I

Datafication and artificial intelligence in the South China Sea

*Emilie van den Hoven**

Abstract

Artificial Intelligence (AI) is a highly transformative technology. No international legal domain will remain untouched by its effects, including the international law of the sea. This contribution examines some of the ways changes could occur in the maritime domain due to the rapid advancement of data-driven practices and AI-powered applications. Using the South China Sea conflict as the main case study, and specifically China's role in that conflict, this contribution explores how datafication and AI are increasingly being used in maritime practices and shaping the debate around interpretations of legal norms in the maritime context. In this way, the ongoing tensions in the South China Sea provide concrete examples to explore the significant effects that datafication and advanced technologies like AI might have on so-called 'lawfare' practices and 'gray

* PhD Candidate at the Faculty of Law and Criminology of the Vrije Universiteit Brussel (Law, Science, Technology and Society research group). This research was made possible by the European Research Council (ERC) under the HORIZON2020 Excellence of Science program ERC-2017-ADG No 788734 (COHUBICOL, 2019 - 2024). I am grateful to the editors of this volume and three helpful anonymous reviewers.

zone' capabilities that can influence the interpretations and practice of the international law of the sea more broadly, and customary international law in particular.

Keywords: South China Sea, International law of the sea, Datafication, Artificial intelligence, Gray-zone capabilities, Lawfare, Customary international law.

1. Introduction

In early 2021, ships registered to the People's Republic of China (hereinafter referred to as China/PRC) were detected off the coast of Oman – seemingly fishing for squid. While the Automatic Identification Systems (AIS) aboard these vessels showed a geolocation beyond Oman's 200 nautical mile Exclusive Economic Zone (EEZ), signals captured by commercial satellites and the rapid analysis of the satellites' data confirmed that the vessels were in fact operating within the Omani EEZ. This demonstrated that the Chinese vessels were acting in contravention of the exclusive fishing rights of the coastal State as protected under international law.[1]

This is not the only case in which advanced digital technologies were used to detect, monitor, or conduct contentious maritime practices.[2]

1. 'Keeping tabs on China's murky maritime manoeuvres: America and its allies are using whizzy new tools to track China's military activity and illegal fishing' *The Economist* (15 August 2023), available at <https://www.economist.com/china/2023/08/15/keeping-tabs-on-chinas-murky-maritime-manoeuvres>.

2. Tom Matkov, 'Maritime Innovator: SynMax' (*Spire Maritime Blog*, 11 April 2023), available at <https://spire.com/blog/maritime/maritime-innovator-synmax/>.

Progressively, practices of datafication, applications of Artificial Intelligence (AI), sensor technology, satellite observation, and robotics for ocean surveillance are being deployed in the maritime domain. These advanced technological tools change what can be done and how we do it in the maritime context. As such, they have a potentially significant, yet underexplored, relation with international law of the sea. Taking the South China Sea conflict as its main case and focusing on China's role in it, this contribution explores how datafication and AI are increasingly used in practices relevant to the maritime domain.[3] More specifically, it explores the relationship of these technologies to so-called 'lawfare' practices and 'gray zone' capabilities.[4] If datafication and AI are leveraged in the pursuit of such strategies, this could have multifaceted implications for the maritime domain and (customary) international law of the sea. This development warrants our attention and should be further investigated.

To this end, the article is structured as follows: first, I provide a brief overview of the South China Sea and the conflict in Section 2. After that, in Section 3, a selection of datafication initiatives is discussed to illustrate the diversity and wealth of data available and to lay the groundwork for various concrete examples of AI-powered applications in the South China Sea, which I discuss in Section 4. In Section 5, I will explore how

3. See Kanupriya Kapoor, 'China warns against 'new Cold War' at ASEAN summit' (*Reuters*, 6 September 2023), available at <https://www.reuters.com/world/asean-welcomes-world-leaders-china-us-rivalry-overshadows-region-2023-09-06/>; and Richard Javad Heydarian, 'Will the South China Sea Spark the Next Global Conflict?' (*The Diplomat*, 1 June 2021), available at <https://thediplomat.com/2021/05/will-the-south-china-sea-spark-the-next-global-conflict/>.

4. While it is perhaps best known in the west as the South China Sea, it's also referred to as the West Philippine Sea or the East Sea by many who dispute China's claims over it, see e.g., Yves Bouquet, 'South China Sea or West Philippine Sea?' in *The Philippine Archipelago* (Springer Geography, 2017) 711. I will use "South China Sea" throughout, although this is not to be read as a recognition of China's claims.

these technologies relate to strategies of Chinese maritime lawfare and accompanying gray zone capabilities in the South China Sea. After that, a brief conclusion follows.

2. The South China Sea at a glance

Shortly after the release of the much-advertised Greta Gerwig film 'Barbie', in the summer of 2023, the film was banned in Vietnam.[5] At the heart of the matter lay the so-called '9-dash line' allegedly depicted on a map in the background of one of the film's scenes. The line symbolizes the PRC's contentious claim over large swathes of territory in the body of water that is commonly known as the South China Sea, which goes far beyond its own EEZ as recognised under UNCLOS and customary international law.[6] While the banning of the film was perhaps the first time that some members of the general public heard about the contentious map, the move by Vietnam certainly did not come as a surprise to those familiar with the South China Sea conflict, described as a "flashpoint, with potentially serious global consequences".[7]

For years, the 9-dash line has been a point of serious political contention and international legal argument, but the situation has argua-

5. 'Vietnam bans Barbie film over disputed map of China's South China Sea claims' *The Guardian* (London, 3 July 2023), available at <https://www.theguardian.com/world/2023/jul/03/vietnam-bans-barbie-film-over-disputed-map-of-chinas-south-china-sea-claims>.

6. Aspects of the dispute were also the subject of an important international arbitration case, see *The South China Sea Arbitration (Republic of the Philippines v. People's Republic of China)* Award of 12 July 2016 [2016] PCA Case No 2013-19, available at <http://pcacases.com/web/sendAttach/2086>.

7. 'What is the South China Sea Dispute?' (*BBC*, 7 July 2023), available at <https://www.bbc.co.uk/news/world-asia-pacific-13748349>.

bly escalated in recent times.[8] Incidents and collisions in the contested waters are becoming increasingly frequent.[9] Freedom of Navigation Operations (FONOPS) have been conducted in the region by numerous States to contest China's claims, only for the PRC to add another dash to its line in the summer of 2023.[10] This new 10-dash line controversially encompasses Taiwan and includes the disputed Aksai-Chin plateau and Arunachal Pradesh as part of Chinese territory, which India in particular has vehemently protested through public and diplomatic channels, with other Southeast Asian nations quickly following suit.[11]

However, although the dashes are perhaps one of the most infamous aspects of the conflict, it is by no means the only bone of contention

8. See e.g. Timothy McLaughlin, 'The Most Dangerous Conflict No One Is Talking About' *The Atlantic* (2 December 2023), available at <https://www.theatlantic.com/international/archive/2023/12/south-china-sea-philippines-dispute-explained/676218/>.

9. See for recent incidents between the Philippines and China e.g. Rebecca Ratcliffe, 'The Philippines summons Chinese ambassador after two South China Sea collisions' *The Guardian* (23 October 2023), available at <https://www.theguardian.com/world/2023/oct/23/china-philippines-ships-boats-collision-south-china-sea-vessels-spratly-islands>; 'Philippines accuses China of swarming reef in South China Sea' *BBC* (3 December 2023), available at <https://www.bbc.co.uk/news/world-asia-67605630>; and Rebecca Ratcliffe, 'Manila accuses Beijing of 'dangerous manoeuvres' in the South China Sea' *The Guardian* (5 March 2024), available at <https://www.theguardian.com/world/2024/mar/05/south-china-sea-philippines-accuses-china-coastguard-of-reckless-action-after-collision>.

