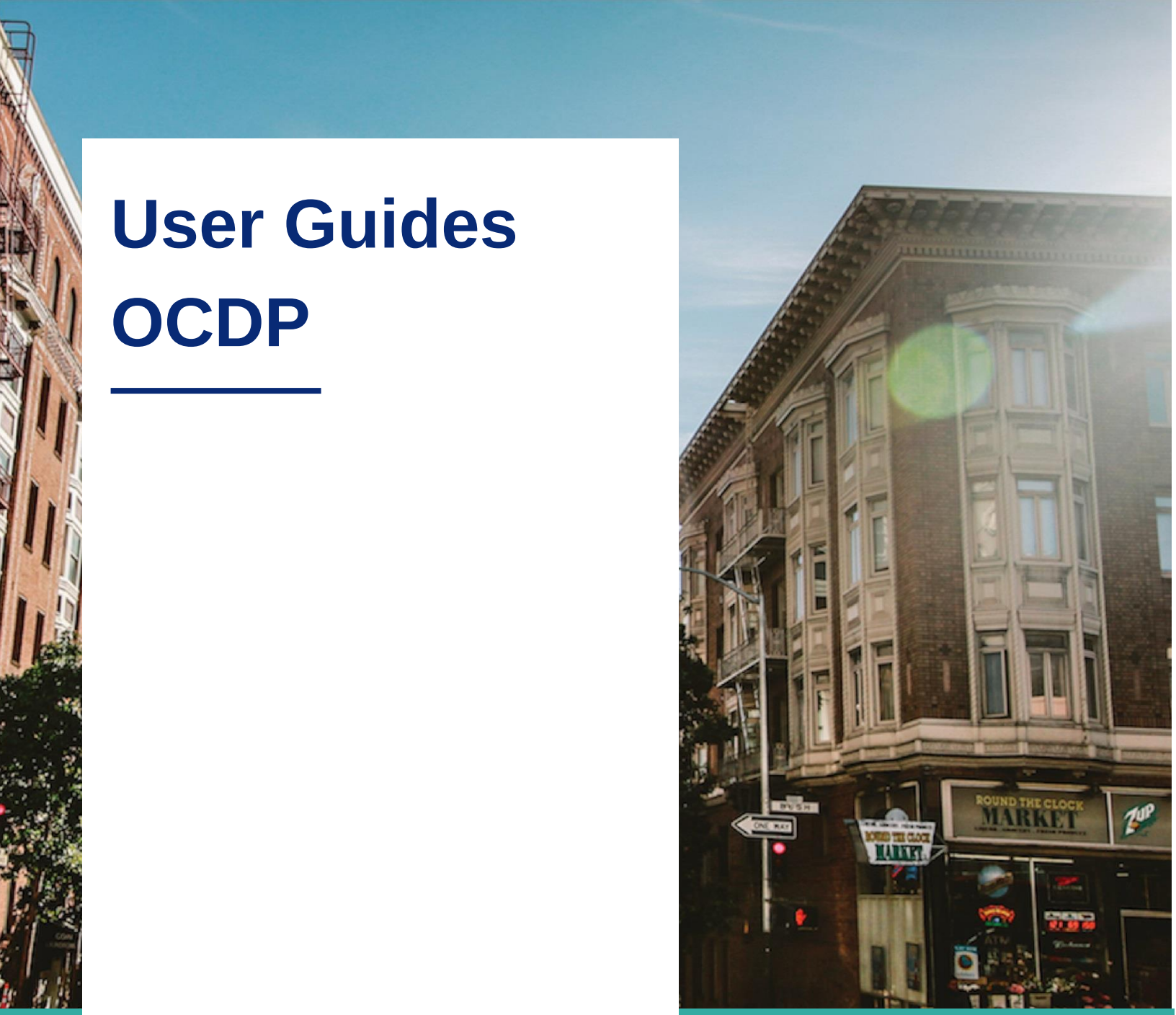

User Guides
OCDP

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Preface

The Climate Change Group at LAMPS (Laboratory for Atmospheric and Climate Physics Modeling and Simulation) of York University has undertaken a project to provide coordinated and user-friendly climate change projections specifically tailored for Ontario. The aim is to address the challenge faced by users who may lack the necessary information or expertise to access and compile relevant climate data that meets their specific needs.

To accomplish this, the Climate Change Group has consolidated a wide range of existing Ontario-specific climate projections into a unified set of climate scenarios. These scenarios have been developed using the most up-to-date data from the IPCC AR5 (Intergovernmental Panel on Climate Change Fifth Assessment Report). By creating this common set of projections, the group intends to offer the most current and relevant climate data for future climate change research and applications in Ontario. This effort will enhance the consistency and comparability of climate risk assessments conducted in the region.

The projections are generated at a resolution of approximately 10km x 10km, providing detailed spatial information. The ERA-Interim dataset, which has a grid network resolution of 10km (0.125°), is utilized as the common grid network for these projections.

The ultimate outcome of this project will be a standardized set of probabilistic projections for both long-term averages and extreme climate indices. These projections will be available at a spatial resolution of approximately 10km and even down to daily time scales. Projections have been developed for all of the RCP (Representative Concentration Pathway) emission scenarios, including RCP 8.5, 6.0, 4.5, and 2.6. Each RCP emission scenario will have its own consistent set of projections.

By providing this comprehensive and accessible set of climate change projections, the Climate Change Group aims to support various stakeholders in Ontario, enabling them to make informed decisions and assessments related to climate change impacts and adaptation strategies.

