Local climate profile

Latrobe Municipality

Past and current climate:

- The Latrobe municipality experiences a mainly temperate, maritime climate and relatively small seasonal variations (an average daily maximum temperature of around 22 °C in February, 13 °C in July).
- The average annual rainfall across the municipality is around 800-1000 mm per year with a strong seasonal cycle (e.g. East Sassafras receives 900 mm, minimum of 40 mm in February and a maximum of 114 mm in August).
- Rainfall in the Latrobe municipality can come from the regular westerly frontal rain systems that cross Tasmania, however an important fraction of the rainfall comes from episodic systems from the north and east, including cutoff lows.
- Year-to-year rainfall variability in this area shows a correlation with the El Niño Southern Oscillation in winter and autumn (where El Niño winters are generally drier than average, La Niña winters are generally wetter than average), and some correlation with the Indian Ocean Dipole in winter and spring.
- Average temperatures have risen in the decades since the 1950s, at a rate similar to the rest of Tasmania (up to 0.15 °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 Latrobe 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 above average rainfalls.

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 Latrobe 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.

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

- 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.

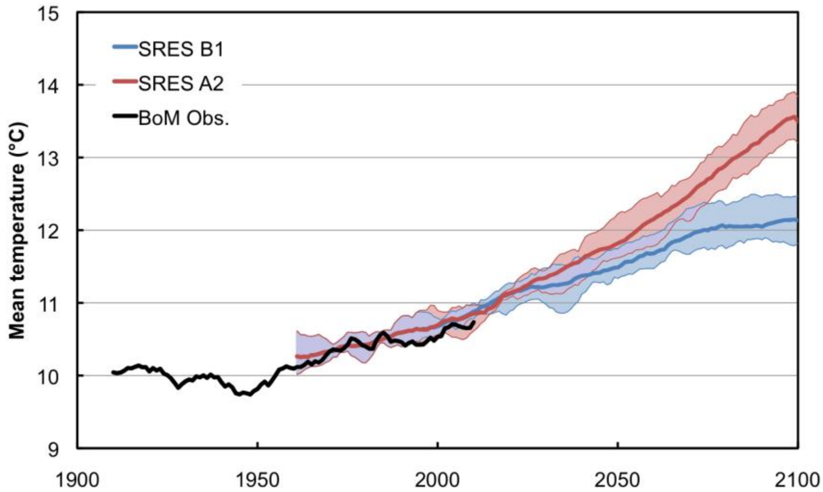

Figure 1. Tasmanian average temperature in observations (black) and model projections for the A2 scenario (red) and the B1 scenario (blue), all series are smoothed (11-year running average), shading shows the range of model projections. Changes under the higher scenario by the very end of the century 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 Port Sorell under the A2 (higher) scenario by the end of the century the projections indicate:
  - The number of Summer Days (>25 °C) increases from around 10 days per year to more than 30 days per year, with nighttime temperatures over 20 °C occurring regularly.
  - The temperature of very hot days increases more than the change in average temperature (by 3 to 4 °C in some locations in some seasons).
  - A reduction in frost-risk days from around 6 per year, to approximately 1 per year.
  - Warm spells (days in a row where temperatures are in the top 5% of baseline levels) currently last around 6 days, are projected to last 19 days longer.

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 Latrobe municipality.

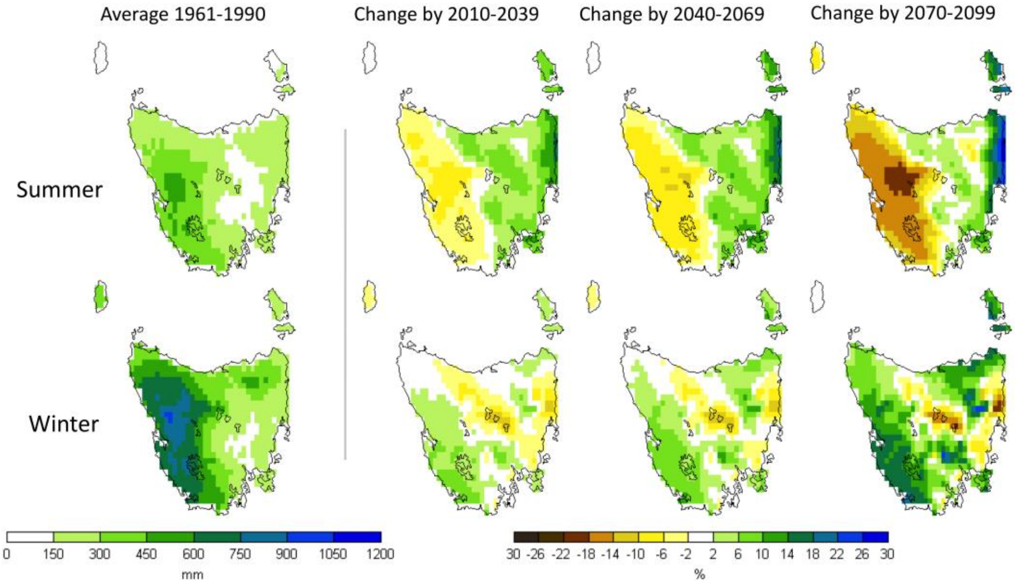

Figure 2. Average rainfall in summer and winter – the left hand side plots show the average rainfall in the baseline period (1961-1990), the plots to the right show the proportional change (%) from that amount in various periods in the 21st century in the average of six climate model projections under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

- The model mean projection is that annual average rainfall is projected to increase under the A2 scenario by the end of the century (model mean is for 0 to 5%). Most models agree with this change. The tendency is for little change under the B1 scenario.
- The model mean shows that rainfall is projected to slightly increase in winter, spring and summer, with little change in autumn (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 area 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 the incidence of the main rain-bearing weather systems from the east and north, including a change in atmospheric blocking and cutoff lows.

