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The changing value of Antarctica to Australia's security policy

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ABSTRACT

Antarctica is a crucial regulator of the world's climate, and as environmental security permeates global security, using Antarctic science to better understand climate is becoming increasingly pressing. Although the Australian Government has recognised that climate change poses 'a current and existential national security' threat and has acknowledged Antarctica's importance regarding the earth's global climate system, the focus of Australia's intelligence community pertaining to Antarctica currently remains restricted to upholding the military-security and diplomatic goals of the Antarctic Treaty System (ATS). This current focus aims to hedge against the possibility of conflict on, or over, the frozen continent via 'working the ATS', however, this paper argues that Antarctic *climate* science holds a greater capacity to deliver security outcomes for Australia. Antarctic climate science offers opportunities regarding intelligence *for* Antarctica, that is, securing Australia's Antarctic interests, as well as regarding intelligence *from* Antarctica; by enhancing natural disaster preparedness, bolstering broader strategic planning, as well as furthering diplomacy and the legitimisation of Australia's leadership on, and over, the frozen continent. It is recommended that the Commonwealth Government establish a climate intelligence working group to ensure the utility of climate science to security and intelligence is realised.

KEYWORDS

Antarctica; intelligence; climate change; science; security

Introduction

Antarctica is a pivotal regulator of the earth's global climate system (Department of Sustainability, Environment, Water, Population and Communities: Australian Antarctic Division 2011, 2; Turner and Bracegirdle 2022; Wilkins *et al.* 2013, 303). Its snow and ice regulate incoming solar radiation, resulting in a cooler climate; its cold temperatures and salty waters initiate deep-ocean currents that distribute heat around the globe; and these deep-ocean currents along with biological processes constitute an important carbon sink (Department of Sustainability, Environment, Water, Population and Communities: Australian Antarctic Division 2011, 19, 27; NASA 2023; Riihelä, Bright, and Anttila 2021, 831–32; Turner and Bracegirdle 2022; US Department of Commerce 2023; Zhang *et al.*

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2022, 4). Although it is well established that Antarctica is crucial to the earth's global climate, high levels of complexity and nonlinearity ensure that any changes in Antarctica associated with a warming climate are currently difficult to understand and predict (Edwards *et al.* 2021, 74, 77, 79–80; Kittel *et al.* 2021, 1218, 1229–30; Reid 2015, 40–41). This is not only of concern for matters directly related to Antarctica, but the world at large, as this partial and incomplete understanding of Antarctica and its processes is a blind spot when it comes to the accuracy and precision of global climate model projections (Kennicutt *et al.* 2019).

Although the Australian Government has recognised that climate change poses 'a current and existential national security' threat and has acknowledged Antarctica's importance for improving climate modelling and projections, the focus of Australia's intelligence community remains restricted to upholding the military-security and diplomatic goals of the ATS, which aim to hedge against the possibility of conflict on, or over, the frozen continent (Australian Antarctic Division 2016; Australian Government 2018, 2021, 30; *Climate Change Is a "National Security Issue", Says PM* 2022). It is important to note that while science, as central to the ATS, has always been pivotal to Australia's Antarctic interests, the central contention of this article is that the security opportunities offered by Antarctic *climate* science specifically, have been overlooked. This oversight is largely due to science's perceived, and hitherto actual, role as merely a support to geopolitical objectives. Antarctic climate science offers the opportunity to not only strengthen the realisation of current policy objectives involving conflict avoidance but also to improve natural disaster preparedness, broader strategic planning, while furthering diplomacy and the legitimacy of Australia's Antarctic leadership (Australian Antarctic Program 2022, 7; Conference on Antarctica 1959).

With this in mind, it is recommended firstly, that the Commonwealth Government establish a climate intelligence working group comprised of scientific and intelligence agencies to be tasked with developing mutually beneficial climate projection capabilities and determining priority areas for investment. Secondly, it is recommended that the Commonwealth Government increase support for Antarctic and scientific research. While there may be some concerns that such efforts may further 'securitize' Antarctic science, it is argued that given existing geopolitical pressures on Antarctic science and the inevitability of climate concerns impacting strategy and intelligence, these concerns should not stymie the development of a climate capacity within intelligence and security.

Before proceeding, the term 'intelligence' will briefly be clarified. Intelligence is taken to accord with the 2011 Independent Review of the Intelligence Community's definition, which defined intelligence as 'Information that enables you to protect your interests or to maintain a valuable advantage in advancing your interests … ' (PM&C 2011). Therefore, references to 'intelligence' speak of the collection, creation, and analysis of information used to identify, defend, or prosecute national interests.

This paper continues as follows; first, the Australian Government's current approach to Antarctica will be outlined. Second, a short literature review of Australia's Antarctic policy will be presented. Third, intelligence *for* Antarctica will be discussed, namely in relation to mineral resources and migrating fish stocks. This will be followed by an analysis of the importance of intelligence *from* Antarctica, namely in relation to natural disaster preparedness, strategic planning, and diplomacy. These two categories (for and from) are merely theoretical, being highly interrelated and interdependent in practice.

It is important to note that this paper's research was limited to open-source material and hence, national security imperatives are inferred from what is discussed in government documents, academic literature, and deduced from government funding. Furthermore, it must be acknowledged that the relationship between increased information input and greater model accuracy and precision is non-linear and depends on numerous factors other than increased scientific understanding, including computing power and a model's ability to accurately represent data. However, this does not reduce the latent potential Antarctic climate science possesses to positively contribute to effective disaster mitigation, adaptation, and overall strategic preparedness (Edwards *et al.* 2021, 77; Kittel *et al.* 2021, 1216).

Current Antarctic approach

Before turning to Australia's current Antarctic approach some background context is required. Antarctica is internationally governed through the Antarctic Treaty (1959), which 'demilitarises' the latitudes below 60°S and establishes a 'rules-based order' built on peace, international cooperation, and science. Fifty-four states have signed the Antarctic Treaty, with twenty-nine of these contributing to Antarctic governance, seven exerting a claim over territory, and two reserving the right to make a claim (Russia and the United States) (Brady 2019a, 254, 256, 2019b, 15; Secretariat of the Antarctic Treaty 2022). The Antarctic Treaty *System* refers to subsequent international agreements that have endeavoured to protect the Antarctic environment, prohibit mining, and manage the Southern Ocean's marine living resources (Press 2019, 6; Press and Bergin 2022a, 5). The ATS is central in Australia's current Antarctic approach.

Australia's Antarctic policy is primarily driven by the Department of Foreign Affairs and Trade (DFAT) and the Department of Climate Change, Energy, the Environment and Water (DCCEEW), with policy from both departments largely focussing on traditional geopolitical objectives.

DFAT's 2017 Foreign Policy White Paper highlights Australia's sovereign claim to 42% of the continent, iterates Australia's leadership position among Antarctic Treaty members, and states that Australia 'is staunchly committed to the Treaty's strength and effectiveness'. The white paper's reasoning for Australia's commitment to the 'Treaty's strength and effectiveness' is stated to be the reduced 'potential for strategic competition to Australia's south'. That is, Australia's principal purpose for supporting the ATS is for reasons of conflict avoidance. From here the paper emphasizes the importance of strengthening the ATS and its effectiveness through investing in new, or enhancing existing, capabilities, infrastructure, and technologies (Department of Foreign Affairs and Trade 2017, 85).

