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FUTURE AIR POWER CAPABILITIES FOR THE CANADIAN ARCTIC

Lieutenant-Colonel Ismael Koussay

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AIM

1. The aim of this service paper is to propose Remotely Piloted Aircraft (RPA) to the Chief of Force Development as a future Royal Canadian Air Force (RCAF) air power capability to support Canadian security and defence policies in Canada's Arctic.

INTRODUCTION

2. To provide context for the integration of RPA as a future RCAF capability, this service paper begins with a narrow assessment of the future security environment. Focusing on climate change generally, and more specifically its impact on the Canadian Arctic, this analysis will provide insights on the most likely environments for future Canadian Armed Forces (CAF) operations.[1] The second part will identify current and future core capabilities that the RCAF requires to support missions in the evolving Canadian Arctic in light of the ongoing initiatives pertaining to North American Aerospace Defence Command (NORAD) Modernization.[2] Using RCAF doctrinal air power characteristics as a framework, the third part will analyze the fundamental advantages and limitations of RPA. This service paper will argue that the RCAF integration of RPA will enhance CAF Intelligence, Surveillance and Reconnaissance (ISR) and Search and Rescue (SAR) missions in Canadian Arctic.

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[1] Department of National Defence, *Capability Based Planning Handbook*, Accessed 3 November 2021, https://mars,cfc.forces.gc.ca/CFCLearn/pluginfile.php/33015/mod_resource/Content/2/190906-UU-CFD-CBP Handbook %282019 en%29.pdf

[2] Department of National Defence, *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017: 57.

DISCUSSION

Climate Change

3. Since the ninetieth century, human activities related to fossil fuel combustion, deforestation, industrial and agricultural practices have resulted in climate change and global warming.[3] The majority of the recent temperature increase can be explained by greenhouse gas emissions, which consists of more than 90% of carbon dioxide and methane[4], with "near-zero statistical probabilities that natural climate variability could account for observed trends."[5] Regardless of the emissions scenario being considered, the Global surface temperature will continue to increase until at least the mid-century.[6] Unless significant reductions in carbon dioxide and other greenhouse gas emissions materialize in the upcoming decades, global warming of 1.5-2 degree Celsius will be exceeded during the 21st century.[7]

4. Moreover, increasing global warming directly amplifies changes in climate system.[8] These changes include heightened frequency and intensity of hot extremes, marine heatwaves, droughts in some regions, intense tropical cyclones and significant

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[3] Yasmeen, Samina, "Climate Change and Human Security: In Context of Global Economy, Culture and Conflict." *Journal of the Research Society of Pakistan* 58, no. 3 (2021): 203. https://www.proquest.com/scholarly-journals/climate-change-humans-security-context-global/docview/2580281552/se-2?accountid=9867; United Nations. Intergovernmental Panel on Climate Change, "*Climate change 2021: The Physical Science Basis*," Accessed 29 October 2021, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FullReport_smaller.pdf

[4] Yasmeen, Samina, "Climate Change and Human Security: In Context of Global Economy, Culture and Conflict." *Journal of the Research Society of Pakistan* 58, no. 3 (2021): 203.

[5] Richard Hodgkins." The twenty-first-century Arctic environment: accelerating change in the atmospheric, oceanic and terrestrial spheres." *The Geographical Journal 180*, no.4 (2014): 429-436

[6] United Nations, "Intergovernmental Panel on Climate Change, *Climate change 2021: The Physical Science Basis*," Accessed 29 October 2021, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FullReport_smaller.pdf 41.

