

Climate Analysis of Daily mean air temperature

Horizons Region, New Zealand

Climate Change Projections from CCAM-Downscaled CMIP6 Simulations

Prepared by

Bodeker Scientific

www.bodekerscientific.com

For

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1 Executive Summary

Average daily air temperature (T_{mean}) is a foundational climate variable, intricately linked to ecosystem function, societal wellbeing, agricultural productivity, and infrastructure resilience. In the Horizons region, T_{mean} shapes seasonal cycles, influences growing seasons, determines frost risk, and impacts both terrestrial and aquatic systems. Its projected changes are therefore essential to regional planning and adaptation.

Analysis of six downscaled CMIP6 climate models reveals that historical (1986–2005) regional patterns of T_{mean} are exceptionally well captured and agree closely: cooler temperatures persist in the higher-elevation east and northeast, while the west and south are consistently warmest. The seasonal cycle is pronounced throughout the region, peaking in summer and bottoming out in winter, with extremely high inter-model agreement on both magnitude and spatial pattern.

Projections for all considered future periods (2021–2040, 2041–2060, 2080–2099) and emissions scenarios (SSP1-2.6 to SSP5-8.5) indicate extremely likely regional warming. By mid-century, even the most optimistic scenario suggests a regional mean increase in T_{mean} of about 1°C. Warming intensifies with higher emissions and over time, reaching or exceeding 4°C by century's end under the highest-forcing pathway (SSP5-8.5). The spatial distribution of warming is remarkably uniform, with only minor local amplifications in elevated inland areas, notably the Volcanic Plateau.

All seasons warm, but the largest increases occur in summer and autumn, while winter and spring exhibit weaker (but still substantial) warming. Seasonality of change is most pronounced in upland zones, which are both cooler at present and projected to warm slightly more (especially in summer).

The agreement among models is extremely high for the signal and direction of change across the region, even though fine-scale spatial patterns and exact magnitudes exhibit moderate spread. Importantly, ensemble statistics show that model minimum and maximum changes closely approximate the lower and upper likely bounds across most areas and timelines. Remaining uncertainties relate mainly to the upper range under high-emissions scenarios, to fine spatial nuances, and to methodological constraints inherent in ensemble size and downscaling.

This robust, region-wide warming of T_{mean} has clear implications: increased heat stress on people, livestock, and crops; lengthening of growing seasons; shifts in phenology and potential invasive species expansion; heightened risk of drought and bushfire; and altered demands on energy and water sectors. Adaptation will require actions such as updating building standards, investing in drought- and heat-tolerant crops, revising land management, and ensuring water resource security. The extremely high confidence in continued T_{mean} warming supports urgent and sustained adaptation and mitigation planning for the Horizons region.

2 Introduction

Average daily air temperature (T_{mean}) is a defining element of regional climate. It influences a wide range of ecological processes, human health, energy demand, and land use patterns, and underpins the functioning of agricultural, hydrological, and infrastructural systems. For the Horizons region, which includes diverse landscapes ranging from low-lying coastal plains to elevated volcanic plateaus, understanding present and future characteristics of T_{mean} is fundamental to informed decision-making in the face of climate change.

The objectives of this synthesis are to

1. describe the historical spatial distribution of T_{mean} across the Horizons region.
2. assess projected future changes under multiple GHG emission scenarios (SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5).
3. examine the temporal evolution of projected changes.



4. evaluate the degree of agreement among climate models.
5. identify sub-regions most vulnerable to pronounced changes, particularly increased heat.
6. characterise the uncertainties associated with these projections; and.
7. discuss practical implications for regional adaptation and planning.

For the historical baseline (1986–2005), synthesised from six high-resolution CCAM model simulations, T_{mean} displays a stable and spatially robust pattern driven by topography and proximity to the coast: coldest conditions persist in the east and high-elevation interior, while the lower-lying west and south are consistently warmer. The strong and predictable seasonal cycle provides a stable framework against which to measure future changes.

Future projections uniformly indicate marked regional warming. All examined models and scenarios project higher mean temperatures for all sub-regions and seasons, with the magnitude of change scaling with both emissions pathway and time. Even under strong mitigation (SSP1-2.6), warming of around 1°C is expected by mid-century, with additional increases thereafter. Under high and very high emissions scenarios, annual mean T_{mean} increases by over 4°C by 2080–2099 are projected. The multi-model mean signal is highly consistent geographically, and seasonally resolved projections show the greatest increases in summer, amplifying hot extremes and extending heat risk periods.

The consequences of such warming for the Horizons region are significant. Agricultural productivity may be challenged by heat stress and shifts in phenology. Water resources will face additional evaporation demand and greater fluctuation in river flows. Ecosystems may experience compositional change or loss of local endemics, while the human population will encounter increased risks of heat-related illness and altered patterns of energy and water demand.

Adaptation options in light of these findings include: anticipatory shifts in crop and livestock species or management; upgrades to infrastructure for heat resilience; urban design modifications to manage heat stress; expansion of shade, shelter, and cooling resources; strategic water storage and irrigation planning; review of health system preparedness; and robust, flexible local planning responsive to both high-confidence trends and remaining uncertainties. Early action and regular review are essential, given the inevitability of continued warming over coming decades. The 12 supporting sub-reports with detailed analyses for each scenario and time period are available on request to Bodeker Scientific for further reference.

3 Understanding Daily Mean Air Temperature

Average daily air temperature (T_{mean}) is typically calculated as the arithmetic mean of the daily maximum and minimum temperatures or as the mean of all hourly or sub-hourly observations over a 24-hour period. In climate modelling and monitoring, T_{mean} represents the near-surface (usually measured at ~2 metres above ground level) air temperature and serves as a key indicator of the thermal state of the atmosphere that interacts closely with land surfaces, vegetation, water bodies, and human systems.

T_{mean} is directly driven by multiple physical processes: the diurnal cycle of solar radiation (which is maximum at local noon, minimum at night), outgoing longwave radiation, atmospheric composition (including greenhouse gas concentrations that trap outgoing infrared radiation), cloud cover (which modulates surface energy receipt and loss), humidity, wind (which affects local thermal mixing), and surface characteristics such as albedo, soil moisture, and vegetation cover. Seasonal and spatial differences are primarily controlled by latitude, elevation (lapse rate effects cause cooler temperatures at higher altitudes), terrain-induced circulation and, regionally, by proximity to the ocean (maritime moderation). Over longer timeframes, T_{mean} is sensitive to changes in global radiative forcing, especially increases in greenhouse gases, which reduce outgoing radiation and raise surface and near-surface temperatures. Land-use changes and urbanisation can further modulate T_{mean} via the urban heat island effect and altered heat fluxes.



In climate models, T_{mean} is simulated by solving relevant equations for energy balance and atmospheric physics at each grid cell, taking into account radiative transfer, atmospheric dynamics, and land-atmosphere interactions. Model skill in reproducing T_{mean} depends on accurate representation of these processes, proper resolution of topographic and surface features, and appropriate treatment of boundary conditions. T_{mean} is also influenced by natural climate variability (such as ENSO or decadal oscillations), leading to fluctuations superimposed upon long-term trends. In summary, T_{mean} integrates complex climate processes and is a critical, policy-relevant indicator for both impact assessment and adaptation planning.

4 Climate Modelling Framework

The projections synthesised in this report were generated using the Conformal Cubic Atmospheric Model (CCAM) by Earth Sciences New Zealand; ESNZ. We acknowledge ESNZ and thank them for making these simulations freely and easily available. CCAM is a regional climate model that dynamically downscales outputs from global climate models to produce higher-resolution climate projections over New Zealand. Papers describing the generation of these climate projections for New Zealand are available [here](#) and [here](#).

Regional climate modelling is necessary because global climate models typically operate at spatial resolutions that are too coarse to adequately represent New Zealand's complex topography. Mountains, coastlines, and local climatic gradients strongly influence regional climate and require higher spatial resolution to be represented realistically.

Six CMIP6 global climate models were used to drive the CCAM simulations:

1. **ACCESS-CM2** is the second-generation coupled climate model developed by the Australian research community through the Australian Community Climate and Earth System Simulator (ACCESS) project. It combines atmospheric, oceanic, sea-ice, and land-surface components and was developed jointly by the Australian Bureau of Meteorology and CSIRO. The model is widely used for climate projections in the Australia/New Zealand region, including studies of temperature, precipitation, and extreme events.
2. **AWI-CM-1-1-MR** is a coupled Earth system model developed by the Alfred Wegener Institute in Germany. One of its key strengths is in representing ocean and sea-ice processes. Its ocean component uses an unstructured mesh, allowing much finer spatial resolution in regions of interest such as the polar regions while retaining manageable computational costs elsewhere. The model is frequently used in studies of polar climate change and large-scale ocean circulation.
3. **CNRM-CM6-1** is developed by the Centre National de Recherches Météorologiques and CERFACS in France. It includes interactive representations of the atmosphere, ocean, land surface, and sea ice, together with substantial improvements over earlier versions in cloud physics and surface processes. The model is widely used in both European and international climate assessments.
4. **EC-Earth3** is a European climate model developed by a consortium of research institutions from several countries, building on operational weather-forecasting systems from the European Centre for Medium-Range Weather Forecasts (ECMWF). It incorporates sophisticated atmosphere, ocean, land, and sea-ice components and is designed to support a broad range of climate applications, from seasonal forecasting to long-term climate projections. It performs particularly well in reproducing large-scale patterns of historical climate.
5. **GFDL-ESM4** is an Earth system model developed by the Geophysical Fluid Dynamics Laboratory (GFDL), part of the US National Oceanic and Atmospheric Administration (NOAA). In addition to the physical climate system, it includes detailed representations of biogeochemical cycles, allowing interactions between climate, ecosystems, and atmospheric composition to be simulated. The model is widely used for studies of carbon cycling, ocean processes, and future climate change.
6. **NorESM2-MM** is the medium-resolution version of the second-generation Norwegian Earth System Model,



developed by a consortium led by the Norwegian Climate Centre. It is based partly on components from the Community Earth System Model but incorporates substantial Norwegian developments, particularly in aerosol processes and ocean dynamics. The model is commonly used in research on high-latitude climate, atmospheric circulation, and climate feedbacks.

These six models cover a range of equilibrium climate sensitivities (ECSs; see Figure 1) and allow some sense of uncertainty associated with model structure and climate sensitivity to be quantified.

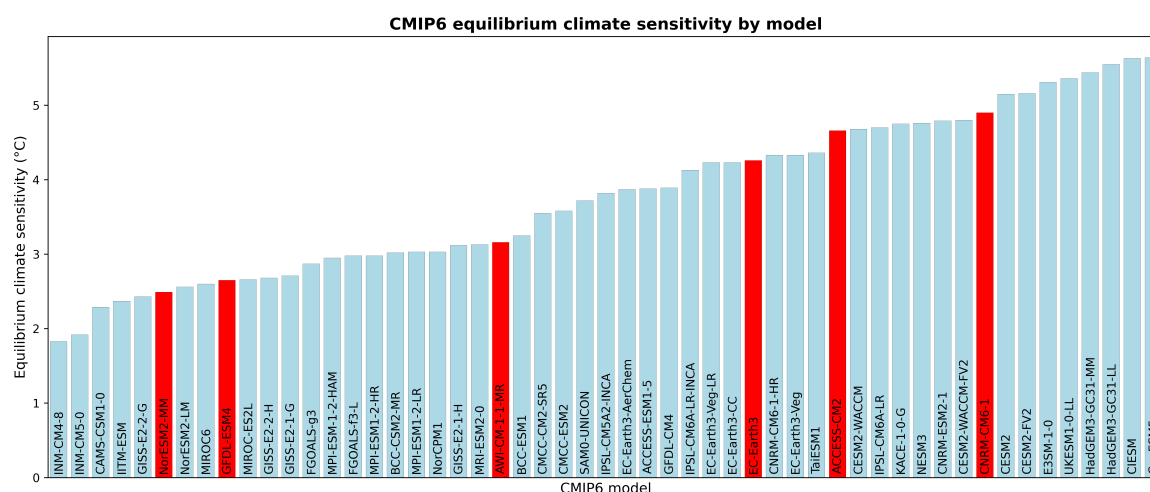


Figure 1: The location of the six guiding CMIP6 models across the full range of equilibrium climate sensitivities (ECSs) of all 53 CMIP6 models. The original of this figure can be downloaded [here](#).

Four Shared Socioeconomic Pathway (SSP) emissions scenarios were considered:

1. **SSP1-2.6:** A low-emissions pathway consistent with strong global mitigation efforts and relatively limited future warming.
2. **SSP2-4.5:** An intermediate pathway representing moderate emissions reductions and moderate warming.
3. **SSP3-7.0:** A medium-to-high emissions pathway associated with substantial future warming.
4. **SSP5-8.5:** A high-emissions pathway characterised by continued growth in GHG emissions and large increases in global temperature.

Three future periods were examined:

1. 2021–2040 (near future)
2. 2041–2060 (mid-century)
3. 2080–2099 (late century)

All projections were evaluated relative to a baseline period of 1986–2005.

A key strength of the modelling framework is the use of an ensemble of climate models rather than reliance on a single simulation. Ensemble approaches allow both the central tendency and uncertainty of projected changes to be assessed. That said, an ensemble of six models does not capture the potential full range of variability. By considering the ECS of each of these models in the context of the much wider range of 53 CMIP6 models (see Figure 1), a method was developed to generate a more complete picture of the potential uncertainty in projected changes. That method is discussed in the companion “overview” report to this T_{mean} -specific report. Uncertainty probability density functions (PDFs) generated using this method appear in many of the plots shown herein.



5 Daily Mean Air Temperature Climatology: 1986 to 2005

The CCAM simulated daily mean air temperature fields, averaged over the period 1986–2005, are shown in Figure 2. This figure shows values for the whole year. Figures showing seasonally disaggregated results are included below. Because the differences between these fields are not readily apparent, differences between

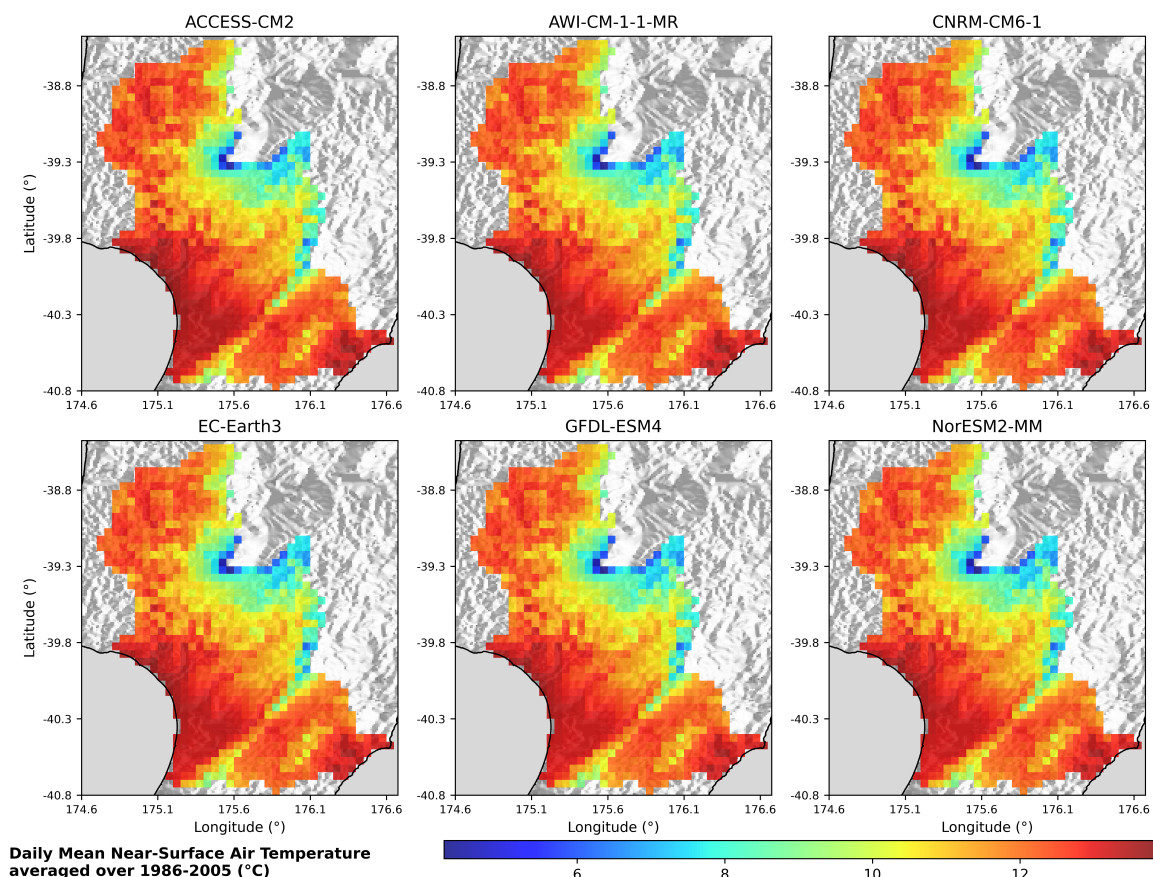


Figure 2: Daily mean air temperature fields as simulated by the CCAM model and averaged over the period 1986 to 2005. The original of this figure is available [here](#).

each field and the multi-model mean are shown in Figure 3. The multi-model mean daily mean air temperature fields, averaged over the period 1986–2005, for each season, are shown in Figure 4.

During the 1986–2005 baseline, the Horizons region’s average daily air temperature (T_{mean}) exhibits pronounced spatial gradients and strong seasonality, as captured with remarkable fidelity by all six CCAM climate model simulations used in this study. The west and southern parts of the region—generally at lower elevations—are consistently the warmest, with T_{mean} values exceeding 12°C in the annual mean, while the cool, elevated interior and eastern margins (particularly the Volcanic Plateau and Upper Rangitikei) present annual mean temperatures often $4\text{--}6^{\circ}\text{C}$ lower. The model ensemble shows this spatial pattern is primarily driven by elevation, latitude, and proximity to the coast, reflecting the physical controls familiar to climatologists and local stakeholders alike.

All six models reproduce the regional gradient with striking coherence: the range of modelled annual mean spatial minima and maxima varies by less than 0.2°C across models, and differences from the multi-model mean are rarely greater than $\pm 0.1^{\circ}\text{C}$. Inter-model agreement is quantified as extremely high, with spatial R^2 values in pairwise model comparisons exceeding 0.9997, and standard deviations across model means and extremes typically below 0.1°C . Residual inter-model differences lack spatial coherence, underlining the reliability of the overall pattern and supporting extremely high confidence in the regional T_{mean} climatology.

Seasonal cycles are robust, with summer (DJF) daily mean temperatures peaking above 15°C throughout much

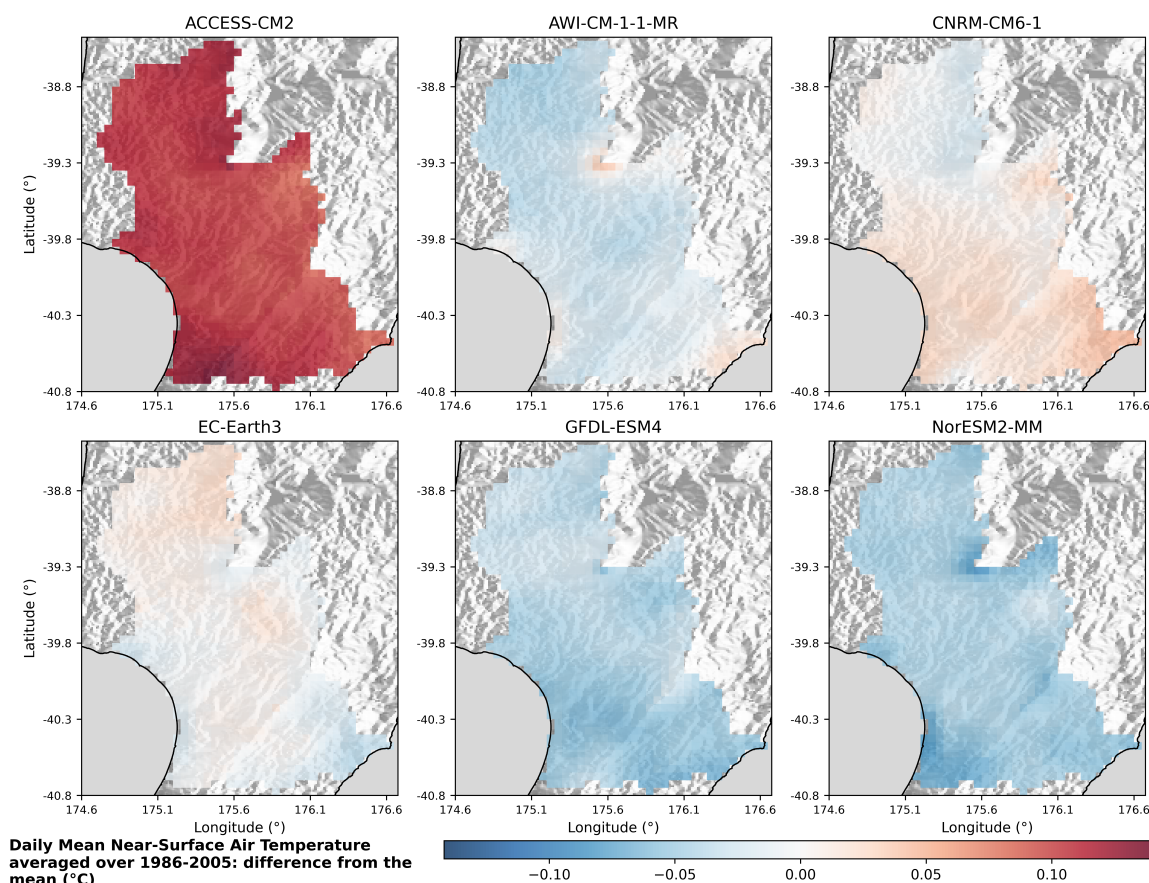


Figure 3: Differences from the multi-model mean. The original of this figure is available [here](#).

of the region, and winter (JJA) means falling to near or below 7°C in cooler sub-regions. This cycle is spatially structured, with the strongest seasonality in interior, elevated areas and most muted along the west and south coastal plains. The lowest gridcell summer means hover around 8°C and rise above 17°C for the warmest cells; in winter, minima can fall below 1°C, while the mildest winter areas reach or exceed 10°C. The coherence of these results across six downscaled global models demonstrates that the region’s spatial and seasonal climate structure is being captured with virtually certain confidence by this ensemble, making it a robust baseline for future climate assessment.

6 Near-Future Projections (2021–2040)

Across the Horizons region, all climate models and emissions scenarios robustly indicate that average daily air temperature (T_{mean}) will increase during the near-term period (2021–2040) compared to the 1986–2005 baseline. The ensemble mean projections show a regionally uniform warming signal, with changes consistently falling in the range of approximately 0.7–0.9°C across all scenarios. Inter-model agreement is exceptionally high concerning the sign of change (all models and scenarios indicate warming) and remains strong with respect to the magnitude and spatial distribution. The spatial gradient in projected warming is modest, with elevated and inland sub-regions (such as the Volcanic Plateau and Upper Rangitikei) generally experiencing slightly greater increases, while lower-elevation coastal sub-regions (Horowhenua and Whanganui–Manawatū Lakes) show a lesser but still clear warming signal.

Seasonality is a persistent feature: projected warming is greatest in summer (DJF), typically around 0.9–1.0°C, and smallest in winter (JJA), often lower by 0.2–0.3°C, with autumn and spring (MAM, SON) changes falling between these extremes. These seasonal differences, although not dramatic, are consistent across all mod-

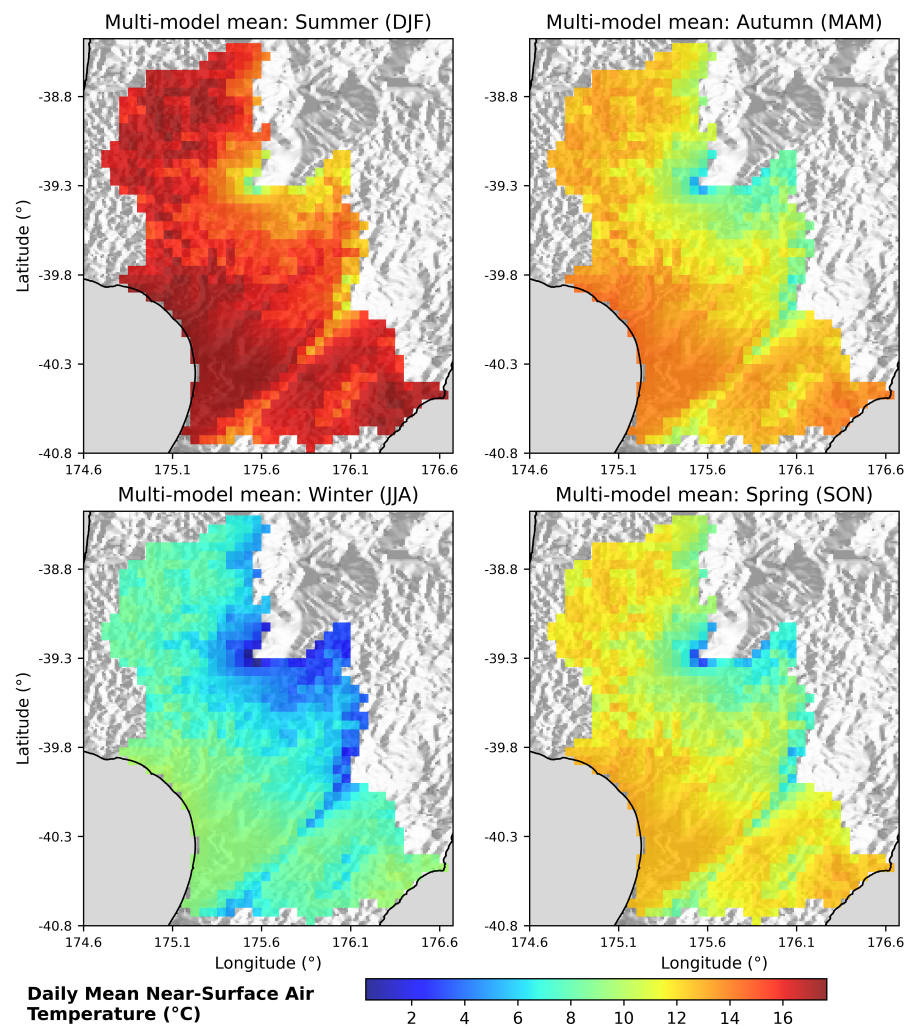


Figure 4: Multi-model mean daily mean air temperature fields for each of the four seasons. The original of this figure is available [here](#).



els and sub-regions, suggesting a systematic regional response. Model spread for both annual and seasonal changes is low; the standard deviation of ensemble outcomes within sub-regions and seasons rarely exceeds 0.05°C. Percentile metrics (P5–P95) closely track minimum and maximum projections, enabling clear and robust characterisation of uncertainty.

No models project regional cooling, even for outlier scenarios, making warming in the near term virtually certain. The signal is sufficiently large to be detectable in all Horizons sub-regions and seasons, providing a solid scientific foundation for regional adaptation planning.

6.1 SSP1-2.6: Extremely likely, modest, regionally widespread increases (<1°C), all seasons

The projected changes in daily mean air temperature from 1986–2005 to 2021–2040 under the SSP1-2.6 scenario, as simulated by the six different models, are shown in Figure 5. The multi-model mean changes in daily

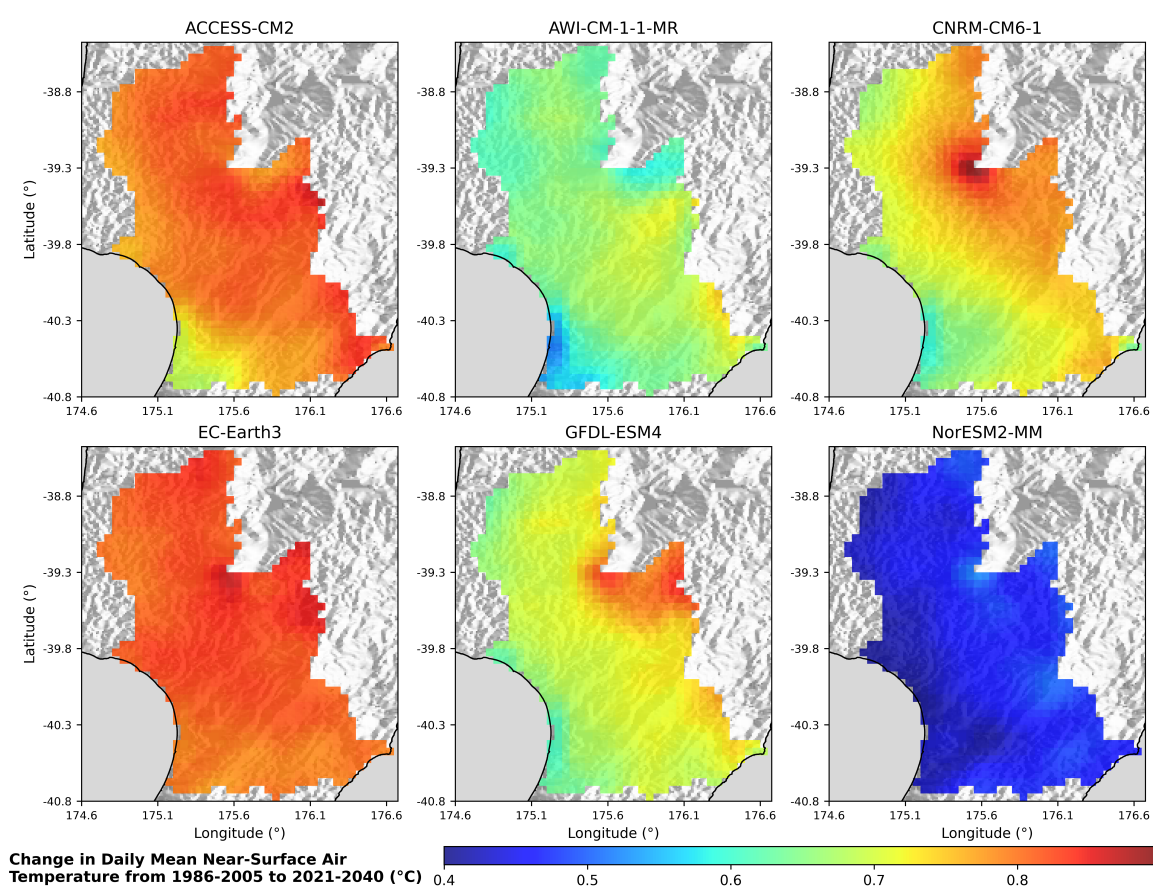


Figure 5: Projected changes in daily mean air temperature from 1986–2005 to 2021–2040 under the SSP1-2.6 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 6.

Projections for the Horizons region under SSP1-2.6 (a low emissions scenario) for the period 2021–2040 reveal a robust but modest warming signal in near-surface air temperature. All models show regional mean temperature increases of about 0.68°C (ensemble average), with individual model projections ranging approximately from 0.46 to 0.82°C. This near-term warming is ubiquitous across the region, with little spatial variability: inland and elevated zones (e.g., Volcanic Plateau, Upper Rangitikei) warm slightly more, but the differences between sub-regions are minor (generally within 0.1°C).

Seasonal analysis indicates that summer (DJF) will warm the most—up to 0.8°C on average—while winter (JJA) and the transitional seasons (MAM, SON) are projected to warm by about 0.6–0.7°C. This pattern is consistent

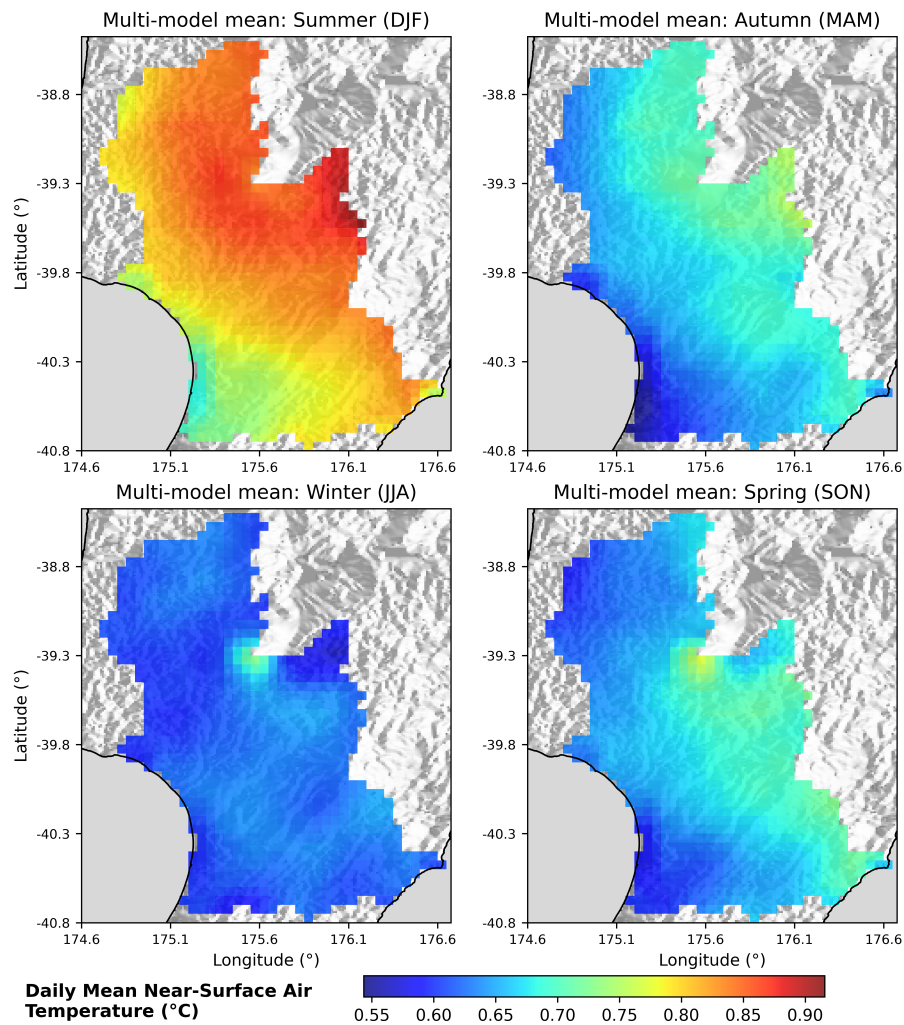


Figure 6: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP1-2.6 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



across models and sub-regions, highlighting a reliably greater summer warming response. The signal's consistency is underlined by extremely low ensemble spread (standard deviations for model means are often below 0.03°C) and tightly clustered percentile ranges for each sub-region and season (P5–P95 typically within $\pm 0.1^{\circ}\text{C}$ of the mean).

Model agreement is exceedingly high for both the sign and magnitude of warming—it is nearly certain (IPCC: extremely likely) that all areas will see rising temperatures. No sub-region emerges as an outlier, either positively or negatively. Natural climate variability and differences in climate model sensitivity produce only minor uncertainty, meaning adaptation strategies can be planned on the basis of a “floor” of about 0.6°C warming expected by 2040 under strong mitigation. Local or seasonal departures from this range are extremely unlikely, cementing strong scientific confidence in these results.

6.2 SSP2-4.5: Extremely likely moderate region-wide increases, robust across all seasons

The projected changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP2-4.5 scenario, as simulated by the six different models, are shown in Figure 7. The multi-model mean changes in daily

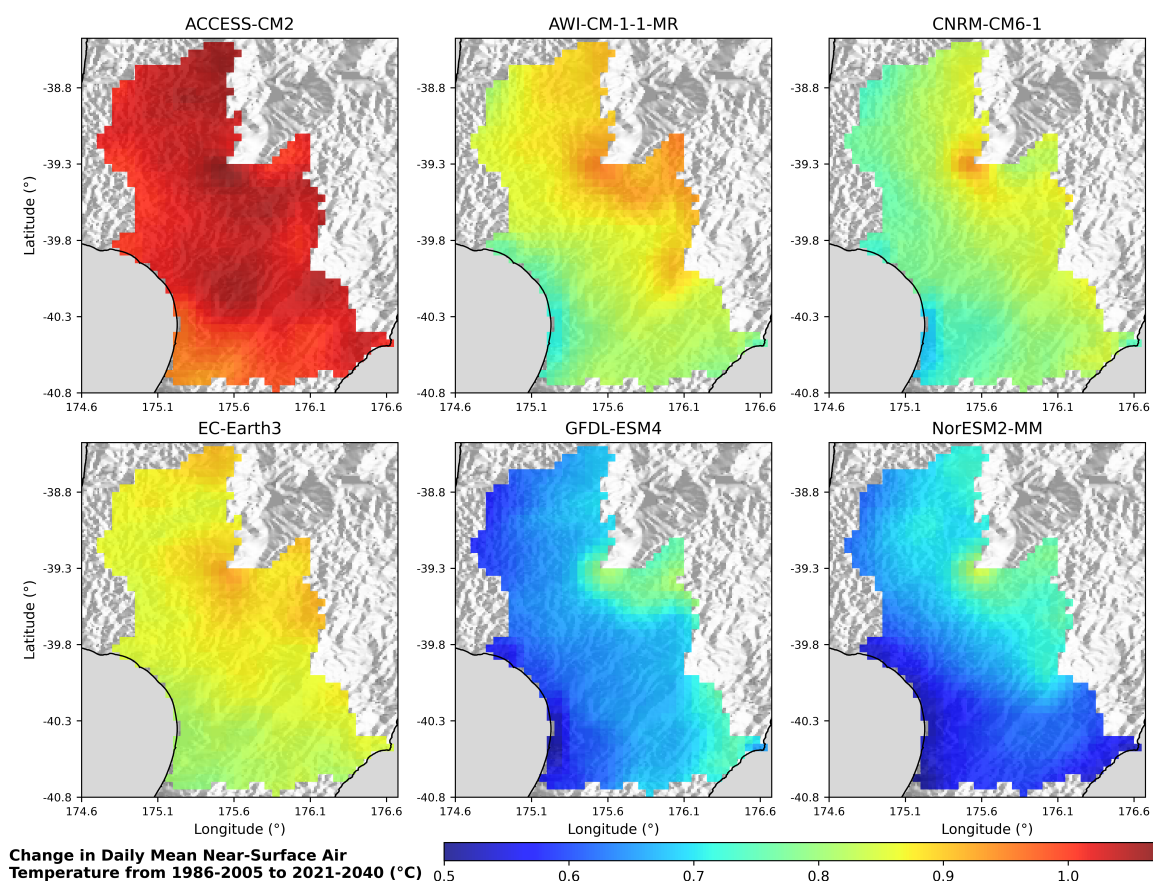


Figure 7: Projected changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP2-4.5 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 8.

Under SSP2-4.5, corresponding to an intermediate emissions scenario, projections for 2021–2040 indicate a slightly larger, yet still moderate increase in mean daily air temperature (T_{mean}) across the Horizons region, compared to the late 20th-century baseline. The ensemble mean warming is approximately 0.8°C , with individual sub-regional averages typically between 0.72°C and 0.86°C . The pattern of warming is spatially uniform, with inland and upland areas (Volcanic Plateau, Upper Rangitikei) experiencing the greatest mean increases and lower coastal zones (Horowhenua, Whanganui–Manawātū Lakes) the least, but with the absolute differ-

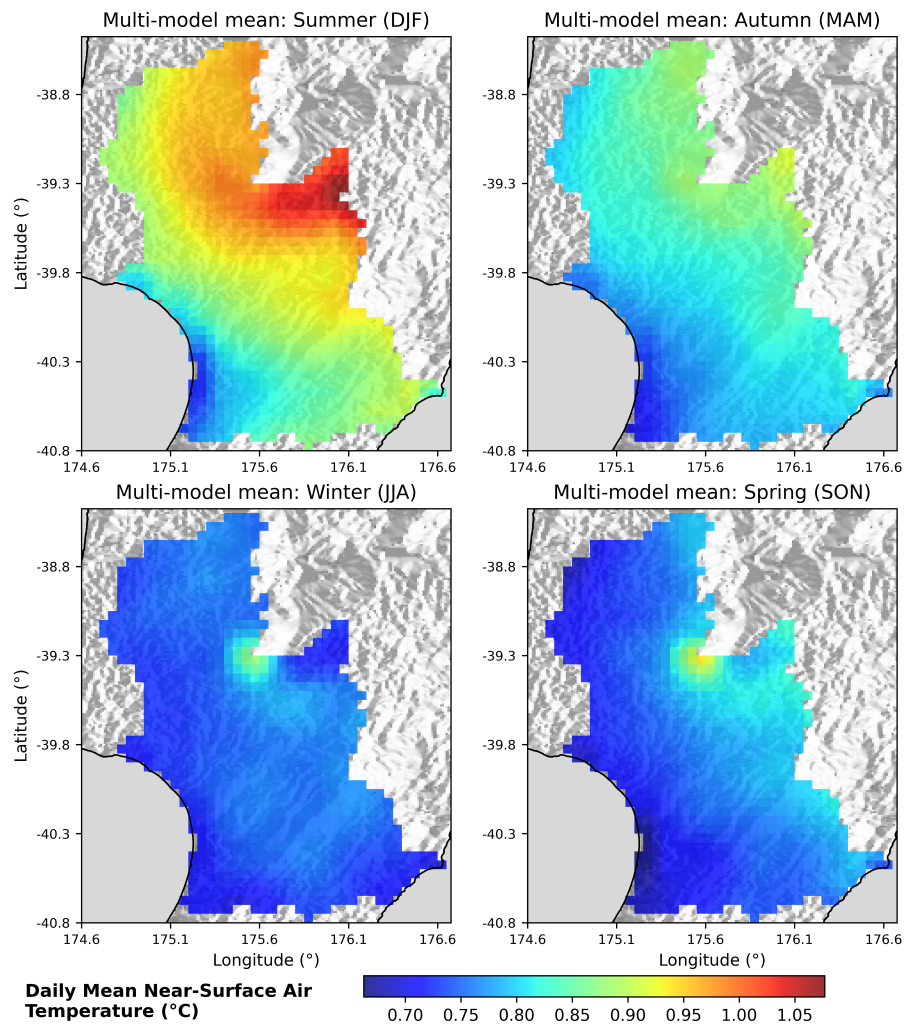


Figure 8: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP2-4.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



ence rarely exceeding 0.15°C across sub-regions.

Seasonal analysis identifies summer as the period of maximum warming, with model means approaching 1°C in the warmest areas, while all sub-regions project increases above 0.75°C in any season. Autumn and spring tend to be intermediate, and winter warming is smallest, but all seasonal increases are robustly positive. Inter-model spread for both spatial and temporal (seasonal) patterns is low, with standard deviation for projected changes within grid cells and sub-regions consistently under 0.03°C. Model agreement remains extremely high; all model outputs, percentiles, and spatial means unambiguously project warming.

Percentile metrics (P5–P95) reaffirm this robustness: even at the 5th percentile, projected warming for all sub-regions and seasons is above 0.3°C, while maxima reach nearly 1.3°C. Equally, there are no outlier sub-regions or locally isolated cooling signals. These results align closely with national projections for comparable scenarios, further strengthening confidence. Outcomes are extremely likely, providing decision-makers and planners with clarity that net warming is a virtual certainty through to 2040 under continued moderate emissions.

6.3 SSP3-7.0: Extremely likely modest, spatially widespread increases; stronger in summer

The projected changes in daily mean air temperature from 1986–2005 to 2021–2040 under the SSP3-7.0 scenario, as simulated by the six different models, are shown in Figure 9. The multi-model mean changes in daily

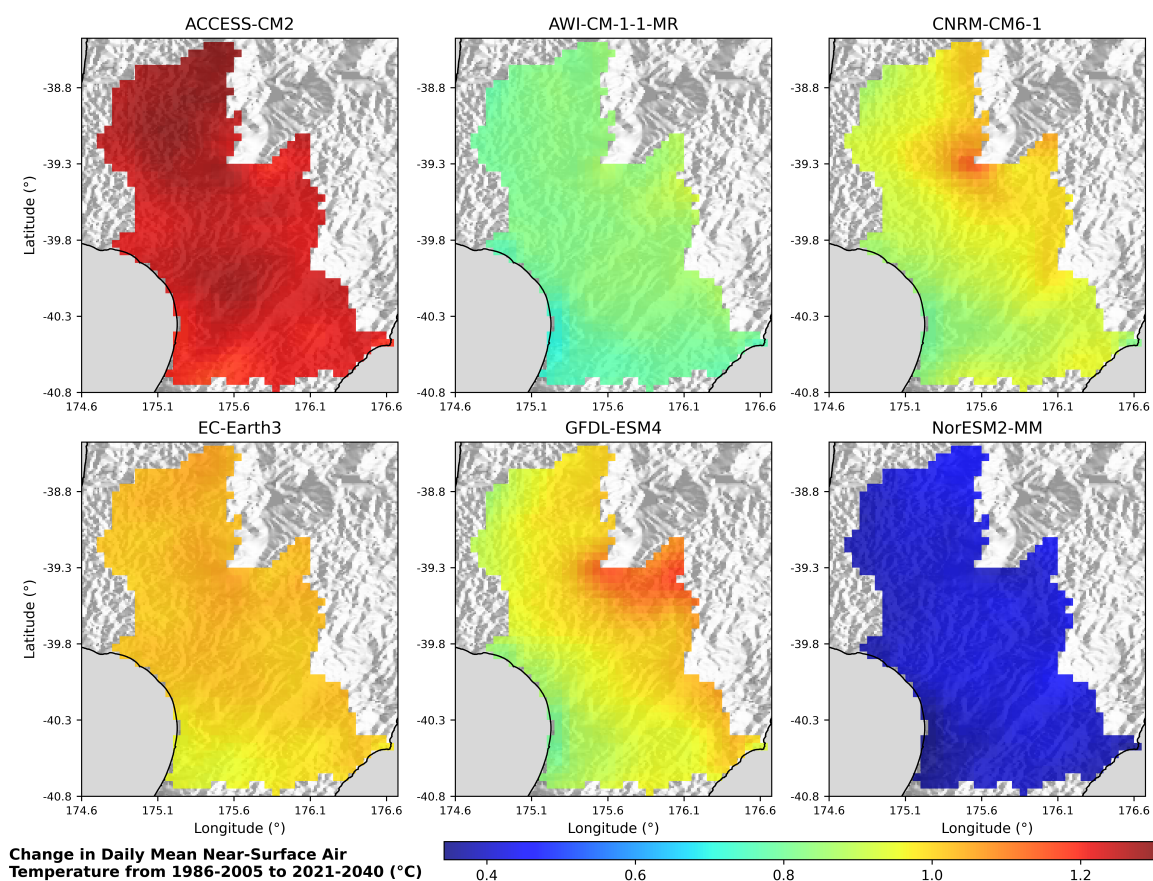


Figure 9: Projected changes in daily mean air temperature from 1986–2005 to 2021–2040 under the SSP3-7.0 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 10.

Climate projections for the near term (2021–2040) under the high emissions SSP3-7.0 scenario show a consistent warming across the Horizons region, with a mean increase in average daily air temperature (T_{mean}) of around 0.9°C relative to the 1986–2005 baseline. Regional differences in projected warming are small, with

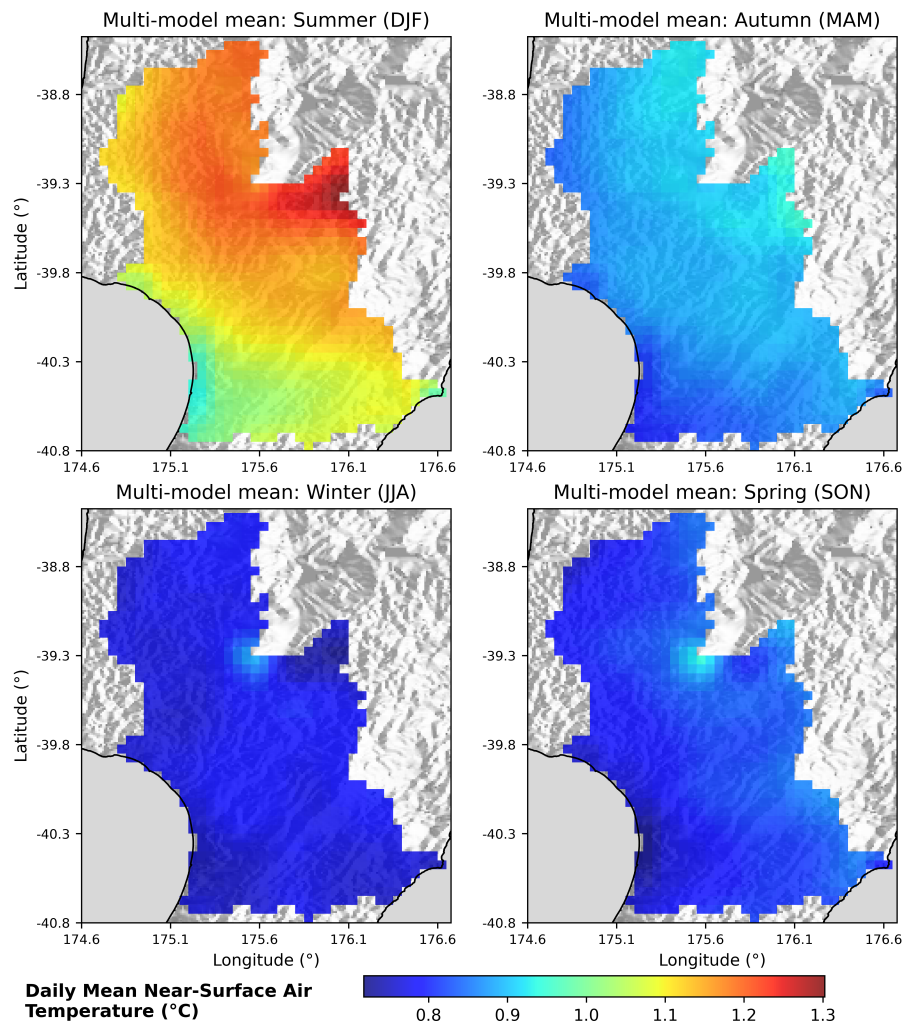


Figure 10: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP3-7.0 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



upland sub-regions such as the Volcanic Plateau and Upper Rangitikei registering the highest increases (up to 0.94°C) and lowland/coastal sub-regions (Horowhenua, Whanganui–Manawatū Lakes) experiencing slightly lesser warming (just above 0.8°C). The difference between the highest and lowest sub-regions is minor (under 0.15°C), indicating a spatially uniform signal.

By season, summer demonstrates the largest projected increase (mean: about 1°C), and winter the smallest (mean: about 0.75–0.8°C), following a regionally persistent ordering in response magnitude. Autumn and spring changes are intermediate, with ensemble means of around 0.8°C. Inter-model spread for the annual and seasonal changes remains minimal. Grid cell and sub-regional percentile spreads (P5–P95) indicate a very narrow likely range of outcomes (0.5–1.4°C across the ensemble), with no models projecting any local cooling. Percentile and minimum/maximum statistics illustrate that uncertainty is best characterised by modest variability in magnitude, not by sign or spatial behaviour.

Model agreement is exceptionally high—extremely likely—for the regional warming trend, with virtually certain increases indicated for all sub-regions and seasons. Fine-scale spatial differences between models are not large enough to qualify as important for policy and adaptation at the regional scale. The overall scientific picture is one of widespread, seasonally structured, and robust warming—even in the absence of aggressive emissions mitigation.

6.4 SSP5-8.5: Extremely likely modest, regionally widespread warming; strongest in summer

The projected changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP5-8.5 scenario, as simulated by the six different models, are shown in Figure 11. The multi-model mean changes in daily

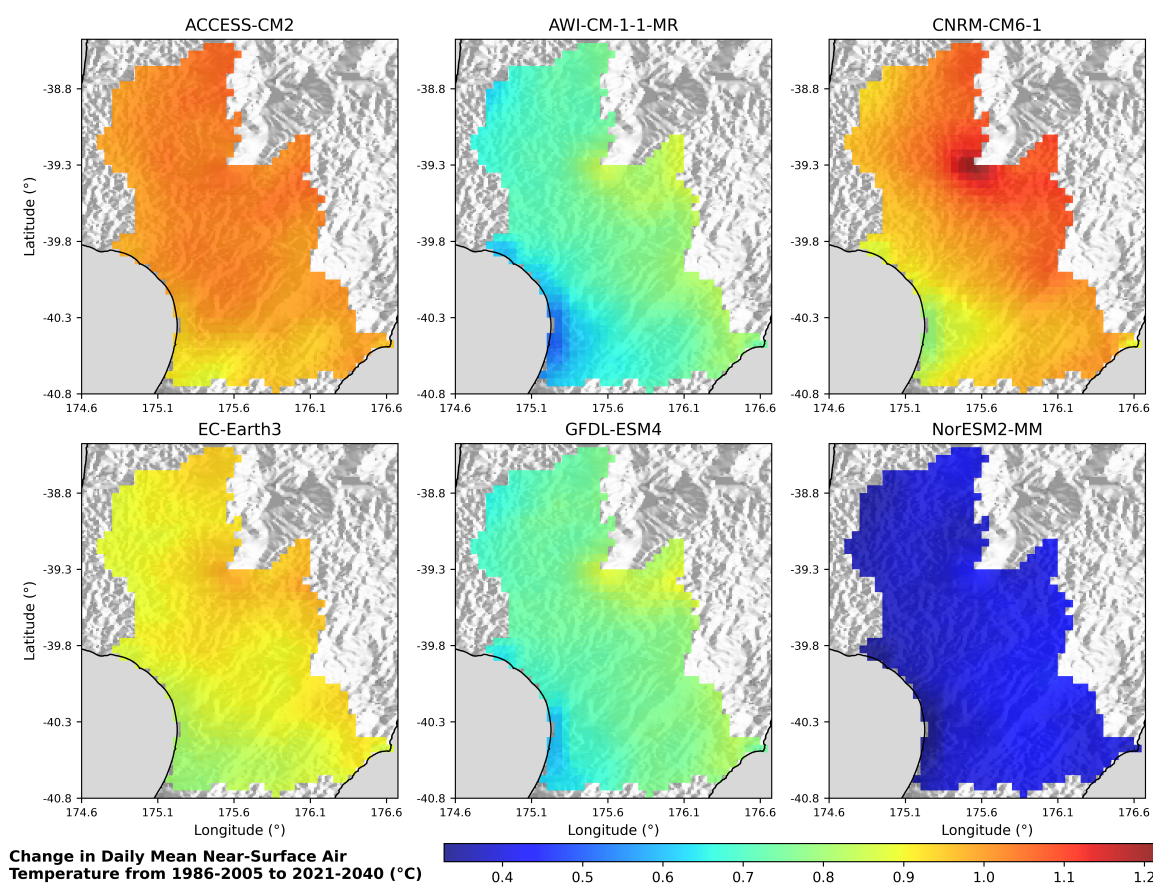


Figure 11: Projected changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP5-8.5 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 12.

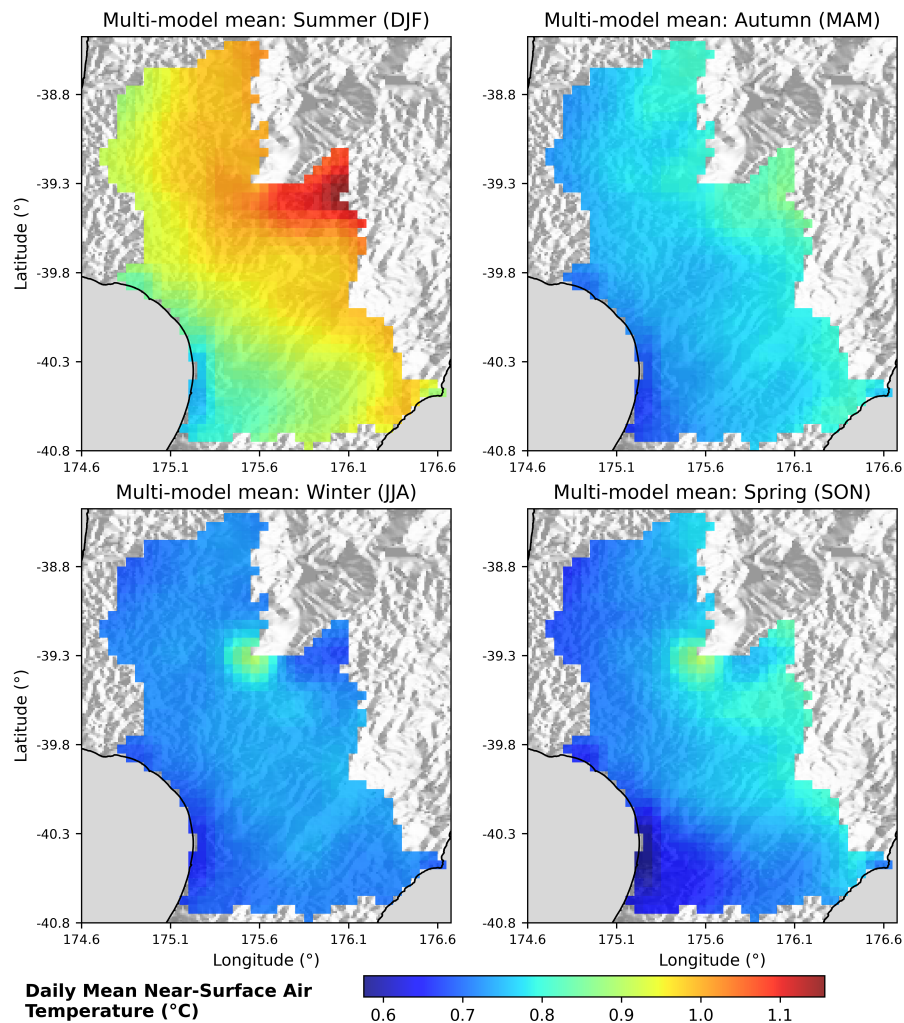


Figure 12: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2021-2040 under the SSP5-8.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



For the SSP5-8.5 scenario, representing very high global emissions, climate projections for 2021–2040 continue to show robust regional warming for the Horizons region, similar in magnitude to other scenarios at this time horizon. Mean daily air temperature (T_{mean}) is projected to increase by approximately 0.8°C on average, with projected warming within sub-regions tightly clustered (about 0.7°C in Horowhenua, up to 0.85°C in the Volcanic Plateau and Upper Rangitikei). Spatial gradients are minor, and the warming response does not deviate substantially from SSP3-7.0 or SSP2-4.5 at this early period, highlighting that divergence among scenarios is not expected until later decades.

All scenarios and models agree on maximum summer warming (up to around 1°C mean), while winter warming leads to the smallest seasonal increases (generally 0.7–0.8°C). Autumn and spring are slightly cooler, in line with regional and national-scale seasonal cycles of projected change. The ensemble spread (P5–P95) remains small within all sub-regions and seasons, showing high inter-model agreement and negligible chance of regional cooling (lowest P5 exceeds +0.35°C). The maximum and minimum of model projections within sub-regions serve as competent proxies for the range of likely warming values, and percentile fields largely correspond to these bounds.

Spatial and seasonal differences are present but not significant relative to the strong unidirectional warming signal. Model agreement remains very high (standard deviations in sub-region changes below 0.03°C). No sub-region stands out as highly anomalous or as a hotspot for either exceptional warming or relative stasis. In summary, regardless of scenario, regional warming by 2040 is a near certainty, providing strong, action-oriented guidance for regional adaptation.

6.5 Comparison Across Scenarios

Projected near-term warming for the Horizons region is highly robust across all four SSP scenarios (SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5). The projected magnitude of change for 2021–2040 does not vary substantially between scenarios, with all pointing to a modest regionally average increase (approximately 0.7–0.9°C) and the greatest warming in summer. Differences between scenarios are smaller than either the model spread or regional variability within this timeframe, reflecting that emissions pathway divergence becomes significant only later in the century. All scenarios yield extremely high confidence in the sign and the broad magnitude of change, with no chance of regional cooling and no sub-region or season showing exceptional outlier behaviour. The regional climatic response in the near term can be summarised as a spatially uniform, seasonally structured, and virtually certain warming signal.

7 Mid-Century Projections (2041–2060)

By the mid-21st century (2041–2060), projections for daily mean air temperature (T_{mean}) across the Horizons region indicate a very likely strengthening of the warming signal evident in the near term. Across all emissions scenarios, all models project regionally uniform increases in T_{mean} , with scenario-dependent differences now emerging: typically, annual mean warming is projected at just over 1°C under SSP1-2.6 (low emissions), about 1.3°C for SSP2-4.5 (intermediate), around 1.6°C for SSP3-7.0 (high), and 1.7°C for SSP5-8.5 (very high emissions). The largest increases are present in inland and elevated sub-regions such as the Volcanic Plateau and Upper Rangitikei, while coastal sub-regions (Horowhenua, Whanganui–Manawatū Lakes) remain at the lower end of warming, but differences between sub-regions are not large (generally 0.2–0.3°C).

A pronounced seasonality persists, with summer warming (DJF) showing the greatest increase—commonly exceeding 1.5°C (particularly under higher-emissions scenarios)—while winter and spring see less but still substantial warming. This is coupled with very high inter-model agreement in sign (virtually certain warming in all sub-regions and seasons) and strong consensus in magnitude: percentile statistics (P5–P95) for each scenario support a likely range (i.e., >66% probability) that excludes any risk of regional cooling. The spatial standard



deviations of projected change remain low and model-to-model variability is low for the sign of change, with moderate spread in magnitude between ensemble members, especially for autumn and summer.

By the 2040–2060 period, scenario-based divergence in projected warming—though palpable—is not yet overwhelming, but it establishes a trajectory toward marked differences later in the century. While spatial nuances may arise due to topography and climate model structure, overall warming is robust and consistent for all practical regional adaptation planning needs. The Horizons region can expect a significant, spatially widespread, and seasonally enhanced temperature increase by mid-century, regardless of scenario, with magnitude scaling reliably with global emissions.

7.1 SSP1-2.6: Very likely region-wide increases, spatially uniform; summer warming dominates

The projected changes in daily mean air temperature from 1986–2005 to 2041–2060 under the SSP1-2.6 scenario, as simulated by the six different models, are shown in Figure 13. The multi-model mean changes in daily

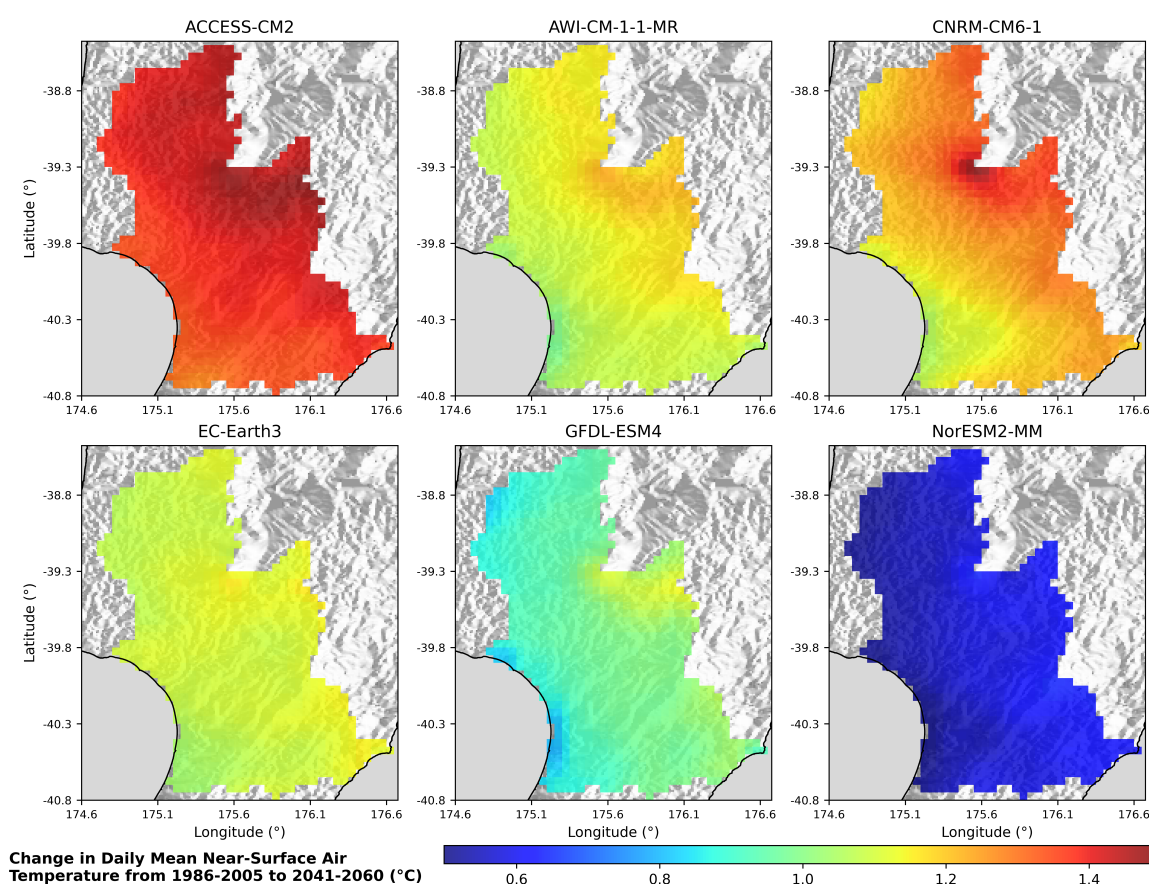


Figure 13: Projected changes in daily mean air temperature from 1986–2005 to 2041–2060 under the SSP1-2.6 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 14.

Under the SSP1-2.6 scenario (low emissions), the Horizons region is projected to experience a region-wide mean temperature increase of just over 1°C by 2041–2060 compared to the 1986–2005 baseline. This warming is fairly uniform across sub-regions, with maxima exceeding 1.1°C in the Volcanic Plateau and Upper Rangitikei and minima just under 1°C in lowland/coastal zones like Horowhenua and Whanganui–Manawatū Lakes. Differences among sub-regions are minor, and percentile bounds (5th–95th) indicate a likely range of 0.6–1.6°C, depending on model and sub-region.