10. Bamba Galang, 'PH rejects, protests China's expanded 10-dash line in South China Sea' *CNN Philippines* (31 August 2023), available at <http://www.cnnphilippines.com/news/2023/8/31/ph-rejects-china-10-dash-line.html>; Richard Javan Heydarian, 'China's ten-dash line ups the ante with the Philippines' *Asia Times* (1 September 2023), available at <https://asiatimes.com/2023/09/chinas-ten-dash-line-ups-ante-with-the-philippines/>.

11. Cliff Venzon, 'China's new map release infuriates Taiwan, India and maritime neighbours' *The Sydney Morning Herald* (2 September 2023), available at <https://www.smh.com.au/world/asia/china-s-new-map-release-infuriates-taiwan-india-and-maritime-neighbours-20230902-p5e1h2.html>.

playing out in the South China Sea. [12] This is not surprising considering its geospatial and geopolitical attributes. The South China Sea encompasses an area of around 1.4 million square miles and is about 1.5 times larger than the Mediterranean Sea.[13] Right in the heart of Southeast Asia, it forms the crucial connection between the Indian and Pacific Oceans, and so is of huge regional and international relevance. It has been estimated that nearly a third of all global trade and roughly 50% of the world's oil and gas shipments pass through the sea every year.[14] Nearly $3.4 trillion in goods cross the Sea, in 2019 it held about 12% of the world's total fish catch, and according to various estimates it holds around 11 billion barrels of oil and 190 trillion cubic feet of natural gas reserves.[15]

In total, seven governments are currently directly involved as claimants in the disputes over the Sea – the PRC, the Philippines, Vietnam,

12. A related issue, outside of the scope of this article, is China's planned instalment a hundred underwater data centres in the South China Sea, see Jeremy Hsu, 'China's first underwater data centre is being installed' *New Scientist* (4 December 2023), available at <https://www.newscientist.com/article/2405830-chinas-first-underwater-data-centre-is-being-installed; another crucial development outside of the scope of this contribution, concerns undersea internet cables, see e.g. Maurizio Geri, 'South China Sea drills conceal a secret war to control the internet' (*The Hill,* 5 March 2023), available at <https://thehill.com/opinion/national-security/3983240-south-china-sea-drills-conceal-a-secret-war-to-control-the-internet/>.

13. Orde Kittrie, 'Chinese Lawfare in the Maritime, Aviation, and Information Technology Domains' (2023) available at SSRN, available at <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4515674>.

14. Stephen Cody, 'Dark Law on the South China Sea' (2022) 23 (1) *Chicago Journal of International Law* 65-66

15. Benjamin Sacks, 'The Political Geography of the South China Sea Disputes: A RAND Research Primer' (Rand Corporation, Santa Monica October 2022) 3, available at <https://www.rand.org/pubs/perspectives/PEA2021-1.html>; Kittrie (n 13) 7; Anders Corr (ed), *Great Powers, Grand Strategies: The New Game in the South China Sea* (Naval Institute Press 2018) 292; see also e.g. U.S. Geological Survey, *Assessment of Undiscovered Oil and Gas Resources of South East Asia, 2010* (2010) [Fact Sheet].

Taiwan, Malaysia, Brunei, and Indonesia.[16] Other non-claimants, such as Japan, Australia, the United States, as well as other Association of Southeast Asian Nations (ASEAN) nations, and increasingly also the United Kingdom and the European Union, are progressively committed to maintaining existing international law on maritime entitlements and to balancing military and strategic political power in the region.[17] The wealth of natural resources that the South China Sea harbours and its global economic and commercial importance, in addition to its historical importance as comprising territory of several states, have given rise to multiple different layers of disputes.[18] In his 2023 book *China's Law of the Sea: The New Rules of Maritime Order*, Isaac Kardon identifies and analyses the disputes as divided into four analytically separate categories: (1) geographic rules; (2) resource rules; (3) navigation rules; and (4) dispute resolution rules.[19] Each of these categories is an arena of contestation between China and some of its maritime neighbours, the United States, and other countries.[20]

All parties involved, but perhaps in particular the PRC and the United States, are rapidly ramping up their technological capabilities at sea in response to the rising tensions.[21] This trend is expected to persist in

16. Ben Dolven, Caitlin Campbell, and Ronald O'Rourke, 'China Primer: South China Sea Disputes' (21 August 2023) *Congressional Research Service Report* [IF10607] 1

17. Andrew Chubb, 'Dynamics of Assertiveness in the South China Sea: China, the Philippines, and Vietnam, 1970-2015 (2022) *The National Bureau of Asian Research* [NBR Special Report #99] 3

18. Ibid., 2.

19. Isaac Kardon, *China's Law of the Sea: The New Rules of Maritime Order* (Yale University Press 2023) 32-34.

20. Ibid., 34

21. See e.g., Gabriel Honrada, 'China using AI for decisive edge in South China Sea' (*Asia Times*, 6 March 2023), available at<https://asiatimes.com/2023/03/china-using-ai-for-decisive-edge-in-south-china-sea/>; Jonathan Hall, 'Artificial Intelligence in the South China Sea' (*Global Risk Insights*, 28 December 2018), available at <https://globalriskinsights.com/2018/12/artificial-intelligence-turning-tide-asia-pacific/>.

the coming years and, although this development is in some ways still in its infancy, now is the time to closely examine these technological developments and their potential implications for the international legal field and global political relations.

3. Datafication in the South China Sea

The world is undergoing rapid and increasing 'datafication'.[22] This also applies to the maritime domain, including the South China Sea. As Andrew Chubb states: "Today, the South China Sea is seen as one of the world's conflict hot spots, with volumes of information available on daily developments".[23] Quoting a commander from the PRC's People's Liberation Army (PLA), the South China Morning Post recently reported that: "Data collection has become one of our key tasks in regular training, which is now an integral part of our detachment".[24] Moreover, the methods and speed of data collection itself are increasing, and with it, the volume of data collected. This is in part because the collection processes, as well as their analysis, are becoming increasingly

22. See e.g. Sheik Jamil Ahmed, 'Datafication: Unleashing the Power of Data in the Digital Age' (*Medium*, 15 July 2023), available at <https://medium.com/dataduniya/datafication-unleashing-the-power-of-data-in-the-digital-age-1550d82dbd88>.

23. Chubb (n 17) 4

24. Minnie Chan, 'Chinese navy looks to big data to give it an edge' *South China Morning Post* (10 October 2023), available at <https://www.scmp.com/news/china/military/article/3237356/chinese-navy-looks-big-data-give-it-edge>. See for a short introduction to the PLA e.g. Caitlin Campbell, 'China Primer: The People's Liberation Army (PLA)' (26 September 2023) Congressional Research Service [Doc IF 11719], available at <https://crsreports.congress.gov/product/pdf/IF/IF11719>.

automated.[25] These are important factors in the pursuit of dominance in 'algorithm confrontation' i.e. the idea behind PRC's key operational concept of 'intelligentized warfare', which holds that the side with the data and algorithm advantage in a dispute or conflict will prevail.[26]

Datafication has long taken place in the maritime realm. Whether for the purposes of marine research or tracking shipping traffic, new databases proliferate. The examples in the following subsections discuss different types of data and data collection initiatives to illustrate the wealth of data and variety of data types that exist about the South China Sea. While these examples demonstrate that smaller, manually collected datasets have long existed and that the quantitative, data-driven study of maritime disputes has been a staple of the domain, they simultaneously illustrate the upward trend of datafication. AI requires data, in large quantities and preferably well curated and annotated, with reliable meta-data for the purpose of training and validation of models. In light of this fact, it is therefore instructive to examine the existing practices and level of datafication, to better understand the feasibility, variety and quality of AI-powered applications that could be developed by leveraging these different data types.

