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Agenda Item:	ATCM 15
Presented by:	Canada
Original:	English
Submitted:	07/04/2017

Preliminary overview of Canadian Antarctic research contributions (1997 – 2016)

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Overview

This information paper provides an overview of Canadian Antarctic research contributions over the past 20 years (1997 to 2016). It is based on a preliminary analysis of bibliographic information pertaining to Canadian Antarctic research publications (journal and review articles) generated using Web of Science.

Canadians have been active in Antarctic research for over 100 years. Physicist and glaciologist Charles Seymour Wright was one of Canada's pioneering scientists, and was a member of Britain's Terra Nova Expedition from 1910 to 1913. Canadian Antarctic researchers are currently based at more than 15 Canadian universities and four federal government organizations, as well as some other institutions. Canadians have expertise in a broad range of Antarctic research disciplines spanning physical, life sciences, and geosciences research, and have also been involved in technology development, data management and geographic information activities. Much of this has been undertaken in partnership with other countries, with Canadians having collaborated with researchers from most Antarctic Treaty nations. Based on a preliminary analysis of Canadian Antarctic research publications over the past two decades (1997 – 2016), it is evident that Canadian researchers have made significant and sustained contributions to Antarctic research.

Methodology

A list of Canadian Antarctic research publications (journal articles and review articles) from 1997 to 2016 was generated using Web of Science.¹ Results were reviewed to ensure inclusion of only relevant publications, defined as those covering research in or about Antarctica, sub-Antarctic islands, and the Southern Ocean, including comparative studies using data or observations from other geographic regions.² Each relevant publication was examined to identify whether the first author was affiliated with a Canadian-based institution, and to categorize it under one of six high-level research themes listed in Table 1, the intention being to provide greater detail regarding research contributions.³ This was achieved primarily by reviewing the title or abstract of the publication, and in some cases, the full publication where further information was required. Some papers crossed theme boundaries, and in these cases, the categorization of a paper depended on the theme to which the main scientific results pertained. It is possible that further analysis of the main topics or subthemes of the papers, or more detailed analysis of the bibliographic results by subject matter experts may lead to re-categorization of some publications, but it is thought that the classification of most papers is appropriate.

¹ Search parameters: All journal articles or review papers between 1997 and 2016 with one or more authors based at an institution in Canada, and one or more of the following keywords in either the title, abstract, author keyword or keywords plus field: 'Antarctic*', 'Southern Ocean', 'Ross Sea', 'Amundsen Sea', or 'Weddell Sea'.

² In order for a paper to be included, in cases where the focus was clearly not on Antarctica, a comparison to the Antarctic case or situation required an element of further analysis or extended discussion. Thus, a cursory one or two sentence comparison to Antarctica or the Southern Ocean case in the main text of the paper, and a brief mention in the abstract would not qualify the paper as "Antarctic research". In contrast, however, the results of laboratory analysis of samples from Antarctica or the Southern Ocean, even in a paper where the majority of samples were collected from elsewhere, would qualify the paper as "Antarctic research".

