

Federal Progress in Implementing Open Science: 2019 Annual Report

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Science & Technology Strategies Directorate
Science & Technology Branch
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Key findings

- Overall, about half (49.2%) of peer-reviewed articles published by Science-based Departments and Agencies' (SBDA) scientists and science contributors between 2008 and 2017 are available in open access. There was a slight decline in publications available in 2016-2017 due to embargo periods imposed by publishers. As these embargo periods end, it is expected that these publications will be made available through institutional repositories.
- SBDAs published 83.1% of their eligible datasets on the Open Government Portal as of December 31, 2018, according to the open data inventory and complementary information provided by SBDAs.
- An increasing number of geospatial datasets were made available to Canadians by SBDAs through Open Maps, 1,057 in total as of March 31, 2019.
- SBDA scientists and science contributors continued to engage Canadians to discuss science, including: laboratory open houses, social media interactions, proactive media calls, and collaborating in citizen science projects.

1. Summary

This first annual report presents the progress made by the federal Science-based Departments and Agencies (SBDAs) to implement open science. This includes making federal scientific publications and data more accessible, engaging directly with Canadians to talk about federal science and involving Canadians federal research. The results of four core metrics and four supplementary metrics and related indicators presented herein will help SBDAs, the Government of Canada, and Canadians identify areas where more open science activities are needed while creating a baseline by which it can be measured.

Since inception of the National Action Plan on Open Government, advances in open science have been made. Canadians can now access more SBDA peer-reviewed publications and data, and federal scientists are engaging Canadians in a variety of innovative ways including social media, live streaming, traditional media, and citizen science projects.

Despite these achievements, there are opportunities to make science more open. New metrics and associated indicators are being developed to measure the impact of federal scientific publications in mainstream medias (e.g. social media) and to help understand the demand for SBDA open datasets.

Everyone is encouraged to be part of the discussion. Do not hesitate to send us your comments on this report or federal open science in general at ec.scienceouverte-openscience.ec@canada.ca.

2. Introduction

The Government of Canada's 2018-2020 National Action Plan on Open Government includes a commitment to open science. It requires federal SBDAs to measure progress made in implementing open science and the resulting benefit to Canadians by:

- Publishing yearly reporting on progress against existing metrics measuring implementation of open science by SBDAs (released in June 2019 and June 2020);
- Developing and publishing new indicators for measuring the benefits of open science for Canadians (by June 2019); and,
- Developing and publishing a report on the benefits of open science for Canadians using the new benefit indicators (by June 2020).

This first annual open science progress report by the Government of Canada outlines the progress made by the SBDAs to advance federal open science and establishes a baseline for future reports. The report was designed and written by the federal SBDAs Open Science Metrics Working Group, led by ECCC Science & Technology Branch and in consultation with the Government of Canada's Open Science Directors General Council. The complete methodology for the report is currently available online¹.

For the purposes of this report, 'metric' is the component of federal open science being monitored (ex. open access publications), while the term "indicator" is information used to provide evidence for a specific metric. For instance, the percentage of peer-reviewed publications available in open access in the indicator of the metric open access publications.

In addition, a second distinction is made between core metrics, that have been reported for most SBDAs and supplementary metrics that have been implemented, on a trial basis, by participating SBDAs.

¹ Federal SBDA Open Science Metrics Working Group (2018). [Monitoring Open Science Implementation in Federal Science-based Departments and Agencies: Metrics and Indicators.](#)

2.1 What is open science?

For governments, open science is generally understood as the efforts made to increase the accessibility of the outputs of publicly funded research to the scientific community, the business sector, and society in general, using digital formats (OECD, 2015). The concept of open science draws on both the tradition of openness in many scientific disciplines and the development of new information and communication technologies, which increases capacity to access and use scientific products (data, results, etc.).

For federal SBDAs, open science encompasses a vast array of activities, including providing access to peer-reviewed publications², the release of datasets, and public engagements involving federal scientists and science contributors.

2.2. What are the expected benefits of open science?

Expected benefits of open science include (OECD, 2015: 9-11):

- Increasing effectiveness and productivity of science, through the reduction of duplication costs associated with the collection, creation, transfer and reuse of data, and scientific material in general.
- Contributing to create innovative solutions, products, and services, as open access to peer-reviewed articles and datasets allow them to be repurposed by scientists, the public, and businesses.
- Allowing greater scrutiny of scientific advice, including the verification and reproducibility of research results.
- The greater involvement of the public in science, either indirectly through easier access to scientific findings and data or directly through participation in citizen science projects.

Supporting open science by making publications, data, and scientists more accessible to all makes the scientific process more effective and creates

2.3. How is progress in federal open science measured?

This report tracks the progress of federal SBDAs to implement open science by reporting the results of four core metrics and four supplementary metrics and related indicators (see Annex 1, Tables A1 and A2). The findings presented generally pertain to open science activities undertaken prior to December 31, 2018, although there are a

² Federal peer-reviewed publications, including, when available, open access versions, can be retrieved through the Canadian Federal Science Repository pilot: <https://cfsr-dsfc.1science.com/search>

few exceptions. For instance, data for the open access publications metric are available from January 1, 2008, to December 31, 2017. This period was selected to capture a full decade of publications while giving time for embargoed papers to be made available in open access.

These metrics and indicators provide a basis for assessing the SBDAs' progress to implement open science and identify opportunities for further action. The consistent implementation of cross-departmental metrics facilitates collaboration and assists in the dissemination of best practices and innovations.

2.3.1 Core open science metrics

The core open science metrics³ and related indicators include:

- 1) Open access publications, measured by the share of open access peer-reviewed publications⁴ released by federal SBDAs.
- 2) Open science public engagement observed through an inventory of open science public engagement activities involving members of the public and federal scientists/science contributors.
- 3) Open science data, using the percentage of releasable/eligible SBDA datasets identified in the Treasury Board Secretariat (TBS) [open data inventory](#) that have been released as indicators.
- 4) Other open science products (open maps), measured by the number of geospatial datasets shared by the SBDAs through the [Open Maps](#) application of the [Open Data Portal](#).

2.3.2. Supplementary open science metrics

While the indicators associated with the core metrics have been measured for all SBDAs, indicators associated with supplementary metrics are generally only available for a few participating departments and agencies. Given that SBDAs have their own specific mandates and priorities, a flexible approach for the development and implementation of open science metrics has been adopted. This approach allows inclusion of diverse SBDA mandates and their different capabilities and challenges concerning the potential for developing open science activities.

³ Federal SBDA Open Science Metrics Working Group (2018). [Monitoring Open Science Implementation in Federal Science-based Departments and Agencies: Metrics and Indicators](#).

⁴ Defined as peer-review journal articles, freely available online and provided either by the publisher or the author(s) (for instance, through an institutional repository).

Supplementary open science metrics and related indicators include: open access publications and funded research, altmetrics, an inventory of open data portals and repositories (other than the [Open Government Portal](#)), and an inventory of SBDA publicly available web-based applications.