Seasonality remains clear: summer exhibits the largest increases (mean: about 1.25°C; up to 1.4°C in cold-

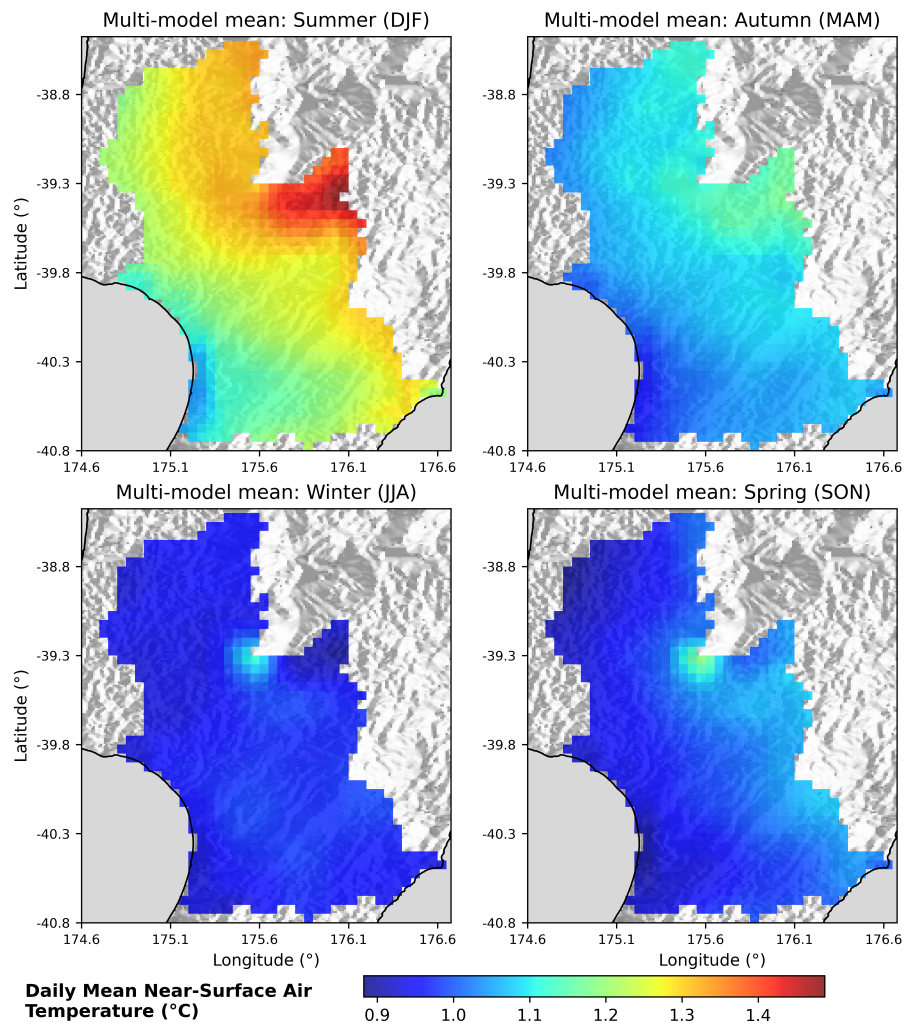


Figure 14: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP1-2.6 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



est/highest sub-regions); winter and spring see the lowest (near 1°C); autumn is intermediate. Inter-model spread in magnitude is present but low for the sign of change (all regions and seasons warm), resulting in very likely (>90% probability) regional warming and high confidence in minimal intra-regional variability.

Model agreement in spatial field structure is moderate (spatial R^2), but the absolute magnitude of projected warming is highly consistent. There is no area at risk of cooling. Inter-model spread is dominated by differences in scenario sensitivity rather than spatial disagreement, ensuring that practical planning can proceed on the basis that all regions and seasons will almost certainly warm by at least 1°C in the absence of emissions reversals, with greatest increases in summer. These findings emphasise the efficacy of low-emissions pathways but still indicate significant mid-century warming for all regional climates.

7.2 SSP2-4.5: Extremely likely region-wide warming, moderate magnitude; summer intensification

The projected changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP2-4.5 scenario, as simulated by the six different models, are shown in Figure 15. The multi-model mean changes in daily

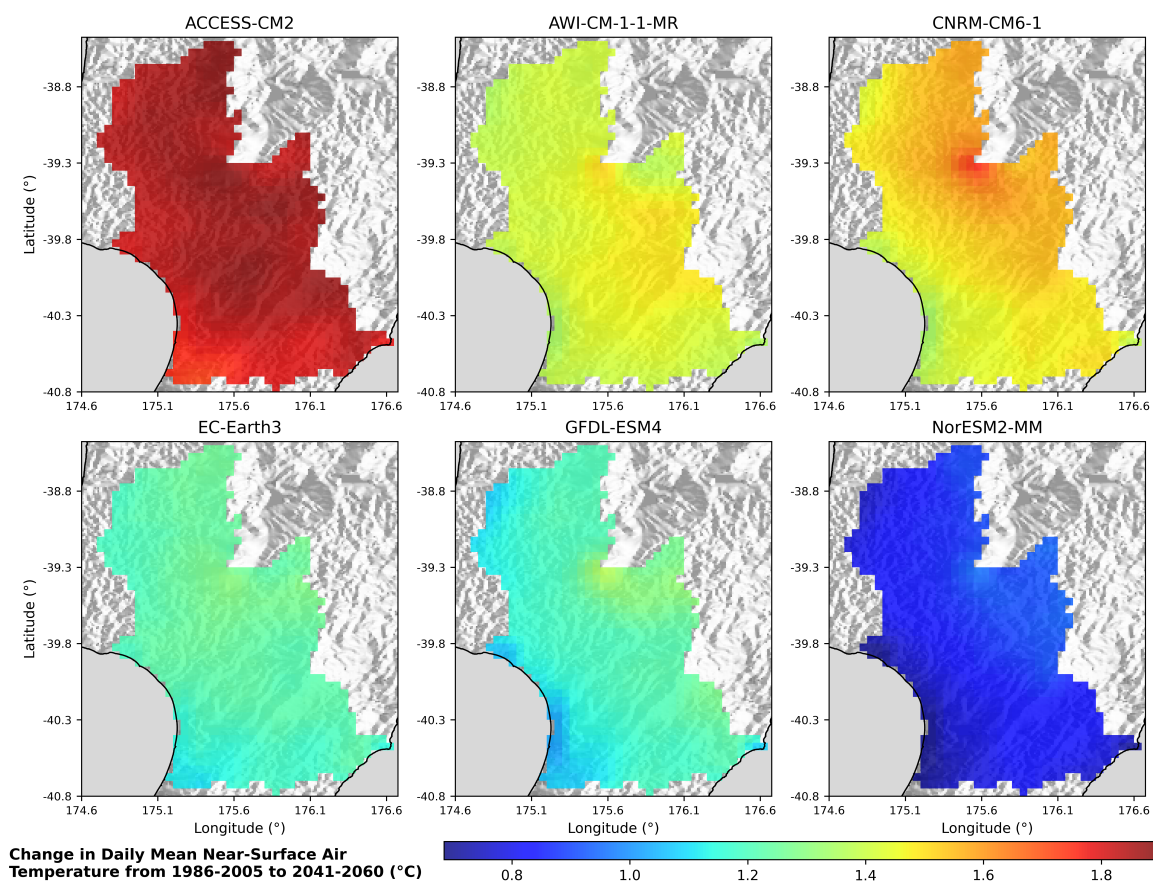


Figure 15: Projected changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP2-4.5 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 16.

For the Horizons region, SSP2-4.5 mid-century (2041–2060) projections indicate robust regional warming, with ensemble mean annual temperature increases of about 1.3°C compared to the 1986–2005 baseline. Warming is spatially coherent: inland and upland sub-regions (Volcanic Plateau, Upper Rangitikei) are projected to warm slightly more (approaching 1.4°C), while low-elevation and western sub-regions (Horowhenua, Whanganui–Manawatū Lakes) see the smallest increases (~1.2°C). No sub-region diverges conspicuously from the overall trend.

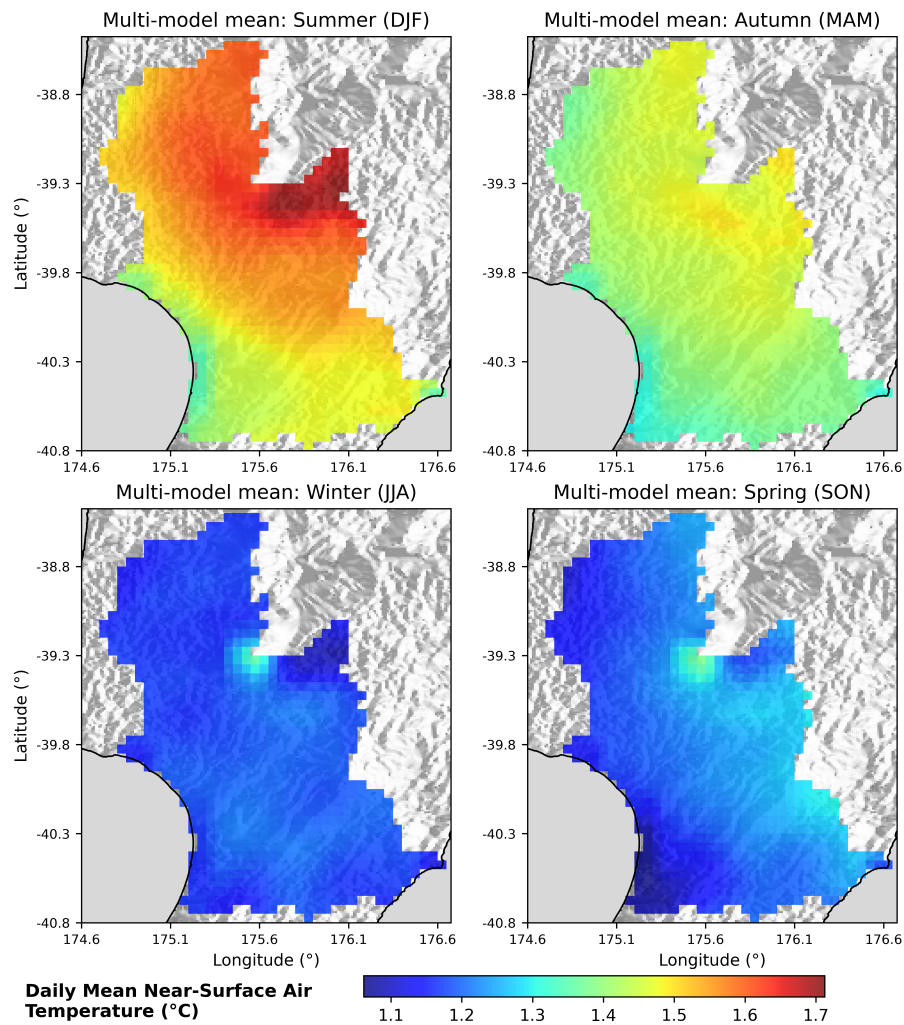


Figure 16: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP2-4.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



Seasonal warming is strongest in summer, with regional means exceeding 1.5°C for the warmest sub-regions and not dipping below 1.3°C in any sub-region. Winter and spring project a mean increase of around 1.2°C, while autumn lies between summer and winter. Percentile bounds (P5–P95) indicate all sub-regions see at least 0.75°C warming and may reach nearly 1.9°C (especially for outlier ensemble members in upland regions). Inter-model spread is moderate, but for the sign of change, consensus is virtually certain. Within-sub-region spatial variation remains extremely low (often under 0.03°C), making the signal operationally uniform across the region.

These projections are highly consistent with national-level results and with broader GCM-emulator outcomes, lending further confidence. While regional differences are modest, elevated sub-regions do emerge as warming slightly more in all seasons. In summary, very high confidence exists that the Horizons region will undergo mid-century warming of at least 1.2–1.4°C, with little spatial heterogeneity and no credible risk of cooling under SSP2-4.5.

7.3 SSP3-7.0: Extremely likely region-wide, moderate-to-large increases; summer amplified

The projected changes in daily mean air temperature from 1986–2005 to 2041–2060 under the SSP3-7.0 scenario, as simulated by the six different models, are shown in Figure 17. The multi-model mean changes in daily

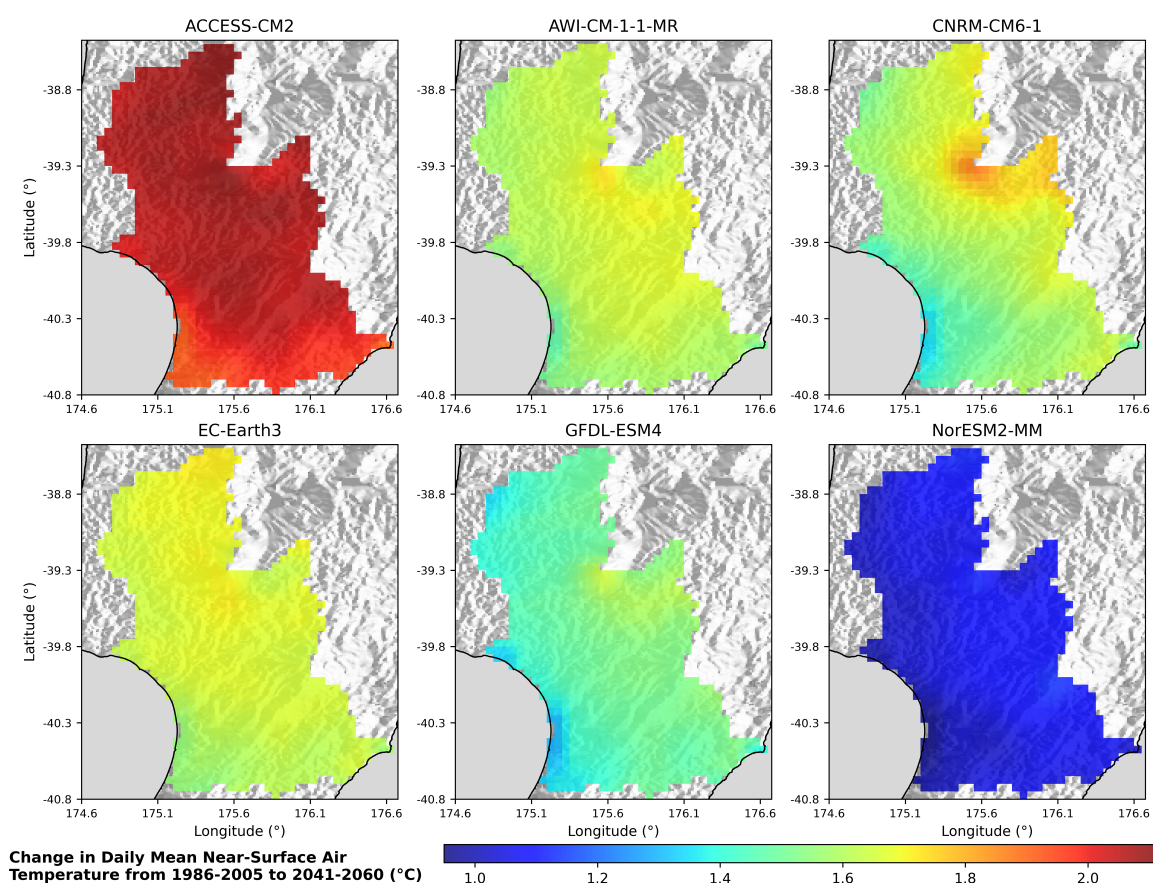


Figure 17: Projected changes in daily mean air temperature from 1986–2005 to 2041–2060 under the SSP3-7.0 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 18.

The high emissions scenario SSP3-7.0 yields mid-century (2041–2060) projections of substantial mean warming for the Horizons region, with regional annual average temperature rises of about 1.6°C relative to the 1986–2005 baseline. All models indicate pronounced, spatially consistent warming across the entire region. Upland and interior sub-regions continue to exhibit the largest mean increases (~1.63°C for the Volcanic Plateau and

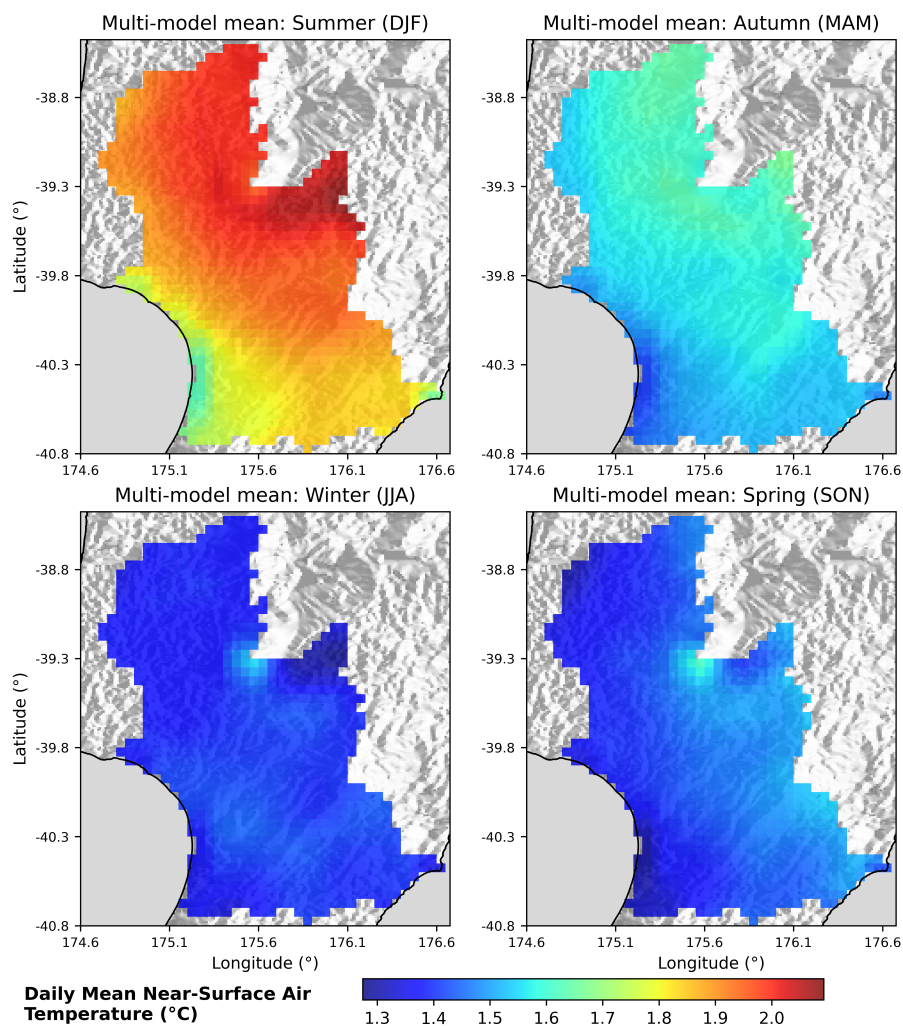


Figure 18: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP3-7.0 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



Upper Rangitikei), while coastal/lowland areas (Horowhenua, Whanganui–Manawatū Lakes) see slightly lower but still significant warming ($>1.45^{\circ}\text{C}$).

The seasonal cycle is accentuated: summer warming is strongest, with means reaching or exceeding 1.9°C in highland zones, and not falling below 1.7°C in any sub-region. Winter and spring project more modest but still robust warming ($1.3\text{--}1.5^{\circ}\text{C}$), with autumn displaying intermediate changes. The inter-model spread in mean and extreme projections is moderate, but no scenario or model produces local or sub-regional cooling, and probabilities for warming exceed 95% throughout.

Intra-region spatial standard deviations are uniformly low, further confirming the uniformity and reliability of the projected signal. Some uncertainty persists in precise magnitude due to differences in ensemble model sensitivity, but all plausible percentiles (P5–P95) remain positive and exceed 1°C across all sub-regions and seasons. There is thus extremely high confidence that robust, spatially widespread warming will dominate the Horizons region at mid-century under this high-emissions scenario, with regional differences only a secondary concern compared to the overarching increase in mean temperature.

7.4 SSP5-8.5: Extremely likely strong region-wide, spatially uniform warming; summer peaks

The projected changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP5-8.5 scenario, as simulated by the six different models, are shown in Figure 19. The multi-model mean changes in daily

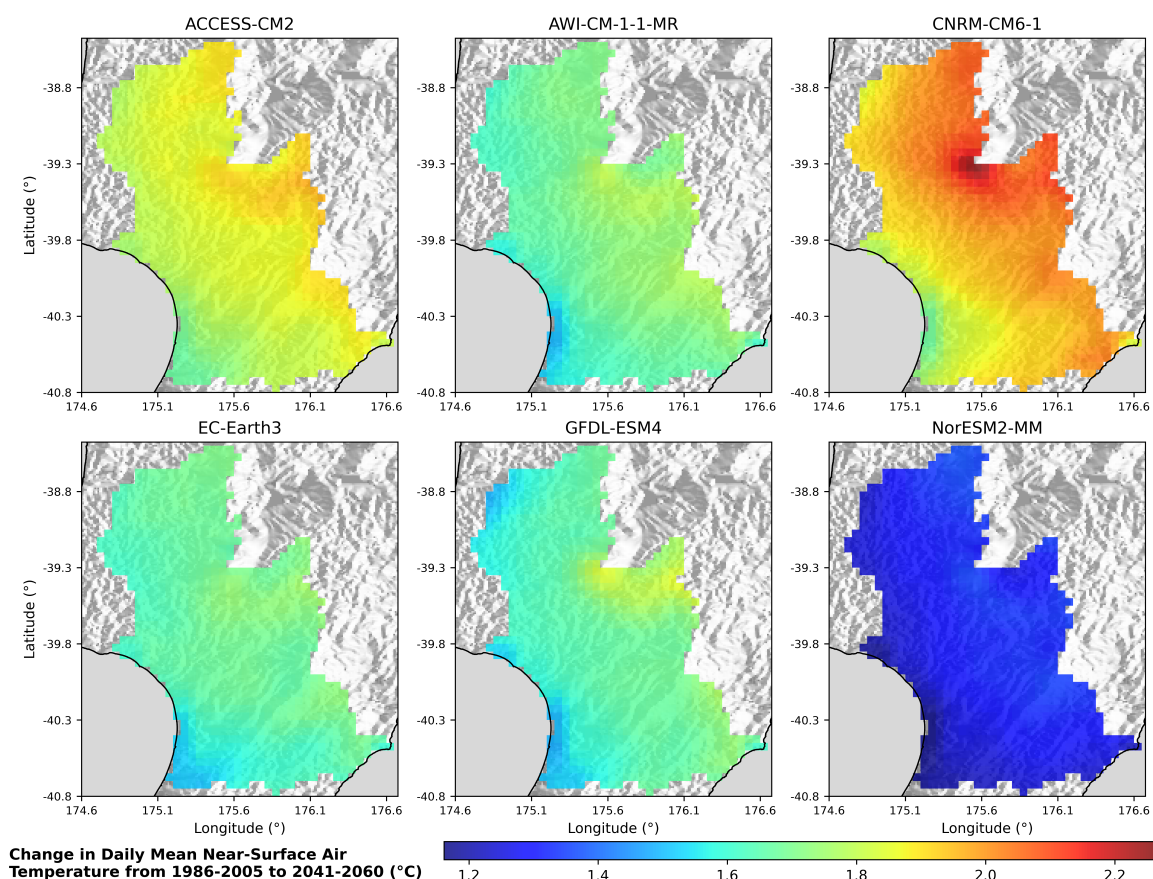


Figure 19: Projected changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP5-8.5 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 20.

Projections for 2041–2060 under the SSP5-8.5 (very high emissions) scenario highlight a similar regional warming magnitude to SSP3-7.0, with annual mean temperature increases averaging around 1.7°C above the 1986–

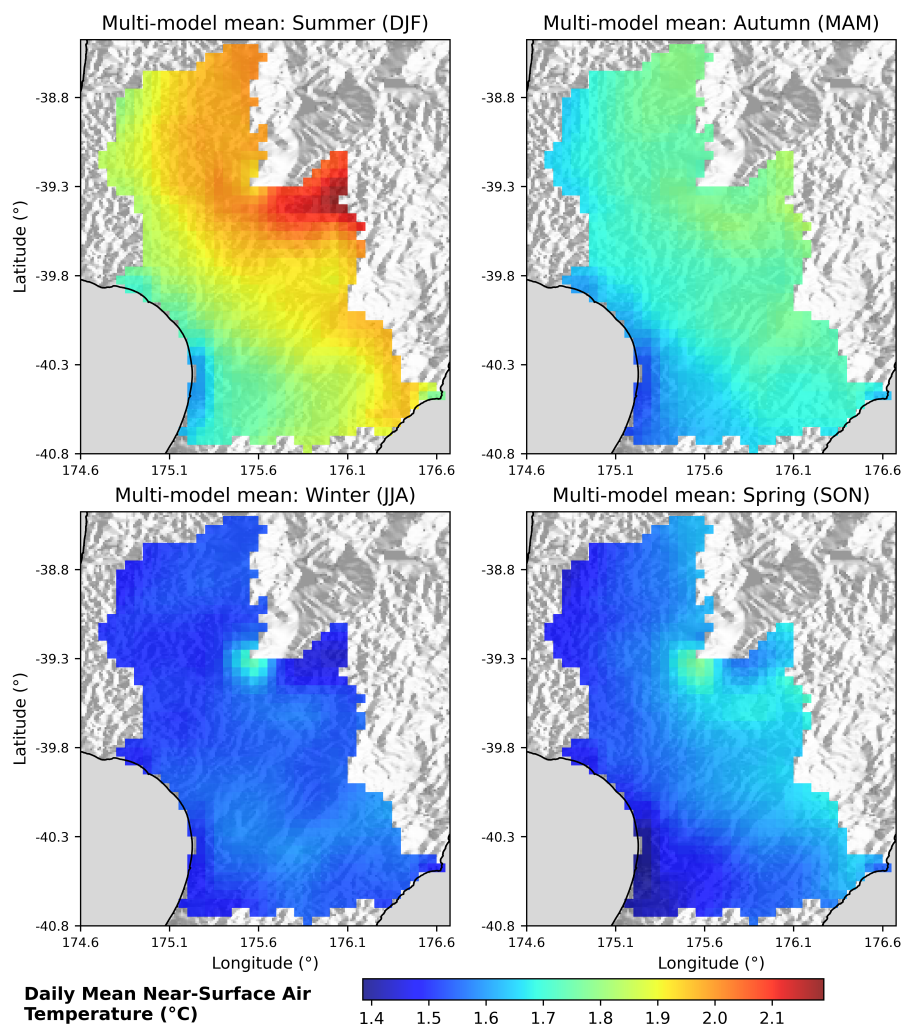


Figure 20: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2041-2060 under the SSP5-8.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



2005 baseline. Spatial differences persist: the Volcanic Plateau, Upper Rangitikei, Turakina, and Puketoi ki Tai sub-regions lead the regional distribution, each likely to warm by 1.7–1.75°C, while Horowhenua and Whanganui–Manawatū Lakes see the smallest increases (just above 1.54°C). All models agree on substantial spatially coherent warming at this horizon.

Seasonal cycles of warming are prominent: Summer (DJF) produces the largest increase, with region-wide means near or above 2°C and highland sub-regions exceeding 2°C. Winter and spring express smaller but highly reliable warming signals, with projected increases nearing 1.5–1.6°C. Seasonal ordering is consistent and uniform, with little internal model disagreement about the sign or presence of increased warming in summer. Standard deviations for projected changes are small (generally <0.05°C intra-sub-region), underpinning very high ensemble confidence.

The spread of projected changes is limited: P5–P95 percentiles in all sub-regions and seasons are well-separated from zero and overlap strongly with minimum and maximum fields, reflecting robust uncertainty characterisation. No sub-region stands out as anomalous, and local climate differences do not alter the broad regional pattern. Even at this relatively short lead time for scenario divergence, all plausible outcomes project a substantial temperature increase, confirming extremely high confidence in rising T_{mean} across the region for all planning, adaptation, and risk assessment purposes.

7.5 Comparison Across Scenarios

By 2041–2060, scenario-based divergence in projected mean air temperature for the Horizons region becomes evident but is not yet dominant. All four pathways (SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5) project robust regional warming, with mean annual increases clustering between 1°C (low emissions) and 1.7°C (very high emissions), scaling progressively with global radiative forcing. Seasonal structure is persistent: summer warming always leads, and all models and scenarios sustain virtually certain increases in each season and sub-region. The spatial signal is uniform with no prospect of regional cooling or exceptions. Differences in spatial pattern or magnitude between scenarios are smaller than the overall warming, but scenario divergence will intensify in subsequent periods. These mid-century projections thus provide a solid, high-confidence basis for planning, with robust agreement across models, seasons, and spatial scale.

8 Late-Century Projections (2080–2090)

By late-century (2080–2099), climate projections for the Horizons region converge on a scenario-dependent, robust, and regionally coherent warming signal for average daily air temperature (T_{mean}). The magnitude of projected warming now differs markedly between scenarios: SSP1-2.6 yields a mean annual increase just over 1°C; SSP2-4.5 projects about 2.2°C; SSP3-7.0 produces rises just above 3°C; and SSP5-8.5 reaches approximately 4°C. In all cases, every sub-region experiences substantial increases, and spatial variation (between zones such as Volcanic Plateau and Horowhenua) remains secondary to the region-wide signal.

Seasonal changes remain structured: warming is largest in summer (up to 4.8°C under SSP5-8.5), smallest in winter (but still above 3.7°C under high scenarios), with the difference between the hottest and coldest seasonally averaged increases often exceeding 1°C in upland zones. The spatial amplitude of warming is greater in interior and elevated sub-regions and smallest along the coast, while the absolute difference between strongest and weakest warming zones is always less than the total regional change.

All available model evidence and percentile statistics point to extremely high confidence (IPCC: virtually certain) that the entire Horizons region will warm significantly by late century. Ensemble spread in mean change is larger under higher-emission scenarios, but the direction and broad magnitude of warming never become ambiguous. The minimum (p5) and maximum (p95) ensemble values serve as highly reliable lower and upper bounds for regional uncertainty. In summary, the late-century climate is best described as one of substantial



and spatially coherent temperature increase—annual and seasonal warming is both a certainty and a dominant regional climate feature.

8.1 SSP1-2.6: Extremely likely modest, regionally uniform warming; high confidence, all seasons

The projected changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP1-2.6 scenario, as simulated by the six different models, are shown in Figure 21. The multi-model mean changes in daily

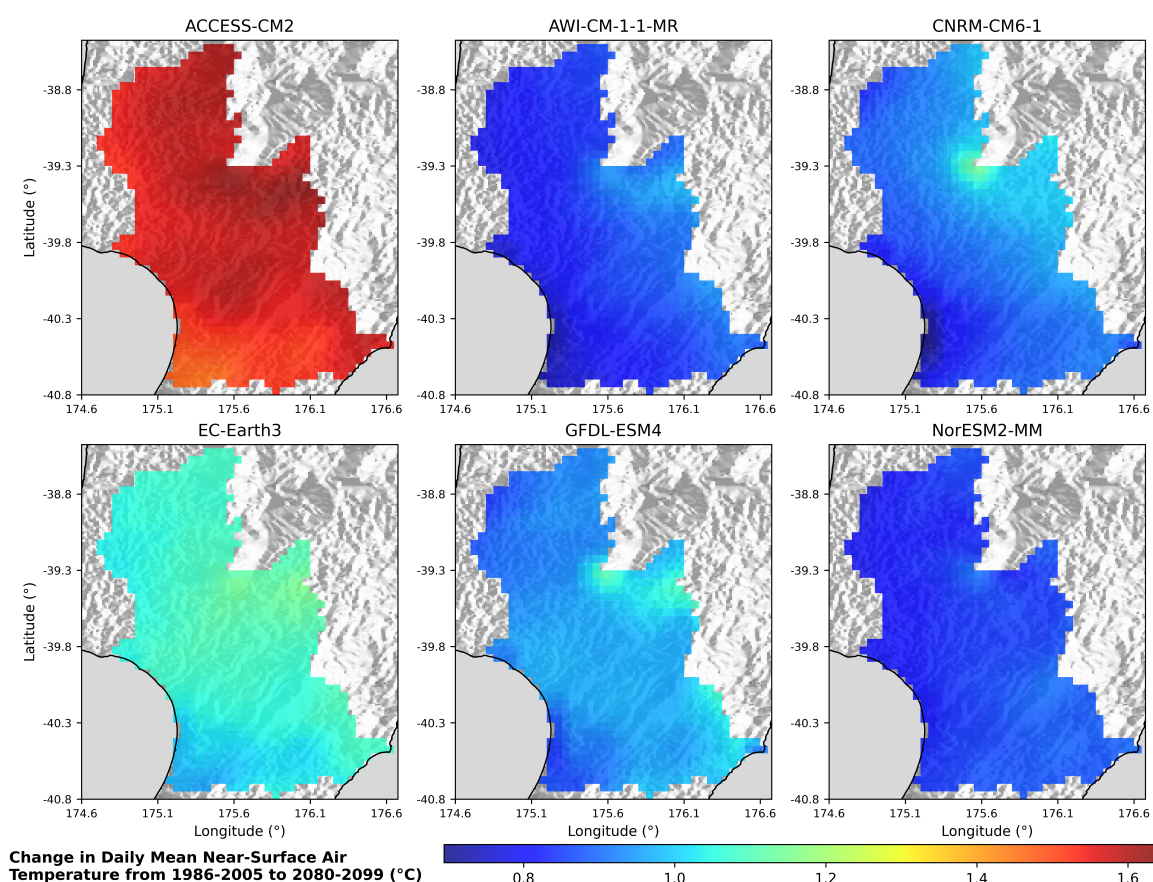


Figure 21: Projected changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP1-2.6 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 22.

Under SSP1-2.6, late-century (2080–2099) warming in the Horizons region, relative to the late 20th-century baseline, remains limited in magnitude but is still robustly positive and spatially coherent. All models project annual mean increases just above 1°C, with some scenarios yielding as little as 0.8°C and others exceeding 1.5°C. Sub-regional differentiation persists, but the gap between warmest and coolest zones is small relative to the overall change: Volcanic Plateau and Upper Rangitikei lead slightly in mean warming, but every region’s increase hovers near the 1°C benchmark.

Seasonally, warming is slightly greater in summer and autumn (up to 1.1°C) and modestly smaller in winter and spring (near 0.95°C). This seasonal structure is consistent across all models. Spatial patterning is uniform, with ensemble spread remaining moderate (standard deviations generally less than 0.04°C)—no sub-region is projected to warm notably less or more than the regional mean. Model agreement is high at both the annual and seasonal scales: minimum P5/95th percentile bounds for late century confirm virtually certain warming, and no model outcome produces localized or regional cooling.

The overall confidence in these projections is very high. Percentile ranges and standard deviations provide

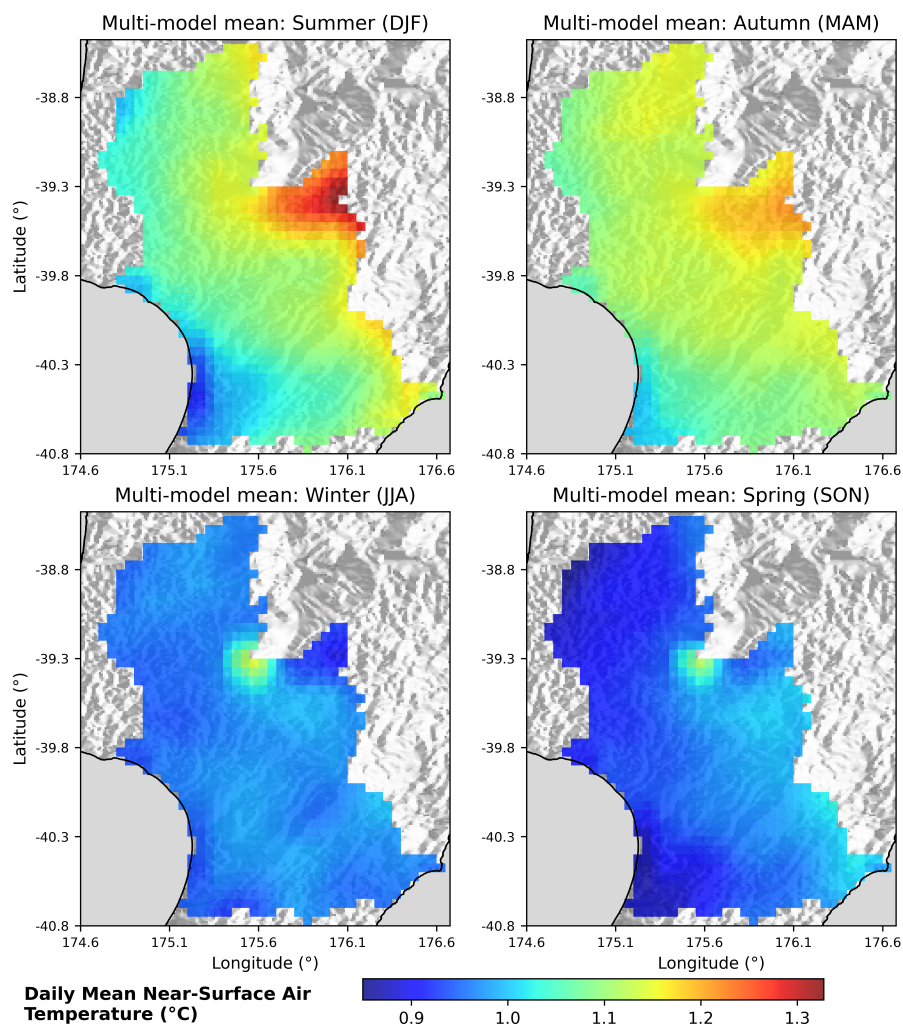


Figure 22: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP1-2.6 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



a strong indication that scenario-based uncertainty is now outpaced by global pathway differences, but all plausible late-century outcomes under this scenario indicate a modest but unequivocal rise. These findings emphasise that even under a greatly mitigated global climate response, the Horizons region can expect a persistent, spatially widespread, but low-magnitude warming signal through to the end of this century.

8.2 SSP2-4.5: Extremely likely large, regionally consistent warming; highest in summer

The projected changes in daily mean air temperature from 1986–2005 to 2080–2099 under the SSP2-4.5 scenario, as simulated by the six different models, are shown in Figure 23. The multi-model mean changes in daily

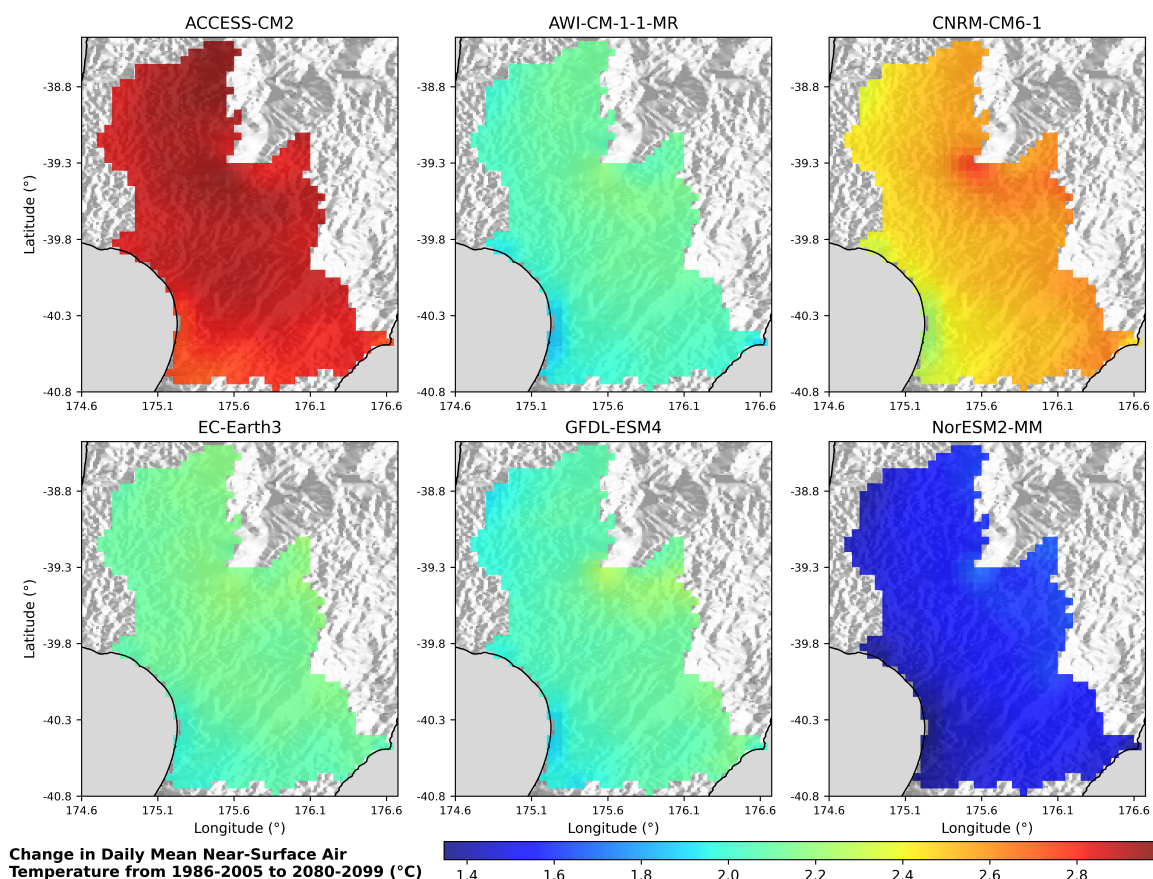


Figure 23: Projected changes in daily mean air temperature from 1986–2005 to 2080–2099 under the SSP2-4.5 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 24.

By 2080–2099, SSP2-4.5 produces a clear intensification and broadening of regional warming in T_{mean} for the Horizons region. Projected mean annual increases are about 2.2°C, with statistically significant, but operationally still modest, spatial gradients: upland and interior sub-regions like the Volcanic Plateau and Upper Rangitikei are projected to surpass 2.25°C, while Horowhenua and adjacent lake sub-regions warm by a minimum of 2.06°C. No area can be expected to see less than 2°C warming, confirming consistency and confidence.

Warming is greatest in summer (DJF), exceeding 2.5°C in the highest sub-regions and not dipping below 2.2°C in any area. Winter and spring increases, although lower at around 2°C, still reflect substantial deviations from baseline. Autumn's increases lie intermediate between summer and the cooler seasons. The amplitude of seasonal warming approaches or exceeds 0.5°C in the highest plateaus and is more muted at the coast, marking stronger seasonality amplification. Model spread in all sub-regions is remarkably low for both annual and seasonal means—standard deviations remain under 0.06°C and percentile-based uncertainty bounds (P5–P95) show a compressed range, reinforcing the validity of the regional, scenario-linked signal.

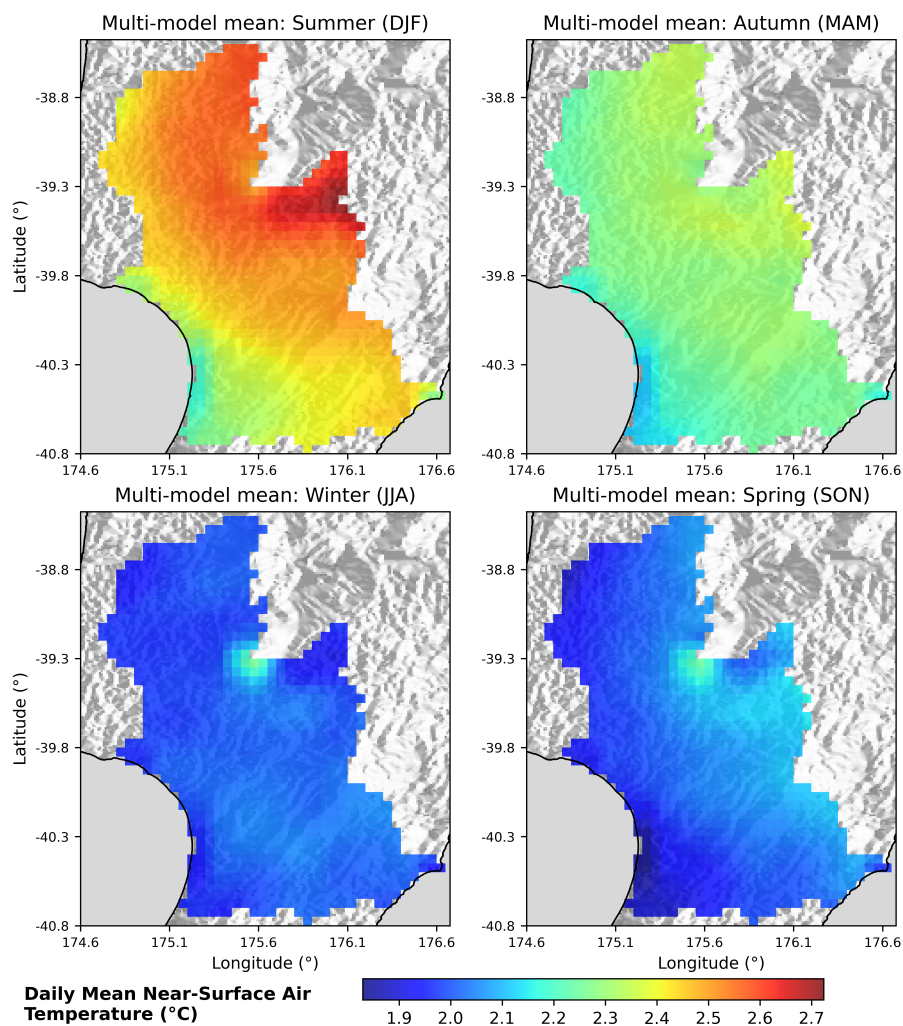


Figure 24: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP2-4.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



The late-century outcome for SSP2-4.5 is thus defined by a widespread, spatially coherent warming exceeding 2°C in all cases, with the degree of change now clearly distinguishable from lower scenarios and with sub-regional differences only subtly distinguishing the spatial pattern. The scientific evidence supports extremely high confidence in these results.

8.3 SSP3-7.0: Extremely likely, large, regionally coherent warming; summer increases dominate

The projected changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP3-7.0 scenario, as simulated by the six different models, are shown in Figure 25. The multi-model mean changes in daily

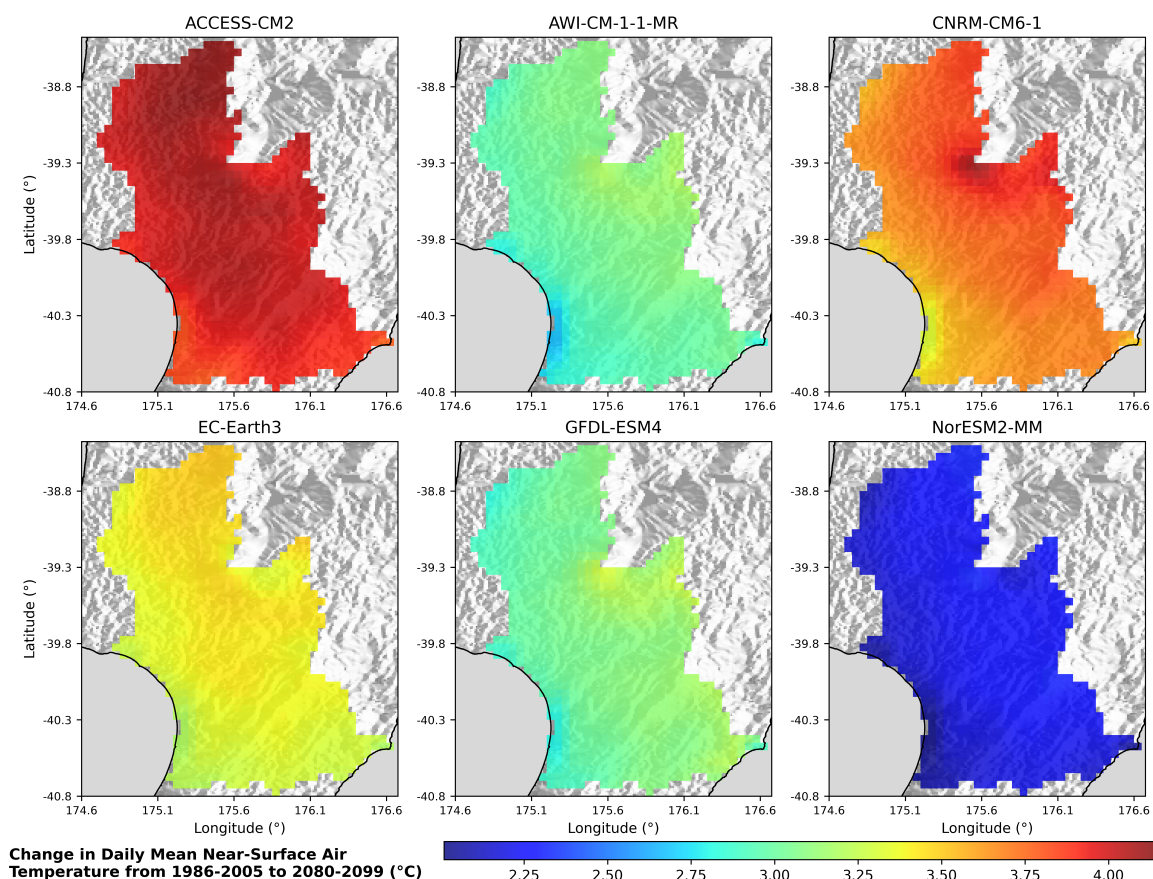


Figure 25: Projected changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP3-7.0 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 26.

Late-century (2080–2099) projections for the Horizons region under the high emissions SSP3-7.0 scenario reveal an unequivocal signal of widespread, large-magnitude temperature increase. Ensemble mean annual warming exceeds 3°C in all sub-regions, peaking at 3.31°C for the Volcanic Plateau and Upper Rangitikei, and only dipping slightly (to about 3.05°C) in Horowhenua and Whanganui–Manawatū Lakes. The upper range of projections reaches or surpasses 5°C in the warmest ensemble members, while the minimum outcome among all models and regions remains firmly above 2°C.

Seasonal amplification is clear: summer peaks at around 4°C in the hottest zones, with minimum summer warming for any sub-region still above 3.5°C. Winter, though remaining the season of smallest change, still projects mean increases above 2.8°C. Autumn and spring yield intermediate rises (3.1–3.9°C depending on sub-region and percentile). These seasonal and spatial patterns show high model agreement, with intra-region standard deviations and percentile spreads well below 0.1°C and no evidence of localised cooling anywhere.

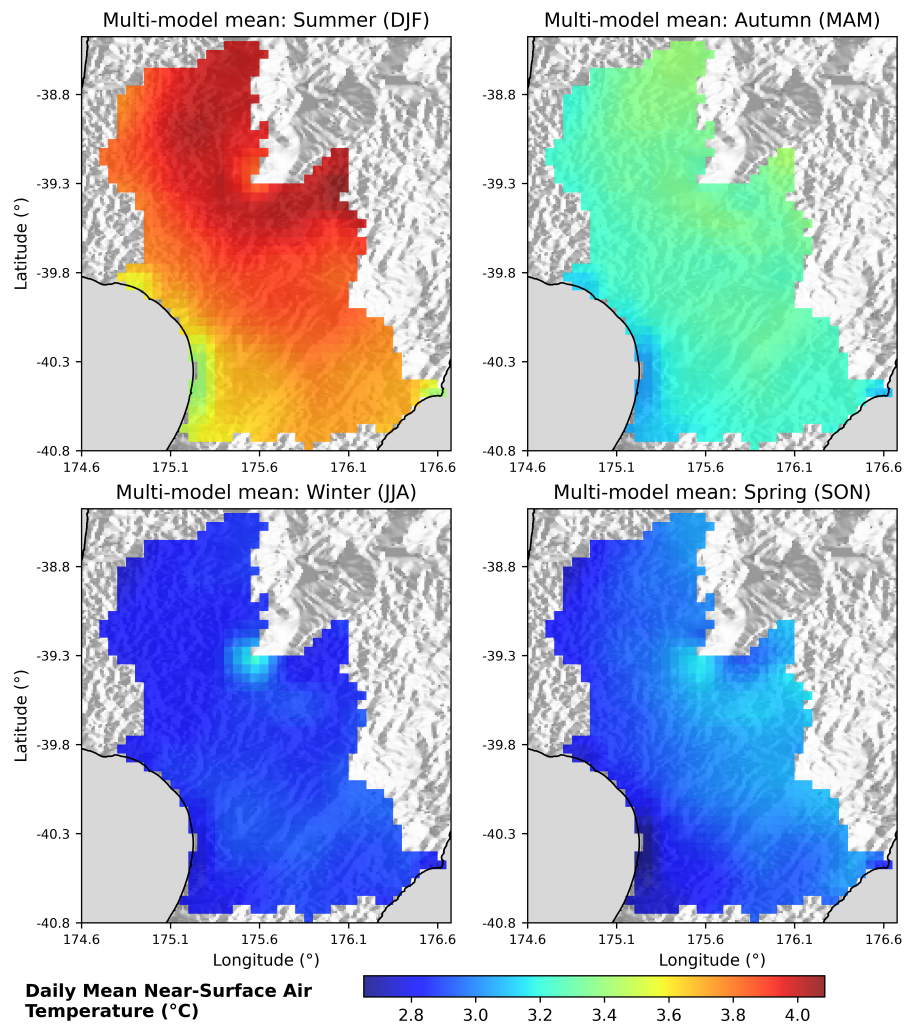


Figure 26: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP3-7.0 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



The pattern is also coherent in the spatial distribution: inland/elevated areas exhibit both highest absolute warming and the largest amplification of the seasonal thermal cycle, while coastal sub-regions show the lowest magnitude of warming and smallest intra-annual difference. Inter-model agreement is extremely high in sign and broadly in spatial pattern, and the magnitude of change now rivals or exceeds many historical cold-warm cycle amplitudes. The evidence supports virtually certain regional warming, with nearly all grid cells and sub-regions warming well above 3°C.

8.4 SSP5-8.5: Extremely likely, large-to-very large, regionally uniform warming, all seasons

The projected changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP5-8.5 scenario, as simulated by the six different models, are shown in Figure 27. The multi-model mean changes in daily

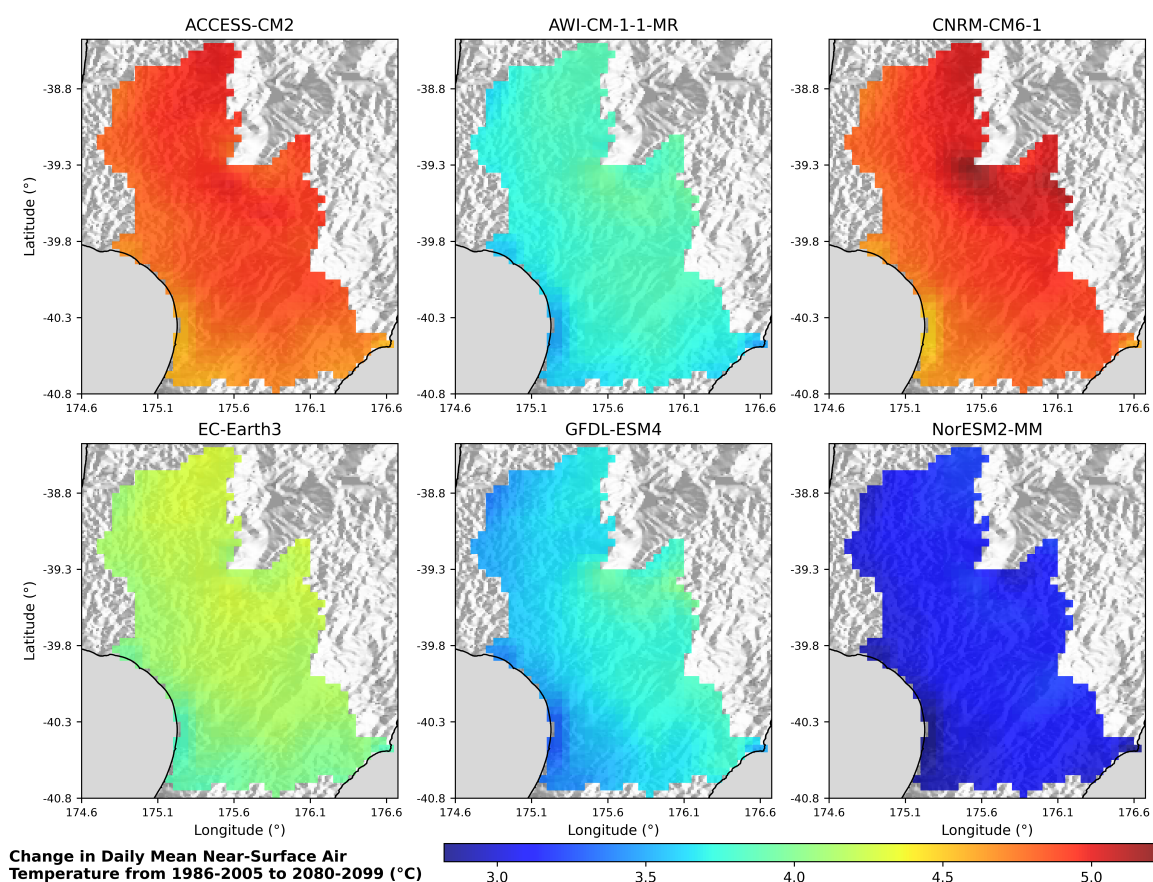


Figure 27: Projected changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP5-8.5 scenario. The original of this figure is available [here](#).

mean air temperature, for each season, are shown in Figure 28.

Under the SSP5-8.5 scenario, late-century (2080–2099) projections for the Horizons region reveal extremely likely, regionally uniform, and unprecedented warming. The mean annual T_{mean} increase approaches 4°C across all sub-regions, with maximum ensemble projections allowing for up to 5°C increases in the warmest locations and the most sensitive models. Even the least-affected zones (Horowhenua, Whanganui–Manawatū Lakes) are expected to warm by over 3.8°C—an increase more than four times the likely warming under low-emissions pathways.

Seasonal warming is most pronounced in summer: sub-regional means run 4.2–4.8°C above baseline, dwarfing historical interannual and spatial variability. Winter warming, although slightly lower (3.7–3.8°C), maintains a pattern of regional coherence but reflects smaller spatial and model-driven amplitudes. Autumn and spring project intermediate warming (3.7–4.2°C), contributing to an accentuated annual temperature cycle, especially

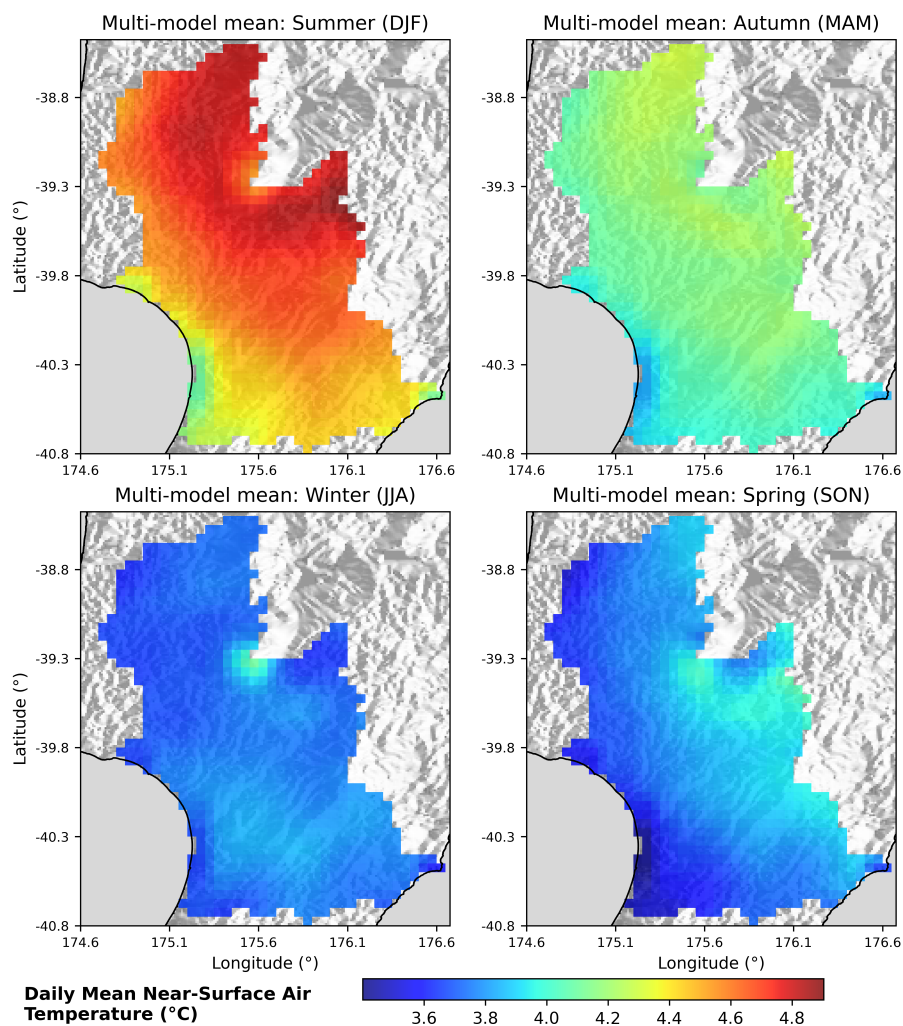


Figure 28: Multi-model mean changes in daily mean air temperature from 1986-2005 to 2080-2099 under the SSP5-8.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six models disagrees with the other five as to the sign of the change. Middle stippling shows where two of the six models disagree with the other four as to the sign of the change. Dense stippling shows where three of the six models disagree with the other three as to the sign of the change. The original of this figure is available [here](#).



in upland sub-regions (Volcanic Plateau, Upper Rangitikei). Spatial gradients persist but pale in comparison to the dominant region-wide rise.

Model agreement is extremely high in both magnitude and sign: standard deviations within sub-regions and seasons are under 0.1°C, and P5–95th percentile ranges are narrow relative to the magnitude of change. There is no model or sub-region with a divergent or outlier response. Percentile and minimum/maximum analysis demonstrates these statistical summaries track ensemble projections very closely, reflecting scientific robustness. In summary, late-century outcomes under SSP5-8.5 are virtually certain: very large warming, unprecedented spatial and seasonal uniformity, and compelling adaptation imperatives for all sectors in the region.

8.5 Comparison Across Scenarios

By 2080–2099, the magnitude of projected warming for the Horizons region diverges sharply between scenarios: from just above 1°C under SSP1-2.6 up to about 4°C under SSP5-8.5, with SSP2-4.5 and SSP3-7.0 yielding intermediate but still substantial increases. In all cases, ensemble and sub-regional means project robust, spatially consistent warming—no models or sub-regions show cooling, and percentile statistics confirm the near certainty of this response. Scenario becomes the dominant source of uncertainty and spatial differentiation, greatly exceeding inter-model or intra-regional differences. Seasonal structure persists, with summer warming accentuated and minor variations between upland inland and coastal regions. The scientific consensus across all scenarios is that large, spatially and seasonally uniform increases in mean air temperature are virtually certain for late-century, although the magnitude of change depends strongly on global emissions outcomes.

9 Evolution of Regional Hot-spots

A full breakdown on projected changes in daily mean air temperature by region is given in the Appendices. What follows below is a brief overview of those results.

Projected warming of T_{mean} is a region-wide feature for the Horizons region, but there is consistent spatial nuance that distinguishes certain sub-regions as relative hotspots or, conversely, areas of reduced change. Across all models, periods, and scenarios, the Volcanic Plateau and Upper Rangitikei stand out as the sub-regions projected to experience the largest absolute increases in daily mean air temperature. This holds true in annual metrics as well as during the warmest seasons (summer and, to a slightly lesser extent, autumn and spring). Notably, these hotspots correspond with areas that are presently among the region's coolest—consequence of elevation and interior location—so their amplified warming may represent a partial climatisation toward mean regional values, rather than outright reversal of baseline spatial patterns.

The spatial pattern is evident at multiple scales. Seasonally, summer (DJF) and autumn (MAM) consistently display the largest warming differentials, especially in these central-eastern and more elevated zones. Differences among scenarios become particularly pronounced by late century, with high- and very high-emissions pathways (SSP3-7.0 and SSP5-8.5) projecting increases of 3–5°C or more for hotspots, compared to increases of 2–3°C elsewhere. In some cases, the seasonal amplitude of warming (the difference between summer and winter warming) is up to 1°C greater in these upland regions than in coastal plains. This accentuation creates a convergence between elevated and low-elevation mean temperatures, potentially diminishing historical cold refugia and reducing some aspects of spatial climate diversity.

The counterpart to these hotspots are the low-lying, coastal and western sub-regions, such as Horowhenua and Whanganui-Manawatū Lakes, which are presently warmest and—throughout the scenario range—show the weakest proportional warming, regardless of baseline climate. This spatial pattern is robust, persisting even as all areas warm absolutely and even when the overall magnitude of warming doubles or triples under higher emissions scenarios.



Beyond the mean spatial pattern, seasonal differences further accentuate hotspot dynamics in future scenarios. The Volcanic Plateau, Upper Rangitikei, and occasionally Puketoi ki Tai show both the greatest summer warming and the greatest seasonal contrast (i.e., the gap between summer and winter warming is amplified most in these regions). These areas experience projected summer temperature changes that can be 0.3–0.5°C higher than in the warmest lowland sub-regions under moderate scenarios, and up to 1°C greater under the highest-forcing pathways. This spatial contrast sharpens for century-end scenarios, coinciding with shifts in growing season length and higher frequency and severity of heat-related extremes.

Hotspot dynamics have important adaptation implications. Agricultural systems in the Volcanic Plateau and interior regions will likely need to accommodate greater increases in summer heat, longer frost-free periods, altered phenological cues, and intensified evaporative demand. In contrast, the relative insulation of coastal and lowland sub-regions accentuates their potential as refugia for some land uses or for human settlement under sustained warming.

While hotspots and cool spots are persistent features, the ensemble model spread for these patterns is remarkably tight, conferring high confidence in the persistence (though not necessarily the magnitude) of these spatial differences. No sub-region displays highly anomalous responses that would challenge this pattern. There is also no evidence of spatially localised cooling or pronounced spatial variability that might otherwise dilute the regional signal.

In summary, regional hotspots for future warming align consistently with currently cool, elevated, or inland sub-regions, particularly the Volcanic Plateau and Upper Rangitikei, which show pronounced increases (especially for summer and under high-emissions scenarios). The lowland and coastal areas of Horowhenua and Whanganui-Manawatū Lakes are consistently coolest both at present and in future scenarios, and experience smaller future changes. These robust spatial patterns should inform place-based adaptation and infrastructure planning, as local exposure to increases in T_{mean} will shape many aspects of ecological and socio-economic risk.

10 Understanding Projection Uncertainty

10.1 Why uncertainty matters

Uncertainty in climate projections is inherent, reflecting a range of plausible futures shaped by emissions pathways, model structure, and natural climate variability. For temperature, particularly, different emission scenarios and climate sensitivities contribute to a wide spectrum of possible warming magnitudes. It is critical to characterise and communicate these uncertainties transparently, as they underpin risk assessments and adaptation strategies for stakeholders in the Horizons region.

In the near-term (2021–2040), uncertainties in T_{mean} projections are modest—dominated by natural inter-annual variability and model differences—while scenario-dependent uncertainty emerges strongly by mid-century and dominates by late-century. This means that, in early decades, any single scenario provides a fairly robust description of likely outcomes, but as time progresses, differences between SSPs (particularly in cumulative GHG forcing) result in much larger divergence in temperature increases. Such divergence is especially pronounced under higher-forcing scenarios, where the upper uncertainty range (i.e., the potential for extreme warming) expands substantially by 2080–2099.

From a practical standpoint, understanding uncertainty helps in designing flexible, low-regret adaptation strategies. For infrastructure resilience, agricultural management, or health system planning, awareness of both the robust signal of warming and the range of possible outcomes (including low-likelihood, high-impact scenarios) makes adaptation more robust. This is particularly relevant for decisions with long lead times or high legacy investments. Ultimately, quantifying uncertainties fosters risk-aware adaptation and enhances the transparency needed for effective community engagement and policy design.