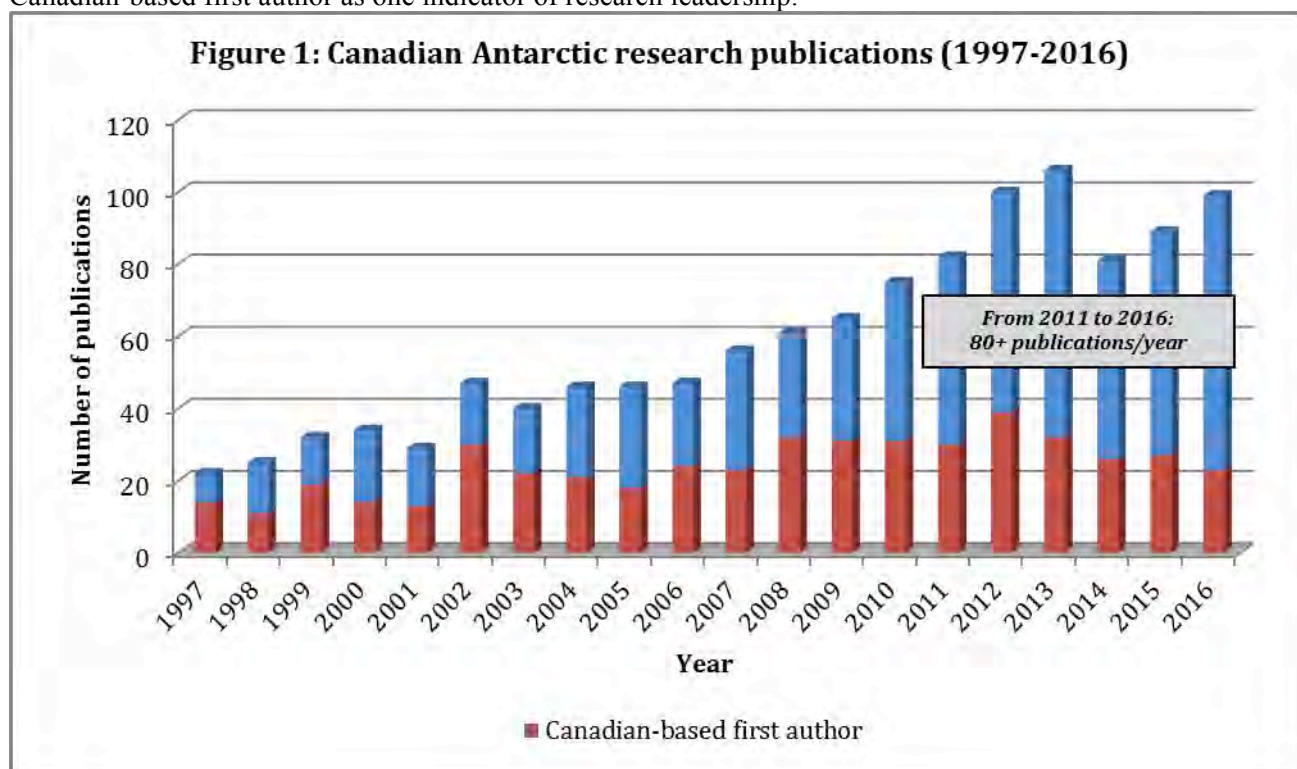
³ Research themes were defined in advance of a Canadian Antarctic Research Workshop convened by Polar Knowledge Canada on October 3-4, 2016 for the purposes of highlighting recent Canadian involvement during the workshop and facilitating associated breakout discussions.

Table 1: Research themes and scope	
(a) Geology, solid-Earth geophysics, and ice sheets	Tectonics, volcanism, ice sheet stability and dynamics, ice sheet interactions with the solid Earth, sea level change, and subglacial hydrology
(b) Atmosphere, Southern Ocean and cryosphere	Climate variability and processes, including linkages with glaciers and/or sea ice, ozone, atmosphere-ocean interactions, and ice core results
(c) Space and atmospheric physics, astronomy and astrophysics	Ionospheric studies (“space weather”), including solar-terrestrial coupling, and origin, nature and evolution of the universe
(d) Permafrost, soils and landscapes	Microbial communities in soils or permafrost, contaminants and remediation of soils, weathering processes, cold-regions geomorphology, and terrestrial analogue sites and astrobiology linkages
(e) Biota and ecosystems	Terrestrial, coastal and marine biota and ecosystems, subglacial ecosystems, and biogeochemical cycling
(f) Human activities in Antarctica	Governance and policy, human health and psychology, history, tourism, data management, geographic information, and education/outreach

Other methodological limitations exist. Given that the analysis does not include additional types of publications such as books and abstracts from some conferences, it may not provide a complete picture of the extent of Canadian research contributions, and in particular, may underrepresent contributions under some research themes. By limiting the keyword search to title, abstract, or keyword fields only, it may not fully capture all potentially relevant Canadian Antarctic publications. For example, this approach may not capture some astronomy or astrophysics research that utilizes Antarctica for its favourable research and observation conditions, but does not explicitly reference the continent in publication title, abstract or keyword fields.