25. Kristen Gunnes, 'China's Gray-Zone Capabilities in the East China Sea' in J W Greenert (ed), *Murky Waters in the East China Sea: Chinese Gray-Zone Operations and U.S.-Japan Alliance Coordination* (May 2021) *The National Bureau of Asian Research* [Special report #90] 16. See also Ryan Fedasiuk, Jennifer Melot, and Ben Murphy, 'Harnessed Lightning: How the Chinese Military is Adopting Artificial Intelligence' (Center for Security and Emerging Technology, October 2021) 18, 51; Anthony Capaccio, 'US Navy, UK, Australia Will Test AI System to Help Crews Track Chinese Submarines in the Pacific' (*Bloomberg*, 2 December 2023), available at <https://www.bloomberg.com/news/articles/2023-12-02/us-navy-will-test-ai-system-to-help-crews-track-chinese-subs-in-the-pacific>.

26. Infra Section 5; For more information on these notions and other key operational concepts of the PLA, see Edmund J Burke and others, 'People's Liberation Army Operational Concepts' (29 September 2020) RAND Corporation Research Report [Doc No RR-A394-1], esp. 21-23.

3.1 Conflict & claims data

As part of the Maritime Awareness Project (MAP) at the National Bureau of Asian Research (NBR), which covers maritime security issues in the Indo-Pacific through mapping technology and analysis, a Special Report was published in 2022 entitled 'Dynamics of Assertiveness in the South China Sea: China, the Philippines, and Vietnam, 1970–2015'.[27] This report, written by Andrew Chubb, draws on qualitative and quantitative data to provide an original data-focused analysis and to identify historical trends of assertive behaviour between these states and assess the implications for the disputes in the South China Sea. The report is accompanied by the Maritime Assertiveness Visualization Dashboard – an interactive online tool illustrating key findings.[28] Drawing on the standardised events data from the Maritime Assertiveness Time Series (MATS) dataset, categorised by Chubb into four categories of assertiveness,[29] users have the opportunity through the report and the dashboard "to explore key trends and relationships encased in the data".[30]

In a similar vein, *Issue Correlates of War* (ICOW), founded by Paul Hensel, is a research project that "is collecting systematic data on contentious

27. Chubb (n 17).

28. 'Maritime Assertiveness Visualization Dashboard (MAVD)' (2022), available at <https://experience.arcgis.com/experience/650184911 7f8482093427d243929c629/>. See for an analysis of the use of dashboards in the humanitarian context and on the notion and implications of "dashboard fever" Fleur E Johns, *#Help: Digital Humanitarianism and the Remaking of International Order* (OUP 2023) 167-168.

29. These include 'statements and actions that advance the claimants' position in a dispute': (1) declarative, (2) demonstrative, (3) coercive, and (4) use of force; the events can be categorized by domain of contestation, specific issue, target country, and geographic area, see Darlene Onuorah and Olivia Truesdale, 'Foreword' in Chubb (n 18).

30. Johns (n 28) 167-168.

issues in world politics".[31] It began over 20 years ago with data collection and now comprises four different issue data sets on territorial, identity, river, and maritime claims.[32] The subset of maritime claims, led by Sarah Mitchell, has been described as "the most comprehensive source of data on maritime disputes worldwide".[33] Supplementary datasets for the ICOW Project are included to help in subsequent data collection and analysis and are used for testing hypotheses. They concern colonial history, historical State names, multilateral treaties of pacific settlement, and non-State actors.[34] The Asia Maritime Transparency Initiative (AMTI) project includes visualizations of the maritime claims of the Indo-Pacific, as well as the outcomes of the 2016 *Philippines v China* case at the Permanent Court of Arbitration (with an accompanying 'Arbitration Support Tracker').[35] Similarly, the Institute for China-America Studies published a South China Sea Maritime Tracker in 2020.[36]

This type of data is useful for keeping up with the arguments, claims, and assertions made by States that are of international legal relevance. As the PRC notoriously does not specifically or publicly announce the extent of its claims, giving the appearance of incrementally ever-expanding

31. Paul Hensel and Sara McLaughlin Mitchell, 'Project Description' (17 November 2019), available at <http://www.paulhensel.org/icow.html#desc>.

32. Bryan Frederick, Paul Hensel, Christopher Macaulay, 'The Issue Correlates of War Territorial Claims Data, 1816-2001' (2017) 54 (1) *Journal of Peace Research* 99; Paul Hensel and Sarah McLaughlin Mitchell, 'From territorial claims to identity claims: The Issue Correlates of War (ICOW) Project' (2017) 34 (2) *Conflict Management and Piece Science* 126.

33. Chubb (n 17) 4. See also Sara McLaughlin Mitchell, 'Clashes at Sea: Explaining the Onset, Militarization, and Resolution of Diplomatic Maritime Claims' (2020) 29 (4) *Security Studies* 637.

34. Ibid.

35. Asia Maritime Transparency Initiative, 'Arbitration Support Tracker' (18 July 2023), available at <https://amti.csis.org/arbitration-support-tracker/>.

36. ICAS Maritime Issue Tracker Team, 'The South China Sea Maritime Tracker: China's Sovereignty and Sovereign Rights and Jurisdiction Claims' (3 September 2020), available at <https://storymaps.arcgis.com/stories/a08a8e24badc4ea68b7cafbc3cfc556a>.

maritime claims, such data and data visualization tools may be useful in keeping up with changing assertions.[37]

3.2 Public opinion & social media data

The South China Sea Data Initiative project, led by political scientists Renard Sexton and Nico Ravanilla, aims to, amongst other things: "create a new, systematic dataset documenting conflict in the South China Sea over the past decade"; "collect and analyse elite and public opinion survey data from littoral countries"; and "generate policy-relevant and theoretically-driven empirical analysis about international relations, conflict and globalization".[38] Their data collection, spanning from 2012-2020, includes both discrete events and reports, i.e. individual news items that provide information about the activities that occurred and the location of an event.[39]

Other potential types of data in this category include social media data that facilitates, for example, social media analytics and sentiment analysis.[40] An example from a different context of how social media data can be useful, beyond giving insights into public opinion, is 'Twiplomacy'. In a 2019 article, a data-driven approach, albeit still manually conducted, was used to shed light on the relationship between social media data and

37. Galang (n 10).

38. 'The South China Sea Data Initiative' (2024), available at <https://scsdi.org/>.

39. Ibid. See also Nico Ravanilla and Renard Sexton, 'South China Sea Data Initiative Public Opinion Survey Pre-Analysis Plan' [unpublished pre-analysis plan available on OSF] (September 2021), available at <https://osf.io/dtf9z>.

40. See e.g. Lei Guo, Kate Mays and Jianing Wang, 'Whose Story Wins on Twitter?' (2019) 20 (4) *Journalism Studies* 563; Hongyu Wang and Tianji Cai, 'Media exposure and Chinese college students' attitudes toward China's maritime claims and disputes in the South and East China Seas' (2018) 4 (1) *Cogent Social Sciences;* On the role of sentiment in this context, see e.g. David Groten, *How Sentiment Matters in International Relations: China and the South China Sea Dispute* (Columbia University Press, 2019).

customary international law.[41] The author analysed the language used in Tweets from official State accounts to see to what extent they bore out their *opinio juris*, as a constitutive element of customary international law.[42] In this way, insofar as international legal arguments and maritime claims by States are being presented on social media platforms, this data might be increasingly relied on in the international law context.

These data types could, for example, be used to gain insights into how State endorsed narratives are accepted by the general population as well as track their further spread on social media. This data type is therefore interesting from the perspective of a State, like the PRC, that has an interest in how its diplomatic, strategic, and legal approaches are being received, both domestically and internationally.[43]

3.3 Geospatial data

Geospatial data, such as marine scientific research data, for example datasets like those from the United States government's National Center for Environmental Information (NCEI), could be of primary importance for gaining an edge in the South China Sea.[44] The NCEI receives oceanographic data from different observing systems and has the world's larg-

41. J A Green, 'The Rise of Twiplomacy and the Making of Customary International Law on Social Media' (2022) 21 (1) *Chinese Journal of International Law* 1 [in which the author argues that States' increased use of social media for issuing official statements means that this material has become part of the "raw material" of customary international law].

