**Maritime security technologies and coastal neo-fortification**

**Alexandra E.J. Hall**
**Department of Politics and International Relations, University of York**
alexandra.hall@york.ac.uk

**Abstract:**
Data technologies promise new ways of tackling maritime security challenges - from trafficking and smuggling, to environmental crime and terrorism. This is particularly the case at coastlines, where global security threats manifest as local maritime issues, and where general maritime traffic conceals small vessel landings, drug drops and clandestine movements. Coastlines are increasingly sites of technological neo-fortification, the prime aim of which is the detection and tracking of seaborne movement. This article draws on qualitative fieldwork with volunteers monitoring the British coast and research on global maritime security technologies. It gains critical traction on new technologies by placing them within a history of littoral fortification, which I show has always been concerned with discerning movement at sea. I make two contributions. First, I show that the machine learning technologies govern maritime movement through movement, weaponising the ocean's materiality in the pursuit of so-called dark targets. Second, I argue that the techno neo-fortification of coastlines is underpinned by algorithmic spatialities and differentiations that seek to render wider ocean movement controllable. Bordering and security practice - from launching life-saving search and rescue missions, to targeting "small boats", countering illegal fishing and disrupting smuggling - is re-ordered via these spatialities and differentiations. Contemporary maritime security technologies do not enhance existing practice: rather, they are reorganising sea borders, reconfiguring the relationship between territorial and global waters, and altering how life is governed at sea.

**Keywords: maritime; security; coast; borders; technology; fortification**

## Introduction

Data and machine learning technologies offer new solutions to pressing security challenges - and this is particularly the case in maritime contexts. In 2023, the British media reported that the Home Office had contracted the US defence firm, Anduril, to install its Maritime Sentry Towers along the southern English coast. There are now at least eight towers in situ, using radar, camera imagery and machine learning techniques to autonomously detect and classify coastal maritime traffic. Anduril is best known for developing autonomous weapons for the US military; its land-based counter-intrusion Sentry towers are deployed at the US-Mexican border, where the company claims they have "produced hundreds of thousands of autonomously identified incursions that have resulted in successful law enforcement, humanitarian, and force protection outcomes" (Anduril 2024). The Anduril Towers are part of a global turn to machine learning in maritime contexts: from the US National Security Strategy's recent emphasis on securing maritime domains (2025) to the rise of AI companies like Sirius Insight, which recently secured UK Home Office contracts "to track 365 days per year, 24 hours per day small vessels operating within UK inland waterways, territorial waters and out-of-limits exclusive economic zone" (Trendell 2023).

The Anduril Towers are not the only watchful activity along Britain's coastlines, however. At any time during daylight hours, stretches of the coast are also monitored by a volunteer coastal watch organisation, to prevent loss of life at the coast. There are over fifty stations: their position allows the volunteers to spot people in the water, a small vessel in trouble, a fisherman cut off by the tide. Volunteers also monitor the coast for suspicious or illicit activity, unusual movements and pollution incidents. This volunteer organisation is separate from His Majesty's Coastguard (HMCG) - the agency formally responsible for the protection of the UK's coast, and with the main responsibility for maritime search and rescue - but liaises with it. The volunteers also liaise with local authorities, police and other law enforcement agencies.

Around what problems does the coastal watch coalesce? And what drives the turn to technologies in coastal regions? The Anduril Towers are part of the UK's response to the "small boat crisis" in the Dover Strait. Recent critical work has highlighted the "digital hostile environment" being generated by these autonomous technologies (Storey 2025Mayblin et al 2024a, 2024b). Migration, though, is not the only security problem at coasts. The UK's 2022 National Strategy for Maritime Security, for instance, argues that "[i]t is easy to underestimate Border Force's task [...] to protect the UK's 11,000 miles of coastline from the threat of serious organised crime" (HM Government 2022: 30) and it identifies maritime terror incidents as a pressing threat. Similarly, the British National Crime Agency (2025) states that organised criminal groups are using the general maritime method more frequently than pre-2023. Small marinas, coastlines and landable beaches are where global security challenges and geopolitics manifest as clandestine vessel landings, drug drops and washed up contraband. While UK maritime security has focused on countering "small boat" arrivals (HM Government 2022), the concern with detecting small maritime targets is global: the ability to stop "rogue small boats", for instance, is a key preoccupation of US counter-narcotics strategy (Gavilian 2025).

This article focuses on the coastal watch and technologies of maritime security. I am concerned with coastlines as a distinctive maritime security problem - and I use the British coast as an example - but I use it to think more broadly about data, algorithms and their role in producing maritime security targets. I show that the coast is where seaborne movement must be "made governable" - and that local efforts to secure the coast relate to global efforts to govern the ocean.  My starting premise is that technologies never simply enhance existing security practice, though they are embedded within it. Rather, I argue, contemporary maritime security technologies are reorganising sea borders, reconfiguring the relationship between territorial and global waters, and altering how life is governed at sea. In this sense, I follow Amoore, who argues that machine learning techniques are "world-making" - providing "an entire way of thinking about difficulty and how to decompose a problem into its parts" (Amoore 2024: 3). I show how machine learning technologies (like those in the Anduril Towers) are not being deployed at a border already constituted but are instead rearranging what a border is in maritime contexts. Technologies *govern maritime movement through movement* and *weaponise the ocean's materiality* in the pursuit of so-called dark targets. Detecting sea-borne movement is a task around which multiple maritime security agendas and practices now coalesce - from preventing illegal fishing and oil dumps, to migration controls and anti-smuggling initiatives.

I make two contributions. I present new qualitative insights gleaned from fieldwork over the last five years with coastal volunteers, technology companies and other agencies involved in monitoring the coast. My interest is to understand the everyday activity of detecting and targeting (via) movement at sea. I discuss machine-learning techniques and the everyday work of coastal watch volunteers together not to suggest that the age-old human coastal watch is being superseded, or that technologies have made embodied visual practice redundant - or even that they are separate. Rather I understand 'security' to be a precarious achievement of human-machine efforts to respond to key questions: What/who is out there? What/who approaches? What threat does the approach pose? As Foucault (1980) highlights, visibility, spatial economies and modes of governing are mutually interdependent, and I agree with Tazzioli (2020), who argues there is always a politics of (in)visibility that pertains to borders. I am therefore concerned with visual practice as a matter of "divided labour" within socio-technical relationships (Aradau and Blanke 2015). My second contribution is to show that the techno neo-fortification of coastlines is underpinned by new algorithmic spatialities and differentiations that seek to secure coastal waters, certainly, but which act on wider maritime movement in distinctive ways. Machine-learning analytics, computer vision and autonomous sensing devices target mobile objects at sea by discerning differences in their movement and materiality. At stake is the coalescing of multiple maritime security agendas around algorithmically-generated targets but also a new way of imagining - and governing - the sea.

The article proceeds as follows. In the next section, I introduce the coast as a distinctive (and understudied) problem of maritime security. I discuss how the movement of general maritime traffic (that is, non-commercial, non-scheduled vessels) at open borders is a long-standing problem of maritime security. I also provide details of my study. In the third section, I outline a short history of coastal fortification, demonstrating the historical entanglement of humanitarian efforts to "save lives" and sovereign efforts to "secure borders". I aim to trace the continuities and discontinuities of contemporary practice by placing technologies within this longer history. In section four, I turn to the techniques of visualising that characterise maritime security at the coast. Security practice craves the ability to see further and more clearly - to intervene on approach earlier and earlier - and this is precisely what new technologies offer with their promise of generating a "picture of everything". But the turn to data produces new problems of clutter - and new thresholds between visibility and invisibility at sea. In section five, I turn to the challenge of classifying movement at sea. The ocean's fluid and mobile materiality poses distinctive problems and opportunities for automation: and the political and ethical questions governing life at sea become deferred into technical processes of differentiating mobility and materiality.

