

# Subversive Submersives: The Unseen Urbanisation of the Southern Ocean

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## Abstract

The enormity of the ocean presents as an unusual physical obstacle that complicates claims for spaces being urbanised well beyond the traditional container of the city, such as the focus of this discussion: the Southern Ocean. Though commonly perceived as a pristine wilderness at the end of the earth, the ocean surrounding Antarctica has been imbricated in planetary-scale processes of urbanisation since the late eighteenth century, so the absence of this oceanic volume from twenty-first-century urban debates is troubling. Representations of the Antarctic as remote and disconnected from cities do nothing to contribute to a critical discussion of its ocean volume, technological histories or ongoing colonial settler imaginaries. Instead, attention might turn to codifying what the ocean increasingly contains by way of urban processes and, ultimately, what might be offered by confirming extended forms of urbanisation operating on and, importantly, through the Earth. In this article I re-present the Southern Ocean via comparative cartographies and critical image-making to cross-examine what its occlusion signifies for the planetary reach of urbanisation. For underneath the machinery of extraction and exploitation lie significant questions regarding representations of the urban as they manifest outside conventions that overstate 'the city' as central to urbanisation.

## Keywords

planetary urbanisation, Southern Ocean, wet ontologies, technology, cartography, urban

The enormity of the ocean presents as an unusual physical obstacle that complicates claims for spaces being urbanised well beyond the traditional container of the city, such as the focus of this discussion: the Southern Ocean. Though commonly perceived as a pristine wilderness at the end of the Earth, the ocean surrounding Antarctica has been imbricated in planetary-scale processes of urbanisation since the late eighteenth century, so the absence of this oceanic volume from twenty-first-century urban debates is troubling, especially given that current discussions often universalise the premise of a 'global urban age'.<sup>1</sup> While the Southern Ocean is remote from most cities, this does not preclude its co-option by expanding urban processes, and though the Southern Ocean, like all oceanspace, is constituted from a materiality resistant to surveillance, it does not necessarily mean these urbanisation processes are completely hidden from view. Examining how the Southern Ocean is being urbanised re-presents foundational questions regarding space, representation and control. For instance: What environments are considered as

'appropriately' urban? Where might representations work to legitimise some spaces as somehow 'outside' of what is urban? And what emancipatory possibilities emerge from dismantling such constraints on lexicons of the urban? These concerns are not only pertinent to the field of urban studies, but also bear on the ways many scholars and practitioners across geography, architecture, art and creative practice seek to work in the world.

Henri Lefebvre's notion of physical and ideological 'blind fields' becomes critical here, as does his demand for the inclusion of methods beyond traditional urban analysis. Lefebvre urges us to interrogate spaces that limit conceptions of the urban by relinquishing prior frameworks, synthesising fragmentary information, and revealing difference: that the analysis of urban phenomena requires a 'gathering together of what gives itself as dispersed, dissociated, separated, and this in the form of simultaneity and encounters'.<sup>2</sup> In this article, I turn my attention to codifying what the ocean increasingly contains by way of urban processes at a planetary scale; representations of human,

more-than-human, and nonhuman encounters experienced within the urbanising Southern Ocean in particular; and, ultimately, what might be offered by confirming extended forms of urbanisation operating on and, importantly, through the earth. Representations of the Southern Ocean as remote and disconnected from cities do little to contribute to a critical discussion more generally of oceanspace, nor do they reveal the diverse ecologies, technological histories, and colonial settler imaginaries produced during the urbanisation of this space. Neither does representing the high seas as uninhabitable or distant from everyday urban life, which avoids a long history of extraction and exploitation undertaken in the Southern Ocean in the service of cities much further away. Together, this helps to externalise oceans from the co-constitution of human and nonhuman relationships across a rapidly urbanising planet. It also runs counter to a large body of creative work produced since the early 2000's by artists (such as Philip Samartzis, Janet Laurence, Nicholas Mangan and many others), filmmakers (like Allan Sekula, Noël Burch, and Harvard University's Sensory Ethnography lab), writers (including Joy McCann and Zakes Mda), spatial practitioners (for instance, 'The Forensic Oceanography Project', a subset of the Forensic Architecture research agency), and cultural organisations (like TBA21-Academy in Venice, Italy) confronting similar concerns.

For oceanspace is not just a blue-tinted blank expanse on a map, but rather an embodied volume comprising a multiplicity of processes working through experienced and materially unique territories. Acknowledging extended forms of urbanisation here transforms a conventional limit to most urban debates, which geographers Philip Steinberg and Kimberley Peters characterise as 'land-sea binaries'.<sup>3</sup> A landed bias in much architectural and urban theory helps support critical disregard of oceanspace, despite it connecting cities and hinterlands across the planet. I will therefore re-present the Southern Ocean to better understand what this disregard signifies for the planetary reach of urbanisation. Through comparative cartographies and critical image-making, I seek to both demonstrate how the Southern Ocean is being urbanised and resituate underwater sensing within Lefebvre's 'spaces of representation' schema, as an experienced space created by ideas, discourse, and theory that works to 'make' the world rather than 'represent space'.<sup>4</sup> Examining the 'disarticulated sensing apparatus' of subsurface data in particular, as gathered by ocean-going robots, satellite surveillance, and ship-based technologies, means asking seriously what contribution can be made to understanding an urbanising planet through encounters with remote worlds inhabited by drone bodies.<sup>5</sup> To this end, I argue that underneath the machinery of extraction and exploitation in the ocean

lie significant questions regarding representations of the urban, outside conventions that overstate 'the city' as central to urbanisation.

### Cities and their elsewhere

The ocean, as figure 1 illustrates, is increasingly consumed by apparatuses that reveal urban processes operating at the scale of the planet.<sup>6</sup> A combination of scientific endeavours and commercial speculation have laid foundations for an ocean made urban, while 'pristine' and 'wilderness' imaginaries of the Southern Ocean falter as exploitation and extraction are acknowledged as long present. Much contemporary discussion of urbanisation is declared through a rhetoric of planet-wide ecological crisis, yet it is significant that locations outside centres of this discourse – what is commonly referred to as the Global South and also, significantly, the Southern Hemisphere (though these two are sometimes assumed to overlap)<sup>7</sup> – seem rendered only as othered spaces within such discussions: marginalised as requiring aid and protection provided from and by those centres (typically its constructed binary, popularly known as the Global North) but without clear agency of their own. These debates originated in major British, European, and North American cities and their prestige institutions (the London School of Economics, Deutsche Bank, The Sorbonne, Harvard University, Brookings Institution, and Rockefeller Foundation among others) via a series of 'urban age' conferences and publications beginning in 2005.<sup>8</sup> While the issue of what exactly constitutes the urban straddles a range of disciplines, including urban theory, geography, planning, and architecture, 'the global urban age' championed today by planners, urbanists, and governments alike grew from these discussions, celebrating the 'emergence' of a dominant condition of city life around the world. However, Australian feminist geographers Ruth Fincher and Jane Jacobs highlighted a need to be wary of 'blockbuster urban commentaries' more than two decades ago, and urban sociologist Neil Brenner and others more recently called out this 'metanarrative' for continuing to privilege the container of the city over more expansive urban processes and unevenly experienced effects.<sup>9</sup>

The exclusion of remote spaces like the ocean and other forms of 'wilderness' – which are seen as *non-urban* – from this discourse has also been problematic.<sup>10</sup> Seeing the ocean only in this way neglects spatial ordering, human and non-human experience, and the continually forming relationships between our social worlds.<sup>11</sup> What is or is not considered appropriate as urban is still largely framed by European and North American narratives and practices projected across the planet. That will surprise few First Nations, Indigenous or Black diaspora scholars, who have



Fig. 1: The Southern Ocean. Photomontage: author.

all argued that settler colonial logics of *terra nullius* render certain environments empty and available for remaking.<sup>12</sup> As a non-Indigenous architect and researcher benefitting from uneven power hierarchies in the lands and waters of Naarm/Melbourne where I live and work, I am indebted to these scholars in recognising the structure of settler colonialism, which continues to authorise lexicons of the urban. I acknowledge that this article builds on their intellectual and emotional labour, and remember to also take care to resist changes in representation that simply reinscribe the colonial project facilitated by many cities and institutions of the Global North. As Timmah Ball warns, ‘the growing appetite for Aboriginal culture is astounding, at times lulling us into a false sense of security where power is shifting’.<sup>13</sup> It remains important that spaces assumed to be outside even extended forms of urbanisation are brought to bear on questions regarding the urban at a planetary scale.