2.3.3 Limitations associated with the selected indicators

Each metric has at least one indicator. However, when analyzing the results associated with the selected indicators, some limitations and complementarities should be understood, especially when considering differences between departments and agencies. Supplementary metrics address these limitations, to the extent possible, as they measure variables that are more complex or for which limited information is available.

SBDAs vary in the number of peer-reviewed publications that they generate; a reflection of their mandate and the number of scientists and science contributors they employ. Therefore, achieving the same share of open access peer-reviewed publications represents more efforts for some SBDAs than others. The same applies for the number of datasets eligible for public release, which varies between SBDAs. Another reflection of their mandates is the nature of the work performed by some SBDAs means that data could be confidential, limiting public accessibility.

For open science data, the core metric only considers data listed in the [Open Data inventory](#), which may not include all the datasets currently made available by SBDAs and their scientists. This is why, for participating SBDAs, we have also included, as a supplementary metric, a list of other open data initiatives through which they are making data available. An exception is the complementary information provided by SBDAs to update their contribution to the TBS inventory.

Different results between SBDAs for the selected metrics and indicators can be partly explained by variation in attitude toward open access among scientific disciplines, as some are more inclined toward open science than others (OECD, 2015: 23; Björk et al., 2010; Gargouri et al., 2012; Laakso and Björk, 2012). For instance, medicine and biomedical scientific publications are more often available in open access than for other disciplines (e.g. engineering and chemistry).

Finally, given that the scientific research process has many stages, the metrics and indicators selected do not cover all aspects of federal open science, science output, or

federal scientists research practices⁵. For instance, the open access publications metric only include peer-reviewed publications, which are only one medium used by federal scientists to publish their findings. This is why we have included additional metrics, including open science data, public engagements, and other science products such as web-based applications and open maps. Furthermore, SBDAs also publish research findings in reports, alternative specialized publications and periodicals. This is notably the case of periodicals published by Statistics Canada (StatCan) including, for instance, [Economic Insights](#), [Analytical Studies: Methods and References](#), [Analytical Studies Branch Research paper series](#). Examples of reports published by the Government of Canada to provide scientific information to Canadians include the [Canada's Changing Climate Report](#), part of the [Changing Climate: Advancing our Knowledge for Action](#) science product series. This suite of metrics and their associated indicators does not capture these.

While the selected metrics provide a first glimpse into the benefits that federal science is providing for Canadians, SBDAs have continued to explore the development and the implementation of additional metrics and indicators. This new generation of metrics and their related indicators would allow further insights into the benefits provided by federal open science for Canadians. These new metrics will be included in future reports.

3. Areas of progress and results

3.1. Core metrics

3.1.1. Open access publications

Open access publications are peer-reviewed articles that are in digital format, online, and free of charge. While open access has been demonstrated to increase the number of citations of scientific publications (OECD, 2015), it also provides social and economic benefits to Canadians. By removing barriers to access scientific results and knowledge, open access contributes to the acceleration of scientific discovery and promotes the reproducibility of science. It also allows Canadian taxpayers to access findings from publicly funded research.

⁵ Several SBDAs also report on the performance and impact of their science in general, not only open science. These examples include Environment and Climate Change Canada's [Measuring Environment Canada's research and development performance \(2014\)](#) and Healthy Environments and Consumer Safety Branch (2017). *Research Excellence Report. January 2015 – December 2016*. Health Canada.

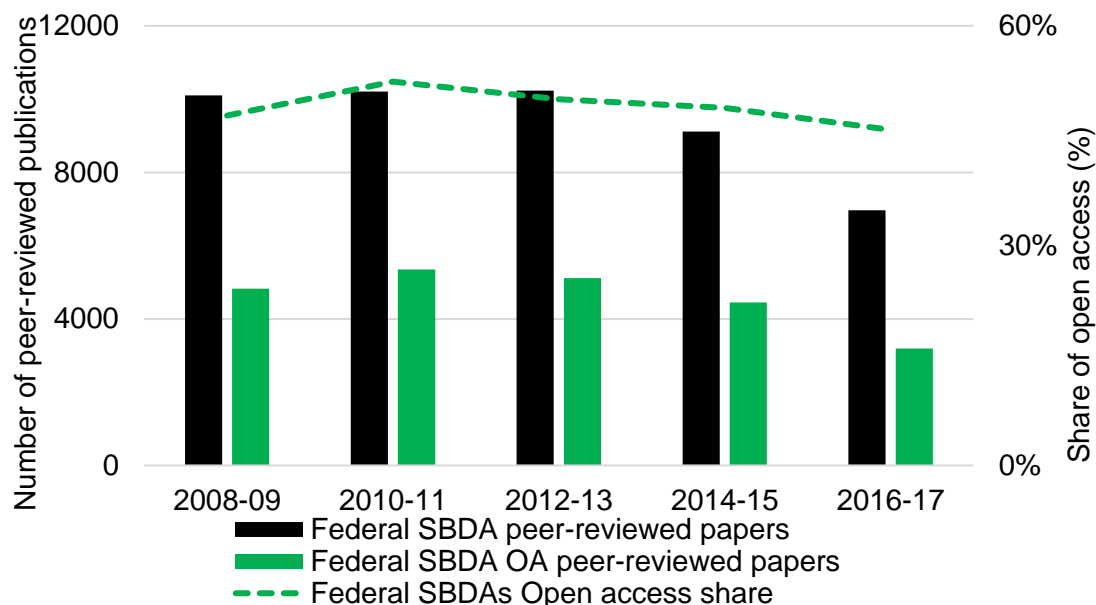
The key indicator used to track federal progress in open access is the percentage of publications from authors affiliated with SBDAs that are made openly accessible either directly by the publisher (for instance, on their website, also known as gold open access) or by the author(s), through an institutional repository (also known as green open access). For this report, the 2008-2017 period was selected to provide a strong baseline and limit the impact of 1) the embargo effect and the 2) backfiling effect. Open access publication rates have been found to increase steadily over the months and years following the end of the publisher embargo period. This is known as the embargo effect, which has a more important impact on the most recent publication years, in this case, for the publication years 2016 and 2017 (ECCC-Science Metrix, 2019: 10). The backfiling effect “refers to older papers that are made available in (open access) only well after their publication date” (ECCC-Science Metrix, 2019: 10). It can also occur when publishers take the decision to make entire older collections available in open access.

Findings

During the 2008-2017 period, federal scientists and science contributors affiliated with SBDAs have authored an estimated 46,610 peer-reviewed publications. Of that number, 49.2% or 22,291 peer-reviewed publications are openly accessible. This number is expected to grow over the coming months and years, as more recent publications are made available through open institutional repositories following the expiration of publishers’ embargo periods.

During the 2008-2017 period, 48.0% of all Canadian and 40.7% of worldwide peer-reviewed publications were available through open access. Federal SBDA publications are, on average, more likely to be available in open access than scientific publications in general, including publications produced by authors affiliated with Canadian institutions. Figure 1 shows the percentage of SBDA open access publications (green dotted lines), number of open access peer-reviewed publications (green bars), along with the total number of peer-reviewed publications authored by SBDA scientists and science contributors (black bars).