The Australian Antarctic Division (AAD) administered by the DCCEEW share a similar outlook (Department of Climate Change, Energy, the Environment and Water: Australian Antarctic Division 2020). As per their Australian Antarctic Strategy and 20-year Action Plan Update 2022, strategic and security considerations are of primary concern. That science be conducted 'consistent with national priorities' is suggestive of the *supporting* role science is considered to play (Australian Antarctic Program 2022, 3, 7). That is, supporting the attainment of 'national priorities', which as per DFAT's 2017 Foreign Policy White Paper, are taken to constitute ensuring that 'Australians

remain safe, secure and free in the face of threats' and that 'the international rules that support stability and prosperity' are promoted and protected (Department of Foreign Affairs and Trade 2017, 3). The supporting role of science was explicitly stated by the Australian government in a joint media released in February 2022; 'We need to ensure that Antarctica remains … free from conflict … science is key to that future' (Ley, Morrison, and Payne 2022).

The above claim of conflict avoidance constituting Australia's primary Antarctic objective with science seen as merely supporting this end, are also borne out in budgetary terms. The Morrison Government's 2022 updated Antarctic Strategy included a significant funding boost to ensure Australia's interests in the Antarctic; over $800 million, $364.5 million of which is to be delivered in the next five years (Ley, Morrison, and Payne 2022). While this funding was nominally delivered 'to support Australia's scientific leadership and international collaboration in Antarctica', much of this funding has raised concerns over investment in 'dual use' technology, with only around $7.4 million (around 2%) being allocated for Australia's allegedly central scientific mission; climate science (Australian Government 2022).

Existing literature

The government's focus on upholding, maintaining, and strengthening the ATS as a hedge against conflict, with science as a supporting element of this objective, has largely been reinforced by the analysis undertaken by 'think tanks' and academic researchers.

This is exemplified by authors such as Anthony Bergin, Tony Press, and Andrew Jackson who highlight the importance of diplomacy in countering ATS erosion. To these authors, the Antarctic Treaty is viewed as the mechanism by which the frozen continent remains free from military conflict (Bergin and Press 2020b; Press and Jackson 2021). More specifically, in their analysis for the Australian Strategic Policy Institute (ASPI), Anthony Bergin and Tony Press, advocate that Australia take a bilateral and transactional approach to Antarctic affairs to bolster the ATS by building trust, cooperation, and credibility (Bergin and Press 2020a, 14, 22, 24; Buchanan and Flamm 2022, 247). Through this engagement, it is thought that Australia may have a greater ability to shape and influence countries' approach to the continent, in a fashion that adheres to the ATS (Bergin and Press 2020a, 14, 21).

Although Bergin and Press recognise that the interactions between Antarctic scientists and the intelligence community holds significant value, this appreciation is merely unidirectional. That is, Bergin and Press support the use of intelligence perspectives to inform Antarctic activities and relationships through regular engagement with Australian Antarctic scientists. This is, for example, in the form of regular briefings *from* the intelligence community (Bergin and Press 2020a, 20–21).

Others, such as International Relations scholar Elizabeth Buchanan, argue that the ATS can be strengthened through cooperation and science. However, this is on the basis of safeguarding territorial claims and strategic advantage (Buchanan 2022b, 14). This focus on strategic competition is indicative of Buchanan's other work in this field (Buchanan 2022a, 2021, 2019). Wilson Centre Analyst Evan Bloom's recent work is similarly concerned with geopolitical competition and military activities on the continent,

with Bloom suggesting that Australia should work more closely with the United States to police activities and enforce adherence to the ATS (Bloom 2022a, 2022b).

Many other scholars, including political scientists Anne-Marie Brady and John Garrick, focus on great power competition in Antarctica, particularly concerning China's revisionist acts and ambitions. For example, Brady, Bergin, and Press have reported that Chinese officials have affirmed China's commitment to the 'sustainable development of Antarctica' and expressed a desire for more 'equitable access' to Antarctic resources; declaring that 'when all the world's resources have been depleted, Antarctica will be a global treasure house of resources' (Brady 2017a, 17; Press and Bergin 2022b, 351–52).

To reduce the pressure of strategic competition over the Antarctic, Brady advocates for a 'whole of government' response, expansion of Australia's Antarctic capacity in terms of institutional expertise and government agencies with an Antarctic mandate, and supports further investment in targeted policy research (Brady 2017a, 6). By comparison, Garrick advocates for a collaborative approach to Antarctic governance and the establishment of compliance mechanisms in defence of the Antarctic Treaty (Garrick 2021). Brady has advocated for similar approaches elsewhere in her recommendations for New Zealand (Brady 2019a, 2017b, 269–70).

What these works hold in common is that all advocate for the bolstering of the ATS to hedge against the possibility of military conflict. Any advocacy for science is seen as merely supporting this end. For example, in her analysis for the Lowy Institute, Ellie Fogarty recommends further investment in Antarctic science. However, Fogarty justifies increased science funding on the basis of Antarctic science's propensity to enhance influence within Antarctic governance and occupation on the continent, rather than due to the security benefits such science may bring in its own right (Fogarty 2011, 7–9).

Furthermore, although various authors do touch on and consider security concerning climate change in Antarctica, their recommendations for mitigation remain limited (Andregg 2020, 2, 13; Busby 2008, 482–83; Campbell *et al.* 2007, 40–42, 52, 71, 83; Chaturvedi 2012, 258; Nevitt 2020, 333–34, 362). For example, recommendations put forth in Anthony Bergin *et al.*'s 2019 paper, follow along the same lines as advocated by Anthony Bergin and Tony Press above (Bergin and Press 2020a, 14, 21, 22, 24; Bergin *et al.* 2019, 49–72). That is, that Australia build trust and cooperation to maintain a 'strong and effective ATS' stated to be in Australia's 'national interest'. Implicit herein is the objective of conflict avoidance. Climate science and its strategic capability are not identified (Bergin *et al.* 2019, 67–72).

Despite the lack of recognition of *climate* science's strategic capability, it must be clarified that science, in general, clearly has an established strategic value in Antarctica. However, as per the above, this value has primarily been in support of geopolitical objectives. This claim is further supported by the various policy pronouncements and strategic analysis which highlights that science is seen as a core legitimating factor in determining which consultative parties (CPs) (to the ATS) may take, and to what degree, an active role in managing the continent's affairs. This notion of 'science diplomacy' holds that scientific collaboration and sharing provides a constructive option on the international stage; in the case of Antarctica, scientific discovery and collaboration will provide a buffer from (or even a disincentive to) political conflict (Ruffini 2020).

However, despite the suggestion that science plays a key role in legitimising Antarctic governance, the importance science currently plays in this process may, in fact, be even smaller than first realised. Indeed, as Joanne Yao notes at the time of the ATS' framing and instigation, almost all the scientific work conducted in Antarctica was undertaken by the core group of territorial claimants, as well as the US and the USSR. Here, the inclusion of science as a legitimating factor operated as a 'gatekeeper' in Antarctic matters (Yao 2021). By deriving legitimacy from an activity that required long lead times, infrastructure, and extensive funding, it appears that the ATS's focus on scientific legitimacy was for political, rather than scientific, purposes.