**Maritime security and the problem of the coast**

Critical interdisciplinary debates about maritime geopolitics and security are addressing a historic 'sea blindness', generating a 'blue turn" across the social sciences and humanities (see, for instance, Braverman and Johnson 2020; Bueger and Edmunds 2024). Recent scholarship has interrogated the ocean's role in capitalist political economy (Campling and Colas 2021; Chua 2018; Khalili 2020). It has also interrogated the relationship between the ocean, imperialism, slavery and ports (Rediker 2007; DeLoughrey 2007), as well as the geopolitical challenges posed by climate change (Jones 2024). A crucial aspect of this literature is how the ocean's "wet ontology" and verticality challenges the planar, landward bias inherent in classic conceptualisations of territory, sovereignty and borders (see Elden 2013; Peters, Steinberg, Stratford, 2018). The ocean is turbulent argue Lehman, Steinberg and Johnson (2021): it is "indisputedly voluminous, stubbornly material and unmistakably undergoing continual reformation" (Peters and Steinberg 2016: 248). As such, it poses profound challenges for the "static, bordered and linear framings that typify human geographical studies of place, territory and time" (ibid.: 247). Oceans are rendered governable by imposing spatial imaginaries and practices in order to create"pragmatic spaces" (Bueger 2022) or "multi-dimensional spheres of predictability and rationality" (Ryan 2015). Importantly for my purposes, knowing the ocean (that is, measuring, or sensing, or visualising it) always deploys proxies or abstractions: noises (Serres 1996); microbes (Helmreich 2009); waves (Helmreich 2023). And in contemporary times, this includes transforming the ocean's material properties into actionable flows of data (Johnson 2020). I take from this body of work the need to attend to the spatial distinctiveness of "borders" and "security" in maritime contexts, and also to the relationship between visual knowledge and security ambitions.

Coastlines are distinctive sites for maritime security. They are often conceptualised as liminal spaces (Weaver 2022) or places of "encounter" between land and sea (Ryan 2012). Coasts have largely been understood via critical investigations of ports as places of extraction, exchange and accumulation (see Land 2007, Bashford 2017, Gillis 2012 for broader considerations). Ports are places of logistical power, where the "fluidity and expansiveness of the open sea meets the channel, the shore, and the port terminal" (Cowen 2014; Chua 2023: 127). Coastlines are often self-evidently considered as borders, but this view occludes the *processes* of security and territorialisation that occur there . In recent political geography work, the 'slipperiness'' (Choi 2019) and 'solid-fluid' character (Wang 2023) of coastlines have come under critical focus.. I take from this work an attentiveness to the specific practices through which the coast is constituted and governed as a border security problem. So, in the British case, the coast offers a "layer of deterrence and detection contributing to creating an effective border" (HM

Government 2022: 30), but it is also characterised by “remote ‘blind spots’” that are hard to monitor and easily exploitable (Weaver 2022: 334; see also Benham 1986; Platt 2011). Coastlines across the world are where “dynamic maritime activities and increasing threats [are] concealed amidst traditional civil maritime activities” (Thales 2024) and where the risk of small vessels being used for terrorist or smuggling activity is a pressing concern (Department for Homeland Security 2011). They are where global security threats manifest as local maritime concerns at beaches and small marinas, but where the heavy securitisation of larger ports is unfeasible. The coast is understood to be an *open border*.

I gain critical traction on contemporary technologies by locating them within a longer history of securing these open borders - and by drawing from fieldwork from coastal watch volunteers. Here, I take inspiration from critical work in the social sciences and humanities which interrogates technologies in tandem, interaction and entanglement with human activity (see, for instance, Hayles 2012). I conducted semi-structured interviews with over 20 coastal watch volunteers: participants were invited to discuss their work, the technologies they used, and the networks they saw themselves to be part of. I also spoke to technology developers from the private sector, focusing on the challenges and potentialities of machine learning technologies in the maritime security sphere. All interviewees were guaranteed anonymity, and it was a criterion of my fieldwork that organisations’ identities were protected. Perhaps more importantly, I conducted over seven weeks’ total ethnographic fieldwork at coastal volunteer stations as well as small port locations around the UK coast (Hull, Cairnryan, Grimsby). The ethnography offered a close view of the informal, embodied routines of volunteering and security work - and the multi-sited approach enabled a triangulated view of technologies as both locally embedded *and* globally significant (see Bosma 2020). Of course, any study of security technologies encounters issues of secrecy around technical “operational details” (see Bosma et al 2020). Understanding *exactly* how maritime security technologies work required me to combine my qualitative data with a critical review of published accounts of maritime machine learning challenges, solutions and applications: product specifications; industry materials; and - often most usefully - published academic research that has had prominent industry applications. Lead developers will often talk openly about principles and techniques of, say, automated classification solutions before (or after) they join military/security companies. My study therefore involved a substantial amount of documentary research to complement and triangulate my qualitative fieldwork.

At the British coastline maritime security is produced by the overlapping and entangled efforts of multiple agencies: Border Force, the Royal Navy and Ministry of Defence, Counter Terrorism Police, the Department for Transport, the Foreign, Commonwealth and Development Office, the Home Office, HM Coastguard (HMCG), HM Revenue and Customs, and the National Crime Agency, Marine Management Organisation, as well as the Royal National Lifeboat Institution (RNLI) and local police forces. The coastal safety volunteers with whom I conducted fieldwork consider themselves - and are broadly considered in turn - to be the “eyes and ears” of HMCG. The function of HMCG is to provide 24-hour maritime and coastal search and rescue emergency coordination and response service for the UK, as well as enforcing standards for ship safety, security, pollution prevention and seafarer welfare. HMCG used to have stations around the British coast but since the mid-C20th, improvements in shipping safety and radio communications - and then the emergence of radar - gradually removed the need for a visual watch and coastguard stations were abandoned (Webb 1976). Nowadays, HMCG search and rescue is coordinated from its Joint Rescue Coordination Centre and ten Maritime Rescue Coordination Centres.

My aim is to trace continuities and discontinuities of the coastal watch. I argue that technological targeting and embodied forms of watchfulness coalesce around the same problems of detection and tracking - how to discern anomalous or risky movement in general maritime traffic - but they spatialise security in distinctive ways. I place both within a tangled history of *fortification*. Coastlines, of course, have been key sites of fortification - or what Virilio terms the “theatricality of defence” (1994: 47). Virilio’s meditation on the littoral boundary (his example was the Third Reich’s bunkered Atlantic Wall) has become a touchstone for thinking about the materiality of war - and about the resurgence of physical barriers to repel “outsiders'' from national territories (Brown 2010; Denman 2020). But Virilio’s overarching point was that the coastal fortifications of the WWII era were “funerary monuments”, built in the face of their own obsolescence heralded by “the sky’s arrival in war” (1994: 12). As I explain in the following section, Virilio’s work points to an important relationship between fortification and *the visual*. Fortification is not only about the material delineation of territory: it is about the martial organisation of vision to facilitate “lines of sight and the ability to survey a field” (Denman 2020: 232).

In contemporary contexts, the possibilities afforded by aerial reconnaissance, satellite and drone imagery appear to confirm Virilio’s argument. They have generated an apparent visual omniscience - and new relationships between coastlines, territorial seas and open oceans. What, then, drives the resurgence of what Virilio calls the “insane situation looking out over the ocean” (1994: 11) as enacted by Anduril Towers and the coastal volunteers? Achieving “full coastal active surveillance capability” and - more importantly - the ability to detect “dark targets” along coastlines (Trendall 2023) have become key priorities for contemporary maritime security. And while the rise of machine-learning techniques appear to signal a novel turn to automation, I agree with Canzutti and Tazzioli’s scepticism about “techno-hype” and the importance of “retracing partial continuities between digital and nondigital technologies” (2023: 4). In sum, I see today’s coastal watch to be the latest iteration of longstanding problems of knowing, sensing and acting on sea-borne threats.

