Local climate profile

Break O’Day Municipality

Past and current climate:

- The coastal areas of the Break O’Day municipality experience mild temperatures and relatively small seasonal variations (Scamander has an average daily maximum temperature of 22 °C in January, 13.8 °C in July). The municipality also covers the area inland west of Mathinna, which experiences a wider temperature variations than coastal locations, including cold overnight temperatures and frosts.
- The region receives some of the hottest temperature extremes in Tasmania, the state record temperature occurred in Scamander in January 2009 (42.2 °C).
- The coastal and lowland areas of the Break O’Day municipality receive low average annual rainfalls with no significant seasonal cycle. For example, Fingal receives 607 mm per year (41 mm in February and 65 mm in June). There is slightly higher average annual rainfall inland and at higher altitudes, with generally more than 1000 mm per year falling at St Marys and at Goulds Country.
- Rainfall in the Break O’Day municipality can come from the regular westerly frontal rain systems that cross Tasmania, however a large proportion of the rainfall comes from episodic systems from the north and east, including cutoff lows. These systems produce the greatest rainfall extremes anywhere in Tasmania. The top three daily rainfalls in Tasmania all occurred in the region: 352 mm at Cullenswood in 1974, 336 mm in Mathinna in 1929 and 327.2 mm in Gray in March 2011.
- Year-to-year rainfall variability in this area shows 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). There is also a correlation with atmospheric blocking in spring, summer and autumn (blocking affects the incidence of easterly systems and cutoff lows). The temperature and rainfall of the region is influenced by the warm waters brought south by the East Australia Current.
- 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 Break O’Day 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, partly due to the contribution from extreme rainfall events.

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 Break O'Day 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.

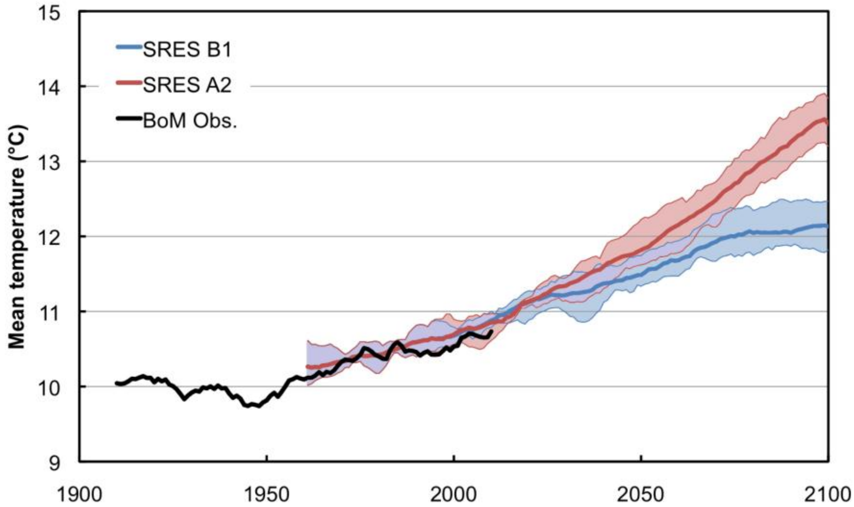

Figure 1. Tasmanian average temperature in observations (black) and model projections for the A2 scenario (red) and the B1 scenario (blue), all series are smoothed (11-year running average), shading shows the range of model projections. Changes under the higher scenario by the very end of the century 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 St Helens under the A2 (higher) scenario by the end of the century the projections indicate:
    - The number of Summer Days (>25 °C) increases from around 13 days per year to more than 25 days per year.
    - The temperature of very hot days increases more than the change in average temperature (by 3-4 °C in some locations in some seasons).
    - A reduction in the number of frost-risk days, from around 7 per year to around 1 per year.
    - Warm spells (days in a row where temperatures are in the top 5% of baseline levels) currently last around 5 days, are projected to last 6-10 days longer.
- An increase in sea temperature at the coast due to the ongoing strengthening of the East Australia Current is likely to have large impacts to marine and coastal systems.

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 an increase in annual average rainfall in the Break O'Day municipality, mainly through increased heavy rainfalls in summer and autumn.

