# 1

# Earth's Amphibious Transformation

> If one has never seen oneself surrounded on all sides by the sea, one does not possess an idea of the world and of one's own relation to it.
>
> (Hat man sich nicht ringsum vom Meere umgeben gesehen, so hat man keinen Begriff von Welt und von seinem Verhältnis zur Welt.)
>
> Johann Wolfgang von Goethe, Palermo, 3 April 1787 (Italian Journey)[1]

A paradigm shift is needed in studying the history of human interactions with marine regions since the mid-twentieth century. It is a sentiment echoed not just by natural scientists, but also a problem of perception.[2] Modernist architect Le Corbusier (1887–1965) spoke in the 1920s of "eyes that do not see," referring to the design of machines like ocean liners, automobiles, and airplanes as radical expressions of functionality that could pave the way for creating new built environments, such as apartment blocks and skyscrapers, for the "modern" era, if seen as such.[3] A century later, the numerous built environments in marine regions represent both a functional adaptation to aquatic material conditions and are unseen – overlooked – by most human eyes. The larger issue, however, is the invisibility-causing lack of attention to the marine regions themselves. The map in Figure 1.1 is a Spilhaus Projection, or World Ocean map, drawing one's eyes to the world ocean rather than continents as is typical in other world maps.[4] When one's eyes look at this world ocean (thereafter here, just ocean) akin to the view from a remote sensing satellite in outer space, they might also imagine the atmosphere above the ocean and notice the varying ocean depths indicated by different shades of

[1] Johann Wolfgang von Goethe, *Italienische Reise* [Italian Journey] (Wiesbaden: Insel-Verlag, 1959), 231.
[2] Jane Lubchenco and Steven D. Gaines, "A New Narrative for the Ocean," *Science* 364, no. 6444 (2019): 911.
[3] Le Corbusier, *Towards a New Architecture* (London: Architectural Press, 1946 [1927]).
[4] Athelstan Spilhaus, "To See the Oceans, Slice up the Land," *Smithsonian* 10, no. 8 (1979): 116–122.



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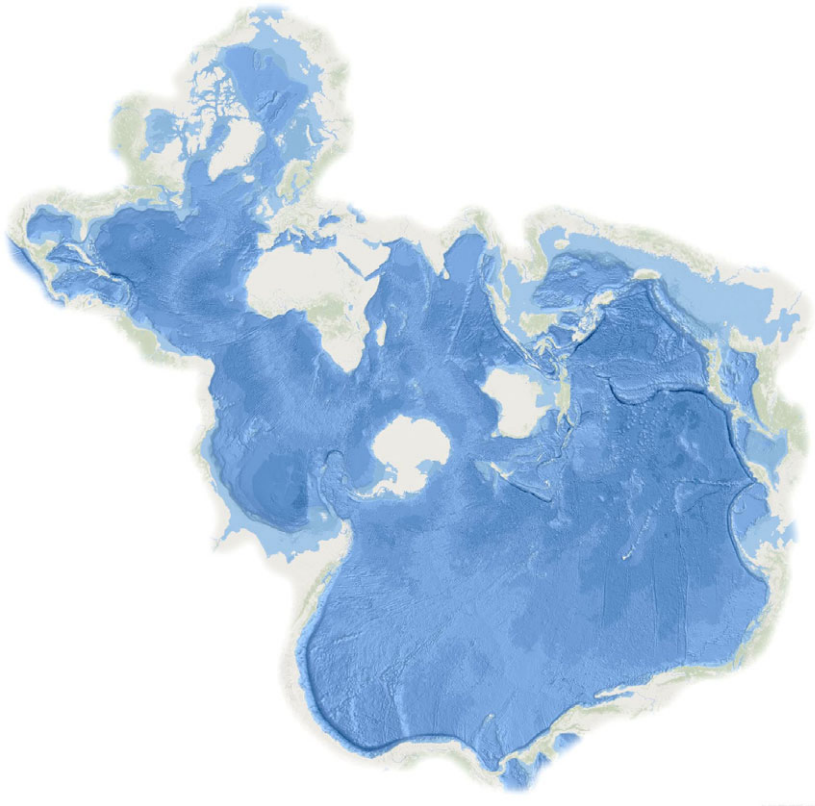


**Figure 1.1** The map depicting Earth's surface with an emphasis on the world ocean, rather than continents, as an eye-opener to the spaces that lie beyond dry coastlines. The illustration, known as the Spilhaus Projection or World Ocean map, was created by geographer Athelstan Spilhaus in 1979. Courtesy of John Nelson, ArcGIS, February 7, 2020, https://nation.maps.arcgis.com/home/item.html?id = 9b2ce7c8179b4744af7bf3ddb86b7804.

shades of blue (or gray) – the darker, the deeper. If one's inner, imaginative eye longs to see more terrestrial space, it might envision the situation during the last Ice Age, when water levels were much lower. For example, what today are known as the Asian and North American continents (visible in the map's right and top-left corners) were connected by a land bridge, now submerged below the ocean, a vertical reminder of earlier global warming. The blue (or gray) indicates the quite low water depth there and at multiple other sites that hint at now submerged extensions of continental land masses.

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If one wants to see, the Spilhaus projection does more than highlight the centrality of the world ocean to planet Earth. It draws one's eyes to different spatial layers above and below the sea surface, ranging from seabeds of strongly varying depth to the atmosphere and outer space.[5] The many built environments now situated on sea surfaces enable humans on them to "see" in the same vertical way. They enable humans to interact vertically with specific other spatial layers above or below the sea surface, whether drilling for offshore oil, harnessing offshore wind, farming fish, or launching rockets offshore. These activities and functional adaptations to marine conditions are legacies of the early Age of Fossil Fuels that Le Corbusier referenced.

Since the mid-twentieth century, such vertical interactions have rapidly intensified, complementing the age-old horizontal journeys across marine regions.[6] This vertical dimension has been pivotal in ushering in a new epoch in the ocean's history, characterized by planetary-scale processes not unlike those that rose and submerged the land bridge, industrialization, the extension of the human habitat onto sea surfaces, and intellectual debates about socio-economic development and environmentalism. The vertical dimension extends downward to spatial layers beneath the sea surface, with the surface forming an asphyxiating boundary for creatures with lungs or gills. Geophysically, these layers include the water column (or pelagic zone, beyond coastal waters) and the seabed, potentially teeming with marine life. They descend to geological strata harboring oil and gas deposits, sources of fossil fuels whose carbon emissions contribute to planetary-scale climate change. The vertical dimension also reaches upward, where once stars aided in celestial navigation and the moon since times immemorial influenced tides. These spatial layers stretch from the airspace above the sea surface, traversed by helicopters, rockets, and birds that depart from or land on new artificial islands, to outer space and Earth's orbits, where satellites assist in navigation, communication, and remote sensing. These drastic changes emerged as various actors constructed an increasing number of artificial islands in the form of offshore platforms made from steel or concrete to tap fossil fuels or wind energy; or in the form of fish net-cages or the foundation of floating homes made from plastics; or gravel and sand accumulations mimicking naturally formed islands, used to provide space for airport construction; or other structures floating on the sea surface or being fixed to the seabed. Such placement, situating these built environments

[5] A recent study added ocean depth in numbers and seabed features to the Spilhaus Projection to emphasize its value as a mapping tool. See Jie Chen et al., "Ocean Sciences with the Spilhaus Projection: A Seamless Ocean Map for Spatial Data Recognition," *Scientific Data* 10, no. 410 (2023): 1–8.

[6] On the ocean and volume, see Philip Steinberg and Kimberley Peters, "Wet Ontologies, Fluid Spaces: Giving Depth to Volume through Oceanic Thinking," *Environment and Planning D* 33, no. 2 (2015): 247–264.

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partially above and partially below the surface, has enabled humans to live and work on them. They form an archipelago of artificial islands of varying sizes, extending the human habitat onto the surfaces of marine regions that previously did not offer such vertical-oriented access to other spatial layers beyond the water column and seabed tapped by fishing vessels or divers.[7] Through artificial islands, vertical access has enabled the extraction of fossil fuels; the concentration of farmed fish, seaweed, and other marine organisms in the upper water column close to the surface; and the reaching of higher altitudes than on land to capture stronger offshore winds with wind turbines, as well as the launching and landing of rockets carrying satellites and other payloads to outer space. Equally, this access has facilitated the use of water for the cooling of floating solar photovoltaics (floatovoltaics), transforming sunlight arriving vertically from another celestial body in the solar system into electricity, or to cool the reactors of floating nuclear power plants. Unlike naturally formed islands or ships, these artificial islands have been built to provide unique opportunities for vertical interactions. Naturally formed islands, lacking open waters beneath them, were immovable and therefore unable, for example, to travel and to support the safe landing of a returning rocket booster stage from an earlier launched rocket. In contrast, floating artificial islands offered vertical adaptation to the ever-changing sea surface, rising or falling with tides, storm surges, and sea level rise induced by climate change. Similarly, seabed-fixed platforms elevated new human habitats above this turbulent layer but were still shaped by events on and in the water column through their structures. In contrast, most ships, designed for movement at high speeds, were generally insufficiently stable in deeper waters to provide safe, long-term access to most other spatial layers. The distinction between ships and artificial islands is not always clear-cut, as both can possess mobility: on water, built environments, often much heavier than those on land, can be moved by tugboats and other means. Immovability is a characteristic of the built environment only in terracentric definitions. In essence, artificial islands have greatly accelerated both the growth in number and the impacts of human interactions with spatial layers above and below the sea surface.

