Help: General

Overview

What it is

The Salmon Climate Impacts Portal (SCIP) is an interactive web application that runs in your web browser. It displays and summarises streamflow and water temperature exposure indices, including maps and graphs.

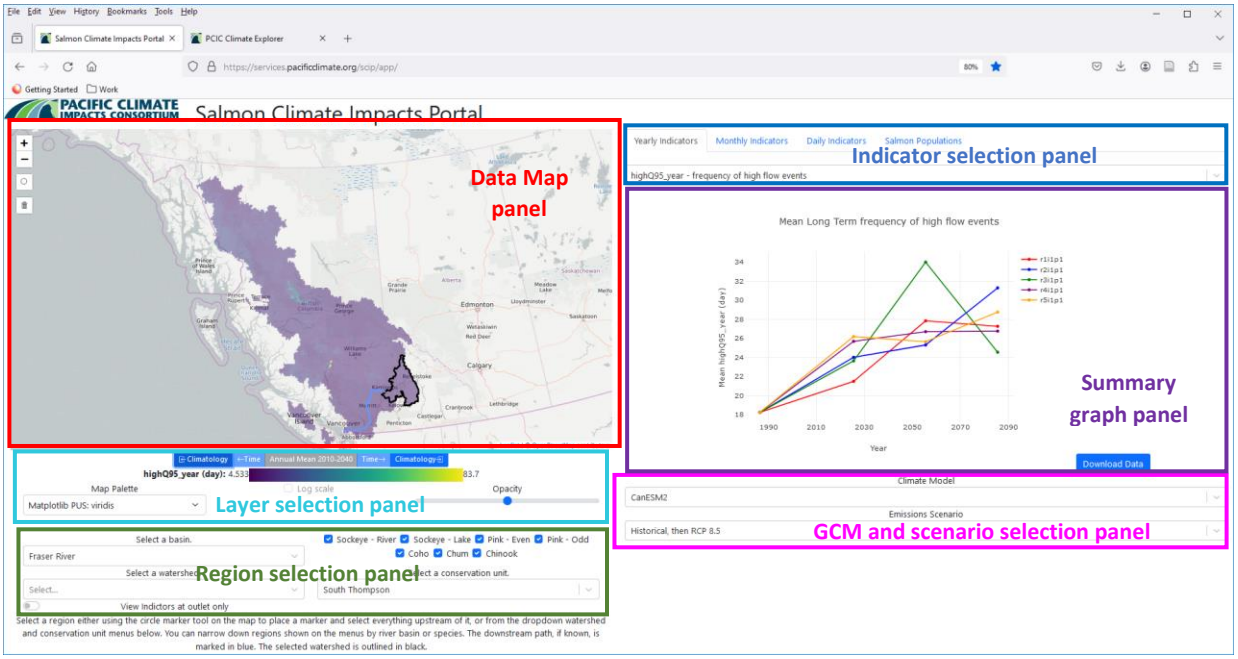
Purpose

The SCIP's purpose is to help you do the following:

- Discover the available exposure indicators
- Select datasets based on global climate model, greenhouse gas concentration scenario, climatological time period, and exposure indicator
- Visualize exposure indicators as gridded data within a map
- Visualize exposure indicators as summary plots for a selected region
- Download summary data shown in the summary graph as a CSV file

Application Elements

The following figure describes the various components of the SCIP user interface.



Data Available in SCIP

Streamflow and water temperature exposure indicators calculated from hydrologic model output. These indicators describe flow and temperature conditions that are potentially hazardous to salmon during various stages of the freshwater life cycle. The data are available as annual, monthly and daily climatologies for four 30-year periods 1971-2000, 2011-2040, 2041-2070 and 2071-2100. These indicators are selected using the **Indicator Selection Panel**.