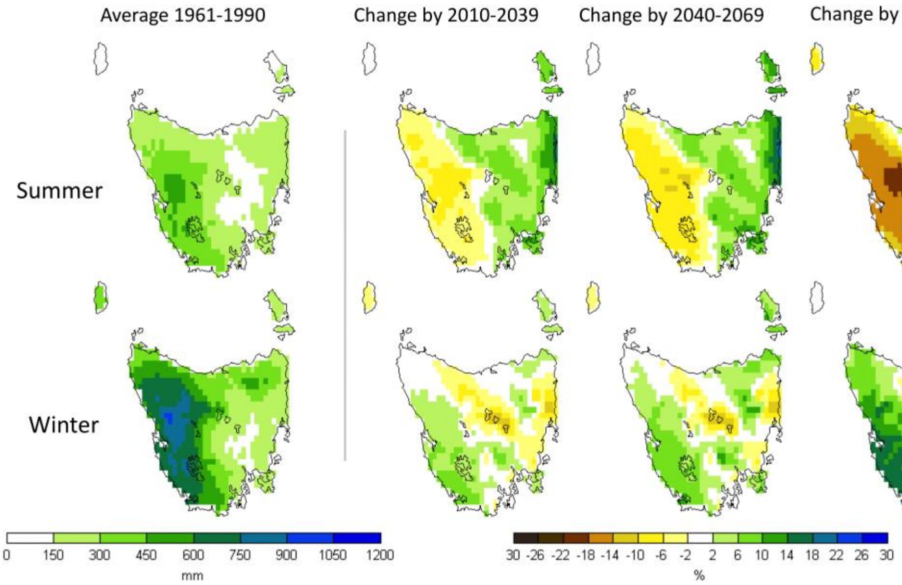

Figure 2. Average rainfall in summer and winter – the left hand side plots show the average rainfall in the baseline period (1961-1990), the plots to the right show the proportional change (%) from that amount in various periods in the 21st century in the average of six climate model projections under 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 +10 to 20%). There is a range of projected by the different models, but the majority agree with this sign of change. The tendency is smaller for the B1 scenario.
- The model mean shows that rainfall is projected to increase in summer and autumn compared to the baseline, but show little change or a slight decrease in winter and spring (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 will actually reduce slightly due to the increase in average rainfall.
- The projected increase in rainfall is driven by increases in sea temperatures, moisture fluxes and convection offshore as the East Australia Current strengthens. There are also projected 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 Break O'Day under the A2 (higher) scenario by the end of the century there is projected to be:
    - Up to 5 fewer rain days per year on average, but significantly more rain per rain day.
    - Between 1 and 5 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, more than 15% 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 increases by over 65 mm (a >45% increase). The 200-year ARI for 48-hour rainfall is projected to increase by more than 130 mm (>65% 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 summer and autumn, but stay much the same or decrease slightly in winter and spring.
    - Proportional (%) increases in average runoff are larger than the change to rainfall, with increases of over 60% 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.
    - There is a range of projected trends in river flows in this region between the different models, but the central estimate is for an increase in flows by the end of the century, including the South Esk (central estimate is around +12%), the Scamander River (+18%), Ansons River (+21%), and the George River (+6%), with changes to the seasonality of flows and the incidence of high flows.

3. Agricultural impacts

- Frosts are projected to decrease significantly with a warming climate.
- 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 Growing Degree Days (a measure of the heat to grow and ripen crops) of up to 100% or more by the end of the century.
- Because of the increase in rainfall and heavy rains, there is projected to be a 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.

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 are expected to continue rising with further climate warming. The upper range of model projections indicates a rise of up to 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 east coast of Tasmania the sea level rise for this scenario is close to the global average.

On the northeast coast of Tasmania, the very high coastal surges contribute more to coastal inundation events than the very high tide height – the current 100-year storm tide event in the Bicheno area is around 1.0 m above average sea level. Projected changes to storm surges by the end of the century are smaller than sea level rise. Accounting for all effects, the current 100-year event in Spring Bay will be 1.56 m by 2100 under the higher emissions scenario. This means that the current 100-year event would be exceeded every 10 to 20 years by 2030, and more than once every 5 years in 2090.

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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