Canadian Antarctic research publications over time

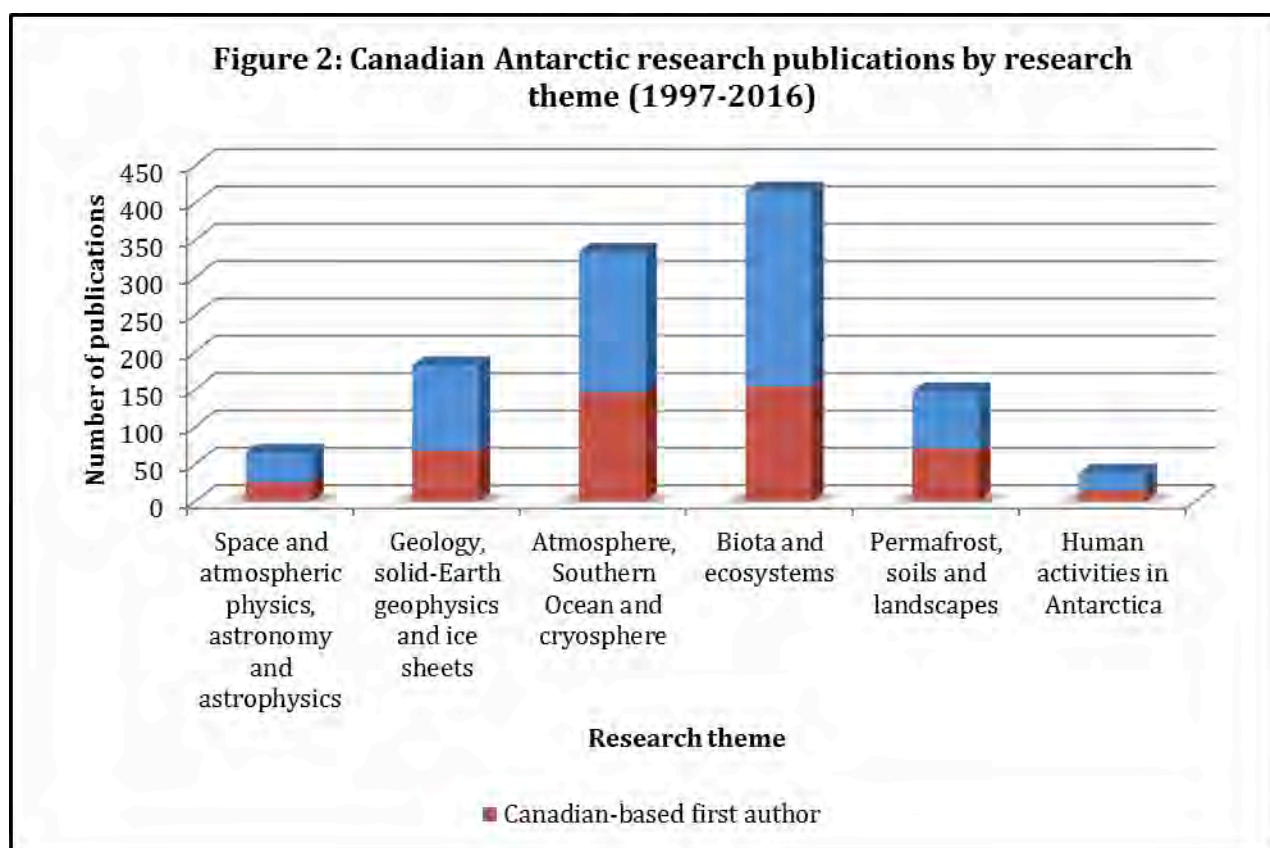
Canadians have sustained involvement in Antarctic research over decades. Figure 1 illustrates the total number of Canadian Antarctic research publications from 1997 to 2016, highlighting those with a Canadian-based first author as one indicator of research leadership.



The total number of Canadian Antarctic research publications has generally increased over time. In particular, over the past six years (2011 to 2016), Canadian researchers have contributed more than 80 distinct publications per year. More than 70 individual Canadian researchers have also been a first author on more than one publication between 1997 and 2016. In general, the number of publications with a Canadian-based first author has also increased, with at least 20 such publications per year over the past decade. Overall, it is evident that Canadians have made significant Antarctic research contributions over the past twenty years.