That is, the expectation that a greater involvement in science increases influence regarding Antarctic governance, likely gives an overly simplistic account of ATS legitimacy; one that overplays the role of science in creating legitimacy and downplays the role of geopolitics in creating science. Indeed, John Dudeny and David Walton observed that while scientific output is a determinant of legitimacy for CPs, there remains no formal mechanism by which the scientific efforts of a nation may be assayed, nor is there any threshold for determining if, or when, a nation's scientific obligations are not met. The lack of such a mechanism is relevant given the disparity between CPs regarding scientific and policy output. While Dudeny and Walton found a correlation between science and policy output, they also found that of the thirty CPs, half accounted for merely 7% of policy output. The bulk of Antarctic management and science came from a core group of the original territorial claimants, the US, and Russia (Dudeney and Walton 2012).

To be clear, this is in no way to downplay or dismiss the scientific efforts of Antarctic researchers or the importance of their research. Instead, it is only to suggest that from the perspective of international security, diplomacy, and international relations, the role of science in legitimating involvement in Antarctic affairs has, and continues to be, one of supporting geopolitical objectives.

Finally, although various authors above advocate for the securitisation (here taken to be the realisation of negative impacts resulting from making something a 'security' issue) of Antarctic policy, a vast amount of literature exists which raises concerns over the securitisation of policy issues (Baysal and Karakaş 2017, 35; Bray 2016, 270). Specifically in relation to Antarctica, for example, Daniel Bray raises the concern that calls for securitisation do not appreciate that '… security considerations have diminished in importance over the past 50 years due to the effectiveness of the Antarctic Treaty' and that 'By securitising Antarctic policy, Australia unnecessarily risks initiating security dilemmas in the region, whereas yet largely undefined threats become self-fulfilling' (Bray 2016, 270). Despite this, Bray acknowledges that the appropriateness of not securitising Antarctic policy may need to be reconsidered in the future in line with changing security environments. As will be seen, this paper proceeds by arguing that this future has now arrived and finishes by dispelling any securitisation concerns.

Intelligence for Antarctica

A better understanding of Antarctica would help improve the accuracy and precision of global climate models, hence, provide an enhanced ability to pre-empt how future

climate changes are likely to affect Australia's interests in Antarctica (Australian Antarctic Program 2022, 7; Kennicutt *et al.* 2019, 95–113). That is, Antarctic climate science functions as 'intelligence' for securing Australia's Antarctic interests.

It has been said that peace within Antarctica depends upon regulating the exploitation of its resources (Jabour 2019, 4). This is concerning in the face of climate change. Although access to, and, therefore, commercial viability of, Antarctic resources currently remains low compared to alternative sources, the increasing materialisation of climate change renders Antarctic exploitation increasingly appealing. Although Russia, India, South Korea, Turkey, Iran, Bulgaria, and Belarus have all publicly expressed an interest in future Antarctic resource extraction, China will be the focus of the following analysis given the considerable literature available (Brady 2019a, 253; A. J. Press and Bergin 2022b, 340, 351–52).

Mineral resources

Climate change is likely to exacerbate existing tensions among Antarctic states concerning mineral resources, largely as a result of changing the incentives to acquire, as well as access to, them (Baysal and Karakaş 2017, 29–30).

Access to Antarctic minerals currently remains restricted firstly, due to sea ice. That is, transport (of equipment, personnel and any mineral products) is presently limited by sea ice surrounding the continent, which impedes vessel navigation and compromises safety ("COMNAP Sea Ice Challenges Workshop" 2015, 10). However, as Antarctica contains some of the fastest-warming regions on the planet, sea ice is predicted to significantly decrease in the medium to long term. One study predicts that, under a high emissions scenario, winter sea ice area could reduce by up to 40% by 2100 (Holmes, Bracegirdle, and Holland 2022, 1).

Access to mineral resources, secondly, also remains restricted due to substantial ice sheet coverage. However, this is set to change with one study suggesting that terrestrial ice-free areas within Antarctica could expand by over 17,000 km^2 by the century's end. This would be accompanied by substantial ice sheet thinning, accumulatively, likely easing mineral extraction abilities (Bromwich *et al.* 2013, 139; Clem *et al.* 2020, 762; Duffy and Lee 2019, 253; Lee *et al.* 2017, 49; Rintoul *et al.* 2018, 234–35, 347).

The importance of Antarctic minerals will also likely shift as the world's mineral requirements evolve. Over 220 types of energy and mineral resources have been found on the Antarctic continent, these include iron, copper, aluminium, lead, zinc, manganese, nickel, graphite, plutonium, and uranium (Brady 2019c, 257; Zhai *et al.* 2021, 110). Many of these are integral to renewable energy systems, the shift to which is expected to increase the demand for copper and rare earth elements; nickel and cobalt; and lithium by up to 40%, 70% and 90% respectively should the Paris Agreement's goals be attained (International Energy Agency 2022, 5).

Regarding China, access to Antarctica's diverse mineral resources would not only support its domination in the production of certain energy transition minerals but also would reduce its processing dependency on the mineral supply from other states. Hence, having access to Antarctic minerals would be another component in the state's '… rise to becoming the kingpin of clean energy supply chains' (International Energy Agency 2022, 162). Statements such as that from China's Arctic

and Antarctic Administration head in 2013, confirming that the new Ross Sea base site had been selected due to it being 'one of the hottest [future] locations in Antarctica' with the greatest 'resource potential', appear to support the concern that China will engage in Antarctic mineral exploitation in the future (Brady 2017b, sec. China's expanding Antarctic capacity and interests, para. 5).

Migrating fish stocks

Southern Ocean fisheries are becoming increasingly vulnerable to enhanced exploitation due to climate change induced changes in fish stock distribution and availability (Baysal and Karakaş 2017, 29–30). Marine fish are predicted to undergo a global-scale poleward shift at speeds of tens to hundreds of kilometres per decade (depending on emission pathways). For example, climate-driven poleward migration is already underway in China, with northward migrations of marine fish recorded over the past decades (Hu *et al.* 2022, 2).

As the world's largest producer and exporter of marine fish and fishery products, China's maritime fishing industry is critical to its income, employment, and development. However, China's fish stocks are currently grossly overexploited (Cao *et al.* 2017, 440; Kang *et al.* 2021, 599–600; Su *et al.* 2020, 436). Furthermore, China's marine environment is warming at a rate that puts it within the top 10% of global warming ocean hotspots (Kang *et al.* 2021, 599–600; Tan *et al.* 2020, 1676). The scale of future fish migration is predicted to be widespread throughout China's seas with, for example, one study predicting that 20 of the 21 species studied would move northward by 2050 (Hu *et al.* 2022, 1, 4). Another study predicts that, by 2099, biomass could reduce by up to 99% in 25 functional groups in the South and East China Seas (Cashion *et al.* 2019, 64).

China has the world's largest distant water fishing fleet, estimated to be approximately 17,000 vessels strong, which with the increasing materialisation of climate-related predictions, is expected to increase its presence in the Southern Ocean (Gutierrez and Jobbins 2020). As the Southern Ocean remains one of the least fished areas on the planet in which no state possesses exclusive territorial control, the possibility of a race to fish the Southern Ocean appears increasingly likely (Bray 2016, 271; Hu *et al.* 2022, 1). This, alongside activity such as purposely blocking consensus to prevent progress in the establishment, expansion, and maintenance of marine protected areas and fishery protection rules, appears telling of China's intentions in the Southern Ocean (Press and Bergin 2022b, 352).

