Environment and Climate Change Canada Open Science Action Plan

2021-2026



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Abstract

To achieve the overall objective of open science and make federal science transparent and accessible for all Canadians, the 2020 Roadmap for Open Science encourages all Government of Canada departments and agencies to develop action plans (Recommendation 3). Through intradepartmental consultations (Recommendation 2), Environment and Climate Change Canada (ECCC) identified already existing activities that support each stage of the Open Science Life Cycle (i.e.: Ideation, Data Collection and Analysis, Publication, and Knowledge Mobilization), as well as areas for potential development. Integrating departmental feedback, the ECCC Open Science Action Plan 2021-2026 reflects the framework of the Open Science Life Cycle with goal-oriented measures. The actions put forward in this plan will enable ECCC to move towards the objectives set by the Roadmap in terms of open access (Recommendation 4) and FAIR (Findable, Accessible, Interoperable, Reusable) data principles (Recommendation 5). They will also aid the development of Ideation and Knowledge Mobilization practices inside the department.

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Introduction

What is open science?

The <u>Chief Science Advisor's Roadmap for Open Science</u> (Roadmap) states that "Open science is the practice of making scientific inputs, outputs and processes freely available to all with minimal restrictions. Scientific research outputs include (i) peer- reviewed science articles and publications, (ii) scientific and research data and (iii) public contribution to and dialogue about science. Open science is enabled by people, technology and infrastructure. It is practiced in full respect of privacy, security, ethical considerations and appropriate intellectual property protection."

By making scientific inputs, outputs and processes freely available, science is made more transparent, inclusive and is accelerated. This applies to disciplines across science, including those at the centre of Environment and Climate Change Canada (ECCC) science – conservation, natural sciences, climate change, atmospheric and meteorological sciences. As a Government of Canada department tasked with protecting and conserving our natural heritage, and ensuring a clean, safe and sustainable environment for present and future generations, ECCC is committed to making ECCC science more transparent, accessible and inclusive.

Why do we need an open science action plan?

Open science is not the way science has historically been conducted. Tradition, culture and incentives have created an environment where scientific inputs, outputs and processes are either closed, or accessible only to the researchers and/or collaborators themselves or for a fee (access to data and publications often involves a fee). For the purposes of this report we will use "research" and "researchers" to refer to work and individuals, respectively that work in and with science.

Recognizing the need to push for open science, the Government of Canada included an Open Science Commitment in both the <u>Third</u> and <u>Fourth National Action Plans</u> (NAP) on Open Government. One of the milestones in the Fourth NAP Open Science Commitment called for the development of a Roadmap for Open Science (the Roadmap), to provide a plan for greater openness in federal science and research activities. The Roadmap was published by the Chief Science Advisor of Canada on February 26th, 2020.

Among the 10 recommendations in the Roadmap is Recommendation 3: "departments and agencies should develop action plans for Open Science. This should include plans for a common, phased approach towards making federal science open and readily and easily available to Canadians". The ECCC Open Science Action Plan (the Action Plan), is a response to Recommendation 3 and a continued commitment to open science.

ECCC has long been a leader in open science within the Government of Canada, having been a lead department for Open Science Commitments since the Third NAP. ECCC plays a leadership role in interdepartmental and intergovernmental work on open science and has a long history of open science practices including open weather, climate and hydrological data. ECCC recognizes data transparency as a foundation for increasing confidence in government decision-making and improving the department's management and use of data. ECCC is committed to maximizing the availability of data as an open

resource and enabling open science. A list of open science resources, where you can find ECCC data and information (such as the Open Science and Data Platform for Cumulative Effects) is available in Annex 1. Additional information on open science initiatives from across the Government of Canada can be found on the <u>Open Science Website</u>.

Through consultations with researchers, policy makers and the public that were mandated by the Fourth NAP, ECCC has heard the growing calls for open science. This Action Plan details how ECCC will meet the recommendations of the Roadmap, and also how ECCC can facilitate making each stage of the research life cycle more open and transparent.

ECCC intradepartmental consultations on the creation of the Action Plan

As proposed by Recommendation 2 of the Roadmap, the development of the Action Plan began with *"intradepartmental consultations with the science community"*. The Action Plan is the culmination of multiple consultations with open science stakeholders. Consultations began in April 2019 with a survey to Science and Technology Branch (STB) employees in a science-related classification. This was followed by bilateral consultations with targeted open science stakeholders including CIO - Library Services and the Open Science Community of Practice and discussions with STB senior management. To get a broader view of open science barriers and goals, a department-wide survey was conducted.

The consultations surfaced three major needs for open science: support for training, guidance on open science practices, and support for open science infrastructure. With this in hand, further meetings were held with groups in the Department that might address these needs. These conversations were used to help identify Action Plan deliverables.