The artificial island habitations faced unstable, fluid, and turbulent marine conditions – materiality as a factor in history – that were distinctly different from the material conditions humans encountered in terrestrial environments. This difference is crucial to emphasize. For humans, encountering turbulent, liquid, and unstable saltwater serves as a stark reminder of their biological-evolutionary adaptations for brief aquatic interactions, such as swimming and

[7] I already investigated this platform archipelago in Stefan Huebner, "The Platform Archipelago: Islands of Adaptation Beyond a Terrestrialized Worldview," in *Oceanic Japan: The Archipelago in Pacific and Global History*, ed. Stefan Huebner et al. (Honolulu: University of Hawai'i Press, 2025), 133–149.

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diving. Saltwater impairs human eyes and ears, renders smell, breathing, and verbal communication impossible underwater, slows down movements, and the pressure in deep waters can be deadly. Unlike in terrestrial environments where the shapes of bodies and structures are strongly shaped by gravity, bodies and structures in water experience buoyancy as a counterforce reducing their weight. This buoyancy has led to the evolution of genuinely different body shapes in many marine creatures, with less dominant bone structures for stabilizing their bodies compared to terrestrial lifeforms, including humans. The aquatic conditions also reduce the weight of built environments compared to land and create very different stability criteria, to name just a few differences whose importance is exemplified in their impacts on biological evolution and technological designs.

The extension of the human habitat through artificial islands, providing permanent vertical access to spatial layers above and below, epitomizes what I term Earth's amphibious transformation. I label this phenomenon *amphibious* ("having two modes of lives") due to the *permanent* technological extension of the terrestrial human habitat onto sea surfaces with genuinely different material conditions. This amphibious phenomenon is permanent – a relative term contingent on material conditions – and must be de-terrestrialized. First, *permanent* refers to the *ongoing*, *continuous* phenomenon collectively created by the multiplicity of individual artificial islands. Second, *permanent* also refers to each artificial island's continuous extension of the human habitat over its lifespan – which, depending on type, typically means several decades or longer – and is a reminder that most terrestrial permanent structures also eventually are demolished. The term therefore does *not equate to forever*. Given the different material conditions, the de-terrestrialized term also does *not imply immovability*, the defining attribute of terrestrial real estate. Moreover, I speak of a *transformation*, since in aggregated form, the projects of artificial island usage ultimately caused substantial environmental and socioeconomic costs and benefits. This usage has altered planetary-scale biogeophysical and biogeochemical processes, leading to climate change, sea level rise, ocean warming, ocean acidification, biosphere degradation, nitrogen and phosphorus overloads, and chemical pollution. Our current predicament is, therefore, largely an accumulation of water-related problems. Offshore oil drilling, a major energy source contributing to carbon emissions and multiple other problems while fueling socioeconomic development, is one of many examples for this issue. At the same time, the adaptability of artificial islands to local oceanic conditions is crucial in the context of these changes in planetary-scale cycles. For instance, intergovernmental organizations like the United Nations (UN) increasingly view artificial islands as a tool in the toolkit for coastal adaptation to sea level rise and climate change. Consequently, this book explores several *key questions*: Why did the amphibious transformation emerge and how did it unfold? Stemming from these primary questions are

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several related ones: How did the materiality of marine environments shape the employment of artificial islands to extend the human habitat onto sea surfaces? How was this extension influenced by political agendas, specifically socioeconomic development policies and environmentalist thought? How have these human interferences in planetary-scale cycles altered the material conditions of marine environments and, subsequently, redirected developmental and environmental agendas?

In this book, I delve into Earth's amphibious transformation as the primary driver for the emergence and intensification of the oceanic Anthropocene, which refers to the marine aspects of a concept regarding a new epoch of life on Earth. Initially proposed as a geological epoch, the Anthropocene (Human Epoch) has gained strong interdisciplinary importance. For periodization purposes, it today denotes a new temporality starting from the mid-twentieth century when humans acquired the capacity to alter planetary-scale cycles and, much like other lifeforms, became confronted with the consequences. Additional examples of alterations considered so problematic that they warrant investigation of planetary boundaries, apart from the previously mentioned climate change and others, include atmospheric nuclear pollution and freshwater overuse.[8] Other studies have proposed different, usually terra-centric and Europe-Americas–focused starting points for the Anthropocene, such as England's Industrial Revolution or European colonialism in the Americas.[9] I see my study as a confirmation of the mid-twentieth-century beginnings, seen from an often overlooked oceanic perspective, which is slowly gaining the attention it deserves in other disciplines as well.[10] A substantial part of the book

[8] In 2024, the Anthropocene was rejected as a new geological epoch, although another vote can take place after ten years. As a concept, it continues to strongly influence a wide range of disciplines, from the humanities and social sciences to engineering, architecture, and the natural sciences; see Jan Zalasiewicz et al., "The Meaning of the Anthropocene: Why it Matters even without a Formal Geological Definition," *Nature* 632 (2024): 980–984. For arguments supporting the mid-twentieth century as the Anthropocene's beginning, see Will Steffen et al., "The Trajectory of the Anthropocene: The Great Acceleration," *Anthropocene Review* 2, no. 1 (2015): 81–98; Julia A. Thomas, Mark Williams, and Jan Zalasiewicz, *The Anthropocene: A Multidisciplinary Approach* (Cambridge: Polity Press, 2020); John R. McNeill and Peter Engelke, *The Great Acceleration. An Environmental History of the Anthropocene since 1945* (Cambridge, MA: Harvard University Press, 2014). Specifically regarding the ocean, see Jean-Baptiste Jouffray et al., "The Blue Acceleration: The Trajectory of Human Expansion into the Ocean," *One Earth* 2 (2020): 43–54. See also Katherine Richardson et al., "Earth Beyond Six of Nine Planetary Boundaries," *Science Advances* 9 (2023): 1–16.

[9] For other starting points, see Thomas, Williams, and Zalasiewicz, *The Anthropocene*. See also the literature discussed in Chapter 2.

[10] These exceptions in other disciplines, such as literary studies, include Elizabeth DeLoughrey, *Allegories of the Anthropocene* (Durham, NC: Duke University Press, 2019). I will return to them later in this chapter.

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therefore focuses on the period since the mid-twentieth century, but earlier chapters also scrutinize the first half of that century and even earlier times. This temporal focus serves to demonstrate the changes that confirm the mid-twentieth century as the starting point of the *oceanic* Anthropocene.

As a new epoch, the Anthropocene signifies the merging of human timescales, measured in decades and centuries due to human lifespan and generational interactions, with the much longer timescales of the Earth system (a holistic model to think about the interplay of planetary-scale processes). Historically, changes in the Earth system occurred over geological timescales, spanning many millennia, as seen in Ice Ages and other climate shifts, making them nearly imperceptible to individual humans. The same is true for the even longer processes that can be addressed as "deep time," such as, for example, the formation of oil-bearing geological strata now located below the sea, which here will merge with human timescales and contribute to our understanding of the oceanic Anthropocene and its global history and present situation. Artificial islands are one of the defining characteristics of the Great Acceleration, the Anthropocene's initial phase shaped by rapid increases in socioeconomic development and environmental problems.[11] The subsequent stage of the Anthropocene necessitates stabilization within the Earth system. In this book, which focuses on historical causation rather than geological issues, scrutinizing the amphibious transformation's reasons is the central objective. Even without a geological focus, approaching this new temporality on different scales of analysis is essential for grasping the world ocean's *vertical history* and the connection to Earth's amphibious transformation. Readers, therefore, should not expect stories about geology, steamships, or lawyers like Hugo Grotius or Carl Schmitt.

