Climate Systems

National Environmental Science Program

Navigating climate portals

September 2024

Key messages

Accessibility and interpretation of climate data can vary between sources: Numerous sources of climate change data in Australia vary in presentation, coverage, scale, and time periods. This guide helps users select the appropriate information for their needs.

There are no right or wrong data sources: Climate data sources represent reasonable future scenarios using different methods and assumptions. Each source has strengths suited to various applications, and even older models remain valuable for understanding climate scenarios.

In this guide, we provide an index to different places to find climate information and describe the features of each source. The focus here is on future climate projections, but some sources also offer historical climate data.

Our understanding of what the climate might be like in the future relies on a range of climate models. These models simulate climate based on mathematical equations to represent physical climate processes, including responses to changing concentrations of greenhouse gases in the atmosphere. There are many Global Climate Models (GCMs) developed and maintained by leading scientific institutions around the world. Australia has its own GCM called ACCESS (Australian Community Climate and Earth System Simulator).

Outputs from these models, depending on settings used to run the model, produce large datasets that provide ranges of change in climate variables. These outputs can be used to describe a plausible scenario of future climate. In its raw form, the data requires considerable processing or interpretation to produce sets of useable climate projections. These outputs are processed by experts into sets of usable climate projections feeding into the portals.

There are numerous publicly accessible places to find climate change data and information in Australia. In each of these places, users will find information presented in different ways with different values for seemingly the same variable and time-period, different coverages and scales, and a range of time-periods. For users, it can be very difficult to know where to source climate change information and whether one source is better than another. This guide has been developed to help you in selecting the right information for you. Note, that Western Australia and Norhern Territory currently don't have a climate portal of their own.

No source of information is right or wrong

No matter which data source you look at, the information is neither 'right' nor 'wrong'. Because we cannot 'predict' the future, each data source represents a reasonable scenario of the future climate produced using different methods and assumptions. Of course, some sources will be better suited to different applications than others. For example, for a first pass scan of climate risk, simple written summaries and limited data is likely to be sufficient, whereas a user looking to feed information into a hydrological model will look for detailed datasets.

Each new generation of climate models represents an increased understanding of climate processes. In general, new generation model outputs do not significantly change the projections scenarios but may be able to provide more detail or more climate variables. This means that data sources using early generation modelling efforts remain plausible future climate scenarios and could still be useful.

The types of information you need

Each climate portal is different and presents information tailored to different purposes. Some of the ways they're organised are listed below:

1. **By sector:** Some portals provide general climate information while others cater to a specific sector such as agriculture or electricity supply and give guidance on applying information or scales relevant to that sector.
2. **By region:** Climate information portals present modelled information at different spatial scales. These can often be explored by catchment area, Natural Resource Management region, local government area or statistical area.
3. **By level:** Each site suits different users with different levels of experience with climate information. This ranges from simple written summaries and visual representations, such as a map or simple graphs, through to detailed data sets that require a high level of technical expertise to use and interpret. We have categorised sites as suited to 'Novice', 'Intermediate' or 'Expert' users:
    a. Novice - Limited data analysis skills and/or climate science expertise required.
    b. Intermediate - Some data analysis skills and climate science knowledge required to make considered choices or to interpret information.
    c. Expert - Advanced data manipulation skills and climate science expertise required. Likely to be used by climate science professional, researcher, modeller or consultant.
4. **By format:** Information can be presented in a range of ways including data visualisations, reports, short summaries, graphs, tables, interactive tools, and/or raw data. For most people short summaries will be sufficient for what you need. For more technical applications, some portals allow users to choose a range of parameters such as climate models and different analysis of climate variables. Some sources make raw data available for the most experienced users.
5. **By climate variables:** Changes in temperature and rainfall are the most common climate variables. Information on variables such as humidity, evapotranspiration or extremes such as heatwaves and extreme rainfall can also be found. Some portals offer hazard-related indices such as for soil moisture, fire weather and drought.

What's behind the data?

