Local climate profile

Northern Midlands Municipality

Past and current climate:

- The Northern Midlands experiences a relatively temperate, maritime climate. However, as the midlands are inland, the municipality experiences wider temperature variations than coastal locations, including cold overnight temperatures and frosts.
- The municipality receives some of the lowest average annual rainfalls of any area in Tasmania (generally <600 mm), with no significant seasonal cycle. For example, Ross receives 500 mm, with 25-50 mm each month of the year. There is slightly higher average annual rainfall in the west where the midlands borders the Great Western Tier and also in the east around Lake Leake. Rainfall in the northern midlands can come from the regular westerly frontal rain systems that cross Tasmania, or from episodic systems from the north and east .
- Year-to-year rainfall variability in this municipality show a correlation with the El Niño Southern Oscillation in winter and spring (where El Niño winters are generally drier than average, La Niña winters are generally wetter than average), and also some effect from the Indian Ocean Dipole, especially in spring. There is also some correlation with atmospheric blocking in summer (blocking affects the incidence of easterly systems).
- Long-term average temperatures have risen in the decades since the 1950s, at a rate similar to the rest of Tasmania (up to 0.1 °C per decade). Daily minimum temperatures have risen slightly more than daily maximum temperatures.
- There has been a decline in average rainfall and a lack of very wet years in the municipality since the mid 1970s, and this decline has been strongest in autumn. This decline was exacerbated by the 'big dry' drought of 1995-2009. The recent two years have seen conditions close to average, or slightly above average.

Future scenarios - from the Climate Futures for Tasmania project

Fine-scale model projections of Tasmanian climate were made for two hypothetical but plausible scenarios of human emissions for the 21st Century (taken from the special report on emissions scenarios (SRES) from the Intergovernmental Panel on Climate Change (IPCC)). The scenarios are of ongoing high emissions, A2, and one where emissions plateau and fall, B1. The climate response under the two scenarios is similar through the first half of the century, but the changes under the higher emissions scenario become much stronger than the lower scenario in the later half of the 21st Century.

Produced by Michael Grose, Antarctic Climate and Ecosystems Cooperative Research Centre,
using material from the technical reports of the Climate Futures for Tasmania project

1. Temperature

- Under the higher emissions scenario (A2), the municipality is projected to experience a rise in average temperatures of 2.6 to 3.3 °C over the entire 21st Century. The rise in daily minimum temperature is expected to be slightly greater than daily maximum temperature, and fairly similar in the different seasons. Under the lower emissions scenario (B1), the projected change over the entire century is 1.3 to 2.0 °C. A time series of projected mean Tasmanian temperature is shown in Figure 1.
- The projected change in average temperatures is similar to the rest of Tasmania, but less than the global average and significantly less than northern Australia and many regions around the world, especially the large northern hemisphere continents and the Arctic.

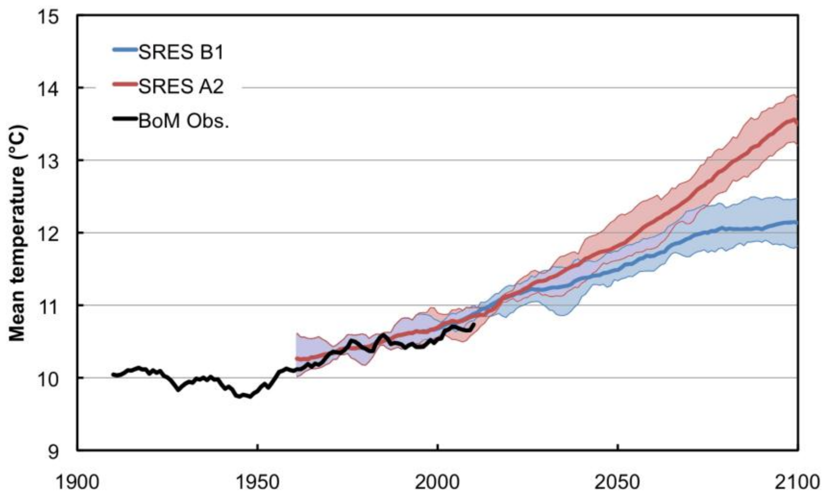

Figure 1. Tasmanian average temperature in observations (black) and model projections for the A2 scenario (red) and the B1 scenario (blue), all series are smoothed (11-year running average), shading shows the range of model projections. Changes under the higher scenario by the very end of the century are discussed in the examples below.