10.2 Interpreting Ensemble Spread

The six-model ensemble used for T_{mean} projections in the Horizons region provides an empirically robust, though not exhaustive, estimate of inter-model spread. Where the ensemble shows narrow spread—i.e., models project similar magnitudes and patterns of change—confidence in the projections is high. This is the case for most baseline and near-future periods, with agreement on both spatial pattern and mean warming being extremely high. Where inter-model spread widens, as for late-century and high-emissions scenarios, uncertainty increases, chiefly in the magnitude of change rather than its sign.

Historical simulations show almost perfect spatial agreement, indicating models reliably capture present-day climate structure. For future projections, ensemble spread is narrow in the near-term, with low standard deviation in both means and spatial structures, modestly increasing for longer horizons and higher emissions. Notably, the ensemble mean provides a stable central estimate, and for most sub-regions and periods, outlier models (i.e., those projecting especially high or low warming) do not qualitatively alter the overall warming signal. Instead, they provide insight into the plausible range for risk management. The practical import of this spread is that the sign, direction, and general magnitude of regional warming can be assessed with very high confidence, while precise local detail is somewhat less certain, justifying adaptation planning based on ensemble means but with awareness of upper-end risks.

10.3 Minimum, Maximum and Percentile Fields

Minimum and maximum projected T_{mean} changes across the six-model ensemble provide useful, but not infallible, proxies for the 5th and 95th percentiles (P5/P95) of possible outcomes. Regression analyses between these extrema and the empirical percentiles reveal strong, but non-perfect, relationships: for most projection periods and scenarios, the R^2 values for minimum vs P5 and maximum vs P95 exceed 0.75 and are often above 0.90, with slopes close to but generally below unity. This means that while the minimum value often aligns with, or slightly underestimates, the P5 (offering a slightly more conservative lower bound), the maximum typically tracks or overstates the P95 (especially for heavier-tailed distributions under high-emissions scenarios).

This pattern suggests that for scenarios and periods with high model agreement (e.g., near-term under low or moderate forcing), the extremes and percentiles can be interchangeably used for practical uncertainty bounds. However, under higher emissions or further into the future, as spread enlarges, the approximation becomes less precise, especially for the upper tail. For decision-makers, this distinction means minimum and maximum values provide a useful guide for conservative planning but should be supplemented by formal percentile estimates where risk quantification is critical. Overall, percentile fields are advised for rigorous, risk-sensitive applications, while extremes remain reasonable for general communication of ranges.

11 Equilibrium Climate Sensitivity and Daily mean air temperature Change

11.1 Understanding ECS

Equilibrium climate sensitivity (ECS), representing the long-term global temperature response to doubled CO_2 , is a primary driver of inter-model differences in projected T_{mean} increases, especially at higher emissions and later periods. Models with higher ECS tend to project larger T_{mean} increases for the same emissions—this is evident for century-end projections, where models at the higher end of the ECS spectrum push upper regional warming toward the envelope's maximum.

However, ECS is not the sole determinant of regional outcomes. T_{mean} in the Horizons region is also modulated by regional climate feedbacks—cloud processes, oceanic influences, land-surface changes, and topography.



This multi-driver nature means that while ECS explains much of the divergence among model projections, some residual spread arises from structural differences in regional processes or internal climate variability. The influence of ECS is clearest under high-forcing (SSP3-7.0, SSP5-8.5), where the temperature response scales most directly with cumulative emissions and the global climate response.

In summary, ECS is a dominant, but not exclusive, explanation for model spread in regional warming. Its influence grows for higher emissions scenarios and longer timescales, making it an important, though not all-encompassing, factor in uncertainty assessment and communication.

12 Sources of Uncertainty

12.1 Emissions Uncertainty

By late century, uncertainty in T_{mean} projections is dominated by future greenhouse gas emissions. Differences between SSP1-2.6 (strong mitigation) and SSP5-8.5 (very high emissions) yield mean regional temperature projections differing by more than 3°C. In the near future, scenario uncertainty is minimal, but beyond 2050, divergence between pathways amplifies rapidly. This uncertainty is essentially societal—dependent on global trajectories of energy use, policy, and behaviour—and cannot be reduced through climate science alone. Therefore, the greatest potential for reducing future climate risk relates to mitigation efforts that limit emissions. The spread among scenarios is a compelling motivator for proactive mitigation and scenario-based adaptation planning.

12.2 Climate Model Uncertainty

Climate model structure and physical representation are another important uncertainty source. Differences in parameterisations for clouds, convection, land-surface feedbacks, and ocean-atmosphere processes manifest as variable climate sensitivities and regional feedbacks, producing spread in mean warming, seasonal amplitude, and spatial pattern. The six-model ensemble used here samples a substantial, but not full, range of plausible climate responses. Nevertheless, high regional agreement on T_{mean} trends, despite these structural differences, underlines the robustness of the warming signal in the Horizons region. Remaining model uncertainty primarily affects the exact magnitude of change and the local detail of warming patterns, rather than the headline outcome.

12.3 Natural Climate Variability

Natural climate variability, on interannual to multidecadal timescales, adds further uncertainty—especially for near-term and local projections. ENSO and other large-scale modes modulate both mean and extremes of T_{mean} , occasionally masking or amplifying background trends. In the first half of the century, such variability may cause realised temperatures to temporarily diverge from projected means, but by late century and under strong climate forcing, the anthropogenic signal becomes large enough to dominate. In practical terms, adaptation should account for both the strong warming trend and the continuing, often unpredictable, influence of variability.

12.4 Downscaling Uncertainty

The projections are derived using the CCAM regional climate model. Regional downscaling provides substantial benefits because it improves representation of New Zealand's complex topography and climatic gradients. However, downscaling introduces its own uncertainties associated with model parameterisations, boundary



conditions, and spatial resolution. Although these uncertainties are difficult to quantify directly, they should be recognised when interpreting local-scale projections. Importantly, the broad consistency of projected regional patterns across multiple climate models suggests that the major conclusions of this report are unlikely to be substantially altered by downscaling uncertainties.

13 Confidence Assessment

Applying IPCC “calibrated language”, the confidence assessment for projected T_{mean} changes in the Horizons region is as follows:

- Virtually certain (>99% probability): That regional mean daily air temperature will increase throughout the Horizons region in all future periods (2021–2040, 2041–2060, 2080–2099) and under all considered scenarios. This confidence is underpinned by universal model agreement and robust understanding of the climate system’s response to greenhouse gas accumulation.
- Extremely likely (>95% probability): That annual mean temperature increases by 2080–2099 will exceed 1°C under even the most ambitious mitigation scenario (SSP1-2.6), and by 4°C or more under the highest-forcing scenario (SSP5-8.5). The probability of local or seasonal cooling is vanishingly small.
- Very likely (>90% probability): That seasonal differences will persist, with summer and autumn experiencing the largest absolute warming and more muted, but still robust, increases in winter and spring. Upland and interior (e.g., Volcanic Plateau, Upper Rangitikei) regions are very likely hotspots for both mean and peak seasonal warming.
- Likely to extremely likely: That minimum and maximum ensemble values closely bracket the range of outcomes, with percentiles (P5 and P95) providing refined uncertainty bounds. For near-term (2021–2040) and mid-term (2041–2060) projections, inter-model spread remains modest, leading to very high confidence in both sign and approximate magnitude for adaptation planning. For century-end and high-emissions scenarios, likely confidence can be ascribed to upper-end projections, though some uncertainty remains for low-probability, high-impact extremes.

Overall, the evidence base—encompassing both dynamical downscaling and a multi-model ensemble—justifies extremely high confidence in the region’s warming trajectory, with some reduction in confidence for detailed local spatial structure and for extreme upper-end outcomes under strong climate forcing.

14 Conclusions

The synthesis demonstrates with extremely high confidence that average daily air temperature (T_{mean}) in the Horizons region will increase substantially over the 21st century, regardless of emissions scenario, with the eventual magnitude contingent strongly on future GHG emissions. The underlying spatial climatology is robust, dominated by a marked elevation-driven gradient captured with nearly perfect agreement by all assessed models. All scenarios produce a regionally coherent warming signal, with increases of approximately 1°C by mid-century even under strong mitigation, and 4°C or more under high emissions by 2080–2099.

Spatial differences in projected change are modest: the Volcanic Plateau and Upper Rangitikei consistently emerge as warming hotspots, while Horowhenua and Whanganui-Manawatū Lakes display more muted—but still substantial—increases. The seasonal signal is consistent and robust: summer and autumn experience the greatest warming, while winter and spring see more moderate, though still significant, increases. Model agreement is outstanding for the sign of change and strong for the magnitude, though precise local details are less certain, especially in outlying or topographically complex zones.

Uncertainty is governed by both emissions pathway (becoming dominant after mid-century) and model struc-



ture. Ensemble extremes (minimum and maximum) give reliable uncertainty bounds, but percentile fields (P5/P95) are preferable for precise risk management and quantification of tail risks, especially under scenarios with greater spread. Downscaling adds value but does not alter the conclusion of geographically widespread, consistent warming.

In terms of adaptation, the future climate of the Horizons region will be notably warmer, with implications for agriculture, biodiversity, water resources, infrastructure, and public health. Hotter summers, reduced cold extremes, and changes in seasonal amplitude should motivate flexible, forward-looking adaptation strategies, including selection of heat- and drought-resistant crops, heat-proofing infrastructure, and enhanced water management. The uniformity and strength of the warming signal underscore the need for a shift from whether change will occur to how best to prepare for, and respond to, a regionally warmer future.

15 Appendices

A map of the sub-regions reported on below is provided in Figure 29. Some of these sub-regions exhibit a



Figure 29: A map of the regions reported on in these appendices.

wide range of elevations which can increase the spatial heterogeneity of the data, especially for temperature related climate variables. This is visible in the larger 1σ standard deviations for those regions listed in the tables below which represent the *spatial spread* of the values within each region (not the intrinsic uncertainty on the values). Histograms of elevations for each region, at the native resolution of the CCAM model, are shown in Figure 30. The Volcanic Plateau, Upper Rangitikei, and, to a lesser extent, the Western Ruahine regions contain a significant number of model cells at elevations above 700 m. For locations at elevation extremes within any

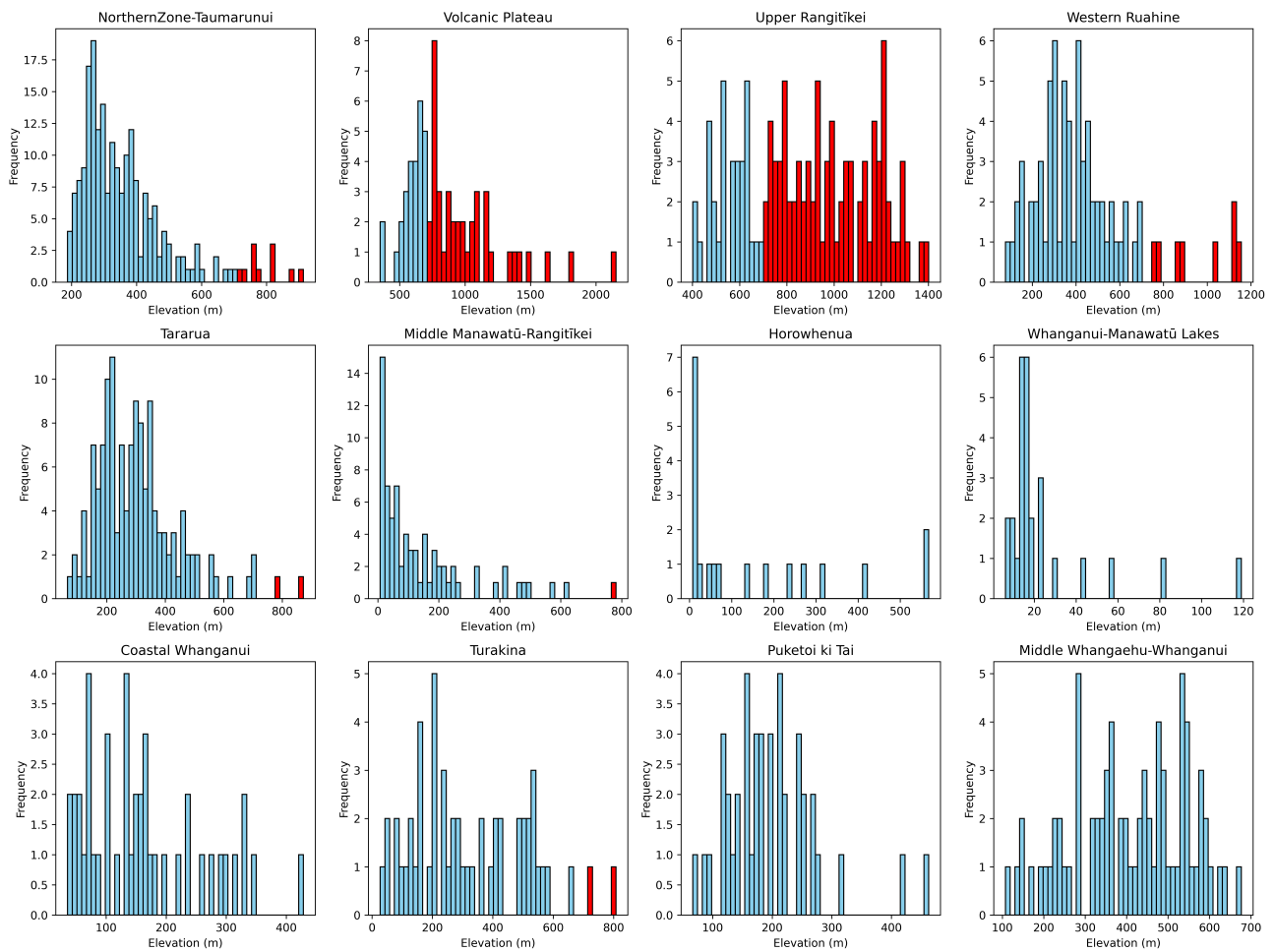


Figure 30: Histograms showing the number of CCAM model cells at each elevation. Histogram bars at elevations exceeding 700 m are shown in red. The original of this figure is available [here](#).



region, the regional average values listed in the tables below may not be indicative of the value at that specific location and the user would do better to consult the data shown as maps for the whole Horizons region and consider the CCAM model value closest to their location.

15.1 Region: NorthernZone-Taumarunui

Area: 5084.04 km²

15.1.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 31. The statistical summary of projected changes in daily mean air temperature over this region is shown

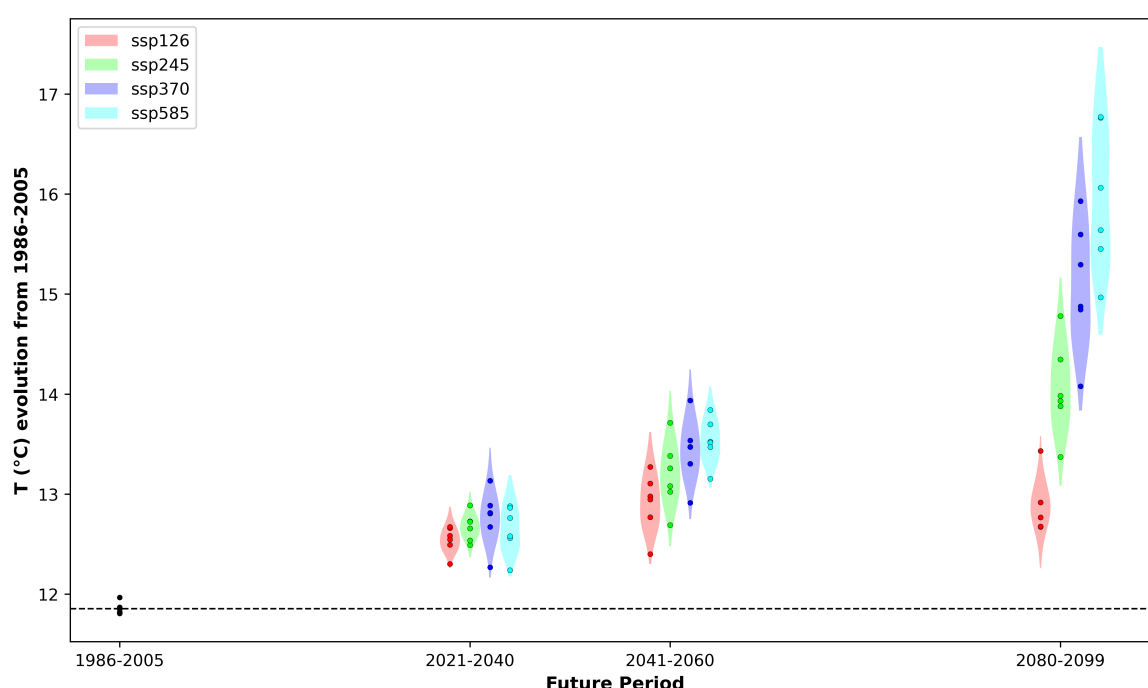


Figure 31: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the NorthernZone-Taumarunui region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

in Table 1. The figure and statistics indicate a very likely increase in annual mean air temperature across the NorthernZone-Taumarunui region through the 21st century, relative to the 1986–2005 baseline. Multi-model mean warming by 2021–2040 ranges between approximately 0.7°C under SSP1-2.6 and 0.9°C under SSP3-7.0, with extremely likely and consistent increases across all emissions pathways. By 2041–2060, projected warming further diverges by scenario: about 1.1°C for SSP1-2.6, up to around 1.7°C for SSP5-8.5, and by 2080–2099 ranges from 1.0°C (SSP1-2.6) to 4.1°C (SSP5-8.5), illustrating a substantial scenario dependency and a likely range of regional outcomes. Inter-model spread within individual scenarios is moderate, but scenario divergence dominates later in the century. The percentage agreement across scenarios drops sharply, from 42% in the 2021–2040 period to 0% by century-end, highlighting increasing uncertainty about the emissions pathway. Spatial variability (standard deviation across the region) remains very low (<0.07°C), suggesting the warming signal is spatially uniform. In summary, substantial, regionally consistent annual warming is virtually certain, with the magnitude by late century strongly dependent on global emissions; higher emissions scenarios result



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.86 ± 0.86	11.86 ± 0.86	11.86 ± 0.86	11.86 ± 0.86
	2021-2040	0.69 ± 0.02	0.82 ± 0.02	0.91 ± 0.02	0.79 ± 0.02
	2041-2060	1.06 ± 0.02	1.34 ± 0.03	1.58 ± 0.03	1.68 ± 0.04
	2080-2099	1.02 ± 0.02	2.19 ± 0.04	3.25 ± 0.05	4.09 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.69 ± 0.02	0.82 ± 0.02	0.92 ± 0.02	0.80 ± 0.02
	2041-2060	1.07 ± 0.02	1.35 ± 0.03	1.59 ± 0.03	1.69 ± 0.04
	2080-2099	1.02 ± 0.02	2.21 ± 0.04	3.28 ± 0.05	4.14 ± 0.07
Multi-model minimum	Baseline	11.81 ± 0.86	11.81 ± 0.86	11.81 ± 0.86	11.81 ± 0.86
	2021-2040	0.45 ± 0.02	0.64 ± 0.03	0.41 ± 0.02	0.38 ± 0.02
	2041-2060	0.55 ± 0.03	0.84 ± 0.03	1.06 ± 0.03	1.30 ± 0.04
	2080-2099	0.82 ± 0.02	1.52 ± 0.05	2.22 ± 0.05	3.11 ± 0.07
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.50 ± 0.02	0.62 ± 0.03	0.51 ± 0.02	0.45 ± 0.02
	2041-2060	0.63 ± 0.02	0.85 ± 0.03	1.12 ± 0.03	1.35 ± 0.03
	2080-2099	0.62 ± 0.02	1.53 ± 0.04	2.33 ± 0.05	3.08 ± 0.06
Multi-model maximum	Baseline	11.97 ± 0.86	11.97 ± 0.86	11.97 ± 0.86	11.97 ± 0.86
	2021-2040	0.82 ± 0.01	1.03 ± 0.02	1.28 ± 0.02	1.03 ± 0.02
	2041-2060	1.42 ± 0.02	1.86 ± 0.02	2.08 ± 0.02	1.99 ± 0.06
	2080-2099	1.58 ± 0.02	2.92 ± 0.04	4.07 ± 0.05	4.92 ± 0.08
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.91 ± 0.02	1.05 ± 0.01	1.37 ± 0.02	1.20 ± 0.03
	2041-2060	1.56 ± 0.03	1.91 ± 0.02	2.13 ± 0.02	2.07 ± 0.04
	2080-2099	1.47 ± 0.02	2.99 ± 0.04	4.36 ± 0.06	5.34 ± 0.08

Table 1: The statistics of the projected changes in daily mean air temperature in units of °C over the NorthernZone-Taumarunui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



in much larger increases. Confidence in both the direction and broad spatial uniformity of the warming signal is very high.

15.1.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 32. The statistical summary of projected changes in daily mean air temperature over this region

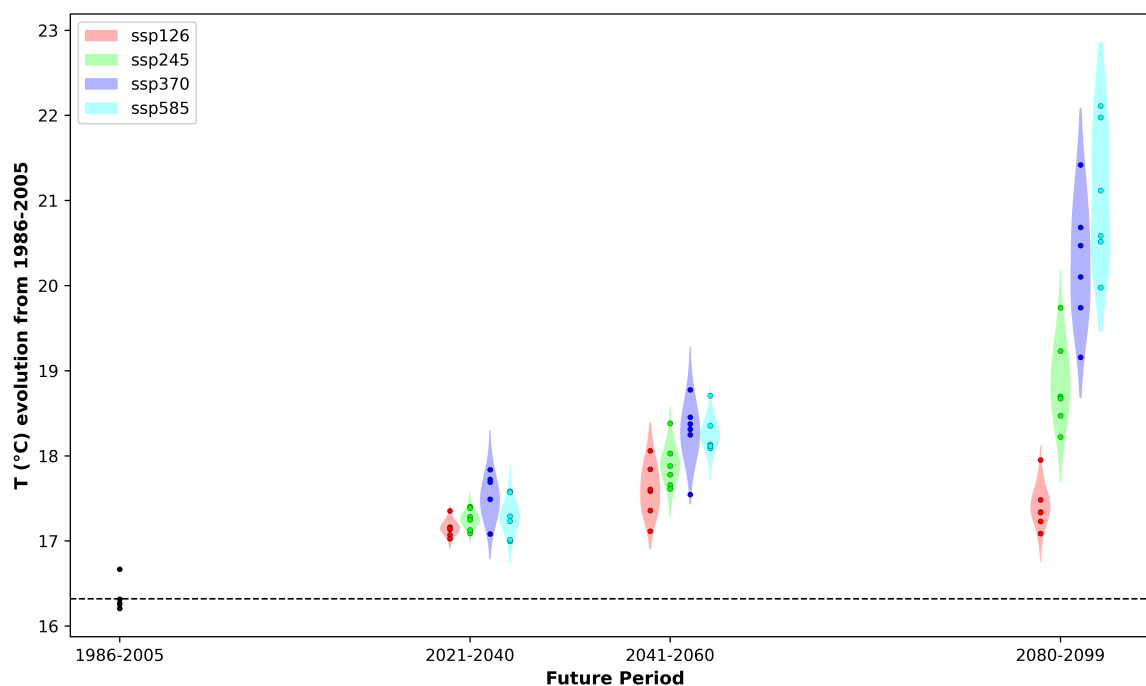


Figure 32: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the NorthernZone-Taumarunui region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

is shown in Table 2. Projected summertime average daily temperatures in the NorthernZone-Taumarunui sub-region show a clear warming signal throughout the 21st century, with the magnitude and rate of change highly dependent on the emissions pathway. All scenarios indicate that it is virtually certain temperatures will increase relative to the 1986–2005 baseline. By 2021–2040, mean increases range from about 0.8°C to 1.2°C across scenarios, with extremely likely (>95% probability) modest inter-model agreement and minimal spatial variability. For mid-century (2041–2060), projected warming intensifies, especially under higher emission pathways, with mean rises of 1.3°C under low emissions (SSP1-2.6) and up to 2.0°C under SSP3-7.0 and SSP5-8.5. By late-century (2080–2099), the divergence between scenarios becomes pronounced: low emissions (SSP1-2.6) plateau at approximately 1.1°C above baseline, while the high emissions scenario (SSP5-8.5) projects likely increases nearing 4.7°C, with individual model projections reaching above 5.7°C. Inter-scenario agreement decreases markedly over time, dropping to zero by century's end, reflecting substantial scenario-driven uncertainty. Across all periods, spatial variability within NorthernZone-Taumarunui remains low, indicating a robust regional signal. In summary, significant and robust warming is very likely, but the extent of late-century change is strongly scenario-dependent, and high confidence can be placed in the direction but not the absolute magnitude of projected changes.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	16.32 ± 0.82	16.32 ± 0.82	16.32 ± 0.82	16.32 ± 0.82
	2021-2040	0.83 ± 0.02	0.94 ± 0.03	1.16 ± 0.03	0.96 ± 0.03
	2041-2060	1.27 ± 0.04	1.57 ± 0.04	1.96 ± 0.04	1.93 ± 0.05
	2080-2099	1.08 ± 0.04	2.52 ± 0.05	3.94 ± 0.07	4.73 ± 0.09
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.83 ± 0.02	0.94 ± 0.03	1.17 ± 0.03	0.96 ± 0.03
	2041-2060	1.28 ± 0.04	1.57 ± 0.04	1.97 ± 0.04	1.93 ± 0.05
	2080-2099	1.09 ± 0.04	2.54 ± 0.05	3.97 ± 0.07	4.78 ± 0.09
Multi-model minimum	Baseline	16.20 ± 0.82	16.20 ± 0.82	16.20 ± 0.82	16.20 ± 0.82
	2021-2040	0.70 ± 0.02	0.77 ± 0.03	0.74 ± 0.03	0.67 ± 0.04
	2041-2060	0.79 ± 0.05	1.29 ± 0.04	1.22 ± 0.04	1.76 ± 0.05
	2080-2099	0.77 ± 0.07	1.90 ± 0.06	2.84 ± 0.07	3.66 ± 0.11
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.67 ± 0.02	0.76 ± 0.02	0.71 ± 0.03	0.61 ± 0.03
	2041-2060	0.80 ± 0.04	1.18 ± 0.04	1.40 ± 0.04	1.60 ± 0.04
	2080-2099	0.68 ± 0.05	1.75 ± 0.06	2.84 ± 0.07	3.54 ± 0.09
Multi-model maximum	Baseline	16.67 ± 0.82	16.67 ± 0.82	16.67 ± 0.82	16.67 ± 0.82
	2021-2040	1.03 ± 0.04	1.08 ± 0.04	1.52 ± 0.03	1.26 ± 0.04
	2041-2060	1.74 ± 0.03	2.06 ± 0.04	2.45 ± 0.04	2.39 ± 0.08
	2080-2099	1.63 ± 0.05	3.42 ± 0.05	5.10 ± 0.09	5.79 ± 0.11
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.00 ± 0.04	1.13 ± 0.05	1.69 ± 0.03	1.34 ± 0.04
	2041-2060	1.83 ± 0.04	2.00 ± 0.04	2.62 ± 0.04	2.29 ± 0.08
	2080-2099	1.53 ± 0.04	3.42 ± 0.05	5.26 ± 0.08	6.19 ± 0.10

Table 2: The statistics of the projected changes in daily mean air temperature in units of °C over the NorthernZone-Taumarunui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



15.1.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 33. The statistical summary of projected changes in daily mean air temperature over this region is

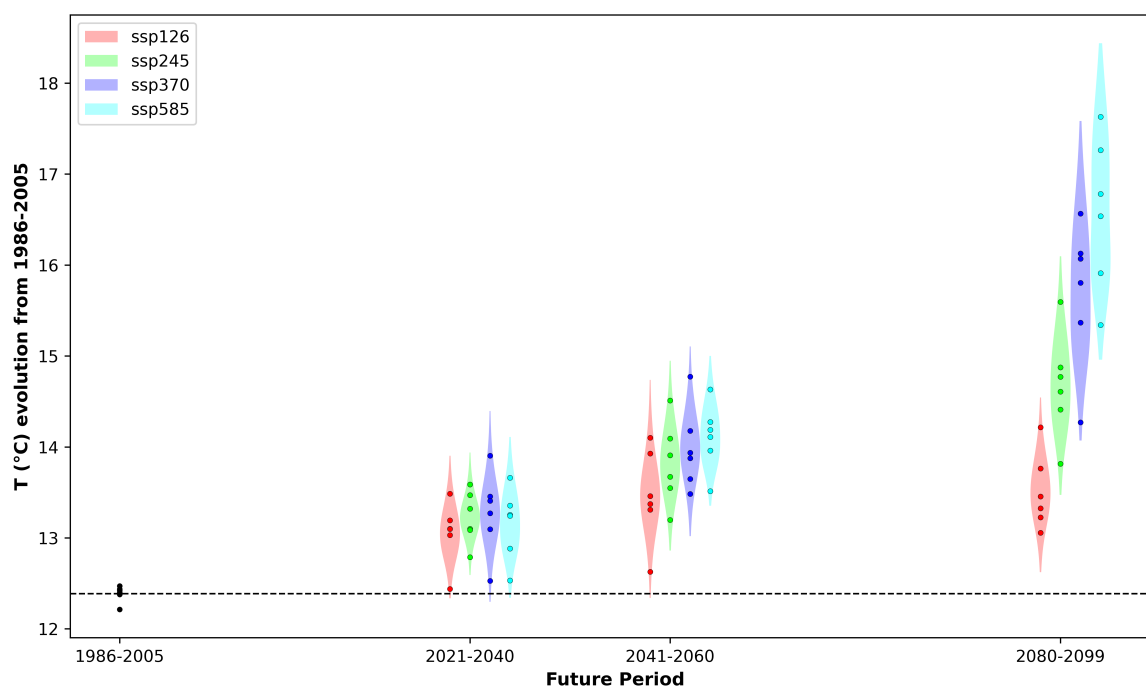


Figure 33: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the NorthernZone-Taumarunui region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 3. Projections for autumn mean air temperature in the NorthernZone-Taumarunui sub-region indicate a robust warming trend across all emissions scenarios compared to the 1986–2005 baseline. By 2021–2040, mean temperature increases are likely, in the range of approximately 0.7 to 0.9°C above baseline, with very high inter-scenario agreement (about 65%) supporting this as a likely outcome with medium confidence. Model spreads are limited, indicating high consistency.

By 2041–2060, projected warming intensifies, ranging from around 1.1°C under low emissions (SSP1-2.6) to over 1.7°C under high emissions (SSP5-8.5). Inter-model agreement remains high but inter-scenario divergence grows, indicating an increasing role for emissions pathway and a decrease to low agreement (about 22%) by this period.

For late century (2080–2099), warming projections diverge substantially—from roughly 1.1°C (SSP1-2.6) to more than 4.2°C (SSP5-8.5). This divergence indicates scenario is the dominant driver under future emissions, with almost no inter-scenario agreement. Spatial variability across the region remains low throughout, giving high confidence in the spatially coherent regional signal, even as scenario uncertainty dominates the projection range.

Overall, warming is virtually certain, and the magnitude of change by late-century is extremely likely to depend strongly on global emissions pathways. Early- to mid-century changes are more consistently projected across models and scenarios, increasing confidence in near-term trends.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.39 ± 0.85	12.39 ± 0.85	12.39 ± 0.85	12.39 ± 0.85
	2021-2040	0.67 ± 0.02	0.84 ± 0.02	0.89 ± 0.03	0.77 ± 0.02
	2041-2060	1.08 ± 0.03	1.43 ± 0.03	1.59 ± 0.03	1.73 ± 0.04
	2080-2099	1.12 ± 0.02	2.29 ± 0.04	3.31 ± 0.05	4.19 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.68 ± 0.02	0.84 ± 0.02	0.90 ± 0.03	0.78 ± 0.02
	2041-2060	1.09 ± 0.03	1.45 ± 0.03	1.61 ± 0.03	1.74 ± 0.04
	2080-2099	1.13 ± 0.02	2.31 ± 0.04	3.34 ± 0.05	4.24 ± 0.07
Multi-model minimum	Baseline	12.21 ± 0.84	12.21 ± 0.84	12.21 ± 0.84	12.21 ± 0.84
	2021-2040	0.05 ± 0.02	0.40 ± 0.03	0.14 ± 0.03	0.15 ± 0.02
	2041-2060	0.24 ± 0.02	0.81 ± 0.04	1.10 ± 0.05	1.13 ± 0.06
	2080-2099	0.67 ± 0.03	1.43 ± 0.04	1.88 ± 0.05	2.95 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.20 ± 0.02	0.44 ± 0.03	0.26 ± 0.03	0.22 ± 0.02
	2041-2060	0.36 ± 0.02	0.81 ± 0.04	0.97 ± 0.04	1.21 ± 0.05
	2080-2099	0.54 ± 0.03	1.48 ± 0.03	2.18 ± 0.05	3.01 ± 0.06
Multi-model maximum	Baseline	12.47 ± 0.85	12.47 ± 0.85	12.47 ± 0.85	12.47 ± 0.85
	2021-2040	1.10 ± 0.03	1.20 ± 0.01	1.52 ± 0.02	1.27 ± 0.03
	2041-2060	1.71 ± 0.03	2.12 ± 0.02	2.39 ± 0.02	2.24 ± 0.04
	2080-2099	1.83 ± 0.03	3.21 ± 0.03	4.18 ± 0.04	5.24 ± 0.07
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.22 ± 0.04	1.28 ± 0.02	1.59 ± 0.03	1.42 ± 0.04
	2041-2060	1.88 ± 0.04	2.16 ± 0.02	2.31 ± 0.03	2.34 ± 0.04
	2080-2099	1.80 ± 0.04	3.26 ± 0.05	4.67 ± 0.07	5.64 ± 0.08

Table 3: The statistics of the projected changes in daily mean air temperature in units of °C over the NorthernZone-Taumarunui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



15.1.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 34. The statistical summary of projected changes in daily mean air temperature over this region is shown

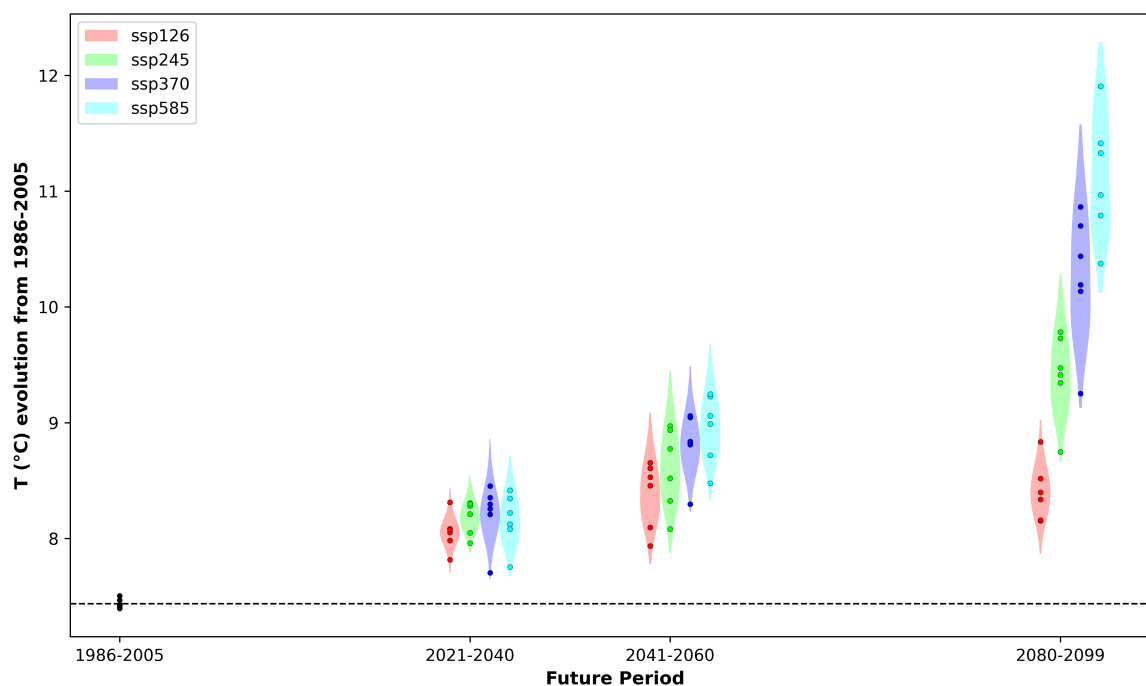


Figure 34: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the NorthernZone-Taumarunui region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

in Table 4. Projections for winter mean air temperature in the NorthernZone-Taumarunui region show a robust warming trend across all scenarios through the 21st century. The multi-model mean indicates an increase from the baseline by about 0.6–0.8°C for 2021–2040, regardless of SSP, with very high inter-model agreement. By mid-century (2041–2060), warming intensifies, ranging from around 0.9°C (SSP1-2.6) to 1.5°C (SSP5-8.5), and by late century (2080–2099), the spread between scenarios increases markedly: approx. 1°C under SSP1-2.6, nearly 2°C under SSP2-4.5, close to 2.8°C for SSP3-7.0, and up to around 3.7°C under SSP5-8.5. These results are extremely likely (IPCC terminology) given the tight cluster of model outcomes within scenarios and consistent warming evident in all models. Inter-model agreement regarding the direction of change remains very high, but the range widens notably under higher-emissions scenarios as the century progresses, consistent with global climate projections. Agreement across scenarios diminishes sharply after mid-century, reflected by declining scenario agreement percentages. Spatial variability in projected temperature change within the region remains low relative to the magnitude of change. In summary, it is virtually certain that winters in NorthernZone-Taumarunui will warm considerably, with the extent of warming dependent on future emissions pathways.

15.1.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 35. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 5. Future projections for average daily spring air temperature (T_{mean}) in NorthernZone-Taumarunui indicate a very likely warming trend across the 21st century, with the magnitude of change increasing with



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	7.437 ± 0.888	7.437 ± 0.888	7.437 ± 0.888	7.437 ± 0.888
	2021-2040	0.616 ± 0.010	0.747 ± 0.012	0.774 ± 0.010	0.720 ± 0.010
	2041-2060	0.942 ± 0.008	1.164 ± 0.008	1.376 ± 0.008	1.516 ± 0.015
	2080-2099	0.963 ± 0.009	1.978 ± 0.020	2.826 ± 0.027	3.693 ± 0.033
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.619 ± 0.010	0.751 ± 0.012	0.780 ± 0.010	0.728 ± 0.011
	2041-2060	0.952 ± 0.008	1.177 ± 0.008	1.383 ± 0.008	1.527 ± 0.015
	2080-2099	0.970 ± 0.009	1.992 ± 0.020	2.851 ± 0.027	3.728 ± 0.034
Multi-model minimum	Baseline	7.392 ± 0.891	7.392 ± 0.891	7.392 ± 0.891	7.392 ± 0.891
	2021-2040	0.379 ± 0.024	0.522 ± 0.022	0.267 ± 0.014	0.316 ± 0.016
	2041-2060	0.497 ± 0.020	0.645 ± 0.035	0.859 ± 0.015	1.039 ± 0.038
	2080-2099	0.706 ± 0.021	1.311 ± 0.032	1.815 ± 0.038	2.938 ± 0.041
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.395 ± 0.015	0.543 ± 0.019	0.413 ± 0.011	0.389 ± 0.013
	2041-2060	0.530 ± 0.012	0.665 ± 0.015	0.992 ± 0.013	1.091 ± 0.026
	2080-2099	0.610 ± 0.016	1.457 ± 0.024	2.025 ± 0.031	2.948 ± 0.038
Multi-model maximum	Baseline	7.505 ± 0.895	7.505 ± 0.895	7.505 ± 0.895	7.505 ± 0.895
	2021-2040	0.875 ± 0.012	0.875 ± 0.016	1.017 ± 0.023	0.979 ± 0.012
	2041-2060	1.223 ± 0.020	1.537 ± 0.014	1.631 ± 0.013	1.821 ± 0.018
	2080-2099	1.397 ± 0.015	2.347 ± 0.028	3.427 ± 0.053	4.469 ± 0.061
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.858 ± 0.015	0.987 ± 0.019	1.184 ± 0.017	1.115 ± 0.017
	2041-2060	1.433 ± 0.011	1.761 ± 0.010	1.824 ± 0.011	2.022 ± 0.014
	2080-2099	1.378 ± 0.010	2.602 ± 0.018	3.793 ± 0.031	4.611 ± 0.047

Table 4: The statistics of the projected changes in daily mean air temperature in units of °C over the NorthernZone-Taumarunui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.37 ± 0.91	11.37 ± 0.91	11.37 ± 0.91	11.37 ± 0.91
	2021-2040	0.63 ± 0.02	0.74 ± 0.03	0.80 ± 0.02	0.72 ± 0.03
	2041-2060	0.95 ± 0.03	1.18 ± 0.03	1.39 ± 0.04	1.54 ± 0.04
	2080-2099	0.91 ± 0.02	1.99 ± 0.05	2.91 ± 0.07	3.73 ± 0.09
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.64 ± 0.02	0.74 ± 0.03	0.81 ± 0.02	0.74 ± 0.03
	2041-2060	0.96 ± 0.03	1.20 ± 0.03	1.40 ± 0.04	1.55 ± 0.04
	2080-2099	0.91 ± 0.02	2.01 ± 0.04	2.94 ± 0.07	3.78 ± 0.09
Multi-model minimum	Baseline	11.30 ± 0.92	11.30 ± 0.92	11.30 ± 0.92	11.30 ± 0.92
	2021-2040	0.37 ± 0.02	0.59 ± 0.05	0.51 ± 0.01	0.37 ± 0.03
	2041-2060	0.66 ± 0.02	0.60 ± 0.04	1.02 ± 0.03	1.25 ± 0.04
	2080-2099	0.69 ± 0.02	1.42 ± 0.07	2.38 ± 0.06	2.88 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.39 ± 0.03	0.45 ± 0.05	0.45 ± 0.02	0.29 ± 0.03
	2041-2060	0.60 ± 0.03	0.62 ± 0.04	0.94 ± 0.04	1.18 ± 0.03
	2080-2099	0.49 ± 0.02	1.31 ± 0.05	2.11 ± 0.06	2.68 ± 0.08
Multi-model maximum	Baseline	11.46 ± 0.91	11.46 ± 0.91	11.46 ± 0.91	11.46 ± 0.91
	2021-2040	0.85 ± 0.02	1.14 ± 0.02	1.18 ± 0.02	1.10 ± 0.02
	2041-2060	1.20 ± 0.05	1.72 ± 0.03	1.90 ± 0.03	1.89 ± 0.07
	2080-2099	1.52 ± 0.03	2.73 ± 0.05	3.77 ± 0.06	4.72 ± 0.08
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.90 ± 0.01	1.05 ± 0.01	1.22 ± 0.03	1.24 ± 0.03
	2041-2060	1.38 ± 0.03	1.85 ± 0.03	1.94 ± 0.04	1.96 ± 0.06
	2080-2099	1.36 ± 0.02	2.80 ± 0.04	3.88 ± 0.08	5.02 ± 0.10

Table 5: The statistics of the projected changes in daily mean air temperature in units of °C over the NorthernZone-Taumarunui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

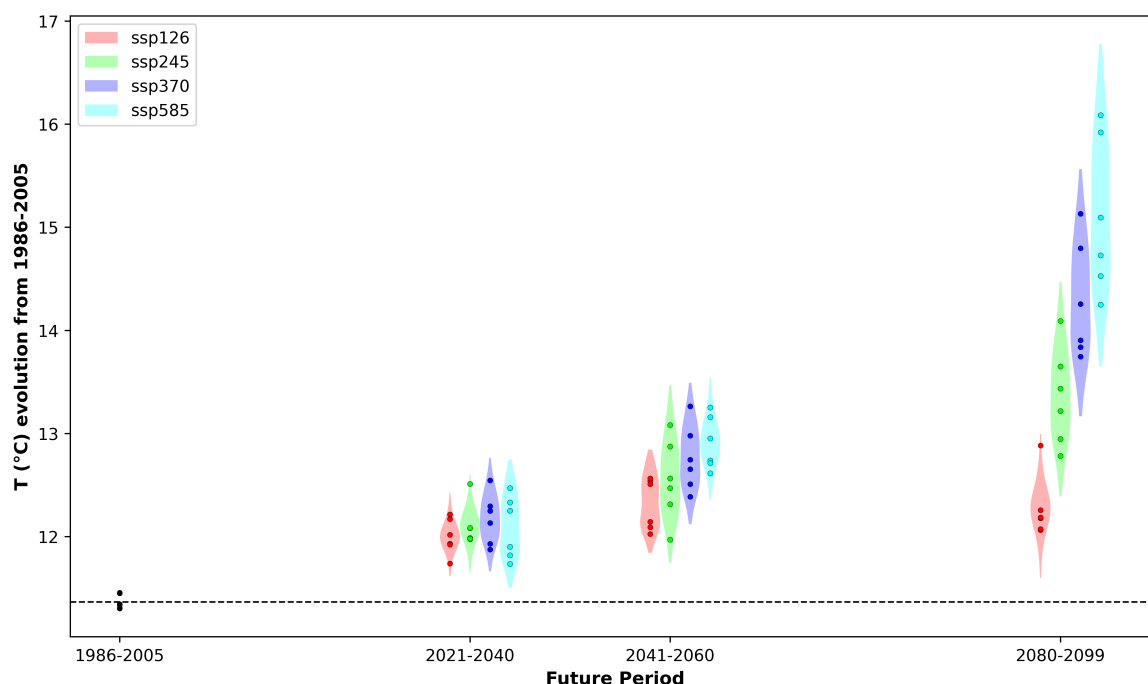


Figure 35: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the NorthernZone-Taumarunui region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

higher emissions scenarios (SSPs). By 2021-2040, all scenarios suggest a small but discernible warming relative to the 1986-2005 baseline; multi-model mean increases are between 0.6°C and 0.8°C, with models showing high inter-scenario agreement (>50%). By 2041-2060, projected warming strengthens and diverges by scenario, with mean changes from about 0.9°C (SSP1-2.6, low emissions) to 1.5°C (SSP5-8.5, high emissions). This indicates likely warming, but with diminishing scenario agreement as the period advances (agreement drops to 8%).

By 2080-2099, scenario separation becomes more pronounced: SSP1-2.6 stabilises near 0.9°C warming, SSP2-4.5 reaches ~2°C, SSP3-7.0 approaches 3°C, and SSP5-8.5 exceeds 3.7°C. The sharp scenario-dependent divergence signals very high confidence in strong emissions dependence of projected warming. Inter-model spread within scenarios increases in later periods, particularly under higher emissions, but all models show more warming than the baseline, making this outcome virtually certain. Spatial variability (regional standard deviation) remains low relative to mean changes.

Overall, significant spring warming is extremely likely for NorthernZone-Taumarunui, with scenario and inter-model spread increasing by century's end, especially under high-emission pathways.

15.2 Region: Volcanic Plateau

Area: 1664.65 km²

15.2.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 36. The statistical summary of projected changes in daily mean air temperature over this region is

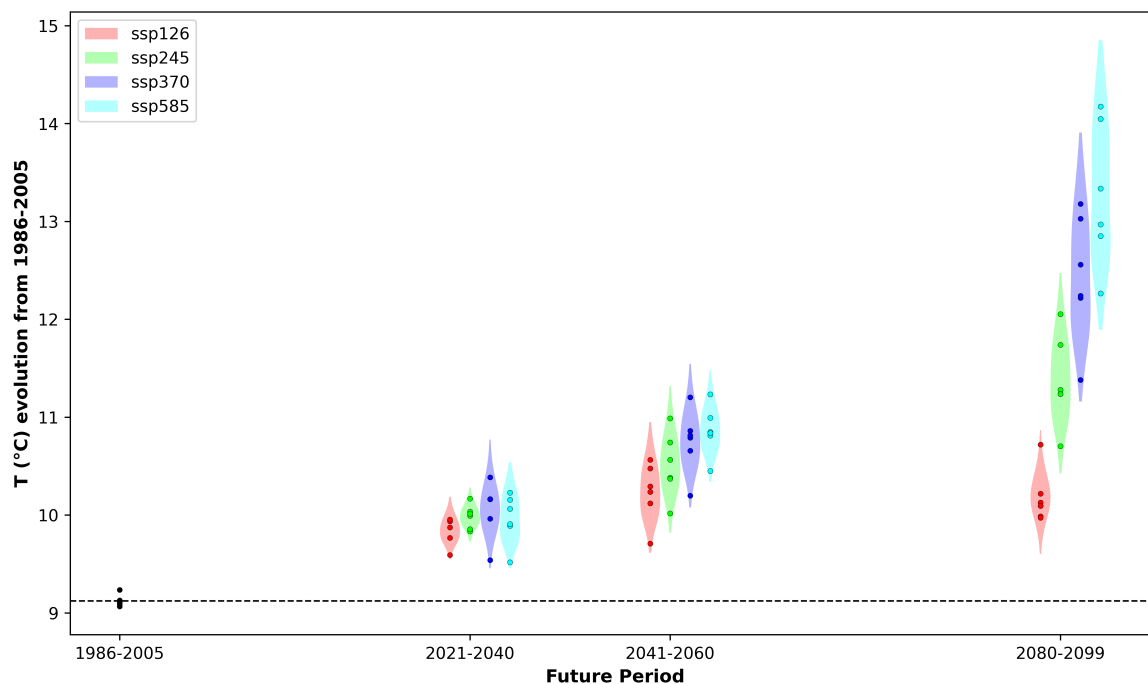


Figure 36: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Volcanic Plateau region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 6. Projections for the Volcanic Plateau indicate a robust warming trend in annual average daily air temperature (T_{mean}) throughout the 21st century, with the magnitude of change dependent on emissions pathway (SSP). By mid-century (2041-2060), multi-model mean warming ranges from approximately 1.1°C under SSP1-2.6 to 1.7°C under SSP5-8.5, relative to the 1986–2005 baseline. By late century (2080-2099), differences between scenarios become more pronounced: warming is just over 1°C for SSP1-2.6, but increases to over 4°C under SSP5-8.5. This large range in projected warming is extremely likely, reflecting strong scenario dependency.

Model spread within each scenario, represented visually and by spatial standard deviations (typically <0.05°C in the future periods), is low compared to the inter-scenario differences, indicating high inter-model agreement on the direction and order of magnitude of warming (very high confidence). SSPs diverge strongly after mid-century, with zero percent model agreement across all scenarios for 2080-2099, highlighting scenario uncertainty as the dominant factor late in the century. Overall, it is virtually certain that the Volcanic Plateau will warm substantially under all future scenarios, with the precise magnitude closely tied to global emissions pathways. The regional warming signal is spatially consistent and robust across the climate models used.

15.2.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 37. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 7. Projected changes in summer mean daily air temperature (T_{mean}) over the Volcanic Plateau indicate a robust warming trend throughout the 21st century across all emissions scenarios. All models project a likely increase in summer T_{mean} relative to the 1986–2005 baseline, with the magnitude of warming highly dependent on the greenhouse gas emissions pathway. By 2021–2040, mean warming ranges from just under 1°C under all scenarios, with very likely agreement among models. For mid-century (2041–2060), projected



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	9.121 ± 1.549	9.121 ± 1.549	9.121 ± 1.549	9.121 ± 1.549
	2021-2040	0.722 ± 0.017	0.861 ± 0.024	0.940 ± 0.015	0.839 ± 0.026
	2041-2060	1.111 ± 0.030	1.388 ± 0.028	1.632 ± 0.025	1.741 ± 0.031
	2080-2099	1.064 ± 0.029	2.253 ± 0.033	3.312 ± 0.037	4.152 ± 0.041
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.726 ± 0.017	0.865 ± 0.023	0.948 ± 0.015	0.851 ± 0.025
	2041-2060	1.123 ± 0.030	1.399 ± 0.028	1.643 ± 0.025	1.750 ± 0.031
	2080-2099	1.071 ± 0.029	2.271 ± 0.032	3.345 ± 0.035	4.201 ± 0.038
Multi-model minimum	Baseline	9.066 ± 1.560	9.066 ± 1.560	9.066 ± 1.560	9.066 ± 1.560
	2021-2040	0.470 ± 0.020	0.712 ± 0.040	0.417 ± 0.008	0.395 ± 0.017
	2041-2060	0.586 ± 0.022	0.894 ± 0.026	1.076 ± 0.018	1.328 ± 0.016
	2080-2099	0.850 ± 0.023	1.582 ± 0.037	2.259 ± 0.028	3.144 ± 0.033
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.523 ± 0.015	0.689 ± 0.042	0.540 ± 0.010	0.480 ± 0.025
	2041-2060	0.684 ± 0.027	0.919 ± 0.033	1.173 ± 0.029	1.381 ± 0.021
	2080-2099	0.684 ± 0.041	1.596 ± 0.040	2.398 ± 0.040	3.129 ± 0.038
Multi-model maximum	Baseline	9.235 ± 1.547	9.235 ± 1.547	9.235 ± 1.547	9.235 ± 1.547
	2021-2040	0.837 ± 0.020	1.046 ± 0.012	1.263 ± 0.013	1.107 ± 0.042
	2041-2060	1.444 ± 0.020	1.866 ± 0.017	2.082 ± 0.015	2.112 ± 0.057
	2080-2099	1.597 ± 0.016	2.932 ± 0.026	4.061 ± 0.036	5.053 ± 0.064
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.958 ± 0.019	1.064 ± 0.010	1.409 ± 0.023	1.272 ± 0.027
	2041-2060	1.622 ± 0.034	1.947 ± 0.025	2.178 ± 0.021	2.169 ± 0.048
	2080-2099	1.503 ± 0.018	3.040 ± 0.029	4.421 ± 0.034	5.414 ± 0.042

Table 6: The statistics of the projected changes in daily mean air temperature in units of °C over the Volcanic Plateau region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	13.65 ± 1.61	13.65 ± 1.61	13.65 ± 1.61	13.65 ± 1.61
	2021-2040	0.86 ± 0.01	0.98 ± 0.02	1.19 ± 0.02	1.01 ± 0.02
	2041-2060	1.32 ± 0.02	1.62 ± 0.02	2.00 ± 0.02	1.99 ± 0.03
	2080-2099	1.14 ± 0.02	2.56 ± 0.03	3.96 ± 0.04	4.74 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.86 ± 0.01	0.98 ± 0.02	1.20 ± 0.02	1.01 ± 0.02
	2041-2060	1.33 ± 0.02	1.63 ± 0.02	2.01 ± 0.02	1.99 ± 0.03
	2080-2099	1.15 ± 0.02	2.58 ± 0.03	3.99 ± 0.04	4.80 ± 0.06
Multi-model minimum	Baseline	13.53 ± 1.61	13.53 ± 1.61	13.53 ± 1.61	13.53 ± 1.61
	2021-2040	0.71 ± 0.04	0.81 ± 0.02	0.75 ± 0.02	0.72 ± 0.01
	2041-2060	0.80 ± 0.03	1.35 ± 0.03	1.21 ± 0.03	1.78 ± 0.03
	2080-2099	0.91 ± 0.04	1.94 ± 0.02	2.83 ± 0.05	3.68 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.66 ± 0.02	0.79 ± 0.02	0.73 ± 0.01	0.65 ± 0.01
	2041-2060	0.85 ± 0.01	1.26 ± 0.04	1.43 ± 0.02	1.63 ± 0.03
	2080-2099	0.77 ± 0.03	1.83 ± 0.04	2.89 ± 0.04	3.57 ± 0.06
Multi-model maximum	Baseline	13.99 ± 1.61	13.99 ± 1.61	13.99 ± 1.61	13.99 ± 1.61
	2021-2040	1.12 ± 0.02	1.15 ± 0.03	1.52 ± 0.04	1.34 ± 0.04
	2041-2060	1.77 ± 0.02	2.06 ± 0.02	2.42 ± 0.04	2.47 ± 0.03
	2080-2099	1.66 ± 0.03	3.39 ± 0.05	5.04 ± 0.07	5.79 ± 0.07
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.08 ± 0.02	1.19 ± 0.03	1.71 ± 0.03	1.40 ± 0.03
	2041-2060	1.88 ± 0.04	2.03 ± 0.02	2.66 ± 0.02	2.38 ± 0.03
	2080-2099	1.56 ± 0.02	3.43 ± 0.04	5.25 ± 0.05	6.18 ± 0.07

Table 7: The statistics of the projected changes in daily mean air temperature in units of °C over the Volcanic Plateau region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

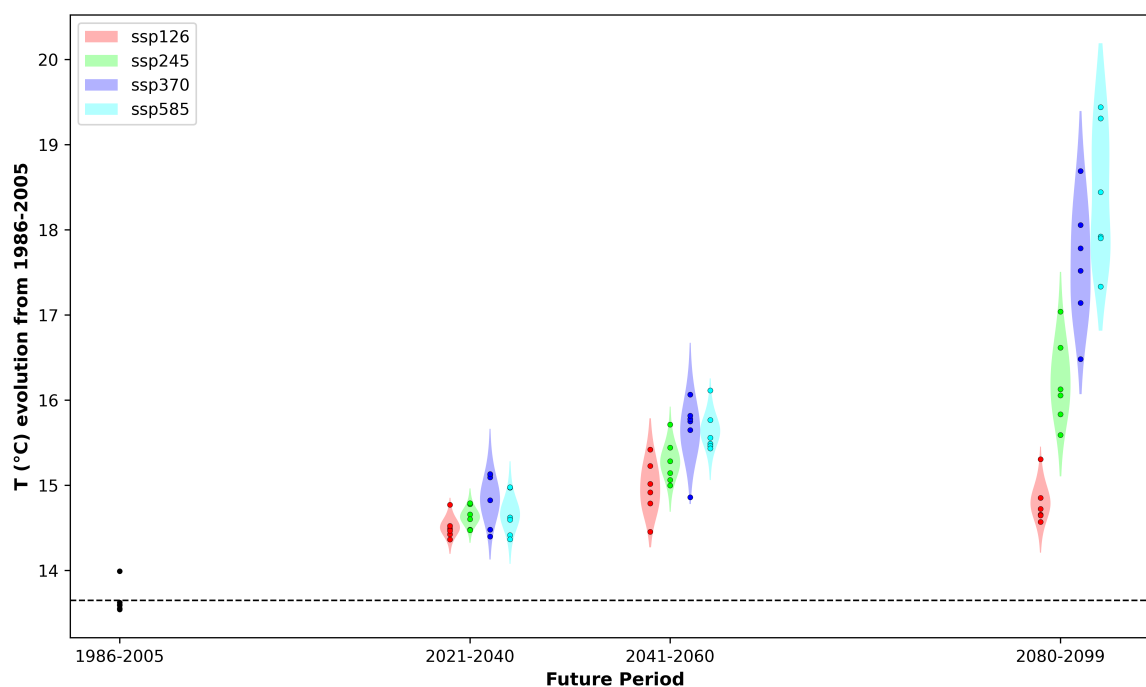


Figure 37: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Volcanic Plateau region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

increases span from about 1.3°C under SSP1-2.6 to 2°C under SSP3-7.0 and SSP5-8.5 (very likely), showing clear scenario separation.

By late century (2080–2099), divergence between scenarios is pronounced: warming under SSP1-2.6 is projected to remain modest at around 1.1°C, while high-emission scenarios (SSP3-7.0, SSP5-8.5) project likely increases of 4–4.7°C, with extreme model projections up to nearly 6°C under SSP5-8.5. Inter-model consistency is high within scenarios (narrow violins) but inter-scenario agreement declines substantially to zero by late century, illustrating that future summer warming is very likely and directly tied to emissions choices. Spatial variability across the Volcanic Plateau is low ($\text{stdv} \leq 0.06^\circ\text{C}$ for all periods), so projected changes are expected to be regionally consistent. Confidence in continued warming is very high (virtually certain), but the precise magnitude by century's end remains scenario-dependent.

15.2.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 38. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 8. Projected changes in average daily air temperature (T_{mean}) during autumn over the Volcanic Plateau indicate a clear warming trend through the 21st century. All scenarios agree on likely warming, with increases by 2021-2040 of roughly 0.7–0.9°C above the 1986-2005 baseline, supported by very high model agreement (over 65% scenario overlap).

By mid-century (2041-2060), warming amplifies further: low emissions (SSP1-2.6) show an increase of just above 1.1°C, while higher emissions (SSP5-8.5) approach 1.8°C. Agreement across scenarios declines (about 22%), reflecting increasing influence of emissions choice on outcome. For late-century (2080-2099), the spread widens substantially: very likely warming from about 1.1°C (SSP1-2.6) to just over 4°C under high emissions (SSP5-8.5), with scenario agreement at 0%, indicating high dependence on future emissions pathways and



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	9.727 ± 1.466	9.727 ± 1.466	9.727 ± 1.466	9.727 ± 1.466
	2021-2040	0.703 ± 0.008	0.864 ± 0.011	0.908 ± 0.007	0.787 ± 0.009
	2041-2060	1.112 ± 0.014	1.466 ± 0.012	1.614 ± 0.012	1.757 ± 0.014
	2080-2099	1.139 ± 0.015	2.317 ± 0.015	3.331 ± 0.017	4.198 ± 0.029
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.712 ± 0.008	0.870 ± 0.011	0.917 ± 0.006	0.801 ± 0.009
	2041-2060	1.123 ± 0.015	1.478 ± 0.012	1.625 ± 0.012	1.771 ± 0.014
	2080-2099	1.150 ± 0.014	2.337 ± 0.015	3.364 ± 0.017	4.249 ± 0.029
Multi-model minimum	Baseline	9.585 ± 1.452	9.585 ± 1.452	9.585 ± 1.452	9.585 ± 1.452
	2021-2040	0.097 ± 0.021	0.431 ± 0.025	0.181 ± 0.021	0.144 ± 0.017
	2041-2060	0.269 ± 0.017	0.852 ± 0.023	1.091 ± 0.021	1.164 ± 0.019
	2080-2099	0.718 ± 0.027	1.473 ± 0.028	1.914 ± 0.030	2.977 ± 0.041
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.245 ± 0.020	0.495 ± 0.024	0.319 ± 0.019	0.218 ± 0.016
	2041-2060	0.413 ± 0.021	0.866 ± 0.017	0.998 ± 0.012	1.242 ± 0.014
	2080-2099	0.585 ± 0.025	1.502 ± 0.020	2.212 ± 0.026	3.025 ± 0.030
Multi-model maximum	Baseline	9.811 ± 1.463	9.811 ± 1.463	9.811 ± 1.463	9.811 ± 1.463
	2021-2040	1.097 ± 0.023	1.188 ± 0.018	1.488 ± 0.019	1.270 ± 0.021
	2041-2060	1.710 ± 0.027	2.105 ± 0.043	2.363 ± 0.027	2.245 ± 0.025
	2080-2099	1.806 ± 0.036	3.204 ± 0.037	4.137 ± 0.046	5.214 ± 0.049
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.239 ± 0.012	1.276 ± 0.011	1.573 ± 0.017	1.465 ± 0.016
	2041-2060	1.900 ± 0.018	2.171 ± 0.032	2.330 ± 0.023	2.372 ± 0.024
	2080-2099	1.793 ± 0.023	3.288 ± 0.031	4.674 ± 0.027	5.638 ± 0.036

Table 8: The statistics of the projected changes in daily mean air temperature in units of °C over the Volcanic Plateau region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

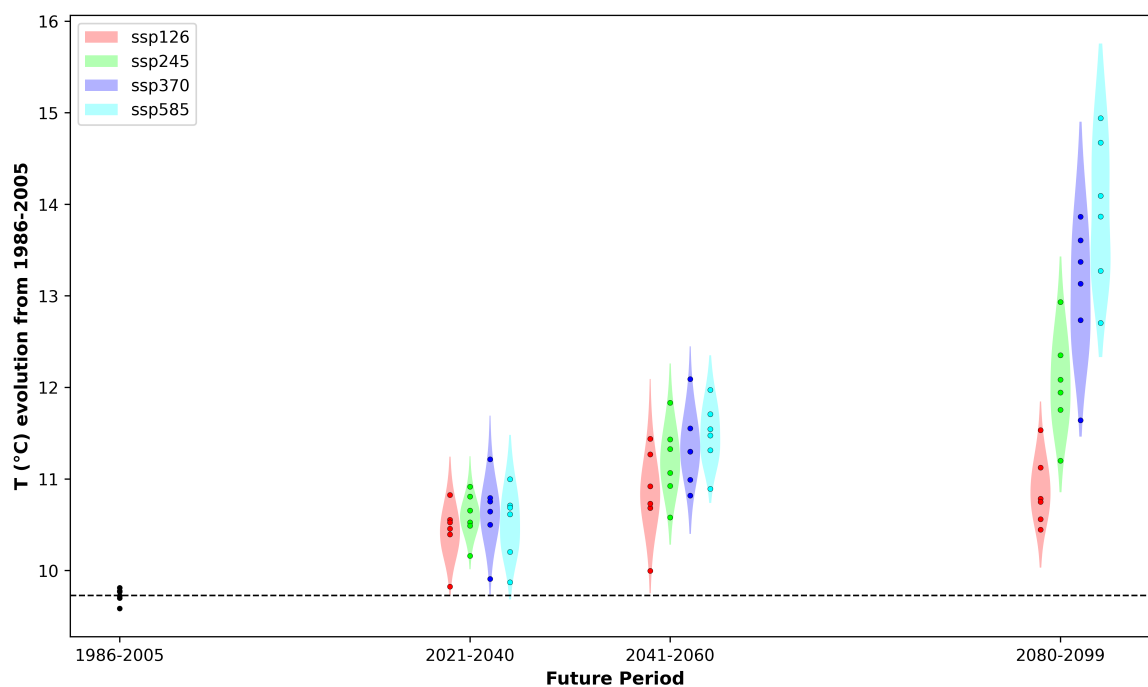


Figure 38: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Volcanic Plateau region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

marked inter-scenario divergence. In all periods, inter-model spread is moderate and does not dominate uncertainty.

Spatial variability in temperature change across the sub-region remains low compared to the size of the projected trend (standard deviation less than 0.03°C in all future periods), suggesting the warming is spatially uniform across the Volcanic Plateau. It is virtually certain that the region will warm in autumn, with the magnitude of change very likely to depend on emissions pathway, especially from mid-century onwards.

15.2.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 39. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 9. Projections for winter mean temperature (T_{mean}) in the Volcanic Plateau indicate a robust warming signal across all emission scenarios. By 2021–2040, an increase of approximately 0.6–0.8°C above the 1986–2005 baseline is very likely, with models showing high consistency and low spatial variability. The magnitude of warming is projected to intensify through the century, with scenario-dependent divergence becoming pronounced beyond mid-century.

For 2041–2060, multi-model means range from about 1.0°C (SSP1-2.6) to over 1.5°C (SSP5-8.5) above baseline, indicating likely warming, with moderate spatial variability. By 2080–2099, warming is projected at roughly 1.0°C under SSP1-2.6, but climbs to near 2.0°C (SSP2-4.5), 2.9°C (SSP3-7.0), and almost 3.8°C (SSP5-8.5), indicating an extremely likely scenario-dependent escalation in temperature. Spatial variability of change remains minor relative to signal magnitude, but scenario agreement across models decreases markedly, reaching zero for end-of-century projections, highlighting increasing uncertainty primarily driven by emissions pathway.