[7] *Ibid.*

[8] *Ibid.*

reductions in Arctic sea ice.[9] Climate change is rapidly disrupting human stability and will further accelerate in the future, hindering access to natural resources which are vital for maintaining livelihoods.[10]

5. Climate change has become part of an international security discussion and was first mentioned in 2007 in the first Security Council debate on climate change security.[11] The Government of Canada (GoC) considers the effect of climate change through a security lens that requires an urgent call for innovation, increased international attention and military activity.[12] It is therefore vitally important for the CAF to understand the effect of climate changes on operational and strategic goals. In particular in the context of the Arctic, it should consider the myriad of logistical and intelligence challenges associated with the conduct of future humanitarian assistance and disaster response (HADR) and SAR operations.[13]

Arctic Transformation

6. The Arctic is experiencing dramatic transformation due to human-induced climate change, and the region is warming at least twice the global average.[14] The ice that has

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[9] *Ibid.*

[10] Yasmeen, Samina, "Climate Change and Human Security: In Context of Global Economy, Culture and Conflict." *Journal of the Research Society of Pakistan* 58, no. 3 (2021): 203. https://www.proquest.com/scholarly-journals/climate-change-humans-security-context-global/docview/2580281552/se-2?accountid=9867.

[11] Chmutina, Ksenia, Peter Fussey, Andrew Dainty, and Lee Bosher,"Implications of Transforming Climate Change Risks into Security Risks" *Disaster Prevention and Management* 27, no.5 (2018): 460-477

[12] Department of National Defence, *Strong, Secure, Engaged: Canada's New Defence Policy,* Ottawa, ON: 2017: 52.

[13] Chad, M. Briggs, "Climate Change and Hybrid Warfare Strategies," *Journal of Strategic Security* 13, no. 4 (2020): 45-57; Department of National Defence, A-FD-005-001/AF-003*, The Future Security Environment 2013-2040* (Ottawa: DND Canada, 2014), 44. Accessed 16 November 2021, https://publications.gc.ca/collections/collection_2015/mdn-dnd/D4-8-2-2014-eng.pdf.; Department of National Defence. *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017. 52

[14] Canosa, I.V., J.D. Ford, G. MCDowell, J. Jones, and T. Pearce, "Progress in Climate Change Adaptation in the Arctic." *Environment Research Letters* 15, no. 9 (2020); Government of Canada. "Canada's Arctic and Northern Policy Framework," Accessed 10 December 2021, https://www.rcaanc.gc.ca/eng/15605233306861/1560523330587

long maintained the Arctic as "a uniquely placid international space"[15] is receding at an accelerated rate for the past decades.[16] As a result, the Canadian Arctic has become more accessible to sea traffic as international shipping migrates to Northern waters, and there has been greater activity in the region due to economic and resources exploitation such as petroleum or fishery activities.[17] These developments all contribute to greater foreign presence in the Canadian Archipelago commonly referred to the Northwest Passage, which Canada considers internal waters and not an international strait.[18] The number of unique[19] ships passing through the Northwest Passage area increased by 44% from 2013 to 2019 with the most common types include bulk carriers, cargo ships, fishing vessels and cruise ships.[20] Although scientific projections of Arctic sea ice loss vary, a median projection of a virtually ice-free Arctic is forecasted in 2037.[21]

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[15] Rob Huebert, Heather Exner-Pirot, Adam Lajeunesse, and Jay Gulledge, North America and Arctic Defence and Security Network (NAADSN), "Climate Change as International Security: The Arctic as a Bellwether," (2012): 91-104, Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uplodas/2021/11/DebatingArcticSecurity-RH-PWL-nov2021.pdf

[16] *Ibid.*

[17] Rob Huebert, North America and Arctic Defence and Security Network (NAADSN), "The Newly Emerging Arctic Security Environment," (2010): 39-72 Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uplodas/2021/11/DebatingArcticSecurity-RH-PWL-nov2021.pdf

[18] Rob Huebert, North America and Arctic Defence and Security Network (NAADSN), "The Newly Emerging Arctic Security Environment," (2010): 39-72 Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uplodas/2021/11/DebatingArcticSecurity-RH-PWL-nov2021.pdf; Rob Huebert, Heather Exner-Pirot, Adam Lajeunesse, and Jay Gulledge, North America and Arctic Defence and Security Network (NAADSN), "Climate Change as International Security: The Arctic as a Bellwether," (2012): 91-104, Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uplodas/2021/11/DebatingArcticSecurity-RH-PWL-nov2021.pdf; Rob Huebert, North America and Arctic Defence and Security Network (NAADSN), "Canada and Future Challenges in the Arctic," (2014): 315-319. Major diplomatic concerns for Canada include the claim by some states that the waters comprising the Northwest Passage as international for trans-navigation purposes, disputed Canada-US boundaries in the Beaufort Sea.