Each source of information uses a specific 'recipe' of climate modelling settings. This is often a source of some confusion around which climate future is 'reliable'. Understanding these different settings helps understand why there are different scenarios, and which is suited to a specific purpose.

1. **Climate scenario/timeframe:** Future climate scenarios can be centred around different points in time. For example, a scenario for 2050. Alternatively, they can provide a picture of the climate that might be associated with an average global temperature increase (GWL – Global Warming Level) for example 1.5°C of global warming. The most appropriate timescale depends on the decision you are making. For example, the planning for a commercial building with a design life of 80 years might require consideration of projections for the year 2100.
2. **Emission pathway**: The future climate is dependent on the rate of greenhouse gas emission which will depend on future climate policy settings, technologies and economic growth among other things. To model the future climate under these different emissions pathways, climate scientists develop sets of different emissions scenarios. For example, a future in which we rapidly achieve net zero versus a world in which our greenhouse gas emissions change very little. There have been several sets of these emissions' pathway scenarios developed over the past few decades. The most recent set are referred to as the Shared Socio-economic Pathways or SSPs. The previous set were called Representative Concentration Pathways or 'RCPs'. Many sites are still based on the RCPs. These are still a robust set of scenarios for future emissions. See the hub's SSP explainer for more information.
3. **Underlying global climate models**: Future climate information is derived from global climate models. Some sites present information from the older third generation of the Coupled Model Intercomparison Project (CMIP3) models. Most have been developed using the more recent CMIP5 models. Few are yet to use the latest generation of CMIP6 modelling although these will be published in coming years.
4. **Baseline:** Future changes in the climate, whether it's temperature, rainfall or any other variable, are always relative to a baseline. The baseline used will influence the change values produced. For example, mean temperature change in 2050 will be higher if compared to an earlier baseline period, such as 1850-1900 (pre-industrial), to which GWLs refer to, than when compared to a more recent baseline period, like 1985-2014 (CMIP6 baseline). There are reasons for choosing a baseline depending on the user's application. Different portals might use different baselines which is one reason that the same variable for the same emissions pathway, region and time horizon can vary when drawn from different sources. Some portals, especially those providing the raw data, use absolute values with no baseline. To know more about global warming levels, see pull-out box.
5. **Frequency:** Climate data can be aggregated across different time periods to address individual months, seasons, years, and multi-year periods. Annual data provides mean change or absolute values across the entire year. Seasonal data is either aggregated over calendar seasons or wet/cool and hot/dry season. Such aggregations combine data from multiple years – often in 20-year blocks. This reduces the influence of natural year-to-year variations. Some portals also offer mean climate data for each month and raw data down to daily and hourly resolution.

What Are Global Warming Levels?

Global warming levels refer to the increase in Earth's average surface (land and oceans) temperature relative to pre-industrial climate conditions (1850-1900), which generally mean the period before the mid-19th century when human activities started to have a significant impact on the climate. The key levels are 1.5, 2, and 3°C. Understanding these levels helps us grasp the urgency of reducing greenhouse gas emissions to mitigate the most severe impacts of global warming on our planet. These global warming levels are increasingly used in policymaking, in line with agreements and reports by the Intergovernmental Panel on Climate Change (IPCC). They serve as critical benchmarks for setting and evaluating climate policies and targets.