Climate Maps

Spatial distribution of climate variables and their changes

The user guide provides access to static and interactive climate maps for Ontario. The static maps display summarized data based on 8964 grid points at approximately 10 km resolution. The maps show temporal averages or changes for four basic variables: daily mean, minimum and maximum temperature, and daily total precipitation. The periods considered are the reference period (1986-2005), the 2050s (mid-term of the 21st century), and the 2080s (last term of the 21st century). The maps use color coding, with blue/brown representing low temperature/precipitation and red/green representing high temperature/precipitation. The interactive maps provide detailed information for

- Summary: provincial averages
- Variables: Temperature, Precipitation and indexes
- Values: Historical Value and Future Changes
- Number of grids: 8964
- Periods: 1986 - 2005 (Reference),2040-2069 (2050s) and 2070-

Introduction

The Maps section contains climate maps for Ontario. These maps show information about the climate in a simplified and interactive way. They are based on data collected from different points across the province, represented by a grid of 8964 points with a resolution of about 10 kilometers. The maps display four main variables: the average temperature for each day, the minimum and maximum temperature for each day, and the total amount of precipitation (rainfall) for each day. These maps show the average values or changes in these variables over three different time periods.

In simpler terms, there are three time periods we are looking at: the reference period (1986-2005), and two future periods: 2040-2069 (2050s) and 2070-2099 (2080s). The future periods represent different parts of the 21st century. We compare the values from the future periods to those from the reference period to see how things have changed.

We use four different scenarios called RCPs (Representative Concentration Pathways) to calculate the

(1) Common top menu: Click on the item to go to different sections.
(2) Search form: Linked to a Google search engine.
(3) Collapsible sidebar: Contains links to all pages.
(4) Page title: Full name and abbreviation of the variable (e.g., Annual Temperature - TmAnn).
(5) Variable definition: Description of the variable. Provincial average for the reference period (1986-2005) is 21.6.
(6) Projected changes in provincial averages: Shows changes in the variable for the 2050s and 2080s relative to the reference period. The ranges in parentheses represent the 5%-95% range.
(7) Spatial distribution of the variable for the reference period (1986-2005).
(8) Temporal variations of the variable averaged over the province annually, under the four RCPs.
(9) Spatial distribution map of changes in the variable for the 2050s (RCP 2.6).
(10) Spatial distribution map of changes in the variable for the 2080s (RCP 2.6).
(11) Spatial distribution map of changes in the variable for the 2050s (RCP 4.5).
(12) Spatial distribution map of changes in the variable for the 2080s (RCP 4.5).
(13) Spatial distribution map of changes in the variable for the 2050s (RCP 6.0).
(14) Spatial distribution map of changes in the variable for the 2080s (RCP 6.0).
(15) Spatial distribution map of changes in the variable for the 2050s (RCP 8.5).
(16) Spatial distribution map of changes in the variable for the 2080s (RCP 8.5).
(17) Button for interactive map section: Clicking this button reveals the interactive maps section.

Interactive maps

The interactive maps section consists of nine maps that provide detailed information for each of the 8964 grid points across the entire province. These maps are generated using backend JavaScript programs.

The interactive maps allow users to explore and access specific information by clicking on any grid point of interest. When hovering the mouse over a grid point in the first map, "Present Climate and a Summary of Projected Changes at each Grid," a popup table appears in the lower-left corner of the window. This table displays climate change statistics similar to the provincial summary table but focuses specifically on that selected grid point.

Users have the option to download the maps in various picture formats such as .png, .jpeg, .pdf, or .svg, as well as download the data as tables in .csv, .xls, or .txt formats.

Since the interactive maps contain a large volume of data, a clickable button is provided at the bottom of the page for users who wish to access more detailed information. This enhancement greatly improves the user experience of the OCDP (Ontario Climate Data Portal) by providing additional options for exploring and obtaining specific climate data.

In the interactive maps section, there are nine maps available. Here is a brief description of the maps: As an example, the map below displays the spatial distribution of average temperature for the reference period. The colors on the maps represent different values of the variable. The color gradient used is from blue to cyan, green, yellow, and finally red. This color scale helps visualize how the variable changes across different locations. Blue indicates low values, while red represents high values. As you move from blue to red on the color scale, it signifies an increase in the variable's value. This color scheme allows users to easily identify areas with low or high values of the variable in the spatial context.