The Open Science Life Cycle

The Action Plan is designed to address open science needs surfaced during the consultations and to respond to recommendations in the Roadmap. To provide a framework for how needs and recommendations will be addressed throughout the research life cycle, the Action Plan uses the Open Science Life Cycle as a guide. The Open Science Life Cycle comprises four broad categories of open science practices that align with the research life cycle: Ideation, Data Collection & Analysis, Publication, and Knowledge Mobilization. The fourth category, knowledge mobilization, feeds back into the first, ideation. The Open Science Life Cycle conceptualizes how each stage of the research cycle can be made open. By supporting open practices in each segment of the life cycle, ECCC's open science needs surfaced in consultations can be addressed.



Figure 1. The Open Science Life Cycle

This document is laid out following the stages of the Open Science Life Cycle beginning with the Ideation stage. Each section describes a stage, defines how that stage can be made open, why it is important to have open practices around that stage, what the goals for making that stage more open are and how ECCC will meet them with the help of ongoing and new initiatives across the Department.

Action Plan

1: Ideation

Research begins at the Ideation stage. This stage is informed by previous research in the form of publications and knowledge mobilization – the last stages in the Open Science Life Cycle. New research needs can also be informed by Indigenous concerns and knowledge, public issues, ECCC program needs, and emerging issues. The Ideation stage is where researchers develop the ideas and methods that result in research projects. This can be developed independently or through collaboration. It is the spark that gives rise to new theories, experiments, model development, data, publications, and the mobilization of new knowledge.

Definition

Open ideation is the concept that the development of research proposals or any document that details scientific activities to be conducted can be opened to feedback and collaboration. This contributes to making the research proposal more inclusive and robust. Feedback and input can come from other researchers, subject matter experts, stakeholders, Indigenous peoples and the communities impacted and/ or where the research is conducted, among others.

Why open ideation matters

The development of a research proposal benefits from feedback and input from multiple perspectives. This further enables the inclusion of diverse expertise and promotes collaboration between multiple scientific disciplines and knowledge systems from the onset. Open ideation can also make the process more inclusive by giving the opportunity for those impacted by the research or outcome of the research to co-create the research proposal.

What is our goal?

The goal is to make the ECCC research proposal development process more open and inclusive where appropriate and available.

How are we going to do it?

1. Promote ideation initiatives in the Department

ECCC researchers are already independently engaging in open ideation by integrating opportunities for the public to be involved in the development of their research proposal. Others are actively seeking diverse perspectives including involving members of a geographical community where the science is being conducted in the development of their research proposal. To further encourage open ideation, ECCC will highlight ongoing open ideation initiatives in the department through internal communication channels and develop guidance to encourage open ideation practices and provide ECCC researcher contacts for individuals interested in adopting open ideation.

2. Support Departmental participation in Government of Canada ideation/ calls for proposals

The Government of Canada has several opportunities to participate in open calls for proposals, for example the <u>IDEaS program</u>. ECCC will support participation in these opportunities by communicating the calls for proposals through ECCC's internal communication channels.

3. Create intra- or inter- departmental group on open ideation

ECCC will explore the development of a dedicated group within the department or as part of the broader federal open science work. The purpose of the group will be to share ideas and knowledge between experts on open ideation in service of growing open ideation at ECCC. The group may form as a working group, interest group, or community of practice, depending on the needs and interests of the group. Outside participation will be welcomed.

2: Data Collection and Analysis

The next stage in the Open Science Life Cycle is the Data Collection and Analysis stage. In this stage, researchers follow the research proposal developed in the previous stage and collect data and perform analyses to tackle their research question(s). Data produced during ECCC scientific activities can include environmental and wildlife monitoring data, modelling data, measurements of variables (e.g., for calibration and validation of model outputs or remote sensing data), GPS coordinates, and species identification.

Definition

For this stage, the ECCC Open Science Action Plan will focus solely on data. Researchers collect reams of data for the research, sometime totalling terabytes of data. When science is enclosed, data are stored where only the researcher can access it. Open Data is the process of *"making [scientific] data freely available on the public internet permitting any user to download, copy, analyze, re-process, pass them to software or use them for any other purpose without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself"*¹.

Why open data matters

Open data have the potential to allow Canadians to retrieve information about the world around them like water quality, weather and species information. They also can offer Canadians the opportunity to access the scientific data funded through federal research grants and facilitate scientific results to be tested and reproduced more easily. Open data can also support an increased pace² of discovery and innovation, as well as the provision of more complete advice to decision makers.

¹ This definition of open data is adapted from Panton Principles: <u>https://www.onthecommons.org/can-data-be-shared</u>

² For more information, visit <u>https://www.oecd.org/sti/inno/open-science.htm</u>

What is our goal?

