# Climate Analogues for NRM in Victoria: How might your town/region look in the future?

This document is provided as background to the associated analogues posters. The posters aim to help provide a visual snapshot of what the future climate of localities in Victoria may be like under a plausible, future climate scenario. Information presented in the posters was developed using the CSIRO's Climate Change in Australia Analogue Explorer Tool.

These analogues are based on the average future annual rainfall and average maximum temperature changes projected for towns/localities around various time periods, based on the maximum consensus of climate models (CMIP5) and a high greenhouse (GHG) emissions scenario, Representative Concentration Pathway, (RCP) 8.5.

## What is an analogue?

In the context of climate change, an analogue is essentially a period of time or a locality that is similar, (analogous), to another. Analogues used here help provide information about the likely impacts to, and response of, natural systems to climatic conditions which fall outside the average range currently experienced at a particular location. There are two types of analogues:

- temporal analogues make use of historical climate data for a region to help identify events or periods of time where a locality experienced climate similar to what we expect to see in the future
- spatial analogues are regions which have a climate similar to that which is projected in the study region in the future. The information presented in the posters draws on spatial analogues.

Comparison of either temporal or spatial analogues can help provide insight into what the future may hold for the study region and assist with adaptation planning. Analogues can help planners to explore possible future scenarios such as:

- if global GHG emissions continue to track at the high (RPS 8.5) scenario, what will the climatic conditions in a study location be like in the year 2030, 2050 or 2090? How does this compare to a lower emissions scenario?
- what types of farming and what farming systems and technologies do farmers undertake in analogue localities that are similar or different to our locality?
- what plant species and communities thrive in analogue localities; which species thrive in both localities; how might this influence our species/provenance choices for revegetation works?

## How analogues have been identified in these posters

The analogues presented in the associated posters have been broadly developed using the Climate Change in Australia Analogues Explorer Tool. This tool matches the proposed future climate of a region with the current climate experienced in another region using annual average rainfall and

maximum temperature (within set tolerances). The tool was developed by CSIRO using the most current set of climate projections for Australia. The projected rainfall and temperature information presented in these analogue posters has been further refined using data provided by the CSIRO Climate Variability, Extreme Weather & Adaptation Group.

The Analogue Explorer Tool (AET) provides a broad indication of what a range of Australian towns and regions might look like in the future; based primarily on matching maximum annual average temperature to within +/- 1 degree Celsius and annual average rainfall (within +/-5%). CSIRO acknowledge that the tool has its limitations, stating;

*'It is important to note that other potentially important aspects of local climate are not matched when using this approach, such as frost days or and other local climate influences. Furthermore, for agriculture applications, solar radiation and soils are not considered. Thus we advise against the analogues being used directly in adaptation planning without considering more detailed information',* Climate Change in Australia.

Hence, in determining the more likely analogue town matches, we have further refined the search for analogues for Victoria by considering and attempting to align with regions/towns with similar:

- rainfall seasonality (per cent of annual rainfall that falls in each of the four seasons)
- temperature seasonality (difference in summer and winter temperature), and
- where possible similar geomorphological landscapes and soil types.

RCP 8.5 is one of four emissions scenarios used in the IPCC Fifth Assessment Report (2013). RCP 8.5 is the scenario that leads to the most warming by 2090. RCP 8.5 was chosen because global GHG emissions are currently tracking at, or above, the levels represented in this emissions scenario.

The Maximum Consensus of models scenario was initially chosen to select the most likely analogue towns. This is a scenario defined using the Climate Futures approach. NOTE: These analogues have been further refined to align with projected seasonal changes based on models which were selected by John Clarke, CSIRO Climate Science Centre, as the most representative models for the region (being either Murray Basin or Southern Slopes). For localities within the Murray Basin Region, this assumes a slight rainfall increase to 2030, later declining across the Murray Basin Region and an average temperature increase of 4.83$C^0$ by 2090, based on data from the Climate Futures Tool.

Other analogue towns under the RCP 8.5 scenario and two other RCP's can be explored using the Analogue Explorer Tool (AET)*. To gain insight into other potential analogue towns for southern Victoria under more optimistic GHG mitigation scenarios, try running the AET using a lower RCP. For example, to examine analogue towns under a scenario which assumes we can achieve the more ambitious target of limiting warming to between 1.1° - 2.6°C degrees by 2100, run the AET using the RCP 4.5 emissions scenario. The RCP 4.5 emissions scenario is considered as an achievable, intermediate mitigation scenario if the world promptly initiates action on climate change where GHG emissions peak earlier (around 2040) and the $CO_2$ concentration reaches 540 ppm by 2100.

*NOTE: variables such as seasonal differences in temperature and rainfall, frost days & other local climate influences, radiation & soil types have not been included in defining appropriate analogues using the AET.

This approach has been validated through discussions with John Clarke, CSIRO Climate Science Centre. For the Murray basin localities, this assumes a slight rainfall increase to 2030, later declining across the Murray Basin Region and an average temperature increase of 4.83$C^0$ by 2090, based on data from the Climate Futures Tool.

## Examples of analogue tools and how they are being used

Climate analogues have been developed for a range of purposes by various researchers and research organisations around the world. Some examples include:

- As mentioned above, the Analogues Explorer Tool was developed by CSIRO in 2015 and is available on the CSIRO Climate Change in Australia website. This tool matches the proposed future climate of a region with the current climate experienced in another region using the most current set of climate projections for Australia.
- CSIRO regional projection cluster reports include examples of how the Analogues Explorer Tool can be used to compare various towns across Australia. Other examples of analogues for south eastern Australia are presented in the Southern Slopes Cluster Report for Victoria, southern New South Wales and Tasmania.
- The Central Slopes NRM Cluster used climate projections data to help identify possible climate analogue years for a selection of key locations within their region. The explanatory report and associated maps can be found at the Terra Nova website.
- Other useful analogues for the SSC can be found at AdaptNRM; a national initiative that aims to support NRM groups in updating their NRM plans to include climate adaptation planning. The focus is on adaptation planning, biodiversity and weeds. The site includes a projected distribution of cool temperate rainforests of the Otway Ranges has been described in the AdaptNRM website and associated report Helping Biodiversity Adapt.
- A South Australian Research and Development Institute (SARDI) study which investigated the extent to which the model APSIM could simulate temporal and spatial analogues for a run of seasons that was 10% drier, or for a region that has a 10% drier climate as a proxy for a 10% future drier climate in regions of South Australia, (Hayman, et al 2010).
- A NCCARF study using analogues to explore how analogue communities organise their infrastructure, built form and services, for three cities across Australia. (Kellett, J, Ness, D, Hamilton, C, Pullen, S & Leditschke, A (2011), Learning from regional climate analogues, National Climate Change Adaptation Research Facility, Gold Coast).
- CCAFS (Climate Change Agriculture and Food Security) analogue tool used in 2012 to track locations whose climate was similar to the climate projected for 2030 in Yamba, Tanzania.
- A study using analogues to explore projected climate change and the relative global impacts on the key wine growing regions of the world. Webb, L.B., Watterson, I., Bhend, J., Whetton, P.H. and Barlow, E.W.R. (2013), Global climate analogues for winegrowing regions in future periods; projections of temperature and precipitation. Australian Journal of Grape and Wine Research, 19: 331–341. doi: 10.1111/ajgw.12045.