Annual

The following annual indices are selected from the **Yearly Indicators** tab and provide a single value per period:

- *highQ95_year*: Mean frequency (days) of high flow events greater than the historical (i.e. 1971-2000) 95th-percentile flow. By definition this values is 18.26 during 1971-2000.
- *lowQ05_year*: Mean frequency (days) of low flow events less than the historical (i.e. 1971-2000) 5th-percentile flow. By definition this values is 18.26 during 1971-2000.
- *peakQmag_year*: Mean magnitude (m^3/s) of annual maximum peak flow.
- *peakQday_year*: Mean date (as day of year from 1 to 365) of occurrence of annual maximum peak flow.
- *POT19dur_year*: Mean spell length (days) of water temperature greater than 19 °C.
- *POT19freq_year*: Mean frequency (days) of water temperature greater than 19 °C.

Monthly

The following indices are selected from the **Monthly Indicators** tab and they provide twelve monthly values per period:

- *flow_month*: Monthly mean streamflow (m^3/s)
- *tw_month*: Monthly mean water temperature (°C)

Daily

The following indices are selected from the **Daily Indicators** tab and they provide 365 daily values (one per day) per period:

- *flow_day*: Mean daily streamflow (m^3/s)
- *tw_day*: Mean daily water temperature (°C)

Models (GCMs)

A GCM (General Circulation Model) is a numerical model representing physical processes in the atmosphere, ocean, cryosphere and land surface of the Earth. GCMs are the most advanced tools currently available for simulating the response of the global climate system to increasing greenhouse

gas concentrations. In SCIP, models are identified by short codes. The following tables give the full name and provenance of these models.

CMIP5

- ACCESS1-0: Australian Community Climate and Earth System Simulator coupled model
- CanESM2: Canadian Centre for Climate Modelling and Analysis ESM2 (Earth System Model ver. 2)
- CCSM4: U.S. National Center for Atmospheric Research CCSM4 4.0 model
- CNRM-CM5: France Centre National de Recherches Météorologiques (National Centre for Meteorological Research) CNRM-CM5 model
- HadGEM2-ES: U.K. Met Office HadGEM2 ES (Troposphere, Land Surface & Hydrology, Aerosols, Ocean & Sea-ice, Terrestrial Carbon Cycle, Ocean Biogeochemistry, Chemistry) model
- MPI-ESM-LR: Germany Max Planck Institute ESM-LR (Earth System Model - low resolution)
- PCIC-HYDRO: An ensemble mean of the six GCM runs ACCESS1-0_r1i1p1, CanESM2_r1i1pi, CCSM_r2i1p1, CNRM-CM5_r1i1p1, HadGEM2-ES_r1i1p1 and MPI-ESM-LR_r3i1p1. A single ensemble member is chosen from each model to avoid over-representing models with multiple realisations (see below for details regarding different model runs).

Model Run

Many of the GCMs indicated above have multiple closely related simulations available. These different simulations are distinguished by different initial states, initialisation methods, or physics details. These single-model ensembles facilitate quantifying the variability of simulation data concerning a single model. For example, climate model simulations are dependent on the initial state and the variability we know from weather is also existent in climate simulations. Much of the following explanation is taken from Taylor et al. (2012) CMIP5 Data Reference Syntax (DRS) and Controlled Vocabularies:

> In the CMIP5 project, ensemble members are named in the rip-nomenclature, *r* for realization, *i* for initialisation and *p* for physics, followed by an integer, e.g. r1i1p1. The “realization” number is used to distinguish among ensemble members generated by initializing a set of runs with different, but equally realistic, initial conditions. Models used for forecasting or decadal prediction might be initialized from observations using different methods or different observation datasets and these are distinguished using different “initialisation method” numbers. Closely related model versions can be referred to as a perturbed physics ensemble and distinguished by the “physics” number.

In practice, the "initialization" and "physics" ensemble members are very specialized and the model runs provided in the SCIP differ only in the realisation members. Such multiple realisations from a single model can be used to explore the effect of internal climate variability (ICV) on the variability of future indicator values. ICV refers to the natural variability of the climate system that occurs in the absence of evolving external forcing.

Datasets and data filtering

The SCIP has a huge base of data available—far too much to present usefully in any single view. A selection (filtering) process must come between data and presentation.