The series of arguments I present trace the amphibious transformation's emergence and its repercussions. During the terrestrial Age of Coal, the ocean's material conditions prevented any form of oceanic coal mining through the water column. Not until the mid-twentieth century did certain marine regions begin producing noteworthy quantities of another fossil fuel – oil – and later natural gas. Prior to this, these marine regions were virtually invisible in the terra-centric and coal-centered geographies of new, energy-intensive built environments, not even considered peripheral areas. It was only with the mid-twentieth century's surge in oil demand that earlier advancements from the Age of Coal in steel and concrete production were utilized to create artificial islands and extend the built environment, either stationary until the end of the lifespan or predominantly stationary but with relocations

[11] The United Nations uses the term as a factor in human development, therefore more in a loose than a stratigraphic sense; see UNDP, ed., *Human Development Report 2020. The Next Frontier: Human Development and the Anthropocene* (New York: United Nations, 2020).

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into marine regions. In Asian waters, for example, material and political factors delayed the onset of governmental offshore oil extraction agendas until the mid-twentieth century, unlike in US waters, resulting in the acceleration since that point in time. Since then, the material conditions of marine regions have influenced the rise of artificial island usage globally by providing access not only to geophysical layers vertically below the sea surface but also to those above, forging upward-oriented connections to airspace and even outer space, where satellites link back to lower spatial layers. However, the prolonged period between coal's transformative use in water control and the advent of artificial islands entrenched a terrestrial mindset. Such terra-centric ideas were not uniquely European, but the global circulation of coal-powered European water management technologies like steam pumps for *large-scale* land reclamation was a major factor in "terrestrializing" other peoples' minds and understandings of civilizational centers and peripheries as well. Eventually, much later, coal also supplied the energy and construction materials needed for extending built environments to sea surfaces, meaning steel and concrete platforms. Yet before this extension became more frequent, the widespread adoption of a Western terrestrial mindset, fostered by coal as a dense energy source, inadvertently had already created an intellectual prison. While not excluding the ocean from understandings of the world, this terrestrial mindset among many people relegated its role in socioeconomic development to millennia-old fisheries, reinforcing the notion of the ocean as an altogether empty, flat, and peripheric expanse, connecting continents as the alleged centers of development. Contrary to this reductionist mindset, the declining costs of radiocommunication and radionavigation since the mid-twentieth century, especially through new satellite constellations, facilitated the extension of the human habitat far beyond visibility from land. It led to a different kind of globalization wherein marine regions turned into production centers and were not merely vacant spaces vessels traversed on their journeys between terrestrial places. Fossil fuel–driven development agendas in various countries have led to the widespread use of offshore platforms and, through carbon emissions (among other factors), have contributed to the oceanic Anthropocene. Since the 1960s, early forms of environmentalism, broadly categorized into technocritical "schools" advocating government-driven reform, and other "schools" inspired by techno-optimism focusing on individual initiative and consumer choice, have challenged these fossil fuel–based development agendas, often finding themselves in conflict with each other. The application of artificial islands for vertical adaptation to flooding or sea level change and for generating pollution-free offshore energy remained marginal until the twenty-first century. It was then that eco-developmentalist agendas, spurred by climate change, sea level rise, and other Anthropocene factors, revisited these ideas. Additionally, mariculture, or marine organism farming, saw rapid expansion after the mid-twentieth century, when the Age

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of Oil's new construction material – plastics – facilitated human access from the sea surface to submerged marine species habitats. Dual-habitat structures, including plastics-made fish net-cages or rafts with ropes for seaweed or oyster cultivation, allowed working on their dryer parts. Japan, in the latter half of the twentieth century, became a center of mariculture research, partially offsetting the sharp decline in fishery yields, though fish farms increasingly disrupted planetary-scale biogeochemical cycles by overfertilizing marine regions with nitrogen and phosphorus – the oceanic Anthropocene's submerged piles of feces and feed leftovers. Nowadays, seaweed and mollusk farming offer carbon capture solutions and help reduce marine overfertilization. The use of artificial islands has led to a vertical coevolution of humans and marine species, creating a global archipelago of steel, concrete, and plastic structures that facilitate species spread. This archipelago also has heightened the risk of biosphere degradation through what biologists call bioinvasions, where species multiply exponentially in a new bioregion and dominate the habitat in terms of biomass or density. The anticipated increase in the number of the amphibious transformation's vertically focused artificial islands, including offshore wind turbines and floating solar photovoltaics, therefore remains intricately linked to the oceanic Anthropocene.

As an analytical tool, my oceanic-vertical perspective operates across multiple geophysical and political scales, navigating the entanglements stretching from local marine regions (micro scale) to Earth system processes (planetary scale). Occasionally, this perspective extends to the solar system scale, emphasizing Earth's material conditions that fostered the amphibious transformation and Earth system processes not found elsewhere in the solar system. This inclusion of outer space as a spatial layer elucidates the evolving connections between oceanic and outer space technologies during the latter half of the twentieth and early twenty-first centuries.[12]

The utility of new artificial islands was defined by vertical interactions yet also intertwined in a myriad of *horizontal* entanglements stretching from coastlines to the open ocean. For example, coastal industrialization and urbanization impacted marine waters, transforming shores through land reclamation and construction. They introduced pollutants into ocean-bound rivers or directly into the sea. Other examples include activities like transporting harvested seafood to ports or installing pipelines and cables for transmitting oil, natural gas, electricity, or data. Ocean currents also played a role in moving or hindering the flow of nutrients, marine organisms, pollutants, and pathogens between bays, offshore waters, and the deep sea. Artificial islands,

[12] On voluminous space and scale in general, see Franck Billé, "Voluminous: An Introduction," in *Voluminous States: Sovereignty, Materiality, and the Territorial Imagination*, ed. Franck Billé (Durham, NC: Duke University Press, 2020), 1–35; Nigel Clark, "Politics of Strata," *Theory, Culture & Society* 34, no. 2–3 (2017): 211–231.

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boats, ships, helicopters, and other machinery were pivotal in traversing horizontal distances, whether for one-time installations offshore or for ongoing connections between artificial islands and land.

Hence, the oceanic-vertical perspective welcomes a second perspective that sees oceanic and terrestrial spaces as horizontally connected. Adopting this *terraqueous* (terrestrial–aqueous) perspective as the norm in horizontal analysis, instead of a reductionist, terra-centric approach that creates a mental barrier along coastlines, is crucial for effectively applying the oceanic-vertical perspective in voluminous space.[13] This terraqueous perspective is relevant, as most chapters focus on specific nearshore marine regions, not deep waters, and their vertical uses, which relied on links to the broader oceanic world, including terrestrial locations and other marine regions.[14]

Methodologically, analyzing marine regions' material conditions through an oceanic-vertical and an inherent terraqueous-horizontal perspective reveals how these conditions turned into a kind of "theory machine" for the socio-economic development of the regions. Material conditions such as currents, waves, tides, buoyancy, monsoons, storms, fog, salinity, corrosiveness, icebergs (the *Titanic* will sink in Chapter 5), marine species attaching to human structures, temperature, nutrient and biomass concentrations, offshore oil and gas deposits, wind strength, industrial pollution, and plate tectonics sometimes causing huge disasters led to specific adaptation trajectories shaped by designers, engineers, architects, politicians, lawyers, economists, and others to extend the human habitat.[15] For analyzing Earth's amphibious

[13] I discussed the two perspectives elsewhere with a stronger focus on Japan; see Stefan Huebner, "Oceanic Japan: Environmental Factors and a New Periodization of Japan's Archipelagic History," in *Oceanic Japan: The Archipelago in Pacific and Global History*, ed. Stefan Huebner et al. (Honolulu: University of Hawai'i Press, 2025), 1–35. See also Alison Bashford, "Terraqueous Histories," *Historical Journal* 60, no. 2 (2017): 253–272; Romain Grancher and Michael-W. Serruys, "Changes on the Coast. Towards a Terraqueous Environmental History," *Journal of the History of Environment and Society* 6 (2021): 11–34.

[14] For conceptualizing Atlantic history, David Armitage called the focus on particular sites and their connections to the wider oceanic world "cis-oceanic history"; see David Armitage, "Three Concepts of Atlantic History," in *The British Atlantic World, 1500–1800*, ed. David Armitage and Michael J. Braddick (New York: Palgrave, 2002), 11–27.

[15] Stefan Helmreich and Prasenjit Duara used this idea of saltwater as a "theory machine" to understand processes like globalization or to analyze historical processes. Both authors relied on a variety of saltwater-derived, metaphorical terminology involving currents, flows, circulations, and others; see Stefan Helmreich, "Nature/Culture/Seawater," *American Anthropologist* 113, no. 1 (2011): 132–144; Prasenjit Duara, "Oceans as the Paradigm of History," *Theory, Culture & Society* 38, no. 7–8 (2021): 143–166. In any case, my focus here is on oceanic material conditions, meaning actual, not metaphorical, aquatic currents, flows, and circulations, among others, and their role as theory machines for technological advances. My focus is therefore closer to Jue's work on the materiality of

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transformation, it is essential to scrutinize these oceanic material conditions to the extent that they were technically and politically relevant for societies.