Overall, it is virtually certain the Volcanic Plateau will experience significant winter warming, with the magni-



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	4.738 ± 1.453	4.738 ± 1.453	4.738 ± 1.453	4.738 ± 1.453
	2021-2040	0.634 ± 0.031	0.781 ± 0.035	0.801 ± 0.029	0.766 ± 0.045
	2041-2060	0.984 ± 0.047	1.201 ± 0.048	1.412 ± 0.046	1.565 ± 0.057
	2080-2099	1.001 ± 0.048	2.041 ± 0.070	2.921 ± 0.097	3.791 ± 0.099
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.637 ± 0.031	0.786 ± 0.034	0.807 ± 0.029	0.775 ± 0.045
	2041-2060	0.996 ± 0.048	1.215 ± 0.048	1.420 ± 0.046	1.577 ± 0.057
	2080-2099	1.009 ± 0.047	2.055 ± 0.070	2.945 ± 0.095	3.822 ± 0.096
Multi-model minimum	Baseline	4.672 ± 1.478	4.672 ± 1.478	4.672 ± 1.478	4.672 ± 1.478
	2021-2040	0.413 ± 0.055	0.522 ± 0.046	0.264 ± 0.009	0.326 ± 0.047
	2041-2060	0.546 ± 0.049	0.703 ± 0.048	0.920 ± 0.065	1.090 ± 0.047
	2080-2099	0.712 ± 0.033	1.380 ± 0.073	1.888 ± 0.090	2.985 ± 0.078
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.407 ± 0.033	0.564 ± 0.052	0.424 ± 0.013	0.400 ± 0.045
	2041-2060	0.558 ± 0.043	0.687 ± 0.042	1.042 ± 0.056	1.121 ± 0.052
	2080-2099	0.634 ± 0.041	1.503 ± 0.059	2.082 ± 0.079	2.961 ± 0.072
Multi-model maximum	Baseline	4.807 ± 1.433	4.807 ± 1.433	4.807 ± 1.433	4.807 ± 1.433
	2021-2040	0.906 ± 0.039	0.917 ± 0.034	1.041 ± 0.028	1.041 ± 0.056
	2041-2060	1.328 ± 0.087	1.615 ± 0.087	1.637 ± 0.030	1.943 ± 0.110
	2080-2099	1.415 ± 0.037	2.463 ± 0.126	3.665 ± 0.169	4.735 ± 0.178
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.889 ± 0.032	1.038 ± 0.023	1.234 ± 0.049	1.203 ± 0.049
	2041-2060	1.496 ± 0.056	1.815 ± 0.060	1.851 ± 0.036	2.096 ± 0.071
	2080-2099	1.436 ± 0.054	2.684 ± 0.083	3.927 ± 0.115	4.802 ± 0.131

Table 9: The statistics of the projected changes in daily mean air temperature in units of °C over the Volcanic Plateau region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

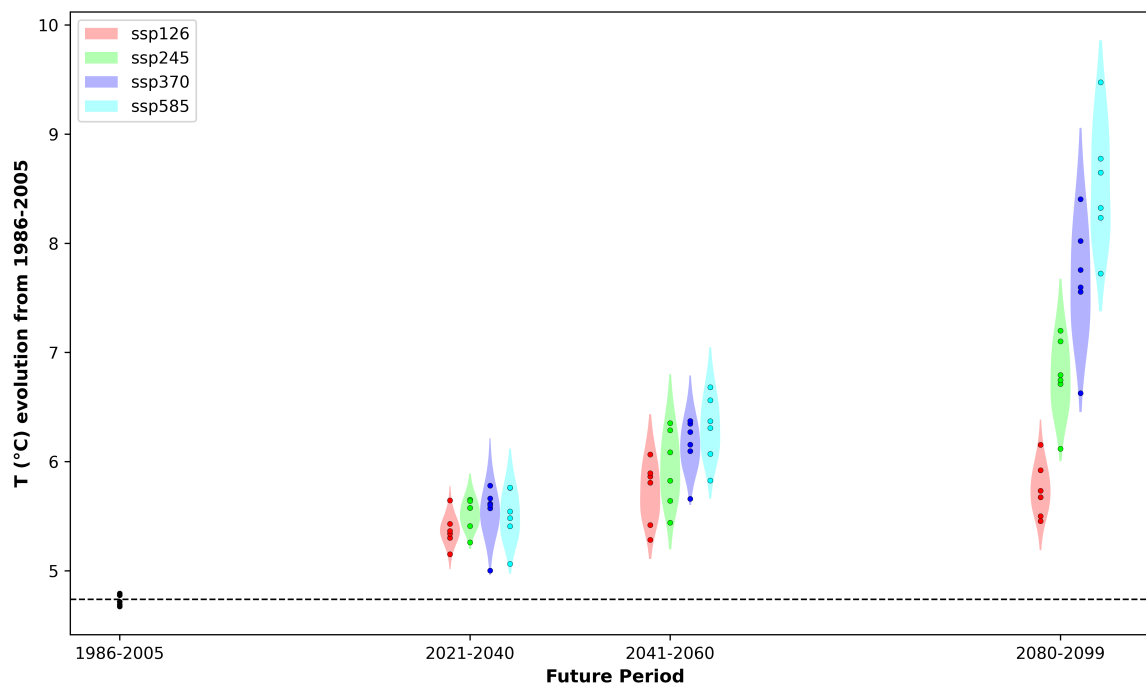


Figure 39: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Volcanic Plateau region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

tude governed by global emissions. Model consistency is high for near-term and mid-century, but longer-term projections are affected by scenario divergence and hence, uncertainty in societal choices remains the dominant source of uncertainty late in the century.

15.2.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 40. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 10. Projections for average spring temperature (T_{mean}) in the Volcanic Plateau indicate a clear and consistent warming trend across all future periods and scenarios. By mid-century (2041–2060), increases in T_{mean} are likely under all emission pathways, with multi-model mean changes ranging from about 1.0°C under SSP1-2.6 to 1.6°C under SSP5-8.5. By late century (2080–2099), projected warming diverges strongly between scenarios: warming is about 1.0°C under SSP1-2.6 but exceeds 2°C under SSP2-4.5, 3°C under SSP3-7.0, and approaches 4°C under SSP5-8.5. These signals are extremely likely (greater than 95% probability) given the sustained increase across all models and scenarios, especially under higher emissions.

Inter-model spread, as visualised within each scenario and period, suggests robust agreement on the direction of change but greater divergence in magnitude as emissions increase and with time. Overlap between scenarios diminishes markedly by the end of the century, evidenced also by the region's scenario agreement statistics dropping to zero, indicating very high scenario dependence. Spatial variability across the Volcanic Plateau is low (stdv mostly below 0.1°C), signifying a consistent warming signal throughout the sub-region. Overall, continued increases in spring temperature are virtually certain for the Volcanic Plateau, with the magnitude controlled by future emissions.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	8.465 ± 1.673	8.465 ± 1.673	8.465 ± 1.673	8.465 ± 1.673
	2021-2040	0.682 ± 0.033	0.810 ± 0.043	0.853 ± 0.029	0.784 ± 0.039
	2041-2060	1.038 ± 0.051	1.254 ± 0.041	1.477 ± 0.048	1.641 ± 0.051
	2080-2099	0.973 ± 0.046	2.090 ± 0.052	3.029 ± 0.060	3.870 ± 0.070
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.684 ± 0.033	0.812 ± 0.042	0.862 ± 0.028	0.801 ± 0.037
	2041-2060	1.051 ± 0.049	1.268 ± 0.040	1.491 ± 0.047	1.647 ± 0.051
	2080-2099	0.977 ± 0.045	2.108 ± 0.051	3.055 ± 0.057	3.905 ± 0.068
Multi-model minimum	Baseline	8.386 ± 1.671	8.386 ± 1.671	8.386 ± 1.671	8.386 ± 1.671
	2021-2040	0.413 ± 0.017	0.677 ± 0.042	0.494 ± 0.012	0.360 ± 0.016
	2041-2060	0.723 ± 0.045	0.667 ± 0.032	1.041 ± 0.032	1.292 ± 0.025
	2080-2099	0.741 ± 0.042	1.514 ± 0.053	2.413 ± 0.031	2.905 ± 0.038
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.445 ± 0.025	0.588 ± 0.063	0.488 ± 0.018	0.351 ± 0.034
	2041-2060	0.703 ± 0.050	0.719 ± 0.044	1.013 ± 0.043	1.217 ± 0.025
	2080-2099	0.554 ± 0.057	1.434 ± 0.062	2.237 ± 0.059	2.809 ± 0.053
Multi-model maximum	Baseline	8.580 ± 1.661	8.580 ± 1.661	8.580 ± 1.661	8.580 ± 1.661
	2021-2040	0.874 ± 0.038	1.120 ± 0.018	1.182 ± 0.028	1.144 ± 0.046
	2041-2060	1.329 ± 0.095	1.742 ± 0.030	1.955 ± 0.034	2.058 ± 0.108
	2080-2099	1.578 ± 0.023	2.769 ± 0.042	3.801 ± 0.060	4.816 ± 0.098
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.940 ± 0.042	1.052 ± 0.020	1.287 ± 0.048	1.313 ± 0.043
	2041-2060	1.446 ± 0.054	1.892 ± 0.039	2.035 ± 0.055	2.118 ± 0.098
	2080-2099	1.423 ± 0.033	2.875 ± 0.047	3.987 ± 0.059	5.155 ± 0.089

Table 10: The statistics of the projected changes in daily mean air temperature in units of °C over the Volcanic Plateau region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

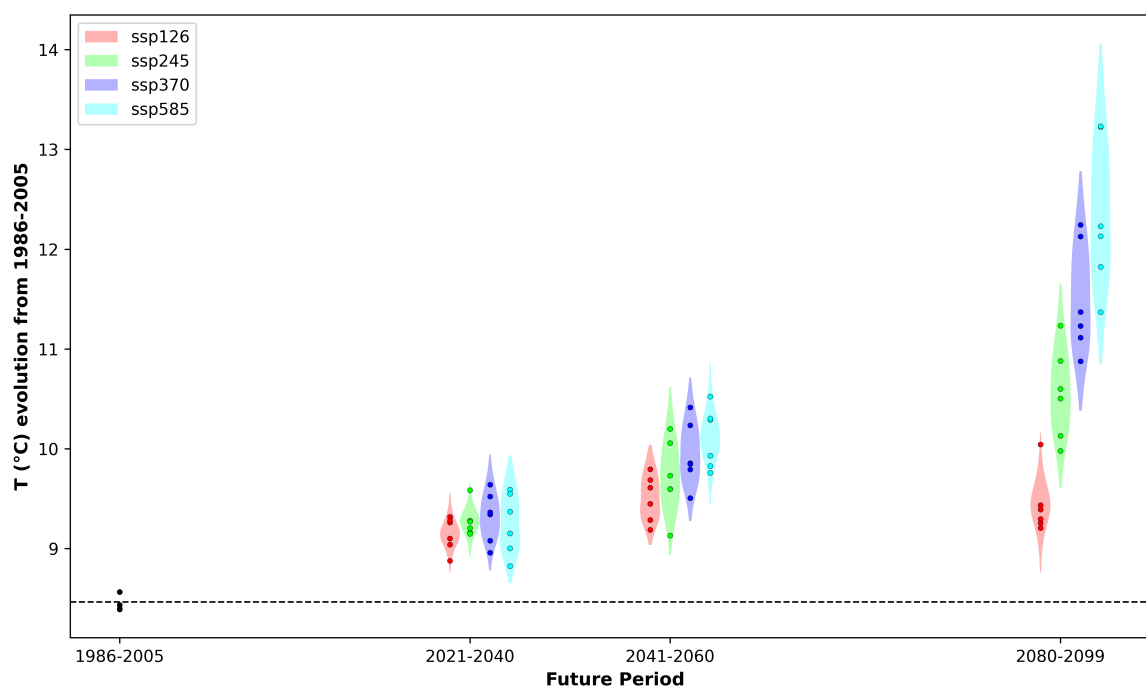


Figure 40: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Volcanic Plateau region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.3 Region: Upper Rangitīkei

Area: 2694.06 km²

15.3.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 41. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 11. Across all future scenarios, annual mean air temperature in Upper Rangitīkei is projected to increase relative to the 1986–2005 baseline. The multi-model mean suggests a likely warming of approximately 0.7–0.9°C by 2021–2040, broadening to 1.1–1.7°C by 2041–2060, with substantial divergence by 2080–2099. Under the lowest emissions pathway (SSP1-2.6), temperature change remains around 1.1°C above baseline by century’s end. However, under the highest warming pathway (SSP5-8.5), mean warming reaches over 4°C, with the upper bound nearing 5°C.

This strong scenario dependency becomes more pronounced after mid-century, with inter-model spread and range among the scenarios increasing substantially, reflected by the decline in cross-SSP agreement from around 41% for near-term projections to 0% by the end of the century. All models and scenarios indicate warming—virtually certain, with very high confidence—but the magnitude is highly scenario-dependent by 2080–2099.

Spatial variability of temperature change across the region is minor compared to the scenario signal, with standard deviations under 0.04°C for all futures. Agreement on the direction of change is extremely high across models within each scenario, though the absolute magnitude of change by 2080–2099 remains scenario-contingent. In summary, rapid and increasing warming is very likely for Upper Rangitīkei, with the precise amount closely linked to global emissions pathways.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	9.105 ± 1.395	9.105 ± 1.395	9.105 ± 1.395	9.105 ± 1.395
	2021-2040	0.725 ± 0.010	0.856 ± 0.015	0.934 ± 0.014	0.847 ± 0.018
	2041-2060	1.122 ± 0.021	1.384 ± 0.013	1.625 ± 0.015	1.746 ± 0.023
	2080-2099	1.081 ± 0.017	2.253 ± 0.021	3.302 ± 0.027	4.158 ± 0.034
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.729 ± 0.010	0.860 ± 0.015	0.941 ± 0.013	0.857 ± 0.017
	2041-2060	1.132 ± 0.021	1.394 ± 0.013	1.635 ± 0.016	1.754 ± 0.023
	2080-2099	1.087 ± 0.017	2.270 ± 0.021	3.331 ± 0.026	4.201 ± 0.034
Multi-model minimum	Baseline	9.054 ± 1.400	9.054 ± 1.400	9.054 ± 1.400	9.054 ± 1.400
	2021-2040	0.471 ± 0.012	0.721 ± 0.033	0.418 ± 0.011	0.414 ± 0.012
	2041-2060	0.601 ± 0.013	0.915 ± 0.013	1.079 ± 0.018	1.318 ± 0.021
	2080-2099	0.857 ± 0.012	1.608 ± 0.022	2.246 ± 0.030	3.126 ± 0.045
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.532 ± 0.013	0.699 ± 0.030	0.549 ± 0.011	0.512 ± 0.012
	2041-2060	0.711 ± 0.015	0.937 ± 0.015	1.183 ± 0.015	1.401 ± 0.018
	2080-2099	0.712 ± 0.016	1.629 ± 0.021	2.416 ± 0.025	3.156 ± 0.035
Multi-model maximum	Baseline	9.202 ± 1.394	9.202 ± 1.394	9.202 ± 1.394	9.202 ± 1.394
	2021-2040	0.836 ± 0.012	1.030 ± 0.015	1.230 ± 0.011	1.075 ± 0.019
	2041-2060	1.448 ± 0.023	1.861 ± 0.019	2.068 ± 0.019	2.053 ± 0.036
	2080-2099	1.599 ± 0.019	2.891 ± 0.028	4.009 ± 0.035	5.021 ± 0.042
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.951 ± 0.014	1.041 ± 0.016	1.375 ± 0.017	1.248 ± 0.028
	2041-2060	1.611 ± 0.031	1.913 ± 0.021	2.148 ± 0.021	2.156 ± 0.041
	2080-2099	1.500 ± 0.020	2.999 ± 0.029	4.372 ± 0.037	5.387 ± 0.038

Table 11: The statistics of the projected changes in daily mean air temperature in units of °C over the Upper Rangitīkei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

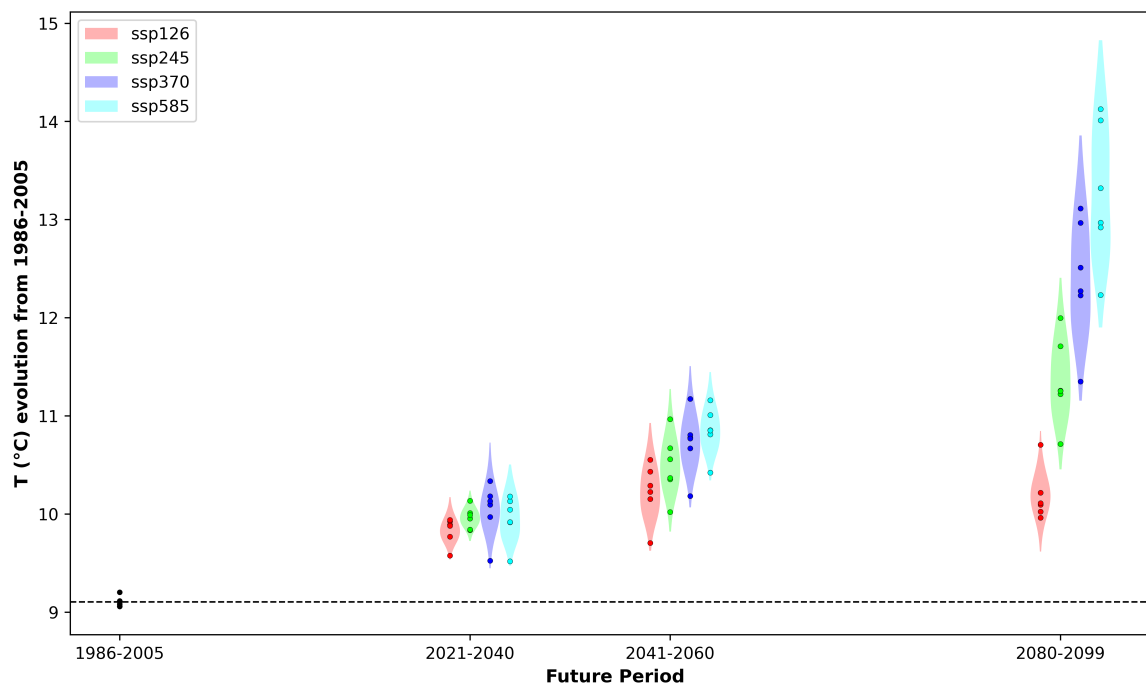


Figure 41: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Upper Rangitikei region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.3.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 42. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 12. Projections for average summer daily air temperature (T_{mean}) in Upper Rangitikei indicate a robust warming trend across all emissions scenarios (SSPs) relative to the 1986–2005 baseline. By mid-century (2041–2060), multi-model mean warming is projected to range from about 1.4°C under SSP1-2.6 to just over 2°C under higher emissions scenarios like SSP5-8.5. This increase is likely (66–100% probability) regardless of scenario. By late-century (2080–2099), the divergence between scenarios grows: projections range from around 1.2°C of warming under SSP1-2.6 to nearly 4.8°C under SSP5-8.5, indicating extremely likely increases, particularly under higher-emissions pathways.

Inter-model agreement on the sign and broad magnitude of change is very high, with all models indicating warming. However, the level of agreement between scenarios diminishes over time—with scenario agreement falling to 0% by 2100, underscoring scenario-dependent outcomes. Spatial variability within Upper Rangitikei is relatively low in projected changes, with standard deviations generally well below 0.1°C for future periods, much smaller than inter-scenario differences.

These results provide very high confidence that Upper Rangitikei will experience significant summer warming through the 21st century. The magnitude of change will be primarily dictated by the global emissions trajectory, with late-century outcomes varying from modest to severe depending on mitigation success. The warming signal is very likely and robust under all plausible scenarios.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	13.67 ± 1.41	13.67 ± 1.41	13.67 ± 1.41	13.67 ± 1.41
	2021-2040	0.86 ± 0.02	0.99 ± 0.05	1.21 ± 0.05	1.04 ± 0.05
	2041-2060	1.36 ± 0.07	1.63 ± 0.05	2.01 ± 0.05	2.03 ± 0.08
	2080-2099	1.20 ± 0.06	2.59 ± 0.07	3.96 ± 0.07	4.77 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.87 ± 0.02	1.00 ± 0.05	1.21 ± 0.05	1.05 ± 0.06
	2041-2060	1.37 ± 0.07	1.64 ± 0.05	2.02 ± 0.05	2.03 ± 0.08
	2080-2099	1.20 ± 0.06	2.61 ± 0.07	3.98 ± 0.07	4.82 ± 0.07
Multi-model minimum	Baseline	13.55 ± 1.42	13.55 ± 1.42	13.55 ± 1.42	13.55 ± 1.42
	2021-2040	0.74 ± 0.05	0.80 ± 0.02	0.72 ± 0.02	0.74 ± 0.01
	2041-2060	0.80 ± 0.04	1.37 ± 0.05	1.21 ± 0.02	1.73 ± 0.04
	2080-2099	0.97 ± 0.03	1.99 ± 0.05	2.81 ± 0.03	3.70 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.68 ± 0.04	0.79 ± 0.03	0.76 ± 0.03	0.69 ± 0.02
	2041-2060	0.88 ± 0.05	1.29 ± 0.04	1.44 ± 0.02	1.68 ± 0.06
	2080-2099	0.83 ± 0.04	1.91 ± 0.08	2.93 ± 0.05	3.65 ± 0.06
Multi-model maximum	Baseline	13.96 ± 1.42	13.96 ± 1.42	13.96 ± 1.42	13.96 ± 1.42
	2021-2040	1.09 ± 0.05	1.17 ± 0.07	1.57 ± 0.11	1.39 ± 0.10
	2041-2060	1.81 ± 0.06	2.05 ± 0.05	2.39 ± 0.03	2.41 ± 0.09
	2080-2099	1.72 ± 0.09	3.32 ± 0.05	4.96 ± 0.04	5.73 ± 0.08
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.06 ± 0.05	1.22 ± 0.08	1.71 ± 0.07	1.42 ± 0.10
	2041-2060	1.93 ± 0.10	2.01 ± 0.07	2.66 ± 0.08	2.40 ± 0.12
	2080-2099	1.61 ± 0.09	3.39 ± 0.06	5.19 ± 0.09	6.14 ± 0.09

Table 12: The statistics of the projected changes in daily mean air temperature in units of °C over the Upper Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

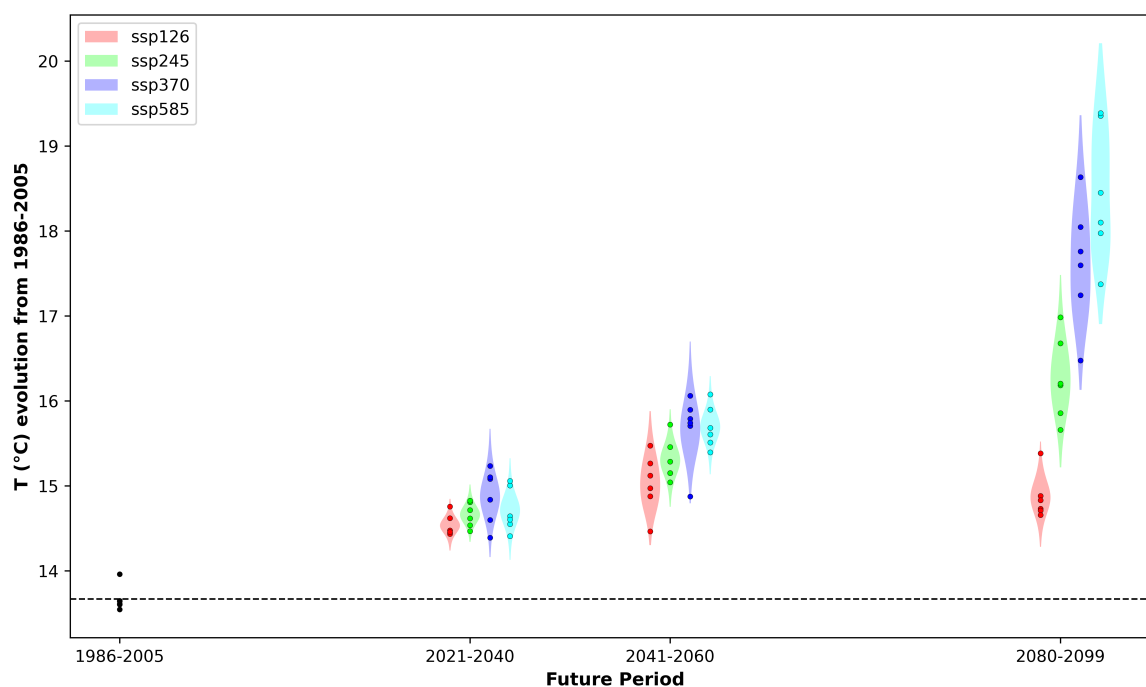


Figure 42: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Upper Rangitikei region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.3.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 43. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 13. Projected changes in average daily air temperature (T_{mean}) for autumn in Upper Rangitikei show a strong warming trend throughout the 21st century across all emission scenarios, relative to the 1986–2005 baseline. By mid-century (2041–2060), the multi-model mean warming ranges from approximately 1.1°C under SSP1-2.6 to 1.8°C under SSP5-8.5. These increases are likely, supported by consistent signals across models and scenarios.

By the end of the century (2080–2099), the warming diverges strongly by scenario: increases are about 1.2°C under low emissions (SSP1-2.6) but reach over 4.1°C under high emissions (SSP5-8.5). This scenario-dependent spread is clearly seen in the figure and is reflected in the 0% agreement between scenarios in late-century projections, indicating very low scenario convergence and high dependence on future emission pathways. Inter-model spread within individual scenarios remains moderate, giving very likely confidence in continued warming but medium confidence in the precise magnitude for later periods.

Spatial variability within Upper Rangitikei is small in comparison to projected changes, with standard deviations generally below 0.04°C. Thus, the regional signal is robust. Overall, it is virtually certain that autumn mean temperatures will rise in Upper Rangitikei, but the magnitude of long-term warming is highly sensitive to emissions, being likely to exceed 3°C by late century under high-emission scenarios.

15.3.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 44. The statistical summary of projected changes in daily mean air temperature over this region is shown

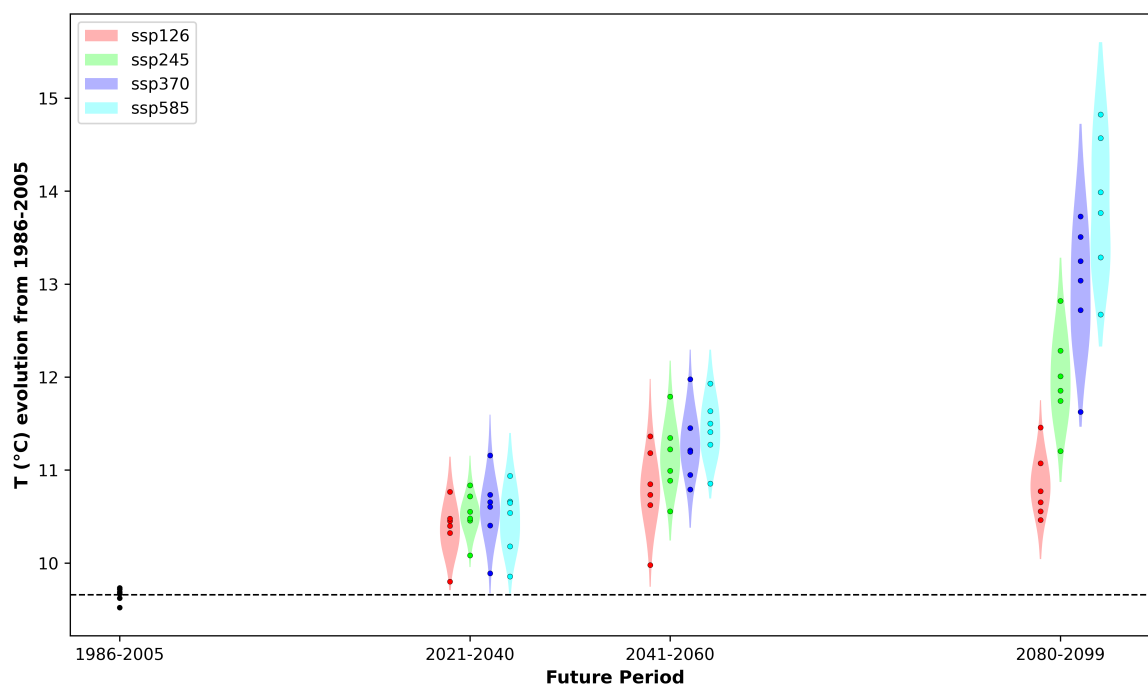


Figure 43: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Upper Rangitikei region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

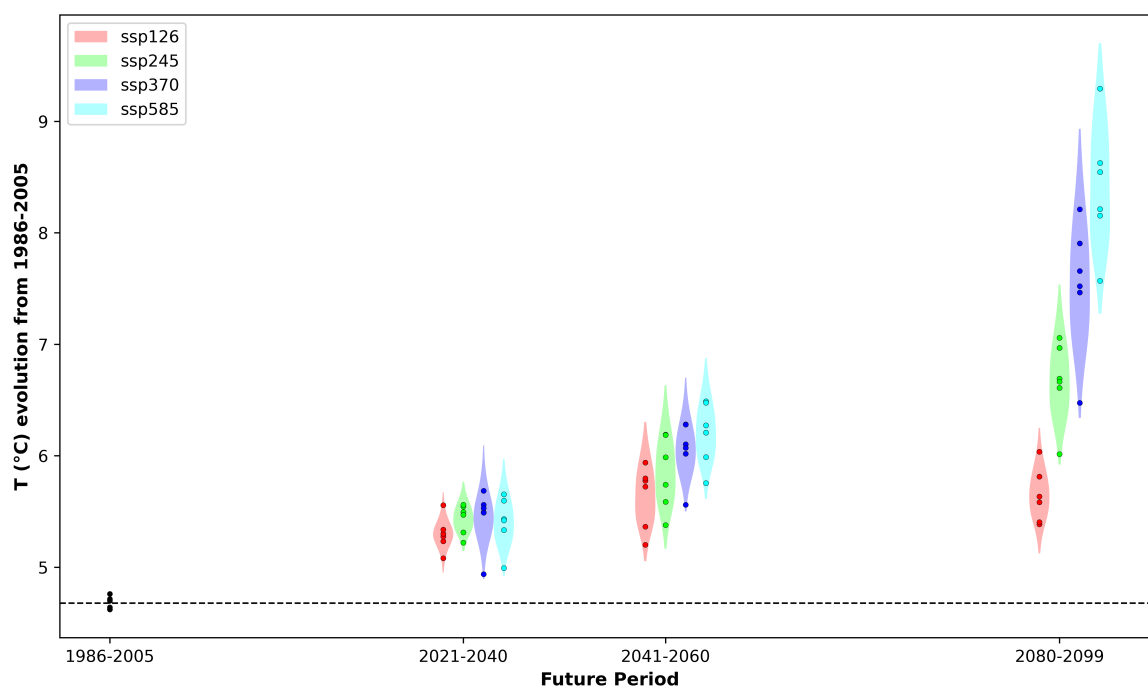


Figure 44: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Upper Rangitikei region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	9.659 ± 1.334	9.659 ± 1.334	9.659 ± 1.334	9.659 ± 1.334
	2021-2040	0.711 ± 0.020	0.862 ± 0.023	0.916 ± 0.016	0.811 ± 0.025
	2041-2060	1.130 ± 0.028	1.473 ± 0.012	1.604 ± 0.023	1.775 ± 0.025
	2080-2099	1.170 ± 0.022	2.327 ± 0.023	3.318 ± 0.035	4.192 ± 0.034
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.720 ± 0.020	0.867 ± 0.023	0.924 ± 0.016	0.825 ± 0.025
	2041-2060	1.139 ± 0.028	1.485 ± 0.012	1.613 ± 0.023	1.788 ± 0.025
	2080-2099	1.180 ± 0.022	2.345 ± 0.023	3.349 ± 0.035	4.239 ± 0.035
Multi-model minimum	Baseline	9.522 ± 1.326	9.522 ± 1.326	9.522 ± 1.326	9.522 ± 1.326
	2021-2040	0.142 ± 0.017	0.423 ± 0.052	0.231 ± 0.024	0.196 ± 0.020
	2041-2060	0.320 ± 0.016	0.897 ± 0.020	1.132 ± 0.021	1.196 ± 0.027
	2080-2099	0.804 ± 0.021	1.545 ± 0.021	1.966 ± 0.033	3.014 ± 0.050
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.271 ± 0.018	0.506 ± 0.043	0.342 ± 0.016	0.265 ± 0.021
	2041-2060	0.461 ± 0.016	0.889 ± 0.019	1.028 ± 0.026	1.268 ± 0.023
	2080-2099	0.656 ± 0.028	1.567 ± 0.028	2.264 ± 0.028	3.077 ± 0.035
Multi-model maximum	Baseline	9.735 ± 1.334	9.735 ± 1.334	9.735 ± 1.334	9.735 ± 1.334
	2021-2040	1.107 ± 0.022	1.176 ± 0.013	1.499 ± 0.012	1.278 ± 0.019
	2041-2060	1.703 ± 0.026	2.132 ± 0.026	2.318 ± 0.025	2.271 ± 0.038
	2080-2099	1.799 ± 0.030	3.161 ± 0.026	4.069 ± 0.033	5.165 ± 0.041
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.229 ± 0.027	1.258 ± 0.017	1.556 ± 0.025	1.461 ± 0.036
	2041-2060	1.878 ± 0.044	2.155 ± 0.017	2.267 ± 0.032	2.379 ± 0.046
	2080-2099	1.768 ± 0.024	3.232 ± 0.028	4.585 ± 0.053	5.561 ± 0.052

Table 13: The statistics of the projected changes in daily mean air temperature in units of °C over the Upper Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



in Table 14. Projections for average winter (JJA) daily air temperature in Upper Rangitikei show a robust warm-

Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	4.677 ± 1.334	4.677 ± 1.334	4.677 ± 1.334	4.677 ± 1.334
	2021-2040	0.620 ± 0.024	0.756 ± 0.022	0.772 ± 0.022	0.728 ± 0.023
	2041-2060	0.956 ± 0.028	1.167 ± 0.041	1.375 ± 0.045	1.521 ± 0.039
	2080-2099	0.966 ± 0.028	1.990 ± 0.038	2.862 ± 0.033	3.723 ± 0.048
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.622 ± 0.025	0.761 ± 0.023	0.778 ± 0.023	0.736 ± 0.023
	2041-2060	0.967 ± 0.029	1.179 ± 0.041	1.383 ± 0.045	1.531 ± 0.039
	2080-2099	0.973 ± 0.028	2.004 ± 0.038	2.884 ± 0.032	3.751 ± 0.048
Multi-model minimum	Baseline	4.609 ± 1.346	4.609 ± 1.346	4.609 ± 1.346	4.609 ± 1.346
	2021-2040	0.403 ± 0.032	0.544 ± 0.019	0.260 ± 0.014	0.316 ± 0.021
	2041-2060	0.524 ± 0.015	0.700 ± 0.024	0.884 ± 0.030	1.078 ± 0.039
	2080-2099	0.699 ± 0.027	1.338 ± 0.027	1.797 ± 0.033	2.892 ± 0.054
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.405 ± 0.011	0.561 ± 0.020	0.413 ± 0.016	0.401 ± 0.016
	2041-2060	0.554 ± 0.009	0.700 ± 0.027	1.008 ± 0.041	1.120 ± 0.036
	2080-2099	0.619 ± 0.016	1.475 ± 0.034	2.033 ± 0.037	2.915 ± 0.062
Multi-model maximum	Baseline	4.761 ± 1.330	4.761 ± 1.330	4.761 ± 1.330	4.761 ± 1.330
	2021-2040	0.880 ± 0.036	0.893 ± 0.029	1.008 ± 0.018	0.977 ± 0.035
	2041-2060	1.261 ± 0.032	1.524 ± 0.038	1.611 ± 0.044	1.822 ± 0.032
	2080-2099	1.360 ± 0.061	2.381 ± 0.029	3.533 ± 0.042	4.615 ± 0.031
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.856 ± 0.049	0.987 ± 0.058	1.180 ± 0.035	1.118 ± 0.041
	2041-2060	1.438 ± 0.057	1.725 ± 0.061	1.807 ± 0.050	1.999 ± 0.043
	2080-2099	1.377 ± 0.046	2.606 ± 0.047	3.851 ± 0.033	4.702 ± 0.035

Table 14: The statistics of the projected changes in daily mean air temperature in units of °C over the Upper Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

ing trend across all emissions scenarios, relative to the 1986–2005 baseline. In the near term (2021–2040), all scenarios indicate increases of approximately 0.6–0.8°C, with very high inter-model consistency, making it extremely likely that winter warming will continue. By mid-century (2041–2060), warming amplifies and begins to diverge with scenario, reaching just under 1°C in SSP1-2.6 and up to about 1.5°C under SSP5-8.5, strongly signalling that higher emissions tracks lead to greater warming.

By late century (2080–2099), the spread among scenarios grows pronounced: a likely increase of about 1°C under SSP1-2.6 is seen, in contrast to nearly 2°C (SSP2-4.5), around 2.9°C (SSP3-7.0), and up to nearly 3.7°C under SSP5-8.5. The magnitude of projected change becomes very scenario-dependent, with virtually certain warming but only about as likely as not for differences between low and high emission pathways to be realised, given model spread. Spatial variability within the region is consistently small, indicating uniform warming. Inter-model scenario agreement falls with time (to 0% in late century), stressing greater uncertainty in the precise magnitude of change, but overall confidence in continued warming is very high.



15.3.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 45. The statistical summary of projected changes in daily mean air temperature over this region

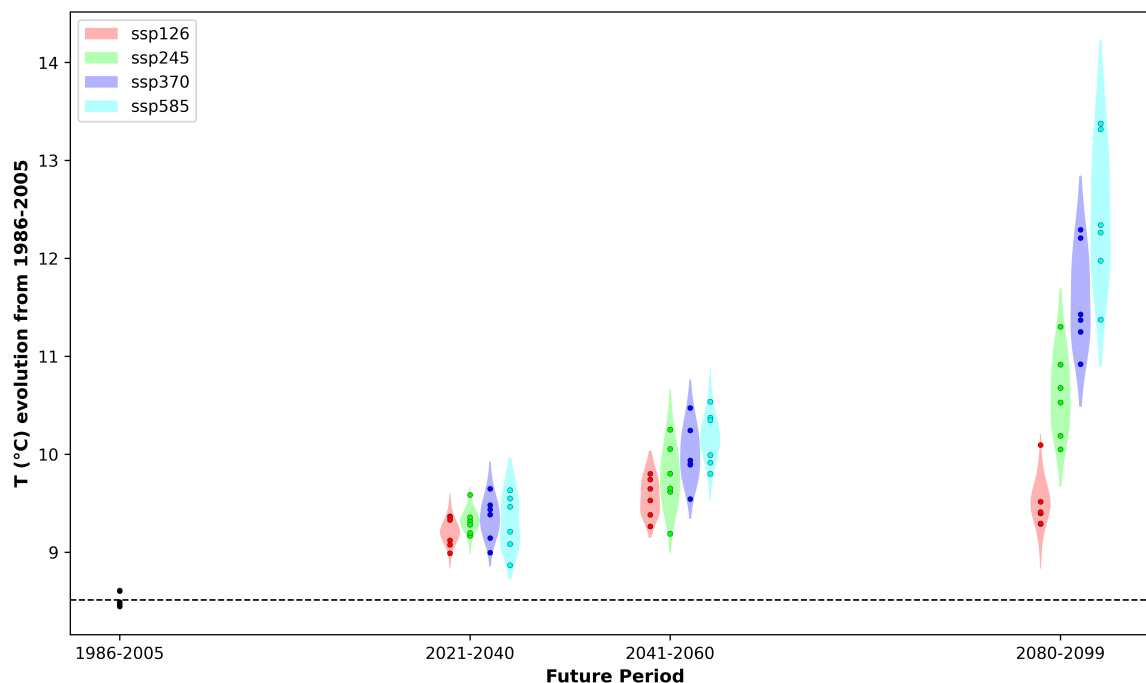


Figure 45: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Upper Rangitikei region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

is shown in Table 15. The climate projections for average daily air temperature (T_{mean}) in Upper Rangitikei during spring show a robust warming trend spanning all emission scenarios (SSPs) and future periods. By 2021–2040, multi-model means indicate a likely increase of around 0.7–0.8°C above the 1986–2005 baseline across all scenarios, signaling strong model agreement and very likely warming even under low emissions (SSP1-2.6). By mid-century (2041–2060), projected mean warming intensifies, ranging from about 1.0°C (SSP1-2.6) to 1.6°C (SSP5-8.5). By century’s end (2080–2099), temperature increases diverge markedly: minimal under SSP1-2.6 (~1.0°C), but exceeding 2°C for SSP2-4.5 and surpassing 3°C (SSP3-7.0) and 3.9°C (SSP5-8.5), indicating extremely likely substantial warming under high emissions.

Inter-model agreement (as seen in violin spread and statistics) is high in early periods and under lower emissions, but decreases toward 2100 and with higher emissions, where projection spreads widen notably. Consistency among models is reflected in small spatial standard deviations (~0.01–0.06°C), underlining that the warming signal is coherent across the region. Scenario agreement declines over time, with near-total divergence (0% agreement) between SSPs by 2080–2099, indicating that policy choices will exert a strong influence on future regional climate. Confidence in a significant warming trend is very high, with magnitude contingent on emissions pathway.

15.4 Region: Western Ruahine

Area: 1758.32 km²



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	8.513 ± 1.501	8.513 ± 1.501	8.513 ± 1.501	8.513 ± 1.501
	2021-2040	0.694 ± 0.014	0.805 ± 0.011	0.836 ± 0.016	0.789 ± 0.016
	2041-2060	1.048 ± 0.017	1.248 ± 0.028	1.486 ± 0.026	1.649 ± 0.028
	2080-2099	0.987 ± 0.016	2.098 ± 0.032	3.065 ± 0.045	3.929 ± 0.058
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.696 ± 0.014	0.806 ± 0.011	0.843 ± 0.016	0.805 ± 0.016
	2041-2060	1.058 ± 0.017	1.261 ± 0.028	1.498 ± 0.025	1.655 ± 0.028
	2080-2099	0.990 ± 0.017	2.116 ± 0.032	3.090 ± 0.045	3.965 ± 0.059
Multi-model minimum	Baseline	8.441 ± 1.500	8.441 ± 1.500	8.441 ± 1.500	8.441 ± 1.500
	2021-2040	0.477 ± 0.056	0.645 ± 0.028	0.483 ± 0.019	0.354 ± 0.025
	2041-2060	0.750 ± 0.036	0.676 ± 0.026	1.031 ± 0.042	1.288 ± 0.038
	2080-2099	0.771 ± 0.035	1.538 ± 0.037	2.408 ± 0.046	2.863 ± 0.065
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.467 ± 0.052	0.596 ± 0.015	0.505 ± 0.015	0.371 ± 0.015
	2041-2060	0.753 ± 0.031	0.728 ± 0.021	1.034 ± 0.030	1.240 ± 0.049
	2080-2099	0.576 ± 0.024	1.446 ± 0.029	2.292 ± 0.041	2.834 ± 0.050
Multi-model maximum	Baseline	8.622 ± 1.505	8.622 ± 1.505	8.622 ± 1.505	8.622 ± 1.505
	2021-2040	0.875 ± 0.031	1.073 ± 0.031	1.134 ± 0.018	1.122 ± 0.034
	2041-2060	1.287 ± 0.026	1.740 ± 0.045	1.960 ± 0.040	2.025 ± 0.053
	2080-2099	1.581 ± 0.021	2.789 ± 0.079	3.784 ± 0.069	4.868 ± 0.091
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.939 ± 0.033	1.025 ± 0.017	1.224 ± 0.024	1.299 ± 0.023
	2041-2060	1.406 ± 0.027	1.866 ± 0.048	2.026 ± 0.036	2.111 ± 0.046
	2080-2099	1.429 ± 0.017	2.879 ± 0.057	3.999 ± 0.061	5.254 ± 0.084

Table 15: The statistics of the projected changes in daily mean air temperature in units of °C over the Upper Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



15.4.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 46. The statistical summary of projected changes in daily mean air temperature over this region is

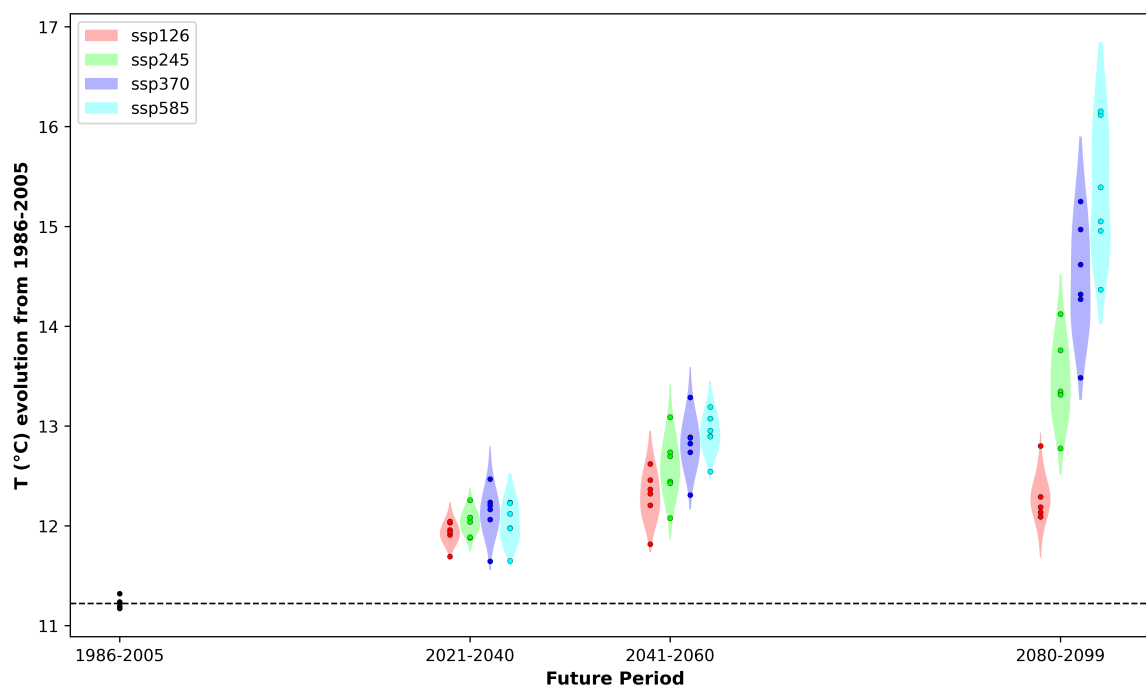


Figure 46: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Western Ruahine region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 16. The Western Ruahine region is projected to experience substantial increases in annual mean air temperature over the 21st century. All scenarios (SSP126, SSP245, SSP370, SSP585) show a warming trend relative to the 1986–2005 baseline, with higher emissions scenarios leading to greater temperature rises. By 2021–2040, the multi-model mean warming is likely in the range of 0.7°C to 0.9°C across scenarios, indicating extremely likely agreement on near-term warming. By mid-century (2041–2060), warming intensifies, with inter-scenario differences increasing – climate model means range from approximately 1.1°C (SSP126) to 1.7°C (SSP585), a divergence that is very likely. By late-century (2080–2099), projected increases span from about 1.0°C (SSP126) up to over 4.1°C (SSP585); this rapid escalation under higher emission pathways is virtually certain. Across scenarios, model agreement is high on the sign of change (nearly certain warming), but the spread and magnitude of late-century projections reflect scenario-dependent uncertainty. Inter-model consensus within each scenario is robust, with a tight clustering of values and low spatial variability. However, the agreement between scenario projections drops to zero by century’s end. Overall, it is virtually certain the Western Ruahine region will warm, with the extent of warming tightly linked to future emissions.

15.4.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 47. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 17. The ensemble projections indicate a likely increase in average summer (DJF) daily air temperature (T_{mean}) in the Western Ruahine sub-region compared to the 1986–2005 baseline. For the near-term (2021–2040), all SSP scenarios project warming of approximately 0.8–1.1°C, with very high inter-model agreement,



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.22 ± 1.24	11.22 ± 1.24	11.22 ± 1.24	11.22 ± 1.24
	2021-2040	0.71 ± 0.01	0.82 ± 0.01	0.91 ± 0.01	0.81 ± 0.01
	2041-2060	1.08 ± 0.01	1.36 ± 0.01	1.60 ± 0.01	1.70 ± 0.01
	2080-2099	1.05 ± 0.01	2.22 ± 0.01	3.26 ± 0.01	4.12 ± 0.02
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.71 ± 0.01	0.82 ± 0.01	0.92 ± 0.01	0.82 ± 0.01
	2041-2060	1.09 ± 0.01	1.37 ± 0.01	1.61 ± 0.01	1.71 ± 0.01
	2080-2099	1.05 ± 0.01	2.23 ± 0.01	3.29 ± 0.01	4.16 ± 0.02
Multi-model minimum	Baseline	11.17 ± 1.24	11.17 ± 1.24	11.17 ± 1.24	11.17 ± 1.24
	2021-2040	0.47 ± 0.02	0.65 ± 0.02	0.42 ± 0.01	0.43 ± 0.01
	2041-2060	0.60 ± 0.02	0.86 ± 0.03	1.09 ± 0.02	1.32 ± 0.01
	2080-2099	0.86 ± 0.01	1.55 ± 0.03	2.26 ± 0.02	3.15 ± 0.03
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.53 ± 0.01	0.62 ± 0.03	0.53 ± 0.01	0.50 ± 0.01
	2041-2060	0.69 ± 0.02	0.88 ± 0.02	1.17 ± 0.02	1.40 ± 0.01
	2080-2099	0.67 ± 0.02	1.58 ± 0.02	2.40 ± 0.02	3.15 ± 0.02
Multi-model maximum	Baseline	11.32 ± 1.24	11.32 ± 1.24	11.32 ± 1.24	11.32 ± 1.24
	2021-2040	0.82 ± 0.00	1.04 ± 0.01	1.25 ± 0.02	1.03 ± 0.02
	2041-2060	1.40 ± 0.01	1.87 ± 0.01	2.06 ± 0.01	1.97 ± 0.03
	2080-2099	1.58 ± 0.01	2.90 ± 0.01	4.03 ± 0.02	4.93 ± 0.03
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.92 ± 0.01	1.05 ± 0.01	1.35 ± 0.01	1.18 ± 0.02
	2041-2060	1.53 ± 0.02	1.92 ± 0.01	2.11 ± 0.01	2.07 ± 0.02
	2080-2099	1.47 ± 0.01	2.98 ± 0.01	4.32 ± 0.02	5.32 ± 0.02

Table 16: The statistics of the projected changes in daily mean air temperature in units of °C over the Western Ruahine region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	15.55 ± 1.22	15.55 ± 1.22	15.55 ± 1.22	15.55 ± 1.22
	2021-2040	0.82 ± 0.01	0.91 ± 0.02	1.13 ± 0.02	0.96 ± 0.02
	2041-2060	1.25 ± 0.02	1.54 ± 0.02	1.93 ± 0.03	1.90 ± 0.03
	2080-2099	1.10 ± 0.02	2.48 ± 0.02	3.86 ± 0.03	4.65 ± 0.04
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.82 ± 0.01	0.91 ± 0.02	1.14 ± 0.02	0.96 ± 0.02
	2041-2060	1.26 ± 0.02	1.54 ± 0.02	1.94 ± 0.03	1.90 ± 0.03
	2080-2099	1.11 ± 0.02	2.50 ± 0.02	3.88 ± 0.03	4.70 ± 0.04
Multi-model minimum	Baseline	15.43 ± 1.21	15.43 ± 1.21	15.43 ± 1.21	15.43 ± 1.21
	2021-2040	0.74 ± 0.02	0.77 ± 0.02	0.72 ± 0.01	0.75 ± 0.02
	2041-2060	0.77 ± 0.02	1.27 ± 0.03	1.21 ± 0.02	1.70 ± 0.02
	2080-2099	0.88 ± 0.06	1.89 ± 0.04	2.79 ± 0.03	3.66 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.71 ± 0.01	0.75 ± 0.02	0.73 ± 0.01	0.66 ± 0.01
	2041-2060	0.81 ± 0.03	1.20 ± 0.03	1.40 ± 0.03	1.59 ± 0.02
	2080-2099	0.76 ± 0.04	1.78 ± 0.04	2.84 ± 0.04	3.57 ± 0.04
Multi-model maximum	Baseline	15.86 ± 1.22	15.86 ± 1.22	15.86 ± 1.22	15.86 ± 1.22
	2021-2040	0.97 ± 0.05	1.05 ± 0.02	1.42 ± 0.02	1.25 ± 0.02
	2041-2060	1.70 ± 0.02	1.99 ± 0.02	2.37 ± 0.03	2.25 ± 0.04
	2080-2099	1.59 ± 0.01	3.26 ± 0.04	4.93 ± 0.05	5.58 ± 0.05
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.95 ± 0.03	1.09 ± 0.02	1.60 ± 0.02	1.26 ± 0.03
	2041-2060	1.76 ± 0.03	1.92 ± 0.02	2.53 ± 0.03	2.22 ± 0.04
	2080-2099	1.49 ± 0.01	3.30 ± 0.03	5.07 ± 0.05	5.98 ± 0.07

Table 17: The statistics of the projected changes in daily mean air temperature in units of °C over the Western Ruahine region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

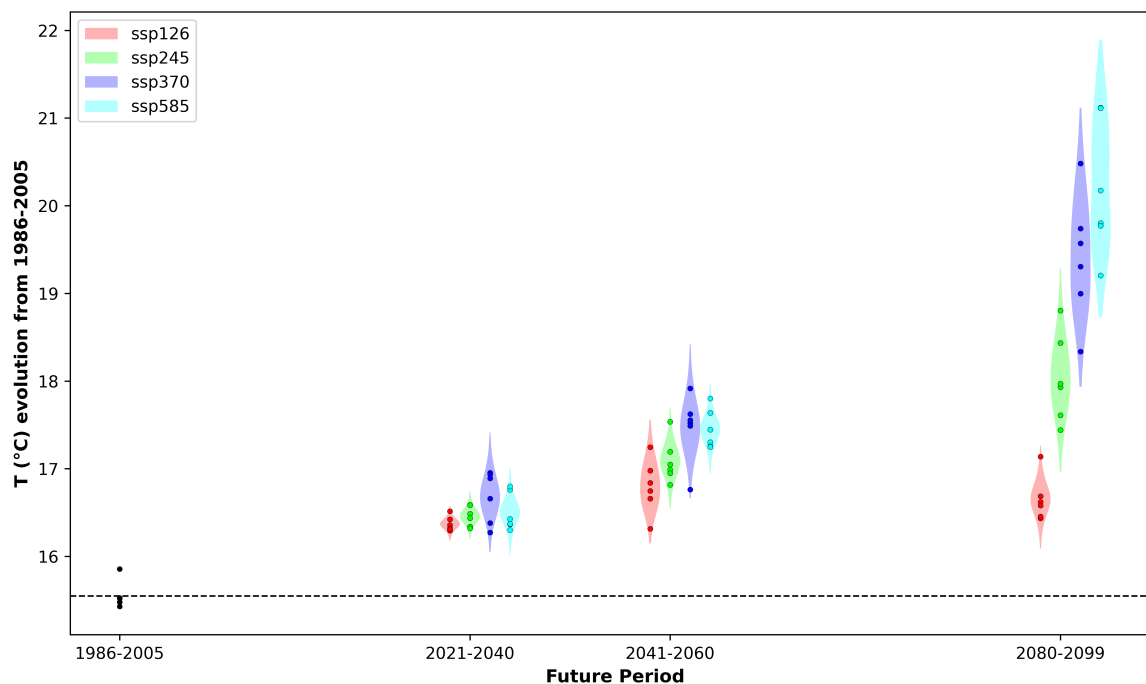


Figure 47: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Western Ruahine region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

suggesting this warming is extremely likely. By mid-century (2041–2060), temperature increases range from about 1.2°C (SSP1-2.6, low emissions) to nearly 1.9°C under the highest emission scenarios (SSP3-7.0 and SSP5-8.5), indicating the divergence of pathways becomes evident, but continued warming is very likely across all scenarios.

By late century (2080–2099), scenario dependence is pronounced. SSP1-2.6 shows a stabilisation or slight decrease in warming to ~1.1°C, while SSP2-4.5 shows ~2.5°C and the highest scenarios (SSP3-7.0 and SSP5-8.5) project increases of ~3.9°C and ~4.7°C, respectively. The spread among models also increases, especially for high emissions, but all models project warming, making further increases virtually certain.

Spatial variability within the sub-region remains low relative to projected changes, and very low scenario agreement by century's end (0% consensus) reflects growing scenario dependence. In summary, substantial summer warming is virtually certain for Western Ruahine, with the magnitude of change depending increasingly on emission pathway—confidence is very high in continued warming.

15.4.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 48. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 18. Projections for average daily air temperature (T_{mean}) in Western Ruahine during autumn show a robust warming signal across all scenarios. Warming is evident from the near term (2021–2040), with multi-model means indicating increases of approximately 0.7°C to 0.9°C relative to the 1986–2005 baseline, regardless of emissions pathway. By mid-century (2041–2060), projected warming ranges from about 1.1°C (SSP1-2.6) to 1.7°C (SSP5-8.5), and by late century (2080–2099), divergences between the scenarios become pronounced: warming stabilises near 1.1°C under strong mitigation (SSP1-2.6), but increases markedly under higher forcing scenarios, reaching over 4°C in SSP5-8.5.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.81 ± 1.22	11.81 ± 1.22	11.81 ± 1.22	11.81 ± 1.22
	2021-2040	0.68 ± 0.01	0.82 ± 0.01	0.89 ± 0.01	0.77 ± 0.01
	2041-2060	1.08 ± 0.01	1.45 ± 0.01	1.57 ± 0.01	1.73 ± 0.02
	2080-2099	1.13 ± 0.01	2.30 ± 0.01	3.29 ± 0.01	4.16 ± 0.02
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.69 ± 0.01	0.82 ± 0.01	0.90 ± 0.01	0.78 ± 0.01
	2041-2060	1.09 ± 0.01	1.46 ± 0.01	1.58 ± 0.01	1.75 ± 0.02
	2080-2099	1.14 ± 0.01	2.31 ± 0.01	3.32 ± 0.01	4.20 ± 0.02
Multi-model minimum	Baseline	11.68 ± 1.22	11.68 ± 1.22	11.68 ± 1.22	11.68 ± 1.22
	2021-2040	0.18 ± 0.02	0.38 ± 0.02	0.24 ± 0.01	0.21 ± 0.01
	2041-2060	0.32 ± 0.01	0.85 ± 0.02	1.11 ± 0.02	1.16 ± 0.03
	2080-2099	0.80 ± 0.02	1.53 ± 0.02	1.97 ± 0.01	3.03 ± 0.03
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.26 ± 0.01	0.42 ± 0.02	0.32 ± 0.01	0.24 ± 0.01
	2041-2060	0.45 ± 0.01	0.83 ± 0.02	0.99 ± 0.02	1.23 ± 0.02
	2080-2099	0.60 ± 0.02	1.52 ± 0.01	2.25 ± 0.02	3.07 ± 0.02
Multi-model maximum	Baseline	11.87 ± 1.22	11.87 ± 1.22	11.87 ± 1.22	11.87 ± 1.22
	2021-2040	1.12 ± 0.01	1.22 ± 0.02	1.53 ± 0.02	1.28 ± 0.02
	2041-2060	1.66 ± 0.01	2.17 ± 0.01	2.31 ± 0.02	2.23 ± 0.02
	2080-2099	1.82 ± 0.02	3.21 ± 0.02	4.10 ± 0.02	5.18 ± 0.02
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.18 ± 0.01	1.26 ± 0.01	1.54 ± 0.01	1.40 ± 0.02
	2041-2060	1.79 ± 0.02	2.16 ± 0.01	2.24 ± 0.01	2.33 ± 0.02
	2080-2099	1.73 ± 0.02	3.21 ± 0.01	4.54 ± 0.01	5.49 ± 0.02

Table 18: The statistics of the projected changes in daily mean air temperature in units of °C over the Western Ruahine region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

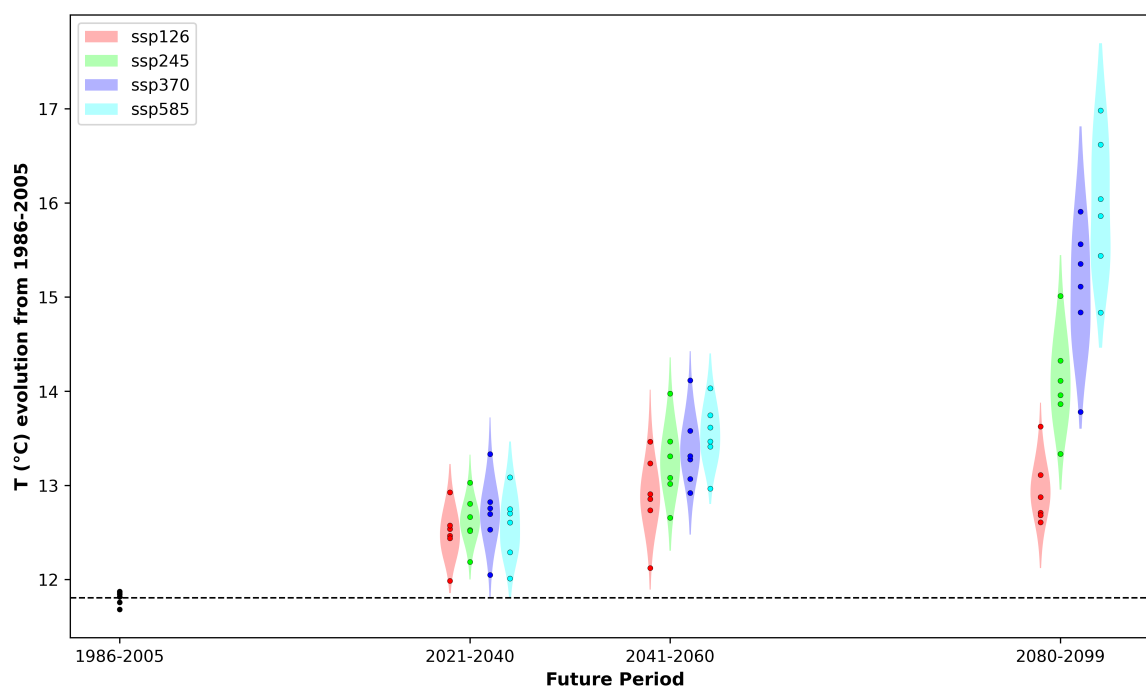


Figure 48: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Western Ruahine region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

Model spread within each scenario remains moderate, with relatively low spatial variability ($\text{stdv} < 0.02^{\circ}\text{C}$ for all periods), supporting high agreement on the spatial pattern of change. However, inter-scenario agreement declines from the near term (about 63% for 2021–2040) to essentially none by century’s end, reflecting scenario-dependent uncertainty in longer-term outcomes. These results suggest it is extremely likely that Western Ruahine will experience substantial increases in autumn T_{mean} , with the magnitude of change very likely to depend on emissions pathway. Confidence in the direction of warming is very high, with divergence in the magnitude of change manifesting mainly after mid-century.

15.4.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 49. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 19. Projections for average winter daily air temperature (T_{mean}) over Western Ruahine indicate a very likely, robust warming trend across all emissions scenarios and future time periods, relative to the 1986–2005 baseline. Model agreement supports that by 2021–2040, mean winter temperatures are expected to rise by roughly $0.6\text{--}0.8^{\circ}\text{C}$ across all scenarios, with minimal spread between models and scenarios, indicating high confidence in near-term warming. By mid-century (2041–2060), differences among scenarios begin to emerge, with projected increases ranging from about 1.0°C (SSP1-2.6) to 1.6°C (SSP5-8.5). For the late century (2080–2099), model consensus further declines and scenario spread widens dramatically, with warming from about 1.0°C under strong mitigation (SSP1-2.6) up to nearly 3.8°C under high emissions (SSP5-8.5). This divergence is reflected in the scenario agreement statistic, which drops from $\sim 54\%$ in the near term to 0% by 2080–2099, indicating low agreement on the magnitude of change under different emissions pathways. The inter-model spread, as visualised, also increases towards the end of the century and higher scenarios. Spatial variability within the sub-region remains modest relative to the projected mean change. Overall, it is extremely likely that winter temperatures in Western Ruahine will increase, with the greatest warming under high emission



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	6.977 ± 1.232	6.977 ± 1.232	6.977 ± 1.232	6.977 ± 1.232
	2021-2040	0.629 ± 0.006	0.758 ± 0.004	0.780 ± 0.006	0.740 ± 0.005
	2041-2060	0.977 ± 0.004	1.195 ± 0.007	1.409 ± 0.011	1.552 ± 0.010
	2080-2099	0.971 ± 0.008	2.025 ± 0.009	2.890 ± 0.019	3.782 ± 0.025
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.631 ± 0.006	0.765 ± 0.004	0.787 ± 0.006	0.748 ± 0.005
	2041-2060	0.987 ± 0.004	1.207 ± 0.007	1.416 ± 0.011	1.561 ± 0.010
	2080-2099	0.979 ± 0.008	2.039 ± 0.009	2.913 ± 0.019	3.812 ± 0.025
Multi-model minimum	Baseline	6.929 ± 1.230	6.929 ± 1.230	6.929 ± 1.230	6.929 ± 1.230
	2021-2040	0.355 ± 0.030	0.527 ± 0.015	0.256 ± 0.015	0.324 ± 0.015
	2041-2060	0.512 ± 0.021	0.669 ± 0.030	0.883 ± 0.022	1.114 ± 0.013
	2080-2099	0.716 ± 0.006	1.328 ± 0.034	1.859 ± 0.023	2.981 ± 0.024
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.382 ± 0.013	0.517 ± 0.020	0.411 ± 0.013	0.407 ± 0.012
	2041-2060	0.558 ± 0.007	0.696 ± 0.010	1.025 ± 0.012	1.153 ± 0.013
	2080-2099	0.620 ± 0.007	1.495 ± 0.015	2.088 ± 0.016	3.015 ± 0.034
Multi-model maximum	Baseline	7.062 ± 1.232	7.062 ± 1.232	7.062 ± 1.232	7.062 ± 1.232
	2021-2040	0.910 ± 0.009	0.924 ± 0.019	1.016 ± 0.015	1.006 ± 0.023
	2041-2060	1.243 ± 0.014	1.554 ± 0.007	1.649 ± 0.024	1.859 ± 0.021
	2080-2099	1.400 ± 0.025	2.391 ± 0.015	3.501 ± 0.039	4.606 ± 0.019
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.902 ± 0.018	1.047 ± 0.021	1.200 ± 0.013	1.136 ± 0.011
	2041-2060	1.474 ± 0.011	1.788 ± 0.012	1.854 ± 0.029	2.024 ± 0.009
	2080-2099	1.386 ± 0.020	2.658 ± 0.026	3.851 ± 0.025	4.715 ± 0.018

Table 19: The statistics of the projected changes in daily mean air temperature in units of °C over the Western Ruahine region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

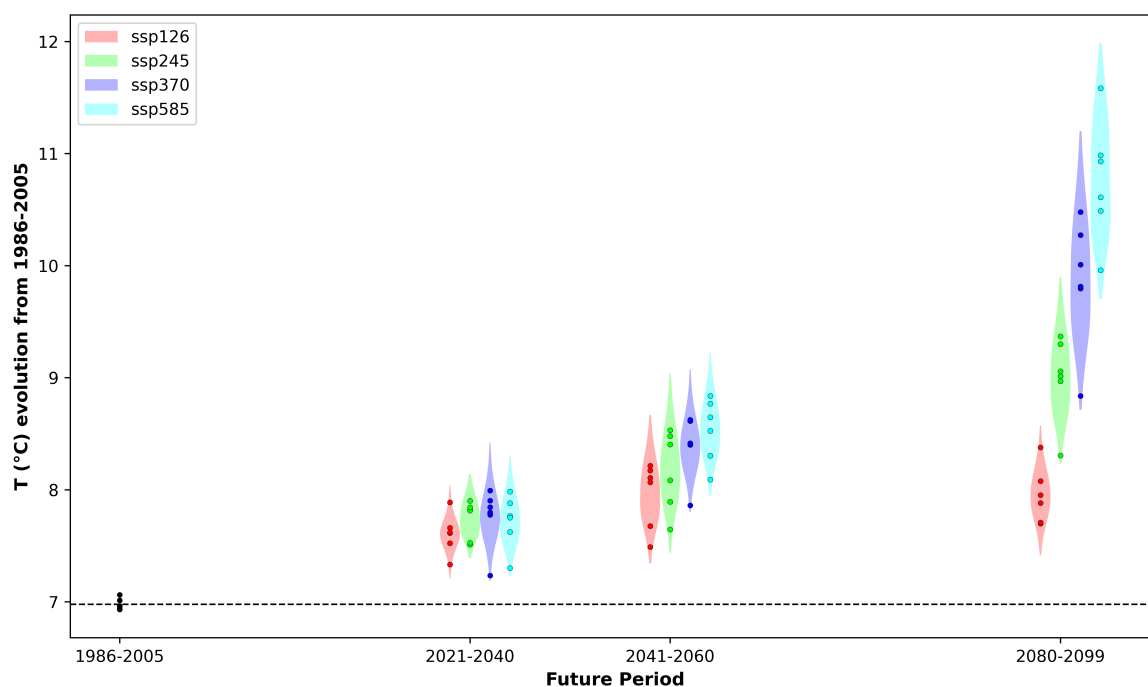


Figure 49: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Western Ruahine region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

futures and broadening uncertainty after mid-century.