- The projected change in average temperature is accompanied by a change in the frequency, intensity and duration of hot and cold extremes of temperature. For the A2 scenario by the end of the century in the Northern Midlands:
    - The number of Summer Days (>25 °C) increases from around 25 days per year to more than 50 days per year.
    - The temperature of very hot days increases more than the change in average temperature (by more almost 4 °C in some seasons).
    - There are currently 80-100 frost risk days per year in the coolest locations in the municipality, this number is projected to decrease by more than half.
    - Warm spells (days in a row where temperatures are in the top 5% of baseline levels) currently last 5-7 days, and will last 6-10 days longer. Heat waves (>3 days over 28 °C) are projected to occur regularly, at least once a year.

2. Rainfall, runoff and rivers

- The projected pattern of change to rainfall and runoff is similar in nature between the two scenarios, but stronger by the end of the century under the A2 scenario. The general long-term influence of climate warming by the end of the century is for a slight increase in annual average rainfall in the Northern Midlands municipality in the long term.

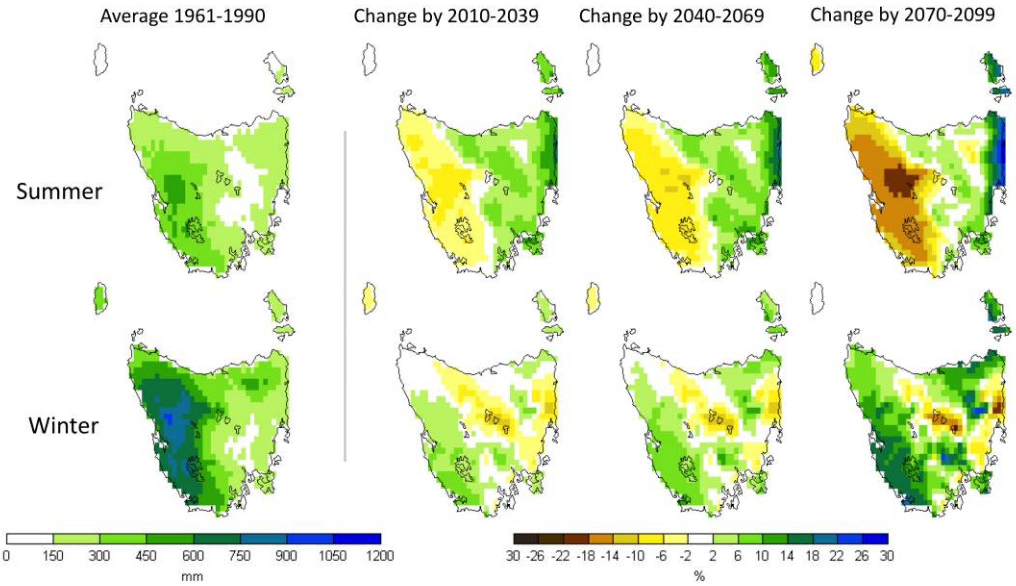

Figure 2. Average rainfall in summer and winter – the left hand side plots show the average rainfall in the baseline period (1961-1990), the plots to the right show the proportional change (%) from that amount in various periods in the 21st century in the average of six climate model projections under the A2 (higher) emissions scenario.

- Annual average rainfall is projected to increase slightly, by 0 to 10% under the A2 scenario by the end of the century, the tendency is smaller for the B1 scenario.
- Rainfall is projected to increase slightly in all seasons compared to the baseline, but with some patches that go against this general trend (see Fig 2 for summer and winter).
- The long-term effect of greenhouse warming is on top of the usual cycles of rainfall, including droughts, termed 'natural variability'. The model projections indicate that the recent dry conditions of the 'big dry' drought is not a new ongoing climate average state. These projections indicate that in the long term, drought frequency and severity may actually reduce slightly due to the increase in average rainfall.
- The projected increase in rainfall is driven by changes to the average circulation of the region and rain-bearing weather systems.
- A major influence of greenhouse warming on rainfall is the tendency for heavier rainfalls interspersed by longer dry periods, and for greater extremes. For eastern Tasmania under the A2 scenario by the end of the century there is projected to be:
  - Up to 9 fewer rain days per year on average, but significantly more rain per rain day.
  - Up to 4 more very wet days each year (where rainfall exceeds the baseline 95th percentile), including 2-3 more days of >10 mm rainfall each year.