**War at the edge: neo-fortification and maritime domain awareness**

Today’s coastal watch emerged from practices of fortification and is embedded in its material structures. The British coast - like others, globally - bears the remnants of these structure: from Roman Fortlets, medieval coast defences and Martello Towers and Palmerston forts, to WWII era bunkers and “coastal crust” defences (Smith, 2012: 1).Take, for example, the physical location of the volunteer coastwatch stations. The volunteer organisation often repurposes abandoned coastguard stations (themselves frequently inherited naval watching posts) towers and wartime lookouts (Smith  2012: 1, 9). Some of the Anduril Towers, also, are located in coastal military locations (WhatDoTheyKnow 2024). The appropriation of abandoned infrastructures of defensive fortification  for contemporary purposes is the reclaiming  of the strategic vantage points they offer over vulnerable or treacherous stretches of coastal waters. And, as Virilio argues, fortification structures are always related to the sovereign capacity to wage war (Virilio 1990: 14). If sovereign efforts to territorialise are always ‘a process, not an outcome… continually made and remade’ (Elden 2013: 36) then coastal fortifications past and present affirm the solidity, ownership and ‘defendability’ of terra as it gives way to the ungovernability of the sea (see Peters, Steinberg and Stratford, 2018; Steinberg and Peters, 2016). There would be no 'international' without seaborne circulation, and no 'national' without efforts to manage that circulation - now or in the past. For this reason, a consideration of “local” coastal security is also always a consideration of how to “tame” the global oceans. And technologies to secure coastlines are also always acting on global oceanic movement.

Certainly the war-like efforts to stop small boats in the UK context enacts “precisely the power of the “no,”’ (Brown 2010: 80) associated with classic sovereign power. Yet fortification, as critical work has shown, is not simply the delimitation of inside/outside or the bunkered demarcation of territory. It is more accurate to see fortification as than the orchestration of movement. It seeks the “‘microphysical’ controls of movements” (Virilio 1994: 203-4; see Denman 2020); itis about “allowing circulations to take place, of controlling them, sifting the good from the bad, ensuring that things are always in movement” (Foucault 2007: 65). So, while coastlines are associated with linear barriers against sea-bourne threat, fortification is more usefully seen as “a kind of infrastructural power, enabling certain movements while inhibiting others” (.Denman 2020: 233). Put differently, within biopolitical forms of government, fortification might appear as a remnant of an older sovereign order, but its materiality, its practices, its modes of calculation have *always* been about delimiting a ‘space of circulation’ (Foucault, 2007: 13). It is this sense of fortification that I see to be important in grasping security at the coast.

The coastal watch is often justified by the need to save lives at sea - certainly the volunteers see themselves as protecting the public, and tech companies frame their automated solutions as aiding security *and* life-saving. The sea is understood to be inherently risky, despite the strategic utilisation of maritime domains to discipline migrants (Stierl 2021, Dickson 2021, and maritime border security is frequently framed as ““really about life saving as people attempt these incredibly dangerous journeys by sea”” (Lauderdale 2023). The biopolitical merging of “security” and “humanitarianism” has become a key critique of contemporary borders. The idea of the humanitarian border captures how “acts of rescue and acts of capture [of migrants] simultaneously reinforce one another” (Pallister-Wilkins 2023: 78). Certainly the military-security-humanitarian efforts of the UK Small Boats Command coalesce around the criminalised, racialised but also vulnerable, endangered small boat migrant (Mayblin et al 2024a). My point is that the preservation of life at the coast has *always* been entangled with martial defence, revenue protection and bordering. Thevery idea of keeping watch for distress at sea emerged from the martial watch: this is a longstanding and hidden logic of littoral fortification.  So, while the coastal volunteers see themselves as continuing the tradition of 'life saving', HMCG has well-documented martial/naval origins (Smith 2012). As Webb argues (1976: 16) the early coast guard formed  "to prevent the running of contraband" with the "giving of every assistance to save life when a ship was wrecked" tacked on to this objective (see Story 1901). If humanitarian practices are always ultimately related to enhancing the security of the state (Fassin 2011) then the coastal watch (past and present) expresses and enacts this relationship.

There is clearly more to say about the history of coastal fortification. Importantly for my purposes, fortification is the *organisation of vision* "so that from whatever side the enemy attacks, he should be frontally or laterally in sight and under attack" (Errard de la Bar-le-Duc cited in Virilio 1994: 38). Fortification, as Virilio argues, is instrumental, existing less in itself than with a view to "doing" something: waiting, watching, then acting or, rather, reacting (1994: 43). So, the *practices* of keeping watch are fundamental to fortification and to the constitution of the coast as border. And coastal lines of sight have underpinned efforts to to "territorialise" the global oceans and to demarcate ownership, control, responsibility, resource extraction and so forth . Technologies - from telescopes and radar to today's machine-learning innovations - have constantly reconfigured the spatial reach and scope of fortification's visual practices. So, for instance, the original bounding of "territorial waters" was related to the spatial reach of the human eye and then to the reach of cannon shot so that "the control of the land (over the sea) extends as far as cannon will carry" (Bynkershoek cited by Pogies 2021). Today, of course, new technologies of visualising and modelling the ocean produce unparalleled possibilities of governing at depth, range and verticality. For my purposes, the totalising forms of visual apprehension associated with what is called Maritime Domain Awareness (MDA) produce new priorities (and problems) for detecting and intervening on maritime movement at the coast and beyond

MDA is defined as the "effective understanding of anything associated with the maritime domain that could impact security, safety, the economy or the marine environment" (International Maritime Organisation). It is an organising imaginary, an ideal of inter-agency collaboration as well as a set of technical practices for gathering information about maritime security threats. MDA involves the processing of data from situational awareness technologies: radar, sonar, vessel tracker systems, GIS information, meteorological data, satellite, camera and thermal imagery.  In the UK context, the Joint Maritime Security Centre (JMSC) is the physical hub and expression of the convergence of military, law enforcement security and civilian agendas around MDA (most littoral countries have similar hubs). Importantly, the JMSC incorporates the National Maritime Information Centre (NMIC) which since 2010 has provided a mechanism for the UK's civilian and military maritime and law enforcement organisations to fuse intelligence, data and capabilities. If the preoccupation of war and security is the "ever-more complete unveiling of the world" (Virilio 1994: 17) then MDA expresses the desire to fuse or mesh all available information to produce in "real time" (Bueger 2024) what is known as a "a single operational view" (Systematic, no date).

The coastal volunteers, however, argue that the reliance on remote sensing is inadequate: these technologies often cannot detect the kinds of dangers that arise along coastlines, nor can they register small vessels or distressed people in general maritime traffic. To be effective in their work, the volunteers must be able to: identify and classify types of small vessel; monitor marine radio channels; be aware of local currents and hazards; monitor weather conditions; ideally, to be able to plot position from the station to aid search and rescue teams if required; to use charts, optical equipment and radios effectively; and to be alert to unusual or risky activity (say, the odd movement of a boat). They pay attention to everything within their field of vision: the comings and goings of fishing vessels; lone kayakers or paddleboarders; the unusual movements of a jetski; larger vessels moored off the coastline; boats on unusual trajectories, or circling, or meeting larger vessels might be flagged, as might the number of passengers on a vessel or erratic manoeuvring. Many of the volunteers are retired but have spent their working lives in maritime careers and can spot incorrectly rigged vessels, unsafe maritime practice or an inexperienced crew. Coastal waters are understood to be risky and dangerous, where inexperience or poor decision-making might lead to tragedy. They consider themselves, "the front line, there's nobody else out here".

> We're keeping an eye on everything, we're not just looking down and recording… usually we'll pick something up if a boat's behaving strangely (Coastal volunteer).