Indeed, geographer Matthew Gandy notes that cities are just one type of urbanisation rather than things isolated from larger processes, and Lefebvre also claimed ‘the city’ could not exist without an ‘elsewhere’.<sup>14</sup> In the classic 1970 text, *The Urban Revolution*, he sees such spaces produced simply to create technologies, knowledges, beings, and objects in the service of the city.<sup>15</sup> Lefebvre later wrote that the externalisation of nature prefigured a ‘planetarization of the urban’ and lamented that this was routinely ignored in mainstream debates.<sup>16</sup> Categorical distinctions between urban and non-urban are never neutral, and the elsewhere/nature’ proposition remains an intrinsic problem for how cities are conceptualised. More recent discussions in architecture and urban theory have re-examined Lefebvre’s premise: most notably in Brenner and urban geographer Christian Schmid’s theorisation of ‘planetary urbanisation’, which sees cities constituted by socio-spatial processes that extend well beyond any city boundary, right up to the scale of the earth.<sup>17</sup> Although critiques regarding the erasure of Indigenous, postcolonial, feminist, queer, and rural studies scholarship already at the intersection of these concerns have been aimed at Brenner and Schmid, few argue against their conceptualisation of ‘extended urbanisation’.<sup>18</sup> For Brenner and Schmid, the ongoing expansion of urban processes transform environments adjacent to cities into operationalised territories, which are radically reconfigured through resource extraction, agribusiness, and/or logistical enclosure to service accelerating growth. Urbanisation thus extends into hinterlands and transnational spaces through forces of capital and planning, degrading once ‘wild’ places well beyond the boundaries of cities.<sup>19</sup> Brenner and urbanist Nikos Katsikis also hold that many spaces assumed as non-urban by dominant discourses are already urbanising and have been for some time.<sup>20</sup>

### The unseen urban ocean

I therefore start from a clear premise: that the ocean is being urbanised. Examples of this can be seen in studies of contemporary urbanisation in among the Atlantic, Pacific and Arctic Oceans, along with the Barents and South China Seas.<sup>21</sup> Brenner and Katsikis look at similar concerns in the Mediterranean region but only obliquely recognise that the oceanic volume co-constitutes urbanising processes. Their 2014 text, *Is the Mediterranean Urban?* seeks to dismantle a land bias common to visualisations of urban analysis by demonstrating the density of transport networks operating across oceanspace. However, the Mediterranean sea basin still figures as a surface to be traversed: most crucially in the ‘Major ground and marine transportation routes around the Mediterranean’ figure, which maps a flat ocean studied with infrastructural points between ports.<sup>22</sup> Indeed, relative few scholars have foregrounded implications of planetary urbanisation for the volume of the ocean itself (those include Nancy Couling, Milica Topalović and Ross Exo Adams; all of whom, intriguingly, trained as architects). In this article I chart instead the extension of urbanisation into oceanspace via ‘wet ontologies’: a conceptual framework developed by Philip Steinberg and Kimberley Peters to more rigorously explore embodied spaces of water at the scale of the planet.<sup>23</sup> Thinking through wetness in these ways reconfigures basic spatial categories: examining what constitutes the urban outside of cities, beyond the limits of dry land, and below the surface of water – enables recognition of extended urbanisation forms largely unseen in urban knowledges and their representations.

Siting this inquiry within the Southern Ocean is critical, due to its position as the world’s newest and arguably most vulnerable ocean: host to complex and unique intersections between ice, water, land, science, geopolitics, commercial incentives, agents, and organisms. ‘New’ in this context refers to institutional recognition: though over thirty million years old, the Southern Ocean was only ‘established’ by the International Hydrographic Organisation in the year 2000 – or, more accurately ‘re-instated’ after many nations lobbied to revoke its listing in the 1928 *Limits of Oceans and Seas*.<sup>24</sup> Since then, it has been fragmented into ‘Southern’ extensions of the Pacific, Atlantic and Indian Oceans, or known as the South Polar or Antarctic Ocean. ‘Newness’ is also very probably a function of a popular misconception, driven by *The National Geographic Society*’s refusal to label it an ocean until 2021.<sup>25</sup> The Southern Ocean is thus constructed by a variety of actors (human, non-human, and otherwise) and confirms law theorist Henry Jones’s claim that meaning here is fixed through arbitrary systems

of demarcation while the ocean itself is perpetually in movement.<sup>26</sup> This challenges basic models of place by creating conflicts between the means of ordering space and that space as it is actually experienced.<sup>27</sup>

For instance, there are long histories of human occupation in the Southern Ocean. The late eighteenth century focused on heroic polar exploration and ignored rapidly industrialising marine mammal harvesting, even as commercial premises began to spread through the Southern Ocean. Factory facilities along the Antarctic coastline and sub-Antarctic islands testify to intensive exploitation of seals embedded in global financial networks and food, fuel, and clothing markets well into the nineteenth century.<sup>28</sup> Seal overharvesting nearly obliterated the 'productive value' of the Southern Ocean, and was remedied only by a new boom in whaling. All the while, marine mammal exploitation continued to recede behind images of heroes battling harsh elements on the Antarctic continent. Up until the twentieth century, urban processes and the Southern Ocean were considered separate although bound together through the supply of fuel and manufacturing resources. Similarly, David Harvey famously noted that nineteenth-century capitalism broke the assumed spatial boundaries of urbanisation through new technologies and their apparatuses.<sup>29</sup> During the mid-twentieth century, new international governance institutions for the Antarctic laid down latent principles for ordering global urbanisation. Clear lines were drawn between the prized 'wilderness' of the Southern Ocean and everywhere else on the planet (where the presence of urbanising activities were normalised) and the Antarctic region was 'restored' as remote, pristine and protected from the rest of the world.

This reminds us that the codification of the ocean is continually constructed, flattened and controlled from a distance.<sup>30</sup> For example, the Southern Ocean's political boundary is often taken as the Antarctic Treaty Limit of 60°S, but that rarely aligns with historical or scientific discourse. For these fields, the Southern Ocean's southern boundary is set at the Antarctic continent, but its full reach is less settled. Unlike other oceans, deep water – rather than landmass – hints at a northern edge and the strong Antarctic Circumpolar Current (ACC) is most often called upon to demarcate that boundary. These are problems with this too, as the ACC operates more like an atmospheric system: essentially a borderless phenomenon subject to other currents, gyres, eddies and seasonal air-sea fluxes, and interactions with the Pacific, Atlantic and Indian oceans.<sup>31</sup> Geopolitics scholar Klaus Dodds says that these 'fuzzy' delineations are open to almost-constant contestation.<sup>32</sup> Indeed, Australia roundly rejects the ACC boundary, arguing instead for its southern shoreline and thus including many industrial ports as ocean entry points.<sup>33</sup> Basic

principles limit seeing the Southern Ocean as a coherent geographical entity, let alone identifying it as 'urban'.

The Southern Ocean is the only body of water on earth that is clearly and materially *planetary*, and is constituted as a global common under the 1959 *Antarctic Treaty System* (ATS).<sup>34</sup> The Southern Ocean is represented variously as a visual, conceptual or legal space but remains held at a distance from cities and experienced by humans almost entirely mediated by images and maps. It is, however, very much present in our world, and in relation with urban centres across the planet. As researchers at the *Antarctic Cities and the Global Commons* project attest, Southern Ocean rim cities like Hobart (Australia), Christchurch (New Zealand), Punta Arenas (Chile), Ushuaia (Argentina) and Cape Town (South Africa) cooperate as international custodians of Antarctic tourism, shipping, logistics, resource speculation and scientific research, and have long produced their city imaginaries in close association with the Southern Ocean. Arguing against seeing these cities as disparate ports, the researchers have created an 'Antarctic Connectivity Index' as evidence of governance and sustainability planning coordinated between the 'gateway cities'.<sup>35</sup> I must also reiterate that the Southern Ocean is governed from and in cities, albeit via multilateral treaties – including the ATS, the 1982 *United Nations Convention on the Law of the Sea* (signed into existence in Montego Bay, Jamaica), and the 1991 *Madrid Protocol on Environmental Protection to the Antarctic Treaty*; regionally-focused protections such as *Convention on the Conservation of Antarctic Marine Living Resources* (CCAMLR, with its secretariat based in Hobart); shipping bodies such as the International Maritime Organisation (IMO, headquartered in London); and ongoing negotiations for a new United Nations treaty to regulate marine biodiversity in areas beyond national jurisdiction ('BBNJ', whose secretariat is located in New York).