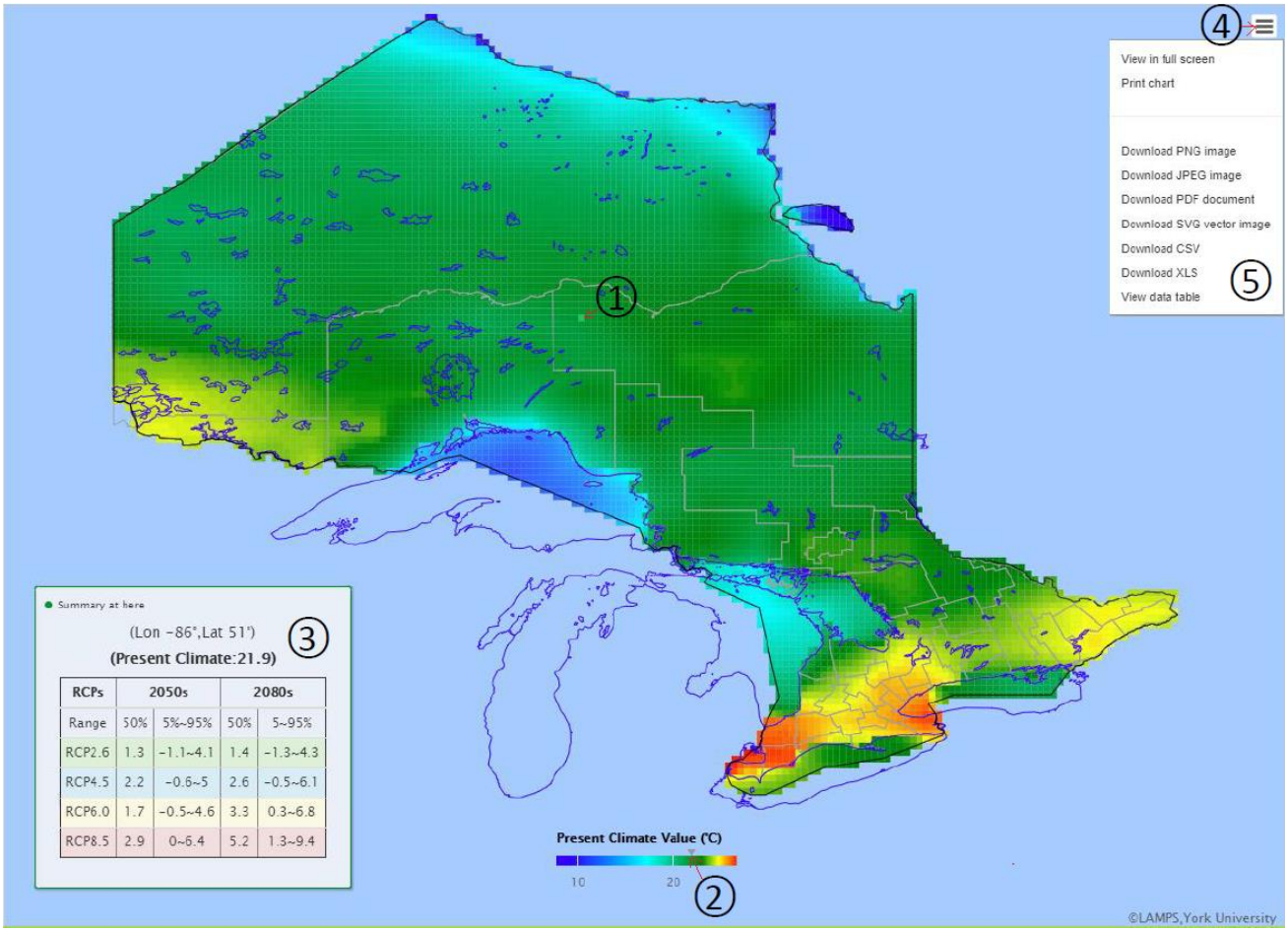


Figure 2 A schematic diagram illustrating the contents featured in the interactive map pages

The information for the 5 items indicated by the numbers 1 to 5:

(1) Mouse interaction: When you move the mouse over the map, for example, to the grid cell (1) indicated by a red arrow, additional information becomes visible.

(2) Value display: The grey 'V' symbol displays the value at the selected grid point (1).

(3) Summary table: This table provides a summary of information. It includes the location of the mouse (latitude and longitude), the current value of the variable (e.g., 21.9), and the projected changes for the 2050s and 2080s relative to the reference value or present climate (e.g., 21.9 in the table) under the four RCPs (RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5). The "50%" column represents the median value, and the "5%-95% range" represents the range between the 5th and 95th percentiles based on the super ensemble.

(4) Output menu button: Clicking this button opens or closes the menu for output options.

(5) Output options: There are nine options available to export the information from the interactive map. These options allow users to save or download the data or images in various formats.

Additionally, the other eight maps show the median values of the changes for the 2050s and 2080s under each of the four RCPs, respectively. These maps provide a visual representation of the projected changes in the variable for different time periods and emission scenarios.

Time-series

Temporary variations of climate variables and indexes

- Spatial: Provincial (Annual), Regional (decadal) and Municipal(decadal)
- Variables: Temperature, Precipitation and indexes
- Values: Changes for 1981-2100 relative to 1986-2005
- RCPs: RCP2.6, RCP4.5, RCP6.0 and RCP8.5

Introduction

Variations in climatic variables over decadal-to-century time scales serve as crucial indicators of climate change. To visually represent these trends, sparklines, which are tiny charts, are suitable. In our analysis, we calculate decadal averages of climatic variables at 10-year intervals (e.g., 1981-1990, 1991-2000, etc.) and present them as sparklines for each sub-region and municipality across Ontario. It's important to note that, due to the extensive volume of data, we only provide ensemble means of these variables for each of the Representative Concentration Pathways (RCPs) in this section.

To enhance the interactive experience, we have created time-series figures that showcase provincial averages for both basic climate variables and climate indices. Each page features five sub-figures corresponding to different RCPs: RCP 2.6, RCP 4.5, RCP 6.0, RCP 8.5, and a combined figure encompassing all four RCPs.

These interactive time-series figures allow users to observe and analyze the long-term trends in climate variables and indices at the provincial level. By exploring the different RCPs, users can gain insights into the potential future scenarios and the impacts of various emission pathways on Ontario's climate.

Below, we will show you a few examples of graphs that track changes over time. We will also explain what kind of information these graphs contain.