Intelligence from Antarctica

Unfortunately projecting exactly when, where, and to what degree these climate impacts, and hence their consequential security implications, will materialise, is currently extremely difficult to predict. The information attained from Antarctica to improve climate model projections would not merely aid the pre-emption of climate change's security ramifications regarding Antarctica (as per above), but also regarding Australia and its region (Australian Antarctic Program 2022, 7; Kennicutt *et al.* 2019, 95–113). That is, Antarctic climate science functions as 'intelligence', with the ability to contribute to securing Australia and its region.

Disaster preparation

The intelligence value of Antarctic climate science extends beyond Antarctica and holds the potential to assist Australia's domestic security efforts. Even under a low-emission scenario, costs from natural disasters are projected to almost double by 2060 (Australian Business Roundtable for Disaster Resilience & Safer Communities 2021, ii). While improved climate modelling cannot stop disasters from occurring, more accurate projections will facilitate better planning and mitigation, lowering the financial and social burden of such events. That is, it is increasingly recognised that risks don't merely arise from external factors alone, but that risks also arise as a result of mitigation and adaptation responses (Simpson *et al.* 2021, 489–90).

Models that possess greater precision and accuracy would be better able to inform officials and communities about the expected severity and timing of climate hazards as well as aid understanding of the interaction between social and ecological systems (Simpson *et al.* 2021, 493, 497). This knowledge would enable the assessment and identification of response opportunities versus limits, and allow more robust mitigation and adaption strategies to be developed (Simpson *et al.* 2021, 497).

This would, in turn, alleviate pressure on the Australian Defence Force (ADF). With greater awareness and accuracy of climate change's projected influences—increased frequency and severity of disaster events and enhanced likelihood of event concurrency—the ADF could better adapt to and plan its ever-increasing humanitarian assistance and disaster relief (HADR) commitments. This alone would account for a significant security benefit, given the current strain placed on ADF capacity by increasing HADR and domestic callouts. It is important to note that assisting the ADF in planning its HADR commitments has the inverse benefit of helping prioritise its warfighting capabilities; by minimising disruptions to training and maximising readiness in times of strategic unrest.

Strategic planning

Interaction is crucial to strategy, taken to be the pursuit of continuing advantage. That is, strategy must be adaptable and flexible in the face of a threat, and not merely the execution of a plan (Meiser 2016, 81, 86). Regarding climate change, strategic planning in Australia remains static, being fixated (as demonstrated above), as historical strategists implore, on violent adversarial logic (Milevski 2019, 1–2). This is despite the fact that future defence and security needs, and priorities, are changing rapidly (Kapetas 2023). Strategic planning requires a rethink of Sun Tzu's famous proverb, that a successful strategy necessitates an understanding of the enemy (Tzu 1971, 84). Increased accuracy and precision within climate projections would provide strategists with a greater insight into 'the enemy', in turn, enhancing the thoroughness of strategic planning. This benefit to strategic planning could be realised not only domestically, but as per the 2022 Antarctic Update, it could be used to assist Australia's partner nations, especially Pacific Island countries. A prominent and pertinent example of how greater insight into 'the enemy' could aid strategic planning is apparent in the case of sea level rise.

The continued *unexpected* collapse of, and accelerating mass loss in, Antarctic ice sheets is cause for concern ("Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action" 2022, 61; DeConto and Pollard 2016, 591). For example, in March 2022 two ice shelves cumulatively spanning an area approximately the size of Sydney and previously thought to be in a stable condition,

collapsed (NASA Earth Observatory 2022). This was similar to the sudden collapse of the Larson B ice shelf earlier this century (Busby 2008, 483; Vidal 2021).

In light of this uncertainty, there is currently significant concern that the West Antarctic Thwaites Glacier may collapse within five years. The Thwaites Glacier is roughly the size of Britain and, should it collapse, is likely to enhance the deterioration rate of other West Antarctic glaciers, possibly leading to the collapse of the entire ice sheet. The collapse of the Thwaites Glacier *alone* would raise global mean sea levels by more than half a metre (Davis *et al.* 2023, 479; Voosen 2021).

To echo the sentiment above, projecting exactly when, where, and to what degree these climate impacts, and hence their consequential security implications, will materialise, is currently extremely difficult to predict. The lack of scientific understanding about Antarctica's glaciers was reiterated on the 15th of February this year when two new studies on Thwaites Glacier were published in the Nature journal (Davis *et al.* 2023; Schmidt *et al.* 2023). As a reviewer of the two articles has commented 'The results highlight challenges for both modelling and observational attempts at understanding the present state of West Antarctica—and predicting its future'. Although the reviewer commended the articles as works to which future observational studies should aspire, the point is made that both studies only covered a small area of *one single* glacier. A similar level of understanding is urgently required of other Antarctic glaciers, all of which are unique (McConnochie 2023).

Diplomacy

As a pivotal regulator of the earth's climate system, Antarctica and the climate science conducted offer a profound opportunity for *shared interests to further* promote and deepen cooperation. That is, Australia, other treaty nations, and ultimately the globe stands to benefit from the improved climate modelling that Antarctic research has the potential to deliver. With the increased interest in Antarctica by state and non-state actors alike and the global changes and challenges currently faced, international cooperation in Antarctica has never been more important than it is today.

Furthermore, as 'science' is said to constitute the currency of power and influence in Antarctica, Australia's enhanced integration of climate science into intelligence assessments would be a practical demonstration of the value of said science and Australia's respect and commitment to it (Buchanan 2022b, 12).

Where to go from here?

Current approaches

Although Australia is seeking to establish a greater capacity to analyse and share climate information for security, these efforts remain limited. The primary attempt, thus far, has been the Australian Climate Service (ACS) (Australian Climate Service 2021). The ACS is to be predominantly tasked by Emergency Management Australia and the National Recovery and Resiliency Agency to create products that support disaster preparedness, response, and relief.

While the ACS provides services for agencies and organisations upon request, it is limited to domestic natural disaster management. That is, the ACS is not designed or empowered to determine interest areas or levels of urgency. However, as government

cannot ask questions or seek information of which it has no knowledge, without an expanded capacity to understand the intersection between climate science and intelligence, the creation of intelligence products regarding climate would be of limited utility.

To develop this current lack of capability two functions are required. Firstly, bidirectional dialogue and deliberation between relevant scientific and intelligence agencies. Secondly, the remit to advise the government on areas of scientific, intelligence, and security need.

As such, the United States Climate Security Advisory Council (CSAC), could be used to inform, shape, and guide Australia's approach. The CSAC's purpose is to bring together the Intelligence Community and Federal Science Agencies to advance insights on the national security impacts of climate change. That is, to ensure that intelligence analysts are adequately assisted concerning climate security analysis, that coordination between the intelligence and science communities is effective and efficient, and that climate change is adequately prioritised within the intelligence community.

