Local climate profile
Huon Valley Municipality

Past and current climate:

- The Huon Valley municipality covers a large and diverse area, from the mountainous and wet southwest national park, to the drier Huon Valley. As such, it has a large gradient of prevailing temperature and rainfall local climates. Overall, the region is classified as a temperate, maritime climate.
- The municipality has a large east-west gradient of rainfall. The western end of the municipality around Port Davey receives around 2200 mm average annual rainfall with a strong seasonal cycle (driest in February, wettest in July), and over 175 days of rain each year, brought mainly from frontal rain systems coming from the west. The eastern part of the municipality receives less than 750 mm average annual rainfall with a weaker seasonal cycle (around 40 mm in January, around 80 mm in August), brought by a variety of weather systems.
- The influence of large-scale rainfall drivers on year-to-year rainfall variability also differs across the municipality. The El Niño Southern Oscillation has some influence on the eastern part of the municipality in winter and spring. Rainfall in the west is correlated with drivers that influence the westerly systems that bring rain: the Southern Annular Mode in most seasons and with the incidence of atmospheric blocking in autumn and winter.
- 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).
- 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. Rainfall since then has been about average or slightly below 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 latter 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 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.

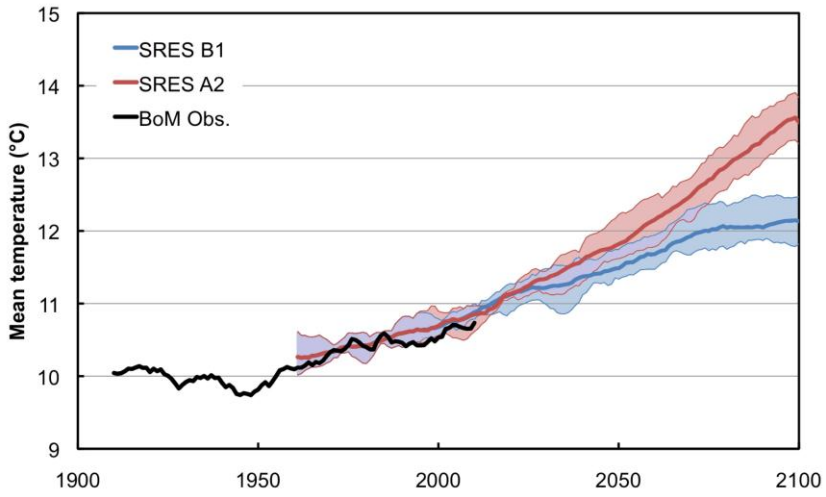

Figure 1. Tasmanian average temperature in observations (black) and model projections for the A2 scenario (red) and the B1 scenario (blue), all series are smoothed (11-year running average), shading shows the range of model projections. Changes under the higher scenario by the very end of the century 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:
    - The number of Summer Days (>25 °C) is projected to increase from around 10-15 days to more than 25 days per year at Port Davey, a similar increase is indicated for Huonville, rising from 15-20 days to 40 days.
    - The temperature of very hot days changes more than the change in average temperature (by more than 3 °C in some seasons).
    - Frost-risk days reduce considerably – at a site of 95 m above sea level in the Huon Valley, frost risk declines from around 40 days per year, to less than 10 days per year.
    - Warm spells (days in a row where temperatures are in the top 5% of baseline levels) that currently last about five days are projected to last up to five days longer. Heat waves may occur at Huonville (>3 days of >28 °C).

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 no change in average annual rainfall in the Huon Valley municipality as a whole, but increases and decreases at some locations and in some seasons.

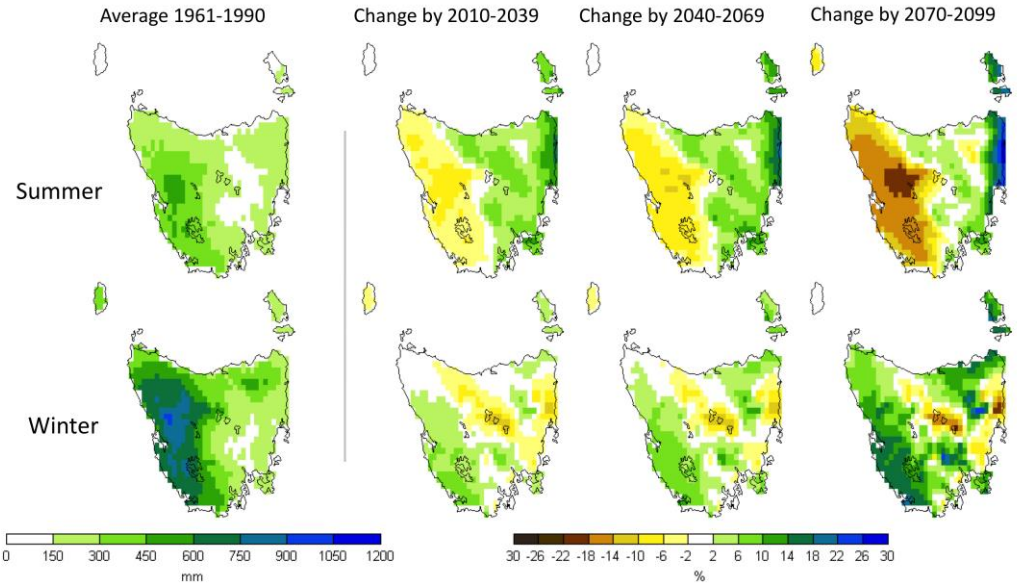

Figure 2. Average rainfall in summer and winter – the left hand side plots show the average rainfall in the baseline period (1961-1990), the plots to the right show the proportional change (%) from that amount in various periods in the 21st century in the average of six climate model projections under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