- A major influence of greenhouse warming on rainfall is the tendency for heavier rainfalls interspersed by longer dry periods, and for greater extremes. For Latrobe under the A2 (higher) scenario by the end of the century there is projected to be:
  - Around 7 fewer rain days with >1 mm per year on average, but significantly more rain per rain day (>10% increase).
  - Up to 4 more very wet days each year (where rainfall exceeds the baseline 95th percentile), including 2 more days of >20 mm rainfall each year.
  - An increase in the maximum instantaneous rainfall rate of over 30% in some seasons, around 20% more rainfall on the wettest day of the year.
  - An increase in rainfall brought by rare extreme events: a 200-year average recurrence interval (ARI) event for daily rainfall is projected to increase by more than 35 mm (an increase of more than 35%). Other ARI events (ARI-10, ARI-50) are projected to 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 slightly in all seasons.
  - Proportional (%) increases in average runoff are larger than the change to rainfall, with increases of over 10% possible in some seasons.
  - 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.
  - There is a range of projected trends in river flows in this region between the different models, but the central estimate is for little change to average flows by the end of the century in the major river, the Mersey (central estimate is around -1%), but with some increase in the Rubicon River (+12%), with changes to the seasonality of flows and the incidence of high flows.
  - Inflows into Cascade Reservoir are projected to stay much the same, or increase slightly towards the end of the century.

3. Agricultural impacts

- Frosts are projected to decrease significantly with a warming climate. At the coast, frosts are projected to become very infrequent, and at Sassafras, frost-risk days are projected to fall from around 35 days per year, to less than 10 days per year by thee end of the century under the higher emissions scenario. Damaging Spring frost may still occur.
- 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). Chill hours in the Spreyton area in the season May-September are projected to fall from around 2200 hours in the baseline period to around 1200 by the end of the century under the higher emissions scenario.

- There is a projected increase in Growing Degree Days (a measure of the heat to grow and ripen crops). This may reduce the time to harvest of many crops, or affect other aspects of crop choice and management.
- Because of the increase in rainfall and heavy rains, there is projected to be a slight decrease in the time in severe drought in the region by the end of the century, measured as the proportion of time when the standardized precipitation index (SPI) is less than minus two. For example, at Merseylea this proportion is projected to fall from 2.3% to 1.8% by the end of the century under the higher emissions scenario.
- Projections show that the growth of grass for dairying will be strongly affected under the higher emissions scenario. Simulations of growing conditions at Merseylea indicate that the annual cut yield of dryland ryegrass could increase by up to 50% and then plateau, with the majority of the increase in spring growth. The increase is caused mainly by a reduction in temperature limitation and then the plateau is due to water limitation. Projected yields of irrigated ryegrass show a moderate increase to the middle of the century, then a decline due to an increase in days over the upper threshold for growth (28 °C). Switching to other cultivars (such as Kikuyu) may give higher yields, and increasing carbon dioxide concentrations can lead to greater water use efficiency.

4. Extreme sea level events

High water events causing coastal inundation comes from a combination of sea level, tide, storm surge and wind waves. Sea level has been rising at a rate of 3.3 ±0.4 mm/year in the recent period, and is expected to continue rising with further climate warming. The last IPCC assessment report gave a central estimate of a rise of 0.82 m global average sea level by 2100 under a high emissions scenario. The sea level rise varies in different locations, and for the coast of Tasmania the sea level rise for this scenario is close to the global average.

On the north coast of Tasmania, the very high tide heights contribute more to coastal inundation events than the relatively modest very storm surge heights – the current 100-year storm tide event is around 1.9 to 2.0 m above average sea level. Changes to storm surges by the end of the century will not be as large as sea level rise. Accounting for all effects, the current 100-year event in George Town will be exceeded every 10 to 30 years by 2030, and more frequently than once every 4 years in 2090 under the high emissions scenario. Similar changes can be expected for the coastal regions in the Latrobe municipality (e.g. Port Sorell).

5. River floods – Mersey River

Changes to design flood hydrographs were calculated for the 1:10, 1:50, 1:100 and 1:200 annual exceedance probability events for future periods using the climate model outputs and flood hydraulic models by partners at Entura consulting. Short duration events are projected to become more intense, so catchments with a critical duration of less than 72 hours will experience high flood levels and faster response times.

The Mersey River has a critical duration of less than 72 hours, so the peak flood discharge is projected to increase significantly through the 21st Century. For Latrobe, increased flooding events can be expected through both increased sea level, changes to storm surge and through increased river floods. Please see the full Entura report and accompanying maps for more details.

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.

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