

ASSOCIATION OF CANADIAN MAP LIBRARIES AND ARCHIVES  
**BULLETIN**

## **Geospatial Data and Software Reviews**

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### **Climate change data**

Anthropogenic climate change is real and its impacts will be widespread. Need evidence? Let's look at some of the sources of maps and GIS data on the topic.

Those of you who, like me, are concerned about climate change will likely be heartened by the sheer volume of scientific data and publications available online. Contrary to what your Trumpist uncle might loudly insist over Thanksgiving dinner, climate science isn't a shady, backroom machination but, you now, science. And much of that science is open.

To narrow the scope of this article, I've chosen to focus mainly on sources of data from the Government of Canada. The current incarnation of the Government of Canada website keeps its information on climate change information nested a couple layers deep, under the Environment and natural resources portal. From there, the Climate change portal<sup>2</sup> is accessible from any of three topical pages: Weather, climate and hazards, Environmental conservation and protection, and Pollution and waste management. The URL [climate-change.canada.ca](http://climate-change.canada.ca) also redirects to the Climate change portal.

Nine ministries contribute content to Climate change, meaning the portal multidisciplinary is targeted to a range of audiences. From there, GIS-compatible data and maps may be found through several links. While there is a great deal of information and data to be found, the site architecture is a bit of a tangled, recursive mess. At this point, we'll leave the web architecture behind and try to focus on specific, programmatic microsites providing data.

### **Canadian Centre for Climate Services (CCCS)**

The CCCS is "a dedicated multi-disciplinary team with expertise across a broad range of climate-related disciplines. We work with partners and stakeholders to support the implementation of the Pan-Canadian Framework on Clean Growth and Climate Change"<sup>3</sup>.

The CCCS website provides access to a wide range of climate resources from a range of sources. The site is divided into four sections: Library of climate resources (including datasets), Climate

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<sup>2</sup> <https://www.canada.ca/en/services/environment/weather/climatechange.html>. All links retrieved July 22, 2019. This author remains skeptical of the durability of any government URL.

<sup>3</sup> <https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services.html>.

information basics, Climate Services Support Desk (a sort of reference and referral service for climate information), and Display and download climate data.

The most valuable section for GIS users will be the Library of climate resources, an information clearinghouse similar to (and likely using the same platform as) Government of Canada's Open Government portal. The digital library contains 325 records as of July 22, faceted by jurisdiction (national, subnational, and international), variable, resource type (Data product, Guidance, Tool, and Additional resources), source (including academic and NGO as well as government sources), spatial type (grid, point, polygon), and temporal resolution. Contact info for the Climate Services Support Desk is prominently displayed above the list of resources, promising help for those seeking to use the resources.

Climate information basics will also be a useful resource for neophytes looking to dip their toes into the (rising) waters of climate science. It is interesting to note that, on the CCCS and other Canadian climate information sites, educational and training resources are well developed and prominently displayed. This is surely because, more so than other GIS data types and sources covered in this column, climate science is a highly contentious and politicized scientific issue. I'm glad to see that resources have been invested in ensuring that there's no excuse for not understanding the basic science and research methods behind climate change.

Display and download climate data links to three portals that have been developed or expanded with the support of the CCCS: the Climate Atlas of Canada (see below), Climate Data Canada (ditto), a tool called PAVICS (once again). There are also links to download pages for climate data from Environment and Climate Change Canada (ECCC) that were not functional at time of writing.

### **Climate Data Canada**

According to the site's blurb, "ClimateData.ca is a climate data portal produced collaboratively by the country's leading climate organizations and supported, in part, by the Government of Canada. The goal of this portal is to support decision makers across a broad spectrum of sectors and locations by providing the most up to date climate data in easy to use formats and visualizations."<sup>4</sup> The CCCS is a key supporter of Climate Data Canada. Although primarily a tool for science communication to a non-academic audience, it does have strengths which make it worthy of inclusion here.