Average temperatures in the province change over time

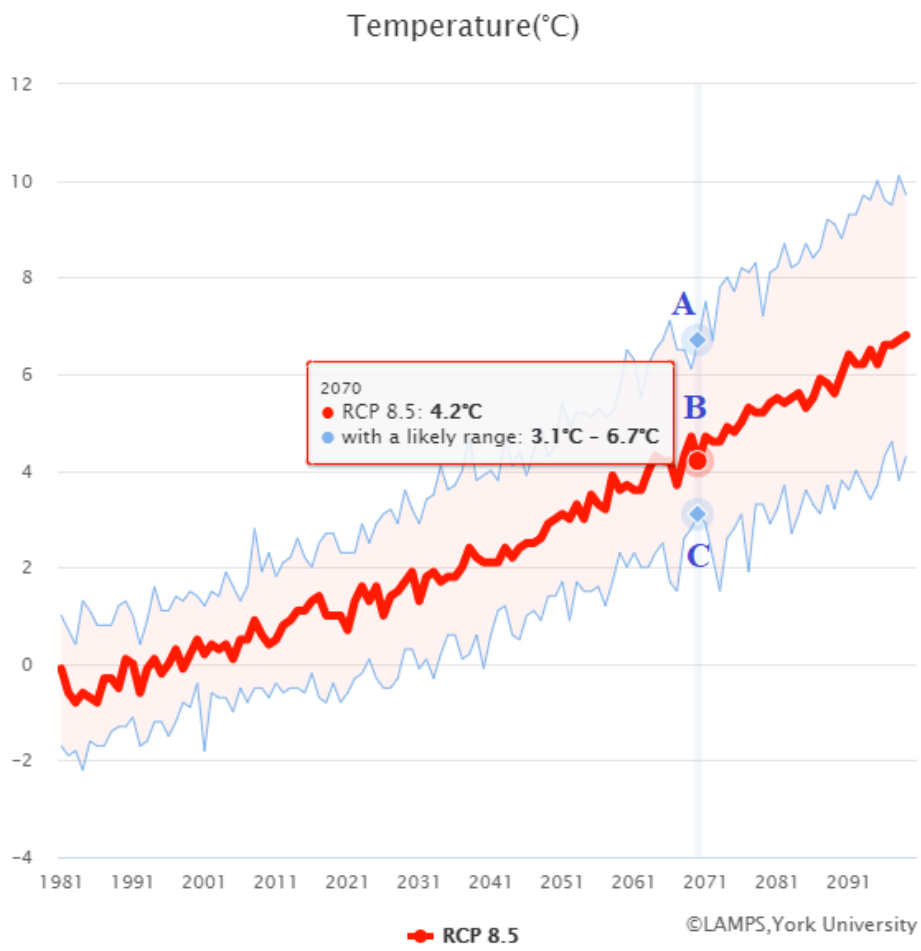


Figure 3: This graph shows how average temperatures in the province change over time (from 1981-2100) compared to the average temperature during the reference period (1986-2005). It represents the climate change scenario RCP 8.5.

Hover your mouse over the figure to see the projected changes compared to the average value during the reference period (1986-2005).

A: Represents the 95th percentile (e.g., shown as 6.7 in the figure).
B: Represents the median or 50th percentile (e.g., shown as 4.2 in the figure).
C: Represents the 5th percentile (e.g., shown as 3.1 in the figure).

Average temperatures in a region change over time

We only show the changes over the decades for the 50 sub-regions.

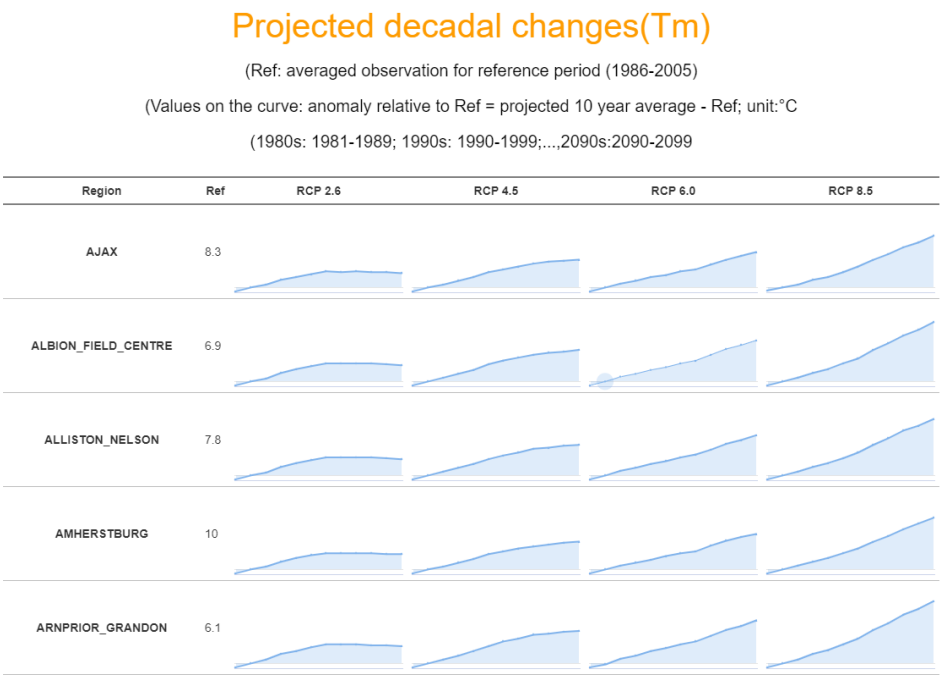


Figure 4 Example page of decadal changes

Hover your mouse over a figure to see the change over a decade (difference from the average) compared to the average value during the reference period (1986-2005). The columns represent:

- Region: Name of the specific region
- Ref: Average value for the entire region during the reference period
- RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5: Changes under specific climate change scenarios
- All values are calculated using 10-year intervals, except for the 1980s, which is based on 9-year data since our data starts from 1981.

Average temperatures in a municipality change over time

The information for the 150 municipalities is similar to the regional data over time, but it is specific to each municipality and is obtained from the weather stations located in those municipalities.

Average temperatures at a grid point change over time

The page may take longer to load because there is a lot of data. As a result, we cannot display time series data on the grid directly. However, if you would like to view time series graphs, you can visit our GitHub website and download a Python program that allows you to create your own time series graphs.

Data Download

- Grids: 8964
- Variables: Temperature, Precipitation and indexes
- Period: 1981-2100, daily, monthly and annual
- RCPs: RCP2.6, RCP4.5, RCP6.0 and RCP8.5
- Locations: direct file Links and GitHub storage

Introduction

Many scientists and policymakers who focus on climate change and adaptation need more detailed information and data to conduct their own analyses. To address this growing demand, we offer a portal that contains over 10 terabytes (TB) of data. This data includes daily, monthly, annual, and long-term averages of minimum, maximum, and average temperatures, as well as precipitation from various climate models under all RCPs (Representative Concentration Pathways). Additionally, annual values of extreme climate indices are provided.