> The first thing is vulnerable people and vulnerable vessels. Keeping an eye on yachts is great, but really it's the kayaker we should be watching, or fishermen on the beach. Or suspicious things, it might be drugs that are being brought in. It might even be firearms, or if it is drugs it's likely to be connected to much bigger things (Coastal volunteer).

To be clear, the volunteers' "eyes-on" tracking of vessels is valued by law HMCG.  Volunteers might be asked by HMCG to watch  for drifting vessels, for instance, and the volunteers are able to report suspicious or dangerous activity to feed into MDA. The granular attention to detail along stretches of the coast is sought from other law enforcement initiatives. Project Kraken, for instance, is a coastal neighbourhood watch-style scheme that encourages general maritime and coastal publics to report suspicious activity to a helpline. The ability to intuitively "filter (ab)normalities" across land and water (Weaver 2022: 335) is seen by law enforcement and security agencies to offer a potentially rich source of information. In many ways, the promise of machine learning technologies is precisely to replicate - but also extend and enhance - the close attentiveness of the volunteer watch: in this sense, techno neo-fortification is framed as a *continuity* of existing watchful activity of littoral fortification even as it becomes the combination of "observations from multiple independent maritime sensors into a single stream of correlated reports" (Sirius Insight 2024).

**Dark targets**

MDA is described by practitioners as a “picture of essentially everything”, yet it is more accurate to understand it as a means of looking “for highly specific things” (Temin 2023) and “identifying what you are looking at, and understanding its purpose” (Lauderdale 2023). In global contexts, the value of technology in maritime contexts is its apparent ability to track “the untrackable”. Take, for instance, Automatic Identification Systems (AIS) data, an important data source for maritime navigation but also maritime security and MDA. AIS enables the visualisation of vessel movements via GPS systems and unique vessel data from an onboard AIS unit. This unit transmits data about the vessel and exchanges data in turn with other vessels and shore-based facilities. AIS transponders are mandatory for vessels over 300 gross tonnage on international voyages, for all cargo ships of 500 gross tonnage and all passenger ships. AIS signals have a horizontal range of about 40 nautical miles which makes them particularly useful for coastal security. AIS data enables snapshot aerial views of vessels, zoomable to the level of global oceans or local regional coast, as well as the retrieval of individual vessel information and journeys. Interactive AIS apps are readily available for mobile and computer devices, allowing anyone to engage in real-time ship tracking. The volunteer coastal watch stations, for instance, have AIS systems: volunteers toggle back and forth between the lateral view offered by their station position overlooking a stretch of coast and the vertical AIS display on the station computer screen. They can click on icons to view the destinations, origins and flags of larger and transmitting  vessels, so that maritime traffic across their field of vision becomes connected to global seas, ports and routes.

AIS data is vital for MDA and the production of common operational pictures that can be used by multiple agencies. For security practitioners, however, the sheer volume of AIS data becomes a problem and the task becomes sorting through the clutter “to surface those so-called dark objects out there, those entities that aren’t abiding by the rules” (Lauderdale 2023). That is, AIS data is only useful when subject to “sophisticated analytics tools to help human viewers sort out what’s significant” (Temin 2023): a snapshot view may visually display a “bunch of dots out there on the water, but it doesn’t tell you anything about what their intent might be” (Lauderdale 2023). More specifically, AIS data is subject to widespread manipulation in efforts to “go dark”: operators can switch off AIS transponders; signals can be switched between ships; reports can be wrong or deliberately imitated. Importantly for my context, AIS is not mandatory for smaller vessels, which are precisely the target of interest in coastal security. Any “aerial view”, argues Kaplan (2018) - in this case the screening of AIS data as a vertical view over a coastline - creates visibility *and* invisibility . Similarly, border-making is always “about the generation and circulation of knowledge/non-knowledge and of visibility/invisibility” (Tazzioli 2021). At the coast despite the vast aerial views of MDA and it is the search for “dark targets”, characterised by an *absence* of AIS data that is often most significant.

Dark targets are made visible by the correlation of (a lack of) AIS data with the detection of other signals: from radar, for instance, or passive radio frequency analysis of signals from communication and navigation devices. Larger objects and vessels in maritime space can be made visible by a process called tipping and cueing: using low-resolution synthetic aperture radars to scan large areas of interest and, once locating a “tip”, deploying high-resolution optical sensors to zoom in (see Hajkova 2024). At coastlines, it is the integration of different kinds of data that can expose small or dark targets. Take, for instance, the contracts recently won by Sirius Insight for UK coastal monitoring. These contracts enable the tracking of non-reporting vessels via the integration of radar data, camera imagery, cell-phone radio waves as well as satellite data - checked against AIS feeds. The idea is precisely not to generate a picture of all general maritime traffic but to produce targets based on “a range of abnormal and other behaviours” (Sirius Insight 2024). There are three points to make for the purposes of this article.

First, the discernment of “abnormal behaviours” at sea has always been the crucial task of coastal fortification. For the volunteers, ostensibly concerned with saving life, detecting “abnormality” in general maritime traffic is the central purpose of their work. Like centuries of coastal watch before them, the stretch of sea taken in by their eye becomes familiar - in terms of its tides, currents and hazards - as well as the movement of local vessels. The volunteers gain a granular, rhythmic sense of coastal life. Volunteer logs note “regulars” (local fishing boats, cold water swimming clubs, kayakers), and it is knowledge of “normal” behaviour that allows the discernment of anomaly. Those with maritime backgrounds, for instance, are aware of how a vessel’s rigging or unusual trajectory might signal danger or vulnerability. They are alert for kayakers without lifejackets, or lone sailors, or suspicious landings and incorrectly rigged boats. The volunteers argue that these small things “might always be connected to something bigger”: “you have watch after watch where nothing happens, but one day the wheels could completely come off, and that’s why it’s important to be up to date with your training” (Coastal volunteer, Interview). The reach of their eye demarcates a maritime zone that has no formal status, but which, through their watchfulness, is constituted as a space of security.

> [Our range here is] ‘everything you can see… from X harbour through to the marina at Y… Where you can easily see with the naked eye is where you’re most likely to pick something up. We can only really pick up an incident out at sea to about a mile – you’re not going to be peering through an optical [binoculars or telescope] for three and a half hours’ (Coastal volunteer)

Second, machine-learning technologies like the ones in the Anduril Towers approach “anomaly” differently. The fusion of radar, optical and AIS data around the coast is oriented to the question of “what is out there?” - but mostly to the question, “what should we focus our attention on?”. Rather than watching and waiting, as Virilio describes, the solutions offered by companies like Anduril and Sirius Insight are “sophisticated analytics” that promise to reveal abnormal maritime behaviours hidden among everyday movement. Amoore (2020) argues that the contemporary abundance of data - or, more specifically, its algorithmic analysis - is not about revealing a world that was always there. The forms of perception at work in the machine-learning solutions that increasingly govern our world are absolutely *not* about seeing everything: they are limited, as she puts it (2020: 16), “to the image of that which interests you”. All perception emerges from “composite beings formed through the relations among humans, algorithms, data and other forms of life” and, importantly, perception is concerned with “seizing an object from the environment” (Amoore 2020: 42, 16). So, whether it is a volunteer straining to discern a jetski in the distance, or the algorithmic extraction of a target from myriad journeys, perception is oriented to action. Understanding the coastal watch as a form of perception in this way shifts focus from the technologies in play, to grasping precisely how they organise attention for security purposes.