[19] Arctic Council, "Report On Shipping In The Northwest Passage Launched," Accessed 13 December 2021, https://arctic-council.org/news/report-on-shipping-in-the-northwest-passage-launched/. Unique Ships refers to each ship counted once but can enter the area multiple times according to the Arctic Council website.

[20] Arctic Council, "Report On Shipping In The Northwest Passage Launched," Accessed 13 December 2021, https://arctic-council.org/news/report-on-shipping-in-the-northwest-passage-launched/

[21] Rob Huebert, Heather Exner-Pirot, Adam Lajeunesse, and Jay Gulledge, North America and Arctic Defence and Security Network (NAADSN), "Climate Change as International Security: The Arctic as a

7. The Arctic is central to Canada's national identity, security and interests.[22] The Canadian Arctic covers 40% of Canada's landmass and comprises 75% of Canada's overall coastline[23] and is home to 200,000 inhabitants, half of whom are Indigenous.[24] Due to scientific as well as commercial interests in petroleum, sea traffic and resources, the Arctic is expected to become an increasingly contested region.[25] The GoC is committed to demonstrating the full extent of Canada's enduring Arctic sovereignty now and into the future through a wide range of activities including improved situational awareness.[26] The CAF plays a key role in safeguarding Canada's sovereignty, and the RCAF with its space and air capabilities will continue to contribute a vital role in enhancing joint situational awareness, sovereignty operations and continental defence in the Arctic.[27]

8. Climate change has also reinforced the importance of the Arctic region in the defence of North America and Canada-United States (U.S.) defence cooperation.[28] While

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Bellwether," (2012): 91-104, Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uplodas/2021/11/DebatingArcticSecurity-RH-PWL-nov2021.pdf

[22] Government of Canada, "Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 11 December 2021, https://www.rcaanccirnac.gc.ca/eng/1562939617400/1562939658000

[23] Government of Canada, "Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 11 December 2021, https://www.rcaanccirnac.gc.ca/eng/1562939617400/1562939658000 ; Department of National Defence, *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON, 2017: 79.

[24] Government of Canada. "Canada and the circumpolar Arctic," Accessed 11 December 2021, https://www.international.gc.ca/world-monde/international_relations-relations-internationales/arctic-arctique/index.aspx?lang=eng

[25] Department of National Defence. *The Future Security Environment 2013-2040*, Ottawa, ON, 2014: 21.

[26] Government of Canada. "Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 11 December 2021, https://www.rcaanccirnac.gc.ca/eng/1562939617400/1562939658000; Department of National Defence. *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017. 90.

[27] Department of National Defence. *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017. 65.; Department of National Defence. *Royal Canadian Air Force Vectors,* Ottawa, ON, 2019: 56.; Government of Canada. "Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 11 December 2021, https://www.rcaanccirnac.gc.ca/eng/1562939617400/1562939658000

[28] Andrea Charron, James Fergusson, Joseph Jockel, Chris Sands and Joel Sokolsky, "NORAD: Beyond Modernization", Centre for Defence and Security Studies, Accessed 11 December 2021, https://umanitoba.ca/centres/cdss/media/NORAD_beyond_modernization_2019.pdf

Canada sees no immediate threat, the Arctic is becoming an area of strategic international importance with both Arctic and non-Arctic states expressing a variety of economic and military interests in the region.[29] Canada must have the ability to respond to Arctic security situations that may arise from the increase in international activity, be it an environmental emergency caused by a vessel to illegal activity and military threats.[30] This is reflected in Government of Canada policy.

