Klaus Dodds, "Our Seabed? Argentina, the Falklands and the Wider South Atlantic," *Polar Record* 52, no. 266 [2016]: 536). Claims are based on geological and geographical criteria including distance, thickness of sedimentary rock, and water depth. The various zones found between territorial waters and the high seas in figure 1.1 represent different ways of calculating the maximum extension of the EEZ. The maximum limit is generally set at 350 nautical miles, or 100 miles from the 2,500-meter isobath, whichever is greatest. But coastal states can also claim an extension of their 200-mile EEZ to include the continental shelf. The claimable area is 60 nautical miles from the foot of the continental shelf, or the distance from the foot of the shelf to the part of the seafloor that has 1 percent sediment (*d*).
- 10 Coastal states are seeking primarily to define areas in which they have sovereign rights, with the view to exploit natural resources. As Philip Steinberg, Jeremy Tasch, and Hannes Gerhardt point out, the common portrayal of seabed-mapping missions as a "competitive mad dash to gain sovereign territory" is misleading. They are marking "limits," not "boundaries" (Philip E. Steinberg, Jeremy Tasch, and Hannes Gerhardt, *Contesting the Arctic: Politics and Imaginaries in the Circumpolar North* [London: IB Tauris, 2015], 32).

- 11 Ian Shaw, *Predator Empire: Drone Warfare and Full Spectrum Dominance* (Minneapolis: University of Minnesota Press, 2016), 15.
- 12 Keller Easterling, *Extrastatecraft: The Power of Infrastructure Space* (London: Verso, 2014).
- 13 See, for instance, Sandro Mezzadra and Brett Neilson, *Border as Method, Or, the Multiplication of Labor* (Durham, NC: Duke University Press, 2013); or Nira Yuval-Davis, Georgie Wemyss, and Kathryn Cassidy, *Bordering* (Cambridge: Polity, 2019).
- 14 Étienne Balibar, *Politics and the Other Scene* (London: Verso, 2002), 76.
- 15 David Ludden, "Maps in the Mind and the Mobility of Asia," *Journal of Asian Studies* 62, no. 4 (November 2003): 1058.
- 16 Stefanie R. Fishel, *The Microbial State: Global Thriving and the Body Politic* (Minneapolis: University of Minnesota Press, 2017).
- 17 John Agnew, "The Territorial Trap: The Geographical Assumptions of International Relations Theory," *Review of International Political Economy* 1, no. 1 (Spring 1994): 53–80.
- 18 Reece Jones, *Violent Borders: Refugees and the Right to Move* (London: Verso, 2016).
- 19 Michael Dear, *Why Walls Won't Work: Repairing the US-Mexico Divide* (Oxford: Oxford University Press, 2013), 177.
- 20 Alexander B. Murphy, "Territory's Continuing Allure," *Annals of the Association of American Geographers* 103, no. 5 (2013): 1212–26, <https://doi.org/10.1080/00045608.2012.696232>.
- 21 Wendy Brown, *Walled States, Waning Sovereignty* (New York: Zone Books, 2010), 24.
- 22 Close to half of all undocumented immigrants come to the United States legally but then overstay their visas. Many of them travel by air, making walls doubly ineffective.
- 23 Clancy Wilmott, "Surface," Theorizing the Contemporary, *Cultural Anthropology*, October 24, 2017, <https://culanth.org/fieldsights/surface?token=540>.
- 24 Stuart Elden, "Secure the Volume: Vertical Geopolitics and the Depth of Power," *Political Geography* 34 (2013): 35–51.
- 25 Peter Adey, *Aerial Life: Spaces, Mobilities, Affects* (Malden, MA: Wiley-Blackwell, 2010); Derek Gregory, "From a View to a Kill: Drones and Late Modern War," *Theory, Culture and Society* 28, nos. 7–8 (2011): 188–215; Alison J. Williams, "A Crisis in Aerial Sovereignty? Considering the Implications of Recent Military Violations of National Airspace," *Area* 42, no. 1 (2010): 51–59; Eyal Weizman, *Hollow Land: Israel's Architecture of Occupation* (London: Verso, 2007); Bradley L. Garrett, *Explore Everything: Place-Hacking the City* (London: Verso, 2013).