In machine learning contexts, the question of “what should we focus our attention on?” involves responding to the question of “What is normal?” or, more specifically, “How far is far, if something is to be considered anomalous?” (Amoore 2020: 68). In general maritime traffic, “anomaly” might be organised around geographic or temporal parameters (vessel movements late night or early morning, an approach to a particular beach) or around data discontinuities (a vessel transmitted AIS, then “went dark”, then re-transmitted). The critical work on algorithms shows that the thresholds between normal and anomalous, at a technical level, are determined by neural networks being trained to recognise meaningful deviations in vast amounts of data. Calibrating thresholds for recognising difference is not neutral, but “expresses a series of judgements, valuations, associations and prejudices involved in determining what is ‘useful’ or ‘good enough’” (Amoore 2020: 68). So, in my context, the threshold of perceptibility that comes to matter might be organised around the “smallness” of boats (rather than, say, a child in danger) or about a vessel’s approach to a “vulnerable” beach (rather than departure). And the application of rules (“show me the vessels that match these known criteria”) is only part of the way that algorithms govern mobility at sea. Machine learning algorithms deploy abductive reasoning, deriving “rules from contingencies” (Parisi 2016) so that “what one will ask of the data is a product of patterns and clusters derived from that data” (Amoore 2020: 47). The collection of vast amounts of data collected as part of global coastal techno-fortification enables the production of ever more precise and technologically-derived “patterns of life” - and the identification of deviations from and within it. This is now how the maritime border is being demarcated and secured: how search and rescue missions are launched, how migrants are targeted, how security is enacted, how illegal activities are governed.

Third, maritime security at the coast is produced from entwined human-machine practices, despite volunteers and security practitioners often insisting on their separation. One one hand, technologies reinvigorate and continue littoral fortification; on the other, they spatialise “the watch” differently. The volunteers, for instance, argue their visual lookout is vital because “the coastguard don’t have that [the ability to see the sea] they’re just sitting in a box”:

> ‘The trouble is the United Kingdom Coastguard aren’t seafarers. They just recruit from whatever they get. A bit like us… for the likes of ourselves who have been at sea for quite a long while you can spot someone who has been at sea and who hasn’t – you can tell they don’t really know what they’re talking about and what the implications are’ (Coastal volunteer).

But *seeing the sea* is not important for techno neo-fortification. The collection and analysis of data about coastal maritime traffic is entirely indifferent to local specificities in the sense of “regulars” and everyday coastal life - though patterns of life are geographically specific. What matters is the thresholds of normal/abnormal that can be gleaned. The promise of technologies is always to alter what Daston refers to as surveyability, or what human beings “can take in and understand as a whole” (2019: 307). The technological generation of knowledge about the ocean does not reflect back an objective reality but makes “perceptible patterns and phenomena” (Lehman 2016) that actively construct "maritime geography". Of course, the coastal watch, understood as a martial visuality, has been constantly inflected by technological developments: from the development of telescopes to radar and drone (see Bousquet 2018). The volunteers’ visual attention, for instance, is shaped by the instruments they use: their embodied watch is enhanced and constrained by their binoculars, or by their interaction with the AIS screen. What Hayles calls technogenesis (2012) is not limited to the advent of digital technologies.

Yet the neural net algorithms of maritime security create a new way of grasping maritime movement and a new spatiality of intervention. Put differently - they do not offer enhanced decision-making over coastal or territorial waters already constituted, nor do they simply extend human capacities, though they appear to be a reassertion of older forms of fortification. When an automatic alert arrives on a screen at hubs like the JMSC, the target of interest - displayed as a lone icon - is an output of iterative machine learning against thousands of movements from a specific coastal region. My argument here is that the space that matters in maritime security is the “useful” deviation from “normal” as determined from movement transformed into data. Security technologies are re-shaping the relationship between local and global in maritime contexts (e.g. when local coastal traffic becomes global datasets for machine learning techniques), detaching security from local coastlines, and separating perceptibility from the human eye. When HMCG or Border Force ask to the volunteers to “keep a watch” for vessels or objects - or when the volunteers report an event to JMSC and it is folded into MDA - we see that “technical beings and living beings are involved in continuous reciprocal causation” (Hayles, 2012: 104). This entanglement, I argue, is what is at stake in the turn to technologies in maritime security. In sum, maritime security, at the coast and beyond, is being reconfigured via the spatialities of algorithmic relationality.

**Maritime motion**

Maritime security technologies promise both the detection of “non-reporting” vessels but also, importantly, the automation of identification and classification. The challenge is not only to reveal what might be unseen (e.g. small vessels without AIS) but to accurately identify different kinds of objects on the water (floating debris, or small vessel, or drowning person? ). This involves “fusing” different data sources but also, importantly, using machine learning and computer vision to classify maritime movement. And to be clear, the problem of “seizing from the environment” - which as Amoore (2020) argues is central to all forms of perception - becomes in machine learning a technical matter of feature extraction, reduction, and condensation. So, for instance, in the Anduril Towers, it is the combination of radar and computer vision techniques that allows for autonomous detections to give “the most realistic possible picture to free up agents who would otherwise have to manually identify crossings” (Software Engineering Daily 2021: 4). Consider the Head of Perception at Anduril Technologies explaining deep neural networks and computer vision in the context of aerial automation:

> [T]he radar we have is actually quite powerful and it can see many kilometers away in all directions. And based on where the radar finds objects moving in the sky, we then point the camera there and get, basically, images on that object. And so pointing the camera at the radar sounds like it should be easy, right? [.... But] there's a couple of problems. One is the ability to focus the camera [...] And then another challenge is the radar sort of error bars around where the radar thinks the object is, especially when you're in complicated terrain with all kinds of echoes and things on the radar. Those error bars may be larger than the field of view of your camera, which means when you point the camera at the radar, there's no guarantee that you're going to find anything. And so the trick we found is you kind of subscribe the camera to where the radar thinks the object is and then you search around it. So you add an offset. You say, "Maybe for a second I’m going to look above where the radar thinks it is by a little bit. And then I’ll look to the left." And you kind of jump around until you find the object (Software Engineering Daily 2021: 14).

In maritime contexts, the problem of echoes and error bars are generated by the fluid materiality of the ocean. The use of radar to detect objects in the water relies on the transmission of electromagnetic waves and the reception of returning echoes from the water surface and floating objects. Although resolved into an image, radar sensing relies on reflected wave energy that is responsive to surface ocean structures, textures and what are called “wave signatures”. These characteristics can reveal a target - its size, shape, distance and speed. In search and rescue contexts, for instance, the ultimate task is to detect small, slow-moving objects in challenging environments such as “a person bobbing in the sea, even when surrounded by waves and clutter” (Allison 2025). But radar, as I have explained, can also be used to detect small or non-AIS-transmitting vessels. Crucially, the detection of vessel “wakes” has become a vital means of detecting dark targets. Satellite synthetic aperture radar (SAR) sends out a pulse of energy to the ocean, registering the energy reflected back, so revealing wakes, which can be affected by wind speed, direction, wave height, length and direction, as well as the vessel size, length and velocity: the faster a vessel is traveling, the bigger and more detectable the wake will be (Prete *et al* 2021). As well as surface vessels, SAR can also be used to detect the wakes trailed by semi-submersible vessels (so called “narco-subs”) that are used to smuggle drugs and contraband. As Helmreich argues, measuring waves as “energy moving across space” (2023: 11) is how geoscientists grasp the turbulence of the oceans to make the ocean’s materiality “readable”. For my purposes, understanding maritime security as premised on the interaction of electromagnetic energy with water offers a new way of thinking about coastal neo-fortification and borders. Border security comes to operate at the level of disturbances in wave patterns, on differences between reflective surfaces, on specific densities of materials within what Curtis and Jackman call an electromagnetic geography (2025). The ocean's "electromagnetic radiance" (McCormack 2025) and the varied reflectivity of "vessel", "body", "water" and "wave" becomes part of a security infrastructure within water itself.

The movement of the sea, then, is both a technical challenge to overcome and the new means of targeting. For automated security practice, a surface object's trajectory is important. Take once again the explanation of how Anduril systems use trajectory in the context of airborne classification.