Datasets

A *dataset* is a collection of data for a specific model, emissions scenario, index, model run, climatology period, and time step. It comprises values of the variable for specific points in space and time, usually over a regular spatial grid and sequence of time points. Specifically, a dataset is a collection of geospatial (longitude-latitude) grids. Each geospatial grid holds the data for a particular time.

Dataset filtering

The first step of any effort to examine the available data is to select a smaller, more digestible subset of it to be examined. This selection goes by the name of *dataset filtering* or just *filtering*. The tools for dataset filtering are divided between the **Indicator Selection Panel** and the **GCM and Scenario Selection Panel** components of the interface.

The criteria by which datasets are filtered by the user are:

- **Indicators**: The output indicator you are interested in (for example: *peakQmag_year* or *tw_month*), grouped into Yearly, Monthly and Daily indicators.
- **Climate Model**: The GCM that originated the base data for the dataset.
- **Emissions Scenario:** Which scenario of climate-changing emissions (greenhouse gases, etc.) was used as an input to the model runs.

The result of data filtering is a collection of multiple *datasets*. This collection of datasets contains indicator values for multiple model runs (for GCMs with multiple runs), all four climatological periods and, for monthly and daily indicators, multiple time steps. Although these elements are not filterable by the user[1], greater discrimination is available in the summary graph and data map. In the **Summary Graph Panel** individual datasets within a filtered collection are plotted by model run, climatological time period, and for monthly and daily indicators, the time step (see the Summary graph features section for more details). In the **Data Map Panel** the collection of filtered datasets can be further refined by selecting the climatology period and time step to be mapped (see Data map features section for more details).

Data presentation

In the SCIP, indicator data are presented in two ways.

- **Data Map**: The data map is an interactive web map that presents the datasets selected from the filtered collection. It shows a spatial slice of the data for a specific point in time. A single index is represented as a raster (a grid of coloured blocks) overlaid on the base map. Colours encode the variable's value. The data map is the most complex data presentation tool, and has a small collection of generic web mapping features and data presentation features. See below for details of these features.
- **Summary Graph**: A data graph presents a non-spatial view of a dataset. This view is temporal, that is, it is a graph with time as the horizontal axis. This data graph presents a summary of a

[1] The daily indicators are an exception. In this case, the user is required to select the time period as well.

filtered collection of datasets for a selected region of interest either as a spatial average or, if preferred, by showing results for the outlet cell of the selected region. See below for details about summarising data.

Data summary

A region of interest (ROI) can be selected for the purposes of creating a data summary of a chosen exposure indicator.

Region Selection

A ROI can be chosen using either pre-defined areas based on watershed groups or salmon conservation units, or by manually selecting an outlet point on the map. The tools for regional selection using pre-defined areas (watershed and conservation unit) are located in the **Region Selection Panel**. The tool for custom selection is located in the **Data Map Panel**.

Watershed group

A ROI can be selected based on the watersheds defined by the BC Freshwater Atlas watershed group boundaries. In-land groups will contain a single polygon, coastal groups may contain multiple polygons (one for each island). Only watershed groups for which exposure indicator data is available are listed (currently 118). The list of watershed groups can be spatially filtered by first selecting a major basin from the options available (currently Fraser River, Mainland Coast, Skeena River, Stewart-Nass, Stikine River, Taku River, and Vancouver Island). IMPORTANT: In order to improve the responsiveness of the SCIP, polygon outlines have been simplified to some degree, resulting in some overlap between adjacent polygons. This means that when employing spatial filtering, watersheds/CUs both within and adjacent to the major basin will be identified in the filtered list.

Conservation Unit

Users have the option of defining there ROI based on salmon conservation units (CUs). According to Canada's Policy for Conservation of Wild Pacific Salmon "A Conservation Unit (CU) is a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable timeframe, such as a human lifetime or a specified number of salmon generations." Only CUs for which exposure indicator data is available are listed (currently 114 CUs). The choice of available CU's can be filtered by major basin (see above) and/or by salmon species (pink-odd, pink-even, chum, coho, chinook, sockeye-river, and sockeye-lake). IMPORTANT: In order to improve the responsiveness of the SCIP, polygon outlines have been simplified to some degree, resulting in some overlap between adjacent polygons. This means that when employing spatial filtering, watersheds/CUs both within and adjacent to the major basin will be identified in the filtered list.