- 26 Elaine Campbell, "Three-Dimensional Security: Layers, Spheres, Volumes, Milieus," *Political Geography* 69 (2019): 10–21; Ian Klinke, *Cryptic Concrete: A Subterranean Journey into Cold War Germany* (Chichester: Wiley-Blackwell, 2018); Marilu Melo Zurita, "Sinkhole," Volumetric Sovereignty forum, *Society and Space*, March 17, 2019, <http://societyandspace.org/2019/03/17/sinkhole>; María Alejandra Pérez, "Exploring the Vertical: Science and Sociality in the Field Among Cavers in Venezuela," *Social and Cultural Geography* 16, no. 2 (2015): 226–47.
- 27 Andrea Ballesterio, *A Future History of Water* (Durham, NC: Duke University Press, 2019); Dominic Boyer and Cymene Howe, *Wind and Power in the Anthropo-*

- cene (Durham, NC: Duke University Press, 2019); Timothy Choy and Jerry Zee, "Condition—Suspension," *Cultural Anthropology* 30, no. 2 (2015): 210–23; John Hannigan. *The Geopolitics of Deep Oceans* (Cambridge: Polity, 2016); Stefan Helmreich, *Alien Ocean: Anthropological Voyages in Microbial Seas* (Berkeley: University of California Press, 2009); Lisa Messeri, *Placing Outer Space: An Earthly Ethnography of Other Worlds* (Durham, NC: Duke University Press, 2016); Laura A. Ogden, *Swamplife: People, Gators, and Mangroves Entangled in the Everglades* (Minneapolis: Minnesota University Press, 2011); Eric Paul Roorda. *The Ocean Reader: History, Culture, Politics* (Durham, NC: Duke University Press, 2020); Jennifer E. Telesca, *Red Gold: The Managed Extinction of the Giant Bluefin Tuna* (Minneapolis: University of Minnesota Press, 2020).
- 28 On cartographic anxieties, see Franck Billé, "Introduction to 'Cartographic Anxieties,'" *Cross-Currents* 21 (2016): 1–18, <http://cross-currents.berkeley.edu/e-journal/issue-21>.
- 29 Grégoire Chamayou, *Théorie du drone* (Paris: La Fabrique, 2013); Gregory, "From a View to a Kill"; Shahar Hameiri and Lee Jones, *Governing Borderless Threats: Non-Traditional Security and the Politics of State Transformation* (Cambridge: Cambridge University Press, 2015); Lisa Parks and Caren Kaplan, *Life in the Age of Drone Warfare* (Durham, NC: Duke University Press, 2017).
- 30 A very powerful description of such entanglements in three-dimensional space is provided by Eyal Weizman in his book *Hollow Land*. The "Tunnel Road," linking Jewish Jerusalem and the West Bank settlement of Gush Etzion, crosses a volumetric space. "Although the road is under Israeli control, both the valley it spans and the city it runs beneath are areas under Palestinian control. As the road threads itself through this folded, topographical arrangement of different jurisdictions, Israeli territory finds itself alternatively above and below the Palestinian. . . . When the bridge's columns rest on Palestinian ground, the 'border' runs, presumably, through the thermodynamic joint between the column and the beams" (Weizman, *Hollow Land*, 180).
- 31 Jason Dittmer, "Geopolitical Assemblages and Complexity," *Progress in Human Geography* 38, no. 3 (2014): 390.
- 32 If the technologies Chambliss discusses are currently used exclusively by the US military, the "fluid movement between military and civilian populations and machinery," as Caren Kaplan has written, suggests that the popular imagination of the underground as static and inhibitive of movement, and thus less amenable to geopolitical mobilizations, will increasingly give way to a more dynamic view (Caren Kaplan, "Drone-O-Rama: Troubling the Temporal and Spatial Logics of Distance Warfare," in *Life in the Age of Drone Warfare*, ed. Lisa Parks and Caren Kaplan [Durham, NC: Duke University Press, 2017], 171). See also section XI, "Militarism and Technology," in Roberto J. González, Hugh Gusterson, and Gustaaf Houtman, *Militarization: A Reader* (Durham, NC: Duke University Press, 2019).