Figure 1. Percentage and number of SBDA open access peer-reviewed publications and total number of publications, from 2008 to 2017 for all SBDAs.



Notes: Data are presented using two-year increments, for instance from January 1, 2016, to December 31, 2017, to increase the accuracy of the observed share of open access peer-reviewed publications, especially for more recent years.

Figure 2 shows the estimated percentage of open access peer-reviewed publications for each SBDA, inclusively (black bar). The figure also includes the federal SBDAs, Canadian, and worldwide open access share of peer-reviewed publications (represented as dotted lines, respectively gray, red, and blue). There is some variation by departments and agencies, however, the open access percentage of peer-reviewed publications of most SBDAs is above or equal to the worldwide share of open access publications over the same period. For the 2008-2017 period, the number of peer-reviewed publications per SBDA varies from 29 to 10,783, as illustrated in Figure 2a. The average number of peer-reviewed publications per SBDA for this period is 3,301.

Figure 2. Percentage of open access peer-reviewed publications per SBDA, 2008-2017 period.

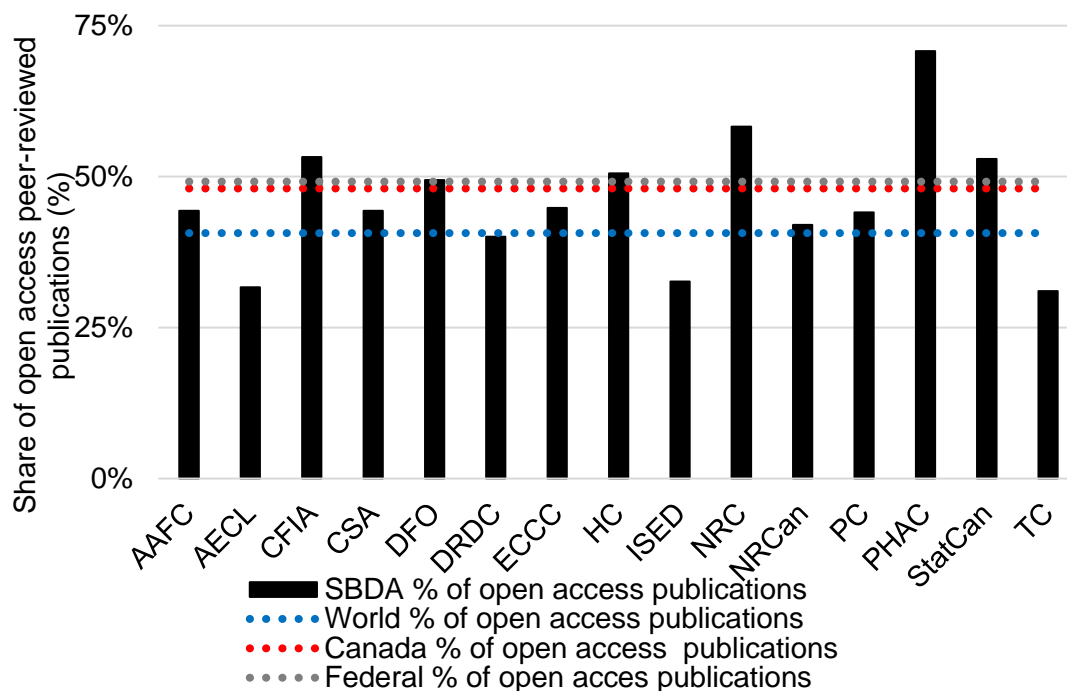
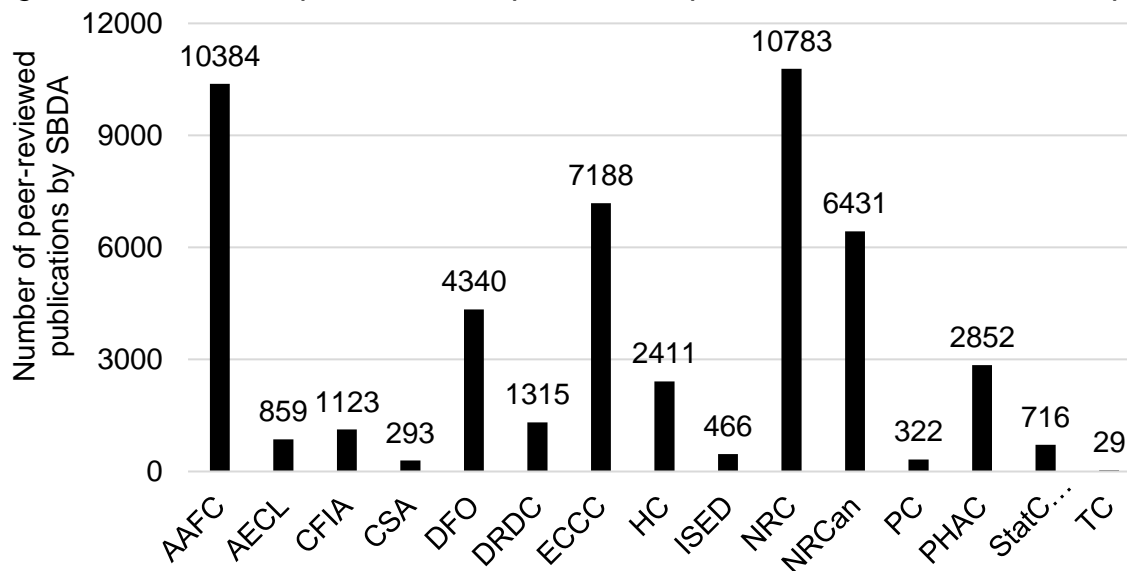


Figure 2a. Number of peer-reviewed publications per SBDA, for the 2008-2017 period.



3.1.2. Open science public engagement

The first year for which a data collection process was implemented (from January 1 to December 31, 2018) was selected for reporting on this metric. During this period, SBDAs participated in a number of diverse open science public engagements. To assess the broad range of engagements, SBDAs were asked to provide a few examples, choosing from different types of open science public engagement, including media calls, open houses, social media, hackathons, and citizen science projects.

Findings

The inventory contains thirteen different types of media engagements, including Twitter takeovers⁶, production of educational videos, and social media engagement (see Annex 2). Six SBDAs provided data for this metric, which allows us to illustrate the scope and diversity of SBDA open science public engagements.

Examples include Environment and Climate Change Canada's (ECCC) "Ask a Scientist" event, where members of the public are invited to watch live stream discussions between federal scientists and ask them questions in real time through social media, and Natural Resources Canada's (NRCan) exhibit for the Association of Mineral Exploration conference. SBDAs also engaged in a number of citizen science initiatives, including the Canadian Space Agency's (CSA) participation at the Festival Eureka! and NRCan's Budworm Tracker Program.