42. See on this also Emilie van den Hoven, 'A Computational Turn in Customary International Law' in Irene Couzigou and Edouard Fromageau, *International Law and Technological Change: Testing the Adaptability of International Law* (Edward Elgar Press, forthcoming).

43. See on the importance of legal narrative in international law Aurel Sari, 'Norm Contestation for Strategic Effect: Legal Narratives as Information Advantage' (2023) 83 *ZaöRV* 119-153.

44. National Center for Environmental Information: National Oceanic and Atmospheric Administration' (*NCEI*, 12 June 2023), available at <https://www.ncei.noaa.gov/news/new-daily-international-comprehensive-ocean-atmosphere-data-set>.

est collection of surface and marine observations, i.e. the International Comprehensive Ocean Atmosphere Data Set (ICOADS), spanning from 1662 to the present day.[45] This dataset includes environmental data on sea surface temperature, air temperature, sea level pressure, and wind speed and direction. These observations are gathered from ships, buoys, oil rigs and coastal offshore structures, as well as increasingly by autonomous vehicles such as drones. The abovementioned AMTI project is also relevant with regard to this data type, as it "strive[s] to provide the most complete, accurate, and up-to-date source of geospatial information on maritime Asia".[46] It includes maps on South China Sea energy exploration and development, depicting China's maritime power projection network, and the South China Sea's features.

While the collection of this type of data is by no means unique to China, the PRC has the world's largest fleet of civilian research vessels that serve a dual-purpose function of conducting scientific research that can also be used to advance key strategic ambitions.[47] In a 2024 report by the Center for Strategic and International Studies, maritime activity data was collected using the AI-driven Windward Intelligence platform.[48] This data revealed that Chinese research vessels carried out hundreds of thousands of hours of operations globally over the past few years, including in the South China Sea, providing the PLA with critical data to enhance its knowledge of the undersea environment. As the report

45. International Comprehensive Ocean-Atmosphere Data Set' (last updated 7 October 2023), available at <https://icoads.noaa.gov/>.

46. Asia Maritime Transparency Initiative, 'Maps of the Asia Pacific' (2024), available at <https://amti.csis.org/maps/>; Infra Section 3.1.

47. Matthew P Funaiole, Brian Hart and Aidan Powers-Riggs, 'Surveying the Seas: China's Dual-Use Research Operations in the Indian Ocean' (*Center for Strategic and International Studies*, 10 January 2024) [Hidden Reach Report], available at <https://features.csis.org/hiddenreach/china-indian-ocean-research-vessels/>.

48. See the Windward company website, available at <https://windward.ai/solutions/predictive-risk-insights/>.

emphasises, such data is "a crucial precursor to confidently deploying naval forces abroad".[49]

3.4 Vessel and shipping traffic data

The United Nations Conference on Trade and Development (UNCTAD) estimated in 2015 that ca. 80 percent by volume and 70 percent by value of all trade is transported by sea.[50] A third of global shipping passes through the South China Sea.[51] Given the amount of shipping and vessel traffic, there is also an astounding amount of data available. Global Maritime Traffic, as only one example, is a service developed to deliver:

> [O]pen access to important information about changing global maritime traffic patterns, providing international maritime stakeholders and policymakers with actionable intelligence to support critical maritime safety, efficiency and sustainability initiatives. Our purpose is to observe and document maritime patterns to enable better coordination of global marine activities.[52]

Additionally, they also offer a Global Maritime Traffic Density Service (GMTDS), which is provided by the U.S. National Geospatial-Intelligence Agency (NGA) and is purported to enhance maritime safety. This service was developed to "collect and apply advanced analytics to hundreds of billions of [Automatic Identification System] messages data

49. Funaiole (n 47)

50. UNCTAD, 'Review of Maritime Transport report 2015' (2015) UNCTAD/RMT/2015.

51. See ChinaPower Project by the Center for Strategic and International Studies in Washington D.C., https://chinapower.csis.org/much-trade-transits-south-china-sea/#easy-footnote-bottom-1-3073.

52. Global Maritime Traffic, 'Improving Access to Maritime Data and Analytics' (Last updated 2022), available at <https://globalmaritimetraffic.org>.

from multiple sources".[53] This "cutting edge geo-analytics and massive computing power" supports actors in use cases such as critical navigation safety analysis, fishing activity monitoring, port activity monitoring, and environmental and economic activity monitoring.[54]

There are many other providers of such tailored services who make this type of data open access about vessel and ship traffic, with examples including Marine Vessel Traffic, Ship Location, and Spire Maritime.[55] Moreover, the International Monetary Fund (IMF) and the World Bank, using various machine learning and spatial data processing techniques, have undertaken a joint effort to map out and "harness the wealth of information generated by [Automatic Identification System] messages and determine whether these insights can inform trade analysis, development work, and public policies".[56] This demonstrates the relevance and increasing employment of these data types for international actors to gain insights into these issues and inform their strategies and policies.

53. Ibid; see especially 'GMTDS Methodology and Output' section.

54. Ibid.

55. See respectively: Marine Vessel Traffic, 'South China Sea Ship Traffic Live Map', available at <https://www.marinevesseltraffic.com/SOUTH-CHINA-SEA/ship-traffic-tracker>; Ship Location, 'South China Sea Ship Traffic Live Map', available at <https://www.shiplocation.com/wikishipia/regions/rivers/SOUTH-CHINA-SEA/MARINE-TRAFFIC>; On Spire Maritime also see Section 4.1 on AI and tracking, where a concrete example is given of how this type of data is leveraged in AI-powered applications to track down specific vessels that are potentially in violation of international law.

56. Diego Cerdeiro et al., 'Using marine spatial data to inform development work and public policies' (*World Bank Blogs*, 28 February 2022), available at <https://blogs.worldbank.org/opendata/using-marine-spatial-data-inform-development-work-and-public-policies>; also see generally on AI and International Organisations like the World Bank and the IMF, Emilie van den Hoven, 'Making the Legal World: Normativity and International Computational Law' (2022) 3 (1) *Communitas* 31, 39-42.

3.5 Sensor data

In 2016, one of China's largest state-owned shipbuilding corporations was reported to have suggested the construction of an 'Underwater Great Wall Project' consisting of ships and subsurface sensors.[57] This was reported as having the potential to "significantly erode the undersea warfare advantage held by U.S. and Russian submarines and contribute greatly to China's future ability to control the South China Sea".[58] Some of these sensors form part of 'Argo', a global scientific observation project that involves close to 30 countries, which together manage a global array of almost 4000 robotic profiling floats and sensors. PRC involvement in such an initiative has also been described by some commentators as a move to 'boost scientific data in disputed waters' to the benefit of the PLA.[59]

Although the purpose of sensor data collection is often scientific in nature, some simultaneously view these initiatives as another part of China's efforts to control the Sea:

> It is unrealistic to assume that [the Chinese Navy's] sensor data cannot be accessed by the [People's Liberation Army Navy] for military purposes. And they may be part of a much larger sensor network, most of which

57. Although sensor data can perhaps better be described as a *method* for collecting certain data types, particularly geospatial data, connected to specific type of hardware, the various ongoing initiatives in this domain warrant its separate discussion here.

58. Catherine Wong, ''Underwater Great Wall': Chinese firm proposes building network of submarine detectors to boost nation's defence' *South China Morning Post* (19 May 2016), available at <https://www.scmp.com/news/china/diplomacy-defence/article/1947212/underwater-great-wall-chinese-firm-proposes-building>.

59. See for more information on Argo: National Oceanic and Atmospheric Administration (Global Ocean Monitoring & Observing), available at <https://globalocean.noaa.gov/research/argo-program/>; Viola Zhou, 'Beijing deploys sensors in South China Sea to boost scientific data in disputed waters' *South China Morning Post* (13 October 2016), available at <https://www.scmp.com/news/china/diplomacy-defence/article/2027687/china-deploys-south-china-sea-sensors-boost-scientific>.