Southern Ocean governance may be global in structure, but it is legislated, implemented and policed through the nation-state, leading to conflicts between territorial claims, extraction opportunities, economic potential and surveillance of a vast region supposedly operating in the peaceful pursuit of scientific knowledge. While Antarctica and its surrounding ocean seem distant, uncultivated and uninhabitable, these assumptions neglect much evidence of increasingly urban processes, as figure 1 illustrates. This includes resource extraction to supply growing populations elsewhere, such as commercial harvests of krill (bound for animal pet feed and fish bait in South Korean, Norwegian, Japanese and Polish markets) and exploitation of vulnerable toothfish (also known as Chilean seabass, sold for domestic consumption in Australia, the US, China, Singapore, South Korea and Japan), an increase in adventure travel (a 32 per cent growth in tourist ship

transports was recorded in 2018–2020 alone, and there has been a significant expansion of tourism facilities over the last twenty years), and marine bioprospecting by commercial entities (for use in agriculture, food product, wine, pharmaceutical and cosmetic industries around the world).<sup>36</sup> Examined closely, the Southern Ocean starts to reveal so many planetary-scale interdependencies operating in long chains of historical transformation and accumulation that anthropologist Stefan Helmreich suggests more ‘thinking from southern oceans’ is urgently required.<sup>37</sup> All this suggests also, as architectural and urban theorist Ross Exo Adams says, that there is a history, logic and political character to the urban; and what is or is not acknowledged as urban may be considered an ongoing project to reorganise power in space.<sup>38</sup> There seems a constructed absence of the urban in the ocean, and as Lefebvre recognised, ‘blind fields’ are not just acts of unconscious blindness, but instead an ideological ‘not-seeing’ that is also a ‘not-knowing’.<sup>39</sup>

Key to the Southern Ocean’s disregard is the matter of its representation: it suffers both from remote geographical distance and normative forms of spatial ordering that support the visibility of certain conditions of urbanisation over others. For instance, commercial fishing, pharmaceutical developments, tourism and logistical support for processes supplying non-adjacent cities have been increasing within the Southern Ocean since 1995, but are typically evidenced through academic scientific publications or government environmental reports rather than urban analysis performed by the same institutions (as is the case in the Antarctic resource extraction and exploitation figures quoted in the paragraph above).<sup>40</sup> These impacts have been shown in decades’ worth of rigorous marine science and disseminated via regular global environmental assessments but remain largely absent from urban debates.<sup>41</sup> Brenner and Schmid’s notion of extended urbanisation can therefore be helpful in confirming that urban processes are operating through the ocean, though not as visible as other spaces on land. Central to the urbanisation of the ocean has been the working of these spaces and transforming their bodies in the service of industrial logics: what geographers Martin Arboleda and Daniel Banoub call a ‘market monstrosity’.<sup>42</sup> Just as early sealing and whaling interests reconfigured the Southern Ocean as a lucrative hunting ground after marine mammal populations crashed elsewhere, so too contemporary efforts to dramatically expand krill harvests in the Antarctic are driven by the near-collapse of once abundant South China Sea fishing grounds and escalating protein demands from China, Australia and beyond.<sup>43</sup>

### Rethinking wetness

The wet ontologies framework developed by geographers Steinberg and Peters demands that we reconceive the ocean as an emergent tool for thinking through space on its own terms: a clear alignment with Lefebvre, Brenner, Schmid, and others’ insistence on the urban as a category of theorising rather than a physical container. Further, they reject any objectification of the ocean: thinking must be from the ocean, not about it.<sup>44</sup> Wet ontologies acknowledge that the ocean is not a homogeneous whole, but rather that specific physical, political, and philosophical characteristics mark its manifestation around the planet. This means that missing relations from many urban debates are within the water and include what geographer Ruth Panelli describes as ‘the operationalisation of more-than-human bodies’.<sup>45</sup> I therefore acknowledge humans, non-humans, and ‘not-quite human things’ as significant assemblages within oceanic volumes shaped by ongoing social, spatial and material processes.<sup>46</sup> Through wet ontologies, Steinberg and Peters seek to reconfigure our planet as an interconnected series of wet volumes that decentres land bias amid norms of space and time. In this context, it is worth remembering a few statistics: approximately 71 per cent of our planet is covered by oceans; humans have explored more territory on Mars than the ocean floor; and the ocean is this planet’s largest carbon sink and thus key for mediating rising global average temperatures.<sup>47</sup> When we avoid relations with the wetness of this planet, critical connections between ourselves, others, and the urban remain unseen, even as they all experience significant transformations together.

Wet ontologies also highlight oceanspace is conceptualised through relations to political and economic change, cultural imaginaries, and historical processes of colonisation, conquest, resource extraction and trade.<sup>48</sup> The bias towards land conveniently allows the disregard of a territory occupying much of the earth, and one that provides literal connections between many urban centres on this planet. By way of example, ocean-going freighters transport more than 80 per cent of all global trade (a figure sustained despite global Covid-19 disruptions since 2020), yet maritime networks are more generally understood through international law or corporate governance frameworks.<sup>49</sup> Large bodies of water such as the Southern Ocean are defined by a seeming lack of characteristics intrinsic to urban discourse, but wet ontologies position oceanspace as a critical lens for reflexive and relational thinking at interdependent urban, global and microscopic scales.<sup>50</sup> Codification of the ocean – including the Southern Ocean – is not restricted to scientific, geopolitical or legal knowledges. Numerous disciplines engage with the ocean and have implications for how the extended urbanisation of the Southern Ocean is represented. Aquatic ecologists

Airlie McCarthy, Lloyd Peck and David Aldridge discovered significant flaws identifying fishing, tourism, research and supply shipping movements across the Southern Ocean as they evaluated invasive species and other biosecurity risks borne by such vessels. Their research revealed that the Southern Ocean is overlooked within global maritime intelligence data because Antarctica has no commercial ports. To correct this flaw, they developed new methods, merging raw satellite observations, commercial ship logs and terrestrial port calls, in order to quantify the actual range and frequency of Antarctic ship traffic. The results identified a tenfold increase in known port-to-port networks connected with the Southern Ocean and unexpected links to urban centres across East Asia, North Africa, and Europe.<sup>51</sup>

### Rethinking (wet) bodies

Not seeing the urbanisation of the Southern Ocean is also a function of how bodies that inhabit it are identified and communicated, and the significance of underwater relations between those bodies. New technologies expanding into the ocean – such as submersible robots and autonomous underwater vehicles (AUVs) used in oceanographic research and resource exploration – present unique considerations. The growth of underwater infrastructures is a surprising manifestation of urbanisation but little attention has been paid to how such technologies operate in these contexts as things with intelligence. Robot bodies move untethered through the ocean and make decisions about data, mapping environmental features while communicating with ships and orbiting satellites, and responding to encounters with others.<sup>52</sup> The technological development of underwater vehicles grew from military-led oceanographic exploration and commercial salvage operations after World War II, and a new awareness of the potential for rare earth mineral extraction from the deep seabed.<sup>53</sup> Underwater vehicles are also the producers of unique visual representations via integration with remote sensing, soundings, multibeam sonar, stereo imaging, satellite surveillance and locational technologies operating planetarily. In figure 2, we can see independent AUVs, drifting ARGO swarms, marine mammals, orbiting satellite systems, secured-in-place buoys, traversing ships, and fixed data centres back on dry land assembled under, on, over and beyond the ocean. AUVs are uncrewed submersibles fitted with thrusters, batteries, and a range of complex instruments and embedded computing power that enable collection of extremely high-resolution, accurately geo-referenced acoustic imagery, and water column data to a depth of 6 000 m, mostly in the service of national science programmes (although commercial markets are growing as demand soars for extractive exploration technologies that can operate in ever more challenging undersea environments).<sup>54</sup> ARGO floats, by

contrast, operate as simple robotic sensing instruments drifting with ocean currents on an automated vertical dive sequence, which allows them to reach depths of up to 2 000 m, and collect water temperature, salinity and pressure information as they sink. After ten days they typically return to the surface to transmit data to communications satellites before beginning the dive loop again. More than three thousand floats operate in the ocean at any time and are usually abandoned to the seafloor when their instruments fail after five years or so of operation.