3.1.3. Open science data

SBDAs regularly release datasets through the Government of Canada's [Open Data portal](#), which resides on the [Open Government Portal](#). To be eligible for release, datasets must be under the ownership of an SBDA and be available in open and accessible formats⁷⁸.

Measuring the percentage of eligible SBDA datasets identified in the TBS [open data inventory](#) that have been released is used to track SBDAs' progress in making their data

⁶ This involves scientists or science communicators taking control of their department or agency's Twitter account for brief periods of time, for instance in the context of a specific event.

⁷ The information from the inventory is also available as a dataset:

<https://open.canada.ca/data/en/dataset/4ed351cf-95d8-4c10-97ac-6b3511f359b7>.

⁸ To complement the information from the Open Data portal, two SBDAs submitted complementary information, which allowed us to include 14 additional datasets released before December 31, 2018, but not included in the open data inventory at the time when this report was published.

open. Under Canada's [2016-2018 Third Biennial Plan to the Open Government Partnership](#) the aim was for SBDAs to have released 20% of eligible datasets by June 2018⁹.

Findings

As of the end of 2018, 83.1% of SBDA eligible datasets listed in the inventory have been released. On average, individual SBDAs have released 65.7% of their eligible datasets. The highest percentage achieved is 100%, observed for four SBDAs, and the lowest percentage is 9.6%. Table 1 presents a breakdown by SBDA. For instance, publishing statistical information is at the core of Statistics Canada mandate under the Statistics Act. As of 2018, 72.6% of the eligible datasets currently released by SBDAs come from Statistics Canada (for a total of 6,563 datasets).

While some SBDAs such as Statistics Canada systematically release eligible data, others are in the process of increasing the number of eligible datasets published. A challenge for some SBDAs is that they have limited resources to devote to the publication of datasets. When excluding datasets from Statistic Canada, the percentage of eligible datasets released by SBDAs is 38.3%, which is still above the key indicator goal of 20%.

⁹ See the [Open Science commitment tracker for Third Biennial Plan to the Open Government Partnership](#).

Table 1. Number and percentage of releasable/eligible SBDA datasets identified in the open data inventory that have been released, as of December 31, 2018.

SBDA	Datasets		Percentage of eligible SBDA datasets released
	Released	Eligible	
AAFC	280	414	67.6 %
CFIA	38	38	100%
CSA	16	22	72.7 %
DFO	138	802	17.2 %
EC	93	362	25.7 %
HC	41	64	64.1 %
ISED	59	85	69.4 %
NRC	23	23	100 %
NRCan	136	381	35.7 %
PC	82	89	92.1 %
PHAC	24	24	100 %
StatCan	6563	6563	100 %
TC	16	167	9.6 %
Total	7509	9034	83.12 %

3.1.4. Open maps

Another open science data indicator is the number of SBDA datasets that can be found in [Open Maps](#), a specialized data portal accessible through the Open Government Portal. Open Maps provides Canadians with access to federal geospatial data and tools for users to combine, visualize, and analyze geospatial data.

Findings

The number of geospatial datasets available through Open Maps is rapidly increasing. Figure 3 indicates the number of geospatial datasets released through Open Maps annually by SBDAs grew from 223 during the fiscal year 2015-2016 to 320 during the

fiscal year 2018-2019. As of March 31, 2019, the total cumulative number of datasets released through Open Maps by SBDAs was 1,057.

Figure 3. Number of new open maps published by SBDAs from fiscal years 2015-16 to 2018-19

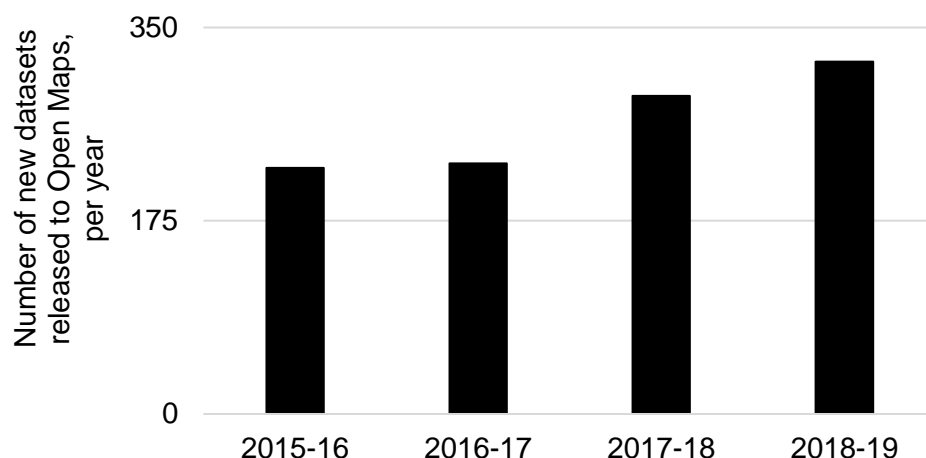


Table 2. Number of open maps published by SBDA, fiscal years 2015-16 to 2018-2019

SBDA	Fiscal years				Total (cumulative)
	2015-16	2016-17	2017-18	2018-19	
AAFC	58	78	121	61	318
DFO	-	45	30	54	129
ECCC	94	29	39	91	253
NRCan	65	72	77	57	271
PC	2	-	10	-	12
StatCan	1	2	10	54	67
Other SBDAs ¹⁰	3	1	1	2	7
Total (per year)	223	227	288	319	1057

¹⁰ Includes Transport Canada, Public Health Agency Canada, Health Canada, and the Canadian Space Agency