- 33 Martin Coward argues that this new military imaginary is blind to contiguity and perceives only a constellation of noncontiguous entities without any territorial reference (Martin Coward, "Networks, Nodes and De-Territorialised Battlespace: The Scopic Regime of Rapid Dominance," in *From Above: War, Violence and Vertical-*

ity, ed. Peter Adey, Mark Whitehead, and Alison J. Williams [Oxford: Oxford University Press, 2013], 112). However, his privileging of connections in the form of nodes and networks leaves unexamined the material texture of space.

- 34 The two collections are available online in Open Access: “Speaking Volumes,” Theorizing the Contemporary, *Cultural Anthropology*, 2017–18, <http://culanth.org/fieldsights/1247-speaking-volumes>; Volumetric Sovereignty forum, *Society and Space*, 2019, <http://societyandspace.org/2019/04/10/volumetricsovereigntyforum>.
- 35 Corey Johnson, Reece Jones, Anssi Paasi, Louise Amoore, Alison Mountz, Mark Salter, and Chris Rumford, “Interventions on Rethinking ‘the Border’ in Border Studies,” *Political Geography* 30 (2011): 61–69.
- 36 Gbenga Oduntan, *Sovereignty and Jurisdiction in the Airspace and Outer Space: Legal Criteria for Spatial Delimitation* (London: Routledge, 2012), 23.
- 37 Joan Cocks, *On Sovereignty and Other Political Delusions* (London: Bloomsbury, 2014), 2–3.
- 38 Oduntan, *Sovereignty and Jurisdiction*, 24.
- 39 See, for instance, Daniel Immerwahr, *How to Hide an Empire: A History of the Greater United States* (New York: Farrar, Straus and Giroux, 2019).
- 40 Even if China is not the only nation involved in terraforming—Vietnam has also carried out land reclamation on Sand Cay Island—the extent of its activities remains unmatched.
- 41 Fiery Cross Reef (*Yongshu jiao* 永暑礁) has, for instance, grown in stunning fashion “from a single coral head that peaked a mere meter out of the waves” into an island “attaining a size of over 200 hectares of reclaimed land—roughly equivalent to about 280 football pitches” (Howard W. French, “What’s behind Beijing’s Drive to Control the South China Sea?,” *Guardian*, July 28, 2015).
- 42 United Nations, *Agreement for the Implementation of the Provisions of the 1982 United Nations Convention on the Law of the Sea Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*, A/CONF.164/ 22/Rev. 1 (New York: United Nations, 1995). See discussion in Philip E. Steinberg, *The Social Construction of the Ocean* (Cambridge: Cambridge University Press, 2001), 172.
- 43 Ryan Bishop, “Project ‘Transparent Earth’ and the Autopsy of Aerial Targeting: The Visual Geopolitics of the Underground,” *Theory, Culture and Society* 28, nos. 7–8 (2011): 270–86, <https://doi.org/10.1177/0263276411424918>.
- 44 The Odessa Catacombs, like their Paris counterpart, have now become important tourist attractions. Elsewhere, other subterranean formations have also led to profit-making enterprises. As Marilu Melo writes, if sinkholes have caused substantial damage and even deaths when the surface suddenly collapses in urban environments, they have, in places like Mexico’s Yucatan Peninsula, transformed into tourist commodities. Taking advantage of the emergence of a sinkhole market, some “land” owners have opted to dynamite the surface to accelerate the creation of sinkholes—thereby manufacturing recreational volume for tourist consumption (Melo Zurita, “Sinkhole”).
- 45 Daphné Richemond-Barak, *Underground Warfare* (Oxford: Oxford University Press), 2018.

- 46 Weizman, *Hollow Land*.
- 47 With space theorists such as Gilles Deleuze, Félix Guattari, and Guy Debord on the reading lists of some of the contemporary military institutions, Israeli military tactics have been relying on postcolonial and poststructuralist theory (Weizman, *Hollow Land*, 187).
- 48 Weizman, *Hollow Land*, 185–86.
- 49 For more on chokepoints, see the recent collection curated by Ashley Carse, Jason Cons, and Townsend Middleton (*Limn* 10 [2019]).
- 50 Guy Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987).
- 51 Richemond-Barak, *Underground Warfare*, 93–104.
- 52 Evangeline McGlynn, “Quake,” Volumetric Sovereignty forum, *Society and Space*, March 12, 2019, <http://societyandspace.org/2019/03/12/quake>.