Coverage	Information source	Sector	Region	Usability (level of expertise required)	What do you get?	Climate indices/ variables	Climate Scenario/ Timeframe	Emission pathway	Baseline/ reference period	Frequency
NATIONAL	Climate Change in Australia NRM Datasets CMIP5	Environment, NRM, infrastructure, services, general, corporate	NRM regions, point location, and selected regions within Victoria	Expert	Climate model output (5km grid in NetCDF files)	Rainfall, temperature, extremes, rel. humidity, fire, evaporation	2030, 2050, 2070, 2090	RCPs 2.6, 4.5, 6.0, 8.5	1986-2005	Annual, seasonal, month
	Climate Change in Australia – Regional Climate Change Explorer CMIP5	General	NRM super-clusters, clusters and sub-clusters	Novice - Intermediate	Brief summaries	Temperature (extremes), rainfall (extremes), drought, coastal, fire, evapotranspiration, solar radiation, humidity	2030, 2090	RCPs 4.5, 8.5	1986-2005	N/A
	Climate Change in Australia - Analogues Explorer CMIP5	General, corporate, services	Point location (cities, towns)	Intermediate	Matches future climate at a location with a location where the current climate is like projected climate	Temperature, rainfall	2030, 2050, 2090	RCPs 2.6, 4.5, 8.5	1986-2005	Annual, seasonal
	Climate Change in Australia – Thresholds Calculator CMIP5	Environment, agriculture, infrastructure, services, general, corporate	Point location (cities, towns)	Expert	Projected changes in days above or below selected thresholds	Temperature (max/min), rainfall	2030, 2050, 2070, 2090	RCPs 4.5, 8.5	1981-2010	Annual, (wet/dry) seasonal, month
	Climate Change in Australia – Extremes Data Explorer CMIP5	Environment, infrastructure, services, corporate	NRM clusters and sub-clusters	Intermediate	Seasonal box plots	Coldest night, hottest day, wettest/1-in-20-year wettest day	2030, 2050, 2090	RCPs 2.6, 4.5, 8.5	1986-2005	Seasonal

Key

- CMIP3 — Using CMIP3 global climate models
- CMIP3 CMIP5 — Using CMIP3 and CMIP5 global climate models
- CMIP5 — Using CMIP5 global climate models
- CMIP5 CMIP6 — Using CMIP5 global climate models, with CMIP6 underway
- CMIP5 CMIP6 — Using CMIP5 and CMIP6 global climate models
- CMIP6 — Using CMIP6 global climate models

Coverage	Information source	Sector	Region	Usability (level of expertise required)	What do you get?	Climate indices/ variables	Climate Scenario/ Timeframe	Emission pathway	Baseline/ reference period	Frequency
NATIONAL	Australian Water Outlook CMIP5	Environment, agriculture, infrastructure	Projections: National, NRM Historical/ seasonal forecast: National, state, river region	Expert	Maps, tables (csv), charts (png, svg, csv), raw data download (NetCDF)	Rainfall, evapotranspiration, soil moisture, extremes	Historical, seasonal forecasts, 2030, 2050, 2070, 2085	RCPs 4.5, 8.5	1976-2005	Annual, (wet/dry) seasonal
	Australian Climate Service Portal CMIP5	Services, infrastructure	National, state, local government	Intermediate	Climate model output (5-10km), maps	Rainfall (extremes), temperature (extremes), fire, TC, drought	GWL 1.2, 1.5, 2, 3˚ C	RCPs 4.5, 8.5; SSP3-7.0	1850-1900	Annual, seasonal
	My Climate View CMIP5	Agriculture, environment	Point location	Novice - intermediate	Snapshot table (pdf) and charts (csv, png) for any location, choice of commodity	Rainfall, temperature, evapotranspiration, soil moisture, extremes	Historical (1964-2023), seasonal forecasts, 2030, 2050, 2070	RCPs 4.5, 8.5	1954-2023	Annual, seasonal, month
	Queensland Future Climate – CMIP6 high-resolution data CMIP6	Environment, agriculture, services, infrastructure, general	National, grid (20km)	Expert	Direct downloads for 15 model outputs (NetCDF)	Temperature, rainfall, wind, evapotranspiration, fire, drought	2030, 2050, 2070, 2090	SSP1-2.6, 2-4.5, 3-7.0	N/A	Month, day, hour
	NSW Climate Data Portal CMIP3 CMIP5 CMIP6	Environment, agriculture, infrastructure, services, general	Australasia, grid (20km, 50km) Southeast Aus, grid (4km, 10km)	Experienced to expert	Download member ensemble outputs (NetCDF, GeoTIFF, CSV)	Temperature, rainfall, evapotranspiration, humidity, pressure, wind, cloud coverage, radiation; climate extremes and natural hazards indices	Historical (1951-2015) Simulated (2016-2100) Reanalysis (1979-2020)	SRES A2 RCP4.5, 8.5 SSP1-2.6, SSP3-7.0	N/A	Daily, monthly, seasonal
	CoastAdapt CMIP5	Land, coastal, sea level rise, general	National, local government, coast/shoreline	Novice	Infographics, case studies, charts, maps	Coastal, temperature, rainfall	2030, 2050, 2070, 2090	RCPs 2.6, 4.5, 6.0, 8.5	1981-2010	Annual
	Coastal Risk Australia CMIP5 CMIP6	Services, infrastructure, environment	National	Expert	Map with inundation overlay	Coastal	current day, 2100 and 2150 (and manual)	RCP 8.5 and SSP5-8.5	current satellite view	Annual
	Canute3 CMIP5 CMIP6	Coastal planning, environment, infrastructure	National coast/ shoreline, point location	Expert	Maps, charts and tables (csv)	Coastal (tides, waves, SLR)	2010-2100	RCPs 2.6, 4.5, 8.5; SSP1-2.6, 2-4.5, 5-8.5	1986-2005, 1995-2014	Annual