All the data available in our portal have been downscaled and bias-corrected, making them directly usable for analyses and practical applications, such as assessing the impacts of climate change on specific sectors. To facilitate access to the data, we provide simple code examples in popular programming languages like Python, Matlab, and R. These codes assist users in reading and utilizing the data from our portal.

The units used for temperature and temperature change are in degrees Celsius (°C), while precipitation is measured in millimeters (mm). For precipitation change maps, the units are in percentage (%), unless otherwise specified in the description.

Download data files from web links

- Historical data for the period 1981-2020
  - ERA-Interim data

    Grid Information: Each grid cell is assigned an ID number. The longitude and latitude represent the location of the center of each grid cell, measured in degrees.

    The data provided is in Matlab format and consists of four variables. These variables have dimensions of 8964 (representing grid cells) * 365 (representing days) * 38

(representing years). The data is derived from ERA-Interim data and includes the following variables:

- Daily temperature
- Daily maximum temperature
- Daily minimum temperature
- Daily total precipitation

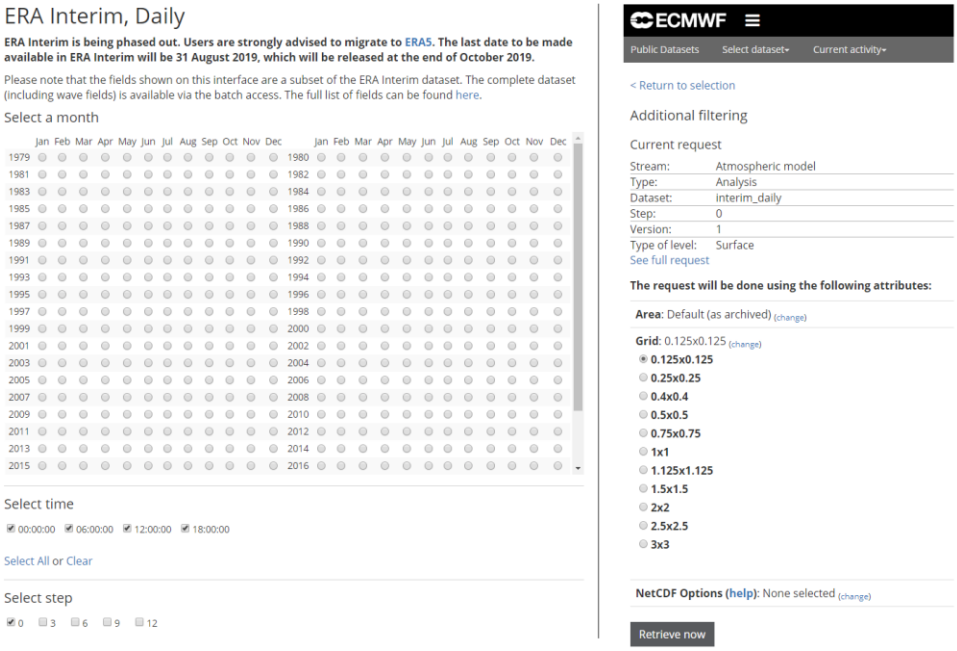


Figure 5 The page where the original data can be downloaded.

The paper that provides reference information about ERA-Interim is:

Dee, Dick P., Sakari M. Uppala, A. J. Simmons, Paul Berrisford, P. Poli, S. Kobayashi, U. Andrae et al. "The ERA-Interim reanalysis: Configuration and performance of the data assimilation system." Quarterly Journal of the royal meteorological society 137, no. 656 (2011): 553-597.

Calculation of the four variables:

- Daily mean temperature is calculated as the average of four values taken at 6-hour intervals.
- Daily minimum temperature is determined as the lowest value among six values. These include four values at 6-hour intervals and two values representing the minimum over a 12-hour period.
- Daily maximum temperature is determined as the highest value among six values. These include four values at 6-hour intervals and two values representing the maximum over a 12-hour period.
- Daily total precipitation is calculated as the sum of two values representing the total precipitation over a 12-hour period.

➢ ERA5 data

As ERA-Interim reanalysis was discontinued on August 31, 2019, it has been replaced by ERA5. To ensure the historical data is up to date, we have updated it with ERA5 on the same grids. For more information on the main features of ERA5 and significant differences compared to ERA-Interim, please refer to the table below.

Comparison table

This table highlights major differences between ERA-Interim and ERA5. There are many additional differences, in particular changes to the computation of individual atmospheric parameters (due to the change in the assimilation system from 31r2 to 41r2) are not listed here.