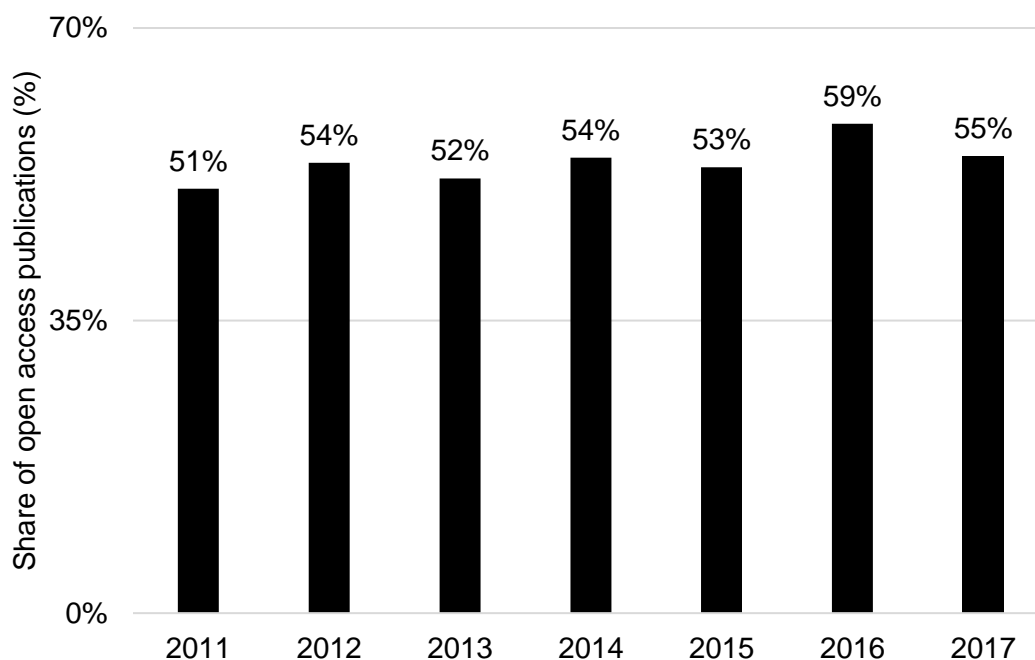
3.2. Supplementary metrics

While the core metrics are common to all SBDAs they do not tell the whole open science story. Therefore, supplementary metrics can be a valuable complement for some SBDAs. These supplementary metrics have been implemented by a few participating SBDAs as a pilot and we are still investigating ways that they could be improved, scaled up, and applied to other or all SBDAs.

3.2.1. Open access publications in funded research

Several SBDAs fund external research done entirely by academic partners. This reality can skew the indicator results of some SBDAs. For example, Figure 2a suggests that the Canadian Space Agency (CSA) publishes a low number of peer-reviewed publications. CSA actively supports scientific research with funding programs and other opportunities through grants and contributions for academic research. From 2011 to 2017, the CSA was able to inject more than \$54 M into university research and during this period an estimated 2,305 publications resulted from research funded by the Agency. The CSA agreed to pilot a study that has identified and analyzed scientific publications associated with its research funding programs in order to determine whether they are available in open access. For the period 2011 to 2017, 54% were available for free through open access. These findings clearly demonstrate the CSA's contribution in making scientific research activities more accessible to Canadians.

Figure 5. Share of open access publications from research funded by the Canadian Space Agency (CSA)



3.2.2. Inventory of portals or repositories

In addition to the Open Data portal, SBDAs use a variety of open platforms to make their data accessible to Canadians online. To support the traceability of SBDAs' open datasets, an inventory of portals and repositories, other than the open government portal and its featured applications, used by participating SBDAs was included as a supplementary metric. ECCC and the CSA both volunteered to pilot the metric. Results can be found in Annex 3, which includes a list of portals and repositories used by ECCC and the CSA to publish data as of December 2018. Twelve portals and repositories were identified for the [CSA](#). Forty were identified for ECCC. These were collected by scanning ECCC programs' web pages and consulting directly with them. These thematic or topic-specific portals can provide useful alternative ways for Canadians interested in a specific topic to access data, foster international collaborations, provide assistance in data collection, or release data in more unusual formats.

The lists in Annex 3 offer a partial overview of portals and repositories used by the CSA and ECCC at a specific point in time. It is important to note that the information contained in these lists is by no means definitive and could change as programs evolve or because of changes in practice. Finally, it is important to note that the portals and repositories reported in Annex 3 could also be used by other SBDAs to store open data.

3.2.3. Altmetrics

Altmetrics help in determining the online visibility of research-related knowledge products (publications, maps, datasets, factsheets, or reports). They are generally defined as “sets of new emerging data sources that measure online social visibility of research artifacts through either lay or scholarly networks.” Altmetrics can be measured in different ways, including news coverage, blog posts, tweets and other social media sharing and interactions. They can be applied at the journal, researcher and article level¹¹.

SBDAs identified altmetrics as a potential complement to other more traditional core metrics selected to measure open science progress and the SBDA Open Science Metrics Working Group is exploring the feasibility of using them as an open science indicator.

For the purpose of this report, a pilot case study was conducted by using the Altmetric Explorer platform provided by Digital Science. Using the Altmetric score, which helps in

¹¹ University of Ottawa (2019). *Scholarly Communications*. Consulted on July 3, 2019. URL: <https://scholarlycommunication.uottawa.ca/research-impact/altmetrics>

determining the relative visibility (or impact) of research outputs, four highly visible publications that are available in open access were selected.

For the purpose of the pilot case study, the Altmetric score was used to select the two highest-ranking peer-reviewed publications affiliated with NRCan and ECCC. Open access status for these two publications was then confirmed by following their respective Digital Object Identifier (DOI). The results are presented in tables 3 and 4. The selected cases underline that for science products, there are many available paths to achieve high impacts. While the two NRCan science products have been heavily cited in peer-reviewed research, the two ECCC articles have achieved high impact, mainly through social media.

Table 3. Selected ECCC science publications for Altmetric case study.

Article	Altmetric score	Twitter	Policy documents	Citations in peer-reviewed papers	News stories	Blog
Le Quéré, Corinne, et al. (2018) "Global carbon budget 2018." Earth System Science Data (Online) 10.4 DOI: 10.5194/essd-10-2141-2018 (available in open access)	1310	1103 tweets UK : 13%, US: 12%, Canada: 3%, General public: 85% Scientists: 11%	2	16	67	N/A
Box, Jason E., et al. "Key indicators of Arctic climate change: 1971–2017." Environmental Research Letters 14.4 (2019): 045010. DOI: 10.1088/1748-9326/aafc1b (available in open access)	1282	1484 tweets US: 22% Canada: 5% General public: 85%, Scientists: 9%	N/A	N/A	53	8

Table 4. Selected NRCAN science publications for the Altmetrics case study.

Article	Altmetric score	Twitter	Policy documents	Citations in peer-reviewed papers	News stories	Blog
Brown, P. G., Assink, J. D., Astiz, L., Blaauw, R., Boslough, M. B., Borovička, J., ... & Cooke, W. D. (2013). A 500-kiloton airburst over Chelyabinsk and an enhanced hazard from small impactors. <i>Nature</i> , 503(7475), 238. DOI: 10.1038/nature12741 (Available in open access, through https://core.ac.uk/).	1006	70 tweets US: 26% UK: 9% General public: 71% Scientists : 14%	N/A	185	128	27
Schulte, P., Alegret, L., Arenillas, I., Arz, J. A., Barton, P. J., Bown, P. R., ... & Collins, G. S. (2010). The Chicxulub asteroid impact and mass extinction at the Cretaceous-Paleogene boundary. <i>Science</i> , 327(5970), 1214-1218. DOI: 10.1126/science.1177265 (available in open access)	565	16 tweets UK: 14% US: 7% General public: 57% Scientists : 43%	1	552	61	23

3.2.4 Inventory of SBDA publicly available web-based applications

While SBDAs are making efforts to ensure that their data are accessible to Canadians, they have also produced software and web-based applications allowing the public to interact directly with their data through electronic devices, including smartphones. As of December 31 2018, we were able to retrieve a total of 39 web-based applications made available by SBDAs on a wide variety of topics.

