Technical information for the South Australian Climate Projections Viewer

The South Australian Climate Projections Viewer displays maps and tables of projected changes to weather variables across South Australia, for a range of future time periods and emission scenarios, in both a regional and grid view. By clicking on the map to select an individual grid cell or region, the value of the selected climate variable in that cell/region is displayed in a pop-up text box. The table displayed below the map is updated with the average projected changes for all time periods and all climate variables for the scenario selected.

Data sources and analysis

The climate projections data tables and maps were developed using data products of the New South Wales and Australian Regional Climate Modelling (NARCliM) project, a partnership between the state governments of New South Wales, South Australia and Western Australia, the Australian Capital Territory and the University of New South Wales.

The NARCliM1.5 climate projection downscaling project provides climate simulations for 1951–2100 on daily and monthly time steps, from six global/regional model combinations and two emissions scenarios (RCP4.5 and RCP8.5). NARCliM1.5 data is at grid resolutions of (approximately) 10 km and 50 km – NARCliM modelling was conducted on fixed latitude and longitude grid points of 0.5° (~50 km) and 0.1° (~10 km) distance. Due to the bulge of the Earth the exact distance between grid points varies slightly by latitude. The part of South Australia to the west of a north-south line passing approximately through Ceduna has simulations of only 50 km resolution. To the east of this line, both 10 km and 50 km resolutions are available and the higher-resolution (10 km) projections are displayed in the maps.

Data for South Australia from the full 50 km and 10 km NARCliM1.5 continental-scale datasets were extracted and compiled in grid form (netcdf format data files).

Emissions scenarios

Climate change projections presented in the maps are based on greenhouse gas scenarios termed Representative Concentration Pathways (RCPs). The two RCPs represented in these maps are the medium emissions scenario RCP4.5 and the very high emissions scenario RCP8.5.

RCP4.5 is a medium emissions scenario, representing a future in which CO_2 concentrations increase steadily until after mid-century, with atmospheric CO_2 concentrations largely stabilizing around 2060, reaching 540 ppm by 2100. The level of greenhouse gases in the atmosphere under this scenario results in global heating of around 2.7°C above the pre-industrial baseline.

RCP8.5 is the highest future emissions scenario, representing a future with little to no controls on emissions through coming decades, resulting in CO_2 concentrations continuing to rapidly rise, reaching 940 ppm by 2100. Climate models indicate this scenario, results in global mean temperatures between 3.2°C and 5.4°C above the pre-industrial baseline.

NARCliM 1.5 GCM and RCM selection process

Downscaled climate projections are produced within boundary conditions supplied by global climate models (GCMs). Global climate modelling efforts in research and scientific institutions around the world have been co-ordinated through a sequence of Climate Model Inter-comparison Projects (CMIPs). A large number of GCMs are available from each CMIP modelling round, although the skill of each GCM in representing Australian climate is quite variable. Because of this, and limitations on available computing resources, a subset of GCMs is selected as the basis for downscaled projection projects.

The GCM evaluation process for NARCliM1.5 is detailed in the NARCliM1.5 Technical Methods Report. From this process, the ACCESS1-0, ACCESS1-5 and CanESM2 GCMs were selected as the basis for NARCliM1.5. The NARCliM1.5 GCMs show good skill overall for their representation of overall Australian and southern Australian climate (Moise *et al.* 2015). ACCESS1.0 scored the highest overall skill score for all CMIP5 GCMs in its representation of Australian climate.

For NARCliM1.5 downscaling, two variations of the Weather Research and Forecasting (WRF) mesoscale weather model were used (Evans *et al.* 2012).

The combination of the three selected GCMs – ACCESS1.0, ACCESS1.3, and CanESM2 – with the two differing chosen regional climate models (RCMs) – WRF versions j and k – results in six different GCM/RCM combinations of downscaled projection model datasets available in NARCliM1.5.

NARCliM data bias correction

The climate system of the Earth is complex, with many interacting elements across a range of timescales. Because of this complexity, model representations are not perfect representations of the climate system, with all model outputs having some degree of bias on comparison to historical observations. In general, the NARCliM1.5 projections tend to be biased toward colder and wetter than observed historical climate, with this varying depending on the GCM/RCM combination and location.

Bias-correction methods are commonly applied to climate model outputs. This aims to minimise model bias by adjusting the model outputs through comparison of model representations of the historical period to observed climate.

The NARCliM1.5 datasets include both raw and bias-corrected datasets for rainfall and temperature. The bias correction applied was a quantile-quantile approach (detailed in Evans and Argueso, 2014), compared against Bureau of Meteorology Australian Gridded Climate Data (AGCD) historical datasets compiled from daily observations. Both bias-corrected and non-bias corrected datasets were extracted and compiled from NARCliM1.5 for South Australia.

For practitioners conducting more detailed projection work, further bias correction of some parameters may be required if the commonly used delta change approach is not sufficient.

Data processing and temporal averaging

A suite of derived parameters was calculated for every grid point in the 10 km and 50 km bias-corrected rainfall and temperature datasets. For each weather variable, the value for each year and for each period in the year was calculated. Averages were calculated for various times of the year - annual, seasonal and southern Australian wet season (Apr to Oct) and southern Australian dry season (Nov to Mar).

These values were then averaged across the climatological base period of 1986 to 2005, and each of four twenty-year future periods centred on the years 2030, 2050, 2070 and 2090. These do not represent the exact years by which each parameter is projected to change, but are marker years for the 20 year period spanning that year.

From the bias corrected rainfall and maximum and minimum temperature projections, projected actual values were derived for of the 20 year time periods. For trend values, the change in values at each future time period was subtracted from the values for the 1986 to 2005 base period.

Note, the values at each grid-point represent an average across a spatial area the size of each model cell, so will vary from values observed in the area of the grid cell.

As well as average climatological variables, extreme values appropriate for Australia were chosen from the guidelines of the Expert Team on Climate Change Detection and Indices (ETCCDI) for temperature (WMO 2009). The seasonality of the values reflects the time of year of occurrence. Yearly values of total numbers of days above 35°C or 40°C reflect the total for the year across each Australian summer season between July to June in successive years, rather than January to December in a single year. Numbers of frost days or cold nights are taken across January to December.

Regional averaging

Spatial averages were calculated for all derived parameters for Landscape South Australia (LSA) regions, and for South Australian Local Health Network regions (LHN). In the creation of the region average values, geotiff (.tiff format) versions derived from each derived parameter netcdf file, were masked using the relevant shapefile for the region. This mask uses all land-based grid points falling within the bounds of the region. Latitudinally weighted averages across all region grid points were calculated for each model combination for each parameter.

Formatting data for the viewer

The resulting processed and averaged datasets were converted into a cell-based format for use as data layers for the SA Climate Projections Viewer. In this process, a regular cell was created for each point centered on each grid point in the NARCliM dataset, with the values for each grid point populating the appropriate cell.

The bias-correction processes using AGCD gridded datasets as the reference, results in the bias-corrected dataset having gaps in some values in coastal regions compared to the projected change dataset. This results in variability in the availability of data between the actual and change values in some coastal cells.

Ocean or water-body based grid point values from the modelling are not representative of land areas. Therefore, cell values where the grid point was centered over major water bodies were removed. Also, differences between the calculation process of extremes versus climatological average values, resulted in some inconsistencies between these values in coastal cells. To ensure consistency, linear interpolation was applied from inland cells for some coastal cells.