AUVs and floats are also often encountered by curious marine mammals including, in the Southern Ocean, those with sensors epoxied to their body by human research teams keen to collect passive hydrographic information as the animals move through oceanspace. Deep-diving southern elephant seals (*Mirounga leonina*) are found throughout the Southern Ocean and enrolled into research regimes for their speed and long-range observation capacity, co-creating more than five hundred thousand open-source oceanographic profiles.<sup>55</sup> Moored buoys further assist all these bodies in their labour, connecting data with satellites overhead or via cable to seabed distributed optical fibre networks transmitting cellular acoustic or optical communications from AUVs and other sensor arrays. Critical to this network of knowledge production are surface ships and orbiting satellites receiving transmissions and redistributing them to onshore commercial data centres and public or private research institutions. The JASON satellite series is of special interest in this context; it was launched as an ocean-atmosphere observation collaboration between NASA and European space agencies in 2001. Named after the Greek mythological hero who journeyed far across the dangerous sea, the first JASON satellite was rendered inoperable in 2013 when hit by space junk and shifted to a graveyard orbit: a technological remnant that will circle the world for at least another thousand years.<sup>56</sup>

It should be noted that marine robotics innovation is typically tied to powerful institutions intent on maintaining power via surveillance and the emancipatory potential offered by such objects is restricted by operational parameters originally conceived by defence industry manufacturers.<sup>57</sup> Even reconfigured for scientific research and exploration, these ‘rebranded “good drones”’ (oceanographic AUVs and the like) are positioned as instruments operating in spaces outside of everyday life.<sup>58</sup> This digital infrastructure supports scientific endeavour in areas inaccessible to all except space-borne monitoring systems, and includes long-range AUVs like the UK National Marine Equipment Pool’s *Boaty McBoatface* plus robotic ARGO floats, deep water moorings, and ocean gliders deployed through Australia’s Integrated Marine Observing System.<sup>59</sup> The ‘smart ocean’ – an oceanic analogue of ‘smart cities’, where

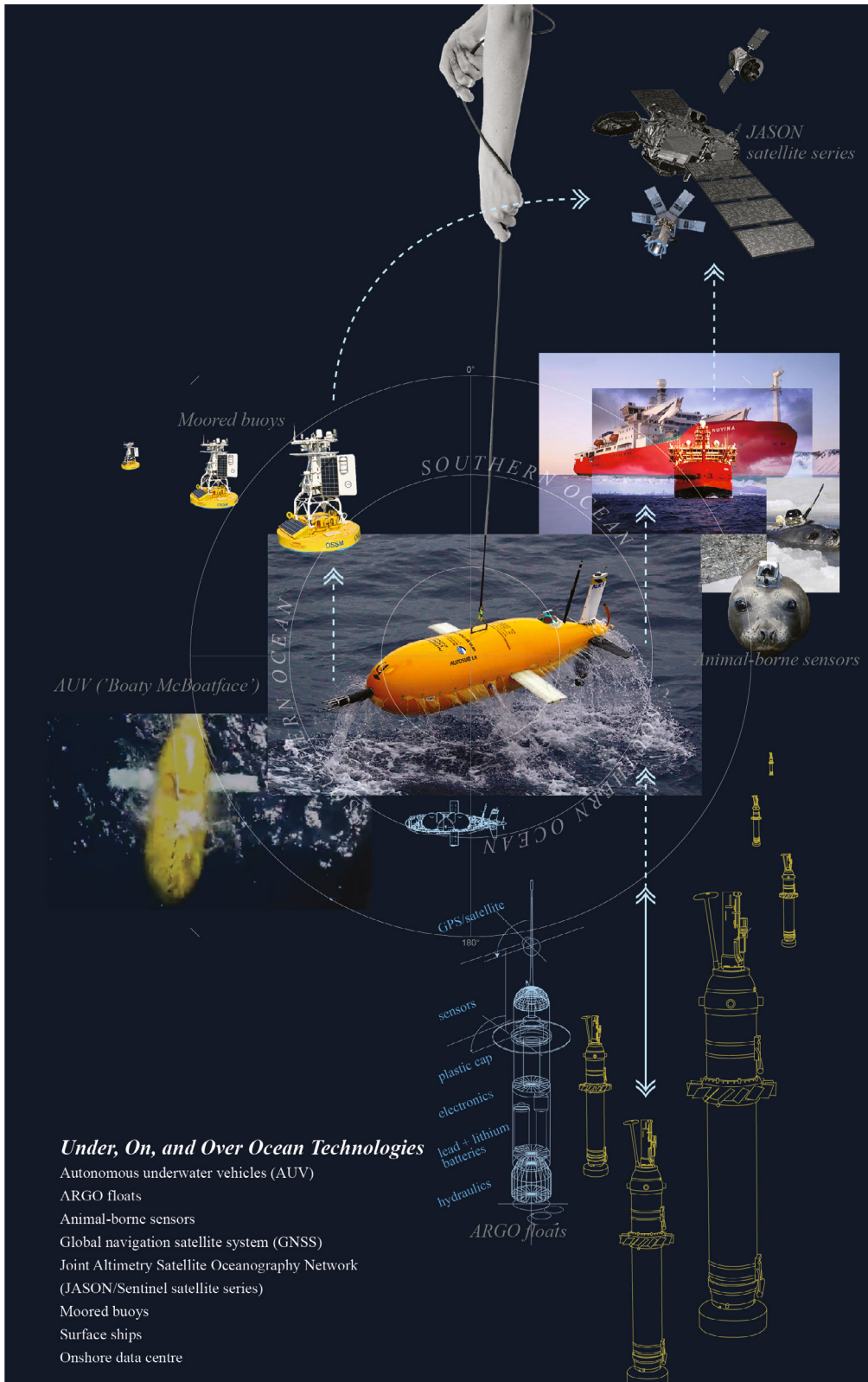
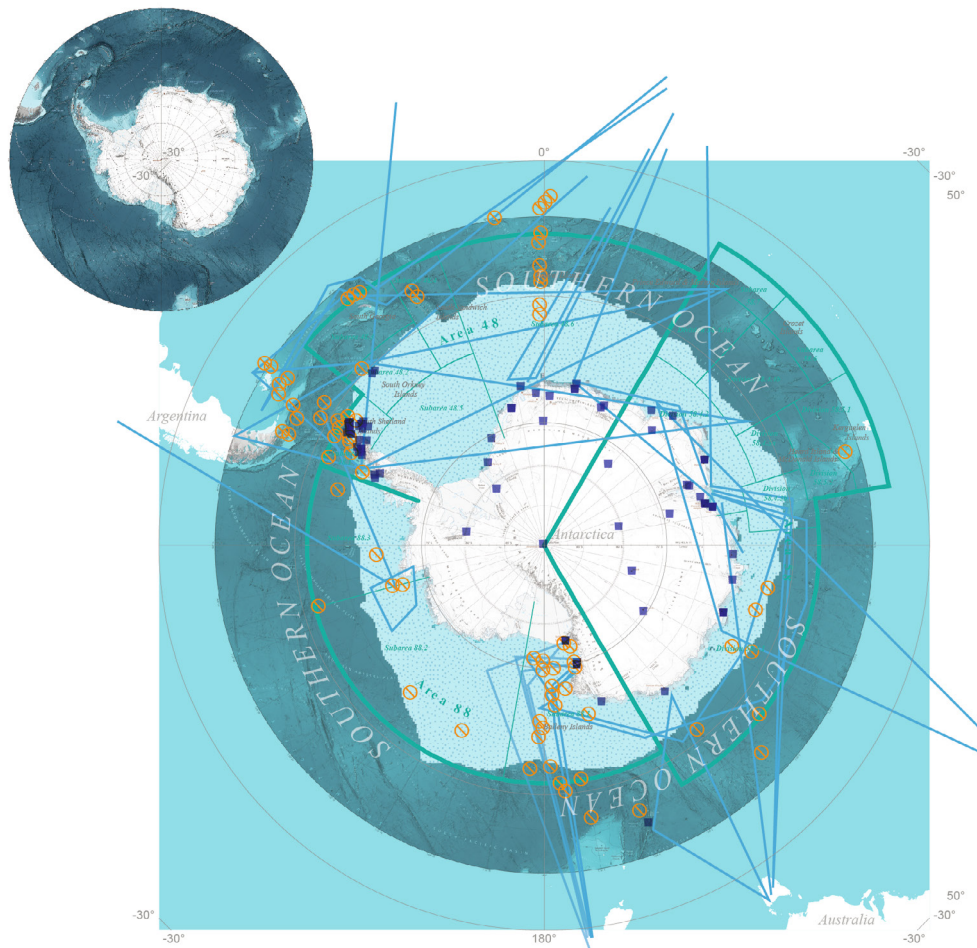