The material conditions were also intertwined with an expanding array of *spatial uses* as artificial island types and purposes diversified, warranting analysis.[16] Spatiality, as a structural concept, explains the socially created spatial structures by which a historical system operates. An analysis of the varying spatial uses offers insights into the political economies of marine regions, forged through technology's dual role in both mitigating and exacerbating environmental challenges. In the vein of historian Thomas P. Hughes, technology is seen as a creative activity that is full of contradictions and unintended consequences. While technology can result in temporary fixes for increasingly complex problems, it can also serve as a tool for enhancing human quality of life and to make the built environment more sustainable.[17] The different spatial uses usually depended on physically extending the human habitat onto sea surfaces. In Chapters 8 and 9, this focus on uses includes interactions between humans and marine species who also turned artificial islands into their habitats. The analysis of material conditions does not imply geographical determinism, however. Following philosopher Henri Lefebvre's and geographer Philip E. Steinberg's conceptualization of spatiality, the material conditions of geophysical layers were both influenced by and influential in social constructions related to the ocean or specific marine regions.[18]

*Spatial representations* entail institutional and managerial agendas, which, in the context of this book, refer to developmentalist and environmentalist thought. Their implementation, leading to spatial uses, created the connection between marine regions and the oceanic Anthropocene. Socioeconomic developmentalism is an ideology rooted in Enlightenment and modernist thought, adopted by both capitalist and communist political systems. It focuses intellectually on transforming nature into an asset, tailoring it to specific economic and other purposes, and using scientific rationality and technology to make

the deep ocean and its impact on visual technologies; see Melody Jue, *Wild Blue Media: Thinking Through Seawater* (Durham, NC: Duke University Press, 2020).

[16] On new materialist approaches, see Diana Coole and Samantha Frost, eds., *New Materialisms: Ontology, Agency, and Politics* (Durham, NC: Duke University Press, 2010). For older materialist approaches of non-Marxist and Marxist orientation, see, e.g., Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II* (New York: Harper, 1972[1949]); Karl Marx, *Das Kapital. Kritik der politischen Ökonomie* [*Capital: A Critique of Political Economy*], Vol. 1 (Berlin: Dietz, 1947 [1867]).

[17] Thomas P. Hughes, *Human-Built World: How to Think about Technology and Culture* (Chicago: University of Chicago Press, 2004), 4–5, 14.

[18] Philip E. Steinberg, *The Social Construction of the Ocean* (Cambridge: Cambridge University Press, 2001), 22–38. See also Henri Lefebvre, *The Production of Space.* Trans. Donald Nicholson-Smith (Oxford: Basil Blackwell, 1991 [1974]).

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future outcomes more predictable and reliable.[19] Fossil fuels, notably oil, played a pivotal role in these transformational ambitions and in establishing the energy regimes that enabled the rapid economic growth and social changes driven by developmental agendas, as exemplified in Japan and other Asian states during the latter half of the twentieth century, which I cover in Chapter 2.[20] Despite important differences in terms of the influence of government and bureaucracy between capitalist and communist developmental states, their development agendas often legitimized authority by improving the populace's living conditions, although military considerations and the potential for embezzlement of funds by ruling elites were also factors. More broadly, the socioeconomic growth, albeit uneven across the world, enabled the vast majority of the rapidly increasing global population over the past two hundred years to escape extreme poverty. Additionally, issues like adaptation to sea level rise and climate change are a reminder that *human development*, as a form of socioeconomic development, explicitly involves questions of social justice beyond merely economic growth. However, such socioeconomic development also contributed to escalating environmental issues (often with unaccounted costs), manifesting unevenly across the globe but increasingly causing the Anthropocene's planetary-scale changes. Like the recent works of energy scholar Vaclav Smil or historians John R. McNeill and Peter Engelke, I explicitly address both forms of growth, recognizing that rapid socioeconomic development and environmental degradation are key defining elements of the oceanic Anthropocene and its Great Acceleration.[21] Various "schools" of environmentalist thought, evolving since the mid-twentieth century, have influenced environmental movements and, in the twenty-first century, led to

[19] Sara Lorenzini, *Global Development: A Cold War History* (Princeton, NJ: Princeton University Press, 2019).

[20] On Japan and capitalist developmental states, see Chalmers Johnson, "The Developmental State: Odyssey of a Concept," in *The Developmental State*, ed. Meredith Woo-Cumings (Cornell, NY: Cornell University Press, 1999), 32–60; Chalmers Johnson, *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925-1975* (Stanford, CA: Stanford University Press, 1982); Mikio Sumiya, ed., *A History of Japanese Trade and Industry Policy* (Oxford: Oxford University Press, 2000).

[21] Vaclav Smil, *Growth: From Microorganisms to Megacities* (Cambridge, MA: MIT Press, 2019), 399–405; McNeill and Engelke, *The Great Acceleration.* Many studies have a tendency to emphasize either environmental disasters or the tremendous impacts of socioeconomic development on health, life expectancy, education, and nutrition. See Robert Fogel and Dora Costa, *The Escape from Hunger and Premature Death, 1700-2100: Europe, America, and the Third World* (Cambridge: Cambridge University Press, 2004); Angus Maddison, *The World Economy*, 2 Vols. (Paris: OECD Publishing, 2006); Marco Armiero, *Wasteocene: Stories from the Global Dump* (Cambridge: Cambridge University Press, 2021); François Jarrige and Thomas Le Roux, *The Contamination of the Earth: A History of Pollutions in the Industrial Age* (Cambridge, MA: MIT Press, 2020).

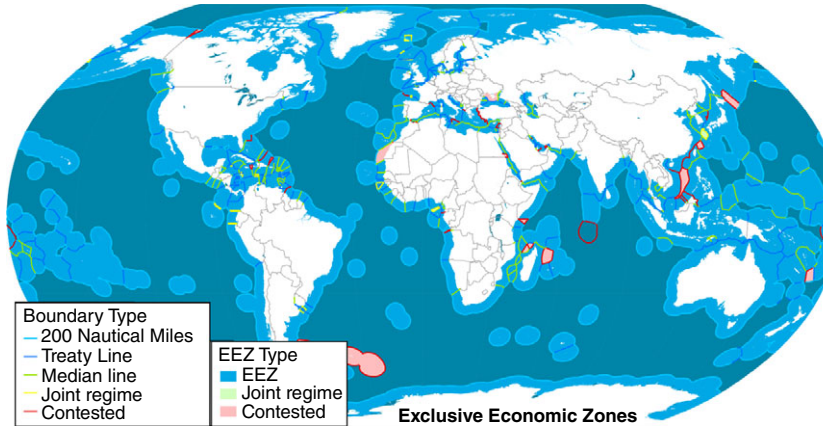
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the emergence of new eco-developmentalisms, striving for socioeconomic advances coupled with ecological sustainability. For example, the UN's International Decade of Ocean Science for Sustainable Development in the 2020s, underpinned by the Sustainable Development Goals from 2015, exemplifies one such spatial representation of the ocean. The ongoing reduction of fossil fuels in industrial processes, transportation, and heating will at least double electricity demand in many countries. A substantial portion of this electricity will be sourced from marine regions, continuing the trend set by oil and natural gas. Chapters 4, 6, and 7 delve into intellectual shifts and debates in spatial representations from the 1960s and 1970s, which remain relevant for urban coastal climate adaptation and oceanic low-carbon energy generation today. Designers, architects, engineers, and others who sought solutions and new technological paths inevitably faced criticism from various quarters, but their nascent environmentalist ideas merit attention for a comprehensive understanding of our current predicament. Additionally, Western and Japanese "islomania," an obsession with islands introduced in Chapter 3 and explored further in subsequent chapters, shaped these developmentalist or environmentalist agendas concerning artificial island construction.