The laws governing the CSAC only came into effect on September the 25th 2022; Australia can therefore consider the merits of the CSAC as it evolves (Office of the Law Revision Counsel: United States Code 2023). It must be clarified that the CSAC was created as a *partnership* between relevant scientific and intelligence agencies. It is not simply a body in which scientific expertise is leveraged by the intelligence community. Similarly, any Australian attempt should be constructed in such a way as to allow scientific expertise to speak directly to the government, rather than be 'drawn upon'. As per the above, the government cannot ask questions or request data on problems it has not yet identified, nor can it prioritise efforts whose utility it is not yet a party to.

Recommendations

An emphasis on climate science allows the issue of Antarctic security to be approached from a new angle, that is, not what the intelligence community can offer Antarctic science and affairs, but what Antarctic science can offer the intelligence community. This exposes new approaches that serve to not only contribute to but build on and exceed, existing recommendations and the policy objectives they seek.

While the traditional Antarctic objective of minimising conflict potential is desirable, it is, in essence, the avoidance of a 'negative' security outcome (avoiding a negative that may occur), rather than the realisation of a 'positive' one (proactively improving security before a threat is present). Given the benefits to both domestic and global security, the realisation of 'positive' security outcomes, via an enhanced emphasis on Antarctic climate science, has the capacity to reframe and recalibrate the importance and outcomes of the ATS. Instead of simply attempting to *negate* the outcome of global competition, the maintenance of Antarctica as a 'global scientific commons' could become a 'positive' security proposition by facilitating proactive planning against natural hazards or force multipliers.

Additionally, however, such an approach does not sacrifice conflict avoidance, but rather, strengthens its realisation. Enhancing intelligence's ability to understand when and to what degree climate impacts might materialise would, for example, aid treaty members' ability to pre-empt, plan for, respond to, and influence revisionist treaty members who may seek to take advantage of Antarctic resources. Without such an

increased capacity to model the Antarctic climate, any response to unfolding events and challenges in, and associated with, Antarctica will be reactive and short-sighted.

In this vein, it is recommended that the Commonwealth establish a climate intelligence working group, drawing on expertise across BOM, CSIRO, AAD, as well as the Office of National Intelligence, the Defence Intelligence Organisation, and the Australian Geospatial-Intelligence Organisation. This working group should be tasked with reporting their findings to the National Security Committee of Cabinet or the Secretaries Committee on National Security and recommending priority areas of scientific study, to deliver a balance between maximal intelligence gains and scientific outcomes. Furthermore, as the sharing of Antarctic developments is a large component of maintaining and upholding the strength of the ATS, some form of public reporting should be included.

The establishment of an Australian climate intelligence working group would significantly benefit both the scientific and intelligence communities, from which such a group would be comprised. A platform such as this would offer the opportunity for bidirectional dialogue and knowledge sharing, allowing the intelligence community to better understand the implications of climate change while providing scientists with invaluable insight into the practical application and importance of this knowledge in a security context. With a deeper understanding of the other, effective mutual assistance would be enhanced (Barnard, Johnson, and Porter 2021, 3).

Once identified by the working group, the priority areas of scientific study should be supported by increased funding and capability; it is recommended that the Australian Government increase its investment in Antarctic climate science. As discussed above, in the Morrison Government's most recent funding boost for the Antarctic, climate research saw a small (around 2%) amount of that funding. While this may be commensurate to traditional views on Antarctic policy, it is not commensurate to the importance of climate science to Australia's future security. Given Australia's bill for natural disaster management sits at around $38 billion per year (and is projected to reach at least $73 billion by 2060), an investment of only 7.4 million over five years towards one of the most important areas of climate science, appears ill-advised (Australian Business Roundtable for Disaster Resilience & Safer Communities 2021). Determining the amount and delivery of this funding should fall on the member agencies in the working group. Given the relatively small sums involved, this funding could be drawn from existing department allocations, identified by the cost of conducting the research, calculated against the possible utility of the gains to each department if realised.

While one may object to such efforts on grounds of securitisation concerns, given existing geopolitical pressures on Antarctic science, and the inevitability of climate change's impact on strategy and intelligence, these concerns should not stymie the development of a climate capacity regarding intelligence. Regarding the former, Antarctic science is *already* securitised in several key ways. From the role it has played in legitimating territorial claims, to the relationship between scientific goals and strategic concerns, Australia's Antarctic science is already loaded with geostrategic importance (Bergin and Press 2020a; Buchanan 2022b; Liu 2022).

Regarding the latter, given time, leveraging climate science for strategic planning and intelligence analysis will become inevitable. As natural disasters become more frequent, climate pressures more acute, and issues such as emissions reduction and climate targets

become more prescient in strategic affairs, climate projections will be crucial for accurate planning and analysis. In this sense, while publicly leveraging Antarctic climate science in the production of intelligence may appear provocative, there is a clear rationale and cost–benefit case as to why it is necessary. Put simply, any effect such an approach may have on creating a new avenue for 'securitization' or strategic competition is overshadowed by the real security threat it seeks to address.

Conclusion

In summation, current Australian approaches to Antarctica predominantly seek to hedge against the possibility of international conflict in, or over, the frozen continent via 'working the ATS'. From the perspective of security, science is merely an offshoot or supporting element of this objective. However, this paper has argued that Australia's intelligence and security approach towards Antarctica needs to recognise the value of Antarctic climate science in the maintenance of Australia's security in its own right. This would not only strengthen the realisation of conflict avoidance on the frozen continent as a result of increased intelligence *for* Antarctica but would also result in several additional benefits as a result of the intelligence gained *from* Antarctica. As discussed, these include enhanced natural disaster preparedness, increased capacity to conduct effective strategic planning, and bolstered diplomacy.

That is, a significant increase in Australia's scientific research in Antarctica would serve the nation's national security in more ways than one. As climate events increasingly impact security planning and capability, the improvements that may be realised by Antarctic research will become ever more compelling. Australia, as the largest claimant over Antarctic territory, is in a prime position to encourage and guide an international effort to increase Antarctic understanding. By being a primary mover on climate intelligence, Australia will not only encourage investment into the scientific commons of Antarctica, but it will also assist other nations to realise similar security gains in climate projections, and help the global community better plan, adapt, and monitor the effects of climate change.

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References

Andregg, Michael M. 2020. *Climate Change and U.S. National Security*. US Government Printing Office. http://conservancy.umn.edu/handle/11299/212321.

"Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action." 2022. Cambridge, UK: SCAR: Science Committee on Antarctic Research.

Australian Antarctic Division. 2016. "Antarctic Climate." *Australian Antarctic Program*. https://www.antarctica.gov.au/science/climate-processes-and-change/.

Australian Antarctic Program. 2022. *Australian Antarctic Strategy and 20 Year Action Plan Update 2022*. Australian Government.

Australian Business Roundtable for Disaster Resilience & Safer Communities. 2021. "Special Report: Update to the Economic Costs of Natural Disasters in Australia." *Deloitte Access Economics*.

Australian Climate Service. 2021. *About: Supporting a More Resilient Nation in the Face of Climate and Natural Hazards*. Australian Government. https://www.acs.gov.au/.

Australian Government. 2018. *Implications of Climate Change for Australia's National Security*. Canberra: Australian Capital Territory: Department of the Senate.