- 53 Banner, *Who Owns the Sky?*, 266.
- 54 Cited in Stephen Graham, *Vertical: The City from Satellites to Bunkers* (London: Verso, 2016), 25.
- 55 In 1976, eight equatorial nations proclaimed sovereignty over segments of the geosynchronous orbit. Brazil, Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda, and Zaire were primarily motivated by the fear, not entirely ungrounded as it turned out, that the first countries capable of launching satellites would fill up the orbit before poorer nations could acquire satellites of their own (Banner, *Who Owns the Sky?*, 286–87).
- 56 Oduntan, *Sovereignty and Jurisdiction*, 301.
- 57 Thus regulations about the subsoil are being implemented through UNCLOS, while the management of outer space is taking the high seas commons as its primary narrative.
- 58 Jon Phillips, “WATER | Order and the Offshore: The Territories of Deep-Water Oil Production,” in *Territory beyond Terra*, ed. Kimberly Peters, Philip Steinberg, and Elaine Stratford (London: Rowman and Littlefield International, 2018), 67; Katherine Genevieve Sammler, “The Deep Pacific: Island Governance and Seabed Mineral Development,” in *Island Geographies: Essays and Conversations*, ed. Elaine Stratford (London: Routledge, 2016), 14. See also Irus Braverman and Elizabeth R. Johnson, *Blue Legalities: The Life and Laws of the Sea* (Durham, NC: Duke University Press, 2020).
- 59 See Alessandro Uras, “The South China Sea and the Building of a National Maritime Culture: A New Chinese Province in the Making,” *Asian Survey* 57, no. 6 (2017): 1008–31.
- 60 This equivalence, Ross Exo Adams argues, is in fact multidirectional. In his recent study of urbanization, he argues that the oceanic imagination has also imparted specific ways of conceptualizing the urban, a “maritimization” of urban space in effect. See Ross Exo Adams, *Circulation and Urbanization* (London: Sage, 2019).
- 61 A British company has recently divided the world into a grid of three-by-three-meter squares and assigned each one a unique three-word address. What3words

can pinpoint an exact location and direct a user to it—a very useful advantage for countries like Mongolia with little infrastructure and no street addresses. The system is however poorly suited to identify elevation.

- 62 The idea of lag presupposes isomorphism in that it implies that the space that is absent will be the same as the one that already exists (Marilyn Strathern, personal communication). On the political fiction of homogeneous space, see Franck Billé, “Territorial Phantom Pains (and Other Cartographic Anxieties),” *Environment and Planning D: Society and Space* 32, no. 1 (2014): 163–78.
- 63 Marco Ferrari, Elisa Pasqual, and Andrea Bagnato, *A Moving Border: Alpine Cartographies of Climate Change* (New York: Columbia University Press, 2018). See also the project on which the book is based, at the Italian Limes website, accessed October 3, 2019, <http://italianlimes.net>.
- 64 Peter Sloterdijk, *In the World Interior of Capital: Towards a Philosophical Theory of Globalization*, trans. Wieland Hoban (Cambridge: Polity Press, 2013), 12.
- 65 Ekaterina Mikhailova, “Broadcast,” Volumetric Sovereignty forum, *Society and Space*, March 3, 2019, <http://societyandspace.org/2019/03/03/broadcast>.
- 66 The outpost of Migron is now one of the largest of the 103 outposts scattered throughout the West Bank (Weizman, *Hollow Land*, 2). As of 2011 it had a population of 260.
- 67 Caren Kaplan, “The Balloon Prospect: Aerostatic Observation and the Emergence of Militarised Aeromobility,” in *From Above: War, Violence and Verticality*, ed. Peter Adey, Mark Whitehead, and Alison J. Williams (Oxford: Oxford University Press, 2013), 21–22.
- 68 See, respectively: Helga Tawil-Souri, “Digital Occupation: Gaza’s High-Tech Enclosure,” *Journal of Palestine Studies* 41, no. 2 (Winter 2012): 27–43; Weiqiang Lin, “AIR | Spacing the Atmosphere: The Politics of Territorializing Air,” in *Territory beyond Terra*, ed. Kimberly Peters, Philip Steinberg, and Elaine Stratford (London: Rowman and Littlefield International, 2018), 35–49; Andrew Barry, *Material Politics: Disputes along the Pipeline* (Oxford: Wiley-Blackwell, 2013).