Finally, throughout the twentieth century, *spatial regulations*, notably in the form of territorialization, played an important role in the implementation of any such agendas. "Territory," in this book's context, extends beyond its traditional connection to land. It denotes a political technology that operates across various horizontally expanding geophysical layers on a vertical axis, aiming to control and enclose spaces, such as seabeds, sea surfaces, or airspace. Territory therefore is shaped by the material conditions of these spaces.[22] Unilateral proclamations and the three UN conferences held between 1958 and 1982, culminating in the UN Convention on the Law of the Sea (UNCLOS), integrated an increasing share of the ocean into territorial principles, thereby granting or denying states various levels of jurisdictional control over space in multiple geophysical layers on the vertical axis. Such political-legal shifts in spatial regulations were pivotal. At the start of the twentieth century, marine space beyond the sovereign territorial sea – typically three nautical miles or 5.56 kilometers from the coastal baseline, volumetrically extending downward to beneath the seabed – were considered part of a global commons, freely accessible to all, following the previous global enforcement of European Law of the Sea practices. From the 1940s, governments began claiming continental shelves – the offshore extensions of continental

[22] Kimberley Peters, Philip Steinberg, and Elaine Stratford, "Introduction," in *Territory beyond Terra*, ed. Kimberley Peters, Philip Steinberg, and Elaine Stratford (London: Rowman & Littlefield, 2018), 1–13, here 1–5. More generally on the idea of territory in the West, see Stuart Elden, *The Birth of Territory* (Chicago: University of Chicago Press, 2013).

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Source: Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11.

**Figure 1.2** Exclusive economic zones (EEZs) typically extend 200 nautical miles (370 kilometers) from coastlines, granting coastal states jurisdictional control over activities like resource exploitation and pollution prevention. They cover about 39 percent of the ocean, with islands often generating the most extensive zones. Courtesy: Jean-Paul Rodrigue, Wikimedia, CC Share Alike 4.0 International licence, https://commons.wikimedia.org/wiki/File:Exclusive_Economic_Zones_by_boundary_type.png.

landmasses that during the last Ice Age were largely above water – asserting jurisdictional control over their seabeds and subsoils (see Figures 1.2 and 1.3). The term "continental shelf," once purely a geological and oceanographic term, thus evolved into a legal concept, detached from its original meaning. In the latter half of the century, the territorial sea expanded to typically 12 nautical miles (22.2 kilometers) from the coast. The territorialization process included a contiguous zone with fewer rights (stretching another 12 nautical miles beyond the territorial sea) and the creation of exclusive economic zones (EEZs), extending up to 200 nautical miles (370 kilometers) from the coastal baselines with a multiplicity of specific rights. The Law of the Sea now refers to the continental shelf and the rest of the continental margin – submerged areas reaching to the boundaries of the deep ocean's abyssal plain – as the "extended continental shelf." This extended continental shelf is a legal tool for governments to extend jurisdictional control over seabed and subsoil resources beyond EEZs, up to an arbitrary maximum of 350 nautical miles (648 kilometers), if oceanographic features (here made relevant again) permit. Consequently, states have grabbed vast oceanic areas as public property. Often leased but not sold, such marine territories contrast with land territories. The

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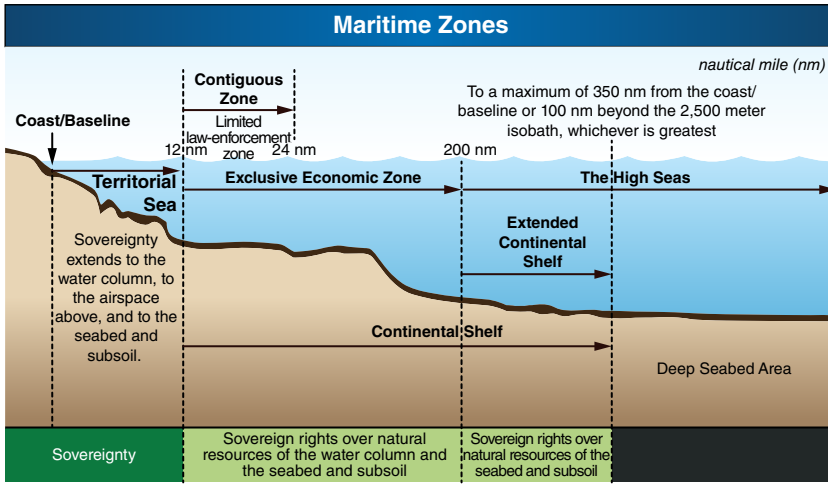



**Figure 1.3** Illustration of various maritime zones and spatial layers of jurisdictional control established by the Law of the Sea. Airspace and outer space are not depicted. Courtesy: NOAA.

construction of artificial islands epitomizes this intertwined process of ocean territorialization and the extension of the human habitat onto sea surfaces.

Discussions about planetary-scale phenomena, such as Earth's amphibious transformation or the Anthropocene, can easily gravitate toward a master narrative of doom, despair, and the end of the world. Historians like Frank Uekoetter (Uekötter) have explored how climate change and numerous preceding environmental disasters have fueled apocalyptic and alarmist narratives.[23] While such "apocalyptic environmentalism" can garner public attention and potentially motivate political action, its tropes, despite often being "omnipresent," usually are also "strangely powerless." We know, for example, that local oceanic as well as political conditions vary greatly across Earth's surface. Changes in planetary cycles, including climate change or sea level rise, do not impact all regions uniformly, nor can one lump all negatively affected groups, rich and poor, into a global master narrative of humanity facing doom and technological inadequacy.[24] Consequently, discussions of

[23] Frank Uekoetter, ed., *Exploring Apocalyptica: Coming to Terms with Environmental Alarmism* (Pittsburgh, PA: University of Pittsburgh Press, 2018).

[24] Frank Uekoetter, "Introduction: The Apocalyptic Moment; Writing about Environmental Alarmism," in *Exploring Apocalyptica: Coming to Terms with Environmental Alarmism*, ed. Frank Uekoetter (Pittsburgh, PA: University of Pittsburgh Press, 2018), 1–11. For a discussion of the problems of social justice and the Anthropocene, see Dipesh

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social and environmental equality and justice on local, national, or global scales must take into account these different local material conditions.[25] The challenges are also predominantly of a political nature, not technological inertia.[26] Within this framework, my analysis of artificial islands and the corresponding developmentalist and environmentalist thinking consciously steers clear of overgeneralizing the vast array of naturally formed and artificial islands into a master narrative of island doom and ruin, a trend not uncommon in other writings.[27]

For a book aimed at opening one's eyes to causality, adopting a "world in ruins" narrative would be blinding. Therefore, I have chosen topics and scales that, when applying the oceanic-vertical perspective, illustrate both major environmental problems and tremendous development achievements associated with the use of artificial islands, whose local impacts can be empirically studied. The actors discussed were selected due to the political or intellectual impacts their developmentalist or environmentalist thought had on extending the human habitat onto sea surfaces. But there were many more, without question. Some chapters also shift the focus to technological advances and their wide-reaching effects on extensive user groups or nonhuman lifeforms, highlighting the intricate relationship between the extension of the human habitat and the environmental changes of the oceanic Anthropocene.

Investigating the temporal, spatial, and material dimensions of marine regions as factors in Earth's amphibious transformation demands the introduction of specific terms and key concepts. They will act as explanatory tools for this complex phenomenon. Unless specified otherwise, "oceanic" here is used synonymously with "marine." The term "ocean" denotes the world ocean, the interconnected body of saltwater and brackish water basins covering Earth's surface, connected to freshwater circulations through rainfall, river inflow, and icebergs. The ocean therefore is a major subsystem in planetary-scale processes. As illustrated in the Spilhaus projection, it includes individual oceans and largely land-enclosed bodies of water like marginal seas, gulfs, bays, and others, typically differentiated by size. Officially recognized names by the International Hydrographic Organization, such as the Sea of Japan and Gulf of Mexico, here are used for these water bodies, whether they make sense or not. After all, my focus is neither on the political naming conflicts of these

Chakrabarty, *The Climate of History in a Planetary Age* (Chicago: University of Chicago Press, 2021).

[25] This is one point of criticism that Dipesh Chakrabarty's earlier article faced, see Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35, no. 2 (2009): 197–222.

[26] See, e.g., Michael Mann, *Our Fragile Moment: How Lessons from Earth's Past Can Help Us Survive the Climate Crisis* (New York: Public Affairs, 2023).

[27] For such narratives, see, e.g., Jonathan Pugh and David Chandler, *Anthropocene Islands. Entangled Worlds* (London: Westminster University Press, 2021), 1–10.

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water bodies nor on restricting this book to arbitrary, human-invented hydrogeographic boundaries that often shifted multiple times during the last millenia. Such limitations risk resembling nation-state or area studies boxes, artificially isolating a subject from the rest of the world.[28] In other words, my interest is usually not in particular bays, seas, or oceans (which are all part of the world ocean). Instead, I am interested in specific marine conditions that have both shaped and been shaped by the extension of the human habitat. Conditions like slow currents in shallow waters or the turbulence and waves of deeper waters are insufficiently represented by hydrogeographic boundaries but are shared by many aquatic bodies. My analysis of oceanic history will extend beyond estuaries to include, where necessary, rivers, swamps, lakes, and bayous (stagnant or very slow-moving waters).[29] In hydrogeographic terms, these aquatic bodies are not part of the world ocean, so one could introduce more artificial boundaries for oceanic history and water flows. However, these boundaries will be transgressed when analytical inclusion of other hydrosphere parts is beneficial. Oceanic history in this book indicates a focus, not a boundary. The transgression of political and other boundaries, inherent in an oceanic-vertical perspective, does not suggest neglecting political entities, such as nation-states or intergovernmental organizations, which have initiated important socioeconomic development agendas, established legal frameworks, and contributed to global environmental change. The scale and focus of my oceanic analysis distinguish between "globe" and "global" as cultural, not natural, phenomena related to the ocean and "planet" and "planetary" for the Earth system's biogeophysical and biogeochemical cycles.