Canadian Antarctic research publications by research theme

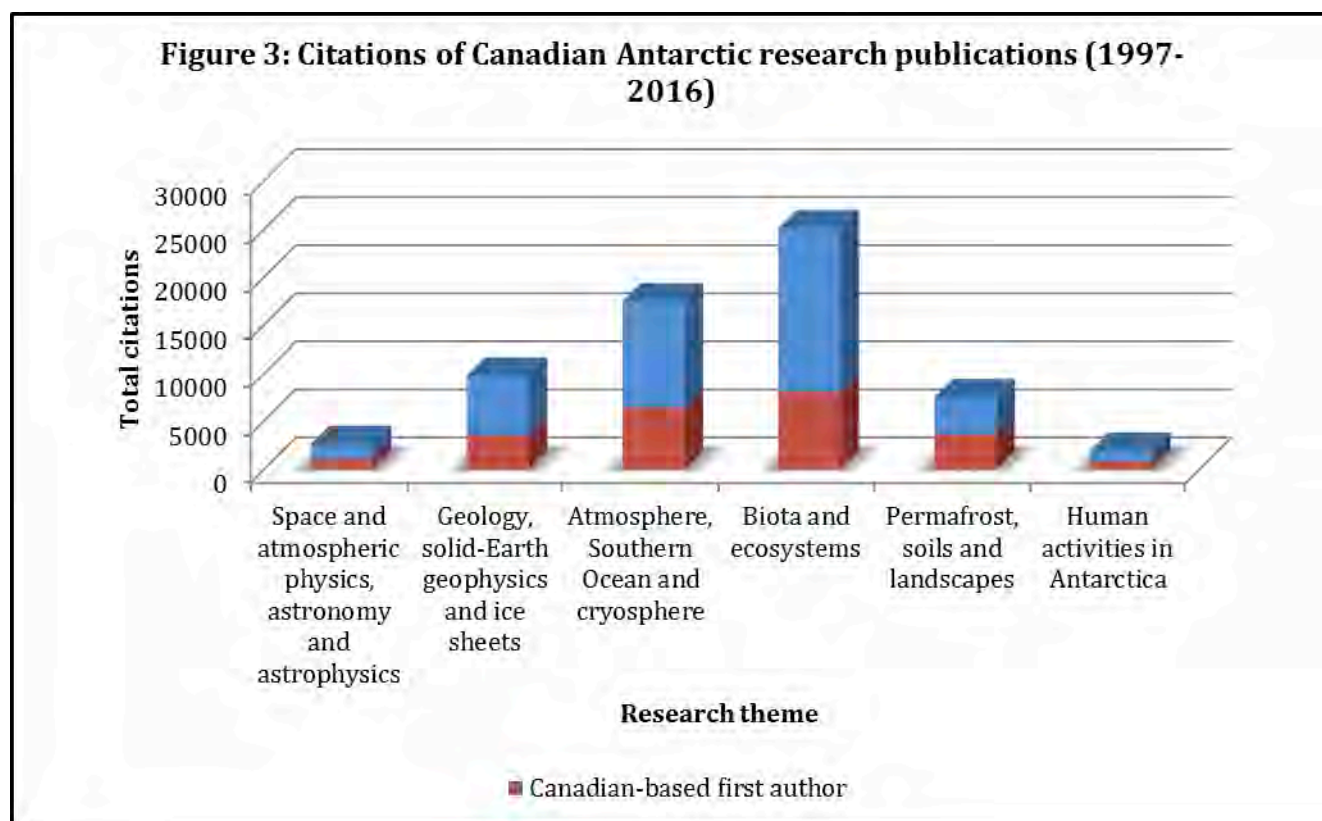
Canadian Antarctic researchers have scientific and technical expertise that spans a range of disciplines and research themes. Figure 2 illustrates the total number of Canadian Antarctic research publications from 1997 to 2016, with each publication categorized under one of six research themes. For each research theme, the total number of publications with a Canadian-based first author is also illustrated.



The research theme with the highest number of Canadian Antarctic research publications is ‘biota and ecosystems’, followed by the ‘atmosphere, Southern Ocean and cryosphere’ theme. Canadian researchers have had significant involvement as well under the ‘geology, solid-Earth geophysics and ice sheets’ and ‘permafrost, soils and landscapes’ themes. Although there are significantly fewer publications pertaining to the ‘human activities in Antarctica’ and ‘space and atmospheric physics, astronomy and astrophysics’ themes, this may be in part due to methodological limitations. For all research themes, a significant percentage of total publications have a Canadian-based first author, ranging from 37 to 48% across themes, with ‘permafrost, soils and landscapes’ having the highest percentage. Overall, it is evident that Canadian Antarctic researchers have contributed expertise that addresses a broad range of research themes.

Impact of Canadian Antarctic research publications

Figure 3 illustrates total cited references (including self-citations) garnered by Canadian Antarctic research publications from 1997 to 2016 for each research theme. The total number of citations generated by Antarctic research publications with a Canadian-based first author is also illustrated.



As of January 2017, Canadian Antarctic research publications from 1997 to 2016 have garnered a total of 64,426 citations, 37% of which are from publications with Canadian-based first authors. Research themes with the highest number of Canadian Antarctic publications, namely ‘biota and ecosystems’ and ‘atmosphere, Southern Ocean and cryosphere’, also have the highest number of total citations.

Conclusion

This preliminary analysis of Canadian Antarctic research publications from 1997 to 2016 is intended to provide an initial overview of Canadian Antarctic research contributions. Further analysis can provide additional quantitative insights with respect to key areas of expertise and associated research impact over time, and Canadian researcher involvement and contributions from an institutional perspective. Nevertheless, with this initial overview, it is evident that Canadian researchers have made significant contributions to Antarctic research, spanning a broad range of disciplines and addressing a range of important research themes.