- 69 Jason Cons and Michael Eilenberg, “Introduction: On the New Politics of Margins in Asia Mapping Frontier Assemblages,” in *Frontier Assemblages: The Emergent Politics of Resource Frontiers in Asia*, ed. Jason Cons and Michael Eilenberg (London: Wiley, 2019), 3.
- 70 Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2010), 23–24.
- 71 The 2010 eruption of the Eyjafjallajökull Volcano in Iceland caused major disruptions in global air traffic yet the fine particles of volcanic ash were largely invisible to the naked eye (Peter Adey, *Air: Nature and Culture* [London: Reaktion Books, 2014], 172–73).
- 72 Rankin, *After the Map*, 4.
- 73 Timothy Choy, *Ecologies of Comparison: An Ethnography of Endangerment in Hong Kong* (Durham, NC: Duke University Press, 2009); Lisa Parks and Nicole Stamosiowski, *Signal Traffic: Critical Studies of Media Infrastructures* (Urbana: University of Illinois Press, 2015).

- 74 See also Klaus Dodds, *Ice: Nature and Culture* (Chicago: University of Chicago Press, 2018).
- 75 Steinberg, Tasch, and Gerhardt, *Contesting the Arctic*, 40.
- 76 See Klaus Dodds, "Flag Planting and Finger Pointing: The Law of the Sea, the Arctic and the Political Geographies of the Outer Continental Shelf," *Political Geography* 29, no. 2 (2010): 63–73.
- 77 Philip E. Steinberg, "Of Other Seas: Metaphors and Materialities in Maritime Regions," *Atlantic Studies: Global Currents* 10, no. 2 (2013): 163.
- 78 For a discussion of this fascinating legal case, see Steinberg, Tasch, and Gerhardt, *Contesting the Arctic*, 45–47.
- 79 Johanne Bruun and Philip Steinberg, "ICE | Placing Territory on Ice: Militarisation, Measurement and Murder in the High Arctic," in *Territory beyond Terra*, ed. Kimberly Peters, Philip Steinberg, and Elaine Stratford (London: Rowman and Littlefield International, 2018), 149–56.
- 80 Katrin Klingan, Ashkan Sepahvand, Christoph Rosol, and Bernd M. Scherer, *Textures of the Anthropocene: Grain, Vapor, Ray* (Cambridge, MA: MIT Press, 2015), 7. On viscosity, also see Nancy Couling and Carola Hein, "Viscosity," Volumetric Sovereignty forum, *Society and Space*, March 17, 2019, <http://societyandspace.org/2019/03/17/viscosity>.
- 81 Comparisons to "America" likely have the United States as referent, but the very looseness of the term (potentially indexing the entire continent) speaks to the amorphousness of the Great Pacific garbage patch and to the impossibility of circumscribing it mentally or territorially.
- 82 Jennifer Gabrys notes that "the relative invisibility and inaccessibility of the patches render them as looming imaginative figures of environmental decline and yet relatively amorphous and unlocatable and so seemingly resistant to environmental action" (Jennifer Gabrys, *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet* [Minneapolis: University of Minnesota Press, 2016]).
- 83 Te Punga Somerville, Alice, "The Great Pacific Garbage Patch as Metaphor: The (American) Pacific You Can't See," in *Archipelagic American Studies*, ed. Brian Russell Roberts and Michelle Ann Stephens (Durham, NC: Duke University Press, 2017), 323.
- 84 Te Punga Somerville, "Great Pacific Garbage Patch as Metaphor," 331.
- 85 Miriam C. Goldstein, Marci Rosenberg, and Lanna Cheng, "Increased Oceanic Microplastic Debris Enhances Oviposition in an Endemic Pelagic Insect," *Biology Letters* 8, no. 5 (2012): 817–20.
- 86 Timothy Morton, *Hyperobjects: Philosophy and Ecology after the End of the World* (Minneapolis: University of Minnesota Press, 2013).
- 87 Hilary Cunningham, "Permeabilities, Ecology and Geopolitical Boundaries," in *A Companion to Border Studies*, ed. Thomas M. Wilson and Hastings Donnan (Chichester: Wiley-Blackwell, 2012), 379. As Cunningham further notes, "what may be regarded as the 'local' or 'regional' impacts of the dust storms may in fact be quite differentially global, both in scope and in effects" (379).