> is unseen beneath the waves. This reinforces China's strategic advantage over other countries in the region, and can be used to monitor U.S. Navy movements.[60]

This type of data forms an important part of what China calls the 'Blue Ocean Information Network'.[61] Research done by the AMTI reported that the state-owned China Electronics Technology Group Corporation (CETC) presented three long-term goals for an extensive future Blue Ocean Information Network, which AMTI summarised as: (1) *2025* – "Complete construction of the Blue Ocean Information Network in 'key maritime areas of [Chinese] jurisdiction' and begin 'Belt and Road' marine network construction"; (2) *2035* – "Build out the 'Belt and Road' marine network to fully support the construction of China's Maritime Silk Road"; and (3) *2050* – "Expand construction to the 'oceanic polar information network' and lead development of the 'global ocean information industry.'"[62]

4. Artificial intelligence in the South China Sea

One may expect that where data is available and stakes in prediction, analysis, classification, and pattern recognition are high, AI will make its ap-

60. H Sutton, 'China Builds Surveillance Network In South China Sea' (*Forbes*, 5 August 2020), available at <https://www.forbes.com/sites/hisutton/2020/08/05/china-builds-surveillance-network-in-international-waters-of-south-china-sea/>.

61. Joseph Trevithick, 'South China Sea Underwater "Environmental" Sensor Net Could Track U.S. Subs" (*The Drive*, 29 June 2019), available at <https://www.thedrive.com/the-war-zone/10906/south-china-sea-underwater-environmental-sensor-net-could-track-u-s-subs>.

62. Asia Maritime Transparency Initiative (AMTI), 'Exploring China's Unmanned Ocean Network (16 June 2020), available at <https://amti.csis.org/exploring-chinas-unmanned-ocean-network/>.

pearance – sooner rather than later. It is therefore perhaps unsurprising that AI is already of great importance in the maritime industry. Key industry players are increasingly working with AI to improve automation processes, replacing manual input with data-driven and predictive information, or to detect patterns and anomalies using large datasets. AI is employed in fleet management to optimize routes, predict maintenance needs, and enhance scheduling. It has also been used to enable more efficient resource allocation, cost reduction and to maximize fleet performance.[63]

Beyond these uses of AI for industry, various types of AI-driven applications are being developed with different purposes for usage by States and other international actors, such as: (1) to monitor (State) conduct and facilitate various forms of observation and tracking; (2) to execute or conduct operations to varying degrees of autonomy; and (3) generate new strategies or devise courses of action. These purposes are not exhaustive nor mutually exclusive but serve to provide insight into different AI-powered systems for the maritime domain, including by way of examples in the South China Sea context, that could be developed leveraging the various data types outlined in the previous section.[64]

4.1 Artificial intelligence for monitoring and tracking

SynMax is a firm that specialises in machine learning applications for the maritime domain. Its intelligence product, 'Theia', works by fusing

63. Spire Maritime, 'Maritime Artificial Intelligence & Machine Learning: Ultimate Guide', available at <https://spire.com/maritime/maritime-artificial-intelligence-and-machine-learning/>.

64. Crucially for the context of this contribution, one can for example also think of using AI-driven systems, such as unmanned maritime vehicles, for the purpose of gathering more data, see e.g. Stephen Chen, 'Beijing plans an AI Atlantis for the South China Sea – without a human in sight' *South China Morning Post* (26 November 2018), available at <https://www.scmp.com/news/china/science/article/2174738/beijing-plans-ai-atlantis-south-china-sea-without-human-sight>; Gunnes (n 25) 16.

multiple data streams, and it is claimed that the company's proprietary approach enables them to detect and identify vessels that engage in the illegal deception of navigation systems by turning off AIS signals and synthetically projecting AIS locations, a practice better known as 'AIS spoofing'.[65] For example, it has been reported that Theia has been used to combine Spire Maritime's AIS data with satellite imagery "in a way that negates any advantage that a dark ship may utilize in an effort to stay hidden".[66] It is also reported that Theia has been successfully used by leading maritime insurance providers to support the ascertainment of whether a specific vessel was engaging with Iran and taking on sanctioned oil. According to the AIS data in that case, the vessel seemed to be staying in a single location outside Iranian waters but "Theia's ability to automatically identify, attribute and track vessels at scale helped the insurance provider to see beyond the AIS data and ensure compliance with the law".[67] Systems like this are already being used by important international actors like the United Nations and will likely swiftly become increasingly important in the evidentiary processes that lie at the root of proving and sanctioning past or present violations of maritime law.[68]

Remote sensing satellites powered by AI are also increasingly used to track vessels in real-time. Chinese researchers, with the use of an AI-driv-

65. "AIS spoofing" has been defined as providing falsified identification information, whereas turning off automatic identification system signals has been described as "going dark", see Windward, 'AIS Spoofing: new technologies for new threats' (4 December 2022), available at <https://windward.ai/blog/ais-spoofing-new-technologies-for-new-threats/>; Spire Maritime, 'Uncovering dark vessels with fusion technology', available at <https://spire.com/case-study/maritime/uncovering-dark-vessels-with-fusion-technology/>.

66. Matkov (n 2).

67. Ibid.

68. The firm Windward is predictive intelligence company that has developed Maritime AI that offers similar functionality. The United Nations is listed on their website as a customer and quoted as having said that "Windward is a valuable source of intelligence for the Panel's investigations concerning maritime sanctions and North Korea', available at <https://windward.ai/solutions/predictive-risk-insights/>.

en satellite, were reportedly able to automatically identify an aircraft carrier and alert Beijing with the precise coordinates.[69] In another test of the 'space-based AI', the same satellite detected and obtained coordinates of military aircraft, naval ships, and strategic assets like oil storage tanks.[70] According to reports, the Chinese government is planning extensive global satellite projects with satellites carrying AI processors.[71] As Chen points out, "these smart communication satellites could receive and analyse raw data from traditional remote sensing satellites, identify targets of interest, and then pass the information to end users at home with little time delay".[72] Whereas in the past, the Chinese military would have had to collect and analyse huge amounts of raw satellite data, and results would not be known until much longer after the event, these new computational resources would exponentially strengthen China's real-time monitoring capabilities.

4.2 Autonomous Maritime Vehicles

The use of Unmanned Maritime Vehicles (UMVs) is by no means a new phenomenon. For example, unmanned surface vessels were used in nuclear weapons tests to collect radioactive water samples in 1946 at Bikini Atoll, and remote-controlled unmanned boats were used for minesweep-

69. Tanmay Kadam, ""Tracking America" — China Claims Its AI-Powered Satellite Monitored US Naval Activity In New York In 'Real Time' (*The EurAsian Times,* 10 May 2022), available at <https://eurasiantimes.com/tracking-america-china-claims-its-ai-powered-satellite-monitored/>.

70. Stephen Chen, 'Chinese smart satellite tracks US aircraft carrier in real time, researchers say' *South China Morning Post* (10 May 2022), available at <https://www.scmp.com/news/china/science/article/3177079/chinese-smart-satellite-tracks-us-aircraft-carrier-real-time>.

71. Andrew Jones, 'China conducts launch to test satellite internet capabilities' (*SpaceNews*, 23 November 2023), available at <https://spacenews.com/china-conducts-launch-to-test-satellite-internet-capabilities/>.

72. Chen (n 70).

ing operations during the Vietnam war.[73] However, the use of uncrewed and autonomous maritime systems has grown rapidly over the past few years as a result of progress in AI, and more specifically developments in machine learning. For example, more than ninety countries and non-state actors operate surveillance or weaponised crewless systems in support of combat operations.[74] The capacity and capabilities of UMVs have been augmented drastically and they are now used to provide enhanced situational awareness, reduce human workload, and improve mission performance, at reduced risk to personnel and at reduced cost. Such is their contribution that Keating has stated that:

> The time may come when ocean shipping is done by fully autonomous vessels. Even now, AI can support human crews on vessels at sea to improve compliance with the international law of the sea, including the UN Convention on the Law of the Sea (UNCLOS) and other treaties and norms that govern hydrographic charting and safe navigation.[75]

In 2018, the International Maritime Organization (IMO) adopted a framework for Maritime Autonomous Surface Ships (MASS), i.e. ships that can operate independently of human interaction to varying degrees.[76]

In early 2023, China inducted an unmanned research vessel equipped with an autonomous navigation system ('Zhu Hai Yun') that is capable

73. Raul Pedrozo, 'Unmanned and Autonomous Warships and Military Aircraft', in James Kraska ad Young Kil Park (eds), *Emerging Technology and the Law of the Sea* (CUP, 2022) 275-6.