For instance, the WeatherCAN application has information on current weather conditions, along with hourly and 7-day forecasts for over 10,000 locations in Canada. It also has ECCC weather alerts, high resolution radar animations, weather facts and climate information relevant to the current weather. Annex 4 presents an inventory of SBDA publicly available web-based applications. While the inventory does not aim to be comprehensive, it provides examples of applications made by SBDAs that enable web-based and mobile access to data generated by SBDAs.

3.3. Challenges

Despite the achievements outlined in the report, there are opportunities to make further progress in implementing open science. An important first step is to better understand the incentives and barriers for federal scientists and science contributors to 'work in the open'.¹² Some of the obstacles documented in the context of academic research could also apply to government scientists and science contributors, while other challenges could be specific to government science.

For instance, open access barriers include the cost associated with publishing in open access and lack of information about possible alternatives. An example is the publication of the preprint version of published articles. While many publishers allow preprints, policy varies from one journal to the next and some work is needed to assess whether a specific article published in a given journal can be made available in open access that way¹³.

Another challenge is that the current open science data indicator does not only include scientific datasets but also other types of data published by SBDAs. Separating science datasets from other types of data for the purpose of cross-departmental comparisons

¹² For research on publications barriers in the academic context, see Warlick and Vaughan (2007); West et al., (2014).

¹³ UK not-for-profit SHERPA RoMEO is a free online resource that provides information publisher open access policies:

<http://sherpa.ac.uk/romeo/about.php?la=en&flDnum=|&mode=simple>

would require developing a common methodology across departments and agencies. In addition, federal scientists and science contributors sometimes produce datasets for the purpose of specific research and publications. Some of these datasets are publicly available on the publisher's websites but have not been systematically inventoried by the SBDAs.

A final challenge example is the need to ensure open science progress reporting does not burden federal scientists and other public servants to the point where it affects their ability to conduct scientific research. Open science metrics must remain easy to implement, flexible, and cost-efficient.

4. Moving forward

The promise of open science is to make knowledge, including publicly funded expertise and research, accessible to the engaged and informed public¹⁴ and to decision-makers. This report aims to track the progress made on federal open science, foster accountability and encourage SBDAs to consider possible areas of improvement.

The results presented in this report will help SBDAs, the Government of Canada, and Canadians in general identify areas where more open science activities are needed while creating a baseline by which it can be measured. Pilot results presented for the supplementary metrics will inform ongoing discussions and decisions as to their inclusion as core metrics by all SBDAs in future reporting.

Under Canada's 2018-2020 National Action Plan on Open Government, a second report on federal progress on open science is planned for release in June 2020. The Action Plan also calls for the development of new metrics to measure the benefits of open science to Canadians. An indicators report on the benefits of open science to Canadians is planned for June 2020. These new impact metrics will further explore the use of altmetrics to determine the extent to which federal scientific publications are mentioned in news reports, government documents, and on social media. They also include metrics designed to show the open access advantage and the gain in citations, impact, and patent uptake from publishing in open access. Finally, these new benefit metrics will help understanding the demand for SBDA open datasets.

¹⁴ Treasury Board Secretariat (2018). *Canada's Commitment to Open Science*. URL: <https://www.canada.ca/en/treasury-board-secretariat/services/access-information-privacy/canada-commitment-open-science.html>

In the meantime, everyone is encouraged to be part of the discussion. Do not hesitate to send us your comments on this report or federal open science in general at ec.scienceouverte-openscience.ec@canada.ca.

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6. List of Abbreviations

Agriculture and Agri-Food Canada (AAFC)
Atomic Energy of Canada Limited (AECL)
Canadian Food Inspection Agency (CFIA)
Canadian Space Agency (CSA)
Defence Research and Development Canada (DRDC)
Environment and Climate Change Canada (ECCC)
Fisheries and Oceans Canada (DFO)
Health Canada (HC)
Innovation, Science and Economic Development Canada (ISED)
National Research Council Canada (NRC)
Natural Resources Canada (NRCan)
Parks Canada (PC)
Polar Knowledge Canada (POLAR)
Public Health Agency of Canada (PHAC)
Science-based Departments and Agencies (SBDAs)
Statistics Canada (StatCan)
Transport Canada (TC)

7. Key Websites

Open Government: <https://open.canada.ca/en>
Open Data Portal: <https://open.canada.ca/en/open-data>
Open Maps portal: <https://open.canada.ca/en/open-map>

Annex 1. Core and Supplementary Metrics

Table A1. Selected Core Metrics for Implementation starting July 2018 and their indicator(s)

Metric	Indicator	Type	Data source	Observation period
Open access publications	1. Percentage of peer-reviewed articles that are available in open access per Science-Based Departments and Agencies (SBDA).	Quantitative	-ECCC Science-Metrix Study	Previous years (2008-17)
Open science public engagement	2. Inventory of open science public engagement activities involving members of the public and federal scientists and science contributors.	Qualitative	-Internal SBDA tracking system.	Latest (2018)
Open science data	3. Percentage of releasable/eligible SBDA datasets identified in the open data inventory that have been released.	Quantitative	-Open data inventory	Latest (2018)
Other open science products	4. Summary of SBDA datasets available through Open Maps*.	Quantitative	-Open Government Portal (Open Maps)	Previous years (2017-18)

Notes: All indicators have been implemented on a yearly basis (using a calendar year).

*While an inventory on SBDA Open Maps datasets was originally proposed, this became impractical given the rapid growth of the number of geospatial datasets. The full list of datasets available can, however, be obtained by directly consulting the Open Maps portal: <https://open.canada.ca/en/open-maps>.

Table A2. Selected Supplementary Metrics for Implementation starting in July 2018 and their indicator(s)

Metric	Indicator	Type	Data source	Observation period
Open access publications - funded research	1. Share of publications from funded external research available in open access	Quantitative	CSA	Previous years (2011-17)
Open science data	2. Inventory of portals or repositories used by SBDAs to provide open access datasets, other than Open Maps and the Open Government Portal.	Qualitative	SBDAs pilot for internal monitoring	2018
Open science engagement - impact	3. Altmetric observations for selected publications	Qualitative	Altmetric	2018
Other open science products	4. Inventory of open science related web-based applications	Qualitative	SBDAs pilot for internal monitoring	2018

Annex 2. Inventory of SBDA open science public engagements

Table A3. Inventory of SBDA open science public engagements, from January 1st to December 31st 2018.