- 88 Dale W. Griffin, Christina A. Kellogg, Virginia H. Garrison, and Eugene A. Shinn, "The Global Transport of Dust: An Intercontinental River of Dust, Microorganisms and Toxic Chemicals Flows through the Earth's Atmosphere," *American Scientist* 90, no. 3 (May–June 2002): 228.
- 89 A seventeenfold increase has been reported for instance in the incidence of asthma on the island of Barbados since 1973, which corresponds to the period when the quantities of African dust in the region started to increase (Griffin et al., "Global Transport of Dust," 233).
- 90 As per a Human Microbiome Project analysis published in 2010, cited in Fishel, *Microbial State*, 59.
- 91 See, respectively, Celia Lowe, "Viral Clouds: Becoming H5N1 in Indonesia," *Cultural Anthropology* 25, no. 4 (2010): 625–49; and Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton, NJ: Princeton University Press, 2015), 231. A more classic example perhaps is that of the lichen. Neither green alga nor a fungus as was initially presumed, the lichen is the coevolution of at least three distinct species (Fishel, *Microbial State*, 65).
- 92 Donna Haraway's book, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008), was an especially important milestone in reframing human-nonhuman relationships. More recently, Jane Bennett's notion of vibrant matter has also been helpful in highlighting the complex entanglements of nonhuman material with the human, showing how "human agency is always an assemblage of microbes, animals, plants, metals, chemicals, word-sounds" (Bennett, *Vibrant Matter*, 120).
- 93 See also Eleana J. Kim, "Flyways," Theorizing the Contemporary, *Cultural Anthropology*, June 27, 2018, <https://culanth.org/fieldsights/flyways>.
- 94 Of all borders aligned on natural features, river borders are perhaps the most recalcitrant, creating misalignments as they alter their course. The border dispute between Croatia and Serbia arose during the twentieth century as natural meanderings and hydraulic engineering works contributed to altering the course of the Danube. Such changes frequently lead to overlapping territorial claims, but in the case of the Croatian-Serbian border it also opened up cartographic breaches, creating patches of land unclaimed by either side. One of these gaps was seized by activist Vít Jedlička who proclaimed the micronation of Liberland in April 2015.
- 95 Sarah Green, "A Sense of Border," in *A Companion to Border Studies*, ed. Thomas M. Wilson and Hastings Donnan, 573–92 (Chichester: Wiley-Blackwell, 2012).
- 96 So extensive was this reclamation that the naval dockyard had to be moved twice as it was no longer on the shore.
- 97 This shifting baseline is a good illustration of the argument recently made by Kate Sammler that the level of the sea constitutes a political surface. In demarcating territory, she writes persuasively, rising sea levels impact legal baselines and shift national terrestrial and maritime borders inland. Katherine Genevieve Sammler. "The Rising Politics of Sea Level: Demarcating Territory in a Vertically Relative World," *Territory, Politics, Governance* (2019) <https://doi.org/10.1080/21622671.2019.1632219>.

- 98 Doreen Massey, *For Space* (London: Sage, 2005), qtd. in Philip Steinberg and Kimberley Peters, "Wet Ontologies, Fluid Spaces: Giving Depth to Volume through Oceanic Thinking," *Environment and Planning D: Society and Space* 33, no. 2 (2015): 248.
- 99 Steinberg and Peters, *Wet Ontologies, Fluid Spaces*, 247.
- 100 Steinberg and Peters, *Wet Ontologies, Fluid Spaces*, 247–48. In a later piece, Peters and Steinberg add a caveat to their original argument, noting that "the ocean is not simply liquid. It is solid (ice) and air (mist). It generates winds, which transport smells, and these may emote the oceanic miles inland." Kimberley Peters and Philip Steinberg, "The Ocean in Excess: Towards a More-than-Wet Ontology," *Dialogues in Human Geography* 9 (2019): 293.
- 101 Austin Lord, "Turbulence," Volumetric Sovereignty forum, *Society and Space*, March 17, 2019, <http://societyandspace.org/2019/03/17/turbulence>.