"Artificial island" is another key term. Naturally formed islands can be described as hills and mountains within aquatic bodies. They do not have open waters below them, but are surrounded by water, resulting in a more horizontal than vertical connection to it. I will not try to define an exact boundary between naturally formed and artificial islands, which would be a fruitless exercise in modern Western ambitions to conceptually separate nature and technology, topped with a land-focused mindset ignoring that islands can change their shape significantly over time with or without human intervention (think of erosion, coral growth, or trash accumulation). The term "artificial islands" was used in UNCLOS but not defined, either on its own or

[28] Martin W. Lewis, "Dividing the Ocean Sea," *Geographical Review* 89, no. 2 (1999): 188–214.

[29] On the importance of river-ocean "water systems," see Terje Tvedt, "'Water Systems,' Environmental History and the Deconstruction of Nature," *Environment and History* 16, no. 2 (2010): 143–166; Stefan Huebner, "Asia's Oceanic Anthropocene: How Political Elites and Global Offshore Oil Development Moved Asian Marine Spaces into the New Epoch," *Journal of Global History* 18, no. 1 (2023): 25–46.

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in comparison to "structures" or "installations."[30] Legal opinions differ whether artificial islands include floating and seabed-fixed structures, but supporters emphasize that all these types are the same by *not* creating a territorial sea.[31] Many disciplines, such as engineering, have their own, very specific terminology. However, I adopt a *broad definition*, reflecting the historical use of the term since the 1920s. In the 1920s and 1930s, newspaper readers were confronted with the emergence of ideas about large floating islands as airports (covered in Chapter 3), and the term over the following decades included further structures. Artificial islands are therefore different types of built environments that strongly vary in size but share the common purpose of creating a human habitat on sea surfaces or elevated slightly above them. They are human-made, surrounded by water, and mostly or completely stationary. One particular type of artificial islands consists of accumulations of gravel, sand, and similar materials, which replicates natural islands. Unlike typical coastal landfill projects, such artificial islands do not extend existing coastlines. Moreover, their construction is rare, and they represent a form of terrestrialization (land reclamation), completely transforming marine spaces into terrestrial ones. This book primarily focuses on artificial islands in the form of *floating and seabed-fixed structures* like offshore platforms, floating plastic cages for mariculture, and high-tech homes and other buildings, all located above or slightly below the surface and surrounded by water.

In the subsequent chapters, as I introduce and explain various types of marine built environments, I will often more specifically refer to offshore wind turbines, oil platforms (technically, mobile offshore drilling units, seabed-fixed platforms, and floating offshore installations), fish net-cages, and other structures rather than broadly using the term "artificial islands." Nevertheless, sometimes employing this term is beneficial, as it underscores the commonalities between different types as well as the intellectual links to naturally formed

[30] For typologies of certain floating and seabed-fixed structures, see Łukasz Piątek, "Displacing Architecture? From Floating Houses to Ocean Habitats: Expanding the Building Typology," in *Architecture for the Society of Knowledge, Vol. 1: Education for Research, Research for Creativity*, ed. Jan Słyk and Lia Bezerra (Warsaw: Wydział Architektury Politechniki Warszawskiej, 2016), 273–280; Fen-Yu Lin, Otto Spijkers, and Pernille van der Plank, "Legal Framework for Sustainable Floating City Development: A Case Study of the Netherlands," in *WCFS2020: Proceedings of the Second World Conference on Floating Solutions, Rotterdam*, ed. Łukasz Piątek et al. (Singapore: Springer, 2022), 433–460; Klaus Dodds and Veronica della Dora, "Artificial Islands and Islophilia," in *The Routledge International Handbook of Island Studies*, ed. Godfrey Baldaccino (London: Routledge, 2018), 392–415.

[31] This book provides multiple examples of terminology use, but for a broad definition and further historical examples, see A. M. J. Heijmans, "Artificial Islands and the Law of Nations," *Netherlands International Law Review* 21, no. 2 (1974): 139–161.

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islands. As will be discussed in later chapters, Western and Japanese intellectual traditions, among others, have shown a special interest in islands, emphasizing that the book's focus overlaps with the field of Island Studies.[32]

The extension of the human habitat to sea surfaces needs to be conceptualized. I refer to it as an *extension* because, as is demonstrated in Chapter 2, the process that led to the construction of steel and concrete artificial islands began on North American, Japanese, and Russian/Soviet coastlines. When other construction options proved inadequate, artificial islands were designed for rivers, bayous, nearshore waters, and further offshore, on their aquatic surfaces replicating – and therefore extending – the most basic material conditions of the terrestrial human habitat to enable habitation (here synonymously used with inhabitation) in liquid, turbulent, and otherwise deadly water environments. Chapter 4 illustrates that inhabiting sea surfaces is not a novel concept, having existed for thousands of years through floating or elevated structures (or sea ice in the Arctic).[33] This long history is one reason why I use "extension," not "advance" onto aquatic surfaces, as the latter term is a reflection of the Western and Japanese techno-optimism of the 1960s and 1970s. The second reason is that "extension" serves to differentiate earlier processes from very recent climate adaptation approaches, in which "advance" refers to one approach, unsurprisingly the one that shifts structures to aquatic surfaces.[34] Thus, my focus is not on the fluctuating number of sea surface inhabitants. Instead, I concentrate on the impacts of this habitat extension, marked by the steep rise in the number of artificial islands since the mid-twentieth century. One aspect of the Anthropocene is land-use change in the form of urbanization, agricultural expansion, and deforestation. Land-use change is a terra-centric term, however, which should be complemented by sea-use change to adequately consider anthropogenic transformations of marine regions. The creation of human habitats on sea surfaces represents an artificial continuation of biological evolution, a technological adaptation to liquid material conditions that, without artificial islands, would make human survival impossible. Thus, "human habitat" underscores human-driven sea-use change and socioeconomic development practices that turned specific marine regions into production sites, as further explored in Chapter 5. The

[32] On Island Studies, see Romain Grancher, "Hybrid Islands: Some Reflections on the Intersection between Island Studies and Environmental History," *Coastal Studies & Society* 2, no. 2 (2023): 155–170.

[33] For an archaeological focus on this topic, see Tanya J. King and Gary Robinson, eds., *At Home on the Waves: Human Habitation of the Sea from the Mesolithic to Today* (New York: Berghahn, 2019).

[34] Joerg Baumeister, "Developing Aquatic Urbanism: A Taxonomy for 35 Tactics," in *SeaCities: Aquatic Urbanism*, ed. Joerg Baumeister et al. (Singapore: Springer, 2023), 1–10.

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extended human habitat, therefore, constitutes a space directly connected to bringing about the Anthropocene.[35]

Another reason for using the concept of human habitat extension is to counteract terra-centric bias. The terrestrial mindset has deeply penetrated certain terminologies, inevitably leading to associations with sedentism and land. For example, "residence" or "residential space," originating from the Latin *residere*, meaning "sitting down," historically implied not engaging in nomadic practices but establishing a stationary dwelling, typically at an agricultural site. Similarly, "settlement," etymologically rooted in "sitting," usually referred in a terra-centric agricultural context to a built environment of fixed dwellings for land cultivation. These terra-centric, sedentary contexts are not conducive to an oceanic-vertical perspective, which is more aligned with mobile structures and dynamic seascapes. In contrast, the technical-biological term "habitat" describes the area where specific species, including humans, live and sustain themselves. The term emphasizes the mobility and nomadism characteristic of most animal species. Sedentism and attachment to a fixed dwelling are cultural choices, not human predispositions.

These habitat characteristics warrant a more nuanced understanding of marine regions and their non-terrestrial material conditions, as opposed to simplifying them as resource frontiers or borderlands. While these concepts can be valuable, utilizing the notion of resource or commodity frontiers in this book would be excessively reductionist, concentrating too narrowly on the extraction of raw materials.[36] US offshore oil company officials, for example, frequently depicted their industry as conquering a new resource frontier.[37] Their offshore platforms operated in marine regions that had previously been territorialized. The officials' frontier claims therefore subtly reverberated with the distant echoes of past imperialist governments that appropriated supposedly unused land, linking property rights with the economic development of these lands. However, this concept is much less useful for comprehending issues like adaptation to sea level rise.