74. Ibid., 273.

75. Steven Geoffrey Keating, 'Artificial Intelligence to Facilitate Safe Navigation of Ships', in Kraska and Park (n 73).

76. International Maritime Organisation, 'Framework for the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships (MASS)' (7 December 2018) Doc. MSC/100/20, annex 2, para 3-4.

of carrying smaller, sensor-equipped Unmanned Surface Vehicles (USV), Unmanned Underwater Vehicles (UUV), and Unmanned Aerial Vehicles (UAV) for monitoring purposes.[77] It was reported that "even though the vehicles were designed for marine scientific research, they will be used to gather intelligence in the disputed South China Sea".[78] In addition to this, there have been reports suggesting that China is working on improving undersea target detection and recognition on the basis of deep learning-based image recognition and target identification systems for undersea vehicles.[79]

5. Strategy generation and simulation

AI is also being put to use in the sensitive areas of diplomacy and strategic decision-making. In 2018, the Chinese Ministry of Foreign Affairs confirmed to the South China Morning Post that they were making use of an early prototype of an AI-driven system for diplomatic

77. Alia Shoaib, 'China launched the world's first AI-operated 'mother ship,' an unmanned carrier capable of launching dozens of drones' (*Business Insider*, 11 June 2022), available at <https://www.businessinsider.com/china-launches-worlds-first-ai-unmanned-drone-aircraft-carrier-2022-6?international=true&r=US&IR=T>; Baird Maritime, 'Vessel Review: Zhu Hai Yun – Chinese-built drone mothership boasts autonomous sailing systems (*Baird Maritime*, 31 March 2023), available at <https://www.bairdmaritime.com/work-boat-world/specialised-fields/marine-research-and-training/vessel-review-zhu-hai-yun-chinese-built-drone-mothership-boasts-autonomous-sailing-systems/>.

78. Prakash Panneerselvam, 'Unmanned Systems in China's Maritime 'Gray Zone Operations' (*The Diplomat*, 23 January 2023), available at <https://thediplomat.com/2023/01/unmanned-systems-in-chinas-maritime-gray-zone-operations/>.

79. Ryan Fedasiuk, 'Leviathan wakes: China's growing fleet of autonomous undersea vehicles' (*Center for International Maritime Security*, 17 August 2021), available at <https://cimsec.org/leviathan-wakes-chinas-growing-fleet-of-autonomous-undersea-vehicles/>.

purposes.[80] This system reportedly "draws on huge amounts of data, with information ranging from cocktail-party gossip to images taken by spy satellites" to contribute to forming Chinese diplomatic strategies.[81] Although it is difficult to gauge the level of sophistication, the quality of the output of such systems, or the pervasiveness of usage by the Chinese State, in large part due to the secrecy around such developments, similar initiatives in other States signal the interest in the deployment of digital or AI-driven diplomacy.[82]

AI applications are also being developed for various types of simulations, such as naval 'war-gaming'[83] or simulations related to China's artificial island building activities in the South China Sea. In the context of the latter, a programme was reported in Spring 2023 as already being used by China.[84] This was construed by commentators as a move that "could help to bolster [China's] maritime claims in the hotly contested maritime region".[85] This AI-driven computer simulation system is purported to predict price tags for the construction, operation, and main-

80. Stephen Chen, 'Artificial Intelligence, immune to fear or favour, is helping to make China's foreign policy' *South China Morning Post* (30 July 2018), available at <https://www.scmp.com/news/china/society/article/2157223/artificial-intelligence-immune-fear-or-favour-helping-make-chinas>.

81. Ibid.

82. See e.g. DiploFoundation, 'Mapping the challenges and opportunities of artificial intelligence for the conduct of diplomacy (2019) [commissioned by the Finnish Ministry of Foreign Affairs]; F Cafiero, 'Datafying diplomacy: How to enable the computational analysis and support of international negotiations' (2023) 71 *Journal of Computational Science* 1.

83. See e.g. Sentient Digital (SDi), 'AI Naval wargaming: SDi's fleet emergence' (21 December 2023), available at <https://sdi.ai/blog/naval-wargaming-fleet-emergence/>; Stephen Chen, 'Chinese scientists work on powerful new 'submarine killer' with eye on US far into the South China Sea' *South China Morning Post* (4 November 2023), available at <https://www.scmp.com/news/china/science/article/3240039/chinese-scientists-work-powerful-new-submarine-killer-eye-us-far-south-china-sea>.

84. Honrada (n 21).

85. Ibid.

tenance of a logistics network across dozens of islands in the area. It was also reported that this network would boost China's economic activity and its claims in the disputed area.[86]

A 2021 study by the Center for Security and Emerging Technology examined nearly 350 artificial intelligence-related equipment contracts awarded by the People's Liberation Army (PLA) and concluded that "Chinese leaders view AI as the key to transforming the PLA into a "world-class" globally competitive military force".[87] Unsurprisingly, the authors conclude that these advances in AI and autonomy will create new vulnerabilities for other States' forces operating in the Indo-Pacific. As this and the sections above demonstrate, the development of AI systems for usage in the context of the South China Sea by the PRC is in full swing.

It is also clear that the PRC is adopting an increasingly expansive and confrontational approach to asserting its maritime claims over the South China Sea. As datafication and AI are leveraged in the pursuit of these approaches, this could have multifaceted implications for the maritime domain and international law of the sea.[88] So where and how do these two developments collide? In a first attempt to shed light on these questions, the next section explores two related strategies employed by the PRC in the South China Sea: 'lawfare' and 'gray zone capabilities.'

86. Stephen Chen, 'AI just predicted the price tag for Beijing's South China Sea ambitions' *South China Morning Post* (3 March 2023), available at <https://www.scmp.com/news/china/science/article/3212199/ai-just-predicted-price-tag-beijings-south-china-sea-ambitions>.

87. Fedasiuk (n 25) iv.

88. See e.g. also Ifesinachi Okafor-Yarwood, 'West Africa's coast was a haven for piracy and illegal fishing – how technology is changing the picture' (*The Conversation*, 6 March 2024), available at <https://theconversation.com/west-africas-coast-was-a-haven-for-piracy-and-illegal-fishing-how-technology-is-changing-the-picture-222803>.

6. Algorithmic lawfare in the data-driven gray-zone of the South China Sea?

It is evident that AI is playing an increasingly crucial role in China's military and political strategies, and thus in the PRC's actions in the South China Sea. The question then becomes, what might the repercussions of this be for other key players in the maritime domain and for the international law of the sea? There are many ways to look at this question. The focus here is on a relatively less discussed angle through which these developments can be examined: 'lawfare' and related 'gray zone tactics.'[89] These notions constitute key operational concepts of the PRC's legal and political strategies. Lawfare has traditionally been described as the use, or misuse, of law as a substitute for traditional military means to achieve an operational objective.[90] The Chinese notion of *falu zhan,* translated as 'legal warfare', has been an essential element of China's strategic doctrine of 'Three Warfares' for a long time.[91] In

89. But see e.g. Marta Hermez, 'Global Commons and the Law of the Sea: China's Lawfare Strategy in the South China Sea' (2020) 22 *International Community Law Review* 559-588; Douglas Guilfoyle, 'The rule of law and maritime security: understanding lawfare in the South China Sea' (2019) 95 (5) *International Affairs* 999, 1005; Jill I Goldenziel, 'Law as a Battlefield: The U.S., China and the Global Escalation of Lawfare' (2020) 106 *Cornell Law Review* (2021) 1085; and Braden Leach, 'Lawfare for the Future' (2023) 2023 *University of Illinois Journal of Law, Technology & Policy* 51.