> "If you're classifying human-made air vehicles, like drones and airplanes, versus birds… what you'll find is human-made air vehicles in most scenarios tend to fly in a fairly straight line. The altitude doesn't jump around too much. It'll have gradual changes. Whereas birds tend to fly these loopy, whimsical patterns [...] So just based on the shape of how the object has moved recently, we can actually use machine learning to infer something about what kind of object it is. Of course, it's not perfect, and it's something that you don't want to rely purely on without other sensors. But it's a good start. And that's something that we use to help decide which radar object to point the camera at next. Is it more of a loopy thing? It's more likely to be a bird. Okay, we'll de-prioritize that. Or is it more of a straight line? Okay, that's probably something we should look at sooner (Software Engineering Daily 2021: 15).

For maritime object identification, "the shape of how the object has moved recently" must take account of the motion of the sea itself - its waves, churns, drifts, tides, molecular vibrancy and "more-than-wet" ontology (Steinberg and Peters 2019). So, "seizing an object from the environment" as Amoore (2020) puts it is, in maritime contexts, quite literally about discerning the *difference in motion between the sea and the target*. So, for instance, the regularised spatio-temporal dynamism of waves causes issues for the background subtraction methods typically used on computer vision: waves tend to be inferred as the patterned (i.e. non-random) movement of foreground objects and wakes, foams, and sea speckle are frequently inferred as foreground by typical background detection methods (Prasad et al 2016; Prasad et al 2020). Motion is also a problem for maritime sensors, producing a "complicated registration problem where even the consecutive frames are not registered and may have a large angular and positional shift - problem of yaw, roll and pitch" (Prasad at el 2016). Moreover, maritime contexts produce a huge variety of weather and illumination conditions (fog, haze, mist) and sea effects (speckle, glint) which affect the "statistical distribution of sea and water, and visibility of far located objects" and which need extremely complicated modelling such that foreground is not detected as the background and vice versa" (Prasad 2016). There are two points to make for the purposes of this article.

First, to return to the volunteers, and the practices of coastal fortification they continue. I have shown that their littoral watch delimits a space of concern demarcated by a scanning line of sight - one that links contemporary bordering with historic martial defence. What approaches? Is that vessel moving as it should? Is it equipped properly? Is the pilot experienced? Theirs is a focus on the general maritime “clutter” that the technologies strive to screen out. Targeting , for the volunteers, is spotting something unusual and then following a person or object as it moves across the water, in and out of sight. Machine learning processes interrogate maritime movement differently. They break down the visual task into questions of continuity, correspondence with instances of a known class (e.g. ship, small boat, wake, oil spill) and background/foreground motion. They understand movement as a trajectory that might be made amenable to intervention via the spatiality of frame or bounding box. Image recognition techniques work on the presence or absence of features, or “the arrangements of edges and assembling of motifs into large combinations that are checked against familiar objects” (see Amoore 2020: 71). The use of machine learning techniques is a matter of the “selection of training data; the detection of edges; the decisions on hidden layers; the assigning of probability weightings; and the setting of threshold values… to generate a regime of recognition” (ibid.). This is an entirely different kind of visual task to the coastal watch enacted by the volunteers. And to be clear, the technical approach to this task is increasingly the basis for littoral fortification and determining key maritime security questions at the coast and beyond: Is it a threat? Is the object a vessel - or a person? Does the object count as a “small boat”? Questions for wider maritime contexts might include those related to oil spills, the migration of maritime wildlife and illegal fishing. The ocean as a biosphere - and the multi-species life that is lived in, on and around it - become grasped via neural net interrogations about motion, edge, continuity, spatiotemporal regularity and trajectory.

Second, the volunteers - situated as they are by the sea and exposed, physically, to its altering conditions - argue that saving lives and securing the coast rely on their embodied attentiveness to coastal waters. Lehman argues that scientific visualisations of the ocean transform its materiality into live data streams in ways that erase any “messy materiality” (2018: 64). Certainly the visual output on the JMSC screen tends to obscure the material conditions under which the target was exposed, eliminating the technical challenges of, say, mist, fog, wave movement and turbulence. Located within the martial dream of omniscience and the dream of sublime and total surveyability offered by the technologies of MDA - like many techno-scientific visualisations of the ocean - develops from western epistemic structures (see Lehman & Johnson 2021). It privileges an ‘objective’, and ‘neutral’ aerial gaze. But it is equally accurate to argue that *the ocean’s materiality becomes weaponised* by technologies for the purposes of bordering and security. On one hand, the ocean’s materiality - its reflectiveness, its motion, its density - poses challenges for technologies of visualising. On the other hand, targeting at sea uses ocean materiality by basing security classifications on differential motion echo, wave, reflection and clutter. In this sense, then, contemporary maritime security is not grounded in vision at all - but in a “more than visual” interaction with the ocean’s materiality (see McCormack 2025) As Steinberg argues “visual knowledge is achieved not in spite of [the ocean’s]volume’s dynamism but through it” (Steinberg 2018). Maritime security technologies achieve the “visibility” of targets not in spite of - *but through* - the ocean’s fluid characteristics. The techniques of maritime security are carried in the ocean’s motionful materiality.

My argument here is that the transformation of the ocean's materiality into a means for targeting rearranges the spatiality and materiality of the border. It is not simply that the maritime spaces delimited by coastal fortification have exploded into aerial views, as Virilio argued. And it is not only that the "ungovernable" quality of the sea is used to create carceral spaces and legal ambiguities for controlling and excluding migrants, though of course this is a central aspect of maritime bordering (Dickson 2021). Rather the spatial arrangements and the visual techniques through which maritime movement is rendered governable (and my example is the coast) are becoming embedded and expressed in the algorithmic differentiations offered by tech companies like Anduril. The promise is the revelation of a picture of essentially everything - and "for most of history, we haven't had that capability" (Ahn 2023) - but the problems of governing the sea become reconfigured as technical tasks. As Amoore argues, the "depth" that is conjured by machine learning implies the abstraction and representation of relations and problems in high-dimensional data -  precisely the qualities that become imperative at the "deep border" (2024: 3). Adding layers to a neural net to solve difficult problems of, say, maritime object recognition "holds out an alluring promise of representing and understanding everything by decomposition, rearrangement and output" so that machine learning technologies reorder what the border is (Amoore 2024: 5). Along the coast, vessel movement is understood not as the visual tracking of a familiar or unknown object, but an iterative interrogation of pixels and clusters of attributes: vessel or foam? Background or foreground? This is precisely the troubling politics of the Anduril Towers - and it goes beyond the UK "small boat crisis" or the US targeting of "narco-terrorists". Political questions about maritime borders and security - and longstanding anxieties about sea-borne threat - become deferred into iterative processes of machine learning and object classification.

**Life by the sea**

In 1901, the Strand Magazine published an article entitled 'Hands Around the Coast' describing the arduous physical work of keeping "look-out, day and night"at the coast (Story 1901: 278). Over 120 years later, securing the British coast involves a complex array of collaborative efforts that would astound the early twentieth century coastguardmen. But as I have shown, the littoral watch is still considered vital - and for not dissimilar reasons. I have argued that machine learning technologies and automation are both a continuation of littoral fortification but also a different mode of perceiving and acting upon maritime threats. The volunteer watch (as the continuation of the embodied visual watch) is not "superseded" by machine-learning techniques but rather, the watch becomes what Aradau and Blanke (2015) call a matter of 'divided labour' within socio-technical relationships. In conclusion, I make two interrelated points.