Climate Data Canada is primarily an interactive, web-based tool for querying climate variables based on location. The interface is slick, attractive, and appears to be quite functional (the site suggests using Chrome but it appeared to work well on Firefox). The chief means of querying data are by location, by variable, and by sector.

The data on the site is generally provided as a combination of historical (1950-2005) and forecast (2005-2100) values. Forecast values are provided for three different emissions scenarios: RCP2.6, RCP4.5, and RCP8.5. RCP stands for Representative Concentration Pathway; each RCP represents

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<sup>4</sup> <https://climatedata.ca/>.

a different scenario for modelling climate change based on emissions<sup>5</sup>. The primary data source for forecast data is the Bias Correction with Constructed Analogues and Quantile mapping, Version 2 (BCCAQv2) from the Pacific Climate Impacts Consortium (PCIC). Observational data comes from NRCan's ANUSPLIN dataset, named after the "the Australian National University Spline (ANUSPLIN) implementation of the trivariate thin plate splines interpolation method"<sup>6</sup>.

Querying data by location allows the user to search for data for a given city or town. The result generates a page that displays historical and forecast values in a line graph for a Temperature variable, a Precipitation variable, and an "Other" variable. For each of these variable types, the user may select between several alternative variables; for example, under Temperature you can view graphs for the mean temperature, days with temperatures above 32C, the maximum temperature, and others.

Querying data by variable allows the user to select a variable and an RCP scenario; the result is displayed as an interactive heatmap (no pun intended!) with a slider that allows you to select the decade for which to display the variable. You can also change the RCP scenario and even select scenario comparisons, which will display the heatmap for each side by side.

Querying data by sector is a little more nebulous and seems to be intended to be able to allow "decision makers" to find relevant variables based on their professional sector rather than to present new information. However, this menu heading does have an entry for "Data by Health Region," which allows you to explore all the variables according to health region boundaries rather than by municipal boundaries.

The site also has a data download function which allows the download of a variable by location, for specific weather stations, and for heat waves (data for a location with user specified numbers of days with temperatures above specific thresholds). Although bulk data download for all or multiple locations isn't possible through the site interface, I imagine more comprehensive data downloads could be available upon request.

As well as being well designed and user friendly, Climate Data Canada is especially noteworthy for providing contextual links to help and definitions, and has a number of carefully designed instructional materials - including basic instruction on the concepts and science of climate change - prominently linked throughout the site. What the site lacks in terms of bulk download functionality, it makes up in providing an excellent tool for dipping one's toes in the water of climate data and for exploring specific geographic locations.

### **Climate Atlas of Canada**

Originally developed by the Prairie Climate Centre, the Climate Atlas of Canada<sup>7</sup> is now in version 2, upgraded with the support of CCCS. The Climate Atlas is also a science communications tool

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<sup>5</sup> Any more detailed an account of RCP is beyond the scope of this column. For more about RCP scenarios, see the RCP Database at <http://tntcat.iiasa.ac.at:8787/RcpDb/dsd?Action=htmlpage&page=welcme#descript>.

<sup>6</sup> <https://climatedata.ca/about/>.

<sup>7</sup> <https://climateatlas.ca/>.

which some similarities to Climate Data Canada but with some novel features. Like Climate Data Canada, the platform is slick and there is ample instructional material available. The Climate Atlas also relies primarily on BCCAQv2 data and provides a slightly more in-depth but still entry level description of key modeling methodologies<sup>8</sup>.

The default interface for the Climate Atlas is an interactive map. It allows the user to choose between “Less” and “More” Climate Change (RCP4.5 and RCP8.5, respectively) for the 2021-2050 and 2051-2081 periods as well as observational data for the “Recent Past” (averages for 1976-2005) for a number of variables classified under Hot Weather, Cold Weather, Temperature, Precipitation, and Agriculture. The map provides either a gridded interface for the whole country or provincial/territorial boundaries, and the visualization can be flipped between average values and change from the recent past to forecast time periods. Clicking grid squares or provinces/territories provides dynamically generated graphs and text reports of climate forecasts across variables for the selected area. The Climate Atlas provides more overlay options than the Climate Data map, including highways, winter roads, rivers, watersheds, and Indigenous territories.