- 102 Nigel Clark, "FIRE | Pyropolitics for a Planet of Fire," in *Territory beyond Terra*, ed. Kimberly Peters, Philip Steinberg, and Elaine Stratford, 69–85 (London: Rowman and Littlefield International, 2018).
- 103 Gravity, as Marx once declared, is all around us: "The atmosphere in which we live weighs upon everyone with a 20,000 pound force. But do you feel it?" (cited in Choy, *Ecologies of Comparison*, 145).
- 104 Derek P. McCormack, *Atmospheric Things: On the Allure of Elemental Envelopment* (Durham, NC: Duke University Press, 2018). On thinking with the elements that literally fill and underpin space, see also Rachael Squire, "Rock, Water, Air and Fire: Foregrounding the Elements in the Gibraltar-Spain Dispute," *Environment and Planning D: Society and Space* 34, no. 3 (2016): 545–63.
- 105 Karen Barad, "No Small Matter: Mushroom Clouds, Ecologies of Nothingness, and Strange Topologies of Spacetime-mattering," in *Arts of Living on a Damaged Planet*, ed. Anna Tsing, Heather Swanson, Elaine Gan, and Nils Bubandt (Minneapolis: University of Minnesota Press, 2017), 610.
- 106 In the fraught environment of Israel and Palestine, border controls also involve a number of techniques such as curfews, and work and travel permits that temporally delineate border crossings. The fact that daylight saving times are not synchronous on both sides brings in an additional layer of complexity by separating the fractured geography of the region into two different time zones for part of the year. See Helga Tawil-Souri, "Checkpoint Time," *Qui Parle* 26, no. 2 (2017): 383–422.
- 107 Marcia Bjornerud uses the term *timefulness* to draw attention to the need for a polytemporal worldview that registers overlapping rates of change (Marcia Bjornerud, *Timefulness: How Thinking Like a Geologist Can Help Save the World* [Princeton, NJ: Princeton University Press, 2018]).
- 108 The underground for instance has recently been discovered to be teeming with life, at depths, temperatures, and pressures far beyond what were previously assumed to be absolute limits. The bacteria, archaea, and other microbes that exist in such extreme environments grow at extremely slow rates, but their carbon mass is 245 to 385 times greater than that of all humans on the surface (Terry

Collins and Katie Pratt, “Life in Deep Earth Totals 15 to 23 Billion Tonnes of Carbon—Hundreds of Times More than Humans,” official website of the Deep Carbon Conservatory, December 10, 2018, <https://deepcarbon.net/life-deep-earth-totals-15-23-billion-tonnes-carbon>).

- 109 *Spacetime mattering* for Barad marks the inseparability of space, time, and matter, while the gerund indexes the dynamic reconfiguration of a field of relationalities among “moments,” “places,” and “things” (Barad, “No Small Matter,” GIII).
- 110 See Helmreich, *Alien Ocean*, 16.
- 111 See, for instance, Adam Bobbette and Amy Donovan, *Political Geology: Active Stratigraphies and the Making of Life* (London: Palgrave Macmillan, 2019); Nigel Clark, *Inhuman Nature: Sociable Life on a Dynamic Planet* (London: Sage, 2010); Jeffrey Jerome Cohen, *Stone: An Ecology of the Inhuman* (Minneapolis: University of Minnesota Press, 2015); and Douglas Rogers, *The Depths of Russia: Oil, Power, and Culture after Socialism* (Ithaca, NY: Cornell University Press, 2015).
- 112 Graham, *Vertical*, 237. See also Jeremy Crampton, “Vortex,” Volumetric Sovereignty forum, *Society and Space*, March 3, 2019, <http://societyandspace.org/2019/03/03/vortex>.
- 113 See Louise Amoore, “Cloud Geographies: Computing, Data, Sovereignty,” *Progress in Human Geography* 42, no. 1 (2018): 4–24; Steve Goodman, *Sonic Warfare: Sound, Affect, and the Ecology of Fear* (Cambridge, MA: MIT Press, 2010); Tung-Hui Hu, *A Prehistory of the Cloud* (Cambridge, MA: MIT Press, 2015); Nicole Starosielski, *The Undersea Network* (Durham, NC: Duke University Press, 2015).
- 114 Easterling, *Extrastatecraft*, 17–18.
- 115 Starosielski, *Undersea Network*, 10.