90. Charles J Dunlap, 'Lawfare Today: A Perspective' (2008) 3 *Yale Journal of International Affairs* 146, 146. See for a short history on the different definitions of Lawfare Wouter G Werner, 'The Curious Career of Lawfare' (2010) 43 (1) *Case Western Reserve Journal of International Law* 61-72.

91. The other two being psychological warfare (the use of certain information, like propaganda, deception, coercion to influence an adversary's decision-making) and media or public opinion warfare (influencing domestic and international law public opinion) respectively, see Michael Clarke, 'China's Application of the 'Three Warfares' in the South China Sea and Xinjiang' (2019) 63 (2) *Orbis* 187, 191-92]; Peter Mattis, 'China's Three Warfares' in Perspective' (*War on the Rocks*, 30 January 2018), available at <https://warontherocks.com/2018/01/chinas-three-warfares-perspective/>.

2003, this doctrine and the concept of legal warfare were explicitly set out and approved by the Chinese Communist Party Central Committee and the Chinese Military Commission.[92] Since then, the PRC has sometimes been referred to as the most explicit and active practitioner of lawfare.[93] Goldenziel defines lawfare as 'the purposeful use of law taken toward a particular adversary' either with the goal of achieving a particular (strategic, operational, or tactical) objective, to bolster the legitimacy of one's own such objectives, or to weaken the legitimacy of those objectives of an adversary.[94] Lawfare can broadly be understood as shaping the legal context and building legal justifications for such actions.[95]

Gray zone tactics are a related, albeit arguably somewhat broader, category of operations that are 'designed to exploit or create legal (and other) uncertainties for a military or strategic advantage' or that fall short of warfare but are arguably beyond normal diplomatic, economic, or other activities.[96] Although not a legal concept per se, gray zone tactics "leverage legal categories and relationships […] to advance strategic objectives".[97] Moreover, it entails the use of "tools below the threshold of war to shift international rules, norms, distribution of goods, and patterns of authority to their benefit".[98] Both these notions are therefore linked

92. Clarke (n 91) 191.

93. Ordre F Kittrie, *Lawfare: Law as a Weapon of War* (OUP, 2016) 161.

94. Goldenziel (n 89) 1097.

95. Peter Mattis, 'China's Three Warfares' in Perspective' (*War on the Rocks*, 30 January 2018), available at <https://warontherocks.com/2018/01/chinas-three-warfares-perspective/>.

96. Rob McLaughlin, 'The Law of the Sea and the PRC Gray-Zone Operations in the South China Sea' (2022) 116 (4) *The American Journal of International Law* 821; also see Bonny Lin et al., 'A New Framework for Understanding and Countering China's Gray Zone Tactics' (Santa Monica, CA: Rand Corporation, 2022) 1.

97. McLaughlin (n 96) 825.

98. Michael J Mazarr, *Mastering the Gray Zone: Understanding a Changing Era of Conflict* (US Army War College Press, 2015) 12.

by falling into the gray spaces in between traditional categories of 'law' and 'not law' and 'war' and 'not war', with an aim to thwart, destabilize, weaken, attack, or constrain an adversary's operational freedom.[99] Indeed, this approach also is sometimes jointly been described as 'Gray Zone Lawfare'.[100]

The PRC's employment of lawfare is particularly clear in the maritime domain. China asserts time and again that their contentious maritime activities are permissible under international law.[101] As Kardon rightly notes, this is clearly an intentional strategy: "underlying and enabling all of this activity is a more fundamental, if less immediately visible, tool of PRC maritime policy: the instrument of international law".[102] Contrary to popular perception, Beijing attaches much value to (international) law in its maritime dealings, albeit in an instrumental and strategic way. China's maritime lawfare strategy in the South China Sea actively seeks to push the boundaries of what constitutes an acceptable interpretation of international law, as recognised under the UNCLOS and customary international law. Two senior U.S. Navy attorneys, James Kraska and Brian Wilson, have noted that:

> Chinese strategists have taken an increasing interest in international law as an instrument to deter adversaries prior to combat … [including by shifting the law of the sea] away from long-accepted norms of freedom

99. Atlantic Council, 'Today's Wars Are Fought in the "Gray Zone." Here's Everything You Need to Know About It' *Hybrid Conflict Project* (23 February 2022), available at <https://www.atlanticcouncil.org/blogs/new-atlanticist/todays-wars-are-fought-in-the-gray-zone-heres-everything-you-need-to-know-about-it>.

100. Kittrie (n 13) 7.

101. See e.g. some of the arguments made in Chinese Society of International Law, 'The South China Sea Arbitration Awards: A Critical Study' (2018) 17 *Chinese Journal of International Law* 555-885 and the analysis of some of those arguments in terms of Lawfare in Hermez (n 89) 573-577.

102. Kardon (n 19) 5; Kittrie (n 93) 165.

> of navigation and toward interpretations of increased coastal state sovereign authority.[103]

They ominously warn that "China continues to advance on the battlefield of international law".[104]

The confrontational use by the PRC of non-uniformed maritime militia or fishing boats and fishermen in the South China Sea, the publication by the Chinese Society of International Law to elaborately and publicly reject the 2016 ruling by the Permanent Court of Arbitration, and the building of artificial islands have all been identified by commentators as clear instances of PRC lawfare to gradually assert its claims in the South China Sea.[105] Clearly, these activities will not change international law overnight. Nor do they seem intended to. Rather, they seem to be envisioned as small steps in a much longer game plan. Rather than winning an argument in an international legal forum tomorrow, Kittrie observes that these strategies often consist of or are accompanied by legal or legal-sounding arguments or narratives that 'plant the seeds' that slowly push international law in a certain direction.[106] Crucially for the purposes of this contribution, these pushes for incremental changes to international law happen both in word and in deed.[107] In addition to the

103. James Kraska & Brian Wilson, 'China Wages Maritime "Lawfare"' (*Foreign Policy*, 12 March 2009), available at <http:// foreignpolicy.com/2009/03/12/china-wages-maritime-lawfare/>.

104. Ibid.

105. Leach (n 89) 57; Goldenziel (n 89) 1104-1140.

106. Kittrie (n 13) 10.

107. For example, the use of the PRC's People's Armed Forces Maritime Militia (PAFMM) as part of the lawfare strategy has become known as "salami-slicing", meaning that none of the small steps towards asserting China's maritime claims (e.g. by the PAFMM gray zone operations creating a *de facto* operating presence in the South China Sea) are considered casus belli on their own, but they accumulate to change the status quo over time, see Goldenziel (n 89) 1105; also see Derek Grossman and Logan Ma, 'A Short History of China's Fishing Militia and What It May Tell Us' (The Rand Blog, 6 April 2020), available at <https://www.rand.org/pubs/commentary/2020/04/a-short-history-of-chinas-fishing-militia-and-what.html>.

international legal claims put forth and international legal arguments made by the PRC, for example on the '9-dash line' and China's historic rights to the Sea, the relevance of (operational) conduct in the maritime domain should not be understated.[108] China's operational actions in the South China Sea consolidate its position in the conflict and support the execution of the PRC's lawfare strategy in the Sea.[109] These acts – whether it be patrolling, monitoring, and controlling access to certain maritime domains, building artificial islands, conducting marine scientific research and collecting data of various kinds, or placing oil rigs – directly or indirectly contribute to bolstering, consolidating, or acting in accordance with the PRC's maritime claims, which often deviate from generally accepted international law.