Name of public engagement	SBDA	Category	Links
World Soils Day Twitter Takeover	AAFC	New media/Twitter takeover	
Ottawa Bug Day Open House	AAFC	Outreach/Open houses	https://www.facebook.com/events/2475788189128783/ http://www.agr.gc.ca/eng/news/events/?id=1281614162882
Ocean pollution social media takeover	CSA	New media/Twitter takeover	https://twitter.com/asc_csa/status/988035545271033856 https://twitter.com/asc_csa/status/988042263610654720
Space radiation video by astronaut David Saint-Jacques	CSA	New media/Video	https://www.youtube.com/watch?v=T6RDftmw_Q&list=PLUaartJaon3KZ79iPSf6PwCPPGjHeTdOy&index=82&t=0s
Space Apps Challenge	CSA	Hackathon	http://www.asc-csa.gc.ca/eng/events/2018/space-apps-citizen-scientist.asp
Festival Eurêka!	CSA	Citizen science	https://festivaleureka.ca/wp-content/uploads/2018/05/10277-EUREKA_Programme2018_FR_LR_WEB.pdf
Science au féminin	CSA	Citizen science	https://www.centredessciencesdemontreal.com/evenement-speciaux/science-au-feminin-edition-2018

Open Labs / Science Odyssey	ECCC	Outreach/Open houses	https://www.canada.ca/en/environment-climate-change/news/2018/05/open-lab-meet-environment-and-climate-change-canadas-scientists-and-get-a-unique-behind-the-scenes-glimpse-into-the-national-wildlife-research-centre.html
Ask A Scientist	ECCC	Ask a scientist	https://www.facebook.com/EnvironmentandClimateChange/videos/263249377691495/
Proactive Media Strategy for study on induced seismicity link to earthquake	NRCan	Media calls/Proactive	https://www.nationalnewswatch.com/2018/10/29/bedrock-stress-factor-in-fracking-caused-earthquakes-study/#.XLSi_XmWw6Z
Proactive media strategy for study on Spruce Budworm	NRCan	Media calls/Proactive	https://ici.radio-canada.ca/nouvelle/1114429/helikite-tordeuse-bourgeons-epinette-papillons-insecte http://www.tvanouvelles.ca/2018/07/26/la-tordeuse-des-bourgeons-de-lepinette-continue-de-ravager-les-forets
Arctic science month campaign	NRCan	New media/Blog or Vlog series; Facebook; Reddit Ask-Me-Anything (AMA); Videos; YouTube channel	
Energy Efficiency in Industrial Facilities Animated Video	NRCan	New media/Video	https://www.youtube.com/watch?v=k517rUMY0Uc (English) https://www.youtube.com/watch?v=OwW_WuQO3x8 (Français)
Demystifying electric vehicles AskNRCan podcast episode	NRCan	New media/Podcast episode (not a series)	https://www.nrcan.gc.ca/simple-science/20489 (English) https://www.nrcan.gc.ca/science-simplement/20490 (Français)
Association of Mineral Exploration conference display	NRCan	Outreach/Exhibitions	https://amebc.ca/releases/ames-roundup-2018-wraps-with-renewed-confidence/

Mackenzie-Beaufort Ice Breakup Facebook Group	NRCan	Citizen science	https://www.facebook.com/groups/1745524288993851/about/
The Budworm Tracker Program	NRCan	Citizen science	https://budwormtracker.ca/#/
Documentary Film – Public Viewing	POLAR	Outreach/Open house	
Science Odyssey	POLAR	Outreach/Open houses	
Earth Day Celebration	POLAR	Outreach/Open houses	
Public engagement on social media	StatCan	New media/Blog or Vlog series; Facebook; Reddit Ask-Me-Anything (AMA); Videos; YouTube channel	https://www.statcan.gc.ca/eng/blog https://www.facebook.com/StatisticsCanada https://www.reddit.com/user/StatCanada https://twitter.com/statcan_eng https://www.instagram.com/statcan_eng/

Annex 3. Inventory of portals or repositories

Table A4. Inventory of portals or repositories used by Environment and Climate Change Canada

Portal name	URL
AEROCAN data in NASA Aerosol Robotic NETwork	https://aeronet.gsfc.nasa.gov/new_web/data.html
Alberta Oil Sands Information Portal	http://osip.alberta.ca/map/
Alberta Water Portal	https://albertawater.com/water-catalog
Anthropogenic Organic Pollutants in Air	http://donnees.ec.gc.ca/data/air/monitor/monitoring-of-combined-atmospheric-gases-and-particles/anthropogenic-organic-pollutants-in-air/?lang=en
BC Ecosystems Branch Information Portal	http://www.env.gov.bc.ca/wld/ecobranch_info_portal/
Breeding Bird Survey Website	https://www.pwrc.usgs.gov/BBS/RawData/

Canada-Alberta Joint Oil Sands Monitoring Portal	https://www.canada.ca/en/environment-climate-change/services/oil-sands-monitoring.html
Canadian Centre for Climate Modelling and Analysis	https://www.canada.ca/en/environment-climate-change/services/climate-change/science-research-data/modeling-projections-analysis/centre-modelling-analysis.html
Canadian Climate Data and Scenarios	http://climate-scenarios.canada.ca/?page=main&lang=en
EBAS of the Norwegian Institute for Air Research (NILU)	http://ebas.nilu.no/
ECCC Data Catalogue	http://donnees.ec.gc.ca/data/
Global Monitoring Plan Data Warehouse	http://visualization.pops-gmp.org/2014/data-selection/progress/8e5c75dac947bbafa17ee8aefa887138
Great Lakes Monitoring Portal	https://greatlakesmonitoring.org/
Greenhouse Gas Reporting Program (GHGRP) Data Search	https://climate-change.canada.ca/facility-emissions/
Historical Climate Data	http://climate.weather.gc.ca/historical_data/search_historic_data_e.html
Historical Hydrometric Data	https://wateroffice.ec.gc.ca/mainmenu/historical_data_index_e.html
Interactive Environmental Indicators Maps	https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/interactive-maps.html
JAXA Repository AIREX	https://repository.exst.jaxa.jp/dspace/index.jsp?locale=en
Lake Winnipeg Basin Information Network	http://130.179.67.140/
National Air Pollution Surveillance Program Data Products	http://maps-cartes.ec.gc.ca/rnsp-naps/data.aspx?lang=en

National Atmospheric Chemistry Database and Archive (NAtChem)	https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/national-atmospheric-chemistry-database.html
National Atmospheric Deposition Program (NADP)	http://nadp.slh.wisc.edu/
National Centers for Environmental Information	https://www.ncei.noaa.gov/access
National Pollutant Release Inventory (NPRI) - Tools and resources	https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/tools-resources-data/access.html
National Pollutant Release Inventory data (NPRI) Data Search	https://pollution-waste.canada.ca/national-release-inventory/archives/index.cfm?lang=en
Newfoundland and Labrador Climate Data Portal	http://nl.communityaccounts.ca/climate/
Newfoundland and Labrador Water Resources Portal	https://maps.gov.nl.ca/water/
Nova Scotia Water Portal	http://www.riversnetwork.org/rbo/index.php/river-blogs/north-america/item/3971-welcome-to-nova-scotia-s-water-portal-water-for-life
OBRS: Observations Based Research Section Data Portal	http://ecpass.ca/
Ontario Climate Change Data Portal	www.ontarioccdp.ca/index_rcp8.5.html
Pangeae Data Publisher	https://www.pangaea.de/
Polar Data Catalogue	https://www.polardata.ca/
Real-Time Hydrometric Data	https://wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html
USGS Geo Data Portal	https://cida.usgs.gov/gdp/
Weather Data Services	https://weather.gc.ca/business/index_e.html
Weather Information	https://weather.gc.ca/