    - An increase in the maximum instantaneous rainfall rate of over 30% in some seasons, up to 25% more rainfall on the wettest day of the year, and up to 20% more rainfall in the wettest 5-day run of wet days.
    - An increase in rainfall brought by rare extreme events: a 200-year average recurrence interval (ARI) event increases by over 30 mm (a >50% increase). More common ARI events (ARI-10, ARI-50) increase by a similar proportion.
- Pan evaporation is projected to increase, by up to 19% under the A2 scenario by the end of the century, driven by the increases in temperature but also changes to relative humidity, wind speeds, cloudiness and radiation.
- Changes to rainfall and evaporation lead to changes in water runoff and river flows. This in turn has impacts on the inflows into dams and water storages. Under the A2 scenario by the end of the century:
    - Average runoff is projected to increase in all seasons.
    - Proportional (%) increases in runoff are larger than the change to rainfall, with increases of over 30% possible in some seasons (especially autumn).
    - High daily runoff amounts are projected to increase, including those that may lead to erosion or flooding, daily runoff amounts during low flows are projected to stay much the same.
    - Flows in the main rivers in the region are projected to increase by the end of the century, including the South Esk River at Llewellyn (central estimate 12%, strongest increase in autumn), and the Macquarie River (17%).
    - Inflows to the Lake Leak are also projected to increase (central estimate is 23%), and reliability to meet current demand is projected to remain consistently above 90%.

3. Agricultural impacts

- Frosts are projected to decrease significantly with a warming climate. At Campbell Town, frosts this is for a reduction from 95 days per year down to 38 days per year, however damaging spring frosts may still occur rarely. This will have effects on a wide range of agricultural sectors.
- Chilling affects the growth and flowering of berries, fruits and nuts. Accumulated chill hours are projected to decrease significantly in a warming climate, except in high-altitude sites where chilling will in fact increase (areas that are currently too cold). There is a projected increase in GDD (a measure of the heat to grow and ripen crops) of up to 100% or more by the end of the century.
- There is a projected to be a slight decrease in the time in severe drought at Cressy by the end of the century, measured as the proportion of time when the standardized precipitation index (SPI) is less than minus two. The current proportion of time in drought is about 2.2%, this is projected to stay about the same in the middle of the century, then decrease to about 1.6% near the end of the century.

Appendix – details of climate projections

Greenhouse gas emissions have an influence on the Earth's climate system, along with other human activities such as the emission of ozone-depleting substances, emission of aerosol (particles) and changing the land cover (e.g. deforestation). Sophisticated model simulations can be used to project the likely effect of these influences into the future given our current state of knowledge. It is impossible to predict exactly what future human emissions will be, so models are run under a set of plausible hypothetical emissions scenarios. A model simulation shows the likely effect if we follow that scenario, so it is not a single 'prediction' of the future. The simulation can't include the effect of things that are impossible to predict (such as major volcanic eruptions).

The Climate Futures for Tasmania project produced a set of climate projections at the regional scale for Tasmania. Two emissions scenarios were considered – one of ongoing high emissions (SRES A2), and one where emissions plateau and fall (SRES B1). The climate response under the two scenarios is similar through the first half of the century, but the changes under the higher emissions scenario become much stronger than the lower scenario in the latter half of the 21st Century.

Climate warming causes many complex changes to the earth's climate system. These changes include alterations to ocean currents, average atmospheric circulation and ocean-atmosphere cycles such as the El Niño Southern Oscillation. Projected effects that are relevant to Tasmania include a continued extension of the East Australia Current bringing warmer waters off the east and northeast coast of Tasmania, a pole-ward shift of the subtropical ridge of high pressure and shifts in the mid-latitude westerlies (the 'Roaring 40s'), and a change in remote climate drivers such as atmospheric blocking, the El Niño Southern Oscillation and the Southern Annular Mode. The position of Tasmania adjacent to the Southern Ocean means that the effect of climate warming is not as severe as other more continental regions.

The results presented in this report were made using established methods, including:

- Extreme value distribution fitting in a generalized Pareto distribution to calculate the average recurrence intervals (ARIs).
- Hydrology runoff models developed and calibrated for the Tasmanian Sustainable Yields project to estimate the runoff, river flows and inflows to storages.
- Standard agricultural indices such as the Utah model to calculate chill hours and standard equations and a 10 °C threshold to calculate Growing Degree Days.

All information is drawn from the Climate Futures for Tasmania Technical reports please see these reports for more details, and to cite in other written work.

Reference list

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