First, my use of the term neo-fortification is to point out something different than the important recent work on technologies and maritime bordering - the money that governments spend on border technologies, the neo-colonial forms of border violence they enable and the capital-accumulation they propel (Mayblin et al 2024a). The use of military grade technology at maritime borders creates a whole new era of martial discipline of the sea and the war-like efforts to repel migrants are a reanimation of older infrastructures of war for contemporary purposes. My contribution here is to point out that maritime security technologies are not simply deployed at an existing border, but are *transforming what a border is* and *the distinctions on which it operate*s. In the increasingly dangerous maritime borders of the world, we see the differential valuation of human lives. Contemporary maritime migration controls exemplify the differential valuing of "life" at sea:. It is therefore important not just to grasp the assembling of human-machine activity, but how military, humanitarian, ecological and security agendas centre on the detection of targets. I have discussed the continuities and discontinuities of littoral security and have located automated technologies with older practices of coastal fortification. The border is no longer to be found delimited by a visual scan, or even solely in the aerial views of AIS or aerial reconnaissance, but increasingly in the algorithmic differentiation of normal and abnormal, vessel or foam, sea clutter or bobbing body. I do not suggest that the technologies of maritime security are always successful or authoritative, but they are on the rise. A critical task in this field is to "expose the ways in which all knowledge is situated, produced by embodied eyes (human and machine) and as such necessarily incomplete" (Lehman 2018: 64). This has been one aim of this article.

Second, my work shows the new spatial forms through which the maritime border is organised. Governing the ocean - perhaps especially at coastal regions - relies on precarious relationships between vision, space and control. Work on maritime geopolitics and security that has pointed out the the flexible way that maritime space is bounded and the organisation of sovereign rights and responsibilities (around migration, for instance, humanitarian responsibility and economic exploitation) are often "offshored" (see Davies et al 2021; Dickson 2021; Stierl 2023). My contribution has been to show that the spatiality of maritime security is increasingly found in an algorithmic distinction between different materialities and movement. Border enforcement or environmental protection or saving life at sea is a matter of "making visual" differences in motion or anomalous trajectories - so that the maritime border and maritime security are organised via the computer vision bounding box, the depth of layers of a neural net, the distance of deviation from an established pattern of life. It is not only coastal security that is reorganised - but the governance of global oceans.

**References**

Allison, G. (2025) *How Leonardo's Osprey radar tracks the unseen*. UK Defence Journal. Retrieved from https://ukdefencejournal.org.uk/how-leonardos-osprey-radar-tracks-the-unseen/#:~:text=One%20of%20its%20most%20notable%20features%20is%20the%20Small%20Target,ready%20for%20other%20mission%20profiles. Accessed 4 December 2025.

Amoore, L. (2020) *Cloud ethics*. Durham: Duke University Press.

Amoore, L. (2024) The deep border. *Political Geography*, 109.

Anduril Systems (2024) *Anduril deploys 300th autonomous surveillance tower (AST).* Retrieved from https://www.anduril.com/article/anduril-deploys-300th-autonomous-surveillance-tower-ast-advancing-capability-for-border-security/ Accessed 4 December 2025.

Benham, H. (1986) *The smugglers' century: Story of smuggling on the Essex coast, 1730-1830*. Essex Record Office.
Bosma, E. (2020) Multi-sited ethnography of digital security technologies. In E.Bosma, M. De Goede and P. Pallister-Wilkins (Eds.) *Secrecy and methods in security research*. London: Routledge.
Bosma, E. De Goede, M. & Pallister-Wilkins, P. (2020) Introduction. In E.Bosma, M. De Goede and P. Pallister-Wilkins (Eds.) Secrecy and methods in security research. London: Routledge.
Bousquet, A. (2018) *The Eye of War.* University of Minnesota Press.
Braverman, I. and Johnson, E. (2020) (Eds.) *Blue legalities*. Durham N.C.: Duke University Press.
Brown, W. (2010) *Walled states, waning sovereignty*. Princeton, NJ: Princeton University Press.
Bueger, C. (2022). Pragmatic spaces and the maritime security agenda. In K.Peters & P. Steinberg (Eds.) *Routledge Handbook of Ocean Space*. London: Routledge.
Bueger, C. (2024) The new frontier of maritime domain awareness. Retrieved from https://bueger.info/wp-content/uploads/2024/06/Bueger-2024-The-new-frontier-of-MDA.pdf. Accessed 4 December 2025.
Bueger, C., and Edmunds, T. (2024) *Understanding maritime security*. Oxford: Oxford University Press,
HM Government (2022) *National strategy for maritime security*. Retrieved from https://assets.publishing.service.gov.uk/media/630880c5e90e0729d9ab15fc/national-strategy-for-maritime-security-web-version.pdf. Accessed 4 December 2025.
Campling, L. and Colas, A. (2021) *Capitalism and the Sea*. London: Verso.
Canzutti, L. and Tazzioli, M. (2023) Digital–nondigital assemblages: Data, paper trails, and migrants' scattered subjectivities at the border. *International Political Sociology* 17(3).
Chua, C. (2023) Docking. In K. Peters, J, Anderson, A. Davies and P. Steinberg (Eds.) *The Routledge Handbook of Ocean Space*. London: Routledge.
Choi, Y.R. (2019) Slippery ontologies of tidal flats. *EPE: Nature and Space* 5(1): 340-361.
Cowen, D. (2014) *The deadly life of logistics: mapping violence in global trade*. University of Minnesota Press.
Daston, L. (2019) The coup d'oeil: On a ode of understanding. *Critical Inquiry* 45(2).
Davies, T., Isakjee, A., Mayblin, L., & Turner, J. (2021). Channel crossings: offshoring asylum and the afterlife of empire in the Dover Strait. *Ethnic and Racial Studies*, 44(13), 2307-2327.
Deloughrey, E. (2007) *Routes and roots: Navigating Caribbean and Pacific Island literatures*. University of Hawaii Press.
Denman (2020) On fortification: Military architecture, geometric power, and defensive design. *Security Dialogue* 51(2-3): 231-47.
Department for Homeland Security (2011) Small vessel security implementation plan. https://www.dhs.gov/sites/default/files/publications/dhs-uscg-small-vessel-security-strategy-report-to-public-012011_0.pdf.
Dickson, A, (2021) The carceral wet: Hollowing out rights for migrants in maritime geographies. *Political Geography* 90.

Elden, S. (2013) Secure the volume: vertical geopolitics and the depth of power. *Political Geography* 32(2): 35-51.
Fassin, D. (2011). *Humanitarian reason*. Oxford: OUP.
Foucault, M. (1980) The eye of power. In C. Gordon (Ed.) *Power/knowledge*. Pantheon Books, New York pp. 146-165.
Foucault M (2007) *Security, territory, population: Lectures at the Collège de France 1977–1978.* Basingstoke & New York: Palgrave Macmillan.
Gavilion, J. (2025) US seeks high-tech solutions to stop rogue small boats. The Defense Post. https://thedefensepost.com/2025/09/18/us-rogue-boat-solutions/#:~:text=A%20Coast%20Guard%20small%20boat%20crew%20from,Guard%20Cutter%20Bertholf%20operates%20a%20Long%20Range. Accessed 4 December 2025.
HM Government (2022) National Strategy for Maritime Security. https://assets.publishing.service.gov.uk/media/630880c5e90e0729d9ab15fc/national-strategy-for-maritime-security-web-version.pdf. Accessed 4 December 2025.
Hajkova, Z. (2024) What is SAR Imagery?. *EUSI*. Retrieved from https://www.euspaceimaging.com/blog/2024/04/05/what-is-sar-imagery/#:~:text=In%20defence%20and%20intelligence%2C%20SAR,%2C%20or%20decision%2Dmaking%20processes. Accessed 4 December 2025.
Hayles, K. (20121999) *How we think*. Chicago: The University of Chicago Press.
Helmreich, S (2009) *Alien ocean: anthropological voyages in microbial seas.* Berkeley: University of California Press.
Helmreich, S. (2023) *A book of waves*. Durham, NC: Duke University Press.
Johnson, E. (2020). The hydra and the leviathan: unmanned maritime vehicles and the militarized seaspace. In I. Braverman and E. Johnson (Eds.) *Blue Legalities.* (pp. 183-201). Durham N.C.: Duke University Press.
Jones, R (2024) Political geography I: Blue geopolitics. *Political Geography* 48(5).
Kaplan, C. (2018) *Aerial aftermaths: wartime from above.* Durham: Duke University Press.
Khalili, L. (2020) *Sinews of War and Trade.* London: Verso.
Khalili, L. (2024) *The Corporeal Life of Seafaring.* Mack Books.
Land, I. (2007) Tidal waves: The new coastal history. *Journal of Social History* 40(3): 731-43.
Lauderdale, D, (2023) How the Coast Guard's satellite imaging plays a huge role in maritime domain awareness. *Federal News Network*. Retrieved from https://federalnewsnetwork.com/defense-industry/2023/11/how-the-coast-guards-satellite-imaging-plays-a-huge-role-in-maritime-domain-awareness/. Accessed 4 December 2025.
Lehman, J. (2018) From ships to robots: The social relations of sensing the world ocean. *Social Studies of Science*, 48(1), 57-79.
Lehman, J. (2016). A sea of potential: the politics of global ocean observations. *Political Geography*, 55, 113-123.