- The western part of the municipality is projected to receive steadily decreasing rainfall in summer and autumn and increasing rainfall in winter and spring through the latter half of the century (changes up to 20%). The eastern part of the municipality is projected to receive slightly increased rainfall in most seasons (changes 0-10%).
- The projected rainfall changes in the west are linked to changes in the westerly circulation that brings frontal rain systems. The increased rainfall in the east is linked to changes in circulation, and also changes to the incidence of episodic weather systems from the north and east.
- 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 stay similar what was experienced in the twentieth century for much of the municipality, or even decrease in the Huonville area due to increased average rainfall.
- A major influence of greenhouse warming on rainfall is the tendency for heavier rainfalls interspersed by longer dry periods, and for greater extremes. However, this effect is not as strong in this area as it is in some other places. Under the A2 scenario by the end of the century in the Huon Valley municipality there is projected to be:

  - Up to 9 fewer days with >1 mm rain per year on average, but significantly more rain per rain day.
  - An increase in the rainfall on the wettest day of the year (10-15% across the municipality), and in the wettest five-day run of days (0-10%), and a large increase in the peak instantaneous rainfall rate (over 20% in some seasons).
  - An increase in the rainfall brought by rare extreme events: the 200-year average recurrence interval (ARI) event is currently 100-150 mm, and is projected to increase by 10-25% at all locations across the municipality. More common ARI events (ARI-10, ARI-50) increase by a similar proportion as well.

- 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:
  - In the western half of the municipality, average runoff is projected to decrease in summer and autumn and to stay around the same or increase slightly in winter and spring, in line with rainfall changes. Around Huonville, runoff is projected to stay roughly the same or increase slightly in all seasons.
  - Proportional (%) increases in runoff are larger than the equivalent change to rainfall, so the largest decreases in the southwest in summer may be up to 20%, and the peak increases around Huonville in autumn may also be 20% or more.
  - Along with average runoff, runoff amounts during low events are also projected to decrease in the western area. These projections indicate that runoff during high events will stay about the same.
  - Average flows in the Huon River are expected to increase slightly by the end of the century in winter and spring. Flows in the Esperance River are projected to decrease slightly by the end of the century, and flows in the Kermandie River are expected to increase by a small amount (central estimate is up to 10%). Changes to flows during high events are projected to change by a different amount than average flows (see section on floods below).

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, and the decrease is greater at lower elevations. Under the A2 scenario, accumulated chill hours drop from around 2500-2700 hours per year around the Huonville area in the baseline climate, to around 2400 per year at high altitude sites and 1600 hours per year at lower elevation sites in the decades at the end of the century. This will influence the berry and blackcurrant industries.
- Conditions to grow wine grapes are projected to change markedly, which will affect farming practices. Vineyards in the Huonville area currently experience less than 800 annual BEGDD (a measure of heating for crop growth and development). Under the A2 scenario, this is projected to change to around 1000 BEGDD in the coming decades, and up to 1400 BEGDD in the last decades of the century. These changes would affect the choice of grape variety, bring the ideal harvest date forward in the year and affect the grape quality. As well as temperature, other

climate changes are likely to impact upon the wine industry, including heavy rain events leading to soil erosion.

- Altitude gradients create gradients in the temperature environment as you go up the hill. In the Huon region there are some areas of suitable agricultural land that have limited development due to temperature limitation. An increase in average temperature and temperature indices means that higher altitude areas of may become more viable. This would create pressure on land use and create new land-management issues for these areas.

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 Tasmania the sea level rise for this scenario is close to the global average.

In the south and southeast coasts of Tasmania, the very high tide height and the coastal surge contribute a roughly equal amount to high sea level events – the current 100-year storm tide event along the coast of this region is around 0.8 to 1.3 m above average sea level. High storm heights in the southeast are generally brought by westerly cold frontal systems with a low-pressure system to the south of Tasmania. 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 Hobart is projected to be 1.87 m in 2090 under the high emissions scenario. This means that the current 100-year event would be approximately a 50-year event by 2030, and a 2 to 6-year event by 2090 under this scenario. Changes in the Huon Valley area are expected to be similar.

5. River floods – Huon 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 are projected to experience high flood levels and faster response times.

For the Huon River, the peak flood discharge is projected to increase significantly through the 21st Century. For Huonville, increased flooding events can be expected through both increased sea level, changes to storm surge (see above point) and through increased river floods.

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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