World Database on Protected Areas (WDPA)	https://www.protectedplanet.net/c/world-database-on-protected-areas
World Meteorological Organization (WMO) Global Atmosphere Watch World Data Centres	https://www.wmo.int/pages/prog/arep/gaw/world_data_ctres.html
World Meteorological Organization (WMO) World Data Centre for Greenhouse Gases	http://ds.data.jma.go.jp/gmd/wdcgg/
World Meteorological Organization (WMO) World Ozone and Ultraviolet Radiation Data Centre (WOUDC)	http://www.woudc.org/

Table A5. Inventory of portals or repositories used by Canadian Space Agency

Portal	URL
BRITE public data archive	https://brite.camk.edu.pl/pub/index.html
Colorado State University CLOUDSAT Portal	http://cloudsat.atmos.colostate.edu/data
Canadian Space Agency Open Data Portal	ftp://ftp.asc-csa.gc.ca/users/OpenData_DonneesOuvertes/pub/
Canadian Space Agency Website For RADARSAT II MOSAIC	http://www.asc-csa.gc.ca/eng/search/images/watch.asp?id=2572
European Space Agency Portal For SWARM	https://earth.esa.int/web/guest/swarm/data-access
Herschel Science Archive	http://archives.esac.esa.int/hsa/whsa/
Planck Legacy Archive	https://www.cosmos.esa.int/web/planck/pla
Planetary Data System For CURIOSITY & PHOENIX	https://pds.nasa.gov/
University of Calgary ePOP Portal	https://epop.phys.ucalgary.ca/data/
University of Calgary Space Physics Data Portal	https://data-portal.phys.ucalgary.ca/home_rt/

University of Toronto MOPITT Portal	https://mopitt.physics.utoronto.ca/
University of Toronto Autonomous Space Robotics Lab For TERRAIN 3D MAPPING DATASET	http://asrl.utias.utoronto.ca/datasets/3dmap/p2a_t_met.html

Annex 4. Inventory of SBDA publicly available web-based applications

Table A6. Inventory of SBDA publicly available web-based applications

Name of application	Department	Link
Cereal Aphid Manager Mobile App	AAFC	https://open.canada.ca/en/app/cereal-aphid-manager-mobile-app
Current drought conditions	AAFC	https://open.canada.ca/en/apps/current-drought-conditions
Canada Census of Agriculture	AAFC	https://open.canada.ca/en/apps/canada-census-agriculture
Weekly Best-Quality Maximum NDVI Anomalies	AAFC	https://open.canada.ca/en/apps/weekly-best-quality-maximum-ndvi-anomalies
AAFC's Agroclimate Map Selector tool – Historic Agroclimate Conditions	AAFC	https://open.canada.ca/en/apps/aafcs-agroclimate-map-selector-tool-historic-agroclimate-conditions
AAFC's Agroclimate Map Selector tool – Current Agroclimate Conditions	AAFC	https://open.canada.ca/en/apps/aafcs-agroclimate-map-selector-tool-current-agroclimate-conditions
Spatial Density of Major Crops in Canada	AAFC	https://open.canada.ca/en/apps/spatial-density-major-crops-canada
Percent Saturated Surface Soil Moisture from SMOS Satellite Data	AAFC	https://open.canada.ca/en/apps/percent-saturated-surface-soil-moisture-smos-satellite-data
Canadian Drought Monitor	AAFC	https://open.canada.ca/en/apps/canadian-drought-monitor
Land Use 1990, 2000, 2010	AAFC	https://open.canada.ca/en/apps/land-use-1990-2000-2010
AgriMap	AAFC	https://open.canada.ca/en/apps/agrimap

Soils of Canada	AAFC	https://open.canada.ca/en/apps/soils-canada
National Ecological Framework for Canada	AAFC	https://open.canada.ca/en/apps/national-ecological-framework-canada
Canada Land Inventory - 1:250 000 Land Capability for Agriculture	AAFC	https://open.canada.ca/en/apps/canada-land-inventory-1250-000-land-capability-agriculture
Biomass Inventory Mapping and Analysis Tool	AAFC	https://open.canada.ca/en/apps/biomass-inventory-mapping-and-analysis-tool
Annual Crop Inventory	AAFC	https://open.canada.ca/en/apps/aaft-crop-inventory
Community Information Database	AAFC	https://open.canada.ca/en/apps/community-information-database
Plant Hardiness Zones of Canada	AAFC	https://open.canada.ca/en/apps/plant-hardiness-zones-canada
Funding Opportunity Database	CIHR	https://open.canada.ca/en/apps/funding-opportunity-database
Funding Decisions Data	CIHR	https://open.canada.ca/en/apps/funding-decisions-data
Canadian Research Information System	CIHR	https://open.canada.ca/en/apps/canadian-research-information-system
National Pollutant Release Inventory	ECCC	https://open.canada.ca/en/apps/national-pollutant-release-inventory
IceGraph 2.0 - Tool	ECCC	https://open.canada.ca/en/apps/icegraph-20-tool
Environmental Indicators - Interactive Maps	ECCC	https://open.canada.ca/en/apps/environmental-indicators-interactive-maps
WeatherCAN	ECCC	https://www.canada.ca/en/environment-climate-change/services/weather-general-tools-resources/weathercan.html
Oceanographic Data Management System (ODMS)	DFO	https://open.canada.ca/en/apps/oceanographic-data-management-system-odms

Atlantic Zone Monitoring Program (AZMP)	DFO	https://open.canada.ca/en/apps/atlantic-zone-monitoring-program-azmp
Notice of Compliance (NOC) Database	HC	https://open.canada.ca/en/apps/notice-compliance-noc-database
Drug Product Database (DPD)	HC	https://open.canada.ca/en/apps/drug-product-database-dpd
Recalls and Safety Alerts	HC	https://open.canada.ca/en/apps/recalls-and-safety-alerts
Inuvik Satellite Station Facility Story Map	NRCan	https://open.canada.ca/en/app/inuvik-satellite-station-facility-story-map
Parks Canada – National App	Parks	https://open.canada.ca/en/apps/parks-canada-national-app
'Edifica' - History in Hand	Parks	https://open.canada.ca/en/apps/edifica-history-hand
Learn to Camp	Parks	https://open.canada.ca/en/apps/learn-camp
Trade Data Online (TDO)	ISED	https://open.canada.ca/en/apps/trade-data-online-tdo
Canadian Importers Database (CID)	ISED	https://open.canada.ca/en/apps/canadian-importers-database-cid
Canadian Copyrights Database	ISED	https://open.canada.ca/en/apps/canadian-copyrights-database
Canadian Trade-marks Database	ISED	https://open.canada.ca/en/apps/canadian-trade-marks-database
Canadian Patents Database	ISED	https://open.canada.ca/en/apps/canadian-patents-database

Annex 5. List of members of the SBDA Open Science Working Group.

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