The goal is to make ECCC data easier to share internally and more publicly available while moving towards making the data more FAIR (Findable, Accessible, Interoperable and Reusable)³ where appropriate and available. This goal is intended to address Recommendation 5 of the Roadmap: "federal departments and agencies should develop strategies and tools to implement FAIR data principles to ensure interoperability of scientific and research data and metadata standards by January 2023, with a phased plan for full implementation by January 2025".

How are we going to do it?

1. Provide open data publication guidelines and best practices

To make it easier for users and producers of data to make their data open, ECCC will provide open data publication guidelines and best practices to maximize the release of departmental data as an open resource, and to enable FAIR data principles. These guidelines will be supported by training on data literacy. ECCC will also review open data procedures and standards to make it easier to share data.

2. Offer support for uploading and accessing ECCC open data

One of the barriers identified in making data open is not having support to navigate the process to format, clean, share/upload or find open data. As such, ECCC will explore providing support for uploading and accessing ECCC open data. We will also explore solutions to sharing large datasets.

3. Develop, provide and integrate data infrastructure

Open data requires proper infrastructure support for upload and access. ECCC is investing in infrastructure, including some cloud-based data storage services, and an updated ECCC Data Catalogue. These infrastructures and support are designed to facilitate both internal and public data sharing.

3 This description is taken from the Roadmap for Open Science: <u>https://www.ic.gc.ca/eic/site/063.nsf/eng/h_97992.html</u>

3: Publication

The main conduit for the communication of scientific results are scientific publications and other research products including government publications, the third stage in the Open Science Life Cycle. Publications describe the results of the Ideation and Data Collection and Analysis stages. As a major stage in the communication of science, it is an imperative that publications be open access, easy and free to access.

Definition

Open access as defined by UNESCO "means free access to information and unrestricted use of electronic resources for everyone. Any kind of digital content can be OA, from texts and data to software, audio, video, and multi-media. While most of these are related to text only, a growing number are integrating text with images, data, and executable code. OA can also apply to non-scholarly content, like music, movies, and novels."⁴ An open access publication is an author accepted manuscript (accepted by journal) that is freely accessible, requiring no fee or registration to read.

The idea of unrestricted use in this definition refers to the absence of barriers. For the purposes of the Government of Canada, open access means that documents should be made proactively available on the Internet, and should be provided free of charge and registration. For instance, documents made available in fulfillment of information requests are not considered open access.

Why open access publications matter

Open access has the benefits of increasing access to publications in a timely manner and supporting scientific discovery and innovation. It also creates better opportunities for collective problem solving, allowing Canadians free access to data and information through publications funded by taxpayer dollars and supports public transparency and scientific credibility.

What is our goal?

The goal for the Publication stage in the ECCC Open Science Action Plan is to make ECCC scientific publications more openly and freely available where appropriate. This includes provisions to help researchers find open access publications and help authors make their publications open access. Our approach to achieving open access goals will rely on **green open access** solutions, which should incur no cost to authors. This goal addresses Recommendation 4 in the Roadmap for Open Science, which states that *"Federal departments and agencies should make federal science articles openly accessible by January 2022 and federal science publications* openly accessible by January 2023, while respecting privacy, security, ethical considerations and appropriate intellectual property protection".

⁴

This definition is adapted from the UNESCO Recommendation on Open Science: https://en.unesco.org/science-sustainable-future/open-science/recommendation

How are we going to do it?

1. Develop a federal open access repository for scientific publications

Infrastructure can support open access by providing a place to house open access versions of publications thereby allowing open access at no cost to ECCC. ECCC will participate in the development of a pilot repository for open publications led by Shared Services Canada and the Office of the Chief Science Advisor.

2. Training on open access publication practices and availability

Through its CIO-Library Services, ECCC will continue to provide orientation and training sessions that cover how to find science articles and publications using tools like the library catalogue, abstract and citation databases and RSS feeds. ECCC CIO-Library Services will also develop a specific module on open access to be included in a training session complement.

3. Provide open access publication guidelines and best practices

ECCC will continue to provide and update open access publication guidelines and best practices documents available on intradepartmental sharing platforms as necessary. These documents are designed to guide readers through choosing the right pathway to making their publications open access.

4: Knowledge Mobilization

The last stage in the Open Science Life Cycle is the Knowledge Mobilization stage. Knowledge mobilization is about connecting knowledge producers such as researchers with knowledge users (e.g. Canadians, provincial partners, Non-Governmental Organizations). To have impact, knowledge needs to be used. The purpose of knowledge mobilization is to maximize the impact of research, and then capture and communicate those impacts as widely as possible. It is also to identify future/further research needs and priorities. This happens through three actions: (1) Knowledge brokering, where knowledge between producers and users is matched; (2) Knowledge exchange, whereby knowledge is transferred between audiences (Figure 2).