As Kardon has thus noted, some of China's operational practices make these expansionary claims possible. For example, he argues that they are directly enabled by substantial facilities built at Subi, Fiery Cross, and Mischief reefs in the South China Sea, as well as highly developed new infrastructures on the Paracel Islands.[110] Such operations at sea are "undertaken expressly to advance China's definition of 'the rules' through actions portrayed as defending China's rights under international law".[111] In this way, China's conduct is an expression of its attempts to revise the rules of international law. In a broader understanding of the concept of lawfare, these types of actions are therefore relevant because they enable, influence, or aim to stretch the understanding of international law of the sea. As Trachtman has put it: "Part of an integrated lawfare operationalisation strategy is to enhance facts as a basis for legal claims as well as to

108. Hermez (n 89) 568.
109. Kardon (n 19); Ibid., 4-5.
110. Ibid., 5.
111. Id.

argue for beneficial rules in the development of customary international law and treaty law".[112]

Indeed, given that State practice is one of the constituent elements of customary international law, all of this is particularly interesting in the context of international custom.[113] In fact, China's actions and claims, for example when they have advanced alternative interpretations of their EEZ, are argued by some to be aimed specifically at changing customary international law.[114] Of course, one State's conduct or stance does not amount to an international custom. However, a custom can be formed through the accumulation of State practice consisting of a wide range of State conduct, accompanied by *opinio juris*. Acquiescence to the candidate custom might also play an important role in this context: "[s]ince inaction may be viewed as acquiescence to the claim, China benefits legally from creating or bolstering a claim by creating a new island or other facts, and then militarily dissuading other states from contesting the claim."[115]

Therefore, if China is trying to 'change the rules' and the interpretations of the law of the sea, its evidence might be most apparent from its practices, incrementally and interstitially, which are increasingly becoming data-driven and AI-powered.[116] However, the role and influence of technology in this light is yet underexplored.[117]

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112. Joel P Trachtman, 'Integrating Lawfare and Warfare' (2016) 39 *Boston College International & Comparative Law Review* 267, 274.

113. *Statute of the International Court of Justice* (1945) XV UNCIO 355, art 38(1)(b), available at <https://digitallibrary.un.org/record/1300969>.

114. Kittrie (n 13) 9-10.

115. Ibid 10.

116. Kardon (n 19) 30-31.

117. Crucial here is also the work of Ingvild Bode, 'Contesting Use of Force Norms Through Technological Practices' (2023) 83 *ZaöRV* 39-64 [in which the author shows how contestation to international norms takes the form of technologically-mediated State practices and that these practices can over time deliberatively and tacitly shape new norms].

Ordre Kittrie has recently argued, firstly, that information technology is itself a subject over which lawfare is waged.[118] He argues that this battle is primarily being fought over issues such as the theft of intellectual property, the content of international law in the cyber arena, and telecommunication pipelines.[119] Secondly, crucially, he argues that the 'information technology revolution' is a major contributing factor to the increasing impact and prevalence of PRC's lawfare, including in the maritime domain.[120] The vast increase in data availability has enabled different actors to "quickly find and deploy many types of information at the level of detail and timeliness necessary to wage lawfare".[121] This includes commercial satellite imagery, ship-tracking websites, trade and foreign press articles from around the world, and many of the other data types discussed in Section 3. However, Kittrie's account of technology's influence on the gray-zone and lawfare does not go far enough. To only briefly touch on information technology as a subject of lawfare and increased data availability, as enabling the waging of lawfare, fails to pay due regard to the pervasiveness of the datafication at play and foregoes the discussion of AI either as a method or subject of lawfare altogether. Data and AI are likely to be a driving force of lawfare and the gray-zone going forward.

Indeed, Kirsten Gunnes has written about some of the impacts of data-driven and AI-powered gray-zone capabilities in relation to the East China Sea. Distinguishing between 'conventional' and 'nonconventional' gray-zone capabilities, she notes that both are increasingly enabled by technologies such as AI.[122] To achieve the PRC's objectives, China's

118. He discusses maritime, aviation, and information technology domains as subjects of lawfare respectively.

119. Kittrie (n 13) 10-11.

120. Ibid., 4; Kittrie (n 93) 48.

121. Kittrie (n 13) 11.

122. Gunnes (25) 12.

nonconventional gray-zone capabilities include cyberattacks for data-harvesting and interference operations, modernised satellite communications infrastructure, space-based survey, mapping, and navigation systems.[123] On the emerging technologies underpinning many of these efforts, Gunnes' pertinent observations deserve to be quoted at length:

> China is investing in emerging technologies that will enable both its conventional and nonconventional gray-zone capabilities. These technologies include AI to gather data and algorithms and big data analytics to evaluate that information. Chinese writings have recently started referring to "intelligentized" (zhinenghua) warfare. This emerging concept suggests that future warfare will evolve from "system confrontation," which holds that modern war is a confrontation between opposing operational systems waged across all warfare domains, to "algorithm confrontation," which states that the side with the data advantage can dominate war with human-computer hybrid operations, AI, and big data.[124]

The various data types discussed in Section 3 provide the foundation for the development of advanced and sophisticated AI-powered applications like those discussed in Section 4. These, in turn, can be (and are being) used in the South China Sea to bolster, monitor, and enforce interests and maritime claims in pursuance of maritime lawfare strategies. The data and AI relied upon by international actors in these contexts will increasingly be used to inform, execute, and justify their respective actions and claims and will play an important role in determining who comes out on top. Therefore, I argue that we can expect more advanced data-driven gray zone capabilities and we should prepare for an age where the international law of the sea will increasingly be an arena of algorithmic lawfare. Increasingly, *algorithm confrontation* will be the name of the game in the world's oceans and seas.

123. Ibid., 16.

124. Ibid., 17 (internal footnotes omitted).

7. Conclusion

On 25 October 2023, the United Kingdom's Minister of State gave a speech to the South China Sea conference in Ho Chi Minh City and stated that 'what happens in the South China Sea matters globally' and that '[t]he peace and prosperity of the South China Sea must remain a priority for all'.[125] This contribution has argued that rapidly emerging AI-powered applications in the maritime domain, and the datafication practices upon which they are built, will make a difference for what happens in the South China Sea and that "peace" might no longer look like it did before. In support of this claim, I have provided an overview of datafication initiatives and various concrete examples of AI-powered applications in the South China Sea. Focusing on the role of the PRC in this context, I have discussed how such technologies potentially play a significant role in maritime lawfare strategies and related gray zone capabilities in the South China Sea.

Director Yang Jiechi of the Chinese Communist Party (CCP) Central Committee for Foreign Affairs Commission explicitly expressed the PRC's mission to "actively guide the direction of change in the international order".[126] Some have therefore asked, if China is indeed changing the rules of the international legal order in the South China Sea, how would we even come to know and "by what process would such changes occur"?[127] The fact that some of the foremost experts on the subject are asking such questions points us right to the heart and the difficulty of

125. Anne-Marie Trevelyan, 'South China Sea Conference 2023: Speech by the UK Minister for the Indo-Pacific' (South China Sea Conference, Ho chi Minh City, 25 October 2023), available at <https://www.gov.uk/government/speeches/south-china-sea-conference-2023-speech-by-the-uk-minister-for-the-indo-pacific >.

126. From Yang Jiechi's 'Firmly Uphold and Practice' and 'Conscientiously Study and Publicize', both as cited in Kardon (n 19) 2.

127. Kardon (n 19) 12.

the matter at hand: it is not a straightforward matter to ascertain how the international legal order is changing and it might be happening in increasingly technological and stealthy ways.[128] For the future of international law and the international rule of law, it is therefore important to ask what the direction and magnitude of those changes might be and how they will come about.[129]

Therefore, notions like algorithm confrontation, algorithmic lawfare, and data-driven gray zone capabilities could help us make sense of a swiftly changing landscape. These developments deserve our full attention, and more research is urgently needed to develop an adequate theoretical framework to contextualise such developments, lest the international legal order be technologically remade 'in the gray'.

128. On "international law-making by stealth", see E van den Hoven (n 57) 39.
129. Kardon (n 19) 4-5.