15.4.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 50. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 20. Projected changes in average daily spring air temperature for Western Ruahine show a robust warming trend relative to the 1986–2005 baseline. All future scenarios display increases in mean temperature, with the magnitude of warming strongly dependent on emissions pathway. For the near term (2021–2040), the multi-model ensemble mean rise is around 0.7–0.8°C across all SSPs, with very high model agreement and low spatial variability, making it very likely that warming will exceed half a degree.

By mid-century (2041–2060), warming ranges from about 1.0°C (SSP1-2.6) to 1.6°C (SSP5-8.5), with moderate divergence between scenarios. By late century (2080–2099), scenario dependence is pronounced: projected warming is approximately 1.0°C under the low-emissions pathway (SSP1-2.6) but exceeds 3.8°C under SSP5-8.5. Maximum model projections reach above 4.8°C for SSP5-8.5, indicating a strong upper bound under high emissions. The spread of model projections increases over time and with scenario, particularly by 2080–2099, where there is no agreement between scenarios and inter-model spread becomes notable (low cross-SSP consensus).

The findings support with high confidence a likely increase in spring mean temperatures throughout Western Ruahine, with the warming magnitude extremely likely to be scenario-dependent by late century. Spatial variability within the region remains low throughout.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	10.64 ± 1.30	10.64 ± 1.30	10.64 ± 1.30	10.64 ± 1.30
	2021-2040	0.69 ± 0.01	0.77 ± 0.01	0.82 ± 0.01	0.76 ± 0.01
	2041-2060	1.01 ± 0.02	1.24 ± 0.02	1.47 ± 0.02	1.62 ± 0.02
	2080-2099	0.98 ± 0.01	2.06 ± 0.02	3.02 ± 0.03	3.87 ± 0.04
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.69 ± 0.01	0.78 ± 0.01	0.83 ± 0.01	0.78 ± 0.01
	2041-2060	1.02 ± 0.02	1.25 ± 0.02	1.48 ± 0.02	1.62 ± 0.02
	2080-2099	0.98 ± 0.01	2.08 ± 0.02	3.04 ± 0.03	3.91 ± 0.04
Multi-model minimum	Baseline	10.57 ± 1.30	10.57 ± 1.30	10.57 ± 1.30	10.57 ± 1.30
	2021-2040	0.50 ± 0.01	0.61 ± 0.04	0.50 ± 0.02	0.39 ± 0.01
	2041-2060	0.78 ± 0.04	0.63 ± 0.03	1.09 ± 0.02	1.32 ± 0.02
	2080-2099	0.74 ± 0.02	1.45 ± 0.04	2.43 ± 0.02	2.89 ± 0.03
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.47 ± 0.02	0.54 ± 0.03	0.50 ± 0.02	0.35 ± 0.02
	2041-2060	0.75 ± 0.03	0.68 ± 0.03	1.05 ± 0.01	1.28 ± 0.01
	2080-2099	0.57 ± 0.01	1.37 ± 0.03	2.26 ± 0.04	2.78 ± 0.04
Multi-model maximum	Baseline	10.74 ± 1.29	10.74 ± 1.29	10.74 ± 1.29	10.74 ± 1.29
	2021-2040	0.89 ± 0.02	1.09 ± 0.02	1.14 ± 0.01	1.13 ± 0.01
	2041-2060	1.20 ± 0.03	1.77 ± 0.02	1.96 ± 0.03	1.91 ± 0.05
	2080-2099	1.57 ± 0.02	2.81 ± 0.02	3.79 ± 0.03	4.81 ± 0.03
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.92 ± 0.01	1.03 ± 0.02	1.21 ± 0.01	1.27 ± 0.01
	2041-2060	1.33 ± 0.02	1.91 ± 0.01	1.96 ± 0.03	2.00 ± 0.04
	2080-2099	1.41 ± 0.02	2.90 ± 0.01	3.94 ± 0.03	5.19 ± 0.04

Table 20: The statistics of the projected changes in daily mean air temperature in units of °C over the Western Ruahine region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

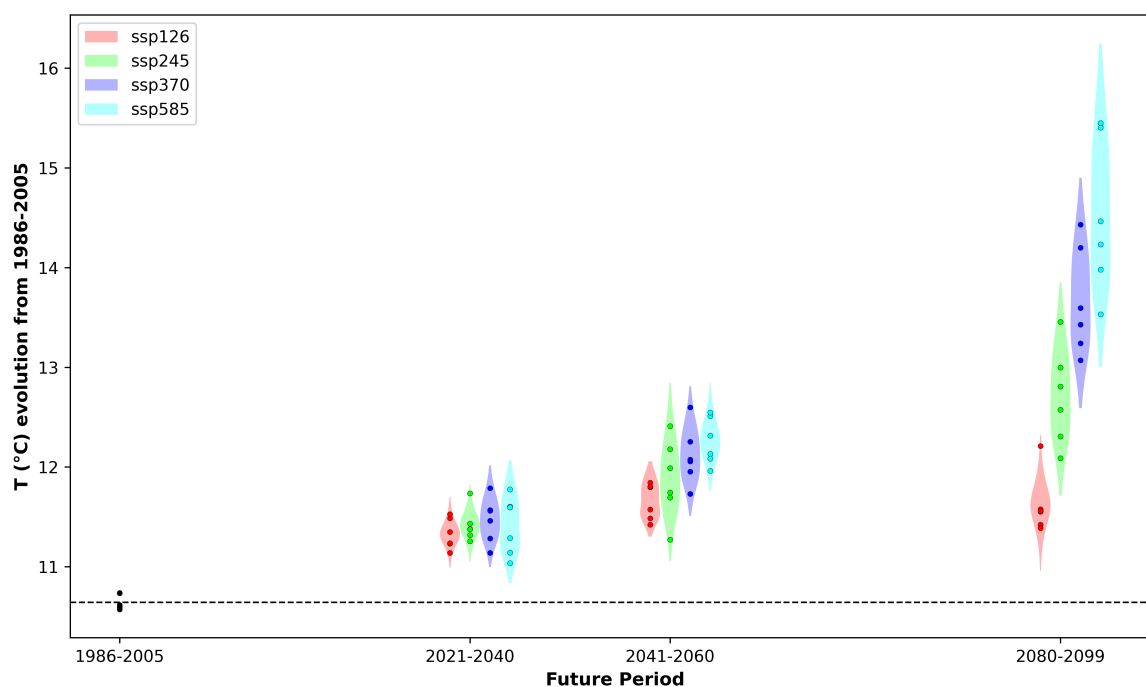


Figure 50: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Western Ruahine region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.5 Region: Tararua

Area: 3155.23 km²

15.5.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 51. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 21. Projections for annual average daily air temperature (T_{mean}) in Tararua indicate a robust warming trend throughout the 21st century. Across all emissions scenarios (SSPs), a temperature increase relative to the 1986–2005 baseline is very likely by mid-century, with the magnitude depending on scenario. For the 2021–2040 period, multi-model means show warming of approximately 0.7–0.9°C, with models in high agreement. By 2041–2060, projected warming increases to approximately 1.1°C (SSP1-2.6, low emissions) up to 1.7°C (SSP5-8.5, high emissions).

By 2080–2099, scenario divergence becomes very pronounced: warming is about 1.0°C under SSP1-2.6, but exceeds 4.0°C under SSP5-8.5. This spread in projections underscores the high sensitivity of late-century outcomes to emissions trajectory. While near-term model agreement is high, scenario agreement falls from about 42% in the near term to zero by century’s end, indicating very high scenario dependence. The spatial variability within Tararua is minor compared to the inter-scenario spread, with standard deviations below 0.06°C regionally in all periods.

In summary, there is very high confidence and it is extremely likely that Tararua will experience substantial warming. The scale of late-century warming is strongly dependent on global emissions, with differences across scenarios dominating over model or regional uncertainty by 2080–2099.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.89 ± 0.74	11.89 ± 0.74	11.89 ± 0.74	11.89 ± 0.74
	2021-2040	0.69 ± 0.02	0.80 ± 0.02	0.89 ± 0.02	0.79 ± 0.03
	2041-2060	1.06 ± 0.03	1.33 ± 0.02	1.57 ± 0.03	1.68 ± 0.04
	2080-2099	1.03 ± 0.03	2.19 ± 0.03	3.22 ± 0.04	4.04 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.69 ± 0.02	0.80 ± 0.02	0.89 ± 0.02	0.80 ± 0.03
	2041-2060	1.07 ± 0.03	1.34 ± 0.02	1.58 ± 0.03	1.69 ± 0.04
	2080-2099	1.04 ± 0.03	2.20 ± 0.03	3.24 ± 0.04	4.08 ± 0.06
Multi-model minimum	Baseline	11.83 ± 0.74	11.83 ± 0.74	11.83 ± 0.74	11.83 ± 0.74
	2021-2040	0.47 ± 0.01	0.61 ± 0.02	0.41 ± 0.01	0.42 ± 0.01
	2041-2060	0.60 ± 0.02	0.82 ± 0.02	1.07 ± 0.02	1.29 ± 0.04
	2080-2099	0.85 ± 0.03	1.52 ± 0.02	2.23 ± 0.04	3.10 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.52 ± 0.02	0.60 ± 0.02	0.52 ± 0.02	0.50 ± 0.02
	2041-2060	0.70 ± 0.02	0.86 ± 0.02	1.15 ± 0.02	1.37 ± 0.04
	2080-2099	0.68 ± 0.02	1.55 ± 0.03	2.37 ± 0.04	3.10 ± 0.05
Multi-model maximum	Baseline	11.99 ± 0.74	11.99 ± 0.74	11.99 ± 0.74	11.99 ± 0.74
	2021-2040	0.80 ± 0.02	1.01 ± 0.02	1.22 ± 0.01	0.98 ± 0.02
	2041-2060	1.37 ± 0.03	1.82 ± 0.03	2.02 ± 0.03	1.94 ± 0.04
	2080-2099	1.54 ± 0.03	2.84 ± 0.04	3.96 ± 0.04	4.85 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.89 ± 0.03	1.03 ± 0.02	1.32 ± 0.02	1.14 ± 0.04
	2041-2060	1.50 ± 0.03	1.87 ± 0.03	2.07 ± 0.03	2.05 ± 0.04
	2080-2099	1.43 ± 0.03	2.94 ± 0.04	4.24 ± 0.04	5.20 ± 0.07

Table 21: The statistics of the projected changes in daily mean air temperature in units of °C over the Tararua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

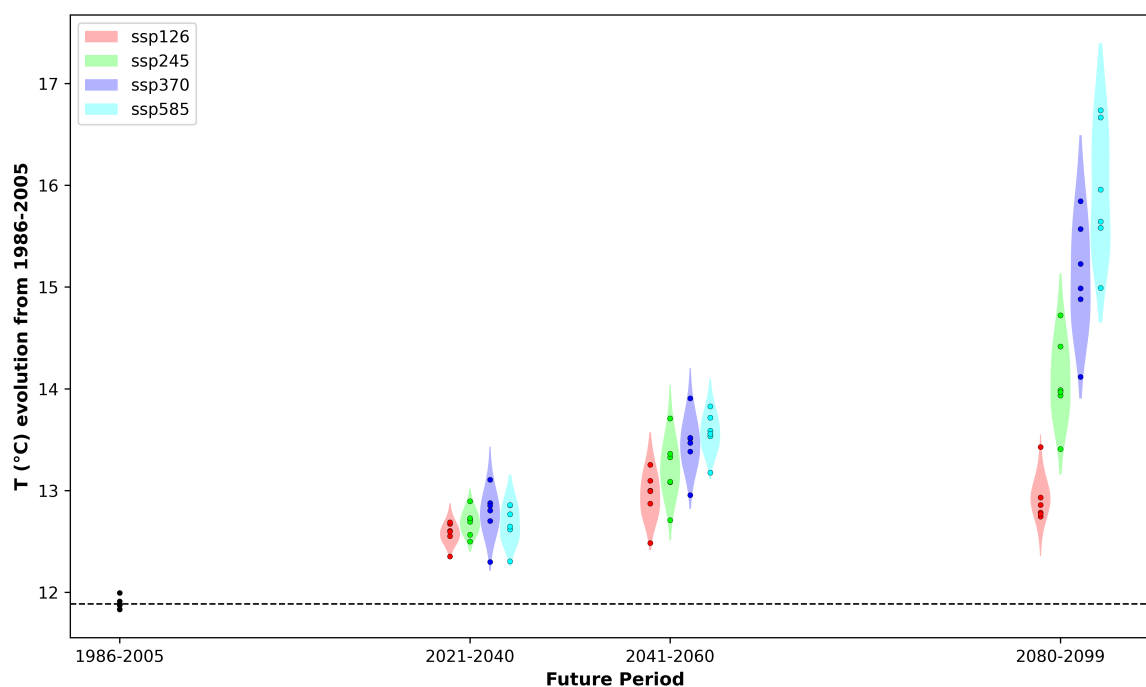


Figure 51: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Tararua region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.5.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 52. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 22. Across all future periods and emissions scenarios, Tararua is projected to experience increases in summer average daily temperature relative to the 1986-2005 baseline. The warming signal is very likely to be positive, with the magnitude scaling strongly with emissions scenario: slight increases under SSP1-2.6, and increasingly pronounced warming under SSP2-4.5, SSP3-7.0, and especially SSP5-8.5. By 2021-2040, mean warming is likely to be between 0.8 and 1.1°C across scenarios. Mid-century projections (2041-2060) show an increase in the multi-model mean to between 1.2°C for SSP1-2.6 and around 1.9°C for the higher scenarios. By 2080-2099, the divergence becomes marked: SSP1-2.6 stabilises at roughly 1.1°C, whereas SSP2-4.5 projects about 2.4°C, SSP3-7.0 nearly 3.8°C, and the high emissions pathway SSP5-8.5 approximately 4.5°C above baseline.

The spread of values from different models increases with both emissions strength and projection horizon, indicating decreasing inter-model agreement, especially post-2060 for high emissions pathways. Agreement across scenarios is high early in the century but diminishes to virtually zero by late century, consistent with emission-driven uncertainty. The spatial variability of warming within Tararua is low compared to the overall regional increase, reinforcing that these changes are robust spatially. These projections are assessed with high confidence and are extremely likely for the direction of change.

15.5.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 53. The statistical summary of projected changes in daily mean air temperature over this region is

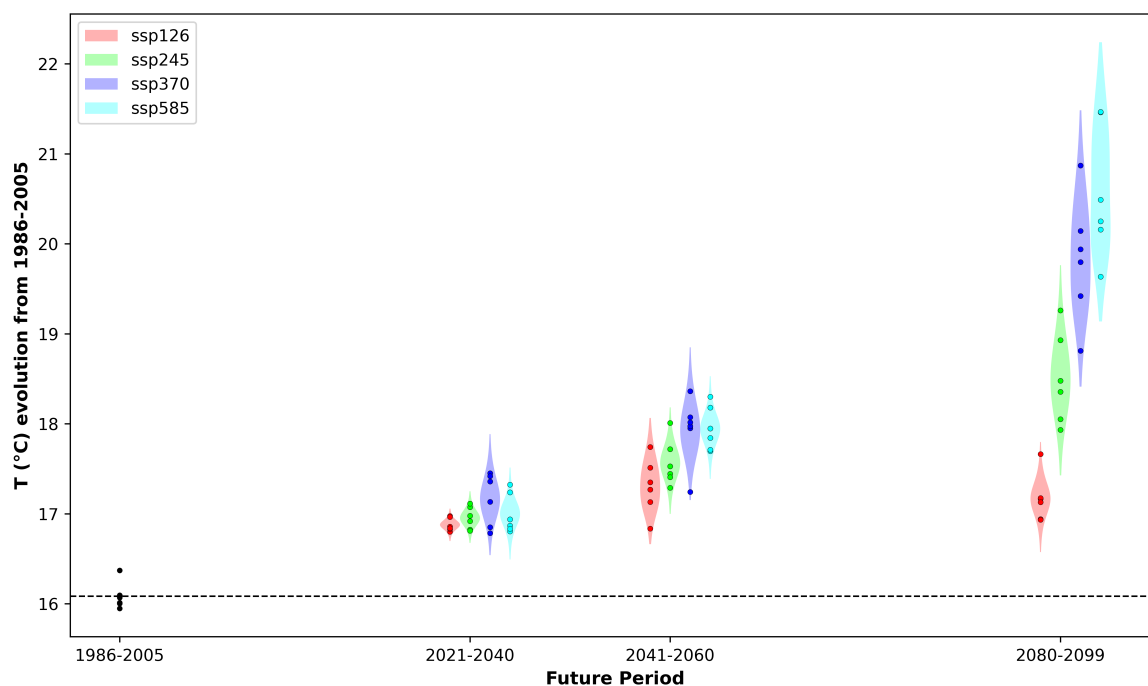


Figure 52: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of $^{\circ}\text{C}$ over the Tararua region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

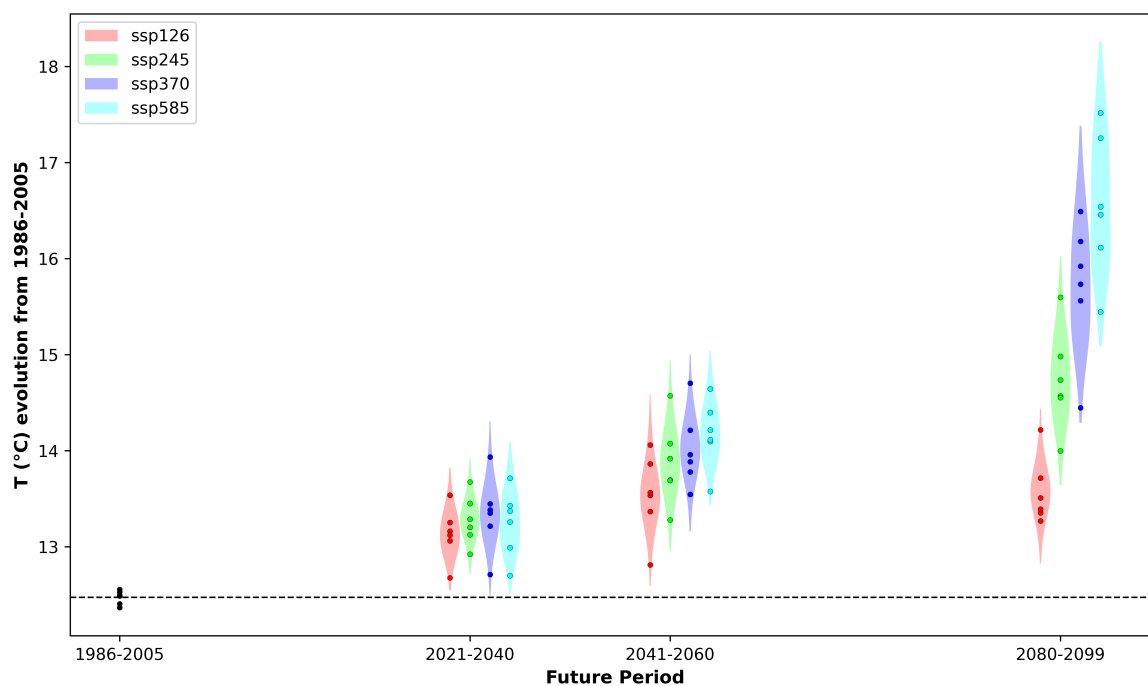


Figure 53: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of $^{\circ}\text{C}$ over the Tararua region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	16.08 ± 0.74	16.08 ± 0.74	16.08 ± 0.74	16.08 ± 0.74
	2021-2040	0.80 ± 0.02	0.87 ± 0.03	1.08 ± 0.03	0.92 ± 0.04
	2041-2060	1.22 ± 0.04	1.48 ± 0.02	1.85 ± 0.03	1.86 ± 0.06
	2080-2099	1.09 ± 0.04	2.42 ± 0.04	3.75 ± 0.04	4.49 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.79 ± 0.02	0.87 ± 0.03	1.09 ± 0.03	0.92 ± 0.04
	2041-2060	1.23 ± 0.04	1.49 ± 0.02	1.86 ± 0.03	1.87 ± 0.06
	2080-2099	1.09 ± 0.04	2.43 ± 0.04	3.77 ± 0.04	4.53 ± 0.07
Multi-model minimum	Baseline	15.95 ± 0.74	15.95 ± 0.74	15.95 ± 0.74	15.95 ± 0.74
	2021-2040	0.71 ± 0.04	0.72 ± 0.02	0.70 ± 0.02	0.71 ± 0.05
	2041-2060	0.75 ± 0.02	1.21 ± 0.02	1.16 ± 0.02	1.60 ± 0.05
	2080-2099	0.82 ± 0.06	1.85 ± 0.02	2.73 ± 0.04	3.55 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.68 ± 0.03	0.70 ± 0.02	0.68 ± 0.02	0.61 ± 0.04
	2041-2060	0.79 ± 0.03	1.13 ± 0.02	1.34 ± 0.03	1.52 ± 0.06
	2080-2099	0.72 ± 0.05	1.71 ± 0.05	2.78 ± 0.05	3.45 ± 0.07
Multi-model maximum	Baseline	16.37 ± 0.73	16.37 ± 0.73	16.37 ± 0.73	16.37 ± 0.73
	2021-2040	0.91 ± 0.03	1.03 ± 0.05	1.38 ± 0.04	1.24 ± 0.06
	2041-2060	1.66 ± 0.05	1.93 ± 0.03	2.28 ± 0.04	2.22 ± 0.04
	2080-2099	1.58 ± 0.04	3.18 ± 0.03	4.79 ± 0.06	5.41 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.90 ± 0.02	1.06 ± 0.06	1.54 ± 0.05	1.23 ± 0.05
	2041-2060	1.74 ± 0.06	1.87 ± 0.03	2.44 ± 0.04	2.22 ± 0.06
	2080-2099	1.47 ± 0.03	3.24 ± 0.04	4.90 ± 0.05	5.76 ± 0.07

Table 22: The statistics of the projected changes in daily mean air temperature in units of °C over the Tararua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



shown in Table 23. The projections for average daily air temperature (T_{mean}) in autumn over Tararua show a

Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.47 ± 0.71	12.47 ± 0.71	12.47 ± 0.71	12.47 ± 0.71
	2021-2040	0.66 ± 0.02	0.80 ± 0.01	0.87 ± 0.02	0.77 ± 0.02
	2041-2060	1.06 ± 0.02	1.40 ± 0.02	1.54 ± 0.02	1.70 ± 0.04
	2080-2099	1.10 ± 0.03	2.27 ± 0.02	3.25 ± 0.03	4.08 ± 0.05
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.67 ± 0.02	0.81 ± 0.01	0.88 ± 0.02	0.78 ± 0.02
	2041-2060	1.07 ± 0.02	1.41 ± 0.02	1.55 ± 0.02	1.71 ± 0.04
	2080-2099	1.11 ± 0.03	2.28 ± 0.02	3.28 ± 0.03	4.12 ± 0.05
Multi-model minimum	Baseline	12.37 ± 0.72	12.37 ± 0.72	12.37 ± 0.72	12.37 ± 0.72
	2021-2040	0.20 ± 0.02	0.45 ± 0.02	0.24 ± 0.03	0.22 ± 0.01
	2041-2060	0.34 ± 0.02	0.81 ± 0.02	1.07 ± 0.04	1.10 ± 0.05
	2080-2099	0.80 ± 0.03	1.52 ± 0.02	1.97 ± 0.04	2.97 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.27 ± 0.02	0.44 ± 0.02	0.32 ± 0.02	0.27 ± 0.01
	2041-2060	0.47 ± 0.02	0.80 ± 0.02	0.99 ± 0.03	1.20 ± 0.05
	2080-2099	0.62 ± 0.03	1.53 ± 0.02	2.26 ± 0.03	3.02 ± 0.05
Multi-model maximum	Baseline	12.56 ± 0.71	12.56 ± 0.71	12.56 ± 0.71	12.56 ± 0.71
	2021-2040	1.06 ± 0.03	1.20 ± 0.02	1.46 ± 0.03	1.24 ± 0.02
	2041-2060	1.59 ± 0.03	2.10 ± 0.04	2.23 ± 0.04	2.17 ± 0.03
	2080-2099	1.74 ± 0.03	3.12 ± 0.04	4.02 ± 0.04	5.04 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.12 ± 0.04	1.21 ± 0.02	1.48 ± 0.02	1.37 ± 0.03
	2041-2060	1.72 ± 0.03	2.09 ± 0.03	2.17 ± 0.03	2.29 ± 0.03
	2080-2099	1.65 ± 0.03	3.14 ± 0.04	4.43 ± 0.04	5.37 ± 0.06

Table 23: The statistics of the projected changes in daily mean air temperature in units of °C over the Tararua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

clear and robust warming trend through the 21st century, with the magnitude of change dependent on emissions scenario. In the near-term (2021-2040), all scenarios indicate a likely increase of roughly 0.7–0.9°C above the baseline (1986–2005), with extremely likely inter-model agreement. Mid-century (2041-2060) warming increases to between 1.1°C (SSP1-2.6) and 1.7°C (SSP5-8.5), and by late century (2080-2099), projected warming ranges from just over 1.1°C under SSP1-2.6 to about 4.1°C under SSP5-8.5. The largest increases occur under high emissions scenarios, where very likely warming exceeds 3°C.

Inter-model spread is moderate, but the percentage agreement between scenarios decreases over time, from 61% in the near-term to zero by century's end, indicating growing divergence between low and high emissions futures. Spatial variability within Tararua is low (regional standard deviations typically <0.06°C for all scenarios), giving very high confidence that the warming signal is regionally consistent. The results indicate it is virtually certain that autumn T_{mean} in Tararua will increase, with the magnitude of change strongly dependent on mitigation pathways, and differences between scenarios becoming increasingly pronounced after mid-century.



15.5.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 54. The statistical summary of projected changes in daily mean air temperature over this region is shown

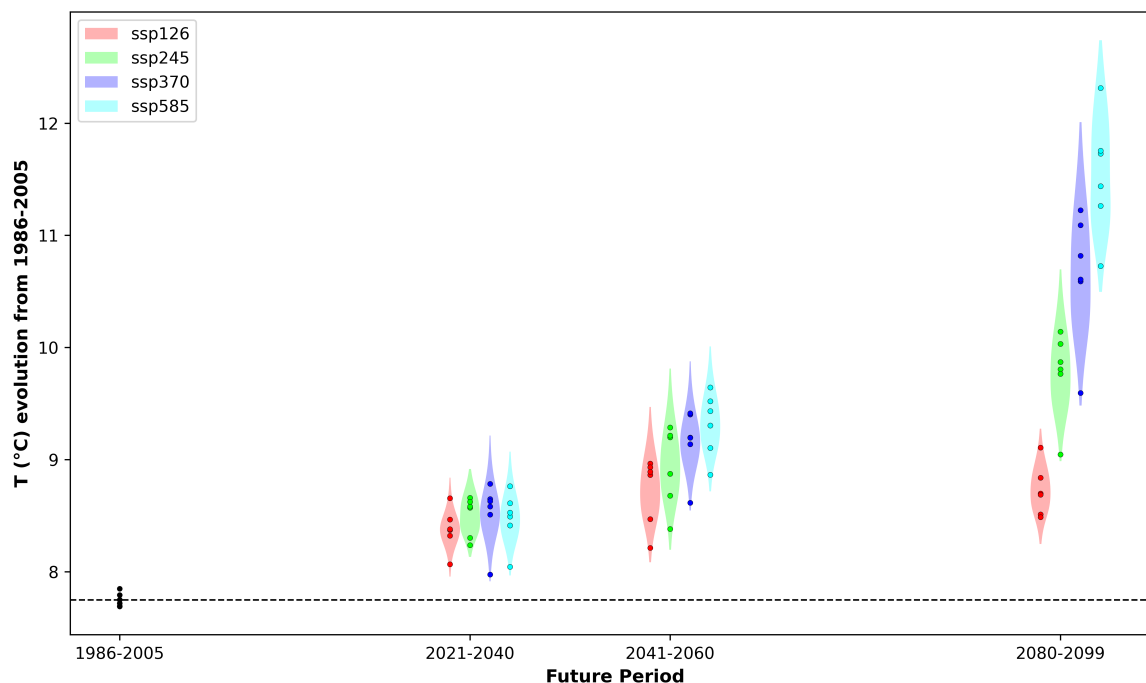


Figure 54: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Tararua region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

in Table 24. Projected winter average daily air temperature (T_{mean}) in Tararua shows a consistent warming trend across all future periods and emissions scenarios relative to the 1986–2005 baseline. For 2021–2040, increases are likely (greater than 66% probability) to be around 0.6–0.8°C over the baseline, with very high inter-model agreement. The magnitude of warming then diverges in the longer term depending on scenario: by 2080–2099, the mean warming under SSP126 (very low emissions) stabilises near 1°C, whereas higher emissions scenarios (SSP245, SSP370, SSP585) indicate much larger changes, reaching up to ~3.8°C for SSP585, indicating it is extremely likely that future emissions pathways will strongly influence the scale of warming.

Inter-model spread is moderate for near- and mid-term periods and expands markedly by late century under higher emissions, with violin plots and statistics showing increasing range and higher maxima, especially under SSP585 (maximum value >4.5°C). The percentage agreement across scenarios diminishes over time, from around 58% (2021–2040) to 0% (2080–2099), signalling growing scenario dependence. Spatial variability within Tararua is low (stdv ~0.01–0.03°C), indicating near-uniform warming across the sub-region. Overall, it is virtually certain that winter warming will occur in Tararua, with the magnitude very likely to depend on global emissions trajectories.

15.5.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 55. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 25. Projected changes in average spring (SON) daily air temperature (T_{mean}) for Tararua indicate a robust warming signal across all future periods, with magnitude strongly dependent on emissions



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	7.749 ± 0.727	7.749 ± 0.727	7.749 ± 0.727	7.749 ± 0.727
	2021-2040	0.628 ± 0.012	0.747 ± 0.015	0.772 ± 0.009	0.726 ± 0.012
	2041-2060	0.973 ± 0.011	1.189 ± 0.013	1.411 ± 0.016	1.562 ± 0.021
	2080-2099	0.972 ± 0.012	2.027 ± 0.018	2.905 ± 0.024	3.788 ± 0.033
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.631 ± 0.011	0.754 ± 0.015	0.778 ± 0.009	0.733 ± 0.012
	2041-2060	0.982 ± 0.011	1.201 ± 0.013	1.418 ± 0.015	1.571 ± 0.020
	2080-2099	0.979 ± 0.012	2.040 ± 0.018	2.928 ± 0.023	3.815 ± 0.032
Multi-model minimum	Baseline	7.686 ± 0.725	7.686 ± 0.725	7.686 ± 0.725	7.686 ± 0.725
	2021-2040	0.317 ± 0.021	0.487 ± 0.035	0.227 ± 0.022	0.294 ± 0.020
	2041-2060	0.463 ± 0.020	0.632 ± 0.022	0.867 ± 0.029	1.116 ± 0.036
	2080-2099	0.734 ± 0.016	1.297 ± 0.028	1.845 ± 0.031	2.977 ± 0.040
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.365 ± 0.018	0.494 ± 0.024	0.384 ± 0.018	0.390 ± 0.019
	2041-2060	0.543 ± 0.014	0.688 ± 0.022	1.011 ± 0.018	1.164 ± 0.032
	2080-2099	0.652 ± 0.016	1.488 ± 0.023	2.092 ± 0.029	3.038 ± 0.040
Multi-model maximum	Baseline	7.848 ± 0.731	7.848 ± 0.731	7.848 ± 0.731	7.848 ± 0.731
	2021-2040	0.906 ± 0.011	0.912 ± 0.025	1.035 ± 0.009	1.014 ± 0.024
	2041-2060	1.219 ± 0.018	1.538 ± 0.017	1.668 ± 0.017	1.894 ± 0.023
	2080-2099	1.358 ± 0.018	2.391 ± 0.025	3.475 ± 0.031	4.564 ± 0.035
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.918 ± 0.016	1.050 ± 0.012	1.208 ± 0.010	1.120 ± 0.022
	2041-2060	1.481 ± 0.012	1.783 ± 0.015	1.869 ± 0.024	2.033 ± 0.015
	2080-2099	1.352 ± 0.014	2.669 ± 0.015	3.878 ± 0.019	4.700 ± 0.028

Table 24: The statistics of the projected changes in daily mean air temperature in units of °C over the Tararua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.33 ± 0.79	11.33 ± 0.79	11.33 ± 0.79	11.33 ± 0.79
	2021-2040	0.67 ± 0.03	0.76 ± 0.03	0.82 ± 0.02	0.73 ± 0.04
	2041-2060	1.01 ± 0.04	1.22 ± 0.04	1.46 ± 0.04	1.58 ± 0.05
	2080-2099	0.96 ± 0.03	2.02 ± 0.05	2.96 ± 0.07	3.79 ± 0.10
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.67 ± 0.03	0.76 ± 0.03	0.83 ± 0.02	0.74 ± 0.04
	2041-2060	1.02 ± 0.04	1.23 ± 0.04	1.47 ± 0.04	1.58 ± 0.05
	2080-2099	0.97 ± 0.03	2.05 ± 0.05	2.98 ± 0.07	3.83 ± 0.10
Multi-model minimum	Baseline	11.26 ± 0.79	11.26 ± 0.79	11.26 ± 0.79	11.26 ± 0.79
	2021-2040	0.45 ± 0.05	0.57 ± 0.03	0.51 ± 0.01	0.36 ± 0.02
	2041-2060	0.80 ± 0.05	0.63 ± 0.03	1.11 ± 0.02	1.31 ± 0.04
	2080-2099	0.74 ± 0.03	1.40 ± 0.03	2.37 ± 0.04	2.87 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.44 ± 0.04	0.53 ± 0.03	0.50 ± 0.02	0.31 ± 0.03
	2041-2060	0.74 ± 0.04	0.68 ± 0.03	1.05 ± 0.02	1.26 ± 0.03
	2080-2099	0.57 ± 0.03	1.32 ± 0.03	2.22 ± 0.05	2.72 ± 0.07
Multi-model maximum	Baseline	11.43 ± 0.79	11.43 ± 0.79	11.43 ± 0.79	11.43 ± 0.79
	2021-2040	0.90 ± 0.02	1.06 ± 0.02	1.15 ± 0.02	1.07 ± 0.04
	2041-2060	1.20 ± 0.04	1.73 ± 0.06	1.93 ± 0.06	1.86 ± 0.07
	2080-2099	1.54 ± 0.04	2.74 ± 0.08	3.67 ± 0.07	4.71 ± 0.12
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.92 ± 0.02	1.02 ± 0.02	1.20 ± 0.02	1.24 ± 0.06
	2041-2060	1.32 ± 0.03	1.87 ± 0.06	1.94 ± 0.07	1.94 ± 0.08
	2080-2099	1.39 ± 0.04	2.88 ± 0.08	3.85 ± 0.09	5.08 ± 0.14

Table 25: The statistics of the projected changes in daily mean air temperature in units of °C over the Tararua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

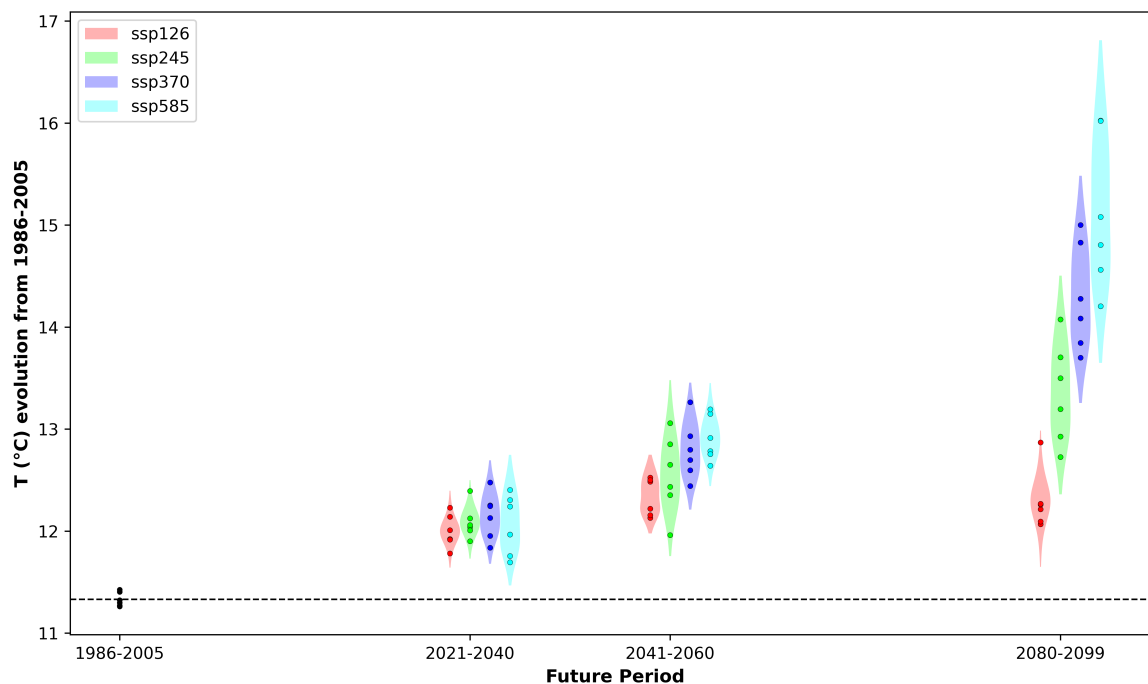


Figure 55: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Tararua region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

scenario (SSP). By 2021–2040, T_{mean} increases by about 0.7–0.8°C (relative to 1986–2005), with high inter-model agreement and little divergence between SSPs. This early 21st-century warming is very likely and shows virtually no scenario distinction.

By 2041–2060, further warming is projected (about 1.0°C in SSP1-2.6 to 1.6°C in SSP5-8.5), but already a spread is evident between higher and lower emissions pathways, and inter-model spread is more apparent. By 2080–2099, the magnitude of warming becomes strongly scenario dependent: under strong mitigation (SSP1-2.6) warming plateaus just below 1°C, while the high-emissions scenario (SSP5-8.5) projects increases nearing 3.8°C, with intermediate increases for SSP2-4.5 and SSP3-7.0. These late-century projections suggest a likely range from about 1°C to almost 4°C, conditional on global mitigation actions.

Model agreement across scenarios declines substantially by mid- and late-century, with scenario agreement dropping to near zero by 2080–2099, reflecting the strong influence of future greenhouse gas pathways. The multi-model ensemble exhibits low spatial variability (stdv <0.1°C), supporting high confidence in the spatial coherence of the projected signal within Tararua.

15.6 Region: Middle Manawatū-Rangitīkei

Area: 1838.51 km²

15.6.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 56. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 26. For the Middle Manawatū-Rangitīkei sub-region, multi-model projections indicate annual mean air temperature is very likely to increase throughout the 21st century across all emissions scenarios (SSPs). Relative



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.53 ± 0.96	12.53 ± 0.96	12.53 ± 0.96	12.53 ± 0.96
	2021-2040	0.67 ± 0.02	0.77 ± 0.02	0.87 ± 0.02	0.75 ± 0.02
	2041-2060	1.02 ± 0.02	1.30 ± 0.02	1.54 ± 0.02	1.63 ± 0.03
	2080-2099	1.00 ± 0.02	2.15 ± 0.03	3.17 ± 0.04	4.00 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.67 ± 0.02	0.77 ± 0.02	0.87 ± 0.02	0.76 ± 0.02
	2041-2060	1.03 ± 0.02	1.31 ± 0.02	1.55 ± 0.02	1.64 ± 0.03
	2080-2099	1.01 ± 0.02	2.17 ± 0.03	3.20 ± 0.04	4.04 ± 0.06
Multi-model minimum	Baseline	12.47 ± 0.97	12.47 ± 0.97	12.47 ± 0.97	12.47 ± 0.97
	2021-2040	0.43 ± 0.01	0.58 ± 0.02	0.40 ± 0.01	0.40 ± 0.01
	2041-2060	0.55 ± 0.01	0.79 ± 0.02	1.03 ± 0.02	1.26 ± 0.02
	2080-2099	0.81 ± 0.02	1.47 ± 0.03	2.18 ± 0.03	3.04 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.49 ± 0.01	0.56 ± 0.02	0.49 ± 0.02	0.46 ± 0.02
	2041-2060	0.65 ± 0.02	0.82 ± 0.02	1.09 ± 0.02	1.34 ± 0.03
	2080-2099	0.63 ± 0.02	1.50 ± 0.03	2.31 ± 0.03	3.04 ± 0.05
Multi-model maximum	Baseline	12.64 ± 0.96	12.64 ± 0.96	12.64 ± 0.96	12.64 ± 0.96
	2021-2040	0.80 ± 0.01	1.01 ± 0.03	1.23 ± 0.02	0.98 ± 0.03
	2041-2060	1.36 ± 0.03	1.82 ± 0.04	2.02 ± 0.04	1.86 ± 0.03
	2080-2099	1.54 ± 0.03	2.84 ± 0.05	3.96 ± 0.05	4.79 ± 0.05
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.88 ± 0.03	1.02 ± 0.02	1.30 ± 0.02	1.11 ± 0.03
	2041-2060	1.47 ± 0.02	1.87 ± 0.03	2.06 ± 0.04	1.97 ± 0.03
	2080-2099	1.42 ± 0.03	2.92 ± 0.04	4.22 ± 0.05	5.18 ± 0.07

Table 26: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Manawatū-Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

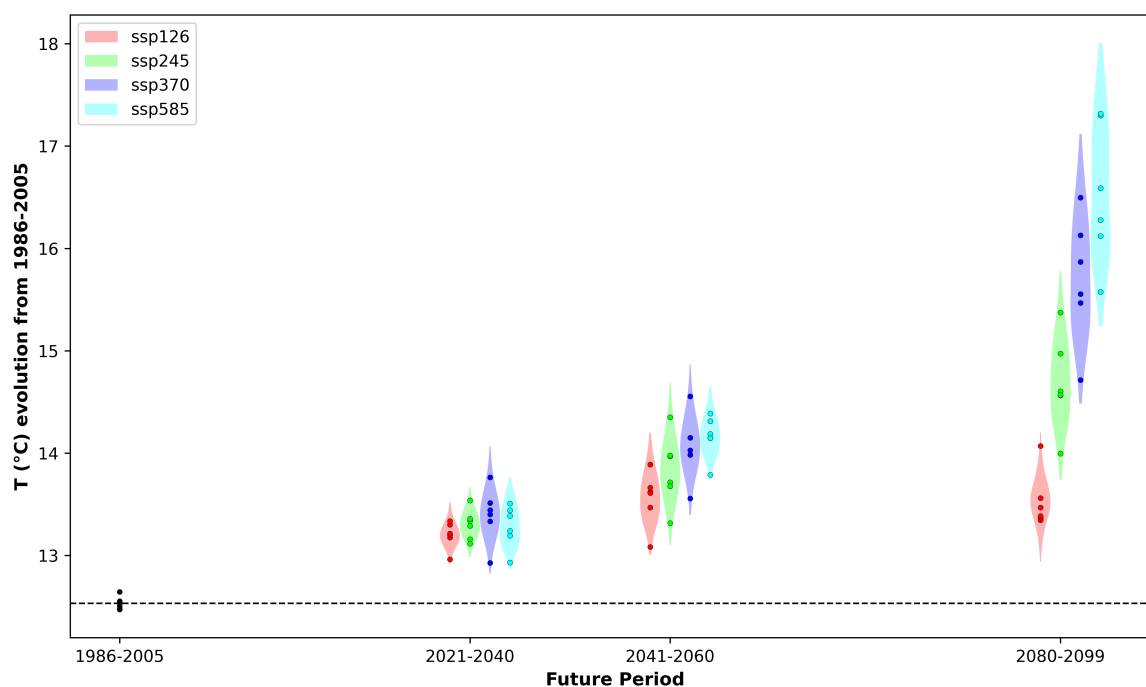


Figure 56: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Manawatū-Rangitikei region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

to the 1986–2005 baseline, warming by 2021–2040 ranges from about 0.7°C to 0.9°C (multi-model mean), with minimal divergence across scenarios and extremely high inter-model agreement for this near-term period. The signal intensifies in later periods: by 2041–2060, projected warming spans approximately 1.0°C (SSP1-2.6, low emissions) to 1.6°C (SSP5-8.5, high emissions). By 2080–2099, there is a pronounced separation between scenarios: SSP1-2.6 stabilises near +1.0°C, while SSP5-8.5 approaches +4.0°C (multi-model mean), indicating warming is extremely likely and dependent on emission trajectory.

Inter-model spread (visible in the violin plots) remains low, demonstrating high model agreement within each scenario even out to late-century. Scenario agreement diminishes sharply by 2080–2099 (0% agreement), indicating the regional outcome is highly sensitive to global emissions choices. Spatial variability (mean inter-grid cell standard deviation) is very low (<0.06°C), meaning the signal is robust spatially across Middle Manawatū-Rangitikei. In summary, it is virtually certain that the region will experience substantial warming this century, with the magnitude strongly determined by global mitigation efforts.

15.6.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 57. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 27. Projections for summer average daily air temperature (T_{mean}) in the Middle Manawatū-Rangitikei sub-region indicate a warming trend across all emission scenarios (SSPs) relative to the 1986–2005 baseline. By 2021–2040, a likely increase of around 0.8°C to 1.1°C is projected across SSPs, with extremely likely and consistent inter-model agreement. By mid-century (2041–2060), further increases are projected, ranging from about 1.2°C (SSP1-2.6) to 1.8°C (SSP3-7.0 and SSP5-8.5), suggesting strong emissions dependency for warming magnitude. For 2080–2099, temperature increases remain modest under SSP1-2.6 (~1.0°C), but reach approximately 2.4°C under SSP2-4.5, 3.7°C under SSP3-7.0, and up to 4.4°C under SSP5-8.5. Thus, under



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	16.67 ± 0.96	16.67 ± 0.96	16.67 ± 0.96	16.67 ± 0.96
	2021-2040	0.76 ± 0.02	0.82 ± 0.03	1.05 ± 0.03	0.86 ± 0.03
	2041-2060	1.16 ± 0.03	1.45 ± 0.02	1.81 ± 0.03	1.78 ± 0.04
	2080-2099	1.03 ± 0.03	2.36 ± 0.04	3.70 ± 0.05	4.45 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.76 ± 0.02	0.82 ± 0.03	1.06 ± 0.03	0.87 ± 0.03
	2041-2060	1.17 ± 0.03	1.46 ± 0.02	1.82 ± 0.03	1.78 ± 0.04
	2080-2099	1.03 ± 0.03	2.38 ± 0.04	3.73 ± 0.05	4.49 ± 0.07
Multi-model minimum	Baseline	16.55 ± 0.95	16.55 ± 0.95	16.55 ± 0.95	16.55 ± 0.95
	2021-2040	0.67 ± 0.04	0.67 ± 0.04	0.69 ± 0.02	0.65 ± 0.05
	2041-2060	0.71 ± 0.02	1.19 ± 0.02	1.14 ± 0.02	1.57 ± 0.05
	2080-2099	0.69 ± 0.06	1.78 ± 0.03	2.65 ± 0.04	3.45 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.66 ± 0.03	0.67 ± 0.02	0.65 ± 0.03	0.58 ± 0.04
	2041-2060	0.74 ± 0.02	1.11 ± 0.02	1.29 ± 0.03	1.47 ± 0.05
	2080-2099	0.62 ± 0.04	1.64 ± 0.04	2.69 ± 0.05	3.37 ± 0.06
Multi-model maximum	Baseline	16.97 ± 0.95	16.97 ± 0.95	16.97 ± 0.95	16.97 ± 0.95
	2021-2040	0.86 ± 0.03	0.96 ± 0.04	1.40 ± 0.02	1.16 ± 0.03
	2041-2060	1.61 ± 0.03	1.91 ± 0.03	2.30 ± 0.04	2.12 ± 0.04
	2080-2099	1.54 ± 0.03	3.21 ± 0.04	4.79 ± 0.07	5.38 ± 0.07
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.87 ± 0.02	0.99 ± 0.04	1.51 ± 0.03	1.16 ± 0.02
	2041-2060	1.66 ± 0.03	1.84 ± 0.03	2.40 ± 0.05	2.10 ± 0.04
	2080-2099	1.46 ± 0.02	3.21 ± 0.04	4.92 ± 0.07	5.77 ± 0.09

Table 27: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Manawatū-Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

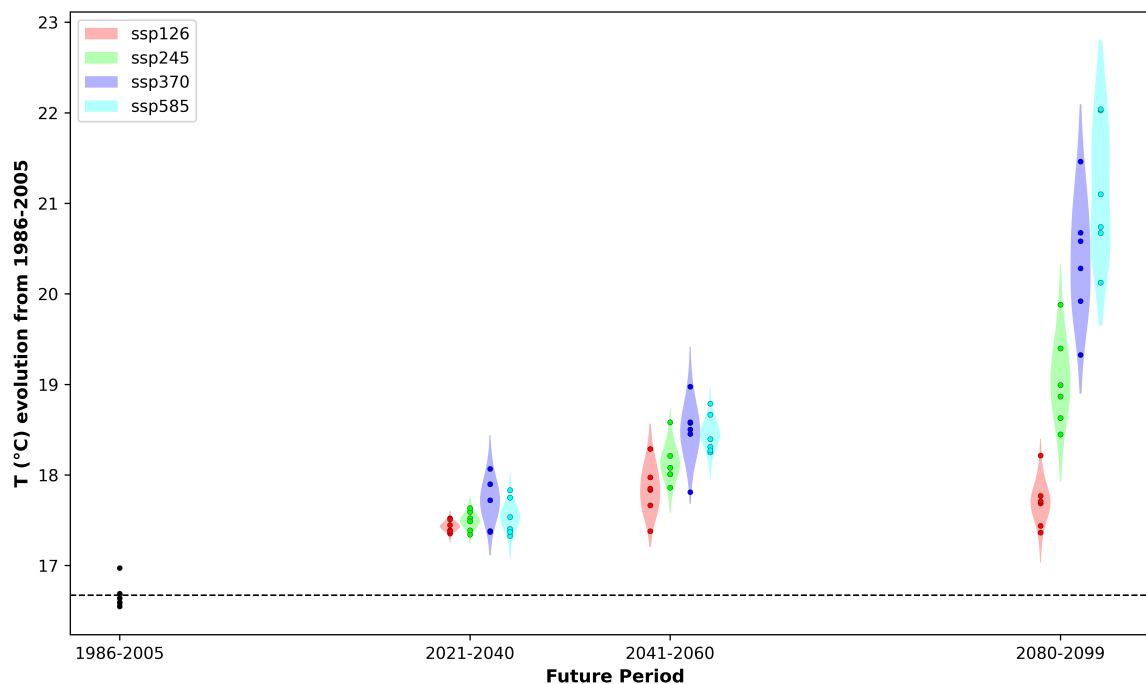


Figure 57: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Manawatū-Rangitikei region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

high-emissions scenarios, summer warming in the sub-region is very likely to exceed 3°C by century's end.

Inter-model agreement is high within each scenario, as evidenced by the relatively tight spread of values for each timeframe. The spatial standard deviation remains low (about 0.02–0.07°C in the future), indicating minimal spatial variability and high agreement on regional averages. However, agreement between scenarios diminishes substantially toward the end-of-century, as indicated by 0% agreement across SSPs. Overall, it is virtually certain that Middle Manawatū-Rangitikei will experience continued summer warming, with the magnitude very likely tied to future emissions pathways.

15.6.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 58. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 28. Projected autumn mean temperatures in the Middle Manawatū-Rangitikei are very likely to increase across all emission scenarios (SSPs) relative to the 1986-2005 baseline. The near-term period (2021-2040) sees multi-model mean increases ranging from approximately 0.6°C (SSP1-2.6) to 0.9°C (SSP3-7.0), with extremely likely agreement across scenarios. This warming intensifies by mid-century (2041-2060), with projected increases from around 1.0°C (SSP1-2.6) to 1.7°C (SSP5-8.5), and the inter-scenario agreement diminishes markedly (about as likely as not between scenarios). By the late century (2080-2099), scenario divergence is pronounced: lower emissions (SSP1-2.6) project around 1.1°C warming, whereas high emissions (SSP5-8.5) exceed 4.0°C, indicating a likely strong sensitivity of temperature to future emissions.

Inter-model spread within each scenario is modest, suggesting high confidence in the direction of change but greater uncertainty in magnitude for higher emission pathways. The statistical evidence indicates low spatial variability in the projected warming across the region. By the end of the century, unanimous warming is virtually certain, but the degree depends strongly on the emissions trajectory chosen. These results highlight the



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	13.19 ± 0.94	13.19 ± 0.94	13.19 ± 0.94	13.19 ± 0.94
	2021-2040	0.63 ± 0.02	0.77 ± 0.01	0.85 ± 0.02	0.74 ± 0.01
	2041-2060	1.03 ± 0.02	1.39 ± 0.02	1.52 ± 0.02	1.66 ± 0.03
	2080-2099	1.08 ± 0.02	2.24 ± 0.03	3.22 ± 0.03	4.05 ± 0.04
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.64 ± 0.02	0.78 ± 0.01	0.86 ± 0.02	0.75 ± 0.01
	2041-2060	1.03 ± 0.02	1.40 ± 0.02	1.53 ± 0.02	1.67 ± 0.03
	2080-2099	1.09 ± 0.02	2.25 ± 0.03	3.25 ± 0.03	4.09 ± 0.04
Multi-model minimum	Baseline	13.07 ± 0.94	13.07 ± 0.94	13.07 ± 0.94	13.07 ± 0.94
	2021-2040	0.17 ± 0.02	0.43 ± 0.02	0.22 ± 0.03	0.22 ± 0.01
	2041-2060	0.30 ± 0.02	0.80 ± 0.02	1.03 ± 0.02	1.06 ± 0.03
	2080-2099	0.76 ± 0.02	1.49 ± 0.02	1.93 ± 0.03	2.92 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.24 ± 0.01	0.39 ± 0.02	0.28 ± 0.02	0.24 ± 0.01
	2041-2060	0.41 ± 0.02	0.77 ± 0.02	0.93 ± 0.02	1.16 ± 0.03
	2080-2099	0.56 ± 0.02	1.49 ± 0.03	2.20 ± 0.03	2.97 ± 0.04
Multi-model maximum	Baseline	13.27 ± 0.93	13.27 ± 0.93	13.27 ± 0.93	13.27 ± 0.93
	2021-2040	1.06 ± 0.04	1.21 ± 0.03	1.50 ± 0.04	1.27 ± 0.03
	2041-2060	1.62 ± 0.03	2.13 ± 0.06	2.26 ± 0.03	2.15 ± 0.03
	2080-2099	1.78 ± 0.04	3.15 ± 0.05	4.07 ± 0.04	5.07 ± 0.05
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.10 ± 0.04	1.21 ± 0.02	1.49 ± 0.03	1.34 ± 0.02
	2041-2060	1.71 ± 0.02	2.11 ± 0.04	2.19 ± 0.03	2.24 ± 0.03
	2080-2099	1.66 ± 0.04	3.12 ± 0.05	4.44 ± 0.04	5.36 ± 0.05

Table 28: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Manawatū-Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

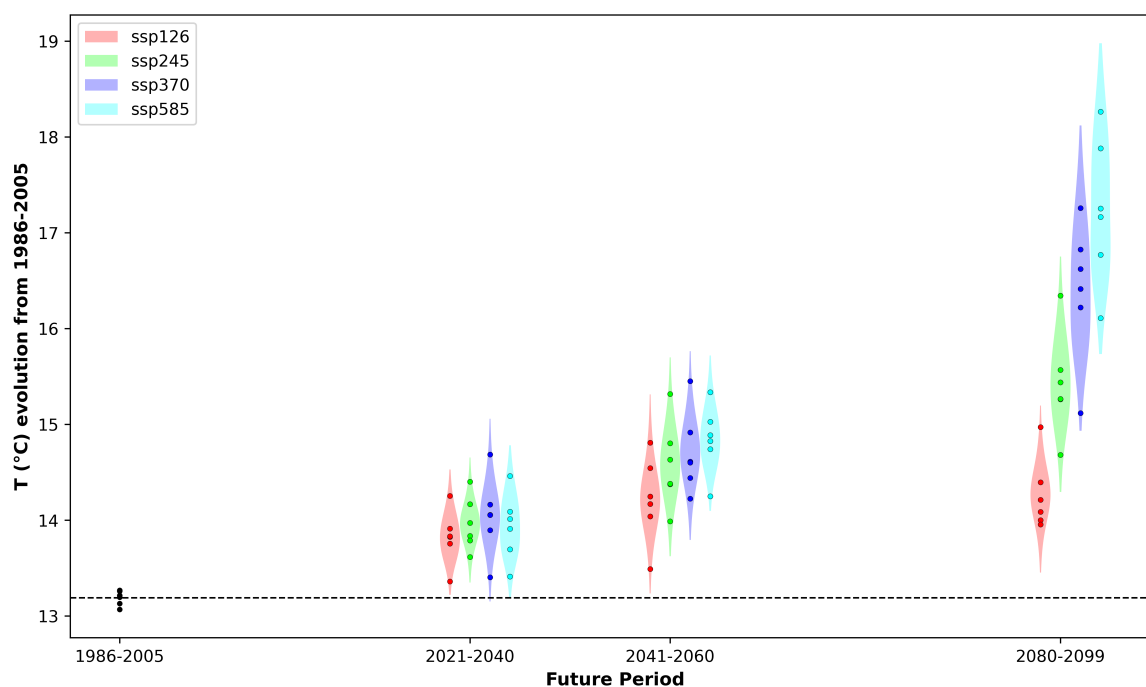


Figure 58: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Manawatū-Rangitikei region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

strong influence of emission policy for regional climate futures, especially after mid-century.

15.6.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 59. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 29. Projections for winter mean daily air temperature in the Middle Manawatū-Rangitikei region indicate a consistent warming trend through the 21st century, with the magnitude of change strongly dependent on emissions scenario (SSP). Relative to the 1986–2005 baseline, multi-model means suggest a likely increase of about 0.6–0.8°C by 2021–2040 across all scenarios, with extremely likely agreement (high scenario convergence and low inter-model spread). Warming continues, and scenario divergence becomes increasingly apparent later in the century: by 2041–2060, projected increases range from about 1°C (SSP1-2.6) to roughly 1.6°C (SSP5-8.5); by 2080–2099, projections span from just below 1°C under strong mitigation to nearly 4°C under high emissions. Spatial variability across the region, as indicated by the standard deviations, remains very low (generally <0.05°C for future periods), underscoring the robustness of the regional signal.

There is virtually certain warming, but scenario agreement decreases markedly beyond mid-century (agreement drops from 62% for 2021–2040 to 0% by 2080–2099), so confidence in the magnitude of late-century change depends on emissions pathways. Inter-model spread within scenarios remains modest, supporting very high confidence in the direction (increase) and moderate-to-high confidence in scenario-specific magnitude, especially in the near term.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	8.422 ± 0.944	8.422 ± 0.944	8.422 ± 0.944	8.422 ± 0.944
	2021-2040	0.628 ± 0.011	0.744 ± 0.014	0.768 ± 0.012	0.714 ± 0.014
	2041-2060	0.972 ± 0.014	1.197 ± 0.018	1.418 ± 0.023	1.561 ± 0.023
	2080-2099	0.973 ± 0.011	2.023 ± 0.024	2.897 ± 0.029	3.807 ± 0.044
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.631 ± 0.011	0.751 ± 0.014	0.774 ± 0.012	0.721 ± 0.015
	2041-2060	0.981 ± 0.014	1.208 ± 0.018	1.425 ± 0.024	1.569 ± 0.023
	2080-2099	0.980 ± 0.011	2.037 ± 0.023	2.919 ± 0.029	3.833 ± 0.043
Multi-model minimum	Baseline	8.363 ± 0.940	8.363 ± 0.940	8.363 ± 0.940	8.363 ± 0.940
	2021-2040	0.287 ± 0.018	0.472 ± 0.026	0.220 ± 0.021	0.296 ± 0.015
	2041-2060	0.443 ± 0.023	0.601 ± 0.021	0.821 ± 0.018	1.127 ± 0.030
	2080-2099	0.719 ± 0.013	1.243 ± 0.030	1.829 ± 0.027	2.984 ± 0.040
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.343 ± 0.014	0.471 ± 0.018	0.374 ± 0.017	0.386 ± 0.018
	2041-2060	0.534 ± 0.015	0.675 ± 0.023	0.977 ± 0.016	1.169 ± 0.027
	2080-2099	0.635 ± 0.014	1.456 ± 0.027	2.089 ± 0.029	3.063 ± 0.048
Multi-model maximum	Baseline	8.515 ± 0.945	8.515 ± 0.945	8.515 ± 0.945	8.515 ± 0.945
	2021-2040	0.911 ± 0.014	0.929 ± 0.026	1.030 ± 0.014	1.011 ± 0.027
	2041-2060	1.250 ± 0.021	1.565 ± 0.018	1.691 ± 0.033	1.883 ± 0.022
	2080-2099	1.399 ± 0.032	2.376 ± 0.027	3.426 ± 0.035	4.561 ± 0.044
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.938 ± 0.015	1.070 ± 0.019	1.210 ± 0.013	1.097 ± 0.023
	2041-2060	1.488 ± 0.027	1.813 ± 0.015	1.915 ± 0.041	2.021 ± 0.020
	2080-2099	1.372 ± 0.024	2.697 ± 0.026	3.862 ± 0.029	4.710 ± 0.041

Table 29: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Manawatū-Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

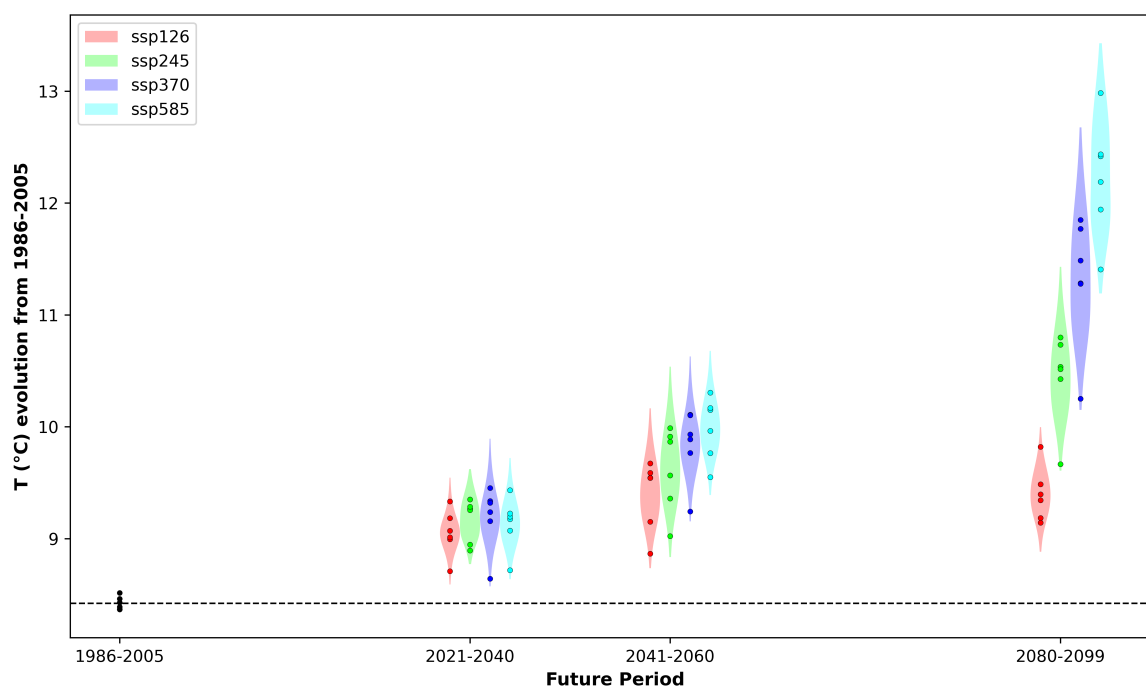


Figure 59: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Manawatū-Rangitīkei region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.6.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 60. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 30. Projections for average daily spring air temperature (T_{mean}) over the Middle Manawatū-Rangitīkei sub-region indicate a robust warming trend relative to the 1986–2005 baseline. By 2021–2040, all emissions scenarios (SSPs) show a very likely increase in spring temperature of approximately 0.6–0.8°C. This warming intensifies through the century, diverging considerably between scenarios. By 2041–2060, projected increases range from just under 1°C (SSP1-2.6, low emissions) to around 1.5°C (SSP5-8.5, high emissions). For the late century (2080–2099), the spread between scenarios is pronounced: under SSP1-2.6, multi-model mean warming remains under 1°C, whereas under SSP5-8.5, warming exceeds 3.5°C, with intermediate scenarios falling in between.