Coverage	Information Source	Sector	Region	Usability (level of expertise)	What do you get?	Climate indices/ variables	Climate scenario/ timeframe	Emission pathway	Baseline/ reference period	Frequency
QUEENSLAND	Queensland Future Climate Dashboard **CMIP5**	Environment, agriculture, services, general	State, local government, regions	Intermediate	User defined regions and analysis Data tables in graphs (csv), summary report download (pdf)	Temperature, rainfall, evapotranspiration, wind, drought, heatwaves, fire, tropical cyclones	2030, 2050, 2070, 2090	RCPs 4.5, 8.5	1986-2005	Annual, (wet/dry) season
	Queensland Regional Climate Explorer **CMIP5**	Environment, agriculture, services, general	State, local government, regions	Novice-intermediate	Summary tables and time series charts (pdf, png, xlsx, csv, json)	Temperature (extremes), rainfall (extremes), evapotranspiration, wind, drought, heatwaves, fire	1986-2005 (baseline), 2030, 2050, 2070, 2090	RCPs 4.5, 8.5	1986-2005	Annual, (wet/dry) season
	Queensland High-resolution Projections Data **CMIP5**	Environment, agriculture, services, infrastructure, general	State, grid (10km)	Expert	Direct downloads for 11 climate model outputs (NetCDF)	Temperature, rainfall, wind, evapotranspiration, drought	2030, 2050, 2070, 2090	RCPs 4.5, 8.5	N/A	Season, month, day
VICTORIA	Victoria's Future Climate Tool **CMIP5**	Environment, agriculture, services, infrastructure, general	State, local government/SA, point location, regions	Intermediate-Expert	Climate model output (5km grid in .tiff, ASCII, Shapefile, GeoJSON) User defined regions and analysis Data tables in graphs (csv), summary report download (pdf)	Temperature (extremes), rainfall (extremes), drought heatwave, coast	2030, 2050, 2070 and 2090	RCP 4.5, 8.5	1986-2005	Annual, (warm/cold) seasons, month
	Victorian Future Climate Projections 2019 **CMIP5**	Environment, agriculture, services, infrastructure	State, regions, point location	Expert	Climate model output (5km grid as NetCDF for raw and application-ready data) Regional summaries in xlsx spreadsheets	Temperature (extremes), rainfall, humidity, evapotranspiration, wind, solar radiation	2030, 2050, 2070 and 2090	RCP 4.5, 8.5	N/A	Annual, season, month