Fig. 2: Under, On, and Over Ocean Technologies. Illustrated photomontage: author.





### ***The Observed Ocean***

- Scientific research stations
- CCAMLR convention areas  
(Commission for the Conservation of Antarctic Marine Living Resources)
- Planned future transports  
(airplane, helicopter, ship, land vehicle and convoys: current as at 01 October 2022)
- ⊗ Distribution/occurrence of micro- and macro-plastics  
(samples gathered, 1984-2017)

Fig. 3: The Observed Ocean. Illustrated map: author; includes data from Dorschel et al., *The International Bathymetric Chart of the Southern Ocean Version 2* (2022); Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR); *Map of the CAMLR Convention Area* (2017); DueSouth Database of Upcoming Expeditions to the Southern Ocean. Antarctic – Planned Routes (2022); and Southern Ocean Observation System (SOOS). *SOOSmap – Plastic Debris* (2022).

environmental data gathering, sensing technologies and institutional relationships are arranged for more efficient marine governance via digital platforms – generates complex legal, ecological, and moral questions. Governance scholars have paid close attention to these socio-technical developments, and some geographers wonder if risks associated with the digitised ocean (in particular, a ‘belief that divergent social and environmental interests can be reconciled with expanding capitalist relations through the proper combination of technological innovation and well-crafted policy’) can be balanced with opportunities they might provide for the assertion of ‘Indigenous data sovereignty’ and meaningful ocean custodianship by First Nations.<sup>60</sup> Thus, extended forms of urbanisation continue to manifest in the Southern Ocean in surprising ways.

As many have argued previously, emergent forms of urbanisation require new representational modes and reflexive cartographies to set forth their analysis and interpretation. In figure 3, we can see the Southern Ocean as it is typically articulated: made abstract through a carefully selected set of open-source research data available from CCAMLR, the Scientific Committee on Antarctic Research, the Southern Ocean Observing System, the Norwegian Polar Institute’s ‘Quantarctica’ GIS resource bank, the General Bathymetric Chart of the Ocean, and DueSouth (an online database of planned research, commercial and tourist expedition routes to the Southern Ocean launched in 2022). Figure 4 illustrates the absence of actual traffic uncovered by McCarthy et al. in their shipping visualisations, which revealed more complex port-to-port traffic networks through the Southern Ocean and beyond.<sup>61</sup> And finally, figure 5 makes use of datasets from Ocean OPS’s open-source global ocean observation dashboard to register ‘seeing’ undertaken by a range of human, nonhuman, and ‘not-quite human things’ in the Southern Ocean via tracking ARGO float swarms, drifting and fixed buoys, animal-borne sensors, automated and crewed floating weather stations, expendable probes and AUVs. How we see or do not see the Southern Ocean assists in the construction of an authority through which certain urban knowledges and representations can become overstated. Similarly, reinscribing settler-colonial distinctions between what is considered appropriately urban or non-urban empties out remote environments and makes them available for extraction and exploitation at a distance. So, while new technologies have long been instruments for transformation in, and of, the ocean (witness the dramatic escalation of whale harvesting in the Southern Ocean as a result of nineteenth-century commercial harpoon innovations), contemporary floating robots and AUVs constitute new operators within this space: neither fully human nor nonhuman, yet lively and suggestive of new forms of agency.<sup>62</sup>

### Untethered forms of agency

Scholars have only recently begun to explore the consequences of urban processes as they extend deep within the ocean.<sup>63</sup> Political geographer Jessica Lehman has lately called attention to global sensing technologies, which she argues signal that ‘the ocean is no longer the constitutive outside but at the centre of modern government concerns, indicated by new enthusiasms for marine spatial planning, marine domain awareness, marine protected areas, and others’.<sup>64</sup> In the Southern Ocean, underwater technologies provide a permanent sub-surface expansion of observation, extraction and accumulation, and pair animal-borne sensors and remote bio-logging with an eye always directed towards commercial application. New notions of the ‘robotisation of the sea’ are championed by oceanographic institutions and defence industry advocates for their capacity to improve marine resource and global environmental management, but it is worth remembering that NASA’s Jet Propulsion Lab have also been prototyping AI-embedded drones in the Southern Ocean in collaboration with scientific researchers and private interests to pursue extraplanetary resource exploration ventures.<sup>65</sup> The Southern Ocean might extend well beyond most human embodied experiences but it is only excised from conceptions of urbanisation in error. Semi-automated agents operating untethered within the Southern Ocean for thinly-veiled commercial benefit calls into question an Antarctic Treaty System claim of ‘devoting Antarctica to science and peace’, given scientific research seems to be, at least in part, directed by a prospecting fervour of human scientific, geopolitical, and financial ambitions in far-off cities. Operationalising the Southern Ocean for profit confirms our understanding of this space as an environment co-opted through extended urbanisation, and one largely unseen and unknown except through nonhuman means. This is not to suggest that humans are somehow external to these technologies. Quite apart from ways autonomous robots demand the support of human designers, programmers, and wranglers to function, architectural theorist Laura Kurgan also observes it is impossible to maintain a critical distance from their deployment. In her words, we are ‘addressed by and embedded within them... Only through a certain intimacy with these technologies – an encounter with their opacities, their assumptions, their intended aims – can we begin to assess their full ethical and political stakes’.<sup>66</sup>

Paying close attention to the knowledges that drifting robots such as ARGO floats and more agential AUVs themselves co-create, allows for what digital ethnographer Sarah Pink calls the possibility of ‘other voices’ to come into representation.<sup>67</sup> Jackman and geographer Rachel Squire agree that there is a real need for ‘approaching volume

through everyday encounters with objects, prompting revised reflections of instruments and attending to alternative instrumentalizations... [where] everyday objects are enrolled as instruments through which to navigate, mitigate, and disrupt water'.<sup>68</sup> In this context, underwater sensing instruments reveal human-nonhuman-technology relations in the Southern Ocean. The technological capture of any environment tends to prefigure its rapid urbanisation, but we must resist a narrow technical understanding of such processes. So too, media theorist Shannon Mattern critiques urban debates for their tendency to concentrate on 'smart city' logics when 'urban environments everywhere are characterised by a lot of messy materiality, residual media and different notions of ambient intelligence, sometimes even reflecting competing epistemologies and clashing politics'.<sup>69</sup> 'Seeing' extended urbanisation manifest in the Southern Ocean requires rethinking assumptions about cities, the technologies which scaffold them, the many bodies enlivening oceanspace, and representations that limit conceptualisations of the ocean. They also demand re-presentation of – and thus, active resistance to – the emptying out of certain environments.