Inter-model agreement on the direction of change is virtually certain (all models project warming), but the magnitude of change and its dependence on emissions scenario is increasingly pronounced mid- and late-century. Agreement between scenarios declines considerably after 2040, with scenario agreement dropping to near zero by 2080–2099, reflecting deep uncertainty around emissions pathways. Spatial variability within the region remains low (mean spatial standard deviation below 0.1°C), underscoring high confidence that change is widespread across the sub-region. In summary, substantial spring warming in Middle Manawatū-Rangitīkei is extremely likely, with the scale of future change highly dependent on global emissions choices.

15.7 Region: Horowhenua

Area: 448.71 km²



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.92 ± 1.02	11.92 ± 1.02	11.92 ± 1.02	11.92 ± 1.02
	2021-2040	0.63 ± 0.02	0.72 ± 0.02	0.78 ± 0.01	0.69 ± 0.03
	2041-2060	0.95 ± 0.02	1.16 ± 0.03	1.40 ± 0.03	1.51 ± 0.04
	2080-2099	0.93 ± 0.02	1.97 ± 0.04	2.87 ± 0.05	3.68 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.64 ± 0.02	0.73 ± 0.02	0.79 ± 0.01	0.70 ± 0.03
	2041-2060	0.96 ± 0.02	1.18 ± 0.03	1.41 ± 0.03	1.52 ± 0.04
	2080-2099	0.93 ± 0.03	1.99 ± 0.04	2.90 ± 0.05	3.72 ± 0.07
Multi-model minimum	Baseline	11.84 ± 1.01	11.84 ± 1.01	11.84 ± 1.01	11.84 ± 1.01
	2021-2040	0.43 ± 0.03	0.54 ± 0.02	0.48 ± 0.02	0.35 ± 0.02
	2041-2060	0.75 ± 0.02	0.55 ± 0.03	1.07 ± 0.02	1.24 ± 0.03
	2080-2099	0.70 ± 0.03	1.33 ± 0.03	2.33 ± 0.05	2.80 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.39 ± 0.02	0.47 ± 0.02	0.46 ± 0.02	0.26 ± 0.03
	2041-2060	0.68 ± 0.02	0.60 ± 0.03	1.01 ± 0.02	1.22 ± 0.03
	2080-2099	0.54 ± 0.02	1.27 ± 0.03	2.13 ± 0.04	2.62 ± 0.06
Multi-model maximum	Baseline	12.01 ± 1.02	12.01 ± 1.02	12.01 ± 1.02	12.01 ± 1.02
	2021-2040	0.91 ± 0.02	1.06 ± 0.03	1.12 ± 0.02	1.05 ± 0.06
	2041-2060	1.17 ± 0.01	1.68 ± 0.05	1.86 ± 0.05	1.78 ± 0.05
	2080-2099	1.49 ± 0.04	2.69 ± 0.06	3.64 ± 0.09	4.62 ± 0.10
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.90 ± 0.03	1.02 ± 0.03	1.17 ± 0.02	1.20 ± 0.05
	2041-2060	1.28 ± 0.01	1.84 ± 0.04	1.86 ± 0.04	1.86 ± 0.05
	2080-2099	1.34 ± 0.04	2.82 ± 0.06	3.77 ± 0.08	4.98 ± 0.11

Table 30: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Manawatū-Rangitikei region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

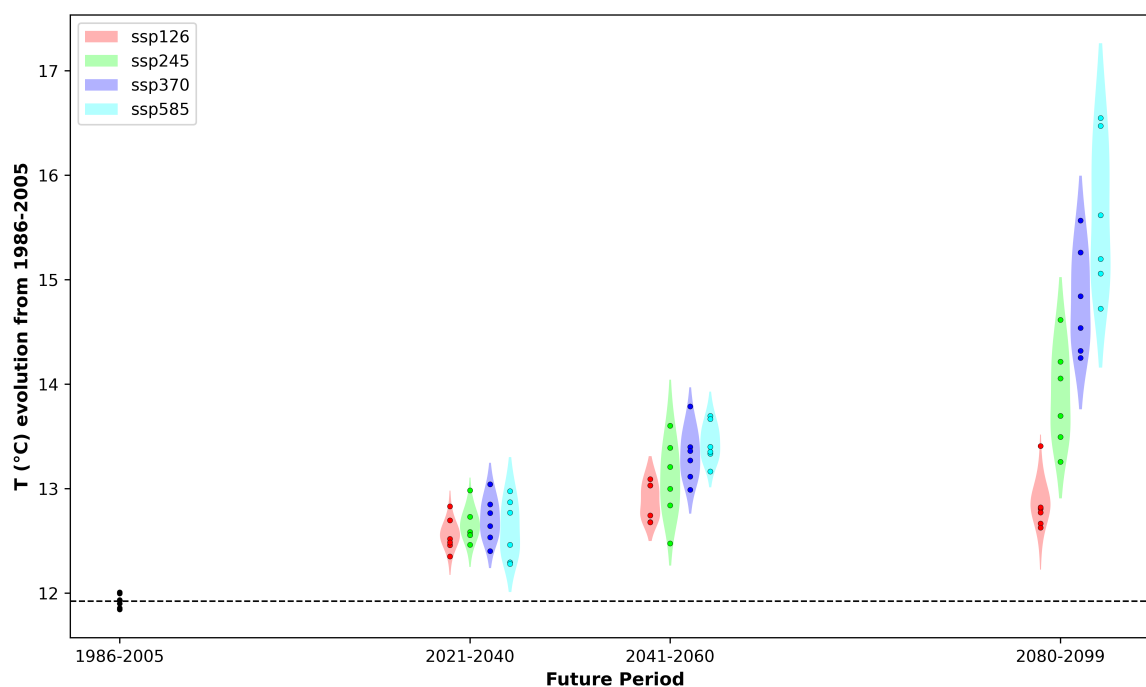


Figure 60: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Manawatū-Rangitikei region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.7.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 61. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 31. The climate projections for Horowhenua indicate a robust warming trend in annual mean air temperature (T_{mean}) relative to the 1986–2005 baseline. Multi-model means show a likely increase of approximately 0.6–0.8°C for 2021–2040 across all scenarios, rising to 1.0–1.5°C by 2041–2060, with the magnitude depending on the emissions pathway. By 2080–2099, scenario divergence becomes pronounced: low emissions (SSP1-2.6) projects stabilisation near a 1.0°C increase, but SSP2-4.5, SSP3-7.0, and especially SSP5-8.5 show progressively stronger warming, with the latter showing a very likely increase near or exceeding 3.8°C.

Model agreement on the direction of change is very high (virtually certain warming across all periods and scenarios). However, inter-scenario agreement decreases with time: moderate for the near term, and very low by late century, with 0% scenario agreement by 2080–2099. This underscores the increasing influence of emissions pathway on projected warming.

Inter-model spread within scenarios remains modest, suggesting high confidence in the warming signal, although spatial variability (regional standard deviation) is low compared to the overall magnitude of change. These results indicate that Horowhenua is very likely to experience substantial warming by century's end, with the greatest changes under high emissions, consistent with broader regional and global projections.

15.7.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 62. The statistical summary of projected changes in daily mean air temperature over this region is

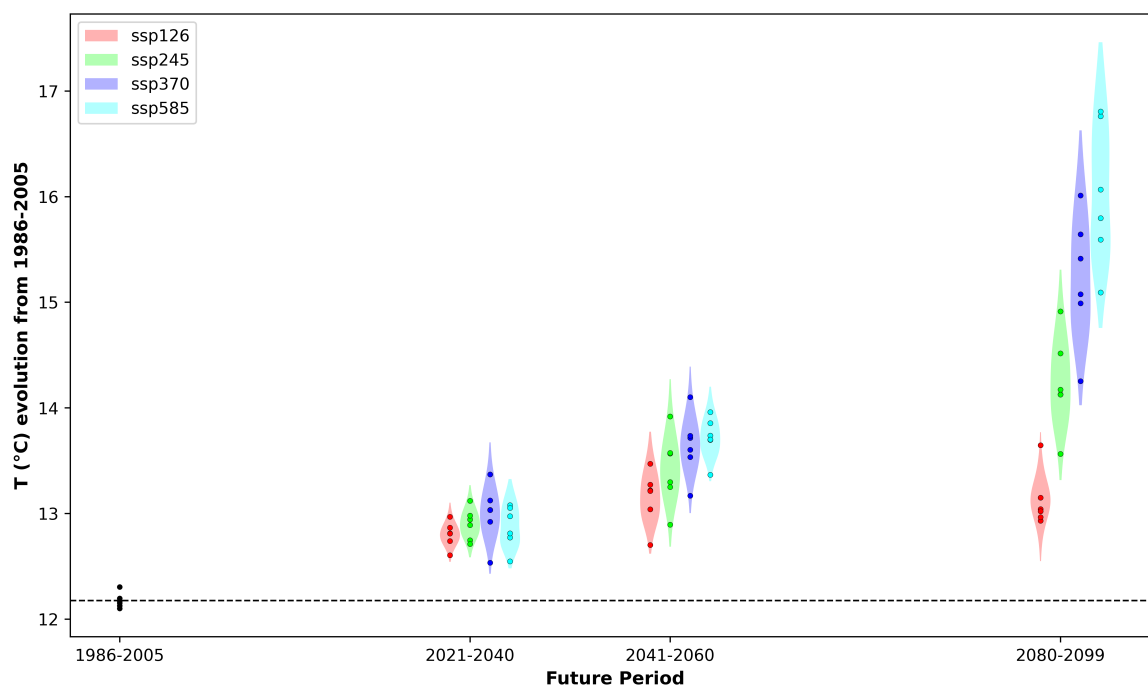


Figure 61: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Horowhenua region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

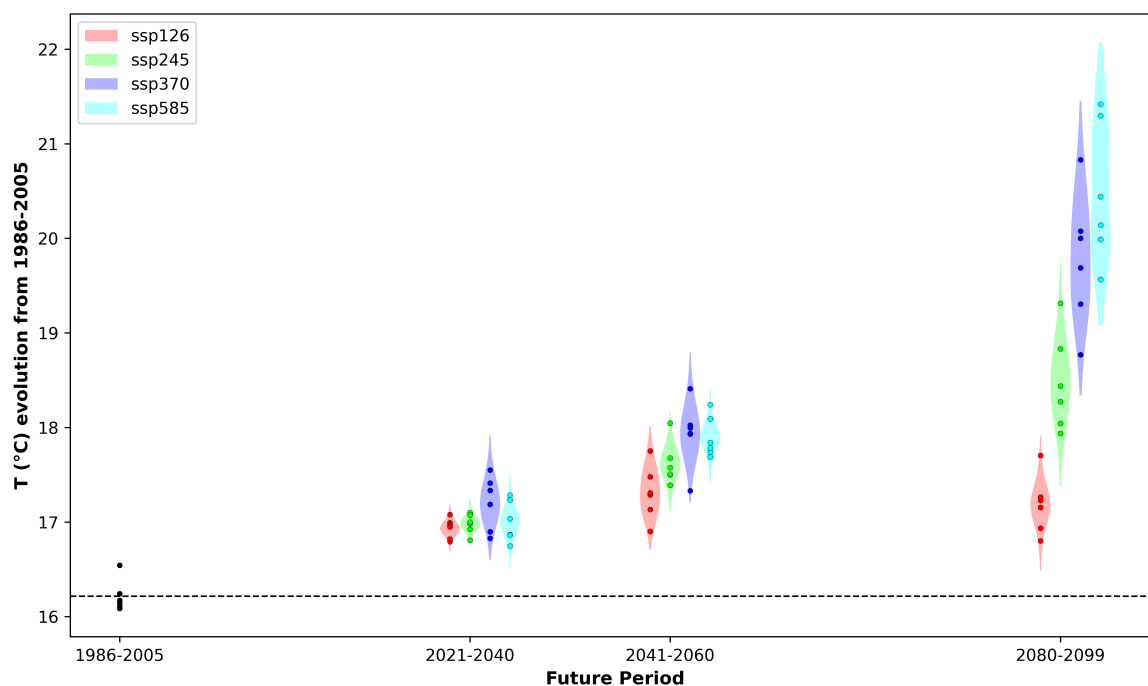


Figure 62: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Horowhenua region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.18 ± 1.15	12.18 ± 1.15	12.18 ± 1.15	12.18 ± 1.15
	2021-2040	0.62 ± 0.01	0.72 ± 0.01	0.83 ± 0.01	0.70 ± 0.01
	2041-2060	0.98 ± 0.01	1.24 ± 0.01	1.47 ± 0.02	1.54 ± 0.02
	2080-2099	0.95 ± 0.01	2.06 ± 0.02	3.05 ± 0.03	3.84 ± 0.04
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.63 ± 0.01	0.73 ± 0.01	0.84 ± 0.01	0.71 ± 0.01
	2041-2060	0.99 ± 0.01	1.25 ± 0.01	1.48 ± 0.02	1.55 ± 0.02
	2080-2099	0.96 ± 0.01	2.08 ± 0.02	3.08 ± 0.03	3.89 ± 0.04
Multi-model minimum	Baseline	12.10 ± 1.15	12.10 ± 1.15	12.10 ± 1.15	12.10 ± 1.15
	2021-2040	0.43 ± 0.01	0.53 ± 0.02	0.36 ± 0.01	0.37 ± 0.02
	2041-2060	0.53 ± 0.02	0.72 ± 0.02	0.99 ± 0.02	1.19 ± 0.02
	2080-2099	0.75 ± 0.02	1.39 ± 0.02	2.08 ± 0.03	2.92 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.45 ± 0.01	0.51 ± 0.02	0.45 ± 0.02	0.41 ± 0.02
	2041-2060	0.61 ± 0.02	0.76 ± 0.02	1.05 ± 0.03	1.26 ± 0.01
	2080-2099	0.59 ± 0.02	1.43 ± 0.02	2.20 ± 0.04	2.91 ± 0.04
Multi-model maximum	Baseline	12.30 ± 1.15	12.30 ± 1.15	12.30 ± 1.15	12.30 ± 1.15
	2021-2040	0.79 ± 0.01	0.94 ± 0.01	1.19 ± 0.01	0.91 ± 0.01
	2041-2060	1.30 ± 0.01	1.74 ± 0.01	1.93 ± 0.01	1.78 ± 0.04
	2080-2099	1.47 ± 0.01	2.74 ± 0.01	3.83 ± 0.02	4.63 ± 0.05
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.82 ± 0.01	0.97 ± 0.00	1.27 ± 0.00	1.04 ± 0.00
	2041-2060	1.41 ± 0.01	1.81 ± 0.01	1.96 ± 0.01	1.88 ± 0.03
	2080-2099	1.35 ± 0.01	2.82 ± 0.01	4.09 ± 0.03	5.00 ± 0.04

Table 31: The statistics of the projected changes in daily mean air temperature in units of °C over the Horowhenua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



shown in Table 32. The Horowhenua sub-region is projected to experience a warming signal in summer mean

Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	16.22 ± 1.11	16.22 ± 1.11	16.22 ± 1.11	16.22 ± 1.11
	2021-2040	0.72 ± 0.01	0.76 ± 0.02	0.99 ± 0.02	0.79 ± 0.02
	2041-2060	1.09 ± 0.03	1.40 ± 0.02	1.72 ± 0.04	1.68 ± 0.03
	2080-2099	0.96 ± 0.02	2.26 ± 0.03	3.56 ± 0.05	4.26 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.72 ± 0.01	0.77 ± 0.02	0.99 ± 0.02	0.79 ± 0.02
	2041-2060	1.10 ± 0.03	1.40 ± 0.02	1.73 ± 0.04	1.68 ± 0.03
	2080-2099	0.97 ± 0.02	2.27 ± 0.03	3.59 ± 0.05	4.31 ± 0.06
Multi-model minimum	Baseline	16.09 ± 1.10	16.09 ± 1.10	16.09 ± 1.10	16.09 ± 1.10
	2021-2040	0.57 ± 0.02	0.59 ± 0.04	0.61 ± 0.04	0.53 ± 0.04
	2041-2060	0.69 ± 0.02	1.17 ± 0.03	1.11 ± 0.02	1.47 ± 0.02
	2080-2099	0.59 ± 0.06	1.72 ± 0.03	2.55 ± 0.04	3.35 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.57 ± 0.02	0.62 ± 0.03	0.59 ± 0.03	0.49 ± 0.02
	2041-2060	0.69 ± 0.04	1.08 ± 0.02	1.24 ± 0.03	1.38 ± 0.01
	2080-2099	0.54 ± 0.05	1.54 ± 0.03	2.57 ± 0.06	3.23 ± 0.05
Multi-model maximum	Baseline	16.54 ± 1.11	16.54 ± 1.11	16.54 ± 1.11	16.54 ± 1.11
	2021-2040	0.87 ± 0.04	0.88 ± 0.04	1.33 ± 0.02	1.07 ± 0.02
	2041-2060	1.54 ± 0.01	1.83 ± 0.02	2.19 ± 0.03	2.03 ± 0.08
	2080-2099	1.49 ± 0.01	3.10 ± 0.02	4.61 ± 0.04	5.20 ± 0.09
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.87 ± 0.02	0.92 ± 0.02	1.45 ± 0.02	1.10 ± 0.02
	2041-2060	1.58 ± 0.02	1.75 ± 0.02	2.27 ± 0.04	1.99 ± 0.06
	2080-2099	1.41 ± 0.01	3.09 ± 0.04	4.75 ± 0.05	5.53 ± 0.07

Table 32: The statistics of the projected changes in daily mean air temperature in units of °C over the Horowhenua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

air temperature over the 21st century, consistent with global and national patterns. By 2021–2040, all emissions scenarios (SSPs) show a likely increase of approximately 0.7–1.0°C relative to the 1986–2005 baseline, with minimal divergence between scenarios, indicating extremely likely warming with high confidence. The inter-model agreement within each scenario is high for near- and mid-term periods, with narrow distributions supporting robust signals and model consensus.

By mid-century (2041–2060), projected warming increases to 1.1°C under low emissions (SSP1-2.6) and up to 1.7°C for higher scenarios. By century's end (2080–2099), emissions trajectory increasingly dominates outcomes: the low-emissions scenario stabilises near 1.0°C, while the highest (SSP5-8.5) scenario projects warming of around 4.3°C, with intermediate pathways (SSP2-4.5 and SSP3-7.0) yielding 2.3°C and 3.6°C, respectively. This strong scenario dependence and low scenario agreement by late century (0% agreement) mean the 2080–2099 signal is very likely to be emissions-dependent and associated with high uncertainty.

Spatial variability across the sub-region is low relative to the mean signal (stdv <0.1°C), affirming strong spatial coherence. These results indicate a warming trend in summer temperatures in Horowhenua, with the magnitude very likely dictated by emissions pathway, and with very high confidence in the direction of change.



15.7.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 63. The statistical summary of projected changes in daily mean air temperature over this region

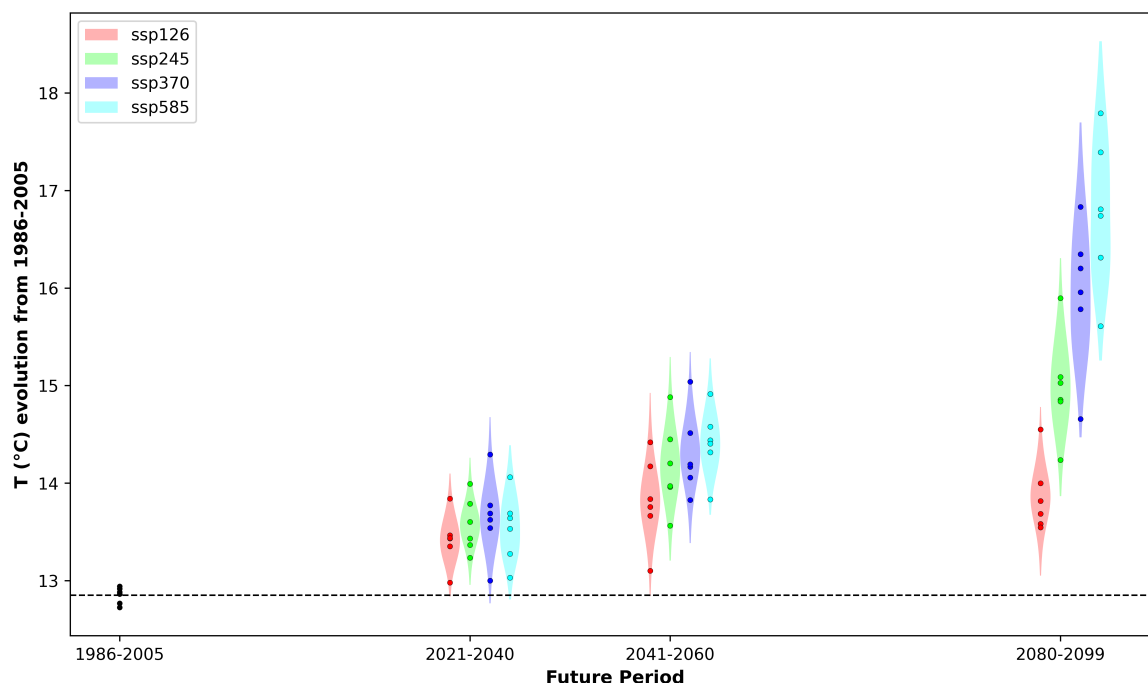


Figure 63: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Horowhenua region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

is shown in Table 33. The ensemble projections indicate a robust warming trend in autumn average daily air temperature (T_{mean}) for Horowhenua throughout the 21st century. In the near-term (2021-2040), all scenarios show a likely increase of 0.6–0.8°C from the 1986–2005 baseline, with very high inter-model consistency across low and high emissions pathways. This warming intensifies over time, with a likely increase of approximately 1.0°C under the low emission scenario (SSP1-2.6) and up to nearly 4.0°C under the highest emission scenario (SSP5-8.5) by 2080-2099.

Inter-model spread, as shown by the violin plots, remains moderate across the early and mid-century periods but increases under SSP3-7.0 and SSP5-8.5 by century's end. Agreement across scenarios diminishes with time: while 55% agreement is maintained for 2021-2040, this falls sharply—dropping to zero by 2080-2099, reflecting increasing scenario divergence. However, within scenarios, the spread in spatial variability (standard deviation) remains low relative to the magnitude of change, suggesting very high confidence in the sign and general magnitude of warming.

Overall, it is extremely likely that Horowhenua will experience ongoing increases in autumn mean air temperature, with projected changes largely determined by the emissions pathway. The magnitude and rate of warming by late-century are very likely to depend on future emissions, with higher scenarios yielding greater increases and wider model spread.

15.7.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 64. The statistical summary of projected changes in daily mean air temperature over this region is shown



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.85 ± 1.12	12.85 ± 1.12	12.85 ± 1.12	12.85 ± 1.12
	2021-2040	0.57 ± 0.02	0.72 ± 0.02	0.80 ± 0.01	0.69 ± 0.02
	2041-2060	0.98 ± 0.02	1.32 ± 0.02	1.45 ± 0.02	1.56 ± 0.03
	2080-2099	1.01 ± 0.01	2.14 ± 0.02	3.11 ± 0.03	3.93 ± 0.04
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.58 ± 0.02	0.73 ± 0.02	0.81 ± 0.01	0.70 ± 0.02
	2041-2060	0.98 ± 0.02	1.33 ± 0.02	1.46 ± 0.02	1.57 ± 0.03
	2080-2099	1.02 ± 0.01	2.16 ± 0.02	3.14 ± 0.03	3.96 ± 0.04
Multi-model minimum	Baseline	12.73 ± 1.13	12.73 ± 1.13	12.73 ± 1.13	12.73 ± 1.13
	2021-2040	0.13 ± 0.01	0.38 ± 0.01	0.15 ± 0.02	0.18 ± 0.02
	2041-2060	0.25 ± 0.01	0.71 ± 0.02	0.98 ± 0.02	0.98 ± 0.02
	2080-2099	0.68 ± 0.03	1.39 ± 0.03	1.81 ± 0.02	2.76 ± 0.03
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.19 ± 0.02	0.33 ± 0.01	0.23 ± 0.01	0.19 ± 0.01
	2041-2060	0.36 ± 0.01	0.70 ± 0.03	0.87 ± 0.02	1.08 ± 0.02
	2080-2099	0.50 ± 0.03	1.40 ± 0.03	2.08 ± 0.03	2.84 ± 0.03
Multi-model maximum	Baseline	12.94 ± 1.11	12.94 ± 1.11	12.94 ± 1.11	12.94 ± 1.11
	2021-2040	0.99 ± 0.01	1.14 ± 0.01	1.44 ± 0.02	1.21 ± 0.01
	2041-2060	1.57 ± 0.02	2.03 ± 0.03	2.19 ± 0.02	2.06 ± 0.02
	2080-2099	1.70 ± 0.02	3.05 ± 0.02	3.98 ± 0.02	4.94 ± 0.03
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.01 ± 0.02	1.15 ± 0.02	1.45 ± 0.01	1.28 ± 0.02
	2041-2060	1.66 ± 0.02	2.03 ± 0.01	2.11 ± 0.03	2.14 ± 0.03
	2080-2099	1.59 ± 0.01	3.01 ± 0.02	4.34 ± 0.04	5.24 ± 0.05

Table 33: The statistics of the projected changes in daily mean air temperature in units of °C over the Horowhenua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

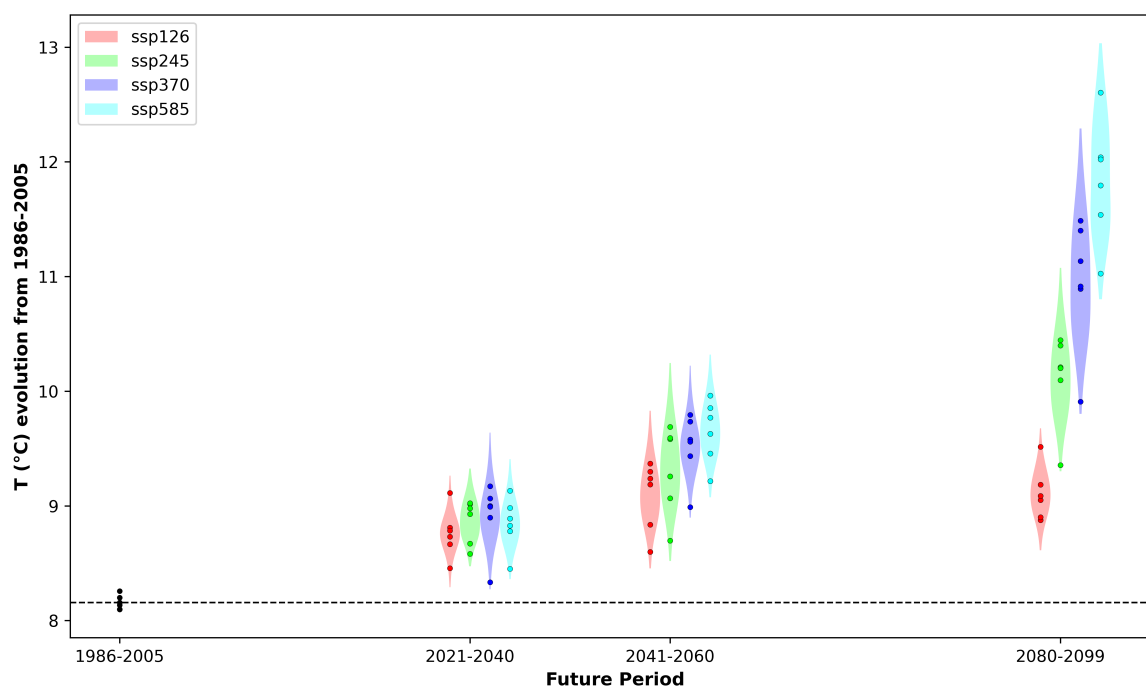


Figure 64: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Horowhenua region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

in Table 34. The projections for winter average daily air temperature (T_{mean}) in Horowhenua indicate a robust warming trend throughout the 21st century, with the magnitude of change highly dependent on emissions scenario. By mid-century (2041–2060), the multi-model mean warming relative to 1986–2005 ranges from just under 1°C under low emissions (SSP1-2.6), up to about 1.5°C for the highest scenario (SSP5-8.5). Late-century projections (2080–2099) show the divergence between scenarios becomes substantial, with increases of approximately 1°C under SSP1-2.6, nearly 2°C under SSP2-4.5, up to 2.8°C for SSP3-7.0, and around 3.7°C under SSP5-8.5. These changes are very likely, with extremely likely further warming under all scenarios.

Inter-model agreement is high for the direction of change—virtually certain warming—but agreement on the magnitude diminishes markedly by late century, as illustrated by widening spreads in the figure and a scenario agreement dropping to zero for 2080–2099. Spatial variability within Horowhenua remains low compared to the regional warming signal, with standard deviations well under 0.03°C across all scenarios and periods. In summary, a likely strong warming signal is projected, with confidence in the magnitude lower towards the end of the century, driven by scenario and inter-model uncertainties.

15.7.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 65. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 35. Climate model projections indicate it is virtually certain that average spring air temperatures (T_{mean}) in Horowhenua will increase relative to the 1986–2005 baseline. All scenarios show a warming trend across the 21st century, with the magnitude tightly constrained and highly consistent across models for 2021–2040—projected increases are around 0.6 to 0.8°C, regardless of emission pathway. Spatial variability (as standard deviation across the region) is very low in future periods, indicating near-uniform warming within Horowhenua.

By mid-century (2041–2060), scenario divergence becomes more apparent: under low emissions (SSP1-2.6),



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	8.157 ± 1.156	8.157 ± 1.156	8.157 ± 1.156	8.157 ± 1.156
	2021-2040	0.603 ± 0.006	0.709 ± 0.005	0.753 ± 0.005	0.686 ± 0.011
	2041-2060	0.931 ± 0.006	1.157 ± 0.010	1.358 ± 0.009	1.491 ± 0.010
	2080-2099	0.945 ± 0.007	1.960 ± 0.010	2.799 ± 0.016	3.680 ± 0.024
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.606 ± 0.006	0.716 ± 0.005	0.759 ± 0.005	0.692 ± 0.011
	2041-2060	0.940 ± 0.006	1.168 ± 0.010	1.364 ± 0.009	1.499 ± 0.010
	2080-2099	0.952 ± 0.007	1.973 ± 0.009	2.821 ± 0.015	3.707 ± 0.023
Multi-model minimum	Baseline	8.094 ± 1.156	8.094 ± 1.156	8.094 ± 1.156	8.094 ± 1.156
	2021-2040	0.299 ± 0.023	0.424 ± 0.023	0.176 ± 0.024	0.294 ± 0.021
	2041-2060	0.441 ± 0.034	0.539 ± 0.027	0.832 ± 0.027	1.059 ± 0.009
	2080-2099	0.716 ± 0.011	1.197 ± 0.025	1.751 ± 0.020	2.870 ± 0.023
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.313 ± 0.009	0.441 ± 0.016	0.344 ± 0.017	0.369 ± 0.018
	2041-2060	0.512 ± 0.018	0.622 ± 0.011	0.961 ± 0.025	1.109 ± 0.012
	2080-2099	0.623 ± 0.016	1.408 ± 0.013	2.000 ± 0.019	2.935 ± 0.027
Multi-model maximum	Baseline	8.257 ± 1.161	8.257 ± 1.161	8.257 ± 1.161	8.257 ± 1.161
	2021-2040	0.955 ± 0.013	0.875 ± 0.014	1.014 ± 0.006	0.974 ± 0.010
	2041-2060	1.212 ± 0.017	1.532 ± 0.023	1.636 ± 0.015	1.804 ± 0.011
	2080-2099	1.358 ± 0.034	2.289 ± 0.023	3.332 ± 0.037	4.447 ± 0.031
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.919 ± 0.015	1.028 ± 0.018	1.211 ± 0.018	1.056 ± 0.005
	2041-2060	1.424 ± 0.020	1.789 ± 0.024	1.804 ± 0.031	1.941 ± 0.014
	2080-2099	1.323 ± 0.018	2.616 ± 0.018	3.755 ± 0.014	4.586 ± 0.021

Table 34: The statistics of the projected changes in daily mean air temperature in units of °C over the Horowhenua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.56 ± 1.22	11.56 ± 1.22	11.56 ± 1.22	11.56 ± 1.22
	2021-2040	0.60 ± 0.00	0.69 ± 0.01	0.76 ± 0.01	0.63 ± 0.01
	2041-2060	0.92 ± 0.01	1.08 ± 0.01	1.32 ± 0.01	1.42 ± 0.01
	2080-2099	0.87 ± 0.00	1.88 ± 0.01	2.74 ± 0.03	3.50 ± 0.03
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.60 ± 0.00	0.69 ± 0.01	0.77 ± 0.01	0.64 ± 0.01
	2041-2060	0.94 ± 0.01	1.10 ± 0.01	1.34 ± 0.01	1.43 ± 0.01
	2080-2099	0.88 ± 0.00	1.91 ± 0.01	2.77 ± 0.03	3.54 ± 0.03
Multi-model minimum	Baseline	11.48 ± 1.22	11.48 ± 1.22	11.48 ± 1.22	11.48 ± 1.22
	2021-2040	0.37 ± 0.02	0.48 ± 0.02	0.46 ± 0.02	0.31 ± 0.03
	2041-2060	0.72 ± 0.01	0.45 ± 0.01	1.00 ± 0.02	1.16 ± 0.02
	2080-2099	0.66 ± 0.01	1.23 ± 0.02	2.21 ± 0.03	2.67 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.36 ± 0.01	0.42 ± 0.03	0.44 ± 0.02	0.22 ± 0.04
	2041-2060	0.63 ± 0.02	0.50 ± 0.02	0.94 ± 0.03	1.13 ± 0.02
	2080-2099	0.51 ± 0.01	1.19 ± 0.03	2.03 ± 0.05	2.48 ± 0.06
Multi-model maximum	Baseline	11.63 ± 1.22	11.63 ± 1.22	11.63 ± 1.22	11.63 ± 1.22
	2021-2040	0.89 ± 0.02	1.04 ± 0.01	1.09 ± 0.01	0.96 ± 0.01
	2041-2060	1.16 ± 0.01	1.58 ± 0.01	1.77 ± 0.00	1.70 ± 0.02
	2080-2099	1.40 ± 0.01	2.57 ± 0.02	3.48 ± 0.03	4.40 ± 0.02
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.86 ± 0.01	1.00 ± 0.02	1.15 ± 0.01	1.12 ± 0.01
	2041-2060	1.29 ± 0.01	1.77 ± 0.01	1.79 ± 0.01	1.77 ± 0.01
	2080-2099	1.27 ± 0.01	2.72 ± 0.02	3.61 ± 0.01	4.75 ± 0.02

Table 35: The statistics of the projected changes in daily mean air temperature in units of °C over the Horowhenua region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

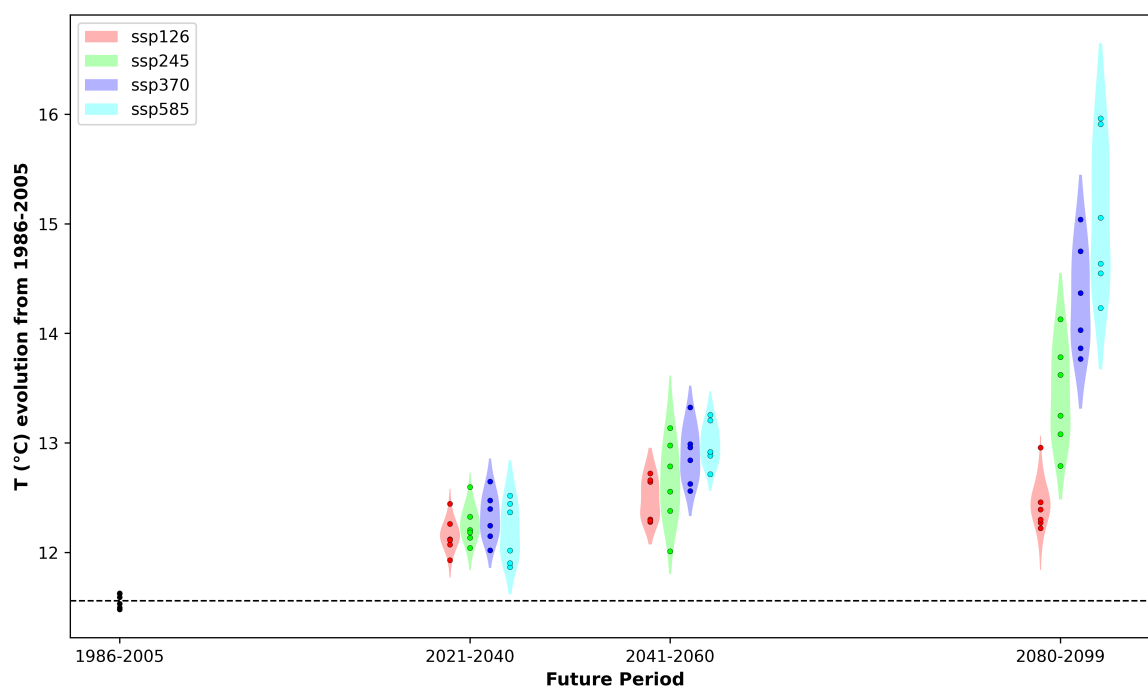


Figure 65: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Horowhenua region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

warming reaches about 0.9°C, while high emissions (SSP5-8.5) push projected increases to roughly 1.4°C. Inter-model spread remains low, reflecting high confidence in the direction of change.

By century's end (2080–2099), scenario spread becomes pronounced: SSP1-2.6 projects warming stays near 0.9°C, while SSP2-4.5, SSP3-7.0 and SSP5-8.5 yield progressively larger increases (about 1.9°C, 2.7°C, and 3.5°C respectively, multi-model mean values). Inter-model agreement across scenarios collapses (0% scenario agreement), but individual scenario agreement within models is still high—agreement on direction of warming is virtually certain, but magnitude is scenario dependent. Therefore, substantial further warming is extremely likely by late-century under high emissions, with differences between scenarios becoming increasingly important for future regional climate outcomes.

15.8 Region: Whanganui-Manawatū Lakes

Area: 623.11 km²

15.8.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 66. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 36. Projections for average annual air temperature (T_{mean}) over the Whanganui-Manawatū Lakes sub-region indicate a robust warming signal across all emissions scenarios, with magnitude and inter-model agreement evolving over time. By 2021–2040, mean warming relative to 1986–2005 is likely (66–100% probability) in the range of 0.6–0.8°C, with minimal differences between scenarios and high model consistency. For 2041–2060, the projected increases rise to around 1.0°C (SSP1-2.6, low emissions) up to 1.6°C (SSP5-8.5, high emissions), with scenario divergence becoming apparent but still overlapping, and moderate model agreement.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	13.27 ± 0.15	13.27 ± 0.15	13.27 ± 0.15	13.27 ± 0.15
	2021-2040	0.63 ± 0.02	0.73 ± 0.02	0.83 ± 0.02	0.70 ± 0.02
	2041-2060	0.98 ± 0.02	1.25 ± 0.02	1.47 ± 0.03	1.55 ± 0.03
	2080-2099	0.96 ± 0.02	2.07 ± 0.04	3.05 ± 0.05	3.85 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.64 ± 0.02	0.73 ± 0.02	0.84 ± 0.02	0.71 ± 0.02
	2041-2060	0.99 ± 0.02	1.26 ± 0.02	1.48 ± 0.03	1.56 ± 0.03
	2080-2099	0.97 ± 0.02	2.09 ± 0.04	3.08 ± 0.05	3.89 ± 0.07
Multi-model minimum	Baseline	13.21 ± 0.16	13.21 ± 0.16	13.21 ± 0.16	13.21 ± 0.16
	2021-2040	0.42 ± 0.01	0.54 ± 0.01	0.36 ± 0.02	0.35 ± 0.02
	2041-2060	0.51 ± 0.01	0.73 ± 0.02	0.98 ± 0.02	1.20 ± 0.03
	2080-2099	0.75 ± 0.03	1.38 ± 0.03	2.07 ± 0.05	2.91 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.45 ± 0.01	0.50 ± 0.02	0.44 ± 0.02	0.39 ± 0.03
	2041-2060	0.59 ± 0.02	0.76 ± 0.03	1.03 ± 0.03	1.28 ± 0.03
	2080-2099	0.57 ± 0.02	1.42 ± 0.03	2.18 ± 0.06	2.90 ± 0.07
Multi-model maximum	Baseline	13.39 ± 0.15	13.39 ± 0.15	13.39 ± 0.15	13.39 ± 0.15
	2021-2040	0.80 ± 0.01	0.98 ± 0.02	1.21 ± 0.01	0.96 ± 0.02
	2041-2060	1.34 ± 0.01	1.79 ± 0.02	1.96 ± 0.04	1.75 ± 0.04
	2080-2099	1.52 ± 0.02	2.79 ± 0.04	3.88 ± 0.05	4.64 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.84 ± 0.03	1.00 ± 0.02	1.28 ± 0.01	1.07 ± 0.03
	2041-2060	1.44 ± 0.02	1.84 ± 0.02	1.99 ± 0.04	1.88 ± 0.04
	2080-2099	1.40 ± 0.03	2.85 ± 0.04	4.10 ± 0.05	5.02 ± 0.07

Table 36: The statistics of the projected changes in daily mean air temperature in units of °C over the Whanganui-Manawatū Lakes region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

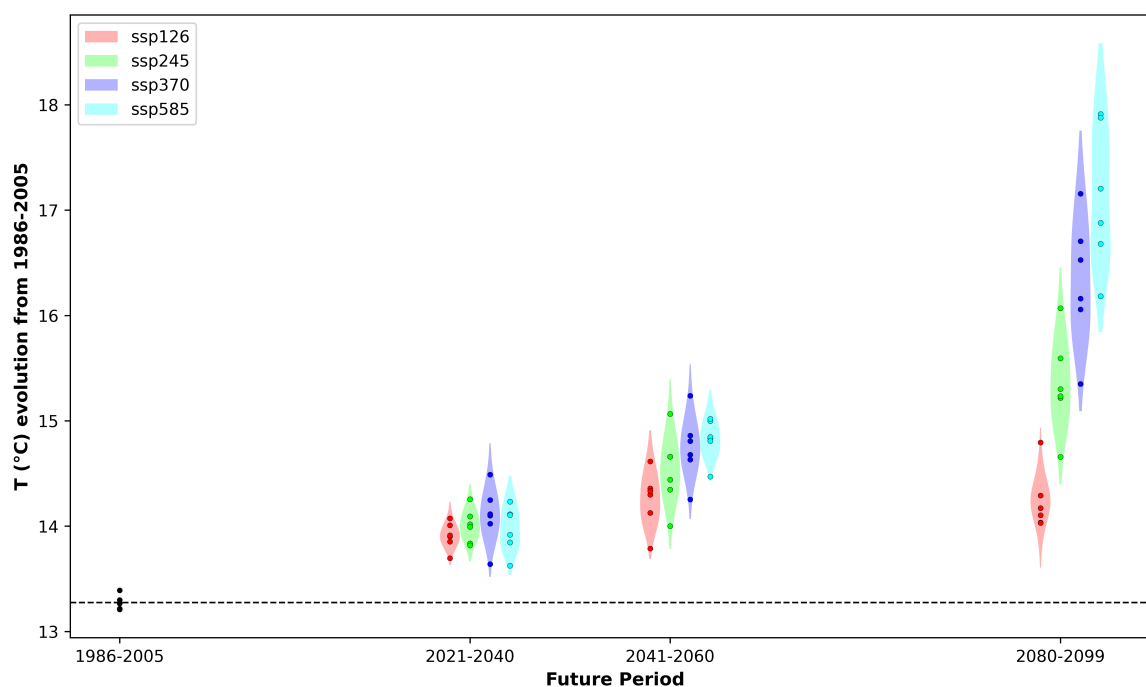


Figure 66: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Whanganui-Manawātū Lakes region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

By the late century (2080–2099), scenario spread becomes pronounced, and it is virtually certain that average temperatures will increase. Under low emissions (SSP1-2.6), mean warming remains near 1°C (very likely), whereas under high emissions (SSP5-8.5), a mean increase around 3.8°C is projected, with individual models indicating changes up to nearly 5°C. Scenario agreement drops sharply beyond mid-century, reflecting high dependence on future emissions trajectories and greater inter-model spread under higher emissions.

Throughout, spatial variability within the region (as assessed by standard deviation) remains low compared to scenario and inter-model differences, indicating high spatial consistency in warming. The overall assessment is extremely likely to virtually certain warming, with magnitude strongly dependant on emissions pathway by 2080–2099.

15.8.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 67. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 37. Projected changes in average summer (DJF) daily air temperature (T_{mean}) for Whanganui-Manawātū Lakes indicate a robust warming trend throughout the 21st century. For the near-term (2021–2040), the multi-model mean increase ranges from about 0.7°C (SSP1-2.6) to 1.0°C (SSP3-7.0) above the 1986–2005 baseline, with very likely agreement across scenarios and models. By mid-century (2041–2060), projected warming strengthens, with mean changes spanning 1.1°C (SSP1-2.6) to 1.7°C (SSP3-7.0/SSP5-8.5), suggesting warming is extremely likely, but with larger scenario divergence. For late-century (2080–2099), increases vary markedly with emission scenario: ~1.0°C (SSP1-2.6); ~2.3°C (SSP2-4.5); ~3.5°C (SSP3-7.0); and ~4.2°C (SSP5-8.5), indicating the trajectory of future emissions drives outcomes and agreement is lower. Across all periods and scenarios, spatial variability (stdv) within the region remains low (~0.03°C to 0.1°C), implying a consistent warming signal region-wide. Inter-model agreement is high in the near-term but falls markedly by century's



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	17.26 ± 0.12	17.26 ± 0.12	17.26 ± 0.12	17.26 ± 0.12
	2021-2040	0.72 ± 0.03	0.76 ± 0.03	0.99 ± 0.03	0.80 ± 0.03
	2041-2060	1.09 ± 0.03	1.39 ± 0.03	1.70 ± 0.05	1.67 ± 0.05
	2080-2099	0.96 ± 0.03	2.26 ± 0.05	3.53 ± 0.08	4.24 ± 0.10
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.72 ± 0.03	0.76 ± 0.03	1.00 ± 0.03	0.80 ± 0.03
	2041-2060	1.10 ± 0.03	1.39 ± 0.03	1.71 ± 0.05	1.67 ± 0.05
	2080-2099	0.97 ± 0.03	2.27 ± 0.05	3.56 ± 0.08	4.29 ± 0.10
Multi-model minimum	Baseline	17.12 ± 0.11	17.12 ± 0.11	17.12 ± 0.11	17.12 ± 0.11
	2021-2040	0.60 ± 0.05	0.55 ± 0.04	0.61 ± 0.05	0.53 ± 0.06
	2041-2060	0.66 ± 0.03	1.13 ± 0.03	1.09 ± 0.03	1.50 ± 0.04
	2080-2099	0.55 ± 0.05	1.69 ± 0.03	2.52 ± 0.06	3.28 ± 0.08
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.59 ± 0.04	0.59 ± 0.03	0.59 ± 0.04	0.51 ± 0.03
	2041-2060	0.66 ± 0.03	1.04 ± 0.03	1.21 ± 0.04	1.40 ± 0.03
	2080-2099	0.50 ± 0.05	1.54 ± 0.04	2.51 ± 0.08	3.19 ± 0.08
Multi-model maximum	Baseline	17.56 ± 0.11	17.56 ± 0.11	17.56 ± 0.11	17.56 ± 0.11
	2021-2040	0.82 ± 0.01	0.87 ± 0.05	1.36 ± 0.02	1.08 ± 0.04
	2041-2060	1.57 ± 0.02	1.86 ± 0.02	2.19 ± 0.05	1.95 ± 0.07
	2080-2099	1.51 ± 0.02	3.14 ± 0.05	4.64 ± 0.08	5.15 ± 0.11
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.86 ± 0.01	0.95 ± 0.04	1.46 ± 0.03	1.11 ± 0.03
	2041-2060	1.61 ± 0.03	1.77 ± 0.03	2.26 ± 0.06	1.95 ± 0.06
	2080-2099	1.45 ± 0.02	3.09 ± 0.07	4.75 ± 0.09	5.53 ± 0.12

Table 37: The statistics of the projected changes in daily mean air temperature in units of °C over the Whanganui-Manawatū Lakes region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

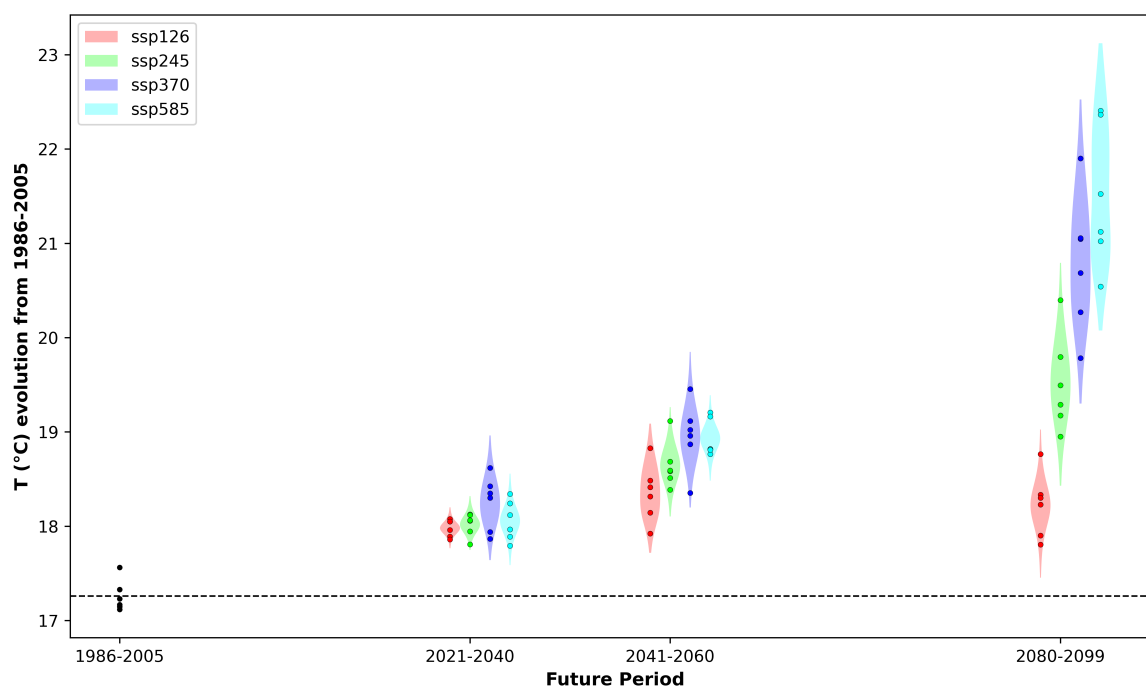


Figure 67: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Whanganui-Manawātū Lakes region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

end, as reflected in decreasing percentage agreement (27.6% for 2021–2040, dropping to 0% by 2080–2099). Overall, it is virtually certain Whanganui-Manawātū Lakes will experience significant summer warming this century, with the magnitude of change very likely proportional to global emissions pathways.

15.8.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 68. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 38. Projections for the Whanganui-Manawātū Lakes region indicate a robust warming signal in autumn average daily air temperature through the 21st century. All scenarios show temperature increases relative to the 1986–2005 baseline, with the magnitude of warming tightly coupled to emissions pathway. For 2021–2040, mean increases range from about 0.6°C to 0.8°C across scenarios, likely with high confidence due to consistent model spread and scenario agreement. By mid-century (2041–2060), warming intensifies, from about 1.0°C under SSP1-2.6 to roughly 1.6°C under SSP5-8.5, and by century’s end (2080–2099), the projected change spans from 1.0°C (SSP1-2.6) to nearly 4.0°C (SSP5-8.5); this is extremely likely under high emissions and likely even under strong mitigation.

Inter-model spread, inferred from the violin plots, is moderate and increases with scenario and time horizon, reflecting greater uncertainty as emission pathways diverge. Agreement across scenarios declines rapidly: scenario convergence for 2021–2040 is moderate (approx. 54%), low for 2041–2060 (19%), and absent by 2080–2099, underscoring scenario dependence for late-century outcomes. Spatial variability in the warming signal within the region itself is low relative to the magnitude of projected change, indicating a consistent regional response. Overall, autumn warming in Whanganui-Manawātū Lakes is extremely likely, with the strongest changes projected under higher emissions pathways.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	13.96 ± 0.18	13.96 ± 0.18	13.96 ± 0.18	13.96 ± 0.18
	2021-2040	0.59 ± 0.02	0.74 ± 0.01	0.83 ± 0.02	0.70 ± 0.02
	2041-2060	0.98 ± 0.02	1.35 ± 0.02	1.45 ± 0.03	1.57 ± 0.03
	2080-2099	1.04 ± 0.02	2.16 ± 0.03	3.11 ± 0.05	3.91 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.59 ± 0.02	0.74 ± 0.01	0.83 ± 0.02	0.71 ± 0.02
	2041-2060	0.99 ± 0.02	1.36 ± 0.02	1.46 ± 0.03	1.58 ± 0.03
	2080-2099	1.05 ± 0.02	2.17 ± 0.03	3.14 ± 0.05	3.95 ± 0.06
Multi-model minimum	Baseline	13.85 ± 0.18	13.85 ± 0.18	13.85 ± 0.18	13.85 ± 0.18
	2021-2040	0.19 ± 0.02	0.40 ± 0.01	0.20 ± 0.01	0.20 ± 0.01
	2041-2060	0.29 ± 0.01	0.76 ± 0.02	1.00 ± 0.01	1.00 ± 0.02
	2080-2099	0.70 ± 0.04	1.42 ± 0.02	1.87 ± 0.03	2.81 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.22 ± 0.02	0.35 ± 0.01	0.25 ± 0.01	0.21 ± 0.01
	2041-2060	0.37 ± 0.01	0.71 ± 0.03	0.88 ± 0.02	1.09 ± 0.02
	2080-2099	0.51 ± 0.02	1.41 ± 0.03	2.11 ± 0.04	2.85 ± 0.05
Multi-model maximum	Baseline	14.03 ± 0.17	14.03 ± 0.17	14.03 ± 0.17	14.03 ± 0.17
	2021-2040	1.01 ± 0.03	1.18 ± 0.02	1.49 ± 0.02	1.26 ± 0.02
	2041-2060	1.59 ± 0.02	2.11 ± 0.03	2.18 ± 0.04	2.07 ± 0.04
	2080-2099	1.76 ± 0.04	3.10 ± 0.04	4.00 ± 0.04	4.95 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.01 ± 0.05	1.17 ± 0.02	1.47 ± 0.02	1.29 ± 0.02
	2041-2060	1.66 ± 0.03	2.07 ± 0.03	2.09 ± 0.04	2.14 ± 0.05
	2080-2099	1.64 ± 0.03	3.04 ± 0.05	4.31 ± 0.06	5.20 ± 0.07

Table 38: The statistics of the projected changes in daily mean air temperature in units of °C over the Whanganui-Manawātū Lakes region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

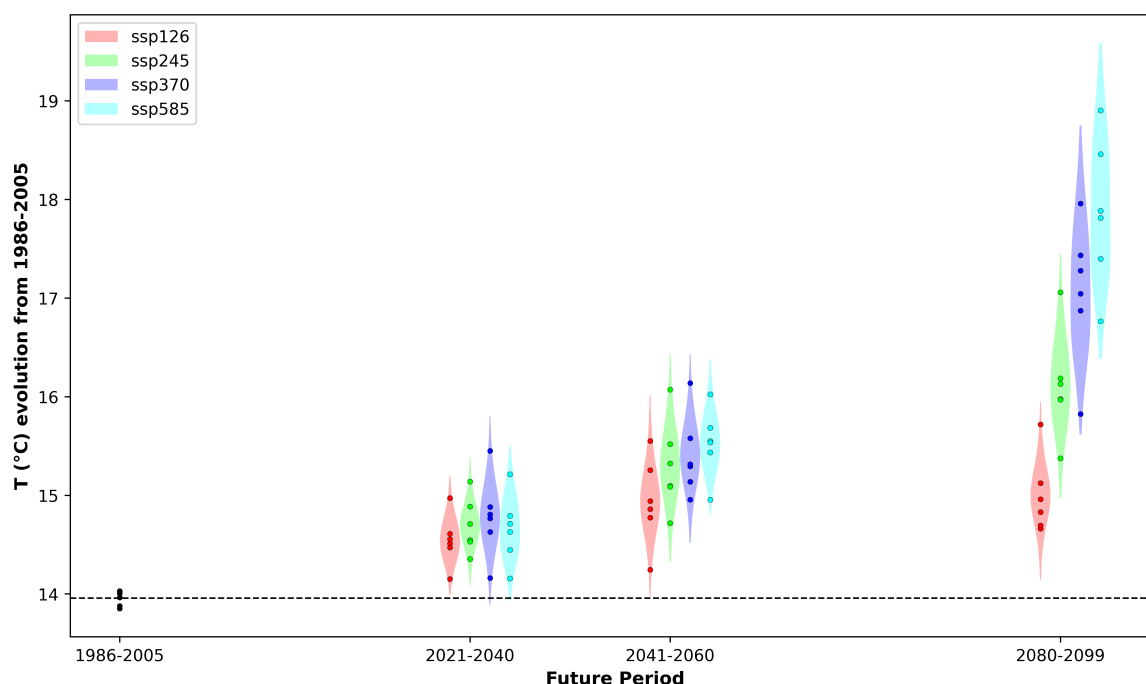


Figure 68: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Whanganui-Manawātū Lakes region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.8.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 69. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 39. Across all SSP scenarios, the Whanganui-Manawātū Lakes region is projected to experience increases in average daily winter air temperature relative to the 1986–2005 baseline, with the magnitude of warming very likely increasing with emissions scenario and over time. By 2021–2040, projected regional warming is modest across scenarios, with multi-model means close to 0.6–0.8°C above baseline and high inter-scenario and inter-model consistency (about 62% agreement). By 2041–2060, the projected warming diverges by scenario, reaching roughly 0.9°C under SSP1-2.6 to over 1.5°C under SSP5-8.5, though inter-scenario agreement falls to about 13%, reflecting emergent scenario dependence.

By the end of the century (2080–2099), projected winter warming ranges from about 1.0°C under SSP1-2.6 to nearly 3.7°C under SSP5-8.5. Inter-model agreement within scenarios remains high, but scenario spread is pronounced, with near-zero agreement across scenarios. These increases are robust, and it is extremely likely that winter temperatures will rise—magnitude increasing from the low to high emissions pathways.

Spatial variability in projected temperature increase across the region is minimal (all spatial standard deviations <0.05°C). Thus, the main source of uncertainty is emissions trajectory rather than spatial or model spread. Overall, robust warming is projected for the Whanganui-Manawātū Lakes, with magnitude very likely scenario-dependent by mid- and late-century.

15.8.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 70. The statistical summary of projected changes in daily mean air temperature over this region is shown

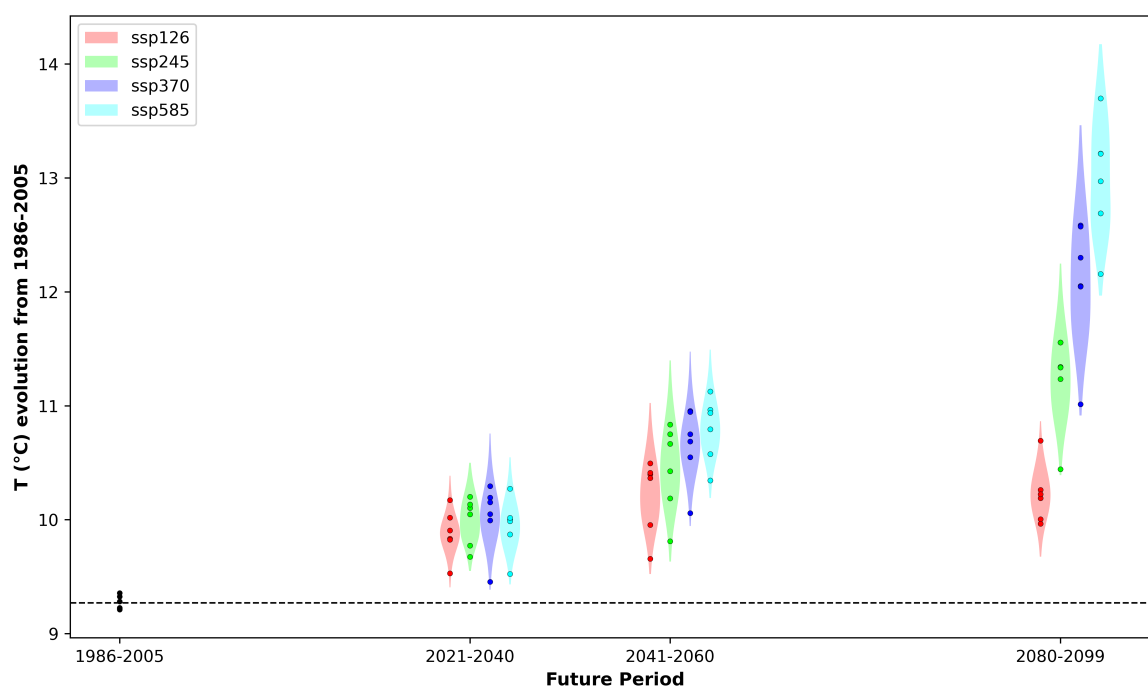


Figure 69: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of $^{\circ}\text{C}$ over the Whanganui-Manawātū Lakes region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

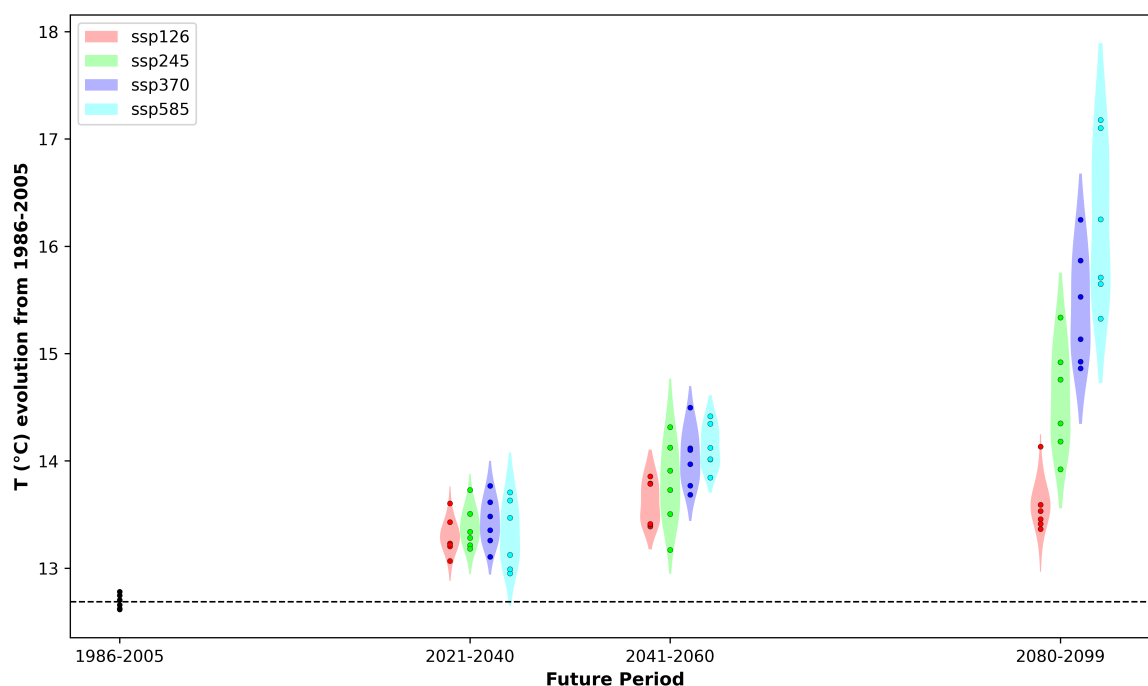


Figure 70: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of $^{\circ}\text{C}$ over the Whanganui-Manawātū Lakes region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	9.270 ± 0.190	9.270 ± 0.190	9.270 ± 0.190	9.270 ± 0.190
	2021-2040	0.610 ± 0.009	0.719 ± 0.008	0.753 ± 0.009	0.676 ± 0.012
	2041-2060	0.943 ± 0.012	1.176 ± 0.012	1.387 ± 0.022	1.520 ± 0.021
	2080-2099	0.952 ± 0.010	1.974 ± 0.023	2.824 ± 0.035	3.720 ± 0.044
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.613 ± 0.009	0.726 ± 0.008	0.759 ± 0.009	0.682 ± 0.012
	2041-2060	0.953 ± 0.012	1.187 ± 0.012	1.394 ± 0.022	1.528 ± 0.021
	2080-2099	0.959 ± 0.010	1.987 ± 0.023	2.846 ± 0.034	3.747 ± 0.043
Multi-model minimum	Baseline	9.207 ± 0.189	9.207 ± 0.189	9.207 ± 0.189	9.207 ± 0.189
	2021-2040	0.259 ± 0.008	0.404 ± 0.018	0.184 ± 0.031	0.253 ± 0.020
	2041-2060	0.386 ± 0.016	0.540 ± 0.024	0.787 ± 0.018	1.075 ± 0.023
	2080-2099	0.695 ± 0.015	1.172 ± 0.028	1.743 ± 0.036	2.886 ± 0.047
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.318 ± 0.012	0.419 ± 0.017	0.343 ± 0.022	0.337 ± 0.022
	2041-2060	0.482 ± 0.018	0.635 ± 0.022	0.930 ± 0.022	1.125 ± 0.020
	2080-2099	0.594 ± 0.018	1.398 ± 0.024	2.009 ± 0.040	2.981 ± 0.046
Multi-model maximum	Baseline	9.357 ± 0.183	9.357 ± 0.183	9.357 ± 0.183	9.357 ± 0.183
	2021-2040	0.902 ± 0.020	0.931 ± 0.019	1.025 ± 0.010	1.001 ± 0.014
	2041-2060	1.224 ± 0.016	1.564 ± 0.008	1.693 ± 0.024	1.856 ± 0.018
	2080-2099	1.423 ± 0.015	2.296 ± 0.029	3.324 ± 0.033	4.428 ± 0.059
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.927 ± 0.009	1.075 ± 0.011	1.214 ± 0.007	1.071 ± 0.017
	2041-2060	1.489 ± 0.018	1.814 ± 0.005	1.901 ± 0.026	1.982 ± 0.024
	2080-2099	1.370 ± 0.017	2.656 ± 0.022	3.798 ± 0.032	4.617 ± 0.042

Table 39: The statistics of the projected changes in daily mean air temperature in units of °C over the Whanganui-Manawatū Lakes region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



in Table 40. Projections for spring average daily air temperature (T_{mean}) over Whanganui-Manawatū Lakes

Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.69 ± 0.14	12.69 ± 0.14	12.69 ± 0.14	12.69 ± 0.14
	2021-2040	0.60 ± 0.02	0.69 ± 0.02	0.74 ± 0.02	0.62 ± 0.03
	2041-2060	0.92 ± 0.02	1.10 ± 0.03	1.34 ± 0.03	1.44 ± 0.04
	2080-2099	0.89 ± 0.02	1.89 ± 0.04	2.74 ± 0.06	3.51 ± 0.08
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.61 ± 0.02	0.69 ± 0.02	0.75 ± 0.01	0.64 ± 0.03
	2041-2060	0.93 ± 0.01	1.12 ± 0.03	1.35 ± 0.03	1.45 ± 0.04
	2080-2099	0.90 ± 0.02	1.91 ± 0.04	2.77 ± 0.06	3.56 ± 0.08
Multi-model minimum	Baseline	12.61 ± 0.15	12.61 ± 0.15	12.61 ± 0.15	12.61 ± 0.15
	2021-2040	0.38 ± 0.04	0.49 ± 0.02	0.42 ± 0.03	0.26 ± 0.05
	2041-2060	0.70 ± 0.03	0.48 ± 0.03	1.00 ± 0.03	1.16 ± 0.04
	2080-2099	0.68 ± 0.03	1.23 ± 0.04	2.17 ± 0.07	2.64 ± 0.08
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.34 ± 0.03	0.40 ± 0.03	0.40 ± 0.02	0.16 ± 0.05
	2041-2060	0.61 ± 0.03	0.52 ± 0.04	0.93 ± 0.04	1.13 ± 0.04
	2080-2099	0.51 ± 0.02	1.16 ± 0.05	1.96 ± 0.07	2.42 ± 0.09
Multi-model maximum	Baseline	12.78 ± 0.15	12.78 ± 0.15	12.78 ± 0.15	12.78 ± 0.15
	2021-2040	0.92 ± 0.02	1.04 ± 0.01	1.08 ± 0.01	1.02 ± 0.04
	2041-2060	1.17 ± 0.02	1.63 ± 0.04	1.81 ± 0.03	1.73 ± 0.04
	2080-2099	1.44 ± 0.03	2.65 ± 0.04	3.56 ± 0.06	4.49 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.90 ± 0.02	1.03 ± 0.02	1.15 ± 0.01	1.19 ± 0.04
	2041-2060	1.30 ± 0.01	1.81 ± 0.03	1.83 ± 0.03	1.81 ± 0.04
	2080-2099	1.31 ± 0.03	2.78 ± 0.04	3.68 ± 0.05	4.86 ± 0.07

Table 40: The statistics of the projected changes in daily mean air temperature in units of °C over the Whanganui-Manawatū Lakes region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

indicate a very likely and robust warming trend throughout the 21st century across all emissions scenarios. For 2021–2040, all scenarios show a likely warming of around 0.6 to 0.75°C relative to the 1986–2005 baseline, with only modest differentiation between scenarios and high inter-model consistency, supporting high confidence in near-term warming. By mid-century (2041–2060), warming continues, with mean increases projected to range from about 0.9°C (SSP1-2.6) to approximately 1.4°C (SSP5-8.5), while inter-model agreement remains high, though the spread between scenarios slightly increases, signalling growing sensitivity to emissions pathway.