[35] The biological term "biome" refers to a geographical region with specific interactions between species and of species with nonhuman environmental parameters, including temperature and rainfall. The term "anthrome," or human biome, was coined to refer to human population density and land-use. The corresponding analysis is too terra-centric, leaving out the ocean, but nevertheless very valuable for understanding the connection between land-use change and the Anthropocene. See Erle C. Ellis and Navin Ramankutty, "Putting People in the Map: Anthropogenic Biomes of the World," *Frontiers in Ecology and the Environment* 6, no. 8 (2008): 439–447; Thomas, Williams, and Zalasiewicz, *The Anthropocene*, 96.

[36] Sven Beckert et al., "Commodity Frontiers and the Transformation of the Global Countryside: A Research Agenda," *Journal of Global History* 16 no. 3 (2021): 435–450.

[37] Tyler Priest, *The Offshore Imperative: Shell Oil's Search for Petroleum in Postwar America*. 2nd Edition (College Station: Texas A&M University Press, 2010).

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I also opted not to employ the "borderlands" concept instead of the extension of the human habitat. Setting aside the terra-centric implications of the term, it has been used in studies of certain marine regions, or more specifically naturally formed islands within them.[38] However, most of the transformations discussed in the following chapters occurred far from any political, physical, or conceptual borders and boundaries. While maritime boundary conflicts are present in several marine regions, and those in Asia are briefly discussed in Chapter 2, the contested space is marginal compared to the extensive territorialization of the seas in the twentieth century (see Figure 1.2). Furthermore, unlike naturally formed islands, artificial islands under the Law of the Sea do not generate territorial claims over adjacent space. This legal position, influenced by governmental concerns about frequent border changes and the possibility of libertarian-minded individuals establishing independent political entities beyond governmental reach, limits the applicability of borderlands concepts. Typically, borderlands are more relevant to areas where multiple cultures, languages, and identities intersect. Future research might consider individual artificial islands as potential borderlands where people of different cultures, genders, and ethnicities come into contact, as was the situation on US oil platforms in the twentieth century, which included conflict and sexual violence.[39] Nevertheless, these issues are of limited relevance for a book concentrating on Earth's amphibious transformation as a driving force of the Anthropocene.

Historical ocean research remains in a state akin to studies on the "Orient" prior to Edward W. Said's provocative 1978 work, *Orientalism*.[40] Said's work shed light on the Eurocentric patterns of negatively stereotyping the Orient and the underlying sense of European civilizational superiority, backed by European knowledge production being valued higher than others. Similarly, in the Anthropocene epoch, it is imperative to open one's eyes to a holistic understanding of Earth, including the full extent of the human habitat, instead of largely ignoring or negatively stereotyping, based on an allegedly superior terra-centric perspective, the ocean with eyes that do not see. Following the introduction of the Spilhaus Projection, the oceanic-vertical perspective, and the themes of this book, I advocate for a paradigm shift. Many historical studies still ignore the importance of the ocean in the

[38] A recent example is Paul Kreitman, *Japan's Ocean Borderlands: Nature and Sovereignty* (Cambridge: Cambridge University Press, 2023). For a more terra-centric introduction, see Pekka Hämäläinen and Samuel Truett, "On Borderlands," *Journal of American History* 98, no. 2 (2011): 338–361.

[39] Diane E. Austin, "Women's Work and Lives in Offshore Oil," in *Markets and Market Liberalization: Ethnographic Reflections*, ed. Norbert Dannhaeuser and Cynthia Werner (Amsterdam: Elsevier, 2006), 163–204.

[40] Edward W. Said, *Orientalism* (New York: Pantheon, 1978).

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Anthropocene, still treating it as a mere flat and vacant space between continents, which are seen as the primary sites of historical events. Certainly, oceanic history has made some advances – but almost exclusively limited to the capture of sea animals and plants, oceanography, shipping, and fiction. The histories of the twentieth and twenty-first centuries fail to adequately explore most forms of ocean industrialization and urbanization, both in terms of their intellectual role in environmentalist and developmentalist thought as well as in terms of their transformative impacts on oceanic environments and planetary-scale processes. The fundamental problem here lies in the prevailing terra-centric bias that is amplified by national history and its focus on terrestrial territories of sedentary inhabitation. As historian Marcus Redicker highlighted a decade ago, "The other side of terracentrism is the unspoken proposition that the seas of the world are unreal spaces, voids between the real places, which are landed and national. This logic – the bias of landed society – is evident in the work of thinkers as radically different as novelist Joseph Conrad and philosopher Michel Foucault."[41] The terra-centric bias nevertheless does not stop there, as noted by several other historians and geographers.[42] As historian Peter N. Miller pointed out, even maritime history is not substantially different from terrestrial history. Maritime history focuses on coastal ports and on ships traversing the ocean between them, with an interest in human mobility, yet it often relegates the ocean to a mere backdrop.[43] Indeed, oceans do "connect and divide," a central concept in maritime history, but the

[41] Marcus Rediker, *Outlaws of the Atlantic: Sailors, Pirates, and Motley Crews in the Age of Sail* (Boston: Beacon Press, 2014), 2–3.

[42] See, for example, Jon Anderson and Kimberley Peters, "'A Perfect and Absolute Blank': Human Geographies of Water Worlds," in *Water Worlds: Human Geographies of the Ocean*, ed. Jon Anderson and Kimberley Peters (Farnham: Ashgate Publishing: 2014), 3–19, here 4; Lincoln Paine, "Oceans and Sea in World Culture," in *The World's Oceans: Geography, History, and Environment*, ed. Rainer F. Buschmann and Lance Nolde (Santa Barbara, CA: ABC-Clio, 2018), 90–108; William Langewiesche, *The Outlaw Sea: A World of Freedom, Chaos, and Crime* (New York: North Point Press, 2005), 3; Peters, Steinberg, and Stratford, "Introduction," 2; John R. Gillis, *Islands of the Mind: How the Human Imagination Created the Atlantic World* (New York: Palgrave Macmillan, 2010), 85. The number of ocean-centered geographical and historical studies grew compared to ten years ago, but most of these studies were written or edited by a quite small group of people. See Kimberley Peters et al., eds., *The Routledge Handbook of Ocean Space* (New York: Routledge, 2023). For urban history contexts excluding the open ocean, see also Isaac Land, "The Urban Amphibious," in *The New Coastal History: Cultural and Environmental Perspectives from Scotland and Beyond*, ed. David Worthington (Cham: Springer International, 2017), 31–48.

[43] Peter N. Miller, "Introduction: The Sea Is the Land's Edge also," in *The Sea: Thalassography and Historiography*, ed. Peter N. Miller (Ann Arbor: University of Michigan Press, 2013), 1–26, here 5.

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horizontal linking of ports requires almost no volume.[44] In this book, connecting and dividing occur primarily in the vertical dimension, granting the ocean its due volume. Although maritime history is undoubtedly valuable, it does not provide any particular insights into the oceanic Anthropocene, the transformation of marine regions through artificial islands, and our current predicament. I am also not yet convinced by the focus of the blue humanities, a new interdisciplinary field. These studies must move beyond the Orientalism-like perceptions of the ocean prevalent in much of the Western literature they study. Repeated, uncritical claims such as the ocean "cannot be our home" reflect a terra-centric, sedentary mindset, at odds with my concept of the extension of the human habitat to sea surfaces and with historical practices in non-Western regions.[45]

Recent important works on oceanic histories by historians David Armitage, Alison Bashford, and Sujit Sivasundaram, among others, have refocused attention on the material conditions of marine regions. However, with a few notable exceptions, these studies have largely been confined to the water column, examining capture fisheries, whaling, or horizontal interactions with naturally formed islands.[46] Other noteworthy exceptions consider the impacts of material conditions on navigation, oceanographic and related scientific research (such as the exploration of plate tectonics and continental drift in the twentieth century), and sea-related fiction.[47] As previously mentioned, these important topics nevertheless did not dispel the Orientalist view of the ocean in most historical analyses, as they limited industrial interactions with it to increasingly sophisticated but still transitory capture or research activities on hardly ever stationary vessels that did not challenge ideas of usually empty, uninhabited sea surfaces. This book aims to expand the scope of oceanic history, offering a comprehensive exploration of human vertical interactions

[44] The classic text in this regard was on Atlantic history; see Benjamin W. Labaree, "The Atlantic Paradox," in *The Atlantic World of Robert G. Albion*, ed. Benjamin W. Labaree (Middletown, CT: Wesleyan University Press, 1975), 195–217. See also Kären Wigen, "Introduction," *American Historical Review* 111, no. 3 (2006): 717–721, and the other articles in this special issue.