Custom Region

The option is available to define a custom ROI. This is done by selecting an outlet point on the map (using the 'circlemaker' tool – see below for details). The drainage area upstream of the selected point is defined as the chosen ROI.

Map Rendering

When an ROI is selected, the associate polygon will be rendered on the map. Along with the polygon, the downstream path from the outlet of the region to tidewater will also be displayed as a blue line.

IMPORTANT: Not all watershed groups or conservation units have a clearly defined outlet point, in which case the downstream path will not be displayed.

Spatial Average or Outlet

Regardless of how the ROI is selected, users have the option of either retrieving a spatial average over the selected region or retrieving the data from the outlet point of the selected region (using the **View Indicators at outlet only** toggle). IMPORTANT: Not all watershed groups or conservation units have a clearly defined outlet point, in which case the option to view indicators at the outlet will not be available.

Data map features

Map Tools

On the left hand side of the **Data Map Panel** you will find a small selection of web map tools

Zoom In / Zoom Out

Change map scale:

1. Click the + (zoom in) or – (zoom out) buttons on the map toolbar
2. Alternatively, roll the mouse wheel forward (zoom in) or backward (zoom out) with the mouse cursor over the map.
3. Alternatively, on a touch screen, spread (zoom in) or pinch (zoom out) on the map.

Circlemaker

Add an outlet point to the map:

1. Click the **Draw a Circlemaker** button on the map toolbar
2. Click on the desired location in the map

Delete Circlemaker

Delete outlet point from map:

1. Click delete button on the map toolbar
2. Select ‘Clear All’ from the context menu
3. Alternatively, select circle on map and click.

Layer Tools

Layer Selection

Depending upon the indicator type (annual, monthly or daily), the **Climatology** and **Time** buttons in the **Layer Selection Panel** can be used to change the dataset layer viewed in the map. The **Climatology** buttons move through the four different climatology periods. For monthly and daily indicators, the **Time** buttons advance through the months (January through December) and days of the year (1 January through 31 December), respectively.

Map Palette

A *colour scale* is a mapping between values that points in the dataset can take on and the colour displayed on the map to represent that data point. Mappings from data value to colour essentially treat colour as one-dimensional real variable ranging from 0 (first colour) to 1 (last colour). For the purposes of discussion, we call this colour variable the "colour index."

In general, a colour scale maps data values lying between chosen minimum and maximum values, V_{min} and V_{max}, respectively. To convey the maximum amount of information to the human user, the minimum and maximum values should be close to the dataset's minimum and maximum values. Value ranges have been set manually as follows:

- *highQ95_year*: [0, 250]
- *lowQ05_year*: [0, 250]
- *peakQmag_year*: [0.0001, 10000]
- *peakQday_year*: [1, 365]
- *POT19dur_year*: [0, 100]
- *POT19freq_year*: [0, 200]
- *flow_month*: [0.0001, 8500]
- *tw_month*: [0, 30]
- *flow_day*: [0.0001, 10000]
- *tw_day*: [0, 35]

We offer two different types of colour scale, linear and logarithmic. These are distinguished by how data values are mapped onto the colour index:

- Linear: Maps the value of the data point linearly to colour index, with V_{min} mapping to colour index 0, and V_{max} mapping to colour index 1.
- Logarithmic: Maps the logarithm of the data point linearly to colour index, with $\log(V_{min})$ mapping to colour index 0, and $\log(V_{max})$ mapping to colour index 1

The linear scale is the default, but a logarithmic scale can be selected using the **Log scale** check box below the color bar in the **Layer Selection Panel**. The linear color scale is generally appropriate for the majority of indicators. However, the logarithmic color scale is often better suited to streamflow data, which can vary by several orders of magnitude across the spatial domain of the data. A number of different color palettes are available from the **Map Palette** dropdown box in the **Layer Selection Panel**.