Barnard, Evan, Loch K. Johnson, and James Porter. 2021. "Environmental Security Intelligence: The Role of US Intelligence Agencies and Science Advisory Groups in Anticipating Climate Security Threats." *Journal of Intelligence History* 1–16. doi:10.1080/16161262.2021.2021687.

Baysal, Başar, and Uluç Karakaş. 2017. "Climate Change and Security: Different Perceptions, Different Approaches." *Uluslararası İlişkiler / International Relations* 14 (54) Uluslararası İlişkiler Konseyi İktisadi İşletmesi: 21–44. doi:10.33458/UIDERGISI.513222.

Bergin, Anthony, David Brewster, Francois Gemenne, and Paul Barnes. 2019. *Environmental Security in the Eastern Indian Ocean, Antarctica and the Southern Ocean: A Risk Mapping Approach*. National Security College, Institut De Relations Internationales Et Strategiques.

Bergin, Anthony, and Tony Press. 2020a. *SPECIAL REPORT: Eyes Wide Open: Managing the Australia-China Antarctic Relationship*. Barton, ACT: Australian Strategic Policy Institute.

Bergin, Anthony, and Tony Press. 2020b. "Working in the Cold: Australia and China in the Antarctic." *The Strategist*, April 27. https://www.aspistrategist.org.au/working-in-the-cold-australia-and-china-in-the-antarctic/.

Bloom, Evan T. 2022a. *Meeting Antarctica's Diplomatic Challenges: Joint Approaches for Australia and the United States*. Special Report. Barton, ACT: Australian Strategic Policy Institute. https://ad-aspi.s3.ap-southeast-2.amazonaws.com/2022-02/SR%20181%20Meeting%20Antarcticas%20diplomatic%20challenges.pdf?VersionId=eERf0X.i9QA6JyQOii_qKFN_BeUaBjhm.

Bloom, Evan T. 2022b. "Priorities for Australian and US Responses to Antarctic Diplomatic Challenges." *The Strategist*, February 22. https://www.aspistrategist.org.au/priorities-for-australian-and-us-responses-to-antarctic-diplomatic-challenges/.

Brady, Anne-Marie. 2017a. *SPECIAL REPORT: China's Expanding Antarctic Interests: Implications for Australia*. Barton, ACT: Australian Strategic Policy Institute.

Brady, Anne-Marie. 2017b. "China's Expanding Antarctic Interests: Implications for New Zealand." *Small States and the New Security Environment Policy Brief* 2 (June): 20.

Brady, Anne-Marie. 2019a. "Climate Change: Antarctic Geopolitics and the Implications for New Zealand Foreign Policy." In *Small States and the Changing Global Order: New Zealand Faces the*

Future, edited by Anne-Marie Brady, 253–270. Cham: Springer International Publishing. doi:10.1007/978-3-030-18803-0_15.

Brady, Anne-Marie. 2019b. "Antarctica as a Site of Strategic Competition: Optimal Responses for Australia and New Zealand." In *Antarctica 2050: Strategic Challenges and Responses*. Australian Government Australian Civil-Military Centre. https://acmc.gov.au/resources/publications/antarctica-2050-strategic-challenges-and-responses.

Bray, Daniel. 2016. "The Geopolitics of Antarctic Governance: Sovereignty and Strategic Denial in Australia's Antarctic Policy." *Australian Journal of International Affairs* 70 (3): 256–274. doi:10.1080/10357718.2015.1135871.

Bromwich, David H., Julien P. Nicolas, Andrew J. Monaghan, Matthew A. Lazzara, Linda M. Keller, George A. Weidner, and Aaron B. Wilson. 2013. "Central West Antarctica among the Most Rapidly Warming Regions on Earth." *Nature Geoscience* 6 (2) Nature Publishing Group: 139–145. doi:10.1038/ngeo1671.

Buchanan, Elizabeth. 2019. "Antarctica: A Cold, Hard Reality Check." *The Strategist*, September 17. https://www.aspistrategist.org.au/antarctica-a-cold-hard-reality-check/.

Buchanan, Elizabeth. 2021. "Australia's Scrapping of Antarctic Aerodrome Could Pave the Runway for China." *The Strategist*, November 30. https://www.aspistrategist.org.au/australias-scrapping-of-antarctic-aerodrome-could-pave-the-runway-for-china/.

Buchanan, Elizabeth. 2022a. "Australia's Southern Flank: Antarctica." In *Australia on the World Stage*, 1st ed., edited by Bridget Brooklyn, Benjamin T. Jones, and Rebecca Strating, 185–197. London: Routledge.

Buchanan, Elizabeth. 2022b. "Antarctica in the Gray Zone." *Australian Journal of International Affairs* 76 (3) Routledge: 324–339. doi:10.1080/10357718.2022.2057917.

Buchanan, Elizabeth, and Patrick Flamm. 2022. "Antarctic Treaty System at 60: Fit for the Future?" *Australian Journal of International Affairs* 76 (3) Routledge: 245–247. doi:10.1080/10357718.2022.2057919.

Busby, Joshua W. 2008. "Who Cares about the Weather?: Climate Change and U.S. National Security." *Security Studies* 17 (3) Routledge: 468–504. doi:10.1080/09636410802319529.

Campbell, Kurt M., Jay Gulledge, J. R. McNeill, John Podesta, Peter Ogden, Leon Fuerth, R. James Woolsey, et al. 2007. *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change*. Center for a New American Security. https://www.jstor.org/stable/resrep06366.

Cao, Ling, Yong Chen, Shuanglin Dong, Arthur Hanson, Bo Huang, Duncan Leadbitter, David C. Little, et al. 2017. "Opportunity for Marine Fisheries Reform in China." *Proceedings of the National Academy of Sciences* 114 (3): 435–442. doi:10.1073/pnas.1616583114.

Cashion, Tim, Juan Jose Alava, Louise SL Teh, William Cheung, and U. Rashid Sumaila. 2019. "Chapter 3. Global Change and the Fate of the East and South China Seas." In *Status, Trends, and the Future of Fisheries in the East and South China Seas*, edited by Louise SL Teh, Tim Cashion, Juan Jose Alava, William Cheung, and U. Rashid Sumaila, 64–85. Vancouver: Institute for the Oceans and Fisheries, The University of British Columbia.

Chaturvedi, Sanjay. 2012. "The Antarctic 'Climate Security' Dilemma and the Future of Antarctic Governance." In *Antarctic Security in the Twenty-First Century: Legal and Policy Perspectives*, edited by Alan D. Hemmings, Donald R. Rothwell, and N. Karen, 257–283. Scott, New York: Routledge, Taylor & Francis Group.

Clem, Kyle R., Ryan L. Fogt, John Turner, Benjamin R. Lintner, Gareth J. Marshall, James R. Miller, and James A. Renwick. 2020. "Record Warming at the South Pole During the Past Three Decades." *Nature Climate Change* 10 (8) Nature Publishing Group: 762–770. doi:10.1038/s41558-020-0815-z.

Climate Change is a "National Security Issue", Says PM. 2022. *ABC News*. https://www.abc.net.au/news/2022-05-24/climate-change-is-a-national-security-issue-says-pm/13896852.

"COMNAP Sea Ice Challenges Workshop". 2015. *Workshop Report*. Hobart, Tas: The Council of Managers of National Antarctic Programs.