	ERA-Interim	ERA5
Period covered	1979 - present	1950 - present
Production Period	August 2006 – **31st August 2019**	Jan 2016 – end 2017, then continued in near real-time
Assimilation system	IFS Cycle 31r2 4D-Var	IFS Cycle 41r2 4D-Var
Spatial resolution	79 km globally, 60 levels to 0.1 hPa	31 km globally, 62km for the Ensemble of Data Assimilations (EDA), 137 levels to 0.01 hPa
Output frequency (temporal resolution)	6-hourly analysis fields Forecast fields on surface and pressure levels 3-hourly up to 24 hours, with reduced frequency up to 10 days	Hourly analysis fields, 3-hourly for the Ensemble of Data Assimilations (EDA) Hourly forecast fields, 3-hourly for the Ensemble of Data Assimilations (EDA), up to 18 hours, with reduced frequency up to 10 days (not in initial release)
Uncertainty estimates	None	From a 10-member Ensemble of Data Assimilations (EDA) at 63 km resolution
Model input	As in operations (inconsistent SST)	Appropriate for climate (e.g. CMIP5 greenhouse gases, volcanic eruptions, SST and sea-ice cover)
Input observations	As in ERA-40 and from Global Telecommunication System	In addition, various newly reprocessed datasets and recent instruments that could not be ingested in ERA-Interim
Variational bias scheme	Satellite radiances	Also ozone, aircraft and surface pressure data
Satellite data	RTTOV-7, clear-sky, 1D-VAR rainy radiances	RTTOV-11, all-sky for various components
New parameters	ERA-Interim contains about 100 parameters on surface and single level alone, plus parameters on other level types.	ERA5 contains over 240 parameters on surface and single level alone, plus parameters on other level types. For specific parameters please compare the technical documentation linked below.
Parameters removed		A few parameters present in ERA-Interim are not available in ERA5. For availability of specific parameters please see the technical documentation linked below.
Handling of accumulated parameters	Accumulated from the beginning of the forecast	Accumulated from previous post-processing
Product main page	http://www.ecmwf.int/en/research/climate-reanalysis/era-interim	http://climate.copernicus.eu/climate-reanalysis
Technical documentation	Berrisford et al 2011: The ERA-Interim archive Version 2.0	ERA5 data documentation
Additional innovations		Long-term evolution of CO2 in RTTOV, cell-pressure correction SSU, improved bias correction for radiosondes, EDA perturbations for sea-ice cover

Figure 6 The page that provides a comparison between ERA-Interim and ERA5 data.

The updated variables and indexes include (in CSV files):

- Monthly data for temperature and precipitation from January 1981 to March 2021.
- 30-year averages for the periods 1981-2010 and 1991-2020, as well as 20-year averages and their changes.
- Averages of extreme indexes for the reference period 1986-2005.
- Daily temperature data for mean, maximum, and minimum values from 1981 to 2020, along with precipitation data.
- Annual precipitation indexes.
- Annual temperature indexes.

❖ Future

➢ Provincial Averages anomaly

The four basic variables (Temperature, maximum temperature, minimum temperature, and total precipitation)

For example:

ProvincialAverageEnsembleMean_month_season_ann.csv

Year	RCP2601	RCP2602	RCP2603	RCP2604	RCP2605	RCP2606	RCP2607	RCP2608	RCP2609	RCP2610	RCP2611	RCP2612	RCP26spr	RCP26sum	RCP26aut	RCP26ann	RCP26win	RCP4501
1981	-6	2.6	2.7	-5.7	0.1	-8.8	-3.1	-1	-1.4	0.2	6.8	1.7	-2.9	-12.9	5.5	-11.9	3.4	-4.2
1982	3	-1.4	-0.1	2.9	1.6	0.1	2.5	-2.8	-9.4	0.8	4.9	-7.2	4.4	-0.2	-3.7	-5.1	-13.3	2.5
1983	-3.3	-2.8	-1.1	-5.4	-1.8	-6.6	-4.3	3.1	-7.8	2.4	1.8	-2.1	-8.3	-7.8	-3.6	-27.8	-8.6	-0.9
1984	-2.6	-4	-4.3	-3.5	-3.6	-7.1	-5.9	1.8	-9.6	-1.7	0.8	-4.2	-11.4	-11.2	-10.6	-44	-3.7	-2.7
1985	-0.7	1.1	-2.4	2.8	-6.1	-5	-0.1	2.9	0	-0.9	-1.7	-2.9	-5.7	-2.3	-2.6	-13	-4.1	-1.3
1986	-3.2	1.9	1.5	2.8	-2.2	-1	2	-4	9	-6.3	0.4	-1.9	2.1	-3	3.1	-1.1	-3.1	-2.2
1987	-0.7	-0.5	3.6	-2.7	3.3	6	3.1	-1.3	0.7	5.6	-5.4	0.6	4.2	7.7	0.9	12.1	-1	-0.2
1988	-0.5	-1.1	2.1	-4.3	1.7	-2.8	3.3	7	-4.8	1.3	0.6	-0.2	-0.5	7.5	-2.9	2.3	6.8	-0.4
1989	1.7	5.2	-0.7	-1.9	-5.6	3.4	4.3	-1.7	5.9	-1.2	3.4	-2.8	-8.2	6.1	8	9.9	-5.3	2.7
1990	-0.9	-1.6	-4	-1.2	-1.1	7.2	5.4	3.5	-1.4	7.7	-4.6	6.3	-6.3	16.1	1.7	15.4	8.1	-2.5
1991	2.7	-0.9	-1.6	0	1.1	-2.4	0.2	2.3	1.2	-3	-3.7	1.1	-0.5	0.1	-5.6	-3.1	0.2	-0.7
1992	2.5	-3.5	-3.9	-5.5	0.7	-6.9	-4.4	3.4	-6.7	-2	-11.1	-0.5	-8.7	-7.9	-19.8	-38	-0.9	0.8
1993	-1.1	0.7	-5.5	-7.4	-6.1	-3.2	3.8	-0.1	3.6	-3.1	-5.3	-2	-19	0.5	-4.8	-25.7	-3.9	-1.1

Figure 7 Table format showing the structure of the provincial averages' anomaly data set.

Detailed description of the table:

The table consists of 69 columns, including the year and data for four RCPs (Representative Concentration Pathways) across 17 columns. The columns represent monthly values from January to December, as well as seasonal values for spring, summer, autumn, and winter. It's important to note that the winter data is located in the last column. The values in the table are anomalies, which means they represent the differences from the average values during the reference period of 1986-2005.