- 116 Representations of communications infrastructures direct our gaze upward: handheld devices, laptop computers, wireless routers, cell phone towers, “cloud” computing, and satellites. As a cable engineer told Starosielski, “satellites are simply just ‘sexier’ than cables” (Starosielski, *Undersea Network*, 5).
- 117 Almost all of Australia’s internet traffic goes out through a single thirty-mile stretch. These concentrations have vast repercussions for resiliency, as became evident in 2011 when a woman in Georgia shut down much of the internet in Armenia when she dug up two fiber-optic lines while looking for scrap metal (Starosielski, *Undersea Network*, 11).
- 118 Lisa Parks and Nicole Starosielski, “Introduction,” in *Signal Traffic: Critical Studies of Media Infrastructures*, edited by Lisa Parks and Nicole Starosielski (Urbana: University of Illinois Press), 2015, 1–2.
- 119 Klaus Dodds, personal communication. See also Starosielski, *Undersea Network*, 2015.
- 120 Aihwa Ong, *Neoliberalism as Exception: Mutations in Citizenship and Sovereignty* (Durham, NC: Duke University Press, 2006).
- 121 See also Franck Billé, “Murmuration,” Volumetric Sovereignty forum, *Society and Space*, April 10, 2019, <http://societyandspace.org/2019/04/09/murmuration>.
- 122 Lauren Bonilla, writing about the Mongolian desert in “Voluminous,” *Theorizing the Contemporary*, *Cultural Anthropology*, October 24, 2017, <https://culanth.org/fieldsights/voluminous>.

- 123 Jeremy Packer and Joshua Reeves, "Taking People Out: Drones, Media/Weapons, and the Coming Humanectomy," in *Life in the Age of Drone Warfare*, ed. Lisa Parks and Caren Kaplan (Durham, NC: Duke University Press, 2017), 261–81.
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- 125 Bishop, "Project 'Transparent Earth,'" 277.
- 126 See for instance Kaplan, *Aerial Aftermath*.
- 127 Rachael Squire, "'Do You Dive?': Methodological Considerations for Engaging with 'Volume,'" *Geography Compass* 11, no. 7 (2017): 1–11.
- 128 Juhani Pallasmaa, *The Eyes of the Skin: Architecture and the Senses* (Chichester: Wiley Academy, 2005), 50. See also Mack Hagood, *Hush: Media and Sonic Self-Control* (Durham, NC: Duke University Press, 2019).
- 129 Pallasmaa, *Eyes of the Skin*, 16.
- 130 Think for instance about how London's industries have traditionally been located in the east, downwind, whereas well-to-do residential areas were west of the city. On mapping smellscape, see Sybille Lammes, Kate McLean, and Chris Perkins, "Mapping the Quixotic Volatility of Smellscape: A Dialogue," in *Time for Mapping: Cartographic Temporalities*, ed. Sybille Lammes, Chris Perkins, Alex Gekker, Sam Hind, Clancy Wilmott, and Daniel Evans (Manchester: Manchester University Press, 2018), 50–90.
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- 133 Goodman, *Sonic Warfare*, 18–19.
- 134 Agnieszka Joniak-Lüthi, "Orbital," Volumetric Sovereignty forum, *Society and Space*, April 10, 2019, <http://societyandspace.org/2019/04/09/orbital>.
- 135 The Russian spaceport Baikonur is located in an area of southern Kazakhstan leased to Russia. After the disintegration of the Soviet Union, the Russian base became an extraterritorial space in the newly independent state of Kazakhstan.
- 136 Jill Stuart, "Unbundling Sovereignty, Territory and the State in Outer Space," in *Securing Outer Space*, ed. Natalie Bormann and Michael Sheehan, 8–23 (London: Routledge, 2009). See also G. E. Hall, "Space Debris—An Insurance Perspective," *Proceedings of the Institution of Mechanical Engineers* 221, part G:J, Aerospace Engineering (2007): 915–24.
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- 138 Evgeny Vinokurov, *A Theory of Enclaves* (Lanham, MD: Lexington Books, 2007), 41.
- 139 An exception is the Order of Malta, a legal oddity which claims to be a sovereign state and a sovereign subject of international law, but has no territory at all.
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- 141 Easterling, *Extrastatecraft*, 171–72.
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