[45] Steve Mentz, "A Poetics of Planetary Water: The Blue Humanities after John Gillis," *Coastal Studies and Society* 2, no. 1 (2023): 137–152, here 140. Cited without comment in Serpil Oppermann, *Blue Humanities: Storied Waterscapes in the Anthropocene* (Cambridge: Cambridge University Press, 2023), 3.

[46] David Armitage, Alison Bashford, and Sujit Sivasundaram, eds., *Oceanic Histories* (Cambridge: Cambridge University Press, 2017).

[47] Such exceptions include Sunil Amrith, *Crossing the Bay of Bengal: The Furies of Nature and the Fortunes of Migrants* (Cambridge, MA: Harvard University Press, 2013); Helen M. Rozwadowski, *Vast Expanses: A History of the Oceans* (London: Reaktion Press, 2018). See also the relevant chapters in Stefan Huebner et al., eds., *Oceanic Japan: The Archipelago in Pacific and Global History* (Honolulu: University of Hawai'i Press, 2025). Further exceptions (and their problems) will be covered in the following chapters.

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with multiple horizontal layers – this could be called a subfield, the oceanic history of the Anthropocene. It is informed by insights from architecture, marine engineering, marine biology, and other fields. I show not only the spatial range of such an interdisciplinary oceanic history but also the various scales it encompasses. Additionally, I want to emphasize its value for revealing the artificial islands that populate the ocean and dispelling the outdated but widespread Orientalism-like perception of marine regions as almost empty spaces subordinate to terrestrial centers of human civilization. In Chapter 4, I illustrate how societies with affordable access to coal as a fuel to power and build technologies of terrestrialization, such as water pumps and dams, adopted a terrestrial mindset. This mindset normalized water removal and control, instead of adaptation to water flows, as a central approach in socio-economic development. Flooding, in this context, becomes a social construct. Dictionaries define it as water beyond its *normal confines*, but the perception of "normal confines" has been heavily influenced by this terrestrial mindset. One manifestation is the marginalization of technological adaptation to sea level rise and the amplification of apocalyptic narratives. While climate fiction narratives can be valuable to draw popular attention to important issues, things become problematic if nonfiction neglects coastal adaptation strategies other than retreating to higher ground, reinforcing the terra-centric bias.[48] This issue is further explored in Chapters 4 and 6.

Using the insights from architecture, marine engineering, marine biology, and other disciplines, I view this book as an instrument to trench several historical fields in the deep waters of an interdisciplinary oceanic history, among them the history of development, the history of technology, Japanese history, the history of inter-Asian engagements, US history, and environmental history, including the intellectual history of environmentalist thought. These fields often display a terra-centric bias, having evolved before the impacts of the oceanic Anthropocene became more evident. They lack frameworks for addressing phenomena that require thinking through water, an oceanic-vertical perspective, and oceanic periodizations like the oceanic Anthropocene, instead of relying on terra-centric thinking. The book's intensive focus on Japanese and other Asian waters is valuable because the interactions of humans with ecological patterns like monsoons and typhoons, along with the river systems flowing from the Tibetan Plateau into the ocean, had important impacts on Earth's amphibious transformation. The specific

[48] Artificial islands and other adaptation options are missing in quite a lot of such apocalyptic publications, among them Elizabeth Rush, *Rising: Dispatches from the New American Shore* (Minneapolis, MN: Milkweed, 2018); Jeff Goodell, *The Water Will Come: Rising Seas, Sinking Cities, and the Remaking of the Civilized World* (New York: Little, Brown, and Co., 2017); Ashley Dawson, *Extreme Cities: The Peril and Promise of Urban Life in the Age of Climate Change* (London: Verso, 2017).

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material conditions in Japanese and Asian waters, not only in and beneath the water column but also when water turned into weather, set them apart from other marine regions. Such a vantage point is vital to avoid the overgeneralization of political and marine conditions in North American and European waters as universally applicable phenomena. Instead, Chapters 2 and 8 offer juxtapositions that highlight both commonalities and differences between waters off Asian, European, and North American regions. Additionally, the examination of marine regions off multiple continents in Chapter 9 reveals the inter-oceanic connections formed by the mobility of numerous artificial islands and the global artificial archipelago they constitute.

Finally, the terra-centric bias extends to quantitative data as well. A recent study emphasized that most socioeconomic development activities both at and below the sea surface are poorly quantified. This deficit not only demonstrates but also perpetuates the bias.[49] One example of such a problematic lack of knowledge is the UN's 2017 estimate of the global ocean economy's value, speculated to be somewhere between US$3 and 6 trillion annually.[50] If the ocean were considered a country, its economy, at the higher estimate, would rank as the world's third largest, trailing only the United States and China. Even at the lower estimate, it would easily secure a spot among the top ten economies (and be the most expansive "country" on Earth in terms of area). Yet, the difference between the upper and lower numbers is representative of vagueness and limited data. The UN and other intergovernmental organizations also largely fail to provide essential data, such as the sizes of individual EEZs and their total area, maybe about 136,850,878 square kilometers. This is likely due to maritime boundary disputes among member states. Accurate data on activities within these EEZs, such as the number of offshore oil and gas platforms or their carbon emissions, are again wild guesses or unknown, often because of secrecy or administrative shortcomings on the national level. The UN seems to be aware of these knowledge deficits and hosted a first Ocean Conference in 2017, followed by the International Decade of Ocean Science for Sustainable Development in the 2020s.[51] Still, researchers often resort to satellite imagery analysis for estimates of oil platforms, offshore wind turbines, and other structures. European and North American waters are exceptions, however, where data are more readily available. Likewise, global fisheries and mariculture statistics are unreliable due to disparities in the quality of national

[49] Fernando Paolo et al., "Satellite Mapping Reveals Extensive Industrial Activity at Sea," *Nature* 625 (2024): 85–91.

[50] UN, "Exploring the Potential of the Blue Economy" (June 7, 2017), www.un.org/development/desa/en/news/sustainable/exploring-potential-of-blue-economy.html.

[51] The UN tried to improve the situation through an assessment of the state of the ocean and the substantial knowledge gaps; see UN, ed., *The First Global Integrated Marine Assessment: World Ocean Assessment I*, https://wedocs.unep.org/20.500.11822/9795.

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data contributing to them. This is the case despite the huge extent of human-built marine structures, such as mariculture facilities, offshore platforms, or coastal protections, which have only very recently begun to be estimated. Based on the limited sources, the authors think that the built environment's impact has modified 1–3.4 million square kilometers of ocean space (roughly equivalent to the size of global urban land cover), and the majority of the structures are concentrated in coastal Asia.[52] Consequently, visions of what is increasingly referred to as the Blue Economy, which aims to both exploit and protect marine regions, are formed in a setting as turbulent for intergovernmental organizations as it is for academics striving to collect or validate relevant figures through alternative methods.[53]

The book's structure centers around the functional diversification of the increasing number of artificial islands that have emerged since the mid-twentieth century and whose usages for access creation have added new spatial layers to the oceanic Anthropocene. The narrative adopts a spatially layered approach rather than a strict chronological one, with each chapter focusing on artificial islands and their vertical connections. Typically, chapters feature a brief section on *longue durée* influences, which is not only a tribute to historian Fernand Braudel's study of the sixteenth-century Mediterranean world but also a tool to emphasize the disruptive impact of Earth's amphibious transformation as the driving force of the oceanic Anthropocene.[54] The chapters, informed by extensive archival research and the evaluation of gray literature in the form of trade journals, news magazines, and newspapers from a large number of countries and in multiple European and Asian languages, weave together distinct yet interconnected uses of artificial islands that have spurred Earth's amphibious transformation. While each chapter can be read alone, they build on one another, introducing new ideas and concepts, which are not reiterated later, though references are made to the chapters where they were first discussed. Altogether, this thematic, spatially layered narrative of the amphibious transformation underscores the mid-twentieth century as the appropriate starting point for the oceanic Anthropocene, based on tremendous changes in vertical space.

[52] The largest impact is associated with China, South Korea, and the Philippines: Ana Bugnot et al., "Current and Projected Global Extent of Marine Built Structures," *Nature Sustainability* 4 (2021): 33–41.

[53] Paolo et al., "Satellite Mapping"; Brooke Campbell and Daniel Pauly, "Mariculture: A Global Analysis of Production Trends since 1950," *Marine Policy* 39 (2013): 94–100.

[54] Braudel opened his study with a *longue durée* overview of material conditions not changing within human time frames measured in decades; see Braudel, *The Mediterranean*.

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