Conference on Antarctica. 1959. *The Antarctic Treaty*. Washington DC: Secretariat of the Antarctic Treaty.

Davis, Peter E. D., Keith W. Nicholls, David M. Holland, Britney E. Schmidt, Peter Washam, Kiya L. Riverman, Robert J. Arthern, et al. 2023. "Suppressed Basal Melting in the Eastern Thwaites Glacier Grounding Zone." *Nature* 614 (7948) Nature Publishing Group: 479–485. doi:10.1038/s41586-022-05586-0.

DeConto, Robert M., and David Pollard. 2016. "Contribution of Antarctica to Past and Future Sea-Level Rise." *Nature* 531 (7596) Nature Publishing Group: 591–597. doi:10.1038/nature17145.

Department of Climate Change, Energy, the Environment and Water: Australian Antarctic Division. 2020. "About Us." Australian Government Website. *Australian Antarctic Program*, September 10. https://www.antarctica.gov.au/about-us/.

Department of Foreign Affairs and Trade. 2017. *2017 Foreign Policy White Paper*. Australian Government.

Department of Sustainability, Environment, Water, Population and Communities: Australian Antarctic Division, Australian Government. 2011. *Australian Antarctic Science Strategic Plan: 2011–12 to 2020–21*. Tasmania: Commonwealth of Australia.

Dudeney, John R., and David W. H. Walton. 2012. "Leadership in Politics and Science Within the Antarctic Treaty." *Polar Research* 31 (1) Routledge: 11075. doi:10.3402/polar.v31i0.11075.

Duffy, Grant A., and Jasmine R. Lee. 2019. "Ice-Free Area Expansion Compounds the Non-Native Species Threat to Antarctic Terrestrial Biodiversity." *Biological Conservation* 232 (April): 253–257. doi:10.1016/j.biocon.2019.02.014.

Edwards, Tamsin L., Sophie Nowicki, Ben Marzeion, Regine Hock, Heiko Goelzer, Hélène Seroussi, Nicolas C. Jourdain, et al. 2021. "Projected Land Ice Contributions to Twenty-First-Century Sea Level Rise." *Nature* 593 (7857) Nature Publishing Group: 74–82. doi:10.1038/s41586-021-03302-y.

Fogarty, Ellie. 2011. *Antarctica: Assessing and Protecting Australia's National Interests*. Sydney, NSW: Lowy Institute: For International Policy. http://www.jstor.com/stable/resrep10200.

Garrick, John. 2021. "The Antarctic Treaty System Is on Thin Ice—and It's Not All about Climate Change." *The Strategist*, November 11. https://www.aspistrategist.org.au/the-antarctic-treaty-system-is-on-thin-ice-and-its-not-all-about-climate-change/.

Government, Australian. 2021. *National Climate Resilience and Adaptation Strategy 2021 to 2025*. Canberra: Commonwealth of Australia.

Gutierrez, Miren, and Guy Jobbins. 2020. "China's Distant-Water Fishing Fleet: Scale, Impact and Governance." *ODI: Think Change*, May 18. https://odi.org/en/publications/chinas-distant-water-fishing-fleet-scale-impact-and-governance/.

Holmes, C. R., T. J. Bracegirdle, and P. R. Holland. 2022. "Antarctic Sea Ice Projections Constrained by Historical Ice Cover and Future Global Temperature Change." *Geophysical Research Letters* 49 (10): e2021G. doi:10.1029/2021GL097413.

Hu, Wenjia, Jianguo Du, Shangke Su, Hongjian Tan, Wen Yang, Like Ding, Peng Dong, Weiwei Yu, Xinqing Zheng, and Bin Chen. 2022. "Effects of Climate Change in the Seas of China: Predicted Changes in the Distribution of Fish Species and Diversity." *Ecological Indicators* 134 (January): 108489. doi:10.1016/j.ecolind.2021.108489.

International Energy Agency. 2022. *The Role of Critical Minerals in Clean Energy Transitions*. IEA.

Jabour, Julia. 2019. "Antarctic Resources and Tourism." In *Antarctica 2050: Strategic Challenges and Responses*, 32–36. Australian Government Australian Civil-Military Centre.

Kang, Bin, Gretta T. Pecl, Longshan Lin, Peng Sun, Peidong Zhang, Yuan Li, Linlin Zhao, et al. 2021. "Climate Change Impacts on China's Marine Ecosystems." *Reviews in Fish Biology and Fisheries* 31 (3): 599–629. doi:10.1007/s11160-021-09668-6.

Kapetas, Anastasia. 2023. "China, Climate and Conflict in the Indo-Pacific." Accessed May 3. http://www.aspi.org.au/report/china-climate-and-conflict-indo-pacific.

Kennicutt, Mahlon C., David Bromwich, Daniela Liggett, Birgit Njåstad, Lloyd Peck, Stephen R. Rintoul, Catherine Ritz, et al. 2019. "Sustained Antarctic Research: A 21st Century Imperative." *One Earth* 1 (1): 95–113. doi:10.1016/j.oneear.2019.08.014.

Kittel, Christoph, Charles Amory, Cécile Agosta, Nicolas C. Jourdain, Stefan Hofer, Alison Delhasse, Sébastien Doutreloup, et al. 2021. "Diverging Future Surface Mass Balance between

the Antarctic Ice Shelves and Grounded Ice Sheet." *The Cryosphere* 15 (3) Copernicus GmbH: 1215–1236. doi:10.5194/tc-15-1215-2021.

Lee, Jasmine R., Ben Raymond, Thomas J. Bracegirdle, Iadine Chadès, Richard A. Fuller, Justine D. Shaw, and Aleks Terauds. 2017. "Climate Change Drives Expansion of Antarctic Ice-Free Habitat." *Nature* 547 (7661) Nature Publishing Group: 49–54. doi:10.1038/nature22996.

Ley, Sussan, Scott Morrison, and Marise Payne. 2022. *$800 Million to Strengthen Our Leadership in Antarctica*. Canberra: Australian Government. https://parlinfo.aph.gov.au/parlInfo/download/media/pressrel/8433223/upload_binary/8433223.pdf;fileType=application%2Fpdf#search=%22media/pressrel/8433223%22.

Liu, Nengye. 2022. "Is Australia's New Antarctica Funding Boost All About Countering China?" *The Diplomat*, February 23. https://thediplomat.com/2022/02/is-australias-new-antarctica-funding-boost-all-about-countering-china/.

McConnochie, Craig. 2023. "High Variability Reveals Complexity under Thwaites Glacier." *Nature* 614 (7948): 420–422. doi:10.1038/d41586-023-00395-5.

Meiser, Jeffrey. 2016. "Ends Ways Means=(Bad) Strategy." *The US Army War College Quarterly: Parameters* 46 (4): 81–91. doi:10.55540/0031-1723.3000.

Milevski, Lukas. 2019. "Western Strategy's Two Logics: Diverging Interpretations." *Journal of Strategic Studies* October: 1–27. doi:10.1080/01402390.2019.1672158.

NASA. 2023. "Arctic and Antarctic Sea Ice: How are They Different?" *Climate Change: Vital Signs of the Planet*. https://climate.nasa.gov/ask-nasa-climate/2861/arctic-and-antarctic-sea-ice-how-are-they-different/.

