REGIONAL COUNCILS
CLIMATE ADAPTATION PROJECT

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## Local climate profile

# Glamorgan-Spring Bay Municipality

**Past and current climate:**

- Glamorgan-Spring Bay has a temperate, maritime climate with relatively mild winters. The average daily maximum temperature at Orford is 22 °C in January and 13.1 °C in July.
- The municipality receives around 600-700 mm of rainfall a year with no strong seasonal cycle (approx. 50-70 mm each month). Rainfall can come from westerly cold fronts systems or episodic rainfalls from easterly systems such as cutoff lows.
- Year-to-year rainfall variability in this municipality is correlated with atmospheric blocking in the Tasman Sea, which is associated with easterly systems including cutoff lows mentioned above. Rainfall is also correlated with the El Niño Southern Oscillation, especially in winter. Temperature and rainfall is influenced by warmer waters offshore brought southwards by the East Australia Current.
- 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 average or slightly above average conditions.

**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 21$^{st}$ 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 21$^{st}$ 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 21$^{st}$ 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.

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

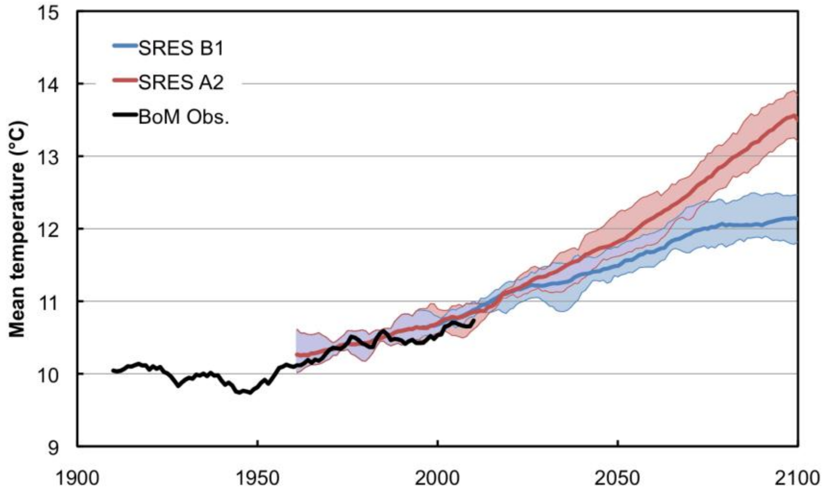


**Figure 1**. Tasmanian average temperature in observations (black) and model projections for the A2 scenario (red) and the B1 scenario (blue), all series are smoothed (11-year running average), shading shows the range of model projections. Changes under the higher scenario by the very end of the century 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 Swansea under the A2 (higher) scenario by the end of the century the projections indicate:
    - The number of Summer Days (>25 °C) more than doubles.
    - The temperature of very hot days will increase by more than the average temperature (up to 4 °C in some seasons).
    - Frost risk days will be very infrequent, but still occur occasionally.
    - Warm spells (days in a row where temperatures are in the top 5% of baseline levels) currently between 4 to 6 days, will last 3 to 5 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 climate response 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 increased average annual rainfall in the Glamorgan-Spring Bay municipality.