9. Released in 2019, Canada's Arctic and Northern Policy Framework provides overarching direction to the priorities and investments in the Arctic through 2030.[31] One of the primary objectives of the GoC is to protect the safety and security of Northerners and defend both the Canadian Arctic and North America now and into the future.[32] To meet this goal, the GoC will continue to enhance Canada's military presence as well as respond to safety and security incidents in the Arctic and the North. Furthermore, the GoC intends to strengthen domain awareness, surveillance, and control capabilities in the Arctic and North[33] while committed as new initiatives to "Prioritize Arctic Joint ISR as a defence research priority to produce innovative solutions to surveillance challenges in the North."[34] There are also implications for Canada's NORAD connection.

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[29] Government of Canada. "Canada's Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 10 December 2021, https://www.rcaanc.gc.ca/eng/15605233306861/1560523330587

[30] Rob Huebert, North America and Arctic Defence and Security Network (NAADSN), "Canada and Future Challenges in the Arctic," (2014): 315-319

[31] Government of Canada. "Canada's Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 10 December 2021, https://www.rcaanc.gc.ca/eng/15605233306861/1560523330587

[32] *Ibid.*

[33] *Ibid.*

[34] Department of National Defence. *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017: 65.

The Arctic, North American Defence, and SAR

10. As the Arctic makes up a large portion of the air and maritime approaches to North America,[35] Canada will continue to work in close partnership with the U.S. under the auspice of the binational NORAD to ensure the North American continent is positioned well into the future to deter and defend against threats.[36] It is vital for Canada and the U.S. to remain firmly committed to modernizing NORAD[37] as highlighted during the first visit to Canada of General VanHerck, Commander of NORAD with the Minister of National Defence and Chief of Defence Staff, in Ottawa on 29 November 2021.[38] NORAD Modernization is naturally focused on the next generation of the North Warning System (NWS).[39] However, it will require an evolution of the command and control arrangements[40] and some mix of ground, air, space and sea-based sensors considering a new generation of Russian nuclear and conventional military capabilities, which pose the most pressing concerns to North American defence.[41] To defend North America against these new threats, the goal is to create an all Domain Awareness capabilities provided by

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[35] *Ibid.*, 79.

[36] Government of Canada. "Canada's Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 10 December 2021, https://www.rcaanc.gc.ca/eng/15605233306861/1560523330587

[37] Andrea Charron, James Fergusson, Joseph Jockel, Chris Sands and Joel Sokolsky, "NORAD: Beyond Modernization", Centre for Defence and Security Studies, Accessed 11 December 2021, https://umanitoba.ca/centres/cdss/media/NORAD_beyond_modernization_2019.pdf

[38] North American Aerospace Defense Command, "Commander NORAD completes first visit to Canada", Accessed 16 December 2021, https://norad.mil/Newsroom/Article/2857152/commander-norad-completes-first-visit-to-canada/

[39] Andrea Charron and James Fergusson, "Beyond NORAD and Modernization to North American defence Evolution", Canadian Global Affairs Institute, Accessed 11 December 2021, https://www.cgai.ca/beyond_norad_and_modernization_to_north_american_defence_evolution; Department of National Defence. *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017: 79.

[40] Government of Canada. "Future Force Design," Accessed 8 January 2022, https://www.canada.ca/en/department-national-defence/corporate/reports-publications/departmental-plans/departmental-plan-2021-22/planned-results/future-force-design.html

[41] Andrea Charron and James Fergusson, "Beyond NORAD and Modernization to North American defence Evolution", Canadian Global Affairs Institute, Accessed 11 December 2021, https://www.cgai.ca/beyond_norad_and_modernization_to_north_american_defence_evolution

a multi-layered sensor system that enables threat detection and identification at its "birth and track until its death."[42]

11. RPA equipped with specialized sensors for collection of imagery and other intelligence information can form a vital part of the aforementioned multi-layered sensor system.[43] RPA sensors, will provide airspace situational awareness allowing greater standoff ranges and reducing impact of obscurants and adverse weather.[44] Lastly, next generation RPA will be able to provide pre-launch detection and airborne missile tracking and engagement.[45] As will be discussed below, RPA can enhance the security of Canada's Arctic and the North in other ways.