Coverage	Information Source	Sector	Region	Usability (level of expertise)	What do you get?	Climate indices/ variables	Climate scenario/ timeframe	Emission pathway	Baseline/ reference period	Frequency
NEW SOUTH WALES	AdaptNSW CMIP6	Local Government, state government, environment, infrastructure, general	State, regions, grid (4km)	Novice-intermediate	Maps, charts, summaries, downloadable data packages	Change in temperature (min, mean, max), rainfall, fire weather, hot days, cold nights	Historical (1990-2009) 2020-2039, 2030-2049, 2040-2059, 2050-2069, 2060-2079, 2070-2089, 2080-2099	SSP1-2.6 SSP3-7.0	1990-2009	Annual, seasonal
	NSW Climate Data Portal (released in late 2024) CMIP3 CMIP5 CMIP6	Environment, agriculture, infrastructure, consultants, services, general	Southeast Australia (4km, 10km), and CORDEX Australasia (50km) grid	Experienced to Expert	Download member ensemble outputs (NetCDF, GeoTIFF, CSV)	Temperature, rainfall, evapotranspiration, humidity, pressure, wind, cloud coverage, radiation; climate extremes and natural hazards indices	Historical (1951-2015) Simulated (2016-2100) Reanalysis (1979-2020)	SRES A2 RCP4.5, 8.5 SSP1-2.6, SSP3-7.0	N/A	Daily, monthly, seasonal
SOUTH AUSTRALIA	SA Climate Projections Viewer CMIP5	Environment, services, corporate, general	State, regions, grid	Intermediate	Maps, summary tables	Temperature, rainfall	Historical/ base line (1986-2005), 2020-2039, 2040-2059, 2060-2079 and 2080-2099	RCP4.5 and 8.5	1986-2005	Annual, seasons
	SA Government Data Directory CMIP5	Environment, services, corporate, general	State, regions (landscape, local health networks), grid (10, 50km)	Expert	Climate data layers of different file types to download (shp, csv, kmz, tif); fact sheets, guides, information (pdf)	multiple temperature, rainfall and extreme temperatures variables	Historical/ baseline (1985-2005), 2020-2039, 2040-2059, 2060-2079 and 2080-2099	RCP 4.5 and RCP 8.5	1985-2005	Annual, seasons

Coverage	Information Source	Sector	Region	Usability (level of expertise)	What do you get?	Climate indices/ variables	Climate scenario/ timeframe	Emission pathway	Baseline/ reference period	Frequency
TASMANIA	ListMap CMIP3	Environment, infrastructure, Services	State, grid	Expert	Online map viewer, customisable with land-based information	Temperature, rainfall, ET/ rel. humidity, coastal	2025, 2055, 2085	SRES A2 and B1	1961-2010	Annual
INTERNATIONAL	IPCC Interactive Atlas CMIP5 CMIP6	Corporate, Environment, general	Worldwide, AR6 WGI reference regions, major basins, point location	Intermediate - expert	Online map viewer, time series	Temperature and rainfall (extremes), wind, evapotranspiration, rel. humidity, coastal	historical, 2030, 2050, 2090 GWL 1.5,2,3,4	RCP2.6, 8.5; SSPs1-2.6,2-4.5, 3-7.0, 5-8.5	1850-1900, 1961-1990, 1981-2010, 1986-2005, 1995-2014	Annual, seasons, custom
	Copernicus Climate Change Atlas CMIP5 CMIP6	Corporate, Environment, general	Worldwide, European Countries/ regions, AR6 WGI reference regions, user defined	Intermediate - expert	Online map viewer, time series, climate stripes	Temperature and rainfall (extremes), wind, evapotranspiration, rel. humidity, coastal, radiation	Historical, 2030, 2050, 2090 GWL 1.5,2,3,4	RCP2.6, 4.5, 8.5; SSPs1-2.6,2-4.5, 3-7.0, 5-8.5	1850-1900, 1961-1990, 1981-2010, 1986-2005, 1995-2014, 1991-2020,	Annual, month, season

For more information:
www.nesp2climate.com.au | info@nesp2climate.com.au

Guides in this series include:

- Everything you need to know about the latest in climate modelling
- Finding and selecting the right climate change information for your needs
- Understanding data inputs for a climate risk assessment
- Navigating climate information

The Climate Systems Hub is funded by the Australian Government under the National Environmental Science Program, with co-investment from the following partners:

Australian Government Bureau of Meteorology | CSIRO | Australian National University | MONASH University | THE UNIVERSITY OF MELBOURNE | UNSW SYDNEY | UNIVERSITY of TASMANIA