Figure 2. The three elements of knowledge mobilization

Definition

Knowledge mobilization inherently differs from other stages of the Open Science Life Cycle in that it is not a process that can be made open. By definition, it is a process to share knowledge products openly.

Why knowledge mobilization matters

Knowledge will sit unused unless it is mobilized. By turning research into action, knowledge mobilization helps make federal science useful to society by supporting research and operations from ideation to impact while allowing broader participation from the public.

What is our goal?

The goal is to make it easier to both produce and find ECCC scientific knowledge products where appropriate and available.

How are we going to do it?

The Action Plan will address all three elements of knowledge mobilization through the production of knowledge products which can include engaging with social media, conferences, workshops and seminars, and science communication events to share research and facilitating dialogue between producers and users.

1. Promotion of existing ECCC knowledge mobilization initiatives

To make it easier to match or transfer knowledge between producers and users or communicate with different audiences, ECCC will explore creating an inventory of existing knowledge mobilization initiatives to be made publicly available.

2. Training on creating scientific knowledge products

In order to equip researchers to disseminate their knowledge, ECCC will develop and implement a science communication training program for researchers centred on narrative story telling.

3. Development of guidance and best practices for scientific knowledge products Science communication training will be complemented by the development of guidance and best practice documents for the creation of scientific knowledge products.

4. Continue to improve access to ECCC scientists and research professionals

Regular updates will be made to Innovation, Science and Economic Development's <u>Directory of Scientists and Research Professionals</u> to ensure the public's comprehensive access to ECCC researchers and their expertise.

Glossary

FAIR data principles

Findable, Accessible, Interoperable and Reusable (Roadmap for Open Science).

Federal science articles

Scholarly articles authored or co-authored by federal scientist(s) or researcher(s) in peer-reviewed academic journals (Roadmap for Open Science).

Federal science publications

Scientific communications that scientists and researchers use to share their work. These include research or scientific reports, monographs, edited books, book chapters, conference proceedings, conference papers, conference contributions, posters, plain language summaries and technical scientific products. These publications have been validated by a peer-review process (Roadmap for Open Science).

Green open access

Refers to author self-archiving, in which a version of the article before typesetting is deposited into a repository. Some publishers require an embargo period before deposition in repositories (<u>Open access - Wikipedia</u>).

Annex 1: Examples of ECCC Open Science Resources

Title	Description	Link
Open Science and Data Platform for Cumulative Effects	The Open Science and Data Platform provides access to environmental data and scientific publications that can be used to understand the cumulative effects of human activities. By looking at science, environmental data and information about development activities across the country, we can learn about potential impacts to support better decisions in the future.	https://osdp-cumulative-effects.canada.ca/
Open Data Portal	Search open data that is relevant to Canadians, learn how to work with datasets, and see what people have done with open data across the country.	https://open.canada.ca/en/open-data
Open Maps	Open Maps provides access to the Government of Canada's geospatial information. You can combine, visualize, and analyze geospatial data and collaborate with other Canadians.	https://open.canada.ca/en/open-maps
Federal Science Libraries Network	The Federal Science Library (FSL) is a one-stop, self-serve portal where you can access library services and search the print collections and repositories of seven science-based departments and agencies from a single place.	https://science-libraries.canada.ca/eng/ home/
Canadian Centre for Climate Services	By delivering climate services driven by user needs, providing access to climate information, building local capacity, and offering training and support, the centre helps Canadians understand climate change and become more resilient. It provides access to a library of climate resources including datasets, tools, and guidance.	https://www.canada.ca/en/environment-cli- mate-change/services/climate-change/ canadian-centre-climate-services.html
Geospatial web services	MSC GeoMet provides access to the Environment and Climate Change Canada's Meteorological Service of Canada (MSC) open data, including raw numerical weather prediction (NWP) model data layers and the weather radar mosaic, via Open Geospatial Consortium (OGC) standards such as the Web Map Service (WMS). Meteorological layers are served dynamically through the Web Map Service (WMS) standard to enable end- users to display meteorological data within their own tools, on interactive web maps and in mobile apps.	https://www.canada.ca/en/environment-cli- mate-change/services/weather-gener- al-tools-resources/weather-tools-special- ized-data/geospatial-web-services.html
Historical Climate Data	Access historical weather, climate data, and related information for numerous locations across Canada. Temperature, precipitation, degree days, relative humidity, wind speed and direction, monthly summaries, averages, extremes and Climate Normals, are some of the information you will find on this site.	https://climate.weather.gc.ca/index_e.html