### Unmoored worlds

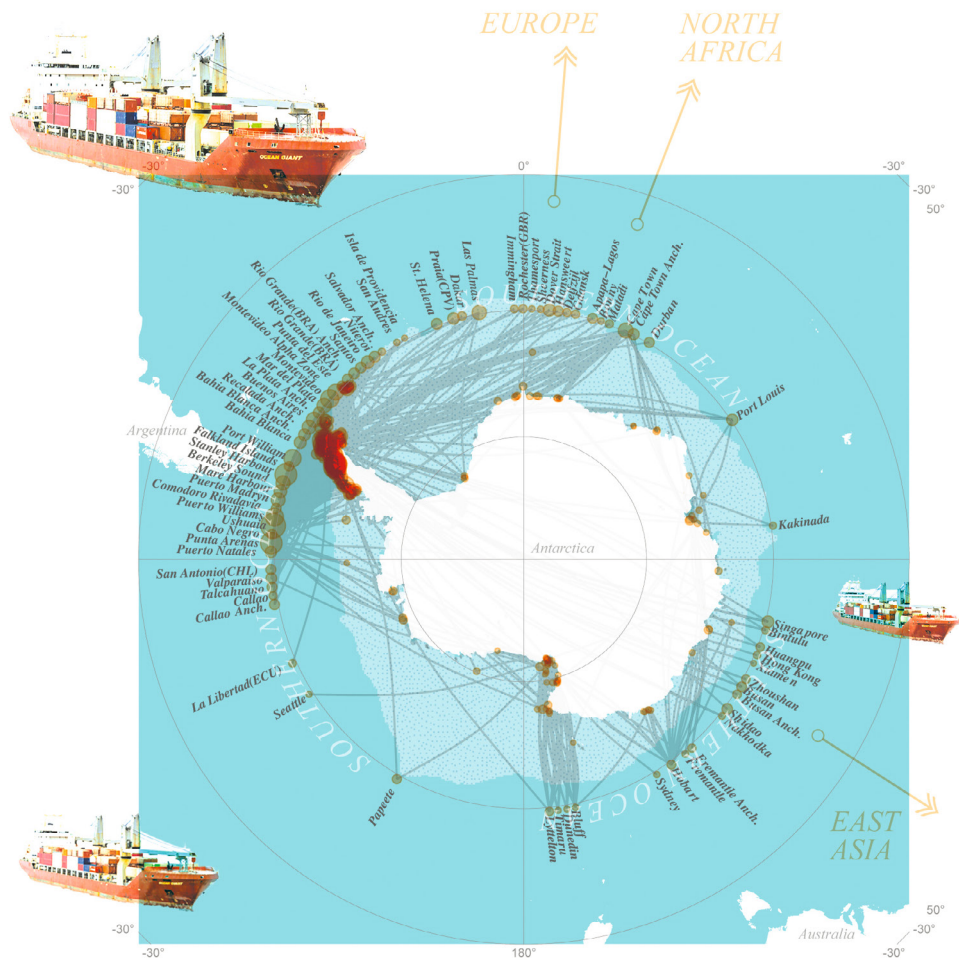
Technologies investigated here in the Southern Ocean are primarily sensing instruments, and media sociologist Jennifer Gabrys reminds us that data produced by environmental sensing does not just generate information, it also gives form to experiences that themselves create new conditions. To wit, environments are not already-existing objects to be translated via devices, but worlds made through and with technologies.<sup>70</sup> An urbanising ocean which operates simultaneously with *and* beyond human presence must pay close heed to technologies that facilitate vision in lieu of our own. There is a real risk that underwater technologies may have their data conflated with actual human vision, as has been observed with other technological intermediaries. For, as artist and visual geographer Trevor Paglen has pointed out, 'most images are made by machines for other machines, with humans rarely in the loop'.<sup>71</sup> That being said, ubiquitous reliance on terrestrially focused surveillance and representation (driven by Google Earth and other satellite image platforms) can be disrupted by the unique character of data gathered by machines under the sea. If we cede autonomy of image-making to these bodies – (in)sights produced by subversive submersives – we might better understand the uneven and often unexpected implications of urban processes unmoored from human control. In keeping with political theorist and philosopher Jane Bennett's reference to a 'confederation of things', I argue that emerging assemblies of nonhumans, humans, not-quite-human 'things' and

ocean environments are due close examination, as their relational possibilities allow for a radical re-presentation of urban processes transforming the planet.<sup>72</sup>

The figures created in support of this article's argument examine the Southern Ocean via cartographic methods underscoring that the urban, the ocean and the planet cannot be separated. They make substantive use of 'diffractive analysis', an approach proposed by feminist theorist Karen Barad alongside science and technology scholar Donna Haraway, which combines techniques drawn from art practice, history, and cultural studies as 'an inquiry into the material effects of difference through an embodied engagement with the materiality of the research data'.<sup>73</sup> Diffractive analysis engages critically with the processes of research to understand the data from 'within', a reference to Haraway's reworking of the term 'diffraction'. This means resisting canonical readings of data, and thinking these entities together and 'through' each other as

a critical practice for making a difference in the world. It is a commitment to understanding what differences matter, how they matter, and for whom. It is a critical practice of engagement, not a distance-learning practice of reflecting from afar... We do not uncover pre-existing facts about independently existing things as they exist frozen in time like little statues positioned in the world. Rather, we learn about phenomena – about specific material configurations of the world's becoming.<sup>74</sup>

Thinking cartographies of the Southern Ocean *together* and *through* each other requires observing the relations of sensing assemblies that produce data, not just their geographical range. Figure 6 therefore resists any single perspective by montaging bodies of extended urbanisation in the Southern Ocean: an array of autonomous technologies, sensors, and satellites – and humans and nonhumans – that co-create representations at once undersea, on the water's surface, and in the cosmos above. It is worth recalling that early modern media of the Southern Ocean helped construct a 'golden age' of heroic exploits and imperial expansion, disregarding the increasing industrialisation enabled by sealing, whaling and other extractive networks in this space.<sup>75</sup> In the twenty-first century, representations of potential climate change catastrophe co-mingle with idealised wilderness imagery of the Southern Ocean, all the while ignoring the growing settlement of Antarctica and ways in which its surrounding ocean is utilised as a resource to support those and other urbanising populations. In both instances, certain types of representation are broadcast around the globe in order to match (largely Western) societal concerns. As visual culture theorist Nicholas Mirzoeff points out, 'seeing the world is not about how we see but about what we make of what we see'.<sup>76</sup>



**Overlooked Urban Ocean**

Recently revealed shipping tracking data identify a tenfold increase in previously known port-to-port networks connected with the Southern Ocean.

After MCCARTHY *et al.* 2022. “Figure 2: The port-to-port traffic network of all ships that visited Antarctica from 2014 to 2018”, Ship traffic connects Antarctica’s fragile coasts to worldwide ecosystems. *Proceedings of the National Academy of Sciences*, 119, p.4

Fig. 4: Overlooked Urban Ocean. Illustrated map: author; includes from Dorschel *et al.*, *The International Bathymetric Chart of the Southern Ocean Version 2* (2022); Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR); *Map of the CAMLR Convention Area* (2017); and McCarthy *et al.*, ‘Ship Traffic Connects Antarctica’s Fragile Coasts to Worldwide Ecosystems’, *Proceedings of the National Academy of Sciences* 119, no. 3 (2022): 1–9, 4 (Fig. 2).