Notably, the Climate Atlas hosts a suite of video stories and text articles on the impacts of climate change. These were developed specifically for the Climate Atlas. While the articles are more general, the videos cover local issues and have been georeferenced for overlay on the default map.

Users may download climate maps and visualizations of climate data under a Creative Commons No Derivatives license<sup>9</sup>. Direct download of historical and forecast climate data is only possible for individual locations as selected in the interactive map.

### **Power Analytics and Visualization for Climate Science (PAVICS)**

PAVICS, which stands for Power Analytics and Visualization for Climate Science, promises to be “the most complex platform”<sup>10</sup> and the most advanced of the offerings here. PAVICS will “[integrate] a network of supercomputers to provide the tools needed to analyze and visualize large amounts of climate data.... PAVICS is a Spatial Data Infrastructure (SDI) for climate data and has modular components that provide access to climate data and to a library of climate services. It provides advanced climate data processing tools for researchers, climate modellers, and other expert users.”<sup>11</sup> The CCCS site doesn’t offer a timeline for the release of PAVICS; however, there is currently a CANARIE-managed instance of PAVICS available online<sup>12</sup>. PAVICS is developed and currently run by Ouranos, a Québécois consortium for climate science and has been live since

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<sup>8</sup> <https://climateatlas.ca/data-sources-and-methods>.

<sup>9</sup> <https://climateatlas.ca/downloads>

<sup>10</sup> [https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services/display-download/additional-information-climate-data-portals.html#coming\\_soon](https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services/display-download/additional-information-climate-data-portals.html#coming_soon).

<sup>11</sup> Ibid.

<sup>12</sup> <https://pavics.ouranos.ca/>. See also <https://science.canarie.ca/res/103>.

2017<sup>13</sup>. Presumably, involvement with the CCCS will entail a change in infrastructure rather than a qualitative change in the tool.

### **Other sources of climate data**

As mentioned at the opening, there is a great deal of climate data freely available - far too much to cover in this article. It's also likely the data users will likely be more familiar with (and perhaps even contribute to!) the sources of more advanced data than their librarians. However, here's a quick overview of some other sources of information.

Canadian Climate Data and Scenarios (CCDS)<sup>14</sup> is hosted by ECCC and has some overlap with the content of CCCS and its supported products. Unlike the CCCS, the CCDS seems to be intended for a more specialized audience and seems to have less focus on science communications and basic instruction. The CCDS does host a large number of datasets for both historical observations and forecasts in a variety of image or GIS-friendly formats, depending on the nature of the datasets.

ECCC also provides fairly granular historical climate data<sup>15</sup>. Many of ECCC's data are for specific weather stations but users may search stations proximal to specific cities and towns. ECCC also provides access to historical weather radar imagery.

On the U.S. side, the National Center for Atmospheric Research (NCAR) has a GIS program with a website specifically geared to GIS-ready climate change datasets<sup>16</sup>. Some of the data there appears to be international in scope. The National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) are also prolific publishers of observation and forecast modeling data.

### **In closing**

This is my final contribution as Software and Data editor for the *ACMLA Bulletin* as I prepare to take on a new role as Digital Publishing Librarian at York University. I hope that you've found my articles here as interesting and informative to read as I have to write!

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<sup>13</sup> <https://www.ouranos.ca/>.

<sup>14</sup> <http://climate-scenarios.canada.ca/>.

<sup>15</sup> [http://climate.weather.gc.ca/historical\\_data/search\\_historic\\_data\\_e.html](http://climate.weather.gc.ca/historical_data/search_historic_data_e.html).

<sup>16</sup> <http://gisclimatechange.ucar.edu/>.