Local climate profile
Southern Midlands Municipality

Past and current climate:

- The Southern Midlands experiences a relatively temperate, maritime climate, however the inland area can have cold overnight temperatures and frosts.
- The municipality is in the rain shadow of the central highlands and so receives low rainfall compared to other regions of Tasmania, at around 550 mm of rainfall a year with no strong seasonal cycle (around 40-50 mm each month). Rainfall comes from a variety of weather systems, including some frontal rain from the west and episodic systems from the north and northeast.
- Year-to-year rainfall variability in this municipality shows some correlation with the El Niño Southern Oscillation in winter and spring (where El Niño years are generally drier than average, La Niña years are generally wetter than average).
- 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 period since the end of the drought has seen conditions close to 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.

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 change over the entire century is projected to be 1.3 to 2.0 °C. A time series of projected mean Tasmanian mean temperature is shown in Fig 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.

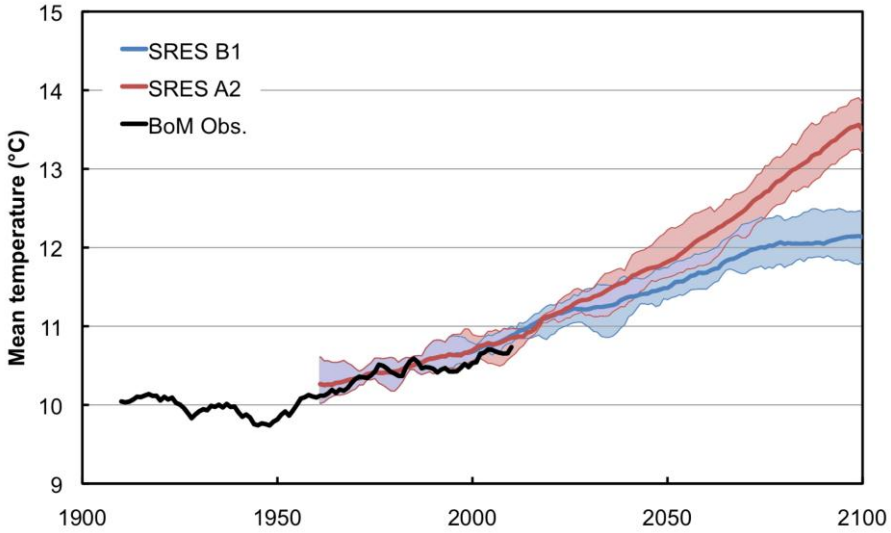

Figure 1. Tasmanian average temperature in observations (black) and model projections for the A2 scenario (red) and the B1 scenario (blue), all series are smoothed (11-year running average), shading shows the range of model projections. Changes under the higher scenario by the very end of the century 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 Southern Midlands under the A2 scenario by the end of the century the projections indicate:
    - The number of Summer Days (>25 °C) increases from around 15-25 days per year to around 50 per year.
    - The temperature of very hot days changes more than the change in average temperature (by more than 3 °C in some seasons).
    - The number of frost-risk days in the coolest locations in the municipality decreases from up to 50 days per year to less than 25.
    - An increase in the average length of warm spells (days in a row where temperatures are in the top 5% of baseline levels) from around five days to around 10 days. Heat waves (>3 days over 28 °C) are projected to occur almost every 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 Southern Midlands municipality.

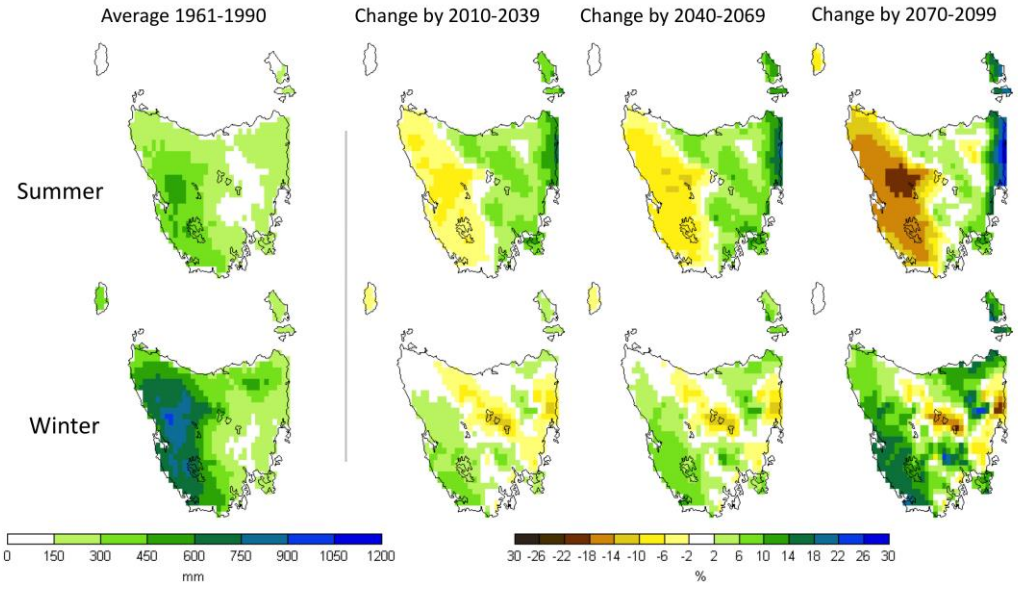

Figure 2. Average rainfall in summer and winter – the left hand side plots show the average rainfall in the baseline period (1961-1990), the plots to the right show the proportional change (%) from that amount in various periods in the 21st century in the average of six climate model projections under 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.
- Rainfall is projected to increase slightly in all seasons, 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 in the Southern Midlands may actually decrease due to the higher 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 5 fewer days per year on average, but more rainfall per rain day.
    - Around 3 more very wet days each year (where rainfall exceeds the baseline 95th percentile).

  - An average of 20% more rainfall on the wettest day of the year, and a similar increase in the maximum 5-day rainfall total.
  - An increase in the rainfall brought by rare extreme events: a 200-year average recurrence interval (ARI) event increases by up to 25 mm (25% 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 changes 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 Coal River (central estimate is around 30%), and the Little Swanport River (15%).
  - Inflows to the Craigbourne Dam are also projected to increase (central estimate is over 20%), and reliability to meet current demand is projected to continue.

3. Agricultural impacts

- Chilling affects the growth and flowering of berries, fruits and nuts. Accumulated chill hours decrease given the warming under the two future climate scenarios. Under the A2 scenario, accumulated chill hours at Campania reduce from around 2500 hours annually, to around 1700 hours by the end of the century.
- The yields from extensive grazing systems are affected by the prevailing temperature, rainfall, evaporation and radiation conditions, as well as the concentration of carbon dioxide in the air. Simulations of extensive grazing systems using phalaris or subclover pasture at Tunbridge under the high emissions scenario show that yields are projected to increase until mid-century due to warmer temperatures, then plateau. The increase in yields occurs mainly in spring and a small increase in autumn, with a decrease in summer yields. Changes to feed quality are also likely, with a decrease in protein content due to elevated carbon dioxide concentrations. These changes would affect farming practices such as the choice of species and cultivar and timing of operations by the second half of the century.
- Simulations of wheat cropping at Tunbridge assuming the Tennant cultivar is grown, fertilizer is applied using current practice and no new technology is developed suggest that yields could be expected to decrease slightly from now until the end of the century (by less than 10%). This is at least partly due to an increase in nitrogen stress, placing a larger demand for fertilizer. Given adequate irrigation and nutrient management, there is a potential for a 10-15% increase in yields. There is also a shorter time to maturity meaning less growth prior to flowering.

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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