Towards the end of the century (2080–2099), scenario dependency becomes pronounced: mean warming is about 0.9°C under SSP1-2.6 but rises to over 3.5°C under SSP5-8.5. The range of projections also expands substantially, indicating reduced agreement both within and between models for higher emissions scenarios, reflected by reduced scenario agreement (0%). This emphasises a likely but emissions-sensitive outcome, with extremely likely warming considerably exceeding natural variability for higher scenarios. In all cases, spatial variability (standard deviation across the region) remains comparatively small relative to the magnitude of change. In summary, spring temperatures in Whanganui-Manawatū Lakes are very likely to increase, with magnitude strongly dependent on global emissions choices.



15.9 Region: Coastal Whanganui

Area: 1048.57 km²

15.9.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 71. The statistical summary of projected changes in daily mean air temperature over this region

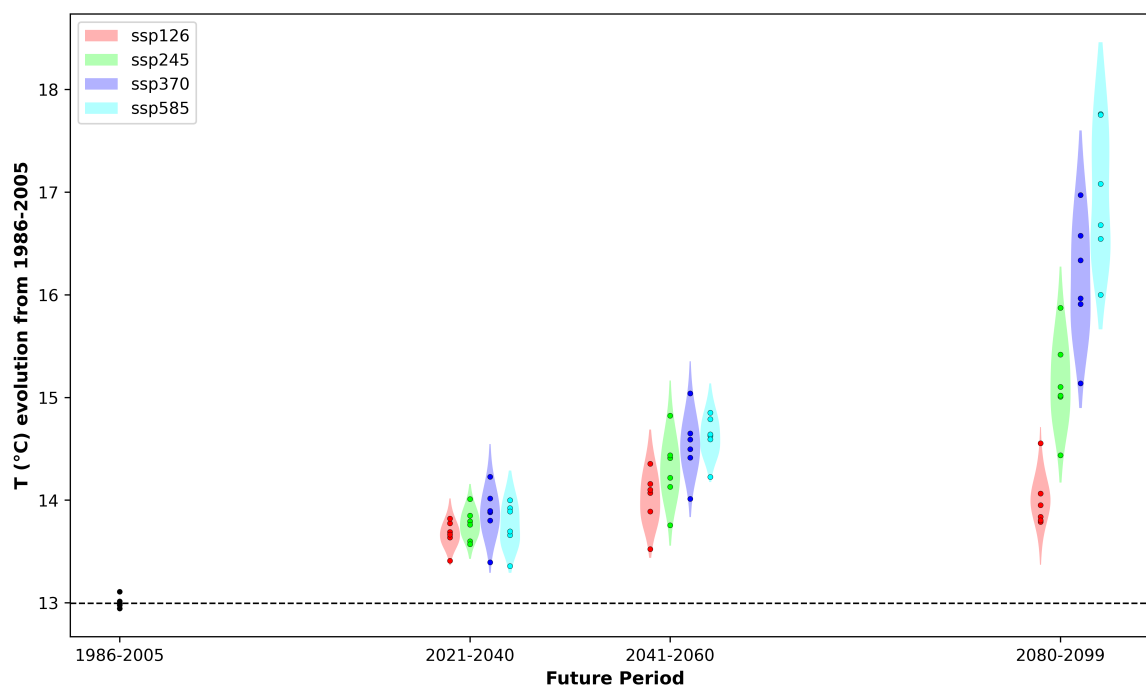


Figure 71: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Coastal Whanganui region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

is shown in Table 41. Projected annual average daily air temperature in Coastal Whanganui shows a robust warming trend across all SSP scenarios, relative to the 1986–2005 baseline. By 2021–2040, warming is likely in the range of 0.7 to 0.9°C, and is extremely likely across all scenarios. By mid-century (2041–2060), the magnitude of projected warming becomes stratified by scenario, with a likely increase between approximately 1.0°C (SSP1-2.6) and 1.6°C (SSP5-8.5). By late century (2080–2099), the scenario spread widens substantially—from roughly 1.0°C (SSP1-2.6, assuming strong mitigation) to nearly 4.0°C (SSP5-8.5, high emissions). These future projections are supported by both multi-model means and medians, indicating very high consistency among models within each scenario.

Spatial variability (standard deviation) across the region is low, remaining well below 0.1°C in future periods, suggesting projected warming is spatially uniform across Coastal Whanganui (very high confidence). However, agreement between SSP scenarios declines sharply over time, especially after 2040, indicating scenario uncertainty dominates late-century projections. All findings are virtually certain for direction of change (warming), but specific magnitude by century's end remains scenario-dependent. Overall, Coastal Whanganui is extremely likely to experience notable warming, with the greatest changes and largest uncertainty after 2060.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.99 ± 0.54	12.99 ± 0.54	12.99 ± 0.54	12.99 ± 0.54
	2021-2040	0.67 ± 0.01	0.77 ± 0.02	0.87 ± 0.01	0.76 ± 0.02
	2041-2060	1.02 ± 0.02	1.30 ± 0.02	1.54 ± 0.02	1.63 ± 0.03
	2080-2099	1.00 ± 0.01	2.15 ± 0.03	3.15 ± 0.04	3.97 ± 0.05
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.68 ± 0.01	0.77 ± 0.02	0.88 ± 0.01	0.77 ± 0.02
	2041-2060	1.03 ± 0.02	1.31 ± 0.02	1.55 ± 0.02	1.63 ± 0.03
	2080-2099	1.01 ± 0.01	2.16 ± 0.03	3.18 ± 0.04	4.02 ± 0.05
Multi-model minimum	Baseline	12.94 ± 0.53	12.94 ± 0.53	12.94 ± 0.53	12.94 ± 0.53
	2021-2040	0.41 ± 0.01	0.58 ± 0.03	0.40 ± 0.01	0.36 ± 0.02
	2041-2060	0.53 ± 0.01	0.76 ± 0.03	1.02 ± 0.02	1.23 ± 0.03
	2080-2099	0.79 ± 0.02	1.44 ± 0.03	2.14 ± 0.04	3.01 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.47 ± 0.01	0.54 ± 0.03	0.49 ± 0.02	0.43 ± 0.02
	2041-2060	0.62 ± 0.02	0.81 ± 0.03	1.08 ± 0.03	1.32 ± 0.03
	2080-2099	0.60 ± 0.02	1.48 ± 0.03	2.27 ± 0.04	3.00 ± 0.05
Multi-model maximum	Baseline	13.11 ± 0.53	13.11 ± 0.53	13.11 ± 0.53	13.11 ± 0.53
	2021-2040	0.83 ± 0.01	1.02 ± 0.01	1.23 ± 0.01	1.00 ± 0.01
	2041-2060	1.36 ± 0.01	1.83 ± 0.01	2.04 ± 0.02	1.86 ± 0.04
	2080-2099	1.56 ± 0.01	2.88 ± 0.02	3.98 ± 0.03	4.77 ± 0.05
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.91 ± 0.01	1.04 ± 0.00	1.32 ± 0.01	1.16 ± 0.02
	2041-2060	1.50 ± 0.01	1.89 ± 0.01	2.08 ± 0.02	1.99 ± 0.03
	2080-2099	1.45 ± 0.01	2.95 ± 0.02	4.23 ± 0.04	5.18 ± 0.06

Table 41: The statistics of the projected changes in daily mean air temperature in units of °C over the Coastal Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



15.9.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 72. The statistical summary of projected changes in daily mean air temperature over this region is

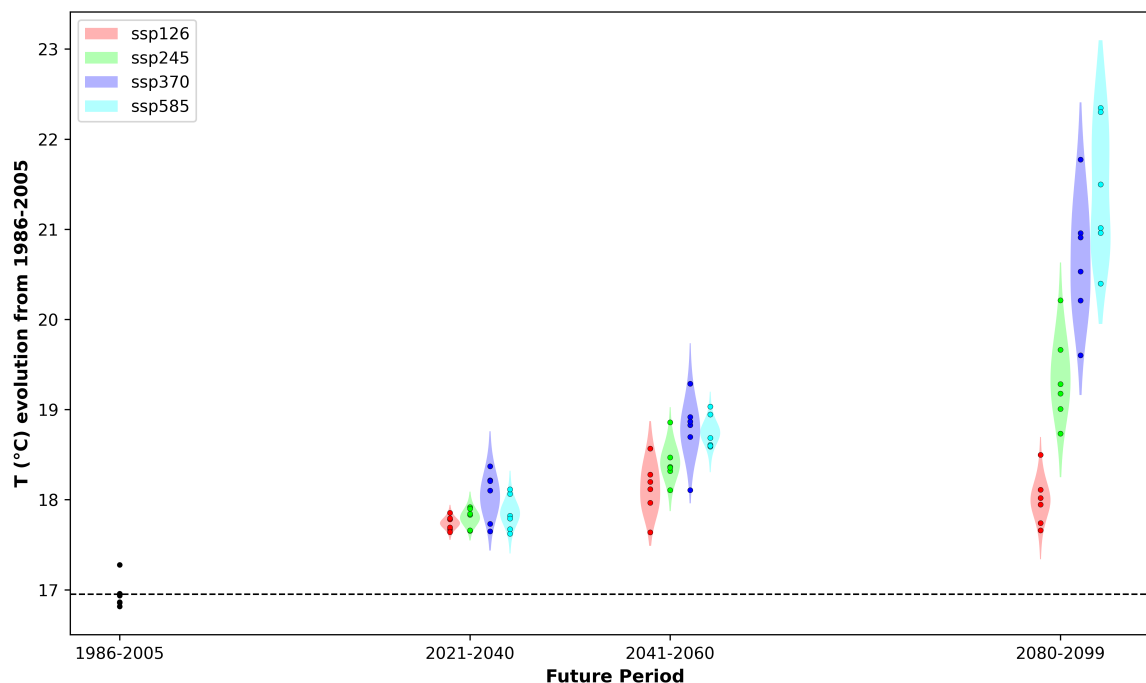


Figure 72: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Coastal Whanganui region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 42. Projected changes in average daily summer air temperature (T_{mean}) for Coastal Whanganui show a clear warming trend throughout the 21st century, with the magnitude of warming dependent on emissions scenario. Across all scenarios, warming is very likely (greater than 90% probability) relative to the 1986–2005 baseline. By mid-century (2041–2060), multi-model means indicate increases of around 1.2°C under low emissions (SSP1-2.6), rising to about 1.8°C for high emissions (SSP3-7.0 and SSP5-8.5), with changes spatially consistent across the region (low stdv <0.05°C). By late century (2080–2099), the warming amplifies, remaining near 1°C under SSP1-2.6, but reaching 2.4°C (SSP2-4.5), 3.7°C (SSP3-7.0), and up to 4.5°C under SSP5-8.5.

Inter-model agreement on the signal is high within each scenario, as shown by tight clustering and low within-scenario spread. However, agreement across scenarios decreases markedly (>20% for 2021–2040, dropping to 0% for 2080–2099), reflecting increasing divergence in emissions pathways. Spatial variability of projected warming across Coastal Whanganui is consistently low (stdv always <0.1°C), giving high confidence in the regional pattern.

In summary, it is extremely likely that Coastal Whanganui will experience substantial summer warming by century's end, with magnitude strongly dependent on global emissions trajectories. There is high confidence and robust model agreement in both the direction and regional consistency of these projections.

15.9.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 73. The statistical summary of projected changes in daily mean air temperature over this region is shown



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	16.95 ± 0.50	16.95 ± 0.50	16.95 ± 0.50	16.95 ± 0.50
	2021-2040	0.79 ± 0.02	0.85 ± 0.03	1.09 ± 0.03	0.90 ± 0.03
	2041-2060	1.18 ± 0.03	1.46 ± 0.04	1.83 ± 0.05	1.79 ± 0.04
	2080-2099	1.04 ± 0.03	2.39 ± 0.05	3.71 ± 0.08	4.47 ± 0.09
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.79 ± 0.02	0.85 ± 0.03	1.10 ± 0.03	0.90 ± 0.03
	2041-2060	1.19 ± 0.03	1.47 ± 0.04	1.84 ± 0.05	1.79 ± 0.04
	2080-2099	1.05 ± 0.03	2.41 ± 0.05	3.74 ± 0.08	4.52 ± 0.09
Multi-model minimum	Baseline	16.82 ± 0.50	16.82 ± 0.50	16.82 ± 0.50	16.82 ± 0.50
	2021-2040	0.69 ± 0.02	0.69 ± 0.05	0.70 ± 0.01	0.67 ± 0.02
	2041-2060	0.69 ± 0.03	1.16 ± 0.04	1.16 ± 0.03	1.63 ± 0.04
	2080-2099	0.71 ± 0.06	1.78 ± 0.04	2.65 ± 0.05	3.45 ± 0.07
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.67 ± 0.02	0.69 ± 0.05	0.69 ± 0.03	0.62 ± 0.02
	2041-2060	0.74 ± 0.04	1.12 ± 0.04	1.30 ± 0.05	1.52 ± 0.03
	2080-2099	0.64 ± 0.05	1.67 ± 0.05	2.67 ± 0.08	3.38 ± 0.07
Multi-model maximum	Baseline	17.28 ± 0.49	17.28 ± 0.49	17.28 ± 0.49	17.28 ± 0.49
	2021-2040	0.90 ± 0.04	0.97 ± 0.04	1.42 ± 0.01	1.16 ± 0.05
	2041-2060	1.62 ± 0.02	1.91 ± 0.03	2.33 ± 0.03	2.08 ± 0.08
	2080-2099	1.55 ± 0.02	3.26 ± 0.03	4.82 ± 0.06	5.40 ± 0.09
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.92 ± 0.02	1.03 ± 0.03	1.56 ± 0.02	1.19 ± 0.04
	2041-2060	1.70 ± 0.03	1.85 ± 0.03	2.43 ± 0.05	2.07 ± 0.07
	2080-2099	1.48 ± 0.02	3.24 ± 0.05	4.95 ± 0.08	5.81 ± 0.11

Table 42: The statistics of the projected changes in daily mean air temperature in units of °C over the Coastal Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

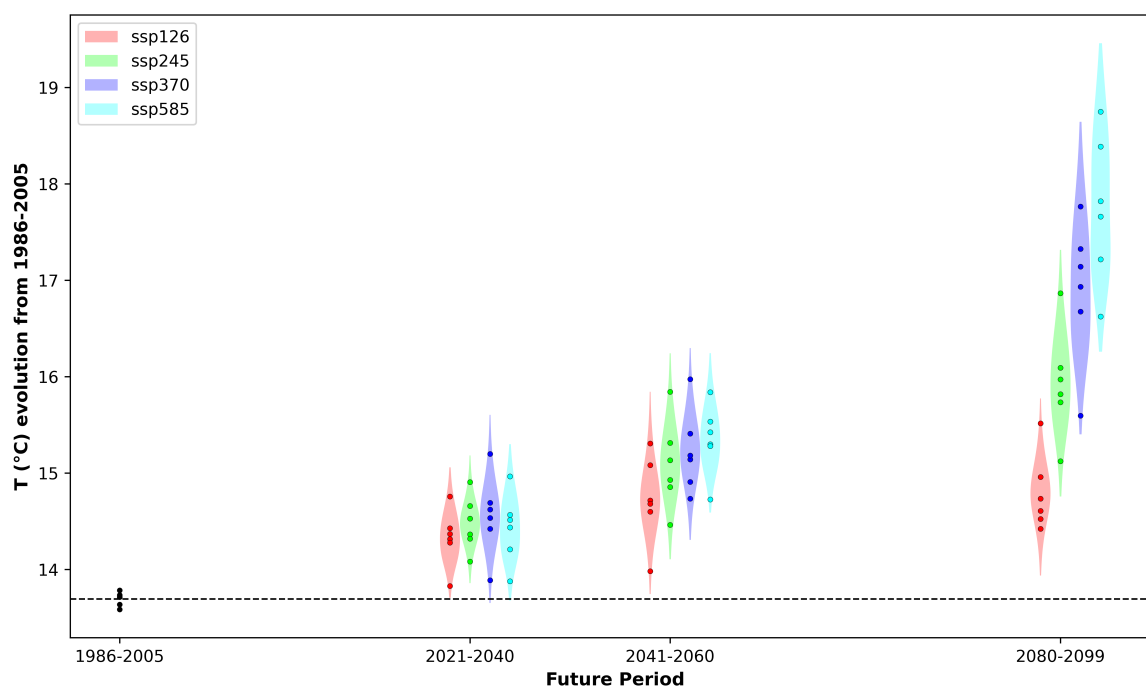


Figure 73: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Coastal Whanganui region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

in Table 43. The figure and associated statistics clearly indicate that average daily air temperature (T_{mean}) in Coastal Whanganui during autumn is projected to increase throughout the 21st century under all emissions scenarios. By 2021–2040, multi-model means show modest warming (around 0.6–0.9°C above the 1986–2005 baseline), with very likely high inter-model agreement across scenarios at this near-term horizon, as supported by approximately 61% scenario convergence.

Warming intensifies with time and scenario: from mid-century (2041–2060), the mean temperature increase ranges from about 1.0°C (SSP1-2.6) to 1.7°C (SSP5-8.5). For 2080–2099, a pronounced emissions-dependent divergence emerges: under low emissions (SSP1-2.6), warming plateaus around 1.1°C, but increases to 2.2°C (SSP2-4.5), 3.2°C (SSP3-7.0), and up to 4.0°C (SSP5-8.5). This is extremely likely, reflecting strong scenario dependency.

The inter-model spread within each scenario remains moderate and does not suggest strong regional uncertainty, with spatial variability staying low relative to the magnitude of warming. However, scenario agreement diminishes significantly after 2040—down to 20% by mid-century and negligible by century’s end—indicating a very likely robust signal of human influence but with increasing divergence tied to global emissions choices. In summary, it is virtually certain that autumn temperatures will rise, with the magnitude strongly dependent on emissions pathway.

15.9.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 74. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 44. Projected winter average daily air temperature (T_{mean}) in Coastal Whanganui is very likely to increase over the 21st century, with the magnitude of warming dependent on emission scenarios (SSPs). For the near-term (2021–2040), multi-model means converge on a modest warming of around 0.6–0.8°C above



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	13.69 ± 0.54	13.69 ± 0.54	13.69 ± 0.54	13.69 ± 0.54
	2021-2040	0.63 ± 0.02	0.78 ± 0.02	0.86 ± 0.02	0.73 ± 0.02
	2041-2060	1.03 ± 0.02	1.39 ± 0.02	1.53 ± 0.02	1.66 ± 0.03
	2080-2099	1.10 ± 0.02	2.24 ± 0.03	3.21 ± 0.04	4.05 ± 0.05
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.64 ± 0.02	0.79 ± 0.02	0.87 ± 0.02	0.75 ± 0.02
	2041-2060	1.04 ± 0.02	1.41 ± 0.03	1.54 ± 0.02	1.67 ± 0.03
	2080-2099	1.11 ± 0.02	2.26 ± 0.03	3.24 ± 0.04	4.09 ± 0.05
Multi-model minimum	Baseline	13.59 ± 0.55	13.59 ± 0.55	13.59 ± 0.55	13.59 ± 0.55
	2021-2040	0.13 ± 0.02	0.39 ± 0.01	0.19 ± 0.03	0.18 ± 0.01
	2041-2060	0.29 ± 0.01	0.77 ± 0.03	1.04 ± 0.02	1.03 ± 0.02
	2080-2099	0.73 ± 0.01	1.43 ± 0.03	1.90 ± 0.03	2.93 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.22 ± 0.01	0.39 ± 0.02	0.28 ± 0.02	0.22 ± 0.01
	2041-2060	0.41 ± 0.01	0.75 ± 0.03	0.93 ± 0.02	1.14 ± 0.02
	2080-2099	0.55 ± 0.02	1.45 ± 0.03	2.17 ± 0.03	2.97 ± 0.04
Multi-model maximum	Baseline	13.78 ± 0.54	13.78 ± 0.54	13.78 ± 0.54	13.78 ± 0.54
	2021-2040	1.06 ± 0.02	1.21 ± 0.02	1.50 ± 0.02	1.27 ± 0.02
	2041-2060	1.61 ± 0.02	2.15 ± 0.02	2.28 ± 0.02	2.14 ± 0.04
	2080-2099	1.82 ± 0.03	3.17 ± 0.03	4.07 ± 0.03	5.05 ± 0.05
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.13 ± 0.04	1.23 ± 0.02	1.52 ± 0.01	1.34 ± 0.03
	2041-2060	1.73 ± 0.03	2.14 ± 0.02	2.22 ± 0.03	2.26 ± 0.04
	2080-2099	1.72 ± 0.03	3.17 ± 0.03	4.46 ± 0.05	5.36 ± 0.06

Table 43: The statistics of the projected changes in daily mean air temperature in units of °C over the Coastal Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	9.023 ± 0.576	9.023 ± 0.576	9.023 ± 0.576	9.023 ± 0.576
	2021-2040	0.610 ± 0.011	0.726 ± 0.006	0.766 ± 0.005	0.707 ± 0.011
	2041-2060	0.949 ± 0.013	1.175 ± 0.014	1.398 ± 0.015	1.522 ± 0.017
	2080-2099	0.953 ± 0.009	1.990 ± 0.019	2.843 ± 0.026	3.717 ± 0.039
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.613 ± 0.011	0.733 ± 0.006	0.772 ± 0.005	0.715 ± 0.011
	2041-2060	0.960 ± 0.013	1.187 ± 0.013	1.406 ± 0.015	1.532 ± 0.017
	2080-2099	0.960 ± 0.009	2.005 ± 0.018	2.867 ± 0.025	3.748 ± 0.038
Multi-model minimum	Baseline	8.977 ± 0.570	8.977 ± 0.570	8.977 ± 0.570	8.977 ± 0.570
	2021-2040	0.307 ± 0.018	0.462 ± 0.032	0.256 ± 0.011	0.261 ± 0.014
	2041-2060	0.434 ± 0.019	0.586 ± 0.030	0.845 ± 0.011	1.053 ± 0.023
	2080-2099	0.669 ± 0.006	1.252 ± 0.026	1.774 ± 0.021	2.883 ± 0.039
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.361 ± 0.008	0.457 ± 0.022	0.400 ± 0.008	0.352 ± 0.015
	2041-2060	0.507 ± 0.011	0.658 ± 0.021	0.976 ± 0.008	1.108 ± 0.018
	2080-2099	0.563 ± 0.011	1.427 ± 0.024	2.016 ± 0.026	2.948 ± 0.044
Multi-model maximum	Baseline	9.087 ± 0.577	9.087 ± 0.577	9.087 ± 0.577	9.087 ± 0.577
	2021-2040	0.864 ± 0.015	0.940 ± 0.018	1.005 ± 0.009	1.004 ± 0.008
	2041-2060	1.208 ± 0.010	1.558 ± 0.012	1.709 ± 0.020	1.830 ± 0.021
	2080-2099	1.433 ± 0.017	2.361 ± 0.013	3.396 ± 0.035	4.492 ± 0.038
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.885 ± 0.029	1.047 ± 0.021	1.182 ± 0.013	1.128 ± 0.009
	2041-2060	1.475 ± 0.023	1.788 ± 0.014	1.888 ± 0.024	2.014 ± 0.016
	2080-2099	1.410 ± 0.010	2.663 ± 0.020	3.836 ± 0.024	4.658 ± 0.031

Table 44: The statistics of the projected changes in daily mean air temperature in units of °C over the Coastal Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

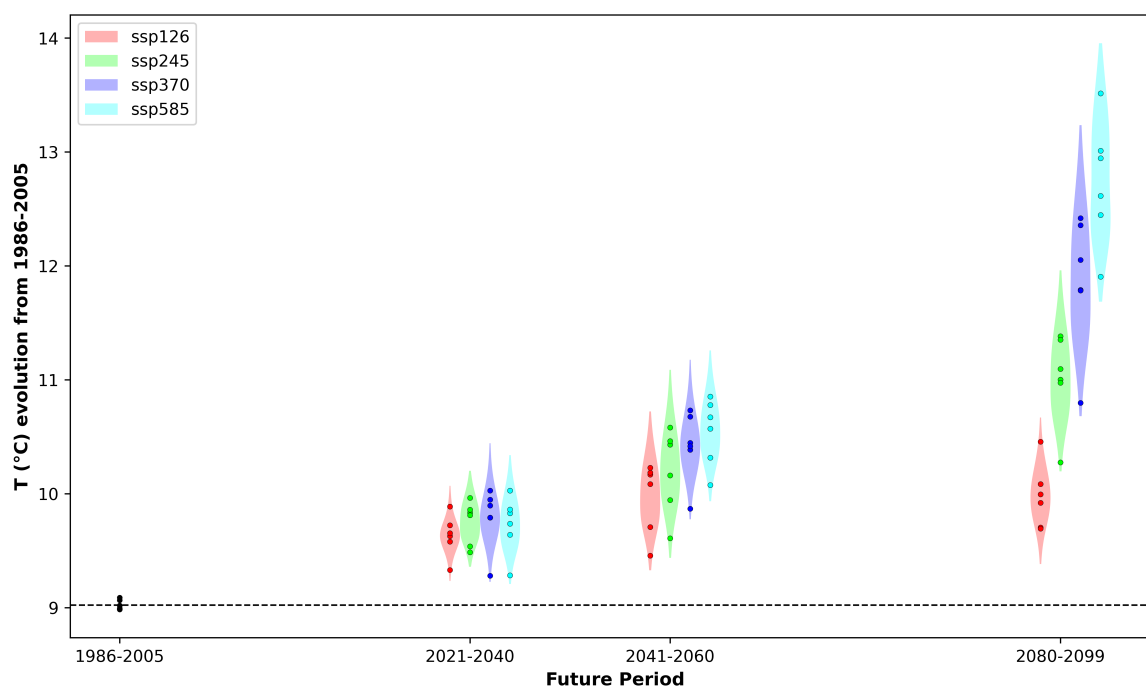


Figure 74: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Coastal Whanganui region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

the 1986–2005 baseline across all SSPs, with high inter-scenario agreement and very high confidence. Spatial variability within the region is very low (mean standard deviation $<0.02^{\circ}\text{C}$), indicating a spatially coherent warming signal.

By mid-century (2041–2060), differences among scenarios become more apparent: SSP1-2.6 (low emissions) projects a warming of just under 1°C , while higher emission scenarios (SSP3-7.0 and SSP5-8.5) project 1.4°C and 1.5°C , respectively. This divergence grows substantial by late century (2080–2099). Under SSP1-2.6, warming plateaus near 1°C , whereas higher scenarios range from $\sim 2^{\circ}\text{C}$ (SSP2-4.5) to over 3.5°C (SSP5-8.5). This translates to a likely (66–90%) but scenario-dependent substantial increase in winter temperatures if emissions are not strongly mitigated.

Model agreement across SSPs diminishes sharply after 2040 (agreement falls to near zero by century's end), so confidence in the exact amount of warming is lower for late-century periods but remains extremely likely that substantial increases will occur relative to the historical baseline.

15.9.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 75. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 45. Projections for average daily air temperature (T_{mean}) in spring over Coastal Whanganui indicate a robust warming trend through the 21st century, with the magnitude of change strongly dependent on emissions scenario. By 2021–2040, all scenarios show a likely increase of about 0.7°C above the 1986–2005 baseline, with extremely likely ($\geq 95\%$ probability) model agreement for near-term warming. Spatial variability within the region is low (standard deviation $\leq 0.02^{\circ}\text{C}$), indicating the warming is spatially consistent.

By mid-century (2041–2060), modelled temperature increases diverge across emission scenarios: SSP1-2.6



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.39 ± 0.54	12.39 ± 0.54	12.39 ± 0.54	12.39 ± 0.54
	2021-2040	0.65 ± 0.01	0.71 ± 0.01	0.77 ± 0.01	0.70 ± 0.02
	2041-2060	0.94 ± 0.01	1.17 ± 0.02	1.39 ± 0.02	1.52 ± 0.02
	2080-2099	0.93 ± 0.01	1.97 ± 0.02	2.85 ± 0.04	3.66 ± 0.05
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.65 ± 0.01	0.72 ± 0.01	0.78 ± 0.01	0.72 ± 0.02
	2041-2060	0.95 ± 0.01	1.18 ± 0.02	1.40 ± 0.02	1.53 ± 0.02
	2080-2099	0.93 ± 0.01	1.99 ± 0.02	2.88 ± 0.04	3.70 ± 0.05
Multi-model minimum	Baseline	12.32 ± 0.55	12.32 ± 0.55	12.32 ± 0.55	12.32 ± 0.55
	2021-2040	0.43 ± 0.02	0.50 ± 0.03	0.47 ± 0.02	0.33 ± 0.03
	2041-2060	0.71 ± 0.02	0.54 ± 0.04	1.00 ± 0.02	1.19 ± 0.04
	2080-2099	0.69 ± 0.02	1.29 ± 0.04	2.26 ± 0.06	2.74 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.39 ± 0.01	0.44 ± 0.03	0.44 ± 0.01	0.24 ± 0.03
	2041-2060	0.63 ± 0.02	0.60 ± 0.03	0.96 ± 0.03	1.19 ± 0.03
	2080-2099	0.53 ± 0.02	1.24 ± 0.04	2.07 ± 0.05	2.59 ± 0.06
Multi-model maximum	Baseline	12.48 ± 0.54	12.48 ± 0.54	12.48 ± 0.54	12.48 ± 0.54
	2021-2040	0.94 ± 0.02	1.06 ± 0.01	1.09 ± 0.02	1.10 ± 0.02
	2041-2060	1.20 ± 0.01	1.70 ± 0.02	1.87 ± 0.01	1.81 ± 0.02
	2080-2099	1.50 ± 0.01	2.73 ± 0.01	3.68 ± 0.04	4.60 ± 0.04
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.94 ± 0.01	1.04 ± 0.01	1.17 ± 0.01	1.26 ± 0.01
	2041-2060	1.32 ± 0.01	1.85 ± 0.01	1.89 ± 0.01	1.92 ± 0.01
	2080-2099	1.37 ± 0.00	2.84 ± 0.02	3.80 ± 0.03	4.97 ± 0.04

Table 45: The statistics of the projected changes in daily mean air temperature in units of °C over the Coastal Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

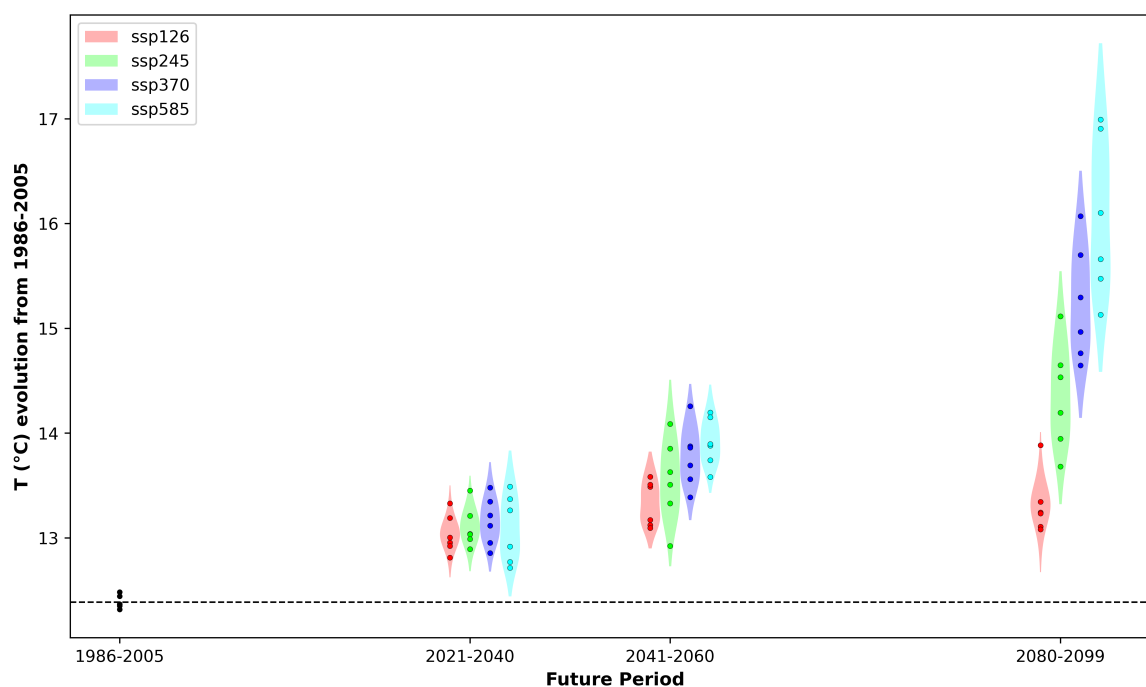


Figure 75: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Coastal Whanganui region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

(low emissions) projects about 0.9°C of warming, while higher scenarios (SSP2-4.5, SSP3-7.0, and SSP5-8.5) predict up to 1.5°C of warming. By late century (2080–2099), this divergence widens considerably: low emissions hold warming at around 0.9°C, but high emissions (SSP5-8.5) project approximately 3.7°C warming (likely range 2.7–4.6°C), making substantial further change extremely likely if mitigation is insufficient. Inter-model agreement decreases with time, particularly after 2040 (about as likely as not for 2041–2060, and very low for 2080–2099), reflecting increased emissions pathway uncertainty. Overall, it is virtually certain that Coastal Whanganui will experience significant spring warming, with the ultimate magnitude tightly linked to global emissions pathways.

15.10 Region: Turakina

Area: 1237.15 km²

15.10.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 76. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 46. Projections for the Turakina sub-region indicate a robust warming signal in annual mean air temperature throughout the 21st century, with both the figure and quantitative statistics supporting a likely and high confidence rise relative to the 1986–2005 baseline. For 2021–2040, projected increases are modest across all scenarios (approximately 0.7–0.9°C), with extremely likely agreement between models and scenarios. By mid-century (2041–2060), warming intensifies and the spread between socio-economic pathways (SSPs) becomes more pronounced, rising from about 1.1°C (SSP1-2.6) to nearly 1.7°C (SSP5-8.5), indicating high confidence but decreasing inter-scenario agreement.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.94 ± 1.06	11.94 ± 1.06	11.94 ± 1.06	11.94 ± 1.06
	2021-2040	0.70 ± 0.02	0.81 ± 0.03	0.90 ± 0.02	0.79 ± 0.02
	2041-2060	1.06 ± 0.03	1.35 ± 0.03	1.59 ± 0.03	1.69 ± 0.03
	2080-2099	1.04 ± 0.02	2.20 ± 0.03	3.24 ± 0.05	4.09 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.70 ± 0.02	0.81 ± 0.03	0.91 ± 0.02	0.80 ± 0.02
	2041-2060	1.07 ± 0.03	1.36 ± 0.03	1.60 ± 0.03	1.69 ± 0.03
	2080-2099	1.04 ± 0.02	2.22 ± 0.03	3.27 ± 0.05	4.14 ± 0.06
Multi-model minimum	Baseline	11.89 ± 1.06	11.89 ± 1.06	11.89 ± 1.06	11.89 ± 1.06
	2021-2040	0.45 ± 0.02	0.63 ± 0.04	0.42 ± 0.01	0.40 ± 0.01
	2041-2060	0.57 ± 0.02	0.83 ± 0.04	1.06 ± 0.02	1.30 ± 0.03
	2080-2099	0.83 ± 0.02	1.51 ± 0.04	2.23 ± 0.03	3.11 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.51 ± 0.02	0.60 ± 0.04	0.52 ± 0.02	0.47 ± 0.02
	2041-2060	0.67 ± 0.02	0.86 ± 0.04	1.14 ± 0.03	1.38 ± 0.02
	2080-2099	0.65 ± 0.02	1.54 ± 0.04	2.36 ± 0.04	3.11 ± 0.05
Multi-model maximum	Baseline	12.04 ± 1.06	12.04 ± 1.06	12.04 ± 1.06	12.04 ± 1.06
	2021-2040	0.83 ± 0.01	1.04 ± 0.01	1.25 ± 0.01	1.03 ± 0.01
	2041-2060	1.40 ± 0.03	1.86 ± 0.01	2.07 ± 0.01	1.94 ± 0.06
	2080-2099	1.58 ± 0.01	2.91 ± 0.02	4.04 ± 0.03	4.90 ± 0.07
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.92 ± 0.02	1.05 ± 0.01	1.35 ± 0.02	1.19 ± 0.03
	2041-2060	1.53 ± 0.04	1.92 ± 0.02	2.11 ± 0.03	2.05 ± 0.05
	2080-2099	1.47 ± 0.01	2.99 ± 0.03	4.32 ± 0.05	5.30 ± 0.07

Table 46: The statistics of the projected changes in daily mean air temperature in units of °C over the Turakina region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

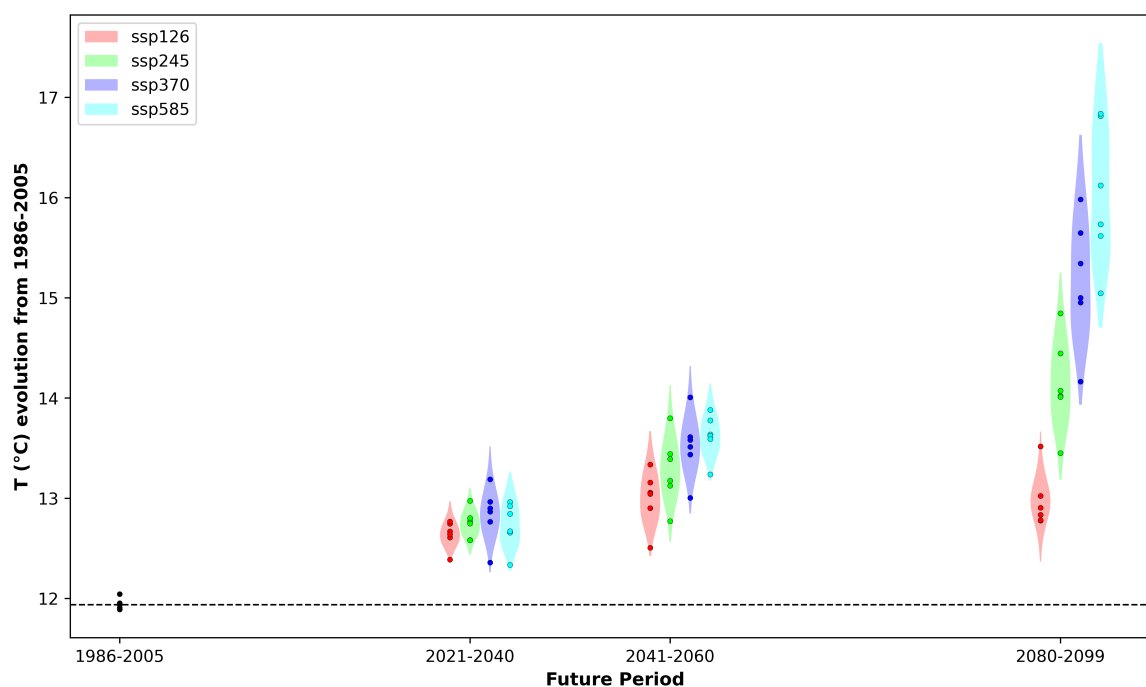


Figure 76: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Turakina region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

For late-century (2080–2099), scenario dependence becomes dominant: mean warming spans about 1.0°C under strong mitigation (SSP1-2.6) to around 4.1°C under high emissions (SSP5-8.5). This range, coupled with minimal scenario agreement (0%), underscores a likely, but highly scenario-dependent, regional response. Inter-model spread is apparent but not excessive in any period, augmenting confidence in these signals. Spatial variability in projections across Turakina remains low versus the magnitude of change, suggesting the warming is a consistent feature across the sub-region. In summary, Turakina is very likely to experience substantial and increasing annual warming through the 21st century, especially under higher emission scenarios, with high confidence in both the signal and associated spatial coherence.

15.10.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 77. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 47. Projections for average summer (DJF) daily air temperature (T_{mean}) in Turakina indicate a warming trend across all scenarios, with the magnitude of change dependent on emissions pathway. By 2021–2040, model ensemble means suggest increases of approximately 0.8–1.1°C above the 1986–2005 baseline, with extremely likely agreement among models. For 2041–2060, warming continues, with mean increases of about 1.2°C under low emissions (SSP1-2.6), and up to nearly 1.9°C under high emissions (SSP3-7.0 and SSP5-8.5); this period exhibits a wider range of projections but remains extremely likely to be warmer than the past.

By 2080–2099, the divergence between scenarios is highly pronounced: under SSP1-2.6, warming stabilises at around 1.1°C, but higher scenarios (SSP2-4.5, SSP3-7.0, SSP5-8.5) result in increases between 2.5°C and 4.6°C (very likely), and up to individual model projections exceeding 5°C under SSP5-8.5. Inter-model consistency remains high within each scenario, as reflected in the relatively low spatial standard deviations across Turakina. However, agreement between scenarios drastically decreases over time (zero by 2080–2099), indicating



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	16.22 ± 0.91	16.22 ± 0.91	16.22 ± 0.91	16.22 ± 0.91
	2021-2040	0.82 ± 0.03	0.90 ± 0.05	1.13 ± 0.04	0.94 ± 0.04
	2041-2060	1.24 ± 0.05	1.54 ± 0.05	1.92 ± 0.06	1.88 ± 0.06
	2080-2099	1.09 ± 0.03	2.48 ± 0.06	3.86 ± 0.09	4.64 ± 0.11
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.82 ± 0.03	0.90 ± 0.05	1.14 ± 0.04	0.94 ± 0.04
	2041-2060	1.25 ± 0.05	1.54 ± 0.05	1.93 ± 0.06	1.88 ± 0.07
	2080-2099	1.09 ± 0.03	2.49 ± 0.06	3.88 ± 0.09	4.69 ± 0.11
Multi-model minimum	Baseline	16.09 ± 0.90	16.09 ± 0.90	16.09 ± 0.90	16.09 ± 0.90
	2021-2040	0.74 ± 0.03	0.73 ± 0.06	0.72 ± 0.01	0.70 ± 0.02
	2041-2060	0.75 ± 0.03	1.25 ± 0.06	1.20 ± 0.03	1.69 ± 0.04
	2080-2099	0.80 ± 0.10	1.85 ± 0.05	2.76 ± 0.07	3.60 ± 0.09
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.69 ± 0.01	0.72 ± 0.05	0.72 ± 0.02	0.64 ± 0.03
	2041-2060	0.79 ± 0.04	1.19 ± 0.06	1.38 ± 0.05	1.57 ± 0.05
	2080-2099	0.71 ± 0.06	1.75 ± 0.07	2.80 ± 0.09	3.52 ± 0.09
Multi-model maximum	Baseline	16.54 ± 0.91	16.54 ± 0.91	16.54 ± 0.91	16.54 ± 0.91
	2021-2040	0.98 ± 0.07	1.04 ± 0.05	1.44 ± 0.03	1.23 ± 0.06
	2041-2060	1.70 ± 0.05	1.99 ± 0.04	2.38 ± 0.03	2.24 ± 0.11
	2080-2099	1.58 ± 0.02	3.30 ± 0.03	4.96 ± 0.07	5.58 ± 0.11
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.96 ± 0.05	1.10 ± 0.05	1.61 ± 0.05	1.26 ± 0.05
	2041-2060	1.77 ± 0.06	1.92 ± 0.05	2.53 ± 0.07	2.21 ± 0.09
	2080-2099	1.50 ± 0.01	3.33 ± 0.05	5.11 ± 0.09	6.01 ± 0.12

Table 47: The statistics of the projected changes in daily mean air temperature in units of °C over the Turakina region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

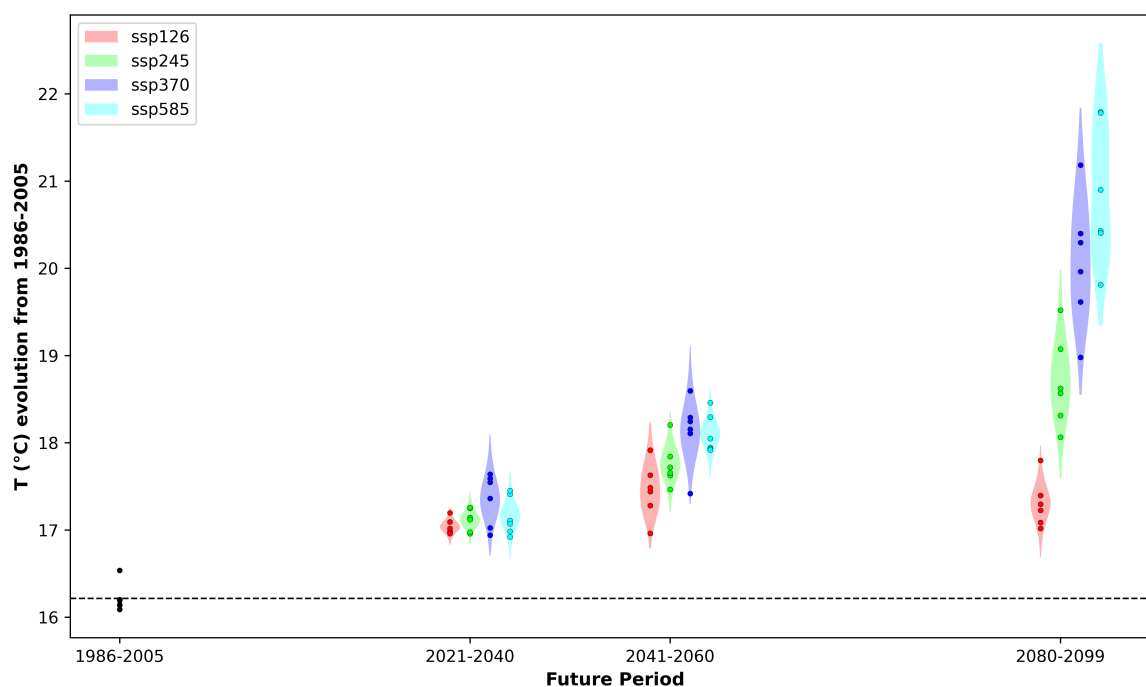


Figure 77: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Turakina region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

scenario choice is the dominant source of uncertainty.

Overall, summer warming in Turakina is extremely likely under all scenarios, with the magnitude strongly emissions-dependent by century's end.

15.10.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 78. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 48. Projected autumn average daily temperatures in Turakina are very likely to increase throughout the 21st century under all emissions scenarios. The baseline (1986-2005) multi-model mean is approximately 12.5°C. By 2021-2040, mean warming is projected between about 0.7°C (SSP1-2.6) and 0.9°C (SSP3-7.0), with extremely likely agreement among models and scenarios for a rise. However, inter-scenario agreement drops sharply in later periods, especially by 2080-2099 (0% scenario agreement), reflecting strong scenario dependence.

By 2080-2099, projected mean warming ranges from just over 1.1°C in the low emissions pathway (SSP1-2.6), to over 4.1°C under high emissions (SSP5-8.5). These differences indicate it is virtually certain emission pathway choices will materially affect autumn temperatures by late century. Model consistency within scenarios remains high, as seen by relatively small spatial standard deviations (~ 0.01 – 0.05 °C), indicating a robust regional warming signal with very high confidence. Importantly, all scenarios show positive shifts well outside the range of baseline variability, making substantial warming virtually certain.

In summary, Turakina is very likely to experience significant autumn warming, with magnitude strongly controlled by global emissions trajectories. The signal is robust across climate models within scenarios and will likely exceed 2°C under medium and high emissions by century's end.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.55 ± 1.11	12.55 ± 1.11	12.55 ± 1.11	12.55 ± 1.11
	2021-2040	0.66 ± 0.02	0.80 ± 0.02	0.89 ± 0.01	0.75 ± 0.01
	2041-2060	1.07 ± 0.03	1.43 ± 0.02	1.56 ± 0.03	1.71 ± 0.03
	2080-2099	1.12 ± 0.01	2.28 ± 0.03	3.26 ± 0.03	4.13 ± 0.05
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.67 ± 0.02	0.81 ± 0.02	0.89 ± 0.01	0.77 ± 0.01
	2041-2060	1.08 ± 0.03	1.45 ± 0.02	1.57 ± 0.03	1.72 ± 0.03
	2080-2099	1.13 ± 0.02	2.30 ± 0.03	3.29 ± 0.03	4.17 ± 0.05
Multi-model minimum	Baseline	12.42 ± 1.11	12.42 ± 1.11	12.42 ± 1.11	12.42 ± 1.11
	2021-2040	0.15 ± 0.01	0.38 ± 0.01	0.22 ± 0.01	0.19 ± 0.01
	2041-2060	0.30 ± 0.01	0.84 ± 0.03	1.09 ± 0.03	1.12 ± 0.06
	2080-2099	0.76 ± 0.01	1.48 ± 0.02	1.94 ± 0.01	2.98 ± 0.03
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.24 ± 0.01	0.41 ± 0.03	0.30 ± 0.01	0.22 ± 0.00
	2041-2060	0.43 ± 0.01	0.81 ± 0.03	0.96 ± 0.02	1.20 ± 0.04
	2080-2099	0.58 ± 0.02	1.49 ± 0.02	2.21 ± 0.02	3.02 ± 0.03
Multi-model maximum	Baseline	12.62 ± 1.11	12.62 ± 1.11	12.62 ± 1.11	12.62 ± 1.11
	2021-2040	1.11 ± 0.01	1.22 ± 0.02	1.53 ± 0.02	1.29 ± 0.01
	2041-2060	1.66 ± 0.03	2.16 ± 0.02	2.32 ± 0.03	2.21 ± 0.03
	2080-2099	1.84 ± 0.01	3.20 ± 0.01	4.12 ± 0.02	5.15 ± 0.04
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.17 ± 0.03	1.25 ± 0.01	1.54 ± 0.01	1.38 ± 0.03
	2041-2060	1.79 ± 0.05	2.16 ± 0.02	2.24 ± 0.03	2.31 ± 0.03
	2080-2099	1.74 ± 0.02	3.21 ± 0.04	4.53 ± 0.05	5.47 ± 0.07

Table 48: The statistics of the projected changes in daily mean air temperature in units of °C over the Turakina region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

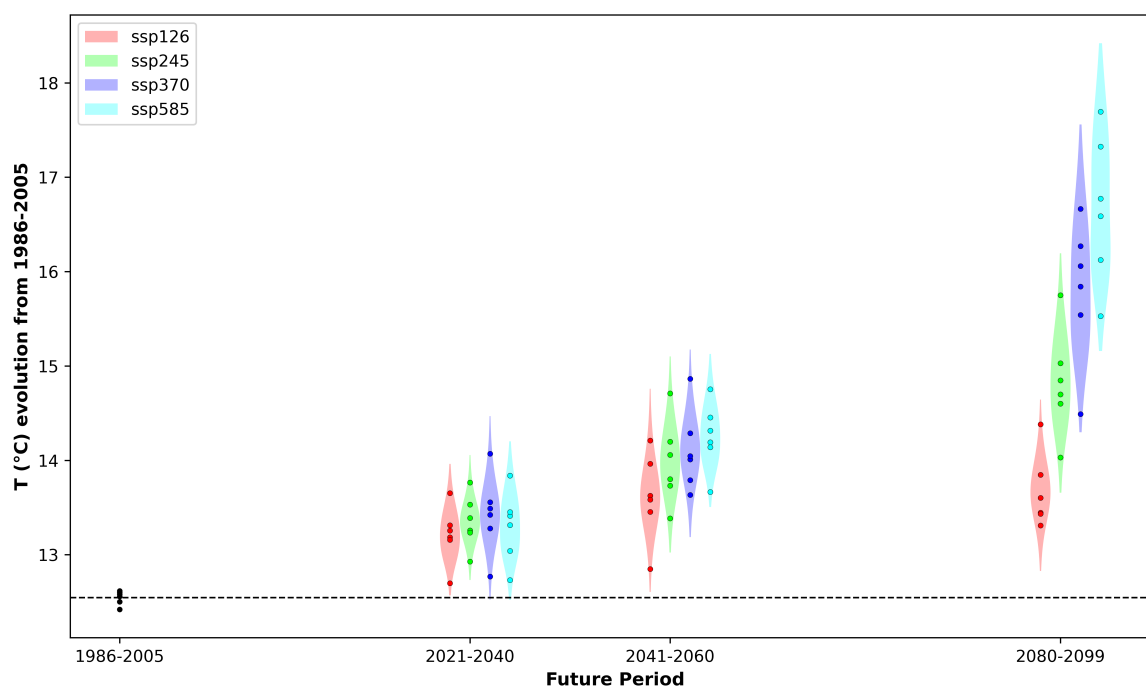


Figure 78: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Turakina region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

15.10.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 79. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 49. Projected winter average daily air temperature (T_{mean}) in Turakina shows a likely increase across all future scenarios, with magnitude and spread growing notably towards the end of the century and under higher emissions pathways. All scenarios project very likely warming relative to the 1986–2005 baseline. For 2021–2040, the multi-model mean increase ranges from approximately 0.6°C (SSP1-2.6) to 0.8°C (SSP3-7.0), with inter-model spread relatively low, suggesting high confidence in near-term warming. By 2041–2060, projected means span ~1.0°C (SSP1-2.6) to ~1.6°C (SSP5-8.5), and in 2080–2099, the range widens from ~1.0°C (SSP1-2.6) to nearly 3.8°C (SSP5-8.5) above baseline. The spread in model projections, and thus uncertainty, increases considerably for the late-century under higher emissions, as reflected by broader violin plots. Scenario agreement drops from 54% for the early century to 0% by late century, indicating diverging outcomes depending on emission trajectory. Spatial variability within Turakina is low (winter stdv generally <0.02°C), so regional results are spatially robust. In summary, it is virtually certain that Turakina will experience increasing winter temperatures, with the magnitude of change very likely contingent on future emission pathways, and inter-model agreement diminishing over time, especially by century's end.

15.10.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 80. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 50. Projected changes in spring average daily air temperature (T_{mean}) for Turakina indicate a consistent and robust warming signal across all considered scenarios (SSP126, SSP245, SSP370, SSP585). By mid-century (2041-2060), warming relative to the 1986-2005 baseline is very likely in the range of ~1°C (SSP126) to over 1.5°C (SSP585), with higher emissions scenarios yielding greater increases. By late century

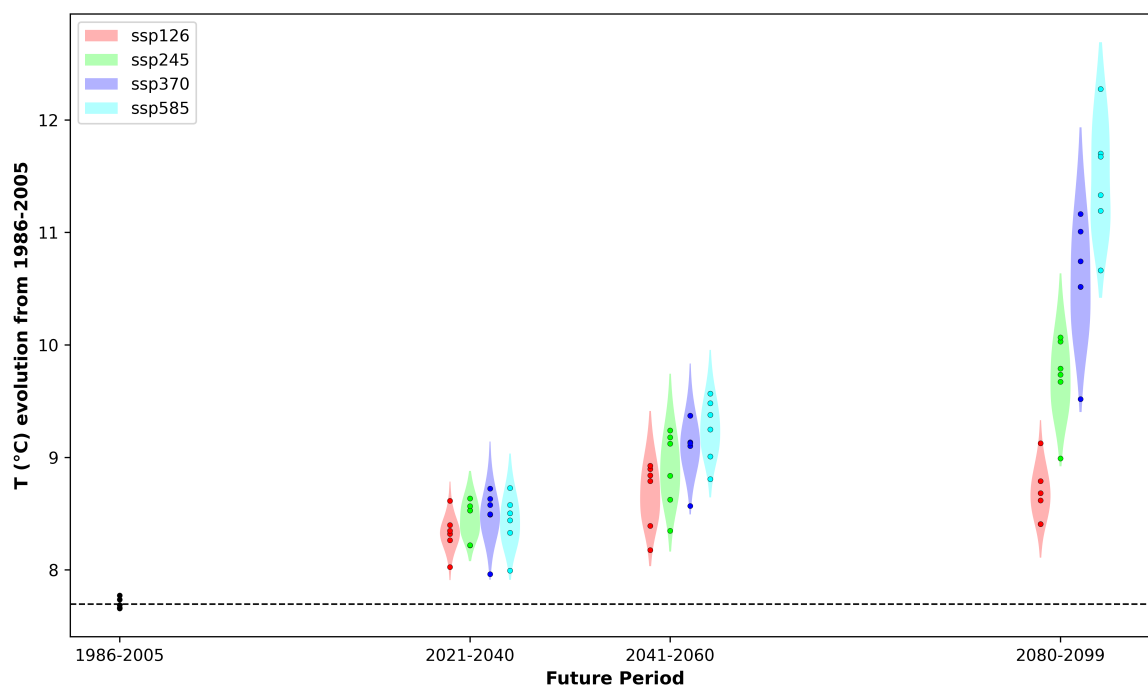


Figure 79: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Turakina region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

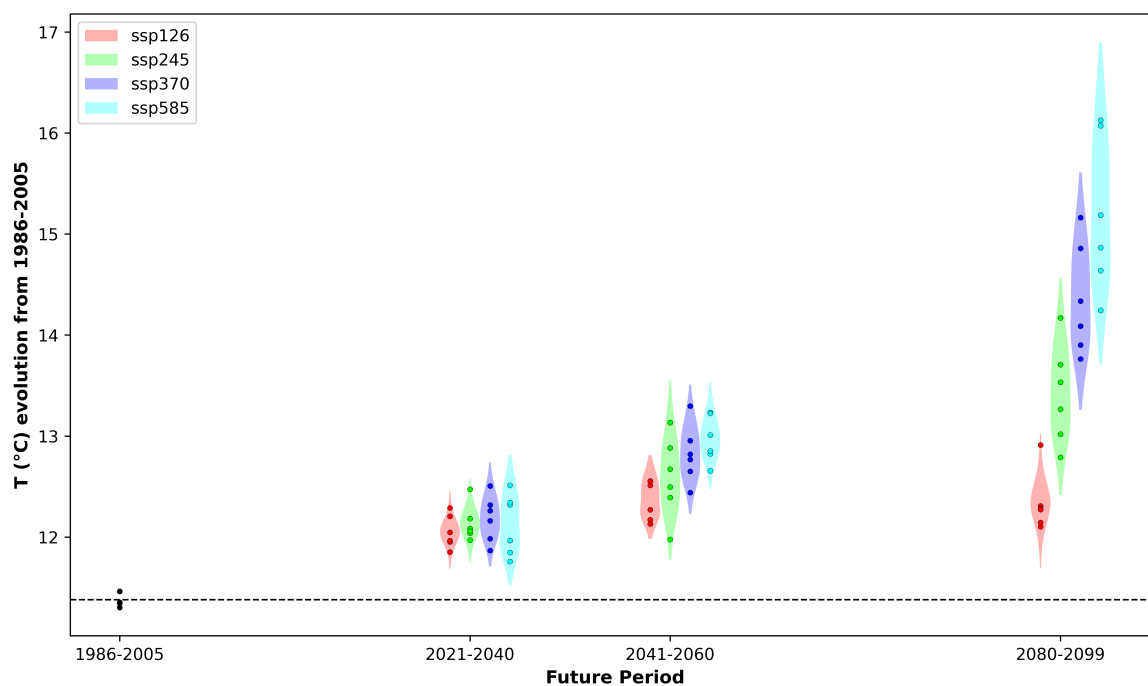


Figure 80: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Turakina region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	7.696 ± 1.177	7.696 ± 1.177	7.696 ± 1.177	7.696 ± 1.177
	2021-2040	0.632 ± 0.005	0.753 ± 0.012	0.784 ± 0.005	0.733 ± 0.016
	2041-2060	0.974 ± 0.006	1.195 ± 0.006	1.416 ± 0.008	1.552 ± 0.007
	2080-2099	0.975 ± 0.007	2.018 ± 0.009	2.881 ± 0.012	3.777 ± 0.019
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.635 ± 0.005	0.760 ± 0.011	0.790 ± 0.005	0.741 ± 0.017
	2041-2060	0.984 ± 0.007	1.207 ± 0.006	1.423 ± 0.008	1.562 ± 0.007
	2080-2099	0.983 ± 0.007	2.032 ± 0.009	2.904 ± 0.012	3.806 ± 0.019
Multi-model minimum	Baseline	7.648 ± 1.173	7.648 ± 1.173	7.648 ± 1.173	7.648 ± 1.173
	2021-2040	0.329 ± 0.032	0.499 ± 0.031	0.267 ± 0.010	0.298 ± 0.022
	2041-2060	0.480 ± 0.034	0.652 ± 0.040	0.872 ± 0.029	1.110 ± 0.010
	2080-2099	0.705 ± 0.014	1.294 ± 0.036	1.822 ± 0.016	2.967 ± 0.020
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.371 ± 0.019	0.495 ± 0.029	0.415 ± 0.013	0.380 ± 0.015
	2041-2060	0.539 ± 0.015	0.700 ± 0.016	1.011 ± 0.022	1.145 ± 0.010
	2080-2099	0.604 ± 0.012	1.472 ± 0.021	2.065 ± 0.014	3.011 ± 0.028
Multi-model maximum	Baseline	7.773 ± 1.176	7.773 ± 1.176	7.773 ± 1.176	7.773 ± 1.176
	2021-2040	0.918 ± 0.012	0.939 ± 0.012	1.027 ± 0.015	1.032 ± 0.014
	2041-2060	1.240 ± 0.021	1.544 ± 0.009	1.679 ± 0.026	1.872 ± 0.011
	2080-2099	1.429 ± 0.008	2.371 ± 0.014	3.467 ± 0.032	4.578 ± 0.029
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.920 ± 0.015	1.063 ± 0.012	1.204 ± 0.010	1.151 ± 0.020
	2041-2060	1.492 ± 0.013	1.784 ± 0.016	1.885 ± 0.029	2.036 ± 0.007
	2080-2099	1.413 ± 0.006	2.669 ± 0.019	3.859 ± 0.014	4.709 ± 0.015

Table 49: The statistics of the projected changes in daily mean air temperature in units of °C over the Turakina region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.38 ± 1.04	11.38 ± 1.04	11.38 ± 1.04	11.38 ± 1.04
	2021-2040	0.67 ± 0.02	0.76 ± 0.03	0.80 ± 0.02	0.74 ± 0.02
	2041-2060	0.99 ± 0.03	1.21 ± 0.03	1.44 ± 0.03	1.59 ± 0.04
	2080-2099	0.96 ± 0.02	2.03 ± 0.04	2.97 ± 0.07	3.81 ± 0.08
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.68 ± 0.02	0.76 ± 0.02	0.81 ± 0.02	0.76 ± 0.02
	2041-2060	1.00 ± 0.03	1.23 ± 0.03	1.45 ± 0.03	1.59 ± 0.04
	2080-2099	0.96 ± 0.02	2.06 ± 0.04	3.00 ± 0.07	3.85 ± 0.08
Multi-model minimum	Baseline	11.30 ± 1.04	11.30 ± 1.04	11.30 ± 1.04	11.30 ± 1.04
	2021-2040	0.47 ± 0.02	0.59 ± 0.05	0.49 ± 0.02	0.38 ± 0.01
	2041-2060	0.75 ± 0.01	0.60 ± 0.04	1.06 ± 0.01	1.28 ± 0.03
	2080-2099	0.72 ± 0.03	1.41 ± 0.06	2.38 ± 0.05	2.87 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.44 ± 0.03	0.51 ± 0.04	0.48 ± 0.02	0.31 ± 0.04
	2041-2060	0.71 ± 0.03	0.65 ± 0.04	1.03 ± 0.02	1.26 ± 0.03
	2080-2099	0.56 ± 0.01	1.33 ± 0.06	2.19 ± 0.07	2.73 ± 0.08
Multi-model maximum	Baseline	11.47 ± 1.04	11.47 ± 1.04	11.47 ± 1.04	11.47 ± 1.04
	2021-2040	0.91 ± 0.02	1.09 ± 0.01	1.13 ± 0.01	1.13 ± 0.02
	2041-2060	1.20 ± 0.04	1.75 ± 0.02	1.92 ± 0.03	1.88 ± 0.05
	2080-2099	1.53 ± 0.02	2.79 ± 0.04	3.78 ± 0.05	4.75 ± 0.07
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.93 ± 0.01	1.04 ± 0.01	1.19 ± 0.02	1.27 ± 0.01
	2041-2060	1.33 ± 0.03	1.89 ± 0.01	1.93 ± 0.04	1.97 ± 0.06
	2080-2099	1.39 ± 0.02	2.88 ± 0.02	3.91 ± 0.07	5.12 ± 0.07

Table 50: The statistics of the projected changes in daily mean air temperature in units of °C over the Turakina region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



(2080-2099), projected warming spans from just under 1°C under SSP126 to around 4°C under SSP585, highlighting the substantial emissions dependency of long-term outcomes. The multi-model means and medians are in close agreement within each scenario, underscoring high internal model consistency.