Opacity

The opacity of the data layer can be adjusted depending upon user needs or taste. The opacity is adjusted using a slider tool below in the **Layer Selection Panel** – moving the button right increases opacity and moving the button left decreases opacity. High opacity (low transparency) will show the indicator data more clearly, but will tend to obscure details in the underlying base map. Low opacity (high transparency) will reveal more detail in the underlying base map, but won't show the indicator data as clearly.

Summary graph features

The graph, which is displayed in the **Summary Graph Panel**, summarises data by region of interest (ROI). Data can represent the spatial average over a region, or show data from the outlet of a given region. Summary statistics will automatically calculate and render as a graph when both a dataset is filtered and an ROI is selected.

Graph type

The graph format varies slightly depending upon the type of indicator selected.

Annual indicator graph

The indicator value is plotted as a function of climatological period (with year shown on the x-axis). Each curve represents an individual model run, for a total of *R* plots, where *R* is the number of model runs.

Monthly indicator graph

The indicator value is plotted as a function of month. Each curve represents an individual time period and model run, for a total of 4*R* plots, where *R* is the number of model runs and 4 is the number of climatological periods.

Daily indicator graph

The indicator value is plotted as a function of day-of-year. Each curve represents an individual model run, for a total of *R* plots, where *R* is the number of model runs.

Graph tools

Graph interaction

A number of tools are available for interacting with the summary graph. Hovering the mouse pointer over a data point will show the value (with units) for that point. When hovering over the graph with the mouse, a modebar will also appear that offers the following tool options:

- Download current plot as png graphic
- Zoom – zoom in to a custom region
- Pan – scroll the graph in any direction
- Zoom in – zoom in to centre of graph
- Zoom out – zoom out from centre of graph
- Reset axis – return plot to its original state

Download data

The user has the option of downloading the summary data for the current plot. This is done using the **Download Data** button in the **Summary Graph Panel**.

Exported data file formats

The underlying data in the summary graph can be downloaded (see above). Data is provided in the CSV format, which is a plain text with comma-separated values. This format conveys data as a table with rows and columns, as is typical for a spreadsheet program.

Content formats

The content and format of the exported data varies with the type of indicator.

Annual

Row Numbers	Content
1	Area description – name of watershed or conservation unit, or coordinates of selected outlet point
2	Name of climate model
3	Emissions scenario
4	Blank
5	Headings for data columns: First heading is Indicator description with units Next four headings give mid-date of each climatological period
6+(*R*-1)	Data points for run r*R*i1p1: First column gives model run in rip format Next four columns give the climatological value for each curve

Monthly

Row Numbers	Content
1	Area description – name of watershed or conservation unit, or coordinates of selected outlet point
2	Name of climate model
3	Emissions scenario
4	Blank
5	Headings for data columns: First heading is Indicator description with units Next twelve headings give the month number
6+4(*R*-1) – 9+4(*R*-1)	Data points for run r*R*i1p1: First column gives climatological period Next 12 columns give the monthly value for each curve

Daily

Row Numbers	Content
1	Area description – name of watershed or conservation unit, or coordinates of selected outlet point
2	Name of climate model
3	Emissions scenario
4	Climatology period
5	Blank
6	Headings for data columns:

	First heading is Indicator description with units Next 365 headings give the day number
7+(*R*-1)	Data points for run r*R*i1p1: First column gives climatological period Next 365 columns give the daily value for each curve

Salmon Populations

Another feature of the SCIP is that is will provide a list of all salmon conservation units that intersect with a chosen region of interest. This summary is available on the **Salmon Populations** tab in the **Indicator Selection Panel** component of the web application. This tab contains a summary table describing each conservation unit by Species, CU code and CU name. This feature allows users to spatially cross-reference all salmon CUs that are contained within or intersect a given region of interest. NOTE: Unlike region selection, this table lists all possible overlapping CUs, not just those for which indicator data is currently available.