12. The transforming Arctic is likely to experience a growth in civilian aviation[46] coupled with international shipping, offshore resources exploitation such as fisheries, tourism and northern economic development over the next decade.[47] These activities bring new risks for people, infrastructure and ecosystems that further stress SAR and HADR capacity.[48] The event of a naturally-occurring or human-induced disaster in the Arctic Archipelago would place tremendous strain on the capacities of all levels of government, as well as on local communities, to support affected people and minimize

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[42] CDA Institute, "NORAD Modernization: Report One: Awareness & Sensors" Accessed 17 December 2021, https://cdainstitute.ca/norad-modernisation-report-one-awarness-sensors/

[43] United States Air Force RPA VECTOR, "Vision and Enabling Concepts 2013-2038," Accessed 23 October 2021, https://www.af.mil/Portals/1/documents/news/USAFRPAVectorVisionandEnablingConcepts2013-2038.pdf 18.

[44] *Ibid.*, 35.

[45] *Ibid.*, 50.

[46] Andrea Charron, James Fergusson, Joseph Jockel, Chris Sands and Joel Sokolsky, "NORAD: Beyond Modernization", Centre for Defence and Security Studies, Accessed 11 December 2021, https://umanitoba.ca/centres/cdss/media/NORAD_beyond_modernization_2019.pdf; Department of National Defence, *Royal Canadian Air Force Future Concepts Directive Part 2: Future Air Operating Concept.* Ottawa, ON, 2016: 8.

[47] Government of Canada. "Canada's Arctic and Northern Policy Framework: Safety, Security, and Defence," Accessed 11 December 2021, https://www.rcaanc.gc.ca/eng/15605233306861/1560523330587

[48] *Ibid.*

damage to affected wildlife, infrastructure and ecosystems.[49] As a result, the CAF may be called upon to assist the civilian authority to address these challenges.

13. The National Search and Rescue Secretariat under Public Safety Canada is responsible for coordinating the national SAR programme which is inherently integrated activity.[50] The RCAF supports national aerial SAR missions with the appropriate equipment and personnel[51] which are largely located in the south.[52] The current SAR posture that produces the slowest response time in the Arctic where a fast response is needed most constitutes one of the greatest challenge of the current Canadian SAR system.[53] The requirements for RCAF assets and capabilities will continue to grow, particularly in the Arctic[54] characterized by vast distances, remoteness, inhospitable natural environment, sparse population with little existing infrastructure to support them.[55] RPA is well suited to mitigate the aforementioned challenges.

Air Power Doctrinal Applications and the Advantages of RPA

14. The distinguishing characteristics of air power (in bold) that are embodied in RPA makes these platforms suitable to address Arctic challenges. Based on the fundamental air

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[49] *Ibid.*

[50] Department of National Defence. *B-GA-400-000/FP-00, Royal Canadian Air Force Doctrine,* Ottawa, ON, 2016: 36.

[51] *Ibid.*

[52] North America and Arctic Defence and Security Network (NAADSN), "Shielding North America: Canada's Role in NORAD Modernization," Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uploads/2021/03/NAADSN-engaged4-NORAD-NT-RD-upload.pdf

[53] Dany Poitras, "Search and Rescue in the Arctic. In Canadian Arctic Operations, 1945-2015: Lessons Learned, Lost and Relearned", The Gregg Centre for War & Society, 2017: 401.; Department of National Defence, *Royal Canadian Air Force Vectors,* Ottawa, ON, 2019: 13.; Department of National Defence, *RCAF Future Concepts Directive Part 2; Future Air Operating Concept.* Ottawa, ON, 2016: 17.