Specific explanations for the RCPs are as follows:

- RCP2601 to RCP2612: These columns represent the anomalies of monthly averages from January to December under RCP 2.6.
- RCP26spr, RCP26sum, RCP26aut, and RCP26win: These columns represent the anomalies of seasonal averages for spring, summer, autumn, and winter under RCP 2.6.
- RCP26ann: This column represents the anomaly of the annual average under RCP 2.6.
- RCP45??, RCP60??, and RCP85??: These columns follow the same pattern as RCP26??, but they represent the anomalies for RCP 4.5, 6.0, and 8.5, respectively.

➢ Indexes

Detailed Description of Contents in an Example Table:

FD_ProvinceAverageEnsembleMean.csv

	A	B	C	D	E
1	Year	RCP26	RCP45	RCP60	RCP85
2	1981	0.6	-1.1	3.6	-1.2
3	1982	2.9	1.9	4.9	0.8
4	1983	9.2	7.4	10.7	6.5
5	1984	6.2	6.4	6.7	6
6	1985	2.4	2.6	1.4	3.7
7	1986	5.2	4.8	4.6	5.4
8	1987	5	4	0.5	4.6
9	1988	4.9	3.9	3.1	2.9

Figure 8 Overview of the structure of the table displaying annual values of climate change indexes.

The table contains five columns: Year and the annual values for each of the four RCPs. The values in the table represent anomalies, which means they are deviations from the averages calculated for the reference period of 1986-2005.

- Regional Averages Ensemble means

Detailed description of the contents of an example data File:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	RCPs	RegName	Data_ 1	Data_ 2	Data_ 3	Data_ 4	Data_ 5	Data_ 6	Data_ 7	Data_ 8	Data_ 9	Data_ 10	Data_ 11	Data_ 12	Data_ 13
2	RCP2.6	ALGOMA	35.1	40.9	49.1	46.3	38.1	42.9	40.4	42.5	38.2	34.8	33.1	44.9	39.2
3	RCP2.6	BRANT	36.9	40.5	49.4	47.1	37.6	43.3	39.9	42.5	35.3	34.5	31.9	45	40.2
4	RCP2.6	BRUCE	35.8	39.5	51	46.8	37.5	43.7	39.5	43.3	35.9	33.6	31.3	44.8	38.8
5	RCP2.6	COCHRAN	36.3	41.7	51.5	47.9	41	44	40.3	41.9	37.3	35.5	34.6	43.1	40.2
6	RCP2.6	DUFFERIN	37.1	39.8	49.7	47	37.5	43.4	40.2	42.5	35.8	35.4	32	44.3	39.4
7	RCP2.6	DURHAM	37.3	39.6	50.3	47.8	38.6	43.4	40.9	43.4	36.8	35.2	32.7	45.3	40.5
8	RCP2.6	ELGIN	37.1	41.7	50	47.5	39.7	43.7	39.7	41.7	35.9	35.8	31	45.3	40.5
9	RCP2.6	ESSEX	36.1	41.5	48.6	46.9	38.3	40.8	38.5	41.8	35.8	36.1	29.9	44.9	40
10	RCP2.6	FRONTEN	38.2	39.7	49.2	46.3	38.1	43.5	41.5	42.6	37.4	35.5	32.8	45.4	41.1
11	RCP2.6	GREY	35.9	39.1	50.2	46.3	37.5	43.3	39.4	42.4	35.9	34.4	31.4	44.5	38.5
12	RCP2.6	HALDIMAI	36.9	40.3	49.7	47.5	38	42.5	39.4	41.8	35.2	34.1	31.7	45.4	40.5
13	RCP2.6	HALIBURT	37.2	40.4	48.6	46.3	39.4	43.7	41	43.2	37.4	35.9	32.8	45	41

Figure 9 Structure of the table showing average values for different regions

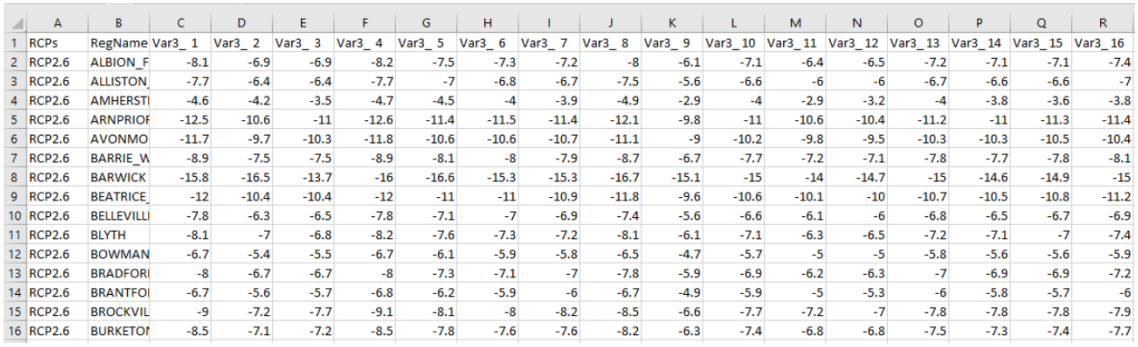
The example data file, named
"FD data" (frost days FD_50Regions_RCPs_EnsembleMean_Ann_head.csv), contains information about frost days. You can download regional index data from this file. The data in the file is organized as follows:

- RCPs: This column represents the four RCPs (Representative Concentration Pathways).
- RegName: This column lists the names of the 50 regions.
- Data_1, Data_2,...,Data_119: These columns contain the values for the years 1981 to 2099.

The file provides information about frost days for different regions and time periods, allowing for analysis and examination of the data.