Inter-model spread at each time slice and scenario is modest compared to the overall magnitude of change, supporting high confidence in the direction and approximate scale of projected warming. However, agreement between scenarios diminishes rapidly after the near term, with scenario agreement dropping to zero by 2080-2099, indicating very high scenario dependence. Spatial variability within Turakina remains low relative to baseline spatial differences, suggesting projected warming is likely to be spatially consistent across the sub-region.

Overall, substantial spring warming in Turakina is extremely likely by the end of the century, with very high confidence in a strong emissions dependence for changes after mid-century.

15.11 Region: Puketoi ki Tai

Area: 966.64 km²

15.11.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 81. The statistical summary of projected changes in daily mean air temperature over this region is

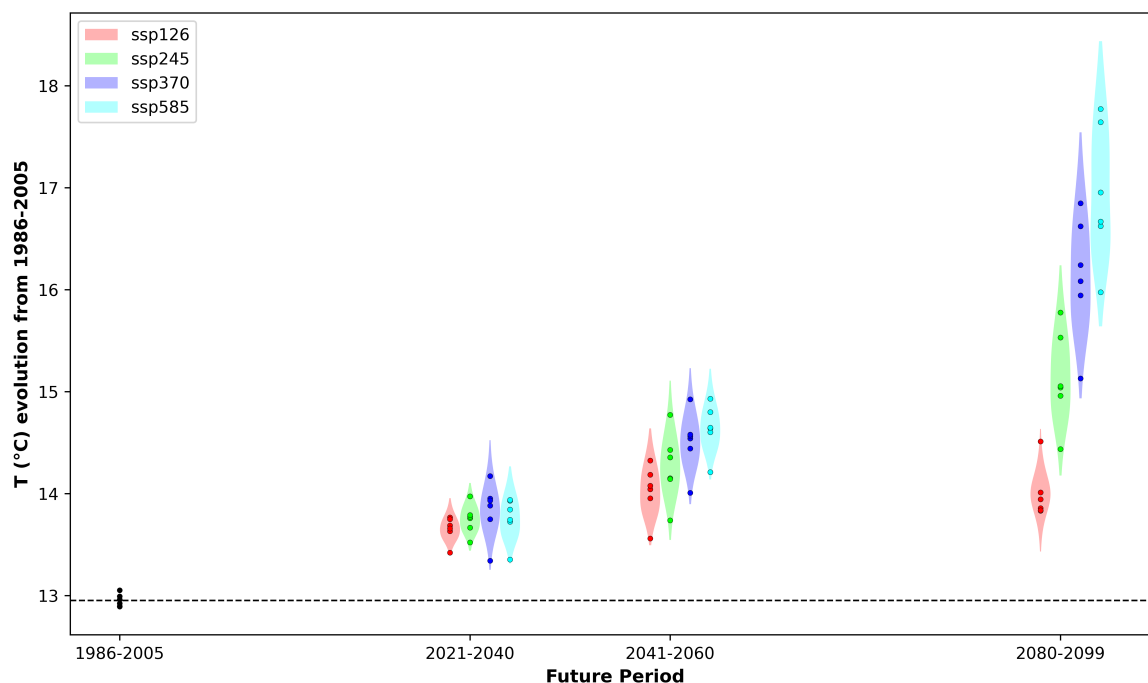


Figure 81: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Puketoi ki Tai region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 51. The figure and accompanying statistics show that annual mean air temperature in Puketoi ki Tai is projected to rise under all emissions scenarios (SSPs), relative to the 1986–2005 baseline. By mid-century (2041–2060), multi-model means indicate warming of approximately 1.1°C under SSP1-2.6, 1.3°C under SSP2-



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.95 ± 0.57	12.95 ± 0.57	12.95 ± 0.57	12.95 ± 0.57
	2021-2040	0.70 ± 0.01	0.79 ± 0.01	0.89 ± 0.01	0.80 ± 0.02
	2041-2060	1.07 ± 0.01	1.31 ± 0.02	1.56 ± 0.02	1.69 ± 0.03
	2080-2099	1.05 ± 0.01	2.18 ± 0.02	3.19 ± 0.04	3.99 ± 0.05
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.70 ± 0.01	0.80 ± 0.01	0.89 ± 0.01	0.81 ± 0.02
	2041-2060	1.08 ± 0.01	1.32 ± 0.02	1.57 ± 0.02	1.69 ± 0.03
	2080-2099	1.05 ± 0.01	2.20 ± 0.02	3.22 ± 0.04	4.02 ± 0.05
Multi-model minimum	Baseline	12.89 ± 0.57	12.89 ± 0.57	12.89 ± 0.57	12.89 ± 0.57
	2021-2040	0.47 ± 0.01	0.57 ± 0.02	0.39 ± 0.01	0.40 ± 0.01
	2041-2060	0.61 ± 0.01	0.79 ± 0.03	1.05 ± 0.01	1.26 ± 0.02
	2080-2099	0.87 ± 0.01	1.48 ± 0.03	2.18 ± 0.04	3.02 ± 0.05
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.53 ± 0.01	0.59 ± 0.02	0.50 ± 0.01	0.50 ± 0.01
	2041-2060	0.70 ± 0.01	0.83 ± 0.03	1.14 ± 0.02	1.35 ± 0.02
	2080-2099	0.69 ± 0.01	1.52 ± 0.02	2.35 ± 0.04	3.04 ± 0.05
Multi-model maximum	Baseline	13.05 ± 0.56	13.05 ± 0.56	13.05 ± 0.56	13.05 ± 0.56
	2021-2040	0.82 ± 0.02	1.02 ± 0.01	1.22 ± 0.01	0.99 ± 0.01
	2041-2060	1.37 ± 0.01	1.82 ± 0.02	1.97 ± 0.02	1.98 ± 0.04
	2080-2099	1.56 ± 0.02	2.82 ± 0.02	3.89 ± 0.03	4.82 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.90 ± 0.02	1.04 ± 0.02	1.33 ± 0.02	1.17 ± 0.02
	2041-2060	1.51 ± 0.02	1.88 ± 0.02	2.04 ± 0.03	2.09 ± 0.04
	2080-2099	1.44 ± 0.02	2.97 ± 0.03	4.20 ± 0.04	5.14 ± 0.05

Table 51: The statistics of the projected changes in daily mean air temperature in units of °C over the Puketoi ki Tai region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



4.5, 1.6°C under SSP3-7.0, and 1.7°C under SSP5-8.5. By late century (2080–2099), temperature increases span from 1.0°C under the lowest emissions pathway to roughly 4.0°C under the highest (SSP5-8.5), with SSP2-4.5 and SSP3-7.0 yielding intermediate projections (2.2–3.2°C). These results are very likely, given strong and consistent warming signals across the suite of models shown in the figure.

Inter-model spread is moderate for the near-term (2021–2040), with considerable overlap between scenarios, but diverges substantially from mid-century, particularly by 2080–2099. Model agreement weakens markedly for later periods and higher emission scenarios, as evidenced by the percentage agreement across scenarios, which falls from 46% (near-term) to negligible (0%) by late century. Spatial variability (as indicated by intra-region standard deviations) is low compared to the forced signal, supporting robust projections of warming. Overall, it is virtually certain that Puketoi ki Tai will experience continued warming, with the magnitude depending strongly on future global emissions.

15.11.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 82. The statistical summary of projected changes in daily mean air temperature over this region is

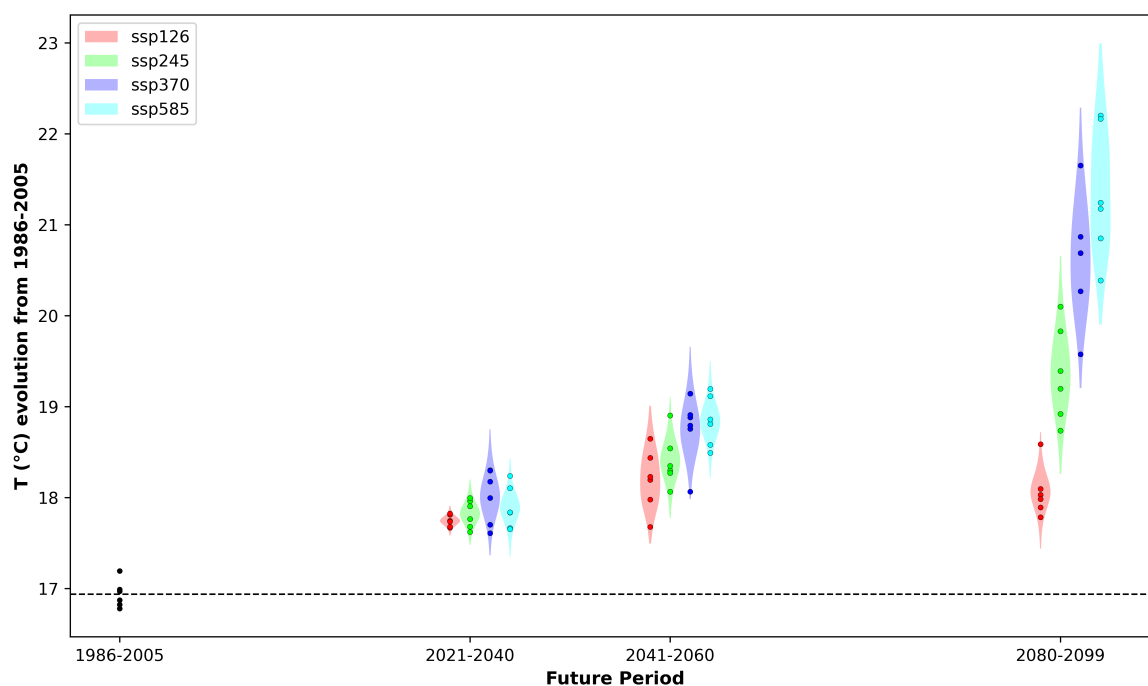


Figure 82: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Puketoi ki Tai region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 52. Projected summer average daily air temperature (T_{mean}) in Puketoi ki Tai is very likely to increase under all emissions scenarios (SSPs) compared to the 1986–2005 baseline. For 2021–2040, the model ensemble shows a warming of approximately 0.8°C–1.1°C across scenarios, with extremely high agreement between models (narrow distributions, low spatial variability). By mid-century (2041–2060), higher emissions scenarios project greater warming (up to around 1.9°C for SSP585), with the separation between scenarios becoming likely. For 2080–2099, emissions pathway dependence becomes very pronounced: low emissions (SSP126) plateau just above 1.1°C warming, while high emissions scenarios (SSP370 and SSP585) project large increases, reaching nearly 3.7°C and 4.4°C warming, respectively. These long-term projections are associated with increasing inter-model differentiation, especially under the higher SSPs, reflected in greater spread.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	16.94 ± 0.55	16.94 ± 0.55	16.94 ± 0.55	16.94 ± 0.55
	2021-2040	0.81 ± 0.02	0.88 ± 0.02	1.08 ± 0.03	0.95 ± 0.03
	2041-2060	1.26 ± 0.02	1.47 ± 0.03	1.82 ± 0.04	1.90 ± 0.04
	2080-2099	1.12 ± 0.02	2.42 ± 0.04	3.69 ± 0.07	4.40 ± 0.08
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.81 ± 0.02	0.89 ± 0.02	1.08 ± 0.03	0.95 ± 0.03
	2041-2060	1.27 ± 0.02	1.47 ± 0.03	1.83 ± 0.04	1.91 ± 0.04
	2080-2099	1.13 ± 0.02	2.44 ± 0.04	3.71 ± 0.07	4.43 ± 0.08
Multi-model minimum	Baseline	16.78 ± 0.55	16.78 ± 0.55	16.78 ± 0.55	16.78 ± 0.55
	2021-2040	0.72 ± 0.02	0.68 ± 0.04	0.67 ± 0.03	0.71 ± 0.02
	2041-2060	0.74 ± 0.02	1.13 ± 0.05	1.13 ± 0.04	1.55 ± 0.04
	2080-2099	0.85 ± 0.03	1.80 ± 0.05	2.64 ± 0.07	3.45 ± 0.08
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.71 ± 0.02	0.67 ± 0.02	0.66 ± 0.02	0.62 ± 0.02
	2041-2060	0.78 ± 0.02	1.07 ± 0.04	1.32 ± 0.04	1.52 ± 0.03
	2080-2099	0.74 ± 0.02	1.70 ± 0.03	2.73 ± 0.07	3.38 ± 0.07
Multi-model maximum	Baseline	17.19 ± 0.54	17.19 ± 0.54	17.19 ± 0.54	17.19 ± 0.54
	2021-2040	0.91 ± 0.02	1.06 ± 0.03	1.38 ± 0.03	1.30 ± 0.04
	2041-2060	1.71 ± 0.03	1.96 ± 0.03	2.20 ± 0.03	2.26 ± 0.08
	2080-2099	1.65 ± 0.04	3.16 ± 0.04	4.71 ± 0.06	5.28 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.91 ± 0.02	1.12 ± 0.04	1.54 ± 0.04	1.28 ± 0.03
	2041-2060	1.82 ± 0.04	1.91 ± 0.03	2.39 ± 0.04	2.31 ± 0.07
	2080-2099	1.53 ± 0.04	3.27 ± 0.06	4.81 ± 0.08	5.62 ± 0.08

Table 52: The statistics of the projected changes in daily mean air temperature in units of °C over the Puketoi ki Tai region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Across the region, spatial variability remains low compared to the regional signal. Agreement across all SSPs declines through time, with almost no scenario overlap by century's end, indicating very high sensitivity to emissions choices. It is virtually certain (>99% probability) that Puketoi ki Tai will experience warmer summers with the magnitude of change governed by future global emissions pathways. The magnitude and pattern of projected warming are consistent with national-scale and international assessments, lending high confidence to these projections.

15.11.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 83. The statistical summary of projected changes in daily mean air temperature over this region

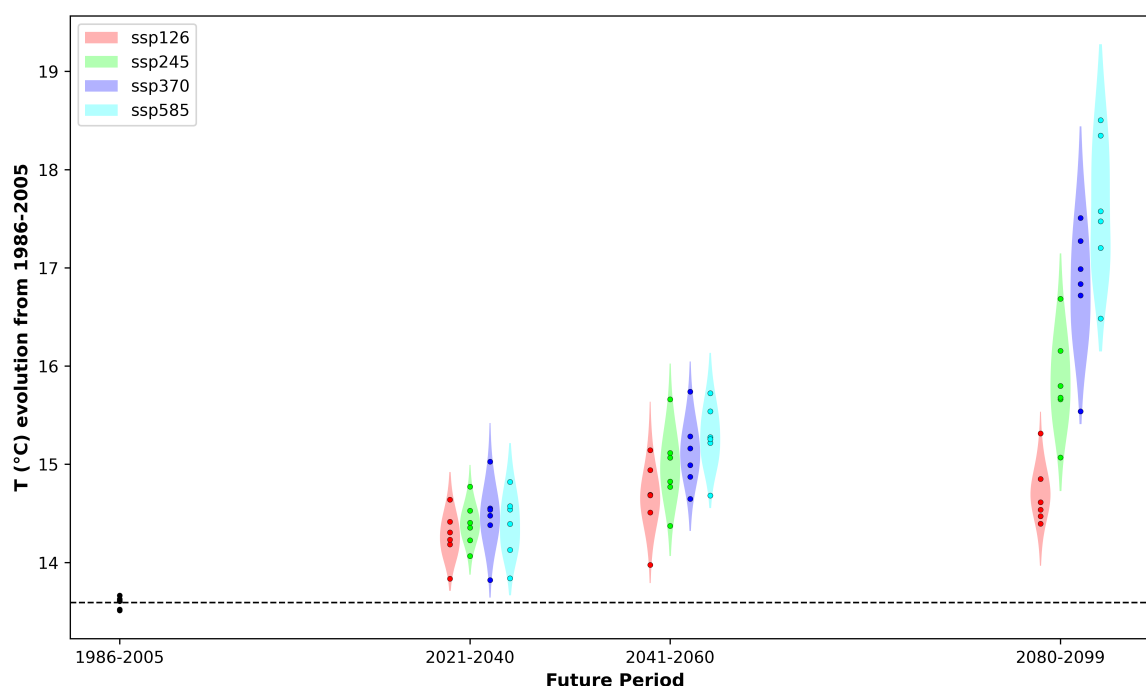


Figure 83: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Puketoi ki Tai region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

is shown in Table 53. Projected autumn average daily temperatures (T_{mean}) in Puketoi ki Tai are very likely to increase throughout the 21st century, with the magnitude of warming dependent on emissions scenario. For 2021–2040, all scenarios show a small but robust rise of around 0.7–0.9°C above the 1986–2005 baseline, with extremely high inter-model agreement, indicating high confidence in near-term warming. By mid-century (2041–2060), projected warming ranges from about 1.1°C (SSP1-2.6) to 1.7°C (SSP5-8.5), and is likely to remain spatially consistent (low spatial standard deviation), suggesting the warming will be experienced broadly across the sub-region.

By century's end (2080–2099), the divergence between scenarios is pronounced: warming ranges from only 1.1°C under low emissions to about 4.0°C under high emissions. This increase in spread indicates scenario-driven uncertainty dominates late-century projections. Percentage agreement across scenarios drops to zero for this period, reflecting the critical importance of emissions pathways on long-term outcomes.

Model agreement within scenarios remains strong, with little inter-model spread apparent in the distributions. Based on the figure and supporting statistics, it is virtually certain that autumn temperatures in Puketoi ki Tai



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	13.59 ± 0.56	13.59 ± 0.56	13.59 ± 0.56	13.59 ± 0.56
	2021-2040	0.68 ± 0.02	0.80 ± 0.01	0.87 ± 0.01	0.79 ± 0.01
	2041-2060	1.07 ± 0.01	1.38 ± 0.02	1.52 ± 0.01	1.69 ± 0.02
	2080-2099	1.10 ± 0.01	2.25 ± 0.02	3.22 ± 0.03	4.01 ± 0.05
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.68 ± 0.02	0.81 ± 0.01	0.88 ± 0.01	0.80 ± 0.01
	2041-2060	1.07 ± 0.01	1.39 ± 0.02	1.53 ± 0.02	1.70 ± 0.02
	2080-2099	1.11 ± 0.01	2.27 ± 0.02	3.24 ± 0.03	4.04 ± 0.04
Multi-model minimum	Baseline	13.51 ± 0.57	13.51 ± 0.57	13.51 ± 0.57	13.51 ± 0.57
	2021-2040	0.24 ± 0.01	0.47 ± 0.02	0.23 ± 0.01	0.25 ± 0.01
	2041-2060	0.38 ± 0.02	0.78 ± 0.01	1.06 ± 0.01	1.09 ± 0.02
	2080-2099	0.80 ± 0.01	1.48 ± 0.02	1.95 ± 0.02	2.89 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.31 ± 0.01	0.46 ± 0.02	0.34 ± 0.01	0.30 ± 0.01
	2041-2060	0.51 ± 0.02	0.78 ± 0.02	1.00 ± 0.01	1.20 ± 0.01
	2080-2099	0.64 ± 0.01	1.49 ± 0.02	2.26 ± 0.03	2.96 ± 0.04
Multi-model maximum	Baseline	13.67 ± 0.55	13.67 ± 0.55	13.67 ± 0.55	13.67 ± 0.55
	2021-2040	1.05 ± 0.02	1.18 ± 0.01	1.44 ± 0.01	1.23 ± 0.01
	2041-2060	1.55 ± 0.01	2.07 ± 0.02	2.15 ± 0.02	2.13 ± 0.02
	2080-2099	1.72 ± 0.02	3.09 ± 0.03	3.91 ± 0.04	4.91 ± 0.05
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.11 ± 0.03	1.18 ± 0.02	1.48 ± 0.01	1.38 ± 0.02
	2041-2060	1.68 ± 0.02	2.07 ± 0.02	2.13 ± 0.03	2.28 ± 0.04
	2080-2099	1.63 ± 0.02	3.15 ± 0.03	4.37 ± 0.04	5.28 ± 0.06

Table 53: The statistics of the projected changes in daily mean air temperature in units of °C over the Puketoi ki Tai region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



will rise over the 21st century. The spatial variability of warming remains low within the sub-region, and the temperature response is robust across models, especially under low to medium emissions scenarios.

15.11.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 84. The statistical summary of projected changes in daily mean air temperature over this region is

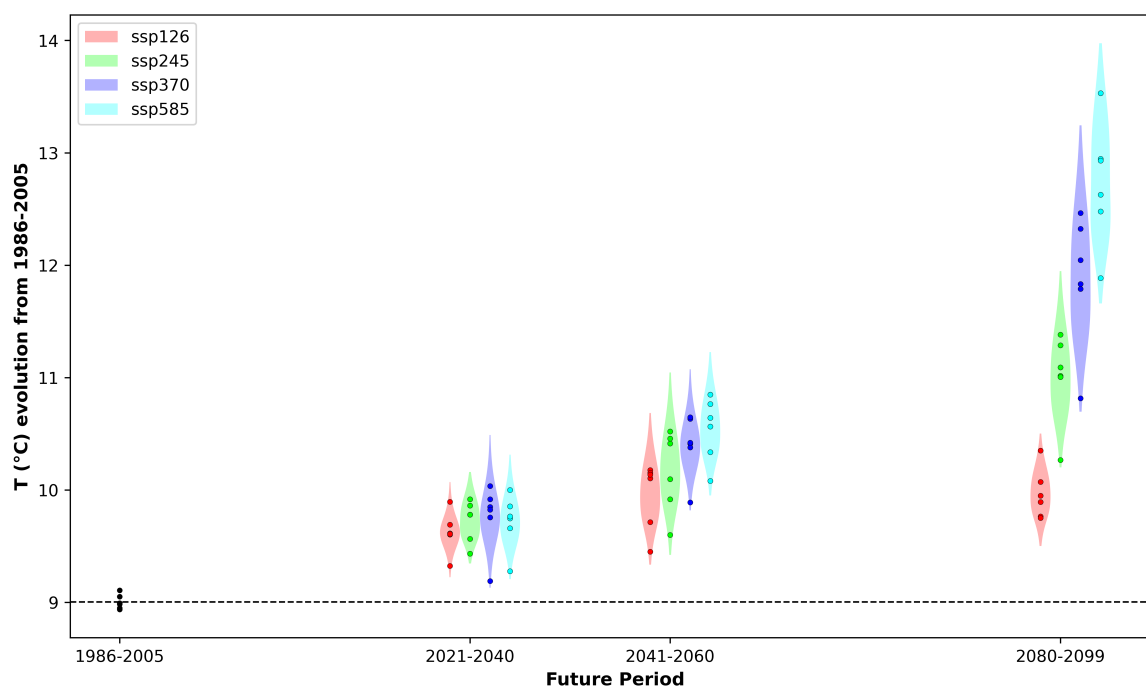


Figure 84: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Puketoi ki Tai region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 54. The projections for average winter (JJA) daily air temperature in Puketoi ki Tai indicate a clear warming trend throughout the 21st century, consistent across all SSP scenarios and model ensembles. For the near-term (2021–2040), temperatures are likely to increase by around 0.6–0.8°C relative to the 1986–2005 baseline under all scenarios, with very high model agreement and limited regional spatial variability. By mid-century (2041–2060), differences between scenarios emerge, with projected mean increases ranging from about 1.0°C (SSP1-2.6) to 1.5°C (SSP5-8.5), suggesting it is extremely likely warming will exceed 1°C under most plausible scenarios. By late century (2080–2099), scenario divergence is pronounced: SSP1-2.6 stabilises near 1.0°C above baseline, while SSP5-8.5 projects an increase approaching 3.7°C. The distribution of ensemble outputs within each scenario remains tight, indicating robust inter-model agreement (high confidence), but agreement across scenarios becomes negligible by 2080–2099 (0%), reflecting increasing scenario uncertainty.

Spatial variability within Puketoi ki Tai remains low throughout, reinforcing the finding that projected warming is a broadly regional signal rather than a localised effect. Overall, it is extremely likely that winter temperatures will rise by at least 1°C by century’s end, with the magnitude dictated primarily by global emissions pathways.

15.11.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 85. The statistical summary of projected changes in daily mean air temperature over this region is



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	9.004 ± 0.582	9.004 ± 0.582	9.004 ± 0.582	9.004 ± 0.582
	2021-2040	0.619 ± 0.008	0.719 ± 0.010	0.758 ± 0.006	0.713 ± 0.007
	2041-2060	0.952 ± 0.008	1.164 ± 0.015	1.393 ± 0.015	1.535 ± 0.017
	2080-2099	0.960 ± 0.006	2.004 ± 0.019	2.875 ± 0.030	3.729 ± 0.041
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.622 ± 0.007	0.726 ± 0.010	0.764 ± 0.005	0.720 ± 0.007
	2041-2060	0.962 ± 0.007	1.175 ± 0.014	1.400 ± 0.015	1.545 ± 0.017
	2080-2099	0.967 ± 0.006	2.018 ± 0.019	2.898 ± 0.029	3.757 ± 0.040
Multi-model minimum	Baseline	8.937 ± 0.582	8.937 ± 0.582	8.937 ± 0.582	8.937 ± 0.582
	2021-2040	0.320 ± 0.014	0.430 ± 0.016	0.186 ± 0.011	0.273 ± 0.012
	2041-2060	0.447 ± 0.008	0.597 ± 0.019	0.885 ± 0.015	1.076 ± 0.014
	2080-2099	0.747 ± 0.019	1.263 ± 0.025	1.812 ± 0.023	2.881 ± 0.044
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.367 ± 0.010	0.458 ± 0.015	0.352 ± 0.008	0.375 ± 0.009
	2041-2060	0.531 ± 0.007	0.658 ± 0.021	1.015 ± 0.014	1.136 ± 0.016
	2080-2099	0.646 ± 0.010	1.453 ± 0.024	2.053 ± 0.031	2.957 ± 0.049
Multi-model maximum	Baseline	9.108 ± 0.581	9.108 ± 0.581	9.108 ± 0.581	9.108 ± 0.581
	2021-2040	0.891 ± 0.005	0.913 ± 0.004	1.030 ± 0.012	0.997 ± 0.021
	2041-2060	1.175 ± 0.016	1.516 ± 0.010	1.643 ± 0.019	1.844 ± 0.028
	2080-2099	1.347 ± 0.007	2.378 ± 0.019	3.461 ± 0.017	4.527 ± 0.030
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.900 ± 0.012	1.032 ± 0.008	1.216 ± 0.005	1.111 ± 0.016
	2041-2060	1.451 ± 0.013	1.763 ± 0.012	1.829 ± 0.024	2.011 ± 0.020
	2080-2099	1.334 ± 0.006	2.661 ± 0.015	3.859 ± 0.028	4.667 ± 0.034

Table 54: The statistics of the projected changes in daily mean air temperature in units of °C over the Puketoi ki Tai region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

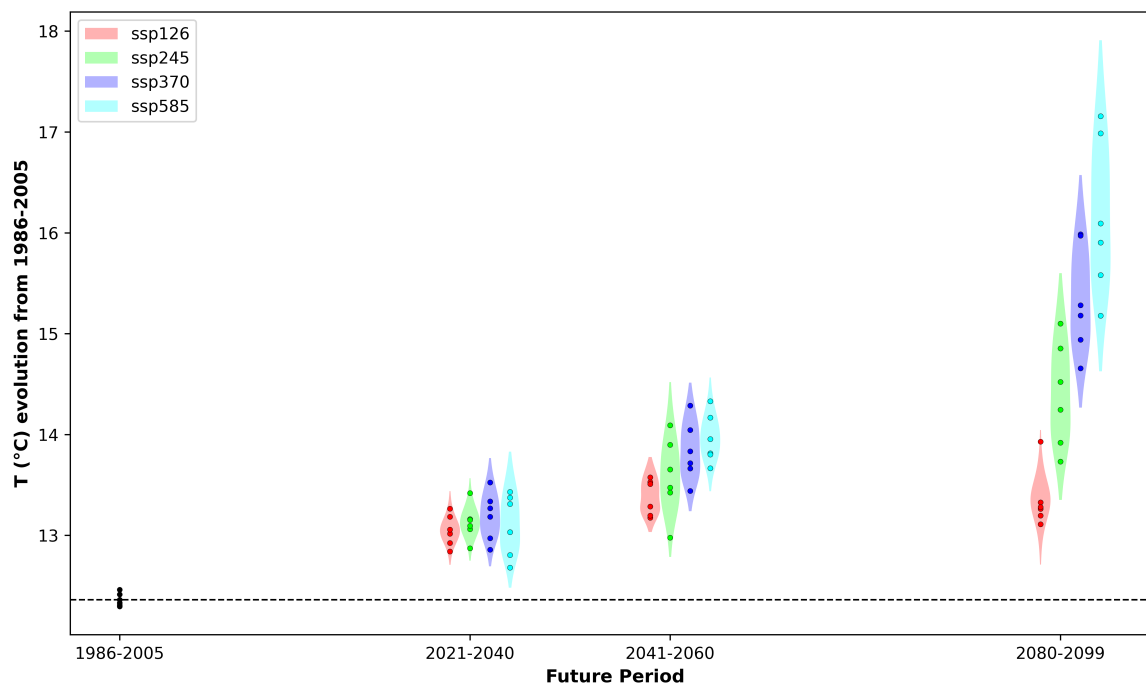


Figure 85: The time evolution of daily mean air temperature from the 1986–2005 baseline in units of °C over the Puketoi ki Tai region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

shown in Table 55. Projections for average daily spring air temperature (T_{mean}) in Puketoi ki Tai indicate a robust warming trend relative to the 1986–2005 baseline. Across all scenarios, a marked increase in T_{mean} is very likely by mid- and late-century, consistent with broader regional and global warming patterns. For 2021–2040, all scenarios project a similar increase around 0.7–0.8°C, with strong inter-model agreement, thus this warming is extremely likely. By 2041–2060, the signal begins diverging: low emissions (SSP1-2.6) project ~1.0°C warming, while high emissions (SSP5-8.5) reach ~1.6°C, reflecting moderate scenario dependency and diminishing inter-scenario agreement (3%). This divergence becomes pronounced by 2080–2099: SSP1-2.6 stabilises, but SSP5-8.5 and SSP3-7.0 suggest further marked increases (~3.0–3.8°C), and SSP2-4.5 is intermediate (~2.0°C). There is virtually no agreement across scenarios in this period, reflecting scenario-driven uncertainty. Inter-model spread within each scenario remains moderate, and spatial variability is low relative to the mean signal, lending further confidence in the overall pattern.

Taken together, a significant increase in spring mean temperatures for Puketoi ki Tai is extremely likely and will be strongly governed by global emissions pathways, with impacts becoming most pronounced and scenario-dependent later in the century. These findings are assessed with high confidence following IPCC guidance.

15.12 Region: Middle Whangaehu-Whanganui

Area: 1816.56 km²

15.12.1 Analysis across all seasons

A plot of the evolution in daily mean air temperature from the 1986–2005 baseline over this region is shown in Figure 86. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 56. Projections for average annual temperature (T_{mean}) over the Middle Whangaehu-Whanganui sub-region indicate a robust warming trend relative to the 1986–2005 baseline. Across all scenarios, warming is



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.36 ± 0.59	12.36 ± 0.59	12.36 ± 0.59	12.36 ± 0.59
	2021-2040	0.69 ± 0.02	0.76 ± 0.02	0.83 ± 0.02	0.74 ± 0.02
	2041-2060	1.02 ± 0.02	1.23 ± 0.02	1.47 ± 0.03	1.59 ± 0.03
	2080-2099	0.99 ± 0.02	2.03 ± 0.03	2.97 ± 0.05	3.79 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.69 ± 0.02	0.77 ± 0.02	0.84 ± 0.02	0.76 ± 0.02
	2041-2060	1.03 ± 0.02	1.24 ± 0.02	1.48 ± 0.03	1.60 ± 0.03
	2080-2099	0.99 ± 0.02	2.06 ± 0.03	3.00 ± 0.05	3.83 ± 0.06
Multi-model minimum	Baseline	12.29 ± 0.59	12.29 ± 0.59	12.29 ± 0.59	12.29 ± 0.59
	2021-2040	0.48 ± 0.03	0.51 ± 0.03	0.50 ± 0.02	0.32 ± 0.02
	2041-2060	0.81 ± 0.02	0.62 ± 0.03	1.08 ± 0.02	1.30 ± 0.02
	2080-2099	0.75 ± 0.01	1.37 ± 0.03	2.30 ± 0.06	2.82 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.47 ± 0.02	0.52 ± 0.01	0.49 ± 0.01	0.30 ± 0.02
	2041-2060	0.77 ± 0.02	0.68 ± 0.03	1.05 ± 0.02	1.25 ± 0.02
	2080-2099	0.59 ± 0.02	1.29 ± 0.03	2.21 ± 0.05	2.69 ± 0.05
Multi-model maximum	Baseline	12.46 ± 0.59	12.46 ± 0.59	12.46 ± 0.59	12.46 ± 0.59
	2021-2040	0.90 ± 0.01	1.06 ± 0.01	1.16 ± 0.02	1.07 ± 0.02
	2041-2060	1.21 ± 0.02	1.73 ± 0.03	1.93 ± 0.02	1.97 ± 0.06
	2080-2099	1.57 ± 0.03	2.74 ± 0.04	3.64 ± 0.05	4.79 ± 0.10
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.93 ± 0.02	1.05 ± 0.03	1.24 ± 0.03	1.28 ± 0.04
	2041-2060	1.33 ± 0.02	1.88 ± 0.03	1.98 ± 0.04	2.01 ± 0.06
	2080-2099	1.42 ± 0.03	2.94 ± 0.06	3.90 ± 0.06	5.12 ± 0.09

Table 55: The statistics of the projected changes in daily mean air temperature in units of °C over the Puketoi ki Tai region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.58 ± 0.88	11.58 ± 0.88	11.58 ± 0.88	11.58 ± 0.88
	2021-2040	0.69 ± 0.01	0.81 ± 0.02	0.90 ± 0.01	0.80 ± 0.01
	2041-2060	1.06 ± 0.02	1.35 ± 0.02	1.59 ± 0.02	1.68 ± 0.02
	2080-2099	1.03 ± 0.01	2.20 ± 0.02	3.24 ± 0.03	4.08 ± 0.04
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.70 ± 0.01	0.81 ± 0.02	0.91 ± 0.01	0.81 ± 0.01
	2041-2060	1.07 ± 0.02	1.36 ± 0.02	1.60 ± 0.02	1.69 ± 0.02
	2080-2099	1.03 ± 0.01	2.22 ± 0.02	3.27 ± 0.03	4.12 ± 0.04
Multi-model minimum	Baseline	11.53 ± 0.88	11.53 ± 0.88	11.53 ± 0.88	11.53 ± 0.88
	2021-2040	0.44 ± 0.01	0.65 ± 0.02	0.41 ± 0.01	0.39 ± 0.01
	2041-2060	0.55 ± 0.02	0.84 ± 0.02	1.04 ± 0.02	1.28 ± 0.02
	2080-2099	0.82 ± 0.01	1.51 ± 0.02	2.21 ± 0.03	3.09 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.50 ± 0.01	0.61 ± 0.02	0.52 ± 0.01	0.46 ± 0.01
	2041-2060	0.65 ± 0.01	0.87 ± 0.02	1.13 ± 0.02	1.36 ± 0.02
	2080-2099	0.64 ± 0.02	1.54 ± 0.02	2.34 ± 0.03	3.09 ± 0.04
Multi-model maximum	Baseline	11.68 ± 0.89	11.68 ± 0.89	11.68 ± 0.89	11.68 ± 0.89
	2021-2040	0.83 ± 0.01	1.02 ± 0.01	1.25 ± 0.01	1.03 ± 0.01
	2041-2060	1.40 ± 0.02	1.85 ± 0.01	2.07 ± 0.01	1.96 ± 0.04
	2080-2099	1.57 ± 0.01	2.91 ± 0.02	4.04 ± 0.03	4.89 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.92 ± 0.01	1.04 ± 0.01	1.35 ± 0.02	1.20 ± 0.02
	2041-2060	1.55 ± 0.03	1.91 ± 0.02	2.13 ± 0.02	2.07 ± 0.03
	2080-2099	1.47 ± 0.02	2.99 ± 0.03	4.33 ± 0.04	5.29 ± 0.05

Table 56: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Whangaehu-Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the whole year (i.e. across all seasons). The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

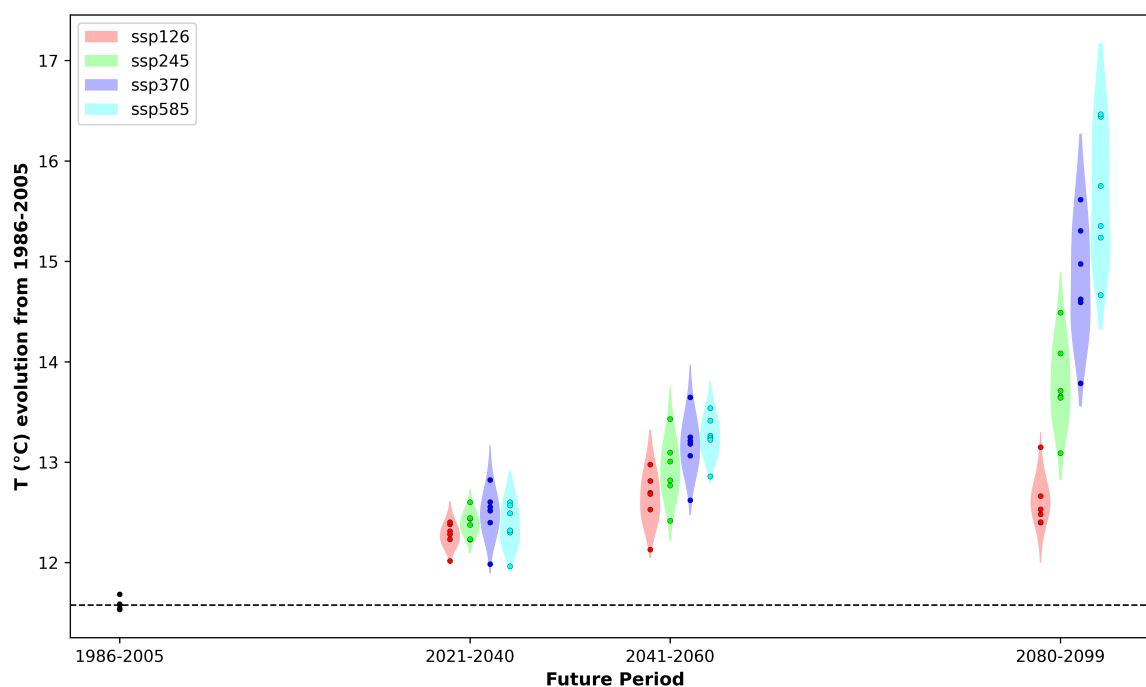


Figure 86: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Whangaeahu-Whanganui region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

already evident for 2021–2040, with multi-model means indicating rises of around 0.7–0.9°C, which is very likely (greater than 90% probability) under all emission pathways. Differences between emission scenarios become more distinct by mid-century (2041–2060), with increases ranging from about 1.1°C (SSP1-2.6) to 1.7°C (SSP5-8.5). Projections for the late century (2080–2099) diverge substantially: under low emissions (SSP1-2.6), warming stabilises near 1.0°C, while high emissions (SSP5-8.5) could see rises exceeding 4°C. This points to extremely likely and high confidence increases, particularly under higher emissions.

Model agreement within scenarios remains high, with tight clustering of simulated values, especially in near-term periods. However, agreement between scenarios decreases markedly over time: by 2080–2099, percentage agreement across scenarios is 0%, reflecting very high scenario dependence for late-century outcomes. Spatial variability within the sub-region is consistently low compared to the projected changes, further reinforcing the robustness of regional signals. In summary, substantial and ongoing warming is virtually certain for Middle Whangaeahu-Whanganui, the magnitude governed by global emission pathways, with very high confidence in the regional pattern and model consistency.

15.12.2 Analysis for the Summer (DJF) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 87. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 57. Projected summer average daily air temperatures in the Middle Whangaeahu-Whanganui sub-region show a robust warming trend throughout the 21st century, with the magnitude of increases strongly dependent on emissions scenario. For the near-term (2021–2040), all scenarios project warming of roughly 0.8–1.2°C above the 1986–2005 baseline, with very likely increases and high inter-model consistency. By mid-century (2041–2060), projected mean temperature increases range from around 1.3°C (SSP1-2.6) to approximately 1.9°C (SSP3-7.0 and SSP5-8.5), indicating a likely further divergence between low and high emissions



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	15.86 ± 0.82	15.86 ± 0.82	15.86 ± 0.82	15.86 ± 0.82
	2021-2040	0.83 ± 0.02	0.93 ± 0.03	1.16 ± 0.02	0.96 ± 0.02
	2041-2060	1.26 ± 0.03	1.56 ± 0.03	1.95 ± 0.04	1.91 ± 0.04
	2080-2099	1.10 ± 0.02	2.51 ± 0.04	3.89 ± 0.06	4.67 ± 0.07
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.83 ± 0.02	0.93 ± 0.03	1.17 ± 0.02	0.96 ± 0.02
	2041-2060	1.27 ± 0.03	1.56 ± 0.03	1.96 ± 0.04	1.91 ± 0.04
	2080-2099	1.10 ± 0.02	2.52 ± 0.04	3.92 ± 0.06	4.72 ± 0.07
Multi-model minimum	Baseline	15.75 ± 0.81	15.75 ± 0.81	15.75 ± 0.81	15.75 ± 0.81
	2021-2040	0.75 ± 0.02	0.78 ± 0.03	0.72 ± 0.02	0.71 ± 0.01
	2041-2060	0.75 ± 0.02	1.28 ± 0.03	1.20 ± 0.02	1.72 ± 0.04
	2080-2099	0.84 ± 0.05	1.88 ± 0.03	2.79 ± 0.05	3.60 ± 0.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.69 ± 0.01	0.77 ± 0.02	0.74 ± 0.02	0.65 ± 0.01
	2041-2060	0.80 ± 0.02	1.21 ± 0.03	1.40 ± 0.03	1.59 ± 0.03
	2080-2099	0.73 ± 0.03	1.78 ± 0.04	2.84 ± 0.05	3.54 ± 0.06
Multi-model maximum	Baseline	16.21 ± 0.82	16.21 ± 0.82	16.21 ± 0.82	16.21 ± 0.82
	2021-2040	1.02 ± 0.04	1.07 ± 0.04	1.45 ± 0.02	1.27 ± 0.03
	2041-2060	1.71 ± 0.04	1.99 ± 0.03	2.39 ± 0.02	2.29 ± 0.07
	2080-2099	1.58 ± 0.02	3.33 ± 0.03	4.98 ± 0.06	5.63 ± 0.08
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.99 ± 0.03	1.10 ± 0.04	1.64 ± 0.03	1.29 ± 0.04
	2041-2060	1.80 ± 0.04	1.94 ± 0.03	2.57 ± 0.05	2.23 ± 0.06
	2080-2099	1.50 ± 0.02	3.36 ± 0.04	5.14 ± 0.06	6.06 ± 0.08

Table 57: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Whangaehu-Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Summer (DJF) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

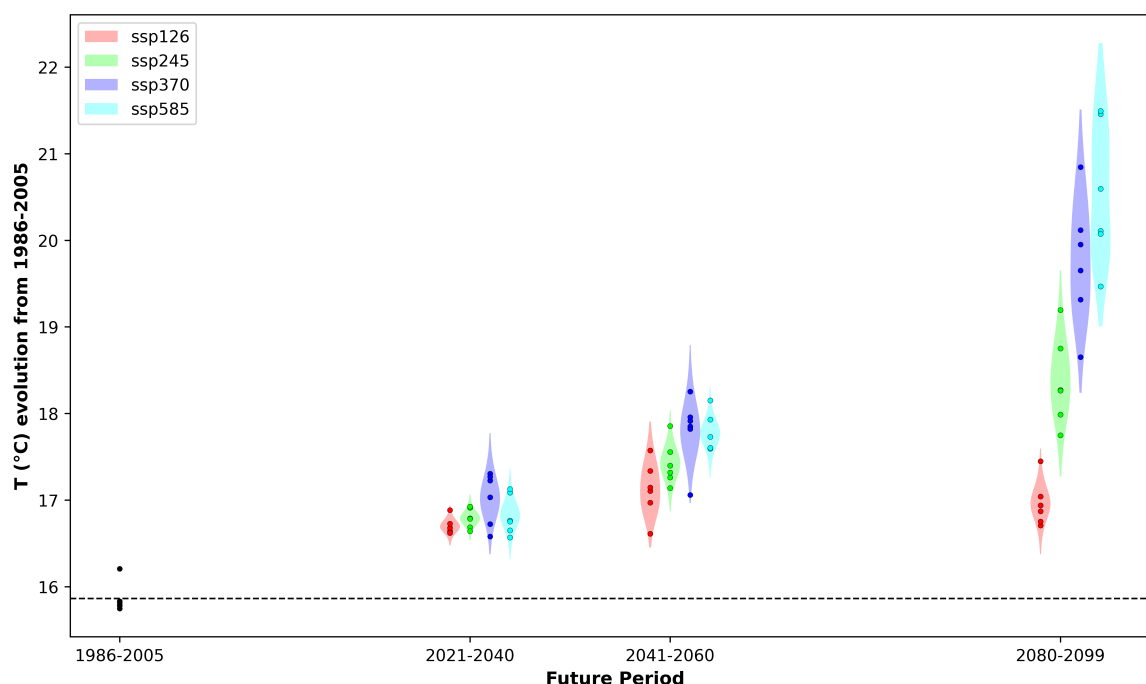


Figure 87: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Whangāehu-Whanganui region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

outcomes.

For late century (2080–2099), scenario dependence becomes extreme: under SSP1-2.6, warming stabilises around 1.1°C, but climbs to about 2.5°C (SSP2-4.5), 3.9°C (SSP3-7.0), and up to 4.7°C (SSP5-8.5). These patterns are visually evident as increasing separation between scenario distributions, and quantitatively supported by the near-zero model agreement (0%) in this period. The spatial variability of projected change within the sub-region remains low relative to the magnitude of warming, suggesting a consistent regional signal.

Overall, it is extremely likely that substantial warming will occur by the end of the century, with very high confidence in scenario-dependent outcomes. The high inter-model agreement early in the period diminishes dramatically by late century, reflecting the dominant role of emissions pathway in long-term outcomes.

15.12.3 Analysis for the Autumn (MAM) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 88. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 58. Autumn mean daily air temperature in the Middle Whangāehu-Whanganui region is projected to increase relative to the 1986-2005 baseline across all emissions pathways. The multi-model mean rise is approximately 0.7–0.9°C for 2021-2040 (very likely, high confidence), with minimal differentiation between scenarios at this early period, and a cross-scenario agreement of about 63%. By mid-century (2041-2060), the warming signal strengthens, ranging between 1.1°C under SSP1-2.6 and up to 1.7°C for SSP5-8.5; inter-scenario agreement declines to around 22%, indicating that scenario choice becomes more significant.

Temperature increases accelerate further by late century (2080-2099), with projected warming spanning just over 1.1°C under SSP1-2.6 to more than 4.1°C under SSP5-8.5 (virtually certain increase, high confidence regarding direction of change). The lowest-emissions trajectory limits additional warming, while high-emissions



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	12.18 ± 0.89	12.18 ± 0.89	12.18 ± 0.89	12.18 ± 0.89
	2021-2040	0.67 ± 0.01	0.82 ± 0.01	0.88 ± 0.01	0.76 ± 0.01
	2041-2060	1.08 ± 0.01	1.44 ± 0.01	1.57 ± 0.01	1.71 ± 0.02
	2080-2099	1.12 ± 0.01	2.29 ± 0.02	3.27 ± 0.02	4.14 ± 0.03
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.68 ± 0.01	0.82 ± 0.01	0.89 ± 0.01	0.77 ± 0.01
	2041-2060	1.09 ± 0.01	1.45 ± 0.01	1.59 ± 0.01	1.72 ± 0.02
	2080-2099	1.13 ± 0.01	2.31 ± 0.02	3.30 ± 0.02	4.18 ± 0.03
Multi-model minimum	Baseline	12.04 ± 0.89	12.04 ± 0.89	12.04 ± 0.89	12.04 ± 0.89
	2021-2040	0.10 ± 0.03	0.38 ± 0.01	0.17 ± 0.03	0.16 ± 0.02
	2041-2060	0.27 ± 0.02	0.81 ± 0.02	1.06 ± 0.02	1.10 ± 0.03
	2080-2099	0.72 ± 0.02	1.46 ± 0.02	1.90 ± 0.03	2.97 ± 0.02
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.22 ± 0.01	0.43 ± 0.02	0.29 ± 0.02	0.21 ± 0.01
	2041-2060	0.41 ± 0.01	0.81 ± 0.02	0.96 ± 0.01	1.19 ± 0.02
	2080-2099	0.56 ± 0.02	1.48 ± 0.01	2.19 ± 0.02	3.02 ± 0.02
Multi-model maximum	Baseline	12.25 ± 0.89	12.25 ± 0.89	12.25 ± 0.89	12.25 ± 0.89
	2021-2040	1.10 ± 0.02	1.21 ± 0.01	1.50 ± 0.01	1.29 ± 0.02
	2041-2060	1.67 ± 0.03	2.15 ± 0.02	2.34 ± 0.02	2.22 ± 0.02
	2080-2099	1.83 ± 0.02	3.21 ± 0.02	4.12 ± 0.03	5.15 ± 0.04
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	1.19 ± 0.02	1.26 ± 0.01	1.56 ± 0.01	1.41 ± 0.03
	2041-2060	1.82 ± 0.04	2.18 ± 0.02	2.28 ± 0.03	2.33 ± 0.02
	2080-2099	1.77 ± 0.03	3.25 ± 0.03	4.58 ± 0.04	5.50 ± 0.04

Table 58: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Whangaehu-Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Autumn (MAM) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

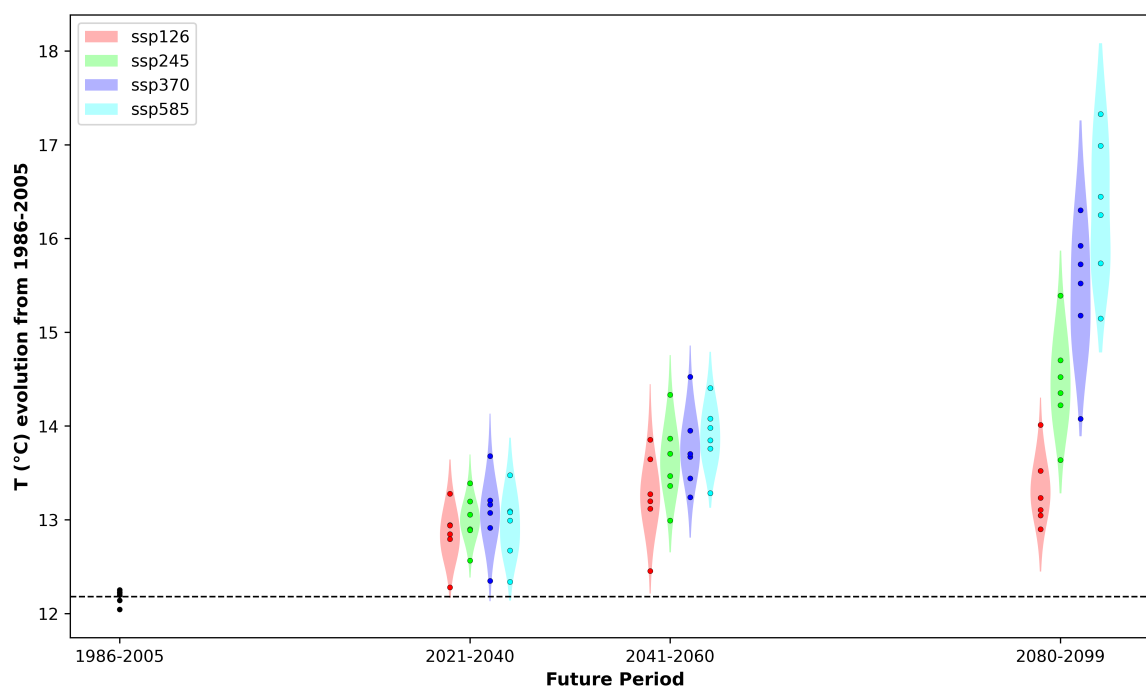


Figure 88: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Whangaeahu-Whanganui region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

scenarios show much greater increases. Spread among scenarios is large, and inter-scenario agreement drops to zero by late century, underscoring substantial scenario dependence. Inter-model agreement within each scenario remains relatively strong, as indicated by the narrow spread and small regional standard deviations.

In summary, warming in autumn in Middle Whangaeahu-Whanganui is very likely, with the magnitude increasingly dependent on emissions pathway after mid-century. This robust ensemble consensus lends high confidence to the projected direction and qualitative range of changes.

15.12.4 Analysis for the Winter (JJA) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 89. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 59. Winter average daily air temperature (T_{mean}) in the Middle Whangaeahu-Whanganui sub-region is projected to increase across all future periods and emissions scenarios. Relative to the 1986–2005 baseline, a likely warming signal is evident by 2021–2040, with multi-model means indicating increases of approximately 0.6–0.8°C across all scenarios. By mid-century (2041–2060), projected changes diverge further by scenario, from just under 1°C (SSP1-2.6) to over 1.5°C (SSP5-8.5). By the end of the century (2080–2099), the projected response ranges from roughly 1°C under the low-emissions pathway (SSP1-2.6) to nearly 3.7°C under the high-emissions pathway (SSP5-8.5), and 2.0–2.8°C for intermediate scenarios (SSP2-4.5, SSP3-7.0).

Inter-model spread within scenarios appears moderate, and the spatial variability (stdv values) reported is low (all <0.04°C in 2080–2099), suggesting minimal sub-regional gradients. There is very high confidence in a warming trend across all scenarios. However, agreement among scenarios decreases through time: while agreement is likely for early-century (51% by 2021–2040), it declines to very unlikely (0%) by century's end, reflecting emissions pathway divergence. Overall, it is virtually certain that winters will warm in Middle Whangaeahu-Whanganui, with the magnitude of change governed by future emissions, and with low spatial variability within



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	7.332 ± 0.925	7.332 ± 0.925	7.332 ± 0.925	7.332 ± 0.925
	2021-2040	0.611 ± 0.010	0.740 ± 0.010	0.769 ± 0.009	0.728 ± 0.009
	2041-2060	0.947 ± 0.014	1.174 ± 0.010	1.386 ± 0.014	1.523 ± 0.014
	2080-2099	0.957 ± 0.011	1.994 ± 0.016	2.843 ± 0.022	3.713 ± 0.031
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.614 ± 0.011	0.746 ± 0.011	0.776 ± 0.009	0.737 ± 0.009
	2041-2060	0.958 ± 0.015	1.187 ± 0.010	1.395 ± 0.014	1.534 ± 0.014
	2080-2099	0.965 ± 0.011	2.009 ± 0.016	2.868 ± 0.021	3.744 ± 0.030
Multi-model minimum	Baseline	7.297 ± 0.925	7.297 ± 0.925	7.297 ± 0.925	7.297 ± 0.925
	2021-2040	0.350 ± 0.018	0.506 ± 0.009	0.267 ± 0.005	0.297 ± 0.011
	2041-2060	0.488 ± 0.015	0.646 ± 0.015	0.862 ± 0.022	1.056 ± 0.029
	2080-2099	0.673 ± 0.014	1.300 ± 0.016	1.791 ± 0.015	2.903 ± 0.031
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.375 ± 0.009	0.505 ± 0.012	0.413 ± 0.006	0.375 ± 0.007
	2041-2060	0.526 ± 0.010	0.671 ± 0.017	0.989 ± 0.018	1.098 ± 0.021
	2080-2099	0.579 ± 0.012	1.456 ± 0.017	2.015 ± 0.021	2.932 ± 0.033
Multi-model maximum	Baseline	7.396 ± 0.928	7.396 ± 0.928	7.396 ± 0.928	7.396 ± 0.928
	2021-2040	0.887 ± 0.022	0.902 ± 0.023	1.006 ± 0.014	1.014 ± 0.023
	2041-2060	1.227 ± 0.018	1.533 ± 0.010	1.654 ± 0.020	1.834 ± 0.020
	2080-2099	1.404 ± 0.018	2.349 ± 0.015	3.464 ± 0.031	4.539 ± 0.037
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.873 ± 0.019	1.020 ± 0.023	1.178 ± 0.016	1.149 ± 0.018
	2041-2060	1.450 ± 0.024	1.773 ± 0.012	1.855 ± 0.017	2.030 ± 0.014
	2080-2099	1.404 ± 0.013	2.639 ± 0.016	3.838 ± 0.023	4.669 ± 0.032

Table 59: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Whangaehu-Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Winter (JJA) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

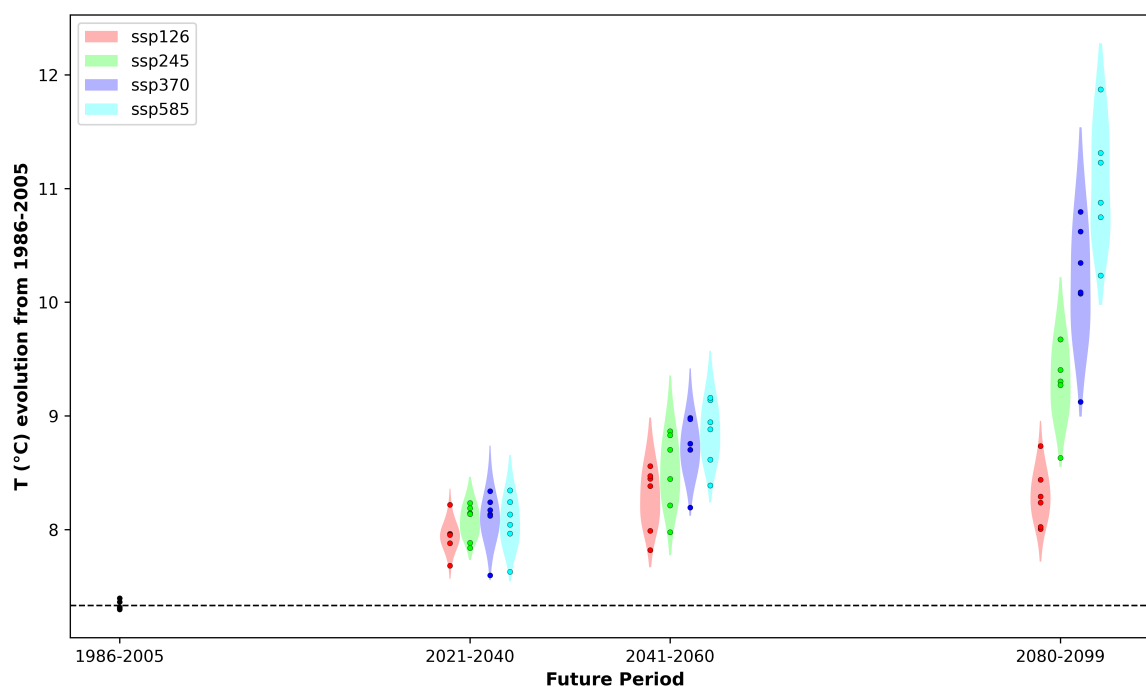


Figure 89: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Whangāehu-Whanganui region. The results shown here are for the Winter (JJA) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).

the sub-region.

15.12.5 Analysis for the Spring (SON) season

A plot of the evolution in daily mean air temperature from the 1986-2005 baseline over this region is shown in Figure 90. The statistical summary of projected changes in daily mean air temperature over this region is shown in Table 60. Projected springtime average daily air temperature (T_{mean}) in the Middle Whangāehu-Whanganui sub-region is very likely to increase throughout the 21st century under all emissions scenarios. For the near-term (2021–2040), warming of around 0.7–0.8°C above the 1986–2005 baseline is projected, with extremely high inter-model agreement and minimal spatial variability within the region. From mid-century onwards, consistent divergence between scenarios becomes apparent. By 2041–2060, projected warming ranges from approximately 1.0°C (low emissions, SSP1-2.6) to 1.6°C (very high emissions, SSP5-8.5), indicating robust scenario dependence.

For 2080–2099, increases are projected to be about 0.9°C under SSP1-2.6, but up to 3.8°C under SSP5-8.5, with intermediate scenarios falling in between. These projections are associated with increasing inter-model spread, especially for higher emission pathways, but warming is still very likely under all scenarios. Agreement across scenarios declines sharply after 2040 (from ~4% to 0%), reflecting the dominance of emission choices over natural variability in shaping future trends.

Spatial variability in projected temperature change within Middle Whangāehu-Whanganui remains low, with standard deviations typically below 0.1°C. In summary, it is virtually certain that spring temperatures will rise in the Middle Whangāehu-Whanganui sub-region, with the magnitude of future warming critically dependent on global emission trajectories.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	11.02 ± 0.91	11.02 ± 0.91	11.02 ± 0.91	11.02 ± 0.91
	2021-2040	0.66 ± 0.01	0.75 ± 0.02	0.80 ± 0.01	0.73 ± 0.02
	2041-2060	0.97 ± 0.02	1.20 ± 0.02	1.42 ± 0.02	1.57 ± 0.03
	2080-2099	0.94 ± 0.02	2.01 ± 0.03	2.95 ± 0.05	3.77 ± 0.06
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.67 ± 0.01	0.75 ± 0.02	0.81 ± 0.01	0.75 ± 0.02
	2041-2060	0.98 ± 0.02	1.22 ± 0.02	1.43 ± 0.02	1.57 ± 0.03
	2080-2099	0.94 ± 0.02	2.03 ± 0.03	2.97 ± 0.05	3.81 ± 0.06
Multi-model minimum	Baseline	10.93 ± 0.92	10.93 ± 0.92	10.93 ± 0.92	10.93 ± 0.92
	2021-2040	0.41 ± 0.03	0.59 ± 0.03	0.50 ± 0.01	0.36 ± 0.01
	2041-2060	0.71 ± 0.03	0.62 ± 0.02	1.02 ± 0.02	1.24 ± 0.03
	2080-2099	0.69 ± 0.03	1.40 ± 0.04	2.37 ± 0.03	2.85 ± 0.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.42 ± 0.02	0.50 ± 0.03	0.47 ± 0.01	0.30 ± 0.02
	2041-2060	0.67 ± 0.03	0.66 ± 0.02	0.99 ± 0.03	1.22 ± 0.03
	2080-2099	0.52 ± 0.02	1.32 ± 0.03	2.17 ± 0.04	2.72 ± 0.05
Multi-model maximum	Baseline	11.12 ± 0.91	11.12 ± 0.91	11.12 ± 0.91	11.12 ± 0.91
	2021-2040	0.88 ± 0.03	1.10 ± 0.01	1.15 ± 0.02	1.13 ± 0.01
	2041-2060	1.19 ± 0.02	1.73 ± 0.02	1.91 ± 0.02	1.86 ± 0.05
	2080-2099	1.53 ± 0.02	2.77 ± 0.04	3.77 ± 0.04	4.71 ± 0.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.93 ± 0.01	1.03 ± 0.01	1.20 ± 0.02	1.26 ± 0.02
	2041-2060	1.35 ± 0.02	1.85 ± 0.02	1.93 ± 0.03	1.97 ± 0.04
	2080-2099	1.38 ± 0.02	2.85 ± 0.03	3.89 ± 0.06	5.05 ± 0.08

Table 60: The statistics of the projected changes in daily mean air temperature in units of °C over the Middle Whangaehu-Whanganui region. Baseline values are shown in absolute units while values for each of the three future periods are shown as changes from the baseline. The results shown here are for the Spring (SON) season. The uncertainties on each value are indicative of the *spatial spread* of the values across the region, not the inter-model spread. The inter-model spread should be diagnosed from the multi-model minimum (and its associated 5th percentile row) and the multi-model maximum (and its associated 95th percentiles).

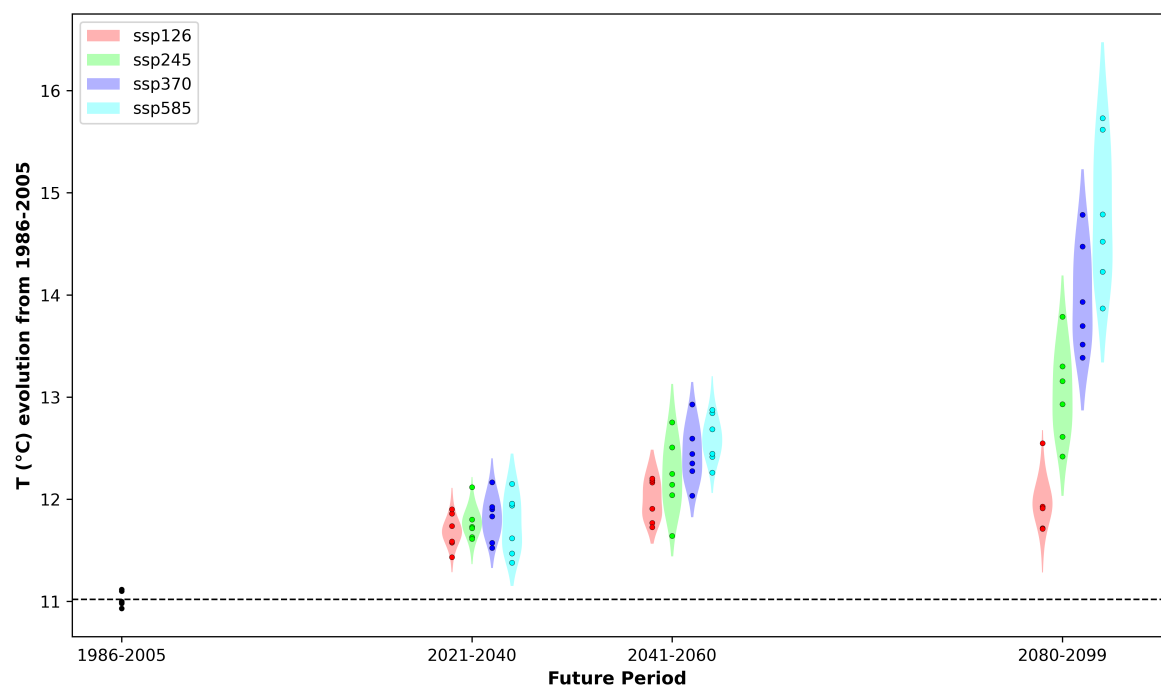


Figure 90: The time evolution of daily mean air temperature from the 1986-2005 baseline in units of °C over the Middle Whangae-hu-Whanganui region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in the main report. Small circles show the individual model values extracted from the data files provided by MfE. The projections under the different SSP scenarios are shown in shown in different colours. The change values for future periods, extracted from the data files, are offset by the *mean* of the baseline model data. The original of this figure can be downloaded [here](#).