[54] Department of National Defence, *Royal Canadian Air Force Vectors*. Ottawa, ON, 2019: 13.; Department of National Defence, *RCAF Future Concepts Directive Part 2; Future Air Operating Concept.* Ottawa, ON, 2016: 8.

[55] Department of National Defence, *The Future Security Environment 2013-2040.* Ottawa, ON, 2014: 21.; North America and Arctic Defence and Security Network (NAADSN), "Shielding North America: Canada's Role in NORAD Modernization," Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uploads/2021/03/NAADSN-engaged4-NORAD-NT-RD-upload.pdf;

power applications of observation, and thanks to air power capacity to be employed above the surface of the Earth, **elevation** gives RPA the ability to locate and monitor activities on the surface.[56] In addition, the distinctive global **reach** characteristic of air power provides strategic options to decision makers for RPA usage in the Arctic while contributing to CAF's power projection.[57] Moreover, the unique air power characteristic of **speed**, ensures a swift response capability by RPA over great distances.[58] Air power, embodied in RPA, thus possesses the required characteristics to conduct ISR and SAR, which are two fundamental RCAF doctrinal core and role capabilities.[59] Therefore, RPA is well suited to support the GoC Arctic and Northern Policy Framework priorities and enhance the NWS in support of NORAD Modernization.

15. RPA embodiment of the air power doctrinal tenet of persistence also offers unique advantages compare to inhabited platforms. In general, the **persistence** employment of air power gives the commander influence and presence in air environment while its characteristics of **speed** and **reach** allow the operational environment to be revisited persistently over time.[60] In particular RPA, unencumbered by human performance or physiological characteristics can achieve extreme **persistence** that far exceeds inhabited air assets and maneuverability.[61] For example, the loitering time of a Global Hawk[62]

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[56] Department of National Defence. *B-GA-400-000/FP-00, Royal Canadian Air Force Doctrine,* Ottawa, ON, 2016: 16.

[57] *Ibid.*, 14.

[58] *Ibid.*

[59] Department of National Defence. *B-GA-400-000/FP-00, Royal Canadian Air Force Doctrine.* Ottawa, ON, 2016: 32.; Richard Goette, "Preparing the RCAF for the Future: Defining Potential Niches for Expeditionary Operations," Ottawa, ON, 2020: 139.

[60] Department of National Defence, *B-GA-400-000/FP-00, Royal Canadian Air Force Doctrine.* Ottawa, ON, 2016: 16.

[61] United Kingdom, Joint Doctrine Publication 0-30.2 Unmanned Aircraft Systems, Accessed 5 September 2021, https://www.gov.uk/government/publications/unmanned-aircrfat-systems-jdp-0-302 51.

[62] United States Air Force RPA VECTOR, "Vision and Enabling Concepts 2013-2038," Accessed 23 October 2021,

could exceed 28 hours while an inhabited CP-140 Aurora long range patrol aircraft loitering time is just over eight hours.[63] ISR was originally the raison d'être for RPA and is often conducted in a joint, multi-agency effort to gain Situation Awareness and subsequently decision superiority.[64] It is therefore not surprising that the use of RPA in support of ISR represents a significant portion of its military application.[65]

16. Considering the limited infrastructure available in Canada's Arctic[66], RPA also have the ability to take advantage of the Remote Split Operations concept to "flex assets between areas of responsibility."[67] Most United States Air Force (USAF) RPA are operated beyond line of sight (BLOS) from geographically separated location; therefore, they produce sustained combat capability more efficiently with a reduced forward footprint.[68] A multirole and swing-role platforms constitute a more viable option for the RCAF as stated preference in the RCAF Vectors[69] and by the RCAF Commander.[70]

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https://www.af.mil/Portals/1/documents/news/USAFRPAVectorVisionandEnablingConcepts2013-2038.pdf 56.