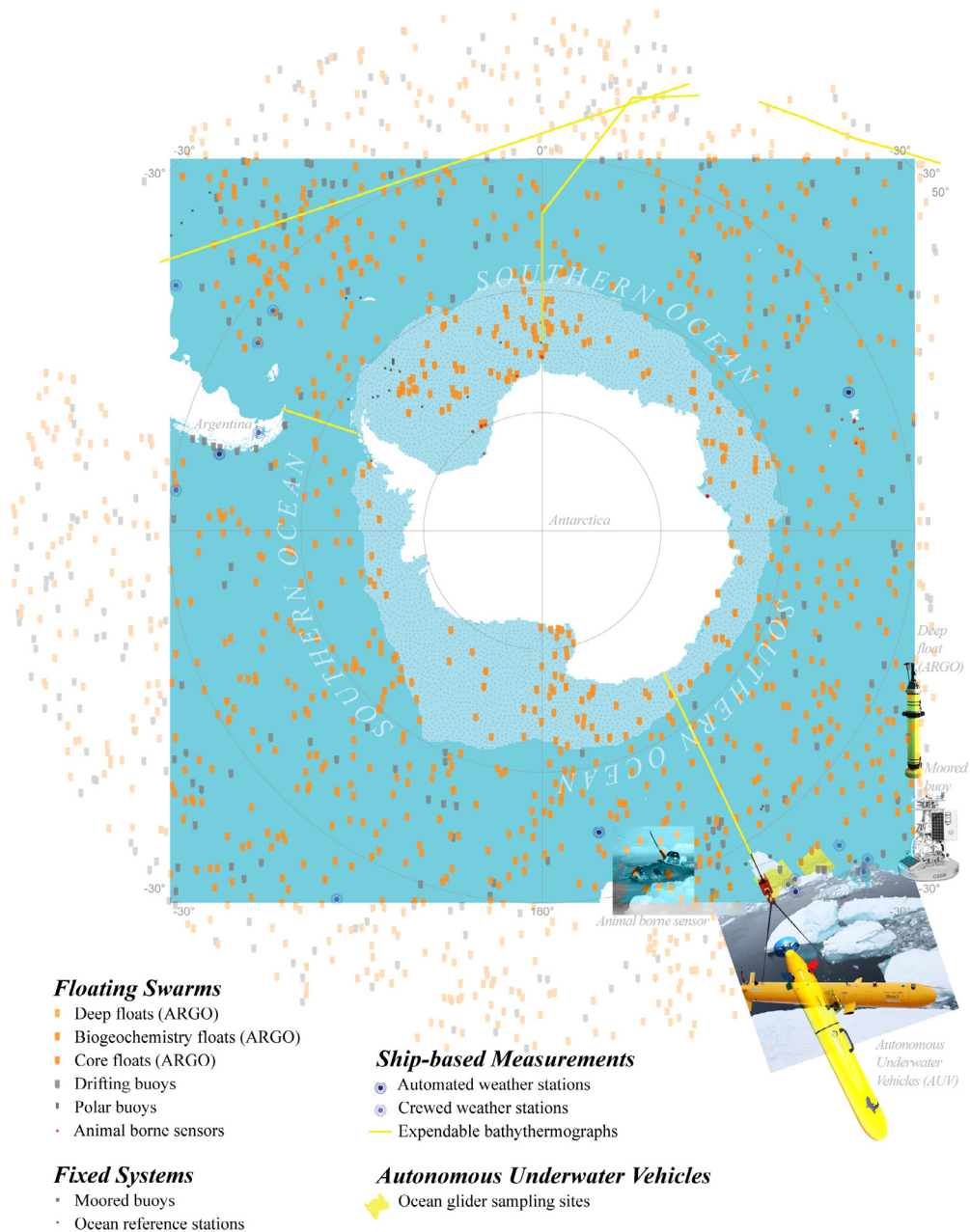


Fig. 5: Seeing the Urban Ocean. Illustrated map: author; includes data from Dorschel et al. *The International Bathymetric Chart of the Southern Ocean Version 2* (2022); Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR); *Map of the CAMLR Convention Area* (2017); DueSouth Database of Upcoming Expeditions to the Southern Ocean, *Antarctica – Planned Routes* (2022); and Global Ocean Observing System (GOOS); *Polar Basins Observing System: In situ operational platforms monitored by OceanOPS* (2022).

Kurgan pushes further and asks, 'what [do] the technologies of spatial representation have to do with the spaces they represent, beyond simply representing them'?'<sup>77</sup>

### Radical new conditions

Underneath the machinery of extraction and exploitation in the ocean lie significant questions for representing urbanisation as it manifests outside usual conventions of the city. I argue that the Southern Ocean provides a compelling illustration of 'not-seeing' the ocean that is also, in Lefebvre's term, a deliberate 'not-knowing' of the ocean: a manoeuvre to excise always-becoming relations between our worlds, spatial ordering, and economic production. In contradistinction, underwater technologies can enable sensorially-rich representations of oceanspace that decentre the controlling eye of the human. Significantly, these can only be mediated through a confederation of humans, nonhumans, and remote encounters with other not-quite human things orbiting the planet itself. To note that we are all embedded within technological networks operating across the globe in the twenty-first century is not surprising, but a lack of intimacy with those relations as they exist underwater makes the long-standing disregard of the ocean (and in particular, the Southern Ocean) clear. Beyond simply recording data, objects, and processes, such technologies co-constitute the spaces in which they operate: as per Gabrys, they give form to experiences and create new conditions in, and of, our worlds.<sup>78</sup> For instance, the ancient Greek hero Jason names a series of oceanographic satellites circling the Earth in full knowledge that in this myth, he and his Argonauts (also the inspiration for ARGO floating robot workers, which aimlessly collect data around the world) take to the seas to seek out (but, more accurately, steal) the Golden Fleece: a symbol of royal power, wealth and dominion over the world.

Contrast this with the University of Tasmania's launch of a new Southern Ocean AUV, *nupiri muka*. The name translates as 'Eye of the Sea' in *palawa kani*: a composite Tasmanian Indigenous language comprising remnants of a dozen other original languages spoken by ancestors dispossessed through the invasion of lutrawita/Tasmania by English and European settler colonisers since at least the eighteenth century. Historically, the Indigenous people of lutrawita/Tasmania were sailors and builders of seafaring vessels, and *nupiri muka* has been conceptualised to survey distant spaces and share information towards a greater understanding of the unfamiliar.<sup>79</sup> Whether *nupiri muka* re-presents oceanspace in radically different ways as a result of its carefully created nomenclature and framing in response to local knowledges of cultural context, history, and environmental sites is open to question; especially given that reporting of its voyages have so far

been limited to scientific journals of conventional research outcomes.<sup>80</sup> Marine ecology scientists Elena Buscher and Darcy Mathews more recently found that co-developing a marine survey with the Songhees Nation in Ti'ches oceanspace, British Columbia, has been key to establishing an Indigenous-led underwater monitoring system using sensing technologies.<sup>81</sup> By mapping subtidal areas with low-cost remotely operated underwater vehicles and generating marine use planning guidelines based on culturally important species, the Nation has been able to negotiate protections against overfishing and increased shipping traffic, and support ongoing social and ceremonial custodianship of this space.<sup>82</sup> In these instances, engaging in technologies with cultural competency in mind help to counter the exclusion of the ocean from urban matters and unsettle *terra nullius* logics that continue to make certain spaces available for remaking in the service of those far removed from them.

Perhaps the real contribution to be made by these submersive technologies reaches beyond technoscientific activities (like revealing illegal extractive operations underwater or policing overfishing in remote locations), and instead could develop from a lack of fixed perspective and rejection of the primacy of sight when encountering unfamiliar phenomena. As agents of exploration with limited supervision, their capacity to provide unexpected and often unsolicited data may ultimately help resist the re-inscription of colonial norms back into the ocean. For the Southern Ocean cannot be understood through the flattening of knowledges or experience. Instead, as shown, it requires the subversion of human control and an invitation to participate in mutually recursive analysis with both non-humans and non-quite-human 'things' alike. As an emancipatory possibility that would seem to emerge only from the dismantling of lexicons that currently work to order our worlds, the actually subversive role of these technologies might simply be in enabling us to continually make and remake sense of the transforming environments we inhabit across time and re-present relations we are forming and reforming throughout the entirety of the planet. In keeping with Barad's insistence that objects and things do not exist in isolation, I therefore argue for greater collaboration with underwater things that are not quite human and yet not quite nonhuman, and acknowledge more-than-human knowing, observing, measuring and theorising acts within the world and co-produces it. As Barad herself says, 'discursive practices and material phenomena do not stand in a relationship of externality to each other; rather, *the material and the discursive are mutually implicated in the dynamics of intra-activity*', which seems to echo Lefebvre's earlier argument that urban analysis should be concerned with 'gathering together of what gives itself as dispersed,