Lehman, J. S., & Johnson, E. (2022). Environmental geography and the inheritance of Western technoscience. *Progress in Environmental Geography*, 1(1-4), 23-32.
Lehman, J., Steinberg, P., & Johnson, E. (2021). Turbulent waters in three parts. *Theory and Event*, 24(1), 192-219.
McCormack, D. (2025) Geographies of reflection and radiance: Radiant worlds, speculative surfaces, and reflective media. Progress in Human Geography 49(3).
Mayblin, L., Davies, T., Isakjee A., Turner, J. and Yemane, T. (2024a) Small boats, big contracts: extracting value from the UK's post-Brexit asylum 'crisis'. *The Political Quarterly*, 95(2), 253-262.
Mayblin, L., Turner, J., Davies, T., Yemane, T. and Isakjee, A. (2024b) 'Bringing order to the border': liberal and illiberal fantasies of border control in the English channel. *Journal of Ethnic and Migration Studies.*
National Crime Agency (2025) *National Strategic Assessment 2025 of Serious and Organised Crime*. Retrieved from https://www.nationalcrimeagency.gov.uk/images/campaign/NSA/2024/NSA%202025%20Website%20-%20PDF%20Version%20v1.0.pdf. Accessed 4 December 2025.
Nail T (2016) *Theory of the Border.* Oxford: Oxford University Press.
Pallister-Wilkins, P. (2023) *Humanitarian borders.* Verso.
Parisi, L. (2016) *Contagious architecture.* Cambridge, MA: MIT Press.
Peters, K., Steinberg, P., & Stratford, E. (Eds.) (2018). *Territory beyond terra.* Rowman & Littlefield International
Platt, R. (2011) *Smuggling in the British Isles: A history.* The History Press.
Pogies, C. (2021) The cannon. *Legal History Insights*. Retrieved from https://legalhistoryinsights.com/the-cannon-a-tool-for-delimiting-maritime-space/. Accessed 4 December 2025.
Prasad, D., Prasath, C. K., Rajan, D., Rachmawati, L., Rajabaly, E., Quek, C., (2016) Challenges in video based object detection in maritime scenarios using computer vision. *Computer Vision and Pattern Recognition*. Retrieved from https://arxiv.org/abs/1608.01079.
Prete, R., Graziano, M., Renga, A. (2021) First Results on Wake Detection in SAR Images by Deep Learning. *Remote Sensing* 13(22): 4573.
Rediker, M. (2007) *The slave ship.* London: Penguin Books.
Ryan, B. (2015) Security spheres: a phenomenology of maritime security practices. *Security Dialogue* 46(6): 568-584.
Ryan, B. (2019). The disciplined sea. *International Affairs*: 1055-1073.
Serres, M. (1996) *Genesis*. Ann Arbor, MI: University of Michigan Press.
Shah, N. (2012) The territorial trap of the territorial trap: global transformation and the problem of the state's two territories. *International Political Sociology* 6 (1), 57-76.
Sirius Insight (2024) *Addressing maritime surveillance core challenges: data sharing and tracking non-reporting vessels*. Retrieved from https://www.siriusinsight.ai/news-article/addressing-maritime-surveillance-core-challenges-data-sharing-and-tracking-non-reporting-vessels-. Accessed 4 December 2025.

Smith, J. (2012) Coastguard Stations. *Historic England*. Retrieved from https://historicengland.org.uk/images-books/publications/iha-coastguard-stations/heag130-coastguard-stations-iha/. Accessed 7 January 2025.
Software Engineering Daily (2021) *Deploying Computer Vision to the Edge at Anduril Industries with Forrest Iandola*. Retrieved from https://softwareengineeringdaily.com/wp-content/uploads/2021/11/SED1381-Forrest-Landola.pdf. Accessed 4 December 2025.
Steinberg, P. (2018) *Views*. Cultural Anthropology. Retrieved from https://www.culanth.org/fieldsights/views. Accessed 4 December 2025.
Steinberg, P. and Peters, K. (2016) Wet ontologies, fluid spaces: giving depth to volume through oceanic thinking. *Environment and Planning D: Society and Space*, 33 (02): 247-264.
Steinberg, P.,and & Peters, K. (2019). The ocean in excess: Towards a more-than-wet ontology. *Dialogues in Human Geography*, 9(3), 293-307
Stierl, M. (2021) The Mediterranean as a carceral seascape. *Political Geography* 88.
Story, A. (1901) Hands round the coast. *The Strand Magazine*, xxii(129).
Storey, S. (2025) The UK's AI borders: Anduril's autonomous surveillance towers. Retrieved from The *Migrants' Rights Network*. https://migrantsrights.org.uk/projects/hostile-office/the-digital-hostile-environment/ai-borders-anduril-autonomous-surveillance-towers/.Accessed 4 December 2025.
Systematic (no date) SitaWare delivers maritime situational awareness of UK waters. Retrieved from https://systematic.com/int/industries/defence/news-knowledge/cases/sitaware-delivers-maritime-situational-awareness-of-uk-waters/. Accessed 7 January 2025.
Tazzioli, M. (2020) Disjointed knowledges, obfuscated visibility. *Political Geography,* 79.
Temin, T. (2023) Imagery is at the center of maritime domain awareness. Federal Insights. Retrieved from https://federalnewsnetwork.com/federal-insights/2023/11/imagery-is-at-the-center-of-maritime-domain-awareness/. Accessed 4 December 2025.
Thales (2024) Thales introduces CoastShield, a coastal surveillance system solution enabling nations to ensure coastal protection and safe maritime operations. Retrieved from https://www.thalesgroup.com/en/worldwide/defence-and-security/press_release/thales-introduces-coastshield-coastal-surveillance. Accessed 4 December 2025.
Trendall, S. (2023). Home Office signs £3m sensor deal for round-the-clock tracking of 'small vessels' in UK waters. PublicTechnology.Net. https://www.publictechnology.net/2023/09/14/defence-and-security/home-office-signs-3m-sensor-deal-for-round-the-clock-tracking-of-small-vessels-in-uk-waters/. Accessed 4 December 2025.
Virilio, P. (1994) *Bunker archaeology*. Princeton N.J: Princeton University Press.
Wang, C. (2023) Towards a solid-fluid territory: Sand dredging, volumetric practices, and earthly elements. *Political Geography*, 106.
Webb, W. (1976) *Coastguard! An Official History of HM Coastguard*. London: HM Stationery Office.
Webber, F. (2024) No safe routes. *London Review of Books*. 46(7).

Weaver, D. (2022) Project Kraken: Surveillance and liminality 'On the Edge' of land and water. *Geopolitics*, 27, 1: 333-359.
WhatDoTheyKnow (2024) Samuel Storey FOI. Retrieved from https://www.whatdotheyknow.com/user/samuel_storey. Accessed 4 December 2025.