NASA Earth Observatory. 2022. "Ice Shelf Collapse in East Antarctica." *NASA Earth Observatory*, March 29. https://earthobservatory.nasa.gov/images/149640/ice-shelf-collapse-in-east-antarctica.

Nevitt, Mark. 2020. "On Environmental, Climate Change & National Security Law." *Harvard Environmental Law Review* 44 (October): 321–366.

Office of the Law Revision Counsel: United States Code, US House of Representatives. 2023. "50 USC 3060: Climate Security Advisory Council." Accessed February 14. https://uscode.house.gov/view.xhtml?req=(title:50%20section:3060%20edition:prelim).

PM&C, Australian Government. 2011. "Chapter One – What is Intelligence and What Can Reasonably be Expected of it?" Australian Government Website. *Independent Review of the Intelligence Community*. https://www.pmc.gov.au/publications/2011-independent-review-intelligence-community/chapter-one-what-intelligence-and-what.

Press, Tony. 2019. "Antarctica 2020-2050: Challenges for Australia and New Zealand." In *Antarctica 2050: Strategic Challenges and Responses*, 6–12. Australian Government Australian Civil-Military Centre.

Press, Anthony J., and Anthony Bergin. 2022a. "Coming into the Cold: China's Interests in the Antarctic." *Australian Journal of International Affairs* 76 (3): 340–358. doi:10.1080/10357718.2022.2057921.

Press, Anthony J., and Anthony Bergin. 2022b. "Coming into the Cold: China's Interests in the Antarctic." *Australian Journal of International Affairs* 76 (3): 340–358. doi:10.1080/10357718.2022.2057921.

Press, Tony, and Andrew Jackson. 2021. "Antarctic Environmental Anniversary a Reminder That Diplomacy is Key to Regional Security." *The Strategist*, October 1. https://www.aspistrategist.org.au/antarctic-environmental-anniversary-a-reminder-that-diplomacy-is-key-to-regional-security/.

Reid, Phil. 2015. "Summation of Antarctic Sea Ice: What We Know and Where We Should Go." In *COMNAP Sea Ice Challenges Workshop: Hobart, Tasmania, Australia 12–13 May 2015: Workshop Report*, 40–44. Christchurch: Council of Managers of National Antarctic Programs.

Riihelä, Aku, Ryan M. Bright, and Kati Anttila. 2021. "Recent Strengthening of Snow and Ice Albedo Feedback Driven by Antarctic Sea-Ice Loss." *Nature Geoscience* 14 (11) Nature Publishing Group: 832–836. doi:10.1038/s41561-021-00841-x.

Rintoul, S. R., S. L. Chown, R. M. DeConto, M. H. England, H. A. Fricker, V. Masson-Delmotte, T. R. Naish, M. J. Siegert, and J. C. Xavier. 2018. "Choosing the Future of Antarctica." *Nature* 558 (7709) Nature Publishing Group: 233–241. doi:10.1038/s41586-018-0173-4.

Ruffini, Pierre-Bruno. 2020. "Conceptualizing Science Diplomacy in the Practitioner-Driven Literature: A Critical Review." *Humanities and Social Sciences Communications* 7 (1) Palgrave: 1–9. doi:10.1057/s41599-020-00609-5.

Schmidt, B. E., P. Washam, P. E. D. Davis, K. W. Nicholls, D. M. Holland, J. D. Lawrence, K. L. Riverman, et al. 2023. "Heterogeneous Melting Near the Thwaites Glacier Grounding Line." *Nature* 614 (7948) Nature Publishing Group: 471–478. doi:10.1038/s41586-022-05691-0.

Secretariat of the Antarctic Treaty. 2022. "Parties." Accessed July 11. https://www.ats.aq/devAS/Parties?lang=e.

Simpson, Nicholas P., Katharine J. Mach, Andrew Constable, Jeremy Hess, Ryan Hogarth, Mark Howden, Judy Lawrence, et al. 2021. "A Framework for Complex Climate Change Risk Assessment." *One Earth* 4 (4): 489–501. doi:10.1016/j.oneear.2021.03.005.

Su, Shu, Yi Tang, Bowen Chang, Wenbin Zhu, and Yong Chen. 2020. "Evolution of Marine Fisheries Management in China from 1949 to 2019: How did China Get Here and Where does China Go Next?" *Fish and Fisheries* 21 (2): 435–452. doi:10.1111/faf.12439.

Tan, Hongjian, Rongshuo Cai, Yunlong Huo, and Haixia Guo. 2020. "Projections of Changes in Marine Environment in Coastal China Seas Over the 21st Century Based on CMIP5 Models." *Journal of Oceanology and Limnology* 38 (6): 1676–1691. doi:10.1007/s00343-019-9134-5.

Turner, John, and Thomas Bracegirdle. 2022. "Antarctica and Climate Change." *British Antarctic Survey*, June 30. https://www.bas.ac.uk/data/our-data/publication/antarctica-and-climate-change/.

Tzu, Sun. 1971. *The Art of War*. Translated by Samuel B. Griffith. New York and Oxford: Oxford University Press.

US Department of Commerce, National Oceanic and Atmospheric Administration. 2023. "Thermohaline Circulation – Currents: NOAA's National Ocean Service Education." Accessed February 13. https://oceanservice.noaa.gov/education/tutorial_currents/05conveyor1.html.

Vidal, John. 2021. "Scientists Watch Giant 'Doomsday' Glacier in Antarctica with Concern." *The Guardian*, December 18, sec. World news. https://www.theguardian.com/world/2021/dec/18/scientists-watch-giant-doomsday-glacier-in-antarctica-with-concern.

Voosen, Paul. 2021. "Key Antarctic Ice Shelf is Within Years of Failure: Breakup of Shelf Holding Back Thwaites Glacier Will Ramp Up Sea Level-Rise." *Science* 374 (6574): 1420–1421. doi:10.1126/science.acz9833.

Wilkins, David, Sheree Yau, Timothy J. Williams, Michelle A. Allen, Mark V. Brown, Matthew Z. DeMaere, Federico M. Lauro, and Ricardo Cavicchioli. 2013. "Key Microbial Drivers in Antarctic Aquatic Environment." *FEMS Microbiology Reviews* 37 (3): 303–335. doi:10.1111/1574-6976.12007.

Yao, Joanne. 2021. "An International Hierarchy of Science: Conquest, Cooperation, and the 1959 Antarctic Treaty System." *European Journal of International Relations* 27 (4) SAGE Publications Ltd: 995–1019. doi:10.1177/13540661211033889.

Zhai, Mingguo, Ruizhong Hu, Yan Wang, Shaoyong Jiang, Rucheng Wang, Jianwei Li, Huayong Chen, et al. 2021. "Mineral Resource Science in China: Review and Perspective." *Geography and Sustainability* 2 (2): 107–114. doi:10.1016/j.geosus.2021.05.002.

Zhang, Xiaoning, Ziti Jiao, Changsen Zhao, Ying Qu, Qiang Liu, Hu Zhang, Yidong Tong, et al. 2022. "Review of Land Surface Albedo: Variance Characteristics, Climate Effect and Management Strategy." *Remote Sensing* 14 (6) Multidisciplinary Digital Publishing Institute: 1–28. doi:10.3390/rs14061382.