[63] Department of National Defence. "CP-140 Aurora," Accessed 6 January 2022, www.rcaf-arc.forces.gc.ca/en/aircraft-current/cp-140.page; Wikipedia. "Lockheed CP-140 Aurora," Accessed 6 January 2022, https://en.wikipedia.org/wiki/lockheed_CP-140_Aurora

[64] Department of National Defence, *B-GA-401-002/FP-001*, *Royal Canadian Air Force Doctrine: Intelligence Surveillance and Reconnaissance*, Ottawa, ON, 2017: 5.

[65] Teal Group, World Military Unmanned Aerial Systems Market Profile and Forecast 2020/2021, Accessed 4 September 2021, https://shop.tealgroup.com/producst/wmuav

[66] North America and Arctic Defence and Security Network (NAADSN), "Shielding North America: Canada's Role in NORAD Modernization," Accessed 11 December 2021, https://www.naadsn.ca/wp-content/uploads/2021/03/NAADSN-engaged4-NORAD-NT-RD-upload.pdf

[67] United States Air Force Unmanned Aircraft Systems, "Flight Plan 2009-2047," Accessed 11 December 2021, https://irp.fas.org/program/collect/uas_2009.pdf .15. As indicated below, the Canadian equivalent of flex assets is the multirole and swing-role capabilities.

[68] United States Air Force Unmanned Aircraft Systems, "Flight Plan 2009-2047," Accessed 11 December 2021, https://irp.fas.org/program/collect/uas_2009.pdf .15

[69] The RCAF or Air Force Vectors remains the key strategic publication of the RCAF. It provides direction and guidance to how the future force will be conceived and how the force of today will be managed.

[70] Department of National Defence, *Royal Canadian Air Force Vectors,* Ottawa, ON, 2019: 57.; Richard Goette, "Preparing the RCAF for the Future: Defining Potential Niches for Expeditionary Operations," Ottawa, ON, 2020: 44.

17. RPA could offer certain advantages that meet government desire to demonstrate prudent stewardship of public resources.[71] Although still Person Year (PY) intensive (similar to inhabited platforms), the lower unit cost of RPA compared to inhabited aircraft further increases its attractiveness.[72] For example the MQ-1 Predator, armed, multi-role and long endurance RPA costs approximately one-thirtieth that of new inhabited fighter aircraft while it is capable of performing many of the same functions.[73]

Other Considerations

18. RPA civilian application in the Arctic also have security implications. The GoC has initiated the procurement of the Hermes 900 StarLiner, a civilian version of the Israeli made Elbit's medium-altitude long endurance military RPA, in support of Transport Canada National Aerial Surveillance Program with a delivery expected by December 2022.[74] Transport Canada intends to use its RPA for oil spills detection, ice and marine habitats survey along with Canada's Arctic Ocean monitoring up to 72 degrees north latitude.[75]

19. The Arctic poses unique challenges to remote ground-based sensors and space-based sensors in polar orbits.[76] RPA operations in the North, specifically at latitudes greater than 70 degrees, could be limited by adequate acquisition of geostationary BLOS

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[71] Department of National Defence. *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017: 47.

[72] Michell Binding, "Have Autonomous and Unmanned Systems Changed War Fundamentally?," *Canadian Military Journal* 19, no. 1 (Winter 2018): 40-45

[73] *Ibid.*

[74] Eye On the Arctic, "Canada buys Israeli drone for Arctic maritime surveillance," Accessed 11 December 2021, https://www.rcinet.ca/eye-on-the-arctic/2020/12/22Canada-buys-israeli-drone-for-arctic-maritime-surveillance/

[75] *Ibid.*

[76] CDA Institute, "NORAD Modernization: Report One: Awareness & Sensors" Accessed 17 December 2021, https://cdainstitute.ca/norad-modernisation-report-one-awarness-sensors/

satellite communication "locks" for proper RPA control[77] due to a very low elevation that increases signal interference with ground clutter.[78] Therefore, in order to expand the use of RPA in the North, in support of ISR and SAR mandates, the BLOS satellite communication challenges must be addressed.[79]