- Municipal Ensemble means

  We offer information for every month across a span of 119 years, covering different climate scenarios. For instance, we provide data about temperatures in January.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	RCPs	RegName	Var3_ 1	Var3_ 2	Var3_ 3	Var3_ 4	Var3_ 5	Var3_ 6	Var3_ 7	Var3_ 8	Var3_ 9	Var3_ 10	Var3_ 11	Var3_ 12	Var3_ 13	Var3_ 14	Var3_ 15	Var3_ 16
2	RCP2.6	ALBION_F	-8.1	-6.9	-6.9	-8.2	-7.5	-7.3	-7.2	-8	-6.1	-7.1	-6.4	-6.5	-7.2	-7.1	-7.1	-7.4
3	RCP2.6	ALLISTON_	-7.7	-6.4	-6.4	-7.7	-7	-6.8	-6.7	-7.5	-5.6	-6.6	-6	-6	-6.7	-6.6	-6.6	-7
4	RCP2.6	AMHERSTI	-4.6	-4.2	-3.5	-4.7	-4.5	-4	-3.9	-4.9	-2.9	-4	-2.9	-3.2	-4	-3.8	-3.6	-3.8
5	RCP2.6	ARNPRIOF	-12.5	-10.6	-11	-12.6	-11.4	-11.5	-11.4	-12.1	-9.8	-11	-10.6	-10.4	-11.2	-11	-11.3	-11.4
6	RCP2.6	AVONMO	-11.7	-9.7	-10.3	-11.8	-10.6	-10.6	-10.7	-11.1	-9	-10.2	-9.8	-9.5	-10.3	-10.3	-10.5	-10.4
7	RCP2.6	BARRIE_W	-8.9	-7.5	-7.5	-8.9	-8.1	-8	-7.9	-8.7	-6.7	-7.7	-7.2	-7.1	-7.8	-7.7	-7.8	-8.1
8	RCP2.6	BARWICK	-15.8	-16.5	-13.7	-16	-16.6	-15.3	-15.3	-16.7	-15.1	-15	-14	-14.7	-15	-14.6	-14.9	-15
9	RCP2.6	BEATRICE_	-12	-10.4	-10.4	-12	-11	-11	-10.9	-11.8	-9.6	-10.6	-10.1	-10	-10.7	-10.5	-10.8	-11.2
10	RCP2.6	BELLEVILLI	-7.8	-6.3	-6.5	-7.8	-7.1	-7	-6.9	-7.4	-5.6	-6.6	-6.1	-6	-6.8	-6.5	-6.7	-6.9
11	RCP2.6	BLYTH	-8.1	-7	-6.8	-8.2	-7.6	-7.3	-7.2	-8.1	-6.1	-7.1	-6.3	-6.5	-7.2	-7.1	-7	-7.4
12	RCP2.6	BOWMAN	-6.7	-5.4	-5.5	-6.7	-6.1	-5.9	-5.8	-6.5	-4.7	-5.7	-5	-5	-5.8	-5.6	-5.6	-5.9
13	RCP2.6	BRADFORI	-8	-6.7	-6.7	-8	-7.3	-7.1	-7	-7.8	-5.9	-6.9	-6.2	-6.3	-7	-6.9	-6.9	-7.2
14	RCP2.6	BRANTFOI	-6.7	-5.6	-5.7	-6.8	-6.2	-5.9	-6	-6.7	-4.9	-5.9	-5	-5.3	-6	-5.8	-5.7	-6
15	RCP2.6	BROCKVIL	-9	-7.2	-7.7	-9.1	-8.1	-8	-8.2	-8.5	-6.6	-7.7	-7.2	-7	-7.8	-7.8	-7.8	-7.9
16	RCP2.6	BURKETOI	-8.5	-7.1	-7.2	-8.5	-7.8	-7.6	-7.6	-8.2	-6.3	-7.4	-6.8	-6.8	-7.5	-7.3	-7.4	-7.7

Figure 10 Structure of the table showing monthly average values across a span of 119 years (Var_1, ...Var_119)

- Municipal daily data

  We offer daily climate information for each of the 150 municipalities. However, due to copyright concerns, we only share data produced by LAMPS and acquired from CORDEX data. Our team at LAMPS has further processed the CORDEX data, obtained from their raw datasets, to minimize any discrepancies compared to the reference data (EAR-Interim data). Unfortunately, we are unable to provide daily data from PCIC, the University of Toronto, and the University of Regina.

- Gridded daily data and average data

  Ensemble members of daily weather data on approximately 10-kilometer grids within Ontario. All members are created by LAMPS at York University. Due to copyright constraints, we haven't included data from other institutes. The data has dimensions of 8964 grids, covering 365 days for 119 years (1981-2099). The data is stored in Matlab format, for example, *tas_LAMPS_NorESM1-M_RCP45_8964X365X119.mat*. To reduce file size, the data is saved as integers, so remember to divide them by 10.0 when using. Additionally, there are ensemble members of averages for various timeframes (Monthly, Spring, Summer, Autumn, Annual, and Winter) on approximately 10-kilometer grids within Ontario. For example, tas_LAMPS_NorESM1-M_RCP26_8964X17X119.mat. This naming convention is designed to make it understandable for non-experts.

- Gridded ensemble means

  Explanation of Ensemble Mean Data for Different Climate Scenarios:

The data comes in a format called Matlab (.mat), and it covers the period from 1981 to 2099. This information is gathered from 8964 different grid points. For variables like average temperature (Tm), maximum temperature (Tx), minimum temperature (Tn), and precipitation (Pr), we have values for each of these 8964 points across 17 categories: the 12 months, plus categories for spring, summer, autumn, annual averages, and winter.

For climate indices, there are 8964 data points for each of the 119 years.

To make it easier for users to understand and work with this data, we've created a GitHub site. On this site, you'll find ten Python programs that help users read, export, and visualize data. These programs are designed to simplify the process for those who may not be familiar with the technical details of the data format.

Download data files from our GitHub Site

Some little files (each less than 2 megabytes in size) are also there for you to grab on our GitHub page.