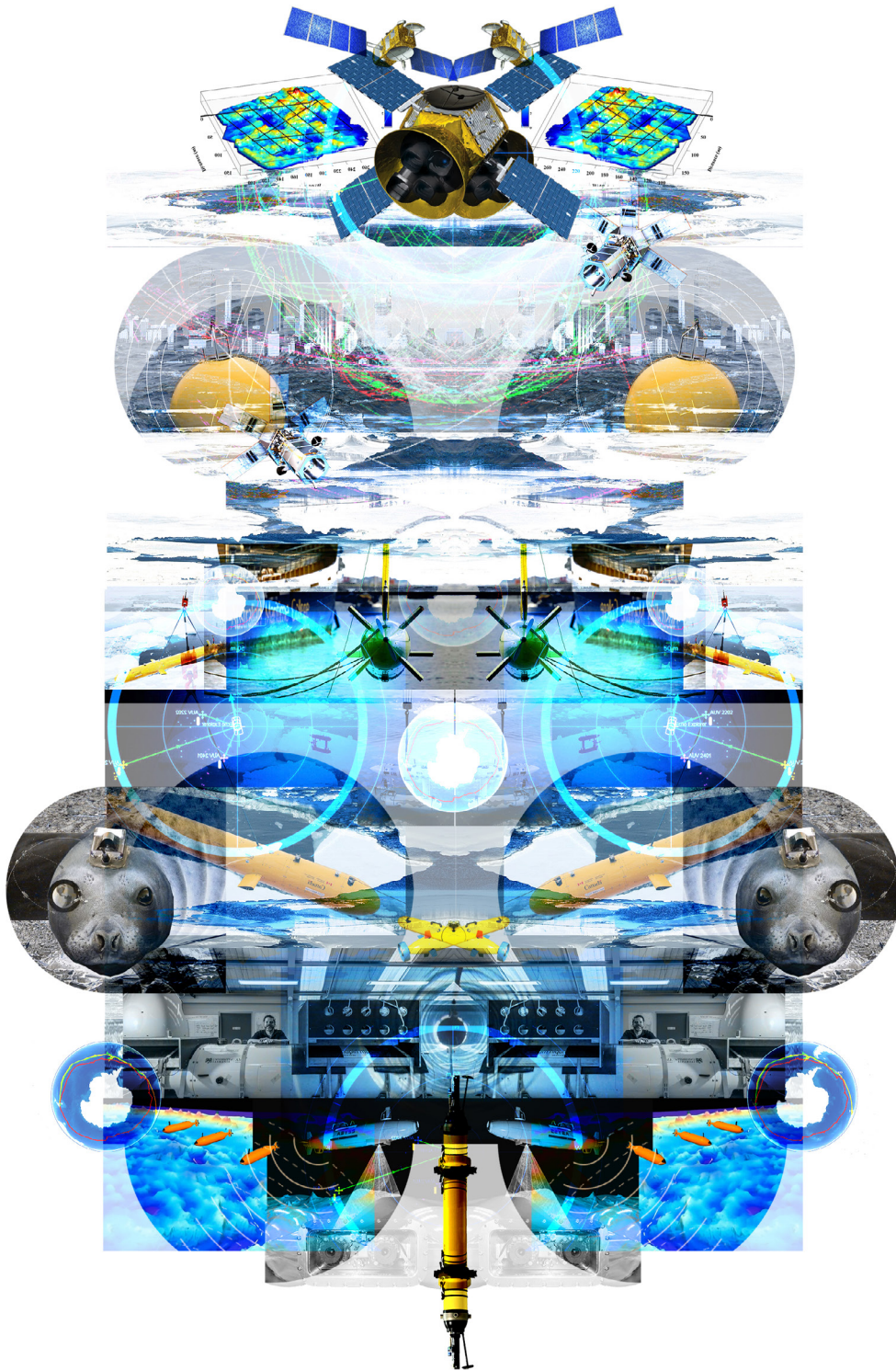


Fig. 6: The Extended Urban Ocean. Photomontage: author.

dissociated, separated, and this in the form of simultaneity and encounters'.<sup>83</sup>

### Conclusion

The ocean may present complications for claims that urbanising spaces extend well beyond the container of the city, but unique characteristics of the Southern Ocean allow for a clear interrogation of spaces that limit conceptions of the urban in contemporary debates. By relinquishing prior frameworks, synthesising fragmentary information, and revealing difference within oceanspace, I have worked in this article to re-present the co-constitution of human and nonhuman relationships across a rapidly urbanising planet. A full consideration of humans and nonhuman relations within the water is absent from many urban debates. I have therefore used Steinberg and Peters's wet ontology framework to argue for the ocean as a critical lens for reflexive and relational thinking at interdependent urban, global, and microscopic scales, which is also in keeping with theorisations by Lefebvre on connections between cities and their 'elsewheres', and Brenner, Schmid and other urban scholars' investigations of the nature and consequences of extended urbanisation at the scale of the planet. Decentring a landed bias across disciplinary norms of space and time, and making use of new materialist approaches to reading data and resisting canonical constructions of imagery, I have created comparative cartographies to examine what not-seeing the extended urbanisation of the Southern Ocean signifies for the planetary reach of urbanisation more generally. What arises from this article is always-becoming evidence that here, in the Southern Ocean, forms of extended urbanisation are operating at the intersection of a scientific research-commercial speculation nexus of resource extraction and exploitation and surveillance through co-opting AUV, ARGO float and sensor data.

Ultimately, what I hope to highlight is that processes occurring in remote locations are not isolated, though they may develop in the interest of those much further away. As such, I argue that working through and with underwater assemblages to know and theorise can co-produce other worlds in which those processes can be observed and evaluated. Reorienting attention towards the proliferation of underwater vehicles, drifting robots and other technologies in the Southern Ocean confirms that extended forms of urbanisation can occur at a distance from humans, though not without 'lively' bodies altogether. If we avoid relations with the many others enrolled in the urbanisation of this planet (whether human, nonhuman or not-quite-human things), critical connections between ourselves, others, and the urban remain unseen even as they experience significant transformations together. The urban and the ocean

are clearly bound together, but are now shown operating at a planetary, though largely unseen, scale and with humans far less in control than assumed.

### Notes

1. Though the data supporting a (conveniently simple) 50 per cent marker for urbanity across the globe seems less confidently asserted today than when those debates first arose, some scholars have identified more troubling concerns within the discourse itself. They see its emphasis on morphological categories of the city at the expense of processual accounts of urbanisation tending towards reductive accounts of any possible urban age. Neglecting to engage with the unevenly experienced effects of diverse forms of urbanisation serves to obscure planetary processes that emerge directly from the continued growth of cities, such as intensified resource extraction, capital accumulation, and climate change impacts across wider territories than the formal container of any city. For detail, see both Hillary Angelo and David Wachsmuth, 'Urbanizing Urban Political Ecology: A Critique of Methodological Cityism', *International Journal of Urban and Regional Research* 39, no. 1 (January 2015) and Kate Shaw, 'The intelligent woman's guide to the urban question', *City* 19 (2015).
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  11. Stuart Elden, 'Secure the Volume: Vertical Geopolitics and the Depth of Power', *Political Geography* 34 (2013): 35–51.
  12. For further reading on settler colonial narratives and urbanisms that continue to enable the enclosure of vast environments and dispossession of their traditional custodians, see the work of Eualeyai/Gamillaro woman and professor of law, Larissa Behrendt in R. J. Miller et al., *Discovering Indigenous Lands: The Doctrine of Discovery in the English Colonies* (Oxford: Oxford University Press, 2012); writer and urban researcher of Ballardong Noongar heritage, Timmah Ball, 'In Australia: White People Write My Culture for Me', *Westerly* 61 (2016): 20–28, [https://westerlymag.com.au/digital\\_archives/westerly-61-1/](https://westerlymag.com.au/digital_archives/westerly-61-1/); Michi Saagiig Nishnaabeg scholar, Leanne Betasamosake Simpson, *Dancing on Our Turtle's Back: Stories of Nishnaabeg Re-Creation, Resurgence, and a New Emergence* (Winnipeg: ARP Books, 2011); and professor of political science and Rastafari activist-scholar, Robbie Shilliam, *The Black Pacific: Anti-Colonial Struggles and Oceanic Connections* (London: Bloomsbury Academic, 2015).
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  15. Ibid.
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**Biography**

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