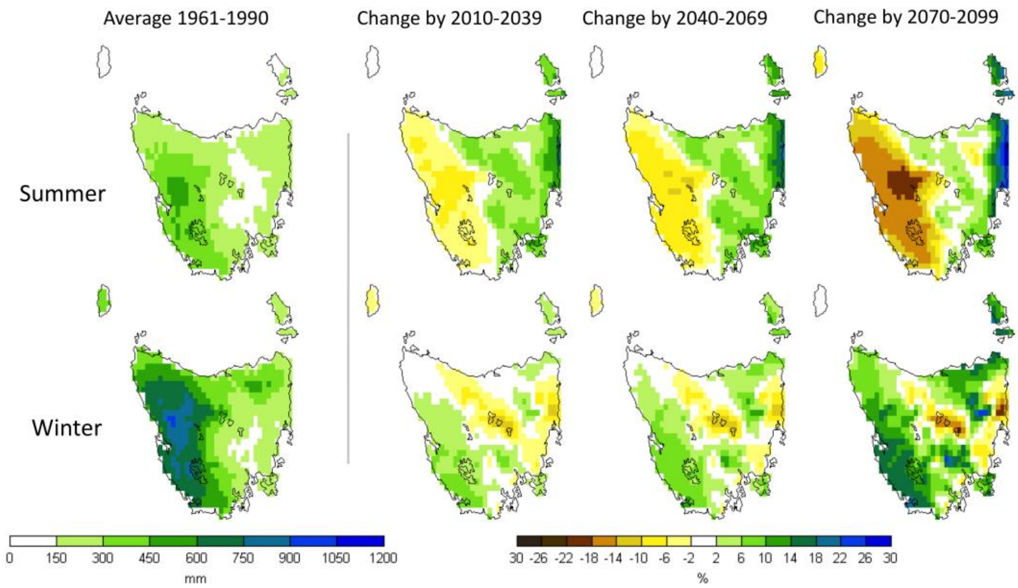


**Figure 2**. Average rainfall in summer and winter – the left hand side plots show the average rainfall in the baseline period (1961-1990), the plots to the right show the proportional change (%) from that amount in various periods in the 21st century in the average of six climate model projections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

- Rainfall is projected to increase in autumn and summer compared to the baseline period for both emissions scenarios – by up to 20% under the higher emissions scenario by the end of the century. The increase is strongest at the coast. Rainfall shows no change or a slight decline in winter and spring.
- 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 will decrease significantly due to the increased average rainfall.
- The projected increase in rainfall is primarily driven by increasing sea temperatures offshore, changes to atmospheric circulation and the synoptic systems that bring rainfall.
- 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:
    - An increase in the average rainfall per rain day of up to 15%.
    - Three more days each year where rainfall exceeds 10 mm (a 20% increase).
    - An average of 12 mm more rainfall on the wettest day of the year (20% increase).
    - Rainfall brought by rare extreme events will increase: a 200-year average recurrence interval (ARI) event increases by up to 110 mm (90% 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 increases considerably in summer and autumn, with no major change in winter and spring.
    - Proportional (%) increases in runoff are larger than the change to average rainfall, changes to runoff may exceed 30%.
    - Runoff amounts during high events are likely to increase, including those that may lead to erosion or flooding, runoff amounts during low events are likely to stay much the same.
    - Flows in the Little Swanport River upstream of the Tasman Highway are likely to increase by around 15% (range -7 to +45 %), and change in seasonality.
    - Inflows into Tooms Lake and Lake Leake are likely to increase by over 20%, but their reliability for meeting current demand may not change considerably.

**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 drop from around 2300 per year in the baseline climate, to around 1300 per year in the decades at the end of the century.
- Conditions to grow wine grapes are likely to change markedly, which will affect choices such as grape variety and harvest date. Vineyards around Swansea currently experience around 1100 ± 200 annual BEGDD (a measure of heating for crop growth and development) making them suitable for growing Pinot grapes. Under the A2 scenario, this is likely to change to around 1300 BEGDD in the coming decades, and around 1800 BEGDD in the last decades of the century. If the vineyard continues growing Pinot grapes, the harvest date will move forward from June to February and the grape quality will be affected. Otherwise, the wine grower may plant other varieties of grapes, such as Shiraz and Cabernet Sauvignon. As well as temperature, other climate changes are likely to impact upon the wine industry, including heavy rain events leading to soil erosion.

**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.

On the east 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 in Spring Bay is 1.05 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 are projected to be much less than sea level rise. Accounting for all effects, the current 100-year event in Hobart is projected to be a 1.58 m in Spring Bay by 2090 under the high emissions scenario.

## 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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