CONCLUSION

20. This service paper demonstrated that the integration of RPA as future RCAF air power capabilities will enhance support to ISR and SAR missions in Canadian Arctic in support of the GoC Arctic and Northern Policy Framework priorities while enhancing the NWS in support of NORAD Modernization. This service paper began with an assessment of the future security environment. The Canadian Arctic is experiencing the most dramatic transformation due to climate change with a projection of a virtually ice-free Arctic by 2037. While Canada sees no immediate threat in the Arctic, climate change has reinforced the importance of the Arctic region in the defence of North America, which is becoming an area of strategic international importance.

21. The second part identified the need for ISR and SAR as core RCAF air power capabilities to enhance the NWS with additional airborne sensors in support of NORAD modernization. In addition, the evolving Canadian Arctic, is expected to experience a growth in civilian aviation, international shipping and northern economic development over the next decade. This condition would strain the national and RCAF SAR resources

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[77] All About Circuits. "The Limits of Satellite Navigation: GPS Challenges in the Arctic," Accessed 16 December 2021, https://www.allaboutcircuits.com/news/navigating-the-arctic-why-gps-might-fail-you/

[78] Rob Huebert, North America and Arctic Defence and Security Network (NAADSN), "The Newly Emerging Arctic Security Environment," (2010): 39-72.; Department of National Defence, *Canadian Forces UAV Campaign Plan*, Ottawa, ON: (2006): 34.

[79] Rob Huebert, North America and Arctic Defence and Security Network (NAADSN), "The Newly Emerging Arctic Security Environment (2010): 39-72; Department of National Defence, *Canadian Forces UAV Campaign Plan*, Ottawa, ON: (2006): 34.

which are largely located in the south - hence producing the slowest SAR response time in the Canadian Arctic.

22. The third part demonstrated that air power, embodied in RPA, possesses the required characteristics to conduct ISR and SAR, which are two fundamental RCAF doctrinal core and role capabilities. RPA characteristics of extreme persistence, reach and speed offers the optimal RCAF capability to support ISR and SAR. Therefore, RPA is well suited to support the GoC Arctic and Northern Policy Framework priorities and enhance the NWS in support of NORAD Modernizationusing. In addition, RPA as a multirole and swing-role platforms constitute a more viable option for the RCAF requirements in light of the Canadian Arctic remoteness and little existing infrastructure.

RECOMMENDATION

23. It is hereby recommended that the Chief of Force Development considers the integration of RPA for the conduct of ISR and SAR in Canada's Arctic. Not only are these two RCAF doctrinal core and role capabilities[80]; they are also in support of the GoC Arctic and Northern Policy Framework priorities and will provide enhancement to the NWS in support of NORAD Modernization. In addition, it is also recommended that the procurement, introduction to operational service and sustainment experience gained by Transport Canada from its RPA Hermes 900 StarLiner be leveraged by CAF for future RPA projects already identified in Canada Defence Policy.[81]

24. In light of the on-going CAF Reconstitution efforts, and acknowledging that RCAF "does not have the foundation needed to build and sustain a full-ISR-capability

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[80] Department of National Defence, *B-GA-400-000/FP-00, Royal Canadian Air Force Doctrine,* Ottawa, ON, 2016: 32

[81] Department of National Defence, *Strong, Secure, Engaged: Canada's New Defence Policy*, Ottawa, ON: 2017: 39.

enterprise on the lines of USAF"[82], a thorough PY assessment in support of RPA operation and sustainment is recommended. It should include operators, maintenance technicians and specialized skill set in the data processing, exploitation and dissemination. Finally, it is recommended to explore the feasibility of RPA operations in the Arctic at latitudes greater than 70 degrees, due to limited acquisition of geostationary BLOS satellite communication.

[82] Richard Goette, "Preparing the RCAF for the Future: Defining Potential Niches for Expeditionary Operations," Ottawa, ON, 2020: 139.

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